

RADIO SET
AN/GRC-9

TÉLÉCOMMUNICATIONS RADIOÉLECTRIQUES ET TÉLÉPHONIQUES
PARIS (FRANCE)

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CHAPTER I

INTRODUCTION

Section I. GENERAL

1. Scope

a. This technical manual contains instructions for the installation, operation, maintenance, and repair of Radio Set AN/GRC-9(*) (fig. 1). In addition to these instructions there are two appendixes covering a list of references and an identification table of parts.

b. Official nomenclature followed by (*) is used to indicate all models of the item of equipment included in this manual. Thus Generator GN-58-(*) represents Generators GN-58 and GN-58-A.

2. Forms and Records

The following standard forms will be used for reporting unsatisfactory conditions of matériel and equipment, or improper preservation, packaging, packing, marking, loading, stowage, or handling thereof.

a. DD Form 6, Report of Damaged or Improper Shipment (Reports Control Symbol CS GLD-66 (Army), S and A-70-6 (Navy) and AF-MC-U2 (Air Force)), will be filled out and forwarded as prescribed in SR 745-45-5 (Army), NAV DEPT SERIAL 85POC (Navy), and AFR 71-4 (Air Force).

b. DA AGO Form 468, Unsatisfactory Equipment Report (Reports Control Symbol CS GLD-247), will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700-45-5.

c. AF Form 54, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700-45-5 and AFR 65-26.

d. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

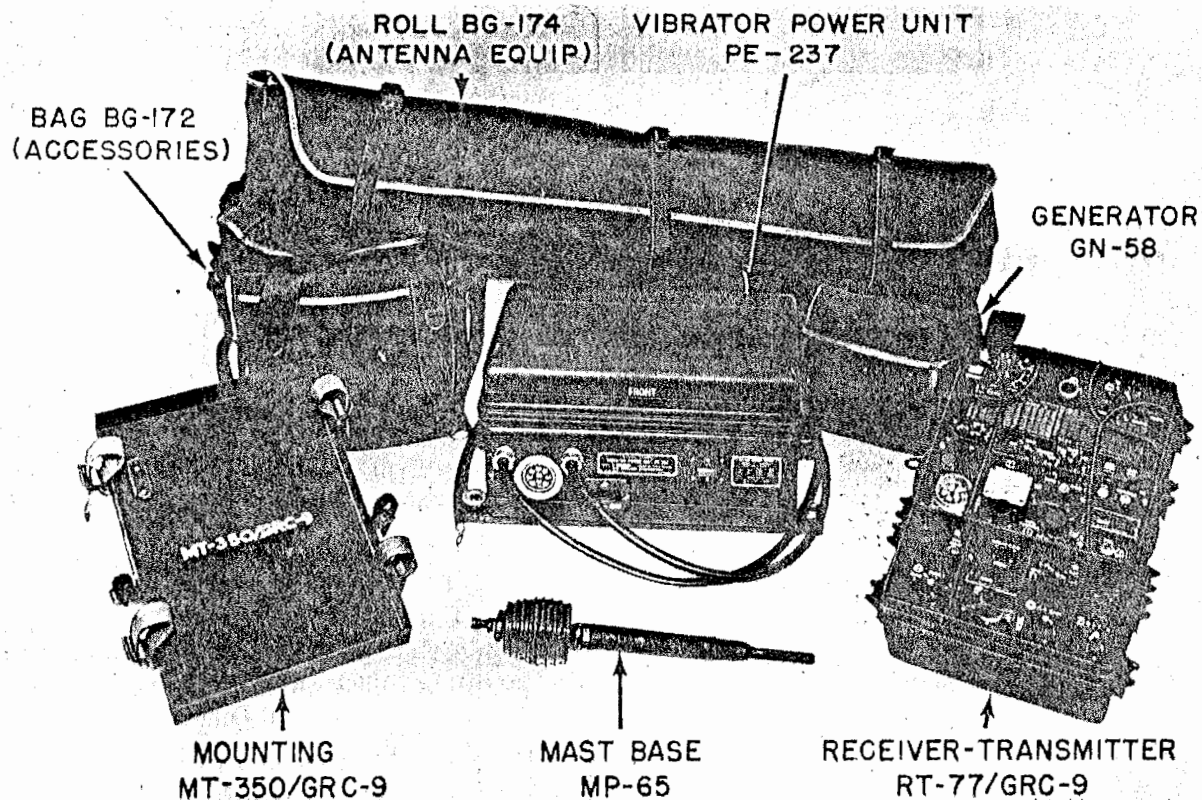
a. Radio Set AN/GRC-9 (fig. 1) is a combined radio transmitter and radio receiver which provides telephone, c-w (continuous-wave), and mcw (modulated continuous wave) communication as a portable field set (fig. 1). It also may be installed on a vehicle.

b. The equipment consists of Receiver-Transmitter RT-77/GRC-9 which can be either crystal- or master-oscillator controlled; it transmits phone, c-w, or mcw signals from 2 mc (megacycles) to 12 mc. All modulation is a-m. (amplitude-modulation). Transmitter-Receiver RT-77/GRC-9 receives c-w, mcw, and phone signals in the same frequency range. Generator GN-58-(*), a hand-operated generator capable

of supplying all the required power for operation of the set, is supplied. Vibrator Power Unit PE-237 which supplies all the power necessary to operate the set from a vehicular battery is included also. A number of additional components are listed in paragraph 7 (fig. 2). The operating equipment set up for normal field use is shown in figure 35.

4. System Application

a. Radio Set AN/GRC-9 is used to communicate with any a-m equipment that operates within the 2-mc to 12-mc band. It can be used as an isolated unit or in a net group. Under favorable conditions, Radio Set AN/GRC-9 will provide communication between moving vehicles.



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Figure 2. Radio set AN/GRC-9, operating components.

up to 15 miles on voice and up to 30 miles on c-w.

b. A simplified block diagram is shown in figure 3. Both the transmitter and the receiver use the same antenna. A relay, located in the transmitter cabinet and actuated by the transmitter key, switches the antenna to the transmitter unit when the key is depressed. When the key is not depressed, the antenna remains connected to the receiver, whereas the transmitter is made inoperative by other contacts of the same relay.

c. The receiver may be used with either high- or low-impedance headphones or Loudspeaker LS-7. Loudspeaker LS-11 (not supplied) also may be used. The receiver can be operated with power supplied from Vibrator Power Unit PE-237, Generator GN-58-(*), or Battery BA-48.

d. The transmitter section generates a continuous r-f (radio-frequency) carrier and provides means for keying or voice modulation. Power is supplied to the transmitter by either Vibrator Power Unit PE-237 or Generator GN-58-(*). Battery BA-48 is not used to operate the transmitter. Gasoline engine-driven Power Supply PE-162 also may be used.

e. Vibrator Power Unit PE-237 supplies all power to Receiver-Transmitter RT-77/GRC-9 from a 6-, 12-, or 24-volt d-c (direct-current) vehicular storage battery supply.

f. When a source of current supply is not available, Receiver-Transmitter RT-77/GRC-9 may be operated by using Generator GN-58-(*), which is hand operated.

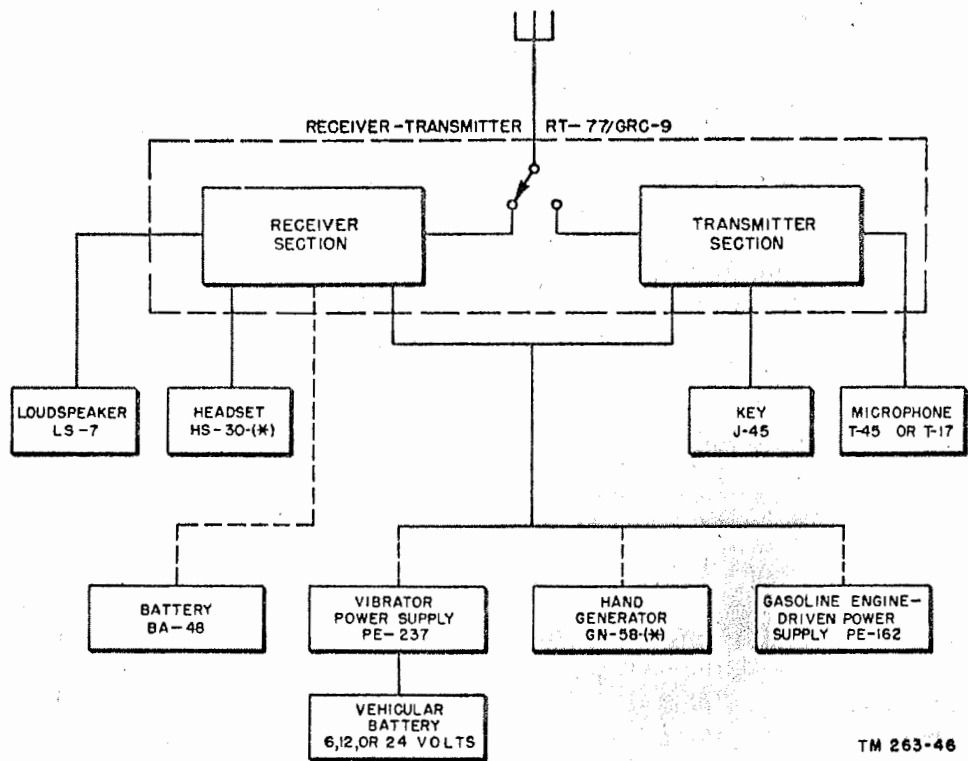
g. Only the receiver may be used for stand-by operation, using Signal Corps Battery BA-48 (not supplied).

GENERATOR
GN-58



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Figure 3. Radio set AN/GRC-9, simplified block diagram.

5. Technical Characteristics

a. TRANSMITTER SECTION OF RECEIVER-TRANSMITTER RT-77/GRC-9.

Frequency range:

- Three bands covering ----- 2.0 mc to 12 mc.
- Band 1 ----- 6.6 mc to 12 mc.
- Band 2 ----- 3.6 mc to 6.6 mc.
- Band 3 ----- 2.0 mc to 3.6 mc.

Transmitter type ----- Crystal or master oscillator p - a (power-amplifier).

Crystal channels ----- Two in each band (crystals not supplied).

Types of signals transmitted C-w, mcw, and phone.

Distance range:*

- C-w:
 - Stationary ----- 75 miles.
 - Moving ----- 30 miles.

Voice:

- Stationary ----- 25 miles.
- Moving ----- 15 miles.

Type of modulation ----- Amplitude.

Number of tubes ----- 5.

Power input to Vibrator Power Unit PE-237 with transmitter operating:

- 6-volt, high-power position -- 27 amperes.
- 6-volt, low-power position -- 24 amperes.
- 12-volt, high-power position -- 13.2 amperes.
- 12-volt, low-power position -- 11 amperes.
- 24-volt, high-power position -- 7 amperes.
- 24-volt, low-power position -- 6.2 amperes.

Power output:**

Power switch position	Vibrator Power Unit PE-237		Generator GN-58- (*)	
	Phone	CW	Phone	CW
High	7 watts	15 watts	3.6 watts	10 watts
Low	1 watt	5 watts	1.2 watts	5 watts

**These values are only approximate and will vary with frequency.

Antennas:

Whip ----- 15 feet long. Consists of three mast sections MS-116-A, one MS-117-A, and one MS-118-A.

*These values are approximations, since the range will vary considerably according to terrain, atmospheric conditions, frequencies, and time of year, month, and day.

operates a con-
sider and pro-
 modulation.
 er by either
 r Generator
 used to op-
 engine-driven
 used.

supplies all
-77/GRC-9
ect-current)

ply is not
-77/GRC-9
GN-58- (*)

for stand-by
ery PA-48

Long-wire _ 244.5 feet long. (The 137-foot length has calibration chart attached; 107.5 feet of the 244.5-foot length is detachable.)

Power supply-- 6-, 12-, or 24-volt vehicular battery through Vibrator Power Unit PE-237 or hand Generator GN-58-(*).

Weight. ----- 29 pounds, less case.

b. RECEIVER SECTION OF RECEIVER-TRANSMITTER RT-77/GRC-9.

Frequency range:

Band 1 ----- 6.6 mc to 12 mc.
 Band 2 ----- 3.6 mc to 6.6 mc.
 Band 3 ----- 2.0 mc to 3.6 mc.

Receiver type ----- Superheterodyne.

Types of signals which can be received ----- C-w, mew, and phone.

Number of tubes ----- 7.

Intermediate frequency ----- 456 kc (kilocycles).

Method of calibration ----- Built-in crystal oscillator.

Calibration points ----- 200-kc intervals.

Power input at STANDBY position using the stand-by section of Vibrator Power Unit PE-237:

6-volt battery 1.25 amperes.
 12-volt battery 8 ampere.
 24-volt battery 6 ampere.

Power supply ----- 6-, 12-, or 24-volt vehicular battery operating Vibrator Power Unit PE-237; Generator GN-58-(*), and Battery BA-48 in a field installation.

Power required by receiver:

A-power ----- 1.4 volts at .45 ampere (maximum).
 B-power ----- 105 volts at .02 ampere (maximum).

Antenna ----- Uses same antenna as transmitter.

Weight ----- 8 pounds, less case.

c. VIBRATOR POWER UNIT PE-237.

Supply requirements 6-, 12-, or 24-volt vehicular battery.

Basic circuit ----- Two separate vibrator power supplies utilizing full-wave rectification.

(1) Full-load output of Vibrator Power Unit PE-237.

Heavy duty section	Early models	Late models
Transmitter plate	475 v at 90 ma	580 v at 100 ma.
Transmitter filaments	6.5 v at 2 amp	6.6 v at 2 amp.
Receiver plates	105 v at 42 ma	120 v at 45 ma.
Receiver filaments	1.35 v at 450 ma	1.5 v at 500 ma.
Keying relay	6.0 v at 500 ma	6.9 v at 575 ma.

Stand-by section	Early models	Late models
Receiver plates	100 v at 17 ma	110 v at 18.5 ma
Receiver filaments	1.35 v at 450 ma	1.6 v at 500 ma.

(2) Full-load input of Vibrator Power Unit PE-237 with transmitter operating.¹

6-volt, high-power position ----- 27 amperes.
 6-volt, low-power position ----- 24 amperes.
 12-volt, high-power position ----- 13.2 amperes.
 12-volt, low-power position ----- 11 amperes.
 24-volt, high-power position ----- 7 amperes.
 24-volt, low-power position ----- 6.2 amperes.

Tube complement ----- One tube type 1006 mercury-vapor full-wave rectifier. One tube type 1005 mercury-vapor full-wave rectifier.

Weight ----- 88 pounds.

Note. The above values are only approximate and will vary with changes in input voltage.

d. GENERATOR GN-58-(*).

Supply requirements ----- Hand operated.
 Basic circuit ----- Regulated and filtered dynamo having both an h-v

¹These values are approximate and will vary with change in crank speed.

rate vibrator
 applies utilizing
 rectification.
 vibrator Power

Late models
680 v at 100 ma.
6.6 v at 2 amp.
120 v at 45 ma.
1.5 v at 500 ma.
6.9 v at 575 ma.

LA' models
110 v at 18.5 ma
1.6 v at 500 ma.

vibrator Power
 transmitter oper-

7 amperes.
 1 amperes.
 1.2 amperes.
 amperes.
 amperes.
 tube type
 100 mer-
 cury-vapor
 full-wave
 rectifier. One
 tube type
 1005 mer-
 cury-vapor
 full-wave
 rectifier.
 pounds.
 approximate
 put voltage.

id operated.
 ulated and
 tered dyna-
 io having
 th an h-v
 change in crank

and l-v wind-
 ing on one
 armature.
 Full-load output ----- Transmitter
 plate, 425
 volts at 115
 ma (milliam-
 peres). Re-
 ceiver plate,
 105 volts at
 32ma. Trans-
 mitter fila-
 ment, 6.3
 volts at 2.5
 amperes. Re-
 ceiver fila-
 ment, 1.4

volts at 465
 ma.
 Weight ----- 29 pounds.

6. Packaging Data

a. PACKING DATA (LATE MODELS). When packaged for export shipment, the components of Radio Set AN/GRC-9 are placed in moisture-vaporproof containers and packed in three wooden export boxes. The method of packing a typical component for export is shown in figure 29. The size, weight, contents, and volume of each crate are given in the following charts for the late models of Radio Set AN/GRC-9.

Note. Items may be packaged in a manner different from that shown, depending on the supply channel. See the packing list in each crate for the exact contents.

Box No.	Contents	Dimensions (in.)			Weight (lb)	Volume (cu ft)
		Length	Width	Depth		
1	Receiver-Transmitter RT-77/GRC-9 Panel Cover CW-109/GRC-9. Cord CD-1119.	25	15 1/2	16 5/8	79	3.7
2	Bag CW-140/GRC-9. Bag BG-172 and contents Equipment literature. Roll BG-174 and contents. Generator GN-58. Bag BG-175. Mast Base MP-65. Mounting MT-350/GRC-9.	47 3/4	21	12 5/8	142	7.6
3	Vibrator Power Unit PE-237 Cord CD-1086.	26 5/8	19 1/2	14 3/8	138	4.6

b. PACKAGING DATA (EARLY MODELS). The early models of Radio Set AN/GRC-9 also are packed for export in three wooden boxes. A packing slip in a moistureproof inclosure is

stapled to box No. 1 and lists the contents for each of the three boxes. The items contained in the boxes are shown in the table below.

Note. Items may be packaged in a different manner from that shown, depending on supply channels.

Box No.	Contents	Dimensions (in.)			Weight (lb)	Volume (cu ft)
		Length	Width	Depth		
1	Receiver-Transmitter RT-77/GRC-9 Panel Cover CW-109/GRC-9. Cord CD-1119.	25	15 1/2	16 5/8	79	3.7
2	Bag BG-172 and contents Roll BG-174 and contents. Mast Base MP-65. Mounting MT-350/GRC-9. Generator GN-58, in Bag BG-175.	47 3/4	21	12 5/8	142	7.6
3	Vibrator Power Unit PE-237 Cord CD-1086 (44 in.).	26 5/8	19 1/2	14 3/8	138	4.6

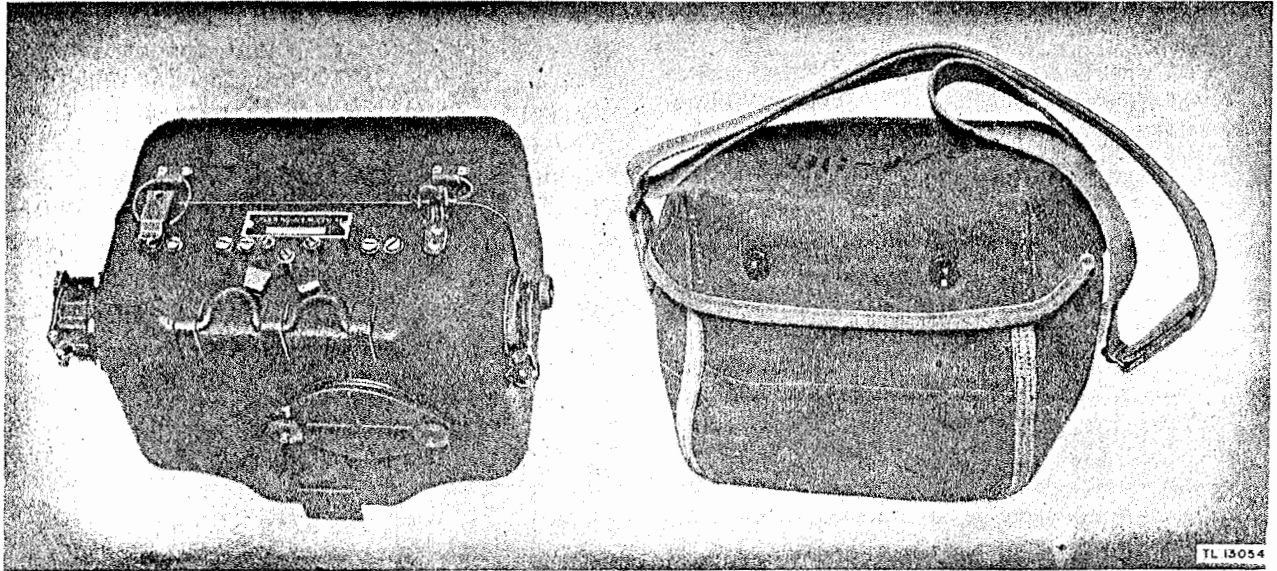


Figure 4. Generator GN-58- (*) and Bag BG-175.

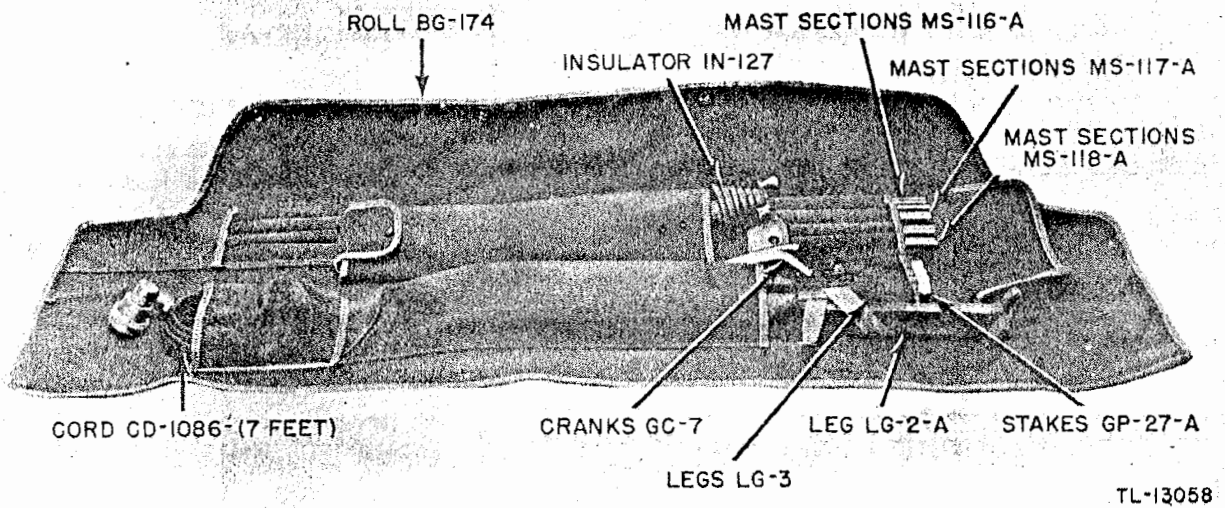


Figure 5. Roll BG-174, with contents.



Figure 6. Bag BG-172, packed.

c. CARRYING BAGS (figs 4, 5, 6, and 7). Four carrying bags are provided for transporting the equipment in the field when using the hand generator as the source of supply. The carrying

bags are constructed of heavy canvas and are provided with straps to facilitate carrying. The contents of the carrying bags are listed in the following charts:

(1) Signal Corps stock No.	Quantity	Description
2Z553-140	1	Bag CW-140/GRC-9 containing-
3E1999-119	1	Cord CD-1119
2Z3350-109	1	Panel Cover CW-109/GRC-9
2C5130-77	1	Receiver-Transmitter RT-77/GRC-9 containing-
2JOC3/VR105	1	Tube type OC3/VR-105
2J1S5	1	Tube type 1S5
2J1L4	2	Tube type 1L4
2J1R5	3	Tube type 1R5
2J2E22	1	Tube type 2E22
2J3A4	3	Tube type 3A4
2J3Q4	1	Tube type 3Q4
2X105-200	1	Crystal Unit CR-23/U
2Z5971.1	2	Lamp, Mazda #49
2Z5889-15	1	Lamp, neon, Mazda #NE-47
3E7173-22	1	Cable assembly, power, p/o Receiver-Transmitter RT-77/GRC-9

(2) Signal Corps stock No.	Quantity	Description
3H160-175	1	Bag BG-175 containing-
3H2358	1	Generator GN-58-A containing-
3H525-97	2	Brush, carbon, H.V.
3H525-99	2	Brush, carbon, L.V.

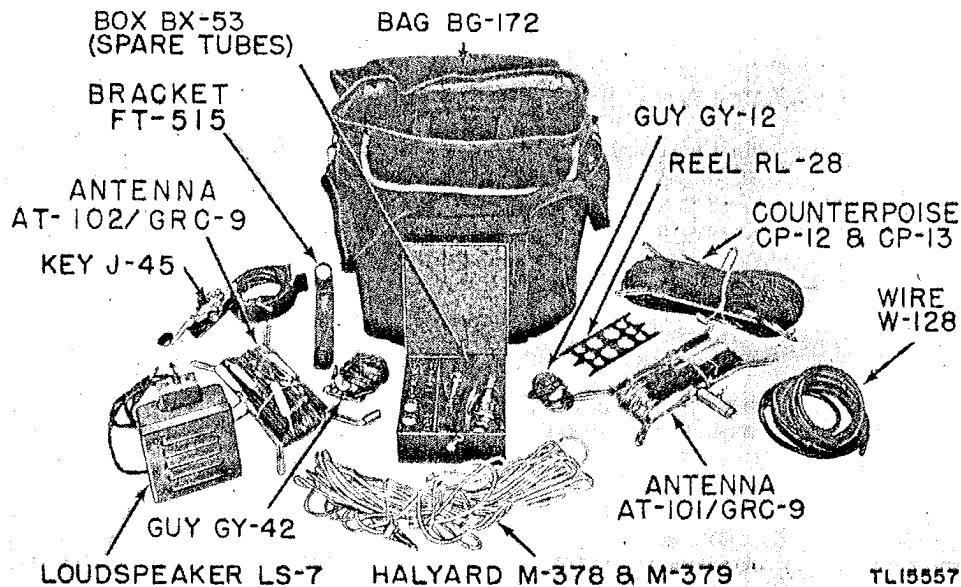
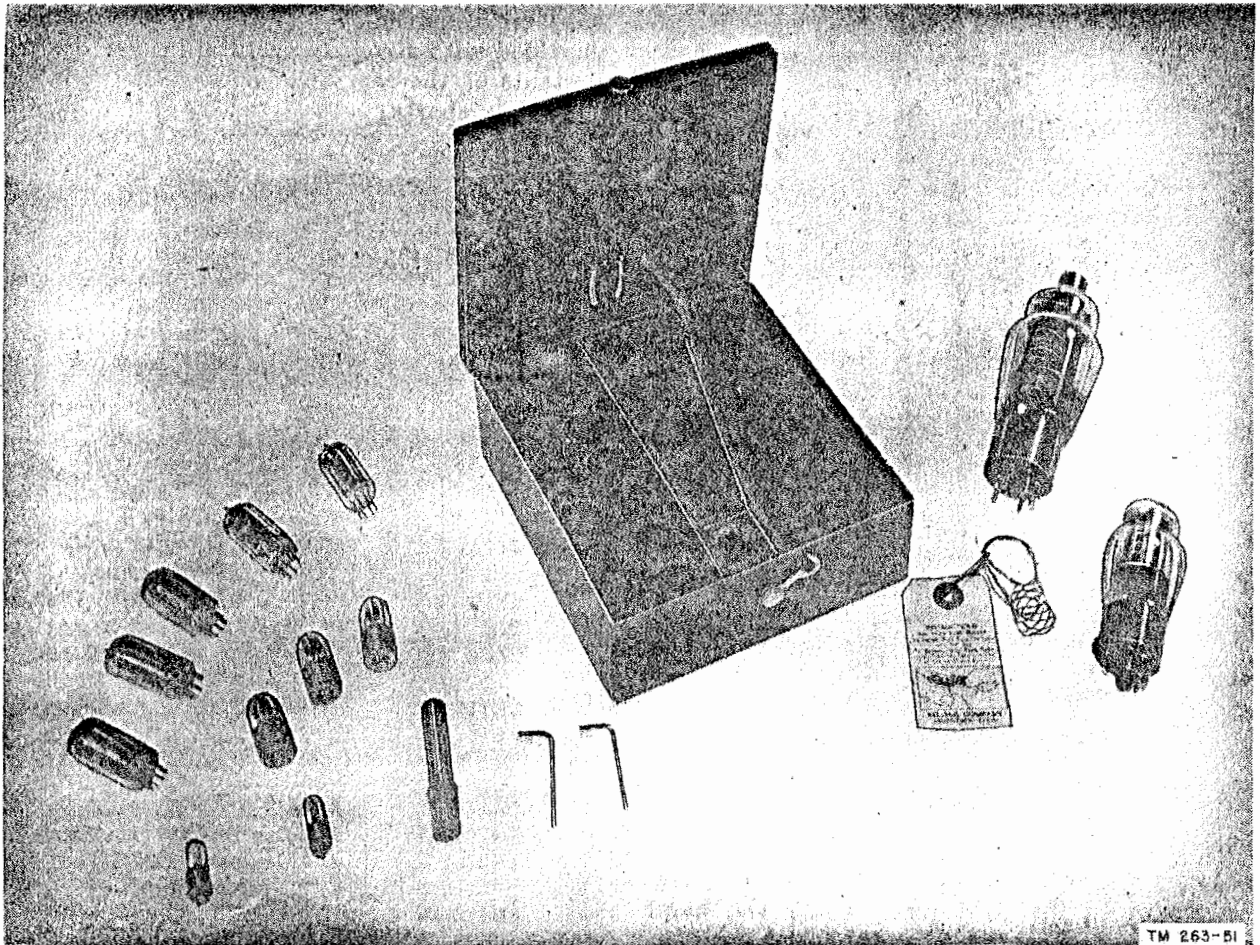


Figure 7. Bag BG-172, contents.



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Figure 8. Box BX-53-C and contents.

(3) Signal Corps stock No.			(4) Signal Corps stock No.			(5) Signal Corps stock No.		
Quantity	Description	Signal Corps stock No.	Quantity	Description	Signal Corps stock No.	Quantity	Description	Signal Corps stock No.
1	Roll BG-174 containing--	28060-174	1	Bag BG-172 containing--	6F153C	1	Box BX-53-C containing--	2A3129
6	Mast Section MS-116-A	2Z2416	1	Wire W-128 (10 ft)	2JOC3/VR105	1	Tube type OC3/VR105	2A712
2	Mast Section MS-117-A	2A2417	1	Guy GY-12	2J1S5	1	Tube type 1S5	2A713
2	Mast Section MS-118-A	2A2418	1	Guy GY-42	2J1L4	1	Tube type 1L4	2Z1203-515
4	Stake GP-27-A	2A3327	1	Antenna AT-101/ GRC-9	2J1R5	1	Tube type 1R5	2Z6310-7
1	Leg LG-2-B	2Z6102B	1	Antenna AT-102/ GRC-9	2J2E22	1	Tube type 2E22	3Z3445
2	Leg LG-3-B	2Z6103B	1	Reel RL-28	2J3A4	1	Tube type 3A4	6Z4938
1	Cord CD-1086 (7 ft)	3E1999-86	1		2J3Q4	1	Tube type 3Q4	6Z4939
1	Insulator IN-127	3G627			2Z5971.1	2	Lamp, pilot, Mazda #49	
2	Crank, hand; Crank GC-7	3H1407			6R7443-4	1	Puller, tube, Kellems #11-16	

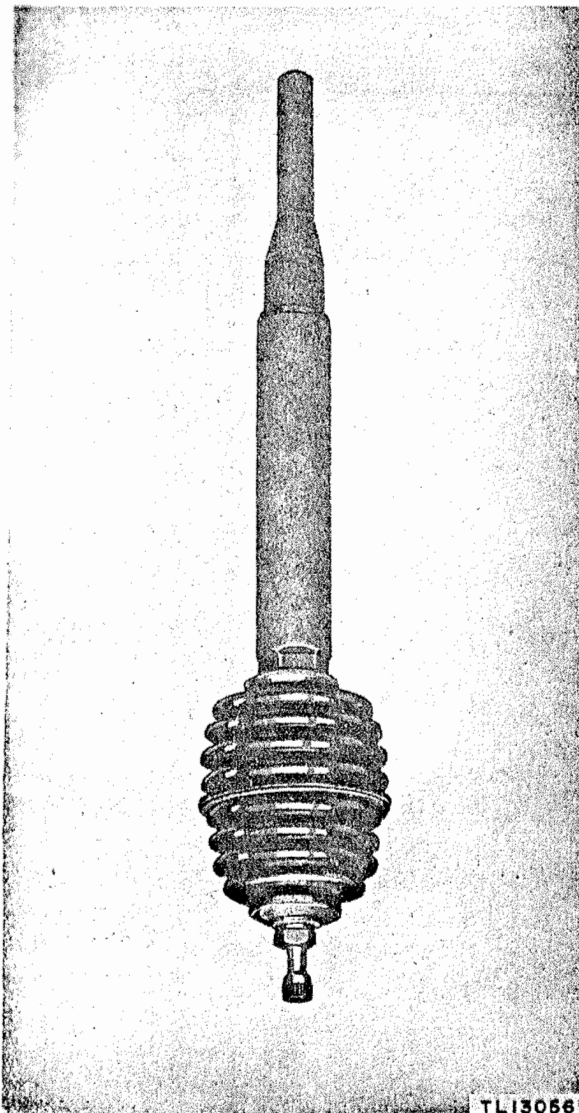


Figure 9. Mast base MP-65-A.

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Signal Corps stock No.	Quantity	Description
2Z5889-15	3	Lamp, neon, Mazda #NE-47
6R55230	1	Wrench, Bristo #6
6R55231.1	1	Wrench, Bristo #8
6Q36920-2	1	Puller, pilot lamp

d. ADDITIONAL COMPONENTS. Additional components not supplied in canvas bags are as follows:

Signal Corps stock No.	Quantity	Description
2A2088-65	1	Mast Base MP-65-A
2Z6763-350	1	Mounting MT-350/GRC-9 containing-
6L80026	1	Bag of hardware consisting of-
6L3608-32.3	18	Nut, hex; steel, #8-32
6L6332-16.495	18	Screw, machine; steel #8-32
6L72208C	18	Washer, lock; steel, #8

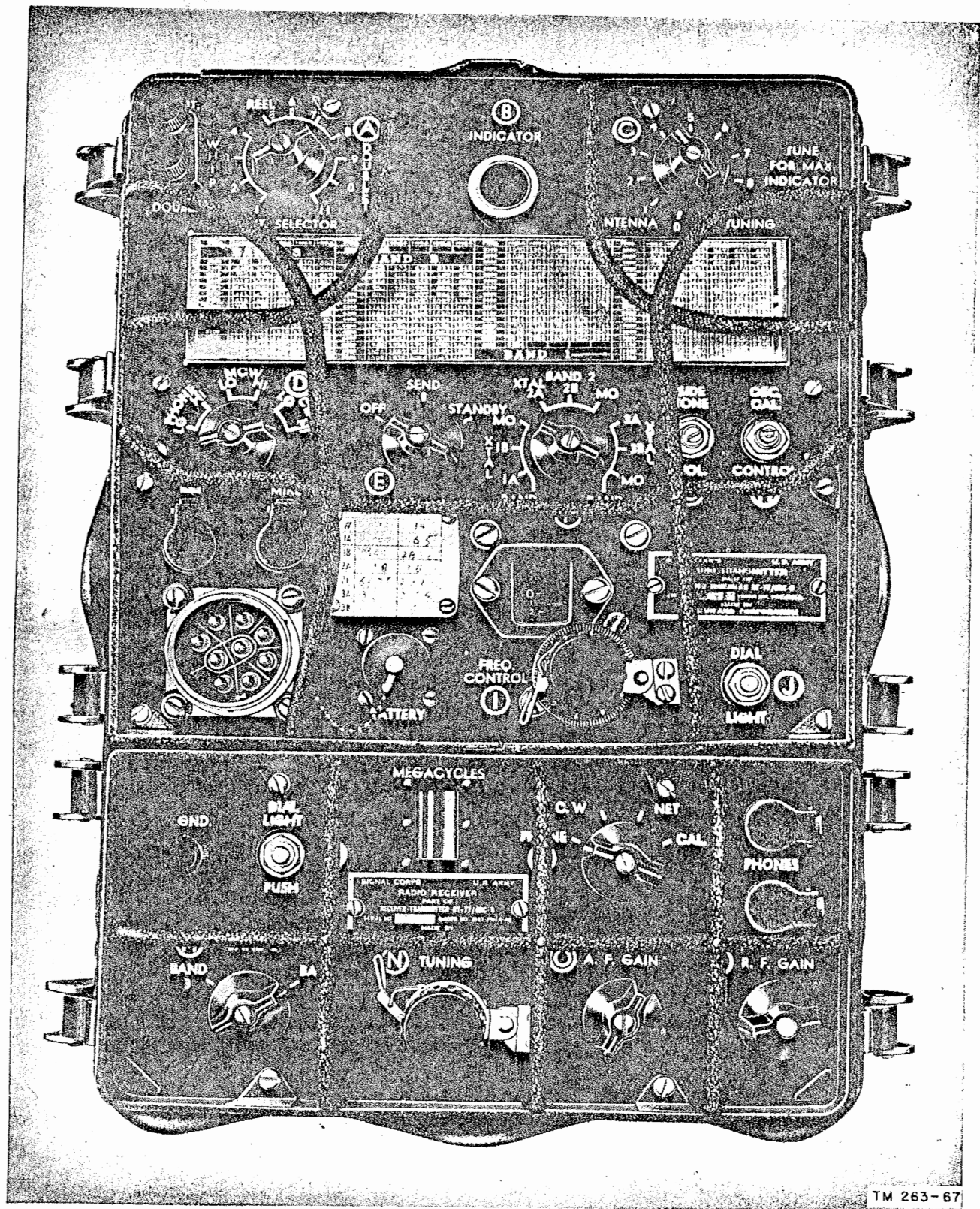
e. CONTENTS OF ONE OF THE PACKING CRATES.

(1) Signal Corps stock No.	Quantity	Description
3E1999-86-3.8	1	Cord CD-1086, 44" long
6L80021	1	Kit of hardware containing-
6L3506-24-10Z	6	Nut, hex, 3/8"-24
6L4906-40.24	6	Screw, cap, 3/8"-24x2 1/2"
6L7220-32	10	Washer, lock, 3/8"
6Z3147	2	Connector, Appleton #61077
(2) Signal Corps stock No.	Quantity	Description
3H6800-237	1	Vibrator Power Unit PE-237 containing-
2J1005	2	Tube type 1005
2J1006	2	Tube type 1006
3H6694-11	2	Vibrator VB-16
3H6707	2	Vibrator, Oak #V6460-17XS
6R57400	1	Wrench, set screw, Allen #8



eriptic
-29
poise CP-12
poise CP-13
FT-515
aker LS-7
5
M-378
M-379

ription
containing-
e OC3/VR105
e 1S5
e 1L4
e 1R5
e 2E22
e 3A4
e 3Q4
ot, Mazda #49
bc, Kellems



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Figure 10. Receiver-transmitter RT-77/GRC-9.

7. Table of Components

Component	Required No.	Length (in.)	Width (in.)	Depth (in.)	Weight (lb)
Antenna AT-101/GRC-9 } Wound on Reel -----	1	12	8½	2	
Antenna AT-102/GRC-9 } RL-29 -----	1	12	8½	2	
Bag BG-172 (for equipment accessories) -----	1	13	13	10	
Bag CW-140/GRC-9 (Receiver-Transmitter RT-77/GRC-9).	1	16½	12½	15	
Bag BG-175 (Generator GN-58) -----	1	10	8	10½	
Box BX-53 (spare tubes, lamps, and pilot lights) -----	1	6½	6	2½	
Cord CD-1086 (7 ft long for connecting receiver-transmitter to generator).	1	84			
Cord CD-1086 (44 in. long for connecting receiver-transmitter to Vibrator Power Unit PE-237).	1	44			
Cord CD-1119 (BA-48 to receiver-transmitter) -----	1	34½			
Counterpoise CP-12 } on Reel -----	1	12	8½	3½	
Counterpoise CP-13 } RL-29 -----					
Cranks GC-7 -----	2	7½	5½	1	
Generator GN-58- (*) -----	1	10½	7½	8	
Guy GY-12 -----	1	2½	2½	¾	
Guy GY-42 -----	1	3	1½	1½	
Halyard M-378 -----	1	14	1½	1½	
Halyard M-379 -----	1	10	1	1	
Insulator IN-127 -----	1	14½	3	3	
Key J-45 -----	1	5½	4¼	2	
Leg LG-2-B -----	1	33¾	6	2½	
Leg LG-3-B -----	2	24	3½	1½	
Loudspeaker LS-7 -----	1	7	4¾	3	
Mast Base MP-65-A -----	1	17½	3¼	3¼	
Mast Section MS-116-A -----	6	39½			
Mast Section MS-117-A -----	2	39½			
Mast Section MS-118-A -----	2	39½			
Mounting MT-350/GRC-9 (with 1 bag hardware) -----	1	16¾	11¾	1¾	
Bracket FT-515 -----	1	7	1¼	1¼	
Receiver-Transmitter RT-77/GRC-9 (complete) -----	1	16	13	8	
Reel RL-28 (guys) -----	1	6½	2¾	½	
Reel RL-29 -----	3	12	8½	1	
Roll BG-174 (antenna sections) -----	1	42	10	4½	
Stake GP-27-B -----	4	7½			
Technical Manual TM 11-263 -----	2				
Wire W-128 -----	10 ft				
Vibrator Power Unit PE-237 -----	1	20	10½	10¾	
Hardware for Vibrator Power Unit PE-237 -----	1 bag				
Total weight (lb) -----					27

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of spare parts.

8. Assembly Description of Receiver-Transmitter RT-77/GRC-9

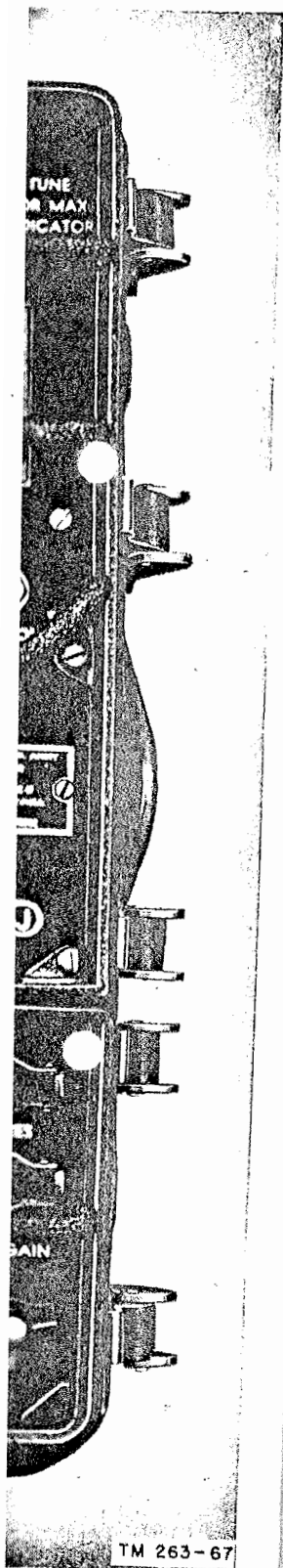
a. The receiver-transmitter (fig. 10) consists of a complete separate receiver unit and a complete individual transmitter unit. The units are mounted in a metal case having a tight fitting metal cover which is removed for operation of the set.

b. This Panel Cover CW-109/GRC-9 has a rubber seal around its edge to prevent water from entering the set. When the cover is in-

stalled on the metal case, the entire assembly will float. To remove the cover, pull up gently on the metal clamps arranged along the edge (fig. 11).

Caution: Be sure to release the clamps in the manner shown in figure 11. Injury may result if the thumb is struck by the clamp as it is released. Hold the clamp firmly and pull up gently.

c. When the cover is completely removed from the case, the individual receiver and transmitter sections may be lifted partly out of



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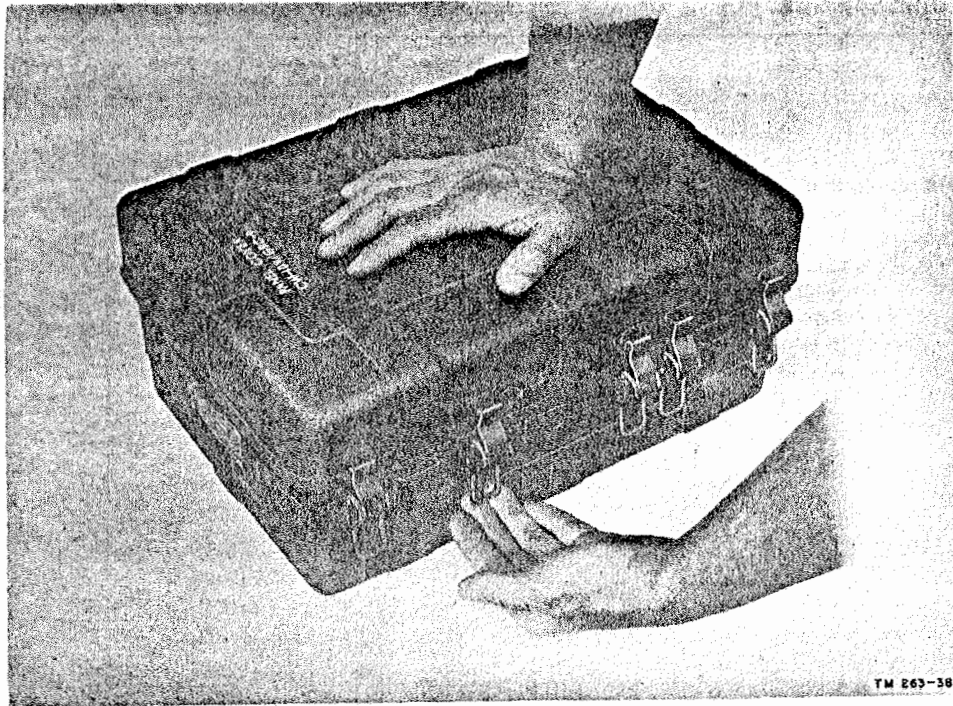


Figure 11. Removing front cover of receiver-transmitter RT-77/GRC-9.

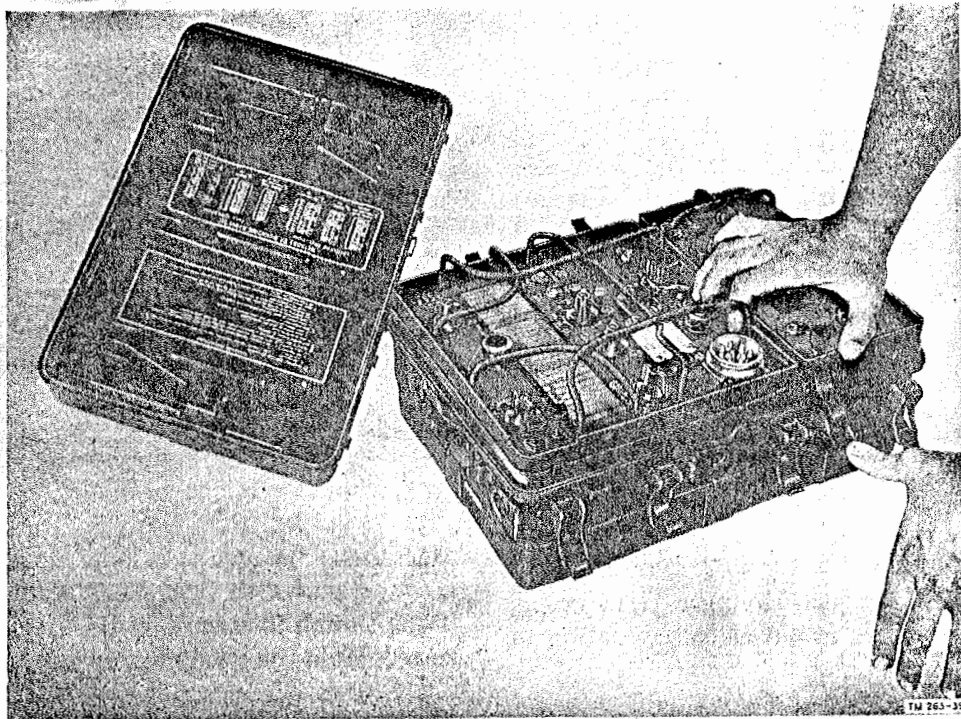


Figure 12. Resetting the clamps on the panels of receiver-transmitter RT-77/GRC-9.

case. To prevent the possibility of these units falling out of the case, reset the clamps on the small projections on the receiver and transmitter front panels (fig. 12). The same precaution must be observed in unhooking the clamps from this position, as when the front cover was on.

d. The individual units are physically and electrically divided into separate sections and are connected together electrically by a separate interconnecting cable (3E7173-22); the two ends plug into individual sockets on the transmitter and the receiver (fig. 39). All jacks and controls, except one, are located on the front panel. The one control in the rear of the receiver is the switch that accommodates the receiver output circuit to the different loudspeaker and headphone impedances (fig. 39).

c. All jacks, controls, and switches are waterproofed for complete protection of the radio set when operating under extremely humid conditions. The entire assembly is mounted in Bag CW-140/GRC-9, which is a canvas bag used to provide additional carrying space when operating or transporting the radio set.

9. Receiver Section of Receiver-Transmitter RT-77/GRC-9 (fig. 13)

a. The receiver is designed to receive a-m signals in the frequency range of 2 mc to 12 mc in three distinct bands.

b. The front panel of the receiver contains the controls necessary for its operation and is

protected by an open grillwork. There are two phone jacks allowing two Headsets HS-30 to be used simultaneously. The jacks have covers which are held tightly over the jack openings by springs. These covers protect the jacks from dirt and moisture. In the upper left-hand corner of the panel is the GND. (ground) connecting post for the lead from the counterpoise which is used when a vertical antenna is used. The TUNING knob, control ①, has a device incorporated on the panel by which it may be locked at any desired dial position. The dial is shown unlocked in figure 13. To lock it, push the metal lever down.

c. Some knobs, such as those on controls ②, ③, ④, have a white line on only one side of their centers. The knob on control ④, however, has a white line on both sides of its center. Knobs having two white lines indicate that the control can be rotated in either direction continuously without having to stop. Knobs with one white line cannot be turned continuously in one direction, but upon reaching the stop position, they must be rotated back in the opposite direction. A knob with one white line must never be forced beyond the stop position or it will break.

10. Transmitter Section of Receiver-Transmitter RT-77/GRC-9 (fig. 14)

a. On the front panel are located all the controls necessary for the operation of the trans-

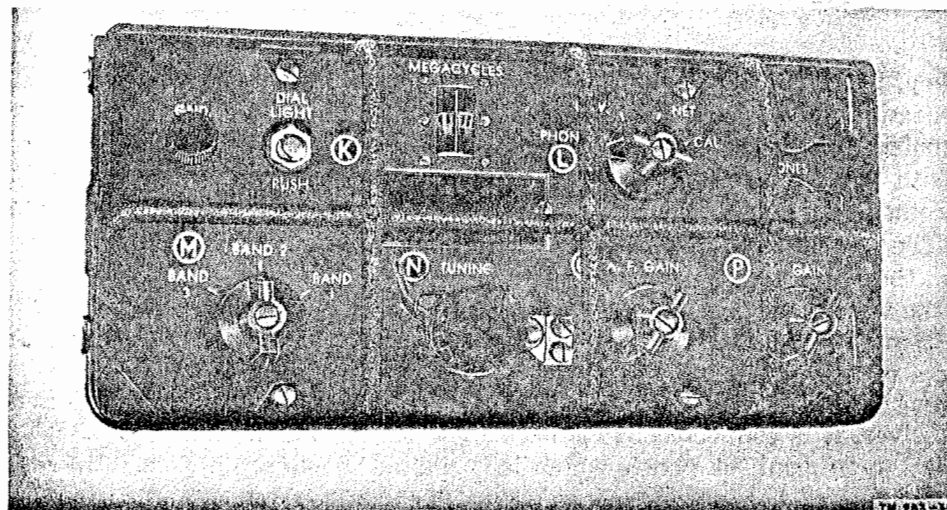
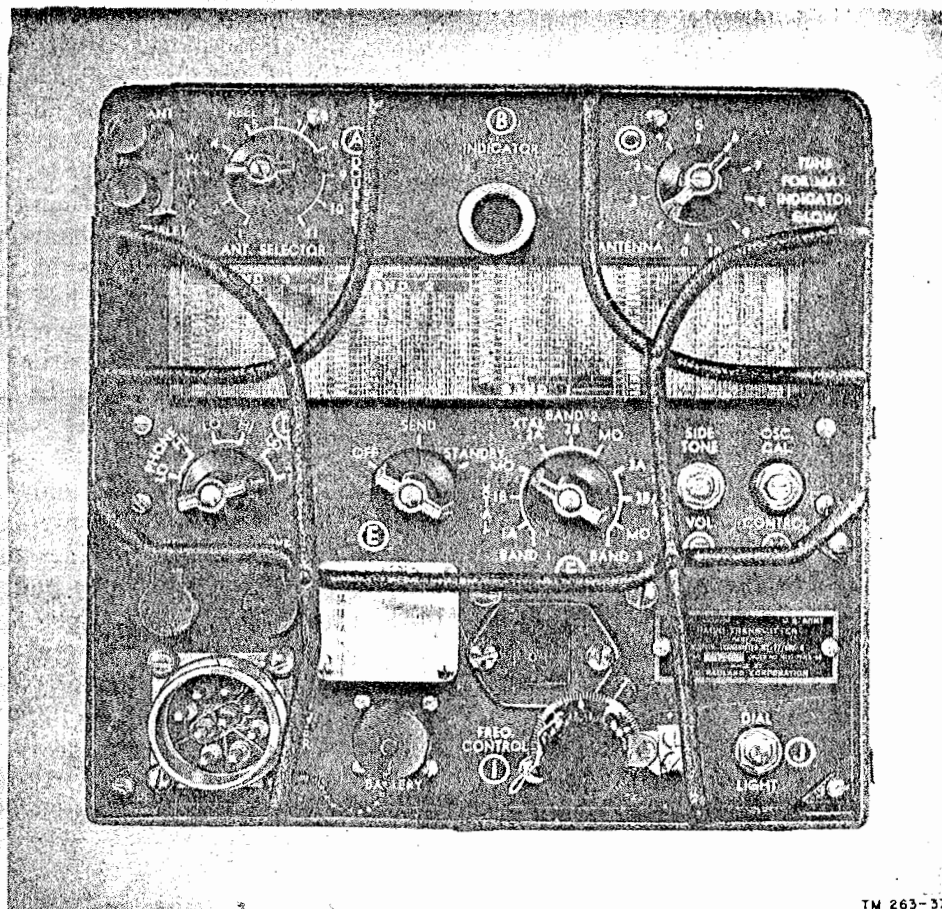


Figure 13. Receiver section of receiver-transmitter RT-77/GRC-9.



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Figure 14. Transmitter section of receiver-transmitter RT-77/GRC-9.

mitter; these controls are protected by an open grillwork. The antenna and doublet lead-ins are attached to the binding posts in the upper left-hand corner. In the lower left-hand corner are two jacks for the insertion of the microphone and the handkey. Small covers are held against the jacks by means of springs in order to keep out dirt and moisture. The d-c power input receptacle for both the transmitter and receiver are in the extreme lower left-hand corner of the transmitter. The receptacle contacts are arranged so that the power cord from either the generator or the vibrator power unit will fit in only one position. This is an assurance that correct voltages will be fed to the proper components. Although the battery supplies power only to the receiver, it is connected by cable to a receptacle on the transmitter panel, which is directly on the right of the power receptacle. There is a small metal key in the battery recep-

tacle which allows the battery cable plug to fit in one position, as is the case with the power receptacle.

b. The frequency control knob ① on the transmitter may be locked in position in the same manner as the receiver tuning dial. Dial knobs on the transmitter which may be turned continuously in one direction, are those with two white lines (controls ② and ③). Controls ④, ⑤, and ⑥ have stops and must not be forced. When the stop position is reached, the knob must be turned back in the opposite direction. The large chart on the transmitter gives the numbers to which the tuning dials must be turned, in order to transmit the corresponding frequencies on the chart. There is a smaller white chart, marked CRYSTALS, on which should be marked in pencil, the frequency ranges of transmission obtained with the different crystals.

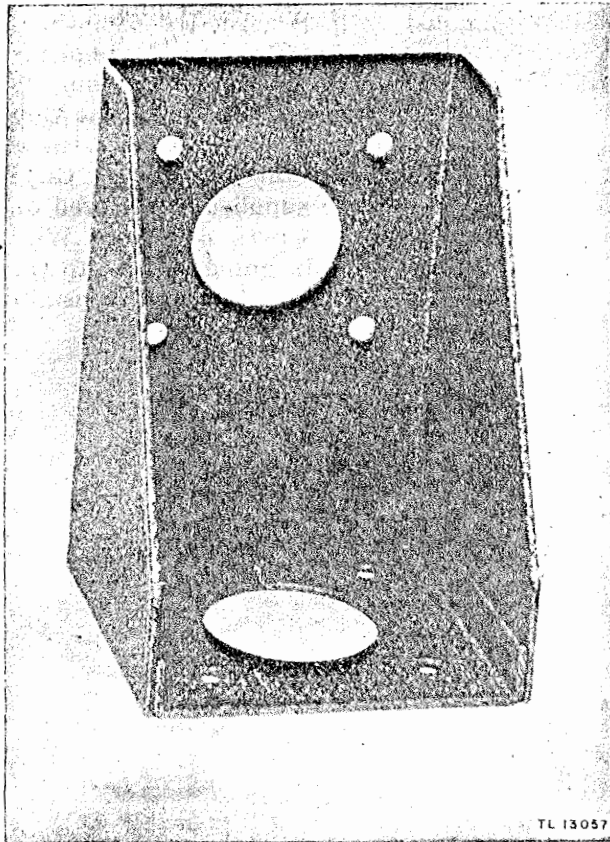


Figure 18. Mast bracket MP-50.

15. Microphone T-45

(figs. 21 and 22)

Microphone T-45 is held in front of the mouth by a harness which can be adjusted for comfort. The plug of Microphone T-45 connects to a corresponding receptacle on Cord CD-318-A. This cord leads to Switch SW-141 which is hung on the chest by means of a strap which fits around the neck. Then the cord emerges from

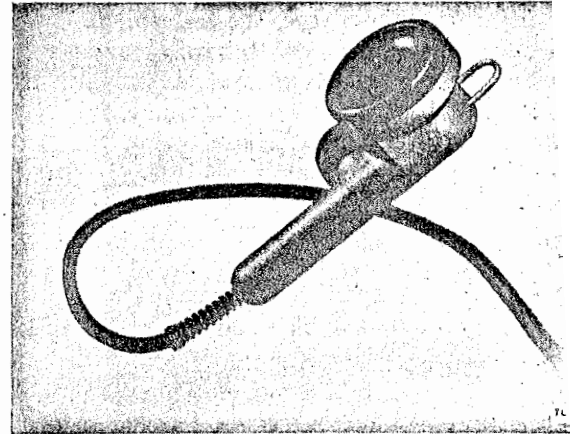


Figure 19. Hand microphone T-17.

the switch box and terminates in Plug PL which fits into the MIKE jack on the transmitter. Figure 22 shows Microphone T-45 use.

16. Key J-45

The key with all the important parts list is shown in figure 23. The unit is designed to be placed on the operator's leg by means of metal bands attached. Plug PL-55, which is attached to the end of the cord connected to the key terminals, fits into the jack marked KE on the transmitter panel.

17. Headset HS-30-(*)

The headset is shown in figure 24. Each earplug can slide partly up and down on the metal headband to adjust to the wearer's comfort. Figure 25 shows the unit in use. The earphones are of the magnetic type.

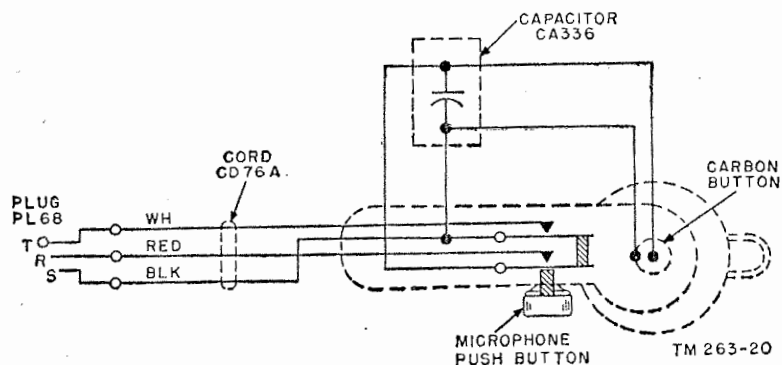


Figure 20. Internal schematic diagram of hand microphone T-17.

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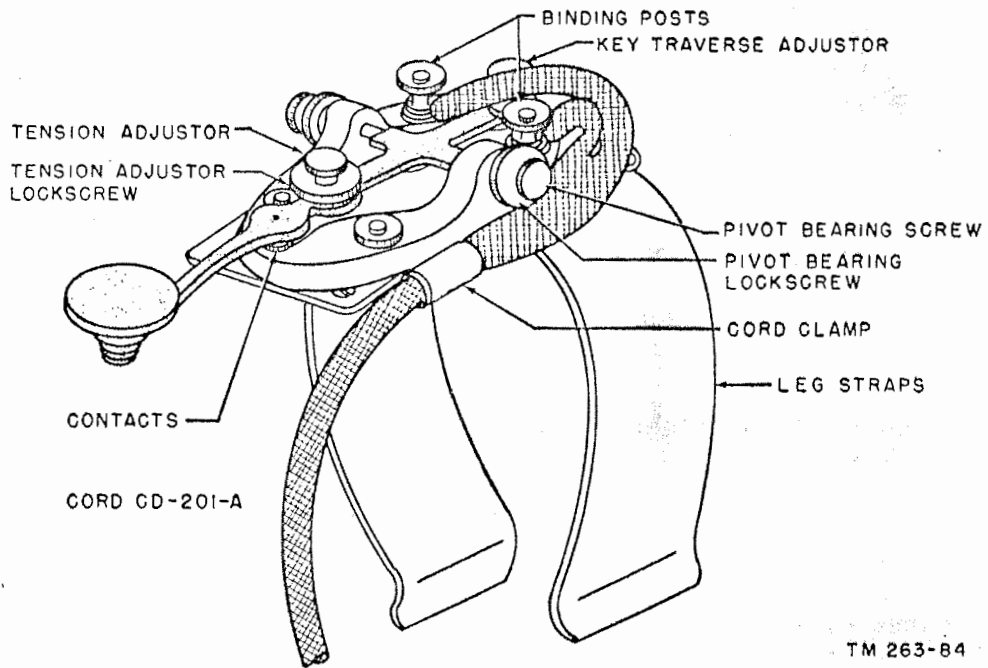
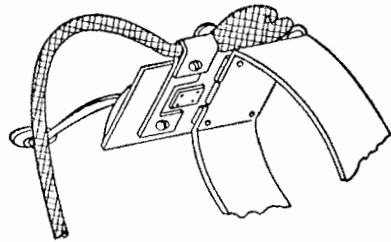


Figure 23. Key J-45.

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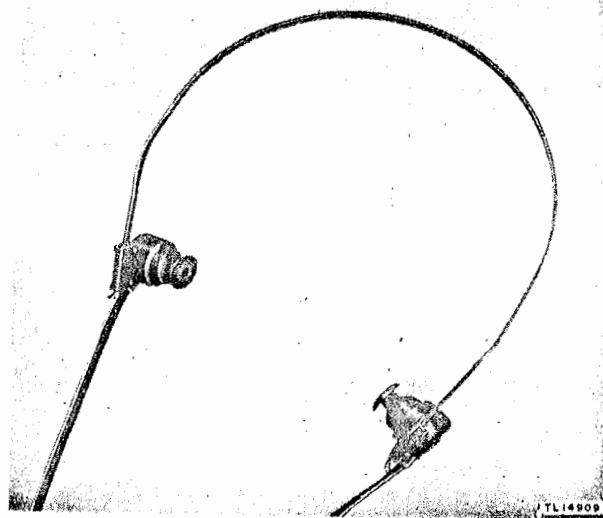


Figure 24. Headset HS-30-(*).

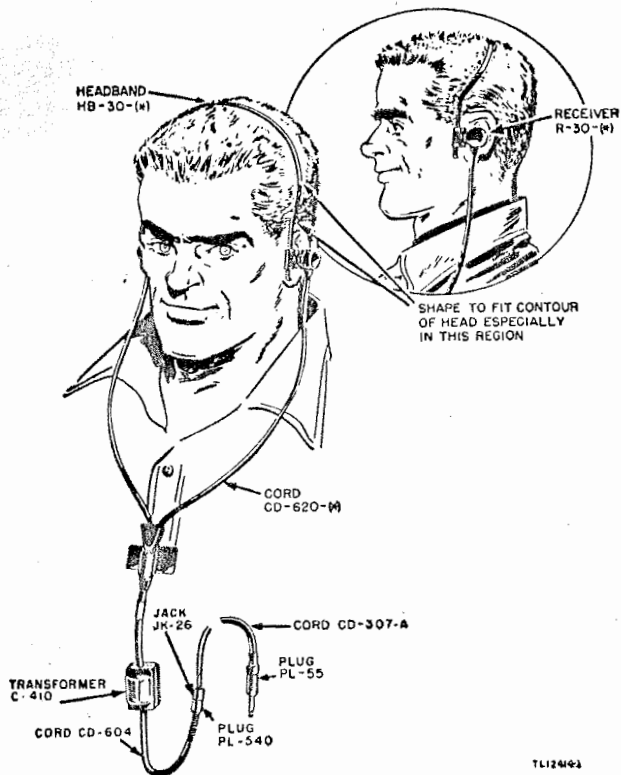


Figure 25. Headset HS-30-*(*) in use.

