TM 11-6625-486-10

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR'S MANUAL

FREQUENCY METER AN/USM-159

HEADQUARTERS, DEPARTMENT OF THE ARMY
APRIL 1962

Operator's Manual

FREQUENCY METER AN/USM-159

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON D.C., *20 December 1963*

TM 11-6625-486-10, 26 April 1962, is changed as follows:

Page 7. Add paragraph 1.1 after paragraph 1.

1.1. Index of Publications

Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to your equipment. DA Pam 310-4 is an index of current technical manuals, technical bulletins, supply manuals (4, 6, 7, 8 and 9), supply bulletins, lubrication orders, and modification work orders which are 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.

Delete paragraph 2 and substitute:

2. 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 manual is authorized and encouraged. DA Form 2028 (Recommended changes to DA technical manual parts lists or supply manual 7, 8, or 9) will be used for reporting these improvements. This form wiil be completed in triplicate using pencil, pen, or typewriter. The original and one copy will be forwarded direct to: Commanding Officer, U. S. Army Electronics Materiel Support Agency, ATTN: SELMS-MP, Fort Monmouth, N. J. 07703. One information copy will be furnished to the individual's immediate supervisor (officer, noncommissioned officer, supervisor etc.).

Page 21. Delete section I and substitute:

Section 1. MAINTENANCE

24. Scope of Maintenance

The maintenance duties assigned to the operator of Frequency Meter AN/USM-159 are listed below, together with a reference to the paragraphs covering the specific maintenance functions. No special tools or test equipment are required.

a. Daily preventive maintenance checks and services (par. 25.2).

b. Weekly preventive maintenance checks and services (par. 25.3).

c. Monthly preventive maintenance checks and services (par. 25.4).

* This change supersedes so much of TM 11-6625-318-12P, 11 September 1959, as pertains to the basic issue items list.

d. Quarterly preventive maintenance checks and services (par. 25.5).

e. Cleaning (par. 25.6).

f. Touchup painting (par. 25.7).

g. Replacement of fuses (par. 28).

25. 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 25.1 through 25.7 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 (pars. 25.2, 25.3, 25.4, and 25.5) 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 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.

25.1. Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of Frequency Meter AN/USM-159 are required daily, weekly, monthly, and quarterly.

a. Paragraph 25.2 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 25.3, 25.4, and 25.5 specify *additional* checks and services that must be performed on a weekly, monthly, and quarterly basis, respectively.

25.2. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Completeness	See that the equipment is complete (par. 5).	
2	Exterior surfaces	Clean the exterior surfaces, including the panel and meter glass (par. 25.6). Check the meter and film readout glasses for cracks.	
3	Connectors	Check the tightness of all connectors.	
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.	
5	Operation	Operate the equipment according to paragraph 27.	Par. 27.

25.3. 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.	
2	Handles and latches	Inspect handles, latches, and hinges for looseness. Replace or tighten as necessary.	
3	Metal surfaces	Inspect exposed metal surfaces for rust and corrosion. Clean and touchup paint as required (par. 25.7).	
4	Battery and compartment.	Inspect the batteries for leakage. Check the compartment for corrosion.	

25.4. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Pluckout items	Inspect seating of pluckout items.	
2	Jacks	Inspect jacks for snug fit and good contact.	
3	Terminal blocks	Inspect terminal blocks for loose connections and cracked or broken insulation.	
4	Resistors and capacitors.	Inspect the resistors and capacitors for cracks, blistering, or other detrimental defects.	
5	Gaskets and insulators.	Inspect gaskets, insulators, bushings, and sleeves for cracks, chipping, and excessive wear.	
6	Variable capacitors.	Inspect variable capacitors for dirt, corrosion and deformed plates.	
7	Interior	Clean interior of chassis and cabinet.	
8	Batteries	Before storing or shipping, remove the batteries.	

25.5. 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 for general condition and method of storage. There should be no evidence of overstock, and all shortages must be on valid requisitions.	Par. 5.

25.6. Cleaning

Inspect the exterior of the frequency meter. The exterior surfaces should be clean, and 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 (FSN 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 panels, meters, and control knobs; use a soft clean cloth. If necessary dampen the cloth with water; mild soap may be used.

25.7. Touchup Painting Instructions

Clean 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 TM 9-213.

Page 22. Delete figure 7.

Page 23. Delete figure 8.

Page 27. Delete the appendix and substitute:

Page 27. Change "APPENDIX" to: APPENDIX I and add the following:

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	The Army Equipment Record System and Procedures.

Add appendix II:

APPENDIX I.

BASIC ISSUE ITEMS LIST

Section I. INTRODUCTION

1. General

a. This appendix lists items supplied for initial operation and for running spares. The 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.

b. Columns are as follows:

(1) *Federal stock number.* This column lists the 11-digit Federal stock number.

(2) *Designation by model.* Not used.

(3) *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.

(4) *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.

(5) *Expendability.* Nonexpendable items are indicated by NX. Expendable items are not annotated.

(6) *Quantity authorized.* Under Items Comprising an Operable Equipment, the column lists the quantity of items supplied for the initial operation of the equipment. Under Running Spare Items the quantities listed are those issued initially with the equipment as spare parts. The quantities are authorized to be kept on hand by the operator for maintenance of the equipment.

(7) *Illustration.* The Item No. column lists the reference symbols used for identification of the items in the illustration or text of the manual.

2. Batteries

Dry batteries shown are used with the equipment but are not considered part of the equipment. They will not be preshipped automatically but are to be requisitioned in quantities necessary for the particular organization, in accordance with SB 11-6.

SECTION II. FUNCTIONAL PARTS LIST

FEDERAL STOCK NUMBER	DESIGNATION BY MODEL	DESCRIPTION	UNIT OF ISSUE	EXP	QTY AUTH	ILLUSTRATION	
						FIGURE NO.	ITEM NO.
6625-892-5360		FREQUENCY METER AN/USM-159: freq data: 125 kc to 1000 mc, 0.01% accuracy, internal freq calibrating crystal incl; oper power regt; ac 115/230 v 50 to 450 cycles, single phase; dc 9 v; internal vatter source		NX			
		ITEMS COMPRISING AN OPERABLE EQUIPMENT					
Ord thru AGC		TECHNICAL MANUAL TM 11-6625-486-12			2		
5935-201-3509		ADAPTER, CONNECTOR UG-641/U			1		
6625-539-9365		ANTENNA AT-564/U			1		
6135-120-1020		BATTERY BA-30			6		
5995-889-0553		CABLE ASSEMBLY, POWER ELECTRICAL CX-7782/USM-159			1		
5995-553-0056		CORD CD-307A/U			1		
5995-752-2057		CORD CG-409E/U			1		
6625-892-5361		FREQUENCY METER FR-149/USM-159		NX	1		
5965-892-3353		HEADSET H-216/U		NX	1		
		RUNNING SPARE ITEMS					
5920-229-1312		FUSE, CARTRIDGE: MIL type F02GR062B			5		
6240-526-0243		LAMP, INCANDESCENT: 115 to 125 v, 6 w; Westinghouse Elec part No. S6			1		DS703

By Order of the Secretary of the Army:

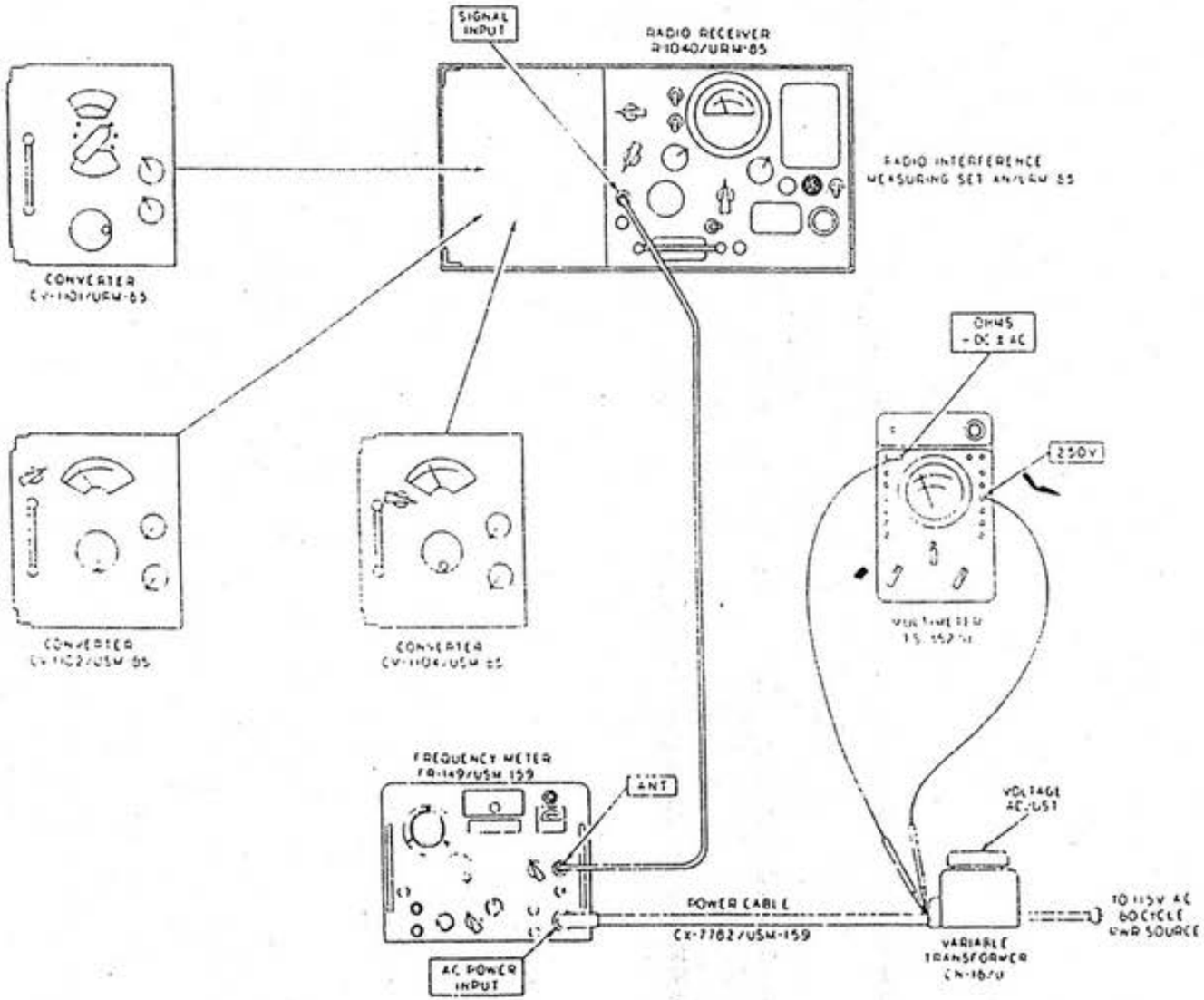
EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

