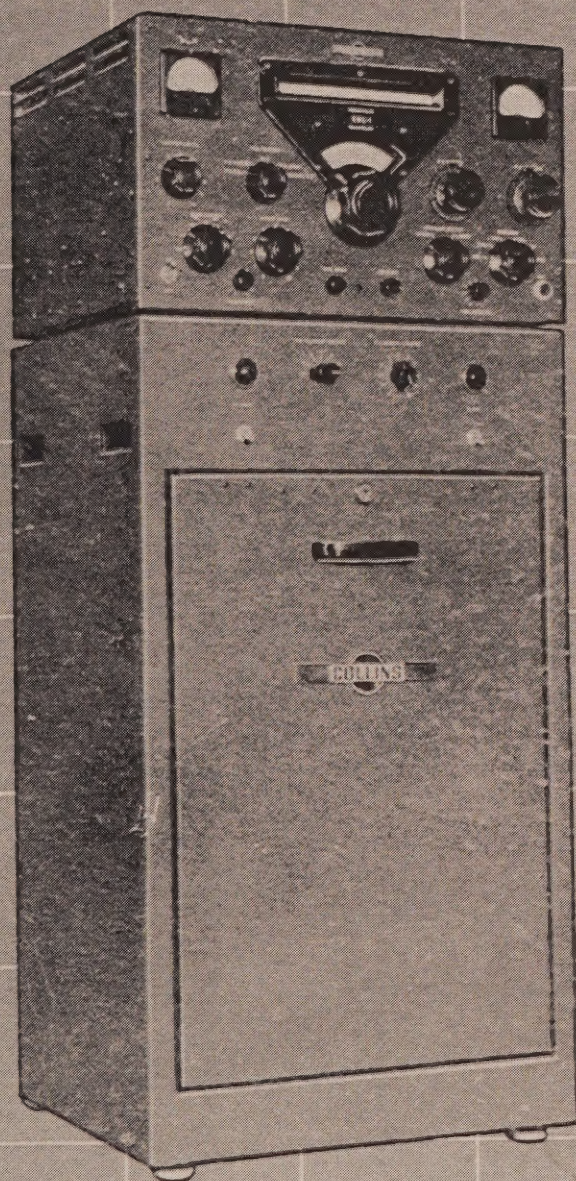



Collins

KWS-1

**AMATEUR
TRANSMITTER**



INSTRUCTION BOOK



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Instruction Book

KWS-1

AMATEUR TRANSMITTER

COLLINS RADIO COMPANY

Cedar Rapids, Iowa

520 5347 00

Second Edition 15 October 1955

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COLLINS AMATEUR EQUIPMENT GUARANTEE

The Collins Amateur equipment described herein is sold under the following guarantee:

Collins agrees to repair or replace, without charge, any equipment, parts, or accessories which are defective as to design, workmanship, or materials, and which are returned to Collins at its factory, transportation prepaid, provided:

- (a) Buyer has completed and returned to Collins promptly following his purchase the Registration Card included in the Instruction Book furnished with the equipment.
- (b) Notice of the claimed defect is given Collins within 90 days from the date of purchase and goods are returned in accordance with Collins' instructions.
- (c) Equipment, accessories, tubes, and batteries not manufactured by Collins or from Collins' designs are subject to only such adjustments as Collins may obtain from the supplier thereof.
- (d) No equipment or accessory shall be deemed to be defective if, due to exposure or excessive moisture in the atmosphere or otherwise after delivery, it shall fail to operate in a normal and proper manner.
- (e) Any failure due to use of equipment in excess of that contemplated in normal amateur operations shall not be deemed a defect within the meaning of these provisions.

The guarantee of these paragraphs is void if equipment is altered or repaired by others than Collins or its authorized service center.

No other warranties, expressed or implied, shall be applicable to said equipment, and the foregoing shall constitute the Buyer's sole right and remedy under the agreements contained in these paragraphs. In no event shall Collins have any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of the products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

IMPORTANT! It is necessary that the business reply card included herewith be filled out and mailed to the Company promptly in order for this guarantee to be effective.

HOW TO RETURN MATERIAL OR EQUIPMENT. If, for any reason, you should wish to return material or equipment, whether under the guarantee or otherwise, you should notify us, giving full particulars including the details listed below, insofar as applicable. If the item is thought to be defective, such notice must give full information as to nature of defect and identification (including part number if possible) of part considered defective. (With respect to tubes we suggest that your adjustments can be speeded up if you give notice of defect directly to the tube manufacturer.) Upon receipt of such notice, Collins will promptly advise you respecting the return. Failure to secure our advice prior to the forwarding of the goods or failure to provide full particulars may cause unnecessary delay in handling of your returned merchandise.

ADDRESS:

Collins Radio Company
Sales Service Department
Cedar Rapids, Iowa

INFORMATION NEEDED:

- (A) Type number, name, and serial number of equipment
- (B) Date of delivery of equipment
- (C) Date placed in service
- (D) Number of hours of service
- (E) Nature of trouble
- (F) Cause of trouble if known
- (G) Part number (9 or 10 digit number) and name of part thought to be causing trouble
- (H) Item or symbol number of same obtained from parts list or schematic
- (I) Collins' number (and name) of unit sub-assemblies involved in trouble
- (J) Remarks

HOW TO ORDER REPLACEMENT PARTS. When ordering replacement parts, you should direct your order as indicated below and furnish the following information insofar as applicable. To enable us to give you better replacement service, please be sure to give us complete information.

ADDRESS:

Collins Radio Company
Sales Service Department
Cedar Rapids, Iowa

INFORMATION NEEDED:

- (A) Quantity required
- (B) Collins' part number (9 or 10 digit number) and description
- (C) Item or symbol number obtained from parts list or schematic
- (D) Collins' type number, name, and serial number of principal equipment
- (E) Unit sub-assembly number (where applicable)

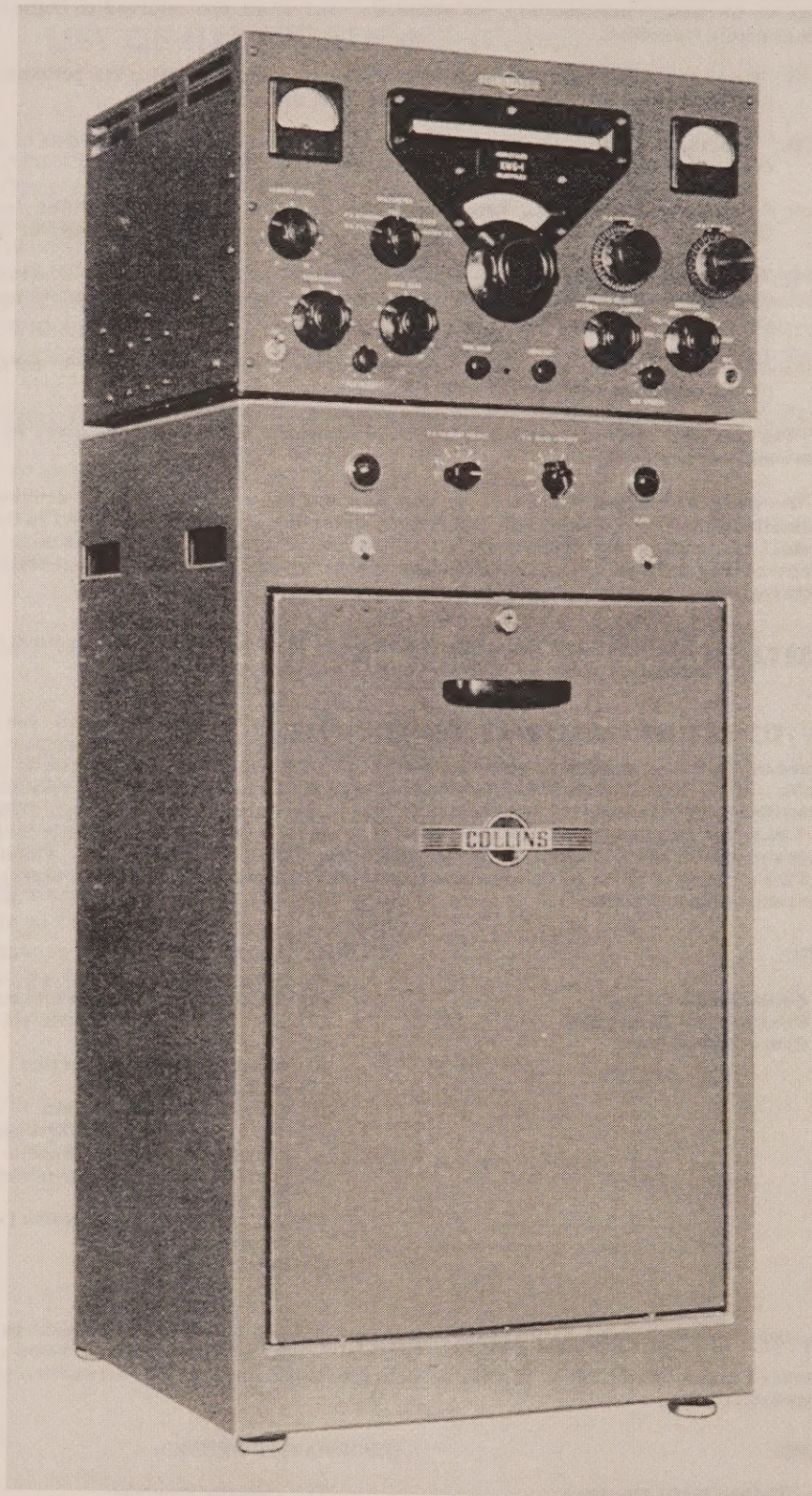


Figure 1-1. KWS-1 Transmitter

SECTION I

GENERAL DESCRIPTION

1.1. GENERAL.

The Collins KWS-1 is a compact amateur transmitter for single sideband, cw and AM. operation. It features filter-type single sideband generation and uses a Collins Type F250Z-3 Mechanical Filter for this purpose.

In the design of the KWS-1, many features formerly available in well-built amateur and commercial transmitters, were preserved and in addition, particular emphasis was placed on high grade single sideband performance. There are several features which particularly tend toward improved operation on single sideband. These include the following:

- a. Additional tuned circuits for spurious rejection.
- b. Careful design of linear amplifiers.
- c. Inverse r-f feedback on the PA for low distortion.
- d. Automatic load control.
- e. Voice operate and speaker quieting circuits.
- f. Crystal controlled double conversion with vfo for good frequency stability.

1.2. MAJOR UNITS.

The KWS-1 Transmitter consists of two major units listed below:

- a. Exciter/Power Amplifier
- b. Power Supply

The Exciter and Power Amplifier are housed in a single cabinet 17-3/8 inches wide, 10-15/32 inches high and 15-1/2 inches deep, weighing approximately fifty pounds. The width is extended to 19 inches when rack mounting brackets are used.

This cabinet may be table mounted, or, if desired, may be mounted on top of the power supply cabinet alongside the operator's table.

The Power Supply is enclosed in a cabinet 17-3/8 inches wide, 30 inches high and 15-1/2 inches deep. It can be rack mounted, if desired. The Power Supply and cabinet together weigh approximately 173 pounds. A forced air system is provided for proper ventilation of the PA tubes and output network.

1.3. GENERAL CHARACTERISTICS AND DESCRIPTION.

1.3.1. EXCITER/POWER AMPLIFIER.

The exciter and power amplifier portion of the Collins KWS-1 Transmitter is vfo controlled with complete band switching and is capable of cw, single sideband suppressed carrier, and single sideband-AM. operation on all amateur bands between 3.5 and 29.7 megacycles. (See figure 4-1.) Intercircuit ganging of tuned circuits provides the operator with quick band switching and operational adjustments. Single conversion heterodyne circuits are utilized for the 80-meter band, and double conversion for all other bands. Stability of operation is maintained by use of a low frequency variable oscillator and a crystal controlled high frequency oscillator. The vfo is permeability tuned and hermetically sealed.

Single sideband generation, with very low distortion, is provided by the use of a crystal diode balanced modulator and the Collins F250Z-3 Mechanical Filter. (See figure 1-2.) Utilization of these components, and associated circuitry, produces carrier suppression of more than 50 decibels, and reduces the unwanted sideband by more than 50 decibels.

Cw operation is obtained by grid-block keying. Wave shaping circuits are used to reduce key clicks and transients.

Section I

Paragraphs 1.3.1. - 1.4.

Optional FSK operation can be obtained by use of an external audio FSK oscillator, fed into the audio circuits to provide a carrier shift output signal.

A voice operated transmitter (VOX) circuit is utilized with the carrier control relay, allowing transmission only during those intervals of actual audio signal input on SSB and AM. operation. A portion of the audio signal is fed into the VOX amplifier, and is rectified to produce a d-c operating voltage for the relay, permitting transmission of the signal. When there is no audio input, the relay does not operate and there is no transmission.

In conjunction with the VOX circuit is a speaker signal squelch feature which prevents the operator's receiver signal from operating the carrier control relay. This is done by a voltage developed by the squelch circuit that cancels out the undesired VOX voltage produced by the audio from the receiver's speaker.

The Power Amplifier is tuned independent of the Exciter, and features continuous tuning and loading from 3.5 to 30 megacycles without the use of switches. Two power amplifier controls are brought out to the front panel. One is for loading the final circuits, and the other for tuning. A meter is mounted in the upper right-hand corner of the front panel for observing the final stage plate current. An Automatic Load Control circuit, operating on principles similar to a receiver AVC system, works in conjunction with the final amplifier stages to provide feedback of a rectified d-c voltage into two low level r-f exciter stages. The control voltage gives a maximum of twelve decibels compression, and prevents modulation peaks from driving the final amplifier stages into grid current and distortion.

Shielding and filtering is used throughout the Exciter/Power Amplifier to minimize the possibility of interference to other services. Since all amplifier stages of the KWS-1 are operated in a linear fashion, harmonic generation is much lower than would be the case in a class C amplifier. If necessary, the Collins Model 35C-2 Low-Pass Filter can be installed at the antenna lead of the KWS-1 Transmitter to prevent interference with fringe area TV signals. Installation of a high-pass filter in the TV receiver antenna lead may also be helpful.

Subunits within the Exciter/ Power Amplifier cabinet are the audio amplifier and balanced modulator; vfo; r-f amplifier mixers; and the power amplifier circuits. The Power Amplifier is enclosed in a separate, shielded unit.

Accessibility to component parts for service and adjustment is provided from underneath the chassis, or by raising the top cover.

Section IV of this handbook gives a complete operational and functional description of all panels controls. Section IV includes a detailed discussion of all circuit theory.

1.3.2. POWER SUPPLIES.

The power supply portion of the KWS-1 includes a high and low voltage supply in the single cabinet. The high voltage Power Supply consists of two single phase, full wave rectifiers and filter networks for supplying voltages to the plates and screen grids of the Power Amplifier. Also included in the high voltage supply are suitable interlocks for safety purposes, a primary switch, overload fuses and a plate contactor. The low voltage Power Supply provides all operating voltages for the exciter portion.

On cw operation, the high voltage is ON and a grid-block system of bias is used to cut off the r-f excitation to the Power Amplifier. On phone operation, the push-to-talk switch on the microphone, or the voice operate (VOX) system, controls the application of operating voltages by the carrier control relay action. Thus, actual transmitting occurs only when the cw key is depressed on CW, when the operator is talking on SSB or when the push-to-talk switch is operated.

1.4. REFERENCE DATA.

Power Source: 115 or 230 volts ac, 50/60 cycles, single phase.

Power Input Requirements: The maximum overall input power requirement is 1500 watts.

PA Plate Power Input: The nominal rated power input is 1000 watts peak envelope power.

Distortion: Third order distortion is down more than 35 decibels with tone frequencies of 900 and 2500 cps.

Frequency Range:

Band (Meters)	Range (Mc)
80	3.0 to 4.0
40	7.0 to 7.3
20	14.0 to 15.0
15	21.0 to 22.0
11	26.4 to 27.4
10	28.0 to 29.0
10	29.0 to 30.0

Calibration: Direct reading in kilocycles on linear scale.

Dial Accuracy: Within 200 cps.

Frequency Stability:

Warmup: 5 minutes, not more than 1000 cps.
10 minutes, not more than 500 cps.

Normal Operation: After 20 minutes, within 300 cps of starting frequency.
After 30 minutes, within 100 cps over 10-minute period.

Audio Frequency Response: Within plus or minus three decibels from 200 to 2900 cps.

Carrier Suppression: Not less than fifty decibels.

Undesired Sideband Suppression: Not less than fifty decibels.

Spurious Radiation: At least 35 decibels down.

Impedance of Microphone Input: High impedance.

Impedance of Antenna Connection: 52 ohms. (See section VIII of this book for suggested antennas.)

Impedance of Phone Patch Connection: 600 ohms

Signal Level of Phone Patch: 0.1 volt.

Finish: St James grey wrinkle.

1.5. TUBE COMPLEMENT.

Quantity	Tube Type	Reference	Function
1	5749	V001	VFO
1	12AT7	V101	Audio Amplifier
1	12AT7	V102	Audio Output/Squelch Amplifier
1	12AT7	V103	VOX Amplifier/Relay Amplifier
1	12AT7	V104	Low Freq. (250 kc) Oscillator/Amplifier
2	OB2	V105, 106	Voltage Regulators
1	6AL5	V107	VOX and Squelch Rectifiers
1	3TF4A	RT101	Filament Regulator
1	12AT7	V201	First Mixer
4	6BA6	V202, 203, 209	1st, 2nd and 3rd Amplifiers
1	12AT7	V204	Second Mixer
2	6CL6	V206, 207	Drivers
1	6AU6	V208	Crystal Oscillator
2	4X150A	V401, 402	Final Amplifiers
1	6X4	V403	Automatic Load Control Rectifier
1	6AN5	V205	4th Amplifier
2	866A	V501, 502	Rectifiers, PA plate voltage
1	5Y3-GT	V503	Rectifier, PA screen voltage
1	6AS7-G	V504	Voltage Regulator, PA screen voltage
1	12AX7	V505	Voltage Regulator, PA screen voltage
1	OB2	V506	Voltage Regulator, PA screen voltage
1	5U4-GB	V508	Voltage Rectifier, low voltage
1	6AL5	V509	Bias Rectifier
1	2D21	V507	PA Screen Protect

1.6. ACCESSORIES (Not Supplied).

35C-2 Low-Pass Filter (for insertion in 52-ohm line). Provides approximately 75 decibels attenuation of television signals.

312A-1 Speaker Control. Provides space for mounting beam direction indicator, clock, etc., and includes a 10-inch speaker for receiver output.

Microphone - High impedance.

Telegraph Key.

Antenna Ammeter or Power Indicator.

Antenna Relay - 115 V dc, 5000-ohm coil.

Coaxial "T" fitting for calibration signal injection.

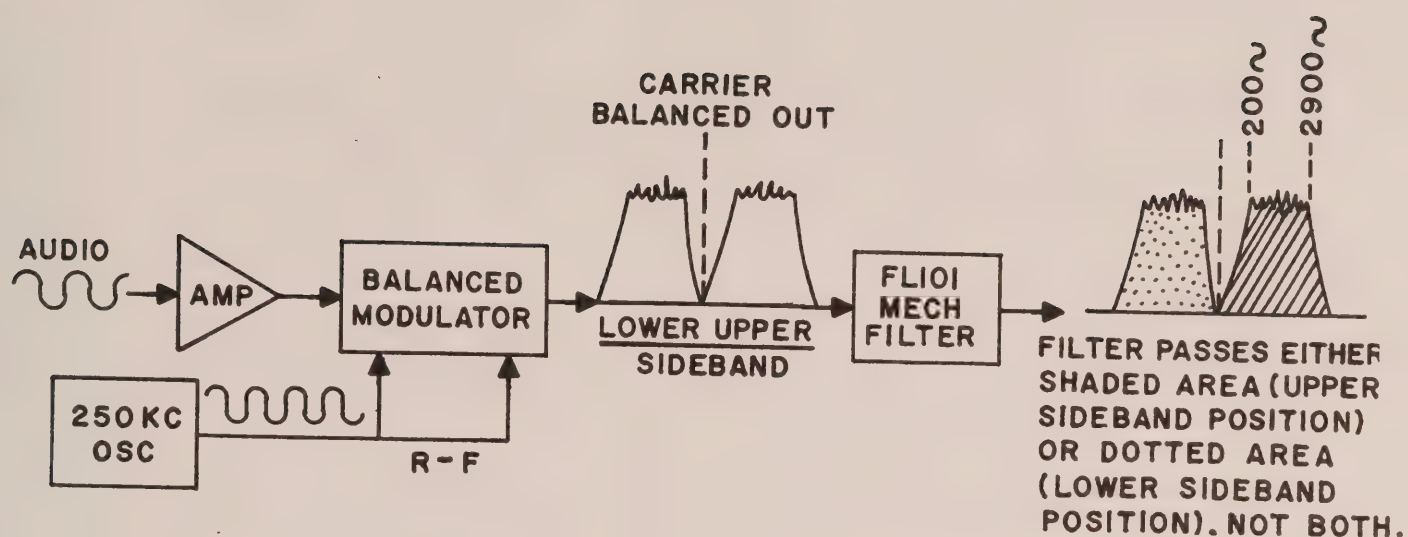


Figure 1-2. Block Diagram of Single Sideband Development

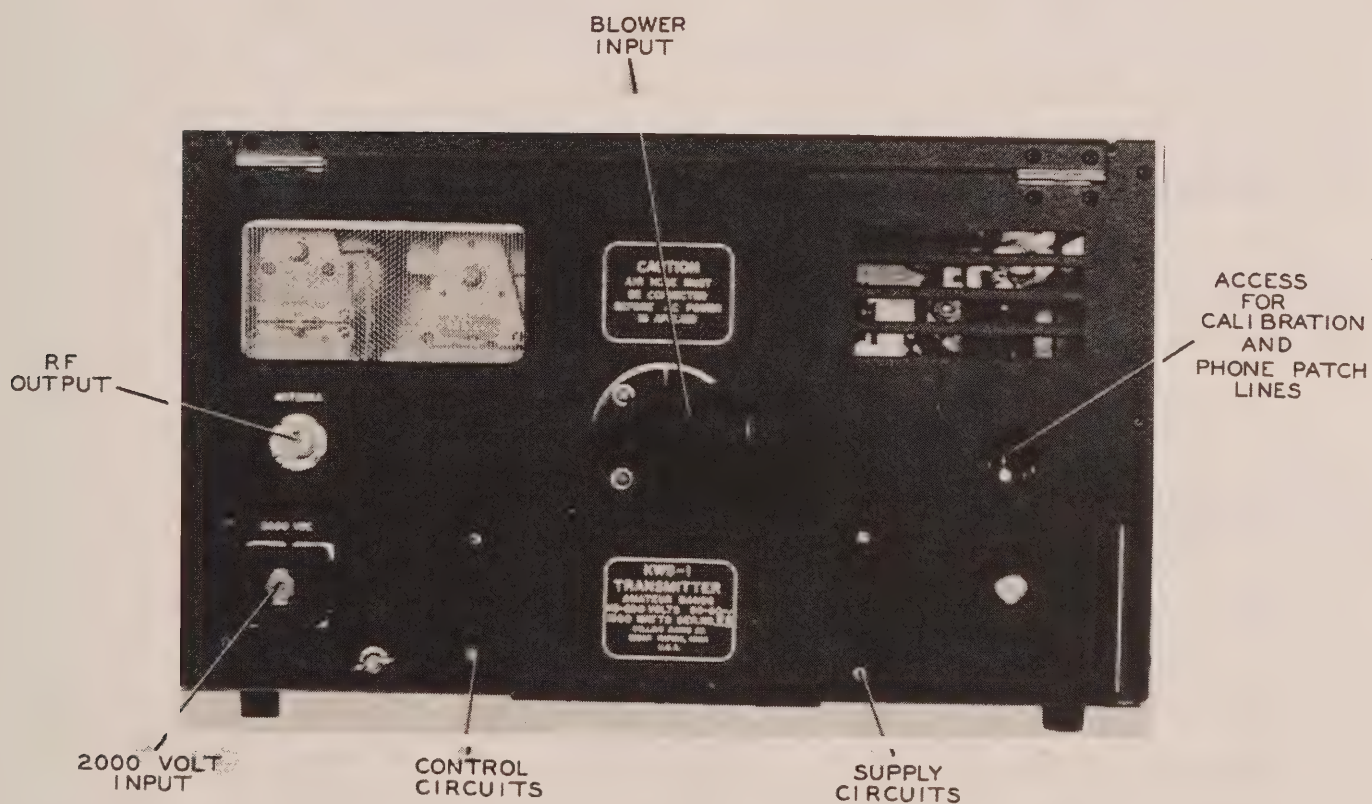


Figure 2-1. Exciter/Power Amplifier Rear Panel

Section II

EXTERNAL CONNECTION	TB504	INTERNAL DESTINATION
NOT USED.	24 ○	
TO HIGH SIDE OF PUSH-TO-TALK (PTT) SWITCH.	25 ○	THROUGH J102-2 TO V103B RELAY AMPLIFIER CATHODE. OPERATES COIL OF RELAY K101. (SEE NOTE 2.)
TO HIGH SIDE OF CW KEY LINE.	26 ○	THROUGH J102-3 TO GRID BLOCK KEYING CIRCUIT.
TO HIGH SIDE OF 5000 OHM ANTENNA RELAY COIL.	27 ○	THROUGH J102-4. 110 VDC, 22MA ANTENNA RELAY COIL SUPPLY WHEN THE NORMALLY OPEN K101 RELAY CONTACTS 4 AND 5 ARE CLOSED. (SEE NOTE 2.)
TO RECEIVER STD BY CIRCUITS.	28 ○	THROUGH J102-5 AND 6 TO NORMALLY CLOSED CONTACTS 6 AND 7 ON K101 RELAY. (SEE NOTE 2.)
	29 ○	
TO RECEIVER. HIGH SIDE VOX 500 OHM AUDIO SQUELCH CIRCUIT.	30 ○	THROUGH J102-7. VOX 500 OHM AUDIO INPUT TO VOX SPEAKER GAIN CONTROL AND V102B SQUELCH AMPLIFIER GRID.
NOT USED.	31 ○	
TO LOW SIDE OF ANTENNA RELAY. AC COMMON LEAD.	32 ○	THROUGH J102-9 AND J103-6. AC COMMON (NO SWITCHING).
GROUND. TO LOW SIDE OF CW KEY, PUSH-TO-TALK, AND VOX CIRCUITS.	33 ○	THROUGH J102-13. GROUND.
GROUND.	34 ○	GROUND.
GROUND. ANTENNA RELAY KEY LINE CONTACT.	35 ○	GROUND.
ANTENNA RELAY KEY LINE CONTACT.	36 ○	THROUGH J102-11 TO NORMALLY OPEN CONTACTS 1 AND 2 ON K101 RELAY. (SEE NOTE 2.)
CONTACTS 37 THROUGH 39 NOT USED.		

- NOTES: 1. INSTALL AT LEAST A 1.0UF SERIES BLOCKING CONDENSER TO PREVENT SHORTING OUT THE V101A CATHODE BIAS VOLTAGE.
 2. K101 IS THE CARRIER CONTROL RELAY.
 3. ANTENNA RELAY SHOULD HAVE A SET OF NORMALLY OPEN CONTACTS TO WHICH 35 AND 36 CONNECT.

Figure 2-2. TB504 Terminations

SECTION II

INSTALLATION AND INITIAL ADJUSTMENT

2.1. INSTALLATION..

2.1.1. UNPACKING.

The KWS-1 Transmitter is packed in two separate cases. The smaller case contains the Exciter/Power Amplifier. The larger case is the cabinet containing the Power Supply. Remove the two cabinets from the packing cases, using care to prevent damage to the units. Retain the packing material, for if shipping damage is evident, the units should be returned to their cases and the transportation company notified immediately.

Make a thorough visual inspection of the outside and inside of each unit. Do not make adjustments or external connections at this time, but look for broken parts and connections, or any other evidence of shipping damage. Reference to figure 1-1 and to the photographs in section VI will be helpful in making the visual check.

2.1.2. PLACEMENT OF UNITS.

The Exciter/Power Amplifier is designed for table mounting or may be mounted on top the power supply cabinet alongside the operator's table. This choice and the accessibility of the local power outlet will determine the actual placement of units.

Allow enough space at the rear of the units for making external connections, replacement of fuses and to provide adequate circulation of air.

2.2. EXTERNAL CONNECTIONS.

Assembling the KWS-1 into an operating station is quite simple and consists briefly as follows:

a. Plug microphone into the MIC jack (J101) located at lower right-hand corner of front panel. (See figure 3-1.)

b. Plug the high voltage cable plug into the 2000 V dc jack J402 at rear of the PA. (See figure 6-1.)

c. Plug the two power supply interconnecting cable plugs into the rear of the transmitter.

d. Connect receiver break-in circuits, key line, antenna relay, etc., into TB504 at rear of Power Supply. (See figure 2-2.) If connections to a 75A-4 receiver are desired, refer to figure 2-3.

e. Install blower hose. Be sure clamps are tight. (See figure 6-1.)

f. Plug antenna coax line into J401 on rear of PA unit. It is recommended that either an r-f ammeter or a power indicating device be used between the KWS-1 and the antenna. It is also recommended that a coaxial antenna change-over relay be used. This relay must have an extra set of normally open contacts for use in grounding the key line interlock. A source of 115 V dc, switched by the break-in relay is provided by the Power Supply for operating the 115 V dc antenna relay coil. (See figure 2-3.)

g. Calibrate signal for the receiver can be secured by running a coax line from the receiver antenna post to the 6CL6 PLATE test point (J201). Run coax through large hole in rear of transmitter. (See figure 2-3.)

h. Connect the Power Supply to a-c source.

