TM 11-6625-228-12

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RADAR TEST SET

AN/UPM-60A

OPERATION AND
ORGANIZATIONAL
MAINTENANCE

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

HEADQUARTERS, DEPARTMENT OF THE ARMY
***MARCH* 1959**

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the – 300-, and –450-volt plate and power supply circuits and on the 115-volt ac line connections. Serious injury or death may result from contact with these voltages.

DON'T TAKE CHANCES!

TECHNICAL MANUAL

Operation and Organizational Maintenance
RADAR TEST SET AN/UPM-60A

TM 11-6625-228-12
CHANGES No. 1

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., *17 June 1963*

TM 11-6625-228-12, 2 March 1959, is changed as follows:

Page 8, paragraph 2. Delete paragraph 2 and add paragraphs 2 and 2.1.

2. 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 bulletins, lubrication orders, and modification work orders that 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.

2.1. 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. Comments on Manual. Forward all comments on this publication direct to: Commanding Officer, U.S. Army Electronics Materiel Support Agency, ATTN: SELMS-MP, Fort Monmouth, N.J. (DA Form 1598 (Record of Comments on Publications), DA Form 2496 (Disposition Form), or letter may be used.)

Page 18. Delete section I and substitute:

Section I. MAINTENANCE INSTRUCTIONS

25. Scope of Maintenance

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

a. Daily preventive maintenance checks and services (par. 26.2).

b. Weekly preventive maintenance checks and services (par. 26.3).

c. Monthly preventive maintenance checks and services (par. 26.6).

d. Cleaning (par. 26.4).

e. Painting (par. 26.9).

26. Materials Required

a. Sandpaper.

b. Paint and brush.

26.1. Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of the equipment to prevent the occurrence of trouble, to reduce *downtime*, and to assure that the equipment is serviceable. These maintenance duties do not

require tools or test equipment other than those issued with the equipment.

a. Systematic Care. The procedures given in paragraphs 26.2, 26.3, and 26.6 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

b. Preventive Maintenance Checks and Services. The daily, weekly, and monthly preventive maintenance checks and services charts (pars. 26.2, 26.3, and 26.6) outline functions to be performed at specific intervals. These checks and services are designed to maintain Army equipment in a combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist the operator and organizational repairman in maintaining combat serviceability, the charts indicate what to check, how to check, and what the normal conditions are; the *References* column lists the paragraph or manual that contains additional information. If the defect cannot be remedied by the organizational repairman, higher echelon maintenance or repair is required. Records and reports of these inspections must be made in accordance with TM 38–750.

26.2. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Radar test set	*a.* Check radar test set for completeness and general condition.	TM 11–6625–228–12P.
		b. Check to make sure that all changes pertinent to the equipment are on hand.	*b.* DA Pam 310–4.
2	Exterior surfaces	Clean exterior surfaces of the equipment	Par. 26.4.
3	Glass	Check all front-panel glass windows for breakage, cracks, and chipping. All glass windows must be in good condition.	
4	Knobs, dials, and switches	During operation, check knobs, dials, and switches for mechanical action. Action must be positive without backlash, binding, or scraping.	
5	Radar test set operation	During operation, be alert for any unusual performance, response, or condition.	

26.3. Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	External cables and cords	Check external cables and cords (fig. 1) for cuts, cracked, or gouged jackets, fraying, bad bruises, kinks, or strains.	
2	External electrical plugs and receptacles.	Inspect external electrical plugs and receptacles for breakage and firm seating.	
3	Hardware	Check for loose or missing hardware. Tighten all loose nuts and bolts.	
4	Pluckout items	Inspect clamps and seatings of pluckout items. All pluckout items should be properly seated, and clamps in proper position and correctly tightened.	
5	Air filter	Inspect the air filter for dust, dirt, and grease. Air filter must be clean and allow free passage air.	

26.4. Cleaning

Inspect the exteriors of the equipment. 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 (Federal stock No. 7930–395–9542) 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.

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

Caution: **Do not press on the meter window (glass) when cleaning; the meter may be damaged.**

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

26.5. Monthly Maintenance

Perform the maintenance functions indicated in the monthly preventive maintenance checks and services chart (par. 26.6) once each month. A month is defined as approximately 30 calendar days of 8-hour-per-day operation. If the equipment is operated 16 hours a day, the monthly preventive maintenance checks and services should be performed at 15-day intervals. Adjustment of the maintenance interval must be made to compensate for any unusual operating conditions. Equipment maintained in a standby (ready for immediate operation) condition must have monthly preventive maintenance checks and services performed on it. Equipment in limited storage (requires service before operation) does not require monthly preventive maintenance.

26.6. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Publications	Inspect manual for completeness and to see if it is in usable condition, without missing pages. Be sure all changes are on hand.	DA Pam 310–4.
2	Modification work orders	Check to see that all URGENT MWO's have been applied and that all ROUTINE MWO's have been scheduled.	DA Pam 310–4.
3	Completeness	Check radar test set for completeness and general condition.	TM 11–6625–228–12P.
4	Preservation	Inspect the equipment to determine that its surfaces are clean, free of bare spots, rust, and corrosion.	Pars. 26.4 and 26.7.
5	Glass	Check all front panel glass windows for breakage, cracks, and chipping. All glass windows must be in good condition.	
6	Cables	Inspect external cables and cords for cuts, cracked, or gouged jackets, fraying, and kinks. All cables and cords are in apparent good condition.	
7	Spare parts	Check all spare parts for general condition and method of storage. There should be no evidence of overstock and all shortages will be on valid requisition.	TM 11–6625–228–12P.
8	Fuses	The fuses in use and the spares should be of the indicated value (fig. 3); 2 ea, 5-amp; 2 ea, 5-amp (spare).	
9	Hardware	Check for loose or missing hardware. Tighten all loose nuts and bolts.	
10	Air filter	Inspect the air filter for dust, dirt, and grease. Air filter must be clean and allow free passage of air.	
11	Interior	Inspect interior components for cleanliness and general physical condition. Interior components must be free of dust, dirt, corrosion, fungus, and moisture.	
12	Pluckout items	Inspect clamps and seatings of pluckout items. All pluckout items should be properly seated, and clamps in proper position and correctly tightened.	

Sequence No.	Item	Procedure	References
13	Knobs, dials, and switches_	During operation (item 14), observe that the mechanical action of each knob, dial, and switch is smooth and free of external or internal binding.	
14	Performance _____	Check the radar test set in accordance with the equipment performance checklist.	Par. 28.

26.7. Painting

Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to applicable cleaning and refinishing practices specified in TM 9–213.

Page 19. Delete figure 10.

Page 23. Add the following after paragraph 33.

APPENDIX I

REFERENCES

The following is a list of applicable references available to the operator and organizational maintenance personnel of the radar test set.

DA Pam 310–4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
SB 38–100	Preservation, Packaging, and Packing Materials, Supplies, and Equipment Used by the Army.
TM 9–213	Painting Instructions for Field Use.
TM 11–6625–228–12P	Operator and Organizational Maintenance Repair Parts and Special Tool Lists; Test Sets, Radar AN/UPM–60 and AN/UPM–60A.
TM 38–750	The Army Equipment Record System and Procedures.

Page 24. After "APPENDIX", add: II

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.

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Corps (2)
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Instl (2) except
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USATC Armor (2)
USATC Engr (2)
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GENDEP (OS) (2)
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Sig Dep (OS) (12)
Army Dep (2) except
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Ft Worth (8)
USA Elct RD Actv (Ft Huachuca) (2)
USA Elct RD Actv (White Sands) (13)
WRAMC (1)
Army Pic Cen (2)
USA Mbl Spt Cen (1)
USA Trans Tml Comd (1)
Army Tml (1)
POE (1)
USAOSA (1)
AFIP (1)
AMS (1)
USA Elct Mat Agcy (25)
Chicago Proc Dist (1)
USASCC (4)
USARCARIB Sig Agcy (1)
Sig Fld Maint Shops (3)
JBUSMC (2)
Units org under fol TOE:
11-7 (2)
11-16 (2)
11-57 (2)
11-98 (2)
11-117 (2)
11-155 (2)
11-157 (2)
11-500 (AA-AC) (RM-RU) (2)
11-587 (2)
11-557 (2)
11-592 (2)
11-597 (2)

NG: State AG (3); units—same as active Army except allowance is one copy to each unit.

USAR: None.

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

809—407

CHANGE
NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC *24 July 1979*

Operation and Organization Maintenance

RADAR TEST SET AN/UPM-60A
(NSN 6625-00-569-0266)

TM 11-6625-228-12, 2 March 1959, is changed as follows:

The title of the manual is changed as shown above.

Page 3, paragraph 2. Delete paragraph 2 and substitute the following:

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 DSAR 4145.8

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33A/ AFR 75-18/MCO P461O.19B and DSAR 4500.15.

2.1 Reporting of Errors

The reporting 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 Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. A reply will be furnished direct to you.

2.2 Reporting Equipment Improvement Recommendations (EIR)

EIR's will be prepared using SF368, Quality Deficiency Report. 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-ME-MQ, Fort Monmouth, NJ 07703. A reply will be furnished direct to you.

Page 24. Appendix. Delete the Appendix and substitute the following:

SECTION II MAINTENANCE ALLOCATION CHART
FOR
TEST SET, RADAR AN/UPM-60 AND AN/UPM-60A

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQPT.	(6) REMARKS
			C	O	F	H	D		
00	TEST SET, RADAR AN/UPM-60 AND AN/UPM-60A	INSPECT		.1				23	a
		TEST		.2				3,23	
		TEST				1.0		1-6,8-22	
		SERVICE		.1				23	
		ADJUST		.1				3,23	
		ADJUST				.5		1-6,8-22	
		ALIGN				.5		1-6,8-22	
		REPLACE		.1				23	
		REPAIR				1.5		1-6,8-22	
		OVERHAUL					33	1-7,9-22	
01	CABLE ASSEMBLY CG-409( )/U	INSPECT		.1					
		TEST		.1				3,23	
		REPLACE		.1					
		REPAIR				.5		3,23	b
02	CABLE ASSEMBLY CX-3072/U	INSPECT		.1					
		TEST		.1				3,23	
		REPLACE		.1					
		REPAIR				.5		3,23	b
03	TEST SET, RADAR TS-743A/UPM, TS-743/UPM	INSPECT		.1				23	
		TEST		.2				3,23	
		TEST				1.0		1-6,8-22	
		SERVICE		.1				23	
		ADJUST		.1				3,23	
		ADJUST				.5		1-6,8-22	
		ALIGN					.5	1-6,8-22	
		REPLACE		.1				23	
		REPAIR				1.5		1-6,8-22	
0301	MODULATOR ASSEMBLY	TEST				.5		1-6,8-22	
		REPAIR				1.5		1-6,8-22	
0302	POWER SUPPLY ASSEMBLY	TEST				.5		1-6,8-22	
		REPAIR				1.0		1-6,8-22	
0303	RF PLUMBING ASSEMBLY	REPAIR				1.0		1-6,8-22	
0304	CRYSTAL AMPLIFIER ASSEMBLY	TEST				.5		1-6,8-22	c
		REPAIR				1.0		1-6,8-22	

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
AN/UPM-60 & 60A

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H,D	TEST SET TS-268/U	6625-00-669-1215	
2	H,D	GENERATOR, PULSE AN/UMP-15	6625-00-643-5969	
3	O,H,D	MULTIMETER AN/USM-223	6625-00-999-7465	
4	H,D	OSCILLOSCOPE AN/USM-281C	6625-00-106-9622	
5	H,D	PROBE, WAVEGUIDE RF-74( )/U	5985-00-892-5549	
6	H,D	SPECTRUM ANALYZER AN/UPM-84	6625-00-557-8262	
7	D	TEST SET, ELECTRON TUBE TV-2/U	6625-00-699-0263	
8	H	TEST SET, ELECTRON TUBE TV-7/U	6625-00-820-0064	
9	H,D	TOOL KIT TK-100/G	5180-00-605-0079	
10	D	TOOL KIT TK-105/G	5180-00-510-8177	
11	H,D	TEST SET, ELECTRON TUBE TV-13/U	6625-00-753-2294	
12	H,D	AMPLIFIER, R.F. AM-1881( )/U	5840-00-072-7924	
13	H,D	ATTENUATOR, VARIABLE CN-491( )/G	5985-00-752-3222	
14	H,D	ATTENUATOR, VARIABLE CN-492( )/G	5985-00-636-8405	
15	H,D	GENERATOR, SIGNAL AN/URM-127	6625-00-783-5965	
16	H,D	TEST SET, R.F., POWER TS-779/U	6625-00-566-4990	
17	H,D	HOLDER, PROBE MX-1545( )/USM-31	6625-00-304-7213	
18	H,D	COUPLER, DIRECTIONAL CU-209/U	5985-00-265-2942	
19	H,D	FREQUENCY METER FR-125/G	6625-00-752-6064	
20	H,D	PROBE, WAVEGUIDE MX-1546( )/USM-37	6625-00-581-5802	
21	H,D	MULTIMETER ME-260/U	6625-00-913-9781	
22	H,D	TUNER, WAVEGUIDE TN-335/G	5985-00-766-7799	
23	O	TOOL KIT TK-101/G	5180-00-064-5178	

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
a	"C" WHICH IS USUALLY THE DESIGNATION FOR "CREW" AND "O" WHICH IS THE DESIGNATION FOR "ORGANIZATIONAL" IN THIS CASE ARE THE GENERAL SUPPORT OR DEPOT MAINTENANCE TECHNICIANS OF RADAR SET AN/PNS-5 FOR WHICH THE TEST SET WAS SPECIFICALLY DESIGNED. NO CREW, ORGANIZATIONAL, OR DIRECT SUPPORT IS REQUIRED.
b	REPAIR BY REPLACEMENT.
c	USED ON AN/UPM-60 ONLY.

