M 11-1247A

TO 33A1-3-55-11

ARMY TECHNICAL MANUAL

TEST SET

147B/UP

eprint which includes current
nges 1 and 2.

HE ARMY • 25 MAY 1956

TECHNICAL MANUAL

RADAR TEST SET TS-147B/UP

TM 11-1247A }
CHANGE No. 1 }

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

TM 11-1247A, 25 May 1956, is changed as follows:

Page 1-1, section 1. Add paragraphs 1.1 and 1.2 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 the equipment. DA Pam 310-4 is an index of current technical manuals, technical bulletins, 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.

1.2. 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 will 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, (e.g., officer, noncommissioned officer, supervisor, etc.).

Page 4-1, section 4. Delete paragraphs 1 through 4 and table 4-1 and substitute:

1. Scope of Maintenance

The maintenance duties assigned to the operator and second echelon repairman of Radar Test Set TS-147B/UP are listed below together with a reference to the paragraphs covering the specific maintenance functions.

a. Daily preventive maintenance checks and services (section 4, par. 4).

b. Weekly preventive maintenance checks and services (section 4, par. 4.1).

c. Monthly preventive maintenance checks and services (section 4, par. 4.2).

d. Quarterly preventive maintenance checks and services (section 4, par. 4.3).

e. Cleaning (par. 4.4, sec. 4).

f. Touchup painting (par. 4.5, sec. 4).

2. Preventive Maintenance

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

a. Systematic Care. The procedures given in paragraph 3 through 4.5, section 4 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. 4 through 4.3; sec. 4) 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 and second echelon repairmen in maintaining combat serviceability, the chart indicates what to check, how to check, and what the normal conditions are. The references column lists the illustrations, paragraphs, or manuals that contain detailed repair or replacement procedures. If the defect cannot be remedied by the operator, 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.

3. Preventive Maintenance Checks and Services Periods

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

a. Paragraph 4, section 4, specifies the checks and services that must be accomplished daily (or at least once each week if the equipment is maintained in standby condition).

b. Paragraphs 4.1, 4.2, and 4.3, section 4, specify *additional* checks and services that must be performed on a weekly, monthly, and quarterly basis, respectively.

4. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Completeness	See that the equipment is complete	Sig 7 & 8 for TS-147/UP.
2	Exterior surfaces	Clean the exterior surfaces, including the panel and meter glasses. Check all meter glasses and indicator lenses for cracks.	Par. 4.4, sec 4.
3	Connectors	Check the tightness of all connectors	
4	Controls and indicators	While making the operating checks (sequence No. 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 section 3, paragraph 3.	

4.1. Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Cables	Inspect cords and cables 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. 4.5, sec 4.

4.2. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Pluckout items	Inspect seating of pluckout items. Make certain that tube clamps grip tube bases tightly.	
2	Connectors	Inspect connectors for snug fit and good contact	

Sequence No.	Item	Procedure	References
3	Transformer terminals	Inspect the terminals on the power transformer. All nuts must be tight. There should be no evidence of dirt or corrosion.	
4	Terminal blocks	Inspect terminal blocks for loose connections and cracked or broken insulation.	
5	Resistors and capacitors...	Inspect the resistors and capacitors for cracks, blistering, or other detrimental defects.	
6	Rf plumbing	Inspect for cleanliness and tightness of mounts and waveguides.	Fig. 2-3.
7	Gaskets	Inspect gaskets for cracks, chipping, and excessive wear.	
8	Interior	Clean interior of chassis and cabinet..................	

4.3. Quarterly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Publications	See that all publications are complete, serviceable, and current.	DA Pam 310-4.
2	Modifications	Check DA Pam 310-4 to determine if new applicable MWO's have been published. All URGENT MWO's must be applied immediately. All NORMAL MWO's must be scheduled.	TM 38-750 and DA Pam 310-4.
3	Spare parts	Check all spare parts (operator and organizational) for general condition and method of storage. There should be no evidence of overstock, and all shortages must be on valid requisitions.	Sig 7 & 8 for TS-147/UP.

4.4. Cleaning

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

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

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

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

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 for more effective cleaning. Wipe dry with a cloth.

4.5. Touchup Painting Instructions

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

Page 4-25. Add the following appendix after Section 4.

APPENDIX

REFERENCES

Following is a list of publications available to the user of Radar Test Set TS-147B/UP:

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, 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.

Page 5-1. Delete section 5.

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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USATC AD (2)
USATC Engr (2)
USATC Inf (2)
USATC Armor (2)
USATC (5)
Instls (2) except
  Fort Monmouth (65)
Svc Colleges (2)
Br Svc Sch (2)
GENDEP (OS) (2)
Sig Sec, GENDEP (OS) (5)
Sig Dep (OS) (12)
Army Dep (2) except
  Fort Worth Army Dep (8)
  Lexington Army Dep (12)
  Sacramento Army Dep (28)
  Tobyhanna Army Dep (12)
AAF (CONUS) (2)
USACECDA (1)
USA Elct Rsch & Dev Actv (13)
  White Sands
USA Elct Rsch & Dev Actv (2)
  Fort Huachuca
POE (1)
Trans Tml Comd (1)
Army Tml (1)
USAOSA (1)
AMS (1)
WRAMC (1)
AFIP (1)
Army Pictorial Cen (2)
USA Mob Spt Cen (1)
USA Elct Mat Agcy (12)
Chicago Proc Dist (1)
USARCARIB Sig Agcy (1)
Sig Fld Maint Shops (3)
Units organized under following TOE:
  (2 copies each)
1–7
1–17
1–37
1–55
1–56
1–67
1–75
1–76
1–107
1–217
1–137
7
7–100
8–137
11–5
11–6
11–15
17
29–1
29–15
29–16
29–17
29–21
29–25
29–26
29–27
29–35
29–36
29–37
29–51
29–55
29–56
29–57
29–75
29–79

29–105
29–109
37
37–100
39–51
39–52
55–157
57
57–100

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

USAR: None.

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

CHANGE No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *15 August 1968*

RADAR TEST SET TS-147B/UP

TM 11-1247A, 25 May 1956, is changed as follows:

Note. The parenthetical reference to previous changes (example: "page 1 of C1") indicates that pertinent material was published in that change.

Page 1-1, paragraphs 1.1 and 1.2 (page 1 of C 1). Delete paragraphs 1.1 and 1.2 and substitute:

1.1 Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1.2 Forms and Records

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

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Report of Packaging and Handling Deficiencies) as prescribed in AR 700-58 (Army), NAVSUP Publication 378 (Navy), AFR 71-4 (Air Force), and MCO P4610-5 (Marine Corps).

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38 (Army), NAVSUP Publication 459 (Navy), AFM 75-34 (Air Force), and MCO P4610.19 (Marine Corps).

d. Report of Equipment Manual Improvements. Report of errors, omissions, and recommendations for improving this manual by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to Commanding General, U.S. Army Electronics Command, ATTN: AMSEL-ME-NMP-AD, Fort Monmouth, N.J., 07703.

Page 4-25. After section 4 (page 4 of C 1), add:

SECTION 5

DEPOT OVERHAUL STANDARDS

1. Applicability of Depot Overhaul Standards

The tests outlined in paragraphs 4 through 10 are designed to measure the performance capability of a repaired equipment. Equipment that is to be returned to stock should meet the standards given in these tests.

2. Applicable References

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

b. Modification Work Orders. Perform all modification work orders applicable to this equipment *before* making the tests specified. DA Pam 310-7 lists all available MWO's.

3. Test Facilities Required

a. The test equipment given below is required for depot testing.

Item	*Technical manual*	*Common name*
Spectrum Analyzer TS-148/UP . . .	TM 11-1249	Spectrum analyzer
Signal Generator SG-299/U	TM 11-5134-15	Square wave generator.
Wattmeter AN/URM-98	TM 11-6625-433-15	Wattmeter
Microwave Receiver Polarad Model R.	. . . .	Microwave receiver.
Transfer Oscillator CM-77	. . . .	Transfer oscillator.

b. A radio frequency (RF) attenuator network is also needed to test the TS-147B/UP.

4. General Test Requirements

The general test conditions given below should be met.

a. Input power to the equipment should be 115 volts of alternating current (ac), ±10 percent, single phase, 60 cycles.

b. All tests should be performed at normal room temperature.

c. The equipment should have a warmup period of 15 minutes before the tests are performed.

d. The TS-147B/UP ON-OFF switch should cause the heater resistors to warm up when the switch is set to OFF.

e. Set the TS-147B/UP FINE control to the center of its range, and adjust the COARSE control for a 0-decibel (referred to 1 milliwatt in 600 ohms) (dbm) setting.

f. The meter should balance to zero with the FINE-SET ZERO control. The function switch should be set to TRAN, and the DBM dial set to maximum attenuation.

g. The PHASE control should show at least three separate positions where the meter pointer deflects to indicate oscillation.

5. Adjustment of Test Equipment

Adjust the test equipment, before proceeding with the tests, as follows:

a. Calibrate the spectrum analyzer against the transfer oscillator.

b. Connect the spectrum analyzer to the TS-147B/UP RF connector.

c. Place the TS-147B/UP function switch at TEST.

d. Adjust the POWER SET control to the SET POWER line indication on the meter.

e. Check the frequency of 8,500, 9,080, and 9,600 megacycles (mc); the frequency should be accurate to within ±2.5 mc.

6. Triggering Tests

Perform the triggering tests as follows:

a. Set the INT FM-EXT MOD switch on the TS-147B/UP to INT FM, and the SIGNAL WIDTH to minimum

b. Connect the square wave generator output to the TS-147D/UP PULSE ANALYZER jack. Set the square wave generator output to 1,000 cycles per second (cps).

c. Vary the square wave generator power output until the sweep is triggering as indicated on the spectrum analyzer.

d. The output of the square wave generator should not be more than 0.1 volt.

e. Change the input connection to TRIGGER IN jack.

f. Vary the square wave generator output to trigger the sweep.

g. The output should not be more than 5 volts.

7. **Sweep Width Test**

a. Determine the TS-147B/UP center frequency as indicated on the spectrum analyzer, without a signal applied to the external trigger input.

b. Apply a 5-volt signal from the square wave generator to the TRIGGER IN jack.

c. Vary the TS-148/UP frequency dial to either side of center frequency.

d. The sweep width on either side of center frequency should be at least 30mc.

8. **External Modulation Test**

a. Set the INT FM-EXT MOD switch to EXT MOD.

b. Vary the MOD AMP control.

c. The modulation pattern on the spectrum analyzer should vary.

9. **Power Output Test**

a. Set the function switch to TRANS and adjust the balance control to zero on the meter.

b. Set the function switch to TEST, and adjust the POWER SET control to SET POWER line on the meter.

c. Connect the TS-147B/UP RF output to the power meter.

d. Adjust the TS-147B/UP DBM control to —7 db on the power meter.

e. The DBM dial should indicate —7 dbm ±1.5.

f. Check at 8,500, 9,080, and 9,600 mc.

10. **Attenuator Accuracy Test**

a. Connect the RF of the square wave generator to input of microwave receiver.

b. Connect the RF attenuator network input to PREAMP of the microwave receiver and the output of the attenuator to the IF input of the microwave receiver.

c. Set the DBM control to +10 on the D-BM dial to establish a reference level on the microwave receiver meter.

d. Vary the DBM control to +30 on the DBM dial and note the meter reading.

e. Return the DBM control to +10 on D-BM dial and insert 20-dbm from the RF attenuator network. The microwave receiver dial reading should be within 2 db of 130 dial setting.

f. Reestablish the reference at +10 db on the DBM dial and turn the TS-147B/UP function switch to RECV. Note the receiver meter indication.

g. Return the function switch to TEST, and insert 35 db from the RF attenuator network.

h. The microwave receiver dial should be within 2 db of the reading obtained with D-BM dial set to —45 on the TS-147B/UP.

i. Peak the microwave receiver output dial with the TS-147B/UP set to —45 dbm.

j. Set the DBM dial to —70; note the microwave receiver output meter indication.

k. Set the DBM dial back to —45 and insert 25 db from the RF attenuator network.

l. The microwave receiver output meter should be within 2 db of the reading with —70 db setting of the DBM dial.

m. Check at 8,500, 9,080, and 9,600 mc.

Appendix (page 3 of C 1). Delete and substitute:

APPENDIX A

REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders
DA Pam 310-7	U.S. Army Equipment Index of Modification Work Orders
TM 9-213	Painting Instructions for Field Use
TM 11-1249	Radar Test Set AN/UPM-33 (Spectrum Analyzer TS-148/UP)
TM 11-6625-433-15	Organizational, DS, GS, and Depot Maintenance Manual, Including Repair Parts and Special Tool Lists: Watt-meters AN/URM-98 and AN/URM-98A.
TM 38-750	Army Equipment Record Procedures

APPENDIX B

BASIC ISSUE ITEMS

Section I. INTRODUCTION

B-1. Scope

This appendix lists items comprising an operable equipment and those required for installation, operation, or operator's maintenance for Radar Test TS-147B/UP.

B-2. Explanation of Columns

The following is a list of explanations of columns in section II.

a. Source, Maintenance, and Recoverability Codes (SMR) Column.

(1) *Source code (S).* The selection status and source for the listed item is the first code indicated in this column. The source codes used and their explanations are:

Code	*Explanation*
P—	Applies to repair parts that are stocked in or supplied from GSA/DSA, or Army supply system, and authorized for use at indicated maintenance categories.
AH —	Applies to repair parts requiring manufacture assembly, or test at a level higher than that authorized to replace the part.
A —	Applies to assemblies that are not procured or stocked as such but are made up of two or more units, each of which carries an individual stock number and description and is procured and stocked and can be assembled by units at indicated maintenance categories.

(2) *Maintenance code (M).* The lowest category of maintenance authorized to install the item is indicated by the second code in the column. The maintenance category code and its explanation is—

Code	*Explanation*
O	Organizational maintenance

(3) *Recoverability code (R).* The recoverability code is the third code in the column. It indicates whether unserviceable items should be returned for recovery or salvage. Recoverability code and its explanation is as follows:

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

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

b. Federal Stock Number Column. This column indicates the Federal stock number for the item.

c. Description Column. This column includes the Federal item name and any additional description of the item which may be required. A part number or other reference number is followed by the applicable five-digit Federal supply code for manufacturer's. *Usable on code* column is not used.

d. Unit of Measure Column. The unit used as a basis of measure (e.g., ea, pr, ft, yd, etc.) is given in this column.

e. Quantity Incorporated in Unit Column. The total quantity of the item used in the equipment is given in this column.

f. Quantity Furnished with Equipment Column. This column lists the quantity of the item supplied for initial operation of the equipment and/or the quantities authorized to be kept on hand by the operator for maintenance of the equipment.

g. Illustrations Column.

(1) *Figure number (a).* The number of the illustration on which the item is shown is indicated in this column.

(2) *Item No. or reference designation (b).* Not used.

B-3. Federal Supply Codes

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

Code	*Manufacturer's name*
56232	Sperry Gyroscope Co. Div of Sperry Rand Corp.
81349	Military Specifications

SECTION II. BASIC ISSUE ITEMS

(1) SMR CODE	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION Reference Number & Mfr Code — USABLE ON CODE	(4) UNIT OF MEAS	(5) QTY INC IN UNIT	(6) QTY FURN WITH EQUIP	(7) ILLUSTRATIONS (a) FIG. NO.	(7) ILLUSTRATIONS (b) ITEM NO. OR REFERENCE DESIGNATION
	6625-256-1377	RADAR TEST SET, TS-147B/UP: (This item is nonexpendable)	ea			1-1	
		TECHNICAL MANUAL TM 11-1247A:	ea		1		
		NOTE: Requisition through pinpoint account number if assigned; otherwise through nearest Adjutant General facility.					
		For technical manuals the quantity indicates the maximum number of copies authorized for packing with this equipment. Where a number of these equipments are concentrated in a small area, the quantity on hand may be reduced to the minimum actual requirements as determined by the commanding officer of the unit.					
P-O	5935-149-3534	ADAPTER, CONNECTOR UG-273/U	ea	1	1	1-3	
P-O	5935-171-3016	ADAPTER, CONNECTOR UG-306/U	ea	1	1	1-3	
P-O	5985-264-9212	ADAPTER, CONNECTOR UG-397/U	ea	1	1	1-3	
P-O	5985-892-0732	ADAPTER, CONNECTOR UG-446A/U	ea	1	1	1-3	
AH-O-R	6625-223-5302	CABLE ASSEMBLY, RADIOFREQUENCY CG-92F/U	ea	1	1	1-3	
AH-O-R	5995-537-5617	CABLE ASSEMBLY, RADIOFREQUENCY CG-409F/U: (6 ft 1-1/2 in)	ea	1	1	1-3	
AH-O-R	6625-502-6077	CORD CX-337/U	ea	1	1	1-3	
P-O	5960-262-3763	ELECTRON TUBE: OB2WA; 81349	ea	1	1		
P-O	5960-107-7605	ELECTRON TUBE: 2K25; 81349	ea	1	1		
P-O	5960-262-1703	ELECTRON TUBE: 5R4WGA; 81349	ea	1	1		
P-O	5960-116-9919	ELECTRON TUBE: 6SH7; 81349	ea	1	1		
P-O	5960-188-0883	ELECTRON TUBE: 6SL7WGT; 81349	ea	1	1		
P-O	5960-617-6097	ELECTRON TUBE: 6Y6GT; 81349	ea	1	1		
P-O	5920-280-4466	FUSE, CARTRIDGE: FO2G2ROOA; 81349	ea	2	5		
P-O	5330-404-8930	GASKET: 5227456; 56232	ea		9		
P-O	6240-155-7864	LAMP LM-32	ea	2	3		
P-O	5985-241-6701	PICK-UP ANTENNA AT-68/UP	ea	1	1	1-3	
P-O	5960-284-6134	SEMICONDUCTOR DEVICE, DIODE: 1N23C; 81349	ea	1	2		
P-O	6625-519-0621	THERMISTOR ASSEMBLY MX-435/UP	ea	1	1		
		NO ACCESSORIES, TOOLS OR TEST EQUIPMENT ARE TO BE ISSUED WITH THIS EQUIPMENT					
		THE FOLLOWING ITEMS ARE MOUNTED IN OR ON THIS EQUIPMENT FOR STORAGE PURPOSES					
		COVER, CARRYING CASE					
	5935-149-3534	ADAPTER, CONNECTOR UG-273/U: 1					
		ADAPTER, CONNECTOR UG-306/U: 1					
	5985-264-9212	ADAPTER, CONNECTOR UG-397/U: 1					
	5985-892-0732	ADAPTER, CONNECTOR UG-446A/U: 1					
	6625-223-5302	CABLE ASSEMBLY, RADIOFREQUENCY CG-92F/U: 1					
	5995-537-5617	CABLE ASSEMBLY, RADIOFREQUENCY CG-409F/U: 1					
	6625-502-6077	CORD CX-337/U: 1					
	5985-241-6701	PICK-UP ANTENNA AT-68/UP: 1					
		POWER SUPPLY CHASSIS					
	6625-519-0621	THERMISTOR ASSEMBLY MX-435/UP: 1					

APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for Radar Test Set TS-147B/UP. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

C-2. Explanation of Format for Maintenance Allocation Chart

a. Group Number. Not used.

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

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

Code	*Maintenance category*
C	Operator/crew
O	Organizational Maintenance
F	Direct support maintenance
H	General support maintenance
D	Depot maintenance

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

e. Remarks. Self-explanatory.

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

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

a. Tools and Equipment. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool for the maintenance function.

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

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

e. Tool Number. Not used.

SECTION II. MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
	RADAR TEST SET TS-147B/UP	C											13	Visual only
			H										4,6,7,9,10	
				O									13	
					O								13	
										O			13	Replacement of easily replaced items
											D		1 thru 8 10,11,12	
	CABLE ASSEMBLIES									H			11	

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE	FEDERAL STOCK NUMBER	TOOL NUMBER
1	D	ANALYZER SPECTRUM TS-148/UP	6625-166-1040	
2	D	COUNTER, ELECTRONIC DIGITAL READOUT AN/USM-207	6625-911-6368	
3	D	GENERATOR, PULSE AN/PPM-1A	6625-504-9603	
4	H,D	GENERATOR, SIGNAL AN/URM-44A	6625-538-9417	
5	D	INDICATOR, STANDING WAVE AN/USM-37B	6625-814-8357	
6	H,D	MULTIMETER, TS-352B/U	6625-553-0142	
7	H,D	OSCILLOSCOPE AN/USM-140C	6625-987-6603	
8	D	TEST SET, ELECTRON TUBE TV-2( )/U	6625-669-0263	
9	H	TEST SET, ELECTRON TUBE TV-7D/U	6625-820-0064	
10	H,D	TEST SET, XTAL RECTIFIER TS-268E/U	6625-669-1215	
11	H,D	TOOL KIT, ELEC EQUIPMENT TK-100/G	5180-605-0079	
12	H,D	WATTMETER, AN/URM-98	6625-566-4990	
13	O	TOOL AND TEST EQUIPMENT AVAILABLE TO THE REPAIRMAN USER BECAUSE OF HIS ASSIGNED MISSION		

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

USASA (2)
CNGB (1)
ACSC-E (2)
Dir of Trans (1)
CofEngrs (1)
TSG (1)
CofSptS (1)
USAARENBD (2)
USAAESWBD (5)
USARADBD (5)
USAAVNTBD (5)
USACDC Agcy (1)
USAMC (5)
USCONARC (5)
ARADCOM (5)
ARADCOM Rgn (2)
OS Maj Comd (4)
USARYIS (5)
LOGCOMD (2)
USAMICOM (4)
USASTRATCOM (4)
USAESC (70)
USACOMZEUR (5)
MDW (1)
Armies (2) except
  Eighth USA (5)
Corps (2)
USAC (3)
Svc Colleges (2)
USASCS (60)
USAADS (40)
USAAMS (2)
USAARMS (2)
USAIS (5)
USAES (2)
USAOC&S (60)
USACSS (5)
Redstone Arsenal (5)
USATC Armor (2)
USATC Inf (2)
USASTC (2)
WRAMC (1)
Army Pic Cen (2)
USACDCEC (10)
ARADMAC (5)
Instl (2) except
  Fort Gordon (10)
  Fort Huachuca (10)
  Fort Carson (25)
  Fort Knox (12)
  Fort Belvoir (5)
  WSMR (5)
  APG (5)

USAEPG (5)
Army Dep (2) except
  LBAD (14)
  SAAD (30)
  TOAD (14)
  LEAD (7)
  SHAD (3)
  NAAD (5)
  SVAD (5)
  CHAD (3)
  ATAD (10)
  TEAD (5)
Gen Deps (2)
Sig Sec Gen Deps (5)
Sig Dep (12)
Sig FLDMS (2)
USAERDAA (2)
USAERDAW (13)
USACRREL (2)
MAAG (2)
USARMIS (2)
AAF (CONUS) (2)
AAF (USARPAC) (2)
Units org under fol TOE:
  (2 copies each)
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1-75
1-76
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1-107
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1-137
1-307
7
7-100
8-137
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11-6
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11-57
11-97
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11-117
11-127
11-155
11-157
11-158
11-500 (AA-AC)
11-587

11-592
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29-245
29-247
29-500
31-105
37
37-100
39-51
39-52
55-89
55-99
55-157
55-405
55-406
55-407
55-457
55-458
55-500
55-510
57
57-100
67
77-100

NG: State AG (3); Units — same as active Army except allowance is one (1) copy per unit.

USAR: None

For explanation of abbreviations used, see AR 320-50

TECHNICAL MANUAL) DEPARTMENT OF THE ARMY
NO. 11-1247A) Washington 25, D. C., 25 May 1956

RADAR TEST SET TS-147B/UP

SECTION 1—GENERAL DESCRIPTION

SECTION 2—THEORY OF OPERATION

SECTION 3—INSTALLATION AND OPERATION

SECTION 4— PREVENTIVE AND CORRECTIVE MAINTENANCE

SECTION 5—PARTS LISTS

LIST OF ILLUSTRATIONS

SECTION 1—GENERAL DESCRIPTION

SECTION 2—THEORY OF OPERATION

SECTION 3—INSTALLATION AND OPERATION

SECTION 4— PREVENTIVE AND CORRECTIVE MAINTENANCE

LIST OF TABLES

SECTION 1—GENERAL DESCRIPTION

SECTION 3—INSTALLATION AND OPERATION

SECTION 4—PREVENTIVE AND CORRECTIVE MAINTENANCE

SECTION 5—PARTS LISTS

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of the Bureau of Ships Manual or superseding instructions on the subject of radio-safety precautions to be observed.

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

Never measure potentials in excess of 1000 volts by means of flexible test leads or probes.

While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS:

Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties always remove power and discharge and ground circuits prior to touching them.

DON'T SERVICE OR ADJUST ALONE:

Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

DON'T TAMPER WITH INTERLOCKS:

Do not depend upon door switches or interlocks for protection but always shut down motor generators or other power equipment. Under no circumstances should any access gate, door, or safety interlock switch be removed, short-circuited, or tampered with in any way by other than authorized maintenance personnel, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

WARNING

Voltages over 300 volts shall be measured as follows:

a. De-energize the equipment. Ground terminals to be measured to discharge any capacitors connected to these terminals. (See Note (6) following.)

b. Connect meter to terminals to be measured using a range higher than the expected voltage.

c. *Without touching meter or test leads,* energize the equipment and read the meter.

d. De-energize the equipment. Ground the terminals connected to the meter before disconnecting meter.

Notes

(1) *Make sure* you are *not grounded* whenever you are adjusting equipment or using measuring equipment.

(2) In general, *use one hand only* when servicing live equipment.

(3) If test meter must be held or adjusted while voltage is applied, *ground* the case of the meter before starting measurement and do not touch the live equipment or personnel working on live equipment while you are holding the meter. Some moving vane type meters should not be grounded. These should not be held during measurements.

(4) *Do not forget* that high voltages *may be present* across terminals that are normally at low voltage, due to equipment breakdown. Be careful even when measuring low voltages.

(5) *Do not* use test equipment known to be in poor condition.

(6) High-voltage high-capacity capacitors should be discharged with a grounding stick with approximately 10 ohms in series with the grounded line. Where neither terminal of a capacitor is grounded, short capacitor terminals to each other.

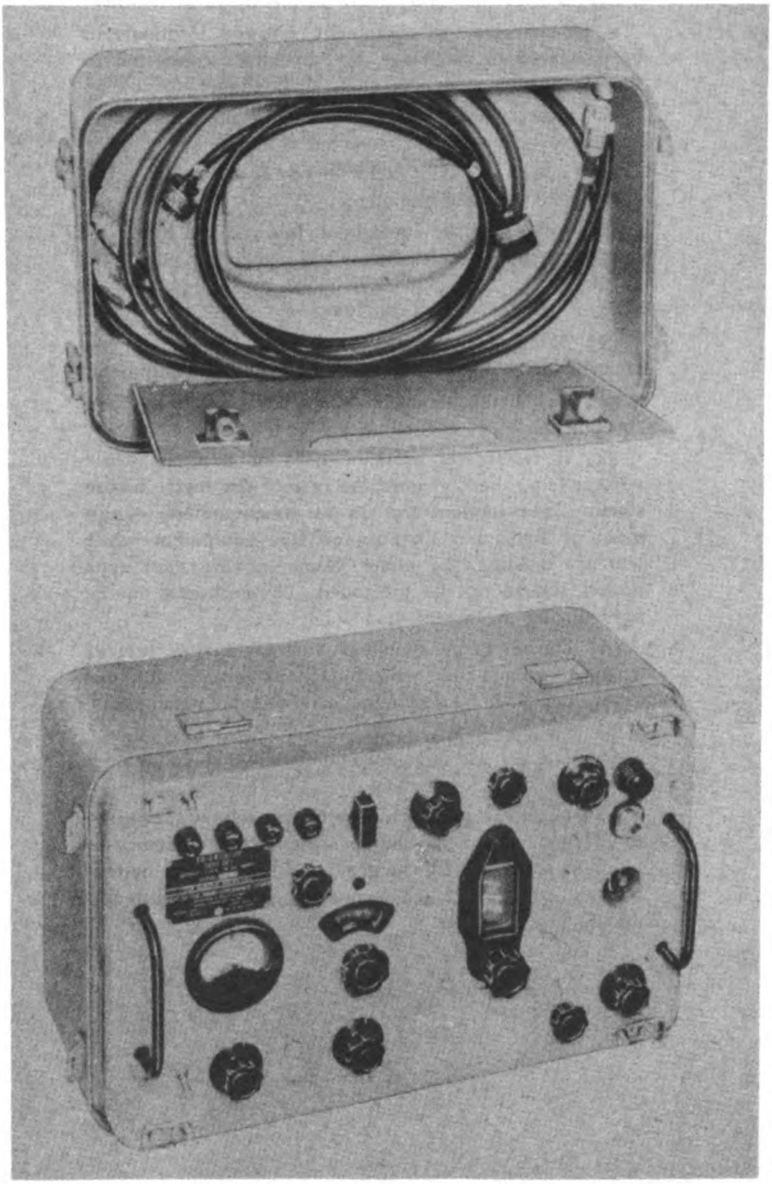

Figure 1–1. TS–147B/UP Radar Test Set—Complete Equipment

SECTION 1

GENERAL DESCRIPTION

1. PURPOSE AND BASIC PRINCIPLES.

a. This publication is issued as a basic handbook of operating and maintenance instructions for Radar Test Set TS-147B/UP.

b. The Test Set (figure 1–1) is a portable microwave signal generator designed for testing and adjusting radar systems and beacon equipment operating within the frequency range from 8500 to 9600 megacycles per second (mc).

c. The Test Set provides either f-m or c-w microwave test signals of known power level and frequency. These signals, together with the aid of an A-type scan oscilloscope for observing the radar video output, can be used in visual alignment methods for testing and adjusting radar systems. The sweep of the frequency-modulated test signal and the horizontal sweep of the oscilloscope are triggered in synchronism with the radar system firing cycle. The resulting pattern observed on the A-scope represents the frequency response curve of the receiver section of the radar system because the synchronizd timing used causes the horizontal sweep of the A-scope to be proportional to the frequencies of the f-m test signals. The oscilloscope patterns, therefore, indicate the effects of system adjustments.

d. In this Test Set provision also has been made to permit observation of the signal envelope of the transmitting tube of the radar system for any indication of power instability.

e. The Test Set contains a direct-reading frequency meter and a power-level meter. These components are used to measure both the frequency and power level of input or output signals without requiring any accessory equipment. The power-level meter is of the "ruggedized" type to give satisfactory performance under all operating conditions normally encountered in service.

f. Applications of the Test Set include measurement of radar transmitter power and frequency; observation of waveshape patterns of transmitting tubes; measurement of radar receiver bandwidth, sensitivity and recovery time; tuning of radar and beacon local oscillators; performance tests of TR boxes, AFC systems and rotating joints.

g. The Test Set operates principally as a microwave signal generator, the generator consisting essentially of a reflex-klystron oscillator and a triggered sweep generator which can modulate the frequency of the klystron by applying a sawtooth voltage to the reflector of the tube. The sweep can be triggered either by r-f pulses applied to the RF receptacle or by voltage pulses applied to the EXT MOD-TRIGGER IN receptacle of the Test Set.

h. Frequency-modulated pulses are produced by an internal sawtooth sweep which can be varied to produce frequency excursions from zero (cw) to at least 60 mc by changing the sweep amplitude. At maximum amplitude the sweep voltage covers three modes of the klystron. On the A-scope, each mode covered appears as a sharp pip. The pips can be widened into broad response curves by decreasing the sweep amplitude. Changing the d-c level of the sweep changes the position of the test signals along the range axis of the A-scope. Test signals can be seen as artificial echo returns on all types of radar indicators.

i. Measurements of average microwave power are made by a temperature-compensated thermistor-bridge wattmeter and a calibrated r-f attenuator. Power is measured in dbm (decibels relative to one milliwatt) over a range of −42 to −85 dbm for peak levels of test signals supplied by the set, and +7 to +30 dbm for average levels of external power applied to the set. These measurements are accurate within 1.5 db. The power ranges mentioned give the levels at the RF input-output receptacle on the Test Set; in operation, the attenuation of any cables or coupling devices used must be added to the stated levels.

j. Frequency measurements are made by an absorption-type cavity frequency meter which uses the thermistor-bridge wattmeter as a tuning indicator. The frequency meter, when tuned to resonance, causes sufficient mismatch in the waveguide to reflect part of the incident power traveling toward the thermistor mount. Therefore, a dip in the wattmeter indication is observed. The range of the frequency meter is 8500 to 9600 mc, and it is accurate to within 2.5 mc over this range. The frequency difference between any two signals not more than 60 mc apart can be measured to within 1.0 mc. The frequency meter is calibrated to within 1.0 mc at 9310 mc.

TABLE 1–1. TUBE AND CRYSTAL COMPLEMENT.

Quantity and Type	Description
2 –OB2	V–R tubes (V105, V106)
1 –1N23B	Silicon rectifier crystal (CR101)
1 –5R4–GY	Full-wave rectifier (V101)
2 –6SL7–GT	Twin triodes (V107, V108)
1 –6SH7	Pentode regulator amplifier (V103)
1 –6Y6–G	Beam power regulator control (V102)
1 –2K25	Microwave oscillator (V104)

2. DESCRIPTION OF UNITS.

a. RADAR TEST SET TS-147B/UP.—The Test Set is enclosed by a dust cover on five sides and a removable cover over the front panel for transit purposes (*see figure 1–2*). With the cover in place over the panel, the Test Set measures 11-27/32 inches wide by 19⅛ inches long by 13⅜ inches high. All cables and accessories are stored inside the removable cover with the exception of the spare thermistor mount which is mounted inside the chassis. When both the removable cover and the dust cover are removed, the Test Set can be separated physically into two major sections (*see figure 4–4*). The one section consists of the front panel upon which are mounted the microwave assemblies and waveguide sections. Input and output r-f signals appear in this section of the Test Set. The other section contains the electronic circuits mounted upon the main frame and chassis assembly. The electronic circuits include the video amplifier, which receives either the detected r-f input pulses or an externally applied trigger voltage and which applies an amplified trigger to the sawtooth sweep generator; the sweep generator, which modulates the internal klystron oscillator; the r-f power-level bridge, which indicates the power levels of internally generated and externally applied signals; and the power supply for filament, bias and plate-supply voltages.

b. PICKUP HORN AT-68/UP (*See figure 1–3*).—The pickup horn is a small, directive-antenna assembly which can be used both for receiving external r-f energy to be measured by the Test Set and for transmitting the r-f test signal generated in the Test Set. The horn consists of a tapered section of waveguide which is terminated by a probe coupling to a coaxial fitting. The horn is connected by means of the output cable assembly, CG-92A/U (8′-0″), to the receptacle marked RF on the Test Set panel.

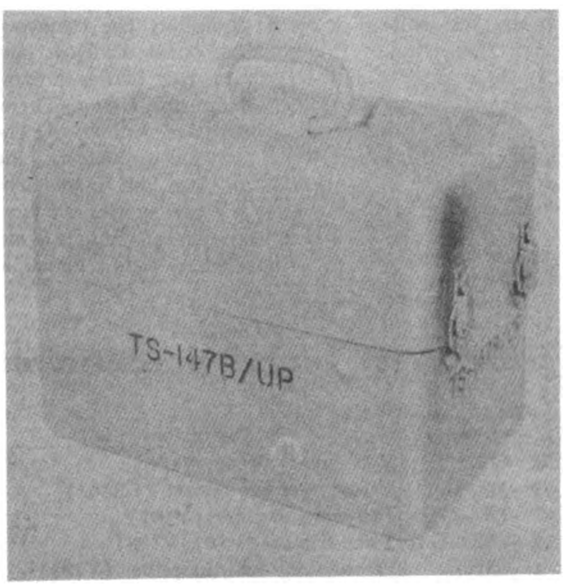

Figure 1–2. Test Set Stowed for Carrying

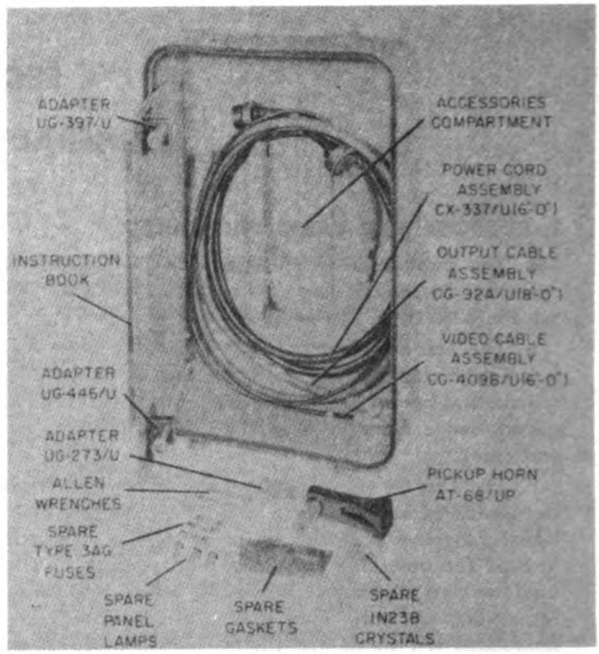

Figure 1–3. Test Set Accessories and Operating Spares

c. OUTPUT CABLE ASSEMBLY CG-92A/U (8′-0″) (*See figure 1–3*).—This cable is used for making the r-f connection to the radar system under test. Either a directional coupler or a pickup horn is used to complete the r-f connection. The cable assembly consists of eight feet of RG-9/U cable fitted with two UG-21B/U connectors. Connection is made to the UG-23B/U receptacle marked RF on the control panel. The value for the r-f attenuation of the cable, accurate to ±0.3 db at 8500, 9080 and 9600 mc, is stamped on a metal tag which is attached to each unit. The attenuation of the cable may change with time.

d. VIDEO CABLE ASSEMBLY CG-409B/U (6′-0″) (*See figure 1–3*).—This cable is used for connecting a trigger voltage to the Test Set when it is not possible to trigger the set by means of r-f pulses. The cable assembly consists of six feet of RG-58/U cable fitted with two UG-88/U connectors. An accessory right-angle video connector, UG-306/U, is coupled to one of the cable fittings. The video cable connects to the receptacle marked EXT MOD-TRIGGER IN on the control panel.

e. POWER CORD ASSEMBLY CX-337/U (6′-0″) (*See figure 1–3*).—Connection of the Test Set to a 115-volt, a-c power source is made by this cord. The assembly consists of six feet of rubber covered two-conductor cord provided with a female and a male

TABLE 1–2. EQUIPMENT SUPPLIED.

QUAN. PER EQUIP.	NAME OF UNIT	ARMY-NAVY TYPE DESIGNATION	DIMENSIONS (INCHES)			WEIGHT (LBS)
			WIDTH	LENGTH	HEIGHT	
1	TEST SET (complete)	TS-147B/UP	11 27/32	19 1/8	13 5/8	35
1	*HORN, Pickup	AT-68/UP	2 1/4	6 3/4	4 1/2	0.14
1	*CABLE ASSEMBLY, Output	CG-92A/U (8′-0″)	—	8 ft	—	1.25
1	*CABLE ASSEMBLY, Video	CG-409B/U (6′-0″)	—	6 ft.	—	1.25
1	†CONNECTOR, Right-Angle Video	UG-306/U	—	—	—	—
1	*CORD ASSEMBLY, Power	CX-337/U (6′-0″)	—	6 ft.	—	0.13
1	ADAPTER, BNC to UHF	UG-273/U	9/16	1 5/16	—	—
1	ADAPTER	UG-397/U	—	—	—	—
1	ADAPTER	UG-446/U	—	—	—	—
1 set	*SPARES, Operating	—	—	—	—	—

* Items packed in cover of Test Set carrying case, except thermistor mount which is attached to power supply chassis.
† Attached to Video Cable CG-409B/U (6′-0″).

fitting. The female fitting connects to the recessed plug marked 115V AC on the control panel. The male plug will fit a standard two-prong flush-base receptacle.

f. ADAPTER UG-273/U (*See figure 1–3*). — This BNC-to-UHF adapter is used to connect video cable CG-409B/U (6′-0″) to female UHF fittings.

g. ADAPTER UG-397/U (*See figure 1–3*).—The UG-397/U adapter is used to connect the type –N fitting on the output cable to 1¼ in. x ⅝ in. waveguide.

h. ADAPTER UG-446/U (*See figure 1–3*).—This adapter serves to connect the type–N fitting on the output cable to 1 in. x ½ in. waveguide.

i. OPERATING SPARES (*See figures 1–3 and 4–5*). —The following operating spares are supplied to replace corresponding parts in the Test Set:

(1) THERMISTOR MOUNT. — One complete spare thermistor mount is attached inside of the Test Set chassis (*figure 4–5*). Details on replacement are contained in Section 4 paragraph 6. *g.* (4).

(2) FUSES.—Five two-ampere type 3AG cartridge fuses are supplied. Two are mounted in the holders marked SPARES on the control panel and three are contained inside the cover.

(3) GASKETS.—Nine gaskets are provided for replacement of those in waveguide flange joints. (*See figure 2–4*).

(4) LAMPS. — Three 3.0-volt panel lamps are included.

(5) CRYSTALS.—Two Navy-type 1N23B silicon rectifier crystals are provided to replace the crystal in the r-f output and detector section.

j. WRENCHES.—Two Allen-type wrenches are supplied to facilitate removal of knobs on the front panel.

3. REFERENCE DATA.

a. Nomenclature: Radar Test Set TS-147B/UP.

b. Contract number and date: Nobsr-57580 dated 30 June 1952.

c. Contractor: Sperry Gyroscope Company, Great Neck, N. Y.

d. Cognizant Naval Inspector: Resident Inspector of Naval Materiel, Sperry.

e. Number of packages per complete equipment: one.

TABLE 1–3. SHIPPING DATA*

SHIPPING BOX NO.	CONTENTS		OVER-ALL DIMENSIONS			VOL	WT
	NAME	DESIGNATION	WIDTH	LENGTH	HEIGHT		
1	Radar Test Set and Accessories	TS-147B/UP	19½	28⅛	19½	6.2	65

* Dimensions are in cu. inches; volume in cu. ft.; weight in lbs.

f. Total cubical contents: Crated 6.2 cu. ft. Uncrated 1.75 cu. ft. Equipment spares are included.

g. Total weight: Crated 65 lbs. Uncrated 35 lbs. Equipment spares are included.

h. Frequency Meter.

(1) Range: 8500 to 9600 mc.

(2) Absolute Accuracy: ±2.5 mc at 25°C and 60% relative humidity.

(3) Relative Accuracy: ±1.0 mc for frequency increments of less than 60 mc. (Accuracy can be greatly improved through use of the temperature and humidity corrections described in Section 3, paragraph 13.)

(4) Calibration Point: 9310 ±1.0 mc at 25°C and 60% relative humidity.

i. Power Meter.

(1) Input Signals (average power levels).

(*a*) Range: +7 to +30 dbm at RF receptacle.

(*b*) Accuracy: ±1.5 db.

(2) Output Test Signals (peak mode power).

(*a*) Range: -42 to -85 dbm and -7 to -30 dbm at RF receptacle.

TABLE 1-4. BASIC DIFFERENCES IN TS-147/UP SERIES EQUIPMENT

CHARACTERISTIC	TS-147/UP	TS-147A/UP	TS-147B/UP	TS-147C/UP	TS-147D/UP
Primary Power	115vAC ±10% 50-1200 cps	115vAC ±10% 50-1600 cps	115vAC ±10% 50-1600 cps	115vAC ±10% 50-1600 cps	115vAC ±10% 50-1600 cps
Pulse Repetition Rates (FM sweeps)	to 3000 pps	to 3000 pps	to 4000 pps	to 3000 pps	to 4000 pps
Input trigger duration requirement	0.5 to 6 usec	0.5 to 6 usec	0.2 to 6 usec	0-6 usec	0.2 to 6 usec
RF Power Level, input	+7 to +30 dbm ±2.0 db	+7 to +30 dbm ±2.0 db	+7 to +30 dbm ±1.5 db	+7 to +30 dbm ±2.0 db	+7 to +30 dbm ±1.5 db
RF Power Level, output	−40 to −80 dbm ±2.0 db	−7 to −80 dbm ±2.0 db	−42 to 85 dbm ±1.5 db	−42 to −83 dbm ±2.0 db	−7 to −85 dbm ±1.5 db
Pulse Analyzer Connector	no	no	yes	no	yes
Capable of being externally modulated	no	no	yes	no	yes
Calibration Curves Mounted on	cover	cover	panel	cover	panel
Thermistor Bridge Circuit	—	—	one disc thermistor eliminated	—	Switch added to change circuit for about a 4 times increase in sensitivity for measurement of short pulses
Frequency Meter	—	—	Friction slow-motion drive in addition to regular drive	—	3:1 step down in regular drive by addition of gears
Chassis	Framed across back only	Framed across top and back	Framed across back and bottom	Framed across top and back	Framed across top and back
Operating Spares	1 Thermistor Mount 5 Fuses, 9 Gaskets 3 Lamps, 2 Crystals	Same as TS-147/UP	Same as TS-147/UP	Same as TS-147/UP	Provision for same as TS-147/UP
Coarse Thermistor Adjust Control Located on	rear of chassis	rear of chassis	front panel	front panel	front panel

NOTE: Some symbol designations are different for each model.

