

# TM 11-809

TO 31R-1-101

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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RADIO  
TRANSMITTER  
T-368/URT  
AND  
ANTENNA  
TUNING UNIT  
BC-939-B



DEPARTMENT OF THE ARMY • APRIL 1955

## **WARNING**

### **DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT**

Be careful when working on the  
2,400-volt dc high voltage  
circuits, or on the 115-volt ac  
line connections.

**DON'T TAKE CHANCES!**

**DANGEROUS RF VOLTAGES ARE EXPOSED  
ON ANTENNA TUNING UNIT BC-939-B**

**EXTREMELY DANGEROUS VOLTAGES  
2,400 VOLTS DC EXIST IN THE FOLLOWING UNITS OF  
RADIO TRANSMITTER T-368/URT  
RF DECK  
MOD DECK  
HV POWER-SUPPLY DECK**

# RADIO TRANSMITTER T-368/URT AND ANTENNA TUNING UNIT BC-939-B

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# CHAPTER 1

## INTRODUCTION

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### Section I. GENERAL

#### 1. Scope

*a.* This manual contains instructions for the installation, operation, maintenance, and repair of Radio Transmitter T-368/URT and Antenna Tuning Unit BC-939-B. Throughout the manual, Radio Transmitter T-368/URT will be called the transmitter, and Antenna Tuning Unit BC-939-B will be called the tuning unit.

*b.* Forward all comments on this manual to the Commanding Officer, Signal Corps Publications Agency, Fort Monmouth, N. J., ATTN: Standards Division.

#### 2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army materiel and equipment and when performing preventive maintenance:

*a.* DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745-45-5 (Army); Navy Ship-

ping Guide, Article 1850-4 (Navy); and AFR 71-4 (Air Force).

*b.* DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer as prescribed in SR 700-45-5.

*c.* DD Form 535, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700-45-5 and AF TO 00-35D-54.

*d.* DA Form 11-238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar) will be prepared in accordance with instructions on the back of the form (fig. 23).

*e.* DA Form 11-239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar) will be prepared in accordance with instructions on the back of the form (fig. 24).

### Section II. DESCRIPTION AND DATA

#### 3. Purpose and Use

(fig. 1)

*a.* Radio Transmitter T-368/URT is a medium power radio-frequency (rf) communications transmitter which transmits continuous wave (cw) and amplitude modulated (am) signals over a distance of more than 100 miles. The frequency range of the transmitter is from 1.5 to 20 megacycles (mc). The transmitter will generate rf output power from 400 to 450 watts with input power of 1,570 to 2,200 watts from a 115-volt, 50- to 60-cycle alternating-current (ac) source.

*b.* Radio Transmitter T-368/URT is also used as a power amplifier of low-powered exciter units or as a driver for high-powered transmitters. When used as an amplifier, the transmitter is capable of transmitting frequency-shift keying (fsk) signals and other types of externally excited

signals such as narrow-band frequency-modulated signals. For a fifth type of operation, the transmitter combines fsk and am operations to permit a single rf signal to be used for two types of communication.

*c.* Antenna Tuning Unit BC-939-B must be used with the transmitter when a long-wire or whip antenna is used. The tuning unit covers a frequency range of 2 to 20 mc.

#### 4. System Application

(fig. 2)

Radio Transmitter T-368/URT is limited to cw and am operation when used as a single unit. To allow other types of modulation to be placed on the rf carrier, the transmitter must be incorporated into a radio system where it becomes a basic component with accessories, and works in con-

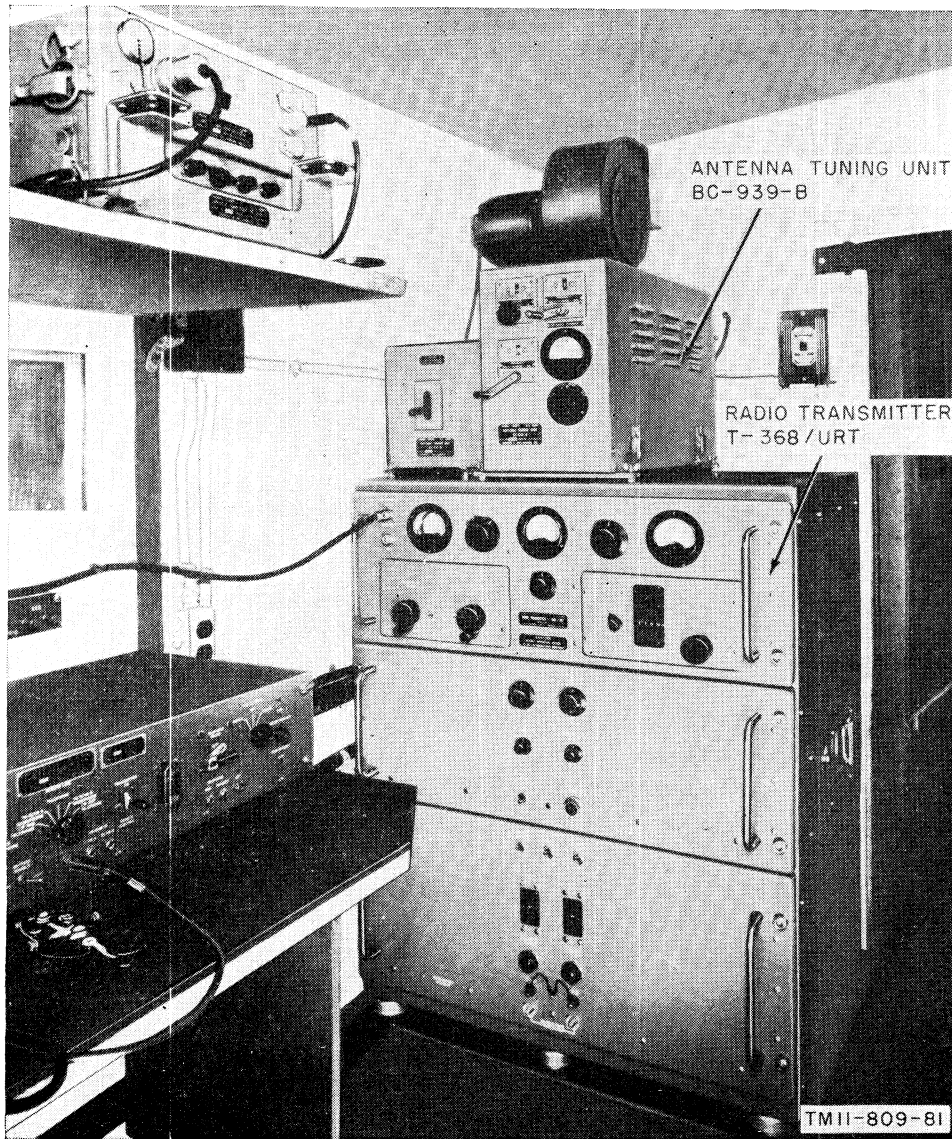


Figure 1. Radio Transmitter T-368/URT and Antenna Tuning Unit BC-939-B.

junction with the other major components. The system application of Radio Transmitter T-368/URT is described in *a* through *f* below.

*a.* For CW operation, a handkey is used to interrupt the rf carrier. A headset or a loud-speaker may be used to monitor the operator's keying by listening to a sidetone signal keyed simultaneously with the rf carrier.

*b.* In AM. operation, a carbon microphone is used to modulate the transmitter carrier in accordance with voice variations. A carrier also may be modulated by using a telephone set over a 600-ohm line.

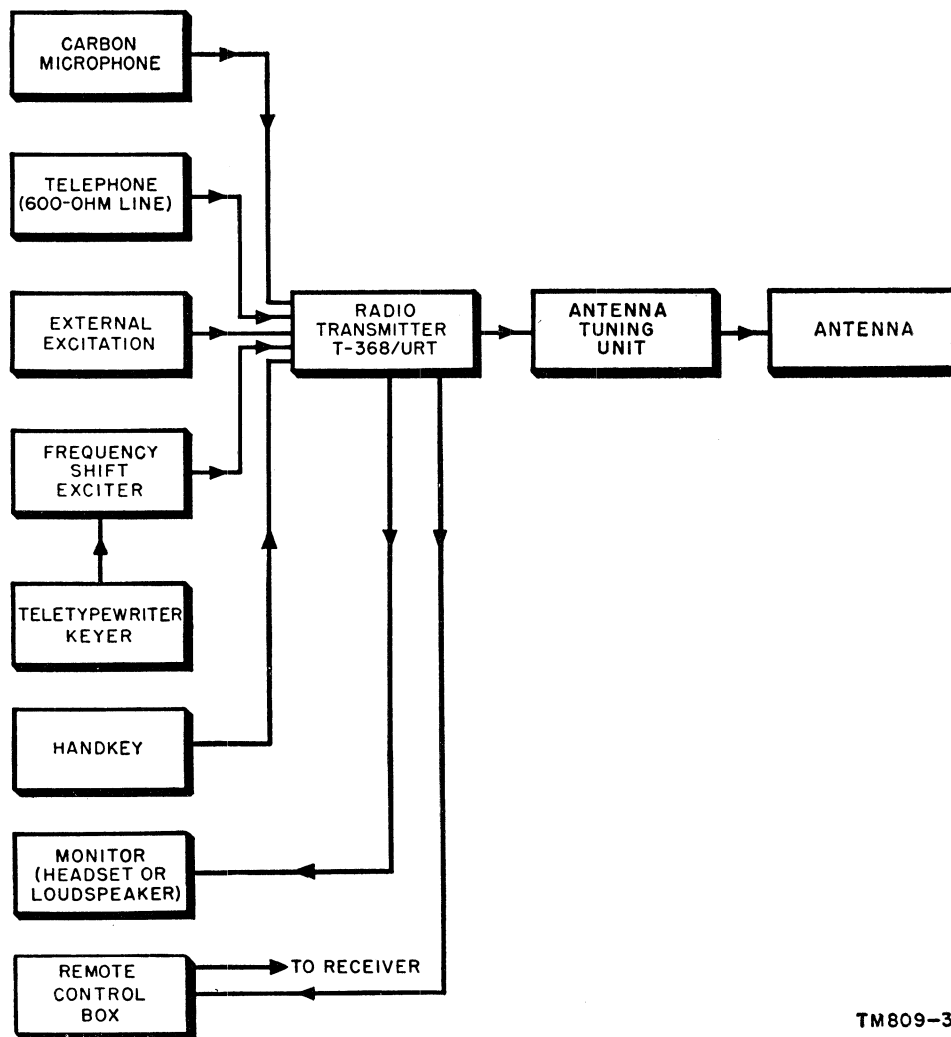
*c.* For FSK and FSK-AM. operations, a frequency-shift exciter feeds keyed signals into the

transmitter, the signals are then amplified and transmitted. A teletypewriter is the keying source.

*d.* For EXT EXC operation, narrow-band frequency-modulated signals (or equivalent) are fed into the transmitter and are then amplified and transmitted.

*e.* For remote control operation, a receptacle is provided on the rear of Radio Transmitter T-368/URT to permit cabling to a remote control box. A relay provided in the control box will disable a receiver when the transmitter is in operation.

*f.* Radio Transmitter T-368/URT may be used in fixed station or mobile operation. A doublet or or long-wire antenna is used for fixed station



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Figure 2. System application, block diagram.

operation, and a whip antenna is used for mobile operation. Antenna Tuning Unit BC-939-B matches the impedance of a long-wire or whip-type antenna to the transmitter.

### 5. Technical Characteristics

Frequency range	1.5 to 20.0 mc.
Distance range	Over 100 miles.
Transmitter type	Master oscillator, frequency multiplier, intermediate power amplifier, and power amplifier.
Types of signals transmitted.	Cw and am.
Type of modulation	Amplitude.
Input signal levels:	
Fsk	3 to 5 volts.
External excitation	30 volts (max).
Input impedance:	
Fsk	56 ohms.
External excitation	1,000 ohms.

Number of tubes	25.
Antennas:	
Fixed station operation	Doublet of proper length to match operating frequency. Long-wire with antenna tuning unit.
Mobile operation	Whip-type with antenna tuning unit.
Power output:	
Cw	450 watts (aprx).
Am	400 watts (aprx).
Power input	115 volts, 50-60 cps, 1 phase; 1,570 watts (cw) or 2,200 watts (microphone); power factor .91 (cw) or .994 (microphone).
Weight	650 pounds.

### 6. Packaging Data

When packaged for shipment, the components of Radio Transmitter T-368/URT are placed in a

wooden crate. A view of a typical component packed is shown in figure 6. The crate is 48 inches high, 39½ inches wide, and 36½ inches deep. The volume of the crate is 38 cubic feet. The weight of the crated equipment is 940 pounds. The

running spares (par. 10) are packed in the crate with the transmitter.

## 7. Table of Components (fig. 3)

Component	Required No.	Height (in.)	Depth (in.)	Width (in.)	Volume (cu. ft.)	Unit weight (lb.)
Radio Transmitter T-368/URT	1	41½	31	32	24	650
Cord CD-763	1	13 ft (lg)				5
Jumper plug (installed)	1	2½ (lg)	1½ (diam)			
Manuals	2	10¼		7¾		
Total weight (lb)						655

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

## 8. Description of Radio Transmitter T-368/URT

*a.* The equipment consists of three separate decks contained in a common housing relay rack. The decks and the housing are finished in a smooth gray enamel. The decks in descending order are the rf, the modulator, and the power supply. Captive bolts and handles are provided on each deck to permit unfastening and removal of the decks from the housing for servicing and adjustment purposes.

*b.* The rf deck (fig. 3) contains all the rf controls and the meters of the equipment on its front panel. Each tuning control contains its own mechanical counter. The other controls and the meters are read from their respective panel markings. Two coaxial receptacles FSK and EXT EXC provide a means of bringing in outside signals for increasing the types of service selected by the SELECT-OR SERVICE switch. The exciter stages are mounted on subassemblies (fig. 50) and may be removed easily for servicing and adjusting.

*c.* The modulator deck (fig. 3) contains all of the modulation controls of the equipment. The chassis contains a speech amplifier subassembly (fig. 65) which can be easily removed for testing purposes. A receptacle is provided to connect either a hand-key or a microphone to the transmitter.

*d.* The power supply deck (fig. 3) contains the protection and indicator devices and all of the ac controls except the THERMAL RESET switch of the equipment. A subpanel covers the two controls used to adjust the overload relay. The panel lamps, fuses, and blown fuse indicators are located on the front panel.

*e.* The housing (fig. 80) contains all the interlock switches of the equipment. Three receptacles are located on the rear of the housing (fig. 4). The power receptacle permits the application of ac power, the second receptacle J13 seats the jumper plug to permit high-voltage operation, and the third provides means for remote control operation. Two coaxial receptacles (fig. 5) located on the left side of the housing connect the transmitting antenna to the transmitter and to a receiver (when used) through an antenna changeover relay. The relay assembly, mounted on the upper left of the inside of the housing (fig. 80) contains two separate relays which are used for antenna changeover. A blower, located on the back panel, improves the ventilation of the equipment; air filters (fig. 4) clean the incoming air. A holder (fig. 5), mounted on the left side, stores the calibration charts used with the transmitter. Carrying handles for the transmitter are provided, one on each side; when not in use, these handles can be folded into the sides of the housing. A hexagonal T-socket wrench (fig. 4), provided for loosening and tightening the panel captive bolts, is mounted in the recess for the right side handle. At the top of the housing are two sets of four threaded studs with wing nuts for mounting a switching unit (used in Radio Set AN/GLQ-2) and an antenna tuning unit (fig. 1). A THERMAL RESET button on the top of the upper front section of the housing (fig. 80) permits manual resetting of the thermostat, which is mounted on the inside top of the housing. The housing base is provided with shock mounts (fig. 4); the equipment is secured to the surface on which it is resting by bolts (not

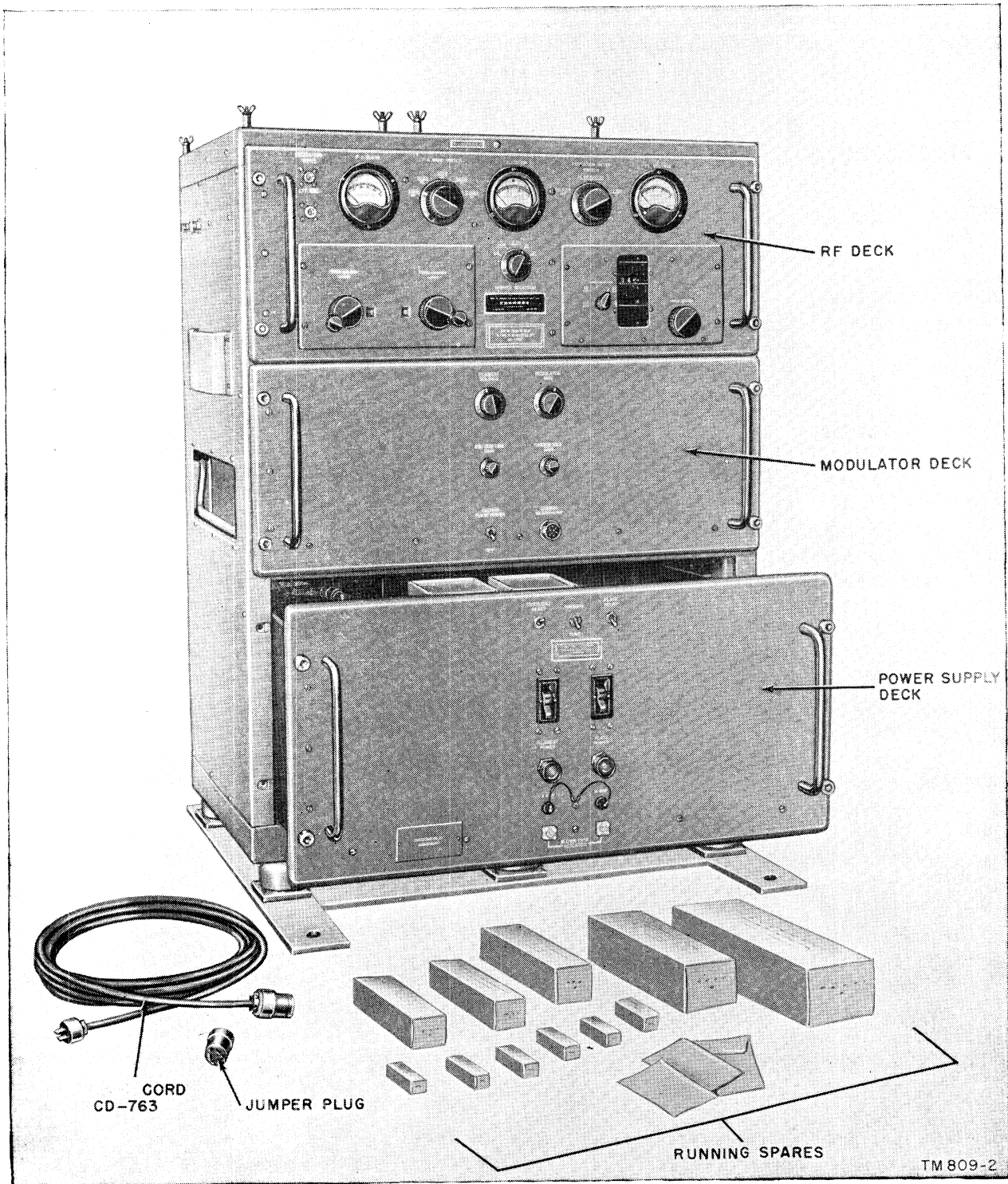


Figure 3. Radio Transmitter T-368/URT, components.

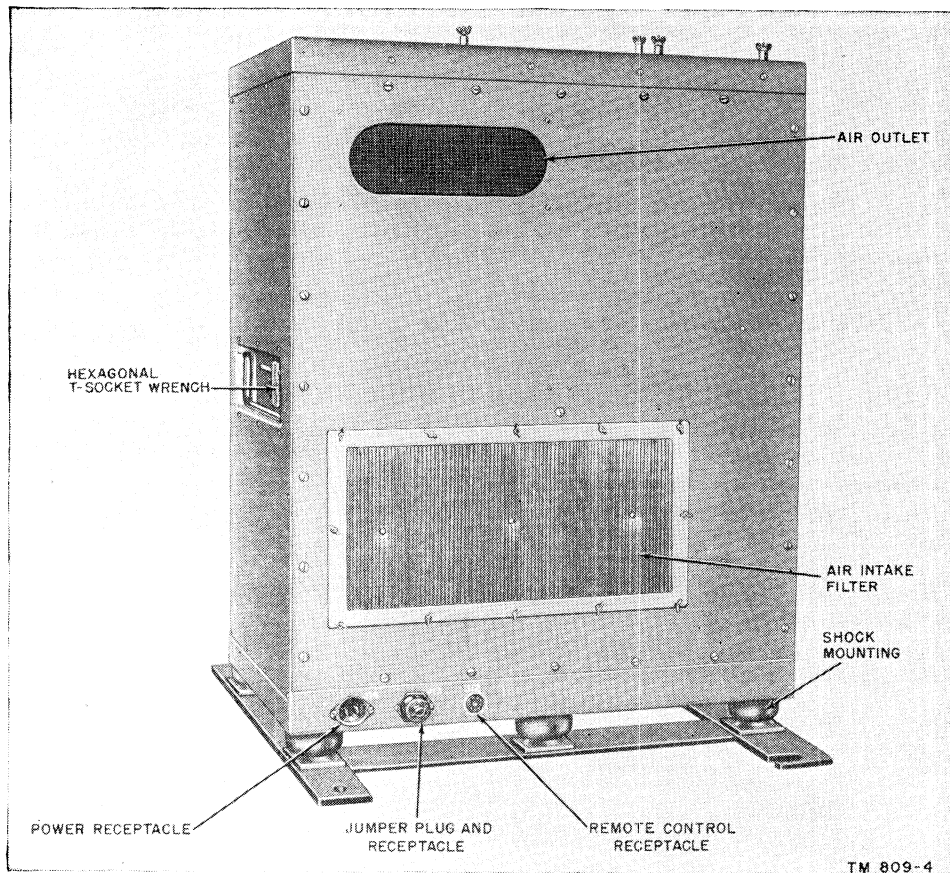


Figure 4. Radio Transmitter T-368/URT, rear view.

supplied) fastened to the base. The rear aprons of the deck chassis become accessible by loosening the Dzus screws that hold the back panel to the housing.

## 9. Description of Antenna Tuning Unit BC-939-B

(fig. 1)

Antenna Tuning Unit BC-939-B consists of coils, capacitors, a switch, and a meter mounted in a gray-finish metal cabinet. All controls and the meter are mounted on the front panel. Terminals are provided on the side and rear to connect the unit to the transmitter and to an antenna (fig. 87). Four spring clasps are mounted on the cover to fasten it to the body. The entire unit is mounted on top of Radio Transmitter T-368/URT and is secured to the transmitter by four wing nuts. The unit weighs 48 pounds.

## 10. Running Spares

A group of running spares is supplied with each radio transmitter. Spares are provided for all normally expendable items, such as pilot lamps,

fuses, and tubes. The following is a list of running spares.

- 2 tubes, OA2.
- 1 tube, 3B28.
- 1 tube, 4D21.
- 1 tube, 4-400A.
- 1 tube, 5R4WGY.
- 1 tube, 6C4W.
- 1 tube, 6AH6.
- 1 tube, 6000.
- 1 tube, 5749/6BA6W.
- 1 tube, 12AT7/6AL5W.
- 1 tube, 5726.
- 1 tube, 5814.
- 1 tube, 5933/807W.
- 1 incandescent lamp, 6 watts, 110 to 120 volts.
- 6 cartridge fuses, 3 amperes, 250 volts.
- 6 cartridge fuses, 6 amperes, 250 volts.

## 11. Additional Equipment Required

The additional equipment required for the operation of Radio Transmitter T-368/URT depends on the type of service to be performed.

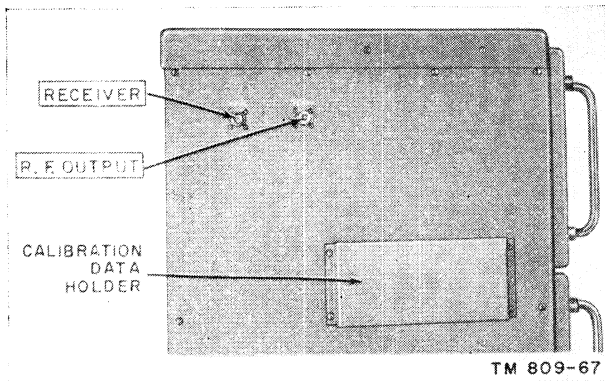


Figure 5. Housing, left side.

In all types of installations, it is necessary to have a power source of 115 volts ac, 2,200 watts minimum; a frequency calibrating device; and an antenna system. The following basic equipment is required for the five types of operation of the transmitter.

*a.* CW operation required a handkey such as Key KY 116/U with Special Purpose Cable Assembly CX 1852/U or equivalent.

*b.* AM. operation requires a carbon microphone such as Microphone M-29A/U with its cable or its equivalent. For remote control operation, a telephone set that works into a 600-ohm line is connected to the remote control receptacle J12.

*c.* FSK operation requires the use of an exciter unit such as Frequency Shift Exciter O-39/TRA-7, O-39A/TRA-7, O-39B/TRA-7, or O-39C/TRA-7 or its equivalent and a teletypewriter keying device such as Teletypewriter TT-4A/TG or its equivalent.

*d.* FSK-AM. operation combines the units used in both AM. and FSK operation.

*e.* EXT EXC operation requires any unit capable of generating rf signals. The transmitter will accept narrow-band frequency-modulated signals also.

*f.* Antenna Tuning Unit BC-939-B may be modified (par. 15) to cover the full frequency range of Radio Transmitter T-368/URT. Frequency Conversion Kit MC-509 is used to extend the frequency range of the tuning unit to include the additional range of 1.0 to 2.0 mc.

## CHAPTER 2

# INSTALLATION

### 12. Siting

a. The best location for radio equipment depends on the tactical situation and local conditions such as the terrain and the need for easy access to messengers. The location of the antenna is important. It should be situated as high as possible, clear of hills, buildings, cliffs, densely wooded areas, and other obstructions. Depressions, valleys, and other low places are poor locations for radio transmission because the surrounding high terrain absorbs rf energy. If possible, choose a location on a hilltop or elevation. Flat land is desirable. Normally, transmission over water is superior to that over land. When locating the antenna, avoid obstructions that are  $2^\circ$  or  $3^\circ$  above the horizontal plane of the antenna in the direction of desired transmission; this is approximately 200 to 300 feet at a distance of 1 mile from the antenna.

b. The shelter housing for the radio transmitter must meet the following requirements:

- (1) The floor must be capable of supporting the weight of the equipment and of keeping the equipment in a level position.
- (2) Sufficient space must be available when repair work or withdrawal of the three decks is necessary. The transmitter should be located so that access to the power and signal cables is convenient.
- (3) Adequate lighting for day and night operation must be provided. Position the transmitter so that the panel markings can be read easily by the operator. A portable drop lamp and extension cord are useful components to assist the operating and maintenance personnel.

### 13. Uncrating, Unpacking, and Checking New Equipment

(fig. 6)

*Note.* For used or reconditioned equipment, refer to paragraph 18.

a. *General.* Equipment may be shipped in a wooden packing crate with a moisture-vaporproof

barrier. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements, and which is convenient to the permanent or semipermanent installation of the equipment.

**Caution:** Be careful when uncrating, unpacking, and handling the equipment; it is easily damaged. If it is damaged or exposed, a complete overhaul may be required or the equipment may be rendered useless.

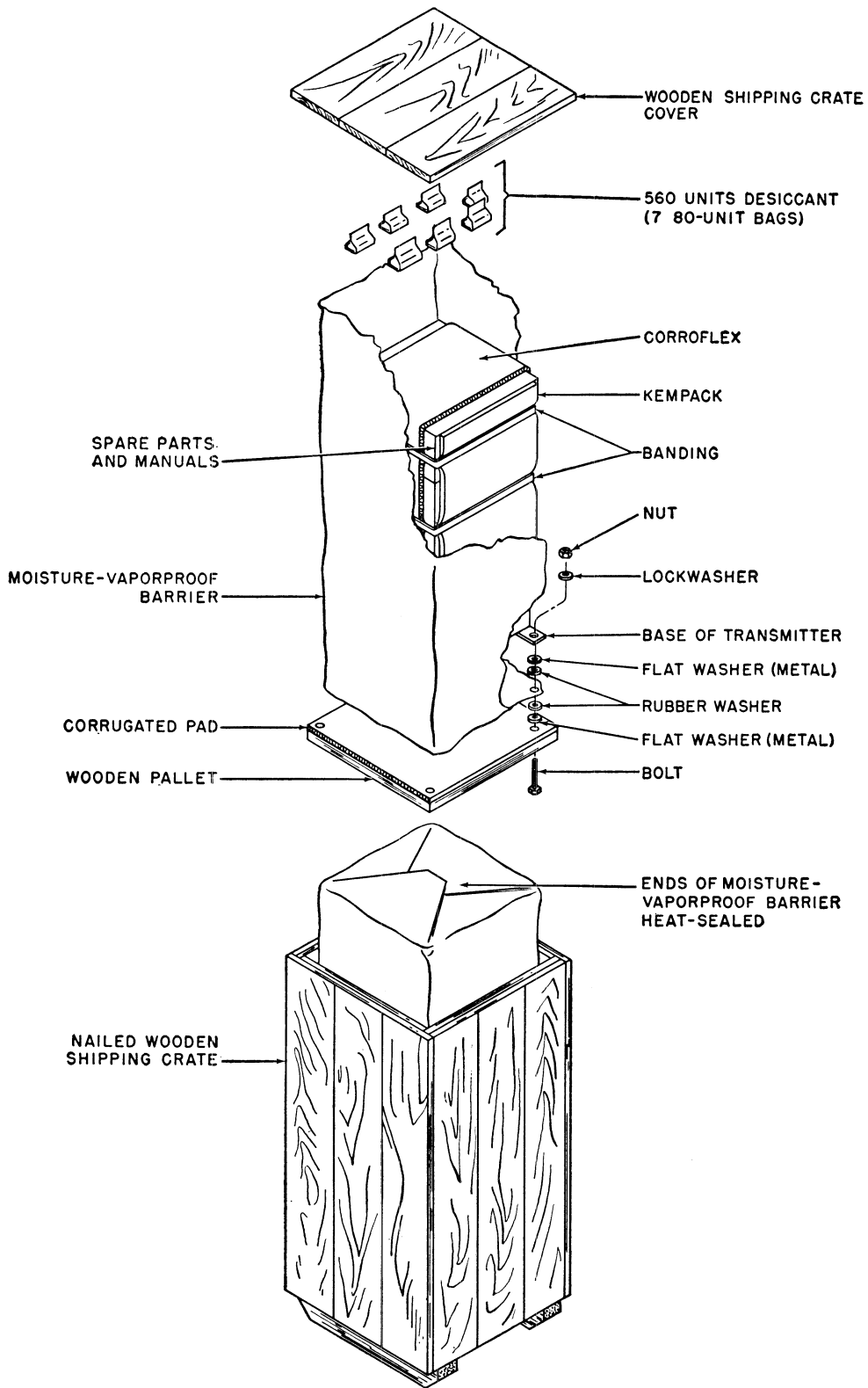
b. *Step-by-step Instructions for Uncrating and Unpacking.*

- (1) Place the packing case as close to the operating position as possible.
- (2) Open the top and one side of the shipping crate. Use a nail puller to remove the nails that fasten the top and side. Do not attempt to pry the top and side off, the equipment may become damaged.
- (3) Remove the equipment (still bolted to its wooden pallet) from the crate.
- (4) Remove the moisture-vaporproof barrier and the bags containing the desiccant.
- (5) Cut the banding that holds the wadding to the equipment.
- (6) Unfasten the equipment from the pallet by removing the nut and lock washer that secure the base of the equipment to each bolt on the pallet.
- (7) Lift the equipment off the pallet and place it near its final location.
- (8) Replace the pallet and the attaching hardware in the shipping crate.

*Note.* Save the original packing case, the pallet, and the attaching hardware. They can be used again when the equipment is repacked for storage or shipment.

c. *Checking.*

- (1) Check the contents of the cartons against the master packing slip.
- (2) Inspect the equipment for possible damage (incurred during shipment) such as bent knobs and cracked or broken glass windows of the meters and frequency indicator dials.



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Figure 6. Packing and packaging of Radio Transmitter T-368/URT.

- (3) Rotate the tuning controls and turn the switches to check for smoothness of movement. Binding or jamming indicates abnormal mechanical operation. Do not force the controls because this may cause permanent damage.
- (4) Remove the back panel by unfastening the 24 Dzus screws that hold it to the housing. Loosen the captive bolts and pull the decks part way out.
- (5) Inspect the chassis and subchassis for broken or loose tubes and loose tube shields; see that all connectors are seated firmly. Push in and tighten the deck bolts and replace and secure the panel.
- (6) Remove the fuses on the power supply deck and see that they are the proper ratings. Be sure that the fuses are seated firmly after replacing them.
- (7) Make sure that the jumper plug is seated firmly in its socket. Inspect the coaxial receptacles on the housing and on the rf deck for bent frames. See that the cable fittings are not bent.
- (8) Check the running spares for damages.

#### 14. Installation of Radio Transmitter T-368/URT

Radio Transmitter T-368/URT is shipped with all tubes (except the 3B28 high-voltage rectifier tubes), fuses, and lights in place. Install the tubes into their sockets on the power supply deck (fig. 74), and connect the caps to the tube anodes.

*a.* For fixed station installation, place the transmitter in a desired position.

*b.* For mobile installation, the equipment must be bolted to the surface on which it is positioned. For this purpose, four holes are provided in the rectangular base. These holes are spaced 29 inches in length and  $2\frac{7}{8}$  inches in width (center to center). Use hex head bolts, at least  $2\frac{1}{2}$  inches long, and  $\frac{1}{2}$ -inch washers to fasten the transmitter to the surface. These bolts are not furnished.

#### 15. Modification of Antenna Tuning Unit BC-939-B

(fig. 7)

Antenna Tuning Unit BC-939-B may be modified by use of Frequency Conversion Kit MC-509 to allow transmission by Radio Transmitter T-368/URT on frequencies from 1.5 to 2 mc. To modify the tuning unit, refer to figure 7 and proceed as follows:

*a.* Open the coaxial line *inside* Antenna Tuning Unit BC-939-B by removing the center conductor of the coaxial line from point Y. Bend this wire away from the insulator, and tape the ends. Attach one end of a 17-inch length of Wire W-128 to point Y.

*b.* Remove the lead that connects coupling coil L5 to the ANTENNA CURRENT meter M4 at terminal 1.

*c.* Attach the free end of the 17-inch length of Wire W-128 to the ANTENNA CURRENT meter M4 at terminal 1.

*d.* Remove the lead from the high-frequency inductor coil L44 to the ANTENNA CURRENT meter M4 at terminal 2. Do not remove the other lead on terminal 2 which runs to a contact of switch SW9.1.

#### 16. Installation of Antenna Tuning Unit BC-939-B

*a.* When the tuning unit is unpacked, follow the checking procedure given in paragraph 13c.

*b.* Set the tuning unit on top of Radio Transmitter T-368/URT and secure it to the transmitter with the four wing nuts (fig. 1).

#### 17. Connections

(figs. 8 and 9)

*a. Power Input.* Connect power Cord CD-763 between the power receptacle J14 and the ac line (115 volts, 50-60 cycles per second (cps), single phase).

*b. CW Transmission.* Connect the handkey cable to the CARBON MICROPHONE receptacle J11.

*c. AM. Transmission.* Connect the carbon microphone cable to the CARBON MICROPHONE receptacle J11.

*d. EXT EXC Transmission.* Connect the external exciter output cable to the EXT EXC receptacle J15.

*e. FSK Transmission.* Connect the output cable of the frequency-shift exciter to the FSK receptacle J16.

*f. FSK-AM. Transmission.* Follow procedure in *c* and *e* above.

*g. Transmitting Antenna.* Connect the antenna to R. F. OUTPUT receptacle J9.

*h. Receiver Using Transmitter Antenna.* Connect a wire to RECEIVER receptacle J10.

*i. Antenna Tuning Unit BC-939-B.*

- (1) Connect a 50- to 70-ohm coaxial cable between R. F. OUTPUT receptacle J9

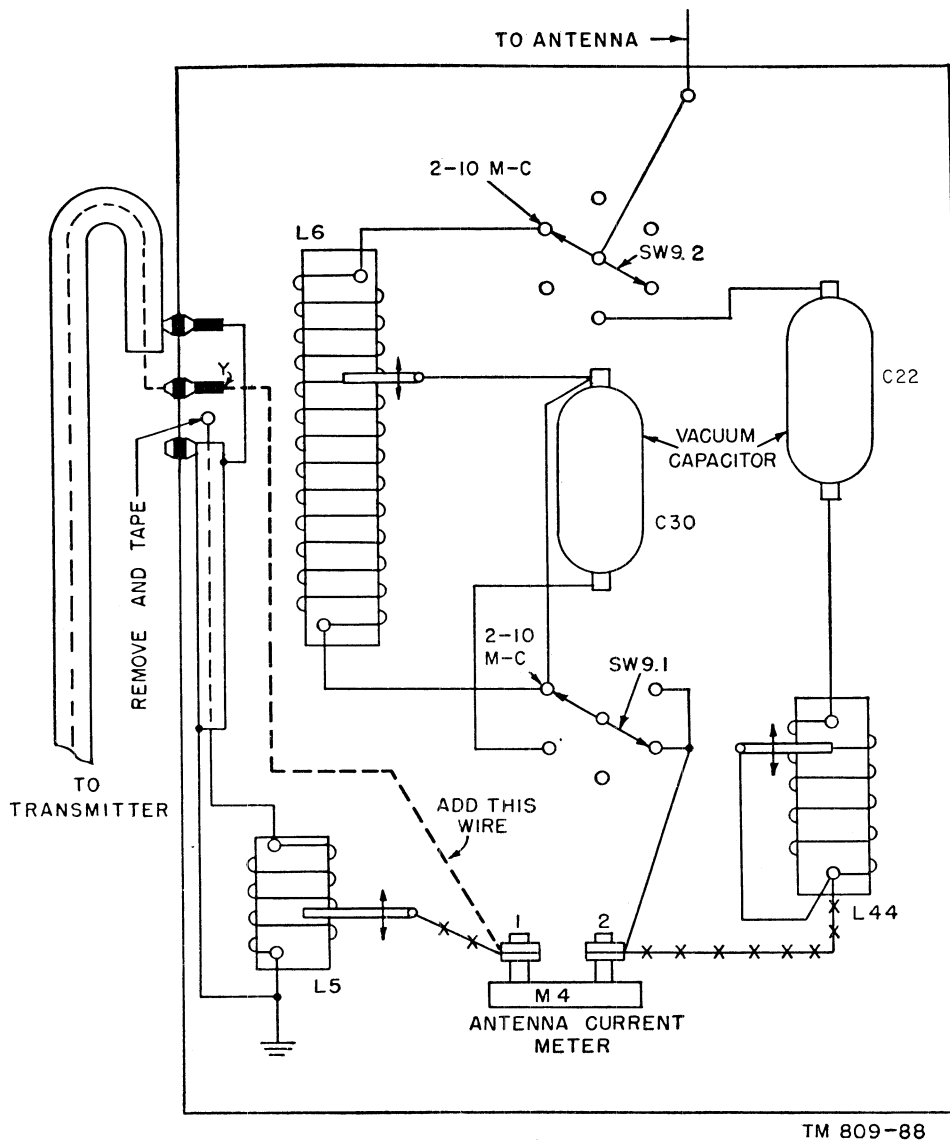


Figure 7. Modification of Antenna Tuning Unit BC-939-B, practical wiring diagram.

of the transmitter (fig. 5) and the input terminals located on the side of the tuning unit (fig. 87).

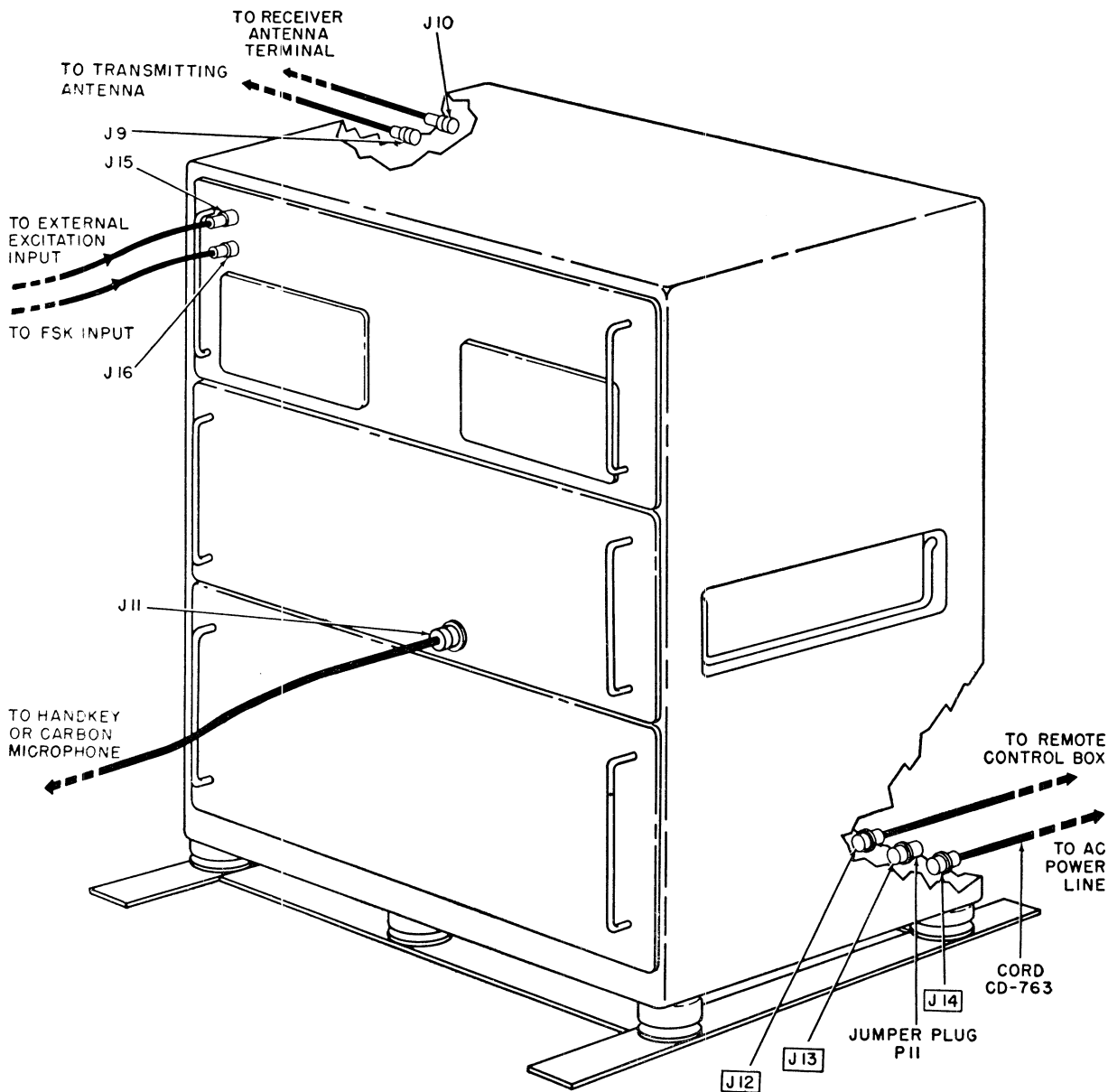
- (2) Connect the antenna to the antenna terminal located on the rear of the tuning unit (fig. 87).

*j. Remote Control Operation.* A special purpose cable must be fabricated to connect the remote control box to the remote control receptacle J12 on the transmitter. The pins of J12 have the following functions:

- (1) Remote control of the push-to-talk and

key relay K2 by shorting pin A to pin E (ground).

- (2) Remote control of the high-voltage relay K6 by shorting pins B and C (115 volts ac).
- (3) Remote control modulation by connecting a telephone to pins D and E.
- (4) Remote control modulation by connecting a carbon mike to pins F and E.
- (5) Monitoring of cw keying by connecting a headset between pins H and E.
- (6) Disabling a receiver by shorting pin J to ground.



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Figure 8. Radio Transmitter T-368/URT, cording diagram.

**18. Service Upon Receipt of Used or Reconditioned Equipment**

- a. Follow the instructions in paragraph 13 for uncrating, unpacking, and checking the equipment.
- b. Check used or reconditioned equipment for tags or other indications of changes in the wiring of the equipment. If any changes in wiring have

been made, note the change in this manual, preferably on the schematic diagram.

c. Check the operating controls for ease of rotation. If lubrication is required, refer to the lubrication instructions in paragraphs 44 through 46.

d. Perform the installation and connection procedures given in paragraphs 14, 16, and 17.



*a. Rf Deck Controls—Continued*

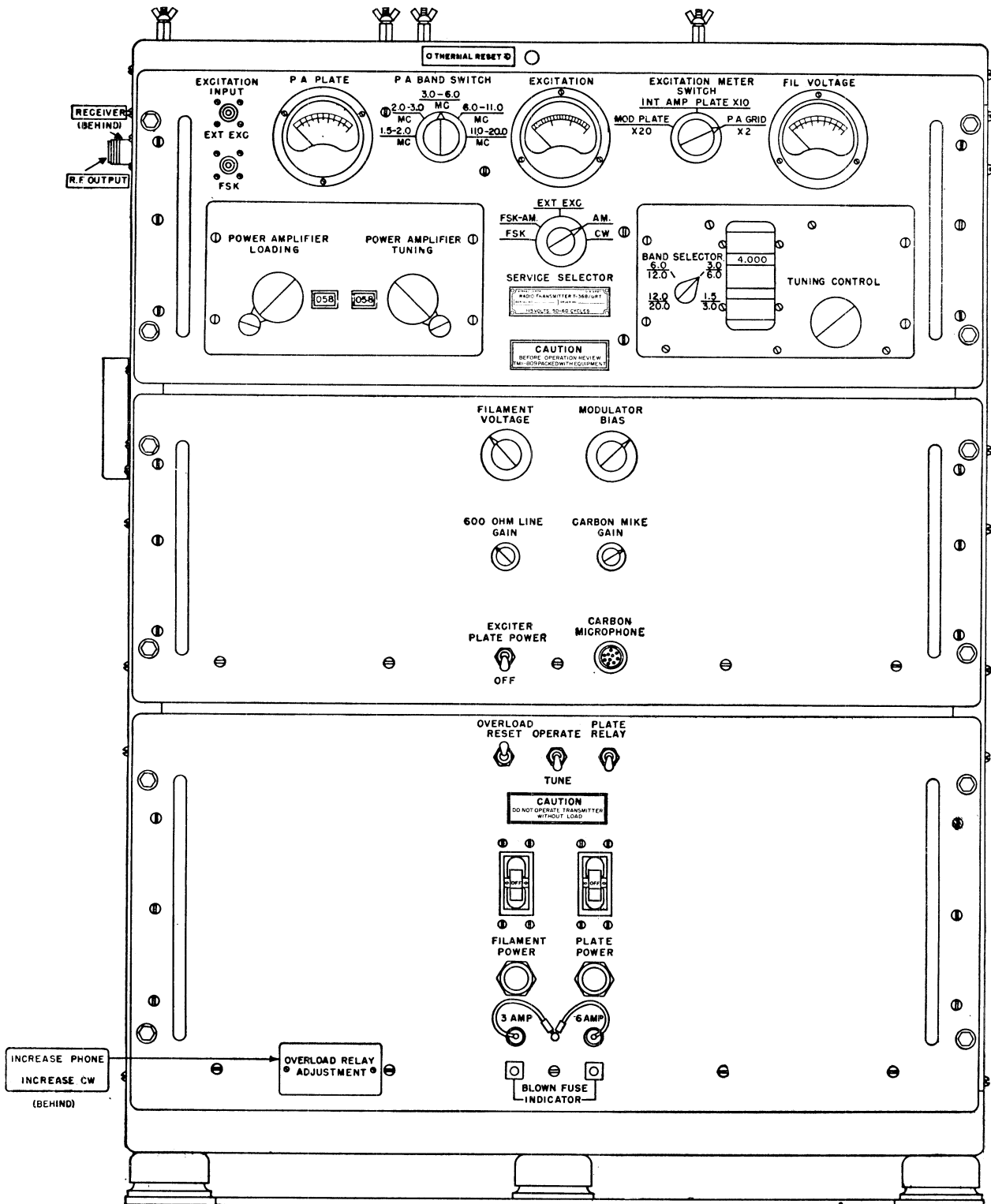
Control or instrument	Function
SERVICE SELECTOR switch.....	Selects any one of the following five types of operation: CW. AM. FSK. FSK-AM. EXT EXC.
POWER AMPLIFIER TUNING control.....	Adjusts the pa stage to operating frequency. Initial setting shown on dial to left of tuning control as determined from the calibration charts. Final setting found during tuning procedure (par. 24).
POWER AMPLIFIER LOADING control.....	Adjusts the pa stage to desired loading level. Initial setting shown on dial to right of loading control as determined from the calibration charts. Final setting found during tuning procedure (par. 24).
POWER AMPLIFIER TUNING and LOADING dials (mechanical counters).	Indicate settings of pa tuning controls found from calibration charts.

*b. Modulator Deck Controls.*

Control or instrument	Function
FILAMENT VOLTAGE control.....	Sets filament voltage for pa tube as indicated on FIL VOLTAGE meter.
MODULATOR BIAS control.....	Sets no-signal plate current of modulator tubes as shown on EXCITATION meter in MOD PLATE X20 position.
600 OHM LINE GAIN control.....	Sets audio level of equipment when using a telephone set.
CARBON MIKE GAIN control.....	Sets audio level of equipment when using a carbon mike.
Clipper gain control (fig. 67).....	Sets maximum audio level to prevent overmodulation.
Sidetone gain control (fig. 67).....	Sets sidetone level to suit operator.
EXCITER PLATE POWER switch.....	Turns on exciter power supply and removes blocking bias for FSK, FSK-AM., and EXT EXC operation when in on (up) position. Left in OFF position for CW and AM. operation, and exciter supply is turned on by PLATE RELAY switch for CW and by closing the mike switch for AM.

*c. Power Supply Deck.*

Control or instrument	Function
FILAMENT POWER circuit breaker....	Applies ac line power to equipment when in ON position.
PLATE POWER circuit breaker.....	Applies high voltage to equipment when in ON position and when either the PLATE RELAY switch is in the on (up) position or the mike switch is closed. In either case, the high voltage cannot be turned on until approximately 25 seconds have passed after the FILAMENT POWER circuit breaker is closed.
OVERLOAD RESET switch.....	Restarts equipment following overloads when pressed down momentarily. Normally kept at off (up) position by a spring.
TUNE-OPERATE switch.....	When set at TUNE, lowers high voltage of equipment. When set at OPERATE, applies normal high voltage to equipment.
PLATE RELAY switch.....	Turns on high voltage when PLATE POWER circuit breaker and PLATE RELAY switch are set at their on (up) positions. Also turns on exciter power supply when set to on position. Switch is left in on position for all services except AM. operation. In AM. operation, high voltage is obtained by closing the mike switch.



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Figure 9. Radio Transmitter T-368/URT, front panel.

*c. Power Supply Deck—Continued*

Control or instrument	Function
FILAMENT POWER indicator light (green).	Indicates presence of filament power in equipment.
PLATE POWER indicator light (red)-----	Indicates presence of plate power in equipment.
3 AMP fuse-----	Protects bias supply transformer and blower motor (located on the back panel).
6 AMP fuse-----	Protects filament, low-voltage circuits, and blower motor (located on rf deck).
BLOWN FUSE INDICATORS-----	Indicators for 3 AMP and 6 AMP fuses for blown condition.
OVERLOAD RELAY ADJUSTMENT including:	
INCREASE PHONE-----	Sets operating point for overload relay for FSK-AM. and AM. operation.
INCREASE CW-----	Sets operating point for overload relay for FSK, EXT EXC. and CW operation.

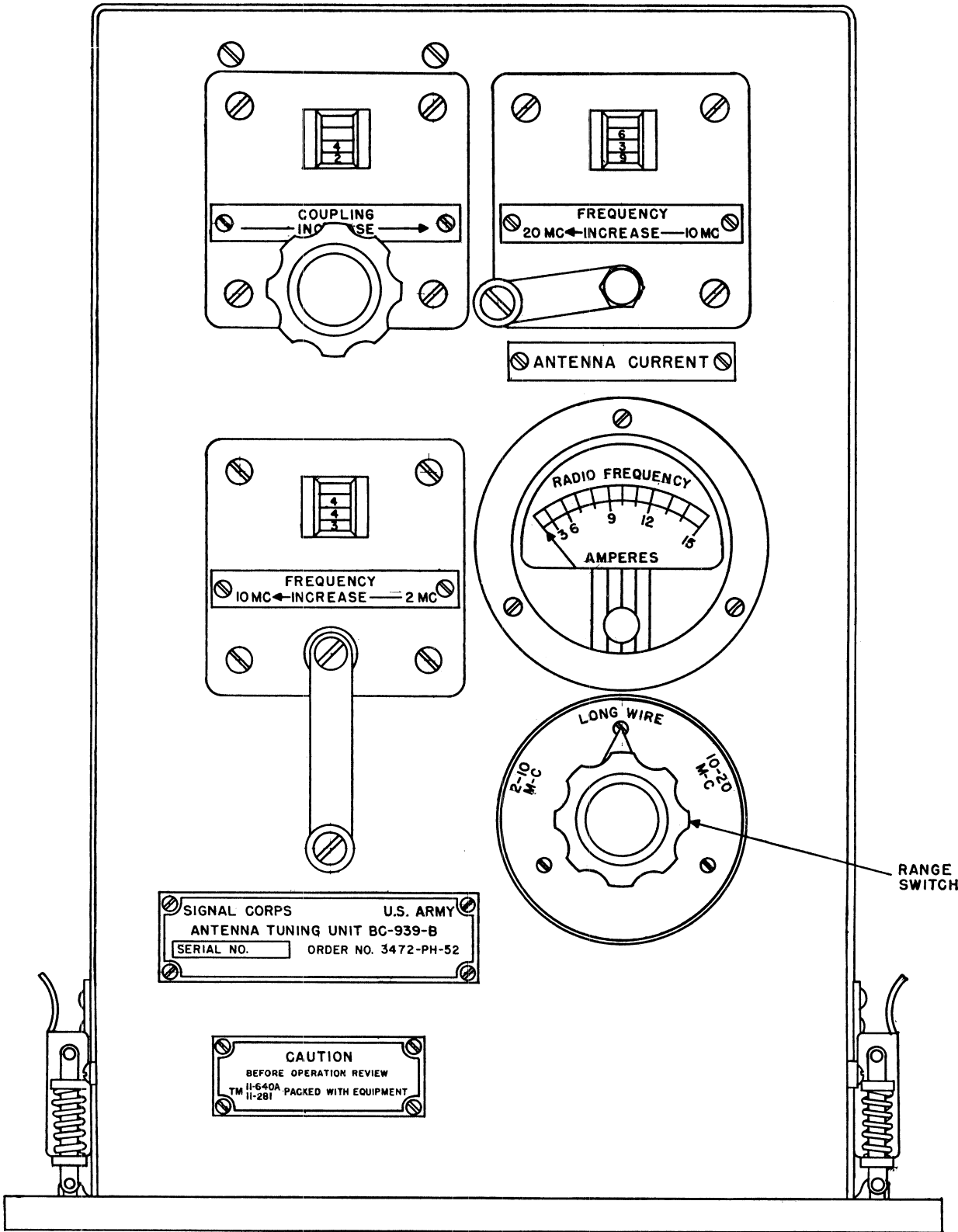
*d. Housing Control.*

Control or instrument	Function
THERMAL RESET push button switch-----	Permits manual resetting of thermostat.

**21. Antenna Tuning Unit BC-939-B Controls and Instruments**

(fig. 10)

Control or instrument	Function
COUPLING control-----	Varies the amount of current in the antenna.
FREQUENCY control 10 MC-IN-CREASE-20 MC.	Adjusts the antenna loading to the transmitter in the high frequency range.
FREQUENCY control 2 MC-IN-CREASE-10 MC.	Adjusts the antenna loading to the transmitter in the low frequency range.
ANTENNA CURRENT meter-----	Measures the rf current in the antenna.
Range switch-----	Three-position switch to match a whip antenna in either the low frequency (2 to 10 mc) or high-frequency (10 to 20 mc) range of the transmitter or to match a long-wire antenna to the 2- to 20-mc range of the transmitter.



TM 809-91

Figure 10. Antenna Tuning Unit BC-939-B, front panel.

## Section II. OPERATION UNDER USUAL CONDITIONS

### 22. Tuning Charts

#### a. Radio Transmitter T-368/URT.

(1) Figures 11 through 15 show a series of five *tuning* curves for the transmitter operating frequency range of 1.5 to 20 mc. Figures 16 through 20 show a series of five *loading* curves for the transmitter which are used in the same frequency range. The vertical numbers along the left edge of the charts represent the numbers of the POWER AMPLIFIER TUNING and POWER AMPLIFIER LOADING indicators of the transmitter depending on whether a tuning or a loading chart is being used. The horizontal numbers along the bottom edge of the charts represent the transmitter operating frequency in mc.

(2) After locating the transmitter operating frequency at the bottom of the chart, follow the line upward to the approximate center of the shaded area of the curve. From this point, follow in a horizontal line to the left edge and note the number intersected. Set the tuning or loading control (whichever adjustment is being made from the appropriate chart) at the number found. Three numbers are exposed on each of the tuning controls dials. The first two cover the ten's and twenty's units as white numbers on a black background and the third covers the tenth's units as black numbers on a white background. The tuning control reads up to approximately 25 and the loading control reads up to approximately 30.

b. *Antenna Tuning Unit BC-939-B.* The following tables give appropriate control settings for the tuning unit when used with Radio Transmitter T-368/URT:

#### (1) 2- to 10-Mc Range.

Operating frequency (mc)	Range switch position	Coupling (COUPLING control)	Loading (FREQUENCY control, 2 mc to 10 mc)
2.00	2-10	4.9	4.6
2.05	2-10	4.9	7.1
2.10	2-10	5.1	9.4
2.15	2-10	4.9	11.4
2.20	2-10	4.8	13.3

Operating frequency (mc)	Range switch position	Coupling (COUPLING control)	Loading (FREQUENCY control, 2 mc to 10 mc)
2.25	2-10	4.7	15.1
2.30	2-10	4.6	16.8
2.35	2-10	4.5	18.3
2.40	2-10	4.5	19.8
2.45	2-10	4.6	21.3
2.50	2-10	4.6	22.6
2.55	2-10	4.3	23.9
2.60	2-10	4.3	25.0
2.65	2-10	4.2	26.2
2.70	2-10	4.2	27.3
2.75	2-10	4.2	28.3
2.80	2-10	4.2	29.3
2.85	2-10	4.2	30.2
2.90	2-10	4.5	31.0
2.95	2-10	4.1	32.0
3.00	2-10	4.1	32.7
3.05	2-10	4.1	33.5
3.10	2-10	4.1	34.2
3.15	2-10	4.2	35.0
3.20	2-10	4.2	35.6
3.25	2-10	4.3	36.3
3.30	2-10	4.3	37.0
3.35	2-10	4.5	37.5
3.40	2-10	4.5	38.2
3.45	2-10	4.3	38.7
3.50	2-10	4.2	38.9
3.55	2-10	4.1	39.5
3.60	2-10	4.0	39.9
3.65	2-10	4.0	40.4
3.70	2-10	4.0	40.9
3.75	2-10	4.1	41.3
3.80	2-10	4.1	41.7
3.85	2-10	4.1	42.2
3.90	2-10	4.1	42.5
3.95	2-10	4.2	42.9
4.00	2-10	4.2	43.2
4.05	2-10	4.0	43.7
4.10	2-10	4.0	44.0
4.15	2-10	3.9	44.3
4.20	2-10	3.8	44.6
4.25	2-10	3.8	44.9
4.30	2-10	3.6	45.2
4.35	2-10	3.4	45.5
4.40	2-10	3.4	45.8
4.45	2-10	3.1	46.1
4.50	2-10	2.9	46.2
4.55	2-10	2.9	46.4
4.60	2-10	2.8	46.7
4.65	2-10	2.8	46.9
4.70	2-10	2.8	47.2
4.75	2-10	2.8	47.4
4.80	2-10	2.7	47.6
4.85	2-10	2.7	47.9
4.90	2-10	2.7	48.1
4.95	2-10	2.7	48.3
5.00	2-10	2.7	48.5

Operating frequency (mc)	Range switch position	Coupling (COUPLING control)	Loading (FREQUENCY control, 2 mc to 10 mc)
5.05	2-10	2.7	48.7
5.10	2-10	2.7	48.9
5.15	2-10	2.6	49.1
5.20	2-10	2.6	49.3
5.25	2-10	2.6	49.5
5.30	2-10	2.5	49.6
5.35	2-10	2.5	49.8
5.40	2-10	2.5	50.0
5.45	2-10	2.5	50.1
5.50	2-10	2.5	50.4
5.55	2-10	2.5	50.5
5.60	2-10	2.5	50.7
5.65	2-10	2.4	50.9
5.70	2-10	2.3	50.9
5.75	2-10	2.3	51.0
5.80	2-10	2.3	51.2
5.85	2-10	2.3	51.3
5.90	2-10	2.3	51.4
5.95	2-10	2.3	51.5
6.00	2-10	2.3	51.7
6.05	2-10	2.3	51.9
6.10	2-10	2.3	51.9
6.15	2-10	2.3	52.0
6.20	2-10	2.3	52.2
6.25	2-10	2.3	52.3
6.30	2-10	2.2	52.5
6.35	2-10	2.2	52.5
6.40	2-10	2.2	52.7
6.50	2-10	2.2	53.0
6.60	2-10	2.1	53.1
6.70	2-10	2.0	53.4
6.80	2-10	2.0	53.6
6.90	2-10	2.0	53.7
7.00	2-10	1.9	54.0
7.10	2-10	1.8	54.2
7.20	2-10	1.8	54.4
7.30	2-10	1.8	54.5
7.40	2-10	1.8	54.7
7.50	2-10	1.7	54.9
7.60	2-10	1.7	55.1
7.70	2-10	1.6	55.2
7.80	2-10	1.6	55.4
7.90	2-10	1.6	55.5
8.00	2-10	1.6	55.7
8.10	2-10	1.5	55.7
8.20	2-10	1.5	55.9
8.30	2-10	1.5	56.1
8.40	2-10	1.5	56.1
8.50	2-10	1.5	56.2
8.60	2-10	1.5	56.4
8.70	2-10	1.5	56.5
8.80	2-10	1.5	56.7
8.90	2-10	1.5	56.8
9.00	2-10	1.5	57.1
9.10	2-10	1.5	57.3
9.20	2-10	1.5	57.4
9.30	2-10	1.5	57.5
9.40	2-10	1.5	57.7
9.50	2-10	1.5	57.7

Operating frequency (mc)	Range switch position	Coupling (COUPLING control)	Loading (FREQUENCY control, 2 mc to 10 mc)
9.60	2-10	1.5	57.8
9.70	2-10	1.5	58.0
9.80	2-10	1.4	58.3
9.90	2-10	1.4	58.4
10.00	2-10	1.4	58.5

(2) 10- to 20-mc range.

Note. For all frequencies in this range, keep the loading FREQUENCY control (2 to 10 mc) at 30.

