TECHNICAL MANUAL

OPERATOR'S ORGANIZATIONAL SIRECT SUPPORT

AND GENERAL SUPPORT MAINTENANCE MANUAL

METER TEST SETS

TS-682/GSM-1 AND TS-682A/GSM-1

(NSN 6625-00-669-0747)

This copy is a reprint which includes current pages from Change 1.

HEADQUARTERS, DEPARTMENT OF THE ARMY

NOVEMBER 1975

WARNING

Hazardous voltages are used in the operation of this equipment. Use extreme caution not to contact 115V input connections, or front-panel, high voltage output jacks. Before working inside the equipment, always disconnect primary power and ground the high-voltage capacitors. Failure to comply may result in serious injury or death to personnel

CHANGE No. 1

**HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *30 May 1979***

**Operator's, Organizational, Direct Support, and
General Support Maintenance Manual
METER TEST SETS TS-682/GSM-1 AND TS-682A/GSM-1
(NSN 6625-00-669-0747)**

TM 11-6625-277-14, 3 November 1975, is changed as follows:

1. A vertical bar appears opposite changed material.
2. Remove and insert pages as indicated in the page list below:

Remove	*Insert*
3-3 and 3-4	3-3 and 3-4

3. File this change sheet in front of the manual for reference purposes.

By Order of the Secretary of the Army:

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Major General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-51, Direct and General Support maintenance requirements for AN/GSM-1.

TECHNICAL MANUAL
No. 11-6625-277-14

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DEPARTMENT OF THE ARMY
WASHINGTON, DC, *3 November 1975*

OPERATOR'S, ORGANIZATIONAL,

DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL

METER TEST SETS TS-682 /GSM-1

AND TS-682A /GSM-1

(NSN 6625-00-669-0747)

*This manual supersedes TM 11-2535A, 13 February 1952, and TM 11-2535B, 6 July 1955, including all changes.

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS-Continued

LIST OF TABLES

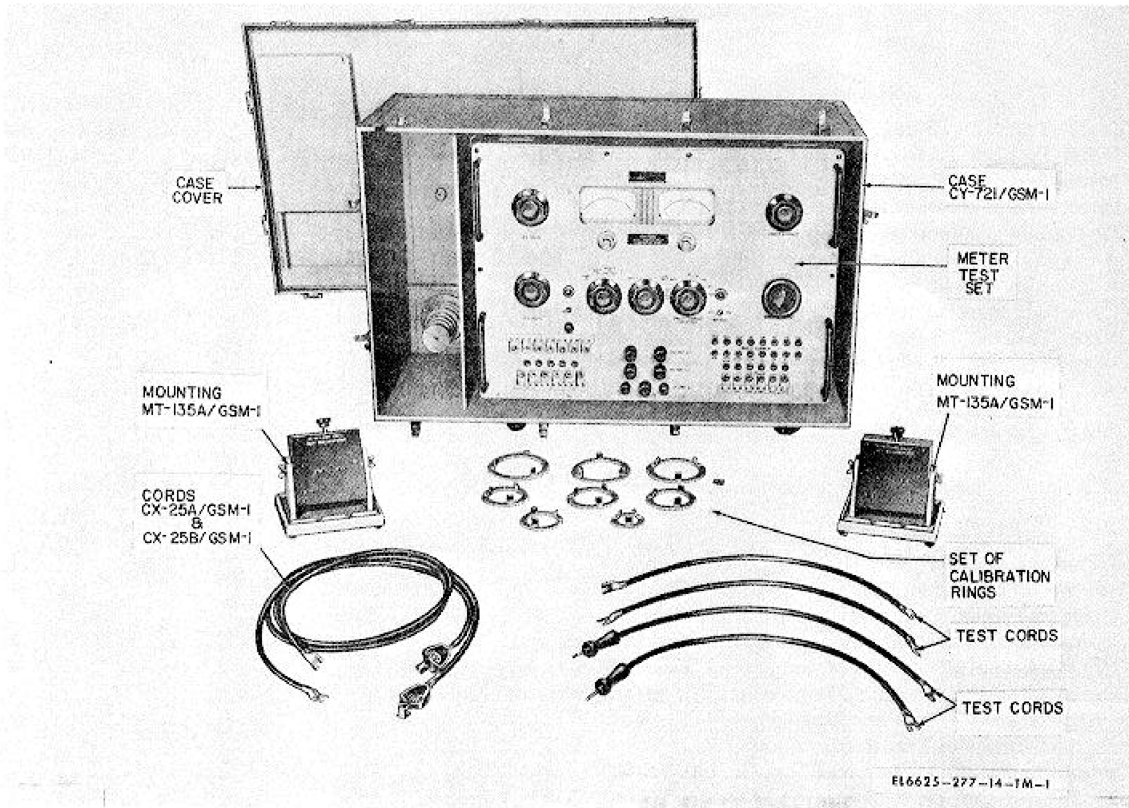

Figure 1-1. Meter Test Set TS-682/GSM-1

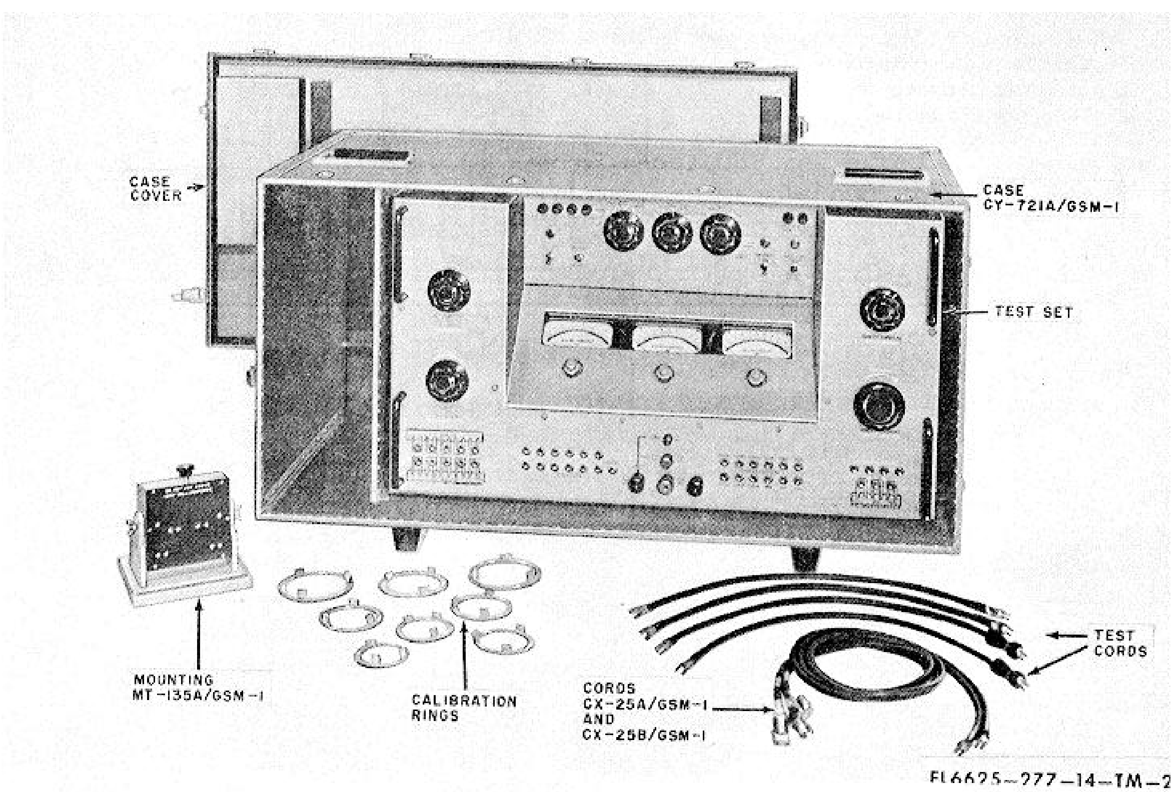

Figure 1-2. Meter Test Set TS-682A/GSM-1

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This manual describes Meter Test Sets TS682/GSM-1 and TS-682A/GSM-1 (fig. 1-1 and 1-2), and provides instructions for operating, cleaning, troubleshooting, testing, aligning, and repairing the equipment. It also lists tools, materials, and test equipment required for organizational and general support maintenance. No direct support maintenance is authorized for the equipment.

b. Official nomenclature followed by (*) is used to indicate all models of the equipment covered in this manual. Thus, Meter Test Set TS-682(*)/GSM-1 refers to both the TS-682/GSM-1 and the TS682A/GSM-1.

1-2. Indexes of 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.

1-3. Forms and Records

a. *Reports of Maintenance and Unsatisfactory Equipment.* Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 7113/MCO P4030.29A, and DSAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33A/AFR 7518/MCO P4610.19B, and DSAR 4500.15.

1-4. Reporting of Equipment Publication Improve-ments

The Report of errors, omissions, and recommendations for improving this publication is authorized and encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to Commander, US Army Electronics Command, ATTN: AMSEL-MA-Q, Fort Monmouth, NJ 07703.

1-5. Administrative Storage

For procedures, forms, and records, and inspections required during administrative storage of this equipment, refer to TM 740-90-1.

1-6. Destruction of Army Materiel

Demolition and destruction of electronic equipment will be under the direction of the commander and in accordance with TM 750-244-2.

Section II. DESCRIPTION AND DATA

1-7. Purpose and Use

Meter Test Set TS-682(*)/GSM-1 provides repair personnel with a means of checking alternating current and direct-current voltmeters and ammeters for accuracy of operation. The meter test set functions as an accurately metered power supply, furnishing all ac and dc power to the meters under test. The standard meters on the front panel measure the power supplied to the meters under test in a wide selection of voltage and current ranges.

1-8. Description

The following is a description of TS-682(*)/GSM-1 and its component parts.

a. Meter Test Set TS-682/GSM-1 (fig. 1-3).

(1) The meter test set contains two indicating meters: one for ac voltage and current measurements and one for dc voltage and current measurements. These meters are mounted adjacent to each other on the upper portion of the front panel. Three rotary switches, mounted below the meters on the panel, permit the selection of the appropriate meter ranges for both ac and dc measurements. All ac designations, including the meter markings, are in purple-blue.

(2) Four variable output controls are located on the front panel: a fine and a coarse control for dc adjustments, and a fine and a coarse control for ac adjustments. In addition, the front panel contains sufficient binding posts and jacks for all current and voltage ranges.

(3) Two primary power switches, one for ac and one for dc, are located on the front panel. Two pilot lamps indicate when primary power is applied, and four lamps supply illumination for the meter dials. The ac circuit, which is fused, is connected to the external source of power by an attached power cord.

(4) An accuracy of ± .25 percent may be obtained by using calibration data charts covering all the ac and dc and voltage ranges. These charts are supplied with the equipment and are located in the pocket on the rear cover of the meter test set.

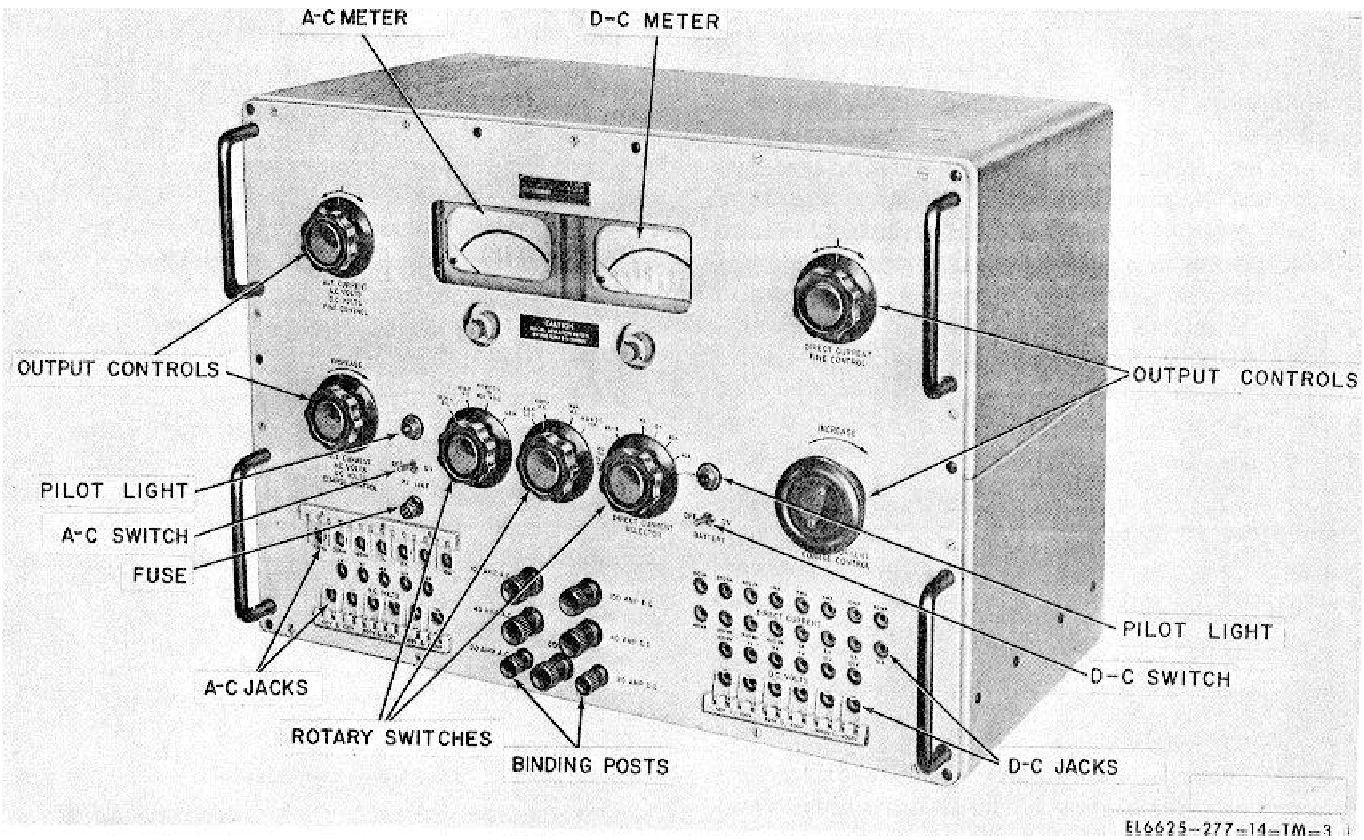

Figure 1-3. Meter Test Set TS-682/GSM-1, front view.

b. Meter Test Set TS-682A/GSM-1 (fig. 1-4).

(1) The meter test set is enclosed in a heavy aluminum frame-work on which all parts and the enclosing panels are mounted. Three standard meters are mounted in a shock-mounted case. The meters are mounted at a 45° angle on the front of the test set. The meter panel, the U-shaped panel on which the output controls, jacks, and binding posts are mounted, and the offset switch panel are faced with insulating phenolic sheets. The entire test set has a light gray enamel finish.

(2) The ac power cord is located at the rear of the test set. Binding posts for connection to an external 12-volt storage battery can be reached through a door in the rear panel. A pocket mounted on this panel holds a set of calibration data charts.

(3) All parts and assemblies are mounted on and insulated from the aluminum framework, or are mounted on separate phenolic panels suspended from the framework. The top, bottom, side, front, and rear panels can be removed.

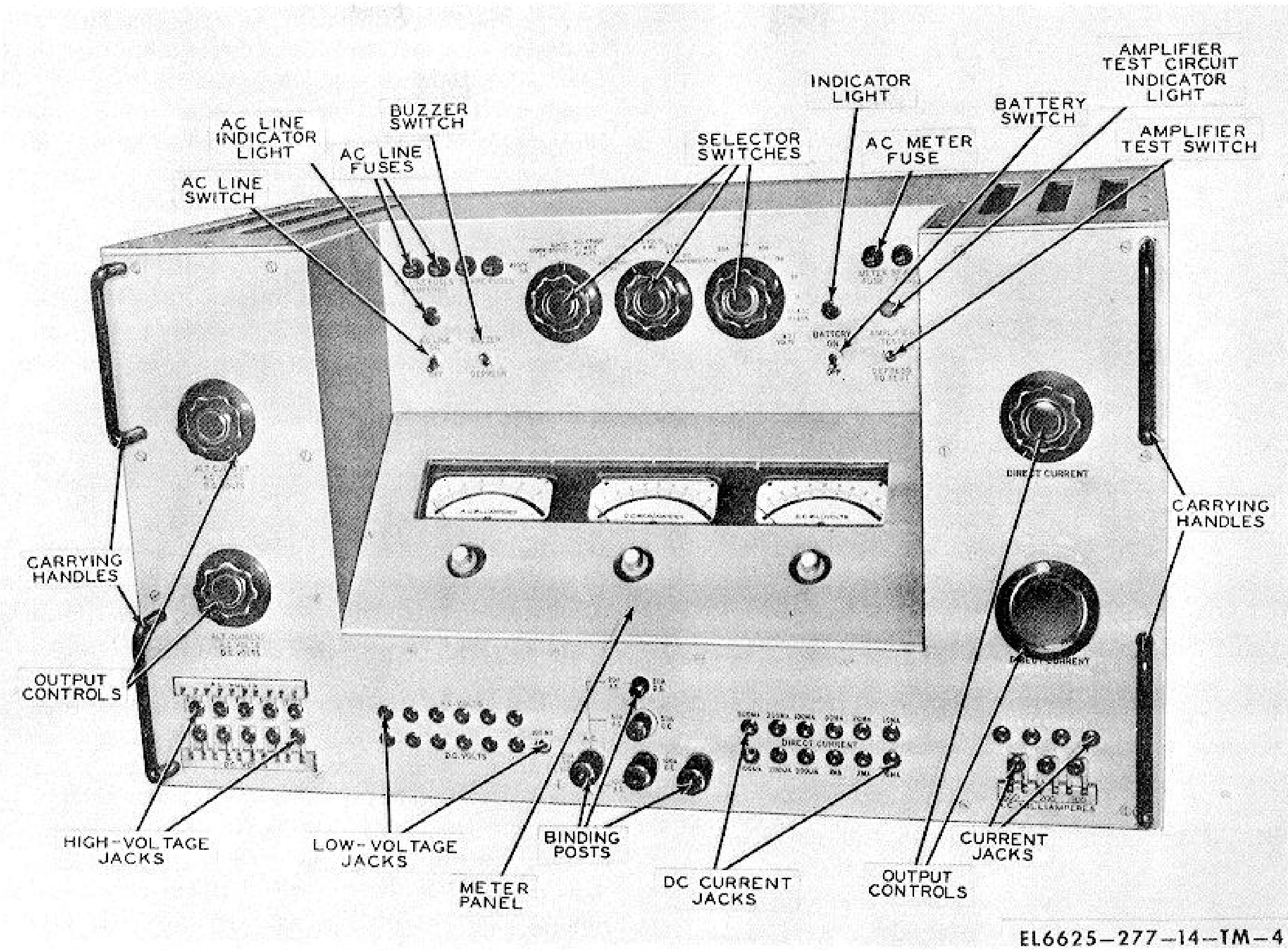

Figure 1-4. Meter Test Set TS-682A/GSM-1, front view.

c. Mounting MT-135A/GSM-1. Mounting MT-135A/GSM-1 (fig. 1-5 and 1-6) is used to mount panel-type meters and to connect these meters electrically to the meter test set for calibration or repair. The mounting consists of a wooden box mounted on a metal shaft between two wooden pedestals. The pedestals are mounted on a wooden base. Thumbscrews at each end of the mounting shaft allow the box to be tilted so that the meter under test can be set in its normal operating position. The meter under test is mounted through two meter mounting holes on the front of the box. Jaws inside the box are adjusted by a knob on top of the unit to hold the meter firmly on the mounting. Two binding posts on the rear of the box are used to connect the mounting to the meter test set.

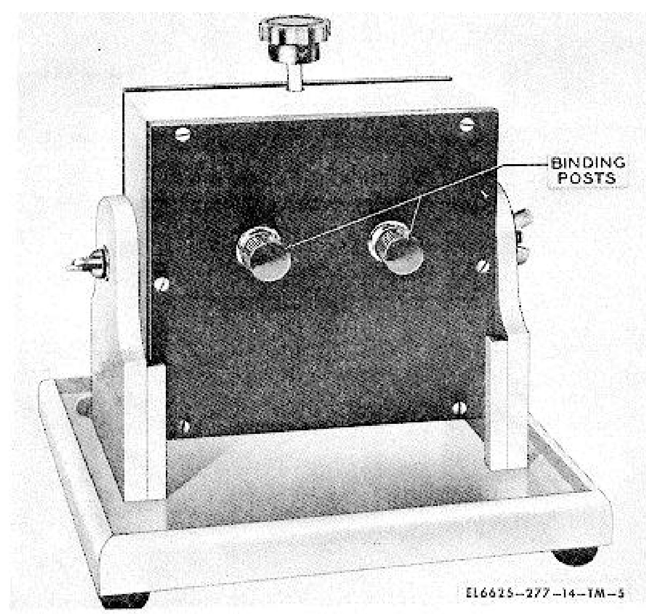

Figure 1-5. Mounting MT 135A/GSM-1, front view.

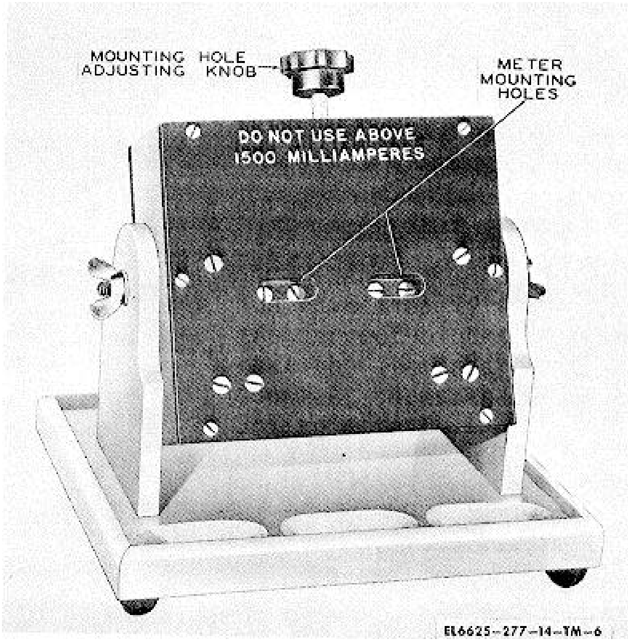

Figure 1-6. Mounting MT-135A/GSM-1, rear view.

d. *Calibration Rings.* These steel, cadmium plated rings are used to simulate steel panels when the meter to be calibrated is mounted on a steel panel in normal use. The eight rings range in inside diameter from 2.05 inches to 3.5 inches for the TS-682/GSM-1 and from 1.5 inches to 3.9 inches for the TS-682A/GSM-1 to accommodate meters of different sizes. Each ring has three spring-steel meter retainers placed at 120° intervals around the circumference, to hold the meter in place during calibration.

e. Cords CX-25A/GSM-1 and *CX-25B/GSM-1.* Cords CX-25A/GSM-1 (positive) and CX25B/GSM-1 (negative) are used to connect a 12-volt storage battery or power supply to the meter test set. The cords are 6 feet long and are rubber insulated. Each cord has a battery clip at one end, marked for polarity, and a spade-type terminal at the other end.

f. Test Cords. Four 24-inch rubber-jacketed test cords are used to connect the meter mounting to the meter test set. Two of the cords terminate in spadetype terminals at both ends. One of these two cables is always used to connect the meter mounting to the COMMON binding post on the meter test set. The other cable is used for connection to one of the binding posts used for ac or dc connections. Each of the two remaining cables terminates in a spade plug at one end; one of these cables terminates in a PL-55 plug (or a .25 inch diameter shank for the TS-682A/GSM-1) and the other in a PL-68 plug (or a .2056 inch diameter shank for the TS-682A/GSM-1) at the other end. Plug PL-55 connects to the voltage jacks on the meter test set. Plug PL-68 connects to the current jacks.

g. Case CY-721/GSM-1. The case is constructed of plywood and finished in gray enamel. It is used to transport the meter test set and its components. Eight latches hold the cover to the case. Two carrying handles are provided at the sides of the case. The inside of the case is divided into two section by a partition; one section holds the meter test set and the other section contains special fittings to hold the other components.

h. Case CY-721A/GSM-1. The case is used to transport the TS-682A/GSM-1 and is constructed of aluminum-clad plywood. A separate compartment holds Mounting MT-135A/GSM-1, the calibration rings, and the cords. The cover is fastened by 12 spring-loaded latches. The case is mounted on four steel channeled legs. Two carrying handles are mounted on the top, two on the cover and two on each end of the case.

i. Additional Equipment Required. One Power Supply PP-1097A/G or PP-1104A/G, or one Battery BA-46, BA-30 or three Batteries BA-31 are required for current supply when checking current measuring meters.

1-9. Differences Between Models

The models of TS-682(*)/GSM-1 are similar in purpose, operation, and appearance. The differences between the models that affect the operator and organization repairman are found in table 1-1.

Table 1-1. Differences between Models

Item	TS-682/GSM-1	TS-682A/GSM-1
Ac line fuse	One fuse is used	Two fuses are used
Ac meter fuse	Not used	Three spare fuse holders are located
Spare fuse	Not used	on front panel
Left hand rotary selector switch	Positions: 2000 V DC 1000 V DC 100 MV DC to 400 V DC ACV	Positions: 2000 V DC 1000 V DC 0.1 to 500 V DC ALL OTHER AC & DC scales

Table 1-1. Differences Between Models—Continued

Item	TS-682/GSM-1	TS-682A/GSM-1
Center rotary selector switch	Positions: ACV-DCV 100 MA AC 40 A AC AC AND DC CUR	Positions: AC AMPERES & MA AC VOLTS DC VOLTS & MA DC MA & UA DC AMPERES
Right hand rotary selector switch	Direct current Selector Positions: 100 UA to 400 MA 2A-1A 4A 10 A 20 A 40 A 100 A	Positions: 100 A 50 A 20 A 10 A 5A 2 A 1A AC & DC MA & UA AC & DC VOLTS
Center meter	Not used	Reads dc micro amperes
Ac current jacks	Located at lower left side 400 MA jack 4 A jack 40 A jack	Located at lower right side 500 MA jack 5 A jack 50 A jack
Dc current jacks	400 MA 4 MA 40 MA 400 MA 4A 40 A	500 MA 5 MA 50 MA 500 MA 5 A 50 A
Ac voltage jacks	400 V 40 V 4 V	500 V 50 V 5 V
Dc voltage jacks	400 V 40 V 4 V	500 V 50 V 5 V

1-10. Tabulated Data

a. Meter Test Set TS-682/GSM-1

(1) *Power input:*

Ac ....115 volts, 60 cycles, single-phase.
Dc ....Storage battery, nominal 12 volts

(2) *Meter ranges*

Dc ....0-100 uA; 0-200 uA; 0-400 uA; 0-1 mA; 0-2mA, 0-4 mA; 0-10 mA: 0-20 mA; 0-40 mA; 0-100 mA; 0-200 mA, 0-400 mA: 0-1 amp; 0-2 amp; 0-4 amp; 0-10 amp; 0-20 amp; 0-40 amp: 0-100 amp.
Ac ....0-100 mA; 0-200 mA; 0-400 mA: 0-1 amp: 0-2 amp; 0-4 amp: 0-10 amp: 0-20 amp; 0-40 amp; 0-100 amp.
Ac and Dc voltage...............0-1 V; 0-2 V; 0-4 V; 0-10 V: 0-20 V, 0-40 V, 0-100 V; 0-200 V; 0-400; 0-1,000 V; 0-2,000 V.
Dc voltage...........................0-100 mV

(3) *Output power.*

Dc voltage ranges:
0-100 mV ....30 mA.
0-1 V through 0-1,000 V ......15 mA.
0-2.000 V ....5 mA.
Ac voltage ranges:
0-200 V through 0-2,000 V ..150 mA.
0-1 V through 0-100 V ....0.5 amp.
Dc ranges (all).....................750 mV.
Ac ranges:
0-100 mA through 0-400 mA..................................2.5 VA.
0-1 ampere through 0-100 amperes.................... 10 VA.

(4) *Output ripple*

....ac ripple not more 5 percent of dc output voltage.

(5) *Accuracy*

Direct-reading ....± Percent.
With correction charts ....± 25 percent.

b. Meter Test Set TS-682A/GSM-1.

(1) *Power input.*

Ac .... 115-volt, 60 Hz single phase

Dc ....12-volt storage battery capable of supplying 100 amperes for 1 minute

(2) ***Meter ranges***

Dc voltage...........................0 to 100 mV, 0 to 1 volt, 0 to 2 volts, 0 to 5 volts, 0 to 10 volts, 0 to 20 volts, 0 to 50 volts, 0 to 100 volts, 0 to 200 volts, 0 to 500 volts, 0 to 1,000 volts and 0 to 2,000

Dc ....0 to 100 uA, 0 to 200 uA, 0 to 500 uA, 0 to 1 mA, 0 to 2 mA, 0 to 5 mA, 0 to 10 mA, 0 to 20 mA, 0 to 50 mA, 0 to 100 mA, 0 to 200 mA, 0 to 500 mA, 0 to 1 ampere, 0 to 2 amperes, 0 to 5 amperes, 0 to 10 am-peres, 0 to 20 amperes, 0 to 50 amperes, and 0 to 100 amperes.

Ac voltage...........................0 to 1 volt, 0 to 2 volts, 0 to 5 volts, 0 to 10 volts, 0 to 20 volts, 0 to 250 volts, 0 to 100 volts, 0 to 200 volts, 0 to and 500 volts, to 1,000 volts, and 0 to 2,000 volts.

Ac ....0 to 100 mA, 0 to 200 mA, 0 to 500 mA, 0 to 1 ampere, 0 to 2 amperes, 0 to 5 amperes, 0 to 10 am-peres, 0 to 20 amperes, 0 to 50 amperes, and 0 to 100 amperes.

(3) ***Output power***.

Dc voltage ranges:
0 to 100 mV ....30 mA.
0 to 1 volt through 0 to 1,000 volts................................15 mA.
0 to 2,000 volts ....5 mA.
Ac voltage ranges:
0 to 1 volt through 0 to 100 volts..................................5 ampere.
0 to 200 volts through 0 to 2,000 volts.......................150 mA.
Voltage available for all dc ranges:
750 mV ....0 to 100 uA through 0-100 amperes.
Ac power output (unity power factor):
2.5 W ....0 to 100 mA through 0 to 500 mA.
10 W ....0 to 1 ampere through 0 to 100 amperes.

(4) ***Accuracy***.

Direct-reading ....± 1 percent
With correction charts ....± .25 percent

1-11. Items Comprising an Operable Equipment

Items comprising an operable TS-682(*)/GSM-1 are listed in table 1-2.

Table 1-2. Items Comprising an Operable TS-682(*)/GSM-1

NSN	Qty	Nomenclature	Figure No.
6625-00-247-0747	1 EA	METER TEST SET TS-682/GSM-1	1-3
		or	
6625-00-247-0747	1 EA	METER TEST SET TS-682A/GSM-1	1-4
6625-00-669-0335	1 EA	CASE CY-721/GSM-1 (used with TS-682/GSM-1)	1-1
		or	
6625-00-669-0335	1 EA	CASE CY-721A/GSM-1 (Used with TS-682A/GSM-1)	1-2
	1 EA	MOUNTING MT-135A/GSM-1	1-5 and 1-6
	1 EA	CORD CX-25A/GSM-1 (positive)	1-1 or 1-2
	1 EA	CORD CX-25B/GSM-1 (negative)	1-1 or 1-2
	1 SET	CALIBRATION RINGS	
	2 EA	TEST CORD (Spade terminals at both ends)	1-1 or 1-2
	1 EA	TEST CORD, PLUG PL-55 AND SPADE (TS-682/GSM-1)	1-1
		or	
	1 EA	TEST CORD, .25 in. DIAMETER SHANK AND SPADE (TS-682A/GSM-1)	1-2
	1 EA	TEST CORD, PLUG PL-68 AND SPADE (TS-682/GSM-1)	1-1
	1 EA	TEST CORD, .2056 in. DIAMETER SHANK AND SPADE (TS-682A/GSM-1)	1-2

CHAPTER 2

SERVICE UPON RECEIPT AND INSTALLATION

Section I. SERVICE UPON RECEIPT

2-1. Packaging Data.

a. Meter Test Set TS-682(*)/GSM-1 may arrive packed for either domestic or overseas shipment. Packaging details are shown in exploded diagram form in figure 2-1.

b. When TS-682(*)/GSM-1 is packed for overseas shipment, the meter test set is placed in the carrying case with the face of the equipment up. Mounting MT-135A/GSM-1, the test cords, the battery connecting cords, and the calibration rings are placed in the small compartment of the carrying case. The equipment, in its carrying case, is placed in a corrugated carton. The carton is sealed with gummed tape. The boxed equipment is then placed in a moisture-vaporproof barrier, which is heat sealed, and this package is placed in a waterproof corrugated carton. The technical manuals are placed under the lid and the carton is sealed with waterproof tape. The packaged meter test set is placed in a wooden shipping container with a waterproof case liner. The wooden shipping container with a waterproof case liner. The wooden container is reinforced with flat metal straps. The packaged TS-682(*)/GSM-1 is 56 inches long, 34 inches wide and 32 inches high. It weighs 520 pounds and displaces approximately 30 cubic feet.

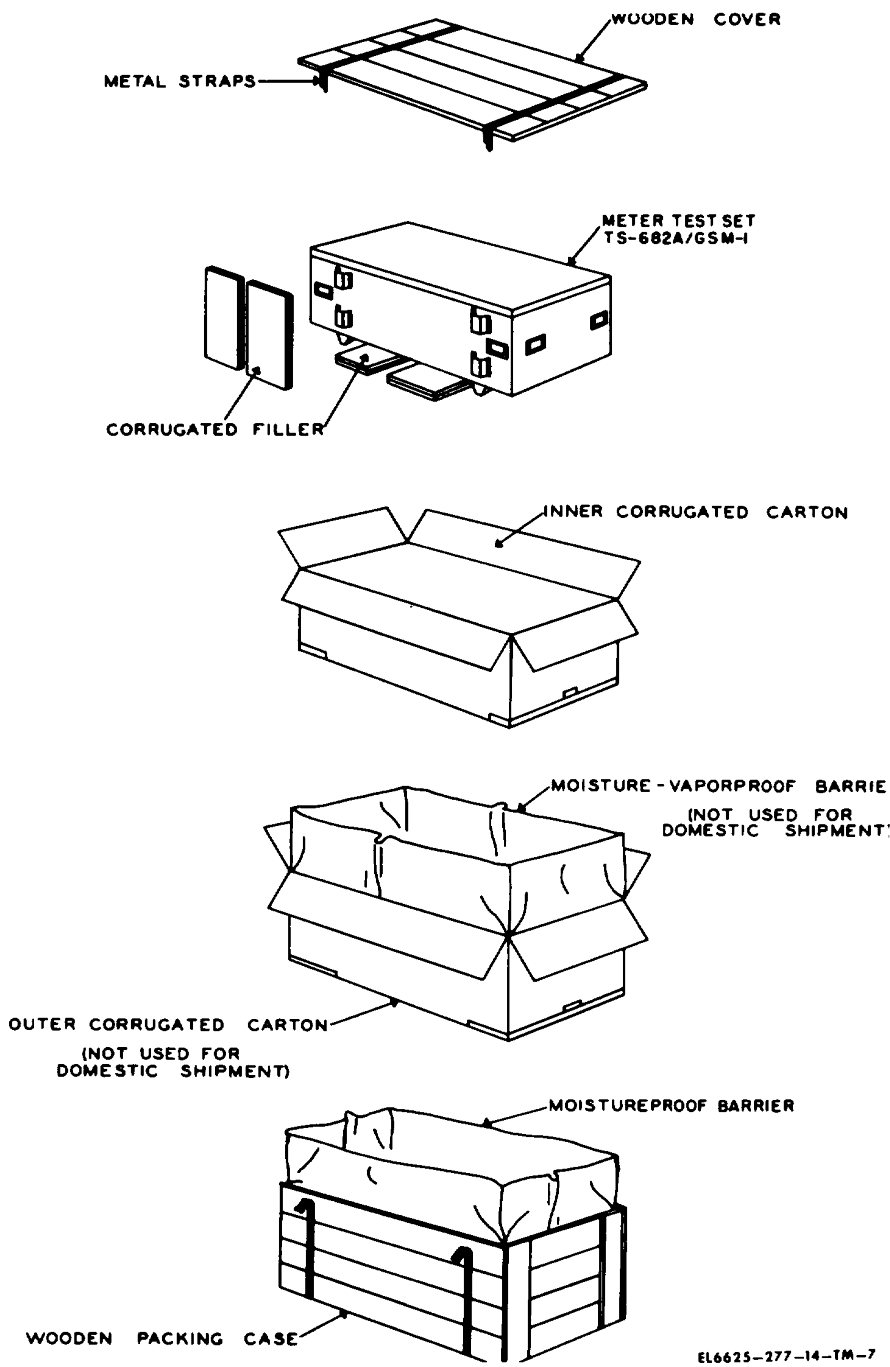

Figure 2-1. Packaging details for Meter Test Set TS-682(*)/GSM-1

2-2. Unpacking

a. For unpacking overseas shipment equipment, proceed as follows:

(1) Cut the metal straps with a suitable cutting tool, or twist them with pliers until the straps break. Remove the straps.

(2) Remove the nails from the top and one side of the wooden case. Do not attempt to pry off the sides and top. Such action may damage the equipment.

(3) Remove the corrugated filler from the packing case and lift the packaged equipment out of the case.

(4) Open the outer corrugated carton and

break the sealed moisture-vaporproof barrier. Lift out the inner corrugated carton.

(5) Open the inner corrugated carton. Remove the equipment in its carrying case and place it near its final location.

(6) Place the case on its legs. Remove the cover by unfastening the spring-loaded latches. Remove the desiccant.

(7) Pull the meter test set from the case by the handles on the front of the equipment.

b. The meter test set may be received in domestic packing cases. The instructions given in a above, also apply to unpacking domestic shipments. If heavy wrapping paper has been used, remove it carefully and take out the components.

2-3. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on DD Form 6 (para 1-3*b*).

b. Check the equipment for completeness against the packing slip. If a packing slip is not available, check equipment against the data given in table 1-2. Report all discrepancies in accordance with paragraph 1-3. The equipment should be placed if service even though a minor assembly or part that does not affect proper functioning is missing.

c. Check to see if the equipment has been modified. Modified equipment will have the MWO number on the front panel near the nomenclature plate. Check also to see whether all currently applicable MWO's have been applied. (Current MWO's are listed in DA Pam 310-7.)

d. After the equipment has been thoroughly checked, clean all items with a soft cloth.

Section II. INSTALLATION

2-4. Power Requirements

a. Ac Power Supply. A source of 115-volt, 60 Hz ac power is required for the operation of the meter test set.

b. Dc Power Supply. An external 12-volt storage battery or power supply is required for operation of the dc ammeter test circuits. The battery must be capable of supplying 100 amperes for a period of 1 minute.

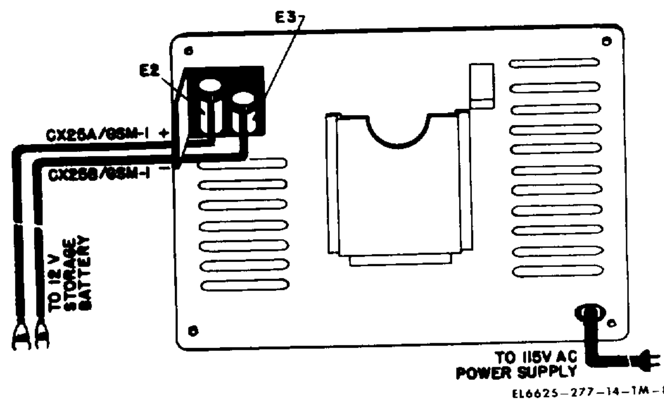

Figure 2-2. Battery and ac power supply connections, TS-682/GSM-1.

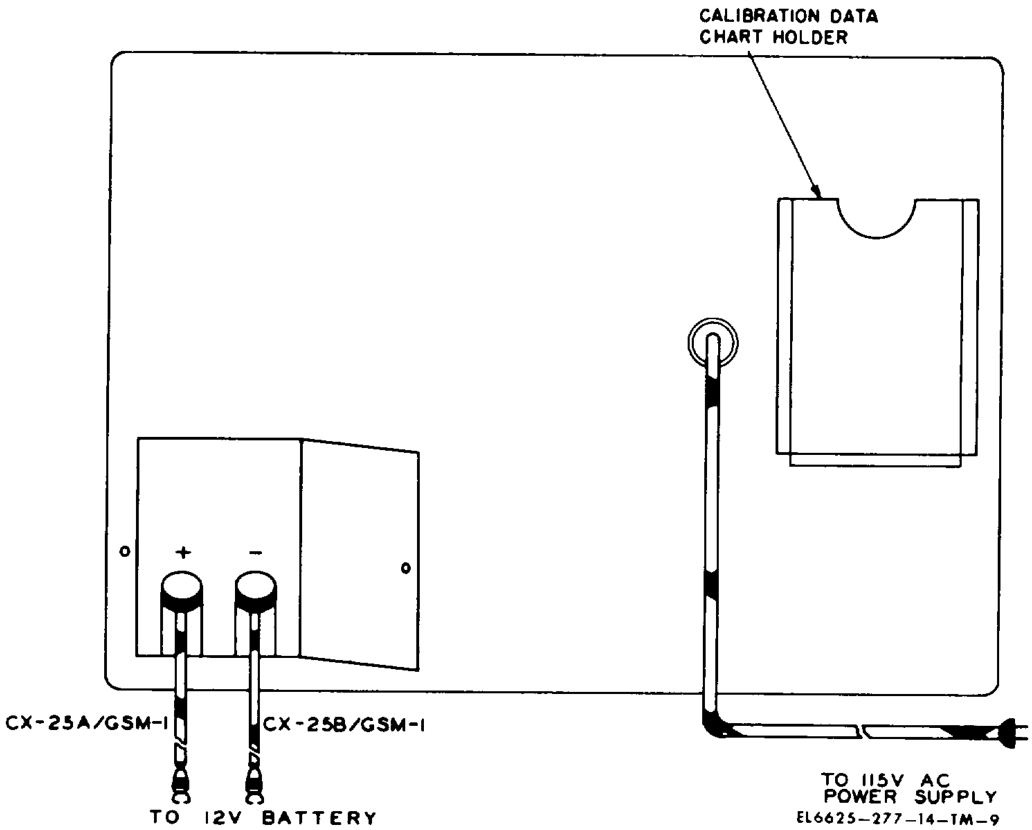

Figure 2-3. Battery and ac power supply connections, TS-682A/GSM-1.

2-5. Connections

CAUTION

Be sure to observe polarity when connecting the power cords from battery or power supply to the meter test set.

NOTE

Mounting MT-135A/GSM-1 should not be connected to meter test set until test set has been set up for proper operation.

a. Plug the ac power cord into a convenient 115volt, 60-Hz ac outlet.

b. Connect the 12-volt storage battery or power supply to the binding posts just inside the door on the rear panel of the meter test set (fig. 2-2 or 2-3). Connect the spade-type terminal of Cord CX-25A/GSM-1 (positive) to the positive (+) binding post; connect the battery clip to the positive battery or power supply terminal. Connect the spade-type terminal of Cord CX-25B/GSM-1 (negative) to the negative (-) binding post; connect the battery clip to the negative battery or power supply terminal.

CHAPTER 3

OPERATING INSTRUCTIONS

Section I. CONTROLS AND INSTRUMENTS

3-1. General

Haphazard operation or the improper setting of switches and controls of the meter test set can damage the equipment. For this reason, it is essential to know the function of every switch and control on the meter test set. All panel designations pertaining to ac ranges are marked in blue; all designations pertaining to dc ranges are marked in black; all designations common to both ac and dc ranges are marked in white.

3-2. Operator Controls

Table 3-1 lists the controls and indicators of the meter test set and their functions. Figures 3-1 and 3-2 show the locations of the operator controls and indicators.

Table 3-1. Operator Controls and Indicators

NOTE

This table covers controls and indicators used by the operator; additional items used by maintenance personnel are covered by the instructions for the appropriate maintenance category.

Control or indicator	Function
AC LINE switch (TS-682/GSM-1)	In ON position, applies ac power to the ac voltage jacks and to the rectifier circuit for dc voltage output. The pilot lamp above the switch lights to indicate that power is on.
AC LINE switch (TS-682A/GSM-1)	In ON position, applies ac power to ac voltage jacks, meter amplifier, and rectifier circuit for dc voltage output. The pilot lamp above switch lights to indicate that power is on.
BATTERY switch	In ON position, applies 12-volt battery current to the meter test set for dc testing. The pilot lamp above the switch lights to indicate that dc power is on.
AMPLIFIER TEST switch (TS-682A/GSM-1)	When depressed, checks amplifier circuit. The pilot lamp above switch lights to indicate proper operation of circuit.
BUZZER switch (TS-682A/GSM-1)	When depressed, energizes buzzer used to overcome friction in meter movements.
ALT. CURRENT AC VOLTS DC VOLTS COARSE CONTROL	Varies ac current, ac volts, and dc volts from zero to full scale in selected range.
ALT. CURRENT AC VOLTS DC VOLTS FINE CONTROL	Used for fine adjustment of output over approximately 10 percent of the selected range.
DIRECT CURRENT COARSE CONTROL	Varies dc current output from zero to full scale in selected range.
DIRECT CURRENT FINE CONTROL	Used for fine adjustment of dc output over approximately 10 percent of selected range.
TS-682/GSM-1	
Left hand selector switch	Four position switch with following range selections: 2000 V DC 1000 V DC 100MV DC to 400 V DC ACV
Center selector switch	Four position switch with following mode selections: ACV DCV 100MA AC 40A AC AC & DC CUR

Table 3-1. Operator Controls and Indicators-Continued

Control or indicator	Function
DIRECT CURRENT SELECTOR (Right hand select-or switch)	Seven position switch with following ranges: 100UA to 400MA, 2A-1A, 4A, 10A, 20A, 40A, 100A
Ac meter (left hand)	Ac voltage ranges: Zero to 2,000 volts Ac ranges: Zero to 500 mA Zero to 100 amperes
Dc meter (right hand)	Dc ranges: Zero to 400 uA Zero to 400 mA Zero to 100 A
TS-682A/GSM-1	
Left hand selector switch	Four position switch with following range selections: 2000 V DC 1000 V DC 0.1V to 500 V DC ALL OTHER AC & DC SCALES
Center selector switch	Five position switch with following mode selections: AC AMPERES & MA AC VOLTS DC VOLTS & MV DC MA & UA DC AMPERES
Right hand selector switch	Nine position switch with following ranges; 100A, 50A, 20A, 10A, 5A, 2A, 1A AC & DC MA & UA, AC & DC VOLTS
Ac milliampers meter (left hand)	Ac voltage ranges: Zero to 2,000 volts. Ac ranges: Zero to 500 mA. Zero to 100 amperes.
Dc microamperes meter (center)	Dc voltage ranges: Zero to 2,000 volts. Dc ranges: Zero to 500 uA. Zero to 500 mA.
Dc millivolts meter (right hand)	Dc voltage ranges: Zero to 100 mV. Dc ranges: Zero to 100 amperes.