By Order of the Secretary of the Army:

E. C. MEYERS
General, United States Army
Chief of Staff

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J. C. PENNINGTON
Major General, United States Army
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USAADS (2)	USAERDAW (1)	29-26
USAFAS (2)	Units org under fol TOE:	29-35
USAARMS (2)	(1 cy each unit, UNOINDC)	29-36
USAIS (2)	29-207 (2)	29-134
USAES (2)	29-610 (2)	29-136
USAICS (3)	7	29-427
MAAG (1)	11-15	29-500
Fort Gordon (10)	11-17	37

ARNG: State AG (1)

USAR: None

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

TECHNICAL MANUAL

NO. 11-6625-228-12

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., *2 March 1959*

RADAR TEST SET AN/UPM-60A

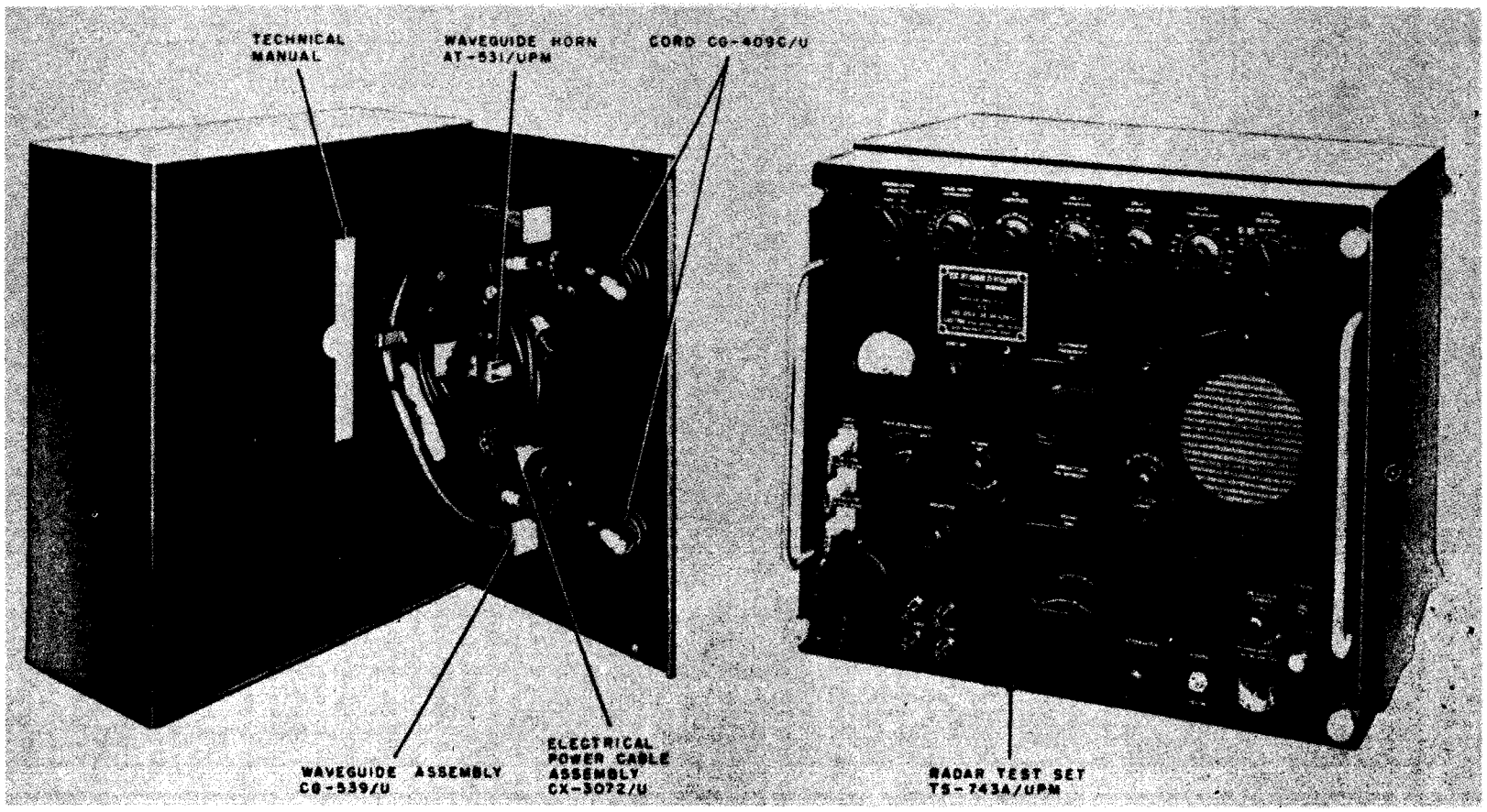

Figure 1. Radar Test Set AN/UPM-60A.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

This manual describes Radar Test Set AN/UPM-60A (fig. 1) and covers its installation, operation, and organizational maintenance. It includes instructions for cleaning and inspection of the equipment and replacement of parts available to organizational maintenance. The appendix contains the Maintenance Allocation Chart.

2. Forms and Records

a. Unsatisfactory Equipment Report. Fill out and forward DA Form 468 (Unsatisfactory Equipment Report) to the Commanding Officer, U.S. Army Signal Equipment Support Agency, Fort Monmouth, N. J., as prescribed in AR 700-38.

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

c. Preventive Maintenance Forms. Prepare DA Form 11-266 (Maintenance Check List for Signal Equipment (Test Equipment)) (fig. 10) in accordance with instructions on the form.

d. Comments on Manual. Forward all comments on this publication directly to the Commanding Officer, U.S. Army Signal Publications Agency, Fort Monmouth, N.J.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. General. Radar Test Set AN/UPM-60A (fig. 1) is a 15,750- to 16,250-mc microwave signal generator and measuring device that is used to test the performance of radar receivers and transmitters. It incorporates facilities for producing an undelayed video pulse, a delayed video pulse, pulsed radiofrequency (RF) signals, frequency-modulated (FM) signals, and continuous-wave (CW) signals.

b. Undelayed Video Trigger Pulse. An undelayed video trigger pulse of positive polarity with a peak amplitude of 20 to 50 volts, pulse width of 0.5 to 1 microsecond (psec), and pulse repetition rate of 100 to 10,000 pulses per second (pps) is available. The leading edge of the undelayed video trigger pulse coincides with the leading edge of either an input trigger pulse or an internally generated trigger.

c. Delayed Video Trigger Pulses. A delayed video trigger pulse is available having characteristics identical with the undelayed video trigger pulse. The delay between this video pulse and the undelayed video trigger pulse is variable from 1 to either 1,000 psec or 90 percent of the interval between trigger pulses, whichever is less. The delayed video trigger pulse can be used to check the time bases of radar indicators.

d. Pulsed RF Signal. A pulsed RF signal that may be varied over a frequency range of 15,750 megacycles (mc) .to 16,250 mc is available for checking receivers in pulse-modulated radar systems. The frequency in mc and the power level in decibels referred to 1 milliwatt (dbm) are indicated on calibrated front panel controls. The pulsed RF signal occurs not more than 1 psec after the delayed video trigger pulse. The delay between the RF pulse and the undelayed video trigger pulse is variable as described in *c* above. The pulse width is variable between 0.2 and 2 psec. The pulse repetition rate is variable between 100 and 10,000 pps.

e. Frequency-Modulated Signal. A frequency-modulated (FM) signal is available for checking

radar receivers in FM radar systems. The center frequency may be varied from 15,750 mc to 16,250 mc. The delay between the leading edge of the undelayed video trigger pulse and the start of the FM sweep is the same as described in *c* above. The sweep repetition rate can be varied from 100 to 10,000 sweeps per second. A deviation from the center frequency of at least 12.5 mc is possible.

f. CW Signal. A CW signal that may be varied over a frequency range of 15,750 mc to 16,250 mc is available for checking CW-type radar receivers. The frequency in mc and the power level in dbm are indicated on calibrated front panel controls.

4. Technical Characteristics

Frequency meter capabilities:
- Range ---------- 15,750 mc to 16,250 mc.
- Absolute accuracy --- ±10 mc.

Power measuring capabilities:
- Input range ---------- +6 dbm to +30 dbm.
- Output range------ 0 dbm to –90 dbm.
- Accuracy (10-w level)_ ±1 db with correction.
- Peak input _ _ _ _ _ _ _ _ 1 kw.

Modulation capabilities:
- Pulse-modulation rate. 100 to 10,000 pps.
- Pulse width _ _ _ _ _ _ _ _ Continuously variable from 0.2 µsec to 2 µsec.
- FM sweep excursion_ At least 12.5 mc from the center frequency.
- FM sweep repetition rate. 100 to 10,000 sweeps per second.

Trigger characteristics:
- Types of triggering_ _ May be triggered either internally by a self-generated trigger or externally by RF pulses, positive or negative video pulses, or sine waves.

Delay:
- Between the triggering pulse and the modulation pulse; between the triggering pulse and the start of the FM sweep; between the triggering pulse and the delayed sync output pulse. 1 to 1,000 µsec, or up to 90 percent of the interval between trigger pulses, which ever is less.

Delayed and undelayed video trigger pulses (sync outputs):
- Amplitude---------- 20 to 50 volts peak.
- Width ---------- 0.5 to 1 µsec.
- Polarity ---------- Positive.
- Repetition rate---------- 100 to 10,000 pps.

Power requirements:
- Input---------- 300 watts, 105 to 125 volts, 50 to 420 cps.
- Plate supply _ _ _ _ _ _ –300 volts, electronically regulated.
- Reflector supply _ _ _ _ _ – 372 to – 468 volts, adjustable.
- Pulse modulator supply. – 172 to – 268 volts, adjustable.
- Keyer supply_ _ _ _ _ _ _ 200 volts, electronically regulated.
- Bias supply _ _ _ _ _ _ _ – 450 volts, gas diode regulated.
- Outputs _ _ _ _ _ _ _ _ CW, pulsed, or frequency-modulated RF, delayed and undelayed video trigger pulses.

CW output stability------- Less than 0.3 mc FM. Less than 0.5 db AM.

Number of tubes _ _ _ _ _ _ _ _ 25.

Weight---------- 108 lb.

5. Components of Radar Test Set AN/UPM-60A

a. Components (fig. 1).

Quantity	Item	Height (in.)	Depth (in.)	Width (in.)	Unit weight (lb.)
1----------	Radar Test Set TS-743A/UPM ----------	$16^{25}/_{32}$	$151^{15}/_{16}$	19¾	102
1----------	Waveguide Horn AT-531/UPM ----------	$2^{9}/_{32}$	3¼	$1^{5}/_{32}$	$^{3}/_{16}$
1----------	Waveguide Assembly CG-539/U (2 ft.) ----------	1	24	⅜	¼
1----------	Cord CG-409C/U (6 ft, 2 in.) ----------	----------	----------	----------	¾
1----------	Electrical Power Cable Assembly CX-3072/U (6 ft, 2 in.).	----------	----------	----------	$1^{1}/_{16}$
2----------	TM 11-6625-228-12----------	10¼	¾	7⅞	⅜
1 set----------	Running spares (*b* below) ----------	2¼	20 1/8	18⅜	2¾

b. Running Spares.