Operating frequency (mc)	Range switch position	Coupling (COUPLING control)	Loading (FREQUENCY control, 2 mc to 10 mc)
10.00	10-20	1.1	2.5
10.10	10-20	1.1	2.7
10.20	10-20	1.1	3.0
10.30	10-20	1.1	3.4
10.40	10-20	1.1	3.7
10.50	10-20	1.1	4.0
10.60	10-20	1.1	4.5
10.70	10-20	1.1	4.7
10.80	10-20	1.1	5.0
10.90	10-20	1.1	5.3
11.00	10-20	1.1	5.7
11.10	10-20	1.2	5.8
11.20	10-20	1.2	6.1
11.30	10-20	1.2	6.5
11.40	10-20	1.2	6.7
11.50	10-20	1.2	7.0
11.60	10-20	1.2	7.1
11.70	10-20	1.2	7.4
11.80	10-20	1.2	7.7
11.90	10-20	1.2	7.9
12.00	10-20	1.2	8.1
12.10	10-20	1.2	8.4
12.20	10-20	1.1	8.6
12.30	10-20	1.1	8.8
12.40	10-20	1.1	9.0
12.50	10-20	1.1	9.2
12.60	10-20	1.1	9.5
12.70	10-20	1.1	9.8
12.80	10-20	1.1	9.9
12.90	10-20	1.1	10.0
13.00	10-20	1.1	10.3
13.10	10-20	1.1	10.4
13.20	10-20	1.1	10.7
13.30	10-20	1.1	10.8
13.40	10-20	1.1	11.0
13.50	10-20	1.1	11.2
13.60	10-20	1.1	11.3
13.70	10-20	1.1	11.6
13.80	10-20	1.1	11.6
13.90	10-20	1.1	11.8
14.00	10-20	1.1	11.9
14.20	10-20	1.1	12.3
14.40	10-20	1.1	12.4

Operating frequency (mc)	Range switch position	Coupling (COUPLING control)	Loading (FREQUENCY control, 2 mc to 10 mc)
14.60	10-20	1. 1	12. 8
14.80	10-20	1. 1	13. 0
15.00	10-20	1. 1	13. 2
15.20	10-20	1. 1	13. 6
15.40	10-20	1. 0	13. 8
15.60	10-20	1. 0	14. 2
15.80	10-20	1. 0	14. 2
16.00	10-20	1. 0	14. 4
16.20	10. 20	1. 0	14. 6
16.40	10-20	. 9	14. 7
16.60	10-20	. 9	14. 7
16.80	10-20	. 8	14. 9
17.00	10-20	. 8	15. 1
17.20	10-20	. 8	15. 4
17.40	10-20	. 7	15. 4
17.60	10-20	. 5	15. 6
17.80	10-20	. 4	16. 0
18.00	10-20	. 4	16. 3
18.20	10-20	. 4	16. 4
18.40	10-20	. 4	16. 7
18.60	10-20	. 3	17. 0
18.80	10-20	. 3	17. 2
19.00	10-20	. 3	17. 4
19.20	10-20	. 3	17. 6
19.40	10-20	. 2	17. 9
19.60	10-20	. 2	18. 3
19.80	10-20	. 2	18. 5
20.00	10-20	. 1	18. 7

### 23. Preliminary Starting Procedure of Radio Transmitter T-368/URT

(fig. 9)

Before starting the equipment, perform the preliminary starting procedure as follows:

- a. Set the FILAMENT POWER circuit breaker to OFF.
- b. Set the PLATE POWER circuit breaker to OFF.
- c. Set TUNE-OPERATE switch to TUNE.
- d. Set the PLATE RELAY switch to OFF (down).
- e. Set EXCITER PLATE POWER switch to OFF.

### 24. Tuning Procedure of Radio Transmitter T-368/URT

(fig. 9)

Refer to paragraph 23 for preliminary power control settings before using the tuning procedure.

**Caution:** Never operate an unloaded transmitter; serious damage to the equipment will result. If a dummy load is not used in the tuneup

procedure, make certain that the antenna is connected to the transmitter.

#### a. CW Tuning Procedure.

- (1) Set the TUNING CONTROL to the desired frequency. Figure 21 shows two positions of the TUNING CONTROL dial. The 1.5-3.0-mc position uses four digits and reads 1.920 mc. The 6.0-12.0-mc position uses five digits and reads 11.350 mc. The 3.0-6.0-mc and 12.0-20.0-mc positions also use four and five digits respectively. When the BAND SELECTOR switch is set in the two lower bands, the fourth digit reads either 0 or 5; when the switch is set in the two upper bands, the fourth digit travels through 0 to 9 and the fifth digit remains at 0. When frequencies are selected that do not fall on these exact numbers such as 1.917 or 11.357 mc, interpolation must be used. The transmitter, therefore, must be calibrated as shown in (10) below.
- (2) Set POWER AMPLIFIER TUNING and POWER AMPLIFIER LOADING controls to the numbers that correspond to the desired frequency (par. 22a).
- (3) Turn the BAND SELECTOR switch to the desired band.
- (4) Turn the P A BAND SWITCH to the desired band.
- (5) Turn the SERVICE SELECTOR switch to CW.
- (6) Throw the FILAMENT POWER circuit breaker to ON.
  - (a) Green FILAMENT POWER indicator lamp goes on.
  - (b) FIL VOLTAGE meter shows a reading.
  - (c) Blowers go on.
- (7) Adjust the FILAMENT VOLTAGE control for a reading of 5 to 5.2 volts on the FIL VOLTAGE meter.
- (8) Turn the EXCITATION METER SWITCH to P A GRID X2.
- (9) Throw the EXCITER PLATE POWER switch to ON (reading appears on EXCITATION METER).
- (10) Calibrate the transmitter with a frequency meter set such as Frequency Meter Sets SCR-211-A, B, C, D, E, F, J, K, L, M, N, O, P, Q, R, T, AA, AC, AE, AF, AG, AH, AJ, AK, AL, or AN in the following manner:

- (a) Set the frequency meter on top of the transmitter.
  - (b) Calibrate the frequency meter as described in TM 11-300.
  - (c) Set the frequency meter at the desired operating frequency.
  - (d) Adjust the TUNING CONTROL on the transmitter until zero beat is heard in the frequency meter.
  - (e) The transmitter is now accurately calibrated at the operating frequency.
- (11) Throw the PLATE POWER circuit breaker to ON.
  - (12) Throw the PLATE RELAY switch to ON (up).
    - (a) Red PLATE POWER indicator lamp goes on.
    - (b) P A PLATE meter shows a reading.
  - (13) Adjust the POWER AMPLIFIER TUNING control to resonance (tuning to the desired frequency) as indicated by the minimum reading on the P A PLATE meter.
  - (14) Adjust the POWER AMPLIFIER LOADING control to obtain a reading of 150 milliamperes (ma) on the P A PLATE meter.
  - (15) Readjust the POWER AMPLIFIER TUNING control for a minimum reading on the P A PLATE meter.
  - (16) Readjust the POWER AMPLIFIER LOADING control for the 150-ma reading on the P A PLATE meter.

*Note.* For the procedures in (13) through (16) above, the numbers of the tuning controls may be changed so that they do not fall in the approximate center of the shaded areas of the calibration charts. This is permissible as long as they remain inside the shaded areas.

- (17) Throw the TUNE-OPERATE switch to OPERATE.
  - (a) P A PLATE meter should read approximately 350 ma. If not, repeat the steps in (15) and (16) above, with the switch at OPERATE, until 350 ma is obtained.
  - (b) EXCITATION meter should indicate a reading of 8 to 12 ma at P A GRID X2 position.
  - (c) Turn the EXCITATION METER SWITCH to INT AMP PLATE X10 position and EXCITATION meter

reading should be between 20 and 70 ma.

**Caution:** Be sure 70 ma is not exceeded, as the life of the intermediate power amplifier (ipa) tube will be reduced considerably.

- (d) FIL VOLTAGE meter should read 5 to 5.2 volts. If not, repeat the procedure in (7) above.
- b. *AM. Tuning Procedure.*
- (1) Follow the tuning procedure for CW (a above) with the following exceptions:
    - (a) For the procedure in a(5) above, turn the SERVICE SELECTOR switch to AM.
    - (b) For the procedure in a(14) above, adjust the POWER AMPLIFIER LOADING control for a 125-ma reading on the P A PLATE meter.
    - (c) For the procedures in a(17)a through (d) above, the P A PLATE meter should read 275 ma for a maximum.
  - (2) Turn the EXCITATION METER SWITCH to the MOD PLATE X20 position.
  - (3) Adjust the MODULATOR BIAS control until a reading of 50 ma is obtained on the EXCITATION meter.
  - (4) Turn the CARBON MIKE GAIN control to its off position (counterclockwise).
  - (5) Turn the clipper gain control (screwdriver adjustment) to its off position (counterclockwise). This is done by pulling the modulator deck out until the clipper control shaft can be seen (fig. 67) and turning the control with a screwdriver.
- Warning:** Be sure that the deck is not pulled out too far; damage to the operator or to the equipment may result because there are no stops to prevent the deck from falling out of the housing.
- (6) Push the deck back into the housing but do not tighten the bolts at this time.
  - (7) Hold the mike in one hand (aprx 4 to 6 in. from the face) and press the mike switch. Hum or whistle a sustaining note into the mouthpiece while turning up the CARBON MIKE GAIN control until approximately 250 ma is read on the EXCITATION meter. If a telephone is used over a 600-ohm line, turn the 600 OHM LINE GAIN control instead of the CARBON MIKE GAIN control.

- (8) Pull the deck out again far enough to turn the clipper gain control halfway on (clockwise) and then push it in again.
- (9) Repeat the procedure in (7) above and check the modulator plate current reading. If it exceeds 230 ma, the clipper control must be turned on more and if it is less than 230 ma, the clipper control must then be turned back a little.
- (10) Repeat the procedures in (8) and (9) above until 230 ma is the maximum reading.
- (11) Now talk normally into the mike and check for a maximum reading of 230 ma on the EXCITATION meter. If 230 ma is not exceeded on peaks, the transmitter is now adjusted for 100 percent modulation with peak clipping control for modulation over 100 percent.
- (12) Tighten the modulator deck bolts.

*c. EXT EXC Tuning.*

- (1) Follow the CW tuning procedure in *a*(1) through (8) above but turn the SERVICE SELECTOR switch to EXT EXC (*a*(5) above).
- (2) Set the tuning control on the external exciter source for the desired frequency. The transmitter accepts signals in the frequency range of 1.5 to 20.0 mc in EXT EXC position.
- (3) Turn on the external exciter unit.
- (4) Calibrate the external exciter unit.
- (5) Turn on the EXCITER PLATE POWER switch.
- (6) Adjust the TUNING CONTROL for a

maximum reading on the EXCITATION meter (8 ma min).

- (7) Follow the CW tuning procedure in *a*(11) through (17) above.
- (8) The transmitter is now tuned for EXT EXC operation.

*d. FSK Tuning.*

The tuning procedure is identical with the EXT EXC tuning procedure except that the SERVICE SELECTOR switch must be turned to FSK. For FSK tuning, the following conditions must be observed:

- (1) Be sure that the fsk exciter is turned on before throwing the transmitter PLATE EXCITER switch to its on position, because the ipa tube has no protective bias in the FSK (and FSK-AM.) position.
- (2) The transmitter accepts signals in the 1.5 to 6.0-mc range only.
- (3) During operation of the radioteletype system, the frequency of the transmitted mark signal is lowered 850 cycles to produce a spacing signal (as in Frequency Shift Exciter 0-39/TRA). The frequency of the transmitted mark signal may range from 1.5 to 20 mc. Since the frequency range of the exciter is limited to a lower range, transmission at higher frequencies involves frequency multiplication in the transmitter. The effect of this frequency multiplication is to reduce the amount of frequency shift required in the exciter. The frequency shift and multiplication factor involved for different ranges of transmitter frequency are shown in the table below.

Exciter frequency (mc)	Transmitter frequency (mc)	BAND SELECTOR switch position	Transmitter multipliers used	Transmitter multiplication	Exciter frequency shift (cps)
1.5-3.0	1.5-3.0	1.5-3.0	None	X1	850
	3.0-6.0	3.0-6.0	1	X2	425
	6.0-12.0	6.0-12.0	2	X4	212.5
3.0-6.0	3.0-6.0	3.0-6.0	None	X1	850
	6.0-12.0	6.0-12.0	1	X2	425
	12.0-20.0	12.0-20.0	2	X4	212.5

*e. FSK-AM. Tuning.*

- (1) Tune the transmitter in the AM. position.
- (2) Tune the transmitter in the FSK position.
- (3) Turn the SERVICE SELECTOR switch to the FSK-AM. position.

*f. Tuning Procedure of Antenna Tuning Unit BC-939-B (fig. 10).*

**Warning:** Extremely high rf voltages are present on the antenna tuning unit when the trans-

mitter is in operation. Painful burns will result upon contact.

(1) *Whip antenna.*

- (a) Follow the CW tuning procedure in a(1) through (8) above.
- (b) Turn the COUPLING control to the setting that corresponds to the desired frequency (par. 22b).
- (c) Turn the FREQUENCY control to the setting (par. 22b) corresponding to the desired frequency.
- (d) Set the range switch to the position (par. 22b) corresponding to the desired frequency.
- (e) Follow the CW tuning procedure in a(9) through (17) above, but use the FREQUENCY control of the tuning unit instead of the POWER AMPLIFIER LOADING control.
- (f) A maximum reading on the ANTENNA CURRENT meter indicates the correct tuning procedure.
- (g) If the minimum P A PLATE meter reading is above or below 350 ma, alternately decrease or increase the COUPLING control to obtain this reading. Repeat the procedures in a(15) and (16) above (TUNE-OPERATE switch at OPERATE) until maximum rf current occurs on the ANTENNA CURRENT meter.

(2) *Long-wire antenna.* The tuning procedure for the long-wire antenna is identical with the whip antenna tuning procedure except for the following differences:

- (a) Set the COUPLING control at about 2.0.
- (b) Turn the FREQUENCY control that covers the low-frequency range to about the center of its range. The exact settings of the COUPLING and FREQUENCY controls will be found in the tuning procedure as indicated by a maximum reading on the ANTENNA CURRENT meter.
- (c) Set the range switch at LONG WIRE.

*Note.* If the tuning or loading numbers of the POWER AMPLIFIER TUNING and POWER AMPLIFIER LOADING indicators of the transmitter are not the same as those within the shaded area of the chart being used, it is an indication that the whip or long-wire antenna does not furnish a proper load to the

transmitter. Check the antenna for proper length at the operating frequency being used.

## 25. Starting Procedure

(fig. 9)

If the transmitter is being energized initially or if the frequency of operation is being changed, follow the procedure outlined in paragraphs 23 and 24. If the transmitter is to be operated at the frequency last used before the equipment was shut down, perform the following steps:

- a. Set the FILAMENT POWER circuit breaker to OFF.
- b. Set the PLATE POWER circuit breaker to ON.
- c. Set the EXCITER PLATE POWER switch to OFF.
- d. Set the PLATE RELAY switch to on (up).
- e. Set the FILAMENT POWER circuit breaker to ON.

- (1) Green FILAMENT POWER indicator light goes on instantly.
- (2) Blowers go on instantly.
- (3) Red PLATE POWER indicator light goes on approximately 25 seconds later.

*Note.* In all types of operation of Radio Transmitter T-368/URT, the FILAMENT POWER and PLATE POWER circuit breakers are left at ON while EXCITER PLATE POWER and PLATE RELAY switches will be on or off, depending on the type of operation desired.

## 26. CW Operation

(fig. 9)

Follow the starting procedure (par. 25) before performing CW operation.

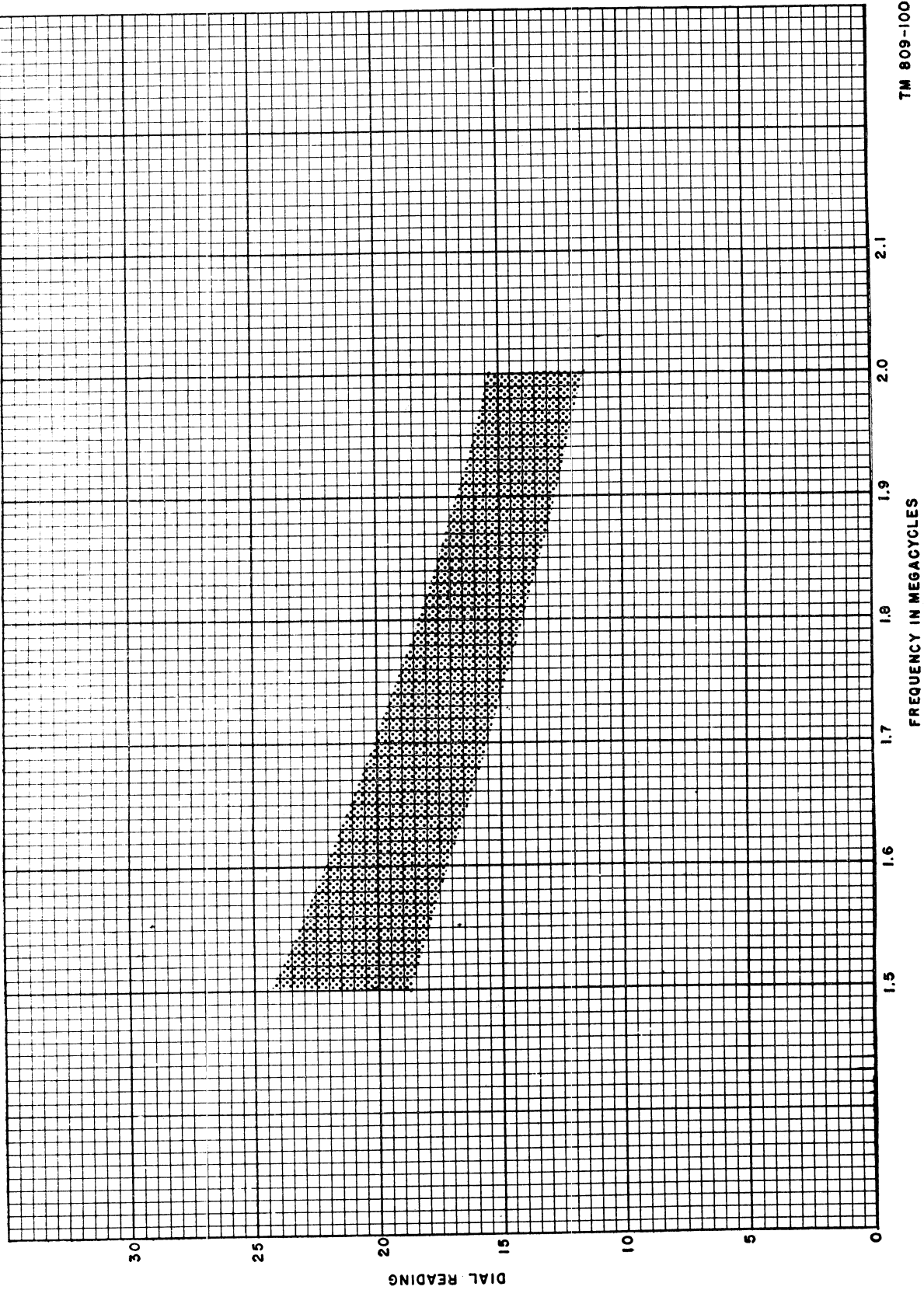
- a. Check to see if the SERVICE SELECTOR switch is at CW.
- b. Throw the EXCITER PLATE POWER switch to OFF.
- c. Throw the PLATE RELAY switch to on (up).
- d. Close the handkey.

## 27. AM Operation

(fig. 9)

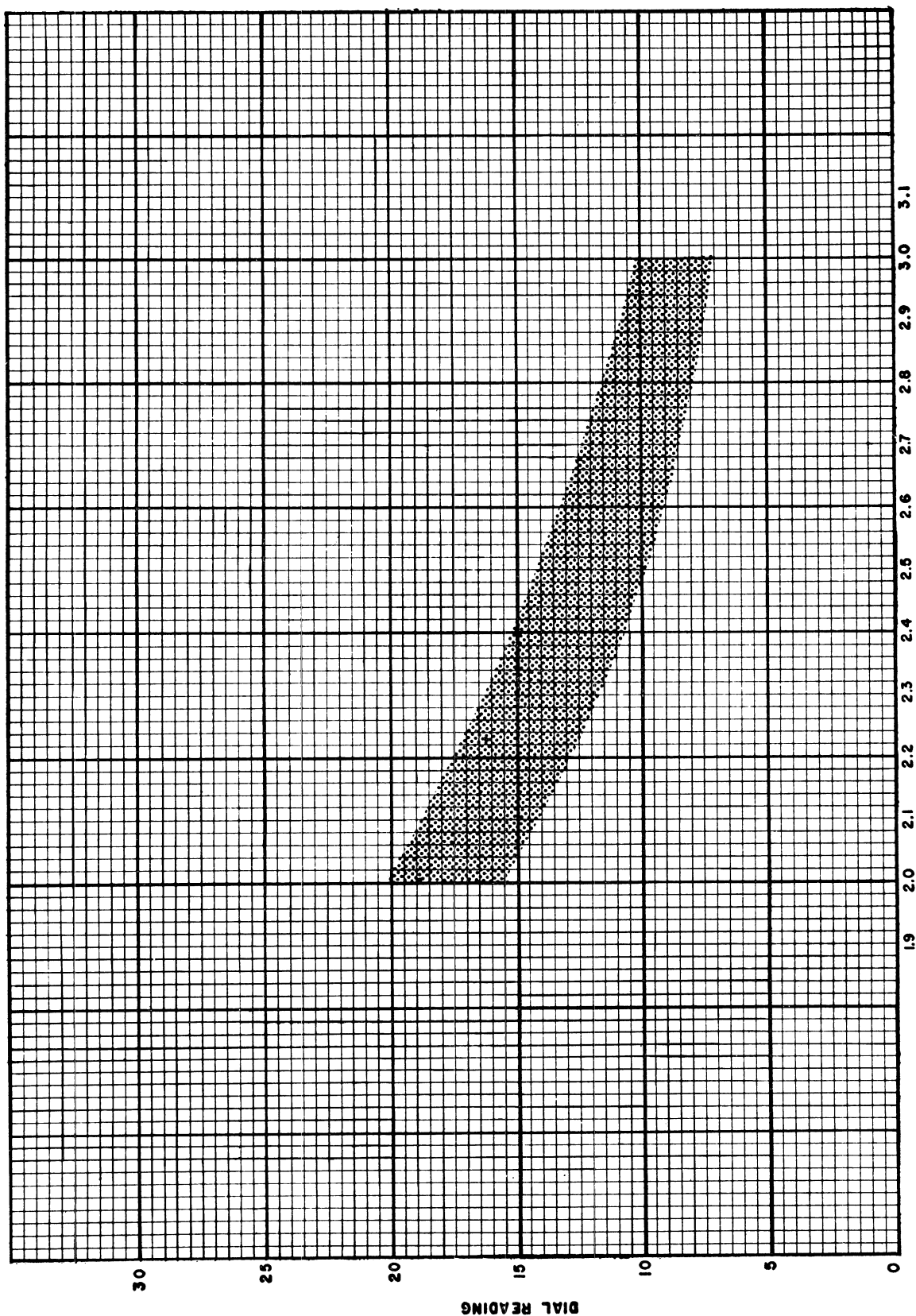
Follow the starting procedure before performing AM operation.

- a. Check to see if the SERVICE SELECTOR switch is at AM.
- b. Throw the EXCITER PLATE POWER switch to OFF.
- c. Throw the PLATE RELAY switch to off (down).
- d. Press the mike switch.



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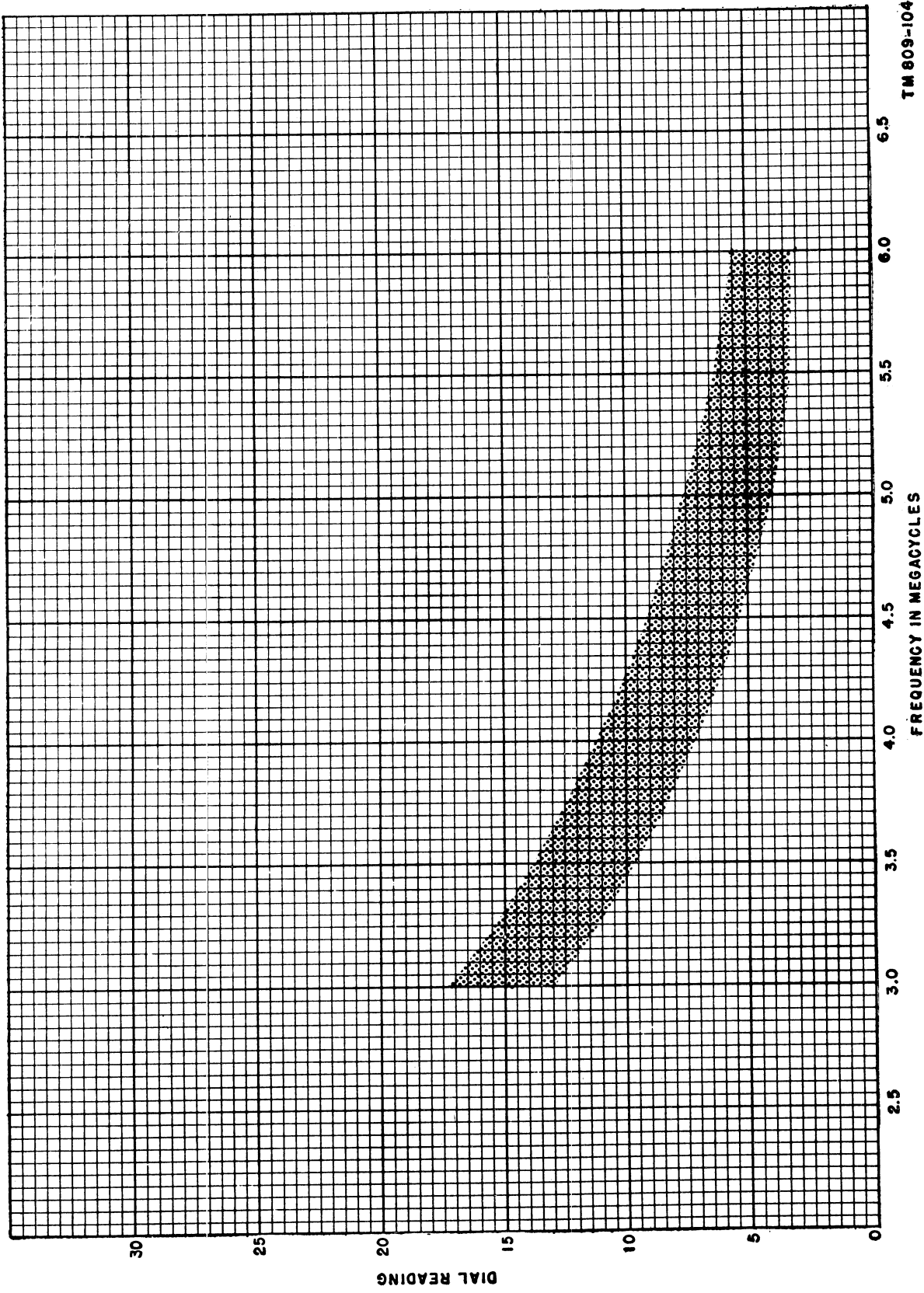
Figure 11. POWER AMPLIFIER TUNING control calibration chart, 1.5 to 2.0 mc.



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FREQUENCY IN MEGACYCLES

Figure 12. POWER AMPLIFIER TUNING control calibration chart, 2.0 to 3.0 mc.

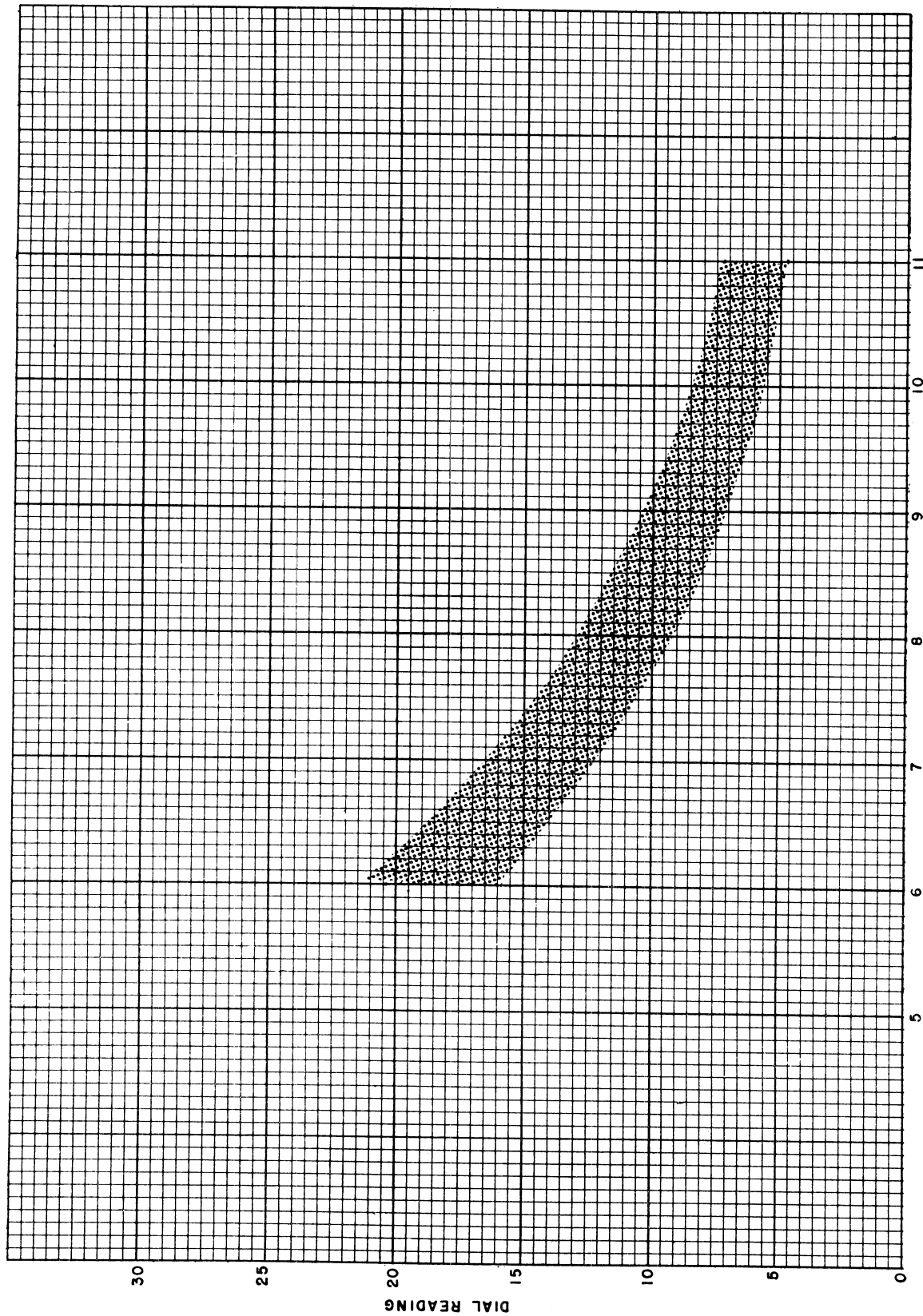


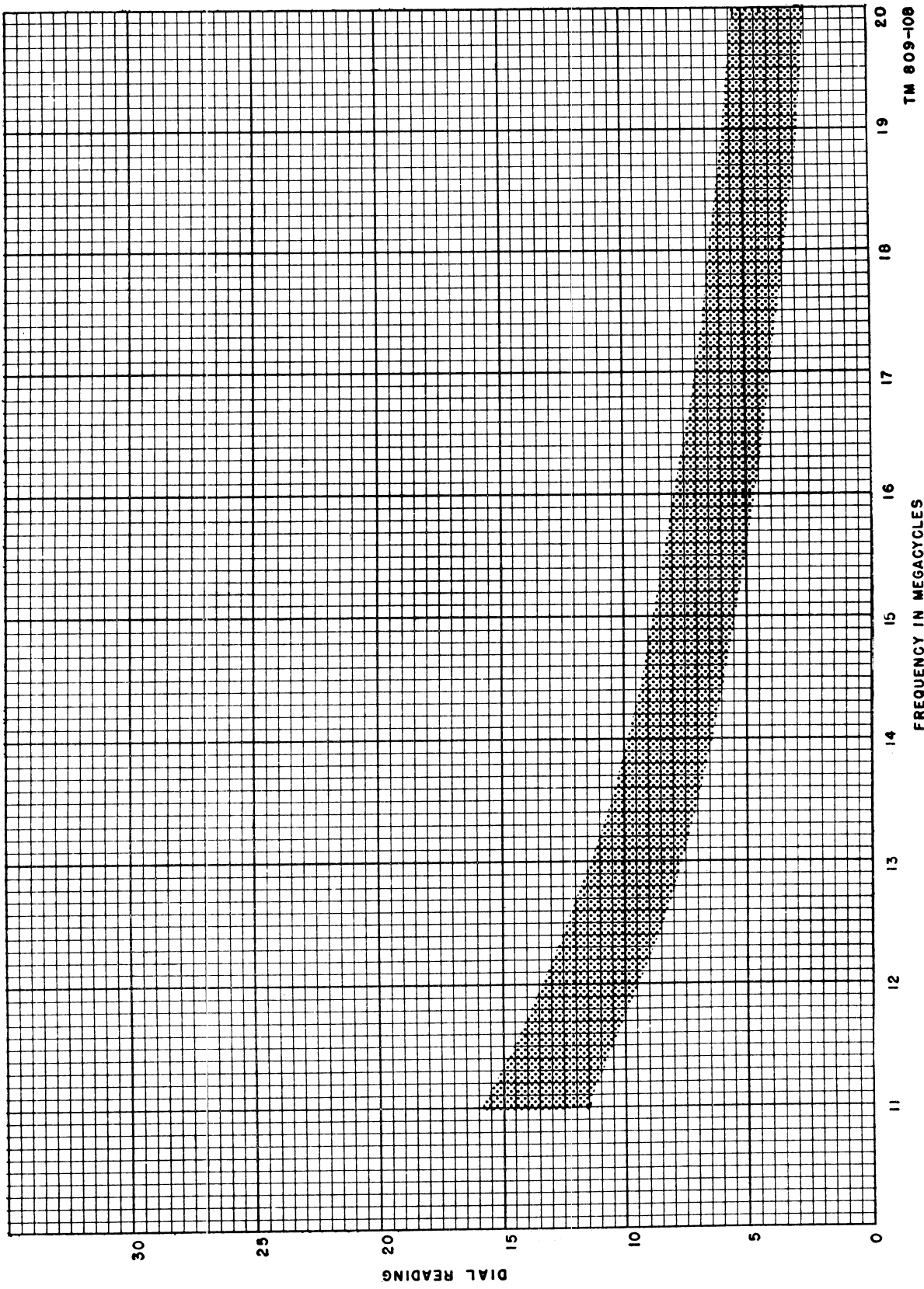
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Figure 13. POWER AMPLIFIER TUNING control calibration chart, 3.0 to 6.0 mc.

FREQUENCY IN MEGACYCLES

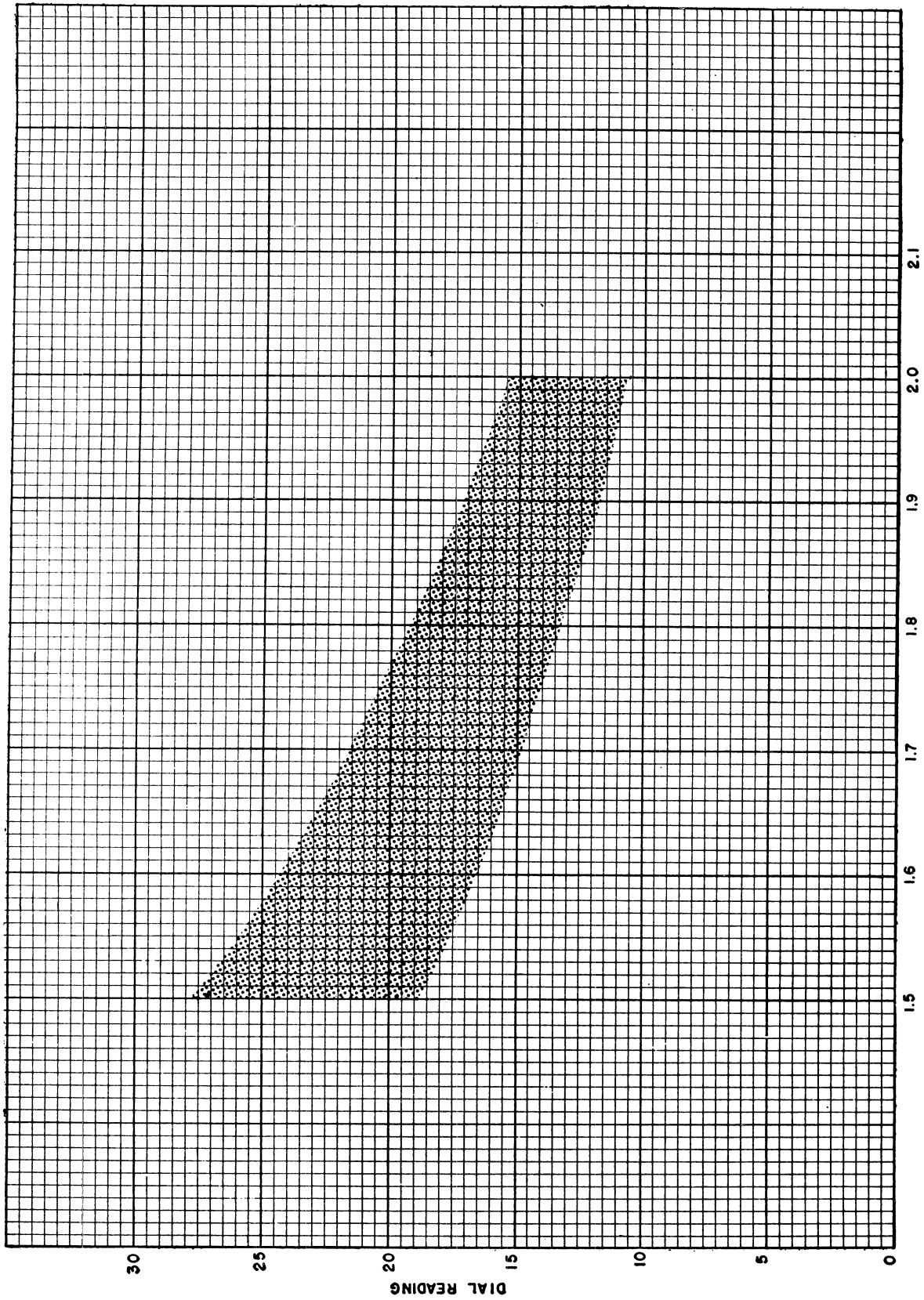
Figure 14. POWER AMPLIFIER TUNING control calibration chart, 6 to 11 mc.





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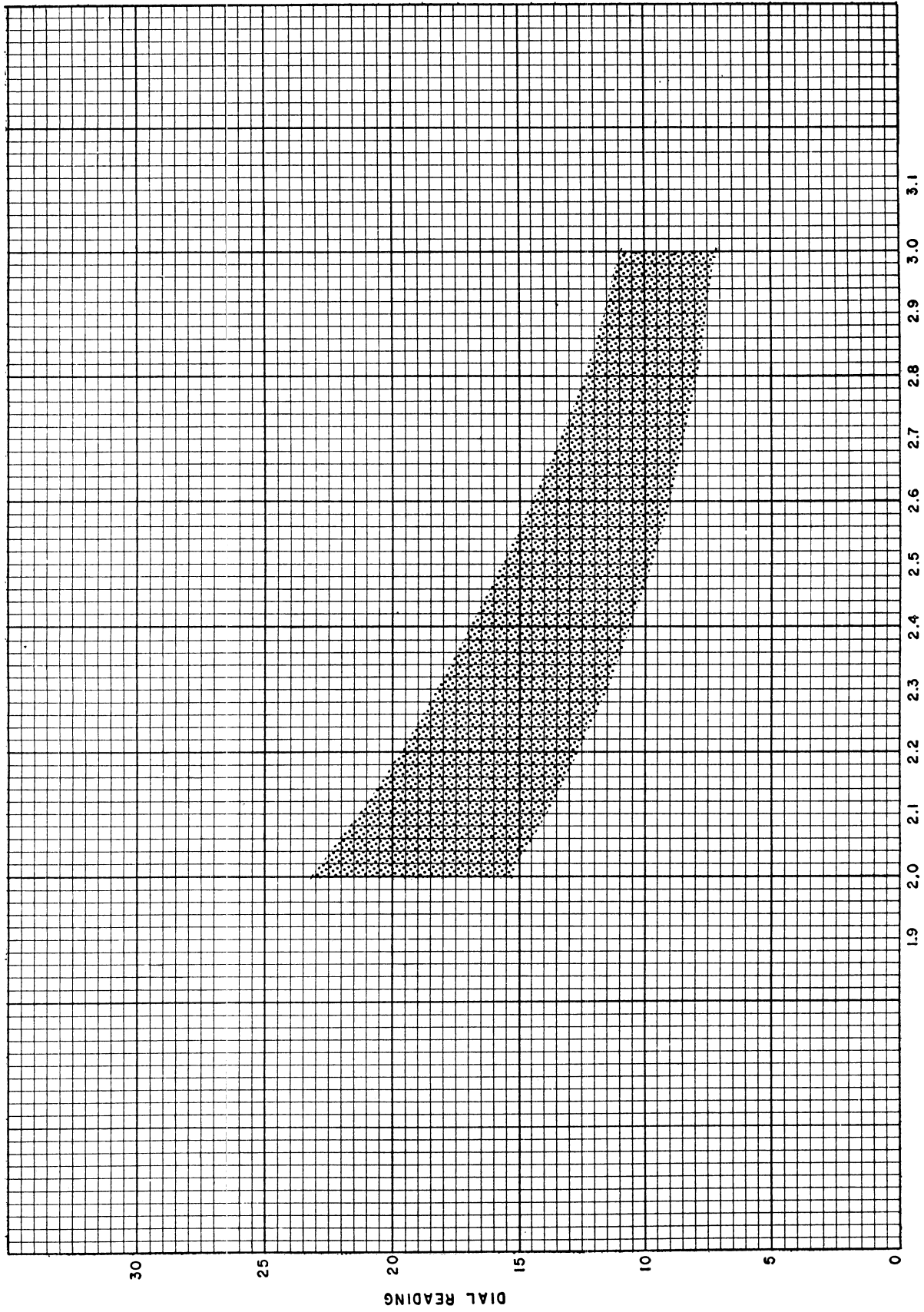
Figure 15. POWER AMPLIFIER TUNING control calibration chart, 11 to 20 mc.



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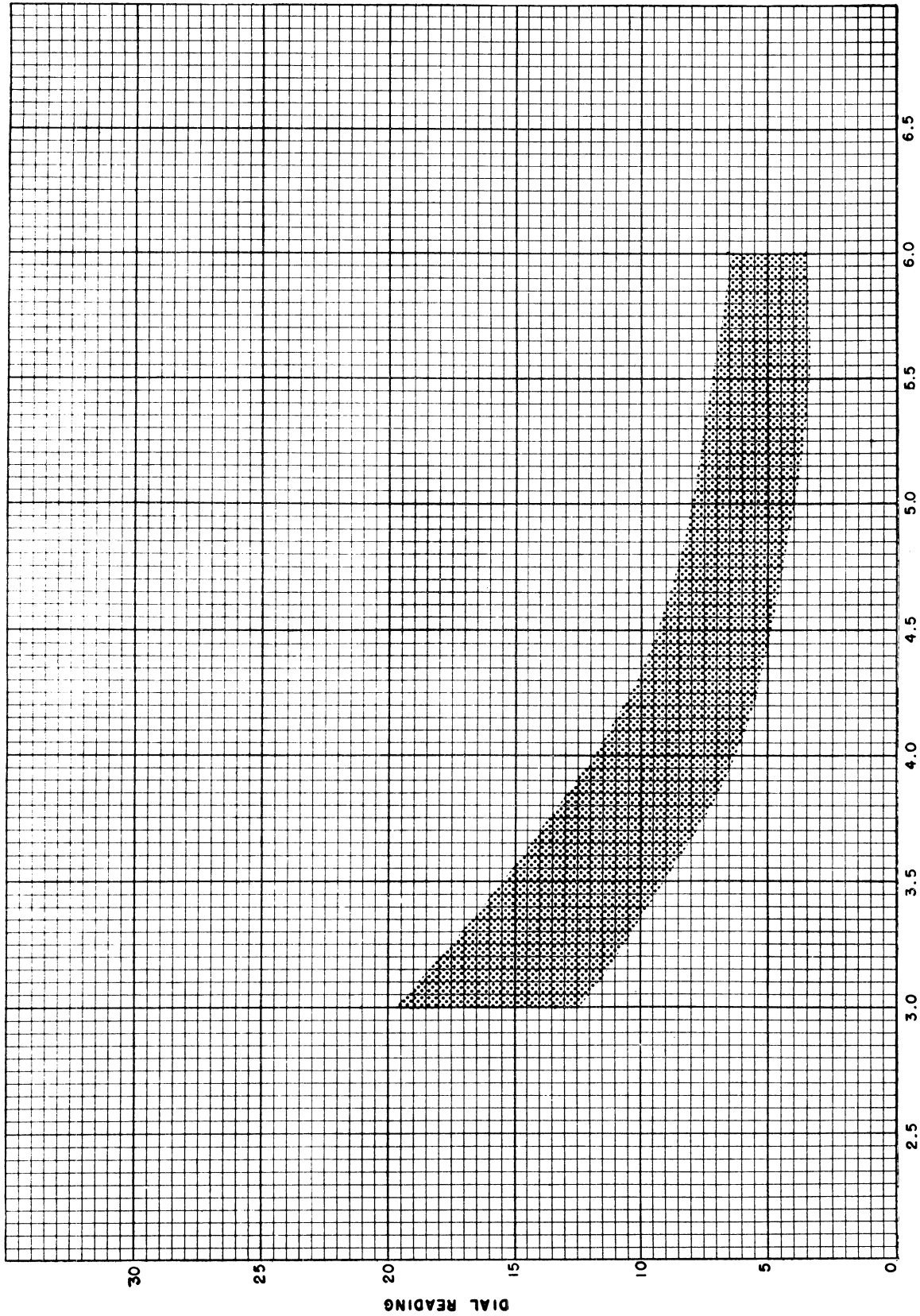
FREQUENCY IN MEGACYCLES

Figure 16. POWER AMPLIFIER LOADING control calibration chart, 1.5 to 2.0 mc.



**FREQUENCY IN MEGACYCLES**

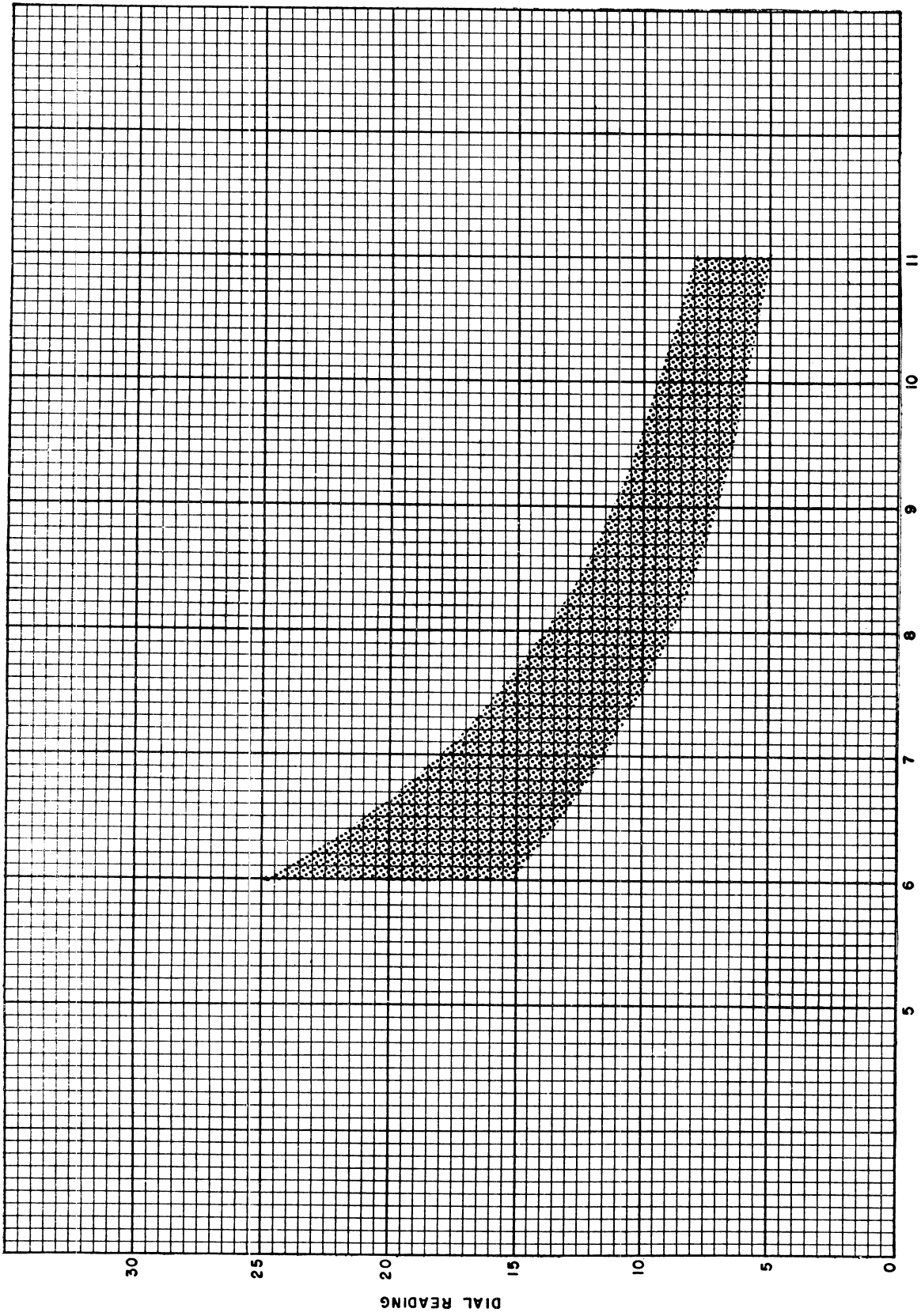
Figure 17. POWER AMPLIFIER LOADING control calibration chart, 2.0 to 3.0 mc.



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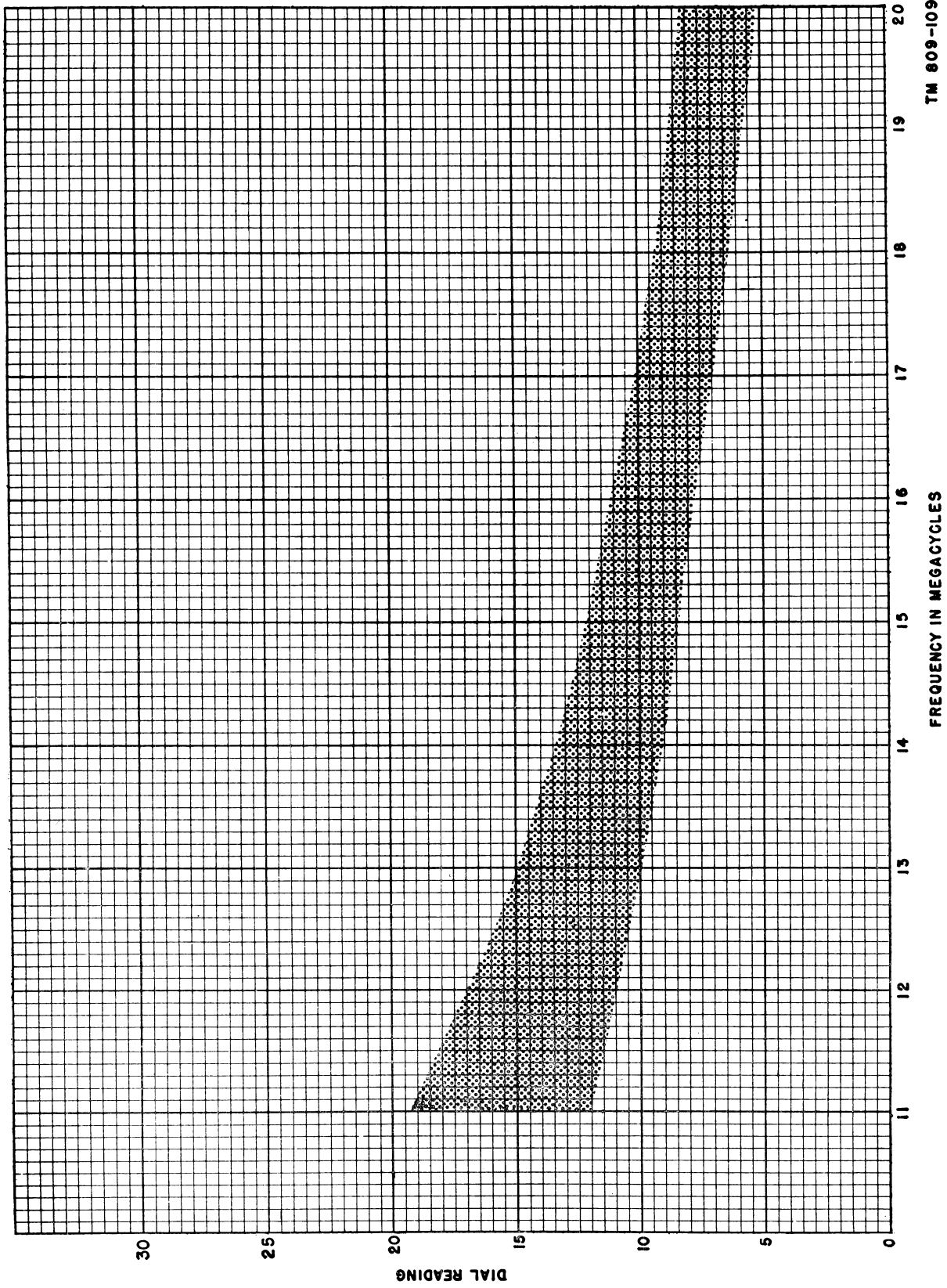
FREQUENCY IN MEGACYCLES

Figure 18. POWER AMPLIFIER LOADING control calibration chart, 3.0 to 6.0 mc.



FREQUENCY IN MEGACYCLES

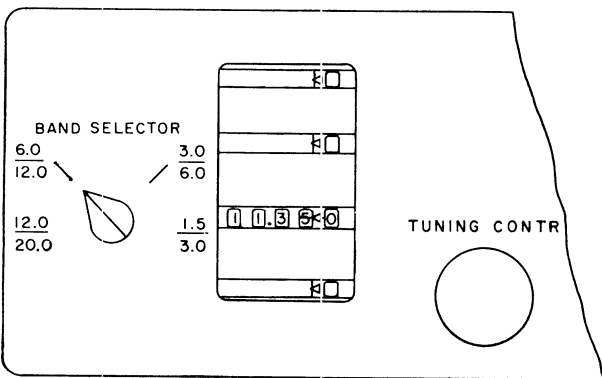
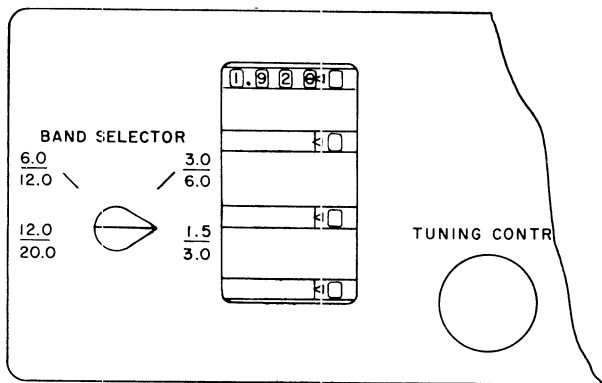
Figure 19. POWER AMPLIFIER LOADING control calibration chart, 6 to 11 mc.



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FREQUENCY IN MEGACYCLES

Figure 20. POWER AMPLIFIER LOADING control calibration chart, 11 to 20 mc.



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Figure 21. TUNING CONTROL dial, 1.5-3.0-mc and 6.0-12.0-mc band positions.

## 28. EXT EXC Operation

(fig. 9)

Follow the starting procedure before performing EXT EXC operation.

- a. Check to see if the SERVICE SELECTOR switch is at EXT EXC.
- b. Turn on the external exciter unit.
- c. Turn the EXCITER PLATE POWER switch to on (up).
- d. Turn the PLATE RELAY switch to on (up).

## Section III. OPERATION UNDER UNUSUAL CONDITIONS

### 32. General

Operation of Radio Transmitter T-368/URT may be difficult in regions where it is subjected to extreme climatic conditions of cold, heat, humidity and moisture, and/or sand. Although every precaution is taken in the design of the equipment to maintain its technical characteristics over a wide temperature and humidity range, adverse conditions may cause large discrepancies in operation unless additional precautions are

### 29. FSK Operation

(fig. 9)

Follow the starting procedure before performing FSK operation.

- a. Check to see if the SERVICE SELECTOR switch is at FSK.
- b. Turn on the frequency-shift exciter unit.
- c. Turn the EXCITER PLATE POWER switch to on (up) and check for a reading on the EXCITATION meter at P A GRID X2 position.
- d. Turn PLATE RELAY switch to on (up).
- e. Key the frequency-shift exciter unit.

### 30. FSK-AM. Operation

(fig. 9)

Follow the starting procedure before performing FSK-AM. operation.

- a. Check to see if the SERVICE SELECTOR switch is at FSK-AM.
- b. Turn on the external exciter unit.
- c. Turn the EXCITER PLATE POWER switch to on (up), and check for a power amplifier grid current reading.
- d. Turn Plate Relay Switch to on (up).
- e. Keying the frequency-shift exciter and talk into the mike.

### 31. Stopping Procedure

(fig. 9)

To stop the equipment, throw the FILAMENT POWER circuit breaker to OFF. As mentioned under the starting procedure (par. 25), the PLATE POWER circuit breaker is normally kept at ON unless the equipment is to be shut down completely. For standby operation of short periods, leave the FILAMENT POWER circuit breaker at ON but turn the PLATE POWER circuit breaker to OFF, the EXCITER PLATE POWER to OFF, and the PLATE RELAY switch to off (down).

taken. However, when the transmitter is used as an operating component of a radio set, it is installed in a trailer. In this case, the above problems are eliminated or greatly reduced.

### 33. Operation in Arctic Climates

To protect the transmitter from the adverse effects of subzero temperatures and climatic conditions associated with cold weather, observe the following precautions:

a. Keep the equipment warm and dry. If necessary, construct an insulated housing for the equipment.

b. Keep the filaments of the tubes lighted at all times, unless this overtaxes the source of line power. To light the filaments only, throw the FILAMENT POWER circuit breaker to the ON position. Make certain that the PLATE POWER circuit breaker is at OFF.

c. Cover the equipment with a blanket or tarpaulin when it is not in use.

d. If work must be performed on the equipment with any of the decks pulled partially or wholly out of the housing, be sure that there is no danger of a cold draft striking any of the temperature-sensitive parts of the equipment. If the inclosure is so constructed that such a draft is possible, place a blanket or some barrier between the source of the draft and the equipment.

e. If the equipment is brought into a warm room after having been exposed to the cold, it will *sweat* (moisture will condense on the surfaces) until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly. This condition also arises when the equipment warms up during the day after exposure during a cold night.

f. Heavy coatings of frost will gather on the carbon microphone in extreme cold weather when the microphones are used in the open air or in a cold room. Frost also will form from the breath in the openings and will affect transmitter modulation. Place a covering over the opening if it will not interfere with microphone operation.

### 34. Operation in Tropical Climates

When the equipment is operated in tropical climates as part of a radio set, it may be installed in tents, huts, or, when necessary, in underground

dugouts. When the equipment is installed below ground and when it is set up in swampy areas, moisture conditions are more acute than normal. Ventilation is usually very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the ambient air. To minimize this condition, keep the equipment in operation.

### 35. Operation in Desert Climates

a. The main problem that arises with equipment operation in desert areas is the large amount of sand, dust, or dirt that enters the moving parts of the equipment. The ideal preventive precaution is to house the equipment in a dustproof, air-conditioned shelter. Where this precaution is impossible, make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors, cover the inside walls with heavy paper, and secure the side walls of tents with sand bags to keep them from flapping in the wind.

b. Never tie power cords, cables, or wires to tent walls. Buffeting of the tent walls may damage the connections or break the lines.

c. Keep the equipment as free from dust as possible. Make frequent preventive maintenance checks (pars. 41 and 42), with particular attention to the cleanliness of the gear trains and associated indicator mechanisms, and exposed switches and rheostats. Make certain that the air filters are clean to ensure adequate ventilation.

d. A large decrease in the temperature at night often causes condensation. To minimize the effect of condensation, cover the equipment with tarpaulin or a similar covering equipment.

# CHAPTER 4

## ORGANIZATIONAL MAINTENANCE

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### Section I. ORGANIZATIONAL TOOLS AND EQUIPMENTS

#### 36. General

The tools, parts, supplies, and test equipment necessary to perform organizational maintenance are authorized by appropriate publications. Additional tools are supplied with the transmitter unit (par. 37).

#### 37. Tools

*a.* Three Allen-head wrenches (Nos. 4, 6, and 8) are mounted on the rf deck (on the metal parti-

tion). In addition, a  $\frac{3}{8}$ -inch hexagonal T-socket wrench is mounted on the outside of the housing.

*b.* Other materials furnished are as follows:

Orangestick.

Cheesecloth, bleached, lint-free.

Carbon tetrachloride.

Sandpaper No. 000.

Solvent, Dry Cleaning (SD) (Fed Spec No. P-S-661a).

### Section II. PREVENTIVE MAINTENANCE SERVICES

#### 38. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so the breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from troubleshooting and repair since its object is to prevent certain troubles from occurring.

#### 39. General Preventive Maintenance Techniques

*a.* Use No. 000 sandpaper to remove corrosion.

*b.* Use a clean, dry, lint-free cloth or a dry brush for cleaning. If the dry cloth or brush will not remove the dirt, use one of the following techniques, as applicable:

(1) When cleaning electrical contacts, use a cloth or brush moistened with carbon tetrachloride; when the contacts are clean, wipe them dry with a *dry* cloth.

**Caution:** Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Be sure that adequate ventilation is provided.

(2) When cleaning surfaces that perform no electrical function, use a cloth or brush moistened with solvent (SD); after cleaning, wipe the parts dry with a *dry* cloth.

*c.* If available, dry compressed air may be used at a line pressure not exceeding 60 pounds per square inch to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result. Do not use compressed air in the vicinity of speaker cones or meter movements.

**Caution:** When using compressed air, always direct the first blast of the air line toward the floor. This procedure is necessary to clear condensed moisture from the line.

*d.* Use a safety shorting stick before touching components in the transmitter. A safety shorting stick may be constructed as follows:

(1) Secure a dry piece of wood or some other material which is a good electrical insulator (fig. 22). It should be about 36 inches long and about 1 inch square. The latter dimension is not very important.

(2) Securely fasten a piece of copper or brass rod (or thin tubing) to one end of the stick in such a manner that the rod extends 12 inches beyond the end of the stick. The free end of the rod should be bent in the form of a small hook.

(3) Solder a piece of heavy, flexible hookup wire about 18 inches long to the metal rod where it is fastened to the stick.