The power supply is shipped ready for 230 volts ac operation. Connect power cord (not furnished) to terminals 41, 42 and 43 on TB503. Use No. 14 AWG.

NOTE

If 115 V operation is desired, consult figure 7-2.

The KWS-1 is now ready for operation.

NOTE

If further information on external connections is desired, read paragraph 4.2.5. of section IV of this book.

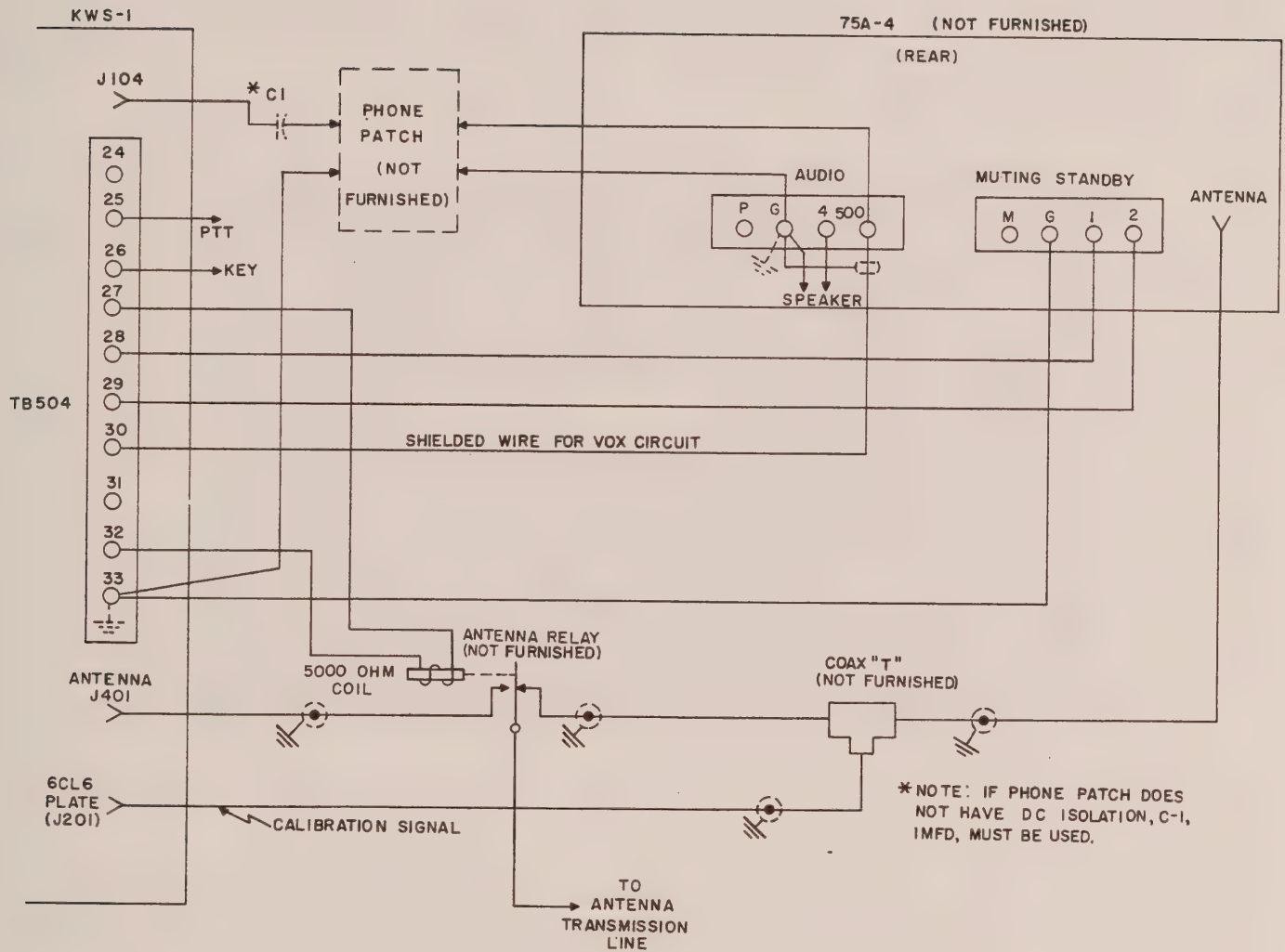


Figure 2-3. KWS-1 Connections to Collins 75A-4 Receiver

SECTION III

OPERATION

3. 1. INITIAL ADJUSTMENTS.

a. Turn FILAMENT switch ON. Blower should start. Adjust PA FILAMENT control on Power Supply for 6 volts on MULTIMETER.

CAUTION

Do not attempt to operate with blower in-operative or air hose disconnected as serious damage will result to the PA tubes.

b. Set EMISSION switch to CW, CARRIER LEVEL to zero, TUNE-OPERATE to OPERATE and BIAS control (on power supply) to "O", ALC at counterclockwise.

c. Turn PA PLATE voltage ON. Advance PA BIAS ADJUST control until PA idling current is 100 ma.

d. Turn PA PLATE voltage OFF.

NOTE

A complete description of the functions of the operating controls appears in paragraph 4.2.4. of section IV.

3. 2. TUNING PROCEDURE.

3.2.1. CW OPERATION.

a. Turn the FILAMENT switch ON.

b. Select the desired band and set the main tuning dial to the frequency desired. (See paragraph 5.1.3.3. of section V for dial calibration procedure). Turn CARRIER LEVEL control full off (CCW).

c. Select CW on the EMISSION switch.

d. Place the TUNE-OPERATE switch in TUNE position.

e. Set the PA TUNING and LOADING controls several turns counterclockwise from the settings indicated in table 3-1.

f. Turn PA PLATE voltage switch ON.

g. Close key. Advance the CARRIER LEVEL control until grid meter reads about midscale.

h. IMMEDIATELY RESONATE THE PA TUNING CONTROL for a dip in plate current.

i. Rotate the LOADING control clockwise to increase loading.

j. Load and resonate simultaneously (use both hands) until the transmitter is loaded to about 150 milliamperes in TUNE position.

k. During the loading and tuning process, the grid drive will tend to disappear. This effect is caused by the action of the PA inverse feedback. Keep advancing the CARRIER LEVEL control so that grid current stays at near midscale.

l. Switch the TUNE-OPERATE switch to OPERATE. Again adjust grid current for midscale.

m. Continue loading to about 400 ma. Note antenna current or power output.

n. Continue loading to 500 ma at resonance while watching both output and PA current. However, if the output ceases to rise as loading is increased, back off the LOADING control slightly and do not try to load beyond this point.

o. The transmitter is now ready to use on cw. Reduced input can be had by simply backing off the CARRIER LEVEL control until the desired plate input is reached. No grid current will show under these conditions as the PA will be operating class AB₁. If full output is desired, run the grid current to about 1/2 to 3/4 meter scale.

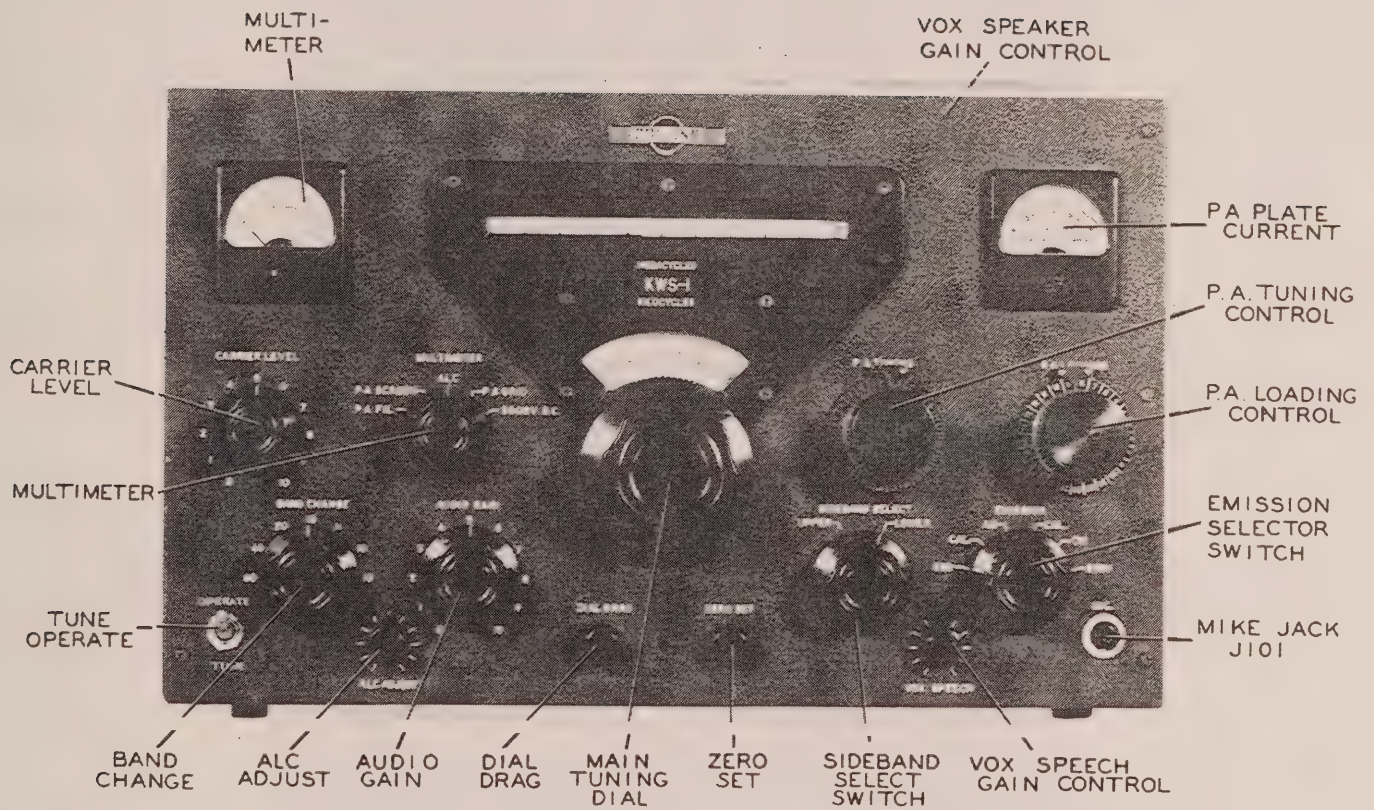


Figure 3-1. Exciter Front Panel

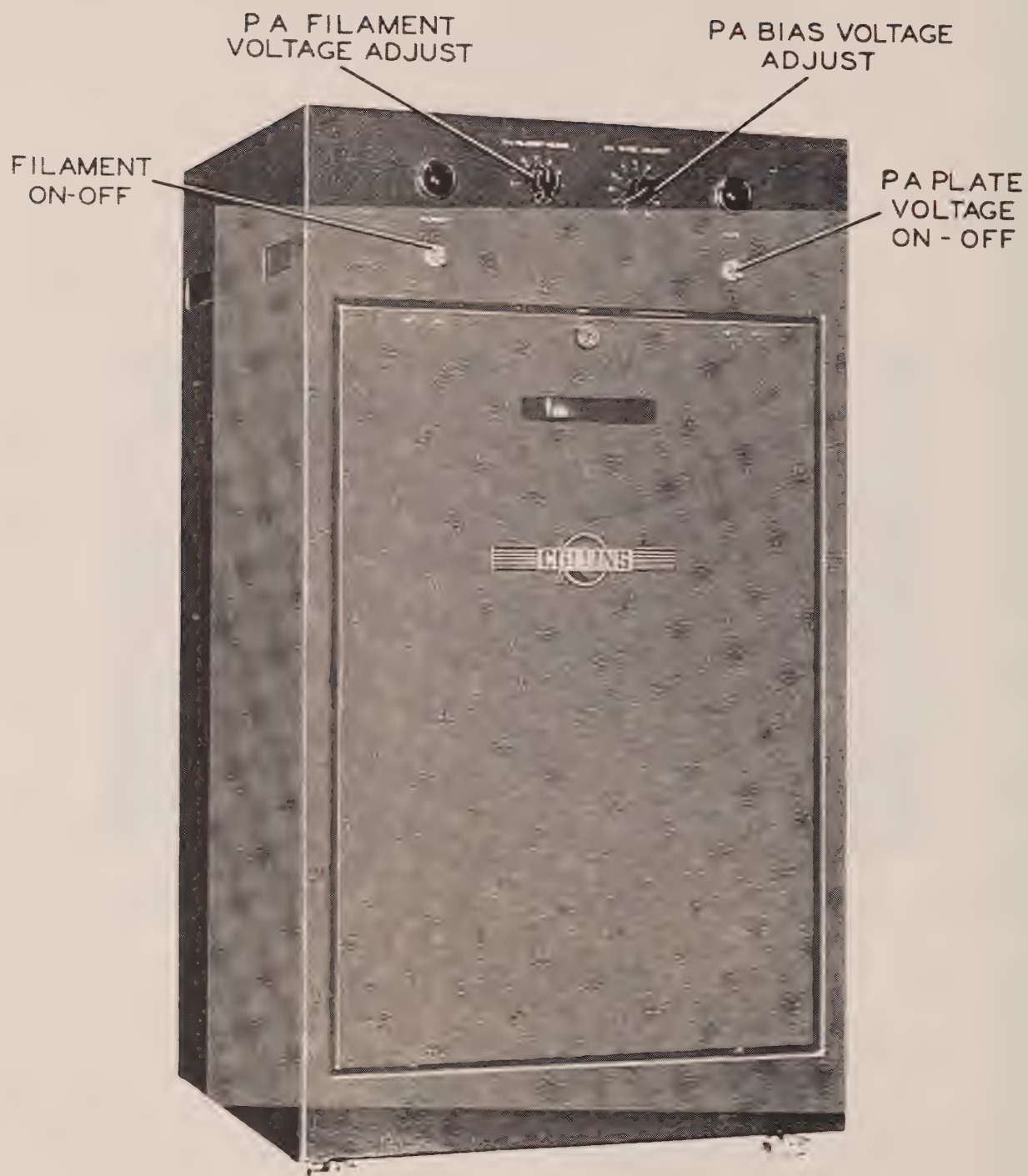


Figure 3-2. Power Supply Front Panel

p. Switch to STANDBY during reception because receiver is disabled when switch is in CW position.

3.2.2. SSB OPERATION.

a. Tune the transmitter exactly as for cw ("a" through "n" above).

b. Switch to SSB.

c. Set AUDIO GAIN at zero and speaker quieting control (inside unit above PA plate meter) to counterclockwise stop.

d. Speak into microphone while advancing the VOX SPEECH control. Set control for a pleasing action of the carrier control relay.

e. Advance AUDIO GAIN until PA GRID meter kicks to about midscale on voice peaks.

f. Advance ALC ADJUST control until PA GRID meter action just ceases.

CAUTION

Under no circumstances should PA GRID current show during SSB operation or distortion will be generated.

g. The ALC meter should now show action on voice peaks. About 8 to 10 db ALC action on peaks is normal.

h. Advance speaker quieting control for minimum feedback.

i. The transmitter is now ready to use on SSB. Choice of sidebands is available at the SIDEBAND SELECT switch. If there appears to be an objectionable amount of carrier present, the balanced modulator can be checked. Refer to paragraph 5.1.4.3. b.(10) of section V.

3.2.3. AM OPERATION.

a. Tune the transmitter exactly as for cw ("a" through "n" of paragraph 3.2.1.). Note antenna current or power output at threshold of grid current. (Use auxiliary r-f current meter or power output indicator.)

b. Switch to AM operation. Turn ALC ADJUST to CCW end-stop (off).

c. Back OFF CARRIER LEVEL control until the power drops to 1/4 the CW value (1/2 antenna current). This corresponds to a plate current of about 275 ma.

d. Advance AUDIO GAIN control until voice peaks just start to show a trace of grid current. This trace of grid current indicates 100% modulation and should not be exceeded or distortion will result.

TABLE 3-1

APPROXIMATE PA TUNING AND LOADING DIAL SETTING
(With 52-ohm Load)

BAND	FREQUENCY IN KILOCYCLES	PA TUNE		PA LOAD	
		APPROX. SETTINGS	ACTUAL SETTINGS	APPROX. SETTINGS	ACTUAL SETTINGS
80M	3,500	262		237	
	3,750	390		353	
75M	4,000	505		435	
40M	7,000	1282		1080	
	7,150	1300		1095	
	7,300	1325		1100	
20M	14,000	1795		1545	
	14,150	1800		1570	
	14,300	1810		1595	
15M	21,000	2000		1765	
	21,450	2015		1767	
11M	27,000	2080		1875	
10M	28,000	2094		1880	
	29,000	2108		1895	
	29,700	2121		1907	

NOTES

SECTION IV

THEORY OF OPERATION

4.1. GENERAL CIRCUIT DESCRIPTION.

Owners of the KWS-1 Transmitter should become thoroughly familiar with operational theory before attempting to solve service or maintenance problems. This section outlines the operational theory in relation first, to the signal path through the Exciter/Power Amplifier and second, by a detailed description of all circuits in the signal path, especially those unique to single sideband, suppressed carrier transmission. Reference should be made to the block diagram in figure 4-1, the overall schematic diagram in figure 7-1, to the photographs in section VI, and to illustrations supplementing the text.

Throughout the text, reference will be made to various jack, tube, plug and switch terminals. In many instances, this reference is made by following the component symbol by a dash and the terminal number. For instance, J102-7 refers to jack J102, terminal seven, and S101C-3 refers to switch S101C, terminal three.

4.1.1. CIRCUIT DESCRIPTION, SSB SIGNALS.

The audio signal is fed from the microphone jack J101 on the front panel through a two-stage amplifier into a cathode follower audio output stage. The cathode follower matches the audio signal to the 1N67A diode balanced ring modulator. The output of a 250-kc oscillator is amplified and fed into the balanced modulator. The output of the modulator contains both upper and lower sidebands, but the carrier is attenuated by more than 50 decibels. The signal is fed through a mechanical filter, the input of which is series tuned to match the low impedance of the balanced modulator. The FL101 Mechanical Filter has an output containing either the upper or lower sideband, depending upon the selection of the operator. The carrier and undesired sideband are greatly suppressed, or, for all purposes of signal consideration, are eliminated.

The output of the FL101 Mechanical Filter is parallel tuned to match the high impedance of the first mixer grid. In addition to accepting output

signals from the FL101 filter, the first mixer also accepts signals from the vfo. The mixer plate circuit contains a special feedback network which provides an additional 20 decibels of attenuation to undesired vfo signals appearing in the plate circuit. The desired output of the mixer is passed through two stages of linear amplification, including five high "Q" tuned circuits. The tuned circuits provide sufficient gain and selectivity to produce essentially spurious-free signals in the 80-meter band.

At this point, the 80-meter signals are fed directly into the paralleled driver stages, while the frequencies of the 40, 20, 15, 11, and 10-meter bands require further conversion. These signals are fed into a second mixer, which also receives an input from a crystal oscillator. The oscillator signal is selected by the BAND CHANGE control to provide correct output frequencies for the desired band. The conversion frequency output of the second mixer is fed through two stages of r-f amplification, including three high "Q" tuned circuits to produce a signal which is again, essentially spurious-free. The amplified signal is then fed into the 6CL6 driver stages. The output of the drivers is fed directly into the Power Amplifier.

The Power Amplifier is designed for linear class AB₁ operation with individual tuning and loading controls in the final amplifier output circuit. Grid-plate neutralization is included to provide improved stability of operation. An r-f feedback system is used to permit operation with lower distortion.

An Automatic Load Control circuit is also included in the Power Amplifier, however, a complete analysis of this circuit is included in the detailed circuit description.

4.1.2. CIRCUIT DESCRIPTION, AM SIGNALS.

For AM signals, the output of the 250-kc oscillator is reinserted at the output of the mechanical filter to provide operation with carrier and one sideband. By adjustment of the CARRIER LEVEL control, it is possible to vary the amount of carrier reinserted and

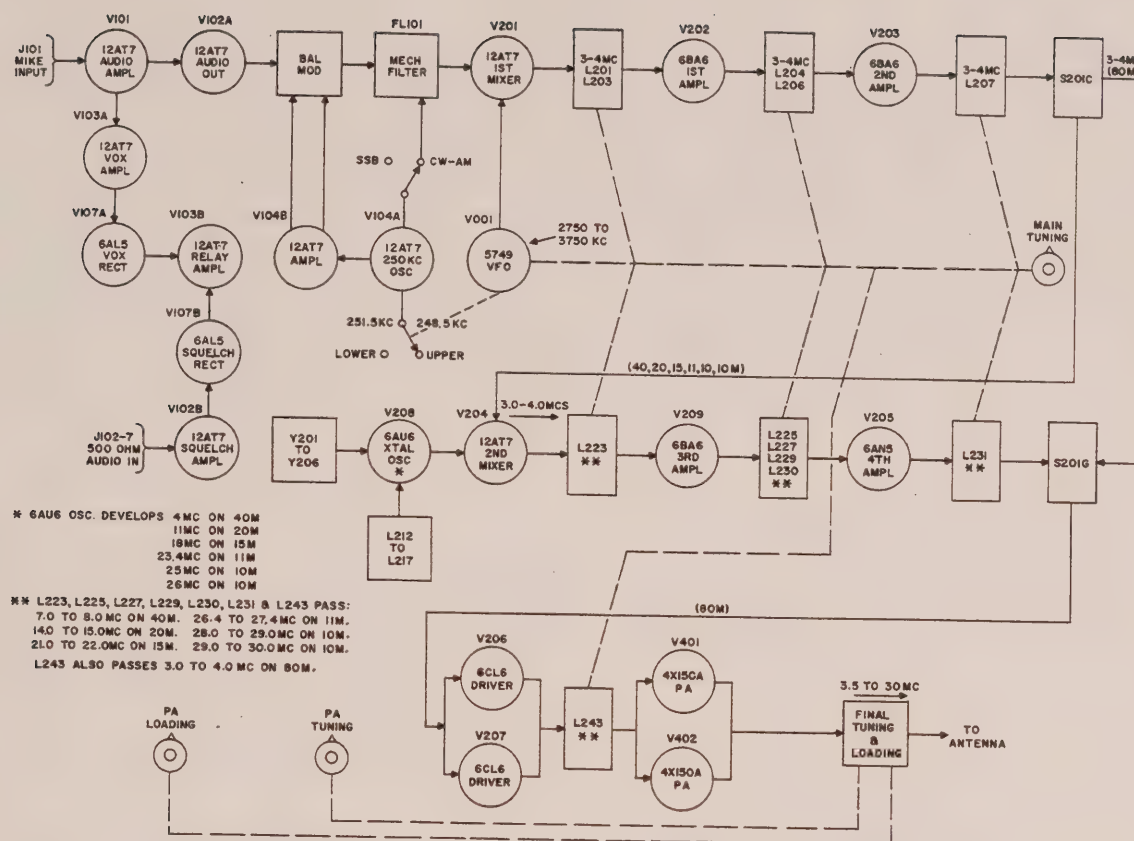


Figure 4-1. Exciter/Power Amplifier, Block Diagram

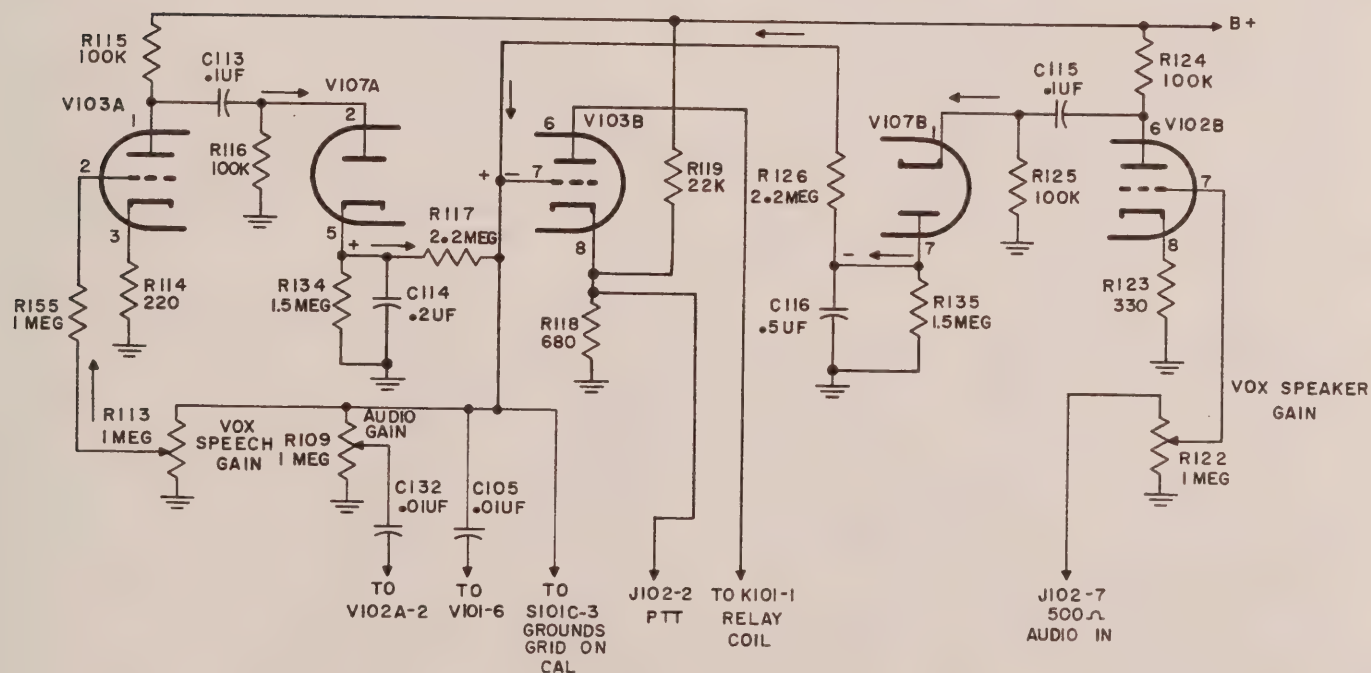


Figure 4-2. VOX Circuits, Simplified Schematic Diagram

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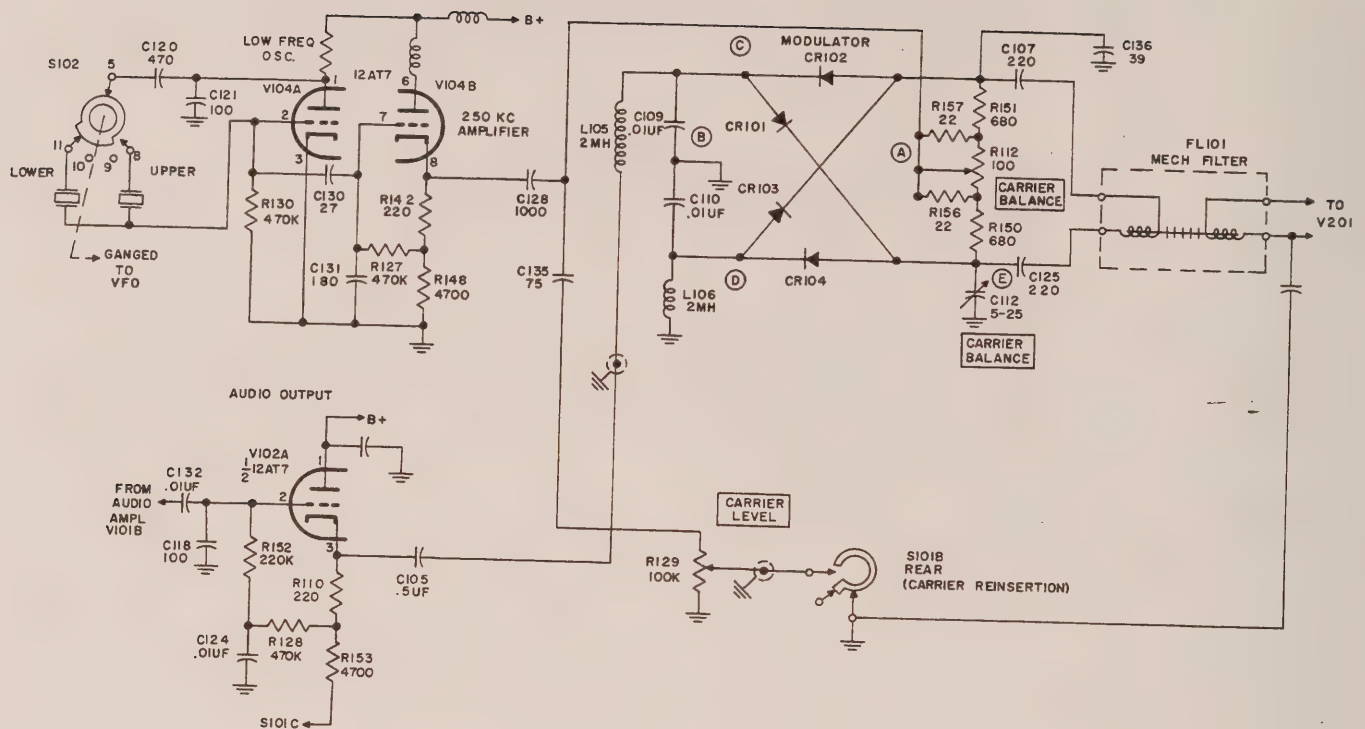


Figure 4-3. LFO, Balanced Modulator and FL101 Mechanical Filter, Simplified Schematic Diagram

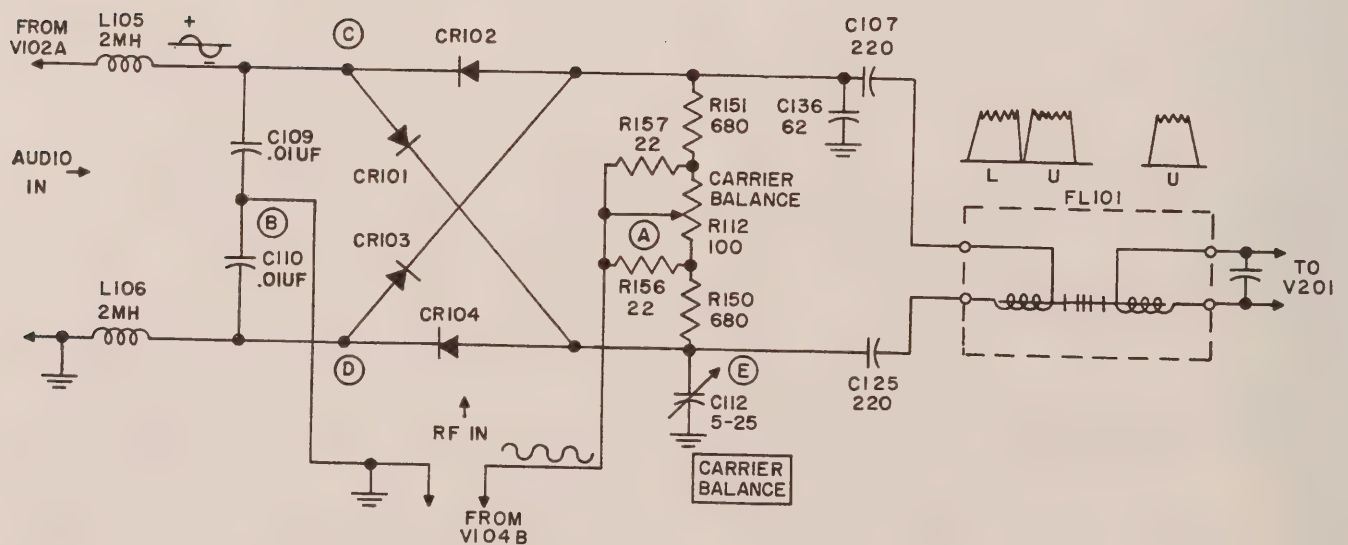


Figure 4-4. Balanced Modulator and FL101 Mechanical Filter, Simplified Schematic Diagram

produce the proper relationship between the sideband and the carrier.

