TM 11-6625-524-15-1

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL DS, GS AND DEPOT MAINTENANCE MANUAL

VOLTIMETER, ELECTRONIC AN/URM-145

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

HEADQUARTERS, DEPARTMENT OF THE ARMY

29 NOVEMBER 1966

TM 11-6625-524-15-1
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HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 17 April 1978

Operator, Organizational, Direct Support, General Support and Depot Maintenance Manual VOLTMETER, ELECTRONIC AN/URM-145 (NSN 6625-00-973-3986)

TM 11-6625-524-15-1, 29 November 1966, is changed as follows:

The title of the manual is changed as indicated above.

Page 4, paragraph A.2. Delete paragraph A.2 and substitute the following:

A.2. 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 71-13/MCO P4030.29A, and DLAR 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 4610.33B/AFR 75-18/MCO P461O.19C and DLAR 4500.15.

Paragraph A.3, line 7. Change "AMSEL-MA-C" to read "DRSEL-MA-Q."

After paragraph A.3 add the following:

A.4. Destruction of Army Materiel

Destruction of Army materiel to prevent enemy use shall be as prescribed in TM 750-244-2.

A.5. Reporting Equipment Improvement Recommendations (EIR)

EIR's will be prepared using DA Form 2407 (Maintenance Request). Instructions for preparing EIR's are provided in TM 38-750, The Army Maintenance Management System. EIR's should be mailed direct to Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-MA-Q, Fort Monmouth, New Jersey 07703. A reply will be furnished direct to you.

Page 21, paragraph 3.1-8. Delete warning and substitute the following

WARNING

The fumes of TRICHLOROETHANE are toxic. Provide thorough ventilation whenever it is used; avoid prolonged or repeated breathing of vapor. Do not use near an open flame or hot surface; trichloroethane is nonflammable but heat converts the fumes to a highly toxic phosgene gas. The inhalation of this gas could result in serious injury or death. Prolonged or repeated skin contact with trichloroethane can cause skin inflammation. When necessary, use gloves, sleeves and aprons which the solvent cannot penetrate.

Paragraph 3.1-9, last line. Change "TB SIG 364" to read "TB 43-0118."

Page 30, Appendix A. Delete Appendix A and substitute the following:

APPENDIX A
REFERENCES

Following is a list of references that are available to the operator, organizational, general support and depot maintenance personnel of the equipment.

DA Pam 310-4	Index of Technical Publications 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 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
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's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-2/U, TV-2A/U, TV-2B/U, and TV-2C/U.
TM 11-6625-320-12	Operator's and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U, ME-30C/U, and ME-30E/U.
TM 11-6625-665-15	Operator's, Organizational, DS, GS, and Depot Maintenance-Manual: Generator, Signal AN/USM-205.
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

Page 35, Appendix C. Delete Appendix C and substitute the following:

APPENDIX C
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations for . 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 y 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 (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To 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 bring 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 equipments used in precision measurement. Consists of comparisons 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 or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (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 resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., 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 equipments 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. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "work time" 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, appropraite "work time" figures will be shown for each category. The number of task-hours specified by the "work time" 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 addition 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.

f. Column 6, Remarks. Column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.

C-4. Tool and Test Equipment Requirements (Sect. III)

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.

C-5. Remarks (Sect. IV)

a. Reference Code. This code refers to the appropriate item in section II, column 6.

b. Remarks. This column provides the required explanatory information necessary to clarify items appearing in section II.

SECTION II MAINTENANCE ALLOCATION CHART
FOR
VOLTIMETER, ELECTRONIC AN/URM-145

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQPT.	(6) REMARKS
			C	O	F	H	D		
00	Voltmeter, Electronic AN/URM-145								
01	Voltmeter, Electronic ME-247/U or ME-247A/U	Inspect	.5						A
		Service		1.0				7	
		Test				2.0		1,2,3,4	
		Adjust				2.0		1,2,3	
		Repair		.5				6	B
						2.5		6	
		Overhaul					4.0	1,2,3, 5,6	
02	Probe Subassembly MX-4528/U	Replace		.25				7	
03	Probe Subassembly MX-4529/U	Replace		.25				7	
		Repair				1.0		6	
04	Lead, Test MX-4527	Replace		.25				7	
		Repair				1.0		6	

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
VOLTMETER, ELECTRONIC AN/URM-145

OOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H,D	Multimeter ME-260/U W/Accessory for reading voltages higher than 300 VAC	6625-00-913-9781	
2	H,D	Signal Generator AN/USM-205	6625-00-892-5542	
3	H,D	Voltmeter, Electronic ME-30( )/U	6625-00-643-1670	
4	H	Test Set, Electron Tube TV-7 D/U	6625-00-820-0064	
5	D	Test Set, Electron Tube TV-2/U	6625-00-699-0263	
6	H,D	Tool Kit, Electronic Equipment TK-1 00/G	51 80-00-605-0079	
7	O	Toolss nd test equipment available to maintenance personnel becsuse of assigned mission.		

SECTION IV. REMARKS FOR
VOLTMETER, ELECTRONIC AN/URM-145

REFERENCE CODE	REMARKS
A	Visual inspection only.
B	Organizational level repairs consists of replacing fuses, lamps, knobs, and adapter connector.

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Brigadier General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-36, Direct and General Support maintenance requirements for AN/ALR-8, AN/ASN-13. DA Form 12-51, Direct and General Support maintenance requirements for AN/GRC-106, AN/TRC-90.

TM 11-6625-524-15-1
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CHANGE
NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *23 May 1974*

Operator, Organizational, Direct Support, General Support, and Depot Maintenance Manual

VOLTMETER, ELECTRONIC AN/URM-145

TM 11-6625-524-15-1, 29 November 1966, is changed as follows:

Page 4. Add the following before the figure caption: *Figure 0.1*

After figure 0.1 add:

SECTION A
INTRODUCTION

A.1. 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.

A.2. 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 (Report of Packaging and Handling Deficiencies) as prescribed in AR 700-58/NAVSUP PUB 378/AFR 71-4/MCO P4030.29, 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 4610.33/AFM 75-18/MCO P4610.19A, and DSAR 4500.15.

A.3. 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 Blank Forms) and forwarded direct to Commander, US Army Electronics Command, ATTN: AMSEL-MA-C Fort Monmouth, NJ 07703.

