OPERATION AND ORGANIZATIONAL MAINTENANCE RADIO TEST SETS TS-97/G AND TS-974/U

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

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
SEPTEMBER 1958

AGO 1355A-Sep

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

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

DON'T TAKE CHANCES!

Selenium rectifiers are used in this equipment. When these rectifiers fail, because of burnout or arc-over, poisonous fumes and compounds are released. The fumes have a strong odor. They should not be inhaled.

PROVIDE ADEQUATE VENTILATION IMMEDIATELY AND DO NOT HANDLE THE RECTIFIER UNTIL IT HAS COOLED

TECHNICAL MANUAL
Operation and Organizational Maintenance
RADIO TEST SETS TS-971/G AND TS-974/U

TM 11-6625-205-12

HEADQUARTERS,
DEPARTMENT OF THE ARMY

CHANGES No. 3

WASHINGTON, D.C., *8 October 1963*

TM11-6625-205-12, 10 September 1958, is changed as follows:

Note. The parenthetical reference to previous changes (example: "page 1 of C 2") indicates that pertinent material was published in that change.

Page 3. Make the following changes:

Add paragraph 1.1.

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 available through publications supply channels. The index lists the individual parts (-10, -20, -35P, etc.) and the latest changes to and revisions of each equipment publication.

Delete paragraph 2 (page 2 of C2) and substitute.

2. Forms and Records

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

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

c. Reporting of Equipment Manual Improvements. The direct reporting by the individual user of errors, omissions, and recommendations for improving this manual is authorized and encouraged. DA Form 2028 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 36, chapter 4. Make the following changes.

Change the heading of chapter 4 to: MAINTENANCE INSTRUCTIONS.

Delete paragraphs 40, 41, and 42, and figures 20 and 21, and substitute:

Section I. MAINTENANCE INSTRUCTIONS

40. Scope of Maintenance

The maintenance duties assigned to the operator and unit repairman of Radio Test Sets TS971/G and TS-974/U are listed below together with a reference to the paragraphs covering the specific maintenance functions. The test equipments required are Multimeter AN/URM-105 and Test Set, Electron Tube TV-7/U.

a. Daily preventive maintenance checks and services (par. 42.1).

b. Weekly preventive maintenance checks and services (par. 42.2).

c. Monthly preventive maintenance checks and services (par. 42.3).

d. Quarterly preventive maintenance checks and services (par. 42.4).

e. Cleaning (par. 42.5).

f. Touchup painting (par. 42.6).

g. Visual inspection (par. 43 and 50).

h. Operational check (par. 44).

i. Repairs and adjustments.

(1) Replacement of defective indicator lamps (par. 45*a*).

(2) Replacement of defective fuses (par. 45*b*).

(3) Cable connections (par. 45*c*).

j. Equipment performance check (par. 51).

k. Replacing tubes (pars. 52 and 53).

l. Replacement of meters (par. 54*a*).

41. Preventive Maintenance

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

a. Systematic Care. The procedures given in paragraphs 42.1 through 42.5 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. 42.1 through 42.4) 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 in maintaining combat serviceability, the charts indicate what to check, how to check, and what the normal conditions are; the *References* column lists the paragraphs or manuals that contain detailed repair or replacement procedures. If the defect cannot be remedied by performing the corrective actions listed, higher echelon maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

42. Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of Radio Test Sets TS-971/G and TS-974/U are required daily, weekly, monthly, and quarterly.

a. Paragraph 42.1 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 42.2, 42.3, and 42.4 specify *additional* checks and services that must be performed on a weekly, monthly, and quarterly basis, respectively.

42.1. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedures	References
1	Completeness	See that the equipment is complete (TM 11-6625-243-12P and TM 11-6625-244-12P).	
2	Exterior surfaces	Clean the exterior surfaces, including the panel and meter glasses (par. 42.5). Check all meter glasses and indicator lenses for cracks.	
3	Connectors	Check the tightness of all connectors.	
4	Controls and indicators.	While making the operating checks (item 5), observe that the mechanical action of each knob, dial, and switch is smooth and free of external or internal binding, and that there is no excessive looseness. Also, check the meters for sticking or bent pointers.	
5	Operation	Operate the equipment according to paragraph44	Par. 44.

42.2. Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedures	References
1	Cables	Inspect cords, cables, and wires for chafed, cracked, or frayed insulation. Replace connectors that are broken, arced, stripped, or worn excessively.	
2	Handle and latches	Inspect handle, latches, and hinges for looseness. Replace or tighten as necessary.	
3	Metal surfaces	Inspect exposed metal surfaces for rust and corrosion. Touchup paint as required (para 42.6).	

42.3. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedures	References
1	Pluckout items.....	Inspect seating of pluckout items. Make certain that tube clamps grip tube bases tightly.	
2	Jacks	Inspect jacks for snug fit and good contact.	
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	Gaskets and insulators.	Inspect gaskets, insulators, bushings, and sleeves for cracks, chipping, and excessive wear.	
7	Variable capacitors.....	Inspect variable capacitors for dirt, corrosion, and deformed plates.	
8	Interior	Clean interior of chassis and cabinet.	
9	Operation	Operate the equipment according to paragraph 51	Par. 51.

42.4. Quarterly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedures	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.	TM38-750 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.	TM11-6625-243-12P and TM 11-6625-244-12P

42.5. Cleaning

Inspect the exterior of radio test set. The exterior surfaces should be clean, and free of dust, dirt, grease, and fungus.

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

Warning

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

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

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

Caution

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

d. Clean the front panel, 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.

42.6. 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 40, chapter 5. Delete the heading of chapter 5, section I (paragraphs 46-49), and figure 22.

Page 51, appendix I (page 1 of C 2). Delete appendix I and substitute:

APPENDIX I
REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders and Modification Work Orders.		77/U.
		TM 11-6625-243-12P	Operator's and Organizational Maintenance Repair Parts and Special Tools List for Test Set, Radio TS-971/G.
TM 9-21.3	Painting Instructions for Field Use.	TM 11-6625-244-12P	Operator's and Organizational Maintenance Repair Parts and Special Tools List for Test Set, Radio TS-974/U.
TM 11-2833	Radio Sets AN/VRC-6, -6X, -6Y.		
TM 11-297	Radio Sets AN/VRC-19, -19X, -19Y, -19Z, -19XX, and -19YY.	TM 11-6625-274-12	Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U,
TM 11-6625-203-12	Operation and Organizational Maintenance Manual: Multimeter AN/URM-105, Including Multimeter ME-	and TV-7D/U.	
		TM 38-750	The Army Equipment Record System and Procedures.

By Order of the Secretary of the Army:

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

Official:

J. C. LAMBERT,
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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.

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DEPARTMENT OF THE ARMY TECHNICAL MANUAL
DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

OPERATION AND ORGANIZATIONAL MAINTENANCE RADIO TEST SETS TS-971/G AND TS-974/U

TM 11-6625-205-12
TO 33A1-5-68-1
Changes No. 2

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *13 April 1959*

TM 11-6625-205-12/TO 33A1-5-68-1, 10 September 1958, is changed as follows:

Page 3, paragraph 2:

e. *Added Comments on Maintenance Allocation Chart.* Any comments concerning omissions and discrepancies in the Maintenance Allocation Charts will be prepared on DA For" 2028, and forwarded direct to Commanding Officer, U. S. Army Signal Equipment Support Agency, Fort Monmouth, N. J., ATTN: SIGFM/ES-M.

Page 51, heading. Change "APPENDIX" to: APPENDIX I.

APPENDIX II
MAINTENANCE ALLOCATION CHARTS
(Added)

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1. Scope

The maintenance allocation charts assign maintenance functions and repair operations to be performed by the lowest appropriate maintenance echelon.

2. Maintenance by Using Organizations

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

3. Basic Entries

The basic entries in these Maintenance Allocation Charts do not include mounting hardware such as screws, nuts, bolts, washers, brackets, clamps, etc.

4. Columns in Maintenance Allocation Chart

a. Part or Component. Only the nomenclature or standard item name is annotated in this column.

b. Related Operation. This column indicates the various maintenance functions allocated to the echelon capable of performing the operation. These are defined as follows:

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

(2) *Adjust.* To regulate periodically to prevent malfunction.

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

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

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

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

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

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

c. 1st, 2d, 3d, 4th, 5th Echelons. The symbol X in the appropriate column indicates the echelon responsible for performing that particular maintenance function, but does not necessarily indicate that repair parts will be stocked at that level. Echelons higher than the echelon marked by X are authorized to perform the indicated function.

d. Repair Facilities Code. Code numbers are assigned to each individual tool equipment, test equipment and maintenance equipment listed in paragraph 5. The grouping of codes in the Repair Facilities Code column indicates the tool, test, and maintenance equipment required to perform the maintenance operation.

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

MAINTENANCE ALLOCATION CHART FOR TEST SET, RADIO TS-971/G

PART OR COMPONENT (1)	RELATED OPERATION (2)	1ST ECH. (3)	2ND ECH. (4)	3RD ECH. (5)	4TH ECH. (6)	5TH ECH. (7)	REPAIR FACILITIES CODE (8)	REMARKS (9)
TEST SET, RADIO TS-971/G								
	service	X						
	inspect	X						
	test		X	X	X	X	1,2,3,8,9	
	repair		X				10,11	
	align						4,5,6,7	
	rebuild					X	11	
ADAPTER, CONNECTOR	replace		X					
ALIGNMENT TOOL, ELECTRONIC EQUIPMENT	replace				X			
BRACKETS: MP501, MP607, MP616, MP703	replace				X			Fabricate if required
BUMPER, RUBBER: MP625	replace				X			Fabricate if required
BUSHINGS	replace				X			Fabricate if required
BUTTON, PLUG: (accessory cover)	replace		X					
CABINET, ELECTRICAL EQUIPMENT: A601	replace				X			Obtain from salvage if required
CABLE ASSEMBLY, POWER, ELECTRICAL: W605	repair		X					
CABLE, POWER, ELECTRICAL	replace		X					
CONNECTORS, PLUG, ELECTRICAL	replace		X					
CABLE ASSEMBLIES, RADIO FREQUENCY: W401, W603, W604	repair			X				
CABLE, RADIO FREQUENCY	replace			X				
CONNECTORS, PLUG, ELECTRICAL	replace			X				
CAP, POTENTIOMETER SEAL: MP619	replace				X			
CAPACITORS	replace				X			
CAPACITOR-RESISTOR: E801	replace				X			
CLAMP, LOOP: MP806	replace				X			Fabricate if required
CLIP, ELECTRICAL: E1OO1	replace			X				
COILS	replace				X			
CONNECTORS: Except P609	replace				X			
CONNECTOR, PLUG, ELECTRICAL: P609	replace			X				
CORES, ADJUSTABLE TUNING: E707, E806	replace				X			
COVERS: MP503, MP805, MP814, MP815	replace				X			Fabricate if required
CRYSTAL UNITS, QUARTZ	replace				X			
DECAL: (electron tube location)	replace				X			Fabricate if required
ELECTRON TUBES	replace	X						
FUSES, CARTRIDGE	replace	X						
FUSEHOLDER	replace			X				
GUIDE, TOOL: MP702	replace				X			Fabricate if required
INSULATORS: E705, E807, MP6(,3	replace				X			
KNOB: (accessory door) MP605	replace				X			Fabricate if required

PART OR COMPONENT (1)	RELATED OPERATION (2)	1ST ECH. (3)	2ND ECH. (4)	3RD ECH. (5)	4TH ECH. (6)	5TH ECH. (7)	REPAIR FACILITIES CODE (8)	REMARKS (9)
TS-971/G (continued)								
KNOBS: MP621, MP810	replace		X					
LAMP, INCANDESCENT	replace	X						
LAMPHOLDERS	replace			X				
SPRING, HELICAL, COMPRESSION: MP611	replace			X				Obtain from salvage if required
LENSES, INDICATOR LIGHT	replace		X					
LOUDSPEAKER, PERMANENT MAGNET	replace			X				
MULTIMETERS, REPLACEMENT	replace				X			
	repair				X			
NUTS: (common hardware)	replace			X				Available in Maintenance Equipment ME-9 and Hardware Kit MK-41/U
OVENS, CRYSTAL	replace	X						
PIN, GROOVED, HEADLESS: (top cover fastener)	replace				X			Fabricate if required
PLATES: MP602, MP606, N601	replace				X			Fabricate if required
POST, CRYSTAL HOLD DOWN MOUNTING	replace				X			Fabricate if required
REACTOR: LIOO01	replace				X			
RECTIFIER, METALLIC	replace				X			
RELAY, ARMATURE	replace				X			
RESISTORS	replace				X			
RETAINER, CAPACITOR (C1OO1 mounting): MP1001	replace				X			
RETAINER, CAPACITOR (C914 mounting): MP803	replace				X			Fabricate if required
RETAINERS, CRYSTAL: MP801, MP812	replace				X			
RING, RETAINER (connector): MT617	replace		X					
SCREEN, SPEAKER	replace		X					

PART OR COMPONENT (1)	RELATED OPERATION (2)	1ST ECH. (3)	2ND ECH. (4)	3RD ECH. (5)	4TH ECH. (6)	5TH ECH. (7)	REPAIR FACILITIES CODE (8)	REMARKS (9)
TS-971/G (continued)								
SCREWS (common hardware)	replace			X				Available in Maintenance Equipment ME-9 and Hardware Kit MK-41/U
SEAL, LEAD (potentiometer)	replace				X			Fabricate if required
SHAFT, DRIVE, FLEXIBLE	replace				X			
SHELL, ELECTRICAL CONNECTOR: MP618	replace			X				
SHELLS, ELECTRICAL CONNECTOR: Except MP618	replace				X			
SHIELDS, ELECTRON TUBE	replace		X					
SOCKETS (Crystal and electron tube)	replace				X			
SPRING, CORE ADJUSTING: MP808	replace				X			
SPRING, HELICAL, COMPRESSION: MP807	replace				X			
SPRING, HELICAL, EXTENSION: MP610	replace			X				
SPRING, TENSION CLIP (V813 and V814 hold down)	replace		X					
SQUELCH RELAY	replace				X			
STRAPS, RETAINING (Cable clamps)	replace				X			Fabricate if required
STUD, TURNLOCK FASTENER (Top cover fastener)	replace				X			Fabricate if required
SWITCHES, ROTARY	replace				X			
SWITCH, TOGGLE	replace			X				
TERMINAL BOARDS	replace				X			Fabricate if required. Material available in Maintenance Equipment ME-9
TRANSFORMERS	replace				X			
WASHERS (Common hardware)	replace			X				Available in Maintenance Equipment ME-9 and Hardware Kit MK-41/U

MAINTENANCE ALLOCATION CHART FOR TEST SET, RADIO TS-9741U

PART OR COMPONENT (1)	RELATED OPERATION (2)	1ST ECH. (3)	2ND ECH. (4)	3RD ECH. (5)	4TH ECH. (6)	5TH ECH. (7)	REPAIR FACILITIES CODE (8)	REMARKS (9)
TEST SET, RADIO TS-974/U								
	service	X						
	adjust			X				
	inspect	X						
	test		X	X	X	X	1,2,3,8,9	
	repair		X				10,11	
	align			X	X	X	4,5,6,7	
	rebuild					X	11	
ADAPTER, CONNECTOR	replace		X					
ALIGNMENT TOOL, ELECTRONIC EQUIPMENT	replace	X						
BRACKETS	replace				X			Fabricate if required
BUMPER, RUBBER: Ref Sym MP625	replace				X			Fabricate if required
BUSHINGS	replace				X			Fabricate if required
BUTTON, PLUG (ACCESSORY COVER)	replace		X					
CABINET, ELECTRICAL EQUIPMENT	replace					X		Obtain from salvage if required
CABLE ASSEMBLY, POWER, ELECTRICAL: W605	repair		X					
CABLE, POWER, ELECTRICAL	replace		X					
CONNECTORS, PLUG, ELECTRICAL	replace		X					
CABLE ASSEMBLIES, RADIO FREQUENCY: W401, W603, W604	repair			X				
CABLE, RADIO FREQUENCY	replace			X				
CONNECTORS, PLUG, ELECTRICAL	replace			X				
CAP, POTENTIOMETER SEAL: MP619	replace				X			
CAPACITORS	replace				X			
CAPACITOR-RESISTOR: E201	replace				X			
CLAMP, LOOP: Mp206	replace				X			Fabricate if required
CLIP, ELECTRICAL: E1OO1	replace			X				
COILS	replace				X			
CONNECTORS (EXCEPT P609)	replace				X			
CONNECTOR, PLUG, ELECTRICAL: P609	replace				X			
CORES, ADJUSTABLE TUNING: E107,E206	replace			X				
COVERS: MP205, MP214, MP215, MP503	replace				X			Fabricate if required
CRYSTAL UNITS, QUARTZ	replace				X			
DECAL (ELECTRON TUBE LOCATION)	replace				X			Fabricate if required
ELECTRON TUBES	replace	X						
FUSES, CARTRIDGE	replace	X						
FUSEHOLDER	replace			X				
GUIDE, TOOL: MP102	replace				X			Fabricate if required
INSULATORS: EIO5, E207, MP603	replace				X			
KNOB (ACCESSORY DOOR)	replace				X			Fabricate if required

PART OR COMPONENT (1)	RELATED OPERATION (2)	1ST ECH. (3)	2ND ECH. (4)	3RD ECH. (5)	4TH ECH. (6)	5TH ECH. (7)	REPAIR FACILITIES CODE (8)	REMARKS (9)
TS-974/U (continued)								
KNOBS: MP210, MP621	replace		X					
LAMP, INCANDESCENT	replace	X						
LAMPHOLDER	replace			X				
SPRING, HELICAL, COMPRESSION: MP611	replace			X				Obtain from salvage if require
LENSES, INDICATOR, LIGHT	replace		X					
LOUDSPEAKER, PERMANENT MAGNET	replace			X				
MULTIMETERS, REPLACEMENT	replace				X			
	repair				X			
NUTS (COMMON HARDWARE)	replace			X				Available in Maintenance equipment ME-9 and Hardware Kit MK-41/U
OVENS, CRYSTAL	replace				X			
PIN, GROOVED, HEADLESS (TOP COVER FASTENER)	replace				X			Fabricate if required
PLATES: MP602, MP606, N601	replace				X			Fabricate if required
POST, CRYSTAL HOLD DOWN MOUNTING	replace				X			Fabricate if required
REACTOR: L101	replace				X			
RECTIFIER, METALLIC	replace				X			
RELAY, ARMATURE	replace				X			
RESISTORS	replace				X			
RETAINER, CAPACITOR (C1OO1 MOUNTING): MP1OO1	replace				X			
RETAINER, CAPACITOR (C305 MOUNTING): MP203	replace				X			Fabricate if required
RETAINERS, CRYSTAL: MP201, MP212	replace				X			
RING, RETAINER (CONNECTOR): MP617	replace		X					
SCREEN, SPEAKER	replace		X					
SCREWS (COMMON HARDWARE)	replace			X				Available in Maintenance Equipment ME-9 and and Hardware Kit MK-41/U
SEAL, LEAD (POTENTIOMETER)	replace				X			Fabricate if required
SHAFT, FLEXIBLE DRIVE	replace				X			
SHELL, ELECTRICAL CONNECTOR: MP618	replace			X				
SHELLS, ELECTRICAL CONNECTOR (EXCEPT MP618)	replace				X			
SHIELDS, ELECTRON TUBE	replace		X					
SOCKETS (CRYSTAL AND ELECTRON TUBE)	replace				X			
SPRING, CORE ADJUSTING: MP208	replace				X			
SPRING, HELICAL COMPRESSION: MP207	replace				X			
SPRING, HELICAL, EXTENSION: MP610	replace			X				
SPRING, TENSION CLIP (V213 and V214 HOLD DOWN)	replace		X					
SQUELCH RELAY	replace				X			
STRAPS, RETAINING (CABLE CLAMPS)	replace				X			Fabricate if required
STUD, TURNLOCK FASTENER (TOP COVER FASTENER)	replace				X			Fabricate if required
SWITCHES, ROTARY	replace				X			

PART OR COMPONENT (1)	RELATED OPERATION (2)	1ST ECH. (3)	2ND ECH. (4)	3RD ECH. (5)	4TH ECH. (6)	5TH ECH. (7)	REPAIR FACILITIES CODE (8)	REMARKS (9)
TS-974/U (continued)								
SWITCH, TOGGLE	replace			X				
TERMINAL BOARDS	replace				X			Fabricate if required; material available in Maintenance Equipment ME-9
TRANSFORMERS	replace				X			
WASHERS (COMMON HARDWARE)	replace			X				Available in Maintenance Equipment, ME-9 and and Hardware Kit MK-41/U
WASHER, SPRING TENSION (COIL TENSION): MP104	replace				X			

5. Columns for Allocation of Tools for Maintenance Functions for Test Sets, Radio TS-9711G and TS-974/U

a. Facilities Required for Maintenance Operations. Tool, test and maintenance equipment required to perform the maintenance functions are listed in this column and coded in the Repair Facilities Code column.

b. 1st, 2d, 3d, 4th, 5th Echelon. The dagger symbol (†) placed in columns 3 through 6 indicates the echelons allocated the facility.

c. Remarks. This entry is an explanatory note.

ALLOCATION OF TOOLS FOR MAINTENANCE FUNCTIONS

FACILITIES REQUIRED FOR MAINTENANCE FUNCTIONS (1)	1ST ECH. (2)	2ND ECH. (3)	3RD ECH. (4)	4TH ECH. (5)	5TH ECH. (6)	REPAIR FACIL-ITIES CODE (7)	REMARKS (8)
ELECTRONIC MULTIMETER TS-505/U			†	†	†	1	
MULTIMETER AN/URM-105		†				2	To be standardized
OSCILLOSCOPE OS-8/U				†	†	3	
TEST SET RADIO AN/GRM-6			†			4	
SIGNAL GENERATOR SG-20/U				†	†	5	
SIGNAL GENERATOR SET AN/URM-25				†	†	6	
SIGNAL GENERATOR TS-497/URR				†	†	7	
TEST SET, ELECTRON TUBE TV-2/U					†	8	
TEST SET, ELECTRON TUBE TV-7/U		†	†	†		9	
TOOL EQUIPMENT TE-41		†				10	
TOOL EQUIPMENT TK-21/G			†	†	†	11	

[AG 413.44 (23 Mar 59)]

BY ORDER OF THE SECRETARIES OF THE ARMY AND THE AIR FORCE:

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

Official:

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

THOMAS D. WHITE,
Chief of Staff, United States Air Force.