4.1.3. CIRCUIT DESCRIPTION CW SIGNALS.

Cw operation is produced by reinserting the 250-kc oscillator signal at the output of the mechanical filter, as in AM. operation, and by grid-block keying of the first mixer and the driver stages. The EMISSION control eliminates exciter circuits unnecessary for cw signals. A wave shaping network is included to reduce transients in the cw output.

4.1.4. CIRCUIT DESCRIPTION, FSK SIGNALS.

Although a 600-ohm audio input circuit is available for use with an external phone patch circuit, it is also possible to feed an external audio FSK oscillator into this circuit to provide for carrier shift FSK operation. With the EMISSION switch in the SSB position, the mark and space frequencies of the audio oscillator produce two r-f voltages in the exciter output, spaced by the correct amount for all bands.

4.2. DETAILED CIRCUIT DESCRIPTION.

4.2.1. EXCITER/POWER AMPLIFIER CIRCUITS.

4.2.1.1. AUDIO CIRCUITS.

a. SPEECH AMPLIFIER CIRCUITS. The audio input signals into the KWS-1 Transmitter are first amplified by a two-stage preamplifier consisting of a duotriode 12AT7; V101. These are conventional audio amplifiers, the output of which is coupled through condenser C132 to the control grid of audio output stage V102A.

The V102A audio output stage is connected as a cathode follower to provide the required low impedance audio input for the balanced modulator and FL101 Mechanical Filter. The audio signal is coupled from the V102A cathode through C106 to the moveable arm of potentiometer R154 in the balanced modulator circuit. Cathode resistance for V102A consists of R110 and R153 to ground through switch S101-C terminal eight. When the transmitter is switched to CW operation, S101-C terminal eight is open to prevent audio modulation of the cw signal.

b. VOX AND SPEAKER SQUELCHING CIRCUITS. The overall purpose of V103A VOX amplifier, V107A rectifier and V103B relay control amplifier is to

operate relay K101 so transmitting occurs only when an audio input from the microphone is present on phone operations.

Part of the audio output from V101 is taken off the AUDIO GAIN potentiometer R109 and fed through the VOX SPEECH gain control R113 to the control grid of amplifier V103A. Thus, by R113, the amplitude of audio signals applied to V103A is regulated. V103A amplifies the signal, which is then coupled through C113 to rectifier V107A. (See figure 4-2.) This circuit includes the diode d-c return resistance R116, and diode load R134 and C114. The value of the diode load components is chosen to produce a time constant for "fast attack and slow release" characteristics. Thus, the condenser charges quickly and discharges slowly. V107A converts the amplified VOX audio signal immediately to a plus d-c voltage, but, due to the diode load time constant, the d-c charge tapers off slowly to prevent relay K101 from shutting off between words spoken into the microphone. The plus d-c voltage present on the cathode of V107A is passed through R117 to the control grid of relay amplifier V103B; the plate current of V103B operates relay K101, responding to the diode load voltage and time constant. Cathode resistors R118 and R119 holds the bias on V103B to a point where the relay is not quite operating. Thus, when audio is spoken into the microphone, a portion of the signal passes through the VOX SPEECH gain control R113, is amplified in V103A, and converted to a plus d-c voltage in V107A. The d-c is applied to V103B grid to overcome the bias on the cathode, causing the tube to conduct more, enough to operate relay K101. When the audio signal source ceases, the operating level of V103B is retarded by R118 and R119, which would normally shut off relay K101, but the time constant of the diode load holds the relay in operation long enough to carry over from word to word of the microphone input.

The purpose of squelch amplifier V102B and rectifier V107B is to prevent the audio signals of the receiver from operating K101 relay by feedback of the audio signals through the transmitter microphone and audio circuits. A connection is made to the receiver output transformer, which feeds the speaker audio signals into the transmitter through J102-7, through the VOX SPEAKER gain control R122, to the grid of V102B. At the same time, the same speaker signals are feeding through the transmitter microphone into the VOX amplifier V103A to produce a plus voltage on the V103B grid, to operate relay K101. However, the voltage applied to the V102B squelch circuit is amplified and fed through C115 to

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Paragraphs 4.2.1.1. - 4.2.1.2.

the cathode of rectifier V107B. This rectifier circuit is identical to V107A, except V107B is connected in reverse, such that a negative voltage is produced and applied through R126 to the grid of relay amplifier V103B. This occurs at the same time the plus voltage is being applied from V107A, at point (A) in figure 4-2. The plus and minus voltages are adjusted by potentiometers R113 and R122 to a point at which they balance out, preventing the receiver speaker signals from operating the transmitter relay K101.

The lead from V103B grid to switch S101C-3 grounds the grid during calibration procedures, to prevent audio signals from operating relay K101 during calibration.

The lead from the V103B cathode to the PTT input on J101-2 or J102-2, permits use of an external, manual push-to-talk control, instead of the voice operate circuits built into the exciter circuits.

4.2.1.2. LFO, BALANCED MODULATOR AND FL101 MECHANICAL FILTER CIRCUITS. Development of the 250-kc carrier frequency in the KWS-1 Transmitting System is accomplished by a crystal controlled oscillator stage, V104. Figure 4-3 is a simplified schematic diagram to show only oscillator V104, the balanced modulator, FL101 Mechanical Filter, and the audio output cathode follower stage. This diagram may be used to study the KWS-1 methods of carrier development, modulation and filtering relative to single sideband transmission.

a. SINGLE SIDEBAND SIGNALS.

(1) LFO. For the development of single sideband signals, the 250-kc output of V104A is coupled through condenser C130 into the grid of the 250-kc amplifier, V104B. The output of V104B is coupled from the cathode through L104 and C128 to point (A), and from the ground to point (B) of the balanced modulator, to provide an r-f input to the modulator. (See figure 4-4.)

(2) BALANCED MODULATOR. The balanced modulator is a "ring type" modulator. It receives two signal inputs, the 250-kc carrier signal at points (A) and (B) in figure 4-4, and the audio signal at points (C) and (D). The purpose of the modulator is to suppress the carrier frequency, and to pass only the upper and lower sideband frequencies resulting from modulation by the impressed audio. As shown by the component values, the modulator is a low impedance unit with two points of "balance"

adjustment at points (A) and (E) in figure 4-4. R112 is adjusted for voltage balance, and C112 for capacity balance of the 250-kc r-f voltages applied.

The 250-kc carrier frequency, because of equal inputs at (A) and (B), and because of the equal component values in the ring, is balanced out, or suppressed. As stated above, R112 and C112 provide vernier adjustments for the balance circuits to take care of component inherent value variations. The diode rectifiers are made up in matched sets at the factory. The adjustment procedure will be discussed in the chapter covering Maintenance and Alignment.

Although the ring is balanced insofar as the r-f carrier voltage is concerned, the audio input essentially "modulates" the carrier by causing unbalance of the ring voltages at an audio rate, relative to the positive and negative alternations of the audio cycles. Thus, on one audio alternation, for example, the CR101 plate is biased positive, causing its impedance to be lowered, while the CR102 cathode is biased positive, causing its impedance to be increased. On the following alternation, the impedance unbalance is the opposite. Thus, the carrier is "modulated" to produce two sidebands, but the carrier is suppressed by the ring balancing action. Assuming a 1000 cps audio note, the modulator output at the input of FL101 would be sideband frequencies of 249 kc and 251 kc, with the 250 kc carrier suppressed. (See figure 4-4.) R112 is adjusted to balance the inherent variations in R150 and R151.

Although figure 4-4 shows the modulator output in a practical "U and L" manner, the actual output waveform, when viewed on an oscilloscope, would be similar to figure 4-5, representing the 249-kc and 251-kc sideband signal plus the audio of the example stated in the preceding paragraph.

(3) FL101 MECHANICAL FILTER. A functional diagram of the Collins FL101 Mechanical Filter is shown in figure 4-6.

Mechanical Filter FL101 operates on the principle of magnetostriction to convert oscillating magnetic energy into mechanical vibrations and back to magnetic energy. In mechanical filter design, the magnetostriction transducer input coil is designed to resonate at a particular frequency or band of frequencies, contingent upon the desired purpose of the filter. For KWS-1 Transmitters, the FL101 Mechanical Filter input circuit contains a fixed value, series-tuned resonant circuit composed

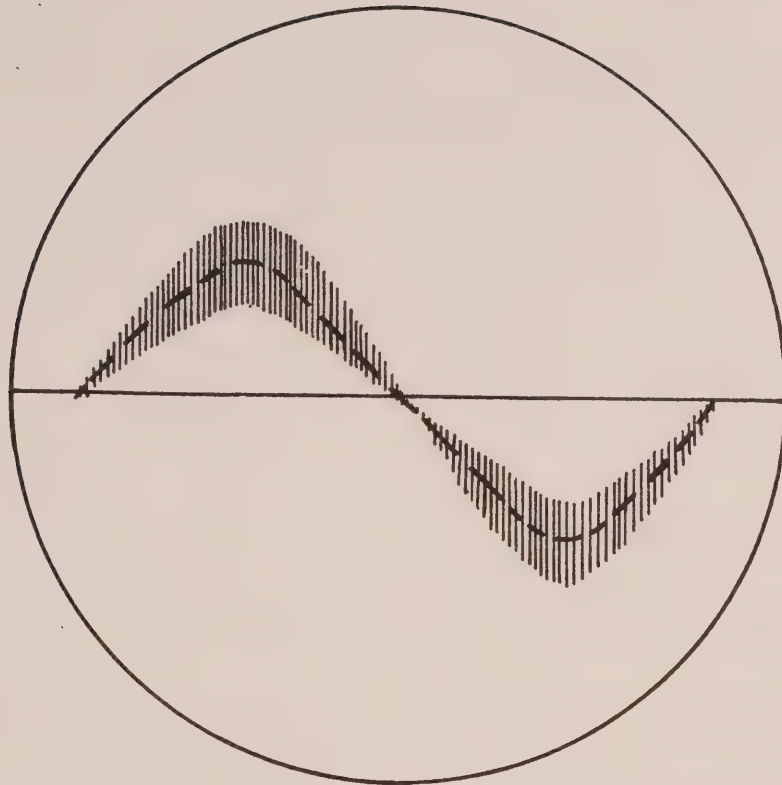


Figure 4-5. Balanced Modulator Output, Typical Oscilloscope Pattern

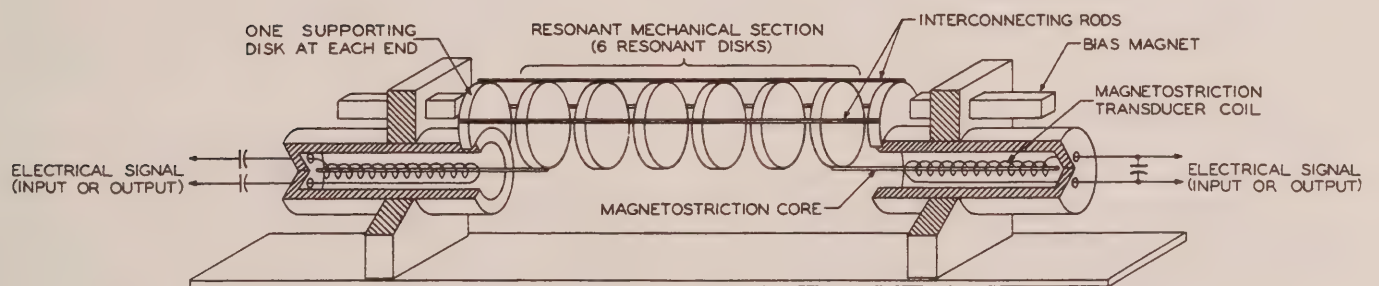


Figure 4-6. FL101 Mechanical Filter, Functional Diagram

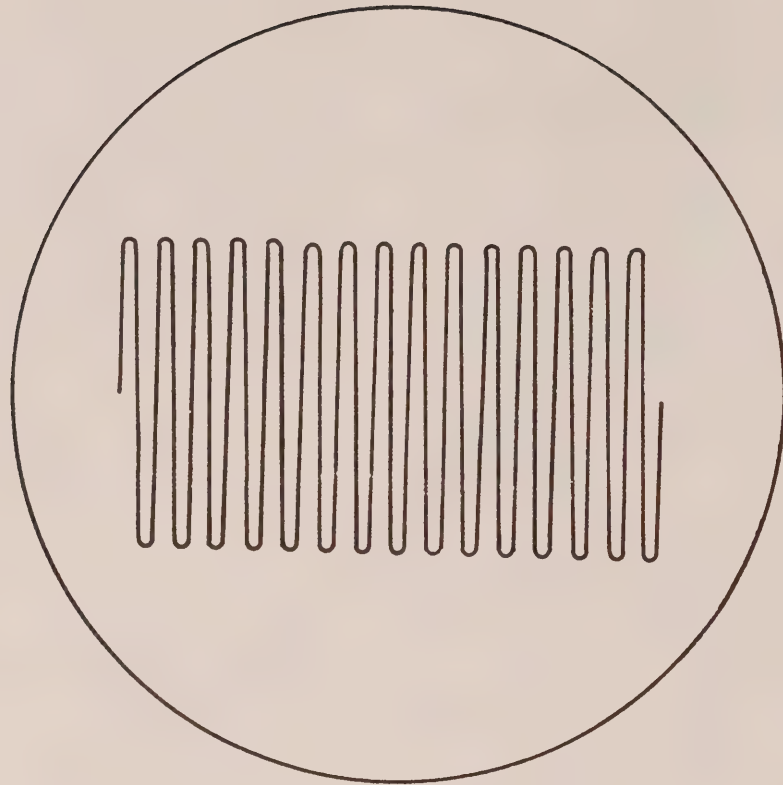


Figure 4-7. FL101 Mechanical Filter Output, Typical Oscilloscope Pattern

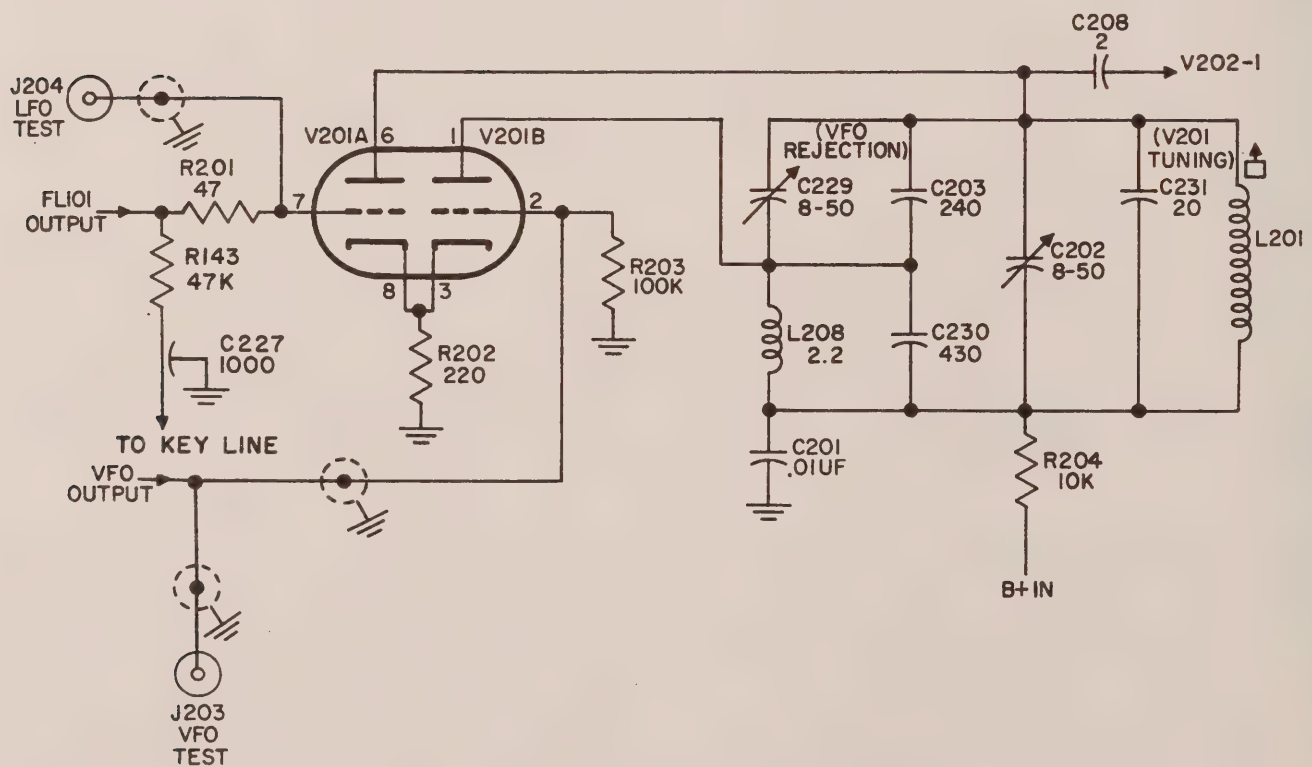


Figure 4-8. First Mixer V201, Simplified Schematic Diagram

of C107, C125 and the transducer input coil. C107 and C125 are chosen to match the filter, and is a series resonant circuit for low impedance input to accept the low impedance output of the balanced modulator. Low impedance input characteristics are desired to attain stability of operation in the development of the low level, single sideband transmission signals.

Within the filter, a nickel wire in the input transducer coil vibrates mechanically and transmits this energy to the first of a series of nickel alloy discs. The mechanical vibration of the first disc is coupled to succeeding discs by means of nickel-wire coupling elements. Biasing magnets at either end of the filter polarize the filter elements to prevent frequency doubling in much the same manner as biasing magnets in a headphone prevent the phone diaphragm from bending the same direction for both alternations of an a-c cycle. The mechanical vibration of the last disc is coupled to a magnetostriction transducer element identical to the one used at the input of the filter. By a reverse principle of magnetostriction, the mechanical vibrations of the nickel-wire transducer core is converted to electrical impulses. Each of the discs used has a mechanically resonant "Q" exceeding 2000. Six of the discs are overcoupled to produce a mechanically-shaped response curve with a flat top and almost vertical sides. Thus the filter passes a band of frequencies very little wider than the flat top of the selectivity curve. In the case of FL101 Mechanical Filter, this band of frequencies is approximately 3 kc wide and centers on 250 kcs. Figure 4-4 shows a practical example of the FL101 Mechanical Filter output wave containing all the USB frequencies however, on an oscilloscope, the wave shape would be that of figure 4-7, with a single r-f frequency when a single audio tone is applied to the balanced modulator, but actually contains the upper or lower sideband output of the modulator.

(4) SIDEBAND SELECTION. The operator has the choice of transmitting on either the upper or lower sideband. The selection is accomplished by switch S102 (see figure 4-3). The KWS-1 normally operates on the lower sideband, however, if S102 is switched to the U, or upper, position, the action selects the "UPPER" sideband crystal for the V104 250-kc oscillator, to change the output frequency of V104 by 3 kc. This is the same bandwidth as the FL101 Mechanical Filter output. In order to maintain the proper frequency relationships between the vfo and the 250 kc lfo, S102 is mechanically ganged to the vfo can. Adjustment of S102 to either sideband automatically adjusts the vfo output 3 kc in

the opposite direction from the lfo adjustment. Thus if the lfo is adjusted down, the vfo is adjusted up 3 kc in their respective frequency ranges, to maintain proper output frequency in the overall KWS-1 Transmitter.

Vernier adjustments of S102 operation are accomplished on the switch itself. This adjustment will be discussed under Maintenance and Alignment.

b. CW AND AM. SIGNALS. Cw and AM. emission in relation to V104, V108A, the modulator and FL101 Mechanical Filter is somewhat different than single sideband.

For both cw and AM, a portion of the 250-kc carrier must be reinserted into the r-f circuits. This is accomplished by taking a part of the carrier frequency off the V104B plate through condenser C131. (See figure 4-3.) This is fed through the CARRIER LEVEL control potentiometer R129, by which the operator may adjust the desired amount of reinserted carrier. The signal is then fed through switch S101B and C117 to the output side of Mechanical Filter FL101, through the filter output transducer coil to the V201 first mixer control grid.

On cw, the cathode circuit of audio output stage V102A is opened by switch S101-C, terminal eight, to prevent audio signals from interfering with cw operation. Thus, the modulator and filter are not used on cw, and the 250 kc carrier is essentially reinserted "around" the filter.

AM. operation is similar, except the audio output is present. The modulator and filter are utilized similar to SSB operation, but the carrier is reinserted into the FL101 filter output, and the total output then consists of AM. with the carrier and one sideband.

4.2.1.3. VFO AND RF CIRCUITS. The output of the FL101 Mechanical Filter is taken off condenser C108 which, with the filter output transducer coil, forms a parallel resonant circuit for high impedance. The output is fed through a coaxial cable and resistor R201, into the grid of the first mixer stage V201, pin number seven, in the r-f section of the exciter.

a. VFO CIRCUITS. (See figure 7-1.) The hermetically sealed, variable frequency oscillator is a permeability tuned, Hartley type circuit, tunable from 2750 kc to 3750 kc with control dial calibration of one kc per division. The tank circuit consists of condenser C001 and inductances L001 and L002. The remaining components designed and connected to

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Paragraph 4.2.1.3.

promote stability of operation in the oscillator over-all action. L001 and L002 are slug tuned, with L002 ganged to the main tuning system.

Operational stability of the vfo is improved by regulating the plate and filament supply voltage and current. This is accomplished for the plate circuit by feeding B plus voltage into the OB2 regulator tubes V106 and V105, connected in series to ground. A 210-volt regulated supply is taken off the V106 plate and fed into the vfo plate circuit. Regulation for the filament supply is provided by RT101, which utilizes a 12.6-volt input to produce a 6.3-volt regulated output for the vfo filament.

The vfo generates frequencies from 2750 kc to 3750 kc. Vfo output is taken off the plate circuit and fed through a coaxial cable into the grid, pin number two, of the duotriode first mixer stage, V201.

b. RF CIRCUITS.

(1) V201 FIRST MIXER STAGE. A simplified schematic diagram of the first mixer stage appears in figure 4-8. This diagram will assist in understanding the theory involved in the first mixer design.

There are two test points available for each of the V201 grids. (See figures 5-1 and 7-1.) One is taken off pin number seven of V201A to jack J204, and the other off pin two of V201B to jack J203. J204 will provide a test voltage for signal input, and J203 for vfo input.

The ratio of voltage input on pin seven of V201A to that of pin two on V201B is approximately 0.1 volt to 1.5 volts. Thus, the vfo input is considerably stronger than the signal input. This is the reason for the rather complex tuned plate circuit consisting of L201, C231, C202, C203, C229 and C230. L208 is a choke in the V201B plate B plus supply circuit. The purpose of the tuned plate circuit is to reject a strong, undesired frequency component in the V201 output, which is a result of the strong vfo input signal at the V201B grid. The theoretical principle involved is selective feedback rejection. The actual tuned plate circuit consists of C202, C231 and L201, with C202 and L201 adjusted to resonate the circuit at the desired 3 to 4-mc output frequency. C203, C229 and C230 form a

capacitive voltage divider. The selected values of C203 and C230 determine the amount of feedback for the undesired vfo frequency component. C229 is adjusted for null of the particular frequency to be rejected. Adjustment procedures will be discussed under Maintenance and Alignment.

Thus, by virtue of the heterodyne action in V201, and the selective feedback rejection in the tuned plate circuit, the output frequency of V201 contains a very satisfactory degree of selective band pass and stability characteristics for the desired 3.0 to 4.0-mc i-f range.

L201 and L203 are top coupled through C208, which serves to couple the V201 output into amplifier V202.

(2) FIRST AND SECOND AMPLIFIERS.

The V202 and V203 amplifier stages are conventional, insofar as the signal amplification is concerned, but the associated circuitry contains several control and neutralization connections which are considered unique to the KWS-1 Transmitter.

Automatic Load Control d-c voltage from the power amplifier circuits is applied to the V202 and V203 control grids. (See figure 7-1.) The action here is similar to receiver avc circuits, and will be discussed in detail with power amplifier circuits. An ALC meter connection is made across the V202 cathode and a reference voltage at R209 to measure the amount of Automatic Load Control in decibels. The V202 cathode circuit also contains a potentiometer, R207, for an ALC meter zero adjustment. The ALC meter action is similar to the "S" meter of an amateur receiver.

Capacitors C268 and C322, off the bottom of the V203 plate tuned circuit inductance L207, are utilized in a circuit for neutralization of plate-to-grid and grid-to-cathode capacitance in the 6CL6 driver stages. These circuits will be discussed with the driver and power amplifier circuit description.

A d-c keying voltage is connected to the first mixer V201 control grid through R143 and FL101 Mechanical Filter output coil. The keying voltages are obtained through a wave shaping network for improvement of the cw keying characteristics.

Selectivity in the V202 and V203 amplifier stages is provided by grid and plate tuned circuits consisting of L203 - C206/C207, L204 - C211/C212, L206 - C216/C217 and L207 - C221/C222 inductance and capacitance combinations. Table 4-1 shows the inductance and capacitance combinations in all exciter circuits which provide selectivity for the respective amateur band frequencies. R210 and R211 form a voltage divider in the V202 screen grid plus supply circuit, while R215 and R216 perform the same purpose for V203.

The output of V202 is coupled by C218 into V203, while the V203 output is coupled by C293 into the C section of switch S201. From here, the 80-meter signals not requiring further frequency conversion, are passed directly into the driver stages. The signals for 40, 20, 15, 11 and 10 meters require further frequency conversion, thus are fed into the second mixer stage V204 through coupling condenser C232.

(3) CRYSTAL OSCILLATOR AND SECOND MIXER CIRCUITS.

