TM 11-6625-610-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ORGANIZATIONAL, DS, GS, AND DEPOT MAINTENANCE MANUAL

VOLTMETER, ELECTRONIC ME-227/U

This copy is a reprint which includes current pages from Changes 1 and 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY

JANUARY 1965

AGO 7236A

CHANGE
No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, *29 January 1974*

ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL

VOLTMETER, ELECTRONIC ME-227/U

TM 11-6625-610-15, 19 January 1965, is changed as follows:

Page 4, paragraph 2. Delete paragraph 2 and substitute:

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

Paragraph 3. Delete paragraph 3 and substitute:

3. Form 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 (Report of Packaging and Handling Deficiencies) as prescribed in AR 700-58 (Army)/NAVSUP PUB 378 (Navy)/AFR 71-4(Air Force)/MCS P4030.29 (Marine Corps), 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(Army)NAVSUPINST 4610.33/AFM 75-18/MCO P4610.19A (Marine Corps), and DSAR 4500.15.

3.1. Reporting of Errors

Report of errors, omissions and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028, Recommended changes to Publications, and forwarded direct to Commander, US Army Electronics Command ATTN: AMSEL-MA-C, Fort Monmouth, NJ 07703

Page 5. After paragraph 4 acid:

4.1. Items Comprising an Operable Voltmeter, Electronic ME-227/U

FSN	*QTY*	*Nomenclature, part No. and mfr code*
6625-892-5117		Voltmeter, Electronic ME-227/U
		Which includes:
6625-689-6874	1	Lead, Test: 6011, 85711
6625-689-6875	1	Lead toot: 6010, 85711

***Page 28*, appendix III. Delete appendix III.**

By Order of the Secretary of the *Army:*

CREIGHTON W. ABRAMS
***General, United States** Army*
chief of staff

Official:
VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 1236, Direct and General Support maintenance requirements for AN/ASW-12, and DA Form 12-61, Direct and General Support maintenance requirements for AN/TRC-90; and AN/TRC-129.

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *3 September 1965*

ORGANIZATIONAL, DS, GS, AND DEPOT MAINTENANCE MANUAL
VOLTMETER, ELECTRONIC ME-227/U

TM 11–6625-610-15, 19 January 1965, is changed as follows:

Page 4, paragraph 2, line 5. Add after (types 4, 6, 7, 8, and 9) : supply catalogs (type CL).

Paragraph 3. Delete subparagraph *c* and substitute:

c. Reporting of Equipment Manual Improvements. The direct reporting of errors, omissions, and recommendations for improving this manual by the individual user is authorized and encouraged. DA Form 2028 (Recommended Changes to DA Publications) will be used for reporting these improvements. This form will be completed using pencil, pen, or typewriter and forwarded direct to Commanding General, U. S. Army Electronics Command, ATTN: AMSEL-MR-(NMP) –MA, Fort Monmouth, N. J. 07703.

Page 22. Add chapter 5 after chapter 4:

CHAPTER 5

DEPOT INSPECTION STANDARDS

23. Applicability of Depot Inspection Standards

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

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

24. Test Facilities Required

The following equipment, or suitable equivalents, will be used to determine the compliance with requirements of this specific standard.

a. Test Equipment.

Equipment	Stock No.	Quantity required	Applicable literature
Meter Test Set TS-682A/GSM-1	6625–669-0747	1	TM 11-2535B
Meter, Ampere-Volt ME-250/U	6625–699-2411	1	TM 11-6625-600-10
Multimeter TS-352B/U	6625-242-5023	1	TM 11-5527
Transformer, Variable CN-16/U	5950-235-2086	1	

b. Additional Equipment. Power Supply, 12 VDC.

25. General Test Requirements

a. Ac voltage requirements are 115 volts, 50 to 60 cycles per second.

b. All equipment must be allowed a warmup period of 5 minutes before beginning tests.

26. Full Scale Accuracy Test

Use the TS–682A/GSM–1 to supply voltages from 10 volts to 1,000 volts. Use the ME-250/U to supply all voltages below 10 volts. The meters furnished with the test instruments are used as standards.

a. Set the millivoltmeter controls as follows:

(1) VOLTS switch: *25* mV.

(2) LOW mVs switch: USE LEFT SWITCH 25 mV UP.

(3) UP-SCALE ZERO switch: OFF.

(4) POLARITY PULSE switch: OFF.

b. Connect the TS–682A/U or the ME-250/U, as required, to the INPUT connector on the millivoltmeter as shown in figure 4.

c. Set the TS–682A/U or the ME–250/U voltage output and the millivoltmeter VOLTS and LOW mVs switches as shown in the chart-below. The readings on the millivoltmeter must be within the acceptable limits shown.

(1) TS–682A/U *or* ME-250/U *voltage Output and millivoltimeter VOLTS switch settings.*

TS–682A/U or ME-250/U voltage output	Millivoltmeter VOLTS switch setting	Millivolt meter acceptable limits
25 mV	25 mV	24.25 to 25.75
100 mV	100 mV	97 to 103
250 mV	250 mV	242.50 to 257.50
25 V		24.25 to 25.75
100 v		
1000 v		

(2) ME-250/U voltage output and LOW mVS switch settings.

ME-250/U voltage output	LOW mVs switch setting	Mlllivoltmeter acceptable limits
10 mV	10 mV	9.7 to 10.3
25 mV	2.5 mV	2.4 to 2.6
1 mV	1 mV	.96 to 1.04

27. 10 mV Scale Accuracy Test

a. Set the millivoltmeter controls as given in paragraph 26a, except set the LOW mVs switch to 10 mV position.

b. Connect the ME–250/U to the millivoltmeter as shown in figure 4.

c. Set the ME–250/U voltage output as shown in the chart below. The readings on the millivoltmeter must be within the acceptable limits shown.

ME-250/U voltage output	Millivoltmeter acceptable limits
10 mV	9.7 to 10.3
9 mV	8.7 to 9.3
8 mV	7.8 to 8.2
5 mV	4.9 to 5.2
4 mV	3.9 to 4.1

28. Polarity Deviation Test

a. Set the millivoltmeter controls as given in paragraph 26a.

b. Connect the ME–250/U to the millivoltmeter as shown in figure 4.

c. Set the ME–250/U voltage output to 10 mV and record the reading on the millivoltmeter.

d. Reverse the ME-250/U leads and record the reading on the millivoltmeter. This reading must be ±1 percent of the reading noted above.