Official:

J. L. TARR,
Colonel, United States Air Force,
Director of Administrative Services.

Distribution:

Active Army:

CNGB (1)
Tech Stf, DA (1) except
CSigO (30)
Tech Stf Bd (1)
USA Arty Bd (1)
USA Armor Bd (1)
USA Inf Bd (1)
USA AD Bd (1)
USA Abn & Elect Bd (1)
USA Avn Bd (1)
USA Armor Bd Test Sec (1)
USA AD Bd Test Sec (1)
USA Arctic Test Bd (1)
USCONARC (5)
US ARADCOM (2)
US ARADCOM Rgn (2)
OS Maj Comd (5)
OS Base Comd (5)
Log Comd (5)
MDW (1)
Armies (5) except
First US Army (7)
Corps (2)
Div (2)
AAF (CONUS) (2)
USATC (2)
USMA (5)
Svc Colleges (5)
Br Svc Sch (5) except
USASCS (25)
GENDEP (2) except
Atlanta GENDEP (none)
Sig Sec, GENDEP (10)
Sig Dep (17)
USA Special Warfare Cen (5)
Army Pictorial Cen (2)
Engr Maint Cen (1)
USA Ord Msl Comd (3)
Fld Comd, AFSWP (5)
TASSA (15)
Mid-Western Rgn Ofc (TASSA) (1)
USA Sig Pub Agcy (8)
USA Sig Engr Agcy (1)
USA Comm Agcy (2)
USA Sig Eqp Spt Agcy (2)
USA Sig Msl Spt Agcy (13)
Valley Forge AH (5)
WRAMC (1)
AFIP (1)
AMS (1)
Ports of Emb (OS) (2)
Trans Terminal Comd (1)
Army Terminals (1)
OS Sup Agcy (2)
Pine Bluff Arsenal (5)
Yuma Test Sta (2)
Dugway PG (5)
USA Elect PG (1)
Engr RD Lab (5)
Sig Lab (5)
Sig Fld Maint Shops (3)
Mil Dist (1)
USA Corps (Res) (1)
Sector Comd, USA Corps (Res) (1)
JBUSMC (2)

Units org under fol TOE:

10-377 (2)
11-7 (2)
11-16 (2)
11-18 (2)
11-57 (2)
11-500 AA-AE (2)
11-587 (2)
11-592 (2)
11-597 (2)
19-55 (2)
19-56 (2)
19-57 (2)
19-217 (2)
19-500 AA-AE (2)
30-500 (2)
55-17 (2)
55-18 (2)
55-28 (2)
55-116 (2)
55-137 (2)

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

RADIO TEST SETS TS-971/G AND TS-974/U, OPERATION AND ORGANIZATIONAL MAINTENANCE

TM 11-6625-205-12
TO 33A1-5-68-1
CHANGES No. 1

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D.C., *10 February 1959*

TM 11-6625-205-12 to 33A1-5-68-1, 10 September 1958, is changed as follows:

Page 4, paragraph 4*a*, line 3. Change "10 and 15 mc" to 5 and 10 mc.

Paragraph 4*b*, line 3. Change "10 and 15 mc" to 5 and 10 mc.

Page 10, paragraph 14, line 4. Change "WWV antenna" to 2 WWV antennas.

Page 13, figure 11. Change the inductance value of L103 from "1.25 UH" to 5.6 UH.

Change the frequency of L101 from "15 MC" to 5 MC.

Figure 12. Change the inductance value of L703 from "1.25 UH" to 5.6 UH.

Change the frequency of L701 from "15 MC" to 5 MC.

Page 14, figure 13. Change "C245" to C234.

Page 15, paragraph 21a, line 14. Change "74 me" to 174 mc.

Page 27, paragraph 30, chart, "Function" column, next to last line. Change "15 me" to 5 me.

Page 31, paragraph 32. Make the following changes:

Line 3. Change "10- and 15-mc" to 5- and 10-mc.

Line 19. Change "10 or 15 me" to 5 or 10 me.

Line 4 in column 2. After "switch," add: and between the 5- and 10-mc antenna.

Change "10 me" to 5 me.

Line 5 in column 2. Change "(position B)n to (position A).

Change "15 me" to 10 me.

Line 6 in column 2. Change "(position A)" to (position B).

Page 42, paragraph 51a, line 9 in column 2. Change "Field Radio Repairman" to Electronic Instrument Repairman.

Page 45, paragraph 55. Make the following changes:

Subparagraph a, line 2. Change "10 or 15 mc" to 5 or 10 mc.

Line 4. Change "a special WWV antenna" to two special WWV antennas, one designed for 5 me and the other for 10 mc.

Lines 5 and 6. Change "a suitable low-impedance type antenna" to suitable low-impedance type antenna.

Subparagraph *c*(1), line 3. Change "32 feet for 15-mc operation" to 44 feet for 5-mc operation.

Page 46, figure 23. Change the WW V antenna wire length on each side of the center insulator from "32 FT (15 MC)" to 44 FT (5 MC).

[AG 418.44 (8 Jan 59)]

TAGO 4104A--Feb. 480472°-59

BY ORDER OF THE SECRETARIES OF THE ARMY AND THE AIR FORCE:

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

OFFICIAL:

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Distribution:

Active Army:

ASA (2)
CNGB (1)
Tech Stf, DA (1) except CSigO (30)
Tech Stf Bd (1)
USCONARC (5)
USA Arty Bd (1)
USA Armor Bd (1)
USA Inf Bd (1)
USA AD Bd (1)
USA Abn & Elct Bd (1)
USA Avn Bd (1)
USA Armor Bd Test See (1)
USA Air Def Ed Test See (1)
USA Arctic Test Bd (1)
US ARADCOM (2)
US ARADCOM Rgn (2)
OS Maj Comd (5)
OS Base Comd (5)
Log Comd (5)
MDW (1)
Armies (5)
Corps (2)
Div (2)
AAF (CONUS) (2)
USATC (2)
Svc Colleges (5)
Br Svc Sch (5) except USASCS (25)
GENDEP (2) except Atlanta
GENDEP (None)
Sig See, GENDEP (10)
Sig Depots (17)
Army Pictorial Cen (2)
Engr Maint Cen (1)
TASSA (15)
Mid-Western Rgn Ofe (TASSA) (1)
USA Sig Pub Agcy (8)
USA Sig Engr Agcy (1)
USA Comm Agcy (2)
USA Sig Eqp Spt Agcy (2)
USA Sig Msl Spt Agcy (18)
Pine Bluff Arsenal (5)
WRAMC (1)
AFIP (1)
AMS (1)
Ports of Emb (08) (2)
Trans Terminal Comd (1)
Army Terminals (1)
OS Sup Agey (2)
Dugway PG (5)
Yuma Test Sta (2)
Jefferson PG (5)
USA Elct PG (1)
Engr RD Lab (5)
Sig Lab (5)
Sig Fid Maint Shops (8)
USA Ord Msl Oomd (8)
Fid Comd, AFSWP (5)
Mil Dist (1)
Sector Comd, USA Corps (em) (1)
USA Corps (Res) (1)
JBUSMC (2)
Units organized under following TOE's:
10-477 (2)
11-7 (2)
11-16 (2)
11-18 (2)
11-57 (2)
11600 (AA-AE) (2)
11-S57 (2)
1187 (2)
11-592 (2)
11-597 (2)
19-55 (2)
19-56 (2)
19-57 (2)
19-217 (2)
19-500 (AA-AE) (2)
80-00 (2)
55-17 (2)
6518 (2)
55-28 (2)
55-116 (2)
55-187 (2)

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

TECHNICAL MANUAL
No. 11-6625-205O2
TECHNICAL ORDER
No. 33A1-5-68-1

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *10 September 1958*

RADIO TEST SETS TS-971/G AND TS-974/U
OPERATION AND ORGANIZATIONAL MAINTENANCE

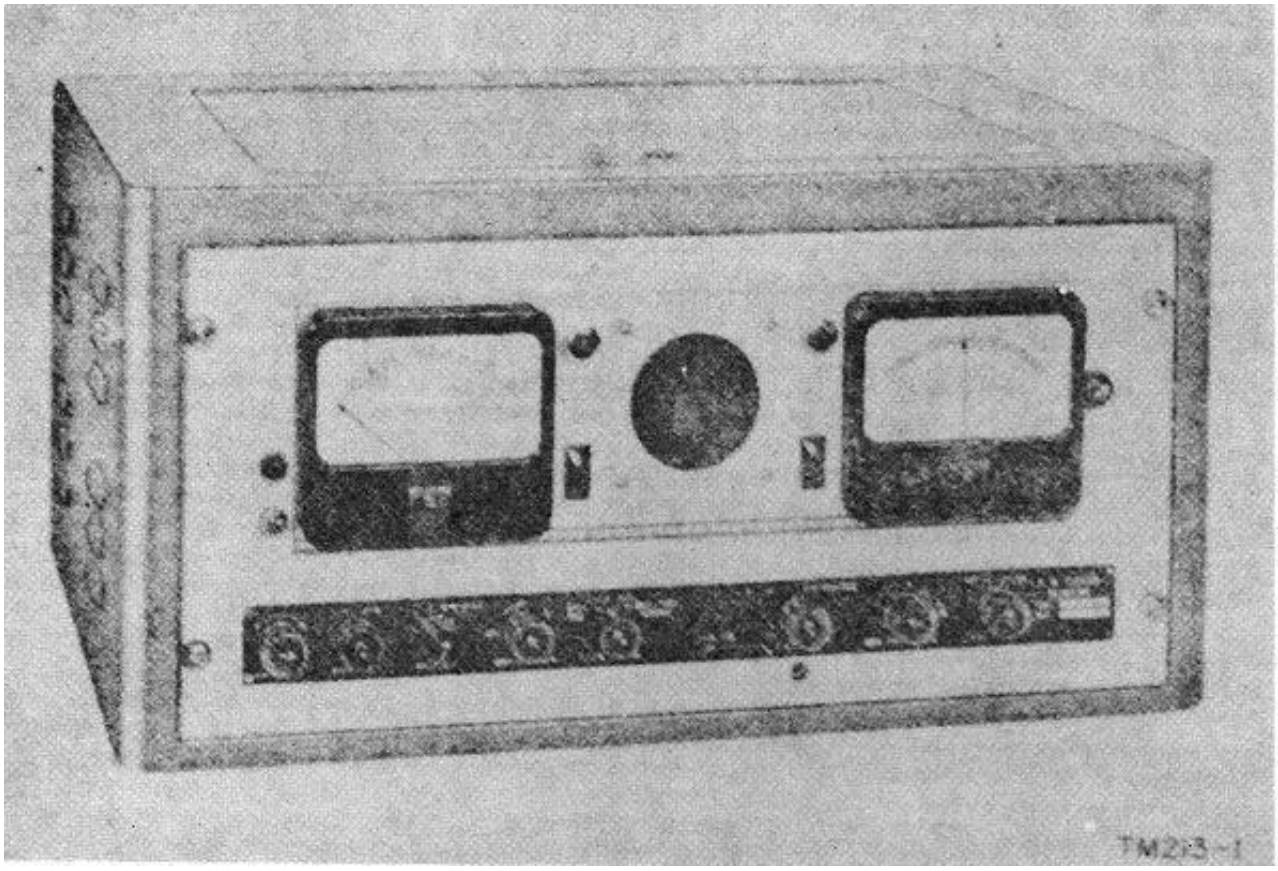

Figure 1. Radio Test Set TS-971/G or TS-974/U, less minor components.

CHAPTER 1
INTRODUCTION

Section I. General

1. Scope

This manual describes Radio Test Sets TS971/G and TS-974/U (fig. 1) and covers their installation, operation, and operator's and organizational maintenance. It includes instructions for the installation of antennas for use with the equipment.

2. Forms and Records

a. Unsatisfactory Equipment Reports.

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

(2) Fill out and forward AF TO Form 29 (Unsatisfactory Report) to the Commander, Air Materiel Command, Wright-Patterson Air Force Base, Ohio, as prescribed in AF TO 0035D-54.

b. Report of Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR-700-58 (Army), Navy Shipping Guide, Article 1850-4 (Navy), and AFR 71-4 (Air Force).

c. Preventive Maintenance Form. Prepare DA Form 11-266 (Maintenance Check List for Signal Equipment (Test Equipment) (figs. 20, 21, and 22)), in accordance with instructions on the form.

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

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Radio Test Sets TS-971/G and TS-974/U (fig. 1) are portable frequency-modulated (FM) station monitors. They have facilities for measuring frequency deviation of a carrier from its assigned frequency, frequency modulation of a carrier signal, and relative signal strength of a monitored transmitter.

b. The radio test sets consist essentially of a WWV receiver, a control receiver, a squelch relay, and a power supply, all assembled to a panel and enclosed in a metal cabinet. Cable assemblies provide interconnection between all units. Controls are conveniently positioned on the front panel.

c. The radio test sets operate on the heterodyne principle. A station frequency is monitored by heterodyning its carrier with the output frequency of a crystal oscillator and then feeding the resulting beat frequency of the two signals into the calibrated control receiver. If the beat frequency between the crystal oscillator signal and the monitored carrier is exactly equal to the frequency to which the receiver is alined, the CARRIER FREQUENCY meter will indicate zero or no reading. If the beat frequency is lower or higher than the alined frequency, a direct indication of carrier frequency error (deviation) of the monitored transmitter will be given on the CARRIER FREQUENCY meter.

d. The TS-974/U has a frequency range of 30 to 50 megacycles (me). The TS-971/G has a frequency range of 152 to 174 mc.

e. The TS-974/U can be used for testing Radio Set AN/VRC-19. The TS-971/G can be used for testing Radio Set AN/VRC-6.

4. Technical Characteristics

a. Radio Test Set TS-974/U.

Frequency range	30 to 50 mc.
WWV receiver frequency	Built-in unit, pretuned to 10 and 15 mc.
WWV receiver sensitivity	5 to 12 microvolts.
Spurious response	With monitor circuits peaked on desired channel, all spurious responses are attenuated at least 35 db.
Frequency stability	Without recalibration, operating frequency is maintained constant over ambient temperature range within ±750 cycles or ±.0015 to .0025%.
Temperature range	4° to +140° F. (-20° to +600 C.).
Channel sensitivity (depends on :frequency to which monitor RF stages are alined):	
Primary channel	8 microvolts.
Secondary channels	2,000 microvolts max.
Primary power source.	117 volts ac, 60 cycles.
Total power input:	
Monitor position	-50 watts, normal.
WWV receiver on	65 watts, calibrate.
Power supply rating	185 volts dc at 60 ma. 6.3 volts ac at 5 amp.
Audio power output	Approx .5 watt to 3-ohm loudspeaker with less than 5 percent distortion.
Modulation accuracy	Excursions may be measured accurately to within ±500 cycles.
Carrier frequency error	Less than ±.001/%.
Meters, 4 1/2-inch dual-scale:	
Mocroammeter (carrier frequency).	Calibrated in kc for direct reading of carrier frequency error. Calibrated in microamperes for monitor circuit alinement.
Decibel meter (modulation deviation).	Calibrated in kc for direct reading of modulation deviation. Calibrated in db for line-level indications.
Number of tubes	25.
Dimension	21 inches wide. 13 1/2 inches deep. 10 1/2 inches high.
Weight	50 lb complete. 56 1/2 lb packed.

b. Radio Test Set TS-971/G.

Frequency range	152 to 174 mc.
WWV receiver frequency	Built-in unit, pretuned to 10 and 15 mc.
WWV receiver sensitivity	5 to 12 microvolts.
Spurious response	With monitor circuits peaked on desired channel, all spurious responses are attenuated at least 35 db.
Frequency stability	Without recalibration, operating frequency is maintained constant over ambient temperature range within ±1,000 cycles or ±.0006%.
Temperature range	4° to +140° F. (-20° to +60° C.).
Channel sensitivity (depends on frequency to which monitor RF stages are alined):	
Primary channel	8 microvolts.
Secondary channels	2,000 microvolts max.
Primary power source	117 volts ac, 60 cycles.
Total power input:	
Monitor position	50 watts, normal.
WWV receiver on	65 watts, calibrate.
Power supply rating	185 volts dc at 60 ma. 6.3 volts ac at 5 amp.
Audio power output	Approx .5 watt to 3-ohm loudspeaker with less than 5% distortion.
Modulation accuracy	Excursions may be measured accurately to with-in ±500 cycles.
Carrier frequency error	Less than ±.0003%.
Meters, 4 1/2-inch dual-scale:	
Microammeter (carrier frequency).	Calibrated in kc for direct reading of carrier frequency error. Calibrated in microamperes for monitor circuit alinement.
Decibel meter (modulation deviation).	Calibrated in kc for direct reading of modulation deviation. Calibrated in db for line-level indications.
Number of tubes	26.
Dimensions	21 inches wide. 13 1/2 inches deep. 101/2 inches high.
Weight	-50 lb complete. 56 1/2 lb packed.

5. Components of Radio Test Sets TS-971/G and TS-974/U

a. Components (fig. 2).

Quantity Radio test set TS/971-G	Quantity Radio test set TS-974/U	Item	Height (in.)	Depth (in.)	Width (in.)	Unit weight (lb.)
0	1	WWV Receiver PA-7226-B	2 3/4	7 1/2	16 1/2	3 1/2
1	0	WWV Receiver PA-7225-B	2 3/4	7 1/2	16 1/2	4
0	1	Control Receiver PA-9034-F	3 1/4	7 1/2	15	4.9
1	0	Control Receiver PA-9033-F	3 1/4	7 1/2	15	5.1
1	1	Power Supply P-8531	2 1/4	5 1/4	15	6
1	1	Squelch Relay TK305	3 3/8	2 3/4	1 5/8	5/8
1	1	Front Panel K-7221-A	8 3/4	7	19	11.8
1	1	Cabinet K-7222	10 5/8	13 5/8	20 1/4	20 1/2
1	1	Ac Outlet K-7223-A	3 1/4	2 1/2	1 1/2	3/8
2	2	TM 11-6625-205-12	11	1/2	8 1/2	1
2	2	Antenna lead-in connector				
1	1	Ac power cord				
1	1	Calibration card				
1	1	Alinement tool				
1 set	1 set	Running spares (b below)				

b. Running Spares.

Quantity Radio test set TS-971/G	Quantity Radio test set TS-9474/U	Item
1	1	Electron tube, OB2
2	0	Electron tube, 6AK5
1	1	Electron tube, 6AK6
1	1	Electron tube, 6AQ5
1	1	Electron tube, 6AT6
1	1	Electron tube, 6BE6
1	1	Electron tube, 6BF7
3	3	Electron tube, 6BH6
1	1	Electron tube, 6BJ6
1	1	Electron tube, 6C4
1	2	Electron tube, 6CB6
1	0	Electron tube, 6J6
I	1	Electron tube, 12AT7
1	1	Electron tube, 5963
6	6	Fuse F1001, % amp
6	0	Fuse F1002, 4/o amp
2	2	Incandescent lamp, 6-8 v, .5 amp
0	1	Crystal, 35 mc
0	1	Crystal, 45 mc
1	0	Crystal, 150 mc
1	0	Crystal, 160 mc

6. Common Names

Nomenclature	Common name
Radio Test Set TS-971/G or TS-974/U.	Radio test set.
WWV Receiver PA:-7225-B or PA-7226-B.	WWV receiver.
Control Receiver PA-9033-F or PA-9034-F.	Control receiver.
Power Supply P-8531	Power supply.
Squelch Relay TK305	Squelch relay.
Front Panel K-7221-A	Front panel.
Cabinet K-7222	Cabinet.
Ac Outlet K-7223-A	Ac outlet.

7. Description of WWV Receivers PA-7225-B and PA-7226-B

(fig. 3)

The WWV receivers are specially designed amplitude-modulated (AM) superheterodyne receivers incorporating a crystal-controlled and temperature-compensated oscillator. They are designed for the reception of primary standard signals from radio station WWV, Washington, D. C. A very high-frequency (VHF) antenna

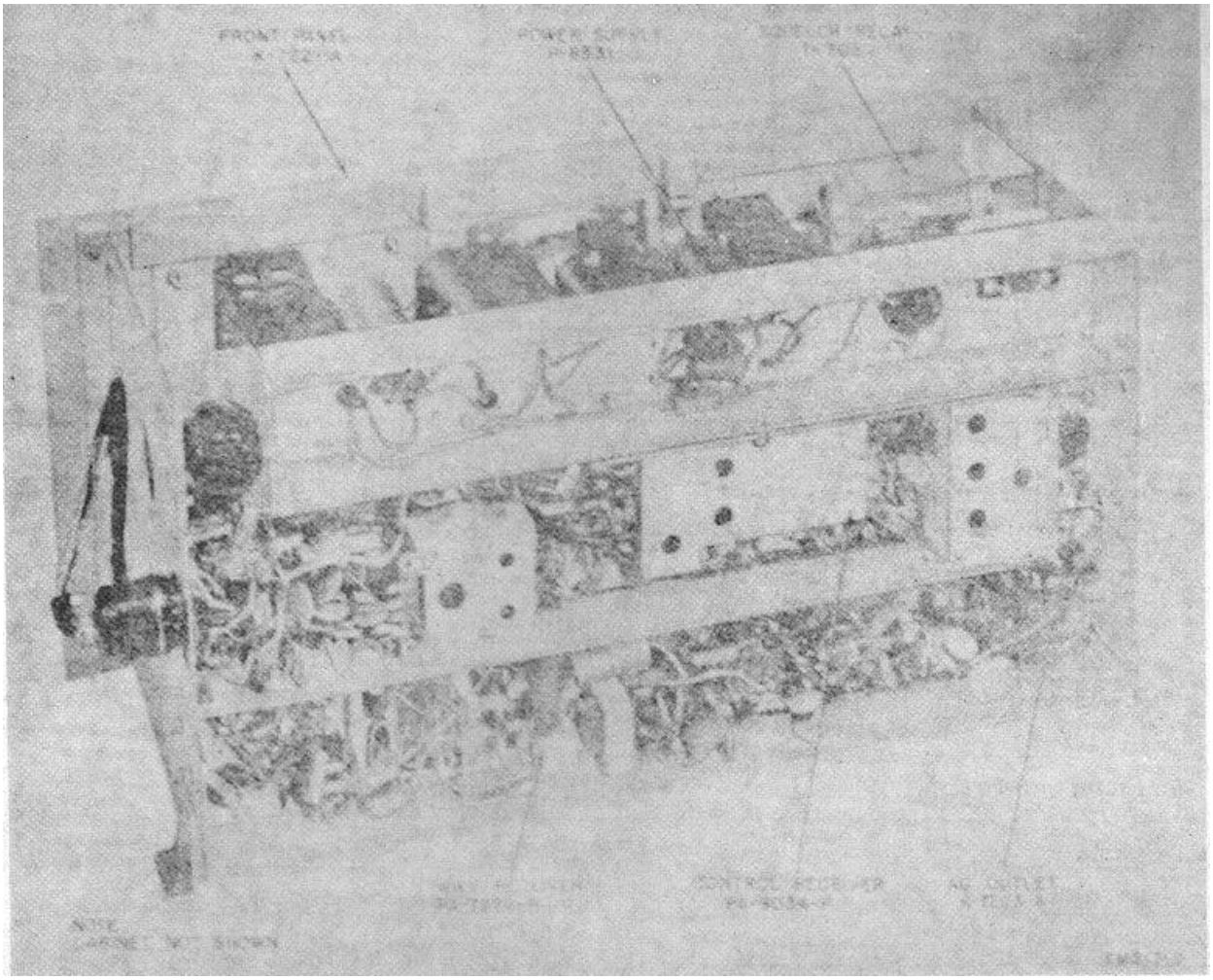

Figure 2. Radio Test Set TS-974/ U, major components (rear view, cabinet removed).

is used to pick up signals from the transmitter being monitored, for application to the calibrating oscillator section. A selector switch selects any one of six crystals as the frequency-controlling element for the oscillator. One of these crystals is used for calibrating the control receiver. The remaining five crystals are used to establish the calibrating oscillator at five specific output frequencies for measurement of different carrier frequencies.