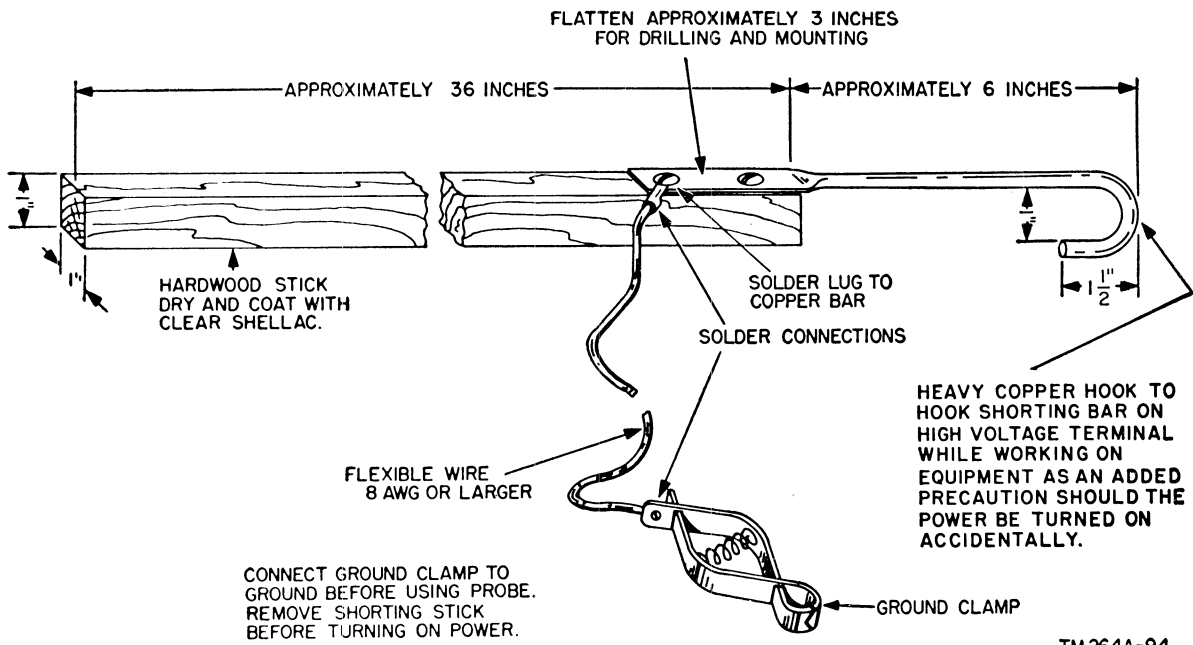


Figure 22. Construction of shorting stick.

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Attach a heavy clip to the free end of the wire.

e. The air filters may be cleaned as follows:

- (1) Use the blowers to get rid of loose pieces of dust.
- (2) Pour cleaning solvent (SD) over a filter. Place a large basin under the filter to catch the solvent (SD). After the dirt particles settle in the solvent (SD), the clear liquid may be used again.
- (3) Use a light water spray to flush out the loosened dirt.
- (4) Use a blower to hasten the drying.
- (5) Spray light oil on the side of the filter that faces the flow of air to keep out dust.

**Caution:** Use oil sparingly.

f. For further information on preventive maintenance techniques, refer to TB SIG 178, Preventive Maintenance Guide for Radio Communications Equipment.

#### 40. Use of Preventive Maintenance Forms

a. The decision concerning the items on DA Forms 11-238 and 11-239 that are to be applied to this equipment is to be made in the case of first echelon maintenance by the communication officer/ chief or his designated representative, and in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. Circled items on figures 23 and 24 are partially or totally applicable to Radio Transmitter T-368/URT. References in the ITEM column are to paragraphs that contain additional maintenance information.

#### 41. Performing Exterior Preventive Maintenance

**Caution:** Tighten screws, bolts, and nuts carefully. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

a. Check for completeness and general condition of the transmitter.

b. Clean dust and moisture from front panels, connectors, and associated operating components (microphone, telephone, antenna, headset, handkey, etc.).

c. Inspect seating of 3 AMP and 6 AMP fuses F2 and F1, and FILAMENT POWER and PLATE POWER lights I 3 and I 4.

d. Inspect controls for binding, scraping, excessive looseness, worn or chipped gears, misalignment, and positive action.

e. Check the equipment for normal operation. For this procedure, refer to paragraphs 22 through 31.

f. Clean and tighten exterior of equipment, supports, and connections.

g. Inspect exposed surfaces for rust and corrosion.

h. Inspect the power and signal cables for

**OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT**  
**RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR**

*INSTRUCTIONS: See other side*

EQUIPMENT NOMENCLATURE

**RADIO TRANSMITTER T-368/URT**

EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; ⊗ Defect corrected.  
 NOTE: Strike out items not applicable.

**DAILY**

NO.	ITEM	CONDITION						
		S	M	T	W	T	F	S
①	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories). <b>PAR.4I a</b>							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.							
③	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. <b>PAR.4I b</b>							
④	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. <b>PAR.4I c</b>							
⑤	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. <b>PAR.4I d</b>							
⑥	CHECK FOR NORMAL OPERATION. <b>PAR.4I e</b>							

**WEEKLY**

NO.	ITEM	COND- TION	NO.	ITEM	COND- TION
⑦	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. <b>PAR.4I f</b>		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
⑧	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. <b>PAR.4I g</b>		⑭	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. <b>PAR.4I j</b>	
⑨	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. <b>PAR.4I h</b>		⑮	INSPECT METERS FOR DAMAGED GLASS AND CASES. <b>PAR.4I k</b>	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHER-PROOFING.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
⑫	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWER-STATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. <b>PAR.4I i</b>		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

**DA** FORM 11-238  
 1 MAY 51

REPLACES DA FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM 809-13

Figure 23. DA Form 11-238.

**SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT**  
**RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR**

*INSTRUCTIONS: See other side*

EQUIPMENT NOMENCLATURE: **RADIO TRANSMITTER T-368/URT**      EQUIPMENT SERIAL NO. \_\_\_\_\_

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; ⊕ Defect corrected.  
 NOTE: Strike out items not applicable.

NO.	ITEM	COND.	NO.	ITEM	COND.
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (Receiver, transmitter, carrying case, wire and cable, microphone, tubes, spare parts, technical manuals and accessories). PAR. 41 d	19	19	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS; INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES. PAR. 42b	
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.	20	20	INSPECT FIRM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR. 41 b	21	21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. PAR. 42e	
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUS-IN COILS AND RESISTORS. PAR. 41 c	22	22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSIONS; BINDING OF PLUNGERS AND HINGE PARTS. PAR. 42c	
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 41 d	23	23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS.	
6	CHECK FOR NORMAL OPERATION. PAR. 41 e	24	24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. PAR. 42d	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND GROUND CONNECTIONS. PAR. 41 f	25	25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS. PAR. 42e	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 41 g	26	26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. PAR. 42 f	
9	INSPECT CUPD, CARB, WIFE, AND SHOCK MOUNTS FOR CUTS, BRUISES, FRAYING, DEGRADATION, KINKS, AND STRAIN. PAR. 41 h	27	27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS. PAR. 42g	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.	28	28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.	29	29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER. PAR. 42h	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERLATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR. 41 i	30	30	INSPECT GENERATORS, AMPLIFYING, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMUTATOR.	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	31	31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS. PAR. 42i	
14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. PAR. 41 j	32	32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE. PAR. 42j	
15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR. 41 k	33	33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.	
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	34	34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	35	35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS.	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	36	36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS.	
		37	37	MOISTURE AND FUNGIPROOF. PAR. 42k	
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.				

FORM DA 1 MAY 51 **11-239**

REPLACES DA FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

16-5100-104-102-1

TM 809-14

Figure 24. DA Form 11-239.

breaks, deterioration, kinks, strain, and loose connectors.

*i.* Inspect for looseness of accessible items, such as the dials, control knobs, and switches.

*j.* Clean air filters, dial, and meter windows.

*k.* Inspect meters for damaged glass or case.

## 42. Performing Interior Preventive Maintenance

**Warning:** Disconnect all power from the equipment before performing the following operations. Upon completion, reconnect power and check for satisfactory operation of the equipment.

*a.* Loosen the captive screws that secure the decks to the housing, and slide the individual decks out for inspection.

*b.* Inspect the tubes for loose envelopes.

*c.* Inspect the relay and circuit breaker assemblies for loose mountings. Check for burned, pitted, or corroded contacts.

*d.* Inspect the resistors, bushings and insulators for cracks, chipping, blistering, discoloration, and moisture.

*e.* Inspect the terminals of large fixed capacitors and resistors for corrosion, dirt, and loose contacts.

*f.* Clean and tighten the switches, terminal blocks, blowers, relay cases, and interiors of sub-

assemblies and housing not readily accessible.

*g.* Inspect the terminal boards for loose connections, cracks, and breaks.

*h.* Lubricate the equipment in accordance with the applicable lubrication instructions.

*i.* Clean and tighten the connections and the mountings for transformers, chokes, potentiometers, and rheostats.

*j.* Inspect the transformers, chokes, potentiometers, and rheostats for overheating and oil-leakage.

*k.* Check moistureproof and fungiproof varnish for cracks and chipping.

## 43. Performing Preventive Maintenance on Antenna Tuning Unit BC-939-B

(fig. 87)

*a.* Inspect, clean, and tighten the following: capacitor clamps, capacitors, coils, bushings and insulators, and switch.

*b.* Inspect and clean gears.

*c.* Inspect, tighten, and lubricate the couplings and control shafts.

*d.* Test for performance after completing preventive maintenance. Refer to paragraphs 22 through 31.

## Section III. LUBRICATION

### 44. Lubrication of Oscillator-Multiplier Assembly and Power Amplifier Tuning Drive Assembly

*a.* The lubrication instructions for the oscillator-multiplier tuning drive assembly are given in figure 25. The power amplifier tuning (and loading) drive assembly lubrication instructions are given in figure 26. The type of lubricant to be used, the interval, and specific instructions for each part are given in these figures. Grease, Aircraft and Instruments (GL), low and high temperature, per MIL-G-3278 is applied to the gear teeth; and Oil, Lubricating, Preservative, Special (PL Special), per MIL-L-644A, is applied to the bearing surfaces.

*b.* Do not apply excessive amounts of lubricants. Do not apply lubricants at points other than those indicated on the lubrication illustrations.

*c.* Be sure that the lubricants and the points to be lubricated are clean and free from sand, grit, or dirt. These abrasives are the primary cause of bearing wear. Use solvent (SD) to clean all parts. Before lubrication, clean all surfaces to be lubricated. Use a lint-free cloth dampened with

solvent (SD); keep the solvent off surrounding parts. The solvent should also be used to remove old lubricants during overhaul. Do not use gasoline as a cleaning fluid for any purpose. Carbon tetrachloride, however, can be used as a cleaning fluid only in the following cases: on electrical equipment where flammable solvents cannot be used because of fire hazard, and for cleaning electrical contacts including relay contacts, connectors, etc.

### 45. Lubrication of Antenna Tuning Unit BC-939-B

Use grease (GL) to lubricate the following points in the tuning unit (fig. 87):

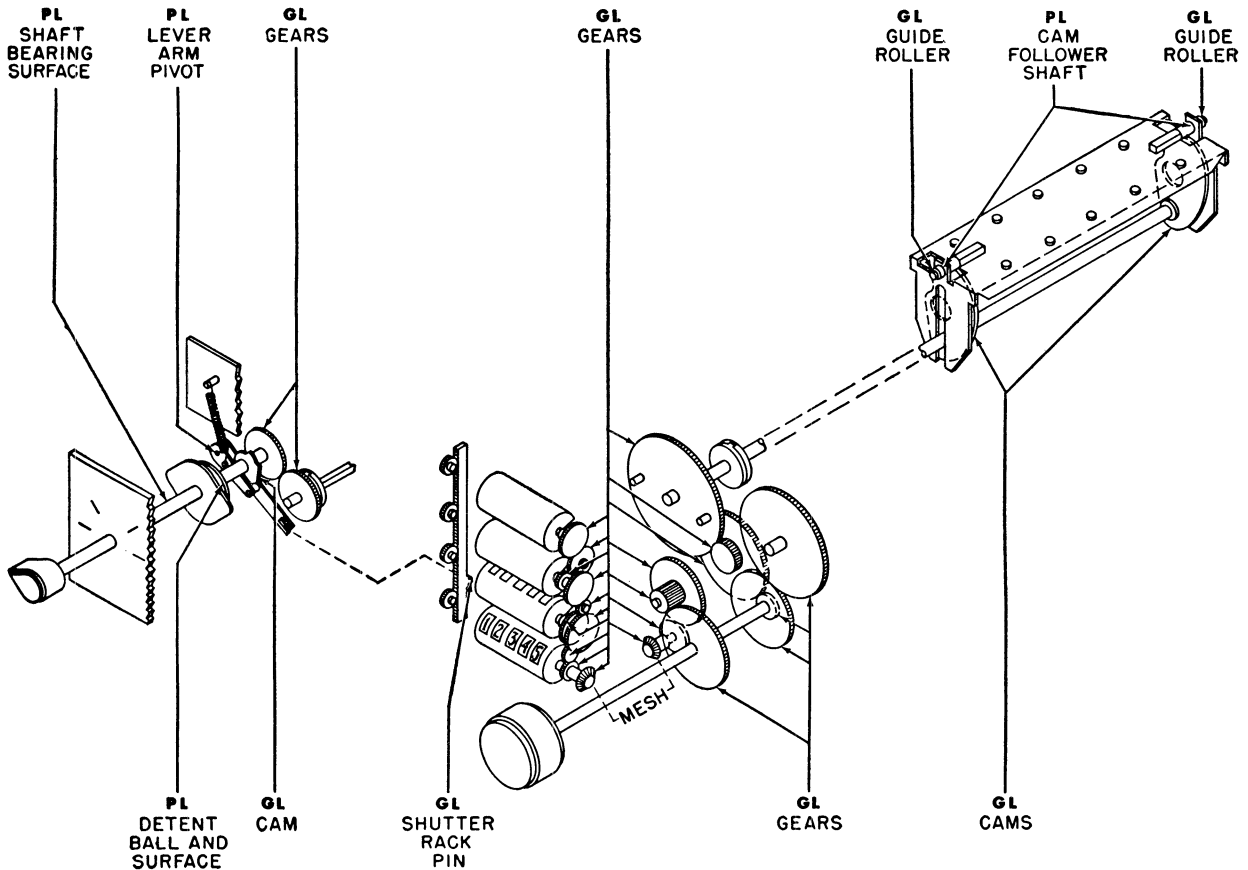
Loading coil contact roller shafts.

Coupling adjustment coil contact roller shaft.

Tuning control bevel pinions.

Coupling adjustment bevel pinion.

**Warning:** Do not lubricate the inductors, contact shoes, or the associated rollers which made contact with them. Use a soft dry brush to remove small metallic particles from the surface of the inductors.



LUBRICANTS	INTERVAL
GL - GREASE, AIRCRAFT AND INSTRUMENT (LOW AND HIGH TEMPERATURE), PER MIL-G-3278. (NOTE 2)	6 MONTHS
PL - LUBRICATING OIL, PRESERVATIVE, SPECIAL, PER MIL-L-644A WITH AMEND. I. (NOTE 3)	

**NOTES:**

1. USE SOLVENT, DRY CLEANING (SD) TO CLEAN PARTS. BEFORE LUBRICATING, CLEAN EXPOSED SURFACES OF PARTS WITH LINTLESS CLOTH LIGHTLY DAMPENED WITH SOLVENT (SD). DRY BEFORE LUBRICATING.
2. CLEAN SURFACES AND APPLY GREASE SPARINGLY; REMOVE EXCESS LUBRICANT.
3. CLEAN SURFACES AND APPLY 1 OR 2 DROPS OF OIL.

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Figure 25. Lubrication of oscillator-multiplier tuning drive assembly.

**46. Lubrication under Unusual Conditions**

*a. Arctic Regions.* Lubricants that are satisfactory at moderate temperatures may stiffen and solidify at subzero temperatures; as a result, moving parts bind or become inoperative. Consult the key on the lubrication order for the proper grade of lubricant for operating the equipment in Arctic regions. The lubricants specified for the equipment have been chosen specifically for their low-temperature characteristics.

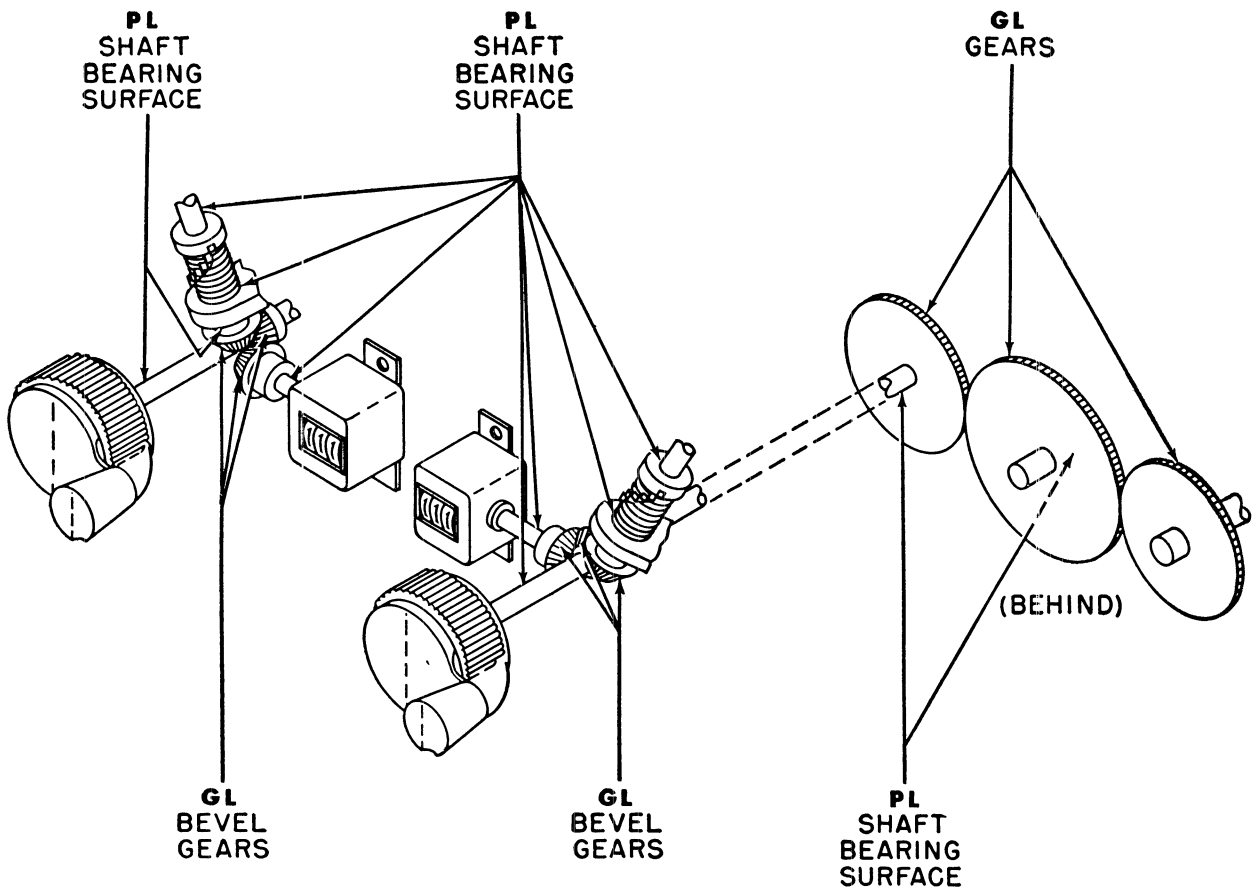
*b. Tropical Regions.* High temperatures and

moisture due to rain, condensation, etc., may cause lubricants that are normally satisfactory to flow from moving parts and other surfaces. These bearing surfaces will wear excessively and will become damaged by rust and corrosion. Inspect the equipment daily, and lubricate it as required to insure efficient operation; use lubricants suitable for high temperatures.

*c. Desert Regions.* Dust and sand infiltration into the equipment causes grit in the lubricants and will seriously impair and damage the moving parts of the set. Hot, dry temperatures may

cause the lubricants to flow from the moving parts, and conditions similar to those described above for tropical regions will result. Use lubricants suit-

able for high temperatures. Inspect and clean the equipment daily. Exercise the precautions described in paragraph 35.



LUBRICANTS		INTERVAL
<b>GL</b> -GREASE, AIRCRAFT AND INSTRUMENT (LOW AND HIGH TEMPERATURE), PER MIL-G-3278. (NOTE 2)		6 MONTHS
<b>PL</b> -LUBRICATING OIL, PRESERVATIVE, SPECIAL, PER MIL-L-644A WITH AMEND.I. (NOTE 3)		

**NOTES:**

1. USE SOLVENT, DRY CLEANING (SD) TO CLEAN PARTS. BEFORE LUBRICATING, CLEAN EXPOSED SURFACES OF PARTS WITH LINTLESS CLOTH LIGHTLY DAMPENED WITH SOLVENT (SD). DRY BEFORE LUBRICATING.
2. CLEAN SURFACES AND APPLY GREASE SPARINGLY; REMOVE EXCESS LUBRICANT.
3. CLEAN SURFACES AND APPLY 1 OR 2 DROPS OF OIL.

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*Figure 26. Lubrication of power amplifier tuning drive assembly.*

## Section IV. WEATHERPROOFING

### 47. Weatherproofing

*a. General.* Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

*b. Tropical Maintenance.* A special moisture-proofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, and TB SIG 72, Tropical Maintenance of Ground Signal Equipment. Most items of Signal Corps equipment are given this treatment at the factory. Therefore, it is necessary to repeat the treatment only when parts are replaced or repaired.

*c. Arctic Maintenance.* Special precautions necessary to prevent poor performance or total operational failure of equipment at extremely low temperatures are explained in TB SIG 66, Winter Maintenance of Signal Equipment, and in TB SIG 219, Operation of Signal Equipment at Low Temperatures.

*d. Desert Maintenance.* Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained in TB

SIG 75, Desert Maintenance of Ground Signal Equipment.

*e. Lubrication.* The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69, Lubrication of Ground Signal Equipment. Observe all precautions outlined in TB SIG 69, and pay strict attention to all lubrication orders when operating equipment under conditions of extreme cold or heat. Refer to paragraphs 44 through 46 for detailed lubrication instructions.

### 48. Rustproofing and Painting

*a.* When the finish on the case has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use No. 00 or No. 000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

**Caution:** Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

*b.* When a touchup job is necessary, apply paint with a small brush. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations. For further information on painting equipment, refer to TM 9-2851, Painting Instructions for Field Use.

## Section V. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

### 49. General

*a.* The troubleshooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is necessarily limited in scope by the tools, test equipment, and replaceable parts issued, and by the tactical situation. Accordingly, troubleshooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out fuses, broken cords, defective tubes, or cracked insulators.

*b.* The paragraphs that follow in this section

help to determine which of the circuits is at fault and in localizing the fault in the circuit to the defective stage or item, such as a tube or fuse.

### 50. Inspection

*a.* When failure is encountered and the cause is not immediately apparent, check as many of the items listed in *b* and *c* below as is practicable before starting a systematic operational check of the equipment. Do not, however, disassemble the set for a complete inspection without some knowledge of the operational symptoms. If possible, obtain

information from the operator of the equipment regarding performance at the time trouble occurred.

b. Complete failure of the radio set often may be caused by one or more of the following faults:

- (1) Improperly connected power cable.
- (2) Worn, broken, or disconnected cords or plugs.
- (3) Blown fuses or tripped circuit breaker.
- (4) Switches (or other controls) set wrong.

c. Partial failure of the radio set often may be caused by one or more of the following faults:

- (1) Faulty relay contacts, caused by overloads.
- (2) Defective resistors, caused by overheating; look for blistering or discoloration of the paint.
- (3) Partially defective tubes.

*Note.* The individual decks (rf, modulator and power supply) of the transmitter may be completely removed for servicing. *Be sure* that on deck is pulled out of the cabinet any farther than just enough to permit removal of the interconnecting plugs to prevent damage to the wiring. Both sides of each deck must be supported when removing it from the cabinet, because mechanical stops are not supplied on this equipment.

## 51. Troubleshooting by Using Equipment Performance Check List

**Caution:** Radio Transmitter T-368/URT contains extremely high voltages which are dangerous to life if contacted. The protective electrical interlock switches should not be relied upon. A red pilot lamp, labeled PLATE POWER, on the front panel of the transmitter indicates when the high-voltage power supply is turned on. Since this lamp may burn out, however, do not rely on it to show that no high voltages are present. Use the shorting stick to insure safety to both the operator and the equipment.

a. *General.* The equipment performance check list (par. 52) will help the operator to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures that the operator can take. *When using this list, follow the items in numerical sequence.*

b. *Action or Condition.* For some items, the information given in the *action or condition* column consists of various switch and control settings under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the *normal indications* column.

c. *Normal Indications.* The normal indications listed include the visible and audible signs that the operator should recognize when checking the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. *Corrective Measures.* The corrective measures are those the operator can make without turning in the equipment for repairs. References in the table to paragraphs in chapter 6 indicate that the trouble cannot be corrected during operation and that troubleshooting by an experienced repairman is necessary. If the set is completely inoperative, or if the recommended corrective measures do not yield results, troubleshooting is necessary. If the tactical situation, however, requires that the equipment be maintained and if the set is not completely inoperative, the operator must keep the set in operation as long as it is possible to do so.

## 52. Equipment Performance Check List

The equipment performance portion of the check list is broken into divisions corresponding to the starting, operational, and type of service selected.

PRELIMINARY STARTING PROCEDURE

Item No.	Item	Action or condition	Normal indications	Corrective measures
1	FILAMENT POWER circuit breaker.	Throw to OFF.		
2	PLATE POWER circuit breaker.	Throw to OFF.		
3	PLATE RELAY switch.	Throw to off (down).		
4	TUNE-OPERATE switch.	Throw to TUNE.		
5	EXCITER PLATE POWER switch.	Throw to OFF.		
6	BAND SELECTOR switch.	Turn to desired band----	Proper bar exposed on dial and pointer set at desired band.	Secure knob to shaft. Check switch.
7	TUNING CONTROL---	Turn to desired operating frequency.	Proper number in mc appears.	See paragraph 86.
8	P A BAND SWITCH---	Turn to desired band----	Pointer at desired band--	Secure knob to shaft. Check switch.
9	POWER AMPLIFIER TUNING and POWER AMPLIFIER LOADING controls.	Settings found from calibration charts for desired frequency.	Numbers rotate to proper settings.	See paragraph 86.
10	SERVICE SELECTOR switch.	Turn to CW-----	Pointer at type of service selected.	Secure knob to shaft. Check switch.
11	EXCITATION METER SWITCH. <i>When using Antenna Tuning Unit BC-939-B:</i>	Place at P A GRID X2 position.	Pointer at desired meter range.	Secure knob to shaft. Check switch.
12	Range switch-----	Set to desired range-----	Pointer at desired range--	Secure knob to shaft. Check switch.
13	FREQUENCY control---	Crank to desired setting found from calibration charts.	Numbers rotate to proper setting.	See paragraph 89.
14	COUPLING control----	Turn to desired setting found from calibration charts.	Numbers rotate to proper setting.	Secure knob to shaft. See paragraph 89.
15	FILAMENT POWER circuit breaker.	Throw to ON. Adjust FILAMENT VOLTAGE control for 5-volt reading on FIL VOLTAGE meter.	Green light on. Blowers go on. A 5v reading on FIL VOLTAGE meter.	Check power Cord CD-763 and connectors between ac source and ac power receptacle J14. Check cables to J7 (power supply deck), J6 and J2 (modulator deck), and J1 (rf deck) and the connectors. Check 6 and 3 amp fuses (F1 and F2). Check FIL VOLTAGE meter M1 and FILAMENT VOLTAGE control R18. Check blowers B1 and B2 and FILAMENT POWER circuit breaker CB1. Check FILAMENT POWER lamp I 3.
16	FILAMENT POWER circuit breaker.	Throw to OFF-----	Green light and blowers go off. Reading on FIL VOLTAGE meter drops to zero.	

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PRELIMINARY STARTING PROCEDURE	17	PLATE POWER circuit breaker and PLATE RELAY switch.	Throw to on (up) positions.		
	18	FILAMENT POWER circuit breaker.	Throw to ON-----	See item 15. Red light goes on approximately 25 seconds after circuit breaker goes on. Also P A PLATE METER shows a low reading.	See item 15. Check PLATE POWER circuit breaker CB2 and lamp I 4; THERMAL RESET PLATE RELAY overload; and relay switches. Check relays K5, K6, K7, and K8 on power supply deck under protective cover. Check P11 for firm seating in jumper plug receptacle J13. Check high-voltage rectifier tubes V18 and V19 and see that all decks are closed. Check P A PLATE meter M3. Check clamper tube V2.
PRELIMINARY OPERATING PROCEDURE	19	EXCITATION METER SWITCH.	Turn to P A GRID X2 and INT AMP PLATE X10.	No readings on EXCITATION meter.	
	20	EXCITATION METER SWITCH.	Turn to MOD PLATE X20.	Reading (approximately 50 ma) appears on EXCITATION meter.	See item 18. Check modulator tubes V9 and V10 and EXCITATION meter M2. Check bias rectifier tube V11 if reading is excessive.
	21	PLATE POWER circuit breaker and PLATE RELAY switch.	Turn to off (down) positions.	Red light goes off and P A PLATE meter reading drops to zero.	
	22	EXCITATION METER SWITCH.	Turn to P A GRID X2--		
	23	EXCITER PLATE POWER switch.	Throw to on (up)-----	8 ma minimum appears on EXCITATION meter.	Check low-voltage power supply rectifier tube V4. Check tubes V801, V802, V101 through V104 in exciter subassembly. Check cable between P101 and J8 on rf deck. See item 23.
	24	EXCITATION METER SWITCH.	Turn to INT AMP PLATE X10.	20 to 70 ma reading on EXCITATION Meter.	
EQUIPMENT PERFORMANCE		<i>CW operation</i>			
	25	SERVICE SELECTOR switch. PLATE POWER circuit breaker; EXCITER PLATE POWER, and PLATE RELAY switches.	Turn to CW. Turn to on (up) position.	Readings on P A PLATE and EXCITATION meters.	
	26	POWER AMPLIFIER TUNING control.	Adjust for resonance-----	Minimum reading on P A PLATE meter.	Check pa tube V1.

Item No.	Item	Action or condition	Normal indications	Corrective measures
	<i>CW operation—Con.</i>			
27	POWER AMPLIFIER LOADING and POWER AMPLIFIER TUNING controls.	Adjust loading control for 150 ma pa plate current. Readjust tuning control for minimum reading on meter. Keep reading 150 ma with loading control.	150 ma on P A PLATE meter.	See item 26.
28	TUNE-OPERATE switch.	Throw to OPERATE.....	Reading on P A PLATE meter increases to 350 ma (approx).	Check switch. Check OVERLOAD RESET. Adjust COUPLING control.
29	ANTENNA CURRENT.	Key held closed.....	ANTENNA CURRENT meter indication.	Adjust FREQUENCY control. Check R. F. OUTPUT receptacle J9. Check control settings, tuning, coupling, and antenna range switch.
30	EXCITER PLATE POWER switch.	Throw to OFF.....	Equipment ready for cw transmission.	Check handkey.
	<i>AM. operation</i>			
31	SERVICE SELECTOR switch.	Turn to AM.		
32	EXCITATION METER switch.	Set at P A GRID X2.		
33	EXCITER PLATE POWER switch, PLATE POWER circuit breaker, and PLATE RELAY switch.	Turn to on (up) position.	Readings on P A PLATE and EXCITATION meters.	
34	POWER AMPLIFIER TUNING control.	See item 26.		
35	POWER AMPLIFIER LOADING control.	See item 27, but adjust for 125 ma pa plate current.		
36	TUNE-OPERATE switch.	Throw to OPERATE.....	Reading on P A PLATE meter increases to 275 ma.	See items 28 and 29.
37	EXCITATION METER SWITCH.	Set to MOD PLATE X20.	50 ma on EXCITATION meter.	Check MODULATOR BIAS control R25 and modulator tubes V9 and V10.
38	MODULATOR BIAS control.	Adjust control for 50 ma modulator plate current.	See item 37.....	See item 37.
39	EXCITER PLATE POWER and PLATE RELAY switches.	Throw to off (down).....	No readings on P A PLATE and EXCITATION meters.	Check switches.
40	Carbon microphone and mike switch.	Adjust for 100% modulation (par. 24b).	230 ma (max) on EXCITATION meter.	Check mike and mike switch. Check input (J11 and P4). Test speech amplifier tubes V12, 13, 14, and 15. Inspect cable and connector of P3 and contacts of J3. Check SERVICE SELECTOR switch.



# CHAPTER 5

## THEORY

### Section I. RADIO TRANSMITTER T-368/URT

#### 53. Block Diagram (fig. 27)

Radio Transmitter T-368/URT is basically a cw and am transmitter that contains its own power supplies. The equipment requires a hand-key, a microphone, an ac source, and an antenna to provide cw and am communications in the frequency range of 1.5 to 20.0 mc. Provisions are made in the equipment to act as a power amplifier to increase the distance range of low-level externally excited units. The input signals are not restricted to the cw type rf signals. The transmitter will accept frequency-shift and also narrow-band signals. Provision also is made in the audio-frequency (af) section for the equipment to accept signals fed over a 600-ohm line from a telephone set. Another provision permits a receiver to use the same transmitting antenna through the use of an antenna changeover relay. The functions of the rf, af, and power supply stages are described briefly in the following subparagraphs and described in detail in paragraphs 54 through 72.

*a.* The master oscillator (mo) and first buffer amplifier use two type 5749 tubes, V801 and V802, in circuits which are operative for CW or AM. only. Oscillator tuning is ganged with the multiplier stages so that the entire frequency range of 1.5 to 20.0 mc can be covered in four bands by a single control. The output of V801 is fed through a capacitor to the grid of first buffer tube V802. First buffer V802 is an unturned amplifier used to isolate load effects of the succeeding stages on the mo to prevent oscillator drift. The output of V802 is fed to the grid of first multiplier tube V101 by a coaxial cable.

*b.* The multiplier subassembly contains three 6AH6 tubes in the multiplier strip and one type 6000 tube in the ipa stage. The multiplier strip consists of a second buffer-first multiplier V101, second multiplier V102, and third multiplier V103. The ipa stage V104 contains four output tank

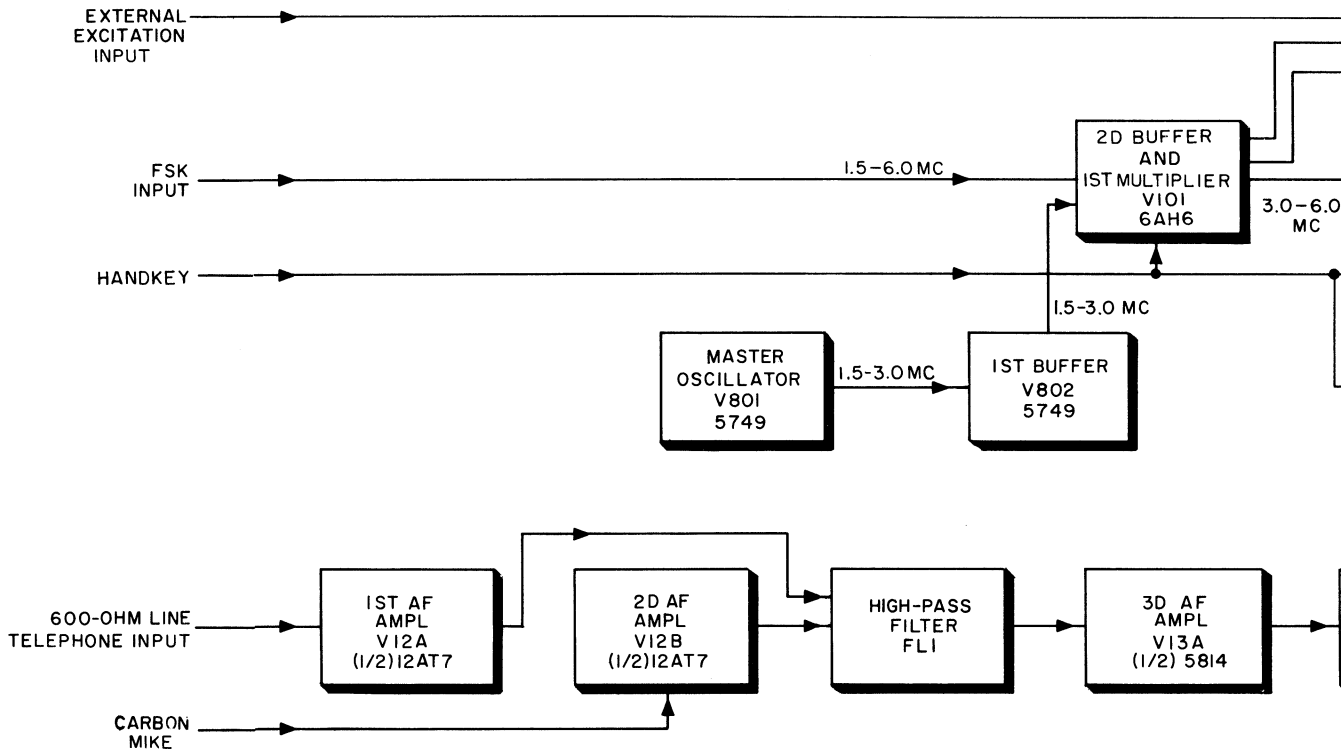
circuits that cover the entire frequency range of the transmitter. The output of V104 is fed to the grid of pa tube V1 by coaxial cable. For operation in the four bands, the following tables show the tubes that function to meet the frequency requirements.

(1) Tubes used for CW and AM. operation are as follows:

Band (mc)	Tubes used	Function
1.5-3.0-----	V801----- V802----- V101----- V104-----	Master oscillator. First buffer. Second buffer. Amplifier.
3.0-6.0-----	V801 and V802. V101----- V104-----	Master oscillator and first buffer. First multiplier. Amplifier.
6.0-12.0-----	V801 and V802. V101----- V102----- V104-----	Master oscillator and first buffer. First multiplier. Second multiplier. Amplifier.
12.0-20.0----	V801 and V802. V101----- V102----- V103----- V104-----	Master oscillator and first buffer. First multiplier. Second multiplier. Third multiplier. Amplifier.

(2) Tubes used for FSK and FSK-AM. operation are as follows:

Fsk exciter output frequency between 1.5 and 3.0 mc		
Band (mc)	Tubes used	Function
1.5-3.0-----	V101----- V104-----	Buffer. Amplifier.
3.0-6.0-----	V101----- V104-----	First multiplier. Amplifier.
6.0-12.0-----	V101----- V102----- V104-----	First multiplier. Second multiplier. Amplifier.



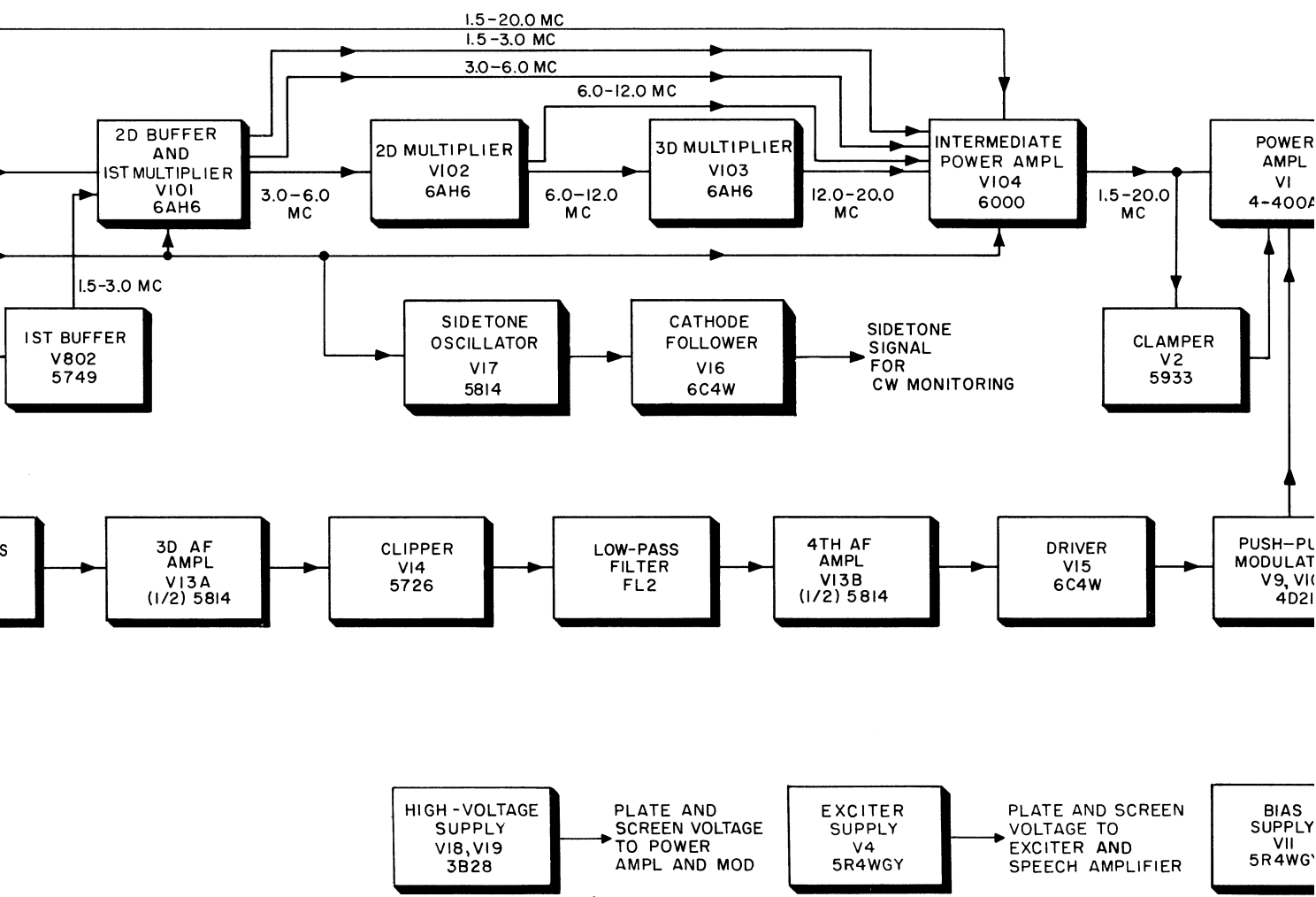
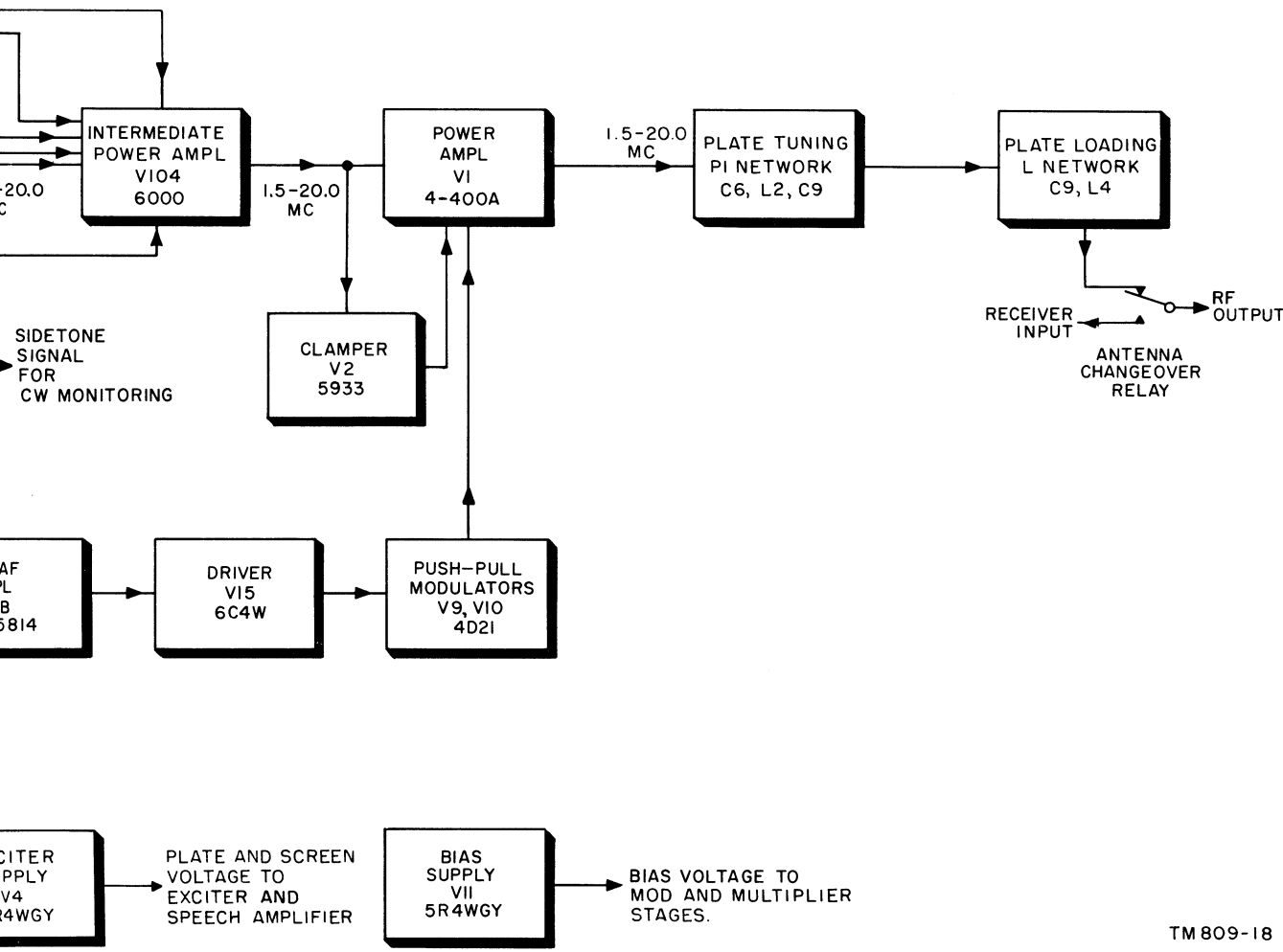


Figure 27. Radio Transmitter T-368/URT, block diagram.



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Fsk exciter output frequency between 3.0 and 6.0 mc

Band (mc)	Tubes used	Function
3.0-6.0	V101	Amplifier.
	V104	Amplifier.
6.0-12.0	V101	Amplifier.
	V102	Multiplier.
	V104	Amplifier.
12.0-20.0	V101	Amplifier.
	V102	Multiplier.
	V103	Multiplier.
	V104	Amplifier.

(3) Tubes used for EXT EXC operation are as follows:

Band (mc)	Tube used	Function
1.5-3.0	V104 for all bands.	Amplifier for all bands.
3.0-6.0		
6.0-12.0		
12.0-20.0		

c. The pa stage uses type 4-400A tube V1 in a circuit that is tuned separately from the ganged tuning exciter circuits. A clamping circuit, that uses type 5933 tube V2, protects the pa tube from drawing excessive current if excitation, which develops pa bias, is lost. The output of V1 is applied to the antenna through tuned pi-network and loading coil circuits. Individual tuning controls, POWER AMPLIFIER TUNING and LOADING, adjusts the pa stage for proper operation. An antenna changeover relay is used so that a receiver may use the transmitting antenna during inoperative periods of the transmitter.

d. For AM. or FSK-AM. operation, the power amplifier is plate-modulated by push-pull type 4D21 modulator tubes V9 and V10. The modulators are driven by a four-stage speech amplifier, which receives an input from either a carbon microphone or a 600-ohm telephone line. The first section of the speech amplifier consists of first and second af amplifiers V12A and V12B (12AT7 tube) which are preamplifiers for the 600-ohm line and the carbon microphone inputs, respectively. The next section contains high-pass filter FL1 and third amplifier V13A ( $\frac{1}{2}$  5814 tube). A speech clipper stage is added to maintain a relatively constant af output level for fluctuating voice input levels. A low-pass filter follows the clipper and serves as input to fourth af amplifier V13B ( $\frac{1}{2}$  5814 tube). The final stage is af driver V15 (type

6C4W tube) which provides the proper af level to drive the modulator tubes. The speech amplifier also contains a sidetone oscillator V17 (type 5814 tube) and a cathode follower V16 (type 6C4W tube) to furnish a means for monitoring the keying by the operator during CW operation.

e. The equipment furnishes all the direct-current (dc) voltages required for the five types of operation from two low-voltage supplies and one high-voltage supply when 115 volts are available. One low-voltage supply is the exciter supply and other is the bias supply; both use type 5R4WGY tubes V4 and V11, respectively. The high-voltage supply uses two type 3B28 tubes V18 and V19, respectively. Refer to figure 27 for the stages to which the power supplies furnish power.

#### 54. Master Oscillator and First Buffer Stages (fig. 28)

a. Master oscillator V801 is an electron-coupled Hartley oscillator tunable from 1.5 to 3.0 mc. Oscillations are produced by coupling rf on the screen grid back to the cathode through bypass capacitor C806 and the tickler portion of coil L801. The voltage feedback to the control grid through capacitor C805 is of sufficient amplitude to overcome the circuit losses and sustain oscillations. During oscillation, the control grid draws current to charge C806 and consequently grid leak bias is developed across grid resistor R801. The mo is tuned by the tank circuit that comprises capacitors C801 through C804 and slug-tuned inductors L801 and L803. The slug in L801 is gear-driven from the panel-mounted tuning control which also drives the tuning slugs in the multiplier strip. Resistor R802 is the screen grid dropping resistor. The signal from the oscillator is coupled to the plate of V801 by the electron stream. The amplified output signal across plate load resistor R803 is coupled through capacitor C807 to the grid of the first buffer V802.

b. First buffer V802 is an untuned resistance-capacitance (rc) coupled amplifier. Resistor R804 is the grid load resistor, R805 is the screen dropping resistor, and C808 is the screen rf bypass capacitor. The output developed across plate load resistor R806 is coupled through capacitor C809 and fed to the multiplier strip through a coaxial cable.

c. The plate and screen of both V801 and V802 are supplied +150 volts regulated through the AM. or CW position of SERVICE SELECTOR

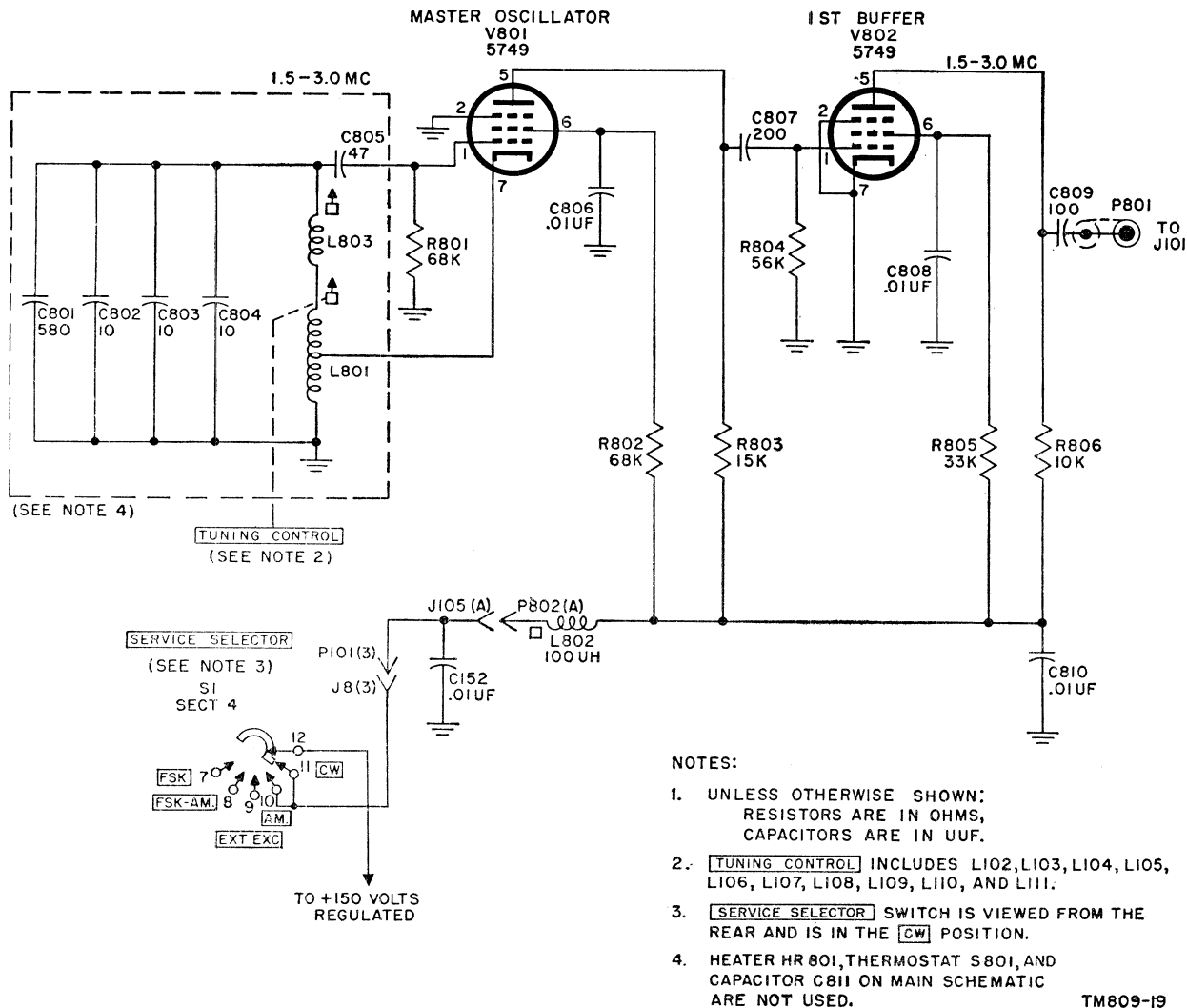


Figure 28. Master oscillator and first buffer, functional diagram.

switch S1. When S1 is set for FSK, FSK-AM, or EXT EXC operation, the power is removed and both the master oscillator and first buffer stages are inoperative. Capacitors C810 and C152 and choke L802 form a decoupling network to prevent rf from entering the supply. Heater HR801, thermostat S801, and capacitor C11 (fig. 91) are supplied as part of the oscillator subassembly, but are not used in this transmitter.

## 55. Second Buffer and First Multiplier Stage (fig. 29)

Second buffer and first multiplier tube V101 receives an rf input from either first buffer tube V802 or from an external fsk exciter. The stage functions as a straight-through buffer amplifier, or as a frequency doubler, depending on the band used.

a. The output of first buffer V802 is received at receptacle J101 through coupling capacitor C809, coaxial cable, and connector P801. This output is impressed across a shunt circuit which consists of high impedance rf choke L101 and resistor R101 in series which, in turn, are effectively paralleled for rf by resistor R103 because capacitor C102 places the lower end of R103 at rf ground potential. The output of the fsk exciter, used for FSK or FSK-AM operation, is brought to V101 from FSK jack J16 by coaxial cable. The cable is terminated by a 56-ohm impedance (R101) through connector P10 and receptacle J102. For input frequencies between 1.5 and 3.0 mc, V101 acts as a buffer amplifier stage, and when the BAND SELECTOR switch is turned to the 3.0-6.0 mc range, V101 acts as a multiplier stage. When the input is in the range of 3.0 to 6.0 mc

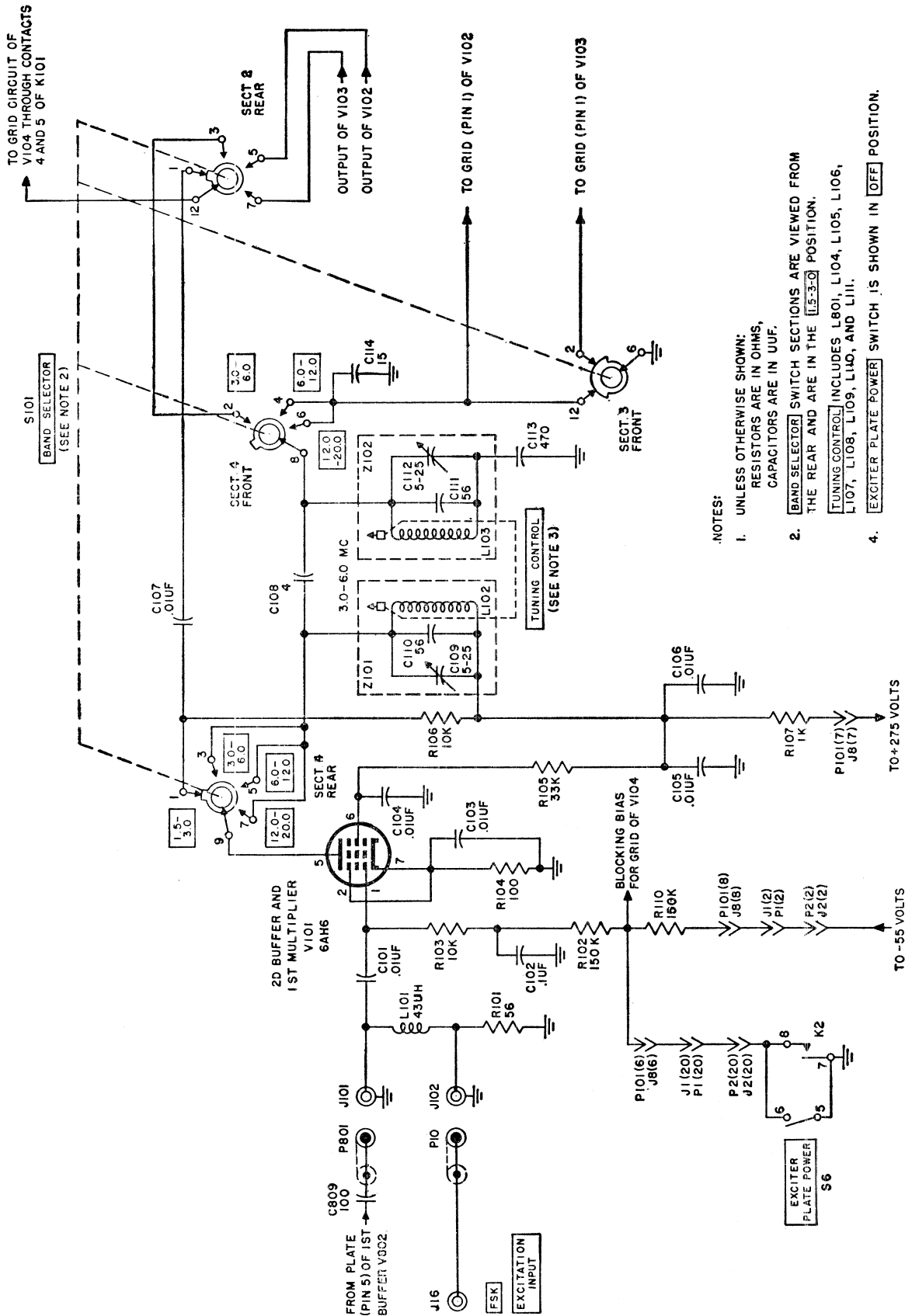


Figure 29. Second buffer and first multiplier, functional diagram.

(fsk exciter source only), V101 acts as a straight-through amplifier, and the BAND SELECTOR switch is set at 3.0–6.0 mc position.

*b.* In CW or AM. operation, V101 is blocked-grid keyed. Blocking bias is applied to the control grid of V101 through resistors R110, R102, and R103. Resistor R102 and capacitor C102 decouple the rf input from the bias supply. Blocking bias is removed from V101 during operation by either the closing of EXCITER PLATE POWER switch of energizing push-to-talk and cw relay K2.

*c.* Rf excitation is applied to the control grid of V101 through capacitor C101. Cathode resistor R104, shunted by capacitor C103, provides normal operating bias when the removal of the blocking bias permits the tube to conduct. The screen grid, bypassed for rf by capacitor C104, is supplied with operating potential through dropping resistor R105. Capacitors C105 and C106, with resistor R107, decouple the screen and plate circuits to prevent rf from entering the 275-volt power source.

*d.* The amplified output of V101 is developed across load resistor R106 or tank circuit Z101, depending on the position of BAND SELECTOR switch S101, section 4 rear. In the 1.5–3.0 position of the BAND SELECTOR switch, the amplified fundamental frequency of the master oscillator or fsk exciter appears across R106 and is coupled through capacitor C107 and section 2 rear of S101 directly to the grid circuit of ipa V104. Operation in the other bands, however, requires one or more stages of frequency multiplication. In the 3.0–6.0, 6.0–12.0, and 12.0–20.0 positions of S101, section 4 rear inserts tank circuit Z101 in place of R106 as the V101 plate load. Tank circuit Z101 is tuned to the second harmonic of the original excitation frequency by variable inductor L102 which is connected to the tuning mechanism, fixed capacitor C110, and trimmer C109. The 2.0- to 6.0-mc oscillations developed across Z101 are coupled through capacitor C108 to tank circuit Z102. Tank circuit Z102 is tuned from 3.0 to 6.0 mc by variable inductor L103 which is connected to the tuning mechanism, fixed capacitor C111, trimmer C112, and the input capacitance of the stage to which Z102 is connected. In the 3.0–6.0 position of the BAND SELECTOR, Z102 tunes the grid circuit of ipa V104 through section 4 front (contact 2) and section 2 rear (contact 3). In the 6.0–12.0 or 12.0–20.0 position of the BAND SELECTOR, Z102 tunes the grid circuit of second multiplier V102 through section 4 front (contact 4 or 6), further frequency multiplication being required

for operation in either of these bands. Capacitor C113 provides a ground return for the rf excitation coupled into Z102.

*e.* Section 3 front of S101 grounds the control grids of both second multiplier V102 and third multiplier V103 when the BAND SELECTOR is in either the 1.5–3.0 or 3.0–6.0 position. This ground prevents these stages from being excited through stray wiring capacities, which would otherwise result in spurious oscillations in the output of the multiplier strip. In the 6.0–12.0 position of the BAND SELECTOR, the ground connection is removed from the grid of second multiplier V102 to permit the additional required multiplication, but is maintained at the grid of V103. The grid of V103 is ungrounded only when the BAND SELECTOR is in the 12.0–20.0 position.