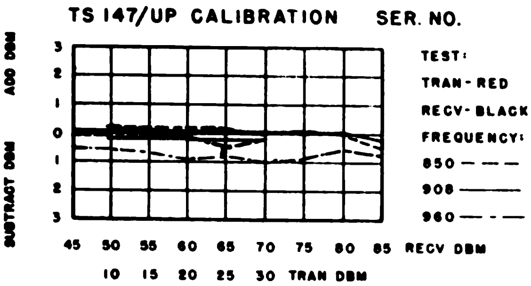

Figure 1–4. Typical Calibration Chart (Sample)

(*b*) Accuracy: ±1.5 db.

Note

Accuracy of power measurements depends upon calibration of directional coupler and r-f cable losses. Attenuation of cables can be checked by the procedure described in Section 3 paragraph 9. The stated tolerances assume use of the calibration chart mounted on the panel of the Test Set. *See figure 1–4.*

j. Signal Generator.

(1) Tuning Range: 8500 mc to 9600 mc, provided a suitable oscillator tube is used.

(2) Power Output (peak mode power).

(*a*) Range: –42 to –85 dbm at RF receptacle.

(*b*) Accuracy: ±1.5 db.

(3) Frequency Modulation.

(*a*) Sweep Rate: Zero to 6 mc/sec. for oscillator tubes having at least 3 mc/volt tuning range.

(*b*) Phase Range: 3 to 50 μ-sec after trigger.

(*c*) Frequency Excursion of Sweep: Zero to over 60 mc. (With suitable oscillator tubes, the reflector voltage sweep can cover three modes.)

(*d*) Triggers Required for Sawtooth Sweep Generator:

1. R-f Trigger: 5 to 500-watts peak, pulse repetition rates up to 4000, 0.2 to 6 μ-sec duration, rise time of 0.5 μ-sec.

2. Video trigger: positive polarity, 10 to 50 volts peak, 0.5 μ-sec time of rise from points between 10% and 90% of peak amplitude of initial rise, flat between 90% peak amplitude of initial rise and 90% of peak amplitude of final decay. Amplitude of not more than 100% nor less than 90% of the peak amplitude of the initial rise; voltage rise in final decay less than 10% of peak amplitude; d-c level ±10 volts.

k. Power Requirements.

(1) Voltage: 115 volts ±10%.

(2) Frequency: 50 to 1600 cycles.

(3) Power: less than 125 watts.

l. Power-Supply Voltages.

(1) Plate Supply: +300 volts, electronically regulated.

(2) Reflector Supply: —210 volts, gas-tube regulation.

(3) Ripple: less than 0.1% peak of d-c level.

m. Sawtooth Sweep.

(1) Amplitude: 0 to —100 volts (negative polarity).

(2) Max. Deviation from linearity: 10% of sweep amplitude.

(3) Slope: 0 to +2.0 volts/μ-sec (positive slope).

(4) D-c Level at Oscillator Reflector: —60 to —210 volts.

(5) Video Amplifier Gain: Approx. 500.

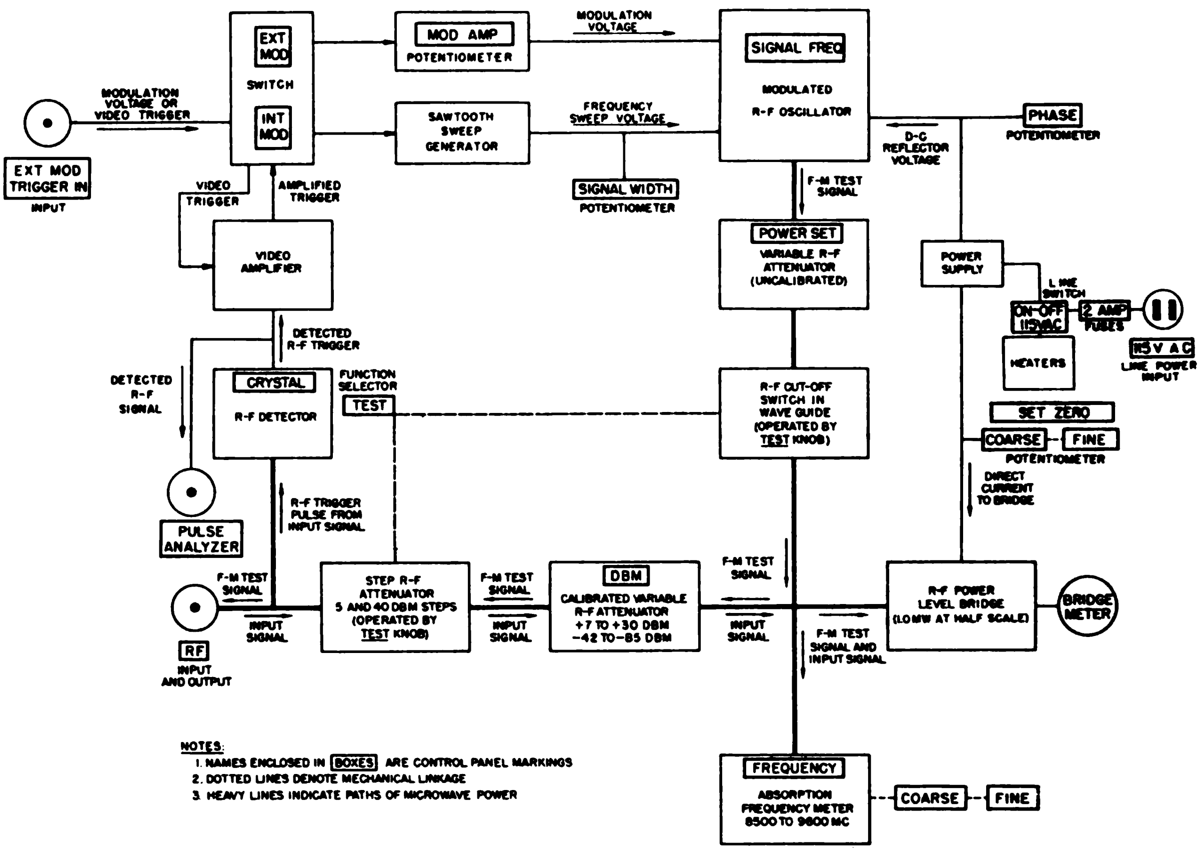

Figure 2–1. TS–147B/UP Radar Test Set—Block Diagram

SECTION 2

THEORY OF OPERATION

1. GENERAL DESCRIPTION OF CIRCUITS.

a. A block diagram of the Test Set is shown in figure 2–1. The test signals are generated by the test oscillator which is frequency modulated by the sawtooth voltage from the triggered sweep generator. The sweep generator is triggered in synchronism with the firing cycle of the radar system under test. This is accomplished either by means of voltage pulses connected to the EXT MOD-TRIGGER IN receptacle, or by microwave pulsed signals applied to the RF receptacle. These signals are detected and amplified by the detector crystal and video amplifier respectively.

b. The output of the test oscillator is controlled directly by means of the Power Set attenuator and the Test r-f cutoff control. The Power Set attenuator provides adjustment of the signal level applied to the thermistor bridge. The Test r-f cutoff control is a waveguide switch which prevents transmission of r-f energy from the oscillator branch to the other three plumbing branches shown in figure 2–2.

c. The output level of the test signal is measured by the Dbm attenuator. When the Power Set attenuator is adjusted so that the meter pointer is at SET POWER, the DBM dial indicates directly the test-signal power level at the RF receptacle. The step attenuator, operated by the TEST knob, sets the range of the Dbm attenuator. When the TEST knob is in RECV position the

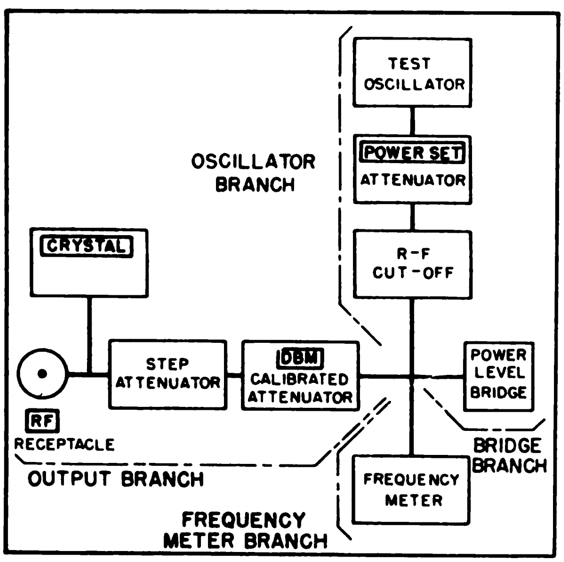

Figure 2–2. Simplified Block Diagram Showing Plumbing Branches

Dbm range is –42 to –85 dbm; in the TEST (dot) position, the Dbm range is approximately –7 to –30 dbm for dial readings of +7 to +30, but the calibration for this range is only approximate.

d. The frequency of the test signal is measured by the frequency meter. When the frequency-meter cavity is tuned to the test-signal frequency, part of the test-oscillator power traveling towards the thermistor input is reflected and a dip in the bridge-meter reading is produced. The incident wave reflection caused by the resonant frequency meter also results in a decrease in the power output of the Test Set. If the test signal is frequency modulated and the frequency meter is tuned within the range of the frequency sweep, some power will be absorbed each time the frequency sweep reaches the resonant frequency of the meter. The instantaneous decrease in power output resulting from the absorption will appear as a small negative pip in the frequency response curve seen on the A-scope. *See figure 3–7.*

e. In addition to operating as a signal generator, the Test Set also measures the power and frequency of external r-f signals applied to its RF receptacle. Power is measured by means of the Dbm attenuator and the thermistor-bridge wattmeter. For this measurement the TEST knob is set to the TRAN position to close the r-f cutoff, and to set the range of the Dbm attenuator to +7 to +30 dbm. The Dbm attenuator is then adjusted to decrease the input power to the 1.0-milliwatt level. At this point, the DBM dial indicates directly the input power level in dbm (decibels above 1.0 milliwatt).

f. Frequency of input signals is measured by the same means used for test signals. At resonance the frequency meter absorbs part of the power applied to the thermistor bridge. The resulting slight mismatch looking into the thermistor mount causes reflection of some of the incident power and a consequent dip in the bridge-meter reading.

2. CIRCUIT ANALYSIS.

a. R-F PLUMBING COMPONENTS.

(1) GENERAL.

(*a*) The r-f plumbing assembly of the Test Set (*see figure 2–3*) consists of the various waveguide components which perform the microwave functions required in the operation of the instrument. Each component is a fixed, replaceable assembly, unsuited to field repair or maintenance. The replacement of any of the calibrated components will require recalibration of the Test Set. See Section 4, paragraph 7 for calibration procedures.

(*b*) The plumbing comprises four branches: namely, the input (or output) branch, the oscillator

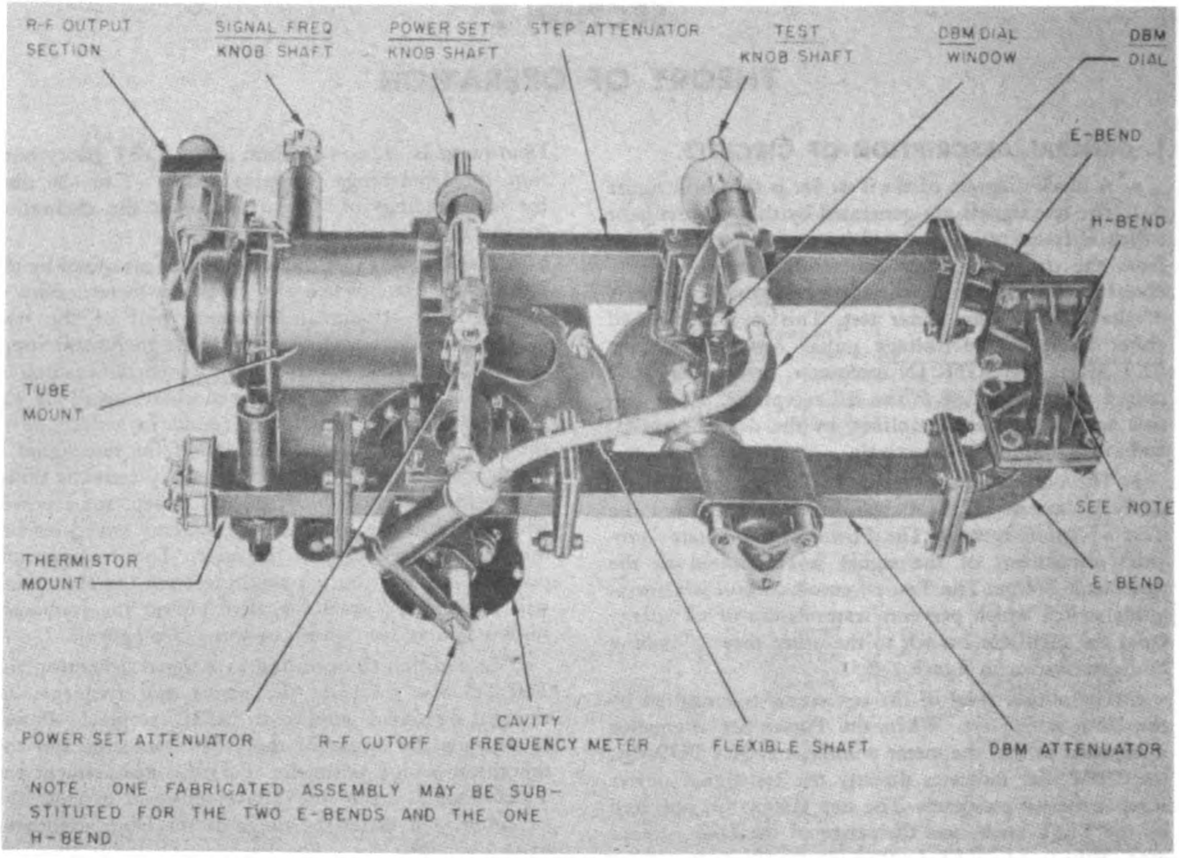

Figure 2–3. R-F Plumbing Arrangement

branch, the bridge branch and the frequency-meter branch. The four branches described are designated in figure 2-2 and will be referred to by these names in locating components in the descriptions which follow.

(*c*) The component assemblies of the r-f plumbing are connected by means of a gasket-flange joint (*see figure 2-4*). These joints replace the more familiar choke-flange joints (figure 2-5) formerly used in most microwave plumbing systems. The gasket-flange joint consists of two flanges having a 0.003-inch-thick silver-plated copper gasket of the same shape as the flange faces. The joint is secured by means of four screws, one through each corner of the mating flanges and gasket.

(2) TUBE-MOUNT ASSEMBLY. (*See figure 2-6*).

(*a*) The tube mount contains the test-oscillator tube (V104) and the Power Set attenuator. The mount consists of a single casting of the waveguide section and shield housing in which an octal socket is mounted. When the oscillator tube is inserted in the socket, the output probe of the tube projects into the waveguide and serves as an antenna to radiate r-f power in the waveguide. The distance from the output probe to the shorted end of the waveguide is effectively one-quarter wavelength so that energy radiated toward the shorted end is reflected back in phase with the energy radiated toward the output.

(*b*) The Power Set attenuator adjusts the power transmitted to the other plumbing components from the test oscillator tube. The attenuator consists of a rectangular strip of Fiberglas coated with resistive material.

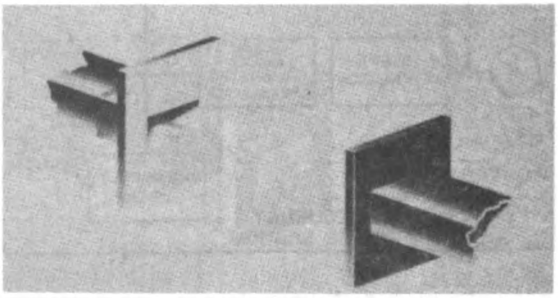

Figure 2–4. Gasket-Flange Joint

Figure 2–5. Choke-Flange Joint

Since the electric field strength varies from maximum at the center of the waveguide to zero at the edge, the power dissipated by the Fiberglas strip increases as the strip is moved towards the center of the waveguide.

(*c*) The metal housing and cover enclose the oscillator tube and provide an r-f shield for minimizing any r-f leakage from the tube. The housing also shields the oscillator tube from air currents which would cause variations in frequency due to temperature changes.

(3) FREQUENCY-METER ASSEMBLY.
(*See figure 2–7*).

(*a*) The frequency-meter assembly consists of the frequency-meter resonator and dial together with a tee section of waveguide which contains the r-f cutoff. The tee section connects the assembly to the three other branches of the plumbing indicated in figure 2–2. The r-f cutoff is a metal slide which opens and closes the opening of the oscillator branch at the junction of the tee.

(*b*) The frequency meter is a cylindrical cavity resonator, the volume of which is adjustable by means of a plunger. The cavity is coupled to the tee section by means of a circular iris located in the waveguide opposite the r-f cutoff. When the length of the cavity is adjusted to one-half the wavelength of the incident microwave signal, the cavity resonates and presents a low impedance at the coupling hole. As a result, some of the transmitted power incident on the tee section is reflected before reaching the bead thermistor thus causing a decrease in the indicated power-level on the thermistor-bridge meter.

(4) THERMISTOR-MOUNT ASSEMBLY.
(*See figures 2–8 and 2–9*).

(*a*) The thermistor mount is a section of waveguide which contains the bead thermistor of the power-level bridge. This thermistor is mounted parallel to the voltage field (E-plane) in the waveguide. A matching stub and an iris are provided to match the impedance of the section to the connecting plumbing components.

(*b*) A disc thermistor is attached to the outside surface of the shorted end of the mount to provide temperature compensation. This thermistor has a relatively large mass and its resistance is affected principally by the ambient temperature of the thermistor mount. The operation of the thermistor-bridge circuit is described under electrical circuits.

(*c*) Matching resistor R201 is attached to the thermistor mount to provide a sensitivity of the combination which corresponds to the sensitivity of the bridge circuit. This makes the thermistor-mount assemblies interchangeable without affecting the accuracy of power measurements.

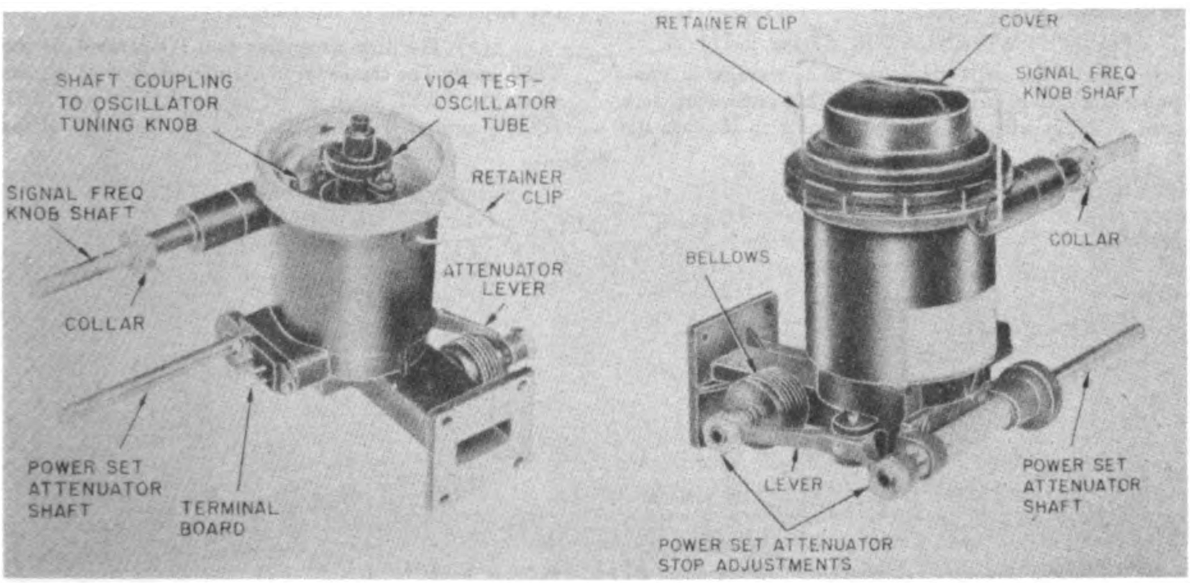

Figure 2–6. Tube-Mount Assembly

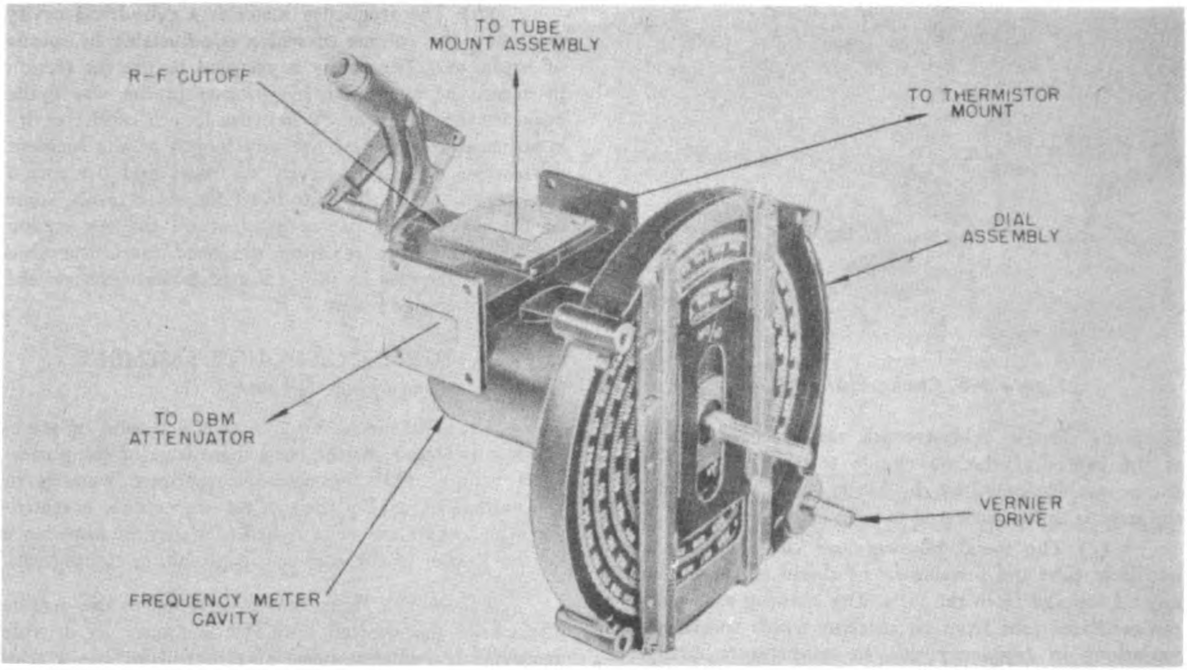

Figure 2–7. Frequency-Meter Assembly

(5) DBM CALIBRATED ATTENUATOR (*See figure 2–10*).—The Dbm attenuator consists of a resistance-coated glass vane rigidly mounted to a pair of sliding rods within a section of waveguide. A linear cylindrical cam driven by the Dbm knob provides the means for adjusting the position of the slide rods and the attenuator vane throughout the range of the electric field within the waveguide, from minimum at the side to maximum at mid-guide.

(6) STEP ATTENUATOR (*figure 2–11*).

(*a*) The step attenuator is a waveguide component similar in principle to the Dbm attenuator. It is used in series with the Dbm attenuator to increase the attenuation range of the Test Set. The step attenuator differs from the Dbm attenuator in the type of cam drive used to move the glass vane across the waveguide. Instead of a linear cylindrical cam, the step attenuator uses a disc cam with three detents. Two of the detents position the cam follower and the attenuator vane for minimum attenuation. The third detent sets the attenuation to a higher value. The resulting action produces two steps or levels of attenuation.

(*b*) The step-attenuator cam is operated by the TEST knob. The cam is set in the minimum-level detents when the TEST knob is set to the TRAN or TEST (dot) positions. For these two settings the range of the

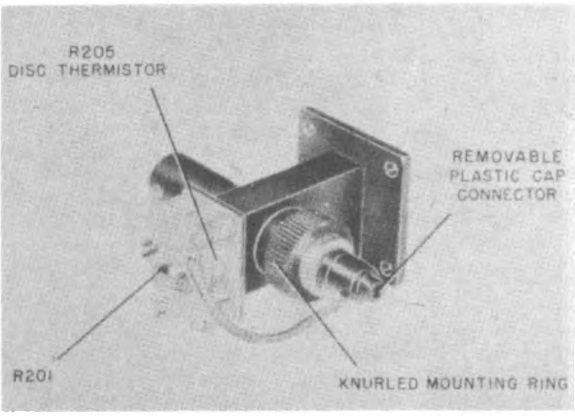

Figure 2–8. Thermistor Mount—Front View

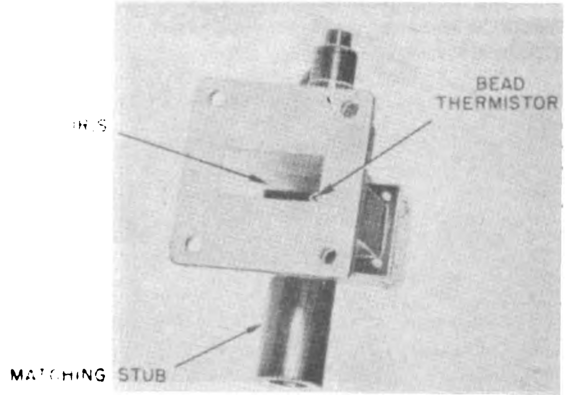

Figure 2–9. Thermistor Mount—Rear View

DBM dial is +7 to +30 dbm. In the RECV position the TEST knob sets the cam in the third or high-attenuation detent to change the Dbm range to cover —42 to —85 dbm.

(7) R-F OUTPUT AND DETECTOR SECTION (*figure 2-12*).

(*a*) The output section consists of a coupling adapter from coaxial line to rectangular waveguide and a crystal detector. The adapter couples the RF panel receptacle to the waveguide plumbing. The center conductor of the RF receptacle projects into the waveguide and becomes, in effect, an antenna which radiates into the guide. The shorted end of the guide acts as a reflector located one-quarter wavelength behind the coaxial probe.

(*b*) The crystal-detector portion of the output section is another section of waveguide which is coupled to the main section by an iris. This secondary section is terminated by a silicon rectifier crystal capsule which detects pulse r-f power for triggering the sweep generator. Detection of pulsed r-f signals is obtainable at the PULSE ANALYZER receptacle on the control panel.

b. ELECTRICAL CIRCUITS.

(1) R-F PULSE DETECTOR AND TRIGGER AMPLIFIER CIRCUIT (*figure 2-13*).

(*a*) The r-f pulse detector and amplifier circuit provides the means for triggering the sweep generator from pulse r-f power applied to the RF receptacle. The r-f pulses are detected by the crystal, CR101, in the output coupling section and the resulting pulse voltage is applied to the input of the trigger amplifier. The output of the amplifier supplies a voltage pulse which triggers the blocking-oscillator sweep circuit. The output pulse is parallel fed through C111 to the primary of the blocking-oscillator transformer, T102. The amplifier is of the three-stage resistance-coupled type consisting of one and one-half 6SL7 twin triodes, V107A, V107B and V108A. The voltage gain is approximately 500.

(*b*) A video trigger is applied to the EXT MOD-TRIGGER IN panel receptacle with switch S102 on INT-FM. (*See figure 2-14*.) The trigger voltage pulses are fed through capacitor C115 directly to the grid of V108A, the final stage of the amplifier.

(*c*) External modulation (either pulse, sawtooth or square-wave) can be applied to the EXT MOD-

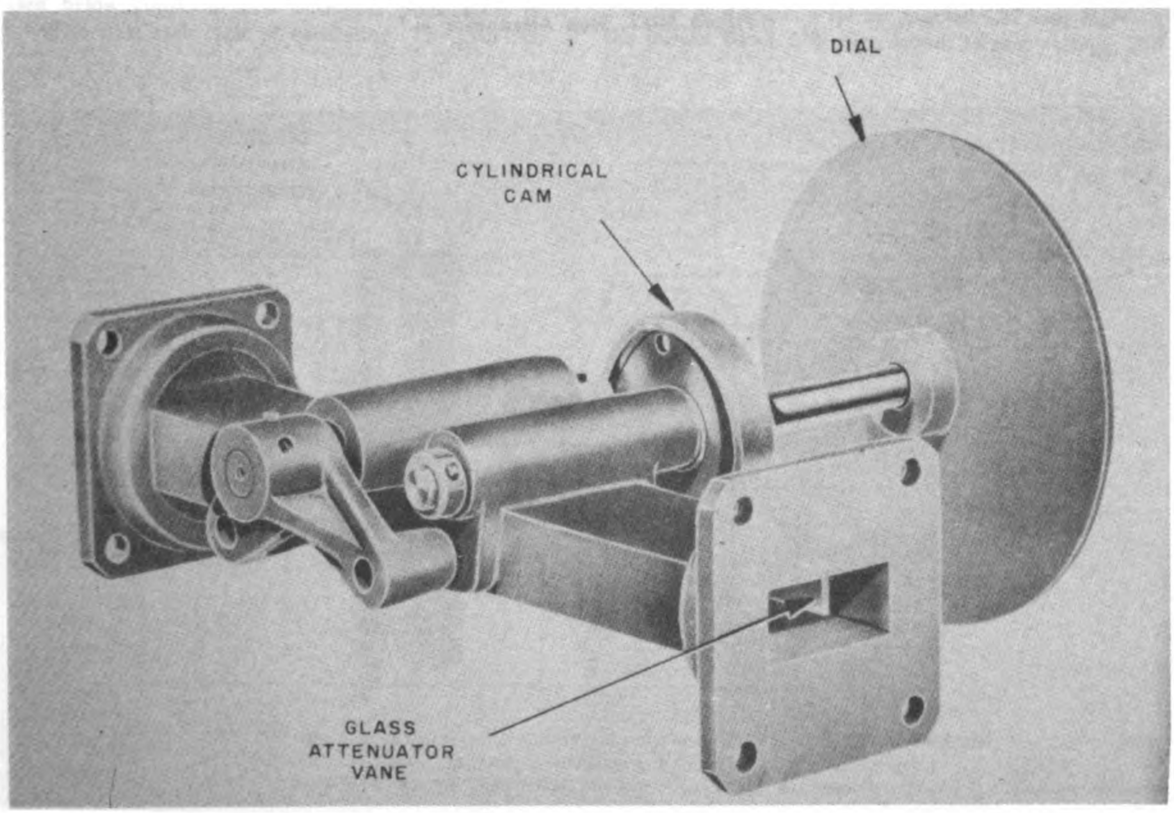

Figure 2-10. DBM Calibrated Attenuator

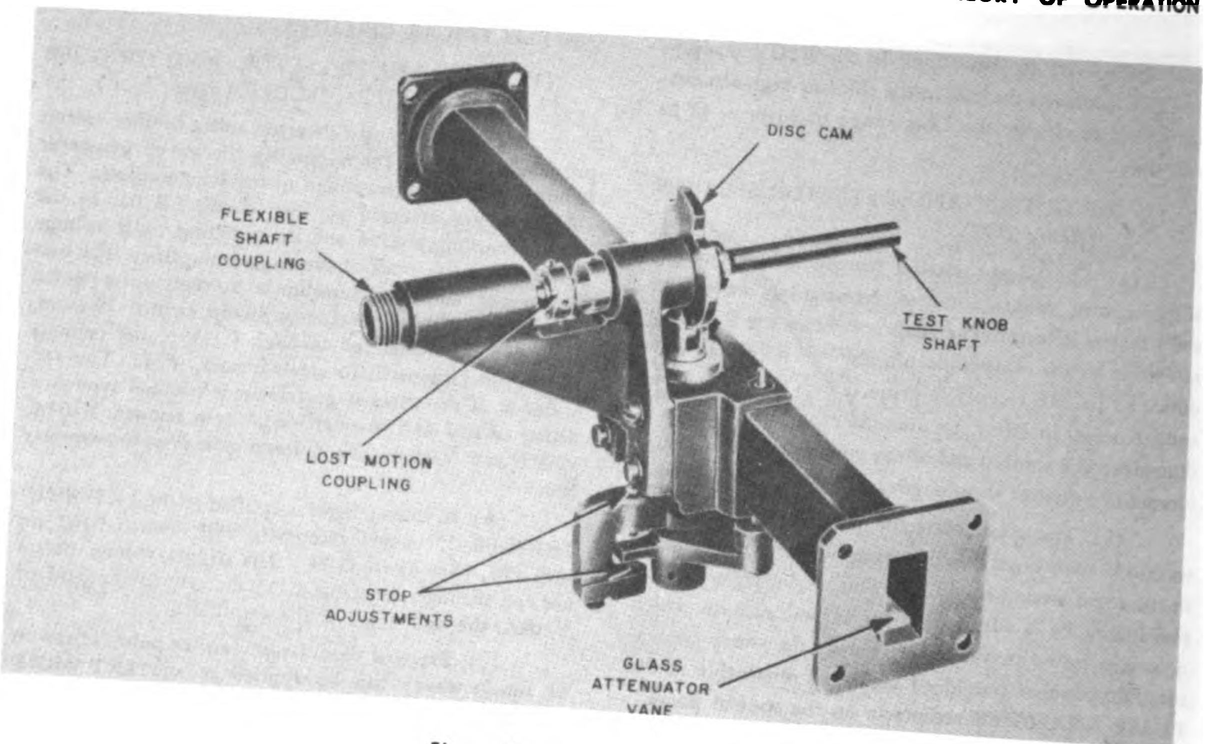

Figure 2–11. Step Attenuator

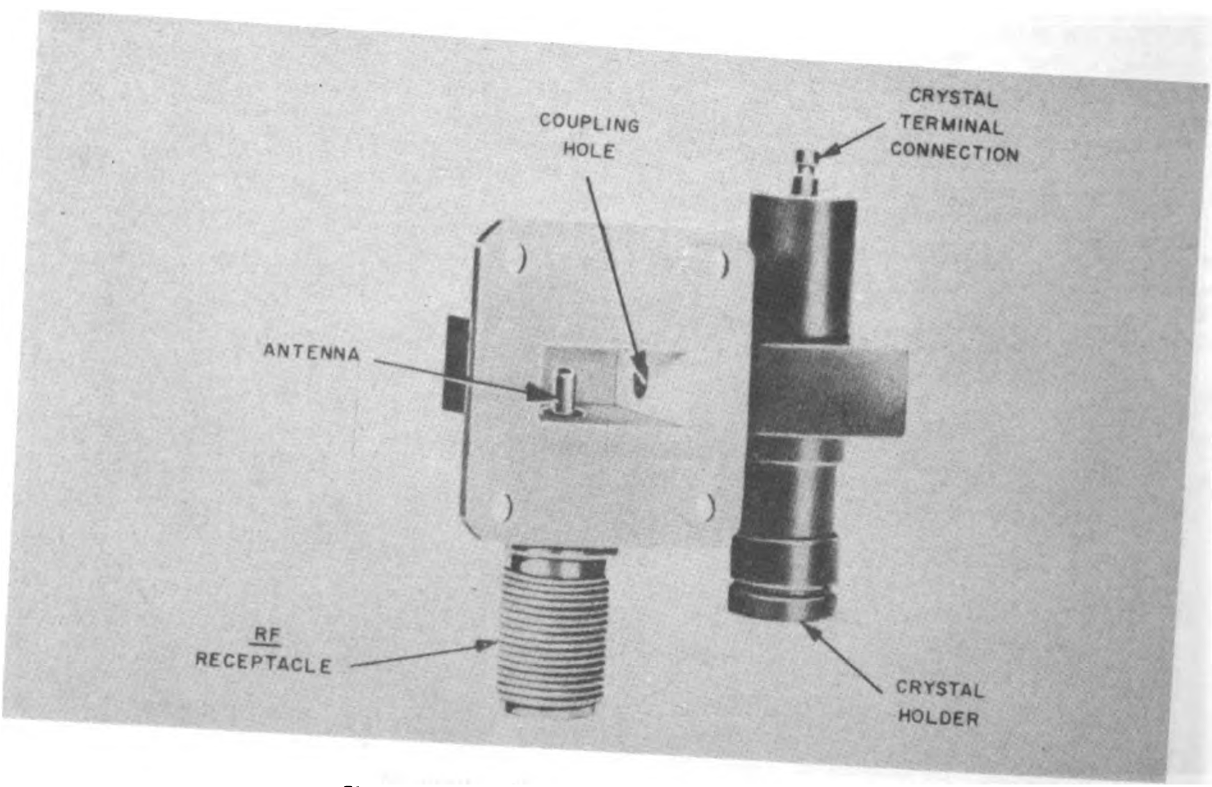

Figure 2–12. R-F Output and Detector Section

TRIGGER IN receptacle with the switch on EXT MOD (*figure 2-14.*) The modulation voltage is fed through capacitor C116 directly to the reflector electrode of the test-oscillator tube.

(*d*) Waveshape patterns of pulsed signals applied to the RF receptacle of the Test Set can be observed on a scope. In order to view the pattern, the detected r-f pulses are fed from the PULSE ANALYZER receptacle to the oscilloscope (*see figure 3-3*). Observation of waveshape will provide an indication of possible malfunctioning of the radar transmitter, resulting from frequency skipping, double moding or instability of power output (*see figure 3-10*). The SIGNAL WIDTH control should be set at MIN, and pulsed signals applied to the RF receptacle should not exceed one-half watt average power.

(2) BLOCKING OSCILLATOR SWEEP AND TRIGGER SWITCHING CIRCUIT (*figure 2-14*).

(*a*) The frequency-sweep circuit for the test oscillator is a sawtooth generator of the triggered blocking-oscillator type. The blocking oscillator consists of one-half of a 6SL7 twin triode (V108B) and a three-winding transformer (T102). The circuit comprises a conventional blocking oscillator except that the grid is biased below cutoff so that a trigger pulse must be applied to start each cycle of oscillation. The grid bias is applied to the cathode by the voltage divider R134 and R135.

(*b*) The blocking oscillator generates sawtooth pulses by discharging C114. When a trigger pulse is applied to the transformer, T102, the grid is raised above cutoff and oscillation starts. The plate current which flows during the time the grid is above cutoff causes a voltage drop across the plate resistor, R142, and part of R137. This decreases the voltage across C114 to a value below the steady-state voltage. When the single-cycle oscillation ceases, the plate current is zero but a voltage drop still exists in the load resistor, R142, due to the charging current of C114. This voltage decreases to zero as the capacitor, C114, charges to the steady-state voltage. The charging curve which occurs after the oscillation ceases is the sawtooth sweep used to modulate the test oscillator. Choke coil L102 is inserted to counteract the exponential decay of current as C114 charges and thus produce a more linear sweep voltage.

(*c*) The amplitude of the sweep voltage depends upon the steady-state voltage across the capacitor, C114. This voltage is made adjustable from 0 to +300V by means of the Signal Width potentiometer, R137. As the steady-state voltage is increased by the SIGNAL WIDTH control, the amplitude of the sweep voltage is increased. The limits of the control are marked CW and MIN on the control panel. CW corresponds to zero voltage, and

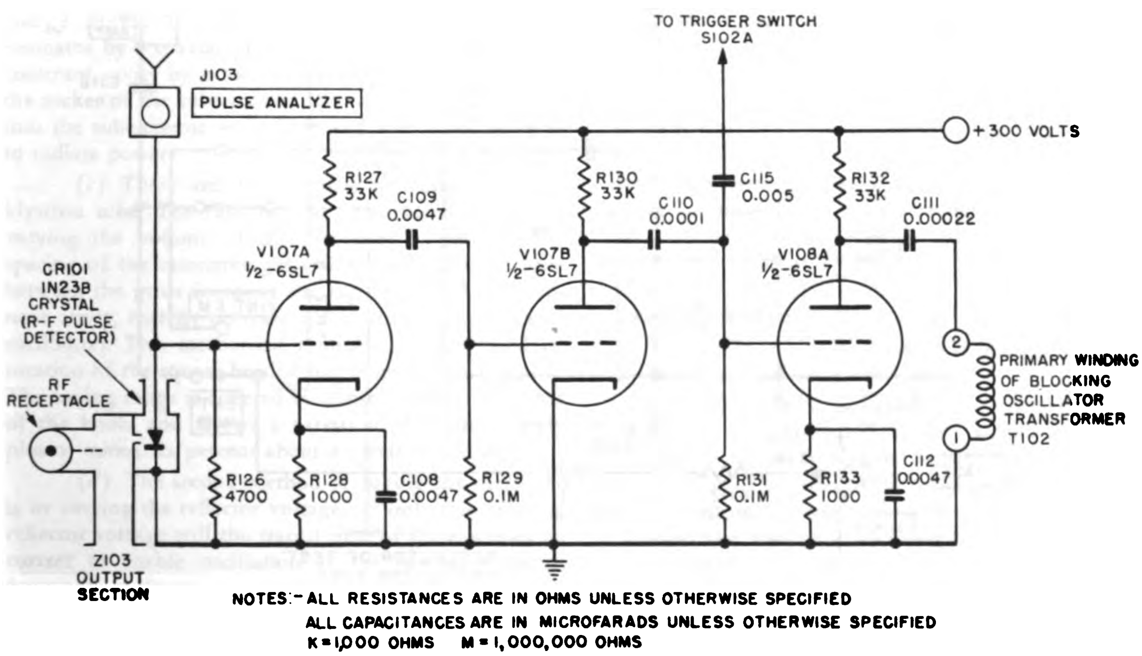

Figure 2-13. R-F Pulse Detector and Amplifier Circuit—Simplified Schematic

MIN corresponds to maximum voltage. These reference marks designate the effect of the SIGNAL WIDTH control on the oscilloscope pattern obtained during receiver tests.

(3) TEST OSCILLATOR CIRCUIT (*figure 2–15*).

(*a*) The test oscillator tube, V104, used in the Test Set is a type 723A/B or 2K25 reflex klystron. Both tubes are similar except that the 2K25 covers a greater band of frequencies.