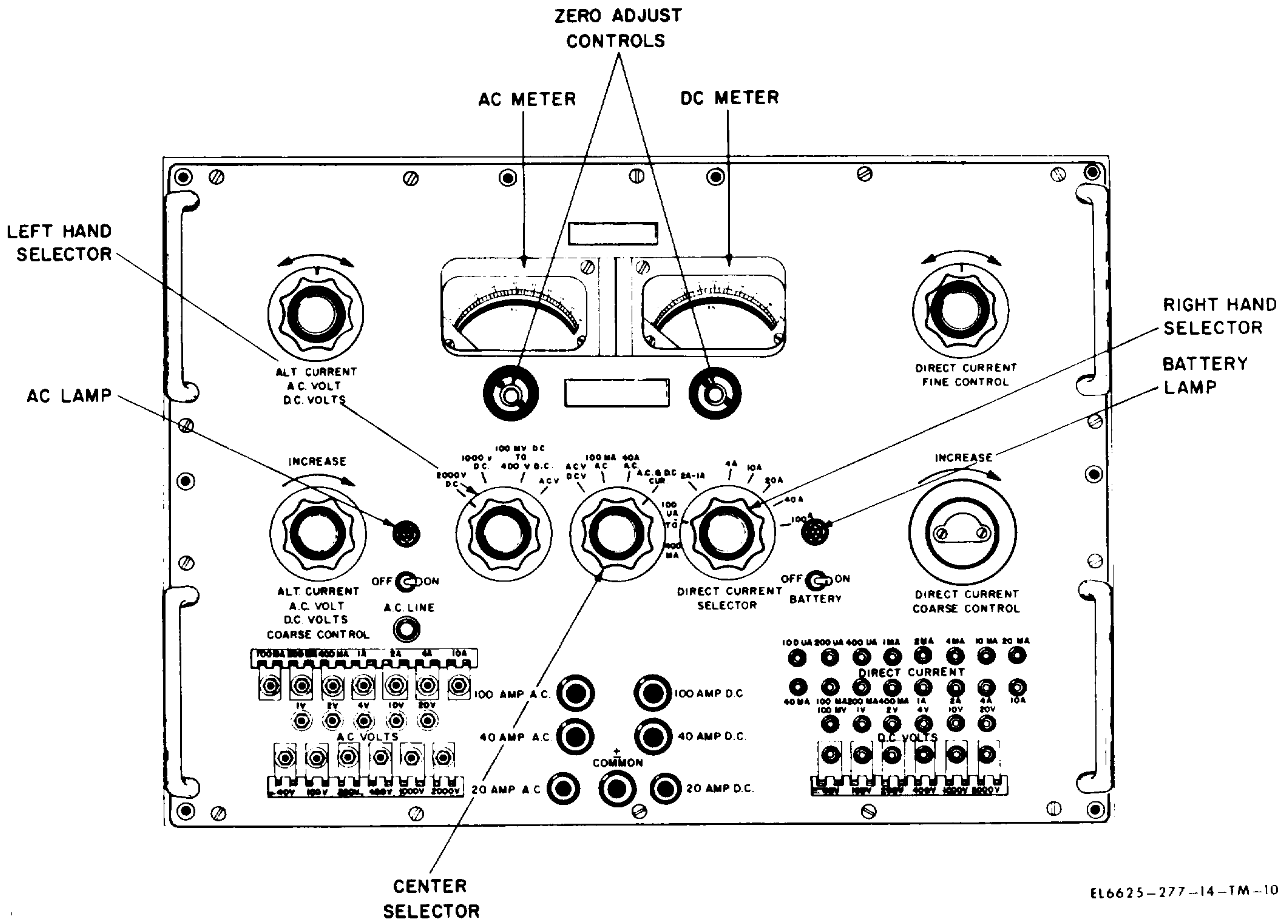

Figure 3-1. Meter Test Set TS-682/GSM-1, front panel.

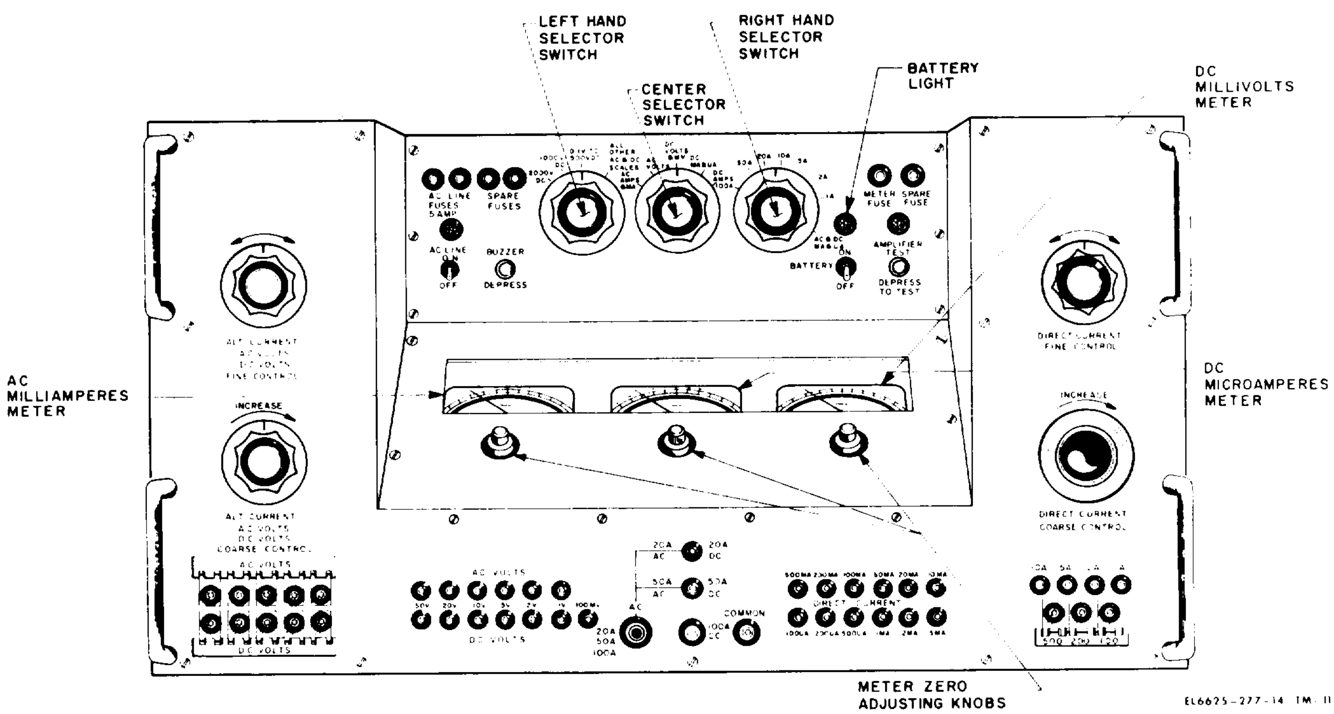

Figure 3-2. Meter Test Set TS-682A/GSM-1, front panel.

Section II. OPERATION UNDER USUAL CONDITIONS

3-3. Preliminary Starting Procedure

a. Place the AC LINE switch in the OFF position.

b. Place the BATTERY switch in the OFF position.

c. Rotate the four output control knobs to their extreme counterclockwise position. Do not move any of the four control knobs from their extreme counterclockwise position until the meter to be tested has been connected to the jacks or binding posts.

3-4. Initial Adjustments

a. Perform the following adjustments before initiating meter operation.

(1) Adjust the standard meters to zero by turning the zero adjusting control associated with and located below each meter. To overcome the friction inherent in the pivot of this type of meter, tap the face of the meter lightly with the fingers or operate the BUZZER switch on the TS-682/GSM-1 when zeroing and each time the meter is read when in use.

NOTE

When adjusting the meters to zero, be sure that no test cords are connected to the jacks or binding posts of the meter test set. If other-equipment is connected to the test set, the meters may indicate false zeros.

(2) Place the AC LINE switch and the BATTERY switch in the ON position. Allow 1 minute for the meter test set to warm up.

(3) On the TS-682A/GSM-1, check the operation of the amplifier circuit by depressing the AMPLIFIER TEST switch. The white indicating light above the switch should light if this circuit is operating normally.

b. Mount the meter to be tested, using the following procedure.

(1) Many meters are mounted on a steel panel. To test and calibrate this type of meter, use a steel calibration ring over the meter case to simulate normal operating conditions. Select a ring of the approximate diameter of the meter to be tested, and slip the ring over the case before mounting the meter on Mounting MT-135A/GSM-1. The spring-steel retainers on the calibration ring secure the ring to the meter.

(2) Press down on the knob on top of the mounting box to open the jaws inside the box.

(3) Place the meter terminals in the mounting holes and release the knob.

(4) Loosen the thumbscrews at each end of the mounting shaft and tilt the box until the meter under test assumes the angle it normally occupies in the equipment from which it was taken. Tighten the thumb-screws securely. Figure 3-3 shows a meter properly mounted on Mounting MT-135A/GSM-1.

NOTE

Before operating the TS-682(*)/GSM-1, determine if the plugs on the test cord set have been modified. If they have not been modified, the test cord set can be used only with the TS-682A/GSM-1. If they have been modified, the test cord set can be used only with the TS-682/GSM-1.

The modification consists of the following:

On the PL-55 or the 0.25-inch diameter plug, pins 1 and 2 are shorted to the metal case.

On the PL-68 or the 0.2056-inch diameter plug, pin 1 is shorted to the metal case and pins 2 and 3 are shorted together. In either case, the test cord with the PL-55 or 0.25-inch diameter plug must be used for voltage tests and the test cord with the PL-68 or 0.2056-inch diameter plug must be used for current tests.

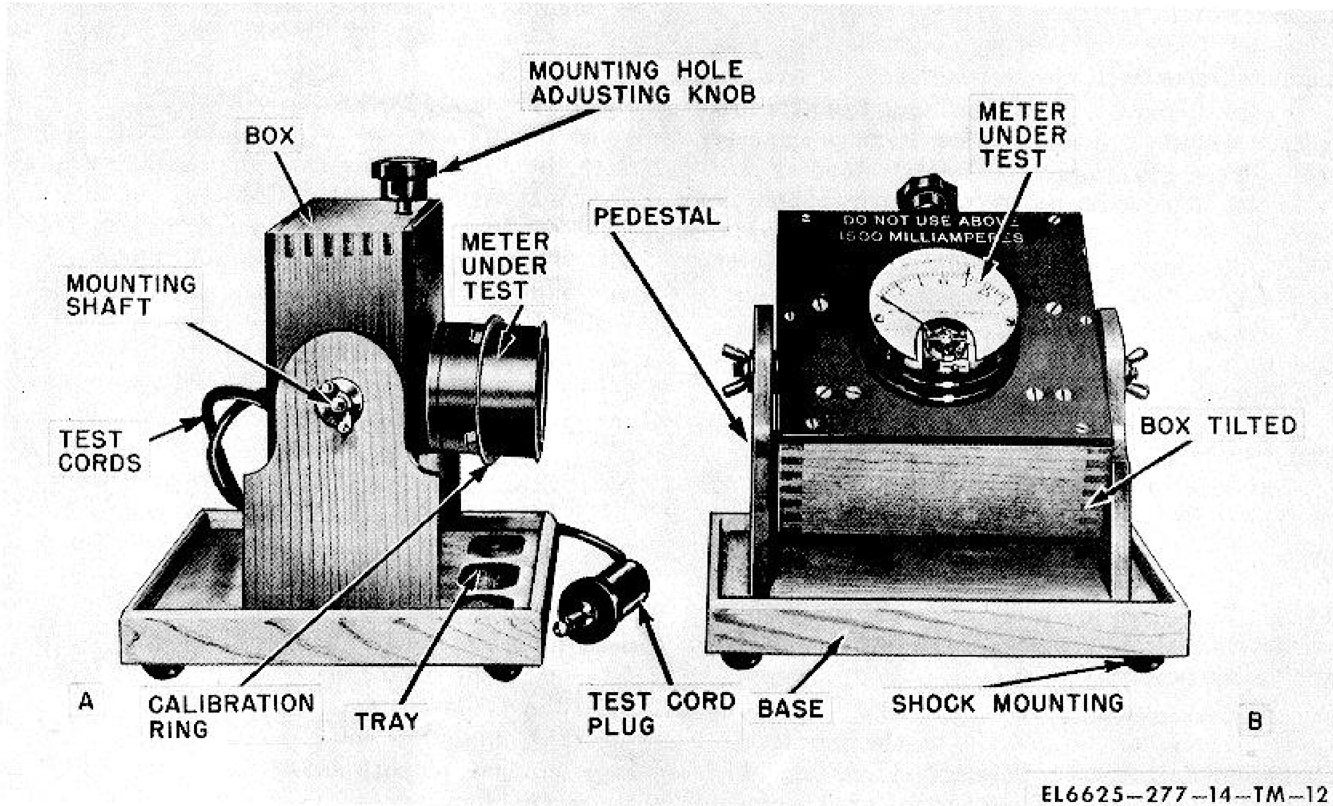

Figure 3-3. Mounting MT-135A/GSM-1, with meter in test position.

3-5. Operating Procedure

The following procedures describe in detail the operation of TS-682(*)/GSM-1 with meters of various types. Control settings for the TS-682/GSM-1 are given in parenthesis.

a. *Testing Ac Voltmeters for Accuracy of Operation.* Perform the preliminary operations in paragraphs 3-3 and 3-4 and proceed as follows:

(1) Turn the center selector switch to the AC VOLTS (ACV DCV) position.

(2) Turn the left-hand selector switch to the ALL OTHER AC & DC SCALES (ACV) position.

(3) Turn the right-hand selector switch to the AC & DC VOLTS position (any position).

(4) Mount the meter to be tested on Mounting MT-135A/GSM-1 (para 3-4).

(5) Connect one end of a test cord with spade type terminals on both ends to one of the binding posts on the rear of Mounting MT-135A/GSM-1. Connect the other end of this cord to the COMMON binding post on the front of the meter test set.

(6) Use the voltage test cord with the PL-55 plug and connect the spade-type terminal to the other binding post on the rear of the mounting. Insert the plug into the test set voltage jack which corresponds to the desired ac voltage output.

NOTE

Always use the lowest range that will provide the required voltage.

(7) Rotate the AC VOLTS COARSE CONTROL clockwise slowly until the pointer of the standard ac meter reaches the desired deflection. Read the scale of the standard ac meter that corresponds to the rated value of the ac voltage jack selected.

(8) Make a fine adjustment with the AC VOLTS FINE CONTROL; at the same time, depress the BUZZER switch on the TS-682A/GSM1 or tap on the meter glass to overcome possible friction in the test set meter movement.

(9) Compare the reading of the meter under test with the reading of the standard ac meter. To obtain a more precise reading, accurate to within ± .25 percent, use the calibration data chart (para 3-6) covering the ac voltage ranges of the meter under test.

(10) Repeat the procedures in (6) through (9) above for as many different readings as is necessary to test the action and accuracy of the meter under test.

(11) When tests have been completed, proceed as follows to prepare the meter test set for testing another meter:

(a) Turn the output controls to their maximum counterclockwise positions.

(b) Remove one test cord plug from the jack on the front of the meter test set. Remove the other test cord terminal from the COMMON binding post.

(c) Remove both test cords from the binding posts on the rear of Mounting MT-135A/GSM-1.

(d) Remove the tested meter from the mounting.

b. Testing Dc Voltmeters for Accuracy of Operation. Perform the preliminary operations in paragraphs 3-3 and 3-4 and proceed as follows:

(1) Turn the center selector switch to the DC VOLTS AND MV (ACV DCV) position.

(2) Turn the left-hand selector switch to the position covering the appropriate dc voltage range.

(3) Turn the right-hand selector switch to the AC & DC VOLTS position (any position).

(4) Mount the meter to be tested on Mounting MT-135A/GSM-1 (para 3-4).

(5) Connect one end of a test cord with spadetype terminals on both ends to the negative(-) binding post on the rear of Mounting MT135A/GSM-1. Connect the other end of this cord to the COMMON binding post on the front of the meter test set.

(6) Use the voltage test cord with the PL-55 plug and connect the spade-type terminal to the positive (+) binding post on the rear of the mounting. Insert the plug into the test set voltage jack which corresponds to the desired dc voltage output.

NOTE

Always use the lowest range that will provide the required voltage.

(7) Rotate the DC VOLTS COARSE CONTROL slowly clockwise until the pointer of the standard dc voltage meter reaches the desired deflection.

(8) Make a fine adjustment with the DC VOLTS FINE CONTROL; at the same time, depress the BUZZER switch on the TS-682A/GSM1 or tap the meter glass to overcome the possible friction in the test set meter movement.

(9) Compare the reading of the meter under test with the reading of the standard dc meter. To obtain a more precise reading, accurate to within ± .25 percent, use the calibration data chart (para 3-11) covering the dc voltage ranges of the meter under test.

(10) Repeat the procedures in (6) through (9) above for as many readings as is necessary to test the action and accuracy of the meter under test.

(11) When tests have been completed, proceed as follows to prepare the meter test set for testing another meter:

(a) Turn the output control to their maximum counterclockwise positions.

(b) Remove one test cord plug from the jack on the front of the meter test set. Remove the other test cord terminal from the COMMON binding post.

(c) Remove both test cords from the binding posts on the rear of Mounting MT-135A/GSM-1.

(d) Remove the tested meter from the mounting.

c. Testing Ac Ammeters up to 10A for Accuracy of Operation. Perform the preliminary operations in paragraphs 3-3 and 3-4 and proceed as follows:

(1) Turn the center selector switch to the AC AMPERES & MA (AC & DC CUR) position.

(2) Turn the left-hand selector switch to the ALL OTHER AC & DC SCALES position (any position).

(3) Turn the right-hand selector switch to the desired current range (any position).

(4) Mount the meter to be tested on Mounting MT-135A/GSM-1 (para 3-4).

(5) Connect one end of a test cord with spade type terminals on both ends to one binding post on the rear of Mounting MT-135A/GSM-1. Connect the other end of this cord to the COMMON binding post on the front of the meter test set.

(6) Use the current test cord with the PL-68 plug and connect the spade-type terminal to the other binding post on the rear of the mounting.

Insert the plug into the test set current jack which corresponds to the desired ac current output.

(7) Rotate the ALT CURRENT COARSE CONTROL slowly clockwise until the pointer of the standard ac meter reaches the desired deflection.

(8) Make a fine adjustment with the ALT CURRENT FINE CONTROL: at the same time, depress the BUZZER switch on the TS-682A/GSM1 or tap on the meter glass to overcome possible friction in the test set meter movement.

(9) Compare the reading of the meter under test with the reading of the standard ac meter. To obtain a more precise reading, accurate to within ± .25 percent, use the calibration data chart (para 3-6) covering the ac current ranges of the meter under test.

(10) Repeat the procedures in (6) through (9) above for as many readings as is necessary to test the action and accuracy of the meter under test.

(11) When tests have been completed, proceed as follows to prepare the meter test set for testing another meter:

(a) Turn the output controls to their maximum counterclockwise positions.

(b) Remove one test cord plug from the jack on the front of the meter test set. Remove the other test cord terminal from the COMMON binding post.

(c) Remove both test cords from the binding posts on the rear of Mounting MT-135A/GSM-1.

(d) Remove the tested meter from the mounting.

d. Testing Ac Ammeters above 10A for Accuracy of Operation. Perform the preliminary operations in paragraphs 3-3 and 3-4, and the operations in c (1) through (4) above, and proceed as follows:

(1) Connect one end of a test cord with spadetype terminals on both ends to one binding post on the rear of Mounting MT-135A/GSM-1. Connect the other end of this cord to the AC 20A 50A 100A (COMMON) binding post.

(2) Connect one end of the other test cord with spade-type terminals on both ends to the other binding post on the rear of the mounting. Connect the other end of this cord to the test set binding post which corresponds to the desired ac current output.

(3) Rotate the ALT CURRENT COARSE CONTROL slowly clockwise until the pointer of the standard ac meter reaches the desired deflection.

(4) Make a fine adjustment with the ALT CURRENT FINE CONTROL: at the same time, depress the BUZZER switch on the TS-682A/GSM-1 or tap on the meter glass to overcome possible friction.

(5) Compare the reading of the meter under test with the reading of the standard ac meter. To obtain a more precise reading, accurate to within ± .25 percent, use the calibration data chart covering the ac current ranges of the meter under test.

(6) Repeat the procedures in (2) through (5) above for as many readings as is necessary to test the action and accuracy of the meter under test.

(7) When tests have been completed, proceed as described in *c*(11)(a) through (d) above to prepare the meter test set for testing another meter.

e. Testing Dc Ammeters up to 10V for Accura-cy of Operation. Perform the preliminary operations in paragraphs 3-3 and 3-4 and proceed as follows:

(1) Turn the center selector switch to the DC AMPERES or DC MA and UA (AC & DC CUR) position, whichever is appropriate.

(2) Turn the left-hand selector switch to the ALL OTHER AC & DC SCALES position (any position).

(3) Turn the right-hand selector switch to the desired current range.

(4) Mount the meter to be tested on Mounting MT-135A/GSM-1 (para 3-4).

(5) Connect one end of a test cord with spade type terminals on both ends to the negative (-) binding post on the rear of Mounting MT-135A/GSM-1. Connect the other end of this cord to the COMMON binding post on the front of the meter test set.

(6) Use the current test cord with the PL-68 plug and connect the spade-type terminal to the positive (+) binding post on the rear of the mounting. Insert the plug into the test set current jack which corresponds to the desired dc output.

(7) Place the BATTERY switch in the ON position.

(8) Rotate the DIRECT CURRENT COARSE CONTROL slowly clockwise until the pointer of the standard dc meter reaches the desired deflection.

(9) Make a fine adjustment with the DIRECT CURRENT FINE CONTROL: at the same time depress the BUZZER switch on the TS-682A/GSM-1 or tap on the meter glass to overcome possible friction in the test set meter movement.

(10) Compare the reading of the meter under test with the reading of the standard dc meter. To obtain a more precise reading, accurate to within ± .25 percent, use the calibration data chart covering the dc ranges of the meter under test.

(11) Repeat the procedures in (6) through (10) above for as many readings as is necessary to test the action and accuracy of the meter under test.

(12) When tests have been completed, proceed as follows to prepare the meter test set for testing another meter.

(a) Turn the output controls to their maximum counterclockwise positions.

(b) Remove one test cord plug from the jack on the front of the meter test set. Remove the other test cord terminal from the COMMON binding post.

(c) Place the BATTERY switch in the OFF position.

(d) Remove both test cords from the binding posts on the rear of Mounting MT-135A/GSM-1.

(e) Remove the tested meter from the mounting.

f. Testing Dc Ammeters Above 10V for Accuracy of Operation. Perform the preliminary operations in paragraphs 3-3 and 3-4 and proceed as follows:

(1) Turn the center selector switch to the DC AMPERES (AC & DC CUR) position.

(2) Turn the left-hand selector switch to the ALL OTHER AC & DC SCALES position (any position).

(3) Turn the right-hand selector switch to the desired current range.

(4) Mount the meter to be tested on Mounting MT-135A/GSM-1 (para 3-4).

(5) Connect one end of a test cord with spade type terminals on both ends to one binding post on the rear of Mounting MT-135A/GSM-1. Connect the

other end of this cord to the COMMON binding post on the front of the meter test set.

(6) Connect one end of the other test cord with spade-type terminals on both ends to the other binding post on the rear of the mounting. Connect the other end of this cord to the test set binding post which corresponds to the desired dc current output.

(7) Operate the BATTERY switch to the ON position.

(8) Rotate the DIRECT CURRENT COARSE CONTROL slowly clockwise until the pointer of the standard dc meter reaches the desired deflection.

(9) Make a fine adjustment with the DIRECT CURRENT FINE CONTROL: at the same time, depress the BUZZER switch on the TS-682A/GSM1 or tap on the meter glass to overcome possible friction in the test set meter movement.

(10) Compare the reading of the meter under test with the reading of the standard dc meter. To obtain a more precise reading, accurate to within ± .25 percent, use the calibration data chart (para 36) covering the dc current ranges of the meter under test.

(11) Repeat the operations in (6), (8), (9), and (10) above for as many readings as is necessary to test the action and accuracy of the meter under test.

(12) When tests have been completed, proceed as described in *c*(12)(a) through (e) above to prepare the meter test set for testing another meter.

3-6. Using Calibration Data Charts

a. To obtain the most precise results when checking or calibrating meters, use the calibration data charts located in the pocket on the rear panel of the meter test set. Ac and dc voltage and current values read on the three standard meters are accurate to within ± .25 percent when corrected according to these charts. A sample calibration data chart is shown in figure 3-4.

b. Obtain the correct value of voltage or current that is being supplied to the meter under test by reading the value on the standard meter and referring to the calibration data for the ac or dc voltage or current range selected. For each 20 meter scale marking, given in the column designated SCALE MARK, a corrected value of voltage or current is given in the right-hand column. Select the corrected value of voltage or current from the column opposite the scale marking.

CALIBRATION DATA CHART FOR TEST SET TS-682/GSM-1

Date 18 SEP 51 Serial No. XX

D.C. CURRENT RANGES

0-100UA RANGE		0-200UA RANGE		0-400UA RANGE		0-1MA RANGE		0-2MA RANGE		0-4MA RANGE	
SCALE MARK.	UA	SCALE MARK.	UA	SCALE MARK.	MA	SCALE MARK.	MA	SCALE MARK.	MA	SCALE MARK.	MA
5	5.05	10	10.00	20	20.00	5	.0495	10	.0995	20	.2000
10	10.10	20	20.10	40	40.05	10	.1010	20	.2005	40	.4005
15	15.10	30	30.05	60	60.05	15	.1505	30	.3000	60	.5995
20	20.00	40	40.00	80	80.00	20	.2005	40	.4000	80	.8000
25	25.10	50	50.00	100	100.00	25	.2505	50	.5010	100	1.0005
30	30.10	60	60.05	120	120.05	30	[illegible]	60	.6000	120	1.2010
35	35.05	70	70.05	140	140.00	35	[illegible]	70	.7000	140	1.4005
40	40.05	80	79.90	160	160.00	[illegible]	[illegible]	80	.8010	160	1.6010
45	44.95	90	89.95	180	[illegible]	[illegible]	[illegible]	90	.9000	180	1.8000
50	49.90	100	99.90	200	[illegible]	[illegible]	.5000	100	1.0000	200	2.0000
55	55.05	110	110.05	220	[illegible]	55	.5520	110	1.1020	220	2.2020
60	6050	120	120.30	240	240.20	60	.6085	120	1.2060	240	2.4085
65	65.20	130	130.60	260	260.30	65	.6570	130	1.3060	260	2.6080
70	70.00	140	139.90	280	279.95	70	.7000	140	1.4005	280	2.8000
75	74.90	150	149.85	300	299.95	75	.7505	150	1.5000	300	3.0000
80	79.80	160	159.80	320	319.90	80	.8005	160	1.6000	320	3.2005
85	84.80	170	169.90	340	339.85	85	.8810	170	1.7005	340	3.4000
90	89.90	180	179.90	360	359.90	90	.9025	180	1.8005	360	3.6005
95	95.05	190	190.00	380	380.05	95	.9560	190	1.9050	380	3.8030
100	100.00	200	200.05	400	400.05	100	1.0030	200	2.0020	400	4.0030

SAMPLE

EL6625-277-14-TM-13

Figure 3-4. Sample meter calibration chart for meter test set.

3-7. Stopping Procedure

To stop operation of the meter test set, proceed as follows:

a. Turn the four output controls to their maximum counterclockwise positions.

b. Remove the test cord plugs and terminals from the jacks and binding posts on the front of the meter test set.

c. Remove the test cord terminals from the binding posts on the rear of Mounting MT-135A/GSM-1.

d. Remove the tested meter from the mounting.

e. Place the AC LINE switch in the OFF position.

f. Place the BATTERY switch in the OFF position.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

3-8. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather may hamper the efficient operation of electronic equipment. Instructions and precautions for operation under such adverse conditions follow:

a. Keep the equipment warm and dry. If the equipment is not kept in a heated enclosure, construct an insulated box for its protection.

b. Make certain the equipment has been warmed up sufficiently before use. This may take 15 to 30 minutes, depending on the temperature of the surrounding air.

c. When equipment which has been exposed to the cold is brought into a warm room, it will sweat until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly.

3-9. Operation in Tropical Climates

In tropical climates, electronic equipment may be installed in tents, huts or, when necessary, in underground dugouts. When equipment is installed below ground, and when it is set up in swamp areas, danger of moisture damage is more acute than normal in the tropics. Ventilation is usually very poor, and the high relative humidity causes condensation on the equipment whenever its temperature becomes lower than the ambient air. To counteract this condition, place lighted electric bulbs under the equipment.

3-10. Operation in Desert Climates

The main problem with electronic equipment in desert areas is the large amount of sand and dust that lodges in the moving parts and mechanical assemblies. Cleaning and servicing intervals should be shortened according to local conditions.

CHAPTER 4

OPERATOR AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. TOOLS AND EQUIPMENT

4-1. General

Tools and test equipment used by the operator and organizational repairman for the meter test set are listed in appendix C.

4-2. Lubrication

No lubrication is required for this equipment.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

4-3. General

To insure that the meter test set is always ready for operation, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services (PMCS) to be performed are listed and described in tables 4-1, 4-2, and 4-3. The sequence numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit will be noted for future correction, to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment. Record all deficiencies, together with the corrective action taken, as prescribed in TM 38-750.

4-4. Scope of Operator and Organizational Maintenance

a. General.

(1) Operator preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to maintain the equipment in serviceable condition. Operator preventive maintenance is performed daily and weekly; specific procedures are provided in table 4-1.

(2) Organizational preventive maintenance is performed on a monthly and quarterly basis; specific procedures are provided in tables 4-2 and 4-3.

(3) Defects that cannot be corrected must be reported to personnel at a higher maintenance category. Records and reports of repair must be made in accordance with procedures given in TM 38-750.

b. Preventive Maintenance Checks and Services Periods. Preventive maintenance checks and services for the meter test set are required on a daily/weekly (table 4-1), a monthly (table 4-2), and a quarterly basis (table 4-3). These checks must be performed during the specified intervals. In addition, the daily checks and services must be performed under the special conditions listed below:

(1) Initial installation.

(2) Return from higher category maintenance.

(3) Once each week, if the equipment is maintained in a standby condition.

Table 4-1. Operator Preventive Maintenance Checks and Services

D—Daily
Time Required: 1.0

W—Weekly
Time Required: 0.4

Interval and sequence no. D	Interval and sequence no. W	Item to be inspected procedure	Work time (M/H)
1		COMPLETENESS See that the equipment is complete	0.1
2		EXTERIOR SURFACES Clean the exterior surfaces, including the panel and meter glasses (para 4-5). Check all meter glasses and indicator lenses for cracks.	0.1
3		CONNECTORS Check the tightness of all connectors	0.1
4		CONTROLS AND INDICATORS While making the operating checks (sequence nos. 5 through 15), observe that the mechanical action of each knob, dial, and switch is smooth and free of external or internal binding, and that there is no excessive looseness. Also check the meters for sticking or bent pointers.	
5		CORD CS-25A/GSM-1 (POSITIVE) Connect to positive (+) battery binding post of test set, and to positive terminal of 12-volt storage battery.	0.1
6		CORD CS-25B/GSM-1 (NEGATIVE) Connect to negative (-) battery binding post of test set, and to negative terminal of 12-volt storage battery.	
7		AC POWER CORD Connect to 115V, 60 Hz ac outlet.	
8		OUTPUT CONTROLS Rotate to extreme counterclockwise positions.	
9		AC LINE SWITCH Operate to ON position; see that AC LINE indicator lamp lights.	
10		BATTERY SWITCH Operate to ON position; see that BATTERY indicator lamp lights.	
11		SELECTOR SWITCHES, AND ALT CURRENT-AC VOLTS-DC VOLTS COARSE AND FINE CONTROLS Select several ac and dc voltage ranges. Rotate COARSE CONTROL clockwise, FINE CONTROL clockwise and counterclockwise for fine adjustment of selected ranges. See that all meters vary within 10 percent of full scale deflection on selected ranges. See that output at jack of binding post is accurate. Measure with TS-352B/U.	0.3
12		SELECTOR SWITCHES, AND DIRECT CURRENT COARSE AND FINE CONTROLS Select several dc ranges. Rotate COARSE CONTROL clockwise, FINE CONTROL clockwise and counterclockwise. See that meters vary within 10 percent of full scale deflection. See that output at jack or binding post is accurate. Measure with TS-352B/U.	0.3
13		OUTPUT CONTROLS Rotate to extreme counterclockwise position.	
14		AC LINE SWITCH Place in OFF position. See that AC LINE pilot lamp goes out.	
15		BATTERY SWITCH Place in OFF position. See that BATTERY pilot lamp goes out.	
	1	CABLES Inspect cords, cables and wires for chafed, cracked or frayed insulation. Replace connectors that are broken, arced, stripped, or worn excessively.	0.1
	2	HANDLES AND LATCHES Inspect handles, latches, and hinges for looseness. Replace or tighten as necessary.	0.1
	3	METAL SURFACES Inspect exposed metal surfaces for rust and corrosion. Touch up the finish as required(para 4-6).	0.2

Table 4-2. Organizational Preventive Maintenance Checks and Services

M—Monthly
Total time Required: 1.4

Sequence Number	ITEM TO BE INSPECTED PROCEDURE	WORK TIME (M/H)
1	PLUCKOUT ITEMS Inspect seating of pluckout items. Make certain that tube clamps grip tube tightly.	0.2
2	RELAYS Inspect relays for dirt, corrosion, and burned contacts.	0.1
3	JACKS Inspect jacks for snug fit and good contact.	0.1
4	TRANSFORMER TERMINALS Inspect terminals on power transformer. All nuts must be tight. There should be no evidence of dirt or corrosion.	0.1
5	TERMINAL BLOCKS Inspect terminal blocks for loose connections and cracked or broken insulation.	0.1
6	RESISTORS AND CAPACITORS Inspect resistors and capacitors for cracks, blistering or other defects.	0.5
7	GASKETS AND INSULATORS Inspect gaskets, insulators, bushings, and sleeves for cracks, chipping, and excessive wear.	0.2
8	INTERIOR Clean interior of chassis and cabinet.	0.1

Table 4-3. Organizational Preventive Maintenance Checks and Services

Q—Quarterly
Total time Required: 0.3

Sequence Number	ITEM TO BE INSPECTED PROCEDURE	WORK TIME (M/H)
1	PUBLICATIONS See that all publications are complete, serviceable, and current. Refer to DA Pam 310-4.	0.1
2	MODIFICATIONS Check DA Pam 310-7 to determine if any new MWO's applicable to the equipment have been published. All URGENT MWO's must be applied immediately. All NORMAL MWO's must be scheduled.	0.1
3	SPARE PARTS Check all spare parts (operator and organizational) for general condition and method of storage. There should be no evidence of overstock, and all shortages must be noted on valid requisitions.	0.1

4-5. Cleaning

Exterior surfaces of the equipment should be clean, and free of dust, dirt, grease, and fungus.

a. Remove dust and loose dirt with a clean soft cloth.

WARNING

The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT use near open flame. Trichloroethane is not flammable but exposure of the fumes to an open flame or hot metal highly toxic phosgene gas.

b. Remove grease, fungus, and ground-in dirt from the cases; use a cloth dampened (not wet) with trichloroethane.

c. Remove dust or dirt from plugs and jack a brush.

CAUTION

Do not press on the meter glass wi cleaning. Damage to the equipment r result.

d. Clean the front panels, meters, and control knobs; use a soft clean cloth. If necessary, dampen the cloth with water; mild soap may be used for effective cleaning.

4-6. Repainting and Refinishing

a. Rustproofing. When the finish on the painted section of the TS-682(*)/GSM-1 becomes badly scarred or damaged, rust and corrosion can be prevented by touching up the bare surfaces. Use No. 000 sandpaper to clean the surface down to the bare metal. Obtain a bright, smooth finish.

b. Painting. Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in TB 746-10.

Section III. ORGANIZATIONAL TROUBLESHOOTING

4-7. General

The troubleshooting of this equipment is based upon the operational check (table 4-1, sequence No. 5 through 15). To troubleshoot the equipment, perform all functions of the TS-682(*)/GSM-1, until an abnormal condition or result is observed. Note the abnormal condition or result and refer to table 4-4, Organizational Troubleshooting. If the corrective measures indicated do not result in correction of the trouble, higher maintenance category repair is required. Paragraph 4-8 contains additional information and step-by-step instructions for performing equipment tests to be used during the troubleshooting procedures.

4-8. Electron Tube Replacement Techniques

To safeguard against disposal of functional electron tubes, observe the following procedures:

a. Inspect all cabling, connectors, and the general condition of the meter test set, before removing the electron tubes.

b. Isolate the trouble, if possible, to a particular circuit of the meter test set.

CAUTION

Do not rock or rotate a tube when removing it from a socket; pull the tube straight out with a tube puller. Failure to comply may result in damage to tube or socket.

c. If a tube tester is available, remove and test one tube at a time. Substitute new tubes only for those that are defective.

d. If a tube tester is not available, use the tube substitution method.

(1) Replace one of the suspected tubes with a known good tube.

(2) Check to see whether the meter test set is operative. If the meter test set is operative, discard the original tube. If the meter test set is inoperative, remove the new tube and reinsert the original tube.

(3) Continue to check the suspected tubes, using the procedure in (1) and (2) above, until the meter test set becomes operative or until all the suspected tubes have been checked.

e. If the meter test set is inoperative after the procedures outlined in *a* through *d* above are completed, continue as follows:

(1) Replace the suspected tubes, one at a time, with known good tubes, until the meter test set becomes operative or until all the suspected tubes have been replaced by new ones. Note the sockets from which the original tubes were removed. If the meter test set begins to operate, discard the last tube removed.

(2) Reinsert the remaining original tubes, one at a time, in the original sockets. If the meter test set fails to operate at any time during this step, discard the last reinserted original tube. Do not leave a new tube in a socket if the meter test set operates satisfactorily with the original tube.

NOTE

If a replacement for a defective tube soon becomes defective also, check the adjustment and condition of parts in the tube circuit. Continued tube replacement will result in only temporary repair, and more serious troubles may result.

f. If the tube substitution does not correct the trouble, reinsert the original tubes and route the equipment to a higher category repair.

g. Discard tubes when:

(1) A test by a tube tester or other instrument shows that they are defective.

(2) The tube defect is obvious; *for example,* the glass envelope, or a connecting prong or lead is broken.

h. Do not discard tubes merely because they have been used for a specified length of time. Satisfactory operation in a circuit is the final proof of tube quality. The tube in use may work better than a new one.

i. Do not discard tubes only because they fall on, or slightly above, the minimum acceptable value when checked in a tube tester. Some new tubes fall near the low end of the acceptable range; yet these tubes may provide satisfactory performance throughout a long period of operational life at this near limit value.

Table 4-4. Organizational Troubleshooting

Malfunction	Probable cause	Corrective action
1. AC LINE pilot lamp does not light when the AC LINE switch is ON	*a.* Defective AC LINE fuses. *b.* Line cord or plug defective. *c.* Defective AC LINE pilot lamp.	*a.* Replace fuses. *b.* Check line cord and plug. *c.* Replace pilot lamp bulb.
2. BATTERY pilot lamp does not light when the BATTERY switch is on	*a.* Battery dead or connected wrong. *b.* Defective pilot lamp	*a.* Check battery charge and connection. *b.* Replace pilot lamp bulb.
3. Voltage meter shows no indication TS-682A/GSM.-1 only	Defective rectifier tube V1.	Check and replace if defective.
4. AMPLIFIER TEST lamp does not light when DEPRESS-TO-TEST Button is pushed, and left-hand selector switch is in ALL OTHER AC & DC SCALES position.	*a.* Defective AMPLIFIER TEST lamp. *b.* Defective rectifier tube V1. *c.* Defective amplifier tubes V6 or V7.	*a.* Replace lamp bulb. *b.* Check and replace V1. *c.* Check and replace tubes V6 or V7.
5. AMPLIFIER TEST lamp is off, but center meter shows no indication.	Defective METER FUSE.	Replace METER FUSE.

CHAPTER 5
FUNCTIONING OF EQUIPMENT

5-1. Block Diagram

The test set (fig. 5-1) has facilities for measuring current in both ac and dc ranges. It is also able to measure ac and dc voltages. Through its own power supply it is able to furnish voltages and currents in a wide range to meters that are to be checked for accuracy. The TS-682A/GSM-1 has an ac meter amplifier circuit operating in conjunction with a warning amplifier. The test set furnishes a regulated current or voltage, either ac or dc, to the meter under test. The meter in the test set is used as a standard meter. A comparison is made between the readings of the two meters.

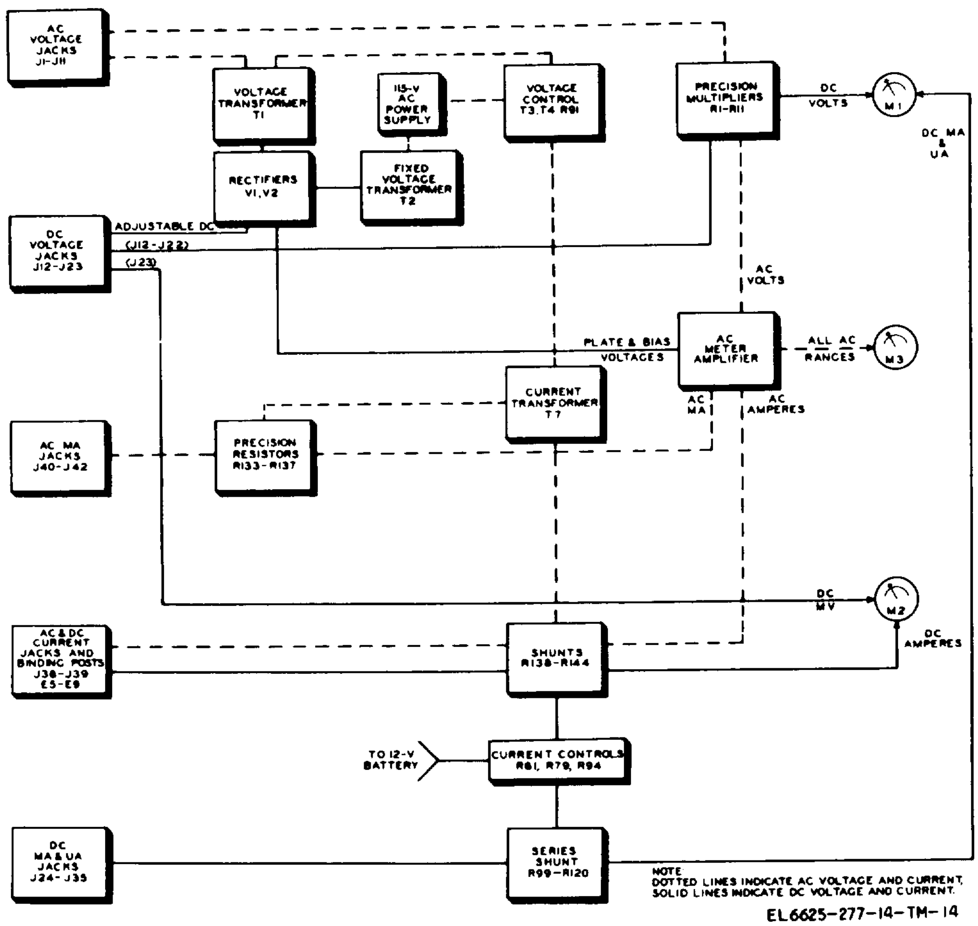

Figure 5-1. Meter Test Set TS-682A/GSM-1, block diagram.

5-2. Block Diagram of Ac Meter Amplifier (TS-682A/GSM-1 only)

The ac meter amplifier (fig. 5-2) consists of two circuits: an ac meter amplifier with its output measured by meter M3 (a below) and a warning amplifier with its output connected to a neon warning lamp (b below).

a. Any test signal that enters the ac meter amplifier circuit is amplified by first voltage amplifier V3A, second voltage amplifier V3B, and third voltage amplifier V4A. The signal is inverted by phase inverter V4B and coupled to the output stage which is coupled to meter M3 which measures the output signal. This reading is compared to the reading of the meter under test.

b. If the amplitude of the signal that enters the ac meter amplifier circuit is so low that it would affect the accuracy of the meter reading, the warning amplifier takes over. The signal is amplified in first warning amplifier V6A, second warning amplifier V6B, and in third warning amplifier V7A which is connected to neon lamp V8. When lighted this neon lamp warns the operator that the reading of the meter is not accurate.

