TM 11-1160

WAR DEPARTMENT TECHNICAL MANUAL

RADAR SET AN/TPX-4

WAR DEPARTMENT • 28 DECEMBER 1944

TECHNICAL MANUAL

RADAR SET AN/TPX-4

CHANGES No. 1

WAR DEPARTMENT
WASHINGTON 25, D. C., 21 February 1946

TM 11-1160, 28 December 1944, is changed as follows, to cover the substitution of Transmitter-Receiver RT-48/TPX-1 for Transmitter-Receiver RT-48A/TPX-1 (procured on Order No. 745-MSCPD-44):

9. LIST OF COMPONENTS.

* * * * *

COMPONENTS OF RADAR SET AN/TPX-4

Quantity	Nomenclature	Function	Dimensions	Weight (lb)
2	Transmitter - Receiver RT-48A/TPX-1 or **Transmitter-Receiver RT-48/TPX-1.**	One in use and one spare.	15⅛" wd, 13⅝" h, 9²⁷⁄₃₂" d, less cover; cover 15⅝" wd, 14⅛" h, ¾" d.	45
*	*	*	*	*

10.1. TRANSMITTER - RECEIVER RT-48/TPX-1 (Added)

Transmitter-Receiver RT-48/TPX-1 differs from Transmitter-Receiver RT-48A/TPX-1 in the following respects:

a. Mechanical Differences. (1) The intake air cleaner (fig. 6.1) used in Transmitter-Receiver RT-48/TPX-1 is smaller than that used in Transmitter-Receiver RT-48A/TPX-1.

(2) The mounting brackets of the receiver r-f unit are cut differently for ventilation.

(3) The mounting details of the high-frequency oscillator terminal board are different.

(4) Transmitter-Receiver RT-48/TPX-1 uses a gasket and backing plate with its blower, while Transmitter-Receiver RT-48A/TPX-1 uses a simple sponge rubber gasket.

(5) Transmitter-Receiver RT-48/TPX-1 has two voltage rating nameplates mounted one behind the other, the correct one to be exposed for each voltage. Transmitter-Receiver RT-48A/TPX-1 has a single nameplate.

(6) The following listed mounting boards in the receiver unit differ in design and lay-out.

(*a*) Rear vertically mounted terminal board.

(*b*) Left side vertically mounted terminal board.

(*c*) Mounting board for resistor 103-1.

(*d*) Mounting board for resistor 103-2.

(*e*) Terminal board No. 1 in the high-frequency oscillator.

(*f*) Mounting board for resistor 113-7 (not used in Transmitter-Receiver RT-48A/TPX-1).

(7) The rear vertically mounted terminal board in the transmitter unit is different.

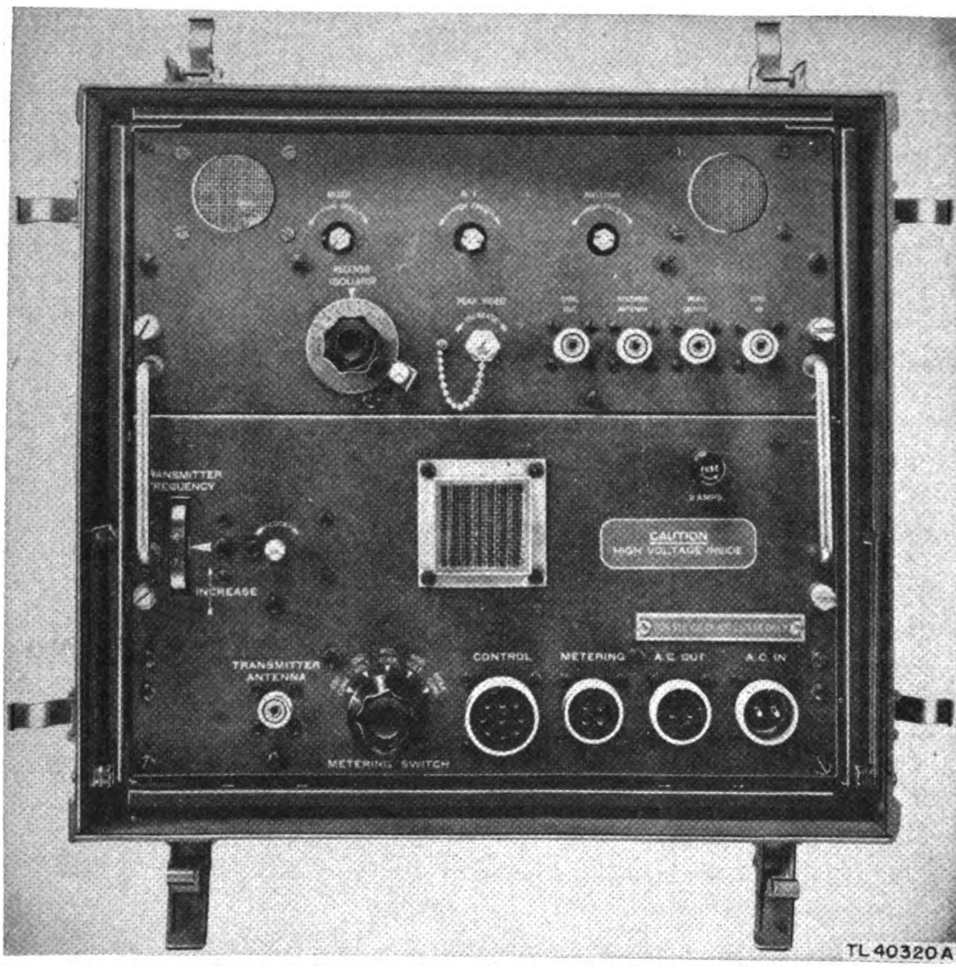


Figure 6.1. Transmitter-Receiver RT-48/TPX-1.

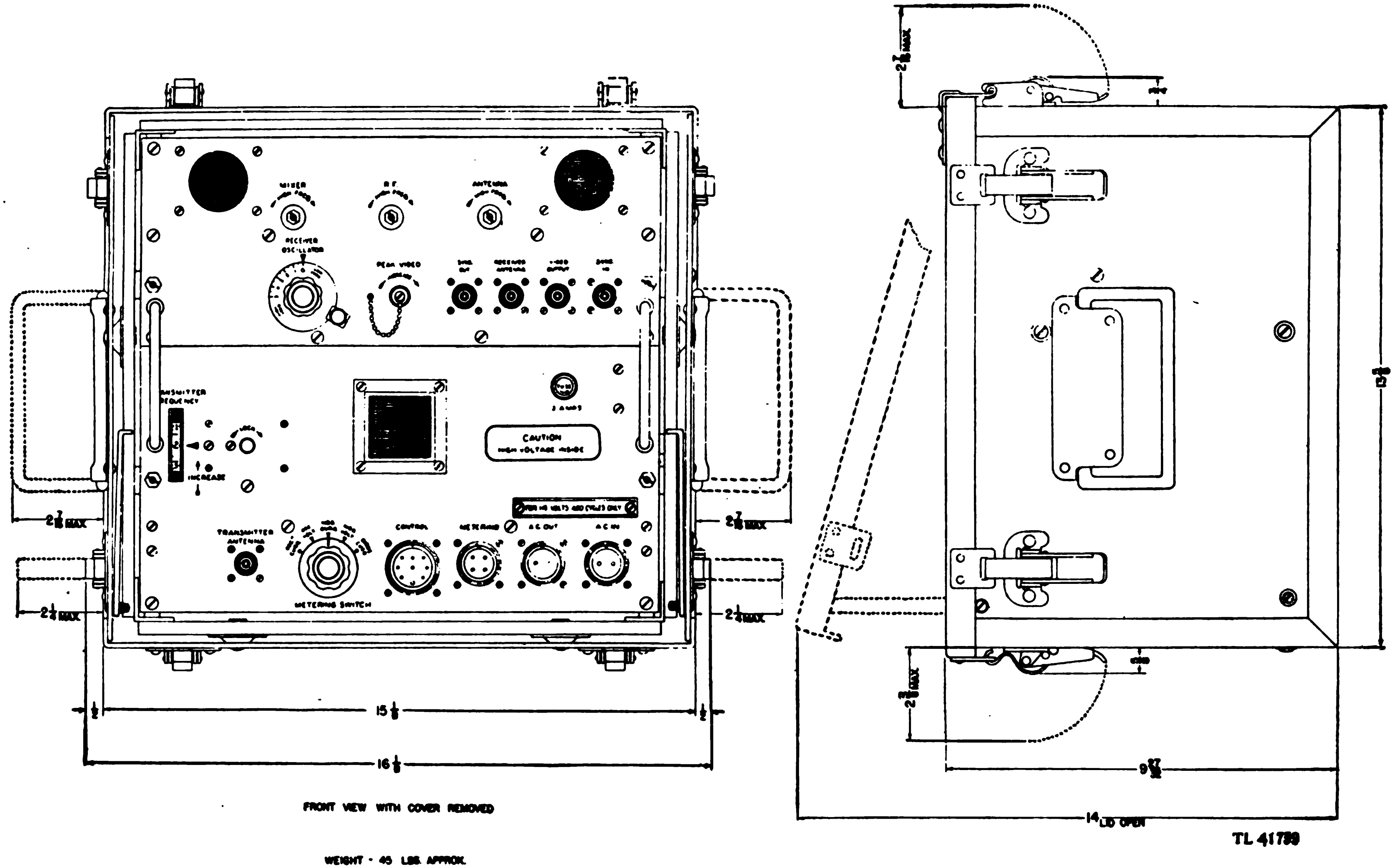


Figure 7.1. Transmitter-Receiver RT-48/TPX-1, outline drawing.

b. Electrical Differences.

TRANSMITTER-RECEIVER RT-48/TPX-1			TRANSMITTER-RECEIVER RT-48A/TPX-1	
Ref. No.	Part description	Function	Ref. No.	Part description
102-1	RESISTOR: 75,000 ohms ±10%; 1w; carbon.	2d i-f screen	126-1, 126-2	RESISTOR: (two in parallel); 150,000 ohms ±10%; 1w; carbon.
102-2	RESISTOR: same as 102-1	3d i-f screen	126-3, 126-4	RESISTOR: same as 126-1, 126-2.
102-3	RESISTOR: same as 102-1	4th i-f screen	126-5, 126-6	RESISTOR: same as 126-1, 126-2.
102-4	RESISTOR: same as 102-1	Video screen	102	RESISTOR: 75,000 ohms ±10%; 1w; carbon.
103-1	RESISTOR: 10,000 ohms ±10%; 1w; carbon.	1st r-f plate decoupler.	123-1, 123-2	RESISTOR: (two in parallel); 20,000 ohms ±10%; 1w; carbon.
103-2	RESISTOR: same as 103-1	2d r-f plate decoupler.	123-3, 123-4	RESISTOR: same as 123-1, 123-2.
108-1	RESISTOR: 3,000 ohms ±10%; 1w; carbon.	1st i-f plate decoupler.	124-1, 124-2	RESISTOR: (two in parallel); 6,000 ohms ±10%; 1w; carbon.
108-2	RESISTOR: same as 108-1	2d i-f plate decoupler.	124-3, 124-4	RESISTOR: same as 124-1, 124-2.
108-3	RESISTOR: same as 108-1	3d i-f plate decoupler.	124-5, 124-6	RESISTOR: same as 124-1, 124-2.
108-4	RESISTOR: same as 108-1	4th i-f plate decoupler.	124-7, 124-8	RESISTOR: same as 124-1, 124-2.
113-7	RESISTOR: 100,000 ohms ±10%; 1w; carbon.	Video limiter fixed bias.	125	RESISTOR: 100,000 ohms ±10%; 2w; carbon.
118	RESISTOR: 15,000 ohms ±10%; 2w; carbon.	H-F oscillator plate dropping.	118-1, 118-2	RESISTOR: (two in parallel); 30,009 ohms ±10%; 2w; carbon.
206-1, 206-2	RESISTOR: (two in parallel); 30,000 ohms ±10%; 2w; carbon.	Gain control dropping.	206-1, 206-2, 206-3, 206-4.	RESISTOR: (four in parallel); 60,000 ohms ±10%; 2w; carbon.
213	RESISTOR: 20,000 ohms ±10%; 2w; carbon.	High-voltage filter	213-1, 213-2	RESISTOR: (two in parallel); 40,000 ohms ±10%; 2w; carbon.
141-5	CAPACITOR: 1,000 mmf; ceramic; 300 vdcw.	1st i-f screen bypass.	150-12	CAPACITOR: 470 mmf; mica; 500 vdcw.
141-8	CAPACITOR: 1,000 mmf; ceramic; 300 vdcw.	2d i-f screen bypass.	150-13	CAPACITOR: 470 mmf; mica; 500 vdcw.
141-11	CAPACITOR: 1,000 mmf; ceramic; 300 vdcw.	3d i-f screen bypass.	150-14	CAPACITOR: 470 mmf; mica; 500 vdcw.
141-14	CAPACITOR: 1,000 mmf; ceramic; 300 vdcw.	4th i-f screen bypass.	150-15	CAPACITOR: 470 mmf; mica; 500 vdcw.
241	CAPACITOR: oil paper; double 0.2 mf; 330v ac.	Blower motor capacitor.	241	CAPACITOR: oil paper; 0.55 mf; 220v ac.
268	MOTOR: 115v, 400 cps; 80v, 1,200 cps.	Ventilator	268	MOTOR: 115v, 400 cps only.
Not used		3d i-f screen filter	176-2	COIL: radio; r-f choke; 4½ microhenries.
176	COIL: choke; r-f	2d detector, r-f filter.	176-1	COIL: radio; r-f choke; 4½ microhenries.

37. LUBRICATION (Superseded)

a. War Department Lubrication Orders. War Department Lubrication Orders are illustrated, numbered, and dated cards or decalcomania labels which prescribe approved first- and second-echelon lubrication instructions for mechanical equipment which requires lubrication by using organizations. Current War Department Lubrication Orders which are available are listed in the latest edition of FM 21-6. Lubrication Orders should be requisitioned in conformance with instructions and lists in FM 21-6, which is published quarterly by The Adjutant General.

b. Compliance with War Department Lubrication Orders. (1) Instructions contained in War Department Lubrication Orders are mandatory and supersede all conflicting lubrication instructions of an earlier date. Applicable War Department Lubrication Orders which are available will be obtained, carried with the equipment at all times, and fully complied with. Difficulties experienced in obtaining and complying with such orders will be reported through technical channels to the Commanding General, Army Service Forces, Attention: Maintenance Division.

(2) The War Department Lubrication Order for Radar Set AN/TPX-4 is furnished on a 10- by 15-inch card. Figure 23.1 is a facsimile of the War Department Lubrication Order for Radar Set AN/TPX-4.

c. Transmitter-Receiver Blower Motor. Disassembly and lubrication of the blower motor is done by higher echelon repair personnel. The motor should be lubricated once a year or when the equipment reaches a higher echelon repair depot for repairs. Instructions for disassembly and lubrication are as follows:

(1) Remove the two screws in the top of the channels which support the rear of the receiver.

(2) Remove both handles from the front panel of the transmitter-receiver by taking off the nut and lockwasher at each end of the two handles. The nuts are located on the inner surface of the front panel.

(3) Remove the four screws in the front panel which connect the receiver to the transmitter.

(4) Disconnect the plug at the right rear corner of the transmitter chassis.

(5) Set the receiver to one side and save all mounting screws removed in previous steps.

(6) Remove the two large screws, located on the bottom of the chassis, that hold the motor support to the chassis.

(7) Unsolder the four motor connections at terminals 1, 2, 3, and 4 on the 1¼- by 1½-inch terminal board located under the chassis and below the motor.

(8) Remove the motor assembly from the transmitter. Care must be taken to guide the four motor wires through the bottom hole in the chassis to prevent damage to the insulation.

(9) Remove the three screws from the blower case.

(10) Using an Allen wrench, loosen the two Allen screws which hold the blower wheel on the motor shaft. Remove the blower wheel.

(11) Remove the three screws from the inner surface of the blower head. This allows the mounting bracket to be removed.

(12) Remove the binding ring from the blower end of the motor.

(13) Remove the two washers directly under the binding ring.

(14) Saturate the felt ring with oil, PS, Lubricating, Preservative, Special. Do not use more oil than the felt pad can absorb.

(15) Remove the three screws in the fan grill at the rear of the motor case.

(16) Remove the fan grill from the body of the motor.

(17) Loosen the two Allen screws in the hub of the fan at the rear end of the motor and remove the fan.

(18) Slip the rotor from the motor body.

(19) Saturate the small felt pad at the ball bearing near the rear end of the rotor with oil, PS, Lubricating, Preservative, Special. Use no more oil than will be absorbed by the pad.

(20) Reverse the above procedure to reassemble the motor and transmitter-receiver.

38. PREVENTIVE MAINTENANCE ITEM INSTRUCTIONS.

* * * * *

c. Items.

* * * * *

(19) ITEM 19, ANTENNA SYSTEM.

* * * * *

(*b*) *Maintenance Procedure.*

* * * * *

L. LUBRICATE (Superseded):

Lubricate the antenna tower and the remote antenna drive according to the instructions contained in figure 23.1.

* * * * *

WAR DEPARTMENT LUBRICATION ORDER LO 11-1160

30 MAR 1945

RADIO EQUIPMENT AN/TPX-4

(Tower TR-29 and Remote Antenna Drive RM-55)

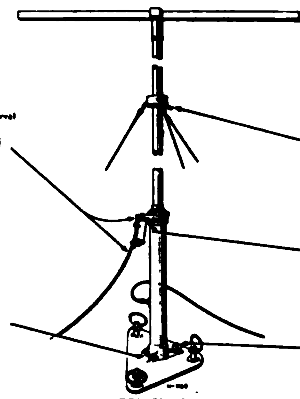
Reference: TM 11-1168.

Clean fittings before lubricating.

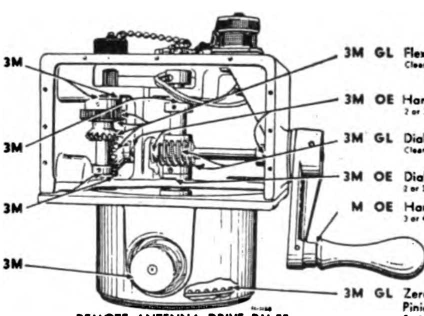
Intervals given are maximums for normal 8-hour day operation. For abnormal conditions or activities, intervals should be shortened to compensate.

Clean parts with SOLVENT, dry cleaning. Dry before lubricating.

CAUTION: This equipment employs high voltages that may be fatal if contacted by operating personnel. Use necessary precautions before servicing.



TOWER TR-29



REMOTE ANTENNA DRIVE RM-55
(Side cover removed)

—KEY AND NOTES—

LUBRICANTS	EXPECTED TEMPERATURE			INTERVALS
OE—OIL, engine	above +32°F.	+32°F. to 0°F.	below 0°F.	
Radio Components	OE 10 or Navy Symbol 9110	PS or Navy Symbol OS 1361	PS or Navy Symbol OS 1361	M—Monthly
Except Radio Components	OE 30 or Navy Symbol 9250	OE 10 or Navy Symbol 9110	PS or Navy Symbol OS 1361	3M—3 months
GL—GREASE, lubricating, special or Navy Symbol OS 1350. All temperatures.				
PS—OIL, lubricating, preservative, special or Navy Symbol OS 1361.				

1. GREASE POINTS—Every 3 months, clean and sparingly lubricate Cable Connector and Terminal Cap Threads with GL. When assembling clean and lightly coat Antenna Mast Section Joints, Antenna Mounting Sleeve and all Assembly Bolts and Capscrew Threads with GL.
2. OIL CAN POINTS—Monthly, lubricate Antenna Mast Section Clamping Thumbscrew Threads, Antenna Mast Brace Cable Snaps and Turnbuckle Threads and Pivot Bolts, Hinges, Locks, and Fasteners with OE. Every 3 months, lubricate Control Shaft Bearings of Test Set TS-159/TPX and Transmitter-Receivers RT-48/TPX-1 and RT-48A/TPX-1 with 1 drop, each of OE.
3. LUBRICATED AFTER DISASSEMBLY BY HIGHER ECHELON—Mast Lower Section Splice Bearing, Transmitter Receiver Blower Motor Bearings.

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 30 Mar 1945.

[A.G. 300.8 (30 Mar 1945)]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

Requisition additional lubrication orders in conformance with instructions and lists in FM 21-6.

TL330695

Figure 23.1. War Department Lubrication Order 11–1160.

Figure 24.1. Transmitter-Receiver RT-48/TPX-1, front view, out of case.

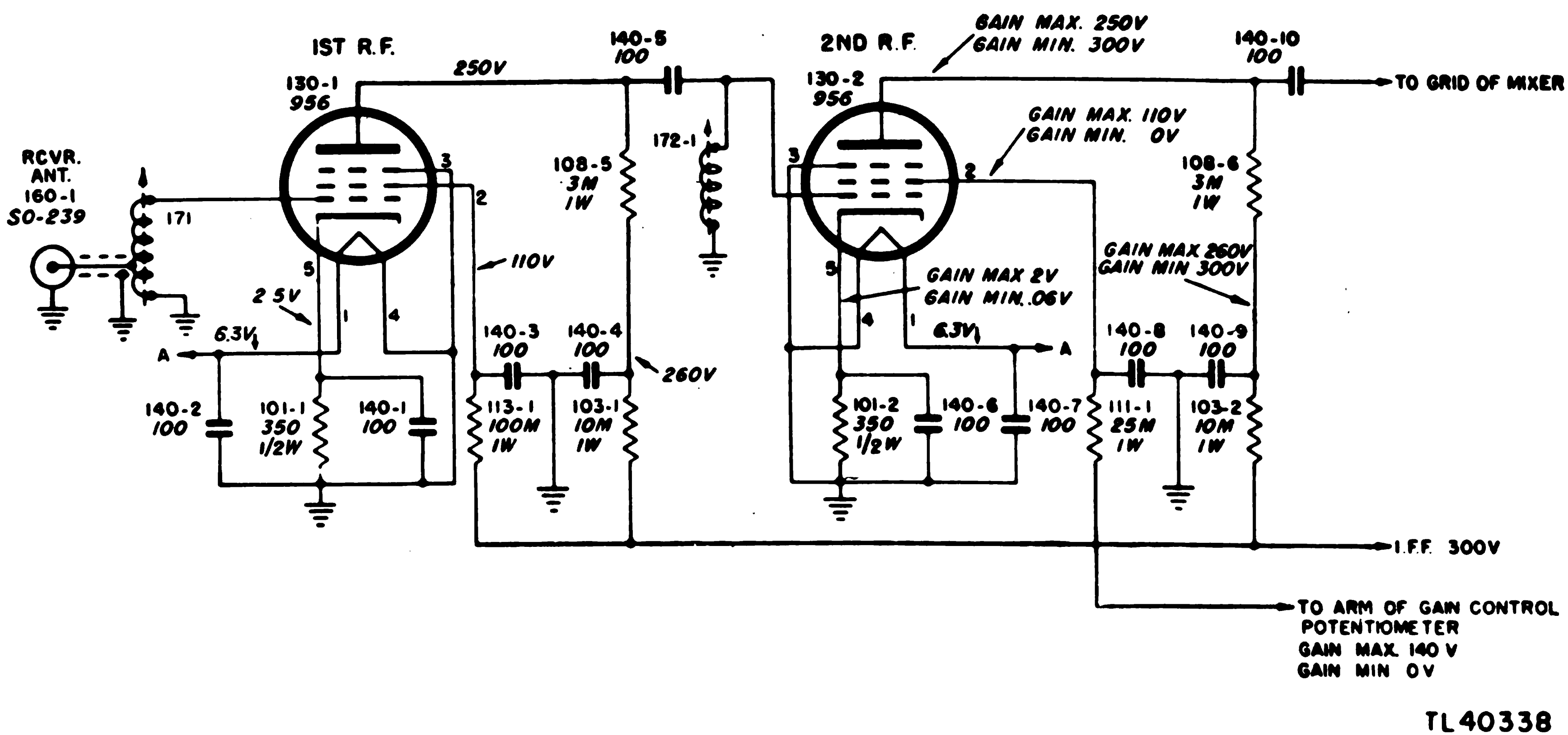


Figure 40.1. Transmitter-Receiver RT-48/TPX-1, functional schematic diagram, receiver unit, r-f amplifier.

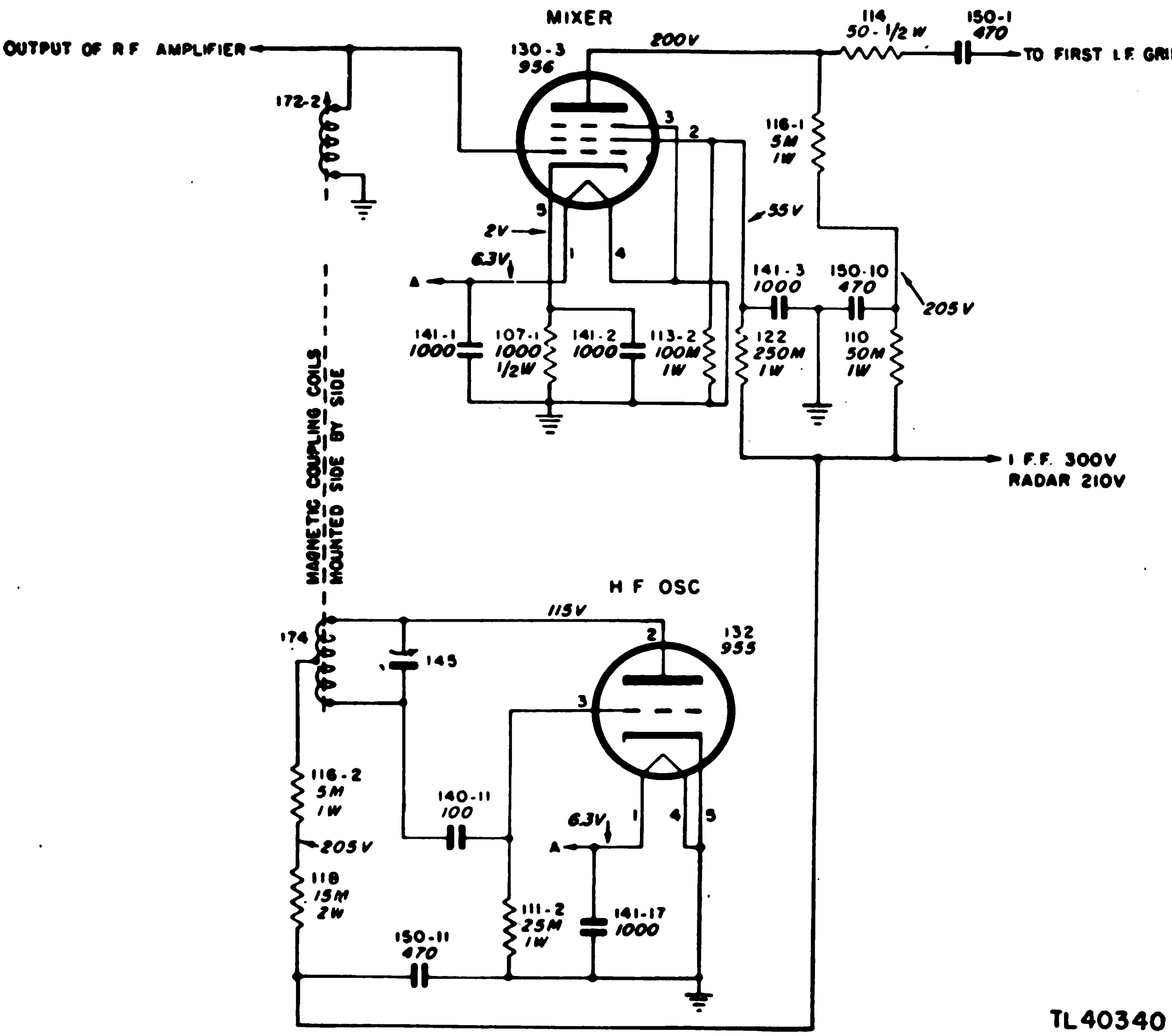


Figure 41.1. Transmitter-Receiver RT-48/TPX-1, functional schematic diagram, receiver unit, mixer and high-frequency oscillator.

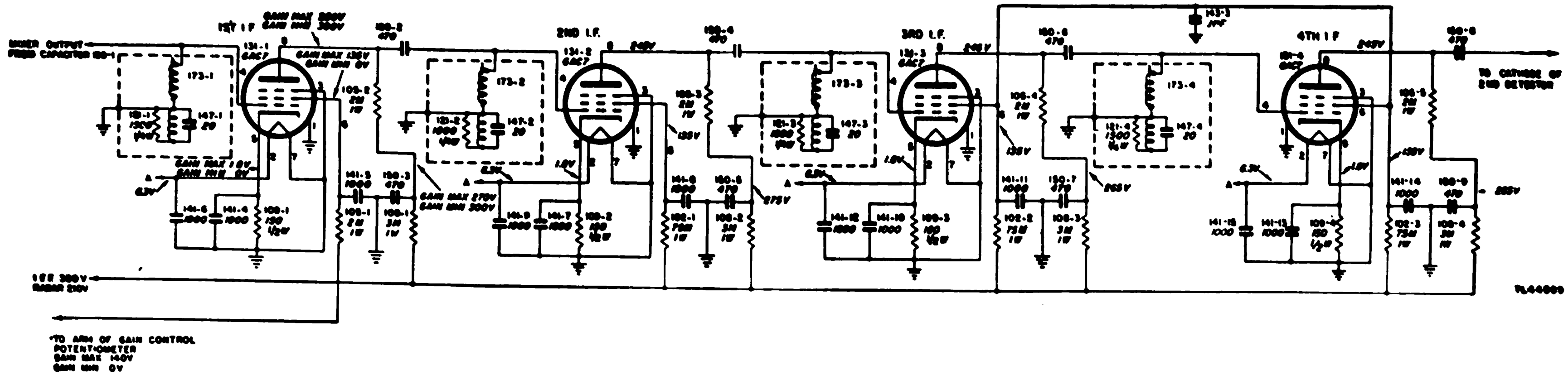


Figure 42.1. *Transmitter-Receiver RT–48/TPX–1, functional schematic diagram, receiver unit, i-f amplifier.*

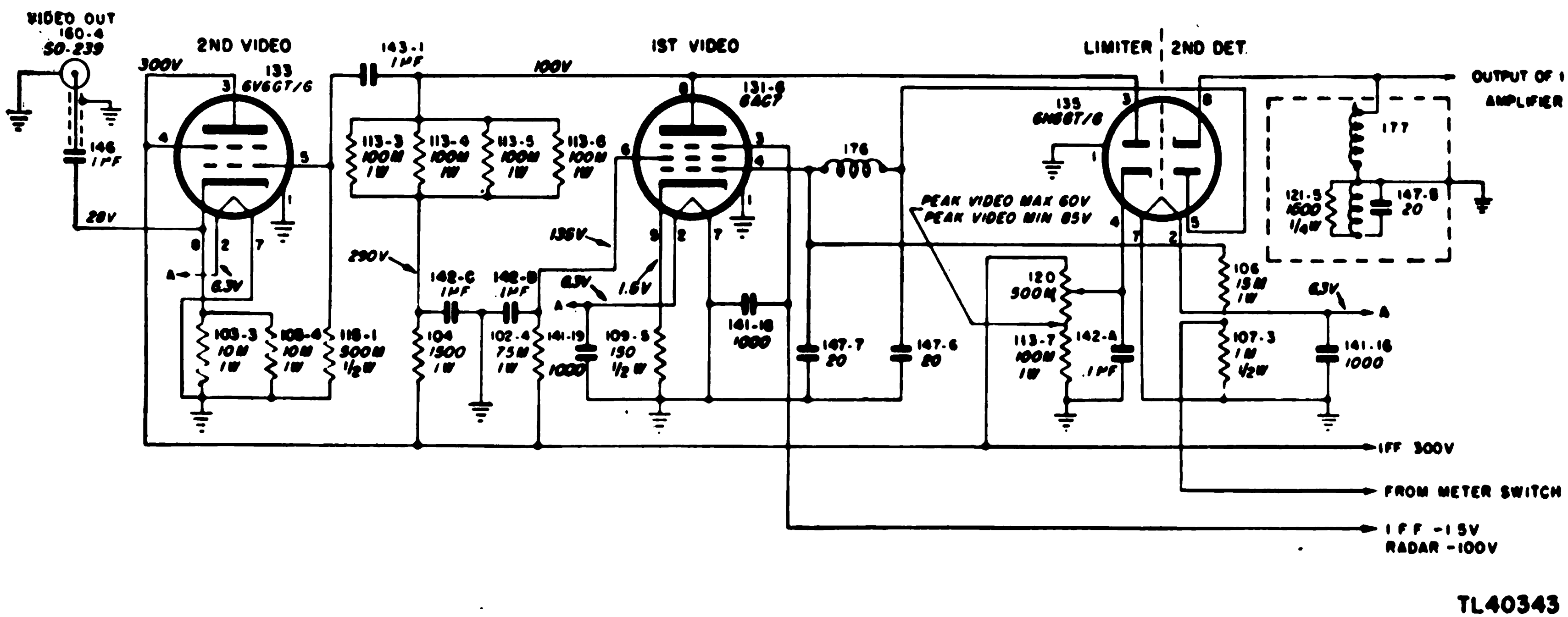


Figure 43.1. *Transmitter-Receiver RT–48/TPX–1, functional schematic diagram, receiver unit, 2d detector, limiter, and video amplifier.*

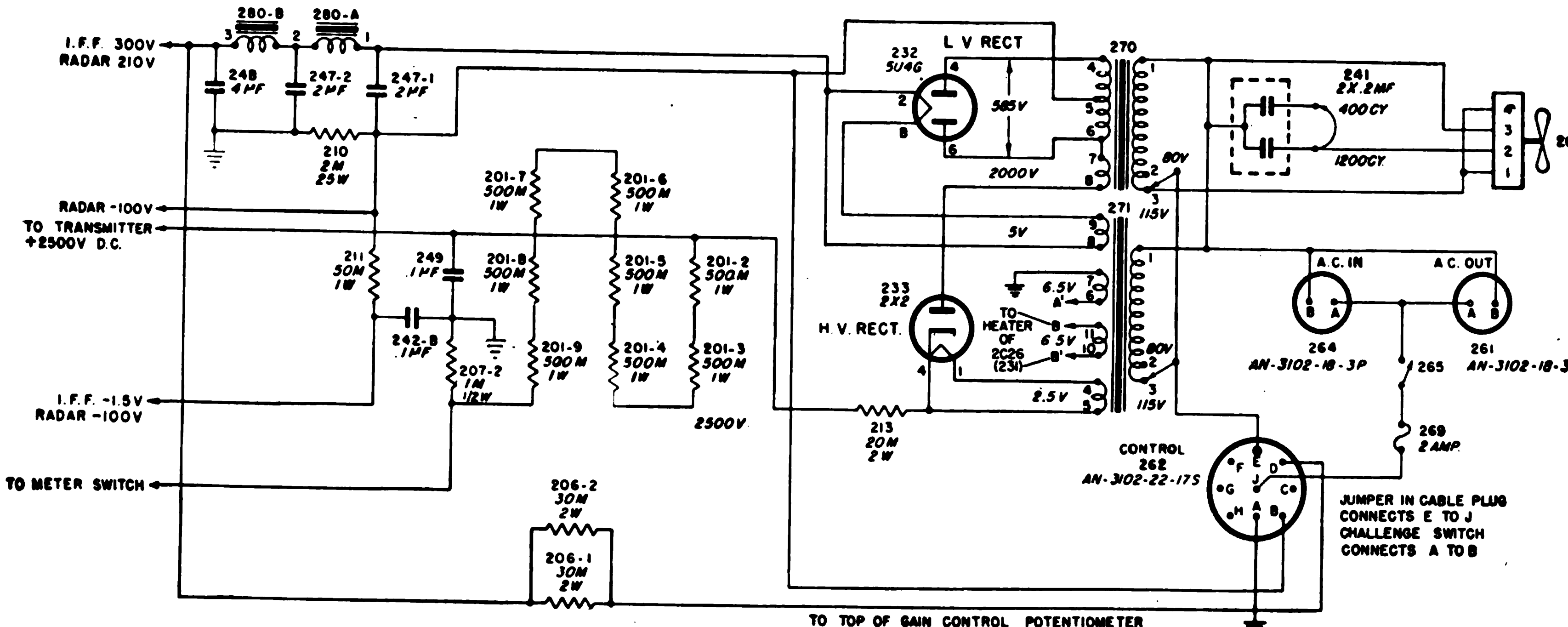


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Figure 44.1. Transmitter-Receiver RT-48/TPX-1, functional schematic diagram, transmitter unit, power supply.

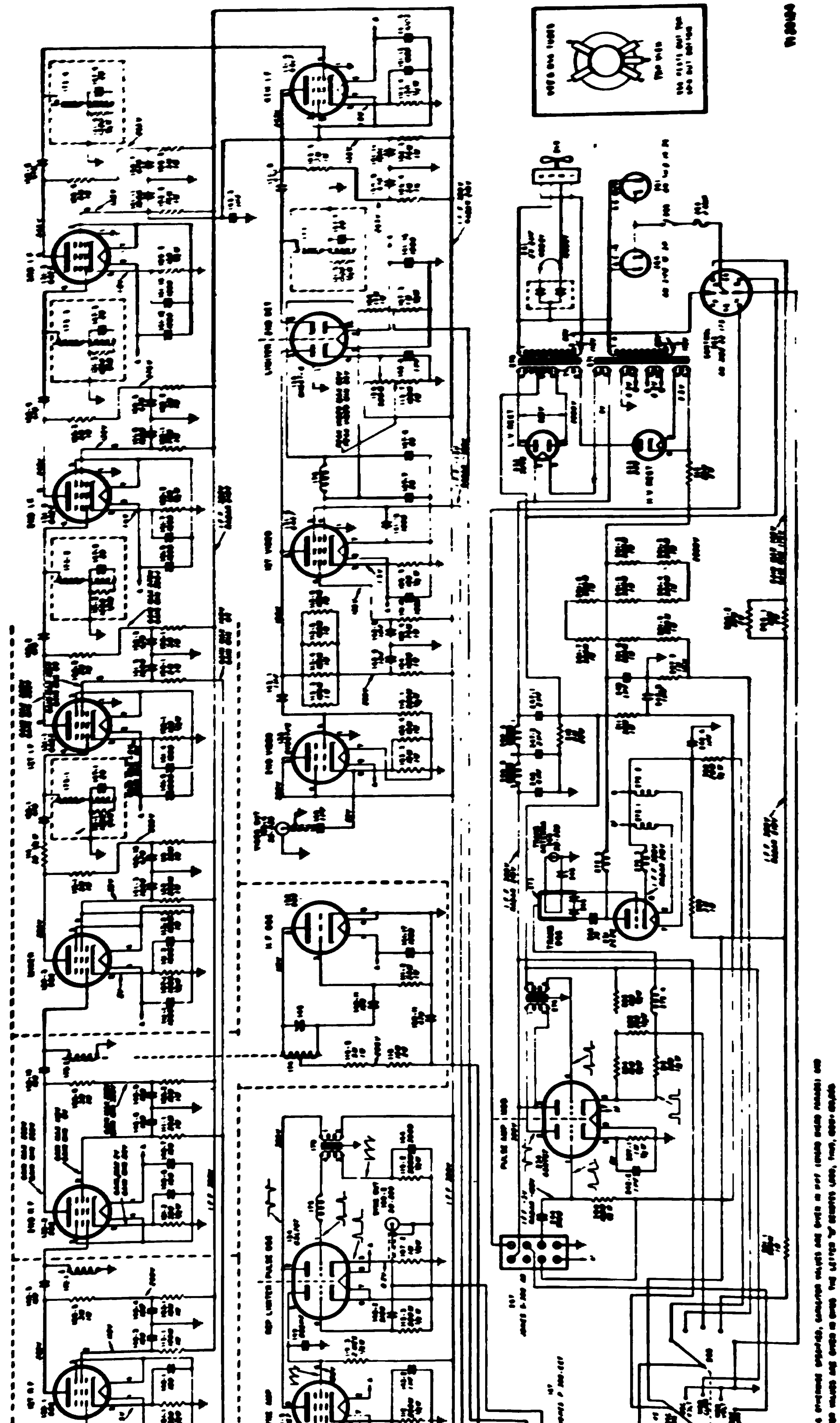

Figure 47.1. Transmitter-Receiver RT 48/TPX 1, schematic diagram.

FUNCTIONS OF PARTS

TRANSMITTER-RECEIVER RT-48/TPX-1

BLOWER

268	Ventilation

CAPACITORS

140–1	1st r-f cathode bypass
140–2	1st r-f heater bypass
140–3	1st r-f screen decoupler
140–4	1st r-f plate decoupler
140–5	1st r-f coupling
140–6	2d r-f cathode bypass
140–7	2d r-f heater bypass
140–8	2d r-f screen decoupler
140–9	2d r-f plate decoupler
140–10	2d r-f coupling
140–11	H-F oscillator grid
141–1	Mixer heater bypass
141–2	Mixer cathode bypass
141–3	Mixer screen bypass
141–4	1st i-f cathode bypass
141–5	1st i-f screen bypass
141–6	1st i-f heater
141–7	2d i-f cathode bypass
141–8	2d i-f screen bypass
141–9	2d i-f heater
141–10	3d i-f cathode bypass
141–11	3d i-f screen bypass
141–12	3d i-f heater
141–13	4th i-f cathode bypass
141–14	4th i-f screen bypass
141–15	4th i-f heater
141–16	Diode heater
141–17	H-F oscillator heater bypass
141–18	1st video suppressor bypass
141–19, 142	1st video heater bypass
142–A	Peak video limiter bias bypass

CAPACITORS—Continued

142–B	1st video screen bypass
142–C	1st video plate bypass
143–1	1st video plate coupling
143–2	Sync amplifier cathode
143–3	3d and 4th i-f screen stabilizer
144	Pulse oscillator grid time constant
145	H-F oscillator tuning
146	Video output coupling
147–1	1st i-f trap tuning
147–2	2d i-f trap tuning
147–3	3d i-f trap tuning
147–4	4th i-f trap tuning
147–5	5th i-f trap tuning
147–6	Video input filter
147–7	Video input filter
148–1	Sync input coupling
148–2	Pulse oscillator coupling
149	Sync amplifier screen
150–1	Mixer coupling
150–2	1st i-f coupling
150–3	1st i-f plate decoupler
150–4	2d i-f coupling
150–5	2d i-f plate decoupler
150–6	3d i-f coupling
150–7	3d i-f plate decoupler
150–8	4th i-f coupling
150–9	4th i-f plate decoupler
150–10	Mixer plate decoupler
150–11	H-F oscillator plate decoupler
241, 242	Blower motor capacitor
242–A	Oscillator cathode bypass
242–B	Stand-by bias filter
242–C	Pulse amplifier cathode bypass

CAPACITORS—Continued

243	Antenna trimmer
244	Pulse amplifier input coupling
245	Oscillator tuning
246	Oscillator plate blocking
247–1	Low-voltage filter, input section
247–2	Low-voltage filter, middle section
248	Low-voltage filter, output section.
249	High-voltage filter.

COILS

171	R-F input
172–1	2d r-f grid
172–2	Mixer grid
173–1	1st i-f grid
173–2	2d i-f grid
173–3	3d i-f grid
173–4	4th i-f grid
174	Heterodyne oscillator tank.
175	Pulse oscillator
176	1st video input filter
177	2d detector
272–1	Oscillator heater choke
272–2	Oscillator heater choke
272–3	Oscillator cathode choke
272–4	Oscillator grid choke
272–5	Oscillator plate choke
280–A	Low-voltage filter, input section.
280–B	Low-voltage filter, output section.

FUSE

269	Line fuse

INDUCTOR

273	Oscillator tank

PLUG

167	Connects receiver chassis to transmitter chassis.

RESISTORS

101–1	1st r-f cathode
101–2	2d r-f cathode
102–1	2d i-f screen
102–2	3d i-f screen
102–3	4th i-f screen
102–4	1st video screen
103–1	1st r-f plate decoupler
103–2	2d r-f plate decoupler
103–3	Video output cathode load
103–4	Video output cathode load
104	1st video plate filter
105–1	1st i-f screen filter
105–2	1st i-f plate load
105–3	2d i-f plate load
105–4	3d i-f plate load
105–5	4th i-f plate load
106	2d detector load
107–1	Mixer cathode
107–2	Pulse oscillator cathode
107–3	2d detector metering shunt
108–1	1st i-f plate decoupler
108–2	2d i-f plate decoupler
108–3	3d i-f plate decoupler
108–4	4th i-f plate decoupler
108–5	1st r-f plate load
108–6	2d r-f plate load
109–1	1st i-f cathode
109–2	2d i-f cathode
109–3	3d i-f cathode
109–4	4th i-f cathode
109–5	1st video cathode

RESISTORS—Continued

110	Mixer plate filter
111–1	2d r-f screen filter
111–2	H-F oscillator grid leak
112	Sync amplifier cathode
113–1	1st r-f screen filter
113–2	Mixer screen bleeder
113–3	1st video plate
113–4	1st video plate
113–5	1st video plate
113–6	1st video plate
113–7	Peak video limiter bias, fixed
114	Mixer output r-f filter
115–1	2d video grid
115–2	Pulse oscillator grid time constant.
115–3	Pulse frequency repetition limiter grid.
116–1	Mixer plate load
116–2	H-F oscillator plate dropping
118	H-F oscillator plate dropping
119–1	Sync amplifier grid
119–2	Sync amplifier cathode bleeder
119–3	Sync amplifier screen
120	Peak video limiter bias, variable.
121–1	1st i-f trap loading
121–2	2d i-f trap loading
121–3	3d i-f trap loading
121–4	4th i-f trap loading
121–5	2d detector trap loading
122	Mixer screen
200	Pulse amplifier grid
201–1	Modulator voltmeter
201–2	High-voltage bleeder
201–3	High-voltage bleeder
201–4	High-voltage bleeder
201–5	High-voltage bleeder
201–6	High-voltage bleeder

RESISTORS—Continued

201–7	High-voltage bleeder
201–8	High-voltage bleeder
201–9	High-voltage bleeder
202	Modulator current metering, series.
203	Modulator current metering, shunt.
204	Modulator cathode
206–1	Sensitivity control dropping
206–2	Sensitivity control dropping
207–1	Sync amplifier cathode
207–2	Oscillator voltage metering shunt.
208	Oscillator current metering
209	Oscillator cathode bias
210	Stand-by bias
211	Stand-by bias, filter
212	Oscillator grid leak
213	High-voltage filter

SOCKETS

160–1	Receiver antenna
160–2	Sync out
160–3	Sync in
160–4	Video out
260	Transmitter antenna connection.
261	A-C out
262	Control cable connection
264	A-C in
266	Metering connection
267	Connection transceiver chassis.

SWITCHES

263	Metering switch
265	Safety interlock

	TRANSFORMERS
170	Pulse oscillator
270	Plate transformer
271	Filament transformer
274	Pulse amplifier
	TUBES
130–1	1st r-f
130–2	2d r-f

	TUBES—Continued
130–3	Mixer
131–1	1st i-f
131–2	2d i-f
131–3	3d i-f
131–4	4th i-f
131–5	Sync amplifier
131–6	1st video
132	H-F oscillator

	TUBES—Continued
133	2d video
134	Pulse oscillator
135	2d detector and peak limiter
231	Oscillator
232	Low-voltage rectifier
233	High-voltage rectifier
234	Pulse amplifier and modulator

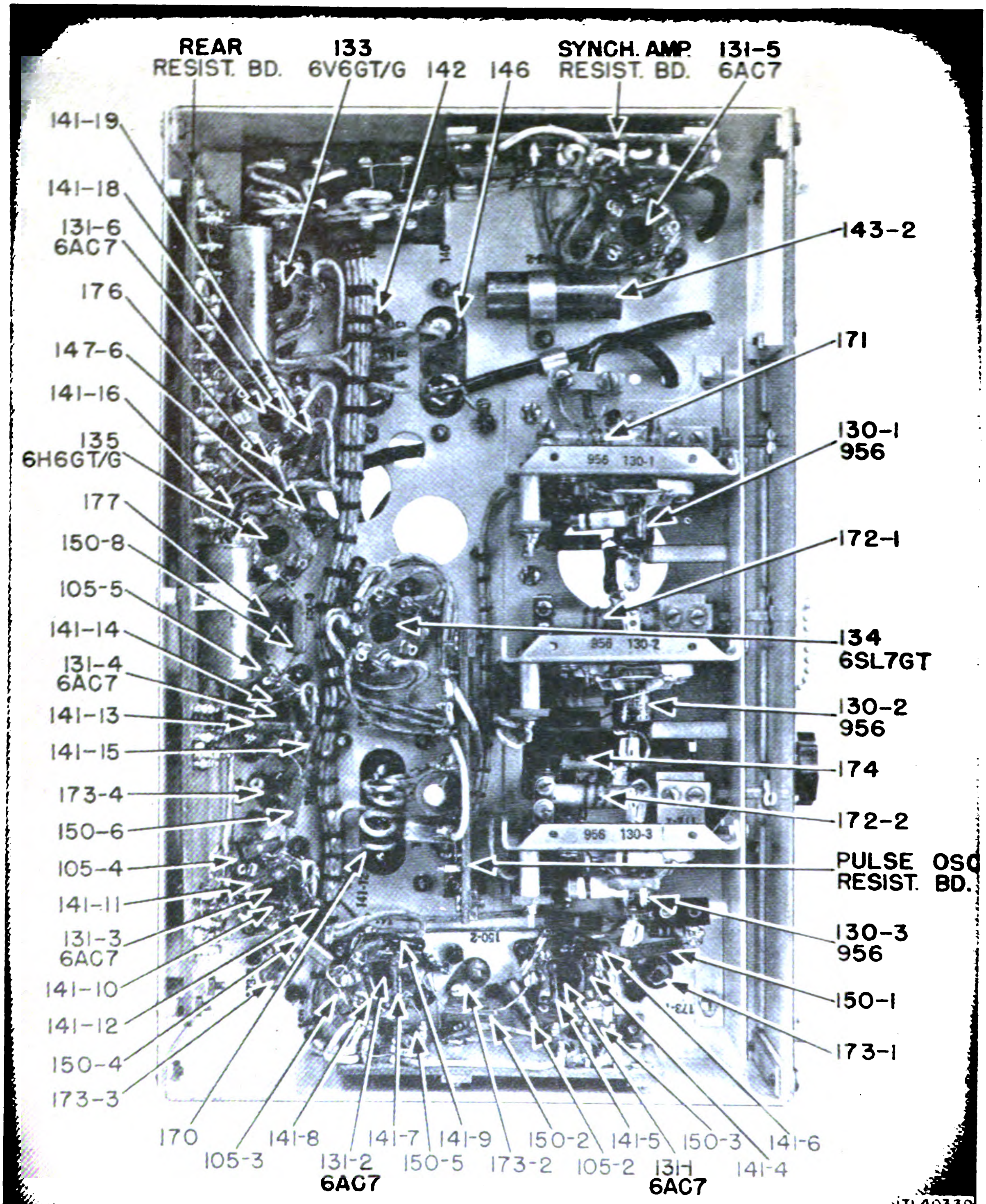

Figure 60.1. Transmitter-Receiver RT-48/TPX-1, receiver unit, bottom view, r-f and mixer stages uncovered.

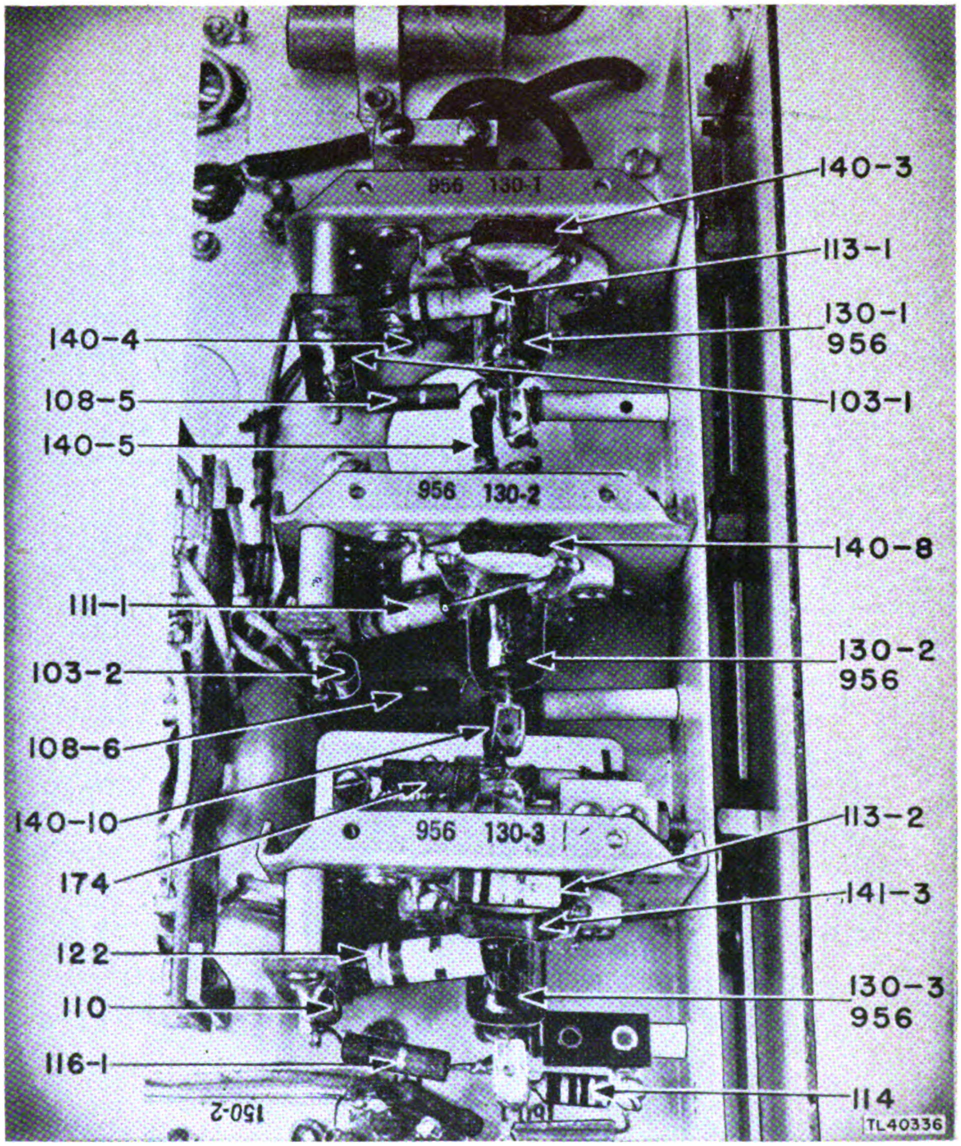

Figure 61.1. Transmitter-Receiver RT-48/TPX-1, r-f and mixer stages, viewed from left-hand side.

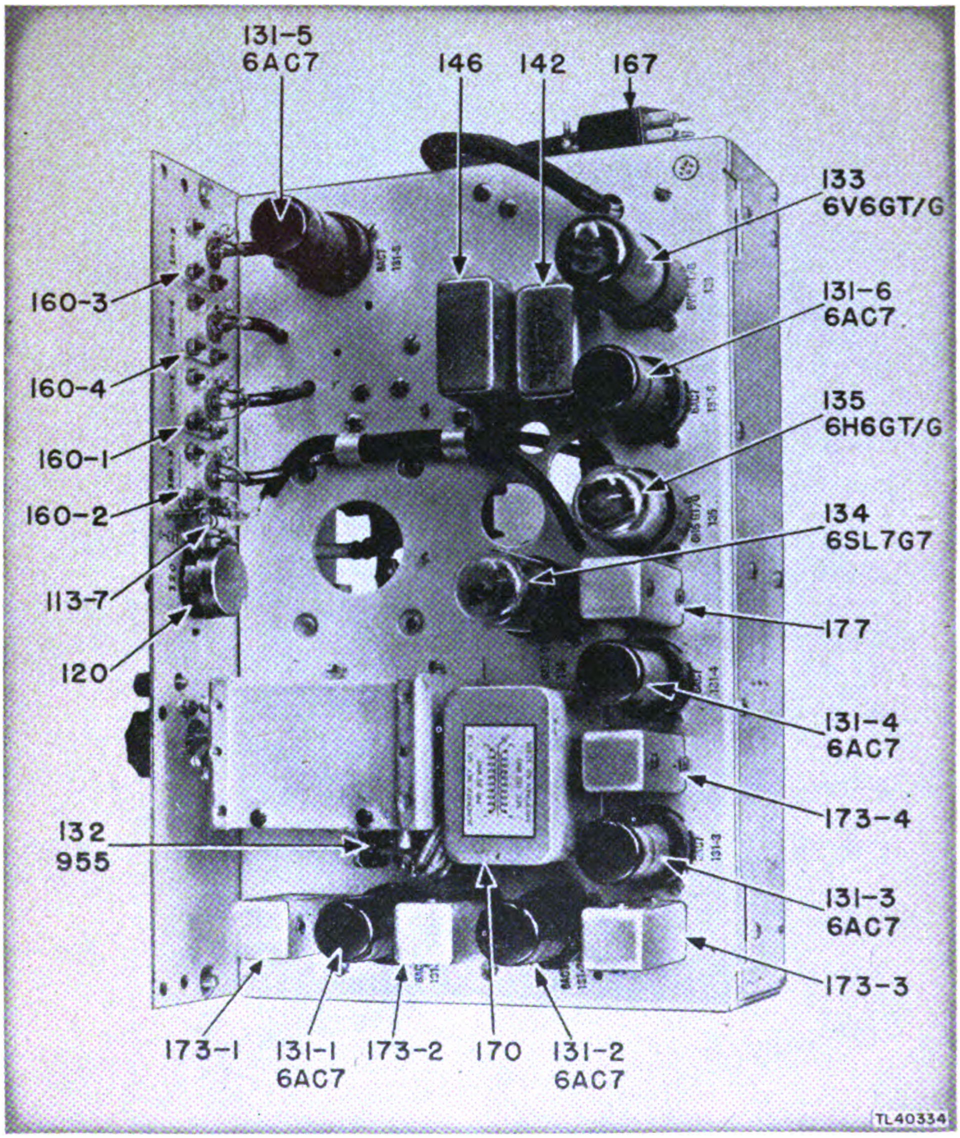

Figure 64.1. Transmitter-Receiver RT-48/TPX-1, receiver unit, top view.

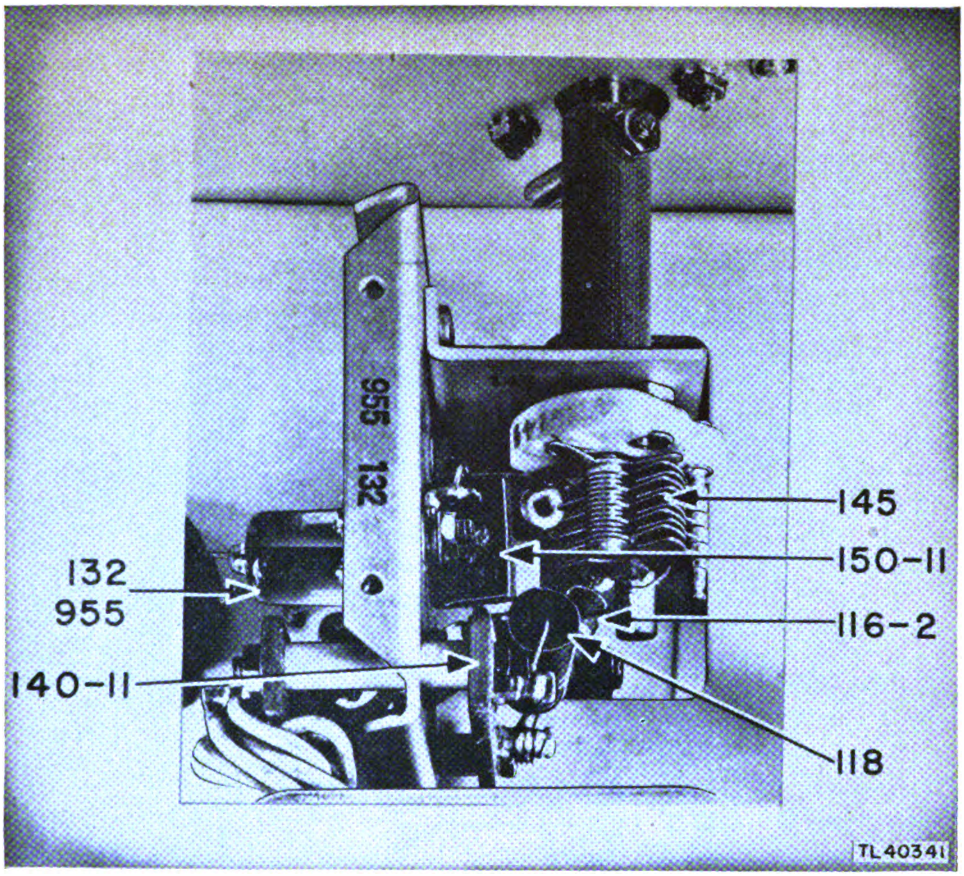

Figure 65.1. Transmitter-Receiver RT-48/TPX-1, receiver unit, oscillator.

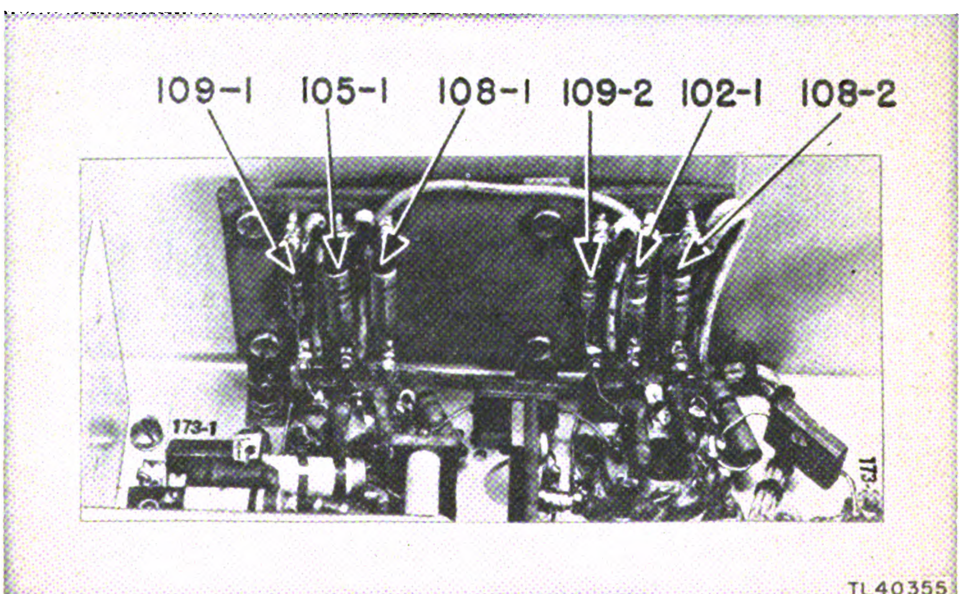

Figure 66.1. Transmitter-Receiver RT-48/TPX-1, receiver unit, resistor mounting board of first and second i-f stages.

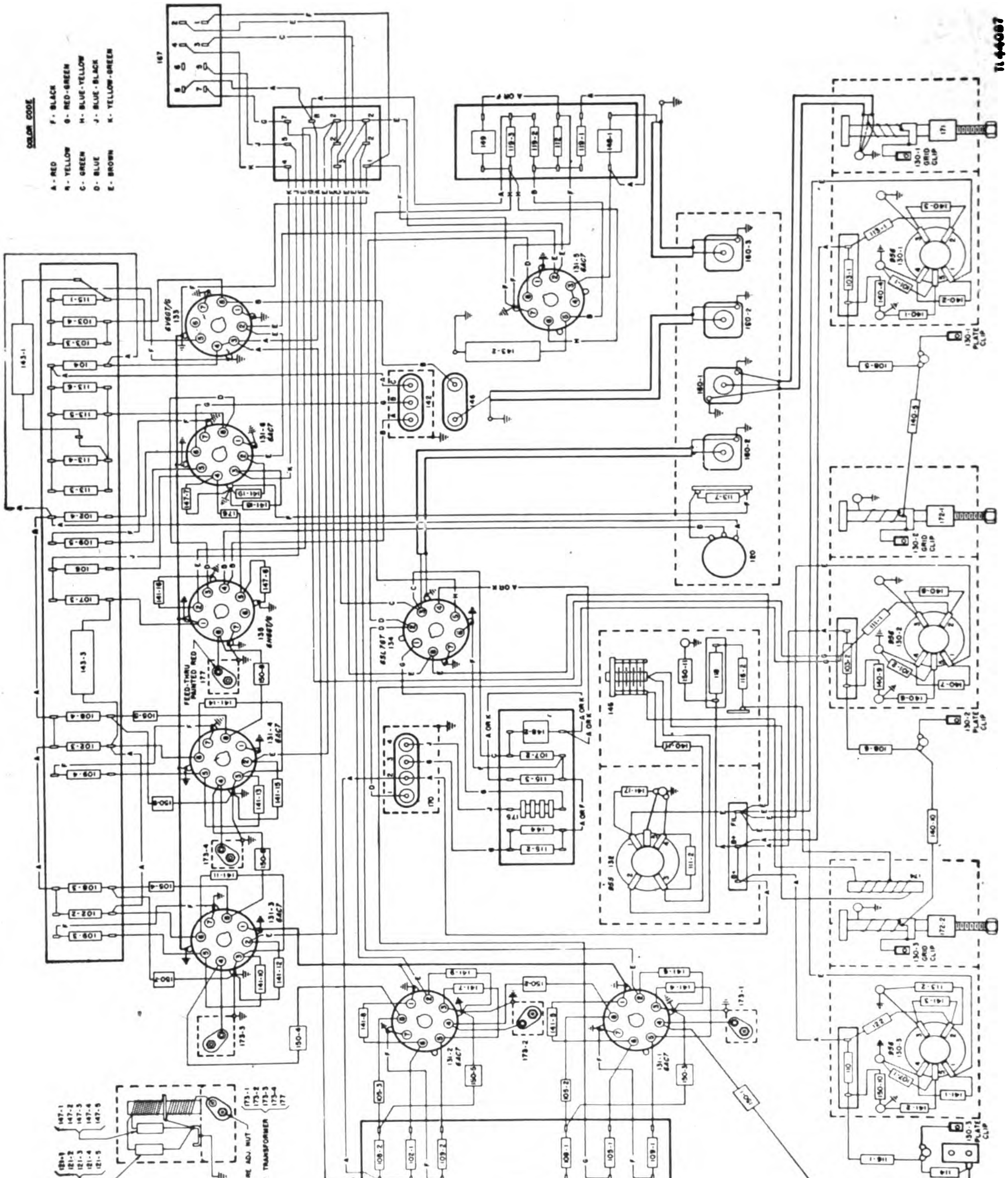

Figure 72.1. Transmitter-Receiver RT-48/TPX 1, wiring diagram, receiver unit.

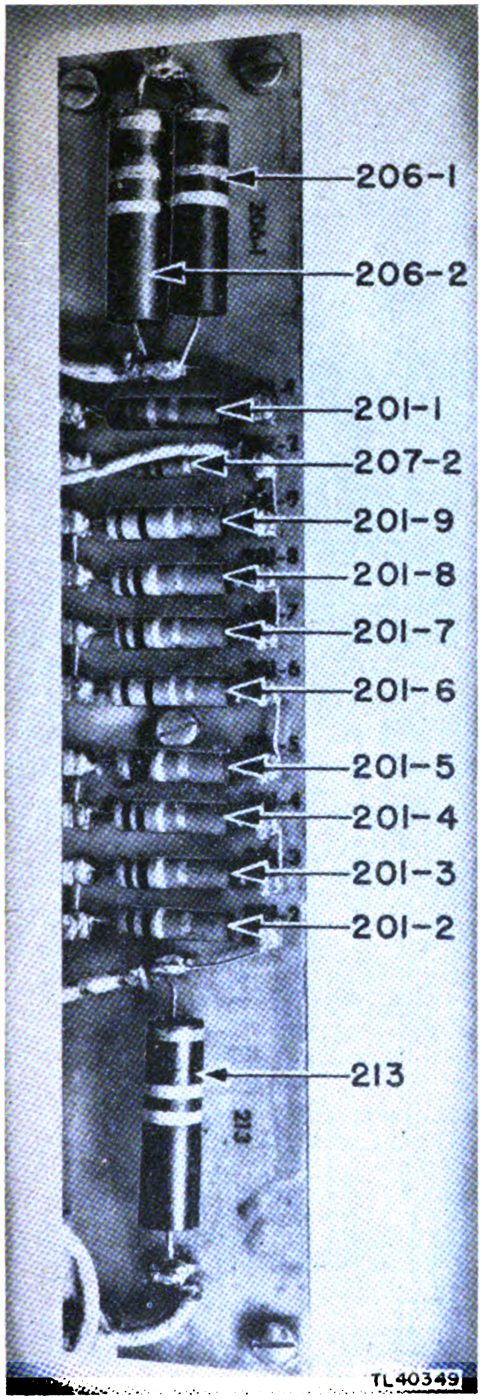

Figure 75.1. Transmitter-Receiver RT-48/TPX-1, transmitter unit, rear vertically mounted resistor board.

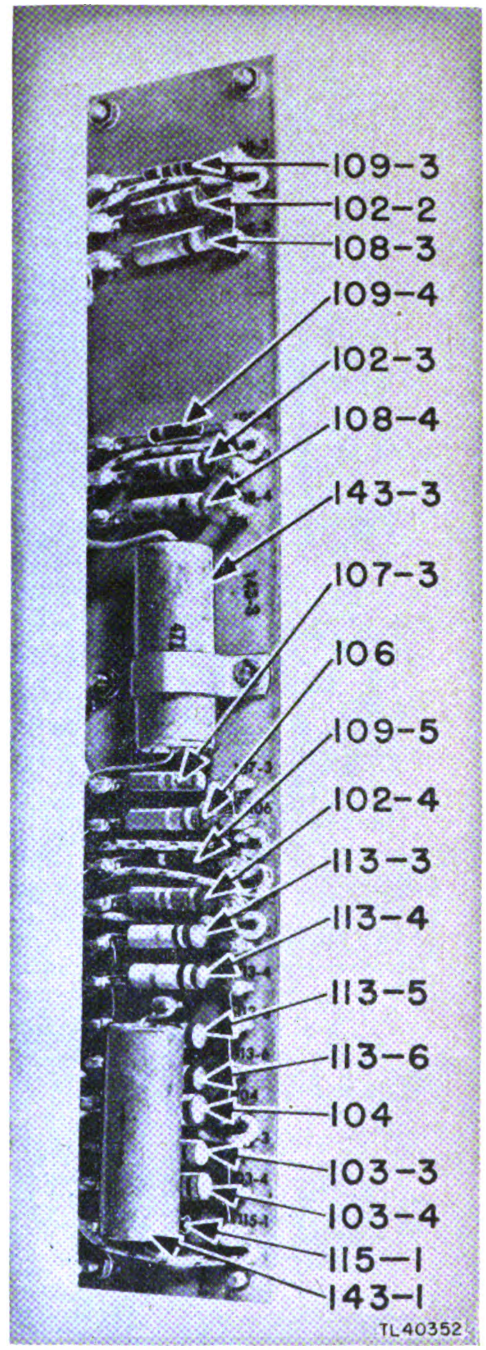

Figure 78.1. Transmitter-Receiver RT-48/TPX-1, receiver unit, rear vertically mounted resistor board.

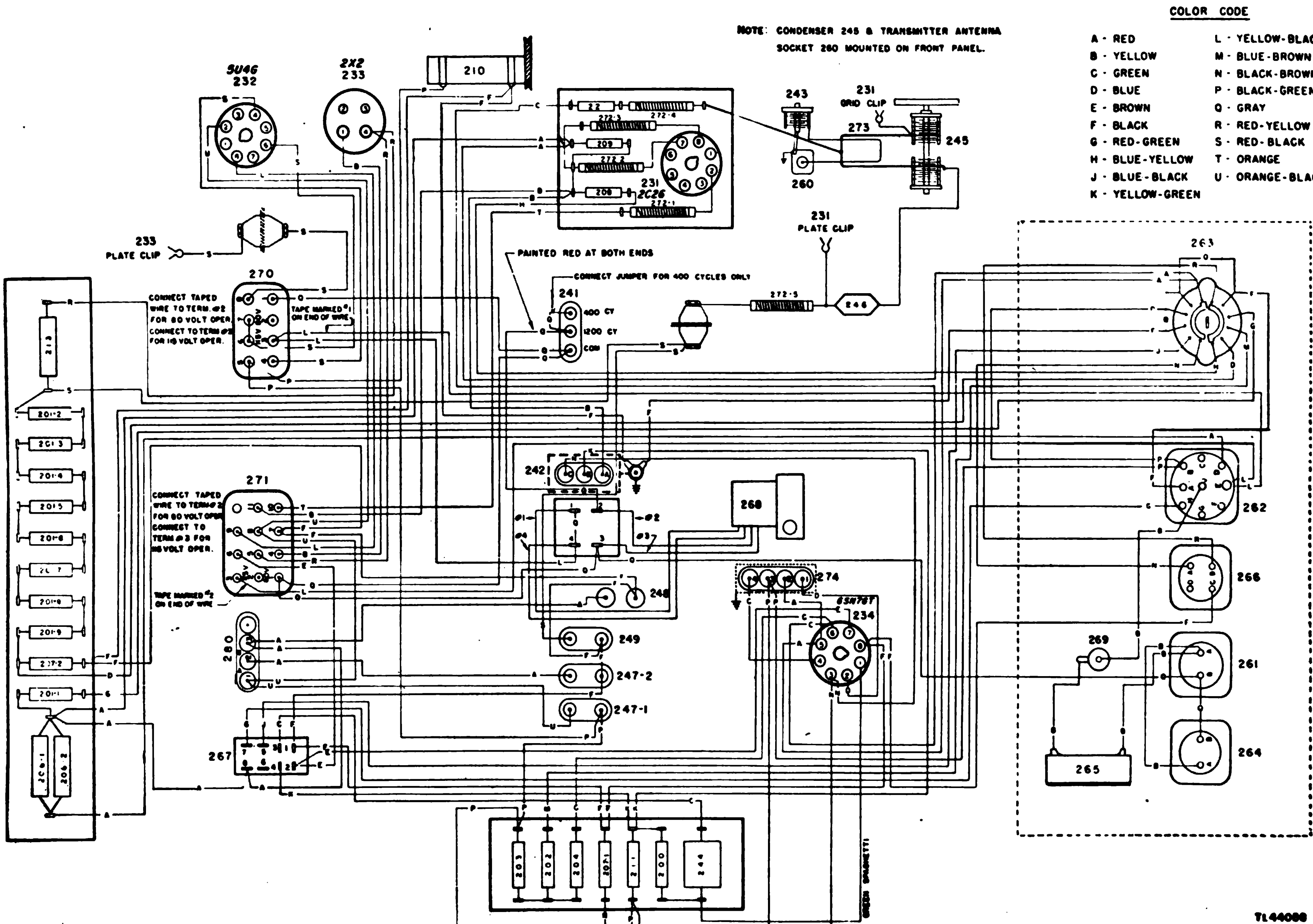

Figure 82.1. Transmitter-Receiver RT 48/TPX 1, wiringdiagram, transmitter unit.

114.1 ARMY SERVICE FORCES SIGNAL SUPPLY CATALOG (Added).

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SIG 8-AN/TPX-4
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[AG 300.7 (8 Nov. 45)]

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11-587, Sig Base Maint Co;
11-597, Sig Base Dep Co;
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(For explanation of symbols see FM 21-6).

TECHNICAL MANUAL
No. 11-1160

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Washington 25, D. C., 28 December 1944.

RADAR SET AN/TPX-4

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WARNING

HIGH VOLTAGE

is used in the operation

of this equipment.

DEATH ON CONTACT

may result if personnel fail

to observe safety precautions.

Be careful not to contact high-voltage plate circuits or 115-volt a-c input connections while installing, operating, maintaining, checking, or servicing the equipment. Make certain that the power is turned off before disassembling any part of the equipment.

Dangerously high voltages are present in the power supplies of this equipment. High-voltage capacitors in these power supplies must be discharged manually when service checks are made after the a-c power has been removed from the components.

EXTREMELY DANGEROUS POTENTIALS

exist in Transmitter-Receiver RT-48A/TPX-1

DESTRUCTION NOTICE

DESTROY EVERYTHING

WHY — To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN — When ordered by your commander.

HOW — 1. *Smash* — Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. *Cut* — Use axes, handaxes, machetes.

3. *Burn* — Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. *Explosives* — Use firearms, grenades, TNT.

5. *Disposal* — Bury in slit trenches, fox holes, other holes. Throw into streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT

WHAT — 1. *Smash* — All tubes, coil forms, transformers, chassis. Take special care to destroy completely the 2C26 tube in the transmitter.

2. *Cut* — All cables, coil windings.

3. *Burn* — All parts of the equipment that cannot be completely demolished by other means.

4. *Bend* — Tuning assembly in transmitter-oscillator circuit.

5. *Bury or scatter* — Nameplates, smashed tubes, all other parts of equipment, after destroying their usefulness.