## 56. Second Multiplier Stage

(fig. 30)

*a.* Second multiplier tube V102 doubles the frequency of the signal generated in tank circuit Z102, when section 4 front of the BAND SELECTOR switch is in either the 6.0–12.0 or 12.0–20.0 position. Operation in either of these bands therefore requires that Z102 tune with the input capacitance of V102, a type 6AH6 tube. In the 3.0–6.0 position of the BAND SELECTOR, however, Z102 tunes with the input capacitance of ipa V104. The input capacitance of V104, a type 6000 tube, is greater than the input capacitance of V102, therefore capacitor C114 is added to the grid circuit of V102 to equalize the shunting effect across Z102 and to permit proper tracking on the high bands. With the BAND SELECTOR in either the 6.0–12.0 or 12.0–20.0 position, the control grid of V102 is ungrounded by section 3 front. Resistor R108 provides a dc return as well as developing grid leak bias. The plate load consists of tank circuit Z103, which is tuned by variable inductor L104 connected to the tuning mechanism, fixed capacitor C119, and trimmer C118, to the second harmonic of the 3.0- to 6.0-mc input frequency. The 6.0- to 12.0-mc oscillations developed in Z103 are capacity-coupled by C121 to tank circuit Z104. Tank circuit Z104, comprising variable inductor L105 which is connected to the tuning mechanism, fixed capacitor C122, and trimmer C123, tunes the grid circuit of either ipa V104 or third multiplier V103, depending on the setting of the BAND SELECTOR switch. In the 6.0–12.0 position

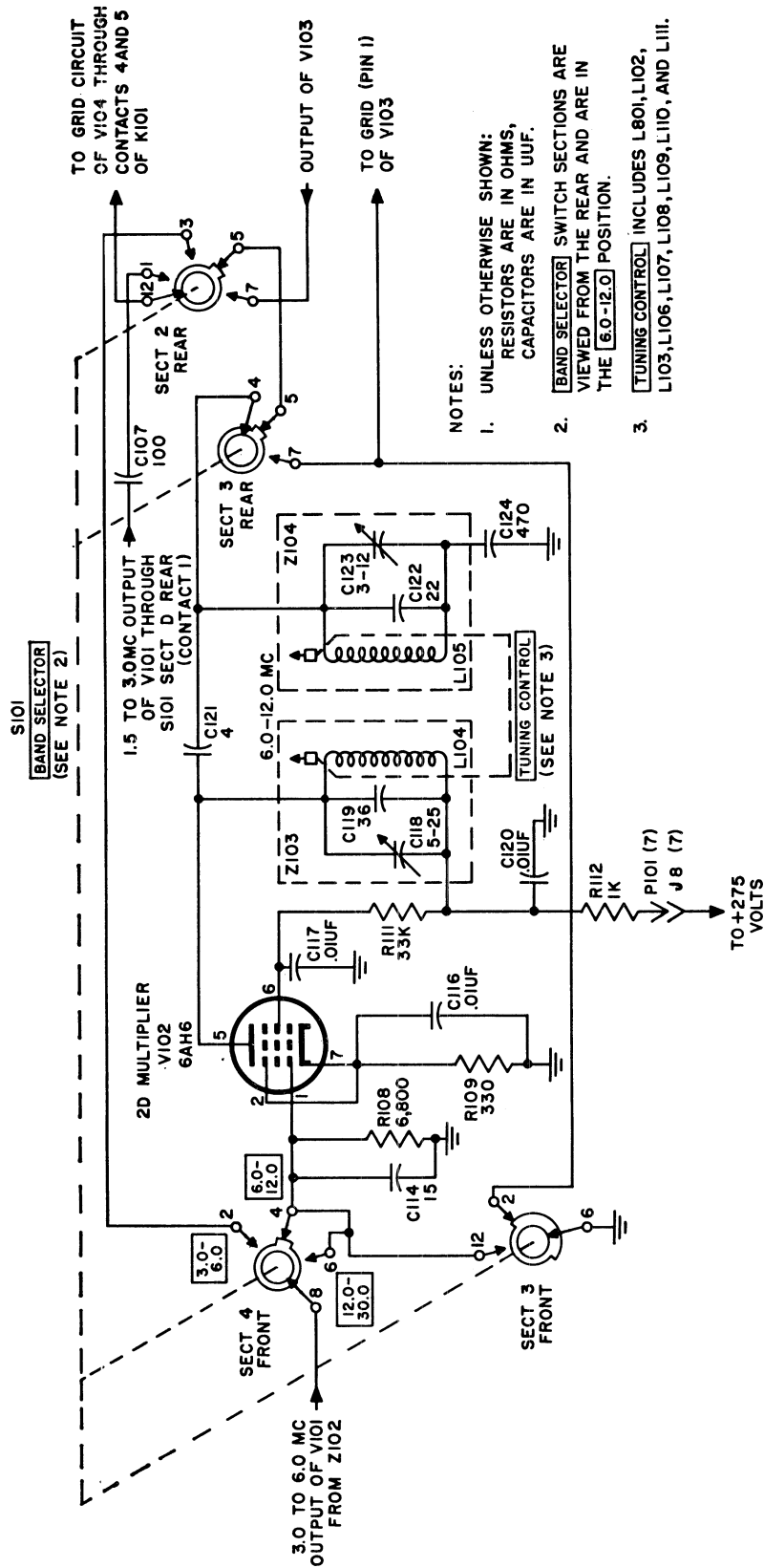


Figure 30. Second multiplier, functional diagram.

of the BAND SELECTOR, Z104 is connected to the grid circuit of V104 through sections 3 and rear. In the 12.0–20.0 position, Z104 is connected to the grid circuit of V103 through section 3 rear (contact 7). Capacitor C124 provides an rf ground return for the signal developed in Z104.

*b.* Other V102 circuit elements include cathode bias resistor R109 and bypass capacitor C116, screen rf bypass capacitor C117 and dropping resistor R111, and decoupling network R112 and C120.

### 57. Third Multiplier Stage

(fig. 31)

*a.* Third multiplier tube V103 receives the 6.0- to 12.0-mc output of second multiplier V102 and doubles it for operation in the 12.0- to 20.0-mc band. Tank circuit Z104 is coupled to the grid of V103 through the 12.0–20.0 position of BAND SELECTOR switch section 3 rear; the corresponding position of section 3 front ungrounds this grid to make the stage operable. Capacitor C125 equalizes the input capacitance of V103 with the input capacitance of ipa V104, to which Z104 is connected when section 3 rear is in the 6.0–12.0 position. The input signal that appears across grid resistor R113 is doubled in frequency by tuning plate tank circuit Z105 to the second harmonic of the input. Tank circuit Z105 is tuned by variable inductor L106 which is connected to the tuning mechanism and trimmer C128. The 12.0- to 20.0-mc signal developed across Z105 is coupled through capacitor C130 to tank circuit Z106, which tunes the grid circuit of ipa V104 through the 12.0–20.0 position of section 2 rear. Tank circuit Z106 is tuned by variable inductor L107 which is connected to the tuning mechanism and trimmer C131. Capacitor C132 is an rf ground return.

*b.* Circuit elements of the third multiplier include cathode bias resistor R114 and bypass capacitor C126, screen bypass capacitor C127 and screen dropping resistor R115, and plate and screen decoupling network C129 and R116.

### 58. Intermediate Power Amplifier Stage

(fig. 32)

Intermediate power amplifier V104 increases the power level of the rf excitation to the level required for driving the power amplifier.

*a.* For FSK, FSK-AM., AM., or CW operation, the output of the multiplier is tapped from

the selected position of BAND SELECTOR switch section 2 rear and is applied to the grid of V104 through normally closed contacts 4 and 5 of K101 and parasitic suppressor R117. The cathode of V104 is returned directly to ground through contacts 2 and 1 of K101. Blocking bias is applied to the grid of V104 through resistors R119 and R118, with R119 and capacitor C133 forming an rf decoupling network. When the blocking bias is removed from V104, the input excitation causes grid current flow which develops operating grid leak bias across R118 and R119. The grid leak bias, and therefore the input excitation are required to prevent excessive plate current flow which might otherwise damage the tube. The plate load of V104 consists of one of four tank circuits, as selected by section 1 rear of the BAND SELECTOR switch. In the 1.5–3.0 position of the BAND SELECTOR, the tank circuit used is Z107 (comprising variable inductor L108, fixed capacitor C137, and trimmer C136); in the 3.0–6.0 position, Z108 (comprising variable inductor L109 and trimmer C138); in the 6.0–12.0 position, Z109 (comprising variable inductor L110 and trimmer C104); and in the 12.0–20.0 position, Z110 (comprising variable inductor L111 and trimmer C141). All variable inductors are connected to the tuning mechanism. To prevent spurious oscillations, the three unused tank circuits are shorted by section 2 front of the BAND SELECTOR. The signal developed across the selected tank circuit is coupled through capacitor C142 to receptacle J103, from which it is fed over coaxial cable to the power amplifier grid circuit. The plate circuit of V104 is decoupled by capacitor C139, which is grounded through contacts 2 and 1 of K101. The intermediate amplifier plate current may be read on meter M2 when EXCITATION METER SWITCH S3 is in the INT AMP X10 position. Resistor R7 is the meter shunt. The screen grid is bypassed by C134 and supplied through dropping resistor R120.

*b.* When SERVICE SELECTOR switch S1 is placed in the EXT EXC position, 26.5 volts ac (also used for the filaments of V104) is supplied to energize external excitation relay K101. Relay K101 then removes the multiplier output signal from the grid of V104 and supplies this grid with an input signal from EXT EXC jack J15. Jack J15, on the front panel of the rf deck, is connected to K101 by coaxial cable, connector P9, receptacle J104, and coupling capacitor C154. With K101





energized, the direct ground connection is removed from the cathode of V104. The cathode is then returned to ground through bias resistor R121, bypassed by capacitors C135 and C155. The bias developed across R121 prevents excessive plate current flow in V104 when the blocking bias is removed or no excitation is present. When K101 is energized, decoupling capacitor C139 is tied back to the cathode of V104 rather than to ground. With these exceptions, the circuit elements of V104 function for EXT EXC operation exactly as described in *a* above.

## 59. Power Amplifier and Clamper Stages

(fig. 33)

*a.* Power amplifier tube V1 (type 4-400A) receives the rf output of ipa V104 at connector P8, and is operated as a class C amplifier. Operating bias is developed when the grid excitation voltage causes grid current flow through rf choke L9 and resistors R1, R2, and R8. Clamper V2 (type 5933) prevents excessive plate current flow through the pa when its grid is not excited. As long as grid excitation is present, the clamper is cut off by the bias developed across R1, R2, and R8. When excitation is lost and there is no clamper bias, the clamper conducts heavily through its plate load resistor, R4, which is connected to the high-voltage supply in the power supply deck through spring contacts E3 and E4. Since R4 is also the screen dropping resistor for the power amplifier, loss of excitation drops the power-amplifier screen voltage, thereby reducing the power amplifier plate current to a safe value. Capacitor C2 maintains the clamper grid at rf ground potential and also filters rf out of the pa grid excitation meter circuit. The dc level of this excitation can be read on meter M2 when EXCITATION METER SWITCH S3 is in the P A GRID X2 position. Resistor R8 is the meter shunt. FIL VOLTAGE meter M1 reads the power amplified filament voltage, which is supplied from a secondary of filament transformer T1. Capacitors C3 and C4 place the filament at rf ground potential. Capacitor C5 places the pa screen grid at zero rf potential.

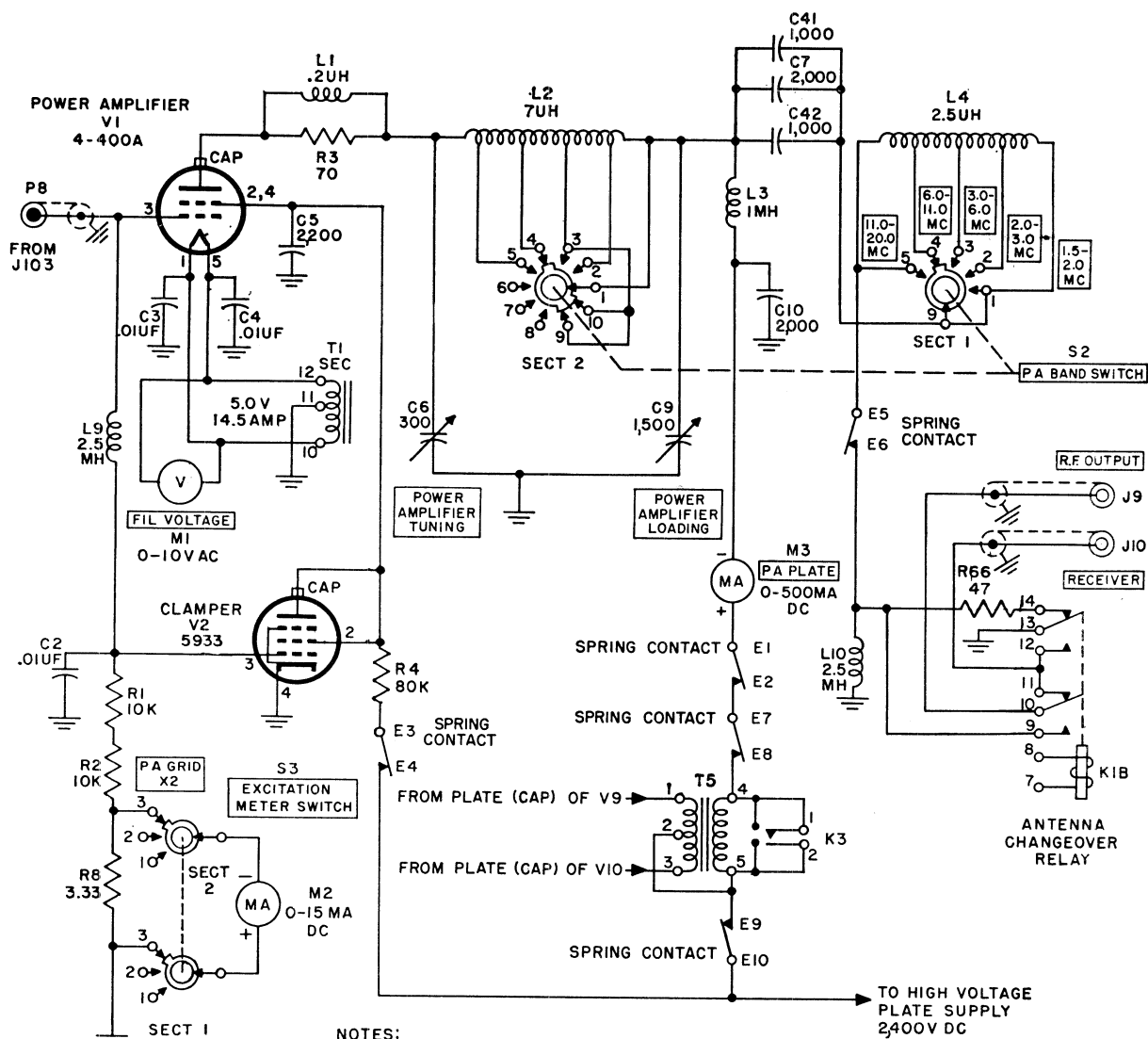
*b.* The output of V1 is applied to the antenna through a parasitic trap (L1 and R3), a tuned pi-network, a tuned L-type coil and capacitor network, and an antenna changeover relay. The pi-network is used because of its effectiveness in attenuating undesired harmonics. Along with an L-network, the pi-network is also effective

in matching the high output impedance of the power amplifier to a wide range of lower antenna load impedances. The pi-network includes POWER AMPLIFIER TUNING variable vacuum-type capacitor C6, inductor L2 (tapped by P A BAND SWITCH S2, section 2), and POWER AMPLIFIER LOADING variable vacuum-type capacitor C9. The POWER AMPLIFIER LOADING tuning capacitor also functions as the input impedance arm of the L-network. The other arm of the L-network contains whatever portion of inductor L4 that is tapped by P A BAND SWITCH S2, section I. The two networks are coupled by parallel capacitors C7, C41, and C42. When S2 is set for the desired band, C6 is used to tune the pi-network to resonance. Capacitor C9 is used to vary the loading so that the pa tube will work into its recommended impedance of 3,000 ohms. The low impedance from the antenna is reflected through the used portion of L4 and effectively increased to match the pa tube load impedance. When the pi-network is properly adjusted, the output impedance of V1 will differ radically from the optimum value of 3,000 ohms for all harmonics of the frequency used; this adjustment helps decrease harmonic radiation to a negligible value. P A BAND SWITCH S2 also operates microswitch S4 in the primary circuit of the high-voltage supply. Microswitch S4 is opened momentarily during band switching to prevent excessive plate current flow through the power amplifier while the stage is improperly loaded as well as to prevent arcing of the contacts of switch S2. The rf output from the L-network is fed through spring contacts E5 and E6 to RF OUTPUT jack J9 through antenna changeover relay K1B and until K1B is energized, the rf output line is grounded through R66 and the relay contacts. Relay R66 is made 47 ohms to approximate the load impedance (50 to 52 ohms) the antenna presents to the pa plate circuit. Under key-up conditions, the antenna is disconnected, but R66 is connected into the circuit to lead the pa circuit in the same manner. The rf energy in the tank circuits will be dissipated across the resistance of R66 to prevent damped waves from distorting the trailing edge of the keyed pulse. (Changing the load in this manner does not damage the power amplifier tube, because in the key-up condition no excitation is present and clamper V2 operates to minimize the power amplifier plate current.) Grounding the rf output line during key-up periods permits the trans-

mitter antenna to be used as a receiving antenna for a suitable receiver connected to RECEIVER jack J10. Rf choke L10 (connected to terminal 14 of K1B) prevents high dc voltage from being applied to the antenna should any one of dc blocking capacitors C7, C41, or C42 become shorted. (The choke presents high reactance to rf voltages and therefore has no effect on the transmitter rf output.) Were this to happen, the

heavy current being drawn from the high-voltage supply would operate the overload relay removing the high voltage.

c. The power amplifier plate is shunt fed through 1 millihenry rf choke L3 in series with P A PLATE meter M3 and the secondary of modulation transformer T5. The high-voltage line is connected from the power supply deck through the modulator deck to the rf deck by



- NOTES:
- UNLESS OTHERWISE SHOWN; RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF, INDUCTORS ARE IN MH.
  - PA BAND SWITCH IS SHOWN IN THE 6.0-11.0MC POSITION.

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Figure 33. Power amplifier and clamper, functional diagram.

spring contacts E1, E2, E3, E4, E7, E8, E9, and E10. Capacitor C10 filters rf out of the meter circuit and power supply.

## 60. First, Second, and Third Af Amplifier Stages

(fig. 34)

a. First af amplifier V12A and second af amplifier V12B are preamplifiers for a remote 600-ohm line input and a carbon microphone input, respectively. The telephone input is impressed across 600 OHM LINE GAIN potentiometer R17. The center arm is connected to the grid of V12A through shielded cable, connector P5, and receptacle J5. To reduce hum pickup, the cable shield is grounded at the speech amplifier end only. The carbon microphone is supplied with dc operating potential from the bias supply. This potential varies at an af rate as the voice input varies the resistance of the carbon granules. The af signal is re-coupled through dc blocking capacitor C20 and impressed across CARBON MIKE GAIN

potentiometer R16. The arm of R16 is connected to the grid of V12B through shielded cable, P4, and J4.

b. Preamplifiers V12A and V12B are similar in design, differing only in the values of their cathode bias resistors. Preamplifier V12A is biased by cathode resistor R26 (200 ohms), while V12B is biased by cathode resistor R28 (1,000 ohms). This makes the gain of V12A greater than the gain of V12B. The two stages are designed in this manner to equalize the 600-ohm line and carbon microphone signals fed to third af amplifier tube V13A, because of a difference in their input levels. The V12A and V12B tube circuits are otherwise identical. Resistors R27 and R29 are plate load resistors. The decoupling networks are formed by R41 and C27 (for the plate of V12A) and by R42 and C28 (for the plate of V12B). Capacitor C22A or C22B couples the output of V12A or V12B to the grid of V13A through high-pass filter FL1. Filter FL1 determines the low-frequency response of the speech amplifier.

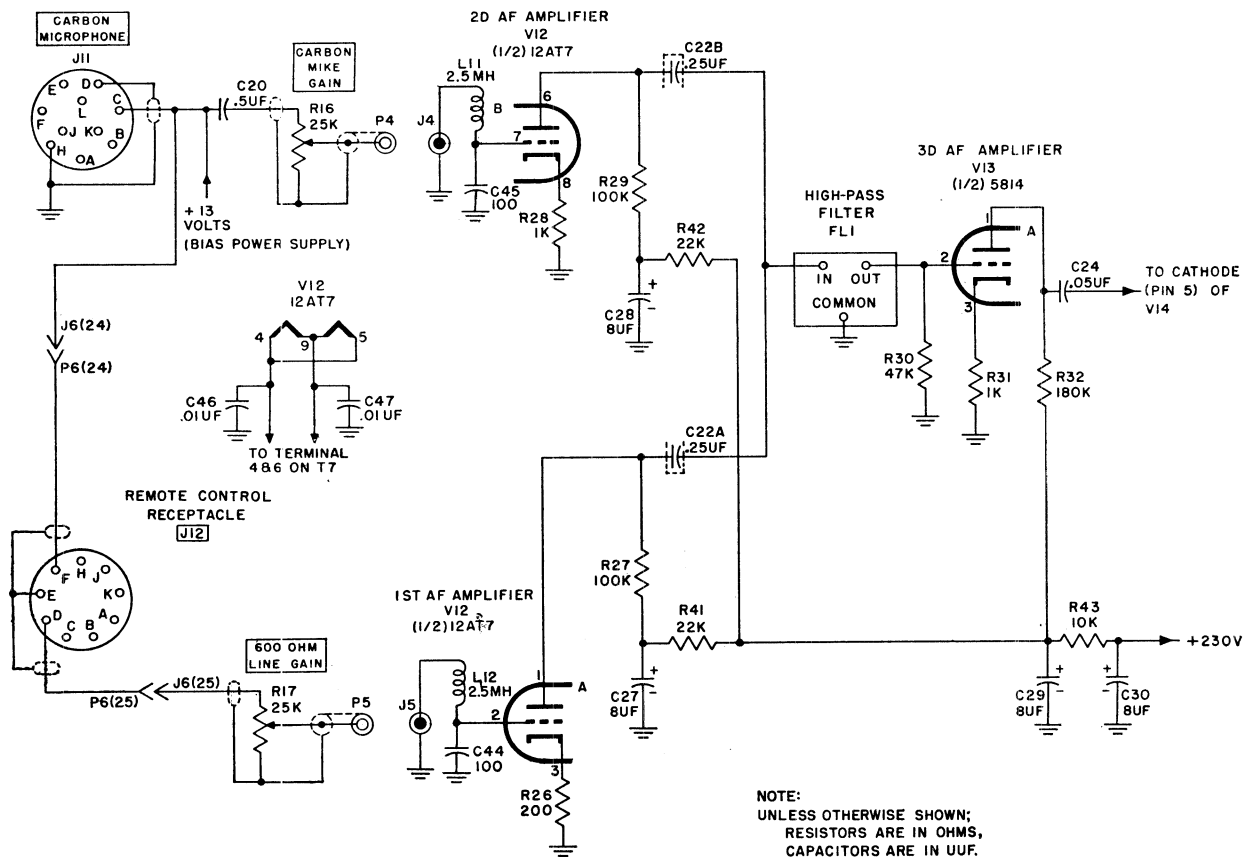


Figure 34. First, second, and third af amplifiers, functional diagram.

TM 809-28

c. The signal that appears across grid load resistor R30 is amplified by third af amplifier tube V13A and fed to a speech clipper stage through C24. Resistor R31 is the cathode bias resistor, R32 is the plate load resistor, resistor R43, with capacitors C29 and C30, form the decoupling network.

## 61. Clipper Stage

(fig. 35)

a. Clipper tube V14 clips high-amplitude voice input signals to insure a relatively constant speech-amplifier output level and prevent overmodulation. The clipping action is controlled by potentiometer R44, which, with resistor R45, forms a voltage divider across +250-volt supply. The output of third af amplifier V13A is coupled through capacitor C24 and appears across cathode resistor R33. If no clipping is desired, R44 is set (extreme counterclockwise) so that the potential at its arm is maximum (theoretical value, approximately 140 volts). The no-signal current (dc) flow through the two halves of V14, their cathode resistors R33 and R35, and common plate resistor R34 then establishes a potential of approximately +7 volts both at the clipper cathodes (pins 5 and 1) and the clipper plates (pins 2 and 7). This potential can be calculated by regarding the diode circuit as a series resistance of 90 kilohms (R33 and R35 in parallel), the resistance of each conducting diode section being negligible.

b. Under the above conditions, a positive half cycle of the input signal, which appears across

R33, will tend to cut off the first half of V14. The voltage at the plate (pin 2), however, will increase because of less drop across R34; this will keep current flowing through R33 and R35 in parallel until actual cutoff is reached. When the first half of V14 is cut off, it becomes an open circuit, and the voltage at the plates and cathodes of the clipper is determined by the drop across R35 and the second half of V14 alone. The maximum value that this voltage can attain is approximately +13 volts (180 kilohms in series with R34 across +140 volts). Thus, a positive half cycle of the input which is +6 volts or less at its peak will be faithfully reproduced across resistor R35. (A signal peak greater than this would be clipped, but signals greater than 6 volts, peak, are not normally received from third af amplifier V13A.) On negative half cycles of the input signal, the saturation characteristics of the diode limits the maximum current flow through the first half of V14. The saturation current is such that the plate (pin 2) voltage and therefore the cathode (pin 1) voltage cannot fall below approximately +1 volt, regardless of the negative input signal amplitude. This permits a negative input peak of -6 volts (greater than normal) before clipping starts.

c. Clipping is produced by setting potentiometer R44 for a smaller voltage at its arm. If the supply is set at +70 volts, for example, the static dc potential at the plates and cathodes of V14 will be approximately +3 volts. The maximum voltage at the plates and cathodes, reached when a positive input cuts the first half of the clipper off,

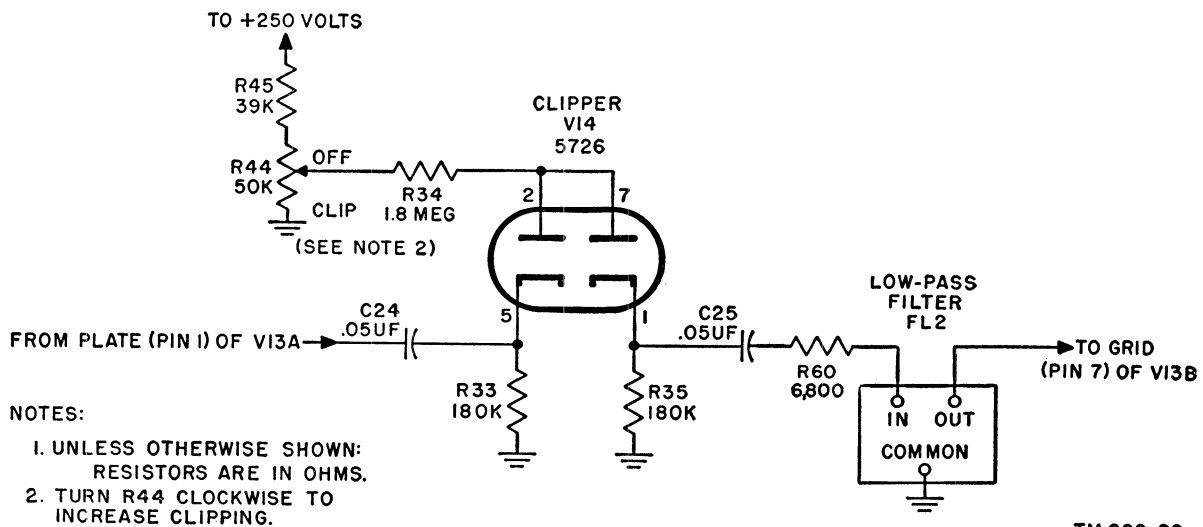


Figure 35. Clipper, functional diagram.

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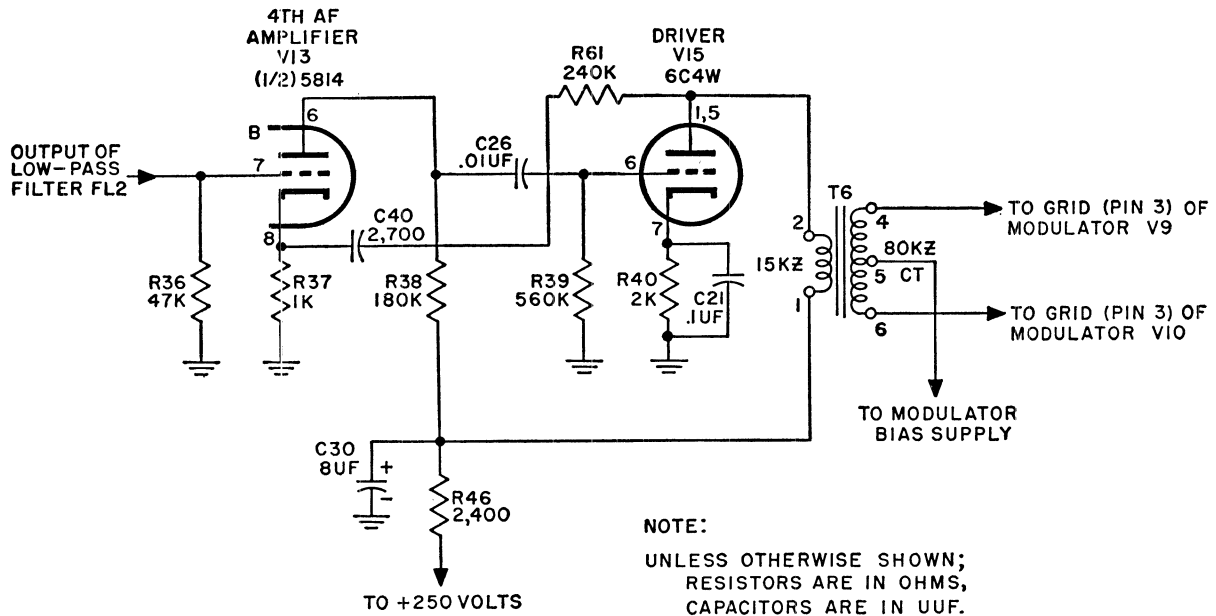


Figure 36. Fourth af amplifier and af driver, functional diagram.

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will be approximately +6.5 volts. Thus, only positive half cycles +3.5 volts or less at their peaks will be faithfully reproduced across R35. Saturation of the first half of V14 on negative half cycle inputs clips all negative peaks above -3.5 volts. Clipping is increased by adjusting R44 for a still smaller supply voltage.

d. Clipping introduces some distortion, particularly of the higher af frequencies. The effects of this distortion are greatly reduced by low-pass filter FL2, which is inserted between the clipper output and fourth af amplifier V13B to determine the high-frequency response of the speech amplifier. Capacitor C25 is a coupling capacitor. Resistor R60 is a termination resistor for filter FL2.

## 62. Fourth Af Amplifier and Af Driver Stages (fig. 36)

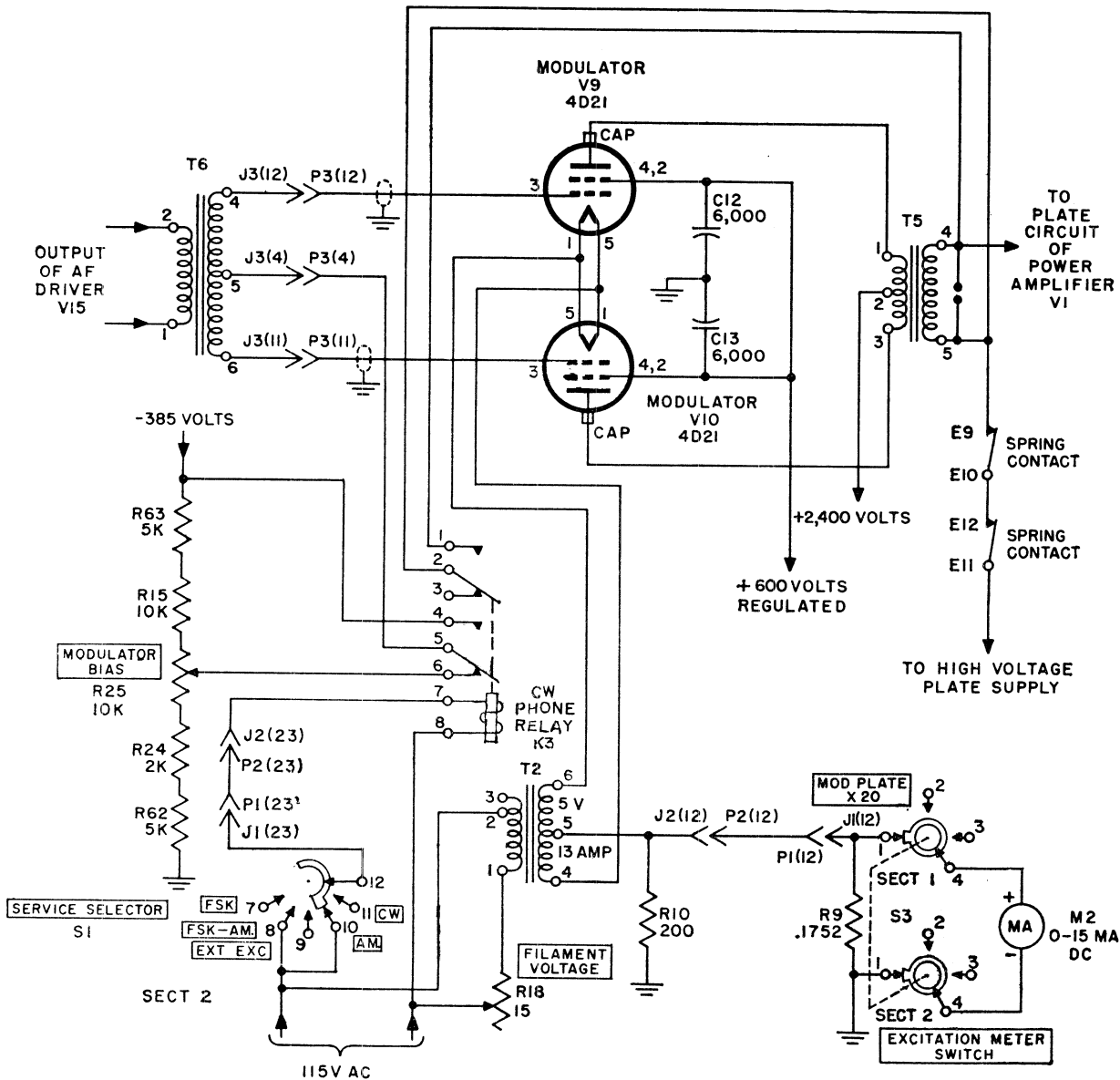
a. Fourth af amplifier tube V13B provides sufficient voltage amplification of the signal received from the clipper stage to drive the speech amplifier output driver tube V15. The circuit is an re-coupled amplifier. Resistors R36, R37, and R38 are the grid lead, cathode bias, and plate load resistors, respectively. Resistor R46 and capacitor C30 form a decoupling network. Plate voltage variations are coupled to the grid of af drive V15 through capacitor C26.

b. The signal that appears across grid load resistor R39 is amplified by V15 and developed

across the primary of speech amplifier output transformer T6. The plate of V15 is coupled back to the cathode of V13B through resistor R61 and capacitor C40 to provide degenerative feedback to improve the linearity of the output. The secondary of T6 is center-tapped to provide a push-pull input for modulators V9 and V10 and is returned to the modulator bias supply. Resistor R40 is the af driver cathode bias resistor, and C21 is its bypass.

## 63. Modulator Stage (fig. 37)

a. Push-pull modulator tubes V9 and V10 plate-modulate the power amplifier when the transmitter is used in either FSK-AM, or AM, operation. The stage is made operable by energizing cw and microphone relay K3 when in the above services. With K3 de-energized, both modulator tubes are biased beyond cutoff by a large negative voltage obtained from a voltage divider across the bias supply. The cutoff bias is applied to the control grids of V9 and V10 through K3 and the center-tapped secondary of speech amplifier output transformer T6. An additional disabling function is K3, which short circuits the secondary of modulation transformer T5. When K3 is energized, bias for the modulators is obtained from the arm of MODULATOR BIAS potentiometer R25 and is reduced to oper-



NOTES:

1. UNLESS OTHERWISE SHOWN; RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2. **SERVICE SELECTOR** SWITCH IS VIEWED FROM THE REAR AND IS IN THE **AM** POSITION.
3. **EXCITATION METER SWITCH** IS VIEWED FROM THE REAR AND IS IN THE **MOD PLATE X20** POSITION.

TM 809-27

Figure 37. Modulator stage, functional diagram.

ating value, while the short circuit is removed from the secondary of T5.

b. The input signal received from the af driver stage in the speech amplifier is increased in power by V9 and V10. The push-pull outputs of V9

and V10 are developed across the center-tapped primary of T5, the secondary of which is part of the power amplifier plate circuit. The transformer secondary is protected against excessive voltages by a spark gap provided across terminals

4 and 5. The modulator screen grids, rf bypassed by capacitors C12 and C13, are regulated at +600 volts. The modulator filaments are supplied by modulator filament transformer T2. The secondary of T2 is center-tapped to provide a plate current return through meter shunt resistor R9. The plate current may be read on meter M2 when EXCITATION METER SWITCH S3 is in the MOD PLATE X20 position. Resistor R10 provides the plate current return if the connectors to the meter circuit are opened.

## 64. Sidetone Oscillator and Cathode Follower Stages

(fig. 38)

a. The speech amplifier chassis contains a sidetone oscillator tube (V17) which allows the operator to monitor his own cw keying. The oscillator is in operation only in the CW position because in all other positions the cathodes of V17 are left floating. During CW operation, V17 is keyed (simultaneously with the transmitter) by energizing push-to-talk and key relay K2. Sidetone oscillator V17 is a multivibrator-type oscillator which, when keyed, generates a 1,000-cycle tone.

b. Oscillations are started by a slight unbalance in the circuit which causes one-half of V17 to be cut off while the other half is conducting. Assum-

ing that the first half of the tube (pins 6, 7, and 8) is cut off, its plate (pin 6) is at B+ potential (250 volts) and capacitor C33 is charged to that value. As C33 begins to discharge through grid resistor R50, the negative voltage developed across R50 reduces the current flow in the conducting half (pins 1, 2, and 3). This increases the plate (pin 1) voltage and causes capacitor C34, which had been nearly at ground potential, to charge through resistor R53. When the amplitude of the positive voltage developed across R53 is sufficient to overcome the cathode bias provided by resistor R52, the first half of V17 begins to conduct. (The time required before this conduction starts depends primarily on the C33-R50 time constant. The values of C33 and R50 determine the rate at which the current flow decreases in the conducting half and the time at which the charging potential applied to C34 becomes sufficiently high.) When the first half of V17 conducts, C33 discharges still more rapidly through R50, driving the second half to cutoff. This in turn increases conduction in the first half. The two halves of V17 remain in this reversed condition until the slow discharge of C34 through R53 initiates the next half cycle. The 1,000-cycle output is taken from across resistor R50 and coupled to the grid of cathode follower V16 through capacitor C32. Resistors R51 and R49 are plate resistors and resistor R54

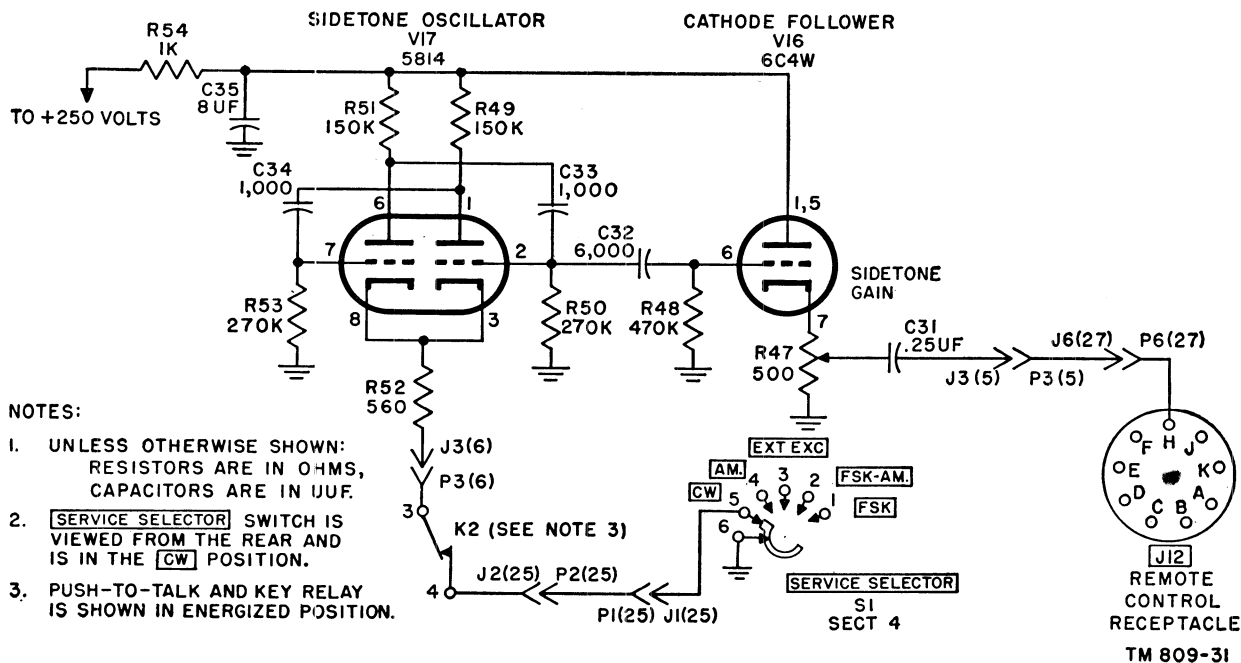


Figure 38. Sidetone oscillator and cathode follower, functional diagram.

with capacitor C35 forms a decoupling network.

c. Cathode follower tube V16 matches the high-impedance output of V17 to the low-impedance headset used for monitoring. Resistor R48 is the grid load resistor. Resistor R47, the cathode load resistor, also functions as the sidetone gain control. The output of V16 is coupled through

capacitor C31 to pin H of remote control receptacle J12.

## 65. Bias Power Supply

(fig. 39)

a. The bias supply provides both the cutoff and operating bias voltages for the modulator; the

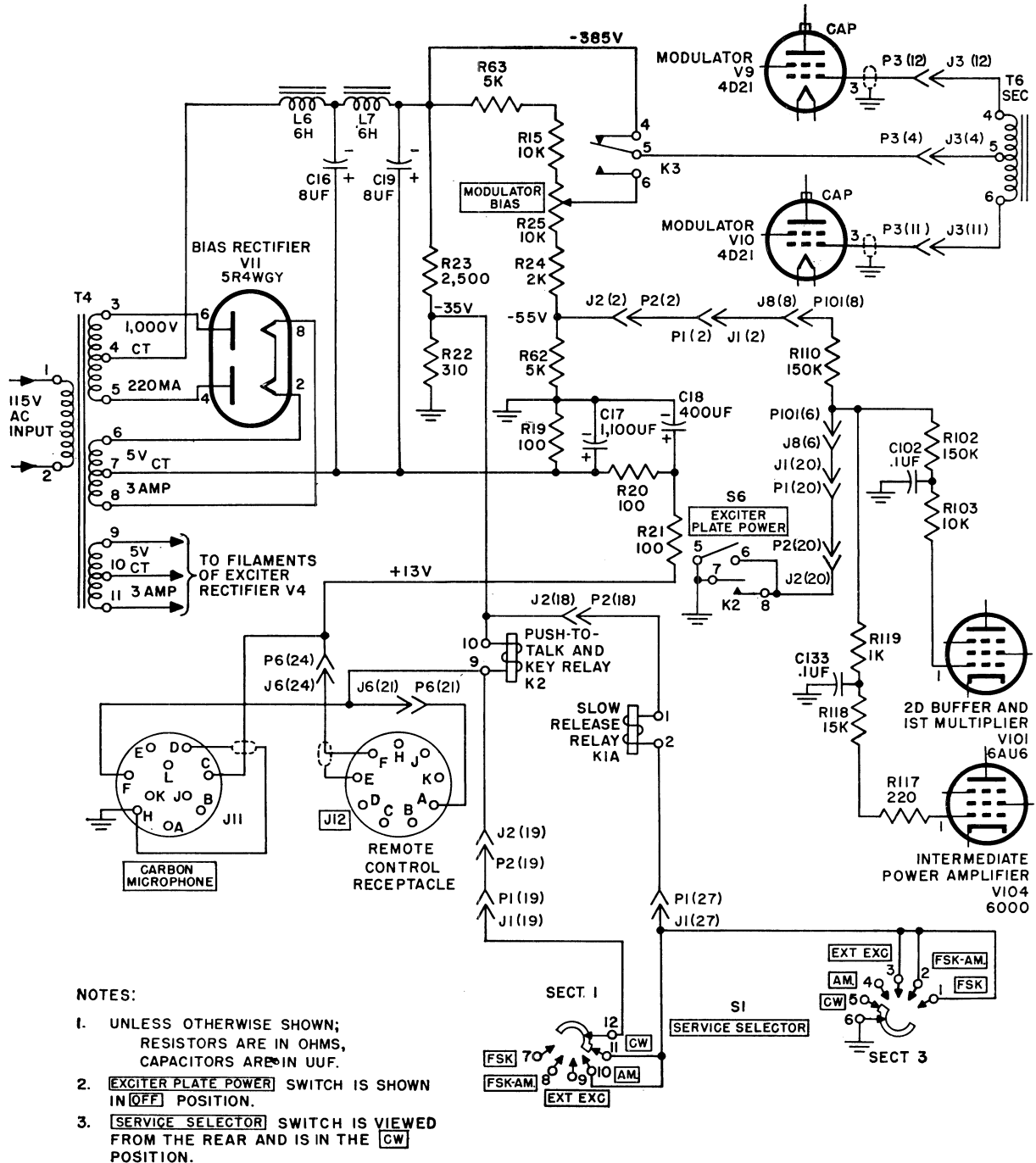


Figure 39. Bias power supply and distribution, functional diagram.

blocking bias voltage for the second buffer and first multiplier and the intermediate amplifier; and the energizing power for the push-to-talk and key relay and for a slow-release relay. It also supplies a low dc voltage necessary to obtain operating current for the carbon microphone.

*b.* When 115-volt ac power is applied to the primary of T4, its secondaries supply filament and plate voltage to bias rectifier tube V11 as well as filament voltage to exciter rectifier tube V4. The full-wave rectified output of V11 is applied to a choke input pi-section filter which consists of chokes L6 and L7 and capacitors C16 and C19. The filtered output is impressed across a series-parallel voltage-dividing network which consists of R23 and R22, paralleled by R63, R15, R25, R24, and R62, in series with R19. All output voltages are tapped from this divider network.

*c.* Disabling grid bias for modulators V9 and V10, tapped from the most negative point on the divider, is applied through cw-microphone relay K3 and the center-tapped secondary of speech amplifier output transformer T6. When K3 is energized for FSK-AM. and AM. operation, a reduced operating bias for the modulators is supplied from the arm of MODULATOR BIAS potentiometer R25 through contacts 6 and 5 of K3.

*d.* Blocking bias for the blocked-grid keying of V101 and V104 is tapped from the junction of R24 and R62. Resistor R110 limits the current drain on the supply when the blocking bias is removed by preventing R22 from being shorted to ground by contacts 7 and 8 of K2. Power for energizing push-to-talk and key relay K2 and slow-release relay K1A is tapped from the junction of R25 and R22.

## 66. Exciter Power Supply

(fig. 40)

*a.* The exciter power supply provides dc operating voltages for the plates and screens of all speech amplifier and oscillator-multiplier tubes. Filament voltage for exciter rectifier tube V4 is supplied from a secondary of T4 and is present as soon as primary power is applied. Plate voltage for V4 is supplied by exciter plate transformer T3. The 115V ac input to T3 is either applied by relay K6 during AM. operation or permanently by switch S6, depending on the type of operation used. The full-wave rectified output of V4 is applied to a capacitor-input filter that consists of capacitors C14 and C15, choke L5, and resistor R13. Capacitor C15, choke L5, and resistor R13

form a filter to prevent key chirps during cw operation. When the current to a coil carrying a current is suddenly reduced during cw conditions, the magnetic field about the coil collapses. The collapsing magnetic field induces an electromotive force (emf) in the coil that is proportional to the product of the inductance of the coil and the time rate of change of the current through the coil. The current through the coil changes very rapidly at the instant the circuit is keyed; accordingly, the voltage induced in the coil may reach extremely high proportions. In a circuit that contains inductance, a dissipative network is connected in series with a coil to ground to prevent voltage surges when the current is suddenly decreased at key-up conditions. The surge voltage decreases quickly at key-down conditions, therefore a shift of voltage in turn causes a cw chirp at the beginning of a letter. This series network is sometimes called a surge filter. The action of a surge filter can best be shown by an example. When Radio Transmitter T-368/URT is keyed for CW operation, the current through coil L5 is changed in accordance with the dots and dashes to be transmitted. When the current is reduced on key-up conditions, the back emf induced in the coil charges C15 through R13. Capacitor C15 then discharges back through R13 and the coil. However, the resistance of the coil together with R13 is such that only a few highly damped oscillations occur and the transient voltage dies out in a very short time. Thus, the back emf, induced in the coil at the instant the current is lowered, is dissipated in the form of heat in resistor R13 and the resistance of the coil. Resistor R14 is a bleeder resistor. The rectified and filtered output is distributed to stages in the speech amplifier, multiplier, and oscillator subassemblies by three parallel voltage dividers, as described in *b* through *d* below.

*b.* Speech amplifier plate voltages are obtained from taps on the voltage divider which consists of resistors R12, R45, and R44. Resistor R12 drops the supply voltage to +250 volts at the junction of R12 and R45. Plate current flow in V12A, V12B, V13A, V13B, and V15 through resistor R46 reduces the voltage at the junction of R43 and R46 to +230 volts. This voltage is applied to the plate of V13B through plate load resistor R38 and to the plate of V15 through the primary of T6. Preamplifiers V12A and V12B and third af amplifier V13A are supplied through a common decoupling resistor, R43. The voltage at



the junction of R43 and R42 is applied to the plate of V13A through plate load resistor R32. The plate voltages for V12A and V12B are reduced still further by dropping resistors R41 and R42, respectively. Resistors R27 and R29 are the respective plate load resistors. Capacitors C27 through C30 are decoupling capacitors. The plates of sidetone oscillator V17 and cathode follower V16 are supplied from +250 volts through decoupling resistor R54. Resistors R49 and R51 are the plate load resistors for V17, and C35 is a decoupling capacitor. Plate voltage for clipper V14 is obtained from the arm of potentiometer R44; its supply potential is variable from 0 to +140 volts. Resistor R34 is the clipper plate resistor.

*c.* Plate and screen voltages for the multiplier stages are obtained from taps on a second voltage divider which consists of resistors R6, R64, and R65. The plate of ipa V104 is supplied from the junction of R6 and R64 through meter shunt resistor R7 and the tank circuit selected by section 1 rear of BAND SELECTOR switch S101. All other multiplier voltages are supplied from the junction of R6 and R65. Screen voltage for V104 is supplied through dropping resistor R120. The plate and screen of V101 are supplied through decoupling resistor R107; plate voltage is supplied through R106 or Z101 depending on the position of S101, section 4 rear, and screen voltage is supplied through dropping resistor R105. The plate and screen of V102 are supplied through decoupling resistor R112; plate voltage is supplied through Z103 and screen voltage through resistor R111. The plate and screen of V103 are similarly supplied through decoupling resistor R116, tank circuit Z105, and screen dropping resistor R115. Capacitors C104, C117, C127, and C134 are rf bypasses. Capacitors C105, C106, C120, C129, and C139 are decoupling capacitors.

*d.* Plate and screen voltages for master oscillator V801 and first buffer V802 are tapped from the voltage divider which consists of resistor R5 and voltage regulator V3. Voltage regulator V3 regulates the supply to V801 and V802 at +150 volts. Both stages are supplied through the AM, or CW position of SERVICE SELECTOR switch S1, section 4, and rf choke L802. Resistors R803 and R806 are plate load resistors, and R802 and R805 are screen dropping resistors. Capacitors C806 and C808 are screen rf bypasses. Capacitors C810 and C152 are decoupling capacitors.

## 67. High-voltage Power Supply

(fig. 41)

*a.* The high-voltage supply in the power supply deck furnishes voltages for the plates and screens of power amplifier tube V1, clamper tube V2, and modulator tubes V9 and V10. The supply is protected against heavy current drains by an overload relay.

*b.* Filament voltage for high-voltage rectifier tubes V18 and V19 is supplied by high-voltage filament transformer T8 and is available as soon as primary power is applied. The 115 volts ac input to high-voltage plate transformer T9 is available for application after a time delay; the input voltage may then be turned on only when the microphone switch is pressed as in AM operation or applied permanently as in the other four types of operation. Red PLATE POWER indicator I 4 lights to indicate the presence of the ac input. TUNE-OPERATE switch S12, when placed in the TUNE position, inserts dropping resistor R11 in series with the double primary windings of T9. Reducing the high voltage during tuneup procedures protects the rf power amplifier tube from excessive plate current flow while it is not properly loaded.

*c.* The full-wave rectified output of V18 and V19 is applied to a choke-input filter which consists of choke L8 and capacitors C38 and C39. A spark gap is placed across L8 to protect it against excessive voltages. Resistor R58 is a bleeder resistor in series with either R56 or R57 (*f* below) to ground. The filtered output is applied to the load in series with overload relay K4 and its paralleled adjustment network (*f* below). The load is connected between B+ line and ground, while K4 is connected between ground and the B- line.

*d.* High voltage is taken from the power supply deck through spring contacts E11 and E12, which serve as a high-voltage interlock. Voltage is applied to the plate and screen of clamper V2 and to the screen of power amplifier V1 through spring contacts E3 and E4 in the rf deck and through resistor R4. The plate of V1 is supplied in series with the secondary of modulation transformer T5, therefore high voltage for it and for the modulator tubes is applied through spring contacts E9 and E10 in the modulator deck. Terminal 5 of T5 is connected to the power amplifier plate through spring contacts E7 and E8 in the modulator deck, spring contacts E1 and E2 in the rf deck,

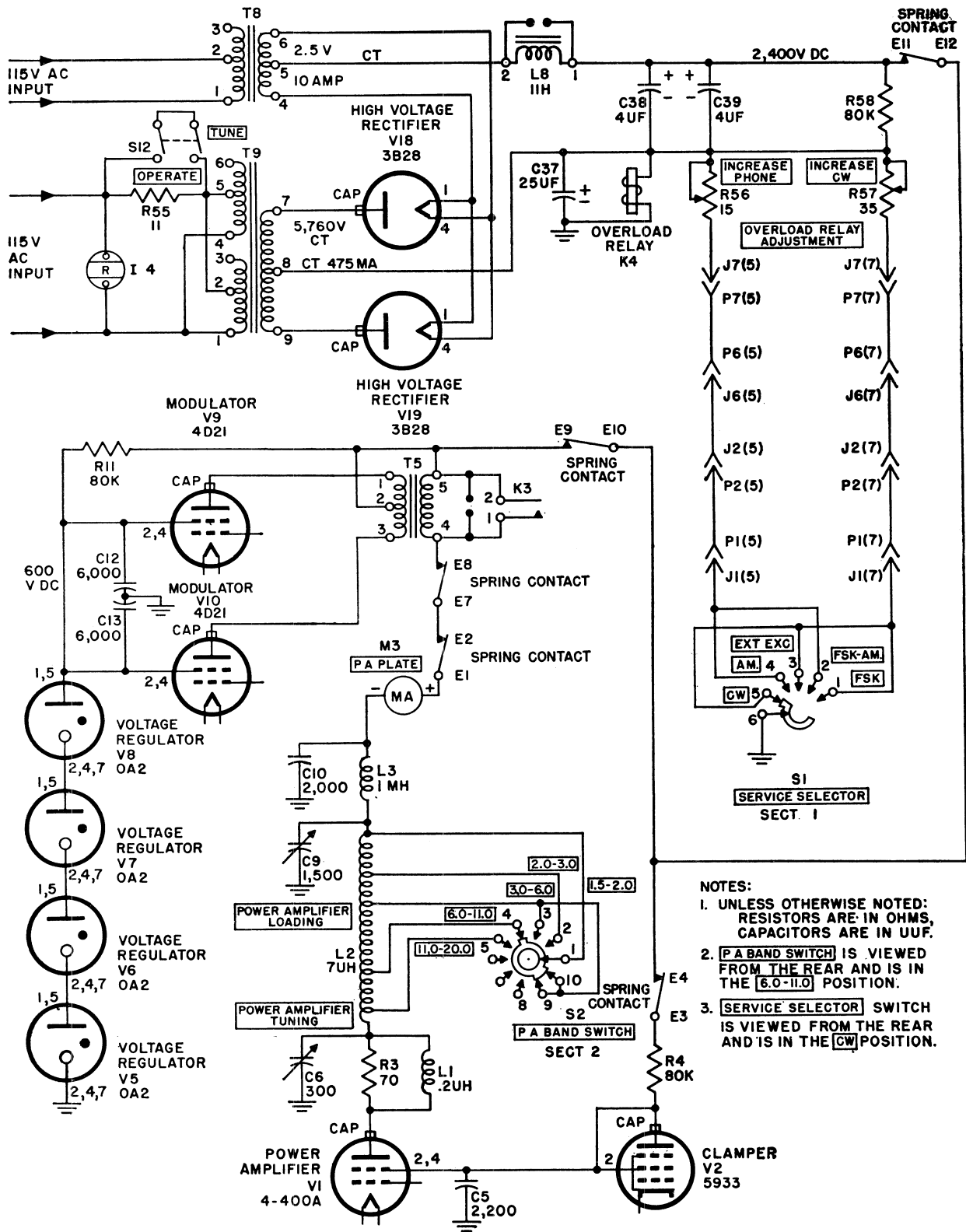


Figure 41. High-voltage power supply and distribution, functional diagram.

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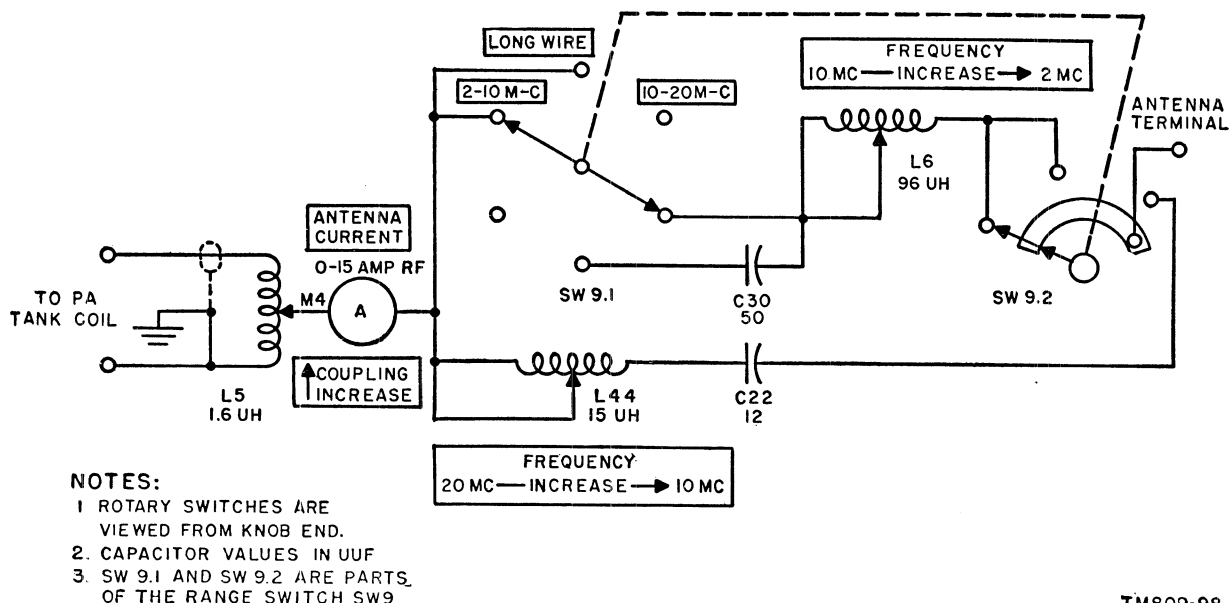


Figure 42. Antenna tuning unit BC-939-B, schematic diagram.

P A PLATE meter M3, rf choke L3, the used portion of tuning inductance L2, and parasitic trap R3 and L1. Capacitor C10 is an rf bypass. Capacitors C9, section 2 of S2, and C6 are in the power amplifier tuned pi-network. Capacitor C5 is a screen rf bypass capacitor.

e. The plates of modulators V9 and V10 are supplied through the center-tapped primary of T5. The modulator screens are regulated by voltage regulators V5 through V3, which form a voltage divider with resistor R11. Capacitors C12 and C13 are screen rf bypasses.

f. The permissible current drain on the high-voltage power supply is set by OVERLOAD RELAY ADJUSTMENT R56 (INCREASE PHONE) or R57 (INCREASE CW), as selected by section 1 of SERVICE SELECTOR switch S1. Overload relay K4 is energized whenever the current drain exceeds the values set by R56 and R57. Capacitor C37 prevents *talking back* in the overload relay with voice modulation.

## 68. Antenna Tuning Unit BC-939-B

(fig. 42)

a. Figure 42 shows the main schematic diagram of the tuning unit. (See fig. 86 also.) The following subparagraphs describe each of the three range switch positions as individual schematic diagrams in order to describe the tuning unit in greater detail.

b. Figure 43 is a functional schematic diagram

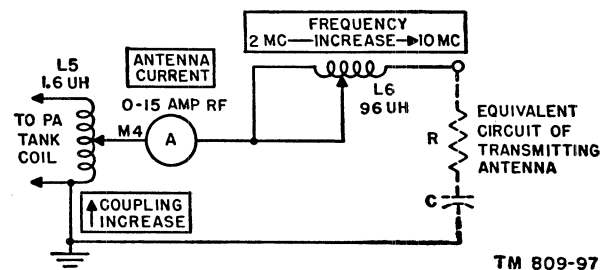


Figure 43. Antenna tuning unit BC-939-B with range switch in 2-10 M-C position, schematic diagram.

of the tuning unit with range switch SW9 (SW9.1 and SW9.2) set to 2-10 M-C and a whip antenna connected to the unit. Since the antenna is electrically much shorter than a quarter wavelength, it presents a highly capacitive load to the transmitter. This capacitive antenna is tuned to resonance by providing added inductance of the low-frequency loading coil L6 through the variable tap controlled by the FREQUENCY (10 MC-INCREASE-2 MC) crank handle control. When the inductive reactance of L6 is made equal to the capacitive reactance of the whip antenna, the load presented to the transmitter is purely resistive. Coupling coil L5 acts as an impedance matching transformer so that the resistance of the antenna, as reflected back to the pa tank circuit, presents the optimum plate load resistance as viewed from the pa tube plate. Rotating the COUPLING INCREASE control handle varies the movable tap of L5 and changes the impedance ratio.

c. Figure 44 is a functional schematic diagram of the tuning unit with range switch SW9 set to 10–20 M-C and a whip antenna connected to the unit. From 10 to 12.5 mc the reactance of the antenna is capacitive; from 12.5 to 20 mc the reactance is inductive. At approximately 12.5

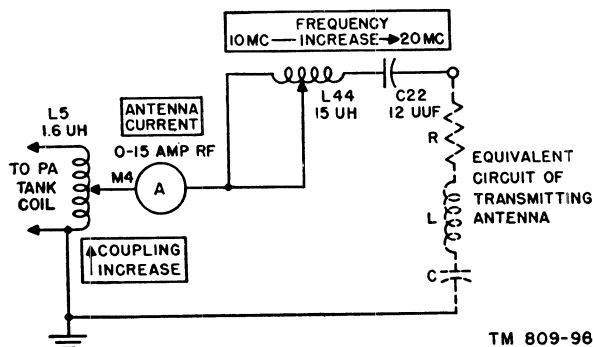


Figure 44. Antenna tuning unit BC-939-B with range switch in 10–20 M-C position, schematic diagram.

mc the antenna is purely resistive. The antenna is tuned to resonance by varying the movable tap of the high-frequency loading coil L44 by the crank handle FREQUENCY (20 MC—INCREASE—10 MC) control. Vacuum-type capacitor C22 provides the added capacitance necessary when operating from 12.5 to 20 mc. Its effect is neutralized when operating from 10 to 12.5 mc by including more turns of coil L44 in the circuit.

d. Figure 45 is a functional schematic diagram of the tuning unit with switch SW9 set to LONG WIRE and a long-wire antenna connected to the unit. The antenna may be either capacitive or inductive depending on the length of the wire and frequency used. The net reactance is made equal to zero by varying the movable tap of the low-frequency loading coil L6. Vacuum-type capacitor C30 provides the necessary capacitance when the reactance of the antenna is inductive because of antenna wire length and operating frequency. ANTENNA CURRENT meter M4 indicates rf current flowing in the series circuit of the antenna and antenna loading circuit. Rf current is maximum when the antenna is tuned to resonance with the transmitter frequency by the antenna loading circuits in the antenna tuning unit.