5-3. Detailed Analysis of Ac Meter Amplifier

a. The ac meter amplifier (fig. 5-3) provides the means for making ac voltage and current measurements. The amplifier drives 0- to 100-milliampere (MA) ac meter M3. The amplifier-meter combination may be regarded as a vacuum-tube meter having an input resistance of 1,000 ohms and a sensitivity of 1,000 ohms per volt (full-scale values of 1 mA, 1 volt).

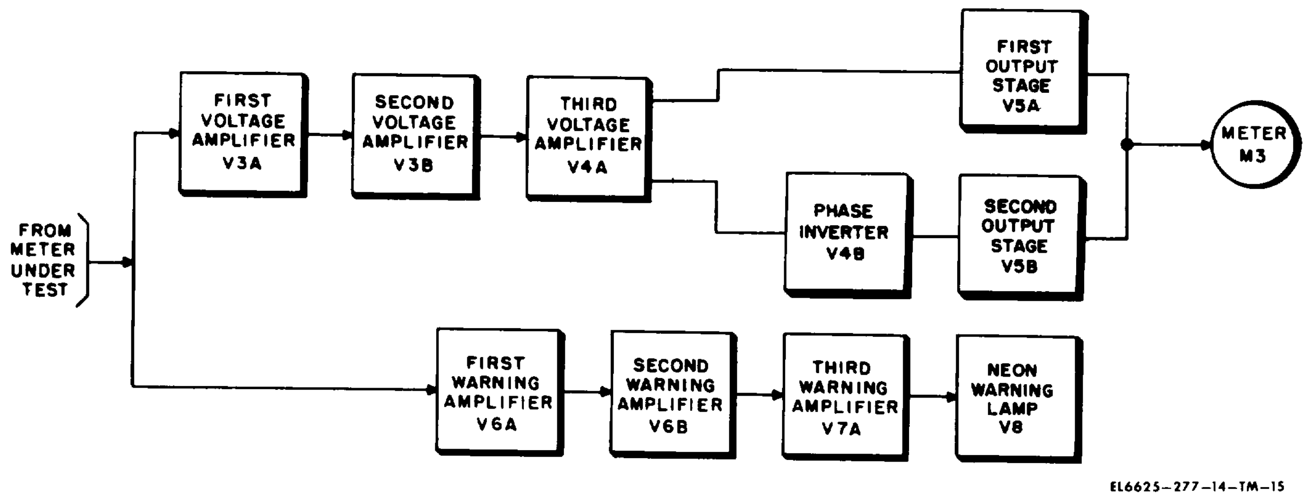

Figure 5-2. Ac meter amplifier circuit, block diagram.

b. The ac meter amplifier is a dc amplifier with two feedback loops. A dc feedback loop automatically adjusts the bias of each stage throughout the ac meter amplifier so that the output stage has approximately equal dc voltage drops across both halves of tube V5. The first stage, which consists of one-half of voltage amplifier tube V3, is operated with its cathode connected directly to ground. No cathode bias is required because of the dc feedback loop. This direct grounding gives a low impedance ac path to ground so that line voltage signals, or harmonics of line voltage signals, are not likely to disturb the operation of the circuit. Resistor R31 is the plate load resistor. Resistors R32 and R36 form a voltage divider. The upper end of resistor R32 is connected to a negative voltage. This division makes the junction of resistors R32 and R36 slightly negative and automatically adjusts to the correct bias required by second voltage amplifier V3B. Resistor R33 and capacitor C3 from the plate of tube V3A to ground control the frequency response of the ac meter amplifier at high frequencies, so that stable operation is achieved. The stabilizing action of the network has a large amount of negative feedback.

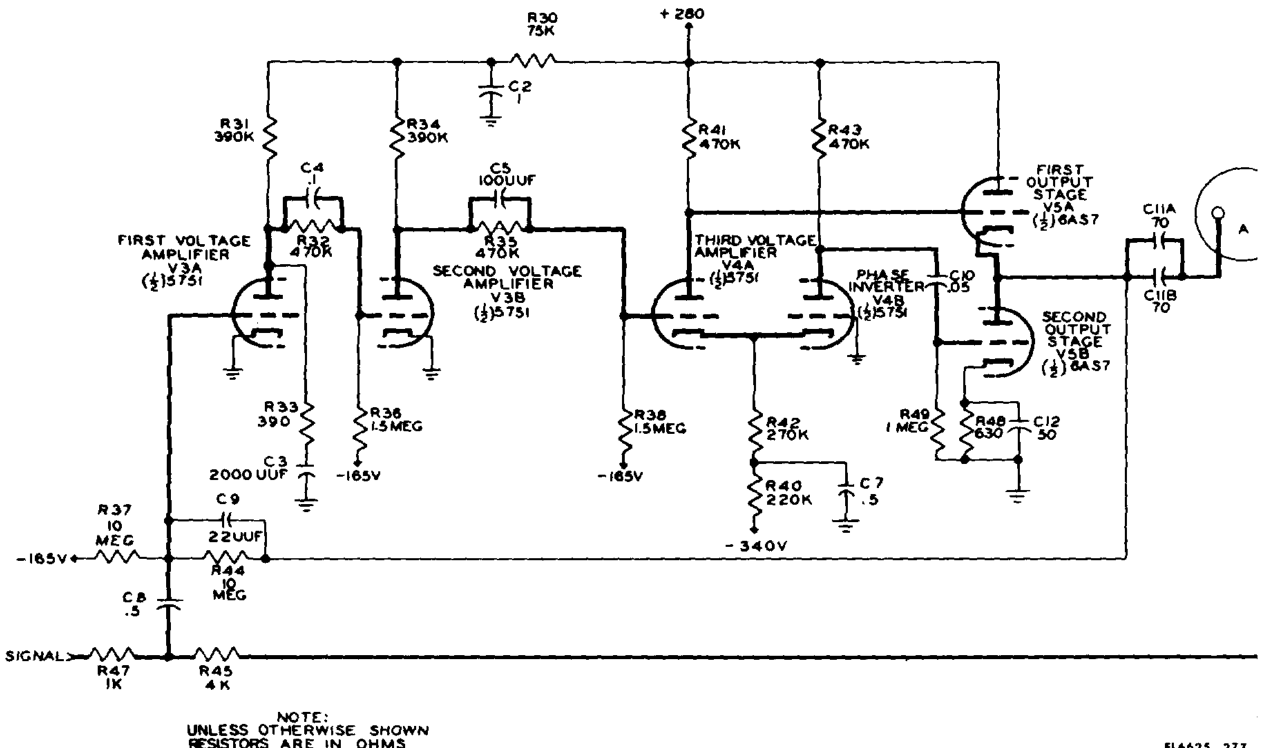

Figure 5-3. Ac meter amplifier circuit, simplified schematic diagram.

c. The second stage is the second half of tube V3, which is referred to as V3B. The second stage is a voltage amplifier; it also has a directly grounded cathode. Resistor R34 is the plate resistor. Resistors R35 and R38 form a voltage divider network that lowers the dc level to the grid of the third voltage amplifier tube V4A and also provides the bias for tube V4A. Capacitors C4 and C5 broaden the response of the second and third voltage amplifiers and allow for a good high-frequency response. Capacitor C4 is also effective at 60 Hz so that the overall gain at 60 Hz is higher than the dc gain. Resistor R30 and capacitor C2 are for filtering and also to prevent unwanted interstage coupling.

d. The third stage is a twin triode which is a voltage amplifier and a phase inverter. Resistor R42 is the common cathode resistor. Resistor R40 and capacitor C7 filter ripple from the negative supply. Resistors R41 and R43 are the plate load resistors. The plate of third voltage amplifier V4A is coupled directly to first output tube V5A.

e. First output tube V5A acts as a cathode follower. Second output tube V5B acts as a grounded cathode and as such it has a higher gain than tube V5A. This gain is compensated for in the input signal by resistor R49, which is an additional load, in the grid circuit to tube V5B. Capacitor C10 is the isolating capacitor that couples the plate of phase inverter tube V4B to the grid of second output tube V5B. Bias for tube V5B is obtained from the voltage drop across cathode bias resistor R48. Cathode bias, which stabilizes the direct current through the second output stage, is required because of the high transconductance of the 6AS7G tube V5. Current through both halves of the output stage is regulated by the series arrangement of the first and second voltage amplifier tube V3A and V3B. Resistor R44 is the dc feedback resistor. Capacitor C9, which is in parallel with resistor R44, assures correct phase shift at ultra-sonic frequencies and therefore assures stable operation of the amplifier. The value of capacitor C9 has a negligible effect on the amplifier at 60 Hz.

f. Resistors R44 and R37 form a voltage divider network between the output of the amplifier and the negative reference voltage. The voltage at the junction of these resistors will adjust automatically to the correct bias voltage for first voltage amplifier tube V3A. Capacitor C8 is a dc blocking capacitor that allows bias voltage to be formed at this point without loading by the low impedance ac feedback loop. The feedback action is such that if the dc voltage at the junction of the first and second output stage is lower in magnitude than the negative reference voltage, the grid of first voltage amplifier tube V3A will become more negative than normal. This causes the first voltage amplifier plate and the grid of second voltage amplifier V3B to become more positive than normal. This positive voltage on the grid of tube V3B causes the voltage at its plate to become lower than normal and the voltage at the grid of tube V4A to become positive. Since the plate of tube V4A is directly coupled to tube V5A, the grid of V5A and the cathode output becomes more positive until the correct voltage is reached. If the dc voltage at the junction of tube V5A and V5B were higher in magnitude than the negative reference voltage, the voltage would change in the direction opposite from that described above.

g. The ac output of second output tube V5B is coupled by capacitor C11 to meter M3. The alternating current from meter M3 flows through resistor R45. With a current of 100 mA flowing through meter M3 causing full-scale deflection of the needle, 99 mA will flow through resistor R46 and 1 8mA through resistor R45. The voltage drop across resistor R46 will be exactly 4 volts. The action of the ac feedback loop is similar to the action of the dc loop except that the dc feedback loop (*f* above) has a constant negative dc potential applied to resistor R37 as its input, while the ac feedback loop has a variable ac voltage applied to resistor R47 as its input. This variable ac voltage is the signal to be measured or a portion of this signal.

h. To understand the response of this ac meter amplifier to an input signal, it must be remembered that this amplifier has extremely high gain (in excess of 100,000 times), that it inverts the signal, and that it responds to instantaneous voltage changes. If a signal voltage is applied at the input of resistor R47 and if this signal is instantaneously positive, the output of resistor R47 will become positive. This positive signal at the output of resistor R47 is coupled through capacitor C8 to the grid of first voltage amplifier tube V3A. The signal is then amplified by second and third voltage amplifier tubes V3B and V4A, inverted by phase inverter tube V4B, and coupled through capacitor C11 to ac milliammeter M3. The current flowing through meter M3 is split in a ratio of 99 to 1 through resistors R46 and R45 respectively (*g* above). This current is in a direction to make the output of resistor R46 become negative which is opposite to the input polarity. Since the output of resistor R46 is negative, it tends to make the junction of resistor R45 and R44 negative and cancel the positive input to the grid of first voltage amplifier tube V3A. The amount of cancellation depends on the gain of the amplifier tubes; the voltage remaining at this junction will be large enough only to produce the proper output across resistor R46.

i. If the gain were to be increased indefinitely, then the residual ac voltage error at the grid of first voltage amplifier tube V3A would diminish toward zero. The voltage error of the meter amplifier is less than 1 millivolt (mV) for a full-scale signal; therefore the error produced because the amplifier does not have infinite gain is negligible. With a 1-volt root mean square (rms) signal at the input of resistor R47, 100 mA flow through meter M3, 4 volts appear at the junction of resistors R45 and R46, and a drop in voltage occurs at the junction of resistors R47 and R45.

5-4. Detailed Analysis of Test Warning Circuit

a. The accuracy of the high-gain amplifier used in the test set becomes independent of variations in gain within the amplifier and depends only on precision resistors R45, R46, and R47 and the meter. A test warning circuit (fig. 5-4) is provided to alert the operator in case the ac meter amplifier gain should reduce to such an extent that it might affect the accuracy of meter readings.

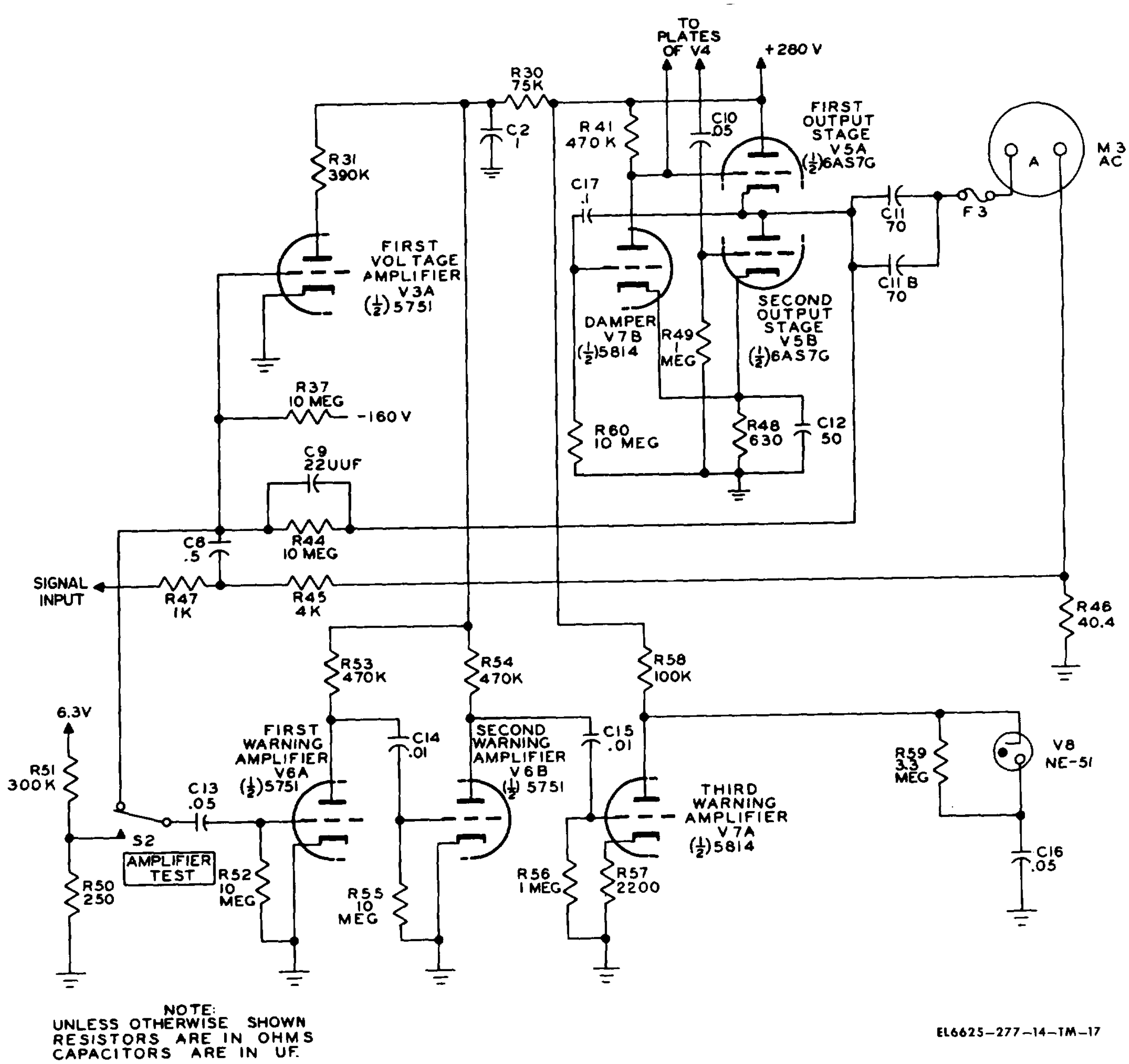

Figure 5-4. Ac meter amplifier and test warning circuit, simplified schematic diagram.

b. The voltage at the grid of first voltage amplifier tube V3A is coupled through capacitor C13 to the grid of first warning amplifier tube V6A. Because of the high value of grid leak resistor R52, self-biasing of tube V6A is accomplished by grid current. Resistor R53 is the plate resistor for this stage. Capacitor C14 couples the amplified signal from the plate of tube V6A to the grid of the second warning amplifier tube V6B. Resistor R55, the grid leak resistor for second warning amplifier tube V6B, allows self-biasing of this stage. Resistor R54 is the plate resistor for tube V6B. Capacitor C15 couples the amplified signal from the plate of tube V6B to the grid of third warning amplifier tube V7A. Resistor R56 is the grid leak resistor for tube V7A. Bias for the third warning amplifier is obtained through cathode bias resistor R57. Resistor R58 is the plate resistor for this stage. Resistor R59 provides a charging path to blocking capacitor C16 so that no dc voltage will appear across neon lamp V8. The three-stage warning amplifier, with tubes V6A, V6B, and V7A, provides ample gain so that if a signal of an amplitude low enough to affect meter accuracy should appear at the grid of first voltage amplifier tube V3A, the neon lamp will light to warn operator. Operation of the warning amplifier can be checked by operating momentary contact AMPLIFIER TEST switch S2. This applies a small ac voltage to the input of tube V6A which should cause the neon lamp to glow.

c. Damper tube V7B is arranged to reduce the size of the transient obtained when selector switch S1 is operated to position 4 and rectifier tubes V1 and V2 suddenly supply power to the ac meter amplifier. The sudden positive rise of voltage at the cathode of first output stage tube V5A is coupled through capacitor C17 to the grid of damper tube V7B. This voltage rise causes tube V7B to conduct rather heavily and tends to hold the voltage at the grid of tube V5A at the lower value because of the voltage drop across resistor R41; this reduces the charging current of capacitor C11 through first output stage V5A tube. The cathode of tube V7B is connected to the cathode of second output stage tube V5B so that when tube V5B is conducting normally, the cathode of tube V7B is held sufficiently positive to prevent damper tube V7B from conducting, even when a signal is present at the output of the ac meter amplifier.

5-5. Dc Ammeter Test Circuit (TS-682/GSM-1) (fig. 5-5 through 5-12 and FO-2)

a. General. The current range required is selected by DIRECT CURRENT SELECTOR switch S6 (fig. 5-5). Current for testing dc ammeters is supplied by an external 12-volt storage battery. The test circuit consists of a current-controlling network, meter M1, and the meter to be checked. Meter M1 is connected to the test circuit by an internal shunt so that the range of meter M1 corresponds to the range of the meter under test. The current-controlling network consists of the DIRECT CURRENT FINE CONTROL (rheostats R60 and R113), fixed resistors in various series and parallel combinations, and five switch relays. Switch S6 selects the proper combination in the current-controlling circuit to give the desired dc output.

b. One Hundred-Microampere to 400-Milliampere Dc Test Circuit (fig. 5-6). When DIRECT CURRENT SELECTOR switch S6 is in the 100UA-400MA position, relay K1 is energized and two parallel paths are formed to supply current to jacks J35 through J46 through the network of current limiting resistors R87 through R107 and R110. The two parallel paths are as follows:

(1) Rheostats R71A, R71B, R71C, and R71D in series; the parallel combination of resistors R69 and R70; and resistors R86, all in series.

(2) Resistors R80, R75, R77, and rheostat R113 in series.

c. One-Ampere and Two-Ampere Circuit (fig. 57). When DIRECT CURRENT SELECTOR switch S6 is in the 2A—1A position, the PL-55 plug is inserted in jack J34 or J33, and relay K1 is energized, the 1-ampere and 2-ampere shunts (E17 and E18, respectively) are connected across meter M1. For the 1-ampere range, resistor R108 is in series with jack J34. Two parallel paths exist as follows:

(1) Rheostats R71A, R71B, R71C, and R71D in series with the parallel combination of resistors R69 and R70 and with resistor R85.

(2) The series path or resistor R75, rheostat R113, and resistor R76.

d. Four-Ampere Dc Test Circuit (fig. 5-8). When DIRECT CURRENT SELECTOR switch S6 is in the 4A position, shunt E19 is connected across meter M1, and relay K1 is energized. Two parallel paths exist as follows

(1) Rheostats R71A, R71B, R71C, and R71D in series with the resistors R83 and R84 and the parallel combination of resistors R69 and R70.

(2) Resistors R75 and R79, and rheostat R113 in series.

e. Ten-Ampere Dc Test Circuit (fig. 5-9). When DIRECT CURRENT SELECTOR switch S6 is in the 10A position, shunt E20 is connected across meter M1. The circuit is the same as that described in *f* below, except that resistors R74 and R83 are added.

f. Twenty-Ampere Dc Test Circuit (fig. 5-10). When DIRECT CURRENT SELECTOR switch S6 is in the 20A position, shunt E21 is connected across meter M1, and relay K1 is energized. Two parallel paths now exist as follows:

(1) Rheostats R60 and R113 of the DIRECT CURRENT FINE CONTROL, resistor R72 and R73 in series with the parallel combination of resistors R61 and R62.

(2) Rheostat R71A, R71B, and R71C of the DIRECT CURRENT COARSE CONTROL are in series with rheostat R71D, which acts as a voltage divider network in series with the parallel combination of resistors R69 and R70.

g. Forty-Ampere Dc Test Circuit (fig. 5-11). When DIRECT CURRENT SELECTOR switch S6 is in the 40A position, shunt E22 is connected across meter M1 and relay is energized. Three parallel paths now exist as follows:

(1) Rheostat R60, part of the DIRECT CURRENT FINE CONTROL, in series with resistor R61 and R62, which are in parallel.

(2) Rheostats R71A and R71B (sections A and B of DIRECT CURRENT COARSE CONTROL) in series with resistor R63.

(3) Rheostats R71C and R71D in series with the parallel combination of resistors R69 and R70.

h. One Hundred-Ampere-Dc Test Circuit (fig. 5 12). When DIRECT CURRENT SELECTOR switch S6 is in the 100A position, shunt E23 is connected across meter M1 and relays K1, K2, and K4, are energized. Five parallel paths now exist as follows:

(1) Rheostat R60 (DIRECT CURRENT FINE CONTROL) in series with resistors R61 and R62, which are parallel.

(2) Rheostat R71A (section A of DIRECT CURRENT COARSE CONTROL) in series with resistors R63 and R64, which are in parallel.

(3) Rheostat R71B in series with resistors R65 and R66, which are in parallel.

(4) Rheostat R71C in series with resistors R67 and R68, which are in parallel.

(5) Rheostat R71D in series with resistors R69 and R70, which are in parallel.

i. Overload Relay K5. Relay K5 is an overload relay that prevents the meters from reading offscale, and excessive current from appearing at the dc jacks and terminals. An overload in a test circuit causes sufficient voltage to energize the relay coil circuit. When relay K5 is energized, the parallel resistance of the circuit is increased, and the current output to the meter is decreased. The meter will not read full scale until relay K5 opens when the current is sufficiently decreased by rheostat R71. Relay K5 operates this way in all the dc circuits. Rheostat R48 and resistor R114 connect relay K5 in the circuit.

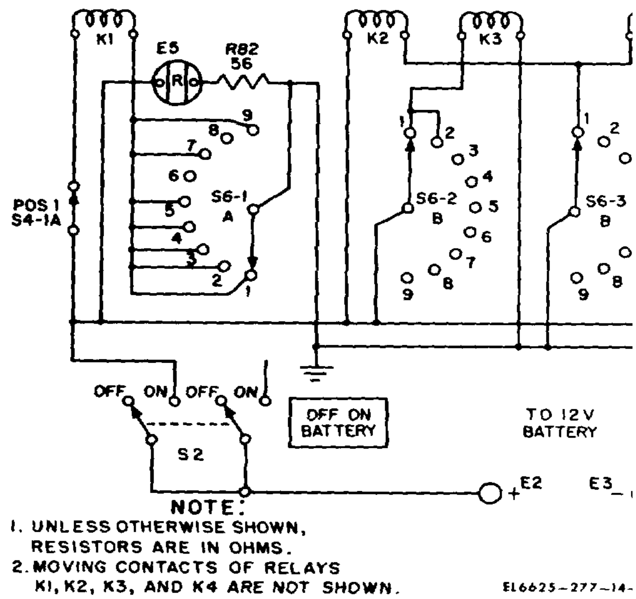

Figure 5-5. Relays K1, K2, K3, and K5.

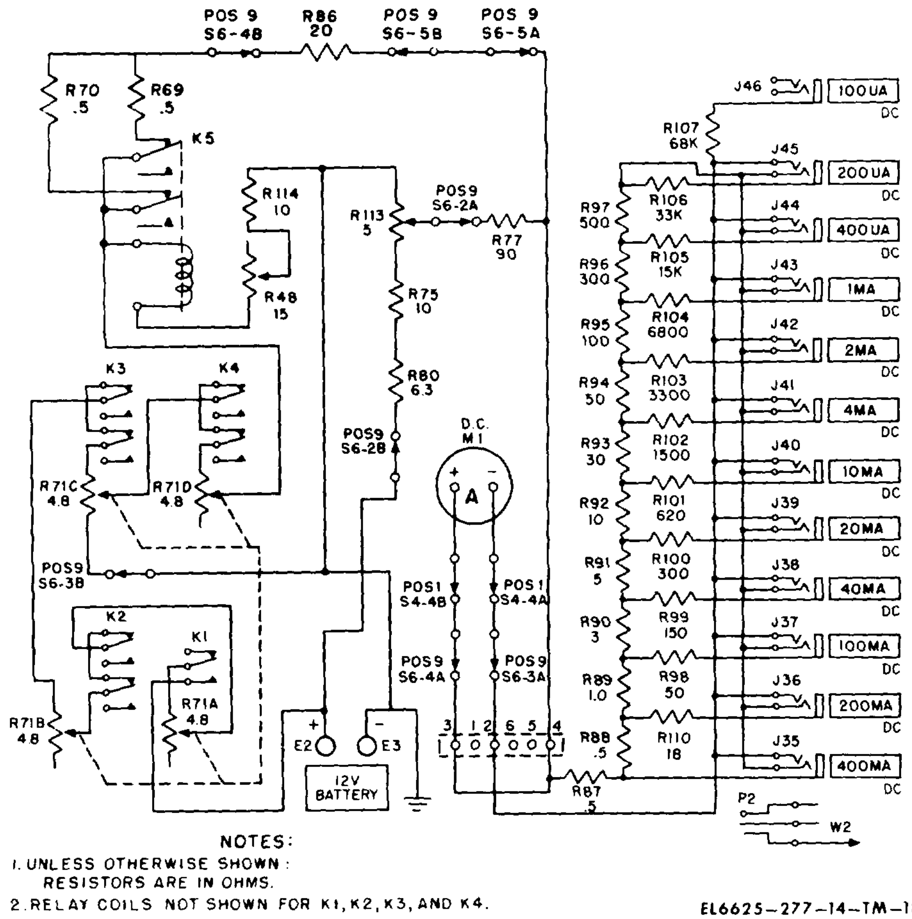

Figure 5-6. Low dc test circuit, 100 uA to 400 uA, simplified schematic diagram.

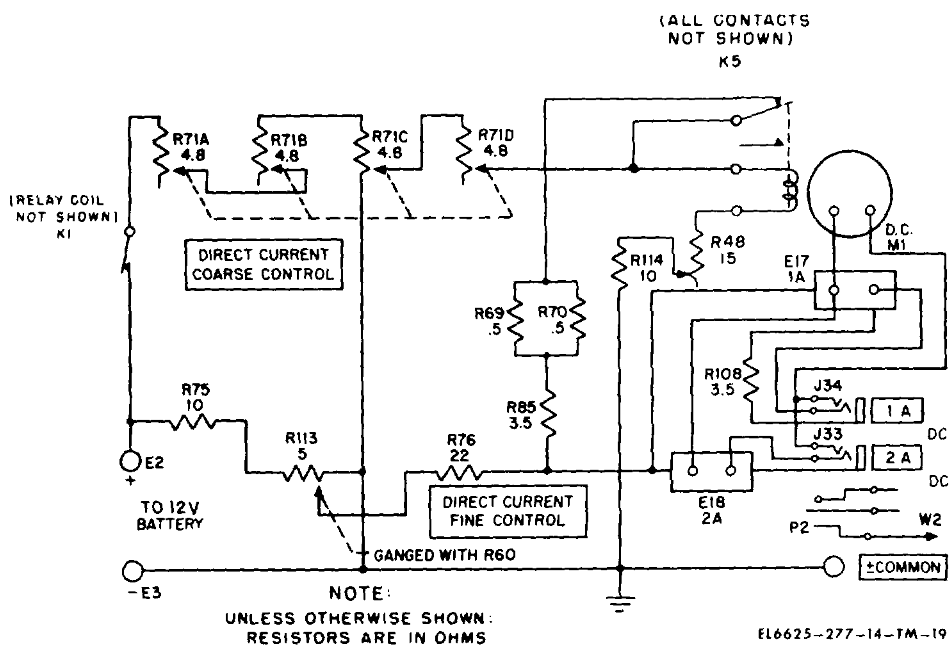

Figure 5-7. One and two ampere dc test circuit, simplified schematic diagram.

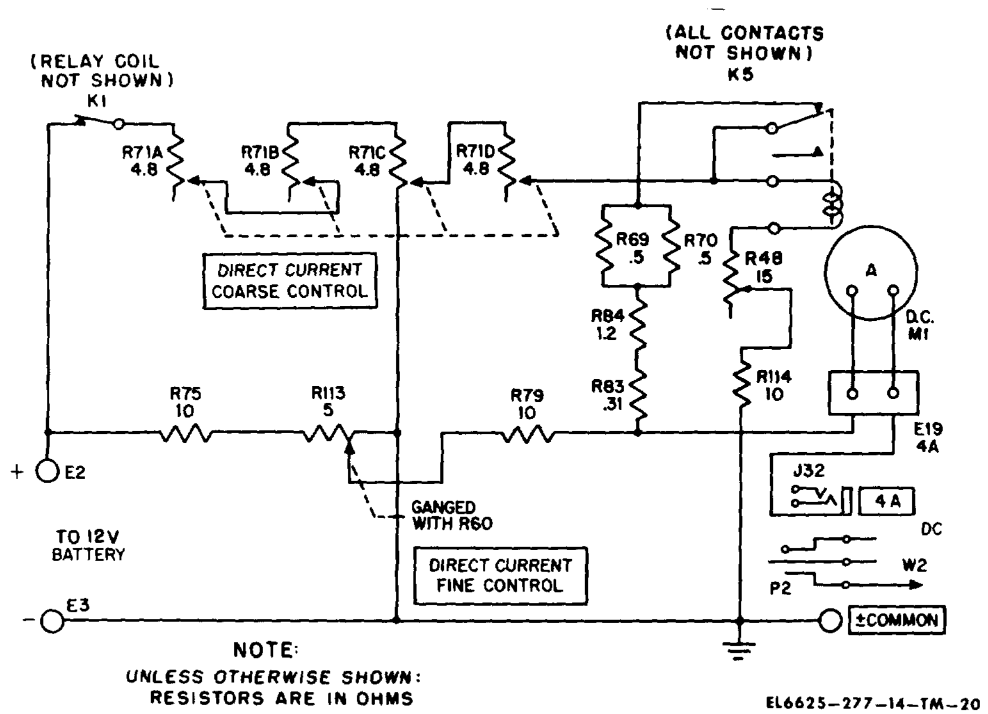

Figure 5-8. Four ampere dc test circuit, simplified schematic diagram.

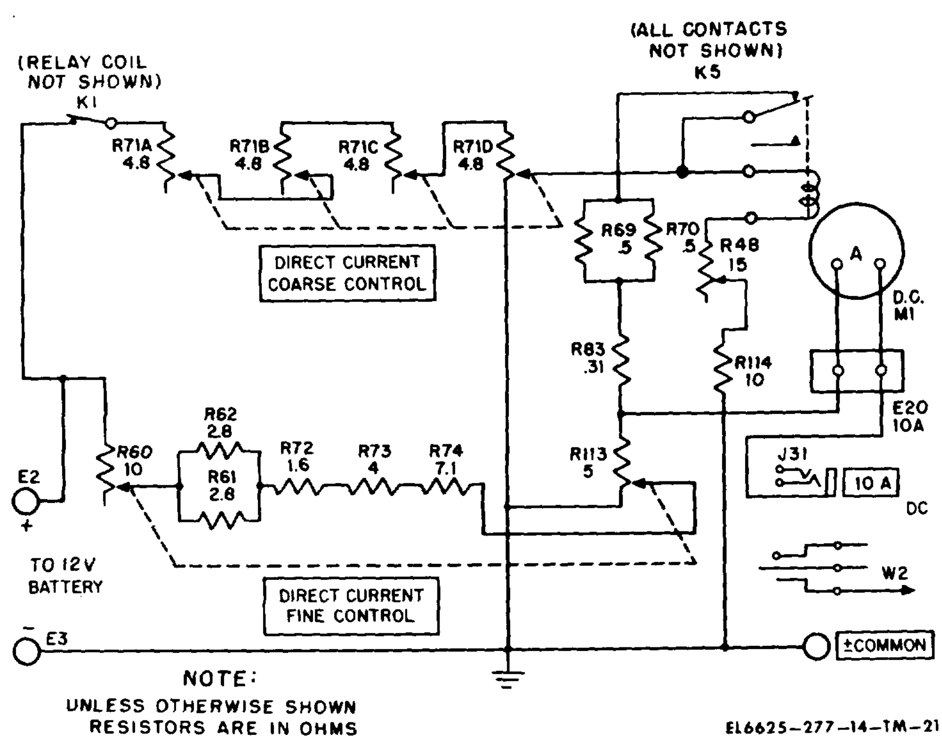

Figure 5-9. Ten ampere dc test circuit, simplified schematic diagram.

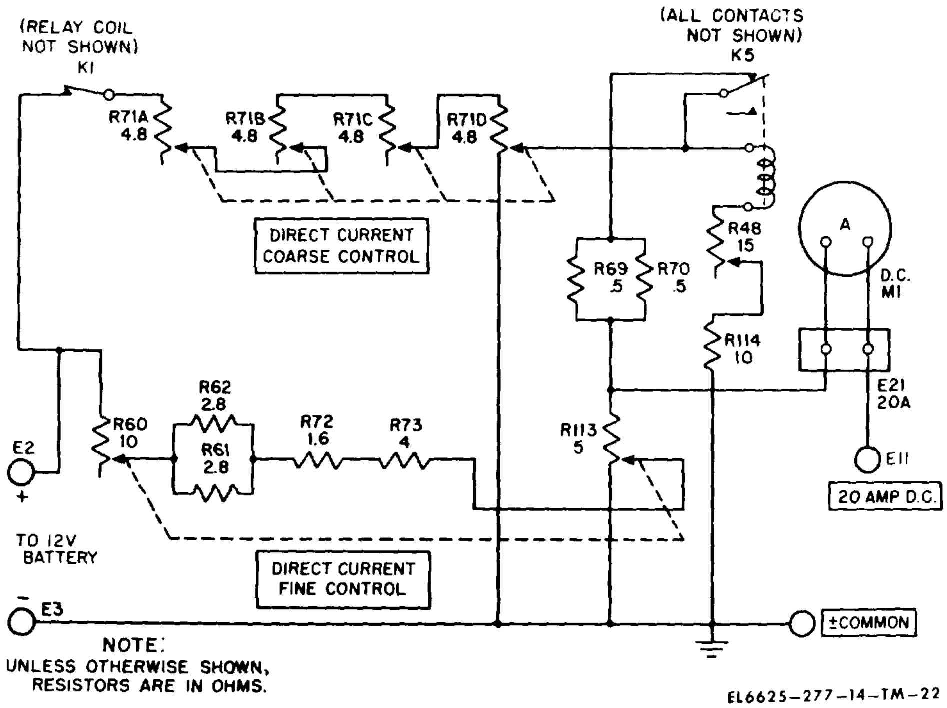

Figure 5-10. Twenty ampere dc test circuit, simplified schematic diagram.

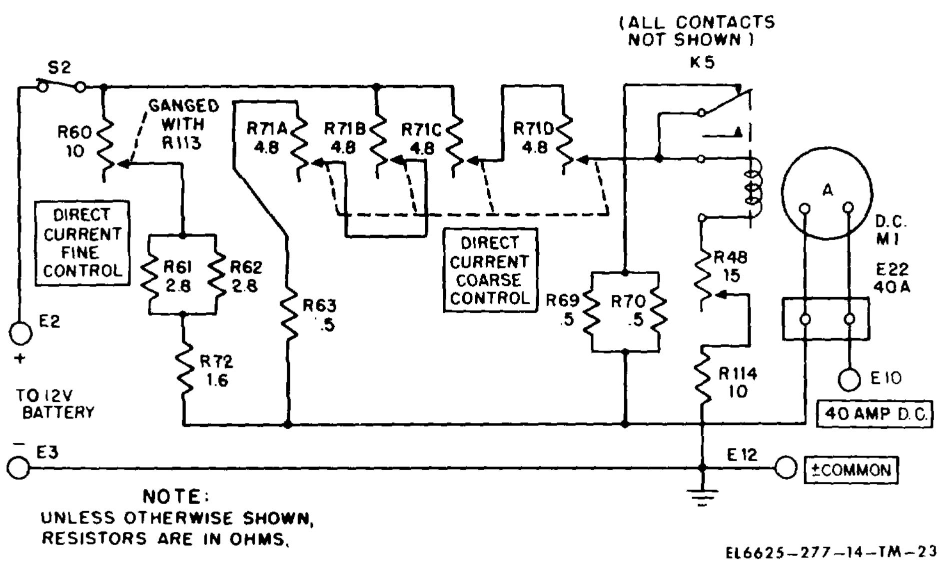

Figure 5-11. Forty ampere dc test circuit, simplified schematic diagram.

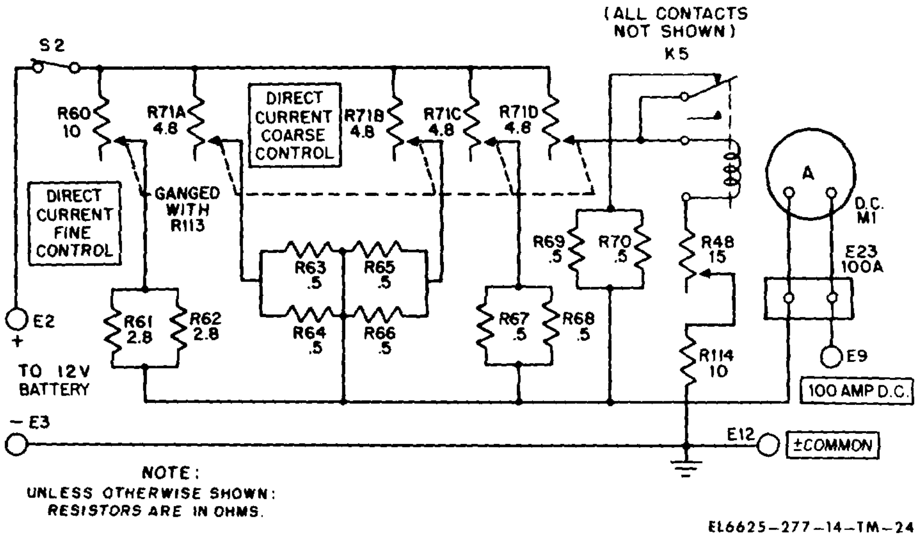

Figure 5-12. One hundred ampere dc test circuit, simplified schematic diagram.

5-6. Dc Ammeter Test Circuit (TS-682A/GSM-1)

{fig. 5-13 through 5-21 and FO-3)

a. General. Test current is supplied by an external 12-volt storage battery. The test circuit consists of a current-controlling network rheostat R61, meter shunts, meter M2, and the meter to be checked (fig. FO-3). Meter M2 is connected to the test circuit through shunts R138 through R144, covering the 1-ampere through 100-ampere dc ranges. The current-controlling network consists of rheostat R61, rheostat R94, fixed resistors R92, R93, R96, and R62 through R71, and relay K5. Jacks J36 through J39 and terminals E6 through E9 are used to select the desired output ranges. Current switching is performed by relays K1 through K4 (fig. 5-13) which operate in conjunction with S6.

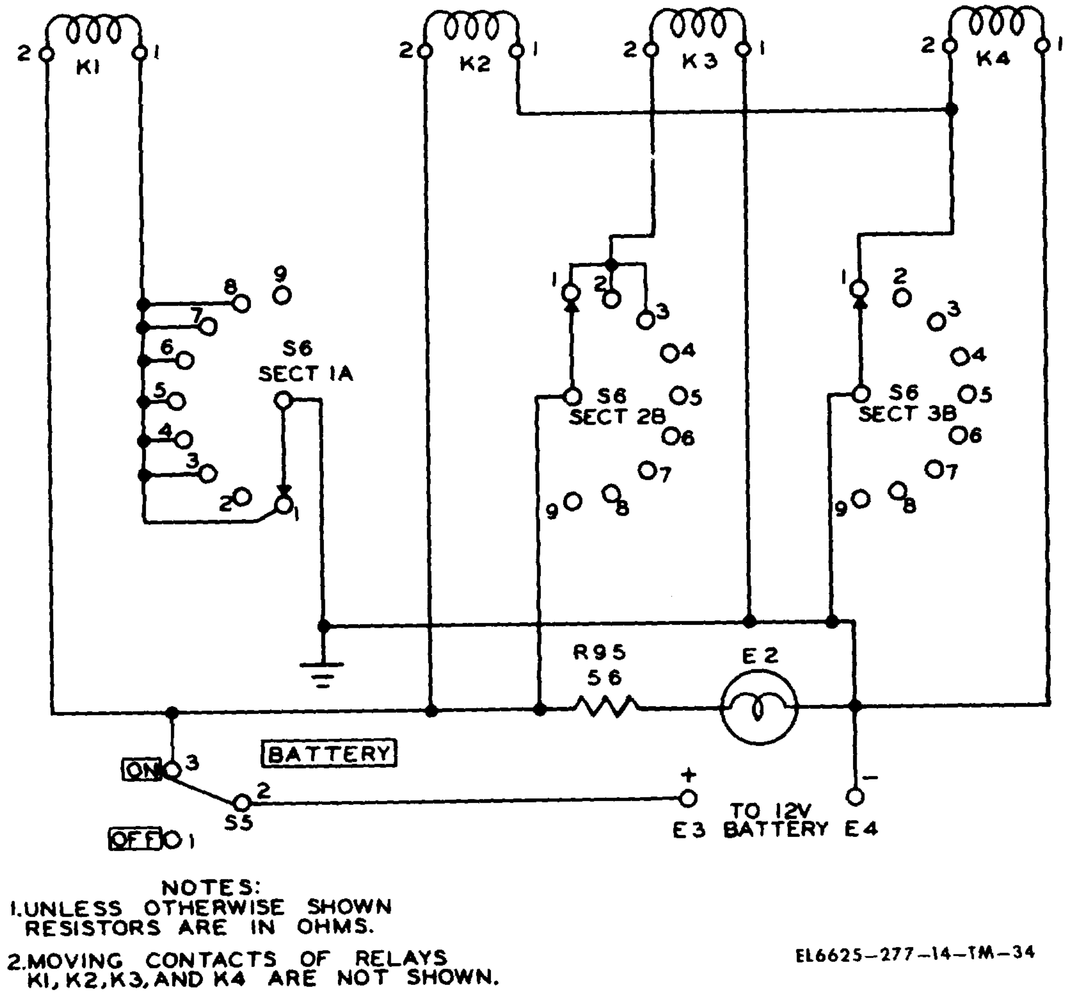

Figure 5-13. Switching relay circuit, simplified schematic diagram.

b. One Hundred-Microampere to 500-Milliampere Dc Test Circuit (fig. 5-14). Meter M1 is used with shunts consisting of .1 percent precision resistors R101, R103, R105, R107, R109, R11, R113, R115, R117, R119, and R120 for ranges of 200 microamperes (uA) to 500 mA. On the 0 to 100 uA range, meter M1 is connected directly in series with the output; the shunt is disconnected by the switch on the 100 uA jack J24. Selection of proper output range is made through selector switches S6 and S7 and by connecting the meter under test to a jack (J24-J35) with the desired current designation.