8. Description of Control Receivers PA-9033-F and PA-9034-F

The control receivers are FM, double-superheterodyne receivers designed for reception of carrier- signals with ±15 kilocycles (kc) maximum deviation. The control receivers are alined to one of three predetermined frequencies. The 6 specific frequency used will depend upon the frequency difference between the carriers to be monitored and the particular harmonics emitted by the channel crystals which will be used to beat with these carriers. The PA-9034-F (fig. 4) is alined to 5, 40, or 45 me and employs 16 electron tubes. The PA-9033-F is alined to 150, 155, or 160 me and employs 17 electron tubes.

9. Description of Power Supply P-8531
(fig. 5)

The power supply operates on 117 volts alternating current (ac) at 60 cycles per second (cps). The unit supplies all voltages necessary for the operation of the radio test set. B+ voltage is obtained from a full-wave, bridge-type, selenium rectifier.

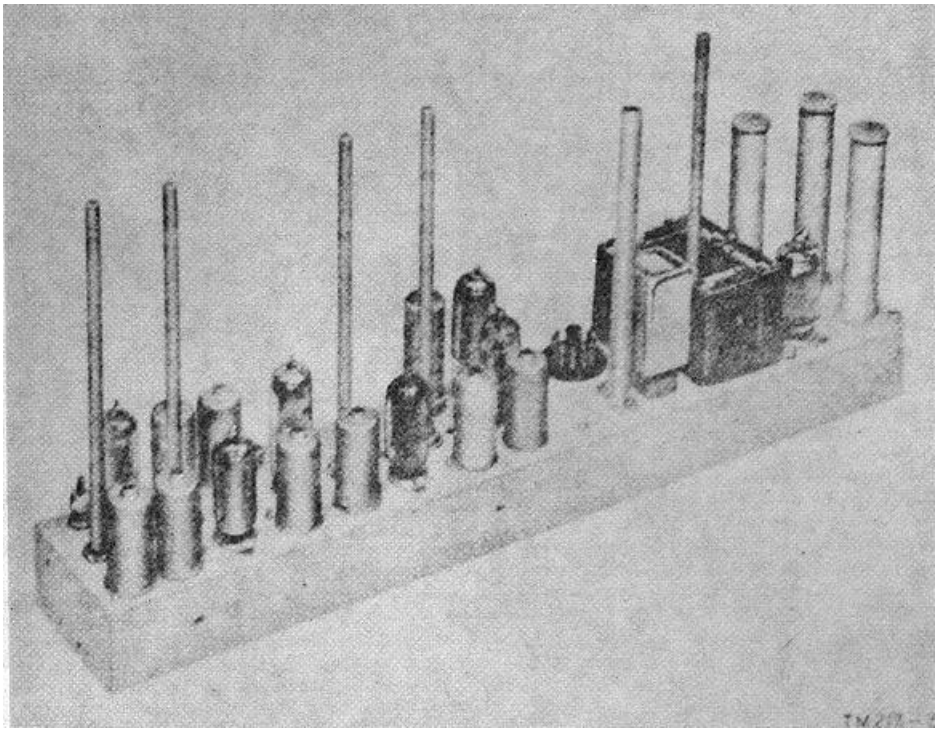

Figure 3. WWV Receiver PA-7225-B.

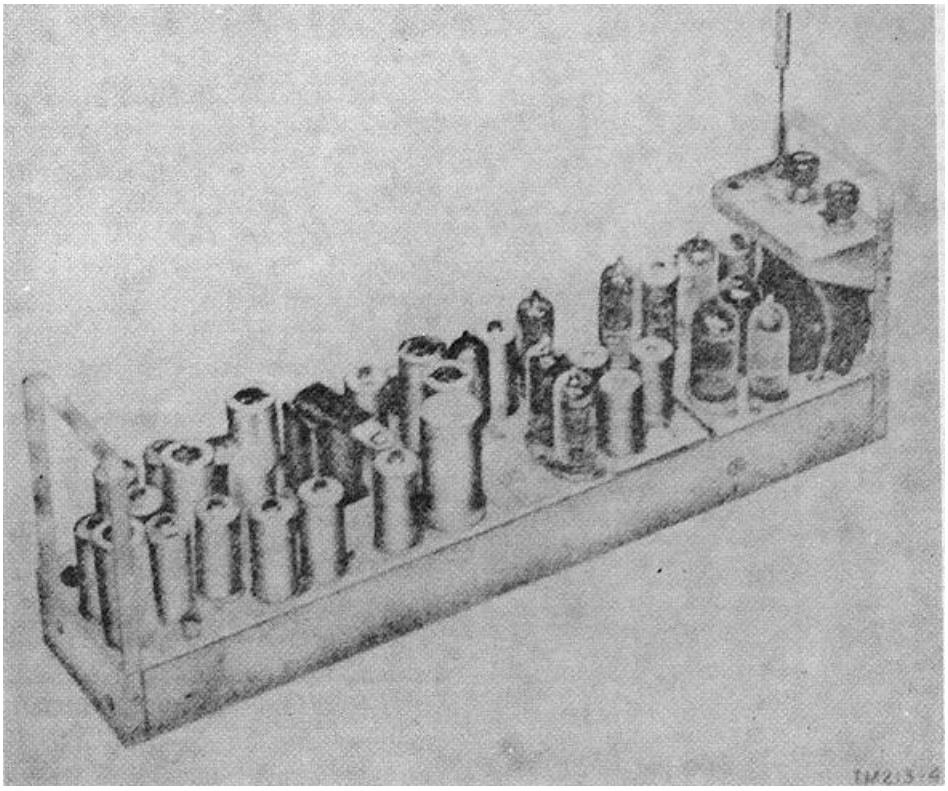

Figure 4. Control Receiver PA-9034-F.

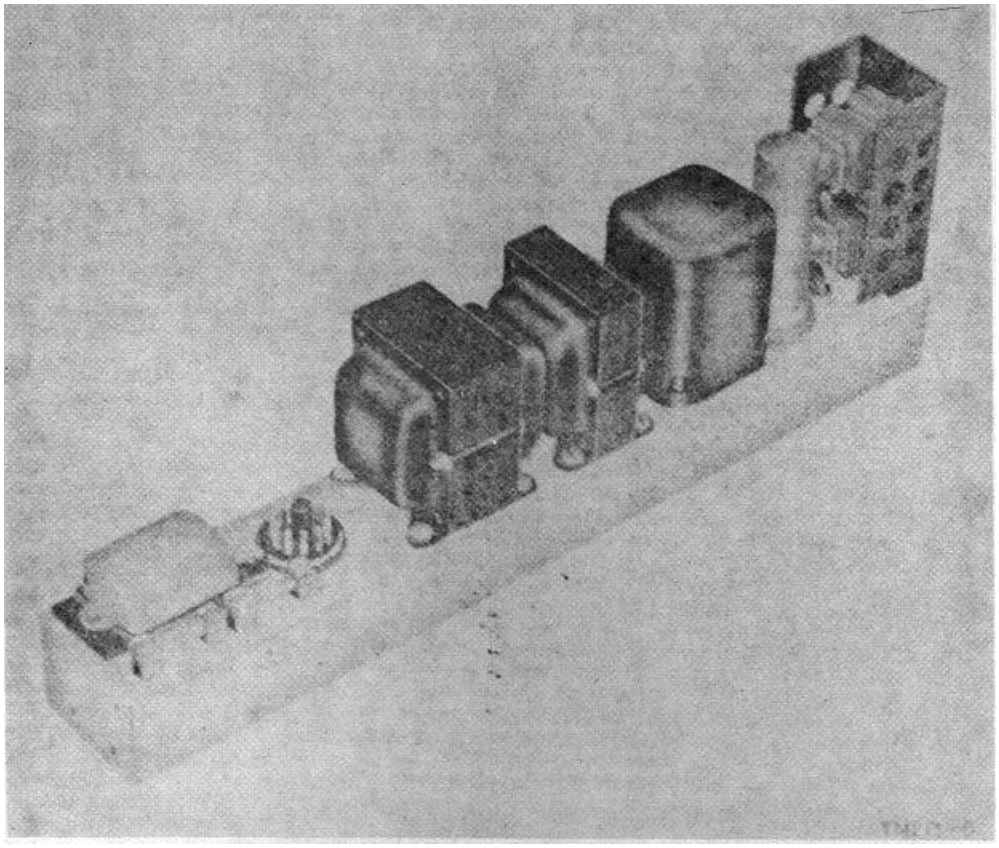

Figure 5. Power Supply P-8531.

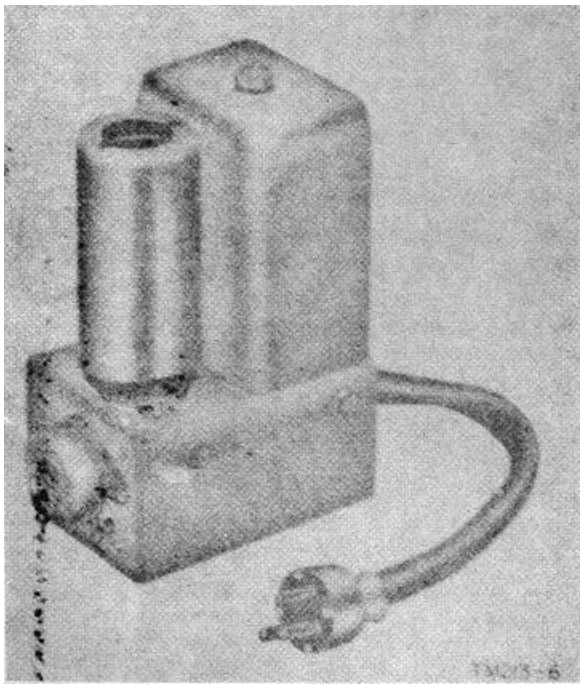

Figure 6. Squelch Relay TK305.

10. Description of Squelch Relay TK305

(fig. 6)

The squelch relay is a vacuum-tube operated relay designed to provide positive indication of radio frequency (RF) carrier signal reception. A sensitivity control provides accurate setting of relay operation to allow closure only with reception of signal levels sufficiently strong to produce from 8 to 26 decibels (db) of noise quieting.

11. Description of Front Panel K-7221-A

(fig. 7)

All subassemblies are mounted to the front panel. This panel may be removed from the cabinet and installed on a standard 19-inch rack. The front panel includes a front access door on which are mounted the CARRIER FREQUENCY and MODULATION DEVIATION meters, the loudspeaker, and the indicators. Lowering this front door permits access to the interior controls and adjustments. Two mount

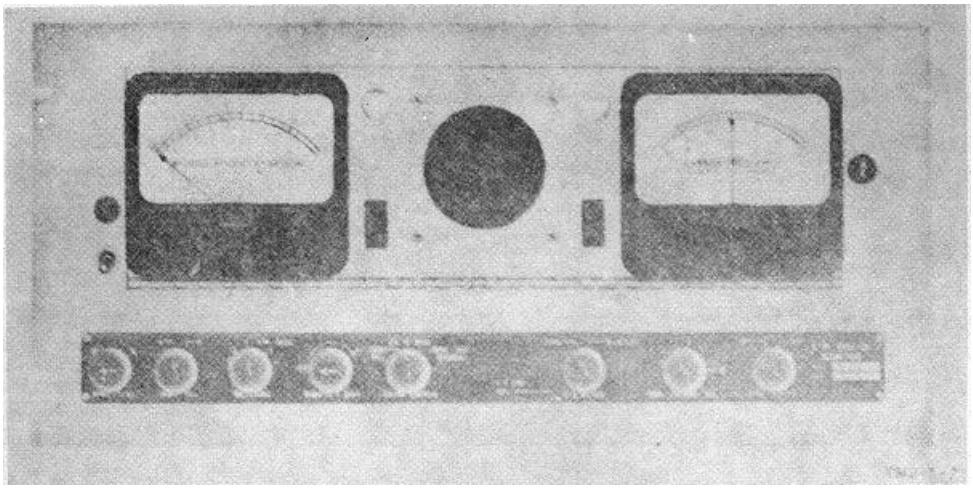

Figure 7. Front Panel K-7221-A.

ing brackets, assembled at the rear of the panel, provide support for all the chassis units. The front panel, with brackets, measures 83/4 inches high, 19 inches wide, and 7 inches deep.

12. Description of Cabinet K-7222

(fig. 8)

The cabinet is designed for table-top installation of the radio test set. The all-steel housing incorporates a piano-hinged top access door and a removable back panel, permitting access to the chassis units. A spare-crystal mounting bracket is assembled to the inner side of the removable panel, Louvers in each end of the cabinet provide adequate circulation for heat dissipation. The cabinet measures 105/8 inches high, 201/i inches wide, and 135/8 inches deep.

13. Description of Ac Outlet K-7223-A

(fig. 9)

The ac outlet is a small chassis mounted below one end of the power supply and on one the

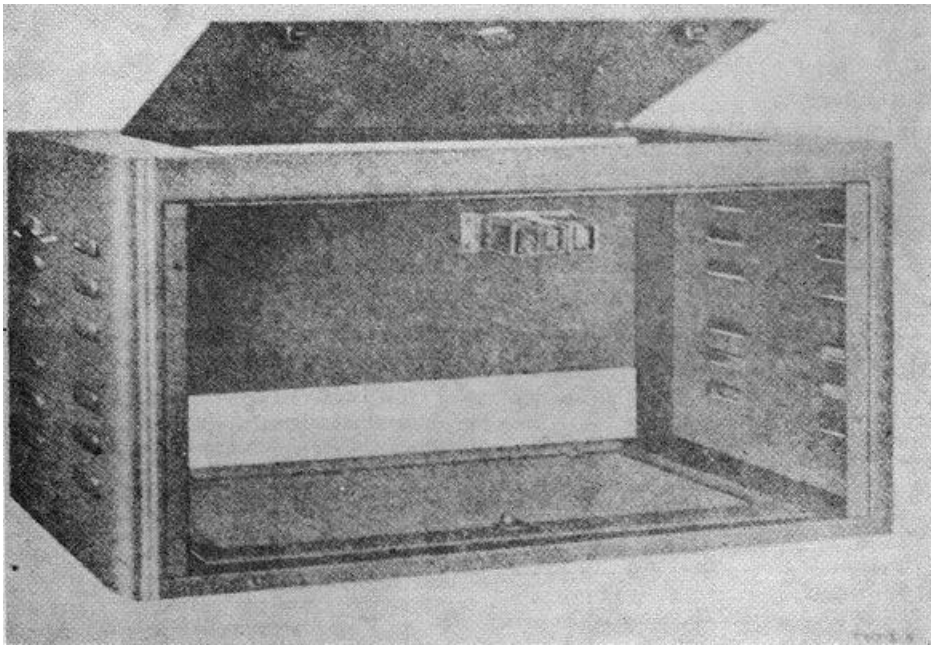

Figure 8. Cabinet K-7222,

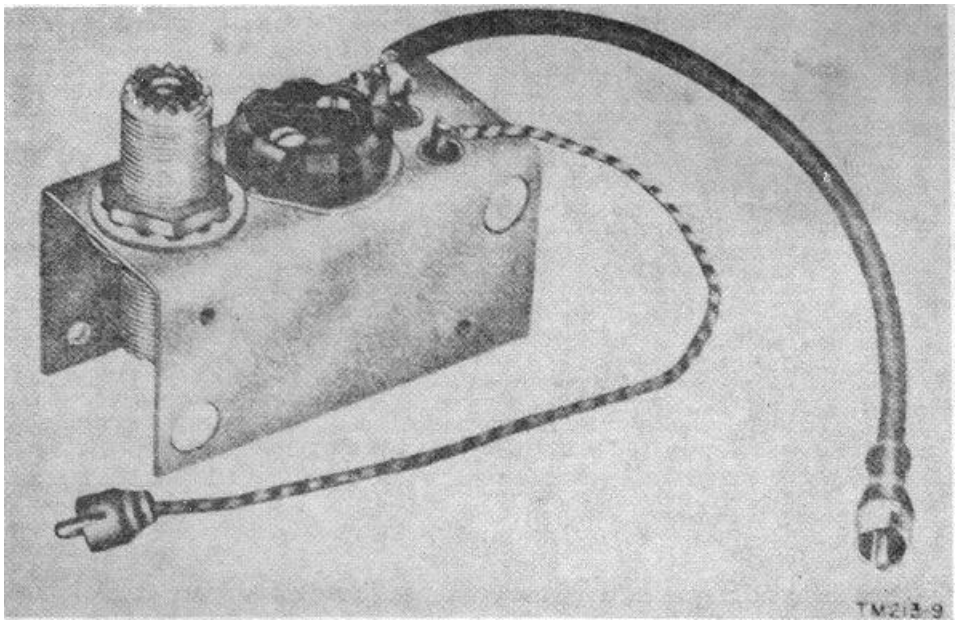

Figure 9. Ac Outlet K-7223-A.

front-panel. brackets. It serves as a distribution center for externally applied 115-volt ac power, WWV signals, and vhf signals. It measures 831 inches high, 11/2 inches wide, and 21/2 inches deep.

14. Additional Equipment Required

The following equipment is not supplied as part of the radio test set, but is required for its operation:

1 WWV antenna.

1 VHF antenna.

Crystals ground to specific frequencies in the range of 1.66 to 12.5 mc. For the specific frequencies, refer to the channel crystal frequency charts in paragraph 21.

15. Differences in Models

a. The external appearance of the TS-974/U and TS-971/G is identical. Characteristic differences between the models are given in the following chart:

Item	Radio test set	
	TS-974/U	TS-971/G
Frequency range.	30 to 50 mc	152 to 174 mc.
Operating frequency stability	Within ±750 cps or ±.0015 to ±0025%.	Within ±1,000 cps or approx ±.0006 %.
Receiver sensitivity.	5 to 12 uv .	5 to 12 uv.
Channel sensitivity.	5 to 2,000 uv	8 to 2,000 uv.
Carrier frequency error.	Less than ±.001%	Less than ±.0003 %.

b. Interchangeability and noninterchangeability of radio test set components are as follows:

Component	Inter changeable	Non-inter-changeable
WWV Receiver PA-7225-B		X
WWV Receiver PA-7226B		X
Control Receiver PA-9033-F		X
Control Receiver PA-9034-F	X	
Power Supply P-8531	X	
Squelch Relay TK305	X	
Front Panel K-7221-A	X	
Cabinet K-7222	X	
Ac Outlet K-7223-A	X	

c. The electrical values of certain parts differ between models. Certain stage circuits are also different.

CHAPTER 2

INSTALLATION

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

16. Unpacking

a. Packaging Data. An exploded view of the method of packaging the radio test set is shown in figure 10. Packaging data is given in the following chart:

Container	Size (in.)			Volume (cu ft)	Unit weight (lb)	Contents
Wooden case _____	25%	19	45½	14.65	210	3 radio test sets in individual cartons.
Outer cardboard carton.	24	17 3/4	13¼	3.92	59	1 radio test set.

b. Removing Contents. Perform all the steps outlined below when unpacking equipment in wooden cases. When unpacking equipment in cartons, omit (1), (2), and (3) below.

(1) Cut and fold back metal straps.

(2) Remove the nails from the top and from one side of the box with a nail puller. Remove the top and one side. Do not attempt to pry them off. This procedure may damage the equipment.

(3) Remove the cartons.

(4) Open the exterior cartons and remove the inner cartons.

(5) Open the inner cartons and remove the radio test sets.

(6) Open the top lids of the radio test set and remove all loose components stored inside.

17. Checking Unpacked Equipment

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

b. Check the equipment against the packing list. When no packing list accompanies the equipment, use of the table of components (par. 5) and/or the packaging data (par. 16*a*) as a general check.

Note. A factory calibration card is contained in an envelope- that is taped to the inside of the top hinged cover of the cabinet. Do not discard this envelope or its contents. The information on the card should also be noted in this manual and cross-referenced to the serial number of the unit it accompanies.

c. If the equipment has been used or reconditioned, check to see whether it has been changed by a Modification Work Order (MWO). If modified, the MWO number will appear on the front panel, or near the nomenclature plate.

18. Placement of Equipment

a. The equipment can be set up on any flat, level surface as close as practicable to the antenna lead-ins and power source. The equipment, less cabinet, may also be assembled on a standard 19-inch equipment rack.

b. Sufficient temperature and humidity control units should be provided to maintain the room or shelter within the temperature limits given in paragraph 4.

19. Special Tool Required for Installation

A special alinement tool is supplied with the equipment (fig. 10). It is used for adjusting the STD. XTAL. ADJ. control on the front panel.

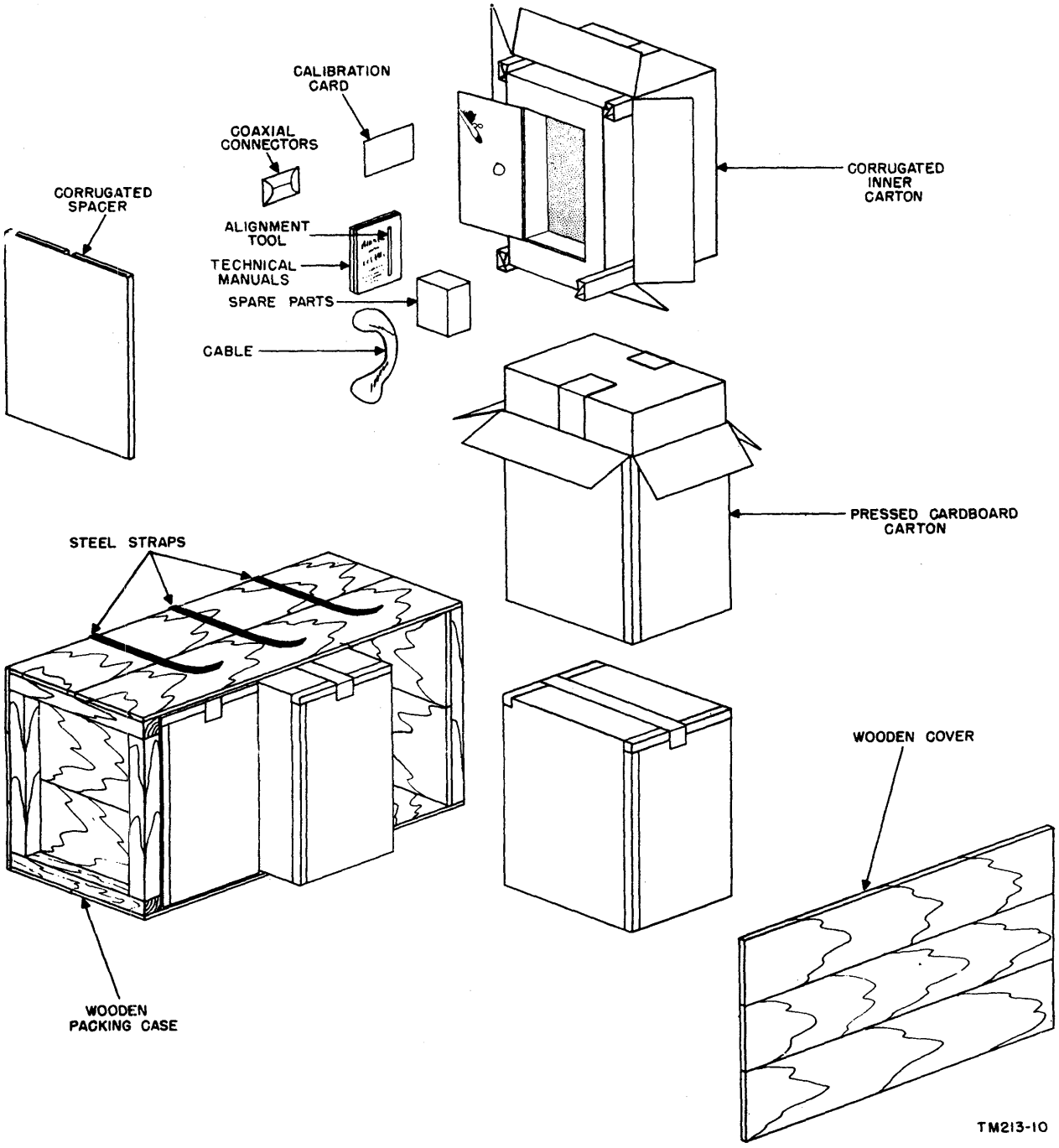

Figure 10. Radio Test Set TS-971/G or TS-9741/ U, typical packaging.