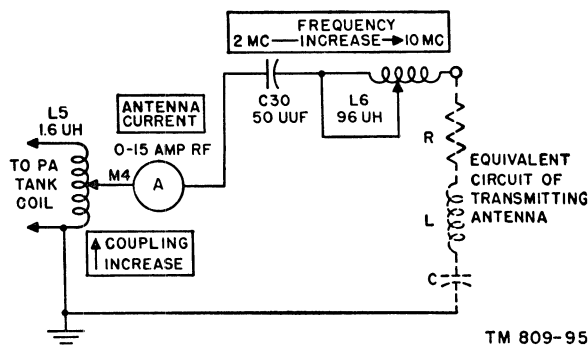


Figure 45. Antenna tuning unit BC-939-B with range switch in LONG WIRE position, schematic diagram.

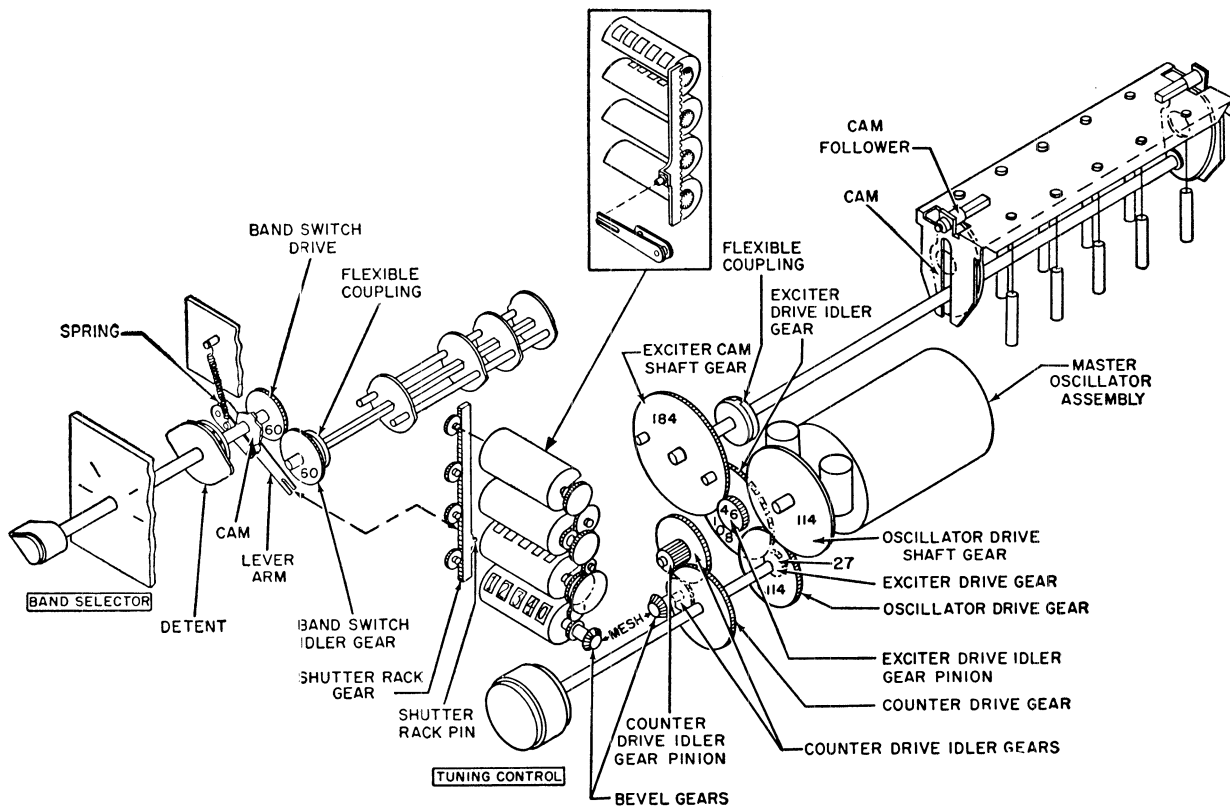
## Section II. MECHANICAL ANALYSIS OF RADIO TRANSMITTER T-368/JRT

### 69. Oscillator-Multiplier Tuning Drive Mechanism

(fig. 46)

The master oscillator, multiplier, and intermediate amplifier stages of the transmitter are tuned by the movement of powdered iron cores (permeability tuning) in inductor L801 and in the inductors in tank circuits Z101 through Z110. Movement of the cores is controlled by cams (except for the core in L801) that are turned through gearing by the TUNING CONTROL knob on the front panel. Band switching is accomplished by turning switch S101 through gearing from the BAND SELECTOR knob. The gearing is designed so that after alignment of individual circuit elements, direct and accurate frequency indications can be obtained from front panel counters.

a. The band switching mechanism includes the BAND SELECTOR knob, a detent, a 60-tooth band switch drive gear meshing with a 60-tooth bandswitch idler gear, a flexible coupling, and the wafers of S101. Frequencies in the selected band are indicated through windows in each of four counter shutters. The shutters are mounted on the shafts of four gears driven by a shutter rack gear. The rack gear is moved vertically by a slotted lever arm which engages the rack pin. The lever arm is operated by a cam on the band switch drive shaft. As the BAND SELECTOR is turned clockwise through each of its detent positions, the lever arm (spring-loaded) moves upwards so that the cylindrical shutters are rotated downwards. The four counter windows are so positioned on the shutters that only the counter which contains frequencies in the



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Figure 46. Oscillator-multiplier tuning drive mechanism, functional diagram.

selected band will be exposed. The three counters not being used are masked by solid portions of their shutters.

b. The powdered iron cores of the inductors in the multiplier tank circuits are mounted on a rack which is raised and lowered by two cams and two cam followers. The camshaft is driven by a 184-tooth exciter camshaft gear through a flexible coupling. The camshaft gear is driven from the TUNING CONTROL knob through a 27-tooth exciter drive gear, a 108-tooth exciter drive idler gear, and a 46-tooth exciter drive idler gear pinion. The powdered iron cores can be individually raised or lowered from the top of the rack for alinement purposes. Master oscillator tuning inductor L801 is located inside the sealed master oscillator assembly. The core of L801 is tuned by the tuning control through a 114-tooth oscillator drive gear, a 114-tooth oscillator drive shaft gear, and additional parts inside the sealed assembly. The frequency counters are driven by the tuning control through a counter-drive gear, a counter-drive idler gear pinion, meshing counter-drive idler gears, and meshing bevel gears. All four counters are driven simultaneously through

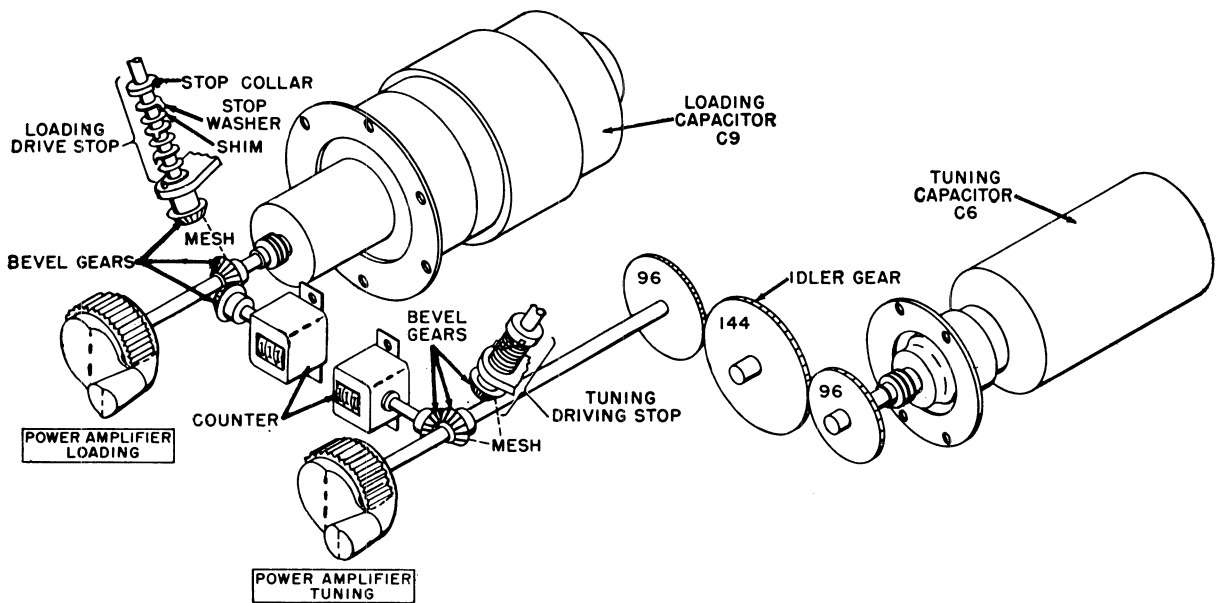
additional gearing as shown in the box insert of figure 46.

## 70. Power Amplifier Tuning Drive Mechanism (fig. 47)

The tuning drive mechanism for the power amplifier consists of two separate sections, loading and tuning.

a. The loading mechanism is manually operated by the POWER AMPLIFIER LOADING control knob. The turning of the control adjusts loading capacitor C9 which is on the same shaft. A mechanical counter is controlled through bevel gears, and registers the position (setting) of the control. Positive stop action to prevent movement past a given number of turns is provided. A typical stop is shown exploded in the figure. As the bevel gear on the stop shaft rotates, the stop collar rotates the adjacent stop washer. The projection on the washer turns freely until it engages the washer below. This action is repeated until the bottom washer is stopped by the projection on the casting ear. The control is now restrained from any further movement.

b. The tuning mechanism is manually operated



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Figure 47. Power amplifier tuning drive mechanism, functional diagram.

by the POWER AMPLIFIER TUNING control knob. This mechanism is identical to the loading mechanism described above except that the tuning capacitor (C6) is driven by a gear train instead of directly by the control shaft. The control shaft

is connected to the capacitor through three gears having 96, 144, and 96 teeth, respectively. As before, a mechanical counter indicates the setting, and a stop prevents rotation beyond a designated number of turns.

### Section III. CONTROL AND PROTECTION CIRCUITS

#### 71. Primary Power Distribution and Control Circuits

(fig. 48)

In Radio Transmitter T-368/URT, control circuits are provided to enable the operator to apply power to the various stages in a definite sequence and to select the desired mode of operation. Ac line voltage (115 volts) is present at ac input receptacle J14, provided that the power cable is connected to an ac power source.

*a. FILAMENT POWER Circuit Breaker CB1.* When FILAMENT POWER circuit breaker CB1 is thrown to ON, indicator lamp I3 lights. Power is immediately available for blower motor B2 and bias transformer T4 through 3 AMP fuse F2 (shunted by BLOWN FUSE INDICATOR I 2) and through thermostat S13. The thermostat will operate to open the primary circuit if the ambient temperature exceeds 250° F. The thermostat can be reset only through manual operation of THERMAL RESET switch S13. With T4 energized, the bias supply, besides furnishing bias voltages, provides dc control voltages for

push-to-talk and key relay K2 and slow-release relay K1A. Closing the FILAMENT POWER circuit breaker also applies power, through 6 AMP fuse F1 shunted by BLOWN FUSE INDICATOR I 1, to filament transformers T7, T2, T1, and T8, whose primaries are in series with FILAMENT VOLTAGE control R18. The purpose of R18 is to provide a manual means for adjusting the filament voltage (from T1) of the pa tube at its recommended value of 5 to 5.2 volts regardless of line variations; the control adjusts other filaments similarly that are connected to T1, T7, T2, and T8. Transformers T7 and T2 supply filaments in the speech amplifier and modulator, respectively; taps on their primaries allow compensation for transmitter wiring voltage drops. Transformer T1 supplies the filaments of the master oscillator, multiplier, clamper, and power amplifier; it also supplies a control voltage for energizing external excitation relay K101. Blower motor B1 in the rf deck parallels the primary winding of T1. Transformer T8 supplies the filaments of the high-voltage rectifiers; its primary is connected as an

autotransformer, with the voltage developed across terminals 3 and 1 used to energize time-delay relay K7 and associated high-voltage circuits (*e* below). Transformer T8 acts as a protective device for the equipment to prevent the application of plate voltage to the high-voltage rectifiers if the primary of T8 fails or voltage to the primary of T8 is absent.

*b. EXCITER PLATE POWER Switch S6.* EXCITER PLATE POWER switch S6 is closed when the stages in the exciter strip (V801, V802, V101, V102, V103, and V104) are required to be continuously operative, with or without the application of high voltage. This requirement must be met for the FSK, FSK-AM., and EXT EXC operation, because each of these uses an uninterrupted rf carrier or a carrier which is keyed externally. The switch normally is left open for CW and AM. operation. When S6 is closed, contacts 6 and 5 remove the blocking bias from the grids of V101 and V104. Contacts 4 and 3 close the ac input circuit to exciter plate transformer T3, thereby energizing the plate and screen supply for the exciter. Transformer T3 is energized also through contacts 1 and 2 of plate relay K6, which close simultaneously with the application of high voltage as described in *d* below. With the blocking bias removed, however, contacts 4 and 3 of S6 permit the exciter to be operated *without* applying high voltage to the transmitter. This condition of operation is useful for servicing; it also permits zero-beating the carrier with the receiver or frequency meter for calibration of the transmitter. Contacts 1 and 2 of S6 insure that antenna change-over relay K1B will be energized whenever the exciter is made operative in the manner described above; this safety feature insures that the antenna is connected when the transmitter is operative.

*c. Time-Delay Circuit.* High voltage is applied to the transmitter by a circuit which includes time-delay relay K7 (plug-in type) and time-delay slave relay K8. The voltage that appears across terminals 1 and 3 of T8 when the FILAMENT POWER circuit breaker is closed is applied to K7 through normally closed contacts 1 and 2 of K8. After a delay of approximately 25 seconds, K7 is energized, closing contacts 5 and 7. This connects one side of the line to terminal 5 of PLATE RELAY K6 to energize it, and also energizes the coil of K8. With K8 energized, its contacts 1 and 2 open to de-energize K7; contacts 2 and 3 (paralleled by contacts 5 and 4, respectively) close, however, to hold K8 energized and to maintain the connection between one side of the line and ter-

terminal 5 of plate relay K6. Even though the de-energizing of K7 causes its contacts 5 and 7 to open, K8 will remain closed. The thermal element of K7 is allowed to cool after it has been initially heated, to insure a full time delay should power be removed from the equipment and then immediately reapplied.

*d. Plate Relay Circuit.* The manner in which plate relay K6 is energized depends on the type of operation desired. For CW operation, K6 must be energized continuously so that high voltage is always applied to the rf power amplifier tube. If the power amplifier plate voltage were also keyed, key clicks and high-voltage arcing would result. For FSK, FSK-AM., and EXT EXC operation, K6 also must be energized continuously to prevent the externally excited carrier from being interrupted by the removal of plate voltage of the power amplifier tube. Plate relay K6 is energized for the above four types of operation by closing PLATE RELAY switch S10 or by closing a remote control box switch paralleled with S10 through pins C and B of remote control receptacle J12. The circuit from terminal 6 of K6 to the ac line is completed through microswitch S4 and normally closed contacts 3 and 4 of overload reset relay K5. Microswitch S4 is normally closed and opened by the P A BAND SWITCH during band switching. For AM. operation, high voltage can be removed during periods of no transmission to conserve power. PLATE RELAY switch S10 therefore is left open and K6 is energized through contacts 6 and 5 of push-to-talk and key relay K2 in series with contact 4 of section 2 of SERVICE SELECTOR switch S1 when in the AM. position. When K6 is energized, contacts 4 and 3 connect one side of the ac line to the primary of high-voltage plate transformer T9 through interlocks S11, S5, S7, and S8. Contacts 2 and 1 of K6 complete a circuit for energizing exciter plate transformer T3, which also may be energized by closing the EXCITER PLATE POWER switch, as described in *b* above.

*e. High-Voltage Circuit.* High-voltage plate transformer T9 receives an ac input as soon as plate relay K6 is energized. The circuit is completed through PLATE POWER circuit breaker CB2, which normally is left in the closed position. Receptacle J13 is provided at the rear of the transmitter to allow the ac input for T9 to be adjusted by a variable autotransformer (not supplied); pins 2 and 3 of J13 normally are jumpered. Indicator lamp I 4 is the plate-power indicator. TUNE-

OPERATE switch S12 inserts dropping resistor R55 in series with the double primary of T9 when it is placed in the TUNE position.

*f. Antenna Changeover Relay K1B.* The function of antenna changeover relay K1B is to connect the rf output of the transmitter to the transmitting antenna during operation. The output is connected from the pa stage through normally open contacts 9 and 10 of K1B. Contact 10 is connected to the internal side of jack R. F. OUTPUT and the antenna is connected to the external side by a coaxial connector. Antenna relay K1B is energized by 115 volts ac during key-down periods on transmission. Until K1B is energized, the rf output line is grounded through R66 and contacts 14 and 13. K1B is energized through contacts 1 and 2 of the push-to-talk and key relay K2 (for AM. or CW operation) or through contacts 1 and 2 of the EXCITER PLATE POWER switch (for FSK, FSK-AM., or EXT EXC operation). Contacts 3 and 4 of slow release relay K1A, which are also in series with the coil of K1B, are discussed in *g* through *k* below.

*g. Slow Release Relay K1A.* The main purpose of slow release relay K1A is to keep the power amplifier tube loaded, by maintaining the antenna changeover relay in the energized condition, until all radiation has ceased after the handkey or microphone button is released. For AM. or CW operation, K1A is energized by -35 volts through section 1 of the SERVICE SELECTOR switch and the button or key. The relay is designed so that the contacts will remain closed for a short period of time (approximately  $1 \pm .2$  second) after its power has been removed. This time, however, is not short enough during keying; K1A could not operate antenna changeover relay K1B fast enough to follow the keying action. Therefore, although contacts 3 and 4 of K1A are in series with K1B, K1B is actually energized through contacts 1 and 2 of push-to-talk and key relay K2; K2 is specifically designed for operation at the required keying speeds. Contacts 4 and 3 of K1A then hold K1B energized for .8 second after releasing the button or key which de-energizes the push-to-talk and key relay. Contacts 6 and 5 can be used to complete a disabling relay circuit in a nearby receiver to keep this receiver disabled until all radiation ceases; contact 6 is connected to pin J of remote control receptacle J12. For FSK, FSK-AM., and EXT EXC operation, K1A is energized continuously through section 3 of the SERVICE SELECTOR switch.

*h. Push-To-Talk and Key Relay K2.* Push-to-talk and key relay K2 receives its energy from the bias supply and is operated for AM. and CW operation only. Key relay K2 is energized by grounding its less negative side (terminal 9) through pins F to H of J11 by pressing the carbon microphone push-to-talk button (for AM. operation) or through the closing of a handkey (for CW operation). The microphone may be connected at the remote control box which is cabled to remote control receptacle J12. Key relay K2 then is energized by pressing the microphone button to place pin A of J12 at ground potential. Contacts 1 and 2 key the antenna changeover relay. Contacts 3 and 4 key the sidetone oscillator (through the CW position of S1, section 4). Contacts 5 and 6 operate the plate relay for AM. operation (through the AM. position of S1, section 2). Contacts 8 and 7 short out the blocking bias applied to the grids of V101 and V104.

*i. Cw-Microphone Relay K3.* Cw-microphone relay K3 disables the modulator when it is in the de-energized (CW) condition. The relay is energized from the ac line when in the FSK-AM. or AM. position. When energized, contacts 1 and 2 open to remove the short from the modulation transformer secondary, and contacts 5 and 6 close to provide the modulator with operating bias.

*j. External Excitation Relay K101.* External excitation relay K101 is energized when the SERVICE SELECTOR switch is in the EXT EXC position by 26.5 volts ac from T1. In the unenergized condition (FSK, FSK-AM., AM., and CW), contacts 1 and 2 ground the cathode of ipa V104. In the energized condition (EXT EXC), contacts 2 and 3 unground the cathode of V104, and contacts 5 and 6 connect the external excitation signal at J104 to the input of V104.

*k. SERVICE SELECTOR Switch S1.* SERVICE SELECTOR switch S1 is a five-position, four-deck rotary switch. Switch sections have been discussed individually throughout this chapter. The functions of the entire switch are grouped as follows.

- (1) *Section 1 (contacts 1 through 6).* In the FSK, EXT EXC, and CW positions of section 1 (contacts 1, 3, and 5) OVERLOAD RELAY ADJUSTMENT R57 (INCREASE CW) is placed across overload relay K4. In the FSK-AM. and AM. positions (contacts 2 and 4), R57 is replaced by OVERLOAD RELAY



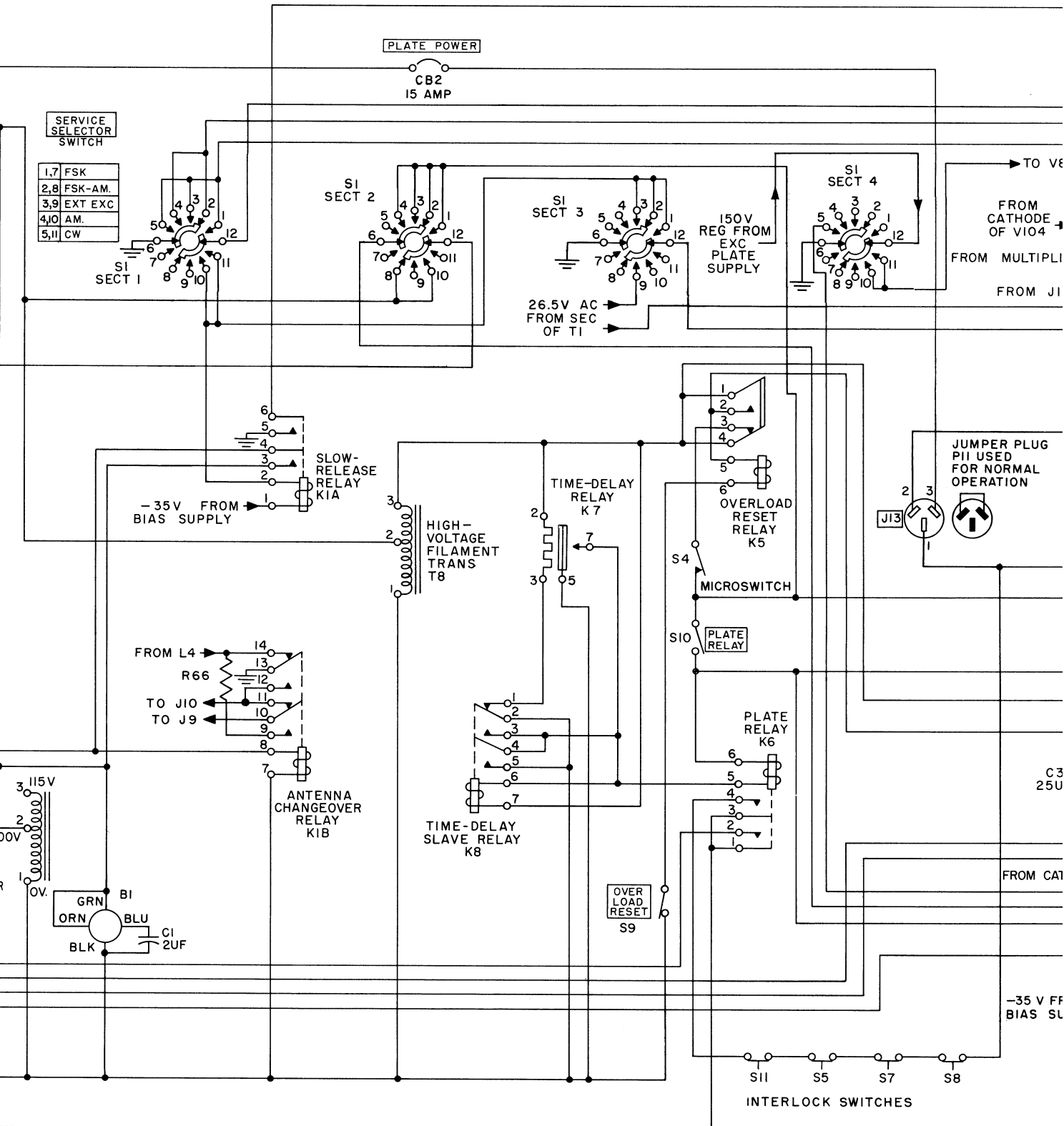
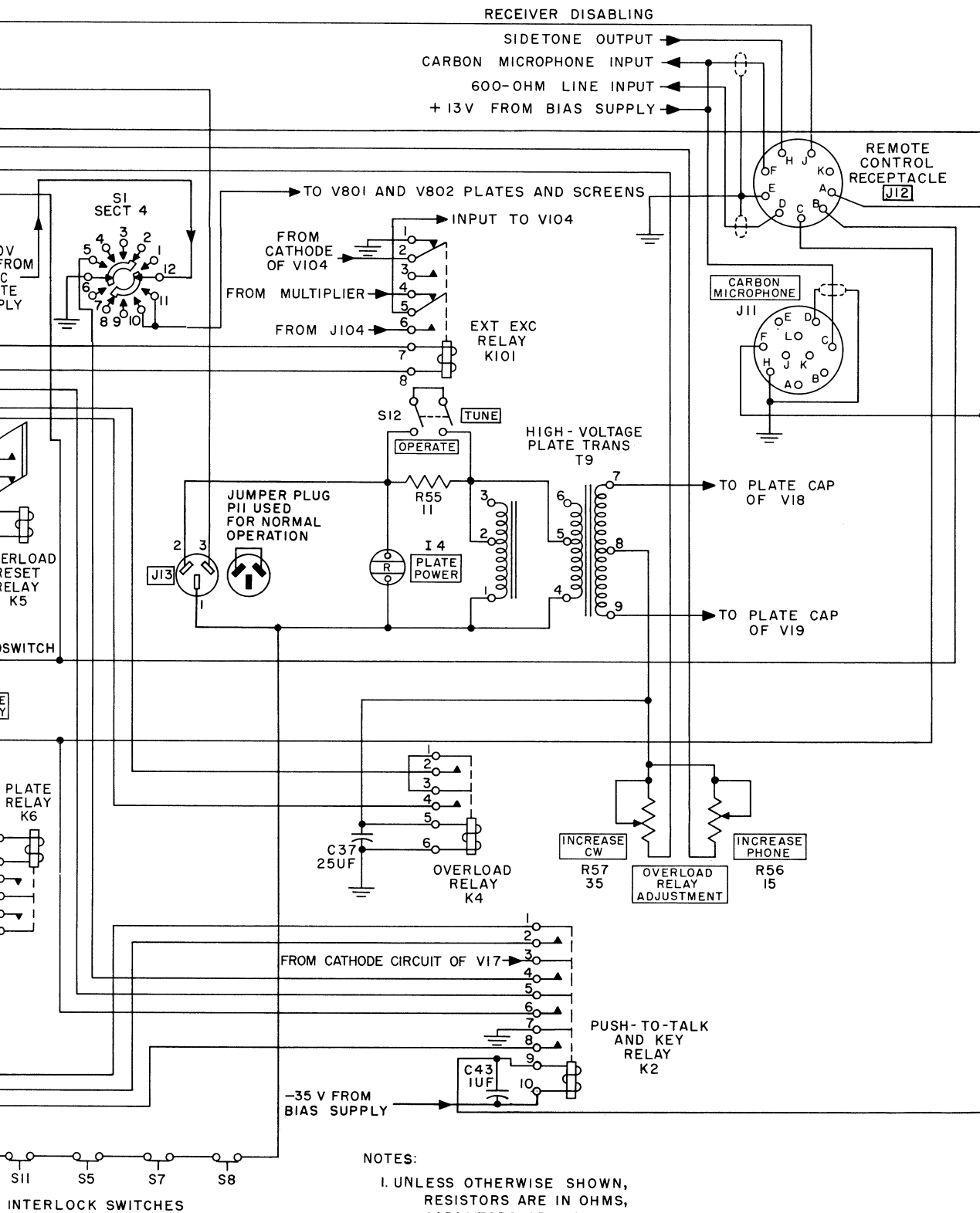


Figure 48. Primary power distribution and control circuits, functional diagram.



## ADJUSTMENT R56 (INCREASE PHONE).

- (2) *Section 1 (contacts 7 through 12)*. The AM. and CW positions of section 1 (contacts 10 and 11) allow the slow release relay to be energized by pressing the microphone button or closing the handkey. The other positions are not used.
- (3) *Section 2 (contacts 1 through 6)*. The AM. position of section 2 (contact 4) allows plate relay K6 to be energized by pushing the microphone button; push-to-talk and key relay K2 is energized, closing its contacts 5 and 6, which together with S1, bypass PLATE RELAY switch S10. This prevents K6 from following the keying action of K2. In the CW position (contact 5), K2 no longer bypasses S10. Therefore for CW operation, as well as for FSK, FSK-AM., and EXT EXC operation, S10 must be closed to operate K6.
- (4) *Section 3 (contacts 7 through 12)*. In the FSK-AM. and AM. positions of section 3 (contacts 8 and 10), cw-phone relay K3 is energized to make the modulator operable. Relay K3 is de-energized in all other positions.
- (5) *Section 4 (contacts 1 through 6)*. The FSK, FSK-AM., and EXT EXC positions of section 4 (contacts 1, 2, and 3) complete the circuit for energizing the slow release relay continuously.
- (6) *Section 3 (contacts 7 through 12)*. In the EXT EXC position of section 3 (contact 9) external excitation relay K101 is energized (*j* above). Relay K101 is de-energized in all other positions.
- (7) *Section 4 (contacts 1 through 6)*. The CW position of section 4 (contact 5) in series with contacts 4 and 3 of the push-to-talk and key relay completes the cathode cir-

cuit of the sidetone oscillator. The sidetone oscillator is inoperative in all other positions.

- (8) *Section 4 (contacts 7 through 12)*. Section 4 feeds operating voltages for the master oscillator and first buffer through its AM. and CW positions (contacts 10 and 11). These stages are inoperative in all other positions.

## 72. Overload Protection Circuits

(fig. 48)

The high-voltage power supply is protected against overloads by relay K4. Relay K4 is energized when the current drain from the supply exceeds 425 ma or 550 ma, depending on the type of operation used. When K4 is energized, contacts 4, 3, 1, and 2 complete a circuit for energizing overload reset relay K5, which is in series with OVERLOAD RESET switch S9. Contacts 3 and 4 of K5 then open to break the plate relay circuit and remove the ac input to high-voltage transformer T9. Contacts 1 and 2 of K5 are holding contacts which keep K5 energized even after no power supply current is available for energizing K4. Thus, once K4 is energized, high voltage can be restored only by momentarily opening OVERLOAD RESET switch S9 to de-energize K5. Relay K5 will remain de-energized when S9 is released to its normally closed position only if the overload was temporary; otherwise, K4 will be energized again as soon as high voltage is applied and will in turn re-energize K5. Overloads are indicated by zero readings on P A PLATE meter and PLATE POWER indicator I 4, which will go out whenever the ac input is removed from T9.

**Warning:** Always use THERMAL RESET switch to restore the thermostat disk to its normal position. Forcing the disk up by pushing it up with the fingers will change the calibration point and damage the equipment.

# CHAPTER 6

## FIELD MAINTENANCE

*Note.* This chapter contains information needed for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and by the skill of the repairman.

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### Section I. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

**Warning:** Radio Transmitter T-368/URT develops extremely high voltages which are dangerous to life if contacted. The protective electrical interlock switches should not be relied upon. Be sure that the back cover and the three decks are closed before applying plate power. A red pilot lamp, labeled PLATE POWER, on the front panel of the transmitter, indicates when the high-voltage supply is turned on. Since this lamp may burn out, do not rely upon it to show that no high voltage is present. When the transmitter is in operation, extremely high rf voltages are present around the antenna tuning unit. Make certain that the voltage is off and use the shorting stick before changing parts and making repairs.

#### 73. Troubleshooting Procedures

*a. General.* The first step in servicing a defective radio transmitter is to sectionalize the fault. Sectionalization means tracing the fault to a major component or circuit responsible for the abnormal operation of the transmitter. The second step is to localize the fault. Localization means tracing the fault to the defective part responsible for the abnormal condition. Some faults, such as burned-out resistors, arcing, and shorted transformers, often can be located but must be localized by checking voltages and resistances or by signal substitution.

*b. Component Sectionalization and Localization.* Listed below is a group of tests arranged to simplify and reduce unnecessary work and to aid in tracing a trouble to a specific component. The simpler tests are used first; those that follow are more complex. For example, the trouble is traced to a further section of the transmitter (a deck, or a subassembly on a deck), and the faulty component in that section is located; then the trouble is remedied. During servicing, be careful

not to cause any further damage to the equipment. The service procedure is summarized as follows:

- (1) *Visual inspection.* The purpose of visual inspection is to enable the repairman to locate any visible trouble. Through inspection alone, the repairman frequently may discover the trouble or determine the circuit in which the trouble exists. This inspection is valuable in avoiding additional damage that might occur through improper servicing methods and in forestalling future failures.
- (2) *Resistance measurements.* The use of resistance measurements to locate trouble will stop further damage to the equipment if possible short circuits are present. When a fault develops in a circuit, its effect will often show up as a change in the resistance values. To assist in the localization of such faults, troubleshooting data include the normal resistance values as measured at the tube sockets and at key terminal points. These values are measured between the indicated points and ground, unless otherwise stated. Often it is desirable to measure the resistance from other points in the circuit to determine whether the particular points in the circuit are normal. The normal resistance values at any point can be determined by referring to the resistance values shown in the schematic diagram, or by the use of the resistor color code (fig. 89). Before making any resistance measurements, turn off the power. An ohmmeter is essentially a low-range voltmeter and battery. If the ohmmeter is connected to a circuit which already has voltages

in it, the needle will be knocked off scale and the meter movement may be burned out.

(3) *Voltage measurements.* Voltage measurements are an almost indispensable aid to the repairman, because most troubles either result from abnormal voltage or produce abnormal voltages. Voltage measurements are taken easily, because they are always made between two points in a circuit and the circuit need not be interrupted.

(a) Unless otherwise specified, the voltages listed on the charts are measured between the indicated points and ground.

(b) Always begin by setting the voltmeter on the highest range so that the voltmeter will not be overloaded. Then, if it becomes necessary to obtain increased accuracy, set the voltmeter to a lower range.

(c) When checking cathode voltage, remember that a reading can be obtained when the cathode resistor is actually open. The resistance of the meter may act as a cathode resistor. Thus, the cathode voltage may be approximately normal only as long as the voltmeter is connected between cathode and ground. Before the cathode voltage is measured, make a resistance check with a cold circuit to determine whether the cathode resistor is normal.

**Caution:** Certain precautions must be followed when measuring voltages above a few hundred volts. High voltages are dangerous and can be fatal. When it is necessary to measure high voltages, observe the following rules:

1. Connect the ground lead to the voltmeter.
2. Place one hand in the pocket. This will eliminate the possibility of making accidental contact with either ground or another part of the circuit and causing the electricity to travel from one hand to the other.
3. If the voltage is less than 300 volts, connect the test lead to the hot

terminal (which may be either positive or negative with respect to ground).

4. If the voltage is greater than 300 volts, shut off the power, connect to the hot lead, step away from the voltmeter, turn on the power, and note the reading on the voltmeter. Do not touch any part of the voltmeter, particularly when it is necessary to measure the voltage between two points which are above ground.

(4) *Current measurements.* Current measurements, other than those indicated by panel meters, are not ordinarily required when troubleshooting the radio set. Under special circumstances, where the voltage and resistance measurements are not sufficient to localize the trouble, a current measurement can be made by opening the circuit and connecting an ammeter to measure the current. This procedure is not recommended except in very difficult cases. When the meter is inserted in a circuit to measure current, it should always be inserted away from the rf end of the resistance. For example, when measuring *plate* current, do not insert the meter next to the plate of a tube, but insert it next to the end of the resistor which connects to the power. This precaution is necessary to keep the meter from upsetting the rf voltages.

**Caution:** A meter has least protection against damage when it is used to measure current. Always set the current range to the highest value. Then, if necessary, decrease the range to give a more accurate reading. Avoid working close to full-scale reading because this increases the danger of overload.

(5) *Capacitor tests.* Leaky or shorted capacitors can be found by resistance checks of the stage. A capacitor which is suspected of being open can best be checked by shunting a good capacitor across it. In rf circuits, keep the lead to the capacitor as short as the original capacitor leads. A capacitor color code (fig. 90) is used for checking the capacitor value against the value shown on the circuit diagram.

**Caution:** Capacitors must always be discharged before resistance measurements are made. This is very important when checking power supplies that are disconnected from their load. The discharge of the capacitor through the meter will burn out its movement, and in some cases may endanger life.

- (6) *Tube checking.* Tube checkers are used to check the emission of electrons from the cathode and to test for shorted elements. Tube checkers will not test the performance of high-voltage tubes, rectifiers, or some special tubes in the modulator and rectifier. Tube checkers are useful, however, for checking receiving-type tubes used in the various components.
- (a) Results obtained from a tube checker are not always conclusive, because the conditions are not the same as those under which the tube operates in the set. For this reason, the final test of a tube must be its replacement with a tube which is known to be good. In many cases it is quicker and more reliable to replace a suspected tube with a good one than to check it with the tube checker.
- (b) An operating chart and a manual are provided with the tube checker. This chart indicates the setting of the tube checker for each tube type. The number of controls, their arrangement, and their settings vary with different types of tube checkers.
- (7) *Operational test.* The operational test (par. 78) is important because it frequently indicates the general location of trouble. In many instances, the information gained will determine the exact nature of the fault. To utilize this information fully, interpret all symptoms in relation to one another.
- (8) *Troubleshooting chart.* The trouble symptoms listed in the troubleshooting chart

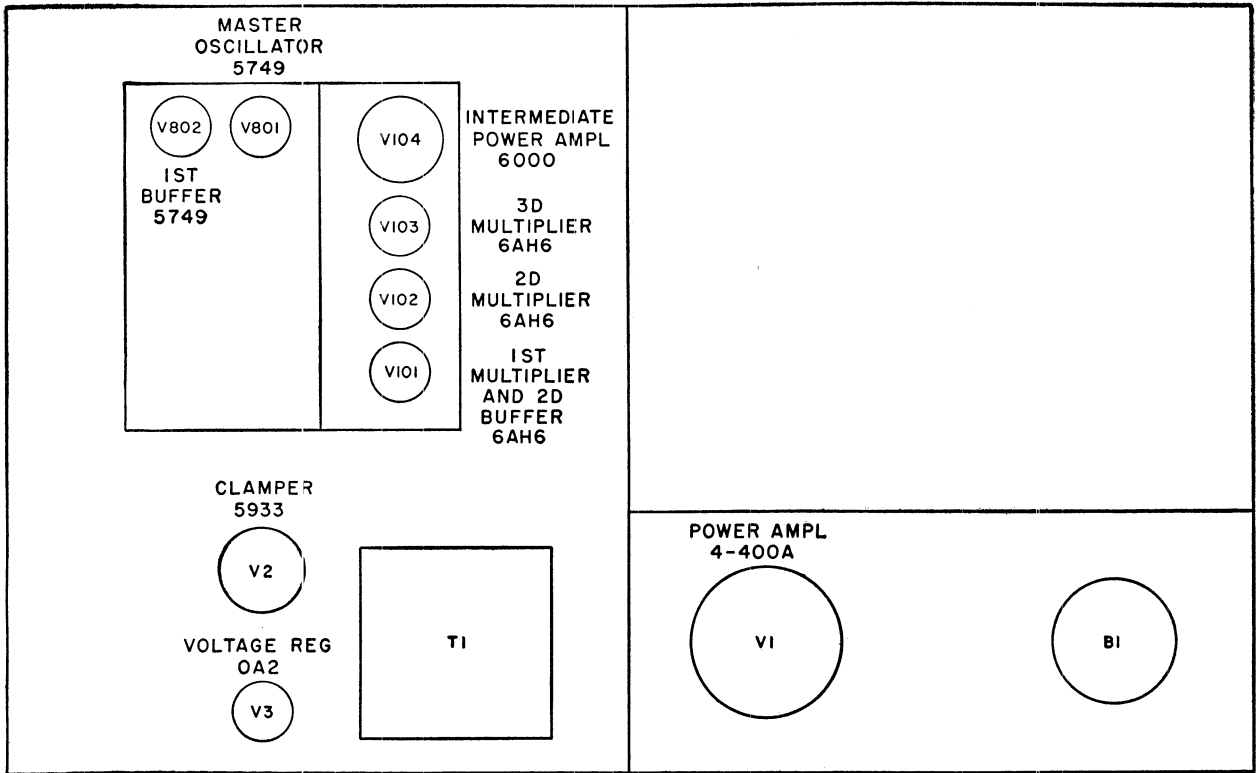
(par. 79) will aid greatly in localizing trouble.

- (9) *Signal substitution.* Signal substitution is effective in localizing trouble (pars. 81 and 82) by use of proper signal generators.
- (10) *Stage-gain charts.* The stage-gain charts help to localize obscure troubles (par. 83).
- (11) *Intermittents.* In all these tests, the possibility of intermittent conditions should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the equipment. It is possible that some external connection may cause the trouble. Gently move the wiring for loose connections, and tap the components with an insulated tool such as a fiber rod. This may show where a faulty connection or component is located.

## 74. Troubleshooting Data

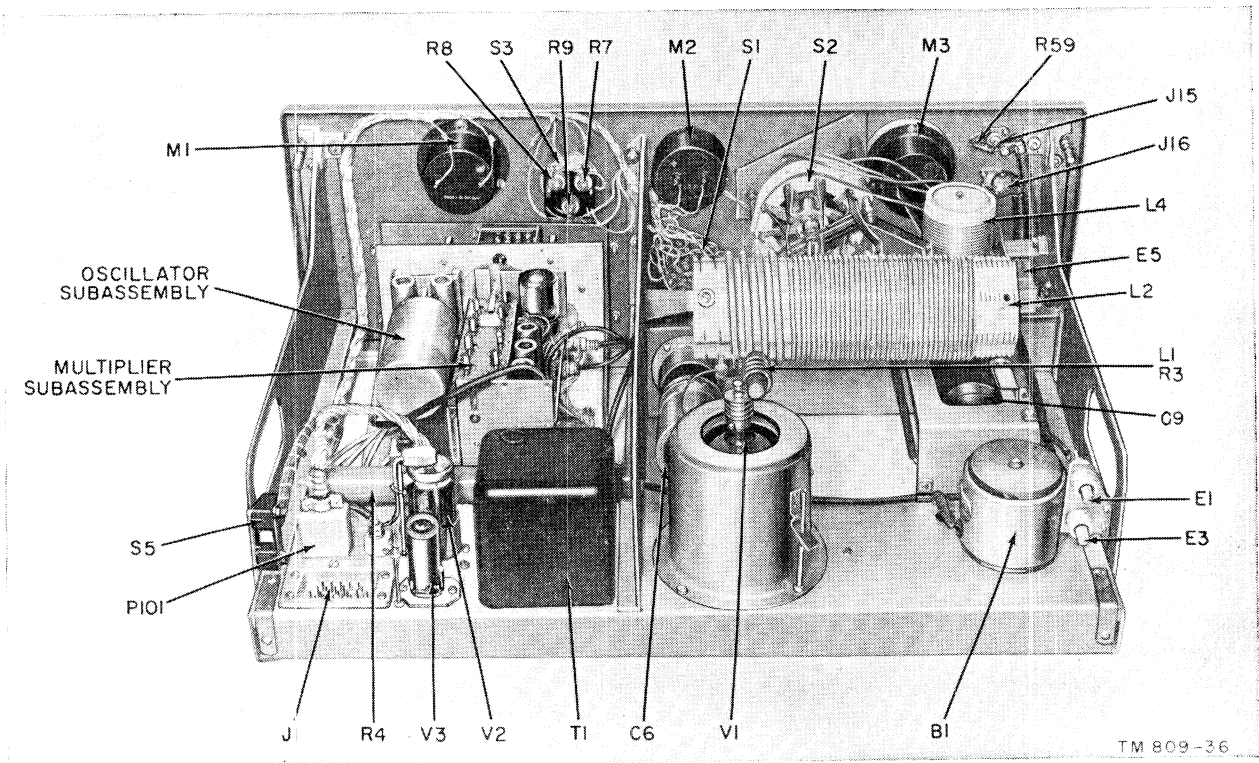
**Caution:** Always check the circuit labels, because the schematic diagram in the manual may not include circuit changes made during equipment production. Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the troubleshooting data in the following chart:

Fig. No.	Description
	RF deck:
49-----	Tube location.
50, 51, 52, 53, 54, 55, and 56.	Component location.
57, 58, 59, 60, 61, 62, and 63.	Voltage and resistance data.
	Modulator deck:
64-----	Tube location.
65, 66, 67, and 68-----	Component location.
69, 70, 71, 72, and 73--	Voltage and resistance data.
	Power supply deck:
74-----	Tube location.
75, 76, and 77-----	Component location.
78 and 79-----	Voltage and resistance data.
	Housing:
80-----	Component location.
81-----	Voltage and resistance data.



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Figure 49. Rf deck, tube location.



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Figure 50. Rf deck, top view.

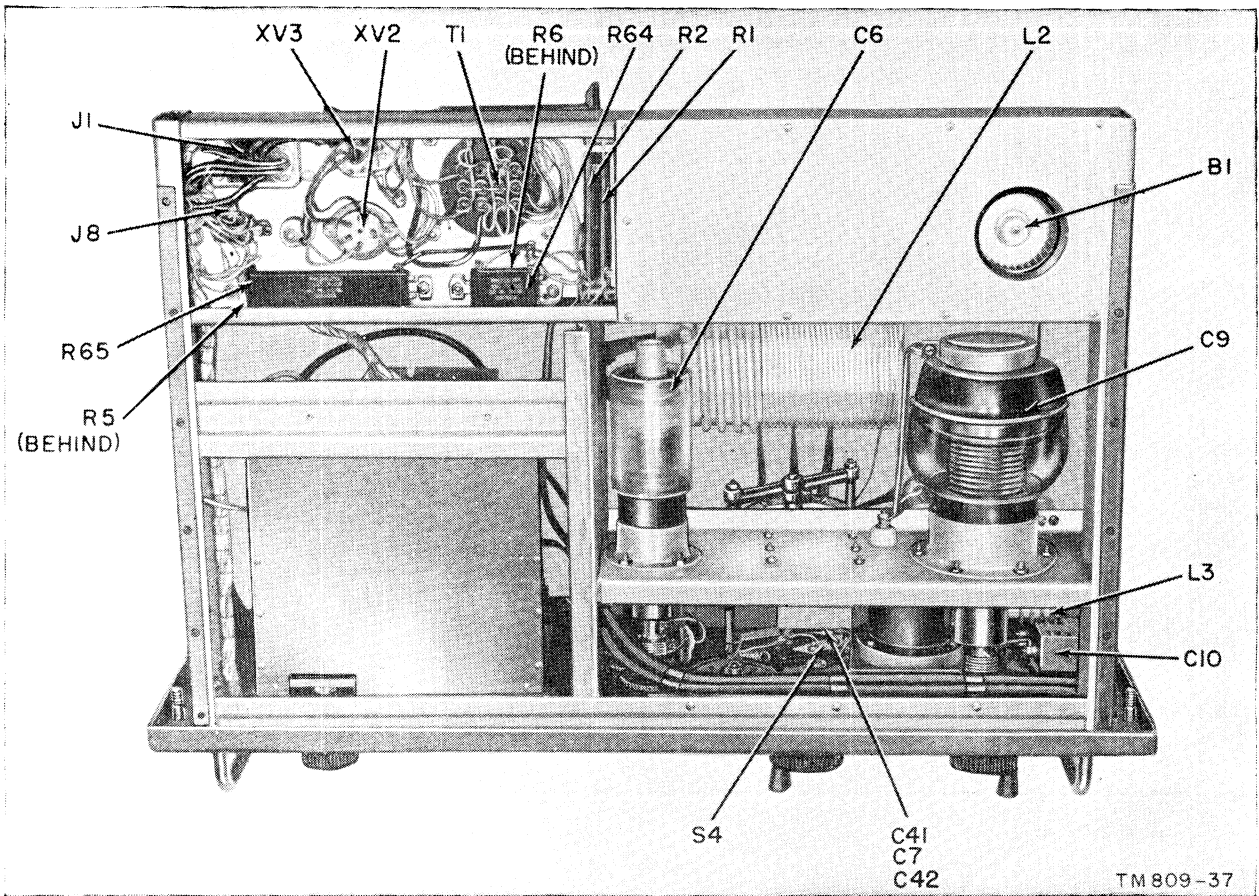


Figure 51. Rf deck, bottom view.

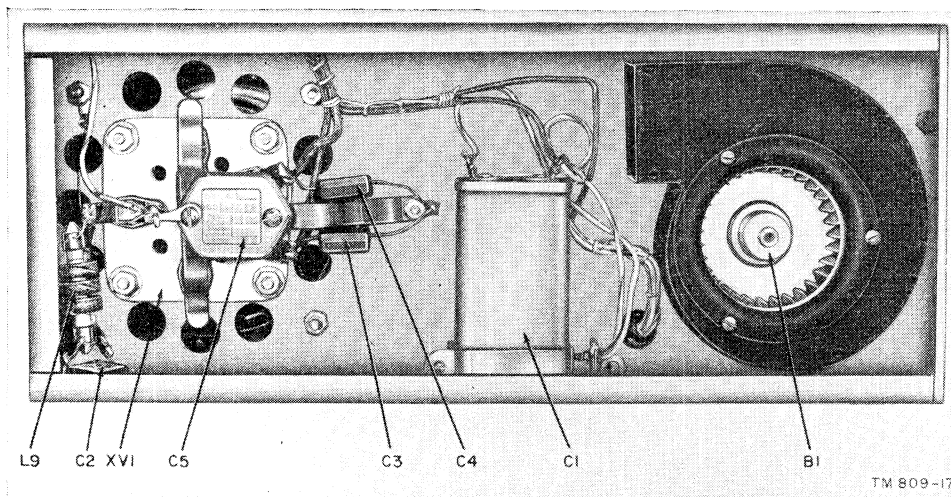


Figure 52. Rf deck, blower duct (cover removed).

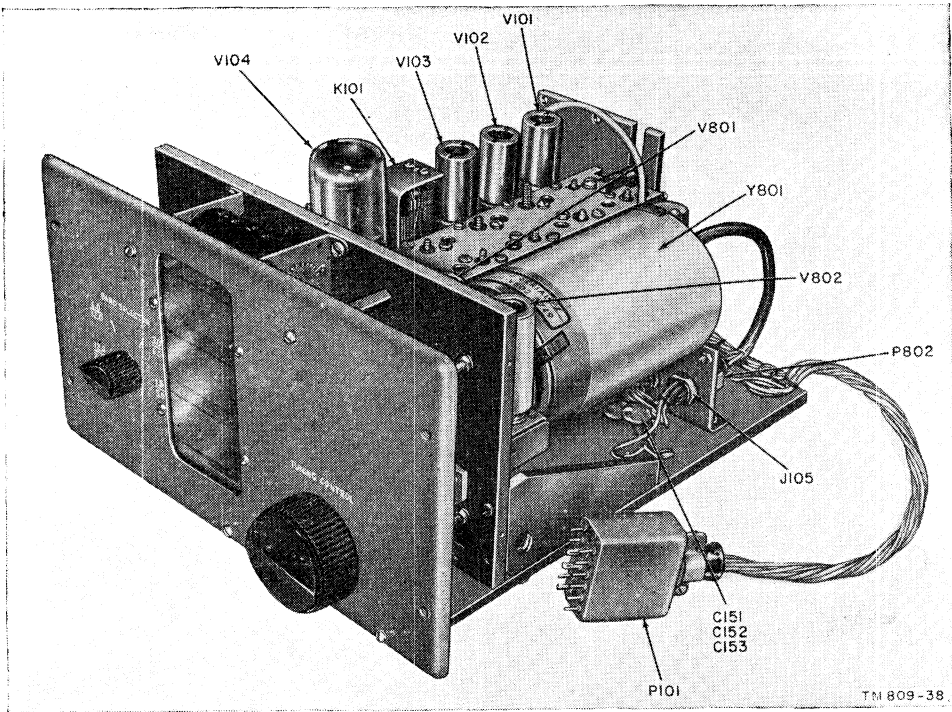


Figure 53. Oscillator and multiplier subassemblies, top view.

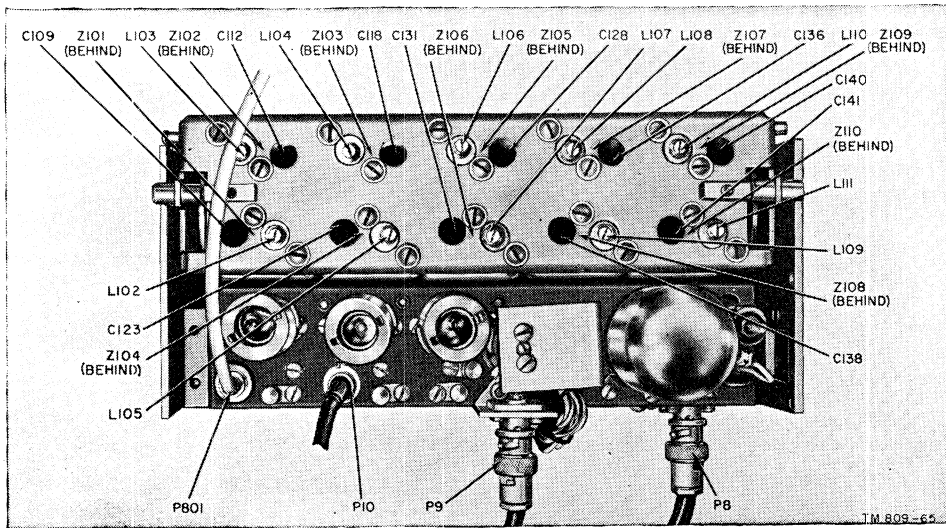


Figure 54. Multiplier subassembly, top view.

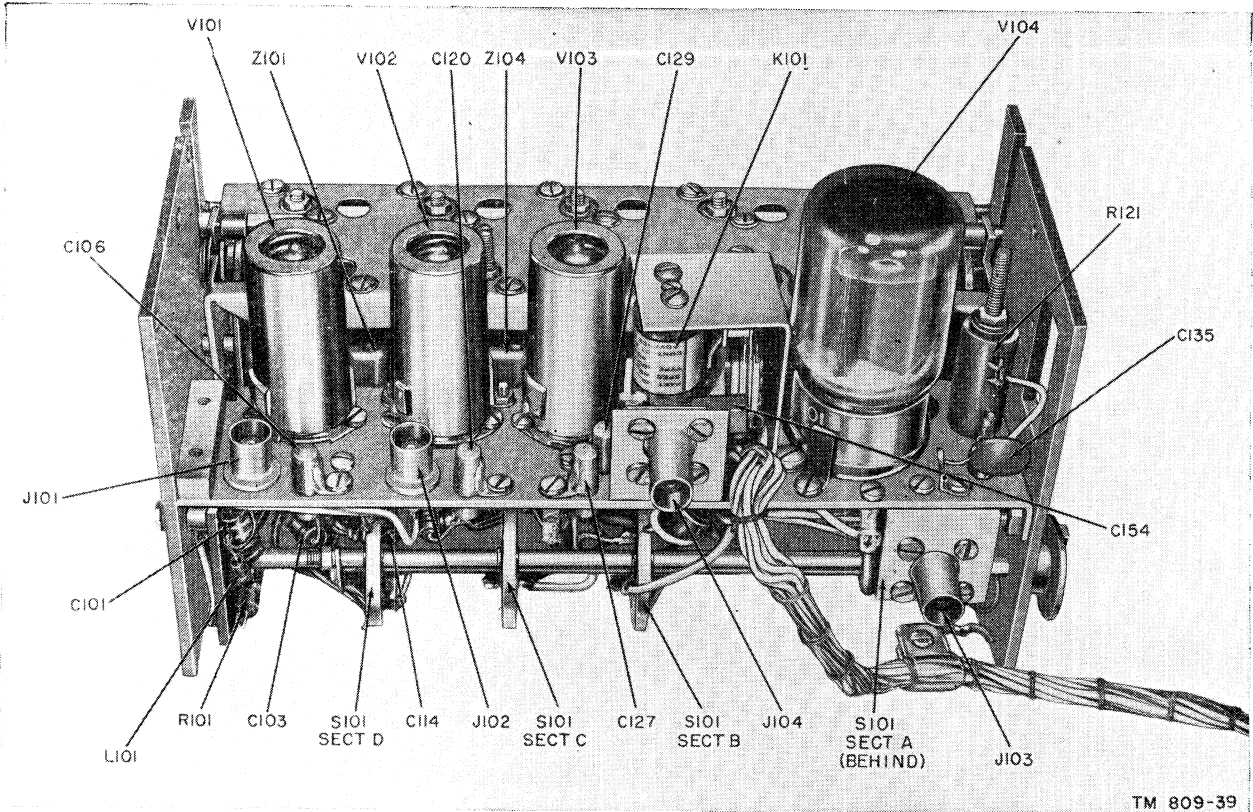


Figure 55. Multiplier subassembly, side view.

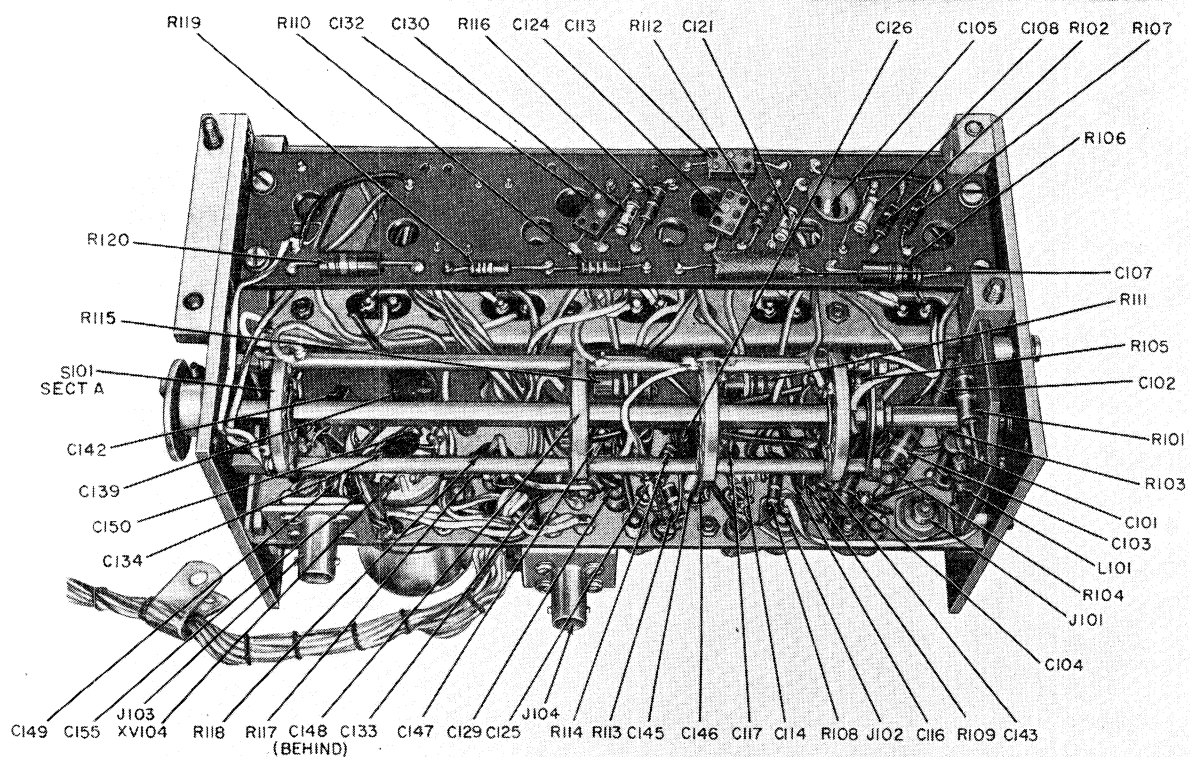
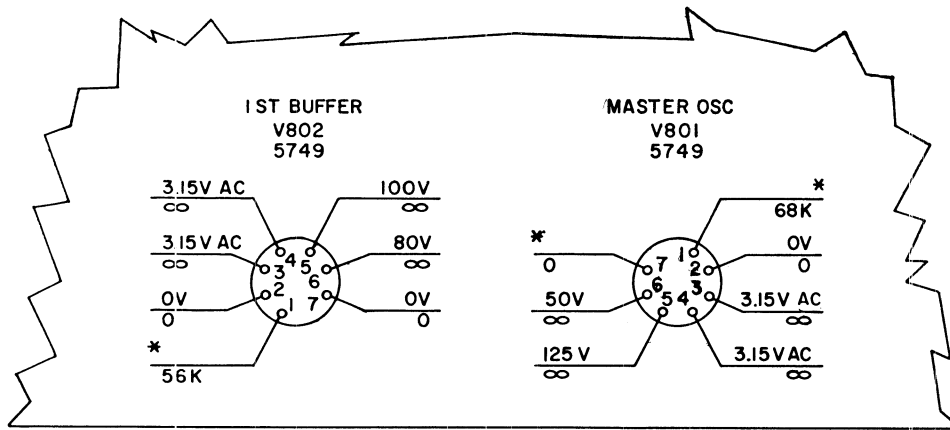


Figure 56. Multiplier subassembly, bottom view.

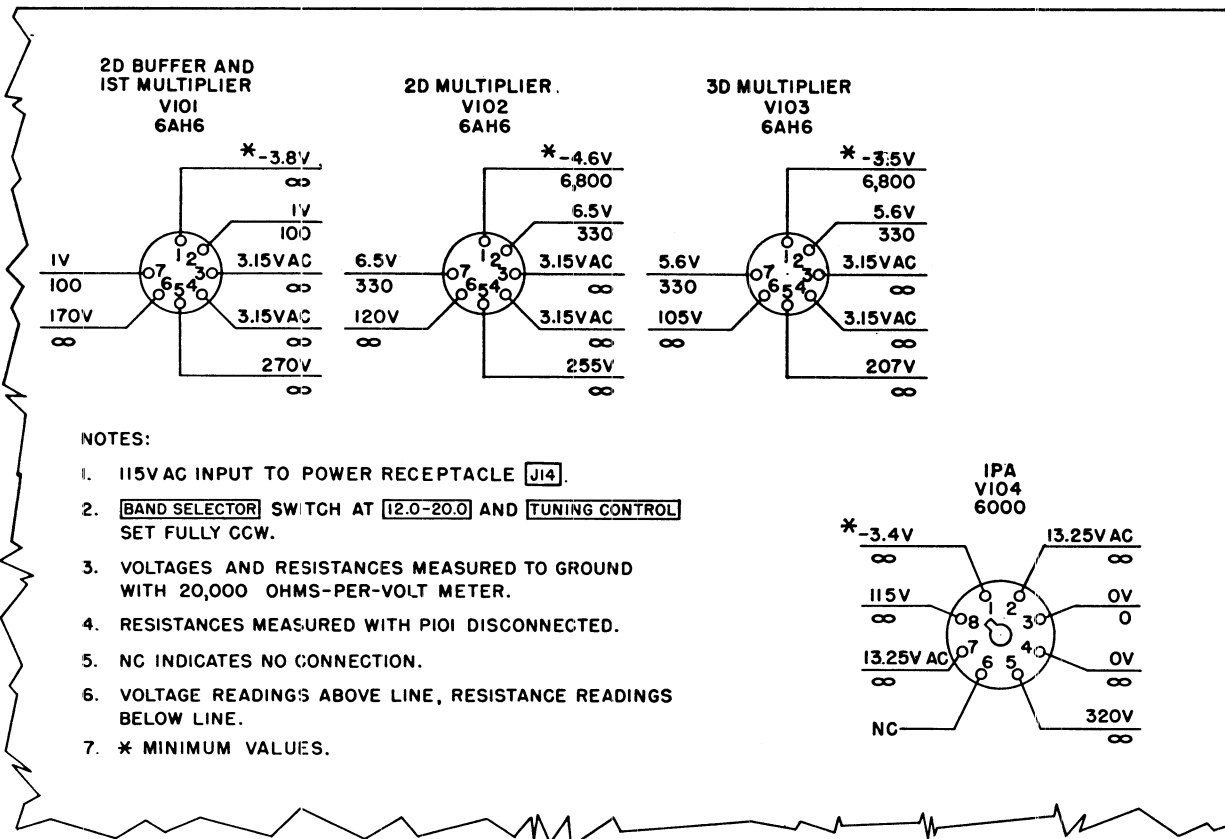


**NOTES:**

1. 115V AC INPUT TO POWER SOCKET [J14].
2. [SERVICE SELECTOR] SWITCH AT [CW] OR [AM].
3. VOLTAGE AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
4. RESISTANCES MEASURED WITH P802 DISCONNECTED.
5. \* INDICATES PINS AT WHICH VOLTAGE MEASUREMENTS WOULD BE MISLEADING BECAUSE OF CIRCUIT UNBALANCE.
6. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.