(*b*) The reflex klystron (*figure 2–16*) is a velocity-modulated microwave oscillator. It consists of an electron gun which produces a focused electron beam of uniform velocity, a reentrant cavity resonator tunable through the range of operating frequencies, and a reflector electrode which decelerates and returns the electron beam towards the resonator. The electrons are emitted from the cathode and are accelerated by the positive potentials on the grid and the resonator. Assuming a varying voltage on the resonator, those electrons that arrive when it is positive will be speeded up and those that arrive when it is negative will be slowed down. This results in a "bunching" of electrons into spaced groups as they proceed down the tube. Arriving near the reflector, which is maintained at a negative potential, they are repelled. If this voltage is correctly adjusted, they will be reflected back to the resonator — when the voltage on it is such that the electron "bunches" are slowed down — and so deliver

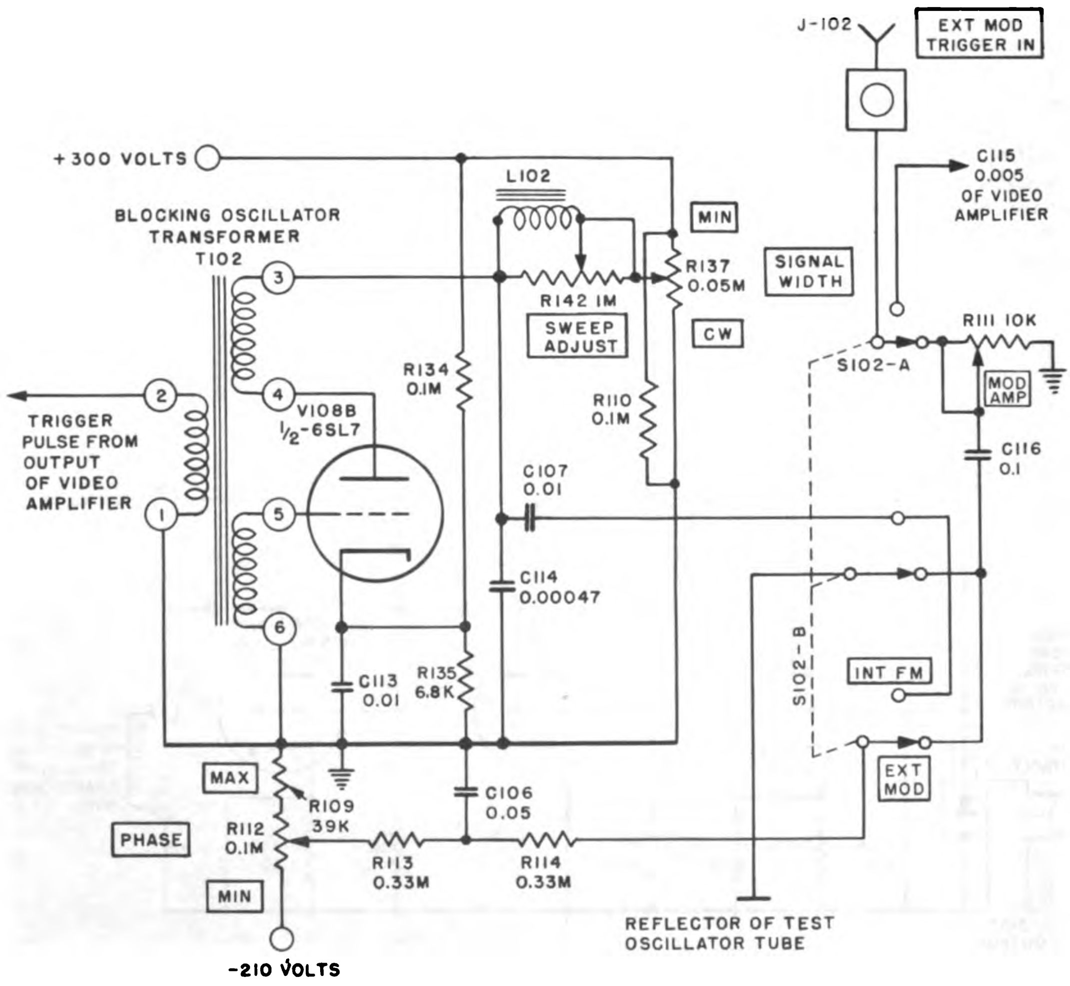

Figure 2–14. Blocking-Oscillator Sweep and Trigger-Switching Circuit— Simplified Schematic

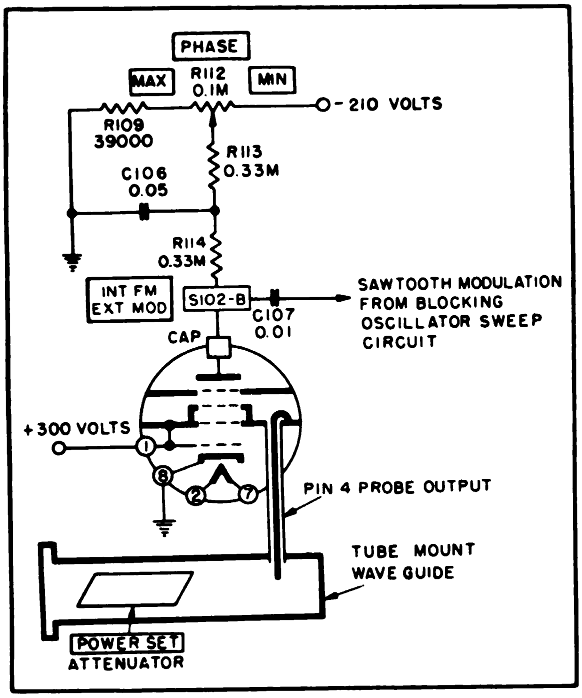

Figure 2–15. Test-Oscillator Circuit—Simplified Schematic

energy to the resonator. Energy is taken from the resonator by a coaxial probe which is terminated in the reentrant cavity by a loop. When the tube is placed in the socket of the tube mount, the coaxial probe extends into the tube-mount waveguide and acts as an antenna to radiate power.

(*c*) There are two methods for tuning a reflex klystron tube. The tube can be tuned mechanically by varying the volume of the resonator cavity and the spacing of the resonator grids. Decreasing the distance between the grids increases the capacitance of the resonant cavity, thereby decreasing the natural frequency of oscillation. This mechanical tuning is accomplished by rotation of the square-headed nut mounted on the tube. The tuning range is covered by approximately 3½ turns of the knob, and allows a variation of approximately plus or minus six percent about a specified frequency.

(*d*) The second method of tuning the oscillator is by varying the reflector voltage. At only one value of reflector voltage will the transit time of the electrons be correct to enable oscillation at the natural resonant frequency of the resonator cavity. If the reflector voltage is varied slightly, the rate at which electron bunches will arrive at the resonator cavity will change. The tube will not stop oscillating immediately, but will shift slightly in frequency to compensate for the change in transit time. Thus, varying the reflector voltage causes the frequency of the oscillator to be swept over a range of approximately 25 to 75 megacycles.

(*e*) As reflector voltage is varied the tube will oscillate in different modes, the four lowest corresponding roughly to reflector voltages of —30, —75, —110 and —170 volts with respect to the cathode. The relations of power output and frequency to reflector voltage are shown for three modes in figure 2–17. These curves give approximate values for any tube and indicate average characteristics of the type 723A/B klystron. The curves indicate that the power output of the tube is greater in the modes with the more negative reflector voltages. The range of frequency sweep within each mode decreases with increasingly negative reflector voltages. Between the half-power points of the —75 volt mode, the frequency variation is approximately 60 megacycles. In the —110 volt mode, the frequency range is approximately 35 megacycles, and in the —170 volt mode approximately 25 megacycles. Frequency data for the —30 volt mode has not been determined accurately.

(*f*) Figure 2–18 shows how the frequency of the test-oscillator tube is modulated by varying the reflector voltage. If the sawtooth voltage is applied to the reflector at a center value of —110 volts d-c as shown, the frequency of the oscillator will be swept through one or more modes and the output will be frequency modulated. The number of modes covered depends upon the amplitude of the sawtooth. This is determined by the setting of the SIGNAL WIDTH control.

(*g*) When it is desired to apply an external sawtooth modulating voltage to the reflector of the tube, the signal is introduced into the Test Set through the EXT MOD-TRIGGER IN receptacle with S102 set to EXT MOD. In this case the amplitude of the sawtooth modulation is adjusted by means of the MOD AMP control.

(*h*) When the d-c level of the sawtooth is lowered, the sawtooth sweeps over a lower mode. Also, the time at which the center frequency of the mode is reached occurs later. Such a change appears as a shift in the position of the frequency-response curve along the range axis of the A-scope. The d-c level of the sawtooth is adjusted by means of the PHASE control.

(4) THERMISTOR-BRIDGE CIRCUIT (*See figure 2–19*).

(*a*) GENERAL. — The thermistor-bridge wattmeter is a Wheatstone bridge which measures the resistance of an r-f power-sensitive resistor called a thermistor. The thermistor has a negative temperature coefficient of resistance, i.e., as the temperature is increased the resistance decreases. The temperature, and therefore the resistance, of the thermistor is determined by the temperature of its environment, by the current flowing through it, and by absorbed r-f power. If the current and ambient temperature conditions are properly controlled, r-f power can be measured by measuring the change in thermistor resistance caused by the applied power.

(*b*) BASIC BRIDGE CIRCUIT.

1. There are two types of thermistors used in the Test Set. The bead thermistor (*see figure 2–20*) used for r-f power measurement has a small mass and is affected by the three changes mentioned in the preceding paragraph. The disc thermistor (*figure 2–21*) used in compensating networks has a large mass. Its resistance is relatively insensitive to the current flowing through it and is primarily dependent upon the ambient temperature. A simplified thermistor bridge circuit is shown in figure 2–22. The Wheatstone bridge consists of three resistors, R115, R116, and R119, and the bead thermistor in the thermistor mount, Z109. When the Wheatstone bridge is balanced, no current flows in the meter. Under this condition, the thermistor's resistance is:

$$\text{resistance of thermistor} = R115 \frac{R119}{R116}$$

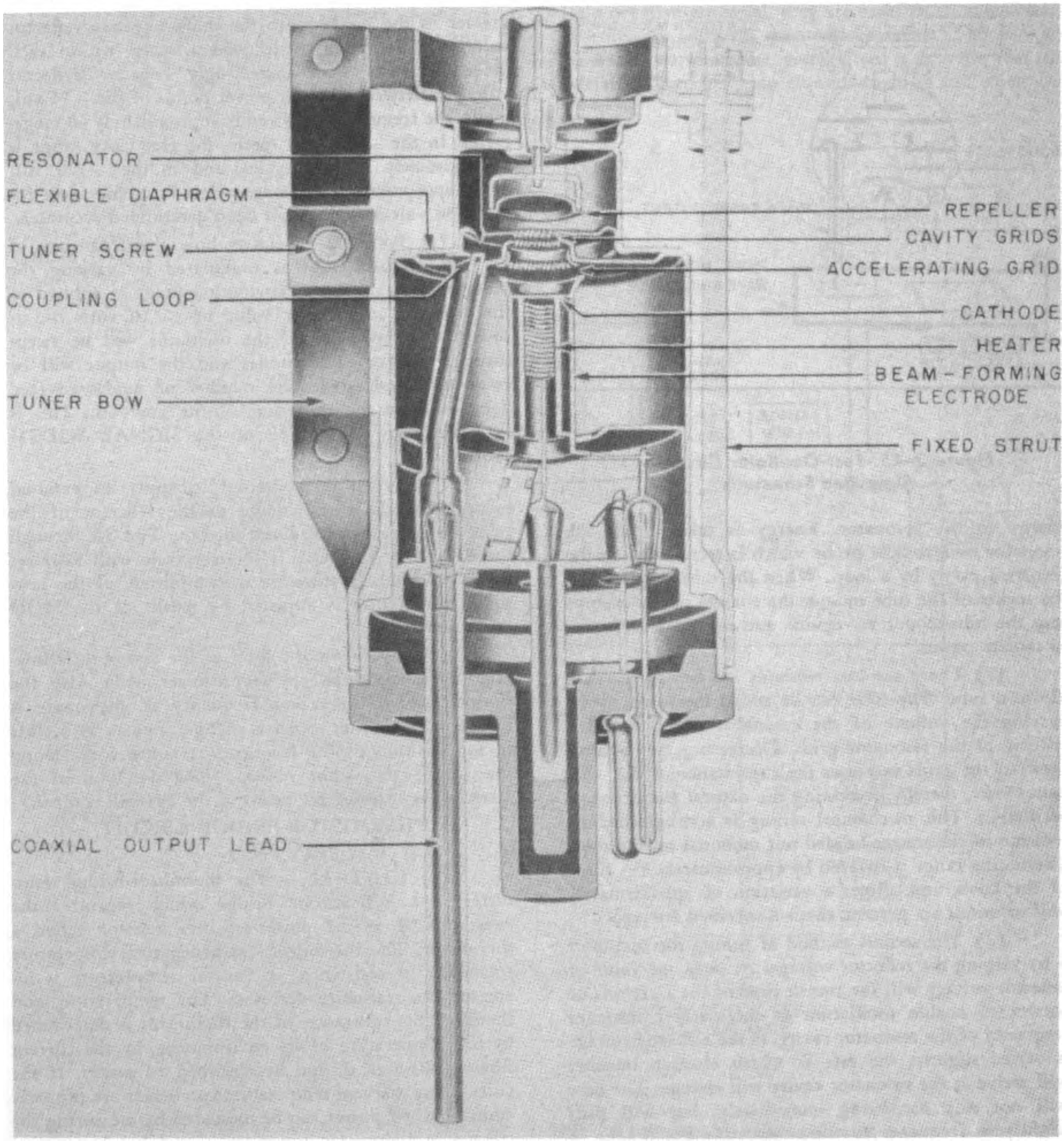

Figure 2–16. Test-Oscillator Tube—Cutaway View

2. In the bridge circuit of the Test Set, balance is obtained by adjusting the FINE SET ZERO control until the meter reads zero. At this adjustment the bridge is balanced and no current flows through the meter.

3. The meter is calibrated in terms of r-f power absorbed by the thermistor bead. When one milliwatt is applied to the thermistor mount, Z109, the bridge is unbalanced to the SET POWER point on the meter. The meter current at this point is 100 microamperes and the meter reads 1 milliwatt of r-f power.

4. The basic thermistor-bridge circuit shown in figure 2–22 must be modified in practice to compensate for the fact that changes in the ambient temperature of the bead thermistor make it necessary to readjust the FINE SET ZERO control before every measurement. The method employed to compensate for this effect is outlined in the following paragraph.

(*c*) ZERO DRIFT COMPENSATION.

1. To eliminate the need to reset the FINE SET ZERO control, an automatic method is provided to increase the current through the bead thermistor when

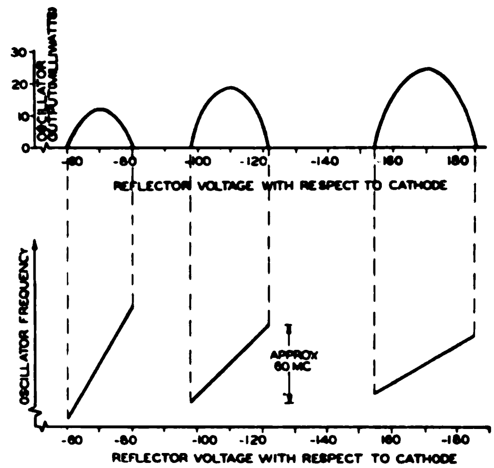

Figure 2–17. Reflex Klystron Characteristics

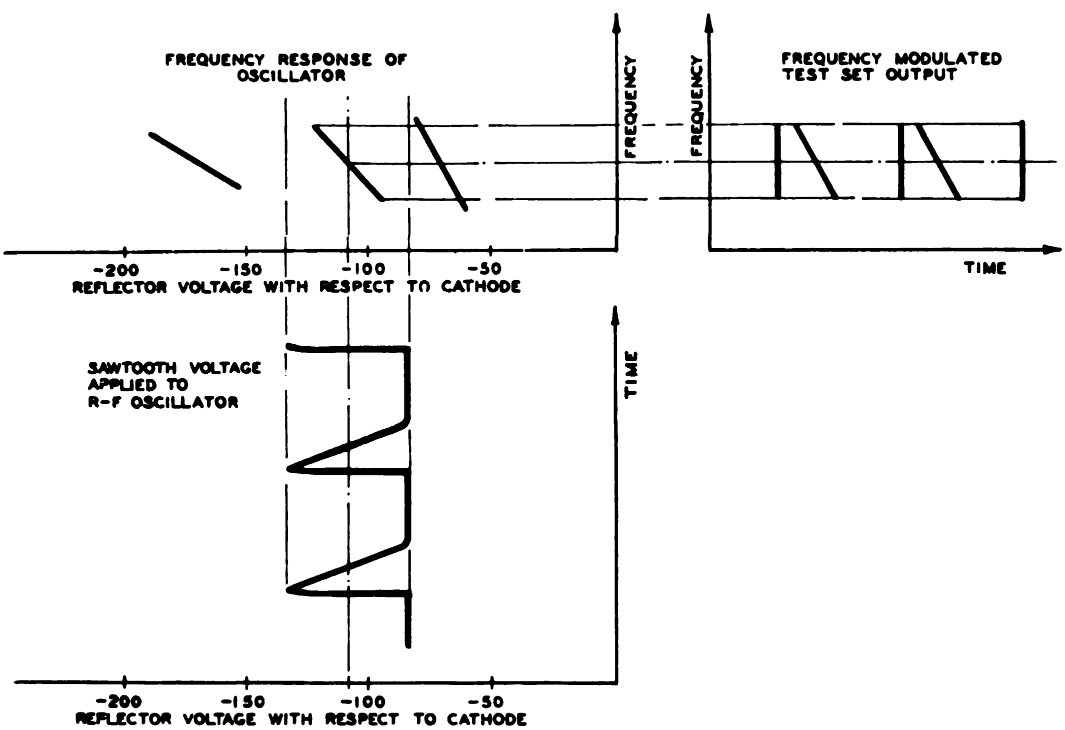

Figure 2–18. Test Oscillator Modulation

a decrease in ambient temperature occurs. A disc thermistor whose resistance increases with decreasing temperature is placed in parallel with the bridge. (*See figure 2–23*). Since more current flows through the bridge at lower temperatures, the ratio of the resistance of the shunting disc thermistor to the resistance of the bridge (across points A and B) is greater at a lower temperature.

2. For adjusting this compensation to cover the required temperature range, the disc thermistor is combined in a network with resistances R121 and R122.

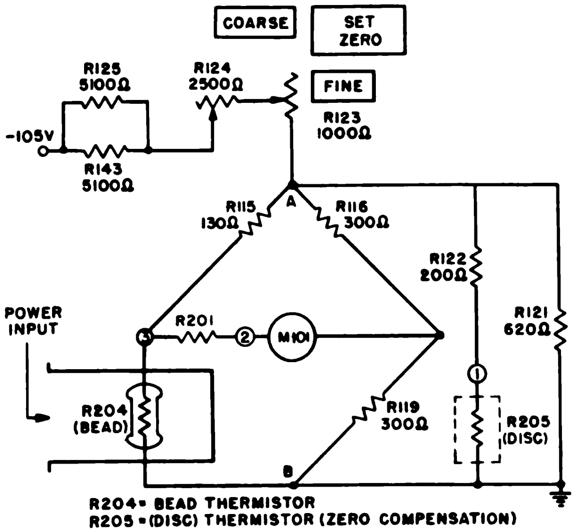

Figure 2–19. Complete Thermistor-Bridge Circuit

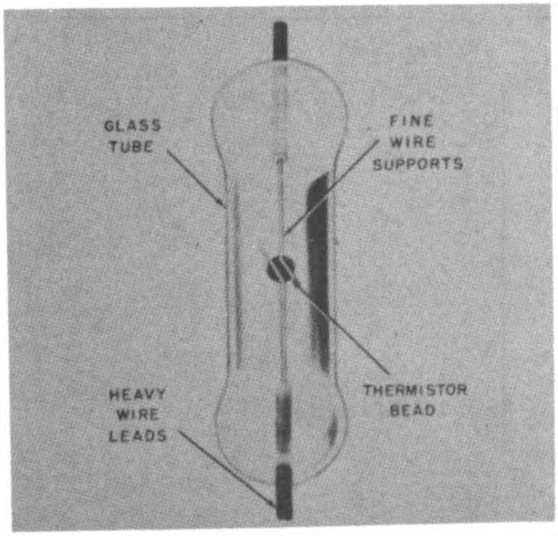

Figure 2–20. Bead Thermistor

(*d*) COMPENSATED BRIDGE CIRCUIT (*figure 2–19*).

1. Resistance R124 (COARSE SET ZERO control) is added in series with R123, (FINE SET ZERO control) to adjust the range of the meter balance to suit the particular thermistor mount in the Test Set.

2. The compensating networks are designed for an average bead thermistor so that the compensation is correct at 0°C, 30°C, and 60°C. Although at intermediate points the compensation is not exact, it is satisfactory for practical use. These networks are not perfect for any bead thermistor due to the variation in thermistor electrical characteristics. As a result, a FINE SET ZERO control is required for adjustments under these conditions.

(5) POWER SUPPLY CIRCUIT (*figure 2–24*).

(*a*) The power supply provides +300 volts and −210 volts to the electrical circuits of the Test Set. The power supply consists of a full-wave rectifier V101, an electronic regulator, and V-R tube regulator. The rectifier supplies about 550 volts d-c ungrounded, through

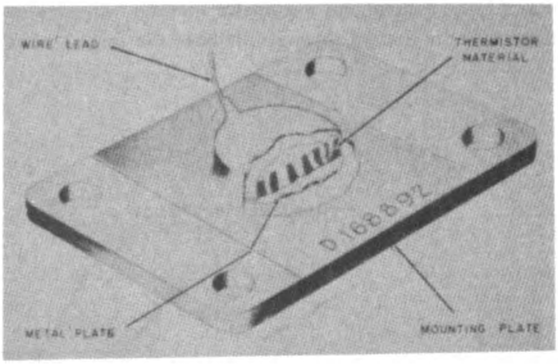

Figure 2–21. Disc Thermistor

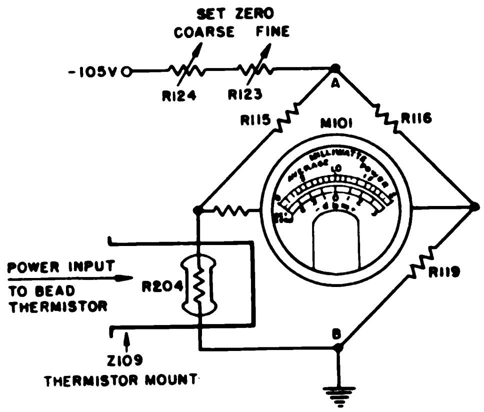

Figure 2–22. Basic Thermistor-Bridge Circuit

a choke-input L-filter. The two regulators act as a voltage divider, the center tap of which is grounded. The electronic regulator on the positive side of ground regulates and filters the +300 volt supply. The V-R tube regulator on the negative side of ground regulates the −210 volt reflector supply and also provides negative bias for the amplifier tube in the electronic regulator.

(*b*) The electronic regulator consists of a regulator tube (V102) which controls the output voltage directly, and an amplifier tube (V103) which controls the grid voltage on the regulator tube. The amplifier tube (V103) is connected as a d-c amplifier to amplify any voltage variations in the regulator output. The amplified variations when applied to the control grid of regulator tube (V102) cause the regulator tube to change its internal resistance, and therefore the voltage drop across it. These voltage changes are in a direction which compensates for the variations.

(*c*) The V-R tube regulator consists of two OB2 tubes (V105 and V106) in series. In normal operation each tube maintains a constant voltage drop of 105 volts so that the total voltage across the two in series is 210 volts. The 105-volt drop across V105 is used to supply the thermistor-bridge circuit. The total voltage (210V) of the two tubes forms the d-c reflector-voltage supply for the test-oscillator tube (V104).

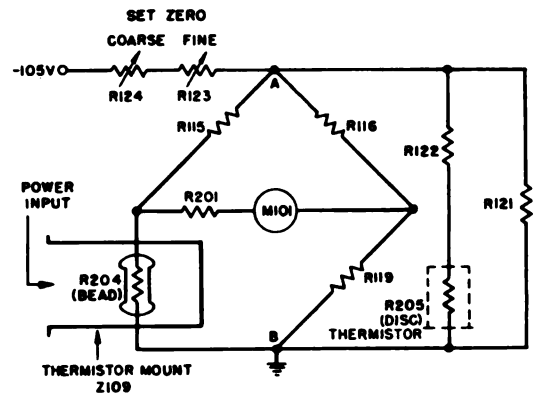

Figure 2–23. Basic Thermistor-Bridge Circuit with Zero-Drift Compensation

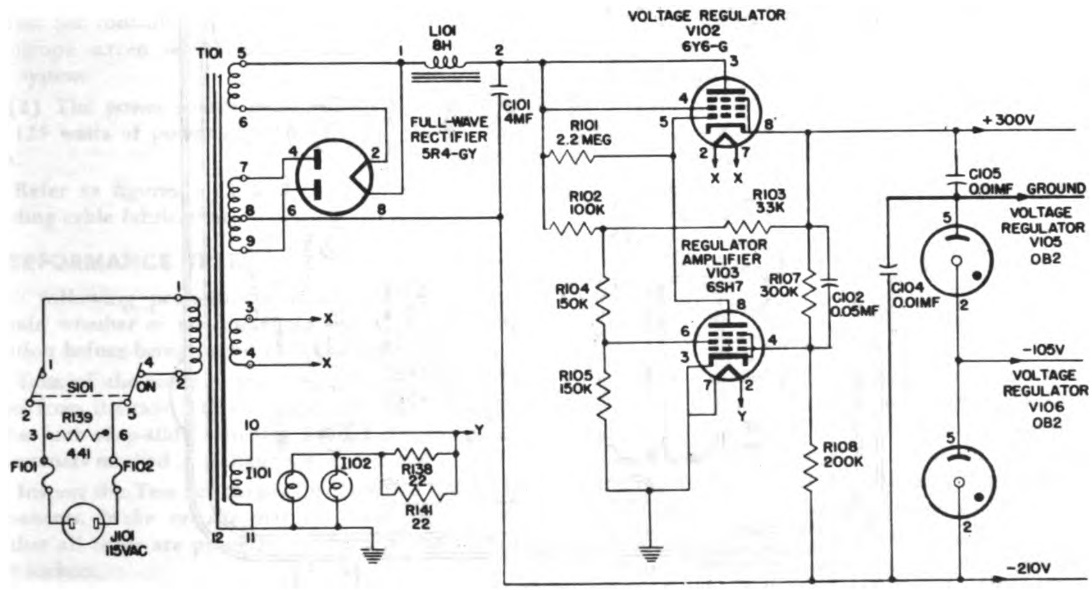

Figure 2–24. Power Supply Circuit—Simplified Schematic

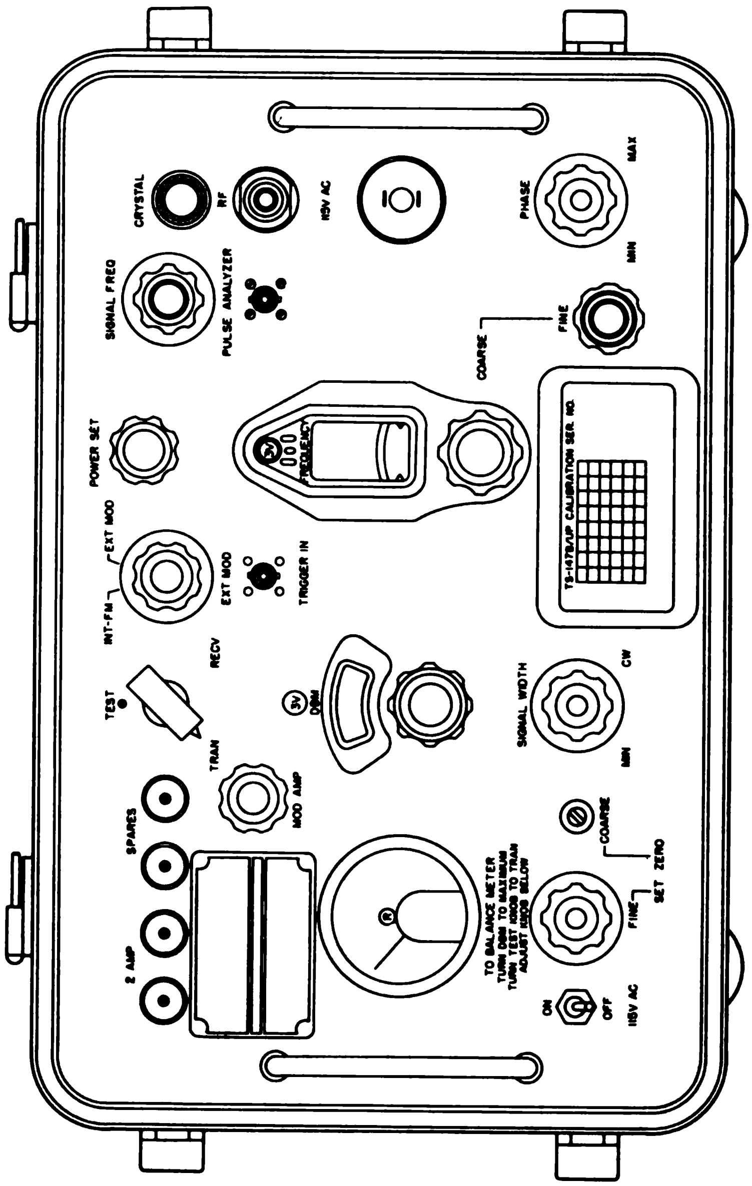

Figure 3–1. TS–147B/UP Radar Test Control Panel

SECTION 3

INSTALLATION AND OPERATION

1. UNPACKING THE TEST SET.

There are no special procedures or instructions to be followed when removing the Test Set from its shipping case. The tools required consist of a metal-band clipper, a claw hammer and a prizing bar. Refer to figure 3–2 which shows the manner in which the Test Set is packaged in its shipping container.

CAUTION

BE CAREFUL NOT TO DAMAGE THE CONTENTS OF THE SHIPPING CASE WHEN USING THE HAMMER AND THE PRIZING BAR.

2. INSTALLATION AND ADJUSTMENT.

a. The Test Set is a portable instrument which requires no installation or special adjustments before it is connected to a power source and put into operation. The sole requirements for best operation of the Test Set are:

(1) When making connections, the operator should arrange the equipment so that it is possible to operate the Test Set controls and observe the patterns on the oscilloscope screen while making adjustments on the radar system.

(2) The power source must be able to furnish at least 125 watts of power at 115V ± 10%, 50 to 1600 cycles.

b. Refer to figures 4–11 and 4–12 for information regarding cable fabrication.

3. PERFORMANCE TEST.

The following performance check can be used to ascertain whether or not the equipment is in operating condition before being issued to operating personnel:

a. Take off the cover of the Test Set and remove the chassis from the case. The chassis is retained in the case by the four snap-slide fasteners on the control panel. See fasteners marked A in figures 4–1, 4–2 and 4–4.

b. Inspect the Test Set chassis for damaged tubes and components. Make certain that no tubes are missing and that all tubes are properly mounted in their designated sockets.

c. Remove the cover of the tube-mount assembly (*figure 2–6*) and inspect the oscillator tube, V104 (2K25). Make certain that the tube is inserted all the way in the socket and that the tube cap is connected. Turn the SIGNAL FREQ. knob to see that the coupling end on the shaft turns the tuning nut on the oscillator tube.

d. Examine the bridge meter for damage. If the pointer stands deflected from the zero line, replace the unit with a meter whose pointer is properly set.

e. Connect the Test Set to a 115-volt 50-to-1600-cps a-c power source.

f. Place the ON-OFF switch to the ON position and allow approximately one or two minutes for the Test set to warm up.

g. During warm up, the dial lamps for the DBM and FREQUENCY dials should light. Also tubes V105 and V106 (*see figure 4–4*) should glow steadily and the pointer of the bridge meter should deflect to the left of the zero point.

h. After warm up is complete, turn the TEST knob to TRAN and adjust the FINE SET ZERO knob until the meter reads zero. If this adjustment cannot be made properly, adjust the COARSE SET ZERO control according to the following instructions:

(1) Set the FINE SET ZERO control to the middle of its range (white index mark up).

(2) Remove adjustment port cap and adjust the COARSE control potentiometer with a screwdriver until the meter pointer is at half scale.

(3) If necessary, readjust COARSE control until FINE control is able to move pointer across entire meter scale. Replace port cap.

i. Make the following control settings:

Control	Setting
SIGNAL WIDTH	Full clockwise (CW)
PHASE	Full counterclockwise (MIN)
TEST	RECV
POWER SET	Full clockwise (minimum attenuation)
SIGNAL FREQ.	Middle of range
INT-FM, EXT MOD	INT-FM

j. Turn the PHASE control slowly clockwise until the meter pointer deflects to the right from zero. This indicates that the oscillator tube is oscillating. Now adjust the PHASE control for maximum deflection, and turn the POWER SET knob counterclockwise to limit the pointer deflection to mid-scale of the meter.

k. Continue to turn the PHASE control slowly clockwise until the pointer drops back to zero position and then deflects again towards mid-scale. There should be at least three separate positions of the PHASE control where the pointer deflects to indicate oscillation.

l. Adjust the PHASE control for the peak of the largest of the several deflections. Adjust the POWER SET knob to set the meter pointer to the highest on-scale reading that is practical to use. Turn the FREQUENCY knob fully counterclockwise.

m. Very slowly turn the FINE FREQUENCY knob clockwise until a dip is produced in the meter deflection.

This dip is very sharp, and the adjustment to obtain it must be performed carefully.

n. If the Test Set passes these performance checks satisfactorily, replace the chassis within the case and secure it with the four fasteners.

4. PANEL CONTROLS (*See figure 3–1*).

NAME	ADJUSTMENT	FUNCTION
ON-OFF (toggle switch)	ON	Applies 115V a-c power to power transformer to start Test Set. Turns set heater off.
	OFF	Turns Test Set off. Turns set heater on as a standby measure.
		Power cord must be disconnected to completely de-energize Test Set for long periods of inactivity.
FINE SET ZERO (potentiometer)	Adjust to balance meter	Adjusts current through thermistor to set bridge-meter reading to zero. DBM dial must be set to maximum attenuation and TEST knob must be set to TRAN when this adjustment is made.
DBM (calibrated output attenuator)	Adjust for 1.0 milliwatt reading on meter. Read +7 to +30 dbm scale.	Measures average level of transmitter power in decibels above one milliwatt. (TEST knob must be set to TRAN position.)
	Adjust for 1.0 milliwatt reading on meter. Read −42 to −85 on dbm scale.	Measures peak power level of test signal output in decibels below one milliwatt. (TEST knob must be set to RECV position.)
TEST (function selector)	TRAN	Sets range of DBM dial for transmitter power measurements (+7 to +30 dbm scale). Cuts off test signal.
	(DOT) TEST position	Turns on test signal. Sets range of DBM dial for high-level test signal outputs.
	RECV	Turns on test signal and sets range of DBM dial for measuring power of low-level test signal output for receiver testing. (−42 to -85 dbm scale.)
FREQUENCY (absorption frequency meter)	Tune to dip in bridge-meter reading.	Tunes frequency meter to resonance at frequency being measured. Multiply dial reading by 10 to obtain frequency in megacycles.
PHASE (potentiometer)	Any position.	Controls d-c reflector voltage on test-oscillator tube. For c-w operation: selects operating mode for test oscillator. For f-m operation: adjusts time delay between trigger and center frequency of test signal. Shifts position of response curve along horizontal axis of oscilloscope.
POWER SET (test signal attenuator)	Adjusts to obtain SET POWER indication on meter.	Adjusts initial power level of test signal to unbalabce bridge by by 1.0 milliwatt.
SIGNAL FREQ. (test oscillator tuning)	Any position.	Tunes test signal to desired frequency.
SIGNAL WIDTH (potentiometer)	Any position.	Controls rate and deviation of test signal frequency modulation. Controls width of pattern on oscilloscope.
INT-FM EXT MOD (trigger switch)	INT-FM	Connects EXT MOD-TRIGGER IN receptacle for external pulsing of sawtooth generator in the Test Set
	EXT MOD	Connects EXT MOD-TRIGGER IN receptacle for external modulation of test oscillator.
MOD FMP (potentiometer)	Any position.	Controls amplitude of externally modulated signals applied to EXT MOD-TRIGGER IN receptacle.

5. CONNECTIONS.

a. Use of the Test Set in the full scope of its applications requires four connections:

(1) Power must be supplied to operate the Test Set. For this connection use Power Cord CX-337/U (6'-0") connected to the 115V AC receptacle on the Test Set panel. The Test Set operates on 115 volts (± 10%) 50- to 1600-cycle power.

(2) R-f coupling must be made between the Test Set and the radar system. For this connection use Output Cable CG-92A/U(8'-0") connected to the RF receptacle on the Test Set panel. Either Pickup Horn AT 68/UP or a directional coupler can be used to couple the cable to the radar system. Be sure the radar transmitter is turned off during the coupling operation.

(3) Triggering for the Test Set sweep generator is required when the f-m test signals are to be used. A trigger is supplied by the r-f pulses applied to the RF receptacle without any additional connections, or by any standard video trigger, such as an IFF trigger, applied to the EXT MOD-TRIGGER IN receptacle (with trigger switch on INT-FM) by means of the Video Cable CG-409B/U (6'-0").

(4) An oscilloscope (TS-34/AP or TS-239/AP) connected to the video output of the radar receiver is used to indicate the response of the system by A-scan.

b. The first two connections, (1) and (2), are always required; connection (3) is necessary for tests on radar receivers. Complete connections are shown in figures 3–3 and 3–4.

Note

For many tests, the radar system indicator is satisfactory in place of the separate A-scope. An A-scope is necessary, however, for measuring receiver bandwidth and recovery time.

6. APPLICATIONS IN RADAR PERFORMANCE TESTING.

Note

Each primary subdivision of this paragraph, i.e., 6a., 6b., 6c., etc. is complete in itself or contains all necessary references to previous tests. For an abridged procedure in which each primary subdivision is dependent upon the preceding subdivision, use paragraph 7 which is intended for use in making a quick but complete performance test in connection with Radar Performance Data Sheets. (See sample in figure 3–13.)

a. PRELIMINARY PROCEDURE.

(1) PREPARE RADAR.—Turn radar on, observe modulator current, rectifier current, and crystal current. Leave radar antenna stationary.

(2) PREPARE THE TEST SET.

(*a*) SET CONTROLS:

Control	*Setting*
TEST	TRAN
DBM	All the way counterclockwise.

(*b*) CONNECT TEST SET.—Make power, r-f, and trigger connections specified in paragraph 5. The trigger connection may not be needed.

CAUTION

SET THE DBM ATTENUATOR TO MAXIMUM ATTENUATION BEFORE CONNECTING THE POWER CORD AND TURNING ON THE TEST SET.

(3) PREPARE OSCILLOSCOPE (not used if radar has A or J-Scope).—Use TS-34/AP, TS-239/AP or equivalent oscilloscope (such as AN/USM-32 or AN/USM-24) with sweep length of 50 to 100 microseconds.

(*a*) TS-34/AP.—Turn the power on and set the horizontal input selector to NORMAL. Place the SWEEP SELECTOR switch in the START-STOP position, the SWEEP SPEED control to MED and the INPUT SELECTOR to HI. Set the ATTENUATION control to 20 db, switch to EXT SYNC and connect the radar trigger to the EXTERNAL SYNC jack (this connection is not necessary if the sync switch is put on INT SYNC). Connect the radar video signal to the SIGNAL INPUT jack and adjust the IMAGE SIZE control for a convenient signal height. Use the SYNC VOLTAGE control to obtain a steady image (check the position of the SYNC POLARITY switch).

(*b*) TS-239/AP, AN/USM-32 or AN/USM-24.—Set controls to equivalent settings as specified in (3) (*a*).

b. MEASURING TRANSMITTER AVERAGE POWER (P_{av}).

(1) CONNECT TEST SET TO RADAR.—Connect Output Cable CG-92A/U (8'-0") from RF receptacle to radar directional coupler (or test horn) as in figure 3–3 (or 3–4). Set TEST knob to TRAN and set DBM knob all the way counterclockwise.

(2) TURN ON TEST SET.—Connect 115V AC receptacle to power line with Power Cord CX-377/U (6'-0"). Turn 115V AC switch to ON and wait two minutes.

(3) BALANCE METER.—With TEST knob on TRAN and DBM control full counterclockwise, adjust FINE SET ZERO control until meter reads zero.

(4) MEASURE POWER.—Turn DBM dial clockwise, reducing attenuation until meter pointer is near 1.0 milliwatt. To be sure that the frequency meter is not absorbing power, thereby affecting the power reading, vary the setting of the FREQUENCY control. If the meter reading does not vary as the FREQUENCY control is moved slightly, adjust the meter pointer to the SET POWER indication with the DBM knob. Read the DBM dial and record.

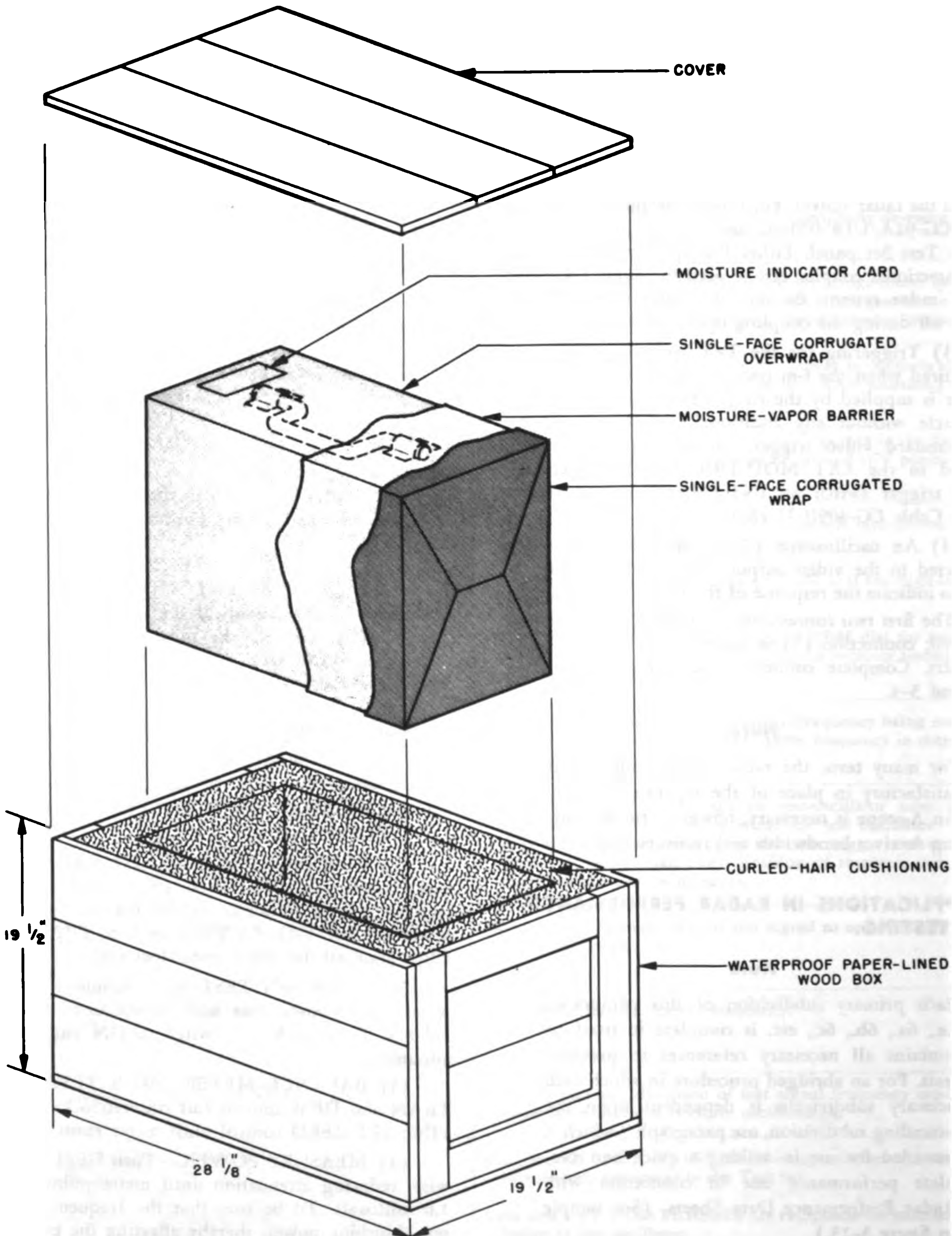

Figure 3–2. Test Set in Shipping Case

(5) COMPUTE TRANSMITTER AVERAGE POWER (P_{av}).—Compute as follows:

$$P_{av(dbm)} = +T'_{(dbm)} + A_{(db)} + C_{(db)}.$$

$T'_{(dbm)}$ = Average r-f power entering the Test Set above one milliwatt).

$T'_{(dbm)}$ = Average r-f power entering the Test Set (in dbm). This is the reading of the DBM dial in step (4).

$A_{(db)}$ = Total attenuation of cable and external attenuators (if any) between Test Set and directional coupler (or horn) in decibels. See paragraph 9 for r-f cable calibration.

$C_{(db)}$ = Coupling of directional coupler in decibels (or space loss between radar antenna and horn).