SECTION A.1
ITEMS COMPRISING AN OPERABLE EQUIPMENT

FSN	QTY	Nomenclature	Fig. No.
6625-973-3986		Voltmeter, Electronic AN/URM-145 consisting of:	0.1
6625-973-2297	1	Lead, Test MX-4527/U	0.1
6625-973-2296	1	Probe Subassembly MX-4528/U	0.1
6625-973-2295	1	Probe Subassembly MX-4529/U	0.1

SECTION A.2
SPARE PARTS LIST

FSN	QTY	Nomenclature
5920-665-0976	5	Fuse, Cartridge: 71400; MDL-2
6240-151-5292	2	Lamp, Incandescent: 08806; 47

Page 31, appendix B. Delete appendix B.

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 12-36, Direct and General Support maintenance requirements for AN/ARC-102, AN/TSQ-72 and DA Form 12-51, Direct and General Support maintenance requirements for AN/GRC-106, AN/GRC-108 and AN/TRC-90.

TABLE OF CONTENTS

Electronic Voltmeter
AN/URM-145

SECTION I

SPECIFICATIONS: VOLTMETER, ELECTRONIC AN/URM-145

Measurement Range:		300 microvolts to 3 Volts
Full Scale Ranges:		.001, .003, .01, .03, .1, .3, 1, 3 Volts.
Frequency Range:		20 Kc to 600 Mc
Accuracy:	.003 range and above	5% F.S. 50 Kc to 400 Mc 10% F.S. 20 Kc to 50 Kc & 400 Mc to 600 Mc
	.001 range only	10% F.S. 50 Kc to 400 Mc 15% F.S. 20 Kc to 50 Kc & 400 Mc to 600 Mc
Input Impedance:		Lead, Test MX-4527/U (91-3C RF Probe) See curve for input resistance data on high impedance probe. Shunt capacitance varies inversely with input voltage fror 1.5 to 3pF approx.
		Probe Subassembly MX-4528/U (91-8B 50Ω BNC Adapter) Max. VSWR 1.2, 20 Kc to 600 Mc
		Probe Subassembly MX-4529/U (91-13B Probe Tip) For direct measurements up to 250 Mc.
Tube Complement:		1 each: BEC 525001, 7199, 6AU6, 0A2, and 6X4.
Power Requirements:		105-125 volts, 58-62 cycles, 30 watts.
Dimensions :		7-5/16 W x 11-1/16 H x 9-7/8 D Overall(handle folded)
Weight:		12 pounds

SECTION II

GENERAL DESCRIPTION

The AN/URM-145 RF Voltmeter is a sensitive instrument for the measurement of voltages of 300 microvolt to 3 Volts spanning a frequency range of 20 kilocycles to 600 megacycles. In addition to conveniently measuring voltage levels in a diversity of RF circuits, the instrument has application for many associated tests. Such measurements include: the frequency response of both active and passive networks, i.e., amplifiers and filters; VSWR and return loss on transmission lines and attendant systems; attenuation and insertion loss of RF attenuators; and high frequency parameters of transistors. With true RMS response below 0.03 Volt, wide band noise can be measured, and using suitable null networks measurement of the harmonic distortion of RF waveforms can be performed without the attendant errors of average type meters.

The instrument is also useful as an RF null detector for bridge measurements and analogous techniques when a sensitivity in the order of 200 microvolt will suffice.

Supplied with each instrument is a general purpose RF Probe, 50 ohm Adapter, and probe Tip. The adapter is fitted with a BNC coaxial connector and provides a 50 ohm termination with a low VSWR up to 600 megacycles. The Probe Tip is useful for direct measurement to approximately 250 megacycles, however, a short wire should be substituted for the ground lead when using above 100 Mc to minimize the effects of ground lead inductance. Above 250 megacycles, the probe may be used directly without the tip but the connecting leads must be extremely short to avoid resonant effects. Normally the RF Probe is used with the 50Ω Adapter in a coaxial system for accurate measurements above 100 Mc.

The RF Probe with its full-wave crystal detecting circuit produces a true RMS response without turnover, or harmonic errors for all voltage levels below 0.03 Volt, gradually changing to peak-to-peak reading (calibrated in RMS) at approximately 1.0 Volt. The probe has a shunt capacitance of approximately 2.5 pF at levels of 0.3 volt or higher, increasing slightly at levels of 0.1 Volt or less. (see Fig. 2) The shunt resistance component shown in Figure 1 is a variable factor, depending on the voltage and frequency.

A db scale in red on the panel meter and range switch provides a convenient means of expressing relative voltage measurements.

There is no zero control but instead a balancing control allows residual indications due to noise to be minimized resulting in excellent stability and ease of reading even on the most sensitive range.