20. Installation of Channel Crystals

The WWV receiver includes the 5-mc calibration crystal when shipped from the factory; however, it does not include the five channel crystals because the values required will depend upon the transmitter frequencies to be monitored. It is necessary for the user of the radio test set to select the proper crystals for the particular application required and to install them in the WWV receiver. Crystal and tube locations are shown in figures 11 through 15. Paragraph 21 includes channel crystal charts for

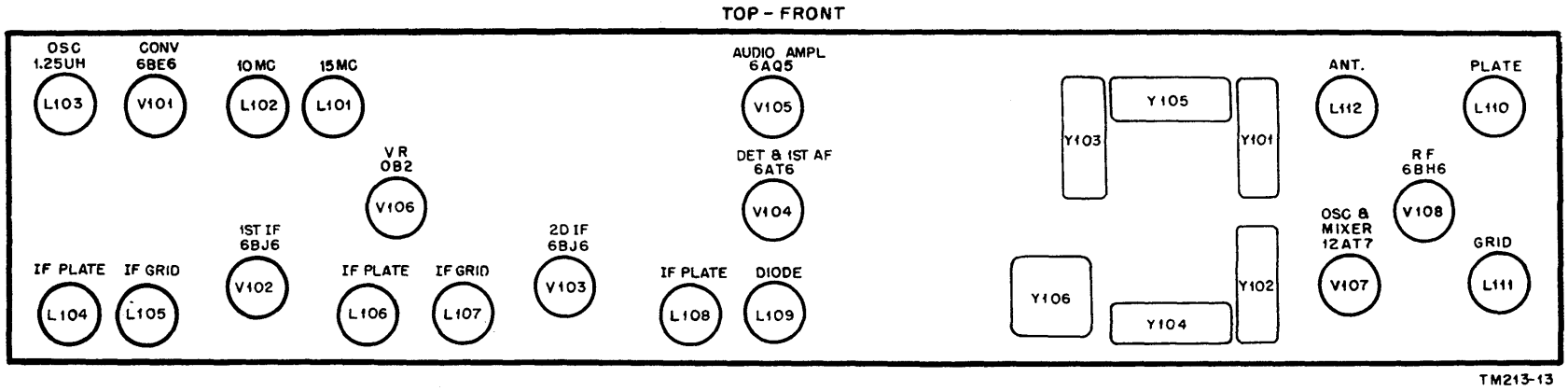

Figure 11. WWV Receiver PA-7226-B, tube and crystal locations.

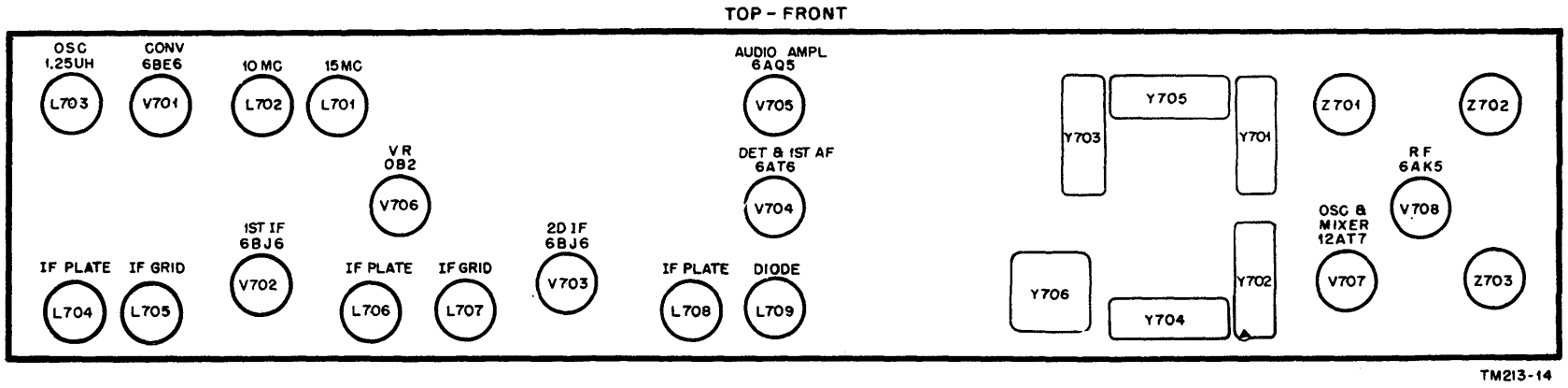

Figure 12. WWV Receiver PA-7225-B, tube and crystal locations.

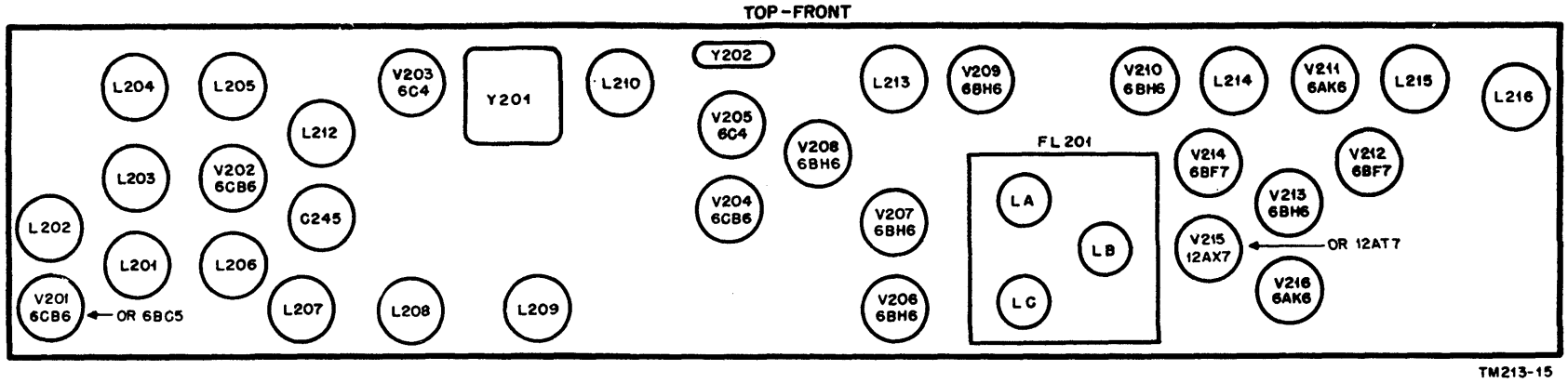

Figure 13. Control Receiver PA-9034-F, tube and crystal locations.

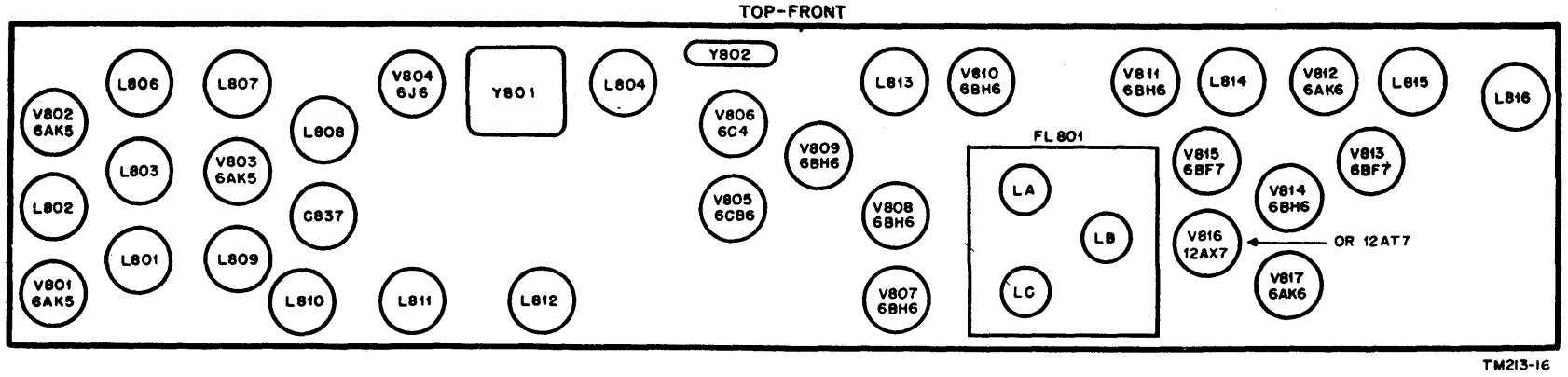

Figure 14. Control Receiver PA-9033-F, tube and crystal locations.

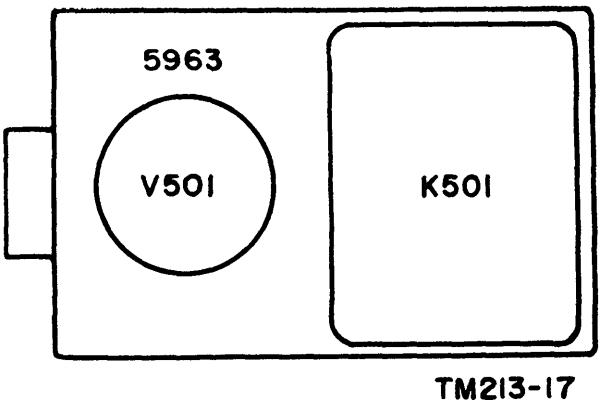

Figure 15. Squelch Relay TK305, tube location.

both radio test sets. These charts list crystal frequencies required for the various transmitter channel frequencies. To install the channel crystals, loosen the four screws holding the back panel to the cabinet. Lift the panel up and away from the cabinet, and plug the crystals into their sockets.

21. Channel Crystal Frequency Charts

a. The radio test sets are designed to monitor any one of five chosen channels within the range of the radio test set without changing crystals. Other channels may be monitored by using other *difference crystals* that are applicable to the particular channels desired to be monitored. The TS-974/U operates in the frequency range of 30 to 50 mc; the control receiver is alined at the factory to 40 mc. Two additional calibrating crystals are provided to aline the receiver to 35 or 45 mc. These extra crystals are mounted in a bracket at the rear of the cabinet. The TS971/G operates in the frequency range of 152 to 74 mc; the control receiver is alined at the factory to 155 me. Two additional calibrating crystals are provided to align the receiver to 150 to 160 me. These extra crystals are mounted at the rear of the cabinet

b. The channel crystal frequency charts list the frequencies of *difference crystals* necessary for monitoring all channels within the specified range. Crystal frequencies are omitted for the channel frequencies where interference occurs within the pass band of the receiver. Channel crystal frequencies for the TS-974/U are as follows:

Channel freq (mc)	Control receiver freq (mc)		
	35	40	45
	Difference crystal freq (mc)		
30.02	4.98		
30.06	4.94	9.94	7.47
30.10	4.90	9.90	7.45
30.14	4.86	9.86	7.43
30.18	4.82	9.82	7.41
30.22	4.78	9.78	7.39
30.26	4.74	9.74	7.37
30.30	4.70	9.70	7.35
30.34	4.66	9.66	7.33
30.38	4.62	9.62	7.31
30.42	4.58	9.58	7.29
30.46	4.54	9.54	7.27
30.50	4.50	9.50	7.25
30.54	4.46	9.46	7.23
30.58		9.42	7.21
30.62		9.38	7.19
30.66		9.34	7.17
30.70		9.30	7.15
30.74		9.26	7.13
30.78		9.22	7.11
30.82		9.18	7.09
30.86	4.14	9.14	7.07
30.90	4.10	9.10	7.05
30.94	4.06	9.06	7.03
30.98	4.02	9.02	7.01
31.02	3.98	8.98	6.99
31.06			
31.10	3.90	8.90	6.95
31.14	3.86	8.86	6.93
31.18	3.82	8.82	6.91
31.22	3.78	8.78	6.89
31.26	3.74	8.74	6.87
31.30	3.70	8.70	6.85
31.34	3.66	8.66	6.83
31.38	3.62	8.62	6.81
31.42	3.58	8.58	6.79
31.46	3.54	8.54	6.77
31.50		8.50	6.75
31.54	3.46	8.46	6.73
31.58	3.42	8.42	6.71
31.62	3.38	8.38	6.69
31.66	3.34	8.34	6.67
31.70	3.30	8.30	6.65
31.74	3.26	8.26	6.63
31.78	3.22	8.22	6.61
31.82	3.18	8.18	6.59
31.86	3.14	8.14	6.57
31.90	3.10	8.10	6.55
31.94	3.06	8.06	6.53
31.98	3.02		6.51
32.02	2.98		6.49
32.06	2.94	7.94	6.47
32.10	2.90	7.90	6.45
32.14	2.86	7.86	
32.18	2.82	7.82	6.41

Channel freq (mc)	Control receiver freq (mc)		
	35	40	45
	Difference crystal freq (mc)		
32.22	2.78	7.78	6.39
32.26	2.74	7.74	6.37
32.30	2.70	7.70	6.35
32.34	2.66	7.66	6.33
32.38	2.62	7.62	6.31
32.42	2.58	7.58	6.29
32.46	2.54	7.54	6.27
32.50		7.50	12.50
32.54	2.46	7.46	12.46
32.58	2.42	7.42	12.42
32.62	2.38	7.38	12.38
32.66		7.34	12.34
32.70	2.30	7.30	12.30
32.74	2.26	7.26	12.26
32.78		7.22	12.22
32.82		7.18	12.18
32.86		7.14	12.14
32.90		7.10	12.10
32.94		7.06	12.06
32.98	2.02	7.02	12.02
33.02	1.98	6.98	11.98
33.06	1.94	6.94	11.94
33.10	1.90	6.90	11.90
33.14	1.86	6.86	11.86
33.18	1.82	6.82	11.82
33.22	1.78	6.78	11.78
33.26	1.74	6.74	11.74
33.30	1.70	6.70	11.70
33.34	1.66		11.66
33.38		6.62	11.62
33.42		6.58	11.58
33.46		6.54	11.54
33.50		6.50	11.50
33.54		6.46	11.46
33.58		6.42	11.42
33.62		6.38	11.38
33.66		6.34	11.34
33.70		6.30	11.30
33.74		6.26	
33.78		6.22	11.22
33.82		6.18	11.18
33.86		6.14	11.14
33.90		6.10	11.10
33.94		6.06	11.06
33.98		6.02	11.02
34.02		5.98	10.98
34.06		5.94	10.94
34.10		5.90	10.90
34.14		5.86	10.86
34.18		5.82	10.82
34.22		5.78	10.78
34.26		5.74	10.74
34.30			10.70
34.34		5.66	10.66
34.38		5.62	10.62

Channel freq (mc)	Control receiver freq (mc)		
	35	40	45
	Difference crystal freq (mc)		
34.42		5.58	10.58
34.46		5.54	10.54
34.50		5.50	10.50
34.54		5.46	10.46
34.58		5.42	10.42
34.62		5.38	10.38
34.66		5.34	10.34
34.70		5.30	10.30
34.74		5.26	10.26
34.78		5.22	10.22
34.82		5.18	10.18
34.86		5.14	10.14
34.90		5.10	10.10
34.94		5.06	10.06
34.98		5.02	10.02
35.02		4.98	9.98
35.06		4.94	9.94
35.10		4.90	9.90
35.14		4.86	9.86
35.18		4.82	9.82
35.22		4.78	9.78
35.26		4.74	9.74
35.30		4.70	9.70
35.34		4.66	9.66
35.38		4.62	9.62
35.42		4.58	9.58
35.46		4.54	9.54
35.50		4.50	9.50
35.54		4.46	9.46
35.58			9.42
35.62			9.38
35.66			9.34
35.70			9.30
35.74			9.26
35.78			9.22
35.82			9.18
35.86		4.14	9.14
35.90		4.10	9.10
35.94		4.06	9.06
35.98		4.02	
36.02		3.98	
36.06		3.94	8.94
36.10		3.90	8.90
36.14		3.86	8.86
36.18		3.82	8.82
36.22		3.78	8.78
36.26		3.74	8.74
36.30		3.70	8.70
36.34		3.66	8.66
36.38		3.62	8.62
36.42		3.58	8.58
36.46		3.54	8.54
36.50		3.50	8.50
36.54		3.46	8.46
36.58		3.42	8.42

Channel freq (mc)	Control receiver freq (mc)		
	35	40	45
	Difference crystal freq (mc)		
36.62		3.38	8.38
36.66			8.34
36.70		3.30	8.30
36.74	1.74	3.26	8.26
36.78	1.78	3.22	8.22
36.82	1.82	3.18	8.18
36.86	1.86	3.14	8.14
36.90	1.90	3.10	8.10
36.94		3.06	8.06
36.98	1.98	3.02	8.02
37.02	2.02	2.98	7.98
37.06		2.94	7.94
37.10		2.90	7.90
37.14			7.86
37.18		2.82	7.82
37.22		2.78	7.78
37.26	2.26	2.74	7.74
37.30	2.30	2.70	7.70
37.34	2.34	2.66	7.66
37.38	2.38	2.62	7.62
37.42	2.42	2.58	7.58
37.46	2.46	2.54	7.54
37.50			39.70
37.54	2.54	2.46	7.46
37.58	2.58	2.42	7.42
37.62	2.62	2.38	7.38
37.66	2.66	2.34	7.34
37.70	2.70	2.30	7.30
37.74	2.74	2.26	7.26
37.78	2.78		7.22
37.82	2.82		7.18
37.86	2.86		7.14
37.90	2.90		7.10
37.94	2.94	2.06	7.06
37.98	2.98	2.02	7.02
38.02	3.02	1.98	6.98
38.06	3.06	1.94	6.94
38.10	3.10		6.90
38.14	3.14	1.86	6.86
38.18	3.18		6.82
38.22	3.22	1.78	6.78
38.26	3.26		6.74
38.30	3.30	1.70	6.70
38.34	3.34		6.66
38.38	3.38		6.62
38.42	3.42		6.58
38.46	3.46		6.54
38.50			6.50
38.54	3.54		6.46
38.58	3.58		
38.62	3.62		6.38
38.66	8.66		6.34
38.70	3.70		6.30
38.74	3.74		6.26
38.78	3.78		6.22

Channel freq (mc)	Control receiver freq (mc)		
	35	40	45
	Difference crystal freq (mc)		
38.82	3.82		6.18
38.86	3.86		6.14
38.90	3.90		6.10
38.94	3.94		6.06
38.98	3.98		6.02
39.02	4.02		5.98
39.06	4.06		5.94
39.10	4.10		5.90
39.14	4.14		5.86
39.18	4.18		5.82
39.22			5.78
39.26			5.74
39.30			5.70
39.34			5.66
39.38			
39.42	4.42		5.58
39.46	4.46		5.54
39.50	4.50		5.50
39.54	4.54		5.46
39.58	4.58		5.42
39.62	4.62		5.38
39.66	4.66		5.34
4.70	5.30		
39.74	4.74		5.26
39.78	4.78		5.22
39.82	4.82		5.18
39.86	4.86		5.14
39.90	4.90		5.10
39.94	4.94		5.06
39.98			5.02
40.02			4.98
40.06	5.06		4.94
40.10	5.10		4.90
40.14	5.14		4.86
40.18	5.18		4.82
40.22	5.22		4.78
40.26	5.26		4.74
40.30	5.30		4.70
40.34	5.34		4.66
40.38	5.38		4.62
40.42	5.42		4.58
40.46	5.46		4.54
40.50	5.50		
40.54	5.54		4.46
40.58	5.58		
40.62	5.62		
40.66	5.66		
40.70	5.70		
40.74	5.74		
40.78	5.78		
40.82			
40.86	5.86		4.14
40.90	5.90		
40.94	5.94		4.06
40.98	5.98		4.02

Channel freq (mc)	Control receiver freq (mc)		
	35	40	45
	Difference crystal freq (mc)		
41.02	6.02		3.98
41.06	6.06		3.94
41.10	6.10		3.90
41.14	6.14		3.86
41.18	6.18		3.82
41.22	6.22		3.78
41.26	6.26		3.74
41.30	6.30		3.70
41.34	6.34		3.66
41.38	6.38		3.62
41.42	6.42		3.58
41.46	6.46		3.54
41.50	6.50		3.50
41.54	6.54		
41.58	6.58		3.42
41.62	6.62		3.38
41.66	6.66		3.34
41.70	6.70	1.70	3.30
41.74	6.74		3.26
41.78	6.78	1.78	
41.82	6.82		3.18
41.86	6.86	1.86	3.14
41.90	6.90	1.90	3.10
41.94	6.94	1.94	3.06
41.98			3.02
42.02		2.02	2.98
42.06	7.06	2.06	2.94
42.10	7.10		2.90
42.14	7.14		2.86
42.18	7.18		2.82
42.22	7.22		2.78
42.26	7.26	2.26	2.74
42.30	7.30	2.30	2.70
42.34	7.34	2.34	2.66
42.38	7.38	2.38	2.62
42.42	7.42	2.42	2.58
42.46	7.46	2.46	2.54
42.50	7.50		
42.54	7.54	2.54	2.46
42.58	7.58	2.58	2.42
42.62	7.62	2.62	
42.66	7.66		2.34
42.70	7.70	2.70	2.30
42.74	7.74	2.74	2.26
42.78	7.78	2.78	
42.82	7.82	2.82	
42.86	7.86		
42.90	7.90	2.90	
42.94	7.94	2.94	2.06
42.98	7.98	2.98	2.02
43.02	8.02	3.02	1.98
43.06	8.06	3.06	1.94
43.10	8.10		1.90
43.14	8.14	3.14	1.86
43.18	8.18	3.18	1.82