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

☆ U. S. GOVERNMENT PRINTING OFFICE: 1963—700795/367

FREQUENCEMETRE FR/149/USM-159 LAVOIE



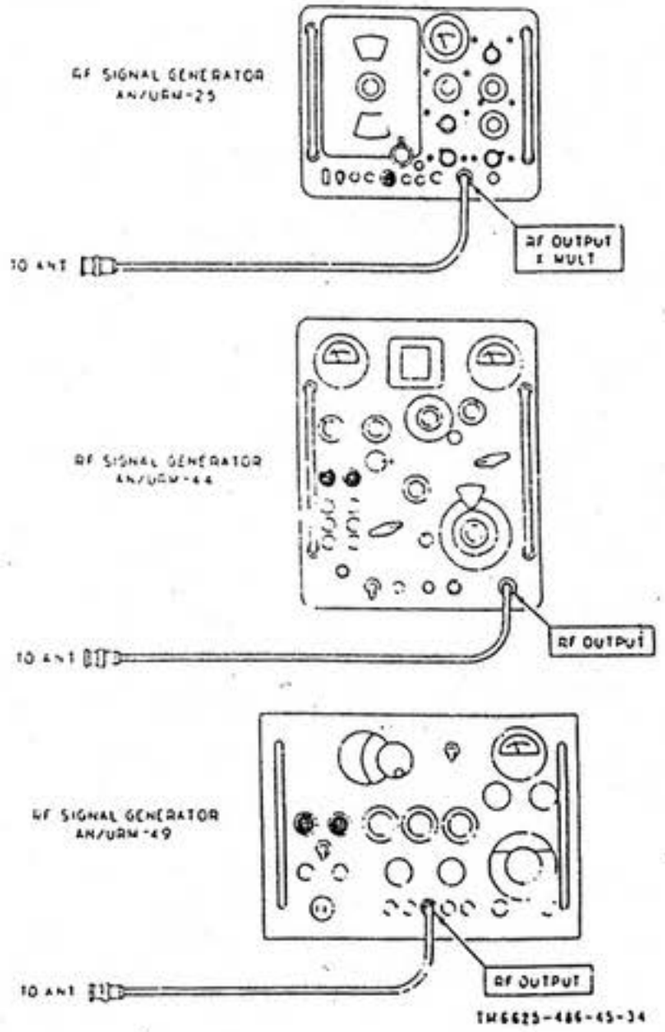
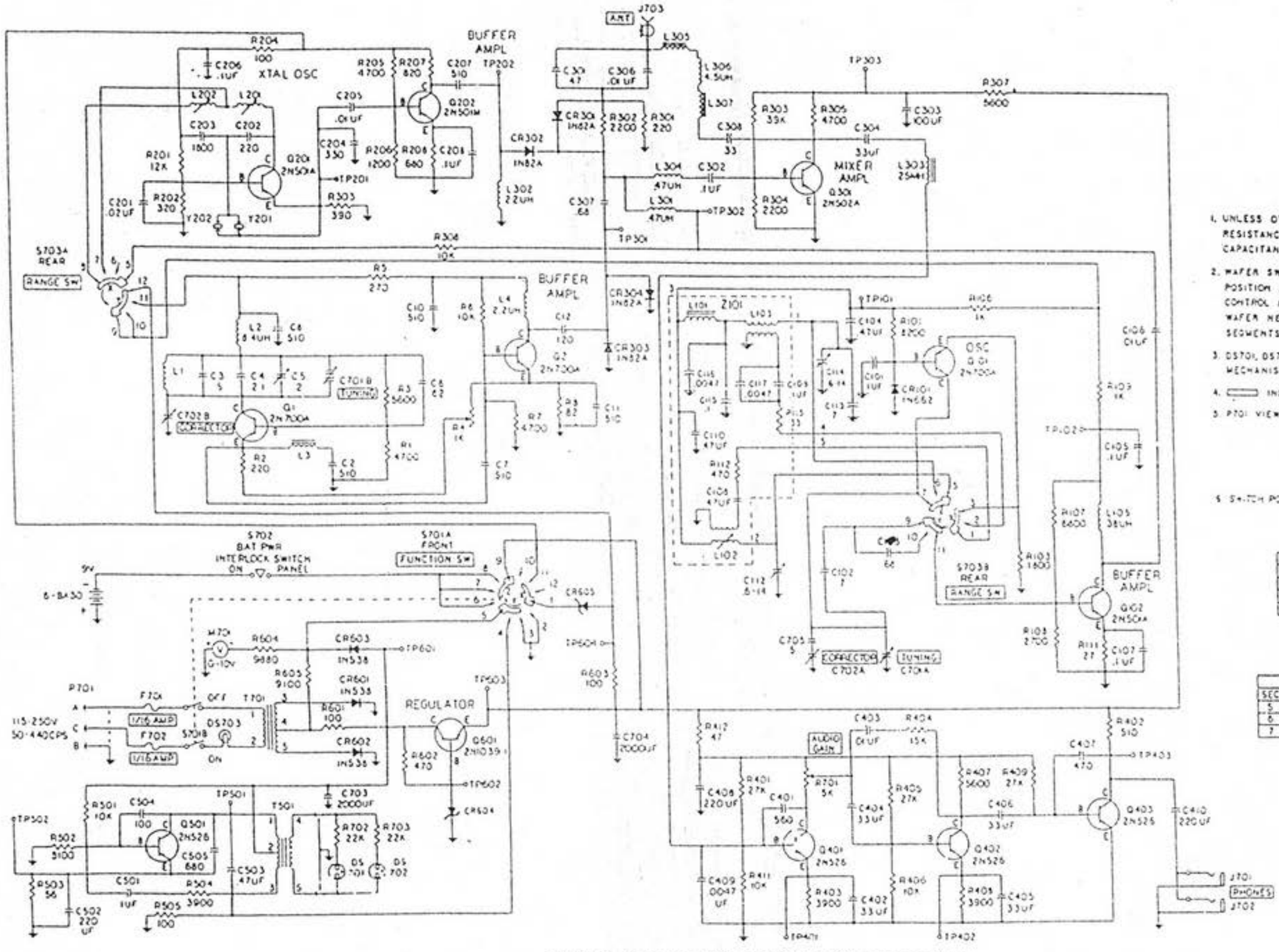


Figure 48. Test setup for radiofrequency output signal amplitude test.



NOTES:

1. UNLESS OTHERWISE INDICATED RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN UUF.
2. WAFER SWITCHES SHOWN IN EXTREME CCW POSITION AND ARE VIEWED FROM END OPPOSITE CONTROL KNOB EXCEPT AS OTHERWISE INDICATED. WAFER NEAREST CONTROL KNOB IS SECTION A. SEGMENTS OF WAFERS ARE DENOTED BY X, Y, S.
3. DS701, DS702, R702, ARE R703 ARE LOCATED IN F... MECHANISM.
4. ⬭ INDICATES EQUIPMENT MARKING
5. P701 VIEWED FROM FRONT PANEL SIDE

5 SWITCH POSITIONS

FUNCTION SW
S701

NO	POSITION
1 5 9	OFF
2 6 10	OPER
3 7 11	CHK
4 8 12	MOD

RANGE SW
S703

NO			POSITION
SECT A	SECT B		
5 9	1 5 9		RANGE A
6 10	2 6 10		RANGE B
7 11	3 7 11		RANGE C

Figure 43. Frequency Meter FR-149/USM-153, schematic diagram.

TECHNICAL MANUAL
No. 11-6625-486-10

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., *26 April 1962*

OPERATOR'S MANUAL

FREQUENCY METER AN/USM-159

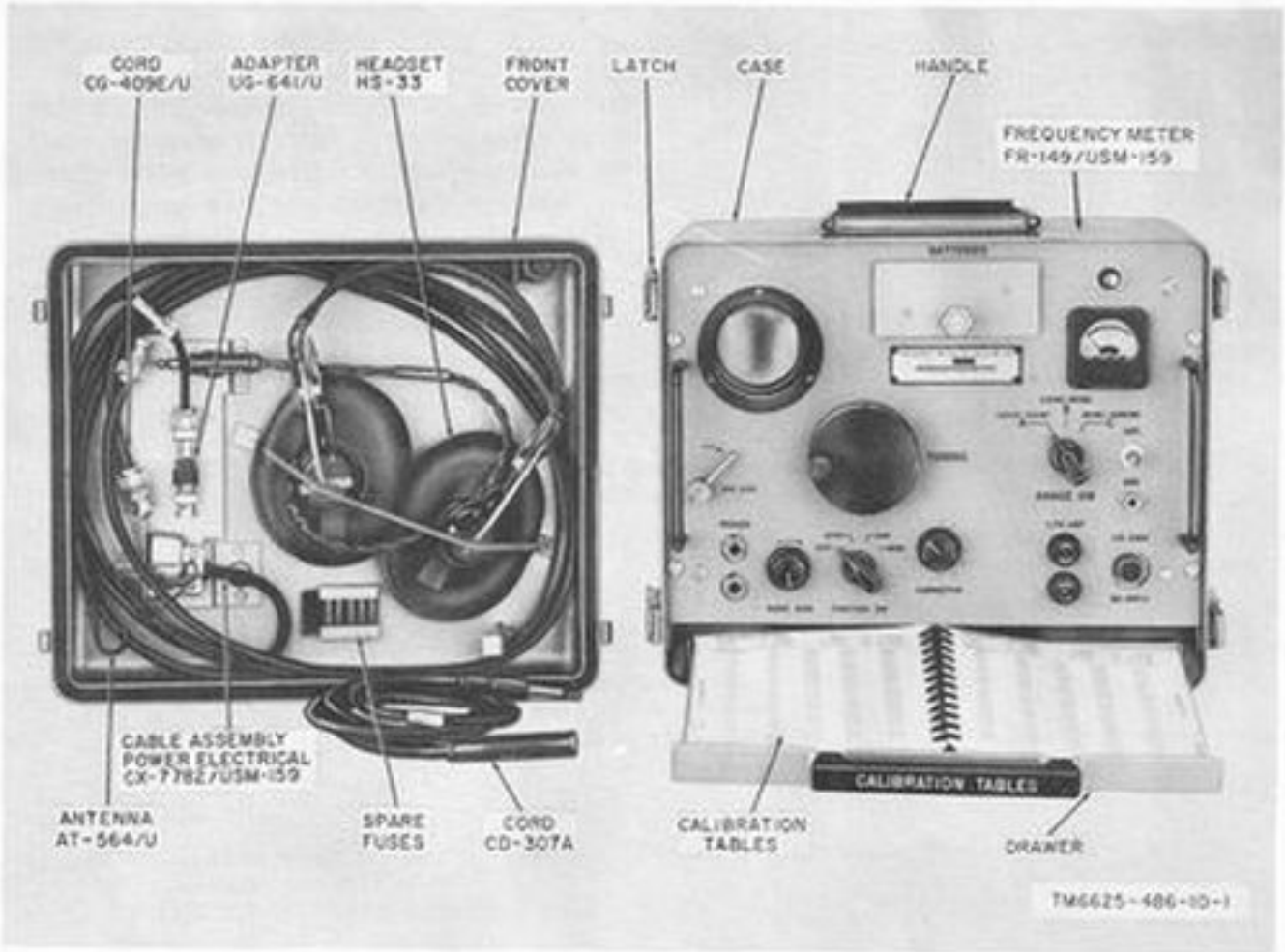


Figure 1. Frequency Meter AN/USM-159.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

This manual describes Frequency Meter AN/USM–159 (fig. 1) and covers its installation, operation, and operator's maintenance. It includes operation under usual conditions, cleaning and inspection of the equipment, and replacement of parts available to first echelon maintenance.