DESTROY EVERYTHING

REFERENCE NOTICE

TM 11-1160, RADAR SET AN/TPX-4, is to be used in conjunction with TM 11-1352, TECHNICAL OPERATION MANUAL, and TM 11-1452, PREVENTIVE MAINTENANCE MANUAL, for Radar Set AN/TPL-1. TM 11-1352 contains description of Equipment Performance Log procedures, and TM 11-1452 describes preventive maintenance techniques which apply to Radar Set AN/TPX-4 as well as to Radar Set AN/TPL-1.

The theory chapters of this manual are written for personnel who have a general knowledge of radar. Less experienced personnel will be assisted in the use of the manual by reference to TM 11-466, which covers the fundamental principles of radar and the electronic theory, and to TM 11-467, which covers common radar systems in use.

FIRST AID TREATMENT FOR ELECTRIC SHOCK

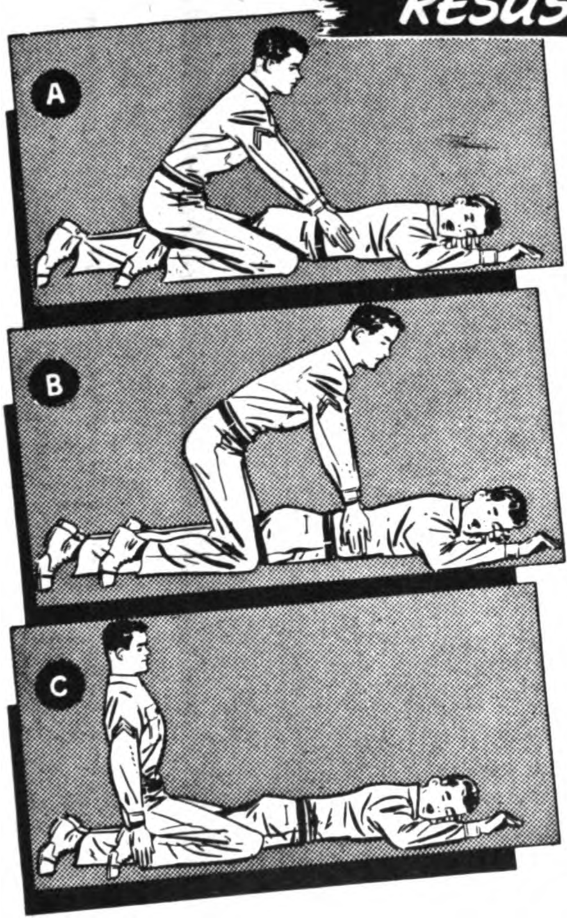
I. FREE THE VICTIM FROM THE CIRCUIT IMMEDIATELY.

Shut off the current. If this is not immediately possible, use a dry nonconductor (rubber gloves, rope, board) to move either the victim or the wire. Avoid contact with the victim. If necessary to cut a live wire, use an axe with a dry wooden handle. Beware of the resulting flash.

II. ATTEND INSTANTLY TO THE VICTIM'S BREATHING.

Begin resuscitation at once on the spot. Do not stop to loosen the victim's clothing. Every moment counts. Keep the patient warm. Wrap him in any covering available. Send for a doctor. Remove false teeth or other obstructions from the victim's mouth.

RESUSCITATION



POSITION

1. Lay the victim on his belly, one **arm extended directly** overhead, the other arm bent **at the elbow, the face** turned outward and resting on **hand or forearm, so that** the nose and mouth are free for **breathing (fig. A).**

2. Straddle the patient's **thighs, or one leg, with your** knees placed far enough from **his hip bones to allow you** to assume the position shown in **figure A.**

3. Place your hands, with **thumbs and fingers in a** natural position, so that your **palms are on the small of** his back, and your little **fingers just touch his lowest** ribs (fig. A).

FIRST MOVEMENT

4. With arms held straight, **swing forward slowly, so** that the weight of your body is **gradually brought to bear** upon the victim. Your shoulders **should be directly over** the heels of your hands at the **end of the forward swing** (fig. B). Do not bend your **elbows. The first movement** should take about 2 seconds.

SECOND MOVEMENT

5. Now immediately swing **backward**, to remove the pressure completely (fig. C).

6. After 2 seconds, swing **forward again. Repeat this** pressure-and-release cycle **12 to 15 times a minute. A** complete cycle should require **4 or 5 seconds.**

CONTINUED TREATMENT

7. Continue treatment until breathing is restored or until there is no hope of the victim's recovery. Do not give up easily. Remember that at times the process must be kept up for hours.

8. During artificial respiration, have someone loosen the victim's clothing. Wrap the victim warmly; apply hot bricks, stones, etc. Do not give the victim liquids until he is fully conscious. If the victim must be moved, keep up treatment while he is being moved.

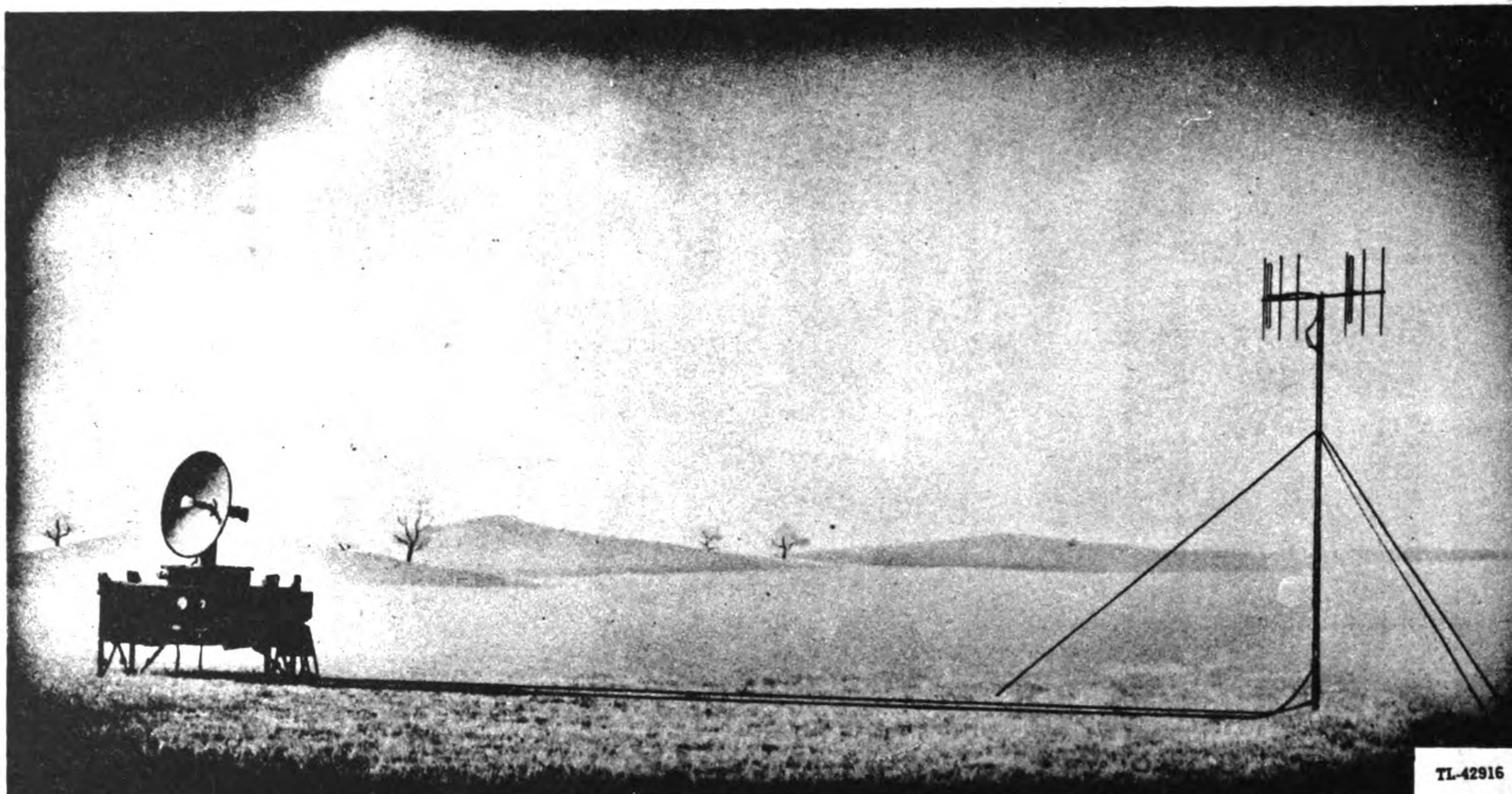
9. At the first sign of breathing, withhold artificial respiration. If natural breathing does not continue, immediately resume artificial respiration.

10. If operators must be changed, the relief operator kneels behind the person giving artificial respiration. The relief takes the operator's place as the original operator releases the pressure.

11. Do not allow the revived patient to sit or stand. Keep him quiet. Give hot coffee or tea, or other internal stimulants.

HOLD RESUSCITATION DRILLS REGULARLY

TL 37451



TL-42916

Figure 1. Radar Set AN/TPX-4 and Radar Set AN/TPL-1 field installation.

PART ONE

TECHNICAL OPERATION

Chapter 1

GENERAL DESCRIPTION

Section I

PURPOSE AND OPERATING PRINCIPLES

1. SCOPE OF MANUAL

Note.—Although the nomenclature of the equipment described in this manual is Radar Set AN/TPX-4, this equipment is not a radar set in the accepted sense of the word; it is IFF (Identification, Friend or Foe) equipment used with Radar Set AN/TPL-1, which is a radar search equipment.

a. General. This manual is divided into three parts as follows:

(1) PART ONE, TECHNICAL OPERATION. Part One acquaints radar operators and repairmen with the general features, installation procedure, and technical operation of Radar Set AN/TPX-4.

(2) PART TWO, PREVENTIVE MAINTENANCE. Part Two furnishes instruction for the application of preventive maintenance procedures and describes methods for moistureproofing and fungiproofing Radar Set AN/TPX-4. (Descriptions of maintenance techniques are contained in TM 11-1452.)

(3) PART THREE, SERVICE. Part Three presents the circuit theory, provides instructions for equipment repairs, outlines step-by-step procedures for quick and accurate trouble shooting, and contains a maintenance parts list to facilitate the ordering of replaceable parts.

b. Part One. Part One of this manual is a practical guide on how to use the equipment. It is primarily concerned with the installation and technical operation of the equipment. It presents an explanation of the functioning of the major circuit systems, but omits discussion of circuit theory, maintenance, and trouble shooting. The chapters are as follows:

(1) GENERAL DESCRIPTION.
(2) INSTALLATION.
(3) OPERATION.
(4) EQUIPMENT PERFORMANCE CHECKS AND LOGS.
(5) CONVERSION FOR TRAVEL.

2. PURPOSE OF RADAR SET AN/TPX-4

Note.—Throughout this manual Radar Set AN/TPX-4 will be referred to as the IFF or identification equipment, and Radar Set AN/TPL-1 will be referred to as the radar set.

This equipment is an auxiliary to the radar ground-station Radar Set AN/TPL–1. Radar Set AN/TPX–4 enables the operator of the radar set to determine whether aircraft located by the radar equipment are friendly or hostile.

3. GENERAL OPERATION OF RADAR SET AN/TPX-4

When an aircraft is located by the radar set, the radar operator throws a switch, causing the IFF transmitter to send out an interrogating signal to the aircraft. Friendly aircraft are equipped with apparatus which responds to the interrogating signal by sending back a coded identifying signal. If the interrogating signal does not produce a proper identifying response, the aircraft is considered unfriendly. The sequence of operation between the ground station and the apparatus in friendly aircraft is as follows:

a. The transmitter of Radar Set AN/TPX-4 sends out a very short pulse of radio-frequency (r-f) energy.

b. The apparatus of the friendly aircraft receives the pulse and transmits a coded reply pulse.

c. The coded reply pulse is received and amplified by the receiver of Radar Set AN/TPX-4.

d. The pulse output of the receiver is fed to the A-scope display unit in the radar equipment for observation by the operator.

e. This sequence of events is repeated periodically.

4. DEVELOPMENT OF MARK III IFF SYSTEM

Radar equipment cannot directly identify targets which it locates. Auxiliary equipment, classified as IFF (Identification Friend or Foe), must be used to identify as friend or foe the planes detected by radar sets. Early forms of IFF used auxiliary airborne equipment that responded to the radar search pulses of the ground station and identified the aircraft as friendly by distorting the radar response received by the ground station. No additional equipment was required by the radar station, but, as the ground-station operating frequencies were made more diversified, the amount of airborne IFF equipment required to provide adequate identification to all radar stations became prohibitive. A universal IFF system, employing a band of frequencies separate from the radar bands and requiring additional ground-station equipment (interrogator-responsor) but only one airborne IFF unit (transpondor), was adopted to overcome the disadvantages of the earlier system. This universal system is known as the Mark III IFF system.

5. COMPONENTS AND OPERATION OF THE MARK III IFF SYSTEM (Fig. 2).

a. Interrogator. The transmitter which sends out the interrogating signals to the aircraft located by the radar set is the interrogator. The interrogator can be set to operate at any frequency on the IFF frequency band.

b. Transpondor. The airborne receiver-transmitter unit which responds to the interrogating signal from the interrogator is the transpondor. The automatic mechanical tuning circuit of the transpondor sweeps through the entire band of IFF frequencies every 2½ seconds. At some time during each tuning sweep, the transpondor is tuned to the interrogator frequency for about ¼ second. During this ¼ second the transpondor receives a number of interrogating pulses. The very sensitive transpondor receiver detects the interrogating pulses and passes them to be amplified in the coding unit. Here the pulse width is varied according to a code, but the repetition rate determined by the interrogator is maintained. These coded pulses are used to actuate the transpondor transmitter which retransmits the altered interrogating pulses at the same

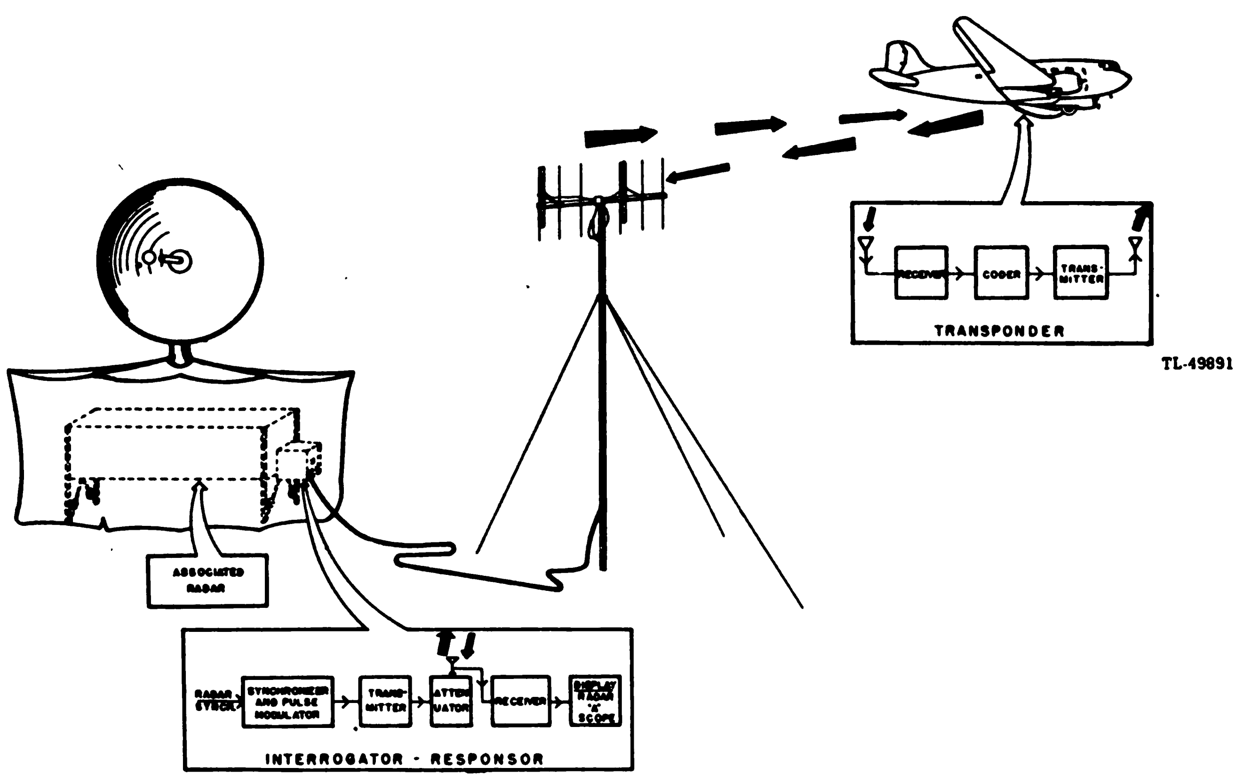


Figure 2. Components and operation of the Mark III IFF system.

frequency and repetition rate used by the interrogator. It is because of this additional *push* given to the original pulses that the IFF equipment with its relatively low power can cover the same range as the larger and more powerful radar set.

c. Responsor. The receiver which receives the response from the transpondor is the responsor. The responsor must be tuned to the same frequency as the interrogator and is either in the same housing as the interrogator or placed near it. The output of the responsor is fed to the radar display unit for observation by the operator. This output is a number of video pulses occurring during the 1/4 second in each 2½ seconds that the transpondor is tuned to the interrogator frequency.

d. Allocation of IFF Frequencies. Spot frequencies are allocated to the interrogator-responsor equipments associated with the various types of radar sets. Use of a frequency band in this manner has important advantages over the use of a single frequency for IFF purposes, including a reduction in the amount of mutual interference and the risk of *over-interrogation* (swamping) of the transpondor in operational areas with many interrogators. The wide pass band of the receivers in the Mark III system insures adequate time during the transpondor tuning sweep to permit easy identification of the pulse coding. As the transpondor is actuated by the interrogator transmission and not (as in early types of interrogation) by the main radar transmission, the system permits additional security in that the interrogator need only be switched on when desired.

e. Display Systems. The identification signals received by the responsor may be displayed either on the display unit of the radar set or on a separate display unit. In Radar Set AN/TPX-4, the identification signals are displayed on the A-scope of Radar Set AN/TPL-1. In this way the identification signal is promptly correlated with the correct target.

f. Coding. (1) The transpondor tunes over the IFF frequency band in approximately 2½ seconds; hence it sweeps through any interrogator frequency at intervals of 2½ seconds. Coding is accomplished by arranging the transpondor so that during consecutive tuning sweeps it may return one of the following to the interrogator-responsor equipment:

(*a*) No reply.
(*b*) A narrow pulse.
(*c*) A wide pulse.

(2) The coding cycle requires four tuning sweeps after which the same cycle is repeated as long as the transpondor is triggered by the interrogator. Six distinct codes have been provided, any one of which can be selected by turning a switch on the transpondor control unit. The minimum time required to receive a complete coded reply is 10 seconds, four sweeps at 2½ seconds each.

(3) The various codes shown in the table below provide either a means of discriminating between different types of friendly craft or a means of gaining additional security. In addition to the six codes described above, an emergency code is available in which a very wide pulse is returned each sweep. This code is the most easily distinguished and is used as a universal distress signal.

TRANSPONDOR CODING POSITIONS, SEQUENCES, AND PULSE DURATIONS

Coding position	1st sweep	2d sweep	3d sweep	4th sweep
1	N	N	N	N
2	N	—	N	—
3	N	N	N	—
4	N	N	W	W
5	N	—	W	—
6	N	N	W	—
Emergency	VW	VW	VW	VW

N = Narrow transmitted r-f pulses, from 5 to 12 microseconds (millionths of a second), causing a narrow video pulse to flash on the A-scope for 1/4 second in the 2½-second sweep period. Only the radar response appears on the A-scope during the remaining 2¼ seconds.

W = Wide transmitted r-f pulses, from 17 to 30 microseconds, causing a wide video pulse to flash on the A-scope for 1/4 second during the 2½-second sweep period. The wide pulse is always at least 2.5 times as wide as the narrow pulse.

VW = Very wide transmitted r-f pulses, from 60 to 100 microseconds (used when the friendly aircraft is in distress). A very wide video pulse flashes on the A-scope once in each 2½-second period.

— = No transmission; no IFF response appears on the A-scope during the 2½-second period.

6. SYNCHRONIZATION OF IFF WITH RADAR

a. The radar equipment transmits its pulse of r-f energy at a definite pulse repetition frequency (prf). The prf of Radar Set AN/TPL-1 is 400 times per second. This prf allows approximately 2,500 microseconds (millionths of a second) between pulses. If an aircraft is within the range of the radar equipment, for example 20,000 yards away, some of the r-f energy is reflected from the aircraft and is received by the radar receiver 122.1 microseconds after the pulse was transmitted (radio energy, like light, travels 1 land mile per 5.37 microseconds). The reflected energy, therefore, returns to the radar receiver long before the next pulse of r-f energy is transmitted. The radar receiver amplifies the r-f pulse, detects it, and sends a video pulse to the radar oscilloscope.

b. The radar A-scope sweep starts out almost immediately after the radar transmitter fires. The time it takes for the electron beam (which causes the luminescence on the A-scope screen) to sweep from left to right is determined by the range switch setting of the radar equipment. If the range switch were set for 30,000 yards, for example, the time for the sweep to travel from left to right would be 183.2 microseconds. This is the time required for radio energy to make a round trip to an aircraft 30,000 yards away. If the sweep line were 4 inches long, the video pulse caused by an aircraft 15,000 yards away would appear on the screen 2 inches from the start of the 30,000 yard sweep. Radar responses on the A-scope of Radar Set AN/TPL–1 appear as positive (upward) pulses on the upper sweep trace (fig. 3) and are caused by deflecting the electron beam upward (for the duration of the pulse) at the same time that the beam is moving from left to right. One pulse would not be sufficient to cause a visible glow on the A-scope, but the entire action described here is repeated 400 times per second, and the effect is reinforced each time.

c. The radar and IFF use a "time sharing" method of display on the A-scope, that is, the display time of the A-scope is shared between the radar and IFF. Both the radar and IFF operate at 400 pulses per second, however, the pulses are staggered in time so that the IFF pulses occur in the intervals between the radar pulses. Since the interval between radar pulses is 2,500 microseconds and the time required for the A-scope sweep on the 60,000 yard maximum range of the radar is 366.4 microseconds, part of the unused time between radar pulses may be used to display the IFF signals. At some time after the completion of the radar display sweep, the IFF transmitter is triggered, and an IFF sweep is started on the A-scope. The duration of the IFF sweep is also 366.4 microseconds. The A-scope traces used for the IFF are displaced approximately ¼ inch below those used for the radar to aid in distinguishing between the IFF responses and the radar echoes. Although the IFF and radar video signals are not displayed simultaneously, the action described above is so rapid that both appear to be displayed at the same time. The sequence of events is as follows:

(1) The A-scope spot is displaced vertically to the upper baseline position and held in that vertical position.

(2) The radar transmitter is triggered, and the A-scope spot is started on its sweep from left to right, holding the upper baseline position plus any signal deflection.

(3) After the completion of the sweep, the A-scope spot is displaced downward to the lower baseline position and held there.

(4) One eight-hundredth of a second after the initiation of the radar pulse, the IFF transmitter is triggered and the A-scope is started on its sweep from left to right, holding the lower baseline position plus any signal deflection. IFF signals are applied with such polarity as to deflect *downward.*

(5) The sequence is repeated as long as the CHALLENGE switch is ON. Since both IFF and radar sweeps are at the same speed, and since the IFF interrogation and response signals travel at the speed of light, the IFF response of a friendly aircraft will appear at the same horizontal position along the baseline as the radar echo from the aircraft. The IFF response will deflect downward just under the radar echo (fig. 3.)

(6) The IFF reply pulses (fig. 3) flash on the A-scope screen for a very short time (1/4 second) once in each 2½ second period.

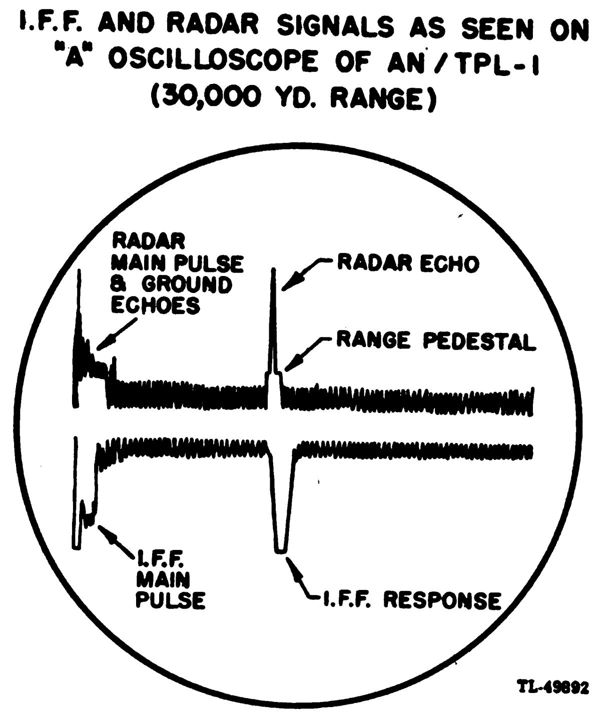


Figure 3. Radar Set AN/TPL-1, A-scope display showing IFF response.

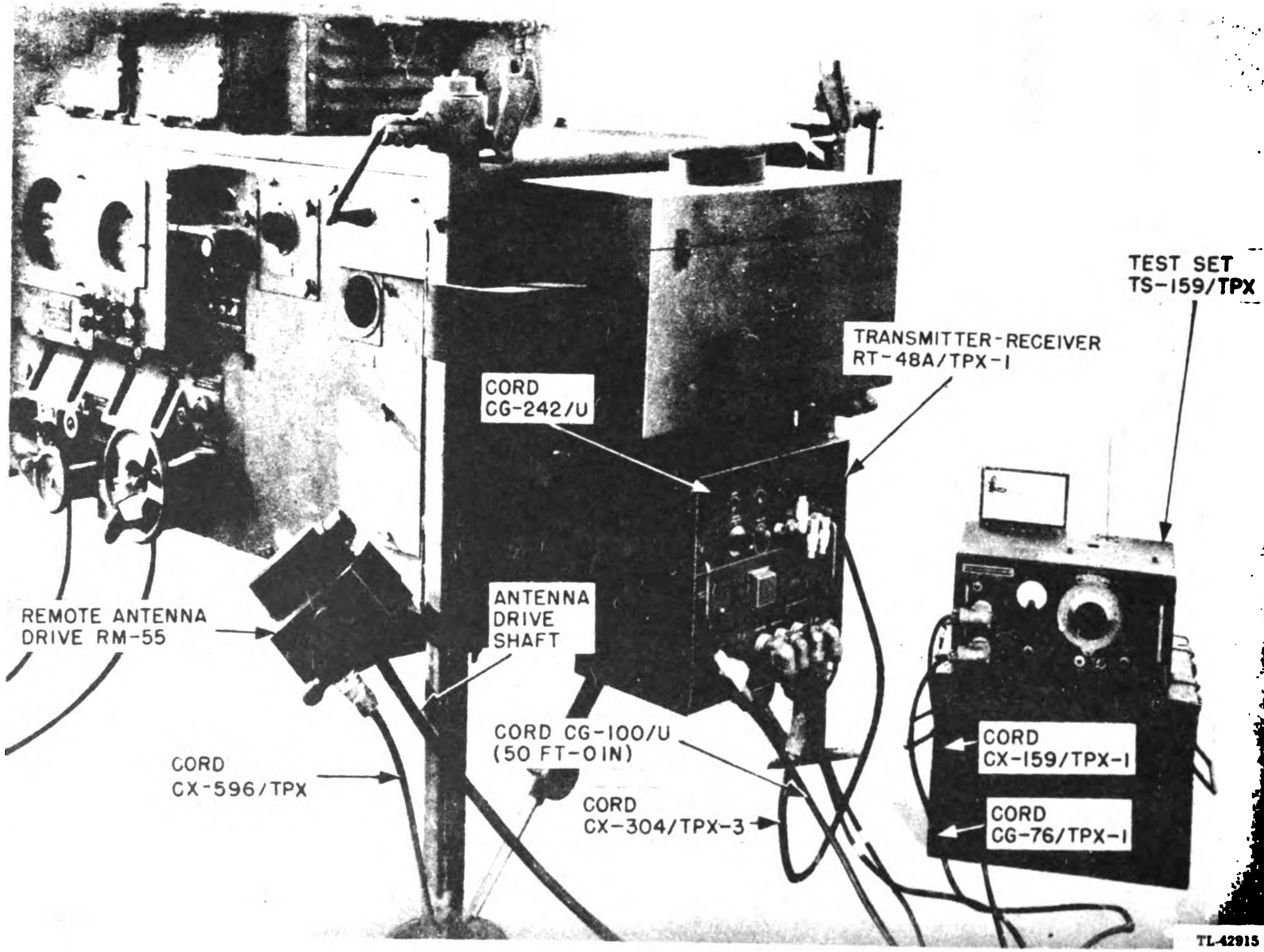


Figure 4. Transmitter-Receiver RT-48A/TPX-1, mounted on Radar Set AN/TPL-1, with Test Set TS-159/TPX set up for testing.

Section II

COMPONENTS AND CHARACTERISTICS

7. GENERAL

Radar Set AN/TPX-4 is compact and simple in design to facilitate transportation, installation, and operation under field conditions. Its components are transported in five transit cases and three transit bags. The main components of Radar Set AN/TPX-4 are Transmitter-Receiver RT-48A/TPX-1 and Antenna System AS-134/TPX. The equipment includes the necessary transmission lines and cords for connection to the antenna and to Radar Set AN/TPL-1, packed in a transit chest. Test Set TS-159/TPX, installation tools, and spare tubes are packed in one carrying chest; the antenna system is packed in three canvas bags and one chest; and each of the two transmitter-receivers (one operating, one spare) is mounted in a transit case which also serves as the housing for the chassis.

8. INPUT POWER REQUIREMENTS

a. Power for operation of Radar Set AN/TPX-4 is drawn directly from Radar Set AN/TPL-1. For normal operation the IFF equipment is connected for 115 volts a-c at 400 cycles per second (cps).

b. The power input for Radar Set AN/TPX-4 is 175 watts. The power output of the transmitter is as follows: 500 watts minimum peak, 1,000 watts maximum peak, 2.4 watts approximate average (the actual power radiated is reduced by the attenuator).

9. LIST OF COMPONENTS

Quantities, nomenclature, functions, dimensions, and weights of the components are given in the following table:

COMPONENTS OF RADAR SET AN/TPX-4

Quantity	Nomenclature	Function	Dimensions	Weight (lb)
2	Transmitter-Receiver RT-48A/TPX-1	One in use and one spare.	15⅛" wd, 13⅝" h, 9-27/32" d, less cover; cover 15⅝" wd, 14⅛" h, ¾" d.	45
1	Antenna System AS-134/TPX	Complete antenna system including supporting mast less transmission lines.	15' h.	150
1	Test Set TS-159/TPX	Used to set transmitter and receiver frequencies, and for testing transmitter and receiver.	8-7/32" d, 13-9/16" wd, 6-29/32" h, exclusive of antenna.	14
1	Chest CY-154/TPX-1	Carries test equipment, tool equipment, ear plugs, 1 set replacement tubes and fuses.	16" wd, 11¾" h, 14" d.	19* (40)†
1	Chest CY-215/U	Carries operating and test cords.	19" wd, 7" h, 19" d.	18* (38)†
1	Cord CG-100/U (50 ft. 0 in.)	Antenna transmission line.	50' lg, 13/32" diam.	6
1	Cord CX-304/TPX	Makes connections to Radar Set AN/TPL-1.		
1	Cord CX-159/TPX-1	Power cable to bring a-c power to test set from transmitter-receiver.	72" lg, 5/16" diam.	1
1	Cord CG-76/TPX-1	Metering cable to bring voltages and currents from transmitter-receiver to test set for metering.	72" lg, 5/16" diam.	1

* Weight empty. † Weight loaded.

9. LIST OF COMPONENTS (cont'd)

COMPONENTS OF RADAR SET AN/TPX-4 (cont'd)

Quantity	Nomenclature	Function	Dimensions	Weight (lb)
1	Cord CG-109/TPX-1	R-f test cable to bring transmitter r-f output to test set for metering.	60" lg, 13/32" diam.	1
1	Cord CG-110/TPX-1	Test cable to bring i-f output from test set to receiver for i-f alignment.	60" lg, 3/16" diam.	½
1	Cord CX-596/TPX	Power cable to bring a-c power to pilot lamp in remote antenna drive from transmitter-receiver unit.		
1	Cord CG-282/TPX	Transmission line, connects antenna array to rotary joint in antenna mast.		
1	Cord CG-242/U	Jumper cable to bring antenna input from attenuator to receiver.	22" lg, 13/32" diam.	½
1	Remote Antenna Drive RM-55	Used to rotate the antenna from operator's position.		
1	Attenuator	Used to reduce transmitter output power. Also forms junction block to connect transmitter and receiver to common antenna.	1¾" x 1¾" x ½".	½
1	Headset HS-30 with Cord CD-605 and Transformer C-410	Used with Test Set TS-159/TPX	Cord 108" lg, headset band 8" diam.	1
1	Tool equipment	Used for assembly, installation, and maintenance of Radar Set AN/TPX-4.		4
2	Technical Manual TM 11-1160		8½" x 11"	2

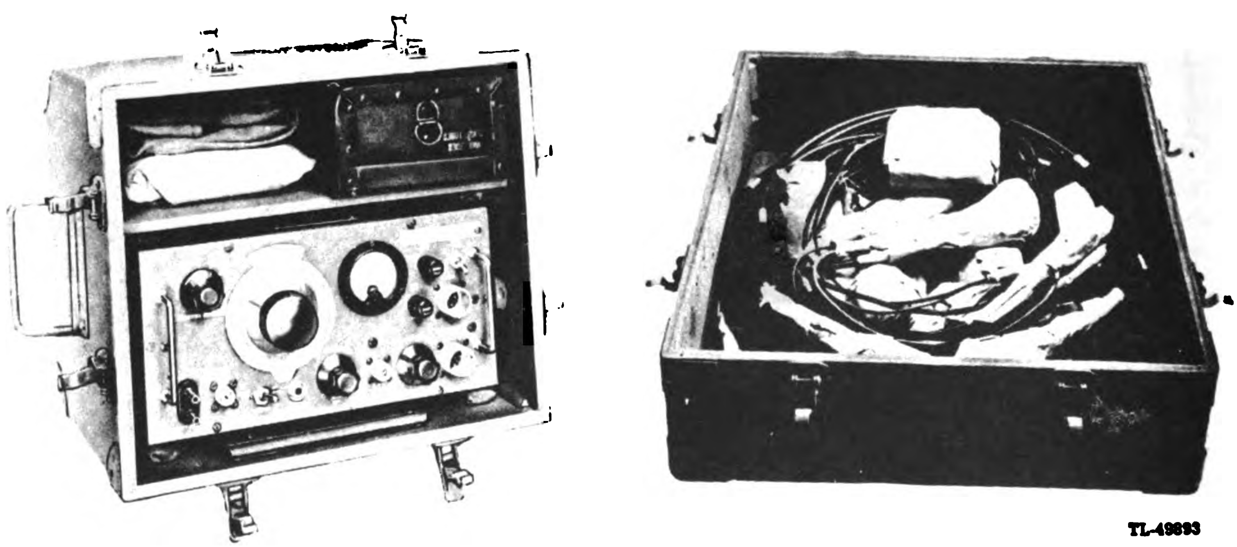


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Figure 5. Chests showing packing.

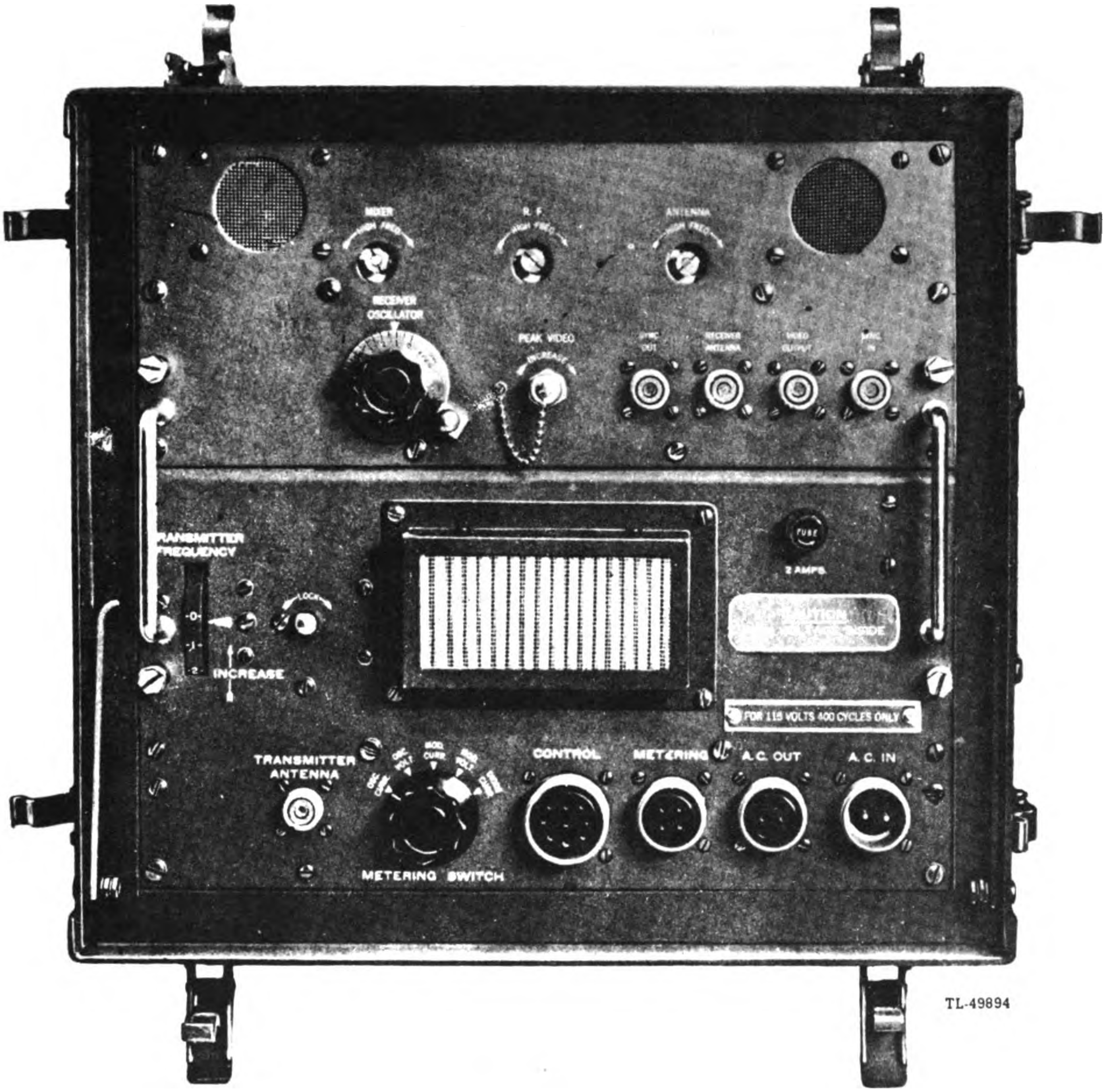

Figure 6. Transmitter-Receiver RT-48A/TPX-1 in case, front view.

10. TRANSMITTER-RECEIVER RT-48A/TPX-1 (Figs. 4, 6, and 7).

a. The transmitter-receiver consists of a receiver chassis and a transmitter and power supply chassis bolted together to make a rigid two-decked unit. The assembly is mounted in an outer case. The front panels of the transmitter and receiver join to form a continuous front panel. The chassis are stacked so that the tubes are mounted on the inside surfaces; the bottoms (wiring sides) of the chassis are thus exposed when the unit is removed from the case. This is done to facilitate servicing, since most small parts and strategic connections are thus made readily accessible. The top and bottom of the two-decked unit are fitted with spring skids on which the unit slides into the outer case.

b. The case for Transmitter-Receiver RT-48A-TPX-1 is an aluminum box 14½ inches wide, 13½ inches high, and 9½ inches deep, painted olive drab. It is fitted on the inside with a shock-mounted frame into which the chassis unit slides. Captive screw fasteners hold the chassis unit in the frame. The case is waterproof and has a waterproof rubber-gasketed aluminum cover. It is fitted with handles so that the transmitter-receiver is transportable in the case and no carrying chest is required.

c. In operation the transmitter-receiver hangs on the right side (viewed from the front) of

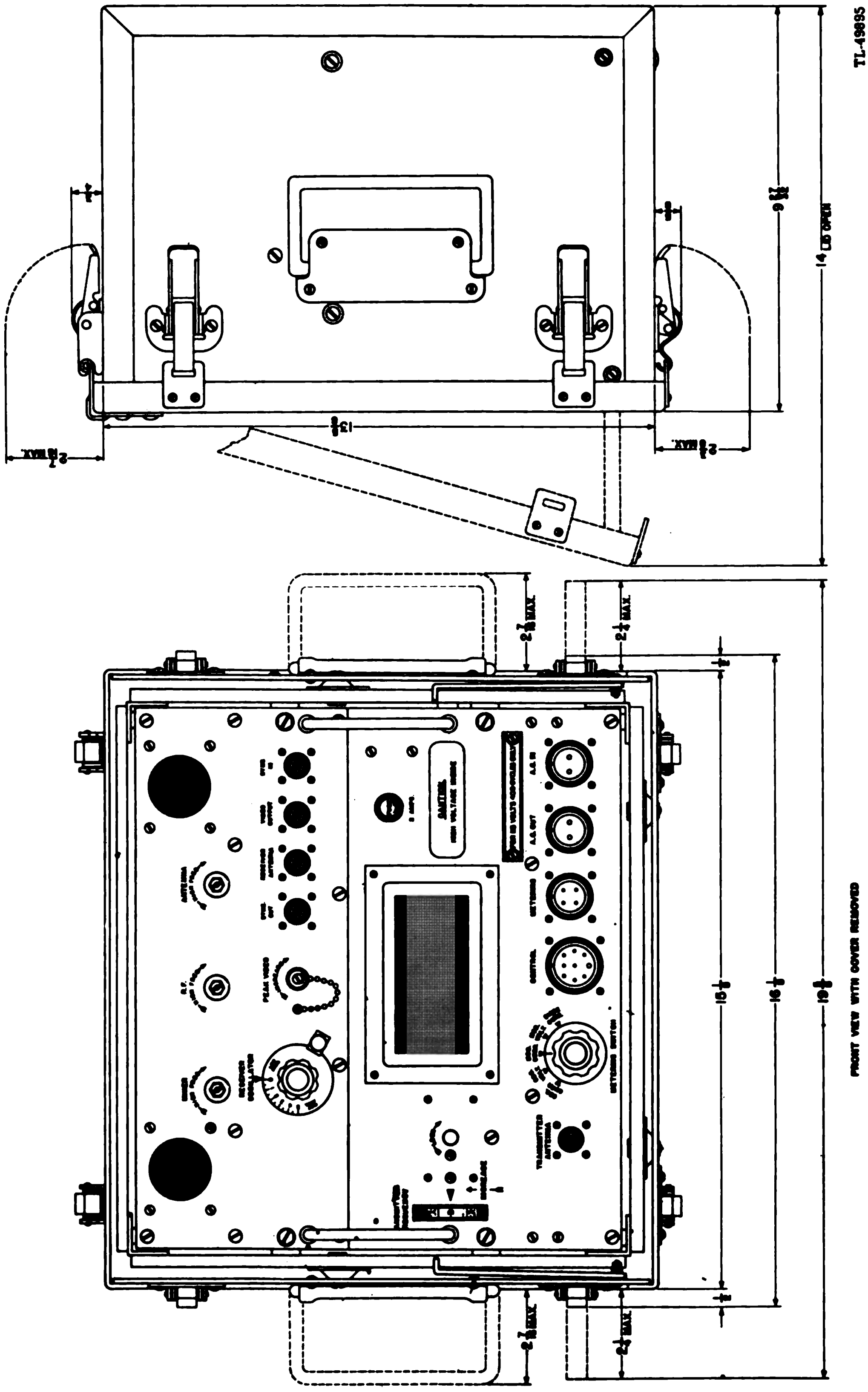

Figure 7. Transmitter-Receiver RT-48A/TPX-1, outline diagram.

Radar Set AN/TPL-1 on two hooks (fig. 4). Brackets are screwed to the rear of the transmitter-receiver case to engage the hooks. In operation the aluminum carrying cover is hinged out from the top. All external connections and tuning adjustments are made on the front panel. A canvas rain cover is provided to slip over the unit to make it rainproof while in operation.

d. The transmitter section consists of a synchronization amplifier, a pulse oscillator, a pulse modulator, and a grid-pulsed r-f power oscillator. The transmitter chassis contains high-voltage and low-voltage rectifiers and a filament transformer requiring power at 115 volts, 400 cycles.

e. The receiver section is a superheterodyne using two r-f stages, a high-frequency oscillator, a mixer stage, four i-f stages, a second detector and limiter, and two video amplifier stages. The sensitivity of the receiver is such that approximately 15 microvolts input is required to give a signal-to-noise ratio of 2 to 1.

11. ANTENNA SYSTEM AS-134/TPX

Note.—Some models of Radar Set AN/TPX-4 may be supplied with Antenna System AS-96/TPX-1 instead of Antenna System AS-134/TPX. Refer to Appendix 1 for information on Antenna System AS-96/TPX-1.

Antenna System AS-134/TPX is composed of Antenna Assembly AS-109/TPX, Tower TR-29, Remote Antenna Drive RM-55, and the associated cables and connectors.

a. Antenna Assembly AS-109/TPX (Fig. 16). The antenna is a directional array composed of two folded vertical dipoles fed by a matching section. Three reflectors are mounted behind each dipole. The antenna is so constructed that it transmits and receives efficiently throughout the frequency range of the IFF equipment. All coaxial cable connections on the assembly are inclosed in polystyrene blocks. The antenna mounts on top of Tower TR-29.

b. Tower TR-29 (Fig. 8). (1) The tower consists of a three-section 16-foot mast mounted on a triangular base and supported by three guy cables. The guy cables fasten to a floating-type bearing on the top mast section and are secured to the ground with screw-in type anchors. Three 15-inch angle-iron stakes are supplied for use where the ground is not suitable for using the screw-in type anchors. The base is staked to the ground and has a hinge pin and wingnut for fastening the mast in place.

(2) Rotation of the tower is controlled by Remote Antenna Drive RM-55 through two 25-foot lengths of flexible drive cable which connects to a worm gear drive in the bottom section of the mast.

(3) A coaxial cable, Cord CG-282/TPX, connects the antenna assembly (fig. 8) to the rotary coaxial joint in the bottom mast section. This cable is inserted through a hole in the top mast section and travels down through the mast to the coaxial joint.

c. Remote Antenna Drive RM-55 (Fig. 9). The remote drive is mounted on the right front side of Radar Set AN/TPL-1 by means of the mounting bracket packed in Chest CY-215/U. The flexible drive cable from Tower TR-29 connects to the rear of the drive unit. The azimuth indicating dial is located on the front of the drive unit and is turned by a crank on the side. The dial is illuminated by an a-c lamp mounted inside the unit. An a-c connector and switch for the dial lamp are on the rear of the unit. A knob, which provides zero adjustment for the azimuth indicating dial, is located under a cap on top of the drive unit.

12. CORDS

In addition to the cords required for normal operation, test cords as listed in paragraph 9 are provided. These cords are used to connect the transmitter-receiver unit to the test set when making various tests and adjustments. The majority of cords are packed in Chest CY-215/U; however, Cords CG-242/U, CX-596/TPX, and CG-282/TPX are packed with Antenna System AS-134/TPX.

13 TOOLS AND ACCESSORIES (Fig. 10).

a. A cloth roll containing tools and accessories is contained in Chest CY-154/TPX-1.

b. The tools listed below are used for assembly, installation, and maintenance of Radar Set AN/TPX-4.

(1) One fiber aligning screwdriver.
(2) One each 3/16-inch, ¼-inch, 5/16-inch, 11/32-inch, and ⅜-inch Spintite socket wrenches.
(3) Two end wrenches, each 7/16 inch on one end and ½ inch on the other end.
(4) One gas pliers.
(5) One long-nose pliers.
(6) One screwdriver with 3-inch blade.
(7) One screwdriver with 1½-inch blade.
(8) Two each No. 6, No. 8, and No. 10 Allen wrenches.

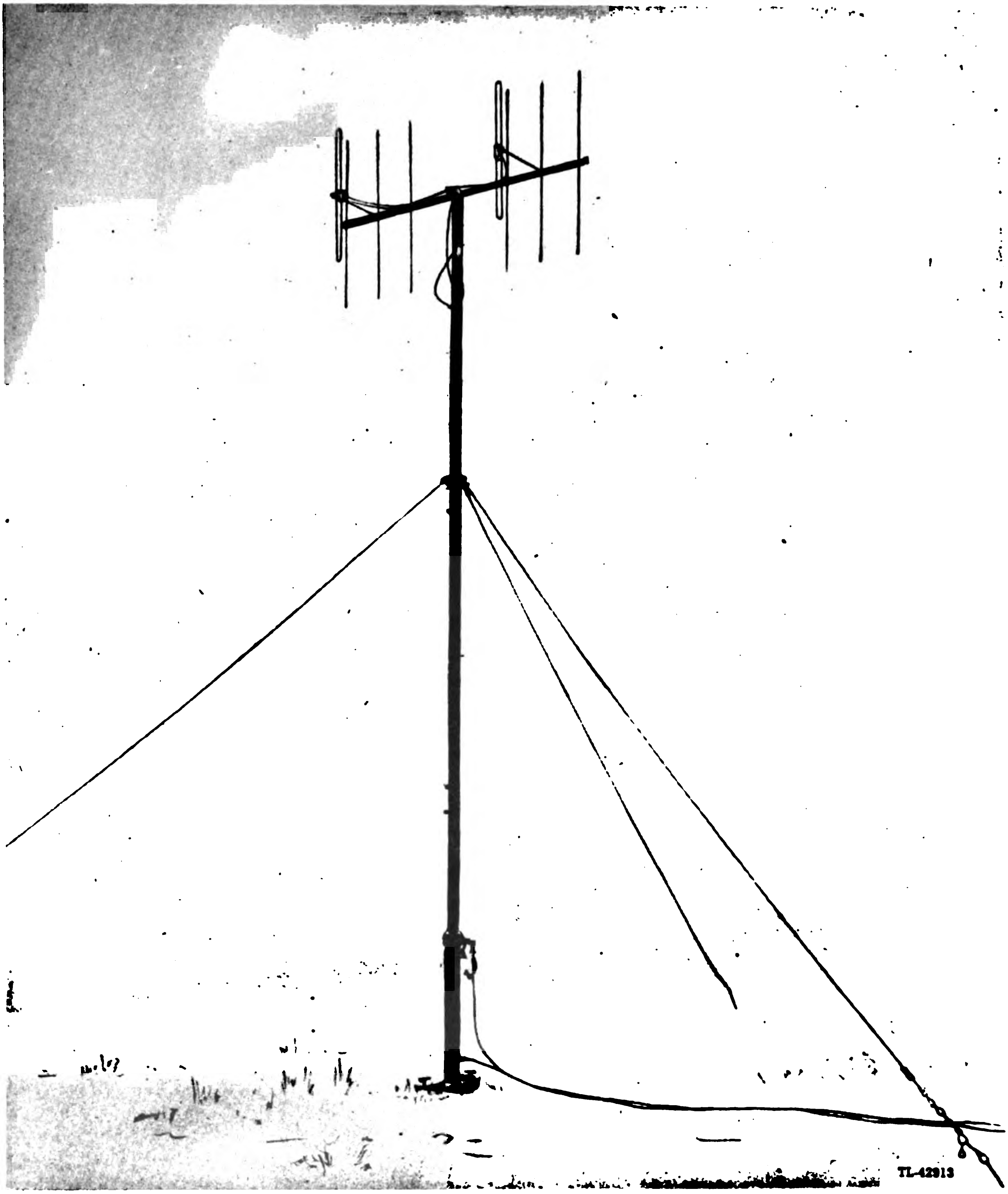

Figure 8. Tower TR-29 set up with Antenna Assembly AS-109/TPX in place.

Figure 9. Remote Antenna Drive RM-55.

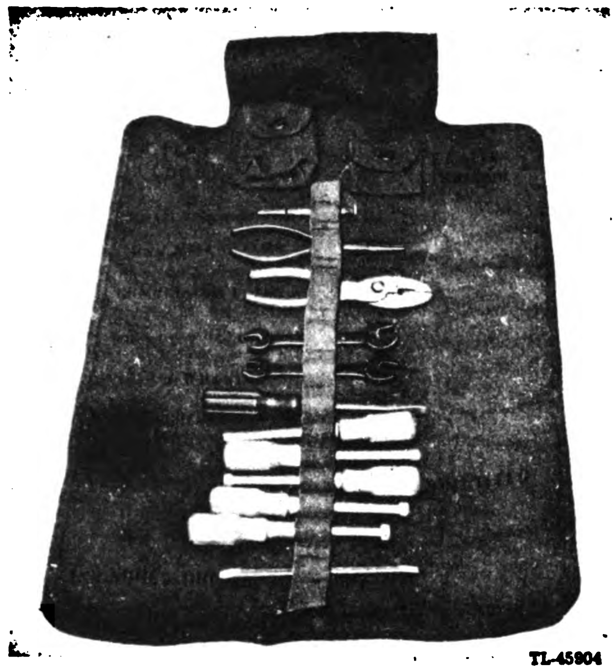

Figure 10. Radar Set AN/TPX-4, tools.

c. The accessories consist of plugs as described below.

(1) One short-circuiting plug: Plug PL-259 wired with the center conductor shorted to the plug body (ground). It is to be attached to the SYNC. OUT receptacle to "kill" the transmitter while the receiver operates (during trouble shooting).

(2) One dummy load: Plug PL-259 with a 50-ohm, 1-watt, carbon resistor connected between the center conductor and the plug body (ground). It is to be attached to the TRANSMITTER ANTENNA receptacle in order to operate the transmitter without radiating a signal (during trouble shooting). The test set is normally used as a dummy load; this plug is for use if the test set is inoperative or not available.

Section III

TEST EQUIPMENT

14. TEST SET TS-159/TPX (Figs. 4, 11, 12, and 13).

a. General. Test Set TS-159/TPX is a compact unit mounted on an aluminum chassis with aluminum panel and inclosed in aluminum cabinet 8 7/32 inches deep, 13 9/16 inches wide, and 6 29/32 inches high. It is equipped with a removable antenna which is clipped to the top of the cabinet when not in use. Test Set TS-159/TPX is used in conjunction with Transmitter-Receiver RT-48A/TPX-1 for testing, tuning, and aligning the IFF equipment.

b. Functions. Test Set TS-159/TPX performs the following functions:

(1) RECEIVER TUNING. A crystal-calibrated oscillator furnishes a very high-frequency signal to tune the r-f stages of the IFF receiver. The crystal oscillator itself is used with a frequency tripler to furnish a 30-mc signal for the i-f alignment of the IFF receiver.

(2) TRANSMITTER TUNING. A crystal-calibrated oscillating detector is used as a wavemeter to measure and adjust the frequency of the IFF transmitter. Audio amplifiers furnish a detected signal which can be heard in the headphones supplied with the test set, or which can be measured on the milliammeter in the front panel of the test set.

(3) POWER MEASUREMENT. The test set provides a dummy load for use when measuring the IFF transmitter power. The transmitter output to the dummy load is detected and measured by a vacuum-tube voltmeter and the reading on the test set milliammeter is converted to peak-power output by use of the chart in figure 23).

(4) METERING. The 0-1 ma d-c meter in the front panel of the test set can be connected to the transceiver (transmitter-receiver) to measure important currents and voltages, or the meter can be used as an external 50- or 500-volt d-c 1,000-ohm-per-volt voltmeter.

c. Packing. Test Set TS-159/TPX is contained in Chest CY-154/TPX-1 together with Headset HS-30, the tool kit, ear plugs, and one set of replacement tubes and fuses. The test cords used with the test set are contained in Chest CY-215/U.

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Figure 11. Test Set TS-159/TPX, antenna and tuning chart down.

Figure 12. Test Set TS-159/TPX, antenna and tuning chart in operating position.

15. HEADSET HS-30

Headset HS-30 is a lightweight phone set used with Test Set TS-159/TPX. Impedance-matching Transformer C-410 is built into the 6-foot Cord CD-605. A clip is provided to fasten the transformer to the operator's clothing.

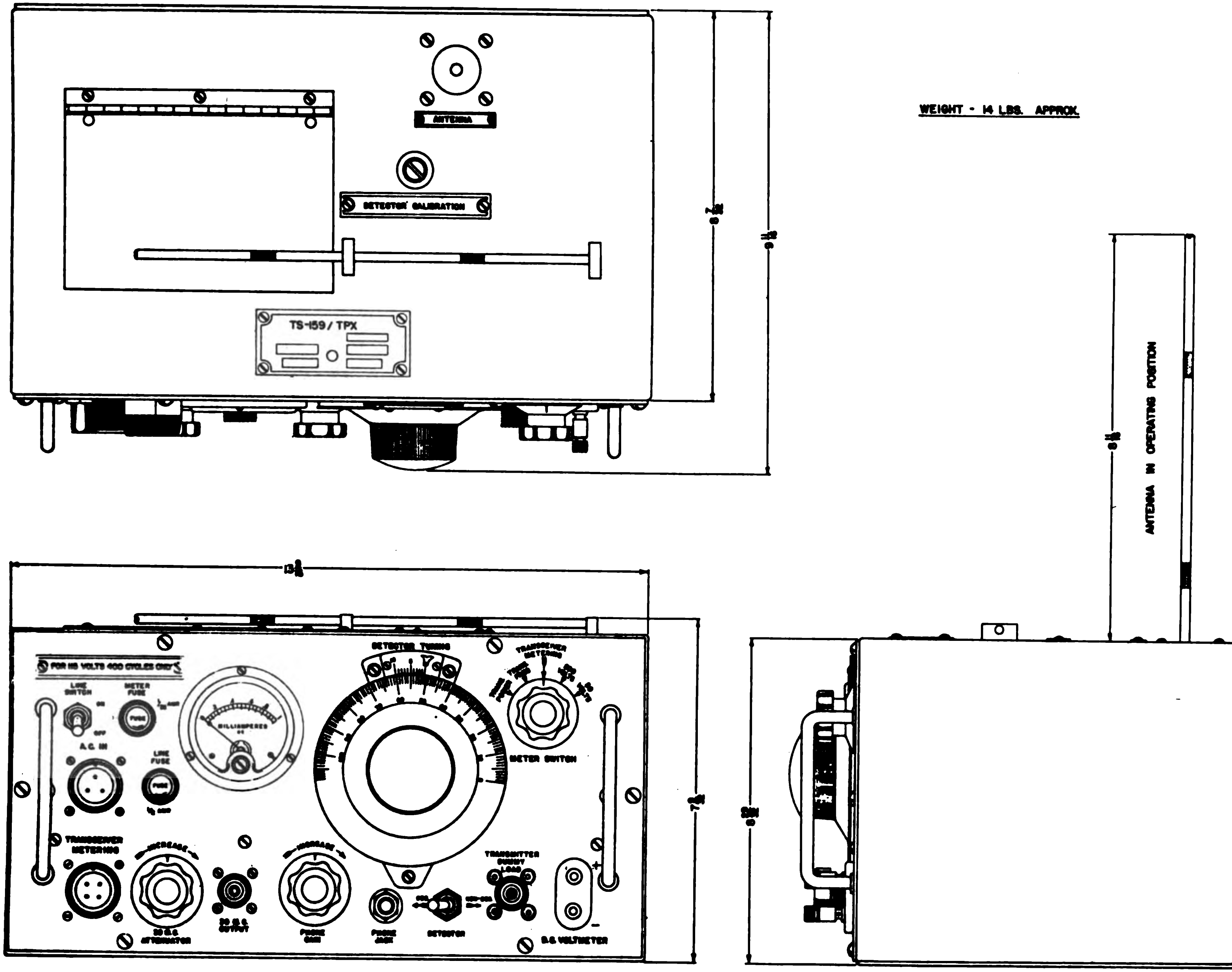

Figure 13. Test Set TS-159/TPX, outline diagram.

Chapter 2

INSTALLATION

16. PREPARATION FOR INSTALLATION

a. Unpack the equipment with care and inspect it to see that the components have not been damaged during shipment. Check all components against the packing list.

b. The following units are required at the operating site of Radar Set AN/TPX-4:

(1) One Transmitter-Receiver RT-48A/TPX-1.

(2) One Antenna System AS-134/TPX.

(3) One Chest CY-154/TPX-1 containing the following:

(*a*) One Test Set TS-159/TPX.

(*b*) One Headset HS-30.

(*c*) One set of tool equipment.

(*d*) One set of spare tubes and fuses for Radar Set AN/TPX-4.

(*e*) One log book.

(*f*) Five pairs of ear plugs.

(4) One Chest CY-215/U containing the following:

(*a*) One Cord CX-304/TPX-1.

(*b*) One Cord CG-100/U (50 ft. 0 in.).

(*c*) One Cord CG-242/U.

(*d*) One Cord CX-159/TPX-1.

(*e*) One transmitter output attenuator.

(*f*) One Cord CG-76/TPX-1.

(*g*) One Cord CG-109/TPX-1.

(*h*) One Cord CG-110 TPX-1.

(*i*) Two mounting brackets for Transmitter-Receiver RT-48A/TPX-1.

(*j*) One mounting bracket for Remote Antenna Drive RM-55.

17. SELECTING A SITE FOR ANTENNA SYSTEM AS-134/TPX

The antenna tower must be installed on a level site not more than 50 feet away from the radar shelter. Choose a point where the IFF antenna will least interfere with the radar signals coming from the sector most likely to contain unfriendly aircraft (fig. 14).

18. INSTALLATION OF ANTENNA SYSTEM AS-134/TPX

a. Assembly of Tower. After the site has been located, assemble the tower in the following manner.

(1) Fasten the base down with the three stakes provided.

(2) Lay out three points, forming an equilateral triangle. Locate each point from the corners of the base a distance of six lengths of the anchor driving pipe. Screw in the anchors at these points. The anchors should lean in toward the base.

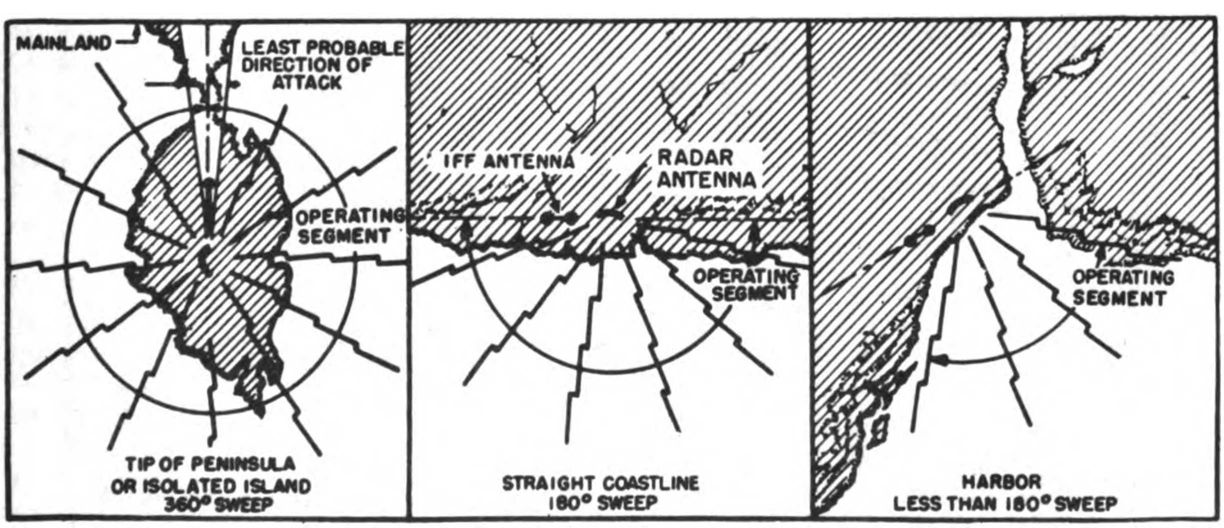

Figure 14. Locating IFF antenna in relation to radar set.

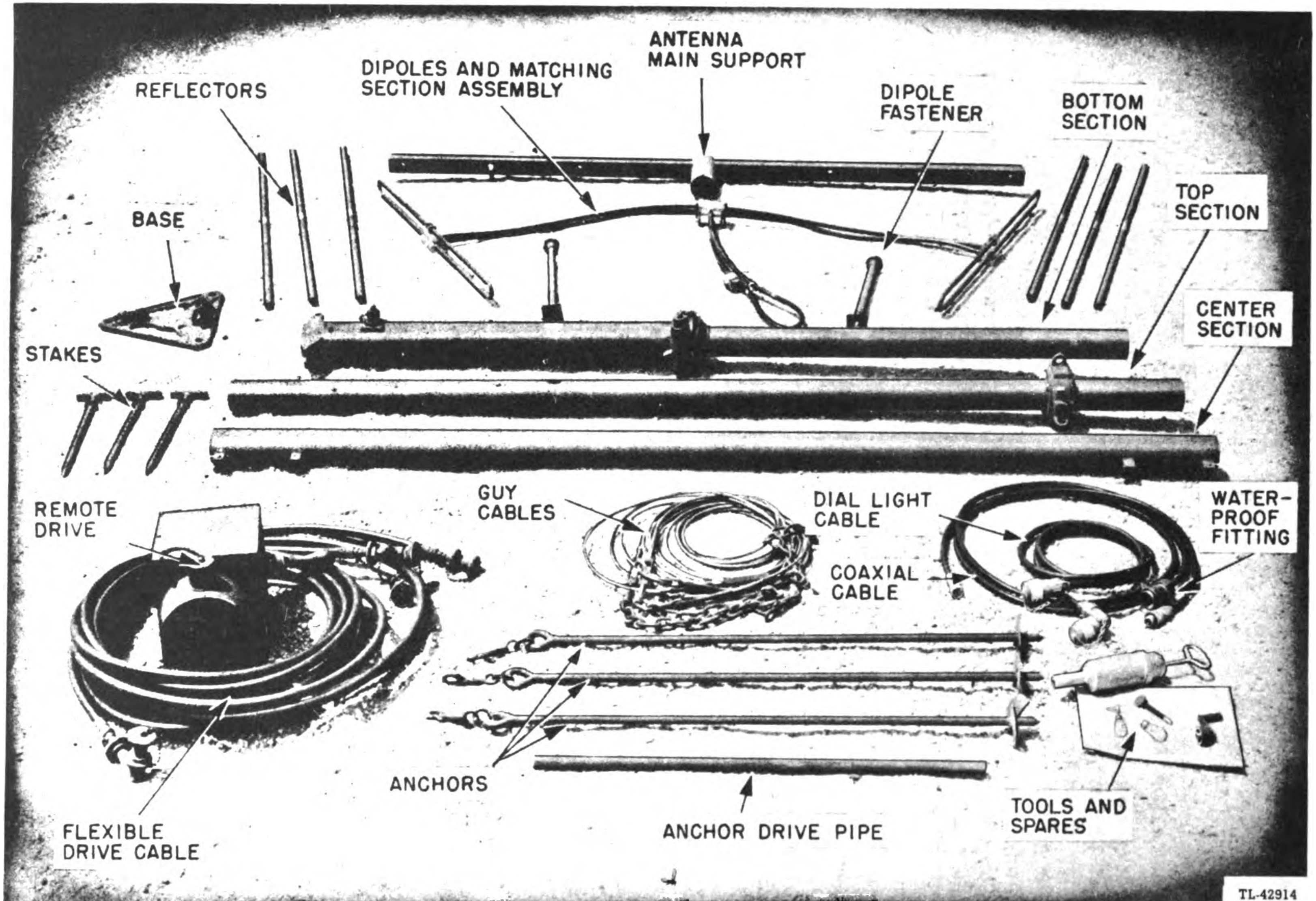

Figure 15. Antenna System AS-134/TPX disassembled.

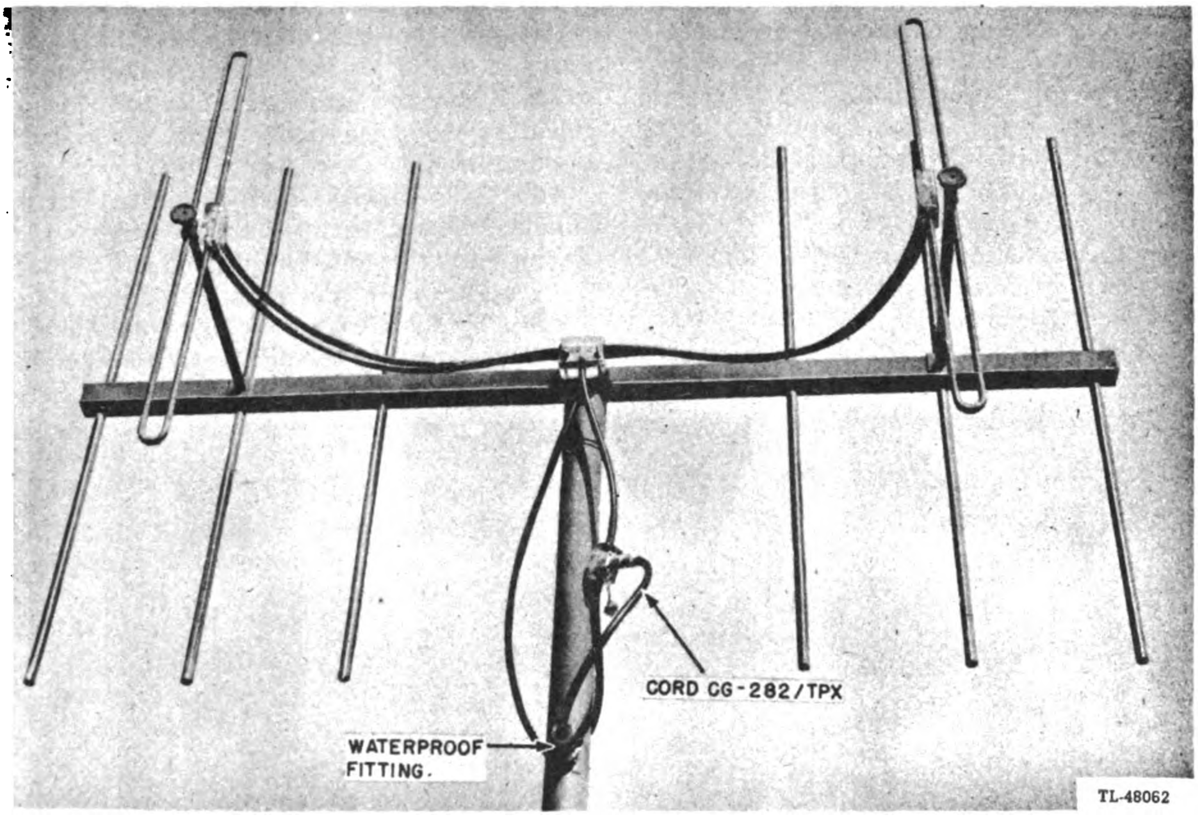

Figure 16. Antenna Assembly AS-109/TPX attached to top of Tower TR-29.

(3) Hinge the bottom section of the mast to the base with the hinge pin which is chained to the base. Lock the pin in place by turning the key in the end of the pin crosswise.

(4) Put the center mast section and the top mast section together and tighten the clamping screws.

(5) Push the coaxial cable (Cord CG-282/TPX) through the hole in the top mast section until it goes through the center mast section. The end with the large connector should come out the bottom end of the center mast section.

(6) Connect the coaxial cable connector to the connector at the top of the bottom mast section.

(7) Slip the center mast section over the end of the bottom mast section and tighten the clamping screws.

(8) Screw the waterproof fitting on Cord CG-282/TPX into the hole in the top mast section.

(9) Raise the top end of the mast and support it on a chest or box.

b. Assembly of Antenna. (1) Push the re-reflectors into the holes in the main support.

(2) Fasten the center polystyrene block to the flat plate on the center of the main support with the captive wing screws in the block. The matching section should hang downward.

(3) Fasten the dipoles to the main support with the dipole fasteners. These fasteners consist of a long hand screw inserted through a metal sleeve.

(4) Install the antenna on the top mast section as shown in figure 16. Tighten the captive hand screw.

(5) Connect Cord CG-282/TPX to the connector on the matching section.

c. Tower Erection. (1) Snap the guy cables to the three rings on the floating-type bearing on the top mast section.

(2) Fasten two guy cables to the anchors on either side of the tower.

(3) Raise the tower to the vertical position and fasten the remaining guy cable to its anchor.

(4) Tighten the mast at the base with the hinged bolt and wingnut.

(5) Extend the guy cable turnbuckles to their full length, and take up the slack by moving the snaps up on the chains. Then tighten the turnbuckles until all guy cables have equal tension but are not tight enough to cause the bearing to bind.

(6) Using the hand crank, turn the tower until the antenna is facing in the same direction as the radar antenna.

(7) Loosen the screws in the ring above the azimuth dial on the bottom mast section. Rotate the ring until the azimuth reading is the same as the reading of the radar azimuth indicator. Tighten the screws.

d. Installing Remote Antenna Drive. (1) Fasten the remote drive to the fixed bracket under the right front corner of Radar Set AN/TPL-1 by means of the removable mounting bracket provided.

(2) Connect the two lengths of flexible drive cable together with the straight connector. Connect one end of the cable to the remote drive.

(3) Using the right-angle connector, connect the other end of the cable to the worm gear drive on the tower.

(4) The azimuth dial calibrated in mils should be used on the remote drive. If the wrong dial is installed, replace it as follows:

(*a*) Unscrew the glass retaining ring by pressing down with the palm of the hand and at the same time turning counterclockwise. If the retaining ring sticks, extra force may be

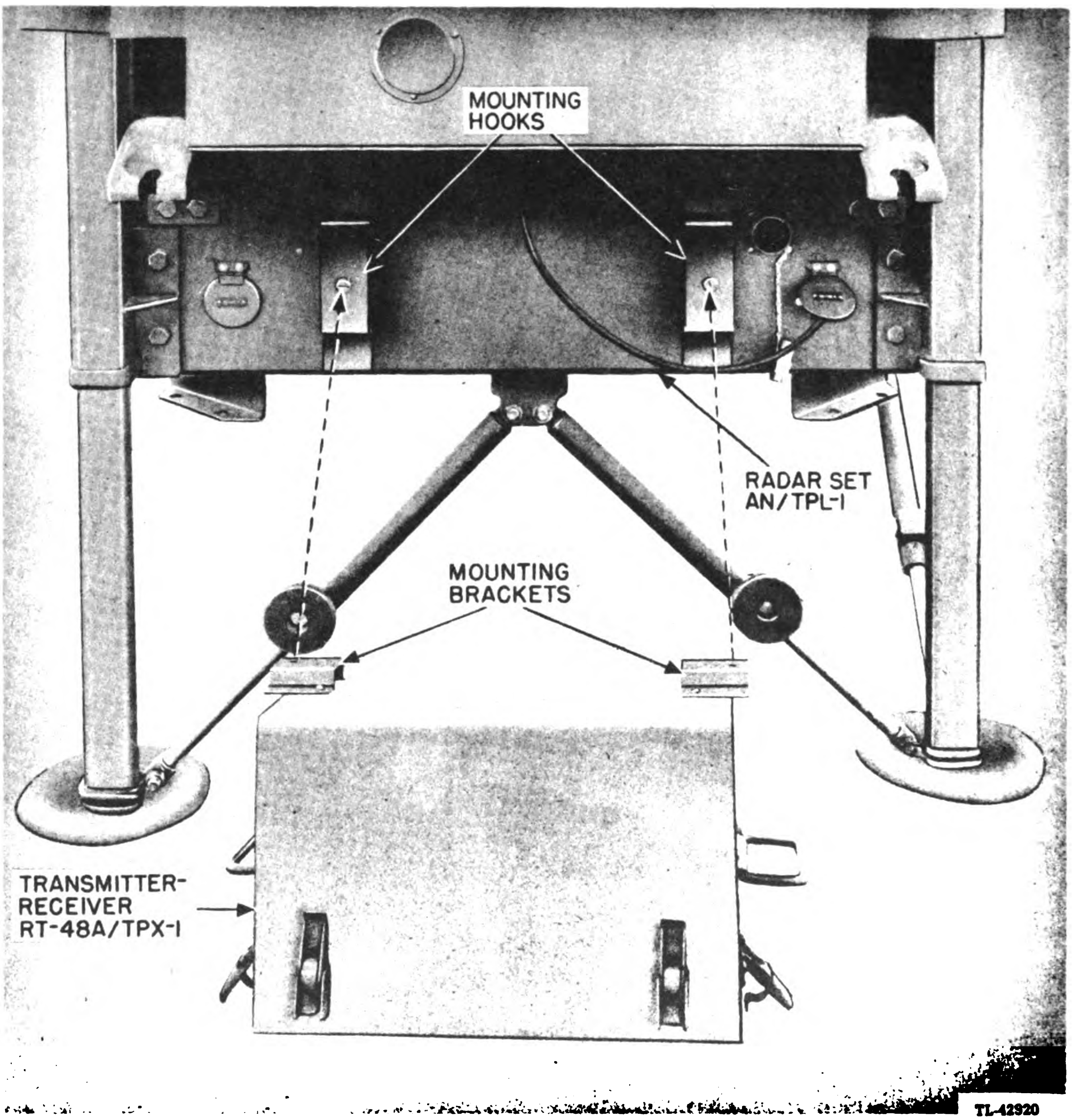

Figure 17. Transmitter-Receiver RT-48A/TPX-1, ready for installation on Radar Set AN/TPL-1.

exerted by inserting nails in the holes on either side of the ring.