(6) COMPARE WITH RATED P_{av}.—Compare the measured value of transmitter average power (P_{av}) with the rated value. If the rated value is not given in dbm, convert to dbm by use of figure 3–5. If the rated peak power is known, compute rated average power by the procedure of paragraph 6. *g*. (2).

c. MEASURING TRANSMITTER FREQUENCY (f_t).

(1) OBTAIN POWER INDICATION.—Perform the following operations, unless already completed:

Operation	*Paragraph*
Connect Test Set to Radar.........	6. *b*. (1)
Turn on Test Set	6. *b*. (2)
Balance Meter	6. *b*. (3)
Set Power	6. *b*. (4)

(2) OBSERVE FREQUENCY. — Tune FREQUENCY knob for dip in meter reading. Carefully set to maximum dip, turning FREQUENCY knob counterclockwise to avoid backlash. Record reading and multiply by ten to convert to megacycles.

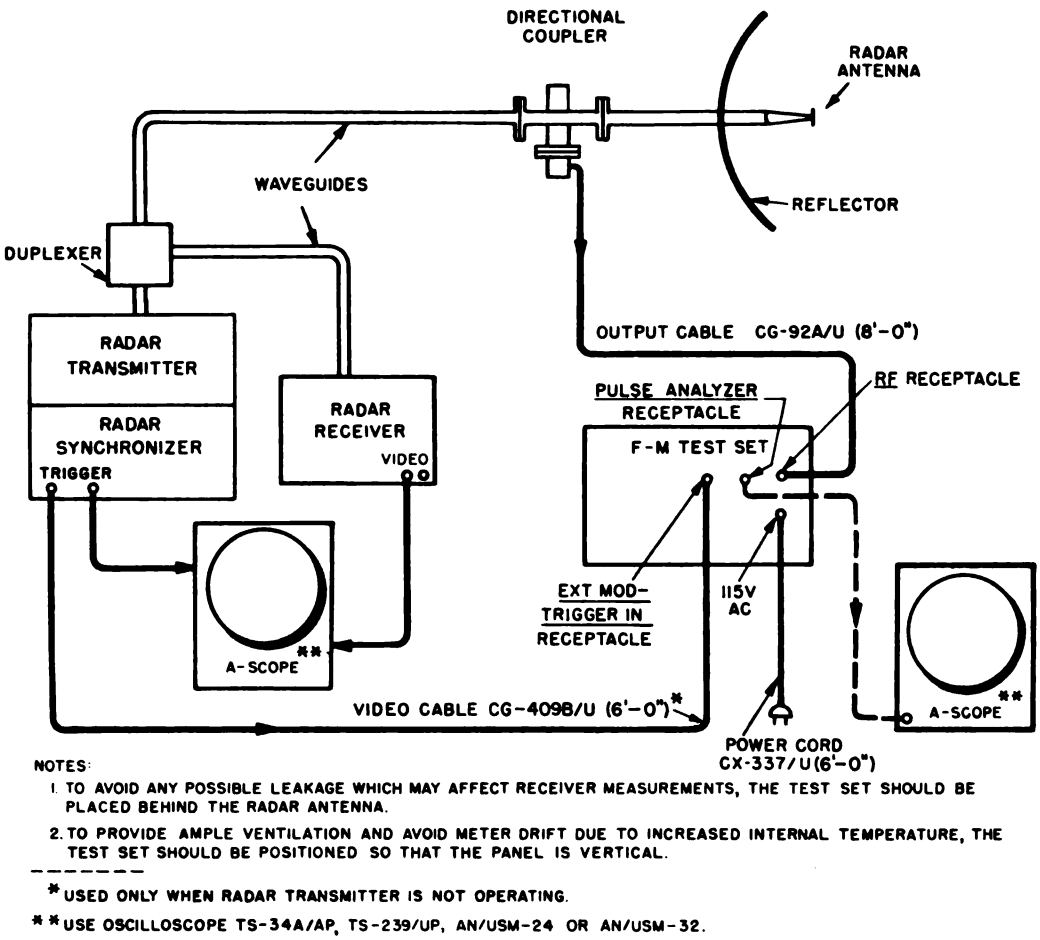

Figure 3–3. Complete Connections Using Directional Coupler

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Note

A spurious mode may be present at frequency-meter dial settings between 9100 and 9600 megacycles when the signal being measured is in the range from 8500 to 9000 megacycles. This indication, which will give a smaller and broader response, should be disregarded.

d. MEASURING RECEIVER FREQUENCY.

(1) PREPARE RADAR, TEST SET, AND OSCILLOSCOPE.—Perform the following operations, unless already completed.

Operation	*Paragraph*
Prepare Radar	6. *a.* (1)
Prepare Test Set	6. *a.* (2)
Prepare Oscilloscope	6. *a.* (3)

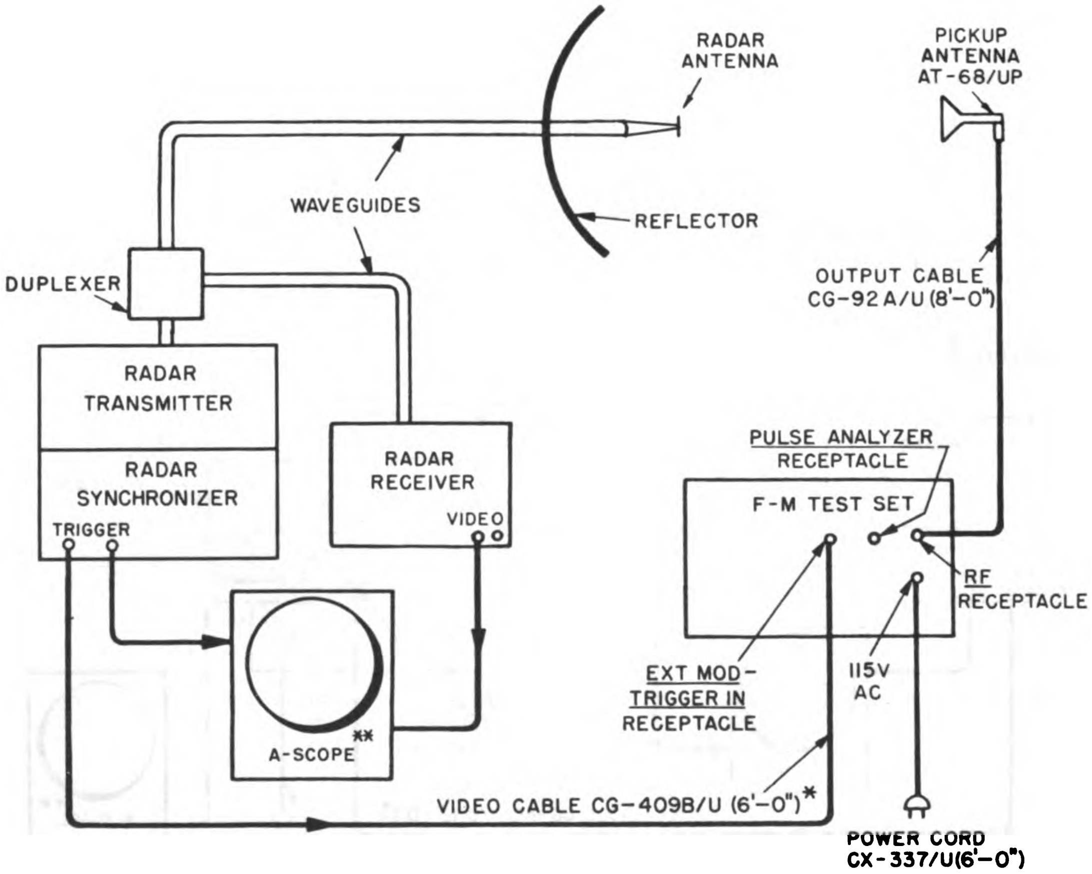
(2) ADJUST RADAR RECEIVER.—Leave Automatic Frequency Control on (if operative). Set gain to show small amount of noise on A-Scope or J-Scope.

(3) TUNE TEST SET TO RECEIVER.

(*a*) ADJUST TEST SET FOR TUNING.—Set TEST knob to TEST (dot) position between TRAN and RECV, DBM knob to about +15 dbm, POWER SET knob near maximum (clockwise), and PHASE knob near mid-position.

(*b*) OBTAIN F-M SIGNAL. — Set SIGNAL WIDTH knob to MIN. Adjust SIGNAL FREQ. knob for maximum signal, set TEST knob to RECV and adjust DBM control to prevent saturation (*see figure 3–6A*). Proceed to step (5) unless no signal is obtained over the range of the SIGNAL FREQ. adjustment.

(4) TUNE RECEIVER (if no test signals are



NOTES:

1. TO AVOID ANY POSSIBLE LEAKAGE WHICH MAY AFFECT RECEIVER MEASUREMENTS, THE TEST SET SHOULD BE PLACED BEHIND THE RADAR ANTENNA.
2. TO PROVIDE AMPLE VENTILATION AND AVOID METER DRIFT DUE TO INCREASED INTERNAL TEMPERATURE, THE TEST SET SHOULD BE POSITIONED SO THAT THE PANEL IS VERTICAL.

*USED ONLY WHEN RADAR TRANSMITTER IS NOT OPERATING.

* *USE OSCILLOSCOPE TS-34 A/AP, TS-239/UP, AN/USM-24 OR AN/USM-32.

Figure 3–4. Complete Connections Using Pickup Antenna AT–68/UP

apparent and Test Set is known to be operating properly).—Maximize crystal current with local-oscillator manual reflector voltage control. Adjust coupling, if necessary, to obtain crystal current. Tune for maximum target signals or echo-box signal and simultaneous maximum crystal current with local-oscillator mechanical tuning. Readjust reflector voltage when necessary to obtain crystal current. Then tune Test Set to receiver as in step (3). If no target signals can be observed, tune receiver with Test Set. See paragraph 6. *k*. (or use an echo box).

(5) MEASURE f_r.

(*a*) OBTAIN BANDPASS CURVE. — Turn SIGNAL WIDTH knob toward center to obtain bandpass curve. Adjust PHASE knob to hold pattern on oscilloscope screen (*see figure* 3–6B).

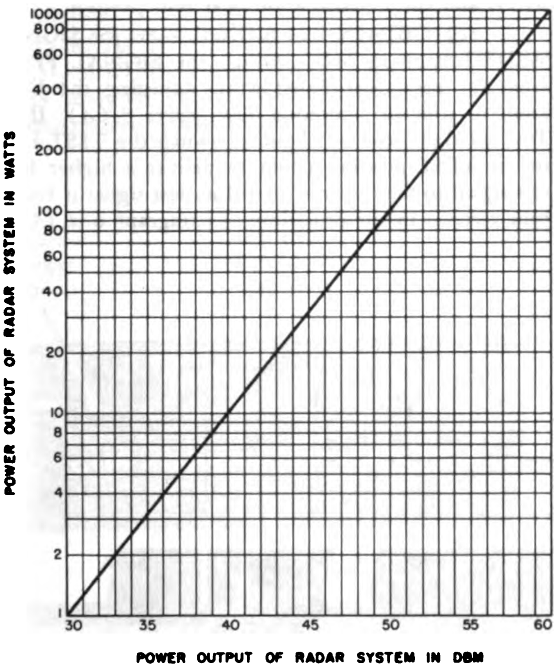


Figure 3–5. DBM-to-Watts Conversion Chart

(*b*) OBSERVE FREQUENCY.—Adjust FINE FREQUENCY control so that pip is on top of bandpass curve. (*See figure* 3–7*A*.) Record reading and multiply by ten. If f_r differs from f_t (or beacon), by twice the radar intermediate frequency, repeat paragraph 6. *d*. (3) and select the alternative signal (clockwise rotation of SIGNAL FREQ. knob decreases frequency). If the frequency differs from transmitter (or beacon) frequency by other than twice intermediate frequency, it indicates AFC troubles. Look for defects in the following:

1. L-O Tuning (see paragraph 6. *k*.).
2. Discriminator tuning.
3. AFC circuit.
4. Shock excitation of first i-f stage (AFC).
5. Bad spectrum.

e. MEASURING BANDWIDTH.

(1) OBTAIN BANDPASS CURVE.—Perform the following operations, unless already completed:

Operation	*Paragraph*
Prepare Radar, Test Set, and Oscilloscope	6. *d*. (1)
Adjust Radar Receiver	6. *d*. (2)
Tune Test Set to Receiver	6. *d*. (3)
Tune Receiver (when necessary)	6. *d*. (4)
Measure Receiver Frequency	6. *d*. (5)

(2) MEASURE BANDWIDTH.—
(*See figure* 3–7.)

(*a*) OBTAIN HALF-POWER HEIGHT.—Increase the setting of the DBM attenuator by 3.0 db to reduce the power by one-half; detune the frequency meter with the FREQUENCY knob and mark the half-power height on the face of the scope. Restore the DBM dial to its original setting.

(*b*) MEASURE FREQUENCY DIFFERENCE.—Move the frequency-meter pip across the curve, observing the readings at the two points where it goes through the half-power line determined in (*a*).

Bandwidth, $B = f_1 - f_2$.

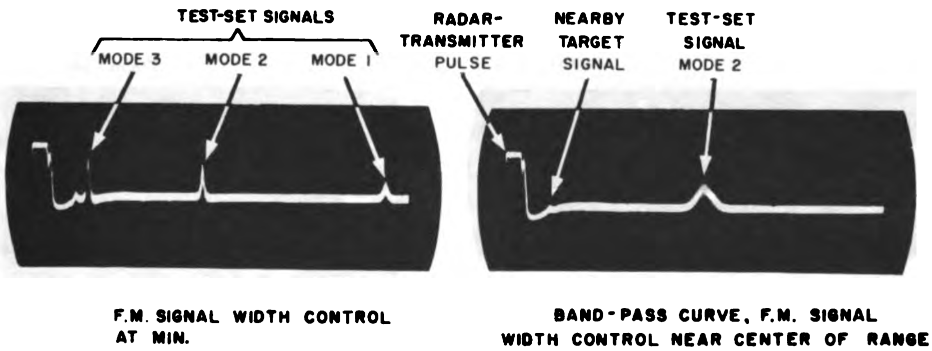


Figure 3–6. Frequency Modulated Test-Set Signals

Note

Sometimes when the frequency-meter pip is tuned within the passband, the response curve on the oscilloscope is so distorted that it is difficult to set the positions of the frequency-meter pip to the half-power points with sufficient accuracy. An alternative procedure, to be used when this condition occurs, is to calibrate the horizontal sweep in megacycles-per-inch and then measure the distance, and hence the frequency, between the two half-power points. The sweep calibration can be made by observing the distance the frequency-meter pip moves when tuned over a definite frequency range. This calibration is dependent on the setting of the SIGNAL WIDTH and PHASE knobs. Therefore, the settings of these knobs must not be changed after the calibration is made.

f. MEASURING RECEIVER PERFORMANCE FIGURE P_m (SENSITIVITY).—If the receiver is not known to be tuned to the transmitter, first check the receiver frequency by following paragraph 6. *d.*

(1) PREPARE RADAR, TEST SET, AND OSCILLOSCOPE.—Perform the following operations, unless already completed:

Operation	*Paragraph*
Prepare Radar	6. *a.* (1)
Prepare Test Set	6. *a.* (2)
Prepare Oscilloscope	6. *a.* (3)

(2) ADJUST RADAR RECEIVER.—Leave Automatic Frequency Control on (if operative). Set gain to show noise one-half of transmitter pulse or saturated signal amplitude.

(3) TUNE TEST SET TO RECEIVER.

(*a*) PREPARE TEST SET FOR RECV TEST.—Set the TEST knob to RECV, the DBM knob to about +15 dbm, the POWER SET knob near maximum (clockwise), and the PHASE knob near mid position.

(*b*) OBTAIN F-M SIGNAL.—Set the SIGNAL WIDTH knob to MIN. Adjust the SIGNAL FREQ. knob for maximum signal while adjusting the DBM knob to prevent saturation (*see figure 3–6A*). If no Test Set signal can be obtained, switch the TEST knob to the TEST position (dot) to deliver a higher level test signal to the receiver. If still no test signal is found, tune receiver by the procedure of paragraph 6. *d.* (4).

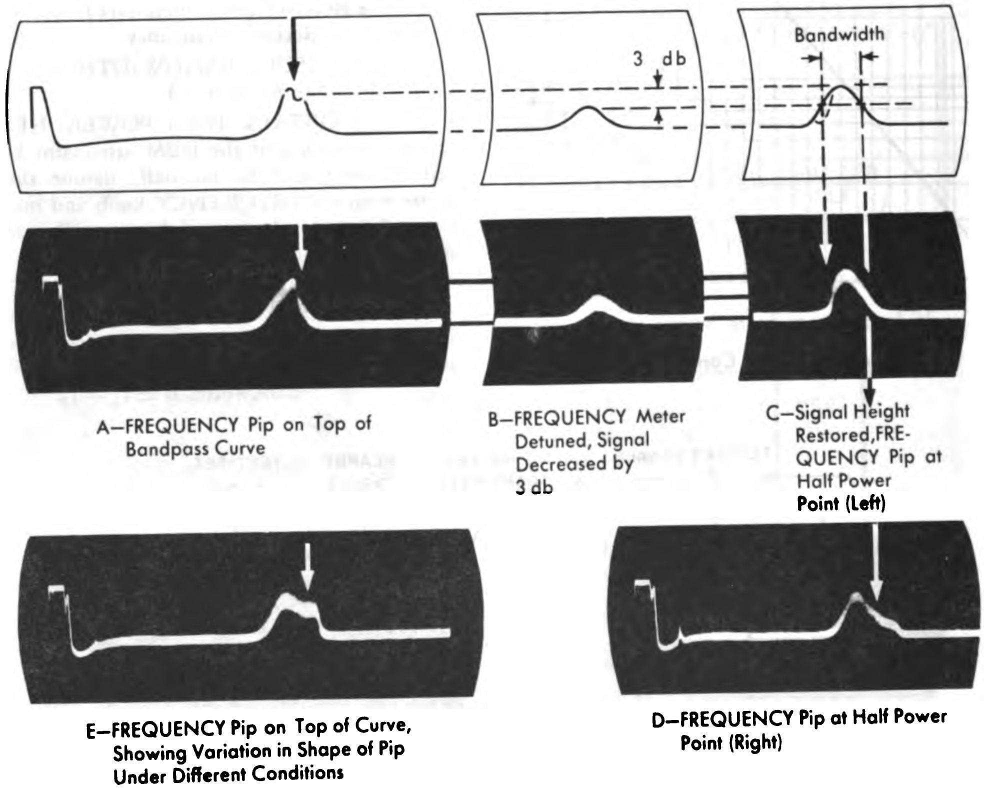


Figure 3–7. Receiver Frequency and Bandwidth Measurements

(4) CHECK METER BALANCE. — Switch the TEST knob to TRAN and turn the DBM control fully counterclockwise. Then adjust the FINE SET ZERO control until meter reads zero.

(5) FIND SIGNAL AGAIN.—Set the TEST knob to RECV and turn the DBM control clockwise to find the f-m signal again.

(6) SET SIGNAL POWER ON C-W.—Broaden bandpass curve to maximum by turning the SIGNAL WIDTH knob clockwise to CW, while holding the pattern on the screen with the PHASE knob. Detune the frequency meter if necessary. Adjust the POWER SET knob so that the meter pointer is at the SET POWER line.

(7) RETURN TO F-M SIGNAL. — Turn the SIGNAL WIDTH control carefully counterclockwise to MIN, using the PHASE control, if necessary, to keep the same pattern on the scope.

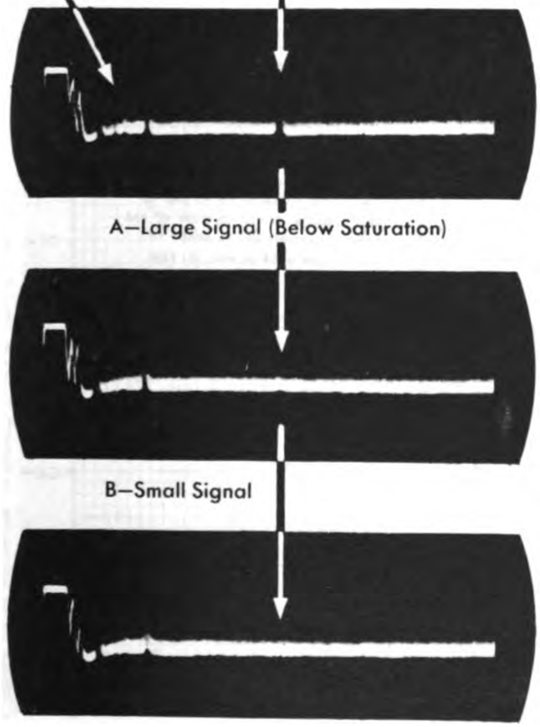


Figure 3–8. Measuring Minimum Discernible Signal Power

(8) DETERMINE MINIMUM DISCERNIBLE SIGNAL (*See figure 3–8*).—Turn the DBM attenuator until signal just disappears in noise. When signal becomes as small as in part A of figure 3–8, turn the DBM knob in one-db steps, and move the signal back and forth with the PHASE knob for identification of signal. When the signal is last visible, read the DBM dial.

(9) COMPUTE RECEIVER PERFORMANCE FIGURE.

$$P_{m(dbm)} = -M_{(dbm)} - A_{(db)} - C_{(db)}$$

where:

$P_{m(dbm)}$ = Receiver performance figure in decibels below one milliwatt (−dbm). (Minimum discernible signal power converted to dbm.)

$M_{(dbm)}$ = Peak power output of the Test Set in dbm (DBM dial reading).

$A_{(db)}$ = Total attenuation of cable and external attenuators (if any) between Test Set and directional coupler (or horn) in decibels.

$C_{(db)}$ = Coupling of directional coupler in decibels (or space loss between radar antenna and horn).

Example: *See figure 3–13.*

(10) COMPARE WITH RATED P_m.—Compare the measured value of Receiver Performance Figure, P_m with the rated value. If the rated value is not given in dbm, convert to dbm by use of figure 3–5.

g. COMPUTING PERFORMANCE DATA.

(1) COMPUTING TRANSMITTER PFRFORMANCE FIGURE.

(*a*) MEASURE TRANSMITTER AVERAGE POWER.—Follow the procedure of paragraph 6. *b*.

(*b*) CONVERT TO TRANSMITTER PERFORMANCE FIGURE.—Compute as follows:

$$P_{pk(dbm)} = P_{av(dbm)} + N_{(db)}$$

where:

$P_{pk(dbm)}$ = Transmitter performance figure in decibels above one milliwatt (+dbm) (transmitter peak power converted to dbm).

$P_{av(dbm)}$ = Transmitter average power in decibels above one milliwatt (+dbm).

$N_{(db)}$ = Number of decibels to be added to average power in dbm to convert to peak power in dbm (db due to duty cycle) (from figure 3–9).

Example:
$P_{av(dbm)}$ = 41.5 dbm.
pulse length = 1 microsecond.
pulse repetition rate = 650/sec.
From figure 3–8, $N_{(db)}$ = 31.5 db.
$P_{pk(dbm)}$ = 41.5 dbm + 31.5 db = +73 dbm.

(2) COMPUTING RATED TRANSMITTER AVERAGE POWER IN DBM.—If known in watts or kilowatts, convert to dbm by use of figure 3–5. If the rated peak power is known, proceed as follows:

(*a*) CONVERT RATED P_{pk} TO DBM.—Convert rated transmitter peak power from watts or kilowatts to dbm by use of figure 3–5. This figure is the rated transmitter performance figure, $P_{pk(dbm)}$.

(*b*) CONVERT RATED TRANSMITTER PERFORMANCE FIGURE TO RATED AVERAGE POWER.—Compute as follows:

$P_{av(dbm)} = P_{pk(dbm)} - N_{(db)}$

Example:

Rated $P_{pk} = 40$ kilowatts.

From figure 3–5, $P_{pk(dbm)} = +76$ dbm.

For a pulse length of 1 microsecond and a pulse repetition rate of 650/sec, N = 31.5 db from figure 3–9.

Rated $P_{av(dbm)} = +76 - 31.5 = +44.5$ dbm.

(*c*) CHECKING FOR FREQUENCY SKIPPING AND DOUBLE MODING.—If the transmitter power level is low, make the following check for possible frequency skipping or double moding of the radar transmitter tube:

Connect video cable CG-409B/U (6′-0″) from the PULSE ANALYZER receptacle to the TS-34/AP oscilloscope (or equivalent). Compare the observed waveshape patterns of the transmitter signal with that of figure 3–10A, showing the normal bandpass curve. Figure 3–10B gives evidence of frequency skipping, while double moding appears in figure 3–10C. Either of the latter conditions indicates the possibility of a faulty transmitter tube.

(3) COMPUTING OVER-ALL PERFORMANCE.

(*a*) DETERMINING RADAR PERFORMANCE FIGURE, S.—The radar performance figure, S, is a measure of the ability of a radar to detect small or distant targets. The effect of external factors such as atmospheric conditions, geometry of target, ground and water reflection is not included in this figure.

1. Compute the radar performance figure from $P_{pk(dbm)}$ obtained in paragraph 6. *g.* (1) and $P_{m(dbm)}$ obtained in paragraph 6. *f.* a follows:

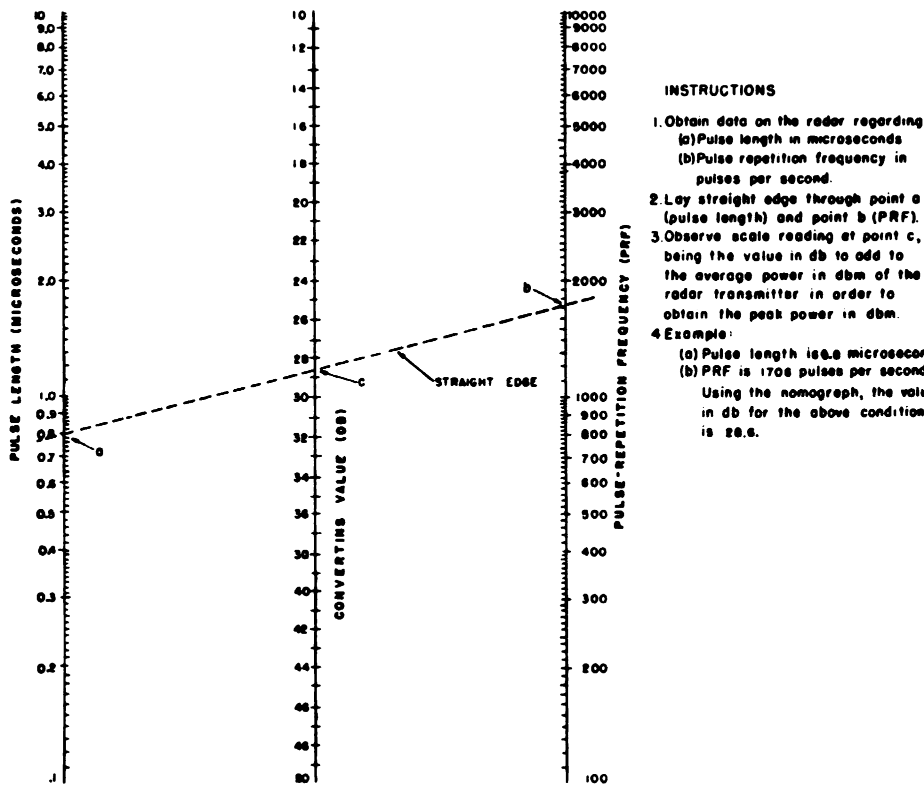


Figure 3–9. Average-to-Peak Power Conversion Chart

$S_{(db)} = P_{pk(dbm)} - P_{m(dbm)}$.

Example:

$P_{pk(dbm)} = +73$ dbm.

$P_{m(dbm)} = -93$ dbm.

$S_{(db)} = +73$ dbm — (—93 dbm) = 166 db.

Note

When considering the ability of a radar to trigger a beacon and receiver, a beacon signal uses the transmitter performance figure $P_{pk(dbm)}$ and the receiver performance figure $P_{m(dbm)}$ separately, instead of combining them into the radar performance figure, S.

2. Compare the radar performance figure $S_{(db)}$ with the expected performance figure. The expected figure can be obtained from the expected value of $P_{pk(dbm)}$ and $P_{m(dbm)}$ or the value obtained when the radar is known to be operating satisfactorily.

Example: If the expected radar performance figure $S_{(db)} = 171$ db and the measured radar performance figure $S_{(db)} = 166$ db, the radar performance is down 5 db.

3. The effect on range can be obtained by reference to figure 3–11.

Note

Where either $P_{pk(dbm)}$ or $P_{av(dbm)}$ (when measured on BEACON) is down 2 db and $P_{m(dbm)}$ is down 1.5 db, the range at which the radar could trigger a beacon is down to 79 percent of normal range and the range at which the radar could receive a beacon signal is down to 84 percent of normal range.

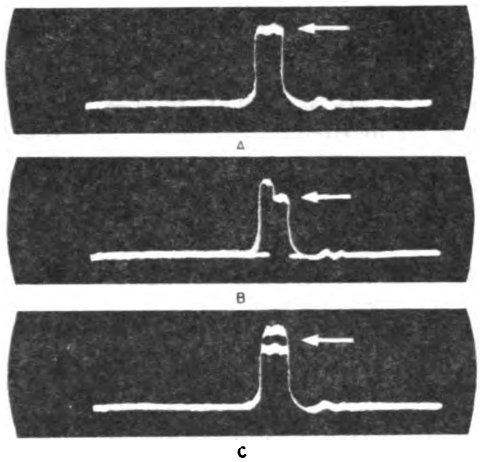


Figure 3–10. Checking for Frequency Skipping and Double Moding

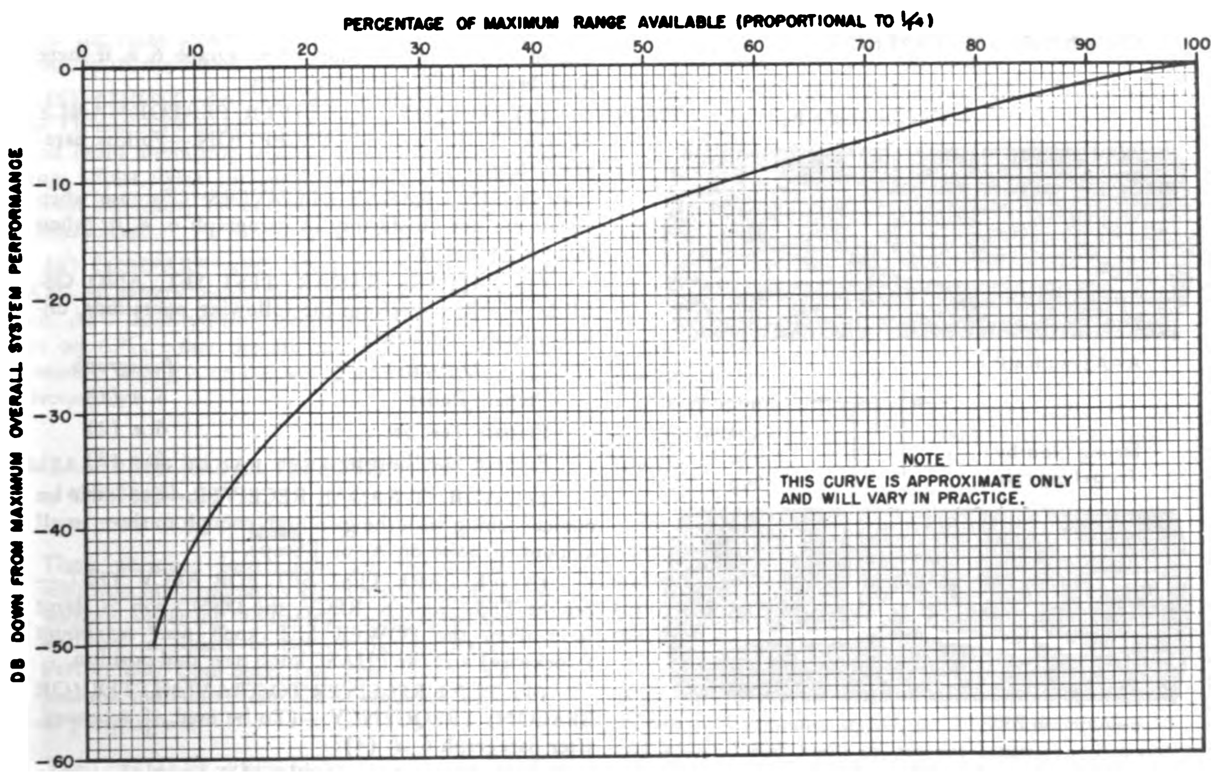


Figure 3–11. Radar Performance Versus Radar Range

(*b*) COMPUTING CHANGE IN OVER-ALL PERFORMANCE.—For routine measurements time can be saved by adding the differences from rated transmitter average power obtained in paragraph 6. *b.* (6) and rated receiver performance figure obtained in paragraph 6. *f.* (10) to get change in radar performance figure as illustrated in figure 3–13, Sample Radar Performance Data Sheet.

h. MEASURING TR RECOVERY TIME.

(1) OBTAIN F-M SIGNAL.—Perform the following operations, unless already completed:

Operation	*Paragraph*
Prepare Radar, Test Set, and Oscilloscope	6. *d.* (1)
Adjust Radar Receiver	6. *d.* (2)
Tune Test Set to Receiver	6. *d.* (3)
Tune Receiver (if no test signals are obtained)	6. *d.* (4)

(2) ADJUST SIGNAL HEIGHT.—Leave AFC on, if operative. Adjust gain for small amount of noise. Adjust DBM knob until signal height is about half way between noise and saturation.

(3) MOVE SIGNAL TOWARD TRANSMITTER PULSE.—Turn PHASE knob counterclockwise toward MIN until signal height just starts to decrease. Measure range from beginning of transmitter pulse to signal.

(4) ALTERNATE PROCEDURE.—See paragraph 11 for alternate method which can be used when very small TR recovery times do not permit phasing of the Test Set pulse close enough to the transmitter pulse.

i. DETECTING TRANSMITTER PULLING AND CHECKING AFC TRACKING.

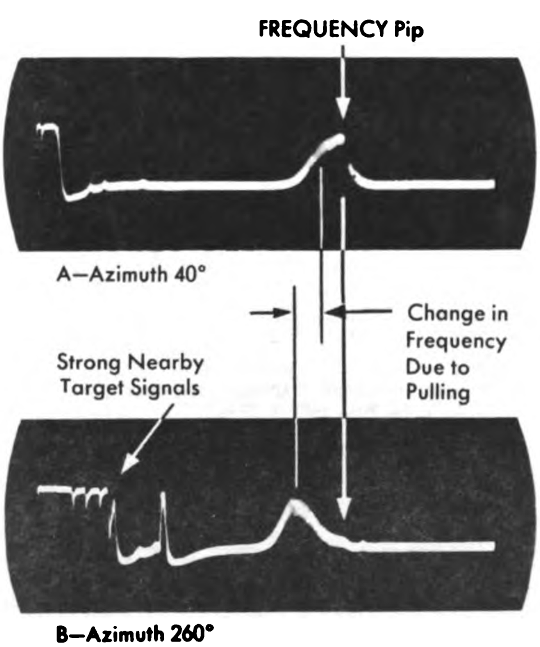


Figure 3–12. Checking Transmitter Pulling and AFC Tracking

(1) OBTAIN F-M SIGNAL.—Perform the following operations, if not already completed:

Operation	*Paragraph*
Prepare Radar, Test Set, and Oscilloscope	6. *d.* (1)
Adjust Radar Receiver	6. *d.* (2)
Tune Test Set to Receiver	6. *d.* (3)
Tune Receiver (if no test signals are obtained)	6. *d.* (4)

(2) OBTAIN BANDPASS F-M SIGNAL.—Turn PHASE knob clockwise to put signal near center of screen. Broaden signal by turning SIGNAL WIDTH knob part way clockwise. Tune frequency meter for pip on top of curve (f_1).

(3) CHECK FOR PULLING AND PROPER AFC TRACKING.—Start radar antenna nutator or spinner motor. If the f-m signal moves, there is probably pulling (*see figure 3–12*). If it remains on the screen, the AFC is tracking satisfactorily.

j. CHECKING BEACON RESPONSE OF RADAR.

(1) PRELIMINARY.—Switch radar to BEACON. Measure crystal current, rectifier current, and modulator current.

(2) MEASURE TRANSMITTER POWER.—Follow paragraph 6. *b.* (Most radars have different pulse length and repetition rate on BEACON.)

(3) MEASURE TRANSMITTER FREQUENCY. —Follow paragraph 6. *c.*

(4) MEASURE RECEIVER FREQUENCY FOR BEACON RECEPTION.—Follow paragraph 6. *d.* substituting 9310 mc for transmitter frequency. First tune beacon receiver by procedure of paragraph 6. *k.* if there is no beacon AFC or tuning cavity.

(5) MEASURE RECEIVER PERFORMANCE FIGURE FOR BEACON RECEPTION.—Follow paragraph 6. *f.*

k. TUNING RADAR RECEIVERS. (For use when results are not satisfactory in paragraph 6. *d.* or when there is no AFC.)

(1) PREPARE RADAR, TEST SET, AND OSCILLOSCOPE.—Perform the following operations, unless already completed:

Operation	*Paragraph*
Prepare Radar	6. *a.* (1)
Prepare Test Set	6. *a.* (2)
Prepare Oscilloscope	6. *a.* (3)

(2) ADJUST RADAR RECEIVER.—Set radar on manual tuning with the gain high enough to show small amount of noise on A- or J-Scope.

(3) PREPARE TEST SET FOR RECV TEST.—Set the TEST knob to RECV, the DBM knob to about +50 dbm, the POWER SET knob near maximum (clockwise) and the PHASE knob near mid-position.

(4) TUNE RECEIVER TO TRANSMITTER (OR BEACON) FREQUENCY.—(To be used, if necessary, after paragraph 6. *d.* (4):

(*a*) OBTAIN C-W OUTPUT SIGNAL.—Turn SIGNAL WIDTH knob clockwise to CW. Maximize meter reading with PHASE control. Leave TEST knob on RECV; set DBM dial to about —50 dbm.

(*b*) TUNE TEST SET TO TRANSMITTER (OR BEACON) FREQUENCY. — Adjust SIGNAL FREQ. knob to transmitter (or beacon) frequency, resetting PHASE knob when meter reading drops ten percent, and checking frequency by dipping meter reading with FREQUENCY control.

(*c*) OBTAIN F-M OUTPUT SIGNAL.—Turn SIGNAL WIDTH knob to MIN and set TEST knob to TEST (dot) position.

(*d*) DETUNE RECEIVER LOCAL OSCILLATOR.—Set radar on manual tuning. Set local oscillator at extreme end of tuning range, but on correct side of transmitter (or beacon) frequency. Adjust local oscillator for crystal current.

(*e*) TUNE RECEIVER TO TEST SET.—Slowly tune receiver local-oscillator mechanical tuning toward center of its range, resetting reflector voltage when crystal current drops. Watch for f-m signal on oscilloscope. Tune mechanical tuner of receiver for maximum f-m signal, and maximum crystal current. Set TEST knob to RECV. Then, if necessary, adjust setting of DBM attenuator to prevent saturation.

(*f*) OBTAIN F-M BANDPASS CURVE.—Carefully broaden the scope pattern with the SIGNAL WIDTH control while holding the signal in view with the PHASE control until the bandpass curve is obtained. Adjust the local oscillator to get the frequency-meter pip on top of the curve.

(5) ADJUST RADAR R-F COMPONENTS.—Tune TR and ATR boxes for maximum Test Set signal. Adjust DBM attenuator to avoid saturated signal while tuning. Adjust crystal current for proper value. Readjust the local oscillator, TR and ATR boxes to compensate for interaction.

(6) COMPARE AFC AND MANUAL.—Switch to AFC. If pattern moves more than a few megacycles, adjust AFC discriminator secondary. If pattern disappears on AFC, either the afc circuit is inoperative or the manual tuning is on the wrong side of the transmitter frequency.

7. MEASURING RADAR PERFORMANCE (abridged).

Note

These abridged instructions are for use in sequence. Sub-paragraphs which may be skipped without upsetting following paragraphs are enclosed in square blocks on Sample Radar Performance Data Sheet (*see figure 3–13*). To perform individual tests out of sequence, refer to paragraph 6.

a. PRELIMINARY PROCEDURE.

(1) RADAR.—Turn radar on, observe modulator current, rectifier current, and crystal current. Leave radar spinner stationary.

(2) TEST SET.—Turn TEST knob to TRAN and DBM knob all the way counter-clockwise. Connect Test Set to source of power and turn on. Connect output cable CG-92A/U (8′-0″) from RF receptacle to radar directional coupler (or test horn).

(3) TS-34/AP (not used if Radar has A- or J-Scope).—Turn the power on and set the horizontal input selector to NORMAL. Place the SWEEP SELECTOR switch in the START-STOP position, the SWEEP SPEED control to MED and the INPUT SELECTOR to HI. Set the ATTENUATION control to 20 db, switch to EXT SYNC and connect the radar trigger to the EXTERNAL SYNC jack (this connection is not necessary if the sync switch is put on INT SYNC). Connect the radar video signal to the SIGNAL INPUT jack and adjust the IMAGE SIZE control for a convenient signal height. Use the SYNC VOLTAGE control to obtain a steady image (check the position of the SYNC POLARITY switch).

b. TRANSMITTER AVERAGE POWER (P_{av}).

(1) BALANCE METER.—With TEST knob on TRAN and DBM dial full counter-clockwise, adjust FINE SET ZERO control until meter reads zero.

(2) SET POWER.—Turn DBM dial clockwise, reducing attenuation until meter pointer is below 1.0 milliwatt. Detune frequency meter. Adjust meter pointer to SET POWER line by turning DBM dial counter-clockwise. Read DBM dial and record.

(3) COMPUTE TRANSMITTER AVERAGE POWER (P_{av}).—Compute as follows:

P_{av} = DBM reading +A +C. (See Sample Radar Performance Data Sheet, figure 3–13.)

(4) COMPARE WITH RATED P_{av}.—Compute difference from rated P_{av}.

c. TRANSMITTER FREQUENCY (f_t).—Tune FREQUENCY knob for dip in meter reading. Carefully set to maximum dip, turning FREQUENCY knob counterclockwise to avoid backlash. Record reading and multiply by ten.

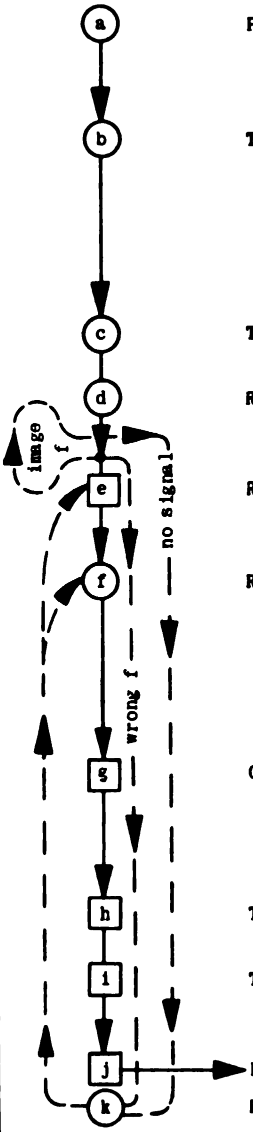
d. RECEIVER FREQUENCY.—Leave radar afc on (if operative) and set gain sufficient to show small amount of noise.

(1) TUNE TEST SET TO RECEIVER.

(*a*) PREPARE TEST SET FOR TUNING.—Set TEST knob to TEST (dot) position between TRAN and RECV, DBM dial to +15 dbm, POWER SET control near maximum (clockwise), and PHASE knob near mid-position.

(*b*) OBTAIN F-M SIGNAL. — Set SIGNAL WIDTH control to MIN. Adjust SIGNAL FREQ. control for maximum signal, set TEST knob to RECV and adjust DBM knob to prevent saturation. Proceed to step (3) unless no signal is obtained over the range of the SIGNAL FREQ. control.