2. Forms and Records

a. Unsatisfactory Equipment Reports.

(1) Fill out and forward DA Form 468 (Unsatisfactory Equipment Report) as prescribed in AR 700–38.

(2) Fill out and forward AF TO Form 29 (Unsatisfactory Report) to the commander, Air Materiel Command, Wright-Patterson Air Force Base, Ohio, as prescribed in AF TO 00–35D–54.

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), Navy Shipping Guide, Article 1850–4 (Navy), and AFR 71–4 (Air Force).

c. Preventive Maintenance Form. Prepare DA Form 11–266 (figs. 7 and 8) (Maintenance Checklist for Signal Equipment (Test Equipment)), in accordance with instructions on the form.

d. Index of Equipment Publications. Refer to DA Pam 310–4 to determine what changes to or revisions of this publication are current.

e. Comments on Manual. Forward all other comments on this publication direct to the commanding officer, U.S. Army Signal Materiel Support Agency, ATTN: SIGMS–PA2d, Fort Monmouth, N.J.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

Frequency Meter AN/USM–159 (fig. 1) is a precision instrument used to measure radio-frequencies (rf) in the range from 125 kilocycles (kc) to 1,000 megacycles (mc). It can also be used as a signal generator to provide modulated or unmodulated signals for testing and calibrating radio equipment. A system of checkpoints is provided to check the calibration of the instrument throughout its operating range.

4. Technical Characteristics

Frequency range:

Range A	125 kc to 2.5 mc (125 to 250 kc on fundamentals).
Range B	2.5 to 65 mc (2.5 to 5 mc on fundamentals).
Range C	65 to 1,000 mc (65 to 130 mc on fundamentals).

Frequency readout:

Direct readout in fundamentals on calibrated filmstrip, magnified, and illuminated.

Input and output signals:

Input sensitivity	With an rf input signal of 0.1 volt, an af output of 0.05 mw is obtained.
Output level	100 uv minimum across an external 50-ohm resistive load.
Accuracy	0.01% when temperature is between −4° to +125° F. (−20° to +52° C.).
Internal modulation	900 cps ±300.
Number of transistors	12.

Power requirements:

Battery operation	9 volts dc, 50 ma (Battery BA-30 (6)).
Ac line operation	115 to 230 volts ac, 50 to 450 cps.
Weight	28 pounds.

5. Components of Frequency Meter AN/USM-159
(fig. 1)

a. Components.

6. Nomenclature and Common Names

Nomenclature and common names of the components of Frequency Meter AN/USM-159 are given below.

Nomenclature	Common name
Frequency Meter FR-149/USM-159.	Frequency meter
Antenna AT-564/U	Antenna
Cord CG-409E/U	Rf cable
Adapter UG-641/U	Adapter
Cable Assembly, Power, Electrical CX-7782/USM-159.	Power cable
Headset HS-33	Headset
Cord CD-307A	Headset extension cable

7. Description
(fig. 1)

a. Frequency Meter FR-149/USM-159. The frequency meter is transistorized throughout

Quantity		Height (in.)	Depth (in.)	Width (in.)	Unit Weight (lb)
1	Frequency Meter FR-149/USM-159	11¼	11½	12$^{15}/_{16}$	26
1	Antenna AT-564/U (1 ft)				
1	Cord CG-409E/U (1 ft)				
1	Adapter UG-641/U				
1	Headset HS-33				
1	Cable Assembly, Power, Electrical CX-7782/USM-159 (8 ft).				
1	Cord CD-307A (5 ft)				
1 set	Running spares (*b* below)				
2	TM 11-6625-486-10				

b. Running Spares.

Quantity	Item	Storage location
1	Ac line ballast lamp, type S6-6W	Under Chassis
5	Fuse, $^1/_{16}$ amp, 125 v, type 3 AG, slo-blo	Front cover
1	Calibrated filmstrip	Under chassis

and can be operated from six Batteries BA–30 that supply 9 volts direct current (dc) or from a powerline source of 115 to 230 volts alternating current (ac), 50 to 450 cycles per second (cps). Automatic switchover from batteries to ac power is accomplished internally. All operating controls and connectors are located on the front panel. The meter dial is an illuminated filmstrip with three ranges of frequencies calibrated in fundamentals. Crystal checkpoints with arrows indicating the direction of the nearest checkpoint are also on the filmstrip. Component parts of the frequency meter are housed within a rectangular metal case. When not in use or during transport, a front cover protects the panel controls and provides an immersionproof seal. The front cover has space for storing the headset, antenna, rf cable, adapter, power cable, and spare fuses. The calibration tables, which contain condensed operating instructions, and a list of fundamental frequencies and selected harmonics produced by the frequency meter, are located on a sliding panel under the frequency meter controls.

b. Antenna AT–564/U. The insulated, hooked end of the antenna is placed near the equipment being tested.

c. Cord CG–409E/U. The rf cable connects the antenna to the frequency meter ANT. jack.

d. Adapter UG–641/U. The adapter adapts the frequency meter ANT. jack to a pigtail clamp connector for use with a suitable cable to connect the frequency meter to remote equipment.

e. Cable Assembly, Power, Electrical CX–7782/USM–159. The power cable connects the power receptacle on the front panel to the source of ac power.

f. Headset HS–33. The headset is a low-impedance type for connection to the jacks labeled PHONES.

g. Cord CD–307A. The headset extension cable is used to extend the cord on Headset HS–33 an additional 5 feet.

8. Additional Equipment Required

Six Batteries BA–30 are required for battery operation. The batteries are not supplied with the set.

CHAPTER 2

INSTALLATION AND OPERATION

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

9. Unpacking

a. Packaging Data. When packed for shipment, the components of Frequency Meter AN/USM-159 are placed in a carton and packed in a wooden box. A typical shipping box and its contents are shown in figure 2. The dimensions of the box are 14 by 14 by 15 inches.

b. Removing Contents.

(1) Cut and fold back the metal straps.

(2) Use a nailpuller to remove the nails from the top and one side of the box. Remove the top and one side. Do not pry them off; prying may damage the equipment.

(3) Open the waterproof barrier which covers the carton inside the box. Remove the carton.

(4) Open the carton and the moisture-vaporproof barrier within the carton. Remove the inner corrugated carton. Open the inner carton and remove the contents.

10. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, refer to paragraph 2.

b. Check the equipment against the packing list. When no packing list accompanies the equipment, use the table of components (par. 5) as a general check.

11. Installation of Equipment

The location of the frequency meter is not limited to any particular area or climatic condition. Provide adequate shelter to prevent water, dirt, and sand from entering the unit when the front cover is off. Maximum operating accuracy will be obtained if the frequency meter is operated in surrounding temperatures within the range of —4° to +125° F. (—20° to +52° C.).

12. Installation of Batteries (fig. 3)

Six Batteries BA-30 are contained in a metal drawer at the top of the frequency meter front panel (marked BATTERIES). A rectangular metal plate covers the drawer opening. Install the batteries as follows:

a. Loosen the knob that secures the metal plate and pull the drawer out of the front panel.

b. Observe the battery polarity diagram printed on the top of the drawer. Lift the top cover of the drawer and insert the six batteries in the same polarity sequence as indicated in the battery diagram.

c. Replace the drawer and tighten the knob.

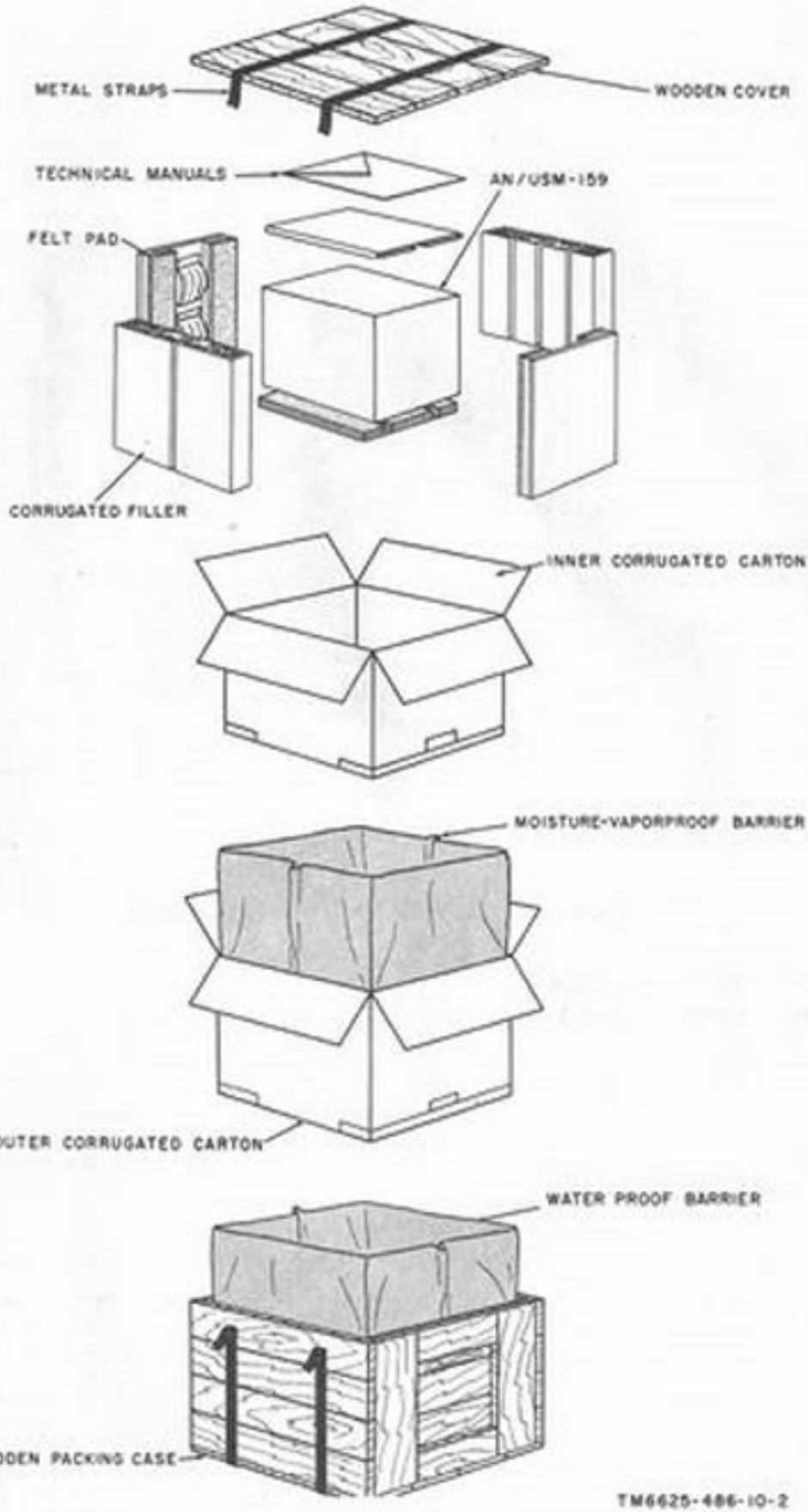


Figure 2. Typical packaging.