Quantity	Item
1	Electron tube OB2WA.
1	Electron tube 5Y3WGTA.
1	Electron tube 6X4W.
1	Electron tube 5R4WGA.
1	Electron tube SRU-55A.
2	Electron tubes 0A2WA.
1	Electron tube 6080WA.
1	Electron tube 5751.
1	Electron tube 5725/6AS6W.
1	Electron tube 6AH6.
2	Electron tubes 6CL6.
2	Electron tubes 12AT7WA.
2	Crystal diodes 1N126A.
1	Crystal diode 1N26.
5	Fuses, 5-ampere.
1	Cord CG-409C/U (6 ft, 2 in.).
1	Incandescent lamp 6-8-v, 0.15-ampere, bayonet base.
2	Incandescent lamps, AN3140-328.
1	Neon lamp, NE-2E.

6. Common Names

Nomenclature	Common name
Radar Test Set AN/UPM-60A.	Radar test set.
Radar Test Set TS-743A/UPM	Test set.
Waveguide Assembly CG-539/U	Waveguide.
Cord CG-409C/U (6 ft, 2 in.)	Pulse cable.
Electrical Power Cable Assembly CX-3072/U (6 ft, 2 in.).	Power cable.
Waveguide Horn AT-531/UPM.	Horn antenna.

7. Description of Radar Test Set (fig. 1)

a. The major component of the radar test set is Radar Test Set TS–743A/UPM. This unit consists of a panel-chassis assembly inclosed in a combination dust cover and carrying case. All indicators, connector receptacles, and operating controls of the test set are mounted on the front panel. The carrying case has feet on the bottom, back, and both sides. The cover of the carrying case includes a compartment that holds the minor components and the manuals.

b. Minor components include—

(1) *Horn antenna.* This is a directional antenna consisting of a 31/4-inch length of Transmission Line RG-91/U waveguide flared into a horn that extends 1 3/16 inches from one end. The other end terminates in Waveguide Flange UG-419/U.

(2) *Waveguide.* The waveguide consists of a 2-foot length of nontwistable waveguide encased in a molded rubber jacket. Each end terminates in Waveguide Flange UG-419/U.

(3) *Pulse cable.* Two pulse cables are provided. Each consists of a 6-foot, 2-inch length of Radio Frequency Cable RG-58C/U with both ends terminating in Radio Frequency Plugs UG-88/U.

(4) *Power cable.* The power cable is a 6-foot, 2-inch length of two-conductor wire with a two-prong, male plug at one end and a two-contact, female connector at the other end.

8. Additional Equipment Required

One directional coupler, PRD type 405 or equivalent, is not supplied with the radar test set, but is required for certain operations.

CHAPTER 2

OPERATION

Section I. SERVICE ON RECEIPT OF EQUIPMENT

9. Unpacking
(fig. 2)

a. Packaging Data. When packed for shipment, the components of the radar test set are placed in two cartons and packed in a wooden box. One carton contains the running spares; the other contains the test set with the minor components and the manuals secured in the cover of the carrying case. The dimensions of the packed wooden box are 18 25/32 by 21 1/8 by 21 3/4

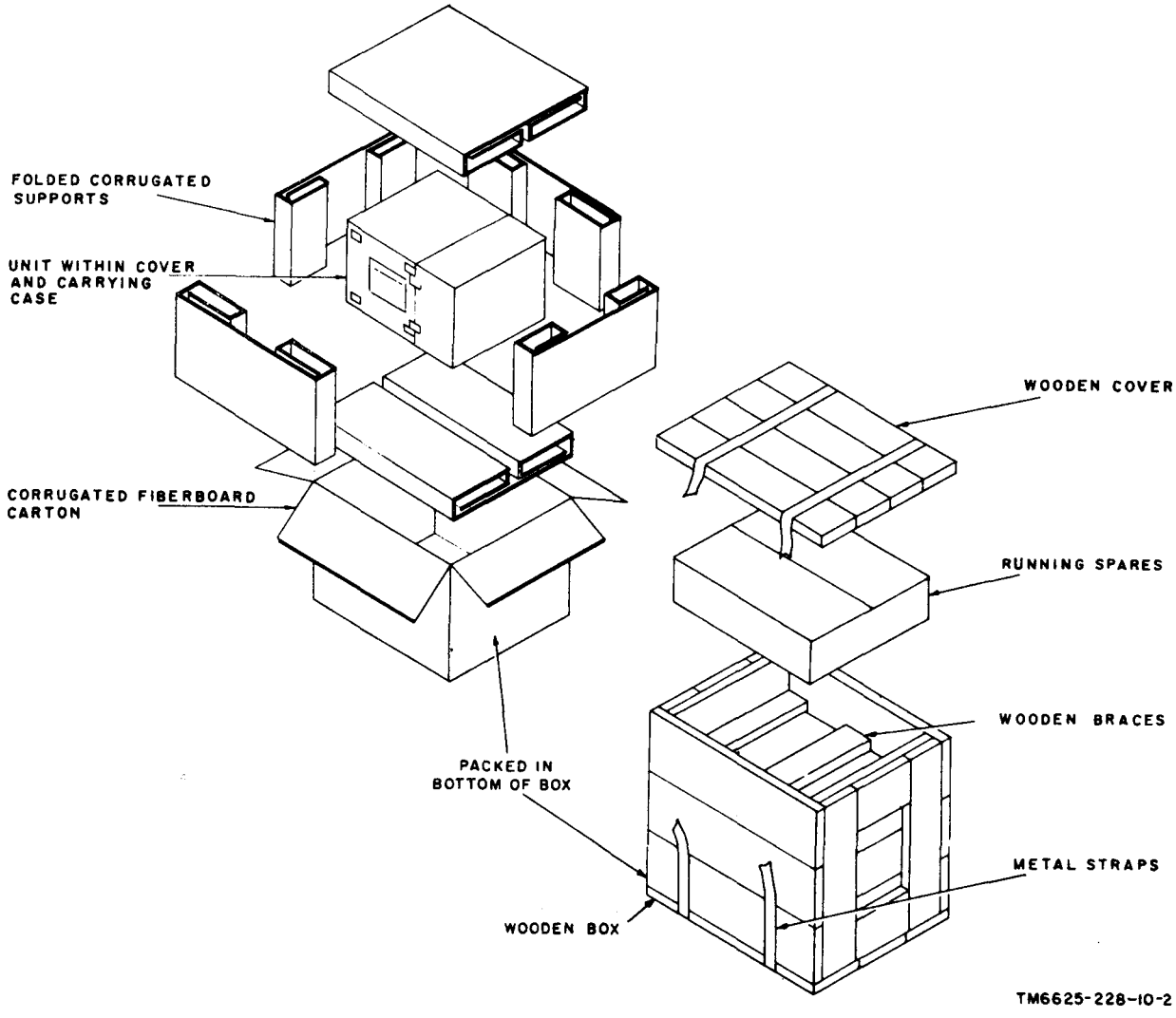

Figure 2. Packing and packaging.

inches. It weighs 140 pounds. The method of packaging and packing for domestic shipment is shown in figure 2. For oversea shipment, each carton is sealed in moisture-vaporproof barrier material.

b. Removinq Contents.

(1) Cut and fold back the metal straps.
(2) Remove the nails from the top and one side of the box with a nail puller. Remove the top and one side. Do not attempt to pry off the top and side; prying may damage the equipment.
(3) Remove the top carton that contains the running spares.
(4) Take out the wooden braces.
(5) Remove the remaining carton. Open it, take out the folded corrugated supports that are on the top and at the sides, and lift out the test set.

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) and/or the packing data (par. 9) as a general check.

11. Installation

Tubes and crystals are installed in the test set before it is shipped. Connection information for various types of operation is given in paragraphs 12 and 13.

a. Location. The test set must be placed within 6 feet of a source of 105- to 125-volt, 50- to 420-cycle-per-second (cps) ac power. If the test set is to be connected to a directional coupler on a radar set, it must be placed within 2 feet of the coupler to permit connection through the waveguide.

b. Fuses. Check to see that 5-ampere fuses are installed in the 5 AMP fuse holders on the front panel of the test set.

Caution: **To avoid damage to the equipment, use 5-ampere fuses only.**

Section II. CONTROLS AND INDICATORS

12. General

The front-panel meter can easily be damaged by careless operation of some of the controls. The meter reacts to settings of the POWER SET, ATTENUATOR, REFLECTOR, ZERO SET, and WAVEMETER TUNIING controls. Watch the meter closely when adjusting any of these controls and adjust the controls only as directed in the operating instructions.

13. Radar Test Set TS-743A/UPMOperating Controls

(fig. 3)

The operating controls and indicators are listed, and their functions are stated, in the table below:

Control or Indicator	Function
POWER switch ----------	In HEATER position, turns on internal heaters; in up position, turns on the test set and turns off the heaters.
POWER light lamp ----------	Lights when POWER switch is in the up position; indicates that power is applied to thc test set.
HEATER pilot lamp ---------- -	Lights when POWER switch is in HEATER position; indicates that heaters are operating.
MODULATION SELECTOR switch----------	Selects mode of operation when test set is used as a signal generator. Has four positions as follow: CW: for producing continuous-wave signals. PULSE: for producing pulse-modulated signals. FM X1: for frequency-modulated operation when the FM sweep rate is between 100 and 1,000 sweeps per second. FM X 10: for frequency-modulated operation when the FM sweep rate is between 1,000 arid 10,000 sweeps per second.
SYNC SELECTOR switch	Selects the type of synchronizing signals to be used. Has three positions for using external signals (EXT RF, EXT SINE EXT NEG, and EXT POS). Has two positions for using internally generated signals (INT X 1 and INT X 10).

Control or indicator	Function
RATE control----------	Sets the internal sync repetition rate or the FM sweep rate, depending on the setting of the MODULATION SELECTOR switch.
ZERO SET control----------	Used to set the meter at 0 on the milliwatt scale when the FUNCTION SELECTOR switch is set at TRANS.
FUNCTION SELECTOR switch--------	Used to make either transmitter or receiver tests. In TRANS position power and frequency measurements of the output of a radar transmitter are made. In RECV position, signal generator operation is provided.
POWER SET control----------	Used to adjust the RF power level when the test set is used as a signal generator. Establishes the l-milliwatt reference level when adjusted for an indication of 0 on the dbm scale, or 1.0 on the milliwatt scale of the meter.
ATTENUATOR control and POWER DBM dial.	Establishes the output power level when the test set is used to test receivers and the input power level when transmitters are tested. The control and dial are used in conjunction with the FUNCTION SELECTOR switch and the meter and, for receiver-testing functions, with the POWER SET control. When the FUNCTION SELECTOR switch is in the TRANS position, power input level from +6 to +30 dbm may be read on the red scale. When the FUNCTION SELECTOR switch is in the RECV position, the reading is taken from the outer, white, scale for power levels from 0 to –90 dbm.
OSCILLATOR TUNING control-------	Used to set the operating frequency in signal-generator operation.
WAVEMETER TUNING control and WAVEMETER FREQUENCY dial.	Used to indicate. the frequency established by the OSCILLATOR TUNING control or the frequency of RF input to the test set. As the control is rotated, a dip in meter indication shows that the dial is at the frequency of the RF being measured. The frequency is read directly from the WAVEMETER FREQUENCY dial.
REFLECTOR control----------	Adjusted for maximum indication on meter during power setting (par. *16d).*
PULSE WIDTH control----------	Varies the width of the output pulses from 0.2 microsecond to 2 microseconds when the MODULATION SELECTOR switch is in the PULSE position.
FM AMPLITUDE control---------	Controls the limits of FM deviation when the MODULATION SELECTOR switch is in either FM position.
DELAY control and MICROSECONDS scale.	Used as a fine adjustment of the time delay between the trigger pulse and the output sync pulse, or between the trigger pulse and either the start of the FM sweep or the RF pulse. The control is used in conjunction with the DELAY MULTIPLIER switch. When the switch is in the X1 position, the delay is variable from 1 to 100 microseconds, and the delay interval is read directly from the MICROSECONDS scale. In the X10 position of the DELAY MULTIPLIER switch, the delay is variable from 10 to 1,000 microseconds and the scale reading is multiplied by 10.
DELAY MULTIPLIER switch---------	Used in conjunction with the DELAY control to permit selection of delay limits. In the X1 position, the limits are set between 1 and 100 microseconds. In the X1O position, the limits are set between 10 and 1,000 microseconds.
METER----------	Provides frequency and power indications when transmitters or receivers are tested. Operates in conjunction with the POWER SET, ATTENUATOR, and WAVEMETER TUNING controls. Indicates proper setting of the ZERO SET and REFLECTOR controls.