(a) CRYSTAL OSCILLATOR. V208 oscillator stage is utilized to produce conversion frequencies for heterodyne action with the 40, 20, 15, 11 and 10-meter signals in mixer stage V204. Oscillation frequencies are selected by switches S201A and S201B from crystals Y201 to Y206, and inductances L212 to L217, respectively. V208 is shunt fed through L228 to keep B plus voltages off the tuned circuits. The output of V208 is fed through C224 to the second mixer V204B pin number two control grid.

(b) SECOND MIXER. V204 mixer stage is a conventional duotriode type, with the signal input frequencies fed into control grid pin number seven through condenser C232.

Similar to V201 mixer, there are two test points provided for V204. (See figure 5-1.) One is taken off pin number seven to jack J206 for measuring signal input levels. The other test point is taken off pin number two to jack J205 for measuring the V204 input level from crystal oscillator stage V208. Usage of all test points will be discussed in detail in the chapter on Maintenance and Alignment.

L220 and C249 form an eight-megacycle trap circuit to reduce the second harmonic of the crystal oscillator on the 40-meter range of frequencies. A similar trap is not needed for the higher

frequency bands, because the harmonic frequencies would fall outside the KWS-1 selectivity circuits' band pass.

The main output tuning inductance is L223. By itself, this inductance is used for the 40-meter band. (See table 4-1.) When S201D is switched to the 20, 15, 11 or 10-meter bands, L218, L219 and L221 are placed in parallel to L223 to provide the proper tuned circuit inductance. Variable capacitors C248, C250, C252, C254, C255 and C256 are provided for high frequency trimming of the respective coils for the frequencies passed by the second mixer. Each coil is inductively trimmed at the low frequency end by an iron slug.

(4) THIRD AND FOURTH AMPLIFIERS
V209 and V205 amplifier stages provide the final amplification and selectivity in the r-f section of the KWS-1 Transmitter.

The tuned output circuit of V209, which could also be considered the tuned input circuits of V205, consists of inductances L225, L227, L229, L230 and trimmers C257, C301, C302, C304, C306 and C308. Switch S201E governs the selection of these components for operation on the 40, 20, 15, 11 or 10-meter bands. (See table 4-1.)

The tuned plate circuit of V205, also considered the tuned grid input circuits for the 6CL6 drivers, consist of inductances L231, L234, L236 and L237, with capacitors C264, C265, C266, C267, C269 and C272 providing the high frequency trimming. Switching of the tuned circuits is accomplished by S201-F-2, while S201-F-1 opens the V205 cathode circuit when the KWS-1 Transmitter is operating on 80-meters. This prevents undesired signals from leaking into the 80-meter output. R237 thru R243 are loading resistors for all bands except 10 meters high.

C273 off the B plus supply input to V205 is in a capacitance neutralization circuit which will be discussed in relation to the driver and power amplifier stages.

The output of V205 is switched through S201-G into the driver stages V206 and V207.

4.2.1.4. DRIVERS AND POWER AMPLIFIER CIRCUITS.

a. SIGNAL CIRCUITS. Single sideband and AM. r-f input signals to the two, parallel connected 6CL6 driver stages passes directly through the E201 and E202 parasitic suppression components to the tube control grids.

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Cw keying voltage to the driver stages is fed through R229, E201 and E202 to the 6CL6 control grids.

The 6CL6 plate circuits are shunt fed through L238 and the parasitic suppression components E203 and E204.

Two test points are provided for the 6CL6 driver stages. One, for the control grids, is taken off the

R229-E202 Junction to jack J207. (See figures 5-1 and 7-1.) The other, for the cathode circuit, is taken directly off the 6CL6 cathode and fed into J208.

Driver stage output signals are coupled through C305 and switched over the amateur bands by S201-I to include the correct power amplifier tuned grid input circuits for the respective bands. The tuned circuit component combinations for each band are shown in table 4-1.

TABLE 4-1. TUNED CIRCUIT COMPONENTS

METER BAND	2ND MIXER OUTPUT (SWITCH S201D)			3RD AMPL. OUTPUT (SWITCH S201E)			4TH AMPL. OUTPUT (SWITCH S201F-2)			6CL6 DRIVER OUT. (SWITCH S201I)		
	IND.	TRIM.	PAD.	IND.	TRIM.	PAD.	IND.	TRIM.	PAD.	IND.	TRIM.	PAD.
80										L701	C710	C703
40	L223	C248	C247	L225	C308	C309	L231	C272	C271	L701 L703	C711	C704
20	L223 L218	C250	C329	L225 L230	C306	C330	L231 L237	C269		L701 L702	C712	
15	L223 L219	C252		L225 L229	C304		L231 L236	C267		L701 L704	C713	
11	L223 L221	C254		L225 L227	C302		L231 L234	C266		L701 L705	C707	C331
10 (LO)	L223 L221	C255		L225 L227	C301		L231 L234	C265		L701 L705	C708	
10 (HI)	L223 L221	C256		L225 L227	C257		L231 L234			L701 L705		

The 4X150A power amplifier tubes V401 and V402 are operated in parallel and as class AB₁ amplifiers. Output signals are coupled through C406 to the power amplifier tuning and loading circuits, and through J401/P401 to the antenna.

The power amplifier final tuning and loading circuits consists of a PI-L network, with C407, L406, L401, C408 and C409 forming the pi tuning circuit, and C408, C409 and L402 and the L-type loading circuit. For final stage tuning purposes, C407 and L401 are ganged together and brought out to the front panel. In the same manner, C408, C409 and L402 are ganged together and brought out to the front panel. The controls provide individual vernier tuning and loading adjustments of the output amplifiers over the entire frequency range of the KWS-1 Transmitter without the use of band switches.

Inductance L404 operates as a static drain to prevent dc voltages from building up on the antenna circuits.

The V401 and V402 screen grid circuits are series fed through L405, while the plate circuits are shunt fed through L403. Control grid bias is received from circuits in the high voltage power supply and fed through TB501-6 and J103-2 to L239 and the respective grid tank inductance for whichever band is selected.

b. NEGATIVE FEEDBACK AND NEUTRALIZATION CIRCUITS.

(1) NEGATIVE FEEDBACK. A portion of the power amplifier r-f output is fed back through C402 into the 6CL6 cathode circuit for the ultimate

purpose of improving final amplifier stage linearity. (See figure 4-9.) At the 6CL6 cathodes, the feedback circuit consists of R708, L706 and C714. The choke, L706, provides a d-c return for the cathode. R708 loads the choke to lower the circuit "Q", preventing oscillations which could be caused by L706 resonating at the feedback frequencies. C714 forms a capacitive voltage divider with C402 off the 4X150A plate to provide the proper value of feedback voltage which produces approximately 12 db of feedback.

(2) NEUTRALIZATION. Certain types of inherent feedback voltages in high level output amplifier stages produce undesirable oscillations which reduce the efficiency of operation. It is this type of feedback the neutralization circuits of the KWS-1 Transmitter eliminates, to improve the linearity and efficiency characteristics. There are four such neutralization circuits, which are discussed below.

(a) 6CL6 GRID TO CATHODE NEUTRALIZATION. (See figures 4-9 and 4-10.) The cathode feedback voltage in the 6CL6 stages will appear on the grid tank circuits to cause stage oscillation, unless the feedback is neutralized. On the bridge diagram of figure 4-10, the feedback voltage is carried over from cathode to grid by the tube's internal grid-to-cathode (Cgk) capacitance. This capacitance forms a voltage divider with the tube's grid-to-ground (Cgg) capacitance. The two capacitances, in series, comprise one side of the neutralization bridge. Neutralization is provided on the 40, 20, 15, 11 and 10-meter bands by condenser C715 and C273, which are in series and form a voltage divider from the 6CL6 cathode to ground. In this position, these capacitors form the other side of the neutralization bridge to balance out the undesired feedback voltage impressed across the Cgk and Cgg arms of the bridge. With the grid tank circuit across the midpoint of both bridge arms, the feedback is balanced out to eliminate this source of stage oscillations. The components of the bridge are shown on the simplified practical diagram of figure 4-9. On 80 meters only, C268 and C322 are placed in parallel to C273 to provide sufficient divider capacitance for neutralization at the 80-meter frequencies.

(b) 6CL6 GRID TO PLATE NEUTRALIZATION (80 Meters). The neutralization of grid-to-plate feedback voltages in the 6CL6 stages when operating on 80 meters is accomplished by the use of condensers C277, C281 and C283 in combination with C268, C322 and C273. (See figures 4-11 and

4-12.) The combination of C277, C281 and C283 is necessary to provide the very small amount of capacitance required in the neutralization arm of the bridge. The feedback voltage is carried over from the tube plate to grid by the internal grid-to-plate (Cgp) capacitance, and from grid-to-ground by the Cgg capacitance, which, together, are in series to form one side of the bridge, with the top of the 6CL6 grid tank circuit connected to the midpoint of the bridge arm. Neutralization balance is provided by the bridge arm consisting of C277, which is in series to ground with the arm consisting of C322, C273, C268, C281 and C283. The bottom of the grid tank circuit is connected to the midpoint of this bridge arm, thus, the tank is across the bridge, and the balanced-out feedback voltage will not affect the stage.

(c) 6CL6 GRID-TO-PLATE NEUTRALIZATION (40, 20, 15, 11 and 10 Meters). There are only two differences between neutralization of grid-to-plate neutralization on 80 meters, and on the higher frequency bands. For the higher bands, C322 and C268 are not placed in parallel to C273 in the bridge circuit. Also, the grid tank components will be different for each band of operation. These differences are shown in the practical diagram of figure 4-13, and the bridge diagram of figure 4-14. Neutralization is accomplished in the same manner as described in subparagraphs (a) and (b) above.

(d) 4X150A GRID-TO-PLATE NEUTRALIZATION. (See figures 4-15 and 4-16.) In this instance, the internal tube capacitances from grid-to-plate (Cgp), and from grid-to-cathode, which is grounded (Cgk), form one side of the bridge. The other side of the neutralization bridge is composed of the Cn capacitance off the 4X150A plate, and C298 off the bottom of the grid tank. The balance of the feedback voltage is accomplished in the same manner as described in preceding subparagraphs (a), (b) and (c). Neutralization capacitor C/N (see figure 6-10) is an adjustable metal bracket mounted close to the plates of the power amplifier 4X150A.

c. RECEIVER INJECTION. (See figure 7-1). J201 is connected to the 6CL6 plate circuit to provide receiver injection during calibration procedures. The receiver can be connected to J201 through a "T" fitting in the coaxial line going to the receiving antenna. During calibration, all sections of the KWS-1 Transmitter are turned ON, except the power amplifier. Thus the calibration signal may be heard by the operator to assist in making the proper adjustments. During power amplifier neutralization adjustments, the receiver is connected to J201, and

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the r-f signal is injected into output connector J401.

d. AUTOMATIC LOAD CONTROL (ALC). The power amplifier circuits include a 6X4 (V403) duodiode tube used as a rectifier in the Automatic Load Control system. This system operates very similar to receiver avc circuits to provide a dc voltage on the higher peaks of the 4X150A output. The d-c control voltage is fed back into the Exciter, amplifier stages V202 and V203 to reduce the KWS-1 overall gain, preventing the higher excitation peaks from causing power amplifier grid current flow with resulting distortion in the power amplifier output.

The simplified schematic diagram of figure 4-17 will assist in understanding the circuitry and operational theory of ALC.

A portion of the V401 and V402 output voltage is impressed upon the V403 cathode through a capacitive voltage divider consisting of C411 and C412. However, the V403 cathode is biased by approximately 40 volts positive from a supply external to the Power Amplifier. This supply is furnished by the Power Supply regulated 350-volt source for the 4X150A screen grids. The 350 volts is fed out of the Power Supply through TB501-1 to J-103-3 on the rear panel of the Exciter. From there, the circuit goes to the TUNE-OPERATE switch S204 on the front panel. Off this side of S204, there is a resistive voltage divider consisting of R703, R702, R704 and R701 to ground. R704 is a potentiometer to provide adjustment for the ALC bias voltage. The 40 volts bias is taken off the arm of R704 and fed into the ALC rectifier V403 cathode through feedthrough capacitor C414 and R405. Tube V403 is not conductive until the higher r-f peaks of the 4X150A output drive the cathode of V403 sufficiently negative to overcome the plus 40 volts external bias. At that point, V403 conducts to produce a d-c voltage output off the plate circuit. The voltage is fed out of the power amplifier section, through L247, R205 and the V202 amplifier grid tank circuit inductance L203 and through R213 and the V203 grid tank inductance L206. The additional d-c bias voltage on the V202 and V203 grids decrease the overall KWS-1 gain, and the excitation peaks which were overdriving the output stages. The measurement of d-c ALC control voltage on amplifiers V202 and V203 is explained in paragraph 4.2.1.5.c. below, under MULTIMETER ALC position.

R406 and C413 are connected in series to ground from the V403 plates to prevent motorboating. R407 is the diode load resistance.

4.2.1.5. MULTIMETER CIRCUITS (See figure 7-1.) Paragraph 4.2.4.6. in this section lists the positions of the MULTIMETER switch (S701) on the Exciter unit front panel. The circuitry involved in each of the five switch positions is described below. Switch terminals 1 and 7 are long contacts connected to either side of meter M201, and are in constant contact with the switch rotor in all positions.

a. PA FIL POSITION. To measure the power amplifier filament voltage, S701 rotor tabs are on terminals 2 and 8. This connects the switch meter terminal 1 to ground through terminal 2, and connects meter terminal 7 to switch terminal 8, which goes through rectifiers CR701 and CR702, and resistor R707 to the 6.3-volt filament supply through jack J103-20 and the power supply TB502-17.

b. PA SCREEN POSITION. The power amplifier screen-grid current is measured when the switch S701 rotor tabs are on terminals 3 and 9. This shunts the one-ohm resistance R705 across meter terminals 1 and 7. Switch terminal 3 is connected to the power amplifier screen grid circuit through feedthrough condenser C415 and choke L405. Switch terminal 9 is connected to jack J103-8 through the K101 relay connections eight and nine. J103-8 is connected to TB501-7 in the Power Supply. This meter circuit is tied in with the TUNE-OPERATE switch S204, which is explained below in paragraph 4.2.1.7.

c. ALC POSITION. The ALC d-c control voltage is fed into amplifiers V202 and V203 through L247 to the control grids. (See figure 4-17.) The ALC meter is connected through MULTIMETER switch S701 across the V202 cathode to the screen grid through R210. The purpose of the meter connected in this manner is to measure the amount of Automatic Load Control voltage in decibels.

To understand how the meter can register decibels in this circuit, the following points should be considered:

a. The R210 screen-grid meter connection provides a reference voltage from the R210-R209 divider.

b. The S701-10 connection to R206 provides a method of measuring the change in V202 cathode voltage due to the ALC d-c control voltage applied to the control grid.

c. The remote cutoff characteristics of V202 produces a change in cathode voltage equivalent to decibels of ALC applied.

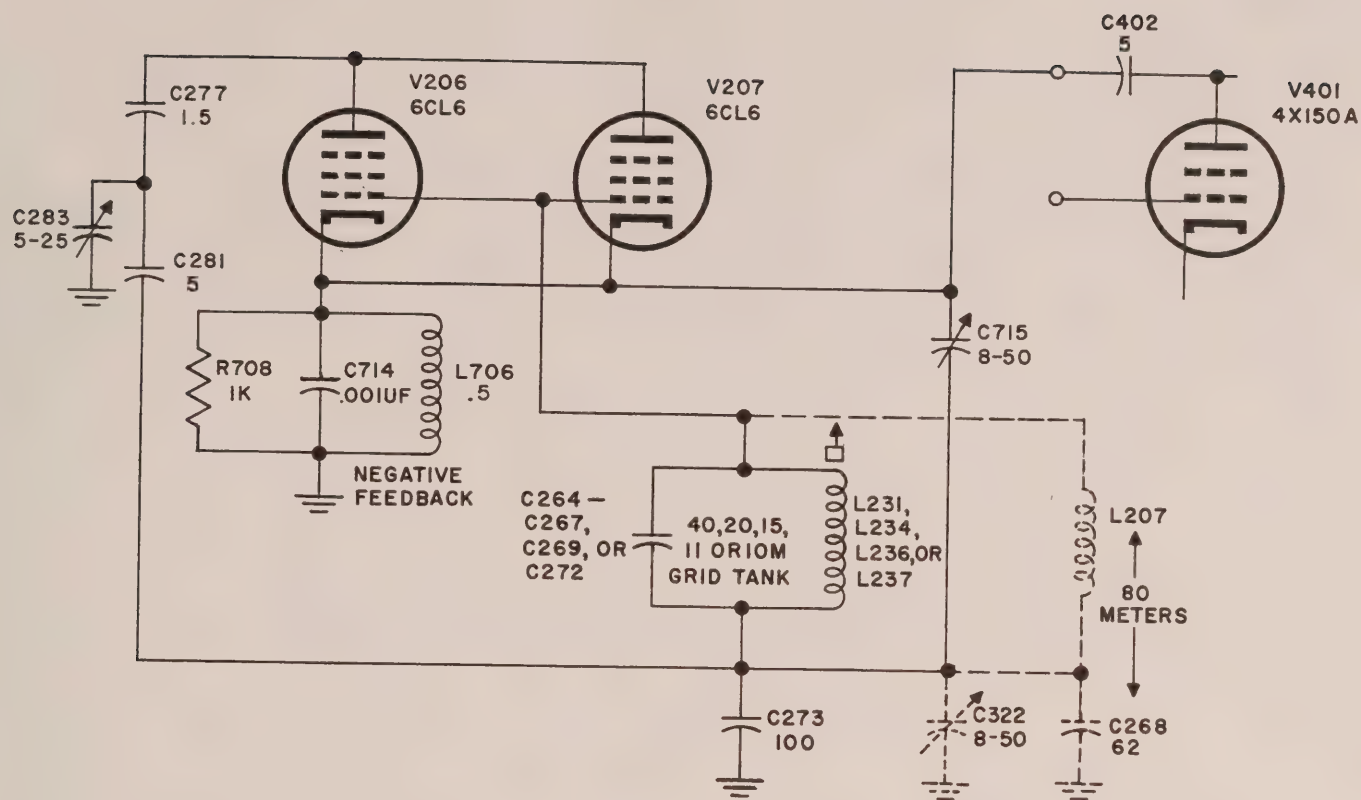


Figure 4-9. 6CL6 Driver Feedback and Grid-to-Cathode Neutralization Circuits, Simplified Schematic Diagram

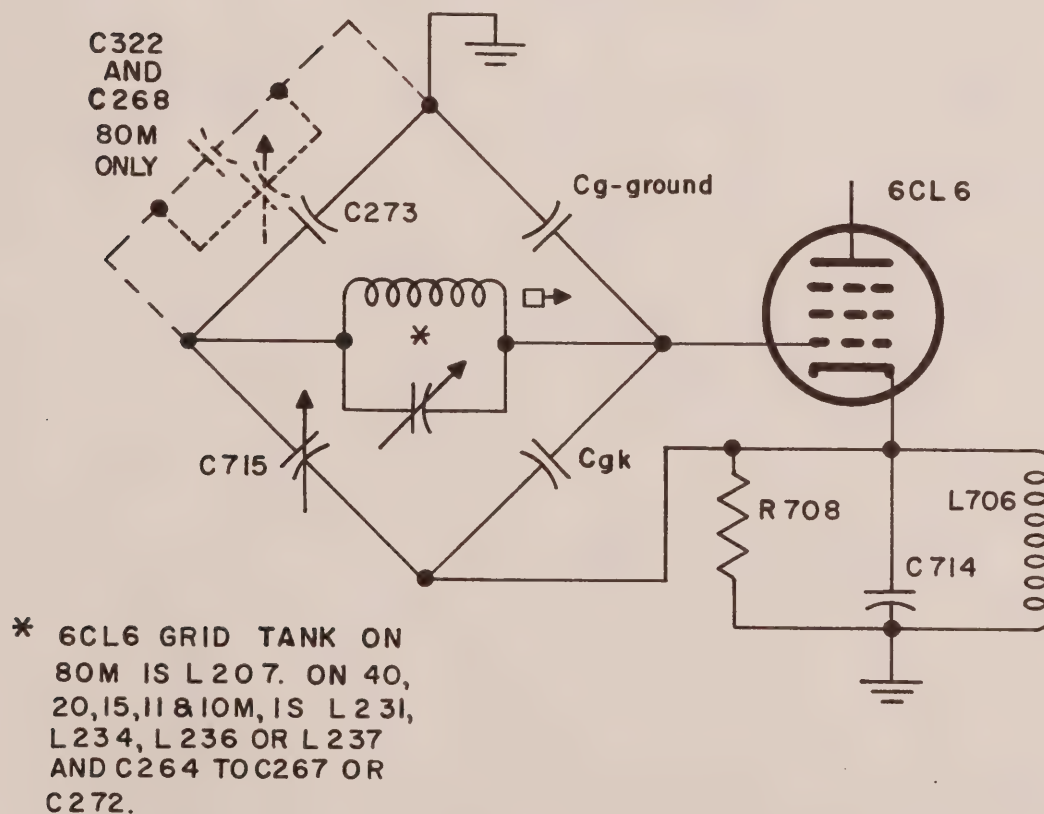


Figure 4-10. 6CL6 Driver Grid-to-Cathode Neutralization Bridge Diagram

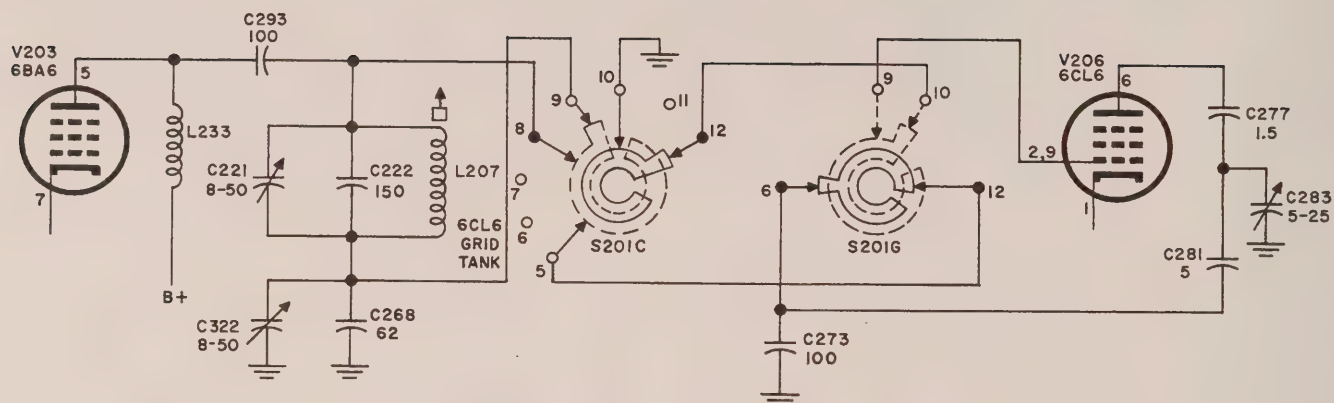


Figure 4-11. 6CL6 Driver Grid-to-Plate Neutralization Circuits (80 Meters), Simplified Schematic Diagram

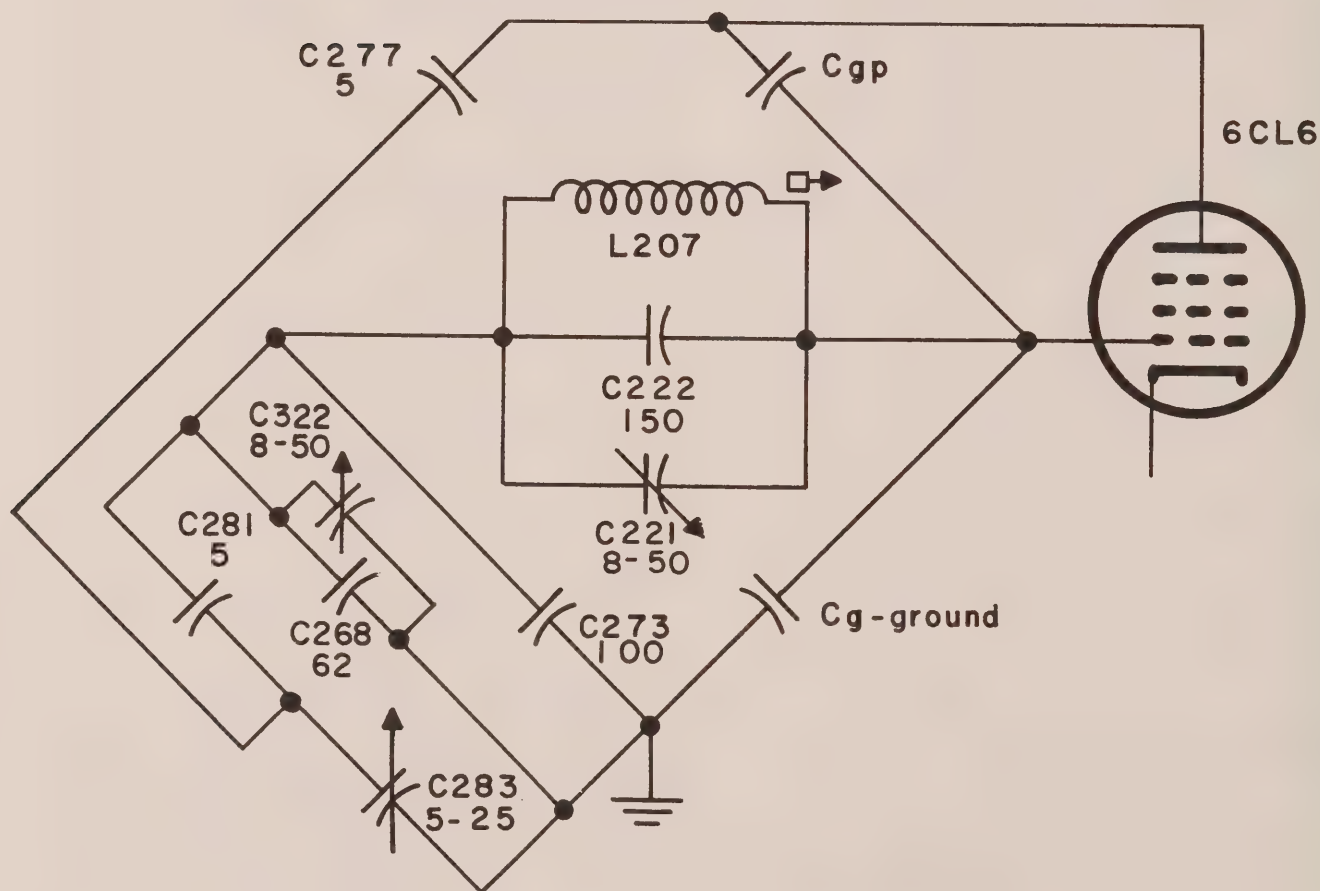


Figure 4-12. 6CL6 Driver Grid-to-Plate Neutralization Bridge Diagram (80 Meters)

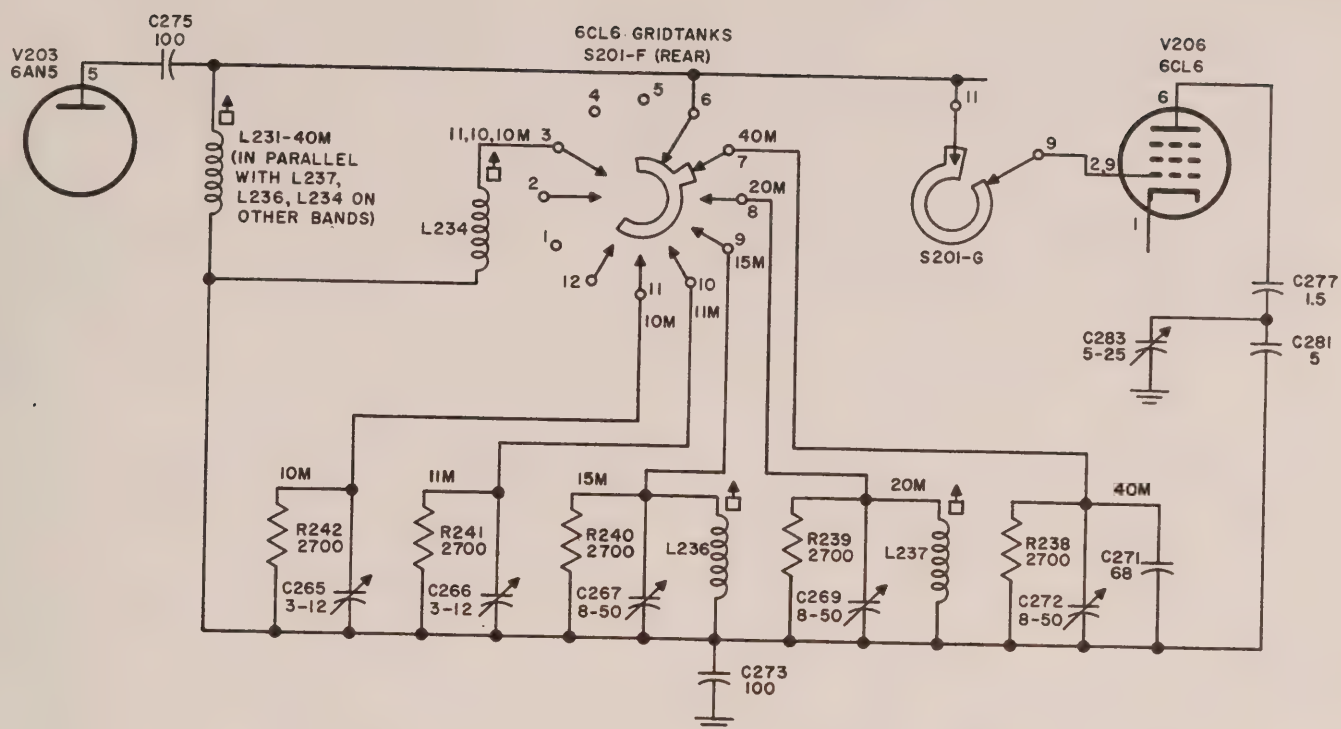


Figure 4-13. 6CL6 Driver Grid-to-Plate Neutralization Circuits, (40, 20, 15, 11 and 10 Meters), Simplified Schematic Diagram