(*b*) Remove the dial-light bezel that is in front of the azimuth dial.

(*c*) Remove the four screws from the outer edge of the dial calibrated, and remove the dial. Put the calibrated dial in mils in its place and replace the screws.

(*d*) Replace the dial-light bezel.

(*e*) Replace the glass and ring removed in subparagraph (*a*) above.

(5) Remove the cap from the knob on top of the remote drive. Push in on the knob and turn until the azimuth dial reads the same as the dial on the tower. Replace the cap.

19. INSTALLATION OF TRANSMITTER-RECEIVER RT-48A/TPX-1

a. Open Chest CY-215/U and remove the mounting brackets for Transmitter-Receiver RT-48A/TPX-1.

b. Screw the mounting bracket and bumpers on the hooks provided on the side of Radar Set AN/TPL-1 (fig. 17).

20. CORD CONNECTIONS (Fig 18)

a. Obtain Cord CX-304/TPX-3 from Chest CY-215/U. Connect the main branch end of this cord (Plug AN-3106-28-IP) to the receptacle marked IFF on the right side of the radar cabinet. The four short arms of Cord CX-304/TPX-3 which come out of the molded crotch are individually marked with the panel designations of the receptacles to which they connect. Connect the arm marked CONTROL to the CONTROL receptacle on Transmitter-Receiver RT-48A/TPX-1, and similarly connect the proper arm to the receptacles marked SYNC. IN, VIDEO OUT, and A.C. IN.

b. Screw the transmitter power attenuator to the TRANSMITTER ANTENNA receptacle. Connect one end of Cord CG-100/U (50 ft. 0 in.) to the right receptacle on the attenuator, and connect the left receptacle to the RECEIVER ANTENNA receptacle with Cord CG-242/U. Connect the angle plug end of cord CX-596/TPX to the A.C.OUT receptacle.

c. Connect the straight plug end of Cord CX/596/TPX to the a-c receptacle on the remote antenna drive. Connect the remaining end of Cord CG-100/U (50 ft. 0 in.) to the coaxial connector at the bottom of the antenna tower.

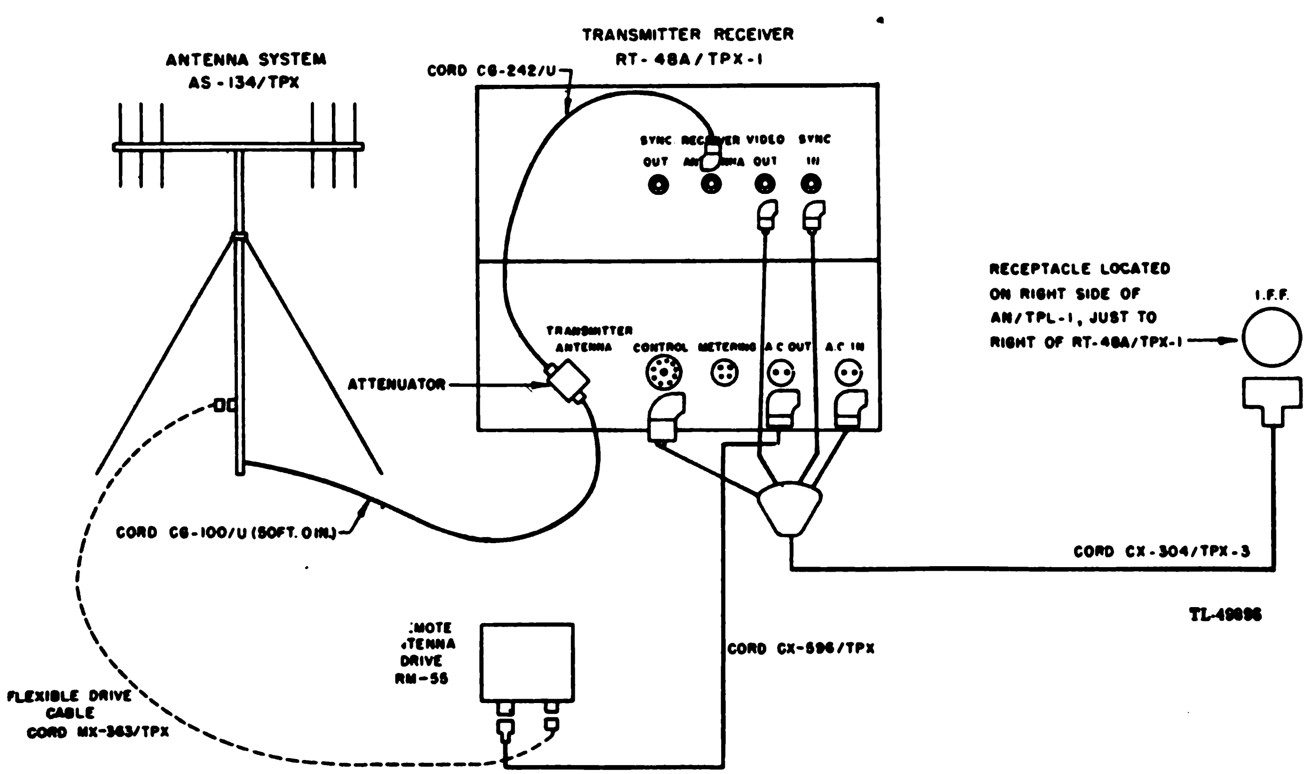

Figure 18. Radar Set AN/TPX-4, interconnecting cording diagram.

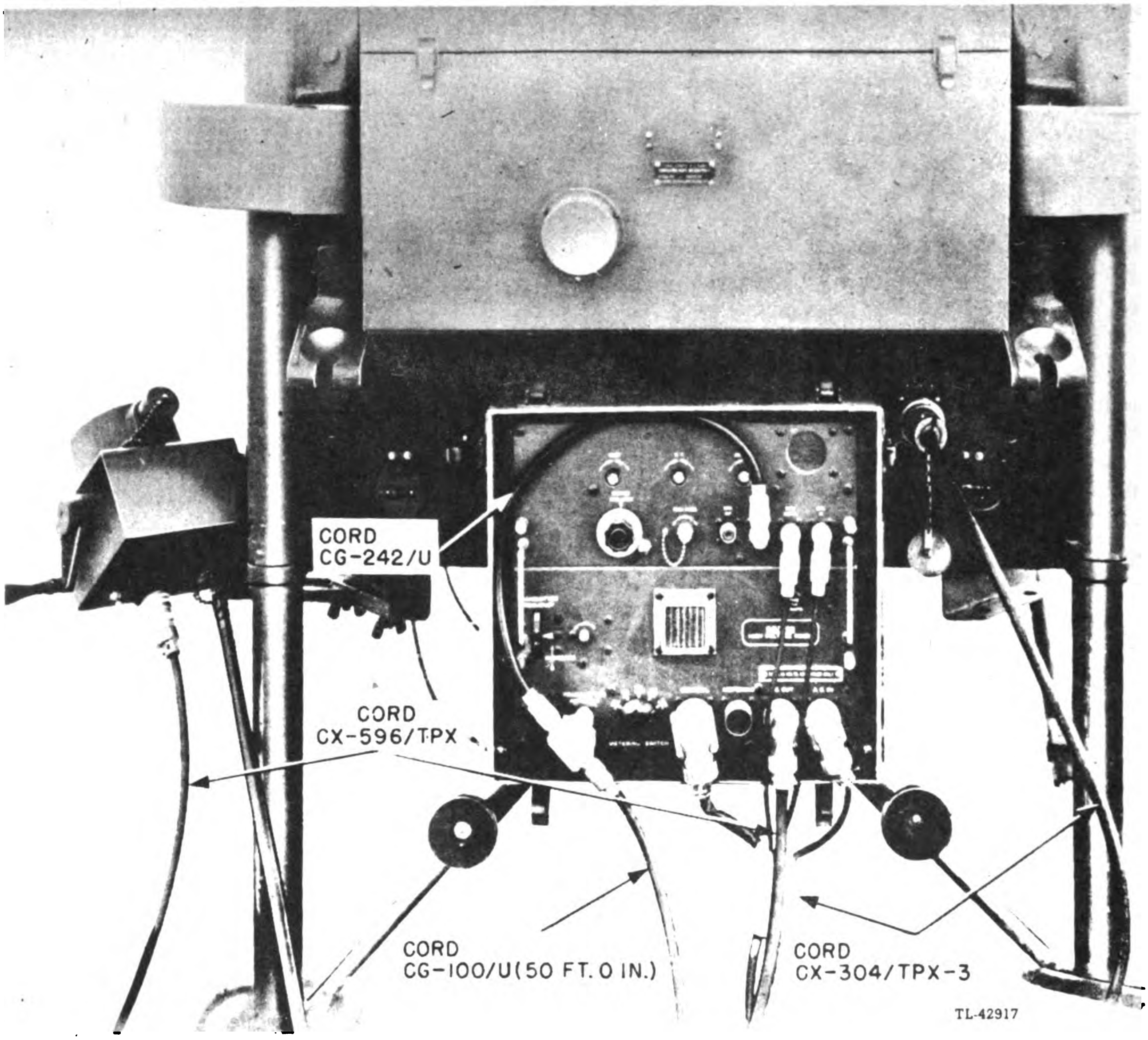

Figure 19. Cord connections for normal operation.

Chapter 3
OPERATION

Section I
PRELIMINARY ADJUSTMENTS

21. GENERAL

a. The only adjustments required before operating Radar Set AN/TPX-4 are to set receiver and transmitter frequency and to adjust the PEAK VIDEO control for satisfactory display. The PEAK VIDEO adjustment is made only when the equipment is first operated. The frequency adjustment should be checked daily or as directed by the person in charge.

b. Radar Set AN/TPX-4 will operate on any frequency in the band from 157 to 187 megacycles, provided both receiver and transmitter are tuned to the same frequency. The frequency to be used will be specified by the person in charge.

c. Unpack the following material.

(1) One Test Set TS-159/TPX from Chest CY-154/TPX-1.

(2) One Headset HS-30 from Chest CY-154/TPX-1.

(3) One Cord CX-159/TPX-1 from Chest CY-215/U.

(4) One Cord CG-76/TPX-1 from Chest CY-215/U.

(5) One 3/8 inch hex socket wrench from the tool equipment in Chest CY-154/TPX-1.

(6) One insulated screwdriver from the tool equipment in Chest CY-154/TPX-1.

d. Before proceeding with the preliminary adjustments of Radar Set AN/TPX-4, make sure that the method of reading the vernier dial on Test Set TS-159/TPX is clearly understood.

22. READING THE VERNIER DIAL ON TEST SET TS-159/TPX (Fig. 20).

Mounted on the top of the case of Test Set TS-159/TPX is a *tuning chart* which specifies DETECTOR TUNING dial settings for various frequencies. In order to read tenths of each dial scale division, a vernier scale is mounted above the dial. The zero end of this scale is indicated by an engraving similar to an arrowhead. If it is desired to set the DETECTOR TUNING dial to approximately 25½, for example, only the arrow at the zero end of the vernier scale is used. Figure 20-D shows the arrow pointing to approximately 25½ on the dial scale. If it is desired, however, to determine more exactly where the dial in figure 20-D is set, find the mark on the vernier scale which lines up exactly with *any line* on the dial scale. Line 6 on the vernier scale is directly opposite an engraving on the dial scale; No other engraving on the vernier scale lines up exactly with any engraving on the dial scale. The dial setting in figure 20-D is therefore 25.6. The only time two engravings on the vernier scale both line up with marks on the dial scale are for settings with zero tenths, as 15.0, 25.0, 92.0, etc. A setting of 25.0 is shown in figure 20-B; the vernier arrow lines up with 25 on the dial, and vernier 10 lines up with another line on the dial. Figure 20 shows four other examples of vernier dial settings to help the operator become familiar with vernier readings.

23. CONNECTION AND CALIBRATION OF TEST SET TS-159/TPX

a. Set the CHALLENGE switch to OFF.

CAUTION.—Do not set the CHALLENGE switch to ON until directed to do so in the following instructions. Never turn the IFF switch on unless the CHALLENGE switch is in OFF position. Always wait at least 30 seconds after turning power ON before turning the CHALLENGE switch ON.

b. Connect Cord CX-159/TPX-1 from the A.C. OUT receptacle on the transmitter-receiver to the A.C. IN receptacle on Test Set TS-159/TPX. Insert the threaded end of the test set antenna vertically into the hole marked ANTENNA and screw it into place.

c. Throw the IFF switch on. Check to see that the IFF circuit breaker is up. Throw the LINE SWITCH on the test set to ON.

d. Calibrate the test set as follows:

(1) Allow 1 minute for the test set to warm up. Set the METER SWITCH in TRANS. FREQ. position. Set the DETECTOR SWITCH

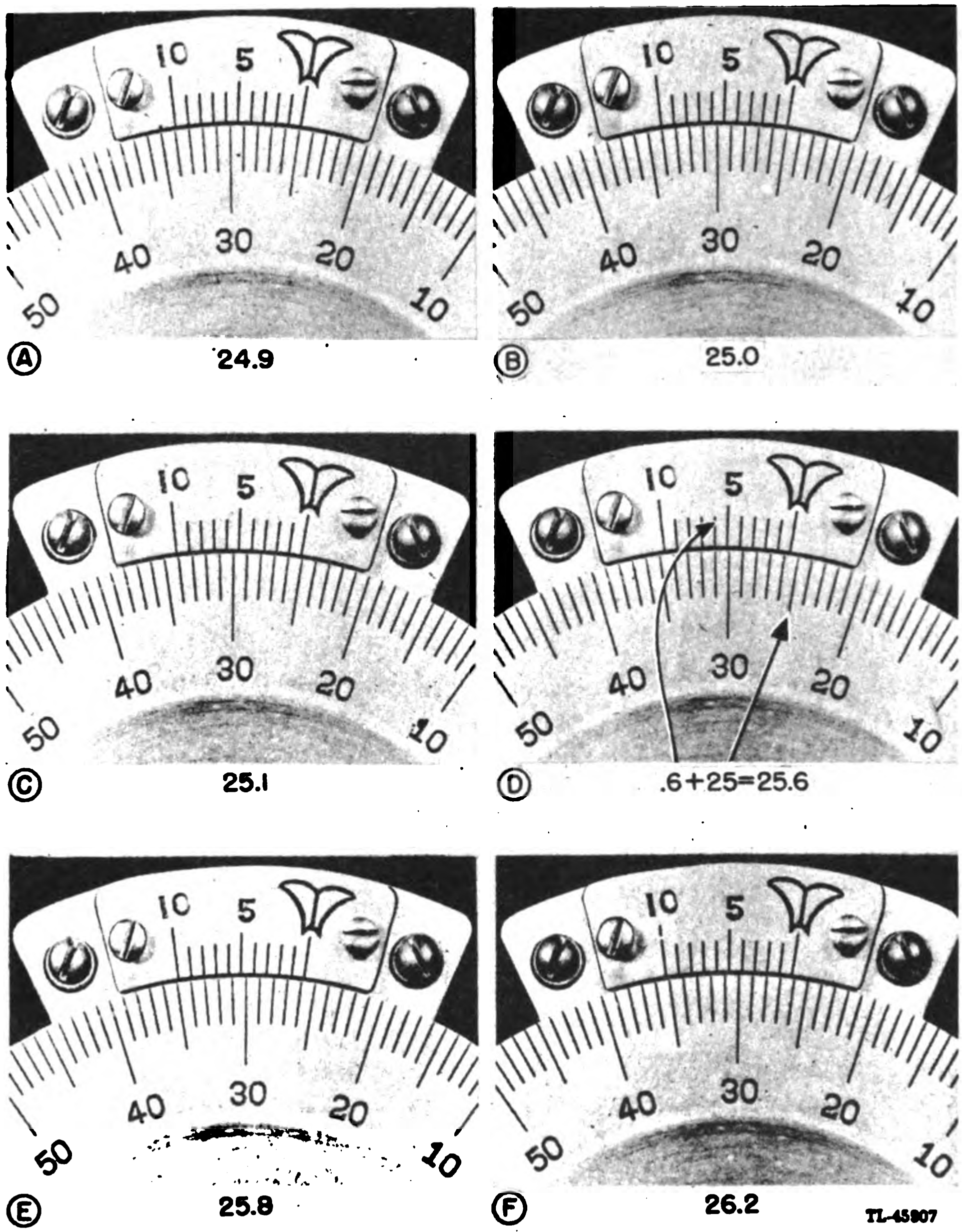

Figure 20. Reading a vernier dial.

to the left (OSC.) position. Turn the PHONE GAIN control about halfway up and plug in the headset. Select the harmonic of 10 megacycles (i.e., 160, 170, 180, or 190 megacycles) nearest the desired operating frequency and from the tuning chart for the test set determine the proper DETECTOR TUNING dial setting. Carefully tune the DETECTOR TUNING knob near this dial setting and listen in the headset for an audible beat note. The PHONE GAIN control may be adjusted for a comfortable level.

(2) If the beat occurs within one-half dial division of the setting given on the tuning chart, the DETECTOR TUNING calibration may be considered satisfactory. If the beat occurs more than one-half dial division off the calibration setting, insert the insulated screwdriver in the slotted bakelite hub visible through the hole marked DETECTOR CALIBRATION on top of the unit and turn the hub until the beat occurs within a few tenths of a division of the calibration setting. The meter on the test set will deflect upward as the beat is tuned in. If the headset is lost or damaged, this deflection can be used for calibration. The CHALLENGE switch should always be in OFF position during the calibration operation to avoid interference from the transmitter.

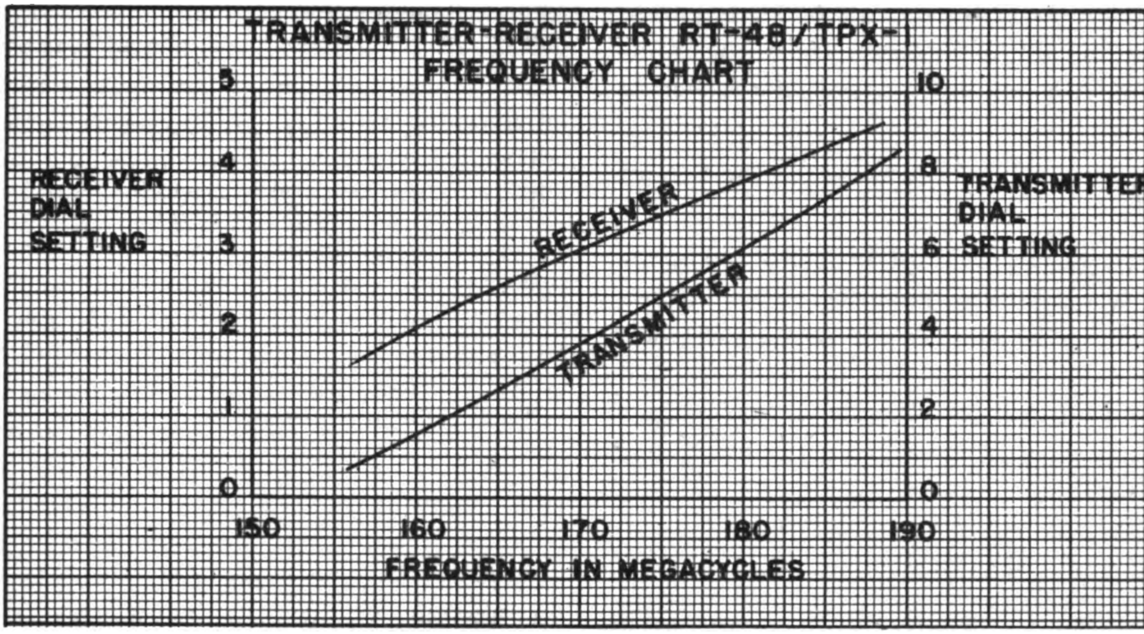

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Figure 21. Radar Set AN/TPX-4, approximate calibration of tuning dials.

Note.—During the following adjustments it is desirable to keep personnel who may be near the equipment from walking or moving around. Since the coupling between the test set and the transmitter-receiver is made by radiation, any change in position of bodies near the test set changes the amount of coupling and prevents accurate maximum settings.

24. TRANSMITTER FREQUENCY ADJUSTMENT

a. Set the METER SWITCH on Test Set TS-159/TPX to TRANS. FREQ. and the DETECTOR switch to NON-OSC. From the test set tuning chart determine the exact DETECTOR TUNING dial setting for the desired operating frequency and set the dial to that point. Rotate the antenna so that the beam is pointed at the operating site.

b. Figure 21 shows the approximate settings of the RECEIVER-OSCILLATOR and TRANSMITTER FREQUENCY dials on the transmitter-receiver for the frequencies in Mark III IFF band. If the frequency to be used is 170 mc, for example, look up along the vertical line corresponding to 170 mc in figure 21. This vertical line intersects the slanted *transmitter* line at 3.8 on the horizontal line scale marked *transmitter dial setting* at the right in figure 21. Turn the TRANSMITTER FREQUENCY dial on the transmitter-receiver to 3.8. The vertical line corresponding to 170 mc intersects the slanted *receiver* line at 3.05 on the horizontal line scale figure. Turn the RECEIVER OSCILLATOR dial on the transmitter-receiver to 3.05.

c. Set the CHALLENGE switch to ON. Tune the DETECTOR TUNING dial on the test set for a maximum response on the meter. If the maximum response occurs at a DETECTOR TUNING dial setting off the desired operating frequency, carefully retune the TRANSMITTER FREQUENCY dial on the transmitter-receiver until the maximum test-meter response occurs exactly on the desired frequency. Then lock the TRANSMITTER FREQUENCY dial. Throw the CHALLENGE switch OFF to make sure the meter response is caused by the transmitter and not some other signal. The meter needle should swing back toward zero.

Note.—The transmitter frequency adjustment depends on energy reaching the test set antenna by radiation from the transmitter antenna. The test set may sometimes be located in such a position that it receives very little energy at the desired frequency because of wave reflections. If a clear maximum reading is not found, move the position of the test set several feet or more. Try rotating the antenna for best pick-up.

25. RECEIVER FREQUENCY ADJUSTMENT

a. Place the CHALLENGE switch in the OFF position.

b. Turn the RECEIVER-OSCILLATOR dial on the transmitter-receiver to approximately the correct position (par. 24b).

c. Connect Cord CG-76/TPX-1 from the METERING receptacle on the transmitter-receiver to the TRANSCEIVER METERING receptacle on the test set.

d. Set the METER SWITCH on the test set to TRANSCEIVER METERING and the METERING SWITCH on the transmitter-receiver to DIODE CURR.

e. Set the DETECTOR switch on the test set to OSC.

f. Turn the DETECTOR TUNING dial on the test set to the desired frequency. This dial setting must be the same as for tuning the transmitter.

g. Turn the IFF GAIN control to maximum.

h. Tune the RECEIVER-OSCILLATOR dial on the transmitter-receiver for a maximum reading on the test-set meter. Check to make sure that the receiver is being tuned to the signal from the test set and not to some external or interference signal, by turning the DETECTOR switch on the test set to NON-OSC. position. The meter indication should disappear. If the meter goes off scale during the tuning, reduce the IFF GAIN setting until an on-scale reading is obtained for the maximum. Lock the RECEIVER-OSCILLATOR dial.

i. Using the 3/8-inch hex socket wrench adjust the ANTENNA, R.F., and MIXER tuning adjustments on the transmitter-receiver for maximum meter reading; reduce the RECEIVER GAIN as required. The equipment is now tuned and ready for operation. Snap the test set LINE SWITCH to OFF or put the DETECTOR switch in the NON-OSC. position. (Any strong c-w signal such as that from the oscillating test set will saturate the receiver video output.)

Note.—If there is insufficient pick-up to find the test set signal with the RECEIVER-OSCILLATOR dial, remove Cord CG-242/U from the RECEIVER ANTENNA receptacle and connect Cord CG-110/TPX-1 to the receptacle. Place the test clip end of the cord near the test set antenna and proceed as directed. When the set is approximately aligned, Cord CG-242/U may be replaced and there will be ample pick-up to complete the alignment.

26. CHECKS AND ADJUSTMENTS USING A-SCOPE

a. Set the IFF GAIN at maximum and the radar range at 30,000 yds. Turn CHALLENGE switch ON. The A-scope display should show the IFF main pulse and one or more ground echoes. IFF responses may also be observed. (All IFF signals display below the lower baseline.) The deflection of the main pulse should be about 1 inch. If it is considerably different, it may be adjusted by the PEAK VIDEO control on the transmitter-receiver. (This control is adjusted with a screwdriver and is normally covered by a screw cap.)

b. The transmitter tuning may be checked by selecting a weak ground echo, preferably one with about 1/2-inch deflection. If no such echo is found, reduce IFF GAIN until a strong echo is reduced to this level. Carefully tune the TRANSMITTER FREQUENCY dial for maximum height of the echo image. Keep reducing the RECEIVER GAIN as necessary to keep the echo deflection less than about 3/4 inch; otherwise the video limiter will prevent tuning by this method. If the original tuning was properly done, the ground echo maximum will be found at the original setting. If the test set is inoperative or not available, this method can be used for tuning both receiver and transmitter, although it cannot put them on any predetermined frequency.

c. Set the radar range to 60,000 yds. and advance the IFF GAIN control to maximum. If any friendly planes are within range of the radar, IFF responses should be observed (fig. 3). The response will break the display baseline. This break is a useful way of finding weak responses obscured by noise. Increase the radar gain and search for echoes. Follow the radar azimuth setting with the IFF antenna. As each echo is displayed on the A-scope, watch directly below it for an IFF response. Note that the IFF response appears to start its deflection at the range of the radar echo.

d. The equipment should now be in satisfactory operation. Remove the cords from the A.C. OUT and METERING receptacles on the transmitter receiver. Replace the front cover, swing down the cover support arms, and close the cover until it rests against the extended arms. If operational and weather conditions require the equipment to be covered, slip the canvas rain cover over the unit.

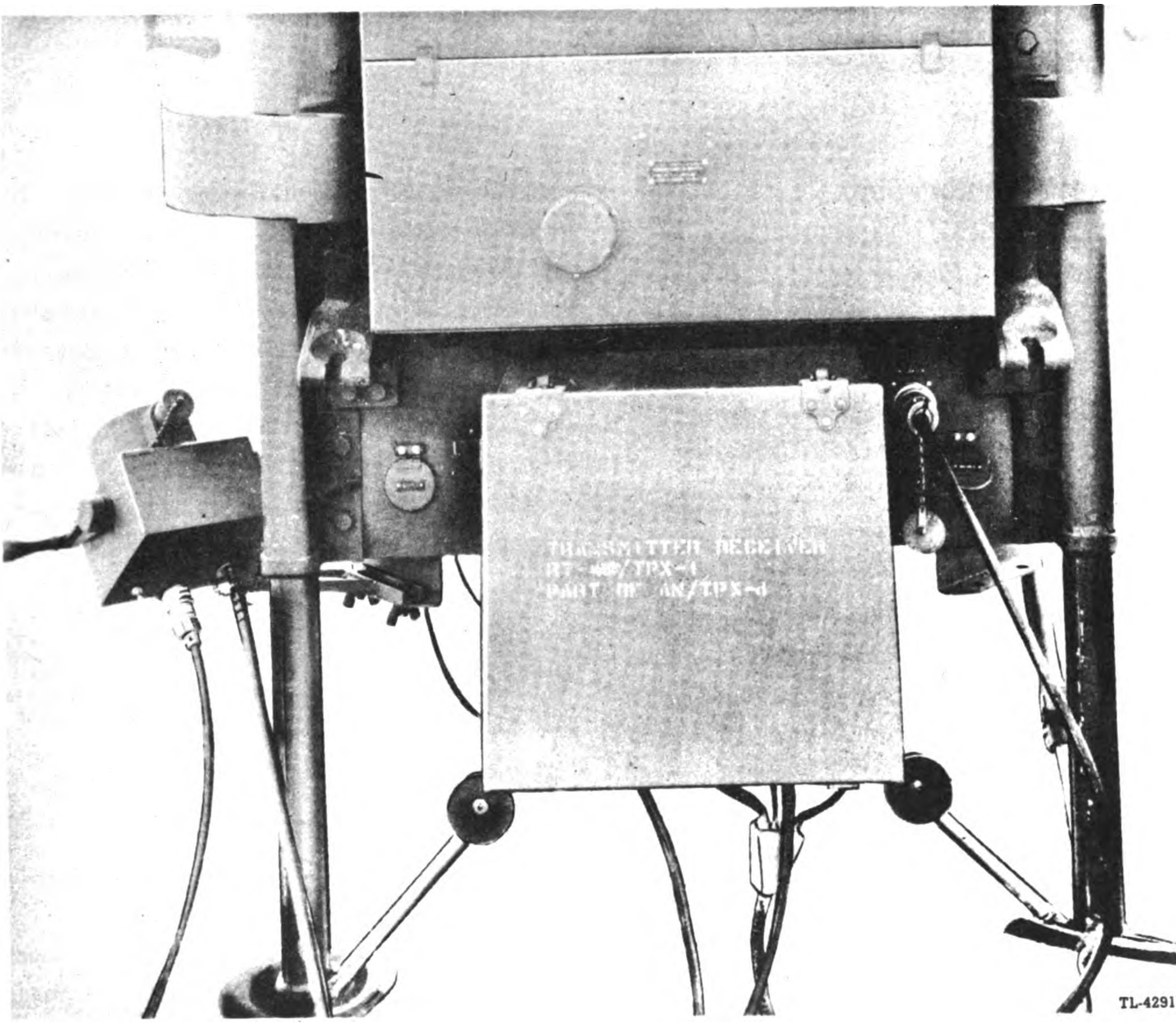


***Figure 22.** Transmitter-Receiver RT-48A/TPX-1 mounted on Radar Set AN/TPL-1, operating condition, rain cover off.*

Section II

TECHNICAL OPERATION

27. STARTING PROCEDURE

a. Turn on Radio Set AN/TPL-1 as described in TM 11-1352.

b. Throw the CHALLENGE switch to the OFF position.

c. Throw IFF switch on. *Wait at least 30 seconds* before throwing CHALLENGE switch ON.

28. OPERATING PROCEDURE

a. Search for aircraft. Follow the radar azimuth setting with the IFF antenna by turning the crank on the new remote antenna drive to obtain the same azimuth dial reading as that indicated on the radar azimuth indicator. When a target is found which requires identification, locate and hold the target on the A-scope. Turn ON the CHALLENGE switch and advance the IFF control to full gain or the highest gain at which noise does not exceed ¼ inch. If the aircraft is friendly, the IFF response will appear as a downward deflection starting at the range of the radar echo (fig. 3). As soon as identification is made, turn OFF the CHALLENGE switch.

Note.—Identification by IFF equipment depends upon the presence of the appropriate airborne equipment in the plane to be identified. Friendly planes in certain regions may not carry the airborne IFF equipment, and those which are properly equipped have the option of turning the equipment on or off. For these reasons do not judge the operating condition of the IFF equipment by the absence of identifying pulses from planes definitely known to be friendly.

b. The beamwidth of Antenna System AS-134/TPX is approximately 45° in the horizontal plane; therefore, friendly aircraft at the same approximate range as the radar target may display IFF responses near the radar target, despite the fact that they may be in slightly different directions. For this reason it is essential that the operator learn to recognize the exact appearance of a radar echo and an IFF response. The IFF response always appears to start at the range of the radar echo (fig. 3). Where many friendly aircraft are in operation, enemy aircraft may be identified as friendly unless care is taken to observe each response closely.

Note.—When Antenna System AS-96/TPX-1 is supplied instead of Antenna System AS-134/TPX, it is essential that the operator learn to associate an IFF response with its particular radar echo since the radiation pattern of Antenna System AS-96/TPX-1 is non-directional and the effect mentioned above is greatly increased.

c. Friendly aircraft can be identified by the following response characteristics:

(1) The responses are brief flashes (appearing on the A-scope for only about ¼ second).

(2) Responses appear once every 2½ seconds (approximately), except for *blanks* in the coding cycle, when approximately 5 seconds elapse between the responses preceding and following the *blank*.

(3) The coding sequence conforms to the plan specified by the person in charge.

Note.—Refer to table of codes in sub-paragraph 5f(3).

29. STOPPING PROCEDURE

To stop the IFF equipment, throw the IFF switch to off.

Chapter 4

ROUTINE EQUIPMENT PERFORMANCE CHECKS AND LOG

30. GENERAL

Chapter 5 of TM 11-1352, the technical operation manual for Radar Set AN/TPL-1, describes the Equipment Performance Log for Radio Set AN/TPL-1. These log sheets will also be used to record over-all performance of Radar Set AN/TPX-4. For all general information on the purpose, procedures, and use of the Equipment Performance Log, refer to section I, chapter 4 of TM 11-1352.

Note.—If Radar Set AN/TPX-4 is used with equipment other than Radio Set AN/TPL-1, refer to the technical operation manual of the alternate equipment for all general information on the purpose, procedures, and use of the Equipment Performance Log.

31. USE OF RADAR LOG SHEET FOR IFF OPERATION

The Equipment Performance Log sheets provided with Radar Set AN/TPL-1 have only one item which is applicable to the operation of the IFF equipment. Items 23, 29, and 30, however, are blank on the radar log sheet and may be used in conjunction with a supplementary form (par. 33) as an equipment performance log for Radar Set AN/TPX-4. The supplementary form will be prepared by the operating personnel.

32. IFF ITEM ON RADAR LOG SHEET

a. Item 9 on the radar log sheet requires that the 400-cycle line voltage be maintained at 115 ± 5 volts. This item is pertinent to the normal operation of the IFF equipment; the IFF test readings (par. 33) will have more meaning, however, if the 400-cycle a-c voltage is adjusted for 115 volts during the period when these readings are being taken.

b. In order to adapt the radar log sheet for use with the IFF equipment, enter the items indicated below in the blanks for items 23, 29, and 30. Entries should be made for these items three times daily. If the daily operating period is less than 3 hours, only two entries should be made.

23	*Range of Farthest Target*	[ ]	( )	(K Yd)	
29	*IFF Equipment*	[ ]	( )	(OK-N*)	
30	*IFF Test Readings*	[ ]	( )	(OK-N*)	

ITEM 23, RANGE OF FARTHEST IFF TARGET

Sample Entry.

23	*Range of Farthest IFF Target*	[ ]	( )	(K Yd)	12	45	*

Log Entry. Enter in the log space the range in thousands of yards of the farthest IFF target detected since the last set of entries was made. If no entry can be made, enter an asterisk (*) in the log space and explain under NOTES.

ITEM 29, IFF EQUIPMENT

Sample Entry.

29	*IFF Equipment*	[ ]	( )	(OK-N*)	OK	OK	N*

Log Entry. Enter OK if the IFF equipment is operating normally; enter N* if it is not. The IFF equipment is operating normally if the following conditions exist:

a. With the IFF GAIN control fully on and the radar range switch on 30,000 yards, the IFF main pulse gives a 1-inch deflection on the A-scope, and the ground echoes are normal.

b. The transmitter is properly tuned.

c. An IFF response is obtained from friendly planes within the range of the radar set.

Corrective Measures.

a. If the IFF main pulse does not produce a 1-inch deflection on the A-scope for the test setting, adjust the PEAK VIDEO control (par. 26**a**) for proper deflection.

b. If the transmitter is not properly tuned, adjust the TRANSMITTER FREQUENCY DIAL for maximum response (par. 26**b**).

c. Adjust the IFF GAIN control to bring in IFF responses.

Note.—No routine method is provided for absolute measurement of receiver gain; the operator's judgment is relied on to detect progressive loss of gain. Unless a great deal of man-made noise is present, a normal receiver will produce about ⅛ inch of noise (grass) on the A-scope with the IFF GAIN control fully on. A normal receiver has sufficient gain to identify any friendly target which can be seen on the A-scope. If distant friendly targets can be detected but not identified, make note in the Work-To-Be-Done book to trouble shoot the equipment at the next shutdown period.

ITEM 30, IFF TEST READINGS

Sample Entry.

30	*IFF Test Readings*	[ ]	( )	(OK-N*)	OK	OK	N*

Log Entry. Enter OK if the IFF test readings are normal as determined by entries in the supplementary log (par. 33); enter N* if any are not.

33. SUPPLEMENTARY IFF LOG

The sample entries below show the suggested form for the home-made supplementary IFF log sheet to be made up by the operating personnel. These entries are to be made three times daily, just prior to making the entry for item 30 on the radar log.

Sample Entries.

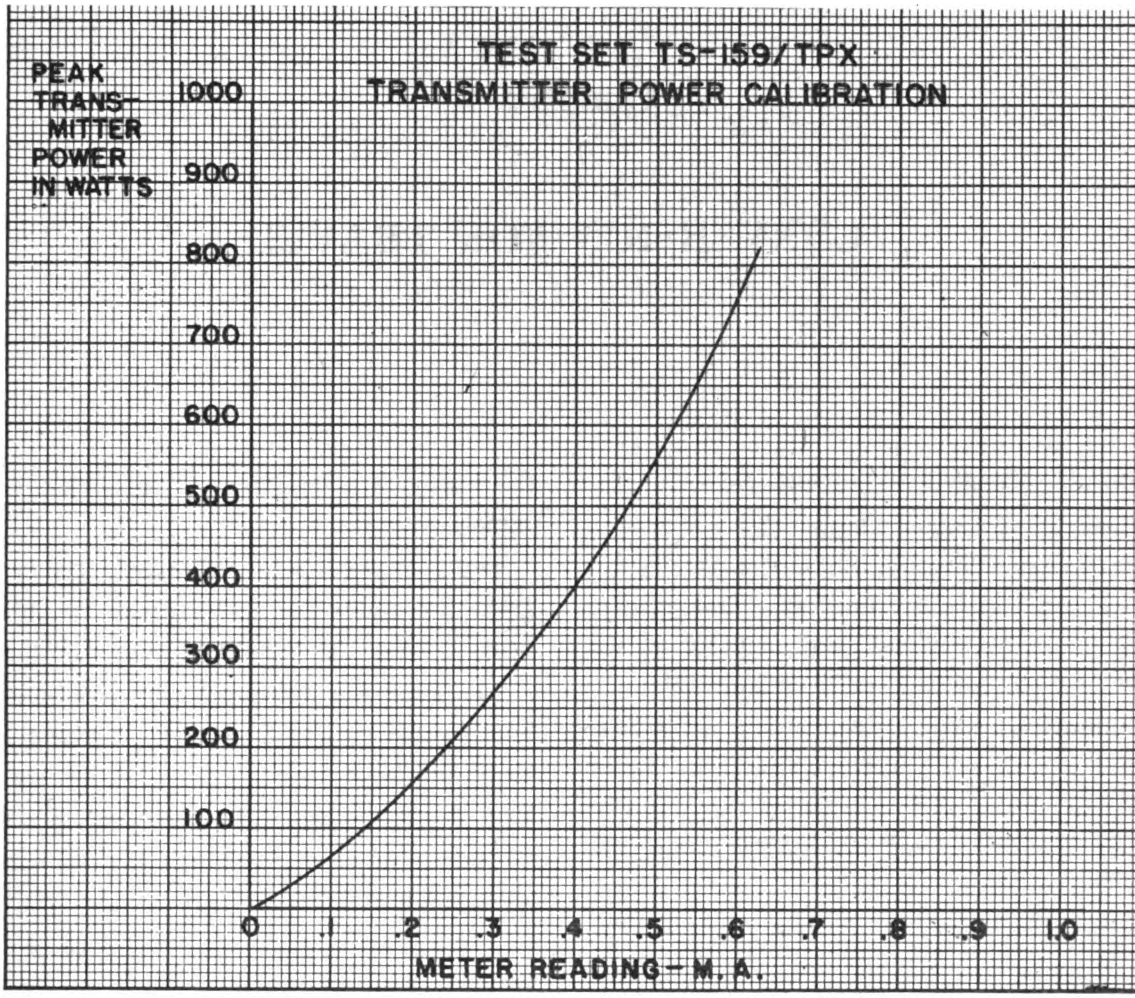
30*a*	IFF Peak Power	[400-1,000]	( )	(Watts)	475	490	325*
30*b*	IFF OSC. CURR.-CHALLENGE OFF	[0-0]	(0)	(Ma)	0	0	0.1*
30*c*	IFF OSC. CURR.-CHALLENGE ON	[0.5]	(0)	(Ma)	0.5	0.5	0.3*
30*d*	IFF OSC. VOLT.-CHALLENGE OFF	[0.7]	( )	(Ma)	0.7	0.7	0.5*
30*e*	IFF OSC. VOLT.-CHALLENGE ON	[0.55]	( )	(Ma)	0.55	0.55	0.35*
30*f*	IFF MOD. CURR.-CHALLENGE OFF	[0.42]	( )	(Ma)	0.42	0.42	0.2*
30*g*	IFF MOD. CURR.-CHALLENGE ON	[0.4]	( )	(Ma)	0.4	0.4	0.18*
30*h*	IFF MOD. VOLT.-CHALLENGE OFF	[0.45]	( )	(Ma)	0.45	0.45	0.22*
30*i*	IFF MOD. VOLT.-CHALLENGE ON	[0.7]	( )	(Ma)	0.7	0.7	0.53*

ITEM 30*a*, IFF PEAK POWER

Log Entry. Enter the peak-power output (in watts) in the log space. Place an asterisk (*) after the reading entered if the power is not normal. The power output may vary with different frequencies but usually will be between 400 and 700 watts. After the equipment is once tuned to a specific frequency and the power output recorded, later readings should not vary greatly from the original reading. The lower tolerance limit of 400 watts is only a typical limit. The terrain near a particular installation may make this figure either too high or too low. The person in charge of the installation should decide what the exact lower limit is. The lower limit of peak-power output is the power which enables the operator to identify a friendly aircraft detected by the radar set. As the 2C26 tube ages, power output declines, but as long as the output is sufficient to identify aircraft in the radar range, is it unnecessary to change tubes or engage in other trouble shooting. The information to be entered in the log for item 30*a* is obtained as follows: With power connected to the test set, place the CHALLENGE switch in the OFF position and snap on the IFF switch on the rear panel of the radar set. Throw the LINE SWITCH on the test set to ON. Remove the transmitter power attenuator from the TRANSMITTER ANTENNA receptacle on the transmitter-receiver and connect one end of Cord CG-109/TPX-1 to this receptacle. Connect the other end of Cord CG-109/TPX-1 to the TRANSMITTER DUMMY LOAD receptacle on Test Set TS-159/TPX and set the METER SWITCH on the test set to TRANS. POWER. Turn the CHALLENGE switch to the ON position and read the milliammeter on the test set. Jot down the reading on a note pad, return the CHALLENGE switch to OFF, and connect the attenuator to the TRANSMITTER ANTENNA receptacle on the transmitter receiver. Perform the above steps as quickly as possible, since the IFF equipment is off the air as long as the attenuator is disconnected. Use the chart (fig. 23) to convert the milliammeter reading to watts output. For example, if the reading was 0.48 ma, look up along the vertical line corresponding to 0.48 ma; this line intersects the heavy curved line at the horizontal line corresponding to 525 watts. Therefore the peak-power output is 525 watts.

ITEMS 30*b* THROUGH 30*i*, IFF METER READINGS

Log Entry. Enter the meter readings in the log space provided for each reading. Place an asterisk after the reading if it is not normal. Except for item 30*b*, no optimum values are given in the parentheses of the above table, and only a fairly typical value is given in the brackets. Equipment which is operating satisfactorily may give readings different from values shown in the brackets. Since the exact values of readings differ with different frequencies, different power units, etc., it is suggested that person in charge fill in parentheses from readings taken with a satisfactorily operating



TL-49898

Figure 23. Radar Set AN/TPX-4, peak-power conversion chart.

equipment at the frequency assigned. A record showing that the readings are declining is useful for trouble shooting, because a steady decline of a particular reading points to deterioration of some circuit component. Do not decide that the equipment requires trouble shooting on the basis of these meter readings. The equipment requires trouble shooting only when it does not produce sufficient output to cover the 60,000 yard range (low power output), or when the receiver does not present responses from the entire 60,000-yard range with power output known to be high. The information to be entered in the log for items 30*b* through *i* is obtained as follows: Connect Cord CG-76/TPX-1 from the METERING receptacle on the transmitter-receiver to the TRANSCEIVER METERING receptacle on Test Set TS-159/TPX.

Note.—Cord CG-76/TPX-1 completes a circuit only when the test set METER SWITCH is in the TRANSCEIVER METERING position. If this switch is placed in some other position, there is no need to disconnect the cord between tests.

Throw the LINE SWITCH on the test set to ON. Turn the METER SWITCH on the test set to the TRANSCEIVER METERING position. Readings of OSC. CURR., OSC. VOLT., MOD. CURR., and MOD. VOLT. can then be made on the test set meter by selecting these positions on the METERING SWITCH of the IFF transmitter-receiver. Two readings should be made in each position of the METERING SWITCH, one with the CHALLENGE switch in the OFF (standby) position (items 30*b*, *d*, *f*, and *h* in the supplementary log), and the other with the CHALLENGE switch in the ON (operate) position (items 30*c*, *e*, *g*, and *i* in the supplementary log).

Chapter 5

CONVERSION FOR TRAVEL

34. DISASSEMBLING AND PACKING

a. General. Whenever Radar Set AN/TPL-1 is moved to a new location, Radar Set AN/TPX-4 should be prepared for transport. This chapter describes the disassembly and packing of the various components of the IFF equipment.

b. Removing Power. Disconnect Cord CX-304/TPX-3 from the IFF receptacle of the radar equipment. After this is done, all other operations can be performed in any sequence or simultaneously.

c. Dismantling Antenna System AS-134/TPX.

(1) Remove Cord CG-100/U (50 ft. 0 in.) and the flexible drive cable, Cord MX-363/TPX, from their connections on the antenna mast.

(2) Disconnect the guy cables from the anchors and loosen the wingnut at the base of the tower. Gently lower the tower until it is supported on a chest or box.

(3) Disconnect Cord CG-282/TPX from the matching section and remove the antenna assembly from the tower.

(4) Disassemble the antenna assembly.

(5) Disassemble the mast and remove the bottom section from the base.

(6) Remove the anchors from the ground by unscrewing and pull out the stakes in the tower base.

(7) Disconnect Cord CX-596/TPX and the flexible drive cable, Cord MX-363/TPX, from the remote antenna drive.

(8) Remove Remote Antenna Drive RM-55 from the radar set and remove the mounting bracket from the remote antenna drive.

(9) Pack the disassembled parts of Antenna System AS-134/TPX in their original transit cases and bags.

d. Disconnecting and Packing Cords. Remove all remaining cords, including the test cords, and pack in Chest CY-215/U.

e. Packing Transmitter - Receiver RT - 48A/TPX-1. Unhook the transmitter-receiver from the hanging bracket on Radar Set AN/TPL-1 and unscrew the mounting brackets. Pack the mounting brackets in Chest CY-215/U. Fold the rain cover and place it against the transmitter-receiver panel. Then fasten the cover to the transmitter-receiver. The transmitter-receiver is then ready for transit with no futher packing.

f. Test Set TS-159/TPX, Tools, and Log Book. Unscrew the test set antenna from its receptacle in the top of the test set and screw it under the clips after snapping the tuning chart down (fig. 11). Pack the test set in Chest CY-154/TPX-1 (fig. 5). Roll the tools in their cloth container (fig. 10) and pack in Chest CY-154/TPX-1 (fig. 5). Wrap Headset HS-30 in paper to protect it from damage and pack it and the log book in the same chest (fig. 5).

PART TWO

PREVENTIVE MAINTENANCE

Chapter 1

ROUTINE PREVENTIVE MAINTENANCE

35. GENERAL

a. Radar Set AN/TPX-4 is an accessory to Radar Set AN/TPL-1 and has only one major component, the transmitter-receiver. In performing preventive maintenance on the equipment, Radar Set AN/TPX-4 is treated as a component of Radar Set AN/TPL-1. This part of the manual supplements TM 11-1452, the preventive maintenance manual for Radar Set AN/TPL-1.

b. Consult chapter 1 of TM 11-1452 for the following information:

(1) Purposes, scope, and significance of preventive maintenance.

(2) Meaning of the feel (F), inspect (I), tighten (T), clean (C), adjust (A), and lubricate (L) operations.

c. Consult chapter 2 of TM 11-1452 for information on tool equipment and for descriptions of preventive maintenance techniques.

d. The following paragraphs in this chapter schedule the performance of specific items of preventive maintenance for Radar Set AN/TPX-4 and describe procedure for performing items.

36. PREVENTIVE MAINTENANCE SCHEDULE FOR RADAR SET AN/TPX-4

The following schedule tells *when* and *what* work is to be done; paragraph 38 tells *how* to do it. The schedule is based on the assumption that equipment is in operation 12 hours a day under average conditions. The person in charge should, at his discretion, schedule more frequent operations in dusty or jungle locations, or reduce frequency of operation as experience indicates.

PREVENTIVE MAINTENANCE SCHEDULE FOR RADAR SET AN/TPX-4

1	2	3	4	5
Item No.	Operation	Description of item	Echelon	Frequency of maintenance
1	IC	Exterior of all components and cords	1st	Daily
2	CL	Air filter in transmitter	2d	Weekly
3		Interchange transmitter-receiver	2d	Semimonthly
4	IC	Cord connectors	2d	Semimonthly
5	I	Interlock switch in transmitter	2d	Semimonthly
6	IC	Tubes and tube sockets in transmitter	2d	Semimonthly
7	IC	Top (tube side) of transmitter chassis	2d	Semimonthly
8	IC	Bottom (wiring side) of transmitter chassis	2d	Semimonthly
9	IC	Octal tubes and sockets in receiver	2d	Semimonthly
10	IC	Top (tube side) of receiver chassis	2d	Semimonthly
11	IC	Bottom (wiring side) of receiver chassis	2d	Semimonthly
12	IC	Front panel of transmitter-receiver	2d	Semimonthly
13	IC	Transmitter-receiver case	2d	Semimonthly
14	IC	Octal tubes and sockets in test set	2d	Monthly
15	FIC	Top (tube side) of test set chassis	2d	Monthly
16	IC	Bottom (wiring side) of test set chassis	2d	Monthly
17	ICA	Front panel of test set	2d	Monthly
18	ITC	Antenna system	2d	Semiannually
19	CL	Control-shaft bearings and potentiometers	2d	Quarterly

37. LUBRICATION CHARTS.

The two charts shown below list all the lubrication data necessary for the routine lubrication of Radar Set AN/TPX-4. The first chart lists the types of lubricant used and gives the approved symbol and specification number of each lubricant. The second chart is a summary of the lubrication information given in paragraph 38. The numbers in the *Item No.* column refer to the items in paragraph 38; the symbols in the *Lubricant* column are those listed in the first chart.

LUBRICANTS USED

Approved symbol	Standard nomenclature	Specification No.
OE	Oil, Engine	U. S. Army 2-104B
SD	Solvent, Dry Cleaning	Federal P-S-661a
PS	Oil, Lubricating, Preservative, Special	U. S. Army 2-120
GL	Grease, Lubricating, Special	Ord. Dept. AXS-637

LUBRICATION CHART

Item No.	Part description	Lubricant	Method and quantity	Frequency of lubrication
2	Air filter	OE	Oil lightly	Weekly
18	Control shaft bearings	PS	Apply a few drops to each bearing	Quarterly
18	Potentiometer	GL	Apply a thin coat to inside of each potentiometer	Quarterly
19	Antenna worm gear	GL	Apply two shots from grease gun to the Zerk fitting.	Semi-annually
19	Antenna guy cable bearing	GL	Apply to Zerk fitting with grease gun until grease extrudes from relief plug hole.	Semi-annually

38. PREVENTIVE MAINTENANCE ITEM INSTRUCTIONS

a. Preparing for Maintenance Work. In getting ready for maintenance activities, collect all the tools and materials that will be needed. Make the preparation as complete as possible. If the maintenance period for the IFF equipment is made to coincide with that for the radar equipment, no special layout of tools or materials will be necessary. The layout for radar maintenance is more than adequate for the IFF equipment.

b. Interchanging the Transmitter-Receiver.

(1) A spare transmitter-receiver is furnished with Radar Set AN/TPX-4. To avoid needless interruption of operation, the semimonthly maintenance items can be performed on the spare unit at the most convenient time, and the units interchanged twice a month. Thus, each unit will operate for half a month and will be idle for half a month, and each unit will have semimonthly maintenance performed on it once each month.

(2) Some of the cord connectors must be detached during the interchange of transmitter-receivers. The interchange, therefore, provides a convenient occasion to perform preventive maintenance on these cord connectors.

Note.—When disconnecting the cords before interchanging transmitter-receiver units, *always remove CORD CX-304-TPX-3 first*. This is the cord to the IFF receptacle on the radar.

c. Items.

(1) ITEM 1, EXTERIOR OF ALL COMPONENTS AND CORDS.

(*a*) *Preparatory Steps.* No preparatory steps are required. This item can be performed while the equipment is in operation. Do not disconnect cords.

(*b*) *Maintenance Procedure.*

I. INSPECT:

1. The exterior of the transmitter-receiver and test set for dirt, rust, fungus, and dents in the cases.

2. The cord connectors for looseness of mounting and connection. Tighten if necessary. Do not use a wrench on connector couplings. *Use only the fingers when tightening cable connectors.*

3. The cords for worn, frayed, cracked, or broken insulation.

4. The cords for dirt, oil, grease, and fungus.

5. The cords for poor support and kinks.

6. The antenna mast assembly. Make sure the guy anchors have not loosened in the ground and that the assembly is firmly fixed in position.

C. CLEAN:

1. The exterior of all components and cords. Scrape off all rust and fungus. Clean the glass face of the test set milliammeter. Clean the test set antenna.

2. Clean and paint all spots from which rust was scraped.

(2) ITEM 2, AIR FILTER IN TRANSMITTER.

(*a*) *Preparatory Steps.* Remove the screws holding the air filter frame to the panel of the transmitter and remove the filter.

(*b*) *Maintenance Procedure.*

CL. CLEAN the filter with dry-cleaning solvent (SD). The gasoline and oil used with Power Unit PU are satisfactory. Blow out excess oil by holding the filter in the air blast from power unit. Wipe the frame, and replace the filter.

L. LUBRICATE the filter lightly with engine oil (OE). Blow out excess oil by holding filter in air blast from Power Unit PU-35/U.

(3) ITEM 3, INTERCHANGE TRANSMITTER-RECEIVER

(*a*) *Preparatory Steps.* Remove Cord CX-304/TPX-3/IFF from the receptacle on the radar set; then remove all other cords from the transmitter-receiver.

(*b*) *Maintenance Procedure (Fig. 17).*

1. Unhook the transmitter-receiver from the hanging bracket on the radar set.

2. Unscrew the mounting brackets.

3. Set aside the transmitter-receiver which was taken out of service.

4. Screw the mounting brackets on the transmitter-receiver which is going into service, and hang it on radar equipment bracket.

(4) ITEM 4, CORD CONNECTORS.

(*a*) *Preparatory Steps.* Remove all cord connectors from their receptacles.

(*b*) *Maintenance Procedure (Fig. 18).*

I. INSPECT:

1. The connector bodies and pins.
2. For rust, fungus, and moisture. Check for loose assembly of connector bodies. Tighten where necessary.

C. CLEAN all parts of the connectors. Use crocus cloth or fine sandpaper if necessary; then wipe all parts thoroughly.

Note.—After completion of Item 5, reconnect all cords (par. 20, figs. 18 and 19) and put the IFF equipment back into service.

(5) ITEM 5, INTERLOCK SWITCH IN TRANSMITTER.

(*a*) *Preparatory Steps.* It is assumed that the transmitter-receiver unit being worked on is the unit that has been taken out of service; the cords have been disconnected and the unit has been re-

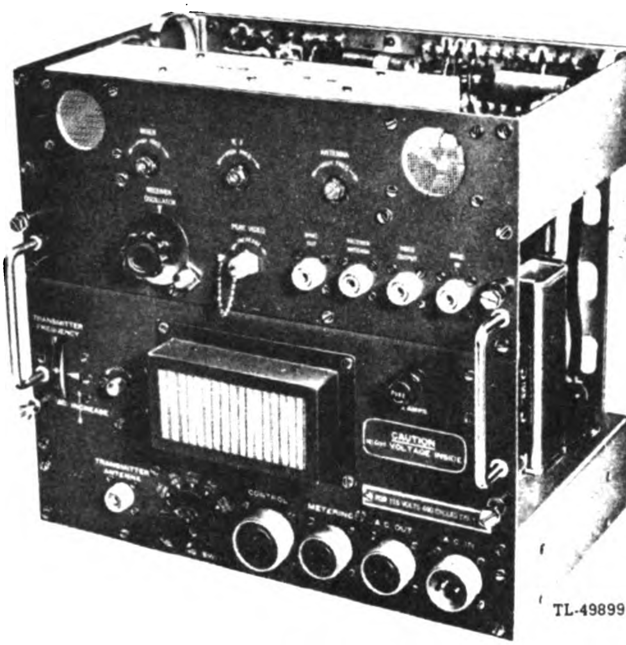


Figure 24. Transmitter-Receiver RT-48A/TPX-1, front view, case removed.

moved from the hanging bracket on the radar set as described under item 3 above. To remove the chassis from the case (fig. 24), loosen the four bright nickel-plated, slotted, 3/8-inch, hex-head captive screws located just above and below the handles. Use the 3/8-inch hex Spintite socket wrench provided in the tool equipment. Pull the chassis unit out of the case by pulling straight out on the handles.

Note.—Never separate the two chassis for preventive maintenance work.

(*b*) *Maintenance Procedure (Fig. 74).*

I. INSPECT:

1. The interlock switch 265 to be sure it clicks open upon removal of chassis from the case. This should always be checked immediately after removing the chassis from the case. Even though the power cord has been removed in this particular procedure, the habit of making this check will carry over to an occasion when this cord has not been removed.

2. The interlock switch to make sure that a click is heard when depressing the actuating spring and that another click is heard when the spring is released.

(6) ITEM 6, TUBES AND TUBE SOCKETS IN TRANSMITTER.

(*a*) *Preparatory Steps.* Remove transmitter-receiver chassis from case. Perform items 6 through 13 consecutively during one maintenance period.

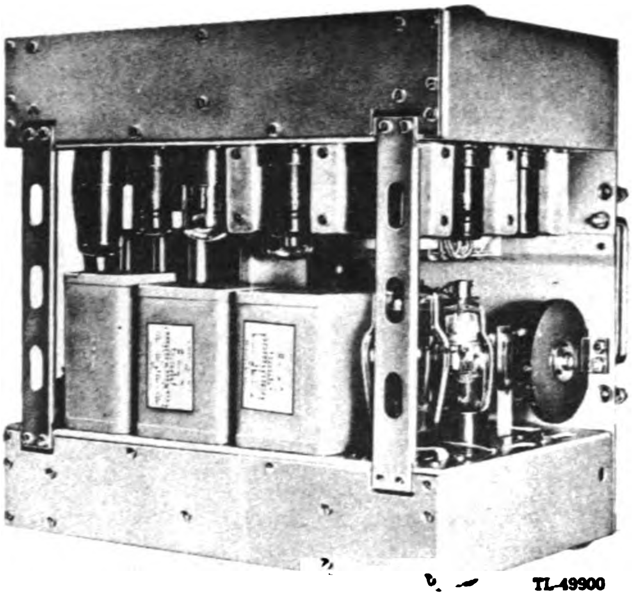


Figure 25. Transmitter-Receiver RT-48A/TPX-1, rear view, case removed.

(*b*) *Safety Precautions.* Although the equipment being worked on is presumed to have been disconnected for some time, personnel should form the habit of discharging capacitors before proceeding with other work. Turn the chassis over so that the bottom (wiring side) of the transmitter chassis is accessible. With a safety shorting bar, discharge capacitor 249 (fig. 73) by shorting across its two terminals. Then repeat this procedure for capacitors 247-1, 247-2, and 248 (fig. 73).

(*c*) *Removing Tubes* (*Fig. 74*). Remove the four tubes from the transmitter chassis. The 6SN7GT tube requires no special method. The 5U4G and the 2X2 tubes are held in place by spring washer clamps. To remove these tubes, press the spring washer clamp down against the chassis with one hand, and rock and pull upward with the other hand. An alternate method is to push down the clamp and hold the tube base with one hand, then push the tube out of the socket by pushing on the octal locating pin from the bottom of the socket with the 3, 16-inch Spintite wrench wrench in the tool equipment. (To replace these tubes, push the tube clamp down to the chassis and insert the tube.) After the 2X2 tube has been removed, remove the grid and plate caps of the 2C26 tube by pinching the small wings together. This spreads the caps so that they may be lifted off (or replaced). Hold the tube with one hand and push on the locating pin from the bottom of the socket with the 3/16-inch socket wrench.

(*d*) *Maintenance Procedure.*

C. CLEAN envelopes, base pins, and tube sockets with crocus cloth or fine sandpaper, for dirt, corrosion, and poor contacts. Take special care to insure that the top of the 2C26 tube (between the plate and grid caps), and the base of the 2X2 tube, and the 2X2 tube socket are clean and free from deposits which might create a high-voltage leakage path. Use dry-cleaning solvent to remove any oily deposit.

A. ADJUST the tension of any socket contact spring not making good connection.

Note.—Do not replace tubes after completion of item 6. Perform the maintenance required in the seven following items (7 through 13) before replacing tubes.

(7) ITEM 7, TOP (TUBE SIDE) OF TRANSMITTER CHASSIS.

(*a*) *Preparatory Steps and Safety Precautions.* See item 7 (*a*) and (*b*) above.

(*b*) *Maintenance Procedure* (*Fig. 74*).

I INSPECT:

1. The transformers 270 and 271, choke 280, and blower motor 268 for signs of overheating.

2. The oil-filled capacitors 247-1, 247-2, 249, 248 and 242 for leakage. (Capacitor 242 is under the blower motor).

3. The three tube caps and leads for dirt and improper soldering. Look for cracked or broken insulation on the lead wires and for corrosion and looseness of the connection to the cap.

4. The mounting of all parts for looseness; the blower motor may have vibrated parts loose. Tighten where necessary.

5. All connections for dirt, improper soldering, and looseness.

6. The Jones plug contacts for dirt. Clean if necessary.

C. CLEAN:

1. The entire top of the transmitter chassis.

2. The variable air capacitor with a small long-haired brush, removing all dust and lint. If dry compressed air is available, blow out dust and lint between plates.

3. Capacitor 246 carefully, and all the parts near it. More than 2,000 volts appear across this capacitor during operation. Remove any greasy film with a dry rag to avoid the possibility of a high-voltage leakage path developing through accumulated dust and the moisture which dust absorbs. Dry all parts carefully.

(8) ITEM 8, BOTTOM (WIRING SIDE) OF TRANSMITTER CHASSIS.

(*a*) *Preparatory Steps and Safety Precautions.* See item 6 (*a*) and (*b*) above.

(*b*) *Maintenance Procedure* (*Fig. 73*).

I. INSPECT:

1. The mounting of all parts for looseness (the blower motor may have vibrated parts loose); tighten where necessary.

2. All connections for dirt, corrosion, improper soldering, and looseness.

3. The oil-filled capacitors 247-1, 247-2, 249, 248, and 242 for leakage.

4. The bodies of all resistors and capacitors for discoloration indicating overheating.

5. The action of the METERING SWITCH. Make sure that it is operating properly.

6. Variable air capacitor 243 for looseness of rotor.

Note.—Capacitor 243 is adjusted at the factory. If the rotor becomes loose tighten the end bearing. If it is known that the rotor has moved, reset it for minimum capacity (rotor plates all the way out). Try not to disturb the setting and do not reset it unless it is known definitely that the rotor has moved. The factory adjustment is not necessarily minimum capacity, but in the absence of the specialized factory test equipment, minimum capacity is safest compromise setting which field maintenance personnel can make.

C. CLEAN:

1. The entire bottom of transmitter chassis.

2. Capacitor 243 with a small long-haired brush, removing all dust and lint. If dry compressed air is available, blow out the dust and lint between the plates.

3. The cylindrical porcelain stand-off insulator (near capacitor 243, fig. 73) which positions the bent flat metal strip (transmitter-oscillator inductance). Remove any greasy film with dry-cleaning solvent to avoid the possibility of an r-f leakage path developing through accumulated dust and moisture. Dry all parts carefully.

(9) ITEM 9, OCTAL TUBES AND SOCKETS IN RECEIVER.

(*a*) *Preparatory Steps and Safety Precautions.* See item 6 (*a*) and (*b*) above.

(*b*) *Removing Tubes* (*Fig. 64*). Remove the nine octal-base tubes from the receiver chassis. These are six 6AC7 metal tubes, one 6V6GT/G tube, one 6H6GT/G tube, and one 6SL7GT tube. Special methods for removing the tubes are unnecessary.

Note.—Mark the location of each 6AC7 tube so that each tube can be replaced in the socket from which it was removed. Otherwise it may be necessary to realign receiver.

(*c*) *Maintenance Procedure.*

I. INSPECT envelopes, base pins, and tube sockets for dirt, corrosion, and poor contacts.

C. CLEAN envelopes, base pins, and tubs sockets with crocus cloth or fine sandpaper.

A. ADJUST tension of any socket contact spring not making good connection.

Note.—Do not replace tubes after completion of *Item* 9. Perform the maintenance required in the four following items (10 through 14) before replacing tubes.

(10) ITEM 10, TOP (TUBE SIDE) OF RECEIVER CHASSIS

(*a*) *Preparatory Steps and Safety Precautions.* See item 6 (*a*) and (*b*) above. Do not attempt to remove the cover over the high-frequency oscillator section (behind the 955 tube).

(*b*) *Maintenance Procedure* (*Fig. 64*).

I. INSPECT:

1. Transformer 170 for evidence of excessive heating.

2. The oil-filled capacitors (142 and 146) for leakage.

3. The mounting of all parts for looseness; tighten where necessary.

4. All connections for dirt, improper soldering, and looseness.

C. CLEAN:

1. The entire top of the receiver chassis.

2. The wiring side of the front panel receptacles. Moisture accumulates in dust and causes r-f leakage paths.

3. All around the 955 tube and socket (do not remove tube unless absolutely necessary).

(11) ITEM 11, BOTTOM (WIRING SIDE) OF RECEIVER CHASSIS

(*a*) *Preparatory Steps and Safety Precautions.* See item 6 (*a*) and (*b*) above. Remove the six screws which fasten the cover over the r-f stages and remove this cover.

Note.—Do not remove the three 956 tubes in the r-f section unless absolutely necessary.

(*b*) *Maintenance Procedure* (*Figs. 60 and 63*).

I. INSPECT:

1. The mounting of all parts for looseness; tighten where necessary.

2. All connections for dirt, corrosion, improper soldering, and looseness.

3. The oil-filled capacitors 142 and 146 for leakage (fig. 60).

4. The bodies of all resistors and capacitors for discoloration indicating overheating.

5. The action of the three adjustable tuning slugs. Tighten or loosen the antibacklash nut (fig. 63-F) as required. *Do not disturb the setting of the tuning slugs.*

C. CLEAN the entire bottom of the receiver chassis.

(12) ITEM 12, FRONT PANEL OF TRANSMITTER-RECEIVER

(*a*) *Preparatory Steps and Safety Precautions.* See item 7 (*a*) and (*b*) above.

(*b*) *Maintenance Procedure (Fig. 6).*

I. INSPECT:

1. The condition of all controls and receptacles on the front panel. Do not disturb the adjustments. Tighten setscrews when necessary. Tighten connector receptacles to the panel where necessary.
2. The action of the locking devices for the RECEIVER OSCILLATOR and TRANSMITTER FREQUENCY adjustments.
3. The panel for loose mounting screws; tighten where necessary.
4. The fuse for corrosion at the contacts.

C. CLEAN:

1. The entire panel and everything on it. All parts of all connector receptacles must be clean and bright.
2. Rust spots from handles and wipe them with an oily rag.

(13) ITEM 13, TRANSMITTER-RECEIVER CASE

(*a*) *Preparatory Steps.* The chassis is presumed to be removed from the case.

(*b*) *Maintenance Procedure.*

I. INSPECT:

1. The inside of the case for cracks or looseness of assembly.
2. The rubber gasketing.

C. CLEAN:

1. The inside of the case.
2. The outside of the case.

Note.—After completion of item 13, replace the cover over the r-f section, replace all tubes, taking care to put each 6AC7 tube in the socket from which it was removed, and fasten the chassis in the case.

(14) ITEM 14, OCTAL TUBES AND SOCKETS IN TEST SET

(*a*) *Preparatory Steps.* Remove the cords. Remove the antenna. Remove the six screws around the edge of the front panel. Remove the two elastic stopnuts and lockwashers from the back of case. Carefully withdraw unit from case.

(*b*) *Safety Precautions* (*Fig. 84*). Tip the chassis on its side to expose the bottom (wiring side). With the safety shorting bar, discharge capacitor 544-1 by shorting across its two terminals; then repeat this procedure for capacitors 544-2 and 544-3.

(*c*) *Removing Tubes* (*Fig. 85*). Remove the five octal-base tubes from the test set chassis. These are three 6SL7GT tubes, one 6X5GT/G tube, and one VR150-30 tube. No special methods for removing the tubes are necessary.

Note.—Mark the location of each 6SL7GT tube so that each can be replaced in the socket from which it was removed. Otherwise it will be necessary to realign the test set. Do not remove the 9006 tube or the 955 tube unless absolutely necessary.

(*d*) *Maintenance Procedure.*

I. INSPECT envelopes, base pins, and tube sockets for dirt, corrosion, and poor contacts.

C. CLEAN envelopes, base pins, and tube sockets with crocus cloth or fine sandpaper.

A. ADJUST tension of any socket contact spring not making good connection.

Note.—Do not replace tubes after completion of item 14. Perform the maintenance required in the three following items (15 through 17) before replacing tubes.

(15) ITEM 15, TOP (TUBE SIDE) OF TEST SET CHASSIS

(*a*) *Preparatory Steps and Safety Precautions.* See under item 14 above. Remove shield over the oscillating detector circuit by removing six screws from top and six screws from back plate.

(*b*) *Maintenance Procedure* (*Fig. 85*).

I. INSPECT:

1. Transformer 570 for evidence of excessive heating.
2. The oil-filled capacitors 543, 544-1, 544-2, and 544-3 for leakage.
3. The mounting of all parts for looseness; tighten where necessary.
4. All connections for dirt, corrosion, improper soldering, and looseness. Check the meter binding-post nuts.
5. The crystal-holder contacts. Remove the crystal holder and examine the contact prongs. They should be clean and bright. Replace the crystal holder.
6. The action of the METER SWITCH. Make sure that it is operating properly.
7. The air tuning capacitor 545 for smooth firm action. See that the rotor and stator plates do not touch.

C. CLEAN:

1. The entire top of test set chassis. Be careful not to disturb setting of capacitor 546. Do not turn slotted bakelite hub above it.

2. The variable air capacitor with a small long-haired brush, removing all dust and lint. If dry compressed air is available, blow out dust and lint between plates.

3. The socket of the 955 tube and all the parts in the oscillating detector section to avoid the possibility of an r-f leakage path through accumulated dust and moisture.

(16) ITEM 16, BOTTOM (WIRING SIDE) OF TEST SET CHASSIS

(*a*) *Preparatory Steps and Safety Precautions.* See item 15 (*a*) and (*b*) above. Remove the shield from the 9006 tube by pressing toward the panel and twisting slightly. The shield is held on in a manner similar to the way a bayonet-base pilot bulb is held in its socket.

(*b*) *Maintenance Procedure* (*Fig. 84*).

I. INSPECT:

1. The mounting of all parts for looseness; tighten where necessary.

2. All connections for dirt, corrosion, improper soldering, and looseness.

3. The oil-filled capacitors 544-1, 544-2 and 544-3 for leakage (fig. 84).

4. The bodies of all resistors and capacitors for discoloration indicating overheating.

5. Variable air capacitors 548-1 and 548-2 for looseness of rotor.

Note.—These capacitors are adjusted at the factory. Do not disturb the settings. If the rotors are accidentally moved, the test set will have to be realigned as described in part three of this manual.

6. The action of controls 504 and 507. The action should be free and smooth.

C. CLEAN:

1. The entire bottom of the test set chassis.

2. Capacitors 548-1 and 548-2 with a long-haired brush, removing all dust and lint. If dry compressed air is available, blow out the dust and lint between the plates.

3. Around the 9006 tube, without removing the tube, if possible.

4. The inside of the 9006 tube shield.

(17) ITEM 17, FRONT PANEL OF TEST SET

(*a*) *Preparatory Steps and Safety Precautions.* See item 14 (*a*) and (*b*) above.

Note.—Do not disassemble the vernier dial or remove it from the panel. Otherwise the entire calibration will have to be done over.

(*b*) *Maintenance Procedure* (*Fig. 12*).

I. INSPECT:

1. The condition of all controls and receptacles on the front panel. Tighten setscrews when necessary. Tighten connector receptacles to the panel when necessary.

2. The panel for loose mounting screws. Tighten cap where necesssary.

3. The fuses for corrosion at the contacts.

C. CLEAN:

1. The glass face of the meter.

2. The dial. Remove all rust spots. Polish the rotating dial scale and the vernier scale so that the engravings are clearly visible. Wipe with oily rag.

3. The entire front panel and everything on it. All parts of connector receptacles must be clean and bright. Remove rust spots from handles and wipe them with an oily rag.

A. ADJUST the meter pointer to zero.

Note.—After completion of item 17, replace cover over the 9006 tube. Replace cover over the oscillating detector section. Replace all tubes, taking care to put each 6SL7GT tube in the socket from which it was removed. Clean inside of case and fasten chassis in case. Reconnect for use.

(18) ITEM 18, CONTROL-SHAFT BEARINGS AND POTENTIOMETERS

(*a*) *Preparatory Steps and Safety Precautions.* See under items 5 and 14 above. Remove potentiometer covers by prying them loose with a knife or small screwdriver. The covers snap on and off. Work only on those parts of the transmitter-receiver which can be reached without separating the two chassis and on all accessible parts of the test set.

Note. When trouble shooting requires more disassembly than is permitted for preventive maintenance, the trouble shooter should clean and lubricate those parts which cannot be reached during preventive maintenance.

(*b*) *Maintenance Procedure.*

C. CLEAN:

1. Shaft bearings and shafts.

2. Inside of potentiometers.

L. LUBRICATE:

1. All shaft bearings with *just a few drops* of oil (PS).

2. Inside of potentiometers with grease (GL); apply only a thin coat.

(19) ITEM 19, ANTENNA SYSTEM (Figs. 8 and 16)

(*a*) *Preparatory Steps.* Disconnect the guy cables and loosen the wingnut at the base of the tower. Gently lower the mast until it is resting on a chest or box.

(*b*) *Maintenance Procedure.*

I. INSPECT:

1. All cords for cracked, frayed, broken, or worn insulation.

2. The cord mountings for looseness; tighten if necessary.

3. All connectors for dirt, corrosion, and moisture accumulation.

4. The entire antenna system for dirt, rust, looseness of assembly, and bent or broken dipoles or reflectors.

5. The remote drive system for smoothness of action and freedom from binding. (This should be done before the antenna mast is lowered.)

T. TIGHTEN:

1. All joints and fastenings.

2. The guy cables if necessary.

C. CLEAN:

1. The entire antenna system.

2. All connectors.

L. LUBRICATE:

1. Worm gear in lower mast section. Apply two shots of grease (GL) to the Zerk fitting in the lower mast housing.

2. Guy cable attachment bearing in upper mast section. First remove the relief plug located on the side of the collar opposite the Zerk fitting; then apply grease (GL) to the fitting until the grease extrudes from the relief plug hole. Wipe off excess grease and replace plug.

Note.—Upon completion of item 19, erect the antenna system as described in paragraph 15*c*.

Chapter 2

MOISTUREPROOFING AND FUNGIPROOFING

39. MOISTUREPROOFING AND FUNGIPROOFING RADAR SET AN/TPX-4

a. General. The operation of Signal Corps equipment requires special attention in tropical areas where temperature and relative humidity are extremely high. The following items represent problems which may be encountered in operation:

(1) Resistors, capacitors, coils, chokes, transformer windings, etc., fail.

(2) Electrolytic action takes place in resistors, coils, chokes, transformer windings, etc., causing eventual break-down.

(3) Hook-up wire and cable insulation breakdown. Fungus growth accelerates deterioration.

(4) Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs.

b. Treatment. A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun or brush. Refer to TB Sig. 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing and the supplies and equipment required in this treatment.

CAUTION. — Varnish spray may have toxic effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise fasten cheesecloth or other cloth material over nose and mouth.

c. Step-by-Step Instructions for Treating Transmitter-Receiver Unit RT-48A/TPX-1. (1) PREPARATION. Make all repairs and adjustments necessary for the proper operation of the equipment.

(2) DISASSEMBLY.

(*a*) Loosen catches holding cover to case.

(*b*) Remove cover from case.

(*c*) Loosen the four screws around edges of front panel.