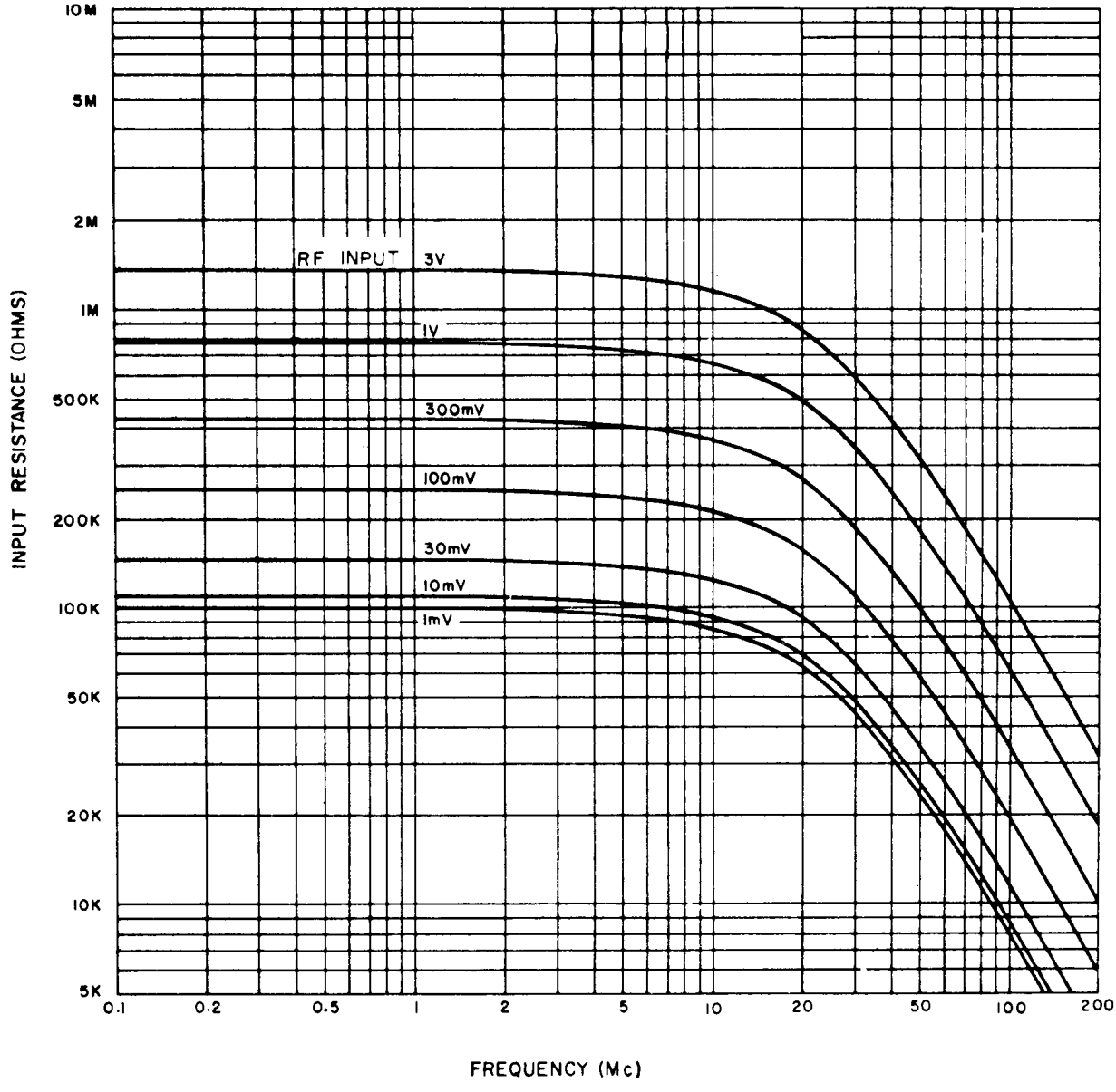

Figure 1

INPUT RESISTANCE OF RF PROBE

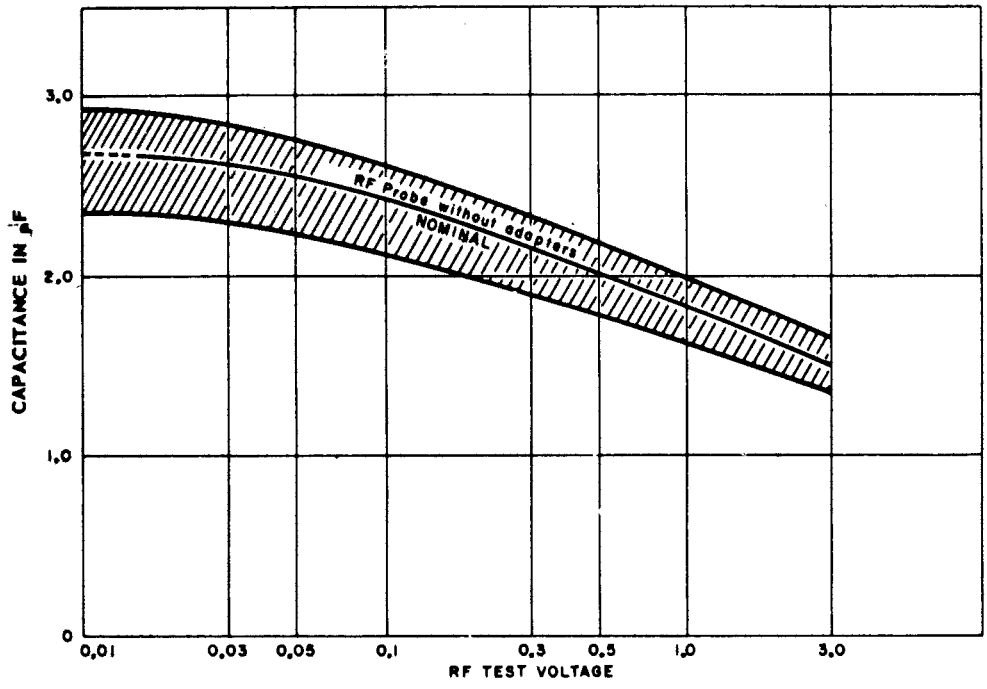

Figure 2

INPUT CAPACITANCE OF RF PROBE (MEASURED AT 10 Mc)