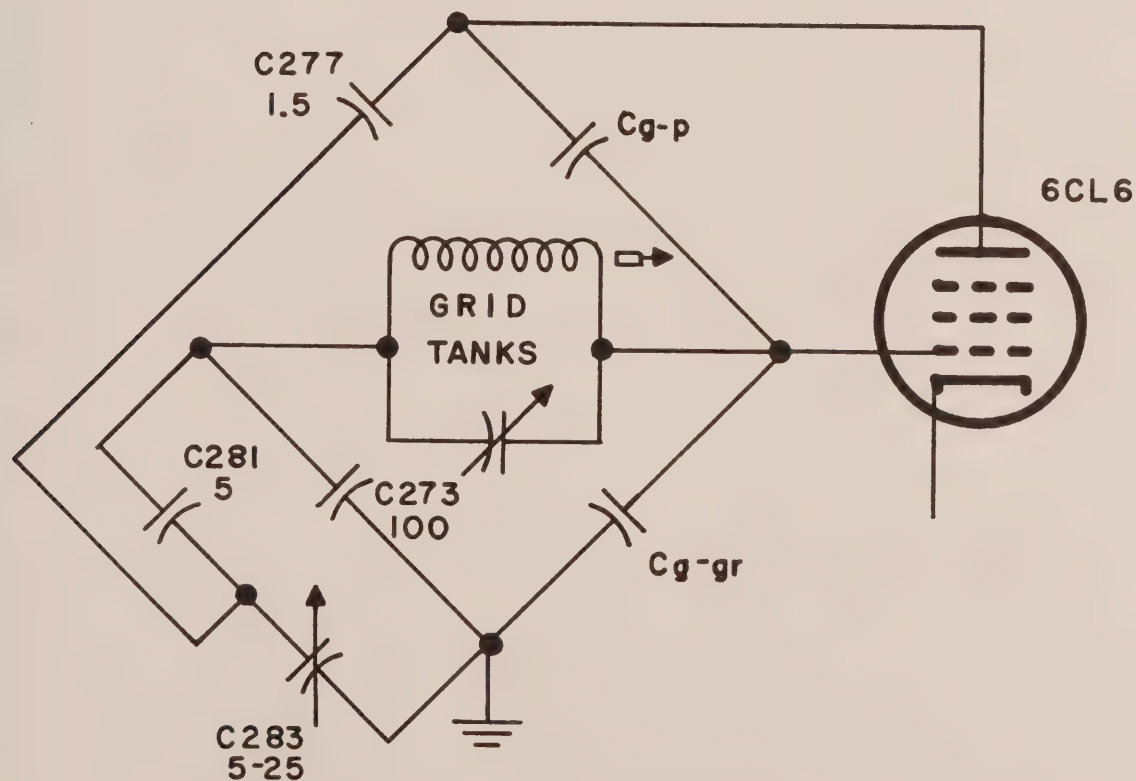


Figure 4-14. 6CL6 Driver Grid-to-Plate Neutralization Bridge Diagram (40, 20, 15, 11 and 10 Meters)

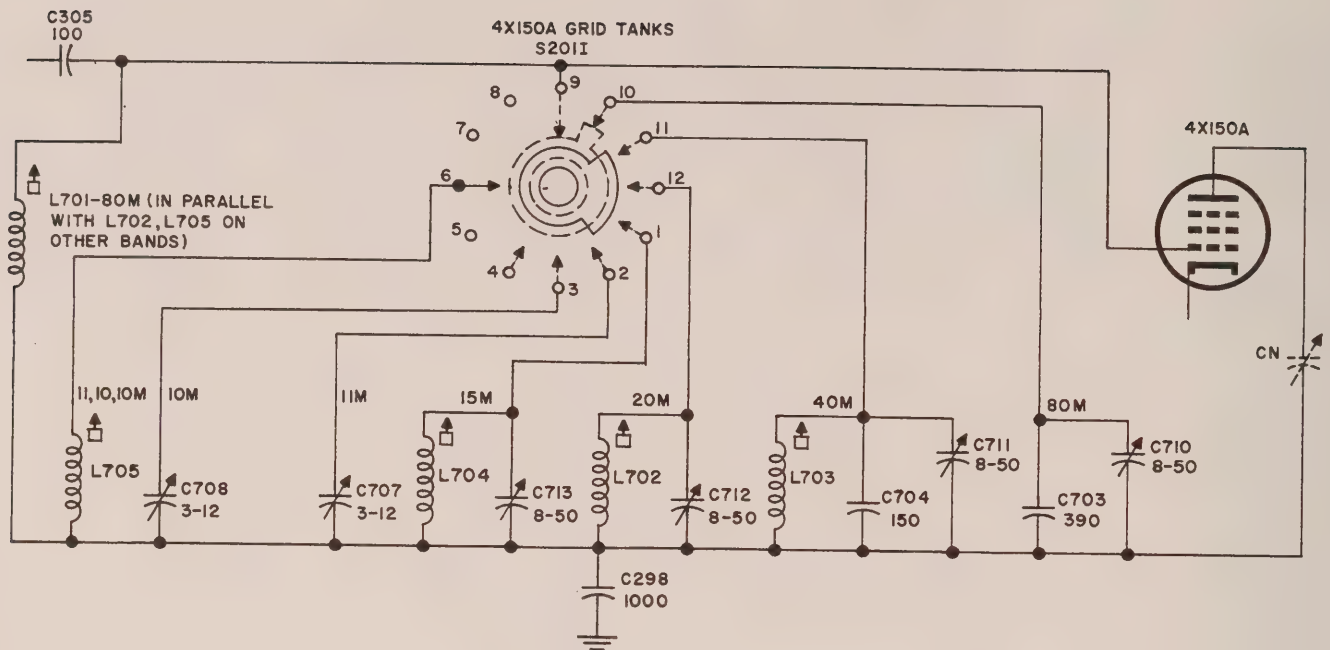


Figure 4-15. 4X150A Final Amplifier Grid-to-Plate Neutralization Circuits, Simplified Schematic Diagram

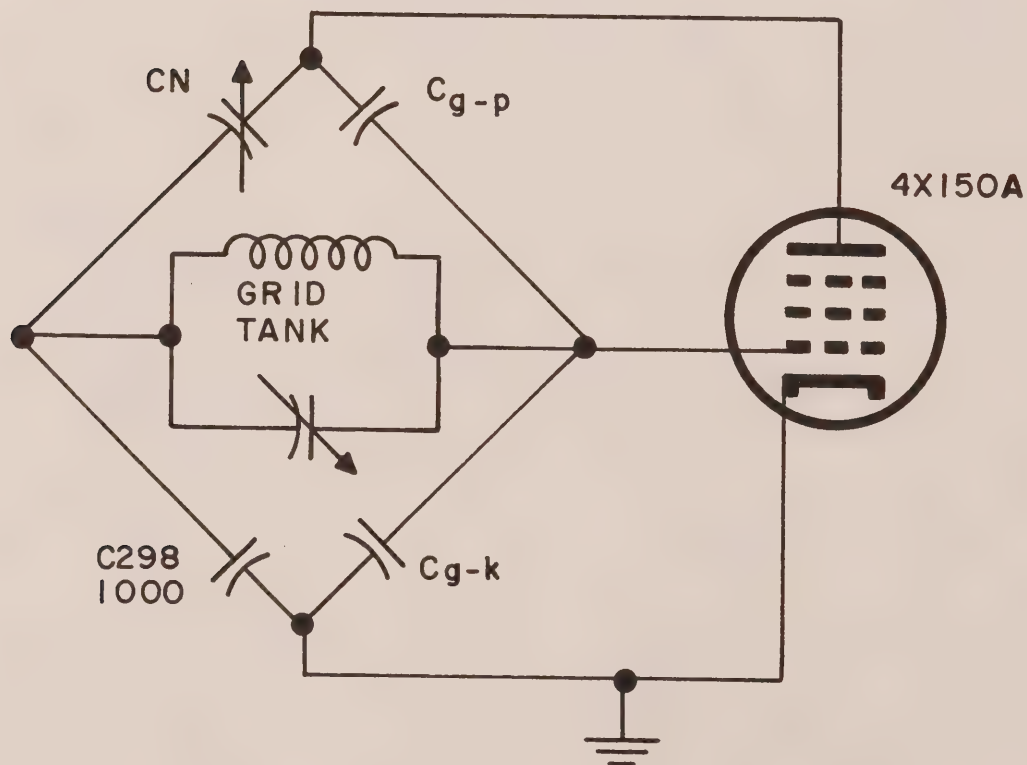


Figure 4-16. 4X150A Final Amplifier Grid-to-Plate Neutralization Bridge Diagram

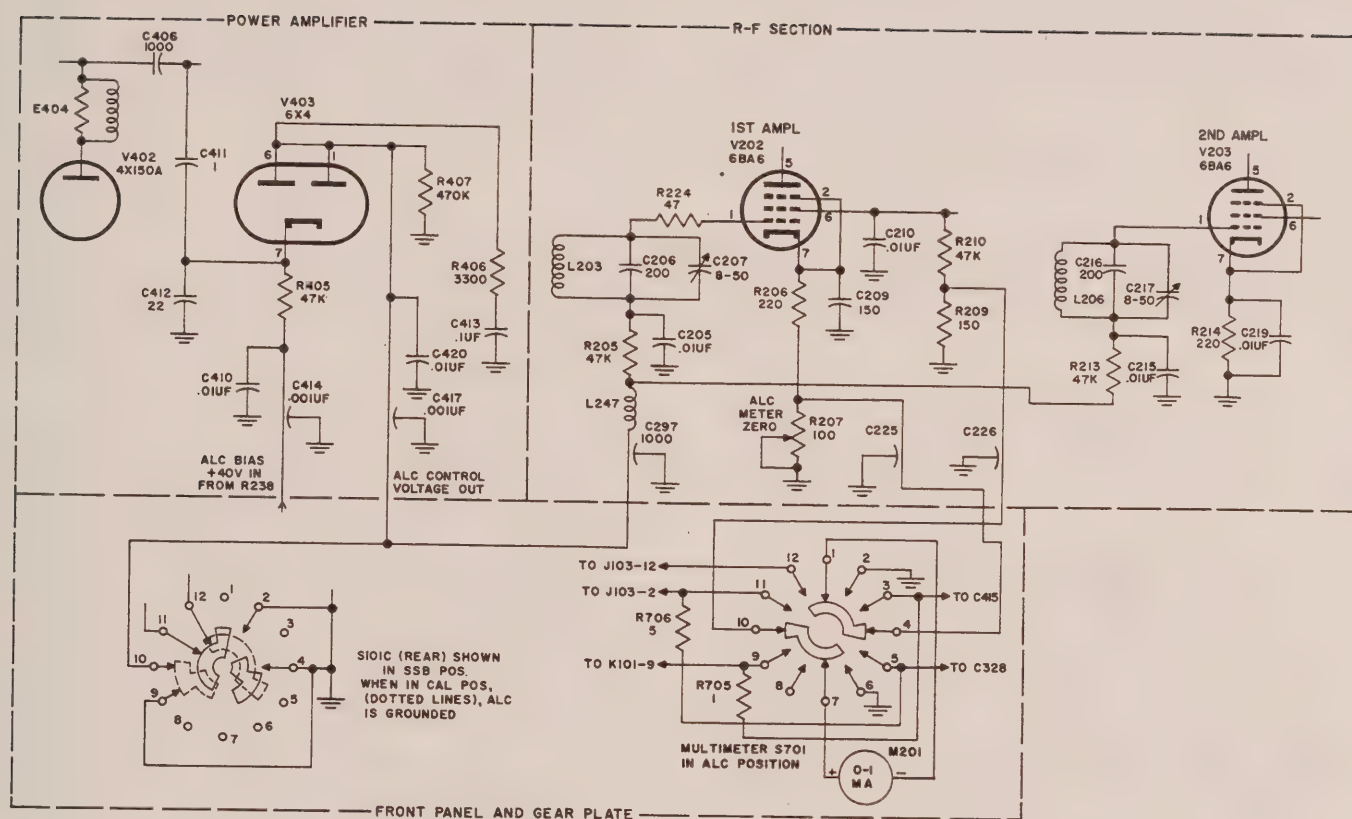


Figure 4-17. Automatic Load Control Circuits, Simplified Schematic Diagram

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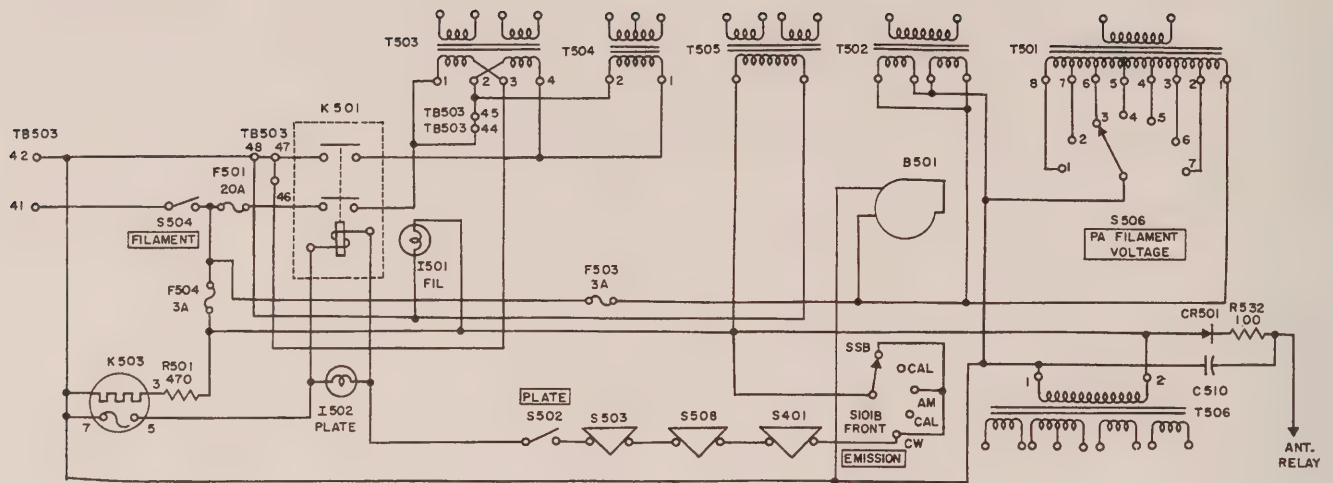


Figure 4-18. Primary Circuits, Simplified Schematic Diagram

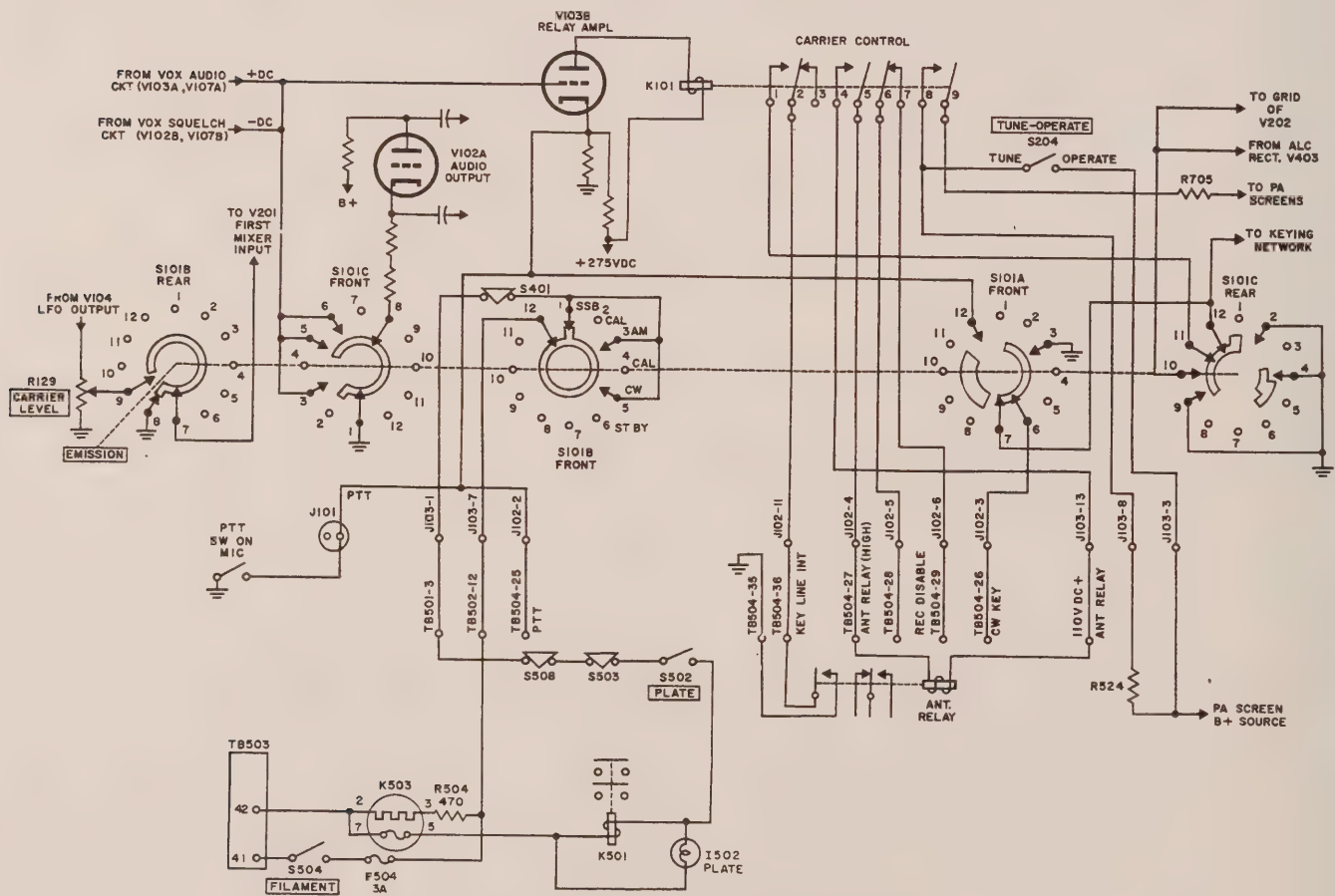


Figure 4-19. Control Circuits, Simplified Schematic Diagram

Under these conditions, if a curve was plotted for the change in cathode voltage due to the ALC applied, it would essentially duplicate a curve plotted for decibels of change in gain for V202 due to ALC voltage applied to the control grid. Therefore, the MULTIMETER ALC position is calibrated in decibels.

The principles of this circuit are equivalent to the "S" meter hookup in the Collins 75A amateur receivers.

d. PA GRID POSITION. Measurement of the power amplifier control grid current is accomplished when the S701 switch rotor tabs are on switch terminals 5 and 11. This position shunts the five-ohm resistance R706 across switch meter terminals 1 and 7. Terminal 5 is then connected to the V401 and V402 control grids through feedthrough condenser C328, inductance L239 and the respective grid tank circuits. Switch terminal number 11 is connected to jack J103-2, and to power supply TB501-6. In the Power Supply, the circuit goes to the PA BIAS voltage circuit consisting of R513, R514 and R515, and from here to TB502-19 on the low voltage power supply which is off the -150 volt bias supply source.

e. 2000-VOLT POSITION. Adjustment of the MULTIMETER switch S701 to the 2000 VDC position places the switch rotor tabs in contact with terminals 12 and 6. Terminal six grounds one side of the M201 meter, while terminal 12 connects through jack J103-12 and the power supply TB501-9 to the high voltage meter circuit. This circuit in the Power Supply connects to the high voltage source through the meter resistance divider consisting of R517 to R521.

4.2.1.6. PA PLATE CURRENT METER. Constant metering of the power amplifier plate current is registered on the meter in the upper right-hand corner of the front panel. The plus side of this meter, M701, is grounded, while the minus side is connected to J103-14. A connection is made from J103-14 through the interconnecting cable to the power supply TB501-4, and from that point to the ungrounded side of R516. This point is connected to the center tap on the high transformer T503 through the overload relay mounted on K502. R516 serves as safety resistance for the meter circuit.

4.2.1.7. PA TUNE-OPERATE CIRCUIT. The normal 4X150A screen-grid voltage (350 volts) originates in the Power Supply off the cathode of

V504, and is fed through TB501-1 and J103-3 to switch S204 on the exciter front panel, labeled TUNE-OPERATE. In its normal position, S204 is closed and the screen grid 350 volts is fed through the switch to terminal eight on K101 relay, and out of the relay through terminal nine to MULTIMETER switch terminal 9. From the switch terminal nine, the circuit passes through R705 to switch terminal 3 and from there to the 4X150A screen grid.

When the TUNE-OPERATE switch is placed in the TUNE position, the above circuit is altered at the source, in that the 350-volt supply passes through R524. The screen-grid voltage, reduced in value, is taken off the lower end of R524 and fed through TB501-7 and J103-8 directly to relay K101 terminal 8, completely bypassing switch S204 which is open.

4.2.1.8. CW WAVE SHAPING NETWORK. The resistive-capacitive network mounted on TB103 provides the necessary circuitry for accepting the -150 volt bias supply from the low voltage power supply, and reducing the supply to the proper value for cw keying of the V206 and V207 driver stages, and V201 first mixer.

The -150 volt supply is fed out of the low voltage supply through TB502-19 to J103-11 on the exciter rear panel. From here, the supply goes directly to TB103.

The cw key lead-in is connected to the Exciter through J102-3, and through S101C-12, S101A-7 to TB103. On TB103, the key is connected across R141 and C134 to improve the cw wave shape during keying operations.

The -150 volts for the cw key is fed through a divider on TB103, consisting of R139, R138 and R141. The key is connected at the junction of R138 and R141. Keying voltage for the driver stages is taken off the divider junction between R139 and R138. Condenser C129 provides additional wave shaping for this circuit. The driver keying voltage is fed out of TB103, through feedthrough C299 and the parasitic suppression components E201 and E202, into the 6CL6 control grids.

Another lead from the R139-R138 junction is connected to a divider consisting of R137 and R136. For the V201 first mixer, the circuit is through TB103-1, R143, the FL101 Mechanical Filter output coil and R201, into the V201 control grid. C127 provides additional wave shaping in this circuit.

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The purpose of keying the drivers and the first mixer during keying operation is to bias these tubes past the cutoff point, eliminating "back wave" of the cw signal.

4.2.1.9. INTERCONNECTION OF THE EXCITER AND POWER AMPLIFIER WITH THE POWER SUPPLIES. (See figure 7-3.) Intercabling between the two cabinets of the KWS-1 Transmitter is accomplished by connecting all signal circuits of the Exciter and Power Amplifier to J102 and all supply circuits to J103 on the exciter rear panel. From here, a single interconnecting cable (W1) with two plugs carries all circuits to the power supply cabinet. In the cabinet, the signal circuits are connected to TB504, and from there, to their respective external connections. The supply circuits in the power supply cabinet connect to TB501 or TB502, according to whether the leads are for the high or low voltage Power Supplies. TB503 is for either a 230-volt or 115-volt a-c input to the cabinet from the external source.

The 2000-volt supply for the final amplifier plate circuits is fed from the high voltage Power Supply through a separate cable (W2) directly to jack J402 on the power amplifier chassis. J402 is mounted inside a metal "can" which is mounted on the power amplifier chassis, but protrudes through the exciter rear panel at the lower left-hand corner below antenna jack J401.

4.2.2. POWER SUPPLY CIRCUITS

4.2.2.1. GENERAL. The Power Supply of the KWS-1 Transmitter is designed for either a 230-volt or 115-volt a-c input. The schematic diagram in figure 7-2 shows alternate connections for either input value, whichever is available at the installation. Power supply primary circuits are shown in the simplified schematic diagram of figure 4-18.

The complete Power Supply is essentially divided into two sources, the low voltage Power Supply and the high voltage Power Supply. The circuitry for each is conventional, and the a-c input for both is brought into the cabinet on terminal board TB503. The input is fed through fuses F501 and F502 to HV transformer T503. Fuse F503 protects the filament transformers and the blower; fuse F504 protects filament transformers and the low voltage supply.

4.2.2.2. LOW VOLTAGE POWER SUPPLY. This Power Supply is constructed as a integral unit, to the high voltage supply cabinet with all leads brought out to terminal board TB502. (See figure 6-16.)

Two duodiode rectifier tubes, V508 and V509, operate from one transformer, T506, the primary of which is connected through fuse F504 to the a-c input on TB503-41 and 42.

A connection across the T506 transformer primary coil feeds 110 ac through a selenium rectifier, CR501, which is filtered by R532 and C510 to provide approximately 110 dc for operation of an antenna relay. This output is made available on TB502-14.

Transformer terminals 3, 4, 5, 6, and 7 are taken off the T506 high voltage secondary winding, with the full voltage taken from 3 and 7, and fed directly to the plates of full-wave rectifier V508. The 275-volt d-c output of V508 is filtered and fed to TB502-18 to provide plate and screen-grid supplies for the Exciter.

Transformer terminals 8 and 9 furnish 5 volts a-c for the V508 filaments, while 10 and 11 furnish 6.3 volts a-c to TB502-17 which is fed through the interconnecting cable into jack J103-20 for the exciter circuit tube filaments.

The cathode bias rectifier V509 receives an a-c input from transformer terminals 4 and 6. Connected in this manner, a -150-volt d-c output is available off the plates, which is fed through a filter network to TB502-19, and through the interconnecting cable to exciter jack J103-11 for use in the cw keying and wave shaping network. Another lead off TB502-19 is fed into the high voltage Power Supply, into a resistive voltage divider consisting of R513, R514 and R515. Off the movable arm of potentiometer R515, a negative bias supply voltage is fed through TB501-6 to J103-2 to supply the power amplifier 4X150A stages with the proper value of grid bias voltage.

Transformer terminals 12 and 13 of T506 provides a 12.6-volt a-c source through TB502-15 and 16, to exciter J103-4 and 5 for the RT101 filament regulation circuit of the vfo. The output of RT101 is 6.3 volts, regulated.

4.2.2.3. HIGH VOLTAGE POWER SUPPLY. The leads in the high voltage source feeding off the a-c input line through FILAMENT switch S504 are as follows:

a. Panel light I501, which is mounted on the power supply front panel above the FILAMENT switch. When ON, this light indicates that voltage is being supplied to the filaments of all tubes and the low voltage Power Supply is turned ON.

b. Transformer T502, which supplies the V501 and V502 with 2.5 volts.

c. Blower B501, connected to the a-c input line through TB505.

d. Thermal Relay circuit K503 and K501. This is the circuit which causes a thirty-second time delay for the high voltage transformer after switch S504 is turned ON, to prevent application of 2000 volts to the plates of V501 and V502 before the tubes have warmed up. Lamp I502 above the switch lights when the time delay period has expired with the PLATE switch S502 ON.

e. The low voltage Power Supply and antenna relay power source.

f. The 115 or 230-volt a-c input to the high voltage Power Supply is fed into two transformers, T503 and T505.

The T505 circuit includes rectifier V503, the output of which is filtered and fed through a voltage regulation circuit consisting of V504, V505 and V506 to provide a regulated 350-volt d-c supply at TB501-1 for the power amplifier screen grids. The PA TUNE-OPERATE circuit components are across the 350-volt supply to ground. This circuit description was given in paragraph 4.2.1.7. above.

V507, a 2D21 thyratron, is used in a screen protect circuit. (See figure 7-2.) Should the bias supply fail, the grid of V507 would lose its bias and allow a large amount of plate current to flow through V507. This plate current is enough to blow screen fuse F505, through which it is drawn, and cut off the PA screen supply. Likewise should a short occur between the plate and screen of the 4X150A tubes, the thyratron would strike and blow the screen fuse. (The plate fuse F506 would likely blow too.)

High voltage transformer circuit of T503 includes the rectifiers V501 and V502. This output is filtered and fed into a separate coaxial cable off an E501 standoff, directly to the Power Amplifier. Resistor R516 is in the power amplifier plate current meter circuit, and is connected from TB501-4 to J103-14. The PA plate current is measured in the negative side of the power supply 2000-volt output, to keep high voltages off the exciter terminals.