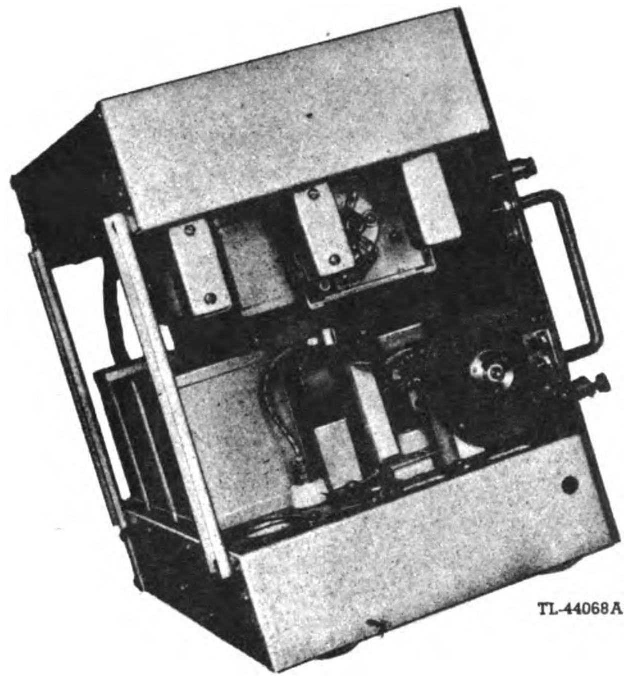


Figure 26. Transmitter-Receiver RT-48A/TPX-1, rear oblique view, tubes removed and chassis propped for convenient spraying.

(*d*) Remove chassis from case.

(*e*) Do not remove the shield which covers the r-f and mixer stages from the bottom (wiring) side of the receiver chassis until after this side of the chassis has been sprayed with lacquer.

(*f*) Remove tubes 6SN7, 6AC7, (six), 6V6, 6H6, 6SL7, 5U4G, 2X2, and 2C26.

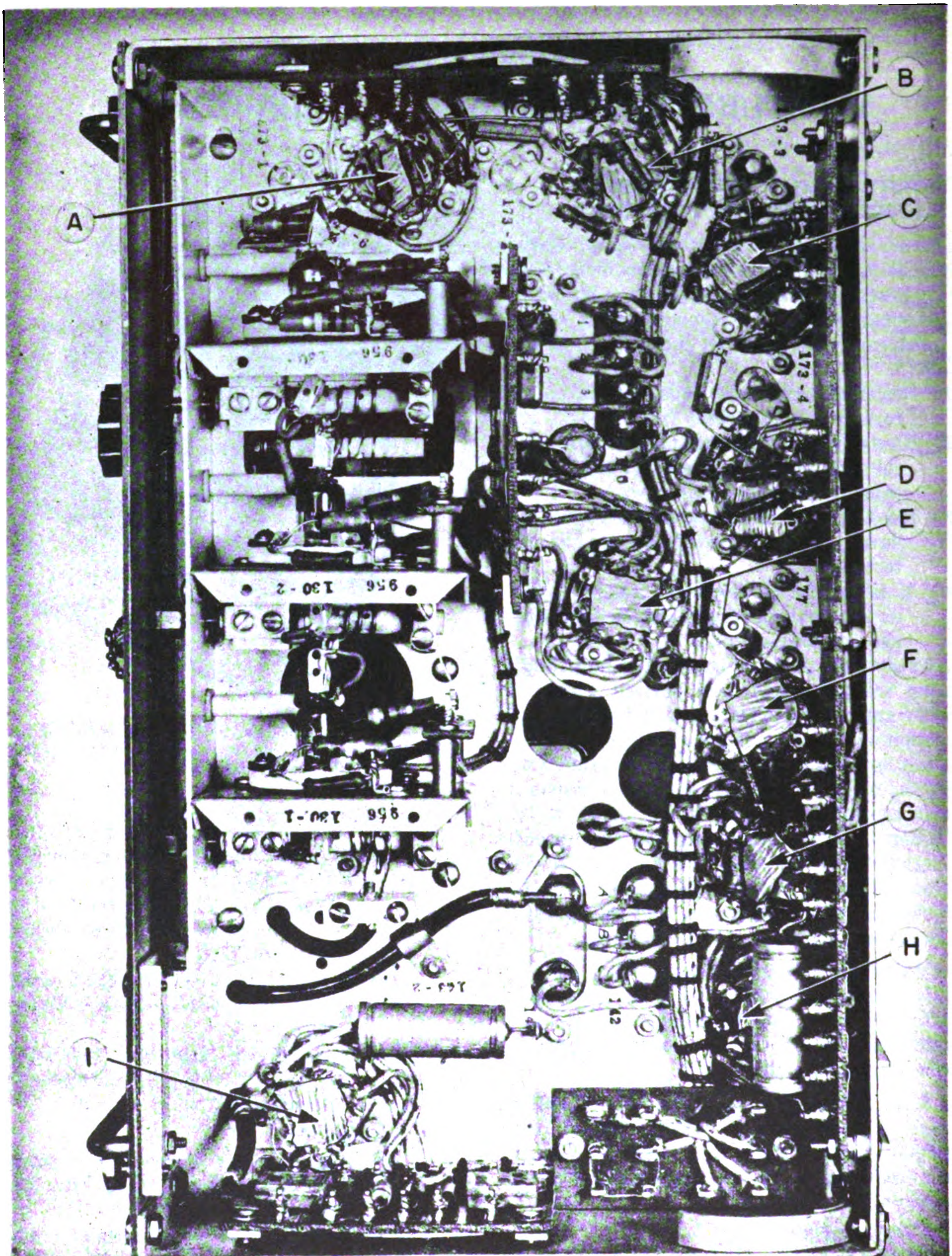
(*g*) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

(3) MASKING.

(*a*) Mask all octal tube sockets on bottom side of receiver chassis (fig. 27-A through -I).

(*b*) Mask all octal tube sockets on bottom side of transmitter chassis (fig. 28 -A, -B, -C).

(*c*) Mask metering switch on bottom side of transmitter chassis (fig. 28-D).



TL-44066A

Figure 27. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, bottom view, spray coat applied and r-f section cover removed for brush-coating.

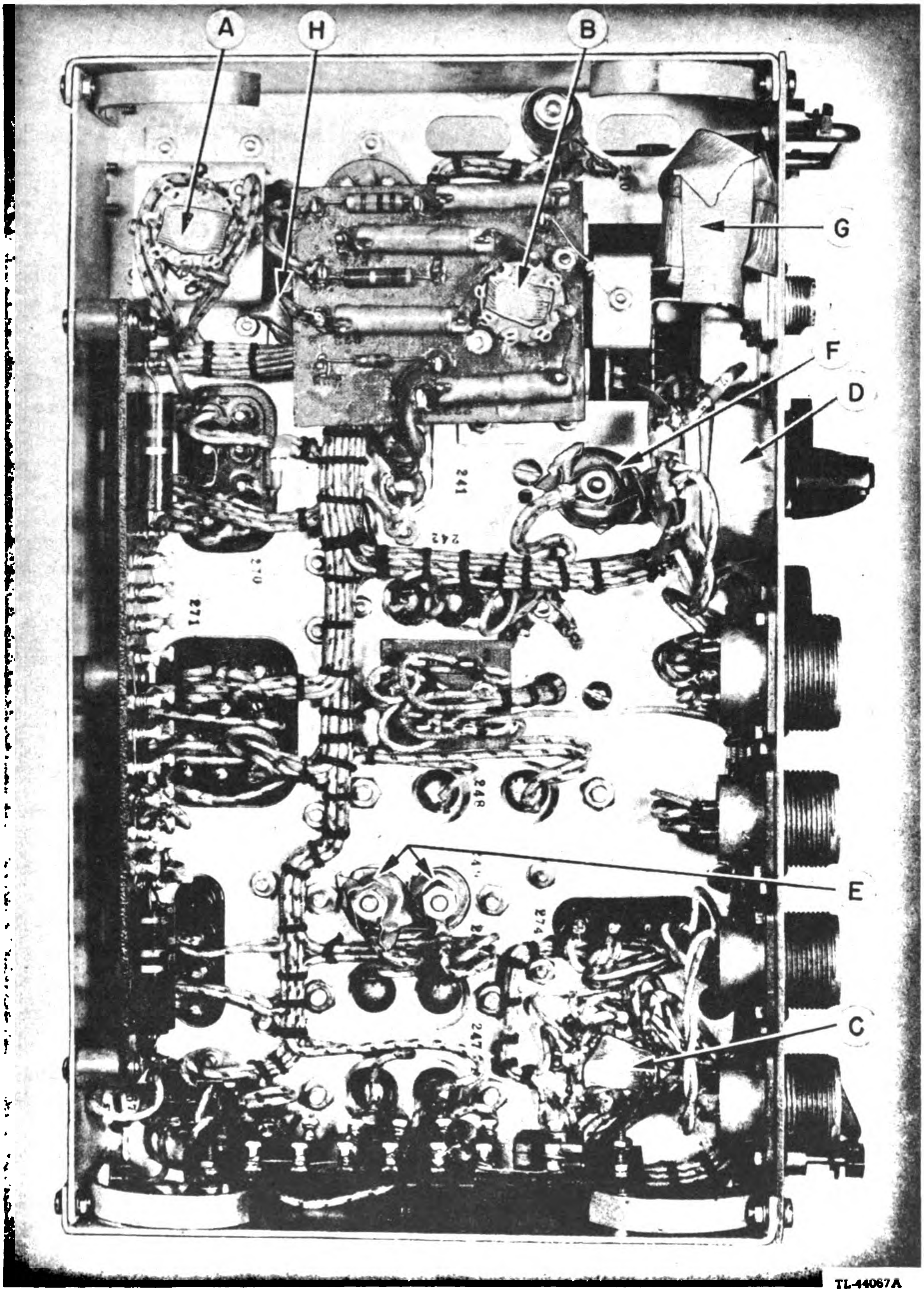


Figure 28. Transmitter-Receiver RT-48A/TPX-1, transmitter chassis, bottom view, ready for spraying.

(*d*) Mask ceramic bushings of capacitor 249 on bottom side of transmitter chassis (fig. 28-E).

(*e*) Mask ceramic bushing near metering switch on bottom side of transmitter chassis (fig. 28-F).

(*f*) Mask antenna tuning capacitor 243 on bottom side of transmitter chassis (fig. 28-G).

(*g*) Mask ceramic bushing on bottom side of transmitter chassis where lead is brought through for connection to cap of 2X2 tube (fig. 28-H).

(4) DRYING. Place equipment in oven or under heat lamps and dry for 2 to 3 hours at 160°F.

(5) VARNISHING.

(*a*) Apply three coats of moisture-proofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec. No. 71-2202 (Stock No. 6G1005.3) or equal).

(*b*) Spray all unmasked surfaces on bottom side of receiver chassis.

CAUTION. — Do not allow spray to flow through cut-outs on chassis to blower-motor vents on top of the transmitter chassis.

(*c*) Remove the shield from the r-f section of the receiver chassis and brush-coat resistors, textile-covered wiring, and all phenolic materials in this section. Touch up with the brush all these items in the rest of the receiver-chassis bottom that were not covered completely by spraying.

(*d*) Brush-coat all textile insulated wiring and phenolic materials on top of both the transmitter and receiver chassis.

Note.—It is not necessary to separate the two chassis to brush-coat in the top (tube) sides. Reach in with the brush.

(*e*) Spray all unmasked surfaces on the bottom (wiring) side of the transmitter chassis.

CAUTION. — Do not allow spray to flow through cut-out of chassis to variable tuning capacitor on top of transmitter chassis.

(6) REASSEMBLY.

(*a*) Remove all masking tape.

(*b*) Clean all contacts with varnish remover and burnish the contacts.

(*c*) Reassemble the set and test its operation.

(7) MARKING. Mark the set with "MFP" and the date of treatment.

EXAMPLE: MFP — 8 June 1944.

d. Step-by-Step Instructions for Treating Test Set TS-159/TPX.

(1) PREPARATION. Make all repairs and adjustments necessary for the proper operation of the equipment.

(2) DISASSEMBLY.

(*a*) Remove the six screws from around edges of front panel. Remove two elastic stop nuts and lock washers from the back of the case.

(*b*) Remove chassis from case.

(*c*) Remove the 10 screws from shield over variable tuning capacitor on top of chassis.

(*d*) Remove shield.

(*e*) Remove crystal from top of chassis.

(*f*) Remove three screws holding meter on front panel.

(*g*) Remove nuts and washers from terminals of meter.

(*h*) Remove meter from chassis.

(*i*) Replace nuts and washers on terminals of meter.

(*j*) Replace the three screws from meter on front of chassis.

(*k*) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

(3) MASKING.

(*a*) Mask all octal tube sockets on under side of chassis (fig. 29-A through -E).

(*b*) Mask two variable capacitors (548-2, 548-1) on under side of chassis (fig. 29-F, -G).

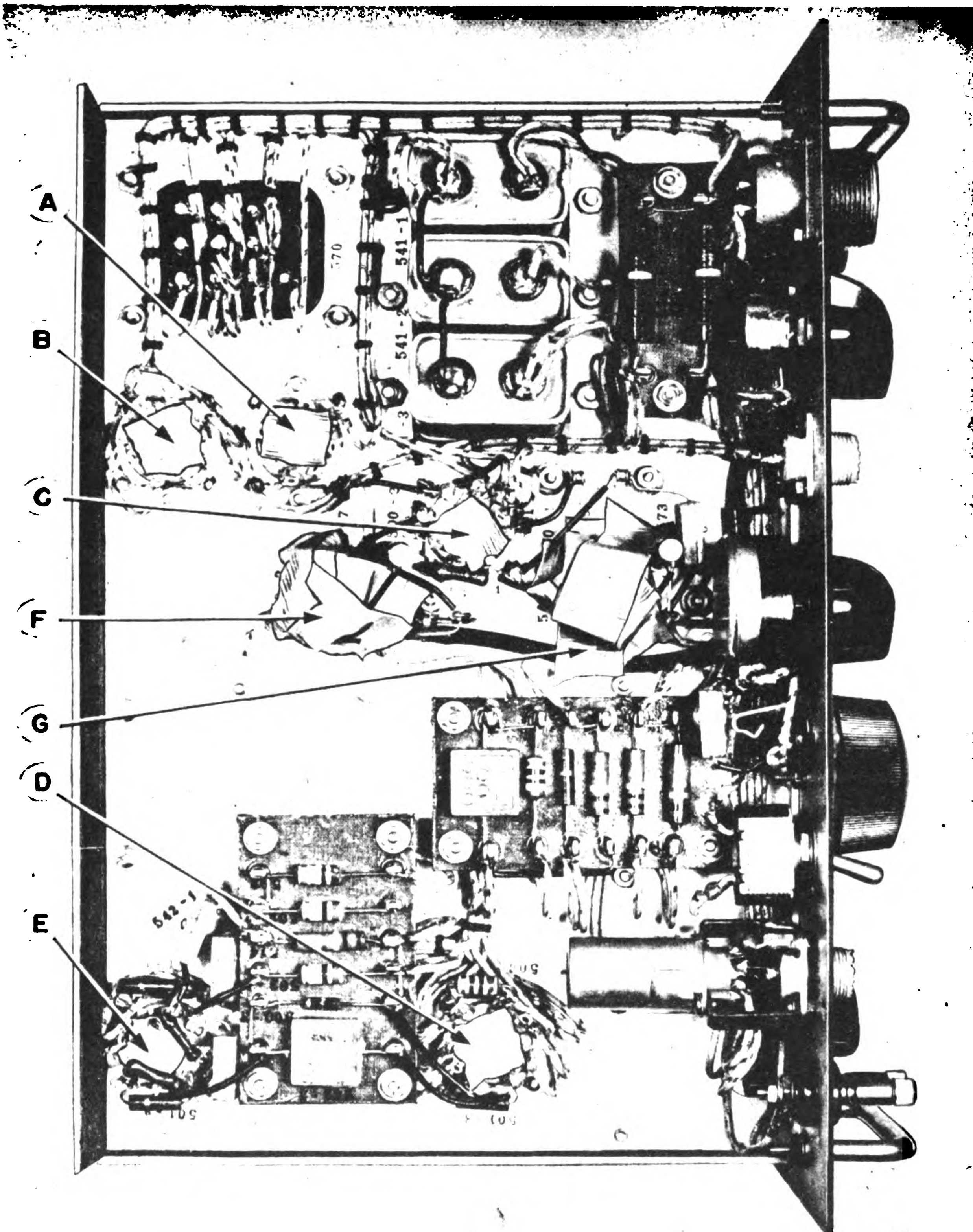


Figure 29. Test Set TS-159/TPX, bottom view, showing masking.

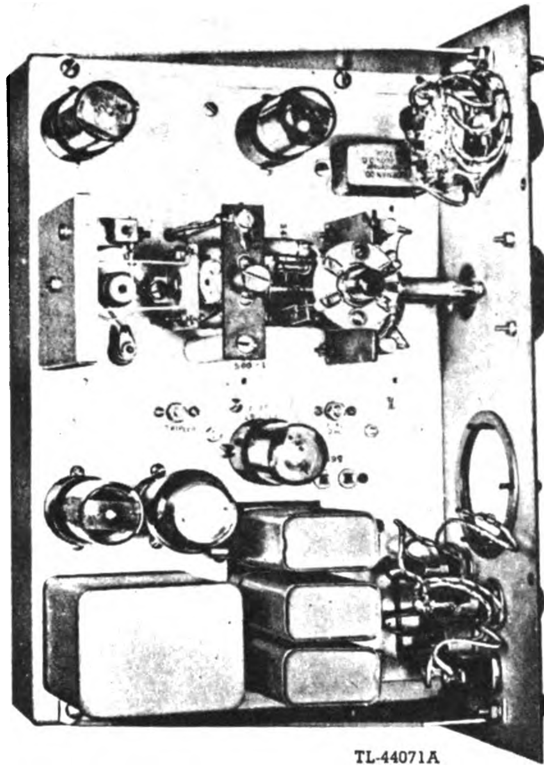


Figure 30. Test Set TS-159/TPX, top view, with shield, crystal and meter removed.

(4) DRYING.. Place the test set in oven or under heat lamps and dry for 2 to 3 hours at 160°F.

(5) VARNISHING.

(*a*) Apply three coats of moisture-proofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec. No. 71-2202 (Stock No. 6G1005.3) or equal).

(*b*) Brush-coat all resistors, phenolic materials, and wiring on top of chassis.

(*c*) Spray all textile-insulated wires, phenolic terminal boards, and unmasked surfaces on bottom of chassis.

(6) REASSEMBLY.

(*a*) Remove all masking tape.

(*b*) Clean all contacts with varnish remover and burnish the contacts.

(*c*) Reassemble set and test its operation.

(7) MARKING. Mark the set with "MFP" and the date of treatment.

EXAMPLE: MFP — 8 June 1944.

PART THREE

SERVICE

Chapter 1

THEORY OF THE OPERATING EQUIPMENT, RADAR SET AN/TPX-4

Section I

CIRCUIT DIVISIONS AND CHARACTERISTICS

40. GENERAL

a. Part Three of this manual is a guide to trouble shooting Radar Set AN/TPX-4. The chapters are as follows:

(1) Theory of the operating equipment, Radar Set AN/TPX-4. This chapter presents the theory of all components of Radar Set AN/TPX-4 except the test set.

(2) Theory of Test Set TS-159/TPX.

(3) General trouble-shooting information.

(4) Trouble-shooting the operating equipment, Radar Set AN/TPX-4.

(5) Trouble-shooting Test Set TS-159/TPX.

(6) Maintenance parts list.

b. Both the operating equipment and the test set are divided into systems for purposes of theory analysis; each system is a circuit division which has a particular function in the over-all equipment operation. Division into systems helps to localize trouble. The trouble shooter first determines what function is not being performed, thus isolating the trouble to the defective system. The search for the defective circuit element is then confined to this particular circuit division.

41. SIMPLIFIED BLOCK DIAGRAM (Fig. 31)

Functionally, the operating components of Radar Set AN/TPX-4 may be divided into seven major circuit divisions (systems) as described below.

a. Synchronizing System. A synchronizing pulse from the radar set is fed to the synchronizing system. This pulse is amplified, reshaped, and fed to the transmitting system. The synchronizing system also includes circuits which limit the IFF repetition frequency to below 750-1,000 pps (pulses per second), even if the radar

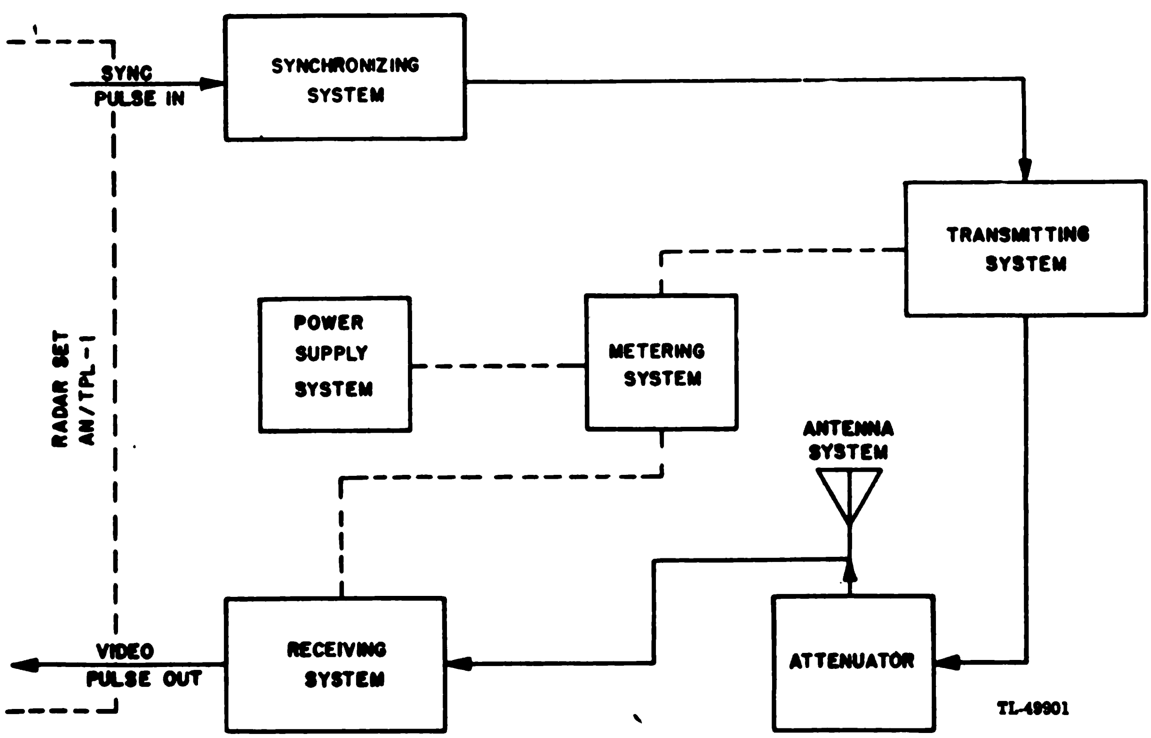


Figure 31. Radar Set AN/TPX-4, simplified block diagram of the operating equipment.

synchronizing pulse has a recurrence rate exceeding 750-1,000 pps. (When used with Radar Set AN/TPL-1, repetition frequency is 400 pps.)

b. Transmitting System. The pulse from the synchronizing system is amplified by the transmitting system, converted to a pulse of v-h-f energy, and fed to the antenna through the attenuator.

c. Antenna System. The antenna system radiates the interrogating r-f pulse. The reply pulse from the airborne transpondor in a friendly aircraft is picked up by the antenna and fed to the receiving system.

d. Receiving System. The received r-f pulse from the antenna is fed to the receiver in which it is amplified and detected. The resulting video pulse is amplified, limited, further amplified, and fed to display unit of radar set for observation.

e. Power-Supply System. The power required by operating components of Radar Set AN/TPX-4 is supplied by power-supply system which converts line voltage from the radar set to low and high B plus voltage, bias voltage, and a-c filament voltage.

f. Control System. With the controls provided for the IFF in the radar set, the radar operator may do the following:

(1) Apply or cut off line voltage to the power supply (IFF switch).

(2) Apply or cut off bias voltage to the transmitter and video circuits. The bias voltage stops the operation of the IFF equipment without allowing the tubes to cool (CHALLENGE switch).

(3) Control gain of receiver (IFF GAIN control).

g. Metering System. The metering system is a switching arrangement by which the operator can select currents in various circuits and pass them through the 0-1 ma meter in the test set. The current and voltage indications thus obtained are useful in checking, adjusting, and trouble shooting the operating equipment.

42. GENERAL FEATURES AND TECHNICAL CHARACTERISTICS

GENERAL

RANGE:	
Maximum	120 miles (approx.) with aircraft at 10,000 feet. When used with Radar Set AN/TPL-1, the maximum range is limited to the maximum radar A-scope sweep, which is 60,000 yds.
Minimum	1 mile except in terrain so mountainous that the ground echo blankets the return pulse from a nearby friendly aircraft.
Accuracy	Depends on radar accuracy. The total IFF delay may vary enough to cause the leading edge of the IFF response to shift slightly with respect to the radar echo (fig. 3), but the operator soon learns where to expect the IFF pulse to appear.
Determination	By determining range of adjacent radar echo (fig. 3) on the radar A-scope.
AZIMUTH:	
Provisions	Directional antenna. (Not useful for accurate azimuth determination.)
Determination of Direction	By determining direction of adjacent radar echo.
ELEVATION:	
Provisions	None.
HEIGHT:	
Maximum	No practical limitations.
Minimum	No practical limitations.
Determination	No provisions.
TYPE OF PRESENTATION:	Uses A-scope of radar set (fig. 3).
OPERATING RANGES:	Depend on radar A-scope sweeps. The A-scope of Radar Set AN/TPL-1 has two ranges, 30,000 yards and 60,000 yards.
FREQUENCY:	157-187 mc.
WAVELENGTH:	1.91-1.60 meters (75-3/16 to 63⅛ inches).
BUILDINGS AND TOWERS:	All components except the antenna system are housed in the radar tent. Antenna is mounted on mast outside of tent.
PACKING BOXES:	Four transit cases and one transit bag.
DIMENSIONS OF SITE:	Dimensions of tent depend on the radar set.
ASSEMBLY TIME:	Approximately 15 minutes with trained crew.

SYNCHRONIZING SYSTEM

PULSE RECURRENCE FREQUENCY:	
Synchronized by Radar Set AN/TPL-1	400 pps (pulses per second)
General	Synchronizing system will not count down under 750 pps., but will count down over 1,000 pps. (The difference is manufacturer's tolerance.)
SYNCHRONIZATION PULSE REQUIRED:	10 to 150 volts peak; time of rise less than 1 microsecond. Pulse width 1-5 microseconds.

42. GENERAL FEATURES AND TECHNICAL CHARACTERISTICS (cont'd)

TRANSMITTING SYSTEM

	From transmitter	Through attenuator
PEAK POWER:		
Maximum	1,000 watts.	100 watts.
Minimum	500 watts.	50 watts.
Usual	500-750 watts.	50-75 watts.
AVERAGE POWER:		
Maximum	8 watts.	0.8 watts.
Minimum	0.44 watts.	0.05 watts.
Usual	1.2–2.4 watts.	0.12-0.24 watts.
PULSE WIDTH:	5-8 microseconds.	
SOURCE OF R-F POWER:	One 2C26 tube.	

ANTENNA SYSTEM

TRANSMISSION LINE TO ANTENNA:	0.410-inch (approx. 13/32-inch) coaxial cable, 52-ohm, AN type RG-8/U.

RECEIVING SYSTEM

SENSITIVITY:	Less than 15 microvolts input required for 2:1 signal-to-noise ratio.
GAIN:	Over 60 volts peak video output for 15 microvolts input.
BANDWIDTH:	4 mc at half-voltage points.
INTERMEDIATE FREQUENCY:	30 mc.
VIDEO PEAK LIMITER:	Adjustable from less than 35 volts to over 70 volts.

POWER-SUPPLY SYSTEM

PRIMARY POWER REQUIRED:	175 va (approx. 175 watts) at 115 volts, 400 cycles.
H-V RECTIFIER OUTPUT:	2.500 volts.
L-V RECTIFIER OUTPUT:	300 volts operating, 210 volts stand-by.
STAND-BY BIAS OUTPUT:	100 volts.

Section II

SYNCHRONIZING SYSTEM

43. INTRODUCTION

a. Function of Synchronizing System. The synchronizing system performs the following two functions:

(1) It triggers the IFF transmitter system one eight-hundreth second after the radar transmitter fires.

(2) It limits the repetition rate of the IFF transmitter to below 1,000 pps even if the associated radar equipment has a pulse recurrence rate higher than 1,000 pps.

b. Location of Synchronizing System. The synchronizing circuits and the two tubes used by the circuits are located on the receiver chassis.

44. BLOCK DIAGRAM OF SYNCHRONIZING SYSTEM (Fig. 32)

The three stages of the synchronizing system are shown in block diagram form in figure 32. The synchronizing pulses from the radar set are applied to the sync (synchronizing) amplifier stage where they are amplified, amplitude limited, and inverted. The output pulse is coupled to the pulse oscillator stage which further amplifies the pulse and reshapes it. The pulse oscillator output is fed to the pulse amplifier and to the repetition limiter stage. The repetition limiter acts on the sync amplifier to limit the repetition rate to a maximum of 1,000 pulses per second.

45. SYNCHRONIZATION AMPLIFIER (Fig. 33)

a. Positive synchronizing pulses from the radar set are applied to both the control grid and the suppressor grid of tube 131-5 through coupling capacitor 148-1. Resistors 119-2 and 112 form a voltage divider from B plus to ground which is tapped by the cathode at the 33-volt point. However, the operating point of the tube allows a high average plate current to flow, which raises the average cathode potential to 90 volts. This potential is also applied to the control grid and the suppressor grid through grid leak resistor 119-1.

b. The tube operates near saturation, and the gain for low inputs is increased by the connection of the suppressor to the control grid. Therefore the stage acts as a limiter, producing approximately the same output for all inputs from 10 to 150 volts.

c. The plate of tube 131-5 is directly connected to the plate of the pulse oscillator tube 134. Positive pulses applied to the grid of tube 131-5 appear as negative pulses on the plate of the pulse oscillator and, by coupling through the pulse transformer 170, appear as positive pulses on the grid of the pulse oscillator. The pulse oscillator determines the shape and duration of the final pulse to the transmitter. The leading edge of the output pulse from the synchronization amplifier is all that is needed to trigger the pulse oscillator.

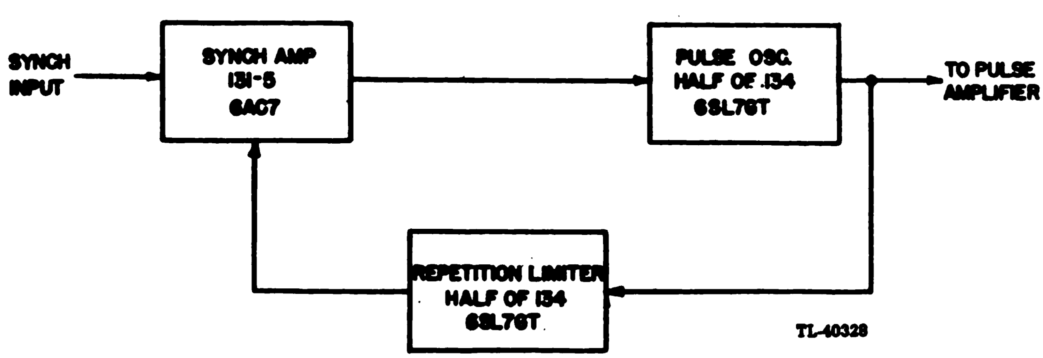


Figure 32. Transmitter-Receiver RT-48A/TPX-1, synchronizing system, block diagram.

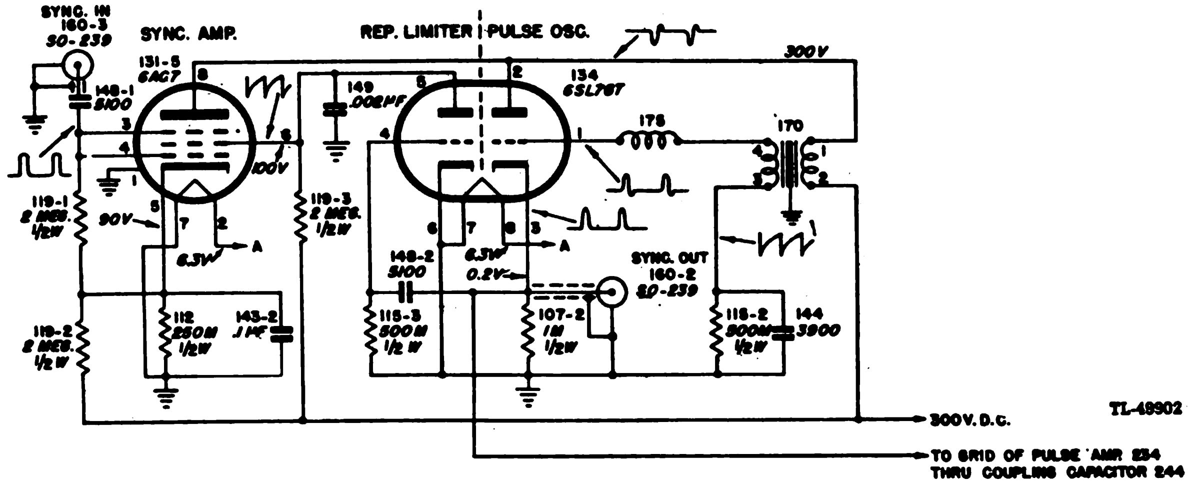


Figure 33. Transmitter-Receiver RT-48A/TPX-1, synchronizing system, functional schematic diagram.

46. PULSE OSCILLATOR (Fig. 33)

a. The pulse oscillator, one triode section of tube 134, is connected as a blocking oscillator. When the power is applied, plate current begins to flow. This current rise through the plate winding of the blocking oscillator transformer 170 induces a high voltage in the grid winding. The connections from the transformer are such that the induced voltage is positive at the grid end of the transformer. This positive voltage further increases the plate current, which in turn increases the positive potential on the grid (pin 1). This cumulative action continues until either plate current saturation of the tube or magnetic saturation of the transformer is reached. During the action, the positive grid potential causes grid current to flow and charges capacitor 144 to a high potential making the grid end of the capacitor negative with respect to ground. The effective resistance in series with the capacitor is the sum of the resistance of the internal grid-cathode path, r-f choke 175, the grid winding of the transformer, and resistor 107-2. With the grid positive, the total effective resistance is low and the charging time of the capacitor is short. When saturation is reached, no voltage is induced in the grid winding, and only the capacitor voltage is effective in the grid circuit. Since the capacitor voltage is much greater than the value necessary for the plate current cut-off, the grid cuts off the plate current abruptly. The discharge path of the capacitor is through resistor 115-2, 500,000 ohms, and the capacitor discharge time is far greater than the charge time (RC = 1,950 microseconds). The plate current remains cut off until the capacitor discharges to the cut-off potential of the tube, at which time plate current again flows and the cycle repeats. The free running repetition rate of the pulse oscillator is thus determined by the values of capacitor 144 and resistor 115-2, and is 175 pulses per second.

b. When synchronizing pulses are applied to the primary of pulse transformer 170 by the sync amplifier tube, a positive pulse appears on the grid of the pulse oscillator tube. Even though the voltage on the grid due to the potential on capacitor 144 is below tube cut-off, the addition of the positive sync pulse instantly raises the grid above cut-off, then the plate current starts to flow and the blocking-oscillator cycle starts. With sync input, therefore, the recurrence rate is determined by the sync recurrence rate rather than by capacitor 144 and resistor 115-2.

c. Pulse output is taken across cathode resistor 107-2 and is applied both to the transmitting system and to the repetition limiter.

47. REPETITION LIMITER (Fig. 33)

a. The other triode section of tube 234 functions as a repetition limiter for repetition rates above 1,000 cycles. Pulse output from the pulse oscillator is fed to the grid (pin 4) through coupling capacitor 148-2. The plate is connected to the screen of sync amplifier tube 131-5.

b. Between pulses, capacitor 149 is charged by B plus voltage through resistor 119-3 (RC = 4,000 microseconds). During the positive pulse from the pulse oscillator, the plate-to-cathode resistance of the repetition limiter tube is very small and capacitor 149 discharges rapidly as high plate current flows through the tube. The screen voltage of tube 131-5 is thereby lowered.

When the pulse is completed, the screen voltage of tube 131-5 rises as capacitor 149 is charged from B plus through resistor 119-3.

c. The cathode of tube 131-5 is kept at approximately 90 volts above ground (par. 45a). When the screen voltage of tube 131-5 is lowered by the pulse of plate current in tube 134, the actual screen to cathode voltage goes negative, cutting off tube 131-5. The time constant of capacitor 149 and resistor 119-3 is so selected that it takes from about 1,000 to about 1,330 microseconds for the screen voltage to rise to a point where the tube will operate. This characteristic automatically limits the maximum pulse repetition rate to between 750 and 1,000 pulses per second. If synchronizing pulses are applied at higher rates, the synchronization amplifier can only respond to alternate pulses, that is, it divides frequency.

Section III

TRANSMITTING SYSTEM

48. BLOCK DIAGRAM OF TRANSMITTING SYSTEM (Fig. 34)

The transmitting system consists of a pulse amplifier, a modulator, and an r-f power oscillator (fig. 34). Positive pulses from the synchronizing system are applied to the pulse amplifier, one section of tube 234, where they are amplified and inverted. The output of the pulse amplifier is coupled through a transformer to the modulator, which is the second section of tube 234. The negative pulses of the pulse amplifier are inverted by the transformer so that positive pulses are fed to the modulator. The positive output pulse from the cathode of the modulator is fed to the r-f power oscillator (transmitter) which produces the v-h-f pulse.

49. PULSE AMPLIFIER AND MODULATOR (Fig. 35)

a. Tube 234 has its first triode section arranged as a pulse amplifier, transformer-coupled to the second section which is connected as a cathode-follower modulator. The output of the pulse oscillator is coupled by capacitor 244 to the grid (pin 1) of the first triode section of tube 234. The grid resistor 200 returns to a point which is at 100 volts negative when the set is not challenging, to cut off the amplifier on stand-by. With CHALLENGE switch ON, resistor 200 is returned to ground.

b. The output of the first triode section of tube 234 is coupled through transformer 274 to the grid of the second section. The transformer is required to reverse the polarity of the negative pulses so as to place positive pulses on the modulator grid. The modulator output from the cathode (pin 6) is used to grid modulate the r-f power oscillator.

c. A current divider consisting of resistors 202 and 203 is used to separate part of the modulator cathode current so that it can be metered on a 1-milliampere meter. This circuit is discussed in greater detail in paragraph 70.

50. TRANSMITTER OSCILLATOR (Fig. 35)

a. Tube 231 is used in a shunt-feed r-f power oscillator circuit. The hairpin tank coil is tuned by capacitor 245, the TRANSMITTER FREQUENCY control, to cover the 157 to 187 megacycle band. The oscillator output is inductively coupled to the antenna circuit through a pick-up loop in series with capacitor 243. Capacitor 243 *does not* resonate the loop to the operating frequency. It is factory adjusted to tune the loop to a frequency above the operating band. This adjustment, together with the close coupling of the loop, permits operation over the entire band without antenna tuning or coupling adjustments. Capacitor 243 is locked at the factory and should never need field adjustment.

b. Cathode current is metered by measuring the d-c voltage across resistor 209 with a 1-milliampere meter, using resistor 208 as a multiplier. This circuit is discussed in greater detail in paragraph 68.

c. The grid is pulsed through r-f isolating resistor 212 and choke 272-4. In the IFF position of the challenge switch, the cathode of tube 231 returns to plus 300 volts through r-f choke 272-3 and resistor 209; the grid is returned to the cathode of the modulator which is only about 14 volts positive between pulses. Therefore there is approximately 286 volts of cut-off bias on tube 231. During the pulse, the modulator cathode voltage is raised to nearly 300 volts, overcoming the bias on tube 231 and permitting it to oscillate.

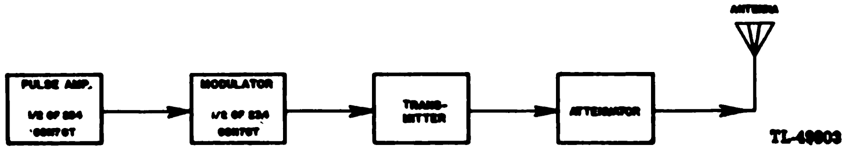


Figure 34. Transmitter-Receiver RT-48A/TPX-1, transmitting system, block diagram.

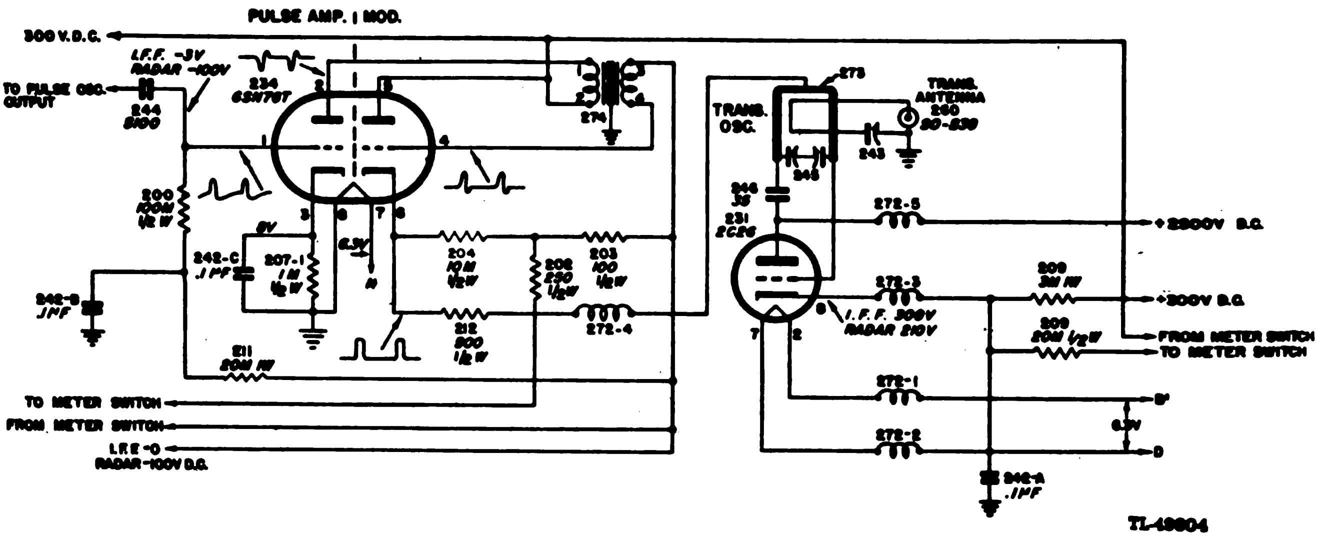


***Figure 35.** Transmitter-Receiver RT-48A/TPX-1, transmitting system, functional schematic diagram.*

d. In the OFF position of the CHALLENGE switch, the 300 volts B plus drops to 210 volts. This would reduce the bias on tube 231 from 286 volts to only 196 volts; the oscillator might then be triggered by random noise pulses. To prevent this, both the grid and the cathode of the modulator tube are returned to a point which is 100 volts negative when the switch is in the OFF position. This does not alter the bias on the modulator tube, but it does place 86 volts negative instead of 14 volts positive on the grid of the transmitter oscillator tube 231. With the cathode at 210 volts positive and the grid at 86 volts negative, the total bias for tube 231 is 296 volts. By this means the bias is actually increased by 10 volts instead of being reduced when the CHALLENGE switch is placed in the OFF position.

Section IV
ANTENNA SYSTEM

51. THEORY OF ANTENNA SYSTEM AS-134/TPX

a. Matching Antenna to Transmitter-Receiver. Because a common antenna is used for both transmitting and receiving, it is necessary to provide a means of reducing the transmitter power loss in the receiver and the received signal loss in the transmitter. This is accomplished by the length of the coaxial line (T-R line) between transmitter output and receiver input.

(1) When the transmitter is operating, some of the r-f energy is applied to the input tube of the receiver. This energy causes the tube to draw a large amount of grid current; as a result a low impedance is placed across the receiver end of the T-R line. The length of this line is such that this low impedance appears as a high impedance at the transmitter end of the line. Since the impedance of the T-R line is much higher than the impedance of the antenna coaxial cable, the power from the transmitter will be delivered to the antenna rather than to the receiver.

(2) The receiver presents its normal impedance to the line during the time the transmitter is not operating. Under this condition, the transmitter end of the T-R line matches the impedance of the r-f cable from the antenna, while the output impedance of the transmitter is much higher. Therefore the received signal is then fed to the receiver rather than to the transmitter.

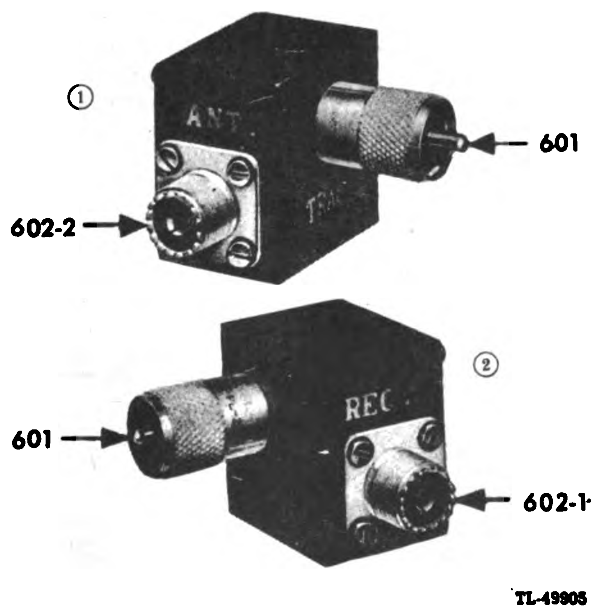


Figure 36. Transmitter attenuator: ① Antenna connections; ② Receiver connections.

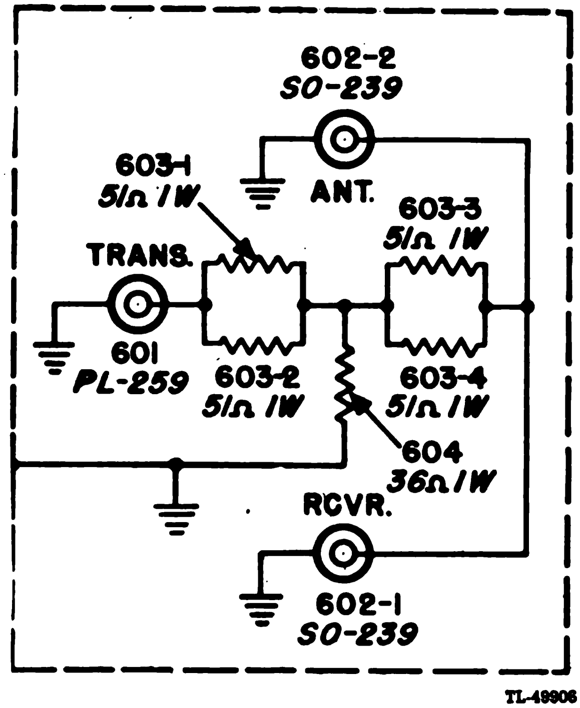


Figure 37. Transmitter attenuator, schematic diagram.

(3) An attenuator (figs. 36 and 37) is supplied with Radar Set AN/TPX-4 to reduce the power reaching the antenna from the transmitter. Less power is required because Antenna System AS-134/TPX is directional; that is, the antenna radiates the major portion of its power in the direction in which it is facing. With nondirectional antennas in other installations the transmitter-receiver is used without the attenuator.

b. Antenna. (1) The two folded dipoles are fed in parallel by a 104-ohm balanced line which is made up of two 52-ohm coaxial cables. Since the impedance between the center conductor and the outer conductor of each cable is 52 ohms, and the outer conductors are connected together, the series impedance between the two center conductors is 104 ohms.

(2) The opposite sides of the balanced 104-ohm line are fed 180° out of phase by means of

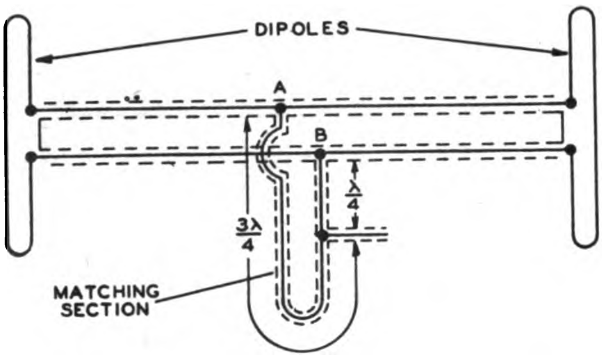


Figure 38. Antenna Assembly AS-109/TPX, diagram of r-f connections.

a matching section (fig. 38). The matching section is a loop of coaxial cable, one wavelength long, fed at a point one-quarter wavelength from one end. Therefore the voltages produced at points A and B are 180° out of phase.

(3) The matching section feeds the 104-ohm line at the exact center; consequently the dipoles are fed in phase. This phase relationship in conjunction with the spacing between the dipoles, gives the directional characteristic to the antenna system. Further directivity is produced by the three reflectors mounted behind each dipole.

Section V

RECEIVING SYSTEM

52. BLOCK DIAGRAM OF RECEIVING SYSTEM (Fig. 39)

The receiving system uses a superheterodyne circuit. Signals from the antenna are amplified by the two-stage r-f amplifier at the signal frequency (157 to 187 mc) and then fed to the mixer. In the mixer stage the amplified r-f signals are mixed with the output of the h-f oscillator which operates 30 mc below the desired signal frequency. The resultant 30-mc i-f signal is fed to the four-stage i-f amplifier. The amplified i-f output is fed to the second detector which converts the i-f signal to a video signal. This video signal is fed to the two-stage video amplifier. The first video amplifier stage is a voltage amplifier, and the second video stage is a cathode follower; thus the video amplifier both amplifies the second detector output and delivers the amplified signal to the display at a low impedance level. The video limiter is a biased diode arranged to clip (limit) the video output of the first video stage at an amplitude such that the final output produces about a ¾-inch to 1-inch maximum deflection on the radar A-scope.

53. R-F AMPLIFIER (Fig. 40)

a. The receiving antenna is coupled to the grid of the first r-f stage, tube 130-1, by inductor 171, the tuning coil marked ANTENNA on the front panel. The position of the antenna tap on inductor 171 is such that the impedance of the antenna coaxial cable is matched to the impedance of the grid circuit of the first r-f stage. Inductor 171 is permeability-tuned by a brass and powdered iron movable core to cover 157 to 187 megacycles. The brass is at one end of the core and the iron at the other end. This arrangement increases the tuning range of the core adjustment. For example, as the iron is moved *out* of the coil to lower the coil inductance and increase the frequency, the brass moves *into* the coil, still further reducing the inductance. (Iron increases inductance by increasing the magnetic lines of force through the coil. Brass, which is non-magnetic, decreases inductance because the eddy currents induced in the brass set up counteracting magnetic lines of force.) The input capacity of the tube, in parallel with inductor 171, completes the resonant circuit.

b. The plate output of tube 130-1 is coupled from plate load resistor 108-5 through coupling capacitor 140-5 to the grid of tube 130-2, the second r-f amplifier. The grid of tube 130-2 is tuned by inductor 172-1 in parallel with the input capacity of the tube. Inductor 172-1 is marked R.F. on the front panel. This conductor is a permeability-tuned coil similar to inductor 171. The gain of tube 130-2 is controlled by varying its screen voltage, which is supplied from the IFF GAIN potentiometer in the radar set.

c. Inductor 172-1 is effectively shunted by load resistor 108-5. This resistance is only 3,000 ohms and severely loads the tuned circuit. This arrangement lowers the gain but increases the bandwidth. The Mark III IFF system requires a very wide band-pass receiver so as to receive as many pulses as possible during each sweep of the mechanical tuner in the airborne transpondor (par. 5b).

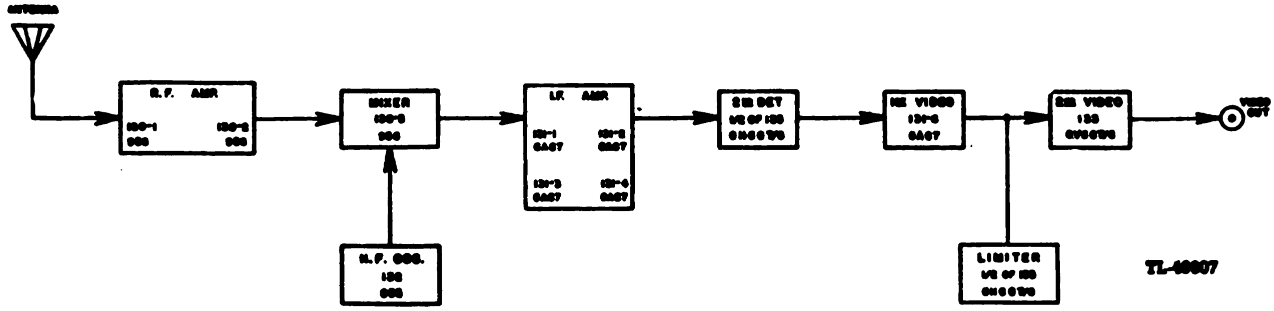


Figure 39. Transmitter-Receiver RT-48A/TPX-1, receiving system, block diagram.

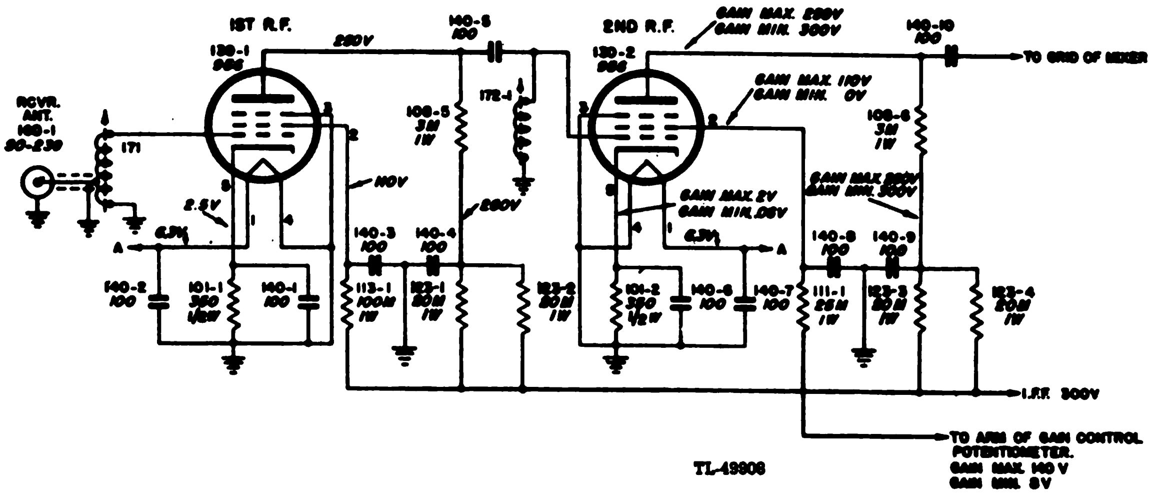


Figure 40. Transmitter-Receiver RT-48A/TPX-1, receiving system, functional schematic diagram, showing r-f amplifier.

54. MIXER

The grid of mixer tube 130-3 is fed from the plate load resistor 108-6 of the second r-f amplifier through coupling capacitor 140-10 (fig. 40). The mixer grid is tuned by permeability-tuned inductor 172-2 (fig. 41). This inductor is marked MIXER on the front panel. The mixer is grid-modulated by the output of the local oscillator tube 132 (H.F. OSC. on fig. 41), which is inductively coupled to coil 172-2 by the adjacent mounting of oscillator tank coil 174. The mixer output is coupled from load resistor 116-1 to the grid of the first i-f stage through resistor 114 and coupling capacitor 150-1. Resistor 114 is used to suppress parasitic oscillations.

55. LOCAL (HIGH-FREQUENCY) OSCILLATOR (Fig. 41)

The high-frequency oscillator uses triode tube 132 in a Hartley circuit. The tapped tank coil 174 is used to series-feed the dc to the plate. The grid is returned to ground through shunt grid leak 111-2. Tank coil 174 is coupled magnetically to the mixer grid coil 172-2 by adjacent mounting. The oscillator operates at a frequency 30 mc below the incoming r-f frequency, and is tuned by variable air capacitor 145. This tuning control is marked RECEIVER OSCILLATOR on the front panel.

56. I-F AMPLIFIER (Fig. 42)

a. The i-f amplifier operates at 30 megacycles with a pass band from approximately 28 to 32 megacycles. It uses tubes 131-1, 131-2, 131-3, and 131-4 in substantially identical arrangements. The gain of the first stage, tube 131-1, is controlled simultaneously with the gain of the second r-f stage, tube 131-2, by varying its screen voltage with the IFF GAIN potentiometer on the radar set. The grid of the first stage is tuned by i-f coil 173-1 which has a permeability-tuned primary coil, inductively coupled to a permeability-tuned secondary trap circuit. The secondary trap uses 147-1 as tuning capacitor and 121-1 as loading resistor. The trap is tuned to 30 megacycles.

b. The function of the trap is to provide selective loading of the primary so that it provides maximum loading at the center frequency and less loading at the outer frequencies of the pass band. This effect flattens the top of the i-f response curve, broadening the useful pass band. This method of coupling is used so that only one tuned circuit in each i-f stage is tuned by vacuum-tube capacity. Therefore the i-f system can be aligned by adjusting one trimmer per stage for maximum response at the center frequency. No stagger tuning or tuning of interlocking overcoupled stages is required. The trap tuning is set at the factory and need never be adjusted in the field.

c. The output of the first i-f stage, tube 131-1, is coupled to the grid of the second i-f stage, tube 131-2, from plate load resistor 105-2 through coupling capacitor 150-2. The low-resistance plate load broadens the pass band. The grid of tube 131-2 is tuned by coil 173-2 and the tube capacity. Coil 173-2 has the same construction as coil 173-1. The second, third, and fourth i-f stages have the same arrangements.

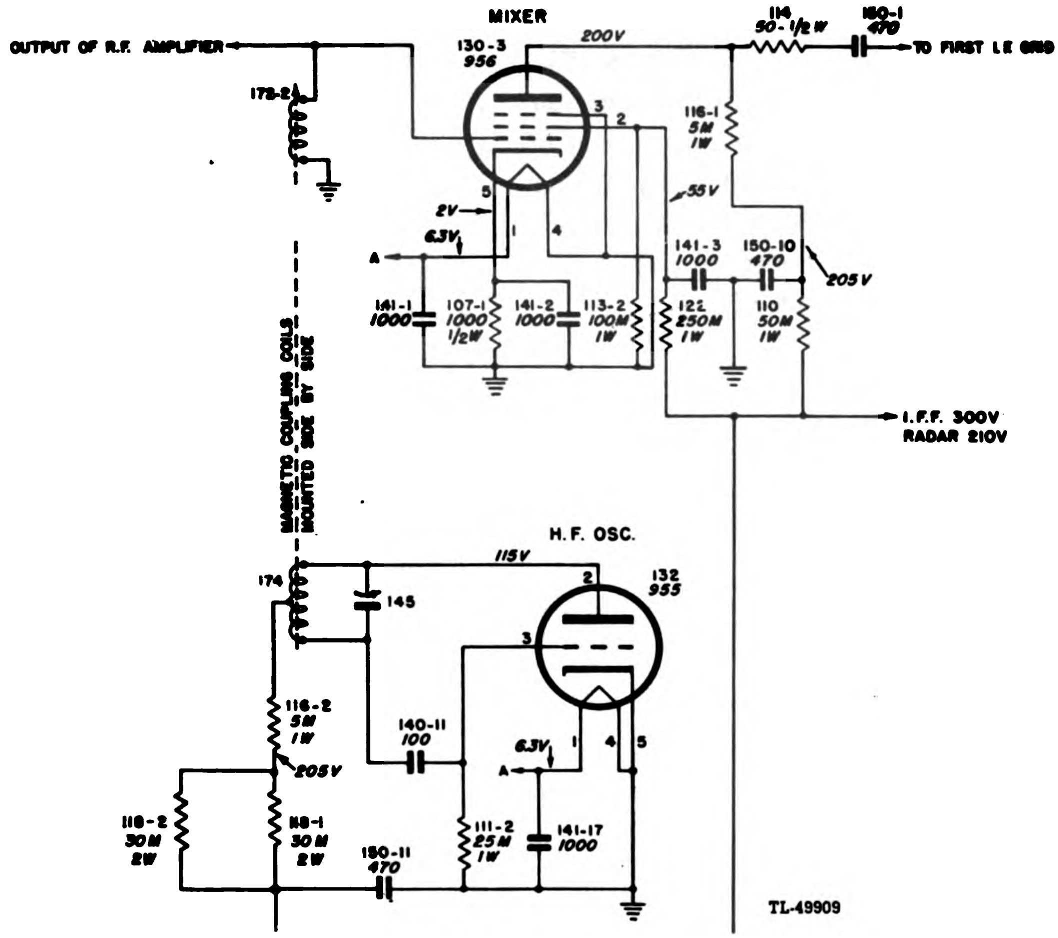


Figure 41. Transmitter-Receiver RT-48A/TPX-1, receiving system, functional schematic diagram, showing mixer and high-frequency oscillator.

57. SECOND DETECTOR (Fig. 43)

One-half of tube 135 is used as the second detector diode. It is fed from 105-5, the plate load resistor of the fourth i-f stage, through coupling capacitor 150-8. It is tuned by coil 177, which is similar to the i-f coils except for a higher inductance. The diode is connected with the i-f voltage applied to the cathode, and with video output taken from plate to ground. This connection is needed in order to get positive pulses from the video output. Capacitors 147-6 and 147-7, and choke 176-1 filter the r-f across load resistor 106. Metering resistor 107-3 is connected in series with the ground side of diode load resistor 106. Diode current is metered by shunting a d-c milliameter across resistor 107-3. This circuit is explained in greater detail in paragraph 72.

58. FIRST VIDEO AMPLIFIER AND LIMITER (Fig. 43)

a. The diode video output across load resistor 106 is directly connected to the grid of the first video amplifier tube 131-6. The video output of tube 131-6 appears across resistors 113-3, 113-4, 113-5, and 113-6, which, in parallel, constitute the plate load resistance. Tube 131-6 is cut off when the set is in stand-by condition by negative bias applied to the suppressor.

b. The video limiter diode is one-half of tube 135. The plate connects to the plate of tube 131-6, and the cathode is returned to a d-c potential intermediate between B plus and ground, determined by the setting of PEAK VIDEO potentiometer 120. When the pulse output of tube 131-6 reaches the amplitude at which the instantaneous plate voltage exceeds the potential of the limiter cathode, the limiter draws current, preventing any further rise of plate voltage. The limiter-cathode resistor is bypassed by capacitor section 142-A, so that the instantaneous value of limiter bias is not disturbed by the pulse of limiter current. To produce a 3/4-inch to 1-inch deflection on the radar A-scope, the limiter cathode is usually set at about 75 volts positive.

59. SECOND VIDEO AMPLIFIER (Fig. 43)

The output video stage is tube 133, which is operated as a cathode follower to give low output impedance. The grid of tube 133 is fed from the output of the first video stage through coupling capacitor 143-1. The video output is taken across the cathode load resistance, which is composed of resistors 103-3 and 103-4 in parallel. Output coupling capacitor 146 blocks the d-c component of output voltage from the external video load.

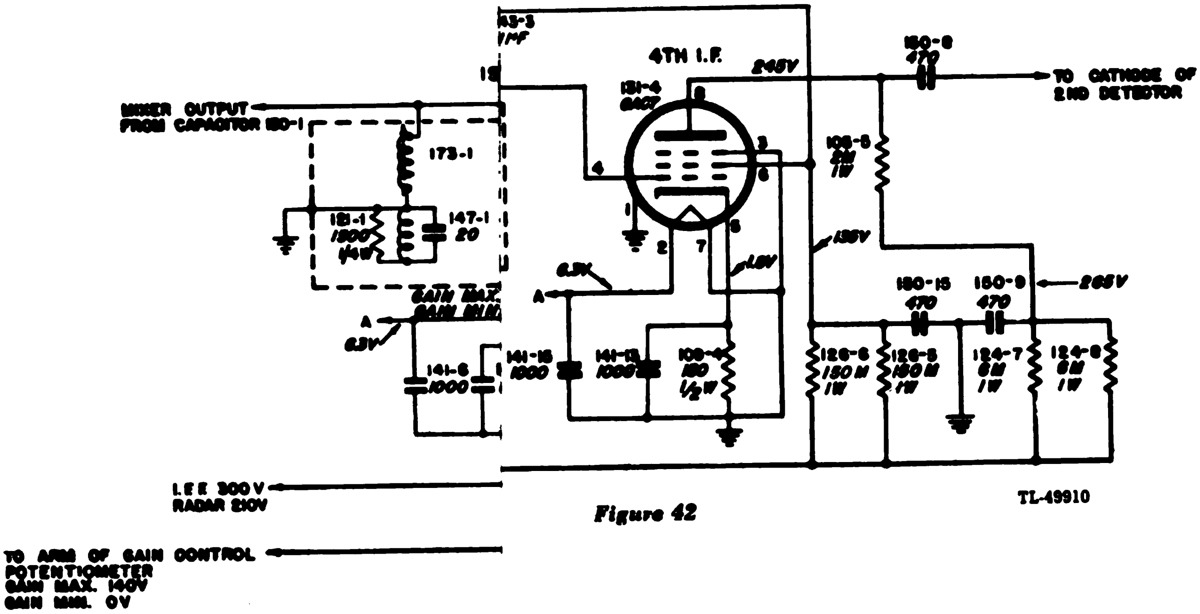


Figure 42

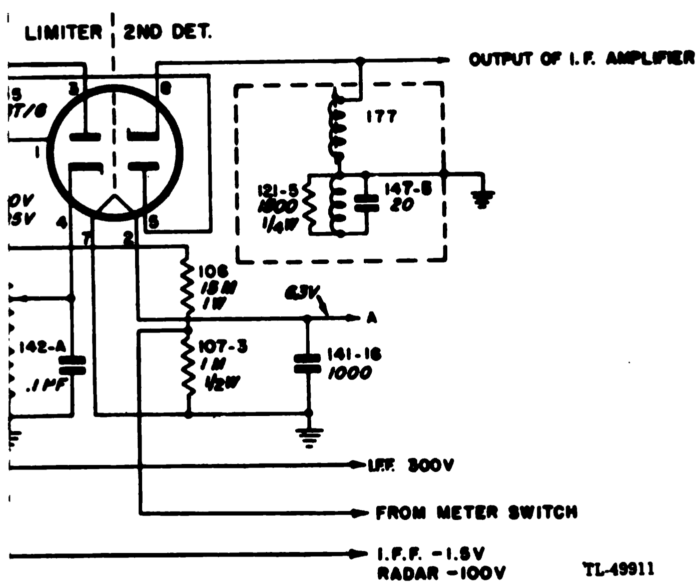


Figure 43

Figure 42. ***Transmitter-Receiver RT-48A/TPX-1, receiving system, functional schematic diagram, showing i-f amplifier.***

Figure 43. ***Transmitter-Receiver RT-48A/TPX-1, receiving system, functional schematic diagram, showing second detector, limiter, and video amplifier.***

Section VI

POWER-SUPPLY SYSTEM

60. POWER-SUPPLY PRIMARY CIRCUITS (Fig. 44)

A-c power is taken in on A.C. IN receptacle 264. The B terminal is wired directly to the common terminal on the primaries of transformers 270 and 271 and blower 268. (These transformers, the blower, and the two power-supply tubes are all mounted in the transmitter chassis.) The A terminal is wired through safety interlock switch 265 and primary fuse 269 to the J terminal of control receptacle 262. A jumper in the CONTROL plug of Cord CX-304/TPX-3 connects the J terminal to the E terminal, placing alternating current on the 80- or 150-volt selector wires on transformers 270 and 271. The a-c return on blower 268 is wired permanently to the 115-volt tap on transformer 270, so that on 80-volt operation the transformer primary acts as an autotransformer to keep 115 volts on the blower.

61. HEATER SUPPLY (Fig. 44)

All tube heaters are supplied from secondaries on filament transformers 271. This transformer has four secondaries; 5.0 volts for filament of tube 232, 2.5 volts for heater of tube 233, 6.5 volts for heater of tube 231, and 6.5 volts for heaters of all other tubes. The primary is tapped for 115 or 80 volts.

62. LOW-VOLTAGE SUPPLY (Fig. 44)

The low voltage rectifier, which supplies 300 volts d-c (in the operating condition) for all B plus circuits except that of the r-f power oscillator, uses tube 232, a 5U4G full-wave rectifier. The plates of tube 232 are fed from the 585-volt winding of plate transformer 270. The center tap of the 585-volt winding returns through bias resistor 210 to ground, when the CHALLENGE switch is in the OFF position. Then resistor 210 develops 100 volts of negative bias, and the B plus lines drop to 210 volts. The CHALLENGE switch shorts resistor 210 to ground in ON position so that no negative bias voltage is developed, and the B plus lines rise to 300 volts. The d-c output of the rectifier is filtered by the two-section capacitor-input filter formed by choke 280 (A-B) and capacitors 247-1, 247-2, and 248. The negative bias output to the transmitter is isolated from the bias supply to the pulse amplifier and first video stage by the filter consisting of resistor 211 and capacitor 242-B.

63. HIGH-VOLTAGE SUPPLY (Fig. 44)

The high-voltage rectifier, which supplies 2,500 volts d-c to the plate of the r-f power oscillator, uses tube 233, a 2X2/879 half-wave rectifier. Alternating current is applied from the 2,000-volt winding of plate transformer 270, in series with half of the 585-volt winding. The rectifier output is filtered by resistors 213-1 and 213-2 in parallel and capacitor 249. The bleeder is composed of resistors 201-2, 201-3, 201-4, 201-5, 201-6, 201-7, 201-8, and 201-9 in series. Rectifier voltage is metered on the 1-milliampere meter in the test set by shunting it across resistor 207-2 which is in series with the ground end of the bleeder. This metering circuit is explained in detail in paragraph 69.

Section VII

CONTROL SYSTEM

64. POWER SWITCH

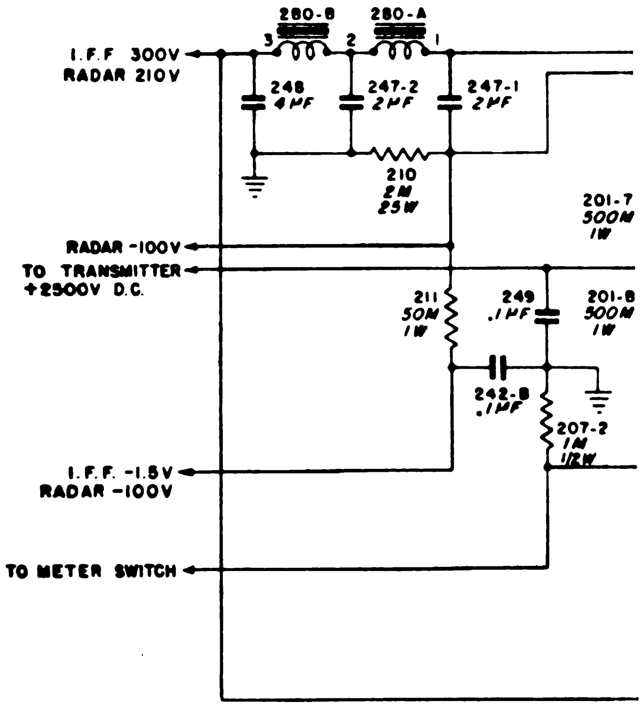
The IFF switch on the rear panel of the radar set energizes the primary circuits through Cord CX-304/TPX-3.

65. CHALLENGE SWITCH

The CHALLENGE switch on the radar set connects through Cord CX-304-TPX-3 and terminals B and A on control receptacle 262, to short resistor 210 when in ON position.

66. RECEIVER GAIN CONTROL

The IFF GAIN potentiometer on the radar set is used to control receiver gain by varying the screen voltage applied to the second r-f and first i-f stages. B plus voltage is brought to terminal D of control receptacle 262 (fig. 44) through the dropping resistance composed of resistors 206-1, 206-2, 206-3, and 206-4 in parallel (fig. 44). The tube screens are fed from the arm of the potentiometer.



280-B
280-A
3
2
1
I.F.F 300V
RADAR 210V
248
4 MF
247-2
2 MF
247-1
2 MF
210
2M
25W
201-7
500M
1W
RADAR -100V
TO TRANSMITTER
+2500V D.C.
211
50M
1W
249
.1MF
201-8
500M
1W
242-B
.1MF
207-2
1M
1/2W
I.F.F. -1.5V
RADAR -100V
TO METER SWITCH

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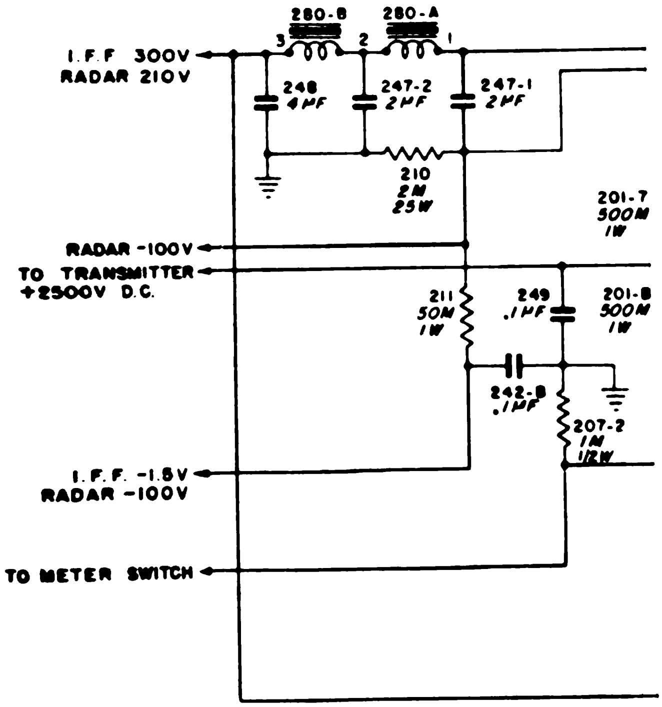


280-B
280-A
3
2
1
I.F.F 300V
RADAR 210V
248
4MF
247-2
2MF
247-1
2MF
210
2M
25W
201-7
500M
1W
RADAR -100V
TO TRANSMITTER
+2500V D.C.
211
50M
1W
249
.1MF
201-8
500M
1W
242-B
.1MF
207-2
1M
1/2W
I.F.F. -1.5V
RADAR -100V
TO METER SWITCH

Section VIII
METERING SYSTEM

67. METERING SWITCH CIRCUIT

a. Provision is made to meter the following voltages and currents, using the 0-1-milliampere meter in the test set:

(1) R-f oscillator cathode current (OSC. CURR.).
(2) R-f oscillator plate voltage (OSC. VOLT.).
(3) Modulator plate current (MOD. CURR.).
(4) Low voltage rectifier output (MOD. VOLT.).
(5) Second detector current (DIODE CURR.).

b. The circuit to be measured is selected by the METERING SWITCH 263 (fig. 47) and placed on the A and B terminals of the METERING receptacle on the front panel of the transmitter-receiver. This is receptacle 266 (fig. 47) and is connected by the metering cable, Cord CG-76/TPX-1, to the TRANSCEIVER METERING receptacle on the test set. When the METER SWITCH on the test set is placed in the TRANSCEIVER METERING position, the connections are the same as if the test set milliammeter, in series with a 1/32-ampere protective fuse, were connected between terminals A and B of receptacle 266 with polarity as shown on figure 47.

c. Simplified drawings of the circuits selected by the METERING SWITCH 263 (fig. 47) are presented in figure 49 and are discussed in paragraphs 68 through 72.

68. OSC. CURR. SWITCH POSITION (Fig. 45)

a. Oscillator current is indicated by measuring the drop across cathode resistor 209, using resistor 208 as a multiplier in series with the milliammeter. The milliammeter is then a 0-20-volt, 1,000-ohm-per-volt voltmeter. As 3/23 of the total oscillator plate current flows through the meter, the total current can be determined by multiplying the meter reading by 23/3, that is, by 7.7. For example, if the meter reading is 0.5 ma, the total average plate current is $0.5 \times 7.7 = 3.85$ ma.

b. As a 2C26 tube ages and its emission decreases, both power output and current decrease. On the other hand, if the tube becomes gassy, current increases but power output decreases. Therefore the power output readings and the oscillator current readings (par. 33) must be compared as a basis for judgment of the tube condition.

c. The transmitter oscillator tube is cut off when the equipment is in the stand-by condition, and the oscillator current should then be zero. In the operating condition, the tube is cut off between pulses. Therefore the average current indicated by the milliammeter depends on pulse width and pulse recurrence rate as well as upon other factors, such as tube condition, input voltage, and impedance of the transmitting antenna system. (The latter factor varies with frequency. A typical reading for the 400-cycle recurrence rate (transmitter-receiver synchronized by Radar Set AN/TPL-1) is 0.5 ma).

69. OSC. VOLT. SWITCH POSITION (Fig. 45)

a. The high-voltage power supply potential is indicated by measuring the current through the high-voltage bleeder. The current is diverted through the meter by connecting the meter across resistor 207-2 which has a much greater resistance than the meter. The milliammeter is then a 0-4,000-volt, 1,000-ohm-per-volt voltmeter, and each 1/10 ma represents 400 volts. For example, a typical reading in the stand-by condition is 0.7 ma. The voltage at the plate of tube 231 is then $7 \times 400 = 2{,}800$ volts.

b. Since the oscillator tube is cut off in the stand-by condition, the current drain on the high-voltage power supply is only the bleeder current. The drop across the internal resistance of the power supply is low, and consequently the voltage output is high. Variations in the current reading from the typical reading of 0.7 ma will be due to the allowable variation in the resistance of the bleeder, variation in power-supply transformers, or variation in the 2X2 high-voltage rectifier tube. If a reading is lower than a previous reading made at the same line voltage, deterioration of the 2X2 tube should be suspected.

c. A typical reading in the operating condition (CHALLENGE switch in the ON position) is approximately 0.55 (2,200 volts at the plate of tube 231).