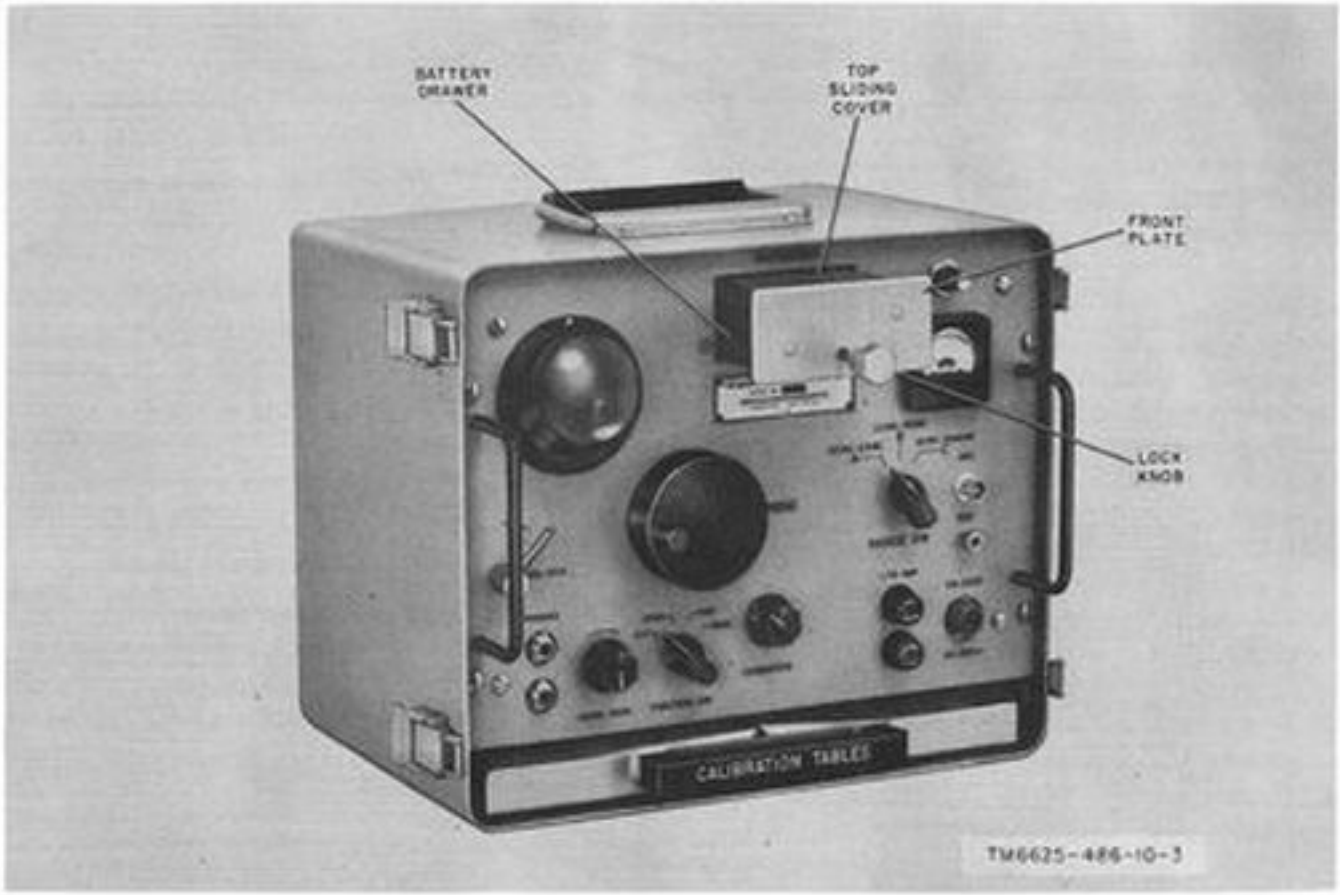


Figure 3. Frequency Meter FR-149/USM-159, battery compartment.

Section II. OPERATING INSTRUCTIONS

13. Frequency Meter AN/USM-159 Operating Controls and Indicators (fig. 4)

Control or indicator	Function	
FUNCTION SW	Selects the function that the frequency meter is performing.	
	Switch position	*Action*
	OFF	Turns frequency meter off.
	OPER	Permits use of vfo to determine the frequency of unknown signals received by the frequency meter or to radiate a signal for test purposes.
	CHK	Turns on internal crystal calibrator. Permits checking vfo frequency against crystal calibrator and crystal checkpoints on filmstrip.

Control or indicator	Function
	MOD — Modulates rf signal with 900 cycles.
AUDIO GAIN control	Adjusts audio output to headset.
TUNING control	Permits tuning vfo to desired frequency within range selected by RANGE SW. Frequencies appear on illuminated filmstrip.
DIAL LOCK	When turned clockwise, locks TUNING control.
Power receptacle	Used to connect power cable to frequency meter.
CORRECTOR control	Adjusts frequency of vfo to coincide with crystal checkpoints printed on the filmstrip. Internal crystal calibrator is turned on when FUNCTION SW is in CHK position.
RANGE SW	Selects one of three frequency ranges and operates a mask that covers all frequency ranges printed on the filmstrip except the range in use.
	Switch position — *Action* 125KC–2.5MC (A) — When used with TUNING control, allows tuning of the frequency meter from 125 kc to 2.5 mc. 2.5MC–65MC (B) — When used with TUNING control, allows tuning of the frequency meter from 2.5 to 65 mc. 65MC–1000MC (C) — When used with TUNING control, allows tuning of the frequency meter from 65 to 1,000 mc.
Voltmeter	Monitors dc output voltage of battery or ac-operated power supply. Meter has red and green scales and indication in the green area means that the operating voltage is sufficient. If meter indicates in the red area, do not operate frequency meter.
ANT. connector	The antenna is plugged into this connector.
PHONES jacks	The headset is plugged into either one of these jacks.
Battery interlock switch	Disconnects battery power from frequency meter when front cover is in place.
Film readout window	Portion of filmstrip in use is visible in this window.
GRD connector	Used for connecting the frequency meter to an electrical ground.

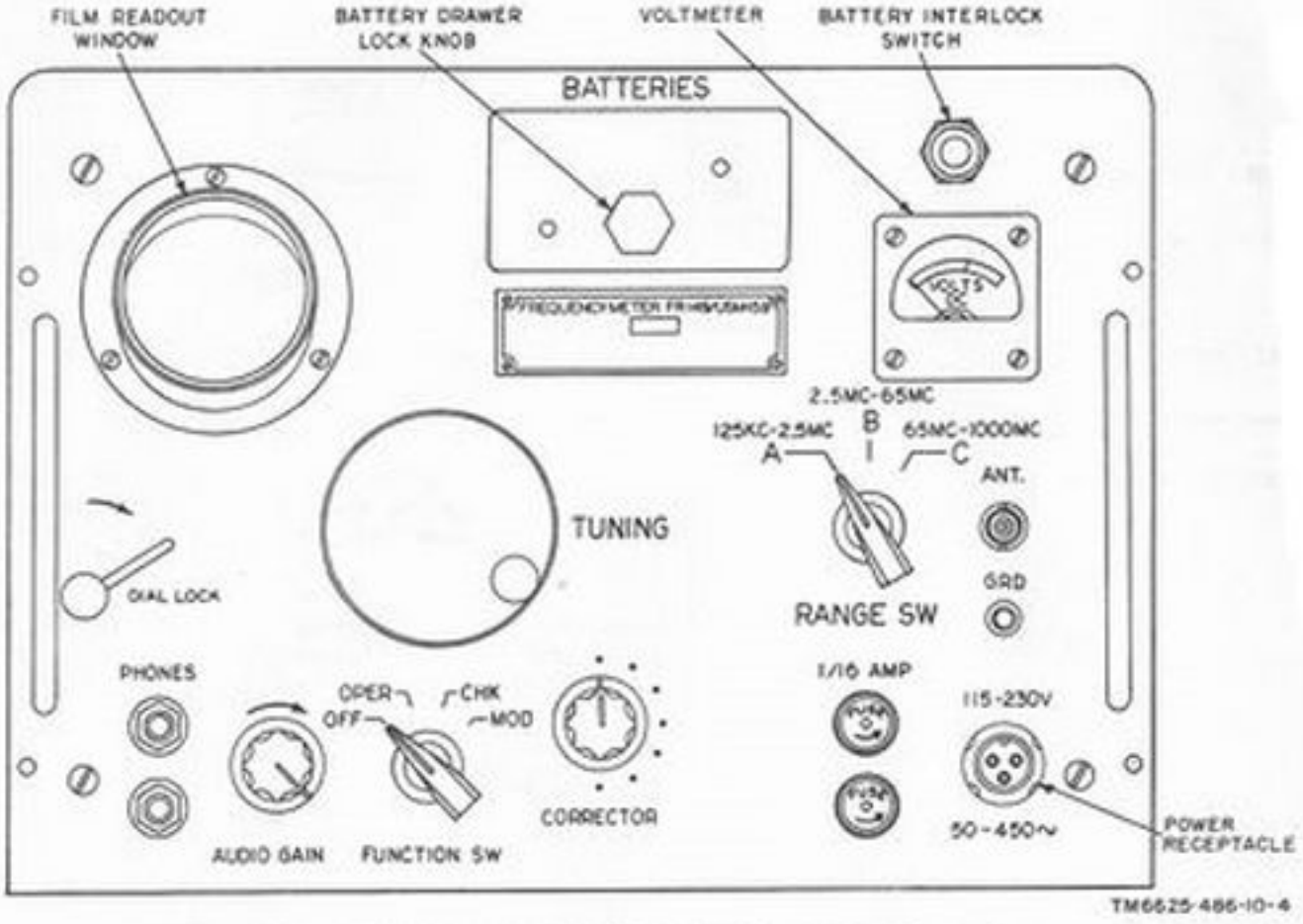


Figure 4. Frequency Meter AN/USM-159, controls and indicators.