Radar *AN/APS-15A* Serial No. *1725* F-M Test Set No. *2* Observer *FBW* Date *5/12/51*



SEARCH

Preliminary Procedure

- Radar Modulator Current .... *7.5* ma
- Radar Rectifier Current .... *9.0* ma
- Radar Crystal Current .... *0.6* ma

Transmitter Average Power

- DBM Dial Reading .... *+17.5* dbm
- Cable Attenuation .... A *4* db
- Coupling .... C *20* db
- Total .... P_{av} *+41.5* dbm
- Rated .... *+44.5* dbm
- Difference .... *-3* db

Transmitter Frequency

- Reading *936.5* , Frequency .... f_t *9365* mc

Receiver Frequency

- Reading *936.6*
- Frequency .... f_r *9366* mc

Receiver Bandwidth

- Readings (1) *936.5* (2) *936.7*
- Bandwidth, f_1 *9365* f_2 *9367* B *2* mc

Receiver Performance Figure (Sensitivity)

- DBM Dial Reading .... *-69* dbm
- Cable Attenuation .... -A *-4* db
- Coupling .... -C *-20* db
- Total .... P_m *-93* dbm
- Rated .... -(*-95*) dbm
- Difference .... *-2* db

Overall Performance

- Differences (b) *-3* db .... (f) *+2* db
- Overall Difference .... (b+f) *-5* db
- Transmitter Frequency Skipping .... No ☑ Yes ☐
- Double Moding .... No ☑ Yes ☐

TR Recovery

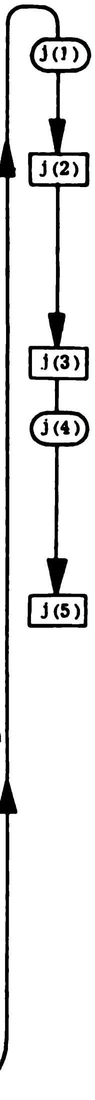
- Range .... *0.2* miles

Transmitter Pulling; AFC Tracking

- Transmitter Pulling: No ☑ Yes ☐
- AFC Tracking Good ☑ Poor ☐

Beacon Response of Radar

Receiver Tuning



BEACON

Preliminary

- *7.0* ma
- *8.6* ma
- *0.55* ma

Trans. P_{av}

- *+18.5* dbm
- A *4* db
- C *20* db
- P_{av} *+42* dbm
- *+44.5* dbm
- *-2* db

f_t on Beacon

- f_t *9365* mc

f_r for Beacon

- *931.0*
- f_r *9310* mc

P_m for Beacon

- *-59.5* dbm
- -A *-4* db
- -C *-20* db
- P_m *-83.5* dbm
- -(*-85*) dbm
- *-1.5* db

Maintenance Notes:

Figure 3–13. Sample Radar Performance Data Sheet

(2) TUNE RECEIVER (if no test signals are observed).—Maximize crystal current with local-oscillator manual reflector voltage control. Adjust coupling, if necessary, to obtain crystal current. Tune for maximum target signals or echo-box signal with local-oscillator mechanical tuning. Readjust reflector voltage, when necessary, to obtain maximum crystal current. Then tune Test Set to receiver as in step (1). If no target signals can be observed, tune receiver with Test Set (see paragraph 7. *k*. or use echo box).

(3) MEASURE f_r.

(*a*) OBTAIN BANDPASS CURVE. — Turn SIGNAL WIDTH control to obtain bandpass curve. Adjust PHASE control to hold pattern on oscilloscope screen.

(*b*) OBSERVE FREQUENCY. — Adjust FREQUENCY control so that pip is on top of bandpass curve. Record reading and multiply by ten. If f_r differs from f_t (or beacon) by twice the radar intermediate frequency, repeat paragraph 7. *d*. (1) and select the alternative signal (clockwise rotation of SIGNAL FREQ. knob decreases frequency). If the frequency differs from transmitter (or beacon) frequency by other than twice intermediate frequency, afc trouble is indicated. If afc circuit is inoperative, see paragraph 7. *k*. for manual tuning.

e. MEASURE BANDWIDTH (Optional).

(1) OBTAIN HALF-POWER HEIGHT. — Increase setting of DBM attenuator by 3.0 db; detune frequency meter and mark half-power height. Restore DBM dial to original setting.

(2) MEASURE FREQUENCY DIFFERENCE.—Move the frequency-meter pip across the curve, observing the readings at the two points where it goes through the half-power line determined in (*b*).

Bandwidth, $B = f_1 - f_2$.

f. RECEIVER PERFORMANCE FIGURE P_m (SENSITIVITY).—Leave radar afc on (if operative) and set gain to show noise one-half of transmitter pulse or saturated signal amplitude.

(1) SET SIGNAL POWER ON C-W.—Broaden bandpass curve to maximum by turning SIGNAL WIDTH knob clockwise to CW, while holding pattern on screen with PHASE control. Detune frequency meter. Adjust POWER SET knob so that meter pointer is at SET POWER line.

(2) RETURN TO F-M SIGNAL.—Turn SIGNAL WIDTH control to MIN, being careful to keep the correct signal (same mode).

(3) DETERMINE MINIMUM DISCERNIBLE SIGNAL.—Turn DBM attenuator until signal just disappears in noise. Move signal back and forth with PHASE knob for identification. Record DBM dial reading. Compute receiver performance figure:

$P_m = -$DBM reading $-A - C$ (see Radar Performance Data Sheet).

(4) COMPARE WITH RATED P_m. — Compute difference from rated P_m.

g. OVER-ALL PERFORMANCE.—Combine the difference from parts *b* and *f* of the data sheet (*see figure 3-13*) to obtain the difference in over-all performance figure from rated performance figure. Observe waveshape patterns from PULSE ANALYZER receptacle for evidence of frequency skipping or double moding which might contribute to impaired performance figure.

h. TR RECOVERY TIME.—Leave AFC on, if operative. Adjust gain for small amount of noise.

(1) RESTORE F-M SIGNAL (which was attenuated down to the noise level during the procedure of paragraph 7. *f*. (3).)—Turn DBM knob clockwise until signal height is about half way between noise and saturation.

(2) MOVE SIGNAL TOWARD TRANSMITTER PULSE.—Turn PHASE knob counterclockwise toward MIN until signal height starts to decrease. Measure range from beginning of transmitter pulse to signal.

i. DETECTING TRANSMITTER PULLING AND CHECKING AFC TRACKING.

(1) OBTAIN BANDPASS F-M SIGNAL.—Turn PHASE knob clockwise to put signal near center of screen. Broaden signal by turning SIGNAL WIDTH control part way clockwise. Adjust frequency meter for pip on top of curve (f_t).

(2) CHECK FOR PULLING AND PROPER AFC TRACKING.—Start radar antenna nutator or spinner motor. If the f-m signal moves, there is probably pulling. If it remains in synchronism with the spinner, the afc circuit is tracking satisfactorily.

j. BEACON RESPONSE OF RADAR.

(1) PRELIMINARY.—Switch radar to BEACON, measure crystal current and modulator current.

(2) MEASURE TRANSMITTER POWER.—Follow paragraph 7. *b*. (Most radars have different pulse lengths and repetition rates on BEACON.)

(3) MEASURE TRANSMITTER FREQUENCY. —Follow paragraph 7. *c*.

(4) MEASURE RECEIVER FREQUENCY FOR BEACON RECEPTION.—Follow paragraph 7. *d*., substituting beacon frequency for transmitter frequency. First tune beacon receiver by the procedure of paragraph 7. *k*., if there is no beacon afc or tuning cavity.

(5) MEASURE RECEIVER PERFORMANCE FIGURE FOR BEACON RECEPTION.—Follow paragraph 7. *f*.

k. RECEIVER TUNING (for use when results are not satisfactory in paragraph 7. *d*. or there is no afc).—Switch radar from AFC to manual tuning.

(1) TUNE RECEIVER TO TRANSMITTER (OR BEACON) FREQUENCY. (To be used, if necessary, after paragraph 7. *d.* (2).)

(*a*) OBTAIN C-W OUTPUT SIGNAL.—Turn SIGNAL WIDTH control clockwise to CW. Maximize meter reading with PHASE control. Leave TEST knob on RECV and set DBM dial to about —50 dbm.

(*b*) TUNE TEST SET TO TRANSMITTER (OR BEACON) FREQUENCY. — Adjust SIGNAL FREQ. control to obtain transmitter (or beacon) frequency, resetting PHASE knob when meter reading drops 10% and checking frequency by using the FREQUENCY control.

(*c*) OBTAIN F-M OUTPUT SIGNAL.—Turn SIGNAL WIDTH control to MIN. Set TEST knob to TEST (dot) position.

(*d*) DETUNE RECEIVER LOCAL OSCILLATOR.—Set radar on manual tuning. Set local oscillator at extreme end of tuning range, but on correct side of transmitter (or beacon) frequency. Adjust local oscillator for crystal current.

(*e*) TUNE RECEIVER TO TEST SET.—Slowly tune radar local-oscillator mechanical tuning toward center of its range, resetting the reflector voltage when crystal current drops, and watching for f-m signal on oscilloscope. Tune mechanical tuner of receiver for maximum f-m signal and adjust reflector voltage for maximum crystal current. Set TEST knob to RECV. Then, if necessary, adjust setting of DBM attenuator to prevent saturation.

(*f*) OBTAIN F-M BANDPASS CURVE.—Carefully broaden the scope pattern with the SIGNAL WIDTH control while holding the signal in view with the PHASE control until the bandpass curve is obtained. Adjust local oscillator to get frequency-meter pip on top of curve.

(2) ADJUST RADAR R-F COMPONENTS.—Tune duplexer TR and ATR boxes for maximum Test Set signal. Adjust DBM attenuator to avoid saturated signal while tuning. Adjust crystal current for proper value. Readjust local oscillator, TR and ATR boxes to compensate for interaction.

(3) COMPARE AFC AND MANUAL.—Switch to AFC. If pattern moves more than half the bandwidth, the afc circuit needs adjustment. If pattern disappears on AFC, either the afc circuit is inoperative or the manual tuning is on the wrong side of the transmitter frequency.

(4) CONTINUE WITH PERFORMANCE CHECK.—Return to paragraph 7. *d.* (2).

8. MEASURING PICKUP HORN SPACE LOSS.

a. Space loss of the pickup horn can be measured by comparison to the loss in a directional coupler. This method can be used only if a directional coupler can be installed in the type of system under test. Once the space loss for a particular type of system is determined, it is unlikely that such a measurement will have to be repeated again for each system of that type, provided that the same horn distance is always used and that the distance chosen is not critical.

b. Connect the Test Set as shown in figure 3–3 and follow steps (1) through (4) of paragraph 7. *b.* Record the DBM dial reading.

c. Connect the Test Set as shown in figure 3–4 and follow steps (1) through (4) of paragraph 7. *b.* Orient the horn for maximum DBM dial reading. Adjust the distance between the antenna and the horn until the least critical convenient spacing is found. Set the power and record the DBM dial reading.

Note

The distance between the antenna and the horn should be from about three to five feet, the best distance depending upon the radar system being tested. At some distance, the coupling is critical to distance, i.e., the coupling varies greatly for small changes in distance. The best position for the horn is at the distance where this effect is minimized.

d. The space loss for the horn and the particular radar system is the difference between the DBM dial readings obtained in steps *b.* and *c.*

e. For reference, the space loss and the corresponding distance should be recorded in the following table.

Radar System	*D*	*H*	*Polarization*	*Space Loss*

D = Horizontal distance between antenna dipole and pick-up horn.
H = Vertical distance from line-of-sight of antenna.

9. MEASURING OUTPUT CABLE ATTENUATION.

If the output cable becomes damaged or has been repaired, the calibration of the cable has probably changed. A new attenuation calibration can be made by the following method:

a. Connect the Test Set as shown in figure 3–3. Follow steps (1) through (4) of paragraph 7. *b.* Record the reading of the DBM dial.

b. By means of a UG-29B/U or a UG-30B/U connector, connect in series an unknown cable similar to the cable used in step *a.*

c. Repeat step *a.*

d. The attenuation of the unknown cable added in step *b.* is equal to the difference between the DBM dial readings obtained in steps *a.* and *c.*

10. ALTERNATE RECEIVER TUNING PROCEDURE.

This c-w procedure does not require an A- or a J-Scope, but it is not as accurate as the procedure of paragraph 6. *k.*

a. PREPARE RADAR AND TEST SET.—Complete the following operations, if not already performed:

Operation	*Paragraph*
Prepare Radar	6. *a.* (1)
Prepare the Test Set	6. *a.* (2)

b. ADJUST RADAR RECEIVER.—Set radar on manual tuning. Set gain high enough to show small amount of noise.

c. PREPARE TEST SET FOR RECV TEST.—Set TEST knob to RECV, DBM knob to about —50 dbm, POWER SET knob near maximum (clockwise) and PHASE knob near mid-position.

d. TUNE RECEIVER TO TRANSMITTER (OR BEACON) FREQUENCY.

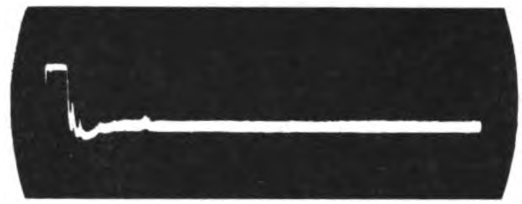
(1) OBTAIN C-W OUTPUT SIGNAL. — Turn SIGNAL WIDTH knob clockwise to CW. Maximize meter reading with PHASE control. Leave TEST knob on RECV and set DBM dial to about —50 dbm.

(2) TUNE TEST SET TO TRANSMITTER (OR BEACON) FREQUENCY.—Adjust SIGNAL FREQ. knob to obtain transmitter (or beacon) frequency, resetting PHASE knob when meter reading drops 10% and checking frequency by using the FREQUENCY control.

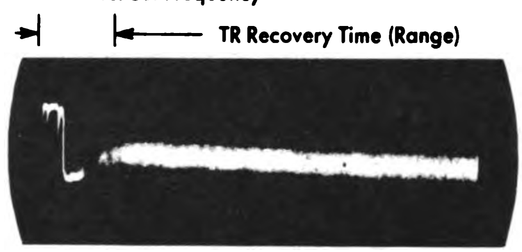
(3) DETUNE RECEIVER LOCAL OSCILLATOR.—Set radar on manual tuning. Set local oscillator at extreme end of tuning range, but on correct side of transmitter (or beacon) frequency. Adjust local oscillator for crystal current.

(4) TUNE RECEIVER TO TEST SET.—Slowly tune receiver local-oscillator mechanical tuning toward center of its range; reset the reflector voltage when crystal current drops and watch for c-w signal on oscilloscope (appearing as intensified range sweep on PPI or B-scope, or as increased noise level on A- or J-scope). *See figure 3–14* for A-scope presentation. Tune mechanical tuner of receiver for maximum c-w signal, increasing setting of DBM attenuator, if necessary, to prevent saturation.

e. ADJUST RADAR R-F COMPONENTS. — Tune TR and ATR boxes for maximum Test Set signal. Adjust DBM attenuator to avoid flat-topped signal while tuning. Adjust crystal current for proper value. Readjust local oscillator, TR, and ATR boxes to compensate for interaction.



A—Receiver Not Tuned to Test Set Frequency



B—Receiver Tuned to Test Set Frequency

Figure 3–14. Receiver Tuning on CW and Alternate Method of Checking TR Recovery

11. ALTERNATE TR RECOVERY CHECK.

The c-w procedure is useful in special cases where the TR recovery time is short and it is not possible to phase the signal all the way into the transmitter pulse.

a. OBTAIN C-W SIGNAL.

(1) Perform the following operations unless already completed:

Operation	*Paragraph*
Prepare Radar	6. *a.* (1)
Prepare Test Set	6. *a.* (2)
Prepare Oscilloscope	6. *a.* (3)

(2) Adjust radar receiver. Leave the Automatic Frequency Control on, if operative. Set gain to show small amount of noise on A-scope or J-scope.

(3) Set the TEST knob to the TEST (dot) position between TRAN and RECV, the DBM knob to about +15 dbm, the POWER SET knob near maximum (clockwise) and the PHASE knob near mid-position.

(4) Turn the SIGNAL WIDTH control to the CW position and adjust the SIGNAL FREQ knob to maximize the amplitude of the noise or grass appearing on the scope. Be sure the frequency meter is detuned.

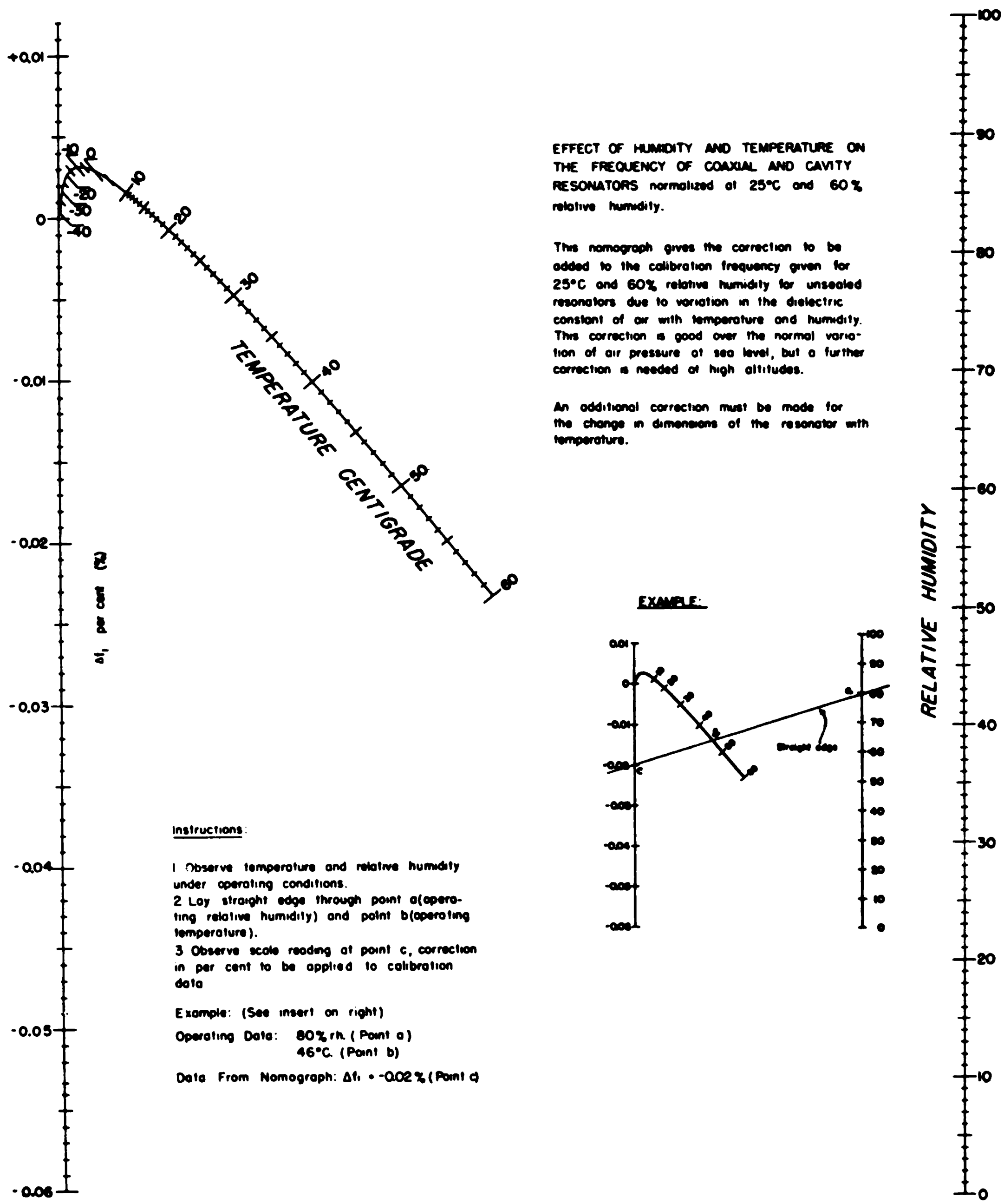


Figure 3–15. Frequency Meter Corrections for Dielectric Changes Due to Temperature and Humidity

b. OBSERVE TR RECOVERY TIME.—*Refer to figure 3–14.* The first portion of the illustration (*figure 3–14A*) shows the scope response before the SIGNAL FREQ control is tuned to obtain the receiver frequency. Figure 3–14B shows the c-w response after the pattern is maximized with the SIGNAL FREQ control. The TR recovery time is indicated on the scope response as that time between the transmitter pulse and the point at which the response first begins to drop off toward the left of the grass.

12. MEASURING AVERAGE TRANSMITTER POWER BELOW +10 DBM.

When transmitter power entering the Test Set is between +1 and +10 dbm, the following procedure may be used (the regular procedure of paragraph 6. *b.* or 7. *b.* is recommended when power entering the Test Set is between +7 dbm and +30 dbm.):

a. CONNECT TEST SET TO RADAR. — Connect Output Cable CG-92A/U (8′-0″) from the RF receptacle to the radar directional coupler (or test horn) as in figure 3–3 (or 3–4). Set TEST knob to TRAN and set DBM knob all the way counterclockwise.

b. TURN ON TEST SET.—Connect 115V AC receptacle to power line with Power Cord CX-377/U (6′-0″). Turn 115V AC switch to ON and wait two minutes.

c. BALANCE METER.—With TEST knob to TRAN and DBM dial full counterclockwise, adjust FINE SET ZERO control until meter pointer is at zero.

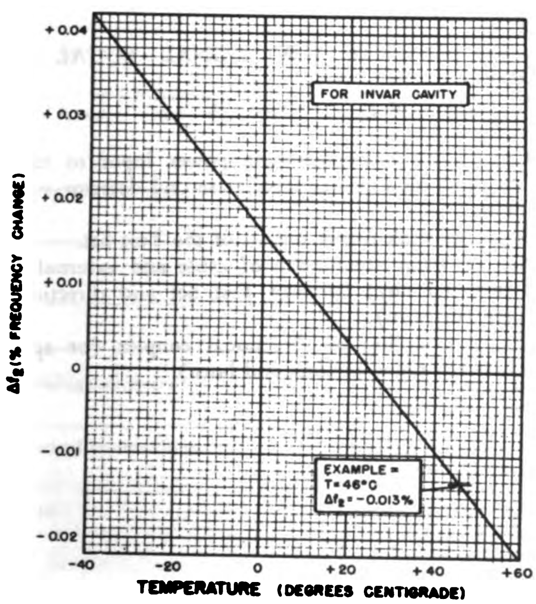


Figure 3–16. Frequency Meter Corrections for Dimensional Changes Due to Temperature

d. SET DBM DIAL.—Turn DBM dial clockwise to end of travel. Then set DBM dial carefully to +10 dbm.

e. OBSERVE POWER.—Read the meter to get power in milliwatts entering the Test Set. The left-hand limit of the scale is zero milliwatts, the mid-scale point is 10 milliwatts, and each major division represents an increase of one milliwatt.

f. CONVERT TO DBM.—Convert power entering the Test Set from milliwatts to dbm by use of figure 3–5.

g. COMPUTE TRANSMITTER AVERAGE POWER.—Compute as follows:

$P_{av(dbm)} = T'_{(dbm)} + A_{(dbm)} + C_{(db)}$

$P_{av(dbm)}$ = Transmitter Average Power (in decibels above one milliwatt).

$T'_{(dbm)}$ = Average r-f power entering the Test Set. Obtained in step *f*.

$A_{(db)}$ = Total attenuation of cable and external attenuators (if any) between Test Set and directional coupler (or horn). An accurate value of db loss is marked on the output cable supplied with the Test Set.

$C_{(db)}$ = Coupling of directional coupler (or space loss between radar antenna and horn).

Example: In step *e*, meter reads four divisions from zero point.

$T' = 4$ milliwatts.

From figure 3–5, $T' = +6$ dbm.

$P_{av(dbm)} = +6 + 4 + 20 = 30$ dbm.

13. TEMPERATURE AND HUMIDITY CORRECTIONS FOR FREQUENCY METER.

(*See figures 3–15 and 3–16.*)

Note

The accurate results which the following corrections produce are seldom necessary in field use except for tuning the beacon local oscillator. Note that the temperature and relative humidity specified refer to the conditions within the frequency-meter cavity. These conditions may differ from those in the external atmosphere.

a. DETERMINE CORRECTION FOR DIELECTRIC CHANGE. (*Use figure 3–15.*)

Example: at 46°C, 80% rh, $\Delta f_1 = -0.02\%$.

b. DETERMINE CORRECTION FOR DIMENSIONAL CHANGE. (*Use figure 3–16.*)

Example: At 46°C, $\Delta f_2 = -0.013\%$.

c. COMBINE CORRECTIONS.—Add Δf_1 and Δf_2 algebraically.

Example: $\Delta f = \Delta f_1 + \Delta f_2 = -0.033\%$.

d. CORRECT FREQUENCY OR DIAL READING.

(1) To correct observed frequency, convert Δf from percent to megacycles and add Δf (mc) to observed frequency.

Example: $\Delta f = -0.033\%$.

FREQUENCY dial reading = 938.2

Observed frequency,

$f_0 = 9382$ mc

$$f = f_0 + (\Delta f) \frac{f_0}{100}$$

$$f = 9382 - 0.033 \times \frac{9382}{100}$$

$$f = 9382 - 3.1 = 9378.9 \text{ mc}$$

(2) To correct desired frequency dial setting, convert Δf from percent to megacycles and subtract Δf(mc) from nominal dial reading.

Example: f = Frequency desired = 9310 mc.

$$\frac{f_0}{10} = \text{FREQUENCY dial reading}$$

$f_0 = f - \Delta f$

$\Delta f = -3.1$ mc

$f_0 = 9310 - (-3.1) = 9310 + 3.1$

$f = 9313.1$ mc

$$\text{FREQUENCY dial reading} = \frac{f_0}{10} = \frac{9313}{10} = 931.3$$

14. MEASURING C-W SIGNAL EQUAL TO NOISE.

Note

The c-w signal equal to noise is a measure of receiver sensitivity used in bench testing. It is related to but not equal to the receiver performance figure (minimum discernible signal power) used in field measurements.

a. CONNECT METER TO SECOND DETECTOR.—Connect a high-impedance electronic voltmeter between ground and the cathode of the second detector tube of the radar receiver.

b. CALIBRATE SECOND DETECTOR.

(1) OBTAIN CALIBRATED C-W SIGNAL.—Complete the following operations, if not already performed:

Operation	*Paragraph*
Prepare Radar, Test Set and Oscilloscope...	6. *f.* (1)
Adjust Radar Receiver	6. *f.* (2)
Tune Test Set to Receiver	6. *f.* (3)
Check Meter Balance	6. *f.* (4)
Find Signal Again	6. *f.* (5)
Set Signal Power on CW.................	6. *f.* (6)

(2) ADJUST RECEIVER GAIN.—Turn receiver gain down and then increase gain until meter deflection starts to increase.

(3) CALIBRATE SECOND DETECTOR.—Turn DBM dial in one-db steps, recording DBM dial reading and corresponding voltmeter reading at second detector cathode. Plot DBM dial reading against meter deflection on graph paper to get calibration curve of meter reading vs. db. As an approximation, this calibration may be assumed a constant for units of the same type radar.

c. SET NOISE LEVEL.—With Test Set DBM dial set to maximum attenuation, turn receiver gain to a convenient level (less than half of saturation) and observe second-detector meter reading.

d. MEASURE C-W SIGNAL EQUAL TO NOISE.

(1) COMPUTE DESIRED METER READING.—From the calibration curve obtained in paragraph 14. *b.* (3) determine the meter reading corresponding to 3 db above the noise level reading obtained in paragraph 14. *c.*

(2) RESTORE C-W SIGNAL.—Adjust DBM dial to restore c-w signal obtained in paragraph 14. *b.* (1).

(3) SET C-W SIGNAL TO EQUAL NOISE.—Adjust DBM knob until meter reading computed in paragraph 14. *d.* (1) is obtained. Observe DBM dial reading.

(4) COMPUTE C-W SIGNAL EQUAL TO NOISE.

$$P_{ncw(dbm)} = M_{(dbm)} - A_{(db)} - C_{(db)}$$

where:

$P_{ncw(dbm)}$ = Continuous-wave power input to radar which produces a power level at second detector equal to noise.

$M_{(dbm)}$ = Peak power output of the Test Set.

$A_{(db)}$ = Total attenuation of cable and external attenuators (if any) between Test Set and directional coupler (or horn).

$C_{(db)}$ = Coupling of directional coupler (or space loss between radar antenna and horn).

SECTION 4

PREVENTIVE AND CORRECTIVE MAINTENANCE

1. ROUTINE CHECK.

The Test Set can be checked occasionally to insure that it is in operating condition by running through the performance test indicated in Section 3, paragraph 3.

2. PERIODIC MAINTENANCE CHECK CHART.

Note

The attention of maintenance personnel is invited to the requirements of Chapter 67 of the Bureau of Ships Manual, of the latest issue.

The following table contains a list of the recommended checks to be made on the Test Set after the indicated periods of time:

3. LUBRICATION.

No lubrication is required to keep the Test Set in proper operating condition.

4. FAILURE REPORTS.

A failure report must be filled out any time a defective part is replaced in the Test Set. Instructions for filling them out are given on page 4–0.

5. THEORY OF LOCALIZATION.

Whenever trouble arises in a unit, the faulty part can be quickly located if the observed symptoms point to a particular stage or circuit. In general, more than one stage or circuit can be suspect, hence simple and

TABLE 4–1. PERIODIC MAINTENANCE CHECK CHART

WHAT TO CHECK	HOW TO CHECK	PRECAUTIONS
	WEEKLY	
1. Power cord, r-f and video cables.	Inspect for worn spots, loose plugs, cuts, kinks, or bruises. Repair or replace, if necessary. (See figures 4-11 and 4-12.)	Disconnect both ends of all cords or cables before inspecting.
2. Panel Controls	See that all control knobs are tight on shafts.	
3. Spare Fuses	Be sure there are two good fuses in the spare fuse holders in the upper left corner of the front panel.	Replace only with type 3AG, 2 amps, 250 volts.
	QUARTERLY	
1. Fastening hardware	Check for and tighten all loose chassis and frame screws, nuts, etc.	Be sure power cord is disconnected from power source.
2. Electrical connections.	Inspect internal wiring and tighten screws on terminal boards.	See preceding precaution.
3. Tubes	Check all tubes and replace those in faulty condition. However, do *not* replace the tubes periodically. Be sure the tube is faulty before replacing it. If the "new tube substitute method" is used to isolate trouble, be sure to return tube to set for continued operation if it proves to be good. Do not leave new tube in operation.	

direct checks should be made to eliminate properly operating circuits from the suspect list. As an example, suppose that the Test Set does not trigger properly when r-f pulses of sufficient level are applied to it. If a video trigger is applied to the EXT MOD-TRIGGER IN jack with S102 on INT F-M and the Test Set then functions normally, the logical place to look for a faulty part would be in the V107 amplifier stage (*see figure 4–13*). As a rule, tubes in malfunctioning circuits should be checked first. After a trouble has been localized, voltage and resistance measurements will usually point out the faulty part.

6. TROUBLE SHOOTING AND REPAIR.

a. GENERAL.—Because the Test Set is a calibrated measuring instrument, corrective maintenance is necessarily limited to trouble shooting in the electrical circuits and to replacement of complete assemblies in the plumbing. At all times maintenance personnel must take care to avoid disturbing the fixed adjustments on any calibrated assembly. If calibration of any part is changed, then the only practical procedure is to replace the entire assembly with a spare calibrated assembly.

b. REPLACEMENT OF FUSES.—The only fused circuit in the Test Set is the primary line of the main power transformer. Two of the five spare fuses provided with the Test Set are located in fuse holders adjacent to the two main fuse holders. They are type 3AG fuses rated at 2 amps, 250 volts.

WARNING

Never replace a fuse with one of higher rating unless continued operation of the equipment is more important than probable damage. If a fuse burns out immediately after replacement, do not replace it a second time until the cause has been corrected.

c. REPLACEMENT OF TUBES.

(1) The inside of the Test Set is made accessible for the replacement of tubes by releasing the four snap-slide fasteners which attach the control panel to the cabinet. These fasteners are marked A in figure 4–1.

(2) Carefully slide the chassis assembly out of the cabinet. Avoid bumping components against the flange in the top of the cabinet.

(3) With one exception, V104, all tubes are easily accessible and can be removed and replaced in the usual manner. The rectifier tube, V101, and the regulator control tube, V102, are held in place by clamps which buckle around the bases of the tubes.

(4) To replace the test-oscillator tube, V104, (*see figures 2–6 and 4–2*) proceed as follows:

(*a*) Release the retainer clip and remove the cover of the tube-mount assembly.

(*b*) Disconnect the cap of the test-oscillator tube.

(*c*) Remove the collar which secures the SIGNAL FREQ. knob shaft (*figure 2–6*).

(*d*) Pull out the SIGNAL FREQ. knob shaft so that the coupling end of the shaft disengages from the tuning nut on the oscillator tube (V104).

(*e*) Depress one side of the flat clamp spring at the tube base and carefully pull the oscillator tube from its socket.

(*f*) Insert a new tube in the socket. The output probe of the tube fits into the enlarged pin hole (pin 4) in the socket. See that the tube is pressed all the way into the socket.

(*g*) Push in the SIGNAL FREQ. knob with a twisting motion until the shaft coupling engages the tuning nut on the tube.

(*h*) Replace the collar removed in step (*c*).

(*i*) Replace the tube cap connection.

(*j*) Replace the tube-mount cover, and secure it in place with the retainer clip.

d. MAINTENANCE TEST EQUIPMENT REQUIRED.—For ordinary circuit trouble-shooting, the only piece of test equipment required is a Simpson Model 260 Multimeter. However, in order to perform the calibration procedures described in paragraph 7 of this section, the following equipments (or equivalent) will be needed:

(1) Microline* Model 555 Klystron Signal Source with a 2K29 Klystron.

(2) Microline Model 123B Wattmeter Bridge.

(3) Microline Model 219C Thermistor Mount.

(4) PRD Model 195 Precision Calibrated Attenuator.

(5) Microline Model 152A Variable-Pad Attenuator.

(6) Microline Model 178 Variable Susceptance Transformer.

(7) Model TSX-4SE Spectrum Analyzer.

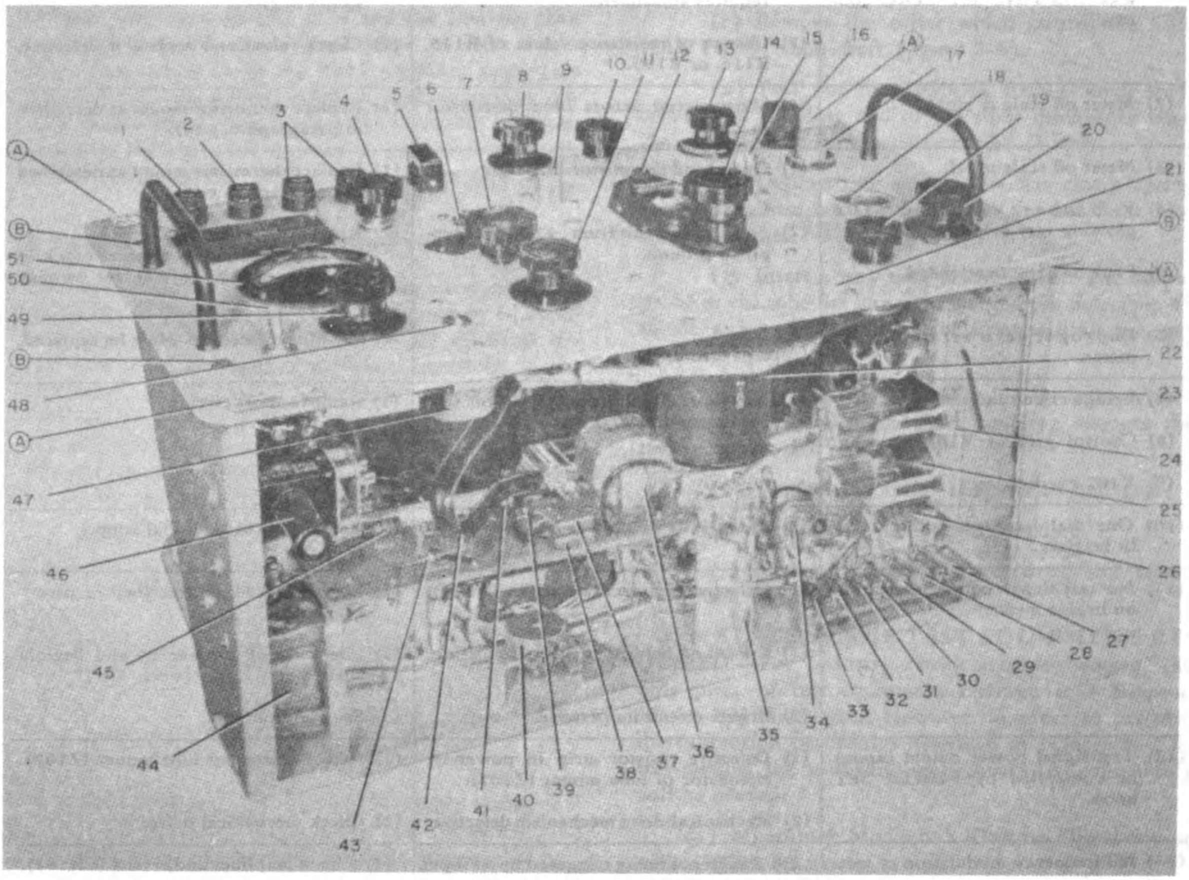
e. TROUBLE SHOOTING TABLE.—The following table indicates some of the probable troubles with suggested possible remedies. In any case, the table serves as a guide for localizing defective or improperly operating circuits. For checking circuits or taking voltage measurements, allow a few minutes warmup after the Test Set has been turned on.

*Reg. U.S. Pat. Off.

TABLE 4-2. TROUBLE SHOOTING CHART

SYMPTOM	PROBABLE CAUSE	REMEDY
(1) Meter cannot be balanced by means of FINE SET ZERO control.	(1) COARSE SET ZERO control (R124) requires adjustment.	(1) Adjust R124 as described in paragraph 6. g.(1).
	(2) Change of resistance values of R115, R116, or R119.	(2) Check values and replace if defective.
(2) Meter off scale to right.	(1) Short circuit across bead thermistor in Z109.	(1) Replace thermistor mount as described in paragraph 6. g.(4).
(3) Meter off scale to left.	(1) Open bead thermistor in Z109.	(1) Replace thermistor mount as described in paragraph 6. g.(4).
(4) V-R tubes, V105 and V106 glowing very brightly. (5) F101 or F102 overloaded. (6) Improper zero set on bridge meter.	(2) Any short circuit from +300-volt supply to ground.	(2) Remove short circuit. (a) Check polyiron terminal block in tube mount (Z107) for voltage breakdown. (b) Meter defective. Must be replaced.
(7) Bridge circuit inoperative. (8) Control grid of V103 glowing. (9) V102 overheating.	(1) Any short circuit from −210-volt supply to ground.	(1) Remove short circuit.
(10) One dial lamp out. other lamp lit brightly.	(1) Either I101 or I102 is burned out.	(1) Replace burned-out dial lamp.
(11) No test-signal output indication on bridge meter.	(1) Defective test-oscillator tube (V104).	(1) Replace V104 as described in paragraph 6. c.
	(2) R-F cut-off held fast in closed position.	(2) Check cut-off mechanism and flexible shaft.
	(3) Bridge circuit inoperative.	(3) See symptom (7).
(12) Test-signal power output cannot be controlled by POWER SET knob.	(1) Defective resistor strip in power-set attenuator of tube mount (Z107).	(1) Repair or replace tube mount (Z107).
	(2) Mechanical-drive mechanism defective.	(2) Check mechanical drive.
(13) No frequency modulation of test-signal output.	(1) Sweep not being triggered by r-f input.	(1) Check amplifier and crystal (CR101).
	(a) Transmitter output weak.	(a) Check transmitter output power.
	(b) Defective crystal (CR101).	(b) Replace CR101.
	(c) Weak amplifier tube.	(c) Replace V107 and V108.
	(d) Defective blocking-oscillator.	(d) Replace T102.
	(2) Sweep not being triggered by video trigger (IFF).	(2) Check amplifier.
	(a) Lack of or weak trigger voltage source.	(a) Check trigger source.
	(b) Weak amplifier tube.	(b) Replace V108.
	(3) Test-oscillator circuit faulty.	(3) Check SIGNAL WIDTH potentiometer (R137) and capacitors C107 and C114.
(14) Test-oscillator signals on A-scope appear jittery.	(1) Ripple present at reflector of test-oscillator tube (V104).	(1) Check filter of −210-volt section of power supply.
	(2) Weak triggering of sweep generator.	(2) Check crystal (CR101) and amplifier.
	(3) Multiple triggering of sweep generator.	(3) Check trigger source; check R134 and R135; switch radar system under test to new repetition rate.

f. CIRCUIT COMPONENTS. — Figures 4–1, 4–2, 4–3, 4–4, 4–5 and 4–6 point out the various components of the Test Set for quick identification in trouble shooting and repair. Note, as shown in figure 4–2, that the cover plate must be removed to make the amplifier components accessible. Also note that the bottom gusset



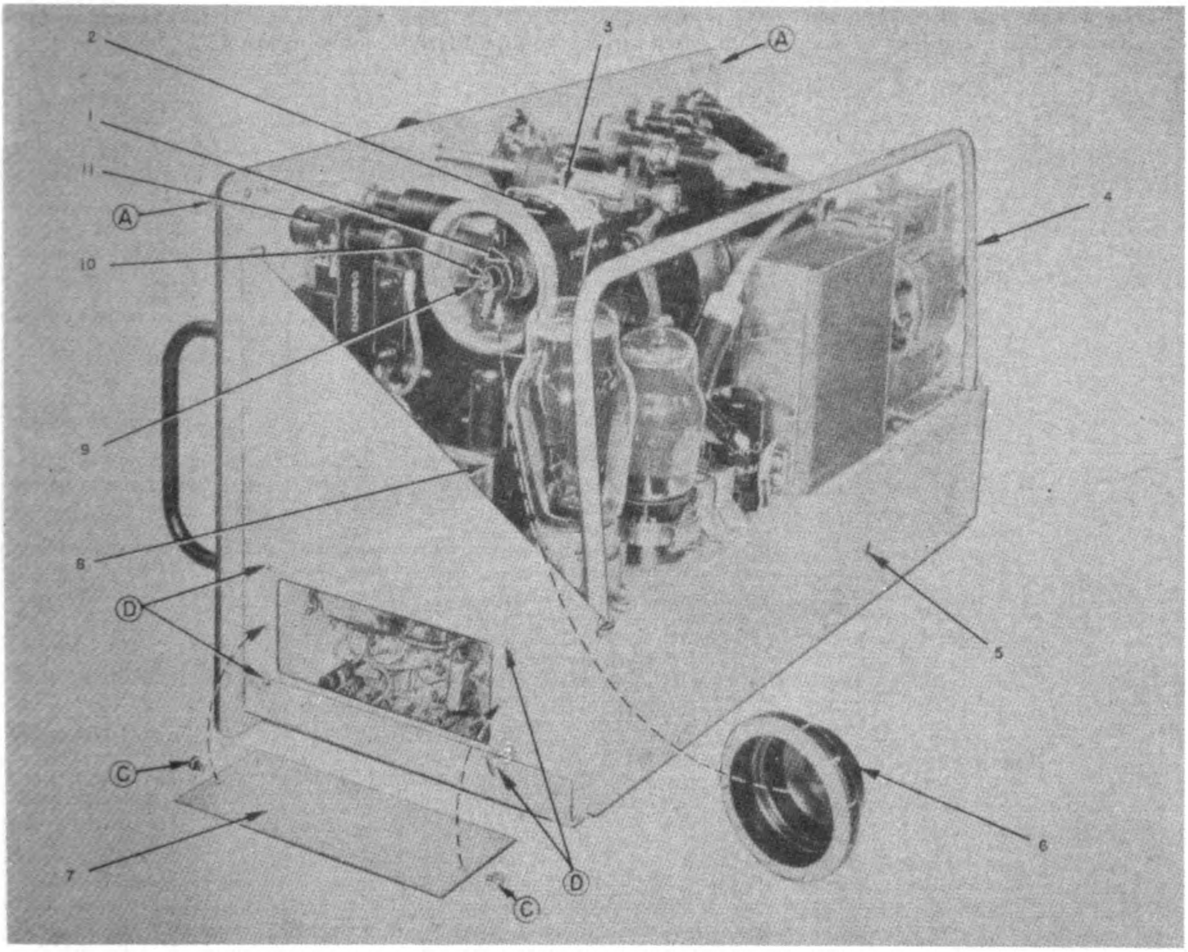
1 Fuse F101
2 Fuse F102
3 SPARE Fuses
4 MOD AMP Control Knob
5 TEST Knob
6 Lamp I101
7 DBM Attenuator Adjustment
8 INT-FM EXT MOD Switch
9 EXT MOD-TRIGGER IN Receptacle
10 POWER SET Attenuator Control
11 SIGNAL WIDTH Control Knob
12 Lamp I102
13 SIGNAL FREQ. Control Knob
14 FREQUENCY-Meter Tuning Knob
15 PULSE ANALYZER Receptacle
16 CRYSTAL Retainer Cap
17 RF Receptacle
18 115V AC Recessed Plug
19 Frequency-Meter Fine Control
20 PHASE Control Knob
21 Calibration Curve
22 Frequency-Meter Assembly Z106
23 Amplifier Unit
24 Amplifier and Blocking Oscillator Tube V108
25 Amplifier Tube V107
26 Tube Rocket XV101
27 Resistor R115
28 Resistor R116
29 Resistor R119
30 Resistor R121
31 Resistor R122
32 Resistor R138
33 Resistor R141
34 Tube Socket XV102
35 Resistor R139
36 Reactor L102
37 Capacitor C104
38 Capacitor C105
39 Resistor R113
40 Sweep Adjust Potentiometer R142
41 Resistor R144
42 Capacitor C103
43 Resistor R104
44 Reactor L101
45 Resistor R143
46 Spare Thermistor Mount Z109
47 Coarse Meter Balance Control Potentiometer R124
48 Removable Cap for COARSE Meter Balance Control
49 FINE METER BALANCE Control Knob
50 115V ON-OFF Switch S101
51 Thermistor Bridge Current Meter M101
A Dust Cover Fasteners
B Panel Mounting Screws

Figure 4-1. Test Set Chassis — Bottom-Front View plate (*see figure* 4–7) must be removed to permit access to chassis components. A voltage and resistance chart is shown in figure 4–8 to facilitate circuit checking inside the Test Set chassis. Wiring diagrams covering the complete Test Set are shown in figures 4–9 and 4–10.

g. REPAIR.