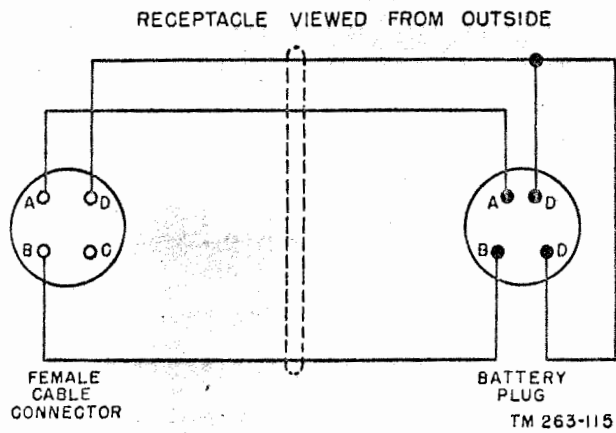


Figure 26. Cord CD-1119, internal wiring.

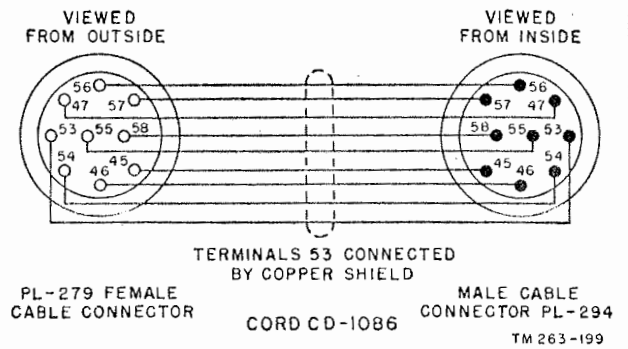


Figure 27. Cord CD-1086, internal wiring.

by removing the four mounting bolts from the skids (fig. 29).

- (5) Remove the moisture-vaporproof barrier as shown in figure 30C.
- (6) Open the inner carton and remove the cushioning material and the bags of desiccant (fig. 30D).
- (7) Inspect all equipment for possible damage during shipment.

c. CHECKING. Check the contents against the master packing slips.

d. UNPACKING DOMESTIC PACKING CASES. Radio equipment may be received in domestic packing cases. The instructions given in *b* above apply also to unpacking domestic shipments. In general, follow the procedure below:

- (1) Cut the metal bands.
- (2) Open the cartons that protect the equipment; or, if heavy wrapping paper is used, remove it carefully and take out the components.
- (3) Check the contents of the packing case against the master packing slip.

Note. Save the original packing cases and containers for both export and domestic shipments. They can be used again when the equipment is repacked for storage or shipment.

25. Selection of Antenna Equipment for Field Operation

a. Most satisfactory performance will be obtained with the selection of the proper antenna, considering the advantages and the disadvantages of each of the three types available for Radio Set AN/GRC-9.

- (1) When a permanent or semipermanent installation can be made, use the long-wire antenna. It will transmit farther and receive weak signals more satisfactorily than the whip antenna.
- (2) However, when the equipment must be moved rapidly and frequently from one location to another or is used as a vehicular installation (par. 34), use the vertical mast antenna.

b. The advantages of the vertical mast antenna are:—

- (1) It can be set up or taken down quickly.
- (2) It will permit satisfactory transmission and reception over short distances (up to approximately 25 miles).

(3) The space required is small.

(4) The presence of tall objects for support is not required.

(5) It permits transmission equally well in all directions.

(6) The antenna can be quickly tuned from one end of the frequency band to the other.

c. The principal disadvantage of the vertical mast antenna is that it is not highly efficient for distance in excess of 25 miles, as compared to the long-wire antenna.

d. The principal advantage of the long-wire antenna is its transmission efficiency. When properly installed, it will permit satisfactory transmission and reception over comparatively long distances.

e. The principal disadvantages of the long-wire antenna are—

- (1) It requires tall objects for support.
- (2) The antenna length must be changed if the frequency is to be shifted appreciably (more than 200 kc).
- (3) The direction of maximum transmission with respect to the orientation of the antenna will depend on the length of the antenna.

26. Installation of Long-wire Antenna

For installation of long-wire Antennas AT-101/GRC-9 and AT-102/GRC-9, proceed as follows:

a. Select an open area where two upright supports for the antenna can be found, such as two trees. A minimum length of 250 feet is required to allow for the full length of the antenna at the low frequencies.

b. Making use of trees, buildings, or fence posts, erect the antenna as high as possible. In no case should the antenna be lower than 6 feet.

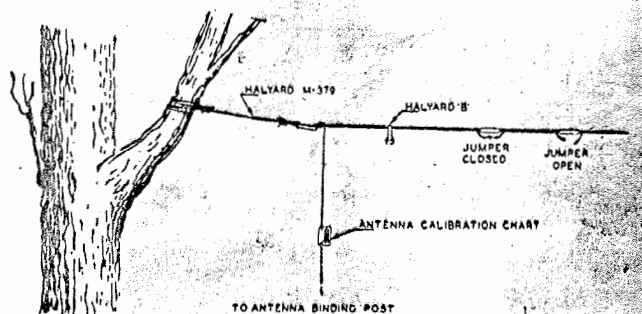


Figure 31. Antenna supports and connections.

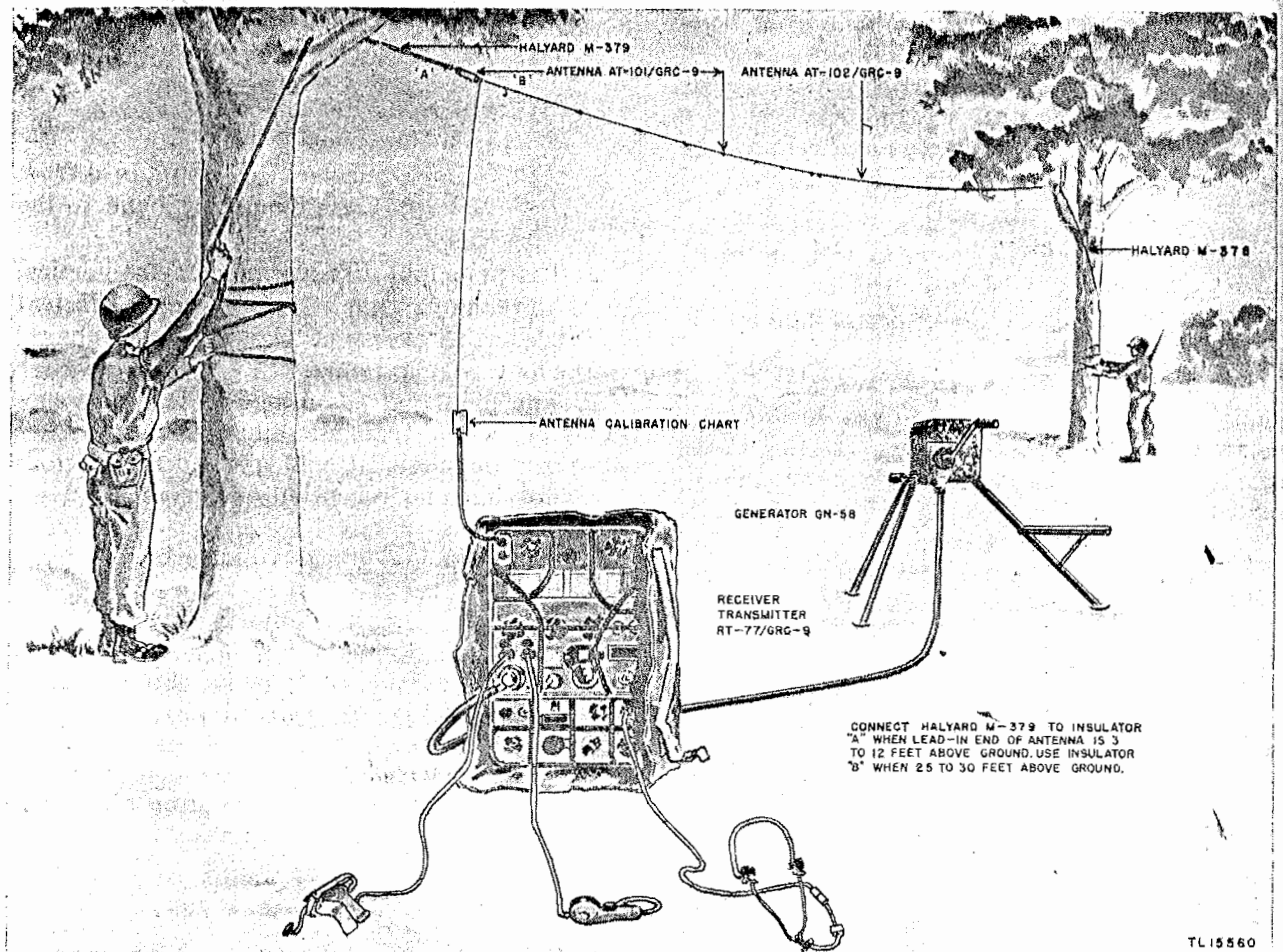


Figure 32. Installation of long-wire antennas AT-101/GRC-9 and AT-102/GRC-9.

c. Connect Antenna AT-101/GRC-9 to its support by means of Halyard M-379, as shown in figure 31. This length of antenna is shown with the calibration chart attached.

d. Connect the clip on Antenna AT-

102/GRC-9 to the small ring on the free end of Antenna AT-101/GRC-9 and fasten the other end of Antenna AT-102/GRC-9 to its support by Halyard M-378. In figure 32, the entire installation of the long-wire antenna is shown.

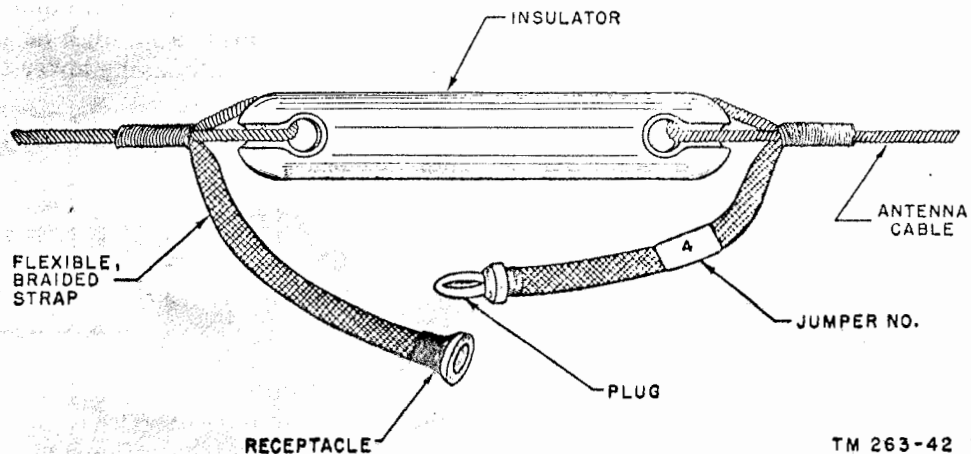


Figure 33. Typical antenna jumper.

e. Locate the radio set at any point that will not allow the lead-in to touch the ground or any other objects such as trees, buildings, or metal fences. Connect the lead-in from the calibration chart end of the antenna to the ANT. binding post on the transmitter.

Note. Since the antenna length, for the best transmission and reception, is directly dependent on the frequency of the signal, it is necessary to adjust the antenna length to the frequency at which the transmitter is to be operated. Jumpers are placed on the antenna. The calibration chart, showing the length of the antenna required for the various frequencies, indicates which jumpers must be opened and closed for the frequencies. A typical jumper is shown in figure 33.

f. In case the antenna calibration chart should be lost or become illegible, it is reproduced here exactly as it looks (fig. 34). The number of antenna lengths to be closed in succession always should start at the lead-in end.

ANTENNA AT - 101/GRC - 9

FREQ.	1	2	3	4	5	6	7	8
12000-9900	0	0	0	0	0	0	0	0
9900-9000	x	0	0	0	0	0	0	0
9000-8400	x	x	0	0	0	0	0	0
8400-7500	x	x	x	0	0	0	0	0
7500-6000	x	x	x	x	0	0	0	0
6000-5300	x	x	x	x	x	0	0	0
5300-4900	x	x	x	x	x	x	0	0
4900-4300	x	x	x	x	x	x	x	0

X = CLOSED JUMPER
O = OPEN JUMPER

ANTENNA AT - 102/GRC - 9

FREQ.	8	9	10	11	12	13	14	15	16
4300-3900	x	0	0	0	0	0	0	0	0
3900-3200	x	x	0	0	0	0	0	0	0
3200-3100	x	x	x	0	0	0	0	0	0
3100-2900	x	x	x	x	0	0	0	0	0
2900-2700	x	x	x	x	x	0	0	0	0
2700-2550	x	x	x	x	x	x	0	0	0
2550-2400	x	x	x	x	x	x	x	0	0
2400-2200	x	x	x	x	x	x	x	x	0
2200-2000	x	x	x	x	x	x	x	x	x

X = CLOSED JUMPER
O = OPEN JUMPER

Figure 34. Antenna calibration chart.

g. If the antenna should be lost or destroyed, another one can be made from any other stranded copper wire available. The following chart gives the correct lengths including the lead-in.

Transmitting frequency (kc)		Antenna length, including lead-in (ft)
From	To	
2,000	2,200	245.5
2,200	2,400	228.0
2,400	2,550	210.0
2,550	2,700	193.0
2,700	2,900	177.5
2,900	3,100	163.0
3,100	3,200	151.5
3,200	3,900	139.0
3,900	4,300	122.0
4,300	4,900	107.5
4,900	5,300	93.0
5,300	6,000	85.5
6,000	7,500	73.5
7,500	8,400	63.0
8,400	9,000	57.5
9,000	9,900	53.0
9,900	12,000	46.0

27. Installation of Whip Antenna

a. Place the radio set in an area free of large obstructions such as trees, buildings, and power lines.

b. Set up the counterpoise by placing link Counterpoise CP-13 on top of Counterpoise CP-12 and clamping them together by means of the wingnut attached (fig. 17).

c. Spread out the eight wires of Counterpoises CP-12 and CP-13 as far as they will reach radially, like the spokes of a wheel. To hold the counterpoises in place, drive Stake GP-27-A through one of the holes in the connecting links. Connect the heavy lead on the bar of Counterpoise CP-12 to the GND. post on the receiver panel.

d. Extend the hinged supports on the side of the radio set case through the opening in the side of Bag CW-140/GRC-9. Insert Insulator IN-127 in these supports.

e. Connect the binding post marked ANT. on the transmitter panel to the insulator binding post with a 12-inch length of Wire W-128. Run the wire through the upper hinge slot in the bag.

f. Screw together three Mast Sections MS-116-A, one Mast Section MS-117-A, and one Mast Section MS-118-A.

g. Close the clamp ring of Guy GY-42 and hook the end of Guy GY-12 through the holes

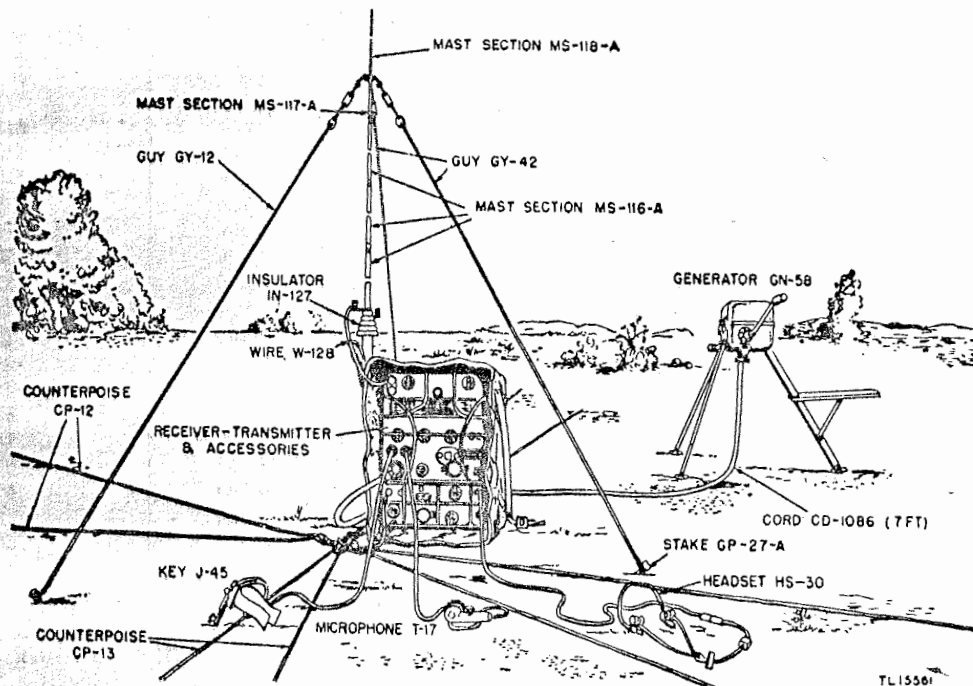


Figure 35. Radio set AN/GRC-9 set up for normal field use.

in the collar clamps to keep the clamps closed (fig. 36). Insert Mast Section MS-116-A into Insulator IN-127.

h. Slip Stakes GP-27-A through the S hooks

attached to the ends of the guy cords and drive the stakes into the ground at equally spaced points around the set to hold the mast erect (fig. 35).

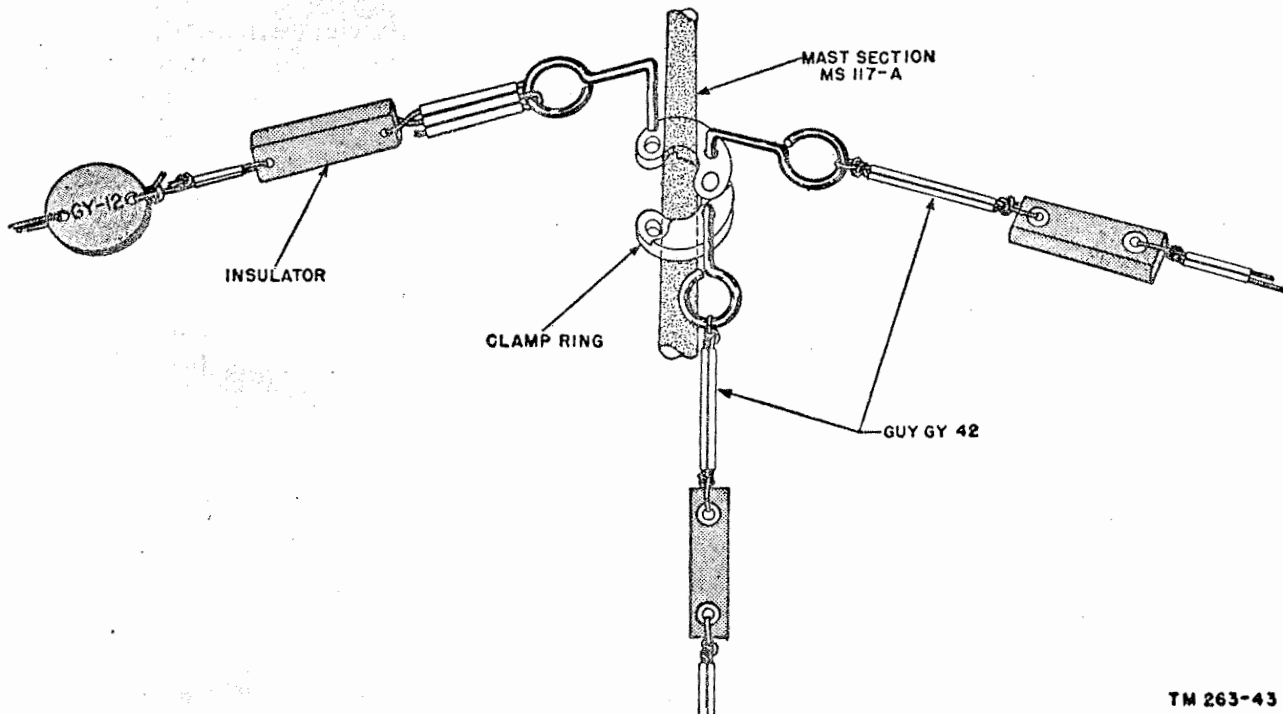
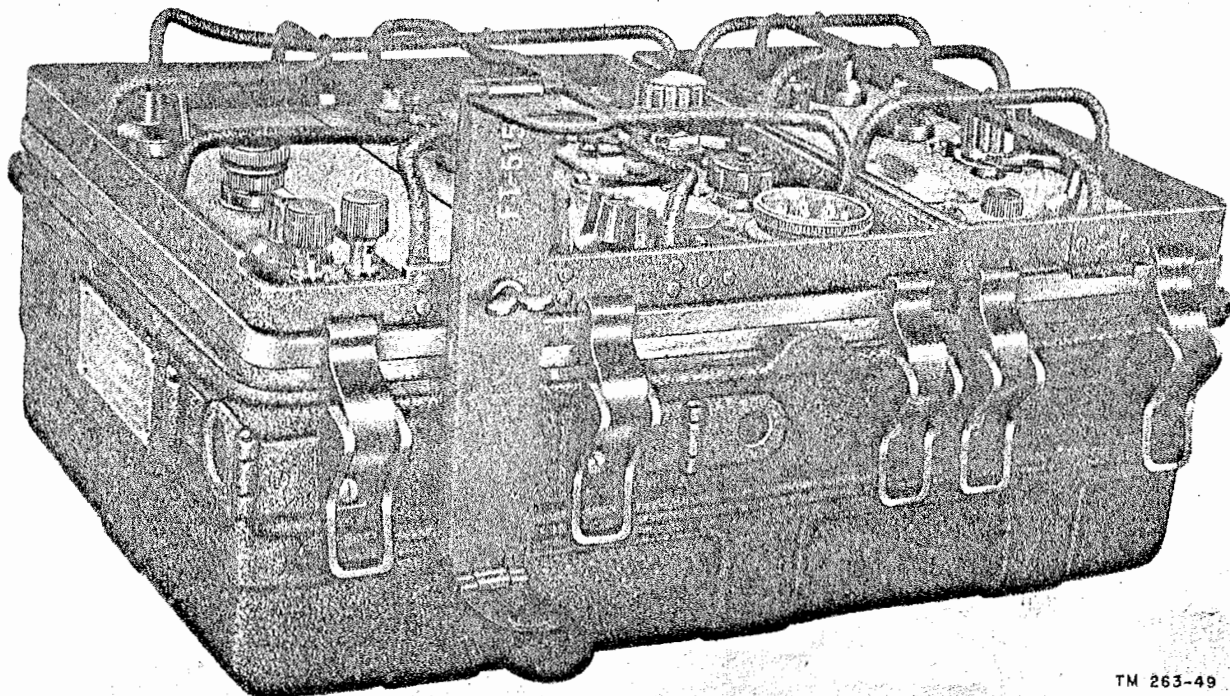


Figure 36. Clamp ring for connecting guy cords to vertical mast antenna.

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Figure 37. Application of bracket FT-515.

28. Bracket FT-515

If it is necessary to operate the radio set in a horizontal position, the antenna is mounted by means of Bracket FT-515. This is shown in Figure 37.

29. Doublet Antenna

At times, the possibility arises that the radio set must be used as a semipermanent installation to hold communication with other sets located in a fixed direction from the first set. In this case, a doublet antenna is advised because

of its greater directivity when operated as a half-wave radiator. The lead-in or feeder to the doublet antenna should be a 50- to 72-ohm transmission line, whose ends are attached to the ANT. and DOUBLET binding posts on the transmitter panel. It is cautioned that a doublet antenna must not be used unless the exact locations of the other radio stations are known, so that the antenna may be orientated for the maximum transmission in that direction. The correct orientation is shown in figure 38. The following table gives the antenna lengths necessary for maximum transmission efficiency over the frequency range of Radio Set AN/GRC-9.

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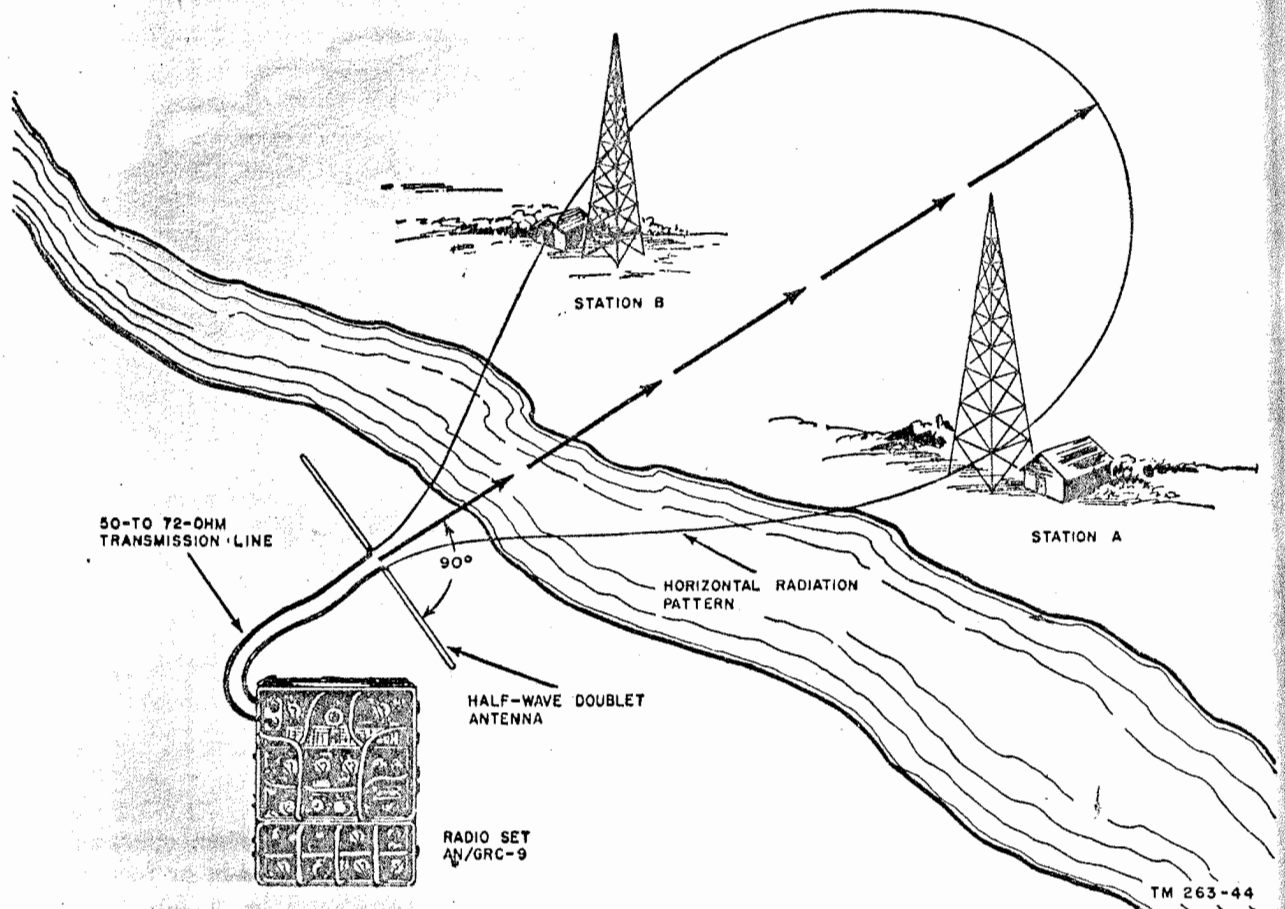


Figure 38. Orientation of a half-wave doublet antenna for maximum range.

Frequency range		Antenna "L" in feet $\frac{1}{4}$ wave (each side of feeders)	Feeders length	Frequency range		Antenna "L" in feet $\frac{1}{4}$ wave (each side of feeders)	Feeders length
<i>From</i>	<i>To</i>						
2,000	2,200	116 ft 7 in.-----	95 ft 6 in.	4,725	4,850	50 ft 6 in.-----	42 ft
2,200	2,400	106 ft 6 in.-----	87 ft	4,850	5,000	49 ft-----	41 ft
2,400	2,575	98 ft-----	80 ft 6 in.	5,000	5,150	47 ft 6 in.-----	39 ft 6 in.
2,575	2,725	91 ft 10 in.-----	75 ft 6 in.	5,150	5,300	46 ft-----	38 ft 6 in.
2,725	2,875	86 ft 10 in.-----	71 ft 6 in.	5,300	5,450	44 ft 8 in.-----	37 ft 6 in.
2,875	3,025	82 ft 3 in.-----	68 ft	5,450	5,600	43 ft 3 in.-----	36 ft 6 in.
3,025	3,150	78 ft 7 in.-----	65 ft	5,600	5,750	42 ft-----	35 ft 6 in.
3,150	3,250	75 ft 10 in.-----	62 ft 6 in.	5,750	5,900	40 ft 11 in.-----	34 ft 6 in.
3,250	3,350	73 ft 6 in.-----	60 ft 6 in.	5,900	6,100	39 ft 8 in.-----	33 ft 6 in.
3,350	3,440	71 ft 7 in.-----	59 ft	6,100	6,300	38 ft 3 in.-----	32 ft 6 in.
3,440	3,520	69 ft 10 in.-----	57 ft 6 in.	6,300	6,500	37 ft-----	31 ft 6 in.
3,520	3,600	68 ft-----	56 ft 6 in.	6,500	6,900	35 ft 10 in.-----	30 ft 6 in.
3,600	3,725	66 ft-----	54 ft 6 in.	6,900	7,500	32 ft 10 in.-----	28 ft
3,725	3,850	63 ft 9 in.-----	53 ft	7,500	8,100	30 ft 2 in.-----	25 ft 6 in.
3,850	3,975	61 ft 8 in.-----	51 ft	8,100	8,700	28 ft-----	24 ft
3,975	4,100	59 ft 8 in.-----	49 ft 6 in.	8,700	9,300	26 ft-----	22 ft 6 in.
4,100	4,225	57 ft 10 in.-----	48 ft	9,300	9,900	24 ft 4 in.-----	21 ft
4,225	4,350	56 ft 3 in.-----	47 ft	9,900	10,500	23 ft-----	19 ft 6 in.
4,350	4,475	54 ft 9 in.-----	45 ft 6 in.	10,500	11,100	21 ft 10 in.-----	18 ft 6 in.
4,475	4,600	53 ft 3 in.-----	44 ft 6 in.	11,100	12,000	20 ft 3 in.-----	17 ft 6 in.
4,600	4,725	51 ft 9 in.-----	43 ft				

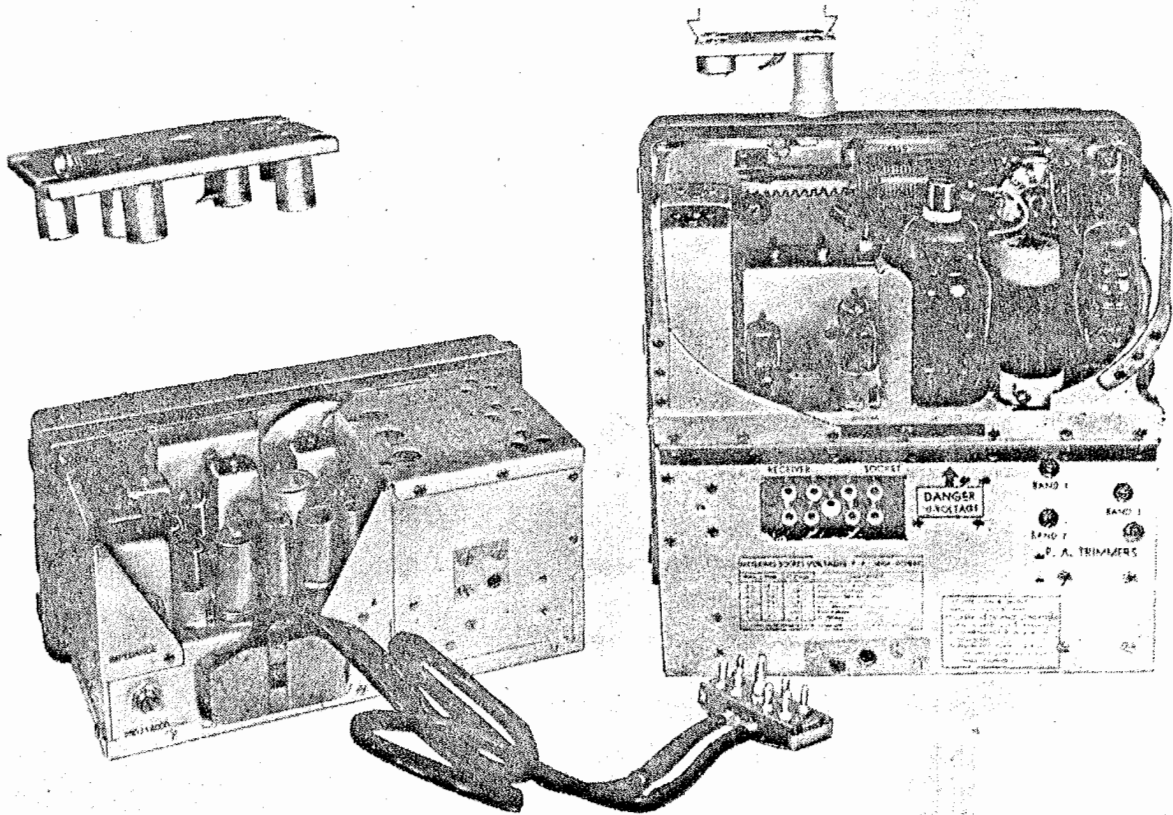


Figure 39. Rear view of transmitter and receiver, and cable 3E7173-22.

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30. Installation of Receiver Tubes and Crystal

a. The receiver tubes and crystal are already installed when shipped. To inspect or replace them, proceed as follows: Remove the cover of Receiver-Transmitter RT-77/GRC-9 (par 8b). Lift the receiver portion partially out of the case and remove the plug of cable 3E7173-22 (fig. 39). The tubes and crystal are located beneath a single metal cover (fig. 39) which is removed without tools.

Caution: Remove this cover by releasing all four cover retaining springs and then lifting cover straight up without tilting it. This is necessary to avoid any damage which may occur if the tube shields on the cover are forced, pushing any tube which is in the receiver, thus causing the tube prongs to snap. Insert or replace tubes and crystal as necessary in accordance with the tube layout chart on the side of the receiver. The same information is found on the cover just removed.

b. There are seven tubes; each one will fit into its socket in only one position. Do not jam

the tube in the socket. Rotate the tube gently, until the tube prongs are lined up with their corresponding socket holes; then press the tube straight down into its socket.

Note. Do not mistake the transmitter tubes for receiver tubes. Some transmitter tubes look exactly like those used in the receiver.

c. There is only one crystal to be inserted. To remove the crystal, insert a screw driver between bias cell BT1 and capacitor C55 and gently pry the crystal upward, and, at the same time, pull it with the fingers. The dial light lamp may be removed by using the pilot lamp puller contained in Box BX-53 of carrying Bag BG-172 (fig. 40). Always remove the pilot lamp from the puller by pulling on the glass bulb and not the brass bayonet pin base.

31. Installation of Transmitter Tubes and Crystals

a. The receiver tubes and crystals are already installed when shipped. To inspect or replace them proceed as follows: When opening the

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Feet or length

- 42 ft
- 41 ft
- 39 ft 6 in.
- 38 ft 6 in.
- 37 ft 6 in.
- 36 ft 6 in.
- 35 ft 6 in.
- 34 ft 6 in.
- 33 ft 6 in.
- 32 ft 6 in.
- 31 ft 6 in.
- 30 ft 6 in.
- 8 ft
- 5 ft 6 in.
- 4 ft
- 2 ft 6 in.
- 1 ft
- 1 ft 6 in.
- 3 ft 6 in.
- ft 6

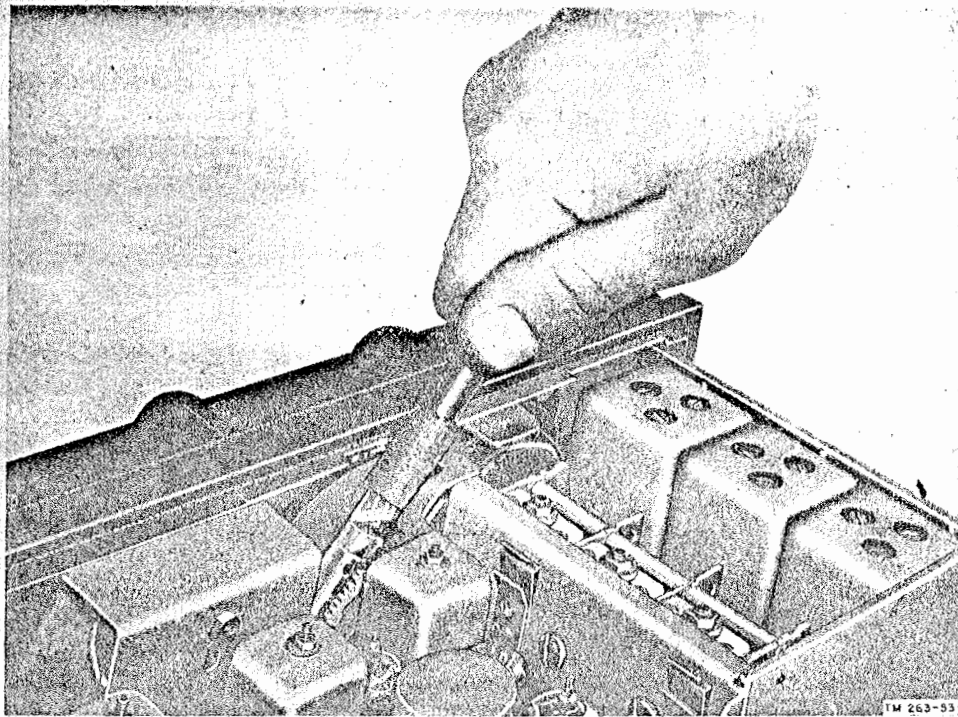


Figure 40. Removing pilot lamp.

transmitter, be sure that the power is shut off. Remove the receptacle of power Cord CD-1086 from the transmitter POWER receptacle. The power amplifier tube 2E22, V103, is easily accessible and may be removed by gently rocking it with a circular motion, pulling upward at the same time. Always remove the connection to the plate cap first. The voltage regulator tube VR105 (V104) can be removed by opening the safety clamp around the base of the tube. The clamp may be opened very easily by inserting a screw driver tip in the small slot on the clamping lever and by twisting the screw driver counterclockwise slowly. To tighten the clamp, twist the screw driver in a clockwise direction.

b. The remainder of the tubes and crystals are located under a small plate (fig. 39). The tubes are V101, V102, and V105 and the crystals are 1A, 1B, 2A, 2B, 3A, and 3B. The cover plate can be removed by releasing the spring catches at both ends of the plate and lifting straight upward. The tubes and crystals are then easily accessible. The tubes can be removed as shown in figure 41.

32. Installation of Generator GN-58-(*)

The hand generator is used to supply power to the receiver-transmitter during field or

portable operation. The generator is carried in Bag BG-175 and the supporting legs are carried in antenna equipment Roll BG-174. To prepare the generator for operation, refer to figure 16 and proceed as follows:

a. Insert two Legs LG-3 upward through the metal loops on the side of the generator which has the order number plate on it. Be sure that the flat metal retaining springs fit into the hollow insides of the legs.

b. Rest the generator on the two legs and slip the bottom of the attachment of Leg LG-2-A into its retainer on the opposite face of the generator. Drop the metal loop over the top of the attachment on the leg.

c. Loosen the thumbscrew on the bottom plate covering the power cable socket and connect the male plug of Cord CD-1086 (7 feet) to the generator receptacle.

d. Loosen one screw on each of the cover plates for the handles, and swing the covers downward. On later models of the unit, the plates are forced open by a spring to expose the crank openings.

e. Insert Crank GC-7 into the sockets on the sides of the generator. The crank handles, when each is fully inserted, should be as far apart as

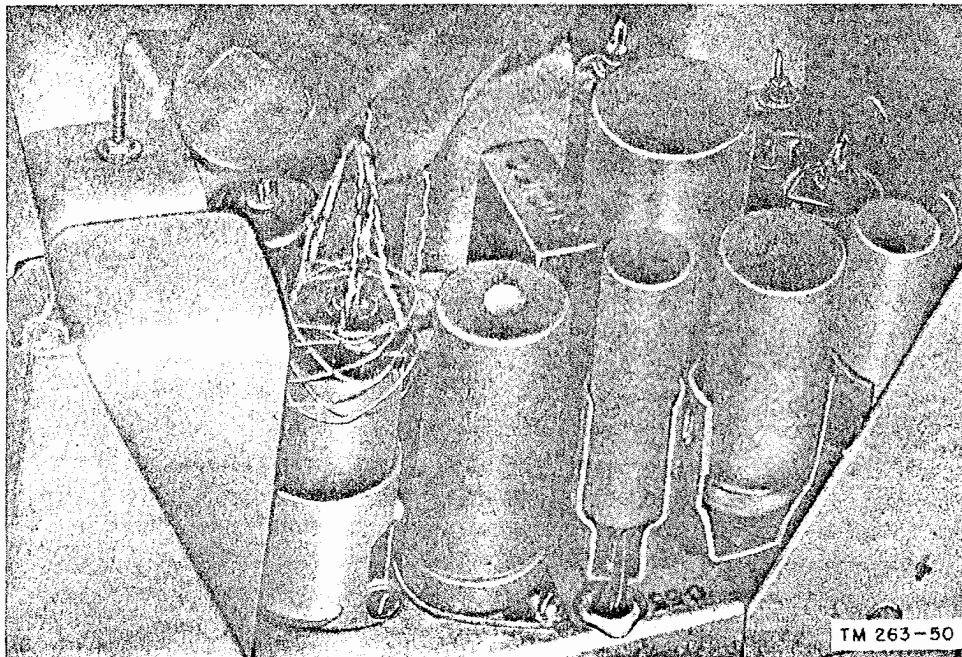


Figure 41. Removing tubes by means of tube puller; Kellems No. 11-16.

possible. This means that if one handle is at its nearest point to the ground, the other handle should be at its highest point in the air (fig. 16).

33. Connections

a. INTERNAL CONNECTIONS. The separate transmitter and receiver sections are connected by cable 3E7173-22 which is concealed by the front panels of the radio set. The cable is shown in figure 39. To replace the receiver and transmitter in the metal case, proceed as follows:

- (1) Place the empty case in a horizontal position with the open face upward and insert either plug of cable 3E7173-22 through the opening in the left-hand corner of the separating partition.
- (2) Insert the connecting cord plug into the corresponding jack on the back of the receiver chassis and gently lower the receiver into the cabinet and fasten the clamps along the side in accordance with paragraph 8.
- (3) Next, place the cable in the small bracket riveted to the back of the case. It is important that this be done to protect the cable from any damage which may occur if it is left to move

about freely inside the case. This cable bracket is not found in some models of Receiver-Transmitter RT-77/GRC-9.

- (4) Connect the remaining plug of the cable to the jack on the back of the transmitter chassis and lower the transmitter gently into the case.
- (5) Fasten the clamps on the side of the case to the transmitter panel.

b. EXTERNAL CONNECTIONS. Connect all operating components of Radio Set AN/GRC-9 in accordance with the cording diagram shown in figure 42 and the illustration in figure 43. Use the cords supplied with the radio set as follows:

- (1) Install Cord CD-1086, connecting one end to the POWER receptacle on the radio set and the other end to Generator GN-58-(*) or Vibrator Power Unit PE-237. When using Generator GN-58-(*), use Cord CD-1086 (7 feet long). For Vibrator Power Unit PE-237, install Cord CD-1086 (3 $\frac{2}{3}$ feet long). These two cords are both marked Cord CD-1086 and are identical except for length.

Note. Vibrator Power Unit PE-237 is used in vehicular installations. Refer to paragraphs 34 through 37.

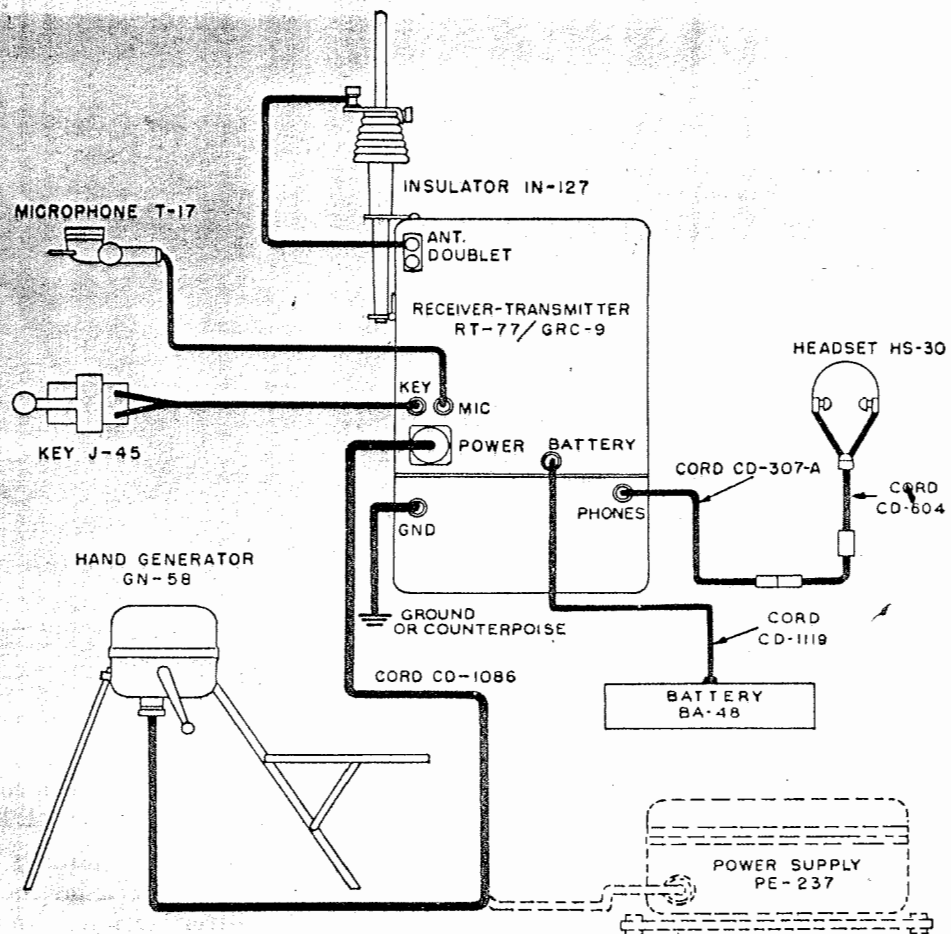


Figure 42. Radio set AN/GRC-9, cording diagram.

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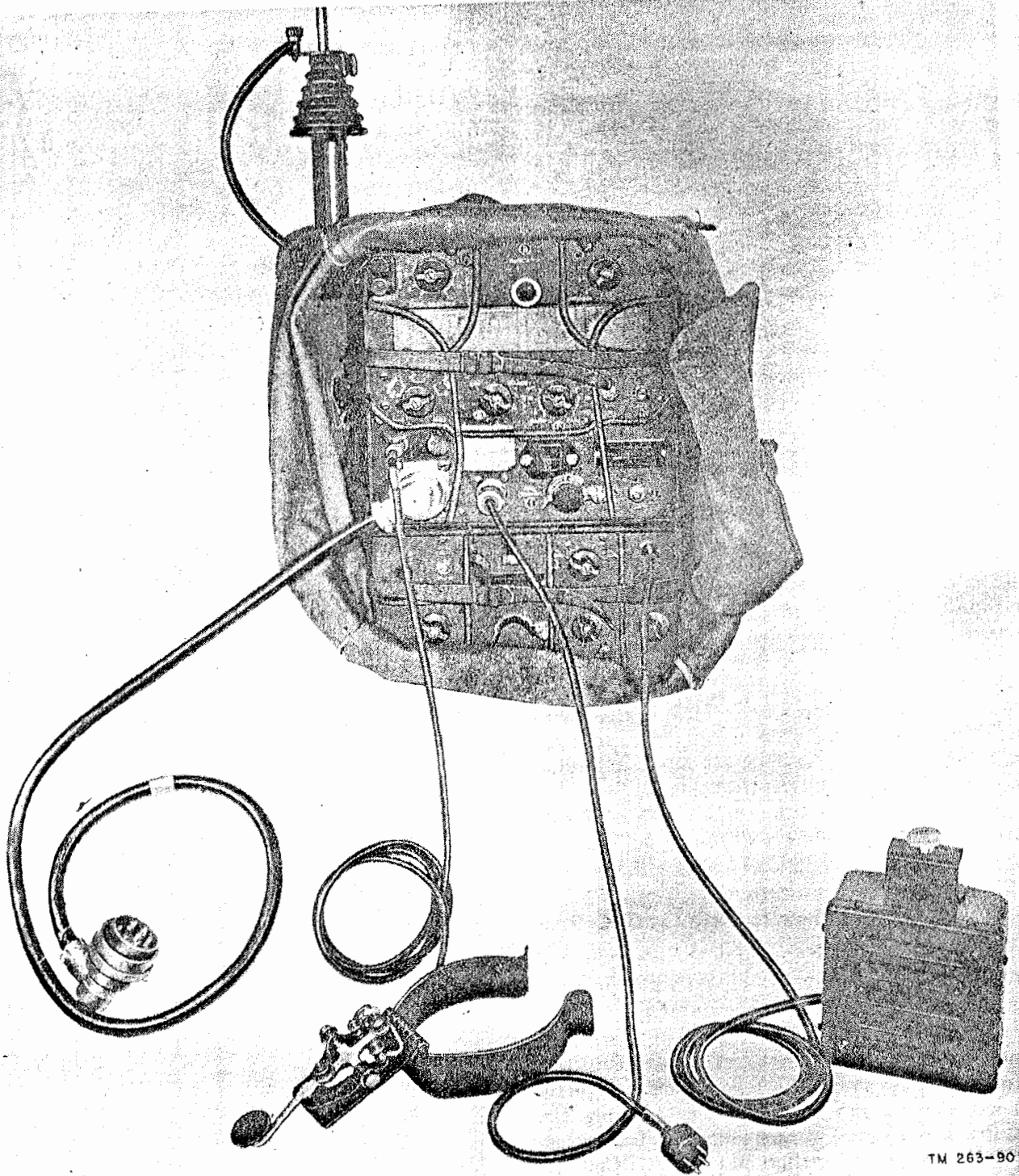
- (2) Insert Plug PL-55 of the headset into the PHONES jack on the receiver panel.
- (3) Insert Plug PL-55 of Key J-45 into the KEY jack of the transmitter if the key is to be used.
- (4) Insert Plug PL-68 of the microphone cord into the MIKE jack on the transmitter panel if the microphone is to be used.
- (5) Connect the antenna lead into the antenna binding posts on the transmitter panel in accordance with paragraph 26, 27, or 29, whichever is appropriate.
- (6) When using Battery BA-48 for operating the receiver only, or when used in conjunction with Generator GN-

58-(*), connect Cord CD-1119 into Battery BA-48 and to the BATTERY receptacle on the transmitter panel.

34. Vehicular Installation (fig. 44)

a. Complete instructions for standard vehicular radio installations are given in technical manuals of the TM 11-2700 series. One manual of this series is normally published for every common type of vehicle requiring radio installations, and new sections are added as new radio requirements arise. Refer to SR 310-20-4 for the applicable manual of the series.

b. For vehicular installations of Radio Set AN/GRC-9 not covered by a technical manual of the TM 11-2700 series, follow the general



TM 263-90

Figure 43. External connections to receiver-transmitter RT-77/GRC-9.

0-1119 into
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0-20-4 for

Rad: Set
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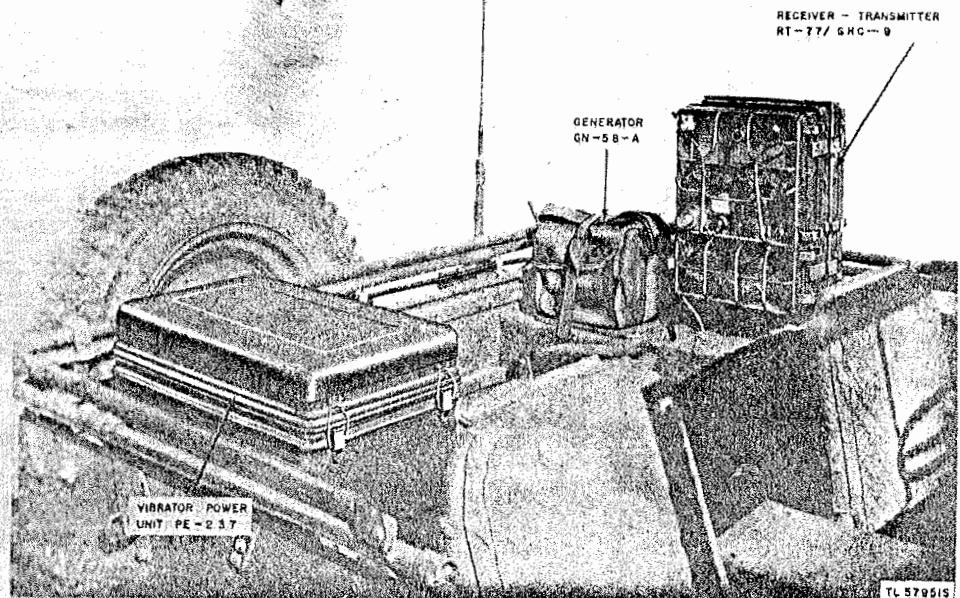


Figure 44. Typical vehicular installation of radio set AN/GRC-9.

instructions given in this manual (pars. 35, 36, and 37).

c. If possible, install Radio Set AN/GRC-9 in a vehicle having a 12-volt or 24-volt electrical system. Installation in vehicles having 6-volt systems should be avoided, since the high current drain at 6 volts makes it difficult to keep the vehicular storage battery charged.

d. A vehicle having an electrical system with negative ground must be used. The radio set will not operate properly in vehicles having positive grounded electrical systems.

e. A typical vehicular installation of Radio Set AN/GRC-9 is shown in figure 44.

35. Vehicular Installation of Receiver-Transmitter RT-77/GRC-9

a. Select a location in which the controls will be accessible to the operator, and which is close to the position chosen for the antenna.

b. Use Mounting MT-350/GRC-9 to support and shockmount the receiver-transmitter. Mounting MT-350/GRC-9 is fastened directly to a vertical surface in the vehicle, using the screws provided. If a horizontal surface is selected, install Mounting MT-350/GRC-9 on Frame FM-85 (Signal Corps stock No. 2Z4660-85), modified as shown in figure 45. Figure 46 shows the mounting and frame installed in a vehicle.

c. For transportation or storage, strap receiver-transmitter in Mounting MT-350/GRC-9 with Panel Cover CW-109/GRC-9 cured over the face with the clamps (fig. 47) WHEN REMOVING THE PANEL COVER.

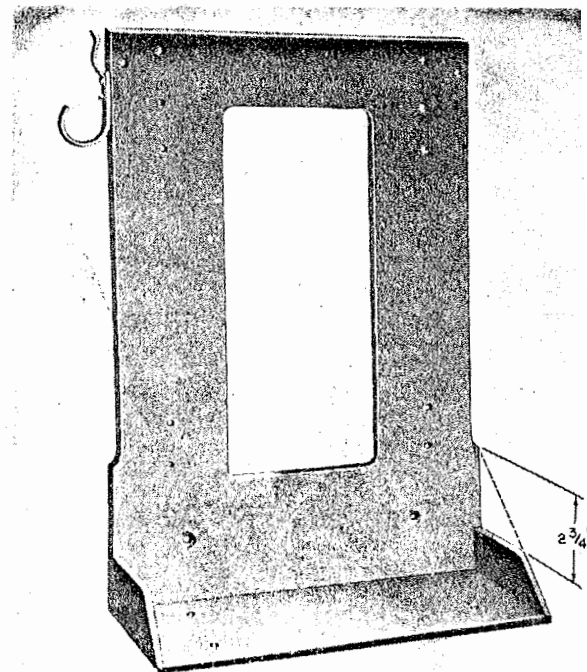


Figure 45. Frame FM-85, with gussets notched to accommodate mounting MT-350/GRC-9.

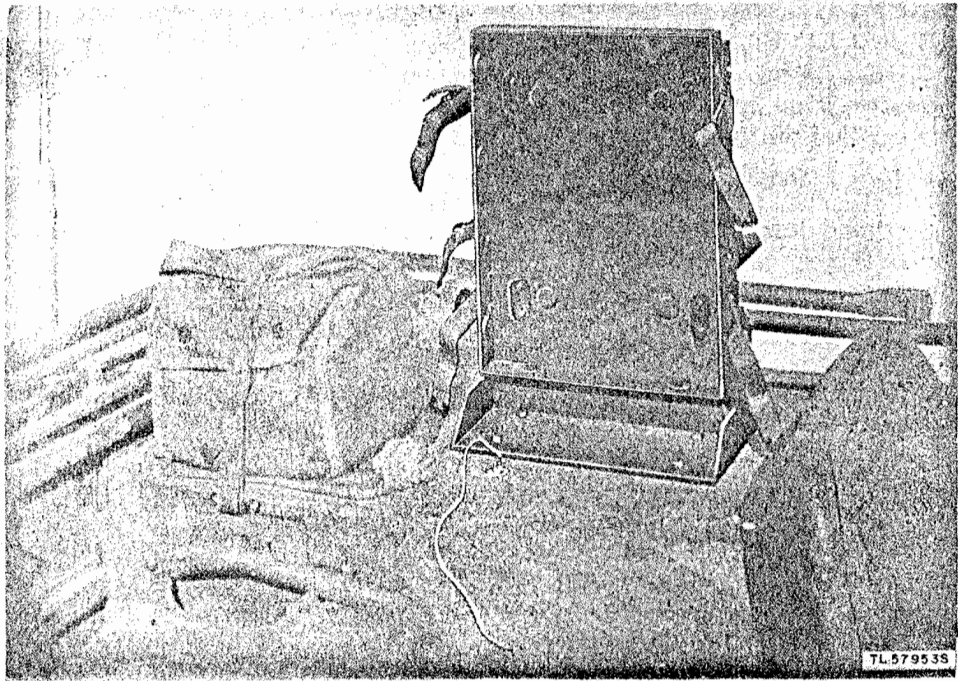


Figure 46. Mounting MT-350/GRC-9 and modified frame FM-85, installed in vehicle.

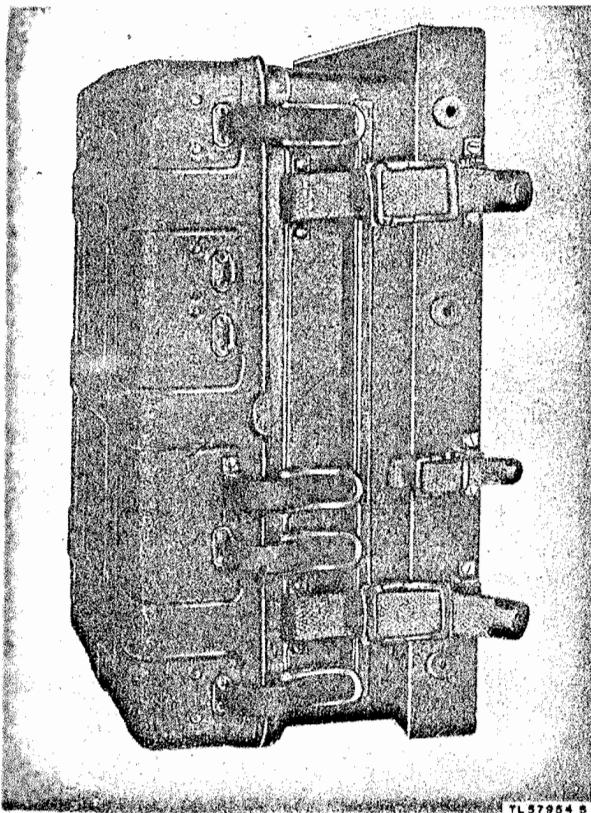


Figure 47. Receiver-Transmitter RT-77/GRC-9, mounted for vehicular transportation or storage.

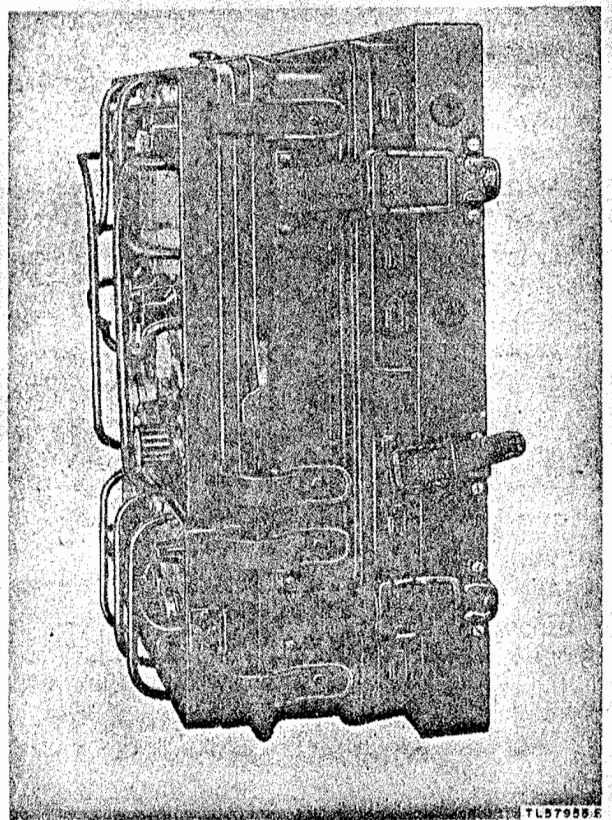


Figure 48. Receiver-Transmitter RT-77/GRC-9, mounted for vehicular use.

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GRC-9 se-
(fig. 47).
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d to

BE SURE TO REFASTEN THE CLAMPS TO SECURE THE RECEIVER-TRANSMITTER CHASSIS TO THE CASE.

d. For normal operation, place the cover between the receiver-transmitter and Mounting MT-350/GRC-9 (fig. 48). Secure the unit with the straps (fig. 48).

e. Connect a ground lead (as short as possible) from the GND, post on the receiver panel to a nearby grounded metal portion of the vehicle.

36. Installation of Vehicular Antenna

a. The vehicular antenna consists of Mast Base MP-65- and five mast sections (three Mast Sections MS-116-A, one Mast Section

MS-117-A, and one Mast Section MS-118-A). Secure the antenna to the vehicle by means of Mast Bracket MP-50 (Signal Corps stock N 2A2090-50) or other appropriate brackets (fig. 49).

b. Select an antenna location close to the receiver-transmitter to permit a short antenna lead of Wire W-128. If possible, use a lead length of 19 inches or less. Where this is not possible, lengths up to 6 feet may be used; however, for antenna leads between 19 inches and 6 feet, use 4 mast sections instead of 5 when operating on frequencies above 11 mc. This is necessary to permit resonance of the transmitter at these upper frequencies when using a long antenna lead.

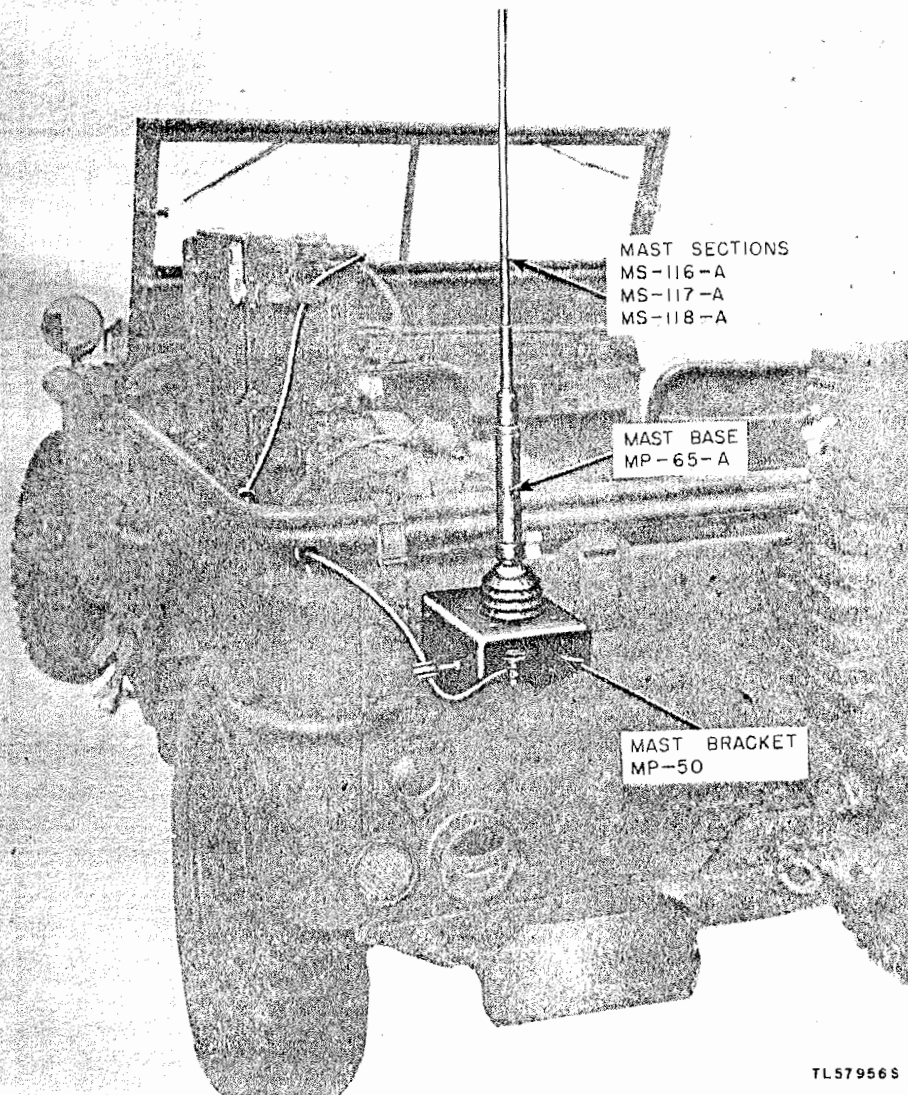


Figure 49. Typical installation of vehicular antenna of radio set AN/GRC-9.

e. Install the antenna.