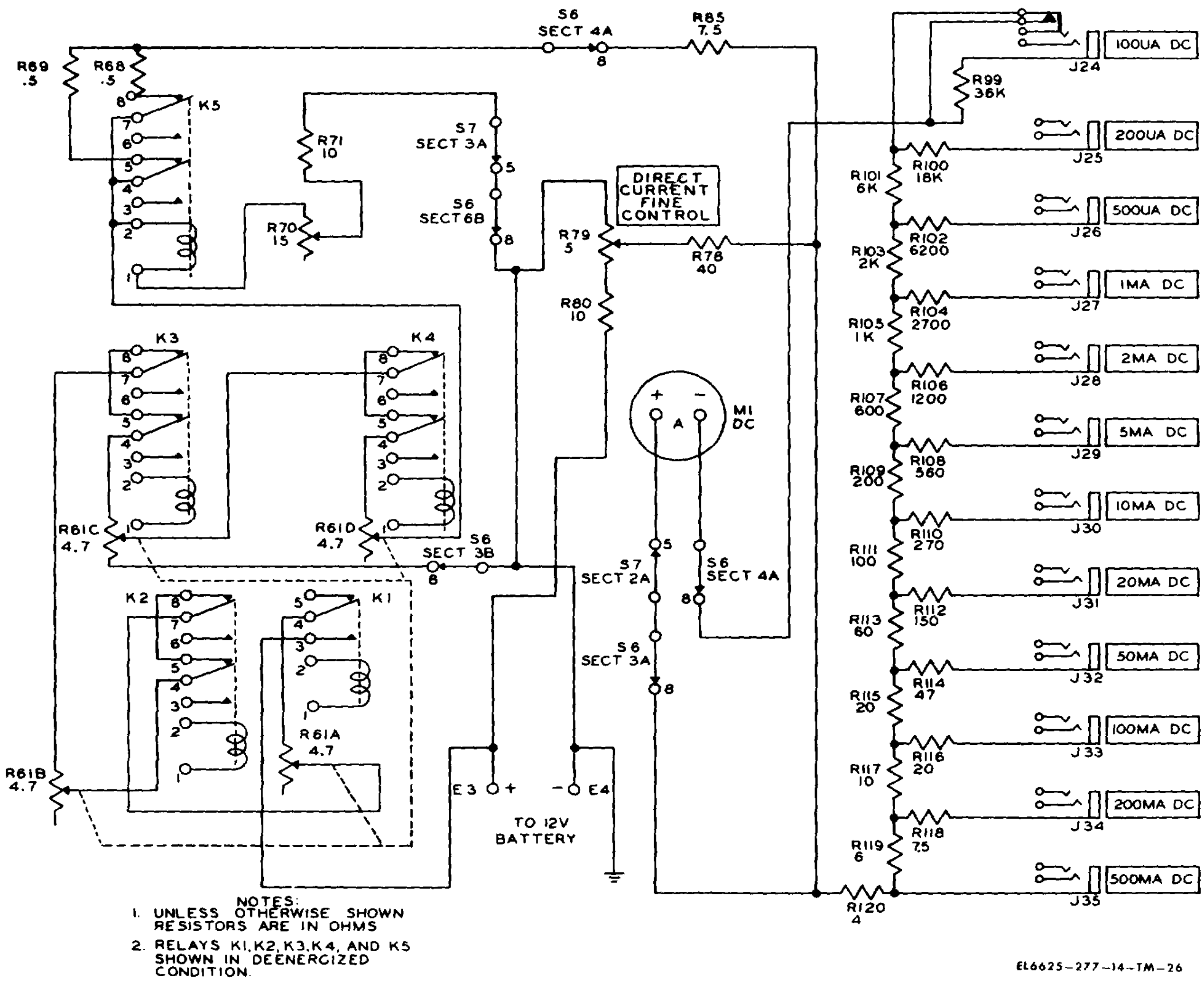

Figure 5-14. Low dc current test circuit, simplified schematic diagram.

c. One-Ampere Dc Test Circuit (fig. 5-15). For the 1-ampere dc test circuit, there are two networks for regulating the supply of current to the meter under test. The DIRECT CURRENT COARSE CONTROL consists of resistors R61B, R61C, R61D, R65, R69, R70, RS1, R82, R83, R84, and variable rheostat R70; and the DIRECT CURRENT FINE CONTROL consists of resistors R75, R76, R77, R80, and variable rheostat R79. These networks control the current supplied to the meter under test through jack J39. Meter shunt R144, meter M2, and binding post E5 (COMMON) complete the 1-ampere dc test circuit. Power is supplied by the 12-volt battery connected to binding posts E3 and E4.

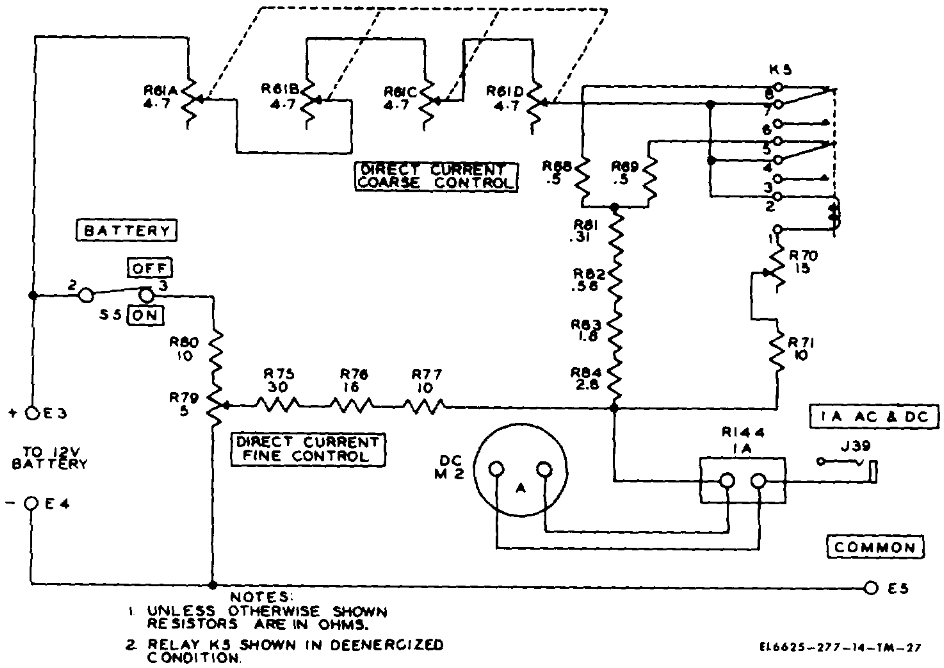

Figure 5-15. One-ampere dc test circuit, simplified schematic diagram.

d. Two-Ampere Dc Test Circuit (fig. 5-16). For the 2-ampere dc test circuit, there are two networks for regulating the supply of current to the meter under test. The DIRECT CURRENT COARSE CONTROL consists of resistors R61A, R61B, R61C, R61D, R68, R69, R81, R82, R83, R71 and variable rheostat R79; and DIRECT CURRENT FINE CONTROL consists of resistors R76, R77, R80 and variable rheostat R79. These two networks control the current supplied to the meter under test through jack J38. Meter shunt R143, meter M2, and binding post E5 (COMMON) complete the two ampere dc test circuit. Power is supplied by the 12-volt battery connected to binding posts E3 and E4.

e. Five-Ampere Dc Test Circuit (fig. 5-17). For the 5-ampere de test circuit, there are two networks for regulating the supply of current to the meter under test. The DIRECT CURRENT COARSE CONTROL consists of resistors R61A, R61B, R61C, R61D, R68, R69, R71, RS1, R82, and variable rheostat R70; and the DIRECT CURRENT FINE CONTROL consists of resistors R77, R80, and variable rheostat R79. These two networks control the current supplied to the meter under test through jack J37. Meter shunt R142, meter M2, and binding post E5 (COMMON) complete the 5-ampere dc test circuit. Power is supplied by the 12-volt battery connected to binding posts E3 and E4.

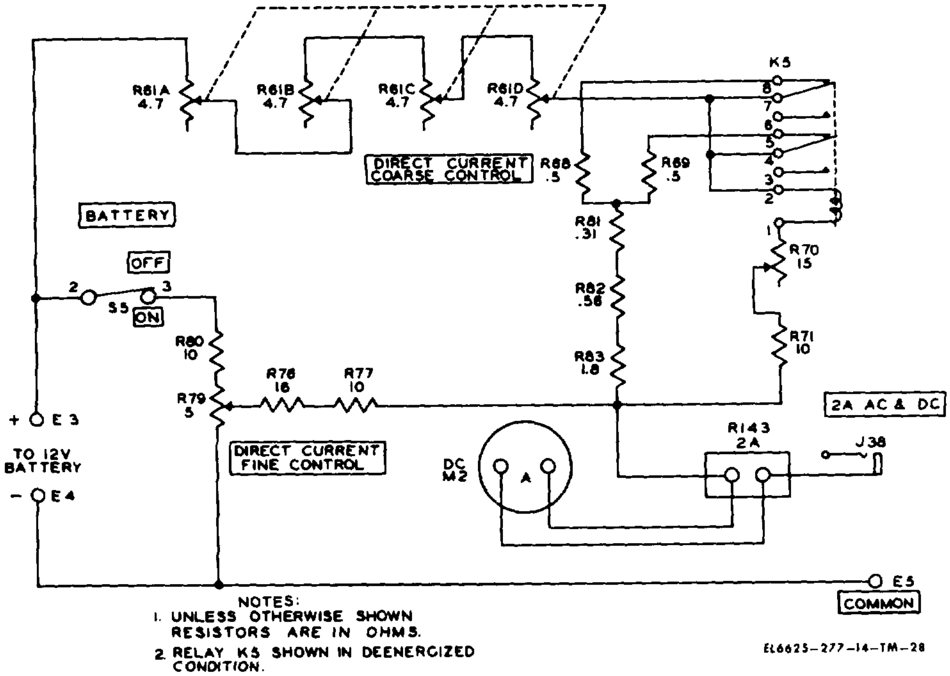

Figure 5-16. Two ampere dc test circuit, simplified schematic diagram.

f. Ten-Ampere Dc Test Circuit (fig. 5-18). For the 10-ampere dc test circuit, there are two networks for regulating the supply of current to the meter under test. The DIRECT CURRENT COARSE CONTROL consists of resistors R61A, R61B, R61C, R61D, R68, R69, R71, R81, and variable rheostat R70; and the DIRECT CURRENT FINE CONTROL consists of resistors R92, R93, R72, R73, R74, variable rheostat R79, and variable rheostat R94. These networks control the current supplied to the meter under test through jack J36. Meter shunt R141, meter M2 and binding post E5 (COMMON) complete the 10-ampere dc test circuit. Power is supplied by the 12-volt battery connected to binding posts E3 and E4.

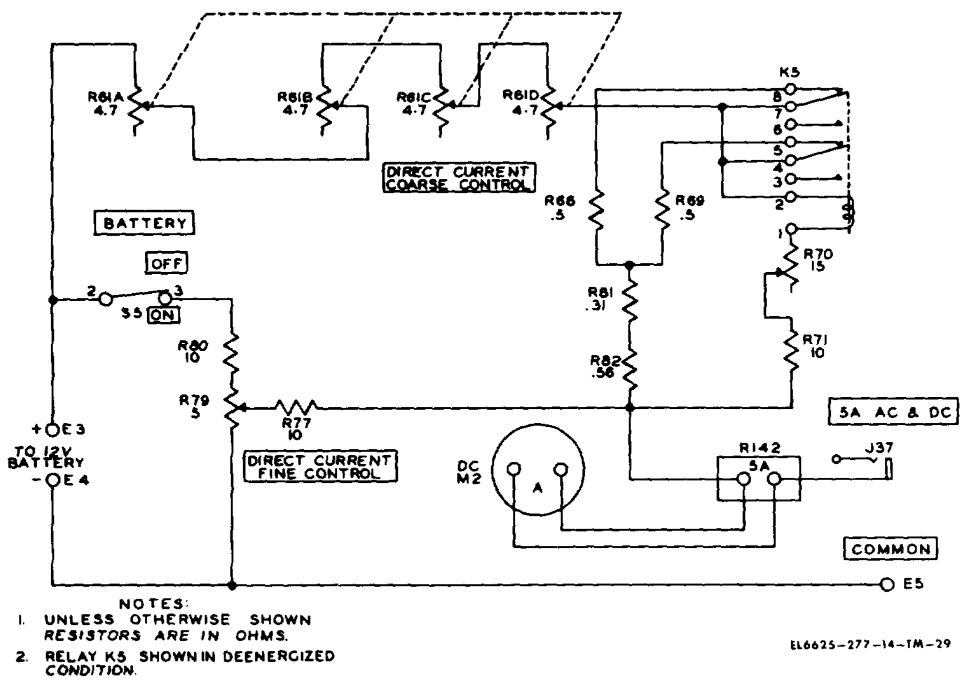

Figure 5-17. Five ampere dc test circuit, simplified schematic diagram.

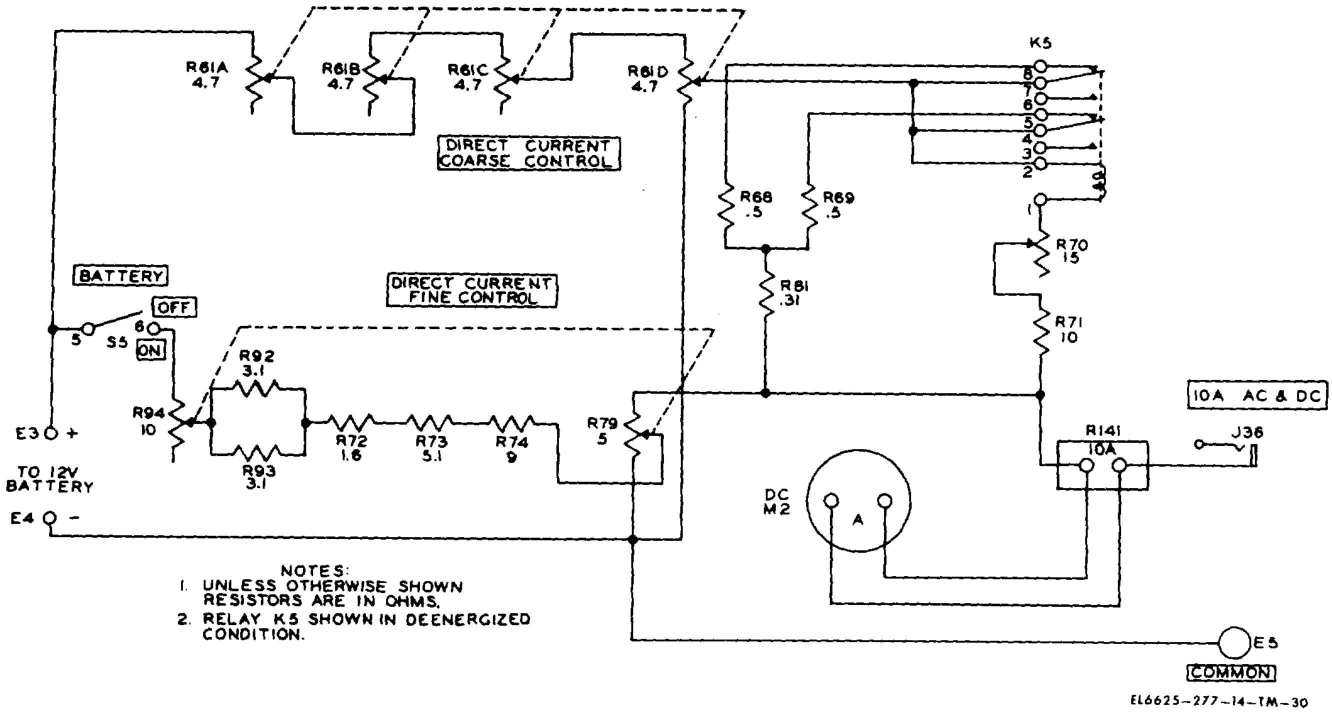

Figure 5-18. Ten ampere dc test circuit, simplified schematic diagram.

g. Twenty-Ampere Dc Test Circuit (fig. 5-19). For the 20-ampere dc test circuit, there are three networks for regulating the supply of current to the meter under test. The first network is the DIRECT CURRENT COARSE CONTROL which consists of resistors R61C, R61D, R68, R69, R71, and variable rheostat R70. The second network is the DIRECT CURRENT FINE CONTROL which consists of resistors R92, R93, R72, R73, and variable rheostat R79. The third network is made up of resistors R123, R124, R125, R126, R127, and R128. These networks control the current supplied to the meter under test through binding post E9. Meter shunt R140, meter M2, and binding post E5 (COMMON) complete the 20-ampere dc test circuit. Power is supplied by the 12-volt battery connected to binding posts E3 and E4.

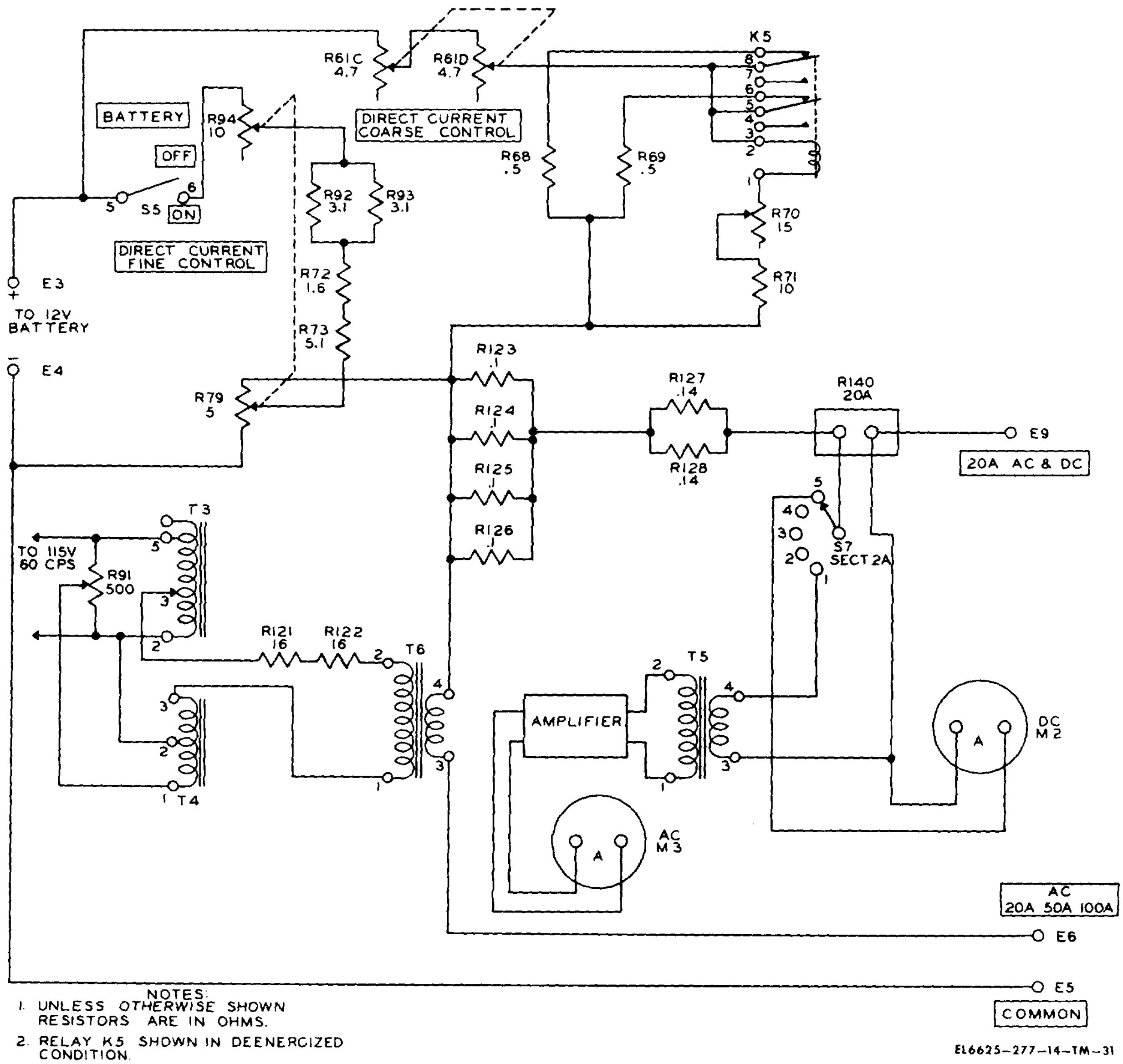

Figure 5-19. Twenty ampere dc test circuit, simplified schematic diagram.

h. Fifty-Ampere Dc Test Circuit (fig. 5-20). For the 50-ampere dc test circuit, there are three networks for regulating the supply of current to the meter under tests. The first network is the DIRECT CURRENT COARSE CONTROL which consists of resistors R61A, R61B, R61C, R61D, R62, R63, R68, and R69. The second network is the direct CURRENT FINE CONTROL which consists of variable rheostat R94, R92, R93, and R72. The third network of resistors is composed of variable rheostat R70, and resistors R71, R123, R124, R125, and R126. These networks control the current supplied to the meter under test through binding posts E8 and E5 (COMMON). Meter shunt R139 and the meter M2 complete the circuit. Power is supplied by the 12-volt battery connected to binding posts E3 and E4.

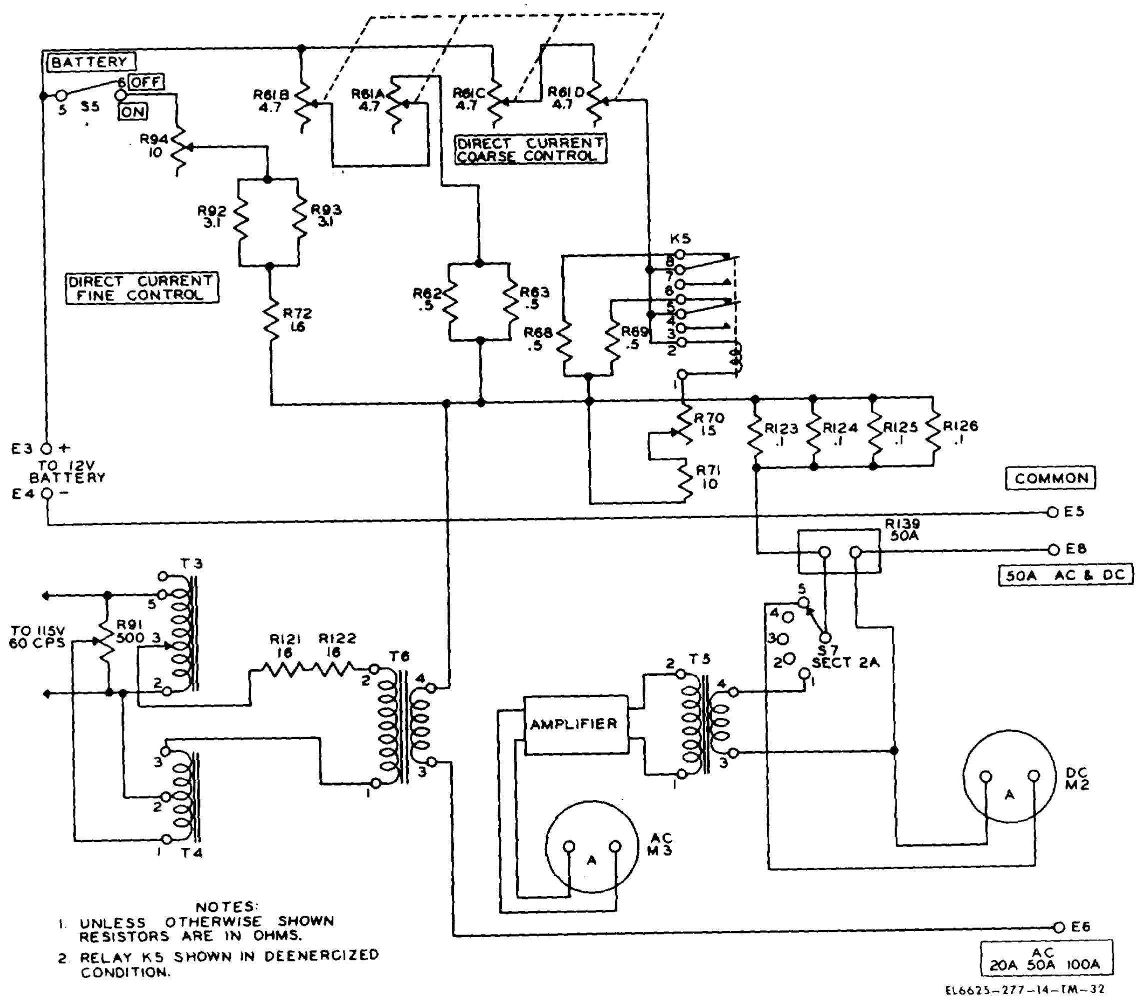

Figure 5-20. Fifty ampere dc test circuit, simplified schematic diagram.

i. One-Hundred-Ampere Dc Test Circuit (fig. 5-21). For the 100-ampere dc test circuit, there are two networks for regulating the supply of current to the meter under test. The first network is the DIRECT CURRENT COARSE CONTROL which consists of resistors R61A, R61B, R61C, R61D, R62, R63, R64, R65, R66, R67, R68, R69, R71, and variable rheostat R70. The second network is the DIRECT CURRENT FINE CONTROL which consists of variable rheostat R94 and resistors R92 and R93. These networks control the current supplied to the meter under test through binding posts E5 (COMMON) and E7. Meter shunt R138 and the meter M2 complete the circuit. Power is supplied by the 12-volt battery connected to binding posts E3 and E4.

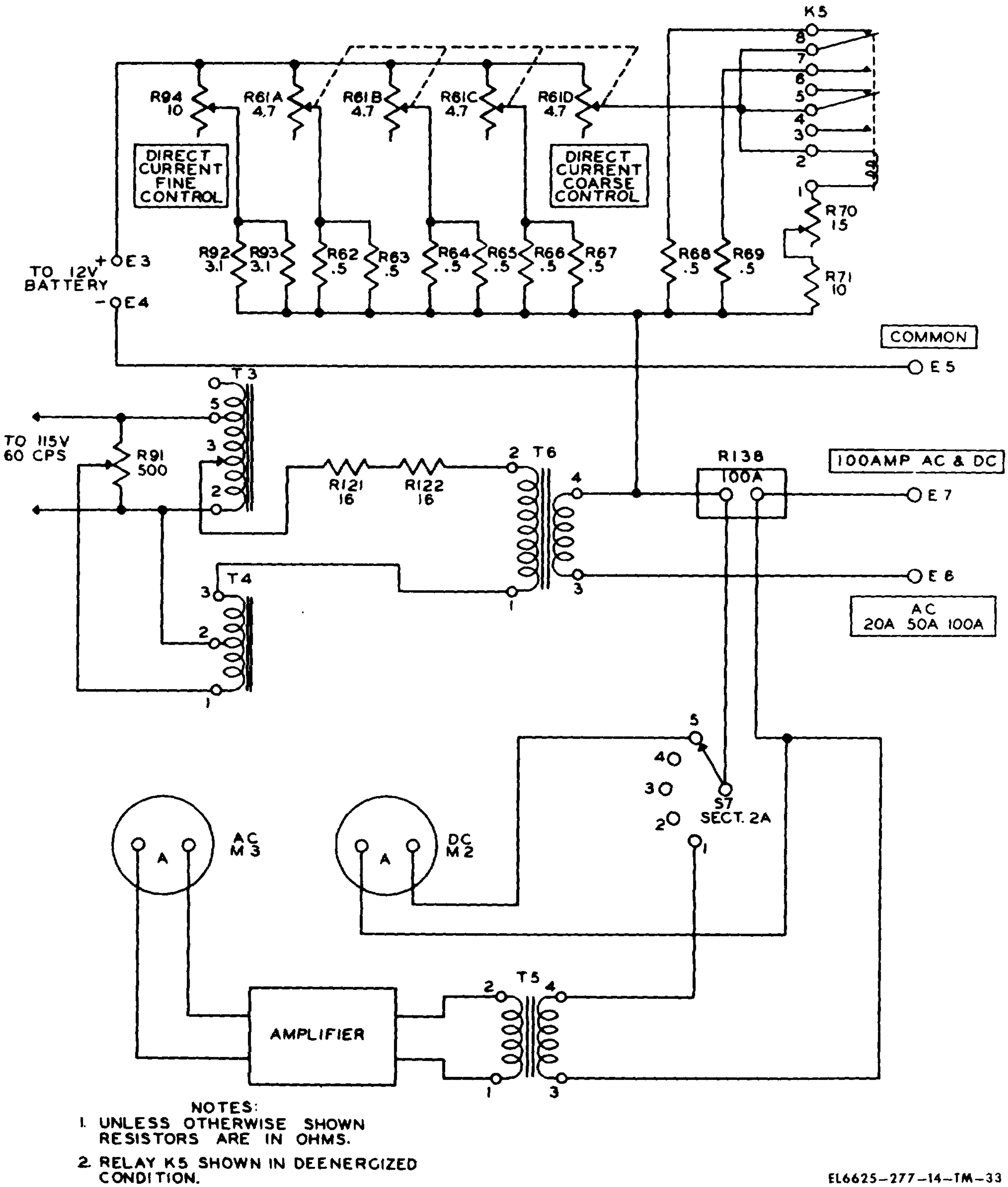

Figure 5-21. One hundred ampere dc test circuit, simplified schematic diagram.

j. Overload Relay K5 (fig. 5-21). Overload relay K5 prevents the current from exceeding 1.5 times its full-scale value. Overloads will energize relay K5. The parallel resistance of the circuit is then increased and the current output to the meter is decreased. Rheostat R70 is an adjustment for relay K5.

5-7. Dc Voltmeter Test Circuit (TS-682/GSM-1) (fig. 5-22 and FO-2)

a. General. Rectifier V1 obtains ac potential from the taps of transformer T1 by means of switch S5 and current-limiting resistor R2. The dc voltage output of rectifier V1 is supplied to two composite bleeder networks. One bleeder network, R23 through R32 and R115, is used for the 100-milivolt through 400-volt ranges; the other bleeder network, R32 through R44 and R109, is used for the 1,000-volt and 2,000-volt ranges. The bleeder network, consisting of R33 through R44 and R109, applies potential to meter M1, which is shunted across R109 to ground when switch S4 is in position DCV. A third bleeder network, consisting of R3 through R22, is in the dc voltage circuit for all ranges. The output of rectifier V1 is filtered by capacitor C1. The voltage supplied to the secondary of transformer T1 is controlled by a voltage circuit consisting of variac T7, autotransformer T3, and rheostat R1, and connected across the primary of transformer T1. Varying the voltage control circuit varies the input to rectifier V1, and thereby varies the output supplied to the dc voltage jacks.

b. One Hundred-Millivolt to 400-Vott Ranges. Switch S5 is turned to the 100 MVDC-400 VDC position for these ranges. Switch S5 connects the 440-volt section of the secondary of transformer T1 to rectifier V1. The 400-volt output of the rectifier is connected to switch S5, through L1 and C2, to R23 of the bleeder network. The meter under test, when connected to one of the meter test set jacks (Jl4 through J23), is shunted across the correct combination of bleeder resistors; the return circuit is to ground.

c. One Thousand Volt Range. When switch S5 is placed in the 1000 VDC position, rectifier V1 is supplied from the 750-volt section of the secondary of transformer T1. The 1,000-volt output of rectifier V1 is connected through switch S5 to jack J13.

d. Two Thousand Volt Range. When switch S5 is placed in the 2000 VDC position, rectifier V1 is supplied from the 1,450-volt section of the secondary of transformer T1. The 2,000-volt output of rectifier V1 is connected, through switch S55 and shunting resistors R33 and R34, to jack 12.

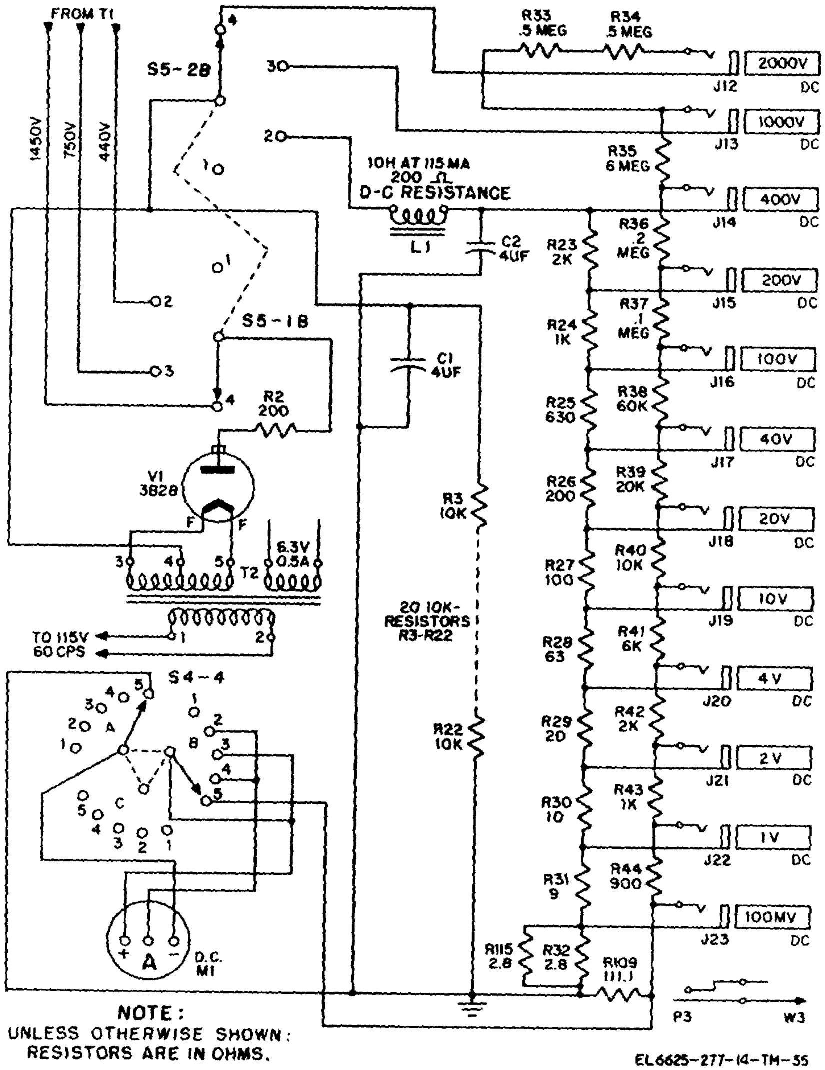

Figure 5-22. Dc voltage circuit, simplified schematic diagram.

55. Dc Voltmeter Test Circuit (TS-682A/GSM-1)

a. 100 Millivolts to 500 Volts (fig. 5-23}. The 5R4WGY rectifier tube V2 obtains its ac potential from transformer T1 and supplies full-wave rectified voltage for the range of 100 mV to 500 volts. The standard meter for the 100-mv range of meter M2, a dc millivoltmeter. All other dc voltage ranges up to and including 2,000 volts are read on meter M1. Meter M2 is selected automatically for the 100-mV range when the test cord plug is inserted into the 100-mV jack J23. Resistors R12 through R21 function as voltage dividers for the various ranges.

b. 1,000-volt Range. The 1,000-volt supply consists of 5R4WGY rectifier tube V2 connected for half-wave rectification. Filtering is accomplished by a pi-section filter consisting of capacitors C19 and C20 and filter choke L1.

c. 2,00 volt Range. The 2,000 volts dc necessary for this range is supplied by 2X2A rectifier tube V1. The output also is filtered by the pi-section filter which consists of capacitors C19 and C20 and filter choke L1.

d. Voltage Control. Voltage control for all the dc voltage ranges is effected by powerstat T3, autotransformer T4, and rheostat R91 which are connected across the primary of transformer T1.

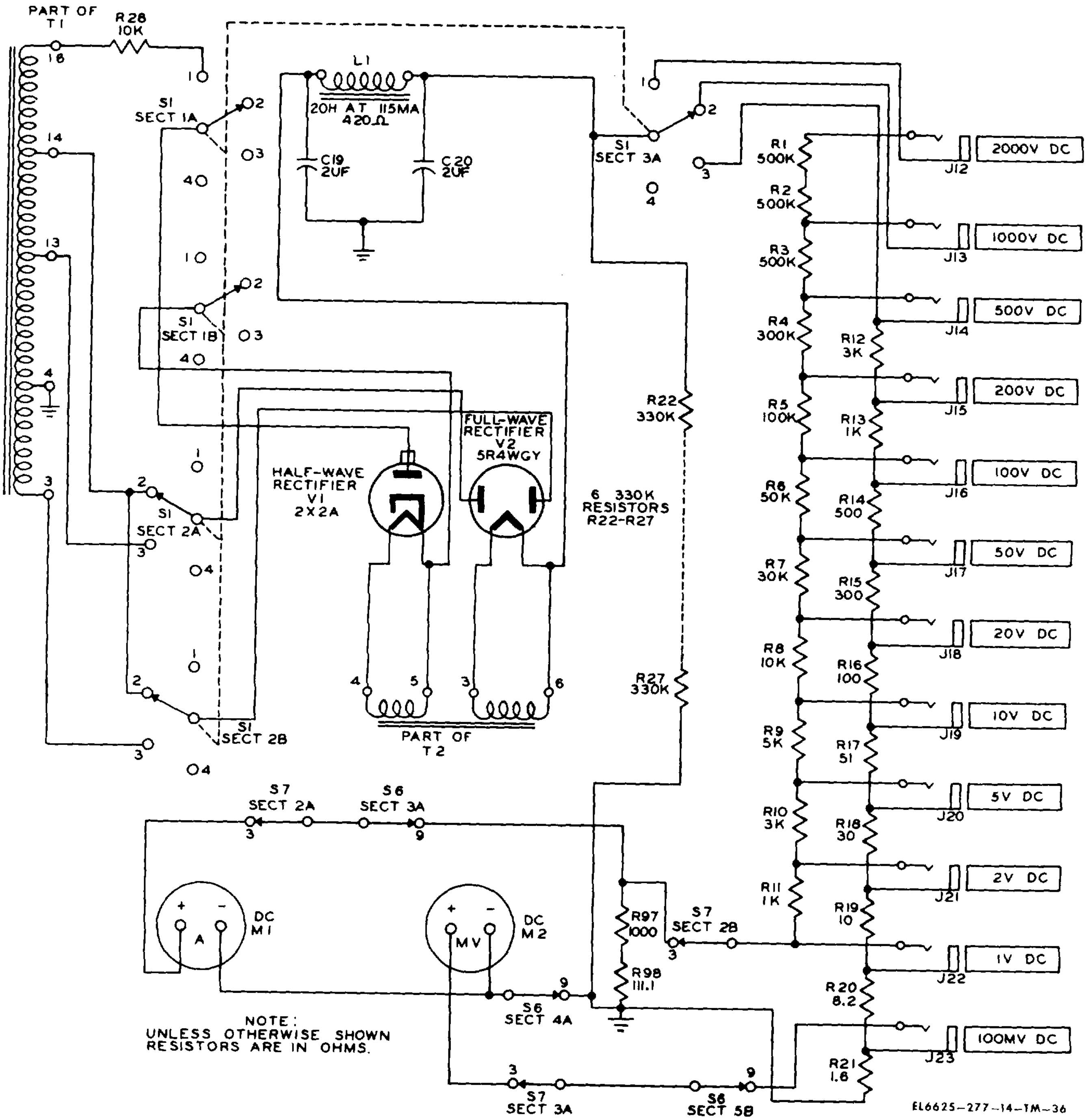

Figure 5-23. Dc voltage test circuit, simplified schematic diagram.

5-9. Ac Ammeter Test Circuit (TS-82/GSM-1) (fig. 5-24)

When switch S4 is set for checking ac ammeters, the test circuit consists of four main parts: a primary voltage control consisting of variac T7, autotransformer T3, and potentiometer R1; current-supply transformers T5 and T8; current transformer T6; and meter M2. When the ac meter to be tested is connected to one of AC jacks J24 through J29 (200 mA through 10 amp}, the series circuit formed includes the secondary of transformer T5, a portion of the primary of transformer T6, one of the secondaries of transformer T8, and the meter under test. The primaries of the two current-supply transformers are connected through various limiting resistors to the output of the primary voltage control.

The magnitude of the current produced in this series circuit is controlled by the coarse (T7) and fine (R1) adjustments of the primary voltage control. Since the same current flows through the meter under test and the primary of transformer T6, the reading of the external meter is checked against the standard meter M2, which is connected to the secondary of T6. When jack J30 (100 MA) is used, the meter under test is in series with meter M2 without the use of transformer T6. Since meter M2 is a 100-mA meter, no current transformer is required. When binding posts E8, E7, and E6 (20 AMP, 40 AMP, and 100 AMP) are used, the same circuit is employed, except that transformer T5 is the sole source of current in the meter circuit.

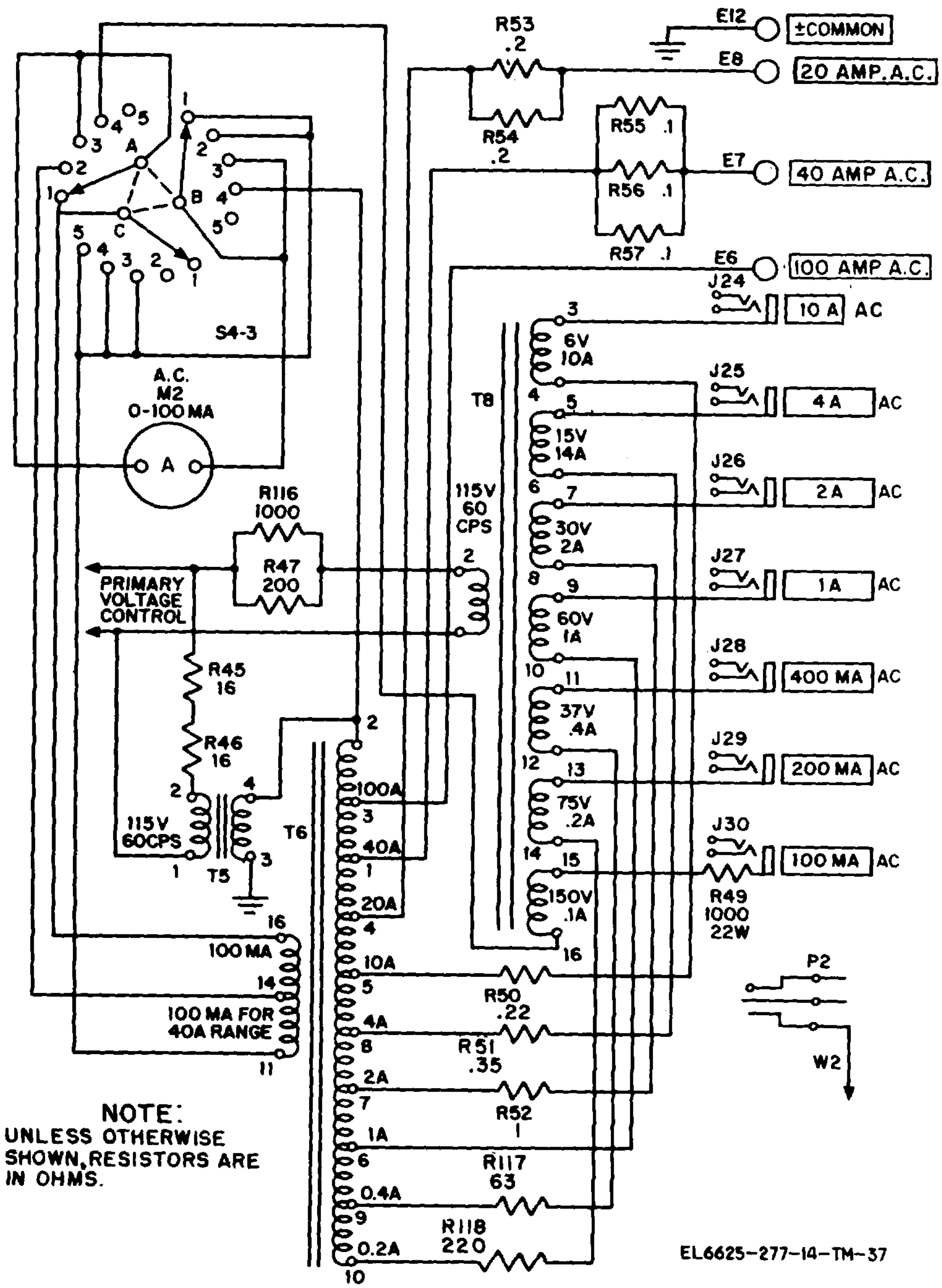

Figure 5-24. Ac ammeter test circuit, simplified schematic diagram (TS-682/GSM-1).

5-10. Ac Ammeter Test Circuit (TS-682A/GSM-1) (fig. 5-25)

The meter shunts R138 through R144 used in the ac ammeter circuit are the same as in the dc ammeter circuit (para 5-5). A small instrument transformer, T5 is connected across the meter shunts the same way as the 0- to 100- mV meter in the dc ammeter test circuit is connected across its meter shunts. Instrument transformer T5 has a ratio of 10.2 (± .025) to 1. Therefore, 100 mV across the primary of transformer T5 produces 1.02 volts at the secondary when the load is 1,000 ohms. A ratio of 10.2 to 1 instead of 10 to 1 is used to compensate for voltage drops in the loads and switches. A resistance network compensates for the fact that transformer T5 does not load the shunts as does the 0- to 100-mV dc meter for which the shunts were calibrated.

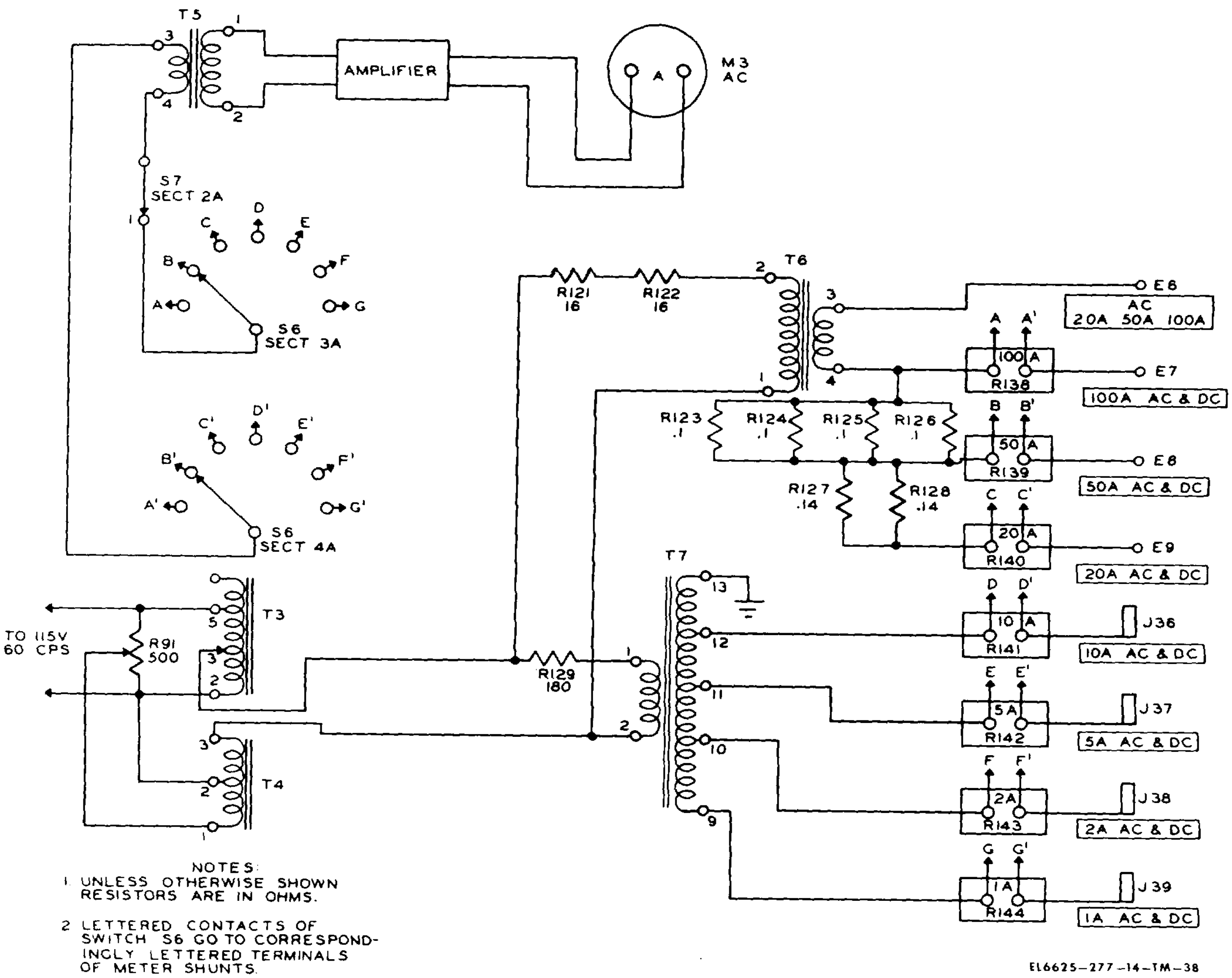

Figure 5-25. Ac ammeter test circuit, simplified schematic diagram (TS-682A/GSM-1).