29. Low Voltage Power Input Test

a. Connect the equipment as shown in figure 5.

b. Set the millivoltmeter controls as in paragraph *26a*, except set the LOW mVs switch to 1 mV position.

c. Adjust the CN–16/U to obtain 115 volts as on the TS–352B/U.

d. Set the ME–250/U for a voltage output of 1 mV and record the reading on the millivoltmeter.

e. Adjust the CN–16/U to obtain 90 volts ac on the TS–352B/U.

f. Record the reading on the millivoltmeter. This reading should be ±4 percent of the reading noted in *d* above.

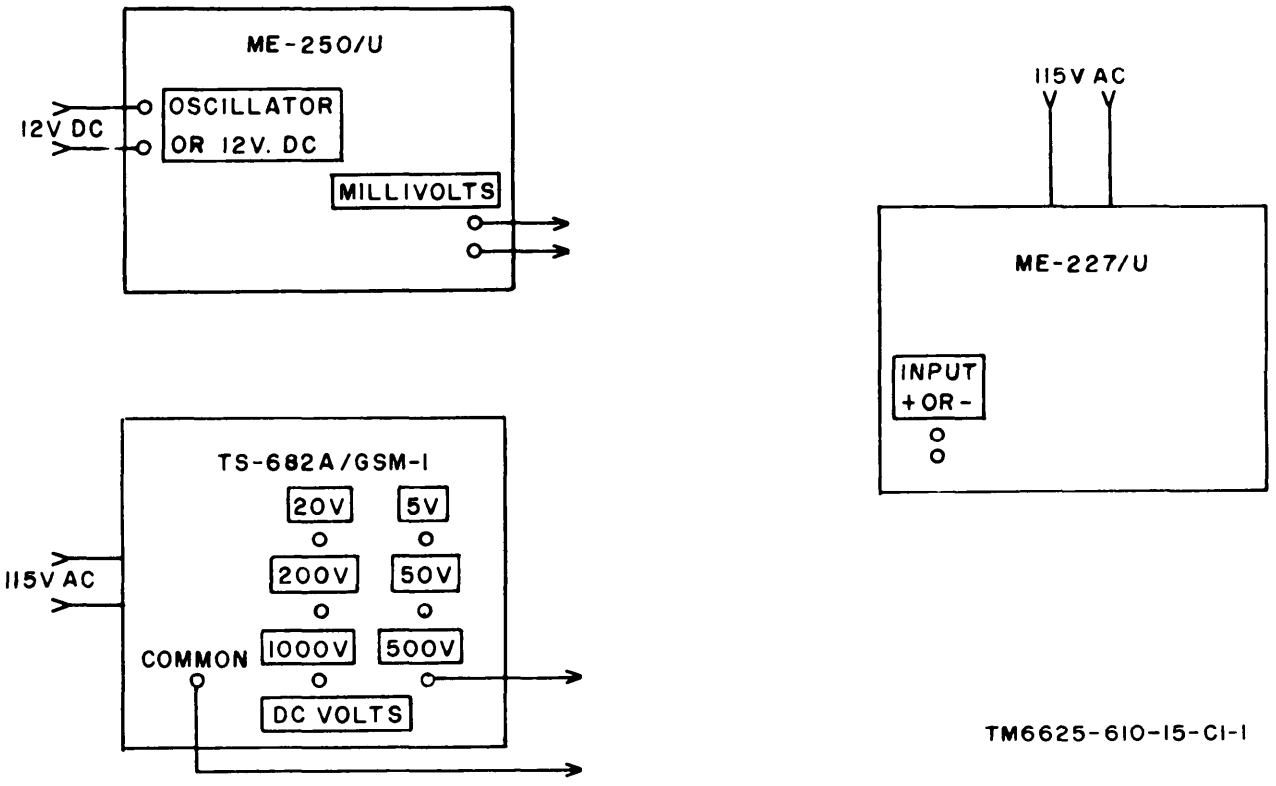

Figure 4. Scale accuracy and polarity deviation test setup.

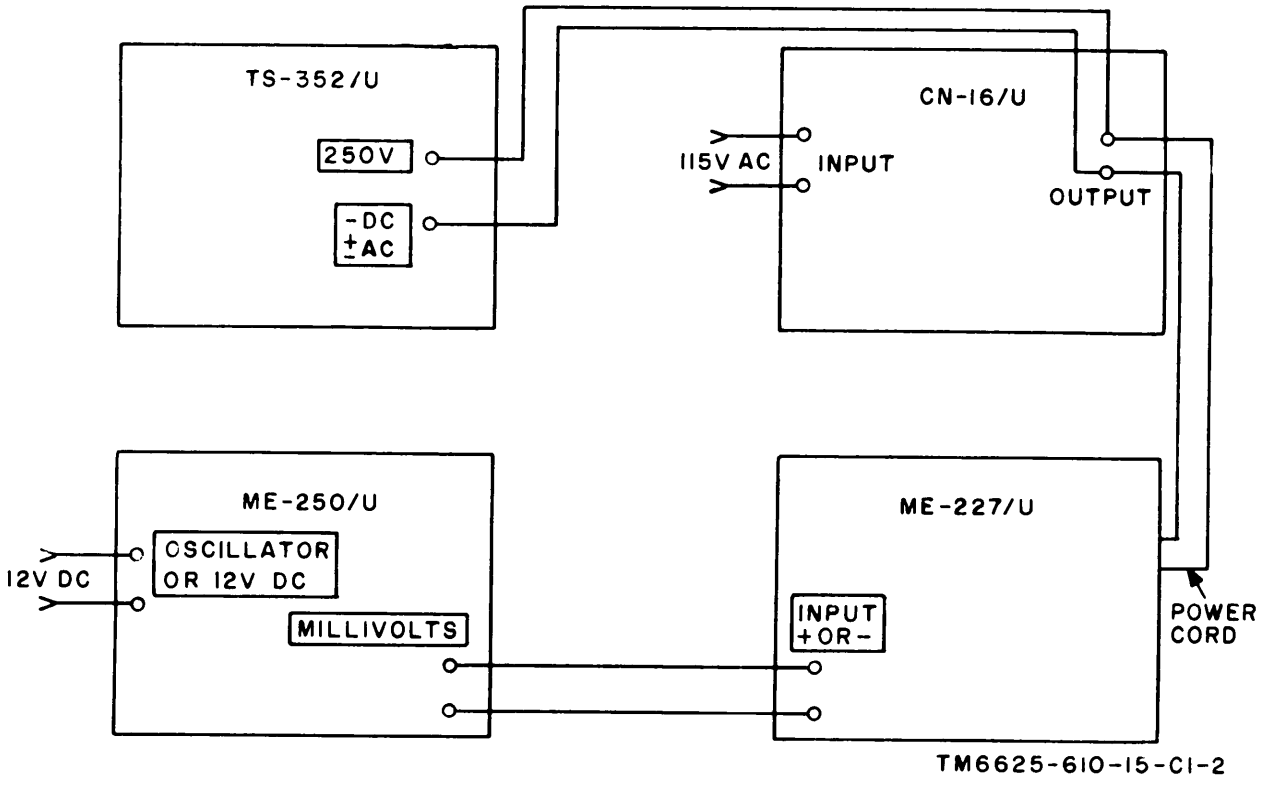

Figure 5. Low voltage input test setup.