Channel freq (mc)	Control receiver freq (mc)		
	35	40	45
	Difference crystal freq (mc)		
43.22	8.22	3.22	1.78
43.26	8.26	3.26	1.74
43.30	8.30	3.30	1.70
43.34	8.34		
43.38	8.38	3.38	
43.42	8.42	3.42	
43.46	8.46	3.46	
43.50	8.50	3.50	
43.54	8.54	3.54	
43.58	8.58	3.58	
43.62	8.62	3.62	
43.66	8.66	3.66	
43.70	8.70	3.70	
43.74		3.74	
43.82	8.82	3.78	
43.78		3.82	
43.86	8.86	3.86	
43.90	8.90	3.90	
43.94	8.94	3.94	
43.98	8.98	3.98	
44.02	9.02	4.02	
44.06	9.06	4.06	
44.10	9.10	4.10	
44.14	9.14	4.14	
44.18	9.18		
44.22	9.22		
44.26	9.26		
44.30	9.30		
44.34	9.34		
44.38	9.38		
44.42	9.42		
44.46	9.46	4.46	
44.50	9.50	4.50	
44.54	9.54	4.54	
44.58	9.58	4.58	
44.62	9.62	4.62	
44.66	9.66	4.66	
44.70	9.70	4.70	
44.74	9.74	4.74	
44.78	9.78	4.78	
44.82	9.82	4.82	
44.86	9.86	4.86	
44.90	9.90	4.90	
44.94	9.94	4.94	
44.98	9.98	4.98	
45.02	10.02	5.02	
45.06	10.06	5.06	
45.10	10.10	5.10	
45.14	10.14	5.14	
45.18	10.18	5.18	
45.22	10.22	5.22	
45.26	10.26	5.26	
45.30	10.30	5.30	
45.34	10.34	5.34	
45.38	10.38	5.38	

Channel freq (mc)	Control receiver freq (mc)		
	35	40	45
	Difference crystal freq (mc)		
45.42	10.42	5.42	
45.46	10.46	5.46	
45.50	10.50	5.50	
45.54	10.54	5.54	
45.58	10.58	5.58	
45.62	10.62	5.62	
45.66	10.66	5.66	
45.70	10.70		
45.74	10.74	5.74	
45.78	10.78	5.78	
45.82	10.82	5.82	
45.86	10.86	5.86	
45.90	10.90	5.90	
45.94	10.94	5.94	
45.98	10.98	5.98	
46.02	11.02	6.02	
46.06	11.06	6.06	
46.10	11.10	6.10	
46.14	11.14	6.14	
46.18	11.18	6.18	
46.22	11.22	6.22	
46.26	11.26	6.26	
46.30	11.30	6.30	
46.34	11.34	6.34	
46.38	11.38	6.38	
46.42	11.42	6.42	
46.46	11.46	6.46	
46.50	11.50	6.50	
46.54	11.54	6.54	
46.58	11.58	6.58	
46.62		6.62	
46.66			1.66
46.70		6.70	1.70
46.74	11.74	6.74	1.74
46.78	11.78	6.78	1.78
46.82	11.82	6.82	1.82
46.86	11.86	6.86	1.86
46.90	11.90	6.90	1.90
46.94	11.94	6.94	1.94
46.98	11.98	6.98	1.98
47.02	12.02	7.02	2.02
47.06	12.06	7.06	2.06
47.10	12.10	7.10	
47.14	12.14	7.14	
47.18	12.18	7.18	
47.22	12.22	7.22	
47.26	12.26	7.26	2.26
47.30	12.30	7.30	2.30
47.34	12.34	7.34	2.34
47.38	12.38	7.38	
47.42	12.42	7.42	2.42
47.46	12.46	7.46	2.46
47.50	12.50	7.50	
47.54	6.27	7.54	2.54
47.58	6.29	7.58	2.58

Channel freq (mc)	Control receiver freq (mc)		
	35	40	45
	Difference crystal freq (mc)		
47.62	6.31	7.62	2.62
47.66	6.33	7.66	2.66
47.70	6.35	7.70	2.70
47.74	6.37	7.74	2.74
47.78	6.39	7.78	2.78
47.82	6.41	7.82	2.82
47.86	6.43	7.86	2.86
47.90	6.45	7.90	2.90
47.94	6.47	7.94	2.94
47.98	6.49		2.98
48.02	6.51		3.02
48.06	6.53	8.06	3.06
48.10	6.55	8.10	3.10
48.14	6.57	8.14	3.14
48.18	6.59	8.18	3.18
48.22	6.61	8.22	
48.26	6.63	8.26	3.26
48.30	6.65	8.30	3.30
48.34	6.67	8.34	3.34
48.38	6.69	8.38	3.38
48.42	6.71	8.42	3.42
48.46	6.73	8.46	
48.50	6.75	8.50	3.50
48.54	6.77	8.54	3.54
48.58	6.79	8.58	3.58
48.62	6.81	8.62	3.62
48.66	6.83	8.66	3.66
48.70	6.85	8.70	3.70
48.74	6.87	8.74	3.74
48.78	6.89	8.78	3.78
48.82	6.91	8.82	3.82
48.86	6.93	8.86	3.86
48.90	6.95	8.90	3.90
48.94	6.97	8.94	3.94
48.98		8.98	3.98
49.02		9.02	4.02
49.06	7.03	9.06	4.06
49.10	7.05	9.10	
49.14	7.07	9.14	4.14
49.18	7.09	9.18	
49.22	7.11	9.22	
49.26	7.13	9.26	
49.30	7.15	9.30	
49.34	7.17	9.34	
49.38	7.19	9.38	
49.42	7.21	9.42	
49.46	7.23	9.46	4.46
49.50	7.25	9.50	
49.54	7.27	9.54	4.54
49.58	7.29	9.58	4.58
49.62	7.31	9.62	4.62
49.66	7.33	9.66	4.66
49.70	7.35	9.70	4.70
49.74	7.37	9.74	4.74
49.78	7.39	9.78	4.78

Channel freq (mc)	Control receiver freq (mc)		
	150	155	160
	Difference crystal freq (mc)		
49.82	7.41	9.82	4.82
49.86	7.43	9.86	4.86
49.90	7.45	9.90	4.90
49.94	7.47		4.94
49.98	7.49		
50.02	7.51		5.02

c. Channel crystal frequencies for the TS-971/G are as follows:

Channel freq (mc)	Control receiver freq (mc)		
	150	155	160
	Difference crystal freq (mc)		
152.03		2.97	
152.09	2.09	2.91	
152.15	2.15	2.85	
152.21	2.21	2.79	7.79
152.27	2.27	2.73	7.73
152.33	2.33		7.67
152.39	2.39	2.61	7.61
152.45	2.45	2.55	7.55
152.51	2.51	2.49	
152.57	2.57	2.43	7.43
152.63		2.37	7.37
152.69		2.31	7.31
152.75	2.75		7.25
152.81	2.81		7.19
152.87	2.87	2.13	7.13
152.93	2.93	2.07	7.07
152.99	2.99		7.01
153.05	3.05	1.95	6.95
153.11	3.11		6.89
153.17	3.17		6.83
153.23	3.23		6.77
153.29	3.29		6.71
153.35	3.35		6.65
153.41			6.59
153.47	3.47		6.53
153.53	3.53		6.47
153.59	3.59		6.41
153.65	3.65		6.35
153.71	3.71		
153.77	3.77		6.23
153.85	3.83		
153.89	3.89		6.11
153.95			6.05
154.01			5.99
154.07			5.93
154.13	4.13		5.87
154.19	4.19		5.81

Channel freq (mc)	Control receiver freq (mc)		
	150	155	160
	Difference crystal freq (mc)		
154.25	4.25		5.75
154.31	4.31		5.69
154.37	4.37		5.63
154.43	4.43		5.57
154.49	4.49		5.51
154.57	4.57		5.43
154.65	4.65		5.35
154.71	4.71		
154.77	4.77		
154.83	4.83		5.17
154.89	4.89		5.11
154.95	4.95		5.05
155.01	5.01		4.99
155.07	5.07		4.93
155.13	5.13		4.87
155.19	5.19		4.81
155.25	5.25		4.75
155.31	5.31		4.69
155.37	5.37		4.63
155.43	5.43		4.57
155.49	5.49		4.51
155.55	5.55		4.45
155.61	5.61		4.39
155.67	5.67		4.33
155.73	5.73		4.27
155.79	5.79		
155.85	5.85		4.15
155.91	5.91		4.09
155.97	5.97		
156.03	6.03		
156.09	6.09		3.91
156.15	6.13		3.85
156.21	6.21		3.79
156.27	6.27		3.73
156.33	6.33		3.67
156.39	6.39		3.61
156.45	6.45		3.55
156.51	6.51		3.49
156.57	6.57		3.43
156.63	6.63		3.37
156.69	6.69		3.31
156.75	6.75	1.75	3.25
156.81	6.81	1.81	3.19
156.87	6.87	1.87	3.13
156.93	6.93		3.07
156.99	6.99		3.01
157.05	7.05	2.05	2.95
157.11	7.11	2.11	2.89
157.17	7.17	2.17	2.83
157.23	7.23	2.23	2.77
157.29	7.29	2.29	
157.35	7.35	2.35	
157.41	7.41	2.41	2.59
157.47	7.47	2.47	2.53
157.53	7.53	2.53	2.47

Channel freq (mc)	Control receiver freq (mc)		
	150	155	160
	Difference crystal freq (mc)		
157.59	7.59	2.59	2.41
157.65	7.65		2.35
157.71	7.71		2.29
157.77	7.77	2.77	2.23
157.83	7.83	2.83	2.17
157.89		2.89	2.11
157.95		2.95	
158.01		3.01	
158.07		3.07	1.93
158.13			1.87
158.19	8.19	3.19	1.81
158.25		3.25	1.75
158.31	8.31		1.69
158.37	8.37		
158.43	8.43	3.43	
158.49	8.49		
158.55	8.55	3.53	
158.61	8.61	3.61	
158.67	8.67		
158.73	8.73	3.73	
158.79	8.79		
158.85	8.85	3.85	
158.91	8.91	3.91	
158.97	8.97		
159.03	9.03		
159.09	9.09	4.09	
159.15	9.15	4.15	
159.21	9.21	4.21	
159.27	9.27	4.27	
159.33	9.33		
159.39	9.39	4.39	
159.45	9.45	4.45	
159.51	9.51	4.51	
159.57	9.57	4.57	
159.63	9.63	4.63	
159.69	9.69	4.69	
159.75	9.75	4.75	
159.81	9.81	4.81	
159.87	9.87	4.87	
159.93	9.93	4.93	
159.99		4.99	
160.05	10.05	5.05	
160.11	10.11		
160.17	10.17	5.17	
160.23	10.23	5.23	
160.29	10.29	5.29	
160.35	10.35	5.35	
160.41	10.41	5.41	
160.47	10.47	5.47	
160.53	10.53	5.53	
160.59	10.59	5.59	
160.65	10.65	5.65	
160.71		5.71	
160.77	10.77	5.77	
160.83	10.88	5.83	

Channel freq (mc)	Control receiver freq (mc)		
	150	155	160
	Difference crystal freq (mc)		
160.89	0.89	5.89	
160.95	10.95	5.95	
161.01	11.01	6.01	
161.07	11.07	6.07	
161.13	11.13	6.13	
161.19	11.19	6.19	
161.25	11.25	6.25	
161.31	11.31	6.31	
161.37	11.37	6.37	
161.43	11.43	6.43	
161.49	11.49	6.49	
161.55	11.55	6.p5	
161.61	11.61	6.61	
161.67	11.67	6.67	
161.73	11.73	6.73	1.73
161.79	11.79	6.79	1.79
161.85	11.85	6.85	1.85
161.91	11.91	6.91	1.91
161.97	11.97	6.97	

22. Connections

Only four connections are required to install the radio test set. An additional six-pin connector is provided to furnish 115-volt ac power, B+ voltage, filament voltage, and audio-frequency (AF) signals for optional equipment (not furnished). This connector is accessible through the front-panel meter door. Three of the connections (a, b, and c below) are grouped on the ac outlet (fig. 16). This unit is accessible when the back panel is removed.

a. WWV Antenna. Connect a low-impedance antenna (coaxial cable lead-in type) to the WWV antenna connector marked LZ, or a long-wire (high-impedance) antenna to the antenna connector marked HZ. See paragraph 55 and figure 23 for a suggested method of installing a low-impedance WWV antenna. A pin-type coaxial connector is provided with the equipment for assembly to the lead-in cable.

b. Vhf Antenna. Connect a vhf antenna to the vhf connector. See paragraph 56 and figure 23 for a suggested method of installing a vhf antenna. A vhf-type coaxial connector is provided with the equipment for assembly to the lead-in cable.

c. Power. Use the ac power cord furnished with the equipment to connect the equipment to a 115-volt ac power source.

d. Ground. Make a suitable connection between the radio test set and an external ground. One of the screws holding the back panel may be used for this purpose.

Caution: Two fuses are used in the power supply. If replacement becomes necessary, use fuses of identical ratings (par. 5*b*) to avoid damage to the equipment.

Note. Remove and discard the jumper across the terminal posts of the CARRIER FREQUENCY meter.

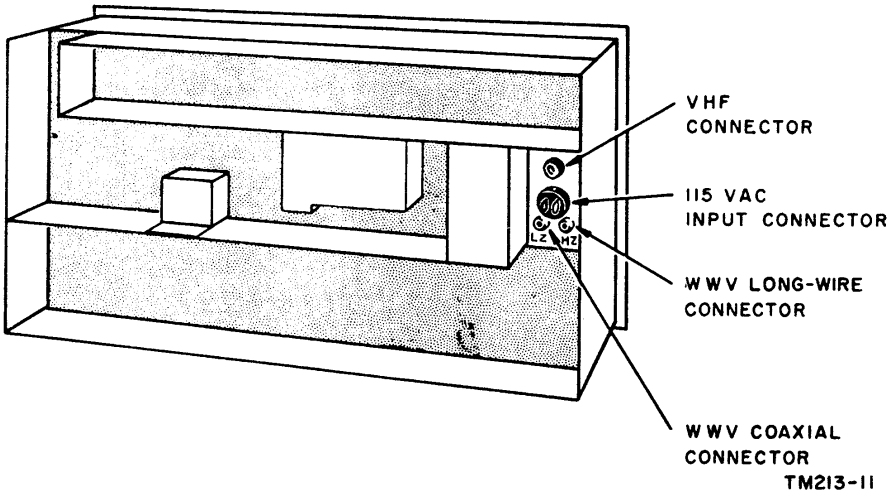

Figure 16. Connector locations.

Section II. INITIAL ADJUSTMENT OF EQUIPMENT

Note. The procedures described in this section should be performed by a Field Radio Mechanic who is familiar with the use of the controls and indicators and with the operating procedures (ch 3).

Warning: This equipment contains selenium rectifiers. When these rectifiers fail, because of burnout or arc-over, poisonous fumes and compounds are released. The fumes have -a strong odor and should not be inhaled. Provide adequate ventilation immediately and do not handle the rectifier until it has cooled.

23. Calibration Instructions

The radio test set is calibrated at the factory and should not require any other calibration before being put in operation, unless the equipment has been mishandled in transit, tampered with, or subjected to extreme climatic changes. However, if the factory setting has been disturbed in any way, the equipment must be recalibrated before being put in operation. The radio test set should be calibrated every 6 months, or more often if necessary. The following paragraphs outline the procedures necessary for proper calibration of, the equipment. The operating controls and indicators are listed and described in paragraph 30.

Note. With the power off, the MODULATION DEVIATION and CARRIER FREQUENCY meters should indicate zero. If not, use the zero adjustment screws (on the meter faces). Make these adjustments carefully, to avoid damage to the meters.

24. Crystal Calibration

a. Step 2, figure 17, shows the initial position of the controls for crystal calibration.

b. Place the ac power on-off switch in the on position (up). The round red indicator, above the switch, should light.

c. Turn the DB METER switch to the LINE position.

d. Turn the WWV-A.F, GAIN control to the OFF position (fully counterclockwise).

e. Turn the XTAL. HEATER switch to the OFF position.

f. Turn the CALIB. SWITCH to the WWV REC. position.

g. Turn the MON. CHANNEL SEL. switch to one of the numbered positions.

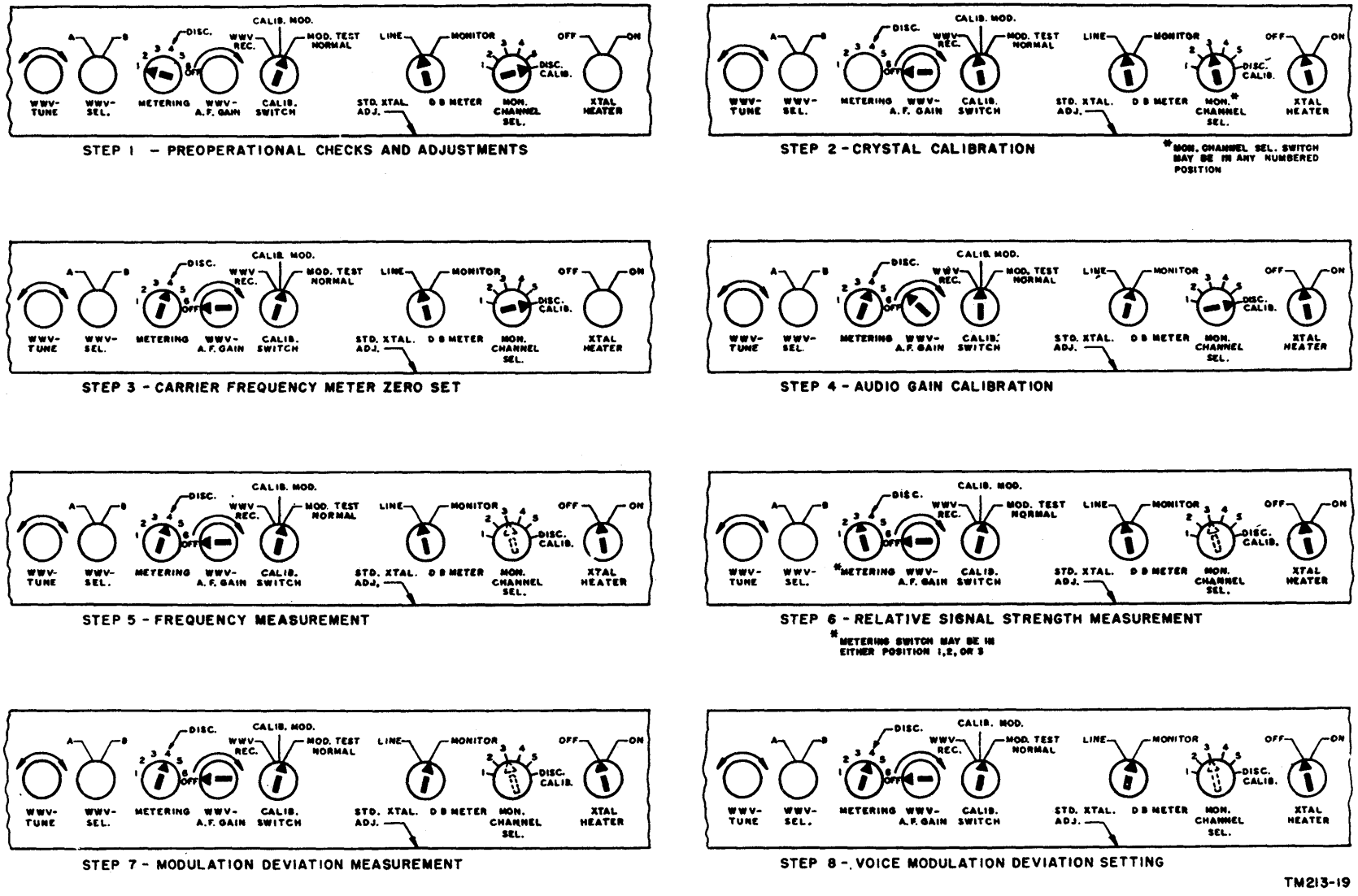

Figure 17. Position of controls for adjustment and operation.

h. Allow the equipment to warm up for at least 1 hour.

i. Turn the WWV-A.F. GAIN control clockwise to turn on the WWV receiver. The rectangular red indicator should light. Adjust the control for the desired audio level.

Caution: Do not keep the WWV receiver on for long periods of time. It should be turned on for calibration only.

j. Turn the WWV-SEL. switch to position A or B and tune in the signal from Radio Station WWV by using the WWV-TUNE control. Use the WWV--SEL. switch position that provides the best reception.

Note. Be careful to avoid tuning in a beat note with the WWV signal. An incorrect zero beat would result.

k. Turn the MON. CHANNEL SEL. switch to the DISC. CALIB. position.

l. When the WWV transmission is unmodulated, vary the STD. XTAL. ADJ. control until the beat note between the crystal and the unmodulated carrier is inaudible (zero beat). (An alinement tool for this purpose is supplied with the equipment.) Note. Radio Station WWV removes modulation for 1 minute at every 5-minute interval (par. 32).

m. When the carrier is again tone-modulated turn the STD. XTAL. ADJ. control (slowly and for a very' small distance) until the audio-amplitude variations of the WWV modulations are reduced to one per second or less. Turn the control slightly clockwise to compensate for the capacitive effect of the alinement tool. The audio-amplitude variations should not be greater than 2 or 3 per second, with the alinement tool removed. This is the correct zero beat.

25. Carrier Frequency Meter Zero Set

a. Step 3, figure 17, shows the initial position of the controls for CARRIER FREQUENCY meter zero set.

b. Turn the WWV-A.F. GAIN control to the OFF position (fully counterclockwise). The rectangular red indicator on the front panel will go out, indicating that the WWV receiver is off.

c.. Turn the DB METER switch to the LINE position.

d. Turn the METERING .switch to the DISC. position.

e. Turn the CALIB. SWITCH to the MOD. TEST NORMAL position.

f. Turn the MON. CHANNEL SEL. switch to the DISC. CALIB. position. The green indicator on the front panel will light, indicating that the calibration crystal is feeding a signal into the control receiver.

g. Adjust the discriminator zero set contrd (fig. 18) until the CARRIER FREQUENCY meter indicates zero.

Note. An off-zero reading with no carrier signal present, or with the MON. CHANNEL SEL. switch in any of the numbered positions, is not an indication of miscalibration and has no effect on the meter reading obtained with the MON. CHANNEL SEL. switch in the DISC. CALIB. position.

26. Audio Gain Calibration

The setting of the VOLUME control on the control receiver (fig. 19) has a direct effect on the readings obtained on the MODULATION DEVIATION meter. To calibrate the gain of the audio amplifier in terms of frequency deviation, perform the following steps:

a. Step 4, figure 17, shows the initial position of the controls for audio gain calibration.

b. Turn the DB METER switch to the MONITOR position.

c. Turn the WWV-A.F. GAIN control 1/, turn clockwise from the OFF position.

d. Turn the METERING switch to the 4 DISC. position.

e. Turn the XTAL. HEATER switch to the OFF position.

f. Turn the CALIB. SWITCH to the CALIB. MOD. position.

g. Turn the MON. CHANNEL SEL. switch to the DISC. CALIB. position.

h. Adjust the WWV-A.F. GAIN control until the MODULATION DEVIATION meter indicates the same value as that shown for the CALIB. MOD. POSITION on the frequency calibration tag attached to the equipment. See next-to-last line in the following example.

2. MODULATION DEVIATION SECTION THIS RADIO TEST SET (MODEL TS-971/G _____) IS CAPABLE OF DIRECT READING OF MODULATION DEVIATION. THIS RADIO TEST SET IS CALIBRATED BY THE CARRIER NULL METHOD AT 15 KC. DEVIATION AT 1000 CPS MODULATION. DEVIATION CALIBRATION (LOW FREQUENCY OSCILLATOR) CHECK POINTS:

1. CALIB. MOD. POSITION _____
2. MOD. TEST. POSITION 15 KC

i. Turn the CALIB. SWITCH to the MOD. TEST NORMAL position. It the MODULATION DEVIATION meter does not read properly, adjust the VOLUME control on the control receiver (fig. 19) to obtain the desired reading of 15 kc. The audio gain calibration procedure is now complete. If the gain of the control receiver audio amplifier is changed by changing the setting of the VOLUME control, by changing tubes, or by other means, the amplifier must be recalibrated as outlined above.