- (1) So that it is not shielded by adjacent metal.
- (2) On a part of the vehicle strong enough to withstand the shock of trees or other obstacles which might hit the antenna.

d. Connect the antenna lead of Wire W-128 from the binding post on Mast Base MP-65-A to the upper antenna binding post on the transmitter marked ANT.

37. Vehicular Installation of Vibrator Power Unit PE-237

a. Bolt the power unit to a horizontal surface, leaving clearance to permit free movement of the power unit on its shockmounts. The location should be selected to permit the power cables to reach the vehicle power terminal box and to permit Cord CD-1086 to reach the receiver-transmitter.

b. Connect the power cables to the vehicle terminal box, making sure of the following:

- (1) The negative (-) terminal of the vehicle storage battery is grounded to the vehicle frame. The set will not operate properly in vehicles with the positive battery terminal grounded.
- (2) The negative lead of the power unit is connected to the grounded terminal in the vehicle terminal box.
- (3) The input voltage setting of the power unit (par. 11) corresponds to the vehicular battery voltage.

c. Connect two short ground straps, one at

each end of the power unit, from any of the bolts on the under side of the power unit to an adjacent grounded metal portion of the vehicle. This is to provide a direct low resistance path to ground for the unwanted r-f interference which vibrator power supplies are subject to generate.

d. Push the OFF button on the power unit, and connect Cord CD-1086 (3 $\frac{2}{3}$ feet) between the power unit and receiver-transmitter. If the cord is not long enough, use Cord CD-1086 (7 feet), and secure it in a manner permitting ready removal for field use.

38. Service upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 24 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications pertaining to changes in the wiring or operation of the equipment. If any changes in wiring have been made, note the change in the appropriate section of this manual. Be sure to change the main schematic so that it agrees with the equipment received.

c. Check the operating controls for ease of rotation. If lubrication is required, refer to the lubrication instructions in chapter 3, section III.

d. Inspect all the cables for possible internal or external damage and repair those that might appear to give trouble later.

e. Perform the installation and connection procedures given in paragraphs 25 through 37 as required.

Section II. CONTROLS AND INSTRUMENTS

39. Transmitter section of Receiver-Transmitter RT-77/GRC-9

The following chart lists the controls of the

transmitter section of Receiver-Transmitter RT-77/GRC-9 and indicates what they do. Figure 50 shows the front panel controls.

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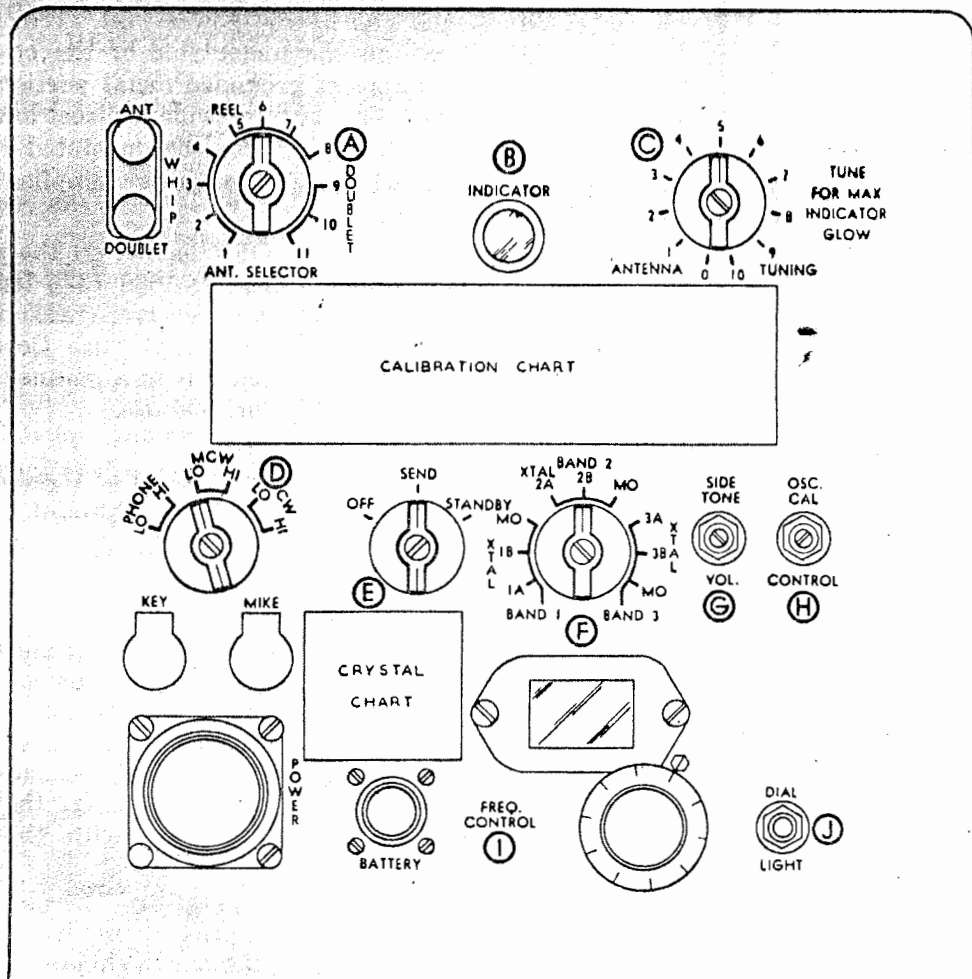


Figure 50. Transmitter controls.

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Panel letter	Control	Function
(A)	ANT. SELECTOR dial switch (S102).	This switch is a multicontact switch which arranges the components in the output circuits of the final power amplifier so that any of the three available antennas connected will be properly tuned to resonance. Positions 1, 2, 3, and 4 match the power amplifier coil to a vertical mast or whip antenna to cover the frequency range of the transmitter. Positions 5, 6, 7, and 8 match the coil to an end-fed long-wire antenna, and positions 9, 10, and 11 match the coil to a center-fed or doublet antenna.
(B)	INDICATOR (I101)	This control is a neon indicator bulb which is connected in the antenna matching circuit; it glows at its brightest level when the antenna is tuned to resonance with the transmitter signal. The bulb is located behind two circular Polaroid lenses; the inner one is stationary whereas the outer one can be rotated around an axis perpendicular to its center. When two red dots on the outer barrels of both lenses are lined up, these lenses will allow the maximum amount of light to penetrate through them. When the two red dots are 90° apart, the light emerging from the indicator bulb will not be allowed to penetrate the lenses. This system is a safety measure for blackout conditions.

Panel letter	Control	Function
Ⓒ	ANTENNA TUNING part of coils T110A and T110B.	This control adjusts the position of powdered iron cores which slide in and out of the antenna matching transformers T110A and T110B. When the proper position of these cores is found, the antenna will be tuned for the frequency of transmission desired and the INDICATOR (control Ⓓ) will glow with maximum brilliancy. Thus, the ANTENNA TUNING control is rotated until the neon indicator shows the brightest glow.
Ⓓ	PHONE-MCW-CW control S-105.	<p>1. This switch is used to select any of the three types of transmission available on this radio set.</p> <p>a. PHONE: This position permits the transmission of voice signals, using a microphone which is inserted in the MIKE jack.</p> <p>b. MCW: In this position, the radio set transmits a signal of constant frequency depending on the tuning dial (control Ⓒ) position. This signal is modulated by a constant audio frequency which is generated by an audio oscillator located in the transmitter. The transmitter is keyed in the usual manner as for c-w signals. This system is also called tone modulation. With this system, the radio set receiving these signals need not have a bfo (beat-frequency oscillator) to make them audible, since they already are modulated and can be detected in the usual manner.</p> <p>c. CW: The signal is keyed by means of a key which is inserted in the KEY jack, and for reception, it requires that the station being sent to have a bfo. Otherwise the signal would be inaudible, as received.</p> <p>2. Each of the three positions described has a HI and LO position also. In the HI position, the maximum power is available for transmission, while in the LO position, the transmitter output is greatly reduced so that operation over only short distance ranges is possible.</p>
Ⓔ	OFF-SEND-STANDBY control S103.	<p>This switch has three positions:</p> <p>1. OFF: In this position, both the receiver and transmitter are not in operation. All power to both units is completely shut off.</p> <p>2. SEND: This position is used when it is desired to transmit or receive signals. When the key is not depressed or the microphone press-to-talk switch is not pushed, only the receiver is supplied with voltage and receives signals. As soon as the key is depressed, relays in the transmitter switch the voltage from the receiver to the transmitter. The transmitter is automatically placed in operation and sends out the desired signal.</p> <p>3. STANDBY: This position is used when Battery BA-48 or when Vibrator Power Unit PE-237 is supplying power. When the switch is turned to STANDBY, only the receiver is in operation. In this position, less power is needed to operate the radio set, so that during long periods of listening there will be less current drain on the battery.</p>
Ⓕ	XTAL-MO-BAND switch S101.	This switch allows the operator to select either crystal control or master oscillator (MO) control of the transmitter on any of the three bands. The crystal portions of this control operate in conjunction with six Crystal Units CR-8B/U, inserted in sockets on the transmitter chassis. Each crystal operates at a particular frequency in the selected band.
Ⓖ	SIDE TONE VOL. potentiometer R115.	It is advantageous to have the operator of the radio set be able to listen to the voice and code signals which he is transmitting. This is especially important for code signals. A special arrangement in the transmitter feeds back to the receiver headset a sidetone signal from an audio oscillator circuit during keying operation. Each time the key is depressed, the oscillations are fed to the headset. For voice transmission, the audio signal from the output of the modulator stage is fed to the headset. The volume of this sidetone signal is adjusted by the SIDE TONE VOL. control. It has a slotted shaft which is turned with a screw driver.

Panel letter	Control	Function
Ⓜ	OSC. CAL. CONTROL variable capacitor C102.	This is another screw driver control which turns a small variable capacitor in the mo (master oscillator) circuit, and thus, varies the frequency between fine limits. The control is used in conjunction with the receiver 200-kc crystal calibrating circuit.
Ⓛ	FREQ. CONTROL variable capacitor C101.	The frequency control is the tuning adjustment for selecting the transmitting frequency. Transmitting frequencies with respect to dial calibration of the drum dial and tuning knob are shown on the calibration chart fastened to the front panel of the transmitter.
Ⓟ	DIAL LIGHT control S104	This is a push-button switch which, when pressed, lights a small panel light in back of the transmitter dial thus illuminating it. The dial light will be illuminated only when Generator GN-58-(*) or Vibrator Power Unit PE-237 (SEND position) is used. Further, on PHONE position of control Ⓛ, the dial light can be lighted only when the key is depressed or the MIKE press-to-talk switch is closed.

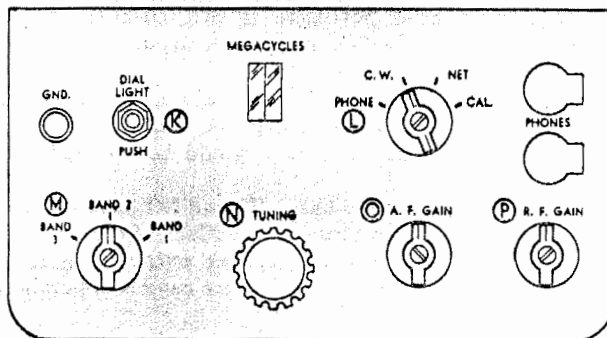


Figure 51. Receiver controls.

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40. Receiver Section of Receiver-Transmitter RT-77/GRC-9

The following table lists the controls of the receiver section of Receiver-Transmitter RT-77/GRC-9 and indicates what they do. The receiver controls are shown in figure 51.

Panel letter	Control	Function
Ⓟ	DIAL LIGHT PUSH control S2.	This is a push-button switch which, when pressed, lights a small panel light in back of the receiver dial, illuminating it.
Ⓛ	PHONE-C.W.-NET-CAL. switch S3.	The function of this switch is to select the type of operation desired and to check the dial calibration of the receiver. <ol style="list-style-type: none"> 1. PHONE: This position allows the reception of voice signals or mcw signals. The output is heard in the headset or the loudspeaker, either of which may be plugged into one of the two jacks marked PHONES. 2. C.W.: When placed on this position, c-w signals can be received. A bfo in the receiver beats with the incoming cw and an audio frequency beat note is heard in the headset. 3. NET: On NET position, it is possible to tune the transmitter to the frequency of any station in which it is desired to hold communication. Also, once the receiver dial calibration is known to be accurate, the transmitter-oscillator frequency can be adjusted (control Ⓜ) by matching it with the receiver dial calibration. In the NET position, the gain of the receiver is greatly reduced. 4. CAL.: A crystal-oscillator circuit in the receiver permits the dial calibration of the receiver. Frequency check points are available over the entire band at every 200 kc.
Ⓜ	BAND 3-BAND-2-BAND 1 switch S1.	This switch permits the selection of any of the three frequency bands available. BAND 3 is the lowest frequency range while BAND 1 is the highest. As the band switch is turned from one band to another, a mechanically coupled mask operates to cover the dial calibration of the unused frequency bands.

Panel letter	Control	Function
Ⓢ	TUNING capacitor C7-----	This knob tunes the radio receiver circuits and controls the operation of the calibrated dial which is viewed through the dial window. There are three dial scales. a. The lower scale on the dial is BAND 3 which covers the frequency range of 2.0 mc to 3.6 mc, with dial mark at each 20 kc. b. The middle scale on the dial is BAND 2, which covers the frequency range of 3.6 mc to 6.6 mc with dial marks at every 20 kc. c. The top scale is BAND 1 which covers the frequency range of 6.6 mc to 12.0 mc with dial marks at every 50 kc. A shutter exposes the portion of the dial being used and covers the unused scales by a mechanical connection to the band switch (control Ⓢ). A dial lock on the tuning knob allows the dial to be locked in a fixed position once it is set on the desired frequency.
ⓐ	A. F. GAIN potentiometers R19A and R19B.	This is a volume control which varies the strength of the audio signal delivered to either the headset or the loudspeaker. The volume will be a minimum when this control is rotated to its furthest counter-clockwise position.
ⓑ	R. F. GAIN potentiometer R9-----	This control varies the d-c voltage on the screen grid of the first r-f amplifier, thus controlling the gain of this stage to prevent overloading of the following stages on strong signals. On all positions but NET of (control ⓐ) the screen grid of tube V3 is also controlled by the R. F. GAIN control.
	IMPEDANCE switch S4-----	This switch is found in the back of the receiver and is used to match the output circuit of the receiver to headsets or Loudspeaker LS-7. Output loads of either 250 or 4,000 ohms impedance can be matched (fig. 39). The switch is adjusted with a screw driver. For Loudspeaker LS-7, the switch is placed at 4,000 ohms.

41. Vibrator Power Unit PE-237

a. ON-OFF SWITCH. The main switch consists of a circuit breaker which is manually operated. The switch is operated by pressing the desired button. Both the ON and OFF buttons are covered with a watertight neoprene gasket (fig. 15).

b. VOLTAGE SELECTOR SWITCH. When the top cover of Vibrator Power Unit PE-237 is removed, the input operating voltage of the unit

can be adjusted to 6, 12, or 24 volts to correspond with that of the vehicular battery used. To change from one operating voltage to another, it is necessary to raise the handle on the voltage change switch to release it from a locked position. When the cover is installed, the switch can be checked visually for correct voltage position by looking at it through the transparent window, which is provided for that purpose in the side of the vibrator case.

Section III. OPERATION OF POWER SUPPLIES UNDER USUAL CONDITIONS

42. Generator GN-58-(*)

The operator sits astride the leg seat and rotates the generator cranks in the direction indicated by the arrow, next to the crank opening in the side of the generator housing. Do not attempt to rotate the cranks in the reverse direction to that indicated by the arrow, or damage to the generator will be done, which will require a major repair. Satisfactory operation may be obtained if the cranks are turned

at a speed from 50 to 70 rpm (revolutions per minute).

43. Vibrator Power Unit PE-237

a. Vehicular installation instructions are given in paragraph 37.

b. The operation of the vibrator unit is automatic, being controlled by relays in the unit which are connected to the OFF-SEND-STANDBY switch (control Ⓢ) on the transmitter.

Merely pressing the ON button contained in the vibrator unit will not start it operating. It is necessary for the transmitter OFF-SEND-STANDBY control to be in any position but OFF before Vibrator Power Unit PE-237 will begin to operate. Thus, if the transmitter is shut off, the vibrator also is shut off automatically. When the transmitter is turned to the SEND or STANDBY position, the vibrator is automatically turned on. Of course, this is only when the ON button on the vibrator first has been pressed in.

c. The ON-OFF switch on Vibrator Power Unit PE-237 is also a circuit breaker which will open the circuit if the vibrator starts to draw too much current from the vehicular battery for any reason. If this happens, it is necessary only to press the ON button and the unit will begin to operate. However, the transmitter must be turned to OFF before the vibrator button is pressed to ON. No damage will result if this is not done, but the ON button on the vibrator circuit breaker may fail to lock, while the transmitter control is at SEND.

Caution: Never hold the circuit breaker in the ON position. If the vibrator switch does not remain closed when the ON button is released

(and the transmitter is at OFF), there is something wrong; an overload condition is present which requires investigation so that it can be removed.

d. To shut off the vibrator unit, press the OFF button. This action will make Vibrator Power Unit PE-237 independent of the transmitter OFF-SEND-STANDBY control, and regardless of the position of this control, the vibrator will remain OFF and no power will be supplied to the radio set.

44. Battery BA-48

This battery can be used to supply power to the receiver only. The transmitter cannot be operated from it. It is possible to use the battery in conjunction with the hand generator in which case both the receiver and transmitter can be operated. The battery will power the receiver, while the generator is turned only when it is desired to use the transmitter. With this arrangement, the generator does not require the usual full manual energy to turn since it powers only the transmitter. The OFF-SEND-STANDBY switch on the transmitter must be on STANDBY at all times during this system of operation.

Section IV. OPERATION OF RECEIVER UNDER USUAL CONDITIONS

45. Receiver Operation from Vibrator Power Unit PE-237

Check the voltage of the storage battery to be used. If the voltage does not agree with that shown on the drum dial as viewed through the window on the side of the vibrator case, remove the top cover of the vibrator power unit and pull up the knob of the voltage change switch. Set the pointer to the correct voltage. Reinstall the top cover. Then follow the succeeding steps:

a. Place switch ① at PHONE or C.W. depending on the type of transmission to be received.

b. Set switch ② for the frequency band to be used.

c. Turn controls ③ and ④ fully clockwise.

d. Insert plug of Cord CD-307-A and Headset HS-30-(*) in one of the PHONE jacks.

e. Press the ON button on the Vibrator Power Unit PE-237.

f. Turn control ⑤ on transmitter to the STANDBY position.

(1) In the STANDBY position of control ⑤, the vibrator power unit supplies only the receiver. When it is desired to use the transmitter along with the receiver, control ⑤ is turned to the SEND position.

(2) The steady hum of the vibrator in Vibrator Power Unit PE-237 should be clearly audible through the power unit housing.

g. Tune the receiver to the desired incoming signal by turning TUNING control ⑥.

h. Press the DIAL LIGHT push button to illuminate the tuning dial if operating in the dark.

i. If voice signals are to be received, lower

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the volume level by turning the A. F. GAIN control ① counterclockwise. When c-w signals are being received, adjust the R. F. GAIN control ② to the point where reception is most satisfactory.

j. The circuit of the receiver is designed so that if the headset is removed from the PHONE jack, the filaments of the receiver will automatically be shut off.

46. Receiver Operation from Generator GN-58-(*)

a. Turn OFF-SEND-STANDBY control ③ on the transmitter to SEND. The generator will not supply power to the receiver if control ③ is in any other position.

b. Except for steps e and f above, the operation of the receiver is the same as described in paragraph 45 above.

c. The generator should be turned at a speed of approximately 60 rpm, and it should be turned in the direction indicated by the arrow on the side of the generator housing.

d. If the turning of the generator is stopped, the receiver and the transmitter will no longer be supplied with power.

47. Receiver Operation from Battery BA-48

The battery will supply power to the receiver only and not to the transmitter. For this operation, perform the following steps:

a. Insert the female connector of Cord CD-1119 into the BATTERY receptacle on the transmitter panel and tighten the retaining ring.

b. Insert the male connector of Cord CD-1119 into the receptacle on the Battery BA-48.

c. Turn OFF-SEND-STANDBY control ③ on the transmitter to the STANDBY position. The battery will not supply power in any other position of this switch.

d. Except for steps e and f, the operation of the receiver is the same as described in paragraph 45.

48. Receiver Operation from Generator GN-58-(*) and Battery BA-48

a. The radio set can be used with this combination, making it necessary to turn the cranks of the generator only when transmitting since

the battery will operate the receiver. The generator will not supply any power to the receiver.

b. The OFF-SEND-STANDBY control ③ must be on STANDBY for this type of operation.

c. The operation is the same as in paragraph 45, except that the generator must be turned only when transmission is desired.

49. Phone Operation and Net Operation

a. The PHONE position of control ④ will allow the reception of voice and mcw signals.

b. The NET position allows the transmitter to be tuned exactly to any frequency which the receiver section is receiving. The NET position is not to be used for normal reception since, at this position, the sensitivity of the receiver is purposely reduced. NET position is to be used only in conjunction with the transmitter, when it is desired to place the receiver-transmitter in a radio communications group or net. For more detailed explanation see paragraph 56.

50. Receiver Calibration

This operation is a means to check whether the dial reading for tuning control ⑤ actually gives the true frequency to which the receiver is tuned.

a. A 200-kc crystal installed in the receiver supplies a series of crystal-controlled check frequencies against which to check the calibration of the receiver and transmitter. These check frequencies are all harmonics of 200 kc. The calibration check points are 2,000 kc, 2,200 kc, 2,400 kc, and up to 12 mc, thus covering the entire band of the radio set. To check the calibration of the receiver dial, connect a pair of earphones to the receiver and proceed as follows:

- (1) Turn control ⑤ to CAL. (calibrate).
- (2) When using Vibrator Power Unit PE-237 or Battery BA-48, turn control ③ on the transmitter to STANDBY. When using Generator GN-58-(*), turn control ③ to SEND.
- (3) Turn control ⑤ on the transmitter to PHONE. In the PHONE position, the filaments of all the transmitter tubes are not supplied with power and are inoperative unless the MIKE push button is pressed. This is a desirable

condition during the calibration operation, since the transmitter cannot interfere with the receiver.

- (4) Turn the A. F. GAIN control ④ to the maximum or greatest clockwise position.
- (5) Turn the R. F. GAIN control ⑤ to the minimum or greatest counterclockwise position.
- (6) Turn control ⑥ to BAND 3.
- (7) Turn the TUNING KNOB ⑦ to the lowest frequency check point (2.0 mc). Increase R. F. GAIN control ⑤ slightly, until the signal is heard. Adjust the TUNING knob until zero beat is heard on the strongest beat note in the vicinity of the crystal check point. At this point, the receiver tuning circuits should be near the 2.0-mc dial.
- (8) After checking the receiver calibration at 2,000 kc, proceed through the entire tuning range on BAND 3,

checking the calibration every 200 kc apart such as 2,200, 2,400, 2,600, and up to 3,600 c or 3.6 mc.

- (9) Turn control ⑥ to BAND 2 and turn control ⑤ to 3.6 mc. Check calibration points every 200 kc on BAND 2 up to 6.6 mc.
- (10) Turn control ⑥ to BAND 1 and turn control ⑤ to 6.6 mc. Check calibration points up to 12.0 mc.
- (11) If the calibration is off enough to cause confusion, it may be corrected as described in chapter 6, section IV.

b. If, during calibration, interference from strong signals is being picked up, the antenna lead-in can be disconnected from the ANT. post to avoid misleading beats.

51. Stopping Procedure

- a. Turn control ⑥ to the OFF position.
- b. Stop cranking the hand generator or press the OFF button on the vibrator power unit.

Section V. OPERATION OF TRANSMITTER UNDER USUAL CONDITIONS

52. Transmitter Operation

a. GENERAL. The transmitter functions only when the OFF-SEND-STANDBY control ⑧ is on the SEND position. In this position, the receiver also may be used. Special circuits and relays in the transmitter determine which section of the receiver-transmitter will be placed in operation. When the key or the press-to-talk switch on the microphone is not depressed, the receiver automatically functions and receives all signals to which it is tuned. When the key or microphone switch is closed, power is supplied to the transmitter and removed from the receiver. The receiver ceases to function while the transmitter sends out the desired signal. Before the operations of the transmitter are described, the use of the transmitter dial and dial charts will be explained.

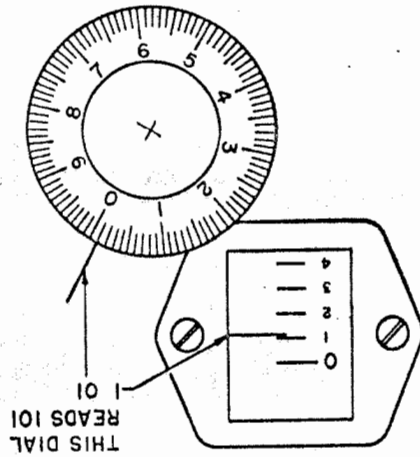
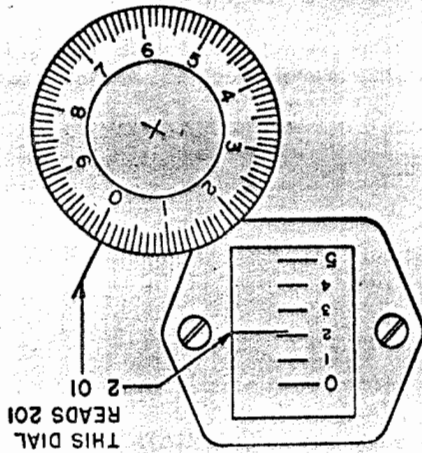
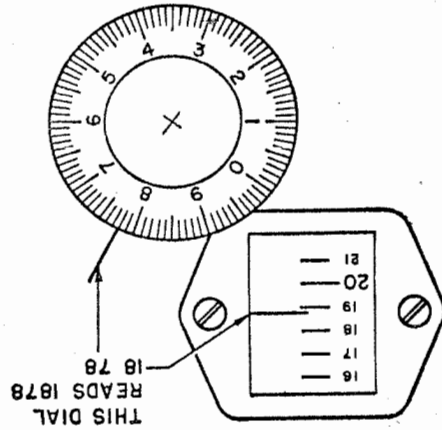
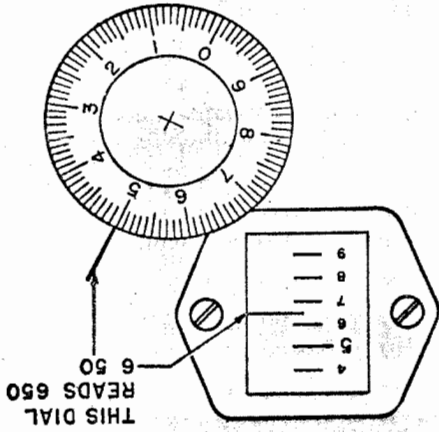
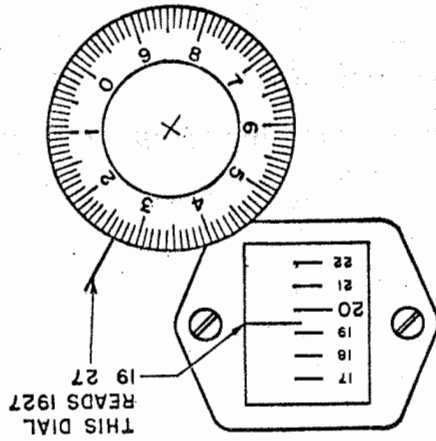
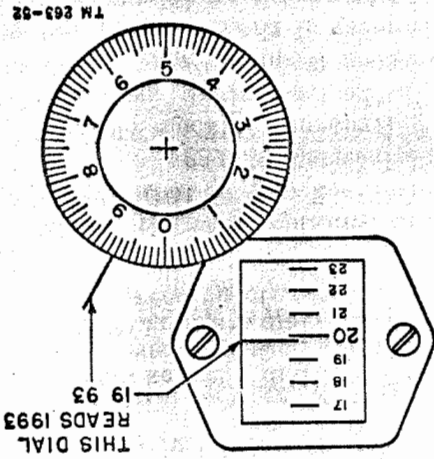
b. DIAL READING. The tuning dial control ⑨ consists of two graduated scales; one scale is located behind a glass window and the other scale is marked around the edge of the tuning control knob. The numbers on both of these scales are taken as one reading and they deter-

mine the frequency to which the transmitter is tuned. The numbers are not the actual transmitting frequencies but are related to these frequencies by the chart on the transmitter panel. Several dial settings with the corresponding dial readings are shown in figure 52.

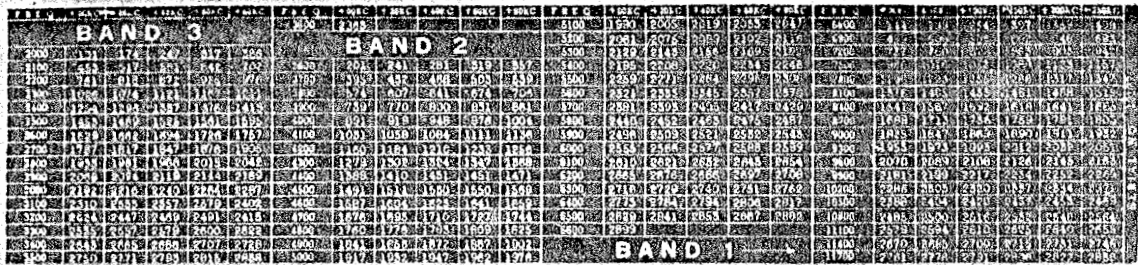
c. DIAL READING CALIBRATION CHART. On the transmitter panel is a dial reading calibration chart (fig. 53), which relates the different frequencies of transmission to the dial settings. This chart will not be the same on the different models of the transmitter. Each individual set must be tuned by the chart on its panel. Assume that it is desired to transmit on a frequency of 5,540 kc in BAND 2, refer to figure 53 and proceed as follows:

- (1) Find 5,500 kc in the frequency column of the BAND 2 section. To the right on the same line as the 5,500 kc, there are 5 columns, each with headings of from +00 kc to +80 kc.
- (2) Since the dial setting for 5,540 kc is wanted, the +40 kc column is the one referred to.

Figure 52. Transmitter dial readings.



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Figure 53. Transmitter dial calibration chart.

- (3) In the small box where lines through 5,500 kc and +40 kc intersect, number 2284 is found. This is the number to which the dial should be set in order to transmit a frequency of 5,540 kc.

d. UNLISTED DIAL SETTINGS. Sometimes a frequency of transmission will be wanted that is between two listed dial settings on the chart; for instance, in BAND 1, 9,238.5 kc. The following interpolation is necessary:

- (1) From the desired frequency (9238.5 kc), subtract the first calibrated frequency below it (9200 kc).

$$\begin{array}{r} 9238.5 \\ -9200 \\ \hline 38.5 \end{array}$$

- (2) Find the difference between the dial readings for the frequencies listed just above and just below the desired frequency.

$$\begin{array}{r} 9250 \text{ kc has a dial} \\ \text{reading of } \text{-----} \quad 1932 \\ 9200 \text{ kc has a dial} \\ \text{reading of } \text{-----} \quad -1911 \\ \hline \quad \quad \quad \quad \quad 21 \end{array}$$

- (3) Multiply the value obtained in step 1 above by that in step 2.

$$\begin{array}{r} 38.5 \\ \times 21 \\ \hline 385 \\ 770 \\ \hline 808.5 \end{array}$$

- (4) Divide this answer obtained in step 3 above by 50 for BAND 1.

Note. When using any frequency in BAND 3 or BAND 2, divide the answer of step 3 by 20, not 50.

$$\begin{array}{r} 16.17 \\ 50 \overline{)808.50} \\ \underline{50} \\ 308 \\ \underline{300} \\ 85 \\ 50 \\ \underline{350} \\ 350 \\ \underline{0} \end{array}$$

- (5) Add the answer obtained in step 3 to the dial setting corresponding to the first calibrated frequency just below the desired frequency. This answer is the dial setting for the unlisted frequency.

$$\begin{array}{r} \text{Dial setting for} \\ 9200 \text{ kc is } \text{-----} \quad 1911 \\ \text{Add } \text{-----} \quad +16.17 \\ \hline \quad \quad \quad \quad \quad 1927.17 \end{array}$$

This 1927.17 corresponds to the desired frequency of 9238.5 kc.

- (6) In the actual setting of the dial to this frequency, the dial numbers after the decimal point are not included. The dial setting is shown in figure 52.

53. Master Oscillator (MO) Operation

a. The oscillator section of the transmitter may be either crystal-controlled or a self-sustaining oscillator called a *master oscillator*. The mo can tune over the entire band, while the transmission frequencies with the crystal oscil-

are fixed, depending on the frequencies of the crystals used. The crystal oscillator is more stable however and should be used when there is no necessity of changing rapidly from one frequency to another.

A. To transmit using the mo, proceed as follows:

- (1) Connect the antenna, key, microphone, power cables, etc., according to paragraph 33.
- (2) Set switch ⑩ to PHONE, MCW, or CW, whichever type of transmission is desired. If low-power emission is desired for short distance range transmission, set the switch to the LO position for that type of transmission.
- (3) Set control ⑪ to the mo position for the desired frequency band.
- (4) Adjust **FREQ. CONTROL** knob (control ⑫) to correspond with the transmitting frequency as shown on the calibration chart. If an unlisted frequency is used, interpolate (par. 52d) to obtain the correct dial setting.

Note. If there is any reason to believe that the transmitter is out of calibration, it can be checked and corrected as described in paragraph 55.

- (5) Turn **ANT. SELECTOR** switch ⑬ to the highest numbered position for the type of antenna being used.
- (6) Turn the outer barrel of **INDICATOR** ⑭ clockwise until the two red dots on the side of the barrel are in line.
- (7) Turn switch ⑮ to the **SEND** or **STANDBY** position, depending on the type of power supply being used.

(a) Vibrator Power Unit PE-237 or Generator GN-58-(*) by itself; turn switch ⑮ to **SEND**.

(b) Generator GN-58-(*) in conjunction with Battery BA-48; turn switch ⑮ to **STANDBY**.

- (8) Turn control ⑯ on the receiver to **PHONE** or **C.W.** position so that the sidetone can be heard.
- (9) Depress the button on the microphone or close the key and rotate **ANTENNA TUNING** control ⑰ until **INDICATOR** control ⑱ glows at its maximum intensity. If the indicator does not glow through a complete sweep of

knob ⑱, turn **ANT. SELECTOR** knob ⑬ to the next lower number. Rotate knob ⑱ again until maximum glow is seen. If there is still no glow, repeat with knob ⑱.

Note. If the indicator glows with more than one setting of knob ⑬, always use the highest numbered position of this switch at which the indicator will glow. When using a long-wire antenna, it is sometimes difficult to see any indication of resonance on **INDICATOR** ⑱ when control ⑱ is tuned through resonance. In that case, temporarily remove the antenna lead from the antenna binding post; adjust control ⑱ to give maximum **INDICATOR** glow, then reconnect the antenna lead and proceed with normal operation. Be sure that the jumpers in the antenna are connected correctly for the selected frequency of operation, according to the instructions on the calibration chart attached to the antenna. When the antenna lead-in is reconnected, it will probably be necessary to readjust control ⑱ for maximum brilliance.

Caution: When tuning for an indication of resonance, never leave the transmitter on in excess of 15 seconds with the antenna lead disconnected from the **ANT.** binding post.

- (10) Adjust **SIDE TONE VOL.** control ⑲ for desired volume.

c. To operate Microphone T-17, hold it close to the lips, press the button on the handle, and speak in a loud, clear voice. Hold the button until finished talking, then release the button to listen for the reply.

Note. About 2 seconds are required for the tubes to heat properly each time the button is pressed. Wait 2 seconds after pressing the button before talking. Always release the button *immediately* after transmitting, since no reply can be heard from the receiver with the button switch closed.

54. Crystal (XTAL) Operation

a. Positions have been provided for the installation of a total of six Crystal Units CR-8/U on the transmitter chassis. The installation of the crystal units is described in paragraph 31. In the crystal operation, only six frequencies of transmission are possible depending on the crystals inserted.

b. A frequency doubler circuit is incorporated in the transmitter; because of this, the transmission frequency will be twice the natural frequency of the crystal. Therefore, if it is desired to transmit on a frequency of approximately 3,000 kc in **BAND 3**, a crystal with



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natural frequency of 1,500 kc should be installed in the appropriate socket. Two crystal oscillator frequencies are available for each of the three bands. Either of the crystals in any one band may be inserted in either of the two sockets available for that band. The crystal sockets are shown in figure 131. Therefore, the 1,500-kc crystal should be inserted in either socket 3A or 3B. The transmitted frequency (2X crystal frequency) with the corresponding dial setting for each of the six crystals, should be written on the small white chart on the transmitter panel.

c. For crystal operation, perform the following procedure:

- (1) Connect the antenna, key, microphone, power cables, and headset to the receiver-transmitter.
- (2) Set switch ⑥ to PHONE, MCW, or CW, whichever type of transmission is desired. If low power emission for short distance is desired, set control ⑦ to the LO position for that type of transmission selected.
- (3) Set switch ⑥ to the XTAL position for the frequency band selected.
- (4) Adjust **FREQ. CONTROL** ⑧ to the proper dial setting as indicated on the calibration chart, on which the transmission frequency (2X crystal frequency) with corresponding dial setting is recorded.
- (5) Turn **ANT. SELECTOR** control ⑨ to the highest numbered position for the type of antenna used.
- (6) Turn the outer barrel of **INDICATOR** ⑩ clockwise until the two red dots on the side of the barrel are in line.
- (7) Turn switch ⑥ to SEND or STANDBY, depending on the type of power supply being used. With Generator GN-58-(*) or Vibrator Power Unit PE-237, turn to the SEND position. Use the STANDBY position when Battery BA-48 is used in conjunction with Generator GN-58-(*).
- (8) Turn control ⑪ on the receiver to the PHONE or C.W. position.
- (9) Depress the button on the microphone or close the key and rotate **ANTENNA**

TUNING control ⑫ until the indicator reaches its maximum glow. Follow the procedure outlined in paragraph 53 step 9.

- (10) Adjust **SIDE TONE VOL.** control ⑬ for desired volume.

55. Transmitter Calibration

It is important to know if the transmitter actually transmits on the frequencies corresponding to the dial settings on the calibration chart. Thus, if it is desired to send a signal of approximately 5,500 kc, the **FREQ. CONTROL** knob ⑧ is set at the appropriated setting. When this setting is made, the calibration operation assures that the transmitter will send a signal of 5,500 kc. This is accomplished by first accurately tuning the receiver and then feeding a reduced signal output of the transmitter into the receiver. The procedure is as follows:

a. First calibrate the receiver as described in paragraph 50. The selected calibration frequency of the receiver must be some multiple of 200 kc, which is closest to the desired signal output of the transmitter. Assume that a transmitter signal of 5,835 kc is desired. The receiver should first be calibrated at 5,800 kc and not at 5,835 kc, because receiver calibration is accomplished by using the harmonics of a 200-kc crystal.

b. Turn control ⑫ to MO for the band being used.

c. From the transmitter calibration chart, determine the dial setting corresponding to the calibration check frequency and turn **FREQ. CONTROL** knob ⑧ to that dial setting.

d. Turn control ⑬ on the receiver to the NET position.

e. Set control ⑬ on the transmitter to MCW or CW. Do not set it to PHONE because calibration will be impossible in that position.

f. Turn control ⑬ to SEND if Generator GN-58-(*) is used alone, or if Vibrator Power Unit PE-237 is used. Turn control ⑬ to STANDBY if Battery BA-48 is used in conjunction with the hand generator.

g. Adjust **A. F. GAIN** control ⑭ for the desired volume.

h. Adjust **OSC. CAL. CONTROL** ⑮ with a screw driver until the beat note which is heard disappears, and a zero beat condition is ob-

indicated. This corrects the calibration for that particular frequency, and all other frequencies within that band also will be correct.

k. To restore the receiver to normal operation, turn control ⑥ to C. W. or PHONE.

56. Net Operation

Net operation means that the transmitter sends out signals which are of the same frequency as those that the receiver is receiving. To make sure that the transmitter is tuned to the same frequency as the receiver, proceed as follows:

a. With Radio Set AN/GRC-9 set up for operation, turn switch ⑥ to the SEND or STANDBY position depending on the power supply being used. Refer to paragraphs 45 through 48.

b. Receive the desired signal with receiver control ⑥ on either PHONE or C.W. and lock the tuning dial at this frequency point.

c. Observe the frequency of the net control station and, referring to the transmitter calibration chart, adjust the transmitter FREQ. CONTROL dial ① to the approximate frequency.

Note. If an end-feed long-wire antenna is being used, make sure that the proper antenna jumpers are closed and that the transmitting antenna is matched to the transmitter.

d. Turn switch ① on the receiver to the NET position.

e. Turn switch ① on the transmitter to MCW or CW. Do not place switch ① on PHONE

or it will be impossible to tune the transmitter to the receiver frequency.

f. With the earphones still connected to the receiver, tune the transmitter FREQ. CONTROL ① until the strongest beat note is heard in the headset.

g. Adjust FREQ. CONTROL ① on the transmitter until the beat note disappears and a condition of zero beat is obtained.

Caution: During the entire process of tuning the transmitter to the receiver, do not depress the key or microphone button because this will cause the transmitter to have full output, and the station which the receiver is receiving will be blocked out.

h. After the zero beat is found, lock the tuning knob of FREQ. CONTROL ①.

i. Turn control ⑥ on the transmitter to PHONE, MCW, or CW, whichever type of transmission is desired.

j. Turn control ⑥ on the receiver to PHONE or C. W., whichever type of reception is obtained from the other net stations.

57. Stopping Procedure

For any type of transmission or reception, the stopping procedure for the transmitter and receiver is exactly the same.

a. Turn control ⑥ to the OFF position.

b. Stop cranking the hand generator and press the OFF switch on Vibrator Power Unit PE-237.

Section VI. OPERATION UNDER UNUSUAL CONDITIONS

58. General

The operation of Radio Set AN/GRC-9 may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. In the following paragraphs instructions are given on procedures for minimizing the effect of these unusual operating conditions.

59. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of the equipment. Instruc-

tions and precautions for operation under such adverse conditions follow:

a. Handle the equipment carefully.

b. Keep the equipment warm and dry. If the set is not in a heated inclosure, construct an insulated box for the set.

c. Heavy coatings of frost will gather on mouth-type microphones in extreme cold weather when the microphones are used in the open air or in a cold room. Frost will form from the breath in the small holes of the cap and will affect transmitter modulation. Rubber diaphragms have been designed to protect some

CHAPTER 5

THEORY

Section I. THEORY OF RECEIVER SECTION OF RADIO SET AN/GRC-9

40. Block Diagram (fig. 55)

a. GENERAL. The receiver section of Receiver-Transmitter RT-77/GRC-9 consists of a 7-tube superheterodyne receiver designed for the reception of c-w and a-m signals over a frequency range of from 2.0 to 12.0 mc. Three bands are used to cover this range; band 1 covers from 6.6 to 12.0 mc, band 2 covers from 3.4 to 6.6 mc, and band 3 covers from 2.0 to 3.6 mc. The block diagram (fig. 55) shows the signal path through the receiver. A complete schematic diagram is shown in figure 138. The same antenna is used for transmitting and receiving; switching between the two sections is accomplished by a relay in the transmitter, which is operated by the key or press-to-talk switch on the microphone.

b. FIRST R-F AMPLIFIER. The signal is fed from the antenna to the tuned r-f amplifier V1. The r-f amplifier not only increases the signal voltage, but serves to isolate the oscillator section of tube V2 from the antenna, and also stops unwanted signals from entering the converter.

c. CONVERTER. The signal then is fed to the mixer section of the combination mixer and oscillator tube V2. The oscillator section of tube V2 produces an h-f oscillator voltage which is 456 kc higher than the signal frequency. This voltage is combined with the received signal in the mixer section of tube V2 to produce a difference beat frequency of 456 kc which is then amplified by the i-f tubes, V3 and V4.

d. I-F AMPLIFIER. The i-f amplifier is a high-gain circuit which is permanently tuned to the frequency difference between the h-f oscillator and the incoming r-f signal, and is thus a constant, single-frequency amplifier, operating on 456 kc. Most of the signal amplification occurs in tube stages V3 and V4.

e. DETECTOR AND FIRST A-F AMPLIFIER. The amplified signal is fed to the detector tube, V5, for demodulation. V5 is a dual tube, which serves as a detector and a first a-f (audio-frequency) amplifier. The detector stage also produces the avc (automatic volume control) voltage which is used to control the bias voltage on the grids of tubes V3 and V1. A bfo tube, V7, is used in conjunction with the detector stage for the reception of unmodulated c-w signals. After demodulation, the signal is fed to the other part of V5, the first a-f amplifier, where it is further amplified and then applied to the final a-f power amplifier V6.

f. FINAL AUDIO POWER AMPLIFIER. The output of the power amplifier V6 is applied across an impedance matching output transformer which permits headset or loudspeaker loads of 250 or 4,000 ohms impedance to be connected to the set.

g. CRYSTAL OSCILLATOR CALIBRATOR. Tube V4 is used as a crystal oscillator in addition to serving as a second i-f amplifier. A 200-kc crystal is installed in the set and operates in conjunction with V4 to generate harmonics of 200 kc which are fed back to the control grid of V1. These harmonics are used to check the dial calibration of the receiver.

h. BEAT-FREQUENCY OSCILLATOR. The bfo, tube V7 (tube type 1R5), is a circuit designed to allow the operator of the set to hear unmodulated c-w signals. The bfo generates a signal of 228 kc, whose second harmonic, 456 kc, is used to beat against the incoming i-f signal. If the receiver tuning dial is slightly detuned, the bfo harmonic will then beat against the i-f signal and produce an audible beat note which is passed on to the a-f amplifiers and can be heard in the headset. The pitch of the note is dependent on the amount of detuning.

i. SIDETONE MONITOR. When the transmitter

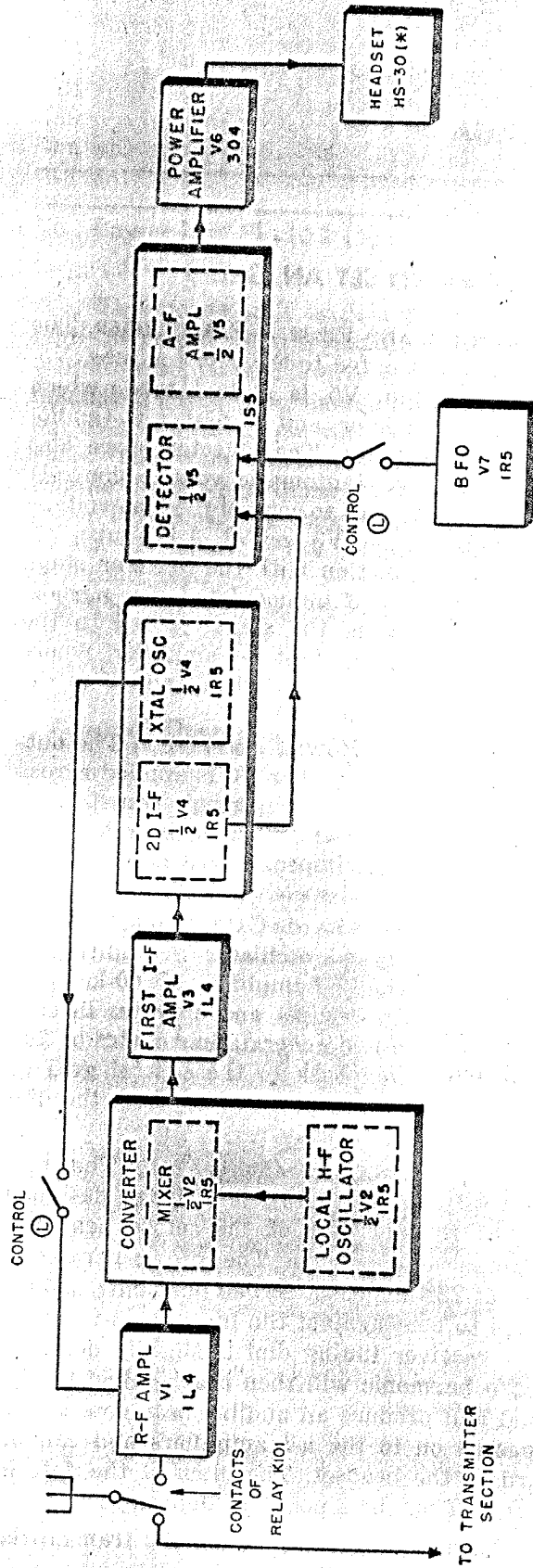


Figure 55. Block diagram of receiver section of receiver-transmitter RT-77/GRC-9.

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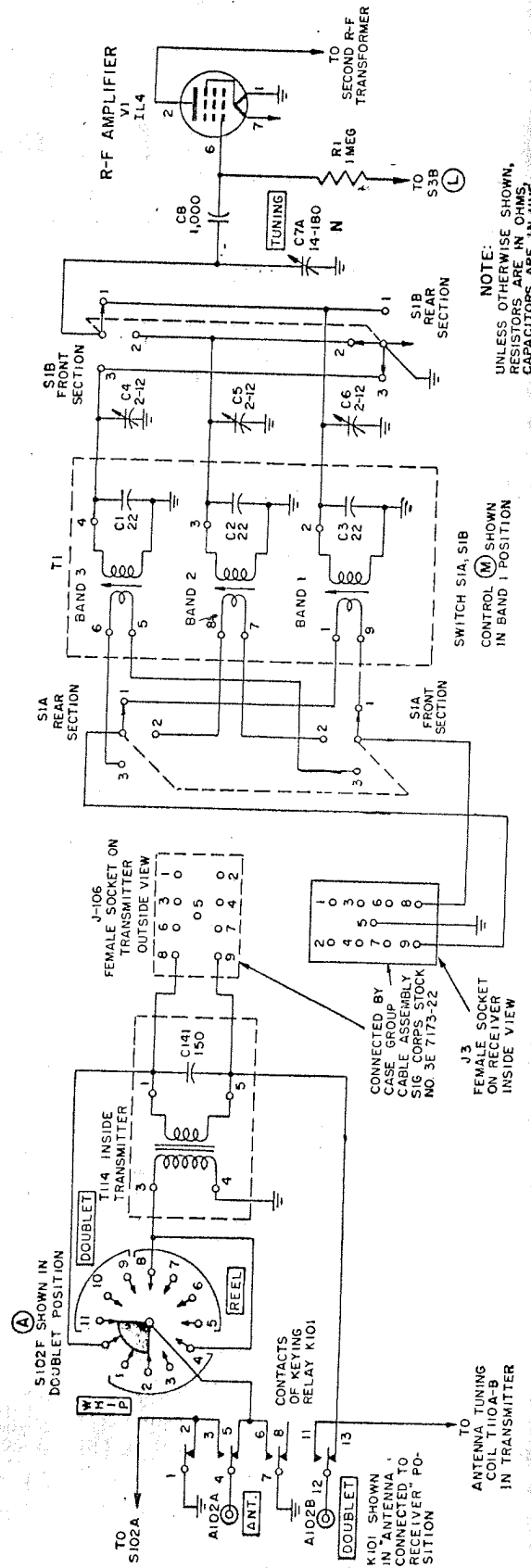


Figure 56. Antenna switching and tuning circuits for receiver-transmitter RT-77/GRC-9.

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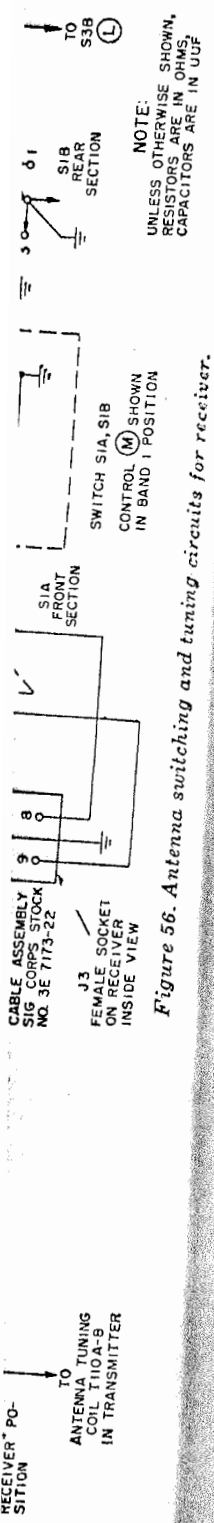


Figure 56. Antenna switching and tuning circuits for receiver.

In operation, a portion of the transmitter modulation is fed to the receiver audio output transformer so that the intelligence going out from the transmitter can be heard in the receiver headset and thus monitored.

81. Antenna Switching and Tuning Circuits (fig. 56)

a. A vertical mast (whip), long-wire, or doublet antenna may be selected by means of the terminals in the upper left-hand corner of the transmitter. The signal is picked up by the antenna and is fed to the contacts of keying relay K101. The relay is controlled by both the transmitter key and the press-to-talk switch on the microphone, and automatically connects the antenna to the transmitter when either of these is operated. The antenna is connected to the receiver at all times that the key or microphone is not in use. Receiver operation only will be described in this section.

b. The signal leaves the relay contacts and is fed to control A, antenna selector switch S102F, which connects the antenna to the matching transformer, T114. Transformer T114 is located inside the transmitter cabinet. When a doublet is used, it is connected to the ANT. and DOUBLET binding posts. With antenna selector switch A in DOUBLET positions 9, 10, or 11, the doublet antenna is connected across the secondary of transformer T114. The impedance of the doublet should be from 50 to 72 ohms for a proper match. When a mast or long antenna is used, it is connected to the ANT. binding post. With antenna selector switch A in WHIP positions 1, 2, 3, and 4, or REEL positions 5, 6, 7, and 8, the antenna is connected to the primary of transformer T114.

c. From T114, the signal is fed to female plug J106 on the transmitter and is connected to the receiver female plug by means of a cable with male plugs on both ends. The female plug J3 on the receiver is connected through switch S1A to antenna transformer T1 which contains three tuned circuits used to tune the antenna to resonance. Switch S1A is a 3-position band change switch, marked M on the receiver panel, which applies the signal to the proper tuned circuit for the band selected. Each switch wiper is actually in two sections: The section nearest the control knob is denoted as the front

section (fig. 56), while the section behind it or furthest from the knob is the rear section.

d. Considering only band 1, capacitor C3 is inside of transformer T1 and is part of the total tuning capacity. C3 is a temperature compensating capacitor. Capacitor C6 is the antenna trimmer and is used to adjust the h-f end of band 1. These two capacitors in conjunction with tuning capacitor C7A (antenna section of the receiver gang) are in parallel, and they tune the input circuit to resonance with the incoming signal. The lower end of band 1 is adjusted by varying the position of the transformer iron core slug. The selected r-f signal in the resonant secondary circuit is coupled to the control grid of r-f amplifier V1 by the coupling capacitor C8. Capacitor C8 isolates the control grid d-c bias voltage of tube V1 from the tuning circuit. Switch S1B is a double-section switch, having a front and a rear part. The front section selects the output of the tuning circuit which is being used. The rear section of switch S1B shorts to ground the two unused secondaries of transformer T1.

82. R-F Amplifier V1 (fig. 57)

a. The first stage of the receiver section is an r-f amplifier which uses tube type 1L4. Resistor R1 is the grid resistor across which the selected signal voltage is applied. In addition, this resistor permits the application of the avc voltage, but does not allow the currents to be shorted to ground through the avc filter capacitor C33. The amplified output of V1 is coupled through band change switch S1C to the second r-f transformer T2. The secondary of T2 is tuned by tuning capacitor C7B. Considering only band 1, capacitor C7B works in conjunction with trimmer C17 and fixed capacitor C14. Capacitor C9 bypasses the screen-dropping resistors so that r-f currents will not flow through these resistors and cause degeneration. Resistor R2 is the plate-dropping resistor and it is bypassed by capacitor C10 so that r-f will not flow into the d-c supply. The screen grid voltage of tube V1 is used as a means to control the r-f gain. This screen voltage is obtained across variable resistor R9, control R.F. GAIN, and is fed through screen-dropping resistor R11 to the screen grid.

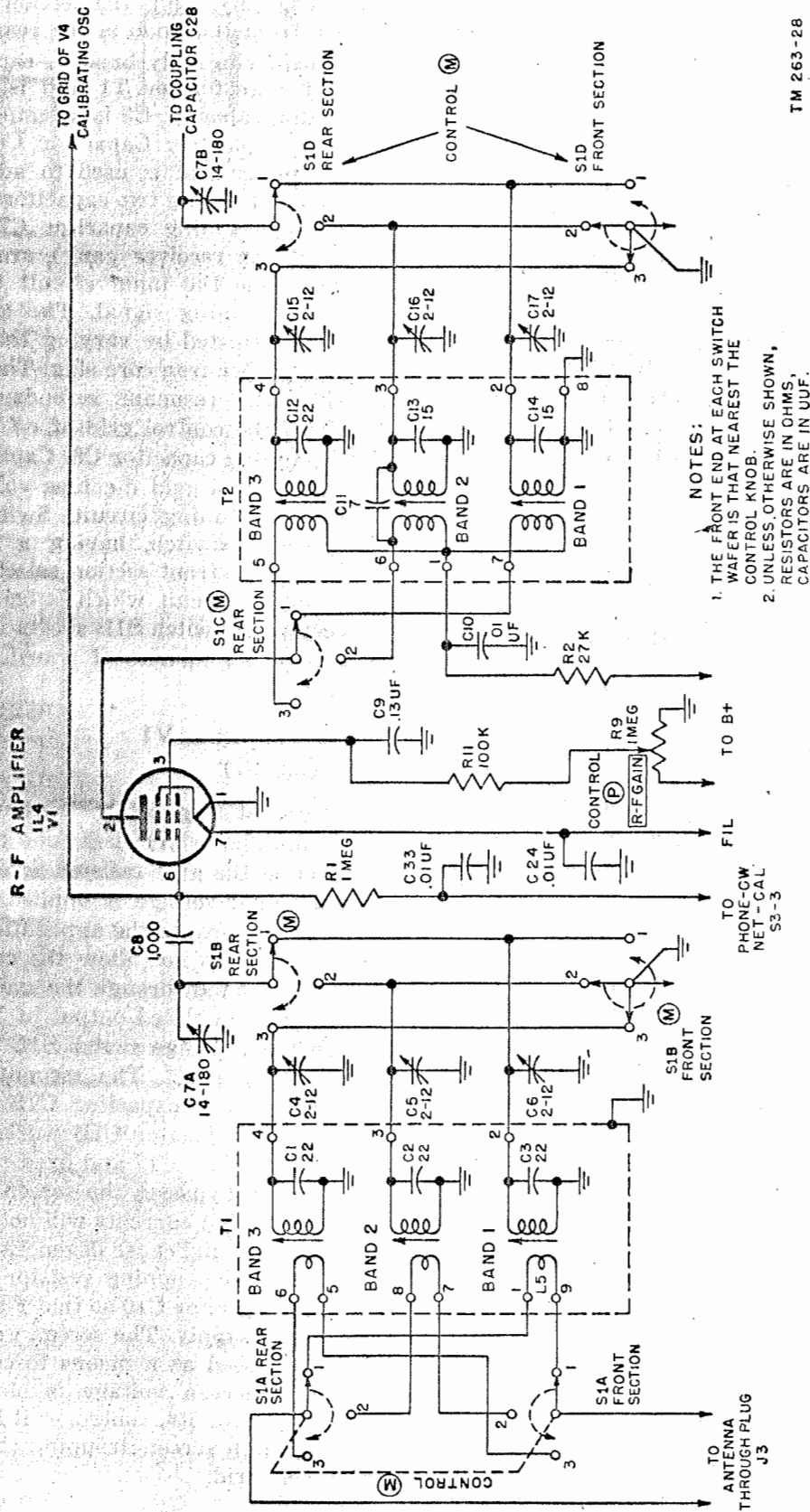


Figure 57. R-f amplifier, simplified schematic.

a. The signal leaves T2 and enters band switch S1D, front section, from which it is then coupled, by means of capacitor C28, to the control grid of converter tube V2.

c. Capacitor C11 improves the coupling of band 2 at the higher frequencies. The rear section of S1D shorts to ground the two tuned secondaries of T2, which are not being used.

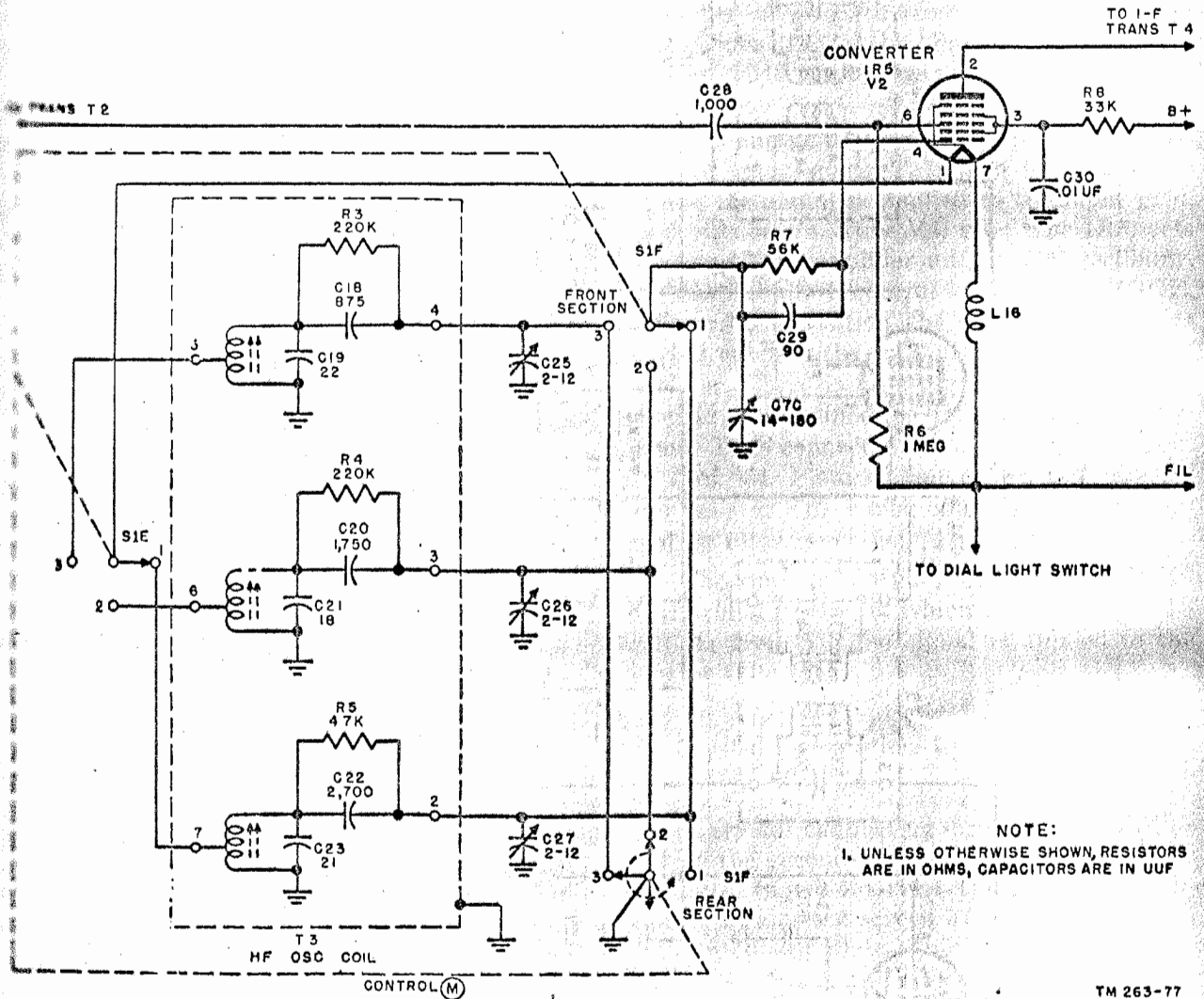


Figure 58. Converter stage, simplified schematic.

33. Converter Stage V2 (fig. 58)

a. The converter stage uses tube type 1R5 as a combined mixer and h-f oscillator of the series fed Hartley type, using the first two grids and the filament.

b. The resonant circuit in the oscillator portion of V2 is formed by one coil of T3, which is selected by switches S1E and S1F and, assuming band 1 is chosen, is tuned to resonance by the ganged capacitor C7C, adjustable trim-

mer C27, and capacitor C23. Capacitor C23 is used as a frequency corrector for temperature changes. When the temperature increases, the coil inductance increases, thus lowering the frequency; however, the capacitor is so made as to decrease its capacity when the temperature increases. The decreased capacitance opposes the increased inductance and the temperature effect on tuning is nullified.

c. Resistor-capacitor combination R5 and C22 provides the grid-leak bias for the oscillator grid (band 1) pin 4 of tube V2.