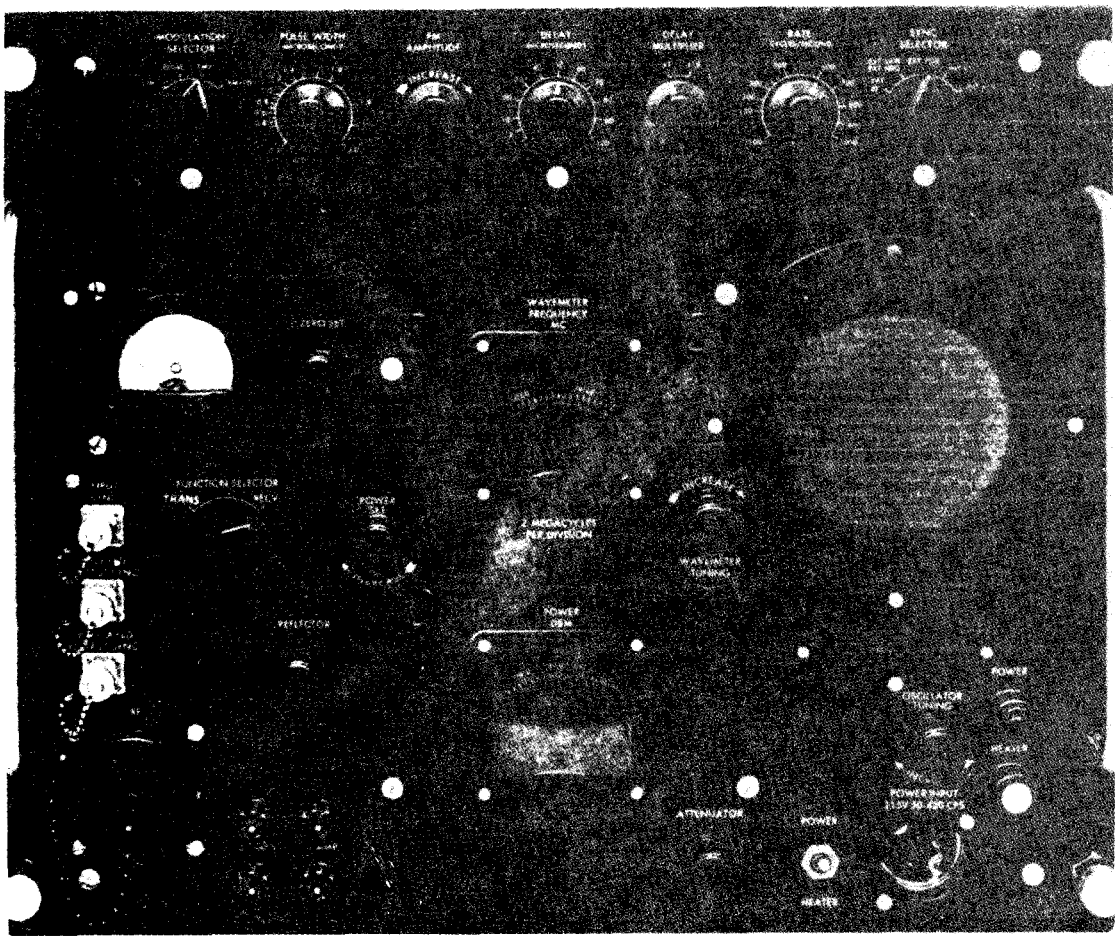

Figure 3. Test set operating controls.

Section III. OPERATING INSTRUCTIONS

14. Types of Operation

a. Radar Test Set AN/UPM–60A may be operated as a frequency meter, a power meter, or as a signal generator. It may be used to measure an unknown frequency, to check the frequency and power outputs of transmitters, and to aline and calibrate receivers.

b. For any type of operation, perform the following procedures:

(1) Preliminary starting procedure (par. 15).
(2) Starting procedure (par. 16).
(3) Procedure for the desired type of operation (pars. 18-23).
(4) Stopping procedure (par. 24).

15. Preliminary Starting Procedure

Perform the preliminary operations listed below before starting the test set as described in paragraph 16.

a. Set the POWER switch at the HEATER position.

b. Connect the power cable between an ac outlet and the POWER INPUT connector on the test-set front panel. The HEATER pilot lamp will light.

16. Starting Procedure

Set the POWER switch at the up position. The HEATER pilot lamp will go out and the

panel lamps for the POWER DBM scale and WAVEMETER FREQUENCY dial will light. The blower motor should operate.

b. Set the FUNCTION SELECTOR switch at TRANS and adjust the ZERO SET control for a zero indication on the milliwatt scale of the meter.

c. Make the following control settings and allow a 20-minute warmup period.

Control	Position
MODULATION SELECTOR	CW
FUNCTION SELECTOR --	RECV.
REFLECTOR----------	Fully countcrclock-wise.
POWER SET----------	Midposition.
OSCILLATOR TUNING---	Midposition.
ATTENUATOR----------	0 dbm on POWER DBM scale.

d. Turn the REFLECTOR control clockwise. Tho meter needle should deflect to the right. This indicates that the klystron is oscillating. Adjust the REFLECTOR control for a deflection to the right of midscale on the meter; turn the POWER SET control clockwise to deflect the meter needle back to midscale. Repeat these two adjustments until maximum deflection caused by the REFLECTOR control setting is limited to midscale (1.0 milliwatt) by the setting of the POWER SET control.

Caution: **Be careful when adjusting the REFLECTOR and POWER SET controls. Misadjustment can cause the meter needle to swing off scale and damage the meter.**

e. Set the WAVEMETER TUNING control to the desired frequency. Adjust the OSCILLATOR TUNING control for a sharp dip in the meter indication; then adjust the REFLECTOR control slightly for a further dip in the meter indication. When maximum dip on the meter is obtained, the klystron is tuned to the frequency indicated by the WAVEMETER FREQUENCY dial.

Note. The adjustments of the OSCILLATOR TUNING and REFLECTOR controls are extremely sensitive; they should be made carefully. Do not confuse the dip on the meter with the full deflection to the left that results when the controls are overadjusted and the klystron is tuned out of oscillation.

f. When the adjustments given in *e* above have been completed, detune the WAVEMETER TUNING control and reset the POWER SET control for a l-milliwatt indication on the meter.

g. To check the accuracy of the control settings, return the WAVEMETER TUNING control momentarily to the desired frequency. The meter needle should dip when the control is set at the proper frequency.

17. Connections for Testing Radar Receivers

By using the test set as a signal generator, receiver frequency, sensitivity, and bandwidth may be measured. The radar indicator may be used for indications of receiver response if it is an A- or J-type scope. If the radar system indicator cannot be used, Oscilloscope AN/USM-24 or equivalent may be substituted. After obtaining the l-milliwatt reference level (par. 16), use figure 4 as a guide and connect the test set to the radar set as follows:

a. With Directional Coupler. If the radar set has a directional coupler, connect the test-set waveguide between the RF connector on the front panel of the test set and the connector on the directional coupler. If the radar set does not have a built-in directional coupler, but provides for the insertion of one in the waveguide assembly, remove the appropriate section of the waveguide assembly and insert a PRD type 405 directional coupler or equivalent.

b. With Bidirectional Coupler. If the radar set has a bidirectional coupler, or provides for the insertion of one in its waveguide, it is important to connect the test set to the proper connection on the coupler. Waveguide Assembly CG-539/U is used for a connection between the RF connector on the test set and the connector on the bidirectional coupler.

Note. A bidirectional coupler is used for measuring power in both directions in a radar set waveguide. One connection on the coupler is used in measuring the radar transmitter power and for injecting certain test signals into the radar system. The other connection is used in measuring reflected power in the waveguide assembly. The combined measurements from both connections are used for computing standing wave ratios. If the test set is connected to the wrong connection on the coupler, the test results will be useless. Refer to the radar equipment manual for instructions on test-set connections to a bidirectional coupler.

c. With Horn Antenna. If a directional or bidirectional coupler cannot be used, the horn antenna must be used with the waveguide as shown in figure 4. (Receiver frequency measurements are accurate, using either connection; however, when making receiver sensitivity tests, the horn antenna cannot be used because the attenuation in-

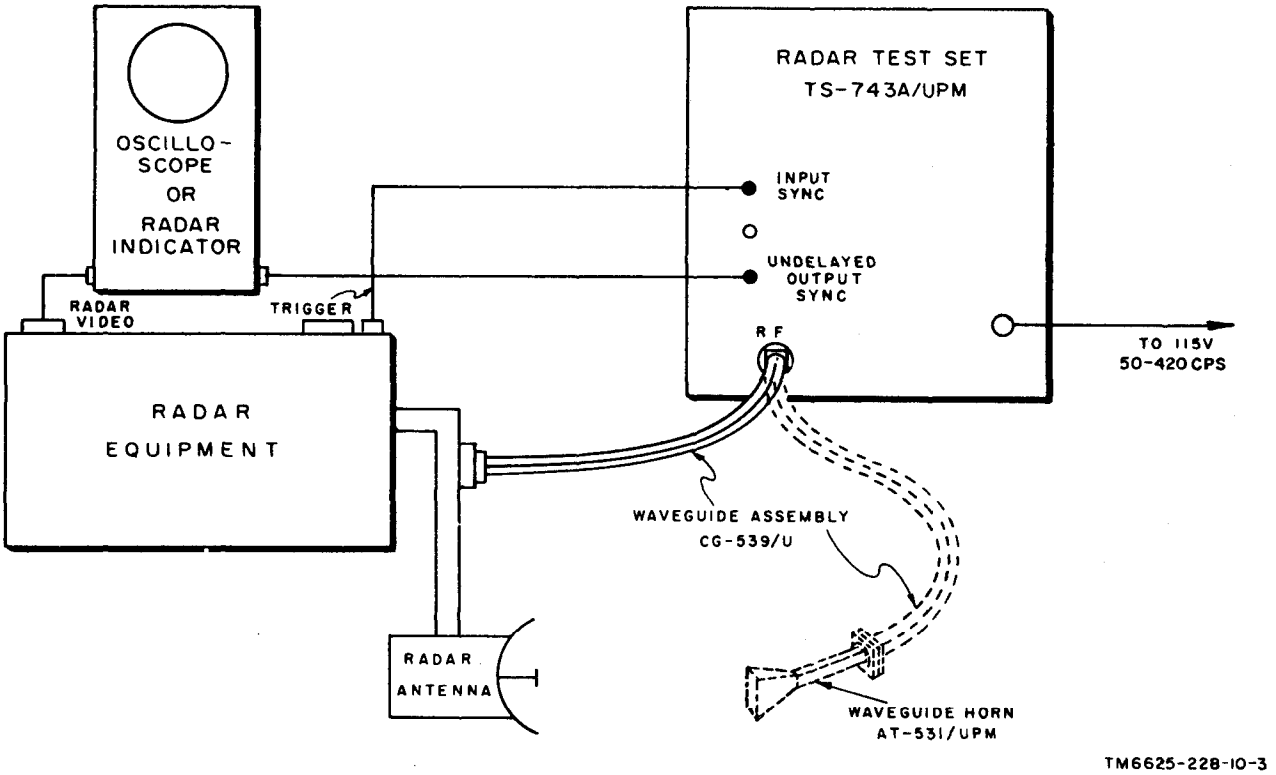

Figure 4. Connection diagram, receiver and transmitter tests.

troduced with the horn antenna must be estimated.) Attach the horn antenna to one end of the waveguide and connect the other end of the waveguide to the RF connector on the test set. In operation, the horn antenna will be directed at the radar antenna.

d. Pulse Cable Conntctions. Connections to be made by pulse cables between the radar set and the INPUT SYNC, DELAYED OUTPUT SYNC, and UNDELAYED OUTPUT SYNC jacks on the test set are determined by the tests to be made. The radar equipment manual will contain specific instructions for connecting the pulse cables.

18. Receiver Frequency Test

a. Obtain the 1-milliwatt reference level at the receiver frequency as described in paragraph 16.

b. Prepare the radar receiver and the oscilloscope or the radar indicator for normal operation. Adjust the receiver gain control to show some grass on the oscilloscope or on the indicator screen. Connect the equipment as described in paragraph 17 and figure 4. If possible, use the test-set waveguide connected to the directional coupler. The test set is synchronized by a sync signal from the radar equipment. The oscilloscope or indicator is synchronized by the undelayed video pulses available at the UNDELAYED OUTPUT SYNC jack on the front panel of the test set.

c. When the repetition rate of the radar set is between 100 and 1,000 pps, set the MODULATION SELETOR switch at the FM X 1 position. When the repetition rate is between 1,000 and 10,000 pps, set the switch at FM X 10.

d. Set the SYNC SELECTOR switch at either EXT POS or EXT SINE EXT NEG, depending on the polarity of the synchronizing signal from the radar set.

e. Vary the RATE, FM AMPLITUDE and DELAY (and DELAY MULTIPLIER switch) controls to obtain a band-pass curve indication (fig. 5) on the oscilloscope or radar system indicator. Adjust the ATTENUATOR control to give a good response indication without saturating the cathode-ray tube screen. Adjust the WAVEMETER TUNING control for a dip in the center of the frequency-response curve on the display screen (A and D, fig. 5). The WAVEMETER FREQUENCY dial now indicates the frequency to which the receiver is actually tuned.