5-11. Ac Milliammeter Test Circuit (TS-682A/GSM-1)

a. General. The ac milliammeter test circuit shown in figure 5-26 uses a meter shunt consisting of resistors R133 through R137. When full scale current is drawn on any range, a 1-volt drop in potential will be produced at the amplifier input terminals.

b. Primary Circuit. Power at 155 volts, 60 Hz is applied to the ac milliammeter test circuit through autotransformers T3 and T4. Autotransformer T3 is variable to permit coarse control of the output voltage. Potentiometer R91, in parallel with autotransformer T3, permits fine control of the output voltage. The output voltage of autotransformers T3 and T4 is coupled to the primary of transformer T7 through current limiting resistor R129.

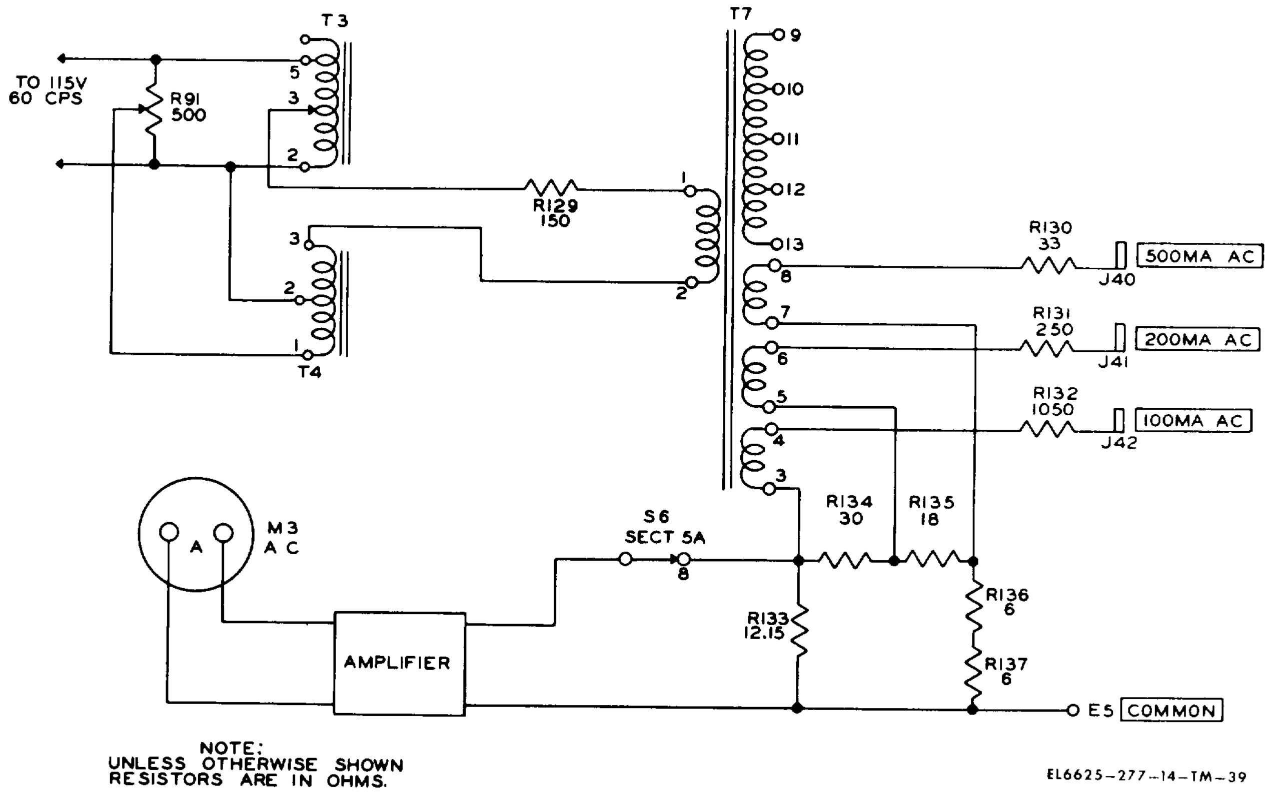

Figure 5-26. Ac milliammeter test circuit, simplified schematic diagram.

c. Secondary Circuits. Three secondary windings of transformer T7 deliver ac current to the milliampere jacks.

(1) Current is delivered through windings 7 and 8 of transformer T7, resistor R130,500 MILLIAMPERES A. C. CURRENT jack J40 and shunt resistors R133 through R137. The voltage developed across shunt R133 is coupled to the amplifier through section 5A of switch S6. The output of the amplifier is measured by meter M3.

(2) Current is delivered through windings 5 and 6 of transformer T7, resistor R131,200 MILLIAMPERES A. C. CURRENT, jack J41 and shunt resistors R133 through R137. The voltage developed across shunt resistor R133 is coupled to the amplifier through section 5A of switch S6. The output of the amplifier is measured by meter M3.

(3) Current is delivered through windings 3 and 4 of transformer T7, resistors R132,100 MILLIAMPERES A. C. CURRENT, jack J42 and shunt resistors R133 through R137. The voltage developed across shunt resistor R133 is coupled to the amplifier through 5A of switch S6. The output of the amplifier is measured by meter M3.

5-12. Ac Voltmeter Test Circuit (TS-682/GSM-1) (fig. 5-27 and 5-28)

Power is delivered to the ac voltage test circuit by the primary voltage control circuit which receives its power from the external ac power source through switch S1 and fuse F1. The functions of all ac voltage ranges are identical, except for the 1-volt range.

a. Two-Volt to 2, 000-Volt Ac Ranges. Since the functioning of the 2-volt through 2, 000-volt ac ranges is identical, the 2-volt range is used here to explain the functioning of the others.

(1) The meter to be tested is connected to the meter test set as outlined in paragraph 2-5. When the meter under test is connected to jack J10, the secondary of transformer T1 is energized, the 2-volt section of the primary of transformer T4 is switched across the secondary of transformer T1, and the meter under test is thereby connected to the appropriate voltage source.

(2) The meter under test reads the voltage across the primary of transformer T1. This voltage is varied by means of the primary control circuit.

(3) Meter M2, which is connected to the secondary of transformer T4, measures the voltage applied to the meter under test, since the 2-volt section of the primary of transformer T4 is connected to the same source of voltage.

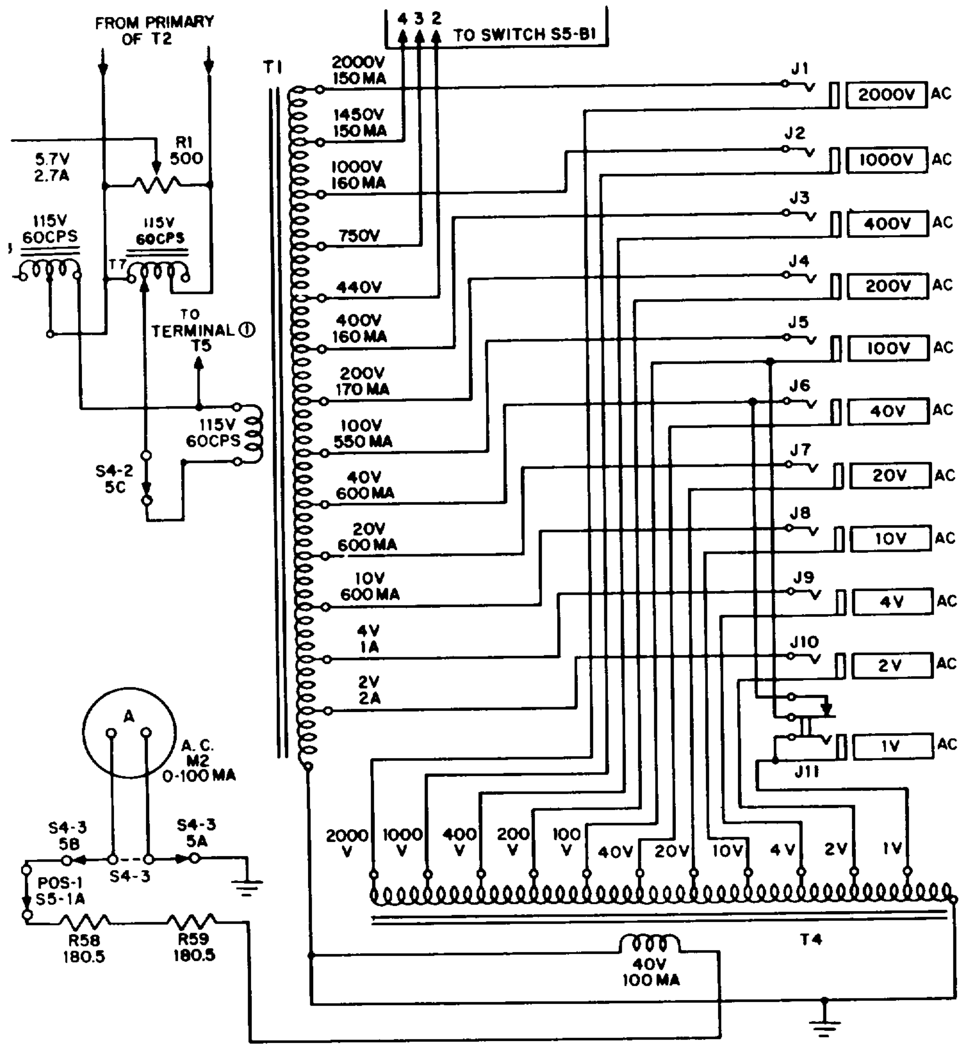

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Figure 5-27. Ac voltmeter test circuit (except Order No. 6876-Phila-51), simplified schematic diagram

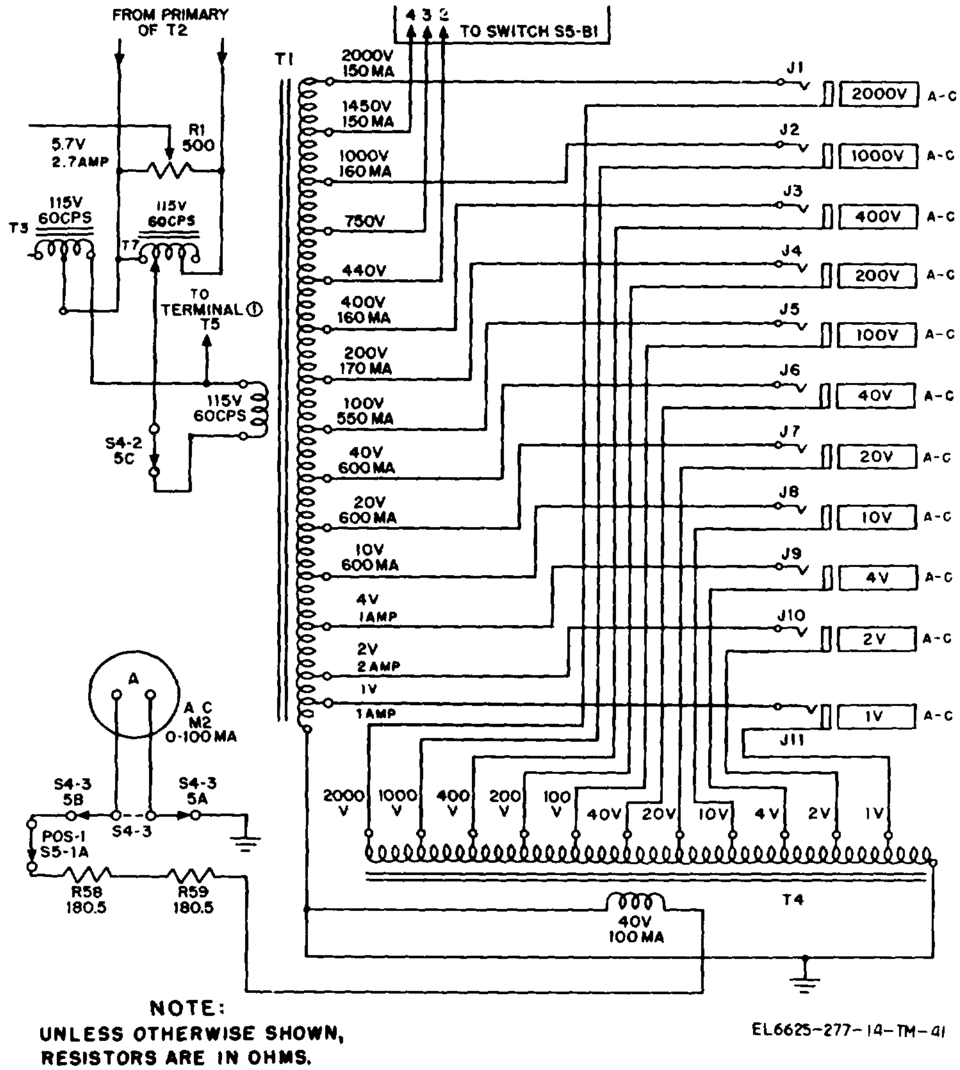

Figure 5-28. Ac voltmeter test circuit (Order 6876-Phila-51), simplified schematic diagram.

b. One Volt Ac Range. In the i-volt ac range, jack J11 acts as a switch to connect the 40-volt portion of the secondary of transformer T1 across the primary of transformer T4. Voltage is supplied to the meter under test by the 1-volt portion of the primary of transformer T4. Transformer T4 is designed so that the correct voltage will appear at its secondary, even though the transformer is used to supply voltage to the meter under test.

c. Voltage Multipliers. Resistors R58 and R59 act as voltage multipliers in the circuit of meter M2.

5-13. Ac Voltmeter Test Circuit (TS-682A/GSM-1)

(fig. 5-29)

Power is delivered to the ac voltage test circuit by the primary voltage control circuit which consists of powerstat T3, auto-transformer T4, rheostat R91, and transformer T1. The .1 percent resistors R4 through R11 used in the dc voltage test circuit (fig. 5-23) are used as meter -multipliers in the ac voltage ranges. The amplifier and meter combination has a sensitivity of 1, 000 ohms per volt and is used the same way as an ordinary 1,000-ohm-per-volt meter movement.

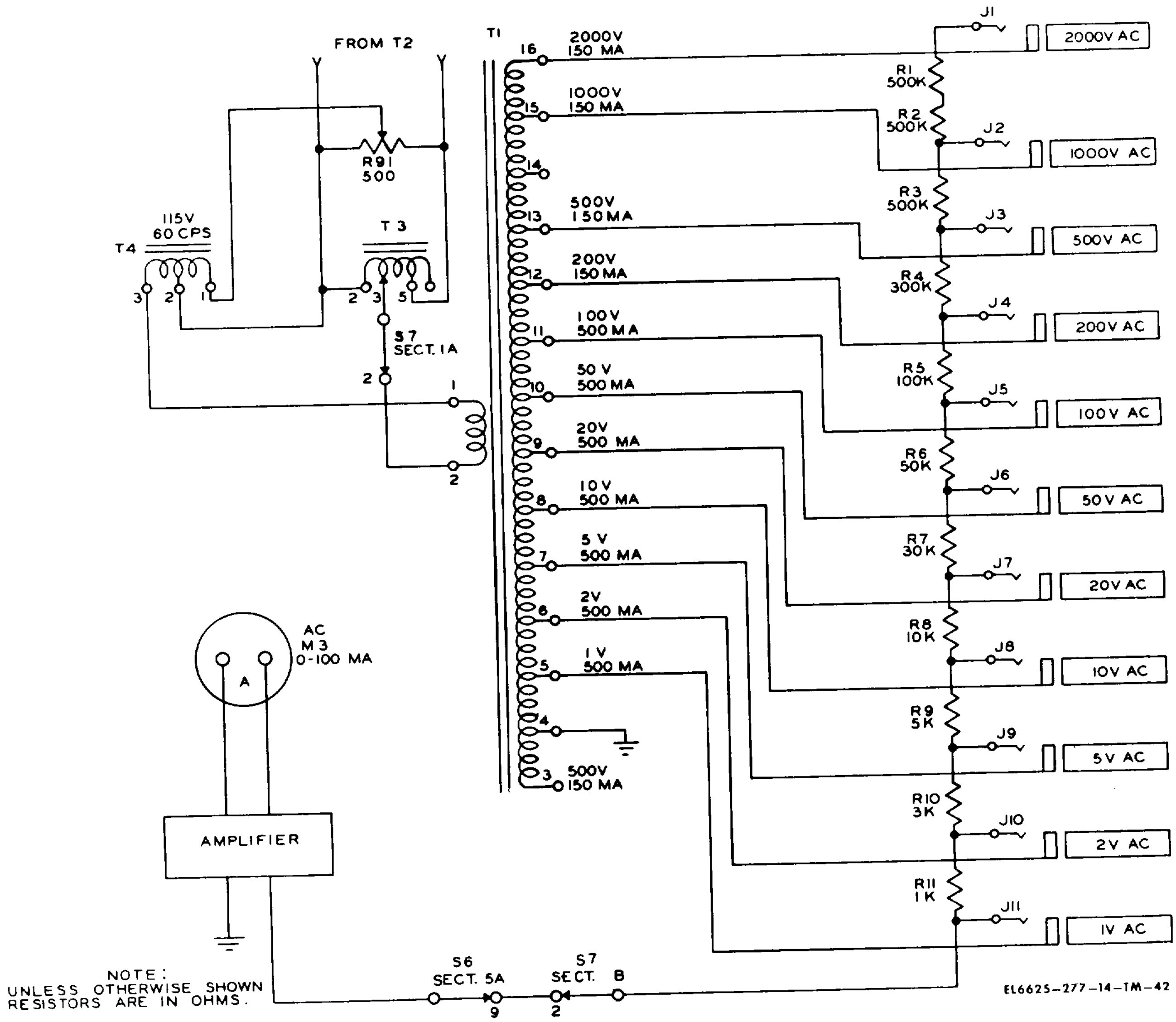

Figure 5-29. Ac voltmeter test circuit, simplified schematic diagram.

5-14. Power Supply Circuits (TS-482/GSM-1)

a. General. The test set is an assemblage of power supply circuits, most of which are used in the six fundamental test circuits for supplying power to the meters under test. A simplified schematic diagram of the ac meter amplifier rectifier power circuit is shown in figure 5-30.

b. Ac Meter Amplifier Rectifier Power Circuit.

(1) *Transformer T2.* Transformer T2 has four secondary windings. The high-voltage winding (taps 10-11-12) applies 600 volts to the plates of rectifier tube V2, and 300 volts between the plate and cathode of rectifier tube V1. The three filament winding deliver power as follows: the 5-volt, 2-ampere winding 3-6 supplies the filament of rectifier tube V2; the 2.5-volt, 1.85-ampere winding 4-5 supplies the filament of rectifier tube V1; the 6.3-volt, 6-ampere winding 7-9 supplies the filaments of tubes V3 through V7 and AC LINE pilot lamp E1.

(2) *Full-wave rectifier tube V2.* Full-wave rectifier tube V2 is a type 5R4WGY rectifier. The 600 volts across the high-voltage secondary of transformer T2 are applied across the plates of V2. These plates conduct alternately on each half-cycle of the applied voltage, and a pulsating dc voltage appears at the common filament. This rectified voltage is subsequently filtered ((3) below).

(3) *Filter network.* The filter network that consists of capacitor C19, filter choke L1, and capacitor C20 reduces the ripple content in the output of full-wave rectifier tube V2. Resistors R22 through R27 form a safety bleeder for the charge on high-voltage filter

capacitor C19. Resistor R29 is a current-limiting resistor. Capacitor C1, on the amplifier chassis, provides additional filtering. The filtered 280-volt supply provides the necessary voltages for the plates of tubes V3 through high-voltage tube V7.

(4) Half-wave rectifier tube V1. Half-wave rectifier tube V1 is a 2X2A rectifier which, with selector switch S1 in position 4, has 300 volts from the center tapped high-voltage winding applied between its plate and cathode. The half-wave output is filtered by capacitor C18. The resultant 380-volt supply is used variously as bias voltage and negative reference voltage in the ac meter amplifier.

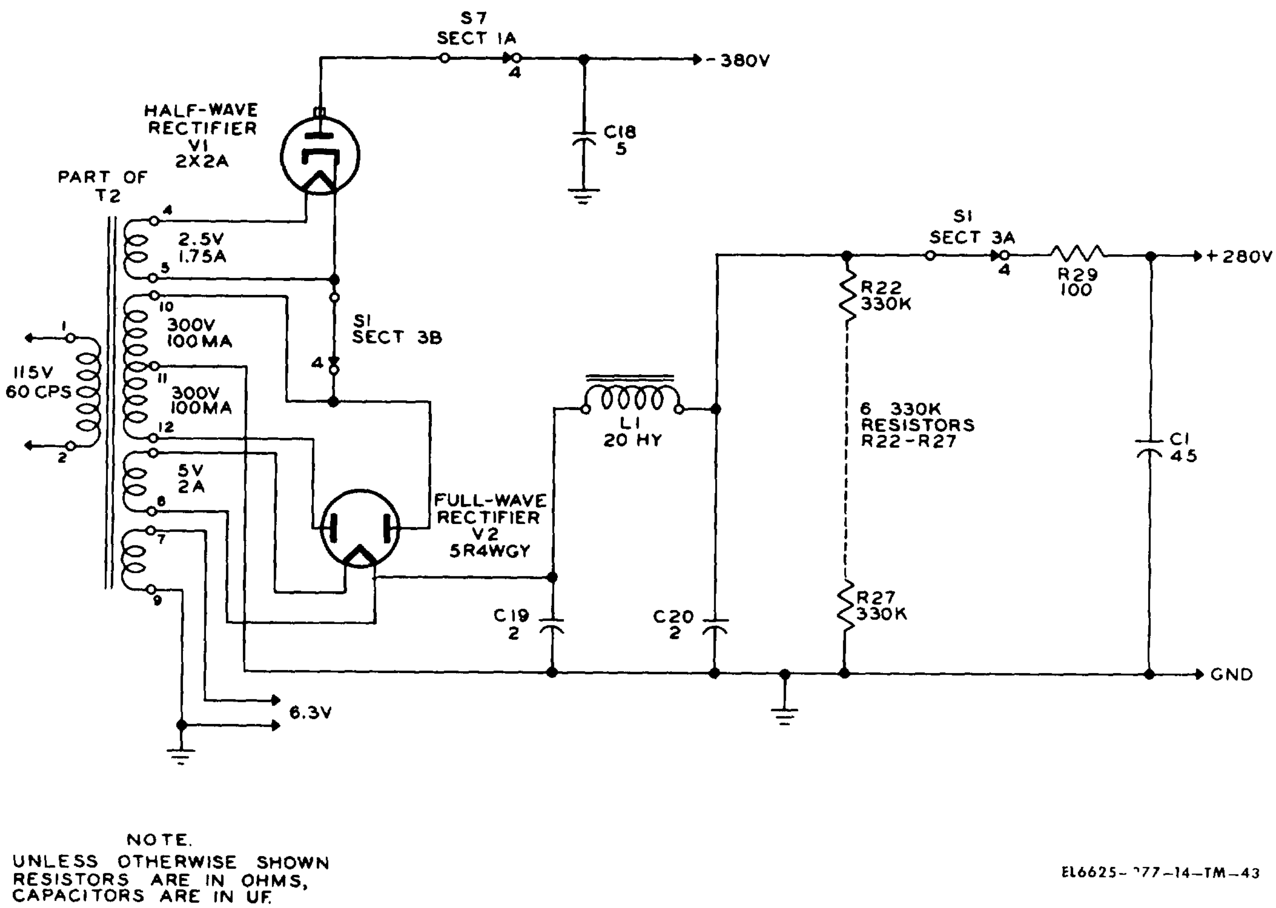

Figure 5-30. Ac meter amplifier rectifier power circuit, simplified schematic diagram.

5-15. Meter Illumination Circuit (TS-682/GSM-1)
Two lamps are provided in each meter to illuminate the meter face. A simplified schematic diagram of this circuit is shown in figure 5-31. Resistor R81 is in series with lamps E15 and E16 and resistor R78 is in series with lamps E13 and E14 to reduce voltage on the lamp filaments.

5-16. Meter Illumination Circuit (TS-682A/GSM-1)
Two lamps are provided in each meter to illuminate the meter face. A simplified schematic diagram of this circuit is shown in figure 5-32. Lamps I5 and I6 receive power from transformer T2. Lamps I3 and I4 may receive power from the battery through R96 or from transformer T2, according to the settings of S1 and S7. Lamps I1 and I2 are switched on and off by operation of J23 as well as switches S1 and S 7.

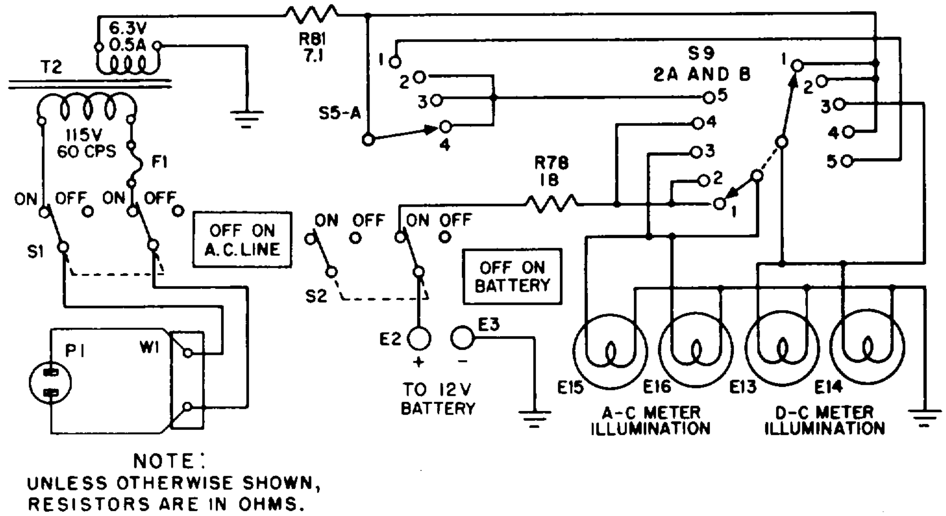

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Figure 5-31. Meter illumination circuit, simplified schematic diagram.

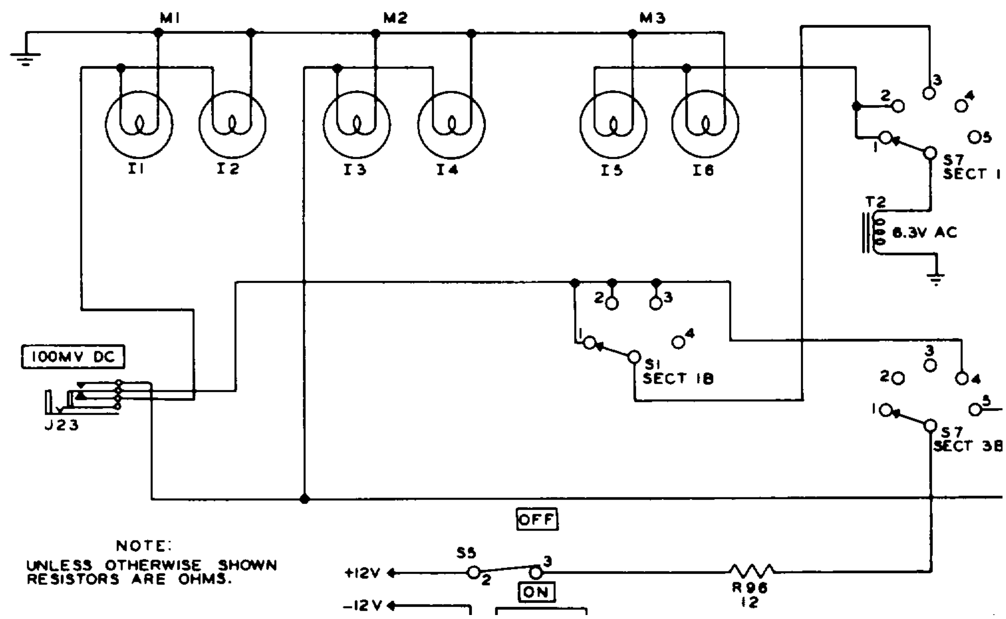

Figure 5-32. Meter dial illumination circuit, schematic diagram.

CHAPTER 6

GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. GENERAL

NOTE

No direct support maintenance is authorized.

6-1. Voltage and Resistance Measurements

It shall be assumed that general support maintenance personnel are capable of making most voltage and resistance measurements without detailed, step-by-step instructions. The basic guidelines below shall be followed:

WARNING

Certain points on the chassis of the meter test set operate at potentials in excess of 250 volts. Be extremely careful when handling or testing any part of the equipment while it is connected to the power source.

a. When measuring voltages, use tape or sleeving to insulate the test prod, except for the extreme tip.

b. Make resistance measurements as directed in table 6-1, or the appropriate schematic diagram.

c. Color code markings of resistors, capacitors, and inductors (fig. FO-1) provide pertinent resistance, voltage, and tolerance information.

d. In all tests, the possibility of intermittent trouble should not be overlooked. This type of trouble may be made to appear by tapping or jarring the equipment.

6-2. Dc Resistance of Transformers and Coils

The dc resistance of the transformers and coils in the meter test set (TS-682A/GSM-1 only) are found in table 6-1. Readings are taken with the power disconnected. The normal resistance of replacement transformers and coils may differ greatly from the values given in the table.

Table 6-1. Dc Resistance of Transformers and Coils

Transformer or coil	Terminals	Dc resistance (ohms)
T1	1-2	0.6
	3-4	70
	3-5	70
	3-6	70
	3-7	70
	3-8	70
	3-9	70
	3-10	71.5
	3-11	74
	11-12	18
	12-13	48
	13-14	43
	14-15	42
	15-16	150
T2	1-2	3
	3-6	0
	4-5	0
	7-9	0
	10-11	120
	11-12	120
T4	1-2	26
	2-3	1
T5	1-2	18
	3-4	0
T6	1-2	6
	3-4	0
T7	1-2	6
	3-4	40
	5-6	10
	7-8	1.8
	9-10	1.4
	9-11	1.8
	9-12	2
	9-13	2
L1	1-2	400

6-3. Tools and Test Equipment Required

The following is a list of common tools and test equipment required for general support maintenance of the meter test set. National stock numbers are also listed. No special tools or test equipment are required.

a. Multimeter TS-352B/U	NSN 6615-00-242-5023	TM 11-6625-366-15
b. Test Set, Electron Tube TV-7/U	NSN 6625-00-820-0064	TM 11-6625-274-12
c. Resistance Bridge ZM-4B/U	NSN 6625-00-570-5722	TM 11-2019
d. Tool Kit, Electronic Equipment TK-100/G	NSN 5180-00-605-0079	

Section II. TROUBLESHOOTING

6-4. General

The first step in servicing a defective meter test set is to sectionalize the fault. Sectionalization means tracing the fault to the major circuit responsible for the abnormal operation. The second step is to localize the fault. Localization means tracing the fault to a particular stage or network within one of the major circuits. The third step is to isolate the fault. Isolation means tracing the fault to the defective part responsible for the abnormal condition. Some faults, such as burned-out resistors, arcing and shorted transformers, can often be located by sight, smell, and hearing. The majority of faults, however, must be isolated by checking voltages and resistances.

6-5. Component Sectionalization, Localization, and Isolation

Listed below is a sequence of tests arranged to reduce unnecessary work and aid in tracing the trouble to a specific component.

a. Visual Inspection. Through inspection alone, the repairman may frequently discover the trouble, or determine the circuit in which the trouble exists. This inspection helps to avoid additional damage to the equipment as a result of improper servicing methods.

b. Troubleshooting Table. The systems listed in tables 6-2 through 6-10 will aid greatly in locating trouble.

c. Intermittent. It is possible that some external connections may cause the trouble. Test wiring for loose connections and move wires and components with an insulated tool. This may indicate the location of a faulty connection or component.

6-6. Locating Ac Meter Amplifier Circuit Faults, TS-682(*)/GSM-1

a. Testing Tubes. Most troubles in the ac meter amplifier are caused by defective tubes. If trouble is indicated in the amplifier circuit and the cause is not immediately apparent, check all tubes with an electron tube test set. The tube check should include tests for short circuits, excessive gas, and filament to cathode leakage. When a tube fault is indicated, and no test set is available, follow the tube testing procedure in paragraph 4-8.

b. Measuring Power Supply Output. If trouble in the ac power supply is indicated, measure the positive output at terminal 1, section 3B, of selector switch S1, and the negative output at terminal 4, section 1A of selector switch S1, with Multimeter TS-352B/U or equivalent.

c. Measuring Voltage and Resistance. Most amplifier troubles can be located and corrected without removing the amplifier chassis from the test set. If it is necessary to remove the amplifier from the test set, take voltage and resistance measurements on the underside of the chassis with Multimeter TS-352B/U and Resistance Bridge ZM-4B/U. All dc voltages in the meter amplifier may be incorrect if a malfunction occurs that affects the feedback loop. Isolate such a defect by locating the stage where the direction of the voltage offset at the input is not reversed at the output.

6-7. Troubleshooting Tables

The following tables are supplied as an aid in locating trouble that exists in the test set. They list the malfunctions that the repairman can observe while testing, and the defects that are most likely to cause the symptoms. In addition, the charts indicate corrective action that the repairman should perform, and reference appropriate schematic diagrams and illustrations. Point to point voltage tests can be used to supplement these procedures.

Table 6-2. Troubleshooting Dc Ammeter Test Circuits, TS-682/GSM-1

Malfunction	*Probable cause*	*Corrective action*
1. Battery lamp E5 does not light	a. Lamp E5 defective.	a. Check lamp (fig. 5-5) and replace if defective (fig. 6-3).
	b. 12-volt storage battery dead or improperly connected to binding posts E2 (+) and E3 (-).	b. Check battery and recharge if low. Check battery connections (fig. 2-2) (para 2-5b) and reverse polarity if necessary.
	c. BATTERY switch S2 defective.	c. Check switch (fig. 5-5) and replace if defective (fig. 6-3).
d.	Resistor R82 defective.	d. Check resistor (fig. 5-5) and replace if defective (fig. 6-3).
2. No dc output at jacks J31 through J46 and binding posts E9, E10, and E11.	a. Selector switch S6 defective.	a. Check switch (fig. 5-5) and replace if defective (fig. 6-3).
	b. Selector switch S4 defective.	b. Check switch (fig. 5-6) and replace if defective (fig. 6-3).
	c. BATTERY switch S2 defective.	c. Check switch (fig. 5-12) and replace if defective (fig. 6-3).
3. No dc output at one or all of jacks J35 through J46.	Resistor or resistors in shunt network consisting of resistors R87 through R107 and R110, defective.	Check resistors (fig. 5-6) and replace those found to be defective.
4. No dc output at jack J31.	Shunt E20 defective.	Check (fig. 5-9) and replace if defective (fig. 6-2).
5. No dc output at jack J32.	Shunt E19 defective.	Check (fig. 5-8) and replace if defective (fig. 6-2).
6. No dc output at jack J33.	Shunt E18 defective.	Check (fig. 5-7; and replace defective (fig. 6-2).
7. No dc output at jack J34.	a. Shunt E17 Defective. b. Resistor R108 defective.	Check (fig. 5-7) and replace if defective (fig. 6-4).
8. No dc output at binding post E9.	Shunt E23 defective.	Check (fig. 5-12) and replace if defective.
9. No dc output at binding post E10.	Shunt E22 defective.	Check (fig. 5-11) and replace if defective.
10. No dc output at binding post E11.	Shunt E21 defective.	Check (fig. 5-101 and replace if defective (fig. 6-2).
11. Excessive dc output at one or all of the jacks J31 through J46 and binding posts E9 through E11.	Resistor or resistors R61 through R70, R72 through R80 and R83 through R86.	Check resistors (fig. 5-7 through 5-12). Replace those found to be defective.
12. DC meter M1 shows no reading on any ampere range.	a. 12-volt storage battery improperly connected to bind-posts E2 (+) and E3 (-).	a. Check battery connections (fig. 2-2). Reverse polarity if necessary.
	b. Meter M1 defective.	b. Check meter M1 (fig. 6-9) and replace if defective.
	c. Overload relay K5 defective, out of adjustment, or has dirty contacts.	c. Check relay K5 (fig. 6-8). Clean and adjust (para 6-9 and 6-10), or replace if defective.
13. Overload relay K5 operates in all positions of selector switch S6.	a. Rheostat R48 defective	a. Check rheostat R48 (fig. 6-8). Adjust (para 6-10), or replace if defective.
	b. Resistor R114 defective,	b. Check resistor R114 (fig. 6-8) and replace if defective.
	c. Rheostat R71 defective.	c. Check each section of rheostat R71 (fig. 6-3). Replace if defective.
14. Dc output cannot be varied with DIRECT CURRENT COARSE CONTROL rheostat R71.	Rheostat R71 defective.	Check each section of rheostat R71(fig. 6-3). Replace if defective.
15. Dc output cannot be varied with DIRECT CURRENT FINE CONTROL. rheostat R60.	Rheostat R60 detective.	Check rheostat R60 (fig. 6-6). Replace if defective

Table 6-3. Troubleshooting Dc Ammeter Test Circuits, TS-682A/GSM-1

Malfunction	*Probable cause*	*Corrective action*
1. Battery lamp E2 does not light.	a. Lamp E2 defective.	a. Check lamp (fig. 6-16) and replace if defective.
	b. 12-volt storage battery dead or improperly connected to binding posts E3 (+) and E4 (-).	b. Check battery and recharge if low. Check battery connections (fig. 2-3, para 2-5b) and reverse polarity if necessary.
	c. BATTERY switch S5 defective.	c. Check switch (fig. 6-16) and replace if defective
	d. Resistor R95 defective.	d. Check resistor (fig. 6-20) and replace if defective.
2. No dc output at jacks J24 through J39 and binding posts E7, E8 and E9.	a. Selector switch S6 defective.	a. Check switch (fig. 6-16 and replace if defective.
	b. Selector switch S7 defective.	b. Check switch (fig. 6-16 and replace if defective.
	c. BATTERY switch S5 defective	c. Check switch (fig. 6-16) and replace if defective.
3. No dc output at one or all of jacks J24 through J35.	Resistor or resistors in shunt network consisting of resistors R99 through R120 defective.	Check resistors (fig. 5-14 and 6-17) and replace those found to be defective.
4. No dc output at jacks J36 through J39 or binding posts E7, E8, and E9.	Shunt or shunts R138 through R144 defective.	Check shunts (fig. 5-15 and through 5-21) and replace those found to be defective (fig. 6-14).
5. Excessive dc output at one or all of the jacks J24 through J39 and binding posts E7, E8, and E9.	Resistor or resistors R62 through R69.	Check resistors (fig. 5-15 through 5-21) and replace those found to be defective (fig. 6-13).
6. DC MICROAMMETER M1 shows no reading on uA and mA ranges.	a. 12-volt storage battery improperly connected to binding posts E3(+) and E4 (-).	a. Check battery connections (fig. 2-3) and reverse polarity if necessary.
	b. Meter M1 defective.	b. Check meter M1 (fig. 6-19) and replace if defective.
	c. Overload relay K5 defective, out of adjustment, or has dirty contacts.	c. Check relay K5 (fig. 6-13). Clean and adjust (para 6-9 and 6-10), or replace if defective.
7. DC MILLIAMMETER M2 shows no reading on any dc ampere ranges.	a. 12-volt storage battery improperly connected to - binding posts E3(+) and E4 (-).	a. Check battery connections (fig. 2-3) and reverse polarity if necessary.
	b. Meter M2 defective.	b. Check meter M2 (fig. 6-19) and replace if defective.
	c. Overload relay K5 defective, out of adjustment, or has dirty contacts.	c. Check relay K5 (fig. 6-13). Clean and adjust (para 6-9 and 6-10), or replace if defective.
8. Overload relay K5 operates in all positions of selector switch S6.	a. Rheostat R70 defective.	a. Check rheostat R70 (fig. 6-13). Adjust (para 6-10) or replace if defective.
	b. Resistor R71 defective.	b. Check resistor R71 (fig. 6-13) and replace if defective.
	c. Rheostat R61 defective.	c. Check each section of rheostat R61 (fig. 6-13) and replace if defective.
9. Dc output cannot be varied with DIRECT COARSE CONTROL rheostat R61.	Rheostat R61 defective.	Check each section of rheostat R61 (fig. 6-13 and replace if defective.
10. Dc output cannot be varied with DIRECT CURRENT FINE. CONTROL rheostat R94.	Rheostat R94 defective.	Check rheostat R94 (fig. 6-16) and replace if defective.

Table 6-4. Troubleshooting Dc Voltmeter Test Circuits, TS-682/GSM-1

Malfunction	*Probable cause*	*Corrective action*
1. AC LINE lamp E1 does not light.	a. Ac power cord defective.	a. Check power cord. Repair or replace cord if defective.
	b. 5-ampere fuse F1 burned out.	b. Check fuse F1 (fig. 6-3) and replace if burned out.

Table 6-4. Troubleshooting Dc Voltmeter Test Circuits, TS-682/GSM-1 (Continued)

Malfunction	*Probable cause*	*Corrective action*
	c. Lamp E1 defective.	c. Check lamp E1 (fig. 6-3) and replace if defective.
	d. AC LINE switch S1 defective.	d. Check switch S1 (fig. 6-3) and replace if defective.
	e. Transformer T2 defective.	e. Check transformer T2 fig. 5-22) and replace if defective (fig. 6-1).
2. No dc voltage output at jacks J13 through J23.	a. Rectifier Tube V1 defective.	a. Test tube V1 (fig. 6-3) and replace if defective.
	b. Powerstat T7 defective.	b. Check powerstat T7 and replace if defective.
	c. Rheostat R1 defective.	c. Check rheostat R1 (fig. 6-3) and replace if defective.
	d. Transformer T2 defective.	d. Check transformer T2 and replace if defective.
	e. Transformer T3 defective.	e. Check transformer T3 and replace if defective.
	f. Selector switch S5 defective.	f. Check switch S5 (fig. 6-3) and replace if defective.
	g. Resistor or resistors R3 through 22 defective.	g. Check resistors R3 through R22 (fig. 6-2 and replace if defective.
	h. Filter capacitor C1 or C2 defective.	h. Check capacitors C1 and replace if defective.
	i. Filter choke L1 defective.	i. Check filter choke L1 (fig. 6-2) and replace if defective.
3. No dc voltage at jacks J14 through J23.	Resistor or resistors R23 through R44 defective.	Check resistors R23 through R44 (fig. 6-4) and replace as necessary.
4. Incorrect dc voltage at any jack J14 through J23.	Resistors or resistors R23 through R44 defective.	Check resistors R23 through R44 (fig. 6-4) and replace as necessary.
5. Unable to vary dc voltage output on all dc ranges.	a. Powerstat T7 defective.	a. Check powerstat T7 and replace if defective.
	b. Rheostat R1 defective.	b. Check rheostat R1 (fig. 6-3) and replace if defective.
6. No reading on dc millivoltmeter.	a. Selector switch S5 defective.	a. Check switch S5 (fig. 6-3) and replace if defective.
	b. Meter M1 defective.	b. Check meter M1(fig. 6-9) and replace if defective.
7. Excessive voltage at jacks J12 and J13 for normal rotation of DC VOLTS COARSE CONTROL, powerstat T7.	Resistor or resistors R3 through R12 defective.	Check resistors R3 through R22 (fig. 6-2) and replace as necessary.

Table 6-5. Troubleshooting Dc Voltmeter Test Circuits, TS-682A/GSM-1

Malfunction	*Probable cause*	*Corrective action*
1. AC LINE lamp E1 does not light.	a. Ac power cord defective.	a. Check power cord and repair or replace if defective.
	b. 5-ampere fuse F1 or F2 burned out.	b. Check fuses F1 and F2 (fig. 3-2) and replace if burned out.
	c. Lamp E1 defective.	c. Check lamp E1 (fig. 6-16) and replace if defective.
	d. AC LINE switch S4 defective.	d. Check switch S4 (fig. 6-16) and replace if defective.
	e. Transformer T2 defective.	e. Check transformer T2 (fig. 6-16) and replace if defective.
2. No dc voltage output at jacks J13 through J23	a. Rectifier tube V2 defective.	a. Test tube V2 (fig. 6-16) and replace if defective.
	b. Powerstat T3 defective.	b. Check powerstat T3 (fig. 6-16) and replace if defective.
	c. Rheostat R91 defective.	c. Check rheostat R91 (fig. 6-13) and replace if defective.
	d. Transformer T2 defective.	d. Check transformer T2 (fig. 6-16) and replace if defective.