70. MOD. CURR. SWITCH POSITION (Fig. 45)

a. Modulator current is measured by diverting some of the modulator cathode current through the meter, using resistors 202 and 203 as a current divider. As 10/35 of the total modulator plate current flows through the meter, the total current can be determined by multiplying the meter reading by 35/10, that is, by 3.5. For example, if the meter reading is 0.42 ma, the total average plate current is $0.42 \times 3.5 = 1.47$ ma.

b. The modulator tube is not cut off between pulses when the CHALLENGE switch is in the OFF position, nor is it cut off when the switch is in the RADAR position. A typical reading under all conditions is approximately 0.4 ma.

c. The reading is slightly higher in the stand-by condition (0.41 or 0.42 ma) because the plate supply voltage for the modulator tube is slightly higher in the stand-by condition. In stand-by, the cathode is returned to a point 100 volts below ground (switch end of resistor 210, fig. 45); the plate is at 210 volts positive. The total supply voltage acting on the tube is 310 volts. In operating condition, the cathode is returned to ground and the plate is at 300 volts positive, or less. The difference in total supply voltage is due to the drop in B plus voltage caused by the added current drain on the power supply when the equipment is operating. With the higher supply voltage in the stand-by condition, the average current of the modulator tube is slightly higher. The pulses fed to the grid in the operating condition do not affect the average current; these pulses are induced in a transformer secondary, and the effect on plate current of the positive portion of the grid swing is cancelled by the effect of the negative portion of the grid swing.

71. MOD. VOLT. SWITCH POSITION (Fig. 45)

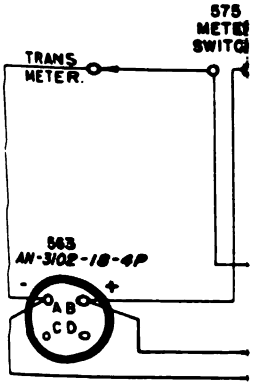
a. The potential on the B plus line from the low-voltage power supply is indicated by using resistor 201-1 as a multiplier in series with the meter. The meter is then a 0-500-volt, 1,000-ohm-per-volt voltmeter and each 1/10 ma represents 50 volts. For example, if the meter reads 0.7 ma, the B plus voltage is $7 \times 50 = 350$ volts.

b. Pulse recurrence rates do not influence the current drain on the low-voltage power supply enough to show a difference in meter readings. However, the reading in stand-by condition is different from the reading in the operating condition. A typical reading in the stand-by condition is 0.45 ma (225 volts), and a typical reading in the operating condition is 0.7 ma (350 volts). In the stand-by condition, 100 volts of the power-supply output appear below ground potential. It would be expected that the reading in the operating condition would be 100 volts higher than the reading in the stand-by condition, since this 100-volt portion of the output is moved up above ground potential. However, because of the larger current drain in the operating condition, the voltage drop in the power supply increases by about 25 volts, and the B plus lines are raised only 75 volts above their potential in the stand-by position.

c. It should be noted that these typical readings are not necessarily optimum readings. B plus voltage varies in different installations of satisfactory equipment. All schematics in this manual, Figure 47 for example, show voltages of 210 in the RADAR (OFF) position of the CHALLENGE switch and 300 in the IFF (ON) position. These voltages correspond to meter readings of 0.42 ma and 0.6 ma respectively. The meter readings depend on the waveform of the line voltage, the 5-percent tolerance of resistor 201-1, the manufacturing variations of transformer 270, and the characteristics of the 5U4G low-voltage rectifier tube. If, however, a reading is much lower than a previous reading taken at the same line voltage, the indication is that either the current drain on the power supply has increased abnormally, or the 5U4G tube has deteriorated.

72. DIODE CURR. SWITCH POSITION (Fig. 45)

Diode current is measured by shunting the meter across resistor 107-3, which is in the diode current return. Most of the current is diverted through the meter, since its resistance is much lower than that of resistor 107-3. The meter then furnishes readings of actual diode current. When the meter is taken out of the circuit, the diode load resistance is changed from 15,000 to 16,000 ohms, but the effect of this increase is neglible. No typical meter reading can be given because the detector output depends on the strength of the input signal to the receiver and on the setting of the IFF GAIN control. The DIODE CURR. switch position is used when tuning and aligning the receiver. With strong input signals, the meter goes off scale and the gain control must be turned down.


575
METER
SWITCH
TRANS
METER.
563
AN-3102-18-4P
-
+
A B
C D

Section IX

SUMMARY OF SYSTEMS

73. COMPLETE BLOCK DIAGRAM (Fig. 46)

This paragraph is a summary of the pulse and signal paths in the operating equipment. The power-supply, control, and metering systems are not included. The complete schematic diagram of the transmitter-receiver, which summarizes the functional schematics presented previously, is shown in figure 46. A discussion of the complete block diagram (fig. 46) follows.

a. The synchronizing signal supplied by Radar Set AN/TPL-1 consists of short positive pulses (A).

b. The synchronizing pulses are amplified by the synchronization amplifier and are delivered to the pulse oscillator as a series of essentially negative pulses (B). The amplitude of the output pulses (B) is independent of the amplitude of the synchronizing pulses (A).

c. The negative (B) pulses synchronize the pulse oscillator which produces a series of positive pulses (C), the duration and shape of which is fixed and independent of the duration and shape of the synchronizing pulses (A).

d. The pulse oscillator output (C) is delivered to the repetition rate limiter which converts it to a saw-tooth wave (D). This saw-tooth wave controls the gain of the synchronization amplifier. Since the recovery time of the saw-tooth is fixed, a limit is automatically set on the repetition rate at which the synchronization amplifier can respond to the synchronizing pulses. When the repetition rate of the synchronizing pulses exceeds some value in the range of 750 to 1,000 per second, the synchronization amplifier can not recover enough gain between pulses to respond to each pulse and therefore amplifies alternate pulses only. The amplified synchronizing pulses (B), and therefore the pulse oscillator output (C) will have a repetition rate which is a submultiple of the repetition rate of the synchronizing pulses (A). (This characteristic is actually not utilized in Radar Set AN/TPX-4 when used with Radar Set AN/TPL-1, since the synchronizing pulses are supplied at a repetition rate of 400 per second).

e. The output of the pulse oscillator (C) is supplied to the pulse amplifier which amplifies the pulses without appreciably changing the duration of the positive portion of the pulse.

f. The output of the pulse amplifier (E) is fed to the modulator which produces positive pulses (F) of the same duration as the positive portion of (E) but at a low impedance level.

g. The output of the modulator (F), grid modulates the transmitter which produces pulses of r-f energy (G), of essentially the same duration as (F). These r-f pulses are passed through the attenuator and then radiated by the antenna.

h. The radiated transmitter pulses (G) are received by the transpondor in a friendly aircraft during the portion of the transpondor tuning sweep at which it is sensitive to the r-f frequency of (G). During this portion of each sweep, the transpondor produces answering pulses of r-f energy (H) which are picked up by the IFF antenna.

i. The received r-f pulses (H) are amplified by the r-f amplifier at the received radio frequency.

j. The amplified r-f pulses (I) are fed to the mixer stage where they are mixed with the output of the h-f oscillator to produce pulses at i-f frequency (J).

k. The i-f pulses (J) are amplified by the i-f amplifier.

l. The amplified i-f pulses (K) are fed to the second detector where they are rectified to form negative video pulses (L).

m. The negative video pulses (L) are amplified by the first video stage to produce positive video pulses (M). The peak amplitude of these pulses is limited by the limiter at this point.

n. The output of the first video stage (M) is transformed to a low impedance level by the second video stage and delivered to the radar display as positive pulses (N)

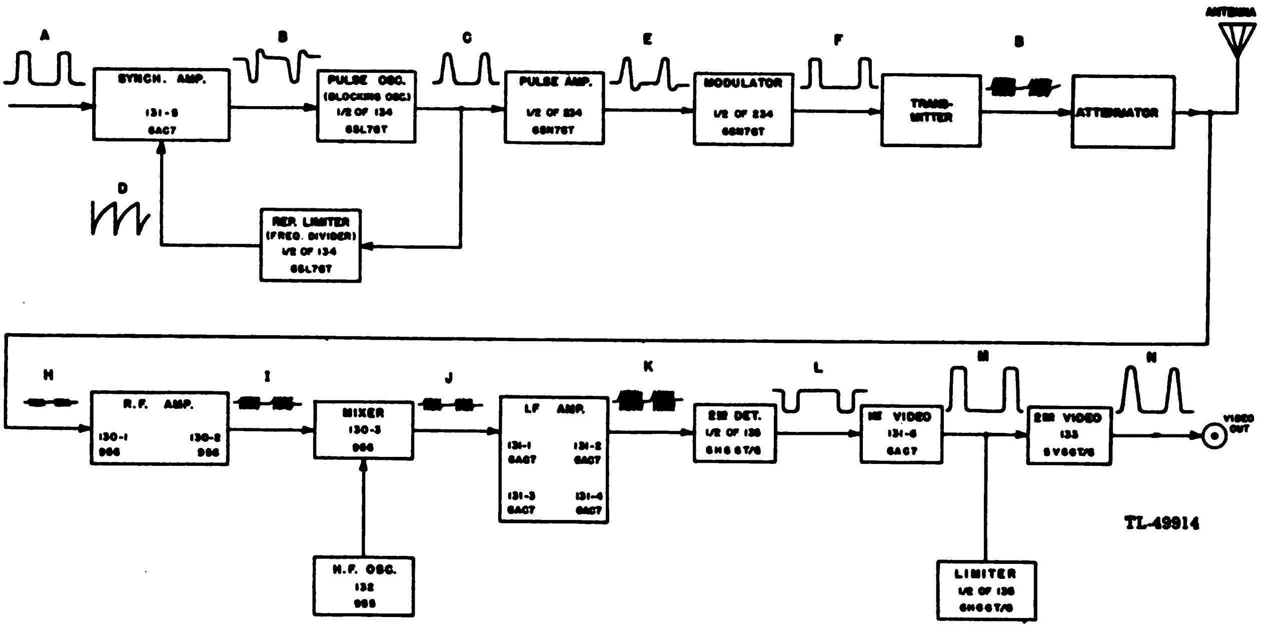


Figure 46. Transmitter-Receiver RT-48A/TPX-1, complete block diagram.

BLOWER

268	Ventilation

CAPACITORS

140-1	1st r-f cathode bypas
140-2	1st r-f heater bypass
140-3	1st r-f screen decoup
140-4	1st r-f plate decoupl
140-5	1st r-f coupling
140-6	2nd r-f cathode bypas
140-7	2nd r-f heater bypass
140-8	2nd r-f screen decoup
140-9	2nd r-f plate decoupl
140-10	2nd r-f coupling
140-11	H-f oscillator grid
141-1	Mixer heater bypass
141-2	Mixer cathode bypass
141-3	Mixer screen bypass
141-4	1st i-f cathode bypass
141-6	1st i-f heater
141-7	2nd i-f cathode bypass
141-9	2nd i-f heater
141-10	3rd i-f cathode bypass
141-12	3rd i-f heater
141-13	4th i-f cathode bypass
141-15	4th i-f heater
141-16	Diode heater
141-17	H-f oscillator heater bypass
141-18	1st video suppressor bypass
141-19	1st video heater bypass
142-A	Peak video limiter bias bypass
142-B	1st video screen bypass
142-C	1st video plate bypass
143-1	1st video plate coupling
143-2	Synch. amplifier cathode
143-3	3rd and 4th i-f screen stabilizer
144	Pulse oscillator grid time constant
145	H-f oscillator tuning
146	Video output coupling
147-1	1st i-f trap tuning
147-2	2nd i-f trap tuning
147-3	3rd i-f trap tuning
147-4	4th i-f trap tuning
147-5	5th i-f trap tuning
147-6	Video input filter
147-7	Video input filter
148-1	Synch. input coupling
148-2	Pulse oscillator coupling
149	Synch. amplifier screen
150-1	Mixer coupling
150-2	1st i-f coupling
150-3	1st i-f plate decoupler
150-4	2nd i-f coupling
150-5	2nd i-f plate decoupler
150-6	3rd i-f coupling
150-7	3rd i-f plate decoupler
150-8	4th i-f coupling
150-9	4th i-f plate decoupler
150-10	Mixer plate decoupler
150-11	H-f oscillator plate decoupler
150-12	1st i-f screen bypass
150-13	2nd i-f screen bypass
150-14	3rd i-f screen bypass
150-15	4th i-f screen bypass
241	Blower motor capacitor

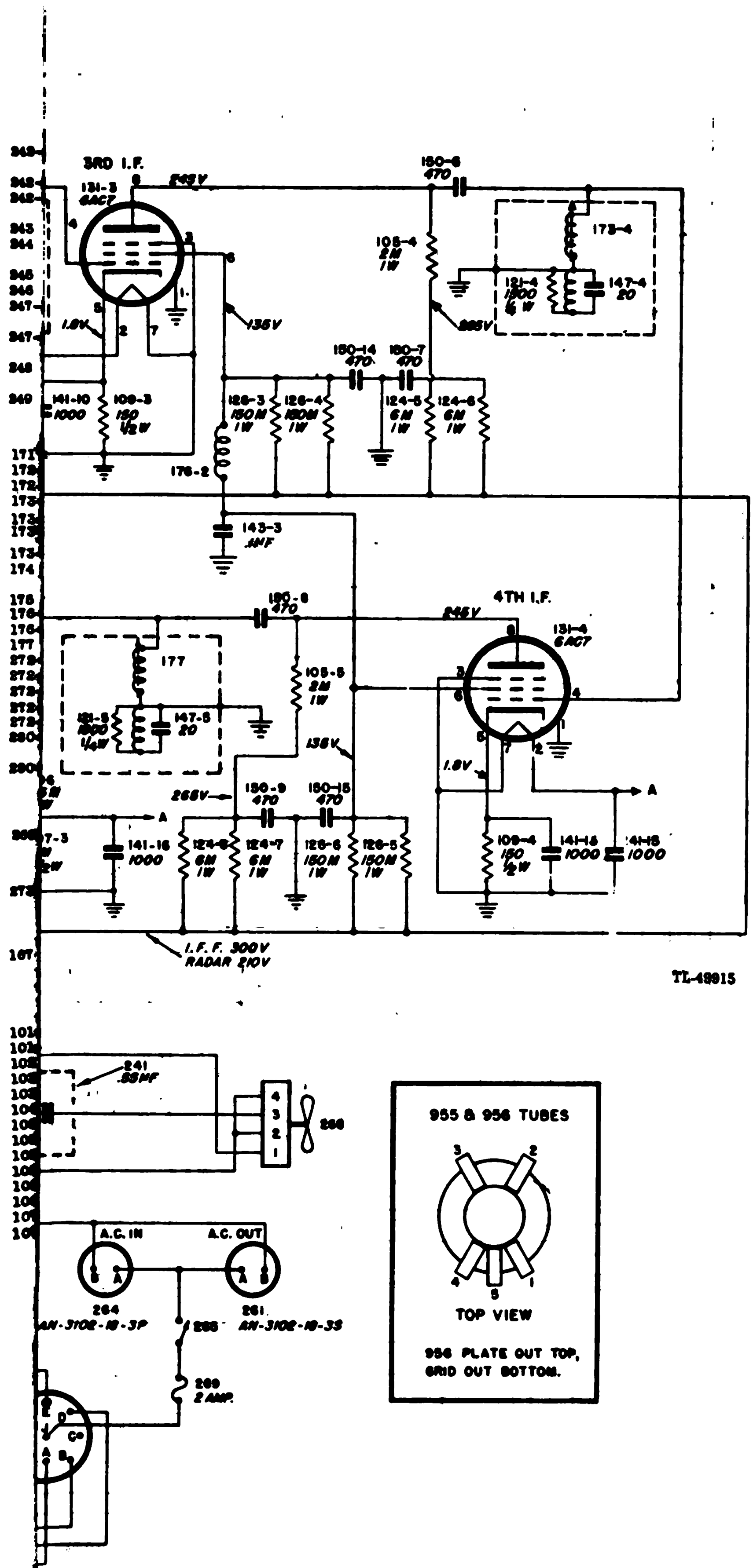


Figure 47. Transmitter-Receiver RT-48A/TPX-1, schematic diagram.

FUNCTIONS OF PARTS -- TRANSMITTER-RECEIVER TR-48A/TPX-1

BLOWER

268	Ventilation

CAPACITORS

140-1	1st r-f cathode bypass
140-2	1st r-f heater bypass
140-3	1st r-f screen decoupler
140-4	1st r-f plate decoupler
140-5	1st r-f coupling
140-6	2nd r-f cathode bypass
140-7	2nd r-f heater bypass
140-8	2nd r-f screen decoupler
140-9	2nd r-f plate decoupler
140-10	2nd r-f coupling
140-11	H-f oscillator grid
141-1	Mixer heater bypass
141-2	Mixer cathode bypass
141-3	Mixer screen bypass
141-4	1st i-f cathode bypass
141-6	1st i-f heater
141-7	2nd i-f cathode bypass
141-9	2nd i-f heater
141-10	3rd i-f cathode bypass
141-12	3rd i-f heater
141-13	4th i-f cathode bypass
141-15	4th i-f heater
141-16	Diode heater
141-17	H-f oscillator heater bypass
141-18	1st video suppressor bypass
141-19	1st video heater bypass
142-A	Peak video limiter bias bypass
142-B	1st video screen bypass
142-C	1st video plate bypass
143-1	1st video plate coupling
143-2	Synch. amplifier cathode
143-3	3rd and 4th i-f screen stabilizer
144	Pulse oscillator grid time constant
145	H-f oscillator tuning
146	Video output coupling
147-1	1st i-f trap tuning
147-2	2nd i-f trap tuning
147-3	3rd i-f trap tuning
147-4	4th i-f trap tuning
147-5	5th i-f trap tuning
147-6	Video input filter
147-7	Video input filter
148-1	Synch. input coupling
148-2	Pulse oscillator coupling
149	Synch. amplifier screen
150-1	Mixer coupling
150-2	1st i-f coupling
150-3	1st i-f plate decoupler
150-4	2nd i-f coupling
150-5	2nd i-f plate decoupler
150-6	3rd i-f coupling
150-7	3rd i-f plate decoupler
150-8	4th i-f coupling
150-9	4th i-f plate decoupler
150-10	Mixer plate decoupler
150-11	H-f oscillator plate decoupler
150-12	1st i-f screen bypass
150-13	2nd i-f screen bypass
150-14	3rd i-f screen bypass
150-15	4th i-f screen bypass
241	Blower motor capacitor

CAPACITORS

242-A	Oscillator cathode bypass
242-B	Standby bias filter
242-C	Pulse amplifier cathode bypass
243	Antenna trimmer
244	Pulse amplifier input coupling
245	Oscillator tuning
246	Oscillator plate blocking
247-1	Low voltage filter, input section
247-2	Low voltage filter, middle section
248	Low voltage filter, output section
249	High voltage filter

COILS

171	R-f input
172-1	2nd r-f grid
172-2	Mixer grid
173-1	1st i-f grid
173-2	2nd i-f grid
173-3	3rd i-f grid
173-4	4th i-f grid
174	Heterodyne oscillator tank
175	Pulse oscillator
176-1	1st video input filter
176-2	3rd i-f screen isolating
177	2nd detector
272-1	Oscillator heater choke
272-2	Oscillator heater choke
272-3	Oscillator cathode choke
272-4	Oscillator grid choke
272-5	Oscillator plate choke
280-A	Low voltage filter, input section
280-B	Low voltage filter, output section

FUSE

269	Line fuse

INDUCTOR

273	Oscillator tank

PLUG

167	Connects receiver chassis to transmitter chassis

RESISTORS

101-1	1st r-f cathode
101-2	2nd r-f cathode
102	1st video screen
103-3	Video output cathode load
103-4	Video output cathode loa
104	1st video plate filter
105-1	1st i-f screen filter
105-2	1st i-f plate load
105-3	2nd i-f plate load
105-4	3rd i-f plate load
105-5	4th i-f plate load
106	2nd detector load
107-1	Mixer cathode
107-2	Pulse oscillator cathod

RESISTORS

107-3	2nd detector metering shunt
108-5	1st r-f plate load
108-6	2nd r-f plate load
109-1	1st i-f cathode
109-2	2nd i-f cathode
109-3	3rd i-f cathode
109-4	4th i-f cathode
109-5	1st video cathode
110	Mixer plate filter
111-1	2nd r-f screen filter
111-2	H-f oscillator grid leak
112	Synch. amplifier cathode
113-1	1st r-f screen filter
113-2	Mixer screen bleeder
113-3	1st video plate
113-4	1st video plate
113-5	1st video plate
113-6	1st video plate
114	Mixer output r-f filter
115-1	2nd video grid
115-2	Pulse oscillator grid time constant
115-3	Pulse frequency repetition limiter grid
116-1	Mixer plate load
116-2	H-f oscillator plate dropping
118-1	H-f oscillator plate dropping
118-2	H-f oscillator plate dropping
119-1	Synch. amplifier grid
119-2	Synch. amplifier cathode bleeder
119-3	Synch. amplifier screen
120	Peak video limiter bias, variable
121-1	1st i-f trap loading
121-2	2nd i-f trap loading
121-3	3rd i-f trap loading
121-4	4th i-f trap loading
121-5	2nd detector trap loading
122	Mixer screen
123-1	1st r-f plate decoupler
123-2	1st r-f plate decoupler
123-3	2nd r-f plate decoupler
123-4	2nd r-f plate decoupler
124-1	1st i-f plate decoupler
124-2	1st i-f plate decoupler
124-3	2nd i-f plate decoupler
124-4	2nd i-f plate decoupler
124-5	3rd i-f plate decoupler
124-6	3rd i-f plate decoupler
124-7	4th i-f plate decoupler
124-8	4th i-f plate decoupler
125	Peak video limiter bias, fixed
[illegible]	2nd i-f screen
126-2	2nd i-f screen
126-3	3rd i-f screen
126-4	3rd i-f screen
126-5	4th i-f screen
126-6	4th i-f screen
200	Pulse amplifier grid
201-1	Modulator voltmeter
201-2	High voltage bleeder
201-3	High voltage bleeder
201-4	High voltage bleeder
201-5	High voltage bleeder

RESISTORS

201-6	High voltage bleeder
201-7	High voltage bleeder
201-8	High voltage bleeder
201-9	High voltage bleeder
202	Modulator current metering, series
203	Modulator current metering, shunt
204	Modulator cathode
206-1	Sensitivity control dropping
206-2	Sensitivity control dropping
206-3	Sensitivity control dropping
206-4	Sensitivity control dropping
207-1	Synch. amplifier cathode
207-2	Oscillator voltage metering shunt
208	Oscillator current metering
209	Oscillator cathode bias
210	Standby bias
211	Standby bias, filter
212	Oscillator grid leak
213-1	High voltage filter
213-2	High voltage filter

SOCKETS

160-1	Receiver antenna
160-2	Synch. out
160-3	Synch. in
160-4	Video out
260	Transmitter antenna connection
261	A-c out
262	Control cable connection
264	A-c in
266	Metering connection
267	Connection transceiver chassis

SWITCH

263	Metering switch
265	Safety interlock

TRANSFORMERS

170	Pulse oscillator
270	Plate transformer
271	Filament transformer
274	Pulse amplifier

TUBES

130-1	1st r-f
130-2	2nd r-f
130-3	Mixer
131-1	1st i-f
131-2	2nd i-f
131-3	3rd i-f
131-4	4th i-f
131-5	Synch. amplifier
131-6	1 video
132	H-f oscillator
133	2nd video
134	Pulse oscillator
136	2nd detector and peak limiter
231	Oscillator
232	Low voltage rectifier
233	High voltage rectifier
234	Pulse amplifier and modulator

Chapter 2

THEORY OF TEST SET TS-159/TPX

Section I

CIRCUIT DIVISIONS AND CHARACTERISTICS

74. GENERAL BLOCK DIAGRAM (Fig. 48)

The circuits of Test Set TS-159/TPX may be divided into four different functional systems.

a. Signal-Generating and Frequency-Measuring Systems. Signal-generating and frequency-measuring systems perform the following functions:

(1) Generate a signal variable over frequency range of IFF set for use in tuning IFF receiver.

(2) Produce a 30-megacycle signal for use in aligning the i-f stages of the IFF receiver.

(3) Provide a frequency selective circuit for measuring frequency of IFF transmitter output.

(4) Produce accurate calibrating frequencies for use in calibrating the frequency selective circuit mentioned in subparagraph (3) above.

b. Metering System. The metering system provides a means for taking certain current, voltage, and power readings on Transmitter-Receiver RT-48A/TPX-1. It acts as the indicator for other functions of the test set and may be used as a voltmeter for measuring external voltages.

c. Power-Measuring System. The power-measuring system is used in measuring the peak-power output of the IFF transmitter.

d. Power-Supply System. Power-supply system provides power for operation of Test Set TS-159/TPX.

75. GENERAL FEATURES AND TECHNICAL CHARACTERISTICS

R-F FREQUENCY RANGE:

As a signal generator	150-190 mc.
As a frequency meter	150-190 mc.
Calibration points	150, 160, 170, 180, 190 mc.

I-F SIGNAL OUTPUT:

Frequency	30 mc.
Amplitude	0-200,000 microvolts.

POWER MEASUREMENT:

Input impedance of circuit	50 ohms resistive.
Power-measuring range	0-800 watts peak power.

METER	0-1-ma d-c meter switched into various circuits to indicate currents, voltages, power, resonance.

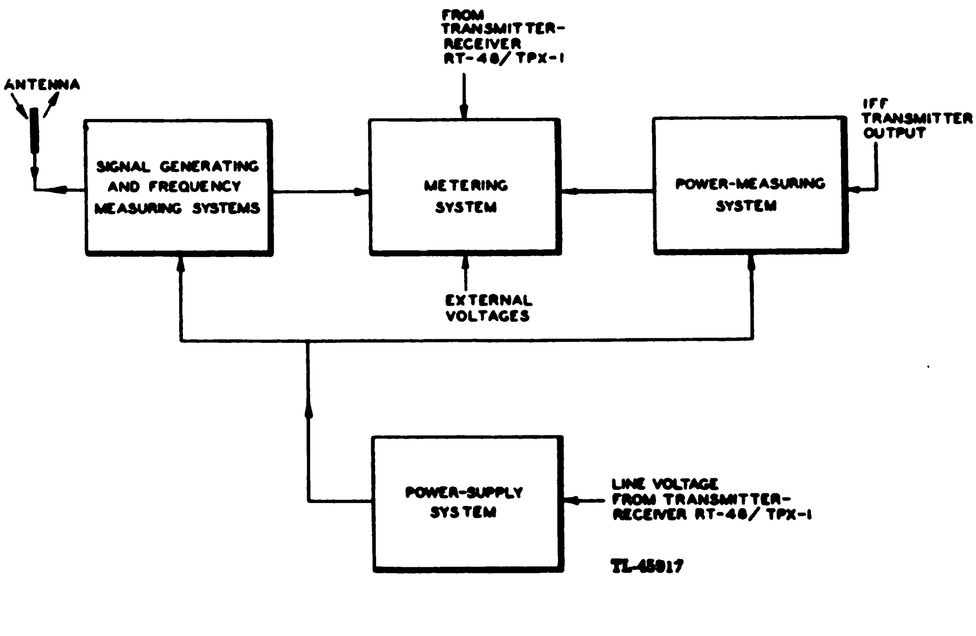


Figure 48. Test Set TS-159/TPX, simplified block diagram.

Section II

SIGNAL-GENERATING SYSTEM

76. CRYSTAL OSCILLATOR (Fig. 49)

The left-hand triode section of tube 531-3 is connected as a tuned plate crystal oscillator, using a 10-megacycle crystal (569) in the grid circuit. The plate tank consists of coil 573 and variable capacitor 548-1. Capacitors 542-6 and 542-7 are bypass capacitors and have a neglible effect on the frequency of the tank circuit. The output is taken from the left-hand plate (pin 2) of tube 531-3.

77. HARMONIC GENERATOR (Fig. 49)

a. The output of the crystal oscillator is coupled by capacitor 541-4 to the grid (pin 4) of the right-hand triode section of tube 531-3. This triode section operates as a harmonic generator. The plate (pin 5) is connected to a tank circuit consisting of capacitor 548-2 and coil 574. This tank circuit is resonant at 30 megacycles with the result that the third harmonic of the 10-megacycle crystal-oscillator output is amplified. The 30-megacycle energy is coupled by the single-turn secondary of transformer 574 to attenuator potentiometer 507 (marked 30 M.C. ATTENUATOR on the front panel). The variable output of potenticmeter 507 is coupled to receptacle 560-2 through blocking capacitor 541-5. This arrangement provides a source of 30-megacycle voltage, variable from about 0.2 volt to a very low value, suitable for aligning the i-f stages of the receiver of Transmitter-Receiver RT-48A/TPX-1.

b. The r-f current carried by tank capacitor 548-2 contains all the harmonics of 10 megacycles. These harmonics are coupled to the oscillating detector tank coil 571 by returning the current of capacitor 548-2 to ground through coupling coil 579. This provides a means for accurately calibrating the oscillating detector at any multiple of 10 mc which lies within the frequency range of the equipment (par. 79).

78. OSCILLATING DETECTOR AS AN OSCILLATOR (Fig. 49)

Tube 530 is connected as a shunt-fed oscillator tuned by capacitor 545 (DETECTOR TUNING) over the frequency range of 150 to 200 megacycles. The entire circuit is mounted in a shield box and capacitor 545 is driven by a precision vernier dial. The circuit is made to oscillate by closing switch 576-2 which shorts out plate dropping resistor 514-1, applying 150-volt B plus to the circuit. Hairpin coil 571 supplies the tank circuit inductance for the oscillator. The connection from tank coil to cathode is made through ground. Pick-up coil 578 couples the r-f energy in tank coil 571 to the antenna rod. The r-f power output radiated from the antenna rod is sufficient to tune the receiver of Transmitter-Receiver RT-48A/TPX-1 when Antenna System AS-134/TPX is 30 or 40 feet from the test set.

79. CALIBRATION OF OSCILLATING DETECTOR (Fig. 49)

The frequency of the oscillating detector (par. 78) may be accurately calibrated at 150, 160, 170, 180 and 190 megacycles. Harmonics of 10 megacycles from the crystal oscillator are coupled to hairpin tank coil 571 by coupling coil 579 (par. 77b). The oscillating detector tuning dial (which controls capacitor 545) is turned to the setting indicated by the calibration chart as correct for the calibration frequency desired. If the oscillating detector is properly tuned, its frequency will now be the same as the calibrating frequency (150, 160, 170, 180, or 190 megacycles, whichever has been selected). The signal produced by the oscillating detector will beat with the calibrating frequency to produce an audio-frequency signal which appears across grid resistor 500-4. If the oscillating detector frequency is exactly the same as the calibrating frequency, the two signals will zero beat, that is, produce a difference frequency of zero cycles per second with the result that no signal will appear across grid resistor 500-4. The tuning adjustments to produce this condition are extremely delicate, however, and for all practical purposes a slight difference between the two frequencies, indicated by an audio-frequency beat note, will indicate proper tuning of the oscillating detector. If the frequency of the oscillating detector is not the same as the calibrating frequency, adjust capacitor 546 (screwdriver adjustment) to obtain the audio beat-frequency signal. As the frequency of the oscillating detector approaches the calibrating frequency, the tone of the audio beat note becomes lower and lower. Capacitor 546 should therefore be adjusted to obtain the lowest possible tone of beat-frequency signal. The audio beat-frequency output is taken from the plate of tube 530, and amplified by the audio amplifier stages (par. 81). The tone is heard in the head phones plugged into PHONE JACK 565.

Section III

FREQUENCY-MEASURING SYSTEM

80. OSCILLATING DETECTOR AS A FREQUENCY-SELECTIVE DETECTOR (Fig. 49)

With switch 576-2 open (NON-OSC.), B plus voltage to the oscillating detector is reduced by the action of the voltage-divider circuit composed of resistors 514-1 and 514-2. The oscillating detector will no longer oscillate and therefore functions as a frequency selective detector. An r-f signal, pulse modulated at an audio-frequency rate, is generated by the transmitter of Transmitter-Receiver RT-48A/TPX-1 and is radiated from Antenna System AS-134/TPX. This signal is picked up by the antenna rod of Test Set TS-159/TPX and coupled to hairpin coil 571 by coupling loop 578. The oscillating detector circuit is tuned to a particular r-f frequency by capacitor 545. The amplitude of the r-f oscillations present in the oscillating detector circuit, therefore, will be greatest when the frequency of the incoming signal is the same as the frequency to which the oscillating detector is tuned. The incoming signal is comprised of pulses of r-f energy occurring at an audio-frequency rate. Tube 530 (955) now functions as a regenerative grid-leak detector with feedback occurring between the grid and the plate through the tank coil. The detected signal appearing at the grid of tube 531-1 will be an audio-frequency signal whose frequency is the same as the repetition frequency of the incoming r-f pulses. The amplitude of this audio-frequency signal will be maximum when the detector circuit is tuned to the r-f frequency of the incoming signal. The audio-frequency signal, as well as the r-f signal, is amplified by tube 530. The output is taken from the plate of tube 530 and fed to the audio amplifier stages through filter choke 572-3.

81. AUDIO AMPLIFIER STAGES (Fig. 49)

a. First and Second Stages. The two triode sections of tube 531-1 are connected as a two-stage resistance-coupled amplifier. The circuit is conventional except that grid bypass capacitors 547-2 and 547-3 are used to eliminate instability due to stray r-f coupling. The audio-frequency signal from the plate of tube 530 is coupled to the grid (pin 1) of the left-hand triode section of tube 531-1 by coupling capacitor 542-1. The output of the first audio amplifier stage is taken from the plate (pin 2) and coupled to the grid (pin 4) of the right-hand triode section of tube 531-1 by coupling capacitor 542-2. The output of the second amplifier stage is taken from the right-hand plate (pin 5) of tube 531-1.

b. Third Stage. The left-hand triode section of tube 531-2 is used as the third audio amplifier. This tube operates as a vacuum tube voltmeter. The cathode resistor, potentiometer 504 (PHONE GAIN), is sufficiently high in value for the tube to be nearly cut off in the absence of an audio signal. The cathode resistor returns to ground through meter 566 when METER SWITCH 575 is in TRANS. FREQ. position. When an audio signal is applied, cathode current increases (plate detector action) and the meter deflects upward. Audio output is taken from the potentiometer variable arm through blocking capacitor 542-4 to the headphone jack 565. The headphones are normally used to listen to the beat between the oscillating detector and crystal harmonic when calibrating the detector (par. 79). The meter indication is normally used to measure transmitter frequency, since the non-oscillating detector will produce maximum audio output at the transmitter repetition frequency when tuned exactly to the transmitter frequency (par. 80). The meter indicates when a calibrating crystal beat is tuned in, and could be used for calibration if a headset were lacking. The headset cannot be used in checking transmitter frequency since the ear can not distinguish changes in the amplitude of very sharp pulses.

FUNCTIONS OF PARTS

TEST SET TS-159/TP

CAPACITORS

540 Detector grid
541-1 Oscillator detector plate blocking
541-2 Diode head cathode
541-3 Diode head cathode
541-4 Crystal oscillator output coupling
541-5 I-f signal d-c blocking
542-1 Detector audio coupling
542-2 1st audio coupling
542-3 2nd audio coupling
542-4 Headphone coupling
542-5 Diode head filter
542-6 Crystal oscillator plate bypass
542-7 Triplet plate bypass
542-8 Detector plate filter
543 V-t voltmeter cathode
544-1 Plate rectifier filter input
544-2 Plate rectifier filter middle section
544-3 Plate rectifier filter output
544 Oscillator detector tuning
546 Oscillator detector trimmer
547-1 Detector heater bypass
547-2 1st audio grid bypass
547-3 2nd audio grid bypass
548-1 Crystal oscillator tuning
548-2 Tripler tuning

COIL

571 Detector tank
572-1 Detector heater choke
572-2 Detector heater choke
572-3 Detector plate choke
572-4 Detector cathode choke
573 Crystal oscillator tank
574 Tripler tank
578 Antenna coupling to detector
579 Harmonic coupling to detector

CONNECTOR

561 External meter posts

CRYSTAL

569 Calibrating crystal

FUSE

567 Meter fuse
568 Line fuse

JACK

565 Phone jack

566
500-1
500-2
500-3
500-4
501-1
501-2
502
503-1
503-2
503-3
504
505
506
507
508
509
510-1
510-2
511-1
511-2
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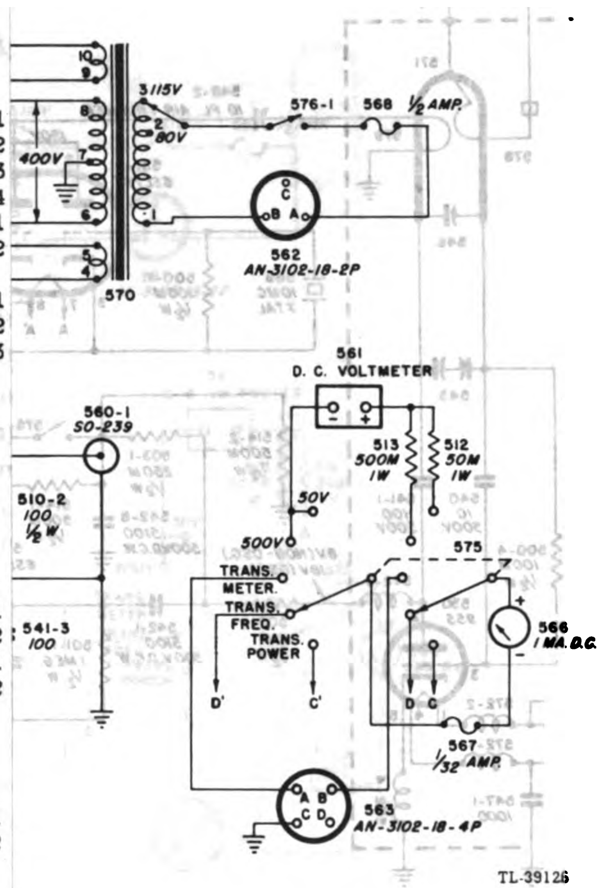


'igure 49. Test Set TS-159/TPX, schematic diagram.

FUNCTIONS OF PARTS

TEST SET TS-159/TPX

CAPACITORS

540	Detector grid
541-1	Oscillator detector plate blocking
541-2	Diode head cathode
541-3	Diode head cathode
541-4	Crystal oscillator output coupling
541-5	I-f signal d-c blocking
542-1	Detector audio coupling
542-2	1st audio coupling
542-3	2nd audio coupling
542-4	Headphone coupling
542-5	Diode head filter
542-6	Crystal oscillator plate bypass
542-7	Triplet plate bypass
542-8	Detector plate filter
543	V-t voltmeter cathode
544-1	Plate rectifier filter input
544-2	Plate rectifier filter middle section
544-3	Plate rectifier filter output
544	Oscillator detector tuning
546	Oscillator detector trimmer
547-1	Detector heater bypass
547-2	1st audio grid bypass
547-3	2nd audio grid bypass
548-1	Crystal oscillator tuning
548-2	Tripler tuning

COIL

571	Detector tank
572-1	Detector heater choke
572-2	Detector heater choke
572-3	Detector plate choke
572-4	Detector cathode choke
573	Crystal oscillator tank
574	Tripler tank
578	Antenna coupling to detector
579	Harmonic coupling to detector

CONNECTOR

561	External meter posts

CRYSTAL

569	Calibrating crystal

FUSE

567	Meter fuse
568	Line fuse

JACK

565	Phone jack

METER

566	D-c meter

RESISTORS

500-1	Crystal oscillator grid leak
500-2	Tripler grid leak
500-3	2nd audio plate
500-4	Detector grid leak
501-1	1st audio grid
501-2	2nd audio grid
502	Detector plate filter
503-1	Detector plate
503-2	1st audio plate
503-3	3rd audio grid
504	3rd audio cathode and headphone gain
505	Diode head rectifier, load top section
506	Diode head rectifier, load bottom section
507	I-f signal attenuator
508	V-T voltmeter cathode
509	V-t voltmeter bias bleeder
510-1	Diode head r-f load
510-2	Diode head r-f load
511-1	Rectifier filter input section
511-2	Rectifier filter output section
512	External meter multiplier for 50 v range
513	External meter multiplier for 500 v range
514-1	Detector plate dropping
514-2	Detector plate shunt

SOCKETS

560-1	Diode head receptacle
560-2	I-f signal output
562	A-c input
563	Metering connector

SWITCH

575	Meter function
576-1	Power switch
576-2	Detector, oscillator non-osc. switch

TRANSFORMER

570	Power transformer

TUBES

530	Oscillator detector
531-1	1st and 2nd audio
531-2	3rd audio and v-t voltmeter
531-3	Crystal oscillator and tripler
532	Diode head rectifier
533	Plate rectifier
534	Plate voltage regulator

Section IV

POWER-MEASURING SYSTEM

82. DUMMY LOAD CIRCUITS (Fig. 49)

Resistors 510-1 and 510-2 are connected in parallel across receptacle 560-1 to provide a 50-ohm dummy load for the transmitter of Transmitter-Receiver RT-48A/TPX-1. This dummy load may be used in place of the Antenna System AS-134/TPX, when it is desired to operate Transmitter-Receiver RT-48A/TPX-1 for test purposes.

83. POWER-MEASURING CIRCUITS (Fig. 49)

Peak voltage, generated across resistors 510-1 and 510-2 when the transmitter output of Transmitter-Receiver RT-48A/TPX-1 is connected to receptacle 560-1, is rectified by diode tube 532. The rectified voltage appears across resistors 505 and 506 in series. Capacitor 542-5 serves as filter capacitor. The electrical connections of capacitors 541-2 and 541-3 place them in parallel with capacitor 542-5; however, their capacitance, physical dimensions, and location are such that they perform a function in the circuit entirely different from that of capacitor 542-5. They are mounted directly on the tube socket of tube 532 and counteract the effect of stray inductance in the input circuit of the tube. One-third of the d-c output voltage of tube 532 appears across resistor 506 and is directly coupled to the grid of the right-hand triode section of tube 531-2. This triode functions as a peak vacuum tube voltmeter, and its cathode current is indicated on meter 566 when METER SWITCH 575 is in TRANS. POWER position. Resistor 509 is used to bleed a small amount of current through cathode resistor 508, with the result that the tube is cut off and the meter reading is zero in the absence of any transmitter output. Capacitor 543 bypasses cathode resistor 508 and smooths out any pulsations which may be present, thereby maintaining a constant current flowing through meter 566 for a given peak power input at receptacle 560-1, regardless of the pulse repetition frequency. A calibration of transmitter peak power versus meter reading is shown in figure 23.

Section V

METERING SYSTEM

84. METER (Fig. 49)

Meter 566 is a 1-milliampere d-c meter which may be switched into various circuits to perform all metering functions for Radar Set AN/TPX-4. The meter is always operated with fuse 567 in series.

85. METERING CIRCUITS

METER SWITCH 575 selects the following positions for meter 566:

a. TRANS. POWER. With METER SWITCH 575 in the TRANS. POWER position, the cathode current of the vacuum tube voltmeter (right-hand triode) section of tube 531-2 flows through meter 566 whose indication is then proportional to the peak transmitter power applied to receptacle 560-1 (par. 83).

b. TRANS. FREQ. With the METER SWITCH in the TRANS. FREQ. position, the cathode current of the third audio amplifier (left-hand triode) section of tube 531-2 flows through the meter. The meter indication will be maximum when the oscillating detector is tuned to the frequency of the IFF transmitter (par. 80).

c. TRANSCEIVER METERING. With the METER SWITCH in the TRANSCEIVER METERING position, the meter is connected to receptacle 563. From receptacle 563 it can be connected by Cord CG-76/TPX-1 to receptacle 266 on Transmitter-Receiver RT-48A/TPX-1 and used to meter currents selected by switch 263 on Transmitter-Receiver RT-48A/TPX-1 (pars. 67 through 72).

d. 500 VOLTS. With the METER SWITCH in the 500 VOLTS position, the meter is connected to the D.C. VOLTMETER binding posts through 500,000-ohm resistor 513 and may be used as a zero to 500-volt, 1,000-ohm-per-volt test voltmeter.

e. 50 VOLTS. With the METER SWITCH in the 50 VOLTS position, the meter is connected to the D.C. VOLTMETER binding posts through 50,000-ohm resistor 512 and may be used as a zero to 50-volt, 1,000-ohm-per-volt test voltmeter.

Section VI

POWER-SUPPLY SYSTEM

86. POWER-SUPPLY CIRCUITS (Fig. 49)

A-c power is taken in on terminals A and B of receptacle 562. The B side connects directly to the primary of power transformer 570. The A side connects through the LINE FUSE 568 and LINE SWITCH 576-1 to either the 80-volt or 115-volt tap on the transformer primary. Transformer 570 has three secondary windings. One supplies 400 volts, center-tapped, for the plate rectifier, one supplies 6.4 volts for all tube heaters except diode tube 532, and the third supplies 6.4 volts for the heater of tube 532. Tube 533 is used as a full-wave rectifier and operates into a two-stage capacitor input filter using capacitors 544-1, 544-2, and 544-3, and resistors 511-1 and 511-2. The filtered d-c output is regulated to 150 v by regulator tube 534 (OD3/VR-150).

Section VII

SUMMARY OF OPERATION OF TEST SET TS-159/TPX

87. COMPLETE BLOCK DIAGRAM (Fig. 50)

a. Oscillating Detector. The oscillating detector serves the dual purpose of an oscillator and a tuned detector. As an oscillator it generates a calibrated r-f signal which is radiated from the test set antenna to the antenna of the IFF equipment and used in tuning the IFF receiver. As a tuned detector it is used in tuning the IFF transmitter. It detects the pulsed IFF transmitter output picked up on the test set antenna, producing an audio-frequency output whose amplitude is maximum when the IFF transmitter is tuned to the same frequency as the detector input circuit.

b. Crystal Oscillator and Tripler. The crystal oscillator produces a 10-megacycle output which is used for two purposes:

(1) Harmonics of the 10-mc crystal-oscillator signal are used for calibrating the oscillating detector. The harmonic output of the crystal oscillator beats with the signal produced by the oscillating detector. An audio beat-frequency signal will result whenever the oscillating detector frequency is at a harmonic of the crystal oscillator output, i.e., 160, 170, 180, or 190 megacycles.

(2) The third harmonic of the crystal oscillator is amplified by the tripler (frequency selective amplifier) to produce a 30-megacycle output for use in aligning the i-f amplifier of the IFF receiver.

c. Audio Amplifier. (1) The first and second stages of the audio amplifier are used to amplify the audio-frequency output of the oscillating detector.

(2) The third stage of the audio amplifier produces an output which has a d-c component proportional to the amplitude of the audio-frequency input signal. This output is fed to a d-c milliameter and used as a tuning indication for tuning the IFF transmitter. The output of this stage can also be heard on the headphones. The headphones are used to listen to the beat note when calibrating the oscillating detector against harmonics of the crystal oscillator.

d. Transmitter Dummy Load and Peak Vacuum Tube Voltmeter. The transmitter dummy load and peak vacuum tube voltmeter are used in measuring the power output of the IFF transmitter. The transmitter dummy load consists of a 50-ohm noninductive load with a peak rectifier connected across it. The output of the peak rectifier is fed to a d-c peak vacuum tube voltmeter which produces a direct-current output proportional to the peak r-f output of the IFF transmitter. A d-c milliameter is used to measure this current.

e. Meter Switch. The meter switch selects the various metering circuits and connects a 1-milliampere d-c meter into these circuits in a manner such that the meter is used as an indicating instrument for measuring power, frequency, currents, and voltages.

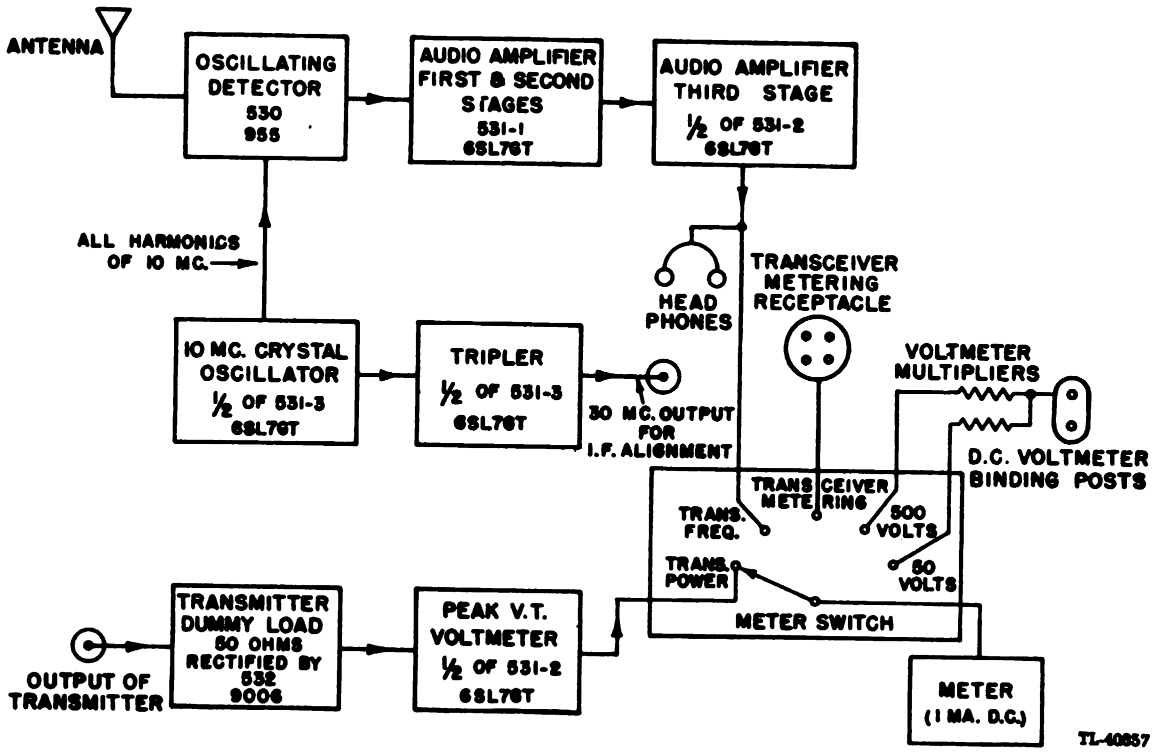


Figure 50. Test Set TS-159/TPX, complete block diagram.

Chapter 3

GENERAL TROUBLE-SHOOTING INFORMATION

88. INTRODUCTION

The purpose of this chapter is to aid personnel in locating and correcting faults as rapidly as possible.

a. Trouble-Shooting Data. Take advantage of the material supplied in this manual. Use the following trouble-shooting aids:

(1) BLOCK DIAGRAMS indicate graphically the electrical functioning of the circuit.

(2) COMPLETE SCHEMATIC DIAGRAMS indicate all components and show all electrical connections to other units.

(3) SIMPLIFIED AND PARTIAL SCHEMATIC DIAGRAMS are particularly useful in trouble shooting. They facilitate the analysis of the electrical functioning of the circuit.

(4) VOLTAGE, RESISTANCE, AND WAVEFORM MEASUREMENTS AT SOCKET CONNECTIONS are shown in the following chapters.

(5) ILLUSTRATIONS OF COMPONENTS (front, top, and bottom views) aid in locating and identifying parts.

b. Trouble-Shooting Steps. The first step when servicing a defective radar set is to *sectionalize* the fault. Sectionalization means tracing the fault to the *system* responsible for the abnormal operation of the set. The second step is to *localize* the fault. Localization means tracing the fault to the *part* responsible for the abnormal operation of the set. Although some faults, such as burned-out resistors and r-f arcing, can be found easily by sight, smell, or hearing, the large majority of them must be found by systematic voltage checks, resistance measurements, and waveform comparisons. The procedures to be follower are explained in subparagraphs c and d below.

c. Equipment Performance Log (EPL). The Equipment Performance Log is a record of the operation of the radar station. In the event of equipment failure or abnormal operation, reference to the EPL aids in sectionalizing the defect. Particularly note any remarks in the EPL concerning the operation of the equipment within the previous 24 hours. Failure may be the result of a previous abnormal condition not serious enough in itself to have caused the equipment to go off the air at the time. This condition and the equipment or parts affected by it are entered in the log book. Always check the log before trouble shooting.

d. Meter-Reading Sectionalization. Thoughtful interpretation of the meter readings may make the cause of trouble apparent. Paragraph 104 presents a trouble-shooting chart based on meter readings.

e. Localization. The following chapters describe the method used in localizing faults within the individual systems. These chapters contain trouble-shooting charts which list abnormal symptoms, their causes, and the procedure for finding the exact location of the fault.

89. VOLTAGE MEASUREMENTS

a. General. Most equipment failures are the direct result of abnormal voltages. Since voltage measurements are easily made and require no elaborate equipment, they are an indispensable aid to the repairman. Use all available data.

> CAUTION. — When measuring voltage in any r-f circuit, *always* shunt the meter with a small mica capacitor (approximately 0.00025 mfd). R-f can damage a meter beyond repair.

(1) To prevent overloading and damaging the voltmeter, set the meter on its highest range. Decrease the setting for accuracy.

(2) When checking very low voltages, such as cathode bias, remember that a reading is obtained when the cathode circuit is open. Internal meter resistance may act as a bias resistor. Thus, the cathode voltage may be approximately normal only as long as the voltmeter is connected between cathode and ground. Before measuring cathode voltage, check the resistance of the circuit (with power off) to make sure that the cathode resistance is normal.

b. High-Voltage Precautions. High voltages are dangerous and can easily prove fatal. When measuring voltages above a few hundred volts, observe the following precautions:

(1) Connect the ground lead to the voltmeter.

(2) Put one hand in your pocket and keep it there.
(3) Connect the test lead to the hot terminal.
(4) If the voltage is greater than 300 volts:
(*a*) Shut the power *off*.
(*b*) Connect the hot test lead.
(*c*) Step away from the voltmeter and turn the power on.
(*d*) Do not touch *any part* of the meter.
(*e*) Note the reading and shut off the power.
(*f*) Discharge any capacitors in the circuit and remove the meter.

c. Voltmeter Loading. If the voltmeter resistance is comparable to the circuit resistance, the voltmeter will indicate a lower voltage than the actual voltage present.

(1) The resistance of the voltmeter on any range can always be calculated by the following simple rule: Resistance of voltmeter equals the ohms-per-volt value multiplied by the full-scale range in volts. Two examples are shown below.

(*a*) Find the total resistance of a 1,000-ohms-per-volt voltmeter on the 300-volt range:

R = 1,000 ohms/volt × 300 volts = 300,000 ohms.

(*b*) Find the total resistance of a 20,000-ohms-per-volt voltmeter on the 30-volt range:

R = 20,000 ohms/volt × 30 volts = 0.6 megohm.

(2) To minimize voltmeter loading in high-resistance circuits, use the highest voltmeter range. Although only a small deflection is obtained (possibly only 5 divisions on a 100-division scale), the accuracy of the voltage measurement is increased. The decreased loading of the voltmeter more than compensates for the inaccuracy resulting from reading only a small deflection on the scale of the voltmeter.

(3) When a voltmeter is loading a circuit, the effect can always be noted by comparing the voltage readings on two successive ranges. If the voltage readings on the two do not agree, voltmeter loading is excessive. The reading, *not the amount of needle deflection*, on the highest range may be greater than on the lowest range. If the voltmeter loads the circuit heavily, the pointer deflection may remain nearly the same when the voltmeter is shifted from one range to another.

(4) The voltage and resistance drawings used in this manual are based on readings taken with an actual meter. The ohms-per-volt sensitivity of the meter used is given in the drawing. When trouble-shooting, use a meter having the same sensitivity.

d. Voltage Analysis. Figure 51 illustrates a typical amplifier stage. The values of the various parts and the input voltages are labeled. The normal voltages at the socket pins of tube V3 are:

Pin No.	1	2	3	4	5	6	7	8
Voltage	6.36	6.3 ac	0	0	6.36	150	0	208

Note.—All voltages are d-c unless otherwise specified. The d-c readings were taken with a 1,000-ohm-per-volt voltmeter.

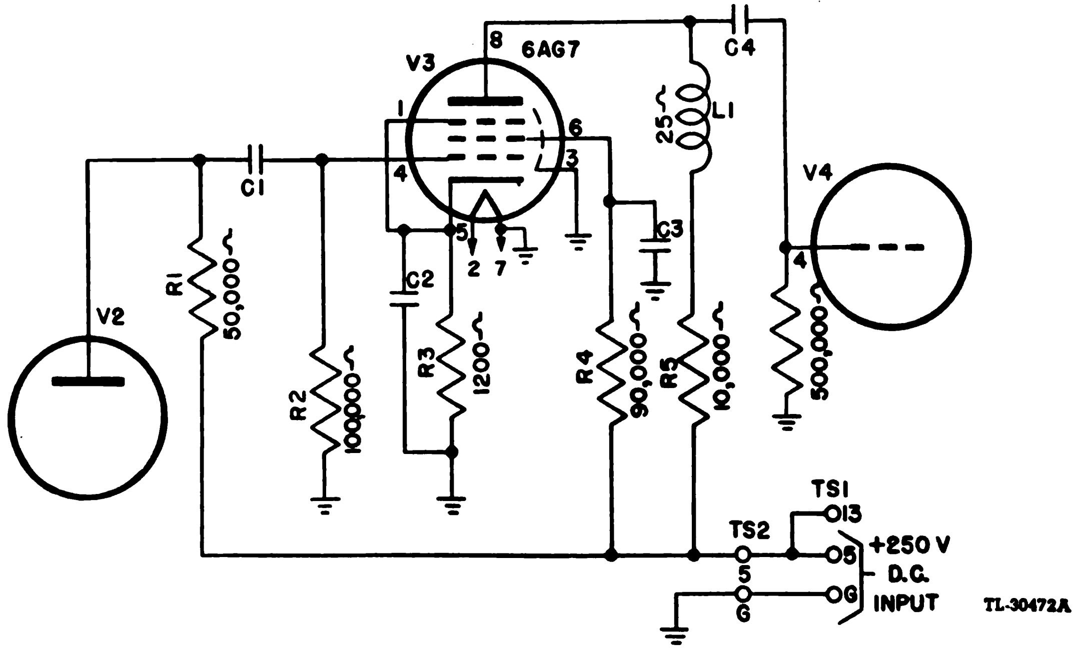


Figure 51. Voltage analysis schematic diagram.

(1) The voltage between pin 1 and the chassis is normally 6.36 volts (note chart above). This voltage should be the same as the voltage between pin 5 and the chassis (subpar. (4) below).

(2) The voltage between pin 2 and the chassis should be 6.3 volts a-c. Pin 2 is on one side of the filament.

Note.—No connections are shown on the diagram because the filaments of amplifier tubes are always connected to a low voltage a-c source. If this voltage is abnormal, check the voltage across the filament transformer.

(3) A Class A amplifier does not normally draw grid current; therefore, the voltage between pin 4 and the chassis should be zero. If capacitor C1 short circuits, the high positive voltage on the plate of tube V2 is delivered to pin 4, and a positive d-c voltage reading is obtained. An internal short circuit in the tube may cause a reading on this contact.

(4) The voltage on pins 1 and 5 should be 6.36 volts (see chart above). The plate-cathode voltage, screen-cathode voltage, and the grid-cathode voltage cause a current to flow through cathode resistor R3. This current is normally 0.0053 ampere (5.3 ma), because the resistor is rated at 1,200 ohms and the voltage across it is 6.36 volts:

$$I = \frac{E}{R} = \frac{6.36}{1{,}200} = 0.0053 \text{ ampere} = 5.3 \text{ milliamperes.}$$

(*a*) If there is no reading, check the plate-supply voltage, tube V3, resistor R3, capacitor C2, and circuit wiring.

(*b*) If the voltage reading is low, the trouble may be low electron emission of tube V3, leaky capacitor C2, open-circuited resistors R4 or R5, shorted capacitor C3 or C4, low plate-supply voltage, open-circuited coil L1, a poor connection, or a change in the value of any of the resistors.

(*c*) If the voltage reading is high, the trouble may be a gassy tube, a short-circuited resistor, too high an applied voltage, or a connection in either the plate-cathode or screen grid-cathode circuits shorted by an external circuit.

(5) Check the screen-grid voltage as follows:

(*a*) The voltage at pin 6 should normally be 150 volts and the voltage drop across the resistor should be 100 volts. (Voltage is 150 volts on one side of the resistor and 250 volts on the other side.) The normal current at this point is 0.0011 ampere (1.1 ma):

$$I = \frac{E}{R} = \frac{100}{90{,}000} = 0.0011 \text{ ampere} = 1.1 \text{ ma.}$$

(*b*) If no voltage reading is obtained at pin 6, check the applied voltage, resistor R4, capacitor C3, and associated circuit wiring.

(*c*) If the voltage reading at pin 6 is low, check capacitor C3; the applied voltage, and the grid bias voltage. Low voltage may be the result of a gassy tube.

Note.—A gassy tube or low grid bias of tube V3 increases the screen grid current. Increasing this current increases the voltage drop across resistor R4. If capacitor C3 is leaky or shorted, the screen grid of tube V3 is connected at or near ground potential, lowering the voltage on pin 6. The current through resistor R4 rises if capacitor C3 is shorted. Resistor R4 is then the only resistance between the applied voltage and the chassis ground and may burn out because of the high current flow. Any fault that causes a high current flow through the screen grid-cathode circuit burns out either resistor R3 or R4.

(6) The voltage between pin 7 and ground is zero normally, because this pin is connected directly to the chassis ground.

(7) The plate voltage is checked as follows:

(*a*) The voltage between pin 8 and the chassis is normally 208 volts. This is one of the points in the plate-cathode circuit comprising resistors R3 and R5, coil L1, and the plate resistance of tube V3. The applied voltage in this circuit is 250 volts. The voltage drop across resistor R5 and coil L1 in series is 42 volts (250 volts minus 208 volts). The current through resistor R5 and coil L1 is 0.0042 ampere (4.2 ma):

$$I = \frac{E}{R} = \frac{42}{10{,}025} = 0.0042 \text{ ampere} = 4.2 \text{ ma.}$$

(*b*) If there is no voltage reading at pin 8, check the applied voltage, resistor R5, coil L1, and connections between terminal 5 on terminal strip T81 and pin 8.

(*c*) If the voltage on contact 8 is low, the trouble may be a gassy tube V3, too low an applied voltage, a shorted or leaky capacitor C2, or a shorted resistor R3, causing the current through the plate-cathode circuit to rise, and increasing the voltage drop across resistor R5 and coil L1. This increase lowers the voltage at pin 8 and may burn out resistor R3 or R5.

(*d*) If the voltage is high, check tube V3, resistor R3, resistor R5, and the applied voltage. If the tube is burned out or resistor R3 is open, no current can flow through the plate-cathode circuit, and there is no voltage drop between the applied voltage and the plate of the tube.

(8) Check capacitor C4 (coupling capacitor to the grid of tube V4) for a shorted or leaky condition by measuring the voltage between pin 4 on tube V4 and the chassis ground. If positive d-c voltage is present at pin 4 of tube V4, the capacitor is leaky or shorted.

90. RESISTANCE MEASUREMENTS

a. General. A fault developing in a circuit very often appears as a change in the resistance values in the circuit. To assist in the localization of such faults, trouble-shooting data includes normal resistance values, as measured at the tube sockets and at the test jacks. Unless otherwise stated, these values are measured between indicated points and ground. It is often desirable to measure the resistance from other points in the circuit, to determine whether the particular points in the circuit are normal. To find the normal resistance value at any point, refer to the resistance charts or the schematic diagrams.

(1) CORRECT USE OF THE LOW AND HIGH RANGES OF THE OHMMETER. Set the voltmeter at its *lowest* range when checking for circuit continuity. To check high resistance or leakage in capacitors or cables, use the highest range.

(2) PARALLEL RESISTANCE.

(*a*) When trouble shooting with a schematic diagram, remember that the total resistance of a parallel circuit is less than the smallest resistor in the network. If the value of a resistor is less than it should be, make a careful study of the schematic diagram and be sure that there are no parallel resistances. Before replacing a resistor, disconnect one terminal from the circuit and measure its resistance again.

(*b*) In some cases, it is impossible to check a resistor that has a low-voltage transformer winding connected across it. To measure a resistor in this type of circuit, disconnect one terminal from the circuit.

(3) CHECKING GRID RESISTANCE. A false resistance reading may be obtained if a tube is still warm and the cathode is emitting electrons. Allow the tube to cool or reverse the ohmmeter test leads so that the negative ohmmeter test lead is applied to the grid.

(4) TOLERANCE VALUES FOR RESISTANCE MEASUREMENTS. *Tolerance* means the normal difference or variation that is expected between the rated value of the resistor and its actual value.

(*a*) Most resistors used in radar circuits have a maximum tolerance of 10 percent. For example, the grid resistor of a stage might have a rated value of 1 megohm. If the resistor is measured and found to have a value between 0.9 megohm and 1.1 megohms, it is considered normal. The ordinary resistors used in circuits are not replaced unless their values are off more than 20 percent. Some precision resistors and potentiometers are used. To check tolerance values, refer to chapter 6, maintenance parts list.

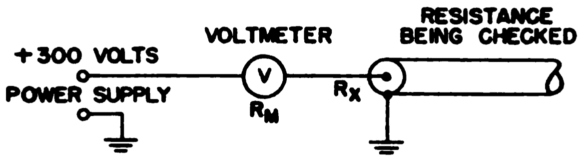
(*b*) The tolerance value for transformer windings is generally between 1 and 5 percent. Suspect a transformer which shows a resistance deviating more than 5 percent from its rated value. Allow the transformer to cool before the resistance test is made.

b. High-Resistance Measurements. Many leakages will not show up when measured at low voltages. Most ohmmeters use a maximum test voltage of 15 volts on the highest resistance range. When it is necessary to measure resistance above a few megohms, or the leakage resistance between conductors of a cable, the test should be made using a *voltmeter* and an applied voltage of 100 volts or more. When it is possible to ground one end of the resistance being checked, one of the low-voltage power supplies in the equipment can be used to provide about 300 volts for making these high-resistance measurements. The manner in which such measurements are made is indicated in figure 52. Use this method only when the resistance being measured is very high. Do not touch the meter after the circuit has been completed. An ammeter (plus the application of Ohm's law) can be used to make the same measurement. The device being measured, however, may break down and short out during the test, destroying the meter. The method shown in figure 52 protects the meter. Use a meter with an ohms-per-volt sensitivity of 1,000 or more. The resistance of the meter is equal to the ohms-per-volt sensitivity multiplied by the range to which the meter is set. The derivation of the formula $Rx = \frac{300\,Rm}{V}$ is shown below. Rx is the unknown resistance, Rm is the meter resistance, and V is the voltmeter reading:

$$\frac{Rx}{Rm} = \frac{300\text{-}V}{V}$$

If Rx is very large, V is small in comparison to 300. Assuming that 300-V can be replaced by 300, the formula $\frac{Rx}{Rm} = \frac{300}{V}$ is obtained. Solving for Rx gives $Rx = \frac{300\,Rm}{V}$. When making the measurement, first put the meter on the 300-volt scale to protect it in case Rx is very low. If the voltage used is not 300 volts, the correct value should be inserted in the formula in place of 300.

c. Resistance Analysis. The low-voltage power supply shown in figure 53 is used as a sample of



$$R_X = \frac{300}{V} R_M \text{ (APPROX.)}$$

EXAMPLE

V = 5 VOLTS. THE METER IS USED ON ITS 300 VOLT RANGE AND HAS A RESISTANCE OF 1,000 OHMS-PER-VOLT.

$$R_M = 300 \times 1{,}000 = 300{,}000 \text{ OHMS.}$$

$$R_X = \frac{300}{5} \times 300{,}000 = 18 \text{ MEGOHMS.}$$

TL-35530

Figure 52. Measurement of high resistance.

resistance analysis. If the fuse in the primary circuit of the power transformer blows, the cause is obviously an overload or short circuit in the unit, in the power supply itself, or in the primary circuit of the power transformer.

(1) Points 1, 2, 3, 4, 5, and 6 represent connections to the output plug. Disconnect the plug and replace the blown fuse. It is unlikely that any damage will be done by blowing another fuse. Turn the power on. If the fuse blows again, the trouble was *not* in the unit to which power is applied.

(2) If the fuse blows a second time, check the resistance between point 2 and ground. If this resistance is within 10 percent of 12,400 ohms (the sum of the resistances in the bleeder chain equals 12,400 ohms), the trouble is in the secondary or primary of the transformer. For the purposes of this analysis, assume that the resistance is found to be much less than 12,400 ohms.

(3) If the resistance between point 2 and ground is found to be zero, capacitor C3 is shorted. To test the capacitor, disconnect its lead from point M. The actual resistance of the capacitor can then be measured.

(4) A resistance between point 2 and ground of 550 ohms indicates that capacitor C2 is shorted; coil L1 has a resistance of 550 ohms. Test capacitor C2 by disconnecting it from ground and measuring its resistance.

(5) A resistance between point 2 and ground of 850 ohms indicates a short circuit in the rectifier tube, the filament winding, or capacitor C. To find the short, remove the tube from its socket and again measure the resistance between point 2 and ground. If the fault is still present, it is either in capacitor C or in the filament winding. If the fault disappears when the tube is removed, the trouble is in the tube.

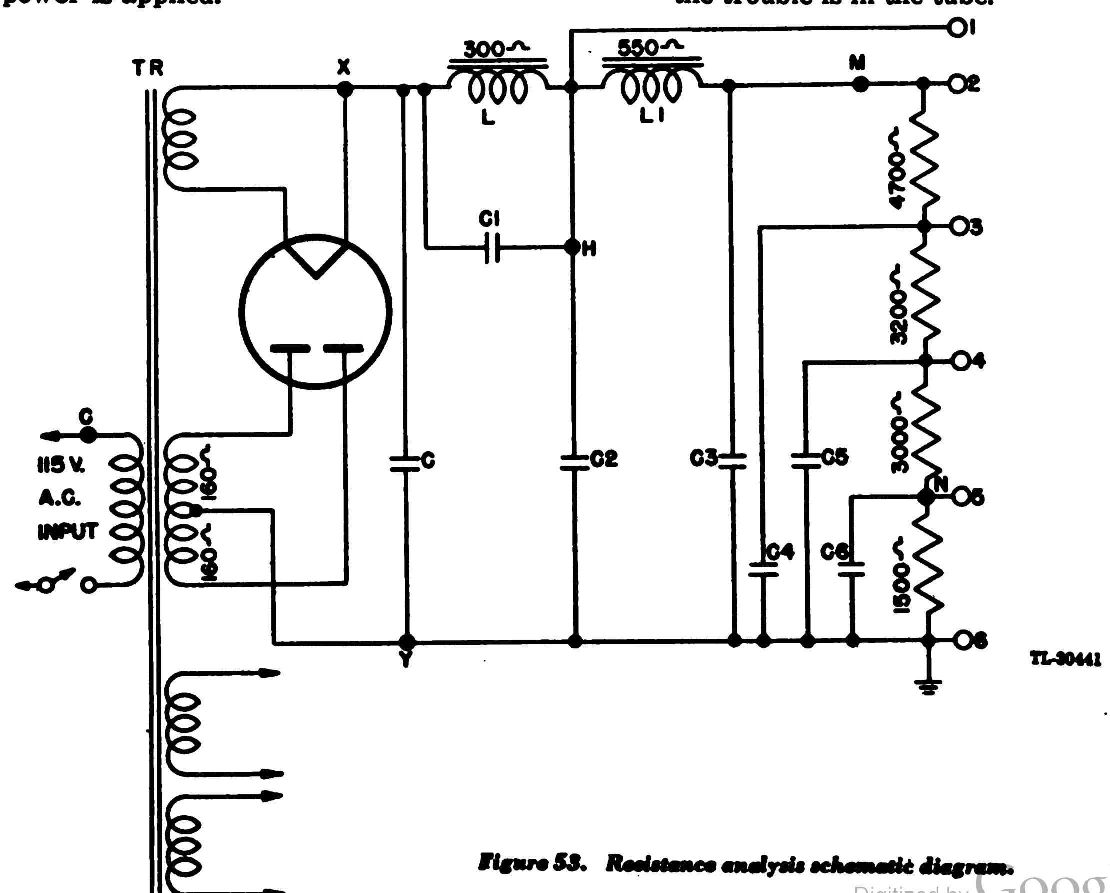


Figure 53. Resistance analysis schematic diagram.

(6) If the resistance between point 2 and ground is approximately 1,000 ohms, the trouble is in either the circuit to the right or to the left of point M. To isolate the trouble, disconnect the circuit at M. If the resistance between point 2 and ground is still much less than 12,400 ohms, the fault is in the bleeder chain. Measure the resistance of the individual resistors in the bleeder network:

(*a*) Measure the resistance between points 2 and 3. If it is not reasonably close to 4,700 ohms, the resistor between these points should be replaced.

(*b*) If the above check is satisfactory, the resistance between point 3 and ground should be 7,700 ohms. If the reading is zero, disconnect and check capacitor C4. If the capacitor C4 is normal, check the 3,200-ohm resistor. If the resistance between point 3 and ground is greater than zero but much less than 7,700 ohms, disconnect capacitors C4, C5, and C6 from the circuit. Check the capacitors and the 1,500-ohm and 3,000-ohm resistors individually.

91. CURRENT MEASUREMENTS

Current measurements, other than those indicated by the test-set meter, are not ordinarily required in trouble shooting in the radar set. A current measurement can be made by opening the circuit and connecting an ammeter in series with the circuit. This procedure is not recommended except in very difficult cases.

a. When the meter is inserted in a circuit to measure current, always insert it away from the r-f end of the resistance; for example, when measuring plate current, connect the meter at the power supply end of the resistor.

> CAUTION.—A meter has least protection against damage when it is used to measure current. *Always* set the current range to the highest value, then decrease the range to give a more accurate reading. Avoid working close to full-scale reading; this increases the danger of overload. When measuring current in any r-f circuit *always* shunt the meter with a small mica capacitor (approximately 0.00025 mfd). R-f can damage a meter beyond repair.

b. In most cases, current can be easily figured from Ohm's law. The current to be measured usually flows through a resistance which is either known or can be measured with an ohmeter. The current flowing in the circuit can be determined by dividing the voltage drop across the resistor by its resistance value. The drop across the cathode resistor is a convenient method of determining the cathode current.

92. CAPACITOR TESTS

Leaky or shorted capacitors can be found by resistance checks. An open capacitor can best be checked by shunting a good capacitor across it. In r-f circuits, keep the lead to the capacitor as short as the original capacitor leads. In video and low-frequency circuits (less than 1 megacycle), the test capacitor leads may be several inches long.

93. TUBES

a. Tube Failures. Tube failures are responsible for a large percentage of the faults which occur. There are, however, too many tubes in the equipment for a trouble shooter to attempt to find a fault by indiscriminate tube changing. Do not resort to tube changing until the fault has been traced to a particular stage.

(1) Before inserting a new tube in a circuit, note the position of all controls before making any changes. If retuning the controls with the new tube in the circuit does not correct the abnormal condition, turn the controls to their original position and put the old tube back in the circuit, unless a tube test proves that the tube is definitely bad.

> CAUTION.—In many high-frequency circuits, the interelectrode capacitance of a tube is a part of a tuned circuit. Tube switching upsets the tuning of a circuit. The set may become seriously misaligned if too many tube substitutions are made.

(2) When a tube is replaced, decide at once whether or not to keep the old tube. The result of indiscriminate tube changing is a spare-tube box full of tubes whose exact age and condition are uncertain.

b. Tube Checking. Tube testers are used to check the emission of electrons from the cathode and to test for shorted elements; a tester is not used to check the performance of high-voltage tubes, rectifiers, and some special tubes. Tube checkers are useful for checking receiving type tubes.

(1) Results obtained from a tube checker are not always conclusive, because the conditions are not the same as those under which the tube operates in the set. The final test of a tube is its replacement with a tube known to be good. It is quicker and more reliable to replace a suspected

tube with a good one than to check it with the tube checker.

(2) An operating chart and an instruction book are provided with the tube checker. This chart indicates the setting of the tube checker for each tube type. The number of controls, their arrangement, and their settings vary with different types of tube checkers.

c. Pin Connections. Pin connections on tube sockets are numbered in a clockwise direction around the sockets when viewed from the bottom. The first pin clockwise from the keyway is pin 1. Any tube element can be readily located by the pin numbers appearing on both the schematic diagrams and the wiring diagrams.

94. CHECKING WAVEFORMS

a. Signal Tracing. Following a voltage through a circuit is known as signal tracing. The terms *signal* means a sweep voltage, a step voltage, or any other waveform which appears in the various parts of the equipment. A departure from the normal waveform indicates a fault located after the point where it was observed to be normal. For example, a waveform observed to be normal at the grid of a stage and abnormal at the plate of the same stage, indicates trouble in that stage.

(1) When the waveform of a blocking-oscillator tube or a similar circuit is found to be abnormal, replace the tube before making any further tests. If replacing the tube does not correct the trouble, put the original tube back in the circuit.