4.2.3. CONTROL CIRCUITS.

4.2.3.1. GENERAL. The carrier control circuits are shown in figure 4-19. All filaments and the entire low voltage supply are energized upon closing FILAMENT switch S504. Assuming that the contacts of time relay K503 are closed, the circuit to close plate contactor K501 is from S504 through S101B (front), S401, S508, S503, PLATE switch S502, the coil of plate contactor K501, K503 to TB503 terminal 42. Notice that EMISSION switch S101B (front) opens the circuit in CAL and STBY positions.

Refer to figure 4-19. The following control functions take place at the various positions of the EMISSION selector switch, S101.

4.2.3.2. SSB. S101A front, no action, except key circuit is fed through contacts 6 and 7; S101B front, contacts 1 and 12 are closed to allow PA plate current to be turned on; S101B rear, contacts 7 and 8 are closed to ground the lead going to V201 grid circuit to prevent rf from feeding around the balanced modulator; S101C front, contacts 1 and 3 are open so that the VOX circuits will operate, contacts 1 and 8 are closed so that the audio output tube V102A will operate; S101C rear, contacts 11 and 12 are closed so that the carrier can be turned on by the relay amplifier tube V103B by means of the VOX circuits.

4.2.3.3. CAL. S101A front, no action except key circuit is fed through contacts 6 and 7; S101B front, PA plate current relay circuit is opened at contacts 12 and 2; S101B rear, output of CARRIER LEVEL control is fed through contacts 9 and 7 to provide an r-f signal for calibration purposes; S101C front, VOX control circuit is grounded at contacts 1 and 3 to prevent VOX from interfering with calibration procedure; S101C rear, Exciter is keyed by grounding the key line through contacts 2 and 12.

4.2.3.4. AM. S101A front, no action except key circuit is fed through contacts 6 and 7; S101B front, PA plate current relay circuit is completed through contacts 1 and 3; S101B rear, output of CARRIER LEVEL control is fed through contacts 9 and 7 to provide r-f signal unhindered by balanced modulator; S101C front, contacts 1 and 4 unground VOX circuit so that it may be used to control carrier; S101C rear, contacts 11 and 12 route keying circuit through

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K101.1 and 2 so that the VOX circuits control turning the carrier on and off.

4.2.3.5. CAL. This position is treated the same as the first CAL position - refer to paragraph 4.2.3.3. above.

4.2.3.6. CW. S101A front, contacts 3 and 12 ground the cathode of relay tube V103B to close Carrier Control Relay K101, the key circuit continues to feed through contacts 6 and 7; S101B front, PA plate current relay circuit is completed through contacts 12 and 5; S101B rear, output of CARRIER LEVEL control is fed through contacts 7 and 9 to provide excitation; S101C front, contacts 1 and 6 ground the VOX circuit to render the VOX inoperative; contacts 1 and 8 open to disconnect the cathode of audio output tube V102A; S101C rear, contacts 11 and 12 are open to make contacts 1 and 2 of K101 inoperative, contacts 9 and 10 are closed to render the ALC inoperative.

4.2.3.7. STBY. S101A, contacts 6 and 7 open to prevent operation of the key circuits, contacts 3 and 12 open to disable Carrier Control Relay K101; S101B front, contacts 12 and 6 are open to disable the PA plate relay circuit; S101B rear, no function; S101C front, contacts 1 and 8 are open to disable V102A; S101C rear, no function.

4.2.3.8. CARRIER CONTROL RELAY K101. The coil of Carrier Control Relay K101 is excited by the plate current of V103B when (a) the grid of V103B is positive with respect to cathode or (b) when the cathode of V103B is grounded to remove its fixed cathode bias. The first condition occurs when SSB or AM. is selected and the microphone is spoken into; the second condition occurs when CW is selected by the EMISSION switch or when a push-to-talk button circuit is used.

Contacts 1 and 2 of K101 perform the keying function in SSB and AM. emission through the NO key line interlock contacts of the antenna relay. Contacts 2 and 3 (NC contacts) are not used. Contacts 4 and 5 (NO contacts) are used to connect antenna relay coil voltage to TB504-27. Contacts 6 and 7 (NC contacts) are used to disable a receiver. Contacts 8 and 9 connect the PA tubes' screen source when transmitting.

4.2.4. FUNCTION OF OPERATING CONTROLS (See figures 3-1 and 3-2.)

4.2.4.1. BAND CHANGE. Selects the proper exciter tuning elements for the amateur band upon

which operation is desired. The knob rotates 30° between adjacent bands. Clockwise rotation selects higher frequency bands. The band selected is indicated by the control knob and appears on the slide rule dial.

4.2.4.2. KILOCYCLES TUNING KNOB. Operates both the slide rule pointer and the vernier dial to select the exact frequency upon which operation is desired.

4.2.4.3. EMISSION SWITCH. Selects the type of emission desired. The different switch positions are explained below:

a. STBY POSITION. Adjusts transmitting operation to a standby status. The high voltage is OFF, the cathode circuit of the audio output (V102A) is open, the Automatic Load Control line is open, and the cw key line is open.

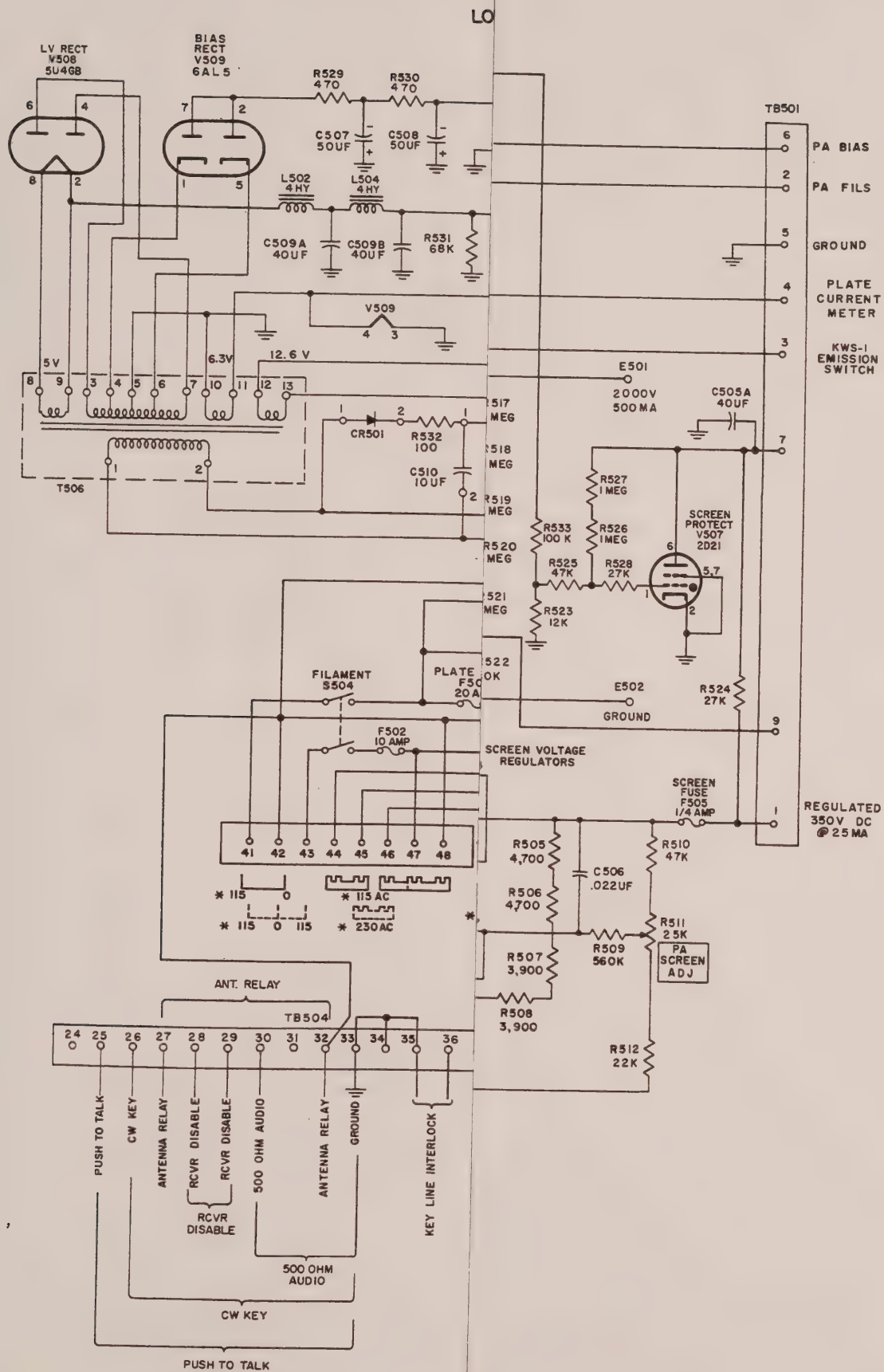
b. CW POSITION. Switches transmitting operation for the purpose of cw keying. The cw key is connected into the transmitting circuits and high voltage is ON. The carrier level control is activated, the audio output cathode circuit is open, and the relay amplifier (V103B) grid is grounded. The Automatic Load Control line is also grounded.

c. CAL POSITION. Adjusts the transmitter circuits for the purpose of frequency calibration. The high voltage is OFF and the carrier level control is activated. The grid of Relay Amplifier V103B is grounded. The cathode of Audio Output Amplifier V102A is closed to provide the operator the opportunity of calibration by "talking self on frequency". This position of the EMISSION control provides a signal for calibration procedures through switch S101A and S101C, which closes the cw key line to unblock the first mixer, second amplifier and driver control grids.

d. AM POSITION. Causes the transmitter to produce an AM. output utilizing the carrier and one sideband. The high voltage is ON, the carrier level circuit is connected, and the audio output amplifier cathode circuit is closed. Carrier Control Relay, K101, completes the cw key circuit when VOX or push-to-talk circuits are activated.

e. CAL POSITION. Same as the CAL position described under position c. above.

f. SSB POSITION. Adjusts the transmitter circuits for the purpose of single sideband, suppressed carrier operation. The high voltage is ON



Schematic Diagram

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Paragraphs 4.2.3.4. - 4.2.4.3.

K101.1 and 2 so that the VOX circuits control turning the carrier on and off.

4.2.3.5. CAL. This position is treated the same as the first CAL position - refer to paragraph 4.2.3.3. above.

4.2.3.6. CW. S101A front, contacts 3 and 12 ground the cathode of relay tube V103B to close Carrier Control Relay K101, the key circuit continues to feed through contacts 6 and 7; S101B front, PA plate current relay circuit is completed through contacts 12 and 5; S101B rear, output of CARRIER LEVEL control is fed through contacts 7 and 9 to provide excitation; S101C front, contacts 1 and 6 ground the VOX circuit to render the VOX inoperative; contacts 1 and 8 open to disconnect the cathode of audio output tube V102A; S101C rear, contacts 11 and 12 are open to make contacts 1 and 2 of K101 inoperative, contacts 9 and 10 are closed to render the ALC inoperative.

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(See figures 3-1 and 3-2.)

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which operation is desired. The knob rotates 30° between adjacent bands. Clockwise rotation selects higher frequency bands. The band selected is indicated by the control knob and appears on the slide rule dial.

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4.2.4.3. EMISSION SWITCH. Selects the type of emission desired. The different switch positions are explained below:

a. STBY POSITION. Adjusts transmitting operation to a standby status. The high voltage is OFF, the cathode circuit of the audio output (V102A) is open, the Automatic Load Control line is open, and the cw key line is open.

b. CW POSITION. Switches transmitting operation for the purpose of cw keying. The cw key is connected into the transmitting circuits and high voltage is ON. The carrier level control is activated, the audio output cathode circuit is open, and the relay amplifier (V103B) grid is grounded. The Automatic Load Control line is also grounded.

c. CAL POSITION. Adjusts the transmitter circuits for the purpose of frequency calibration. The high voltage is OFF and the carrier level control is activated. The grid of Relay Amplifier V103B is grounded. The cathode of Audio Output Amplifier V102A is closed to provide the operator the opportunity of calibration by "talking self on frequency". This position of the EMISSION control provides a signal for calibration procedures through switch S101A and S101C, which closes the cw key line to unblock the first mixer, second amplifier and driver control grids.

d. AM POSITION. Causes the transmitter to produce an AM. output utilizing the carrier and one sideband. The high voltage is ON, the carrier level circuit is connected, and the audio output amplifier cathode circuit is closed. Carrier Control Relay, K101, completes the cw key circuit when VOX or push-to-talk circuits are activated.

e. CAL POSITION. Same as the CAL position described under position c. above.

f. SSB POSITION. Adjusts the transmitter circuits for the purpose of single sideband, suppressed carrier operation. The high voltage is ON

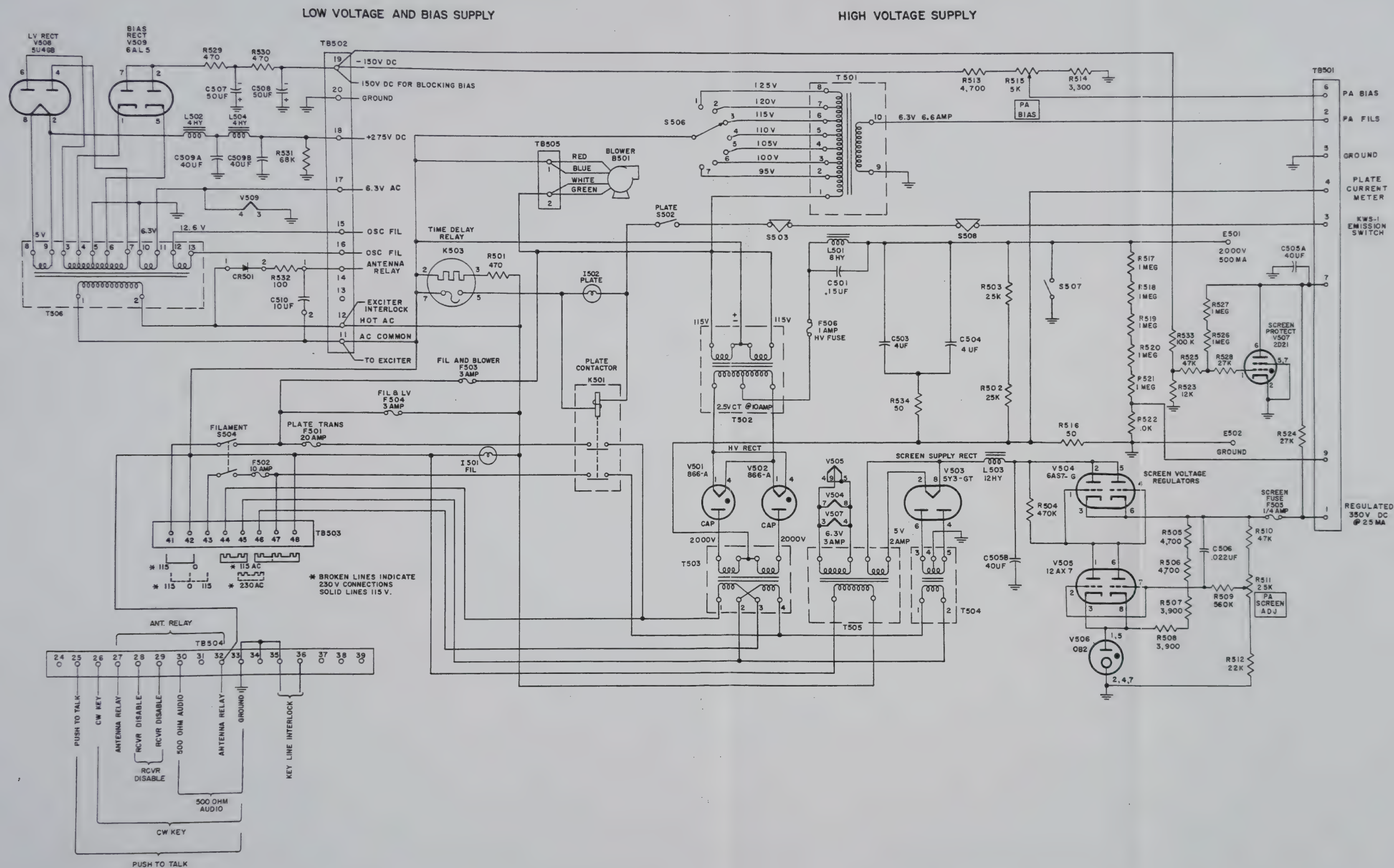


Figure 7-2. Power Supply, Complete Schematic Diagram

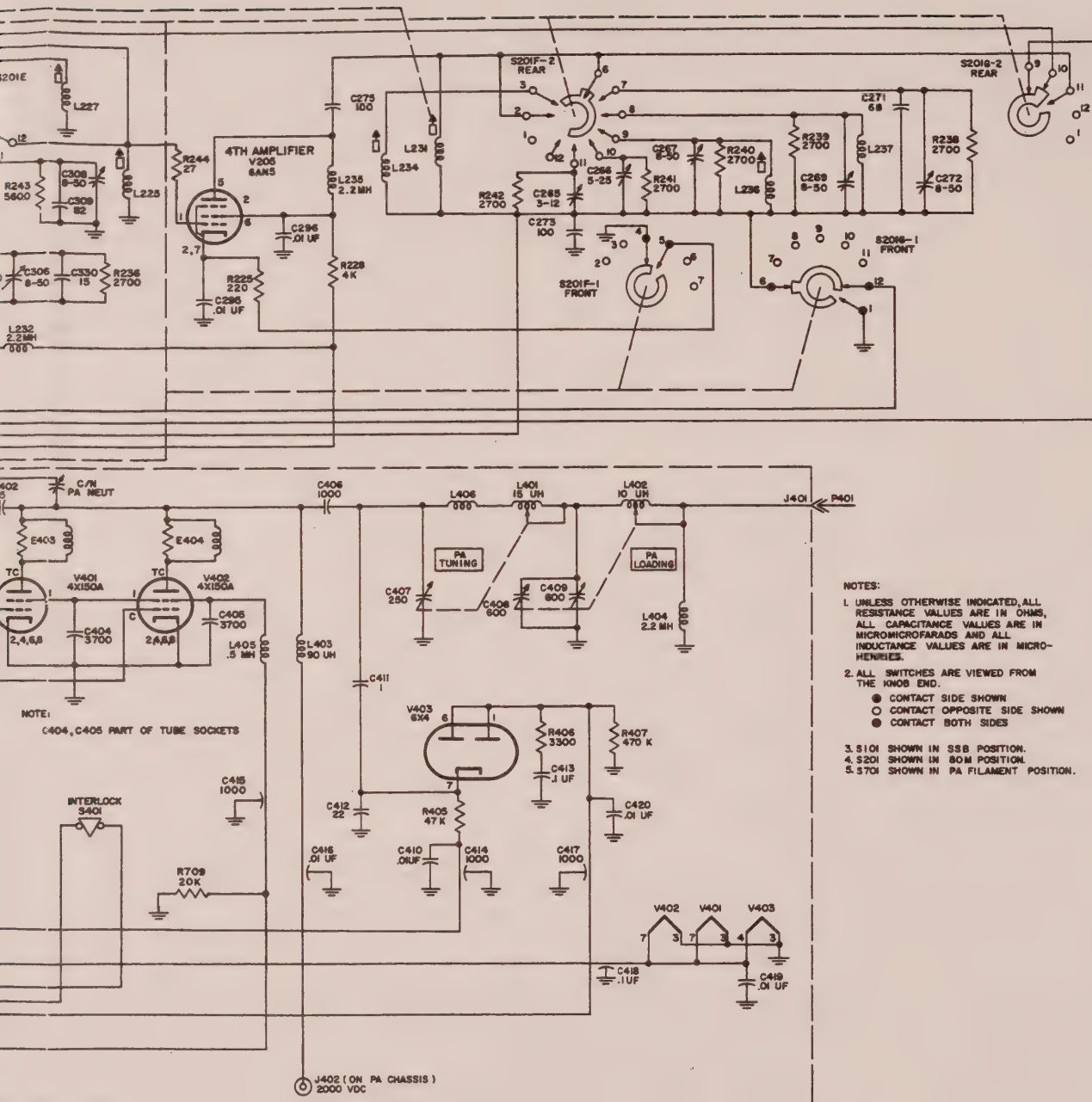
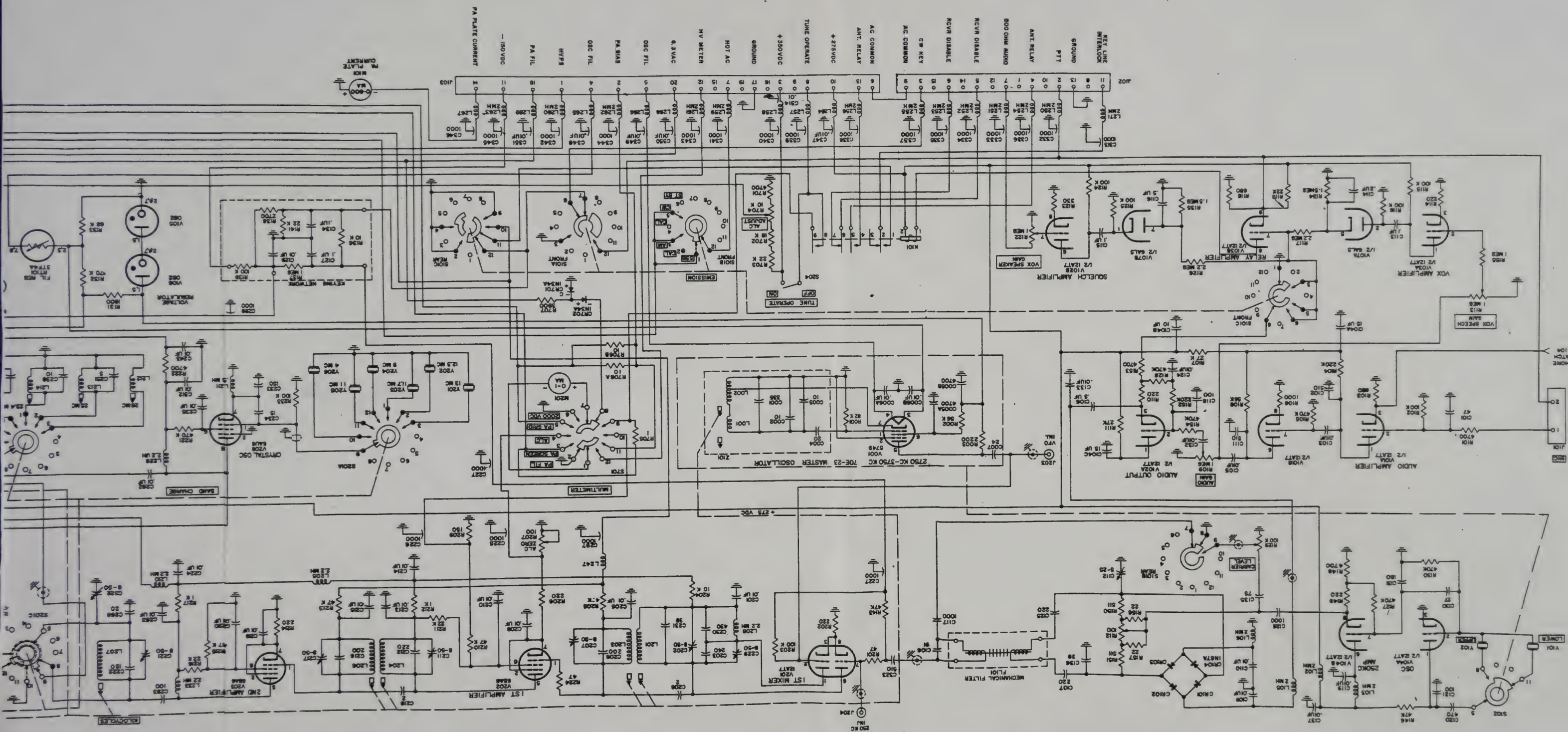
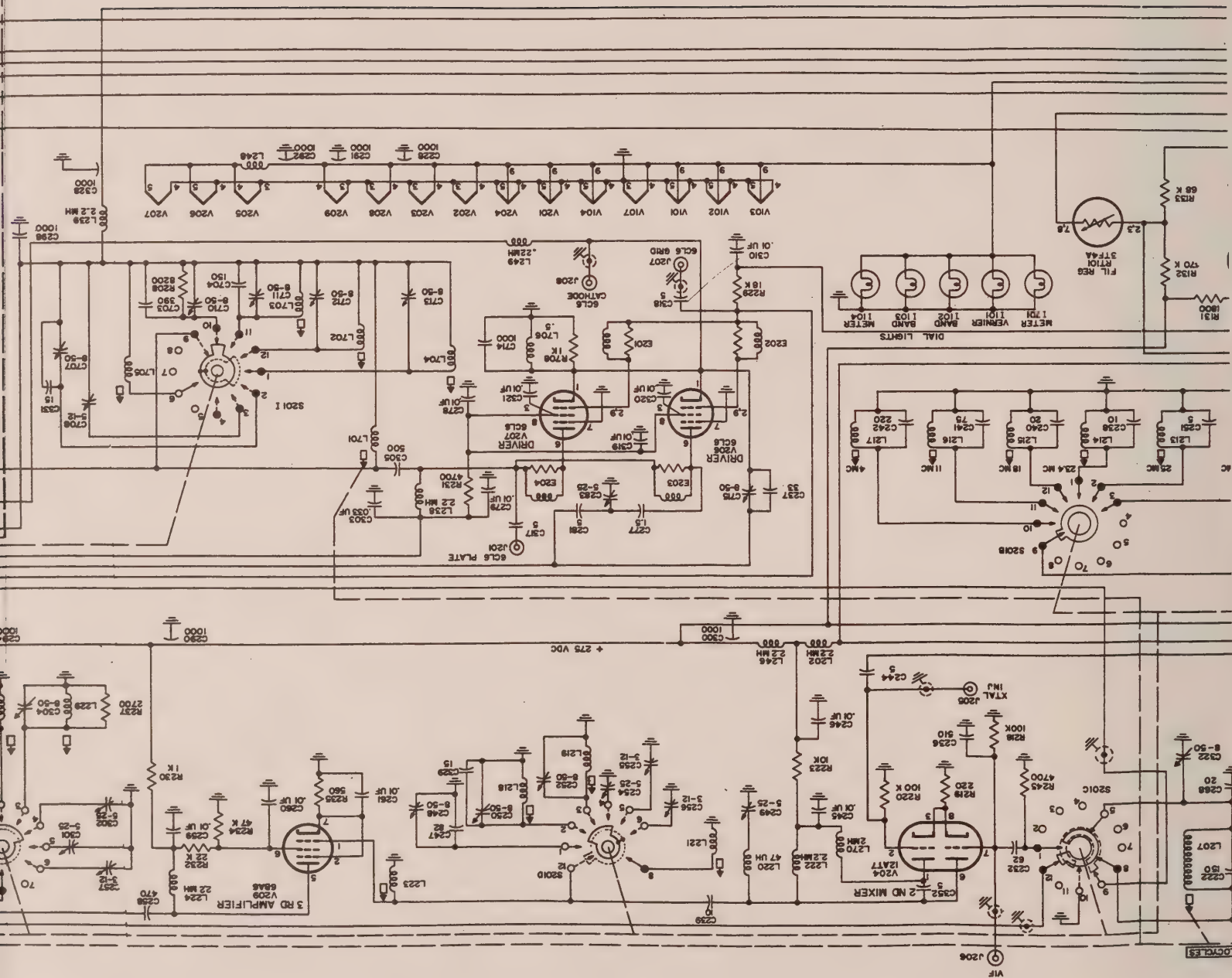
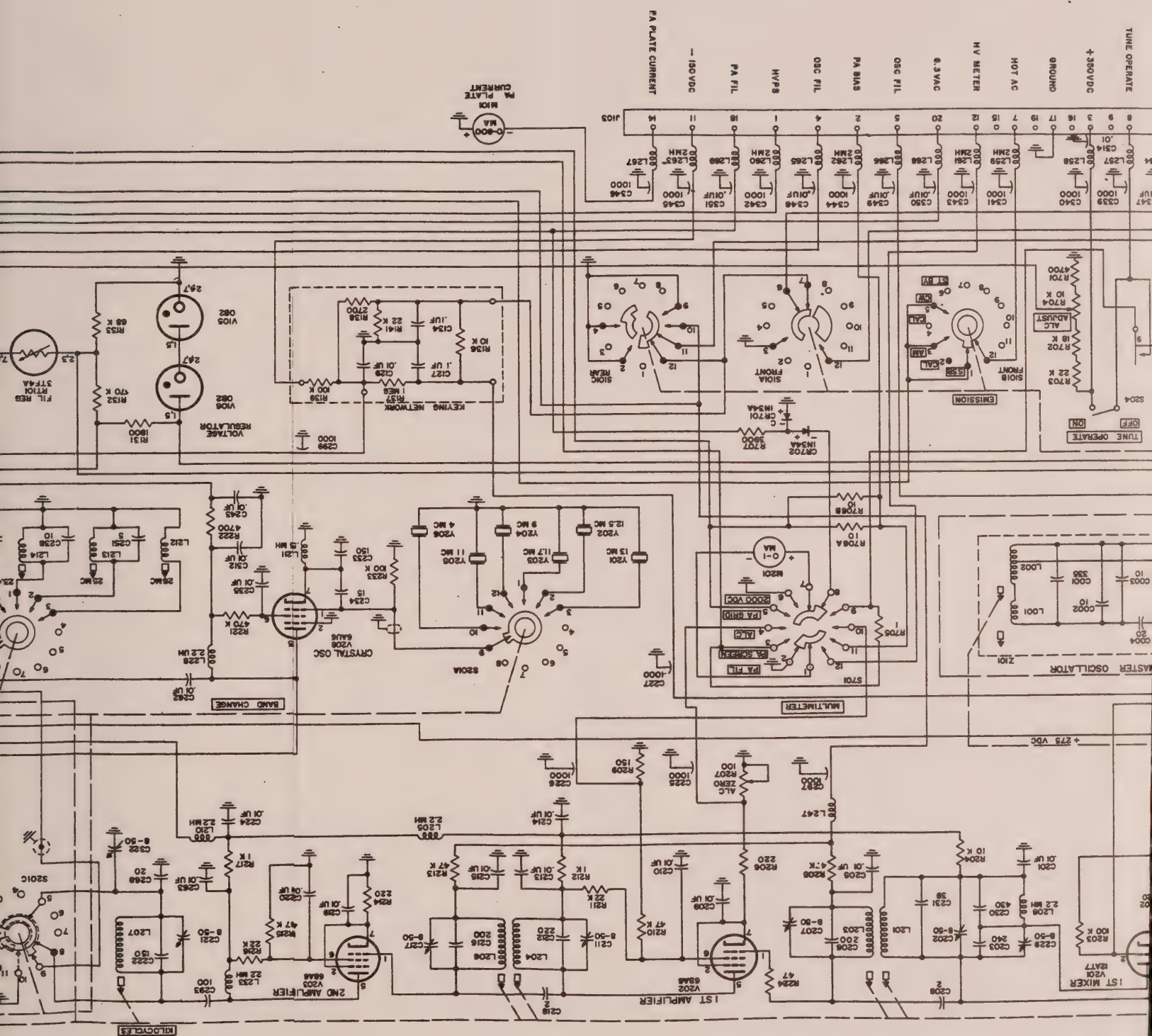
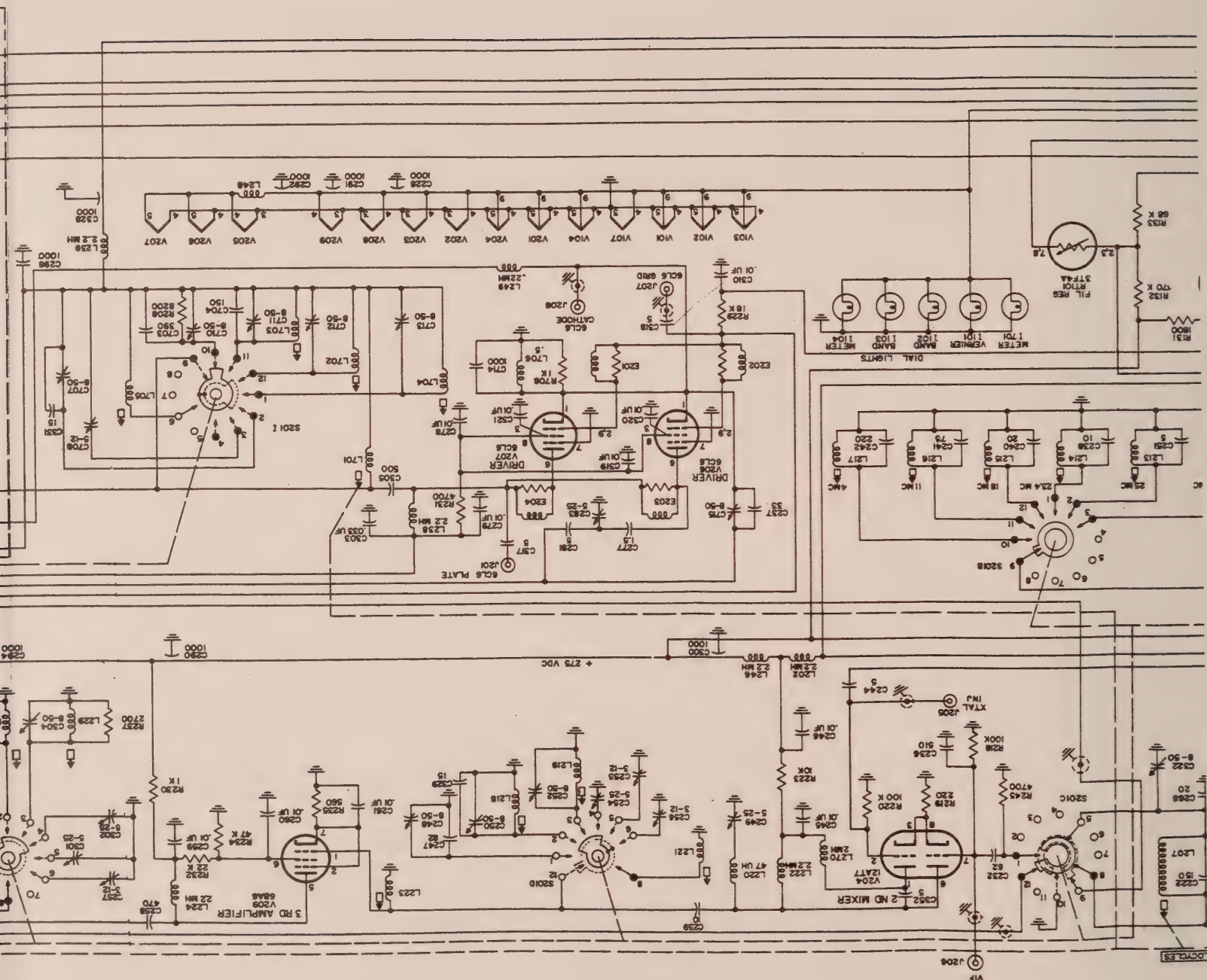