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12-36 requirements for Operator and Crew Maintenance Instructions for OV-1A, OV-1B, OV-1C and CH47A Aircraft plus USASESCS (50), USAAVNS (25), USASCS (5), and USATSCH (25).

TECHNICAL MANUAL)
)
NO. 11-6625-610-15)

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 19 January 1965

Organizational, DS, GS, and Depot Maintenance Manual

VOLTMETER, ELECTRONIC ME-227/U

TYPE MV-17C

DC Millivohmeter

UP SCALE READING REGARDLESS OF POLARITY

1,2.5 mV MID-ZERO RANGES FOR BRIDGE OR NULL INDICATION

REASONABLY PRICED

3% BASIC ACCURACY

HIGH IMPEDANCE INPUT

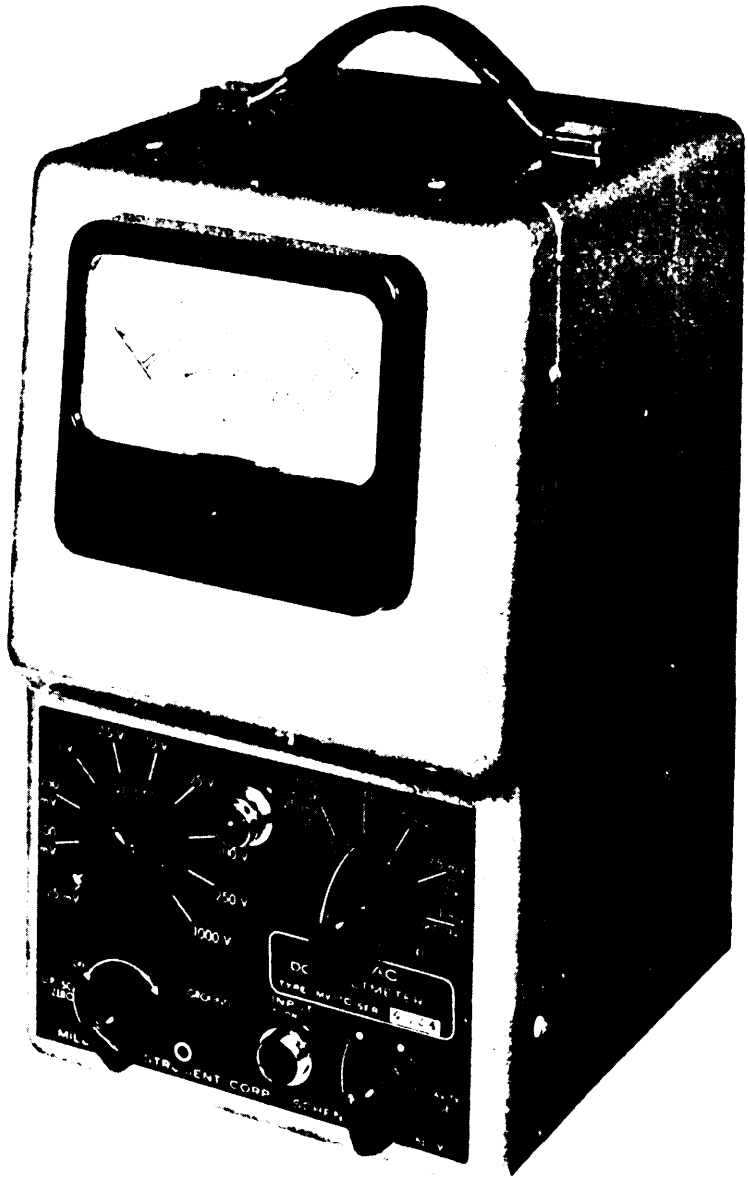

Figure 1. Voltmeter, Electronic ME-227/U.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

This manual describes Voltmeter, Electronic ME-227/U (fig. 1) and provides instruction for operation, operator and organizational maintenance, and functioning of equipment. All references to MV-17C, in this manual, apply to Voltmeter, Electronic ME-227/U.

2. Index of Equipment Publications

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. Department of the Army Pamphlet No. 310-4 is an index of current technical manuals, technical bulletins, supply manuals (types 4, 6, 7, 8, and 9), supply bulletins, lubrication orders, and modification work orders available through publications supply channels. The index lists the individual parts (-10, -20, -35P, etc) and the latest changes to and revisions of each equipment publication.

3. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions in TM 38-750.

b. Report of Damaged or Improper shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700-58 (Army), NAVSANDA Publication 378 (Navy), and AFR 71-4 (Air Force)'.

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

Section II. DESCRIPTION AND DATA

4. Specifications

Accuracy: 3% full scale from 10 mV up, 4% on lower ranges.

Sensitivity: 1 mV DC, mid-zero.

Total Ranges: 13, 1 mV and 2.5 mV mid-zero, 10 mV to 1 kV left zero.

Input Impedance: 1 mV to 100 mV - 6 meg; 250 mV - 16 meg;
l V-l kV- 60 meg.

Zero Drift: Less than 1% from 10 mV up, 3% on lower ranges.

Physical Characteristics: Gray steel, hammertone finish case.

Height 12”, Width 7“, Depth 7“, Weight 25 lbs.

5. DEESCRIFI'ION AND DESIGN

The model MV-17C is a good high-impedance, general-purpose Millivoltmeter. It contains a well proven (now in its 8th year of production) chopper amplifier stabilized by heavy AC feedback. The instrument has two range switches, the "Volts" switch and the "Low mV" switch. The "Volts" switch handles all "regular" ranges between 25 mV and 1000 V full scale by breaking down all incoming DC voltages to 10 mV full scale. The carrier amplifier's gain is then set for 20% maximum amplification. Stability, tube noise and modulator noise at this low level of amplification are transmitted to the out-put stage at such small amplitudes that the meter is completely stable having less than 1% of full scale zero drift over many months of continuous operation.