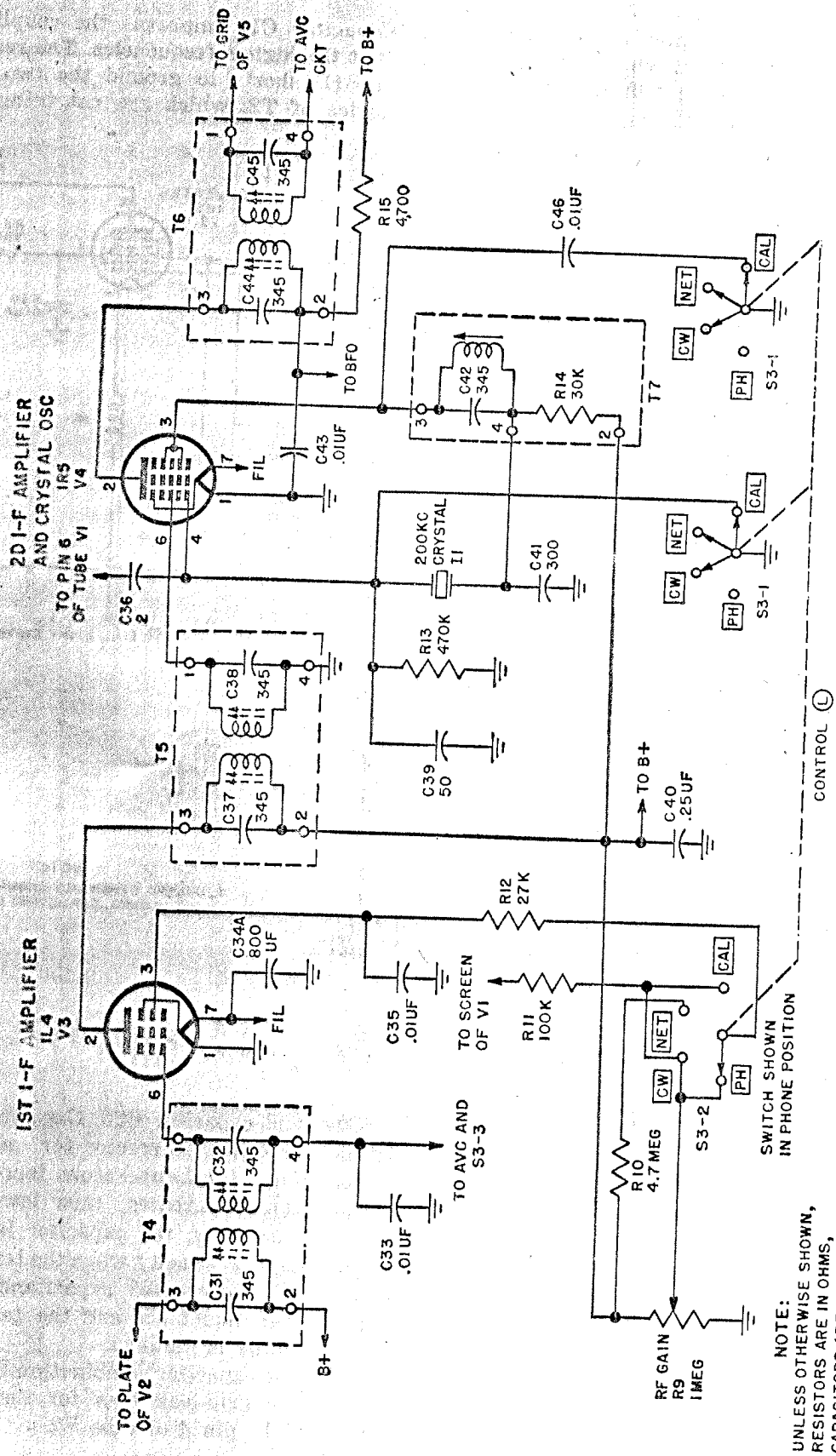


Figure 59. I-f amplifiers, simplified schematic.

d. Resistor-capacitor combination R7 and C34 is placed in the grid circuit to provide additional bias.

e. Grid 2, pin 3 of tube V2, acts as the oscillator plate and receives its plate voltage through resistor R8 which is bypassed to ground for r-f through capacitor C30.

f. Choke coil L16 prevents r-f currents from entering the filament circuit and causing disturbances in the other tubes. Resistor R6 is the signal grid return resistor.

g. The h-f oscillator is tuned by \odot TUNING capacitor C7C so that it is always 456 kc higher in frequency than the signal frequency. Thus, when the received signal from the r-f amplifier is applied to grid 3, pin 6 of tube V2, the two frequencies will beat together, forming sum and difference frequencies. The tuned primary of i-f transformer T4 in the plate of the mixer section is resonant at the difference frequency of 456 kc and, therefore, allows only this frequency to continue on to the first i-f amplifier V3 (fig. 59). The primary and secondary of i-f transformer T4 are shunted by capacitors C31 and C32, respectively. These capacitors, combined with adjustable powdered iron cores inserted in the primary and secondary coils, tune the transformer to 456 kc.

84. I-F Amplifiers V3 and V4 (fig. 59)

a. Two i-f amplifier stages are used, the first stage, V3, using tube type 1L4, and the second stage, V4, using tube type 1R5. The 456-kc signal leaves the transformer T4 secondary and is applied to V3. The gain of V3 is controlled by the voltage on the screen grid, pin 3, which is fed through the \odot R.F. GAIN resistor R12 from switch S3-2. Switch S3-2, control \odot , leads to potentiometer R9, control \odot , which is across the plate supply voltage. The screen grid voltage for tube V3 may be controlled only when switch S3-2 is in the PHONE, C.W., or CAL. position. During net operation, the r-f gain may be varied by changing the screen voltage to the first r-f tube V1 only. Thus, switch S3-2 permits tube V3 to be used together with the tube V1, or not at all, to control the r-f gain. Also, during net operation, the gain of tube V3 is reduced because of the introduction of the larger screen circuit dropping resistor R10.

b. Capacitor C35 acts as a bypass for the screen voltage supply resistors, R12 and R9. Capacitor C33 is used as a filter capacitor for the avc voltage, supplying bias to the control grid, pin 6 of tube V3. Capacitor C33 also completes the r-f path from the low side of i-f transformer T4 to the filament of tube V3. Capacitor C40 is a bypass capacitor for the B+ supply line.

c. The output of V3 is fed through the primary of transformer T5 which is identical to T4 and the signal is applied to the input grid, pin 6 of tube V4. Tube V4, tube type 1R5, acts as a second i-f amplifier and crystal oscillator. When switch S3-1, control \odot , is in the PHONE, C.W., or NET position, the oscillator portion is shorted out and the tube acts as a straight i-f amplifier. There is no d-c grid bias on the signal grid of V4 since the low side of i-f transformer T5 is connected directly to the filament, pin 1 of V4. Plate voltage is fed through r-f filter resistor R15, which is bypassed to the filament by filter capacitor C43.

d. The amplified output signal from V4 is fed to i-f transformer T6, which is identical to T5 and T4; from T6, the signal is applied to the detector tube V5.

85. Crystal Calibrating Circuit (fig. 60)

a. A crystal calibrating circuit is included as part of the second i-f stage and utilizes grids 1 and 2 of tube V4. Grid 1 (pin 4) is the oscillator grid, and the screen grid (pin 3) is used as the oscillator plate. This circuit is resonant at 200 kc and provides the means of checking accurately the receiver calibration at 200-kc intervals. This oscillator will operate only when switch S3-1 is in the CAL. position. Calibration of the receiver is obtained by feeding harmonics of the crystal oscillator signal from the oscillator grid (pin 4) through coupling capacitor C36 to the control grid of V1.

b. This signal is amplified by the first r-f amplifier and fed to the signal grid, pin 6 of the converter tube V2. In this tube it is mixed with the h-f oscillator signal to form an i-f signal of 456 kc which is passed on through the intermediate amplifier stages. Upon leaving i-f transformer T6, the signal is mixed with the output of the bfo. Since the bfo generates a signal of

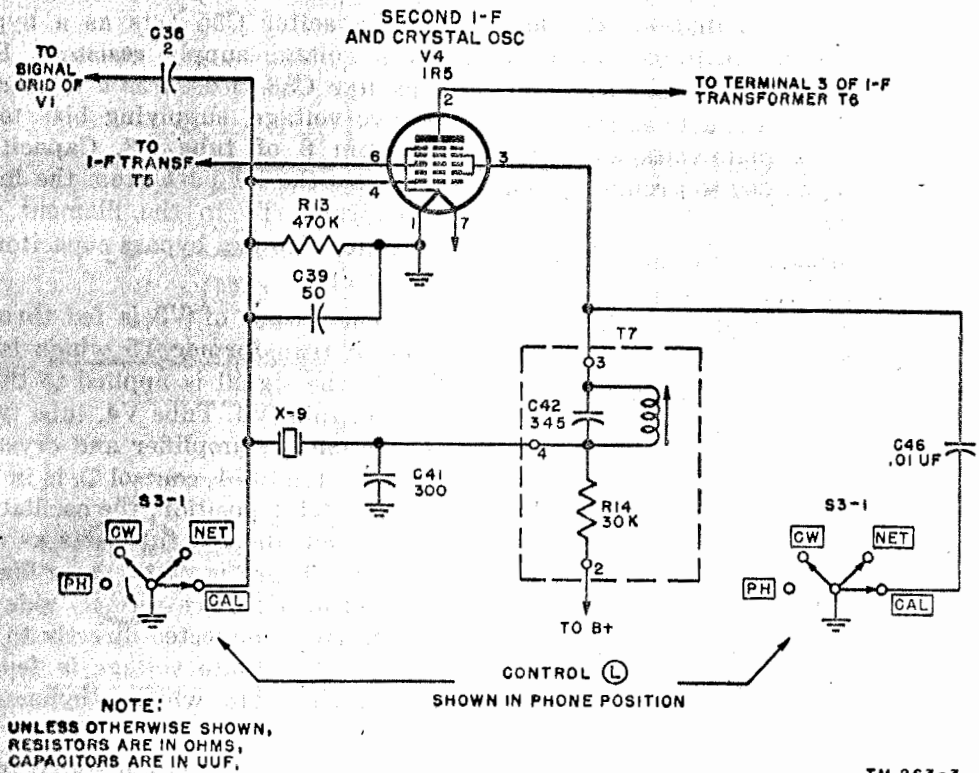


Figure 60. Crystal calibrator circuit.

456 kc, a zero beat results, because the i-f signal is also 456 kc.

c. The tuning dial is placed at any setting corresponding to a harmonic of the 200-kc crystal. If the r-f and h-f oscillator tuned circuits are not tuned exactly to the frequency stated on the dial, it will be evident that the converter tube will not produce an i-f signal of precisely 456 kc. It will then be necessary to detune the TUNING knob slightly so that a frequency of 456 kc will be produced to zero-beat with the 456-kc output signal of the bfo. The amount of detuning necessary to obtain zero beat is the error in the dial calibration. If the zero-beat note occurs when the dial number, corresponding to the crystal harmonic frequency, is exactly under the hairline, the receiver dial is accurately calibrated.

d. The calibration may in this manner be checked at any dial point which corresponds to a frequency equal to any of the harmonics of the crystal oscillator 200-kc crystal. The crystal oscillator therefore acts as a very accurate signal generator. An external oscillator

could be used but it is advantageous to have a self-contained signal generator, so that the receiver dial calibration can be checked at any time and at any place.

e. Transformer T7 is tuned to slightly higher than the crystal frequency of 200 kc, by means of capacitor C42 and an adjustable iron core. It is necessary for the tank circuit to be tuned to slightly above the crystal frequency, otherwise the circuit will not oscillate. Accurate adjustment of the iron core is made by the manufacturer and should not be disturbed.

f. Resistor R14 which is located within T7 is the screen grid voltage-dropping resistor. Capacitor C39 and grid leak resistor R13 develop the d-c bias voltage for the oscillator grid (pin 4). Capacitor C46 is the usual screen grid (pin 3) bypass when switch S3-1 is in any position but CAL. A plug-in type Crystal Unit CR-2B/U 200-kc crystal is used.

g. The crystal oscillator is prevented from working in any but the CAL. position by a section of switch S3-1 that returns grid 1 to ground.

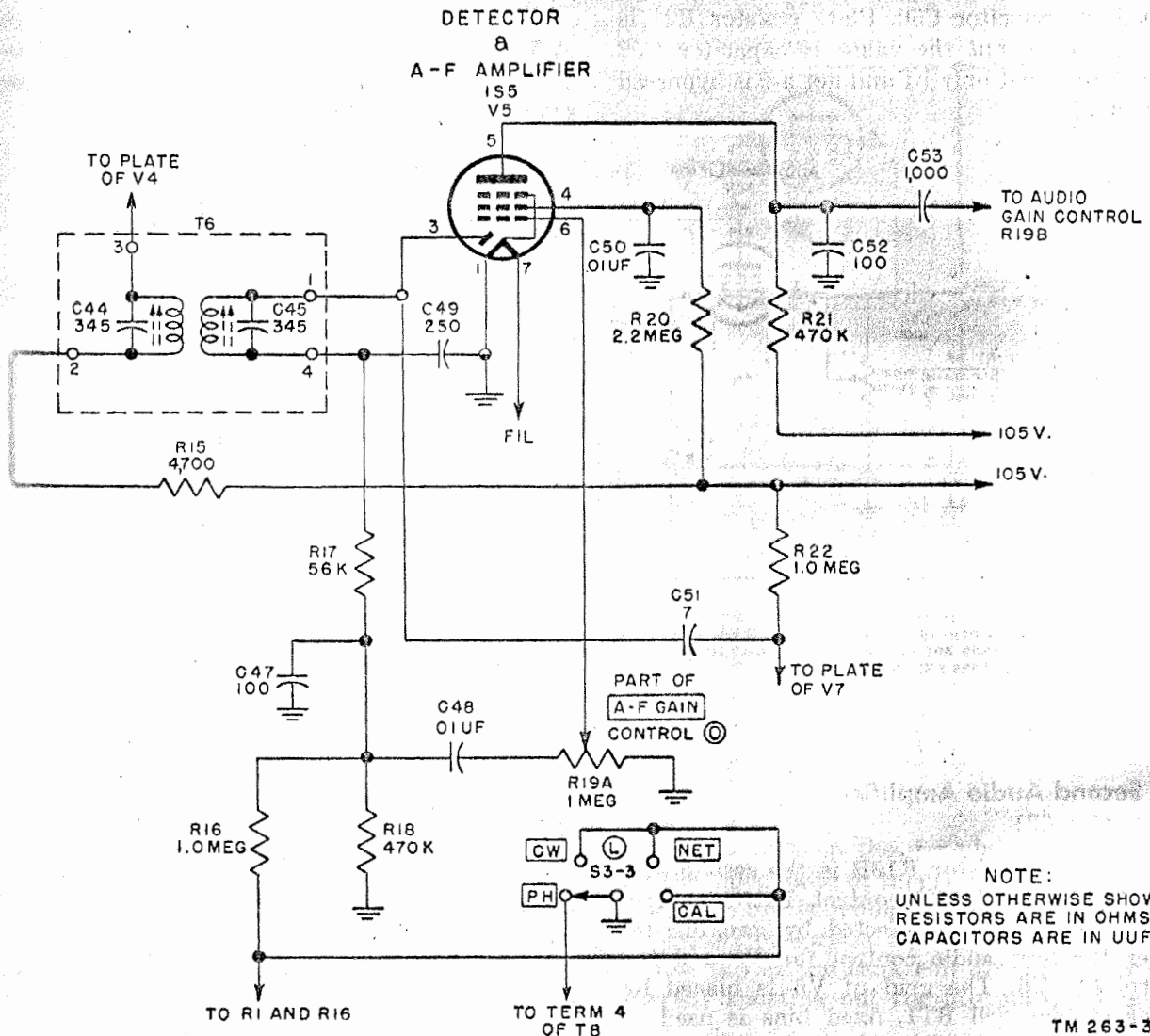


Figure 61. Detector and first audio amplifier, simplified schematic.

26. Detector and First Audio Amplifier (fig. 61)

a. The detector stage uses the diode section of V5, tube type 1S5, as a diode detector. The output of the secondary of T6 is applied to the diode section, pin 3 of V5, where the signal voltage is rectified. Resistor R18 is the diode load across which is developed the audio voltage and avc voltage. Shunted across the diode load is a capacitor C49 which, along with R17 and C47, filters out the i-f component.

b. Resistor R16 and capacitor C33 constitute a filter circuit which supplies the avc voltage to the grids of tubes V1 and V3. This filter is

necessary to insure that only the d-c voltage and not the audio variations is applied to the avc controlled tubes. The avc voltage can be shorted to ground by means of switch S3-3, which is the case when any switch position but PHONE is in use.

c. The audio voltage appearing across the diode load resistors is tapped off above R18 and applied through coupling capacitor C48 to the A.F. GAIN control, R19A, marked Ⓞ on the receiver panel. From there the a-f signal goes to the control grid, pin 6 of tube V5.

d. The d-c plate voltage is fed through plate load resistor R21 and the d-c screen voltage through dropping resistor R20 which is by-

passed by capacitor C50. Plate resistor R21 is also bypassed, but the value of capacitor C52 is so chosen that only i-f and not a-f is bypassed to ground.

e. Capacitor C53 couples the a-f signal to A.F. GAIN control R19B which is ganged to R19A. The signal is then fed directly to the control grid of tube V6.

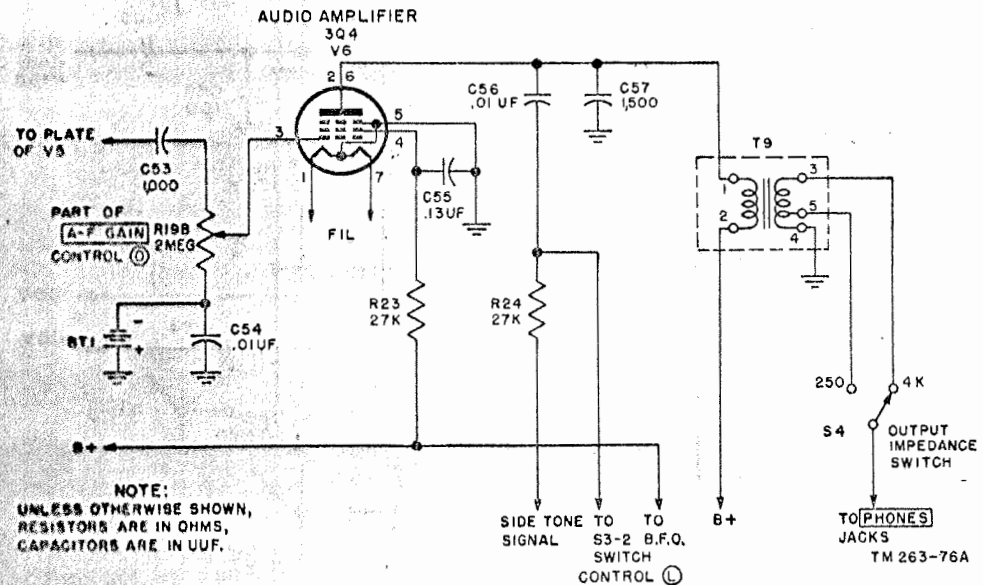


Figure 62. Second audio amplifier stage V6.

87. Second Audio Amplifier (fig. 62)

a. Variable resistor R19B is the second section of the A.F. GAIN control. Better control of the audio gain is effected by ganging together the first audio control for V5 and the control for V6. The grid of V6 is biased by means of bias cell BT1, fixed bias is used to minimize distortion. The bias cell is bypassed for audio by capacitor C54. The plate load of audio amplifier V6 is the audio output transformer T9 which provides secondary output impedances of 250 and 4,000 ohms. The required output impedance is selected by switch S4 which is located on the rear of the receiver chassis. Capacitor C57 bypasses unwanted h-f and improves the stability of the audio signal. The screen receives voltage from resistor R23 which is bypassed by C55.

b. A sidetone monitoring system is incorporated to monitor the transmitter. When switch S3-2, control ©, is in the PHONE, C.W., or CAL. position and during operation of the transmitter, a sidetone signal is taken from the secondary of the modulation transformer in the transmitter and is connected to the primary

of the receiver output transformer through resistor R24 and coupling capacitor C56. The sidetone volume is adjusted by means of the sidetone volume control located on the transmitter. The sidetone is shorted to ground when switch S3-2 is in the NET position.

c. Two phone jacks are provided so that two headsets can be placed in parallel across the secondary of output transformer T9.

88. Beat-frequency Oscillator (fig. 63)

a. Since the received c-w code signal is not audible, it is necessary to provide means for producing an audible note. The bfo consists of an electron-coupled oscillator, the oscillator section being a series-fed Hartley circuit. The oscillator output, when beat against the amplified c-w i-f signal, produces an audible difference frequency. The fundamental of the bfo is 228 kc, but the second harmonic of 456 kc does the actual heterodyning.

b. The oscillator section of V7 uses grid 1 (pin 4) as the oscillator grid and uses grid 2 (pin 3) as the oscillator plate. The coil of T8 is tapped at the correct point to maintain oscilla-

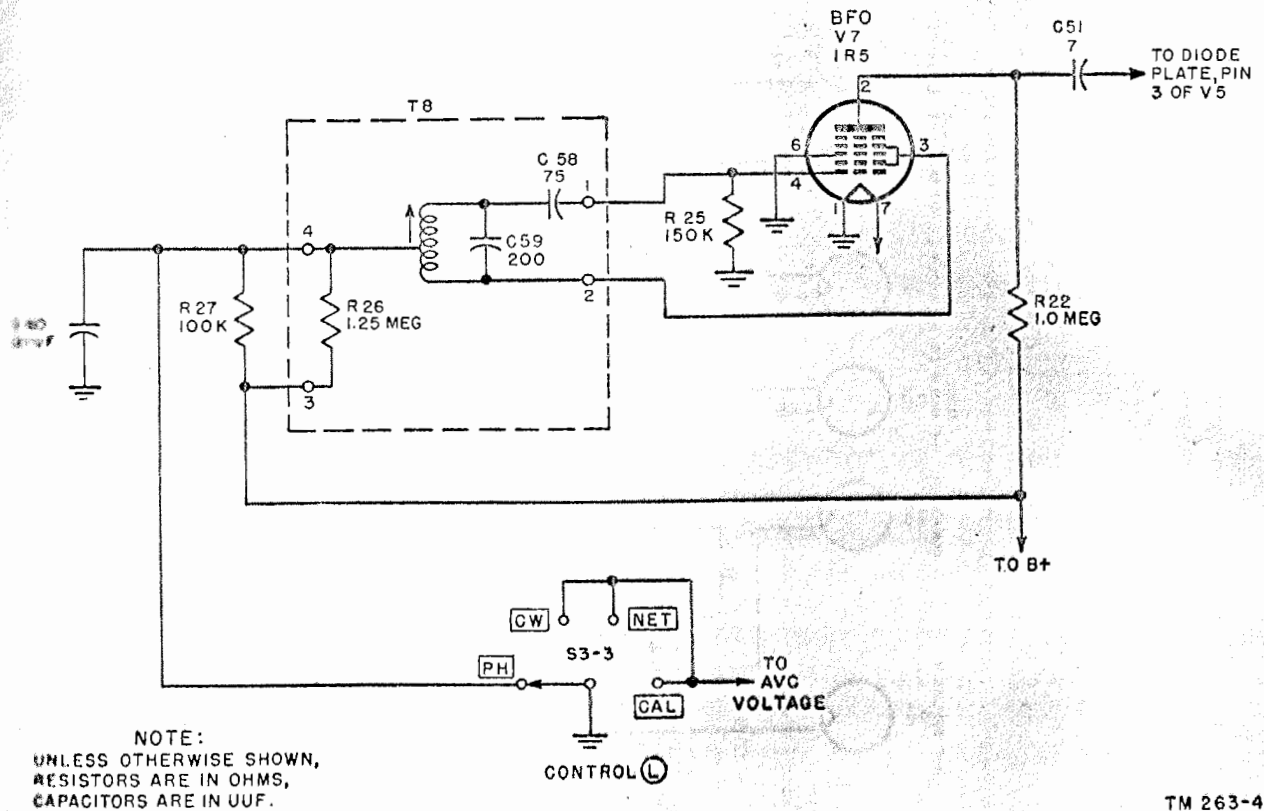


Figure 63. Beat-frequency oscillator.

TM 263-4

ions, and is directly connected for r-f, through capacitor C60, to the filament of V7. The tank coil is tuned to resonance by capacitor C59. Capacitor C58 is placed between the tank circuit and the oscillator grid so as to prevent the d-c voltage in the tank circuit from entering the oscillator grid circuit. The d-c bias is developed across grid-leak resistor R25, C58 acting as the grid leak capacitor. The oscillator plate (pin 3) receives its voltage through the parallel combination of resistors R26 and R27. The bfo is aligned by adjustment of a powdered iron slug in coil T8.

c. The oscillations produced by the oscillator section of V7 are electronically coupled to the plate circuit of V7, are amplified, and appear across resistor load R22. From resistor R22, the 456-kc signal is applied through capacitor C51 to the diode plate of detector tube V5. At the diode, it mixes with the incoming i-f signal and, if the main tuning capacitor is slightly detuned, there will be produced an audible beat note, the frequency of which is dependent on the amount of detuning. Capacitor C51 is

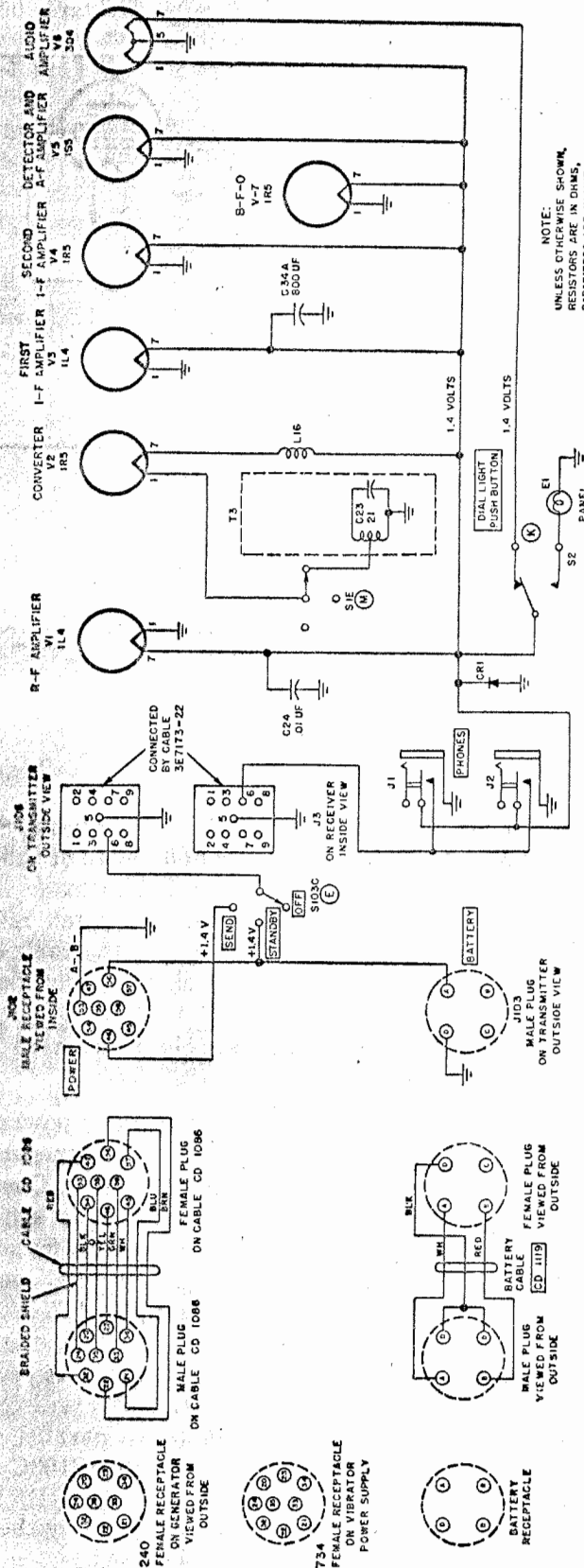
necessary to keep the d-c plate voltage of V7 off the diode plate of tube V5.

d. The bfo is made inoperative on PHONE by means of switch S3-3 which connects the center tap of the tank coil directly to ground, thereby shorting out the bfo plate voltage.

89. Receiver Filament Voltage Supply (fig. 64)

a. The vibrator power supply, the battery, or the hand-driven generator may be used to supply filament power. Connections of the various cables to the radio set can be seen from the wiring diagram (fig. 42).

b. Cord CD-1086 connects either Vibrator Power Unit PE/237 or Generator GN-58-A to male plug J102 on the transmitter, which in turn is connected to switch S103C, control @. Battery BA-48 also is connected to S103C and is in effect, in parallel with the generator and vibrator. Switch S103C allows the battery to be used for the STANDBY position only. In the SEND position, only the vibrator or the generator may be used.



TM 803-9

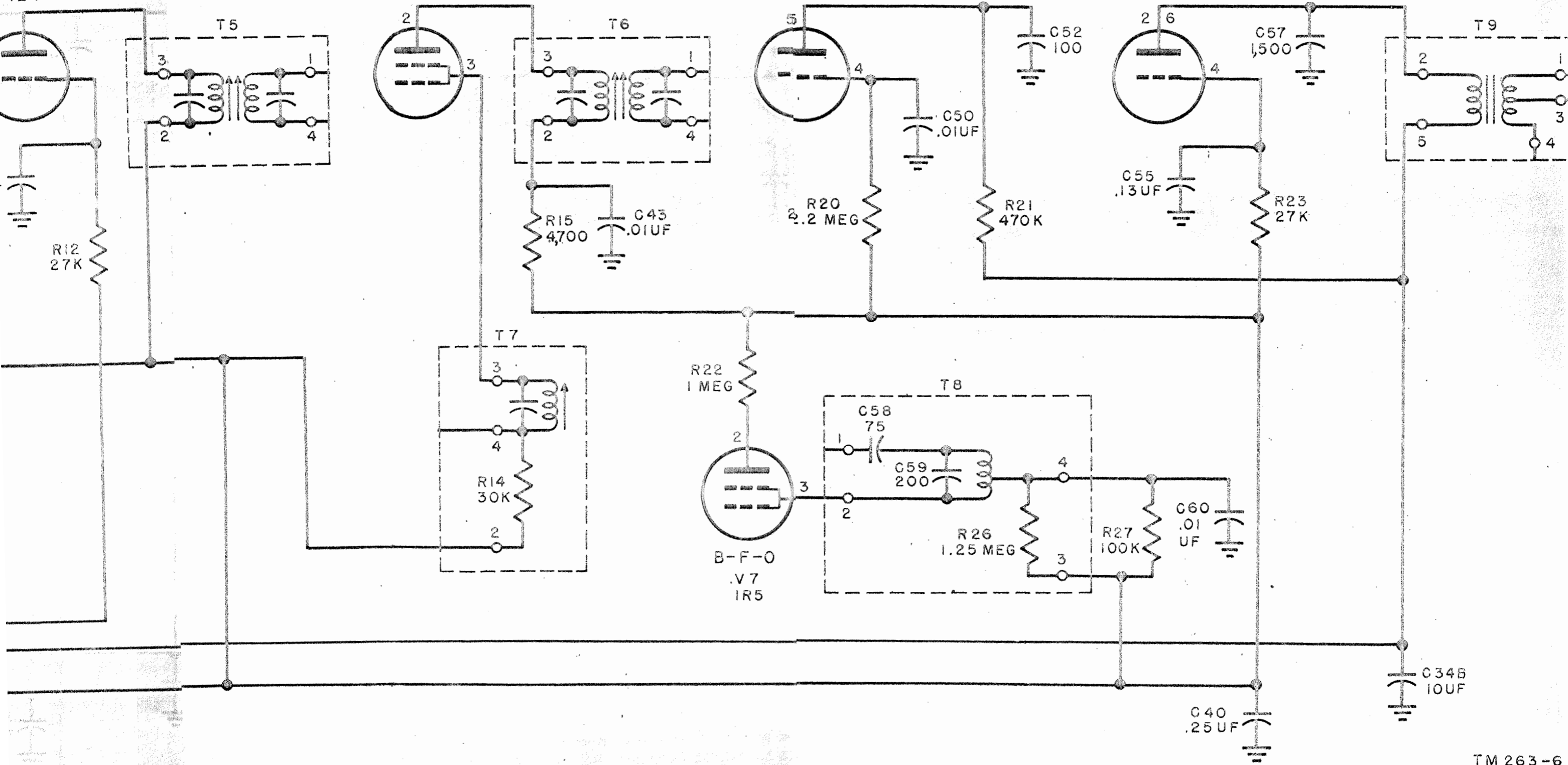
Figure 64. Receiver filament supply circuits.

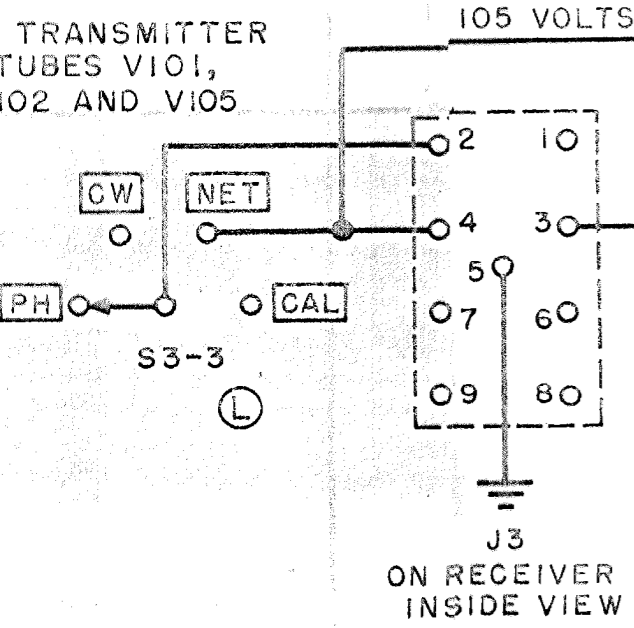
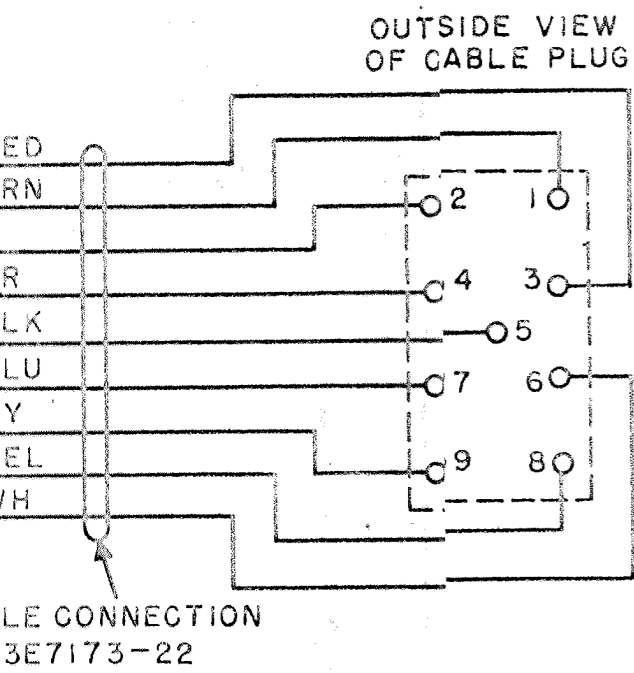
AMPLIFIER
V3
1L4

I-F AMPLIFIER
AND
CRYSTAL OSCILLATOR
V4
1R5

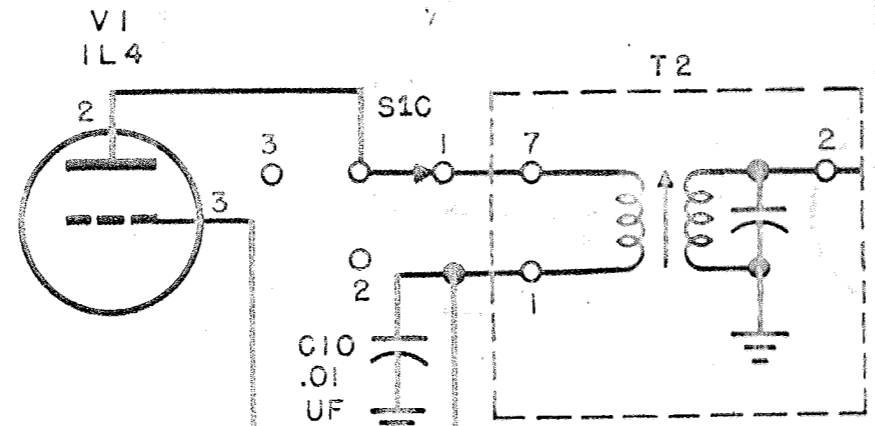
DETECTOR
AND
A-F AMPLIFIER
V5
1S5

AUDIO AMPLIFIER
V6
3Q4

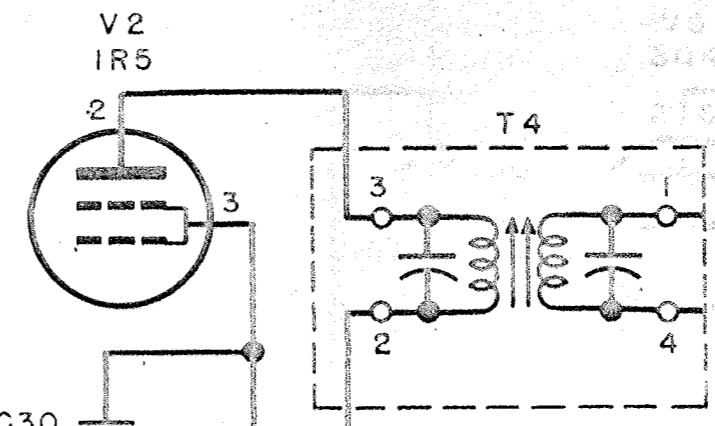




R-F AMPLIFIER



CONVERTER



AUDIO AMPLIFIER

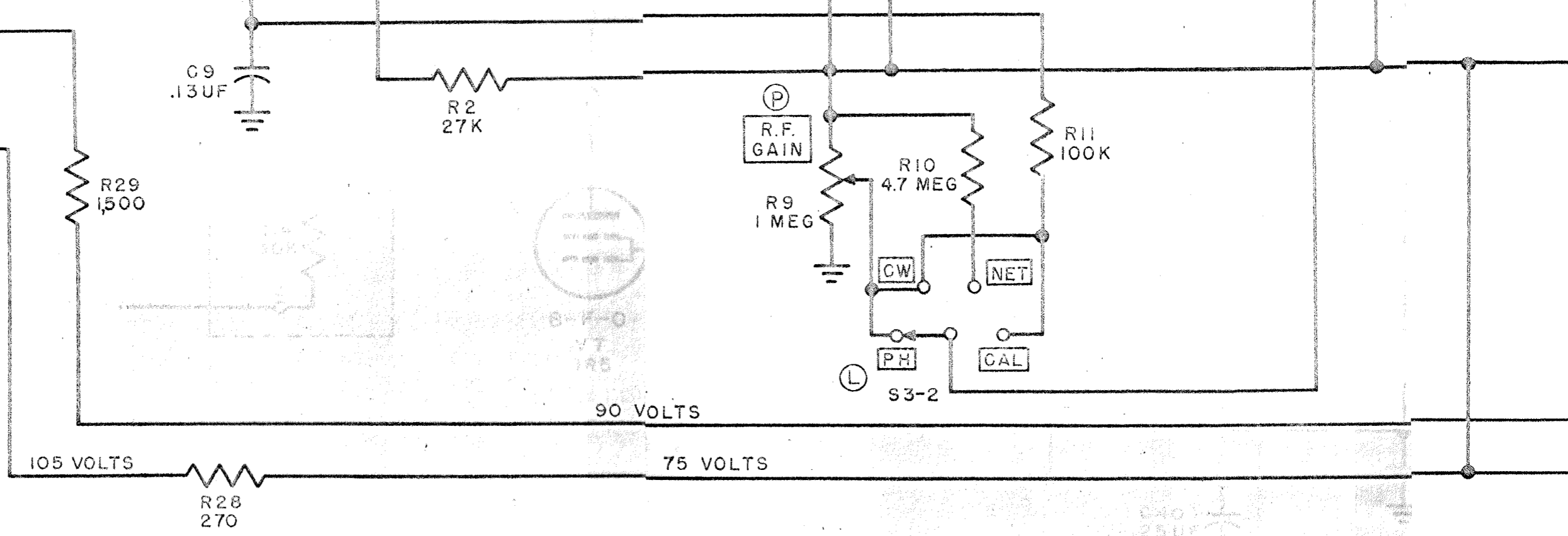
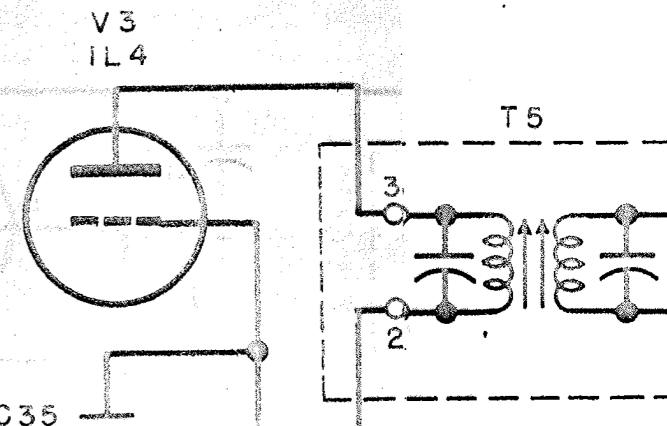
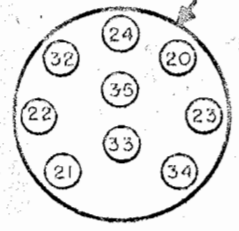
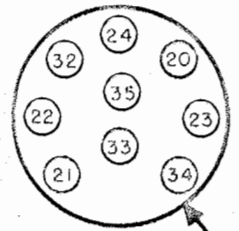
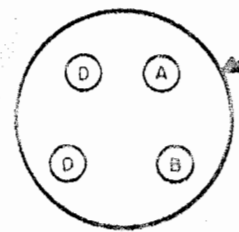


Figure 65. Receiver plate and screen grid voltage supply circuits.

240 FEMALE
GENERATOR
RECEPTACLE
OUTSIDE VIEW



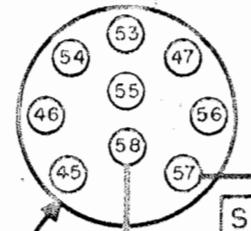
734
VIBRATOR
RECEPTACLE



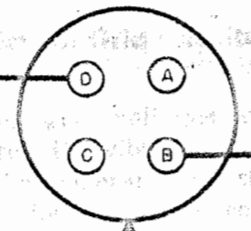
BATTERY
RECEPTACLE

J102
VIEWED FROM
INSIDE

POWER



BATTERY



J103
BATTERY
RECEPTACLE ON
TRANSMITTER,
OUTSIDE VIEW

CD 1119
BATTERY
CABLE

NOTE:
UNLESS OTHERWISE SHOWN
RESISTORS ARE IN OHMS, CAPACITORS
ARE IN UUF

S103D

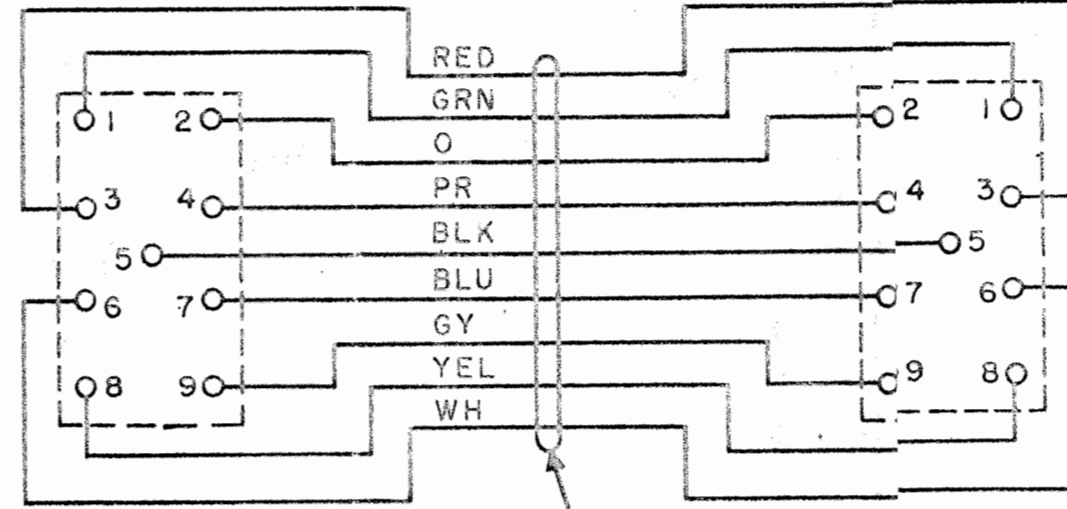
105V SEND

105V STANDBY

OFF

VOLTAGE
REGULATOR
V104
V105

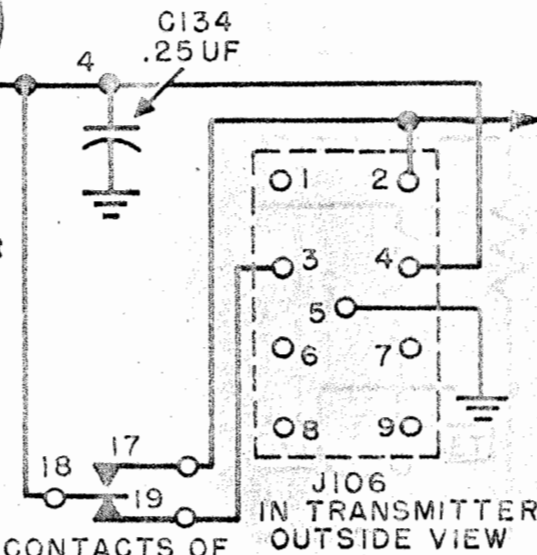
INSIDE VIEW
OF CABLE PLUG



CABLE CONNECTION
3E7173-22

OUTSIDE VIEW
OF CABLE PLUG

TO TRANSMITTER
TUBES V101,
V102 AND V105



CONTACTS OF
RELAY K101
SHOWN IN
"KEY UP"
POSITION

J106
IN TRANSMITTER
OUTSIDE VIEW

CW NET
PH CAL

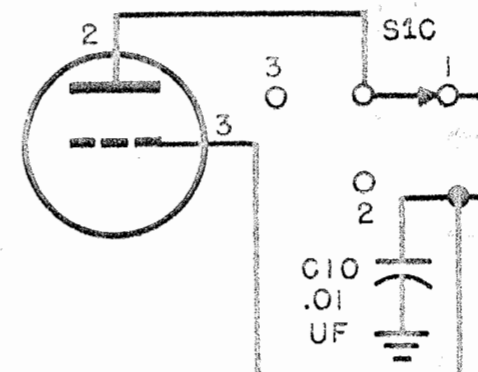
S3-3

(L)

J3
ON RECEIVER
INSIDE VIEW

R-F AMPLIFIER

V1
1L4



C9
.13UF

R29
1500

105 VOLTS

R28
270

3. Switch S103C then leads to the female transmitter jack, J106, which is connected by cable 3E7173-22 to female receiver jack J3. Jack J3 is connected to the headphone jacks J1 and J2. These headphone jacks act as a switch; when the headphones are not plugged into the jack, the filament circuit is disconnected.

4. The filaments are all connected in parallel, including the two filaments in tube V6 (tube type 3Q4). The dial light switch S2, control Ⓞ, disconnects one half of the filament of tube V6, and connects in its place the dial light E1.

5. CR1 is a selenium metallic rectifier which serves as a filament voltage regulator, maintaining it at 1.4 volts. Capacitor C24 is an r-f bypass which is so connected that the r-f will not enter the filament supply lines. Choke L16 is the filament lead of tube V2 also serves this purpose. The filament of V2 is connected to the h-f oscillator coils by means of band switch S1E, control Ⓞ. C-34A acts as an r-f and i-f filter capacitor.

90. Receiver Plate and Screen Grid Circuits (fig. 65)

a. The plate and screen grid voltages are obtained from the generator, the vibrator unit, or the battery. Either the generator or the vibrator may be selected by means of connecting Cord CD-1086, as shown in the cording diagram (fig. 42).

b. The selected power supply is connected through Cord CD-1086 to the transmitter receptacle J102. Receptacle J102 is then connected to switch S103D, control Ⓞ, which determines if the battery is to be used instead of the generator or vibrator. The contact marked STANDBY is connected to pin B on the battery plug and to pin 58 on J102. Pin 58 is connected by cable to pin 33 of generator receptacle 240. The generator wiring diagram (fig. 137) shows that pin 33 is not connected to anything. Therefore, on the STANDBY position of switch S103D, only the battery supplies power to the receiver. On the SEND position of control Ⓞ, the battery is disconnected, and the receiver is connected through pin 57 on J102 to pin 21 on receptacle 240 and from there to the h-v coil on the generator.

c. From switch S103D, the voltage is applied across tube V104, a voltage regulator which

keeps the voltage that is fed to the plate circuit equal to exactly 105 volts. The output of tube V104, pin 5, is externally connected to pin 3 which is internally connected to pin 7. Pin 7 is then connected to pin 4 on terminal board J106 and to contact 18 on keying relay K101. Relay K101 further determines whether pin 3 or pin 2 is to be connected to the supply voltage. Pin 4 is constantly energized, regardless of the position of relay K101, because it is directly connected to pin 7 of the voltage regulator tube V105.

d. Transmitter terminal board J106 is connected to receiver terminal board J3 through cable 3E7173-22. The plate voltages of tubes V5 and V6 only are obtained from pin 4 on J3. All other plate and screen voltages are obtained from pin 3 on J3.

e. When the transmitter section is not in use, contact 19 of relay K101 is connected with contact 18 to the power supply, and all the receiver tubes receive plate and screen grid voltage. However, when the transmitter key is depressed or the press-to-talk switch on the microphone is pushed, relay K101 disconnects contact 19 and connects contact 17 to the power supply. The disconnection of contact 19 removes screen voltage from all tubes, and plate voltage from all tubes but tubes V5 and V6.

f. In order to tune the transmitter to the receiver frequency for net operation, it is necessary that both the transmitter and receiver operate simultaneously. However, it has been pointed out that, because of relay K101, only the receiver or the transmitter may function at any one time, depending on the position of the key or microphone button. If the handkey is left up, the receiver will automatically obtain voltage since relay contacts 18 and 19 will remain closed. Thus it will be necessary only to short contacts 18 and 17 by some external means, to provide voltage to the transmitter. This is the function of switch S3-3, control Ⓞ, located within the receiver cabinet. Figure 65 shows that relay contact 17 is connected to pin 2 on receptacle J106, which is in turn connected by cable 3E7173-22 to pin 2 of receptacle J3 in the receiver cabinet. Pin 2 of receptacle J3 connects to the movable rotor of switch S3-3. When switch S3-3 is placed on NET position pin 2 is directly connected to pin 4 on receptacle J3. This effectively shorts contacts 17 and 18

of relay K101, thus supplying voltage to the transmitter tubes. Only some of the transmitter tubes are energized to permit net operation.

g. The plates of tubes V5 and V6 receive their voltage through dropping resistor R29 while the plate and screen currents of the other

tubes pass through resistor R28. This is done so that the low-frequency audio signals of V5 and V6 cannot modulate the r-f signals in the other tubes, or cause oscillations, which might occur if allowed to pass through the same dropping resistor used by the r-f and i-f stages.

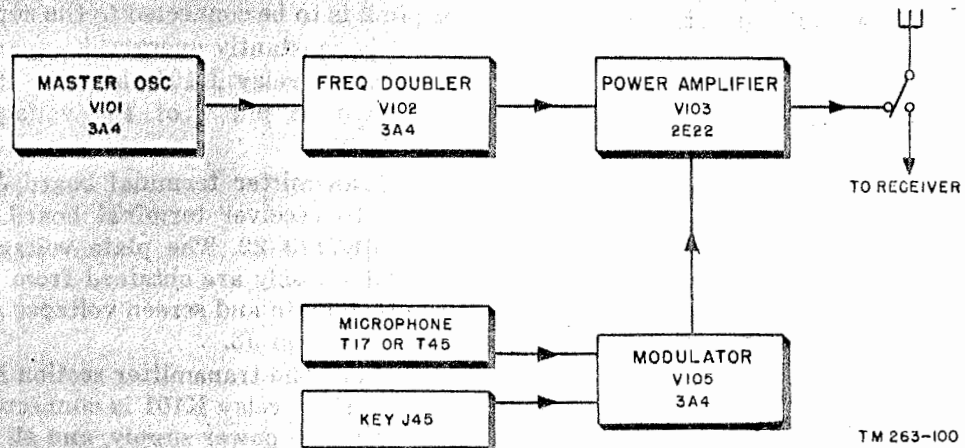


Figure 66. Block diagram of transmitter section of receiver-transmitter RT-77/GRC-9.

Section II. THEORY OF TRANSMITTER SECTION OF RADIO SET AN/GRC-9

91. Block Diagram (fig. 66)

a. GENERAL. The transmitter section of Receiver-Transmitter RT-77/GRC-9 consists of a master oscillator, frequency doubler, power amplifier, and modulator circuit as shown in the block diagram (fig. 66). The circuit is designed to provide c-w, mcw, and voice modulated signals over a frequency range of 2.0 to 12.0 mc. As in the case of the receiver, the frequency range is covered in three bands, 2.0 to 3.6 mc, 3.6 to 6.6 mc, and 6.6 to 12.0 mc.

b. BLOCK DIAGRAM (fig. 66). The block diagram shows a master oscillator, which can be either self-excited or crystal-controlled, to supply an r-f signal voltage to the grid of the doubler stage whose plate circuit is tuned to the second harmonic of the input signal. The output of this stage is fed to the grid of the power amplifier stage at a sufficient power level to drive the power amplifier as a Class C amplifier. The modulator circuit supplies the audio power necessary to *suppress grid modulate* the power amplifier during phone and mcw operation. The output of the power amplifier is then coupled

to the antenna through a suitable coupling network.

92. Master Oscillator (Noncrystal-controlled Tube V101, Tube Type 3A4) (fig. 67)

a. The oscillator section of the transmitter may be either crystal-controlled or a self-excited tuned-plate tickler coil feedback oscillator. For the present, the noncrystal-controlled master oscillator will be discussed for band 1.

b. The upper coil of assembly T101 is in the plate circuit of V101 and is tuned to any frequency from 3.3 to 6 mc, considering band 1 only, by means of ganged capacitor C101A, control ⓐ, alignment trimmer C106B, calibrating capacitor C102, control ⓑ, and fixed capacitor C146. Ganged capacitor C101A is plugged into terminal board J101A, and is therefore a complete plug-in unit. Plate voltage to V101 is applied through filter resistor R103 which is bypassed for r-f by filter capacitor C104 and resistors R105, R120, and R121. Screen grid voltage is fed through dropping resistor R101 which is bypassed for r-f by capacitor C103.

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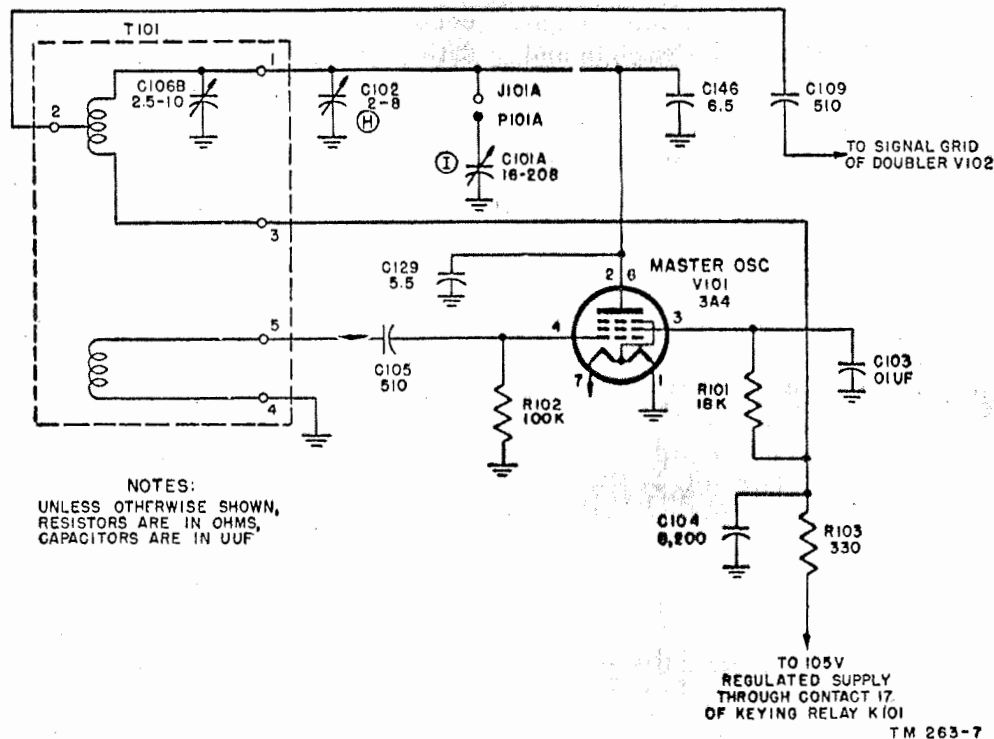


Figure 67. Transmitter master oscillator, simplified schematic.

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 trolled)
 smitter
 -excited
 or. For
 master
 s in the
 ny fre-
 band 1
 A, con-
 brating
 apacitor
 ed into
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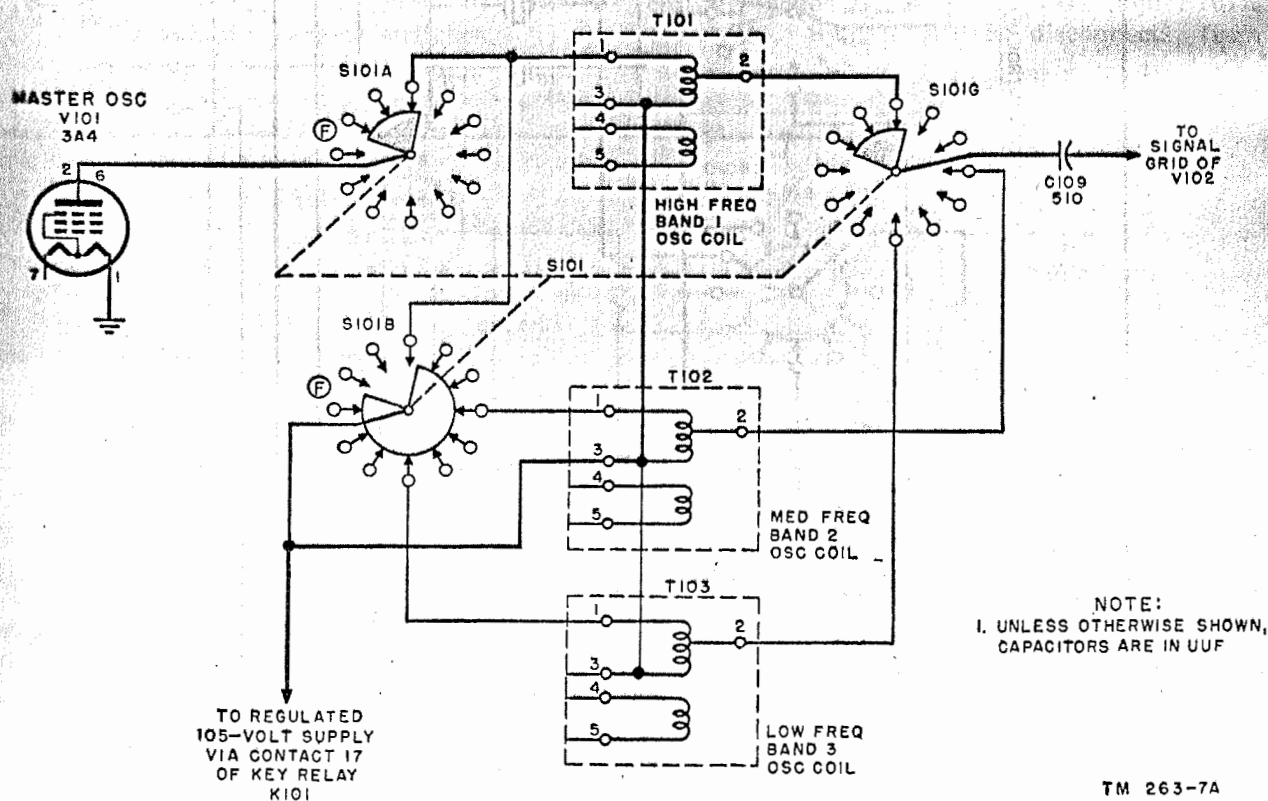


Figure 68. Master oscillator switch sections S101A and S101B.

c. The coupling necessary to sustain oscillations is produced magnetically by the plate and grid circuit coils of T101.

d. The control grid receives its d-c bias from the combination of grid leak resistor R102 and capacitor C105. The output from the oscillator is fed through capacitor C109 to the voltage

doubler V102. C146 is a temperature compensating capacitor.

e. From the upper left of the main schematic (fig. 139), it can be seen that seven sections of switch S101, control ©, are associated with the oscillator circuit of V101.

(1) S101A (fig. 68). Section A of S101

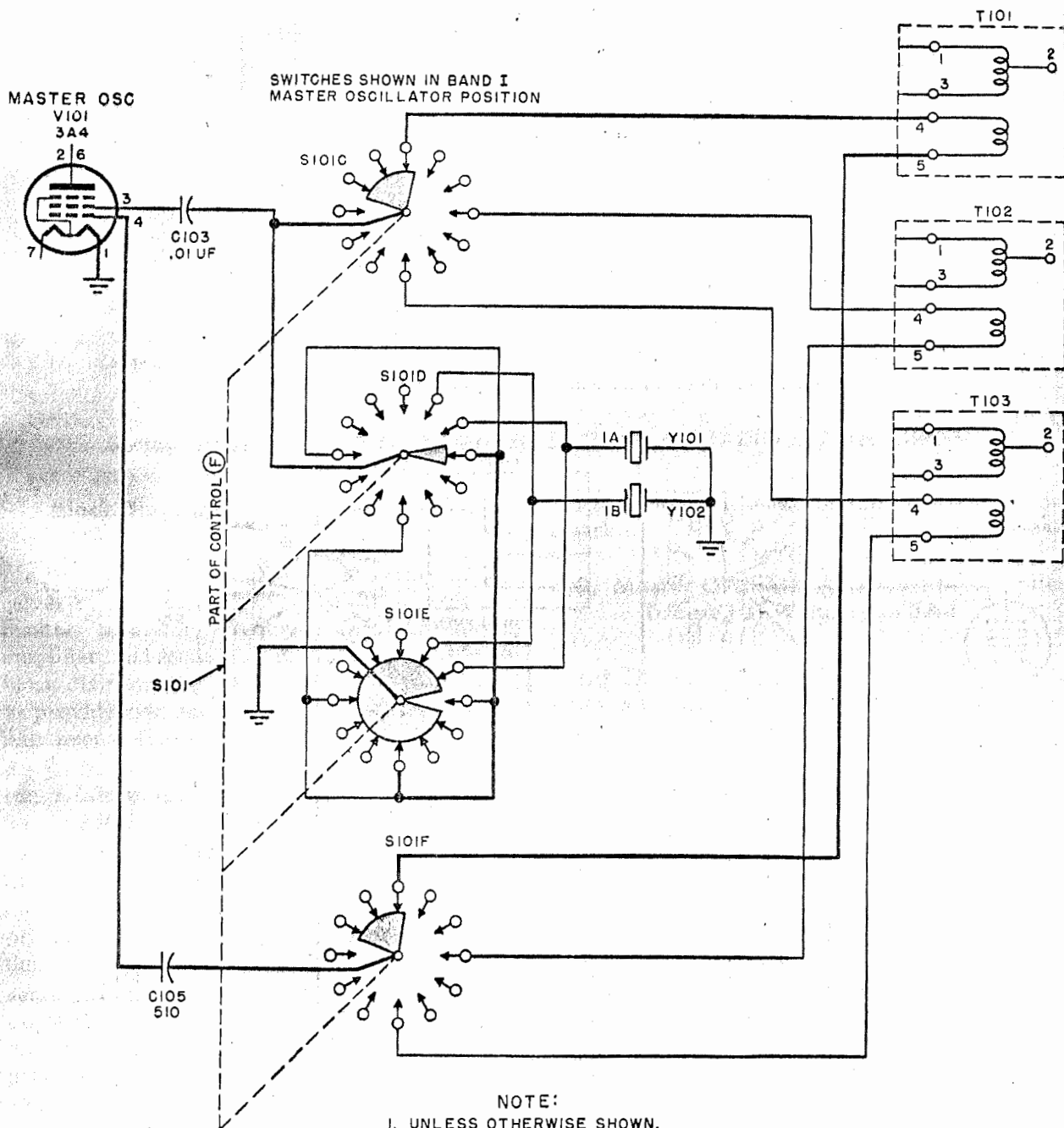
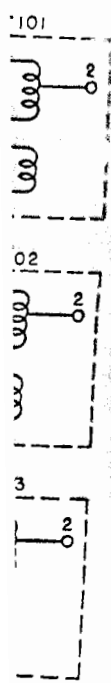


Figure 69. Master oscillator switch sections S101C, D, E, and F.