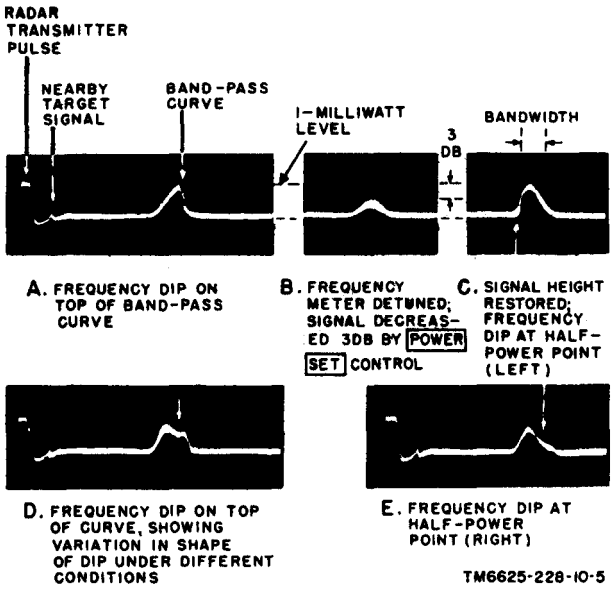

Figure 5. Receiver frequency and bandwidth measurements.

19. Receiver Sensitivity Tests

Receiver sensitivity may be measured by the two methods given below. Both methods use outputs from the test set.

a. Using Pulse-Modulated Signals (fig. 6).

(1) Establish the 1-milliwatt reference level at the receiver frequency (par. 16). Connect the test set to the receiver. Use the waveguide connected to a directional coupler; the horn antenna cannot be used for this test.

(2) Set the MODULATION SELECTOR switch at PULSE and set the FUNCTION SELECTOR switch at RECV. Set the SYNC SELECTOR switch at either EXT POS or EXT SINE EXT NEG, depending on the polarity of the synchronizing signal from the radar set. Adjust the DELAY control and the radar receiver gain control to present the test-set pulse on the display screen (fig. 6).

(3) Adjust the OSCILLATOR TUNING control for maximum test-set pulse and set the receiver gain control so that the grass is about half, the amplitude of the test-set pulse near saturation (A, fig. 6).

(4) Determine the minimum discernible signal by increasing the setting of the ATTENUATOR control until the pulse just disappears into the grass (C, fig. 6). As the pulse begins to disappear, increase the ATTENUATOR setting in 1-db steps, and vary the DELAY control to permit the signal to be discernible in the noise pattern.

(5) Note the POWER DBM dial reading when the signal disappears in the grass. This figure is the power output of the test set expressed in dbm below 1 milliwatt. Add to this figure the attenuation losses introduced in coupling the signal to the receiver. The total is the *uncorrected* minimum power level in dbm below 1 milliwatt at the receiver input necessary to produce a minimum discernible signal indication. This figure is therefore a relative index of receiver sensitivity. To obtain the absolute value, refer to the dbm correction curve supplied with the equipment (fig. 7).

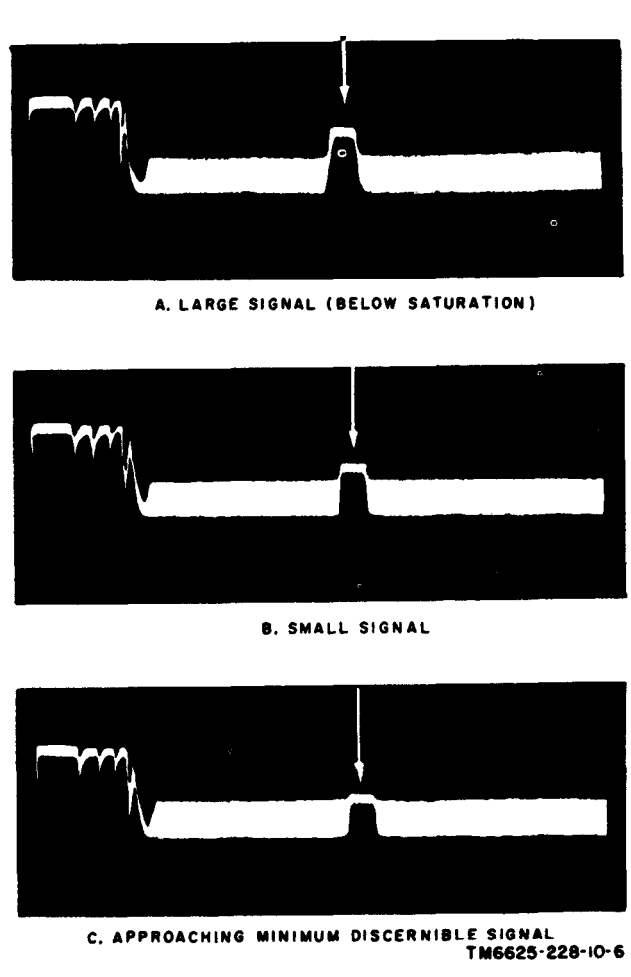

Figure 6. Minimum discernible signal power, pulse signal.

Read the correction along the vertical axis for the appropriate frequency curve. Add this correction *algebraically* to the original POWER DBM dial reading. Next, add the attenuation losses introduced in coupling the signal to the receiver. The total obtained is the *corrected* minimum power level in dbm below 1 milliwatt at the receiver input necessary to produce a minimum discernible signal indication. As an example:

(a) Assume that the WAVEMETER FREQUENCY dial is at 16,250 mc and the POWER DBM dial (RECV) indicates *—40.*

(b) At the point where the RECV 16,250-mc curve (marked W for white scale) intersects the vertical line that represents an indication of *—40* on the POWER DBM scale, read the correction. It is +1.35 dbm. Add this reading algebraically to the POWER DBM dial setting:

$$(+1.35)+(-40)=-38.65 \text{ dbm}$$

(c) Algebraically, add the losses introduced in coupling the test-set output to the receiver to the above corrected power level at the receiver input.

b. Using Frequemy-Modulated Signals (fig. *8).*

(1) Establish the l-milliwatt reference level at the center frequency of the receiver (par. 16) before connecting the test set to the radar set.

(2) Set the controls on the radar receiver and on the oscilloscope or the radar indicator for normal operation. Connect the equipment as instructed in paragraph 17. Use the test-set waveguide connected to the radar set directional coupler. (The waveguide horn antenna cannot be used for this test.)

(3) Set the MODULATION SELECTOR switch in either of the FM positions, depending on the pulse repetition rate of the radar system. When the pulse repetition rate is between 100 and 1,000 pulses per second, set the switch to the FM X 1 position. When the pulse repetition rate is between 1,000 and 10,000 pulses per second, set the switch to the FM X 10 position. Set the SYNC SELECTOR switch to either the EXT POS or the EXT SINE EXT NEG position, depending on the polarity of the synchronizing signal from the radar set.

(4) Set the FUNCTION SELECTOR switch at RECV. Adjust the RATE, FM

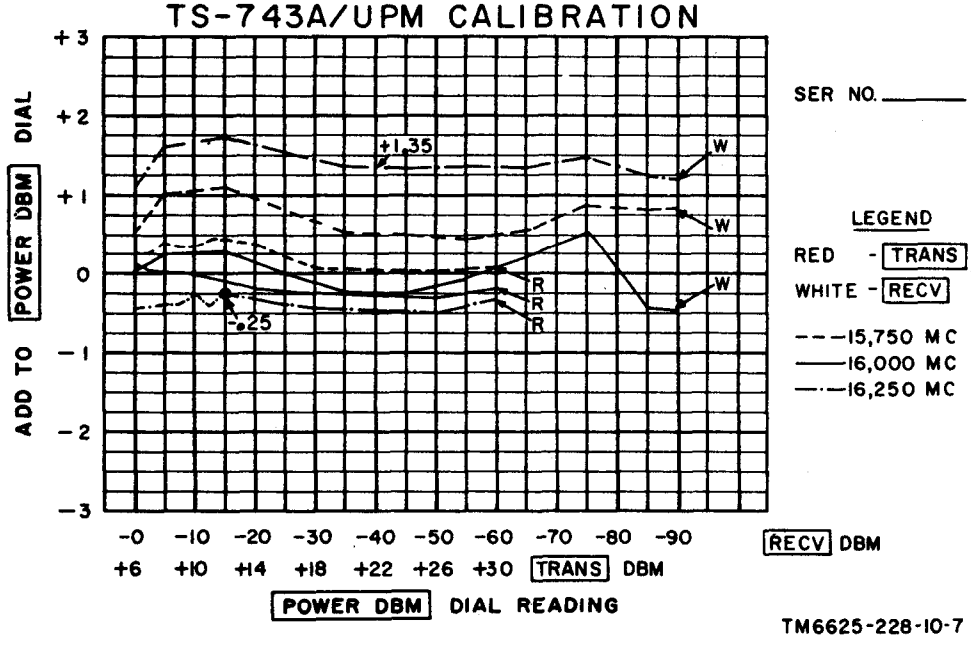

Figure 7. Typical POWER DBM scale correction curves.

AMPLITUDE, DELAY, and the receiver gain controls to obtain the test-set signal on the display screen. The test-set signal should appear as the receiver band-pass response curve (fig. 8).

(5) Set the receiver gain control so that the grass is about half the amplitude of the test-set signal on the scope (A, fig. 8).

(6) Adjust the test-set OSCILLATOR TUNING control for maximum test-set signal. Determine the minimum discernible signal by increasing the ATTENUATOR setting until the signal just disappears in the grass (C, fig. 8). As the signal begins to disappear, increase the ATTENUATOR setting in 1-db steps and vary the DELAY control to make the signal distinguishable in the grass.

(7) Determine the actual power level at the receiver input by performing the procedure given in *a(5)* above.

20. Receiver Bandwidth Tests
(fig. 5)

Two methods of measuring the bandwidth of a radar receiver are given in *a* and *b* below.

a. Measuring Bandwidth From WAVEMETER FREQUENCY Readings.

(1) Establish the 1-milliwatt reference level at the center frequency of the receiver (par. 16).

(2) Connect the test set to the radar receiver as instructed in paragraph 17.

(3) Obtain the receiver band-pass curve as described in paragraph 18b and illustrated in A, figure 5. Determine the receiver frequency.

(4) Detune the WAVEMETER FREQUENCY dial and draw a horizontal line at the peak of the signal indication on the scope screen. This line represents the 1-milliwatt level (A, fig. 5).

Note. Do not change the settings of the FM AMPLITUDE and REFLECTOR controls after the band-pass curve has been obtained.

(5) Set the MODULATION SELECTOR switch in the CW position and rotate the POWER SET control until the meter reads 0.5 milliwatt (—3 dbm).

(6) Set the MODULATION SELECTOR switch to the FM X 1 position and draw a horizontal line at the peak of the signal indication on the scope screen (B, fig. 5). This line represents the half-power points.

(7) Rotate the POWER SET knob until the peak of the signal touches the horizontal line representing 1 milliwatt. The horizontal line representing the half-power points now intersects the band-pass curve at the half-power points (C, fig. 5).

(8) Move the frequency dip across the receiver band-pass curve by varying the WAVEMETER TUNING control. Note the readings on the WAVEMETER FREQUENCY dial when the frequency dip falls at the two half-power points near the ends of the band-pass curve (E, fig. 5). The difference between the readings obtained at these two points is the frequency bandwidth of the receiver.