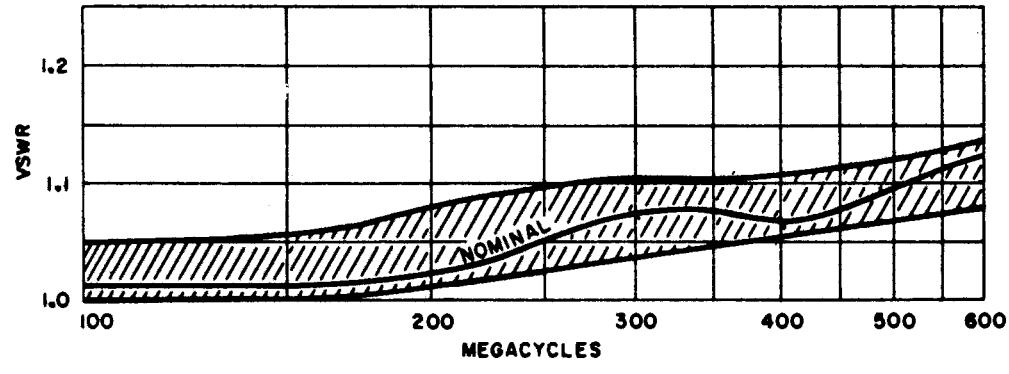

Figure 3

VSWR OF RF PROBE WITH 50 OHM ADAPTER ATTACHED

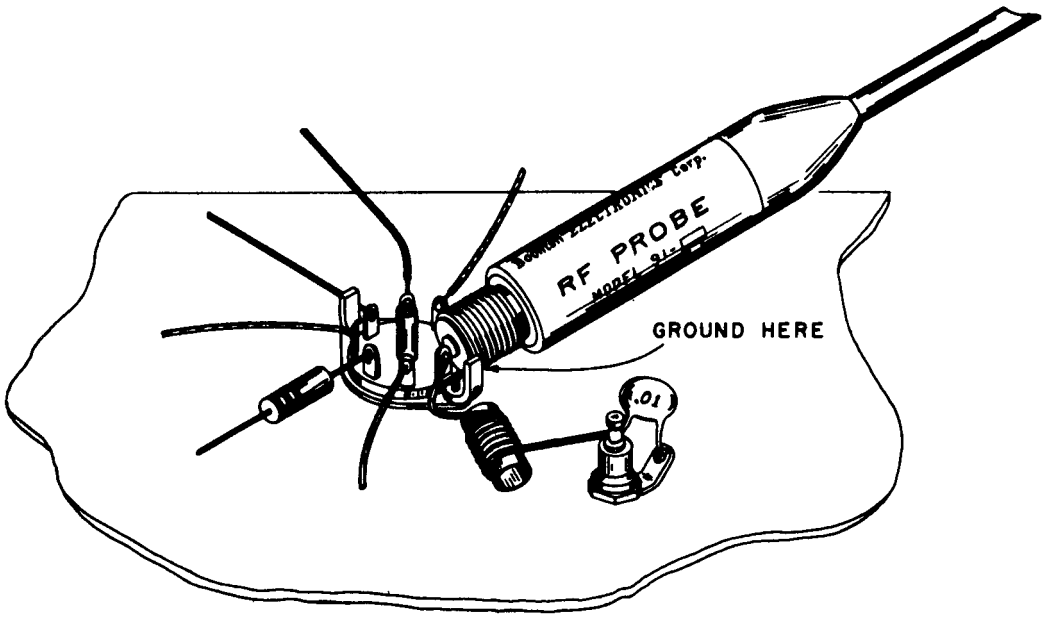

Figure 4

METHOD FOR MAKING LOW INDUCTANCE CONNECTIONS TO TEST SIGNAL POINT DIRECTLY USING THE RF PROBE. USE FOR IN-CIRCUIT MEASUREMENTS WHEN LOWEST CAPACITANCE LOADING IS REQUIRED OR WHEN GROUND LEAD INDUCTANCE OF PROBE TIP CANNOT BE TOLERATED.

SECTION III

OPERATING PROCEDURE.

3.1 General Information

This section should be read carefully before using the instrument. It contains information necessary for proper operation of the RF Voltmeter.

The power line frequency and voltage requirements of the instrument are 105 to 125 Volts, 58 to 62 cycles. It is important that it is plugged into its proper power source.

3.2 Turn-on Procedure

a. With the power cord plugged into an appropriate AC source, turn the instrument on and allow a warm-up period of approximately one minute.

b. Connect the RF Probe cable to the "PROBE" receptacle on the front panel. (Note: Check to determine that the serial number of the probe matches that of the instrument. Each RF Voltmeter is calibrated for its individual probe. If probes should be interchanged without recalibrating the instrument, errors in measurement may result.)

c. Attach 50Ω Adapter to RF Probe in order to shield the input from any stray RF fields (3.4c) before preceding to adjust BALANCE control (3.2d).

d. Set RANGE-FULL SCALE control to .001 and carefully adjust BALANCE control for minimum meter deflection. Normal meter deflection for zero input signal is as follows:

RANGE	DEFLECTION
.001	less than 3/4 inch
.003, .01, .03, .1, .3, 1, 3	less than 1/16 inch Suppressed

3.3 Measurement Procedure

a. Set RANGE-FULL SCALE control to appropriate setting (or higher) for voltage to be measured.

b. For "in-circuit" measurements, remove 500 Adapter and attach Probe Tip to RF Probe. The Probe Tip is useful for direct measurement to approximately 250 megacycles, however, a short wire should be substituted for the ground lead when using above 100 Mc to minimize the effects of ground lead inductance. Above 250 megacycles, the probe may be used directly without the tip but the connecting leads must be extremely short to avoid resonant effects, see Fig. 4.

c. Connect ground clip or wire to suitable ground and connect tip to point where voltage is to be measured. Alternatively measurement may be made using direct connection (Fig. 4.).

d. Read RF voltage on appropriate meter scale corresponding to setting of RANGE-FULL SCALE control.

e. To obtain readings in decibels, add the db (red scale) meter reading to the db (red) setting of the RANGE-FULL SCALE control. Although individual db readings have no significance as absolute measurements, the difference between two db readings is a useful way of expressing voltage ratio.

f. For terminated measurements in 50Ω systems, the 50Ω Adapter should be attached to the RF Probe. Always

use the adapter wherever possible for accurate measurements above 100 Mc.

3.4 Operating Precautions

a. Maximum Input Voltages:

RF voltages exceeding 10 Volts must not be applied to the probe or permanent damage to the crystal diodes may result. The 50Ω Adapter should not be subjected to continuous overloads exceeding 10 Volts to avoid excessive heating of terminating resistor.

Maximum DC voltage for RF Probe is 400 Volts.

Maximum DC voltage for 50Ω Adapter is 10 Volts.

Note: Do not apply maximum DC voltage simultaneously with maximum RF voltage when using 50Ω Adapter.

b. Temperature Effects:

The normal ambient temperature range for specified accuracy is 65° to 90° F. Appreciable inaccuracies can be expected while the probe is exposed to temperatures above or below this range. No permanent change in probe characteristics will result from the high or low temperature exposure.

Inaccuracies due to temperature effects may occur after soldering to the probe Tip or from heat sources such as resistors or tubes.

When making low level measurements in the order of 2 millivolts or less, it is important to make sure that the probe has attained a uniform temperature throughout. A temperature difference between the inside and outside of the probe can generate a small thermal voltage that may add to or subtract from the DC voltage generated by the diodes.

c. Hum, Noise, and Spurious Pick-up:

When measuring low level RF voltages, precautions should always be taken to avoid the possibility of erroneous readings resulting from hum, noise, or stray RF pick-up. Although all low frequency hum and noise is attenuated at the input by 60 db, it is still possible for high level unwanted signals to get through and cause errors. The best test for this condition is to reduce the test signal to zero level and note whether the voltmeter continues to read some spurious signal level. In some cases it may be necessary to provide extra shielding around the probe connections to reduce stray field pick-up. Typical sources of spurious radiation are induction or dielectric heating units, diathermy machines, local radio transmitters, grip dip meters, and amplifiers with parasitic oscillations.

d. Magnetic Fields:

Operation of the voltmeter in strong 60 cycle magnetic fields such as those surrounding unshielded power transformers should be avoided; otherwise a standing reading that cannot be nulled by the balance control may result. The magnetic field induces small 60 cycle currents in the amplifier section of the instrument which, due to the extremely high gain at this frequency, appear as an indication on the panel meter.

SECTION III.1

PREVENTIVE MAINTENANCE INSTRUCTIONS

3.1-1. Scope of Maintenance

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

a. Operator's preventive maintenance checks and. services (para 3.1-4).

b. Organizational weekly preventive maintenance checks and services (para 3.1-5).

c. Organizational monthly preventive maintenance checks and services (para 3.1-6).

d. Organizational quarterly preventive maintenance checks and services (para 3.1-7).

e. Cleaning (para 3.1-8).

f. Touchup painting (para 3.1-9).

3.1-2. 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 3.1-8 and 3.1-9 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 3.1-4 through 3.1-7) 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 the normal conditions; 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 action indicated, higher category of 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.