(2) If a component does not give the proper waveforms, the fault may be the result of the absence of a synchronizing or triggering pulse from another component. Start signal tracing at the signal input to the component.

(3) It is sometimes desirable to know definitely whether a signal voltage is getting to the grid of the first tube in a channel. Remove the first tube in the channel to make the grid connection of the tube available from the top of the chassis. Insert the test lead of the oscilloscope in the grid connection of the tube socket.

b. Use of Test Oscilloscope. The outstanding advantage of the oscilloscope is that it can be used to observe and to measure waveforms at various points in the equipment. By comparing the observed waveforms with the actual reference waveform shown in the data, the fault can be rapidly localized. If waveforms are measured at random, without logical procedure, loss of time results. Measuring waveforms with the test oscilloscope involves the following essential points:

(1) INITIAL ADJUSTMENTS. Set up the oscilloscope in accordance with the manufacturer's instructions.

(2) SWEEP FREQUENCY. Adjust the sweep frequency to a frequency *lower* than the repetition frequency of the waveform being observed. For ordinary measurements, adjust the sweep frequency so that two or three cycles of the waveform appear on the screen. If more detail is desired, increase the sweep amplitude to spread the waveform.

(3) SYNCHRONIZATION. Avoid excessive synchronizing voltage. If the synchronization control is advanced too far, the sweep will become nonlinear, resulting in distortion. Be sure that the fine frequency control on the oscilloscope is set to obtain a nearly stationary image. Advance the synchronization control only far enough to make the trace stationary.

(4) POWER-FREQUENCY PICK-UP. If there is a fault, it may be impossible to obtain a stationary pattern, even though the oscilloscope frequency control is properly adjusted. This effect is usually the result of a power-frequency modulation or pick-up combined with the observed waveform. Check by turning the oscilloscope sweep frequency to the lowest setting. If the effect is the result of cable pick-up, a stationary pattern can be obtained. Because of the much higher frequency of the waveform being observed, the inside of this pattern is more or less filled.

(5) REACTIONS OF OSCILLOSCOPE IN WAVEFORM. Remember that the oscilloscope, because it shunts capacitance and resistance across the circuit, modifies the actual operating waveforms present in the circuit. This does not affect the usefulness of waveform measurements. The reference waveforms shown in this manual were taken with a typical oscilloscope under the same conditions as those under which the repairman takes the waveforms.

(6) TEST LEADS. Avoid the use of a shielded test lead or twisted leads when taking waveforms, because they shunt a capacitance across the circuit under test and cause distortion. The waveforms shown in the test data were taken with an unshielded lead. Connect the ground lead at all times.

(*a*) Keep the ungrounded oscilloscope test lead away from other circuits to avoid feedback.

Bring test leads from the test points in a way which introduces a minimum amount of coupling.

(*b*) Keep the leads to the oscilloscope short when measuring grid voltages. The smallest reaction on the waveform is introduced when measuring the voltage across the output (cathode) of a cathode follower, or of any low-impedance circuit.

(*c*) When measuring waveforms in high-impedance circuits, do not handle the *hot* test lead. This action causes the waveform to be distorted as a result of loading the circuit and picking up power-frequency voltage.

(*d*) If a signal voltage is picked up on the test leads, the oscilloscope indication may be misleading. For example; a signal may appear on the oscilloscope even when a plate-to-grid coupling capacitor is open. This effect occurs most often in circuits carrying narrow-pulse waveforms. The waveform will be reduced in amplitude below the normal and will be distorted because the high-frequency components are overemphasized.

(7) R-F AND I-F CIRCUITS. Never measure waveforms in any of the r-f or i-f circuits. These frequencies are beyond the range of ordinary test oscilloscopes and no useful indications can be obtained.

(8) REVERSING LINE PLUG. In some instances, a more stable pattern may be obtained by reversing the a-c line plug of the oscilloscope circuit. This may reduce the amount of power-frequency pick-up.

(9) RELATIVE AMPLITUDE. When following the path of the signal through a component, the amplitude of the waveform usually increases as the checking point is advanced from the input stage toward the output stage. This, however, is not always true. When going from the grid to the cathode of the cathode-follower stage, there is a loss of about 10 percent signal amplitude. This is a normal condition. Another example is in connection with wave-shaping circuits, when a decrease in the width of a signal is sometimes accompanied by a decrease in amplitude (differentiating circuits).

(10) CALIBRATION. If it is necessary to measure the voltage of the waveform, calibrate the oscilloscope by finding how many volts correspond to a 1-inch deflection on the screen. This is the *sensitivity* of the scope.

(11) HIGH-VOLTAGE MEASUREMENTS. To measure voltages above a few hundred volts. turn the power off at the source before connecting the test lead.

c. Comparison of Waveforms. If there is no fault in the circuit or equipment, an actual waveform taken at a point in the equipment should closely resemble the reference waveform. In some cases differences in shape may occur for the following reasons:

(1) The test leads to the oscilloscope are not placed properly.

(2) The test oscilloscope used has values of input resistance and capacitance differing from those of the oscilloscope used when taking the reference waveforms.

(3) The various equipment controls are in a different position from the settings used when taking the reference waveforms.

(4) The frequency is different.

(5) The vertical or horizontal amplitudes of the reference and the test patterns are not proportional. This produces apparent differences in the shape of the two waveforms although there is no real difference.

(6) Whether or not a waveform is regarded as abnormal depends upon the symptom accompanying the fault being traced. The discrepancy should be considered significant if the fault could be caused by a minor difference in waveform at the point under test. Otherwise, time should not be spent in hunting down the cause of relatively minor differences between the shape of the reference waveforms and of the test waveforms.

95. REPLACING PARTS

Careless replacement of parts often creates new trouble. Note the following points:

a. Before a part is unsoldered, note the position of the leads. If the part, such as a transformer, has a number of connections to it, tag each of the leads.

b. Be careful not to damage other leads by pulling or pushing them out of place.

c. Drops of solder falling into the set may cause short circuits. A carelessly soldered connection is a very difficult fault to find.

d. Replace parts in r-f or i-f circuits exactly as they were originally. A part having the same electrical value, but different physical size, may cause trouble in h-f circuits. Give particular attention to proper grounding. Use the same ground point as in the original wiring. Failure to observe these precautions results in decreased gain, or in oscillation of the circuit.

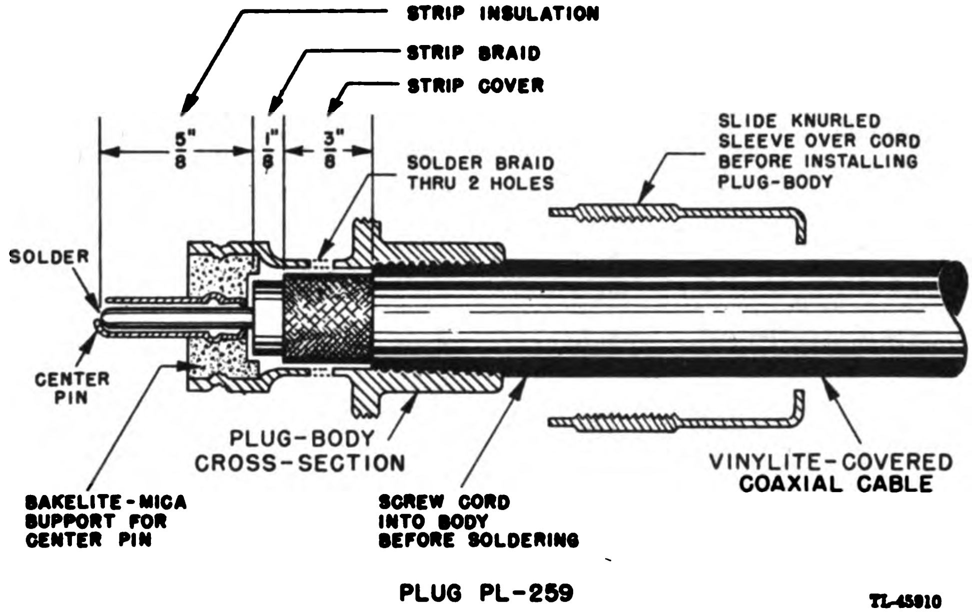


Figure 54. Plug PL-259, cable preparation and assembly.

96. REPLACING CABLE CONNECTORS

a. When insulation at a cable connector becomes frayed, cracked, or cut, or when leads have pulled loose, repair or replacement is necessary. If the cord is long enough to permit cutting the wire back to where the insulation is in good condition, remove the connector and clean it carefully, using crocus cloth and dry-cleaning solvent. If necessary, re-tin those surfaces to which the wires are to be soldered. Prepare the wire and replace the connector.

b. The following table specifies the terminations of the interconnecting and test cords furnished with Radar Set AN/TPX-4. All these cords are vinylite covered, making the replacement of connectors comparatively easy. Figures 54 and 55 are self explanatory aids in the cable

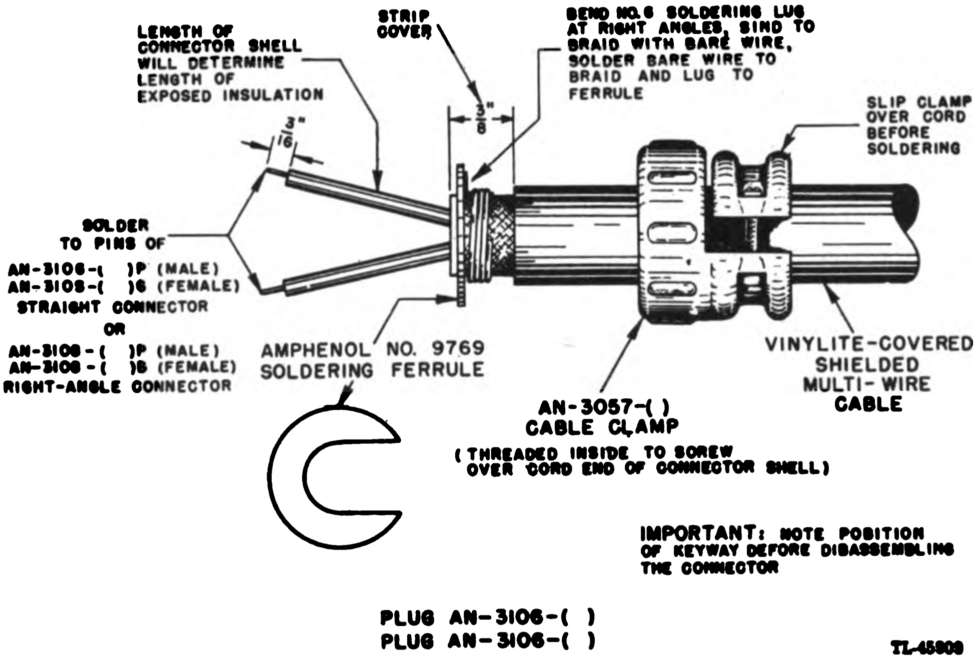


Figure 55. Plugs AN-3106-() and AN-3108-(), cable preparation.

INTERCONNECTING CORDS AND CABLES*

Cord	Terminal A	Terminal B	Type and length
CG-100/U (50 ft. 0 ")	Plug UG-21/U	Plug PL-259 and angle Adapter M-359	50 ft. 52-ohm coaxial, AN type RG-8/U
CG-242/U	Plug PL-259	Plup PL-259	22" 52-ohm coaxial An type RG-8/U
CX-596/TPX	Plug A3-3106-18-3S	Plug AN-3108-18-3P	6 ft. 2-conductor, rubber co‥ered
CG-282/TPX	Lapp 26243	Plug UG-21/U	10 ft. 10" 52-ohm coaxial AN type RG-8/U

Cord	Terminal A	Terminal B	Terminal C	Terminal D	Terminal E
CX-304/TPX-3	Plug AN-3106-28-1P	Plug AN-3108-22-17F	Plug PL-259 and angle Adapter M-359	Plug PL-259 and angle Adapter M-359	Plug AN-3108-18-38

CORD CONNECTORS, TEST CABLES*

Cord	Terminal A	Terminal B	Type and length
CX-159/TPX-1	Plug-AN-3108-18-3P	Plug AN-3108-18-22S	72", 2-conductor, type WD-2/U
CG-76/TPX-1	Plug AN-3108-18-4P	Plug AN-3108-18-4S	72", 2-conductor, type WD-2/U
CG-109/TPX-1	Plug P1-259	Plug PL-259	60", 52-ohm coaxial, AN type RG-8/U
CG-110/TPX-1	Plug P1-259	Mueller No. 85 crocodile clips	60", 50-ohm coaxial, AN type RG-58/U

*For use and quantity supplied, see table in paragraph 9.

preparation and assembly of Plugs PL-259, AN-3106-(), and AN-3108-(). Angle Adapter M-359 needs no wiring. Connection to the Mueller crocodile clips is obvious upon inspection.

c. Be extremely careful to attach the proper wire to the correct pin number on the multiwire assemblies. Use an ohmmeter to determine continuity and to test for absence of shorts and cross connections. Ground connections must be electrically and mechanically secure. *AN OPEN GROUND CONNECTION OR A MISPLACED WIRE CAN CAUSE DEATH OR DAMAGE TO THE EQUIPMENT.*

d. When soldering, remember that *flux cannot clean a dirty terminal.* The primary considerations in soldering are a clean tinned terminal, a clean tinned wire, and a hot tinned soldering iron tip of the proper size.

(1) Use only rosin-core solder.

(2) Do not permit the melted flux or solder to flow around the pins or insulated part of the connector.

(3) Avoid excessive heating of the pins and insulated parts of the connector.

(4) A firm mechanical connection is necessary before beginning to solder. Clasp wire firmly to terminal to be soldered.

(5) Do not touch clean terminal with fingers because an oily film will be deposited.

(6) Apply the solder to the work, not to the iron. If the terminal is heated sufficiently, the solder will melt readily upon contact and adhere to the work, whereas when the solder is applied to the iron, it will cool when it hits the terminal and form a cold soldered joint which can be dislodged easily.

(7) If the solder forms globules and runs off the surface of the terminals, dirt, oil, or improper tinning is indicated.

(8) Be careful not to move the terminal or the wire when withdrawing the iron and before the solder has cooled to a bright hard joint. Any movement of the solder while it is solidifying will cause it to crystalize into a granular mass which will not adhere properly and which will make a high-resistance connection.

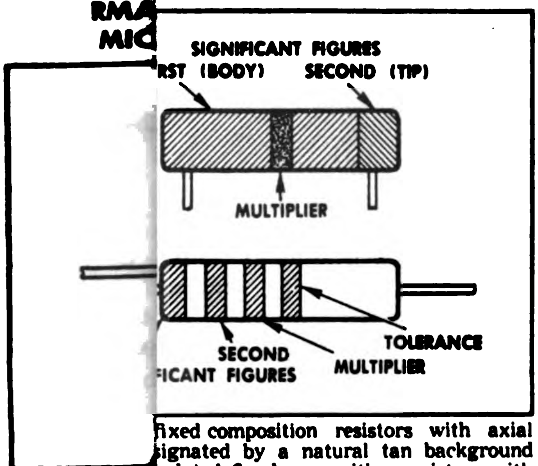
(9) Remove excess rosin and particles of solder and clean these surfaces carefully with dry-cleaning solvent. Even a microscopic film of rosin changes the characteristics of high-frequency circuits.

(10) When soldering in difficult places, see that no damage or short circuits have been caused by contact of iron with surrounding wiring. Use the proper soldering iron tip to avoid burning the insulation of nearby wires.

C RESISTOR CO LOR CODES

RMA MIC

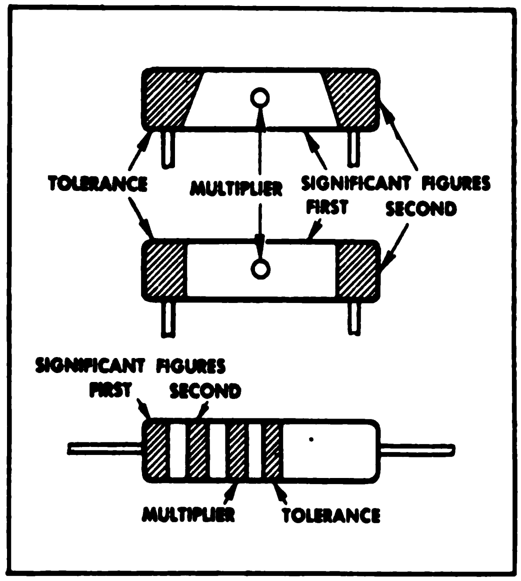
MA COLOR CODE FOR
COMPOSITION RESISTORS



fixed composition resistors with axial signated by a natural tan background sulated fixed composition resistors with re designated by a black background

Capacitor rating of 50

AWS COLOR CODE FOR FIXED COMPOSITION RESISTORS



The exterior body color of insulated resistors may be any color except black. The usual color is natural tan. The exterior body color of uninsulated resistors with axial leads may be either black or white. The exterior body color of uninsulated resistors with radial leads may be black or it may be the color of the first significant figure of the resistance value.

COLOR	SIGNIFICANT FIGURE	MULTIPLIER	TOLERANCE (PERCENT)
BLACK	0	1	
BROWN	1	10	
RED	2	100	
ORANGE	3	1000	
YELLOW	4	10,000	
GREEN	5	100,000	
BLUE	6	1,000,000	
VIOLET	7	10,000,000	
GRAY	8	100,000,000	
WHITE	9	1,000,000,000	
GOLD		0.1	5
SILVER		0.01	10
NO COLOR			20

RMA: *Radio Manufacturers Association*
AWS: *American War Standard (American Standards Association)*

TL-13418

Figure 56. Resistor and capacitor color code.

Chapter 4

TROUBLE SHOOTING THE OPERATING EQUIPMENT RADAR SET AN/TPX-4

Section I

TROUBLE SHOOTING BASED ON THE EQUIPMENT PERFORMANCE LOG

97. TROUBLE SHOOTING BASED ON LOG ITEMS

a. The record kept by the operating personnel in the Equipment Performance Log is very valuable to the trouble shooter. Item 23 (par. 32b) is a record of the range in yards of the farthest IFF target. The three possible reasons for a maximum range entry less than 60,000 yards are:

(1) No friendly aircraft was 60,000 yards away in the period covered by each log entry.

(2) The transmitter power was too low to trigger the transpondor in a friendly aircraft 60,000 yards away.

(3) The receiver output was too low to receive response from a friendly aircraft 60,000 yards away.

b. Item 29 (par. 32b) is a record of the over-all performance of the IFF equipment, and the entries under *NOTES* which refer to item 29 should clarify doubtful entries under item 23.

c. Item 30*a* (par. 33) is a record of peak power output. If the power output is adequate, an N* entry in item 29 must be due to a faulty receiving system. If the receiver cannot be improved sufficiently by tuning (par. 32b), the most likely defect is in a tube. Try replacing the following tubes in the sequence given. Leave in the set each replacement tube that shows a noticeable improvement.

Tube Type	Ref. No.
956	130-1
956	130-2
956	130-3
6AC7/1852	131-1
6AC7/1852	131-2
6AC7/1852	131-3
6AC7/1852	131-4
6AC7/1852	131-6
955*	132*
6V6GT/G*	133*
6H6GT/G*	135*

*It is unlikely that these tubes are the cause of trouble.

98. TROUBLE SHOOTING BASED ON METER READING

Paragraph 33 gives instructions for keeping a record of vacuum tube voltages and currents. If this record shows reductions from the normal values, figure 45 and paragraphs 68 through 71 suggest the following interpretations and corrective steps:

METERING SWITCH position	Typical normal values with challenge switch at: RADAR	IFF	Possible meaning of change from normal
OSC. CURR.	0	0.5	Drops progressively, power output drops, OSC. VOLT. and MOD. CURR. readings remain normal; replace tube 231 (2C26). Reads very high or off scale, MOD. CURR. and MOD. VOLT. normal; replace tube 231 (2C26).
OSC. VOLT.	0.7	0.55	Drops progressively, accompanied by drop in OSC. CURR. and transmitter power; replace tube 233 (2X2/879).
MOD. CURR.	0.42	0.4	Drops progressively, accompanied by drop in transmitter power, MOD. VOLT. normal; replace tube 234 (6SN7-GT).
MOD. VOLT.	0.45	0.7	Drops progressively; replace tube 232 (5U4G).

Section II

GENERAL TROUBLE SHOOTING OF THE OPERATING EQUIPMENT, RADAR SET AN/TPX-4

WARNING.—*Voltages sufficient to cause death on contact are exposed at many points in the transmitter-receiver. Always ground high-voltage capacitors before touching them or their associated circuits. Do not depend upon bleeders. If the safety interlock switch 265 is tied down for a test or measurement, there is no protection against high voltage. Do not place hands, arms, or tools within the transmitter-receiver when the power is on.*

99. REFERENCE DATA

The following illustrations are supplied to assist maintenance personnel to trouble shoot the operating equipment.

Fig. No.	Subject
47	Schematic diagram. (See also partial and simplified schematics, figs. 33, 35, 37, 40 through 45.
57	Tube location diagram.
58	Tube base connections.
59 through 68	Parts location illustrations, receiver chassis.
69 through 71	Voltage, resistance, and waveform diagrams, receiver chassis. (All voltages specified in this manual, whether on schematic or on voltage diagrams, are measured with a 1,000-ohm-per-volt d-c meter to ground, unless otherwise stated.)
72	Wiring diagram of receiver chassis.
73 through 78	Parts location illustrations, transmitter chassis.
79 through 81	Voltage, resistance, and waveform diagrams, transmitter chassis.
82	Wiring diagram of transmitter chassis.
56	Capacitor and resistor color codes.

100. GENERAL

a. Preliminary. If it becomes necessary to operate the transmitter-receiver outside its case, block the safety interlock switch 265 by depressing the actuator spring until a click is heard. A piece of tape or string may be used to hold it down.

CAUTION.—WHEN THE INTERLOCK IS BLOCKED THERE IS NO PROTECTION AGAINST VOLTAGE AS HIGH AS 2,500 VOLTS. WORK WITH ONLY ONE HAND PLACE THE OTHER HAND IN YOUR POCKET. BE SURE STRING OR TAPE IS REMOVED BEFORE REPLACING TRANSMITTER-RECEIVER IN ITS CASE.

b. Procedure. Attempt to diagnose trouble in advance by using the meter readings and operating indications. Study the trouble location and remedy chart (par. 103). Turn the power off and check the suspected defective components with an ohmmeter. Use the resistance charts, figures 70 and 80. If this method does not locate the trouble, block the safety interlock switch 265 and make voltage measurements as required using voltage charts, figures 69 and 79.

c. Shorting Plug. Plug PL-259 with the inner connector shorted to the plug body is provided in a pocket of the cloth roll containing the tools. In order to operate the receiver without allowing the transmitter to operate, attach this shorting plug to the SYNC. OUT receptacle on the transmitter-receiver front panel. This connection shorts out the sync pulse trigger to the transmitter (Fig. 47).

d. Dummy Load. A dummy load Plug PL-259 with a 50-ohm, 1-watt carbon resistor connected between the inner conductor and the plug body is provided in a pocket of the cloth roll containing the tools. Normally, the test-set power-measuring circuit is used as a dummy load when it is desired to operate the transmitter without radiating a signal. Connection to the test set is made as described in paragraph 33, item 30*a*. If the test set is not available, however, attach the dummy load plug to the TRANSMITTER ANTENNA receptacle on the front panel of the transmitter-receiver.

WARNING.—Do not remove the antenna cord from the TRANSMITTER ANTENNA receptacle when the transmitter is operating. The transmitter can be damaged during the time it takes to replace the transmitter antenna cord with the dummy load plug or the cord to the test set. Either throw the CHALLENGE switch to OFF or the IFF switch to off, or kill the sync trigger with the shorting plug at the SYNC. OUT receptacle (subpar. c above).

e. Voltmeter. Test Set TS-159/TPX has two binding posts, marked + and —, and designated D.C. VOLTMETER. These are connections for using the test-set meter as a 1,000-ohm-per-volt voltmeter. The two ranges available, 0-50 volts and 0-500 volts, can be selected by the METER SWITCH on the test-set front panel.

(1) The 0-50 volt range is marked 50 VOLTS on the METER SWITCH calibration. As the meter scale reads 0-1 ma, it is necessary to multiply the meter reading by 50 to determine the volt reading on the 50 VOLT position of the METER SWITCH. For example, a reading of 0.35 ma means 17½ volts ($0.35 \times 50 = 17.5$).

(2) The 0-500 volt range is marked 500 VOLTS on the METER SWITCH calibration. Multiply the meter reading by 500 to determine the volt reading on the 500 VOLT position of the METER SWITCH. For example, a reading of 0.47 ma means 235 volts ($0.47 \times 500 = 235$).

101. REMOVAL OF CHASSIS FROM CASE

To remove the chassis of the transmitter-receiver from its case, loosen the four bright-nickel-plated, slotted, ⅜-inch hex.-head captive screws located just above and below the handles. Use the ⅜-inch hex. socket wrench provided in the tool equipment. Then pull straight out on the handles.

Note.—Try to avoid separating the two chassis; most trouble shooting can be completed without this separation. The screws which hold the two chassis together are fastened into tapped extrusions of the chassis metal. The threads of these extrusions wear out rapidly.

102. TUBE REPLACEMENT (Figs. 57, 64, and 74)

Most of the tubes can be readily removed without special methods. The following tubes require special attention.

a. R-F Tubes 130-1, 130-2, and 130-3 (956). Remove the six screws which hold the r-f shield cover in place. Remove the plate and grid caps by sliding them along and off the end of the tube tips. Remove the tubes by rocking them in a vertical plane to free the lower group of prongs and then by pulling them out to the left. Replace the tubes by centering the prongs over the socket clips and giving them a firm push. Replace the grid and plate clips by pushing them on at right angles to the tip, using one finger to support the tip. Note that the grid and plate clips are identical in action with the socket clips. These tubes are delicate and should be handled carefully.

b. Low-Voltage Rectifier 232 (5U4). To remove tube, press the spring washer clamp down against the chassis with one hand and rock and pull upward with the other hand. An alternate method is to push down the clamp and hold the tube base with one hand, and push the tube out of the socket by pushing on the octal locating pin from the bottom of the socket. The 3/16-inch socket wrench in the tool equipment makes an ideal tool with which to push. To replace the tube; push the tube clamp down to the chassis, insert the tube, rotate the tube to locate the key in the tube base, and then push firmly downward.

c. High-Voltage Rectifier 233 (2X2). This tube uses a clamp similar to that used on tube 232. Depress both sides of the clamp attached to the chassis in order to insert or remove the tube.

d. Transmitter Oscillator 231 (2C26). In order to remove this tube, first remove the 2X2/879 rectifier tube 233. Remove the grid and plate caps by pinching the small wings together. This spreads the caps so that they may be lifted off. Hold the tube with one hand and push on the locating pin from the bottom of the socket with a 3/16-inch socket wrench. To replace the tube, locate the base key and push firmly downward. Pinch the plate and grid cap wings when replacing them.

103. TRANSMITTER-RECEIVER TROUBLE-SHOOTING CHART

Symptom	Possible Fault and Remedy
a. No IFF display. Filaments not lighted. Blower motor dead.	Check transmitter-receiver line fuse 269. Check for 115-v a-c from terminals A and B on A.C. IN plug on Cord CX-304/TPX-3. Trace a-c through interlock switch 265. Check IFF circuit breaker on radar set.
b. IFF operates but blower motor does not run.	Check blower motor for connections to capacitor 241. Check capacitor 241. Check blower windings for continuity. Terminal resistance is 90 ohms from 1 to 2, and 70 ohms from 3 to 4. Remove air filter and rotate blower wheel by hand to check for brozen bearings.
c. Tubes lighted, blower operating, no IFF display. no IFF main pulse.	Check for radar display on A-scope to check A-scope operation. Check as per suggestions below.

Symptom	Possible Fault and Remedy
d. Low receiver gain shown by absence of noise and distant responses.	Check to see that IFF GAIN is full on. Check transmitter power. Check MOD. VOLT. If normal, signal trace the receiver following the suggestions made in paragraph 104.
e. Receiver noise normal on A-scope. No main pulse or responses.	Transmitter either inoperative or mistuned. Check OSC. VOLT., OSC. CURR., and transmitter power. Check transmitter tuning.
f. Transmitter power low or zero (par. 33).	Check OSC. VOLT., OSC. CURR., MOD. VOLT., and MOD. CURR. Follow suggestions below. Refer also to paragraphs 97 and 98. If all meter readings but MOD. CURR. are normal, replace tube 231 (2026).
g. OSC. VOLT. zero.	Try new rectifier tube 233 (2X2/679). Check high voltage rectifier circuit for opens or shorts. DO NOT OPERATE SET IN THIS CONDITION.
h. OSC. VOLT. low.	Try new rectifier tube 233 (2X2/879). Check for open or leaky capacitor 249, and transformer 270. DO NOT OPERATE SET IN THIS CONDITION.
i. MOD. VOLT. zero, OSC. VOLT. normal or slightly low.	Try new rectifier tube 232 (5U4G). Check for shorts or opens in 300-volt rectifier circuit. If short is in receiver chassis, remove interconnecting cable plug 167. DO NOT OPERATE SET IN THIS CONDITION.
j. MOD. VOLT. low.	Try new rectifier tube 232 (5U4G). Filter capacitor 247-1 may possibly be open, or half-wave rectification exists because of an open in transformer 270.
k. MOD. and OSC. voltage about 35 percent high.	Check primary connections on transformers 270 and 271 for 115-volt connection. They may be connected for 80 volts.
l. OSC. CURR. and transmitter power zero. OSC. VOLT. and MOD. VOLT. normal.	Make sure IFF-RADAR switch is in IFF position and is operating properly. Try new transmitter tube 231 (2C26). Check modulator for pulse output. Check tubes 131-5 and 134. Check for open capacitor 242-A.
m. Transmitter pulses not properly synchronized. Responses and main pulse do not break baseline. Stray responses drift through display.	See if removing plug from SYNC. IN lowers OSC. CURR. about 50 percent. If not, transmitter is not being synchronized. Check for synchronizing voltage from radar. Check synchronizing amplifier stage (131-5, 6AC7/1852).
n. OSC. CURR. high, OSC. VOLT. and MOD. VOLT. normal.	Tube 231 (2C26) may be defective. Make sure transmitter load is connected. Check d-c voltage at junction of choke 272-4 and resistor 212. If in excess of 90 volts, defect may be in modulator cathode circuit. Check for open cathode resistor 209.
o. Receiver gain control inoperative.	Check IFF GAIN control in radar, and circuits in receiver leading from terminals D and H on receptacle 262.
p. Cannot tune transmitter to desired frequency.	Make certain the dial is tight on shaft of capacitor 245. Check test set. Increase test set antenna pick-up by moving test set to another position. Try bringing hand near test set antenna. Rotate antenna to face test set. Check transmitter power.
q. Cannot tune receiver to test set. Receiver responds to false signals not coming from test set.	Remove Cord CG-242/U from RECEIVER ANTENNA receptacle. If this eliminates false responses, they are probably due to interfering c-w signals. Obtain permission to change frequency. If false signal indications remain, the defect is in the receiver. Try tuning with CHALLENGE switch in OFF position. This lowers the gain of the receiver but will eliminate false responses during tuning. If the false response is found with the RECEIVER OSCILLATOR dial between 4 and 5 and the MIXER adjustment screwed out, the mixer is tuned to the local oscillator frequency. To tune the receiver to the high-frequency end of the band, screw the MIXER, R-F, and ANTENNA controls nearly all the way in and try tuning again. To tune to the middle or low end of the band, search carefully for a response between 4 and 1 on the RECEIVER OSCILLATOR DIAL.

104. SIGNAL TRACING THE RECEIVING SYSTEM

a. I-F Amplifier Tests. Test Set TS-159/TPX can be used to trace defects or circuit faults in the i-f amplifier as follows:

(1) Connect Cord CG-110/TPX-1 to the 30 M.C. OUTPUT of Test Set TS-159/TPX. This cable has two rubber-sleeved clips at one end to be used in supplying the 30 mc signal to the receiver.

(2) Connect Cords CX-159/TPX-1 and CG-76/TPX-1 from the transmitter-receiver to the test set (see pars. 23b and 25c).

(3) Set the METER SWITCH on the test set to the TRANSCEIVER METERING position.

(4) Set the METERING SWITCH on the transmitter-receiver to the DIODE CURR. position.

(5) Attach the red clip on Cord CG-110/TPX-1 to the grid (pin 4) of the fourth i-f tube 131-4 (6AC7), and attach the black clip to ground (chassis).

(6) Set the LINE SWITCH on the test set, and the IFF switch on the radar set to ON.

(7) Throw the DETECTOR switch on the test set to the NON-OSC. position. Set the 30 M.C. ATTENUATOR to full position (extreme clockwise rotation).

(8) An approximate midscale diode current indication shows that the fourth i-f stage and the second detector diode stage are operating.

(9) Turn off the transmitter-receiver.

(10) Attach the red clip lead to the grid of the third i-f tube 131-3 (6AC7), and attach the black clip lead to ground (chassis). Snap on the IFF switch and check diode current as before. The diode current meter should read off-scale until the 30 M.C. ATTENUATOR control is backed off.

(11) Repeat readings of diode current for the second and first i-f stages, tubes, 131-2 and 131-1. Appreciable gain in each stage is indicated by the need to back down the 30 M.C. ATTENUATOR.

(12) When checking the first i-f stage, the IFF GAIN control should vary the diode current meter from zero to off-scale. To avoid regeneration, the IFF GAIN control should not be set beyond half scale during this test.

(13) Connect the test cable to the mixer grid 130-3 (956), and again observe diode current. Keep IFF GAIN below half scale.

(14) No diode current reading or lack of increased sensitivity at any stage indicates a defective tube or a circuit fault. When proceeding from the fourth i-f grid to the mixer grid, the 30 M.C. ATTENUATOR should be reduced (counterclockwise) to keep the diode-current meter reading on scale.

(15) If no gain or little gain is found in any stage, try a new tube. If this does not help, check the tube socket pins for proper voltages. Check for open bypass capacitors by trying a new capacitor in parallel.

b. R-F Amplifier Tests. Do not make these tests until the i-f amplifier has been tested and is operating properly. For purposes of testing or trouble shooting only (not for r-f alignment), sufficient r-f signal is supplied by the 30 M.C. OUTPUT plug on the test set with the 30 M.C. ATTENUATOR in the extreme counterclockwise position.

(1) Set up for testing as directed in subparagraphs a(1) to (4) above.

(2) Set the 30 M.C. ATTENUATOR on the test set to the extreme counterclockwise position.

(3) Attach the red clip to the grid of the mixer tube 130-3 (956), and attach the black clip to ground (chassis).

(4) Set the DETECTOR TUNING dial on the test set to the desired operating frequency and throw the DETECTOR switch to the OSC. position.

(5) Set the LINE SWITCH on the test set and the IFF switch on the radar to ON.

(6) Set the IFF GAIN control to full.

(7) Tune the RECEIVER OSCILLATOR for a maximum diode current reading.

(8) No diode current rise indicates a defective receiver oscillator tube 132 (955).

(9) Remove the red clip from the mixer tube grid and attach it to the grid of the second r-f tube 130-2 (956), and attach the black clip to ground.

(10) Tune the MIXER tuning control for maximum diode current. The diode current meter should read off-scale unless the IFF GAIN control is reduced. No diode current reading indicates a bad tube or a circuit fault in the second r-f amplifier stage.

(11) Remove the red clip from the second r-f tube grid and attach it to the first r-f tube grid 130-1 (956), and attach the black clip to ground.

(12) Tune the R.F. tuning control for maximum diode current reading. No diode current reading indicates a bad tube or a circuit fault in the first r-f amplifier stage.

(13) When a defective stage is found, check the operating voltages at the tube socket terminals to locate a circuit fault. Replace any defective tube.

Note.—When replacing antenna coil 171, r-f coil 172-1, or mixer coil 172-2 in the field, it may be found that the turn spacing of the spare coil needs adjustment. This condition can be checked by attempting to align the set at both the low-frequency and high-frequency ends of the band. If the replaced coil does not tune to a proper peak at a low-frequency end, squeeze the coil turns together until a proper peak is found. If the coil does not peak at the high-frequency end, spread the turns apart. After each change in turn spacing, check *both* ends of the band.

c. Video Amplifier Tests. Do not make these tests until the r-f and i-f amplifiers have been tested and are operating properly. A suitable test pulse for checking video operation is obtained by observing the transmitter main pulse on the radar A-scope.

(1) Check transmitter and receiver tuning. They should be within 1 megacycle of each other.

(2) Observe the receiver VIDEO OUTPUT either by using the 30,000 yd. sweep on the A-scope or by using a test oscilloscope. If a test oscilloscope is used, the voltage appearing at the SYNC. OUT receptacle may be used to synchronize the oscilloscope. The transmitter pulses are of very short duration and must be observed carefully.

(3) Increase the PEAK VIDEO control to the maximum clockwise position. The pulse should increase to approximately 90 volts maximum.

(4) If no pulse is obtained, connect the test oscilloscope to the grid of the second video tube 133 (6V6-GT). Remove tube 133 to make sure a

shorted grid does not ground the signal. If the signal is obtained at this point, the defect is in tube 133 or one of its circuits.

(5) If no pulse is obtained on the grid of tube 133, check at the grid of tube 131-6, the 6AC7/1852 first video amplifier. If the receiver is working as far as the diode (subpars. a and b above), pulses should be found at this point. The level will be low (not over 10 volts). Remove tube 131-6 so that the signal will not be shorted out by a possible shorted tube grid. If pulses are found at this point, check the first video tube and associated circuits.

105. REMOVAL AND REPLACEMENT OF PARTS

a. Separation of the Two Chassis. See note in paragraph 101. Make certain that it is necessary to separate the chassis before beginning. If necessary, proceed as follows:

(1) Stand the assembly on its side so that the two rear support bars are parallel to the table.

(2) Remove the four screws which join the receiver portion to the transmitter portion of the front panel.

(3) Remove the nuts which hold the handles to the receiver portion and loosen the nuts which hold the handles to the transmitter portion of the front panel.

(4) Swing the handles clear of the receiver panel.

(5) Remove the two screws which hold each rear chassis-support bracket to the receiver chassis.

(6) Remove the Jones plug (167).

(7) Remove the receiver chassis from the transmitter chassis.

Note.—When reassembling, be extremely careful to avoid stripping the threads when starting the screws into the tapped holes of the aluminum panels.

b. Replacement of Tuning Slug (Fig. 63). Figure 63 shows a typical tuning-slug assembly. To replace slug, proceed as follows:

(1) Screw in the slug to within a few turns of the end.

(2) Loosen the Allen setscrew (fig. 63-A) which holds the hex driving nut (fig. 63-B) to the tuning-slug screw (fig. 63-D).

(3) Unscrew and remove the hex driving nut (fig. 63-B).

(4) Loosen the two screws (fig. 63-C) which hold the antibacklash nut retainer angle.

(5) With a small screwdriver, screw in the tuning-slug screw (fig. 63-D) until the back end of the slug appears outside the rear of the coil form (fig. 63-E). Screw out the slug the rest of the way by hand. Be careful not to lose the antibacklash nut (fig. 63-F) and the spring washer behind it.

(6) Grease the threaded portion of the new tuning slug with Grease, Lubricating, Special, Ordnance AXS-637.

(7) Insert the new tuning slug by reversing the above procedure.

(8) Adjust the antibacklash nut for minimum tension with no axial play.

c. Replacement of R.F. Coil 171 or ANTENNA Coil 172-1 (Fig. 63).

(1) Remove the tuning slug as described in subparagraph b above.

(2) Unsolder all connections to the old coil.

(3) Remove the two screws (fig. 63-G) which hold the bakelite tail block (fig. 63-H) to the mounting angle.

(4) Remove the assembly which consists of the coil on the coil form (fig. 63-E) and the bakelite tail block (fig. 68-H)

(5) Remove the coil form from the bakelite tail block.

(6) Install the bakelite tail block on the new coil form.

(7) Replace the assembly which consists of the new coil on the new coil form and the old bakelite tail block. Simply reverse the above procedure.

d. Replacement of MIXER Coil 172-2 (Fig. 60). The procedure for replacing coil 172-2 is the same as described in subparagraph c above, except that the pulse oscillator resistor board (fig. 60) prevents the moving of the coil assembly back in order to remove it. It is therefore necessary to loosen the two screws which mount this resistor board to the chassis so that the board can be moved aside.

e. Replacement of Components on the Filament and Cathode Side of Tubes 130-1 and 130-2 (Fig. 63).

(1) Screw in the tuning slugs as far as they will go.

(2) Remove the five screws which hold the entire r-f assembly to the main chassis.

(3) Twist the r-f assembly so that the mounting screws (fig. 63-I) holding the socket mounting shelves can be removed.

(4) Twist the socket mounting shelves so that the desired components are accessible.

f. Removal of Capacitor 242 (Figs. 73 and 74). Loosen the blower mounting screws in order to remove capacitor 242.

106. RECEIVER ALIGNMENT

a. Introduction. A complete receiver alignment consists of the following operations:

(1) I-f amplifier for maximum diode current with 30-mc input to mixer grid.

(2) Preliminary adjustment of local oscillator (RECEIVER OSCILLATOR) for maximum diode current with desired r-f frequency input to the RECEIVER ANTENNA receptacle.

(3) Adjustment of ANTENNA, R.F., and MIXER trimmers for maximum diode current with desired r-f frequency input.

(4) Final adjustment of local oscillator (RECEIVER OSCILLATOR) with desired r-f frequency input.

b. I-F Amplifier Alignment. (1) The i-f amplifier should be aligned only with exactly 30-mc input. This signal is available from the 30 M.C. OUTPUT receptacle on Test Set TS-159/TPX. Never align the i-f amplifier with an r-f signal applied to the receiver input. This precaution is necessary because of the tuned trap system used to broaden the i-f band. The traps are factory aligned to 30 mc and serve to reduce peak i-f gain at 30 mc. If the i-f amplifier were to be aligned for maximum gain at some other frequency (as 28 mc), the traps would no longer serve their intended purpose. The gain per stage could increase to the point of regeneration and the bandwidth would be greatly reduced. The traps should never require field adjustment; therefore, no provision is made for their adjustment.

(2) The i-f tuning adjustments are the green painted 3/16-inch hex nuts projecting from the bottom of i-f coils 173-1, 173-2, 173-3, 173-4, and 177 (fig. 60). A 3/16-inch hex socket and wrench is included in the tool equipment for adjustment. Connect Cord CG-110/TPX-1 to the 30 M.C. OUTPUT on Test Set TS-159/TPX and turn on the test set. Remove the shield covering the r-f stages of the receiver; fasten the red test clip of Cord CG-110/TPX-1 to the grid of mixer tube 130-3, and fasten the black clip to ground. Connect Cord CG-76/TPX-1 from the METERING receptacle on the transmitter-receiver to the TRANSCEIVER METERING receptacle on the test set. Set the transmitter-receiver METERING SWITCH to DIODE CURR. and the test set METER SWITCH to TRANSCEIVER METERING. Set the IFF GAIN at 1/3 full. Set the DETECTOR switch to NON-OSC.

(3) Turn on the receiver and advance the 30 M.C. ATTENUATOR on the test set until the meter reads approximately 0.5 milliampere of diode current. Trim each i-f coil carefully for maximum diode current; reduce the 30 M.C. ATTENUATOR, if necessary, to keep the meter on scale. Note that the adjustments tune broadly. Because of the broad tuning, care is necessary in finding the peak response.

c. R-F Amplifier Alignment (Bench Alignment). (1) Replace the r-f shield cover. Connect Cord CG-110/TPX-1 to the RECEIVER ANTENNA receptacle and lay the test clip end on top of the test set near the test set antenna. Set the DETECTOR TUNING dial on the test set to the desired frequency. Set the detector switch to OSC. Leave metering Cord CG-76/TPX-1 connected and leave the metering switches on DIODE CURR. and TRANSCEIVER METERING. Set IFF GAIN to full. Tune the RECEIVER OSCILLATOR dial for a maximum meter reading. If a suitable maximum is not found, increase the receiver signal input by moving the red test clip of Cord CG-110/TPX-1 closer to the test set antenna. If the meter goes off-scale, move the test clip away or reduce IFF GAIN. Trim the ANTENNA, R.F., and MIXER controls for maximum meter reading.

(2) After these controls are tuned, recheck the RECEIVER OSCILLATOR dial very carefully. The actual i-f response of the receiver may be slightly double-peaked. This will be evidenced by a slight dip in meter reading located between two peaks. The exact setting of the RECEIVER OSCILLATOR dial is on this slight dip. Lock the RECEIVER OSCILLATOR. When the set is installed for operation with the receiving antenna connected, it will be necessary to retrim the ANTENNA trimmer as instructed in paragraph 25.

107. TRANSMITTER ALIGNMENT

There is no alignment procedure for the transmitter. Refer to paragraph 38, item 8 for notes on the adjustment of capacitor 243.

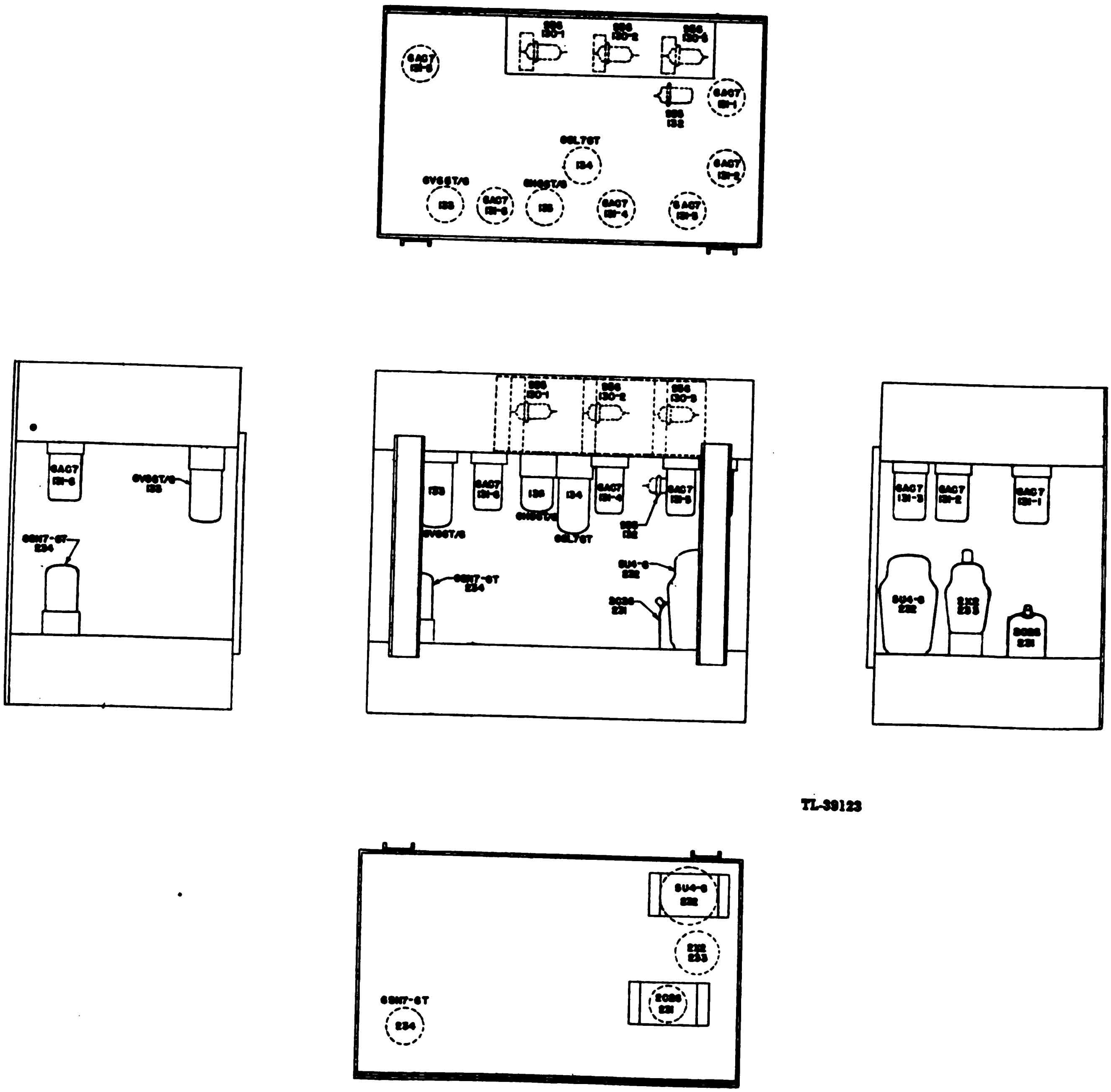


Figure 57. Transmitter-Receiver RT-48A/TPX-1, tube location diagram.

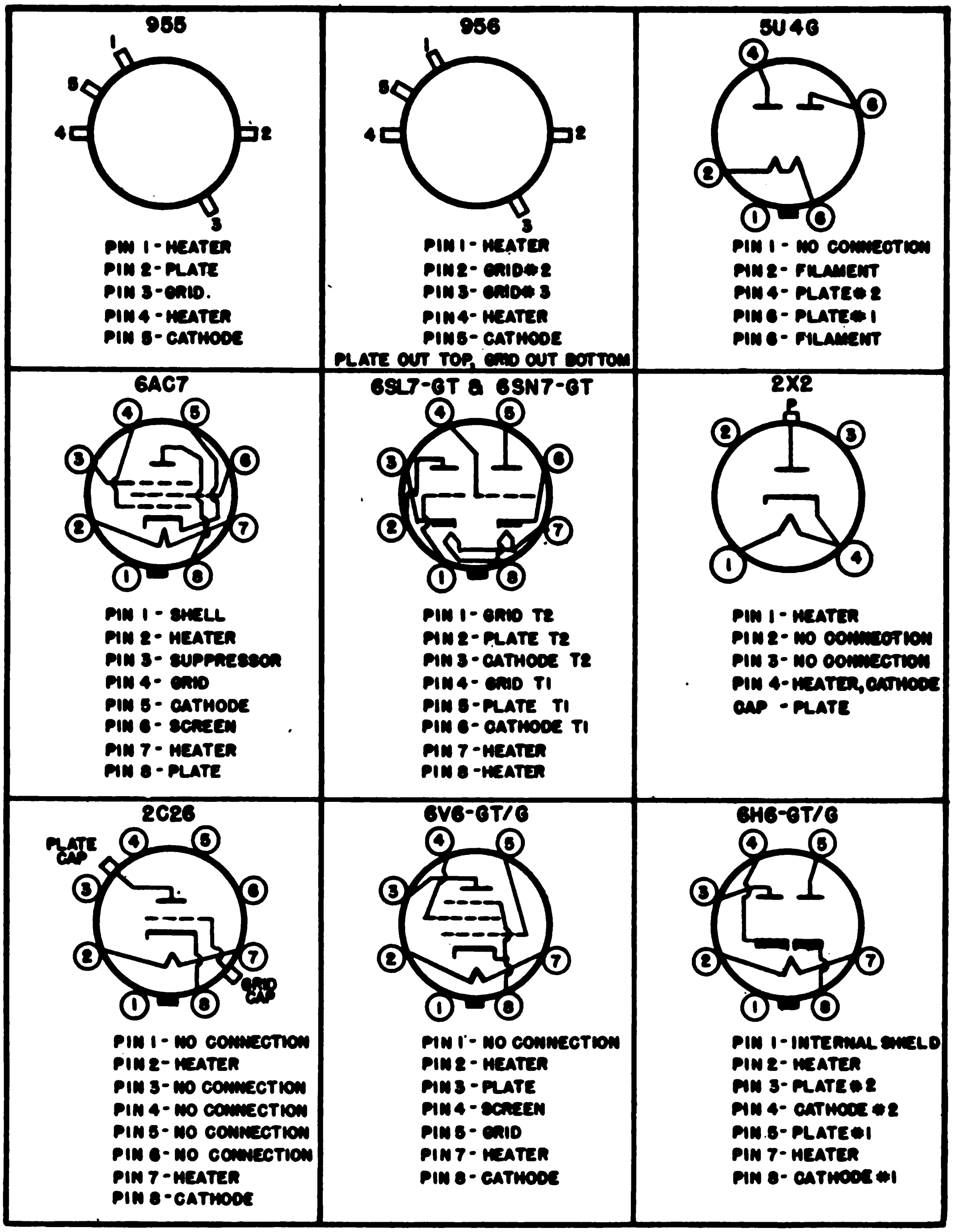


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Figure 58. Transmitter-Receiver RT-48A/TPX-1, tube base connections.

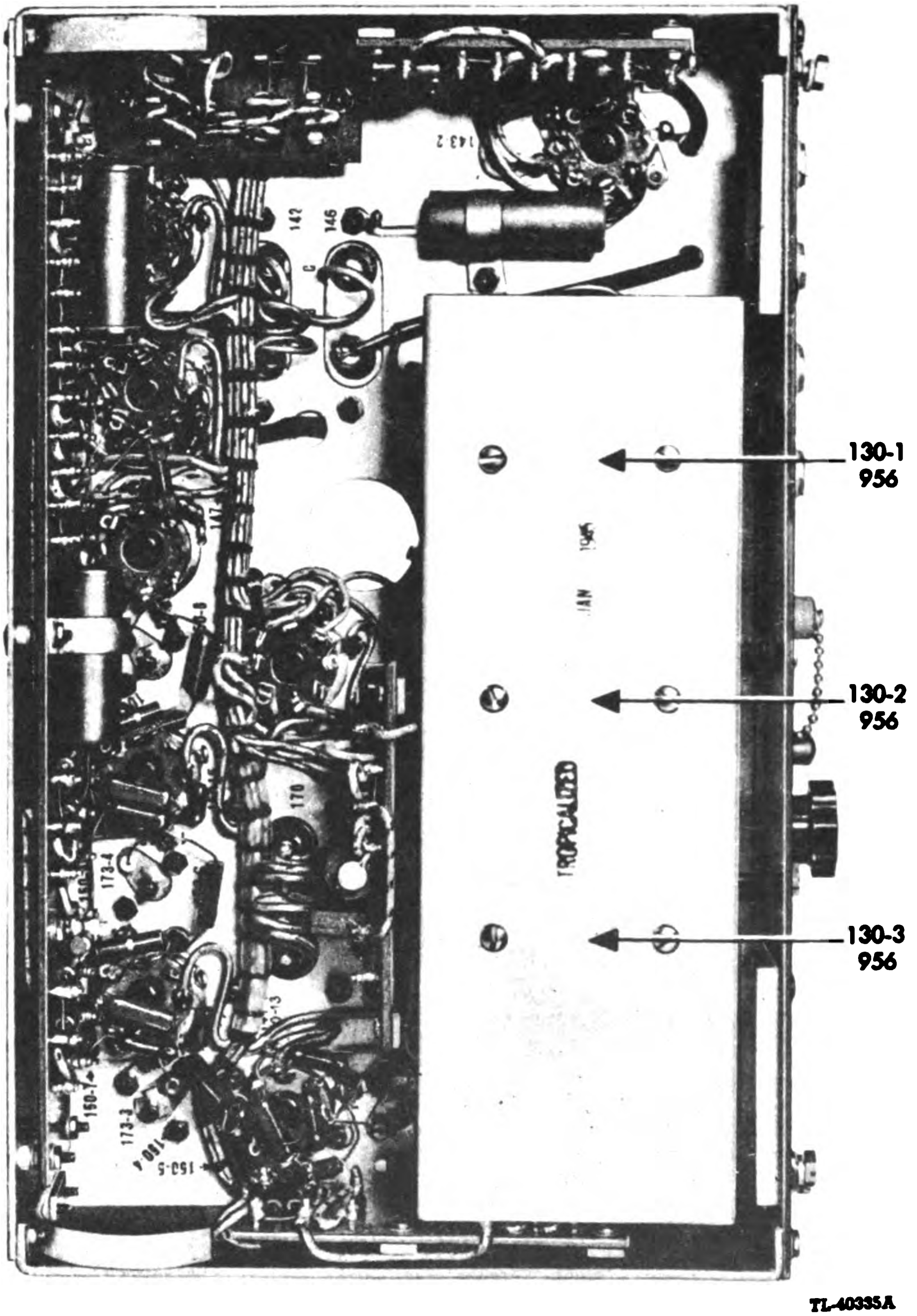

Figure 59. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, bottom view, r-f and mixer stages covered.

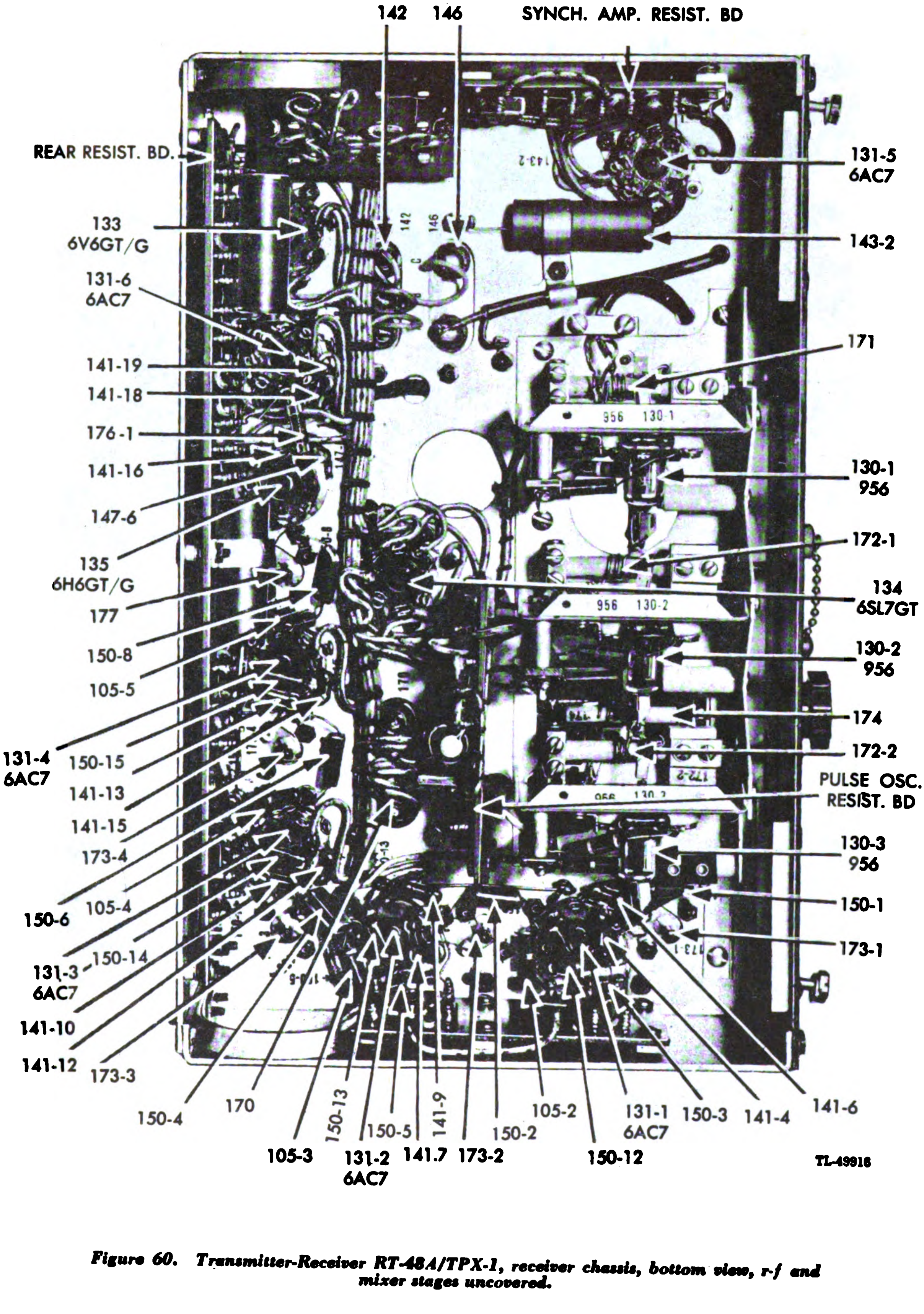

Figure 60. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, bottom view, r-f and mixer stages uncovered.

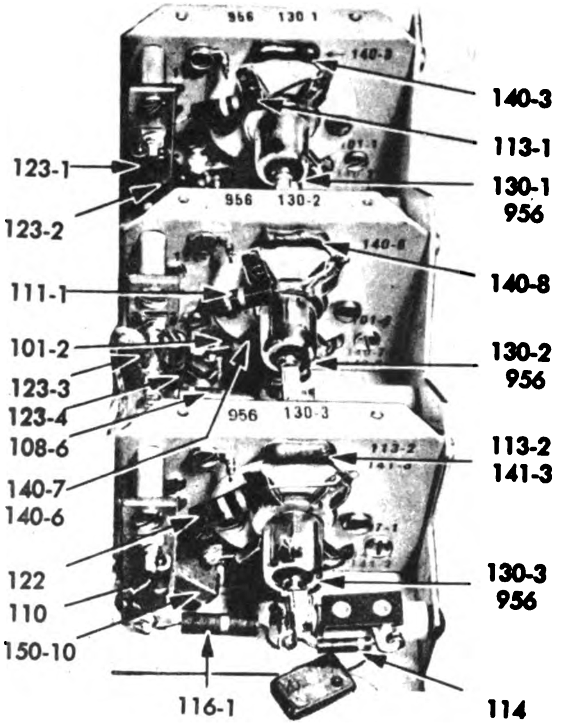

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Figure 61. Transmitter-Receiver RT-48A/TPX-1, r-f and mixer stages viewed from left-hand side.

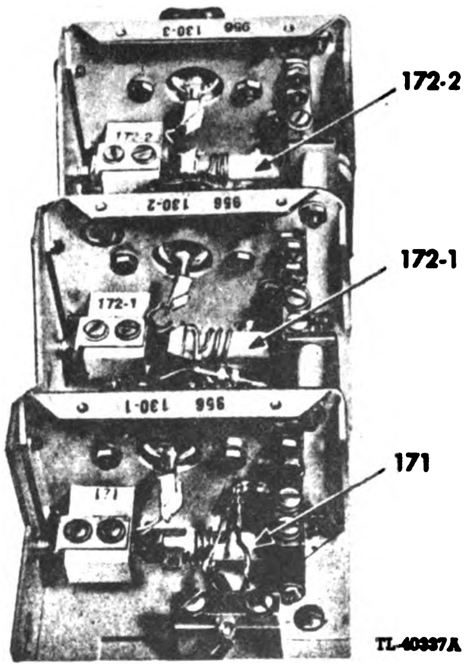


Figure 62. Transmitter-Receiver RT-48A/TPX-1, r-f and mixer stages viewed from right-hand side.

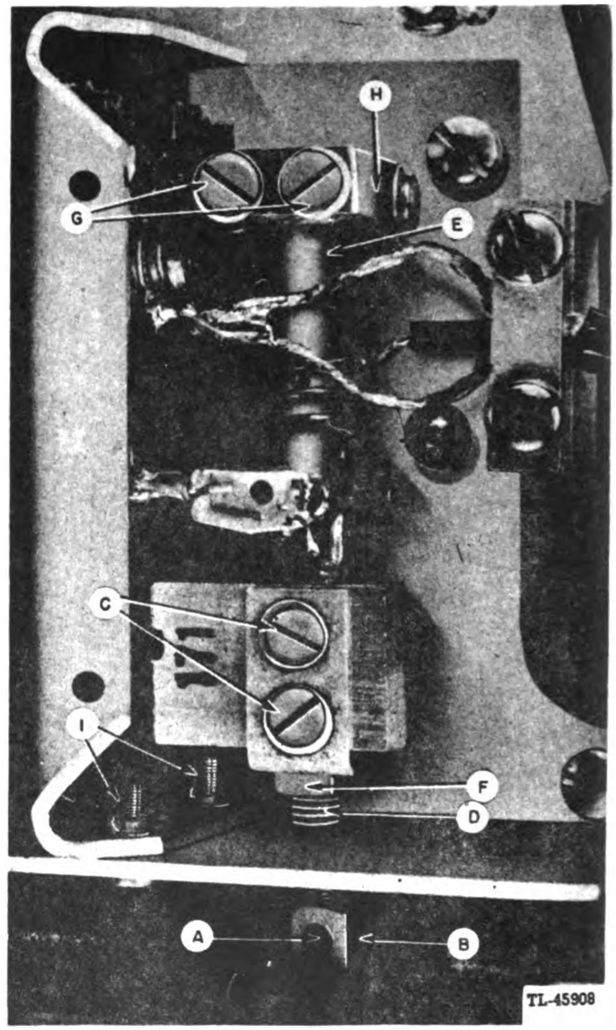


Figure 63. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, typical r-f tuning assembly.

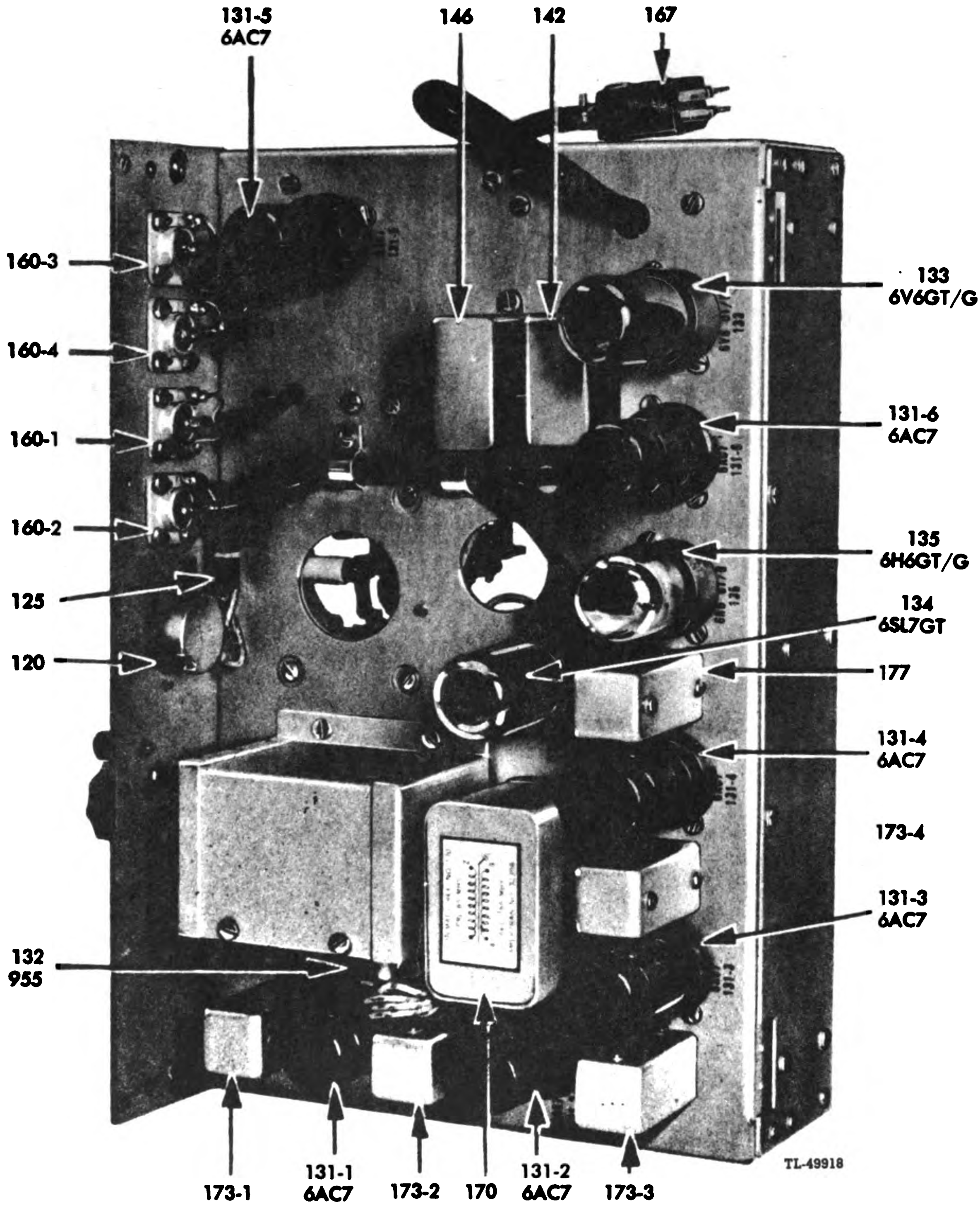


Figure 64. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, top view.

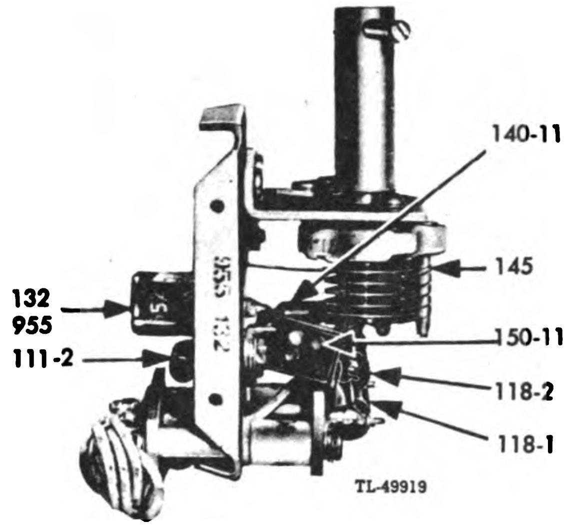


Figure 65. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, local (H.F.) oscillator, cover removed.

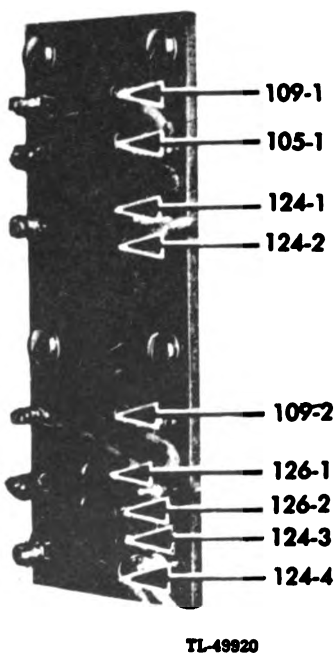


Figure 66. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, first and second i-f resistor mounting board.

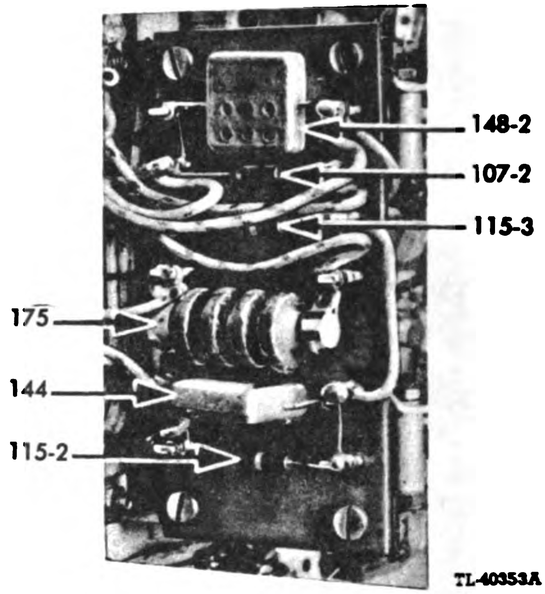


Figure 67. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, pulse oscillator mounting board.

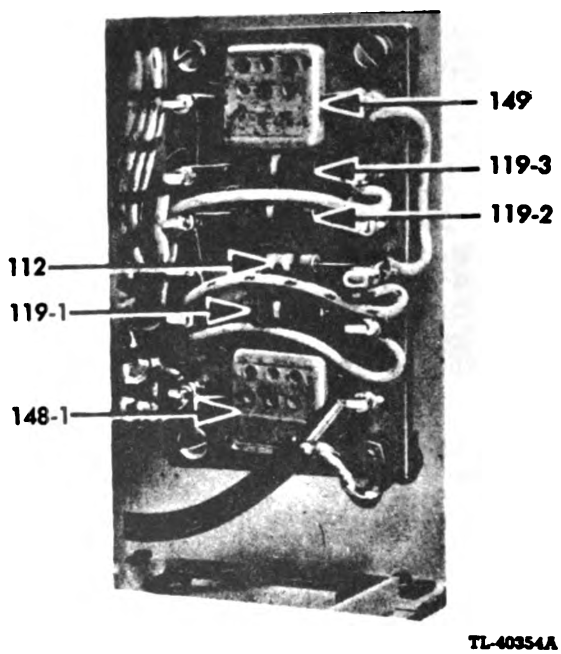
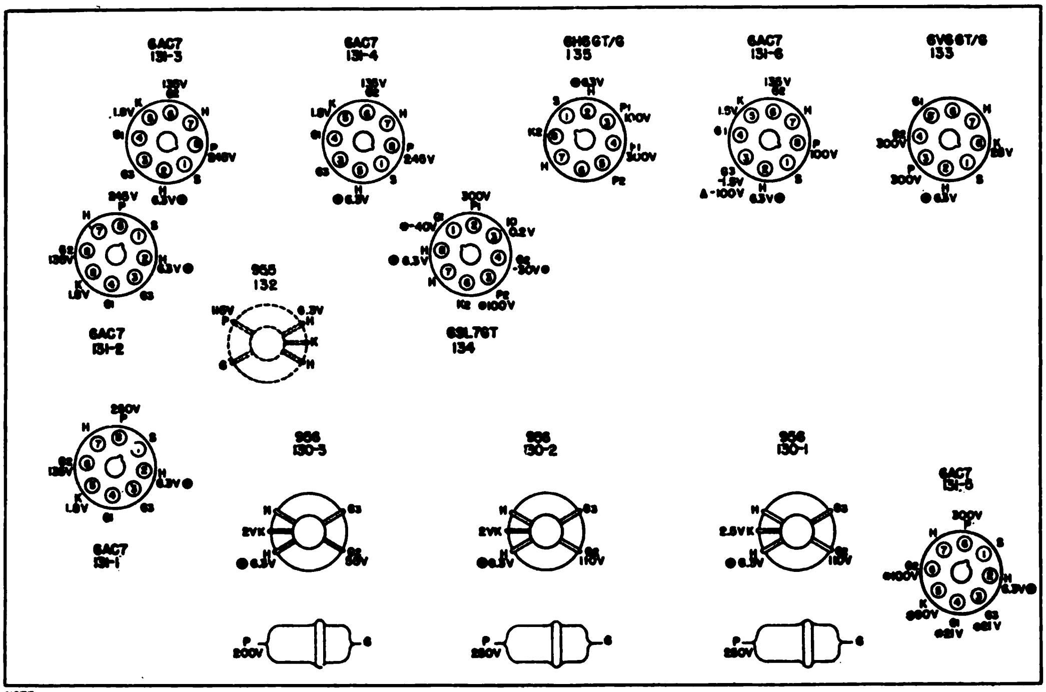


Figure 68. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, synchronizing amplifier resistor mounting board.



NOTE:
ALL VOLTAGES ARE POSITIVE D.C. AND TO GROUND (CHASSIS) UNLESS OTHERWISE INDICATED.
VOLTAGES MEASURED WITH CHALLENGE SWITCH IN I.F.F. POSITION & GAIN MAXIMUM.
▲ • CHALLENGE SWITCH IN RADAR POSITION.
◉ • A.C. VOLTAGE.
● • MEASUREMENTS MADE WITH 20,000 OHMS/VOLT METER ON 250 VOLT RANGE.