Figure 7-1. Exciter/Power Amplifier, Complete Schematic Diagram









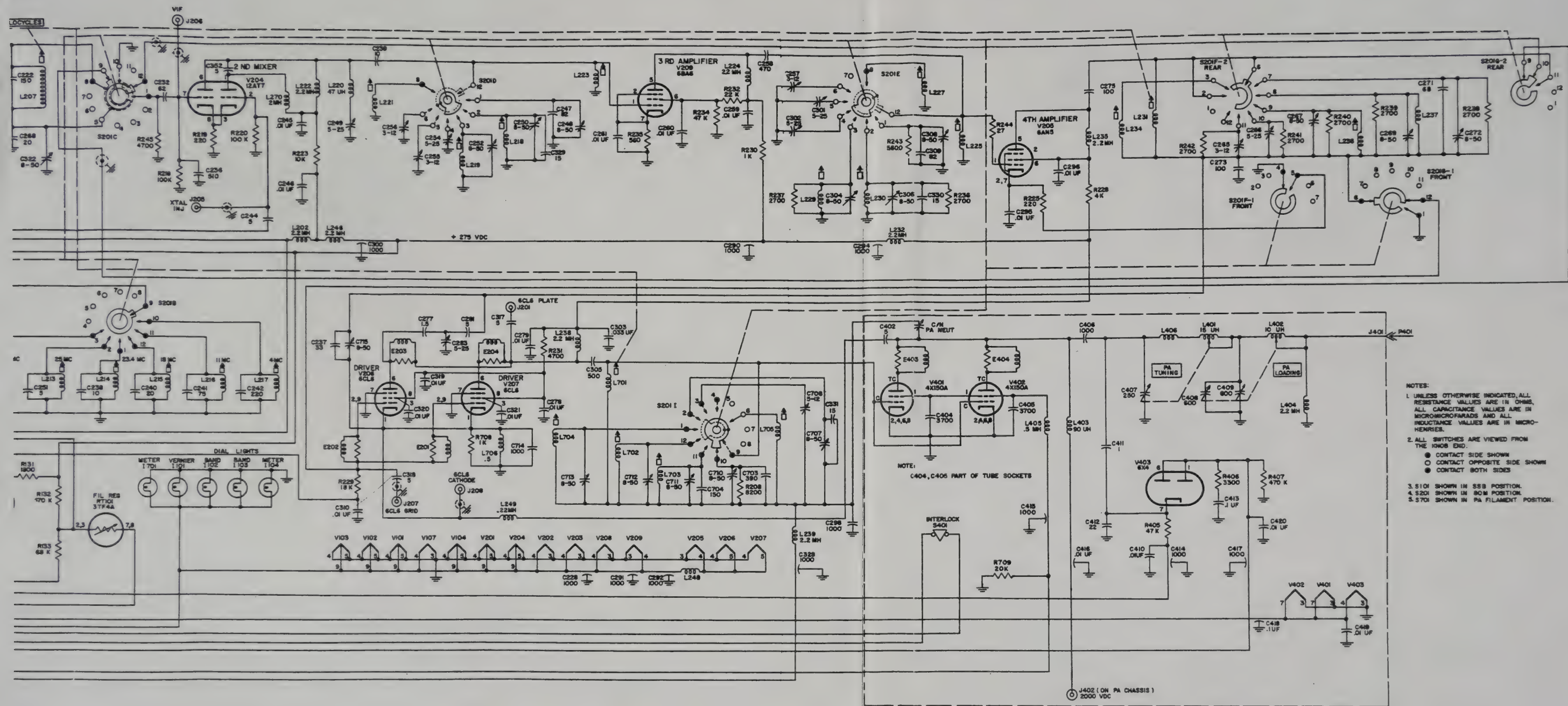
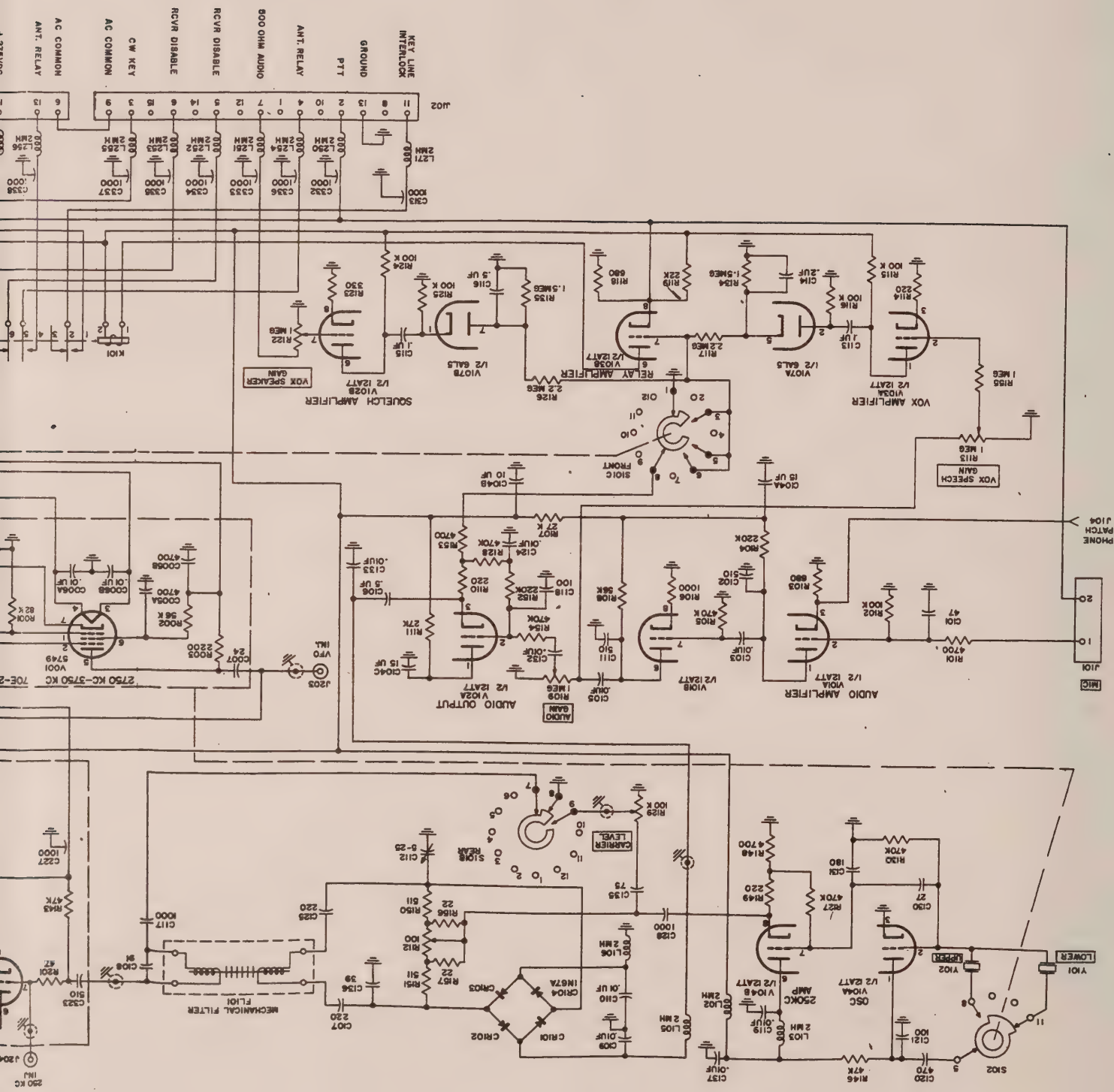


Figure 7-1. Exciter/Power Amplifier, Complete Schematic Diagram



and the carrier level control circuit is open. The cathode circuit of the audio output stage is closed. The K101 relay completes the cw key circuit when VOX or push-to-talk circuits are activated.

4.2.4.4. **SIDEBAND SELECT.** Selects either the upper or lower sideband for transmission by altering the frequency of the low frequency (250 kc) oscillator V104. This control shifts the vfo frame to maintain proper dial calibration.

4.2.4.5. **CARRIER LEVEL.** Adjusts the amount of carrier reinserted for CW, CAL and AM. operations.

4.2.4.6. **MULTIMETER AND PA PLATE CURRENT METER.** The MULTIMETER switch on the exciter front panel selects the various circuits to be measured on the meter in the upper left-hand corner.

The PA plate current meter does not have a control knob associated with its operation, but constantly indicates the value of final stage plate current.

Each position of the MULTIMETER switch, and, the PA plate current meter, is functionally explained below. Table 4-2 gives full scale and typical readings for the MULTIMETER.

a. **PA FIL.** This position of the MULTIMETER switch causes the upper left-hand meter to indicate filament voltage values of the power amplifier final stage. Variations of line voltage will cause the filament voltage to vary, reducing the efficiency of overall operation. Adjustment of this voltage to the correct value (6 volts) should be made after the initial warmup period has expired. The adjustment is accomplished by the PA FILAMENT VOLTAGE control on the power supply front panel.

b. **PA SCREEN.** The MULTIMETER switch in this position gives the operator a reading of the final amplifier screen grid current. It is used during the operation adjustments of the PA LOADING control on the exciter front panel. (See paragraph 5.1.3.2.) When first switched to this position, the screen current indicated will appear rather high, but this value should fall 17 ma when the proper level of PA loading is obtained.

c. **ALC.** This position of the MULTIMETER switch provides a reading in decibels for the amount of Automatic Load Control attenuation being applied to the exciter first and second amplifier stages. The manner in which a decibel reading is obtained is explained in paragraph 4.2.1.5.c.

In this position, the meter may be adjusted to zero reading by operating the PLATE switch on the power supply front panel to the OFF position and adjusting the ALC ZERO control until the meter needle comes to rest at zero. The ALC ZERO control is a screwdriver adjustment inside the top of the exciter cabinet. (See figure 5-1 and paragraph 4.2.4.20.c. below).

The ALC ADJUST control on the exciter front panel is used in conjunction with the operation procedure as explained in paragraph 5.1.3.2., below, in relation to the PA grid current indicated on the meter.

The ALC position of the MULTIMETER switch is also used to monitor the KWS-1 output during actual transmitting operation. This is explained in the operation procedure of paragraph 5.1.3.2. below.

d. **PA GRID.** This position of the MULTIMETER switch is used in the operation procedure explained in paragraph 5.1.3.2. below, relative to the level of PA grid current necessary for proper operation of the KWS-1 Transmitter.

e. **2000 V DC.** This MULTIMETER position is used for measuring the final stage plate supply voltage. The measurement procedure is explained in section V, paragraph 5.1.4.3.b.(8).

f. **PA PLATE CURRENT METER.** The power amplifier final stage plate circuit operates with an idling plate current, which means the plate current meter in the upper right-hand corner of the exciter front panel should register at least 100 milliamperes at all times during transmitter operation. Adjustment of the transmitter to this level of operation should be made after the initial warmup period has expired, and is accomplished as follows:

(1) The final stage idling plate current adjustment should be made with no r-f drive applied, therefore, the CARRIER LEVEL control should be operated to its zero position, TUNE-OPERATE in OPERATE and PA BIAS ADJUST in CCW position.

(2) To attain proper final stage plate current adjustment, the final stage screen grid voltage should be properly adjusted to 350 volts dc. To accomplish this, connect a voltmeter to J103-3 on the exciter rear panel. The voltage adjustment is made with a screwdriver on the potentiometer shaft located between tubes V501 and V502 inside the power supply cabinet. (See paragraph 4.2.4.20, below, and figure 6-12). In order to make this

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adjustment, the power supply cabinet front door panel will have to be removed, breaking the inter-lock connections. Therefore, the adjustment must be made, the door panel returned to position, and the new reading observed on the voltmeter. This procedure should be repeated until a 350-volt dc value is obtained on the voltmeter.

(3) After the PA screen-grid voltage is properly adjusted, operate the PA BIAS ADJUST control on the power supply front panel until the plate current meter on the exciter front panel reads 120 milliamperes.

4.2.4.7. PA TUNING. Tunes final amplifier (V401 and V402) plate circuit (continuous coverage from 80 through 10 meters).

4.2.4.8. PA LOADING. Adjusts amount of loading for final output circuit (continuous coverage from 80 through 10 meters).

4.2.4.9. TUNE-OPERATE. This is the toggle switch in the front panel lower left-hand corner. It lowers the power amplifier (V401 and V402) screen-grid voltage when the control is in the TUNE (down) position. Prevents plate current soar during initial tuning.

TABLE 4-2

TYPICAL METER READINGS

CONTROL POSITION	CIRCUIT METERED	FULL SCALE READING	TYPICAL READING
PA FIL	PA Filament Voltage	10 V, ac	6 Volts
PA SCREEN	PA Screen Current	50 ma, dc	Starts at approximately full scale, and decreases as PA is loaded, reaching about 17 ma when proper loading level is obtained.
ALC (Automatic Load Control)	Decibels of ALC attenuation	18 db	Typical reading depends upon final stage drive, and setting of ALC ADJUST control.
PA GRID	PA Grid Current	10 ma, dc	Typical reading depends upon amount of final stage drive. In AM. and SSB grid current is zero. In CW grid current can be as high as 7 ma.
2000 V DC	Final stage plate supply	5000 V, dc	Approximately 2000 volts, dc.

4.2.4.10. ALC ADJUST. Adjusts the delay bias voltage applied to the ALC rectifier V403.

4.2.4.11. DIAL DRAG. This control applies a braking action to the KILOCYCLES, vernier tuning control to prevent its turning when the SIDEBAND SELECT control is operated. The purpose of the DIAL DRAG is not to completely lock the vernier control dial, and should never be left in a tight adjustment.

4.2.4.12. ZERO SET. Operates the slide-rule pointer on the KILOCYCLES vernier scale during calibration adjustments. Once it has been set,

further adjustments will be unnecessary over long periods of time.

4.2.4.13. VOX SPEECH. Adjusts the gain of the V103A voice operate circuits.

4.2.4.14. VOX SPEAKER. Adjusts the gain of the V102B speaker squelching circuit. This control is a potentiometer located inside the exciter cabinet. It is accessible by raising the top cover, and may be found at the inside top edge of the front panel, toward the right end. (See figures 3-1 and 6-2).

4.2.4.15. PA FIL ADJUST. Adjusts the 6-volt filament supply applied to V401 and V402.

4.2.4.16. PA BIAS VOLTAGE. Adjusts the grid bias voltage applied to V401 and V402. This is utilized for adjustment of final stage plate current to proper idling level. (See paragraph 4.2.4.6.f. above).

4.2.4.17. FILAMENT. Applies supply voltages to all filaments in the KWS-1 Transmitter, the blower, the low voltage power supply, and to the regulated final screen-grid supply circuit. To prevent damaging the power amplifier tubes, the screen grid supply is never applied to the tubes unless the high voltage is ON. When the FILAMENT switch is operated, a green light above the switch goes ON.

4.2.4.18. PLATE. Turns ON high voltage to tubes V401 and V402. In this circuit, there is a time delay of thirty seconds provided by Thermal Relay K501, after the filament circuits have been activated.

4.2.4.19. INTERNAL SCREWDRIVER ADJUSTMENTS.

a. PA SCREEN VOLTAGE. Adjusts amount of voltage applied to the power amplifier stage screen grids to 350 volts. This adjusting facility (R511) is located between the two high voltage rectifiers V501 and V502 in the power supply cabinet. (See figure 6-12 and paragraph 4.2.4.6.f. (2) above).

b. ALC ZERO. This adjustment is inside the exciter cabinet top side, to the left of center. Its purpose is to adjust the multimeter ALC action to zero, and is made only when the FILAMENT switch is ON and final amplifier supply is OFF. The EMISSION switch should be in the CAL position.

4.2.5. EXTERNAL CONNECTIONS.

4.2.5.1. EXCITER/POWER AMPLIFIER CABINET.

a. FRONT PANEL. (See figure 3-1.)

The only external connection to be made on the exciter front panel is to the J101 microphone jack. This jack is located in the lower right-hand corner of the front panel.

b. REAR PANEL. (See figure 2-1.)

There are five external connections to be made on the exciter and power amplifier rear panel.

(1) J102/P102. All signals and control circuits of the Exciter which require external connections are brought out to J102/P102 on the rear panel and fed through the interconnecting cable (W1) to TB504 in the power supply cabinet. (See figure 6-15.) TB504 serves as a terminal board, on which all signal, control or auxiliary circuits external to the KWS-1 Transmitter are connected. Each of these circuits will be discussed in paragraph 4.2.5.2.b. below.

(2) J103/P103. This connection provides an input from the high voltage Power Supply and low voltage Power Supply for all B plus and filament supplies necessary for the operation of the Exciter and Power Amplifier, except the 2000-volt supply to the final amplifier stages. All wiring to J103 is fed through the W1 interconnecting cable from terminal boards TB501 and TB502 in the power supply cabinet.

(3) J104. This receptacle is located on top of the exciter's audio chassis. It is a 600-ohm connection for phone patch. Use a 1 mf capacitor in series if the phone patch does not have dc isolation.

(4) J402/P402. The power amplifier 2000-volt supply is brought directly from the high voltage Power Supply output at E501, and through separate interconnecting cable (W2) to the power amplifier chassis. J402 is mounted on the power amplifier chassis, and protrudes through the exciter rear panel in a shielding "can" located at the lower left-hand corner below the antenna jack J401.

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(5) J401/P401. This connection provides the r-f output for the KWS-1 Transmitter.

(6) BLOWER. The blower for the KWS-1 forced air cooling system is located in the power supply cabinet and is interconnected to the power amplifier chassis through a flexible hose. The connection is made to an elbow on the rear wall of the Power Amplifier, which protrudes through the center of the exciter rear panel wall.

(7) A good, external ground connection may be made to the ground stud adjacent to the terminal strips.

4. 2. 5. 2. HIGH VOLTAGE AND LOW VOLTAGE POWER SUPPLIES.

a. FRONT PANEL. (See figure 3-2.)

There are no front panel connections to be made on this unit.

b. REAR PANEL. (See figure 6-16.)

The "rear panel" referred to is the horizontal plate mounted about one third the distance up from the chassis bottom TB502 and TB501 terminal boards are the inner left and right-hand boards, respectively, on the horizontal plate, looking into the rear of the cabinet. (See figure 6-16.) TB503 is the black colored terminal board (to which either a 230 or 115-volt a-c input connection is made). TB503-42 should be used for the a-c common connection. TB503 is the board mounted to the right of TB503. This is the board used as a "junction" for the exciter control and signal circuits requiring external connections. Figure 2-2 shows the external connections for TB504. They are explained below.

(1) TB504-25. Connections through J102-2 to the exciter V103B relay amplifier cathode, which operates Carrier Control Relay K101. Externally, TB504-25 connects to the high side of the push-to-talk switch.

(2) TB504-26. This lead is fed through J102-3 to switch S101B (front) terminals 7 and 6,

to the grid-block keying network. Externally, this line connects to the high side of the cw key.

(3) TB504-27. Feeds through J102-4 to the normally open contacts 5 and 4 of Carrier Control Relay K101. When these contacts close, the circuit is fed through J103-13 to the low voltage Power Supply TB502-14. This is a rectified 110 volts dc, 22 milliamperes supply for operating a 5000-ohm antenna relay coil mounted externally to the KWS-1 Transmitter. The low side of this circuit is furnished by TB504-32 through TB502-11, J102-9 and J103-6.

(4) TB504-28 and 29. These leads connect through J102-5 and 6 to the normally closed contacts 6 and 7 of the Carrier Control Relay K101. Externally, the leads connect into a receiver's standby circuits.

(5) TB504-30. Provides a 500-ohm audio frequency input through J102-7 to the VOX SPEAKER gain control potentiometer R122, and to the grid of amplifier V102B in the speaker signal squelch circuits. Externally, this lead connects to the high side of the 500-ohm VOX audio source.

(6) TB504-32. This lead feeds to J102-9 in the Exciter and directly out J103-6 to TB502-11 of the low voltage Power Supply a-c common connection. Externally, TB504-32 connects to the low side of the antenna relay.

(7) TB504-33 and 34. Provides a ground connection at J102-13 in the Exciter, and a ground for the externally connected cw key, push-to-talk and VOX circuits.

(8) TB504-35. Provides a ground connection for the key line interlock circuit. (See next paragraph.)

(9) TB504-36. This lead (along with the ground lead above) connects to a set of normally open contacts on the antenna relay. This prevents the carrier from coming on before the antenna is connected to the transmitter output.

SECTION V

MAINTENANCE AND ALIGNMENT

5.1. MAINTENANCE.

5.1.1. GENERAL. This section is written to provide the operator of this equipment with suggestions and procedures for properly maintaining the KWS-1 Transmitter in good operating condition.

Correlative to all electronic equipment, tube failure is the most common cause of trouble.

The maintenance procedures which follow are divided into two categories, electrical and mechanical. Frequent reference should be made to the photograph and diagrams included with the text of this section, and in sections VI and VII.

5.1.2. CLEANLINESS. A common cause of high voltage arcs, consequently of intermittent or permanent equipment failure, is dust and dirt between tuning condenser plates, switch contacts or relay contacts.

For those operators living in a high-humidity locality, or where there is a salt-laden atmosphere, it is possible to experience equipment failure for no apparent reason. Investigation will reveal corrosion of switch and relay contacts or other connections due to the type of climate.

Regardless of the reason, cleanliness in the equipment is essential for reliable operation. Dust may be removed with a small blower or a soft lintless cloth. Contacts may be cleaned with carbon tetrachloride or an equivalent nonabrasive cleaning fluid.

5.1.3. TROUBLE SHOOTING.

5.1.3.1. GENERAL. If the results obtained with the transmitter are in a gradual decline, use the following operational check to evaluate its condition. If a complete failure is experienced go to paragraph 5.1.4., Trouble Shooting Procedure, and follow the procedure there outlined.

5.1.3.2. OPERATIONAL CHECK, CW.

a. Turn FILAMENT switch ON. Blower should start. Be sure blower does start, otherwise the PA tubes may become damaged. Be sure air hose is connected.

b. Adjust PA FILAMENT VOLTAGE to 6 volts. If 6 volts are unobtainable, the a-c supply line may be inadequate or filament transformer T501 may be defective.

c. Set EMISSION switch to CW, CARRIER LEVEL to 0, TUNE-OPERATE to OPERATE, BIAS control to "O", and ALC to counterclockwise.

d. Turn PA PLATE voltage ON. Advance PA BIAS ADJUST control until PA idling current is 100 ma.

e. Turn PA PLATE voltage OFF.

f. Select high 10-meter band with BAND CHANGE switch.

g. Set up on 29 mc with main tuning dial.

h. Place the TUNE-OPERATE switch in the TUNE position.

i. Set the PA TUNING and PA LOADING controls several turns clockwise from the settings given in table 3-1 of section III.

j. Turn PA PLATE voltage ON.

k. Close the telegraph key. Advance the CARRIER LEVEL control until the MULTIMETER in the PA GRID position shows about midscale.

m. Immediately resonate the PA TUNING control for a dip in plate current. If a dip is not obtainable, the PA LOADING may still be too high or a PA tube may be gassy or otherwise defective.