(1) ELECTRICAL ADJUSTMENTS. — The Test Set contains only two adjustments which can be made by operating personnel without danger of changing the Test Set calibration. No other adjustments should be attempted in the field.

(*a*) COARSE SET ZERO POTENTIOMETER, R124.—The purpose of this adjustment is to set the range of the FINE SET ZERO control so that meter balance can always be attained. The COARSE SET ZERO potentiometer shaft is accessible through a front-panel adjustment port located just above the word COARSE. A removable cap covers the port. (*See figure 4–1.*)



1 Test Oscillator V104
2 Tube-Mount Assembly Z107
3 Retainer Clip
4 Chassis Guard Rail
5 Access Hole (R142) Sweep Adjustment
6 Tube-Mount Cover
7 Amplifier-Unit Cover Plate
8 Thermistor-Mount Assembly Z109
9 Connector
10 Reflector Cap
11 R-F Output and Detector Section Z103
A Cover Fasteners
C Cover Plate Mounting Screws
D Amplifier Mounting Screws

Figure 4-2. Test Set Chassis
Right-End View — Amplifier Unit Cover Plate Removed

1. Turn on the Test Set and allow about five minutes for warm up.

2. Set the TEST knob to TRAN.

3. Set the FINE SET ZERO control to the middle of its range (white index mark up).

4. Remove adjustment port cap and adjust the COARSE control potentiometer with a screwdriver until the meter is set at half scale.

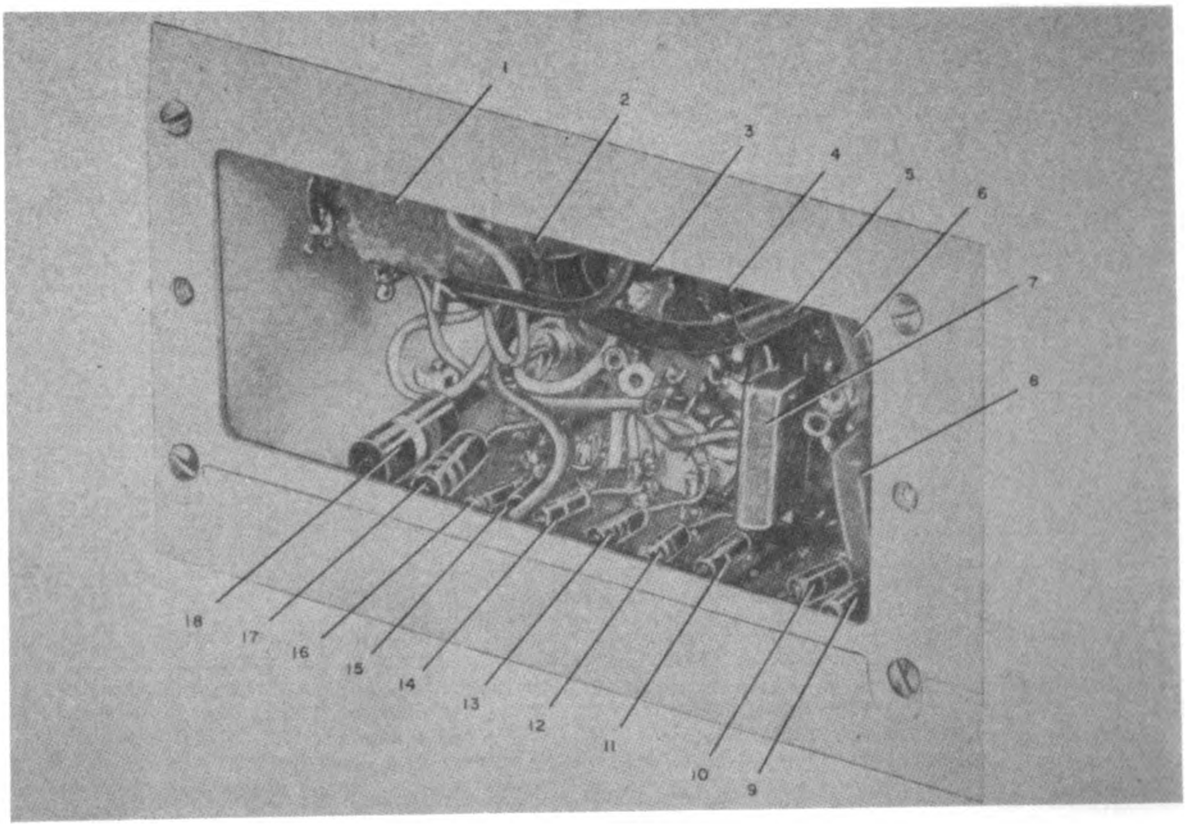
5. Replace port cap when COARSE control is set so that adjustment of FINE SET ZERO control permits pointer to cover the entire meter scale.

(*b*) SWEEP ADJUST POTENTIOMETER, R142.—The purpose of potentiometer R142 is to adjust the linearity, slope, and peak of the sawtooth sweep for the oscillator tube. The potentiometer shaft is accessible through the adjustment port on the rear of the chassis (item 5 in figure 4–2 and item 12 in figure 4–5). The Test Set must be removed from its dust cover for this adjustment.

1. Connect an oscilloscope (Type TS-34A/AP or equivalent) to the reflector of V104. Trigger both the Test Set and the start-stop sweep of the oscilloscope together with a suitable trigger source.

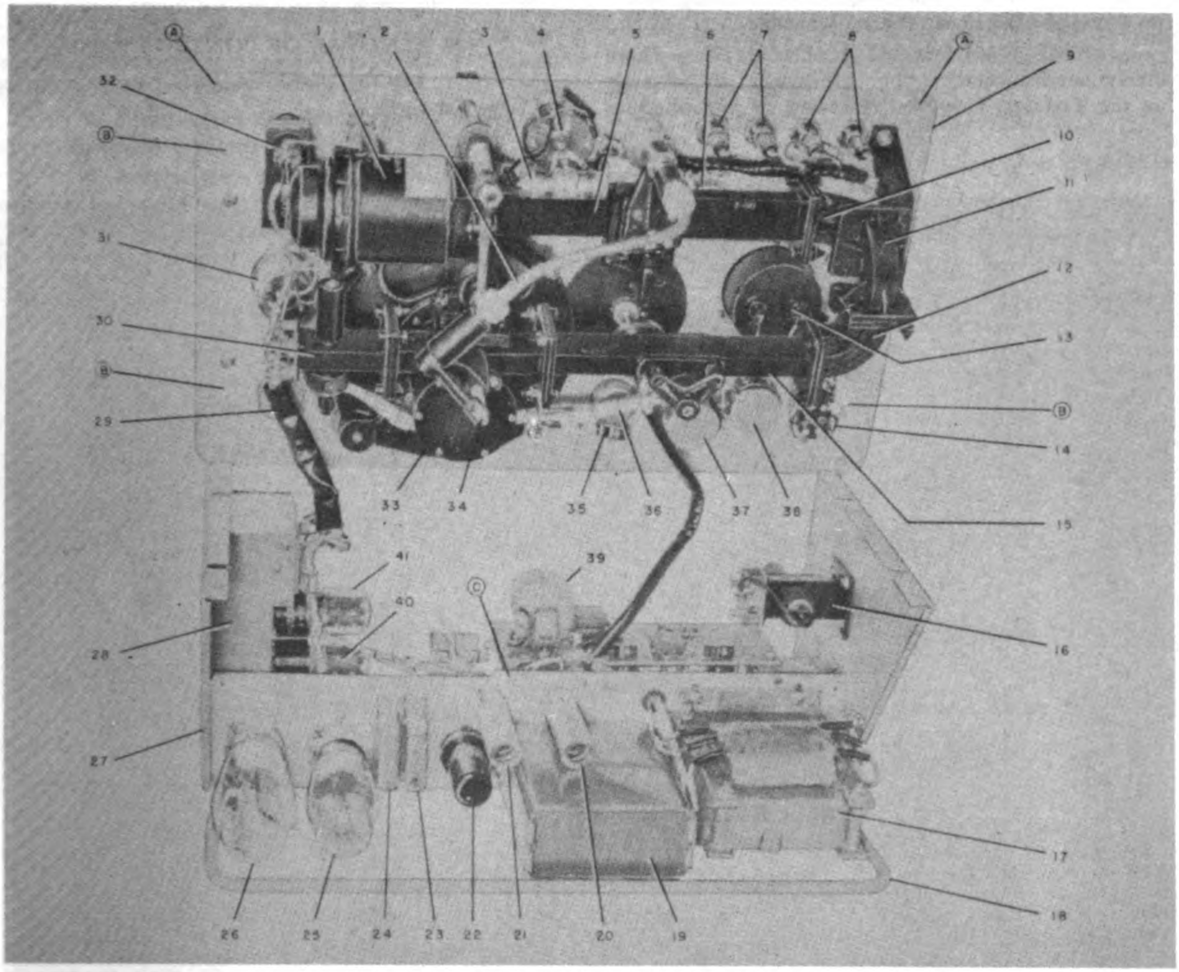
2. Turn on the Test Set and allow a few minutes for warm up.

3. Set the SIGNAL WIDTH control to MIN and the PHASE control to MAX.



1 Transformer T102
2 Capacitor C111
3 Capacitor C115
4 Capacitor C113
5 Capacitor C112
6 Capacitor C108
7 Capacitor C110
8 Capacitor C109
9 Resistor R126
10 Resistor R128
11 Resistor R129
12 Resistor R127
13 Resistor R135
14 Resistor R131
15 Resistor R133
16 Resistor R132
17 Resistor R130
18 Resistor R134

Figure 4-3. Amplifier Unit Close-Up View of Inner Components



1 Tube-Mount Assembly Z107
2 Flexible Shaft
3 Capacitor C116
4 Switch S102
5 Step Attenuator Z101
6 Mod Amp Potentiometer R111
7 Spare Fuses
8 Fuses F101 and F102
9 Control Panel
10 E-Bend Section Z104
11 H-Bend Section Z104
12 E-Bend Section Z104
13 Bridge Meter M101
14 Switch S101
15 DBM Attenuator Z105
16 Spare Thermistor Mount Z109
17 Power Transformer T101
18 Chassis Guard Rail
19 Capacitor C101
20 V-R Tube V106
21 V-R Tube V105
22 Vacuum Tube V103
23 Capacitor C106
24 Capacitor C102
25 Regulator Control Tube V102
26 Rectifier Tube V101
27 Power Supply Chassis
28 Amplifier Unit
29 Phase Potentiometer R112
30 Thermistor Mount Z109
31 115V AC Plug J101
32 R-F Output and Detector Section Z103
33 Frequency-Meter Assembly Z106
34 R-F Cutoff
35 Resistor R110
36 Signal Width Potentiometer R137
37 Meter Balance Potentiometer R123
38 Coarse-CW Potentiometer R124
39 Reactor L102
40 Blocking-Oscillator Tube V107
41 Amplifier and Sawtooth Generator V108
A Cover Fasteners
B For Front Panel Retaining Screw
C For Plumbing Retaining Screw

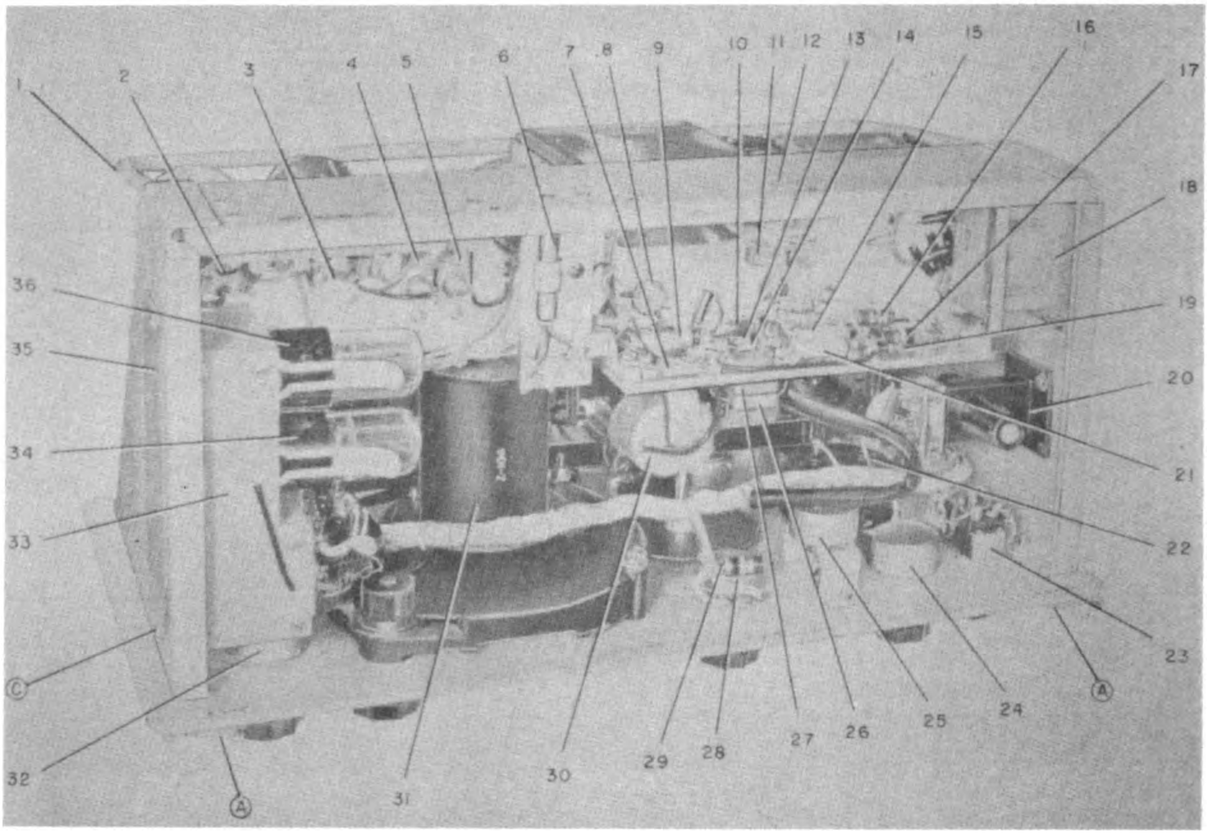
Figure 4-4. Test Set Chassis
Top View — Control Panel Detached

4. With a screwdriver, set the SWEEP ADJUST potentiometer so that the sawtooth voltage reaches 100 volts at 50 microseconds. This setting should produce the most linear sweep obtainable.

(2) MECHANICAL ADJUSTMENTS. — There are no mechanical operating adjustments to be made on the Test Set. However, removing or disconnecting certain assemblies will, in some cases, facilitate part replacement and repair. The procedures are indicated in the following paragraphs.

(*a*) REMOVAL OF CONTROL PANEL.

1. Lay the chassis assembly bottom down on a large flat surface.



1 Chassis Guard Rail
2 Socket XV101
3 Socket XV102
4 Capacitor C102
5 Capacitor C106
6 Resistor R139
7 Capacitor C114
8 Socket XV106
9 Capacitor C107
10 Capacitor C101
11 Resistor R106
12 Resistor R142
13 Resistor R114
14 Resistor R109
15 Resistor R107
16 Resistor R125
17 Resistor R102
18 Filter Choke L101
19 Resistor R105
20 Spare Thermistor Mount Z109
21 Resistor R108
22 Bridge Meter M101
23 115V AC Switch S101
24 Fine Meter Balance Potentiometer R123
25 Coarse Meter Balance Potentiometer R124
26 Capacitor C104
27 Capacitor C105
28 Resistor R137
29 Resistor R110
30 Pulse Transformer L102
31 Frequency-Meter Assembly Z106
32 Phase Potentiometer R112
33 Amplifier Unit
34 Tube V108
35 Amplifier Cover Plate
36 Tube V107
A Dust Cover Fastener
C Cover-Plate Mounting Screw
E Access Hole to Sweep Adjustment R142

Figure 4-5. Test Set Chassis Bottom-Rear View

2. Remove the calibration curve and holder from the front panel by taking out the four corner screws which retain the curve and holder.

3. Remove the four screws which secure the front panel to the bottom gusset plate (figure 4–7 points out the gusset plate).

4. Remove the four front-panel attaching screws marked B in figure 4–1.

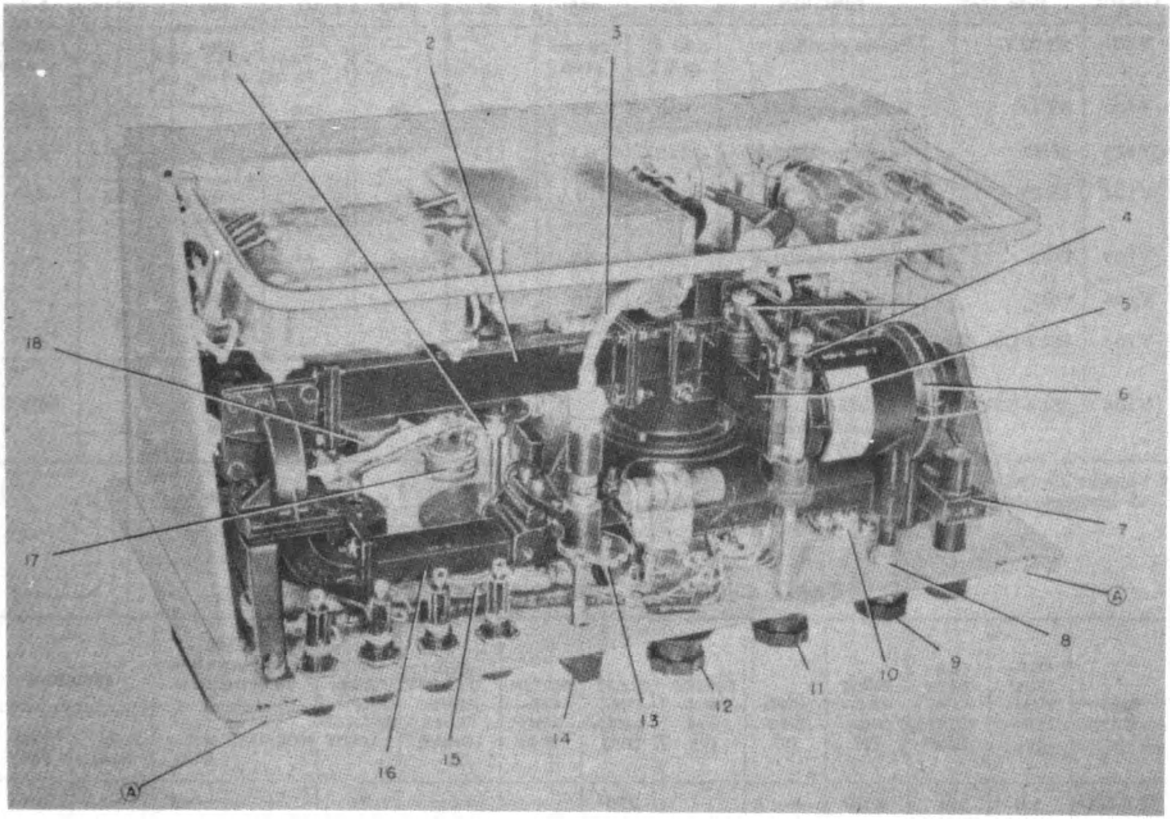
5. Remove the screw which attaches the plumbing-support bracket at the center of the power-supply chassis (refer to C of figure 4–4). The bracket is located at the frequency-meter-to-DBM-attenuator joint.

6. Allow the control panel to fold out and down onto the bench. Avoid pulling or entangling the laced cable which connects panel components to the chassis. If handled properly, the cable is long enough to separate the panel and chassis sufficiently to make parts readily accessible.

(*b*) REMOVAL OF AMPLIFIER UNIT.

1. Remove the amplifier-unit cover plate. (*See figure 4–2.*)

2. Remove the four amplifier mounting screws marked D in figure 4–2.



1 Dbm Attenuator Cam
2 Dbm Attenuator
3 R-F Cutoff Flexible Drive Shaft
4 Power Set Attenuator Lever
5 Power Set Attenuator
6 Tube-Mount Assembly Z107
7 R-F Output and Detector
8 Section Z103
8 Collar
9 SIGNAL FREQ. Knob
10 PULSE ANALYZER Receptacle
11 POWER SET Knob
12 INT-FM-EXT MOD Switch
13 Step Attenuator
14 TEST Knob
15 Mod Amp Potentiometer
16 Step Attenuator
17 Signal Width Potentiometer
18 Coarse Meter Balance Potentiometer
A Cover Fastener

Figure 4-6. Test Set Chassis Top — Rear View

3. The unit can now be moved away from the chassis for repair. If it is desirable to remove the unit entirely, unsolder the five wires which connect to the small square terminal board on the amplifier.

(3) COMPONENT CHARACTERISTICS.

(*a*) ELECTRON TUBES.—The electron tubes used in the Test Set are neither critical in operation nor must they be carefully chosen from good tubes of the same type. Good tubes from general stock may be used for all replacements. Table 4–3 shows the operating voltages and currents for the tubes used in the Test Set. Table 4–4 lists typical characteristics of these tubes.

Note

All tubes of a given type supplied with the equipment shall be consumed prior to employment of tubes from general stock.

TABLE 4–3. TUBE OPERATING VOLTAGES AND CURRENTS*

SYMBOL	TUBE TYPE	FUNCTION	PLATE (E)	PLATE (MA)	SCREEN (E)	SCREEN (MA)	SUPP. (E)	CATH. (E)	GRID (E)	HEATER (E) A-C
V101	5R4GY	Power rectifier	850 AC to CT	20 per plate	—	—	—	680	—	5.0
V102	6Y6-G	Voltage regulator	680	40	680	40	300	300	225	6.3
V103	6SH7	Regulator amplifier	225	0.2	172	.08	0	0	−5.7	6.3
V104	2K25	Oscillator	−57 to −182	0	—	—	—	0	300	6.3
V105	OB2	Voltage regulator	0	20	—	—	—	−105	—	—
V106	OB2	Voltage regulator	−105	20	—	—	—	−210	—	—
V107	6SL7-GT, (A)	Amplifier	230	2	—	—	—	2	0	6.3
	(B)		180	3.3	—	—	—	0	−0.3	—
V108	6SL7-GT, (A)	Amplifier	225	2	—	—	—	2	0	6.3
	(B)	Sawtooth generator	0 to 300	0	—	—	—	18	0	—

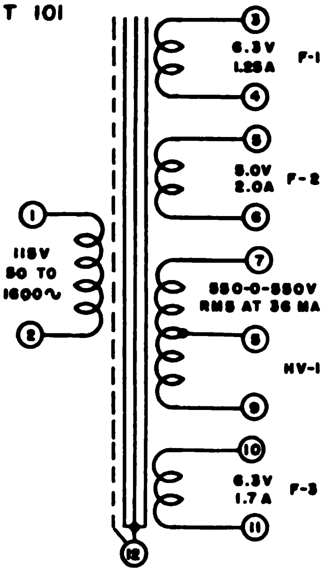
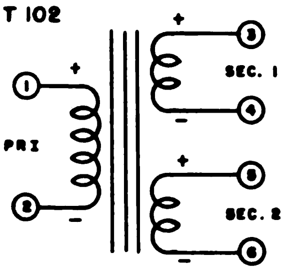
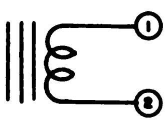
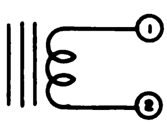
* Voltages are DC to ground unless otherwise specified.
All readings taken with a Simpson Model 260 Multimeter.

TABLE 4–4. RATED TUBE CHARACTERISTICS

TUBE TYPE	FILAMENT VOLTAGE (V)	FILAMENT CURRENT (AMP)	PLATE VOLTAGE (V)	GRID BIAS (V)	SCREEN VOLTAGE (V)	PLATE CURRENT (MA)	SCREEN CURRENT (MA)	A-C PLATE RESISTANCE (OHMS)	VOLTAGE AMPLIFICATION FACTOR	TRANSCONDUCTANCE (MICROMHOS) NORMAL	MINIMUM	EMISSION IS (MA)	TEST VOLT
5R4-GY	5.0	2.0	850[1]	—	—	250[2]	—	—	—	—	—	—	—
6Y6-G	6.3	1.25	200	−14.0	135	61.0	2.2	18,300	—	7100	5800	150	25
6SH7	6.3	0.3	250	− 1.0	150	10.8	4.1	900,000	—	4900	4000	95	20
2K25[3]	6.3	0.44	300[4]	—	—	22[5]	—	—	—	—	—	—	—
OB2		Regulation must not exceed 2 volts between min (5 ma) and max (30 ma) plate current.											
6SL7-GT	6.3	0.3	250	−2.0	—	2.3	—	44,000	70	1600	1200	40	30

[1] A-C volts per plate with choke-input filter.
[2] Output current.
[3] Reflector voltage range: −20 to −300 volts.
[4] Beam voltage.
[5] Beam current.

TABLE 4-5. WINDING DATA

DESIG-NATION SYMBOL	DIAGRAM	WINDING	WIRE SIZE	TURNS	D-C RESIS-TANCE IN OHMS	IMPED-ANCE RATIO	HIPOT A-C VOLTS	REMARKS
T 101		Primary	#22	365 ±2	3.8	—	1500	—
		Fil. No. 1	#22	22	.35	—	1500	—
		Fil. No. 2	#21	18	.25	—	1500	—
		HV. No. 1	#37	6000	2600	—	2750	—
		Fil. No. 3	2 x #24	22	.35	—	1500	—
T 102		Primary	#33	90	2.32	—	1000	—
		Sec. No. 1	#33	90	2.46	1	1000	—
		Sec. No. 2	#38	135	12.4	2.25	1000	—
L 101		Single	#37	2208 ±10	430	—	2500	8 Henries at 10V Rms, 120 Cps, 45 Ma Dc.
L 102		Single	#33	2960 ±15	230	—	1780	6 Henries at 10V Rms, 1000 Cps, (No Dc).

(*b*) WINDING DATA.—Table 4–5 provides data on the transformers and choke coils used in the Test Set.

(4) PART REPLACEMENT WITH SUPPLIED SPARES.

(*a*) GENERAL.—Parts of the Test Set which can be most easily damaged are supplied as spares within the operating-spares container located in the cover. The complete set of spares supplied with each Test Set is listed in Section 1, paragraph 2. *g*. The following replacements can be made by maintenance personnel.

(*b*) GASKETS.—Nine gaskets for use in waveguide gasket-flange joints are supplied in the operating spares. These gaskets are to be used as replacements whenever gaskets are found to be corroded or damaged in disassembly of the plumbing system.

(*c*) THERMISTOR MOUNT.—A spare thermistor mount with matched compensating resistor is furnished with each Test Set. The spare unit is attached to the left side panel near the bottom of the chassis. (*See Z-109 in figures 4–1 and 4–4.*) Replacement is accomplished by unsoldering the terminal-board connections on the unit in the Test Set, and removing it from the waveguide assembly after loosening the four self-locking nuts on the flange joint. Attach the spare thermistor mount and resolder the connections to the terminal board. The thermistor bridge must be rebalanced each time this replacement is made.

(*d*) FUSES.—In addition to the two fuses in the spare fuse holders on the front panel, three spare fuses are supplied with the operating spares.

(*e*) CRYSTALS.—Two 1N23B silicon rectifier crystals are supplied to replace the trigger detector crystal in the RF output section. The detector crystal is replaced by removing the knurled cap marked CRYSTAL on the control panel and inserting a new crystal cartridge into the cap.

(*f*) LAMPS.—Three 3.0-volt panel lamps are supplied to replace the lamps used to illuminate the DBM and FREQUENCY dials on the control panel. The dial lamps in use are removable from the front of the control panel. *See figure 4–1.*

7. CALIBRATION PROCEDURES.

a. Power-In Calibration

(1) The following pieces of test equipment (or equivalent) are required for making this calibration:

(*a*) Microline Model 555 Klystron Signal Source with 2K29 Klystron

(*b*) Microline Model 123B Wattmeter Bridge

(*c*) Microline Model 219C Thermistor Mount

(*d*) PRD Model 195 Precision Calibrated Attenuator

(*e*) Microline Model 152A Variable Pad Attenuator

(*f*) Microline Model 178 Variable Susceptance Transformer

(2) After the various equipments have been connected as indicated in figure 4–14 (*a*) turn them on and allow a 20-minute warm-up period.

(3) Turn the function selector knob on the TS-147B/UP to the TRAN position and set the DBM dial to +7 dbm.

(4) Turn the calibrated attenuator to maximum attenuation and zero the power meter on the TS-147B/UP.

(5) Adjust the calibrated attenuator to zero db.

(6) Set the signal source to 8500 mc, determining this frequency by using the frequency meter in the test set.

(7) Tune the susceptance transformer for maximum indication on the test set meter.

(8) Set the calibrated attenuator at its maximum value and recheck the zero on the test set.

(9) Turn the calibrated attenuator back to its zero position.

(10) Obtain a 1-mw indication on the test-set meter by adjusting the variable-pad attenuator.

(11) Disconnect the TS-147B/UP from the calibration setup and connect the thermistor mount.

Note

Special care should be exercised in the transition not to disturb the position of the input coaxial cable to the TS-147B/UP (if one is used). If the cable is moved, its attenuation value will change and the subsequent reading will be in error.

(12) Set the wattmeter bridge to the 1-mw range and adjust the calibrated attenuator to obtain a deflection on the bridge meter of approximately three-quarters scale.

(13) Tune the susceptance transformer to obtain maximum indication on the wattmeter.

(14) Set the calibrated attenuator to its maximum value and zero the wattmeter.

(15) Adjust the calibrated attenuator to obtain a 1-mw deflection on the wattmeter.

(16) Read the dial indication on the calibrated attenuator and convert the reading to its equivalent db value. This value represents the correction to be added algebraically to test set readings at the applicable frequency. Perform this procedure also for frequencies of 9080 and 9600 mc.

b. Power-Out Calibration

(1) For this calibration test the following test equipments (or equivalent) are needed:

(*a*) Microline Model 123B Wattmeter Bridge

(*b*) Microline Model 219C Thermistor Mount

(*c*) Microline Model 178 Variable Susceptance Transformer

(2) Arrange the equipment as shown in figure 4-14 (*b*). Allow a 20-minute warm-up period.

Note

Do not use any connecting devices (such as r-f cable) which introduce external attenuation. It will be necessary, however, to use an adapter between the test set and the susceptance transformer.

(3) Switch the range knob on the wattmeter bridge to the 0.1-mw scale.

(4) Turn the function selector on the test set to the TRAN position.

(5) Rotate the DBM dial to maximum attenuation and zero the power meter on the test set.

(6) Set the function-selector knob to the TEST position.

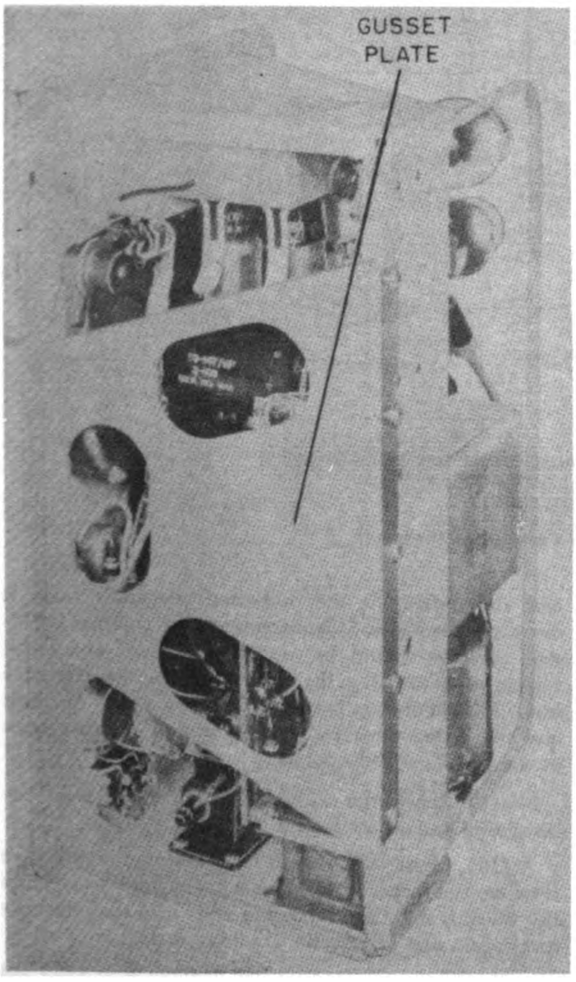


Figure 4-7. Test Set Chassis—Bottom View with Gusset Plate Attached

(7) Turn the test-set local oscillator to 8500 mc.

(8) Peak the reading on the test-set power meter using the PHASE control to obtain this peak at the highest mode of oscillation.

(9) Rotate the DBM dial clockwise to obtain half-scale deflection on the wattmeter-bridge indicator.

(10) Tune the susceptance transformer for maximum indication on the wattmeter bridge.

(11) Turn the DBM attenuator fully counterclockwise to maximum attenuation.

(12) Switch the test-set function selector to the TRAN position.

(13) Zero the test-set power meter.

(14) Switch the function selector to the TEST position.

(15) Use the POWER-SET control on the test set to obtain a 1-mw reading on the TS-147B/UP power meter.

(16) Zero the external wattmeter bridge and then adjust the test-set DBM dial to obtain full-scale deflection on the wattmeter bridge.

(17) Read the DBM dial. The difference between +10 dbm and the dial reading represents the test set correction at 8500 mc. Perform this test also for frequencies of 9080 and 9600 mc.

c. Relative-Error Calibration

(1) The following test equipments (or equivalent) are required for this procedure:

(*a*) Model TSX-4SE Spectrum Analyzer

(*b*) PRD Precision Calibrated Attenuator Model 195

(2) Arrange the equipments as indicated in figure 4-14 (*c*) and allow a 20-minute warm-up period.

(3) Set DBM dial on test set to —10 dbm and turn function selector to the TEST position.

(4) Tune TS-147B/UP output signal to 8500 mc.

(5) Turn POWER-SET control to maximum (fully clockwise).

(6) Set dial reading of calibrated attenuator to approximately 100.

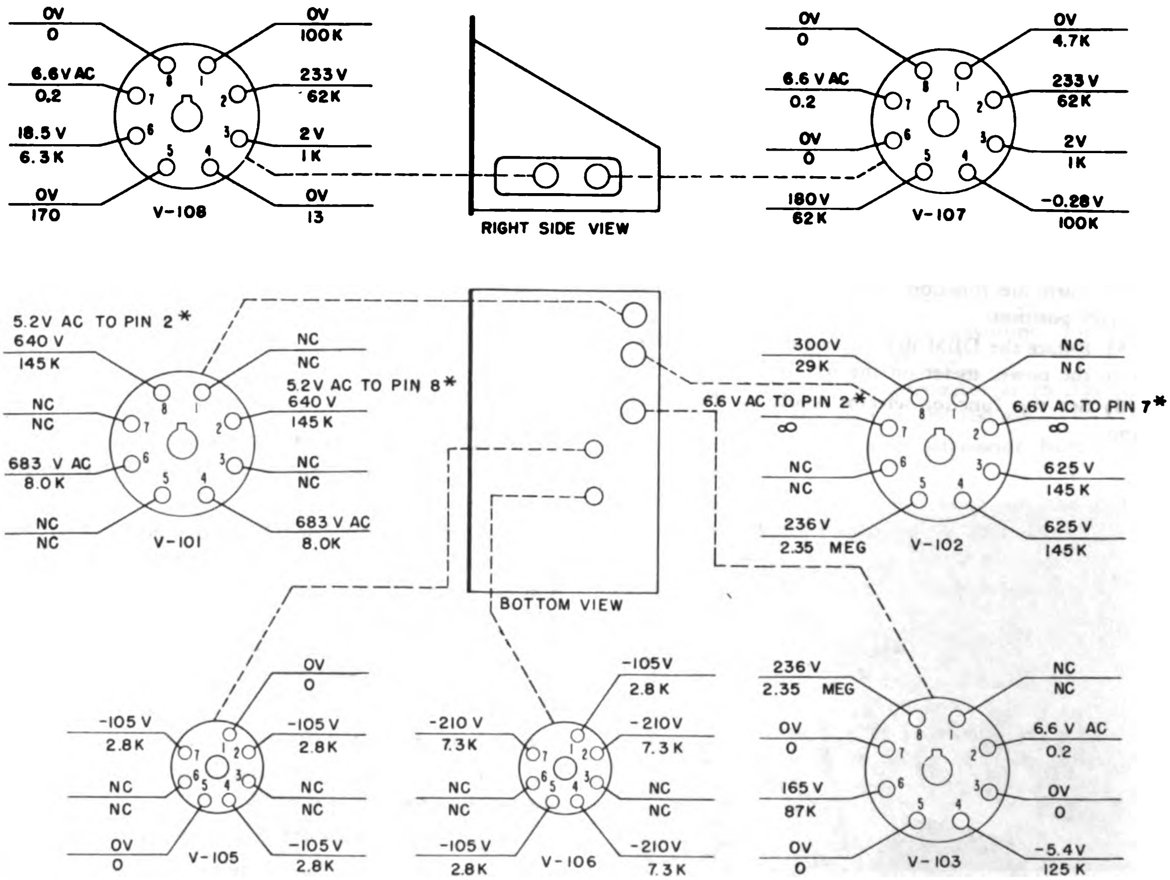
(7) Tune spectrum analyzer so that signal from TS-147B/UP appears on scope.

(8) Peak signal on scope by using the analyzer controls.

(9) Set calibrated attenuator to introduce 40-db attenuation.

(10) Peak the test-set signal on the scope using the analyzer controls and then set the pattern to a convenient amplitude (such as 20 squares) using the analyzer gain control.

(11) Turn the test-set function selector to RECV.



NOTE:

READINGS TAKEN WITH ALL CONTROLS CLOCKWISE.
READINGS TAKEN WITH REFERENCE TO GROUND EXCEPT WHERE OTHERWISE INDICATED (*).
RESISTANCES IN OHMS, VOLTAGES DC UNLESS INDICATED OTHERWISE.
ALL READINGS TAKEN WITH A SIMPSON MODEL 260 MULTIMETER.

Figure 4—8. Voltage and Resistance Diagram

(12) Reduce setting of calibrated attenuator until test signal returns to reference level on scope. The difference between the db indication of the calibrated attenuator and 35 db represents the DBM dial correction at the operating frequency

(13 Return the test-set function selector to TEST and reset the calibrator attenuator to —40 db.

(14) Check the test-set signal level on the scope and adjust the analyzer controls, if necessary, to bring the level to the reference point.

(15) Check the DBM dial to be sure it is set at —10 dbm.

(16) Set the calibrated attenuator to —35 db.

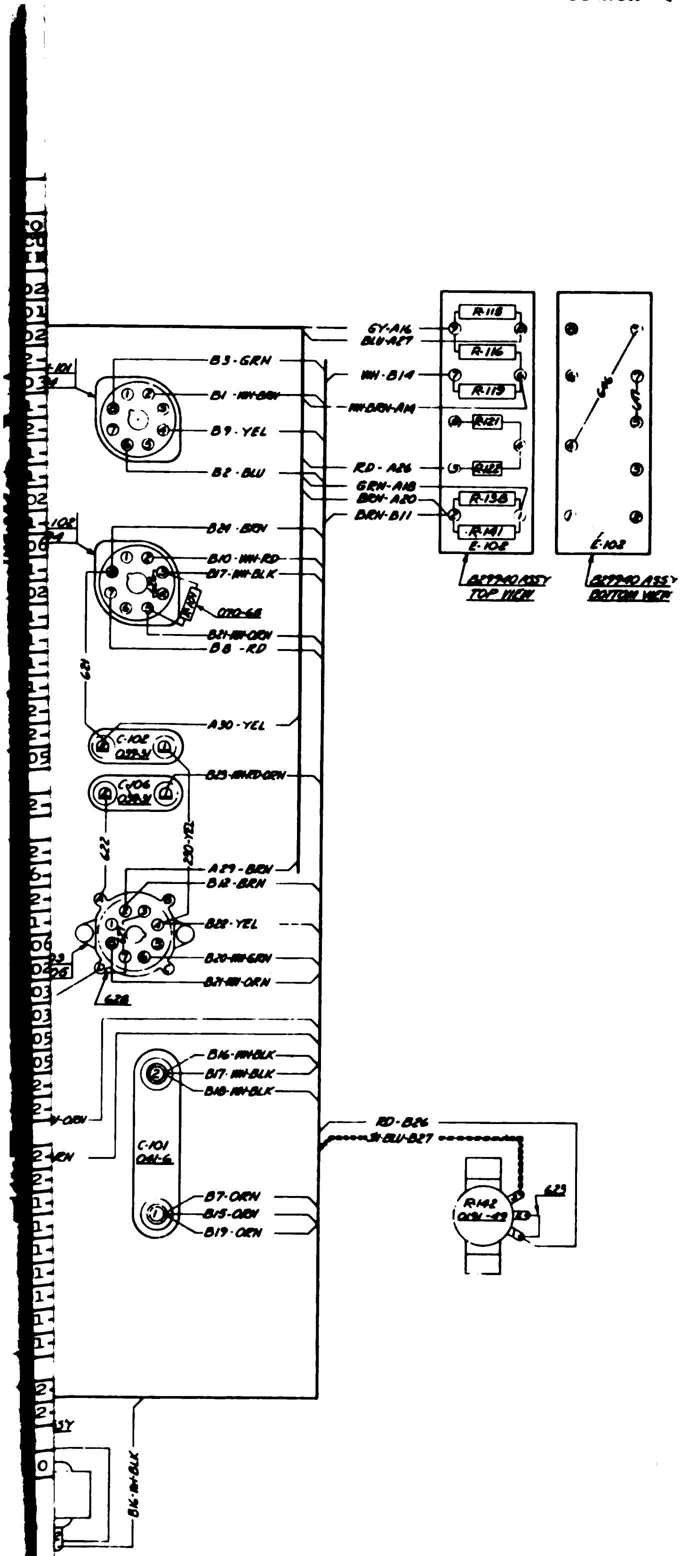
(17) Turn the DBM dial counterclockwise until the signal returns to the reference level on the scope.

(18) Read the attenuation directly from the DBM dial and record. As the calibrated attenuator value is decreased further in 5-db increments, the nominal DBM-dial readings should be —15, —20, —25, and —30, respectively, to bring the signal back to the reference level. The differences between the nominal dial readings and the actual dial readings represent the corrections at the particular 5-db points.