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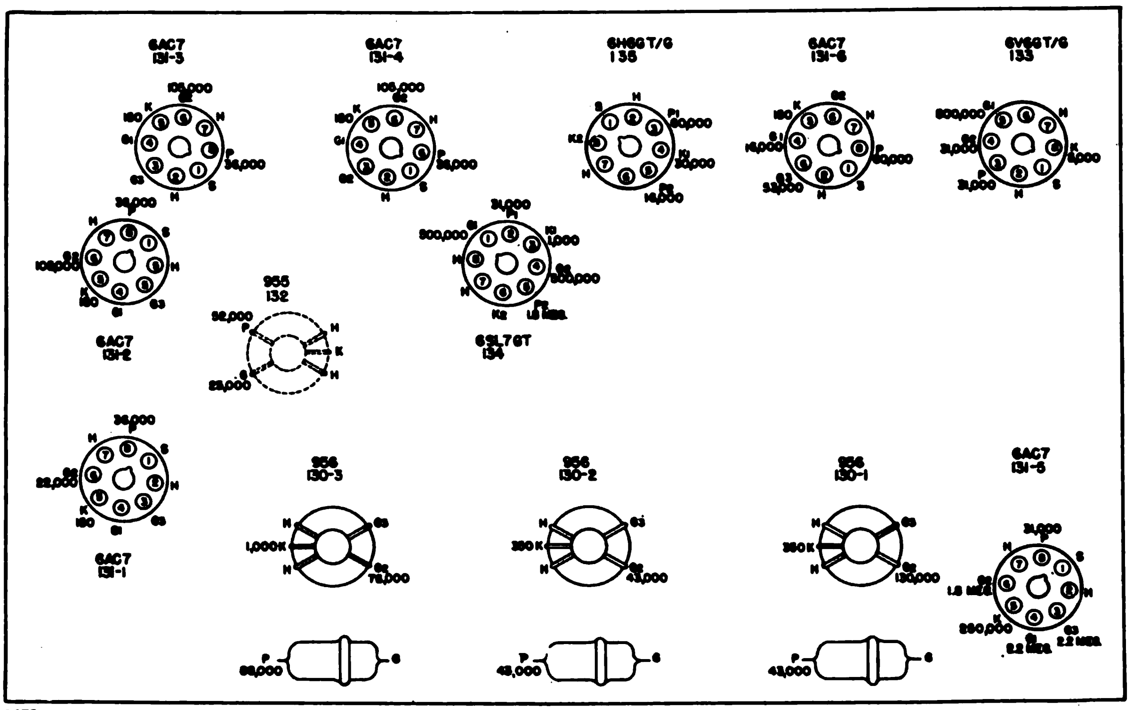
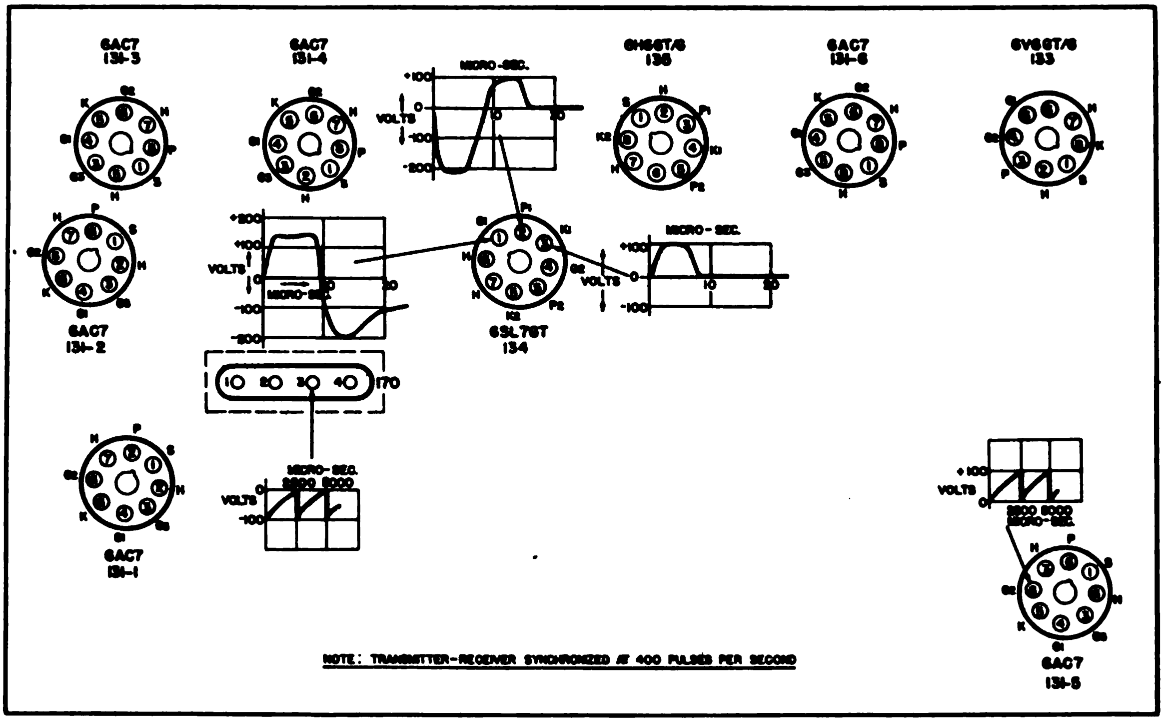
Figure 69. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, voltage diagram.



NOTE:
ALL READINGS REFERRED TO CHASSIS.
CHALLENGE SWITCH IN RADAR POSITION & GAIN MAXIMUM.
RESISTANCE VALUES IN OHMS UNLESS MARKED "MEG"
"MEG" • MEGOHM.
VIDEO PEAK SET AT MAXIMUM.

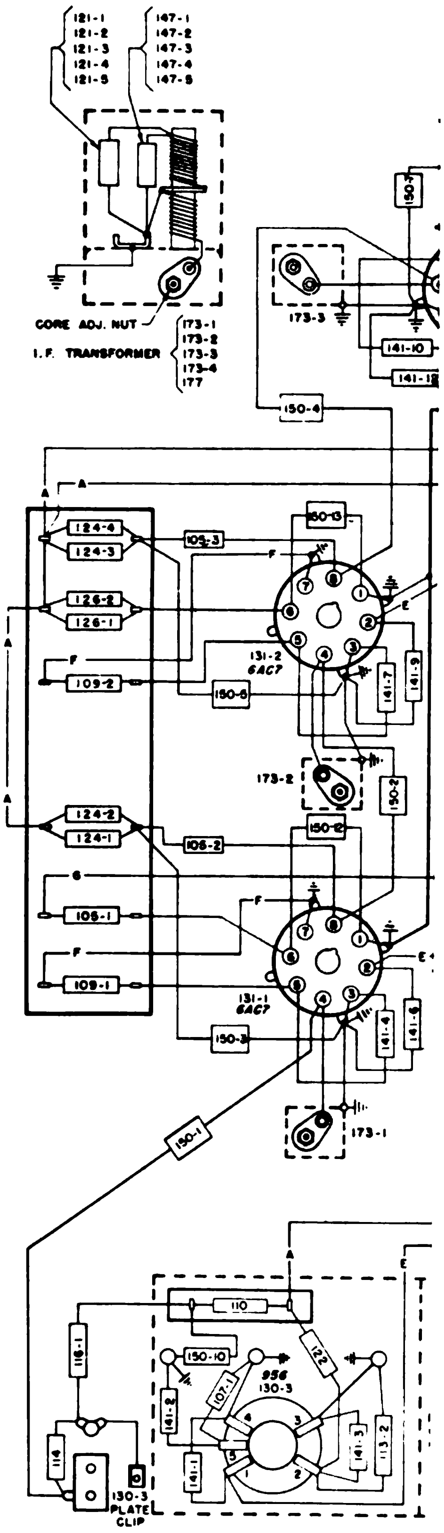
TL-39116

Figure 70. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, resistance diagram.



TL-40344

Figure 71. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, waveform diagram.


121-1
121-2
121-3
121-4
121-5
147-1
147-2
147-3
147-4
147-5
CORE ADJ. NUT
I. F. TRANSFORMER
173-1
173-2
173-3
173-4
177
150-4
141-10
150-13
105-3
124-4
124-3
126-2
126-1
109-2
131-2
6AC7
150-6
141-7
141-9
150-2
150-12
124-2
124-1
105-2
105-1
109-1
131-1
6AC7
150-3
141-4
141-6
150-1
110
150-10
956
130-3
122
107-1
141-2
141-1
141-3
113-2
116-1
114
130-3
PLATE
CLIP

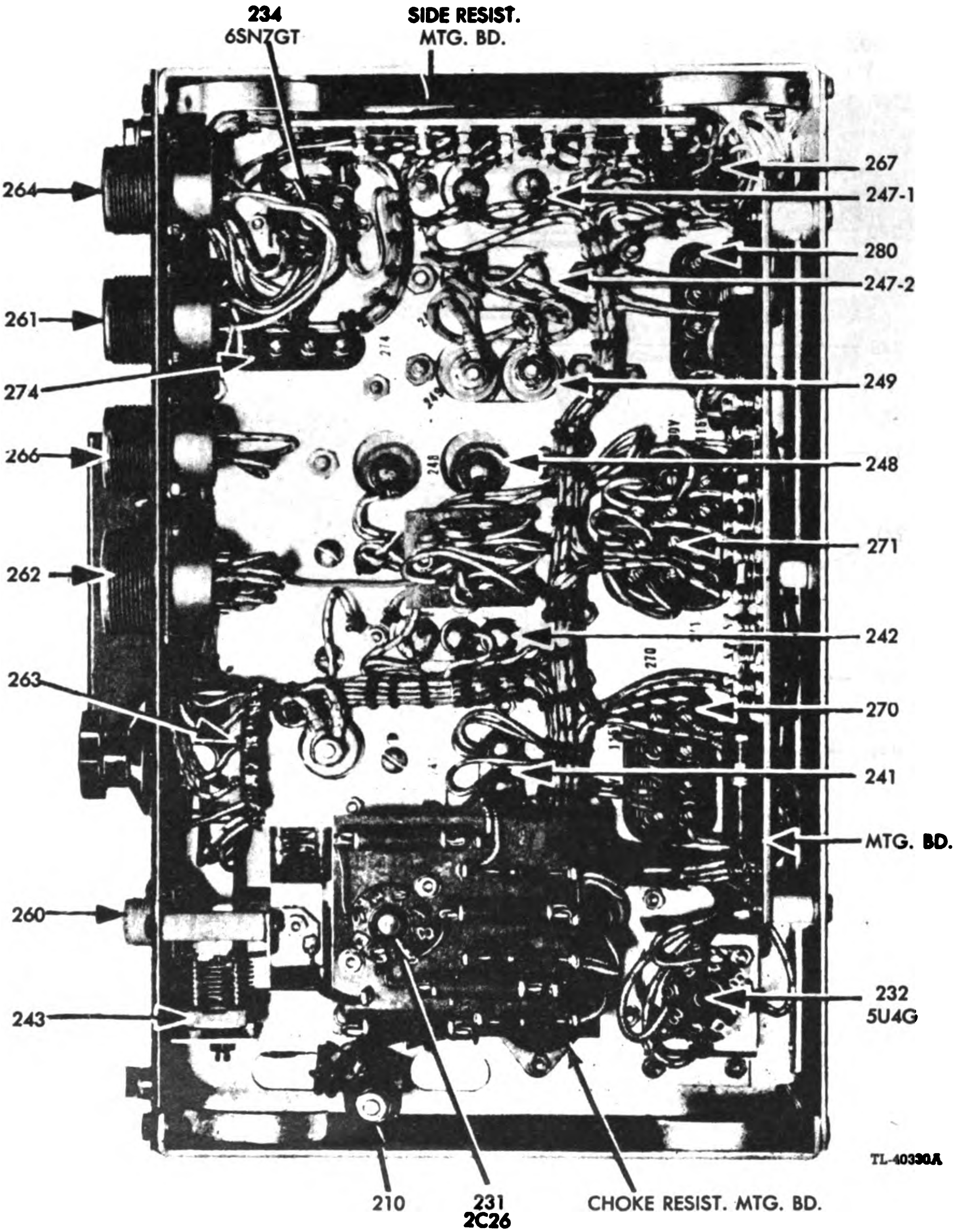


Figure 73. Transmitter-Receiver RT-48A/TPX-1, transmitter chassis, bottom view.

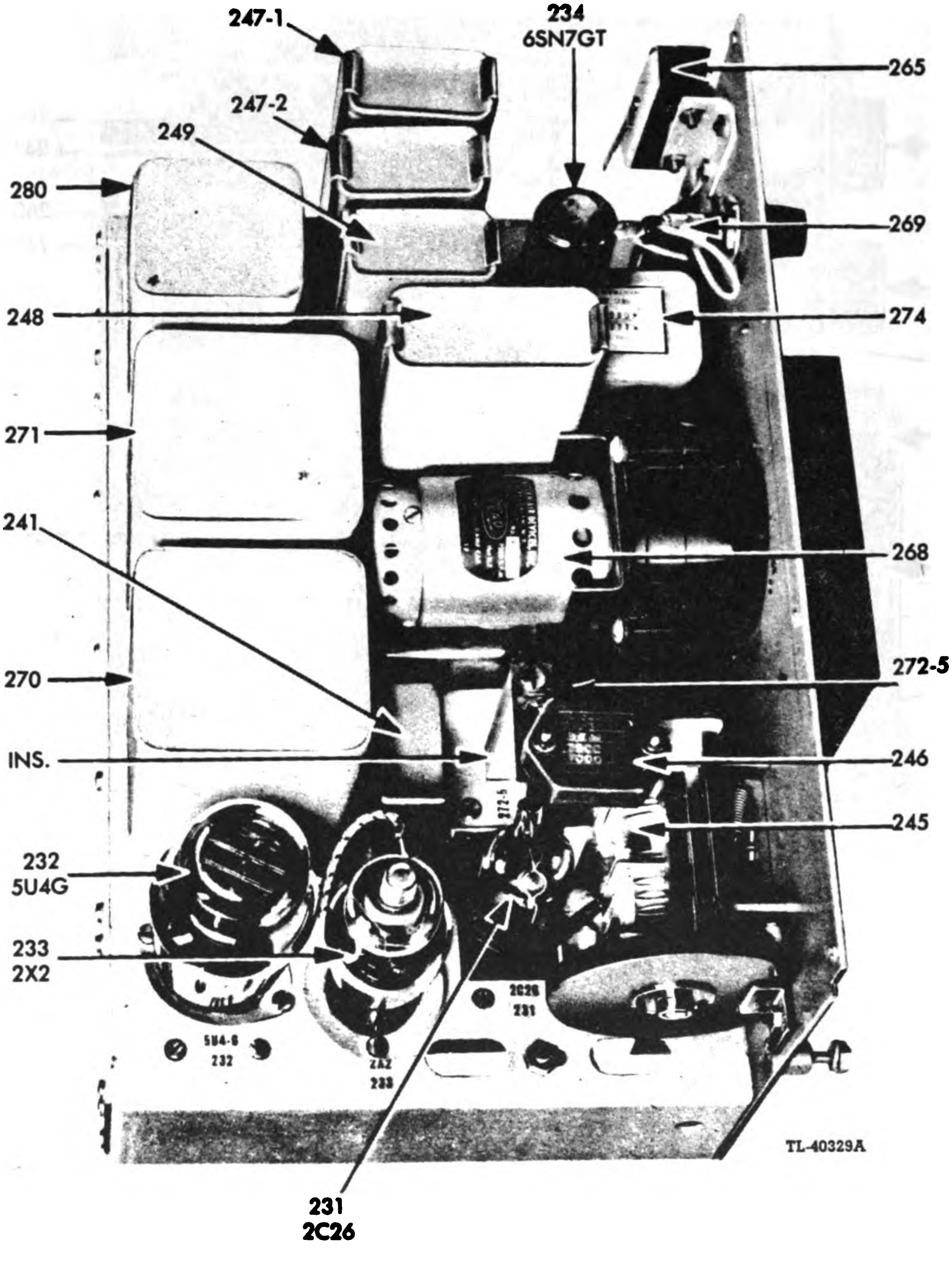


Figure 74. Transmitter-Receiver RT-48A/TPX-1, transmitter chassis, top view.

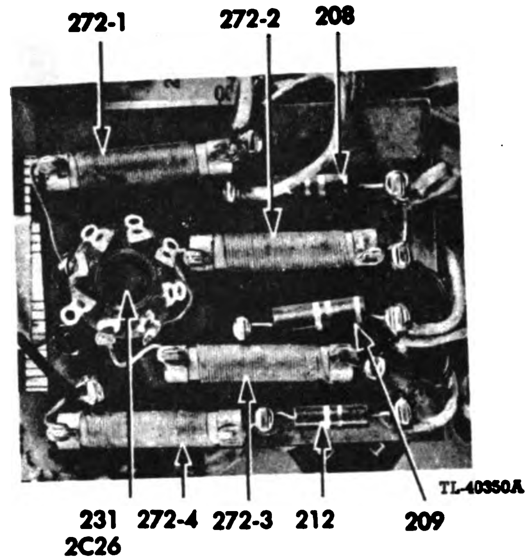


Figure 76. Transmitter-Receiver RT-48A/TPX-1, transmitter chassis, resistor and r-f choke mounting board.

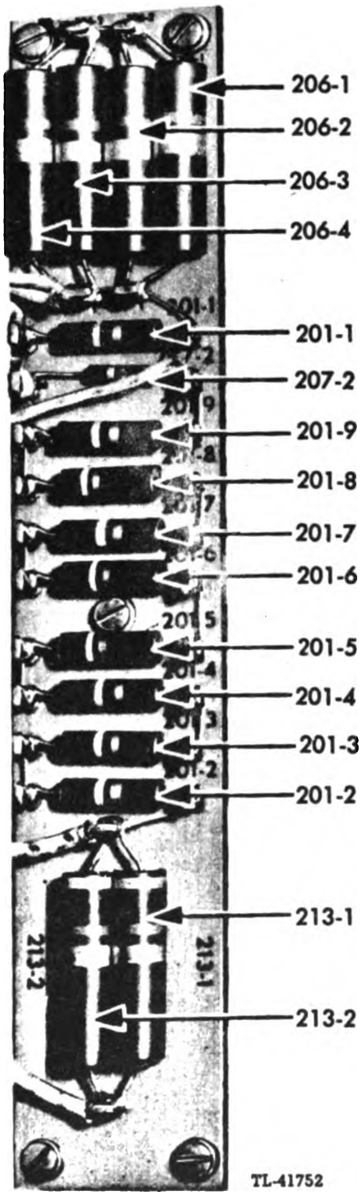


Figure 75. Transmitter-Receiver RT-48A/TPX-1, transmitter chassis, rear vertically mounted resistor board.

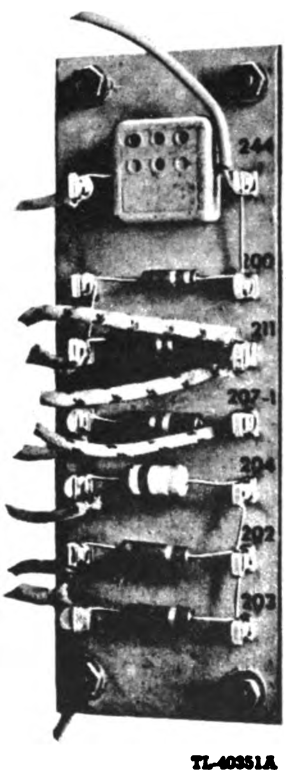


Figure 77. Transmitter-Receiver RT-48A/TPX-1, transmitter chassis, side vertically mounted resistor board.

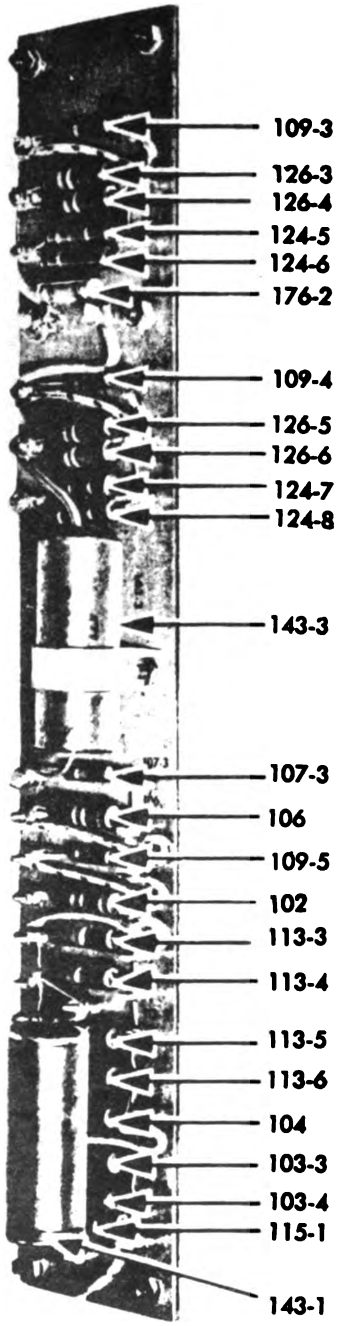
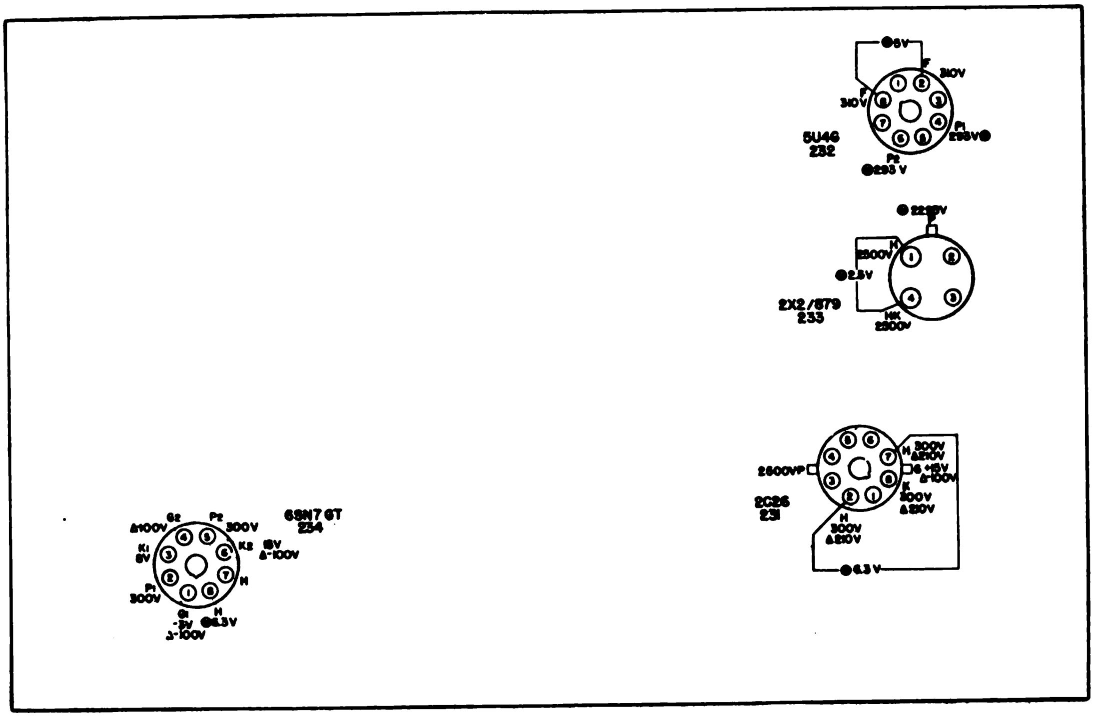


Figure 78. Transmitter-Receiver RT-48A/TPX-1, receiver chassis, rear vertically mounted resistor board.



NOTE:
ALL VOLTAGES ARE POSITIVE D.C. AND TO GROUND (CHASSIS) UNLESS OTHERWISE INDICATED.
VOLTAGES MEASURED WITH CHALLENGE SWITCH IN I.F.F POSITION & GAIN MAXIMUM.
Δ= CHALLENGE SWITCH IN RADAR POSITION.
●= A.C. VOLTAGE.

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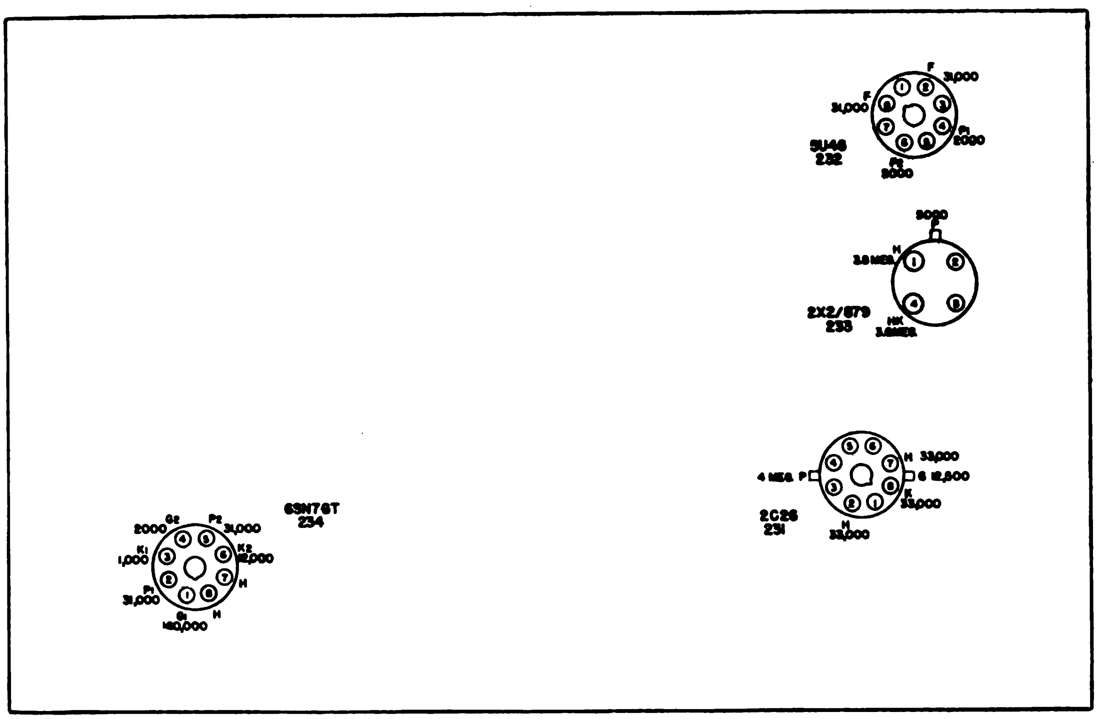
Figure 79. Transmitter-Receiver RT-48A/TPX-1, transmitter chassis, voltage diagram.



NOTE:
ALL READINGS REFERRED TO CHASSIS.
CHALLENGE SWITCH IN RADAR POSITION & GAIN MAXIMUM.
RESISTANCE VALUES IN OHMS UNLESS MARKED "MEG"
"MEG" = MEGOHM.

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Figure 80. Transmitter-Receiver RT-48A/TPX-1, transmitter chassis, resistance diagram.

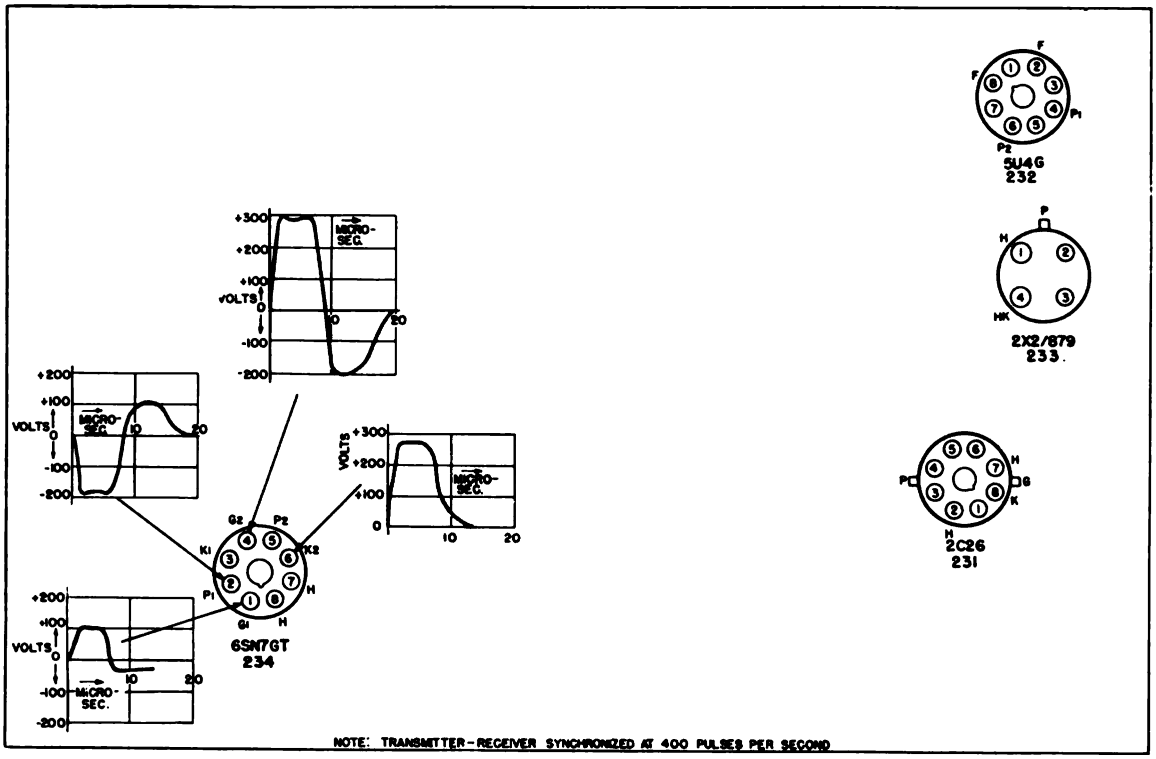
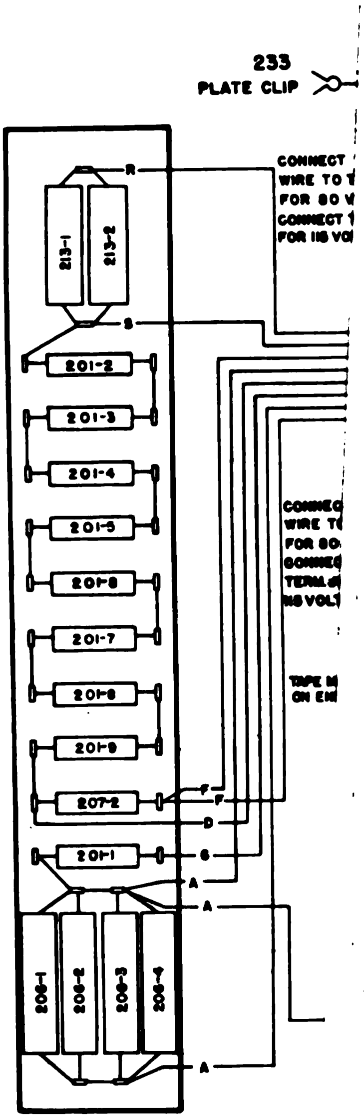


Figure 81. Transmitter-Receiver RT-48A/TPX-1, transmitter chassis, waveform diagram.


233
PLATE CLIP
CONNECT
WIRE TO
FOR 80
FOR 115
213-1
213-2
201-2
201-3
201-4
201-5
201-6
201-7
201-8
201-9
207-2
201-1
206-1
206-2
206-3
206-4
R
S
F
F
D
A
A
A
WIRE
FOR 80
TERM.
115 VOLT
TAPE
ON

Chapter 5

TROUBLE SHOOTING TEST SET TS-159/TPX

WARNING.—***Voltages sufficient to cause death on contact are present in this equipment. Do not touch high-voltage connections while the equipment is operating.***

108. REFERENCE DATA

The following reference data is provided to aid in trouble shooting Test Set TS-159/TPX.

Fig. No.	*Subject*
49	Schematic diagram.
83	Tube base connections.
84 through 88	Parts location illustrations.
89 through 90	Voltage and resistance diagram. (All voltages specified in this manual, whether on schematics or on voltage diagrams, are measured with a 1,000-ohm-per-volt d-c meter to ground, unless otherwise stated.)
91	Wiring diagram.
56	Capacitor and resistor color codes.

109. GENERAL

The general trouble-shooting information given in paragraphs 88 through 96 is applicable to Test Set TS-159/TPX. A thorough understanding of the theory of operation of the test set, given in paragraphs 74 through 87, will facilitate analyzing and isolating trouble. Use of the reference data listed in paragraph 108 will simplify the trouble-shooting and servicing procedure.

110. REMOVING TEST SET FROM CABINET

To remove Test Set TS-159/TPX from its cabinet, remove the six screws from around the edge of the front panel which hold the panel to the front lip of the cabinet. Remove the two elastic stopnuts and lockwashers from the rear of the cabinet. (These elastic stopnuts and lockwashers are not present on some sets.) Carefully withdraw the panel-chassis unit from the cabinet.

111. REMOVAL AND REPLACEMENT OF TUBES AND PARTS

a. To remove the shield covering the oscillating detector circuits, remove the six screws which hold the shield to the chassis and the six screws which hold it to the rear shield plate and lift it off.

b. To remove the shield can over tube 532 (9006) press the can downward (toward the tube base), twist counterclockwise to disengage the bayonet catches, and lift the can off.

c. With the exceptions mentioned in **a** and **b** above, removal and replacement of all tubes and parts in Test Set TS-159/TPX is quite simple and will be obvious upon inspection.

112. TEST SET TROUBLE-SHOOTING CHART

Symptom	Possible Fault or Remedy
a. Meter indicates normally on TRANSCEIVER METERING. No meter deflection on TRANS. POWER or TRANS. FREQ. Tubes do not light.	Check LINE FUSE 568. Check for a-c supply from terminals A and B on test set end of Cord CX-159/TPX-1 through receptacle 562, fuse 568, LINE SWITCH 576-1, and primary of transformer 570.
b. No meter indication. Tubes light and normal calibration beats can be heard in phones.	Check METER FUSE 567 and meter.
c. Set performs normally but calibration beats are not heard. No 30-mc output.	Try new crystal. Try new tube 531-3 (6SL7GT). Try resetting crystal tuning capacitor 548-1 to lower capacitance setting. Check voltages on tube 531-3 and check coils 573 and 574 for continuity. When beats are again found, reset capacitor 548-1 as described in paragraph 113a.
d. 30-mc (tripler) output weak.	Try new tube 531-3 (6SL7GT). Realign tripler trimmer capacitor 548-2 as described in paragraph 113b.
e. Detector oscillates over part or none of band as evidenced by no calibration beats and no signal output to align receiver.	Make sure detector switch is on OSC. Try new tube 530 (955). Check for proper voltage at junction of choke 572-3 and resistor 502. Check heater voltage on tube 530.

Symptom	Possible Fault or Remedy
f. Meter deflection very low on TRANS. FREQ. Calibration beats very weak.	Try new tubes 531-1 and 531-2. Check voltages on audio amplifier tube 531-1. Check potentiometer 504.
g. Meter deflection low when measuring TRANS. FREQ. Meter shows two slight peaks with a dip between.	This condition is normal when too little transmitter power is coupled to the test set antenna. Increase coupling by moving test set to another position or by placing hand near test set antenna.
h. TRANS. POWER reads very low or very high with apparently normal transmitter.	Check d-c resistance across receptacle 560-1. It should be 50 ohms. Check resistors 505, 506, 508, and 509. Try new tube 531-2. Try new tube 532. If reading is low, capacitors 541-2, 541-3, 542-5, or 543 may be open.
i. Detector oscillates over part of band or not at all. Plate voltage low. Tube 534 does not have violet glow.	Check line voltage. Try new tube 533.

113. ADJUSTMENTS OF TEST SET TS-159/TPX

a. Adjustment of Capacitor 548-1. Whenever crystal 569 or tube 531-3 (6SL7GT) is replaced, it is necessary to adjust capacitor 548-1. With LINE SWITCH in the ON position and DETECTOR switch in the OSC. position, proceed as follows:

(1) Turn DETECTOR TUNING dial to a point where a beat note is heard in the headset. (This should be at or near the setting indicated by the test set TUNING CHART as correct for one of the calibration frequencies, i.e., 150, 160, 170, 180, or 190 megacycles.)

(2) Increase the capacitance of capacitor 548-1 (by turning the screwdriver adjustment marked XTAL OSC. on top of test set chassis) just to the point where the beat note is no longer heard in the headset.

(3) Decrease the capacitance of capacitor 548-1 to a value slightly lower than the highest value at which the beats can be heard in the headset.

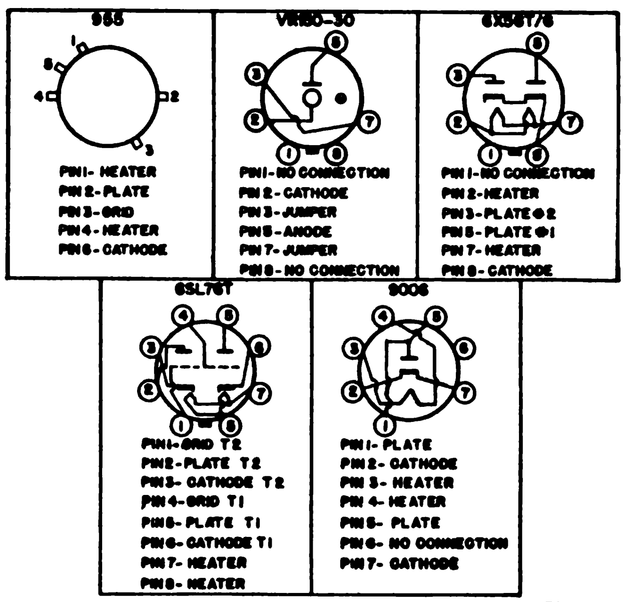
(4) Throw the LINE SWITCH to OFF and then to ON several times and note each time whether the beat note is heard in the headset to make sure that the crystal always starts oscillating.

b. Adjustment of Capacitor 548-2. In order to obtain maximum 30-megacycles output from the tripler, capacitor 548-2 must be properly adjusted. This adjustment is made as follows:

(1) Connect the test set to Transmitter-Receiver RT-48A/TPX-1 and set all controls as for alignment of the IFF receiver (par. 106).

(2) Adjust capacitor 548-2 (by turning the screwdriver adjustment marked TRIPLER on top of the test set chassis) for maximum receiver diode current.

c. Calibration of Oscillating Detector. The procedure for calibrating the oscillating detector is described in paragraph 23.



TL-46787

Figure 83. Test Set TS-159/TPX, tube base connections.

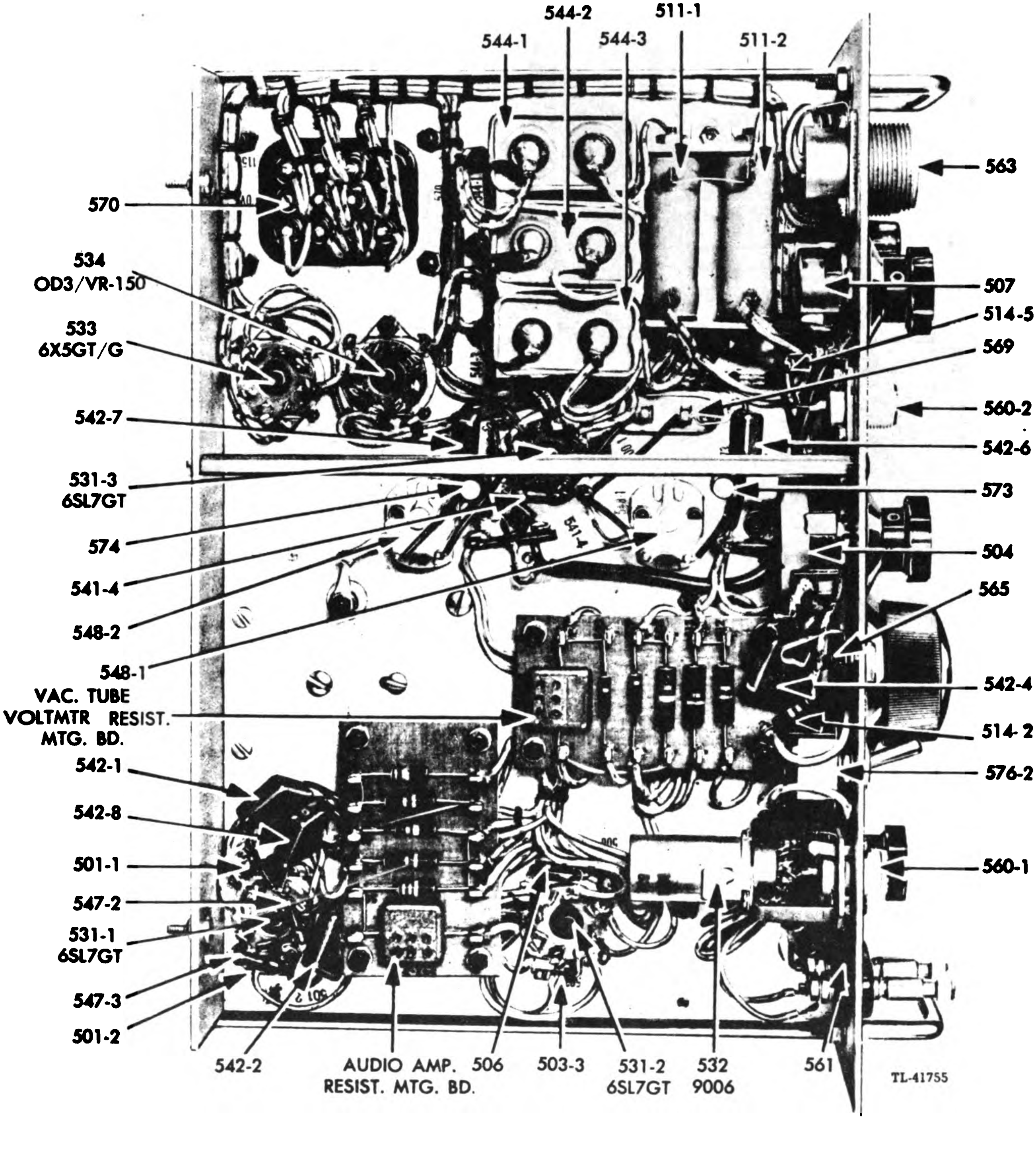


Figure 84. Test Set TS-159/TPX, bottom view, cover off.

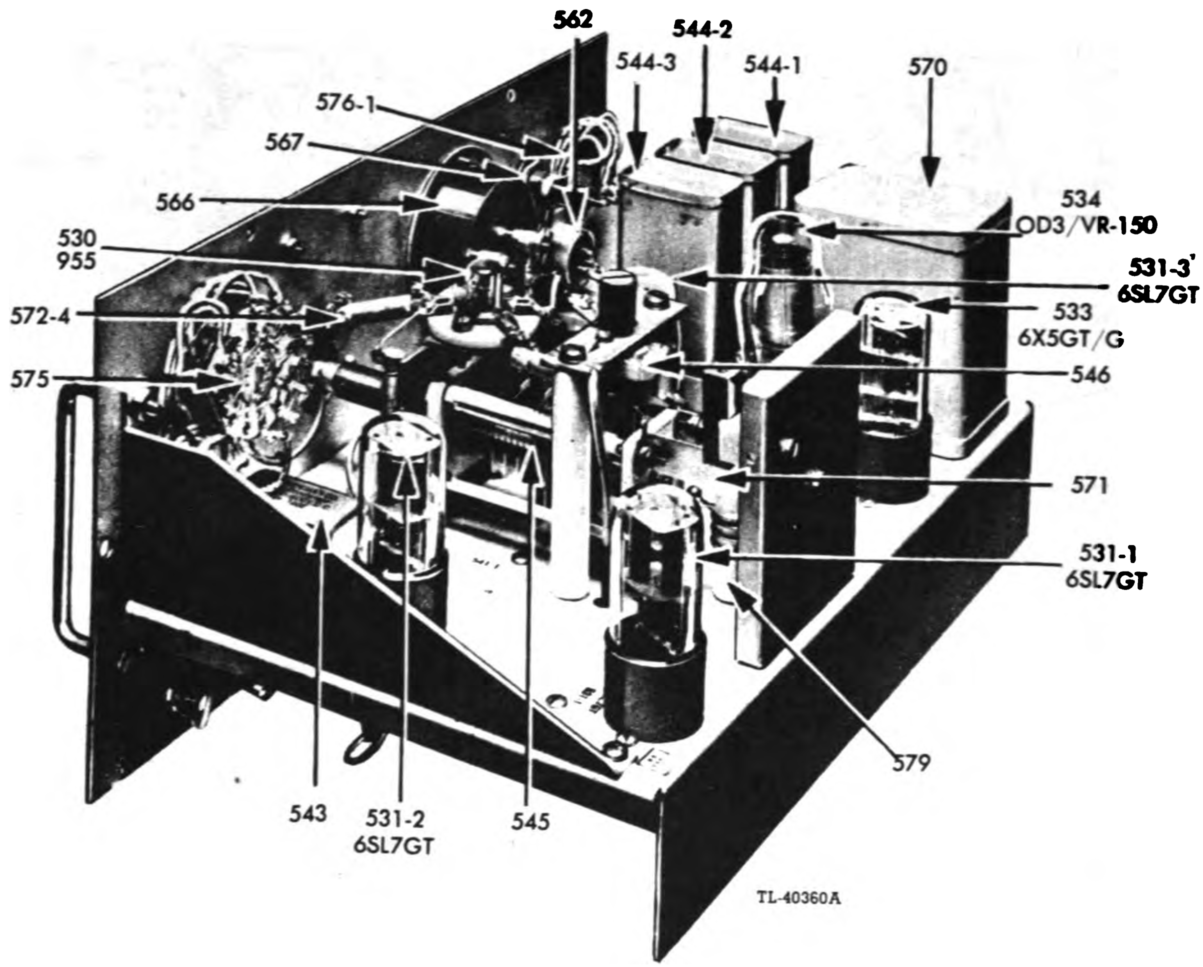


Figure 85. Test Set TS-159/TPX, top view, cover off.

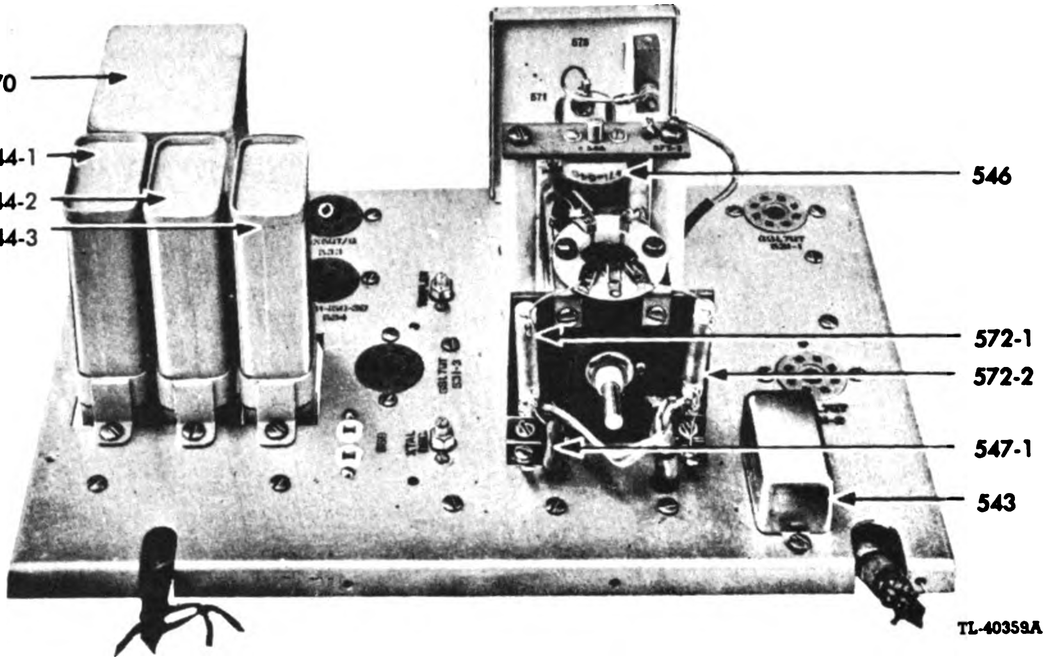


Figure 86. Test Set TS-159/TPX, detector tuning assembly.

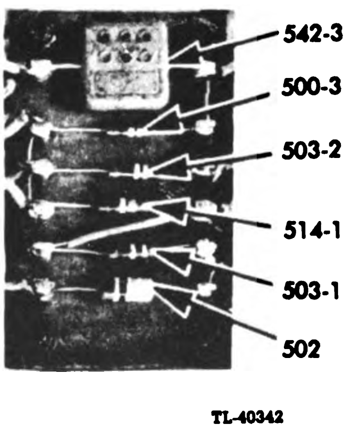


Figure 87. Test Set TS-159/TPX, audio amplifier resistor mounting board.

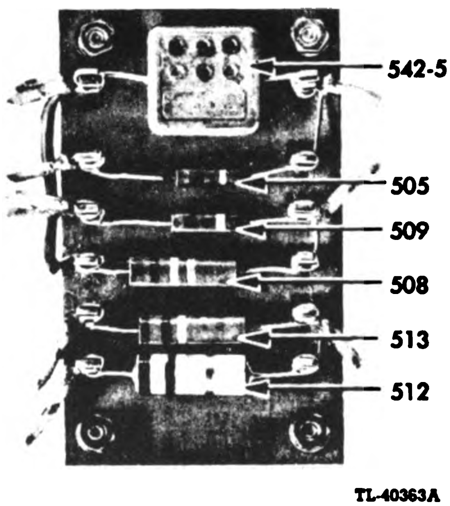
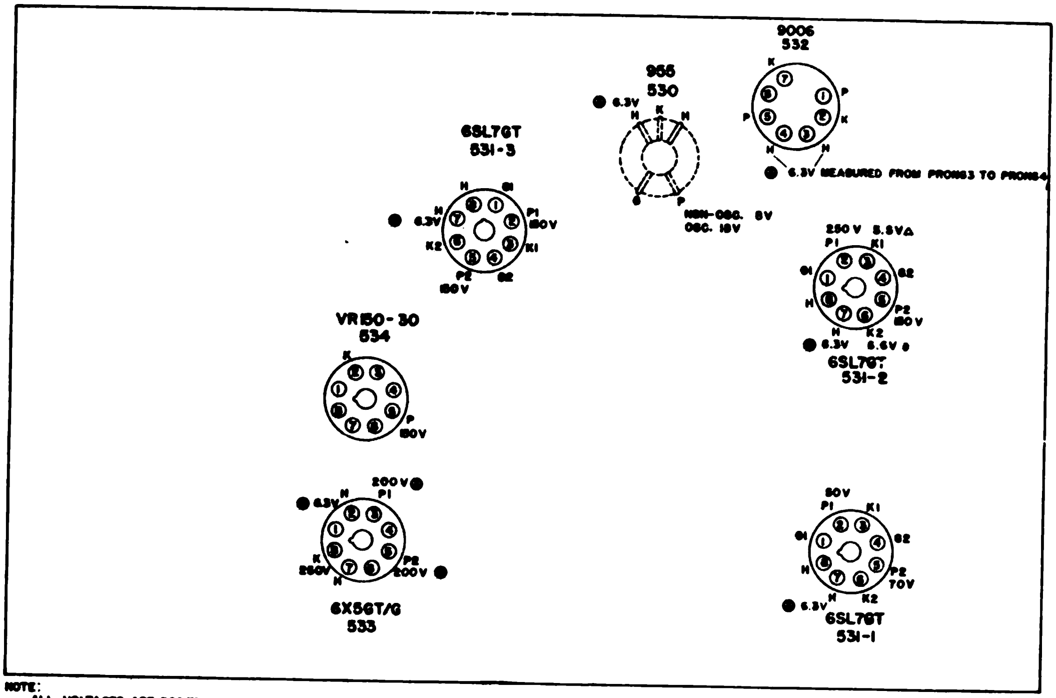


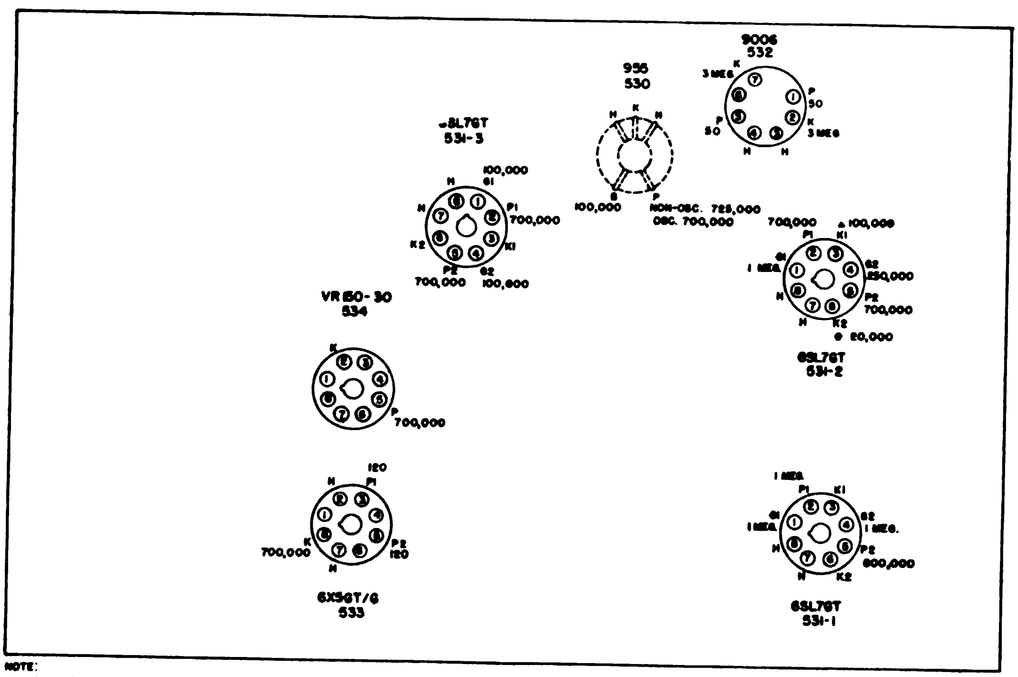
Figure 88. Test Set TS-159/TPX, vacuum tube voltmeter resistor mounting board.



NOTE:
ALL VOLTAGES ARE POSITIVE D.C. AND TO GROUND (CHASSIS) UNLESS OTHERWISE INDICATED.
METER SWITCH IN 50 VOLTS SCALE UNLESS OTHERWISE INDICATED.
DETECTOR SWITCH IN OSC. POSITION.
● = A.C. VOLTAGE.
△ METER SWITCH IN TRANS. POWER POSITION.
◆ METER SWITCH IN TRANS. FREQ. POSITION.

TL-46789

Figure 89. Test Set TS-159/TPX, voltage diagram.



NOTE:
ALL READINGS REFERRED TO CHASSIS.
METERING SWITCH ON 50 VOLT SCALE UNLESS OTHERWISE INDICATED
DETECTOR SWITCH IN OSC. POSITION UNLESS OTHERWISE INDICATED.
RESISTANCE VALUES IN OHMS UNLESS MARKED "MEG."
"MEG" = MEGOHM.
△ = METERING SWITCH IN TRANS. POWER POSITION.
◆ = METERING SWITCH IN TRANS. FREQUENCY POSITION.

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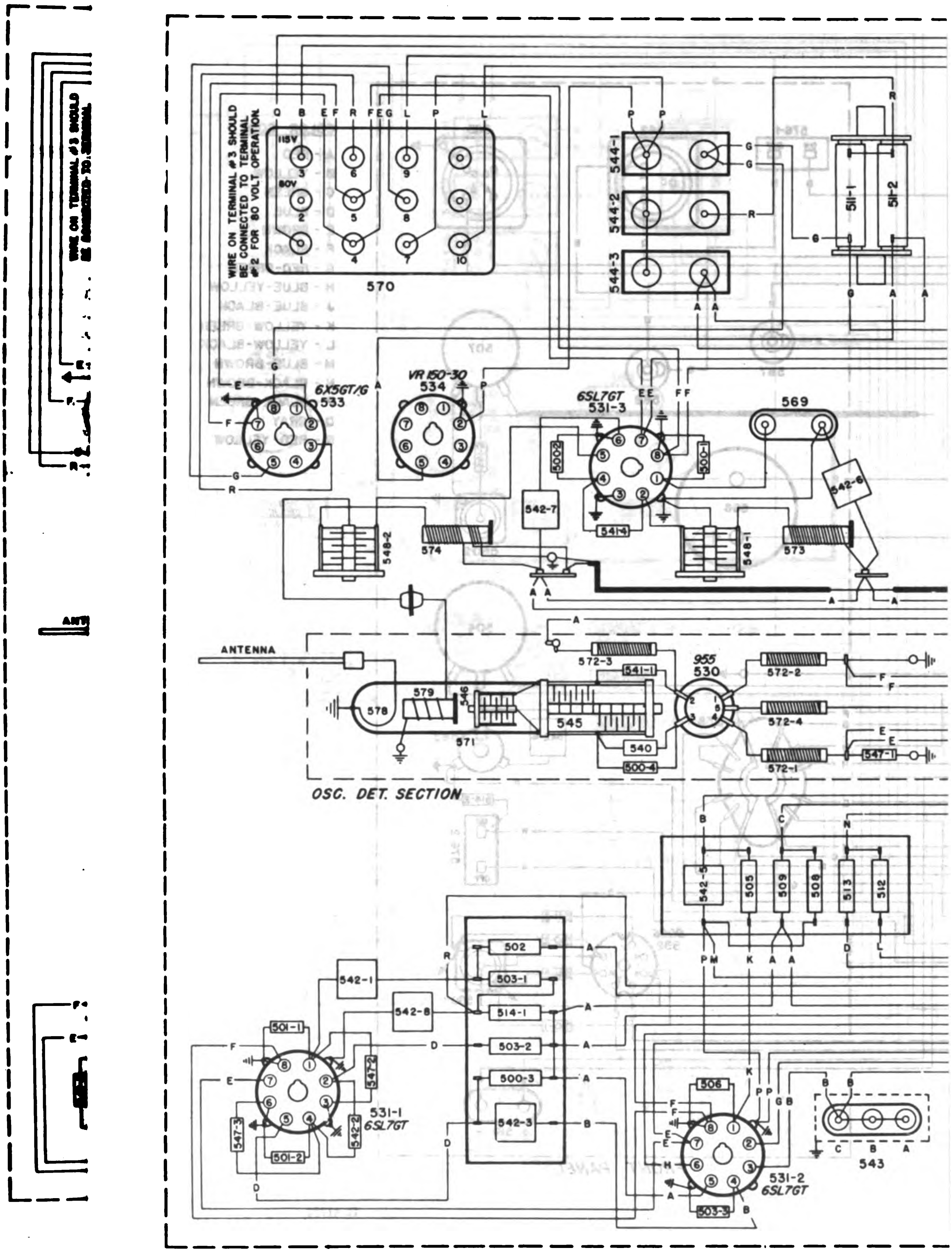
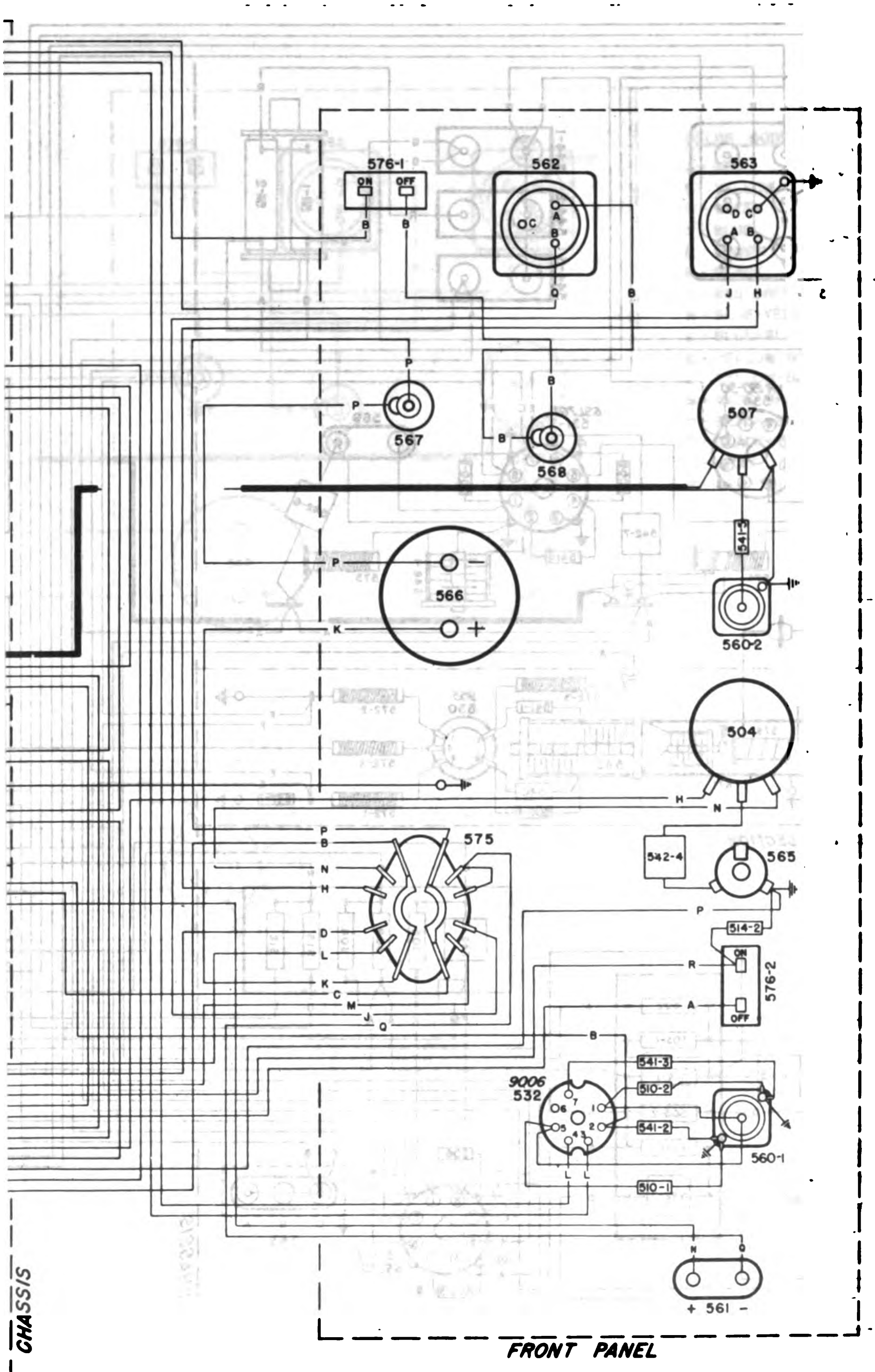
Figure 90. Test Set TS-159/TPX, resistance diagram.



TL-41756

Figure 91. Test Set TS-159/TPX, wiring diagram.



COLOR CODE

A - RED
B - YELLOW
C - GREEN
D - BLUE
E - BROWN
F - BLACK
G - RED-GREEN
H - BLUE-YELLOW
J - BLUE-BLACK
K - YELLOW-GREEN
L - YELLOW-BLACK
M - BLUE-BROWN
N - BLACK-BROWN
P - BLACK-GREEN
Q - GRAY
R - RED-YELLOW

Chapter 6

MAINTENANCE PARTS LIST

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX-4

Following is an explanation of the symbols found in the "Major Components" column:

Component	Symbol
Antenna System AS-134/TPX	AS
Test Set TS-159/TPX	TS
Transmitter-Receiver RT-48A/TPX-1	RT
All cords	"/TPX-1" omitted

All parts are listed alphabetically by name of part, and numerically by reference symbol within the alphabetical listing.

a. **All Major Components except Antenna System AS-134/TPX.**

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
	2Z320-2	RT	ANGLE: antiturn, for receiver r-f tuning back-lash nut; part of 171, 172-1, and 172-2; spcl; Radio Receptor dwg #A-2613-3.	3		*			*
	2A295-7	TS	ANTENNA, rod: fixed type; spcl; Radio Receptor dwg #B-179-194.	1		*			*
	2A297-137	AS	ANTENNA-TOWER SYSTEM AS-134 ()/TPX.	1					
600	2Z394.31		ATTENUATOR: fixed, 10 db. "T" pad type; characteristic impedance 50 ohms; operating frequency range 0 to 200 mc max. power input; 3 watts average spcl; Radio Receptor dwg #C-179-357.	1		*			*
	2Z700-11	RT	BLOCK, backing: rear mounting bracket for transmitter-receiver case; spcl; Radio Receptor dwg #A-179-41.	4		*			*
	2Z700-12	RT	BLOCK, support: receiver antenna input support, consisting of one top and one bottom; spcl; Radio Receptor dwg #A-179-108.	1		*			*
268	6ZK992-1	RT	BLOWER, ventilation: counterclockwise rotation, for direct coupling to type J-31-A motor; L-R Mfg. Co. type #2 with blower housing modified; Radio Receptor #A-179-15.	1		*			*
	2Z9402.226	RT	BOARD, terminal: with two #5-308 Cinch lugs; CE natural bakelite; 3/32" thick x ½" x 2¼"; spcl; Radio Receptor dwg #A-179-339; (1st r-f, reference symbols 123-1, 123-2, and 108-5 indicated on board).	1					*
	2Z9402.103	RT	BOARD, terminal: with two #5-308 Cinch lugs; CE natural bakelite; 3/32" thick x ½" x 2¼"; spcl; Radio Receptor dwg #A-179-118; (mixer part: reference symbols 110 and 116-1 indicated on board).	1					*

*Indicates that stock is available.

	2Z9402.101	TS	BOARD, terminal: with two #5-308 Cinch lugs; CE natural bakelite; 3/32" thick board 2⅝" x 2½"; spcl; Radio Receptor dwg #A-179-177; (oscillating detector variable capacitor mtg board; reference symbols 572-1, 572-2, and 572-4 indicated on board).	1					•
	2Z9402.227	RT	BOARD, terminal: with two #5-308 Cinch lugs; CE natural bakelite; 3/32" thick x ⅝" x 2¼"; spcl; Radio Receptor dwg #A-179-341; (oscillator board #1; reference symbols 116-2, 118-1, and 118-2 indicated on board).	1					•
	2Z9403.140	RT	BOARD, terminal: with three #5-308 Cinch lugs; CE natural bakelite; 3/32" thick x ½" x 2¼"; spcl; Radio Receptor dwg #A-179-340; (2nd r-f, reference symbols 108-6, 123-3, and 123-4 indicated on board).	1					•
	2Z9403.61	RT	BOARD, terminal: with three #5-308 Cinch lugs; CE natural bakelite; 3/32" thick x ½" x 2¼"; spcl; Radio Receptor dwg #A-179-119; (oscillator board #2; reference letters Fil. and B+ indicated on board).	1					•
	2Z9410.37	RT	BOARD, terminal: with ten #5-303 Cinch lugs; CE natural bakelite; 3/32" thick x 2⅝" x 3¼"; spcl; Radio Receptor dwg #A-179-75; (coil and resistor board).	1					•
	2Z9410.39	RT	BOARD, terminal: with ten #5-303 Cinch lugs; CE natural bakelite; 3/32" thick x 1⅝" x 2⅝"; spcl; Radio Receptor dwg #A-179-100; (input terminal board).	1					•
	2Z9412.54	RT	BOARD, terminal: with 12 #5-303 Cinch lugs; CE natural bakelite; 3/32" thick x 2" x 3⅝"; spcl; Radio Receptor dwg #A-179-98; (resistor mtg board).	1					•
	2Z9412.49	RT	BOARD, terminal: with 12 #5-303 Cinch lugs; CE natural bakelite; 3/32" thick x 2" x 4"; spcl; Radio Receptor dwg #A-179-99; (center capacitor and resistor board).	1					•
	2Z9412.53	TS	BOARD, terminal: with 12 #5-303 Cinch lugs; CE natural bakelite; 3/32" thick x 2" x 3⅝"; spcl; Radio Receptor dwg #A-179-191; (audio amplifier resistor mtg board).	1					•
	2Z9412.51	TS	BOARD, terminal: with 12 #5-308 Cinch lugs; CE natural bakelite; 3/32" thick x 2" x 3⅝"; spcl; Radio Receptor dwg #A-179-181; (vacuum tube voltmeter resistor mtg board).	1					•
	2Z9412.105	RT	BOARD, terminal: with 12 #5-308 Cinch lugs; CE natural bakelite; 3/32" thick x 2" x 4⅛"; spcl; Radio Receptor dwg #A-179-338; (resistor mtg board, left side).	1					•
	2Z9414.25	RT	BOARD, terminal: with 14 #5-303 Cinch lugs; CE natural bakelite; 3/32" thick x 1⅝" x 5"; spcl; Radio Receptor dwg #A-179-70; (side chassis resistor board).	1					•

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX-4 (cont'd)

a. All Major Components except Antenna System AS-134/TPX (cont'd).

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
	2Z9426-25	RT	BOARD, terminal: with 26 #5-303 Cinch lugs; CE natural bakelite; 3/32" thick x 1⅝" x 8-15/16"; spcl; Radio Receptor dwg #B-179-344; (rear chassis resistor board).	1					*
	2Z9438-6	RT	BOARD, terminal: with 40 #5-303 Cinch lugs; CE natural bakelite; 3/32" thick x 2" x 11⅛"; spcl; Radio Receptor dwg #B-179-345; (rear resistor mtg board).	1					*
561	2Z9402.106	TS	BOARD, terminal: double binding posts. Millen; Radio Receptor dwg #A-167-110.	1					*
	2S5009-1/B1		BOOK, LOG: 9⅝" x 7⅞" x 11/16"; Boorum and Pease #38 journal and ledger.	1					*
	2Z1241-10	RT	BRACKET, rear mtg (left), key hole slot; two steel mounting screws captive in bracket; spcl; Radio Receptor dwg #B-179-409, item 2; (for mtg transceiver case on field equipment).	1					*
	2Z1241-9	RT	BRACKET, rear mtg (right), key hole slot; two steel mounting screws captive in bracket; spcl; Radio Receptor dwg #B-179-409, item 1; (for mtg transceiver case on field equipment).	1					*
	2Z1244-5	RT	BRACKET: capacitor mtg; J type; spcl; Radio Receptor dwg #A-179-22.	8		*			*
	2Z1244-8	TS	BRACKET: capacitor mtg; universal type; Solar or Gudeman Co.	3		*			*
	2Z1409-18	RT	BUSHING: shock mtg: 11/16" long with ⅝" hex shape end; 0.257" diam body for fit inside shock mounting; spcl; Radio Receptor dwg #A-179-35.	8		*			*
p/o 1006	1F425-8		CABLE: AN type #RG-8/U; coaxial; impedance 52 ohms; polyethylene; outside covering vinylite 0.410" diam; Amphenol type 21B-290-7/21-XV.						*
p/o 1007	1F425-58		CABLE: AN type #RG-58/U; coaxial; flexible; impedance 53 ohms; single #20 solid copper wire; center cond; Amphenol type #21B-116-20-XV.						*
p/o 1010, 1011	1B190-2		CABLE: Ansonia Elec Works; Navy spec RE-13-A-737; (Airborne Radio Cable type #WD-2/U).						*
p/o 1013	1F425-8		CABLE: same as p/o 1006.						

	2Z1612.23	RT	CAP AND CHAIN, ASSEMBLY: spcl; for limiter control; special brass nickel plated knurled cap, chain attached; Radio Receptor dwg #A-179-117.	1					*
140-1 thru 140-11	3DK9100-109.1	RT	CAPACITOR, fixed: ceramic; 100 mmfd ±10%; 500 v d-c working; Muter type #20N750.	16		*	*	*	*
141-1 thru 141-15	3DKAI-110	RT	CAPACITOR, fixed: ceramic; Hi-K dielectric; 1,000 mmfd ±20%; 300 v d-c working; Muter type #20K1200.	18		*	*	*	*
142-A, 142-B, 142-C	3DA100-240	RT	CAPACITOR, fixed: oil-filled paper; bathtub; 3-sect. 0.1 mfd ±20% —10%; 600 v d-c working; Solar type #3XDMRBW or Gudeman type #7202.	3		*	*	*	*
143-1, 143-2, 143-3	3DA100-238	RT	CAPACITOR, fixed: oil paper tubulars; 0.1 mfd ±20%; 400 v d-c working; Micamold type #351-56.	3		*	*	*	*
144	3K3539231	RT	CAPACITOR, fixed: mica; 3,900 mmfd ±10%; 500 v d-c working; ASA type CM35C392K; Solar type #MWBW.	1		*	*	*	*
145	3D9020VE6	RT	CAPACITOR, variable: air dielectric; 4.1 to 20.6 mmfd; Amer Steel Pkg type H, Code 21P.	1		*	*	*	*
146	3DB1.32	RT	CAPACITOR, fixed: air-filled paper; 1 mfd +20% —10%; 400 v d-c working; Solar type #XDDRMBW.	1		*	*	*	*
147-1 thru 147-7	3D9020-22	RT	CAPACITOR, fixed: ceramic; 20 mmfd ± 5%; 500 v d-c working; Muter type #10N300.	7		*	*	*	*
148-1, 148-2	3DA5.100-7	RT	CAPACITOR, fixed: mica; 5,100 mmfd ±20%; 500 v d-c working; ASA type CM35C512M; Solar type #MWBW.	11		*	*	*	*
149	3DA2-134	RT	CAPACITOR, fixed; mica; 2,000 mmfd ±20%; 500 v d-c working; ASA type CM30C202M; Solar type #MWBW-1233.	1		*	*	*	*
150-1 thru 150-15	3K3047131	RT	CAPACITOR, fixed: mica; 470 mmfd ±10%; 500 v d-c working; ASA type CM20C471K; Solar type #MOBW.	15		*	*	*	*
241	3DA550	RT	CAPACITOR, fixed: 0.55 mfd ±20%; mineral oil paper; 220 v a-c, rms, 400 cps; Solar type #XDDRMBW.	1		*	*	*	*
242-A, 242-B, 242-C	3DA100-240	RT	CAPACITOR, fixed: same as 142-A.						
243	3D9010VE8	RT	CAPACITOR, variable: air dielectric; 3.8 to 10.8 mmfd; Amer Steel Pkg type J, Code 11S.	1		*	*	*	*

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX-4 (cont'd)

a. All Major Components except Antenna System AS-134/TPX (cont'd).

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
244	3DA5.100-7	RT	CAPACITOR, fixed: same as 148-1.						
245	3D9010V-2	RT	CAPACITOR ASSEMBLY, variable: air dielectric; 2 sect; 19 mmfd per sect; (tank inductor assembled to capacitor) Cardwell type #ET-19-AD (spcl); Radio Receptor (spcl) per dwg #A-179-23; Radio Receptor dwg #B-179-24.	1		*	*	*	*
246	3D9035-12	RT	CAPACITOR, fixed: mica, 35 mmfd ±5 mmfd; 3,500 v d-c working; 7,000 v d-c test; CM56B; Micamold type #1.	1		*	*	*	*
247-1, 247-2	3DB2-21	RT	CAPACITOR, fixed: oil-filled paper; 2 mfd +20% —10%; 600 v d-c working; Solar type #KLMRW or Gudeman type #7199.	5		*	*	*	*
248	3DB4-119	RT	CAPACITOR, fixed: oil-filled paper; 4 mfd + 20% —10%; 600 v d-c working; Solar type #KLMRW or Gudeman type #7200.	1		*	*	*	*
249	3DA100-232.1	RT	CAPACITOR, fixed: oil-filled paper; 0.1 mfd + 20% —10%; 3,500 v d-c working; Solar type #XLMW or Gudeman type #7201.	1		*	*	*	*
540	3K2010011	TS	CAPACITOR, fixed: silver mica; 10 mmfd ±10%; 500 v d-c working; ASA type CM20A100K; Solar type #MOSW-1403.	1		*	*	*	*
541-1 thru 541-5	3DK9100-109.1	TS	CAPACITOR, fixed: same as 140-1.						
542-1 thru 542-8	3DA5.100-7	TS	CAPACITOR, fixed: same as 148-1.						
543	3DA100-240	TS	CAPACITOR, fixed: same as 142-A.						
544-1 544-2 544-3	3DB2-21	TS	CAPACITOR, fixed: same as 247-1.						
545	3D9025V-49	TS	CAPACITOR, variable: air dielectric; 2 sect; 8 to 25 mmfd per sect; similar to E. F. Johnson type #25-HD-30; Radio Receptor dwg #B-2705-1.	1		*	*	*	*
546	3D9003VE7-1	TS	CAPACITOR, variable: air dielectric; 2.5 to 3.7 mmfd; Amer Steel Pkg type H, Code 4S.	1		*	*	*	*

547-1, 547-2, 547-3	3DKA1-110	TS	CAPACITOR, fixed: same as 141-1.						
548-1, 548-2	3D9015V-23	TS	CAPACITOR, variable: air dielectric; 4.5 to 15.0 mmfd; Amer Steel Pkg type J, Code 15S.	2		*	*	*	*
	6G190		CEMENT, gasket: rubber, 2 oz bottle.			*	*		*
	2Z2650-15	RT	CLAMP ASSEMBLY: coil form; rear mtg piece; LE bakelite; Radio Receptor dwg #A-2613-2 and #A-2613-4.	3		*			*
p/o 1010, 1011, 1012	2ZK2636-15	CX-159 CG-76 CX-304	CLAMP, cable: adjustable; die cast; aluminum body; 1-13/16" diam x 1-3/16" lg; Amphenol type #97-3057-10-6.	5		*			*
p/o 1012	2Z2642.24	CX-304	CLAMP, cable: adjustable; die cast; aluminum; 1-3/8" diam x 1-1/16" lg; Amphenol type #97-3057-12-6.	1		*			*
p/o 1012	2Z2646.20	CX-304	CLAMP, cable: adjustable; die cast; aluminum body; Amphenol type #97-3057-16-10.	1		*			*
	2Z2639-20		CLAMP, cable: Zierick #201.	2		*			*
	2Z3765-7	RT	CLAMP, dial: assembly consists of one knurled screw, one mounting block, one locking angle, and one C washer; spcl; Radio Receptor dwg D-179-421; (used on receiver for locking receiver oscillator dial).	1		*			*
	2Z3765-6	RT	CLAMP, dial: assembly consists of one knurled screw, one mounting bracket, one cam, one spring, one lock pin, and one groove-pin; spcl; Radio Receptor dwg #D-179-422; (used on transmitter for locking transmitting frequency dial drum).	1		*			*
	2Z2642.4	RT	CLAMP, tube: Cinch type #8548.	1		*			*
	2Z2650.6	RT	CLAMP, tube: modified Cinch type #8527; Radio Receptor dwg #A-179-16.	1		*			*
	6Z3856-56	RT	CLEANER, air, assembly: consists of one filter holder, one metal screen, one crimped element, and two support strips; spcl; Radio Receptor dwg #B-179-403; (used on transmitter front panel).	1		*			*
171	2C5130-48/C2	RT	COIL, radio, r-f: antenna assembly; unshielded; 3½ turns of #18 bare tinned copper wire; Radio Receptor dwg #A-2613-10 (spcl).	1		*	*	*	*
172-1, 172-2	2C5130-48/C1	RT	COIL, radio, r-f: assembly; unshielded; 2-1/3 turns of #18 bare tinned copper wire; Radio Receptor dwg #A-2613-11 (spcl).	2		*	*	*	*
174	2C5130-48/C3	RT	COIL, radio, r-f: osc fixed; unshielded; 4 turns of #22 bare tinned copper; Radio Receptor dwg #A-2532-1 (spcl).	1		*	*	*	*
175	3C342-13	RT	COIL, radio, r-f: choke; unshielded; 2.5 mh; 125 ma d-c max; 2 mmfd distributed capacity; 4 universal wound pie; Miller JW type #4537.	1		*	*	*	*

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX–4 (cont'd)

a. All Major Components except Antenna System AS–134/TPX (cont'd).