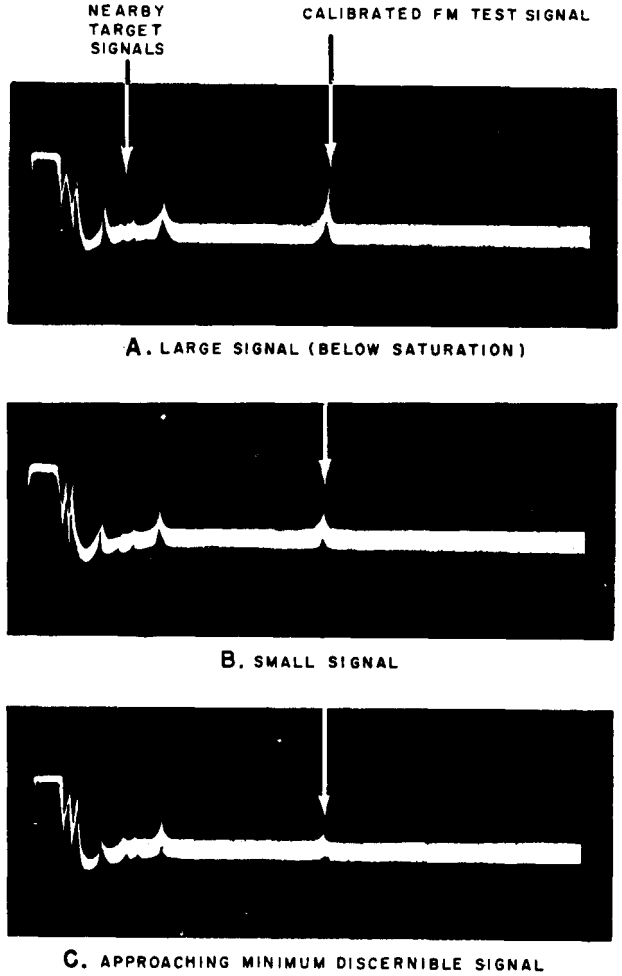

Figure 8. Minimum discernible signal power, FM test signal.

Note. The movement of the frequency dip in the procedure just described sometimes causes so great a distortion of the band-pass curve that half-power points cannot be accurately estimated (D, fig. 5). An alternate procedure is given in *b* below.

b. Calibrating Horizontal Sweep on Scope in Megacycles per Inch.

(1) Perform the procedures given in a(1) through (7) above.

(2) Move the frequency dip across the receiver band-pass curve by varying the WAVEMETER TUNING control. Note the readings on the WAVEMETER FREQUENCY dial when the frequency dip falls at the *extremities* of the band-pass curve. To obtain the frequency range between the two extremities, subtrack the lower frequency from the higher one.

(3) Measure the distance in inches between the two extremities of the band-pass curve.

(4) Divide the frequency range between the two extremities obtained as instructed in (2) above by the distance in inches between the two extremities obtained in (3) above. The figure obtained is the megacycle-per-inch ratio of the display.

(5) Measure the distance across the band-pass curve at the half-power points (C, fig. 5), and multiply this distance by the megacycle-per-inch ratio obtained as instructed in (4) above. The result obtained is the frequency bandwidth of the radar receiver.

21. Testing Radar System Time Bases

a. Only the outputs from the DELAYED OUTPUT SYNC and UNDELAYED OUTPUT SYNC jacks are required for checking radar system time bases. Information necessary for connecting the radar set to these jacks for various tests will be found in the radar equipment manual.

b. The test set makes available undelayed and delayed video pulses when the MODULATION SELECTOR switch is in the PULSE or either of the FM positions. The undelayed video pulses begin coincidentally with the trigger from the radar system. The delayed video pulses begin coincidentally with the RF output pulses or with the beginnings of the FM sweeps. These pulses follow the undelayed pulses by an interval continuously adjustable from 1 microsecond to either 1,000 microseconds or to 90 percent of the time interval between pulses, whichever is less. The video pulses may be used in any manner required for checking or recalibrating the timing circuits of radar systems.

c. The curve of figure 9 shows the maximum possible delay settings, as established by the DELAY control and the DELAY MULTIPLIER switch, between the undelayed pulses and the RF output pulses (or the delayed video pulses) at any pulse repetition rate within the range of the equipment. Any delay setting greater than that shown by the curve will result in a false indication of the delay. For example, if the pulse repetition rate is 3,000 pulses per second, the maximum delay setting allowable is 300 microseconds, as shown by the dot on the curve.

22. Testing Radar Transmitters

a. Connections. Only an RF connection through the test-set waveguide between the radar set and the test set is required for the tests that may be made on a radar transmitter. The connections are the same as those for receiver testing (par. 17). A directional coupler or a bidirectional coupler should be used on the radar set when possible. The radar signal can be fed through the horn antenna or either type of directional coupler for *frequency* measurements. The horn antenna cannot be used in taking *power* measurements because the loss between the radar set and the horn coupling can only be estimated, and any loss between the radar set and the test set must be known exactly for accurate power measurements.

Caution: **The radar test set is capable of measuring average power input up to 30 db above 1 milliwatt (30 dbm); that is, 1 watt, or a peak power input of 1 kilowatt with a 0.001 or less duty cycle. Exceeding these values of input power may damage the calibrated attenuator or the bead thermistor.**

b. Power Measurements.

(1) Set the attenuator (POWER DBM) dial for maximum attenuation.

(2) Set the FUNCTION SELECTOR switch in the TRANS position and adjust the ZERO SET control for a zero reading on the meter (0 on the milliwatt scale).

Note. Zero the meter before connecting the radar transmitter.

(3) Connect the equipment as instructed in

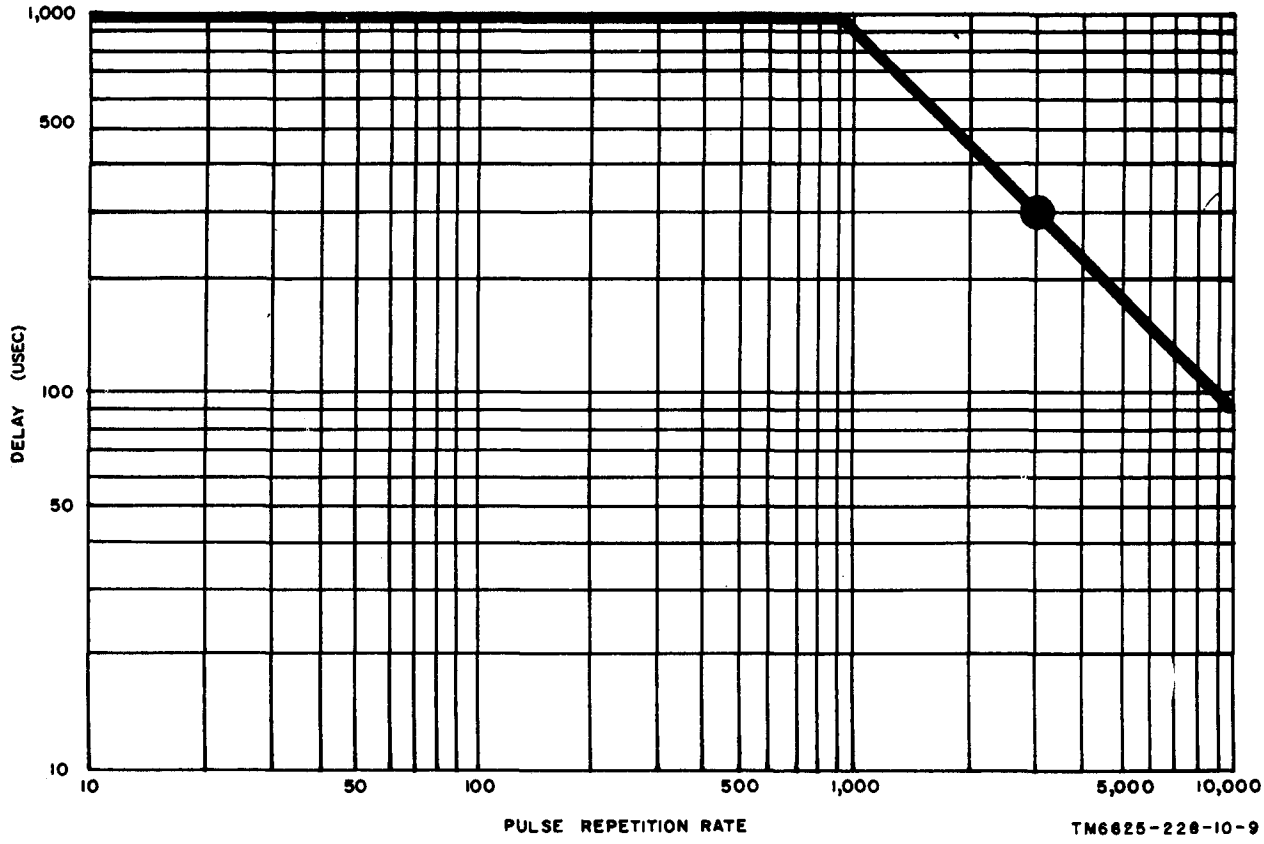

Figure 9. Maximum pulse delay versus pulse repetition frequency.

paragraph 17; use the waveguide assembly to connect the test set to the directional coupler on the radar equipment.

(4) Detune the WAVEMETER TUNING control.

(5) Adjust the ATTENUATOR control to obtain a 1.0-milliwatt reading on the meter.

(6) Note the POWER DBM dial reading on the +6 to +30 scale. Refer to the dbm correction curve (fig. 7) and read the correction along the vertical axis for the POWER DBM dial reading on the appropriate frequency curve. Add this correction *algebraically* to the POWER DBM dial reading. To this figure, add the attenuation losses introduced in coupling the radar transmitter to the test set. The result obtained is the absolute measurement of average transmitter power.

(a) Assume that the WAVEMETER FREQUENCY dial is at 16,250 mc and the POWER DBM dial (TRANS) indicates +12.

(b) At the point where the TRANS 16,250-mc curve (marked R for red scale) intersects the vertical line that represents an indication of +12 on the POWER DBM dial, read the correction. It is −0.25 dbm. Add this reading to the POWER DBM dial setting:

(+12)+(−0.25)=+11.75 dbm

(c) Algebraically, add the losses introduced in coupling.

c. Frequency Measurements.

(1) Perform the steps given for the transmitter power measurements *(b(1)-(5)* above).

(2) Vary the WAVEMETER TUNING knob slowly for a sharp deflection on the power meter needle. The deflection indicates that the frequency meter is tuned to the incoming signal; read the frequency of the transmitter on the WAVEMETER FREQUENCY dial.

23. Special Operating Considerations

The thermistors in this test equipment are extremely sensitive to temperature conditions. The accuracy of the measurements made with the equipment depends, to a large extent, on the values of resistance of the thermistors. The thermistor resistance values vary with the temperature variations. Under extreme climatic conditions, be sure that the equipment has reached proper operating temperatures before reference levels are set (par. 16) or measurements are taken. In severely cold regions, an extended warmup period of the equipment is necessary before it is put into full operation. In addition to the extended warmup period; check the reference levels occasionally during operation to correct for any variations that may result from the temperature conditions.

24. Stopping Procedure

a. To keep the internal heaters on when removing power from the operating circuits, place the POWER switch in the HEATER position.

b. To stop operation of the test set completely, remove the power cable from the POWER INPUT jack on the front panel.

CHAPTER 3

MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE

25. Tools and Materials

The tools and materials required for organizational maintenance of the radar test set are listed in *a* and *b* below.

a. Tool.

Tool Equipment TE-113.

b. Materials.

(1) Cheesecloth, bleached, lint-free.

(2) Cleaning Compound (Federal stock No. 7930-395-9542).

(3) Sandpaper, No. 000.

26. Preventive Maintenance Form

a. DA Form 11–266. DA Form 11–266 (fig. 10) is a preventive maintenance checklist to be used by the operator. Items not applicable to the radar test set are lined out in the figure. References in the ITEM block in the figure are to paragraphs that contain additional information pertinent to the particular item. Instructions for use of the form appear on the form.

b. Items. This information is supplementary to DA Form 11-266. The item numbers correspond to the ITEM numbers on the form.

Item	Maintenance procedures
1	Use clean cheesecloth to remove dust, dirt, moisture, and grease from the carrying case, front panel, RF connector, POWER INPUT connector, front-panel controls, waveguide, and horn antenna. If necessary, wet the cloth with Cleaning Compound; wipe the parts with a dry clean cloth.
2	Inspect the seating of the 5 AMP fuses on the front panel. Inspect the spare fuses and replace if necessary.
5	Repair any cuts in power-cord insulation by covering them with suitable tape. Repair or replace broken RF cables. Inspect the horn antenna and and waveguide for bends and breaks.
10	With sandpaper, remove all corrosion from the components. Where necessary, touch up bare spots with paint.

Warning: **Cleaning Compound is flammable and its fumes are toxic. Do not use it near a flame; provide adequate ventilation.**

Section II. TROUBLESHOOTING

27. Visual Inspection

When the test set fails to perform properly, turn off the power and check all the items listed below. Do not check any internal item with the power on. Inspection may save repair time and may also avoid further damage.

a. Burned-out fuse (usually indicates some other fault).

b. The seating of all connectors on pulse cables and power cord.

c. Seating of connectors of subchassis connecting cables.

d. The seating of all tubes.