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Figure 57. Oscillator subassembly, V801 and V802, voltage and resistance data.

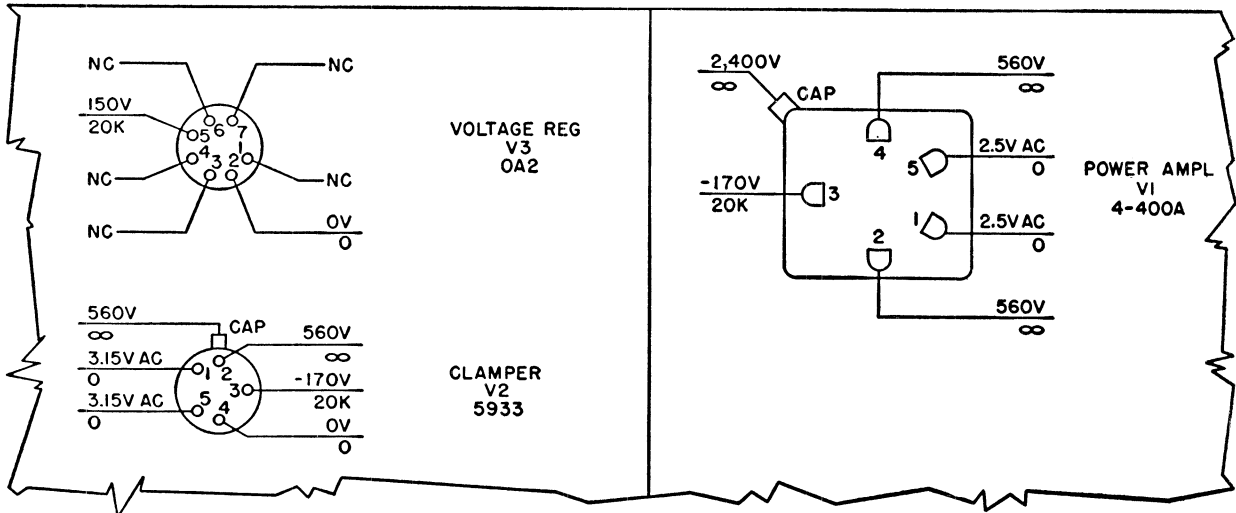


**NOTES:**

1. 115V AC INPUT TO POWER RECEPTACLE [J14].
2. [BAND SELECTOR] SWITCH AT [12.0-20.0] AND [TUNING CONTROL] SET FULLY CCW.
3. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
4. RESISTANCES MEASURED WITH P101 DISCONNECTED.
5. NC INDICATES NO CONNECTION.
6. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.
7. \* MINIMUM VALUES.

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Figure 58. Multiplier subassembly, V101 through V104, voltage and resistance data.



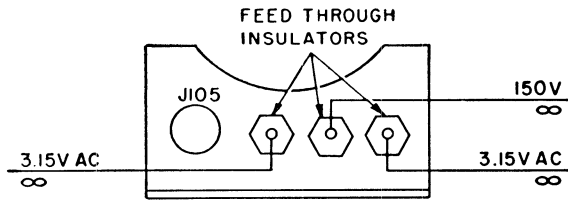
NOTES:

1. 115V AC INPUT TO POWER RECEPTACLE J14.
2. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
3. RESISTANCES MEASURED WITH PLUGS DISCONNECTED FROM J1 AND J8.
4. NC INDICATES NO CONNECTION.
5. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.

TM 809-52

Figure 59. Rf deck, V1 through V3, voltage and resistance data.



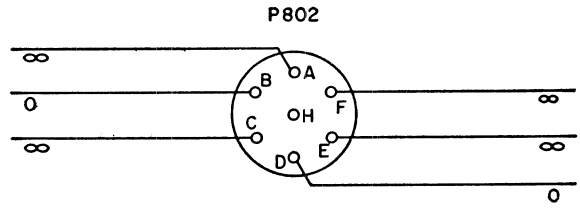


NOTES:

1. 115V AC INPUT TO POWER SOCKET **J14**.
2. **SERVICE SELECTOR** SWITCH AT **AM** OR **CW**.
3. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
4. RESISTANCES MEASURED WITH P101 DISCONNECTED FROM J8.
5. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.

TM 809-54

Figure 61. Rf deck, terminal bracket, voltage and resistance data.

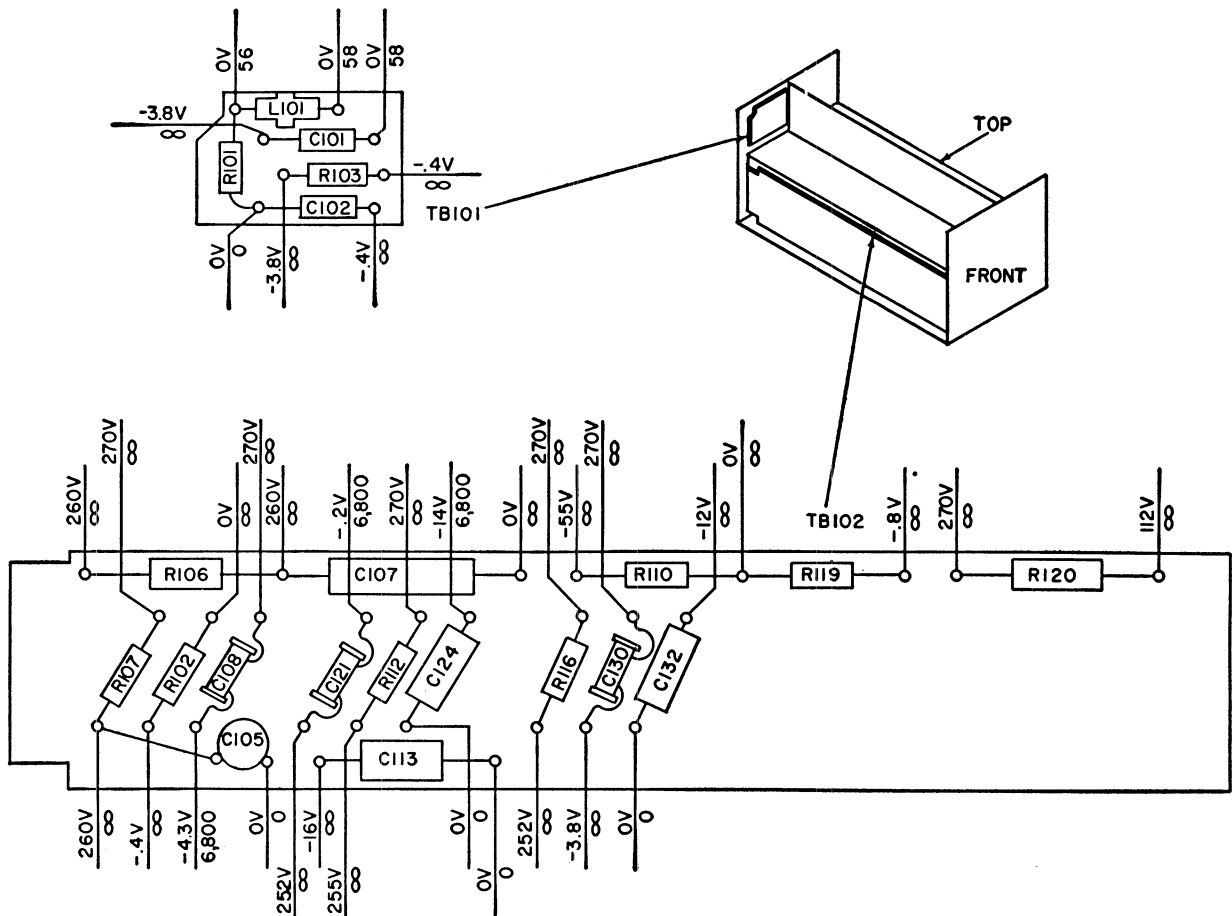


NOTES:

1. RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
2. MEASUREMENTS MADE WITH P802 DISCONNECTED FROM J105 ON MULTIPLIER SUBASSEMBLY.
3. RESISTANCE READINGS BELOW LINE.

TM 809-49

Figure 62. Oscillator subassembly, P802, resistance data.

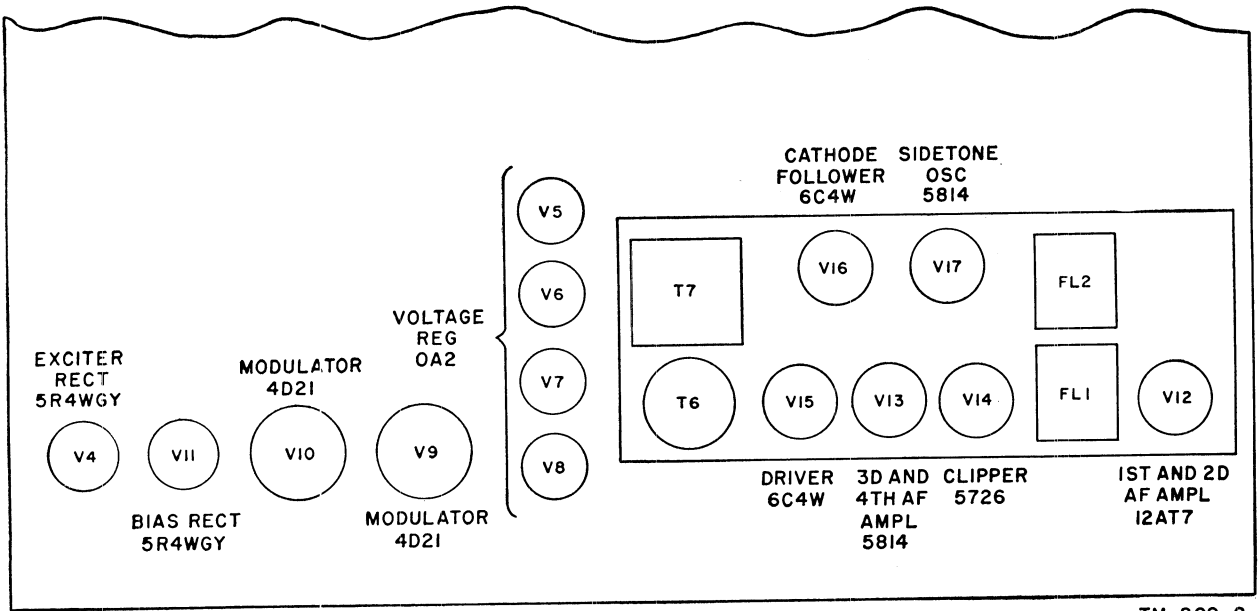


NOTES:

1. 115V AC INPUT TO POWER RECEPTACLE **J14**.
2. **BAND SELECTOR** SWITCH AT **12.0-20.0**, POSITION.
3. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
4. RESISTANCES MEASURED WITH P101 DISCONNECTED.
5. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.

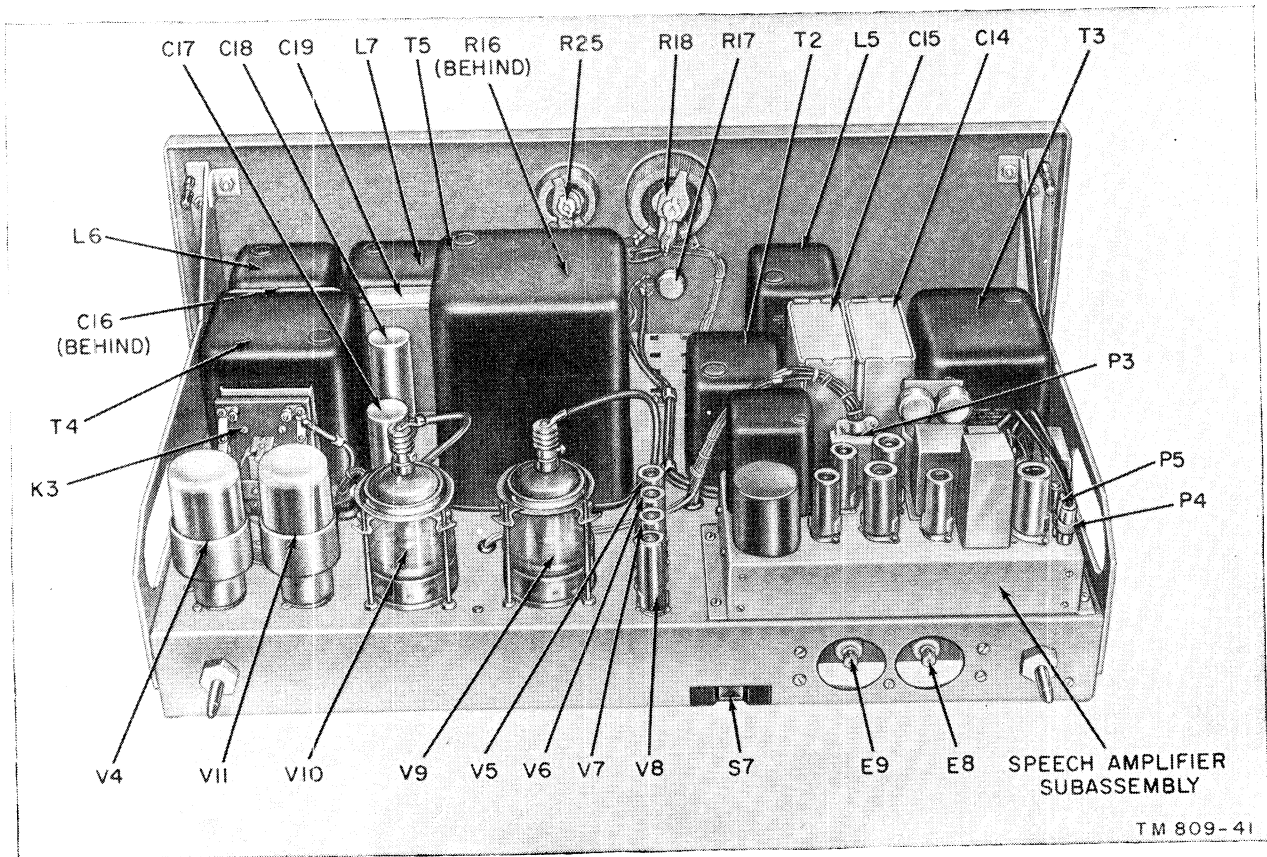
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Figure 63. Multiplier subassembly, terminal board, voltage and resistance data.



TM 809-8

Figure 64. Modulator deck, tube location.



TM 809-41

Figure 65. Modulator deck, top view.

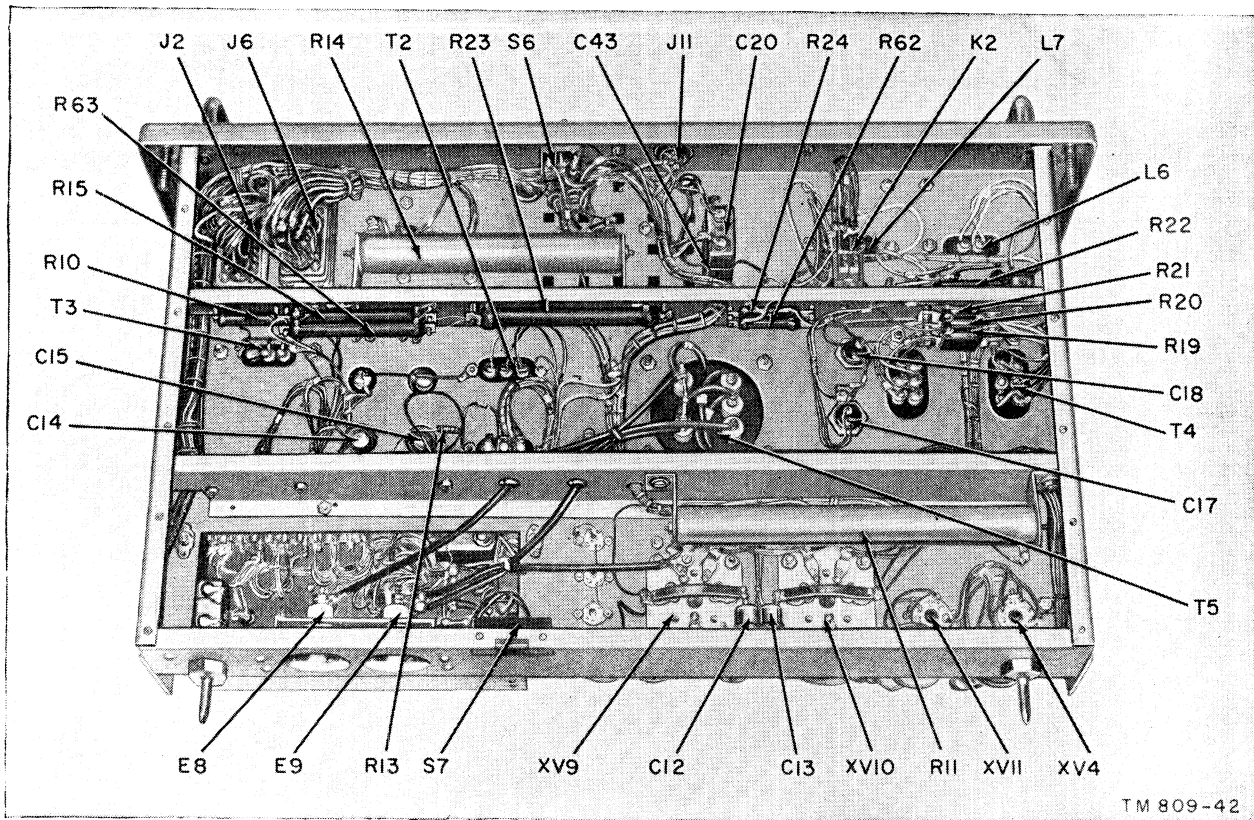


Figure 66. Modulator deck, bottom view.

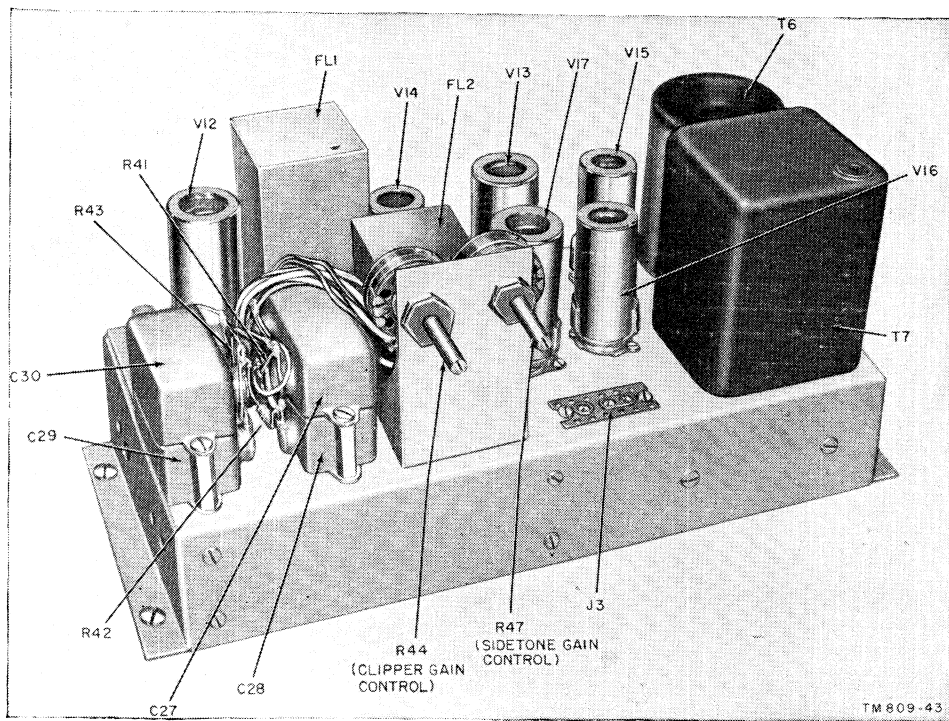


Figure 67. Speech amplifier subassembly, top view.

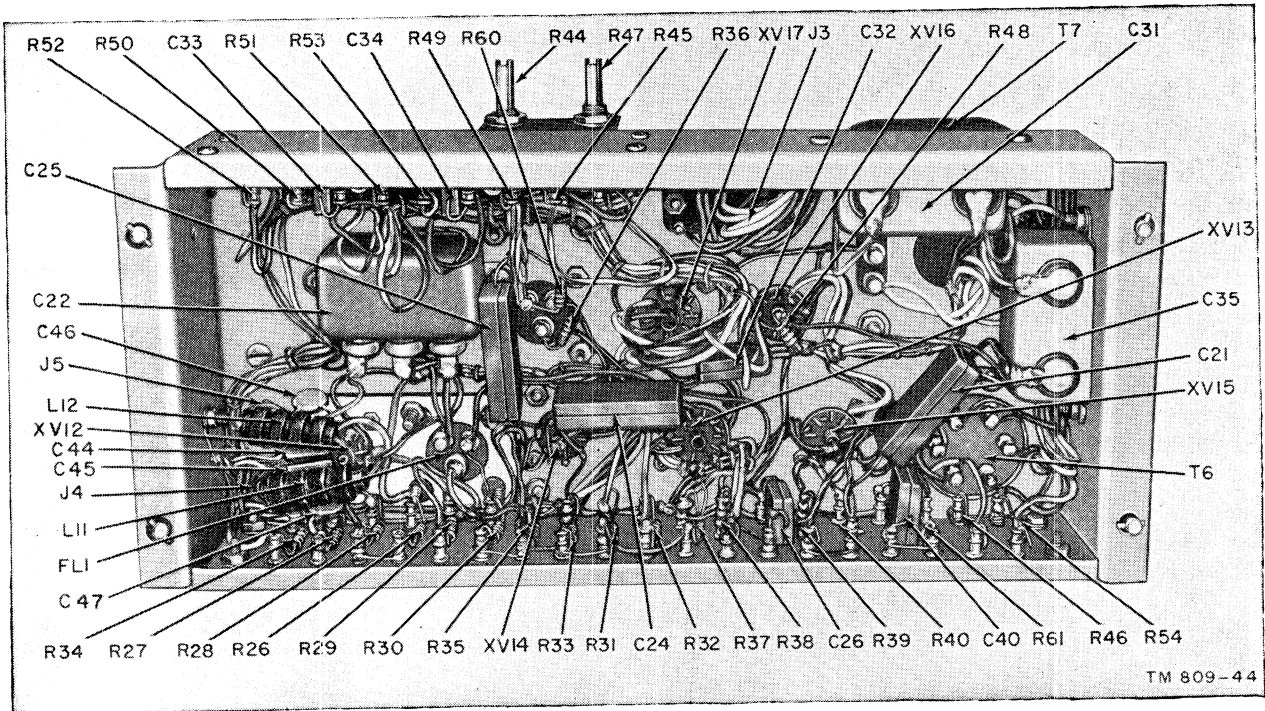
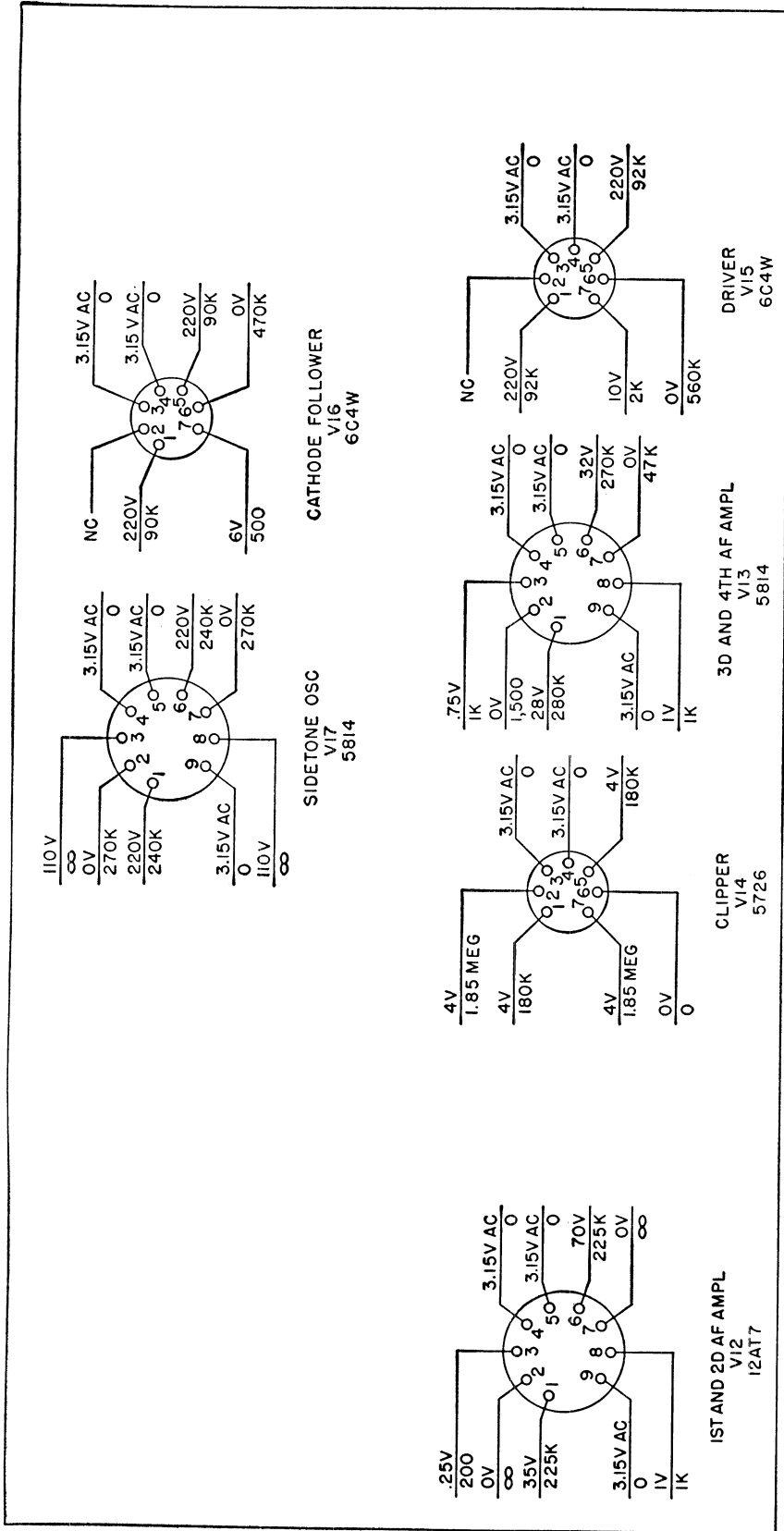


Figure 68. Speech amplifier subassembly, bottom view.

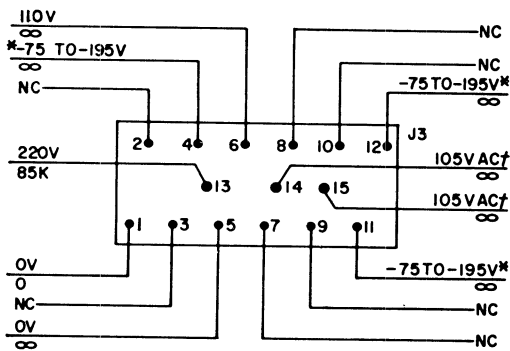


NOTES:

1. 115V AC INPUT TO POWER RECEPTACLE [J14].
2. SET FOR 600 OHM LINE (PHONE) OPERATION.
3. CLIPPER CONTROL (R44) TURNED TO OFF (CCW POSITION).
4. SIDETONE OSCILLATOR TURNED OFF.
5. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
6. NC INDICATES NO CONNECTION.
7. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.

Figure 69. Speech amplifier subassembly, V12 through V17, voltage and resistance data.





**NOTES:**

1. 115V AC INPUT TO POWER SOCKET [J14].
2. SET FOR 600-OHM LINE (PHONE) OPERATION.
3. CLIPPER CONTROL (R44) TURNED OFF (CCW POSITION).
4. SIDETONE OSCILLATOR TURNED OFF (ANY POSITION BUT [CW]).
5. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
6. \* INDICATES MEASUREMENT RANGE AS [MODULATOR BIAS] CONTROL IS MOVED FROM CCW TO CW POSITION.
7. ‡ INDICATES MEASUREMENT ACROSS PINS 14-15.
8. NC INDICATES NO CONNECTION.
9. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.

TM 809-57

Figure 71. Speech amplifier subassembly, J3, voltage and resistance data.

### 75. Test Equipment Required for Troubleshooting

The test equipment required for troubleshooting Radio Transmitter T-368/URT is listed below.

Nomenclature	Common name
Audio Oscillator TS-382A/U	Audio oscillator.
Electronic Multimeter ME-30/U	Vtvm.
Frequency Meter Set SCR-211	Frequency meter.
Multimeter TS-352/U	Multimeter.
Oscilloscope OS-8A/U	Test scope.
Signal Generator AN/URM-25	Signal generator.
Electron Tube Test Set TV-7/U	Tube tester.
Relay Test Set I-181	Relay tester.
Ammeter TS-76	Rf meter.
Analyzer Spectrum TS-723/U	Analyzer.
Test Set 100-A	Reversal machine (dot keyer).
Frequency Shift Exciter O-39/TRA-7	Frequency shift exciter.
Teletypewriter TT-4A/TG	Teletypewriter.

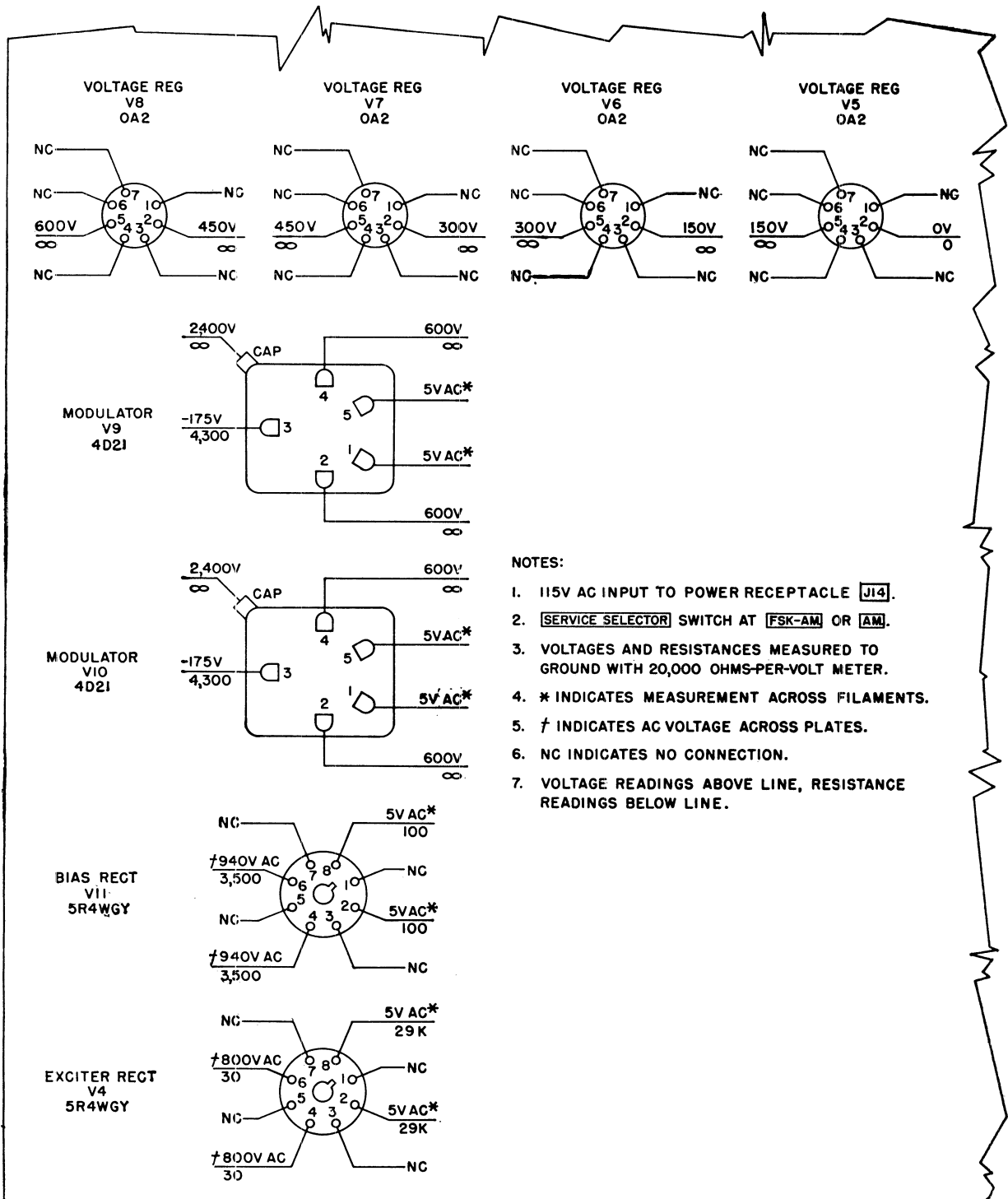
### 76. General Precautions

Observe the following precautions when servicing the radio transmitter:

a. Be very careful when servicing the equipment with the interlocks bypassed. Dangerous voltages are exposed.

b. Careless replacement of parts often makes new faults inevitable. Note the following points:

- (1) Before a part is unsoldered, note the position of the component and the placement of its leads. If the part, such as a power transformer, has a number of connections, tag each lead.
- (2) Be careful not to break the leads or other parts by pushing or pulling them out of the way.
- (3) Do not use a large soldering iron when soldering small resistors or ceramic capacitors. A large soldering iron used in a narrow, confined area can damage nearby components. Overheating of the small parts may ruin or change the value of the component.
- (4) Remove drops of solder that fall into the equipment; they may cause short circuits.
- (5) Make well-soldered joints. A poorly soldered joint, which can cause intermittent and poor operation, is one of the most difficult faults to find.
- (6) When a part is replaced in a high-frequency circuit, it must be placed in the exact position occupied by the original part. A part that has the same electrical value but different physical dimensions may cause trouble in these circuits. Give particular attention to proper grounding when replacing a part; use the same ground as that used in the original wiring. Failure to observe these precautions may result in improper operation.
- (7) *Do not disturb* any of the alignment adjustments unless it definitely has been determined that trouble is caused by an adjustment that is improperly set.

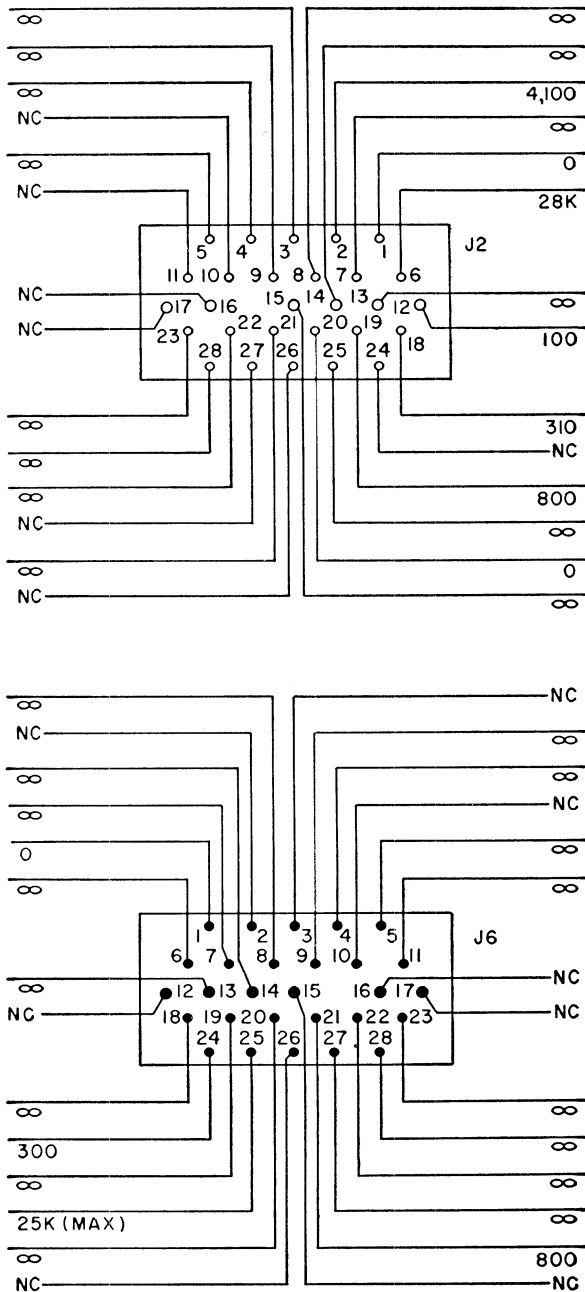


**NOTES:**

1. 115V AC INPUT TO POWER RECEPTACLE **J14**.
2. **SERVICE SELECTOR** SWITCH AT **FSK-AM** OR **AM**.
3. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
4. \* INDICATES MEASUREMENT ACROSS FILAMENTS.
5. † INDICATES AC VOLTAGE ACROSS PLATES.
6. NC INDICATES NO CONNECTION.
7. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.

TM 809-58

Figure 72. Modulator deck, V4 through V11, voltage and resistance data.

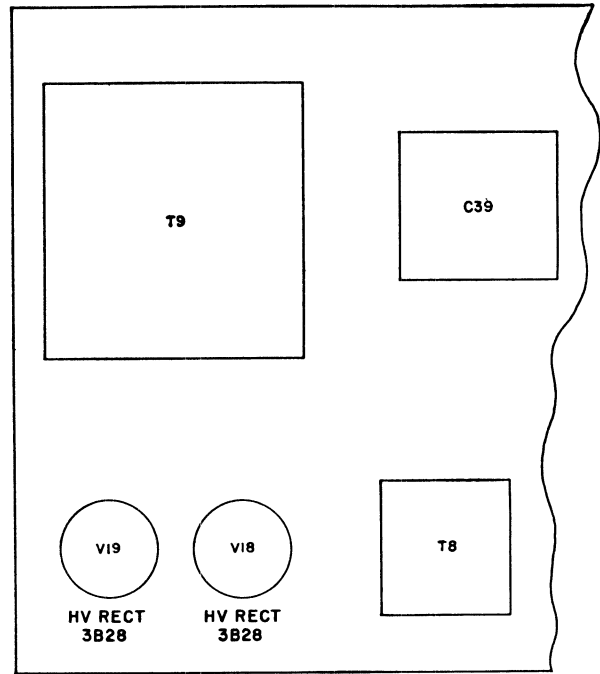


NOTES:

1. RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
2. [EXCITER PLATE POWER] SWITCH AT ON.
3. MEASUREMENTS MADE AT J2 WITH P6 DISCONNECTED FROM J6, AND AT J6 WITH P2 DISCONNECTED FROM J2.
4. NC INDICATES NO CONNECTION.
5. RESISTANCE READINGS BELOW LINE.

TM 809-59

Figure 73. Modulator deck, J2 and J6, resistance data.



TM 809-9

Figure 74. Power supply deck, tube location.

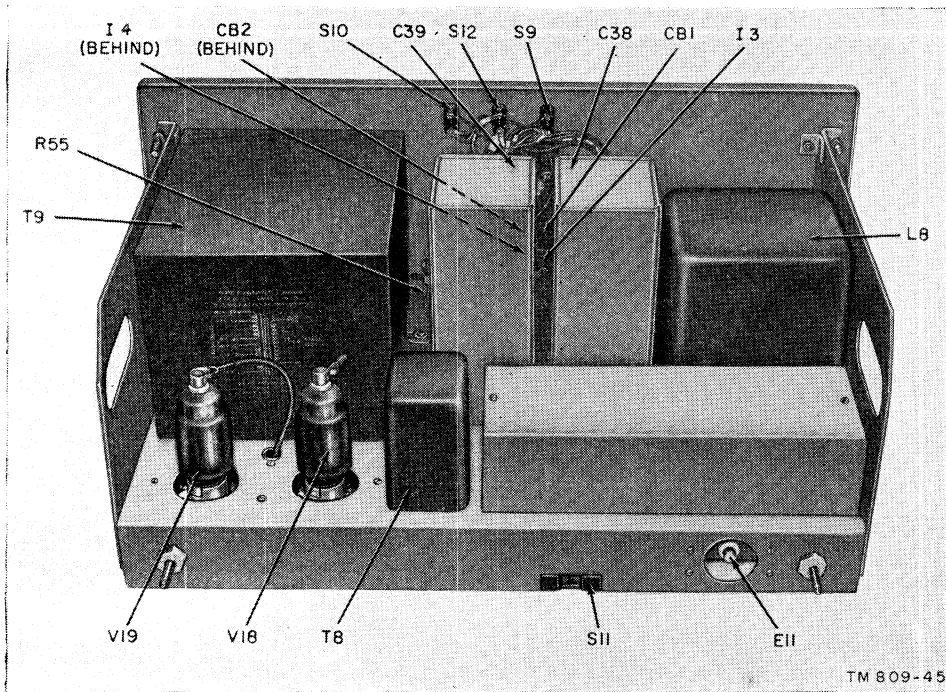


Figure 75. Power supply deck, top view.

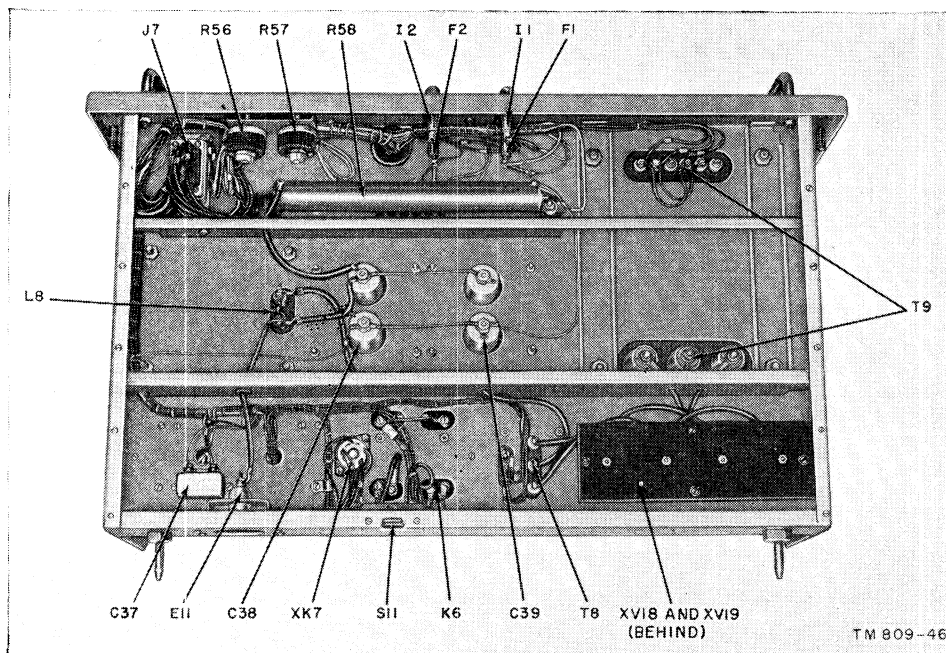


Figure 76. Power supply deck, bottom view.

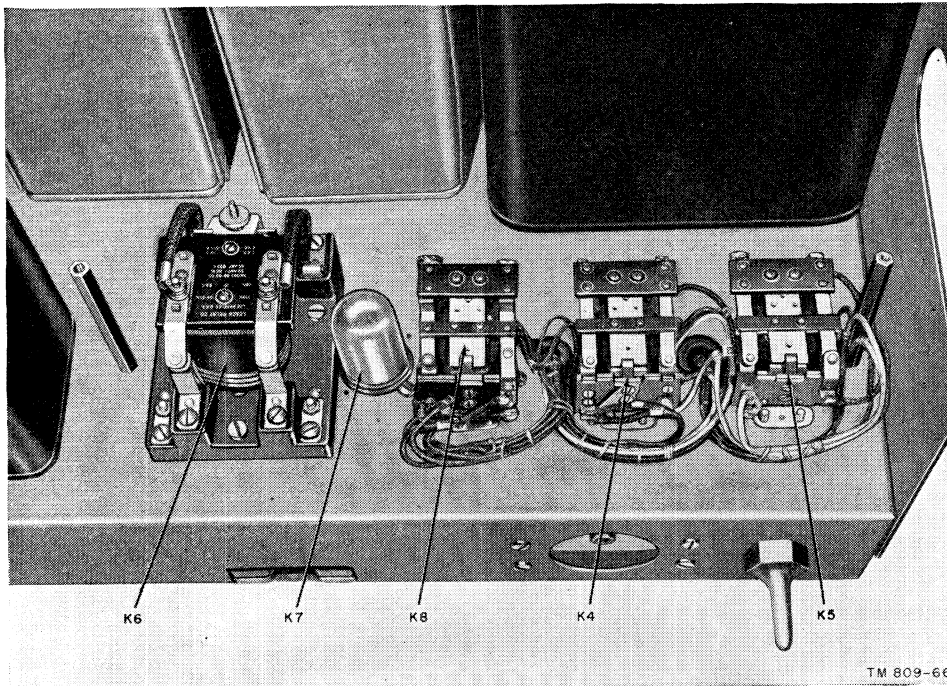
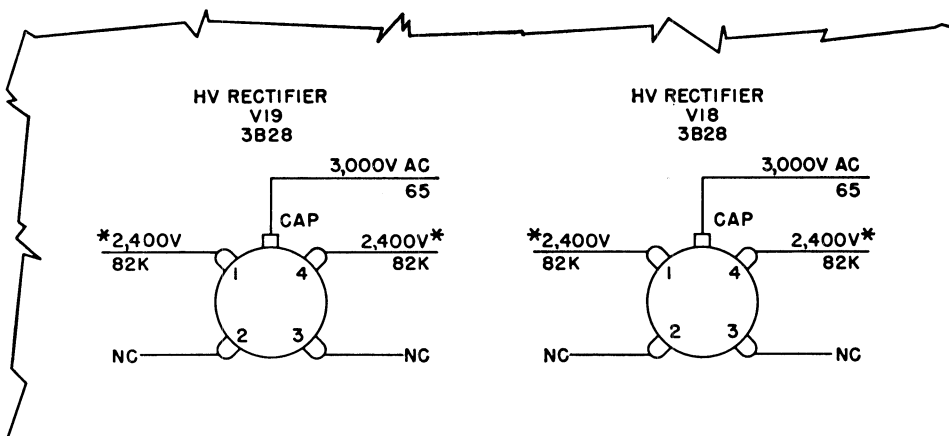


Figure 77. Power supply deck, relay assembly (cover removed.)

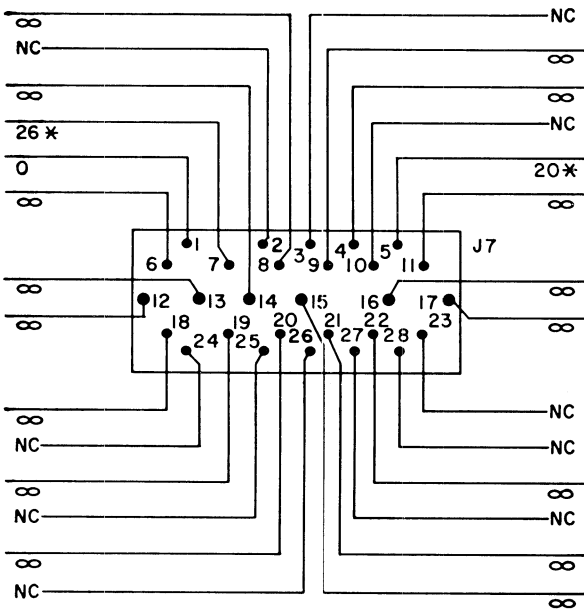


NOTES:

1. 115V AC INPUT.
2. SWITCH S12 AT OPERATE, AND ALL OTHER SWITCHES AT ON.
3. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
4. \*INDICATES 2.5V AC ACROSS FILAMENTS IN ADDITION TO 2,400V TO GROUND.
5. NC INDICATES NO CONNECTION.
6. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.

TM 809-60

Figure 78. Power supply deck, V18 and V19, voltage and resistance data.



**NOTES:**

1. ALL SWITCHES AT ON POSITION.
2. RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
3. NC INDICATES NO CONNECTION.
4. RESISTANCE READINGS BELOW LINE.
- 5.\*WILL VARY FOR DIFFERENT UNITS.

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Figure 79. Power supply deck, J7, resistance data.

c. Do not overtighten screws when assembling mechanical couplings.

d. When changing a component that is held by screws and lockwashers, always be sure to put back the lockwashers.

e. If the equipment has been operating for some time, use a cloth when removing the metal tube shields and a tube puller to remove the tubes to prevent burning the hands or fingers. For the same reason, avoid touching any of the large power resistors.

## 77. Checking Filament and B+ Circuits for Shorts

Trouble with the radio transmitter may often be detected by checking the resistance of the filament and B+ circuits *before applying power* to the equipment. This will also prevent damage to the power supplies in case of a short circuit. To make the filament circuit check, remove the tubes to avoid misleading indications as filament circuits are low-resistance circuits. Use the shorting stick test before making the following checks.

a. Check the filament circuit in the rf deck. Filament power for this deck is obtained from filament transformer T1.

b. Check the filament circuit in the speech amplifier (on the modulator deck). Make the check at terminals 4 and 6 of filament transformer T7.

c. Check the filament circuit of the remainder of the modulator deck. Make the checks at terminals 4 and 6 of modulator filament transformer T2, and terminals 6 and 8, as well as 9 and 11, of power transformer T4.

d. Check the filament circuit in the power supply deck. Measure for shorts at terminals 4 and 6 of filament transformer T8. When checking the filament terminals (1 and 4) of high-voltage rectifier tubes V18 and V19, remove the insulator plate beneath the sockets.

e. Check the filter capacitors (C14 and C15) in the exciter power supply on the modulator deck for shorts.

f. Check the filter capacitors (C16, C17, C18, and C19) in the bias supply.

g. Check the high-voltage power supply in the power supply deck for short circuits. Check the filter capacitors (C38 and C39) and the spark gap across the filter choke (18).

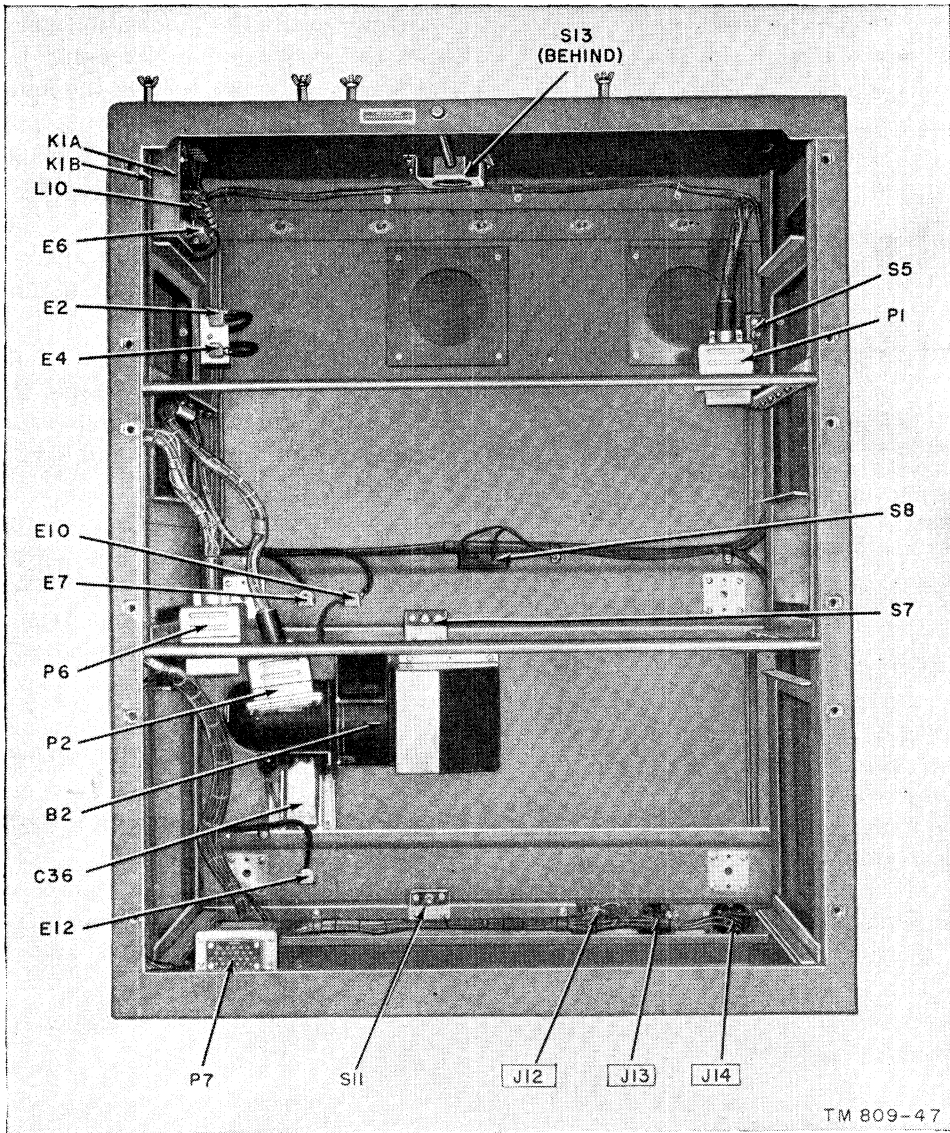


Figure 80. Housing (decks removed)

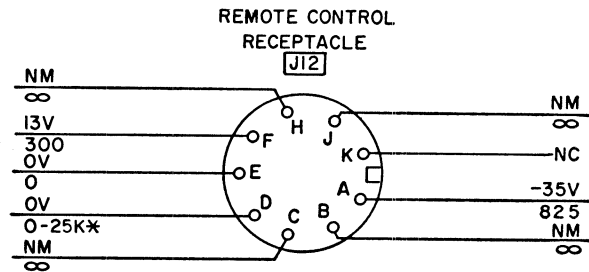
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## 78. Operational Test

With the radio transmitter connected for normal operation, operate it as described in the equipment performance check list in paragraph 52. The check list is important since it frequently indicates the general location of trouble. Listen for crackling or buzzing noises that indicate high-voltage arcing. Also check for smoke and the odor of burned or overheated parts. If smoke or odor is present, turn the set off immediately to prevent further damage to the equipment.

## 79. Troubleshooting Chart

The following chart is supplied as an aid in locating trouble in the radio transmitter. It lists the symptoms that the repairman observes, either visually or aurally, while making a few simple tests. The chart also indicates how to localize trouble quickly to a deck, subassembly, or circuit. After the trouble has been localized to a stage of a circuit, a tube check and voltage and resistance measurements of this stage or circuit



### NOTES:

1. 115V AC INPUT TO POWER SOCKET **J14**.
2. **SERVICE SELECTOR** SWITCH AT **FSK**.
3. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
4. NC INDICATES NO CONNECTION.
5. NM INDICATES NOT MEASURED.
6. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.
7. \* DEPENDS UPON SETTING OF **600 OHM LINE GAIN** CONTROL.

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Figure 81. Housing, J12, voltage and resistance data.

ordinarily should be sufficient isolate the defective parts.

Symptom	Probable trouble	Correction
1. FILAMENT POWER circuit breaker ON. No green light, blower motors not running, and no reading on FIL VOLTAGE meter.	1. No ac to equipment.....	1. Check power Cord CD-763, receptacle J14, FILAMENT POWER circuit breaker CB1, and THERMAL RESET switch S13. Repair or replace as needed.
2. FILAMENT POWER circuit breaker ON. No green light, blower motor on rf deck not operating, no reading on FIL VOLTAGE meter, and BLOWN FUSE INDICATOR lamp below 6 AMP fuse lighted.	2. Ac line partly open.....	2. Replace fuse F1.
3. FILAMENT POWER circuit breaker ON. Blower on back panel not running, BLOWN FUSE INDICATOR below 3 AMP fuse lighted and green light on.	3. Ac line partly open.....	3. Replace fuse F2.
4. FILAMENT POWER circuit breaker ON. Green light on, and blower on back panel on. Blower on rf deck not operating, and no reading on FIL VOLTAGE meter. Speech amplifier, modulator, and rf tubes not lighted.	4. Ac line partly open.....	4. Check FILAMENT VOLTAGE control R18 and repair or replace as required. If speech amplifier and modulator filaments are lighted, check for a broken connection to transformer T1.
5. Same conditions as in symptom 4 but blower on rf deck running and speech amplifier, rf exciter, and modulator filaments lighted.	5. Meter M1.....	5. Repair or replace M1.
6. Same as symptom 4 but pa tubes not lighted.	6. Pa filament transformer T8....	6. Check secondary of T8 and replace transformer.

Symptom	Probable trouble	Correction
7. FILAMENT POWER circuit breaker ON. PLATE POWER indicator light not lighted (about 25 seconds after filament power is applied) with PLATE RELAY switch on and TUNE-OPERATE switch in TUNE position.	7. PLATE POWER indicator light I 4 burned out. PLATE POWER circuit breaker CB2 defective. Interlock circuit open; deck may not be fully in housing.  Plate relay K6 defective----- Time delay relay K7 defective-- Overload reset relay K5 kept in operation by overload in high-voltage circuit. PLATE RELAY switch S10 defective. Microswitch S4 defective----- High-voltage filament transformer T8 defective. Ac dropping resistor R55 defective. High-voltage rectifier tubes V18 and V19 defective. Shorting plug P11 defective----	7. Replace I 4.  Check CB2 and repair or replace, as needed. Be sure that all decks are fully in housing. Check interlock switches and repair if necessary. Replace K6. Replace K7. Press OVERLOAD RESET switch. If overload persists, check high-voltage circuit. Replace S10.  Check S4 and repair. Check T8 and replace.  Check R55 and replace.  Check V18 and V19 and replace.  Check P11 and repair.
8. PLATE POWER circuit breaker opens during operation.	8. Overload relay K4 defective---- Overload relay adjustments R56 or R57 set too low. Overload reset relay K5 defective.	8. Check K4 and repair. Adjust to proper value.  Check K5 and repair.
9. Overload relay operates during CW operation, which is otherwise normal.	9. Overload reset relay switch S9 defective. Continuous overload.  High-voltage supply component defective. Modulator deck component defective. Rf deck component defective.	9. Check S9 and replace. Check components in overload circuit and replace defective parts. Check L8, C38, C39, and replace. Check T5 and replace.  Check C10 and replace.
10. P A GRID X2 reading obtained when in fsk operation, but no reading when in CW or AM. operation.	10. Oscillator subassembly, V801 and V802 stages defective.	10. Check stages and replace defective parts.
11. No P A GRID X2 reading obtained when in 1.5-3.0 mc band, for FSK or CW operation. Equipment operates with external excitation input.	11. Second buffer and first multiplier stage V101 defective.	11. Check stage and replace defective parts.
12. No P A GRID X2 reading obtained when on 3.0-6.0 mc band, for FSK or CW operation. Operates on 1.5-3.0 band; operates with external excitation input.	12. Tank circuits Z101 or Z102 defective.	12. Check Z101 and Z102, and replace defective part.
13. No P A GRID X2 reading obtained when on 6.0-12.0 mc band, for FSK or CW operation. Operates on 3.0-6.0 mc band; operates with external excitation input.	13. Second multiplier stage V102 defective.	13. Check stage and replace defective parts.
14. No P A GRID X2 reading obtained when on 12.0-20.0 mc band; for FSK or CW operation. Operates on 6.0-12.0 mc band; operates with external excitation input.	14. Third multiplier stage V103 defective.	14. Check stage and replace defective parts.

Symptom	Probable trouble	Correction
15. No P A GRID X2 reading in any position.	15. Ipa stage defective.	15. Check V104 and circuit components, and replace defective parts.
16. Low rf output. P. A. GRID X2 reading is below normal.	16. Misalignment.	16. Realine.
17. With equipment in EXT EXC operation, no output except on other modes of operation and no INT AMP PLATE X10 reading.	17. Burned-out cathode resistor R121 of V104 stage. External excitation relay K101 defective.	17. Check R121 and replace. Check K101 and replace.
18. With equipment in ECT EXC operation, no output is present in any operation and no INT AMP PLATE X10 reading is obtained.	18. Intermediate amplifier V104 stage defective. No exciter B+ voltage.	18. Check stage. Replace defective part. Check V4 in exciter power supply and replace.
19. In key-down position, PLATE POWER indicator light on and reading obtained on INT AMP PLATE X10 setting of EXCITATION METER SWITCH, but no P A GRID X2 reading obtained, P A PLATE reading very low, and no output present.	19. Shorted capacitor C2. Open resistors R1 or R2.	19. Check C2 and replace. Check resistors and replace.
20. In key-down position, PLATE POWER indicator light I 4 on, and readings obtained on P A GRID X2 and INT AMP PLATE X10 settings of EXCITATION METER SWITCH, but no reading on P A PLATE meter.	20. Power amplifier plate circuit components defective.	20. Check for open-circuit components and replace.
21. In key-up position overload relay operating, turning off PLATE POWER indicator light. Overload relay operative even after OVERLOAD RESET switch is pressed.	21. Clamper V2 defective. Shorted capacitors C5, C6, or C9. Blower motor on rf deck inoperative. (Overload relay does not operate immediately.)	21. Check V2 and replace. Check capacitors and replace. Check B1 and replace.
22. No sidetone signals during CW operation, which is otherwise normal.	22. Sidetone oscillator V17 or cathode follower V16 stages defective.	22. Check stages and replace defective parts.
23. Operates with carbon microphone input, but not with 600-ohm line input (or vice versa).	23. First af amplifier stage V12A (or second af amplifier stage V12B) defective.	23. Check stage and replace defective parts.
24. Rf output in all modes of operation, but no modulation in AM.	24. Modulator stages V9 and V10, or speech amplifier defective.	24. Check stages and speech amplifier, and replace defective parts.
25. Excessive MOD PLATE X20 reading, uncontrollable by MODULATOR BIAS control.	25. Bias rectifier V11 defective. Component parts in grid circuit of modulator defective.	25. Check stage and replace defective parts.
26. No MOD PLATE X20 reading.	26. Modulator filament transformer T2 defective.	26. Check T2 and replace.
27. Transmission during EXT EXC, FSK, or FSK-AM. operation, but no transmission during AM. or CW operation. In AM. operation, pressing push-to-talk button (on microphone) does not initiate transmission; PLATE POWER indicator light does not go on. In CW operation, PLATE POWER light remains on; no sidetone oscillations.	27. Cw-phone relay K3 defective. Push-to-talk and key relay K2.	Check K3 and replace. 27. Check K2 and repair or replace as needed.