(19) Return the calibrated attenuator to the —40-db setting and adjust the DBM dial to —10 db.

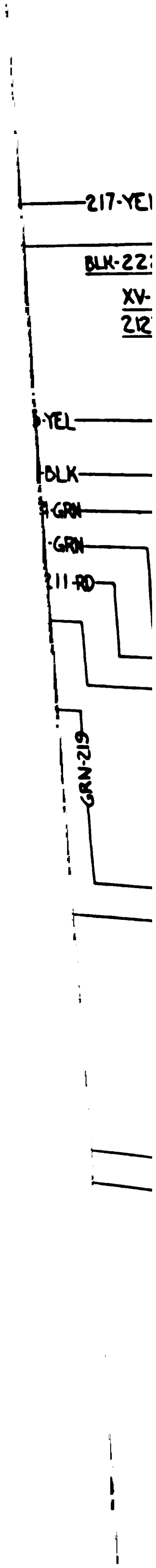
(20) Check the —40-db level against the reference level on the scope. If the signal has drifted away from this level, it will be necessary to reset it to the reference level again and to take the readings again.

(21) Repeat the entire test through step (20) for the two other calibration frequencies of 9080 and 9600 mc.



and Control Panel—Wiring Diagram

387708 O - 56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BLK-22
XV-
212
YEL
BLK
GRN
GRN
211-RD
GRN-219

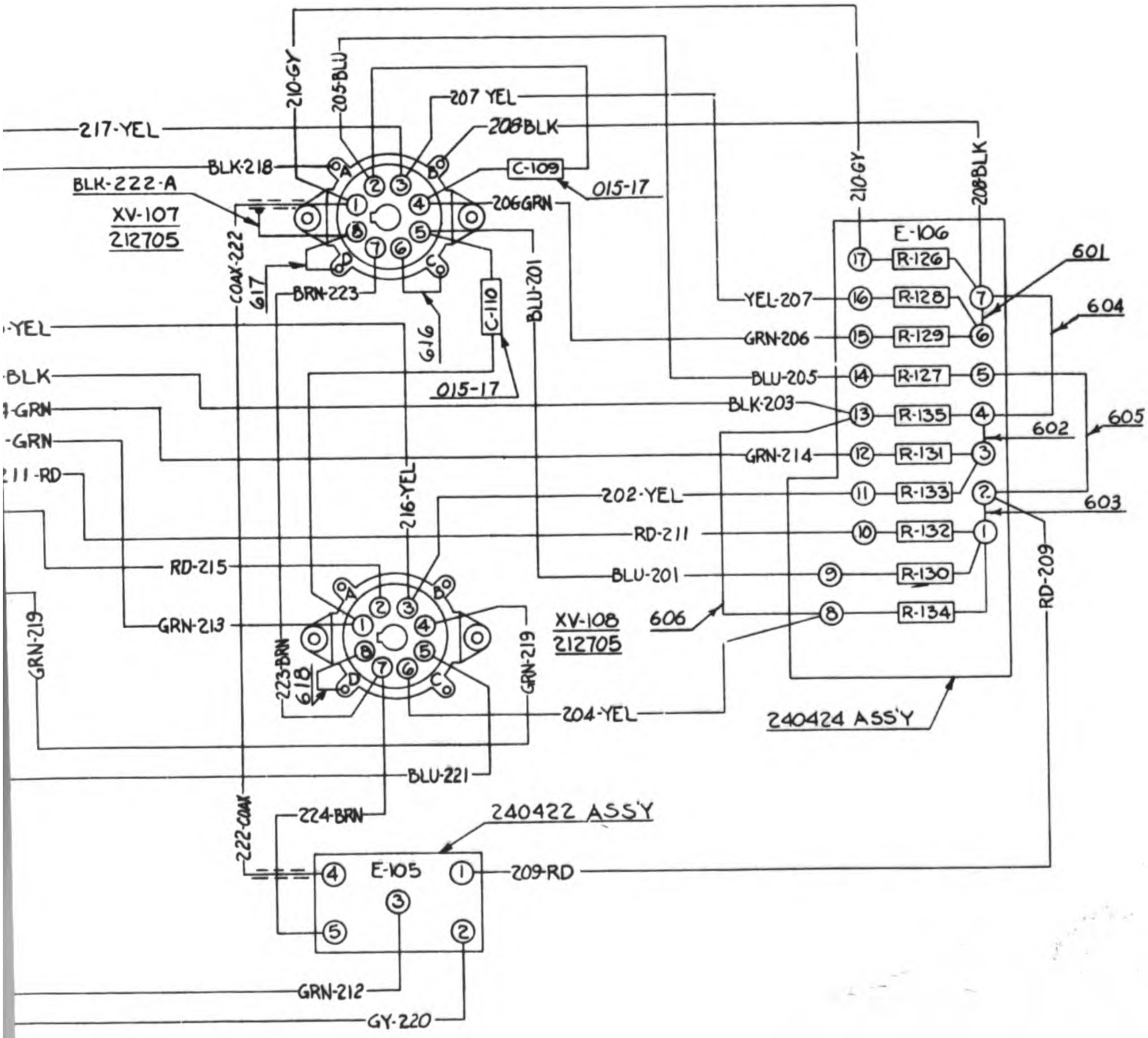

Figure 4-10. Amplifier Unit—Wiring Diagram

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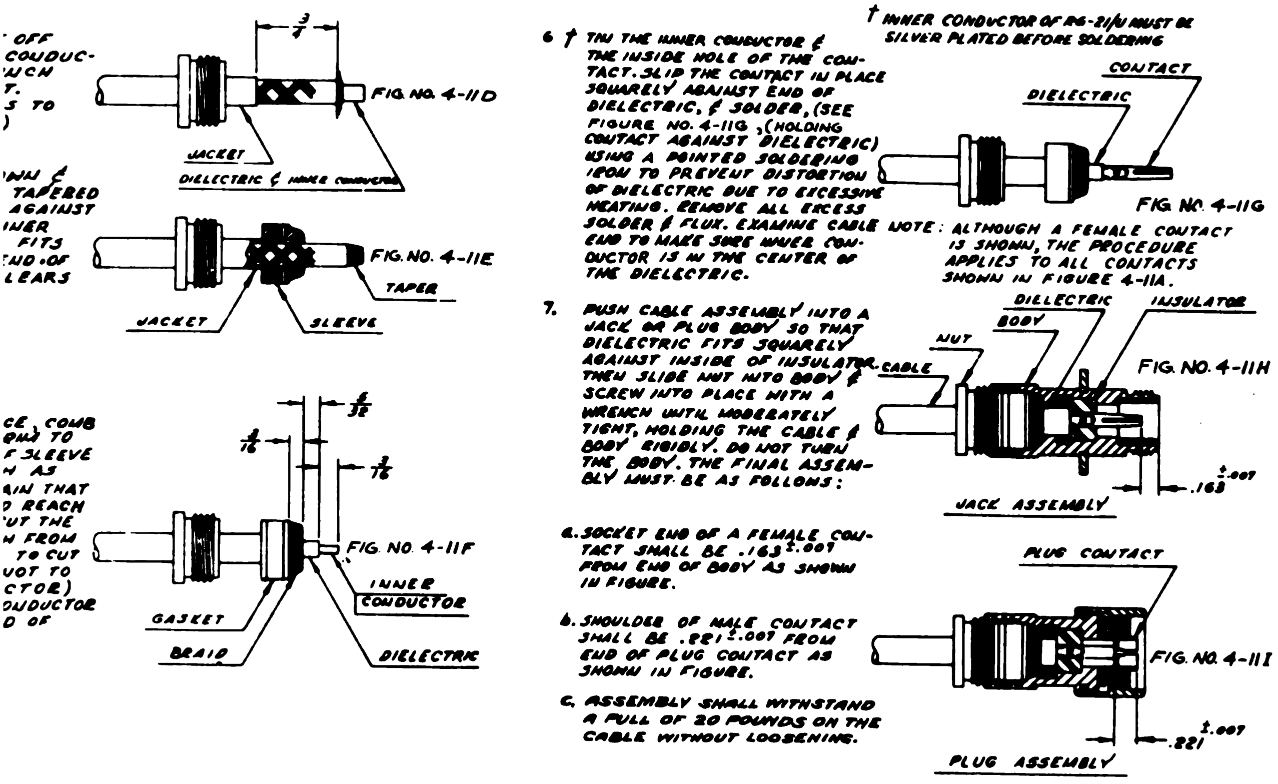

Figure 4–11. Output Cable CG–9ZA/U (8'-0")—Fabrication Notes

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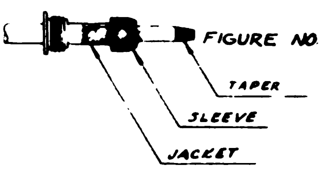

FIGURE NO. 4-12E

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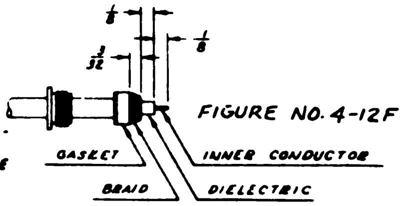

FIGURE NO. 4-12F

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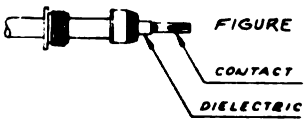


FIGURE NO. 4-12G

NOTE: ALTHOUGH A .090 DIA. FEMALE CONTACT IS SHOWN, THE PROCEDURE APPLIES TO ALL CONTACTS SHOWN IN FIG. NO. 4-12A.

7. PUSH CABLE ASSEMBLY INTO A JACK OR PLUG BODY SO THAT DIELECTRIC FITS SQUARELY AGAINST INSIDE OF INSULATOR. THEN SLIDE NUT INTO BODY & SCREW INTO PLACE WITH A WRENCH UNTIL MODERATELY TIGHT, HOLDING THE CABLE & BODY RIGIDLY. DO NOT TURN THE BODY. THE FINAL ASSEMBLY MUST BE AS FOLLOWS:

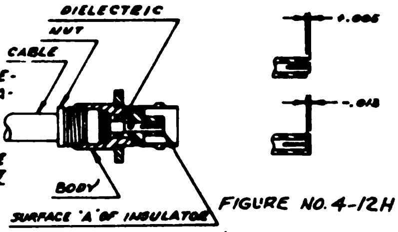


FIGURE NO. 4-12H

JACK ASSEMBLY

a. SOCKET END OF A FEMALE CONTACT (.090 OR .125 DIA.) SHALL BE FLUSH (+.005, -.013) WITH SURFACE "A" OF INSULATOR AS SHOWN IN FIGURE 4-12H.

b. SHOULDER OF AN .090 DIA. MALE CONTACT SHALL BE .816 ±.009 FROM SURFACE "A" OF INSULATOR, AS SHOWN IN FIGURE 4-12I.

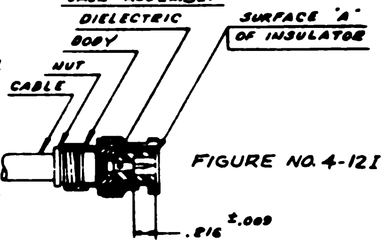
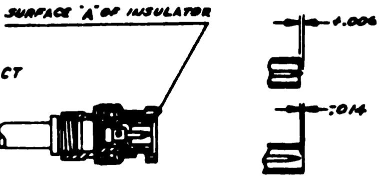


FIGURE NO. 4-12I

PLUG ASSEMBLY (.090 DIA. CONTACT)

c. POINT OF .125 DIA. MALE CONTACT SHALL BE FLUSH (+.005, -.014) WITH SURFACE "A" OF INSULATOR AS SHOWN IN FIGURE 4-12J.

d. ASSEMBLY SHALL WITHSTAND A PULL OF 10 POUNDS ON THE CABLE WITHOUT LOOSENING.

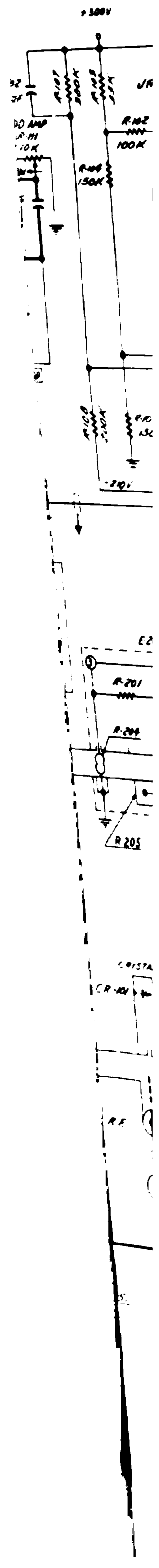


PLUG ASSEMBLY (.125 DIA. CONTACT)

FIGURE NO. 4-12J

Figure 4–12. Video Cable (BNC) CG–409B/U (6'-0")—Fabrication Notes

387708 O - 56


+300V
R-102
100K
150K
R-201
R-204
R 205
CR-101
R.F.

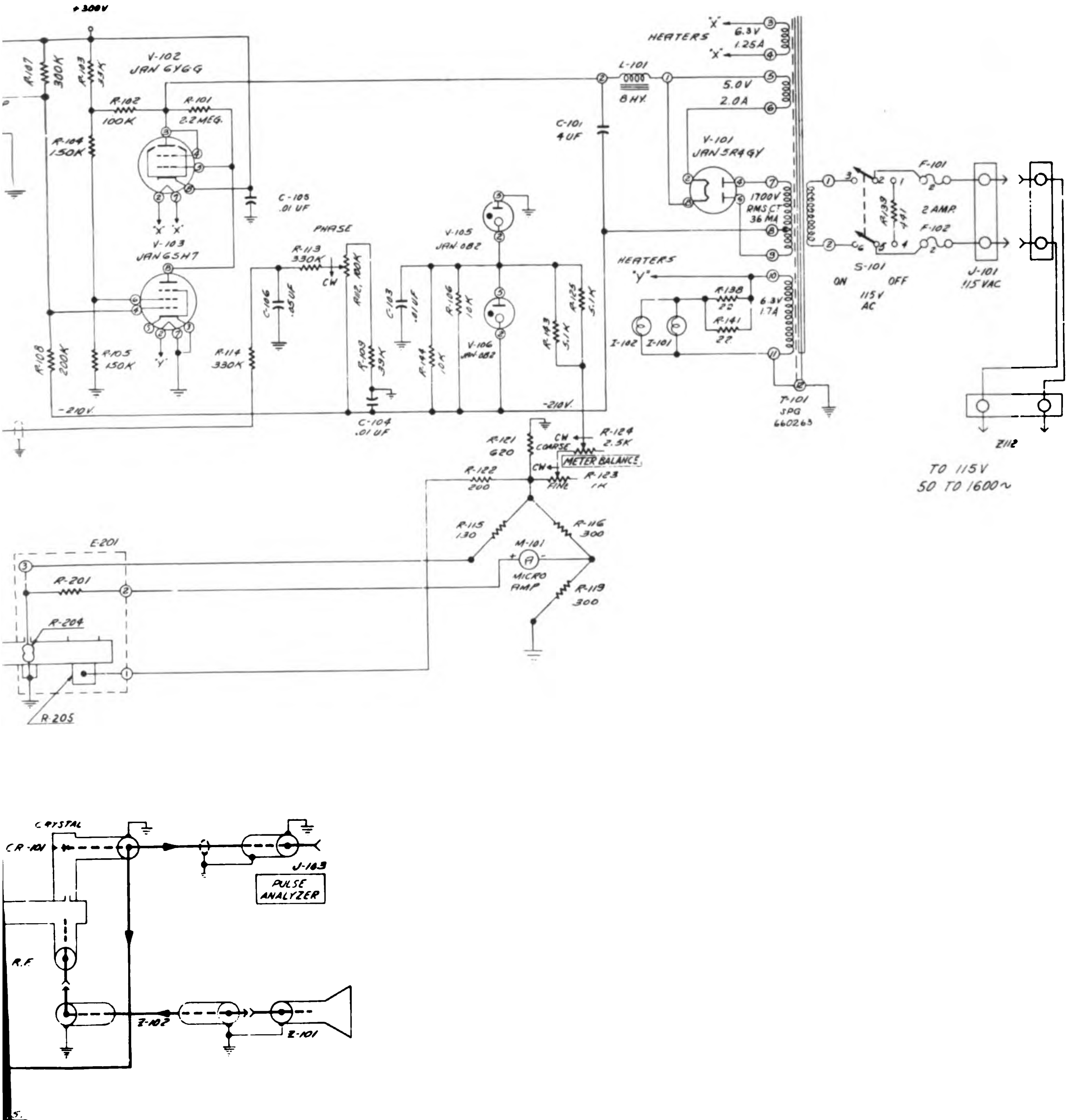


Figure 4-13. TS-147B/UP Test Set—Schematic Diagram

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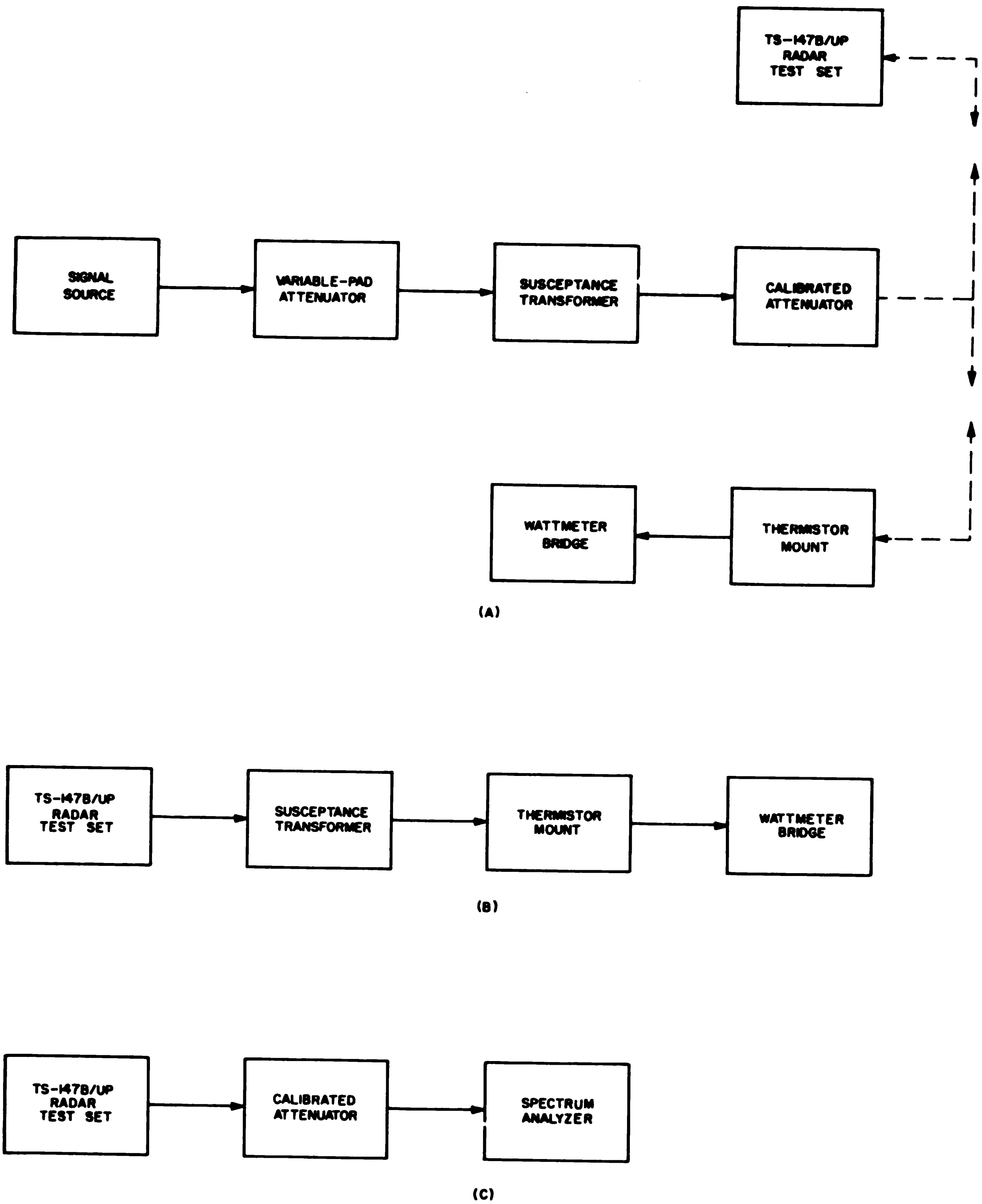


Figure 4–14. Test Set-Ups for Calibration Procedures

SECTION 5

PARTS LISTS

TABLE 5–1. WEIGHTS AND DIMENSIONS OF SPARE PARTS BOXES

Information Not Available

TABLE 5–2. SHIPPING WEIGHTS AND DIMENSIONS OF SPARE PARTS BOXES

Information Not Available

TABLE 5–3. LIST OF MAJOR UNITS

SYMBOL GROUP	QTY	NAME OF MAJOR UNIT	TYPE DESIGNATION
101 thru 199 and R201, R204, R205	1	Radar Test Set	TS-147B/UP

TABLE 5-4. TABLE OF REPLACEABLE PARTS

REF DESIG	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	FUNCTION	MFR AND MFRS DESIG	CONTRS DWG AND PART NO.	ALL SYMBOL DESIG INVOLVED
C-101	— — N16-C-49982-1098 — —	CAPACITOR, FIXED, PAPER DIELECTRIC: 1 section; 4.0 mf, ±20%, −10% tolerance; 1500 v DC working voltage; hermetically sealed metal case; case dim., excluding terminals, 4.0 in. lg, 1-3/4 in. wide, 4-7/8 in. high; 2 solder lug type terminals, located on top; mineral oil impregnated; mineral oil filled; no internal ground connections; bracket mounted w/four 0.190 in.-32 thd mounting studs spaced 5/8 in. apart C to C; resistant to humidity and corrosion; spec. no. JAN-C-25	Power Supply Filter	AEV CP70B1EH405V	041-6	C-101
C-102	3DA50-233 N16-C-44257-2900 3330-316163390	CAPACITOR, FIXED, PAPER DIELECTRIC: 1 section; 50,000 mmf, ±10% tolerance; 600 v DC working voltage; hermetically sealed metal case; case dim., excluding terminals, 1-3/4 in. lg, 41/64 in. wide, 1-1/16 in. high; 2 solder lug type terminals, located on bottom; mineral oil impregnated; mineral oil filled; no internal ground connections; mounted w/2 slots 0.156 in. wide, spaced 2-1/8 in. apart C to C; resistant to humidity and corrosion; spec no. JAN-C-25	R107 bypass	AEV CP69B1EF503K	039-31	C-102, C-106
C-103	3K351034-2 N16-C-33617-4751 3330-376144160	CAPACITOR, FIXED, MICA DIELECTRIC: 10,000 mmf, ±5% tolerance; 300 v DC working voltage; −100 to +100 parts per million per deg C temp coefficient; molded thermosetting plastic case; case dim., 53/64 in. lg, 53/64 in. wide, 11/32 in. deep; 2 wire lead type terminals, located one on ea end; terminal mounted; resistant to humidity and corrosion; spec. no. JAN-C-5	V105 bypass	AEV CM35D103J	015-25	C-103, C-104 C-105, C-113
C-104		CAPACITOR, FIXED: Same as C-103	V105 and V106 bypass			
C-105		CAPACITOR, FIXED: Same as C-103	+300V bypass			
C-106		CAPACITOR, FIXED: Same as C-102	Phase control bypass			
C-107	— — — — — —	CAPACITOR, FIXED, PAPER DIELECTRIC: 1 section; 10,000 mmf, +20, −10% tolerance; 600 v DC working voltage; hermetically sealed metal case; case dim., incl bracket, excluding terminals, 1-1/8 in. lg, 7/16 in. dia; 2 wire lead type terminals, located one on ea end; mineral oil impregnated; mineral oil filled; no internal ground connections; bracket mounted, w/one 5/32 in. dia mounting hole; non-insulated case; spec no. JAN-C-25	Couple blocking oscillator T102 to V104 when S102 is in INT FM position	AEV CP29A1EF103V	094-53	C-107

C-108	3K3547242 N16-C-32641-6338 3330-376152015	CAPACITOR, FIXED, MICA DIELECTRIC: 4700 mmf, ±5% tolerance; 500 v DC working voltage; −100 to +100 parts per million per deg C temp coefficient; molded thermosetting plastic case; case dim., 53/64 in. lg, 53/64 in. wide, 11/32 in. deep; 2 wire lead type terminals, located one on ea end; terminal mounted; resistant to humidity and corrosion: spec no. JAN-C-5	V107A Cathode bypass	AEV CM35D472J	015-17	C-108, C-109 C-110, C-112
C-109		CAPACITOR, FIXED: Same as C-108	Couple V107A to V107B			
C-110		CAPACITOR, FIXED: Same as C-108	Couple V107B to V108A			
C-111	3K2022142 N16-C-29370-7606 3330-376017410	CAPACITOR, FIXED, MICA DIELECTRIC: 220 mmf, ±5% tolerance; 500 v DC working voltage; −100 to +100 parts per million per deg C temp coefficient; molded thermosetting plastic case; case dim., 51/64 in. lg, 15/32 in. wide, 7/32 in. deep; 2 wire lead type terminals, located one on ea end; terminal mounted; resistant to humidity and corrosion; spec no. JAN-C-5	Couple V108A to T102	AEV CM20D221J	011-39	C-111
C-112		CAPACITOR, FIXED: Same as C-108	V108A Cathode bypass			
C-113		CAPACITOR, FIXED: Same as C-103	V108B Cathode bypass			
C-114	— — N16-C-30109-3806 — —	CAPACITOR, FIXED, MICA DIELECTRIC: 470 mmf, ±5% tolerance; 500 v DC working voltage; −100 to +100 parts per million per deg C temp coefficient; molded thermosetting plastic case; case dim., 51/64 in. lg, 15/32 in. wide, 7/32 in. deep; 2 wire lead type terminals, located one on ea end; terminal mounted; resistant to humidity and corrosion; spec no. JAN-C-5	Sawtooth charging	AEV CM20D471J	011-47	C-114
C-115	3K3551242 N16-C-32720-7538 3330-376152819	CAPACITOR, FIXED, MICA DIELECTRIC: 5100 mmf, ±5% tolerance; 500 v DC working voltage; −100 to +100 parts per million per deg C temp coefficient; molded thermosetting plastic case; case dim., 53/64 in. lg, 53/64 in. wide, 11/32 in. deep; 2 wire lead type terminals, located one on ea end; terminal mounted; resistant to humidity and corrosion; spec. no. JAN-C-5	Couple TRIGGER to V108A	AEV CM35D512J	015-18	C-115
C-116	3DA100-688 N16-C-45777-3316 3330-316777558	CAPACITOR, FIXED, PAPER DIELECTRIC: 1 section; 100,000 mmf, ±10% tolerance; 600 v DC working voltage; hermetically sealed metal case; case dim., incl bracket, excluding terminals, 1-7/8 in. lg, 5/8 in. dia; 2 wire lead type terminals, located one on ea end; mineral oil impregnated; mineral oil filled; no internal ground connections; bracket mounted, w/one 5/32 in. dia mounting hole; non-insulated case; spec no. JAN-C-25	Couples EXT MOD & TRIGGER in (J102) to V104 when S102 is in EXT MOD position	AEV CP29A1EF104K	094-56	C-116

TABLE 5-4. TABLE OF REPLACEABLE PARTS (cont)

REF DESIG	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	FUNCTION	MFR AND MFRS DESIG	CONTRS DWG AND PART NO.	ALL SYMBOL DESIG INVOLVED
CR-101	— — N16-T-51723-10 3370-211000-2345	CRYSTAL UNIT, RECTIFYING: silicon type; 0.768 in. lg, 0.250 in. dia; standard mounting; 2 terminals; frequency convertar; spec no. JAN-1A	Detector	SLE 1N23B	824256-1	CR-101
E-101	— — — — — —	POWER SUPPLY SUBASSEMBLY: principal parts c/o 13 resistors, 1 resistor board, 5 capacitors, 1 reactor and 23 terminals; over-all dim., 7.0 in. lg, 3-7/16 in. wide, 2-1/8 in. high; four 0.166 in. dia mounting holes on 6.625 in. by 1.375 in. mounting centers	Resistor Board Assy		705319	E-101
E-102	— — — — — —	POWER SUPPLY SUBASSEMBLY: principal parts c/o 7 resistors, 1 resistor board and 9 terminals; over-all dim., 4-1/4 in. lg, 1-9/16 in. wide, 7/8 in. high; four 0.166 in. dia mounting holes on 3.750 in. by 0.875 in. mounting centers	Resistor Board Assy		829940	E-102
E-103	— — — — — —	POWER SUPPLY SUBASSEMBLY: principal parts c/o 1 heater element, 3 terminals and 1 board assy; over-all dim., 3-1/4 in. lg, 1-13/16 in. wide, 15/16 in. high; bracket mounted	Heater Assy		829970	E-103
E-104	— — — — 8880	TERMINAL BOARD: D-1(MP-2312) polyiron board; incl 8 wire lead type terminals; w/o barriers; over-all dim., 1-3/16 in. lg, 0.810 in. wide, 0.489 in. high; clamp mounted; marked "1", "2", "3", "4", on both sides	Terminal Assy, tube mount		228962	
E-105	— — — — — —	TERMINAL BOARD: laminated plastic, type GLE; incl 5 solder lug type terminals; w/o barriers; over-all dim., 2-1/8 in. lg, 1-3/8 in. wide, 7/16 in. thick; mounted w/two 0.1406 in. dia mounting holes, spaced 1.750 in. apart C to C; stencilled "1", "2", "3", "4", "5", "E-105"	Component mounting board		240422	
E-106	— — — — — —	AMPLIFIER SUBASSEMBLY: principal parts c/o 10 resistors, 1 terminal board and 17 terminals; over-all dim., 4-5/8 in. lg, 2.0 in. wide, 11/16 in. high; three 0.140 in. dia mounting holes on 1.000 in. by 4.187 in. mounting centers, two 0.140 in. dia mounting holes spaced 1.375 in. C to C	Resistor Board Assy		240424	
E-107	— — — — — —	AMPLIFIER SUBASSEMBLY: principal parts c/o 5 capacitors, 1 transformer, 1 terminal board, and 9 terminals; over-all dim., 4-5/8 in. lg, 2.0 in. wide, 1-3/4 in. high; three 0.140 in. dia mounting holes on 1.000 in. by 4.187 in. mounting	Terminal Board Assy		240426	

		centers, two 0.140 in. dia mounting holes spaced 1.375 in C to C				
E-108	— — — — — —	TERMINAL LUG: rd link tongue type; brass or bronze; solder or tin plated finish; 0.348 in. lg, 3/8 in.wide, 0.0180 in. to 0.0201 in. thk; soldered wire connection; one 0.115 in. dia internal tooth mounting hole on one end	Pilot Light Solder Lug	SH 2103-04-00	093-12	E-108, E-109
E-109		TERMINAL LUG: Same as E-108	Pilot Light Solder Lug			
E-110	— — — — — —	TERMINAL LUG: rd link tongue type; copper or brass; solder finish; no. 13 AWG wire accommodated; over-all dim., 0.616 in. lg, 17/64 in. wide, 0.159 to 0.0250 in. thk; soldered wire connection; one 0.112 in. dia mounting hole on one end	Holds wire	TBC 616	092-1	
E-111	— — — — — —	TERMINAL LUG: ring type; copper; tinned or hot solder dipped finish; no. 18 AWG wire accommodated; over-all dim., 31/32 in. lg, 5/16 in. wide, 5/32 in. thick; crimped wire connections; one 0.190 in. dia mounting hole	Holds wire	ARP No. 31662	0190-8	
E-112	3Z12073-41.21- — — 8880-396470222	TERMINAL LUG: rd link tongue type; copper or brass; tin solder dipped finish; no. 13 AWG wire accommodated; over-all dim., 0.8672 in. lg, 5/16 in. wide, 0.0159 in. to 0.0250 in. thick; soldered wire connection; one 0.112 in. dia mounting hole, on one end; resistant to humidity and corrosion	Grounding lug	TBC 1525	092-2	
E-201	— — — — — —	TERMINAL BOARD: laminated plastic; includes 3 turret type terminals; w/o barriers; over-all dim, 1-1/4 in. lg, 7/8 in. wide, 0.719 in. high; four 0.235 in. dia mounting holes on 0.625 in. by 1.000 in. mounting centers; board marked 1, 2, 3	Bridge compensating resistor board		830760	
F-101	— — — — 8870-042-09	FUSE, CARTRIDGE: 2 amp, 250 v; time delay type, 135% for 60 minutes max, 200% for 2 minutes max; ferrule type terminal, 5/32 in. lg, 1/4 in. dia; enclosed type, glass body; one time; non-indicating; over-all dim., 1-1/4 in. lg, 1/4 in. dia; resistant to corrosion and thermal shock	Fuse in AC line	BUS AGC2	042-09	F-101, F-102
F-102		FUSE, CARTRIDGE: Same as F-101	Fuse in AC line			
I-101	— — — — — —	LAMP, INCANDESCENT: 3 v, 1/2 W, 0.19 amp; kollsman base, T-1-1/4, clear, white, 1 tungsten filament, C-2; 0.525 in. max over-all height; over 25 hr rated life; any burning position; spec no. AN-3136	Scale illuminator DBM attenuator Z-105	GE AN3136-323	151514	I-101, I-102
I-102		LAMP, INCANDESCENT: Same as I-101	Scale illuminator frequency meter Z-106			

TABLE 5-4. TABLE OF REPLACEABLE PARTS (cont)

REF DESIG	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	FUNCTION	MFR AND MFRS DESIG	CONTRS DWG AND PART NO.	ALL SYMBOL DESIG INVOLVED
J-101	— — — — — —	CONNECTOR, RECEPTACLE: 2 rectangular male contacts; straight type; over-all dim., 2.031 in. lg, 1-1/2 in. wide, 1.062 in. high; contacts electrical ratings, 10 amp at 250 v, 15 amp at 125 v; cylindrical shape w/oval mounting flange, metal shell, moisture and fungus proofed; 0.406 in. dia max cable opening; two 0.136 in. dia mounting holes, spaced 1.750 in. apart C to C; molded bakelite insulation	115V AC power input	HAW 6808	235417	J-101
J-102	2Z7390-290 N17-C-73108-1267 8850-654218	CONNECTOR, RECEPTACLE: 1 rd female contact; straight type; over-all dim., 53/64 in. lg, excluding protruding contact, 11/16 in. wide, 11/16 in. high; contact electrical rating, 500 v; radio frequency connector, 50 ohms nominal impedance, non-constant frequency impedance characteristic; cylindrical body w/sq mounting flange, copper, silver plated finish; copolymerstyrene insert; four 0.099 in.-56 NF-2 mounting holes on 0.500 in. by 0.500 in. mounting centers; weather proofed, for use w/plug UG-88/U, Navy Dwg No. RF49F246 or plug UG-260/U, Navy Dwg RE49F380	EXT. MOD. & TRIGGER INPUT connector	AMP Type BNC	813848	J-102, J-103
J-103		CONNECTOR, RECEPTACLE: Same as J-102	PULSE ANALYZER output			
L-101	— — — — — —	REACTOR: filter choke; 1 section; 7 henries overall inductance, 45 ma DC; 430 ohms DC resistance; 2500 v (RMS) insulation test voltage; open metal frame; over-all dim., 2-13/16 in. lg, 1-53/64 in. wide, 1-3/4 in. high; four 0.166 in. dia mounting holes, on 1.437 in. by 2.421 in. mounting centers; 2 solder lug type terminals, located on side; Sperry Gyroscope Co., Type No. RE-1661	Power supply filter		660264	L-101
L-102	— — — — — —	REACTOR: filter choke; 1 section; 6 hys ±1 hy over-all inductance, no DC rating; 230 ohms DC resistance; 1780 v (RMS) test voltage; open frame, metal; over-all dim., 1-13/16 in. lg, 1-3/4 in. wide, 1-3/4 in. high; 2 integral mounting feet, each with 0.140 in. wide slot, 15/16 in. apart end to end; 2 solder lug type terminals, located on side, opposite ea other; Fosterite impregnated	Sweep adjust choke		662040	L-102

M-101	— — — — — —	AMMETER: panel mounted; designed for DC circuit; marked "milliwatts" and " −dbm +", range "0 to 200 cw" and " −6 to +3 cw", two scales, one graduated in increments of 10 and one graduated logarithmically; cylindrical shaped; metal case; flange 2.695 in. max dia, 0.38 in. max thick, 2.21 in. max body dia, 2.36 in. max body depth from mounting surface, excluding terminals; ±2% accuracy at full scale reading; 75 ohms ±10% DC coil resistance; calibrated for either magnetic or non-magnetic panel; black scale markings, white background, black lance type pointer; meter is self-contained; mounted with three 0.112 in.-40 NC-2 thd screws; equally spaced on 2.440 in. dia; 1 solder lug type terminal, 0.5 in. lg min; ruggedized construction, incl shock mounting ring; spec No. MIL-M-10304 (except scale, resistance and friction)	Bridge current indicator	MAI HS22B2	710997	M-101
R-101	— — W16-R-51064-431 — —	RESISTOR, FIXED, COMPOSITION: 2.2 meg total resistance, ±10% tolerance; 1/2 W power dissipation; F characteristic; body dim, excluding terminals, 0.406 in. lg, 0.175 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec no. JAN-R-11	V102 grid voltage divider	AB RC20BF225J	070-65	R-101
R-102	— — N16-R-50633-811 — —	RESISTOR, FIXED, COMPOSITION: 0.10 megohm total resistance, ±10% tolerance; 2 W power dissipation; F characteristic; body dim, excluding terminals, 0.750 in. lg, 0.370 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec no. JAN-R-11	V103 screen voltage divider	AB RC42BF104J	076-49	R-102, R-110 R-134
R-103	— — N16-R-50417-811 — —	RESISTOR, FIXED, COMPOSITION: 33,000 ohms total resistance, ±10% tolerance; 1/2 W power dissipation; F characteristic; body dim, excluding terminals, 0.406 in. lg, 0.175 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec no. JAN-R-11	V103 screen voltage divider	AB RC20BF333J	070-43	R-103, R-127 R-132
R-104	— — N16-R-50678-811 3350-381167200	RESISTOR, FIXED, COMPOSITION: 0.15 meg total resistance, ±10% tolerance; 1/2 W power dissipation; F characteristic; body dim, excluding terminals, 0.406 in. lg, 0.175 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec. no. JAN-R-11	V103 screen voltage divider	AB RC20BF154J	070-51	R-104, R-105
R-105		RESISTOR, FIXED: Same as R-104	V103 screen voltage divider			
R-106	— — N16-R-50283-529 3350-391516160	RESISTOR, FIXED, COMPOSITION: 10,000 ohms total resistance, ±10% tolerance; 2 W power dissipation; F characteristic; body dim, excluding terminals, 0.750 in. lg, 0.370 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec no. JAN-R-11	V105, V106 bleeder	AB RC42BF103J	076-37	R-106, R-144

TABLE 5-4. TABLE OF REPLACEABLE PARTS (cont)

REF DESIG	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	FUNCTION	MFR AND MFRS DESIG	CONTRS DWG AND PART NO.	ALL SYMBOL DESIG INVOLVED
R-107	— — — — — —	RESISTOR, FIXED, DEPOSITED FILM: 0.30 meg total resistance, ±1% tolerance; 1/2 W power dissipation; −0.002% per v, voltage coefficient; body dim., excluding terminals, 25/32 in. lg, 0.266 in. dia; uninsulated; 2 wire lead type terminals; transparent sleeving to cover body.	V103 grid voltage divider	IRC	723155-085	R-107
R-108	— — — — 3350	RESISTOR, FIXED, DEPOSITED FILM: 0.20 meg total resistance, ±1% tolerance; 1/2 W power dissipation; −0.002% per v, voltage coefficient; body dim., excluding terminals, 25/32 in. lg, 0.266 in. dia; uninsulated; 2 wire lead type terminals; transparent sleeving to cover body	V103 grid voltage divider	IRC	723155-081	R-108
R-109	— — N16-R-50444-811 — —	RESISTOR, FIXED, COMPOSITION: 39,000 ohms total resistance, ±10% tolerance; 1/2 W power dissipation; F characteristic; body dim., excluding terminals, 0.406 in. lg, 0.175 in. dia; insulated, resistant to humidity and corrosion, 2 wire lead type terminals; spec no. JAN-R-11	Phase control voltage divider	AB RC20BF393J	070-44	R-109
R-110		RESISTOR, FIXED: Same as R-102	Shunts R137 Signal Width control			
R-111	— — N16-R-87682-5220 3350	RESISTOR, VARIABLE: composition element; 1 section, 10,000 ohms total resistance, ±20% tolerance; 2 W nominal power rating; std A taper; 3 lug type terminals; enclosed metal case, 1-5/32 in. dia, 5/8 in. deep; rd metal shaft, 0.250 in. dia, 7/8 in. lg from mounting surface, normal torque; mounted w/ 3/8 in.-32 NEF-2 thd bushing, 0.375 in. lg, non-turn device located on 0.531 in. radius at 9 o'clock	MOD. AMP. control	AB J1U1032P-3056	0192-7	R-111
R-112	— — — — — —	RESISTOR, VARIABLE: composition element; 1 section, 100,000 ohms total resistance, ±20% tolerance; 1/2 W nominal power rating; std A taper; 3 lug type terminals; enclosed metal case, 1.280 in. dia, 5/8 in. deep; plain rd shaft, 0.250 in. dia, 7/8 in. lg from mounting surface, normal torque; mounted w/ 3/8 in.-32 NEF-2 thd bushing, 0.375 in. lg, non-turn device located on 0.531 in. radius at 9 o'clock	PHASE control	AB J1U1042P-3056	0191-13	R-112
R-113	— — N16-R-50759-811 — —	RESISTOR, FIXED, COMPOSITION: 0.33 meg total resistance; ±10% tolerance; 1/2 W power dissipation; F characteristic; body dim, excluding terminals, 0.406 in. lg, 0.175 in. dia; insulated,	P/o Phase control circuit	AB RC20BF334J	070-55	R-113, R-114

		resistant to humidity and corrosion; 2 wire lead type terminals; spec no. JAN-R-11				
R-114		RESISTOR, FIXED: Same as R-113	V104 reflector coupler			
R-115	— — — — — —	RESISTOR, FIXED, DEPOSITED FILM: 130 ohms total resistance, ±1% tolerance; 1/2 W power dissipation; −0.002% per v, voltage coefficient; body dim, excluding terminals, 25/32 in. lg, 0.266 in. dia; uninsulated; 2 wire lead type terminals; transparent sleeving to cover body	Bridge circuit	IRC	723155-005	R-115
R-116	— — — — 3350	RESISTOR, FIXED, DEPOSITED FILM: 300 ohms total resistance, ±1% tolerance; 1/2 W power dissipation; −0.002% per v, voltage coefficient; body dim., excluding terminals, 25/32 in. lg, 0.266 in. dia; uninsulated; 2 wire lead type terminals; transparent sleeving to cover body	Bridge circuit	IRC	723155-013	R116, R-119
R-119		RESISTOR, FIXED: Same as R-116	Bridge circuit			
R-121	— — N16-C-49822-431 3350-101000-2971	RESISTOR, FIXED, COMPOSITION: 620 ohms total resistance, ±5% tolerance; 1/2 W power dissipation; F characteristic; body dim., excluding terminals, 0.468 in. lg, 0.249 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec no. JAN-R-11	Bridge voltage divider	AB RC20BF621J	069-44	R-121
R-122	— — N16-R-49651-431 3350-101000-2461	RESISTOR, FIXED, COMPOSITION: 200 ohms total resistance, ±5% tolerance; 1/2 W power dissipation; F characteristic; body dim., excluding terminals, 0.468 in. lg, 0.249 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec no. JAN-R-11	Bridge compensating	AB RC20BF201J	069-32	R-122
R-123	— — N16-R-90298-5420 — —	RESISTOR, VARIABLE: wire-wound element; 1 section, 1000 ohms total resistance, ±10% tolerance; 2 W nominal power rating; std A taper; 3 lug type terminals; enclosed metal case, 1.280 in. dia, 0.620 in. deep; rd metal shaft, 0.250 in. dia, 7/8 in. lg from mounting surface, normal torque; mounted w/ 3/8 in.-32 NEF-2 thd bushing, 0.375 in. lg, non-turn device located on 0.531 in radius at 9 o'clock; spec no. JAN-R-19	SET ZERO-FINE control	IRC RA20A1RD102AK	0193-18	R-123
R-124	— — — — — —	RESISTOR, VARIABLE: wire-wound element; 1 section; 2500 ohms total resistance, ±10% tolerance; 2 W nominal power rating; std A taper; 3 lug type terminals; enclosed metal case, 1.280 in. dia, 0.620 in. deep; screwdriver slotted metal shaft w/ 0.047 in. wide, 0.063 in. deep slot in end, shaft 0.250 in. dia. 1/2 in. lg from mounting surface, normal torque; mounted w/ 3/8 in.-32 NEF-2 thd bushing, 0.375 in. lg, non-turn device located on 0.531 in. radius at 9 o'clock; spec no. JAN-R-19	SET ZERO-COARSE control	IRC RA20A1SD252AK	0193-50	R-124