28. Equipment Performance Checklist

a. General. The equipment performance checklist will sssist the operator or organizational maintenance man to locate trouble in the equipment systematically. Corrective measures that the organizational maintenance man can perform are given in the *Corrective measures* column. When using the checklist, start at the beginning and follow each step in order. If the corrective measures indicated do not fix the equipment, troubleshooting is required by higher echelon. Note on the repair tag how the equipment performed and the corrective measures that were taken.

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

DAILY CONDITION FOR MONTH OF FEBRUARY 1959

NO.	DAILY ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	2D 3D ECHELON
		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
1.	CLEAN DIRT AND MOISTURE FROM EXPOSED SURFACES OF [illegible], CASES, [illegible], CONTROL PANELS, INTERCONNECTING PLUGS, CABLES, [illegible], METER WINDOWS, ETC.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
2.	INSPECT FOR LOOSENESS OF EXTERIOR ITEMS SUCH AS SWITCHES, KNOBS, JACKS, CONNECTORS AND PILOT LIGHTS.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
3.	INSPECT CONTROLS FOR BINDING, SCRAPING. [illegible]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
4.	DURING OPERATION BE ALERT FOR ANY UNUSUAL PERFORMANCE OR CONDITION. PAR. 18-22	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

WEEKLY	CONDITION EACH WEEK 1ST	2D	3D	4TH	5TH	2D 3D ECH
5. INSPECT CORDS, CABLES, [illegible] FOR BREAKS, CUTS, KINKS, DETERIORATION, STRAIN AND FRAYING.	✓	⊗				
6. [illegible]						
7. HAND CHECK FOR LOOSENESS OF EXTERIOR ITEMS SUCH AS HANDLES, LATCHES, HINGES.	✓	✓				
8. [illegible]						
9. [illegible]						
10. INSPECT EXPOSED METAL SURFACES FOR RUST AND CORROSION.	✓	✓				
11. INSPECT METERS FOR DAMAGED GLASS AND CASES.	✓	✓				

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

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	CONDITION
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)*
- FEB-10 CORD CG-409C/U FRAYED. H.G.
FEB-12 CORD REPLACED. H.G.

2 3

TM6625-228-10-10

Figure 10. DA Form 11-266.

b. Procedure. With the power cord disconnected, check to see that the fuses are 5 amperes. Set the POWER switch to the HEATER position. Place the test set in operation as shown in the checklist below.

c. Checklist.

	Step	Action	Normal Indications	Corrective measures
START	1	Connect power cable to ac outlet and to POWER INPUT connector.	HEATER pilot lamp lights ------	Check fuses. Check ac source. Check pilot lamp and replace if necessary. Check continuity of power cable.
	2	Set POWER switch at up position.	HEATER pilot lamp goes out --- Illumination lamps for POWER DBM and WAVEMETER FREQUENCY dials light. Blower motor operates ---------	Remove and check lamps. Replace if necessary. Higher echelon repair required.
EQUIPMENT PERFORMANCE	3	Set FUNCTION SELECTOR switch at TRANS position. Vary setting of ZERO SET control.	Meter needle can be set at 0 on milliwatt scale.	Check tubes V4, V7, and V9 by substitution (par. 29).
	4	Set MODULATION SELECTOR switch at CW. Set FUNCTION SELECTOR switch at RECV. Set POWER SET control to midposition. Turn REFLECTOR control fully counterclockwise. Set OSCILLATOR TUNING control at midposition. Turn REFLECTOR control slowly clockwise.	Meter needle deflects to right ----	Higher echelon repair required.
	5	Adjust REFLECTOR control for maximum deflection of meter needle.	Meter needle deflects to right ----	Higher echelon repair required.
	6	Turn POWER SET control clockwise to set the deflection of meter needle after each adjustment of the REFLECTOR control.	Meter needle deflects to 1-milliwatt level.	Higher echelon repair required.
	7	Turn WAVEMETER TUNING control fully counterclockwise, then turn slowly clockwise. (This adjustment is very sharp; make it carefully.)	Meter needle dips sharply when the WAVEMETER TUNING control is rotated through the frequency at which the klystrom is oscillating.	Higher echelon repair required.
STOP	8	Set POWER switch at HEATER position.	POWER DBM and WAVEMETER FREQUENCY dial lamps go out. HEATER lamp lights. Blower stops.	
	9	Remove power cord from POWER INPUT receptacle.	HEATER lamp goes out.	

29. Tube Replacement by Substitution

a. When trouble occurs, check all cabling, connections, and the general condition of the equipment before attempting removal of electron tubes. To remove the panel-chassis from the case, first release the four cam lock fasteners at the back of the case. Then unscrew the four knurled captive screws on the front panel (one near each corner). Slide the panel-chassis from the case.

b. Replace tubes, one at a time, with new tubes. Discard a tube only if its defect is obvious or if replacement by a new tube of the same type causes the test set to operate. Do not leave a new tube in a socket if the test set operates satisfactorily with the original tube. If tube substitution does not cause the test set to operate and it must be forwarded for higher echelon repair, reinsert all original tubes in the test set.

Caution: **Do not attempt to change the klystron tube. This can only be replaced at bigher echelon.**

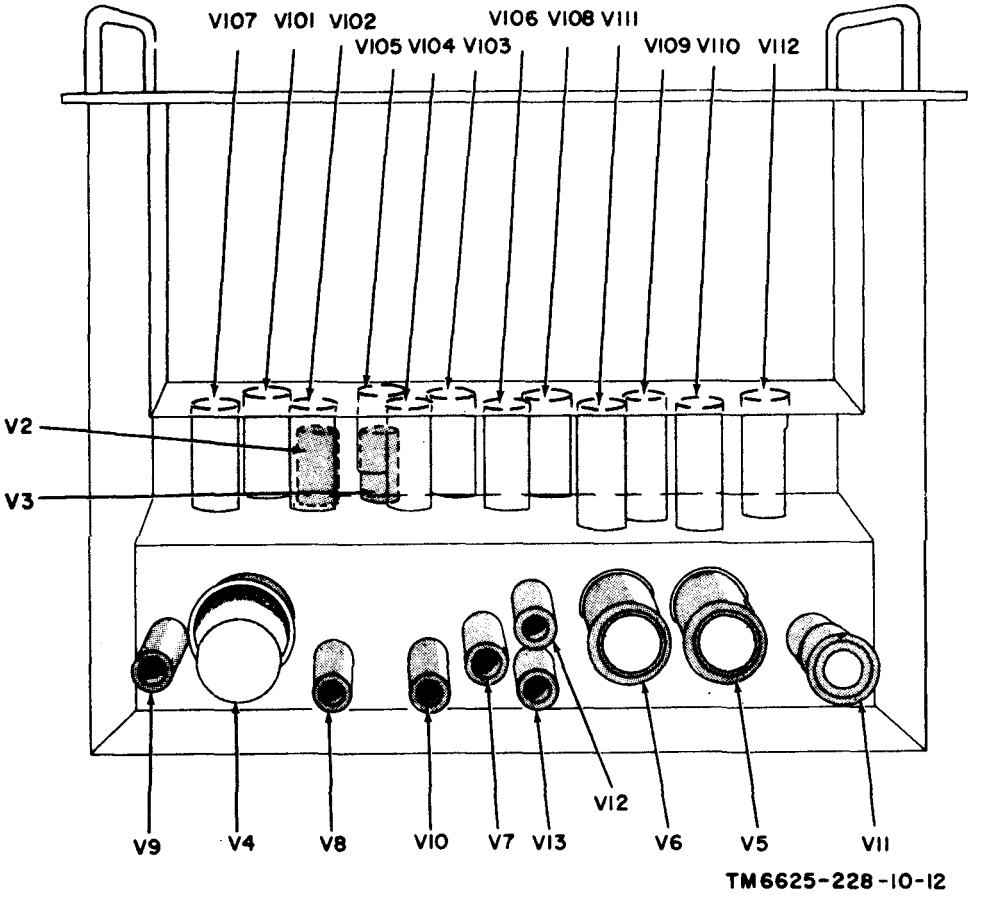

Figure 11. Tube location diagram.

CHAPTER 4

SHIPMENT, LIMITED STORAGE, AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

30. Disassembly of Equipment

To prepare the radar test set for shipment or storage, proceed as follows:

a. Disconnect the RF cords, the power cord, and the waveguide.

b. Coil the pulse cables and the power cord and place them in the proper clamps in the carrying-case cover (fig. 1).

c. Place the waveguide and the horn antenna in their clamps (fig. 1).

d. Insert the manuals in their compartment in the carrying-case cover (fig. 1).

e. Replace the cover of the carrying case and secure it with the four trunk-type spring latches.

31. 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. Adapt the procedures outlined below whenever circumstances permit. The information concerning the original packaging (par. 9) will also be helpful.

a. Material Requirements. The following materials are required for packaging the radar test set. For stock numbers of materials, consult SB 38-100 (Preservation, Packaging and Packing Materials, Supplies, and Equipment used in the Army).

Material	Quantity
Corrugated, single-faced, flexible cardboard	22 sq ft.
Water-vaporproof barrier material	22 sq ft.
Water-resistant gummed tape	25 ft.
Pressure-sensitive tape	30 ft.
Flat steel strapping	10 ft.
Wooden shipping box (*c* below)	1.
Filler material	5 lb.

b. Packaging. Package the items as outlined below.

(1) *Radar test set.* Cushion the unit on all surfaces with pads of filler material. Wrap corrugated cardboard around the cushioned unit to inclose it completely. Use gummed paper tape to hold the cardboard tight. Secure all openings with pressure-sensitive tape.

(2) *Spare parts.* Wrap the spare parts in corrugated cardboard and secure the package with gummed tape. Wrap the package in barrier material and seal all openings with pressure-sensitive tape.

c. Packing.

(1) Construct a wooden box with inside dimensions of 18 by 19 by 21 inches.

(2) Line the box with water-vaporproof barrier material, leaving enough material so

that the top of the top package, when placed in the box, can be covered. Seal the openings with pressure-sensitive tape.

(3) Place the two packages *(b* above) in the box, with the spare parts package on top. Fold the barrier material over the top package and seal all openings with pressure-sensitive tape.

(4) Nail the cover on the box and apply two bands of steel strapping.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

32. Authority for Demolition

Demolition of the equipment will be accomplished only on the order of the commander. The demolition procedures outlined in paragraph 33 will be used to prevent the enemy from using or salvaging this equipment.

33. 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 equipment is undertaken. The tactical situation also will determine in what manner the destruction order will be carried out.

a. Smash. Remove the chassis from the cabinet and smash the blower, the tubes, resistors, and capacitors above and below the chassis. Use a heavy tool, such as a sledge or crowbar. Smash the waveguide and the horn antenna.

b. Cut. Use an ax or similar tool to cut the internal wiring, the RF cords, and the power cord.

c. Bend. Bend the carrying case and the chassis with a heavy tool.

d. Burn. Burn the instruction literature first. Pour gasoline on the cut internal wiring and ignite it.

e. Dispose. Bury or scatter the destroyed parts or throw them into nearby waterways.

APPENDIX

MAINTENANCE ALLOCATION CHART

Section I. MAINTENANCE ALLOCATION

1. General

a. This appendix assigns maintenance functions and repair operations to be performed by the lowest appropriate maintenance echelon.

b. Columns in section II are defined as follows:

(1) *Part or component.* Only the nomenclature or standard item name is listed in this column. Additional descriptive data are included only where the clarification is necessary to identify the part. Components and parts comprising a major end item are listed alphabetically. Assemblies and subassemblies are in alphabetical sequence with their components listed alphabetically immediately below the assembly listing.

(2) *Maintenance function.* This column indicates the various maintenance functions allocated to the echelon capable of performing the operation. These are defined as follows:

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

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

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

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

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

(f) Repair. To restore to a serviceable condition by replacing unserviceable parts or by any other action required utilizing tools equipment, and skills available, to include welding, grinding, riveting, straightening, adjusting, etc.

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

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

(i) Rebuild. To restore to a condition comparable to new by disassembling the item to determine the condition of its component parts and reassembling it using serviceable, rebuilt, or new assemblies, subassemblies, and parts.

(3) *1st: 2d, 3d, 4th, 5th echelon.* The symbol X placed in columns 3 through 7 indicates the echelon responsible for performing that particular maintenance operation, but does not necessarily indicate that repair parts will be stocked at that level. Echelons higher than the echelon marked by X are authorized to perform the indicated operation.

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

(5) *Remarks.* Entries in this column are used to clarify data cited in the preceding columns.

c. Columns in section III are defined as follows:

(1) *Tools required for maintenance functions.* This column lists tools, test, and main-

tenance equipment required to perform the maintenance functions.