3.1-3. Preventive Maintenance Checks and Services Periods

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

a. Paragraph 3.1-4 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 3.1-5, 3.1-6, and 3.1-7 specify additional checks and services that must be performed on a weekly, monthly, and quarterly basis, respectively.

3.1-4. Operator's Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item to be inspected	Procedure	References
1	Completeness	See that the equipment is complete (appx II).	None.
2	Exterior surfaces	Clean the exterior surfaces, including the panel (para 3.1-8). Check the meter glass 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 switch and control is smooth and free of external or internal binding, and that there is no excessive looseness.	None.
5	Operation	During operation, be alert for any unusual performance or condition.	None.

3.1-5. Organizational Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item to be inspected	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 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 3.1-9).	None.

3.1-6. Organizational Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item to be inspected	Procedure	References
1	Pluckout items	Inspect seating of pluckout items. Make sure that the tube clamps grip the tube bases tightly.	None.
2	Jacks and plugs	Inspect jacks and plugs for snug fit and good contact.	None.
3	Transformer terminals.	Inspect the terminals on the power transformer. All nuts must be tight. There should be no evidence of dirt or corrosion.	None.
4	Resistors and capacitors.	Inspect the resistors and capacitors for cracks, blistering, or other detrimental defects.	None.

3.1-7. Organizational Quarterly Preventive Maintenance Checks and Services Chart

Sequence No.	Item to be inspected	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.
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 on valid requisitions.	

3.1-8. Cleaning

Inspect the exterior of the equipment. The exterior surfaces must be free of dust, 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. Avoid contact with the skin; wash off any that spills on your hands.

b. Remove grease, fungus, and ground-in dirt from the case and cover of the equipment. Use a cloth dampened (not wet) with Cleaning Compound (FSN 7930-395-9542).

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

d. Clean the front panel and control knobs with a soft clean cloth. If dirt is difficult to remove, dampen the cloth with water; use mild soap if necessary.

3.1-9. 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 applicable cleaning and refinishing practices specified in TB SIG 364.

SECTION IV

THEORY OF OPERATION

4.1 An understanding of the operating features of the RF Voltmeter may be obtained by a study of the block diagram (Fig. 5) in conjunction with the following description.

The radio frequency voltage to be measured is rectified in the RF Probe by means of a full wave germanium diode rectifier circuit. The resulting DC potential is then attenuated as required before conversion to 60 cycle AC by the chopper. This AC signal is then amplified in a narrow band feed-back stabilized amplifier prior to its re-conversion to DC for use in actuating the meter.

The germanium diodes used in the RF Probe have been carefully selected for several characteristics. As the selected diodes do not all exhibit the same rectification efficiency characteristics, it becomes necessary to adjust each meter range to match individual probe diodes. The range adjustments consist of individual non-linear circuits shunting the output meter circuitry. As the RANGE switch is set to the required test voltage position the appropriate non-linear adjusting circuit is automatically shunted across the output. It is also important to understand that the non-linear output circuitry is designed to compensate for the non-linear characteristics of the probe diodes when operating at levels below 0.3 Volt.

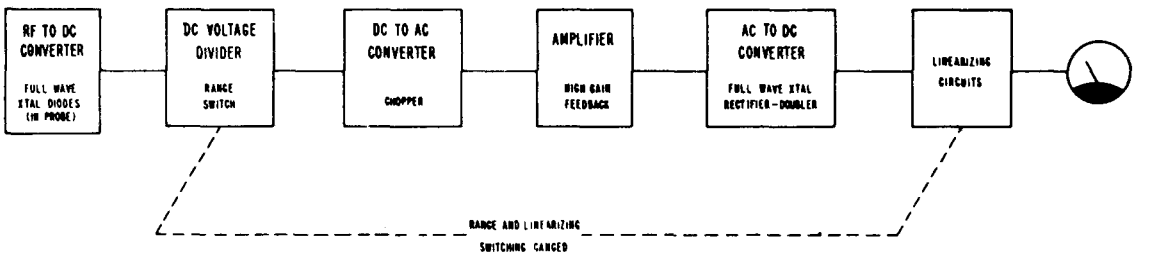

Figure 5

BLOCK DIAGRAM OF RF VOLTMETER

SECTION V

MAINTENANCE

5.1 Periodic Checking

The RF Voltmeter is designed to give long periods of service without maintenance when operated in accordance with these instructions. It is recommended, however, that the instrument be checked occasionally using reliable standards to insure against errors resulting from deterioration of tubes or chopper. To make these checks, it is necessary to have a signal source in the 200 to 500 Kc region with less than 2% distortion at levels up to 3 Volts across 50Ω. A precision electronic voltmeter of the averaging response type, such as the Ballantine Model 310A or 314, Hewlett Packard Model 400D or 400H, may be used to monitor the signal source for this purpose. To insure its accuracy, the monitoring meter should be checked at some low frequency (50-100 cycles) of good waveform against a dynamometer type AC meter of at least 1% accuracy.

5.2 Calibration Precautions

When attempting to check the voltage calibration accuracy on art instrument having the sensitivity and bandwidth of this RF Voltmeter, it is essential to take precautions to avoid errors resulting from stray pick-up voltages. (See paragraph 3.4c,d). A well shielded signal source must be used in conjunction with coaxial connections to both the RF Voltmeter and the standard referenced meter. Even with a well shielded generator and associated connections, it is sometimes possible for the reference meter to pick up stray RF signals and feed them into the probe. Check for this condition by disconnecting the standard meter and noting change in level.

5.3 Calibration Check Procedure

With suitable calibrating equipment (paragraph 5.1) and taking necessary precautions (paragraph 5.2), we can now check calibration accuracy. Each range should be checked at a voltage representing 90% of full scale value. If these check points agree within ± 2% of the standard, it is recommended that no adjustment be made. If the check points deviate by more than ± 5% from the standard, it is recommended that a trouble shooting procedure be followed as outlined in paragraph 5.4. If the check points fall between 2% and 5% of the standard, the calibration adjustment procedure as outlined in paragraph 5.5 should be followed.

5.4 Trouble Shooting Procedure

a. Case Removal

The instrument may be removed from its case after first removing the two screws located at the back of the case (near the bottom) and the four screws located on the sides of the case near the front.