14. Preliminary Starting Procedure (Fig. 4)

Perform the following steps before operating the frequency meter:

a. If operating on ac power, plug the power cable into the front panel power receptacle and ac power source. If operating on batteries, do not plug the power cable into the ac power source.

b. Plug the headset into one of the jacks marked PHONES.

c. Turn the FUNCTION SW to CHK. No warmup time is necessary.

Note. To avoid signal radiation, do not connect the frequency meter antenna.

d. Note that the voltmeter indicates in the green area of the scale and the filmstrip is illuminated.

e. Turn the RANGE SW to any range. Adjust the TUNING control until a crystal checkpoint (horizontal arrow on the filmstrip, fig. 6) coincides with the hairline indicator in the readout window. An audio tone will be heard in the headset as the checkpoint is approached.

Note. Vertical arrows point in the direction of the nearest crystal checkpoint.

f. Adjust the AUDIO GAIN control for a comfortable volume level as heard in the headset. Adjust the CORRECTOR control for a zero beat.

g. If the above results are not obtained, refer to the operational checklist (par. 27).

Caution: **Do not couple the frequency meter antenna directly to the output of a transmitter. If the transmitter is feeding a nonradiating load, place the hooked part of the frequency meter antenna near the transmitter oscillator coil or tank circuit. If the transmitter is feeding an antenna, place the frequency meter antenna in the radiated field.**

h. Connect the frequency meter antenna to the ANT. connector and place near the signal

to be measured. Turn the FUNCTION SW to OPER.

15. Operating Procedure

a. General. The frequency meter uses two variable frequency oscillators (vfo) to cover the range between 125 kc and 1,000 mc. In each range, the vfo covers, in fundamentals, only a portion of the frequency range. RANGE A covers 125 to 250 kc in fundamentals. The other frequencies (250 kc to 2.5 mc) are obtained by the use of harmonics of the vfo frequency. RANGE B (2.5 to 5.0 mc in fundamentals) and RANGE C (65 to 130 mc in fundamentals) operate in a similar manner. The filmstrip is calibrated in fundamentals only. By using the calibration tables (fig. 5), any frequency desired (within the range setting) can be obtained.

b. Setting Meter Dial to Desired Frequency. The frequencies printed on the filmstrip are calibrated in kilocycles and cycles for RANGE A and RANGE B and in megacycle and kilocycles for RANGE C. All frequencies represent fundamentals. Sections of filmstrip showing major and minor calibration marks, crystal checkpoint direction arrows, and typical checkpoints are shown in figure 6. Note that RANGE A has major calibration marks every 100 cycles and minor calibration marks every 10 cycles. RANGE B has major calibration marks every 1 kilocycle and minor calibration marks every 200 cycles. RANGE C has major calibration marks every 50 kilocycles and minor calibration marks at 5-kilocycle intervals. Set the dial to the desired frequency as follows:

(1) Assume that a frequency setting of 235, 240 cycles (235.24 kilocycles or 0.23524 megacycles) is desired.
(2) Set the RANGE SW to RANGE A.
(3) Adjust the TUNING control until the major calibration mark representing 235.2 is under the hairline indicator.
(4) Start from major calibration mark 235.2, count four minor calibration marks upward, and set 235.24 under the hairline indicator.

c. Setting Frequency Meter to Desired Harmonic Frequency. The calibration tables are multiplication tables that give the harmonic multiples of the basic fundamental frequencies (125 to 250 kc, 2.5 to mc, and 65 to 130 mc) on the filmstrip. The top of each page in the calibration tables (fig. 5) gives the frequencies covered on that page. The left-hand column of these tables gives the fundamental frequencies covered by the filmstrip. The other columns give harmonic frequencies covered by the range in use. In figure 5, the harmonics given are the second, fourth, and eighth. The harmonics given will be different for each range. If these tables are lost, the harmonic frequencies of any given dial setting can be found by multiplying the fundamental readout frequency by the desired harmonic number. Conversely, the correct dial setting for any given harmonic frequency can be found by dividing the harmonic frequency by any number that will give a fundamental frequency within the range of the frequency meter filmstrip.

16. Determining Local Transmitter Frequency When Approximate Frequency Is Known

a. Set the RANGE SW to the appropriate frequency range. If the frequency is not in the fundamental frequencies (125 to 250 kc, 2.5 to 5.0 mc, or 65 to 130 mc) covered by the RANGE in use, find the frequency in an harmonic column in the calibration tables and obtain the filmstrip setting from the FREQUENCY column (par. 15*c*). If not using the calibration tables, divide by a number to obtain a frequency in the fundamental range of the filmstrip.

b. Set the FUNCTION SW to CHK.

Note. When performing the check procedure, do not connect the frequency meter antenna.

c. Adjust the TUNING control to bring the checkpoint (nearest to the desired fundamental frequency) under the hairline indicator. Adjust the CORRECTOR control for a zero beat.

Caution: **Do not couple the frequency meter antenna directly to the transmitter output. The correct separation between the transmitter and the frequency meter antenna will depend on the amount of power being radiated. Place the frequency meter antenna as far away from the transmitter as possible and then start moving the antenna closer for the desired result.**

d. Set the FUNCTION SW to OPER and connect the frequency meter antenna to the

FREQUENCY RANGE

181.0KC	TO	184.4KC	/	.1810MC	TO	.1844MC	
362.0KC	TO	368.8KC	/	.3620MC	TO	.3688MC	R
724.0KC	TO	737.6KC	/	.7240MC	TO	.7376MC	A
1448.0KC	TO	1475.2KC	/	1.4480MC	TO	1.4752MC	N

FREQUENCY				G
181.0	362.0	724.0	1448.0	E
181.1	362.2	724.4	1448.8	
181.2	362.4	724.8	1449.6	
181.3	362.6	725.2	1450.4	A
181.4	362.8	725.6	1451.2	
181.5	363.0	726.0	1452.0	
181.6	363.2	726.4	1452.8	
181.7	363.4	726.8	1453.6	
181.8	363.6	727.2	1454.4	
181.9	363.8	727.6	1455.2	
182.0	364.0	728.0	1456.0	
182.1	364.2	728.4	1456.8	
182.2	364.4	728.8	1457.6	
182.3	364.6	729.2	1458.4	
182.4	364.8	729.6	1459.2	
182.5	365.0	730.0	1460.0	
182.6	365.2	730.4	1460.8	
182.7	365.4	730.8	1461.6	
182.8	365.6	731.2	1462.4	
182.9	365.8	731.6	1463.2	
183.0	366.0	732.0	1464.0	
183.1	366.2	732.4	1464.8	
183.2	366.4	732.8	1465.6	
183.3	366.6	733.2	1466.4	
183.4	366.8	733.6	1467.2	
183.5	367.0	734.0	1468.0	
183.6	367.2	734.4	1468.8	
183.7	367.4	734.8	1469.6	
183.8	367.6	735.2	1470.4	
183.9	367.8	735.6	1471.2	
184.0	368.0	736.0	1472.0	
184.1	368.2	736.4	1472.8	
184.2	368.4	736.8	1473.6	
184.3	368.6	737.2	1474.4	
184.4	368.8	737.6	1475.2	

25

TM6625-486-10-6

Figure 5. Frequency Meter FR-149/USM-159, calibration tables.

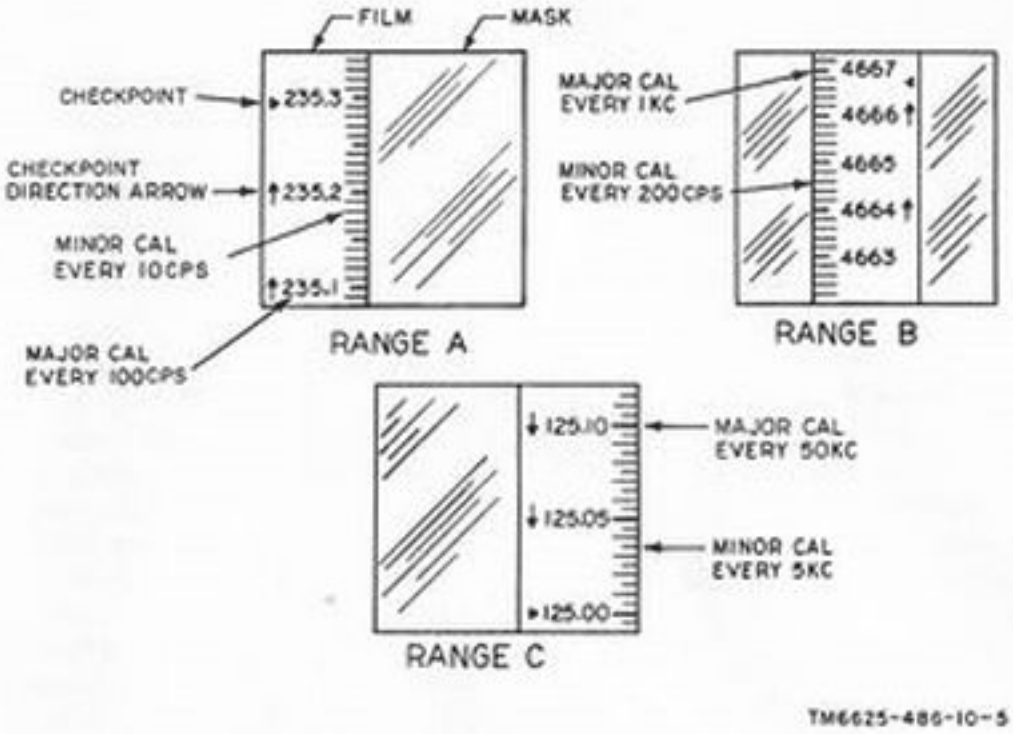


Figure 6. Interpretation of filmstrip.

ANT. connector and place the antenna near the transmitter.

e. Tune the frequency meter in the immediate area of the estimated frequency and listen for an audio beat note. If several beat notes are heard, tune the frequency meter to the strongest beat note; then tune the frequency meter on both sides of this frequency for a zero beat.

f. If necessary, locate the frequency found in *e* above, in the FREQUENCY column of the calibration tables. At the intersection of this frequency and the harmonics column, read the frequency of the signal being measured. If not using the calibration tables, multiply by the number used in *a* above.