27. Discriminator Slope Check

The control receiver discriminator slope (frequency displacement versus output voltage) should be checked only when the signal from Radio Station WWV is strong enough to produce a good beat note with the 5-mc calibration crystal. The slope is checked as follows:

a. Repeat the crystal calibration outlined in paragraph 24.

b. Adjust the discriminator zero set control (fig. 18) until the CARRIER FREQUENCY meter indicates zero

c. When the WWV carrier is modulated, vary the STD. XTAL. ADJ. control until the tone of the beat note between the 5-mc crystal and the WWV signal is the same as the tone of the WWV modulation. The two audio beat notes should now be of the same frequency; this may be checked by momentarily turning the MON. CHANNEL SEL. switch off the DISC. CALIB. position. This action should not produce any difference in the tone of the audio beat note.

> **Note. Use of the STD. XTAL. ADJ. control may not vary the crystal frequency sufficiently to produce a b(eat note equal to the WWV modulation frequency. In this case, adjust the audio beat note to 1'. the WWV audio frequency. Thus, the second harmonic of this beat note will be equal to the WWV modulation frequency.**

d. Observe the CARRIER FREQUENCY meter reading and log the value in the Field column of the discriminator slope calibration chart (par. 28). If the logged readings do not coincide with the calculated readings, proper interpolation must be applied when frequencies are being monitored.

28. Discriminator Slope Calibration Chart

The Discriminator Slope Calibration Chart provides check points for nine combinations of WWV receiver and control receiver frequencies in both radio test sets. The check points are calculated as follows. Assume that a TS-971/G WWV receiver is tuned to 10 mc, the control receiver is operating at 150 mc, the WWV modulation is 440 cps, and a 5-mc calibration crystal is being used. To produce a 440-cycle beat note between the 5-mc crystal and the 10-me WWV signal, the crystal frequency must be varied 220 cycles. If the crystal frequency is changed 22(0 cycles at 5 me, it will be changed 440 cycles at its second harmonic of 10 mc. If the crystal is changed 220 cycles at its fundamental frequency, it will be changed 6.6 kc at its 30th harmonic of 150 mc. Thus, the frequency to the control receiver will be 150 mc ±6.6 kc and the CARRIER FREQUENCY meter should read ±6.6 kc with the METERING switch in the 4 DISC. position. This is the calculated meter reading shown on the chart.

Frequency (me)		Meter readings (kc)							
		440-cycle beat		220-cycle beat		600-cycle beat		800-cycle beat	
WWV rcvr	Control rcvr	Calcu-lated	Field	Calcu-lated	Field	Calcu-lated	Field	Calcu-lated	Field
Radio Test Set TS-974/U									
5	35	3.08*		1.54*		4.20*		2.10*	
5	40	3.52*		1.76*		4.80*		2.40*	
5	45	3.96*		1.98*		5.40*		2.70*	
10	35	1.54*		.770		2.10*		1.05	
10	40	1.76*		.880		2.40*		1.20	
10	45	1.98*		.990		2.70*		1.35	
15	35	1.02		.513		1.40		.700	
15	40	1.17		.587		1.60		.800	
15	45	1.32		.660		1.80		.900	
Radio Test Set TS-971/G									
5	150	13.2*		6.6*		Off sc		9.0*	
5	155	13.64*		6.82*		Off sc		9.3*	
5	160	14.08*		7.04*		Off sc		9.6*	
10	150	6.6*		3.3		9.0*		4.5	
10	155	6.82* J		3.41		9.3*		4.65	
10	160	7.04*		3.52		9.6*		4.8	
15	150	4.4		2.2		6.0		3.0	
15	155	4.55		2.27		6.2		3.1	
15	160	4.7		2.35		6.4		3.2	

* Values are not readable on most radio test sets. See note. paragraph 27c.

CHAPTER 3

OPERATING INSTRUCTIONS

Warning: Selenium rectifiers are used in this equipment. When these rectifiers fail, because of burnout or arc-over, poisonous fumes and compounds are released. The fumes have a strong odor and should not be inhaled. *Provide adequate ventilation immediately and do not handle the rectifier until it has cooled.*

Caution: Before operating the radio test set, make sure that the jumper across the terminal posts of the CARRIER FREQUENCY meter has been removed.

Section I. CONTROLS AND INDICATORS

Note. This section describes, locates, and illustrates the controls and indicators provided for the proper operation of the equipment.

29. General

Before placing the radio test set in operation, consideration should be given to the following facts. At the factory, the control receiver of the TS-974/U is alined to 40 me and that of the TS-971/G to 155 mc. In some cases, it will be necessary to change the frequency of the former to 35 or 45 me, and the latter to 150 or 160 mc, to provide interference-free monitoring. This alinement is performed at a higher echelon. The channel crystal frequency charts (par. 21) list the frequencies that are free from interference (developed within the radio test set) for the various frequencies to which the control receiver is alined. Each time a transmitter is to be monitored, it is necessary to insure that the control receiver is alined to a frequency that provides no interference. Interference can also be caused at some frequencies by external equipment such as am radio stations, television stations, oscillating test equipment in a laboratory, or other communications equipment operating in the vicinity of the radio test set which would interfere with its operation. It is not possible to find an interference-free area in which to operate the radio test set, a shielded booth should be used.

30. Operating Controls

The operating controls and indicators (fig. 18 and 19) are listed, and their functions are stated, in the following chart:

Control or Indicator	Function
Ac power on-off switch	In on position (-up), connects radio test set to ac power source.
Ac power on-off indicator (round red).	When lit, indicates that ac power is connected.
WWV receiver on-off indicator (rectangular red).	When lit, indicates that WWV receiver is on.
Carrier on-off indicator (rectangular green).	When lit, indicates that a carrier signal has opened thecontrol receiver squelch circuit.
CARRIER FREQUENCY meter	Indicates carrier frequency error, relative signal strength, and control receiver circuit readings. Calibrated in kc and microamperes. When used with METERING switch, this meter can be used as a test meter for touch-up alinement of control receiver.
MODULATION DEVIATION meter.	Indicates carrier deviation due to modulation. Also used for calibration of audio amplification. Calibrated in db and kc.
WWV-TUNE control	Tunes WWV receiver oscillator circuit.
WWV-SEL. switch .	In A position, selects WWV frequency of 15 mc. In B position, selects WWV frequency of 10 mc.

Control or Indicator	Function
METERING switch	Connects CARRIER FREQUENCY meter to following control receiver circuits: Position 1 — 2d If grid. Position 2 — 1st limiter grid. Position 3 — 2d limiter grid. Position 4 DISC. — discriminator balance. Position 5 — discriminator plate. Position 6 — multiplier grid.
WWV-A.F. GAIN control	Varies gain of WWV receiver audio amplifier. Also varies output of audio oscillator. In OFF-position, removes power from WWV receiver filaments.
CALIB. SWITCH	In WWV REC. position: Connects WWV detector output to WWV audio amplifier. With DB METER switch in LINE position, connects WWV audio amplifier to speaker. With DB METER switch in MONITOR position, connects WWV audio amplifier to MODULATION DEVIATION meter by means of control receiver output transformer. Connects B+ to RF section of WWV receiver. In CALIB. MOD. position: Inserts resistor-capacitor feed-back network into 1st audio amplifier of WWV receiver, causing amplifier to operate as audio oscillator. Connects audio oscillator output to speaker with DB METER switch in LINE position, or to MODULATION DEVIATION meter with DB METER switch in MONITOR position. In MOD. TEST NORMAL position: Inserts resistor-capacitor feed-back network into 1st audio amplifier of WWV receiver, causing amplifier to operate as audio oscillator. Connects audio oscillator output to audio input of control receiver. Connects B+ to screen grid of control receiver power amplifier tube.
STD. XTAL. ADJ. control	Varies trimmer capacitor of 5-mc calibration crystal.
DB METER Switch	In LINE position: Connects WWV receiver output to speaker, with CALIB. SWITCH in WWV REC. position. Connects control receiver output to speaker, with CALIB. SWITCH in MOD. TEST NORMAL position. In MONITOR position: Connects WWV receiver output to MODULATION DEVIATION meter, with CALIB. SWITCH in WWV REC. position. Connects control receiver output to MODULATION DEVIATION meter with CALIB. SWITCH in MOD. TEST NORMAL position.
MON. CHANNEL SEL. switch	In positions 1 through 5, selects channel crystal frequency to be used for mixing with monitored carrier frequency. In DISC. CALIB. position, connects 5-mc calibration crystal into oscillator circuit.
XTAL. HEATER switch	Controls heater for 5-mc calibration crystal. **Note. Use crystal heater only when calibration crystal is subjected to extremely low temperatures.**
DISCR control	Balances control receiver discriminator.
VOLUME control	Controls audio gain of control receiver.
SQUELCH control	Sets level at which squelch opens.
Front panel speaker level control	Controls speaker output level.
Squelch sensitivity control	Controls squelch sensitivity.

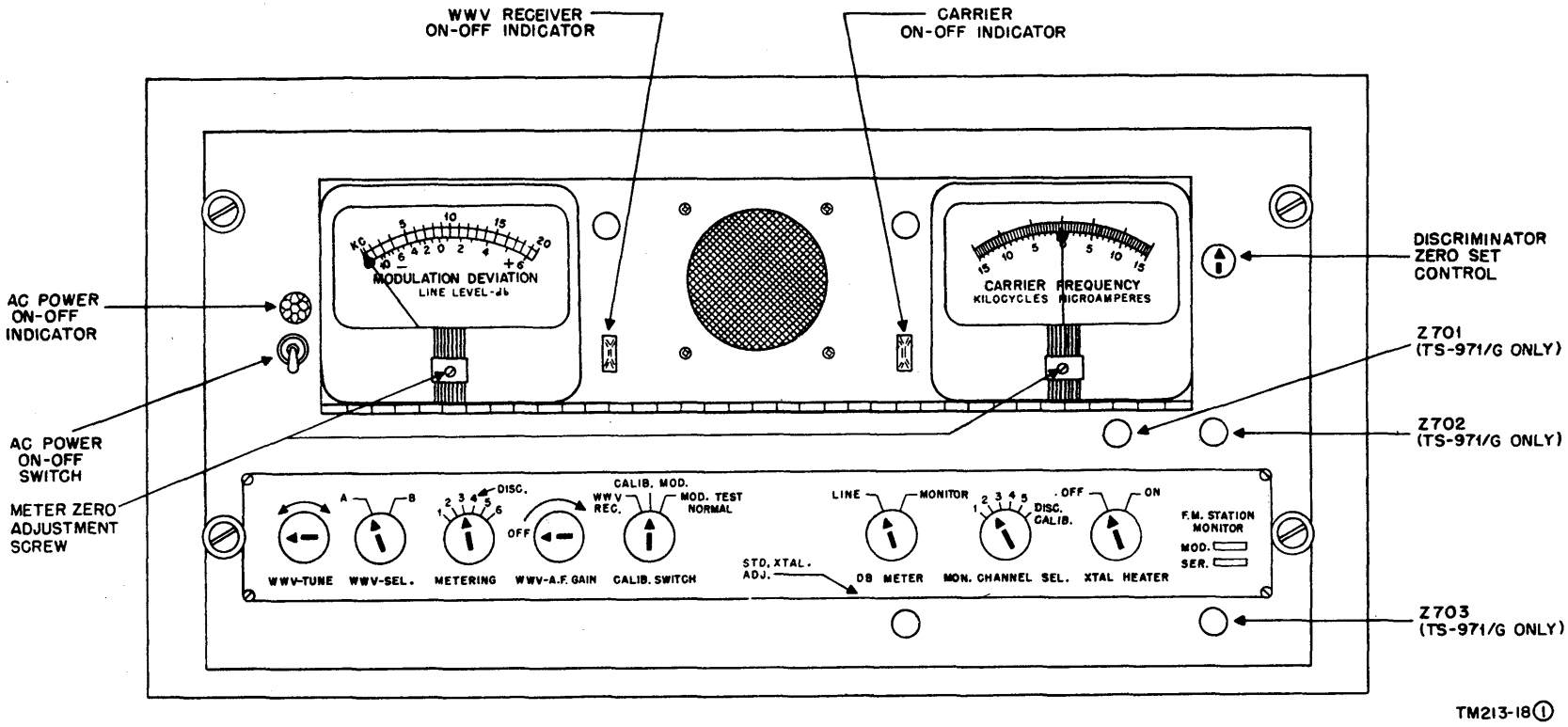

Figure 18. Operating controls and indicators, front panel.

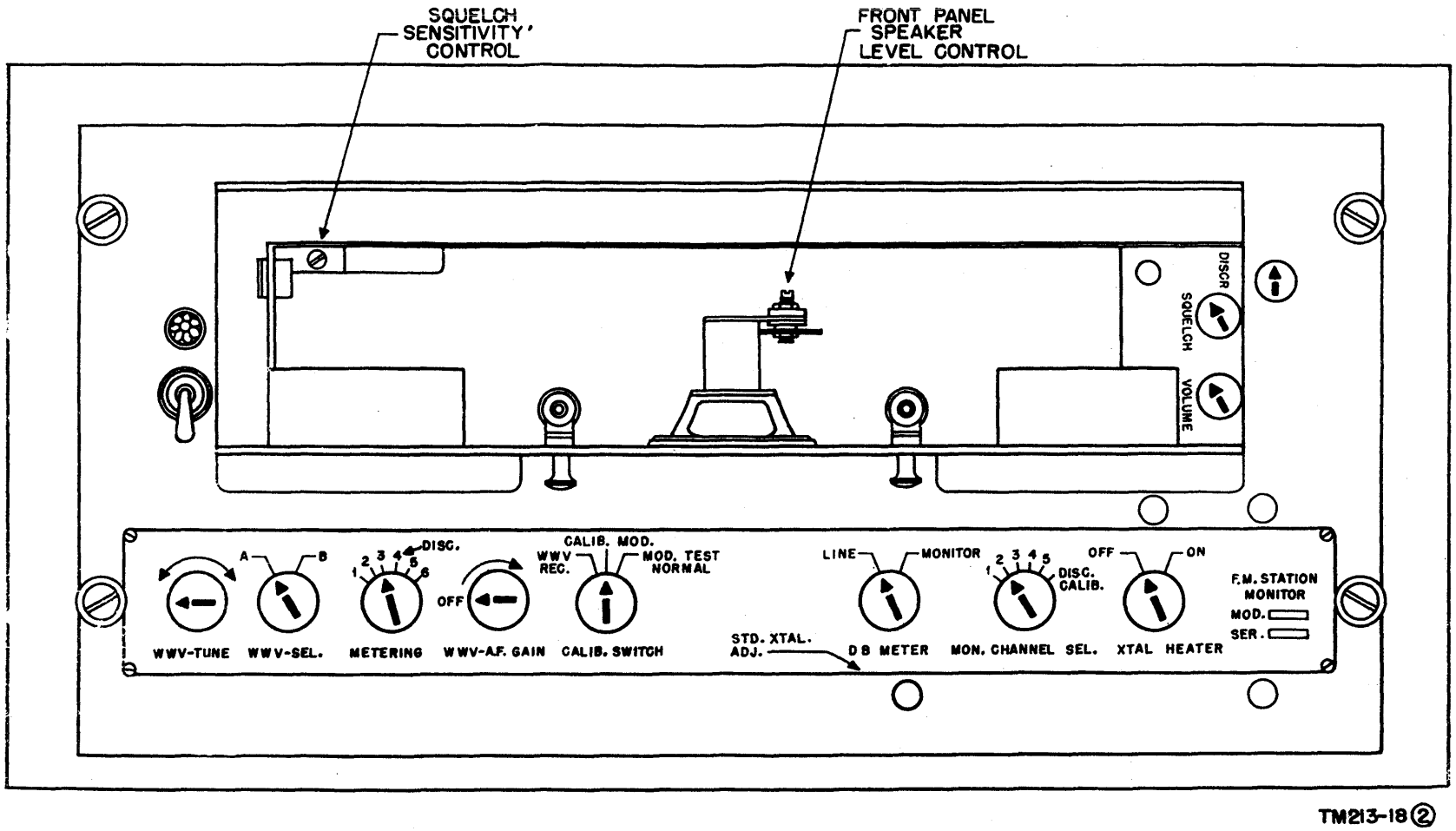

Figure 19. Operating controls, interior.

Section II. OPERATING PROCEDURES

31. Types of Operation

The radio test set is designed to perform four functions, as follows:

a. It measures carrier frequency deviation from the assigned frequency.

b. It measures frequency modulation of the carrier signal.

c. It measures transmitter relative signal strength.

d. It provides a special internal precision calibration system which eliminates the usual requirement of obtaining additional equipment for this purpose.

Note. The radio test set operates on the heterodyne principle. A transmitter frequency is monitored by heterodyning, or beating, its carrier with the output frequency of the crystal oscillator and then feeding the resultant (combined) frequency into the calibrated control receiver. If the beat frequency between the crystal-oscillator signal and the monitored carrier is exactly equal to the frequency of the alined control receiver, the CARRIER FREQUENCY meter will indicate zero. If the beat frequency is lower or higher than the control receiver frequency, a direct indication of carrier frequency error, in the monitored transmitter, will be indicated on the CARRIER FREQUENCY meter. The beat frequency, fed to the control receiver, may be either the sum or the difference of the channel-crystal and the monitored-channel frequencies.

32. Radio Station WWV

The National Bureau of Standards (NBS), over Radio Station WWV, Washington, D.C., broadcasts a 10- and 15-mc carrier at all times which is modulated with either a 440- or 600-cycle audio frequency. The audio frequency is interrupted at precisely 1 minute before the hour and at each 5-minute interval thereafter. The audio frequency is resumed precisely on the hour and at each 5-minute interval thereafter. The audio frequencies are transmitted alternately. The 600-cycle tone starts precisely on the hour and lasts for 4 minutes. After a 1-minute period of no modulation, the 440- cycle tone starts and lasts for 4 minutes. Then, after a 1-minute period of no modulation, the 600-cycle tone comes back for 4 minutes, etc. The frequency accuracy is better than one part in 50 million. Reliable reception should be possible on either 10 or 15 mc at all times, except during periods of radio propagation disturbances such as those caused by ionospheric storms. Selection of the frequency that gives best reception may be made by switching between positions A and B on the WWV-SEL. switch. Generally, 10 mc (position B) is better at night and 15 me (position A) is better in the afternoon or late morning.

33. Starting Procedure

Perform the starting procedure given below before using the operating procedures described in the following paragraph. Step 1, figure 17, shows the position of the controls for the starting procedure. Be sure that the equipment has been properly calibrated (par. 23).

Caution: Before operating the radio test set, make sure that the jumper across the terminal posts of the CARRIER FREQUENCY meter has been removed.

Note. If an abnormal indication is obtained during the starting procedure, refer to the operational check list (par. 44) for corrective measures.

a. Make sure that the five channel crystals are plugged into the WWV receiver (par. 20).

b. With the power off, manually adjust the pointers of the CARRIER FREQUENCY and MODULATION DEVIATION meters to zero. The adjusting screw is located on the front of each meter.

Caution: Make these adjustments with extreme care, to avoid damage to the meter.

c. Check the gain and sensitivity of the control receiver as follows:

(1) Place the ac power on-off switch in the position (up). The ac power on-off indicator, above the toggle switch, should light.

(2) Turn the MON. CHANNEL SEL. switch to the DISC. CALIB. position. After a short warm-up, the carrier on-off indicator (green) should light, indicating the presence of a carrier signal (in the control receiver) of sufficient strength to open the squelch circuit. If the indicator does not light, check the squelch control (*d* below).

(3) Turn the METERING switch to position 1. The CARRIER FREQUENCY meter should indicate ½ microampere or *more* to the *right*.

d. Check the squelch control as follows:

(1) Turn the DB METER switch to the LINE position.

(2) Turn the CALIB. SWITCH to the MOD. TEST NORMAL position.

(3) Turn the MON. CHANNEL SEL. switch to any position except DISC. CALIB.

(4) Turn the SQUELCH control fully counterclockwise (off).

(5) Remove all signals at the antenna so that only noise is present in the speaker.

(6) Turn the SQUELCH control clockwise until the noise is squelched or cut out. The carrier on-off indicator (green) should go out.

34. Calibrating Oscillator

a. The radio test set includes a temperature compensated crystal oscillator operating at 5 me. Its output frequency is checked and calibrated at exactly 5 me by comparing it with the primary standard signal from radio station WWV. The oscillator is then used to calibrate the control receiver. The control receiver in the TS-974/U is calibrated for 35-, 40-, or 45-mc operation. Therefore, the seventh, eighth, and ninth harmonics of the 5-mc crystal frequency standard must be used to calibrate the control receiver to 35, 40, or 45 me, respectively. The control receiver in the TS-971/G is calibrated for 150-, 155-, or 160-mc operation. Therefore, the 30th, 31st, and 32d harmonics of the 5-me crystal frequency standard must be used to calibrate the control receiver to 150, 155, or 160 me, respectively.

b. The TS-974/U was calibrated at the factory for 40-mc operation, and the TS-971/G was calibrated for 155-mc operation. There are some cases where it is necessary to aline the control receiver to another frequency to provide interference-free monitoring. Two crystals, mounted in a bracket on the removable rear panel of the cabinet, are provided for aligning to 35 or 45 me (TS-974/U), or 150 or 160 mc (TS-971/G). The channel crystal frequency charts (par. 21) list control receiver frequencies that are free from interference for the various channel frequencies being monitored.

c. The MON. CHANNEL SEL. switch operates with the calibrating oscillator and may be used to select the 5-mc calibration crystal or any one of five channel crystals. The selected crystal becomes the frequency-controlling element of the oscillator.

d. For example, assume that a transmitter operating on 31.1 mc is to be monitored and the control receiver is calibrated at 40 me. The required channel crystal will have a frequency of 8.9 me, which is the difference between 40 and 31.1 mc. If the transmitter is on frequency, the 31.1-mc signal will mix with the 8.9-mc channel-crystal frequency to produce an output signal of 40 me at the control receiver and result in a zero reading on the CARRIER FREQUENCY meter. If the monitored transmitter carrier is above or below 31.1 me, the input signal to the control receiver will be above or below 40 me, causing the discriminator to produce an output voltage which is fed to the CARRIER FREQUENCY meter to give a direct reading, in kc, of carrier frequency error. Channel crystals are available in the range of 1.66 to 12.5 me. For a list of crystals and their application, see paragraph 21. When a crystal frequency higher than 12.5 me is required, it is necessary to beat the second harmonic of a crystal having half the required frequency against the monitored carrier to produce the frequency of the control receiver. For example, a transmitter operating on 58.2 me would require an 18.2-mc crystal. Such a crystal is not available; therefore, it is necessary to use the second harmonic of a 91.1-mc crystal mixed with the 58.2-me frequency to produce an output signal of 40 me at the control receiver. Use of the second harmonic introduces no appreciable error in monitoring accuracy, as the crystals are held within .002 per cent of the specified frequency over the ambient temperature range (par. 4). Therefore, in this example, the maximum frequency error of a 9.1-mc crystal would be .0025 per cent of 9.1 me or 227.5 cycles; percentage error would be 227.5 cycles divided by 58.2 me multiplied by 100, or .000309 per cent. This amount of error is not discernible on the CARRIER FREQUENCY meter. The actual channel crystal frequency, after grinding and setting, is measured and shown on the calibration card supplied with the equipment.