Table 6-5. Troubleshooting Dc Voltmeter Test Circuits, TS-682A/GSM-1 (Continued)

Malfunction	*Probable cause*	*Corrective action*
	e. Transformer T4 defective.	e. Check transformer T4 (fig. 6-13) and replace if defective.
	f. Selector switch S1 defective.	f. Check switch S1 (fig. 6-16) and replace if defective.
	g. Resistor or resistors R22 through R27 defective.	g. Check resistors R22 through R27 (fig. 6-15) and replace if defective.
	h. Filter capacitor C19 or C20 defective.	h. Check capacitors C19 and C20 (fig. 6-15) and replace if defective.
	i. Filter choke L1 defective.	I. Check filter choke L1 (fig. 6-15) and replace if defective.
3. No dc voltage at jack J12.	a. Rectifier tube V1 defective.	a. Test tube V1 (fig 6-16) and replace if defective.
	b. Winding 4-5 (2.5 volts) of transformer T2 defective.	b. Check winding 4-5 of T2 (fig. 6-16) and replace transformer if defective.
	c. Resistor R1 or R2 defective.	c. Check resistors R1 and R2 (fig. 6-17) and replace defective resistor.
	d. Jack J12 defective.	d. Check jack J12 (fig. 6-18) and replace if defective.
	e. Selector switch S1 defective.	e. Check switch S1 (fig. 6-16) and replace if defective.
4. No dc voltage at jack J13.	a. Jack J13 defective.	a. Check jack J13 (fig. 6-18) and replace if defective.
	b. Selector switch S1 defective.	b. Check switch S1 (fig. 6-16) and replace if defective.
5. No dc voltage at J14 through J23.	Resistor or resistors R4 through R21 defective.	Check resistors R4 through R21 (fig. 6-17) and replace as necessary.
6. Incorrect dc voltage at any jack J14 through J23.	Resistor or resistors R4 through R21 defective.	Check resistors R4 through R21 (fig. 6-17) and replace as necessary.
7. Unable to vary dc voltage output on all dc ranges.	a. Powerstat T3 defective.	a. Check powerstat T3 (fig. 6-16) and replace if defective.
	b. Rheostat R91 defective.	b. Check rheostat R91 (fig. 6-16) and replace if defective.
8. No reading on dc microammeter M1.	a. Selector switch S1 defective.	a. Check switch S1 (fig. 6-16) and replace if defective.
	b. Meter defective.	b. Check meter M1 (fig. 6-19) and replace if defective.
9. No reading on dc millivoltmeter M2.	a. Selector switch S1 defective.	a. Check switch S1 (fig. 6-16) and replace if defective.
	b. Meter defective.	b. Check meter M2 (fig. 6-19) and replace if defective.
10. Excessive voltage at jacks J12 and J13 for normal rotation of DC VOLTS COARSE CONTROL, powerstat T3.	Resistor or resistors R22 through R27 defective.	Check resistors R22 through R27 (fig. 6-15) and replace as necessary.

Table 6-6. Troubleshooting Ac Ammeter Test Circuits TS-682/GSM-1

Malfunction	*Probable cause*	*Corrective action*
1. No output at jacks J24 through J30 and binding posts E6, E7, and E8.	a. Selector switch S4 defective. -	a. Check switch S4 (fig. 6-3) and replace defective switch.
	b. Powerstat T7 defective.	b. Check powerstat T7 and replace if defective.
	c. Transformer T3 defective.	c. Check transformer T3 and replace if defective.
2. No control of current output.	a. Powerstat T7 defective.	a. Check powerstat T7 and replace if defective.
	b. Rheostat R71 defective.	b. Check rheostat R71 (fig. 6-3) and replace if defective.
3. No output at binding posts E6, E7, and E8.	a. Transformer T5 defective.	a. Check transformer T5 (fig. 6-2) and replace if defective.
	b. Resistor R45 or R46 defective.	b. Check resistors R45 and R46 (fig. 6-6) and replace if defective.

Table 6-6. Troubleshooting Ac Ammeter Test Circuits, TS-682A/GSM-1 (Continued)

Malfunction	*Probable cause*	*Corrective action*
4. No output at jacks J24 through J30.	a. Transformer T8 defective.	a. Check transformer T8 (fig. 6-2) and replace if defective.
	b. Selector switch S4 defective.	b. Check switch S4 (fig. 6-3) and replace if defective.
5. No output on any one of jacks J24 through J30 or binding posts E6, E7, and E8.	Resistor R49 through R57 or R117 or R118 defective.	Check resistors R49 through R57 and R117 and R118. Replace defective resistor or resistors.
6. No control of current output.	a. Powerstat T7 defective.	a. Check powerstat T7 and replace if defective.
	b. Transformer T5 defective.	b. Check transformer T5 (fig. 6-2) and replace if defective.
	c. Rheostat R1 defective.	c. Check rheostat R1 (fig. 6-3) and replace if defective.
7. Meter M2 shows no deflection.	a. Selector switch S4 defective.	a. Check switch S4 (fig. 6-3) and replace defective switch.
	b. Meter M2 defective.	b. Check meter (fig. 6-9) and replace if defective.
	c. Transformer T8 defective.	c. Check transformer T8 (fig. 6-2) and replace if defective.
8. No control of ac voltage output.	a. Powerstat T7 defective.	a. Check powerstat T7 and replace if defective.
	b. Rheostat R1 defective.	b. Check rheostat R1 (fig. 6-3) and replace if defective.

Table 6-7. Troubleshooting Ac Ammeter Test Circuits, TS-682A/GSM-1

Malfunction	*Probable cause*	*Corrective action*
1. No output at jacks J36 through J42 and bindings posts E7 through E9.	a. Selector switch S1, S6, or S7 defective.	a. Check switches S1, S6, and S7(fig. 6-16). Replace defective switch.
	b. Powerstat T3 defective.	b. Check powerstat T3 (fig. 6-16) and replace if defective.
	c. Transformer T4 defective.	c. Check transformer T4 (fig. 6-15) and replace if defective.
	d. Defect in ac meter amplifier.	d. See table 6-10.
2. No control of current output.	a. Powerstat T3 defective.	a. Check powerstat T3 (fig. 6-16) and replace if defective.
	b. Rheostat R61 defective.	b. Check rheostat R61 (fig. 6-16) and replace if defective.
3. No output at jacks J32 through J39 and binding posts E6 through E9.	a. Transformer T6 defective.	a. Check transformer T6 (fig. 6-16) and replace if defective.
	b. Resistor R121 or R122 defective.	b. Check resistors R121 and R122 (fig. 6-13) and replace if defective.
4. No output at jack J40, J41, or J42.	a. Transformer T7 defective.	a. Check transformer T7 (fig. 6-16) and replace if defective.
	b. Selector switch S1, S6 or S7 defective.	b. Check switches S1, S6, and S7 (fig. 6-16) and replace if defective.
5. No output on any one of jacks J36 through J39 or binding posts E7, E8, and E9.	a. Shunt in group R138 through R144 defective.	a. Check shunts R138 through R144(fig. 6-14) and replace if defective.
	b. Resistor R123 through R128 defective.	b. Check resistors R123 through R128 (fig. 6-13 and replace as necessary.
6. No control of current output.	a. Powerstat T3 defective.	a. Check powerstat T3 (fig. 6-16) and replace if defective.
	b. Transformer T4 defective.	b. Check transformer T4 (fig. 6-15) and replace if defective.
	c. Rheostat R91 defective.	c. Check rheostat R91 (fig. 6-16) and replace if defective.
7. Meter M3 shows no deflection.	a. 15-ampere fuse F3 defective.	a. Check fuse F3 (fig. 6-16) and replace if defective.
	b. Selector switch S1, S6, or S7 defective.	b. Check switches S1, S6, and S7 (fig. 6-16) and replace defective switch.

Table 6-7. Troubleshooting Ac Ammeter Test Circuits, TS-682A/GSM-1 (Continued)

Malfunction	*Probable cause*	*Corrective action*
	c. AC MILLIAMMETER M3 defective.	c. Check meter M3 (fig. 6-19) and replace if defective.
	d. Defect in ac meter amplifier.	d. See table 6-10.
	e. Transformer T1 defective.	e. Check transformer T1 (fig. 6-15) and replace if defective.
	f. Defect in ac meter amplifier.	f. See table 6-10.
8. No control of ac voltage output.	a. Powerstat T3 defective.	a. Check powerstat T3 (fig. 6-16) and replace if defective.
	b. Rheostat R91 defective.	b. Check rheostat R91 (fig. 6-16) and replace if defective.
9. No reading on ac milliammeter M3.	a. Selector switch, S1, S6, or S7 defective.	a. Check switches S1, S6, and S7 (fig. 6-16) and replace if defective.
	b. Meter defective.	b. Check meter M3 (fig. 6-19) and replace if defective.
	c. 15-ampere fuse F3 burned out.	c. Check fuse F3 (fig. 6-16) and replace if defective.
	d. Defect in ac meter amplifier.	d. See table 6-10.
10. Incorrect voltage or no voltage on any jacks J1 through J11.	a. Secondary of transformer T1 defective.	a. Check transformer T1 (fig. 6-15) and replace if secondary is defective.
	b. Defect in ac meter amplifier.	b. See table 6-10.

Table 6-8. Troubleshooting Ac Voltmeter Test Circuits, TS-682/GSM-1

Malfunction	*Probable cause*	*Corrective action*
1. No ac voltage output jacks J1 through J 11.	a. Switch S1 or S4 defective.	a. Check S1 and S4 (fig. 6-3) and replace if defective.
	b. Fuse F1 defective.	b. Check F1 (fig. 6-3) and replace if defective.
	c. Transformer T1 or T3 defective.	c. Check T1 (fig. 6-2) and T3 and replace if defective.
	d. Powerstat T7 defective.	d. Check T7 and replace if defective.
	e. Rheostat R1 defective.	e. Check R1 (fig. 6-3) and replace if defective.
2. No control of ac voltage output.	a. Powerstat T7 defective.	a. Check T7 and replace if defective.
	b. Rheostat R1 defective.	b. Check R1 (fig. 6-3) and replace if defective.
3. No reading on ac meter M2.	a. Switch S4 or S5 defective.	a. Check S4 and S5 (fig. 6-3) and replace if defective.
	b. Meter M2 defective.	b. Check M2 (fig. 6-9) and replace if defective.
	c. Resistor R58 or R59 defective.	c. Check R58 and R59 (fig. 6-2) and replace if defective.
4. Incorrect or no voltage on any of jacks J1 through J11.	Secondary of transformer T1 defective.	Check T1 (fig. 6-2) and replace if defective.

Table 6-9. Troubleshooting Ac Voltmeter Test Circuits, TS-682A/GSM-1

Malfunction	*Probable cause*	*Corrective action*
No ac voltage output at jacks J1 through J11.	a. Selective switch S1, S6, or S7 defective.	a. Check switches S1 S6, and S7 (fig. 6-16) and replace defective switch.
	b. Transformer T4 defective.	b. Check transformer T4 (fig. 6-13) and replace if defective.
	c. Powerstat T3 defective.	c. Check powerstat T3 (fig. 6-16) and replace if defective.
	d. Rheostat R91 defective.	d. Check rheostat R91 (fig. 6-16) and replace if defective.

Table 6-10. Troubleshooting Ac Meter Test Circuits, TS-682A/GSM-1

Malfunction	*Probable cause*	*Corrective action*
1. Ac milliammeter M3 does not deflect and indicator lamp V8 lights as to soon as attempt is made obtain an output.	a. 15-ampere fuse F3 burned out.	a. Check fuse F3 (fig. 6-16) and replace if defective.
	b. Tube V1, V3, V4, or VS defective.	b. Test tubes V1, V3, V4, V5 (fig. 6-16). Replace defective tube.
	c. Meter M3 open or defective.	c. Check meter M3 (fig. 6-19) and repair or replace as necessary.
2. Ac milliammeter M3 deflects normally but indicator lamp V8 lighted all the time.	a. Tube V6 or V7 defective.	a. Test tubes V6 and V7 (fig. 6-16) and replace defective tube.
	b. Capacitor C16 leaky.	b. Check capacitor C16 (fig. 6-21; and replace if defective.
3. Ac milliammeter M3 deflects; indicator lamp V8 lights as output is increased.	Amplifier gain low; tube V1, V2, V3, V4, or V5 defective.	Test tubes V1, V2, V3, V4, and V5 (fig. 6-16). Replace defective tube.
4. Ac milliammeter M3 does not deflect; indicator lamp V8 does not light.	a. Tube V2 defective.	a. Test tube V2 (fig. 6-16) and replace if defective.
	b. Selector switch S1 defective.	b. Check switch S1 (fig. 6-16) and replace if defective.
5. Ac milliammeter M3 partially deflects; indicator lamp V8 does not light.	a. Capacitor C11 leaky.	a. Check capacitor C11 (fig. 6-16) and replace if defective.
b.	Tube V3, V4, or V5 defective.	b. Test tubes V3, V4, and V5 (fig. 6-16). Replace defective tube.
6. Ac milliammeter M3 deflects normally; indicator lamp V8 does not light when AMPLIFIER TEST switch S2 is depressed.	Tube V6, V7, or V8 defective.	Test tubes V6, V7, and V8 (fig. 6-16). Replace defective tube.

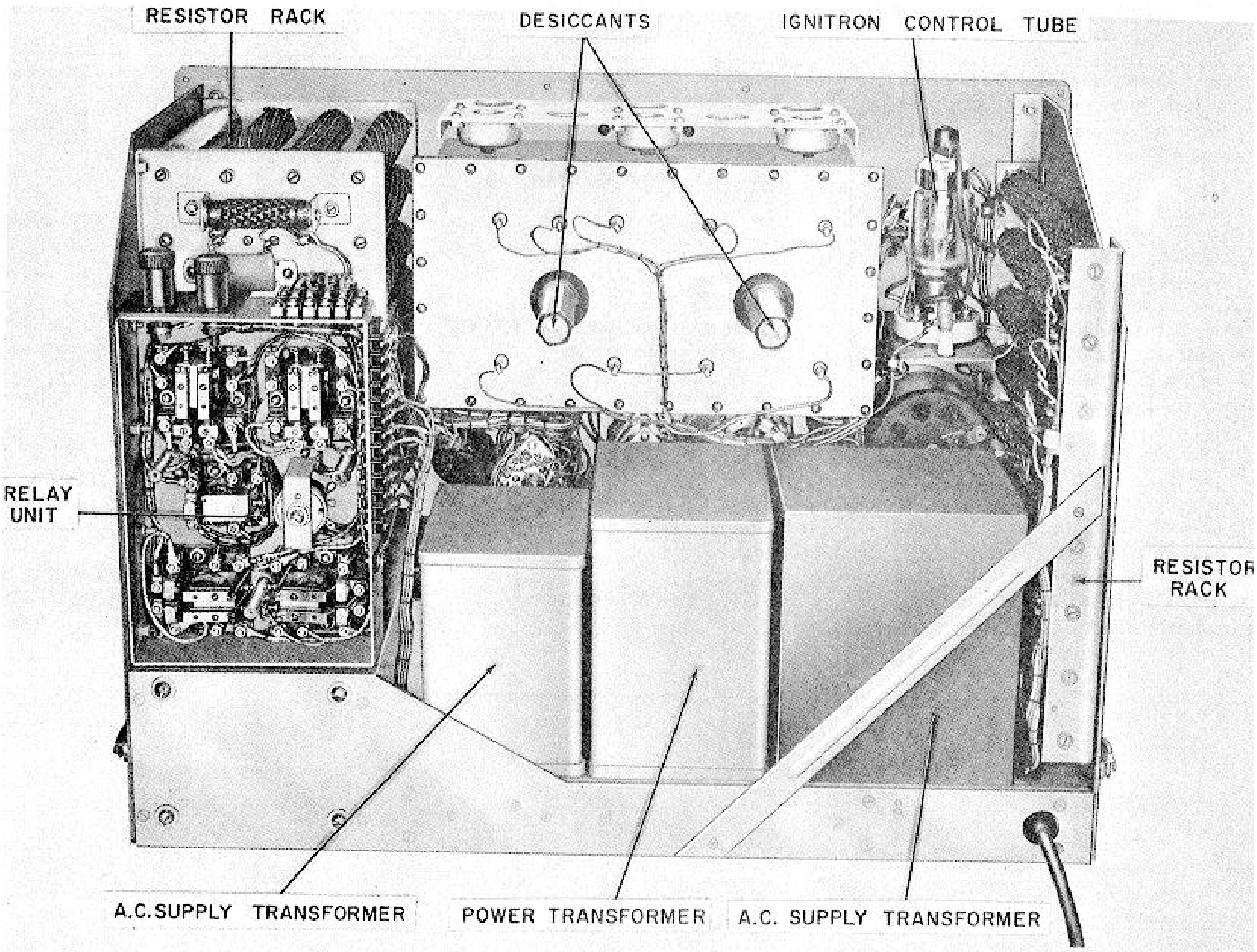

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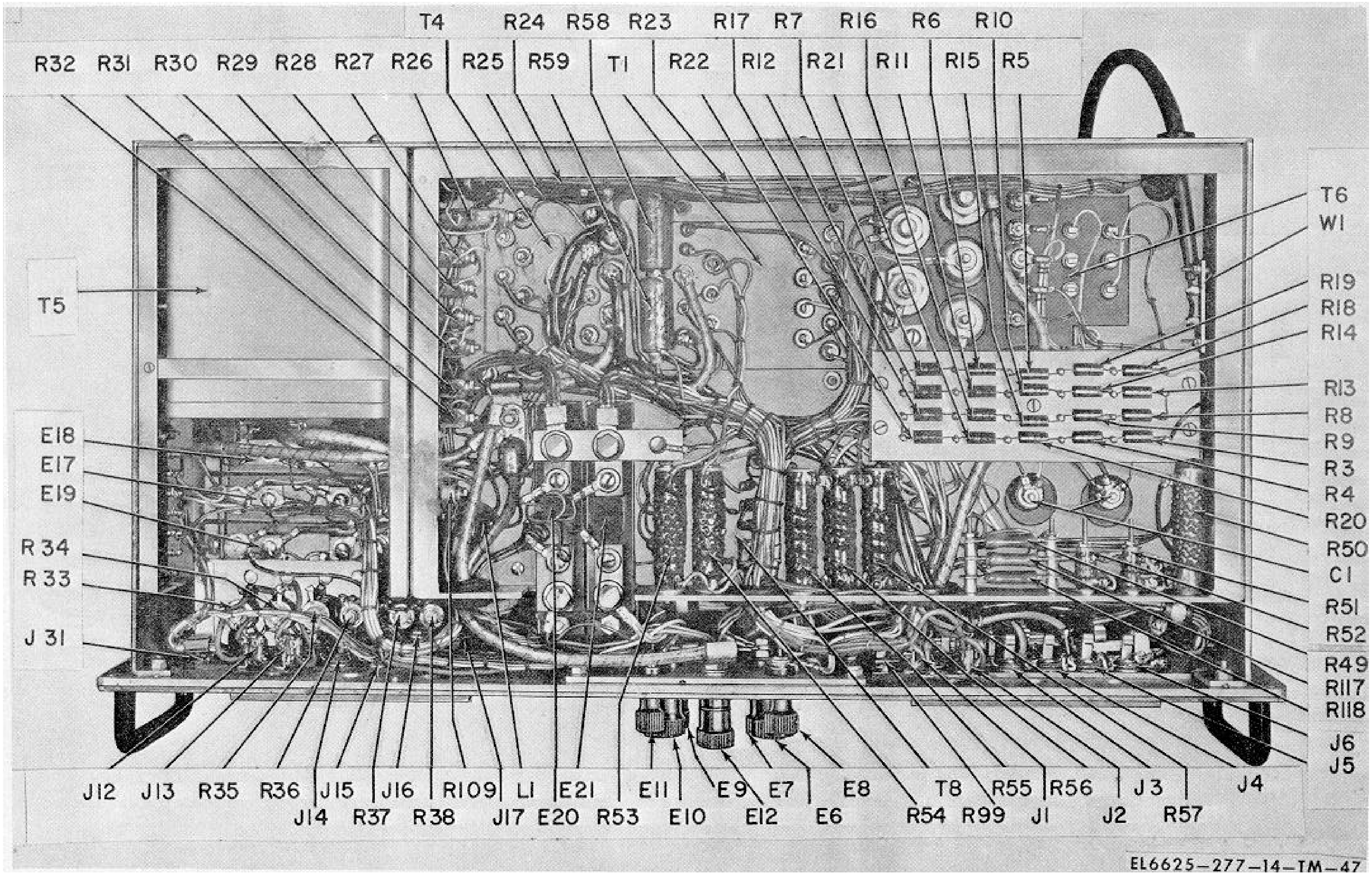
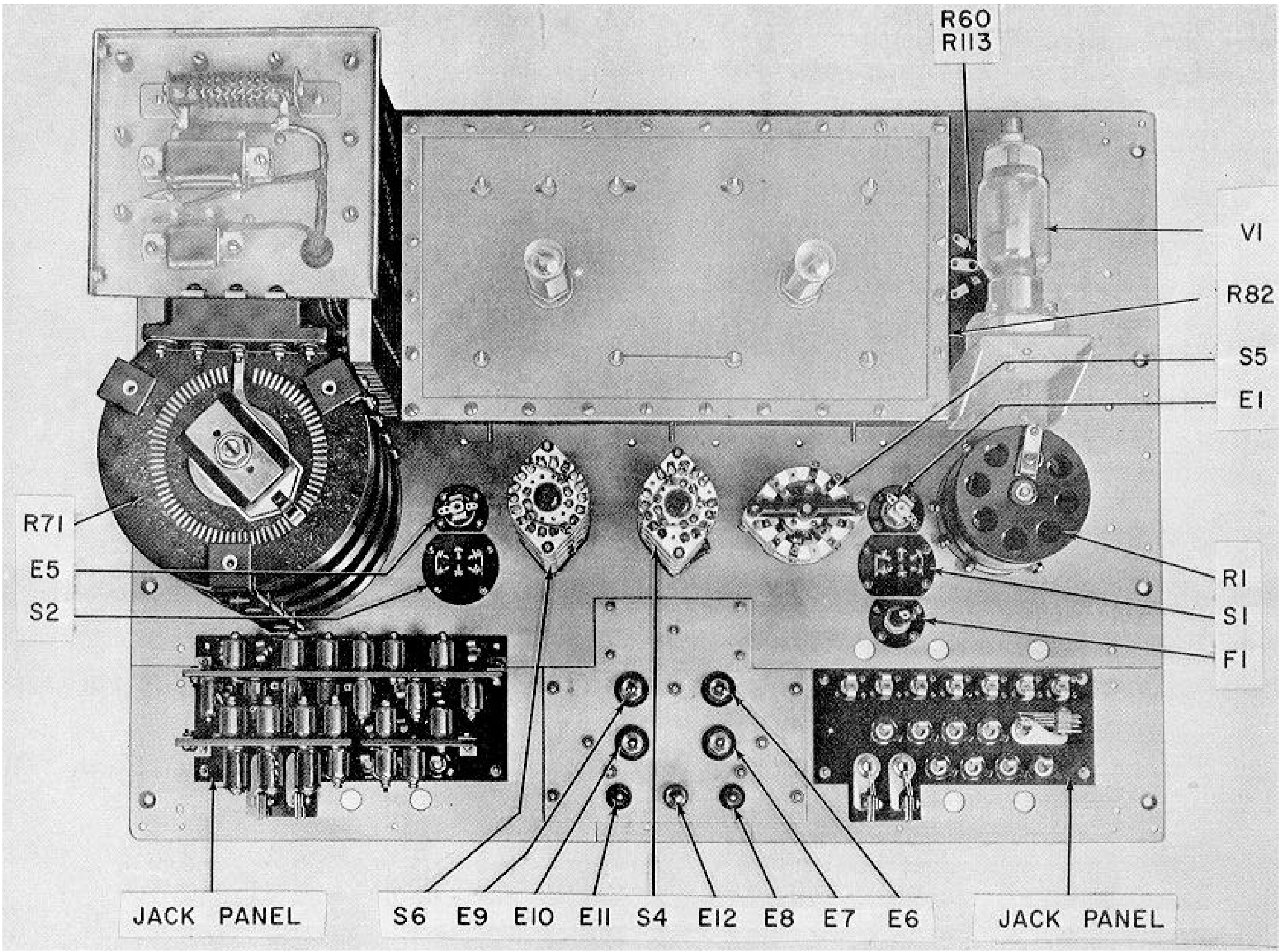
Figure 6-1. Meter Test Set TS-682/GSM-1, rear view, case removed



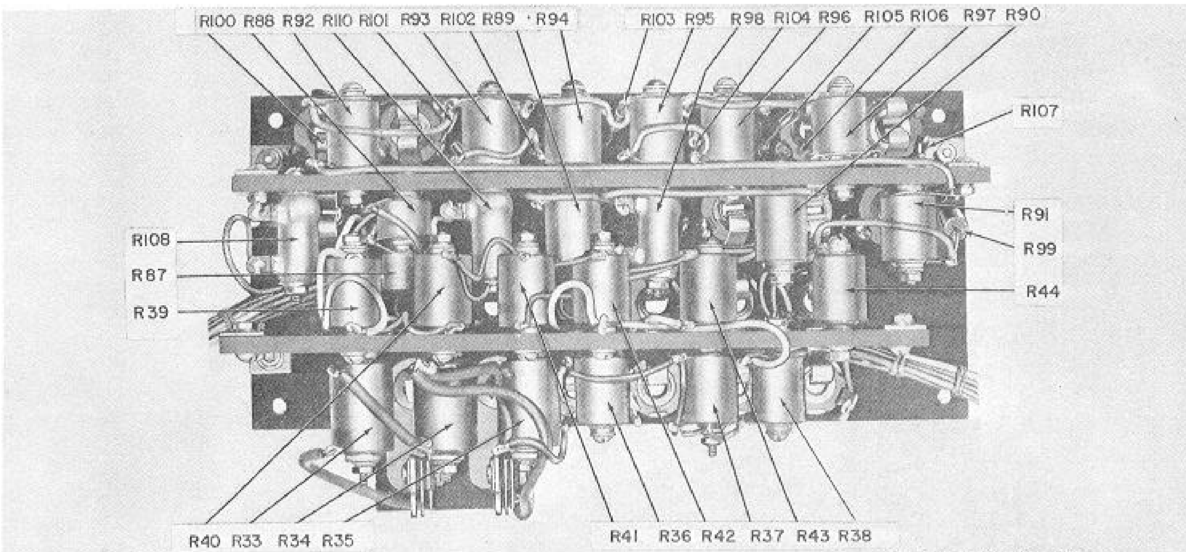
EL6625-277-14-TM-47

Figure 6-2. Meter Test Set TS-682/GSM-1, bottom view, case removed.



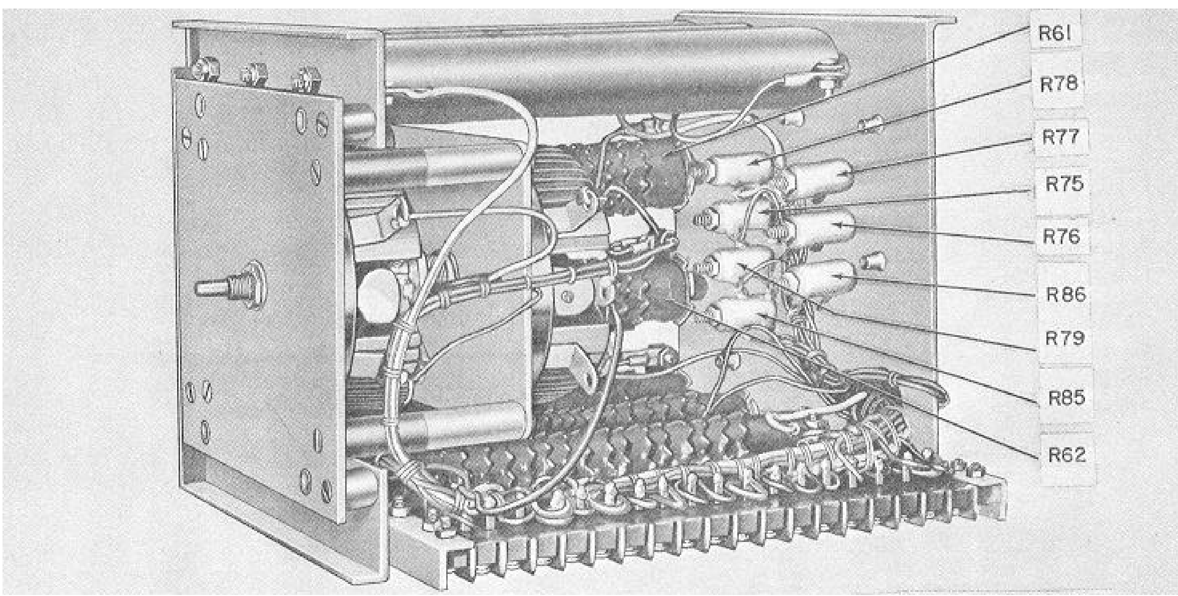
EL6625-277-14-TM-48

Figure 6-3. Meter Test Set TS-682/GSM-1, rear view of front panel.



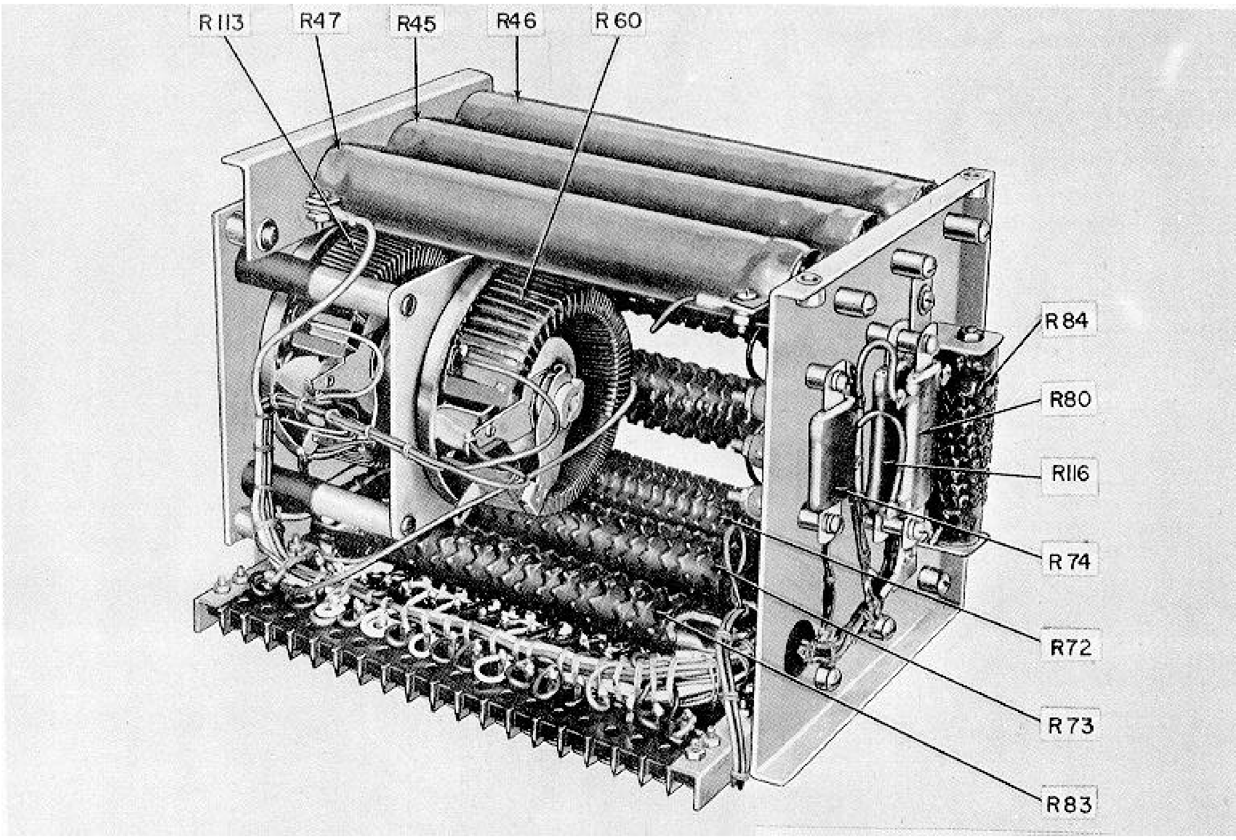
EL6625-277-14-TM-49

Figure 6-4. Meter Test Set TS-682/GSM-1, rear view of dc and voltage jack panel.



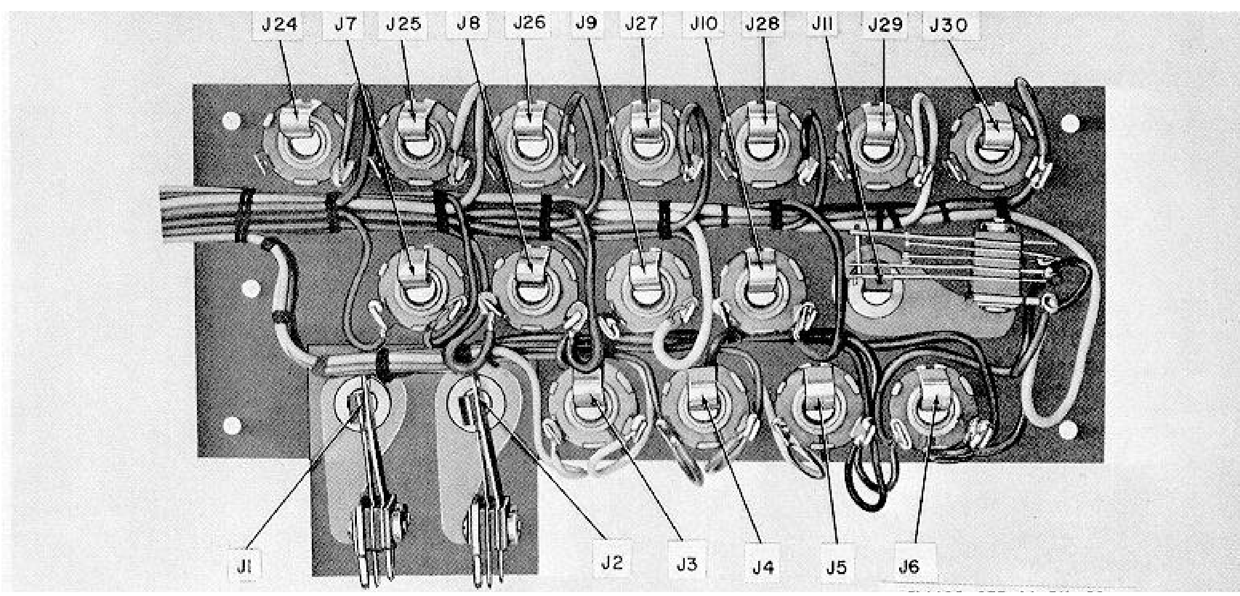
EL6625-277-14-TM-50

Figure 6-5. Meter Test Set TS-682/GSM-1, dc limiting resistors.



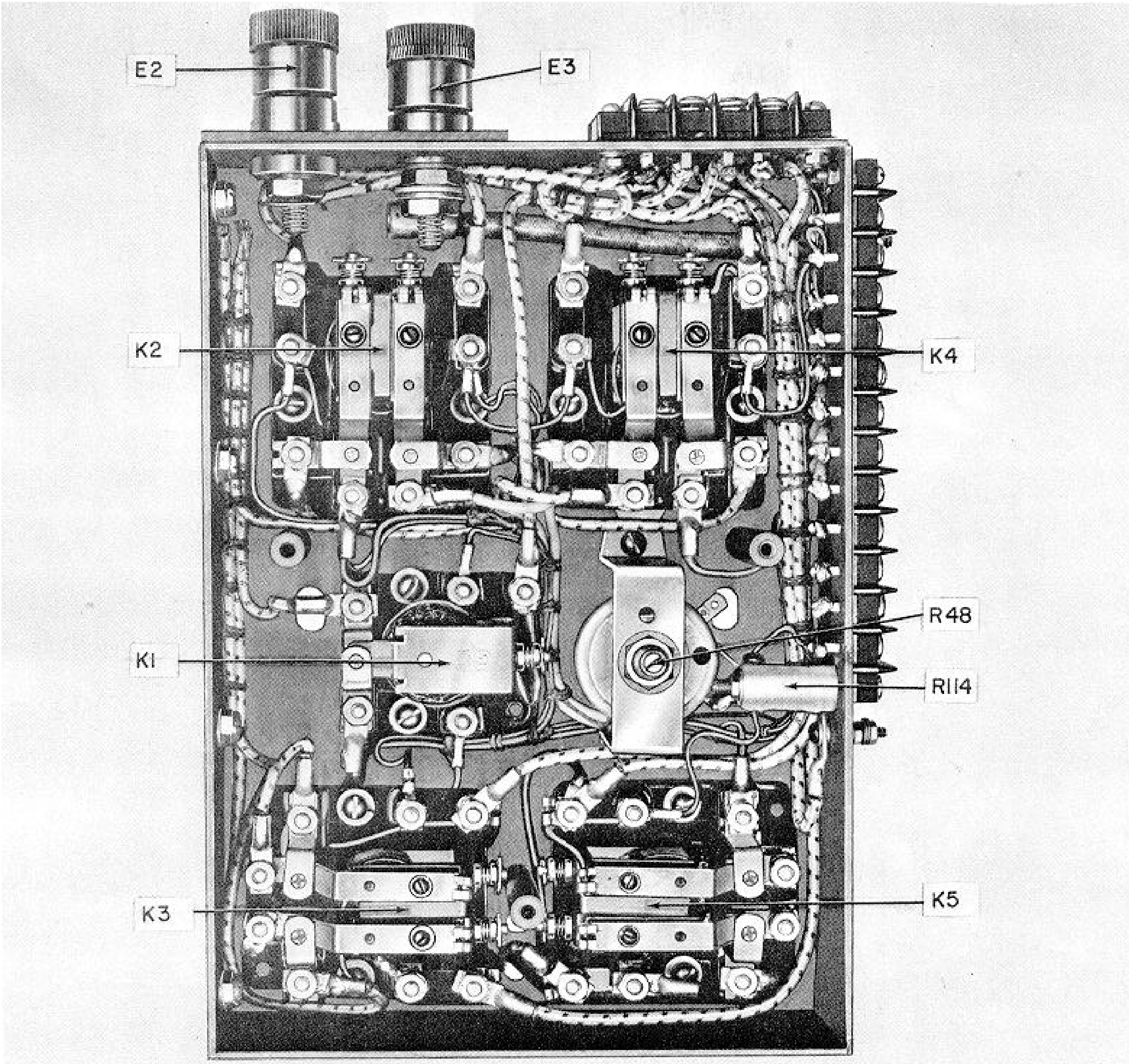
EL6625-277-14-TM-51

Figure 6-6. Meter Test Set TS-682/GSM-1, dc control unit.



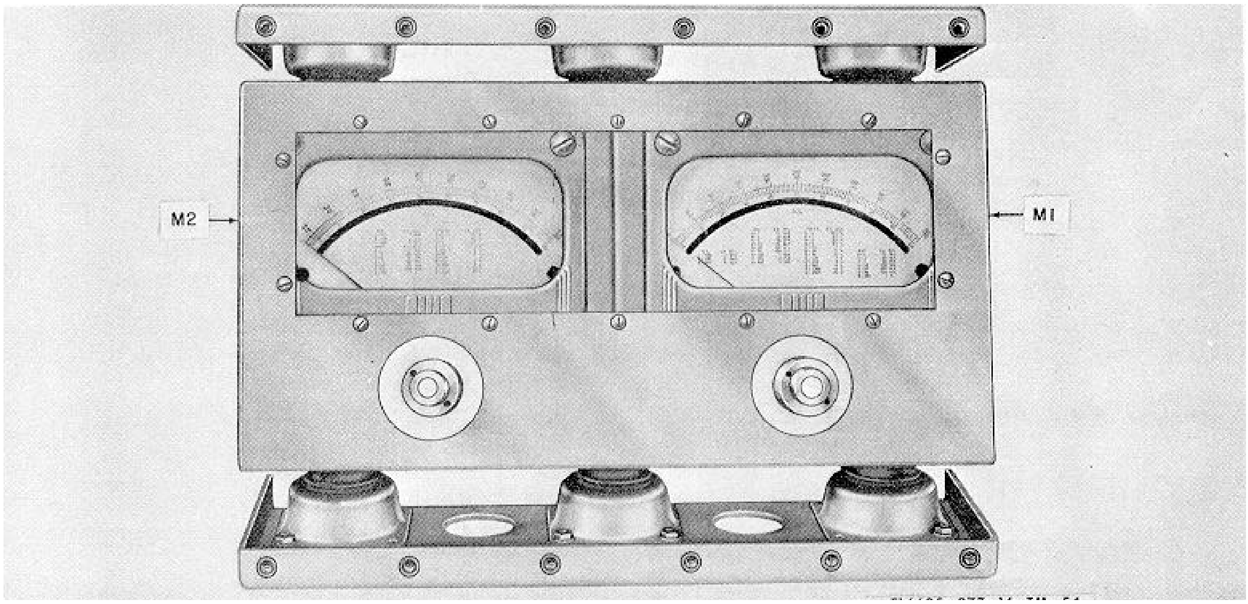
EL6625-277-14-TM-52

Figure 6-7. Meter Test Set TS-682/GSM-1, rear view of ac and voltage jack panel.



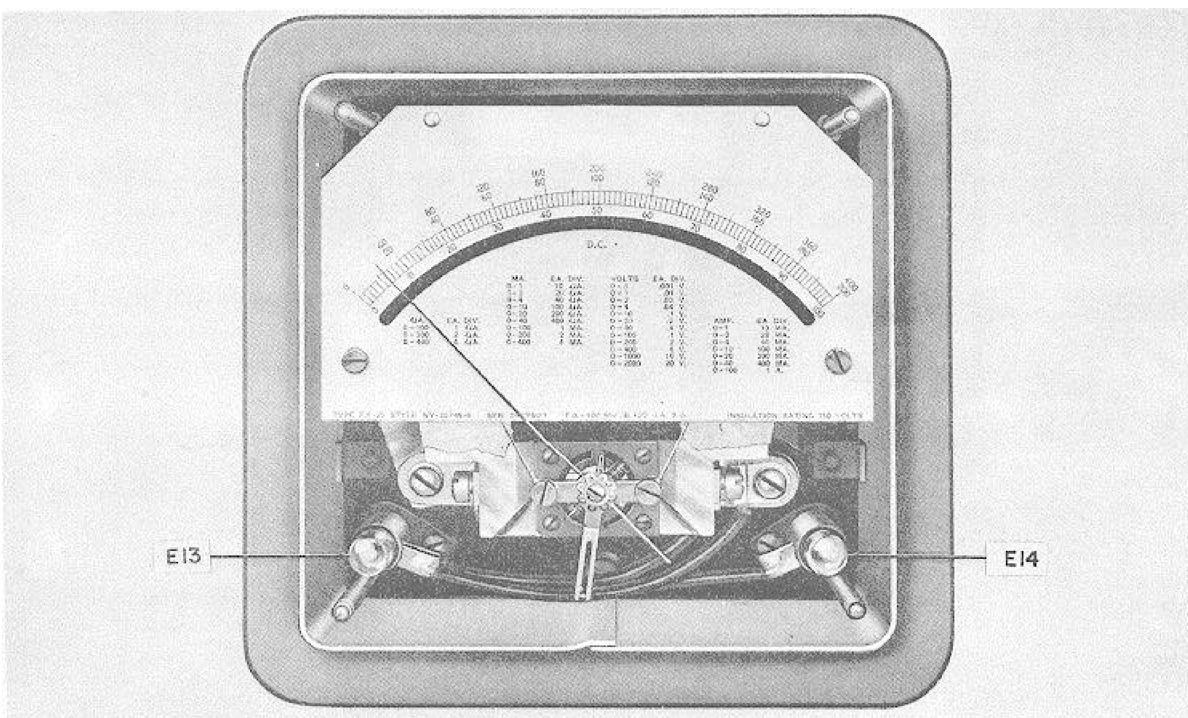
EL6625-277-14-TM-53

Figure 6-8. Meter Test Set TS-682/GSM-1, relay unit.



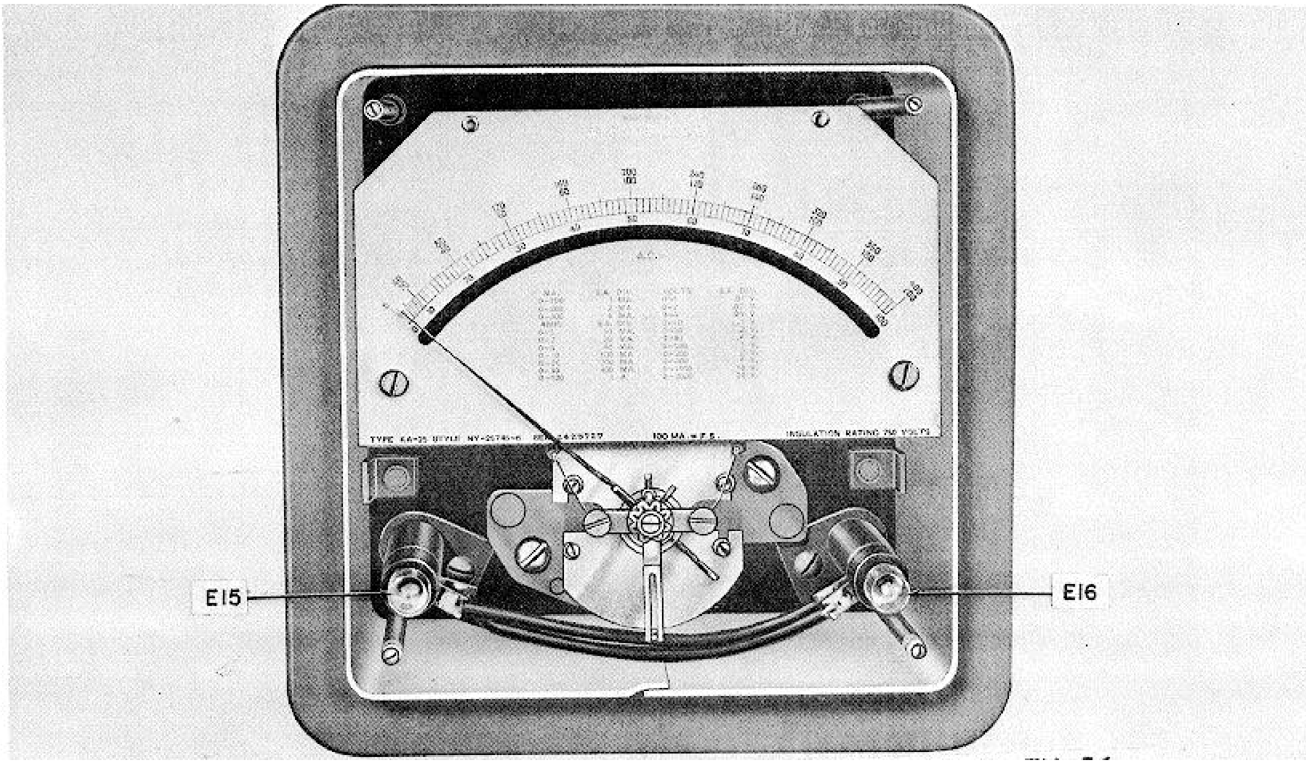
EL6625-277-14-TM-54

Figure 6-9. Meters used in Meter Test Set TS-682/GSM-1.