17. Determining Frequency of Local Transmitter When Approximate Frequency Is Known

To determine the frequency when the approximate frequency is unknown, proceed as follows:

a. Use either an absorption-type wavemeter or radio receiver to determine the approximate frequency, and then follow the procedure given in paragraph 16. If the above equipment is not available, follow the procedures given in *b* through *m* below.

Caution: **Do not couple the frequency meter antenna directly to the transmitter output. The correct separation between the transmitter and the frequency meter antenna will depend on the amount of power being radiated. Place the frequency meter antenna as far away from the transmitter as possible and then start moving the antenna closer for the desired result.**

b. Set the FUNCTION SW to OPER and connect the frequency meter antenna to the ANT. connector. Place the antenna near the transmitter.

c. Turn the frequency meter TUNING control from the high end of the range toward the low end and listen for strong beat notes. Select the two adjacent beat notes that have the loudest sound and zero beat on each adjacent beat note. Record the filmstrip frequencies for these two points.

d. When several beat notes are heard, this indicates that consecutive harmonics of the vfo are beating against the unknown frequency. For example, if the unknown frequency is 120 mc, the fifth harmonic of 24 mc, the fourth

(3) Note the approximate frequency.

(4) Turn down the regeneration control before proceeding.

c. Set the RANGE SW according to the frequency found above. If the frequency is not in the fundamental frequencies covered by the RANGE in use, find the fundamental frequency in the calibration tables (par. 15*e*). If not using the calibration tables, divide by the appropriate number to obtain a frequency in the fundamental range of the dial.

d. Set the FUNCTION SW to CHK.

Note. When performing the check procedure, do not connect the frequency meter antenna.

e. Adjust the TUNING control to bring the checkpoint (nearest the desired fundamental frequency) under the hairline indicator. Adjust the CORRECTOR control for zero beat.

f. Set the FUNCTION SW to OPER. Connect the frequency meter antenna to the ANT. connector and place the antenna close to the receiver antenna lead.

g. While listening to the receiver through the receiver headset or loudspeaker, tune the frequency meter in the region of the receiver frequency setting until a beat note or whistle is heard; then tune the frequency meter for a zero beat or as near to a zero beat as possible.

h. If the transmitter frequency obtained in *g* above, was a fundamental frequency of the range being used, then the reading obtained in *g* above, gives the exact transmitter frequency directly. If the transmitter frequency obtained in *g* above, was an harmonic in the range being used, the fundamental frequency obtained in *g* above, is located in the calibration tables and the exact transmitter frequency is obtained from the appropriate harmonic column (par. 15*e*). If the transmitter frequency obtained in *g* above, was an harmonic in the range being used and the calibration tables are not being used, the fundamental frequency obtained in *g* above, is multiplied by the appropriate harmonic number (*e* above) to determine the exact transmitter frequency.

19. Tuning Transmitter to Desired Frequency

To tune a transmitter to a desired frequency, proceed as follows:

a. Set the RANGE SW to the proper range. If the frequency is some harmonic multiple of the frequencies covered by the frequency meter dial, consult the calibration tables to determine the frequency meter dial setting (par. 15*e*). If not using the calibration tables, divide by the appropriate number to obtain a frequency covered by the frequency meter dial.

b. Set the FUNCTION SW to CHK. Use the CORRECTOR control and calibrate the frequency meter at the checkpoint nearest the fundamental frequency obtained in *a* above; then set the FUNCTION SW to OPER and set the dial to the desired fundamental frequency.

Note. When performing check procedure, do not connect the frequency meter antenna.

Caution: **Do not couple the frequency meter antenna directly to the transmitter output. The correct separation between the transmitter and the frequency meter antenna will depend on the amount of power being radiated. Place the frequency meter antenna as far away from the transmitter as possible and then start moving the antenna closer for the desired result.**

c. Connect the frequency meter antenna to the ANT. connector. Place the frequency meter antenna near the transmitter oscillator circuit to be tuned.

d. Tune the transmitter for a zero beat in the frequency meter headset. If it is impossible to obtain a true zero beat, tune the transmitter to the middle of the audio beat note. No appreciable error will result.

20. Tuning CW Receiver to Desired Frequency

a. Set the RANGE SW to the proper range. If the desired frequency is some harmonic multiple of the fundamental frequencies covered by the filmstrip, consult the calibration tables to determine the frequency meter dial setting (par. 15*e*). If not using the calibration tables divide by the appropriate number to obtain a fundamental frequency covered by the frequency meter dial.

b. Set the FUNCTION SW to CHK and calibrate the frequency meter at the checkpoint nearest the desired fundamental frequency by tuning for a zero beat.

c. Set the FUNCTION SW to OPER and set the frequency meter filmstrip to the desired fundamental frequency.

d. Connect the frequency meter antenna to the ANT. connector. Place the frequency meter antenna near the receiver.

e. If the receiver has a bfo, turn it on. Tune the receiver for a beat note from the frequency meter. Make sure that you are tuned to the frequency meter signal by turning the FUNCTION SW to OFF and then back to OPER. Tune the receiver to zero beat.

Note. When tuning a receiver with a bfo, it is often difficult to get a true zero beat. If this occurs, tune the receiver to the middle of the beat note.

f. If a regenerative receiver is used, advance the regeneration control until the receiver oscillates. Tune the receiver for a zero beat.

21. Tuning Receiver with No Means of Producing Beat Note

a. Set the RANGE SW to the proper range. If the desired frequency is some harmonic multiple of the fundamental frequencies covered by the frequency meter dial, consult the calibration tables to determine the frequency meter dial setting (par. 15*c*). If not using the calibration tables, divide by the appropriate number to obtain a fundamental frequency covered by the frequency meter dial.

b. Set the FUNCTION SW to CHK and calibrate the frequency meter at the checkpoint nearest the desired fundamental frequency.

Note. When performing check procedure, do not connect the frequency meter antenna.

c. Set the frequency meter dial to the desired fundamental frequency. Set the FUNCTION SW to MOD.

d. Connect the frequency meter antenna to the ANT. connector. Place the frequency meter antenna near the receiver and tune the receiver for the loudest audio tone in the receivr headset or loudspeaker.

22. Determining Frequency to Which Receiver is Tuned

a. Set the RANGE SW to the proper range. If the desired frequency is some harmonic multiple of the fundamental frequencies covered by the filmstrip consult the calibration tables to determine the filmstrip setting (par. 15*c*). If not using the calibration tables, divide by the appropriate number to obtain a fundamental frequency covered by the filmstrip.

b. Set the FUNCTION SW to CHK and calibrate the frequency meter at the checkpoint nearest to the estimated fundamental frequency.

Note. When performing check procedure, do not connect the frequency meter antenna.

c. Set the FUNCTION SW to OPER. Connect the frequency meter antenna to the ANT. connector and place the frequency meter antenna near the receiver.

d. If the receiver has a bfo, turn it on. Tune the frequency meter for a zero beat in the receiver headset or loudspeaker.

e. If the receiver has no bfo, set the frequency meter FUNCTION SW to MOD and tune the frequency meter for maximum indication on the receiver S meter or for maximum audio in the receiver headset or loudspeaker.

f. Read the frequency meter filmstrip and, if necessary, locate this frequency in the FREQUENCY column of the calibration tables. At the intersection of this frequency and the harmonics column, read the frequency being measured. If not using the tables, multiply by the number found in *a* above.

23. Stopping Procedure

a. Turn the FUNCTION SW to OFF.

b. Unplug the headset from the PHONES jack.

c. Disconnect the antenna and the power cable and place them in the cover.

d. Replace the front cover.

CHAPTER 3

MAINTENANCE INSTRUCTIONS

Section I. MAINTENANCE

24. Scope of Operator's Maintenance

The following is a list of maintenance duties normally performed by the operator of Frequency Meter AN/USM-159. These procedures do not require special tools or test equipment.

a. Preventive maintenance (par. 25).

b. Visual inspection (par. 26).

c. Operational check (par. 27).

d. Replacement of defective fuse (par. 28).

25. Preventive Maintenance

a. DA Form 11-266. DA Form 11-266 (figs. 7 and 8) is a preventive maintenance checklist to be used by the operator. Items not applicable to the frequency meter are lined out in figure 8. References in the ITEM block in figure 8 are to paragraphs that contain additional information pertinent to the particular item. Instructions for use of the form appear on the form.

b. Items. The information in the chart below supplements DA Form 11-266. The item numbers correspond to the ITEM numbers on the form.

Item	Maintenance procedures
1	***Caution:*** **Cleaning compound is flammable and its fumes are toxic. Do not use near a flame; provide adequate ventilation.** Use a clean cloth to remove dust, dirt, moisture, and grease from the case and front panel. If necessary, wet the cloth with cleaning compound (Federal stock No. 7930-395-9542) and then wipe the parts with a dry, clean cloth.
2	All control knobs should work smoothly, be tight on the shafts, and should not bind. Tighten all loose knobs and be sure the knobs do not rub against the panel.

Section II. TROUBLESHOOTING

26. Visual Inspection

a. When the equipment fails to perform properly, visually check all the items listed below. Do not check the fuses ((3) below) with ac power on.

(1) Setting of the switches and the controls.

(2) Equipment power source (batteries or ac).

(3) Burned-out fuses (usually indicates some other fault). Be sure that the proper fuses are used (par. 28).

(4) The headset, cables, connections, and insulation.