TM 263-7B

det
cir
cor
tur
wc
V1
T1
th
(2) S1
sh
so
co
ac
sil
(3) S
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determines which of the three plate circuit coils is to be used. Thus, should control © on the transmitter panel be turned to BAND 1, switch S101A would lead the plate current of tube V101 to the larger coil in transformer T101, and no other. This is shown by the weighted line in figure 68.

- (2) *S101B* (fig. 68). Section B of S101 shorts out the other unused plate coils so as to prevent interaction with the coil circuit being used; such interaction tends to cause undesirable parasitic oscillations.
- (3) *S101C* (fig. 69). Section C of S101 selects the proper grid circuit coil for the frequency selected. This is done in conjunction with switches S101D, S101E, and S101F which connect the coil selected to the grid by capacitor C105. Since the entire bank of switches is ganged, the grid coil is automatically connected to the grid circuit. By following the weighted line, starting at the signal grid of V101, the entire grid circuit path may be traced through the various switches.

- (4) *S101D*. Section D of S101 selects, during crystal operation, the proper crystal to be used for the frequency desired. Section D also connects the grid coil to ground through section E, as shown in figure 69.
- (5) *S101E*. The rotor of section E is permanently connected to ground and serves as the actual ground connection for the coil selected. It also shorts out all or any crystals that are not in use.
- (6) *S101F*. Section F of S101 connects the selected coil to the grid of tube V101 through capacitor C105.
- (7) *S101G* (fig. 68). Section G of S101 connects oscillator voltage from the plate coil in use to the signal grid of the voltage doubler V102.

93. Crystal Oscillator (Crystal-controlled) (fig. 70)

a. When control © is at one of the XTAL positions, the circuit then functions as a crystal oscillator. Crystal 1A is placed in the grid circuit by means of switches S101D and S101E (fig. 71). Switch S101E disconnects from

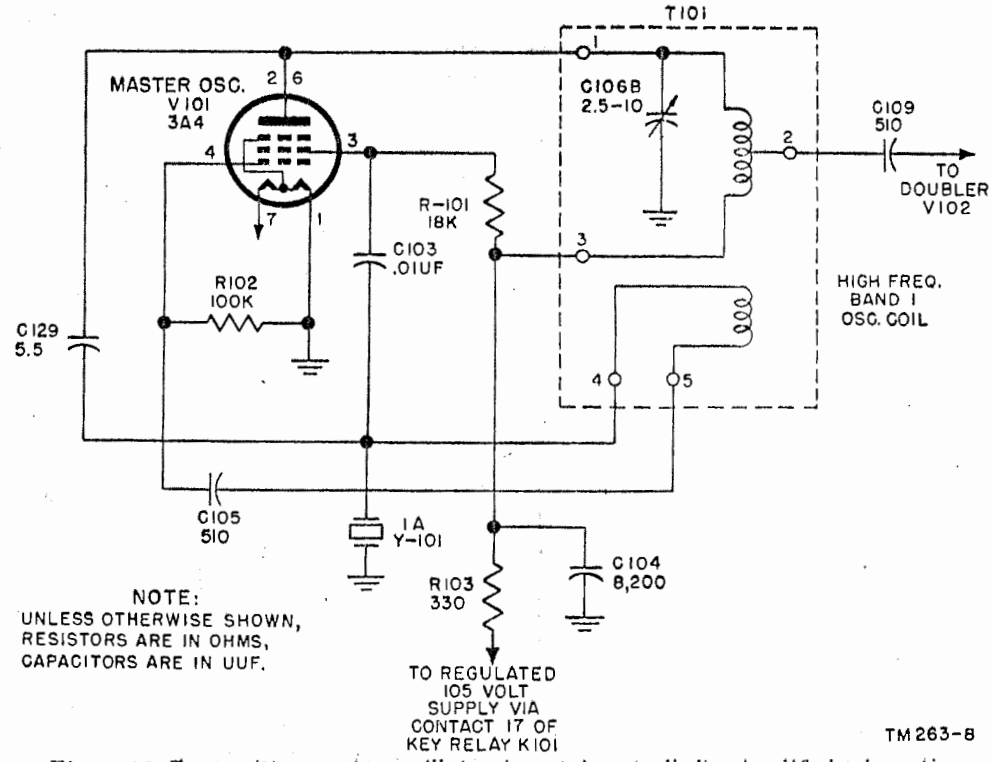


Figure 70. Transmitter master oscillator (crystal-controlled), simplified schematic.

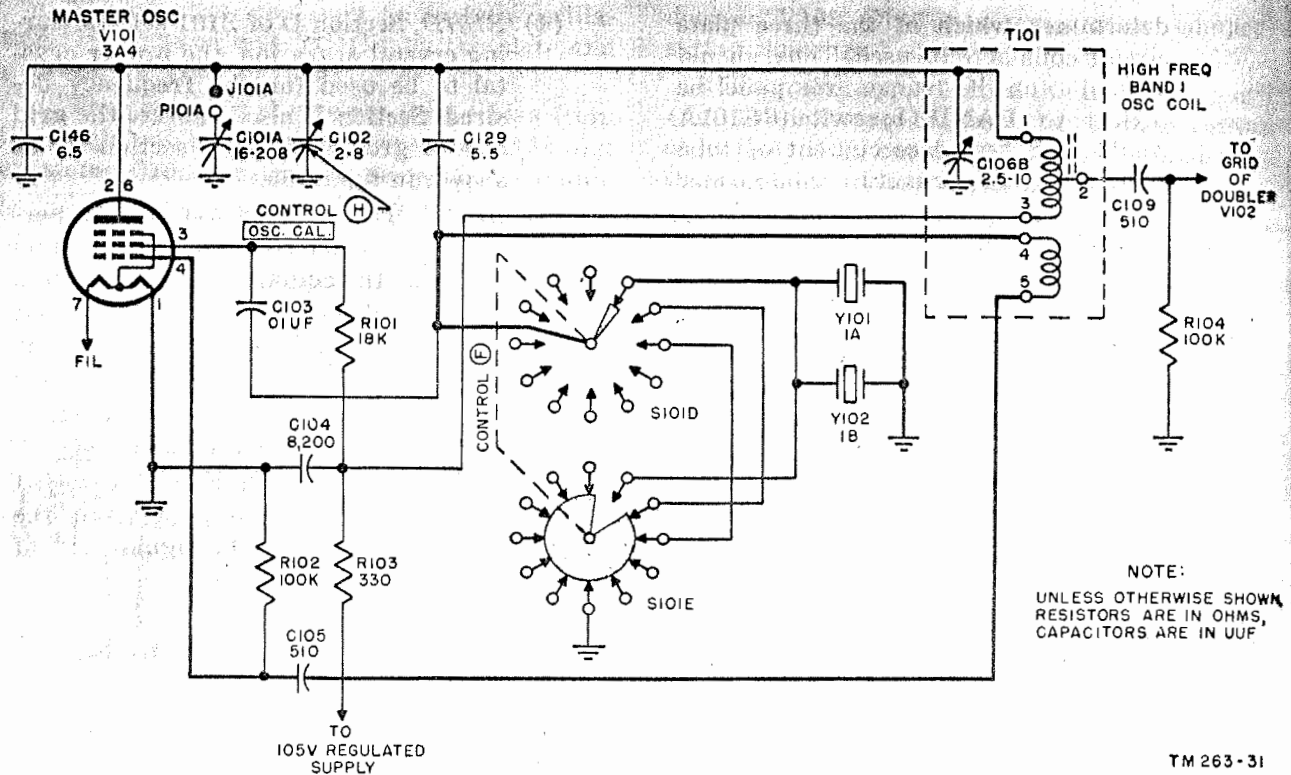


Figure 71. Transmitter master oscillator (crystal-controlled), switch sections S101D and S101E, simplified schematic.

ground the crystal used, and connects to ground all unused crystals.

b. Screen grid capacitor C103, which was an r-f bypass for MO operation, becomes by means of switches S101D and S101E, the coupling capacitor from the screen grid to the oscillator crystal. When control © is at one of the XTAL positions, the circuit function is the same as for MO operation except that the ungrounded crystal circuit is coupled to the screen. When the tuned circuit is adjusted to the crystal, fre-

quency V101 will oscillate by virtue of the fact that the combination of capacitor C103 and the crystal results in a low-impedance circuit on the screen grid. If the circuit is tuned to any other frequency but the crystal frequency, the resultant high-impedance circuit is not effectively bypassed to ground and the oscillation will cease since neither the screen grid nor the low r-f side of the feedback winding in the oscillator grid (pin 4) circuit is effectively bypassed to ground.

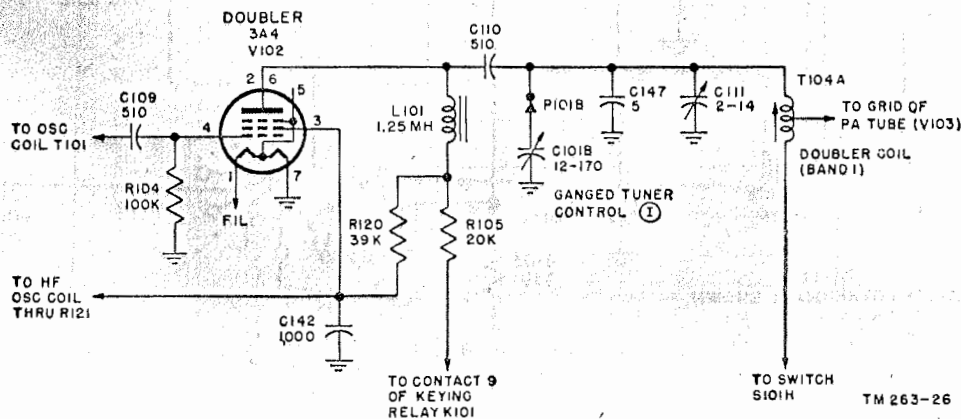


Figure 72. Frequency doubler stage V102, simplified schematic.

c. Resistor R102 is still the grid bias resistor as in MO operation, while capacitor C105 is the grid leak capacitor. R104 is an r-f decoupling resistor.

d. Capacitor C129, which connects from the tube plate to the crystal, is used to provide degenerative feedback from the plate circuit to the crystal. This circuit allows crystals of a wide range of activities to be used. The plate circuit is tuned to the crystal frequency desired by capacitor C101A, control ③.

e. Tube V101 is in operation only when the key is depressed or the press-to-talk switch on the microphone is pushed. This is so because V101 derives its plate and screen voltage through keying relay K101 and the relay is actuated only when the microphone or key is in use. Tube V101 also operates on the NET position of control ④, regardless of the position of relay K101.

94. Frequency Doubler V102, Tube Type 3A4 (fig. 72)

a. The output of the oscillator V101 is coupled by capacitor C109 to the frequency doubler stage V102, which uses a tube type 3A4.

b. The doubler is operated as a Class C amplifier and is adjusted to distort the frequency input to its grid. The tuned tank coil in the plate circuit is tuned to resonance at a frequency just twice that of the incoming oscillator signal and, therefore, selects only the second harmonic of the oscillator output to pass on to the power amplifier.

c. The output of the oscillator stage is coupled to the control grid of the doubler stage by capacitor C109 and grid return resistor R104. The load in the plate circuit of V102 consists of a parallel resonant circuit, using T104 which is slug-tuned, alignment capacitor C111, fixed capacitor C147, and ganged tuning capacitor C101B. Capacitor C101B is connected to the transmitter through plug P101B by means of which it may be easily removed from the transmitter for replacement. Capacitor C110 is used to block the d-c plate voltage from the tuned circuit.

d. The plate of V102 is shunt-fed through choke coil L101 in series with dropping resistor R105. The voltage to the screen is made lower than the plate voltage by means of dropping

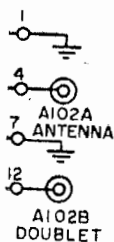
resistor R120. The combination of R120 and R105 is bypassed to ground, for r-f screen current, through capacitor C142. Plate and screen voltages to the doubler are cut off when the keying relay is open. When the key is depressed, the relay closes and the doubler then receives voltage for operation.

e. From the main schematic (fig. 139), it can be seen that switches S101H, S101I, and S101J are associated with the doubler tuned circuits. These are part of control ④ on the transmitter panel. There are three plate coils, one for each of the three transmission bands. Switch S101I determines which of these coils is connected to the plate of tube V102. Switch S101H shorts out the other two coils that are not being used. Switch S101J connects the doubler output from the coil in use to the grid, pin 3, of the power amplifier tube V103. All these switches are ganged.

95. Power Amplifier Stage V103, Tube Type 2E22 (fig. 73)

a. GENERAL. In order that the antenna receive sufficient power for radiation of the signal, a power amplifier is coupled between the voltage doubler and the antenna. This amplifier is operated Class C. Modulation of the signal takes place in the power amplifier stage. Three types of signal are possible: cw, mcw, and phone. The process by which modulation is accomplished is the variance of the *suppressor grid* voltage by means of a modulator tube, and is explained more fully in paragraph 97.

b. SIGNAL PATH. The signal enters the amplifier grid, pin 3, directly from the plate load coil of the preceding doubler stage V102, through the switch S101J. After amplification by the tube the signal leaves the plate and enters one of the tuned tank circuits selected by band switch S101L, control ⑤. Since the transmitter is designed to operate with a whip, long-wire, or doublet (with a 72-ohm transmission line) antenna, it is necessary to provide the correct matching circuit for maximum power transfer. Thus S101M, which selects the output from the plate coil in use, leads the signal to switches S102A, B, C, D, and E, control ⑥. This last bank of switches selects the proper matching circuits for the antenna being used. After the signal has



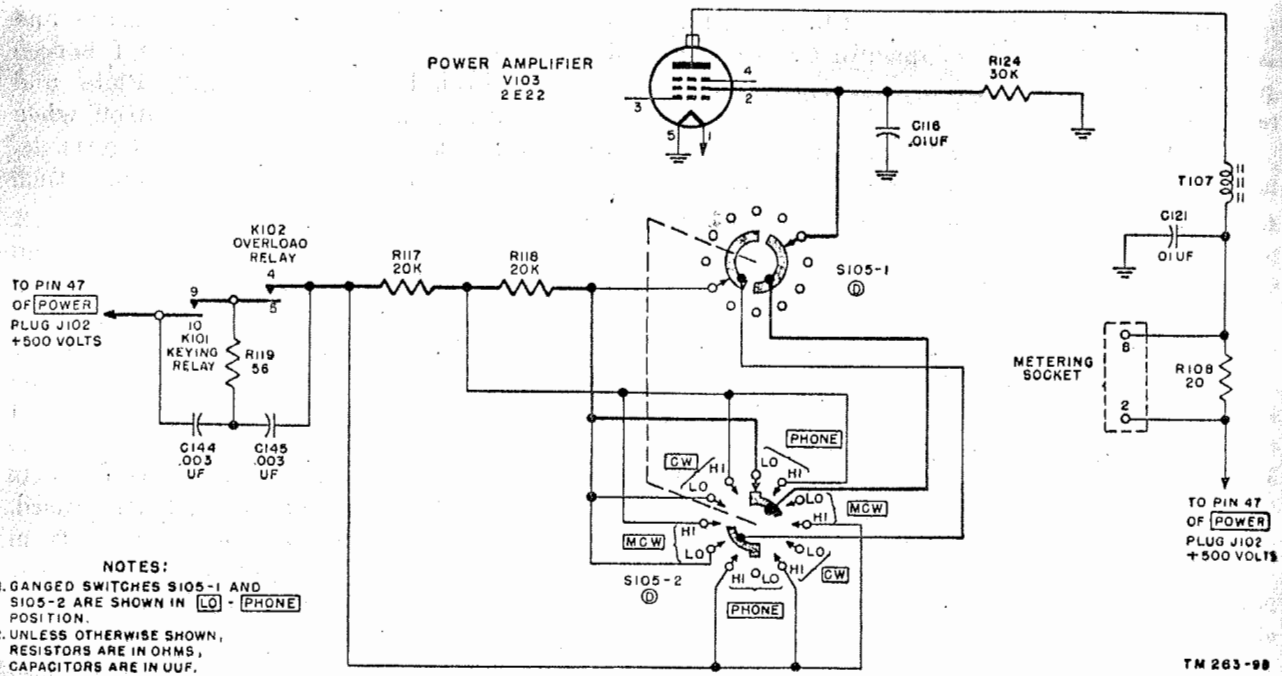


Figure 74. Power amplifier screen grid circuits arranged for LO (low) power operation.

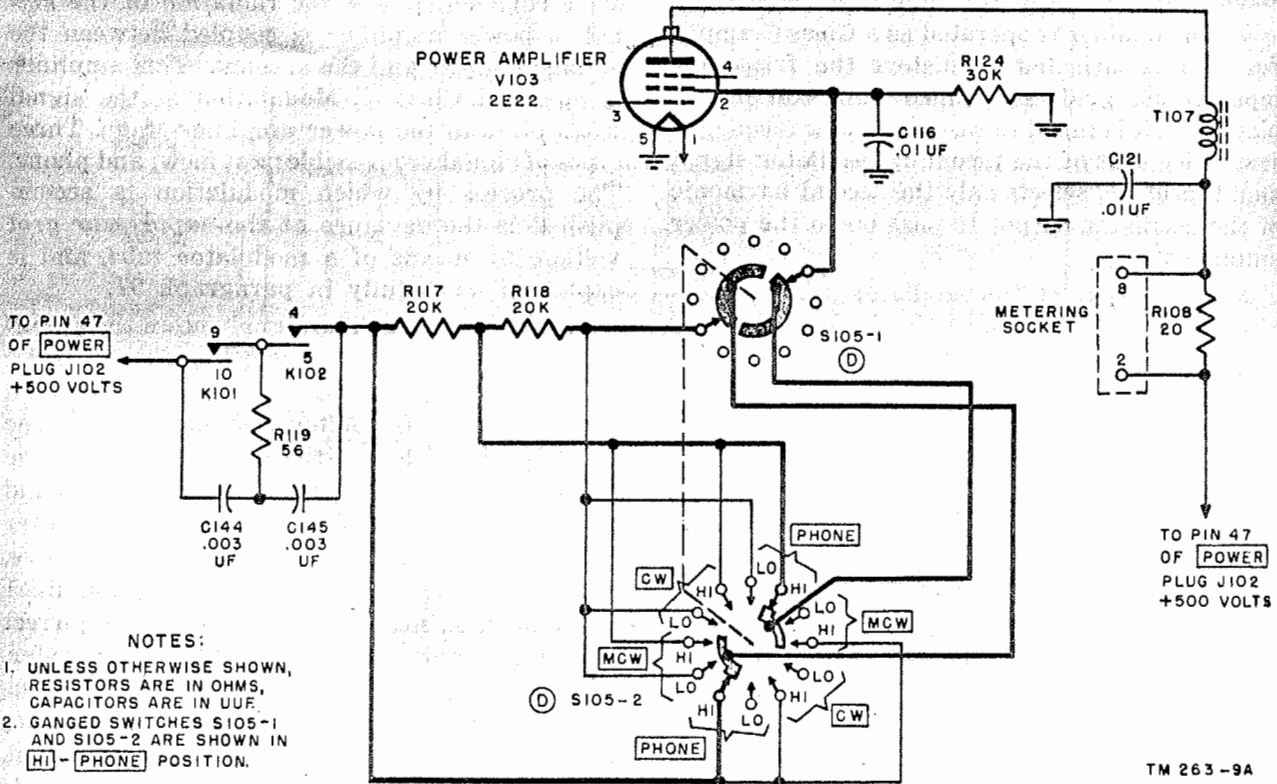


Figure 75. Power amplifier screen grid circuits arranged for HI (high) power operation.

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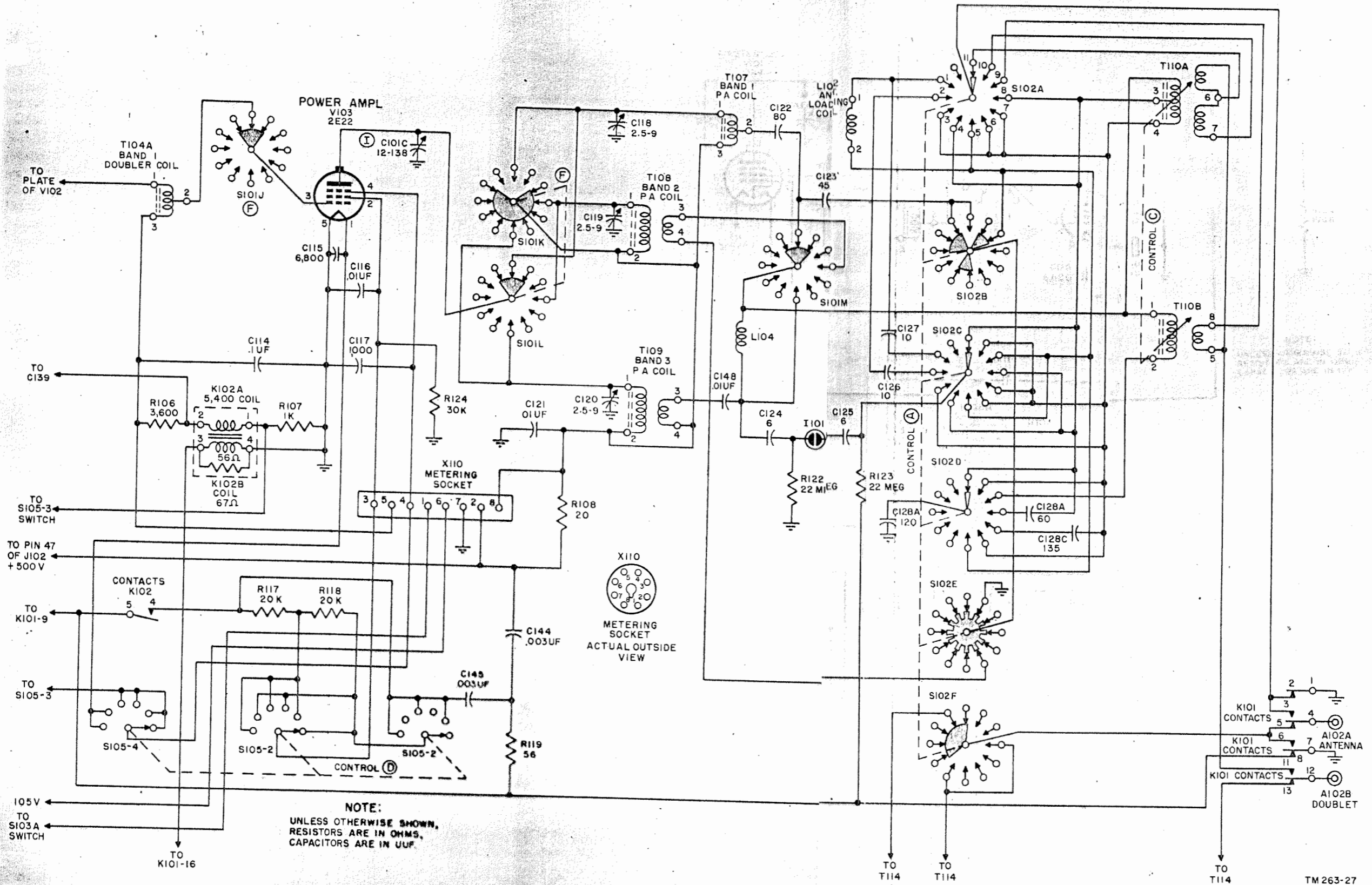


Figure 73. Transmitter power amplifier stage V103, simplified schematic.

c. Resistor R102 is as in MO operation, and grid leak capacitor resistor.

d. Capacitor C129 tube plate to the crystal generative feedback the crystal. This circuit is tuned to the wide range of activity by capacitor C101A.

e. Tube V101 is key is depressed or the microphone is V101 derives its through keying re. actuated only when in use. Tube V101 position of control of relay K101.

94. Frequency Do (fig. 72)

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c. The output... pled to the contr... capacitor C109... The load in the... of a parallel res... is slug-tuned, a... capacitor C147... C101B. Capaci... transmitter thr... which it may be... mitter for repl... to block the d... circuit.

d. The plate... choke coil L101... R105. The vol... than the plate

been led to the proper transformer T110A or B, it goes to contacts 3 and 11 of keying relay K101, and when the key or microphone is in use, it is fed to the antenna and radiated out into space.

c. **SIGNAL GRID CIRCUIT.** Switch S101J selects the output of the doubler coil for the band in use and applies this output to the grid, pin 3, of the power amplifier. The grid return is through resistor R106, relay coil K102A, and resistor R107. The d-c bias for the tube is developed across these three items, while they are bypassed for r-f by capacitor C114. Pin 1 of the filament is bypassed to pin 5 of the filament with capacitor C115. Capacitor C115 bypasses to ground the unwanted r-f pickup of the lead connected to pin 1. Relay coil K102A has its contacts in the screen grid circuit and should grid excitation fail, these contacts open, removing voltage from the screen and preventing destruction of the tube (*f* below).

d. **SCREEN GRID CIRCUIT, HI AND LO POWER** (fig. 74).

- (1) The power output of the power amplifier is controlled by varying the screen grid voltage. R124, the screen grid bleeder, stabilizes the screen grid voltage. There are two possible levels of output; HI and LO power, and these are selected by switches S105-1 and S105-2, control \odot . If the weighted line in figure 74 is followed from the screen grid, pin 2 of V103, it will be seen that the screen current passes through S105-1 and S105-2 to the series combination of resistors R117 and R118, and then to the power supply through the contacts of relays K102 and K101. This series arrangement of the two resistors is the LO power circuit since the screen of V103 is at a low potential because of the large drop across the series combination of R117 and R118. When HI power output is desired, ganged switches S105-1 and S105-2 are turned to HI and R117 is then placed in parallel with R118 (fig. 75). There is less voltage drop across the parallel combination than the series combination and thus the screen grid has more voltage placed upon it. The screen grid voltage de-

termines, to a large extent, the current through the tube and therefore the power output.

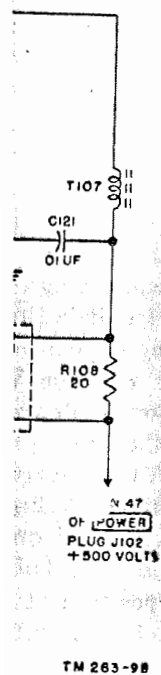
- (2) Resistor R124 forms a voltage divider system with the combination of R117 and R118 across the power supply, and the screen grid receives its voltage from across R124. Capacitor C116 is the screen grid bypass which is used to bypass r-f currents directly to ground, and not through the screen supply circuit.

e. **SCREEN CIRCUIT CUT-OUT RELAYS.** The contacts of two different relays are in series with the screen to open or close the circuit. Relay K101 is controlled by the keying circuit and is normally open, so that the screen grid does not receive any voltage and the power output of the power amplifier stage is almost zero. This makes the transmitter inoperative while the receiver is being listened to. However, when the key is depressed or the press-to-talk switch on the microphone is pushed, relay coil K101 is energized and contacts 9 and 10 in the screen circuit of V103 are closed. These contacts permit screen current to flow and the transmitter is then in operation.

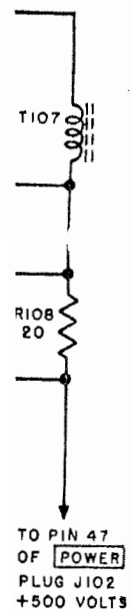
f. **RELAY K102A.** The contacts of relay K102A are located in series with the screen grid, but the relay coil is in series with the control grid, pin 3 of V103 (fig. 139). Thus, the direct current in the control grid circuit flows through the relay, keeping contacts 4 and 5 closed during transmitter operation. Should the signal grid excitation be cut off for any reason, the grid current would cease and the relay would no longer be energized; the contacts in the screen circuit would open and the screen would no longer receive any voltage. This arrangement, which cuts off screen grid voltage when excitation fails, is necessary to prevent damage to the power amplifier tube and circuit. The tube is a Class C amplifier with 500 volts on the plate, and the negative grid bias is developed solely by the d-c grid current. Therefore, if the grid excitation should fail, there would be no negative bias on the grid. This would result in a plate current large enough to ruin the tube.

g. **RELAY COIL K102B.**

- (1) Relay coil K102B is placed on the same iron core as section K102A. One



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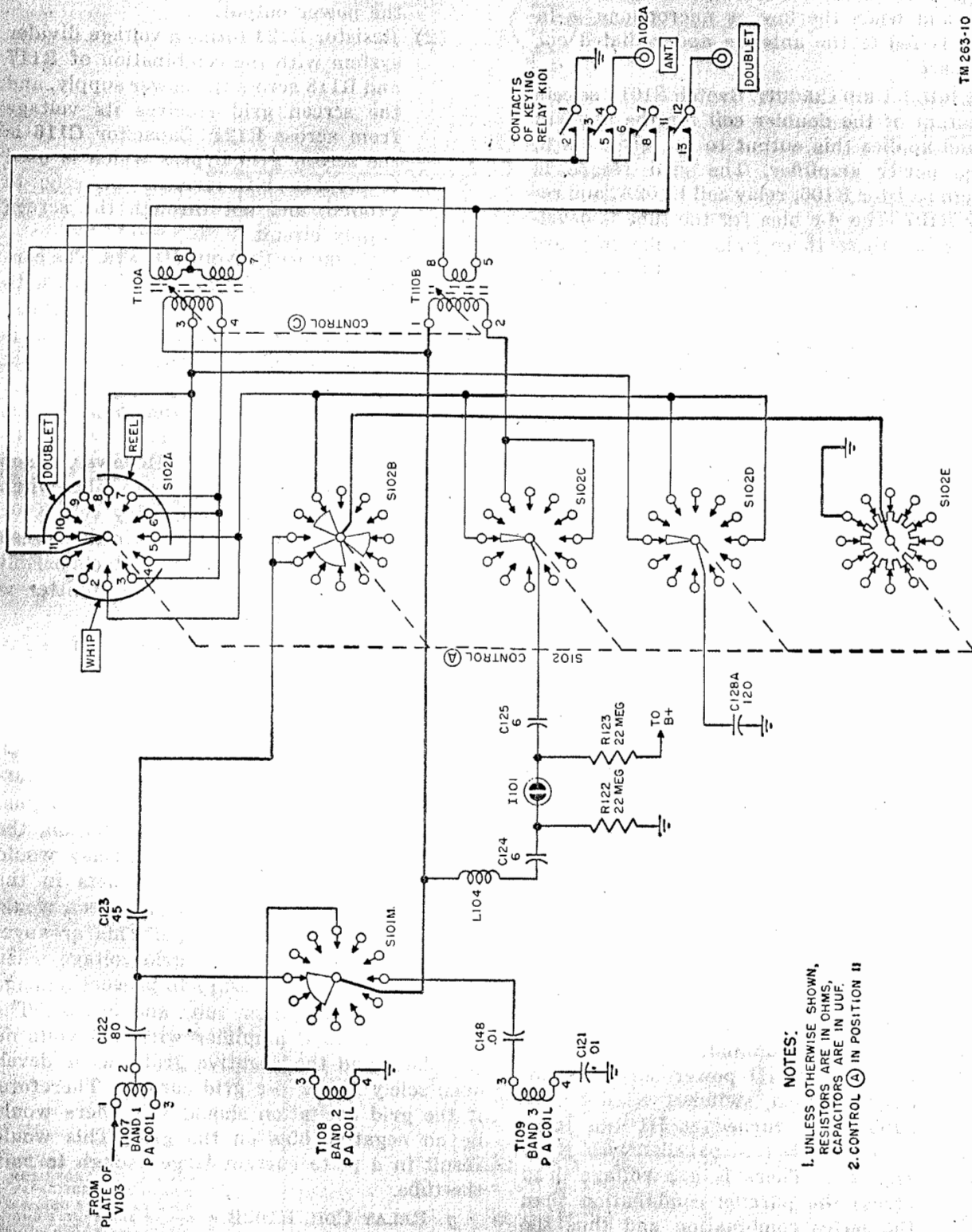


Figure 76. Antenna switching and tuning circuits for transmitter.

TM 263-10

- NOTES:
1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
 2. CONTROL (A) IN POSITION II

end of K102B connects to ground. The other end leads through contacts 15 and 16 of keying relay K101 (fig. 139) to switch S103A, which connects to the 6.3-volt regulated supply voltage. Contacts 15 and 16 are closed only when the receiver is being operated and, therefore, coil K102B is energized only when the receiver is operating. Thus, there is some magnetism in the iron core even when the transmitter is not in use, as when the key is up, or when the press-to-talk switch in the microphone is not depressed.

- (2) As soon as the key is pressed down, a small signal current starts to flow in the power amplifier grid circuit, causing coil K102A to be energized and contacts 4 and 5 to close. Because coil K102B had already been energized and the iron core magnetized when the key was up, it is possible for the signal current through K102A to be only a very small value to close contacts 4 and 5. Therefore, more rapid keying is allowed since, almost immediately upon key closure, coil K102A has enough energy to close the power amplifier screen grid circuit.
- (3) If coil K102A had to magnetize the iron core from a point of zero magnetism, there would be an appreciable time lag until the current through K102A became great enough to produce a magnetic field strong enough to close contacts 4 and 5.

A. ARC SUPPRESSION. When the contacts of relays K101 and K102 open, arcs are formed which create r-f disturbances, called *key-clicks*, in addition to damaging the contacts. These arcs can not be eliminated but the length of their duration with each opening of the contact can be shortened considerably by means of a suitable filter or arc suppression circuit. This is the function of capacitors C144 and C145 and resistor R119 (fig. 75).

i. PLATE CIRCUIT (fig. 73). The signal from the plate of V103 enters the coil selector switch S101L, control ①. Coil T107, T108, or T109 may be selected, depending on the band of transmission desired. Capacitor C101C is the main tuning capacitor for the coil selected and is ganged to

the other tuning capacitors, control ②, for the preceding stages. Switch S101K shorts out those tuning coils which are not in use. Considering band 1, capacitor C118 is the alinement trimmer. The bottom of each coil is connected to resistor R108 and from there directly to the 500-volt d-c supply (fig. 73). Two leads are connected from across R108 to the metering socket. This is a means whereby the current in the plate circuit can be measured. Capacitor C121 is the bypass for R108, and places the lower end of coils T107, T108, and T109 at ground r-f potential.

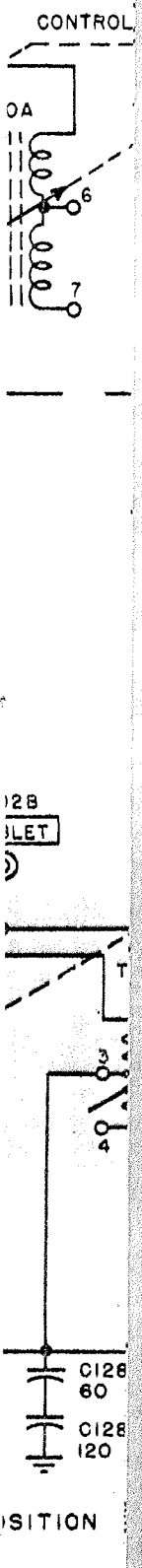
96. Antenna Switching and Tuning Circuits for Transmitter (fig. 76)

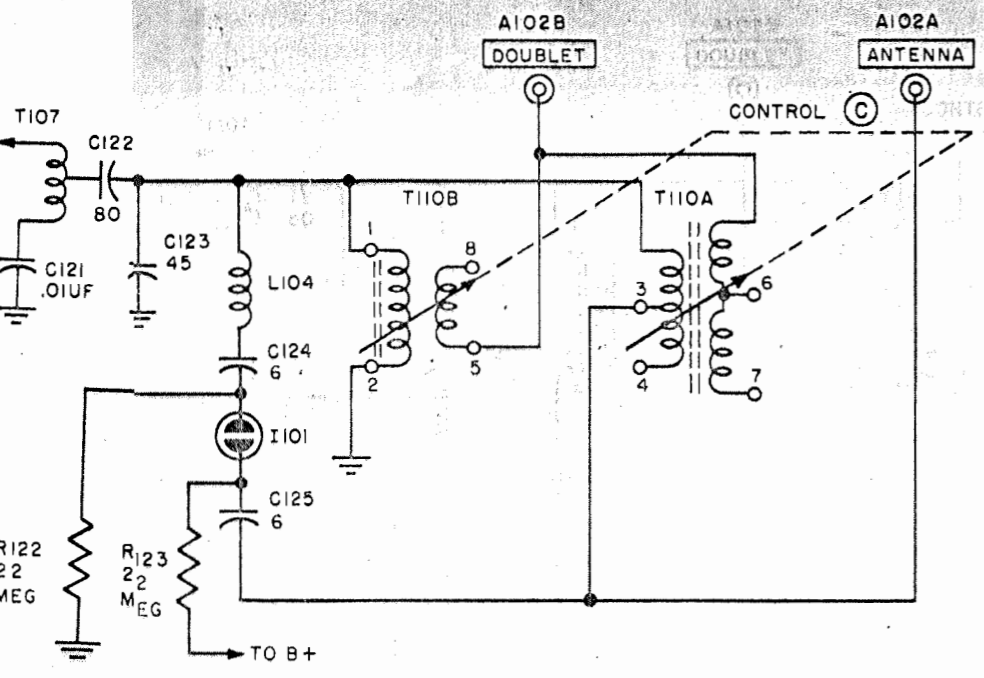
a. There are 11 possible positions for ganged switch bank S102, control ③ (fig. 76). Only switches A through E enter into transmitter operation. Section F is for receiver operation only. These 11 different positions are necessary so that the antenna will be matched to the power amplifier output coil for maximum power transfer throughout the entire frequency range of the transmitter. The functions of the different switch positions are:

- (1) Positions 1, 2, 3, and 4 match the power amplifier coil to a vertical mast or whip antenna for all frequencies.
- (2) Positions 5, 6, 7, and 8 match the power amplifier coil to an end-fed antenna for all frequencies.
- (3) Positions 9, 10, and 11 match the power amplifier coil to a center-fed or doublet antenna for all frequencies.

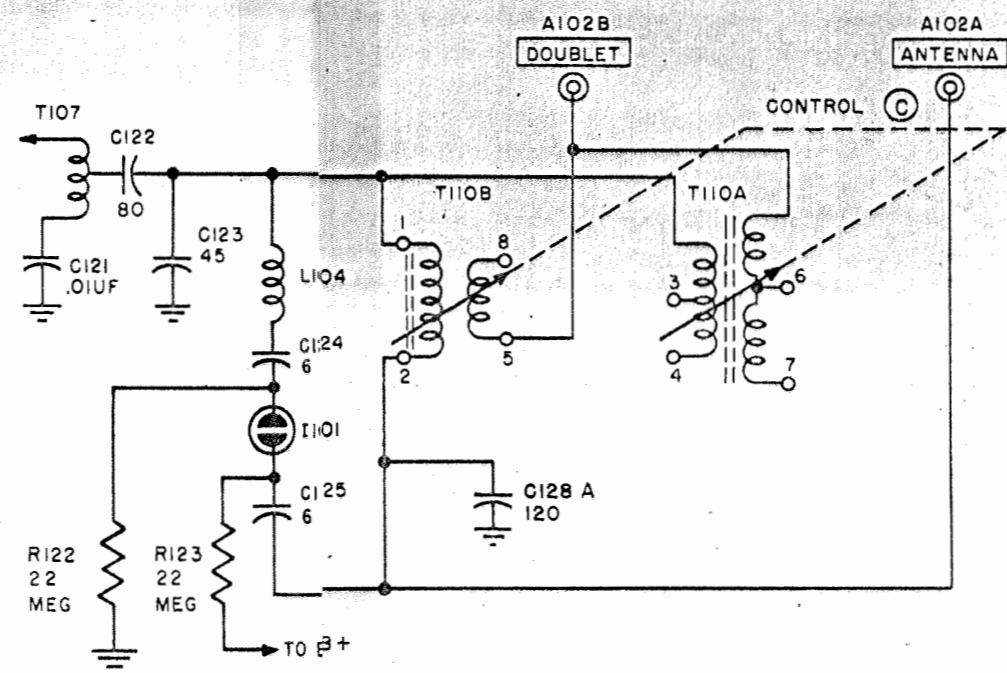
Note. Figure 77 shows, in simplified form, the different circuit elements connected for each of the 11 distinct positions of control ③.

b. The whip or long-wire antenna when connected to the ANT. post can be considered as an impedance to ground. For positions 1 through 8 of control ③, the antenna is in series with the primary of either transformer T110A or T110B and this series circuit is in parallel with a portion of coil T107. In position 1 only, loading coil L102 is added to the series combination. In positions 6, 7, and 8 additional capacity is placed in parallel with the antenna by means of capacitor C128A, C128B, or C128C. For the doublet circuit, positions 9, 10, and 11, the primary of transformer T110A or T110B is completed to ground through capacitor C128A.

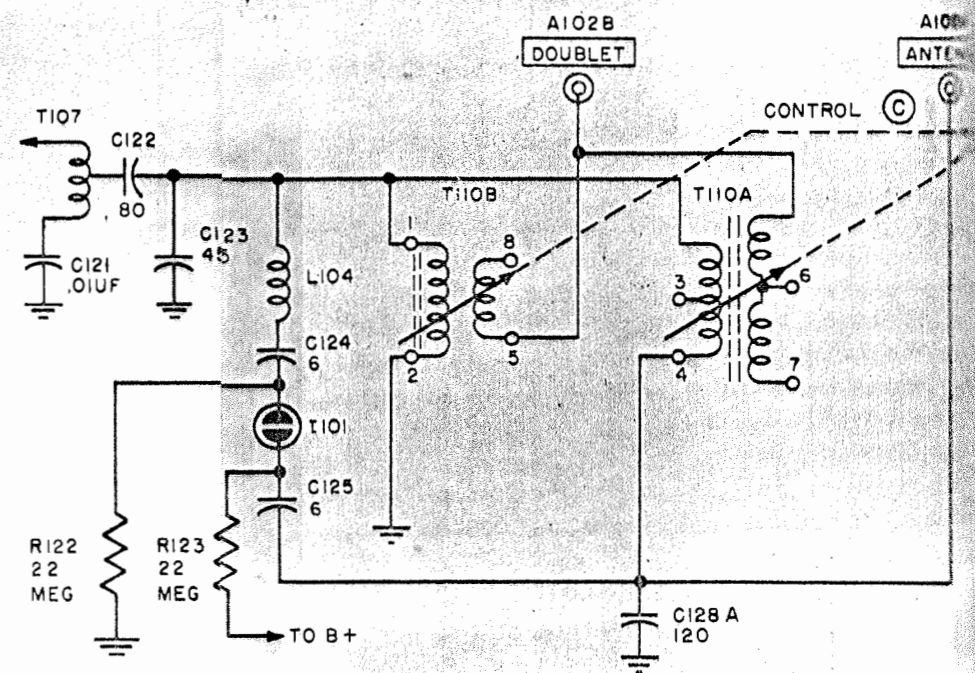




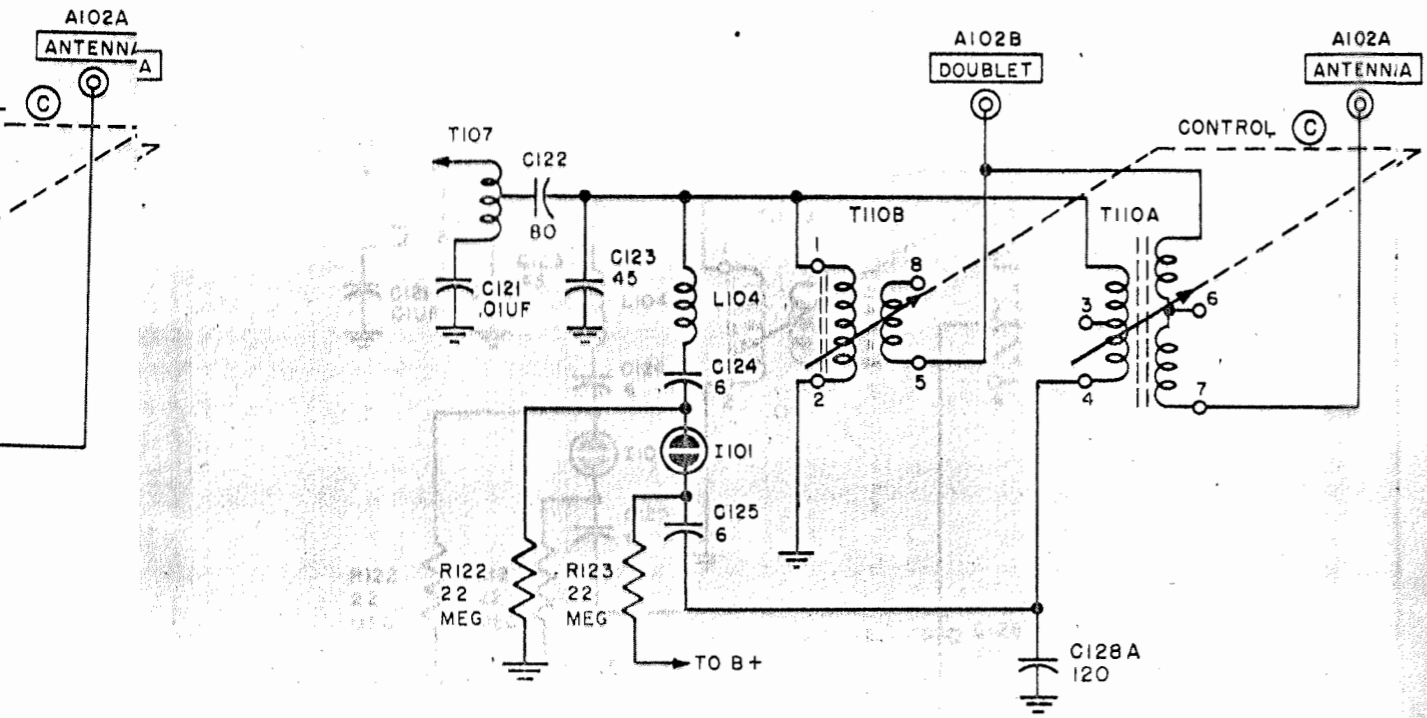
WHIP ④ POSITION



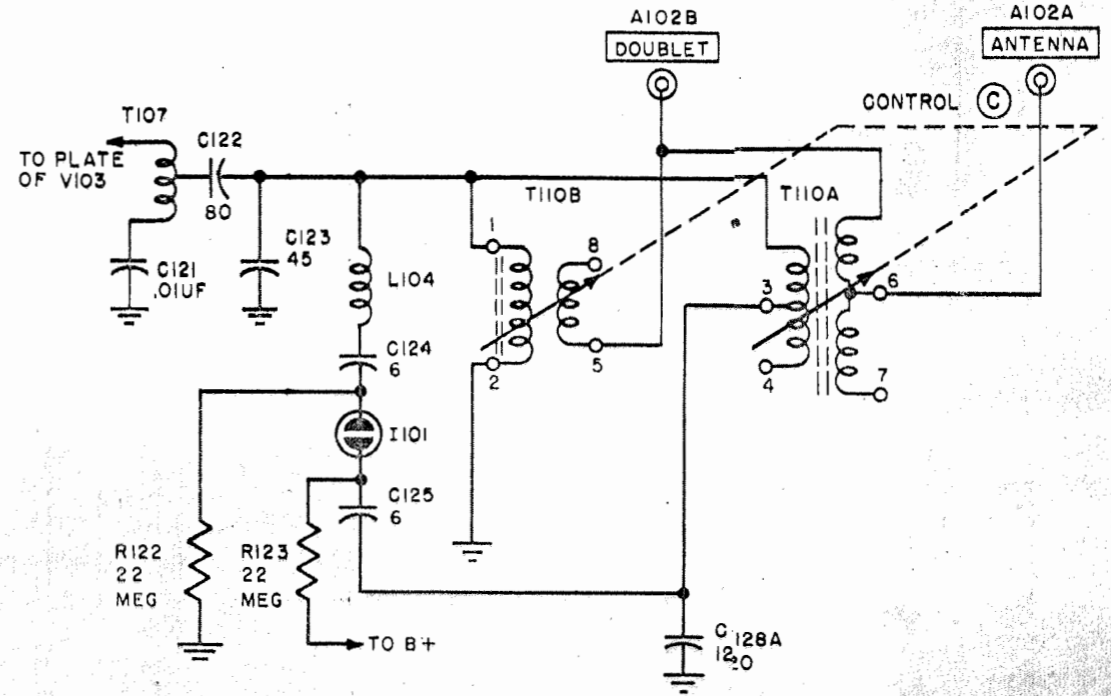
REEL ⑤ POSITION



REEL ⑥ POSITION



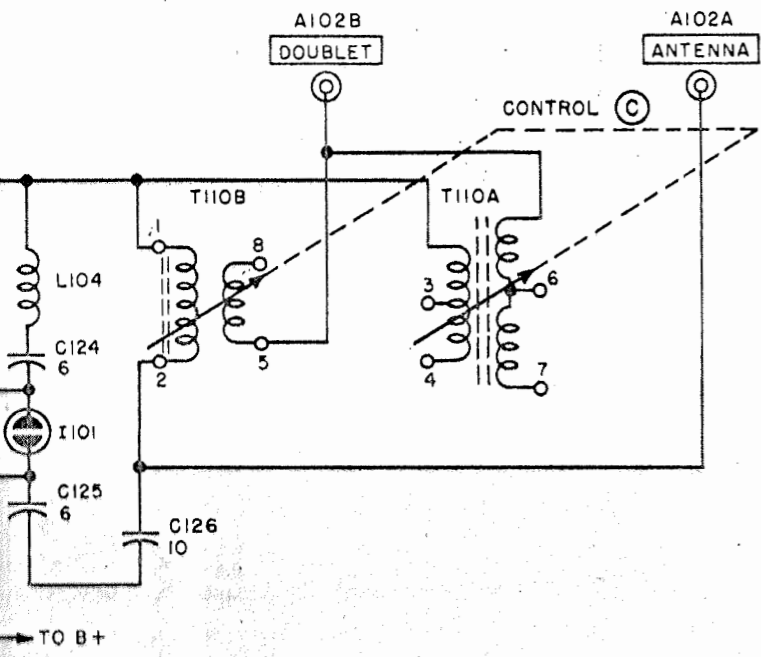
DOUBLET ⑩ POSITION



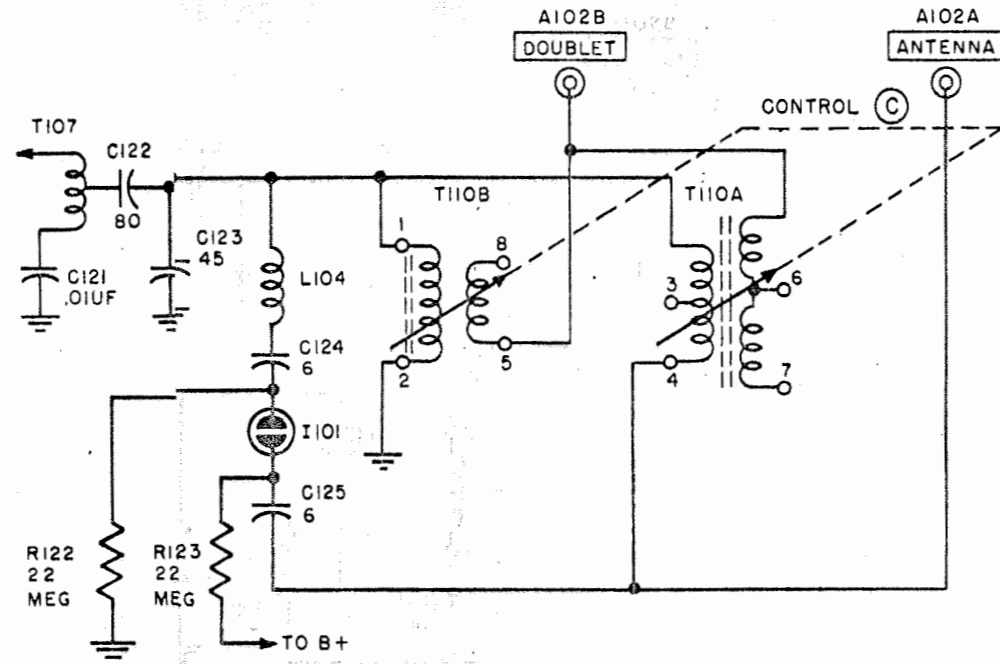
DOUBLET ⑪ POSITION

- NOTES:
1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
 2. IN LATER MODELS, R123 IS GROUNDED AND B+ IS FED TO R122 INSTEAD OF R123.

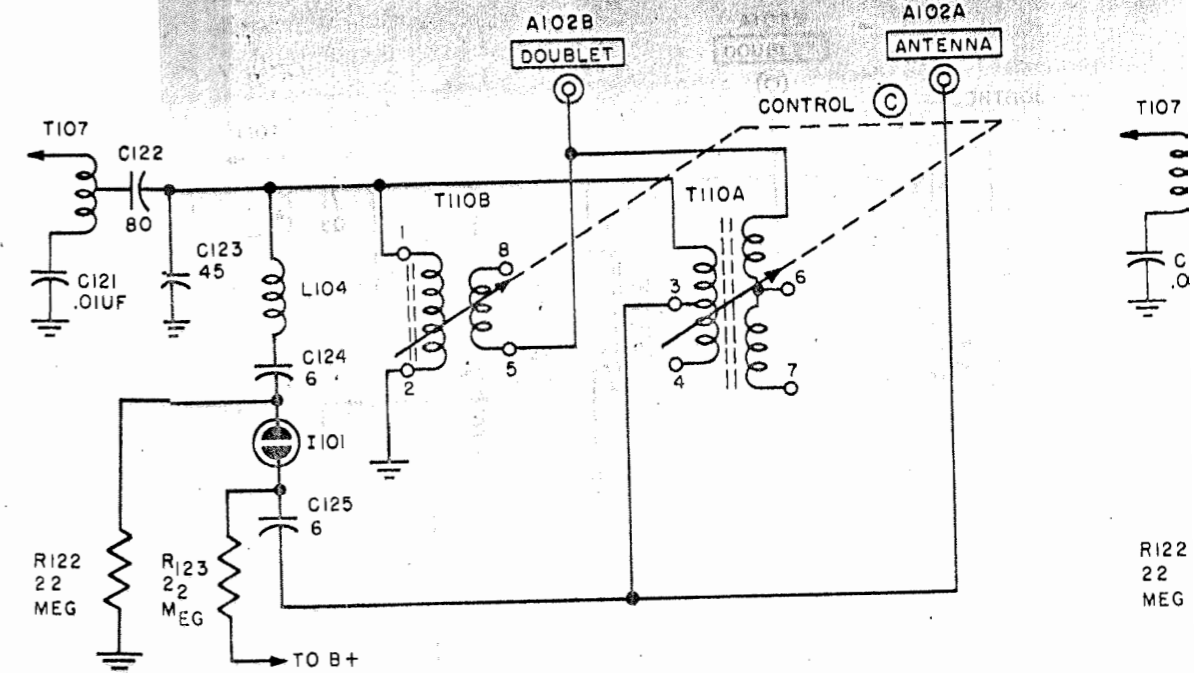
Circuits for transmitter, switch S102.02.



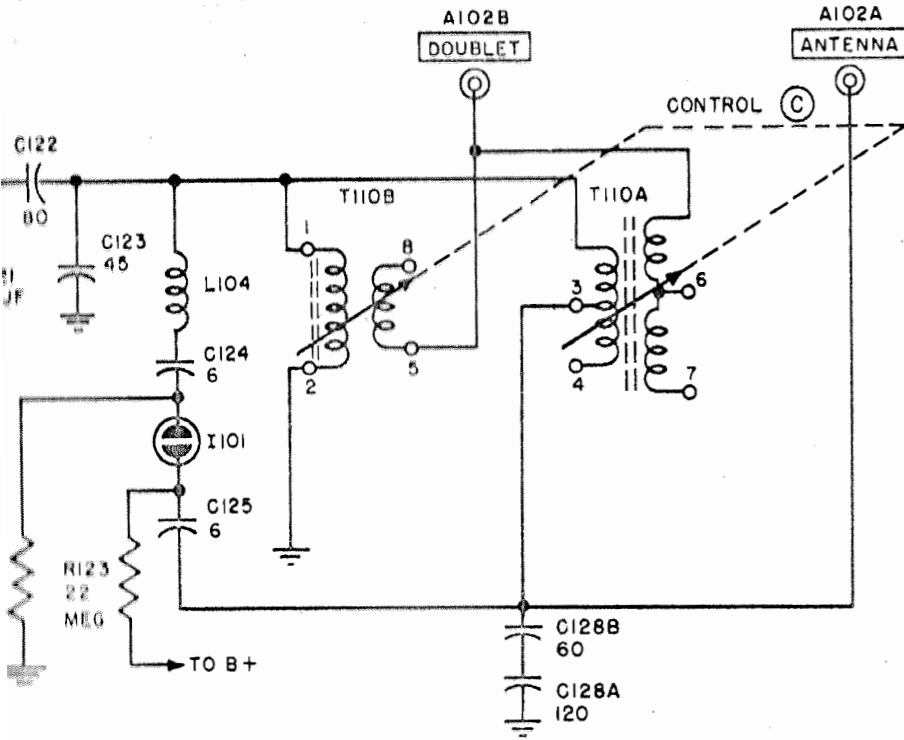
WHIP ② POSITION



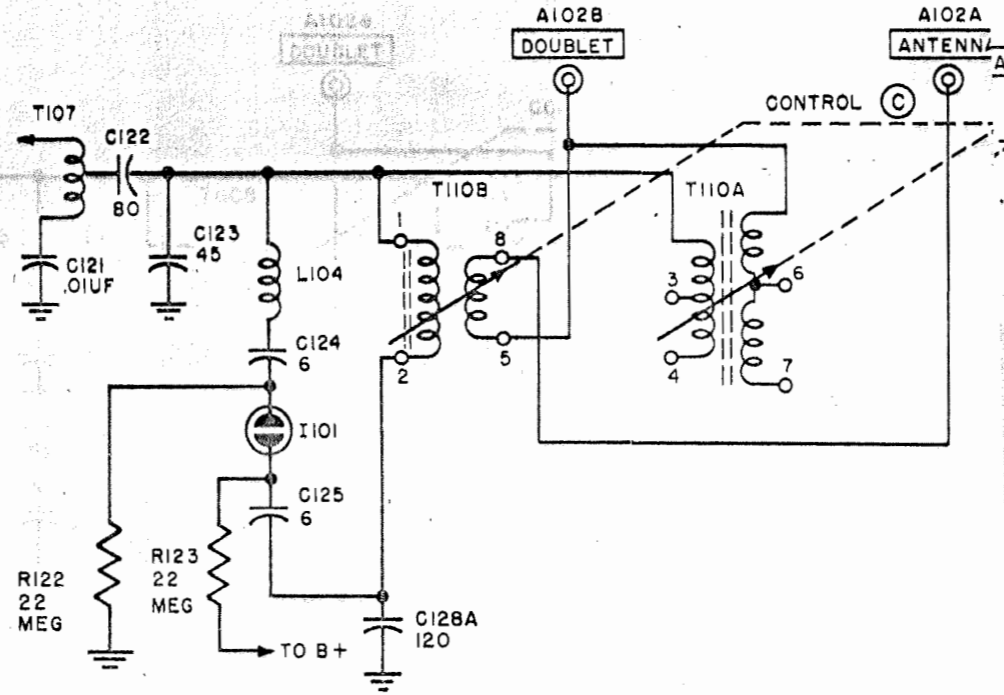
WHIP ③ POSITION



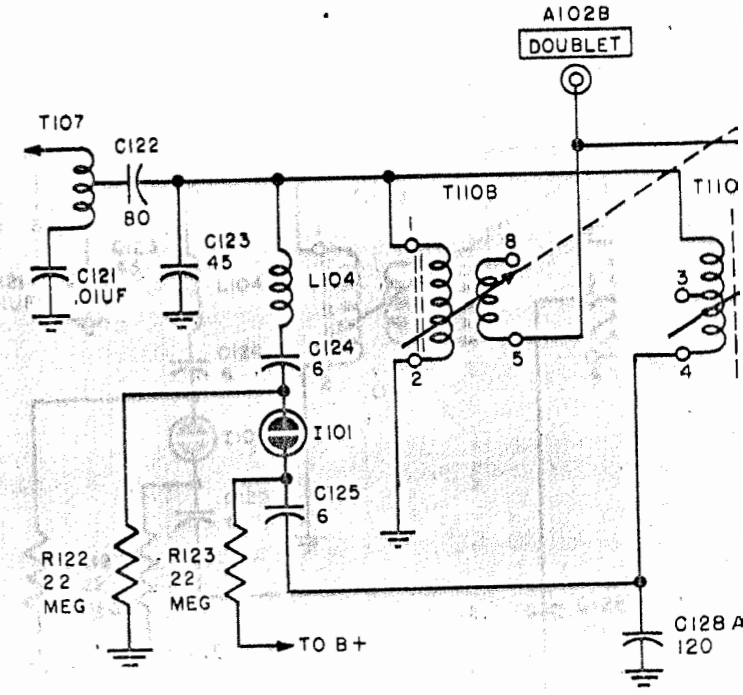
WHIP ④ POSITION



REEL ⑧ POSITION

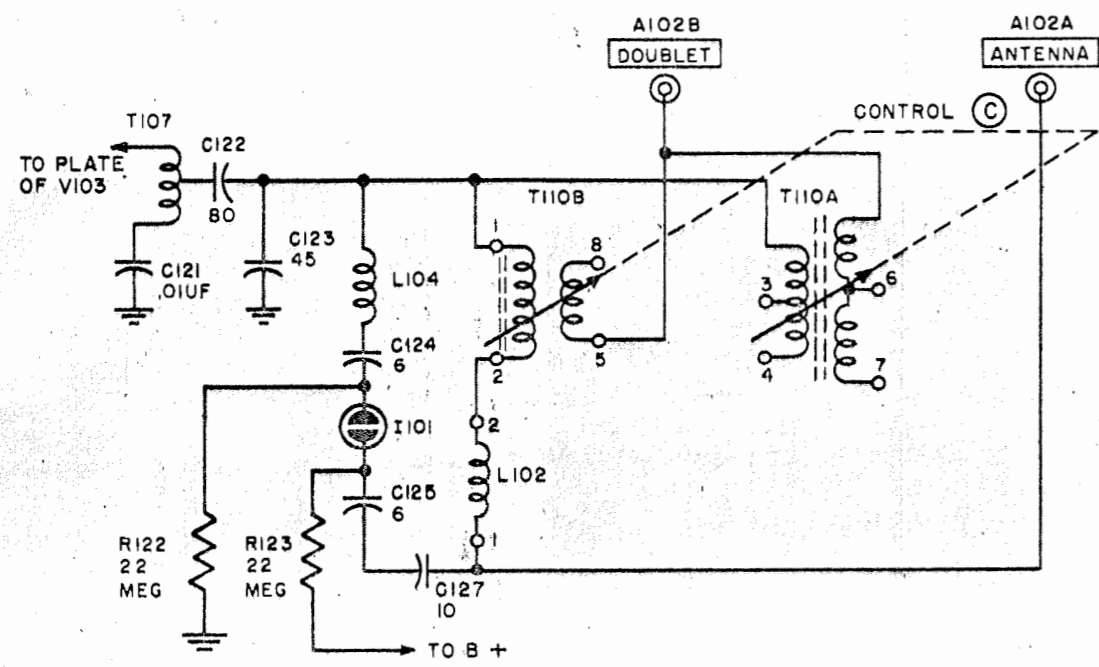


DOUBLET ⑨ POSITION

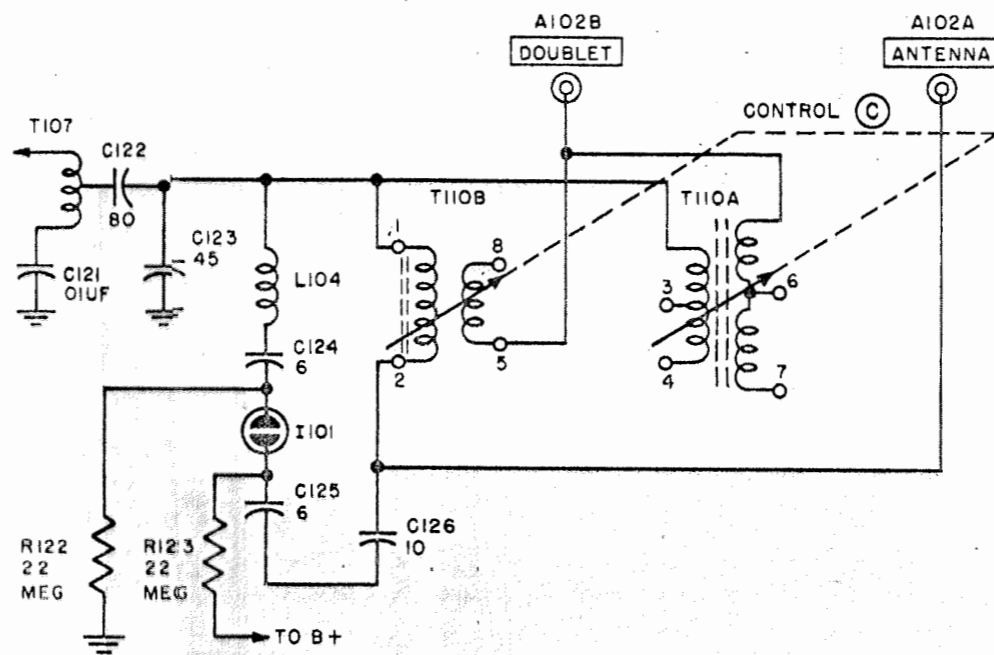


DOUBLET ⑩ POSITION

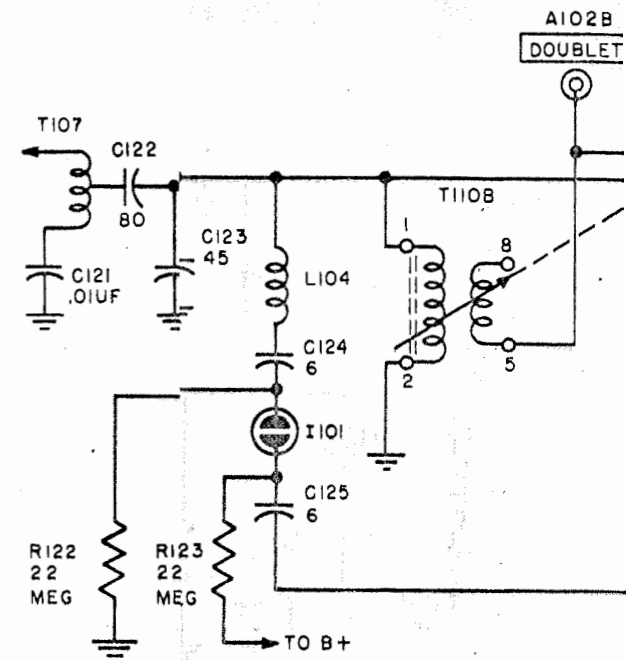
Figure 77 Antenna switching and tuning circuits for transmitter, simplified schematic for positions of switch S102.02.