35. Operation as Frequency Meter

To monitor a transmitter for correct frequency, set the controls as follows (step 5, fig. 17):

a. Place the ac power on-off switch in the on position (up). The ac power on-off indicator (above the toggle switch) should light.

b. Turn the DB METER switch to the LINE position.

c. Turn the WWV-A.F. GAIN control to the OFF position (fully counterclockwise) d. Turn the METERING switch to the 4 DISC. position.

e. Turn the XTAL HEATER switch to the OFF position.

f. Turn the CALIB. SWITCH to the MOD. TEST NORMAL position.

g. Turn the MON. CHANNEL SEL. switch to one of the numbered positions, selecting the channel crystal frequency to be used for monitoring the transmitter carrier frequency.

h. Place the carrier (to be monitored) on the air. Listen for the monitored carrier signal at the loudspeaker and check the CARRIER FREQUENCY meter for frequency indication. A zero reading denotes that the carrier signal is on frequency; a meter deflection to the left indicates that the carrier signal is below frequency; and a meter deflection to the right indicates that the carrier signal is above frequency.

36. Operation as Relative Signal Strength Meter

To make a comparison of transmitter signal strength, set the controls as follows (step 6, fig. 17):

a. Place the ac power on-off switch in the on position (up).

b. Turn the DB METER switch to the LINE position.

c. Turn the WWV-A.F. GAIN control to the OFF position (fully counterclockwise).

d. Turn the METERING switch to position 1, 2, or 3, depending upon the degree of sensitivity required (position 3 is the most sensitive).

e. Turn the XTAL HEATER switch to the OFF position.

f. Turn the CALIB. SWITCH to the MOD. TEST NORMAL position.

g. Turn the MON. CHANNEL SEL. switch to the numbered position corresponding to the channel crystal being used.

h. With two or more transmitters operating and being monitored on the same channel frequency, relative signal strength is determined as follows:

(1) Log the reading shown on the CARRIER FREQUENCY meter.

(2) Place another transmitter on the air and, with the METERING switch in the same position as in d above, log the reading shown on the CARRIER FREQUENCY meter.

(3) Compare the logged meter readings. The difference between them is the indication of relative signal strength.

37. Operation as Frequency Modulation Deviation Meter

a. General. The. MODULATION DEVIATION meter scale is calibrated to give a reading of peak voltage based on a sine-wave signal; however, the meter actually responds to average voltage. When the incoming signal wave form departs from a pure sine wave, the meter reading will not indicate the true energy level of the signal (energy level being the ratio of average voltage to peak voltage). If the energy is above the. sine-wave value, the meter will indicate high; if the level is below the sine-wave value, the meter will indicate low. Deviation measurement may be made by the oscilloscope method or the MODULATION DEVIATION meter method, both of which are described in the following subparagraphs. Both methods are applicable to all types of channel spacing operation. The deviation values for specific channel spacing are as follows:

Channel spacing	*Deviation*
20 kc	±5 kc
30 kc	±5 kc
40 kc	±15 kc
50 kc	±15 kc
60 kc	±15 kc
120 kc	±15 kc

b. Preliminary Procedure. To measure frequency modulation deviation, set the controls as follows (step 7, fig. 17):

(1) Turn the DB METER switch to the MONITOR position.

(2) Turn the WWV-A.F. GAIN control to the OFF position (fully counterclockwise).

(3) Turn the METERING switch to the 4 DISC. position.

(4) Turn the XTAL HEATER switch to the OFF position.

(5) Turn the CALIB. SWITCH to the MOD. TEST NORMAL position.

(6) Turn the MON. CHANNEL SEL. switch to the numbered position corresponding to the crystal being used for monitoring.

c. Oscilloscope Measuring Procedure. In addition to the radio test set, the following instruments are required: oscilloscope, ac vtvm, and 1,000-cycle! tone generator. Specific test equipment will be listed in the manual covering the transmitter being tested. Connect the oscilloscope across the discriminator output of the control receiver; that is, between pin 5 and V213 (TS-974/1J) or V813 (TS-971/G) and ground. Connect the vtvm and 1,000-cycle tone generator across the microphone input terminals of the transmitter being measured. Calibrate the oscilloscope by modulating the transmitter with a 1,000-cycle tone set at a level that will produce a ±10-kc deviation on the MODULATION DEVIATION meter. Set the oscilloscope VERTICAL GAIN control to 10 squares on the tube face for a calibration. The calibrated oscilloscope is now an accurate deviation indicator. To check deviation, proceed as follows:

(1) Turn the instantaneous deviation control of the transmitter being monitored to the fully open position (clockwise).

(2) Apply the 1,000-cycle tone signal to the transmitter.

(3) Increase the signal strength until a minimum 1-volt microphone input is received at the transmitter.

(4) Turn the instantaneous deviation control slowly in a counterclockwise direction until a reading of ±15 kc is observed on the oscilloscope. (The instantaneous deviation control circuit of the transmitter is at an accurate level and provides reliable deviation readings. The oscilloscope is a very accurate deviation indicator, as readings are instantaneous and peak readings are not affected by the wave form. Operational line voltage must be kept constant to avoid calibration errors.)

d. MODULATION DEVIATION Meter Measuring Procedure. In general, the MODULATION DEVIATION meter method corresponds to the procedure outlined in c above. Except for oscilloscope, instrument connections are the same. However, the instantaneous deviation control setting should be such that a reading of ±17 kc is observed on the MODULATION DEVIATION meter.

38. Operation as Voice Modulation Frequency Meter

To check transmitter carrier frequency deviation due to voice modulation, set the controls as follows (step 8, fig. 17):

a. Turn the DB METER switch to the MONITOR position.

b. Turn the WWV-A.F. GAIN control to the OFF position (fully counterclockwise).

c. Turn the METERING switch to the 4 DISC. position.

d. Turn the XTAL HEATER switch to the OFF position.

e. Turn the CALIB. SWITCH to the MOD. TEST NORMAL position.

f. Turn the MON. CHANNEL SEL. switch to the numbered position corresponding to the channel being monitored.

g. Modulate the transmitter through the microphone and note the deviation on the MODULATION DEVIATION meter.

Note. As previously stated, the meter is calibrated to read peak value of a sine wave only. The ratio of the root-mean-square (rms) value to peak value of a sine wave is substantially higher than that for speech impulses. Therefore, the peak deviation may be higher than that indicated on the meter. In transmitters without an instantaneous deviation control, speech levels that cause peak deviation of 15 kc give peak indications averaging 7.5 kc on the MODULATION DEVIATION meter. When an instantaneous deviation control circuit is used in the transmitter, speech input levels are clipped when exceeding a predetermined magnitude. The level of the clipped output is adjusted by the variable instantaneous deviation control for 15-kc maximum deviation. Thus, a speech input level that is just sufficient

for the peaks to cause a 15-kc deviation will not be clipped, and the MODULATION DEVIATION meter will indicate 7.5 kc as before. As the speech level is increased, the peaks will be clipped. The rms level of the clipped impulses will approach the rms value of a sine wave, and deviation, as indicated on the meter, will increase although the actual deviation will not exceed 15 kc. For high levels of speech input, the MODULATION DEVIATION meter will show incorrect indication.

39. Stopping Procedure

a. Place the ac power on-off switch in the off position (down).

b. Be sure that the XTAL HEATER switch is in the OFF position.

c. Turn the WWV-A.F. GAIN control to the OFF position (fully counterclockwise).

CHAPTER 4

OPERATOR'S MAINTENANCE INSTRUCTIONS

Warning: This equipment contains selenium rectifiers. When these rectifiers fail, because of burnout or arc-over, poisonous fumes and compounds are released. The fumes have a strong odor and should not be inhaled. *Provide adequate ventilation immediately and do not handle the rectifier until it has cooled.*

40. Scope of Operator's Maintenance

The following is a list of maintenance duties normally performed by the operator of the radio test set:

a. Preventive maintenance (par. 42).

b. Visual inspection (par. 43).

c. Operational check list (par. 44).

d. Replacement of defective indicator lamps (par. 45a).

e. Replacement of defective fuses (par. 45b).

f. Replacement of crystals.

g. Checking cable connections (par. 45c).

h. Crystal calibration (par. 24).

i. CARRIER FREQUENCY meter zero set (par. 25).

j. Audio gain calibration (par. 26).

k. Discriminator slope check (par. 27).

41. Special Tool Required for Maintenance

An alinement tool is supplied with the equipment to adjust the STD. XTAL. ADJ. control.

42. Operator's Preventive Maintenance

a. DA Form 11-266. DA Form 11-266 (figs. 20 and 21) is a preventive maintenance check list to be used by the operator. Items not applicable are lined out in figure 21. References in the ITEM block (fig. 21) are to paragraphs that contain additional maintenance information pertinent to the particular item. Instructions for use of the form appear on the form.

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

Item	Maintenance procedures
1	Use a clean cloth to remove dust, dirt, moisture, and grease from the cabinet and front panel. If necessary, wet the cloth with Cleaning Compound (Federal stock No. 7930-395-9542) and then wipe the parts with a dry, clean cloth. **Warning: Cleaning Compound is flammable and its fumes are toxic. Do not use it near a flame; provide adequate ventilation.**
3	All control knobs should work smoothly, be tight on the shafts, and should not bind. Tighten all loose knobs and be sure that the knobs do not rub against the panel.
5	Repair any cuts in the insulation by covering them with rubber tape and then with friction tape.

43. Operator's Visual Inspection

a. When the equipment fails to perform properly, turn off the power and check all the items listed below.

Warning: Do not check any item with the power on.

(1) Wrong settings of switches and controls (fig. 17).

(2) Cables or antenna lead-in wires disconnected or poorly connected.

(3) Disconnected connectors.

(4) Grounded or broken antennas or antenna lead-in wires.

(5) Defective ground connection.

(6) Defective fuses (usually indicate some other fault).

(7) Improper seating of vacuum tubes and plug-in crystals.

(8) Defective indicator lamps.

(9) Loose terminal connections at meters.

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

EQUIPMENT NOMENCLATURE: RADIO TEST SET TS-974/U

EQUIPMENT SERIAL NUMBER: 123

INSTRUCTIONS

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

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

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

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

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

FOLD

TYPE OF INSPECTION

OPERATOR	2/3 ECHELON	DATE	SIGNATURE
✓		5 SEP 58	Jack Jones

U. S. GOVERNMENT PRINTING OFFICE 1957 O—427138

4

DA FORM 1 MAY 57 11-266

TM213-20

Figure 20. DA Form 11-266, pages 1 and 4, as used by operator.

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

DAILY CONDITION FOR MONTH OF SEP 58

NO.	DAILY ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	2D 3D ECHELON
		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
1.	CLEAN DIRT AND MOISTURE FROM EXPOSED SURFACES OF ~~HOUSINGS, CASES,~~ CABINETS, CONTROL PANELS, INTERCONNECTING PLUGS, CABLES, ~~HEADSETS,~~ METER WINDOWS, ETC. PAR. 42	✓	✓	✓	✓	✓													
2.	INSPECT FOR LOOSENESS OF EXTERIOR ITEMS SUCH AS SWITCHES, KNOBS, ~~JACKS,~~ CONNECTORS ~~AND PILOT LIGHTS.~~	✓	✓	(X)	✓	✓													
3.	INSPECT CONTROLS FOR BINDING, SCRAPING. TAP CONTROLS LIGHTLY FOR CUT-OUT DUE TO LOOSE CONTACTS. PAR. 42	✓	✓	✓	✓	✓													
4.	DURING OPERATION BE ALERT FOR ANY UNUSUAL PERFORMANCE OR CONDITION.	✓	✓	✓	✓	✓													

WEEKLY	CONDITION EACH WEEK					2D 3D ECH
	1ST	2D	3D	4TH	5TH	
5. INSPECT CORDS, CABLES, WIRE ~~AND SHOCK MOUNTS~~ FOR BREAKS, CUTS, KINKS, DETERIORATION, STRAIN AND FRAYING. PAR. 42	✓					
6. ~~INSPECT CANVAS AND LEATHER ITEMS FOR FUNGUS, FRAYING, TEARS, BROKEN ZIPPERS AND SNAP FASTENERS.~~						
7. HAND CHECK FOR LOOSENESS OF EXTERIOR ITEMS SUCH AS ~~HANDLES,~~ LATCHES, HINGES.	X					
8. ~~INSPECT FOR LUBRICATION IN ACCORDANCE WITH APPLICABLE DA LUBRICATION ORDER.~~						
9. ~~INSPECT DRY BATTERIES FOR DIRT, LOOSE TERMINALS AND LEAKAGE.~~						
10. INSPECT EXPOSED METAL SURFACES FOR RUST AND CORROSION.	✓					
11. INSPECT METERS FOR DAMAGED GLASS AND CASES.	✓					

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	CONDITION
12. INSPECT SEATING OF READILY ACCESSIBLE ITEMS OF A PLUG-IN OUT NATURE: CRYSTALS, FUSES, CONNECTORS, PLUG-IN COILS, LAMPS, ETC. DO NOT REMOVE, ROCK OR TWIST TO INSPECT. USE ONLY A DIRECT PRESSURE TO INSURE THE ITEM IS FULLY SEATED.	
13. INSPECT FOR CLEANLINESS AND TIGHTNESS OF SUCH ITEMS AS SHOCK MOUNTS, ANTENNA, ANTENNA MOUNTS AND WAVE GUIDES.	
14. INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR DIRT, CORROSION, WORN OR BURNED CONTACTS.	

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	CONDITION
15. INSPECT RESISTORS, BUSHINGS, INSULATORS FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE.	
16. INSPECT JACKS AND CONNECTORS FOR SNUG FIT AND GOOD CONTACTS.	
17. INSPECT VARIABLE CAPACITORS FOR DIRT AND MOISTURE.	
18. INSPECT AIR FILTERS FOR CLEANLINESS.	
19. INSPECT SCREWTYPE TERMINALS OF TRANSFORMERS, FIXED CAPACITORS, RESISTORS, CHOKES, POTENTIOMETERS AND RHEOSTATS FOR CORROSION, DIRT AND LOOSE CONTACTS.	
20. CLEAN AND TIGHTEN SWITCHES, BLOWERS, RELAY CASES; CLEAN INTERIOR OF CHASSIS AND CABINETS.	
21. INSPECT GENERATORS, MOTORS AND DYNAMOTORS FOR BRUSH WEAR, SPRING TENSION, ARCING AND COMMUTATOR WEAR.	
22. INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.	
23. INSPECT GASKETS AND BUSHINGS FOR WEAR AND DAMAGE.	
24. INSPECT CATHODE RAY TUBES FOR BURNED SCREEN SPOTS.	
25. BEFORE STORING OR SHIPPING - REMOVE ALL BATTERIES.	

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

ITEM 7. BROKEN HINGE ON TOP OF CABINET. REPORTED TO 2D ECHELON MAINTENANCE FOR REPAIR.

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Figure 21. DA Form 11-266, pages 2 and 3, as used by operator.

b. If the above checks do not locate the trouble, proceed to the operational checklist (par. 44).

44. Operational Checklist

a. General. The operational checklist will help the operator to locate trouble quickly. The corrective measures are used to repair this trouble. If the measures suggested do not restore normal equipment performance, second echelon maintenance is required. Note on the repair tag what corrective measures were taken and how the equipment performed at the time of failure.

b. Procedure. Perform the steps shown in c below, in the order given. Observe the equipment operation and perform any corrective measures necessary.

c. Operational Checklist.

Action	Normal indication	Corrective measures
Place ac power on-off switch in on position (up).	Ac power on-off indicator (red, above toggle switch) lights.	Check ac power on-off indicator lamp and associated wiring (at rear of meter door).
Turn MON. CHANNEL SEL. control to DISC. CALIB. position.	After short warm up, carrier on-off indicator (green) lights.	Check ¾-ampere fuse on power supply. Check carrier on-off indicator lamp and associated wiring (at rear of meter door). Check .4-ampere fuse on power supply.
Turn WWV-A.F. GAIN control clockwise.	After short warm up, WWV receiver on-off indicator (red rectangular), lights.	Check WWV receiver on-off indicator lamp and associated wiring (at rear of meter door). Check .4-ampere fuse on power supply.
Turn METERING switch to position 1.	CARRIER FREQUENCY meter indicates ½ microamperes or more deflection to right.	Check WWV and vhf antenna connections (fig. 16).

45. Operator's Repairs and Adjustments

a. Replacement of Defective Indicator Lamps.

(1) Lower the front-panel meter door.

(2) All indicator lamp sockets are held in place by spring clips. The lamps have a screw base.

(3) Turn the lamp counterclockwise to remove the base.

b. Replacement of Defective Fuses.

(1) Two fuses are incorporated in the power supply (fig. 5). Spares are mounted in clips on the front of the power supply.

(2) Open the cover of the fuse compartment and select an identical fuse for replacement.

(3) Refill spare fuse clip with a fuse of identical value for future substitution.

c. Checking Cable Connections.

(1) Check to be sure that the external power cable, WWV antenna wire, vhf antenna wire, and ground connections are secure (fig. 16).

(2) Check all connections between units. Insure that there are positive connections and no loose or broken wires.

(3) Check the wire connections to the meters, switches, and controls on the front panel.

CHAPTER 5

UNIT REPAIRMAN'S MAINTENANCE INSTRUCTIONS

Warning: This equipment contains selenium rectifiers. When these rectifiers fail, because of burnout or arc-over, poisonous fumes and compounds are released. The fumes have a strong odor and should not be inhaled. *Provide adequate ventilation immediately and do not handle the rectifier until it has cooled.*

Section I. UNIT REPAIRMAN'S MAINTENANCE

46. Scope of Unit Repairman's Maintenance

a. Second echelon maintenance duties are listed in b below. Their scope is determined by the available tools, materials, test equipment, spare parts, and the military occupational specialty (MOS) of the unit repairman.

b. Second echelon maintenance of the radio test set consists of the following:

(1) Preventive maintenance (par. 48).

(2) Visual inspection (par. 50).

(3) Equipment performance check list (par. 51).

(4) Replacement of defective tubes (pars. 52 and 53).

(5) Repair of defective cables.

47. Tools, Materials, and Test Equipment Required

The tools, materials, and test equipment required for second echelon maintenance are listed below.

a. *Tools*. Tool Equipment TE-41.

b. *Materials*.

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

(2) Cleaning cloth (cheesecloth, lint-free) (Federal stock No. 8305-170-5062).

c. *Test Equipment.*

(1) Multimeter TS-297/U.

(2) Electron Tube Test Set TV-7/U.

48. Unit Repairman's Preventive Maintenance

a. *DA Form 11-266*. DA Form 11-266 (fig. 22) is a preventive maintenance check list to be used by the second echelon. Items not applicable to the equipment are lined out in the figure. References in the ITEM block in the figure are to paragraphs that contain additional maintenance information pertinent to the particular item. Additional preventive maintenance information concerning items 1, 3, and 5 on DA Form 11-266 will be found in paragraph 42. Instructions for the use of the form appear on the form.

b. *Items*. The information shown in this subparagraph is supplementary to DA Form 11266. The item numbers correspond to the ITEM numbers on the form.

Warnings:

1. Disconnect the power before performing the following operations. After power is disconnected, some capacitors still may retain dangerous voltages. Before touching exposed electrical parts, short-circuit the parts to ground. When maintenance is completed, replace the equipment in its cabinet, reconnect the power, and check for satisfactory operation.

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

Item	Maintenance procedures
12	Check to see that all plug-in crystals are in place and securely seated, particularly the 5-mc crystal (Y106 or Y706, fig. 11 or 12).
16	Check WWV and VHF connectors on the ac outlet (fig. 16).

49. Lubrication

This equipment does not require lubrication.

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

DAILY CONDITION FOR MONTH OF SEP 58

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

WEEKLY	CONDITION EACH WEEK 1ST	2D	3D	4TH	5TH	2D 3D ECH
5. INSPECT CORDS, CABLES, WIRE ~~AND SHOCK MOUNTS~~ FOR BREAKS, CUTS, KINKS, DETERIORATION, STRAIN AND FRAYING.						✓
6. ~~INSPECT CANVAS AND LEATHER ITEMS FOR FUNGUS, FRAYING, TEARS, BROKEN ZIPPERS AND SNAP FASTENERS.~~						
7. HAND CHECK FOR LOOSENESS OF EXTERIOR ITEMS SUCH AS ~~HANDLES~~, LATCHES, HINGES.						✓
8. ~~INSPECT FOR LUBRICATION IN ACCORDANCE WITH APPLICABLE DA LUBRICATION ORDER.~~						
9. ~~INSPECT DRY BATTERIES FOR DIRT, LOOSE TERMINALS AND LEAKAGE.~~						
10. INSPECT EXPOSED METAL SURFACES FOR RUST AND CORROSION.						✓
11. INSPECT METERS FOR DAMAGED GLASS AND CASES.						✓

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	CONDITION
12. INSPECT SEATING OF READILY ACCESSIBLE ITEMS OF A PLUCK-OUT NATURE: CRYSTALS, FUSES, CONNECTORS, ~~PLUG-IN COILS~~, LAMPS, ETC. DO NOT REMOVE, ROCK OR TWIST TO INSPECT. USE ONLY A DIRECT PRESSURE TO INSURE THE ITEM IS FULLY SEATED. PAR. 48	✓
13. INSPECT FOR CLEANLINESS AND TIGHTNESS OF ~~SUCH ITEMS AS SHOCK MOUNTS~~, ANTENNA, ~~ANTENNA MOUNTS AND WAVE GUIDES~~.	✓
14. INSPECT RELAY ~~AND CIRCUIT BREAKER~~ ASSEMBLIES FOR DIRT, CORROSION, WORN OR BURNED CONTACTS.	✓

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	CONDITION
15. INSPECT RESISTORS, ~~BUSHINGS, INSULATORS~~ FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE.	X
16. INSPECT JACKS AND CONNECTORS FOR SNUG FIT AND GOOD CONTACTS. PAR. 48	✓
17. INSPECT VARIABLE CAPACITORS FOR DIRT AND MOISTURE.	✓
18. ~~INSPECT AIR FILTERS FOR CLEANLINESS.~~	
19. INSPECT SCREWTYPE TERMINALS OF TRANSFORMERS, FIXED CAPACITORS, RESISTORS, CHOKES, POTENTIOMETERS ~~AND RHEOSTATS~~ FOR CORROSION, DIRT AND LOOSE CONTACTS.	✓
20. CLEAN AND TIGHTEN SWITCHES, ~~BLOWERS~~, RELAY CASES; CLEAN INTERIOR OF CHASSIS AND CABINETS.	(X)
21. ~~INSPECT GENERATORS, MOTORS AND DYNAMOTORS FOR BRUSH WEAR, SPRING TENSION, ARCING AND COMMUTATOR WEAR.~~	
22. INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.	✓
23. ~~INSPECT GASKETS AND BUSHINGS FOR WEAR AND DAMAGE.~~	
24. ~~INSPECT CATHODE RAY TUBES FOR BURNED SCREEN SPOTS.~~	
25. ~~BEFORE STORING OR SHIPPING REMOVE ALL BATTERIES.~~	

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

ITEM 15. RESISTOR R277 BLISTERED AND DISCOLORED. REPORTED TO 3D ECHELON MAINTENANCE FOR REPAIR.