The power supply may be removed from the case after first removing the four screws located on the sides of the case near the rear.

b. Tube Replacement

If the tube VI should become weak or noisy, it should be replaced with Boonton Electronics Part Number 525001. A commercial low noise 12AX7 which has low microphonism and meets the requirements of paragraph 3.2c may be used if a BEC 525001 is not available. The Telefunken ECC83/ 12AX7 has been found to meet these requirements consistently. After replacing this or other defective tubes, re-check calibration as outlined in paragraph 5.3 and adjust if necessary as described in paragraph 5.5

c. Chopper Replacement

If satisfactory operation is not obtained by replacing

tubes, a replacement chopper should be tried. If the new chopper does not clear the difficulty, place the original chopper back in socket. The calibration accuracy must be re-checked. If the chopper is replaced, the drive coil connections should be reversed (twisted pair from chopper top cap to meter terminal board) to discover which polarity gives lowest residual meter deflection (para. 3.2c) The leads should then be resoldered in this polarity.

d. Voltage and Resistance Tests

After determining that the trouble cannot be cured by replacement of tubes or chopper it is advisable to make a systematic check of AC voltage, DC voltage, and resistance at each socket pin. Table I shows the nominal AC and DC voltages to ground from each socket pin number. Table 2 shows the nominal resistance values expected for each point. Large or erratic deviations from the listed values of voltage or resistance will serve as a clue in tracking down a faulty component. Once the trouble has been found and corrected, the calibration must be re-checked and re-adjusted as outlined in paragraph 5.3 and paragraph 5.5

e. RF Probe Replacement:

Probes that have been damaged by overload or have become inoperative or insensitive for any other reason should be replaced rather than repaired. After replacement calibration must be rechecked and adjusted if necessary. The Probe serial number should agree with that of the instrument; if exchanged, recalibration may be necessary.

5.5 Calibration Adjustment Procedure

Before making any calibration adjustments, it is essential to provide the necessary reference standards as described in paragraph 5.1 and take all precautions as outlined in paragraph 5.2. The calibration adjustment procedure shall then be made as outlined in Table 3.

TABLE 1

TEST POINT VOLTAGES

Conditions:

117V 60 cycle line input.
Readings are in volts unless otherwise shown.
All measurements to chassis unless otherwise noted.
Input 0.0IV at any frequency between 100 Kc and 1 Mc.
Use Ballantine Model 314 VTVM for all AC voltage measurements.
Use Hewlett-Packard Model 410B or C for all DC voltage measurements.

Pin #		1	2	3	4	5	6	7	8	9	10	11
Tube	DC	70	0	0.76	53	53	90	0	0.85	47	-	-
V1 BEC 525001	AC	2.7mV	1.4mV	-	-	-	0.1	2.3mV	-	-	-	-
	DC	0.69	1.7	59	53	20	38	1.7	-	-	-	-
V2 (6AU6)	AC	0.1	-	-	-	0.5	-	-	-	-	-	-
	DC	300	100	50	0	0	1.35	-	170	150	-	-
V3 (7199)	AC	0.4	21	-	0	6.3	-	0.1	18	21	-	-
	DC	-	-	-	-	-	-	400	-	-	-	-
V4 (6X4)	AC	340	-	6.3	0	-	340	-	-	-	-	-
	DC	150	-	-	-	150	-	-	-	-	-	-
V5 (OA2)	AC	-	-	-	-	-	-	-	-	-	-	-
	DC	-	-	-	-	52	-	150	300	0	47	58
J2 Socket	AC	6.3	0	115	115	-	-	-	-	-	-	-
	DC	-	-	-	-	-	-	-	-	-	-	-
Chopper Socket	AC	-	-	1.5 mV	-	-	-	-	-	-	-	-

Pin 10 to Pin 11 of J2	DC	11
	AC	0.32
Pin 10 to Pin 5 of J2	DC	5.4
	AC	15 mV

TABLE 2

TEST POINT RESISTANCES

Conditions:

Power turned off.
Tubes in sockets.
Amplifier and power supply interconnected (J2 to P2)
All measurements to chassis

Pin #	1	2	3	4	5	6	7	8	9	10	11
Tube											
V1 BEC 525001	1.2MΩ	6.8MΩ	11KΩ	16KΩ	16KΩ	500KΩ	2.2MΩ	6.8KΩ	16KΩ	-	-
V2 (6AU6)	850KΩ	3.8KΩ	16KΩ	16KΩ	500KΩ	1MΩ	3.8KΩ	-	-	-	-
V3 (7199)	68KΩ	300KΩ	1.1MΩ	0	0	1.2KΩ	1MΩ	20KΩ	1MΩ	-	-
V4 (6X4)	300Ω	-	0	0	-	300Ω	68KΩ	-	-	-	-
V5 (OA2)	50KΩ	0	-	0	50KΩ	-	0	-	-	-	-
J2 Socket	0	0	Inf.	Inf.	17KΩ	-	45KΩ	60KΩ	0	16KΩ	16KΩ

TABLE 3

CALIBRATION ADJUSTMENT PROCEDURE

Step	Reference Std. Voltage	Voltage Range Setting	Adjust #	Adjust To Read	Notes
1.	0.3 V	1	1	0.3 V	Main gain adjustment: affects down scale readings on ranges 3 V to .1V.
2.	0.9 V	1	2	0.9 V	Slope adjustment: affects up scale readings more than down scale: adjusts 1 V range only.
3.	2.5 V	3	3	2.5 V	Slope adjustment: affects up scale readings more than down scale: adjusts 3 V range only.
4.	0.25 V	.3	4	0.25 V	Slope adjustment: affects up scale readings more than down scale: adjusts .3 V range only.
5.	0.09 V	.1	5	0.09 V	Slope adjustment: affects up scale readings more than down scale: adjusts .1 V range only.
6.	0.003 V	.01	6	0.003 V	Main gain adjustment: affects down scale readings on ranges .03 V to .003 V.
7.	0.005 V	.01	7	0.005 V	Mid range slope adjustment: affects mid scale linearity on .01 V range only.
8.	0.009 V	.01	8	0.009 V	Slope adjustment: affects up scale readings more than down scale: adjusts .01 V range only.
9.	0.025 V	.03	9	0.025 V	Slope adjustment: affects up scale readings more than down scale: adjusts .03 V range only.
10.	0.0025 V	.003	10	0.0025 V	Slope adjustment: affects up scale readings more than down scale: adjusts .003V range only.
11.	0.0009 V	.001	11	0.0009 V	Main gain adjustment: adjusts calibration of .001V range only.

NOTE: Adjustment #1 to 6 are located from front to rear on right side of cabinet.
Adjustment #7 to 11 are located from rear to front on left side of cabinet.