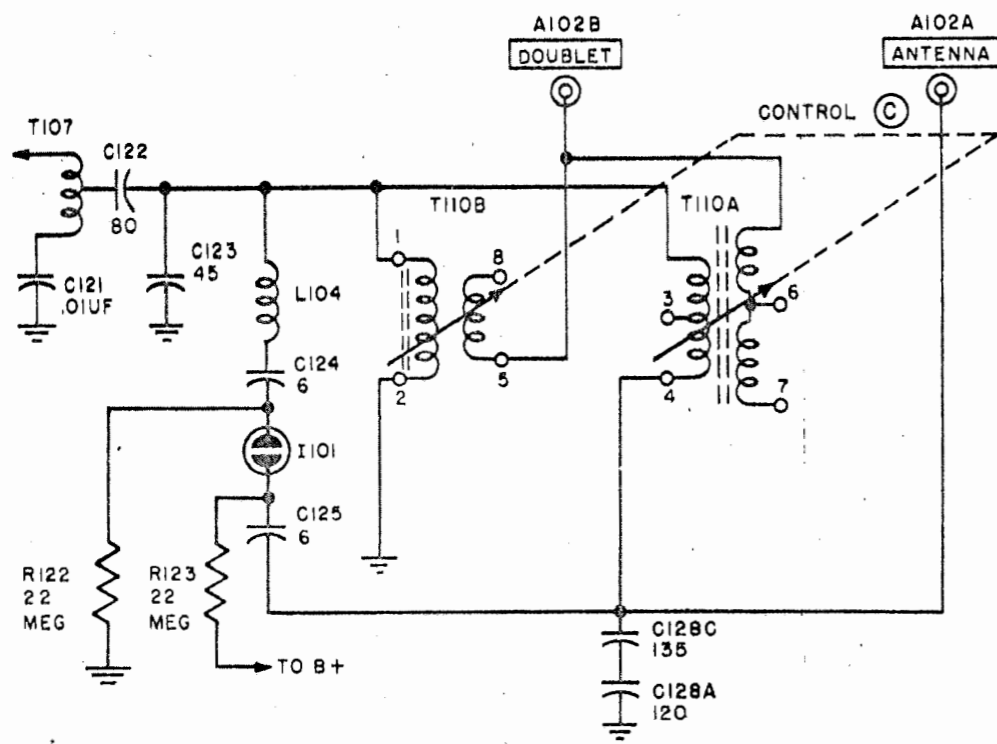
WHIP ① POSITION



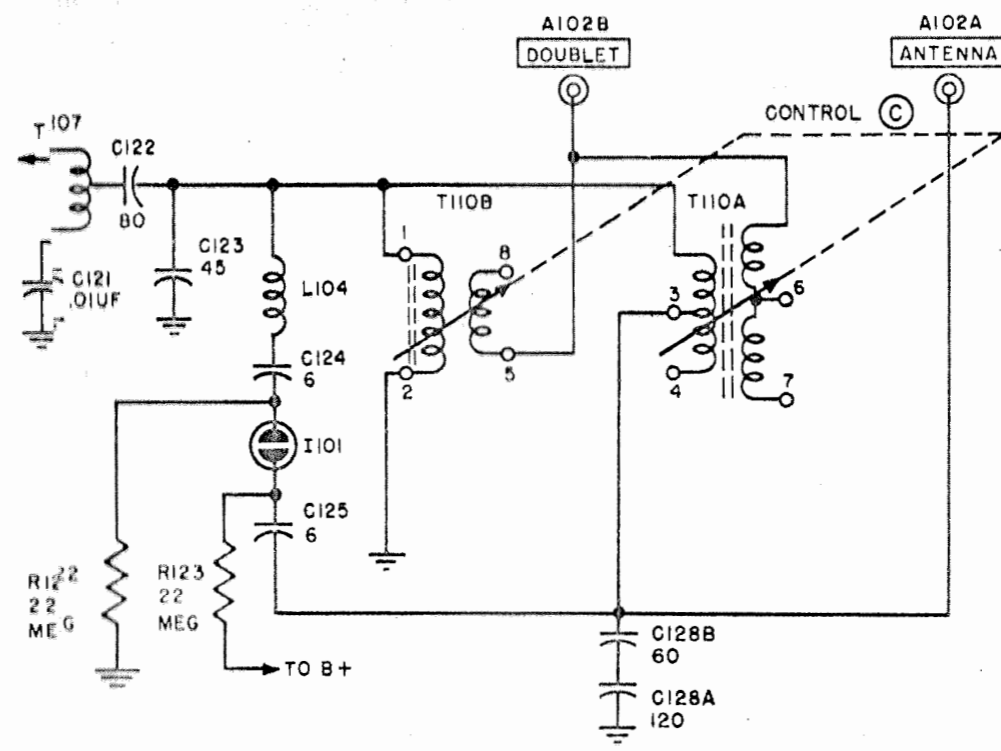
WHIP ② POSITION



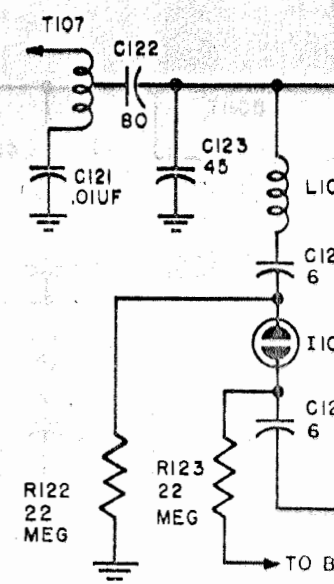
WHIP ③ POSITION



REEL ⑦ POSITION



REEL ⑧ POSITION



c. Control © is an adjustable powdered iron core that slides within coils T110A and T110B, tuning them to resonance. Indicator I101 is a small neon bulb which, by means of its highest brilliancy, indicates when control © has tuned the antenna coils to resonance. Figure 77 shows that the neon bulb is in series with coil L104, capacitor C124, and capacitor C125. This high-impedance series combination is placed across the primary of either transformer T110A or T110B, depending on the switch position of control ©. Thus the r-f voltage across the primary coil is impressed across this series circuit and this causes a voltage to appear across the neon

indicator. The indicator glows at brilliancy which is roughly proportional to the r-f voltage across the primary coil, and is therefore an indication of how closely the transformer is tuned to resonance. Resistors R122 and R123 are in series with the neon indicator bulb and this series combination is placed across the 500-volt d-c line, when contacts 9 and 10 of relay K101 close. This arrangement is necessary to provide a break-down voltage so that the neon tube will be ready to light as soon as enough r-f voltage is put across it. The d-c is thus like a keep-alive voltage.

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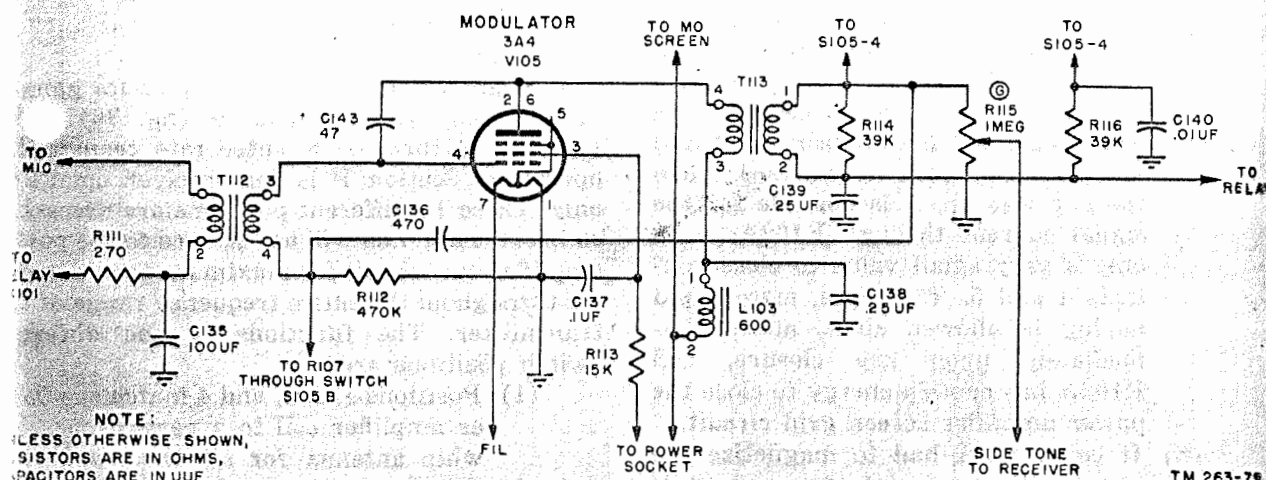


Figure 78. Modulator stage V105, simplified schematic.

7. Modulator Stage V105, Tube Type 3A4 (fig. 78)

a. GENERAL. The modulator circuit develops an audio voltage to suppressor-grid modulate the power amplifier during phone and mcw operation. These audio variations from the microphone are fed from the matching transformer T112 to the control grid of V105; they are amplified and appear across the modulation transformer T113. If the suppressor grid circuit of the power tube is traced on the main schematic (fig. 139) from pin 4 of V103, it will be seen that it goes through switch S105-4 to resistor R114, which is connected across the secondary of the modulation transformer. The other end of R114 connects to relay coil K102A in series with resistor R107 to the grounded filament lead of the power tube. Thus, the modulation voltage is in series with the negative volt-

age on the suppressor grid, developed by the control grid current through K102A and resistor R107. The modulation voltage, therefore, varies the voltage on the suppressor grid in accordance with the intelligence in the microphone, and the suppressor voltage determines to a large extent the plate current of the power amplifier.

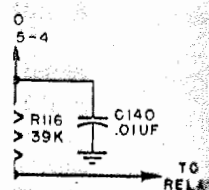
b. PHONE OPERATION.

(1) If the signal grid lead from pin 4 of modulator tube V105 is traced, it will be found that terminal 4 of T112 connects to switch S105-3 which, in the PHONE position only, leads to resistor R107 in the signal grid circuit of power amplifier tube V103 and from there to ground (fig. 139). The grid current of V103 develops a voltage across R107 and since this resistor is also in the grid circuit of V105, tube

e. MCW OPERATION. The fixed bias derived from the no longer present broken by near schematic). The comes an audic feedback through tube then develops just the right voltage resistor R116 is modulation transformer to adjust circuit change is made suppressor grid of filter signal is variations of the modulation from the a

d. C-W OPERATION. The modulation, the modulation grid bias from therefore, controlled. However suppressor grid side of the filament

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of V105, tube

V105 is also biased to its correct operating point by this resistor.

- (2) The modulator tube receives its plate voltage through the decoupling filter composed of L103 and capacitor C138. This filter is connected to the power supply through contacts 17 and 18 of keying relay K101. Thus, unless the key of the microphone button is depressed, the contacts are open and the modulator does not receive any plate voltage.
- (3) The screen receives its voltage from dropping resistor R113 which connects to terminal 7 on receptacle J106 (see main schematic). Terminal 7 on J106 is connected to terminal 2 on J106 by means of connections through circuits located inside the receiver cabinet (fig. 81). Terminal 2 is connected to B+ through contacts 17 and 18 of keying relay K101. Thus the screen voltage depends, as with the plate, on the position of the keying relay. If the key is up, there is no screen or plate voltage on the modulator tube. Capacitor C137 is the screen bypass capacitor.

c. MCW OPERATION. During mcw operation, the fixed bias which the modulator tube received from the power amplifier grid circuit is no longer present because the connection is broken by means of switch S105-3 (see main schematic). Therefore, the modulator tube becomes an audio oscillator due to the positive feedback through capacitor C136 and C143. The tube then develops its own bias across R112 of just the right value to sustain oscillations. Resistor R116 is placed across the output of the modulation transformer T113 by switch S105-4 to adjust circuit conditions for oscillation. No change is made in the connection to the suppressor grid of V103 and, therefore, the transmitter signal is modulated by the audio oscillations of the modulator tube and a mcw is radiated from the antenna.

d. C-W OPERATION (fig. 139). For c-w operation, the modulator tube does not receive any grid bias from the power amplifier tube and, therefore, continues to operate as an audio oscillator. However, switch S105-4 connects the suppressor grid of V103 directly to the positive side of the filament of V103, and disconnects it

from the modulator tube. Thus, the signal radiated is c-w without any modulation. Although the modulator tube no longer modulates the radiated signal, it still oscillates to provide a sidetone signal.

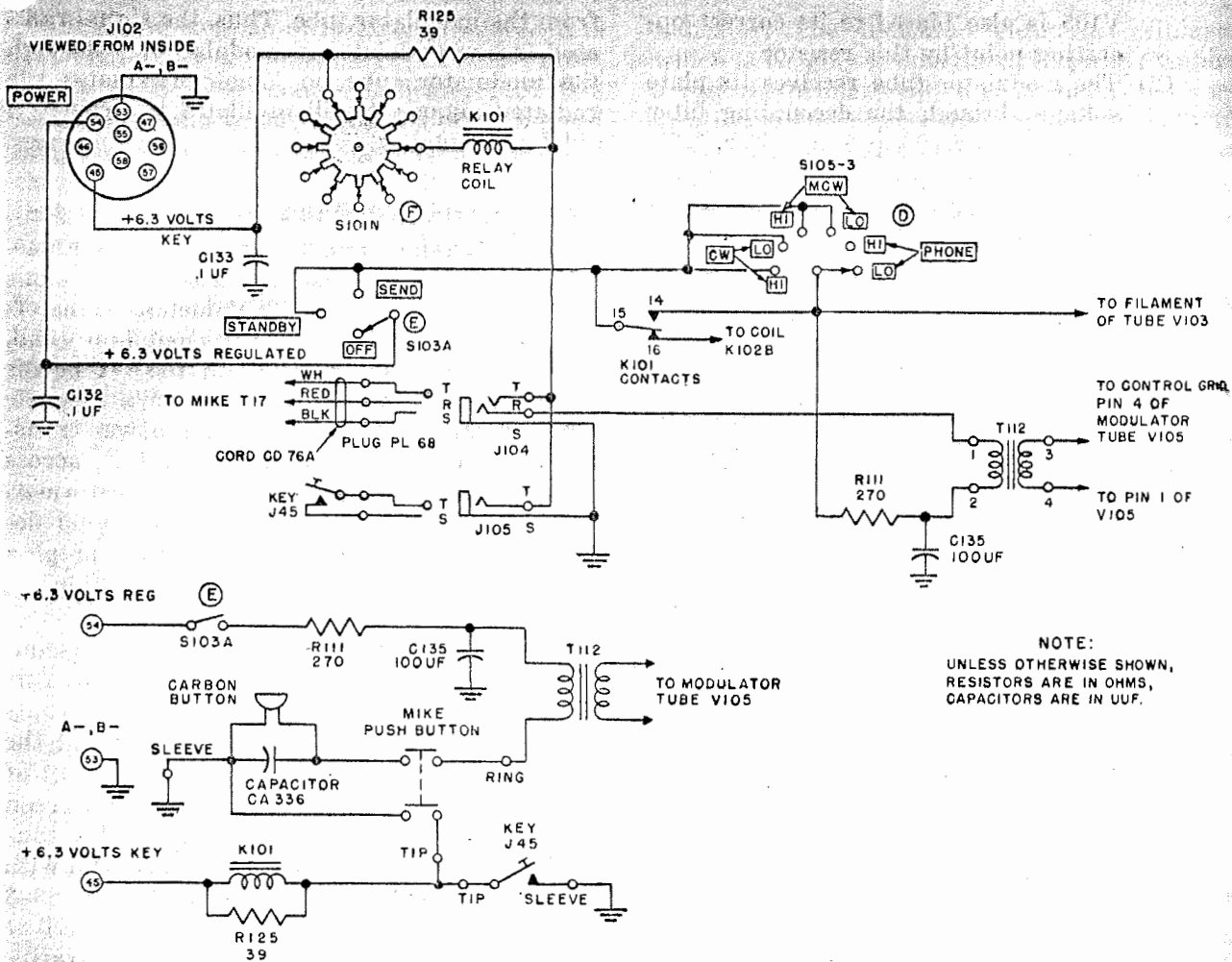
98. Sidetone Monitoring Circuit

a. A sidetone circuit in the transmitter permits the operator to monitor his transmissions on phone, mcw, or c-w. The sidetone signal is obtained directly from the modulator and, therefore, does not depend on the r-f power transmitted. It is possible to hear a sidetone even though there may be no r-f power transmitted. Potentiometer R115, control ©, across the secondary of the modulation transformer, adjusts the volume of the sidetone signal delivered to the receiver through pin 1 of plug J106 on the transmitter, cable 3E7173-22 in the case, and pin 1 of plug J3 in the receiver.

b. When transmitting mcw or c-w, the modulator tube operates as an audio oscillator, furnishing the sidetone. The keying relay interrupts the plate voltage of the modulator tube at the same time that it interrupts the plate circuit of the master oscillator, doubler, and the screen circuit of the power amplifier. The relay thus keys the sidetone oscillator in synchronism with the transmitted signals. When switch S3-3 (control © on the receiver) is turned to NET or CAL, the sidetone oscillator is made inoperative by the removal of the screen voltage. This prevents sidetone from interfering with zero beating of the transmitter to the receiver.

99. Microphone and Key Connections (fig. 79)

a. Both the microphone and the key are arranged so that either may complete the electrical circuit of relay K101. The microphone does so by means of a self-contained push-button switch, while the key acts as its own switch. The current for energizing the relay coil enters the transmitter through pin 45 of receptacle J102. It then flows through switch S101N to the relay coil and from there to the tip, marked T, on both the microphone and key receptacles. It can be seen from the diagram that the key, when closed, connects the relay through the sleeve of J105 to ground, thus completing the relay circuit. Should the press-to-talk switch on the



SIMPLIFIED SCHEMATIC DIAGRAM OF MIKE AND KEYING RELAY CIRCUIT SHOWN ABOVE.

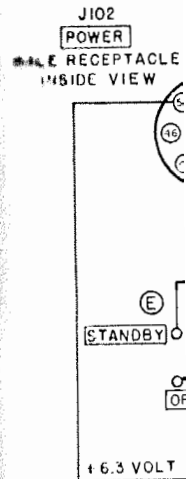
Figure 79. Microphone and key connections.

microphone be depressed instead of the key the keying circuit would be closed through the internal switch of the microphone. The relay current flows through the tip on J104 to the white lead in microphone Cord CD-76-A, through the switch to the black lead connected to the sleeve on Plug PL-68. The sleeve on Plug PL-68 fits into the sleeve on J104, which is directly connected to ground.

b. In order for the microphone to perform its function, there must be a d-c current flowing in its circuit. The current enters the transmitter from pin 54 of receptacle J102 and flows through the SEND position of switch S103A to the contacts of relay K101, and switch S105-3. If S105-3 is in the CW or MCW position, the current will reach the microphone regardless of

the position of the relay contacts (fig. 79). However, if S105-3 is in PHONE position, the only way that the microphone can be energized is if relay contacts 15 and 14 are closed. From the pole arm of S105A, the current goes through current limiting resistor R111 to the primary of T112, and from there to ring on jack J104. The connection within the microphone itself is from ring on Plug PL-68, through the red lead to the switch contacts and to the microphone carbon button. From the button the current flows to the black lead connected to the sleeve of Plug PL-68, which fits into the sleeve of jack J104 and from there to ground. Capacitor CA-336 (inside the microphone (fig. 20)) is a filter to bypass any disturbances set up between the carbon granules. Capacitor C135

as a filter ca
microphone h
c. Capacito:
to keep inter:
d. Because
key coil, there



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RESISTORS A
CAPACITORS

100. Transm Coni (fig.

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filaments rec
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b. Capit
to keep r-f o
C100 are vo
c. A smal

- a. a filter capacitor which is used to lessen microphone hiss.
- c. Capacitors C132 and C133 are bypasses to keep interference from the power supply.
- d. Because of the high inductance of the relay coil, there is an appreciable time lag before

the current through it can build up or die down, which is undesirable for rapid keying. Therefore, resistor R125 is placed across the coil so that the current through the coil can follow the key variations more closely because of the dampening of the inductance effect by R125.

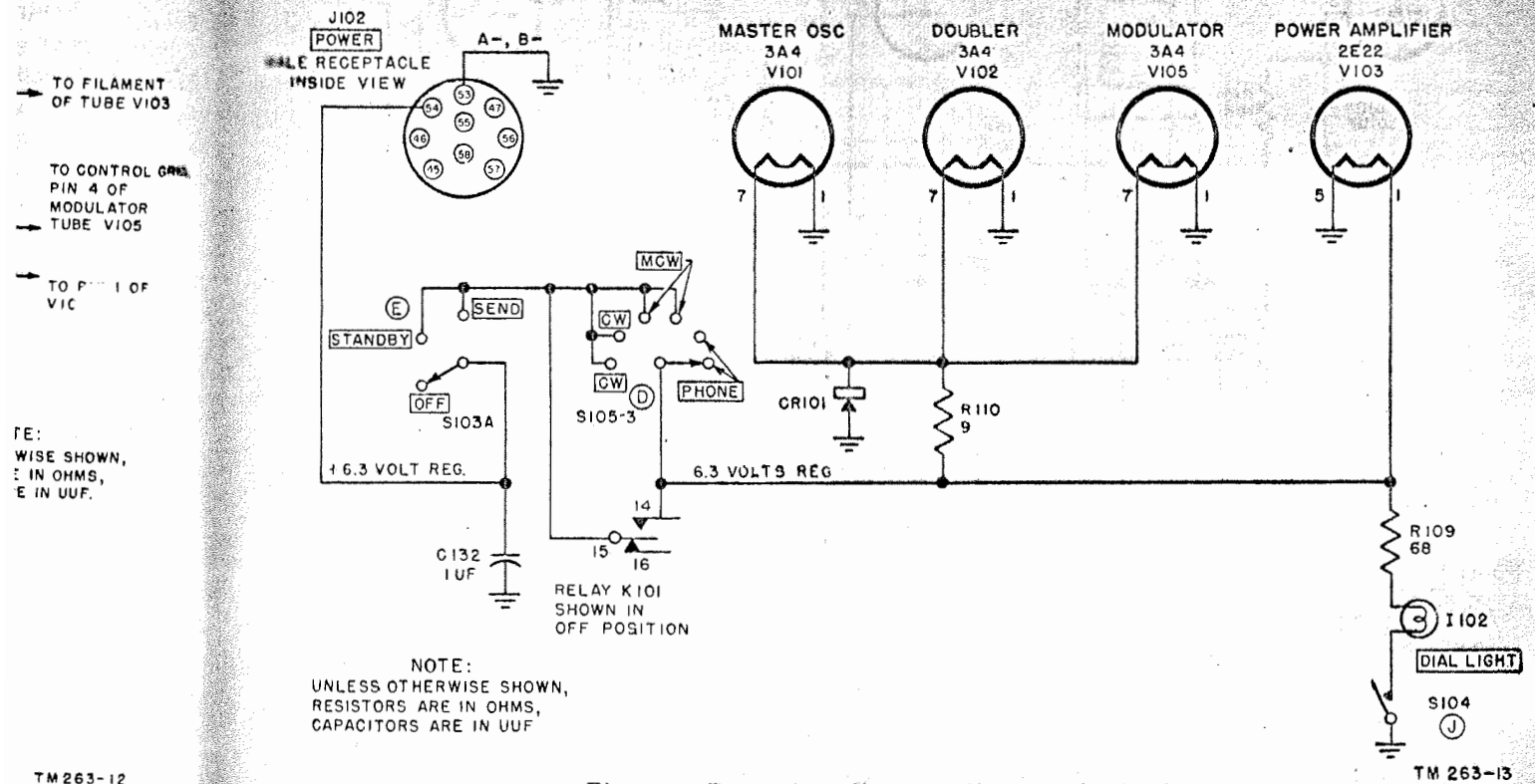


Figure 80. Transmitter filament voltage supply circuits.

100. Transmitter Filament Supply Connections (fig. 80)

a. The transmitter filaments receive their voltage from pin 54 of receptacle J102. The regulated 6.3-volt supply is fed to switch S103A, control ⓐ, and from there to S105-3, control ⓑ, and also to contact 15 of keying relay K101. In the PHONE position of control ⓑ, the tubes can receive filament voltage only if contacts 15 and 14 of K101 close; which they do only when the key or microphone button is depressed. In the mcw and c-w positions of control ⓑ, the filaments receive voltage regardless of the position of the relay contacts.

b. Capacitor C132 is an r-f bypass capacitor to keep r-f out of the power supply. R110 and R109 are voltage-dropping resistors.

c. A small dial light, Indicator I-102, is

located in the transmitter and may be turned on by means of push-button switch S104, control ⓐ, which normally is held open by a spring.

d. CR101 is a selenium voltage regulator used to keep the filament voltage on tubes V101, V102, and V105 constant at 3.6 volts.

101. Transmitter Plate and Screen Supply Circuits (fig. 81)

a. GENERAL. The transmitter plate and screen voltages may be obtained from either the hand-operated generator or the vibrator power supply, depending on whether Cord CD-1086 is connected to the generator or the vibrator. Voltage from these two sources enters the transmitter through plug J102.

b. POWER AMPLIFIER PLATE. Terminal 47 supplies 500 volts d-c plate voltage for power

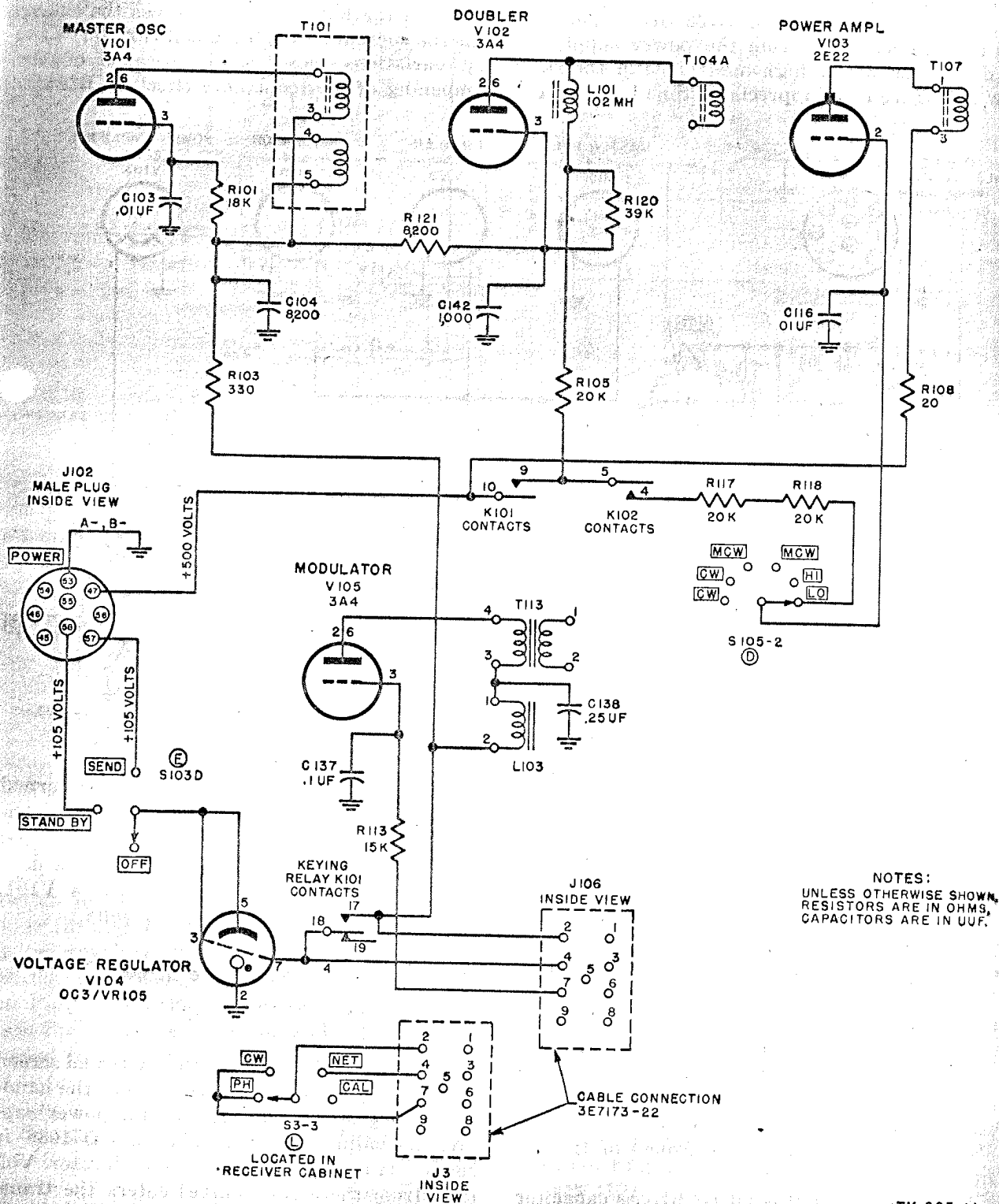
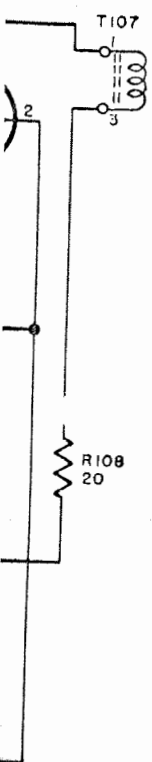
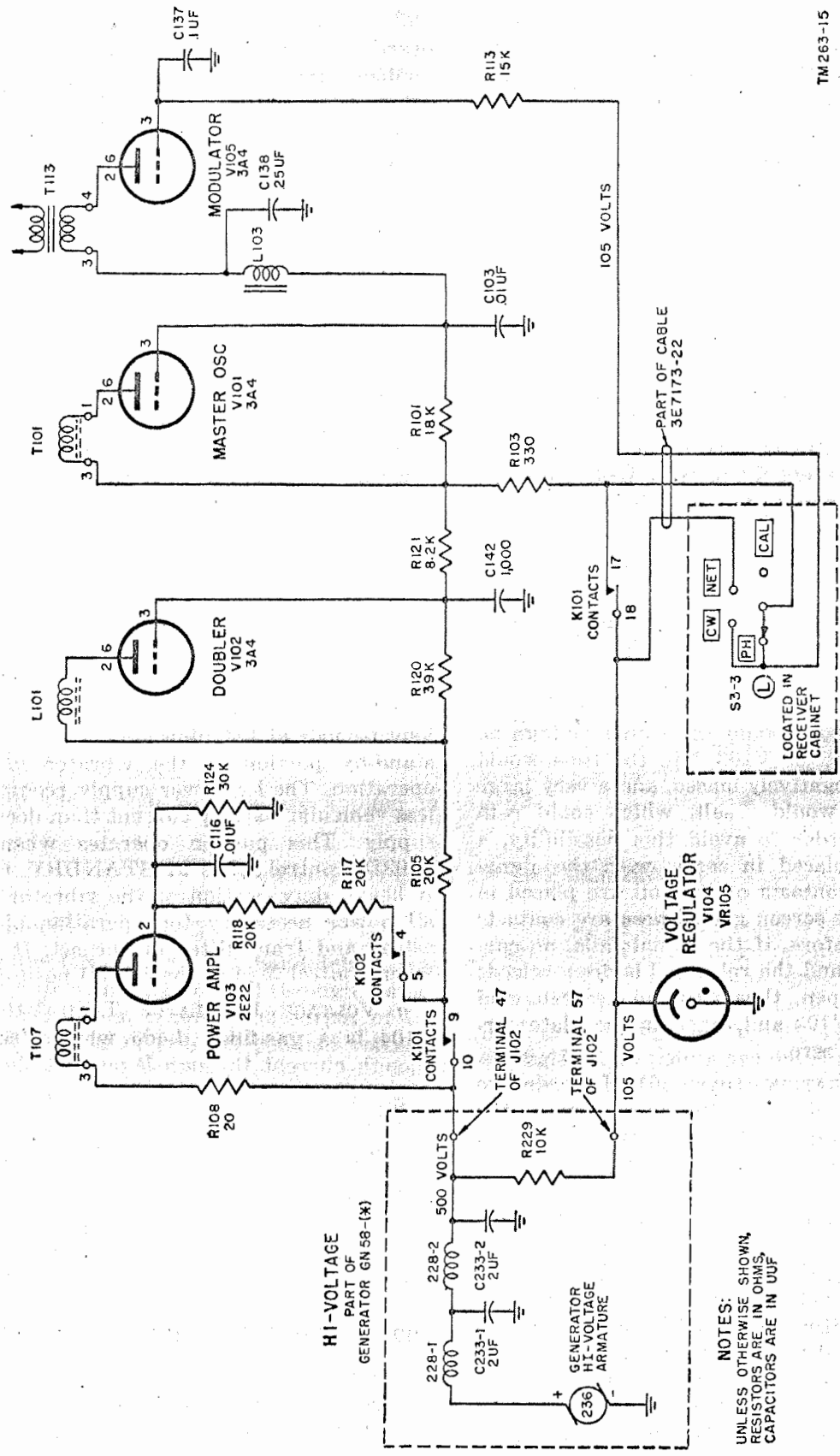


Figure 81. Transmitter plate and screen grid voltage supply circuits.

TM 263-14



NOTES:
OTHERWISE SHOWN,
RESISTORS ARE IN OHMS,
CAPACITORS ARE IN UUF.



NOTES:
UNLESS OTHERWISE SHOWN,
RESISTORS ARE IN OHMS,
CAPACITORS ARE IN UUF.

Figure 82. Transmitter plate and screen grid voltage supply circuits, simplified schematic.

amplifier tube V103. The plate of V103 is connected by T107 and R108 to pin 47 of J102 (fig. 81). Thus, the moment the generator is cranked, or the vibrator is switched on, the power amplifier plate is energized.

c. GENERATOR POWER SUPPLY. The 105-volt output of the generator enters the transmitter through terminal 57 of J102 and is fed to the SEND tap on switch S103D, control Ⓞ. When control Ⓞ is placed on SEND, the voltage is fed to pins 3 and 5 of V104 (voltage regulator tube) and reaches the contacts of keying relay K101, through the internal connection between pins 3 and 7 of V104. When contacts 17 and 18 and contacts 9 and 10 of relay K101 are open, none of the plates or screens of the tubes receive voltage, except the plate of V103 (fig. 82). If the key or press-to-talk switch on the microphone is depressed, these contacts close; all tubes receive voltage and the transmitter is in operation.

d. OVERLOAD RELAY. Contacts 5 and 4 of overload relay K102 are in series with the dropping resistors to the screen grid of the power amplifier tube V103 (fig. 82). These contacts normally are closed. Should the signal voltage on the control grid of V103 fall, the tube would no longer be negatively biased, and a very large plate current would result, which could ruin the tube. In order to avoid this possibility, a relay coil is placed in series with the signal grid and the contacts of the coil are placed in series with the screen grid. These are contacts 5 and 4. Therefore, if the signal falls, no current is drawn and the relay coil is deenergized; the contacts open, thus removing screen grid voltage from V103 and reducing the plate current to almost zero.

e. NET OPERATION (par. 56). In order to tune the transmitter to the frequency of the net, it is necessary first to tune the receiver to the net frequency and then to tune the transmitter oscillator tuning dial to zero-beat with the incoming net signal in the receiver. If the full power of the transmitter is used, it will drown out the net signal making it impossible to zero-beat. Therefore, the key or microphone button should not be depressed during the tuning of the transmitter for net operation. However, if the key or microphone button is not depressed, relay K101 contacts 17 and 18 will not be closed and the transmitter tubes

will not receive plate and screen voltages. To overcome this, only oscillator tube V101 and doubler tube V102 are fed with enough operating plate and screen grid voltages. This is accomplished with switch S3-3, control Ⓞ, which is located in the receiver cabinet and is connected to the transmitter by cable 3E7173-22. When switch S3-3 is turned to NET, it shorts out contacts 17 and 18 of relay K101 (fig. 82). This allows the combined plate and screen grid currents of the doubler and oscillator tubes to flow through resistor R103 and switch S3-3 to terminal 57 of receptacle J102, and from there, by Cord CD-1086, to the generator. Switch S3-3 also disconnects the screen grid of the modulator tube V105 from the voltage source so that the tube is inoperative. This prevents sidetone from interfering with the zero beating in preparation for net operation.

f. VIBRATOR POWER UNIT PE-237. In order for the transmitter to receive power from the vibrator unit, Cord CD-1086 is plugged from J106 on the transmitter to plug 734 on the vibrator (fig. 64). When the set is used for long periods of listening only, a low voltage or stand-by portion of the vibrator unit is in operation. The l-v power supply requires much less vehicular battery current than does the h-v supply. This portion operates when switch S103D, control Ⓞ, is at STANDBY (fig. 81). A heavy duty portion of the vibrator supplies all power necessary for operation of the receiver and transmitter of the set. It operates when control Ⓞ is at the SEND position.

g. VOLTAGE REGULATOR TUBE V104. Tube V104 is a gas-filled diode which draws just enough current through it so that the voltage drop across resistor 229 in the generator or resistors 721-1 and 721-2 in the vibrator will just compensate for any rise or fall of voltage in the power supply. Thus, the plate and screen voltages of the master oscillator and modulator tubes are regulated, as are the plate and screen voltages to the receiving tubes, during receiver operation.

102. Keying Relay K101

Keying relay K101 is actuated by either the telegraph key or by the microphone press-to-talk switch. When neither of these devices is

depressed, the microphone switch contacts are per-

a. The antenna receiver to the

- (1) Control the
- (2) Control
- (3) Control
- (4) Control

b. Plate voltages of receiver tubes are removed from receptacle J106 because of which, if allowed to open, the

c. Plate an

103. Generator

Generator with its up gear train generator coils which are regulated voltages are ripple and 38-(*) is a wound fieldature consists of 6-volt windings and a 425-volt motor.

104. H-v Circuit (fig.

a. In a direct constant dir

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V104. Tube
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Depressed, the receiver is in operation, while
for transmitter operation, the key or micro-
phone switch must be closed. When the key or
microphone switch is closed, the following func-
tions are performed by keying relay K101:

a. The antenna circuit is switched from the
receiver to the transmitter.

- (1) Contacts 1 and 2 open, disconnecting the ground from switch S102A.
- (2) Contacts 3 and 4 close, connecting terminal A102A to switch S102A.
- (3) Contacts 6 and 7 close, connecting the receiver antenna-matching transformer T114 to ground.
- (4) Contacts 11 and 12 close, connecting the doublet lead to transmitter coil T110A.

b. Plate voltages are removed from all re-
ceiver tubes except V5 and V6. Screen voltages
are removed from all receiver tubes. Contacts
18 and 19 open, disconnecting terminal 3 on
receptacle J106 from the power feed line. Plate
voltages are not removed from tubes V5 and
V6 because of the higher currents they carry
which, if allowed to flow through the contacts of
the relay, would pit and burn them upon the
opening of the contacts.

c. Plate and screen voltages are applied to

the master oscillator and doubler stages. Con-
tacts 17 and 18 close, connecting the plates and
screens to the power line through pin 7 of
voltage regulator tube V104.

d. Screen voltage is applied to power ampli-
fier tube V103. Contacts 9 and 10 close, con-
necting the screen voltage-dropping resistors
R117 and R118 to terminal 47 of power re-
ceptacle J102.

e. When switch S105-3, control @, is in the
PHONE position only, the filaments of the
transmitter tubes are off, unless the key or
press-to-talk switch on the microphone is de-
pressed. Contacts 14 and 15 close, connecting
resistor R110 and filament pin 1 of tube V103
to terminal 54 of receptacle J102, through
switch S103A.

f. Direct current is fed to the microphone
circuit. Contacts 14 and 15 close, connecting
resistor R111 to the 6.3-volt supply entering
terminal 54 of receptacle J102.

g. Coil K102B, which is part of overload re-
lay K102, is constantly energized during re-
ceiver operation. For transmitter operation the
voltage across the coil is removed. Contacts 15
and 16 open, disconnecting K102B from the 6.3-
volt supply entering terminal 54 of receptacle
J102.

Section III. THEORY OF THE GENERATOR

103. General

Generator GN-58-(*) is a hand-driven ma-
chine with its armature rotated through a step-
up gear train from cranks. The output of the
generator consists of two independent voltages
which are regulated by a voltage regulator. Both
voltages are filtered to eliminate commutator
ripple and r-f interference. Generator GN-
58-(*) is a two-pole machine which has two
wound field coils, 237-1 and 237-2. The arma-
ture consists of two independent windings; a
6-volt winding connected to a 1-v commutator
and a 425-volt winding connected to a h-v com-
mutator.

104. H-v Circuit

(fig. 137)

a. In a d-c generator, the output is not a pure
constant direct voltage because the magnetic

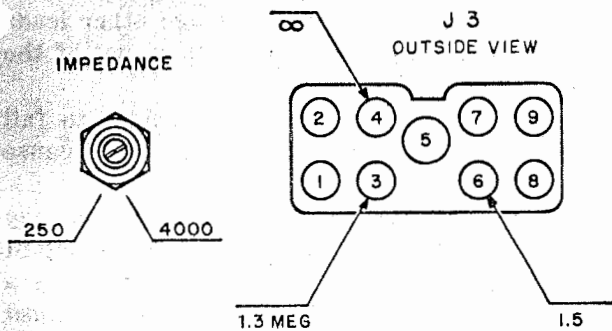
field set up by the field poles is not uniform. The
magnitude of the voltage induced in the arma-
ture coils depends on the speed of rotation of
the armature and the strength of the magnetic
field. Since the magnetic field is not of the same
strength at all points around the armature, the
voltage output of the armature will have a rip-
ple in it instead of a smooth constant value.
This is called commutator ripple. In order to
smooth out this ripple, a filter circuit is incor-
porated in the generator housing. This filter
consists of choke coils 228-1 and 228-2 and
capacitors 233-1 and 233-2. The filter also
serves another purpose. The sparks under the
brushes, which rest on the commutator, cause
r-f interference. The filter removes this inter-
ference from the power leads by bypassing the
r-f to ground through the capacitors.

b. Because power amplifier tube V103 re-
quires about 500 volts on the plate, while the

135. Checking Filament and B+ Circuits for Shorts

Trouble within the receiver or transmitter often may be detected by checking the resistance of the filament and h-v circuits before applying power to the equipment, thereby preventing damage to the power supply. Make the following checks before attempting to put the receiver-transmitter into operation.

a. RECEIVER FILAMENT AND PLATE CIRCUITS (figs. 64, 65, and 92). Remove the receiver-transmitter interconnecting cable from the socket in back of the receiver chassis. The resistances to be obtained between ground and terminals 3, 4, and 6 are clearly shown in figure 92. If these readings are not obtained, *do not* supply power to the radio set, but trace the circuits to see where the shorts or opens are located. If this is not done, the power supply may be damaged,



TM 263-57A

Figure 92. Receiver power receptacle J3.

b. TRANSMITTER POWER SUPPLY CIRCUITS (figs. 80, 81, 82, and 93). Disconnect power cables, Cords CD-1086 and CD-1119, from the transmitter and remove the key and microphone from their jacks. Check the resistances to ground of the contacts of the transmitter POWER socket (fig. 93). If the readings shown are not obtained, *do not* apply power to the radio set; trace the circuits to see where the trouble is located. Otherwise, damage may be done to the power supply. Correct all conditions leading to abnormal readings before applying power to the radio set.

136. Operational Test

a. If the foregoing tests in paragraph 135 have not shown any abnormal readings, connect

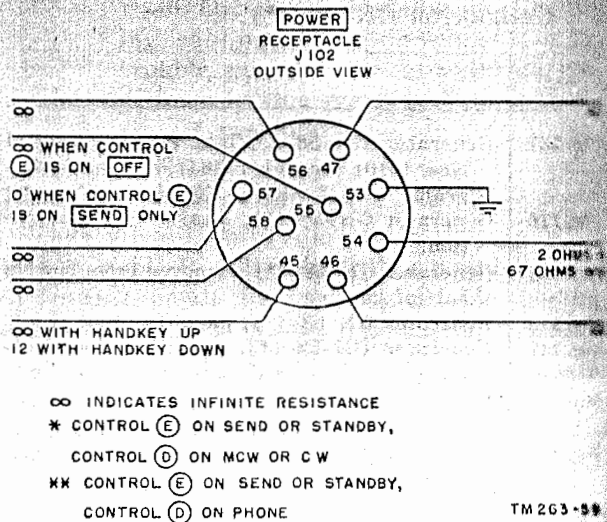


Figure 93. Transmitter power socket resistances to ground.

the power supply to the radio set and set up the unit for normal operation. Refer to the equipment performance checklist in paragraph 77 and operate the set as described in the checklist. This step is important because it frequently indicates the general location of trouble. Also listen for crackling or buzzing noises, which indicate h-v arcing.

b. In some of the tests to be described later, it may be desirable to use a dummy antenna instead of an actual radiator. The dummy antenna for transmitter tests is a 20-ohm noninductive resistor in series with a 70-uuf (micro-microfarad capacitor and an 0 to 2 amperes r-f meter. This is equivalent to a 15-foot whip antenna. Connect the meter end to the chassis or GND. post on the receiver. The resistor end connects to the ANT. post on the transmitter.

Note. A 5,400-ohm noninductive resistor is equivalent to a half-wave antenna (control ⊙ in REEL position).

137. Trouble-shooting Charts

The following nine trouble-shooting charts are supplied as an aid in locating trouble in the equipment.

a. The chart in paragraph 138 covers sectionalizing trouble in Radio Set AN/GRC-9; it lists the various symptoms which may be easily recognized and gives the probable location of the existing trouble as well as the recommended correction. The chart also tells the operator if the trouble is in the transmitter

140. Localizing Trouble in Receiver Section—Continued

Symptom	Probable trouble	Correction
	or even positive, then the bfo circuit is not oscillating.	
	b. Tube V7 (1R5) defective	b. Replace tube V7 (1R5). Checking not necessary.
	c. Resistor R25 may be open	c. Short resistor R25 with one of equal value.
	d. Coil T8 may be open or shorted	d. Make resistance checks on the terminals of coil T8. Replace coil T8 if another unit is available.
	e. Capacitor C60 may be open	e. Short capacitor C60 with one of equal value.
	f. Coil T8 not alined	f. Refer to paragraph 167.
32. Incorrect d-c voltage on pin 2. All other tubes are normal.	32. Resistor R22 open or shorted	32. Replace resistor R22.
33. Incorrect d-c voltage on pin 3. All other tubes normal. Control Ⓢ on C.W. or CAL.	33a. Part of coil T8 open	33a. Check the resistance between terminals 2 and 4 of coil T8.
	b. Capacitor C60 shorted	b. Replace capacitor C60.
	c. Resistors R26 and R27 defective	c. Replace resistors R26 and R27.
	d. Tube V7 (1R5) internally shorted	d. Replace tube V7 (1R5).
34. No d-c voltage on pin 7. All other tubes normal.	34a. Short or open in the supply line to tube V7.	34a. Remove tube V7 and check for zero resistance between pin 7, of socket V7 and pin 7 of tube V4 (1R5).
	b. Tube V7 (1R5) defective	b. Replace tube V7 (1R5).

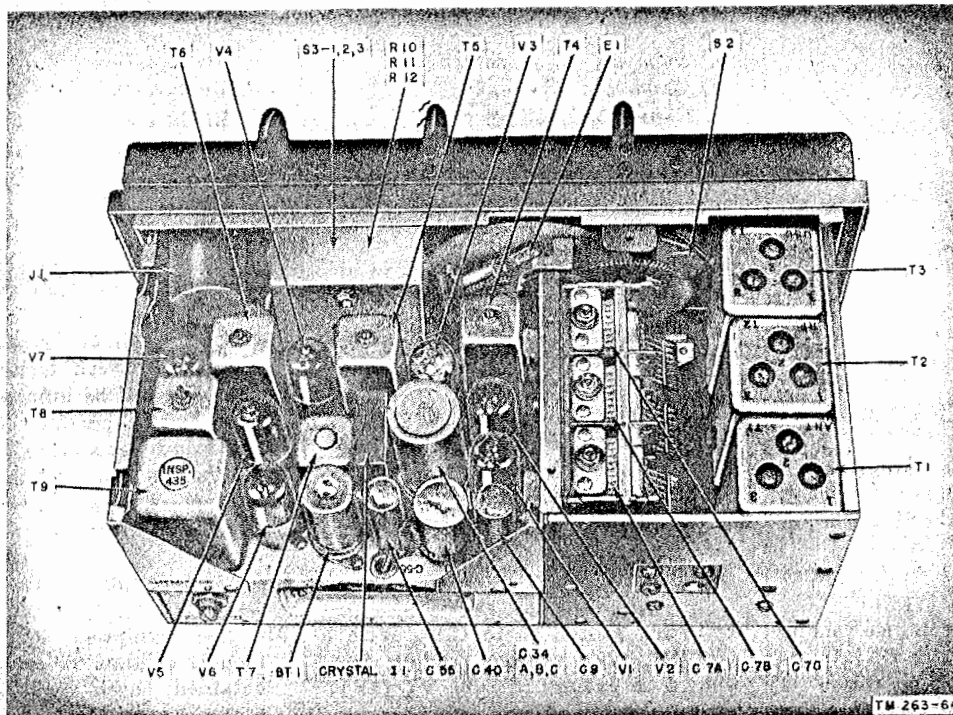


Figure 94. Receiver top, parts location.

n

(1R5). Check...

25 with one of

checks on the ter-
Replace coil T8
available.

60 with one of

h 167.

2.

ce between ter-
T8.
C60.
26 and R27.
1R5).
d check for zero
7, of socket V1
(1R5).
R5).

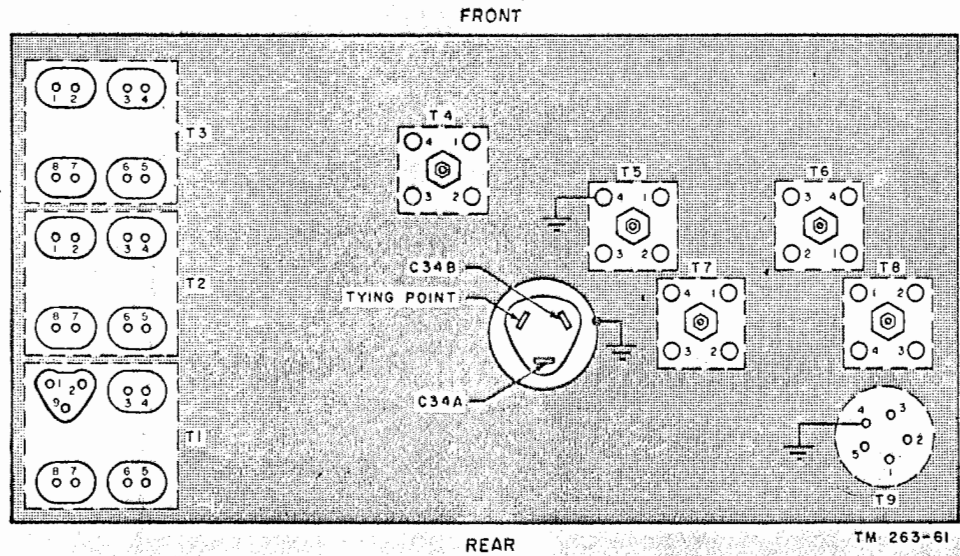


Figure 95. Receiver transformer and electrolytic capacitor terminal designations.

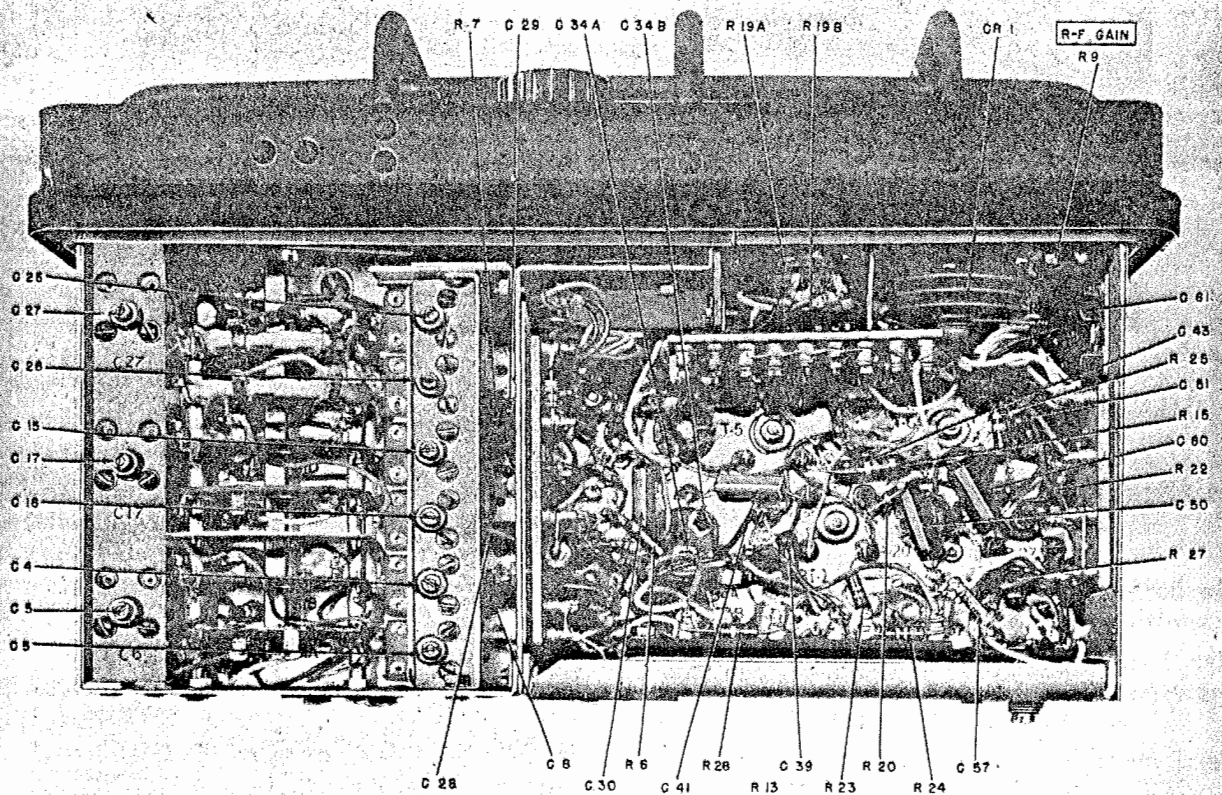


Figure 96. Receiver bottom, parts location.

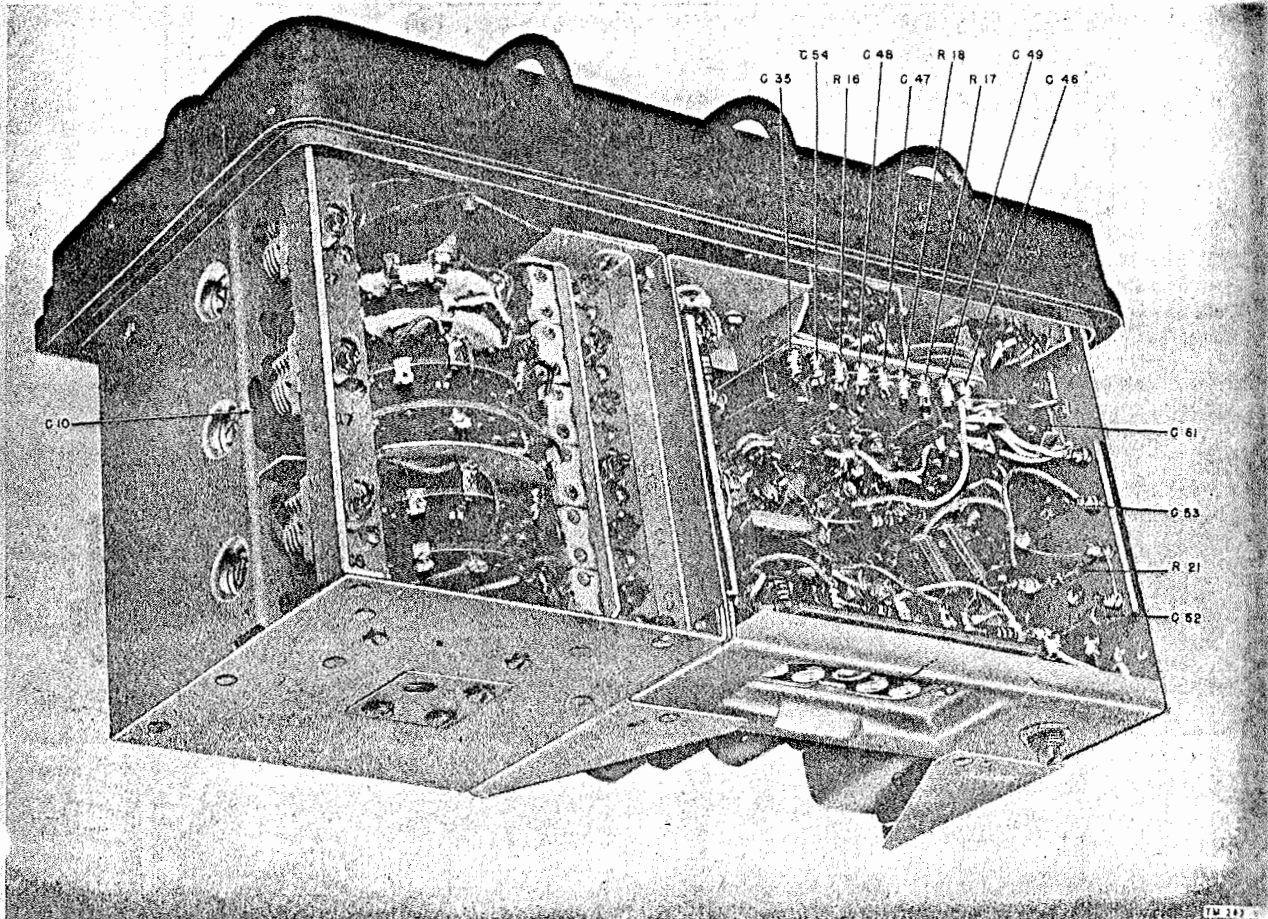


Figure 97. Receiver bottom, parts location.

41. Rec
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marked w
VTVM.

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- (2)
- (3)
- (4)
- (5)

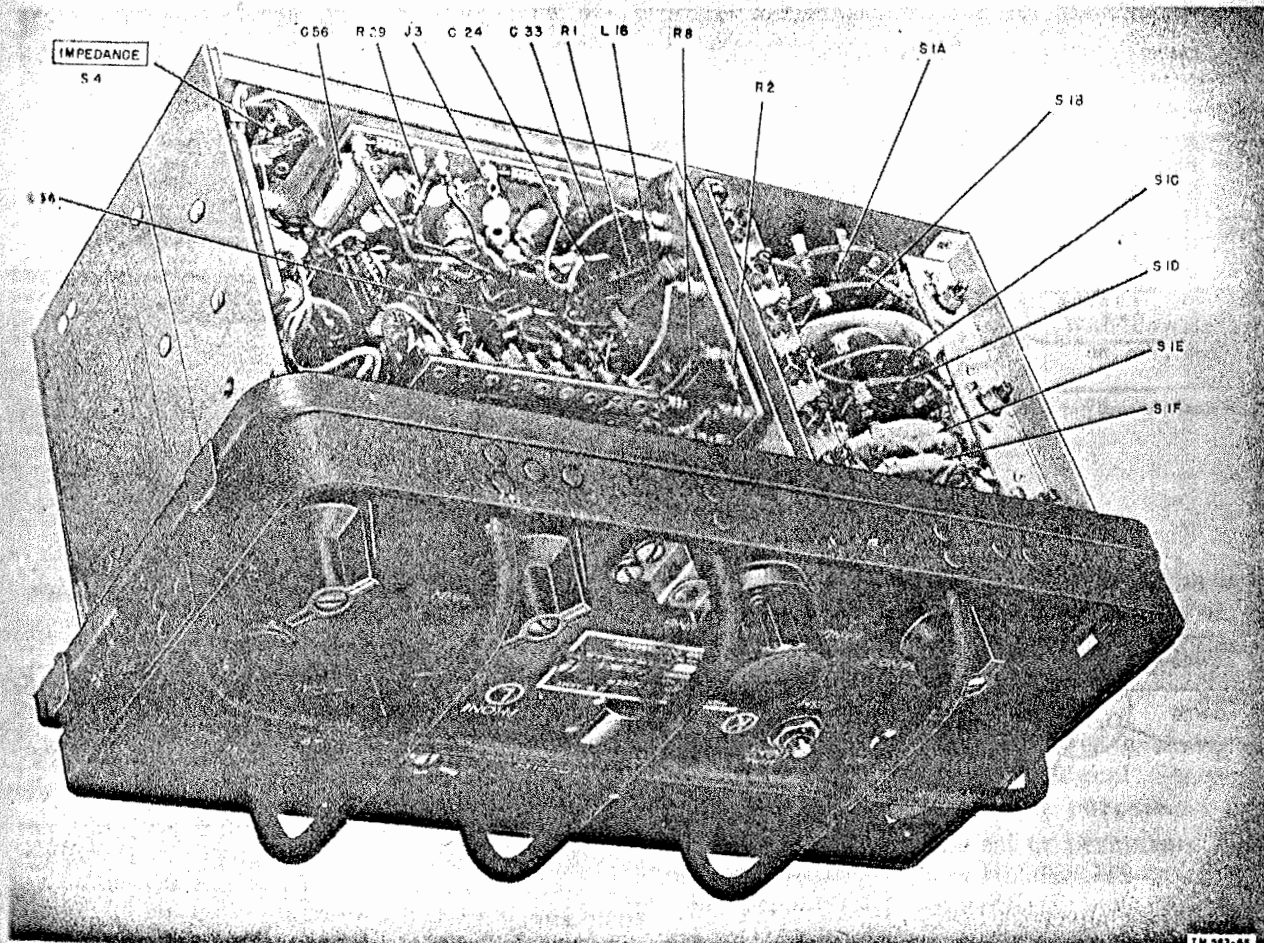


Figure 98. Receiver bottom, parts location.

141. Receiver Tube Socket, Voltage and Resistance Diagram

a. The d-c voltages given in figure 99 were made with a 20,000-ohm per volt meter under the following conditions, except as noted on the diagram. Those voltage readings which are marked with an asterisk (*) were made with a VTVM.

- (1) Switch Ⓢ (on transmitter) at SEND.
- (2) Switch Ⓢ (on transmitter) at BAND 2-MO.
- (3) Switch Ⓢ (on transmitter) at CW-HI.
- (4) TUNING control Ⓢ on receiver tuned to 5,100 kc.
- (5) Control Ⓢ on receiver at C.W.