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Figure 22. DA Form 11-266, pages 2 and 3, as used by unit repairman.

Section II. TROUBLESHOOTING

50. Unit Repairman's Visual Inspection

Before .operating the equipment, inspect it. Inspection will save repair time and may also avoid further damage. Disconnect the power and do the following:

a. Check the chassis tie points for broken connections.

b. Look for broken wires at resistors, capacitors, coils, transformers, and switches.

Warning: Do not check any item with the power on.

51. Equipment Performance Checklist

a. General. The equipment performance checklist provides a procedure for systematically checking equipment performance. All corrective measures that the second echelon repairman can perform are given in the corrective measures column. When using the checklist, start at the beginning and follow each step in order. If the corrective measures indicated do not fix the equipment, troubleshooting is required by a Field Radio Repairman. Note on the repair tag how the equipment performed and the corrective measures that were taken.

b. Procedure. Place the radio set in operation as shown in the checklist below.

c. Equipment Performance Checklist.

	Step	Action	Normal indication	Corrective measures
PREPARATORY	1	Connect low-impedance antenna to LZ connector, or high-impedance antenna to HZ connector (fig. 16).		
	2	Connect VHF antenna to VHF connector (fig. 16).		
	3	Connect power cable to power connector (fig. 16) and outside 115-volt ac power source, and ground the equipment.		
	4	Insert desired 5-mc calibration crystal; make sure that other crystals are in place.		
START	5	Place ac power on-off switch in on position (up).	AC power on-off indicator (red, above toggle switch) lights.	Check wiring to ac power on-off switch. Check ac power on-off indicator lamp and associated wiring (at rear of meter door). Check ¾-ampere fuse on power supply.
	6	Set controls as shown in step 1, figure 17.	After short warm up, carrier on-off indicator (green) lights.	Check carrier on-off indicator lamp and associated wiring (at rear of meter door).
	7	Set controls as shown in step 4, figure 17.	After short warm up, WWV receiver on-off indicator (red rectangular) lights.	Check WWV receiver on-off indicator lamp and associated wiring (at rear of meter door).
PERFORMANCE EQUIPMENT	8	Turn DB METER switch to LINE.	Audio signal heard through loudspeaker.	Check loudspeaker (at rear of meter door) for loose connections.
	9	Set controls as shown in step 1, figure 17.	CARRIER FREQUENCY meter indicates 1/2 microampere deflection to right.	Check rear of CARRIER FREQUENCY meter for loose connections. Check tube V210 (V802).
	10	Set controls as shown in step 4, figure 17.	MODULATION DEVIATION meter indicates as shown on frequency calibration card (par. 26*h*).	Check rear of MODULATION DEVIATION meter for loose connections.

	Step	Action	Normal indication	Corrective measures
PERFORMANCE EQUIPMENT	11	Set controls as indicated in paragraph 33d.	Carrier on-off indicator (green) goes out and noise is squelched at loudspeaker	Check tube V501.
	12	Set controls as shown in step 2, figure 17, and follow calibration instructions given in paragraph 24.	2 or 3 audio amplitude variations per second (the correct zero beat).	Check crystal Y106 (Y706). Check tube V105 (V705).
STOP	13	Place ac power on-off switch in off position (down). Turn XTAL HEATER switch to OFF. Turn WWV-A.F. GAIN control to OFF (fully counterclockwise).		

52. Tube-testing Techniques

Note. Tube locations are shown in figures 11 through 15. When trouble occurs, check the power supply and all cabling and connections before removing any tubes. Try to isolate the trouble to a component or stage. If tube failure is suspected, use the applicable procedure below to check the tubes.

Caution: Do not rock or rotate a tube when removing it from a socket; pull straight out with a tube puller.

a. Use of Tube Tester. Remove and test one tube at a time. Discard a tube only if its defect is obvious or if the tube tester shows it to be defective. Do not discard a tube that tests at or near its minimum test limit on the tube tester. Put back the original tube, or insert a new one if required, before testing the next one.

b. Tube Substitution Method. Replace a suspected tube with a new tube. If the equipment still does not work, remove the new tube and put back the original one. Repeat this procedure with each suspected tube until the defective tube is located.

53. Preferred-Type Tubes

The chart below lists the preferred-type tube for each nonpreferred-type tube. Do not use a nonpreferred type tube to replace a preferred-type tube.

Nonpreferred-type tube	Preferred-type tube	Where used
OB2	OB2WA	Voltage regulator, WWV receiver.
6AK5	5654/6AK5W	RF amplifier, WWV receiver. First RF amplifier, control receiver (TS-971/G). Second RF amplifier, control receiver (TS-971/G). First mixer, control receiver (TS-971/G).
6AQ5	6005/6AQ5W	Audio amplifier, WWV receiver.
6BE6	5750/6BE6W	Converter, WWV receiver.
6BF7	6BF7W	Discriminator, control receiver. Noise rectifier, control receiver.
6C4	6C4WA	Oscillator-multiplier, control receiver (TS-974/U). Crystal oscillator, control receiver.
12AT7	12AT7WA	Oscillator-mixer, WWV receiver. Audio-squelch, control receiver.

54. Repairs and Adjustments

a. Replacement of Meters.

(1) Lower the front-panel meter door.

(2) Remove the four nuts holding the meter to the panel.

Note. One nut secures a cabling clip. Be sure that this clip is secured when reassembling the meter.

(3) Disconnect the wires and terminals at the meter posts.

b. Chassis Units. In most cases, replacements and minor repairs can be accomplished without disassembling the chassis units.

(1) Remove the detachable rear panel of the cabinet and lower the front-panel meter door. Tubes can be replaced from the front. Voltage and resistance readings can be obtained from the rear.

(2) If it becomes necessary to remove components, tag the disassembled connectors so that they may be properly reassembled.

Caution: Be careful when handling chassis units, as many resistors and capacitors are assembled in the circuit by their pigtails only and might become disconnected through careless handling.

55. WWV Antenna

a. The radio test set is designed to receive WWV signals on either 10 or 15 mc. To receive these signals with optimum efficiency, it is necessary to construct a special WWV antenna. Directions for constructing a suitable low-impedance type antenna are provided in the following subparagraphs.

b. As a rule, the radio test set will be located close to a station tower. This tower may be used to/support the WWV antenna. In the absence of a tower, any tall structure may be substituted -provided that it is situated in an interference free area. A typical installation is shown in figure 23.

c. To construct the antenna, proceed as follows:

(1) Obtain two lengths of No. 12 gage (or heavier) wire (49 feet for 10-mc operation and 32 feet for 15-mc operation).

(2) Connect the two wires to opposite ends of an insulator.

(3) Terminate the opposite end of each wire with similar insulators.

(4) With two suitable lengths of supporting wire, connect the two wires from the top of the tower to a ground anchor. The angle between the antenna and ground is not critical.

(5) Obtain a length of RG-8/U or RG-58/U coaxial cable that will reach the LZ connector on the radio test set. Keep the length to a minimum to reduce line losses.

Note. RG-8/U is preferable, because it has lower loss characteristics.

(6) Solder the center conductor of one end of the coaxial cable to the upper portion of the antenna, and the outer conductor to the lower portion.

(7) Bind the coaxial cable to the center insulator to prevent the wire from breaking.

(8) Install the pin-type coaxial connector (provided with the radio test set) on the opposite end of the coaxial cable. Connect it to the LZ connector on the radio test set.

56. VHF Antenna

The TS-974/U and TS-971/G require VHF antennas that are capable of receiving signals in the 30- to 50-mc and 152- to 174-mc ranges, respectively.

a. Utilizing VHF Stations Antenna. A VHF station antenna, which is being used for other communications equipment of corresponding frequency, may also be used for the radio test set. This should only be done, however, when slightly reduced station receiver sensitivity will not affect the operation of the communications system. In this type of installation, connect the radio test set to the antenna as follows:

(1) Insert a coaxial T-type connector in series with the receiver transmission line as shown in figure 23.

(2) Connect a length of RG-8/U coaxial cable, terminated with a suitable VHF connector, to the T-type connector.

(3) Route the cable to the radio test set and install the coaxial VHF connector (provided with the radio test set) on the end of the cable.

(4) Connect the cable to the VHF antenna connector on the radio test set.

b. Using Separate Antenna. If a VHF station antenna is not available, or is being used to its maximum capacity, a separate VHF antenna should be erected. Any high-gain VHF-type antenna will be acceptable for use with the radio test set. A typical VHF antenna installation is illustrated in figure 23. General requirements for this type of antenna installations are as follows:

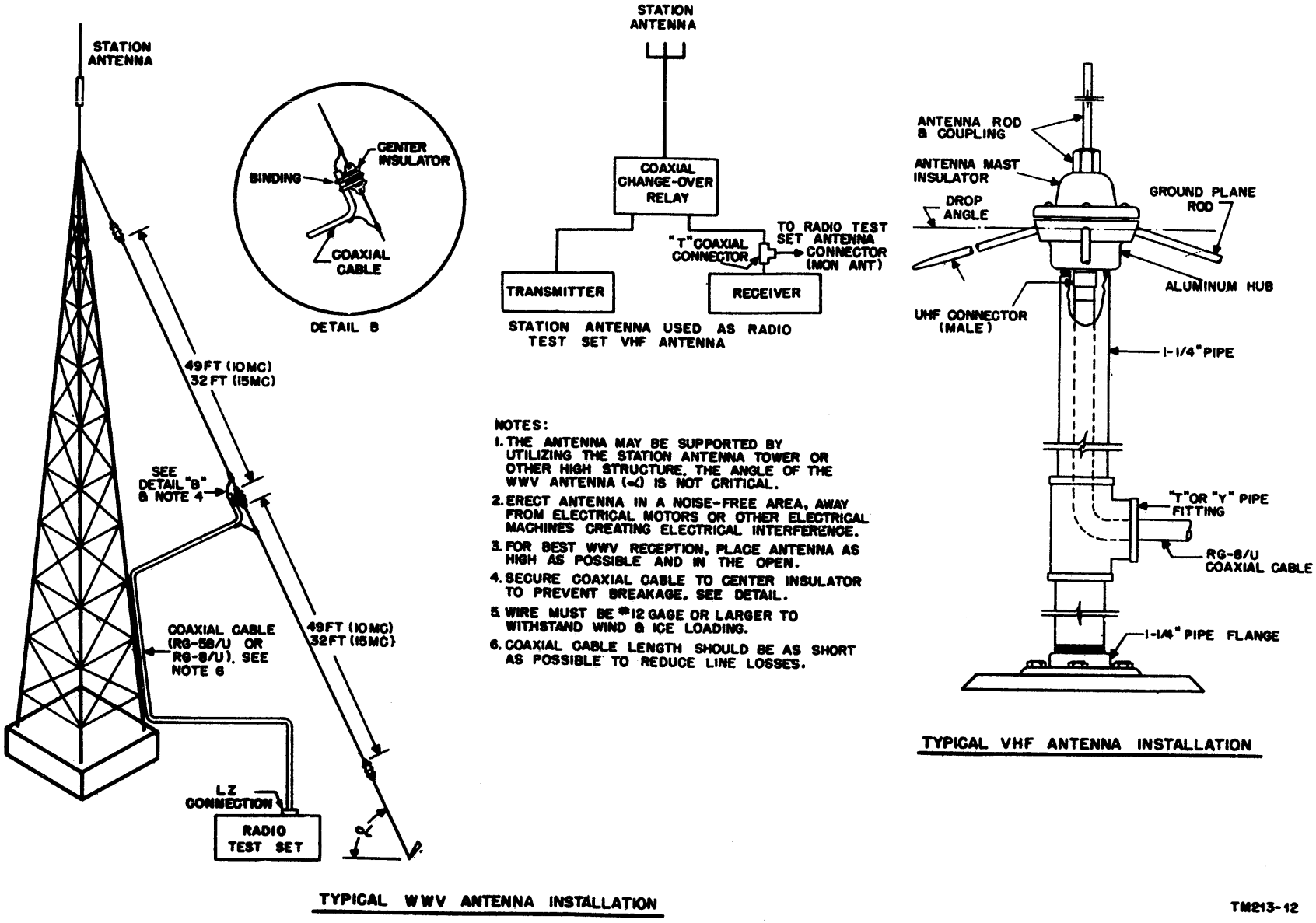

Figure 23. Typical antenna installations.

(1) The main assembly consists of an antenna rod and coupling which is mounted vertically on a 1¼-inch pipe. An antenna mast insulator prevents the antenna rod from being grounded to the support pipe. An aluminum hub provides a means for mounting the antenna rod -to the support pipe.

(2) The aluminum hub also supports four ground plane rods and makes the electrical connections from the ground plane rods to the outside conductor of the coaxial transmission line. The optimum drop angle for the ground plane rods is 60° for the 30- to 50-mc band, and 28° for the 152- to 174-mc band.

(3) The base of the support is secured to a solid surface by means of a 1¼-inch pipe flange. The antenna should be mounted in an area that is free from surrounding metallic objects and interference..

(4) A T- or Y-type fitting should be inserted in the pipe near the base to permit a length of RG-8/U coaxial cable to be routed through the support pipe to the antenna. The cable is connected to the antenna coupling by means of a vhf connector. The coaxial vhf connector provided with the radio test set should be installed on the opposite end of the lead-in cable within reach of the radio test set. The cable should then be connected to the vhf antenna connector on the radio test set.

(5) The antenna rod and ground plane rod lengths, which are identical, should be chosen to provide optimum efficiency at the desired monitoring frequency. The following chart indicates the recommended rod lengths for various frequencies. If the monitoring frequency lies between any two frequencies specified in the chart, proper rod lengths may be calculated by interpolation. If several frequencies are to be monitored with the same antenna, rod lengths should be chosen for the mean of the frequencies involved.

Radio test set	Frequency (mc)	Antenna and ground plane rod lengths (in.)'
TS-974/U	30	88
	35	75
	40	65
	45	58
	50	52
TS-971/G	150	16.8
	155	16.3
	160	15.7
	165	15.2
	170	14.7
	175	14.2

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

57. Disassembly of Equipment

To prepare the radio test set for shipment and storage-

a. Disconnect the WWV antenna lead-in from the LZ or HZ connector on the ac outlet.

b. Disconnect the vhf antenna from the vhf antenna connector on the ac outlet.

c. Disconnect the ground lead from the equipment.

d. Disconnect the ac power cable from the ac power source and from the ac power connector on the ac outlet.

e. Remove the coaxial connectors from the end of the WWV and VHF antenna lead-ins and place them inside a suitable envelope.

f. Tape the alinement tool to the back cover of the technical manual.

g. Tape the calibration card to the inside of the top lid of the radio test set.

h. Check: the equipment against the table of components (par. 5).

58. Repackaging for Shipment or Limited Storage

a. The exact procedure for repackaging depends on the material available and the conditions under which the equipment is to be shipped or stored. Adapt the procedures outlined below whenever circumstances permit. The information concerning the original packaging (par. 16*a*) will also be helpful. The following materials are required for packaging the radio test set. For stock numbers of materials, consult SB-38-100, Preservation, Packaging and Packing Materials, Supplies, and Equipment Used in the Army.

Material	Quantity
Filler paper, 1" thick, 12" wide, roll stock	4 sq ft
Cellulose wadding- 1 lb	
Wrapping paper, 120 lb	2 sq ft
Hard-faced flexible corrugated cardboard 3/32" thick.	28 sq ft
Corrugated, single-faced, flexible paper	20 sq ft
Gummed, water-resistant, 3" wide	38 ft
Corrugated cardboard carton, 50 lb test	1
Corrugated cardboard carton, 275 lb test	1
Pressed cardboard carton, 350 lb test, V3C grade per spec PPP-B-636.	1

b. The following materials ate required for packaging three radio test sets (bulk shipment).

Material	Quantity
All material specified in preceding chart	triple
Flat steel strapping	40 ft
Wooden packing case	1

c. Dimensional data for all cardboard and wooden boxes are as follows:

Container	Inner dimensions			(Board feet	Cubic feet (estimated)	Packed weight (lb)
	Height (in.)	Width (in.)	Depth (in.)			
Spare parts carton	6¼	3 5/8	2 3/4		.48	.75
Inner cardboard carton	23 1/8	16 3/4	1 1/4		3.11	55
Outer cardboard carton	23 7/8	17 5/8	13 1/8		3.92	210
Wooden packing box	24¼	18	40 1/2	18	14.65	59

59. Field Repackaging

Whenever possible, use the procedure outlined below to repackage the equipment. The information concerning the original packaging (par. 16a and fig. 10) may also be helpful.

a. Loose Components. All loose components are inclosed within the radio test set for shipping. Package them as follows:

(1) Wrap the ac power cable in wrapping paper and secure it with gummed tape. Place it inside the top lid of the radio test set.

(2) Place the technical manuals (with alignment tool taped on one back cover) inside the top lid of the radio test set.

(3) Place the envelope containing the two antenna lead-in coaxial connectors inside the top lid of the radio test set.

(4) Package all spare tubes and parts individually with cellulose wadding and put them inside the small cardboard spare parts box. Place the box inside the top lid of the radio test set.

(5) Stuff filler paper into the inside of the radio test set with the loose components to prevent the components from moving about.

(6) Shut the top lid of the radio test set, making sure that it is closed securely.

b. Radio Test Set. The radio test set, with all loose components inclosed, is packed in its inner shipping carton as follows:

(1) Obtain a cardboard carton of the type and inner dimensions specified in paragraph 58c (inner corrugated cardboard carton).

(2) Construct four corner spacers 10¼ inches long from the stock of 3/32-inch hard flexible corrugated cardboard. Place the spacers in the four corners of the cardboard carton.

(3) Insert the radio test set in the carton (top up) so that it is held securely by the four corner spacers.

(4) Construct the top corrugated spacer from the stock of 3/32-inch hard-faced flexible corrugated cardboard. The spacer should measure 23 1/8 by 16 3/4 inches, and should be folded over so as to form a pad 1 inch thick.

(5) Close the carton lid and tape it securely shut with gummed tape. Tape both the top and bottom carton seams with tape.

60. Field Repacking, Strapping, and Marking

a. Packing Outer Pressed Cardboard Carton.

This packaging prepares a single unit for normal shipment.

(1) Obtain a cardboard carton of the type and inner dimensions specified in paragraph 58c (outer pressed cardboard carton).

(2) Insert the inner carton, containing the radio test set, in the outer carton.

(3) Close the carton lid and tape it securely shut with gummed tape. Seal all the open seams on the carton with gummed tape.

b. Packing Wooden Packing Case. This packaging prepares three units for bulk shipment.

(1) Construct a wooden case having the inner dimensions listed in paragraph 58c. Each end of the box should have four 2- by 2-inch exterior braces running horizontally and vertically to form a square frame (fig. 10). End panels are fastened to the inside of the two frames. The four remaining sides of the box are made up of wood planks extending from frame to frame.

(2) Insert three radio test sets, packed as described in a above, in the wooden case side by side. Fill the voids in the case with pads of flexible corrugated paper. Secure the cover to the case and band the box with three metal straps.

c. Marking. Mark all shipping containers in accordance with the requirements of SR 55720-1, Transportation and Travel, Preparation for Oversea Movement of Units (POM).

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

61. Authority for Demolition

The demolition procedures given in paragraph 62 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon the order of the commander.

62. Method of Destruction

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

a. Smash. Smash the controls, coils, switches, capacitors, transformers, and meters; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or other heavy tools.

b. Cut. Cut the power cord and the meter and control cables; use axes, handaxes, or machetes.

c. Burn. Burn cords and technical manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend the front panel and cabinet.

e. Explode. If explosives are necessary, use firearms, grenades, or TNT.

f. Dispose. Bury or scatter the destroyed parts in slit trenches or foxholes, or throw them into streams.

APPENDIX

REFERENCES

Following is a list of references applicable and available to the operator and unit repairman of Radio Test Sets TS-971/G and TS-974/U:

a. Operator.

TM 11-283 Radio Sets AN/VRC-6, -6X, and -6Y.

TM 11-297 Radio Sets AN VRC-19, -19X, and -19Y.

b. Unit Repairman.

TM 11-5083 Electron Tube Test Sets TV-7/U, TV-7A/U, and TV-7B/U.

TM 11-5500 Multimeter TS-297!U.

[AG 413.44 (12 Aug 54)]

BY ORDER OF THE SECRETARIES OF THE ARMY AND THE AIR FORCE:

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

OFFICIAL:
HERBERT M. JONES,
Major General, United States Army,
The Adjutant General.

THOMAS D. WHITE,
Chief of Staff, United States Air Force.

OFFICIAL:
J. L. TARR,
Colonel, United States Air Force,
Director of Administrative Services.

Distribution:
Active Army:
ASA (2)
CNGB (1)
Technical Stf, DA (1) except
CSigO (30)
Technical Stf Bd (1)
USA Arty Bd (1)
USA Armor Bd (1)
USA Inf Bd (1)
USA Air Def Bd (1)
USA Abn & Elct Bd (1)
USA Avn Bd (1)
USA Armor Bd Test Sec (1)
USA Air Def Bd Test Sec (1)
USA Arctic Test Bd (1)
USCONARl (5)
US ARADCOM (2)
US ARADCOM Rgn (2)
OS Maj Comd (5)
Log Comd (5)
MDW (1)
Armies (5)
Corps (2)
USA Corps (Res) (1)
Div (2)
USATC (2)
Svc Colleges (5)
Br Svc Sch (5) except
USASCS (25)
Inst (2) except
Atlanta Gen Depot (none)
Sig Sec, Gen Depots (10)
Sig Depots (17)
WRAMC (1), AMS (1), USA Elct PG (1),
Dugway PG (5), Jefferson PG (5), Pine
Bluff Arsenal (5)
Fld Comd, AFSWP (5)
Engr Maint Cen (1)
AFIP (1)
Trans Terminal Comd (2)
OS Sup Agcy (2)
USA Sig Pub Agcy (8)
USA Sig Engr Agcy (1)
USA Comm Agcy (2)
TASSA (13), Mid-Western Rgn Ofc (1)
USA Sig Eqp Spt Agcy (2)
USA White Sands Sig Agcy (13)
Yuma Test Sta (2)
Sig Fld Maint Shops (3)
Sig Lab (5)
Mil Dist (1)
Sectors, USA Corps (Res) (1)
JBUSMC (2)
Units org under fol TOE:
10-377 (2)
11-7 (2)
11-16 (2)
11-18 (2)
11-57 (2)
11-127 (2)
11-128 (2)
11-500 (AA-AE) (2)
11-557 (2)
11-587 (2)
11-592-(2)

11-597 (2)
19-55 (2)
19-56 (2)
19-57 (2)
19-217 (2)
19-500 (AA-AE) (2)
30-500 (2)
55-17 (2)
55-18 (2)
65-28 (2)
W5-116 (2)
55-137 (2)

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

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RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

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PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

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PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

TM 11-6625-205-12/T0 33A1-5-68-1 RADIO TESTS SETS TS-971/G AND TS-914/U-1958

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