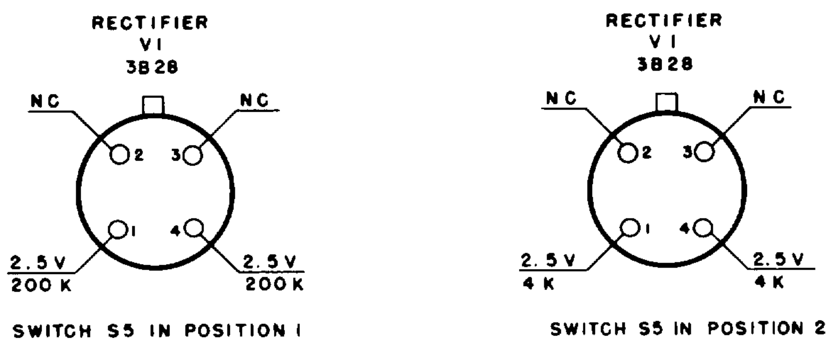
EL6625-277-14-TM-55

Figure 6-10. Meter M1, cover removed.



EL6625-277-14-TM-56

Figure 6-11. Meter M2, cover removed.

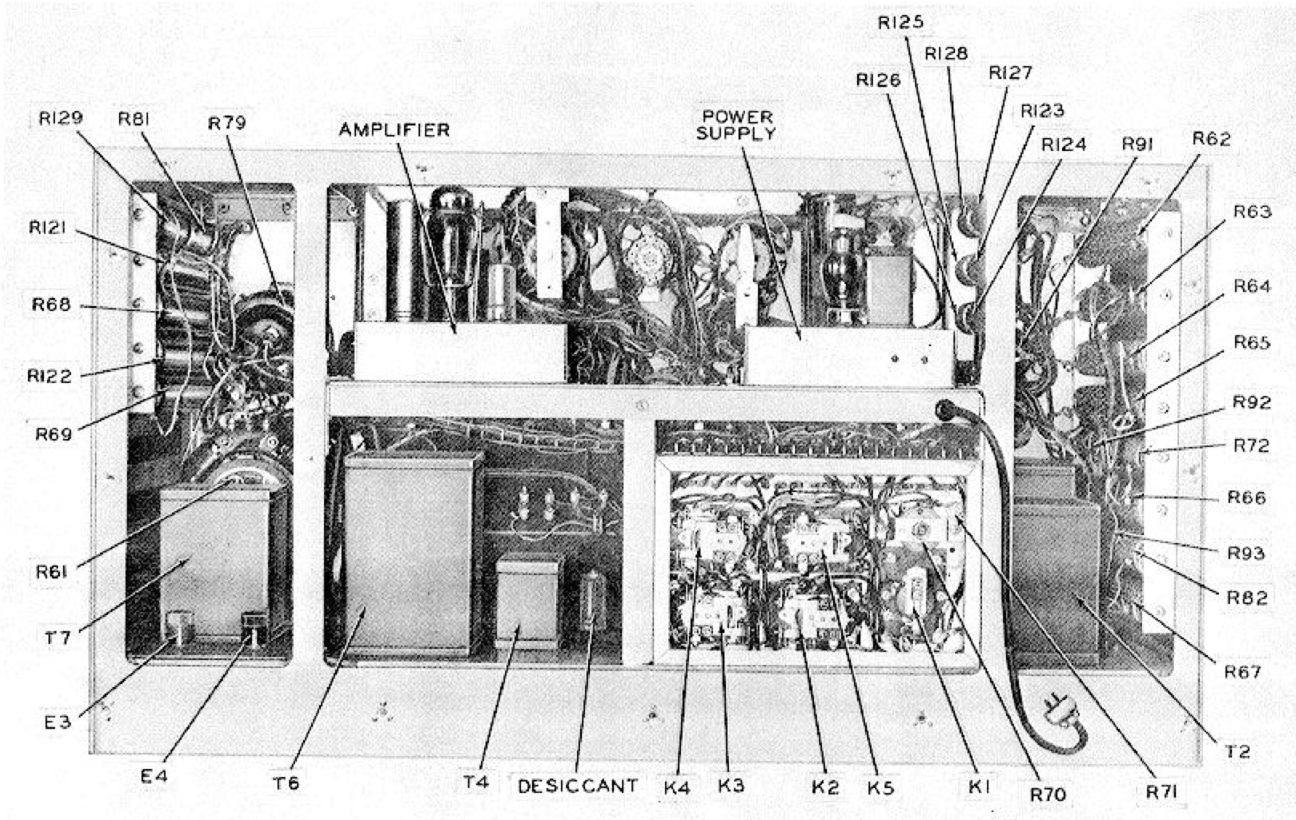


NOTES:

1. VOLTAGE MEASUREMENTS SHOULD ONLY BE TAKEN WITH SWITCH S5 IN POSITION 1.
2. VOLTAGES AND RESISTANCES ARE MEASURED TO GROUND.
3. NC INDICATES NO CONNECTION.
4. ALL RESISTANCE VALUES SHOWN IN OHMS.

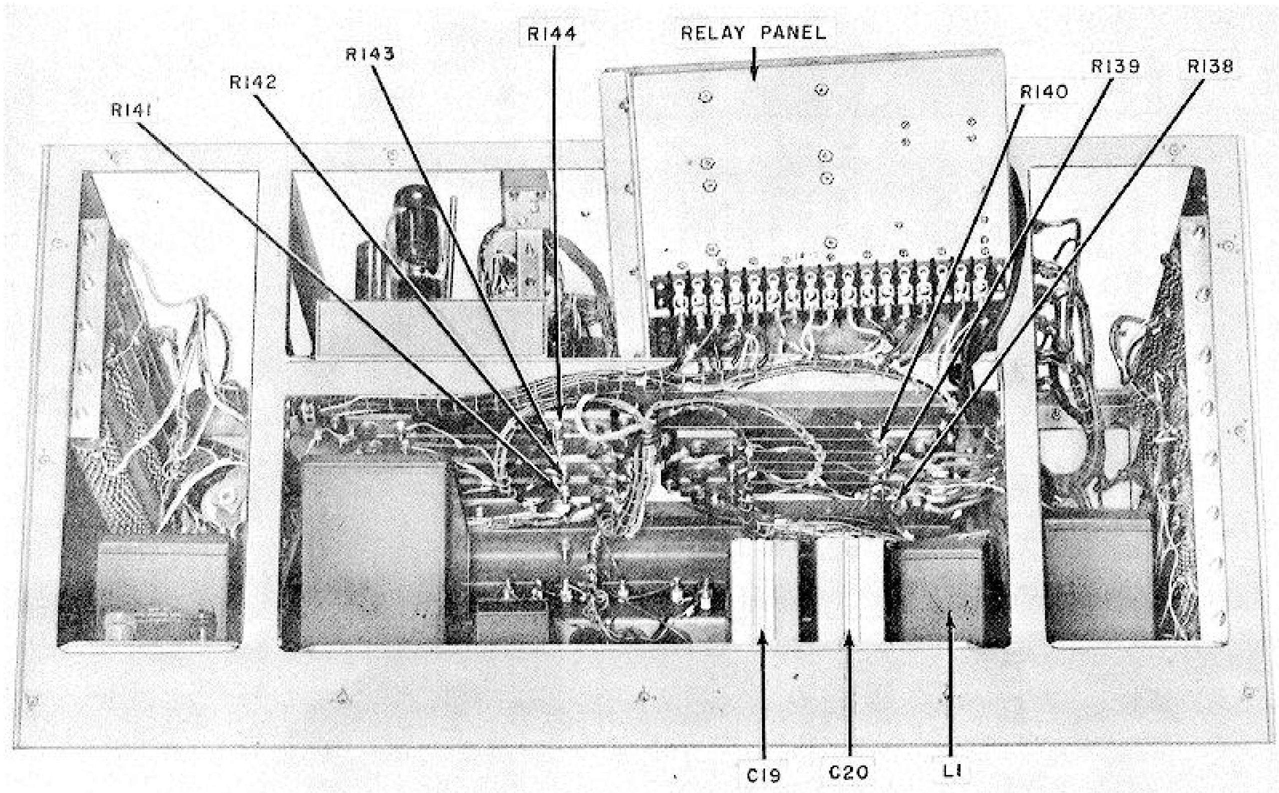
EL6625-277-14-TM-57

Figure 6-12. Meter Test Set TS-682/GSM-1, tube socket resistance diagram.



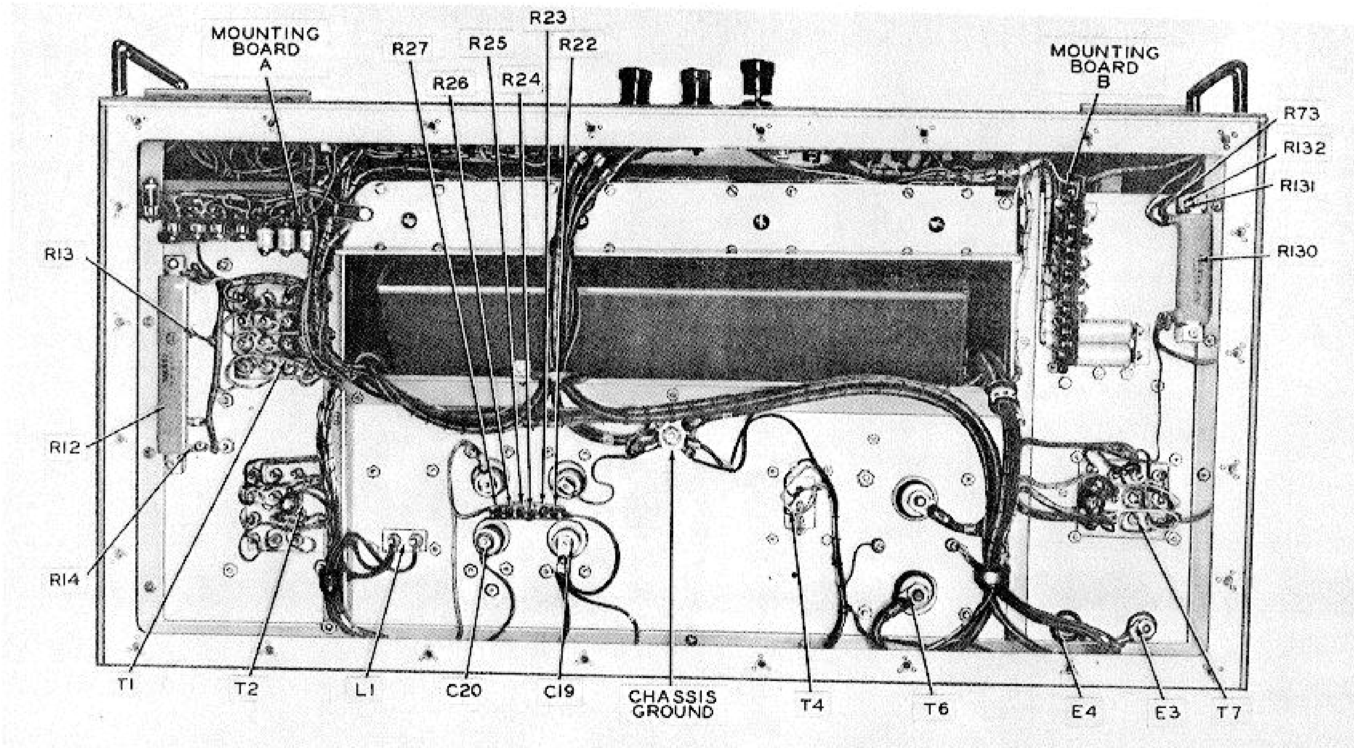
EL6625-277-14-TM-58

Figure 6-13. Meter Test Set TS-682A/GSM-1, rear view, rear panel removed.



EL6625-277-14-TM-59

Figure 6-14. Meter Test Set TS-682A/GSM-1, rear view, relay panel removed.



EL6625-277-14-TM-60

Figure 6-15. Meter Test Set TS-682A/GSM-1, bottom view, bottom plate removed.

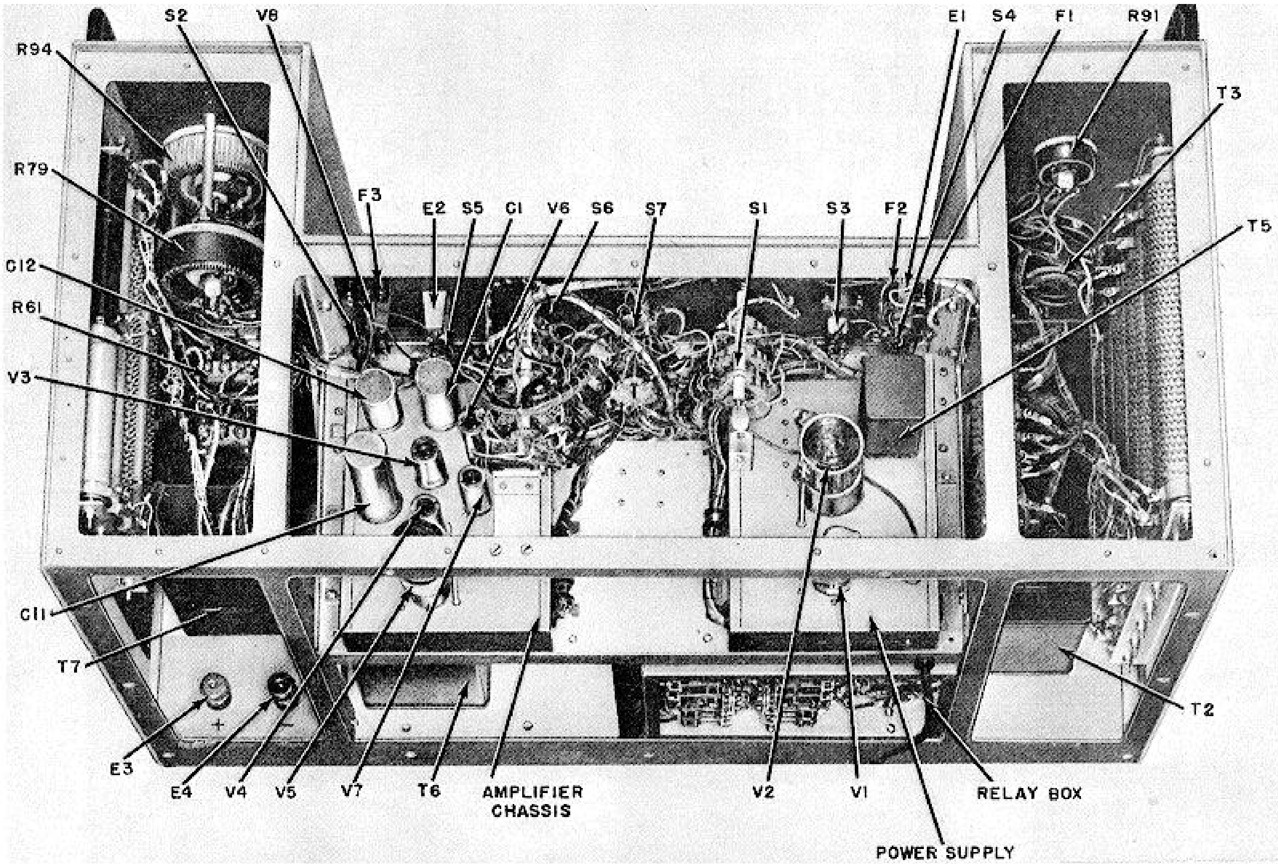


Figure 6-16. Meter Test Set TS-682A/GSM-1, top view, top and rear panels removed.

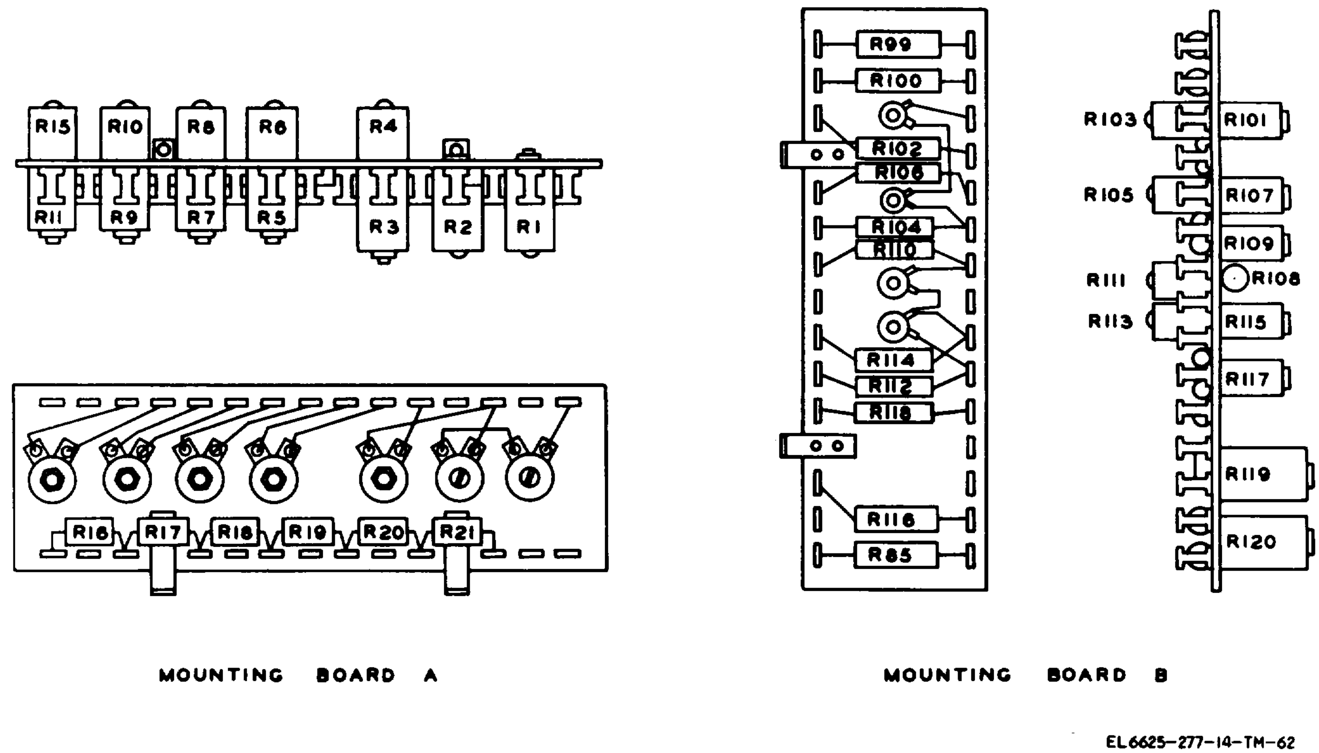


Figure 6-17. Meter Test Set TS-682A/GSM-1, resistor mounting boards.

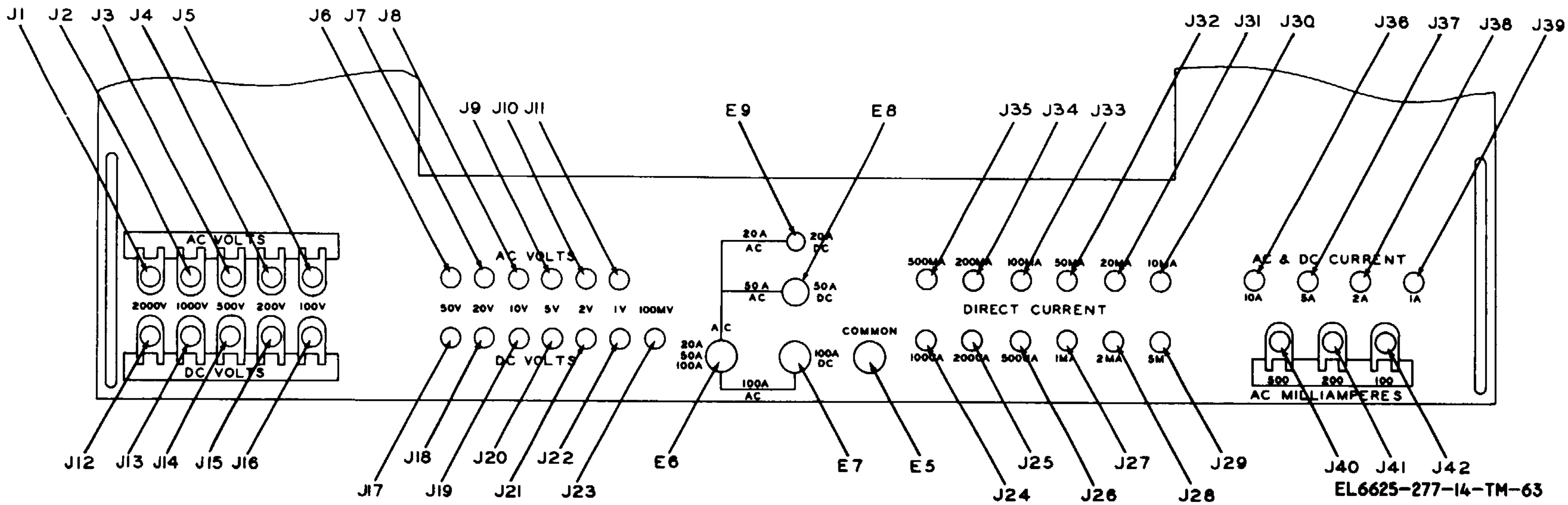


Figure 6-18. Meter Test Set TS-682A/GSM-1, jack and binding post panel.

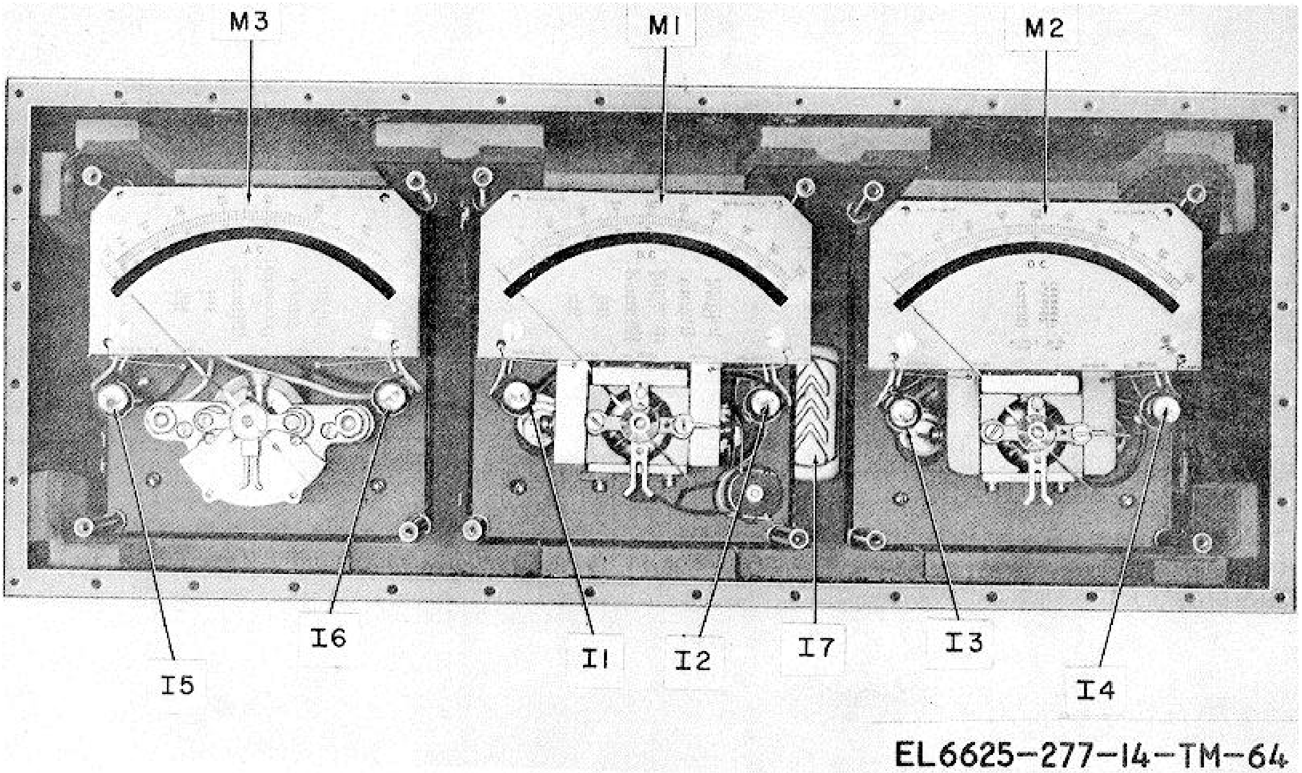


Figure 6-19. Meters used in Meter Test Set TS-682A/GSM-1.

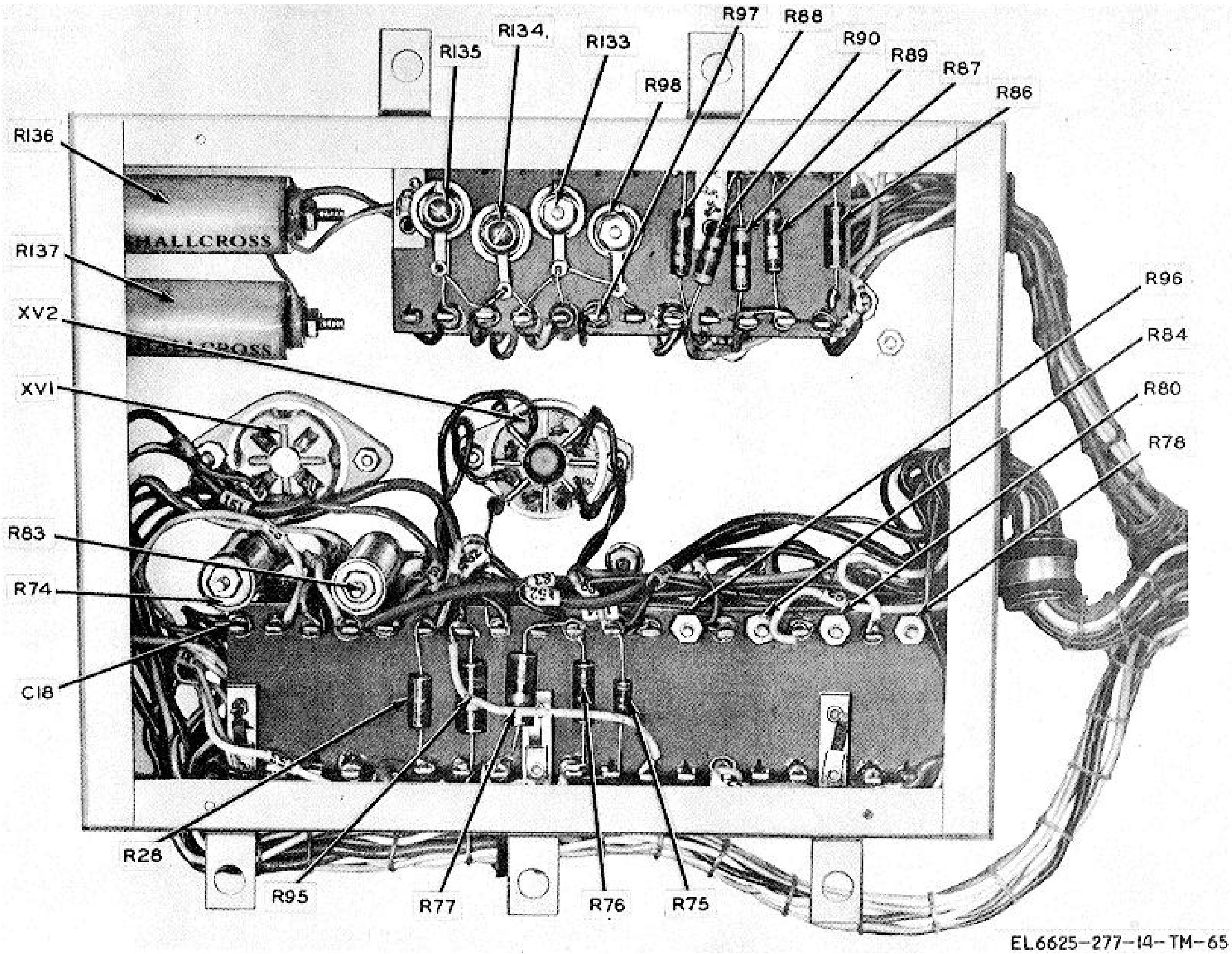


Figure 6-20. Meter Test Set TS-682A/GSM-1, voltage power supply chassis, bottom view.

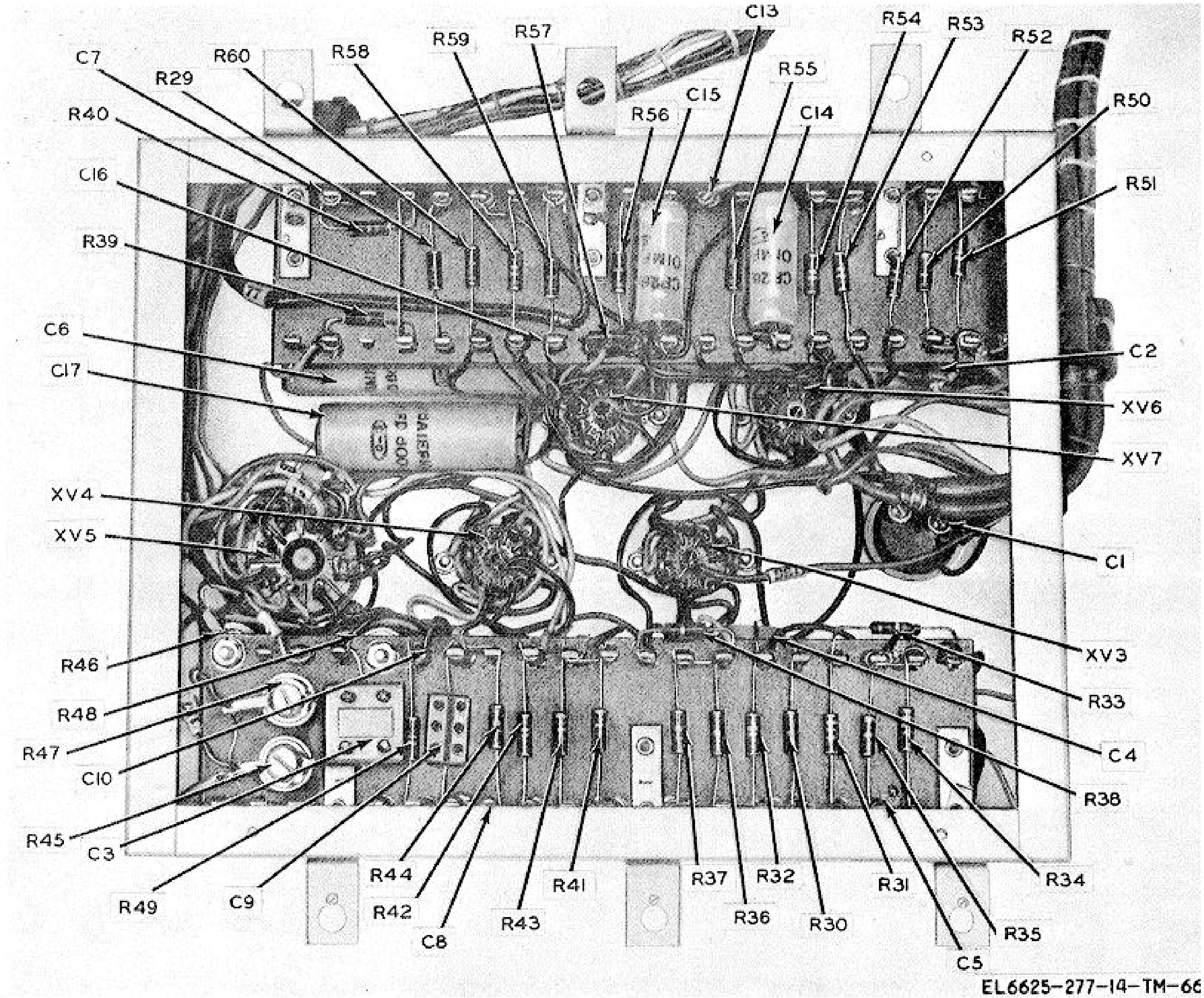
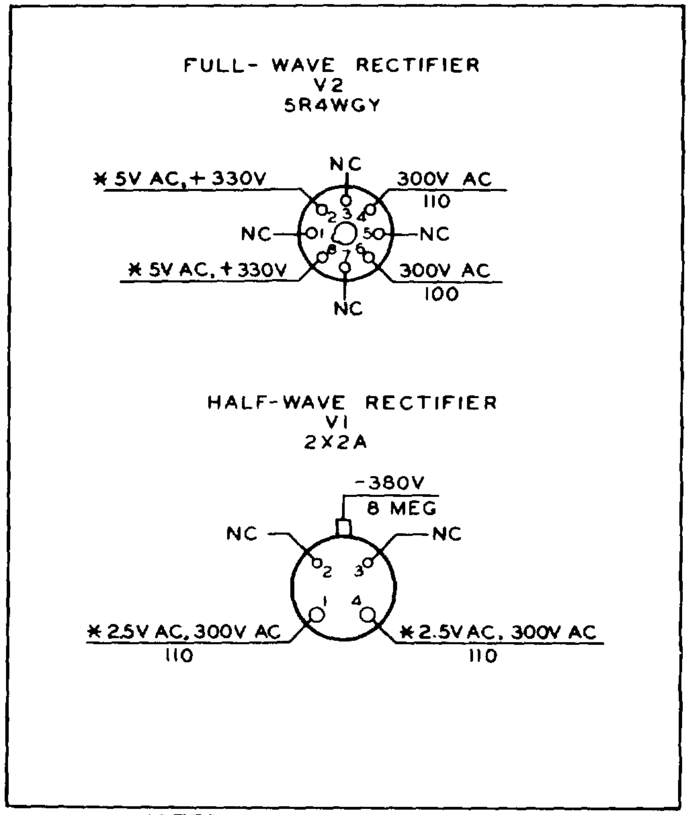


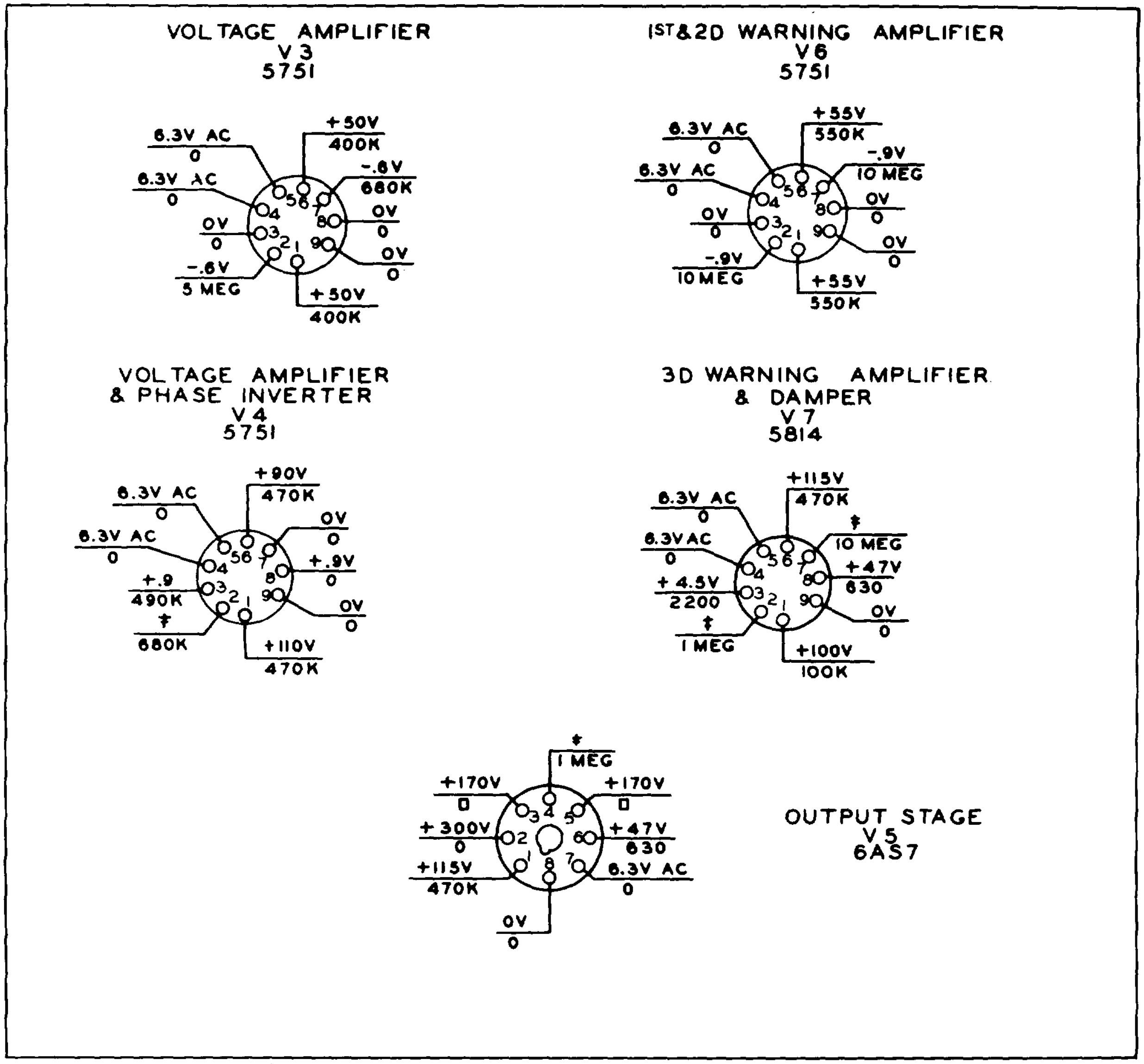
Figure 6-21. Meter Test Set TS-682A/GSM-1, ac meter amplifier chassis, bottom view.



NOTES:
1. 115V INPUT.
2. SWITCH S4 ON FOR VOLTAGE MEASUREMENTS.
3. SWITCH S1 FULLY CLOCKWISE.
4. VOLTAGE & RESISTANCE MEASURED TO GROUND WITH A VTVM.
5. NC INDICATES NO CONNECTION.
6. ✱ INDICATES MEASUREMENTS ACROSS FILAMENTS.
7. VOLTAGE READINGS ABOVE LINE RESISTANCE READINGS BELOW LINE.

EL6625-277-14-TM-67

Figure 6-22. Meter Test Set TS-682A/GSM-1, power supply chassis, tube socket voltage and resistance diagram



NOTES:

1. 115V INPUT.
2. SWITCH S4 ON FOR VOLTAGE MEASUREMENTS.
3. SWITCH S1 FULLY CLOCKWISE.
4. VOLTAGE & RESISTANCE MEASURED TO GROUND WITH A VTVM.
5. NC INDICATES NO CONNECTION.
6. ± INDICATES A SLIGHT POSITIVE OR NEGATIVE VOLTAGE.
7. VOLTAGE READINGS ABOVE LINE RESISTANCE READINGS BELOW LINE.
8. FOR RESISTANCE MEASUREMENTS, GROUND JUNCTION OF R39 & R40 & POSITIVE TERMINAL OF C1.
9. □ INDICATES HIGH VALUE, AFFECTED BY CAPACITORS IN THE CIRCUIT.

EL6625-277-14-TM-68

Figure 6-23. Meter Test Set TS-682A/GSM-1, amplifier chassis, tube socket voltage and resistance diagram.

Section III. MAINTENANCE OF METER TEST SET TS-682(*) GSM-1

6-8. Repairs

a. General. Follow the general procedures below in repair of the meter test set.

(1) For all routine servicing and most troubleshooting and repair, remove only the back and bottom panels of the test set, with the equipment resting on one end.

(2) Many parts in the test set have smaller tolerances than those used in most radio equipment. Always consult the appropriate schematic when replacing parts; be sure to use an exact duplicate of the part removed. If a part with a slightly different value is used, the calibration of the test set will be inaccurate.

(3) Never change the location of parts or wiring leads. Never substitute a longer lead, a lead of different material, or a lead of different gage.

(4) If it is necessary to disconnect a number of leads to replace a defective part, tag each lead so that it will be placed on the proper terminal when the equipment is reassembled.

(5) Always use the correct tools when disassembling any part of the equipment.

b. Replacement of Parts. Following the general procedures below for parts replacement. The components of the meter test set readily accessible.

(1) The transformers, reactors, and resistors are mounted securely to the chassis with hexagonal nuts and machine screws.

(2) If any of the switch wafers require replacement, carefully mark the wires connected to the wafer with tags to avoid misconnection when the new switch is installed.

(3) All knobs are secured by a setscrew. The knobs must be put on in the correct position so that they point to the proper index. When removing a knob, make a note of the position of the pointer and shaft and replace the knob in the same position.

6-9. Cleaning and Burnishing Relay Contacts

a. Cleaning Nonpitted Contacts. To clean nonpitted contacts, proceed as follows:

(1) Flush the contacts with trichloroethane. Dip the flat end of a clean toothpick into the trichloroethane to a depth of about one-half inch and deposit the liquid on the contacts without rubbing. Hold normally closed contacts separated during this operation.

(2) Dip the flat end of another toothpick into the trichloroethane and deposit it on the contacts, again without rubbing, to flush away the dirt that was loosened on the first application. Be careful to keep the trichloroethane away from insulators.

(3) When the contacts are thoroughly dry, burnish them so that no deposit or residue from the trichloroethane or other foreign material remaining on the contacts.

b. Burnishing Contacts.

(1) Clean the contact burnishers before using by wiping with a clean, dry cloth. During the burnishing process, wipe frequently with a clean cloth moistened with trichloroethane.

(2) When burnishing normally open contacts, press the contact together by hand to give a slight pressure on the blade of the burnisher. When contacts are normally closed, the tension of the springs usually will furnish sufficient pressure against the burnisher.

(3) Rub the burnisher back and forth against the contacts two or three times. When contacts are pitted, additional strokes of the burnisher may be required. Do not use abrasives other than the burnisher blade.

c. Cleaning Pole and Armature Faces. Relay pole and armature faces, the surfaces of the core and armature which touch each other when the relay operates, must be cleaned if a relay tends to stick during operation. Clean with a contact burnisher and trichloroethane or insert a strip of bond paper between the armature and the core, hold the contacts closed, and withdraw the paper. Repeat this process with clean paper until the paper shows no evidence of dirt.

6-10. Alignment

a. Equipment Required. The only item of test equipment required for alignment is Multimeter TS352B/U or equivalent.

b. Procedure for TS-682/GSM-1. Relay K5 closes when potentials in excess of 6 volts are applied across its coil. Voltage is varied by adjustment of rheostat R48 (fig. 6-8). Make the adjustments outlined in (1) through (4) below:

(1) Connect a multimeter, set to a range of 0 to 10 volts, to the end of the relay coil not connected to R48, and connect the other side of the multimeter to ground.

(2) Place switch S4 in the AC & DC CUR position.

(3) Turn the DIRECT CURRENT COARSE CONTROL clockwise, until multimeter reads 6 volts.

(4) Adjust rheostat R48 so that relay K5 closes when a potential in excess of 6 volts is applied.

c. Procedure for TS-682A/GSM-1. Relay K5 closes when potentials in excess of 7 volts are applied across its coil circuit. The operating voltage is varied by including or excluding resistor R71 as a coarse adjustment and rheostat R70 as a fine adjustment. Make the adjustment outlined in (1) through (6) below.

(1) The two lugs of the terminal strip mounted between relay K5 (fig. 6-13) and rheostat R70 are connected to resistor R71 by two blue leads. A green lead also is tied to one lug of this terminal strip. With the green lead connected to the upper tie point and rheostat R70 fully counterclockwise, connect multimeter between the lower end of the relay coil and the upper tie point on the terminal strip.

(2) Place selector switch S7 in the DC MA & UA position.

(3) Place selector switch S6 in the AC & DC MA & UA position.

(4) Place battery switch S5 in the ON position.

(5) Turn the DIRECT CURRENT COARSE CONTROL clockwise until multimeter reads 7 volts.

(6) Adjust rheostat R70 to the point where relay K5 just closes. If relay K5 does not close with rheostat R70 fully clockwise, move the coarse adjustment (green) lead to the lower tie point and adjust rheostat R70 again. If the adjustment still cannot be made, loosen the spring tension on relay K5 by bending the spring tang.

Section IV. GENERAL SUPPORT TESTING PROCEDURES

6-11. General

a. The following test procedures are prepared for use by general support maintenance personnel to determine the acceptability of repaired equipment. These procedures set forth specific requirements that repaired equipment must meet, before it is returned to the using organization.

b. Follow the instructions preceding each chart before proceeding to the chart. Perform each step in sequence. For each step, perform all the actions in the Control settings columns; then perform each specific procedure and verify it against its performance standard.

6-12. Modification Work Orders

The performance standards listed are based on the assumption that all MWO's have been applied. A listing of current MWO's will be found in DA Pam 310-7.

6-13. Physical Tests and Inspections

a. Test Equipment and Materials. None required.

b. Test Connections and Conditions.

(1) No connections are necessary.

(2) Remove meter test set from case.

c. Procedure. Follow steps as indicated in table 6- 11.