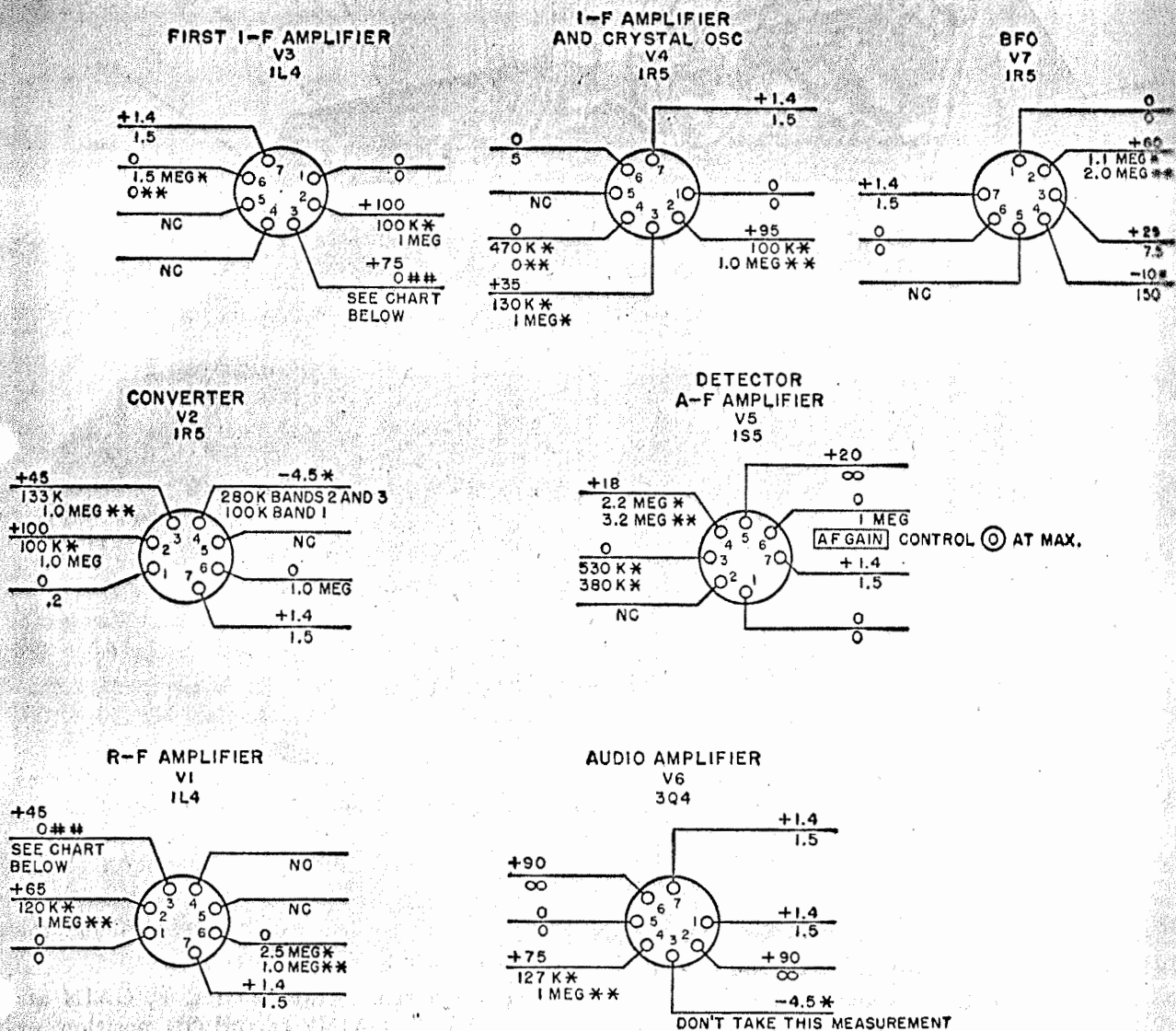
(6) Switch Ⓢ at BAND 2.

(7) Controls Ⓢ and Ⓢ (A. F. GAIN and R. F. GAIN) at full ON position, except as noted.

(8) All voltages measured to chassis, except as noted.

b. The resistance values were measured with an ohmmeter under the following conditions:

- (1) All resistances are measured with tubes in sockets and are measured from tube pin to chassis.
- (2) Receiver is disconnected from transmitter.
- (3) Phone plug is disconnected from PHONE jack.



RESISTANCE MEASUREMENTS NOTES:
 ## INDICATES SWITCH \odot IN CAL.
 * INDICATES SWITCH \odot IN PHONE POSITION.
 ** SWITCH \odot IN ALL OTHER POSITIONS.

VOLTAGE MEASUREMENTS NOTES:
 ** INDICATES \square R-F GAIN CONTROL \odot AT OFF.
 NC INDICATES NO CONNECTION.

V1 PIN 3 (SCREEN) RESISTANCE TO CHASSIS			V3 PIN 3 (SCREEN) RESISTANCE TO CHASSIS		
SWITCH POSITION	R-F GAIN CONTROL		SWITCH POSITION	R-F GAIN CONTROL	
	MAXIMUM	MINIMUM		MAXIMUM	MINIMUM
PHONE	190 K	100 K	PHONE	120 K	27 K
CW	1.1 MEG	100 K	CW	500 K	27 K
NET	1.1 MEG	100 K	NET	5.7 MEG	5.7 MEG
CAL	1.1 MEG	100 K	CAL	500 K	27 K

Figure 99, Receiver tube socket, voltage and resistance diagram.

TM 263-58A

13-1
13-5
Figure 10
142. D-c
C
The d-c
colls in th
Transformer
or coil
T1
T2
T3
T4
T5
T6
T7

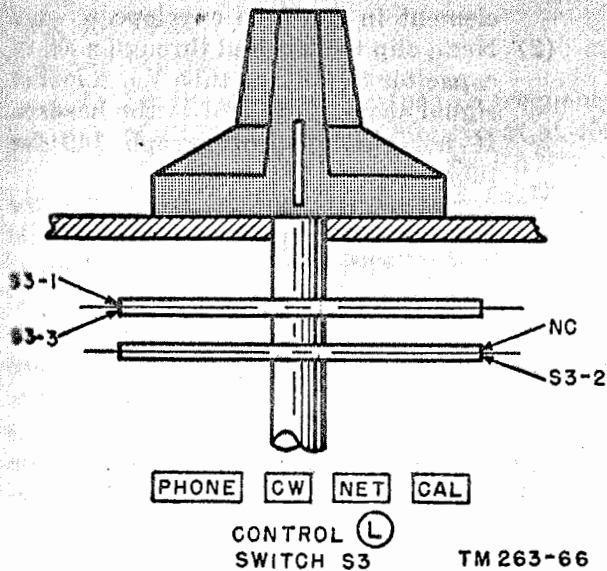
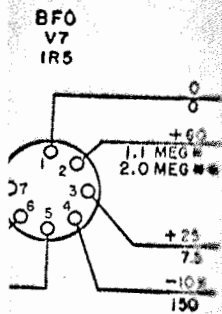


Figure 100. Location of wafer sections of switch S3.

142. D-c Resistances of Transformers and Coils

The d-c resistances of the transformers and coils in the receiver are listed below:

Transformer or coil	Terminals	Ohms	
T1	Place test prods into 8-9 on power socket J3 to test all three primary coils of transformer T1.	BAND 1* .5**	
		BAND 2 .5**	
		BAND 3 .5**	
	4-GND.	BAND 3* .5**	
	3-GND.	BAND 2 .5**	
	2-GND.	BAND 1 .5**	
	T2	5-1	21
		6-1	10
		7-1	1
	T3	4-GND.	BAND 3 .5**
3-GND.		BAND 2 .5**	
2-GND.		BAND 1 .5**	
4-GND.		BAND 3* 220,000	
3-GND.		BAND 2 220,000	
2-GND.		BAND 1 47,000	
5-GND.		BAND 3 .5**	
T4	6-GND.	Remove tube V2 BAND 2 .5**	
	7-GND.	Remove tube V2 BAND 1 .5**	
		Remove tube V2	
T5	3-2	5	
T6	1-4	5	
T7	3-4	26	
	4-2	30,000	

Transformer or coil	Terminals	Ohms
T8	1-4	Cannot be checked because capacitor C58 is in series with coil.
T9	2-5	1,200
	1-3	350
	3-4	22
L16		.5* With converter tube V2 removed.

*Turn control @ to the band indicated for the terminals to be checked.

**Resistance negligible, .5 ohm or less.

143. Signal Substitution Notes

At times the condition arises where the troubleshooting charts will not disclose the source of trouble in the receiver. For such a situation the signal substitution or signal tracing method must be used.

a. Signal substitution requires a source of audio, i-f, and r-f signals. Signal Generator I-72-(*) is suitable for this purpose.

b. In addition, a headset or permanent magnet loudspeaker such as Headset HS-30-(*) or Loudspeaker LS-7, respectively, is necessary. In the tests indicated, ground the negative lead of the signal generator to the receiver chassis. For r-f signals, connect the other lead of the signal generator through a 110-uuf capacitor. For i-f signals, use a .05-uf (microfarad) capacitor.

c. Note the volume, and listen for serious distortion from the loudspeaker or headset at the various points in the signal substitution procedure. When working back from the output to the input stages, decrease the output of the signal generator as much as possible. If possible, compare the defective receiver with a receiver known to be in good condition.

d. Check the wiring and soldering in each stage during the procedure.

Caution: Do not remove shield cans from transformers unless the trouble has been traced to a specific unit. Do not damage the wiring by pushing it back and forth during inspection. Be careful not to damage the receiver in any other way.

e. Misalignment of one or more stages of the receiver will cause reduced output. Misalign-

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C115.

with S103D.

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: C121.

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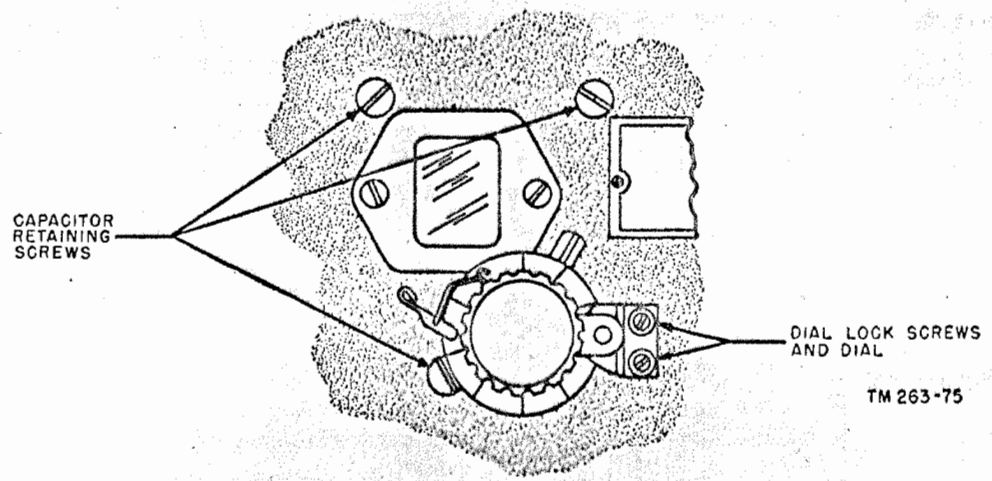
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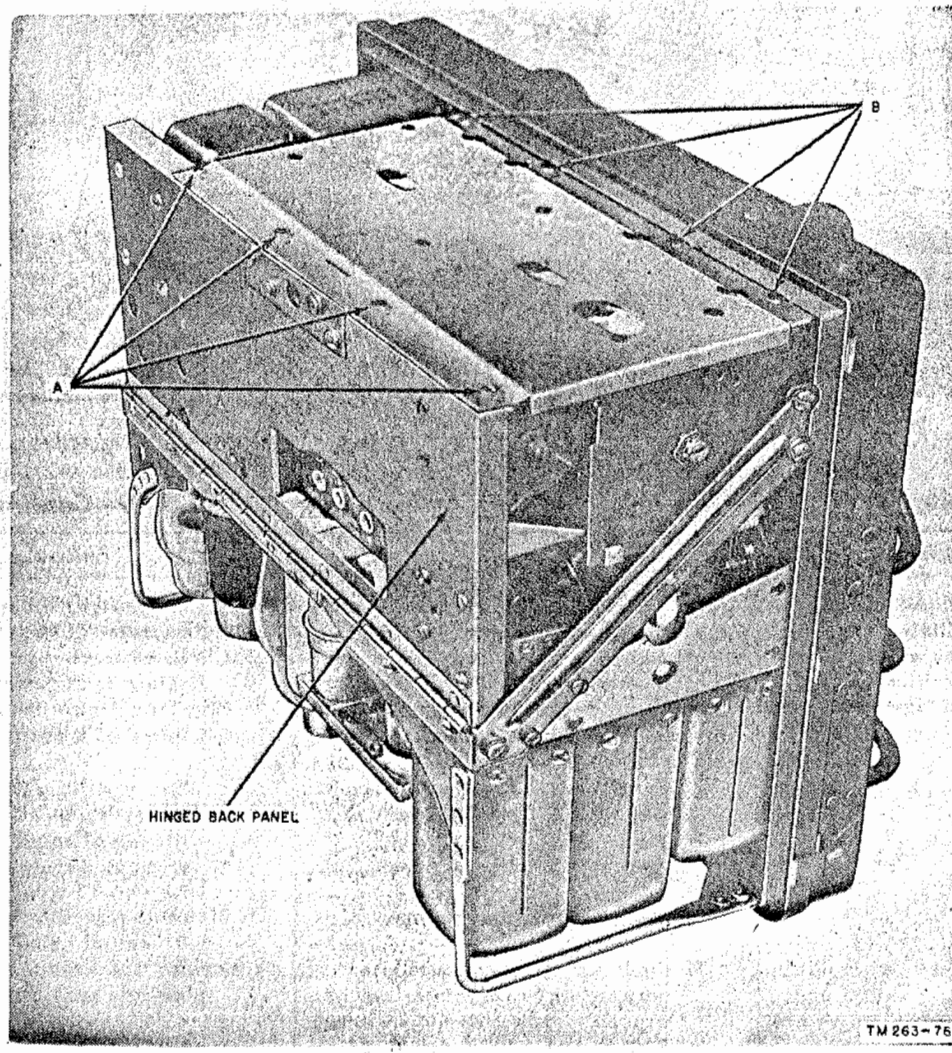
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TM 263-75

Figure 101. Transmitter capacitor and dial retaining screws.



TM 263-75

Figure 102. Location of screws A and B.

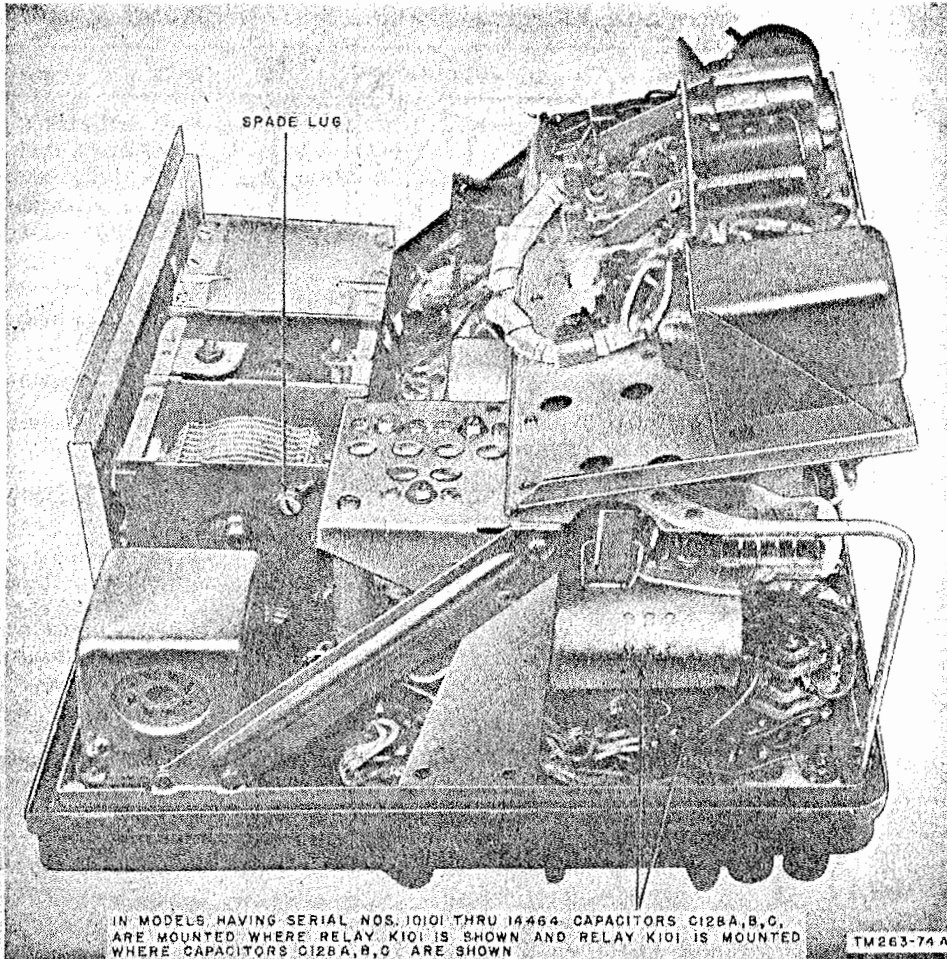


Figure 108. Back panel of transmitter shown swung up to expose tuning capacitor.

148. Localizing Trouble in Transmitter Section of Radio Set AN/GRC-9—Continued

Symptom	Probable trouble	Correction
MASTER OSC 3A4 (V101): 1. Master oscillator does not oscillate on either MO or XTAL position. All d-c supply voltages are normal.	1a. Faulty tube V101----- b. Grid coil between terminals 4 and 5 of transformer T101 is open. c. One of capacitors C146, C101A, C102, C129, and C106B may be shorted. d. Grid resistor R102 is open----- e. Capacitor C105 may be open----- f. Capacitor C103 may be open----- g. Capacitor C104 may be open-----	1a. Replace tube V101. b. Check resistance between 4 and 5. Replace transformer T101. c. Check resistance between terminals 1 and 3 of transformer T101. d. Replace resistor R102. e. Momentarily, short capacitor C105 with one of equal capacity. f. Momentarily, short capacitor C103 with one of equal capacity. g. Momentarily, short capacitor C104 with one of equal capacity.
2. Oscillator does not oscillate on XTAL position only. All d-c supply voltages are normal.	2a. If oscillator does not oscillate for only one or two crystals, they are probably defective or switches S101D and S101E are dirty or open.	2a. Replace the crystals. Clean or replace the switch sections.

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148. Localizing Trouble in Transmitter Section of Radio Set AN/GRC-9—Continued

Symptom	Portable trouble	Correction
<p>INDICATOR neon bulb will not light. Signal is known to be radiated.</p>	<p>25a. Resistor R122 or R123 open b. Coil L104 open c. Defective neon indicator I101</p>	<p>25a. Check resistance and replace faulty unit. b. Check resistance of coil L104. c. Replace neon indicator.</p>
<p>OVERLOAD RELAY K102: 26. Overload relay fails to open 27. Overload relay fails to close</p>	<p>26. Contacts jammed or bent 27. Coil K102A open</p>	<p>26. Replace relay K102. 27. Disconnect the lead from pin 1, and check resistance between terminals 1 and 2.</p>
<p>28. Relay chatters</p>	<p>28a. Contacts 15 and 16 of keying relay K101 are defective. b. Overload relay coil K102B is open</p>	<p>28a. Clean and repair the contacts. b. Turn control ⑩ to OFF. Turn control ⑪ to PHONE. Check resistance between pin 3 and ground. It should be 67 ohms; if not, coil K102B is open.</p>

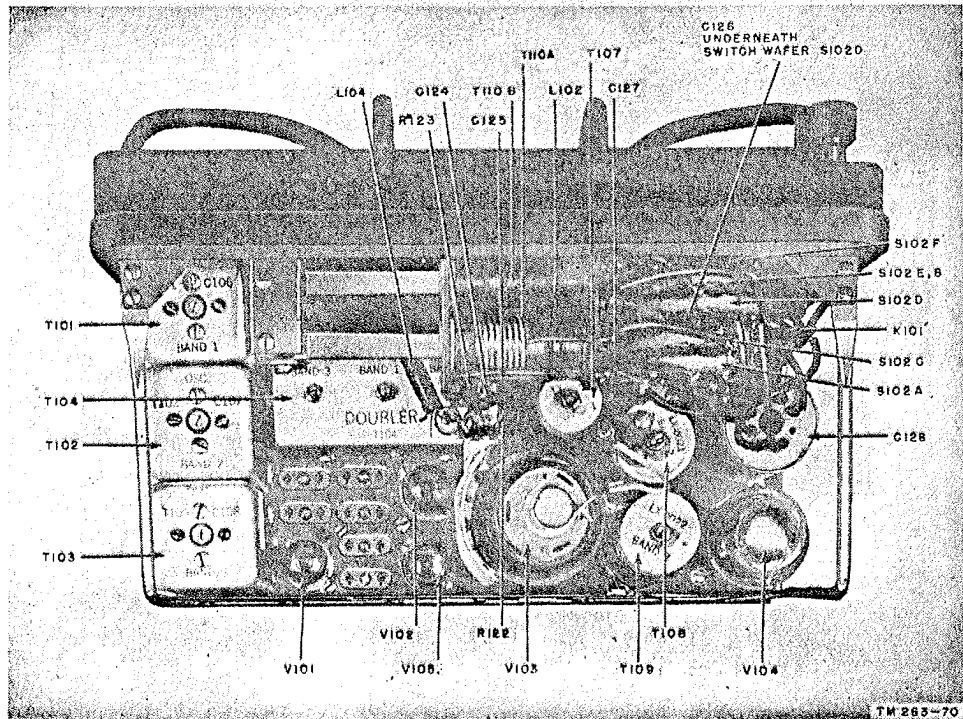
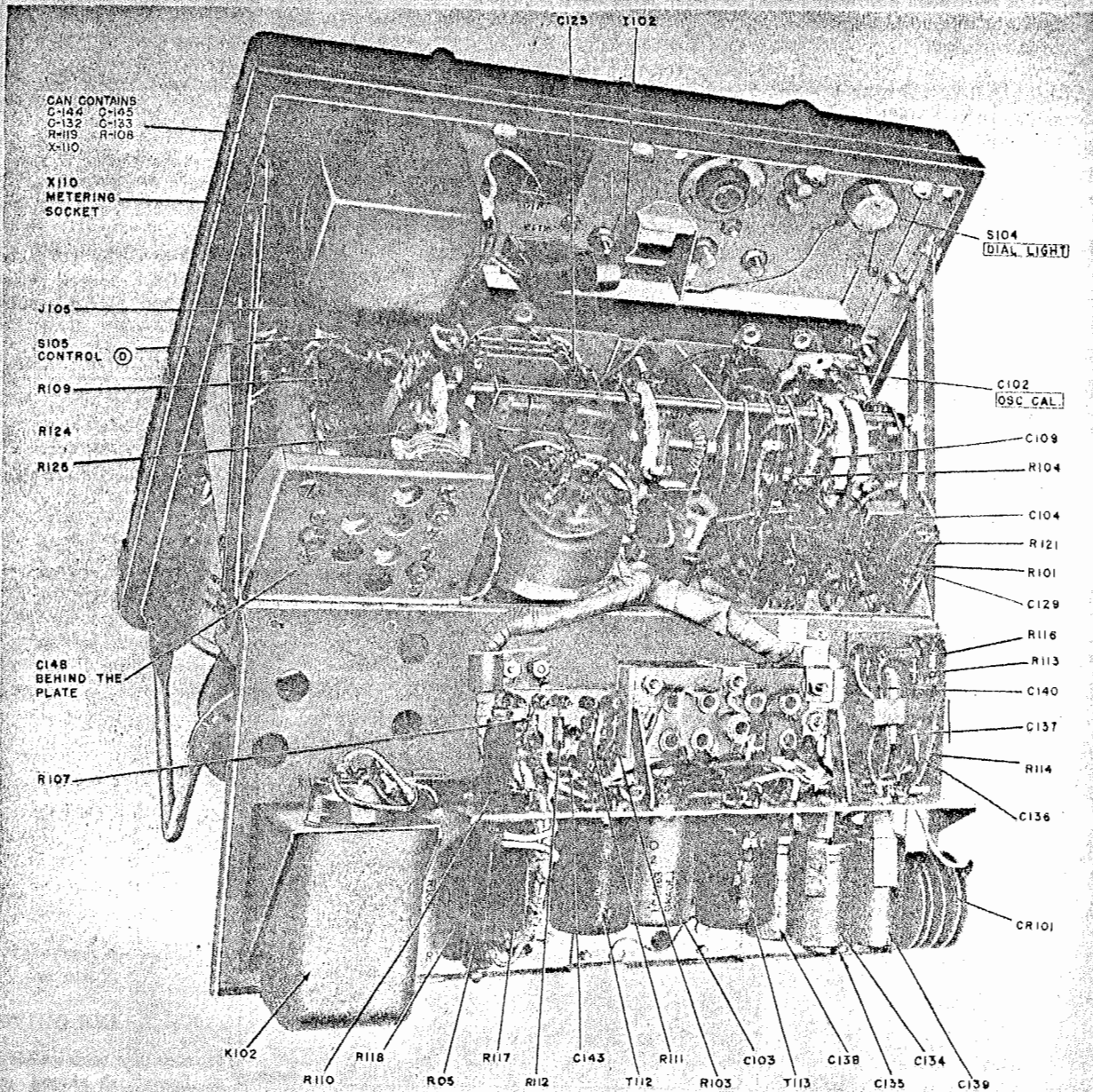


Figure 104. Transmitter parts location (top).

921610°-51--10



NOTE:
 VARIABLE TUNING CAPACITOR C101A,B,C HAS BEEN REMOVED.

TM 283-71

Figure 105. Transmitter parts location (bottom).

S104
DIAL (RIGHT)

C102
OSC. CAL.

C109

R104

C104

R121

R101

C129

R116

R113

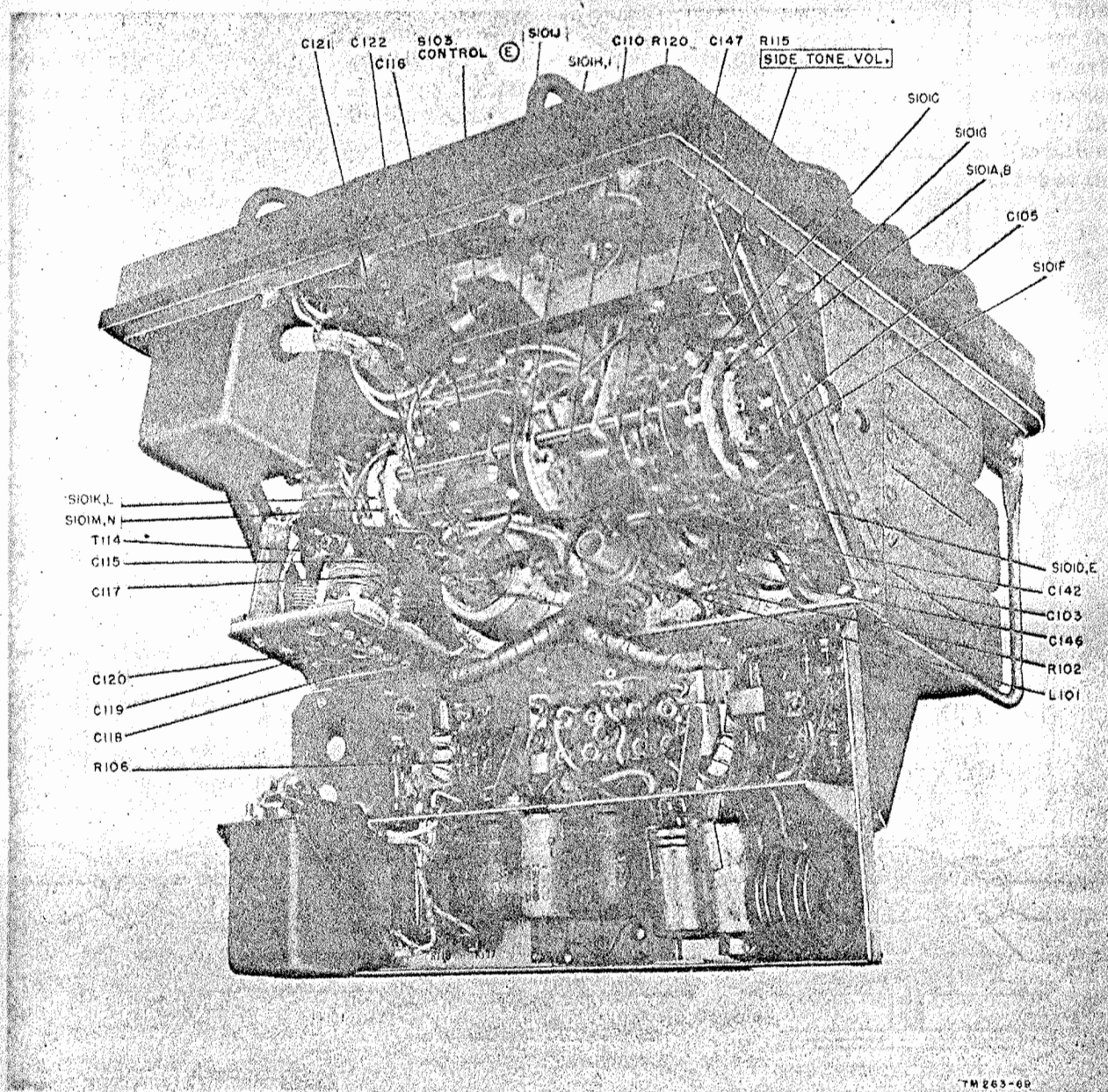
C140

C137

R114

C101

CR 101



NOTE:
VARIABLE TUNING CAPACITOR C101, A, B, C
HAS BEEN REMOVED.

TM 263-69

Figure 106. Transmitter parts location (bottom).

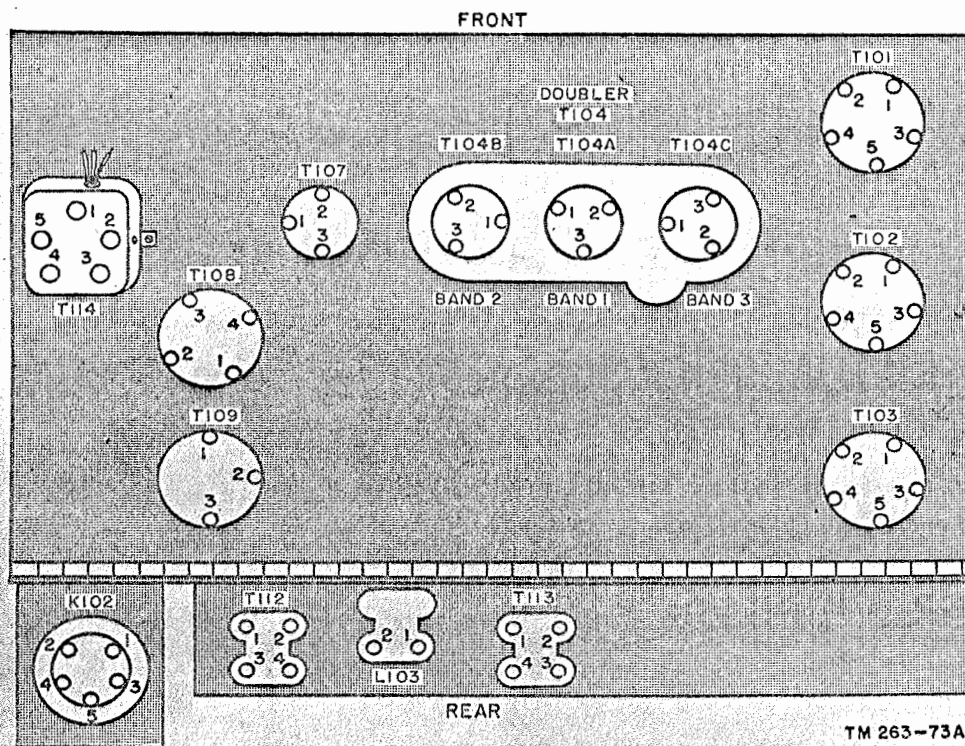


Figure 107. Transformer pin designation on transmitter.

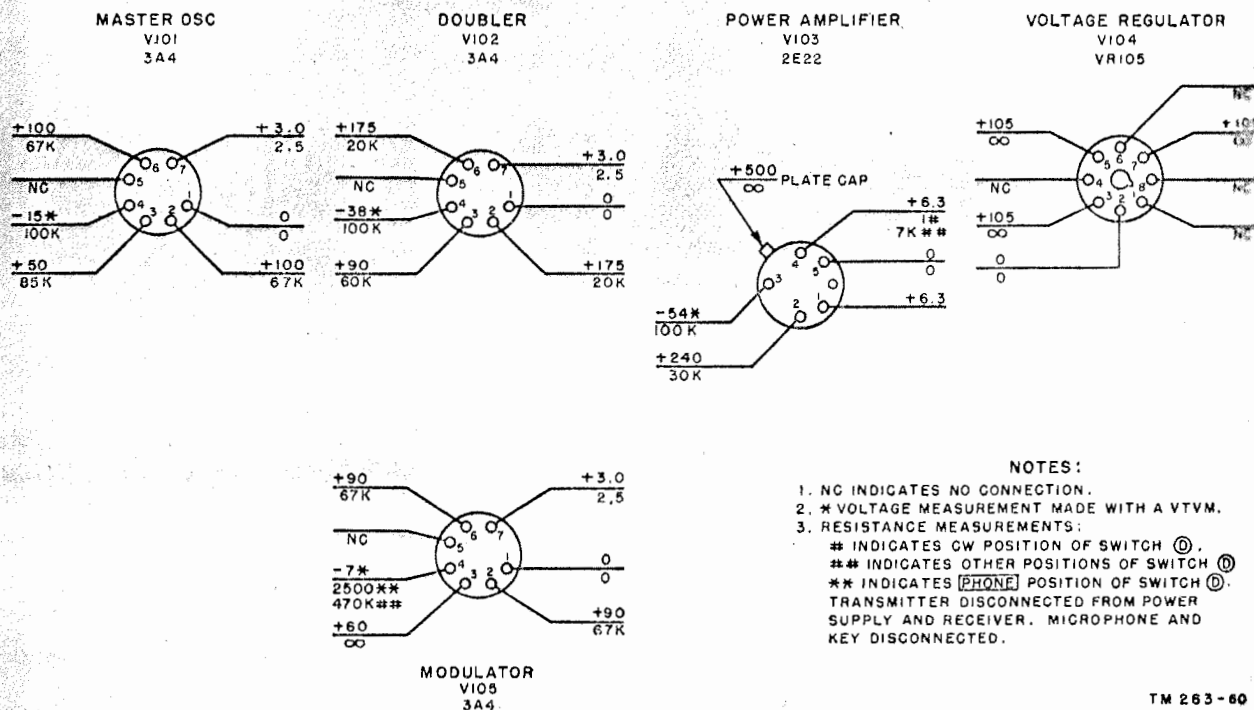


Figure 108. Transmitter tube socket voltage and resistance diagram.

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149. Transmitter Tube Socket, Voltage, and Resistance Diagram (fig. 108)

The d-c voltage values given in the following diagram were made with a 20,000-ohm per volt meter, except those readings marked with an asterisk (*) which are measured with a VTVM. The following control settings were used:

- a. Control ① at BAND 2-MO.
- b. Control ② at CW-HI.
- c. Control ③ at SEND.

d. Supply voltage 500 and 105 volts to the plates and screen grids, and 6.3 volts to the filaments.

e. Control ④, at WHIP position, is tuned to the antenna being used. The resistance values given in the diagram were measured under the same switch conditions as the voltage charts except that the transmitter was disconnected from the receiver and power supply, and the MIKE and KEY were disconnected. Variations in switch positions are given in the chart at the bottom of figure 99.

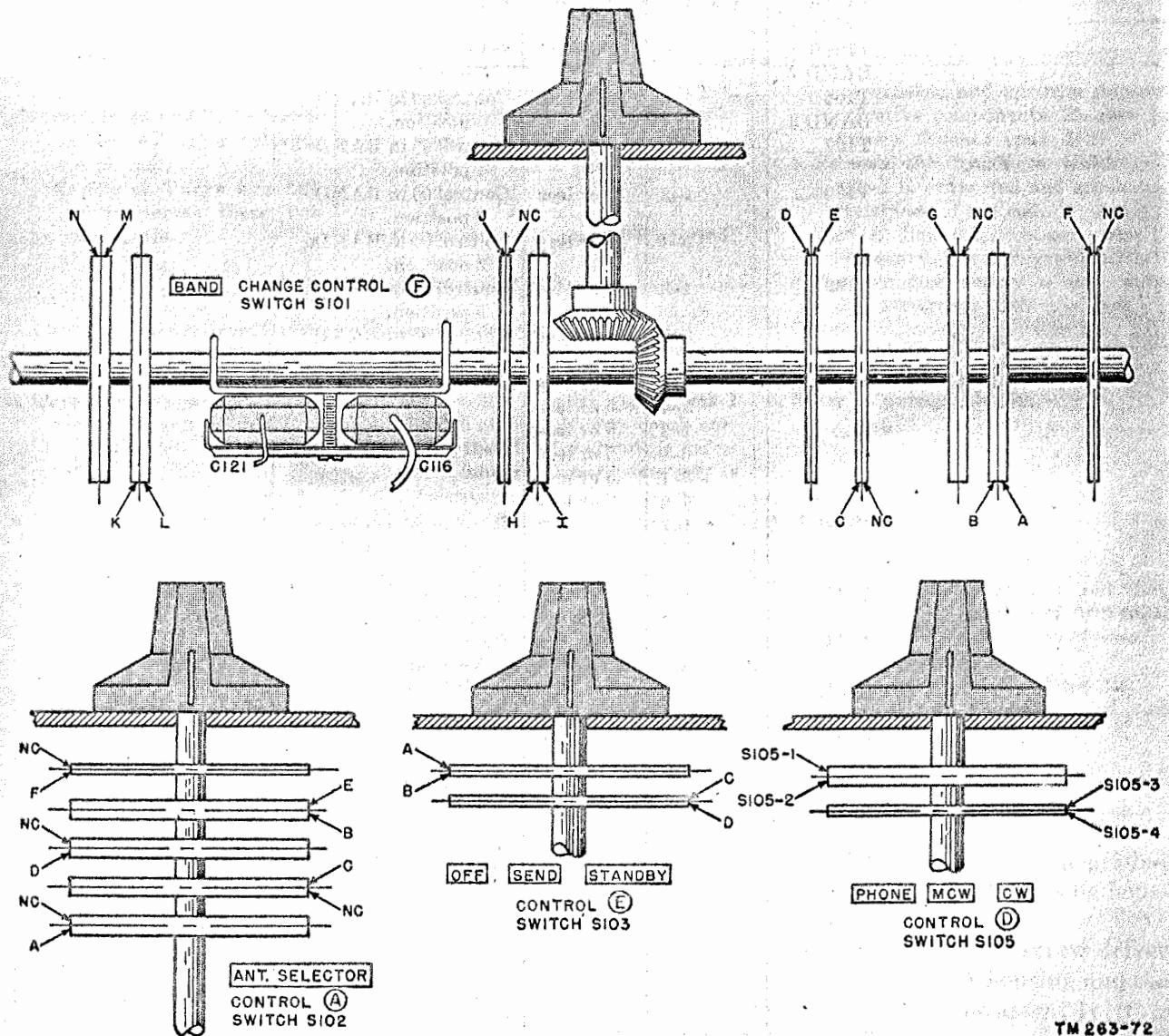


Figure 109. Transmitter wafer switch sections.

150. D-c Resistance of Transmitter Coils and Transformers

In order to measure the resistance between several of the contacts listed, first it will be nec-

essary to perform the steps given in the column headed *Condition*. If these steps are not performed before the reading is taken, the value found will be in error.

Transformer or coil	Terminals	Ohms	Condition
T101	1-3	.5 or less	Control Ⓟ in BAND 1 position.
	4-5	.5 or less	
T102	1-3	.5 or less	Control Ⓟ in BAND 2 position.
	4-5	.5 or less	
T103	1-3	2.0 or less	Control Ⓟ in BAND 3 position.
	4-5	.5 or less	
T104A BAND 1	1-3	.5 or less	Control Ⓟ in BAND 1 position.
T104B BAND 2	1-3	.5 or less	Control Ⓟ in BAND 2 position.
T104C BAND 3	1-3	.5 or less	Control Ⓟ in BAND 3 position.
T107	1-3	.5 or less	Control Ⓟ in BAND 1 position.
T108	1-2	.5 or less	Control Ⓟ in BAND 2 position.
	3-4	.5 or less	Control Ⓟ in BAND 2 position.
T109	1-2	.5 or less	Control Ⓟ in BAND 3 position.
	3-2	.5 or less	Control Ⓟ in BAND 3 position.
T110A	1-2	.5 or less	
	3-4	.5 or less	
	1-3	.5 or less	
	5-6	.5 or less	
	6-7	.5 or less	
	5-8	.5 or less	
T112	1-2	30	Remove microphone plug from MIKE jack.
	3-4	1,100	
T113	1-2	725	Unsolder all leads to terminal 1.
	3-4	425	
T114	1-5	.5 or less	Control ⓐ turned to position 11.
	3-4	2.0	
L101		10	
L102	1-2	.5 or less	
L103	1-2	600	
L104		1.0	
K101		11	Disconnect the lead to one of the K101 coil terminals.
K102A	1-2	5,400	Disconnect the lead to terminal 1 of relay K102.
K102B	3-chassis	67	Control Ⓟ at OFF position. Control Ⓧ at PHONE position.

151. Section G

In order to perform the steps given in the column headed *Condition*. If these steps are not performed before the reading is taken, the value found will be in error.

151. Section G

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To det generator remove to fan half follows:

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c. ADJUSTMENT OF VOLTAGE REGULATOR IN GENERATOR GN-58-(*). A vibrating contact-type voltage regulator is incorporated in the hand generator. Adjust, only when necessary, with Signal Corps Gauge TL-127 (stock No. 6Q45127) according to directions inside the cover of the generator.

d. ADJUSTMENT OF INDEX MARK OF TRANSMITTER MAIN TUNING CAPACITOR. The flat of

the main tuning capacitor shaft should be rotated to position for easy tightening up of setscrew of the frequency control dial after the assembly is replaced. The setscrew of the frequency control dial must be seated on the flat of the capacitor shaft, otherwise calibration will be inaccurate. To readjust dial lock, place lock in approximately the normal position, close clamp, and tighten mounting screws.

Section IV. RECEIVER ALINEMENT PROCEDURES

164. Test Equipment Used for Alinement of Receiver Section of Receiver-Transmitter RT-77/GRC-9

a. SIGNAL GENERATOR. The signal generator should be an accurately calibrated instrument producing modulated r-f signals, such as Signal Generator I-72-(*). In addition to 456 kc, the unit must have a range of from 2 mc to 12 mc, covering the three bands of the receiver. The signal generator should have an output of impedance of approximately 100 ohms for best results when the r-f and h-f oscillator circuits are alined. For i-f alinement, these values are not critical. The frequency calibration of the signal generator is extremely important in order that the receiver dial calibration be correct.

b. OUTPUT METER. The output meter in Test Set I-56-(*) is satisfactory.

c. OTHER EQUIPMENT. Additional test equipment necessary are Headset HS-30-(*), a 110-uuf and .05-uf capacitors, and an alinement tool.

165. Preliminary Alinement Procedures

a. Turn on the signal generator and allow it to reach a stable operating temperature (approximately 15 minutes). Using the instruction book furnished with the signal generator, see that it is accurately calibrated.

b. Stand the receiver on its right side; connect the output meter by attaching the two wires from it to Plug PL-55, and insert the

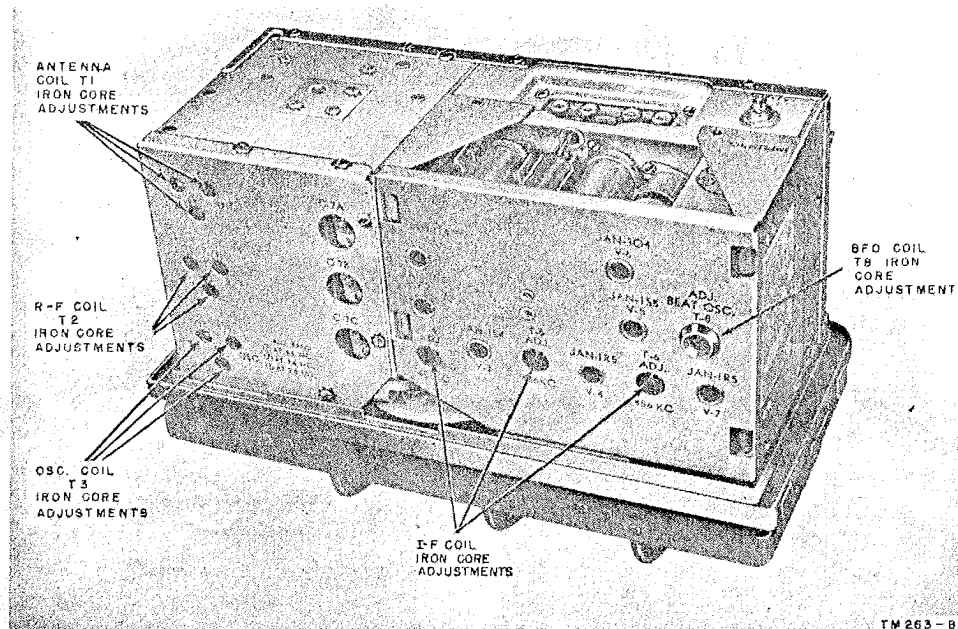


Figure 128. Receiver top, alinement points.

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plug in one of the PHONES jacks. Plug the headset into the other phone jack.

c. Any of the usual power supplies may be used, but the battery power is recommended, because it is a more constant power source. If battery power is available, attach Cord CD-1119 to the BATTERY receptacle on the transmitter and to Battery BA-48.

d. Turn control Ⓢ to STANDBY if Battery BA-48 or Vibrator Power Unit PE-237 is used. If Generator GN-58-(*) is used, turn control Ⓢ to SEND.

e. Allow the receiver and signal generator to warm up for about 15 minutes before any attempt is made at alinement.

166. I-f Alinement

(figs. 128 and 129)

Remove the bottom cover of the receiver and refer to figure 95 for the placement of the i-f transformers. Proceed with the following:

a. Loosen the tuning slug locknuts on the top and bottom of i-f transformers T4, T5, and T6.

b. Turn A. F. GAIN control Ⓢ clockwise to the maximum position. Turn R. F. GAIN control Ⓢ clockwise to the maximum position. Set control Ⓢ to PHONE. Set the output IMPED-

ANCE switch in the back of the receiver chassis for 250 ohms.

c. Cut out the avc voltage. This can be done most easily by connecting a shorting wire from the terminal board lead of resistor R1 to the chassis. The receiver will function normally except that the avc voltage will be shorted to ground.

d. Set the output meter for an impedance of 250 ohms.

e. Set the signal generator at 456 kc. Set the modulation at 30 percent at 400 cycles.

f. Connect the ground side of the signal generator to the receiver chassis.

g. Connect the hot lead of the signal generator output to the signal grid, pin 6 of the second i-f amplifier tube V4, through a .05-uf capacitor.

h. Adjust the signal generator attenuator to produce an approximate midscale reading on the visual indicating output meter.

Note. As alinement progresses, it may be necessary to reduce the signal generator output to keep the output meter on scale.

i. Adjust the top and bottom screws on i-f transformer T6 until a maximum reading is obtained on the visual indicating output meter.

j. Tighten the locknuts slightly, maintaining the peak output.

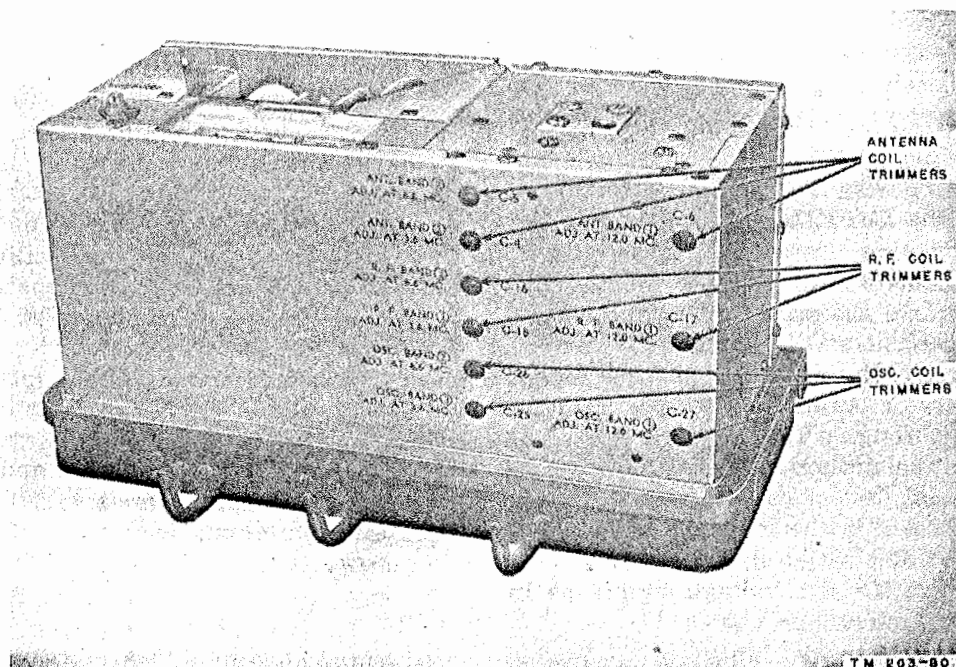


Figure 129. Receiver bottom, alinement points.

k. Repeat steps g, h, i, and j above for each of the other two i-f transformers. For transformer T5, connect the hot lead of the signal generator to pin 6 of tube V3. For transformer T4, connect the hot lead to pin 6 of the converter tube V2.

l. When the hot lead is on pin 6 of the converter tube, recheck the settings on all the i-f transformers and then tighten the locknuts snugly, being careful to maintain maximum reading on the output meter.

167. Bfo Alinement

To aline the bfo, use the following procedure:

- a. Set the TUNING dial control ③ at 2 mc.
- b. Set control ④ at C.W.
- c. Turn A. F. GAIN control ⑤ clockwise to its maximum position.
- d. Set the signal generator at 456 kc with no modulation.
- e. Clip the hot side of the signal generator output to pin 6 of tube V2.
- f. Loosen the locknut on the top of the bfo coil T8 and adjust the tuning slug screw for a zero beat.
- g. Tighten the locknut, being careful to maintain zero beat after the nut is tightened.

168. R-f Alinement

a. PRELIMINARY ADJUSTMENTS. For the r-f alinement on each of the three bands, the following steps apply:

- (1) Set the visual indicating output meter at 250 ohms.
 - (2) Set the IMPEDANCE switch on the receiver chassis at 250 ohms.
 - (3) Set control ① to PHONE.
 - (4) Modulate the signal generator output 30 percent at 400 cycles.
 - (5) Connect the hot lead of the signal generator output to the ANT. binding post through a 110-uuf capacitor. Connect the ground lead to the receiver chassis.
 - (6) Control ② in the transmitter must not be set at position 9, 10, or 11.
 - (7) Disable the avc voltage supply as in paragraph 166c.
- b. BAND 1 ALINEMENT.
- (1) To aline the receiver at the l-f end of

BAND 1, proceed as follows:

- (a) Set the signal generator at 6.6 mc.
- (b) Turn control ③ to BAND 1.
- (c) Set the receiver TUNING dial to exactly 6.6 mc.
- (d) To aline the BAND 1 coil of r-f transformer T2, carefully adjust the coil ① tuning slug screw (on the top of the receiver chassis) for a maximum deflection on the output meter.
- (e) To aline the BAND 1 coil of ANT. transformer T1, carefully adjust the coil ① tuning slug screw (on the top of the receiver chassis) for a maximum deflection on the output meter.
- (f) To aline the BAND 1 coil of OSC. transformer T3, carefully adjust the coil ① tuning slug screw (on the top of the receiver chassis) for a maximum deflection on the output meter.

(2) To aline the receiver at the h-f end of BAND 1, proceed as follows:

- (a) Set the signal generator at 12 mc.
- (b) Set the receiver TUNING dial at exactly 12 mc.
- (c) Carefully adjust OSC. BAND 1 trimmer capacitor C27 (on the bottom of the chassis) for a maximum deflection of the output meter.

Caution: It may be found that there are two positions of the OSC. trimmer capacitor C27 which will give a maximum reading on the output meter. In this situation, the trimmer setting which has less capacity, is the correct one. Referring to figure 130, a capacitor setting at A gives the same capacity as at A' because of the circular construction of the trimmer, and either setting may be used. If the capacitor adjustment, however, results in the output meter indicating a peak at two points such as at A and B, the correct setting is at A, which gives the minimum amount of capacity.

- (d) Adjust the R.F. GAIN BAND 1 trimmer capacitor C17 (on the bottom of the receiver chassis) for maximum deflection of the output meter.

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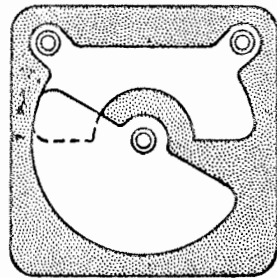
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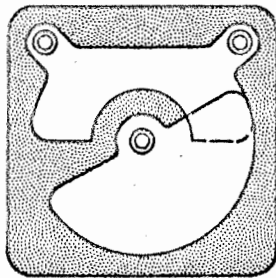
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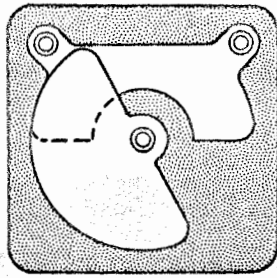
IN BAND 1
 7 (on the bot-
 chassis) for
 of the output



SETTING A



SETTING A'



SETTING B

EITHER ONE OF SETTINGS A AND A' MAY BE USED IF MAXIMUM DEFLECTION IS OBTAINED AT THOSE SETTINGS. IF MAXIMUM DEFLECTION IS OBTAINED WITH SETTINGS A, A' AND ALSO SETTING B, USE ONLY SETTING A OR A' SINCE THESE SETTINGS WILL GIVE MINIMUM CAPACITY. SETTING B IS INCORRECT.

TM 263-81

Figure 130. Determination of the correct settings for OSC. trimmer capacitors C25, C26, and C27.

- (e) Adjust the ANT. BAND 1 trimmer capacitor C6 (on the bottom of the chassis) for a maximum deflection on the output meter.
 - (3) Repeat the entire procedure from step (d) above of the l-f alinement to correct any errors due to interaction of adjustments. It may be necessary to repeat these operations twice. This depends on the initial degree of misalinement.
- c. BAND 2 ALINEMENT.
- (1) To aline the receiver at the l-f end of BAND 2, proceed as follows:
 - (a) Turn control ④ to BAND 2.
 - (b) Set the signal generator at 3.6 mc.
 - (c) Set the receiver TUNING control ⑤ to exactly 3.6 mc.
 - (d) To aline the BAND 2 coil of r-f transformer T2, carefully adjust the coil ② tuning slug screw (on the top of the receiver chassis) for a maximum deflection on the output meter.
 - (e) To aline the BAND 2 coil of ANT. transformer T1, carefully adjust the coil ② tuning slug screw (on the top

- of the chassis) for a maximum deflection on the output meter.
- (f) To aline the BAND 2 coil of OSC transformer T3, carefully adjust the coil ② tuning slug screw (on the top of the chassis) for a maximum deflection on the output meter.
- (2) To aline the receiver at the h-f end of BAND 2, proceed as follows:
 - (a) Set the signal generator at 6.6 mc.
 - (b) Set the receiver TUNING dial to exactly 6.6 mc.
 - (c) Carefully adjust OSC. BAND 2 trimmer capacitor C26 (on the bottom of the chassis) for a maximum deflection on the output meter. Refer to figure 130.
 - (d) Adjust the R. F. GAIN BAND 2 trimmer capacitor C16 (on the bottom of the chassis) for a maximum deflection on the output meter.
 - (e) Adjust the ANT. BAND 2 trimmer capacitor C5 (on the bottom of the chassis) for maximum deflection on the output meter.
- (3) Repeat steps (d) and (e) above of the

l-f alinement of BAND 2 to correct any errors due to interaction of adjustments.

d. BAND 3 ALINEMENT.

(1) To aline the receiver at the l-f end of BAND 3, proceed as follows:

- (a) Turn control ⑩ to BAND 3.
- (b) Set the signal generator at 2 mc.
- (c) Set the receiver TUNING control to exactly 3.6 mc.
- (d) To aline the BAND 3 coil of r-f transformer T2, carefully adjust the coil ③ tuning slug screw (on the top of the receiver chassis) for a maximum deflection on the output meter.
- (e) To aline the BAND 3 coil of ANT. transformer T1, carefully adjust the coil ③ tuning slug screw (on the top of the chassis) for a maximum deflection on the output meter.
- (f) To aline the BAND 3 coil of OSC. transformer T3, carefully adjust the coil ③ tuning slug screw (on the top of the chassis) for a maximum deflection on the output meter.

(2) To aline the receiver at the h-f end of BAND 3, proceed as follows:

- (a) Set the signal generator at 3.6 mc.
 - (b) Set the receiver TUNING dial to exactly 3.6 mc.
 - (c) Carefully adjust OSC. BAND 3 trimmer capacitor C25 (on the bottom of the receiver chassis) for a maximum deflection on the output meter (fig. 130).
 - (d) Adjust the R. F. GAIN BAND 3 trimmer capacitor C15 (on the bottom of the chassis) for a maximum deflection of the output meter.
 - (e) Adjust the ANT. BAND 3 trimmer capacitor C4 (on the bottom of the chassis) for a maximum deflection on the output meter.
- (3) Repeat steps (d) and (e) above of the l-f alinement of BAND 3 to correct any errors due to interaction of adjustments.

169. Crystal Calibrator Oscillator Alinement

The adjustment of the iron slug in transformer T7 is made by the manufacturer and the necessity of its being reset is very unlikely. The position of the slug will not change the frequency output of the crystal oscillator to any extent, therefore, do not attempt to adjust the crystal oscillator output.

Section V. TRANSMITTER ALINEMENT PROCEDURES

170. Test Equipment Used for Alinement of Transmitter Section of Receiver-Transmitter RT-77/GRC-9

To aline the transmitter, use the following equipment:

- a. Frequency Meter Set SCR-211-(*).
- b. A voltmeter with an internal resistance of 1,000 ohms per volt or more. Correct metering socket voltages are found on the back panel of the transmitter (par. 147).
- c. A power source for operation of the transmitter. A stable source should be used such as Vibrator Power Unit PE-237, although Generator GN-58 can be used if necessary.
- d. Dummy antenna load of 72 ohms or 5,000 ohms noninductive resistance with a rating of 20 watts or higher.

171. Transmitter Alinement Procedure (figs. 131 and 132)

- a. Remove the power cable from the transmitter.
 - b. Unfasten the catches and remove the transmitter from its case. Be careful not to damage the p-a tube.
 - c. Attach the power cable to the power receptacle on the front of the panel.
- Caution:** Be careful, since the top cap of the output tube and many other points carry approximately 500 volts when the power is turned on.
- d. Set switch ⑩ to PHONE-HI.
 - e. Set switch ⑪ to BAND 1-MO.
 - f. Turn the ANT. SELECTOR switch ⑫ to WHIP position 4, and adjust the ANTENNA TUNING control ⑬ to 10. Do not use any posi-

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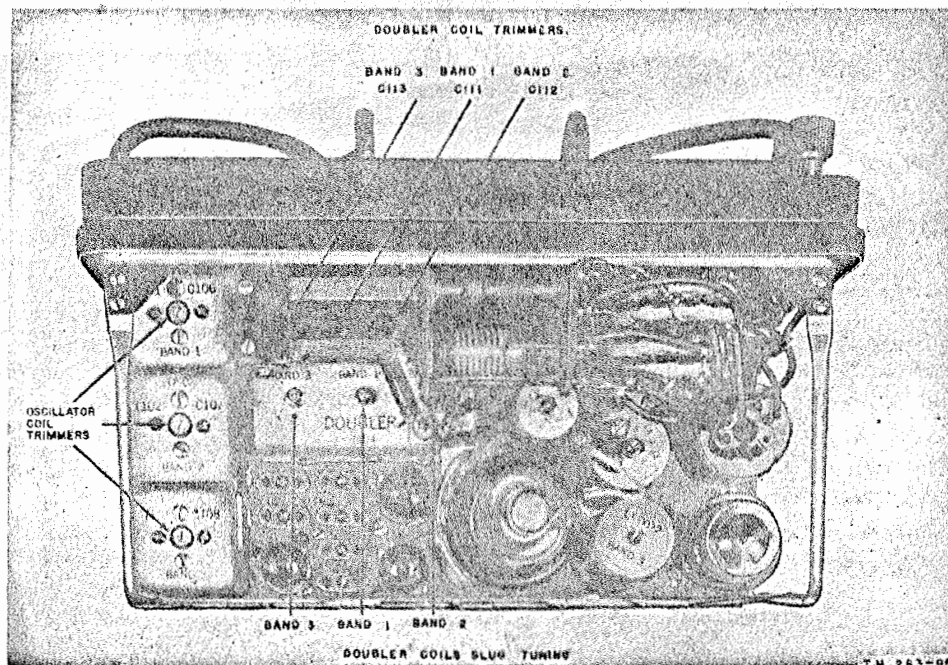


Figure 131. Transmitter alinement points, top of chassis.

tion lower than 10, since misalinement will result.

g. Set the frequency meter to 11,200 kc.

h. Set control @ (OSC. CAL. control) to midposition.

i. Set the FREQ. CONTROL @ knob on the transmitter to the setting indicated on the calibration chart for 11,200 kc.

j. Press the microphone button and listen in the phones connected to the frequency meter for the signal from the transmitter. Adjust the MO BAND 1 (MO) trimmer (C106B) to exactly zero beat. If the 200-kc crystal in the receiver is used instead of the frequency meter, proceed as instructed in paragraph 55.

Note. Since Frequency Meter SCR-211-(*) can give beat notes between harmonics of the transmitter and frequency meter, measurements of the transmitter frequency should be taken at several points on the dial to be sure that the transmitter has been alined to the correct frequency, and that it has calibrated closely over its entire range. If a check is made at several points and it is found that only the one at which the adjustment has been made is closely on frequency and that the other points checked are considerably in error, it is probable that the wrong beat note was used in the frequency meter and that none of the frequencies are correct.

k. Connect the negative lead of the 1,000-ohm per volt meter to point No. 5 on the metering

socket and connect the positive lead to the chassis or pin 7, using the 100-volt scale on voltmeter.

l. Adjust the doubler trimmer (C111) BAND 1 for maximum output indication on the meter.

m. Using approximately a 3-volt scale of the meter, connect the positive lead of the meter to point No. 2 and the negative lead to point No. 8 of the metering socket.

Caution: Be careful, since both ends of the meter connected in this way are approximately 500 volts above the chassis.

n. Adjust the power amplifier trimmer (C118) BAND 1 for MINIMUM indication on the meter.

o. Set the FREQ. CONTROL @ knob on the transmitter to the setting indicated on the calibration chart for 6.6 mc. Using the 100-volt scale, connect the negative meter lead to pin 5 and the positive lead to pin 7 of the metering socket. Adjust the BAND 1 DOUBLER screw on coil T104 (core) for MAXIMUM voltage and tighten the locknut.

p. Using the 3-volt scale, connect the negative meter lead to pin 8 and the positive meter lead to pin 2 at the metering socket. Adjust BAND 1 (PA) iron core for MINIMUM voltage on the meter and tighten the locknut.

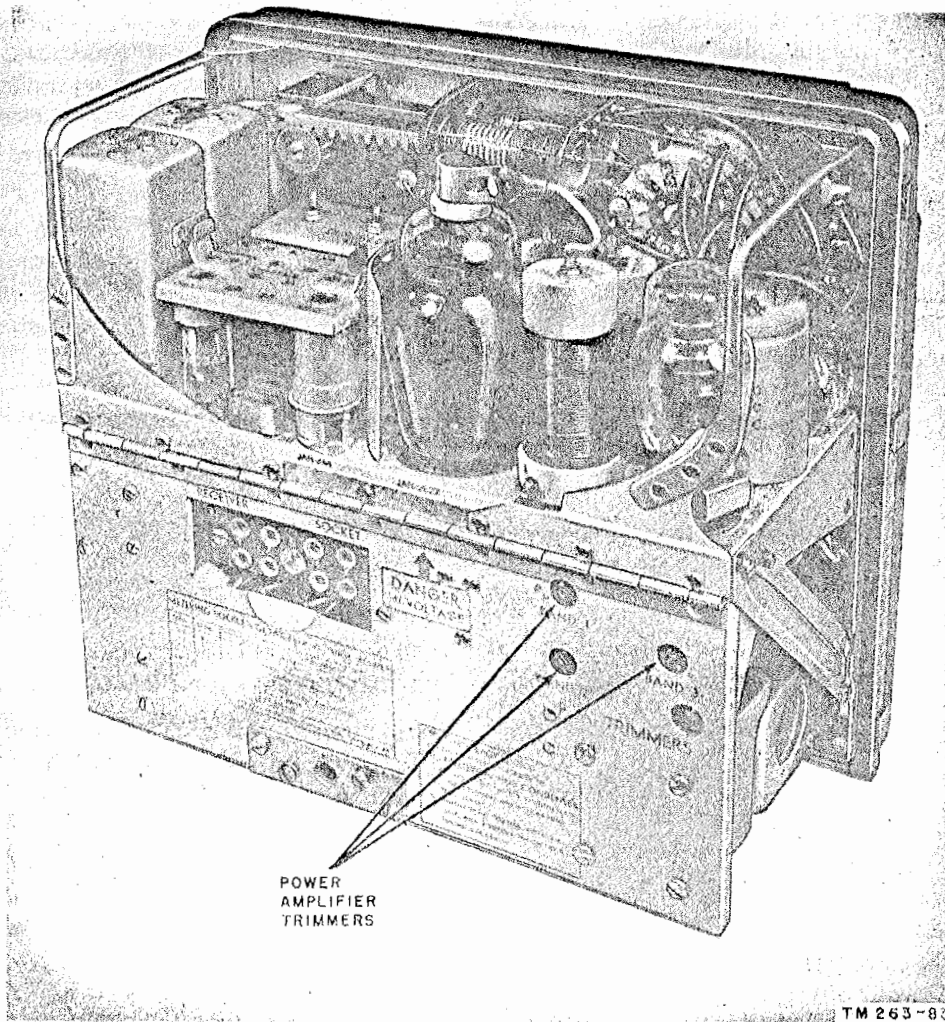


Figure 132. Transmitter alignment points, back of chassis.

g. Repeat operations as described in subparagraphs *k*, *l*, *m*, and *n* above in their proper sequence.

r. Connect the 5,000-ohm carbon resistor from the ANT. post on the transmitter to some bare metal part of the chassis of the transmitter. Turn the ANT. SELECTOR switch Ⓐ to REEL 5, 6, 7, or 8, whichever will resonate. Rotate ANTENNA TUNING knob (control Ⓒ) until INDICATOR glows brightest.

s. As a final check to insure proper alinement, the transmitter should be tuned at one end of the frequency band and then at the other. At the same time, adjust knobs Ⓐ and Ⓒ at each

end of the band. This is done to make the indicator glow at normal brilliance and assures that the antenna coupling circuits can be tuned to resonance at each end of the band.

t. The alinement of the transmitter is now complete on BAND 1. The same procedure will be carried out for BANDS 2 and 3 using alinement frequencies of 6,100 kc and 3,600 kc for BAND 2 and 3,300 kc and 2,000 kc for BAND 3.

u. Remove the power cable as a safety measure.

v. Replace the transmitter in its case.