TABLE 5-4. TABLE OF REPLACEABLE PARTS (cont)

REF DESIG	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	FUNCTION	MFR AND MFRS DESIG	CONTRS DWG AND PART NO.	ALL SYMBOL DESIG INVOLVED
R-125	— — N16-R-50147-109 3330	RESISTOR, FIXED, COMPOSITION: 5100 ohms total resistance, ±5% tolerance, 2 W power dissipation; F characteristic; body dim., excluding terminals, 0.750 in. lg, 0.370 in. dia; insulated; resistant to humidity and corrosion; 2 wire lead type terminals; spec no. JAN-R-11	SET ZERO voltage divider	AB RC42BF512J	075-66	R-125, R-143
R-126	— — N16-R-50129-811 — —	RESISTOR, FIXED, COMPOSITION: 4700 ohms total resistance; ±10% tolerance; 1/2 W power dissipation; F characteristic; body dim., excluding terminals, 0.406 in. lg, 0.175 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec no. JAN-R-11	V107A grid leak	AB RC20BF472J	070-33	R-126
R-127		RESISTOR, FIXED: Same as R-103	V107A plate load			
R-128	— — N16-R-49922-811 — —	RESISTOR, FIXED, COMPOSITION: 1000 ohms total resistance, ±10% tolerance; 1/2 W power dissipation; F characteristic; body dim., excluding terminals, 0.406 in. lg, 0.175 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec no. JAN-R-11	V107A cathode bias	AB RC20BF102J	070-25	R-128, R-133
R-129	— — — — — —	RESISTOR, FIXED, COMPOSITION: 0.10 meg total resistance, ±10% tolerance, 1/2 W power dissipation; F characteristic; body dim., excluding terminals, 0.406 in. lg, 0.175 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec. no. JAN-R-11	V107B grid leak	AB RC20BF104J	070-49	R-129, R-131
R-130	— — — — — —	RESISTOR, FIXED, COMPOSITION: 33,000 ohms total resistance, ±10% tolerance, 1 W power dissipation; F characteristic; body dim., excluding terminals, 0.750 in. lg, 0.280 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec. no. JAN-R-11	V107B plate load	AB RC30BF333J	073-43	R-130
R-131		RESISTOR, FIXED: Same as R-129	V108A grid leak			
R-132		RESISTOR, FIXED: Same as R-103	V108A plate load			
R-133		RESISTOR, FIXED: Same as R-128	V108A cathode bias			
R-134		RESISTOR, FIXED: Same as R-102	V108B bias voltage divider			
R-135	— — N16-R-50201-811 — —	RESISTOR, FIXED, COMPOSITION: 6800 ohms total resistance, ±10% tolerance; 1/2 W power	V108B cathode bias	AB RC20BF682J	070-35	R-135

		dissipation; F characteristic; body dim., excluding terminals, 0.406 in. lg, 0.175 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec no. JAN-R-11				
R-137	3Z7480-210 — — 3350-793000-3931	RESISTOR, VARIABLE: composition element; 1 section, 100,000 ohms total resistance, ±20% tolerance;2 W nominal power rating; std A taper; 3 lug type terminals; enclosed metal case, 1-5/32 in. dia, 5/8 in. deep; rd metal shaft, 0.250 in. dia, 7/8 in. lg from mounting surface, normal torque; mounted w/ 3/8 in.-32 NEF-2 thd bushing, 0.375 in lg, non-turn device located on 0.531 in. radius at 9 o'clock	SIGNAL width control	AB J1U1042P-3056	0192-13	R-137
R-138	— — N16-R-49318-751 — —	RESISTOR, FIXED, COMPOSITION: 20 ohms total resistance, ±5% tolerance; 1 W power dissipation; F characteristic; body dim., excluding terminals, 0.750 in. lg, 0.280 in. dia; insulated, resistant to humidity and corrosion; 2 wire lead type terminals; spec no. JAN-R-11	Voltage dropping for 3 v pilot lamps	AB RC30BF201J	072-9	R-138, R-141
R-139	— — — — — —	RESISTANCE ELEMENT: wire type; 441 ohms total resistance; ±10% tolerance; 30 W power dissipation; dim. data, 1-5/8 in. lg, 3/8 in. dia; 2 wire lead type terminals, dim., one is 1-3/8 in. lg, other is 1-1/8 in. lg; nichrome wire on ceramic core, resistive element; terminal mounted; 25 meg insulation resistance; incl brass sheath and fiberglas sleeving	Heater element	WG C-202	287087	R-139
R-141		RESISTOR, FIXED: Same as R-138	Voltage dropping for 3 v pilot lamps			
R-142	— — — — — —	RESISTOR, VARIABLE: composition element; 1 section, 1.0 megohm, total resistance, ±20% tolerance; 1/2 W nominal power rating; std A taper; 3 lug type terminals: enclosed metal case, 1.280 in. dia, 5/8 in. deep; screwdriver slotted metal shaft w/0.047 in. wide, 0.063 in. deep slot in. end, shaft 0.250 in. dia, 1/2 in. lg from mounting surface, normal torque; mounted w/ 3/8 in.-32 NEF-2 thd bushing, 0.375 in. lg, non-turn device located on 0.531 in. radius at 9 o'clock	Sweep adjust (internal)	AB J1U1052SD-3032	0191-49	R-142
R-143		RESISTOR, FIXED: Same as R-125	SET ZERO voltage divider			
R-144		RESISTOR, FIXED: Same as R-106	V105, V106 bleeder			
R-201	— — — — — —	RESISTOR, FIXED, WIRE-WOUND: 400 ohms total resistance, ±10% tolerance; 1 W power dissipation; body dim., excluding terminals, 0.156 in. dia, 1/2 in. lg; insulated, 2 wire lead type terminals	P/o Z-109 (calibration)		305805	

TABLE 5-4. TABLE OF REPLACEABLE PARTS (cont)

REF DESIG	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	FUNCTION	MFR AND MFRS DESIG	CONTRS DWG AND ART NO.	ALL SYMBOL DESIG INVOLVED
R-204	— — N16-R-85056-1101 — —	RESISTOR, THERMAL: 2000 ohms nominal resistance, 25° C ambient temp; 25 ma max continuous current; designed for AC or DC; over-all dim., 5/32 in. dia, 0.40 in. thick; terminal mounted; temp coefficient of resistance at 25° C, approx −0.034/° C	Thermistor bead	WE 166382	272824	
R-205	— — — — — —	RESISTOR, THERMAL: 803 ohms nominal resistance, 75° ambient temp; designed for DC; over-all dim., 1-1/4 in. lg, 7/8 in. wide, 5/16 in. high; four 0.128 in. dia mounting holes on 1.000 in. by 0.625 in. mounting centers	Compensating thermistor	WE D168392	227898	
S-101	3Z9863-52N N17-S-73959-1025 3300-395853615	SWITCH, TOGGLE: DPDT; 30 amp, 30 v DC; phenolic body; over-all dim., 1-21/64 in. lg, 49/64 in. wide, 1-1/16 in. high bat type actuating handle, 11/16 in. lg, excluding lgth of bushing; locking action; 6 solder lug type terminals, located on back; single hole mounting type, mounts w/ 15/32 in.-32 NS-2 thd bushing, 15/32 in. lg from mounting surface; incl lockwasher, locking ring, and 2 hex nuts assembled on bushing; spec no. JAN-S-23	Power ON-OFF	CUT ST52N	0233-4	S-101
S-102	— — — — — —	SWITCH, ROTARY: 2 sections; 2 positions, max number of switching positions possible; non-"pile-up" type, 4 poles, 2 throws; 300 v AC (RMS), 300 v DC; brass contacts, silver plated finish; phenolic wafer section; dim., 1-5/16 in. lg, 1-3/8 in. wide, 1-5/8 in. high; mounted w/ 3/8 in.-32 NEF-2 thd bushing; rd type shaft, 7/8 in. lg, 0.250 in. dia; solder lug type terminals	EXT MOD-INT FM	OAK 46706-N-3	711001	S-102
T-101	— — — — — —	TRANSFORMER, POWER, STEP-DOWN AND STEP-UP: open frame, metal; 115 v AC, 50 to 1600 cycles per sec, single phase; 4 output windings, no. 1 secondary, full load 850-0-850 v, no's. 2 and 4 secondaries 6.3 v ±5%, no. 3 secondary, 5 v ±5%, no. 1 secondary 36 ma (RMS), no. 2 secondary 1.25 amp, no. 3 secondary 2 amp, no. 4 secondary 1.7 amp; 1500 v (RMS) and 2750 v (RMS) insulation; Fosterite impregnated; dim., 3-53/64 in. lg, 2-7/8 in. wide, 4-15/32 in. high; 12 solder lug type terminals, located on front and back, two integral mounting feet w/ 0.193 in. wide by 3/8 in. lg mounting slots, on 2-9/16 in. by 2-1/8 in. mount-	Power		660263	T-101

		ing centers; internally shielded; Sperry Gyroscope Co., Type No. RBF-1660C				
T-102	— — —	TRANSFORMER, PULSE: blocking oscillator type; variable repetition rate, 50 microsecond sawtooth wave at 200 v amplitude; primary impedance at reference frequency, not rated, DC resistance of winding 1–2, 2.32 ohms ± 10%; DC resistance of winding 3–4, 2.46 ohms ±10%, DC resistance of winding 5–6, 12.4 ohms ± 10%; operating voltage of primary and both secondaries, not rated; 1000 v, 60 cycles (RMS) test voltage; open type metal frame; dim., of body, excluding terminals, 1-11/16 in. lg, 23/32 in. wide, 1-1/8 in. high; Fosterite impregnated; 6 solder lug type terminals, located along outer edges; flange mounted, with two 0.141 in. dia mounting holes; Westinghouse type "C" core, SNo. 1317996	Blocking oscillator	WES 7-P-20	228775	T-102
V-101	— N16-T-55444 3370	ELECTRON TUBE: diode; RMA glass envelope ST-16(16–3); medium shell octal base, 5 pin type terminations, located on bottom; full wave high-vacuum rectifier; spec no. JAN-1A	Power rectifier	GE 5R4GY	805147-1	V-101
V-102	— N16-T-56916 3300-234820	ELECTRON TUBE: diode; RMA glass envelope ST-14(14–3); medium shell octal base, 7 pin type terminations, located on bottom; beam power amplifier; spec no. JAN-1A	Voltage regulator	RCA 6Y6G	807594-1	V-102
V-103	— N16-T-56660 —	ELECTRON TUBE: pentode; RMA glass envelope MT-8(8–1); small wafer octal base, 8 pin type terminations, located on bottom; R-F pentode, sharp cutoff; spec no. JAN-1A	Regulator amplifier	GE 6SH7	805881-1	V-103
V-104	— N16-T-52625 3370-274000-2245	ELECTRON TUBE: klystron; metal envelope, nonstandard envelope, cylindrical shape, 1-39/64 in. dia, 2.344 in. high; 6 pin type terminations, located on bottom, and 1 miniature cap terminal, located on top; klystron, integral cavity; spec. no. JAN-1A	Oscillator	WE 2K25	812535-1	V-104
V-105	2JOB2 N16-T-52001-5 3300-234006	ELECTRON TUBE: diode; RMA glass envelope T-5-1/2(5–3); button 7 pin miniature type terminations, located on bottom; miniature voltage regulator; spec no. JAN-1A	Voltage regulator	HYT OB2	818236-1	V-105, V-106
V-106		ELECTRON TUBE: Same as V-105	Voltage regulator			
V-107	— — —	ELECTRON TUBE: triode; RMA glass envelope T-9(9–11); intermediate shell octal 8 pin phenolic type terminations, located on bottom; twin triode high-mu amplifier; spec no. JAN-1A	Amplifier	SLE 6SL7GT	804381-1	V-107, V-108

TABLE 5-4. TABLE OF REPLACEABLE PARTS (cont)

REF DESIG	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	FUNCTION	MFR AND MFRS DESIG	CONTRS DWG AND ART NO.	ALL SYMBOL DESIG INVOLVED
V-108		ELECTRON TUBE: Same as V-107	Amplifier and blocking oscillator			
XV-101	— — — — — —	SOCKET, ELECTRON TUBE: 8 contacts, phosphor bronze, silver plated finish; octal size; oval shape; over-all dim., excluding terminals, 1-7/8 in. lg, 1-9/32 in. wide, 31/64 in. thick; mica-filled bakelite body: stainless steel mounting plate, 1-1/4 in. dia chassis hole required, two 0.157 in. dia mounting holes, spaced 1-1/2 in. apart C to C; corrosion resistant	Socket for V101	AMP M1P8TM	232294	XV-101, XV-102
XV-102		SOCKET, ELECTRON TUBE: Same as XV-101	Socket for V102			
XV-103	— — N16-S-63515-1938 8850-892154	SOCKET, ELECTRON TUBE: 8 contacts, beryllium copper or phosphor bronze, silver plated finish; octal size; oval shape; over-all dim., excluding terminals, 1-7/8 in. lg, 1-3/16 in. wide, 1/2 in. high; mica-filled bakelite body; one piece saddle mounting, two 0.138 in. dia mounting holes, spaced 1-1/2 in. apart C to C; corrosion resistant	Socket for V103	CIN 51B13416	212705	XV-103, XV-106, XV-107
XV-105	— — N16-S-62603-6702 8850-882880	SOCKET ELECTRON TUBE: 7 contacts, beryllium copper or phosphor bronze, silver plated finish; miniature size; incl metal base shield, 0.800 in. dia, 5/8 in. high; incl center shield 0.102 in. ID; oval shape; over-all dim., excluding terminals, 1-1/8 in. lg, 0.800 in. wide, 25/32 in. high; mica-filled bakelite body, type MFE per MIL-P-14B; one piece saddle mounting, 0.625 in. dia chassis hole required, two 0.125 in. dia mounting holes, spaced 0.875 in. apart C to C; corrosion resistant: spec no. JAN-S-28A (except for plating)	Socket for V105	CIN TS102P01	219150	XV-105, XV-106
XV-106		SOCKET, ELECTRON TUBE: Same as XV-105	Socket for V106			
XV-107		SOCKET, ELECTRON TUBE: Same as XV-103	Socket for V107			
XV-108		SOCKET, ELECTRON TUBE: Same as XV-103	Socket for V108			
Z-101	— — — — — —	HORN, ANTENNA: 8500 to 9600 mc frequency range; coupling connected to coaxial cable; aluminum alloy; chromic acid anodic oxidized, semi-gloss black enamel; over-all dim., of throat and mouth, throat 1.469 in. lg, 1-1/16 in. wide, 17/32 in. deep, mouth 1-7/8 in. lg, 1-1/16 in.	Pick-up antenna	AT-68/UP	660159	Z-101

		wide, 1-1/4 in. deep; inside dim., of throat and mouth, throat 2.032 in. lg, 0.900 in. wide, 0.440 in. high, mouth 1.218 in. lg, 0.960 in. wide, 1.125 in. high; 3-21/64 in. lg over-all; mounted w/ 1/2 in.-28 NS-3 thd; receives and radiates RF energy				
Z-102	— — — — — —	CABLE ASSEMBLY, RADIO FREQUENCY: AN, R-F Cable, Type No. RG-9A/U, coaxial, 51 ohms characteristic impedance, 4000 v (RMS) max operating voltage, single conductor, 7 strands, no. 21 AWG, copper conductor, silver coated, polyethylene, 0.280 in. OD, single copper silver coated shield, rd shape, 0.420 in. dia cross section, polyvinyl chloride jacket; assy 8.0 ft lg over-all, assy 7 ft, 8-1/4 in. lg excluding terminations; 2 AN No. UG-21B/U plug type terminations	Output cable	CG-92A/U(8)	660283	Z-102
Z-103	— — — — — —	COUPLER-DETECTOR, RADIO FREQUENCY: couples coaxial line to waveguide, coupling accomplished w/coaxial cable and connector; 8500 to 9600 mc frequency range; incl waveguide, black painted exterior finish, silver plated interior finish, 1.000 in. by 0.500 in. interior; crystal type rectifier, JAN, crystal rectifier, Type No. 1N23B, crystal mounted in holder which is spring loaded into waveguide; over-all dim., 5-3/4 in. lg, 2-3/8 in. wide, 5-1/2 in. high	Output/Input section		660170	Z-103
Z-104	— — — — — —	WAVEGUIDE ASSEMBLY: rigid type, twisted "J" shape, aluminum, silver plated internal finish, 1.000 in. by 0.500 in. inner dim., approx 6-1/2 in. lg over-all; stencilled "660285"; incl supporting bracket	Waveguide		660285	Z-104
Z-105	— — — — — —	ATTENUATOR, VARIABLE: waveguide type; brass cavity, silver plated, black enamel finish inner dim., 1.000 in. lg, 0.500 in. wide; 8500 to 9600 mc frequency response; 43 db attenuation range, ±1.5 db tolerance, continuously variable; over-all dim., 6-1/2 in. lg, 5-3/4 in. wide, 3.0 in. high; 2 waveguide flange terminations, located one on ea end; mounted w/eight 0.169 in. dia mounting holes on 1.280 in. by 1.220 in. mounting centers, four holes in ea flange; incl calibrated dial	DBM attenuator		660524	Z-105
Z-106	— — — — — —	CAVITY, TUNED: 8500 to 9600 mc frequency range; invar enclosure; silver inner wall; iris coupling power take-off; manually tuned; dial calibrated from 8.5 to 9.6 kmc; over-all dim., 8.0 in. lg, 6-1/8 in. wide, 6.0 in. deep; incl waveguide "T" section; adjusts resonant frequency of waveguide	Absorption type frequency indicator		660169	Z-106

TABLE 5-4. TABLE OF REPLACEABLE PARTS (cont)

REF DESIG	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	FUNCTION	MFR AND MFRS DESIG	CONTRS DWG AND PART NO.	ALL SYMBOL DESIG INVOLVED
Z-107	— — — — — —	MOUNTING: aluminum alloy; heat resisting black enamel finish; holds item in octal socket w/spring clip, attached to chassis w/waveguide flange; incl adjustment controls for klystron tube; used to mount klystron	Mount for RF oscillation for V104		660164	Z-107
Z-109	— — — — — —	THERMISTOR, ASSEMBLY: used in thermistor bridge circuit; principal parts c/o 1 Terminal assy, Sperry Gyroscope Co., Part No. 830760, 1 Resistor, Sperry Gyroscope Co., Part No. 305802, and 2 Thermistors, Sperry Gyroscope Co., Part No's 227898 and 272824; over-all dim., 3-3/16 in. lg, 1-5/8 in. wide, 2-13/16 in. deep; mounted w/four 0.169 in. dia mounting holes, in waveguide flange, on 1.280 in. by 1.220 in. mounting centers	Thermistor bridge waveguide section		669160	Z-109
Z-110	— — — — — —	ATTENUATOR, VARIABLE: waveguide type, brass cavity, silver plated, black enamel finish, inner dim., 1.000 in. lg, 0.500 in. wide, 8500 to 9600 mc frequency response; 5 db to 35 db attenuation range, ±1.5 db tolerance, variable in steps, 2 steps; over-all dim., 11-1/4 in. lg, 5-1/16 in. wide, 4.0 in. deep; 2 waveguide flange terminations, located one on ea end; mounted w/eight 0.169 in. dia mounting holes, on 1.280 in. by 1.220 in. mounting centers, four holes in ea flange; incl actuating cam	Dual position attenuator		660655	Z-110
Z-111	— — — — — —	CABLE ASSEMBLY, RADIO FREQUENCY: AN, R-F Cable, Type No. RG-58A/U, coaxial, 50 ohms characteristic impedance, 1900 v (RMS) max operating voltage, single conductor, 19 strands, no. 20 AWG, copper conductor, silver coated, polyethylene, 0.116 in. OD, single copper, tinned shield, rd shape, 0.195 in. dia cross section, polyvinyl chloride jacket; assy 6 ft. 1.0 in. lg over-all assy 5 ft, 10.0 in. lg excluding terminations, 1 AN No. UG-88/U plug type termination at one end, 1 AN No. UG-306/U right angle adapter, located at other end.	Video Cable	CG-409B/U(6)	684595	Z-111
Z-112	— — — — — —	CABLE ASSEMBLY, POWER, ELECTRICAL: AN, Type No. CX-337/U(6), 2 conductors, stranded, no. 16 AWG, natural or synthetic rubber compound insulation, cotton or jute fibers fillers, natural or synthetic rubber jacket; 600 v (RMS)	Power cord	CX-337/U(6)	243142	Z-112

		max rated working voltage; 6 ft overall; terminal fitting on one end, 1, Harvey Hubbell, Inc. Body, Cat. No. 7257, terminal fitting on other end, 1 Harvey Hubbell Inc., Cap, Cat. No. 7057; 65 strands to ea conductor, no. 16 AWG				
	— — — — — —	ARM: flexible shaft support; irregular shape; over-all dim., 2.250 in. lg, 1.484 in. wide, 1.249 in. high; mounted w/two 9/64 in. dia mounting holes; spaced 0.812 in. apart C to C; silicon brass casting; nickel plated, baked black enamel; 1/2 in.-20 NF-3 thd, one end	Holds barn door arm and slide (R.F. switch)		815014	
	— — — — — —	ARM: opens and closes RF cutoff switch; irregular shape; over-all dim., 2.093 in. lg, 1.343 in. wide, 3/8 in. thick; shaft mounted; aluminum, chromic acid anodic oxidized, flat black enamel	Opens and closes RF cut-off switch		235790	
	— — — — — —	CABLE, RADIO FREQUENCY: coaxial; 50 ±2 ohms nominal impedance, 1900 v (RMS) max voltage rating; one inner conductor, stranded, copper, coated finish, 19 strands, 0.0068 in. dia; polyethylene dielectric; tinned copper braid outer conductor; polyvinyl chloride jacket; 0.195 in. dia over-all; spec no. JAN-C-17A	Coax cable	AMP RG-58A/U		
	— — — — — —	CABLE, RADIO FREQUENCY: coaxial; 51 ohms nominal impedance, 4000 v (RMS) max voltage rating; one inner conductor, stranded, copper, silver coated finish, 7 strands, 0.0285 in. dia; polyethylene dielectric; silver coated copper braid, outer conductor; polyvinyl chloride jacket; 0.420 in. OD over-all, spec no. JAN-C-17	Coax cable	FDR RG-9A/U		
	2Z2636-26 N16-C-300798-866 3370	CLAMP, ELECTRICAL: stainless steel passivated or immunized; 1 cl p type fastening device; over-all dim., 1-57/64 in. lg, 1.600 in. wide, 59/64 in. thick; one integral mounting bracket w/ 9/32 in. lg, 3/16 in. wide mounting slot; designed to hold material 1.357 in. nominal dia	Used as tube clamp	BHE 926C	0200-21	
	— — — — — —	CLIP, ELECTRICAL: tube base style; annealed spring steel; cadmium plated finish; dim., 1-3/8 in. high, 21/32 in. wide, 15/32 in. deep; no electrical rating; 1.355 in. jaw opening, when fully spread	Used as tube clip		285642	
	— — — — 3370-719000-2965	CLIP, ELECTRICAL: tube base style; annealed spring steel; cadmium plated finish; dim., 1-15/16 in. high, 21/32 in. wide, 9/16 in. deep; no electrical rating; 1.897 in. jaw opening, when fully spread; treated for hydrogen embrittlement	Used as tube clip		242890	

TABLE 5-4. TABLE OF REPLACEABLE PARTS (cont)

REF DESIG	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	FUNCTION	MFR AND MFRS DESIG	CONTRS DWG AND PART NO.	ALL SYMBOL DESIG INVOLVED
	— — — — — —	CONNECTOR, ADAPTER: 1 rd female contact one end and 1 rd male contact other end; straight type; over-all dim., 1-1/4 in. lg excluding protruding contact, 23/32 in. dia; contacts electrical rating, 500 v peak; radio frequency connector, 50 ohms nominal impedance, non-constant frequency impedance characteristic; cylindrical body, brass silver plated, locking type; copolymerstyrene insert; receptacle and plug mounted; 5/8 in.-24 NEF-2 thd, inside male end Navy Dwg RE49F389	Coax connector	IPC UG-273/U	716939	
	— — — — — —	CONNECTOR, PLUG: 2 rectangular female contacts; parallel; straight type; over-all dim., 0.9530 in. lg, 1.375 in. dia; contacts electrical rating, 250 V AC, 10 amp (RMS), 125 V AC, 15 amp (RMS); cylindrical shape black cold mold composition body covered w/ steel jacket, steel parts to be zinc plated w/iridite; 0.406 in dia to 0.625 in. dia cable opening; corrosion resistant	AC female connector	HAW 7257	235847	
	— — — — — —	CONNECTOR, PLUG: 2 rectangular male contacts; parallel blades; straight type; over-all dim., 1.156 in. lg excluding contacts, 1-17/32 in. dia; contacts electrical ratings, 250 V AC, 10 amp (RMS), 125 v AC, 15 amp (RMS); cylindrical shape black cold mold composition body covered w/steel jacket, steel parts to be zinc plated w/iridite; 0.296 in. dia to 0.406 in. dia cable opening; corrosion resistant	AC male connector	HAW 7057	235846	
	— — — — — —	CONTACT, ELECTRICAL: p/o lamp; does not incl conducting points; beryllium copper; unbuffed silver plated finish; over-all dim., 0.687 in. lg, 1/4 in. wide, 0.008 in. thick, stock size; 13/32 in. from mounting hole to contact surface, located above mounting hole; one 0.140 in. dia mounting hole, 0.1640 in. from end of contact; incl 0.187 in. dia hole through other end	Pilot lamp assy		304699	
	3Z3282-42.16 — — 8870-585500-375	FUSEHOLDER: extractor post type: 250 v, 15 amp max electrical rating; accommodates one cartridge type fuse over-all dim., 1-1/4 in. lg, 1/4 in. dia; molded bakelite body; lug type brass contacts; over-all dim., 2-5/16 in. lg, 11/16 in. hex; two lug type terminals; panel mounted; corrosion resistant and fungus treated	For 15 amp fuse	BUS HKP-HJWRZ	236260	

	— — — — — —	GASKET: for tube mount; rd shape; over-all dim., 2.225 in. ID, 2.525 in. OD, 0.154 in. thick; mounted w/o.225 in. dia hole; D1(MP-2312) polyiron; coated w/fungicidal lacquer	Prevents RF leakage in tube mount (Z107)	CHL	228964	
	— — — — — —	GASKET: prevents R-F leakage between wave-guide components; sq shape; over-all dim., 1-5/8 in. sq, 0.003 in. thick; mounted w/four 0.193 in. dia mounting holes, on 1.280 in. by 1.220 in. mounting centers; brass, unbuffed silver plated, palladium plated.	Prevents RF leakage between wave-guide components		227456	
	— — — — — —	GASKET: used as spacer and shock mount, between panel and crystal holder; rd shape; over-all dim., 1/2 in. ID, 1.0 in OD, 3/32 in. thick; mounted w/ 1/2 in. dia mounting hole; synthetic rubber	Used as spacer and shock mount between panel and crystal holder		235980	
	— — — — — —	GENERATOR, SWEEP: 1 to 40 mc frequency range, 1 band, 300 to 400 cycles per sec pulse repetition frequency; internally and externally synchronized; resistance tuned oscillator; +300 v DC operating power requirements; non-portable type; over-all dim., 5-5/16 in. lg, 3.0 in. wide, 3-3/8 in. high; used to generate saw-tooth waves for modulating klystron	Amplifier chassis		660662	
	— — — — 6600-324379-7	GROMMET: rubber; fits 0.500 in. dia hole; 0.375 in. ID, 0.062 in. wide groove; temp range from 0°F to 212°F; over-all dim., 5/8 in. dia, 1/4 in. thick	Cable protection	ATI 230	0128-13	
	— — — — — —	KNOB: rd, fluted; bakelite, per JAN-P-14; black; designed to accommodate shaft cylindrical shape, 1/4 in. dia, 0.937 in. deep shaft hole, set screw fastening device; brass insert; w/o marking; over-all dim., 1-3/8 in. dia, 1-1/8 in. lg; counterbored for 0.164 in.-32 cup point allen head screw; incl black alumilite tuning knob drum rim, at one end	Frequency meter coarse tuning	CPT	243080	
	— — — — — —	KNOB: rd, fluted; bakelite; per JAN-P-14, BN-120; black; designed to accommodate shaft, cylindrical shape, 1/4 in. dia, 5/8 in. deep shaft hole, set screw fastening device; brass insert; w/o marking; over-all dim., 1-3/8 in. dia, 11/16 in. thick; counterbored, for two 0.164 in.-32 or 0.190 in. -32 allen head cup point set screws, on side	DBM	DHM -4101A	243064	
	— — — — — —	KNOB: rd, fluted; phenolic, per JAN-P-14, type MTS-E-1; black; designed to accommodate shaft, cylindrical shape, 1/4 in. dia, 11/16 in. deep shaft hole, set screw fastening device; marked "INCREASE"; over-all dim., 1-1/2 in. dia, 13/16 in. thick; counterbored 0.1360 in. dia thru one side, 0.164 in.-32 tap	Signal freq	DHM 4104D	240623	

TABLE 5-4. TABLE OF REPLACEABLE PARTS (cont)

REF DESIG	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	FUNCTION	MFR AND MFRS DESIG	CONTRS DWG AND PART NO.	ALL SYMBOL DESIG INVOLVED
	2Z5822-571 — — 3320-292241-030	KNOB: rd; molded bakelite; black; designed to accommodate a rd, 1/4 in. dia shaft, 33/64 in. deep shaft hole, w/2 set screw attachments, 0.164 in.-32 thd brass insert; w/o marking; dim., 45/64 in. lg, 1-1/8 in. dia; incl two cadmium or zinc plated hardened steel Allen head set screws	Power set, mod lamp, freq fine tuning	KK S-308-64BB	242448	
	2Z5822-77 — — — —	KNOB: rd; molded bakelite per JAN-P-14, grade MTS-E-1; black; designed to accommodate shaft, cylindrical shape, 0.253 in. dia, 13/16 in. deep shaft hole, set screw fastening device; brass insert; indicator line marked on knob; over-all dim., 1-1/2 in. dia, 15/16 in. thick; counterbored for two 0.190 in.-32 hex socket, cup-point, plated set screws	Set zero-fine, signal width, phase, int-FM ext mod	KK S-380-64L-BB	251128	
	— — — — — —	KNOB: rectangular shape; bakelite; black; designed to accommodate shaft, cylindrical shape, 1/4 in. dia, 17/32 in. deepshaft, hole, set screw fastening device; w/o marking; over-all dim., 1-1/2 in. lg, 3/4 in. wide, 0.652 in. thick; counterbored for two 0.164 in.-32 set screws, one 1/4 in. lg, other 7/16 in. lg	Test	NAC HRP-P	243709	
	— — — — — —	NUT, PLAIN, ROUND: leaded brass, ASTM spec no. B16 nickel plated, polished and buffed; finished; wrench drive; 5/8 in.-24 NS-2 thd; dim., 1.0 in. OD, 1/8 in. thick, 13/16 in. wide across flats	Holds output section to front of panel		236376	
	— — — — — —	SHAFT, FLEXIBLE: used to open and close R-F cutoff switch; cylindrical shape; over-all dim., 7.374 in. lg, 5/8 in. dia; coupling mounted; phosphor bronze, nickel plated; incl 1 phosphor bronze casing, 2 phosphor bronze or brass casing end fittings, 2 phosphor bronze or brass coupling nuts, 1/2 in.-20 NF-3 thd, and 2 brass shaft end fittings; corrosion resistant	Open and close RF cutoff switch	WD	240859	
	— — — — — —	SHAFT: cylindrical shape; over-all dim., 2-1/64 in. lg, 1/4 in. dia; arm and plate mounted; plastic; Type PEA natural; flatted one end for arm connection, slotted other end for barn door plate.	RF cut-off switch actuating shaft		235789	
	2Z8304.172 — — 3300-295579677	SHIELD; ELECTRON TUBE: brass, cadmium plated; cylindrical shape; over-all dim., 2-1/4 in. lg, 7/8 in. dia; bayonet type mounting; incl spring; phosphor bronze or beryllium copper, cadmium	Shield for electron tube	CIN TS102UO3	219148	

		plated or unplated stainless steel; corrosion resistant; spec no. JAN-S-28A (except for plating)				
	— — — — — —	SPRING, EXTENSION: dim., 0.655 in. lg, 9/32 in. OD, 0.020 in. dia stock size; music wire, cadmium plated finish; 15 active turns, left hand wound, half loop at center, both ends	Actuates barn door assy		243081	
	— — — — — —	SPRING: over-all dim., 1-7/16 in. lg, 7/16 in. OD, 0.0285 in. dia stock size; phosphor bronze spring wire, unbuffed silver plated and palladium plated; 13 active turns, left hand wound, squared and ground ends	Holds crystal in output section		236278	
	— — — — 8880-735000-1455	TERMINAL LUG: rd link tongue type; copper or brass; tin solder dipped finish; no. 13 AWG wire accommodated; over-all dim., 0.8672 in. lg, 5/16 in. wide, 0.0159 in. to 0.0250 in. thick; soldered wire connections; one 0.138 in. dia mounting hole, on one end; resistant to humidity and corrosion	Holds wire	ZE 46(6)	092-4	
	— — — — — —	WINDOW: attenuator dial window; reactangular shape; over-all dim., 2-1/4 in. lg, 1.0 in. wide, 0.060 in. thick; mounted w/ two 0.104 in. wide, 0.250 in. lg mounting slots, spaced 1-7/8 in. apart C to C; clear plastic sheet, type PAA.	Attenuator dial window		236156	
	— — — — — —	WINDOW: covers a frequency meter dial face; irregular rectangular shape; over-all dim., 3-1/4 in. lg, 1-17/32 in. wide, 0.343 in. thick; mounted w/ 5/16 in.-32 NS-2 tapped hole, on one end; clear plastic molding, flat black lacquer, gloss white enamel	Covers frequency meter dial face		228651	
	— — — — — —	WINDOW: for calibration chart; rectangular shape; over-all dim., 4-3/16 in. lg, 2-9/16 in. wide, 0.015 in. thick; mounted w/ four 9/32 in. lg, by 1/4 in. wide mounting slots, spaced on 3.250 in. by 2.250 in. mounting centers; plastic sheet, type PBA	For calibration chart		830860	

TABLE 5-5. MAINTENANCE PARTS KIT

KEY DESIG	KEY DESIG	KEY DESIG	KEY DESIG
R-111	S-102	Z-105	Clamp (0200-21)
R-112	T-101	Z-106	Clip (242890)
R-115	T-102	Z-110	Clip (285642)
R-116	Z-103	Arm (235790)	Contact (304690)
R-142	Z-104	Arm (815014)	Generator, Sweep (660662)

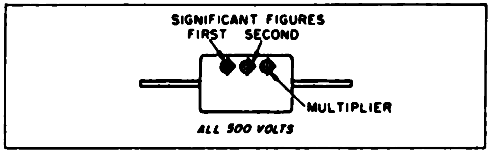
TABLE 5-6. CROSS REFERENCE PARTS LIST

JAN NO.	KEY DESIG	JAN NO.	KEY DESIG	JAN NO.	KEY DESIG	JAN NO.	KEY DESIG
CM20D221J	C-111	RC20BF104J	R-129	RC42BF103J	R-106	6Y6G	V-102
CM20D471J	C-114	RC20BF154J	R-104	RC42BF104J	R-102		
CM35D103J	C-103	RC20BF201J	R-122	RC42BF512J	R-125	**AN NO.**	
CM35D472J	C-108	RC20BF225J	R-101	ST52N	S-101		
CM35D512J	C-115	RC20BF333J	R-103	TS102P01	XV-105	AT-68/UP	Z-101
CP29A1EF103V	C-107	RC20BF334J	R-113	TS102U03	—	CG-409B/U (6)	Z-111
CP29A1EF104K	C-116	RC20BF393J	R-109	OB2	V-105	CG-92A/U (8)	Z-102
CP69B1EF503K	C-102	RC20BF472J	R-126	IN23B	CR-101	CX-337/U (6)	Z-112
CP70B1EH405V	C-101	RC20BF621J	R-121	2K25	V-104	RG-58A/U	—
RA20A1RD102AK	R-123	RC20BF682J	R-135	5R4GY	V-101	RG-9A/U	—
RA20A1SD252AK	R-124	RC30BF201J	R-138	6SH7	V-103	UG-273/U	—
RC20BF102J	R-128	RC30BF333J	R-130	6SL7GT	V-107	3136-323	I-101

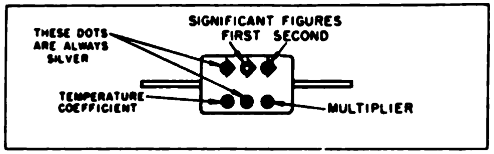
TABLE 5-7. APPLICABLE COLOR CODES AND MISCELLANEOUS DATA

CAPACITOR COLOR CODES

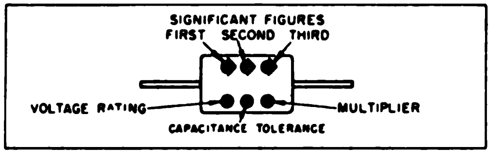
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



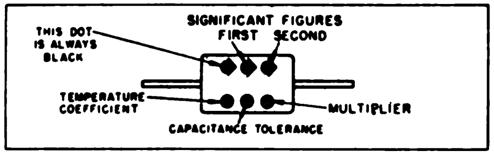
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



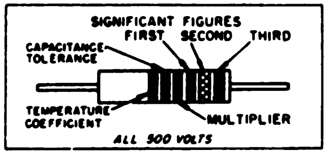
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

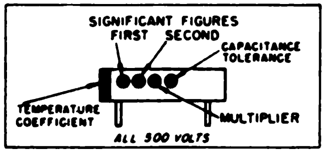


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

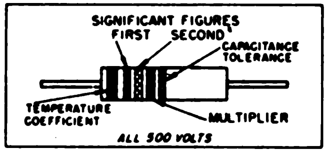


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON-INSULATED



AXIAL TYPE INSULATED



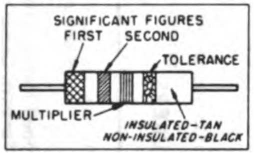
RMA RADIO MANUFACTURERS ASSOCIATION
JAN JOINT ARMY-NAVY

RESISTORS				CAPACITORS				
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	MULTIPLIER: RMA MICA AND CERAMIC-DIELECTRIC	MULTIPLIER: JAN MICA AND PAPER-DIELECTRIC	MULTIPLIER: JAN CERAMIC DIELECTRIC	VOLTAGE RATING	TEMPERATURE COEFFICIENT
	1	0	BLACK	1	1	1		A
	10	1	BROWN	10	10	10	100	B
	100	2	RED	100	100	100	200	C
	1000	3	ORANGE	1000	1000	1000	300	D
	10,000	4	YELLOW	10,000			400	E
	100,000	5	GREEN	100,000			500	F
	1,000,000	6	BLUE	1,000,000			600	G
	10,000,000	7	VIOLET	10,000,000			700	
	100,000,000	8	GRAY	100,000,000		0.01	800	
	1,000,000,000	9	WHITE	1,000,000,000		0.1	900	
5	0.1		GOLD	0.1	0.1		1000	
10	0.01		SILVER	0.01	0.01		2000	
20			NO COLOR				500	

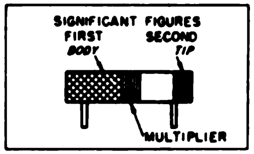
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

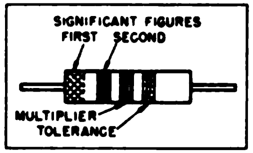


RADIAL TYPE



JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED

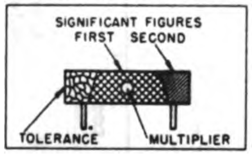


TABLE 5-8. LIST OF MANUFACTURERS

CODE SYMBOL	NAME AND ADDRESS	CODE SYMBOL	NAME AND ADDRESS
AB	Allen-Bradley Co. Milwaukee, Wis.	HAW	Hubbell Harvey Inc. Bridgeport, Conn.
AEV	Aerovox Corp. New Bedford, Mass.	HYT	Hytron Radio & Electronic Corp. Salem, Mass.
AMP	American Phenolic Corp. Chicago, Ill.	IPC	Industrial Products Co. Philadelphia, Pa.
ARP	Aircraft Marine Products Harrisburg, Pa.	IRC	International Resistance Co. Philadelphia, Pa.
ATI	Atlantic India Rubber Works Inc. Chicago, Ill.	MAI	Marion Electrical Instrument Co. Manchester, N. H.
BHE	Birtcher Corp. North Los Angeles, Calif.	OAK	Oak Mfg. Co. Chicago, Ill.
BUS	Bussmann Mfg. Co. St. Louis, Mo.	RCA	Radio Corp. of America New York, N. Y.
CHL	Crowley Henry L. & Co. Inc. West Orange, N. J.	SH	Shakeproof Inc. Chicago, Ill.
CIN	Cinch Mfg. Co. Chicago, Ill.	SLE	Sylvania Electric Products Inc. New York, N. Y.
CPT	Croname Inc. Chicago, Ill.	TBC	Thompson-Bremer & Co. Chicago, Ill.
CUT	Cutler-Hammer Inc. Milwaukee, Wis.	WE	Western Electric Co. New York, N. Y.
DHM	Davies, Harry Moulding Co. Chicago, Ill.	WES	Wesche B. A. Electric Co. Cincinnati, Ohio
FDR	Federal Telephone & Radio Corp. Clifton, N. J.	WG	Wigand, Edwin L. Co. Pittsburg, Pa.
GE	General Electric Co. Schenectady, N. Y.		

INDEX

INDEX

[AG 413.44 (11 May)]

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

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

Official:

JOHN A. KLEIN.
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

CNGB (1)
ASA (3)
Tec Svc, DA (1) except CSIGO (30)
Tec Svc Bd (1)
Hq CONARC (5)
CONARC Bd (Incl ea Test Sec) (1)
Army AA Comd (2)
OS Maj Comd (5)
OS Base Comd (5)
Log Comd (5)
MDW (1)
Armies (5)
Corps (2)
Tng Div (2)
Ft & Cp (2)
Gen & Br Svc Sch (5) except Sig Sch (25)
Gen Depots (2) except Atlanta Gen Depot (None)
Sig Sec, Gen Depots (10)
Sig Depots (20)
Sp Wpn Comd (2)
POE (OS) (2)
Trans Terminal Comd (2)
Army Terminals (2)
OS Sup Agencies (2)
Army Flct PG (1)
Sig Fld Maint Shops (3)
Sig Lab (5)
Mil Dist (1)
ACS (3)
Units organized under following TOE's:
11-7C, Sig Co, Inf Div (2)
11-16C, Hq & Hq Co, Sig Bn, Corps or Abn Corps (2)
11-57C, Armd Sig Co (2)
11-127R, Sig Rep Co (2)
11-128R, Sig Depot Co (2)
11-500R (AA-AE), Sig Svc Org (2)
11-557C, Abn Sig Co (2)
11-587R, Sig Base Maint Co (2)
11-592R, Hq & Hq Co, Sig Base Depot (2)
11-597R, Sig Base Depot Co (2)

NG: State AG (6); units—same as Active Army except allowance is one copy per unit.
USAR: None.
For explanation of abbreviations used, see SR 320-50-1.

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