SECTION VI

SHIPPING INSTRUCTIONS

6.1 If it becomes necessary to ship the instrument, the following steps should be followed:

a. Wrap the instrument with heavy wrapping paper and seal the seams with gummed tape. Place in fibreboard carton large enough to permit three inches of soft packing material between instrument and sides of box.

b. Separately wrap with heavy paper and pad the correct serial number probe and accessories and include with voltmeter.

c. Alternatively Boonton Electronics will provide an appropriate shipping container and packing materials at nominal cost. These may be obtained by writing to the Sales Department, Boonton Electronics Corporation, Route 287 at Smith Rd., Parsippany, N. J. 07054.

APPENDIX A

REFERENCES

Following is a list of references that are available to the operator, organizational, general support, and depot maintenance repairmen of the equipment.

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TB SIG 364	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 38-750	Army Equipment Record Procedures.

APPENDIX B

BASIC ISSUE ITEMS

Section I. INTRODUCTION

B-1. General

This appendix lists items for Voltmeter, Electronic AN/URM-145, the component items comprising it, and the items which accompany it, or are required for installation, operation, or operator's maintenance.

Note: This basic issue items list applies only to equipments on Order No. FR 36-039-N-6-00345(E).

B-2. Explanation of Columns

An explanation of the columns in section II is given below,

a. Source, Maintenance, and Recoverability Codes, Column 1.

(1) Source code, column 1a. The selection status and source for the listed item is noted here. The source code used is:

Code	Explanation
P	Applies to repair parts which are stocked in or supplied from the GSA/DSA, or Army supply system, and authorized for use at indicated maintenance categories.

Code	Explanation
A	Applies to assemblies that are not procured or stocked as such but are made up of two or more units, each of which carry individual stock numbers and descriptions and are procured and stocked and can be assembled by units at indicated maintenance categories.

(2) Maintenance code, column lb. The lowest category of maintenance authorized to install the listed item is noted here. The maintenance code used is as follows:

Code	Explanation
O	Organizational maintenance
H	General support maintenance

(3) Recoverability code, column lc. The information in this column indicates whether unserviceable items should be returned for recovery or salvage. Recoverability codes and their explanations are as follows:

Note: When no code is indicated in the recoverability column, the part will. be considered expendable.

Code	Explanation
R	Applies to repair parts and assemblies that are economically repairable at DSU and GSU activities and are normally furnished by supply on an exchange basis.

b. Federal Stock Number, Column 2. The Federal stock number for the item is indicated in this column.

c. Description, Column 3. The Federal item name, a five-digit manufacturer's code, and a part number are included in this column.

d. Unit of Issue, Column 4. The unit used as a basis of issue (e.g. ea, pr, ft, yd, etc) is noted in this column.

e Quantity Incorporated in Unit Pack Column 5. Not used.

f. Quantity Incorporated in Unit, Column 6. The total quantity of the item used in the equipment is given in-this column.

g Quantity Authorized, Column 7. The total quantity of an item required to be on hand and necessary for the operation and maintenance of the equipment is given in this column.

h. Illustration, Column 8. Not used.

B-3. Federal Supply Codes

This paragraph lists the Federal supply code with the associated manufacturer's name.

Code	Manufacturer
08806	General Electric Co.
71400	Bussmann Mfg Division of McGraw-Edison Co.

SECTION II. BASIC ISSUE ITEMS LIST

(1) SOURCE CD (A)	(1) MAINT. CD (B)	(1) REC. CODE (C)	BASIC ISSUE ITEMS LIST (2) FEDERAL STOCK NUMBER	MODEL 1	2	3	4	5	6	(3) DESCRIPTION	(4) UNIT OF ISSUE	(5) QTY INC IN UNIT PACK	(6) QTY INC IN UNIT	(7) QTY AUTH	(8) ILLUSTRATIONS (A) FIGURE NUMBER	(B) ITEM OR SYMBOL NUMBER
A	H	R	6625-973-3986							VOLTMETER, ELECTRONIC AN/URM-145 (THIS ITEM IS NONEXPENDABLE)	ea					
			ORD THRU AGC							TECHNICAL MANUAL TM 11-6625-524-15-1	ea		1	1		
										NOTE: For technical manuals the quantity indicates the maximum number of copies authorized for packing (or issue) with the equipment. Where a number of these equipments are concentrated in a small area, the quantity on hand may be reduced to practical levels. Excess publications must be returned to publication supply centers through AG channels.						
P	O		5920-665-0976							FUSE, CARTRIDGE: 71400; MDL1-2	ea		1	5		
P	O									LAMP, INCANDESCENT: 08806; 47	ea		2	2		
P	O	R	6625-973-2297							LEAD, TEST MX-4527/U	ea		1	1		
P	O		6625-973-2296							PROBE SUBASSEMBLY MX-4528/U	ea		1	1		
P	O		6625-973-2295							PROBE SUBASSEMBLY MX-4529/U	ea		1	1		
A	O	R								VOLTMETER, ELECTRONIC ME-247/U	ea		1	1		
										NO ACCESSORIES, TOOLS, OR TEST EQUIPMENT ARE TO BE ISSUED WITH THIS EQUIPMENT						
										NO PARTS ARE MOUNTED, IN OR ON THIS EQUIPMENT, FOR STORAGE PURPOSES						

ESC-FM 96-66

APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-l. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for Voltmeter, Electronic AN/URM-145. 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.

Note: This maintenance allocation chart applies only to equipments on Order No. FR 36-039-N-6-00345(E).

C-2. Explanation of Format for Maintenance Allocation Chart

a Group Number. Not used.

b Component Assembly Nomenclature. This column lists the item names of component units, assemblies, subassemblies, and modules on which maintenance is authorized.

c. Maintenance Function. This column indicates the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform a function at any category also includes authorization to perform that function at higher categories. The codes used represent the various maintenance categories as follows:

Code	Maintenance category
c	Operator/Crew
o	Organizational Maintenance

Code	Maintenance category
F	Direct Support Maintenance
H	General Support Maintenance
D	Depot Maintenance

d. Tools and Equipment. The numbers appearing in this column refer to specific tools and equipment which are identified by these numbers in section III.

e. Remarks. Self explanatory.

C-3. Explanation of Format for Tool and Test Equipment Requirements

The columns in the tool and test equipment requirements chart are as follows:

a. Tools and Equipment. 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 for the maintenance function.

b. Maintenance Category. The codes in this column indicate the maintenance category normally allocated the facility.

c. Nomenclature. This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

d. Federal Stock Number. This column lists the Federal stock number.

e. Tool Number. Not used.