The "Low mV" switch permits a step-by-step increase of the carrier amplifier's gain in order to increase the meter's sensitivity. At the same time, tube noise and modulator noise are being transmitted to the output stage at increasing levels. In order to mask them at zero signal input and also in order to improve the instrument's "minimum observable deflection" both the 2.5 mV and 1 mV ranges are operated at midscale zero. This "preloads" the amplifier and its output rectifier stage, improving the meter's scale distribution. in spite of higher gains on the 1 mV and 2.5 mV ranges the meter is remarkably stable on these ranges, temporary drifts being less than 3% of full scale and long-time drifts usually remaining within 5-10%.

The MV-17C voltmeter measures positive and negative DC signals in a forward direction. This eliminates the necessity of either switching leads or operating a reversing switch. However, the polarity of the voltage being measured can be determined by switching on the meter's "Polarity Pulse". This is a slowly beating neon-oscillator which every second adds a small positive DC voltage in the measuring circuit. If the pointer periodically kicks to the right the polarity is plus, if it kicks to the left it is minus. On the mid-zero scales polarity is indicated by right or left deflection of the pointer.

6. ACCESSORIES

The MV-171 Shunt Box has a total of 23 ranges, 0-250 uuA to 0-10 A. It converts the MV-17C Millivoltmeter into a DC Micro-Micro-Ammeter with the following range breakdown,

0 - 250 uuA in 2	ranges
250 uuA - 250 muA in 6	ranges
250 muA -250 uA in 6	ranges
250 uA -250 mA in 6	ranges
250 mA - 10 A in 3	ranges

Accuracy: 3% of full scale except above l A and below 1 muA which are 5%.

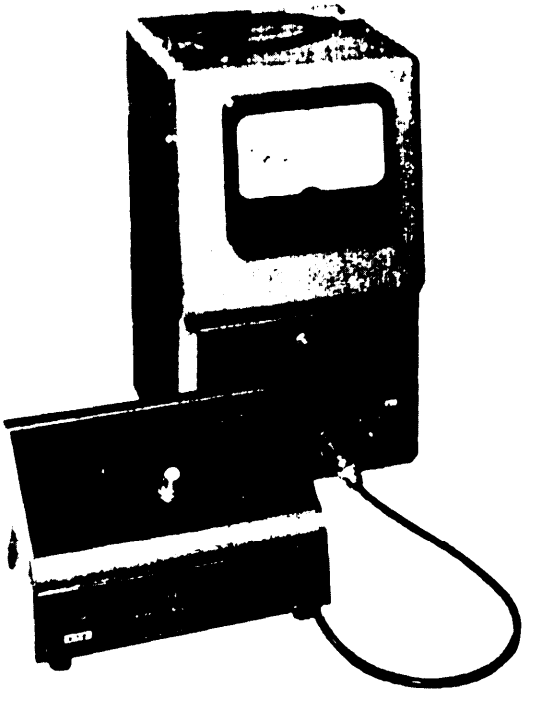

Figure 2. MV-171 Shunt Box as used with MV-17C.

CHAPTER 2

OPERATING INSTRUCTIONS

7. General Information: The MILLIVAC MV-17C is several thousand times more sensitive than other DC Vacuum Tube Voltmeters. This offers great advantages to the user of this instrument but it also requires special consideration. Therefore, in order to obtain the greatest value and trouble-free operation from this meter, it is recommended that the following instructions be read carefully.

8. Initial Operation and Tests:

a) After unpacking and before plugging the meter into the power circuit for the first time, make sure that the meter pointer moves freely (rotate complete instrument) and that the pointer is set at zero. Any adjustment required to bring the pointer to zero should be made with the screw on the center of the meter face.

b) Check the glass fuse in the back of the instrument. It should be rated 0.25A slo-blo.

c) Before plugging the meter in, make sure that the power supply is the regular 115 volts, 60 cycles, AC and not DC.

d) Connect the instrument to the power supply and turn its "LOW mV's" switch to its left position marked "25mV to 1000V". The pilot light should light up.

e) Set the "VOLTS" switch to its 2.5 V position.

f) Allow the instrument to warm up for more than 25 seconds.

g) Turn both the MID-ZERO control and the POLARITY PULSE counter-clockwise until they or. switched off. The meter should then read zero with a possible slight deviation to the right. If this deviation is less than one quarter of one scale division leave it as it is, otherwise turn the meter screw in the center of the meter to set the pointer back to zero.

h) Plug the shielded clip lead supplied with the instrument, into the panel. With the VOLTS SWITCH at 2.5V. connect a single flashlight cell, rated 1.5 volt. to the red and black clips The meter should-then read 1.5 volts regardless of-the polarity of 'the cell terminals. A small difference in readings (polarity deviation) may be noted when changing from plus to minus connection. However, this deviation should not be greater than plus minu 2% of full scale which is equivalent to a maximum deviation of 4%. In the average it is considerably lower, usually less than plus minus 1% (equivalent to a maximum deviation of 2% between both readings referred to full scale).

i) Connect again the 1.5 V battery cell with its plus terminal to the red terminal of the meter and switch on the POLMITY PULSE. The pointer will now periodical y (approximate y every 2 seconds) kick to the right side thereby indicating that the voltage being measured is positive against ground. Now reverse the polarity of the battery and note that the pointer periodically kicks to the left side thereby indicating the polarity being measured is negative.

CAUTION: When making measurements on the MV-17C's "left zero" ranges (10 mV to 1 kV) do not use MID-ZERO control for zero adjustments, as this creates polarity errors and miscalibration. The MID-ZERO control should be used for mid-zero adjustment only, as required on the 1 mV and 2.5 mV ranges.

i) Switch the POLARITY PULSE off and turn the LOW mV RANGES switch to its 2.5 mV range. This will bring the pointer Slightly above the left end zero due to increased gain which allows more tube and modulator noise to pass. The actual zero position for this range is in the middle of the scale. The pointer should be set to this position by first shorting the input terminals and then turning the MID-ZERO control clockwise until the pointer is exactly on mid-zero. The meter is now set for DC voltage measurements up to plus 2.5 mV and minus 2.0 mV. Plus VOltages read to the right, minus voltages to the left. However, there are three important points which must be considered at al I times when making MID-ZERO measurements with the MV-17C, they are:

9 . SPECIAL INSTRUCTIONS FOR MID-ZERO OPERATION

1) When overloading the meter with negative VOltages exceeding the values indicated on the left end of the mid-zero scales (minus 2.0 mV on the "2.5 mV" scale and minus 800 microvolt on the "1 mV" scale) the pointer will swing back and begin to read "positive" voltages, Therefore, if the magnitude of the voltage to be measured is unknown always use less sensitive scales first in order to ascertain the general magnitude of the Voltage to be measured.