Symptom	Probable trouble	Correction
28. No output during any mode of operation, and PLATE POWER indicator light is lighted. Overload relay not energized, but abnormally high plate current flow shown on P A PLATE meter. Receiver connected to J10 operative only if not connected to the receiver disabling circuit.	28. Antenna change-over relay (K1B) defective.	28. Check K1B and repair.
29. During CW or AM. operation, PLATE POWER indicator light goes out from overload. OVERLOAD RESET switch may temporarily reinstitute operation. Receiver connected to J10 not disabled during transmission.	29. Slow release relay K1A defective.	29. Check K1A and repair.

## 80. Dc Resistances of Transformers, Coils, and Relays

### a. Transformer Windings and Coils.

Transformer or coil	Terminals	Ohms
T1	1- 3	1. 8
	4- 6	. 16
	7- 9	2. 1
	10-12	. 05
T2	1- 3	3. 8
	4- 6	. 05
T3	1- 3	1. 6
	4- 6	60
T4	1- 2	1. 9
	3- 5	135
	6- 8	. 01
T5	9-11	. 01
	1- 3	370
T6	4- 5	150
	1- 2	450
T7	4- 6	2, 200
	1- 3	24
T8	4- 6	. 28
	1- 3	13
T9	4- 6	. 06
	1- 3	. 12
L1	4- 6	. 12
	7- 9	110
L2		. 03
L3		. 08
L4		5. 5
L5		. 08
L6		100
L7		100
L8		100
L9		68
L10		40
L11		40
L12		40
L102		. 23
L103		. 23

### a. Transformer Windings and Coils—Continued

Transformer or coil	Terminals	Ohms
L104		. 24
L105		. 25
L106		. 07
L107		. 06
L108		. 84
L109		. 27
L110		. 12
L111		. 07
L801*		
L802		3. 3
L803*		

\*Parts inclosed in sealed containers.

### b. Relay Coils.

Relay reference symbol	Dc resistance (ohms)	Relay reference symbol	Dc resistance (ohms)
K2	500	K5	400
K4	11	K3	400
K1	300	K1	400
K8	400	K101	45
K6	100	K7	2, 000

## 81. Signal Substitution Notes

The following information applies to signal substitution and signal tracing in the transmitter:

a. An rf signal generator capable of operating over the transmitter frequency range of 1.5 to 20.0 mc is required. When the master oscillator stage is known to be functioning properly, it may be used in place of this test signal generator (in 1.5-3.0 mc range). An audio oscillator is required to check the modulator portion of the transmitter.

*b.* To measure, observe, or listen to the output of the circuit being tested, a vacuum-tube voltmeter (vtvm), an oscilloscope, or a headset, may be used.

*c.* A tube tester is needed to isolate the defective tube after the faulty stage has been indicated by signal substitution.

*d.* In all tests indicated in *e* through *j* below, where dc potentials exist, put the ground lead (*cold* side) from the signal generator to the transmitter chassis, and connect the other lead (*hot* side) to the point indicated through a 1,000-volt .1-microfarad capacitor.

*e.* When checking the af circuits with a headset, note the volume and listen for serious distortion at the various points during the signal substitution procedure. Use the same procedure as in *d* above when connecting the leads of the headset.

*f.* Check the wiring and soldering in each stage during the procedure. Do not remove the shield or can of a tune circuit (in the multiplier) until trouble has been traced to that part. Do not damage the wiring by pushing it back and forth during the inspection.

*g.* If one or more stages of the multiplier are not alined, the output of the transmitter will be absent or reduced.

*h.* When trouble has been localized to a stage, first test the tube. Next, measure the resistances in the stage, since this can be done with the power turned off. (Use shorting stick test for the safety of both operator and meter.) Finally, measure the voltage at the tube pins. When the resistance of individual parts is being measured, it often is necessary to disconnect one lead of the part to prevent the associated circuit from causing misleading results.

*i.* Remove only one tube at a time when testing. Check the tube number, test the tube, and, if it is defective, replace it. If the tube is good, return it to its socket before another tube is removed for testing.

*j.* Each step presupposes satisfactory completion of all previous steps. Isolate and correct any trouble located before proceeding with succeeding steps.

## 82. Signal Substitution in Transmitter

### *a.* Check of Rf Stages.

- (1) Turn the EXCITATION METER SWITCH to P A GRID X2, and turn on the transmitter without the high voltage applied. Set the BAND SE-

LECTOR switch to the proper range, and inject a test signal (3 to 5 volts) into the control grid (pin 1) of V104. The absence of any output (P A GRID X2 reading at zero) indicates the possibility of a defective tube. Check the tube on a tube tester. Also check the cathode (pin 3) voltage; this pin should read 0 volts for all modes of operation except EXT EXC. The absence of a reading under the latter condition may be caused by a burned-out cathode resistor (R121). The presence of a reading on some bands and none on others indicates trouble in the tuned circuits; check tuned circuits Z107, Z108, Z109, and Z110. The resistance of the coils in these circuits can be checked against the values given in paragraph 80.

- (2) Turn the BAND SELECTOR switch to the 12.0-20.0 position. At this setting, all three multiplier stages are functioning. Connect the rf signal generator to jack J101, if the output of the oscillator is not to be used. A minimum reading of 8 ma on the EXCITATION meter at P A GRID X2 position shows these stages to be working. If no reading is obtained, one multiplier stage is defective. Connect a vtvm to the control grid (pin 1) of the second multiplier, V102. The absence of negative dc voltage at the control grid of V102 indicates trouble in the interstage circuitry, possibly in capacitor C108 or tuned network Z102. Repeat this procedure at the control grids of V103 and V104. If necessary, the signal generator can be disconnected from the input to the first stage and connected to the input of the stage in question. Inject a signal of 1.5 to 3 mc into the control grid (pin 1) of the first buffer tube V801. This stage can be checked by reading a negative dc voltage at the control grid (pin 1) of the second buffer tube V101 or by setting the BAND SELECTOR switch to its lowest range and obtaining a reading on the EXCITATION meter (P A GRID X2 position of EXCITATION METER SWITCH). The master oscillator can be checked by noting a negative dc voltage at the control grid of either

V802 or V101 or a current reading on the EXCITATION meter. The individual stages can also be checked as described in the troubleshooting chart.

- (3) The pa stage can be checked by the meters on the transmitter itself. The grid circuit will be normal, when a minimum of 8 ma (a max of approx 12 ma) is read on the EXCITATION meter at P A GRID X2 position of the EXCITATION METER SWITCH. A signal should be applied to the ipa grid either by using an outside signal source or the mo of the transmitter. When checking the plate circuit, always place the TUNE-OPERATE switch at TUNE before applying high voltage to the equipment. A minimum value of current seen on the P A PLATE meter indicates a normal condition in the plate circuit when tuning through resonance with the POWER AMPLIFIER TUNING control. The plate current should rise sharply for a normal indication when the POWER AMPLIFIER LOADING control is turned to the correct setting.

*b. Check of Speech Amplifier.*

- (1) The speech amplifier can also be checked by the method of signal substitution. Connect an audio oscillator to pin D of remote control receptacle J12 located on the back of the transmitter housing (fig. 4). Set the oscillator to a frequency of 1 kc. Turn the 600 OHM LINE GAIN control fully clockwise for maximum gain. Use an input level of .015 volt. If this value is used, the stage-gain chart given in paragraph 83 can be used to check the grid, plate, and output voltages.
- (2) To check the carbon microphone section

of the speech amplifier, connect the audio oscillator between pin C and ground on CARBON MICROPHONE receptacle J11 on the front panel or to pin F and ground of J12 located on the rear of the housing. Set the oscillator for 1 kc. Turn the CARBON MIKE GAIN control fully clockwise for maximum gain. Use an input level of .028 volt. As in the case of the 600-ohm line input described above, refer to the stage-gain chart.

*Note.* Turn the gain control (that is not being used) fully counterclockwise to prevent extraneous signals from affecting the operation of the speech amplifier.

### 83. Af Stage-Gain Chart

The stage-gain chart given in this paragraph lists the input and output voltages for each stage of the speech amplifier; these voltages are based on an input voltage of .015 volt at pin D of J12 for a 600-ohm line input and of .028 volt at pin C of J11 or pin F of J12 for carbon-microphone input. Use an input frequency of 1 kc. Set both the 600 OHM LINE GAIN and the CARBON MIKE GAIN control fully clockwise for maximum gain. Set the clipper potentiometer R44 (fig. 67) to off (fully counterclockwise). The values of V13, V15, and T6 were obtained with the input at pin C of J11 (CARBON MICROPHONE input).

Stage	Input (volts)	Output (volts)
First af ampl V12A	.015 (pin 2)	.108 (pin 1).
Second af ampl V12B	.028 (pin 7)	.122 (pin 6).
Third af ampl V13A	.125 (pin 2)	1.12 (pin 1).
Fourth af ampl V13B	.675 (pin 7)	6.5 (pin 6).
Driver V15	6.5 (pin 6)	72 (pins 1, 5).
Output trans T6	80 (terminals 4 or 6 to 5).	

## Section II. REPAIRS

### 84. Replacement of Parts

Most of the parts in the transmitter are readily accessible and are easily replaced if necessary. When a large number of leads are being disconnected from a part to be replaced, the rewiring time can be shortened and the process will be accurate if the leads are marked with identification tags.

### 85. Removal of Subassemblies

**Caution:** Do not try to pull any of the decks out farther than about 4 inches without first disconnecting the cabling in the housing. Some of these cables become taut when a deck is pulled out more than 4 inches and may become damaged if the deck is pulled out any farther. Disconnect the cables that prevent complete removal of the deck.

*a. Removal of Speech Amplifier Subassembly* (figs. 65 and 67).

- (1) To gain access to the speech amplifier subassembly, remove the modulator deck from the equipment housing. An alternate procedure is to leave the deck in place and remove only the back panel.
- (2) Remove all electrical connections to the subassembly. Disconnect plugs P3, P4, and P5 from their respective receptacles J3, J4, and J5 on the chassis.
- (3) Loosen the four Camloc fasteners that hold the subassembly to the modulator deck. The speech amplifier subassembly can now be removed.

*b. Removal of Oscillator and Multiplier Subassemblies* (figs. 50 and 53).

- (1) Remove the four screws that fasten the assembly to the front panel of the rf deck.
- (2) Disconnect plug P101 from receptacle J8 on the deck, and disconnect coaxial plugs P8, P9, P10, and P801 from jacks J101, J102, J103, and J104 on the multiplier subassembly. The assembly can now be withdrawn from the rf deck.

*c. Removal of Multiplier Subassembly.*

- (1) Set the equipment to 3 mc by turning the BAND SELECTOR control to 1.5–3.0, and the TUNING CONTROL until the mechanical counter indicates 3.000.
- (2) Insert a ¼-inch diameter metal rod through the appropriate holes in the cams. Insert the rod from the back and through the slotted portion of the end plates.
- (3) Remove the three cable clamps that hold the cable harness of plug P101.
- (4) Unsolder the three leads to the three feedthrough terminals on the mounting bracket at the back of the oscillator subassembly. Tag the leads for later reconnection.
- (5) Loosen the four captive screws on the subassembly. Access to one of these screws at the back is through the top of the subassembly.
- (6) The subassembly can now be removed. To do so, lift it up and out.

*Note.* Note the positions of the flexible couplings for the band switch and the camshaft, with the equipment set for 3 mc. The two

shafts can be coupled at either their correct setting or one 180° away; erroneous operation can result if they are coupled incorrectly.

*d. Removal of Oscillator Subassembly.*

- (1) Disconnect plug P802 from receptacle J105 on the rear mounting bracket, and disconnect plug P801 from jack J101 on the multiplier subassembly.
- (2) Loosen the setscrews of the scissor gears on the oscillator drive shaft.
- (3) While supporting the subassembly, remove the three screws that fasten the subassembly to the gear plate.
- (4) Still supporting the subassembly, loosen the two screws that fasten the rear mounting bracket to the bracket on the bottom plate. (Since the latter bracket uses slotted holes, these screws need only be loosened and not completely removed.) The subassembly can now be removed.

*Note.* The scissor gears detached from the oscillator drive shaft may be removed and replaced if necessary.

## 86. Disassembly of Drive Mechanisms

*a. Disassembly of Oscillator-Multiplier Tuning Drive Mechanism* (figs. 42, 82, 83 and 84).

*Note.* For easier servicing of the tuning drive mechanism, first remove the multiplier and oscillator subassemblies by following the procedures given above.

- (1) Remove the BAND SELECTOR and TUNING CONTROL knobs after loosening their set screws. Detach the bearing plate behind the TUNING CONTROL knob by removing the two screws that attach the plate to the front panel.
- (2) Remove the front panel by removing the five screws that hold the panel in place.
- (3) Remove the mechanical counter assembly by removing the four screws that fasten the assembly to the gear plate. Since one of the lower corners is positioned by a locating pin, remove the assembly with a forward motion to clear the pin.
- (4) Loosen the hub clamp on the exciter drive gear (behind the gear plate). Similarly loosen the hub clamp on the oscillator drive gear, which is next to and on the same shaft as the exciter drive gear. Slide both gears off their shaft. Withdraw the shaft together with the counter drive gear. Remove this

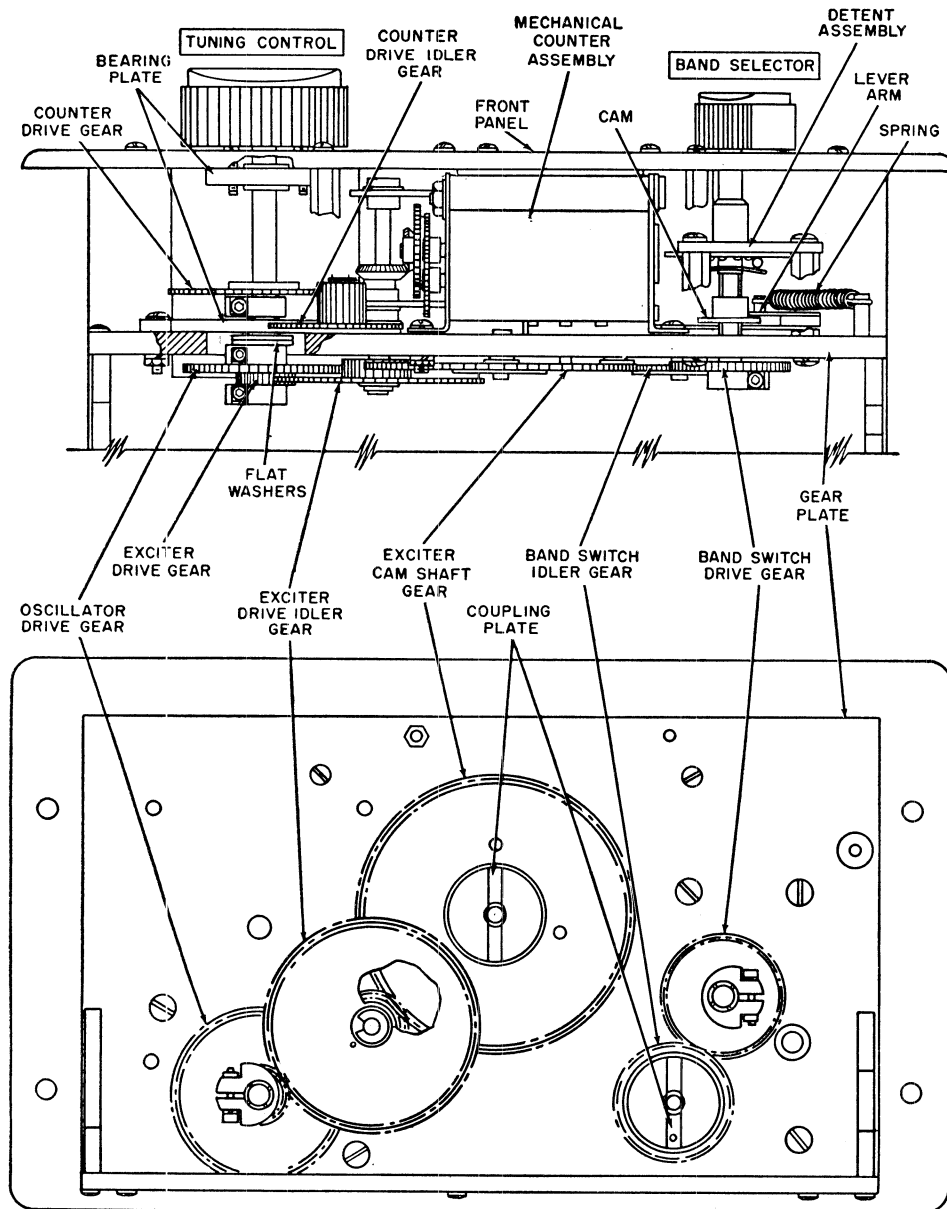
gear from the shaft by loosening its hub clamp. If necessary to facilitate disassembly, unfasten the bearing plate from the gear plate.

- (5) Remove the counter drive idler gear by removing its retainer ring.
- (6) Remove the exciter drive idler gear (behind the gear plate) by removing its retainer ring.
- (7) Remove the exciter camshaft gear (behind the gear plate) by removing its retainer ring (in front of the gear plate).
- (8) Remove the band switch idler gear (behind the gear plate) by removing its retainer ring (in front of the gear plate).
- (9) Remove the band switch drive gear (behind the gear plate) by loosening its hub clamp.
- (10) To gain access to the cam on the BAND SELECTOR shaft, remove the three screws that hold the detent assembly to the gear plate. Depress the lever arm by hand and slide the cam and shaft out; if desired, disconnect the spring between the lever arm and the gear plate. The cam is pinned to the shaft. To detach the lever arm, remove the retainer ring that holds the lever arm to its shaft.
- (11) To remove the cam followers and guides on the multiplier tuning mechanism, first disconnect the two springs that hold the rack down.

**Caution:** When handling the rack, make sure not to damage the tuning slugs or bend their adjustment screws.
- (12) The rack is now free to be lifted clear of the multiplier. To remove the rack guide at each end of the rack, remove the retainer ring at the end of the shaft that mounts the follower and guide. To detach the shaft from the rack, remove the screw (under the rack) that holds the two parts together. The cam follower can now be slid off its shaft.
- (13) To remove the cams on the multiplier tuning mechanism, remove the retainer ring at the back end of the camshaft. Slide the shaft forward and remove the two retainer rings and the two washers. To remove the cams, force the pins out of the cam hubs and slide the cams off the shaft.

*b. Disassembly of Power Amplifier Tuning Drive Mechanism (figs. 43 and 85).*

- (1) To disassemble the power amplifier tuning drive mechanism, remove it in one piece from the rf deck. Disconnect the flexible couplings to the tuning and loading capacitors (C6 and C9). To unfasten the assembly from the deck front panel, remove the four screws.
- (2) Remove the gear that is normally coupled to the tuning capacitor (C6). The gear is fastened to its shaft by both a setscrew and a pin. Loosen the setscrew and remove the pin to unfasten the gear.
- (3) Remove the idler gear by removing its retainer ring.
- (4) Remove the gear on the POWER AMPLIFIER TUNING shaft by loosening its setscrew and removing its pin.
- (5) Remove the bevel gear on the POWER AMPLIFIER TUNING shaft by loosening its setscrew and removing its pin. Slide the shaft forward until the gear becomes free.
- (6) Remove the bevel gear on the shaft of the tuning drive stop by loosening its setscrew and removing its pin. If necessary, loosen the setscrew on the mechanical counter bevel gear and slide it back on its shaft to give the first gear clearance.
- (7) Remove the bevel gear on the shaft of the mechanical counter by loosening its setscrew.
- (8) To disassemble the tuning drive stop, loosen the setscrew and remove the pin on the stop collar. Slide the shaft out. Remove the flat washer at the bottom next to the stop pin, the five shims in succession, and alternately remove the 27 stop washers and 26 shims.
- (9) To disassemble the bevel gears associated with the POWER AMPLIFIER LOADING control, remove the retainer ring on the shaft and follow a procedure similar to that for the POWER AMPLIFIER TUNING control ((5), (6), and (7) above).
- (10) To disassemble the loading drive stop, follow a procedure similar to that for the tuning drive stop ((8) above). For this stop, there are a flat washer, five shims in succession, and alternately, 33 stop washers and 32 shims.



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Figure 82. Oscillator-multiplier tuning drive, gear assembly.

## 87. Reassembly of Drive Mechanisms

*Note.* Reassembly is essentially the reverse of the disassembly procedure previously given. Observe the following points during reassembly:

### a. Reassembly of Oscillator-Multiplier Tuning Drive Mechanism.

- (1) When reassembling the cam assembly, slide the cams back over their shaft. The front surface of each cam should be 6.937 inches apart. Slide a 1/4-inch metal rod through the cams and the slots in the end plates of the multiplier subassembly.

With the cams so positioned, replace the pins that fasten the cams to their shaft. Make sure that the hub end of the back cam is aligned with the edge of the inner retainer ring groove on the shaft.

- (2) When replacing the two flat washers and two retainer rings at the back end of the camshaft, make sure that the washers are *between* the retainer rings. The end slots of the movable rack fit between the two washers and are positioned by them.
- (3) When replacing the oscillator drive gear,

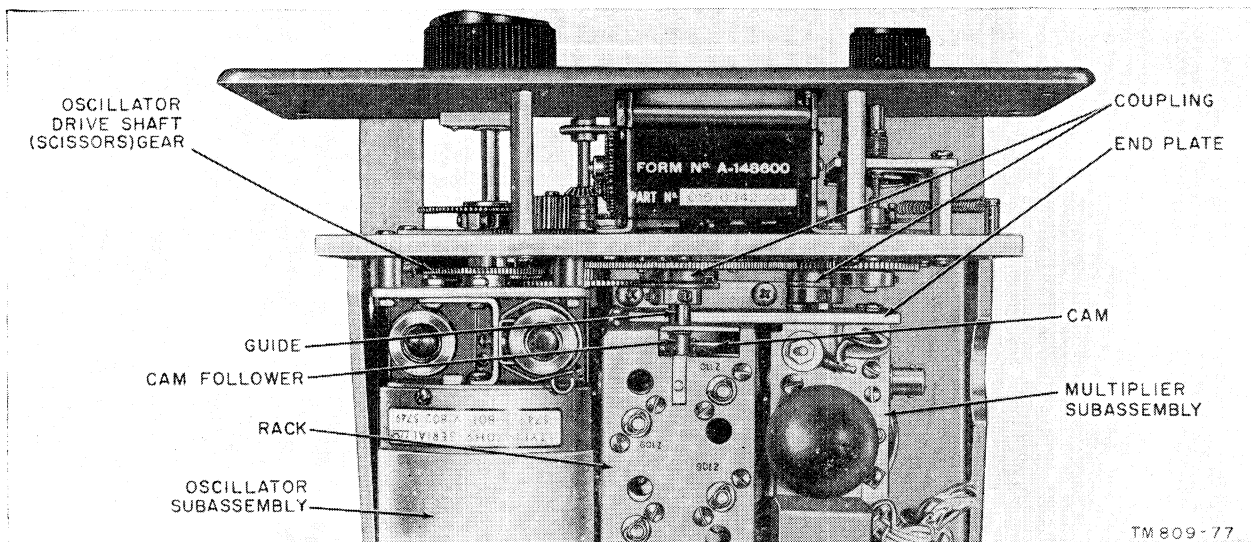


Figure 83. Oscillator-multiplier tuning drive, top view.

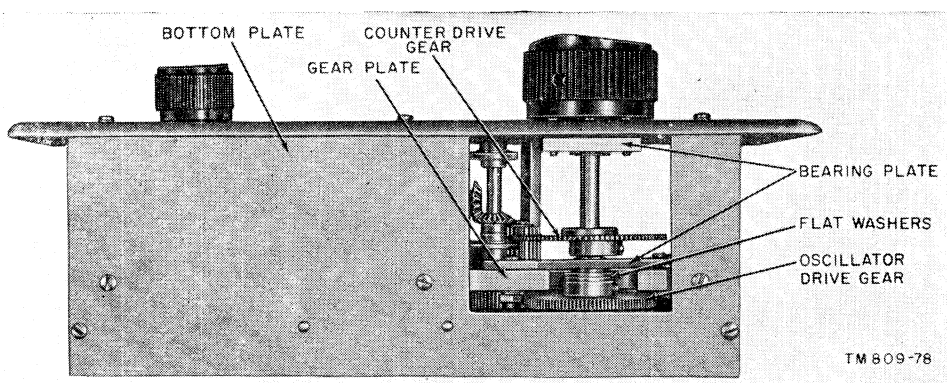


Figure 84. Oscillator-multiplier tuning drive, view through bottom plate.

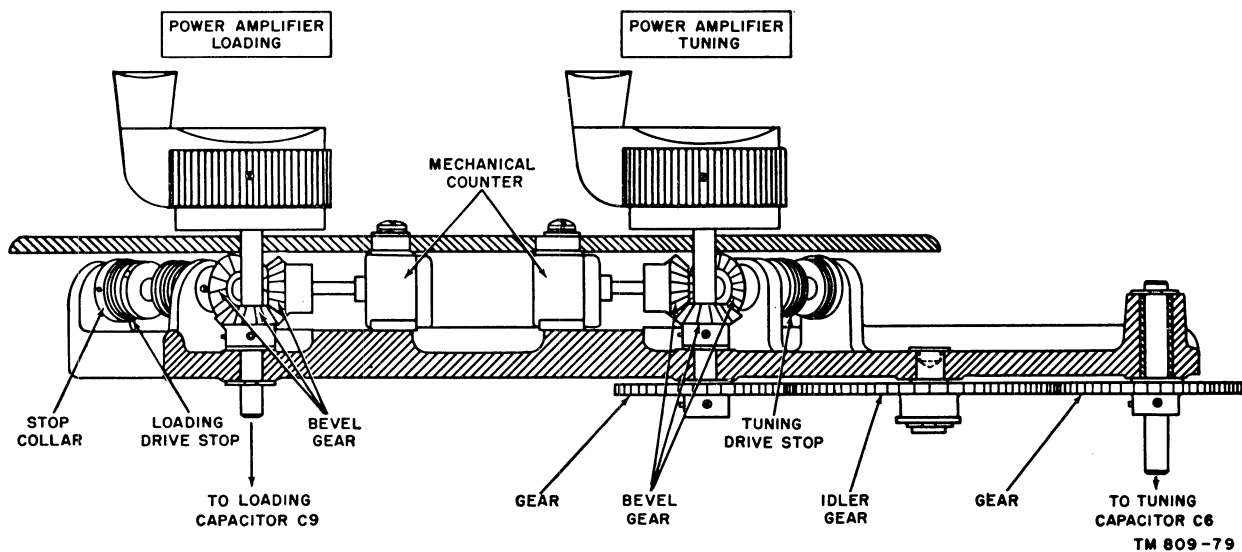


Figure 85. Power amplifier tuning drive, gear assembly.

be sure to replace the two flat washers onto the tuning control shaft, between the bearing plate and the oscillator drive gear. These washers correctly locate the oscillator drive gear on its shaft and, therefore, they are in the proper position with respect to the oscillator drive shaft (scissors) gear. After reassembly, the oscillator drive gear hub coupling is left loose to permit manual adjustment of the tuning drive mechanism (par. 91).

*b. Reassembly of Power Amplifier Tuning Drive Mechanism.*

- (1) Make sure that the flat washer, shims, and stop washers on each mechanical stop are replaced in the order indicated in the disassembly procedure.
- (2) Leave the bevel gears on the shafts of the mechanical counters loose to permit adjustment (par. 91).

## 88. Replacement of Subassemblies

*Note.* Replacement is essentially the reverse of the removal procedures previously given. Observe the following points during replacement:

*a. Replacement of Oscillator Subassembly.* When replacing the oscillator drive shaft (scissors) gear, offset the teeth on one gear with respect to the other gear by one or two teeth. The amount of offset should give no binding while still reducing backlash to a minimum.

*b. Replacement of Multiplier Subassembly.*

- (1) If the  $\frac{1}{4}$ -inch diameter metal rod has been removed from the holes through the cams, replace the rod. This positions the cams and the rack at their highest position.
- (2) Reconnect the three wires in the cable harness to the three feedthrough terminals on the bracket at the back of the oscillator subassembly.
- (3) Make sure that the positions of the two couplings correspond to that at the start of the equipment disassembly. As mentioned in the removal procedure for the multiplier subassembly, it should be coupled to the drive mechanism with the BAND SELECTOR at 1.5–3.0 and the mechanical counters indicating 3.000; the cams should be locked with the metal rod as mentioned in (1) above.

## 89. Servicing Antenna Tuning Unit BC-939-B (figs. 86 and 87)

All components of the tuning unit are easily removed and replaced when repair or replacement is necessary. Be careful when handling the vacuum capacitors and ceramic parts because excessive pressure will damage them. To service the tuning unit, proceed as follows:

- a.* Remove the antenna connecting wire from the rear binding post of the unit.
- b.* Remove four wingnuts that secure the unit to the top of the transmitter. Lift the unit from the transmitter to the repair space.
- c.* Remove the cover of the unit by releasing the four catch assemblies along the bottom edge and lifting it free.
- d.* Carefully remove the two vacuum capacitors from the spring clip connectors and put them in a safe place.
- e.* Remove the ANTENNA CURRENT meter as follows:

- (1) Remove the wires connected to the meter.
- (2) Remove the two mounting screws and nuts.
- (3) Hold the meter and remove the last (third) mounting screw and nut.
- (4) Remove the meter from the front panel.
- (5) To replace, reverse the order of the removal procedure.

*f.* Remove inductor L6 (FREQUENCY 10 MC-INCREASE-2 MC) as explained in (1) below.

- (1) To remove the glass rod, proceed as follows:
  - (a)* Remove the screws and nuts that secure the two phenolic blocks to the ceramic ends.

*Note.* Fiber shims may be in the large holes of phenolic blocks. These shims (if used) take up the length left by rod and end tolerances. *Do not lose these shims, as it may be necessary to use all or some of them when installing the new rod.*

- (b)* Remove the adjustable contact shoe from the rod.
- (2) To replace the glass rod, proceed as follows:
    - (a)* Try the rod between the ceramic end plates to be sure that it fits and also to find the number of fiber shims necessary, if any are needed.
    - (b)* Place the adjustable tap on the rod.

- (c) Rotate the FREQUENCY control crank (fig. 10) clockwise until three zeros appear on the indicator.
- (d) Position the adjustable contact shoe to the front turn of the inductor.
- (e) Secure the rear phenolic block (glass rod mounted) to the ceramic end with screws and nuts.
- (f) While holding the front phenolic block in place, rotate the FREQUENCY control crank counterclockwise, moving the adjustable shoe to the rear turn, and be sure that the motion is free and

that the shoe is following the inductor windings.

- (g) Secure the front phenolic block (glass rod mounted) to the ceramic end with screws and nuts.
  - (h) Rotate the FREQUENCY control crank to check operation again.
- (3) To remove the inductor, proceed as follows:
- (a) Remove the two screws and elastic stop nuts from the angle brackets which secure the phenolic base of inductor L44 and vacuum capacitor.

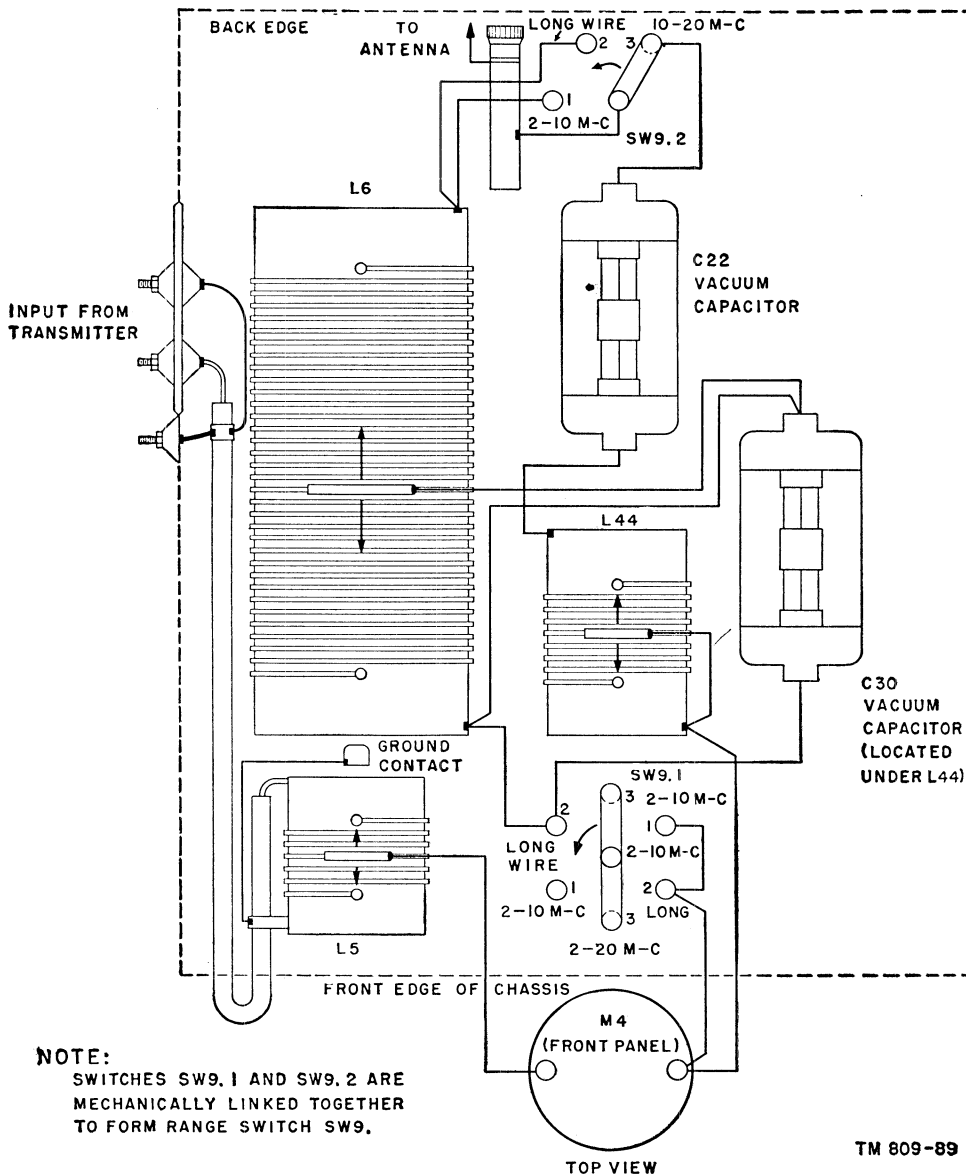


Figure 86. Antenna Tuning Unit BC-939-B, practical wiring diagram.

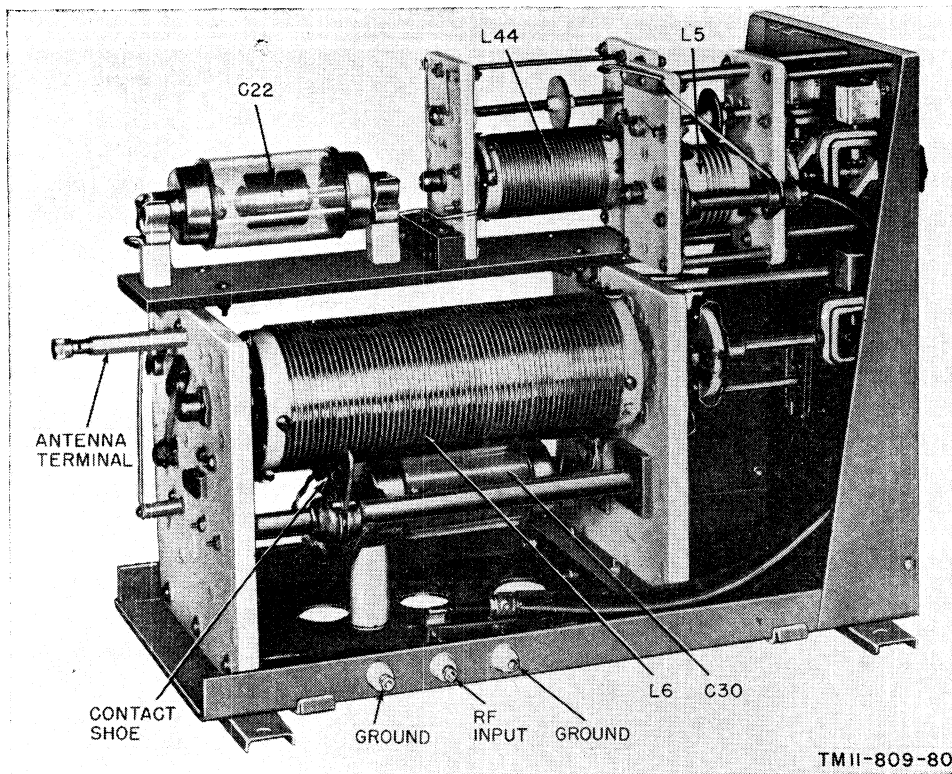


Figure 87. Antenna Tuning Unit BC-939-B, cover removed.

- (b) Loosen the two setscrews on the inductor side of the FREQUENCY control flexible coupling.
- (c) Loosen the Allen setscrew in the rear shaft collar and remove the collar.
- (d) Remove the screw and nut from the rear switch extension shaft.
- (e) Remove the three screws and elastic stop nuts that secure the ceramic end plate to the phenolic base strip.
- (f) Hold the glass rod and gently pull the ceramic end plate free of the inductor through the shaft.
- (4) To replace, reverse the removal procedure and align the movable contact shoe as described in (2) above.

*g.* The same general disassembly and assembly instructions apply to inductors L5 and L44 as well as to L6. Although some items do not apply, the maintenance procedure is quite simple and the same care should be exercised in handling. The COUPLING control rotates counterclockwise to bring the movable shoe to the front winding and the indicator to zero.

*h.* Servicing of the range switch (2-10M-C LONG WIRE 10-20M-C) is usually a matter of

adjusting the spring contact pressure. This can be done without removing any parts. Work carefully, and do not put sharp bends in the spring contacts. Clean the contacts with very fine sandpaper, and brush them clean.

#### 90. Removal of Antenna Tuning Unit BC-939-B (fig. 1)

To remove the antenna tuning unit, proceed as follows:

- a.* Disconnect the antenna and ground leads.
- b.* Disconnect the coaxial cable leading from the transmitter.
- c.* Take off the four wing nuts that hold the tuning unit to the top of the transmitter.
- d.* Lift the unit up and forward.

#### 91. Apparatus Adjustment

*a.* To adjust the oscillator-multiplier tuning drive mechanism (fig. 46), proceed as follows. Turn the SERVICE SELECTOR switch to the AM. position. Set the transmitter for 1.5 mc operation by turning the BAND SELECTOR switch to 1.5-3.0 and by turning the TUNING CONTROL until 1.5 mc is indicated on a fre-

quency meter connected to the transmitter. Make the setting as close to 1.5 mc as the accuracy of the measuring equipment will allow. If the counters do not indicate this frequency, they will have to be reset while maintaining the setting of the oscillator. To do this, loosen the oscillator drive gear by loosening its hub clamp on the shaft of the oscillator assembly so that the gear will turn freely without affecting the oscillator frequency. Now move the gear train until the counters indicate the desired frequency. When this is done, refasten the loose gear to the oscillator shaft. Repeat this procedure at the 3.0 mc setting (on the 1.5 to 3.0 mc band as a check).

b. If the power amplifier tuning drive mechanism (fig. 47) has to be disconnected from the two counters, the counters will have to be reset. First loosen the bevel gear on the shaft of the counter, and then turn the drive shafts to their extreme clockwise positions. Set the counters to their zero settings, and recouple the bevel gear to the counter shaft.

## 92. Refinishing

General instructions for refinishing are given in paragraph 48. Instructions for refinishing badly marred panels on cabinet exteriors are given in TM 9-2851, Painting Instructions for Field Use.

## Section III. ALINEMENT PROCEDURES AND FINAL TESTING

### 93. Alinement and Adjustment Procedures

#### a. Alinement of Multiplier Subassembly.

- (1) Set the transmitter for 1.5 continuous operation for the exciter units only. Set the BAND SELECTOR switch to 1.5-3.0 and turn the TUNING CONTROL until 1.5 mc is registered on the counters. Check the output frequency with the frequency meter to determine if the oscillator is operating on 1.5 mc (par. 24a). If the two frequencies do not agree (zero beat), adjust the oscillator drive mechanism as described in paragraph 91. Also check the output frequency at 3.0 mc.
- (2) Set the TUNING CONTROL for 1.55 mc. Turn the EXCITATION METER SWITCH to P A GRID X2. Adjust capacitor C136 in Z107 for maximum reading on the EXCITATION meter.
- (3) Set the BAND SELECTOR switch to 3.0-6.0, while keeping the TUNING CONTROL at its previous setting. Adjust capacitors C109 (in Z101), C112 (in Z102), and C138 (in Z108) for maximum P A GRID X2 reading.
- (4) Set the BAND SELECTOR switch to 6.0-12.0, while keeping the TUNING CONTROL at its previous setting. Adjust capacitors C118 (in Z103), C123 (in Z104), and C140 (in Z109) for maximum P A GRID X2 reading.
- (5) Set the BAND SELECTOR switch to 12.0-20.0, while keeping the TUNING CONTROL at its previous setting. Adjust capacitors C128 (in Z105), C131

(in Z106), and C141 (in Z110) for maximum P A GRID X2 reading.

- (6) Return the BAND SELECTOR switch to 1.5-3.0, and turn the TUNING CONTROL for a frequency of 2.9 mc. Adjust the tuning slug of coil L108 (in Z107) for maximum P A GRID X2 reading.
- (7) Set the BAND SELECTOR switch to 3.0-6.0, while keeping the TUNING CONTROL at its previous setting. Adjust the tuning slugs of coils L102 (in Z101), L103 (in Z102), and L109 (in Z108) for maximum P A GRID X2 reading.
- (8) Set the BAND SELECTOR switch to 6.0-12.0, while keeping the TUNING CONTROL at its previous setting. Adjust the tuning slugs of coils L104 (in Z103), L105 (in Z104), and L110 (in Z109) for maximum P A GRID X2 reading.
- (9) Set the BAND SELECTOR switch to 12.0-20.0, and set the TUNING CONTROL at 20 mc. Adjust the tuning slugs of coils L106 (in Z105), L107 (in Z106), and L111 (in Z110) for maximum P A GRID X2 reading.
- (10) If necessary, repeat the procedure in (4) through (9) above until no further tuning of the adjustable coils and capacitors is required to give a maximum P A GRID X2 reading.

*Note.* The above procedure is usually satisfactory for the alinement of all circuits on bands 1 and 2 (1.5-3.0 and 3.0-6.0) and for the multi-

plier stages on bands 3 and 4 (6.0–12.0 and 12.0–20.0). The tuning of Z109 on bands 3 and 4, and Z110 on band 4 may require repeating to get maximum grid current.

- (11) Check the overall tracking characteristic of the multiplier. Connect a multimeter through a 150K resistor to the control grid (pin 1) of V104 and ground. The meter should indicate a minimum reading of 10 volts (dc).
- (12) Set the BAND SELECTOR switch to either 6.0–12.0 or 12.0–20.0. If the equipment is operating properly, the P A GRID X2 reading should be over 10 ma for all frequencies and should drop to 10 ma or slightly below (but not below 8 ma, with the power amplifier fully loaded) at the extremes of the band.

*Note.* If either slug in Z109 or Z110 is too far in the coil form, the response at a frequency near the band midpoint will be low. To correct this condition, withdraw the slug of the adjusting screw 1 turn at a time and retune capacitor C140 (in Z109) for maximum output when the TUNING CONTROL is set to approximately 9.5 mc (BAND SELECTOR at 6.0–12.0) and 15.5 mc (BAND SELECTOR at 12.0–20.0). Recheck the response. Withdrawing the slug and returning at midband has the effect of decreasing the circuit bandwidth while increasing the response near midband. Adjusting the slug to start farther in the coil form will extend the band edge response while possibly decreasing the midband response.

**b. Overload Relay Adjustments.** The procedure for adjusting the overload relay is given in paragraphs 95 and 96.

**Caution:** Do not reset the OVERLOAD RELAY ADJUSTMENT controls unnecessarily. Both controls are initially preset at the factory. Do not arbitrarily set them in the maximum clockwise position because this will not adequately protect the equipment from overloads.

**c. Speech Amplifier and Clipper Adjustments.**

- (1) Adjust the equipment for 100 percent modulation (par. 24b).
- (2) When the MOD PLATE X20 current reading does not exceed 230 ma for the entire range of the CARBON MIKE GAIN control, the mike control and the speech clipper gain control are properly adjusted.
- (3) Repeat the procedure in (1) and (2) above with an af signal generator connected between pins D and E (ground) of

remote control receptacle J12; vary the 600 OHM LINE GAIN control. The line gain control is now properly set.

**d. Sidetone Gain Control Adjustment.**

- (1) Adjust the transmitter for CW operation (par. 26).
- (2) Adjust the sidetone gain control R47 (fig. 67) on the front of the speech amplifier until an adequate level is obtained on the headset. For connections of the headset, refer to the note in paragraph 11a.

## 94. Final Testing

Paragraphs 95 through 106 are intended as a guide to be used in determining the quality of a repaired transmitter. The minimum test requirements outlined in the paragraphs below may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

## 95. CW Overload Relay Adjustment

The overload relay in the equipment should be set to operate at approximately 425 ma during CW operation.

**a.** Remove the back panel to gain access to the high-voltage circuits. Bypass the interlock switches, which are opened by the removal of the panel.

**b.** Remove power amplifier tube V1 and clamper tube V2 from their sockets.

**Caution:** Be sure that the disconnected plate caps are insulated from ground to prevent the high-voltage power supply from being short circuited. Use a shorting stick as a safety precaution (fig. 22).

**c.** Connect an adjustable resistor-type dummy load with an adequate power rating and resistance (about 1,100 watts and 5,900 ohms) to high-voltage contact E4 (fig. 80) behind the rf deck. Connect the other end of the dummy load to the positive terminal of a 0 to 1 ampere dc ammeter; connect the negative terminal of the ammeter to ground.

**d.** Set the equipment for CW operation (par. 26).

**e.** Turn the INCREASE CW (OVERLOAD RELAY ADJUSTMENT R57) control (fig. 76) on the power supply deck full clockwise.

**f.** Reduce the dummy load resistance until it draws 425 ma, as indicated on the ammeter.

**g.** Adjust the INCREASE CW control until the

overload relay operates. At this time, the PLATE POWER indicator light should go out, and the dummy load current reading should drop to zero.

*h.* Operate the OVERLOAD RESET switch momentarily. The plate relay (K6) in the transmitter should close and immediately reopen.

## 96. AM. Overload Relay Adjustment

The overload relay in the equipment should be set to operate at approximately 550 ma load current during AM. operation.

*a.* Set up the transmitter and test equipment as described in paragraphs 95*a* through *c*. To draw the required current of 550 ma, the adjustable dummy load should have a power rating of 1,400 watts minimum and a resistance of about 4,500 ohms.

*b.* Set the equipment for AM. operation (par. 27).

*c.* Turn the INCREASE PHONE (OVERLOAD RELAY ADJUSTMENT R56) control (fig. 76) on the power supply deck fully clockwise.

*d.* Reduce the dummy load resistance until it draws 550 ma, as indicated on the ammeter.

*e.* Adjust the INCREASE PHONE control until the overload relay operates. At this time, the PLATE POWER indicator light should go out, and the dummy load current meter should drop to zero.

*f.* If no further adjustments are to be made, disconnect the test equipment, replace tubes V1 and V2 and their plate caps, disconnect the interlock bypasses, and replace the back cover.

## 97. AM. Power Measurement

The output power of the equipment is measured under AM. conditions in the following procedure:

*a.* Connect the test audio oscillator to pins D and E of remote control receptacle J12 (at the back of the housing). Adjust the oscillator for 1 kilocycle (kc) at 0 decibel referred to 1 milliwatt in 600 ohms (dbm).

*b.* Connect an rf ammeter (0 to 5 amperes) between the R. F. OUTPUT receptacle and the output load.

*c.* Couple the transmitter output to the vertical deflection plates of the oscilloscope by means of a pickup coil. This is done by winding 2 to 4 turns of insulated wire (No. 14 gage, soft-drawn copper) over a winding space of 3 inches around coil L4 (on the rf deck). Connect the ends of the coil to oscilloscope by means of a twisted-pair line.

*d.* Set the equipment for AM. operation.

*e.* Adjust the tickler coil for optimum response to give an adequate amplitude on the oscilloscope.

*f.* Adjust the 600 OHM LINE GAIN control for 100 percent modulation, as observed on the oscilloscope (fig. 88). The EXCITATION meter should read 8 ma (min) for P A GRID X2 and 70 ma (max) or 20 ma (min) for INT AMP PLATE X10.

*g.* The output power is obtained from the relationship  $P=I^2R$ , where  $I$  is the current reading of the rf ammeter, and  $R$  is equal to 51.5 ohms as the output load. With the P A BAND SWITCH in the first four positions, the approximate power should be 470 watts between 1.5 and 11 mc; in the fifth position, the approximate power should be 440 watts between 11 and 18 mc, and 400 watts between 18 and 20 mc.

## 98. CW Wave Form and Power Test

(fig. 88)

The following test checks the output wave form and power during CW operation:

*a.* Replace the handkey with the reversal machine (dot keyer). Test Set 100-A is set for 22 dot cycles.

*b.* Set the equipment for CW operation (par. 26).

*c.* Observe the output CW wave form on a test oscilloscope (using a tickler coil as previously described). The carrier amplitude (A+B) should not exceed the steady-state key-down amplitude (B) by more than 10 percent.

*d.* Replace the dot keyer with the handkey. Operate the handkey at a moderate speed. The sound (as heard on a headset) should be free from chirps, tails, and any other form of distortion. Hold the key down for about 10 seconds. There should be no change in pitch.

*e.* Measure the output power during CW operation (key down). Use an rf ammeter in the antenna line, as described in paragraph 97*b*. The output power should be about 450 watts.

## 99. AM. Modulation Measurements

The modulation portion of the equipment is tested in the following procedures:

*a. Input Level Measurements.*

(1) Use the audio oscillator and oscilloscope (connected to the equipment as described for the AM. power measurements, with a tickler coil).

(2) Set the audio input level to -34 dbm.

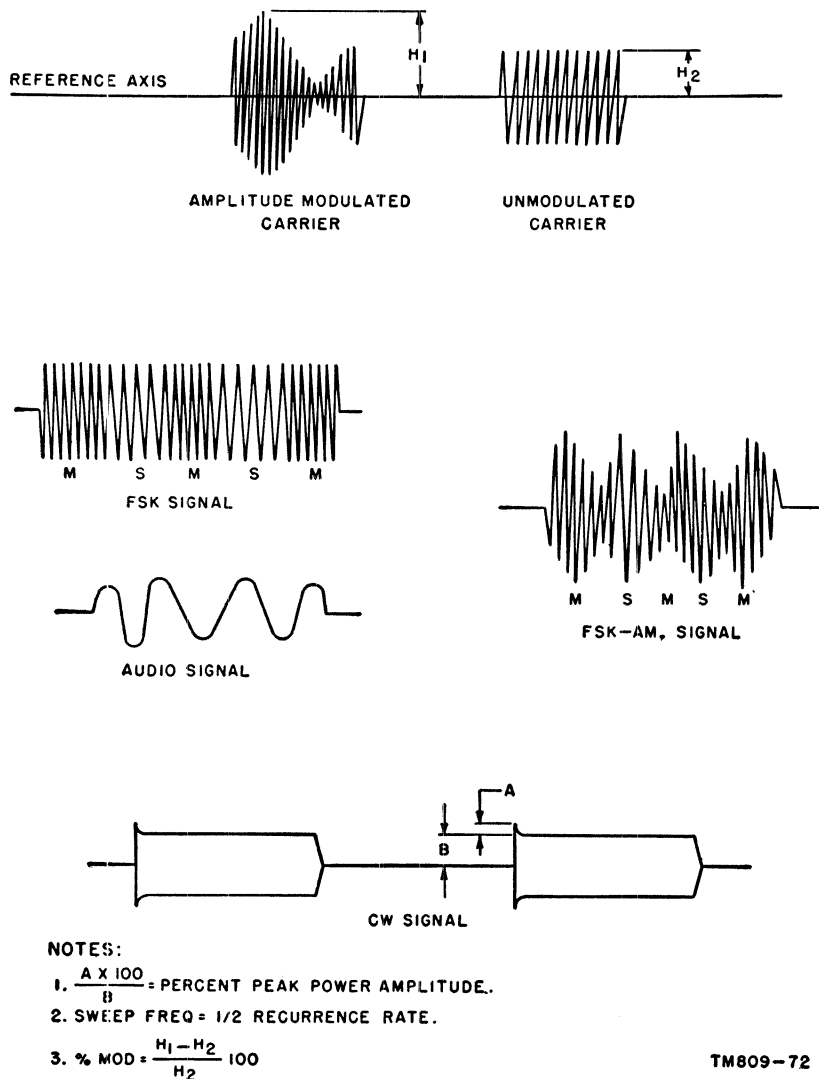


Figure 88. Wave forms.

Turn the CARBON MIKE GAIN control fully counterclockwise to prevent the introduction of extraneous signals into the speech amplifier. By varying the 600 OHM LINE GAIN control, it should be possible to obtain 100 percent modulation.

- Repeat the procedure in (2) above for an input level of +6 dbm.
- Turn the 600 OHM LINE GAIN control fully counterclockwise. With an input level of +29 dbm, it should be possible to obtain 100 percent modulation by varying the CARBON MIKE GAIN control.
- Repeat the procedure in (4) above for an input level of +45 dbm.

b. Residual Hum and Noise Measurement.

- With the audio oscillator connected for 600-ohm line operation (CARBON MIKE GAIN control turned down), adjust it for a 1-ke audio signal at 0 dbm.
- Connect Analyzer Spectrum TS-723/U to the tickler coil after disconnecting the test oscilloscope. Connect a vtvm with a decibel (db) scale to the output of the linear detector.
- Adjust the 600 OHM LINE GAIN control for 100 percent modulation. Note the reading on the db scale of the vtvm.
- Remove the audio oscillator signal. Terminate the 600-ohm line with a 600-ohm resistor. The vtvm reading should be

not less than 40 db below the previous reading obtained in (3) above.

*c. Input Frequency Measurements.*

- (1) With the audio oscillator connected for 600-ohm line operation (CARBON MIKE GAIN control turned down), adjust it for a 1-ke audio signal.
- (2) Adjust the 600 OHM LINE GAIN control for 40 percent modulation. This is done by observing the modulated wave on the oscilloscope for a height of 1.4 times the height of the unmodulated wave. Refer to note 3 on figure 88 for use of the modulation formula.
- (3) While varying the input signal frequency, measure the input power to obtain 40 percent modulation. The input power should have the following values for the given frequencies:

Input freq (cps)	Input power (dbm)
1,000 -----	Measured value.
500 -----	Within 1.5 db of freq No. 1.
300 -----	Within 1.5 db of freq No. 1.
100 -----	+30 db greater than freq No. 1.
1,500 -----	Within 1.5 db of freq No. 1.
2,500 -----	Within 1.5 db of freq No. 1.
3,500 -----	Within 1.5 db of freq No. 1.
5,500 -----	+30 db greater than freq No. 1.

**100. AM. or FSK-AM. Distortion Measurement**  
(fig. 88)

In the following tests, the distortion present in the amplitude modulated carrier is measured for different percentages of modulation:

- a.* Connect the spectrum analyzer to the equipment.
- b.* Adjust the equipment for 95 percent modulation (fig. 88) with a 1-ke audio input.
- c.* For the above and four other modulation levels, measure the distortion as follows:

Modulation (percent)	Distortion (percent)
95 -----	10 (max).
70 -----	Less than that for 95 percent.
30 -----	Less than that for 70 percent.
5 -----	Less than that for 30 percent.

**101. Stability Test**

The following test is made to determine if the equipment is free from spurious oscillations:

*a.* Connect a 600-ohm resistor to the 600-ohm input line (pin D of J12); turn the 600 OHM LINE GAIN control down (fully counterclockwise). Turn the CARBON MIKE GAIN control up (fully clockwise). The static value of modulator plate current indicated on the EXCITATION meter (switch at MOD PLATE X20) should not increase.

*b.* Repeat the above procedure for the carbon microphone line. Connect a 200-ohm resistor to the carbon microphone input at pin F of J12; turn the CARBON MIKE GAIN control down. Turn the 600 OHM LINE GAIN control up. The static value of modulator plate current should not increase.

*c.* Check for stability during CW operation. Set the equipment for CW operation (par. 26). Connect the handkey and then operate the handkey in rapid succession. The pa grid current should drop to zero (on the EXCITATION meter) when the key is in the up position. The pa plate current should drop to its static value.

**102. Antenna Relay and Receiver Disable Test**

The following test checks the operation of the antenna changeover and receiver disabling features of the equipment:

- a.* Set the equipment for CW operation.
- b.* Close the handkey. The receiver connected to the RECEIVER receptacle (J10) should be disabled, assuming that it was operating before the handkey was operated. At the same time, the receiver is disconnected from the antenna line. In the key-down condition, the output of the sidetone oscillator should be heard in the monitoring headset. The PA PLATE and other meters should give their normal indications (for CW operation).
- c.* Release the handkey; the sidetone oscillations should cease, and the output of the transmitter should drop to zero. The receiver is then reconnected to the antenna line.

**103. Fsk Operational Test**

The following test checks the FSK operation of the equipment. The test, at the same time, also checks the band-edge tuning to make certain

that there are no major discrepancies in output between the end of one band and the beginning of the following band.

*a.* Set the equipment for FSK operation (par. 29).

*b.* Apply fsk signals (fig. 88) of a maximum of 5 volts to the FSK input receptacle (J16) at the following frequencies and control settings. Note the output power.

**Caution:** When changing transmitter frequency, throw the TUNE-OPERATE switch to TUNE and keep it at TUNE while adjusting the POWER AMPLIFIER TUNING and POWER AMPLIFIER LOADING controls. Make the measurements with the switch at OPERATE.

Input frequency (mc)	BAND SELECTOR switch	PA BAND SWITCH (mc)	Output frequency (mc)	Minimum output power (watts)
1.475	1. 5-3. 0	1. 5-2. 0	1. 475	470
2.025	1. 5-3. 0	1. 5-2. 0	2. 025	470
1.975	1. 5-3. 0	2. 0-3. 0	1. 975	470
2.975	1. 5-3. 0	3. 0-6. 0	2. 975	470
3.025	1. 5-3. 0	2. 0-3. 0	3. 025	470
5.975	3. 0-6. 0	6. 0-11. 0	5. 975	470
6.025	3. 0-6. 0	3. 0-6. 0	6. 025	470
5.5125	6. 0-12. 0	6. 0-11. 0	11. 025	470
5.4875	6. 0-12. 0	11. 0-20. 0	10. 975	470
5.00625	12. 0-20. 0	11. 0-20. 0	20. 025	400

#### 104. External Excitation Operational Test

The following test checks the output power of the transmitter during EXT EXC operation:

*a.* Adjust the transmitter for EXT EXC operation (par. 28).

*b.* Apply a maximum of 30 volts to the EXT EXC receptacle (J15).

*c.* Use an rf ammeter in the antenna line, as described in paragraph 97*b* to measure the output power. It should be at least 400 watts.

#### 105. Speech Clipper Test

The following test checks the effectiveness of the speech clipper in the speech amplifier sub-assembly:

*a.* Adjust the transmitter for AM. operation (par. 27).

*b.* Connect a carbon microphone to the CARBON MICROPHONE receptacle (J11). Press

the push-to-talk button on the microphone and speak into the microphone, while varying the setting of the CARBON MIKE GAIN control over its entire range. The modulator plate current reading on the EXCITATION meter should not exceed 230 ma for any setting of the gain control.

#### 106. Safety Device Test

The following test checks the operation of the safety devices built into the transmitter:

*a.* Remove high voltage from the equipment by throwing FILAMENT POWER and the PLATE POWER circuit breakers to OFF. Check with shorting stick.

*b.* Connect a high-voltage probe to the high voltage bus in the power supply deck; the probe is connected to a voltmeter.

*c.* Throw the PLATE POWER circuit breaker to ON, and the PLATE RELAY switch to on (up). The time delay relay in the equipment operates about 25 seconds after filament power has been applied. The presence of high voltage is indicated by the PLATE POWER indicator light going on, and by a reading on the voltmeter connected to the probe.

*d.* In turn, slide out each deck. When a deck is withdrawn about three-fourths inch, high voltage is removed by the interlock switch, as indicated by the PLATE POWER indicator light going out. The voltmeter connected to the probe should indicate zero voltage.

*e.* Repeat the steps in *a* through *d* above, with the high-voltage probe connected to the modulator and rf deck side of the high-voltage bus.

*f.* Repeat the steps in *a* through *e* above. Remove the back cover of the housing. The high voltage should be removed by this action. Throw the PLATE POWER circuit breaker and the PLATE RELAY switch to the OFF position. Replace the back cover.

*g.* Operate the FILAMENT POWER circuit breaker. Note that the blower (B2) in the housing goes only when the circuit breaker is thrown to the ON position.

*h.* At the conclusion of the tests, throw all switches and circuit breakers to the OFF position. Use the shorting stick before disconnecting the high-voltage probe and all other test equipment.

# CHAPTER 7

## SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

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### Section I. SHIPMENT AND LIMITED STORAGE

#### 107. Disassembly

When the transmitter is part of a system, refer to the appropriate manual for specific disassembly instructions. General instructions are given below:

- a. Disconnect and remove any antenna tuning unit that may be on top of the transmitter.
- b. Disconnect all cabling to the equipment.
- c. If the base is bolted to the floor, remove the bolts.

#### 108. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for shipment or limited storage depends on the materials available and the conditions under which the equipment is to be shipped or stored.

b. The packing procedure is illustrated in figure 6. Make sure that the desiccants are placed in the moisture-vaporproof barrier. Before the ends of the barrier are heat-sealed, the inside air has to be exhausted. For specific information on this procedure, refer to TM 38-230, Preservation, Packaging, and Packing of Military Supplies and Equipment.

### Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

#### 109. General

The demolition procedures outlined in paragraph 110 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon order of the commander.

#### 110. Methods of Destruction

a. *Smash.* Smash the controls, indicators and meters, tubes, coils, capacitors, switches, transformers, gears, and sealed assemblies; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. *Cut.* Cut cords and wiring; use axes, handaxes, or machetes.

c. *Burn.* Burn cords, resistors, capacitors, coils wiring, and technical manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. *Bend.* Bend panels, housing, and chassis.