(2) *1st, 2d, 3d, 4th, 5th echelon.* A dagger (†) symbol placed in columns 2 and 6 indicates the echelons allocated the facility.

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

(4) *Remarks.* Entries in this column are used to clarify data in the other columns.

2. Maintenance by Using Organizations

When this equipment is used by signal service organizations organic to theater headquarters or communication zones to provide theater communications, those maintenance functions allocated up to and including fourth echelon are authorized to the organization operating this equipment.

3. Mounting Hardware

The basic entries of this Maintenance Allocation Chart do not include mounting hardware such as screws, nuts, bolts, washers, brackets, and clamps.

4. Comments or Suggestions

Any comments concerning omissions and discrepancies in this appendix will be prepared on DA Form 2028 and forwarded directly to Commanding Officer, U.S. Army Signal Equipment Support Agency, Fort Monmouth, N.J., ATTN: SIGFM/ES-M.

(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH.	(4) 2ND ECH.	(5) 3RD ECH.	(6) 4TH ECH.	(7) 5TH ECH.	(8) TOOLS REQUIRED	(9) REMARKS
TEST SET, RADAR AN/UPM-60; AN/UPM-60A	service				X			
	adjust				X		19	
	inspect				X			
	test				X		1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 17, 18, 19, 20, 21	
	repair				X			
	align				X		4, 9, 10, 11, 12, 18, 20	
	calibrate				X		2, 3, 5, 6, 8, 9, 10, 11, 13, 14, 15	
	rebuild					X		
CABLE ASSEMBLY, POWER, ELECTRICAL-CX-3072/U; W1000	repair		X					
CABLE, POWER, ELECTRICAL; W1001	replace		X					
CONNECTORS, PLUG ELECTRICAL; P1000, P1001	replace		X					
CABLE ASSEMBLY, RADIO FREQUENCY CG-409C/U; W2000	repair			X				
CABLE, RADIO FREQUENCY; W2001	replace			X				
CONNECTORS; P2000	replace			X				
CASE ASSEMBLY, CARRYING, TEST SET	repair					X		
CASE, TEST SET: less cover	replace					X		Fabricate if required or obtain from salvage.
CATCH, LUGGAGE	replace				X			Fabricate if required.
FEET	replace					X		Fabricate if obtained from salvage.
HANDLES, CARRYING	replace					X		Fabricate if required.
COVER, TEST SET CASE	replace					X		Fabricate if required or obtain from salvage.
	repair					X		
PARTITION, HINGED	replace					X		Fabricate if required.
HINGE	replace					X		Fabricate or obtain from salvage.
STRIKE: for luggage catch	replace					X		Fabricate or obtain from salvage.
LOCK WASHERS	replace			X				Available in Maintenance Equipment ME-9 and Hardware Kit MK-41/U
NUTS	replace			X				Available in Maintenance Equipment ME-9 and Hardware Kit MK-41/U
SCREWS, MACHINE	replace			X				Available in Maintenance Equipment ME-9 and Hardware Kit MK-41/U

(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH.	(4) 2ND ECH.	(5) 3RD ECH.	(6) 4TH ECH.	(7) 5TH ECH.	(8) TOOLS REQUIRED	(9) REMARKS
AN/UPM-60; AN/UPM-60A (continued)								
TEST SET, RADAR TS-743/UPM	service				X			
	adjust				X			
	inspect				X			
	test				X		1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 13, 14, 15, 16, 17, 18, 19, 20, 21	
	repair					X		
	align				X		4, 9, 10, 11, 12, 18, 20	
	calibrate				X		2, 3, 5, 6, 8, 9, 10, 11, 13, 14, 15	
AMMETER; M1	replace				X			
ARMASSEMBLY (033,034)	replace				X			Plain model only
ASSEMBLY, FLEXIBLE SHAFT (015)	replace				X			Plain model only
ATTENUATORS; AT1, AT2, AT3	replace				X			
SPRING, HELICAL EXTENSION (p/o AT-2 only); MP20, MP21	replace				X			
BRACKET, TERMINAL BOARD MOUNTING (A30,A31,A32)	replace				X			Plain model only
BUSHING, RUBBER (040,041,042)	replace				X			Plain model only
CAP, ELECTRICAL; E8	replace			X				
CAPACITORS	replace				X			
CLAMP, ELECTRICAL (A20 thru A27) (H1 thru H16) (H21,H22,H23,H26,H27,H28)	replace			X				Plain model only
COILS, RADIO FREQUENCY	replace				X			
CONNECTOR, PLUG; J7	replace				X			
SHIELD, ELECTRICAL CONNECTOR; E14	replace				X			
CONNECTOR, RECEPTACLES; J4, J5, J6, J7, J10, J11	replace				X			
COUPLING, SHAFT, RIGID (010,037,038)	replace				X			Plain model only
COVER, DIAL (A7)	replace			X				Plain model only
COVERS, ELECTRICAL CONNECTORS	replace		X					
DRIVE, TUNING (011)	replace				X			Plain model only
ELECTRON TUBE (KLYSTRON)	replace				X			
ELECTRON TUBES (except KLYSTRON)	replace	X						
ESCUTCHEON PLATE	replace				X			Fabricate if required
FAN, AXIAL	replace			X				
FILTER, AIR CONDITIONING (Ref 018)	replace			X				Plain model only
MOUNTING, AIR FILTER (Ref 08)	replace			X				Plain model only
FUSE, CARTRIDGE	replace	X						

(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH.	(4) 2ND ECH.	(5) 3RD ECH.	(6) 4TH ECH.	(7) 5TH ECH.	(8) TOOLS REQUIRED	(9) REMARKS
AN/UPM-60; AN/UPM-60A (continued)								
FUSEHOLDER	replace			X				
CAP, ELECTRICAL	replace		X					
GASKETS (Ref E31 thru E-45)	replace				X			Plain model only
GROMMETS	replace				X			
HOLDER, SEMICONDUCTOR DEVICE & WAVEGUIDE ASSEMBLY	repair					X		
CAP, ELECTRICAL; E17	replace				X			
SPRING, HELICAL COMPRESSION MP16	replace				X			
CONNECTOR, RECEPTACLE, ELECTRICAL (UG-290A/U); J3	replace				X			
HOLDER, CRYSTAL UNIT; XCR1	replace					X		
SEMICONDUCTOR DEVICE, DIODE (1N26)	replace				X			
HUB, STOP-WASHER (Ref 013)	replace				X			Plain model only
JACK, TELEPHONE (Ref J15)	replace				X			Plain model only
KNOBS	replace		X					
LAMP, GLOW; D37	replace				X			
LAMP, INCANDESCENT; D31 thru DS6	replace				X			
LAMPHOLDER	replace				X			
LIGHT, PANEL	replace				X			
LOCK, SHAFT (Ref H39 thru H50)	replace				X			Plain model only
MULTIMETER REPLACEMENT (Ref M1)	replace				X			Plain model only
PANEL-CHASSIS ASSEMBLY	repair					X		
FRAME ASSEMBLY	replace repair					X X		Fabricate or obtain from salvage
PANEL	replace					X		Fabricate if required
HANDLES	replace					X		Fabricate if required
GASKET	replace				X			
REACTOR (Ref L1,L2)	replace				X			Plain model only
RESISTORS	replace				X			
RETAINER, TUBE (Ref H17 thru H20, H24, H25)	replace		X					Plain model only
SEMICONDUCTOR DEVICE, DIODE (1N69)	replace		X		X			
SHAFT, TUNING (Ref 012)	replace				X			Plain model only
SHIELD, ELECTRICAL CONNECTOR	replace				X			
SHIELD, ELECTRON TUBE	replace		X					
SOCKET, ELECTRON TUBE	replace				X			
STUDS, PLAIN	replace				X			Fabricate if required
STUD, THREADED (Ref H30 thru H36)	replace			X				Plain model only
SWITCHES, ROTARY	replace				X			
SWITCH, TOGGLE	replace			X				
TERMINAL BOARD (Ref TB5 thru TB9)	replace				X			Plain model only

(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH.	(4) 2ND ECH.	(5) 3RD ECH.	(6) 4TH ECH.	(7) 5TH ECH.	(8) TOOLS REQUIRED	(9) REMARKS
AN/UPM-60; AN/UPM-60A (continued)								
THERMISTOR MOUNT ASSEMBLY	replace				X			
TRANSFORMERS	replace				X			
WASHER, KEY (Ref H54, H55 H58 thru H63)	replace				X			Plain model only
WAVEGUIDE ASSEMBLIES; Z3, 4, 5, 7	replace				X			
WAVEMETER	replace				X			
WASHERS FLAT	replace			X				Available in Maintenance Equipment ME-9 and Hardware Kit MK-41/U
WAVEGUIDE ASSEMBLIES; Z3000 & Z4000	replace		X					

(1) TOOLS REQUIRED FOR MAINTENANCE FUNCTIONS	(2) 1ST ECH.	(3) 2ND ECH.	(4) 3RD ECH.	(5) 4TH ECH.	(6) 5TH ECH.	(7) TOOL CODE	(8) REMARKS
AN/UPM-60; AN/UPM-60A (continued)							
AMPLIFIER, RF AM-1881( )/U				†	†	1	
ATTENUATOR, VARIABLE CN-491( )/G				†	†	2	
ATTENUATOR, VARIABLE CN-492( )/G				†	†	3	
AUDIO OSCILLATOR TS-382/U				†	†	4	
BRIDGE, SUMMUTION TS-779/U				†	†	5	
CARRIAGE, PROBE MX-1545/USM-37				†	†	6	
CRYSTAL RECTIFIER TEST SET TS-268E/U				†	†	7	
DIRECTION COUPLER CU-209/U				†	†	8	
FREQUENCY METER FR-67/U				†	†	9	
MULTIMETER AN/URM-105				†	†	10	
OSCILLOSCOPE AN/USM-50				†	†	11	
PULSE GENERATOR AN/UPM-15				†	†	12	
PROBE UNTUNED MX-1546/USM-37				†	†	13	
PROBE WAVEQUIDE RF-74( )/U				†	†	14	
SPECTRUM ANALYZER AN/UPM-58				†	†	15	
TEST SET, ELECTRON TUBE TV-2/U					†	16	
TEST SET, ELECTRON TUBE TV-7/U				†		17	
TEST SET, ELECTRON TUBE TV-13/U					†	18	
TOOL EQUIPMENT TK-21/G				†	†	19	
TUNER, WAVEQUIDE (Hewlett Packard P870A)				†	†	20	To be nomenclatured and standardized
VOLTMETER, METER ME-26/U				†	†	21	

[AG 413.44 (20 Feb 59)]

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

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

Official:

R. V. LEE,
Major General. United States Army,
The Adjutant General.

Distribution:

Active Army:

ASA (2)
CNGB (1)
Tech Stf, DA (1) except CSigO (30)
Tech Stf Bd (1)
USCONARC (5)
USA Arty Bd (1)
USA Armor Bd (1)
USA Inf Bd (1)
USA AD Bd (1)
USA Abn & Elct Bd (1)
USA Avn Bd (1)
USA Armor Bd Test Sec (1)
USA AD Bd Test Sec (1)
USA Arctic Test Bd (1)
US ARADCOM (2)
US ARADCOM Rgn (2)
OS Maj Comd (5)
Log Comd (5)
MDW (1)
Armies (5)
Corps (2)
Div (2)
USATC (2)
Svc Colleges (5)
Br Svc Sch (5) except USASCS (25)
GENDEP (2) except Atlanta GENDEP (none)
Sig Sec, GENDEP (10)
Sig Dep (17)
Army Pictorial Cen (2)
Engr Maint Cen (1)
USA Ord Msl Comd (3)
TASSA (15)
Mid-Western Rgn Ofc (TASSA) (1)
USA Sig Pub Agcy (8)
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USA Comm Agey (2)
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USA Sig Msl Spt Agcy (13)
WRAMC (1)
AFIP (1)
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Ports of Emb (OS) (2)
Trans Terminal Comd (1)
Army Terminals (1)
OS Sup Agcy (2)
Yuma Test Sta (2)
USA Elct PG (1)
Sig Lab (5)
Sig Fld Maint Shops (3)
Fld Comd, AFSWP (5)
Mil Dist (1)
Sector Comd, USA Corps (Res) (1)
USA Corps (Res) (1)
JBUSMC (2)
Units organized under following TOE's:
11-7 (2)
11-16 (2)
11--57 (2)
11-500 (AA-AE, RR) (2)
11-557 (2)
11-587 (2)
11-592 (2)
11-597- (2)

NG: State AG (3); units-same as Active Army except allowancc is one copy to each unit.
USAR: None.
For explanation of abbreviations used, see AR 320-50.

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