2) THE POLARITY PULSE CAN EFFECTIVELY BE USED TO INDICATE WHETHER THE METER, ON MID-ZERO MEASUREMENTS, IS OVERLOADING OR NOT. Kicks to the right mean "right" or "not overloading", kicks to the left "wrong" or "negatively overloading".

3) When setting the pointer to mid-zero always make sure that the meter's input terminals are shorted or - better - that a resistance load equivalent to the DC impedance of the circuit to be measured is attached between them. The MID-ZERO control actually adds a small adjustable DC Voltage to the ground return path of the meter. This voltage is produced by a small current flowing through the DC modulator's input circuit as well as the external load. It therefore varies with variations of the external load. If the external load (DC impedance of the circuit to be measured) is of a substantially lower magnitude than the meter's 6 megohm input impedance on its 1 mV and 2.5 mV ranges the leads may simply be shorted before setting the pointer to mid-zero. All impedances below 100,000 ohms may be replaced by a simple shorting Of the leads when setting the pointer to mid-zero.

This includes the majority of low voltage DC sources, amongst them all thermocouples, Wheatstone bridges, etc. However, if the DC impedance of the circuit to be measured exceeds 100,000 ohms it is necessary to make mid-zero adjustments with the proper impedance between the meter's terminals.

k) After having familiarized yourself with the MID-ZERO operation of the meter on its 2,5 mV range turn the LOW mV Range switch to its 1 mV position which is the meter's most sensitive range. Note that with the MID-ZERO control switch off, tube and modulator noise drive the pointer still a little higher above the left end zero as a result of a further increase in amplifier gain. Again, set the pointer to mid-zero after having shorted the leads and follow the same 3 rules above.

SPECIAL INSTRUCTIONS FOR MID-ZERO OPERATION outlined above.

1) Mid-zero operation is also possible on any of the main ranges of the meter, controlled by the VOLTS switch. The dial is not calibrated directly for this kind of operation. instead, use again the 1 mV and 2.5 mV scales and multiply their readings by one half and the number of decimals by which the actual operating range is removed from the scale in question. For instance, if operating on the 250 mV range with the pointer set to mid-zero use the 2.5 mV scale and read "1 .2 mV" as 0.6 x 100 or 60 mV" (plus if to the right, minus if to the left of zero), It will be found that on all scales including and above 100 mV mid-zero settings can be made without shorting the leads because the voltage dividers in the VOLTS switch provide shunt resistors low enough in value and series resistors in the in-put lead large enough to make this simplified operation possible. Mid-zero operation on the higher ranges will be mainly found useful when using the MV-17C as a nuli detector for bridges.

With these basic operating instructions It is possible to use the Millivac MV-17C Vacuum Tube Voltmeter for all DC voltage measurements for which any type of DC Vacuum Tube Voltmeter is customari l y used. However, the following special instructions were written for the purpose of pointing out the special measuring possibilities which this instrument offers beyond conventional instruments,

10. Special Operating Instructions:

1) Overloading Like most vacuum tube Voltmeters, the MV-17C will stand *a* considerable amount of overloading. The main limiting factors with regard to overloadability are insulation and polarization, Do not overload more than specified below,

Range	1 mV	2.5 mV	10 mV	25 mV	100 mV	250 mV	1 V	2.5 V
Max. Volts	100V	100V	100V	100V	250V	1000V	1000V	1000V

Range	10V	25V	100V	250V	1000V
Max, Volts	1000V	1000V	1000V	1000V	1000V

2) Polarization: The heart of the MV-17C is its DC modulator, which converts the incoming DC voltage into a 60 cycle signal wave, which is then amplified, rectified, and metered. A 1.1 megohm/.05 MFD filter protects the DC input circuit against large AC signals, as well as excessive ripple or hum signals which would create DC reading errors. AC rejection for 60 cycle signals is approximately 40-fold. One shout d, however, keep in mind that the .05 MFD filter condenser may become polarized if exposed to prolonged DC overvoltages. Such polarization results in temporary off-zero reading, polarity errors, and slow drifts.

In order to avoid these phenomena, avoid overloading, particularly the meter's lowest 1 mV range, as follows:

Do not overload more than 100,000 times at any time,
not more than 10,000 times for more than 5 seconds
not more than 1,000 times for more than 30 seconds
not more than 100 times for more than 2 minutes
not more than 10 times for more than 10 minutes

If these overload limitations are not observed the following irregularities might arise.

Over 100,000 times (100 volts input): Breakdown of insulation and condenser dielectrics.
Over 10,000 times (10 volts input): Rapid polarization of filter condensers in input circuit, resulting in temporary off-zero reading after overvoltage has been removed. This condition corrects itself within 10 to 60 minutes after overvoltage has been removed, as the polarization gas layers wear themselves out through secondary element discharge into the filter circuit and the modulator.

As far as the meter's higher measuring ranges are concerned corresponding overloading limitations prevail and, in addition, those listed under 1).

3) Calibration: The MV-17C has a number of voltage dividers which are directly mounted on the gangs of the VOLTS switch. In addition the meter is equipped with 3 adjustable dividers which control the gain of the 60 cycle carrier-amplifier as follows:

Adjustable Control, Located on Amplifier Chassis	Controls Full Scale Deflection Of Ranges

MV-17C

TOP	10 mV up to 1,000 volts
MIDDLE	2.5 mV only
BOTTOM	1 mV only

Recalibration can easily and quickly be performed by turning these controls clockwise for increased and counter-clockwise for decreased gain.

CHAPTER 3

PREVENTIVE MAINTENANCE INSTRUCTIONS

11. Scope of Maintenance

The maintenance duties assigned to the operator of the equipment are listed below together with a reference to the paragraphs covering the specific maintenance functions.

a. Wily preventive maintenance checks and services (para 14).

b. Weekly preventive maintenance checks and services (para 15).

c. Monthly preventive maintenance checks and services (para 16).

d. Quarterly preventive maintenance checks and services (para 17).

e. Cleaning (para 18).

f. Touchup painting (para 19).

12. Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to assure that the equipment is serviceable.

a. Systematic Care. The procedures given in paragraphs 14 through 19 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

b. Preventive Maintenance Checks and Services. The preventive maintenance checks and services charts (para 14 through 17) outline functions to be performed at specific intervals. These checks and services are to maintain Army electronic equipment in a combat-serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the charts indicate what to check, how to check, and what the normal conditions are; the References column lists the illustrations, paragraphs, or manuals that contain detailed repair or replacement procedures. If the defect cannot be remedied by performing the corrective actions listed, higher echelon maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

13. Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of the equipment are required daily, weekly, monthly, and quarterly.

a. Paragraph 14 specifies the checks and services that must be accomplished daily (or at least once each week if the equipment is maintained in standby condition).

b. Paragraphs 15, 16, and 17 specify additional checks and services that must be performed on a weekly, monthly, and quarterly basis, respectively.

14. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Completeness.....	See that the equipment is complete (appx III).	None.
2	Exterior surfaces.....	Clean the exterior surfaces, including the panel and meter glass (para 18). Check meter glass and indicator lenses for cracks.	None.
3	Connectors.....	Check the tightness of all connectors.....	None.
4	Controls and indicators.....	While making the operating checks (item 5), 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 meter for sticking or bent pointer.	None.
5	Operation.....	Operate the equipment according to chapter 2.	None.

15. Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Cables.....	Inspect cords, cables, and wires for chafed, cracked, or frayed insulation. Replace connectors that are broken, arced, stripped, or worn excessively.	None.
2	Handle.....	Inspect the handle for looseness. Replace or tighten as necessary.	None.
3	Metal surfaces.....	Inspect exposed metal surfaces for rust and corrosion. Touchup paint as required (para 19).	None.

16. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Pluckout items.....	Inspect seating of pluckout items.....	None.
2	Jacks.....	Inspect jacks for snug fit and good contact.	None.
3	Transformer.....	Inspect the power transformer. All nuts must be tight. There should be no evidence of dirt or corrosion.	None.
4	Resistors and capacitors.....	Inspect resistors and capacitors for cracks, blistering, or other detrimental defects.	None.

17. Quarterly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Publications.....	See that all publications are complete, serviceable, and current.	DA Pam 310-4.
2	Modifications.....	Check DA Pam 310-4 to determine if new applicable MWO's have been published. All URGENT MWO's must be applied immediately. All NORMAL MWO's must be scheduled.	TM 38-750 and DA Pam 310-4.
3	Spare parts.....	Check all spare parts (operator and organizational) for general condition and method of storage. No overstock should be evident and all shortages must be on valid requisitions.	Appx III.

18. Cleaning

Inspect the exterior of the equipment. The exterior surfaces should be free of dust, dirt, grease, and fungus.

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

Warning: Cleaning compound is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and ground-in dirt from the cases; use a cloth dampened (not wet) with Cleaning Compound (Federal stock No. 7930-395-9542).

c. Remove dust or dirt from plugs and jacks with a brush.

Caution: Do not press on the meter face (glass) when cleaning; the meter may become damaged.

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

19. Touchup Painting Instructions

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 explicable cleaning and refinishing practices specified in TM 9-213.

CHAPTER 4

FUNCTIONING OF EQUIPMENT

20. General Description of Circuit

The MV-17C uses a completely stable carrier-type DC amplifier which does not contain bridge circuits and therefore, for all practical purposes, is free from zero drifts and the necessity of repeated zero adjustments. A "shunting contact" type DC modulator converts DC voltages into 60 cycles. The modulator should never be opened or tampered with since this automatically y cancels the instrument's one year guarantee.

A complete circuit diagram is attached.

The instrument has two range switches, the "VOLTS" switch and the "LOW mV's" switch. The "VOLTS" switch handles all ranges between 25 mV and 1000 V full scale and breaks all incoming DC voltages down to 10 mV full scale. The carrier amplifiers variable gain control is then set for 20% maximum amplification. The remaining three lowest ranges (10 mV, 2.5 mV and 1 mV full scale) are handled by the "LOW mV's" switch which feeds the incoming DC signal directly into the modulator but varies the carrier amplifier's gain. On the 10 mV scale it is 20%, on the 2.5 mV scale it is 40% and on the 1 mV scale it is 100% of its maximum. Both the 2.5 mV and the 1 mV range ore operated at mid-scale zero in order to "preload" the carrier amplifier's output rectifier. This lowers the instrument's "minimum observable deflection" to less than 10 microvolt and makes it more valuable as a hyper-sensitive null detector.

The carrier amplifier used in this instrument has a so-cailed "starved" input tube (6J7) which operates at reduced plate current (0.02 mA) and has an exceptional l y large load-resistor (16 meg.). This increases its gain 1,000 or more. The second stage is directly coupled to the first. It is not starved and has a gain of 200, bringing the total gain of the first two stages to 200,000. The starved amplifier in this case amplifies the carrier signal produced by a DC modulator having less than 10 microvolt noise at 11 megohms input impedance. The negative feedback, on the most sensitive scale of this voltmeter, is roughly 100 to 1 and on the less sensitive scales, 1,000 to 1. With such high feedback rates, tube noise and hum are negligible.

The MV-17C measures positive and negative DC voltages in a forward direction. This eliminates the necessity of either switching leads or operating a reversing switch. However, the polarity of the voltage being measured can be determined by switching on the meter's "Polarity Pulse". This is a slowly beating neon-oscillator which every two seconds adds a