SECTION II. MAINTENANCE ALLOCATION CHART

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
	VOLTMETER, ELECTRONIC AN/URM-145	C		C									7	
			H										1,2,3,4	
					H								1,2,3	
										H			6	
											D		1,2,3,5,6	
	PROBE SUBASSEMBLY MX-4528/U								H	H			6	
	PROBE SUBASSEMBLY MX-4529/U								H	H			6	
	LEAD, TEST MX-4527/U								H	H			6	
	VOLTMETER, ELECTRONIC ME-247/U AND ME-247A/U								H				6	

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE	FEDERAL STOCK NUMBER	TOOL NUMBER
		AN/URM-145 (continued)		
1	H,D	MULTIMETER ME-260/U*	6625-913-9781	
2	H,D	SIGNAL GENERATOR AN/USM-205	6625-892-5542	
3	D,H	VOLTMETER, ELECTRONIC ME-30( )/U	6625-669-0742	
4	H	TEST SET, ELECTRON TUBE TV-7( )/U	6625-376-4939	
5	D	TEST SET, ELECTRON TUBE TV-2( )/U	6625-699-0263	
6	H,D	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G		
7	O	TOOLS AND TEST EQUIPMENT AVAILABLE TO REPAIRMAN-USER BECAUSE OF HIS ASSIGNED MISSION.		
		*ACCESSORY REQUIRED FOR VOLTAGE READINGS HIGHER THAN 300 VAC.		
		HP 11040A CAPACITIVE VOLTAGE DIVIDER		

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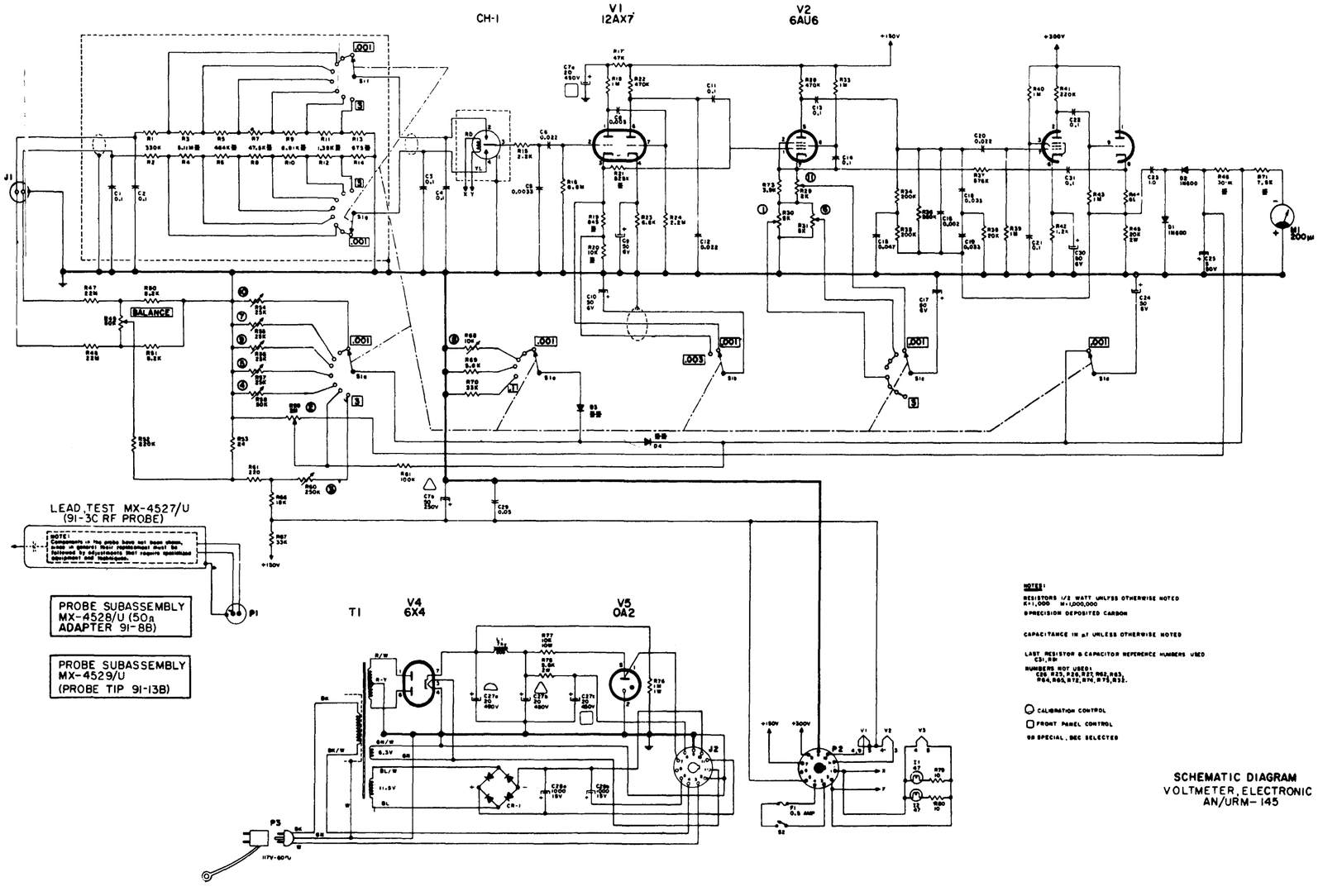
CH-1
V1
12AX7
V2
6AU6
+150V
+300V
BALANCE
LEAD, TEST MX-4527/U
(91-3C RF PROBE)
PROBE SUBASSEMBLY
MX-4528/U (50Ω
ADAPTER 91-88)
PROBE SUBASSEMBLY
MX-4529/U
(PROBE TIP 91-13B)
T1
V4
6X4
V5
0A2
P1
P2
P3
J1
J2
SCHEMATIC DIAGRAM
VOLTMETER, ELECTRONIC
AN/URM-145

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *29 November 1966*

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USAESC (70)
MDW (1)
Armies (2)
Corps (2)
USAC (3)
USATC (2)
Svc Colleges (2)
USASESCS (100)
USAADS (2)
USAAMS (30)
USAARMS (30)
USAIS (30)
USAES (2)
WRAMC (1)
Army Pic Cen (2)
Instl (2) except
Ft Hancock (4)
Ft Gordon (10)
Ft Huachuca (10)
Ft Carson (25)
Ft Knox (12)
Gen Dep (2)
Sig Sec, Gen Dep (5)
Sig Dep (12)
Army Dep (2) except
LBAD (14)
SAAD (30)
TOAD (14)
LEAD (7)
NAAD (5)
SVAD (5)
ATAD (10)
Sig FLDMS (2)
AMS (1)
USACRREL (2)
USAERDA (2)
USAERDAW (13)
Units org under fol TOE (2 ea):
11-57
11-97
11-98
11-117
11-127
11-155
11-157
11-158
11-500(AA-AC)
11-587
11-592
11-597

NG: State AG (3).

USAR: None.

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

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