Note. Transmitter alinement without test equipment is virtually impossible. Never attempt to aline the transmitter without a voltmeter.

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Section VI. FINAL TESTING OF RECEIVER SECTION

172. General

Sections VI and VII are intended as a guide to be used in determining the quality of a repaired Radio Set AN/GRC-9. The minimum test requirements outlined in paragraphs 175 through 200 may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

173. Test Equipment Required for Final Testing of Receiver Section

The instruments needed for testing the repaired equipment are listed below:

a. Signal generator with a frequency range from 2 mc to 12 mc. It should be capable of producing a signal modulated 30 percent at 400 cycles. Signal Generator I-72-(*) is suitable.

b. A vacuum-tube microvoltmeter if there is none available in the signal generator. It should be capable of reading from 0 to 500 microvolts.

c. Output meter having a range of at least 90 mw (milliwatts) and should be sensitive enough to have one midscale reading for 10 mw. It also should have a 4,000-ohm input impedance.

174. Receiver Section Preliminary Adjustments

All receiver measurements are made under the test conditions listed below, unless otherwise indicated:

Dummy antenna ____110 uuf
Standard output ___10 mw or 6.3 volts in
a 4,000-ohm noninductive load
Load impedance ___4,000 ohms noninductive
Power ratio _____Signal-plus-noise to
noise ratio (10:1)
Modulation _____30 percent at 400
cycles
Controls © and ® __Set at maximum

The signal generator is connected to the ANT. binding post on the transmitter through the dummy antenna specified above. The output

meter should be connected to one of the PHONES jacks. Then the receiver is tuned to resonance at each of the test frequencies. The transmitter control © is set at the approximate center of its range, and the antenna selector switch (control ®) is set to WHIP position 1.

175. Sensitivity Test

a. GENERAL. Sensitivity test input is expressed in microvolts and is the least input signal which, when modulated 30 percent at 400 cycles and fed into the receiver, will produce the standard output of 10 mw with controls © and ® at maximum settings. The test is conducted to give a signal-plus-noise ratio of 10 to 1. The sensitivity is measured at the following test frequencies:

Band	High	Medium	Low
1	12 mc	9.3 mc	6.6 mc
2	6.6 mc	5.1 mc	3.6 mc
3	3.6 mc	2.8 mc	2.0 mc

b. C-W SENSITIVITY TEST. The procedure is as follows:

- (1) Turn control © to C.W.
- (2) Adjust TUNING control ® to the test frequency.
- (3) Set the signal generator to the same unmodulated test frequency.
- (4) Adjust the A. F. GAIN control © and the signal generator output control until the output meter reads 10 mw.
- (5) Detune the signal generator to at least 20 kc away from resonance and adjust the R. F. GAIN control © until the output meter reads 1 mw.
- (6) It is probable that when the signal generator is set again at the resonant frequency, the output meter no longer reads 10 mw. Readjust the volume controls until it has the correct reading.
- (7) Repeat steps 5 and 6 above until the condition is maintained where the output meter reads 10 mw with the signal generator on resonance and 1 mw with the generator detuned, for the same setting of receiver and signal generator volume controls.
- (8) The sensitivity is then the signal voltage input to the receiver when the out-

put meter records 10 mw after the condition in step 7 is found.

c. **PHONE SENSITIVITY TEST.** The procedure is as follows:

- (1) Turn control ① to PHONE.
- (2) Adjust TUNING control ② to the test frequency.
- (3) Set the signal generator to the same test frequency, modulated 30 percent at 400 cycles.
- (4) Adjust the A. F. GAIN control ③ and the signal generator output control until the output meter reads 10 mw.
- (5) Remove the modulation from the signal input and adjust the R. F. GAIN control ④ until the output meter reads 1 mw.
- (6) When the modulation is removed, the output is no longer 10 mw. Readjust the volume controls until it is 10 mw.
- (7) Repeat steps 5 and 6 above until the condition is maintained where the output meter reads 10 mw with the signal generator modulated and 1 mw with the generator unmodulated, *for the same setting of receiver and generator volume controls.*
- (8) The sensitivity is then the signal voltage input to the receiver when the output meter records 10 mw and when the condition in step 7 is found.

d. **SENSITIVITY VALUES.** For a receiver output of 10 mw at a signal-plus noise to noise ratio of 10, the sensitivity figure of the receiver should be not more than 3 microvolts for c-w reception, and not more than 10 microvolts for phone reception.

176. Selectivity Test

The selectivity test gives an indication of the shape of the bandwidth or band-pass characteristics of the tuned circuits in the receiver. The selectivity is measured at 6,600 kc (BAND 2).

a. The signal generator is set at 6,600 kc, modulated 30 percent at 400 cycles, and has an initial input of 10 microvolts.

b. Receiver volume controls ① and ② are adjusted so that a 10-mw output is indicated

on the output meter. These controls are not changed for the remainder of the test.

c. The input voltage from the signal generator is successively increased to 2, 10, 100, and 1,000 times its initial value and, at each value of signal strength, the signal generator is detuned *on each side* of 6,600 kc so that the receiver will produce exactly a 10-mw output.

d. The selectivity of the receiver is within the following limits, using the above steps.

Signal generator input	Total bandwidth (kc)	
	Minimum*	Maximum
2 x initial setting	3.5	—
10 x initial setting	—	12
100 x initial setting	—	20
1000 x initial setting	—	30

*Minimum indicates that for a signal generator input of 2 x initial setting there should not be less than 3.5 kc between the two points (on either side of 6,600 kc) at which the power output will be equal to the 10-mw prevailing at the initial input of 10 microvolts.

177. Image Frequency Rejection Ratio

This is defined as the ratio of signal input voltage at the image frequency to the signal input voltage required at the desired frequency, with the receiver power output being the same for both frequencies. The image frequency rejection ratios for the receiver should be—

Band	Ratio
1	Greater than 50 to 1
2	Greater than 250 to 1
3	Greater than 1000 to 1

The image frequency rejection ratio is determined at the high, middle, and low end of each band. Proceed as follows:

a. Set the output voltage of the signal generator at 10 microvolts with a 400-cycle signal modulated 30 percent.

b. The receiver volume controls are adjusted to produce a 10-mw output indication on the output meter.

c. Tune the signal generator to the image frequency of the resonant frequency to which the receiver TUNING control ② is set. The image frequency is 912 kc plus the resonant frequency. Image ratio is obtained by dividing the microvolts necessary to produce a 10-mw output at image frequency (912 kc plus resonant frequency) by the microvolts required for the same 10-mw output at the resonant frequency, the volume control being in the same position for the two measurements.

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178. I-f Rejection Ratio

The i-f rejection ratio should be greater than 100 db at all frequencies within the 2 mc to 12 mc bandwidth of the receiver. It is measured at the low end of each band, 2 mc, 3.6 mc, and 6.6 mc. The input voltage of the signal generator is 10 microvolts at resonance. The receiver volume controls are adjusted to produce 10-mw output. The ratio is obtained by dividing the microvolts, necessary to produce 10-mw output at the i.f. (456 kc), by the microvolts required for the same output at the resonant frequency, the receiver volume controls being in the same position for the two measurements.

179. A-f Output

a. The maximum power output of the receiver should not be less than 90 mw at all frequencies from 250 to 2,500 cps (cycles per second) for both 250- and 4,000-ohm output impedances. Also, for these impedances, the maximum undistorted output (less than 10 percent distortion) should be not less than 75 mw at all frequencies from 250 to 2,500 cps.

b. The input level of the test signal is set to 500 microvolts at 5,100 kc modulated at 30 percent, and the receiver is tuned to resonance. The af is varied, and receiver volume control \odot is adjusted to maximum undistorted output at each af. Maximum undistorted power output is defined as the maximum power output which contains less than 10 percent total harmonic distortion (root-mean-square voltage).

180. Audio Fidelity

a. With both 250- and 4,000-ohm output impedances, the maximum undistorted output at all frequencies from 250 to 2,500 cps should be within +2 db or -5 db (decibel) of the output at 400 cps.

b. The input level of the test signal is set to 500 microvolts at 6,600 kc (BAND 2) and modulated at 30 percent at 400 cps. The receiver is tuned to 6,600 kc and the receiver volume controls are set to produce an output meter reading of 10 mw. The volume controls should not be touched for the remainder of the test. The a-m frequency is varied, while the modulation remains at 30 percent for all modulation frequencies.

181. Calibration Accuracy

a. The dial calibration should be accurate to within 30 kc on BANDS 2 and 3 and 50 kc on BAND 1.

b. The calibration accuracy of the receiver is checked at 200-kc intervals over the entire frequency range of each band, starting at 2,000 kc. The dial is turned in the direction of the increasing frequency for each check point.

c. See paragraph 50 for calibration operation.

182. Crystal Calibrator Circuit

a. With the receiver set to CAL. and the volume controls set at maximum, the power output of the receiver is measured at each crystal check point as the receiver is tuned through the entire frequency range. The power output indicated by the output meter should be a minimum of 10 mw.

b. The crystal calibrator oscillator circuit should have an accuracy of plus or minus 20 cps at 200 kc when using standard Crystal Unit CR-2/U which is calibrated to plus or minus 18 cps.

c. The spurious response should have a rejection ratio of more than 27 db compared to the crystal check points on either side of the particular spurious response. With the receiver set to CAL. and volume controls set to maximum, the receiver is tuned over the entire range and spurious responses are noted. The receiver is tuned to the weaker of the crystal check points on either side of each spurious response, and the R. F. GAIN control \odot is reduced so that the receiver output is 50 mw. The receiver then is tuned to the spurious response without disturbance of the volume control. The spurious response power output reading should be less than .1 mw.

183. Beat Frequency Oscillator

The bfo is checked at 6,600 kc (BAND 2). The volume controls are adjusted to produce an output of 50 mw at a signal input of 500 microvolts when left in this position. Using Headset HS-30-(*), the audible beat note is distinct, without slurring as the signal input voltage is increased to 500 millivolts.

184. Resettability

The resettability is a measure of the backlash in the tuning gears. The resettability is checked at the h-f end of each band. Each test frequency is approached from the clockwise and counter clockwise directions, and the difference in readings is recorded. There should not be more than 5 kc difference in the dial reading when the test frequency is approached from the clockwise and counterclockwise directions.

185. Spurious Responses

Spurious responses caused by harmonics of the h-f oscillator and bfo should have a rejection ratio of more than 50 db over the entire tuning range. Spurious responses are measured at the h-f end of each band. With 10 microvolts input at the receiver signal frequency, the volume control is adjusted to give a 10-mw output. The input is then adjusted to 10,000 microvolts, and the signal generator frequency is adjusted over the frequency range of plus or minus 2 mc of the test frequencies. If spurious responses are encountered, the input should be reduced to give an output of 10-mw. The voltage ratio of this input to the resonant frequency input is recorded as the spurious response ratio.

186. Current Drain

The receiver current drain is measured with the receiver set for c-w operation, using a 0- to 50-ma meter in series with the B supply and a 0- to 1-ampere meter in series with the A supply. At 105 volts and 1.4 volts input, the B drain

should be less than 20 ma and the A drain should be less than 500 ma, respectively, under conditions of maximum current consumption.

187. Sidetone

The receiver should provide clear monitoring when the transmitter is operating on C.W. or MCW or PHONE. With the SIDE TONE VOL. control @ set at maximum, the sidetone output at the receiver jack should be a minimum of 10 mw.

188. Receiver Section Tests at Reduced D-c Supply Voltage Input

a. SENSITIVITY. With a 1.2-volt filament voltage, a plate voltage of 75 volts and an output of 10 mw, the sensitivity should be not less than 50 microvolts for voice reception and not less than 25 microvolts for c-w reception.

b. CALIBRATOR OUTPUT. The crystal calibrator output under l-v conditions are measured by use of headphones at the receiver output jacks. With 1.2 volts filament voltage and a plate voltage of 75 volts, the calibrator output should be audible over the frequency range within two consecutive crystal check points.

c. FILAMENT VOLTAGE REGULATION. The filament voltage is measured at a tube socket when operating the filaments through a 10.6-ohm dropping resistor in series with a 6-volt source and an 8-volt source in turn. The filament voltage should be greater than 1.2 volts for a 6-volt source and less than 1.7 volts for an 8-volt source.

Section VII. FINAL TESTING OF TRANSMITTER SECTION

189. Test Equipment Required for Final Testing Transmitter Section

The instruments needed for final testing of the transmitter are listed below:

R-f meter	0 to 2 amperes
D-c voltmeter	20,000 ohms per volt
Oscilloscope	BC-1060-(*)
Test Set	TS-505/U
Frequency Meter	SCR-211-(*)

190. Transmitter Section, Preliminary Adjustments

Unless otherwise specified, all transmitter measurements are made under the following test conditions:

a. Dummy antenna: Use a 20-ohm noninductive resistor in series with a 70-uuf capacitor and 0- to 2-ampere r-f meter. This is equivalent to a 15-foot whip antenna. Connect the meter end to the chassis or ground side.

Note. A 5,400-ohm noninductive resistor is equivalent to a half-wave antenna (control Ⓐ in REEL position).

b. Control Ⓓ is set to PHONE-HI position unless otherwise stated.

191. Power Output

With input voltages of 6.3 volts filament and 500 and 425 plate voltages at the POWER receptacle, the power outputs should not be less

than those listed in the table below. The ANTENNA TUNING control Ⓒ is adjusted to maximum meter deflection for each frequency. The power output is: (ANTENNA CURRENT)² (20 ohms). The input power to the transmitter is obtained by measuring the total d-c plate and screen currents of the p-a tube. The input power to the transmitter should be less than the input powers listed in the following table.

Operating voltages	Plate and screen input power (watts)	Position of control Ⓓ		Power output (watts)	Frequency (kc)	Frequency band
500	100	CW	HI	7	2,000	3
500	80	PHONE	HI	2	2,000	3
500	70	CW	LO	3	2,000	3
500	50	PHONE	LO	.3	2,000	3
500	100	CW	HI	12	3,600	3
500	80	PHONE	HI	3	3,600	3
500	100	CW	HI	10	3,600	2
500	80	PHONE	HI	3.5	3,600	2
500	100	CW	HI	12	6,600	2
500	80	PHONE	HI	3	6,600	2
500	100	CW	HI	7.5	6,600	1
500	80	PHONE	HI	3	6,600	1
500	100	CW	HI	12	12,000	1
500	80	PHONE	HI	5	12,000	1
425	60	CW	LO	2	2,000	3
425	40	PHONE	LO	.2	2,000	3

192. Microphone Input Voltage

In phone operation for audio-modulation frequencies between 250 and 3,000 cps, 100 percent modulation should be obtained for an input of less than .5 volt to the primary of microphone transformer T112.

193. Mcw Operation

a. The frequency of the modulating tone in mcw operation should be between 600 and 850 cps. The transmitter should be modulated from 70 to 100 percent.

b. The transmitter is set up for normal operation and the sidetone control is adjusted for maximum output. The percentage of modulation, as viewed on an oscilloscope, is checked for both high and low power mcw operation at 8 mc.

194. Netting Operation

a. At all frequencies in the range of the transmitter, it should be capable of netting with

another radio transmitter within plus or minus 1,000 cps.

b. The transmitter is set up for high-power, mo, and c-w operation (HI-MO-CW). The receiver of the radio set is zero-beat to a frequency meter adjusted to 12 mc. The transmitter then is adjusted to zero beat with the receiver in the NET position. Then the transmitter is set to normal c-w operation and the frequency of the beat note in the frequency meter should be checked.

195. Overload Relay K102

a. The overload relay in the p-a circuit should open during crystal operation when mistuning of FREQ. CONTROL Ⓔ exceeds 7 percent of the operating frequency. The overload relay should cut out before the grid voltage drops below 10 volts.

b. The transmitter is set up for CW-HI-XTAL operation for frequencies in the middle of each band. The transmitter tuning dial is set to the crystal frequency, and is tuned above

and below until the overload relay opens. The dial readings and the p-a grid voltage should be recorded.

196. Metering Socket Readings

a. The transmitter is set for high-power, mo, and c-w operation with a 20-ohm, 70-uuf dummy antenna load on the antenna circuit. The plate

supply should be adjusted to 500 volts and the filament supply to 6.3 volts. The antenna circuit should be resonated, and the voltages at the metering socket should be recorded for c-w operation. The measurements are made by using a 20,000-ohm per volt d-c meter. Plate current (with no load) measurements are made with the dummy antenna removed.

b. The following readings should be obtained:

Metering socket pins		Circuit	Value
1+	7-	P.A. filament voltage -----	+6.3 volts
2+	7-	P.A. plate voltage -----	+500 volts
2-	8-	P.A. plate current (loaded) -----	BANDS 1, 2, and 3, 110 ma; maximum
		P.A. plate current (unloaded) -----	Less than 30 ma on all bands
3+	7-	P.A. screen grid voltage -----	275 volts maximum on all bands
4+	7-	P.A. suppressor grid bias-CW -----	+6.3 volts
4-	7+	P.A. suppressor grid bias-PHONE -----	-40 volts
5-	7+	P.A. signal grid bias -----	-45 to -70 volts
6+	7-	Master oscillator plate voltage -----	+105 volts
		Modulator plate voltage -----	
7+	7+	Terminal 7 is grounded to the transmitter chassis -----	0 volt

197. Keying

It should be possible to key the transmitter at speeds up to 25 words per minute either in the MO or XTAL position of control Ⓞ.

198. Frequency Stability Versus Input Voltage

a. The transmitter is connected to the dummy antenna and is fully loaded for high-power c-w operation.

b. The transmitter is tuned to 12,000 kc and is allowed to warm up for 5 minutes at input voltages of 5.4 and 400 volts. The frequency is checked by a frequency meter and the transmitter is set to zero beat with the frequency meter. The supply voltages are increased to 7.5 and 700 volts. The frequency meter is then zero-beat to the transmitter. The difference in readings is considered the drift.

c. The frequency drift of the mo should not exceed .02 percent for a variation from 5.4 volts filament and 400 volts plate to 7.5 volts filament and 700 volts plate.

199. Vibrator Power Unit PE-237, Voltage Output Test

With a 6-, 12-, or 24-volt vehicular battery connected to the input of the power unit, the voltage outputs are as follows:

Terminals	Circuit	Value in volts
20 24	Transmitter filaments -----	6.3
21 24	Receiver plates (SEND) -----	105
22 24	Receiver filaments (SEND) -----	1.35
23 24	Receiver filaments (SEND) -----	1.35
32 24	Transmitter plates -----	500
33 24	Receiver plates (STANDBY) -----	100
34 24	Keying relay K101 -----	6.0

These measurements are made with the power unit loaded. Refer to paragraph 155c for measurement disassembly.

200. Generator GN-58-(*) , Voltage Output Test

With the hand generator being driven at approximately 60 rpm, the voltage outputs should be the same as those given in the VOLTAGE CHART on the main schematic diagram (fig. 137). Refer to paragraph 151 for disassembly of the generator so that it may be checked under load.

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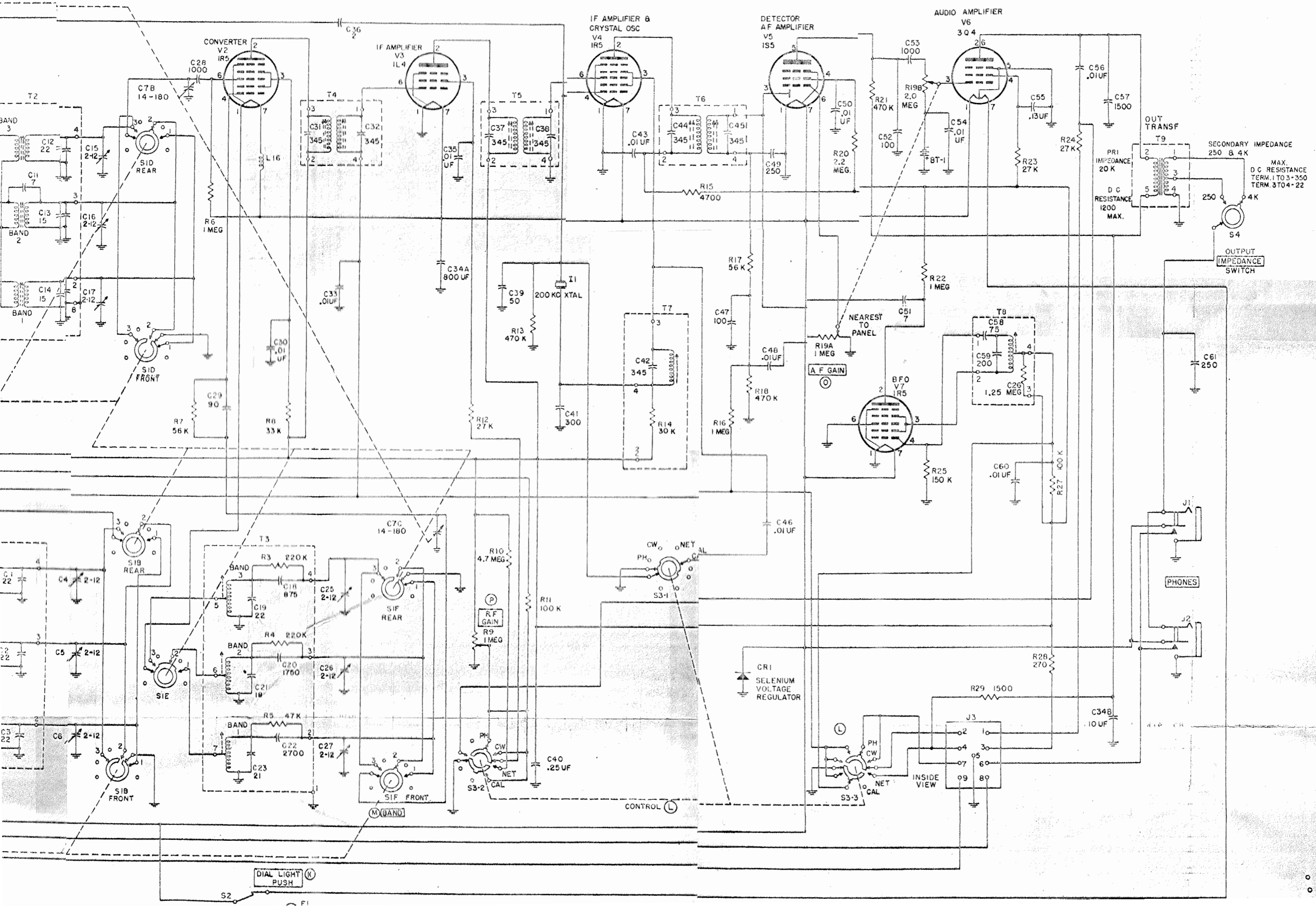
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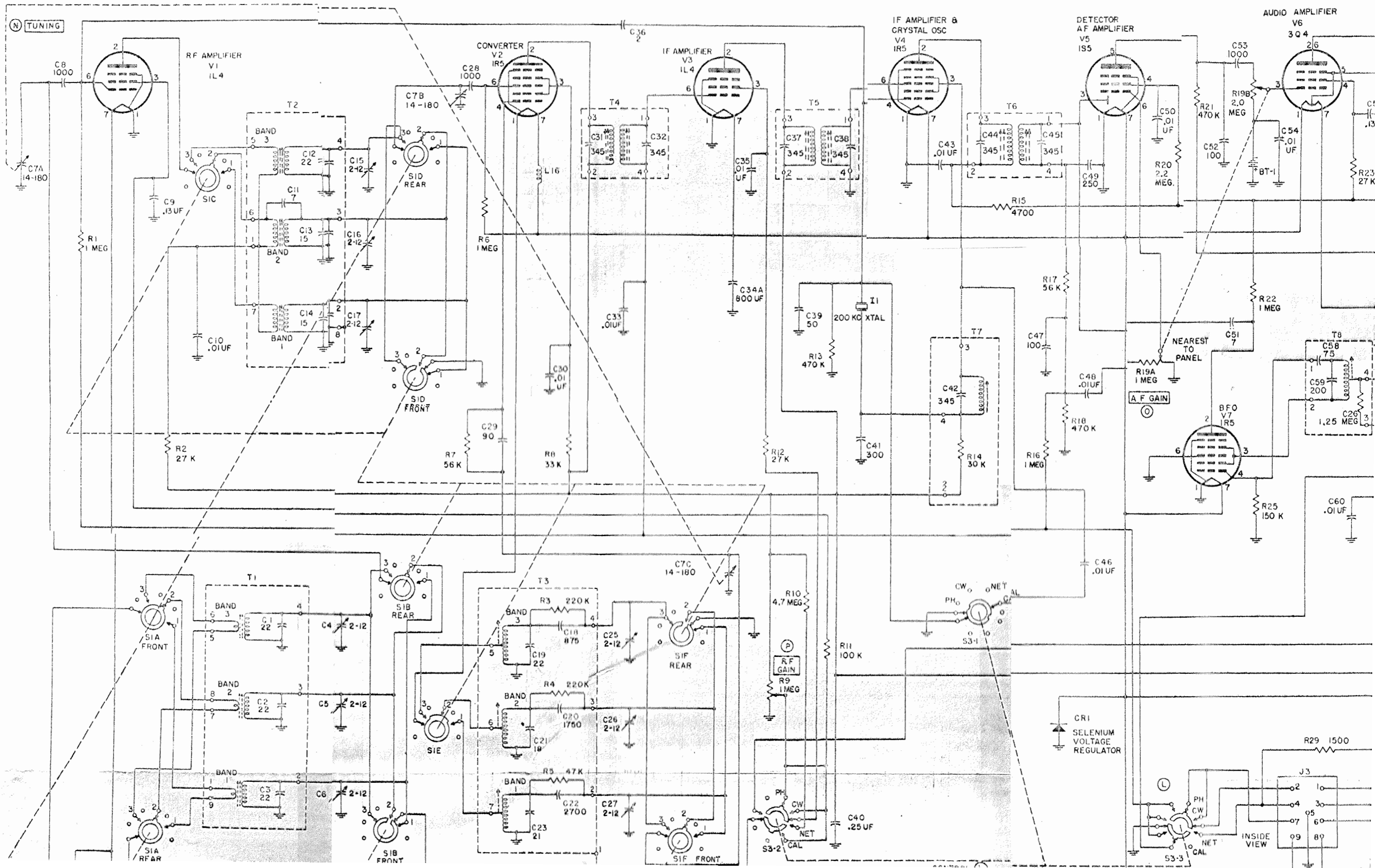
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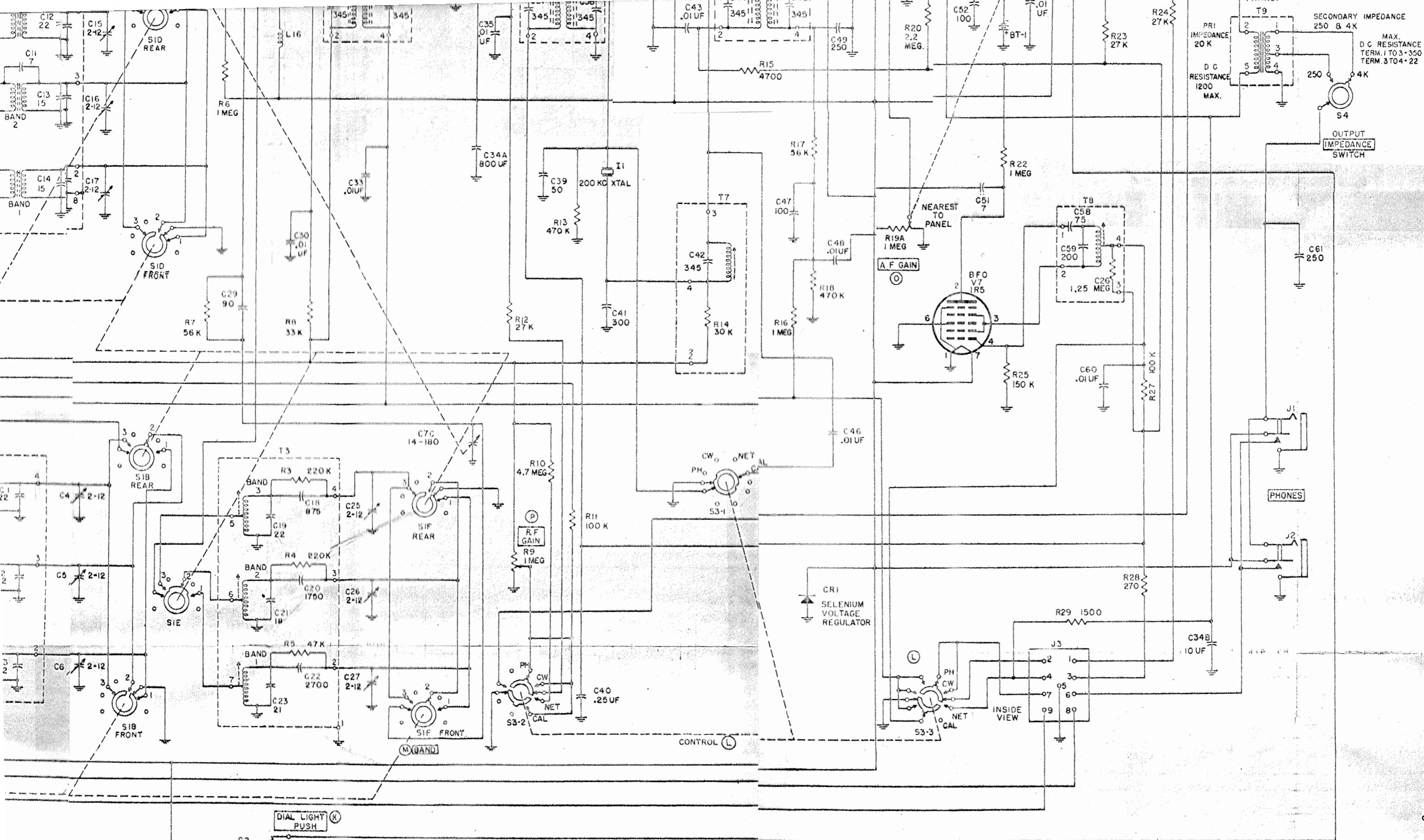
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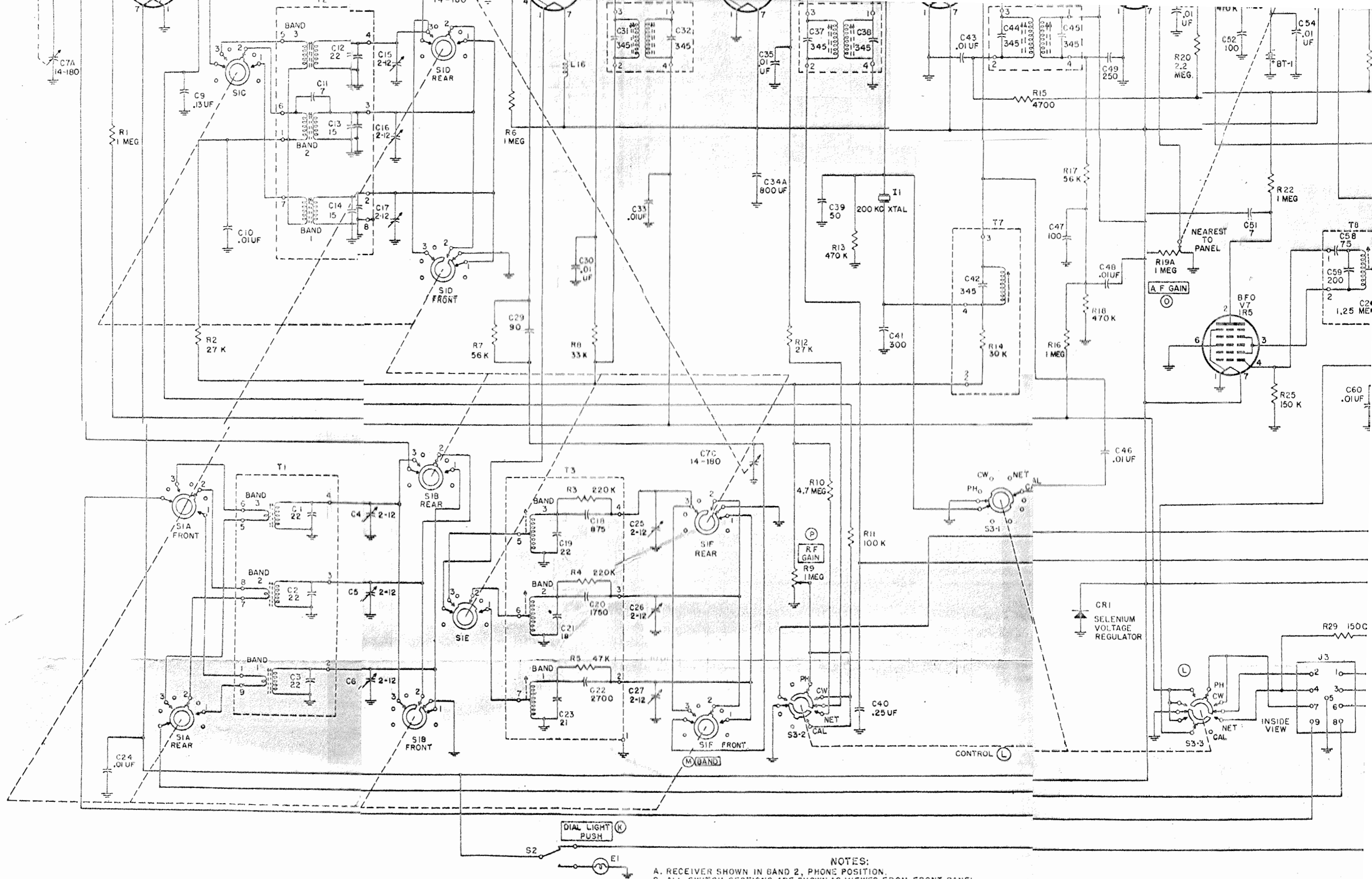




- NOTES:**
- A. RECEIVER SHOWN IN BAND 2, PHONE POSITION.
 - B. ALL SWITCH SECTIONS ARE SHOWN AS VIEWED FROM FRONT PANEL.
 - C. FRONT SECTION OF EACH WAFER SECTION IS THE ONE NEAREST CONTROL KNOB.
 - D. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
 - E. UNMARKED VALUES BESIDE COILS ARE D-C RESISTANCE IN OHMS.
 - F. J3 TERMINALS:

1. SIDETONE	6. RECEIVER 1.4 V.
2. NET +105V	7. AUDIO TUBE POWER CONTROL
3. RECEIVER +105V	8. RECEIVER ANTENNA
4. +105V	9. RECEIVER ANTENNA
5. GROUND	

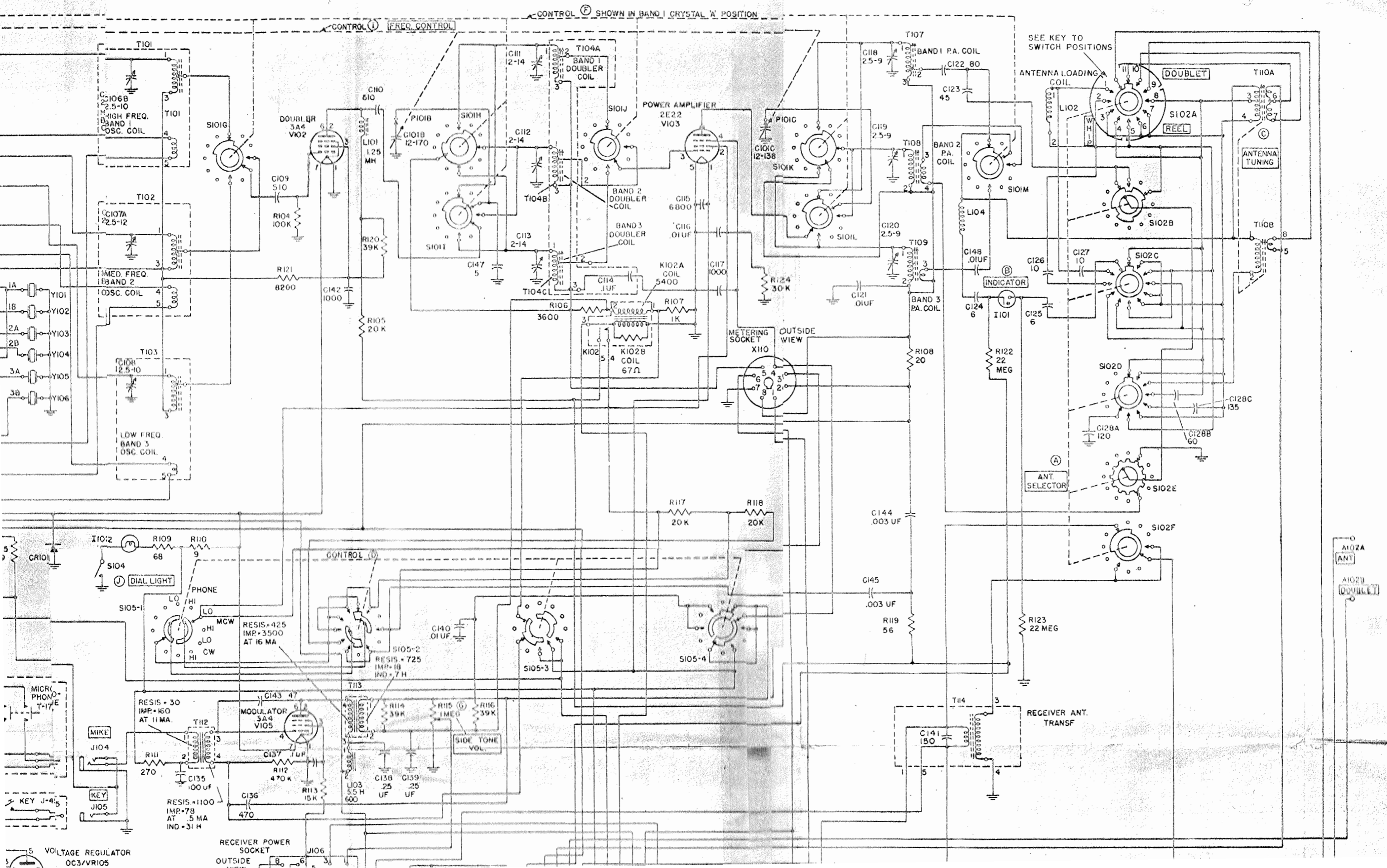
Figure 138. Receiver section of receiver-transmitter ET-17/GRC-9, schematic diagram.



- NOTES:
- A. RECEIVER SHOWN IN BAND 2, PHONE POSITION.
 - B. ALL SWITCH SECTIONS ARE SHOWN AS VIEWED FROM FRONT PANEL.
 - C. FRONT SECTION OF EACH WAFER SECTION IS THE ONE NEAREST CONTROL KNOB.
 - D. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
 - E. UNMARKED VALUES BESIDE COILS ARE D-C RESISTANCE IN OHMS.
 - F. J 3 TERMINALS:

1. SIDETONE	6. RECEIVER 1.4 V.
2. NET +105V	7. AUDIO TUBE POWER CONTROL
3. RECEIVER +105V	8. RECEIVER ANTENNA
4. +105V	9. RECEIVER ANTENNA
5. GROUND	

Figure 138. Receiver section of receiver-transmitter RT-11/GRC-9, schematic diagram.



CONTROL (D) SHOWN IN BAND 1 CRYSTAL 'A' POSITION

SEE KEY TO SWITCH POSITIONS

METERING SOCKET X110 OUTSIDE VIEW

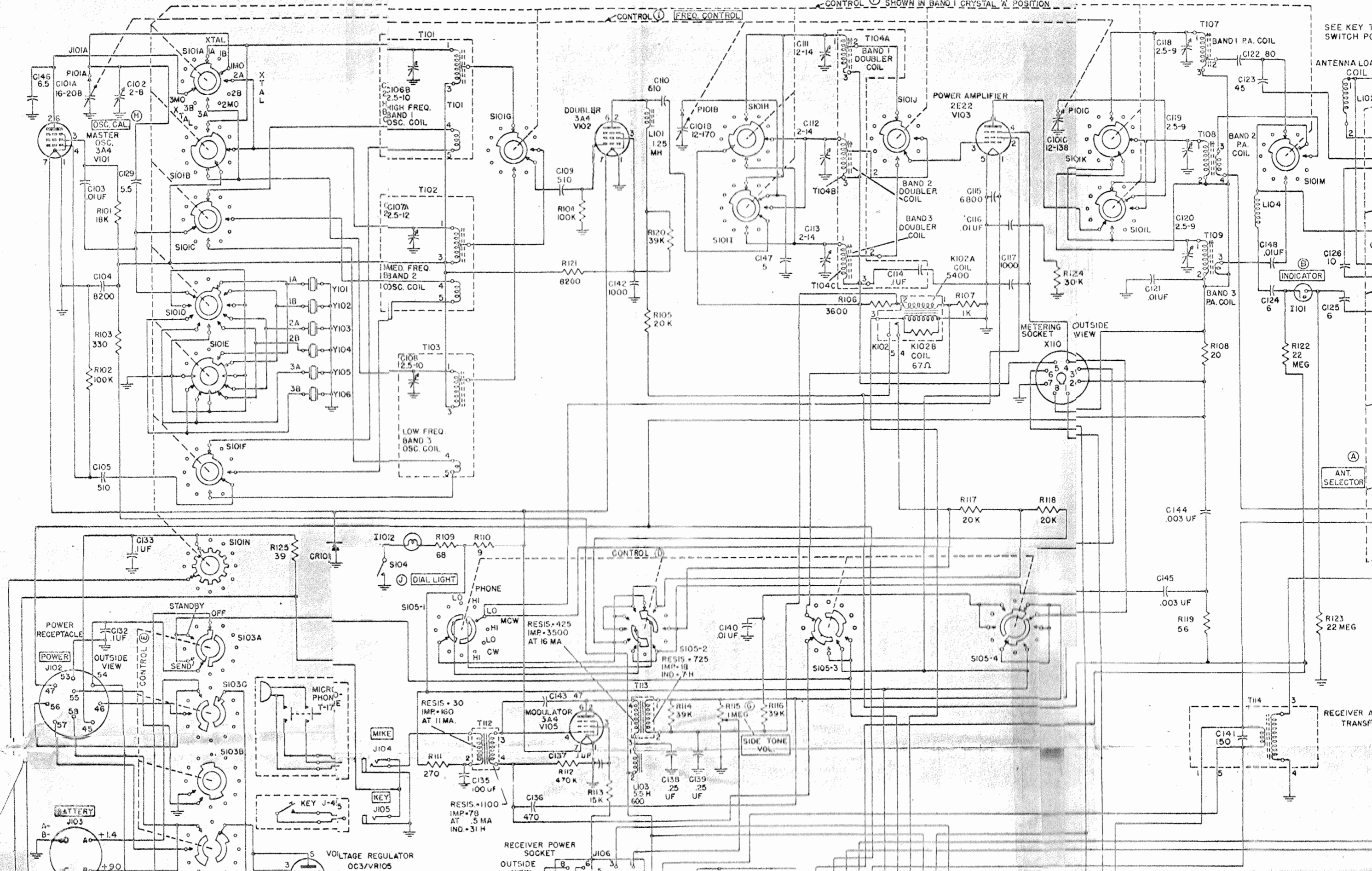
RECEIVER ANT. TRANSF

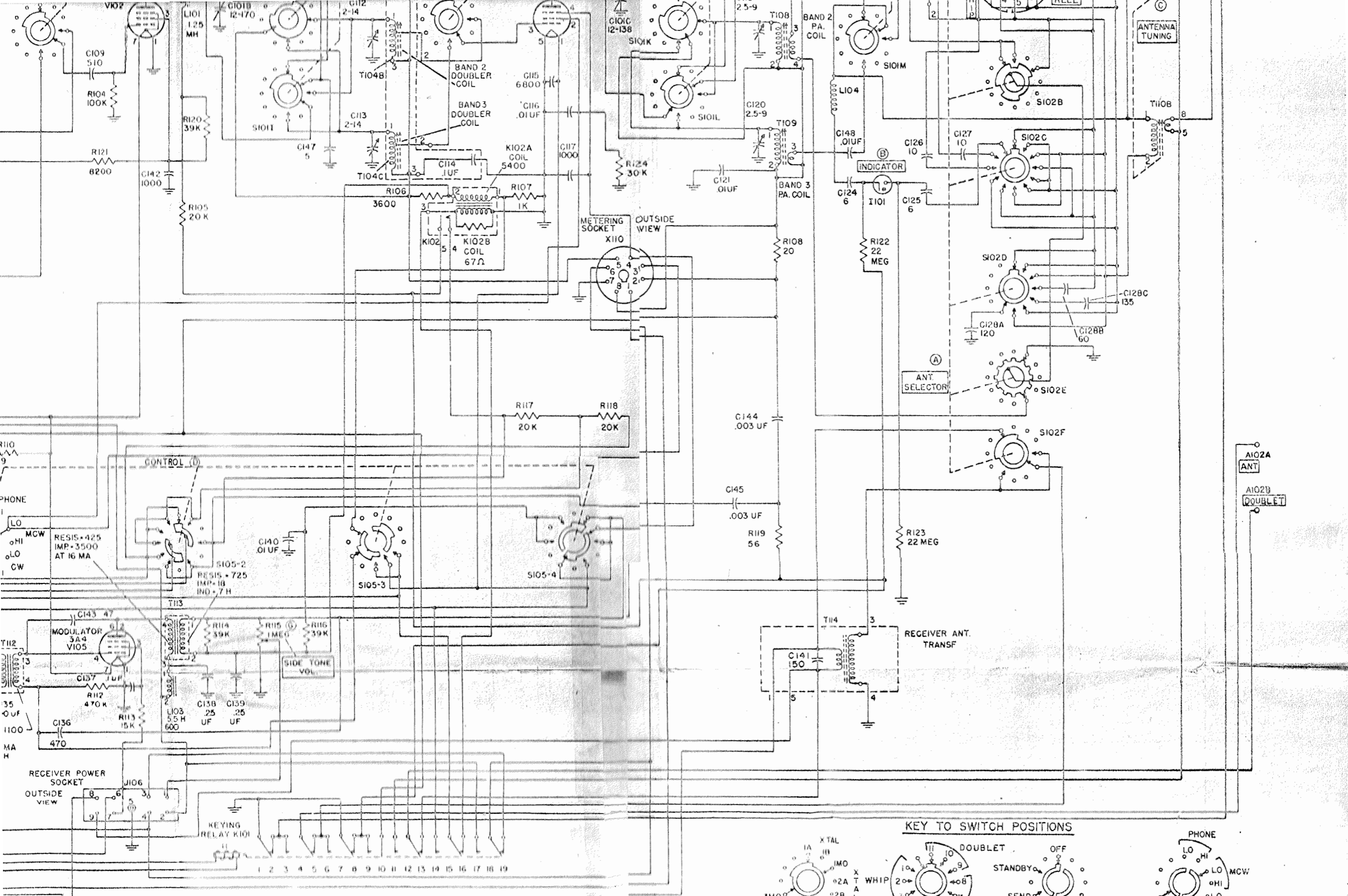
5 VOLTAGE REGULATOR OC3/V105

RECEIVER POWER SOCKET OUTSIDE

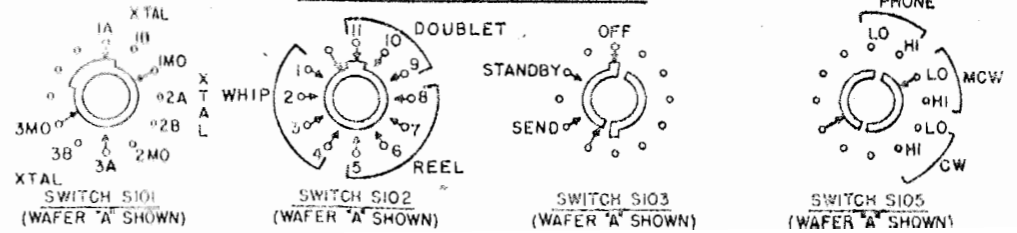
A102A ANT
A102B DOUBLER

CONTROL (E) SHOWN IN BAND 1 CRYSTAL 'A' POSITION





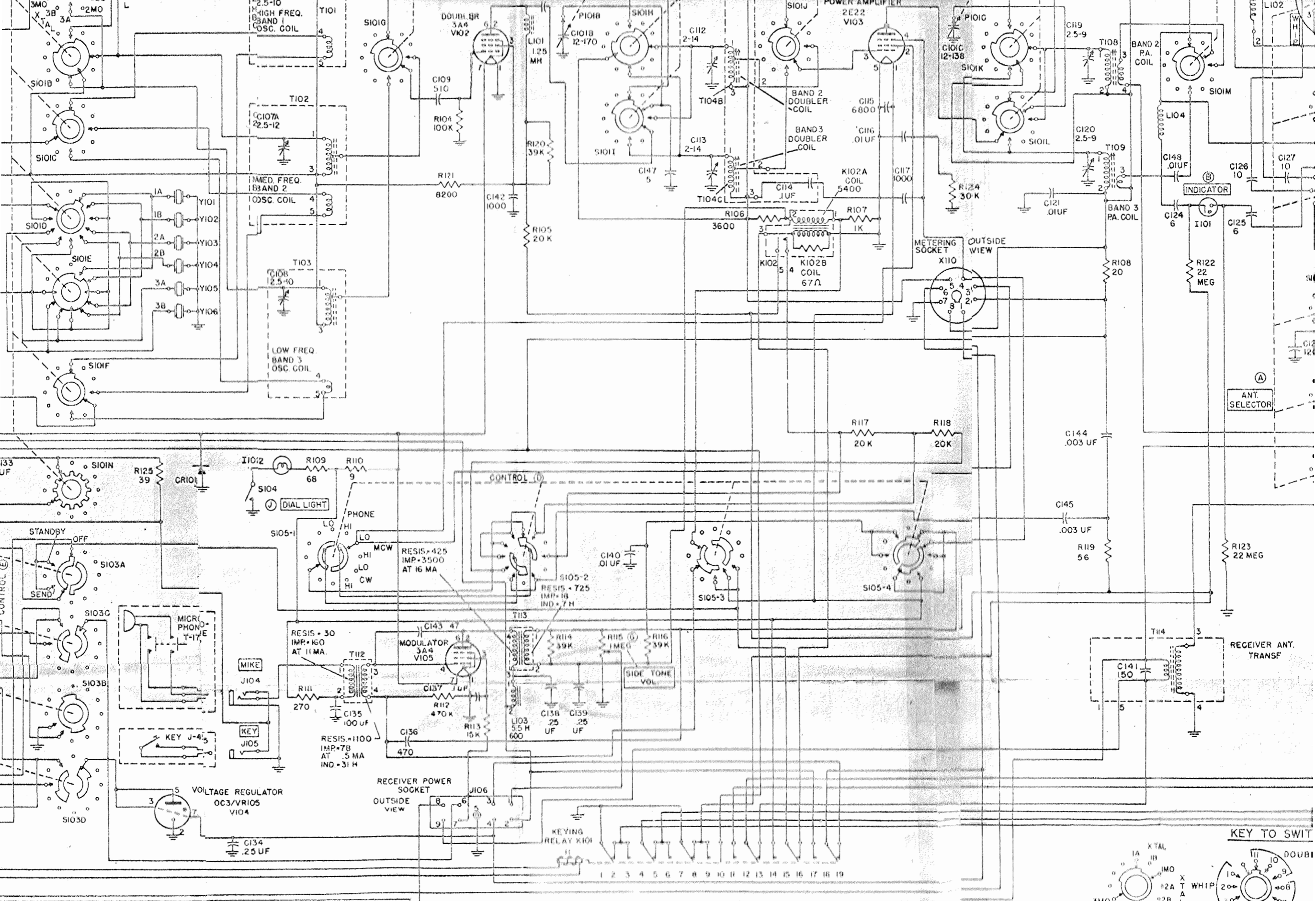
KEY TO SWITCH POSITIONS



NOTES:

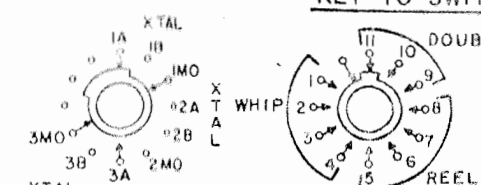
- A. TRANSMITTER IS SHOWN IN "OFF", "PHONE-LO", "BAND 1 CRYSTAL A" KEY UP, DOUBLET II POSITION.
- B. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
- C. UNMARKED VALUES BESIDE COILS ARE D-C RESISTANCE IN OHMS.

POWER
102
VOLTS
100
STANDBY

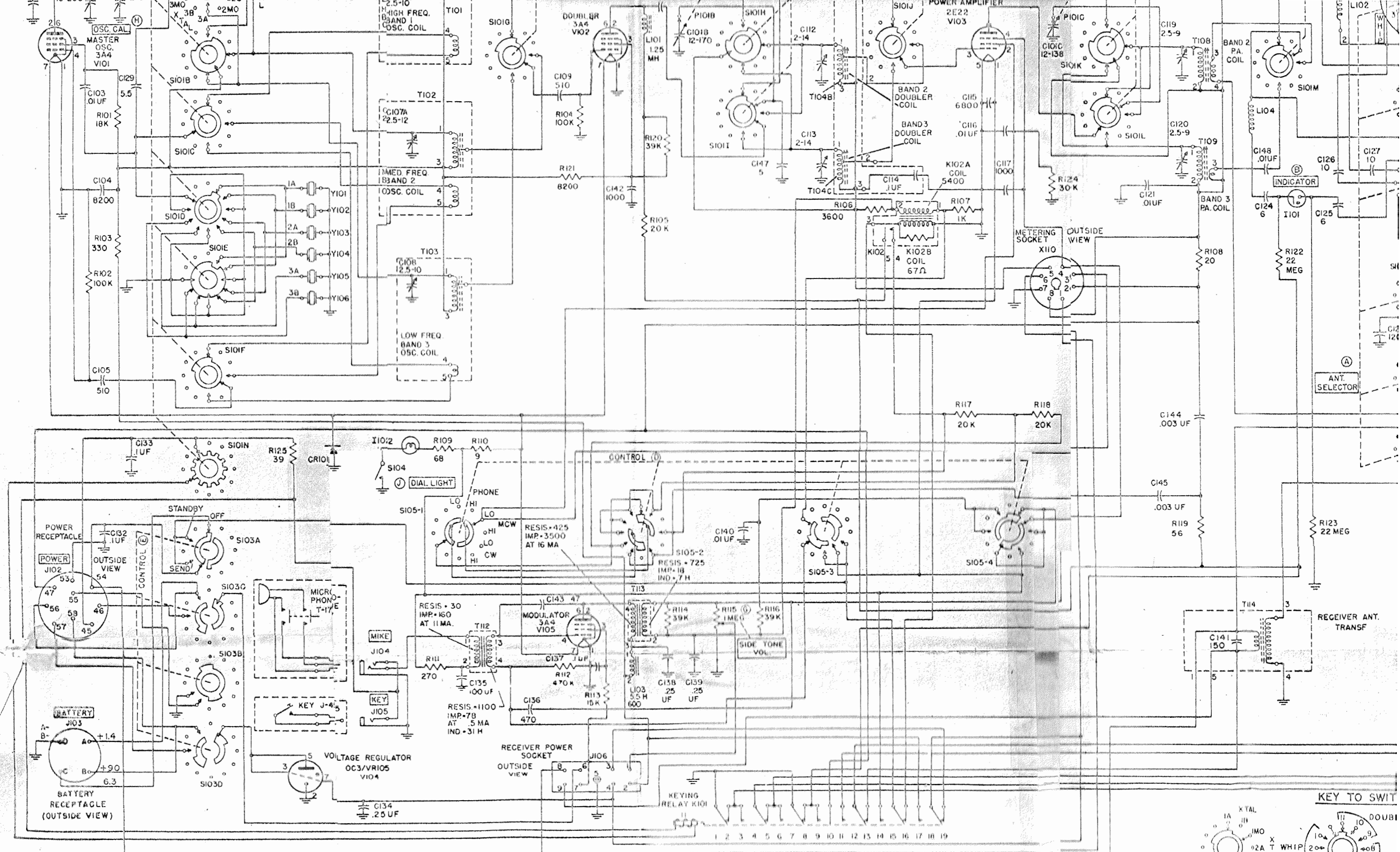


TRANSMITTER POWER INPUT PLUG J102
 POWER OUTPUT RECEPTACLE 734
 TRANSMITTER POWER INPUT PLUG J102

NOTES:



EMITTING



POWER OUTPUT RECEPTACLE 734		TRANSMITTER POWER INPUT PLUG J102		POWER OUTPUT RECEPTACLE 734		TRANSMITTER POWER INPUT PLUG J102	
PIN	CONNECTS TO	PIN	VOLTS	PIN	CONNECTS TO	PIN	VOLTS
20	"	54	+6.3 REG	32	"	47	+500
21	"	57	105 SEND	33	"	58	105 STANDBY
22	"	56	1.4 STANDBY	34	"	45	+6.3 KEY
23	"	46	1.4 SEND	35	"	55	SEND CONTROL
24	"	53	A- B-				

NOTES:
 A. TRANSMITTER IS SHOWN IN "OFF" POSITION.
 B. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
 C. UNMARKED VALUES BESIDE COILS ARE D-C RESISTANCE IN OHMS.
 D. J106 TERMINALS:
 1. SIDE-TONE SIGNAL
 2. NET 105V
 3. RECEIVER 105V
 4. 105V
 5. GROUND
 6. RECEIVER 1.4V
 7. AUDIO TUBE POWER CONTROL
 8. RECEIVER ANTENNA
 9. RECEIVER ANTENNA

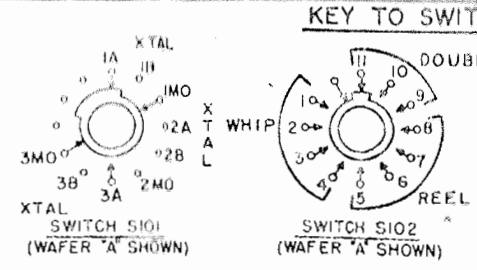
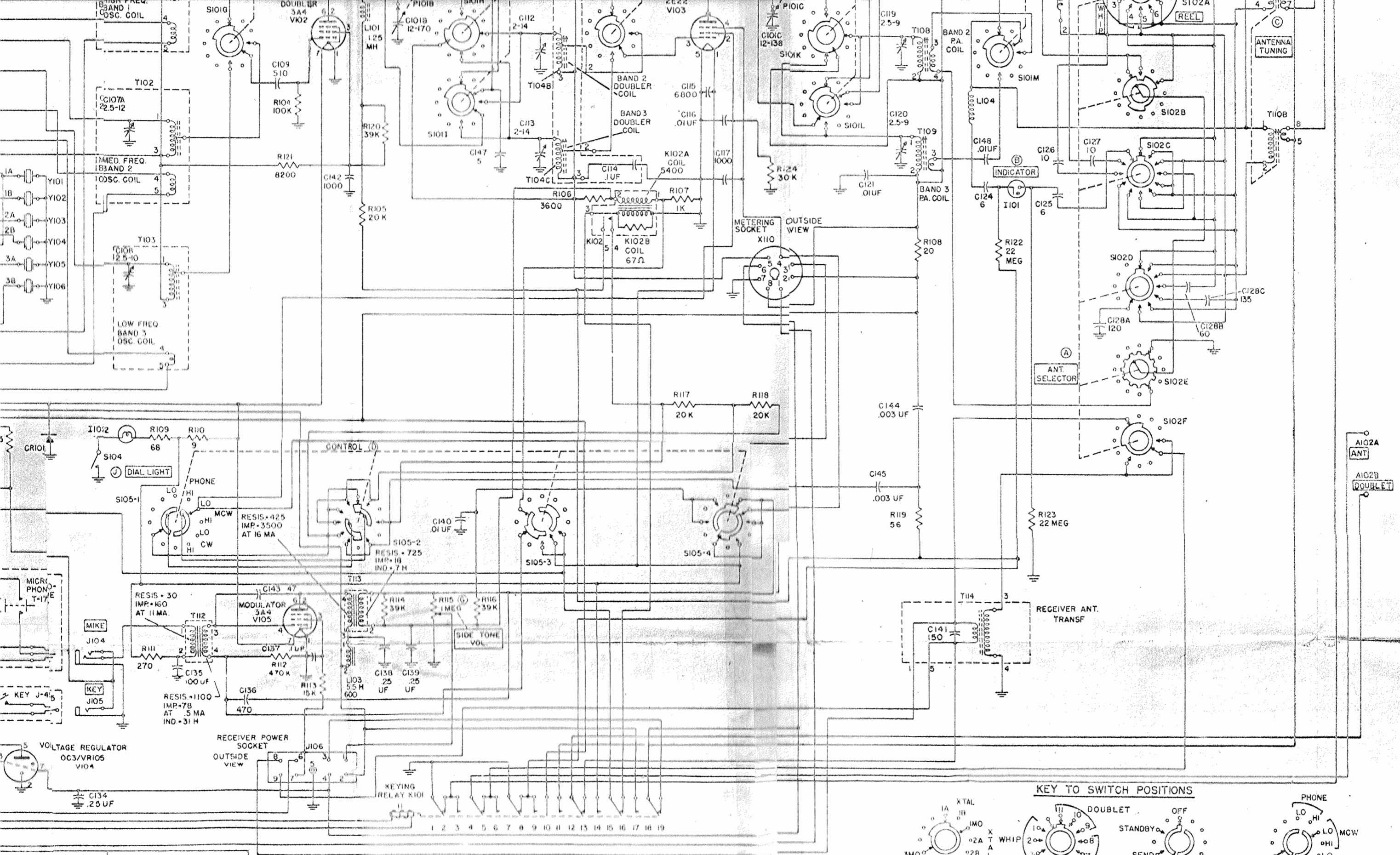


Figure 139. Transmitter section of receiver-transmitter RT-71/GRC-9, schematic diagram.



POWER OUTPUT RECEPTACLE 734		TRANSMITTER POWER INPUT PLUG J102	
PIN	CONNECTS TO	PIN	VOLTS
32	"	47	+ 500
33	"	50	105 STANDBY
34	"	45	+6.3 KEY
35	"	55	SEND CONTROL

- NOTES:
- A. TRANSMITTER IS SHOWN IN "OFF", "PHONE - LO", "BAND 1 CRYSTAL A" KEY UP, DOUBLET II POSITION.
 - B. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
 - C. UNMARKED VALUES BESIDE COILS ARE D-C RESISTANCE IN OHMS.
 - D. J106 TERMINALS:
 - 1. SIDE-TONE SIGNAL
 - 2. NET 105V
 - 3. RECEIVER 105V
 - 4. 105V
 - 5. GROUND
 - 6. RECEIVER 1.4V
 - 7. AUDIO TUBE POWER CONTROL
 - 8. RECEIVER ANTENNA
 - 9. RECEIVER ANTENNA

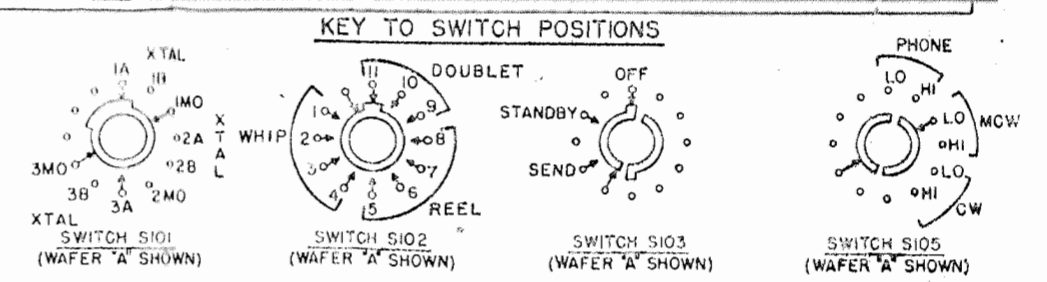


Figure 139. Transmitter section of receiver-transmitter RT-77/GRC-9, schematic diagram.