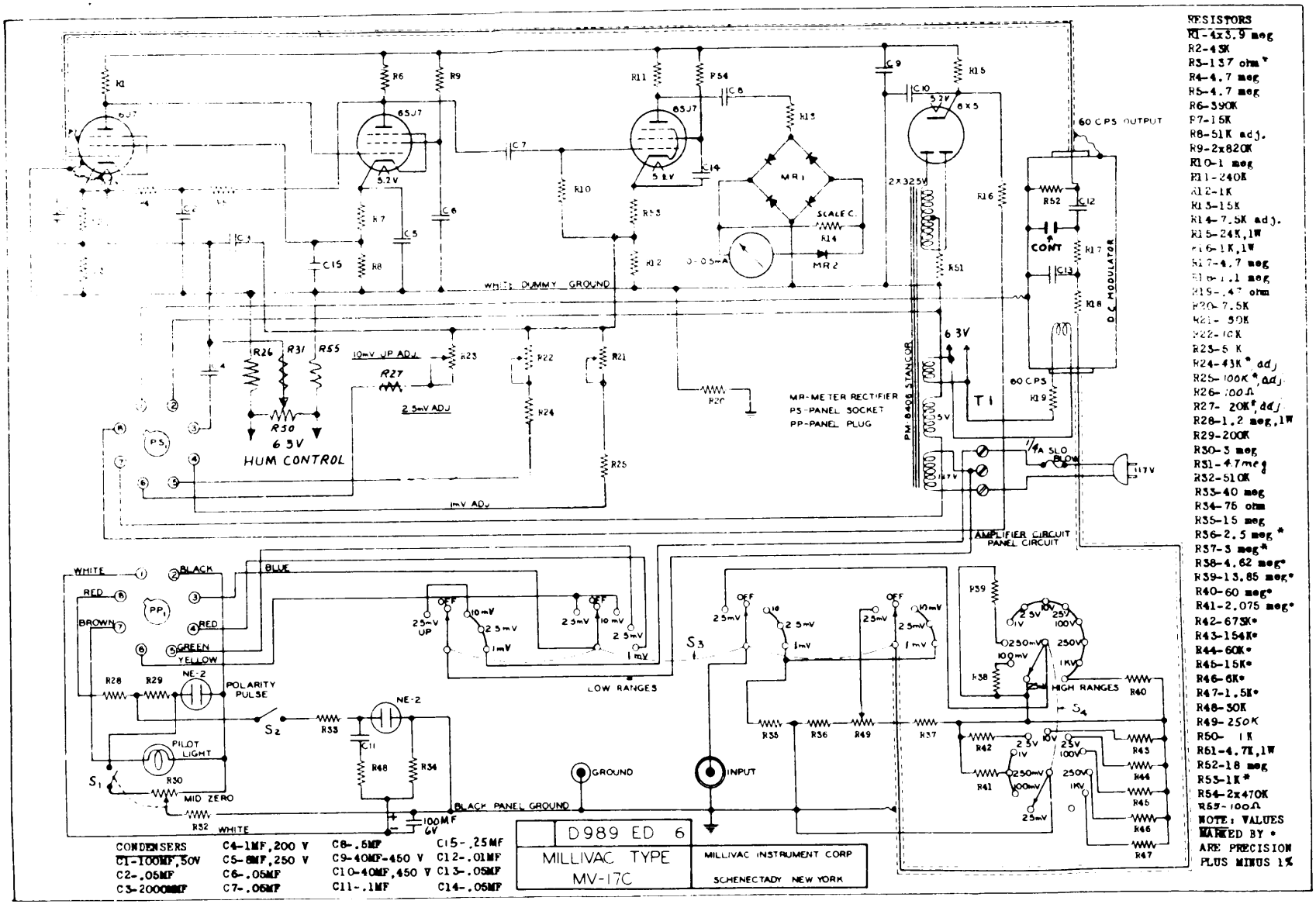

Figure 3. Voltmeter, Electronic ME-227/U, schematic diagram.

small positive DC voltage in the measuring circuit. If the winter periodically kicks to the right the polarity is plus, if it kicks to the left it is minus.

The meter has a 4" x 2" rectangular dial with 5 scales. They are the main scale covering all measuring ranges between 10 mV and 1000 V full scale, two special mid-zero scales for the 2.5 mV and 1 mV ranges, a decibal scale and a square-law scale. The latter is mainly for RF--RMS measurements with thermocouples. It facilitates conversion of DC readings into RF values. Its zero is raised to 20% full scale in order to "preload" the output rectifier which makes the meter more sensitive at very low DC input voltages.

21. Applications:

The Millivac MV-17C is an ideal DC vacuum-tube voltmeter for general measurements of DC potentials in amplifiers and power supplies, Due to its higher sensitivity it can be used for numerous measuring applications which so far have been considered beyond reach of other vacuum tube voltmeters, or meters of any kind. Typical examples of these special measurements are: Rectification of crystal diodes at very low AC or RF input levels, contact potentials developed by pentodes, grid-current measurements, exceptionally sensitive RF-RMS measurements with thermocouples, delicate photo-electric measurements, insulation measurements, extremely sensitive null detectors for Whetstone bridges, etc.

a) Grid Current Measurements: By inserting a 1000 ohm resistor in series with the regular grid leak resistor of an amplifier stage, a single micro-ampere in the grid circuit will create a 1 mV or full-scale deflection of the meter if its INPUT TERMINAL is attached to one end of this shunt and the GROUND terminal to the other end of the shunt. In order to reduce measuring errors caused by hum pickup, excessive ripple, etc. it is recommended that the MV-17C's ground terminal be connected to the terminal of the shunt which is nearer to ground or any ground-by-passed tie-point. It is, of course possible to use higher or lower values to meet specific measuring requirements,

b) Plate Current, Screen Current and Other Current Measurements.

These measurements are similar to those described above except that they usually involve heavier currents. Consequently shunt resistors, rated at 1 ohm, 100 ohms or higher should be used. Again, special care should be taken that the MV-17C's ground terminal is attached to either ground or points by-passed to ground.

c) Bridge Measurements: The MV-17C can be used as a highly sensitive null detector for Whetstone bridges and other DC bridges. Its main advantage is high sensitivity. In addition this instrument also provides an opportunity to adjust bridge sensitivity in range steps which greatly helps balancing a bridge if the general magnitude of the unknown resistor is questionable. The MV-17C as a null detector in bridges can be operated in two different manners.

1. With its zero at the left end of the scale. This operation is mainly intended to be used on the instrument's higher scales from 10 mV up. When balancing a bridge simply turn the meter to a higher range such as 10 volts and adjuit the decade resistors until the instrument reads zero or is near zero. Then switch the MV-17C down to 1 volt or 100 mV full scale and again

balance the bridge for greater accuracy. Finally, switch the meter to its 10 mV range and make the final adjustments. Any deviations whether positive or negative will now read in a forward direction. To decide whether the deviation is positive or negative switch on the polarity pulse. Positive voltages in the gal vanometer circuit of the bridge are then indicated by kicks of the pointer to the right and negative voltages by kicks to the left.

2. With the zero position in the middle of the scale: use any of the meter's scales and follow the directions given above under INITIAL OPERATION AND TESTS.

22. Special Instructions for Square Law Dial:

The square law dial is provided for the direct reading of DC output voltages generated by square law sources such as thermocouples and certain detectors. This dial will be found to be extremelly useful for delicate temperature and bolometer measurements. Before using this dial connect input terminals to the thermocouple and set pointer to square-law zero by using MID-ZERO control.

APPENDIX I

REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 4, 6, 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TM 9-213	Painting Instructions for Field Use.
TM 38-750	Army Equipment Record Procedures.