Table 6-11. Physical Tests and Inspections

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	None	Controls may be in any position.	a. Inspect case and chassis for damage, missing parts, and condition of paint. **NOTE** **Touchup painting is recommended instead of refinishing whenever prac-tical; screw heads, binding posts, receptacles, and other plated parts will not be painted or polished with abra-sives.**	a. No damage evident or parts missing. External surfaces intended to be painted will not show bare metal. Panel lettering will be legible.
			b. Inspect all controls and mechanical assemblies for loose or missing screws, bolts and nuts.	b. Screws, bolts, and nuts will be tight. None missing.
			c. Inspect all connectors, sockets, receptacles, holder, and meter for looseness, damage, or missing parts.	c. No loose parts or damage. No missing parts.

Table 6-11. Physical Tests and Inspections-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
2	None	Controls may be in any position.	a. Rotate all panel controls throughout their limits of travel. b. Inspect dial stops for damage or bending, and for proper operation.	a. Controls will rotate freely without binding or ex excessive looseness. b. Stops will operate properly without evidence of damage.

6-14. Direct Current Accuracy Test (20A to 100 uA Range)

a. Test Equipment and Materials.

(1) Multimeter TS-352B/U.

(2) Power Supply PP-1097A/G, or PP-1104A/G, or wet Battery BA-46.

b. *Test Connections*. Connect the power supply or battery to the binding posts inside the door on the rear panel of the meter test set. Make no other connections until instructed to do so in the test procedures.

c. *Procedure.* Follow steps as indicated in table 6-12.

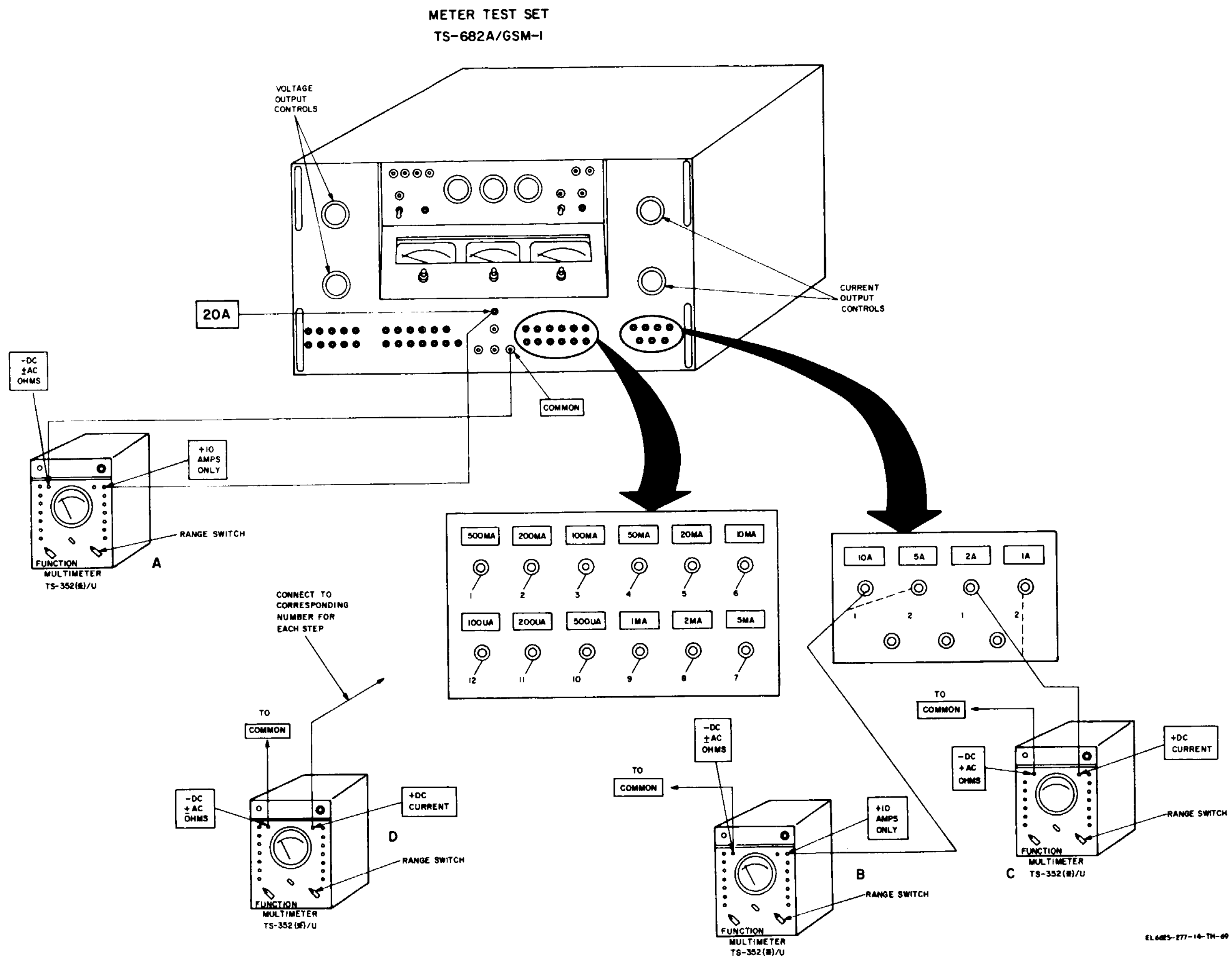


Figure 6-24. Direct current accuracy test setup (20A to 100 uA).

Table 6-12. Direct Current Accuracy Test (20A to 100 uA Range)

Step No.	Control settings — Test equipment	Control settings — Equipment under test	Test procedure	Performance standard
1	*TS-352B/U* FUNCTION switch: DC CURRENT. Range switch: 10 AMP.	**NOTE** **For TS-682/GSM-1, use corresponding control settings shown in parentheses**. AC LINE switch: OFF. BATTERY switch: OFF. Output controls: Maximum counterclockwise. Right-hand selector switch: 20A. Center selector switch: DC AMPERES. (AC & DC CUR.) Left-hand selector switch: ALL OTHER AC AND DC SCALE (May be in any position.)	a. Connect the equipment as shown in figure 6-24A. b. Place the BATTERY switch in the ON position. c. Adjust the current output controls on the meter test set until the multimeter indicates 10 amp on the dc scale. d. Press the BUZZER switch on the meter test set for approximately 2 seconds; note the indication on the center meter (right-hand meter on TS-682/GSM-1) of the meter test set. **NOTE** **TS-682/GSM-1 does not have a buzzer. Tap the face of the meter with the fingers to overcome friction of the meter movement.**	a. None. b. None. c. None. d. Indication on the meter test set should be 10 ± .03 amp.
2	Same as step 1.	Right-hand selector switch: 10A.	a. Connect the equipment as shown in figure 6-24 B1 (10A jack). b. Repeat procedures c and d of step 1, for a 5 amp reading on dc scale.	a. None b. Indication on the meter test set should be 5 ± 0.15 amp.
3	Same as step 1.	Right-hand selector switch: 5A(4A).	a. Connect the equipment as shown in figure 6-24 B2 (5A jack). b. Repeat procedures c and d of step 1, for a 2.5 amp reading on dc scale.	a. None b. Indication on meter test set should be 2.5 ± 0.075 amp.
4	TS-352B/U Range switch: 2.5 amp.	Right-hand selector switch: 2A(2A-1A).	a. Connect the equipment as shown in figure 6-24 C1. (2A jack). b. Repeat test procedures c and d of step 1 for a 1 amp reading on dc.	a. None b. Indication on meter test set should be 1 ± 0.03 amp.
5	TS-352B/U Range switch: 500 MA.	Right-hand selector switch: 1A(2A-1A).	a. Connect the equipment as shown in figure 6-24 C2 (1A jack). b. Repeat test procedures c and d of step 1 for a 500 MA reading on dc scale.	a. None b. Indication on meter test set should be 500 ± 15 mA.
6	TS-352B/U Set range switch to positions indicated below. *Range Switch* 500 MA 100 MA 50 MA 50 MA 10 MA 10 MA 2.5 MA 2.5 MA 2.5 MA 250 Micro A 250 Micro A 250 Micro A	Right-hand selector switch: AC AND DC MA AND A (100 uA to 400 MA). Center selector switch: DC MA and uA. :AC & DC CUR).	a. Connect the equipment as shown in figure 6-24 D for the steps listed below and repeat test procedures c and d of step 1 for the current readings listed below. *Step Current Readings* D1 250 MA D2 100 MA D3 50 MA D4 25 MA D5 10 MA D6 5 MA D7 2.5 MA D8 1 MA D9 500 UA D10 250 UA D11 100 UA D12 50 UA	a. None b. Indication on meter test set should be as listed below: 250 ± 7.5 MA 100 ± 3 MA 50 ± 1.5 MA 25 ± .75MA 10 ±.3 MA 5 ± 15 MA 2.5 ± .07 MA 1 ± .03 MA 500 ± 15 UA 250 ± 7.5 UA 100 ± 3 UA 50 ± 1.5 UA

6-15. Dc Voltage Accuracy Test

a. Test Equipment and Material. Multimeter TS-352B/U.

b. Test Connections and Conditions. Connect a test lead between the common terminal post on the meter test set (fig. 6-25) and the -DC + AC jack on the multimeter. Do not make any other connection until instructed to do so in the test procedure.

NOTE

Jack panel markings on the TS-682A/GSM-1 of 5V and 500V correspond to the jack markings on the TS-682/GSM-1 of 4V and 400V.

c. Procedure. Follow steps as indicated in table 6-13.

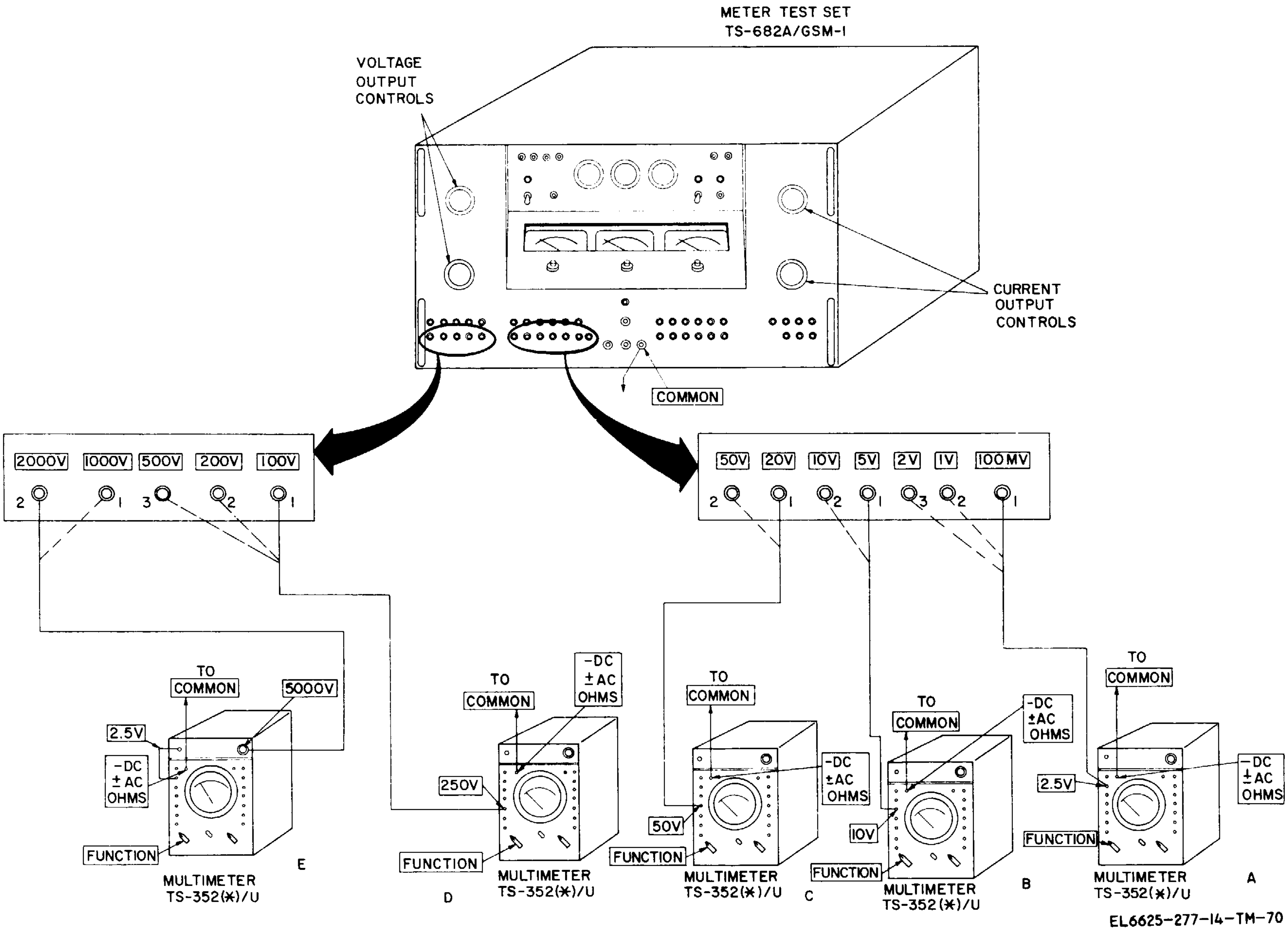


Figure 6-25. Dc voltage accuracy test setup.

Table 6-13. Dc Voltage Accuracy Test

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*TS-352B/U* Function switch 20000 Ω/VDC.	**NOTE** **For TS-682/GSM-1, use the corresponding control settings shown in parentheses.** AC LINE switch: OFF. BATTERY switch: OFF. Output controls: maximum counterclockwise. Right-hand selector switch: AC AND DC (may be in any position). Center selector switch: DC VOLTS AND MA. (ACV-DCV). Left-hand selector switch: .1 TO 500V. (100 MV DC TO 400 VDC).	a. Connect the equipment as shown in figure 6-25 A1 (100 MV jack). b. Operate the AC LINE switch on the meter test set to ON. c. Adjust the voltage output controls on the meter test set until the multimeter indicates 50 millivolts on the dc scale. d. Press the BUZZER switch on the meter test set for approximately 2 seconds; note the indication on center meter (right-hand meter if TS-682/GSM-1 is used) of the meter test set. **NOTE** **TS-682/GSM-1 does not have a buzzer. Tap the face of the meter lightly with the fingers to over-come friction of the meter movement.** e. Operate the voltage output controls maximum counterclockwise.	a. None b. None. c. None. d. Indication on the meter test set should be 50 ± 1.5 millivolts. e. None
2	Same as step 1.	Same as step 1.	Repeat test procedures c, d, and e of step 1, for each of the following equipment connections (fig. 6-25): a. Figure A2 (multimeter indicates 0.5 volt) b. Figure A3 (multimeter indicates 1 volt) c. Figure B1 (multimeter indicates 2.5 volts) d. Figure B2 (multimeter indicates 5 volts) e. Figure C1 (multimeter indicates 10 volts) f. Figure C2 (multimeter indicates 25 volts) g. Figure D1 (multimeter indicates 50 volts) h. Figure D2 (multimeter indicates 100 volts) i. Figure D3 (multimeter indicates 250 volts)	Indication on the meter test set should be: a 0.5 ± 0.15 volt b. 1 ± 0.03 volt c. 2.5 ± 0.075 volt d. 5 ± 0.15 volt e. 10 ± 0.3 volt f. 25 ± 0.75 volt g. 50 ± 1.5 volts h. 100 ± 3 volts i. 250 ± 7.5 volts
3	Same as step 1.	Left-hand selector switch: 1000 VDC.	a Connect the equipment as shown in figure 6-25E1 (1000V jack). b. Repeat test procedures c, d, and e of step 1. (multimeter indicates 500 volts).	a. None b. Indication on the meter test set should be 500 ± 15 volts.
4	Same as step 1.	Left-hand selector switch: 2000 VDC.	a. Connect the equipment as shown in figure 6-25 E2. (2000V jack). b. Repeat test procedures c, d, and e of step 1(multimeter indicates 1000 volts)	a. None b. Indication on the meter test set should be 1,000 ± 30 volts.

6-16. Ac Voltage Accuracy Test

a. Test Equipment and Material. Multimeter TS-352B/U.

b. Test Connections and Conditions. Make no connections until instructed to do so in the test procedure.

c. Procedure. Follow steps as indicated in table 6-14.

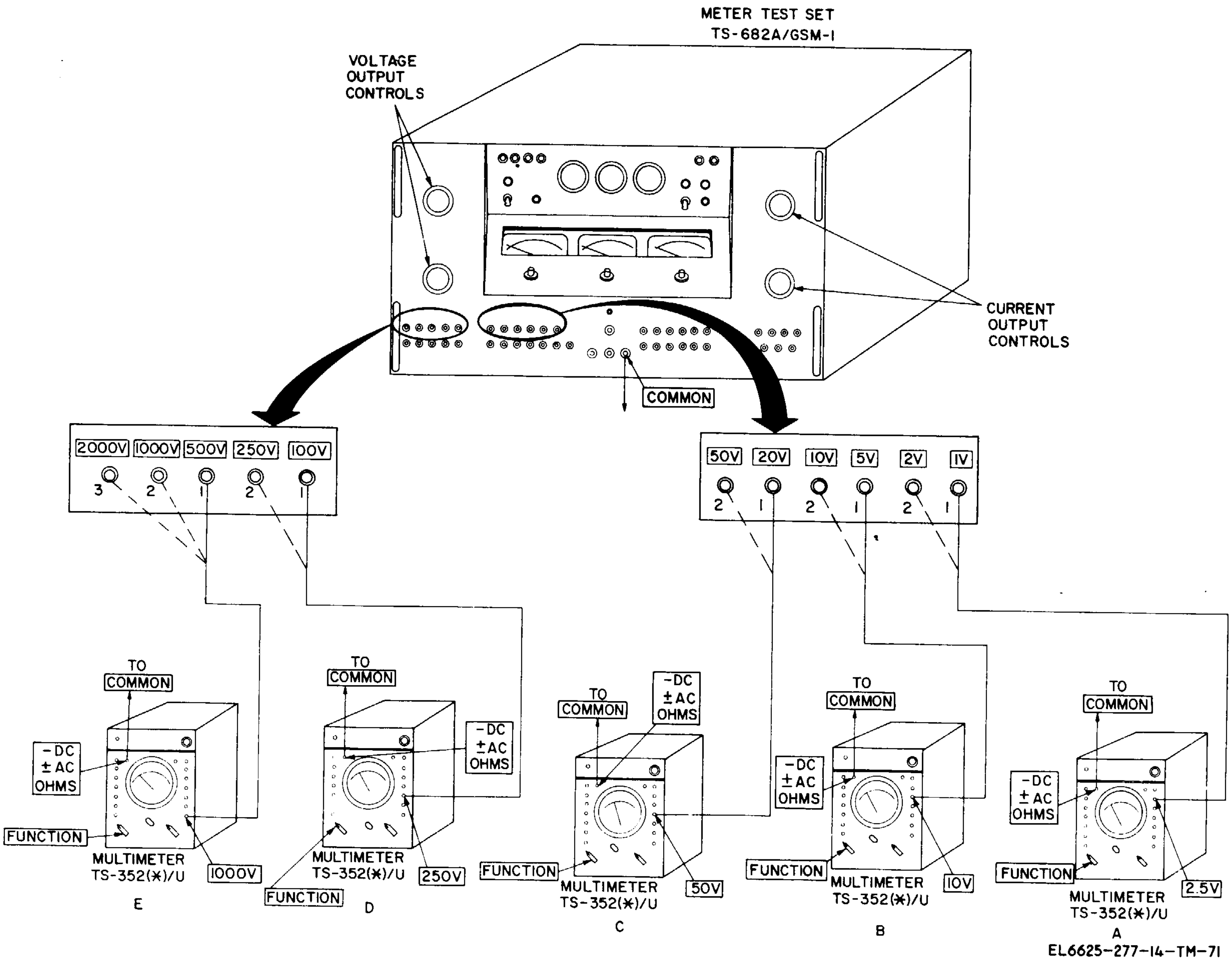


Figure 6-26. Ac voltage accuracy test setup.

Table 6-14. Ac Voltage Accuracy Test

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*TS-353B/U* Function switch: AC Volts	**NOTE** **For TS-682/GSM-1, use use corresponding settings shown in parentheses.** AC LINE switch: ON. Output controls: maximum counterclockwise. Right-hand selector switch: AC AND DC VOLTS. (May be in any position.) Center selector switch: AC VOLTS. (ACV-DCV). Left-hand selector switch: ALL OTHER AC AND DC SCALES (ACV).	a. Connect the equipment as shown in figure 6-26 A1 (1V jack). b. Adjust the voltage output on the control meter test set until the multimeter indicates 0.5 volt on the ac scale. c. Note the indication on the left-hand meter of the meter test set.	a. None b. None. c. Indication on the meter test set should be 0.5 ± 0.02 volt.
2	Same as step 1.	Same as step 1.	Repeat test procedures b and c of step 1 for the following equipment connections: a. Figure A2 (multimeter indicates 1 volt) b. Figure B1 (multimeter indicates 2.5 volts) c. Figure B2 (multimeter indicates 5 volts) d. Figure C1 (multimeter indicates 10 volts) e. Figure C2 (multimeter indicates 25 volts) f. Figure D1 (multmeter indicates 50 volts) g. Figure D2 (multimeter indicates 100 volts) **WARNING** **HIGH VOLTAGE! Turn the voltage output controls on the meter test set fully counterclockwise before making any changes to the connections.** h. Figure E1 (multimeter indicates 250 volts) i. Figure E2 (multimeter indicates 500 volts) j. Figure E3 (multimeter indicates 1000 volts)	Indication on the meter test set should be: a. 1 ± 0.04 volt b. 2.5 ± 0.1 volt c. 5± 0.2 volt d. 10 ± 0.4 volt e. 25 ± 1 volt f. 50 ± 2 volts g. 100 ± 7 volts h. 250 ± 7.5 volts i. 500 ± 20 volts j. 1000 ± 40 volts

6-17. Alternating Current Accuracy Test

a. Test Equipment and Material.

(1) Multimeter TS-352B/U.

(2) Resistors, 1%, 1W, 1, 10, and 100 ohms.

b. Test Connections and Conditions. Make no connections until instructed to do so in the test procedure.

c. Procedure. Follow the steps as in table 6-15.

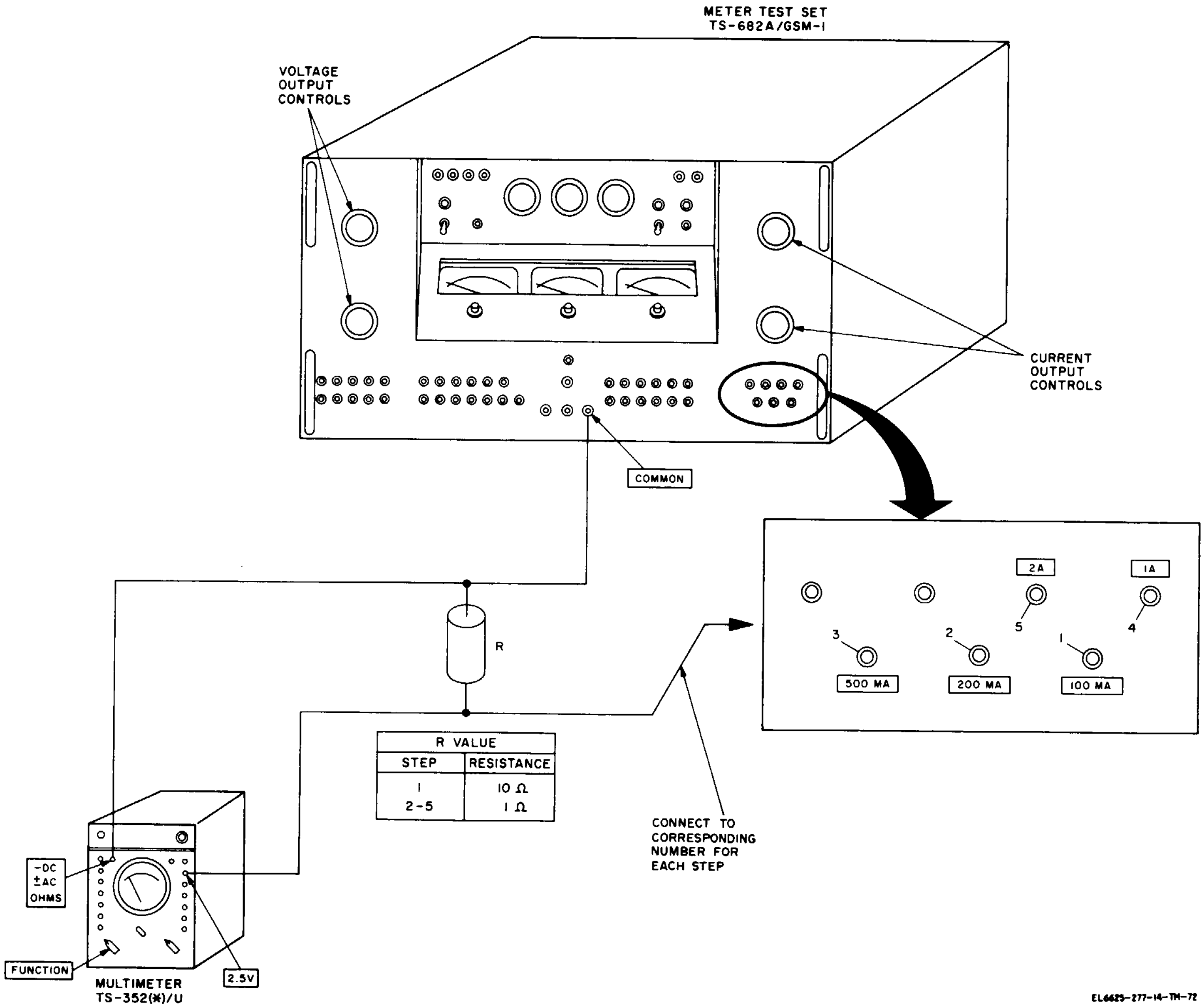


Figure 6-27. Alternating current accuracy test setup.

Table 6-15. Alternating Current Accuracy Test

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*TS-352B/U* FUNCTION: AC VOLTS	**NOTE** **For TS-682/GSM-1, use use corresponding control settings shown in parentheses.** AC LINE switch: OFF BATTERY switch: OFF Output controls: maximum counterclockwise. Right hand selector switch: AC & DC MA & UA (may be in any position) Center selector switch: AC AMPERES AND MA (100) MA AC)	a. Connect the equipment as shown in figure 6-27 (100 MA jack), using 10 ohm resistor across multimeter. b. Operate the AC LINE switch on the meter test set to ON. c. Press the BUZZER switch on the meter test set for approximately 2 seconds. **NOTE** **TS-682/GSM-1 does not have a buzzer. Tap the face of the meter lightly with the fingers to overcome friction of the meter movement.** d. Adjust the alternating current output controls on the meter test set until the meter test set indicates 50 mA ac.	a. None b. None c. None d. Multimeter indicates 0.5± .01 Vac.
2	Same as step 1	Center selector switch: AC AMPERES AND MA (AC & DC CUR)	a. Connect the equipment as shown in figure 6-27 (200 MA jack) and replace 10 ohm resistor with a 1 ohm resistor. b. Adjust the alternating current output controls on the meter test set until the meter test set indicates 100 mA.	a. None b. Multimeter indicates 0.1± .003 Vac.
3	Same as step 1	Same as step 2	Connect the equipment as shown in figure 6-27 (500 MA jack) and adjust the alternating current output controls on the meter test set until the meter test set indicates 250 mA.	Multimeter indicates 0.25 ± .07 Vac.
4	Same as step 1	Same as step 2	Connect the equipment as shown in figure 6-27 (1A jack) and adjust the alternating current output controls on the meter test set until meter test set indicates 500 mA.	Multimeter indicates 0.5± .15 Vac.
5	Same as step 1	Same as step 2	Connect the equipment as shown in figure 6-27 (2A jack) and adjust the alternating current output control on the meter test set until the meter test set indicates 750 mA.	Multimeter indicates 0.75± 0.22 Vac.

APPENDIX A

REFERENCES

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	US Army Equipment Index of Modification Work Orders.
TB 746-10	Field Instructions For: Painting and Preserving Electronics Command Equipment.
TM 11-2019	Test Sets I-49, I-49A, and I-49B and Resistance Bridges ZM-4A/U, and ZM-4B/U. (TO 33A1-12-15-1).
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U.
TM 11-6625-316-12	Operator and Organizational Maintenance Manual: Test Set, Electron Tube TV-2/U, TV-2A/U, TV-2B/U, and TV-2C/U.
TM 11-6625-366-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual; Multimeter TS-352B/U.
TM 38-750	The Army Maintenance Management System (TAMMS)
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use

APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the main- tenance operations for TS-682/GSM-1 and TS-682/GSM-1. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

C-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean, preserve, drain, paint, or to replenish fuel/lubricants/-hydraulic fluids or compressed air supplies.

d. Adjust. Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.

h. Replace. The act of substituting a service-able like-type part, subassembly, model (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfac-ing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component/assembly, end item or system.

j. Overhaul. That periodic maintenance effort (service/action) necessary to restore an item to a com-pletely serviceable/operational condition as prescribed by maintenance standards (e.g., DMWR in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc) considered in classifying Army equipment/components.

C-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "worktime" figures will be shown for each category. The number of man-hours specified by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time and quality assurance/quality control time in additional to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C—Operator/Crew
O—Organizational
F—Direct Support
H—General Support
D—Depot.

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

C4. Tool and Test Equipment Requirements (Table 1)

a*. Tool or Test Equipment Reference Code*. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC.

The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

SECTION II. MAINTENANCE ALLOCATION CHART
FOR
METER TEST SETS TS 682/GSM-1 AND TS-682A/GSM-1

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools and Equipment
			C	O	F	H	D	
00	METER TEST SET TS-682/GSM-1, TS 682A/GSM-1	Inspect		0.5				
		Service		0.5				
		Test				1.0		1, 3, 4, 6
		Adjust				0.5		
		Repair				1.0		1, 3, 4, 6
		Rebuild					2.0	1, 2, 4, 5, 6

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
METER TEST SETS TS-682/GSM-1 AND TS-68A/GSM-1

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H, D	MULTIMETER TS-352B/U	6615-00-553-0142	
2	D	TEST SET, ELECTRON TUBE TV-2/U	6625-00-699-0263	
3	H	TEST SET, ELECTRON TUBE TV-7/U	625-00-820-0064	
4	H, D	RESISTANCE BRIDGE ZM-4B/U	6625-00-500-0937	
5	D	ELECTRONIC STANDARDS SET	AVAILABLE AT DEPOT	
6	H, D	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-00-605-0070	

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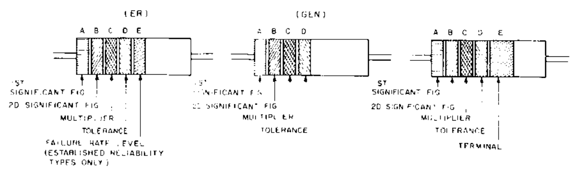


TABLE I
COLOR CODE FOR COMPOSITION TYPE AND FILM TYPE RESISTORS

BAND A		BAND B		BAND C		BAND D		BAND E		
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)	COLOR	FAILURE RATE LEVEL	TERM.
BLACK	0	BLACK	0	BLACK	1			BROWN	M=1.0	
BROWN	1	BROWN	1	BROWN	10			RED	P=0.1	
RED	2	RED	2	RED	100			ORANGE	R=0.01	
ORANGE	3	ORANGE	3	ORANGE	1,000			YELLOW	S=0.001	
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	±10 (COMP. TYPE ONLY)	WHITE		SOLDERABLE
GREEN	5	GREEN	5	GREEN	100,000	GOLD	±5			
BLUE	6	BLUE	6	BLUE	1,000,000	RED	±2 (NOT APPLICABLE TO ESTABLISHED RELIABILITY).			
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7							
GRAY	8	GRAY	8	SILVER	0.01					
WHITE	9	WHITE	9	GOLD	0.1					

BAND A — THE FIRST SIGNIFICANT FIGURE OF THE RESISTANCE VALUE (BANDS A THRU D SHALL BE OF EQUAL WIDTH)
BAND B — THE SECOND SIGNIFICANT FIGURE OF THE RESISTANCE VALUE
BAND C — THE MULTIPLIER (THE MULTIPLIER IS THE FACTOR BY WHICH THE TWO SIGNIFICANT FIGURES ARE MULTIPLIED TO YIELD THE NOMINAL RESISTANCE VALUE)
BAND D — THE RESISTANCE TOLERANCE
BAND E — WHEN USED ON COMPOSITION RESISTORS, BAND E INDICATES ESTABLISHED RELIABILITY FAILURE - RATE LEVEL (PERCENT FAILURE PER 1,000 HOURS) ON FILM RESISTORS, THIS BAND SHALL BE APPROXIMATELY 1-1/2 TIMES THE WIDTH OF OTHER BANDS, AND INDICATES TYPE OF TERMINAL

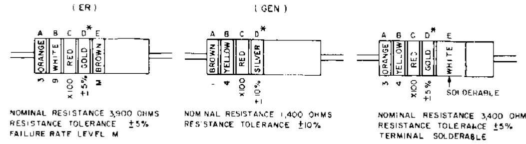
RESISTANCES IDENTIFIED BY NUMBERS AND LETTERS (THESE ARE NOT COLOR CODED)

SOME RESISTORS ARE IDENTIFIED BY THREE OR FOUR DIGIT ALPHA NUMERIC DESIGNATORS. THE LETTER R IS USED IN PLACE OF A DECIMAL POINT WHEN FRACTIONAL VALUES OF AN OHM ARE EXPRESSED. FOR EXAMPLE:

2R7 = 2.7 OHMS   10R0 = 10.0 OHMS

FOR WIRE-WOUND-TYPE RESISTORS COLOR CODING IS NOT USED, IDENTIFICATION MARKING IS SPECIFIED IN EACH OF THE APPLICABLE SPECIFICATIONS

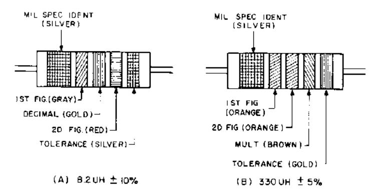
EXAMPLES OF COLOR CODING



COMPOSITION-TYPE RESISTORS   FILM-TYPE RESISTORS

* IF BAND D IS OMITTED, THE RESISTOR TOLERANCE IS ±20% AND THE RESISTOR IS NOT MIL-STD

A. COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS.



COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES. AT A, AN EXAMPLE OF OF THE CODING FOR AN 8.2UH CHOKE IS GIVEN. AT B, THE COLOR BANDS FOR A 330UH INDUCTOR ARE ILLUSTRATED

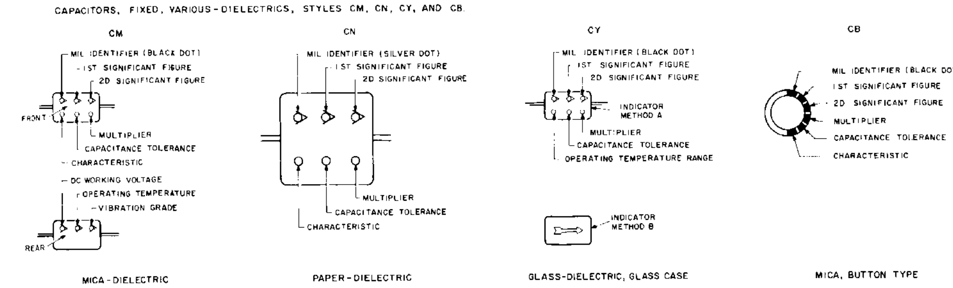
TABLE 2
COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES.

COLOR	SIGNIFICANT FIGURE	MULTIPLIER	INDUCTANCE TOLERANCE (PERCENT)
BLACK	0	1	
BROWN	1	10	1
RED	2	100	2
ORANGE	3	1,000	3
YELLOW	4		
GREEN	5		
BLUE	6		
VIOLET	7		
GRAY	8		
WHITE	9		
NONE			20
SILVER			10
GOLD	DECIMAL POINT		5

MULTIPLIER IS THE FACTOR BY WHICH THE TWO COLOR FIGURES ARE MULTIPLIED TO OBTAIN THE INDUCTANCE VALUE OF THE CHOKE COIL.

B. COLOR CODE MARKING FOR MILITARY STANDARD INDUCTORS.

CAPACITORS, FIXED, VARIOUS-DIELECTRICS, STYLES CM, CN, CY, AND CB



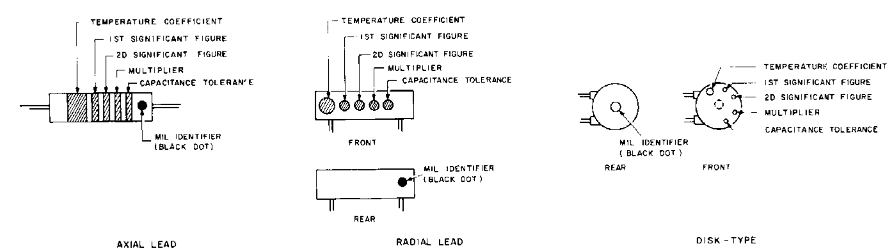


TABLE 3 — FOR USE WITH STYLES CM, CN, CY AND CB.

COLOR	MIL ID	1ST SIG FIG.	2D SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE				CHARACTERISTIC[2]			DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CB	CM	CY, CM	CM
BLACK	CM, CY CB	0	0	1			±20%	±20%		A			-55° TO +70°C	10-55 HZ
BROWN		1	1	10					B	E	B			
RED		2	2	100	±2%		±2%	±2%	C				-55° TO +85°C	
ORANGE		3	3	1,000		±30%			D		D	300		
YELLOW		4	4	10,000					E				-55° TO +125°C	10-2,000HZ
GREEN		5	5		±5%				F			500		
BLUE		6	6										-55° TO +150°C	
PURPLE (VIOLET)		7	7											
GRAY		8	8											
WHITE		9	9											
GOLD				0.1			±5%	±5%						
SILVER	CN			0.01	±10%	±10%	±10%	±10%						

TABLE 4 — TEMPERATURE COMPENSATING, STYLE CC.

COLOR	TEMPERATURE COEFFICIENT[4]	1ST SIG FIG.	2D SIG FIG.	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					CAPACITANCES OVER 10 UUF	CAPACITANCES 10 UUF OR LESS	
BLACK	0	0	0	1		±2.0 UUF	CC
BROWN	-30	1	1	10	±1%		
RED	-80	2	2	100	±2%	±0.25 UUF	
ORANGE	-150	3	3	1,000			
YELLOW	-220	4	4				
GREEN	-330	5	5		±5%	±0.5 UUF	
BLUE	-470	6	6				
PURPLE (VIOLET)	-750	7	7				
GRAY		8	8	0.01*			
WHITE		9	9	0.1*	±10%		
GOLD	+100			0.1		±1.0 UUF	
SILVER				0.01			

1. THE MULTIPLIER IS THE NUMBER BY WHICH THE TWO SIGNIFICANT (SIG) FIGURES ARE MULTIPLIED TO OBTAIN THE CAPACITANCE IN UUF.
2. LETTERS INDICATE THE CHARACTERISTICS DESIGNATED IN APPLICABLE SPECIFICATIONS: MIL-C-5, MIL-C-25D, MIL-C-11272B, AND MIL-C-10950C RESPECTIVELY.
3. LETTERS INDICATE THE TEMPERATURE RANGE AND VOLTAGE-TEMPERATURE LIMITS DESIGNATED IN MIL-C-11015D.
4. TEMPERATURE COEFFICIENT IN PARTS PER MILLION PER DEGREE CENTIGRADE.
* OPTIONAL CODING WHERE METALLIC PIGMENTS ARE UNDESIRABLE.

C. COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS.

ESC-FM 913-73

Figure FO-1. Color code markings for MIL-STD resistors, capacitors, and inductors.

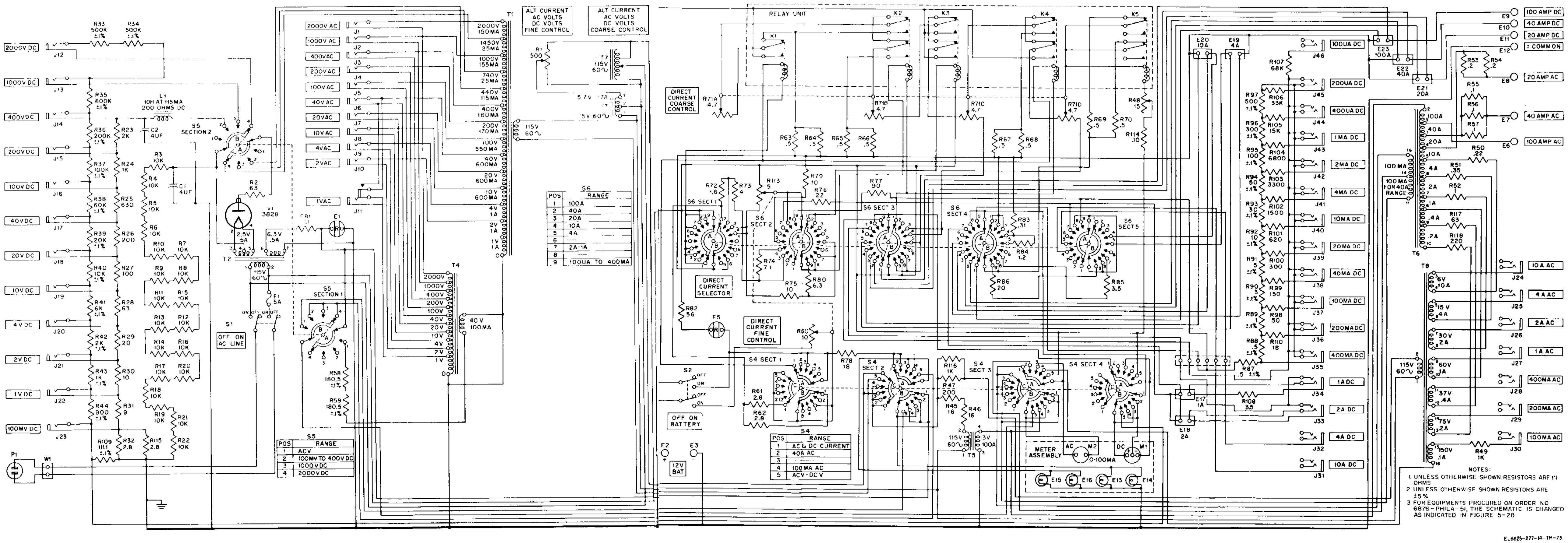


Figure FO-2. Meter Test Set TS -682/GSM -1, overall schematic diagram.

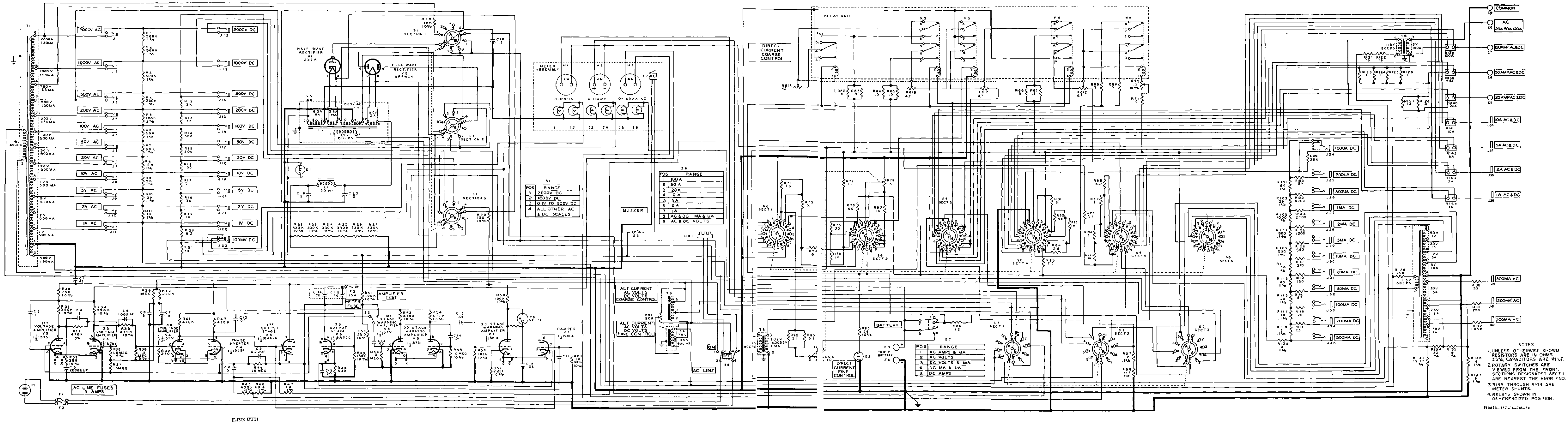


Figure FO-3. Meter Test SetTS-682A/GSM-1, overall schematic diagram.

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FRED C. WEYAND
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Chief of Staff.

Official:

PAUL T. SMITH
Major General, United States Army,
The Adjutant General.

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MICOM (2)
TECOM (2)
USACC (4)
MDW (1)
Armies (2)
Corps (2)
HISA (Ft Monmouth) (43)
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USAADS 12)
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USAES (2)
USAINTCS (3)
WRAMC (1)
ATS (1)
Fort Gordon (10)
Fort Huachuca (10)
WSMR (1)
Fort Carson (5)
Ft Richardson (ECOM Ofc) (2)
Army Dep (1) except
- LBAD (14)
- SAAD (30)
- TOAD)14)
- SHAD (3)

Fort Gillem (10)
USA Dep (2)
Sig Sec USA Dep (2)
Sig Dep (2)
Sig FLDMS (1)
USAERDAA (1)
USAERDAW' (1)
MAAG (1)
USARMIS II)
Units org under fol TOE.
- (1 copy each unit)
- 11-16
- 11-97
- 11-98
- 11-117
- 11-500 (AA-AC)

NG. None

USAR: None

For explanation of abbreviations used, see AR 310-50.

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