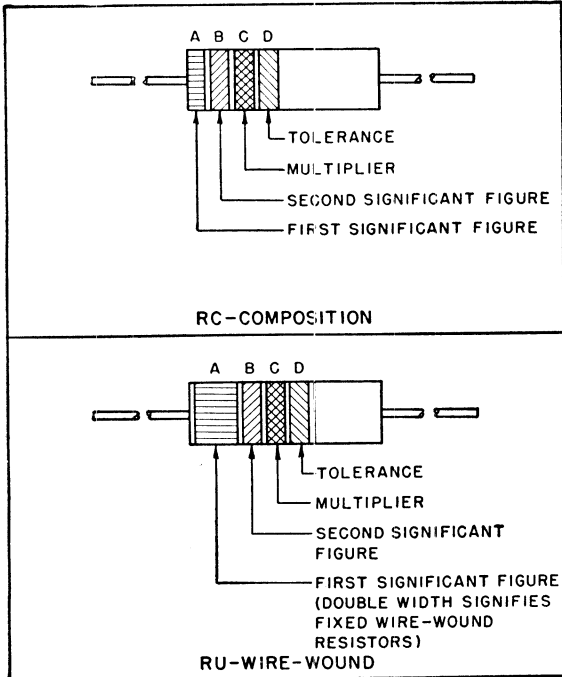
e. *Explosives.* If explosives are necessary, use firearms, grenades, or TNT.

f. *Disposal.* Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

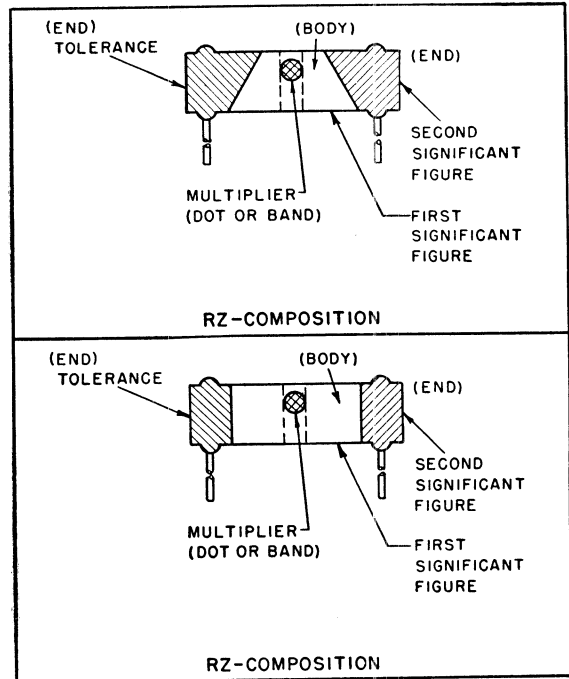
g. *Destroy.* Destroy everything.

## RESISTOR COLOR CODE MARKING (MIL-STD RESISTORS)

### AXIAL-LEAD RESISTORS (INSULATED)



### RADIAL-LEAD RESISTORS (UNINSULATED)



## RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	$\pm 20$
BROWN	1	BROWN	1	BROWN	10	SILVER	$\pm 10$
RED	2	RED	2	RED	100	GOLD	$\pm 5$
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

\* FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

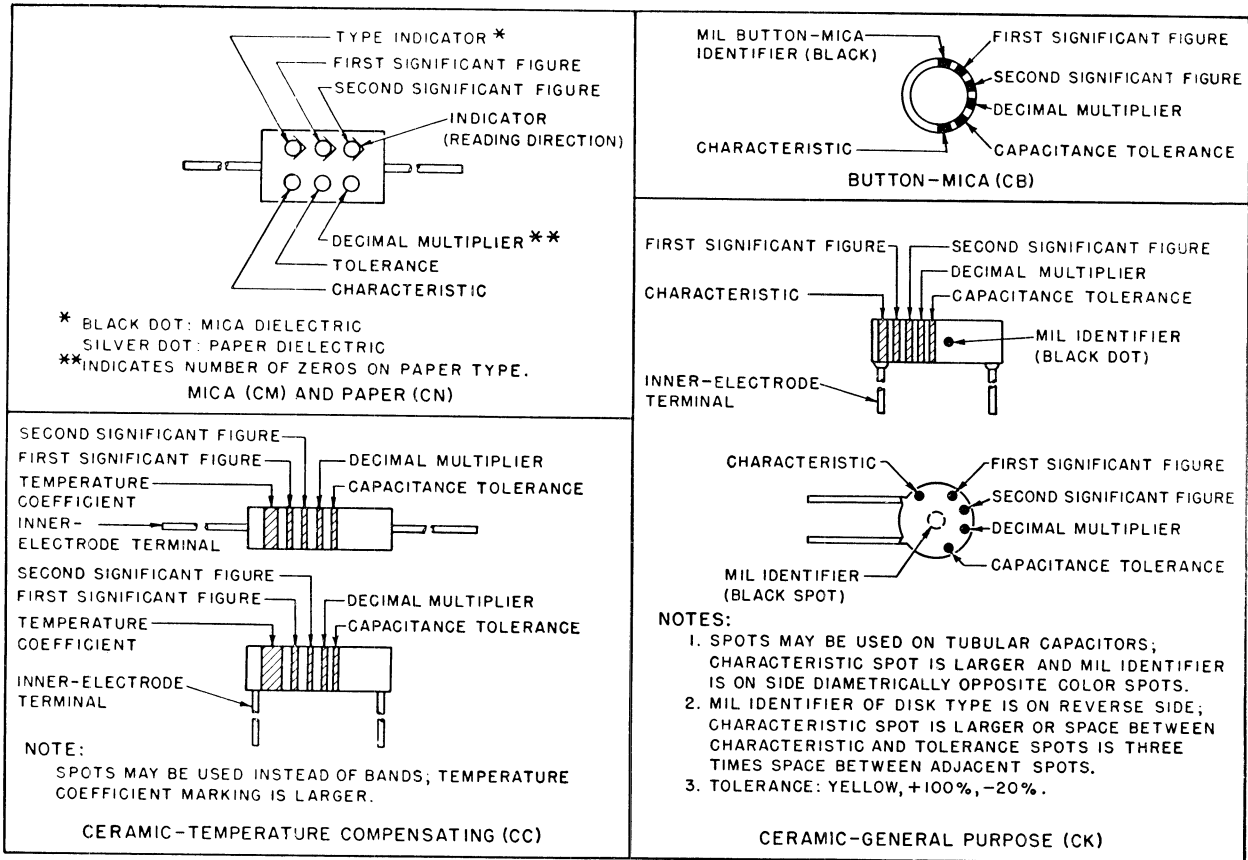
**EXAMPLES (BAND MARKING):**  
 10 OHMS  $\pm 20$  PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.  
 4.7 OHMS  $\pm 5$  PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

**EXAMPLES (BODY MARKING):**  
 10 OHMS  $\pm 20$  PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.  
 3,000 OHMS  $\pm 10$  PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-R1

Figure 89. MIL STD resistor color codes.

## CAPACITOR COLOR CODE MARKING (MIL-STD CAPACITORS)

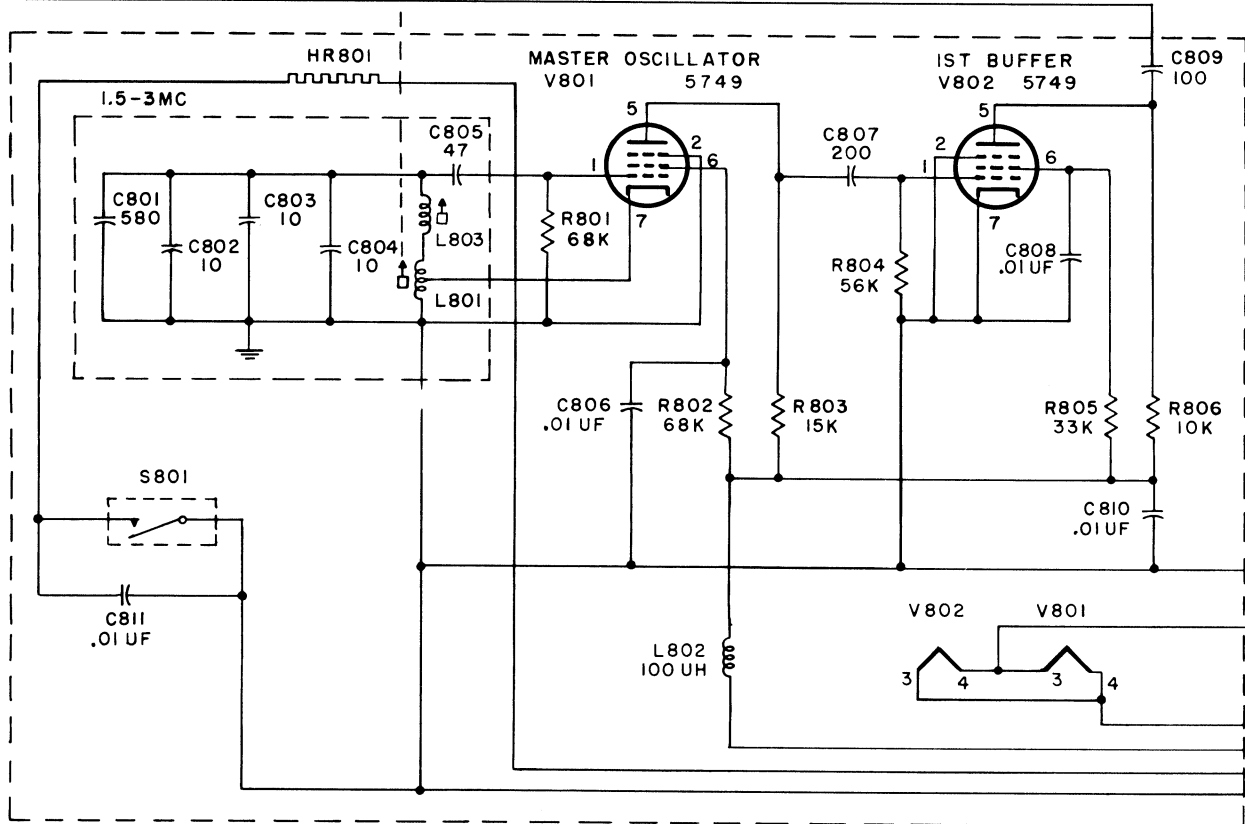
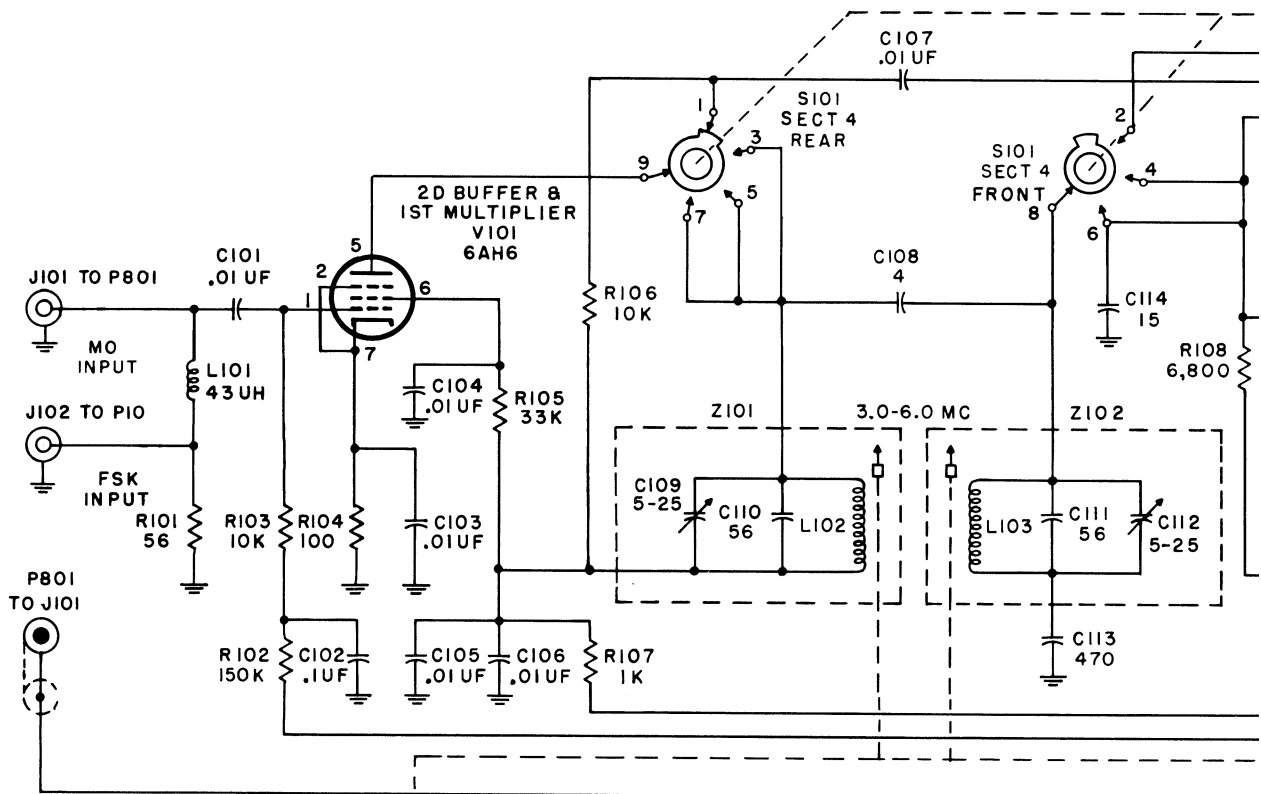


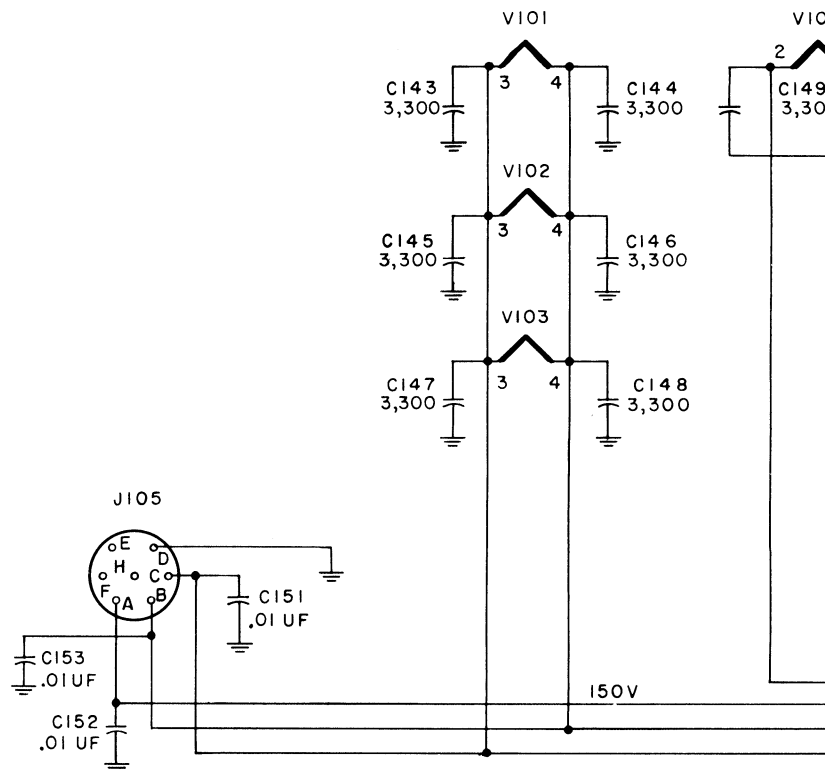
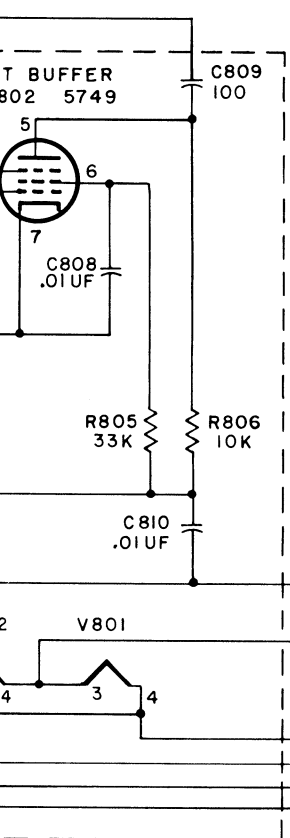
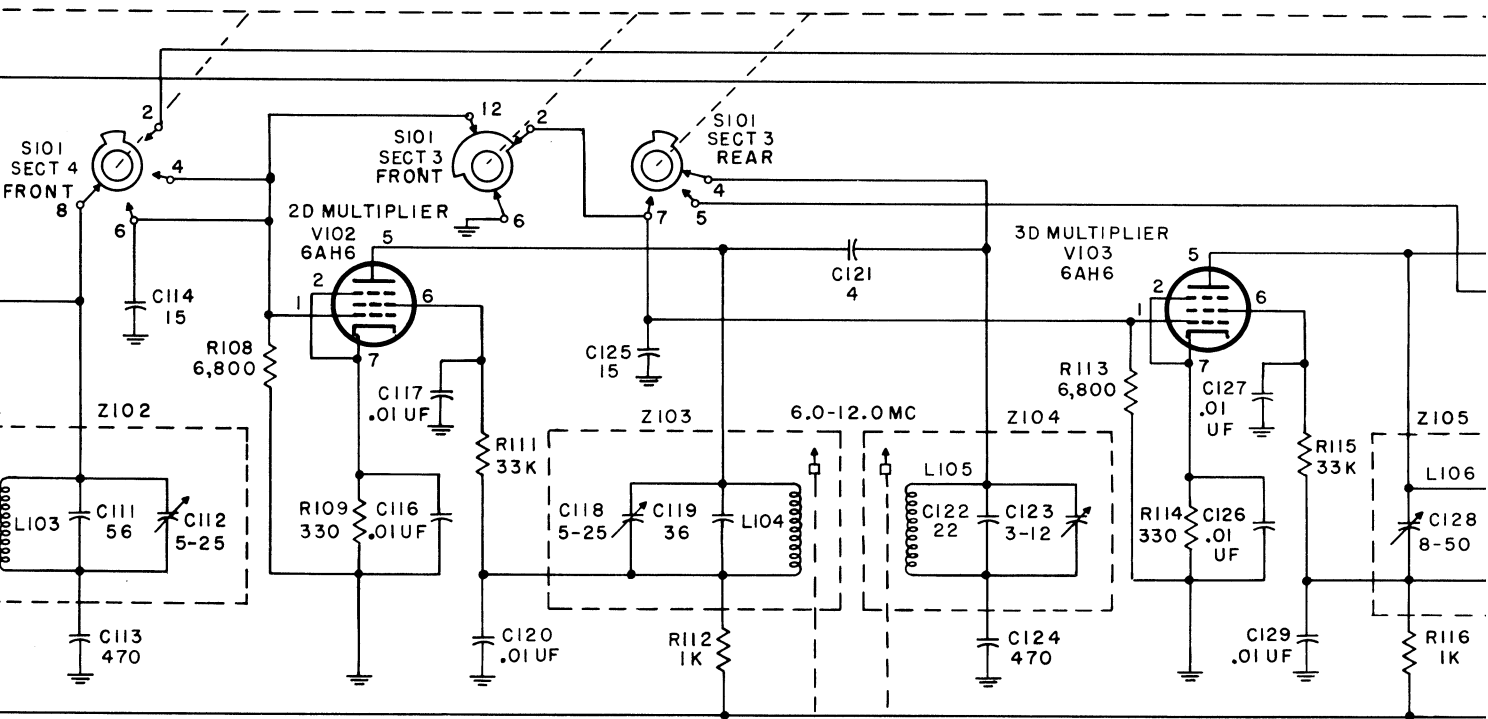
## CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC <sup>1</sup>				TOLERANCE <sup>2</sup>				TEMPERATURE COEFFICIENT (UUF/UF/°C)	
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER IOUUF		OR LESS
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500) <sup>3</sup>
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.  
 2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.  
 3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-C1





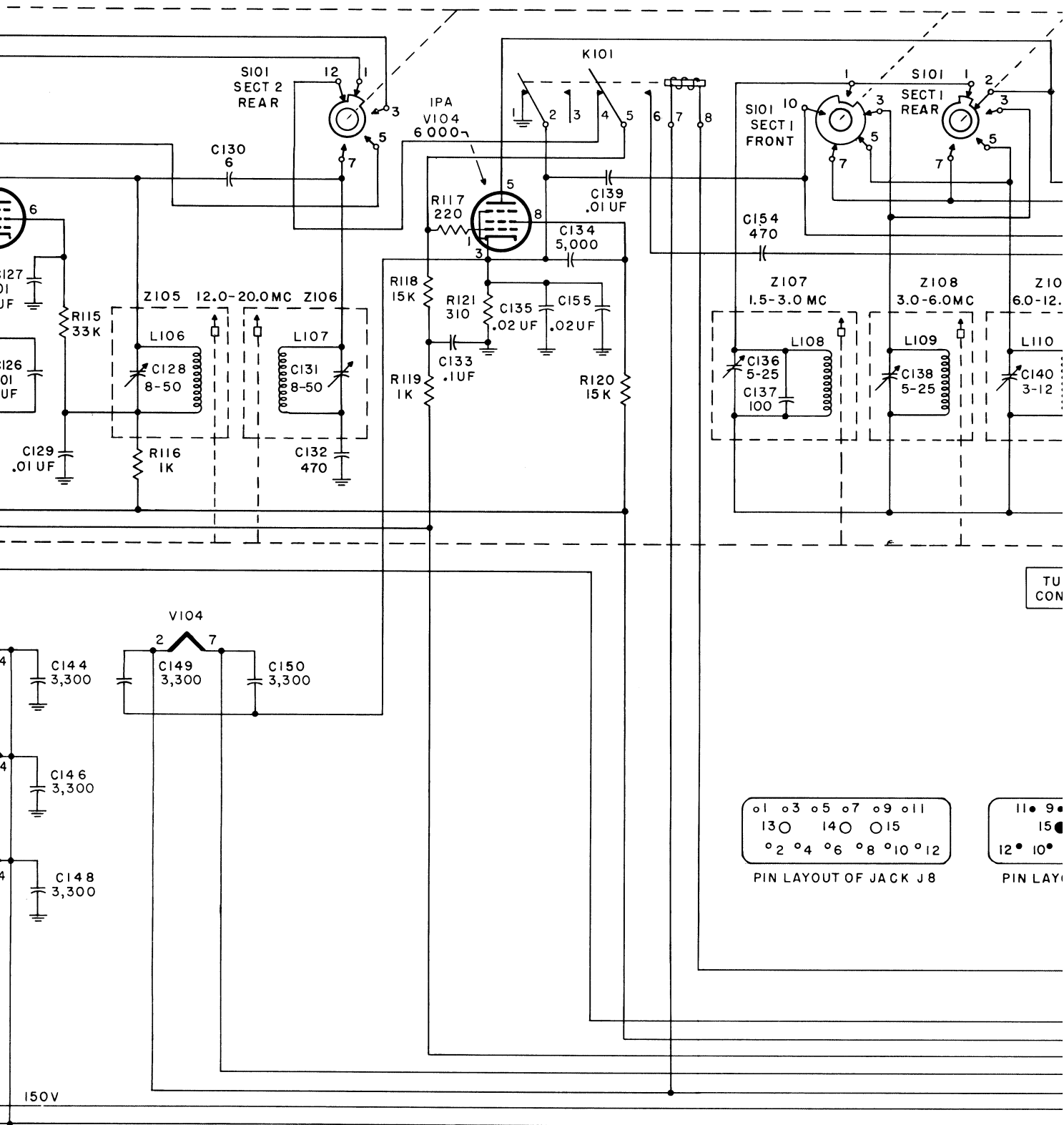
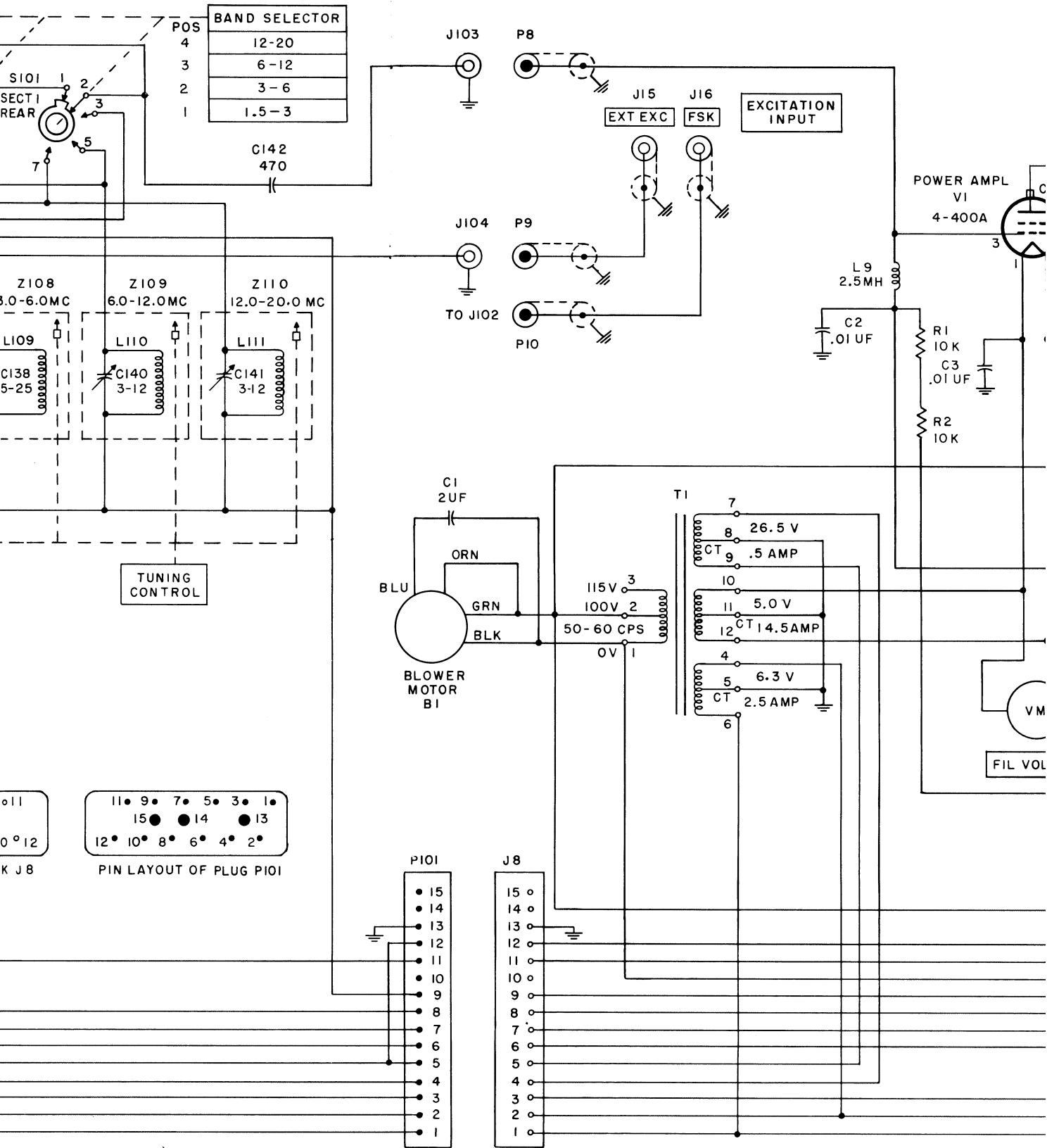
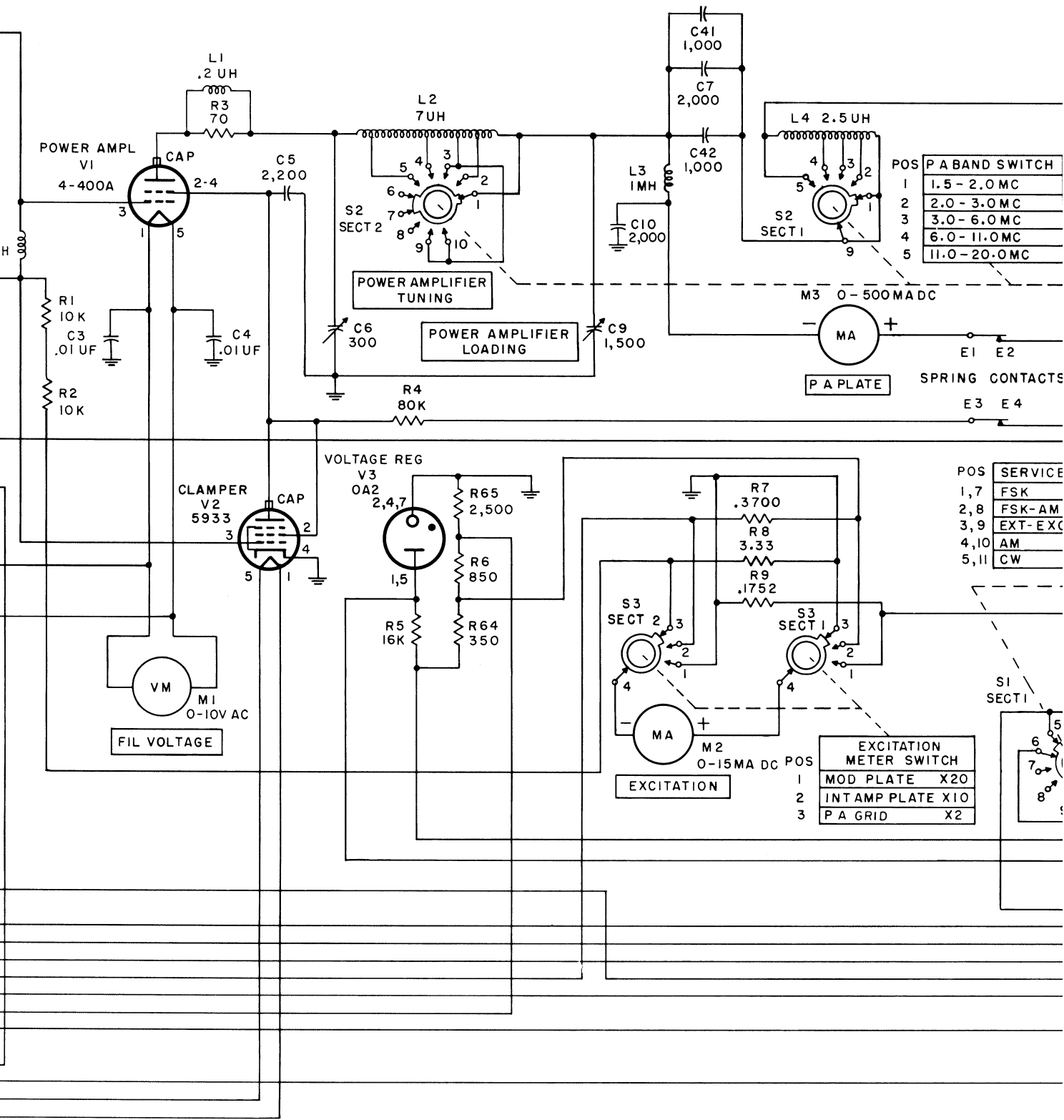


Figure 91. Radio Transmitter



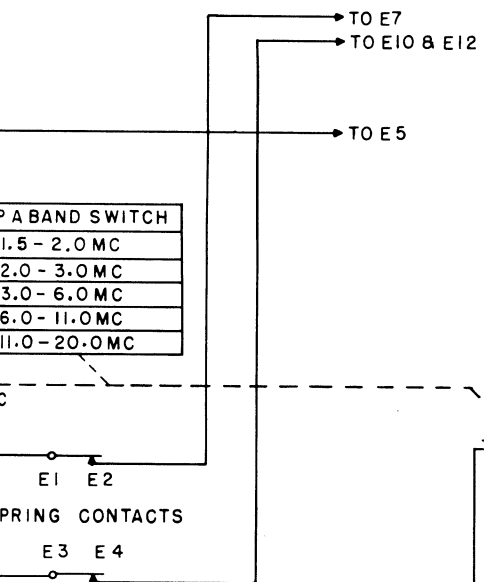
91. Radio Transmitter T-368/URT, rf deck, schematic diagram.



POS	P A BAND SWITCH
1	1.5 - 2.0 MC
2	2.0 - 3.0 MC
3	3.0 - 6.0 MC
4	6.0 - 11.0 MC
5	11.0 - 20.0 MC

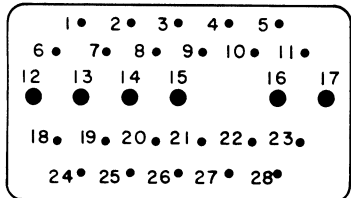
POS	SERVICE
1,7	FSK
2,8	FSK-AM
3,9	EXT-EXT
4,10	AM
5,11	CW

POS	EXCITATION METER SWITCH
1	MOD PLATE X20
2	INTAMP PLATE X10
3	P A GRID X2



**NOTES:**

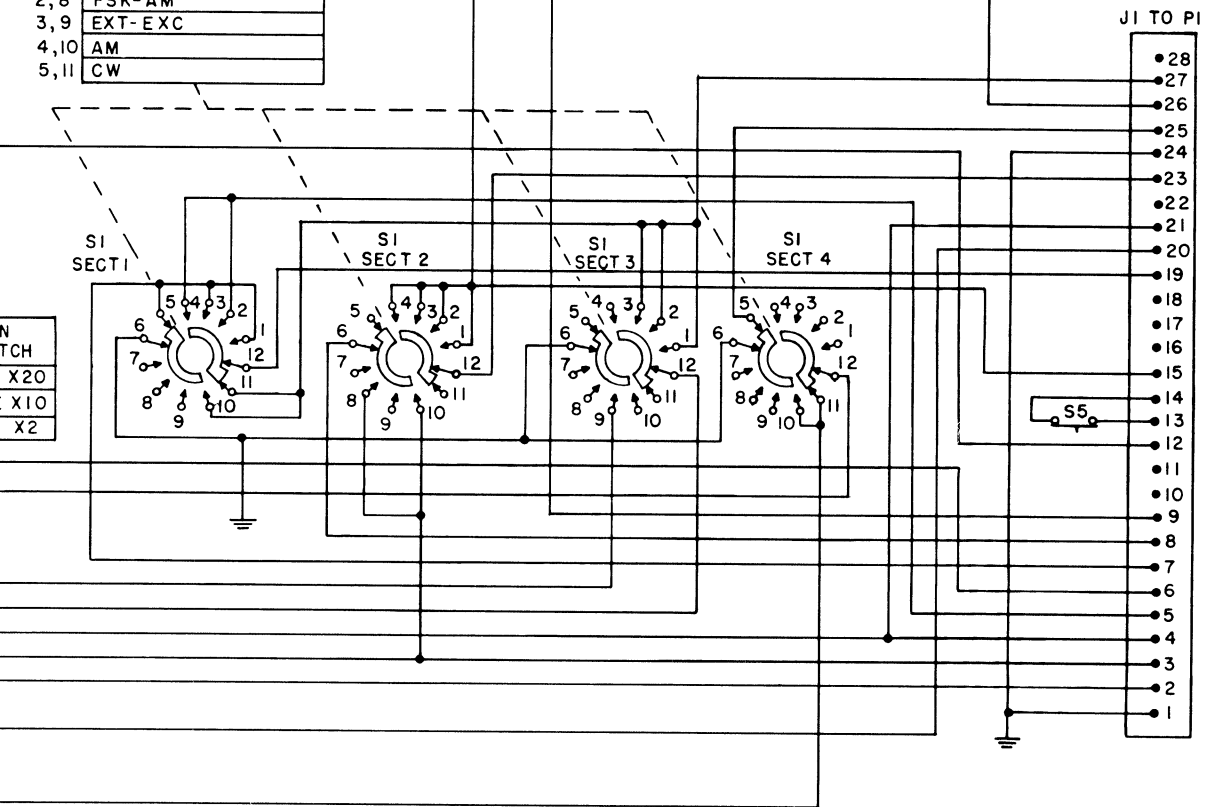
1. UNLESS OTHERWISE SHOWN; RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2. ROTARY SWITCHES S1, S2, & S3 ARE VIEWED FROM REAR. S1 AND S3 ARE SHOWN IN EXTREME CW POSITION, S2 IN EXTREME CCW POSITION. S101 IS VIEWED FROM KNOB END. & ROTOR IS SHOWN IN EXTREME CCW POSITION. (KNOB IS IN EXTREME CW POSITION.) SECTIONS DESIGNATED "1" ARE NEAREST THE KNOB END.



PIN LAYOUT OF JACK J1

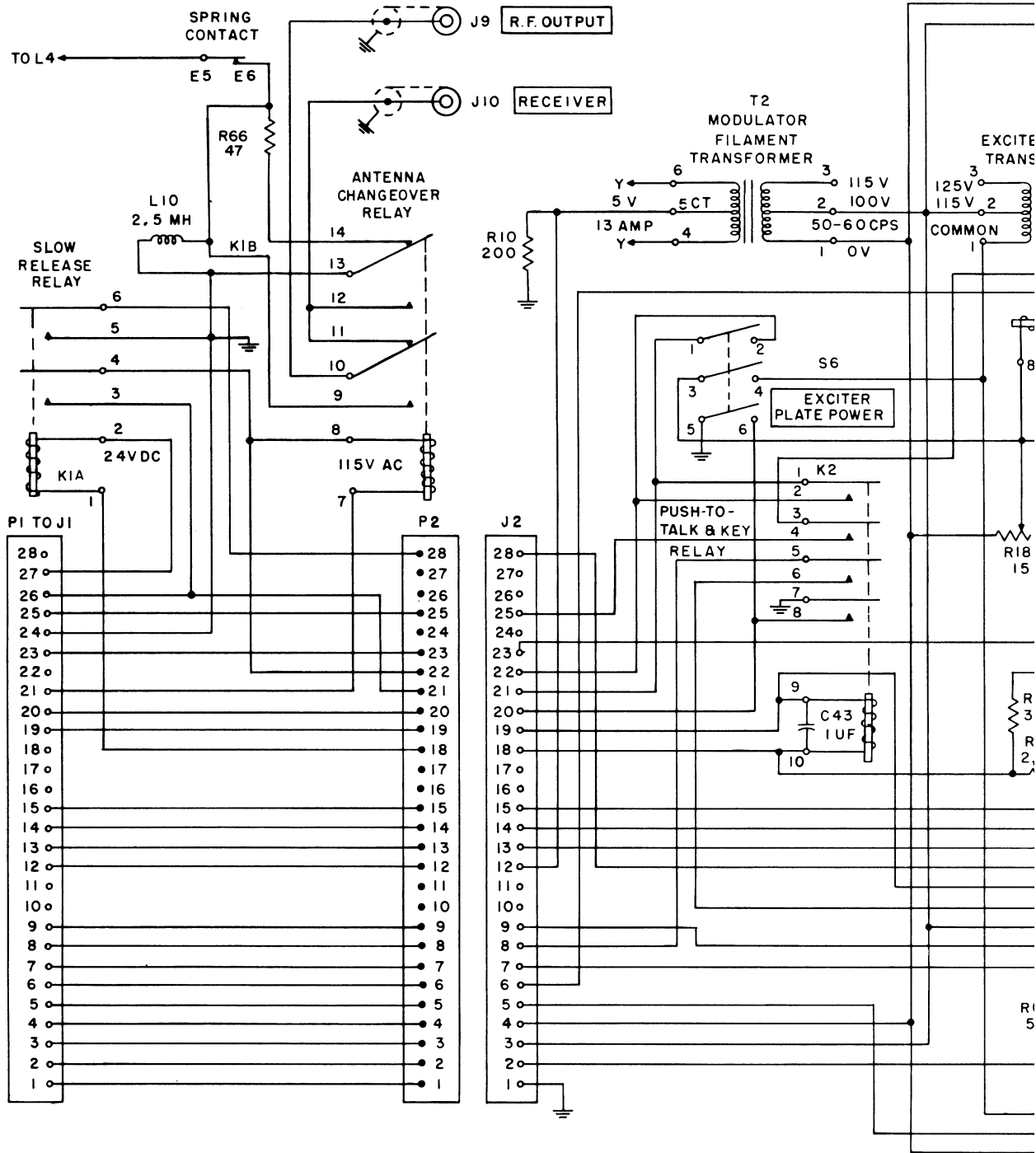
S4 OPENS WHEN ROTOR OF S2 IS IN BETWEEN SWITCH POSITIONS.

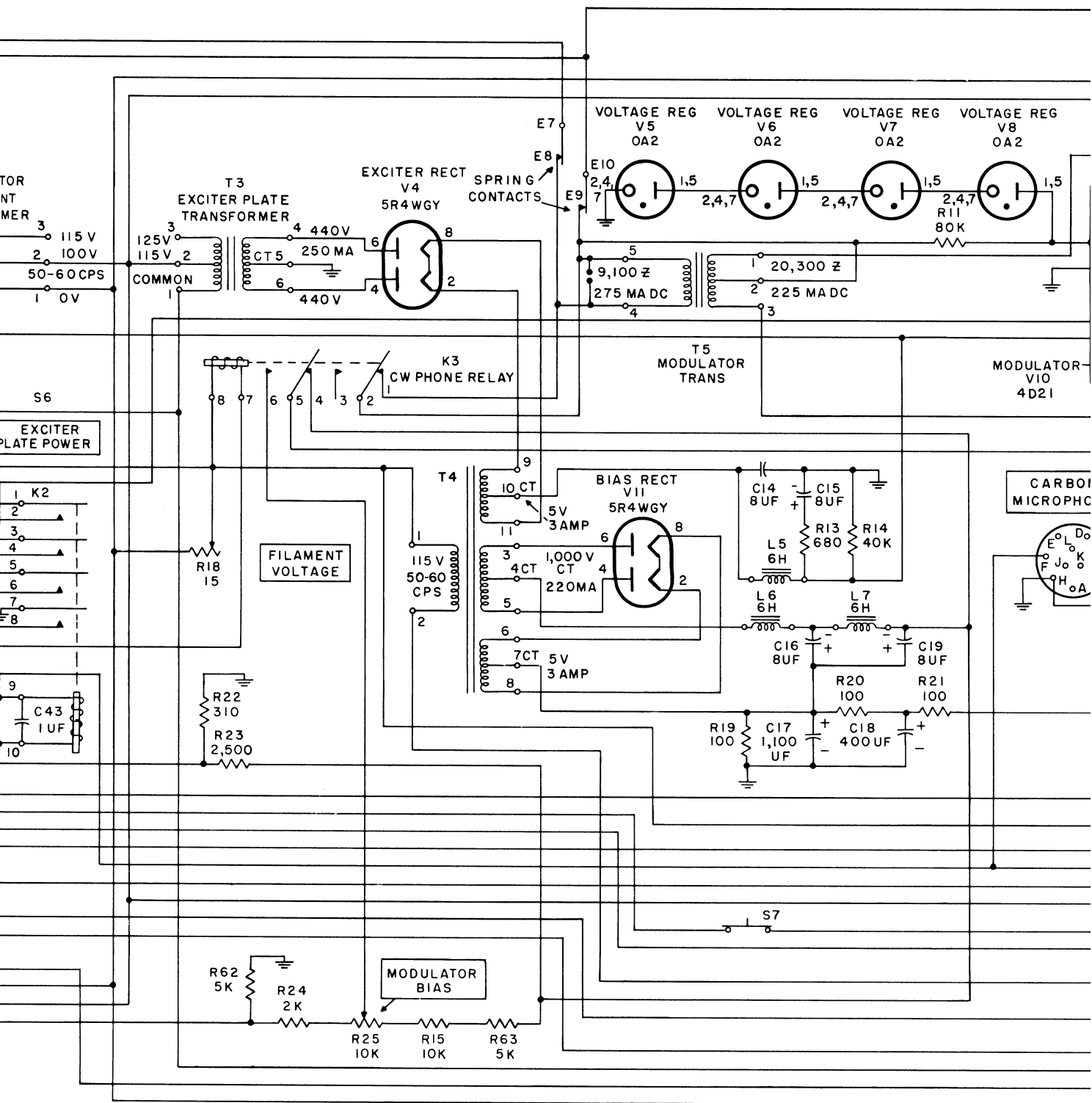
POS	SERVICE SELECTOR
1,7	FSK
2,8	FSK-AM
3,9	EXT-EXC
4,10	AM
5,11	CW



TM 809-73

TO E2  
TO E4





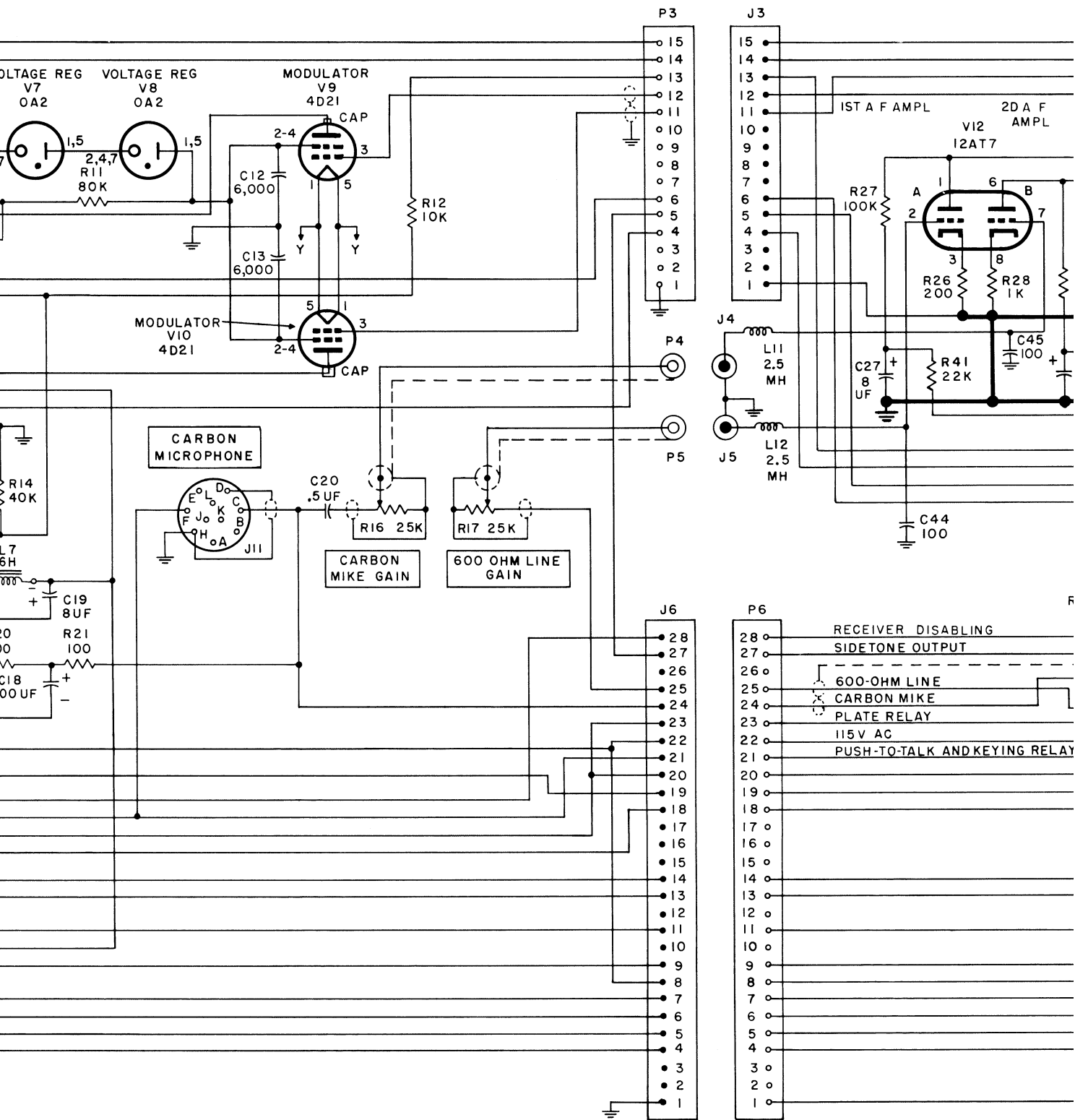
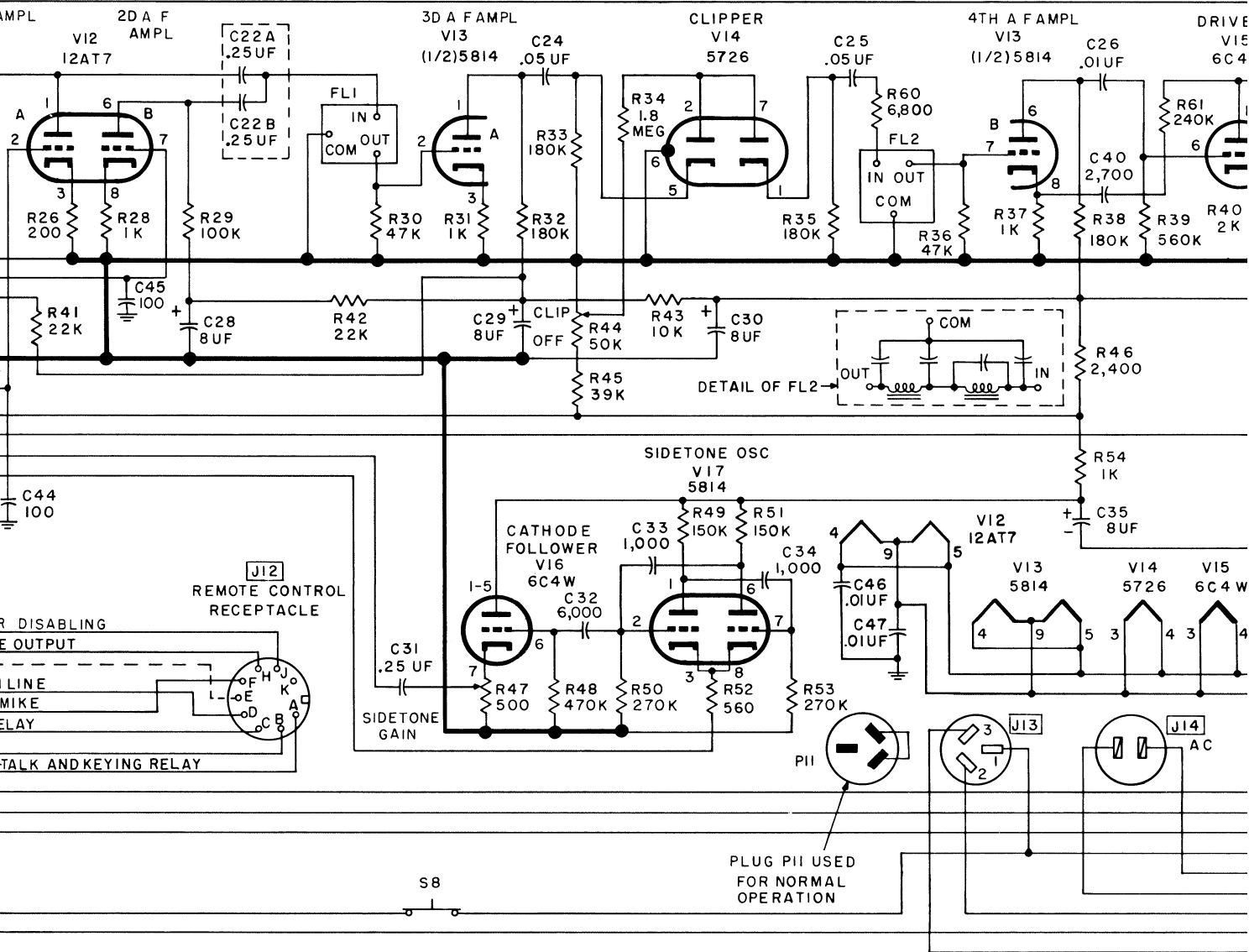
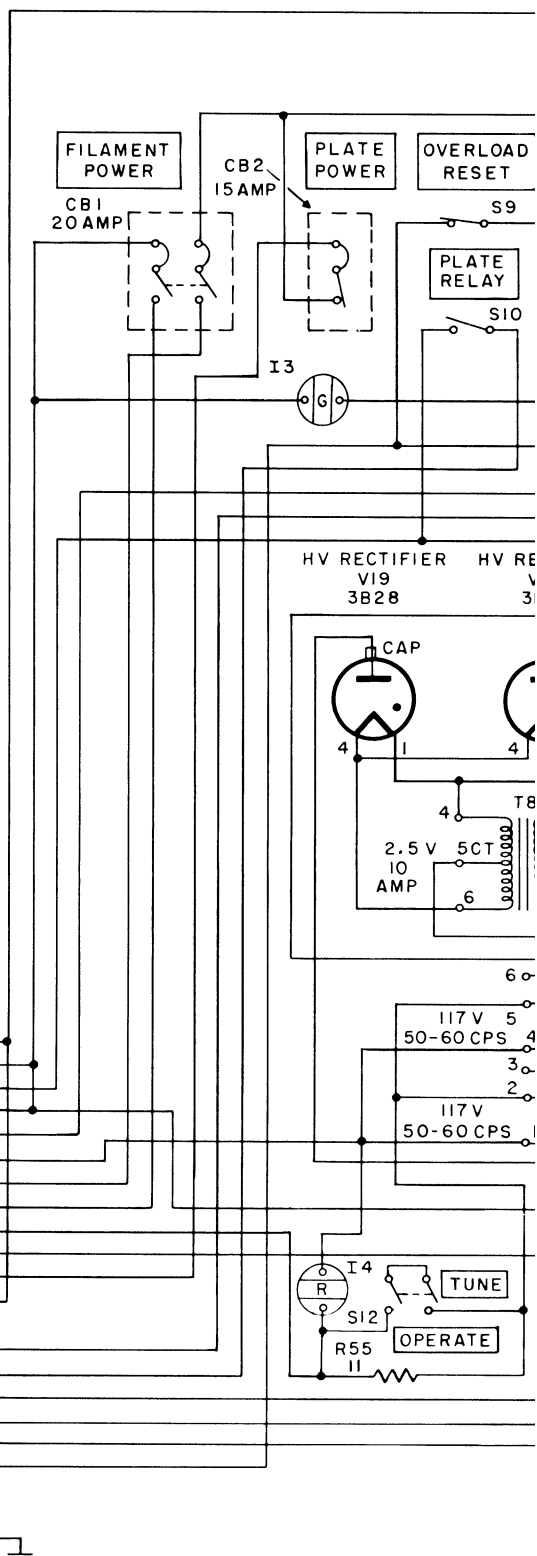
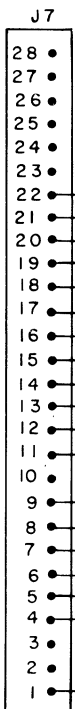
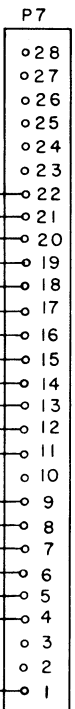
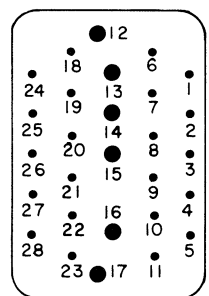
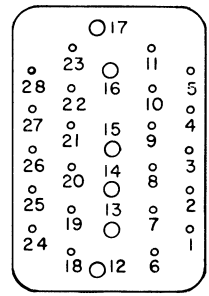
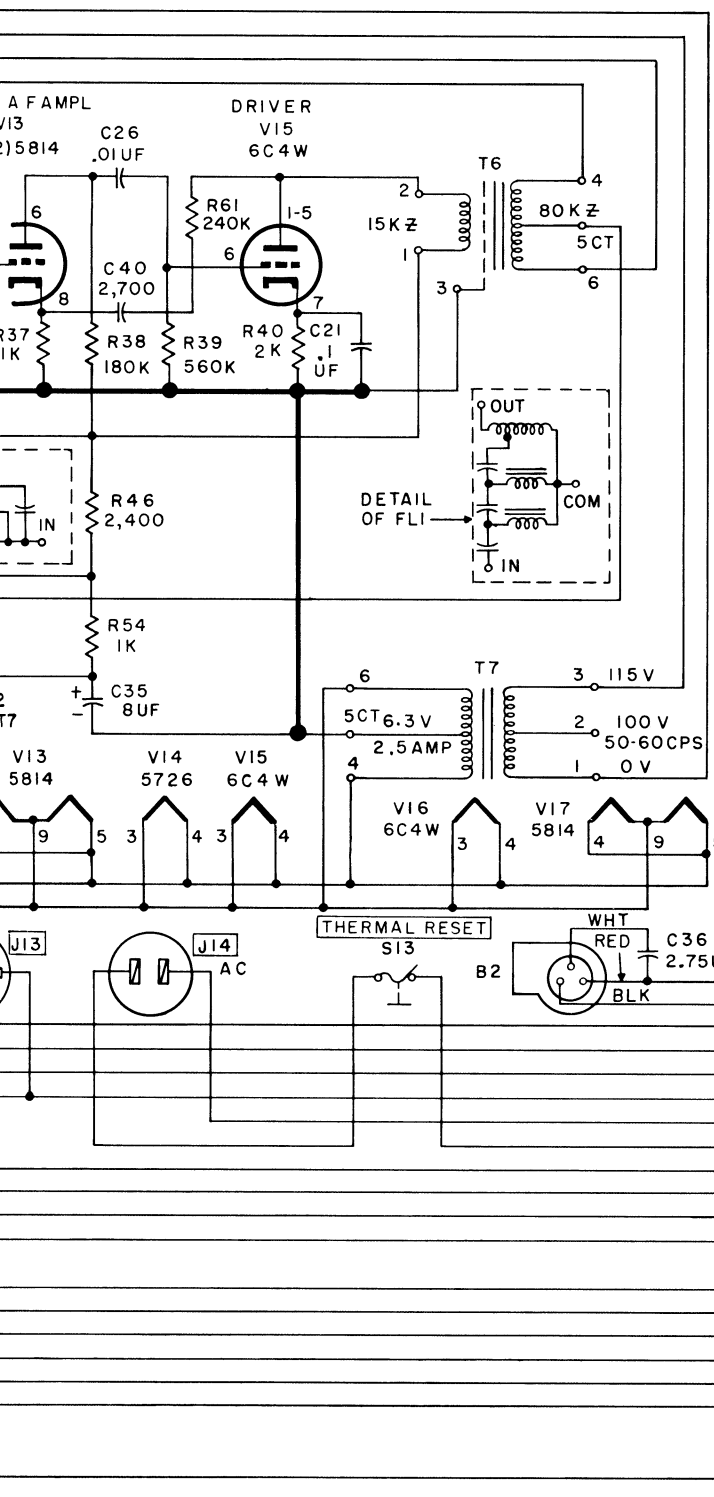
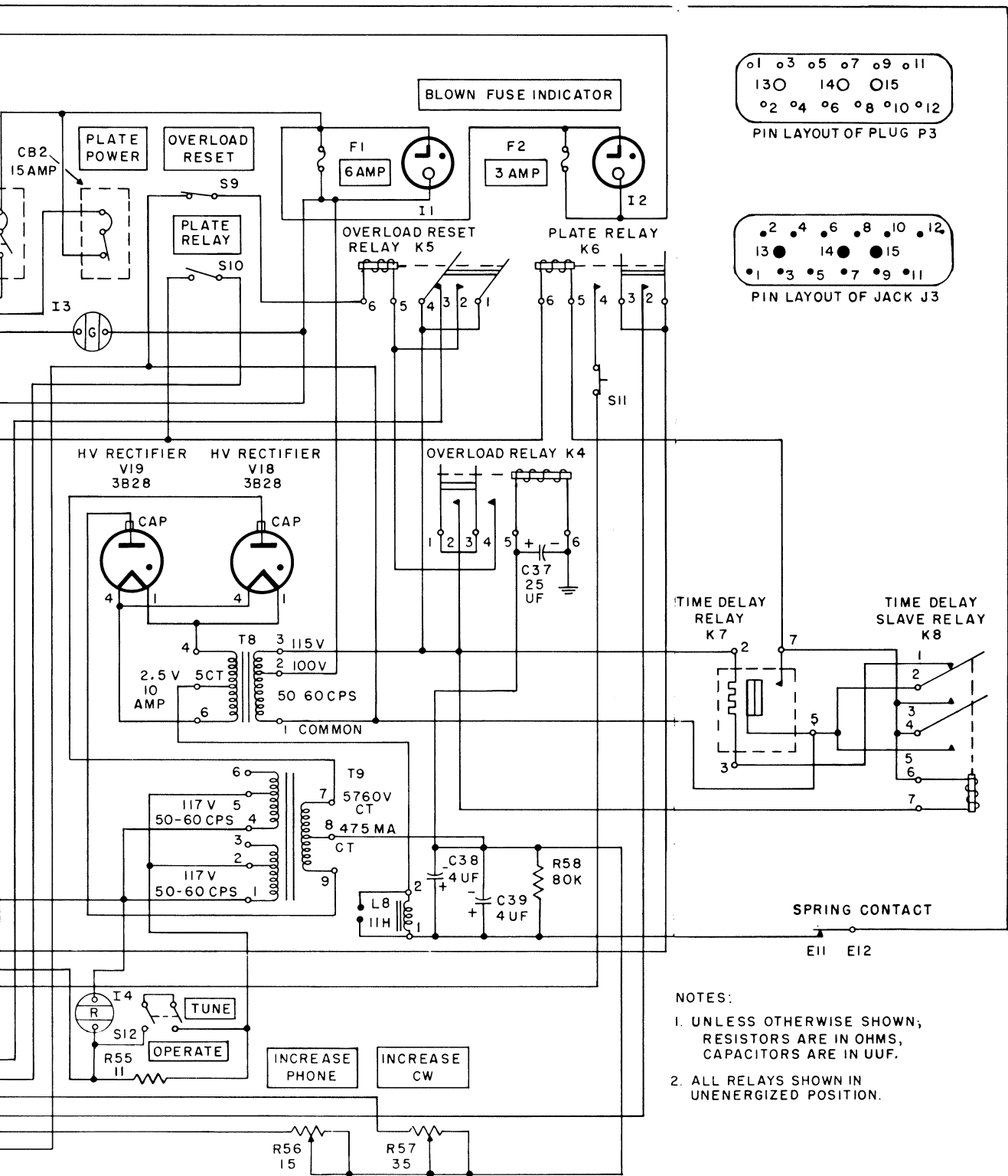


Figure 92. Radio Transmitter T-368/URT, modulator deck



8/URT, modulator deck, power deck, and housing, schematic diagram.





**NOTES:**

1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2. ALL RELAYS SHOWN IN UNENERGIZED POSITION.

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[AG 413.44 (11 Apr 55)]

BY ORDER OF THE SECRETARY OF THE ARMY:

M. B. RIDGWAY,  
*General, United States Army,  
Chief of Staff.*

OFFICIAL:

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

DISTRIBUTION:

*Active Army:*

CNGB (1)  
Tec Svc, DA (1)  
Tec Svc Bd (1)  
CONARC (5)  
CONARC Bd (Incl ea Test Sec) (1)  
Army AA Comd (2)  
OS Maj Comd (5)  
OS Base Comd (5)  
Log Comd (5)  
MDW (1)  
Armies (5)  
Corps (2)  
Tng Div (2)  
Ft & Cp (2)  
Gen & Br Svc Sch (5)  
Sig C Sch (25)  
Gen Depots (2)

Sig C Sec, Gen Depots (10)  
Sig C Depots (20)  
POE (2)  
OS Sup Agencies (2)  
Sig C Fld Maint Shops (3)  
Sig C Lab (5)  
Mil Dist (1)  
Units organized under following  
TOE's:  
11-7, Sig Co Inf Div (2)  
11-16A, Hq & Hq Co, Sig Bn,  
Corps or Abn Corps (2)  
11-57, Armd Sig Co (2)  
11-127, Sig Rep Co (2)  
11-128A, Sig Depot Co (2)  
11-500A (AA-AE), Sig Svc Org  
(2)

Units organized under following  
TOE's—Continued  
11-557A, Abn Sig Co (2)  
11-587A, Sig Base Maint Co (2)  
11-592A, Hq & Hq Co, Sig Base  
Depot (2)  
11-597A, Sig Base Depot Co (2)  
20-45, Scout Bn, A, NG (2)  
20-47, Scout Co, Bn, A, NG (2)  
44-7, AAA Opr Det (2)  
44-12, Hq & Hq Btry AAA Gp  
(2)  
44-101, Hq & Hq Btry, AAA  
Brg (2)  
55-201 GHQ, TMRS (2)

*NG:* State AG (6); units—same as Active Army except allowance is one copy to each unit.

*USAR:* None.

For explanation of abbreviations used, see SR 320-50-1.