APPENDIX II

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

1. General

a. This appendix assigns maintenance functions to be performed on components, assemblies, and subassemblies by the lowest expropriate maintenance category.

b. Columns in the maintenance allocation chart are as follows:

(1) Part or component. This column shows only the nomenclature or standard item name. Additional descriptive data are included only where clarification is necessary to identify the component. Components, assemblies, and subassemblies are listed in top-down order. That is, the assemblies which are part of a component are listed immediately below that component, and the subassemblies which are part of an assembly are listed immediately below that assembly. Each generation breakdown (components, assemblies, or subassemblies) is listed in disassembly order or alphabetical order.

(2) Maintenance function. This column indicates the various maintenance functions allocated to the categories.

(a) Service. To clean, to preserve, and to replenish lubricants.

(b) Adjust. To regulate periodically to prevent malfunction.

(c) Inspect. To verify serviceability and to detect incipient electrical or mechanical failure by scrutiny.

(d) Test. To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc.

(e) Replace. To substitute serviceable components, assemblies, or subassemblies, for unserviceable components, assemblies, or subassemblies .

(f) Repair. To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes but is not limited to welding. grinding, riveting, straightening, and replacement of parts other than the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

(g) Align. To adjust two or more components of an electrical system so that their functions are properly synchronized.

(h) Calibrate. To determine, check, or rectify the graduation of an instrument, weapon, or weapons system, or components of a weapons system.

(i) Overhaul. To restore an item to completely serviceable condition as prescribed by serviceability standards developed and published by heads of technical services. This is accomplished through employment of the technique of "Inspect and Repair Only as Necessary" (IROAN). Maximum utilization of diagnostic and test equipment is combined with minimum disassembly of the item during the overhaul process.

(J) Rebuild. To restore an item to a standard as near as possible to original or new condition in appearance, performance, and life expectancy. This is accomplished through the maintenance technique of complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements using original manufacturing tolerances and/or specifications and subsequent reassembly of the item.

(3) Operator, organization, direct support, general support, and depot. The symbol X indicates the categories responsible for performing that particular maintenance operation, but does not necessarily indicate that repair parts will be stocked at that level. Categories higher than those marked by X are authorized to perform the indicated operation.

(4) Tools required. This column indicates codes assigned to each individual tool equipment, test equipment, and maintenance equipment referenced. The grouping of codes in this column of the maintenance allocation chart indicates the tool, test, and maintenance equipment required to perform the maintenance function.

(5) Remarks. Entries in this column will be utilized when necessary to clarify any of the data cited in the preceding columns.

c. Columns in the allocation of tools for maintenance functions are as follows:

(1) Tools required for maintenance functions. This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

(2) Operator, organization, direct support, general support, and depot The dagger (†) symbol in these columns indicates the categories normally allocated the facility.

(3) Tool code. This column lists the tool code assigned.

2. Maintenance by Using Organizations

When this equipment is used by signal services organizations organic to theater headquarters or communication zones to provide theater communications, those maintenance functions allocated up to an including general support are authorized to the organization operating this equipment.

SECTION II. MAINTENANCE ALLOCATION CHART

PART OR COMPONENT	MAINTENANCE FUNCTION	ECHELON O/C	ECHELON O	ECHELON DS	ECHELON GS	ECHELON D	TOOLS REQUIRED	REMARKS
VOLTMETER, ELECTRONIC ME-227/U	service		X					
	inspect		X					
	repair		X				3	Replace lamps, fuses, knobs.
					X		1,2,5	
	overhaul					X	1,2,4,6	

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SECTION III. ALLOCATION OF TOOLS FOR MIANTENANCE FUNCTIONS

TOOLS REQUIRED FOR MAINTENANCE FUNCTIONS	ECHELON					TOOL CODE	REMARKS
	O/C	O	DS	GS	D		
ME-227/U (continued)							
MULTIMETER TS-352/U				†	†	1	
TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G				†	†	2	
TOOLS AND TEST EQUIPMENT NORMALLY AVAILABLE TO THE REPAIRMAN-USER BECAUSE OF HIS ASSIGNED MISSION.		†				3	
TEST SET, ELECTRON TUBE TV-2/U					†	4	
TEST SET, ELECTRON TUBE TV-7/U				†		5	
TEST SET, METER TS-682/GSM					†	6	

SELMS Form 1149 (Supersedes SELMS-005 TF, which is obsolete) 1 Mar 64

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APPENDIX III

BASIC ISSUE ITEMS LIST

Section I. INTRODUCTION

1. General

This appendix lists items supplied for initial operation. Tile list includes tools, parts, and material issued as part of the major end item. The list includes all items authorized for basic operator maintenance of the equipment. End items of equipment are issued on the basis of allowances prescribed in equipment authorization tables and other documents that are a basis for requisitioning.

2. Columns

Columns are as follows:

a. Federal Stock Number. This column lists the n-digit Federal stock number.

b. Designation by Model. Not used.

c. Description. Nomenclature or the standard item name and brief identifying data for each item are listed in this column. When requisitioning enter the nomenclature and description.

d. Unit of Issue. The unit of issue is each unless otherwise indicated and is the supply term by which the individual item is counted for procurement, storage, requisitioning, allowances and issue purposes.

e. Expendability. Nonexpendable items are indicated by NX. Expendable items are not annotated.

f. Quantity Authorized. Under “Items Comprising an Operable Equipment," the column lists the quantity of items supplied for the initial operation of the equipment.

g. Illustration. Not used.

SECTION II. FUNCTIONAL PARTS LIST

FEDERAL STOCK NUMBER	DESIGNATION BY MODEL	DESCRIPTION	UNIT OF ISSUE	EXP	QTY AUTH	ILLUSTRATION	
						FIGURE NO.	ITEM NO.
6625-892-5117		VOLTMETER, ELECTRONIC ME-227/U: ranges 1 mv to 1000 vdc, in 13 steps; oper power reqt: 150v ac, 60 cycles, single phase; Portable type; 7 in d x 7 in w x 12 in h o/a		NX			
		ITEMS COMPRISING AN OPERABLE EQUIPMENT					
ORD thru AGC		TECHNICAL MANUAL TM 11-6625-610-15			2		
		VOLTMETER, ELECTRONIC ME-227/U (BASIC COMPONENT)			,1		
6625-689-6874		LEAD, TEST: Millivac Instruments, Inc. dwg No. 6011			1		
6625-689-6875		LEAD, TEST: Millivac Instruments, Inc. dwg No. 6010			1		
		RUNNING SPARE ITEMS					
		NO PARTS AUTHORIZED FOR STOCKAGE AT OPERATING LEVEL.					

(29)

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
chief of Staff

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

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