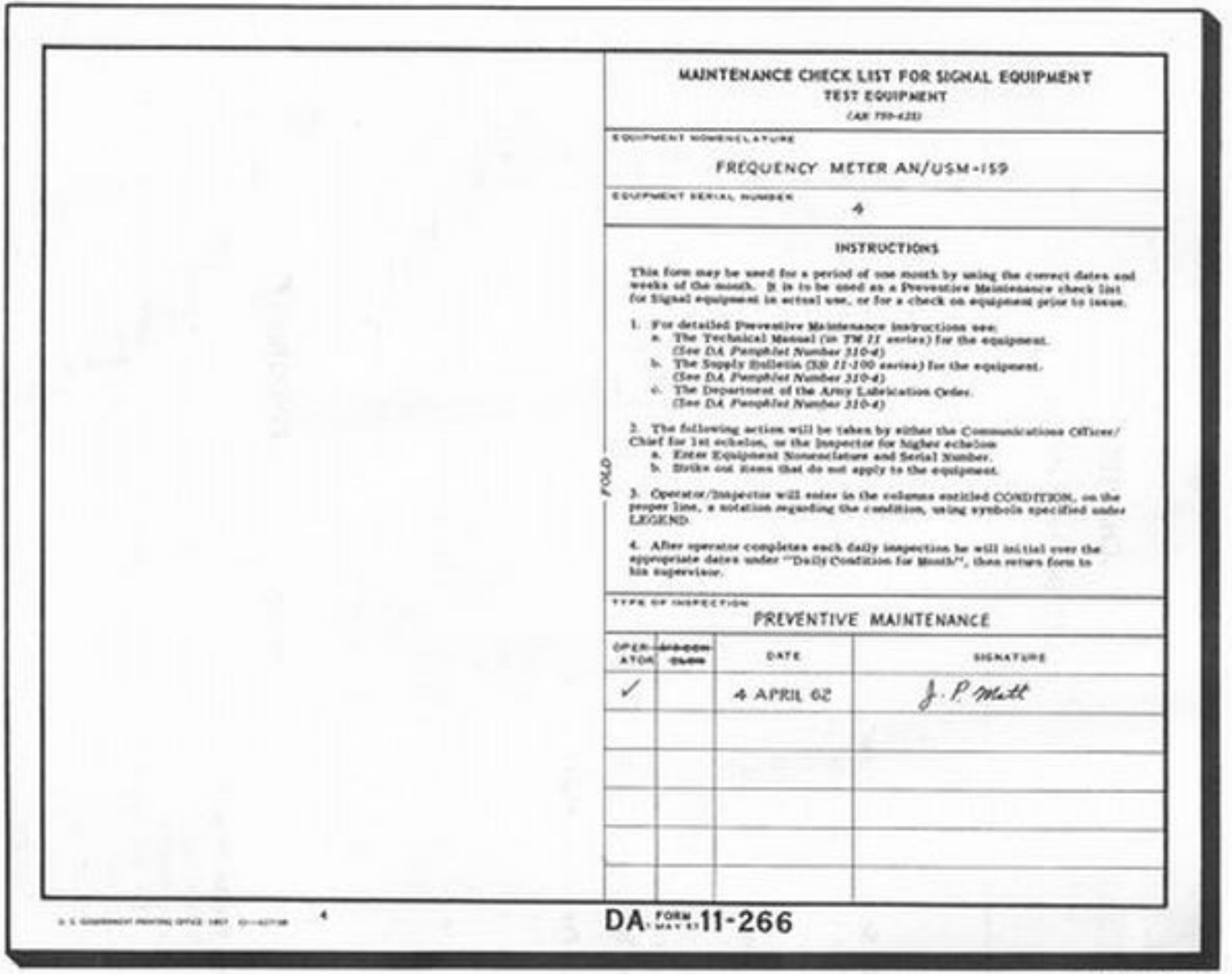
(5) Voltmeter for evidence of sticking by tapping the meter.

(6) Front panel battery power interlock switch.

b. If the above checks do not locate the trouble, proceed to the operational checklist (par. 27).

27. Operational Checklist

a. General. The operational checklist will help the operator to locate the trouble quickly.



MAINTENANCE CHECK LIST FOR SIGNAL EQUIPMENT
TEST EQUIPMENT
(AR 750-625)

EQUIPMENT NOMENCLATURE
FREQUENCY METER AN/USM-159

EQUIPMENT SERIAL NUMBER
4

INSTRUCTIONS

This form may be used for a period of one month by using the correct dates and weeks of the month. It is to be used as a Preventive Maintenance check list for Signal equipment in actual use, or for a check on equipment prior to issue.

1. For detailed Preventive Maintenance instructions see:
   a. The Technical Manual (in TM 11 series) for the equipment. (See DA Pamphlet Number 310-4)
   b. The Supply Bulletin (SB 11-100 series) for the equipment. (See DA Pamphlet Number 310-4)
   c. The Department of the Army Lubrication Order. (See DA Pamphlet Number 310-4)

2. The following action will be taken by either the Communications Officer/ Chief for 1st echelon, or the Inspector for higher echelon
   a. Enter Equipment Nomenclature and Serial Number.
   b. Strike out items that do not apply to the equipment.

3. Operator/Inspector will enter in the columns entitled CONDITION, on the proper line, a notation regarding the condition, using symbols specified under LEGEND.

4. After operator completes each daily inspection he will initial over the appropriate dates under "Daily Condition for Month", then return form to his supervisor.

FOLD

TYPE OF INSPECTION
PREVENTIVE MAINTENANCE

OPERATOR	~~ORGAN~~ CLERK	DATE	SIGNATURE
✓		4 APRIL 62	J. P. Matt

4

DA FORM 1 MAY 57 11-266

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Figure 7. DA Form 11-266, pages 1 and 2.

LEGEND for marking conditions:
Satisfactory, ✓.
Adjustment, Repair or Replacement required, X.
Defect corrected, (X).

DAILY CONDITION FOR MONTH OF APRIL 1962

NO.	DAILY ITEM		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	INITIALS
1.	CLEAN DIRT AND MOISTURE FROM EXPOSED SURFACES OF HOUSINGS, CASES, CABINETS, CONTROL PANELS, INTERCONNECTING PLUGS, CABLES, HEADSETS, METER WINDOWS, ETC.	PARA 25	✓	✓	✓	✓	✓	✓	✓																									
2.	INSPECT FOR LOOSENESS OF EXTERIOR ITEMS SUCH AS SWITCHES, KNOBS, JACKS, [illegible]	PARA 25	✓	✓	✓	✓	✓	✓	✓																									
3.	INSPECT CONTROLS FOR BINDING, SCRAPING. TAP CONTROLS LIGHTLY FOR CUT-OUT DUE TO LOOSE CONTACTS.		(✓)	✓	✓	✓	✓	✓	✓																									
4.	DURING OPERATION BE ALERT FOR ANY UNUSUAL PERFORMANCE OR CONDITION.		✓	✓	✓	✓	✓	✓	✓																									

WEEKLY	CONDITION EACH WEEK					DO not use
	1ST	2D	3D	4TH	5TH	
6. INSPECT CORDS, CABLES, [illegible] FOR BREAKS, CUTS, KINKS, DETERIORATION, STRAIN AND FRAYING.	✓					
9. [illegible]						
7. HAND CHECK FOR LOOSENESS OF EXTERIOR ITEMS SUCH AS HANDLES, LATCHES, HINGES.	✓					
8. [illegible]						
9. INSPECT DRY BATTERIES FOR DIRT, LOOSE TERMINALS AND LEAKAGE.	✓					
10. INSPECT EXPOSED METAL SURFACES FOR RUST AND CORROSION.	✓					
11. INSPECT METERS FOR DAMAGED GLASS AND CASES.	X					

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	REMARKS
12. [illegible]	
13. [illegible]	
14. [illegible]	

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	REMARKS
15. [illegible]	
16. [illegible]	
17. [illegible]	
18. [illegible]	
19. [illegible]	
20. [illegible]	
21. [illegible]	
22. [illegible]	
23. [illegible]	
24. [illegible]	
25. [illegible]	

IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING THE INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. (Continue on page 4, if more space is needed)

ITEM 11. METER GLASS BROKEN. SENT TO HIGHER ECHELON FOR REPAIR.

2 3

Figure 8. DA Form 11-266, pages 2 and 3.

TM 6625-436-10-8

The corrective measures are used to repair this trouble. If the measures suggested do not restore normal equipment performance, troubleshooting is required by a higher echelon repairman. Note on the repair tag what corrective measures were taken and how the equipment performed at the time of failure.

b. Procedure. Perform the preliminary operating procedures (par. 14); then perform the procedures in *c* below, in the order given. Observe the equipment in operation and perform any corrective measures necessary.

c. Checklist.

Action	Normal indication	Corrective measures
1. Set FUNCTION SW to CHK.....	Voltmeter indicates in green area of voltmeter scale.	Check meter for jammed needle by gently tapping meter face.
		Check batteries (par. 12).
	Portion of film not covered by mask is illuminated.	Check fuses (par. 28).
		If operating on ac power, check power cable and ac source.
		Higher echelon maintenance is required.
2. Set RANGE SW to RANGE A..... Plug headset into PHONES jack.	Loud whistles heard in headset when frequency meter is turned near a crystal checkpoint.	Check headset.
		Check headset extension cable.
Turn AUDIO GAIN control fully clockwise.		Higher echelon maintenance is required.
3. Tune frequency meter to nearest crystal checkpoint and adjust CORRECTOR control for a zero beat.	Zero beat obtained on checkpoint.	Higher echelon maintenance is required.
4. Set RANGE SW to RANGE B and RANGE C and repeat step 3.	Zero beat obtained on checkpoint.	Higher echelon maintenance is required.
5. Set FUNCTION SW to OPER. Connect antenna to ANT. jack.	Whistles heard in nearby radio receiver when frequency meter tuning is varied.	Higher echelon maintenance is required.
6. Set FUNCTION SW to MOD.	A 900-cycle modulated rf signal is obtained at ANT. jack and heard in headset.	Higher echelon maintenance is required.

28. Replacement of Fuses

To replace the fuses, proceed as follows:

a. Press in the fuseholder and turn it counterclockwise. Pull the fuseholder out to expose the defective fuse.

b. Remove the blown fuse from the fuseholder cap and install a new fuse.

Note. Be sure that the fuse is rated at 1/16 ampere, 125 volts, type 3AG, slo-blo.

c. Press the fuseholder cap into the fuseholder and turn it clockwise to lock.

CHAPTER 4

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

29. Disassembly of Equipment

To prepare the frequency meter for shipment and limited storage, proceed as follows:

a. Disconnect the cables, antenna, and headset. Place them in the cover.

b. Place the cover on the frequency meter and secure it with the latches.

30. Repackaging for Shipment or Limited Storage

The exact procedure for repackaging depends on the material available and the conditions under which the equipment is to be shipped or stored. Use the procedure outlined below whenever circumstances permit. The information concerning the original packaging (par. 9) will also be helpful.

a. Materials Required. The following materials are required for packaging Frequency Meter AN/USM–159. For stock numbers of materials, consult SB 38–100.

Material	Quantity
Corrugated cardboard	8 sq ft
Pressure-sensitive tape	6 ft
Waterproof paper	7 & 9 ft
Waterproof tape	7 ft
Filler material	2 lbs
Flat steel strapping	6 ft
Wooden box (16 by 15 by 15 inches inside dimensions)	6 board ft

b. Packaging. Package Frequency Meter AN/USM–159 as follows:

(1) Cushion the frequency meter on all surfaces with pads of filler material. Place the cushioned equipment within a wrap of corrugated cardboard. Secure the wrap with pressure-sensitive tape.

(2) Line the inside of the wooden box with waterproof paper.

(3) Place the packaged frequency meter inside the lined wooden box. Fill the excess space in the box with pads of corrugated cardboard and filler material. Secure the paper with waterproof tape.

(4) If interheater shipment is intended, nail the cover on the box and apply a band of metal strapping around the box.

Section II. DEMOLITION OF MATERIAL TO PREVENT ENEMY USE

31. Authority for Demolition

Demolition of the equipment will be accomplished only upon the order of the commander. The demolition procedures given in paragraph 32 will be used to prevent further use of the equipment.