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
176–1 and 176–2	3C335–17	RT	COIL, radio, r-f: choke; unshielded; 4½ µh; 50 ma d-c max current; less than 1 mmfd distributed capacity; freq range 25–35 megacycle; approx 50 turns of #36 SSE wire; Radio Receptor dwg #A–2529–1 (spcl).	2		*	*	*	*
272–1 thru 272–5	3C342–14	RT	COIL, radio, r-f: ~~choke;~~ unshielded; 2.5 µh ±10%; current rating, 2 amp; d-c resistance 0.07 ohms; less than 1 mmfd distributed capacity; freq range 150 to 200 megacycles; 40 turns of #24 SSE wire; Miller JW type #4528.	9		*	*	*	*
280–A, 280–B	3C323–2X	RT	COIL, radio, a-f: dual filter choke; shielded; ea sect 0.8 henry at 130 ma d-c; total resistance 25 ohms; Amertran #32333; dwg #S–63963 (spcl); hermetically sealed case; Radio Receptor dwg #A–2905–5.	1		*	*	*	*
571	3F4325–159/C5	TS	COIL, radio, r-f: osc; fixed; unshielded; ⅝ turn; Radio Receptor dwg #A–179–182 (spcl).	1		*			*
572–1 thru 572–4	3C342–14	TS	COIL, radio, r-f: same as 272–1.						
573	3F4325–159/C4	TS	COIL, radio, r-f: fixed; unshielded; 68 turns of #30 E wire; Radio Receptor dwg #A–2534–1 (spcl).	1		*			*
574	3F4325–159/C1	TS	COIL, radio, r-f: fixed; unshielded; 22 turns of #26 E wire; sec winding: 1 turn of #22 tinned copper wire; spaced ⅛" from pri; Radio Receptor dwg #A–2535–1 (spcl).	1		*			*
578	3F4325–159/C2	TS	COIL, radio, r-f: antenna; fixed; unshielded; ¼" turn of #14 bare tinned copper wire; ⅝" radius; Radio Receptor dwg #A–2533–1 (spcl).	1		*			*
579	3F4325–159/C3	TS	COIL, radio, r-f: unshielded; 3½ turns of #14 bare tinned copper wire; Radio Receptor dwg #A–2536–1 (spcl).	1		*			*
	6G1005.7		COMPOUND, locking, glyptal: red; 2 oz bottle; G. E. Supply Co.			*	*		*
160–1 thru 160–4	2Z7111.61	RT	CONNECTOR, female contact: receptacle, Sig C socket SO–239, for PL–259 plug or equal part; Amphenol type #83–1R.	9		*			*
167	2Z7226–208	RT	CONNECTOR male contact: plug; H. B. Jones type #P–308–CCT.	1		*			*
260	2Z7111.61	RT	CONNECTOR, female contact: same as 160–1.						
261	2ZK3096–20	RT	CONNECTOR, female contact: receptacle; 2 term; Amphenol type #AN–3102–18–3S.	1		*			*

262	2ZK3096-21	RT	CONNECTOR, female contact: receptacle; 9 term; Amphenol type #AN-3102-22-17S.	1		*			*
264	2Z8799-207	RT	CONNECTOR, male contact: receptacle; 2 term; Amphenol type #AN-3102-18-3P.	1		*			*
266	2Z8674.21	RT	CONNECTOR, female contact: receptacle; 4 term; Amphenol type #AN-3102-18-4S.	1		*			*
267	2Z8639-15	RT	CONNECTOR, female contact: receptacle; 8 slots for blade type prong; H. B. Jones type #S-308-AB.	1		*			*
560-1, 560-2	2Z7111.61	TS	CONNECTOR, female contact: same as 160-1.						
562	2Z7113.41	RT	CONNECTOR, male contact: receptacle; 3 cylindrical prongs; Amphenol type #AN-3102-18-2P.	1		*			*
563	2ZK7409-2	TS	CONNECTOR, male contact: 4 cylindrical prongs; Amphenol type #AN-3102-18-4P.	1		*			*
602-1, 602-2	2Z7111.61	RT	CONNECTOR, female contact: same as 160-1.						
p/o 1006, 1007, 1012, 1013	2Z7226-259	CG-109 CG-110 CX-304 CG-100	CONNECTOR, male contact: plug; Sig C Plug #PL-259; Amphenol type #83-1SP.	8		*			*
p/o 1010	2Z7112.1	CX-159	CONNECTOR, male contact: plug; 2 pin cont; Amphenol type #AN-3108-18-3P.	1		*			*
p/o 1010	2Z8673.54	CX-159	CONNECTOR, female contact: Amphenol type #AN-3108-18-22S.	1		*			*
p/o 1011	2Z7114.11	CG-76	CONNECTOR, male contact: plug; 4 pin cont; Amphenol type #AN-3108-18-4P.	1		*			*
p/o 1011	2Z8674.4	CG-76	CONNECTOR, female contact: plug; 4 socket cont; Amphenol type #AN-3108-18-4S.	1		*			*
p/o 1012	2Z7119.13	CX-304	CONNECTOR, male contact: plug; 9 pin cont; Amphenol type #AN-3106-28-1P.	1		*			*
p/o 1012	2Z7119.1	CX-304	CONNECTOR, male contact: plug; 9 pin cont; Amphenol type #AN-3108-22-17P.	1		*			*
p/o 1012	2ZK3096-23	CX-304	CONNECTOR, female contact: plug; 2 socket cont; Amphenol type #AN-3108-18-3S.	1		*			*
p/o 1012, 1013	2Z7299-359	CX-304	CONNECTOR: plug M-359; angle plug adapter; cylindrical prong; die cast; zinc; Amphenol type #83-1AP.	3		*			*

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX-4 (cont'd)

a. All Major Components except Antenna System AS-134/TPX (cont'd)

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
	2Z7226-259.2		CONNECTOR, short circuiting plug: plug PL-259 internally short circuited; red fibre screw insert per Radio Receptor dwg #A-179-121; spcl; assembly of plug per Radio Receptor dwg #A-179-154.	1		*			*
1006	1F430-109	CG-109	CORD: AN-type #RG-58/U; 60" coaxial; flexible; impedance 52 ohms; 7 strands #21 Awg bare copper wire cond; solid dielectric; stabilized polyethylene; Amphenol type #21B-290/7-21-XV; Radio Receptor dwg #A-179-127.	1		*		*	
1007	1F430-110	CG-110	CORD: AN-type #RG-58/U; 60" coaxial; flexible; impedance 53 ohms; single #20 solid copper wire; center cond; solid dielectric; stabilized polyethylene; spcl; Radio Receptor dwg #B-179-128.	1		*		*	
1008	3E7193-4		CORD: 60"; two separate flexible test leads, held together by metal or plastic clip; one lead red, other black; ICA; Radio Receptor dwg #B-179-129.	1		*		*	
1010	3E6000-159	CX-159	CORD: AN type #WD-2/U; 72"; 2 cond; Plug AN-3108-18-3P; 3 pin cont Plug AN-3108-18-22S; Radio Receptor dwg #B-179-50; Navy spec RE-13-A-737.	1		*		*	
1011	3E6015-76	CG-76	CORD: AN type #WD-2/U; 72"; 2 cond; 4 pin cont angle Plug AN-3108-18-4P; 4 socket cont angle Plug AN-3108-18-4; Radio Receptor dwg #B179-49; Navy spec RE-13-A-737.	1		*		*	
1012	3E6000-304	CX-304	CORD: multiple branch, 60"; AN type #WM-1/U; 8 cond; main cable end 9 pin contact; straight Plug; AN-3106-28-1P; 9 pin contact; angle Plug AN-3108-22-17P. Left center and right center branches; single pin contact; straight Plug PL-259; angle plug adapter M-359; right branch; 2 socket contact angle Plug AN-3108-18-3S; Radio Receptor dwg #C-179-54.	1		*			
1013	1F4RZ-6.600	CG-100	CORD: AN type #RG-8/U; 50'; coaxial; impedance 52 ohms; polyethylene; Plug PL-259; fitted with Angle Adapter M-359; Plug AN type #UG-21/U (Navy #49268); spcl; Radio Receptor dwg #B-179-402.	1		*			
	3E1605-6.5	HS-30	CORD CD-605: 76"; one end terminated transformer C410; other end PL-55; (G.F.E.).	1					*
p/o 171, 172-1, 172-2	2Z3262-8	RT	CORE, coil: permeability tuning; brass core; per Radio Receptor dwg #A-2613-7; powdered iron core; per Radio Receptor dwg #A-2613-9; made of Crowley type #UF5 iron CRO-EX-2268.	3		*			*

	2Z3269–24	RT	COUPLING, shaft: insulating; CE bakelite tubing; spcl; shaft plug; two Allen head set screws.	1		*			*
	2Z3269–23	TS	COUPLING, shaft: insulating; CE bakelite tubing; four Allen head set screws.	1		*			*
569	2X4–10000	TS	CRYSTAL UNIT: 10 megacycle ±3 kc; —40° to +65°; in holder, molded brown bakelite; Bliley type #SR–5.	1		*	*		*
	2C4404A/D1	TS	DIAL VERNIER: Natl Co type #N; (with #3 scale).	1		*			*
	2Z3724.38	RT	DIAL AND HUB ASSEMBLY: hub screwed to drum dial of natural bakelite; numerals from 0 to 10; hub supplied with two Allen head set screws; drum supplied with two stop spacers; spcl; Radio Receptor dwg #B–179–271; (used on transmitter).	1		*			*
	2Z3765–3	RT	DIAL ASSEMBLY: black bakelite knob with one 5–0 dial; dial staked knob; spcl; Radio Receptor dwg #A–179–116; (used on receiver).	1		*			*
269	3Z1927	RT	FUSE: 2 amp, 250 v; non-renewable; #3AG; Littelfuse type #1042.	1	*	*	*	*	*
567	3Z2572	TS	FUSE: 1/32 amp, 250 v; non-renewable; #8AG; Littelfuse #1002.	1	*	*	*	*	*
568	3Z1946	TS	FUSE: ⅛ amp, 250 v; non-renewable; #3AG; Littelfuse type #1046.	1	*	*	*	*	*
	2C5130–48/C4	RT	GASKET, molded rubber: rectangular, to fit on outside front rim of RT–48A/TPX–1 shock mount frame; OD 14¼" x 13"; spcl; Radio Receptor dwg #B–179–277.	1		*			*
	2C5130–48/G1	RT	GASKET, molded ruber: to fit in channel of the under side of cover of transit chest for RT–48A/TPX–1; OD 15⅝" x 13⅞" wd x 5/16" thk; spcl; Radio Receptor dwg #A–179–6.	1		*	*		*
	2Z4867.76	CY–154	GASKET, molded rubber: to fit the under side cover of Chest CY–154/-TPX–1; OD 13⅝" x 15⅞"; spcl; Radio Receptor dwg #B–179–241, item 1.	1		*	*		*
	2Z4867.77	CY–215	GASKET, molded rubber: to fit the under side cover of Chest CY–155/TPX–1; OD 18⅞" x 18⅞"; spcl; Radio Receptor dwg #B–179–241, item 4.	1		*	*		*
	2Z4867.78	CY–156	GASKET, molded rubber: to fit the under side of cover of Chest CY–156/TPX–1; OD 18⅝" x 13¼"; spcl; Radio Receptor dwg #B–179–241, item 3.	1		*	*		*
	2Z4867.79	CY–157	GASKET, molded rubber: to fit the under side of cover of Chest CY–157/TPX–1; OD 18⅝" x 10⅞"; spcl; Radio Receptor dwg #B–179–241, item 2.	1		*	*		*
p/o 1010, 1011, 1012,	2Z4866.100	CX–159 CG–76 CX–304	GASKET, washer: black rubber; for cords; 15/16" OD x ¼" ID x 3/32" thk; spcl; Radio Receptor dwg #A–179–57, item 1.	5		*			*

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX-4 (cont'd)

a. All Major Components except Antenna System AS-134/TPX (cont'd)

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
p/o 1012	6L54007-1	CX-304	GASKET, washer: black rubber; 1-11/32" OD x 7/16" ID x ⅛" thk; spcl; Radio Receptor dwg # A-179-57, item 3.	1		*			*
p/o 1012	2Z4866.102	CX-304	GASKET, washer: black rubber; 1⅛" OD x 7/16" ID x 3/32" thk; spcl; Radio Receptor dwg # A-179-57, item 4.	1		*			*
	2C5130-48/3	RT	GASKET: black sponge rubber; 2⅝" OD x 1½" ID x ⅜" thk; spcl; Radio Receptor dwg # A-179-404.	1		*			*
	2Z4866.97	RT	GASKET, backing block: 15/16" x ⅝" x 1/32" thk; spcl; Radio Receptor dwg # A-179-45.	4		*			*
	6Z5022-2	RT TS	HANDLE: U shaped; ¼" diam brass rod; nickel-plated; spcl; Radio Receptor dwg # A-179-20.	4		*			*
	-4B1310		HEADSET HS-30.	1					*
	3Z3285-2	RT TS	HOLDER, fuse; # 3AG fuse; Buss type # HKM.	2		*	*	*	*
	3Z3285-6	TS	HOLDER, fuse: for # 8AG fuse; Buss type HJM.	1		*			*
	2B1300	HS-30	INSERT, M-300; for Head Set HS-30.	2	*	*			*
p/o 600, 1012, 1007	3G1837-25	CX-304 CG-110	INSULATOR, bushing: Radio Receptor dwg # A-179-55 (spcl); (used with PL-259 on Cables RG-58/U).	4		*			*
	3G115-32	RT	INSULATOR, bushing: feedthru; steatite; white; glazed; AlSiMag type # 1174.	2		*			*
	3G115-24.1	TS	INSULATOR, bushing: ceramic; feedthru; steatite; AlSiMag type # 1172.	1		*			*
	3G1250-12.14	TS	INSULATOR, stand-off: post; steatite; AlSiMag type # 1645.	1		*			*
	3G1250-48.3	TS	INSULATOR, stand-off: post; steatite; AlSiMag type # 1005.	2		*			*
	3G1250-16.26	RT	INSULATOR, stand-off: post; steatite; AlSiMag type # 1706.	3		*			*
	3GK1250-8.12	RT	INSULATOR, stand-off: post, steatite; AlSiMag type # 1700.	7		*			*
	3G1250-20.6	RT	INSULATOR, stand-off: post; steatite; AlSiMag type # 1708.	2		*			*
	3G1450-40	RT	INSULATOR; stand-off: post; steatite; Isolantite type # 393.	1		*			*

	3G2518.1		INSULATOR, tubing: red; extruded vinylite ID to fit #18 AWG.			*			*
565	2Z5534A	TS	JACK, telephone: single circuit; 2 silver-plated term; Amer Rad Hdwe type #JK-34-A.	1		*			*
	2Z5829-6	TS	KNOB: LE natural bakelite; supplied with two Allen head set screws; spcl; Radio Receptor dwg #A-179-186.	1		*			*
	2Z5822-77	RT TS	KNOB: round, with skirt, black bakelite; for ¼" shaft with brass insert. Kurz Kasch Type S-380-64-BBL; knob supplied with two set screws; modified per Radio Receptor dwg #A-179-9.	4		*			*
	2Z3899		LOAD, DUMMY: 50 ohms; plug PL-259, plug terminated internally in a 50 ohm ± 10%, 1 w, carbon, bakelite insulated resistor; Stackpole #CM-1; spcl; Radio Receptor dwg #A-179-112.	1		*			*
	3Z12027-18.2		LUG: solder, standard, Zierick type #46, #6 hole.			*			*
	3Z12072-18		LUG: solder, standard, Zierick type #46, #10 hole.			*			*
	3ZK12072-37		LUG: solder, standard, Zierick type #105, #6 hole.			*			*
	3Z12072-40		LUG: solder, standard, Zierick type #123, #8 hole.			*			*
	3Z12072-5		LUG: solder, standard, Zierick type #147, #6 hole.			*			*
	3Z12072-41		LUG: solder, standard, with slotted hole; Zierick type #163.						*
	3Z12031-14		LUG: solder, standard, Stewart #307, #10 hole.			*			*
566	3F891-37	TS	METER, ammeter: d-c; 0-1 ma; Weston; ASA type #MR24WOO1-DCMA; (self-contained).	1		*	*		*
268	3H3000-30	RT	MOTOR: blower; freq 400 cycle, permanent, split phase capacitor; 1/100 horsepower; 115 volt; 7200 rpm; required capacity 0.55 mfd; Eastern Air Devices type #J-31-A.	1		*			*
	2Z8502-1	RT	MOUNT, vibration: plate type; rated for 12 lb load; Lord type #150-P236-12.	8		*			*
	3G1838-43.2	TS	MOUNTING BOARD: CE natural bakelite; 2 11/16" x ¾" x 3/32" thk; (reference symbols 546 and 572-3 indicated on board); spcl; Radio Receptor dwg #A-179-184.	1		*			*
	6L3104-40.1		NUT, hexagon: standard; brass; nickel-plated; ¼", #4-40.			*			*
	6L3106-32-4.1		NUT, hexagon: standard; brass; nickel-plated; ¼", #6-32.			*			*
	6L3106-32.1		NUT, hexagon: standard; brass; nickel-plated; 5/16", #6-32.			*			*
	6L3108-32.1		NUT, hexagon: standard; brass; nickel-plated; 5/16", #8-32.			*			*
	6L3110-32.1		NUT, hexagon: standard; brass; nickel-plated; 3/8", #10-32.			*			*

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX-4 (cont'd)

a. All Major Components except Antenna System AS-134/TPX (cont'd).

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
p/o 171, 172-1, 172-2	6L2720-32-6	RT	NUT, adjustment: ⅜" hex brass; ⅜" long; supplied with one Allen head set screw; spcl; Radio Receptor dwg #A-2613-6.	3		*			*
101-1, 101-2	3Z6035-26	RT	RESISTOR, fixed: carbon; 350 ohms ± 10%; ½ w; Stackpole type #CM-½ or Speer type #ST-½.	2		*	*	*	*
102	3Z6675-33	RT	RESISTOR, fixed: carbon; 75,000 ohms ±10%, 1 w; Stackpole type #CM-1.	1		*	*	*	*
103-3, 103-4	3RC31AE103K	RT	RESISTOR, fixed: carbon; 10,000 ohms ±10%; 1 w; Speer type #SI-1 or Stackpole type #CM-1.	2		*	*	*	*
104	3RC31AE152K	RT	RESISTOR, fixed: carbon; 1,500 ohms ±10%; 1 w; ASA type #RC31AE152K.	1		*	*	*	*
105-1 thru 105-5	3Z6200-138	RT	RESISTOR, fixed: carbon; 2,000 ohms ±10%; 1 w; Speer type #SI-1 or Stackpole type #CM-1.	5		*	*	*	*
106	3RC31AE153K	RT	RESISTOR, fixed: carbon; 15,000 ohms ±10%; 1 w; Speer type SI-1 or Stackpole type #CM-1.	1		*	*	*	*
107-1, 107-2, 107-3,	3RC20AE102K	RT	RESISTOR, fixed: carbon; 1,000 ohms ±10%; ½ w; Speer type SI-½ or Stackpole type #CM-½.	5		*	*	*	*
108-5, 108-6	3Z6300-142	RT	RESISTOR, fixed: carbon; 3,000 ohms ±10%; 1 w; Speer type #SI-1 or Stackpole type #CM-1.	8		*	*	*	*
109-1 thru 109-5	3RC20AE151K	RT	RESISTOR, fixed: carbon; 150 ohms ±10%; ½ w; ASA type #RC20AE15K.	5		*	*	*	*
110	3Z6650-116	RT	RESISTOR, fixed: carbon; 50,000 ohms ±10%; 1 w; Speer type SI-1 or Stackpole type #CM-1.	2		*	*	*	*
111-1, 111-2	3Z6625-137	RT	RESISTOR, fixed: carbon; 25,000 ohms ±10%; 1 w; Speer type #SI-1 or Stackpole type #CM-1.	2		*	*	*	*
112	3Z6725-21	RT	RESISTOR, fixed: carbon; 250,000 ohms ±10%; ½ w; Speer type #SI-½ or Stackpole type #CM-½.	4		*	*	*	*
113-1 thru 113-6	3RC31AE104K	RT	RESISTOR, fixed: carbon; 100,000 ohms ± 10%; 1 w; ASA type RC31-AE104K.	6		*	*	*	*

114	3Z6005-31	RT	RESISTOR, fixed: carbon; 50 ohms ±10%; ½ w; Speer type #SCI-½ or #SI-½ or Stackpole type #CM-½.	1		•	•	•	•
115-1, 115-2, 115-3	3ZK6750-40	RT	RESISTOR, fixed: carbon; 500,000 ohms ±10%; ½ w; Speer type #SI-½ or Stackpole type #CM-½.	5		•	•	•	•
116-1, 116-2	3Z6500-192	RT	RESISTOR, fixed: carbon; 5,000 ohms ±10%; 1 w; Speer type #SI-1 or Stackpole type #CM-1.	2		•	•	•	•
118-1, 118-2	3Z6630-56	RT	RESISTOR, fixed: carbon; 30,000 ohms ±10%; 2 w; Speer type #SI-2.	2		•	•	•	•
119-1, 119-2, 119-3	3RC20AE205K	RT	RESISTOR, fixed: carbon; 2 megohms ± 10%; ½ w; ASA type RC20-AE205K.	4		•	•	•	•
120	2Z7272-91	RT	RESISTOR, variable: carbon; 500,000 ohms ±20%; linear; peak limiter bias; Clarostat type #37.	1		•	•	•	•
121-1 thru 121-5	3Z6150-91	RT	RESISTOR, fixed: carbon; 1,500 ohms ±10%; ¼ w; Stackpole type #CM-1/3.	5		•	•	•	•
122	3Z6725-26	RT	RESISTOR, fixed: carbon; 250,000 ohms ±10%; 1 w; Speer type #SI-1 or Stackpole type #CM-1.	1		•	•	•	•
123-1 thru 123-4	3Z6620-123	RT	RESISTOR, fixed: carbon; 20,000 ohms ±10%; 1 w; Speer type #SI-1 or Stackpole type #CM-1.	4		•	•		•
124-1 thru 124-8	3Z6560-65	RT	RESISTOR, fixed: carbon; 6,000 ohms ±10%; 1 w; Speer type #SI-1 or Stackpole type #CM-1.	8		•	•		•
125	3ZK6700-94	RT	RESISTOR, fixed: carbon; 100,000 ohms ±10%; 2 w; Speer type #SI-2.	1		•	•		•
126-1 thru 126-6	3Z6715-29	RT	RESISTOR, fixed: carbon; 150,000 ohms ±10%; 1 w; Speer type #SI-1 or Stackpole type #CM-1.	6		•	•		•
200	3RC20AE104K	RT	RESISTOR, fixed: carbon; 100,000 ohms ± 10%; ½ w; ASA type RC20-AE104K.	5		•	•	•	•
201-1 thru 201-9	3Z6750-70	RT	RESISTOR, fixed: carbon; 500,000 ohms ±5%; 1 w; Speer type #SI-1 or Stackpole type #CM-1.	10		•	•	•	•
202	3Z6025-63	RT	RESISTOR, fixed: carbon; 250 ohms ± 5%; ½ w; Speer type #SCI-½ or Stackpole type #CM-½.	1		•	•	•	•
203	3RC20AE101J	RT	RESISTOR, fixed: carbon; 100 ohms ±5%; ½ w; ASA type RC20AE101J.	3		•	•	•	•

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX-4 (cont'd)

a. All Major Components except Antenna System AS-134/TPX (cont'd).

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
204	3RC20AE103K	RT	RESISTOR, fixed: carbon; 10,000 ohms ± 10%; ½ w: ASA type RC20-AE103K.	2		*	*	*	*
206-1 thru 206-4	3Z6660-19	RT	RESISTOR, fixed: carbon; 60,000 ohms ±10%; 2 w; Speer type #SI-2.	4		*	*		*
207-1, 207-2	3RC20AE102K	RT	RESISTOR, fixed: same as 107-1.						
208	3RC20AE203J	RT	RESISTOR, fixed: carbon; 20,000 ohms ± 5%; ½ w; ASA type RC20-AE203J.	1		*	*	*	*
209	3Z6300-142	RT	RESISTOR, fixed: same as 108-5.						
210	3Z5420.18	RT	RESISTOR, fixed: wire-wound; 2,000 ohms ±10%; 25 w; Ward Leonard type #A.	3		*	*	*	*
211	3Z6650-116	RT	RESISTOR, fixed: same as 110.						
212	3Z6050-121	RT	RESISTOR, fixed: carbon; 500 ohms ±10%; ½ w; Speer type #SCI-½ or SI-½ or Stackpole type #CM-½.	1		*	*	*	*
213-1, 213-2	3Z6640-43	RT	RESISTOR, fixed: carbon; 40,000 ohms ±10%; 2 w; Speer type #SI-2.	2		*	*		*
501-1, thru 500-4	3RC20AE104K	TS	RESISTOR, fixed: same as 200.						
501-1, 501-2	3RC20AE105K	TS	RESISTOR, fixed: carbon; 1 megohm ± 10%; ½ w; ASA type RC20-AE105K.	2		*	*	*	*
502	3RC20AE103K	TS	RESISTOR, fixed: same as 204.						
503-1, 503-2, 503-3	3Z6725-21	TS	RESISTOR fixed: same as 112.						
504	2Z7281.38	TS	RESISTOR, variable: wire-wound; 20,000 ohms ±10%; Clarostat type #P-58-20,000; (potentiometer).	1		*	*	*	*
505	3RC20AE205J	TS	RESISTOR, fixed: carbon; 2 megohms ± 5%; ½ w; ASA type RC20-AE205J.	1		*	*	*	*
506	3Z6801-3	TS	RESISTOR, fixed: carbon; 1 megohm ±5%; ½ w; Speer type #SI-½ or Stackpole type #CM-½.	1		*	*	*	*

507	2Z7267.24	TS	RESISTOR, variable: carbon; 500 ohms ±20%; Clarostat type #37; (potentiometer).	1		*	*	*	*
508	3RC31AE104J	TS	RESISTOR, fixed: carbon; 100,000 ohms ± 5%; 1 w; ASA type RC31-AE104J.	1		*	*	*	*
509	3RC20AE205K	TS	RESISTOR, fixed: same as 119–1.						
510–1, 510–2	3RC20AE101J	TS	RESISTOR, fixed: same as 203.						
511–1, 511–2	3Z5420.18	TS	RESISTOR, fixed: same as 210.						
512	3Z6650–147	TS	RESISTOR, fixed: carbon; 50,000 ohms ±5%; 1 w; Speer type #SI–1 or Stackpole type #CM–1.	1		*	*	*	*
513	3Z6750–70	TS	RESISTOR, fixed: same as 201–1.						
514–1, 514–2	38K6750–40	TS	RESISTOR, fixed: same as 115–1.						
	6L6256–59.5		SCREW, standard: RH, brass; nickel-plated; #2–56 x 5/16" lg.			*			*
	6L6440–3.9		SCREW, machine: Bind H; brass; nickel-plated; #4–40 x 3/16" lg.			*			*
	6L6440–6.9B		SCREW, machine: Bind H; brass; black nickel-plated; #4–40 x 3/8" lg.			*			*
	6L6440–7.5		SCREW, machine: RH; brass; nickel-plated; #4–40 x 7/16" lg.			*			*
	6L6440–9.5		SCREW, machine: RH; brass; nickel-plated; #4–40 x 9/16" lg.			*			*
	6L6632–5.9		SCREW, machine: Bind H; brass; nickel-plated; #6–32 x 5/16" lg.			*			*
	6L6632–6.9		SCREW, machine: Bind H; brass; nickel-plated; #6–32 x 3/8" lg.			*			*
	6L6632–6.7		SCREW, machine: FH; brass; nickel-plated; #6–32 x 3/8" lg.			*			*
	6L6632–10.9		SCREW, machine: Bind H; brass; nickel-plated; #6–32 x 5/8" lg.			*			*
	6L6632–14.1		SCREW, machine: RH; brass; nickel-plated; #6–32 x 7/8" lg.			*			*
	6L6632–16.9		SCREW, machine: Bind H; brass; nickel-plated; #6–32 x 1" lg.			*			*
	6L6832–5.9		SCREW, machine: Bind H; brass; nickel-plated; #8–32 x 5/16" lg.			*			*
	6L6832–8.11		SCREW, machine: Bind H; brass; nickel-plated; #8–32 x 1/2" lg.			*			*
	6L6832–8.7		SCREW, machine: FH; brass; black nickel-plated; #8–32 x 1/2" lg.			*			*
	6L7032–6.9–1		SCREW, machine: Bind H; brass; nickel-plated; #10–32 x 3/8" lg.			*			*
	6L7032–6.9–1		SCREW, machine: Bind H; brass; black nickel-plated; #10–32 x 3/8" lg.			*			*
	6L185062.39Z1		SCREW, machine: set; Allen H; zinc plate and Cronak; #6–32 x 1/8" lg; cup point.			*			*

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX–4 (cont'd)

a. All Major Components except Antenna System AS–134/TPX (cont'd).

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
	6L18508–3.39Z1		SCREW, machine: set; Allen H; zinc plate and Cronak; #8–32 x 3/16" lg; cup point.			*			*
	6L18510–3.39Z		SCREW, machine: set; Allen H; zinc plate and Cronak; #10–32 x 3/16" lg; cup point.			*			*
	6L7224–14.85N	RT	SCREW, special; hex head; brass; nickel-plated; #12–24 x 7/8"; Radio Receptor dwg #A–179–152.	4		*			*
	6L7920–4–8 .49S2	RT	SCREW, special: RH mach; steel; 1/4"–20; 1/2" lg; Radio Receptor dwg #A–179–14A.	4		*			*
	2Z8761.20	TS	SOCKET, crystal: holder; 2-prong; Millen type #33202.	1		*	*	*	*
	2Z8674.84	RT	SOCKET, tube: 4-prong; mica-filled bakelite; Amphenol type #MIP–4TM.	1		*	*	*	*
	2Z8761.1	RT TS	SOCKET, acorn tube: 5-prong; double grip beryllium copper contact; silver plated; Hammarlund type #UHS–900.	5		*	*	*	*
	2Z8672.60	TS	SOCKET, tube: receiver; miniature type; 7-prong; Cinch type #8660.	1		*	*	*	*
	2Z8650.1	RT TS	SOCKET, tube: receiver; octal; mica-filled bakelite; silver-plated contact; Cinch type #9919.	17		*	*	*	*
	2C5130–48/1	RT	SPACER: 3/16" hex brass rod; nickel-plated; 5/8" long; #4–40 tap one end; #4–36 x 7/32", threaded section on other end; spcl; Radio Receptor dwg #A–179–336.	4		*			*
	2Z8871–7	RT	SPRING: double leaf; spcl; outer spring as per Radio Receptor dwg #A–179–25; inner spring as per Radio Receptor dwg #A–179–26; spring strap as per Radio Receptor dwg #A–179–19.	6		*			*
	6L31210N	TS	STUD: brass; nickel-plated; #6–32 x 1" lg; spcl; Radio Receptor dwg #A–179–199, item 6.	1		*			*
	6L31217N	TS	STUD: brass; nickel-plated; #6–32 x 1 3/4" lg; spcl; Radio Receptor dwg #A–179–199, item 3.	1		*			*
	6L31228N	RT	STUD: brass; nickel-plated; #10–32 x 2 1/4" lg; spcl; Radio Receptor dwg #A–179–199, item 4.	2		*			*
	6L31234N	RT	STUD: brass; nickel-plated; #10–32 x 2 11/16" lg; spcl; Radio Receptor dwg #A–179–199, item 5.	1		*			*
263	3Z9825–58.16	RT	SWITCH, rotary: Centralab type #BHXC–7217; Radio Receptor dwg #A–179–155.	2		*			*

265	2C586C/S5	RT	SWITCH, micro: 125 v a-c; 10 amp; Micro Sw type #YZ-RL8.	1		*			*
575	3Z9825-58.16	TS	SWITCH, rotary: same as 263.						
576-1, 576-2	3ZK9845-19	TS	SWITCH, toggle: single pole, single throw; 125 v a-c; 4 amp; C-H type #8803K3.	2		*			*
	2Z1605-18.1	RT	TERMINAL: tube cap; National Co. type #8, for 1/4" tube cap; spcl; Radio Receptor dwg #A-179-123, item 2.	1		*			*
	2Z1605-18	RT	TERMINAL: tube cap; National Co. type #8, for 1/4" tube cap; spcl; Radio Receptor dwg. #A-179-123, item 1.	1		*			*
	2Z2724	RT	TERMINAL: plate cap; for 3/8" plate cap; National Co. type #24.	1		*			*
	2Z2736-5	RT	TERMINAL: spring clip; Hammarlund type #3568-1.	6		*			*
	3F4325-159	TS	TEST SET TS-159/TPX: cased in olive drab painted aluminum cabinet, 8-7/32" x 13-1/16" x 6-29/32"; controls and connections on front panel; weight 14 lb; 10" rod antenna and hinged tuning chart mounted on top; spcl; Radio Receptor dwg #D-179-7.	1					*
170	2Z9614-46	RT	TRANSFORMER, video: hermetically sealed case; Amertran spcl #32398; Amertran dwg #S-64518; Radio Receptor dwg #A-2905-1.	1		*			*
173-1 thru 173-4	2Z9643.81	RT	TRANSFORMER, i-f: aluminum shield can; spcl; Radio Receptor dwg #C-2528-1, items 1 thru 4.	4		*	*	*	*
177	2Z9643.82	RT	TRANSFORMER, l-f: aluminum shield can; spcl; Radio Receptor dwg #C-2528-1, item 5.	1		*	*	*	*
270	2Z9601.56	RT	TRANSFORMER, power: plate; hermetically sealed case; Amertran spcl #32330; Amertran dwg #S-63965; Radio Receptor dwg #A-2905-2.	1		*			*
271	2Z9617-41	RT	TRANSFORMER, power: filament; hermetically sealed case; Amertran spcl #32331; Amertran dwg #S-63961; Radio Receptor dwg. #A-2905-3.	1		*			*
274	2Z9640-5	RT	TRANSFORMER, pulse amplr: hermetically sealed case; Amertran spcl #32399; Amertran dwg #64515; Radio Receptor dwg #A-2905-4.	1		*			*
570	2Z9619.41	TS	TRANSFORMER, power: filament; Amertran spcl #32332; Amertran dwg #S-63959; Radio Receptor dwg #A-2905-6.	1		*			*
	2C5130-48	RT	TRANSMITTER-RECEIVER RT-48A/TPX-1: cased in olive drab aluminum chest, 15-5/8" x 14-1/8" x 10"; rubber gasketed waterproof cover, held on by toggle clamps and removable hinge toggle clamps; receiver and transmitter built in two chassis unit with common front panel; chassis unit slides into aluminum channel frame which is suspended in chest by 8 shock mounts; total weight 45 lb; two carrying handles; supplied with canvas rain cover per Radio Receptor dwg #B-179-217; spcl; Radio Receptor dwg #D-179-4.	1	*				*

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX-4 (cont'd)

a. All Major Components except Antenna System AS-134/TPX (cont'd).

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
130-1, 130-2, 130-3	2J956	RT	TUBE: JAN-956.	3	*	*			
131-1 thru 131-6	2J6AC7	RT	TUBE: JAN-6AC7/1852.	6	*	*			
132	2J955	RT	TUBE: JAN-955.	2	*	*			
133	2J6V6GT	RT	TUBE: JAN-6V6GT/G.	1	*	*			
134	2J6SL7GT	RT	TUBE: JAN-6SL7GT.	4	*	*			
135	2J6H6GT/G	RT	TUBE: JAN-6H6GT/G.	1	*	*			
231	2J2C26	RT	TUBE: JAN-2C26.	1	*	*			
232	2J5U4G	RT	TUBE: JAN-5U4G.	1	*	*			
233	2J2X2	RT	TUBE: JAN-2X2/879.	1	*	*			
234	2J6SN7GT	RT	TUBE: JAN-6SN7GT.	1	*	*			
530	2J955	TS	TUBE: Same as 132.						
531-1, 531-2, 531-3	2J6SL7GT	TS	TUBE: Same as 134.						
532	2J9006	TS	TUBE: JAN-9006.	1	*				
533	2J6X5GT/G	TS	TUBE: JAN-6X5GT/G.	1	*				
534	2JVR150-30	TS	TUBE: JAN-OD3/VR-150.	1	*				
	3G1838-5.7		WASHER: bakelite; 5/16" OD x 5/32" ID x 1/32"; spcl; Radio Receptor dwg # A-3814-1, item 1.			*			*
	6L50712		WASHER: cork; 1/4" OD x 1/8" ID x 1/32"; spcl; Radio Receptor dwg # A-3813-1, item 16.			*			*
	6L50713-1		WASHER: cork; 3/8" OD x 5/32" ID x 1/32"; spcl; Radio Receptor dwg # A-3813-1, item 1.			*			*
	6L50714-1		WASHER: cork; 7/16" OD x 7/32" ID x 1/32"; spcl; Radio Receptor dwg # A-3813-1, item 2.			*			*

	6L50713		WASHER: cork; ½" OD x 3/16" ID x 1/16"; spcl; Radio Receptor dwg #A-3813-1, item 8.			*			*
	6L50714		WASHER: cork; ½" OD x ¼" ID x 1/16"; spcl; Radio Receptor dwg #A-3813-1, item 9.			*			*
	6L50718		WASHER: cork; ⅝" OD x ½" ID x 1/16"; spcl; Radio Receptor dwg #A-3813-1, item 6.			*			*
	6L50524-4		WASHER: fibre; ⅝" OD x 7/32" ID x 1/16".			*			*
	6L50002N		WASHER: flat; brass; nickel-plated; #2.			*			*
	6L50004N		WASHER: flat; brass; nickel-plated; #4.			*			*
	6L50006N		WASHER: flat; brass; nickel-plated; #6 small pattern.			*			*
	6L50010NP		WASHER: flat; brass; nickel-plated; #10 small pattern.			*			*
	6L72202Z1		WASHER: lock; steel; zinc-plated and cronak; (#2 internal tooth).			*			*
	6L72204Z1		WASHER: lock; steel; zinc-plated and cronak; (#4 internal tooth).			*			*
	6L72206Z1		WASHER: lock; steel; zinc-plated and cronak; (#6 internal tooth).			*			*
	6L72208Z1		WASHER: lock; steel; zinc-plated and cronak; (#8 internal tooth).			*			*
	6L72210Z1		WASHER: lock; steel; zinc-plated and cronak; (#10 internal tooth).			*			*
	6L72212Z1		WASHER: lock; zinc-plated and cronak; (#12 split ring; National #7918-A soft type "C" ring).			*			*
	6L72220Z1		WASHER: lock; steel; zinc-plated and cronak; (⅜" internal tooth).			*			*
	6L7224Z1		WASHER: lock; steel; zinc-plated and cronak; (½" internal tooth).			*			*
u/w 171, 172-1, 172-2	6L58024-13	RT	WASHER, spring steel: ¼" ID, 7/16" OD, 1/16" h uncompressed; 0.012" compressed; Shakeproof #3539-14-2.			*			*
	1B822.31	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with black tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.25	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with green tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.55	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with med brown tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.27	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with red tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX-4 (cont'd)

a. All Major Components except Antenna System AS-134/TPX (cont'd).

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
	1B822.28	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with yellow tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.30	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray, no tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.			*			*
	1B822.17	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with blue and yellow tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.16	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with green and red tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.18	TS	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with black and green tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.23	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with black and yellow tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.56	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with blue and med brown tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.20	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with blue tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.19	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with green and yellow tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.20	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with red and yellow tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.21	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with yellow tracer; Vinylite insulation 0.030"; over-all cotton braid; Rome Cable.						*

	1B822.34	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with black and green tracer; Vinylite insulation 0.080"; over-all cotton braid; Rome Cable.						*
	1B822.33	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with red and black tracer; Vinylite insulation 0.080"; over-all cotton braid; Rome Cable.			*			*
	1B822.22	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with red and yellow tracer; Vinylite insulation 0.080"; over-all cotton braid; Rome Cable.						*
	1B818.86	RT	WIRE, insulated: copper; tinned; single #18 stranded cond; 19 strands; 0.0092" diam; color coded gray with black tracer; Vinylite insulation 0.015" over-all cotton braid; Rome Cable.			*			*
	1B818.110	RT	WIRE, insulated: copper; tinned; single #18 stranded cond; 19 strands; 0.0092" diam; color coded gray with medium brown tracer; Vinylite insulation 0.015"; over-all cotton braid; Rome Cable.						*
	1B818.82	RT	WIRE, insulated: copper; tinned; single #18 stranded cond; 19 strands; 0.0092" diam; color coded gray with orange tracer; Vinylite insulation 0.015"; over-all cotton braid; Rome Cable.						*
	1B818.84	RT	WIRE, insulated: copper; tinned; single #18 stranded cond; 19 strands; 0.0092" diam; color coded gray with orange and black tracer; Vinylite insulation 0.015"; over-all cotton braid; Rome Cable.						*
	1B818.83	RT	WIRE, insulated: copper; tinned; single #18 stranded cond; 19 strands; 0.0092" diam; color coded gray with yellow and black tracer; Vinylite insulation 0.015"; over-all cotton braid; Rome Cable.						*
	1B818.111	RT	WIRE, insulated: copper; tinned; single #18 stranded cond; 19 strands; 0.0092" diam; color coded gray with yellow tracer; Vinylite insulation 0.015"; over-all cotton braid; Rome Cable.						*
	1B822.15	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with black and blue tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1B822.57	RT	WIRE, insulated: copper; tinned; single #22 stranded cond; 7 strands; 0.010" diam; color coded gray with black and medium brown tracer; Vinylite insulation 0.012"; over-all cotton braid; Rome Cable.						*
	1A822.5		WIRE, bare: copper; #22 Awg; solid (tinned); Birnbach Radio; Radio Receptor.						*

*Indicates that stock is available.

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX-4 (cont'd)

b. Antenna System AS-134/TPX.

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
	2Z299-359	AS	ADAPTER, angle plug: single contact; Signal Corps Adapter M-359.	1		*			*
	2A3340	AS	ANCHOR ASSEMBLY: steel angle 3/16" x 1⅛" x 1⅛" x 15" long with 3/16" x 3" diam ring and roundeye snap bolt; hot dip galvanized; parts #1, #2, and #3.	3		*			*
	2Z272-13	AS	ANTENNA ASSEMBLY: antenna beam, dwg D-6100A; steel tubing 1½" sq x 61⅞" long, machined to receive 6 reflector rods, ⅝" diam x 39¼" long, dwg C-6200, and dipole assembly and feeder harness dwg D-6400, secured to antenna beam by two dipole supports, dwg B-6300.	1					*
	2A998-55	AS	AZIMUTH CONTROL DRIVE BOX ASSEMBLY: Sig C Remote Antenna Drive RM-55; consisting of cast aluminum housing approx 7" x 6" x 7" high with crank handle for manual operation of flexible shafting; illuminated indicator dial; rotation in both clockwise and counterclockwise direction and bevel gear assembly for resetting dial reading.	1					*
	2A236	AS	BASE PLATE ASSEMBLY: triangular cast bronze base plate 10¾" each side x 5/16" thick with fixed fulcrum pin (part #1), cotter pin (part #4), swivel screw (part #7) and wingnut assembly (part #17); lock pin assembly consisting of bead chain (part #10), stainless steel ring (part #11), brass rivet (part #12) peened to assembly, stainless steel lock (part #13), stainless steel pin (part #14), stainless steel rod 7/16" diam x 3⅝" long (part #15), with three corner holes to receive anchor stakes.	1					*
	2A297-134/19	AS	BEAM ASSEMBLY: stainless steel sleeve and coupling device for attaching to top upper mast section with beam tube welded to same; beam tube 1½" sq x 61⅞" long containing 6 sockets to receive reflector rods and fittings for attaching dipole feeder harness assembly.	1					*
	2A297-154/8	AS	BEARING: phosphor-bronze; Oilite catalog #F-501; length under flange ¼ inch.	1					*
	2A297-134/10	AS	BEARING: phosphor-bronze; Boston Gear Works catalog #F1-512; length under flange 3/16".	1					*
	2A297-134/4	AS	BEARING: phosphor-bronze; Oilite catalog #F-501; length under flange 3/16".	1					*
	2A297-134/22	AS	BEARING: phosphor-bronze; Boston Gear Works catalog #F1-301; ⅝" long over-all.	1					*

	3E6000–596	AS	CABLE CX–596/U: for alternating current; identification marked CX–596/TPX; consisting of 6 ft type SJ two-conductor cord, terminating on the power supply end with an Amphenol #3108–18–3P connector and #3106–18–3S connector at opposite end; in addition a two-prong connector; GE catalog #2813 is included with the above but unattached.	1		•			•
	1F430–245.17	AS	CABLE ASSEMBLY CG–245/U: 17" long; consisting of coaxial cable terminated at each end by PL–259 connectors; complete with identification band CG–245/U.	1		•			•
	1F430–242	AS	CABLE ASSEMBLY CG–242/U: 22" long; consisting of coaxial cable terminated at each end by PL–259 connectors; complete with identification band CG–242/U.	1		•			•
	2Z1612.1	AS	CAP ASSEMBLY: aluminum; as made by American Phenolic Corp., catalog No. 9760; with chain assembly, #10 brass bead chain 7½" long and type A couplings at each end; part #13 of assembly.	1					•
	2A297–134/14	AS	CAP ASSEMBLY: aluminum; fitting part #2; 1⅝" diam x 1⅝" length with 1–⅝–18 tap with 0.067" hole in top to receive RH machine screw for chain assembly (part #4); #10 brass bead chain 4" long supplied with type A coupling on each end.	1					•
	2A297–134/16	AS	CAP ASSEMBLY: aluminum; fitting part #15; 1" diam x ½" long with med diam knurl ¾–20 NEF with 0.128" hole to receive RH machine screw for chain assembly (part #1); #10 brass bead chain 7½" long supplied with type A coupling on each end.	1					•
	2Z3273–33	AS	CONNECTOR: right angle; for transmitting power at 90° angle from flexible drive shaft to drive mechanism, complete with attached protecting caps; S. S. White Dental Mfg Co #Q–2007.	1		•			•
	2Z3264–433	AS	CONNECTOR: middle; for coupling two lengths of flexible drive shafting #A–1300A, complete with attached protecting caps; S. S. White Dental Mfg Co #Q–2008.	1		•			•
	2Z299–358	AS	CONNECTOR, tee: single contact; Signal Corps Adapter M–358.	1		•			•
	2Z7390–21	AS	CONNECTOR UG–21/U.			•			•
	2A297–134/15	AS	CRANK ASSEMBLY: spline fitting A7101 set inside of bronze coupling A7102, with aluminum crank attached to steel shaft A7108 at one end and "Balcrank" handle at other end.	1					•
	2A288A–30	AS	DIPOLE AND FEEDER HARNESS ASSEMBLY: coaxial cable harness protected at junction points by molded polystyrene bodies and electrically connected to 2 brass dipoles; coaxial cable feeder connection has type N fitting connected to J-shaped section.	1		•			•
	2A297–134/20	AS	DIPOLE SUPPORT ASSEMBLY: steel tube ⅝" diam OD with coupling rod plunger inside operated by aluminum handle and U-shaped steel channel fitting for locating and securing to antenna beam and to support	2		•			•

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX–4 (cont'd)

b. Antenna System AS–134/TPX (cont'd).

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
	2Z4867.113	AS	GASKET: vellumoid; 4.62" OD x 4.468" ID x 1/32" thick.	1		*			*
	2Z4867.121	AS	GASKET: vellumoid; 1/32" sheet; U-shaped in plane; base 6½" long, upright 3-13/16" long x ¼" wide, with 9 holes 0.152" diam.	1					*
	2Z4867.115	AS	GASKET: vellumoid; 1/32" sheet; 5-31/32" x 6½"; 3 sides ¼" wide, 1 side 3/16" wide; corners rounded with 10 holes 3/16" radius.	1					*
	2Z8206–432	AS	DRIVE SHIFTING, flexible: 25 ft. long; complete with couplings and attached protecting caps; S. S. White Dental Mfg Co #Q–2006.	2		*			*
	2A297–134/12	AS	GEAR, miter: steel; 16 teeth; involute; pitch diameter 1", diametral pitch 16, hub diameter ⅝" to slip ⅜" shaft.	1					*
	2A297–134/13	AS	GEAR, miter: steel; 16 teeth; involute; pitch diameter 1", diametral pitch 16, hub ⅝" diameter slip for 5/16" shaft.	1					*
	2A297–134/7	AS	GEAR, spur: steel; 12 teeth; pitch diameter ½", diametral pitch 24, pitch angle 14½°; hub diameter 13/32", hub projection 5/16", over-all length 15/32".	1					*
	2A297–134/11	AS	GEAR, spur: steel; 30 teeth; pitch diameter 1.25", diametral pitch 24, pitch angle 14½°; length under 1" hub 5/16", over-all length 9/16".	1					*
	2A297–134/2	AS	GEAR, bevel: bronze; 128 teeth, 14½° standard involute, 79° 23 minute pitch cone angle, pitch diameter 4", diametral pitch 32, machined to receive adapter plate B–2126.	1					*
	2A297–134/18	AS	GEAR, worm: bronze; 20 teeth; single thread; diametral pitch 16; hub ⅞" diameter drilled 0.484" diameter; over-all width 11/16"; pitch diameter 1.373".	1					*
	2A1344	AS	GUY WIRE ASSEMBLY: stainless steel flexible cable 3/16" diam x 14 ft long with terminals swaged at each end, one end terminating with snap bolt; opposite end containing turnbuckle and 1-foot steel chain; parts #8, #7, #9, #4, #11, and #12.	3		*			*
	2Z5753.32	AS	KNOB: phenolic catalin; 1¼" diam x ⅝" long with 0.250" hole in top and setscrew hole inside tapped for #4–40 setscrew.	1					*
	2Z5879–15	AS	LAMP, pilot: Herzog T–4; 120 v, 4 w; clear tabular bulb; candelabra screw base; over-all lg 1⅝".	1	*	*			*

	2A197–134/17	AS	LOCK PIN ASSEMBLY: stainless steel rod 7/16" diam x 3⅝" long (part #15), machined to receive (part #14) stainless steel pin, (part #13) stainless steel lock, (part #12) brass rivet, (part #11) stainless steel ring, (part #10) bead chain.	1					*
	2A2492–3	AS	MAST ASSEMBLIES: LOWER MAST SECTION ASSEMBLY: 3" OD tubing at base; 2⅛" OD above drive mechanism x 62" long over-all; seamless steel tubing with attached hinge base, mast drive mechanism, and enclosed coaxial line assembly; upper end to receive and connect to midde mast section.	1					*
	2Z4867.120		(a) GASKET: vellumoid 4-9/16" OD x 3.885 ID x 1/32" thick 6 holes 0.152" diam equidistant; part #5.	1					*
	6Z3859–11		(b) GREASE FITTING: Stewart Warner #1637; ¼–28 thread, 45° angle, over-all ⅝" long.	1					*
	2Z3714–70		(c) DIAL: aluminum 3½" diam OD x 2-3/16" ID x 1¼" high; two scales, in mils and in degrees; finish, alumilite, black; markings, white for degrees at 45° angle, red for mils on vertical plane; part #12.	1					*
	6Z8089–5		(d) SEAL: Victoprene type H #60839; 2⅛" ID x 3.355" OD x ½" wide; part #13.	1					*
	2Z8877.67		(e) SPRING: beryllium copper; 3-15/32" OD x 2.87" ID x 0.0159" thick; part #16.	1					*
	2Z4875–20		(f) END FITTING: S. S. White Co. #3705X; pinion stock 12 teeth, 48 pitch, over-all length 23/32"; pinion section 0.250" long, shaft diam 0.2185"; part #19.	1					*
	6Z3429–7		(g) COUPLING: steel 1½" diam x 1-11/32" long; male thread, ¾–20 x ⅝" long at one end, male thread 1"–14 class 1 x ¼" long at other end; drilled and C'S'K for spline fitting; part #20.	1					*
	2Z4867.118		(h) GASKET: vellumoid 1⅜" OD x 1-3/32" ID x 0.015" thickness; part #30.	1					*
	6Z8089–4		(i) SEAL: Victoprene type W #62038; ⅜" OD x 0.752" ID x ⅝" wide; part #22.	1					*
	3H304–14		(j) BALL BEARING: Norma Hoffmann #S–3–R; bore ⅜", OD ⅞", width 7/32"; part #24.	1					*
	2A297–134/1		(k) CAP: aluminum, 1" diam x 1" long tapped ⅜"–20 x 9/16" deep with captive (part #9) machine screw 6/32 x 3/16" filister head, steel; (part #10) bead chain #10, 5" long; (part #11) machine screw 4–40 x ¼" long, filister head, steel; part #18.	1					*

114. MAINTENANCE PARTS LIST FOR RADAR SET AN/TPX-4 (cont'd)

b. Antenna System AS-134/TPX (cont'd).

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock. 1st ech	2d ech	3d ech	4th ech	Depot stock
	1F4C4-2.58		(l) COAXIAL LINE ASSEMBLY: Lapp Insulator Co; coaxial cable, type RG-8/U enclosed in retainer sleeve with brass elbow fitting outlet at one end terminating in type N fitting, and nonarcing rotary joint #30547 at opposite end; approx over-all length 58"; part #7; assembly with captive end nuts.	1					*
	2Z4867:117		(m) GASKET: vellumoid, 1¼" OD x 15/16" ID x 0.015" thick; part #12.	1		*			*
	2A2492-1	AS	MIDDLE MAST SECTION ASSEMBLY: 2¼" OD steel tube 70" long, with 4 clamp fittings for attaching to upper and lower mast sections.	1					*
	2A2492-2	AS	ROTATABLE MAST ASSEMBLY: 16 ft 6" high x 3" OD consisting of lower mast section assembly 3" tubing at base, 2⅛" OD above drive mechanism over-all length approx 62" long; middle mast section assembly 2¼" OD tubing x 70" long; upper mast section assembly 2⅛" OD x 70" long.	1					*
	2A2492	AS	UPPER MAST SECTION ASSEMBLY: 2⅛" OD steel tube x 70" long with ball bearing; rotatable guy wire housing; arranged to receive antenna beam.	1					*
	2Z2643.38		(a) SPRING CLIP: phosphor-bronze to retain coaxial cable; 0.015" x ⅝"; part #5.	1					*
	2A327-17		(b) ROTATABLE GUY WIRE ATTACHMENT ASSEMBLY: aluminum retainer plate (part #6), cast aluminum housing (part #9), containing Victoprene seal (part #10), ball bearing (part #11), cast aluminum container (part #13), felt seal (part #15); assembled complete with gaskets (parts #8 & #12); screws (part #7), and lockwashers (part #14).	1					*
	2Z4867.112		(c) GASKET: vellumoid; 4⅛" OD x 2⅝" ID x 0.021" thick; 6 holes 0.152" diam; part #8.	1					*
	6Z8089-5		(d) SEAL: Victoprene, type #60894; 2⅛" ID x 3.355" OD x ½" wide; part #10.	1					*
	2Z4867.116		(e) GASKET: vellumoid; 4¾" OD x 3-25/32" ID x 0.021" thick; 3 holes 0.152" diam; part #12.	1					*
	2Z4867.114		(f) GASKET: vellumoid; 11/32" OD x 0.144" ID x 0.021" thick; part #17.	2					*

	6Z3859-12		(g) GREASE FITTING: Stewart Warner #1637; ¼"-28 thread, 45° angle, ⅝" long over-all; part #2.	1					*
	1F4C4-1.130		(h) COAXIAL CABLE ASSEMBLY: coaxial cable, type AN/RG-8U, with assembly parts #1, Lapp coupling cat. #2643, weatherproof gland packing consisting of part #3, rubber grommet, enclosed between bronze wing fittings, parts #2 & #4, with type H fitting at opposite end; over-all length approx 11½".	1					*
	2A297-134/5	AS	PINION, bevel: phosphor-bronze; 24 teeth; pitch diameter ⅜", diametral pitch 32, pitch angle 14½°; hub drilled 0.188" diameter.	1					*
	2A3167-2	AS	REFLECTOR ROD ASSEMBLY: steel tubes ⅜" OD 39⅝" long with ends plugged for weathertight seal; and stainless steel collar attached to center of tubing.	6		*			*
			REMOTE ANTENNA DRIVE BOX: see AZIMUTH CONTROL DRIVE BOX ASSEMBLY.						
	2A297-134/21	AS	RING, adapter: aluminum Z-shaped ring; 3⅝" OD x ¼" lg x 2¼" ID; with 6 holes #2-56 tap, 3/16" deep, and 3 holes #2-56 tap through face.	1					*
	2A397-134/3	AS	RING, retaining: aluminum; 4.203" OD x 3.875" ID x 3/16" thick; outside diam machined 32 threads per inch and 2 holes 0.093" diam x 5/64" deep spaced 180° apart on face of rim.	1					*
	2Z8076-32	AS	SCALE: lamicoid; 4.370" OD x 3" ID x ⅛" laminated thickness with degree graduations and markings engraved through black opaque sheet to translucent ivory-colored plastic; complete with 4 countersunk holes 0.1015" diam.	1					*
	2Z8076-31	AS	SCALE: lamicoid; 4.370" OD x 3" ID x ⅛" laminated thickness; with mil graduations and markings engraved through black opaque sheet to translucent ivory-colored plastic; complete with 4 countersunk holes 0.1015" diam.	1					*
	2A297-134/9	AS	SHAFT, pinion: steel; 12 teeth; pitch diameter ¼", diametral pitch 48, pitch angle 14½°; over-all length 3-7/16", machined to 0.249" diameter for 3".	1					*
	2Z5885-20	AS	SOCKET: candelabra base; phenolic; American Radio Hardware Company #2021.	1					*
	2A3181	AS	STAKE ASSEMBLY: steel parts #16 and #3; steel rod ⅜" diam x 12-9/16" long with 1-5/16" OD; washer welded on 1" from top with 11/32" hole to receive 3½" diam pull ing.	3		*			*
	2ZA1352-49	AS	WINDOW: nonshatterable glass disk; 4.120" diam laminated to 0.093" thickness.	1		*			*
	5B180	AS	WING ANCHORS, steel: Hubbard #7543 screw anchor, snap bolt secured to the anchor by means of steel ring; parts #2, #3, & #9.	3		*			*

Appendix I
ANTENNA SYSTEM AS-96/TPX-1

115. GENERAL

Some models of Radar Set AN/TPX-4 may be supplied with Antenna System AS-96/TPX-1 instead of Antenna System AS-134/TPX described in paragraph 11. A description of Antenna System AS-96/TPX-1, instructions for installation, and theory of operation are given in the following paragraphs.

116. DESCRIPTION (Figs. 92, 93, 94, 95, and 96)

a. The antenna system consists of a self-supporting mast, a boom at the top of the mast, and a vertical folded dipole at each end of the boom. Structurally the mast consists of a self-guyed low tripod with a base triangle 12½ feet on a side and with the apex 5 feet high, supporting a single 15-foot vertical section. The vertical section is guyed down to the middle of the tripod legs. The elements of the mast are sections of 1⅝-inch aluminum tubing, 5 feet long, with ends arranged to slip one in the other. The crotch piece at the apex of the tripod is an aluminum casting; so are the tripod feet, guy rings, and top fitting. The boom at the top consists of two 4-foot U-sections folded of aluminum sheet and pinned to the top casting, open side down, to make an 8-foot crossarm. Each end of the boom contains a quarter-wave linear matching transformer constructed of dural rods encased in molded polystrene sections. The folded dipole antenna elements are made in one piece from dural rod. The open ends are fitted with screw couplings to connect with the transformer terminations. The center of the antenna snaps into a spring catch fitting which projects from the end of the crossarm.

b. The complete mast structure will withstand winds up to 20 miles per hour without staking. Stakes are provided to be driven through holes in the feet. The mast will withstand a 60-mile-per-hour wind if properly staked. If the ground does not permit staking, the carrying bag for the antenna may be hooked under the crotch casting and loaded with rocks. If wind velocities exceed 60 miles per hour, the mast should be dismantled, because the antenna castings may break on overturning.

c. The entire antenna system breaks down into sections 5½ feet long or less, and packs into the carrying bag to make a package 76 inches long by 12 inches diameter, and weighing 40 pounds.

117. SELECTING A SITE FOR ANTENNA SYSTEM AS-96/TPX-1

The antenna may be located at any spot 25 feet or less from the center of the radar tent. The ends of the antenna legs which form an equilateral triangle with corners approximately 12½ feet apart should all be at the same level in order to make the mast vertical. The antenna need not be erected exactly at the spot chosen; it may be assembled and erected at any convenient working space and then carried to the desired position. Locate the antenna as far from the tent as the cords permit. Choose a point where the IFF antenna will interfere least with signals coming to the radar antenna from the sector most likely to contain unfriendly aircraft (Fig. 14).

118. INSTALLATION (Figs. 95 and 96)

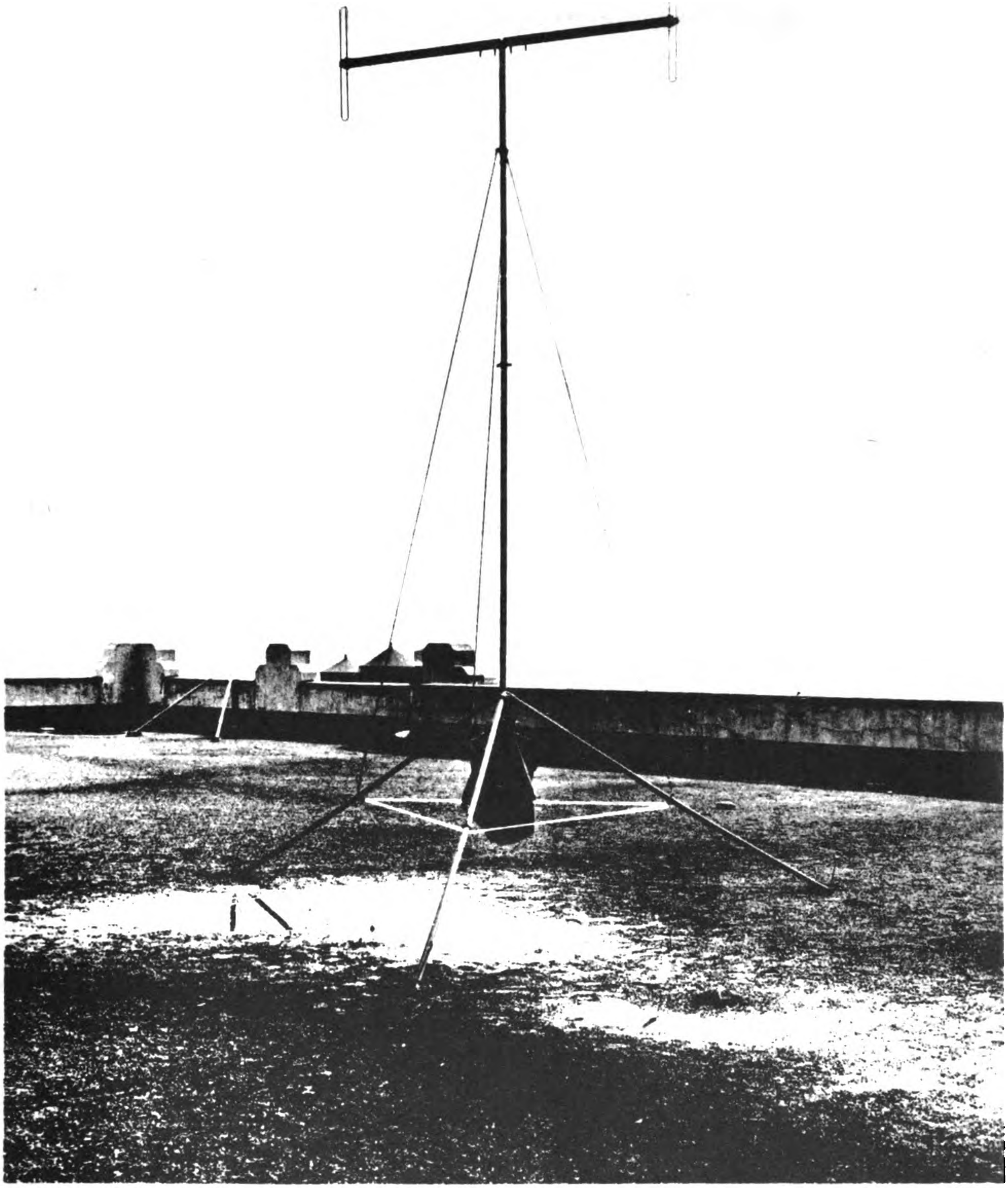
a. Components. The antenna system consists of 13 components (plus spares and spare parts) packed in a transit bag (Figs. 93 and 94). The components used in erection are identified as follows:

COMPONENTS OF ANTENNA SYSTEM AS-96/TPX-1

Part No.	Item	Quan.
301	Transit bag	1
302	Bottom tripod leg	3
303	Top tripod leg	3
304	Bottom mast section	1
305	Middle mast section	1
306	Top mast section	1
307	Boom assembly	2
308	Center support casting	1
309	Dipole element	3*
310	Stake	4*
311	Vertical guy	4*
312	Horizontal guy	2*
313	Erection rope	1

*Including one spare

b. Tools and Cables. Two open-end wrenches size ½ inch x 7/16 inch are necessary. These are provided in the tool equipment in Chest CY-154/TPX-1. Two cables (Cords CC-74/TPX-1) are supplied for connecting the antenna to Transmitter-Receiver RT-48A/TPX-1.



TL-40318

Figure 92. Antenna System AS-96/TPX-1, set up for operation.

TL-40319

Figure 93. Antenna System AS-96/TPX-1, packed in roll for carrying.

c. **Assembly.** (1) Unpack the transit bag (part 301) and lay out the parts in an orderly manner.

Note.—In assembling be sure that parts with the same color band or spot go together.

(2) Insert each of the top tripod legs (part 303) into the appropriate holes in the center support casting (part 308). Rest the assembly on its side; that is, two legs on the ground and one in the air. Avoid getting dirt into the ends of the legs.

(3) Insert a bottom tripod leg (part 302) into each of the two top tripod legs which are resting on the ground.

(4) Take a vertical guy (part 311) and pass the hook end of the turnbuckle through the hole in the guy ring on the third bottom tripod leg. (In this and succeeding operations the turnbuckle screws should be turned out so that the beginning of the threads is flush with the interior of the turnbuckle body). Trail the guy wire out in a straight line; avoid kinks. Tie one end of the erection rope (part 313) securely to the foot casting of the bottom tripod leg. Insert the leg with rope and guy attached into the top tripod leg, which is off the ground.

(5) Take a horizontal guy (part 312) and pass it around the hooks in the guy rings of each tripod leg. Hook the turnbuckle and the end of the guy wire together and close the turnbuckle enough to make the wire taut without noticeably bending the legs. Equalize the tension all around the wire by bending each leg slightly inward, then allowing it to bend back into position.

(6) Assemble the bottom, middle, and top mast sections (parts 304, 305, and 306, respectively) on the projection of the center support casting. Note that these parts are keyed to prevent turning when fully engaged. The position of the bottom and middle mast sections is unimportant, but the top mast section must be inserted so that the holes in its guy ring are in line with those on the legs.

(7) The vertical guy previously hooked on the up-ended tripod leg may now be snapped into the appropriate hole on the mast guy ring and the remaining two vertical guys similarly installed. It is not necessary to tighten the turnbuckles.

(8) Pin a boom assembly (part 307) to each side of the top mast section and secure the free end of the clevis pins with the locking pins.

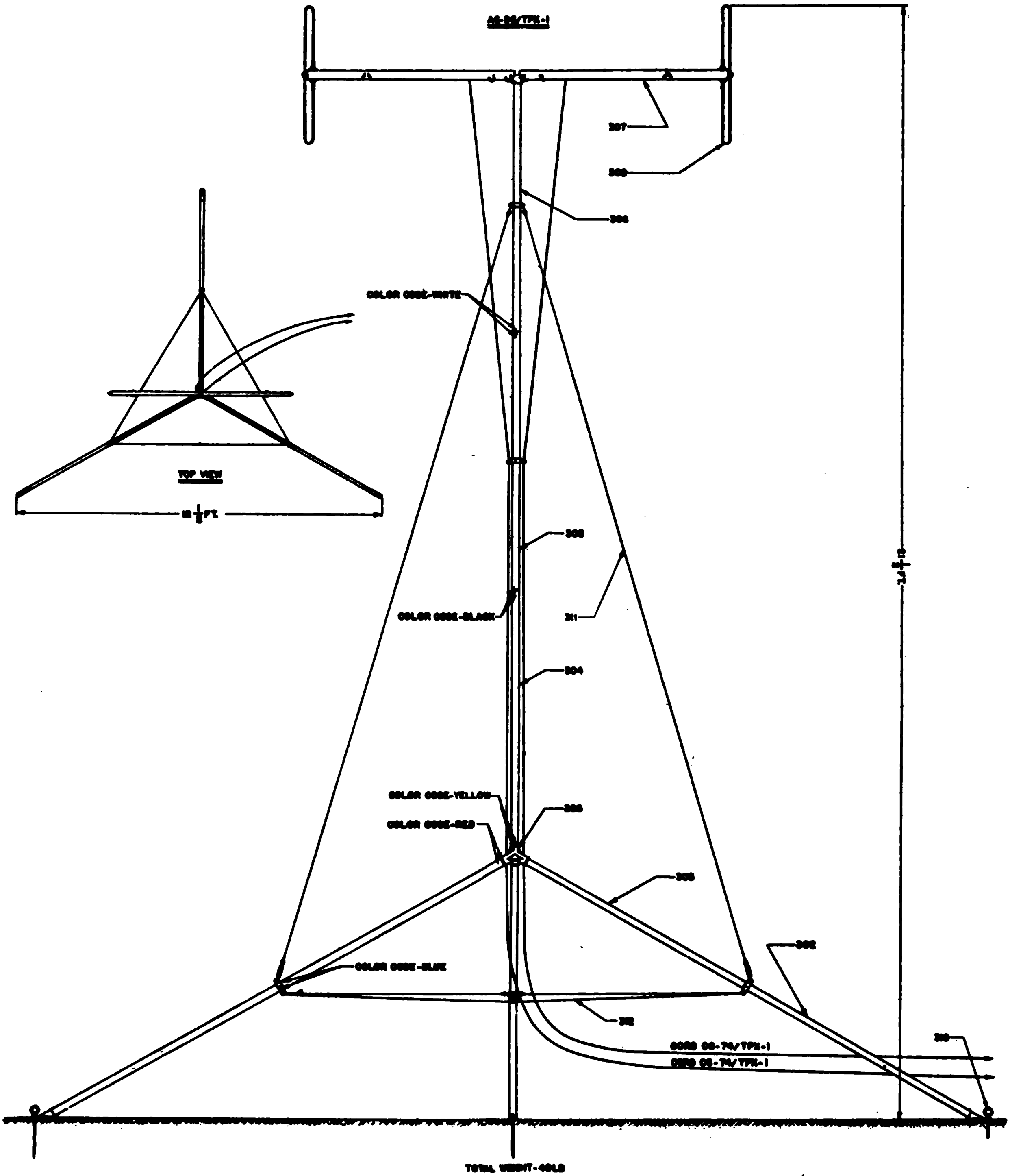
(9) Rest the boom end of the mast on a box or other support 1 or 2 feet off the ground. Using the open-end wrenches, fasten a dipole element (part 309) to the end of each boom. The dipole elements will spring sufficiently to allow their free ends to be inserted into the connectors. Before tightening the connector nuts, clip the dipoles in place in the spring device on the extreme end of each boom. Tighten the connector nuts, and adjust the dipoles so that they are not twisted or out of line.

> CAUTION:—All connectors and cables must be handled carefully. Do not kink these cables or coil them too sharply. Keep them free of dirt. In temperatures of less than 5° F above zero, cables must be warmed before handling to avoid breaking the insulation.

(10) Unroll the two Cords CG-72/TPX-1; do not let them kink. Slip the ends bearing Plug PL-259 (straight plug) through the cast bushings on the center support casting, then through the cast bushings in the center of the middle mast section, then through the bakelite bushings in

TL-40321

Figure 94. Antenna System AS-96/TPX-1, carrying pack unrolled.



TL-39129

Figure 95. Antenna System AS-96/TPX-1, outline diagram.

either boom. Finally remove the safety caps from the receptacles and insert the plugs.

(11) Secure the two legs on the ground to prevent the whole structure from sliding forward while it is being tilted. If the ground permits, drive a stake (part 310) about halfway into the ground through each of the foot castings of these legs. The legs may be twisted slightly to bring the foot castings parallel to the ground. If the ground is too rocky for driving stakes, pile rocks or other material in front of the legs in the direction of sliding. The mast should be erected by at least 2 men, if possible: one walks the mast up, starting from the boom end, while the other pulls down on the rope previously tied to the up-ended leg.

(12) After the mast is assembled, erected, and moved to the desired location, examine it from all sides to make sure it is vertical. Build up the ground under one or more of the legs if necessary. The mast may be secured in either or both of two ways. (Both methods should be used if winds in excess of 25 mph are likely).

(*a*) By means of the stakes (part 310).

(*b*) By means of the transit bag (part 301). The bag is provided with a hanger which may be placed around the center support casting. The bag is then weighted with rocks or other material. About 40 to 50 pounds of ballast will suffice to secure the mast in high winds.

(13) When the mast is satisfactorily staked and/or ballasted, adjust the tension in the vertical guy wires by means of the turnbuckles. The guys should be adjusted so that they are slightly loose on all sides and take hold only when the wind tends to bend the mast.

119. THEORY (Fig. 97)

a. Separate receiving and transmitting antennas are used with Radar Set AN/TPX-1; therefore no device is required to protect the receiving circuits from the transmitter pulse. Both antennas are alike, and it does not matter which of the two 50-foot feed cables from them is connected to the receiver and which is connected to the transmitter.

b. To match the relatively high impedance of the antenna to the low impedance of the feed cable, a ¼-wave length matching transformer is used as shown in figure 97. The spacing of the two dural rods and the dielectric constant of the polystyrene in which the rods are molded is such that the characteristic impedance of this transmission-line section matches the cable to the antenna. This matching system produces standing waves along the dural rods and coaxial feed cable, but they are not too objectionable for two reasons:

Figure 96. Antenna System AS-96/TPX-1, dipole assembly.

(1) The U-shaped antenna support boom shields the stray radiation from the dural rods of the matching transformer.

(2) The standing wave ratio is low, from about 1.75:1 to about 2.2:1, depending on the operating frequency. Therefore the radiation loss from the coaxial cable is low.

c. The lengths of the components in the antenna system are a compromise for the frequency band of 157-187 mc. Therefore various currents and potentials in the transmitter-receiver are different for different operating frequencies. This should be taken into account when interpreting meter readings.

d. Each antenna field pattern is approximately doughnut-shaped, with a negligible distortion due to the adjacent antenna. The field pattern is therefore practically uniform over the entire azimuth, but a narrow *cone of silence* exists directly overhead.

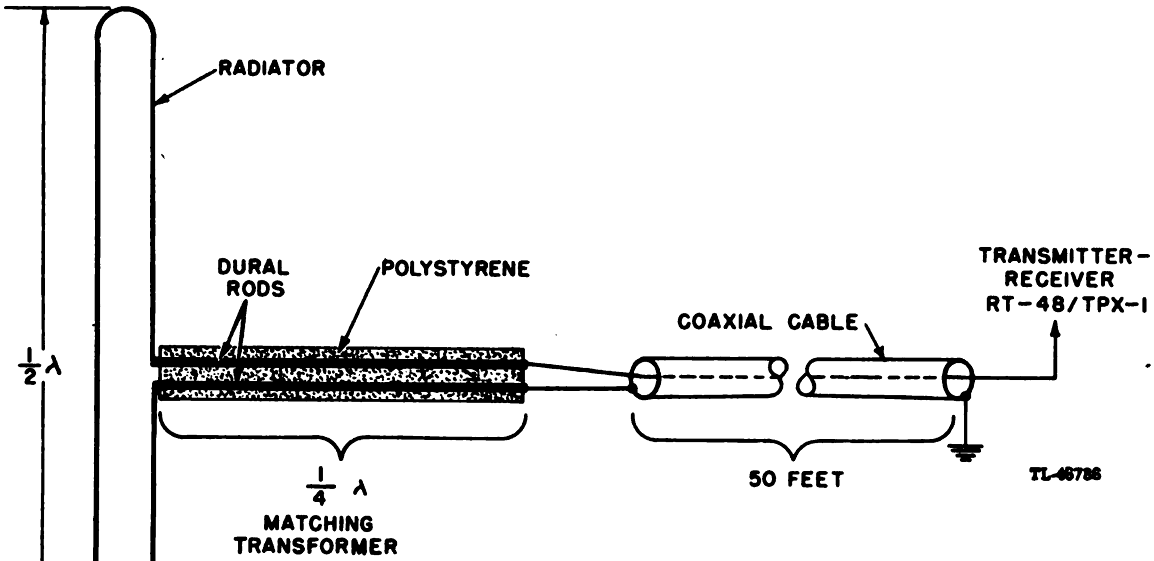


Figure 97. Antenna System AS-96/TPX-1, radiator and matching transformer.

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