32. Methods of Destruction

Any or all of the methods of destruction given below may be used. The time available will be the major determining factor for the methods to be used in most instances when destruction of the equipment is undertaken. The tactical situation also will determine in what manner the destruction order will be carried out. It is preferable to demolish completely some portions of the equipment rather than partially to destroy the entire equipment.

a. Smash. Smash the controls, switches, transformers, and spare parts; use sledges, axes, hammers, and any other heavy tools available.

b. Cut. Cut the power cable in several places; use axes or machetes.

c. Burn. Burn as much of the equipment as is flammable; use gasoline, oil, flamethrowers, etc. Burn the technical manuals, cabling, and spare parts. Use incendiary grenades to complete the destruction of the frequency meter interior.

***Warning:* Be extremely careful with explosives and incendiary devices; use these items only when the need is urgent.**

d. Explode. Use explosives to complete demolition or to cause maximum damage before burning when time does not permit complete demolition by other means. Place an incendiary or fragmentation grenade in the frequency meter. Clear the area before the explosion takes place.

e. Dispose. Bury or scatter the destroyed parts in slit trenches or throw them into nearby streams.

OPERATING INSTRUCTIONS FOR TUNING TRANSMITTER OR RECEIVER TO DESIRED FREQUENCY:

1. If operating on ac power, plug power cord into panel receptacle.
2. Turn FUNCTION SW to CHK and turn RANGE SW to Range A, B or C as required.
3. Observe VOLTAGE meter. If indication is in green area, sufficient operating voltage is available.
4. Insert headset plug in phone jack.
5. Consult Harmonic Multiplication Table for frequency desired and set film readout dial to nearest crystal check point indicated by arrows.
6. Adjust CORRECTOR for zero-beat in headset. If more than one beat is heard, use the loudest beat.
7. Turn FUNCTION SW to OPER and reset dial to desired frequency.
8. In tuning a transmitter, loosely couple transmitter to frequency meter input and adjust transmitter for zero-beat indication in headset.
9. In tuning a receiver, set FUNCTION SW to OPER. Turn receiver AVC off. Tune receiver for zero-beat in receiver headset. If receiver BFO is used, set BFO to center of intermediate frequency.
10. If receiver has no BFO, set FUNCTION SW to MOD and tune receiver for maximum audio output.
11. After tuning procedure, turn FUNCTION SW to OFF.

NOTE

In generating a frequency where maximum output level is required, use the fundamental frequency which provides the strongest harmonic output at the desired frequency. If the harmonic in use is not listed in the tables, multiply the film readout by the harmonic number which gives a figure closest to the estimated frequency. The result is the actual frequency.

TO MEASURE AN UNKNOWN FREQUENCY

If the frequency is unknown, the approximate frequency can be determined by the following method:

1. Determine if the incoming signal is picked up at more than one point on the frequency meter dial.
2. If more than one beat note is heard, carefully measure the frequencies corresponding to the two consecutive beats having the loudest sounds. Zero-beat on these two frequencies (F_1 and F_2).
3. Use the two frequencies F_1 and F_2 in the following formula, where F_x is the unknown frequency:

$$F_x = \frac{F_1 \times F_2}{F_2 - F_1}$$

NOTE

If F_1 and F_2 are expressed in kilocycles, F_x will be in kilocycles. If F_1 and F_2 are in megacycles, F_x will be in megacycles.

4. Check the value of F_x by determining the other two consecutive zero-beat frequencies, and repeat the computation. Any one of the zero-beat frequencies multiplied by the appropriate harmonic number will give the frequency of the unknown signal.

PRECAUTION

Because of the many opportunities for errors when using heterodyne type frequency meters, it is always advisable to know the approximate frequency of the unknown signal and what range to use.

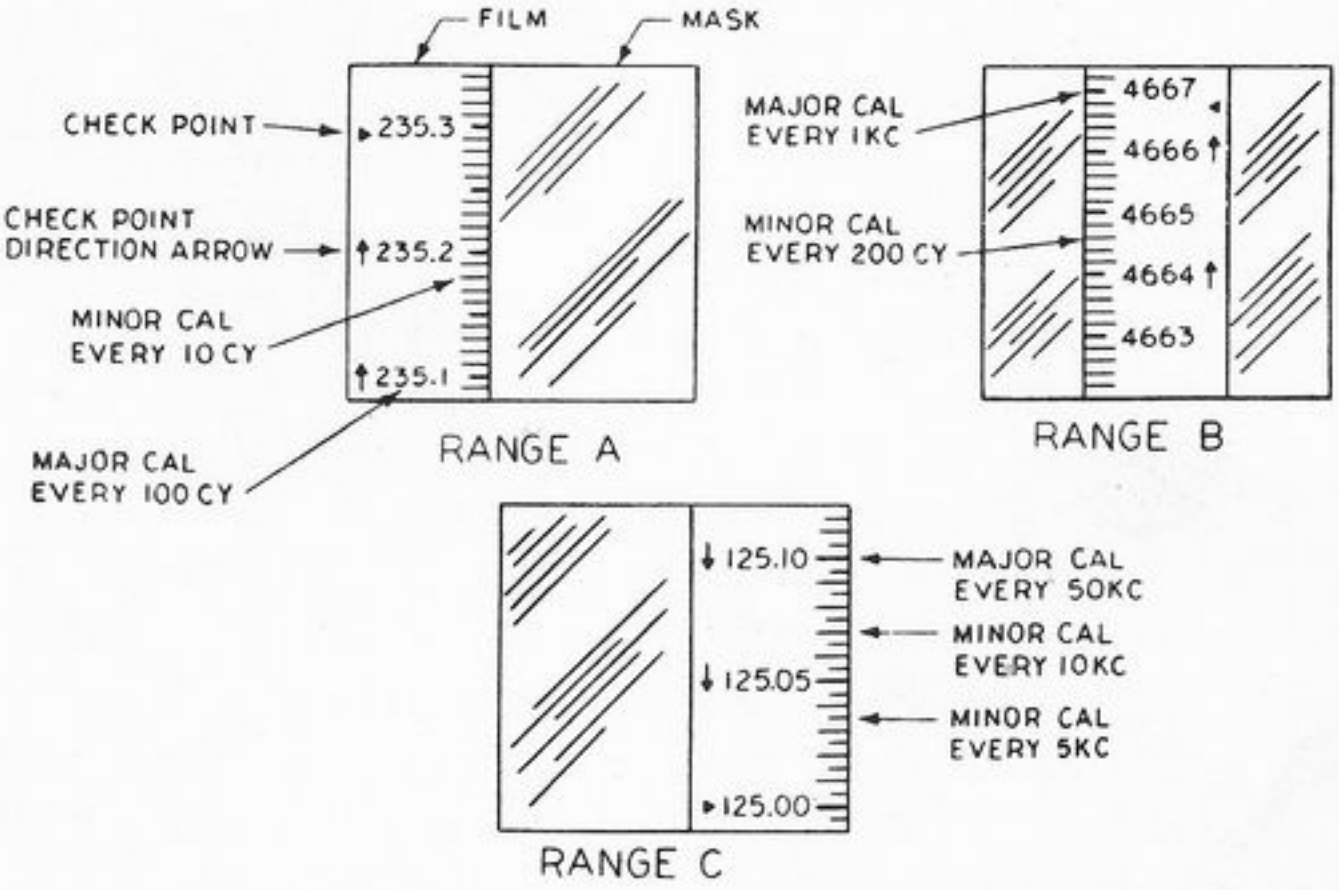

Figure 1. Film Readout, Ranges A, B and C

0.01% accuracy using three fundamental ranges and harmonics to measure and generate radio frequencies continuously variable over a range of 125 Kc to 1000 Mc. Crystal oscillators are used for accuracy verification. A built-in mixer and amplifier facilitates signal comparison and zero-beating during measurement. Generated signals may be modulated or unmodulated.

Description of panel controls and jacks

1. FUNCTION SW (lower left)
   a. OFF - turns off unit power.
   b. OPER - permits use of VFO's* to measure or generate signal frequencies throughout 125 Kc to 1000 Mc range.
   c. CHK - permits comparison between internal VFO signals and crystal oscillator frequencies.
   d. MOD - amplitude modulates VFO's when generating signals.
2. RANGE SW - selects VFO frequency range (A, B or C).
3. CORRECTOR - corrects frequency of VFO's against 1 Mc crystal check points on film for Ranges A and B, and against 2.5 Mc crystal for Range C.
4. AUDIO GAIN - Adjust audio beat sound level.
5. PHONES - permit use of headsets with standard plugs.
6. ANT - functions as signal input or output jack.
7. TUNING - tunes VFO's in accordance with three ranges of calibrated frequencies printed in fundamentals on film.
8. VOLTAGE - meter indicates voltage of battery or internal power supply.

*Variable Frequency Oscillators

USE OF HARMONIC MULTIPLICATION TABLES

These tables list the three ranges of fundamental frequencies printed as major calibration marks on the film strip (see figure 1) and certain harmonic multiples of these frequencies. For RANGE A, the fundamental, 2nd, 4th and 8th harmonics are tabulated from 125 Kc to 199.9 Kc. From 200 Kc to 250 Kc, the 10th harmonic is tabulated in addition. For RANGE B, the fundamental, 2nd, 4th and 8th harmonics are tabulated from 2500 Kc to 2999 Kc. From 3000 Kc to 5000 Kc, the 13th harmonic is tabulated in addition. For RANGE C, the fundamental, 2nd, 4th and 8th harmonics are tabulated from 65 Mc to 130 Mc. Harmonic multiples not listed in tables (minor calibration marks on film), can be determined by multiplying the film readout by the desired harmonic number.

To find the harmonic multiple of a frequency read to a minor calibration mark on the film, as for example: 202:15 Kc (last figure 5 read as .05 from minor calibration mark), proceed as follows: If estimated frequency is 8th harmonic of fundamental calibration.

1. In table, find the 8th harmonic of the next lower frequency represented by the 202.1 Kc major calibration mark.
2. Listed 8th harmonic of 202.1 Kc = 1616.8 Kc.
3. Minor calibration mark figure of 202.15 Kc (.05) X harmonic number (8) = .4. Add .4 to the harmonic multiple found in step 2.
4. 1616.8 +.4 = 1617.2 KC = 8th harmonic of 202.15 Kc.

To determine the dial setting for a harmonic frequency not listed in the table, perform the reverse order as per example:

1. Desired harmonic 641.36 Kc.
2. Next lower harmonic listed in table 641.2 (4th harmonic).
3. Difference between listed harmonic and desired harmonic 641.36 - 641.2 = .16.
4. Difference (.16) ÷ harmonic number (4) = .04.
5. Table listed fundamental of 641.2 = 160.3.
6. 160.3 + .04 = 160.34 = dial setting.