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n. Rotate the PA LOADING control clockwise to increase loading.

o. Load and resonate simultaneously (use both hands) until the PA is loaded to about 150 ma in the TUNE position.

p. During the loading and tuning process the grid current will tend to disappear. This effect is caused by the action of the PA inverse feedback. Keep advancing the CARRIER LEVEL control so that grid current stays at near midscale.

q. Switch the TUNE-OPERATE switch to OPERATE. Again adjust the grid current for midscale.

r. Continue loading to about 400 ma. Note antenna current or power output.

s. Continue loading to 500 ma at resonance while watching both PA plate current and output. However, if output ceases to rise as PA plate current increases, back off PA LOADING control slightly and do not try to load beyond this point. If this point is reached much too soon, check the screen voltage on the PA tubes.

t. The transmitter should now be ready for use on cw.

5.1.3.3. OPERATIONAL CHECK, SSB.

a. Tune up the transmitter exactly as for cw (paragraph 5.1.3.2. above).

b. Set AUDIO GAIN at zero and speaker quieting control (inside exciter unit above PA plate meter) to counterclockwise.

c. Speak into microphone while advancing the VOX SPEECH control. Set the control for a positive action of the carrier control relay. If the vox circuit cannot be made to operate satisfactorily, check the condition of tubes V103 and V107.

d. Advance the AUDIO GAIN until the MULTIMETER in the PA GRID position kicks to about midscale on voice peaks.

e. Advance ALC ADJUST control until PA GRID meter action just ceases. There must be no grid current showing on SSB operation or distortion will be generated.

f. The ALC meter should now show action on voice peaks. About 8 to 10 db ALC action on peaks is normal.

g. Advance speaker quieting control for minimum feedback. If good action cannot be achieved, check V102, V103 and V107.

h. The transmitter should now operate satisfactorily on SSB. Choice of sidebands is available at the SIDEBAND SELECT switch. If there appears to be an objectionable amount of carrier present, the balanced modulator can be checked as in paragraph 5.1.4.3. (10).

5.1.3.4. OPERATIONAL CHECK, AM.

a. Tune the transmitter exactly as for cw (paragraph 5.1.3.2. above).

b. Switch to AM. Turn ALC off.

c. Back off the CARRIER LEVEL control until the output power drops to 1/4 the cw value (1/2 antenna current). This corresponds to a plate current of about 275 ma.

d. Advance the AUDIO GAIN control until the PA GRID current just starts to kick on audio peaks.

e. The transmitter is now ready to use on AM.

5.1.3.5. DIAL CALIBRATION. The following procedure is given to assist with dial calibration.

a. Turn the equipment ON as instructed in the OPERATIONAL CHECK, CW given in paragraph 5.1.3.2.

b. Tune a communications receiver to WWV at 15 mc. The bfo in the receiver should be OFF.

c. Rotate the KWS-1 Exciter BAND CHANGE control to the 20-meter band.

d. Rotate the MAIN TUNING dial to 15.0 mc.

e. Rotate the EMISSION switch to either CAL position.

f. Continue to rotate the MAIN TUNING dial about the 15.0 point until the calibration signal is zero beat with WWV.

g. Adjust the ZERO SET knob until the KILOCYCLES dial fiducial is exactly on 15.0 mc.

5.1.4. TROUBLE SHOOTING PROCEDURE.

With all external connections made, the following checks should be made on the KWS-1 equipment. For mechanical checks listed below, all power should be OFF.

5.1.4.1. TEST EQUIPMENT.

Test equipment for the electrical checks listed below consists of a 1000-ohm-per-volt ohmmeter and a VTVM.

5.1.4.2. MECHANICAL CHECKS.

a. TUNING MECHANISM. Release the DIAL DRAG on the exciter front panel. Rotate the MAIN TUNING dial (KILOCYCLES) and check the following:

(1) SLUG RACK. Raise the cabinet lid and observe the slug rack movement. The rack should move up and down freely when the dial is turned. If there is any tendency to stick or bind, check closely for a bent rack, or for foreign matter in the turning mechanism and travel-path of each tuning slug.

(2) SLIDE RULE DIAL FIDUCIAL. The fiducial should move back and forth freely as the MAIN TUNING (KILOCYCLES) dial is operated. The end limits of the fiducial travel should agree with the mechanical stops on the tuning dial. The stops are located on the tuning shaft adjacent to the backside of the front panel.

(3) GEAR TRAIN. The gear trains of the KILOCYCLES tuning dial and Power Amplifier should operate with no binding or unusual gear tooth noise. Backlash should be mechanically undetectable. The KILOCYCLES tuning dial gear train may be viewed in figure 6-3, and the power amplifier gear train in figure 6-11.

The exciter front panel may be taken off by removal of the BAND CHANGE, KILOCYCLES tuning, SIDEBAND SELECT, PA TUNING and PA LOADING control knobs and six recessed head screws, three on each end of the panel. The

loose panel should be lowered carefully to prevent breakage of the internal wiring interconnections.

If trouble is suspected in the power amplifier gear train, the entire unit should be removed from the exciter cabinet. The power amplifier front cover may then be removed by loosening the PA TUNING and PA LOADING tuning shaft couplers (see figure 6-2) and four recessed head screws on both sides of the front cover. The cover should be removed carefully to prevent disturbance of the gear positions on the gear train. Tip the Power Amplifier back to keep the gears intact as they are manually rotated.

The cause of any gear strain or binding should be determined and eliminated.

b. FRONT PANEL CONTROLS. The following front panel controls should particularly be checked for free movement and proper switch alignment, where applicable.

(1) DIAL DRAG. This knob should have right and left-hand turning limits, and should, in its tight position, hold the KILOCYCLES tuning dial in a secure, immovable position. This knob should never be permitted to remain in its tight position.

(2) ZERO SET. This control will have right and left-hand turning limits, and should move the KILOCYCLES tuning pointer to the left or right for the purpose of zero-setting during calibration procedures. Once the KWS-1 Transmitter is calibrated, the ZERO SET should not require movement until a dial error is noticed.

(3) BAND CHANGE. The BAND CHANGE should move freely to each of its seven positions. If sticking or hesitation of movement is noticed, the exciter bottom plate should be removed to check the movement of all mechanically moving parts associated with the operation of this control.

(4) MULTIMETER SWITCH AND EMISSION SWITCH. These controls should also have free and definite movement through each of their positions. If not, the front panel of the Exciter should be lowered, and the reason for faulty movement determined and eliminated.

(5) SIDEBAND SELECT SWITCH. Operate this control, and, at the same time, raise the top panel to observe the vfo movement to be sure it moves freely and does not rub the chassis at any point. If it does, locate the point of contact and

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perform mechanical adjustments to eliminate the cause.

5.1.4.3. ELECTRICAL CHECKS.

a. FUSES. Remove power line connection.

All fusing circuits are located in the power supply cabinet. (See figure 6-13.) The following checks should be made.

(1) HIGH VOLTAGE PRIMARY. The S504 FILAMENT switch on the power supply front panel should be OFF. Measure the resistance from TB503-41 to the output side of F501. Reference to the power supply schematic in figure 7-2 will be helpful in making this measurement. With the fuse out, there should be an open circuit, and with it in, a short circuit.

Repeat this procedure from TB503-43 to the output side of fuse F502. A fuse replacement table will be found in paragraph 5.2.1.3.

(2) LOW VOLTAGE POWER SUPPLY.

With S504 FILAMENT switch on the power supply front panel ON and the power line disconnected, measure the resistance between TB503-41 and T501-2. An open circuit should be measured when F501 is removed, and a short circuit with it in.

b. SUPPLY CIRCUITS. For these checks, remove high voltage rectifiers V501 and V502, the power amplifier screen grid supply rectifier V503, and the low voltage rectifier V508. These tubes may be found in the power supply cabinet. (See figure 6-13.) Operate the EMISSION switch on the exciter front panel to the STBY position.

(1) BLOWER AND FILAMENT CIRCUITS.

Plug in the external power line cord and operate the FILAMENT switch to the ON position. Make the following observations:

(a) The blower should come on.

WARNING

IF THE BLOWER DOES NOT COME ON WHEN THE FILAMENT SWITCH IS OPERATED, TURN OFF ALL POWER IMMEDIATELY. WITHOUT COOLING, THE 4X150A POWER AMPLIFIER TUBES COULD BE DAMAGED IN VERY SHORT TIME.

If the blower does not come on, and with all power OFF, run a continuity check on the blower circuits, using figure 7-2 as a guide. The blower hose must always be in place if the 4X150A tubes are in their sockets.

(b) Inspect all tubes and dial lights for filament operation. If any tubes do not light, they should be checked for replacement. If the tube checks good, the power should be shut OFF and the filament circuits subjected to continuity checks.

(c) Check the power amplifier filament voltage by operating the MULTIMETER switch to the PA FIL position. Operate the PA FILAMENT VOLTAGE control on the power supply front panel through its positions and observe the readings on the MULTIMETER in the upper left-hand corner of the exciter front panel. This voltage should vary from 5.0 volts to 6.3 volts. If it does not, check out the power amplifier filament circuits. (See figure 7-2.) Adjust the filament voltage for 6.0 volts.

(2) -150 BIAS SUPPLY. The d-c voltage between TB502-19 in the power supply cabinet and ground should measure -150 volts. A faulty measurement here would require a check of the V509 bias rectifier and associated circuitry.

(3) PA BIAS. Remove the exciter cabinet bottom cover and check the d-c voltage from condenser C328 (see figure 6-7) to ground. This measurement should vary from -53 volts to -125 volts when the PA BIAS ADJUST control on the power supply front panel is varied through its entire range. Maximum voltage should be obtained when this control is in its farthest counterclockwise position. Adjust to -62 volts. A failure to obtain correct readings here would indicate faulty circuit wiring or trouble involving R513, R514 and R515.

(4) DRIVER BIAS. Operate the EMISSION switch on the exciter front panel to the CW position. Remove the bottom cover from the exciter cabinet and measure the voltage on V206 pin two. This measurement to ground should be -30 volts dc with the cw key up, and -4 volts with the key down. If not, check the keying network mounted between the gear plate and front panel beneath the PA plate current meter, M701.

(5) V201 FIRST MIXER KEYING. The voltage from V201 pin 7 to ground should measure -26 volts with the cw key up and -.04 volts with the key down. If it does not, check the keying network mentioned in the preceding paragraph (4).

(6) LOW VOLTAGE SUPPLY. Return tube V508 to its socket, and measure the voltage from TB502-18 to ground. If this measurement is not 275 volts positive, either the tube is bad or there is component trouble in this circuit. If so, check T506, L502, L504, C509 or R531.

(7) REGULATED SCREEN SUPPLY. Return V503 to its socket and measure the voltage from TB501 to ground. By varying the PA SCREEN ADJUST control with a screwdriver inside the power supply cabinet (see figure 6-13) set this voltage to plus 350 volts dc. PA screen-grid voltage adjustments are made with a screwdriver on the R511 potentiometer located between V501 and V502 in the power supply cabinet. (See figure 6-12, and paragraph 4.2.4.6f.(2).) If it is impossible to make the 350-volt adjustment, check V503 and associated circuitry.

(8) HIGH VOLTAGE SUPPLY. To make this check, perform the following steps:

- (a) Return V501 and V502 to their sockets.
- (b) Replace the rear door to the power supply cabinet and see that the exciter lid is down.
- (c) Operate the PA BIAS ADJUST control on the front panel to a completely counter-clockwise position.
- (d) Operate the MULTIMETER switch on the exciter front panel to the 2000 V dc position.
- (e) Operate the EMISSION switch to the CW position. Key must be open.
- (f) Operate the PLATE toggle switch on the power supply front panel to the ON position. The red light above the switch should go ON.

(g) The high voltage reading on the multimeter should read approximately 2000 volts.

(9) NEUTRALIZATION CHECK. The following procedure will show whether or not the KWS-1 r-f circuits are properly neutralized.

- (a) Operate the EMISSION switch on the exciter front panel to the AM. position.
 - (b) Operate the MULTIMETER switch to PA GRID.
 - (c) Operate the CARRIER LEVEL control until grid current begins to show on the meter.
 - (d) Operate the PA TUNING control through resonance, and observe the meter reaction. If the circuits are neutralized properly, the grid current will dip exactly on resonance, and will rise symmetrically on either side of resonance.
- (10) BALANCED MODULATOR CHECK. The following procedure will determine if the ring modulator is in balance.

- (a) Operate the EMISSION switch to SSB.
- (b) A receiver antenna connection should be made to J201 into the 6CL6 driver plate circuit.
- (c) The carrier will be heard if the modulator is not in balance. Adjust R112, and C112 (see figure 5-1) for minimum sound of the carrier.

(11) COLLINS MODEL 35C-2 LOW-PASS FILTER. It is not likely the Collins KWS-1 Transmitter will require precautionary adjustments because of TVI. However, if this problem does arise, for some reason unique to a particular installation area, the 35C-2 Low-Pass Filter may be installed in the KWS-1 antenna lead. In rare cases of extreme difficulty, a high-pass filter may be installed in the TV receiver antenna lead in.

5.2. ELECTRICAL MAINTENANCE.

5.2.1. TEST CONDITIONS.

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Paragraphs 5.2.1.1. - 5.2.1.4.

5.2.1.1. TEST EQUIPMENT REQUIRED. The following test equipment is required to perform the specified procedure.

EQUIPMENT	SPECIFICATIONS
a. Signal Generator	Output to 30 mc.
b. Voltmeter	Hewlett-Packard 400 C or equivalent. (Must have r-f probe).
c. Accurately Calibrated Receiver	75A-4 (or equivalent with "S" meter and Crystal Calibrator).
d. 1 kw, 50 ohm, resistive load	
e. Microphone with locking PTT switch	

5.2.1.2. POWER REQUIREMENTS.

at 60 cps, or a 230-volt a-c supply at 60 cps. The transmitter must be externally and internally connected to satisfy the power source.

For proper maintenance checks, the KWS-1 Transmitter must have either a 115-volt a-c supply

5.2.1.3. FUSES.

TABLE 5-1
FUSE TABLE

SYMBOL	LOCATION	RATING	TYPE
F501	HV PRI.	20 Amp.	Cartridge - 3AG
F502	HV PRI. and Screen (230-V)	10 Amp.	Cartridge - 3AG
F503	Filament and blower	3 Amp.	Cartridge - 3AG
F504	Filament and LV Supply	3 Amp.	Cartridge - 3AG
F505	Screen Voltage Output	1/4 Amp.	Cartridge - 3AG
F506	HV Supply Output	1 Amp.	Cartridge - High Voltage

5.2.1.4. TEST POINTS.

Table 5-2 below lists the typical voltage values for the KWS-1 test point jacks.

TABLE 5-2
TEST JACKS
(Refer to figure 5-1)

TEST JACK	VOLTAGE VALUE (RF VOLTS)
J 201	40-50 (with PA on)
J 203	1.5
J 204	0.1 (for full output)
J 205	1.5 (on bands 40 thru 10m)
J 206	0.1 (for full output)
J 207	8-10 (with PA on)
J 208	5-6 (with PA on)

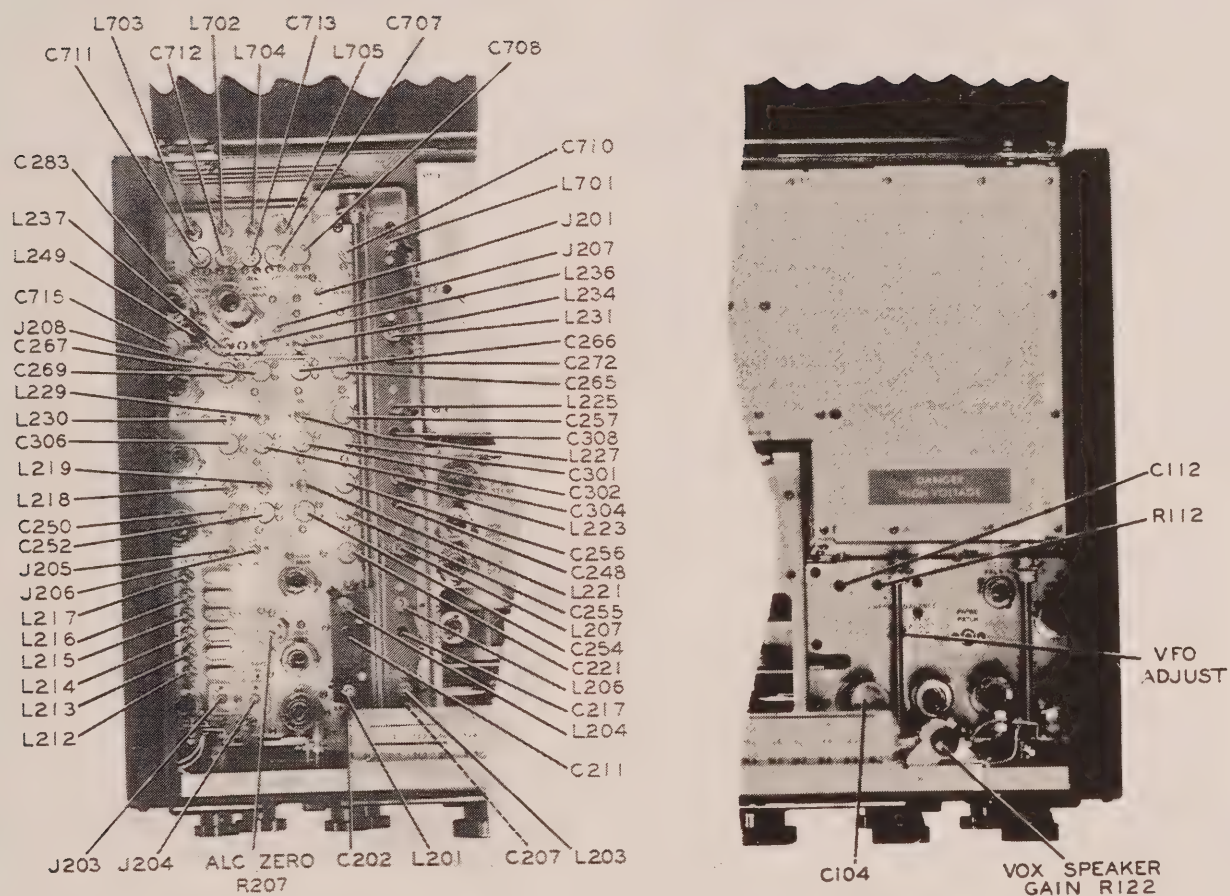


Figure 5-1. Exciter Test Jacks and Points of Tuned Circuit Adjustments

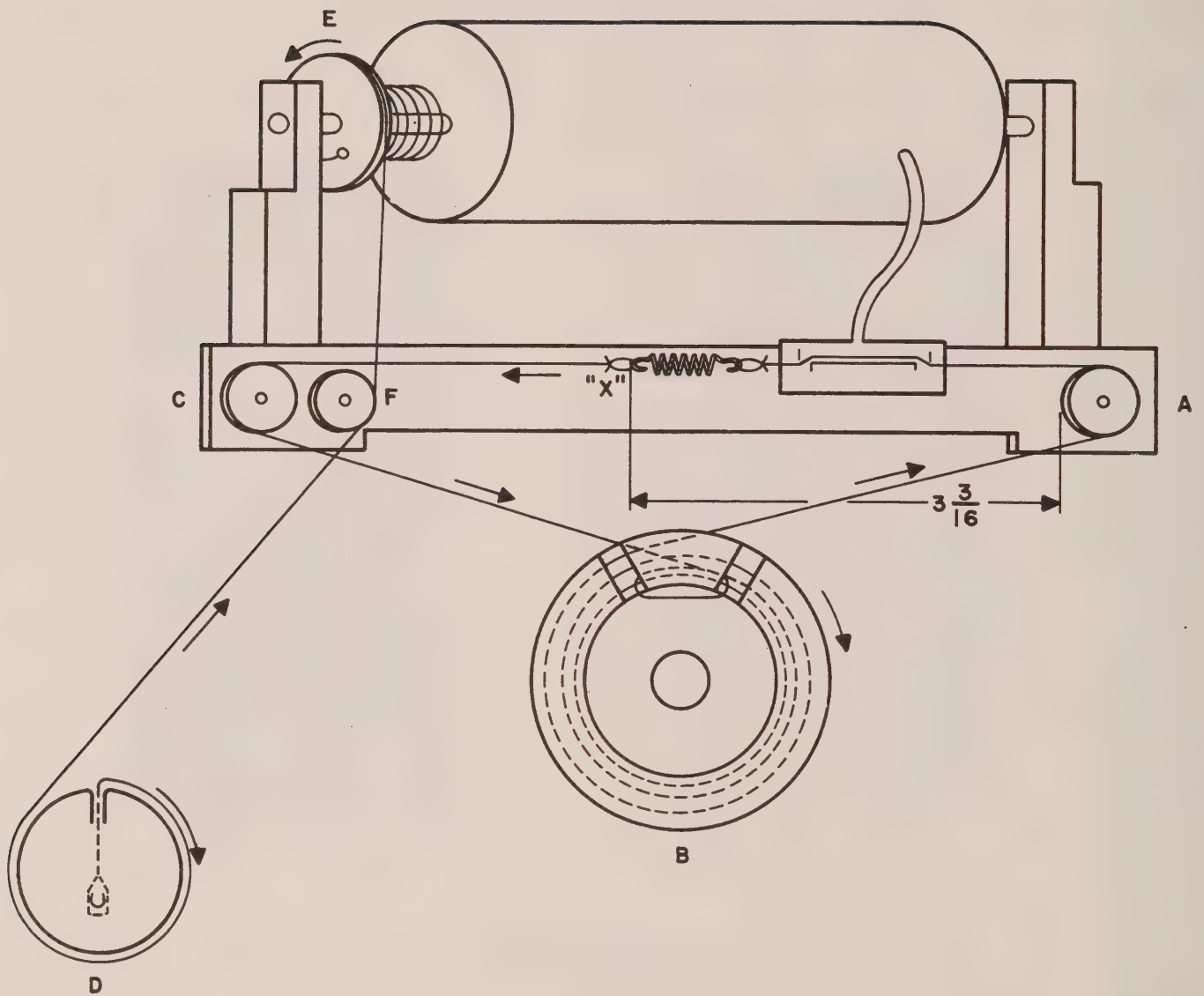


Figure 5-2. Dial Cord Replacement

5.2.2. EXCITER AND POWER AMPLIFIER.

5.2.2.1. TUBE REPLACEMENT.

a. GENERAL. All tubes are removed by pulling straight up after first removing their shields, if they are so equipped. Special instructions apply to the 4X150A tubes. (See next paragraph.) Should the tube pins become bent, be sure they are straightened to perfect alignment before attempting to insert them into their sockets. Use a special tube pin straightener available for such purposes.

b. PA TUBES. The top cover of the power amplifier enclosure must be removed to get at the PA tubes (as well as the ALC rectifier V403). Once the cover is off, check by means of a shorting tool to see that there is no charge in the hv filter capacitors.

WARNING

WHENEVER ANY ADJUSTMENTS INVOLVING THE HIGH VOLTAGE OR POWER AMPLIFIER CIRCUITS ARE CONTEMPLATED, DISCONNECT THE TRANS-MITTER FROM THE POWER LINES AND SEE THAT ALL FILTER CAPACITORS ARE DISCHARGED.

Grasp the plate connector of the tube to be removed and pull straight up. (The plate connector consists of a large ring with metal fingers running radially in from the ring to provide a pressure fit to the tube plate and a connecting pin which snaps into an adjacent clip.)

Once the plate connector has been removed, the tube can be pulled from its socket.

When replacing the tube connector assembly, see that it is on straight and down as far on the tube as it will go.

When replacing the compartment cover, be sure that the cover screws are pulled fully down so that the interlock (S401) operates.

5.2.3. ALIGNMENT OF KWS-1. The following alignment procedure assumes that the KWS-1 is completely out of alignment. Use all of it or any part of it that is necessary to accomplish the desired results.

5.2.3.1. VFO ALIGNMENT.

NOTE

This assumes a vfo in good adjustment. If the vfo is out of frequency adjustment, refer to paragraph 5.2.3.9.

a. Remove V104 from its socket.

b. Connect the antenna of a communications receiver to J203. (See figure 5-1.)

c. Set the KILOCYCLES tuning to 3.5 mc and the BAND CHANGE to 80.

d. Place the EMISSION switch in the CAL position and turn up the CARRIER LEVEL control to half scale and turn the FILAMENT switch ON.

e. Set the receiver dial to 3250 kc (must be very accurately calibrated - use an external calibrator if necessary).

f. Turn the receiver bfo on and set it to center of i-f passband.

g. Loosen the coupler of the vfo shaft and rotate the shaft until zero beat is obtained in the receiver.

h. Replace V104 in its socket.

i. Calibrate and tune the receiver to 3.5 mc.

j. Leave the KWS-1 KILOCYCLES dial at 3.5 mc and the receiver at 3.5 mc.

k. Manually rotate the vfo shaft until zero beat is obtained.

m. Tighten the coupler.

5.2.3.2. SIDEBAND SELECT ADJUSTMENT.

a. With the KILOCYCLES dial accurately set on 3.5 mc, set up the DIAL DRAG.

b. Set SIDEBAND SELECT at LOWER.

c. Connect the communications receiver antenna input to J203.

d. Set the EMISSION switch to CAL and CARRIER LEVEL to half scale.

e. Tune the receiver for zero beat with the bfo on.

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f. Operate the SIDEBAND SELECT switch to "UPPER".

g. Adjust the mechanical limit of the SIDEBAND SELECT switch (available through the top of the audio chassis) for zero beat.

h. Operate the SIDEBAND SELECT switch back and forth a few times to make sure that the zero beat stays.

5.2.3.3. CRYSTAL OSCILLATOR ADJUSTMENT.

a. Connect an r-f voltmeter (vacuum tube voltmeter) from J205 to ground. (Transmitter remains in CAL operation.)

b. Select bands 40 thru 10 and adjust associated crystal oscillator tuning slug for maximum. (See table below.) A value of about 1.5 volts should be obtained on each band. The 10 and 11-meter bands will run slightly lower because the oscillator is used as a doubler on these bands.

BAND	40	20	15	11	10 LO	10 HI
COIL	L217	L216	L215	L214	L213	L212

5.2.3.4. TRAP ADJUSTMENTS.

a. FIRST MIXER PLATE TRAP.

(1) Connect the communications receiver antenna input to J207.

(2) Set the BAND CHANGE switch to "80".

(3) Set the KILOCYCLES dial to 3.5 mc.

(4) Set EMISSION to CAL.

(5) Turn CARRIER LEVEL control fully counterclockwise.

(6) Tune the communications receiver until the transmitter VFO is heard near 3.25 mc.

(7) Adjust C229 for minimum signal at the receiver. (Use "S" meter and bfo off.)

b. 8 MC TRAP.

(1) Connect communications receiver as in 5.2.3.4. above.

(2) Set the KWS-1 BAND CHANGE switch to "40".

(3) Set the KILOCYCLES dial to 7.3 mc.

(4) Tune the communications receiver until the second harmonic of Y206 (8 mc) is heard.

(5) Adjust C249 for minimum signal at the receiver.

5.2.3.5. EXCITER TRACKING.

a. 80-METER TRACKING.

(1) Place the EMISSION switch in the CAL position.

(2) Use the CARRIER LEVEL control to adjust drive.

(3) Connect the communications receiver antenna to J207. BFO OFF.

(4) Short out L701 with a short jumper (put jumper across coil - not to ground), (see NOTE** below).

(5) Set BAND CHANGE switch to "80" position.

(6) Set the KILOCYCLES dial at 3.1 mc and adjust L201, L203, L204, L206 and L207 for maximum indication on the receiver "S" meter (receiver tuned to 3.1 mc).

(7) Tune transmitter and receiver to 3.9 mc and adjust C202, C207, C211, C217 and C221 for maximum indication on receiver "S" meter.

NOTE

It may be necessary to reduce gain in receiver as alignment proceeds to keep the "S" meter in range. Do this by loosening the coupling to the receiver.

(8) Repeat steps (6) and (7) until tracking is accomplished.

b. 40-METER TRACKING.

(1) Repeat steps (1), (2), (3) and (4) of paragraph 5.2.3.5.a. above (80-meter tracking).

(2) Set the BAND CHANGE switch to "40" position.

(3) Set the transmitter and receiver

tuning dial to 7.1 mc and adjust L223, L225 and L231 for maximum "S" meter readings.

(4) Set the transmitter and receiver dials to 14.3 mc and adjust C250, C306 and C269 for maximum "S" meter readings.

(5) Repeat steps (3) and (4) until tracking is accomplished.

c. 20-METER TRACKING.

(1) Repeat steps (1), (2), (3) and (4) of paragraph 5.2.3.5.a. above.

(2) Set the BAND CHANGE switch to the 20 position.

(3) Set the transmitter and receiver dials to the 14-mc bands and adjust L218, L230 and L237 for maximum "S" meter readings.

(4) Set the receiver and transmitter dials to 14.3 mc and adjust C250, C306 and C269 for maximum "S" meter readings.

(5) Repeat steps (3) and (4) until tracking is accomplished.

d. 15-METER TRACKING.

(1) Repeat steps (1), (2), (3) and (4) of paragraph 5.2.3.5.a. above.

(2) Set the BAND CHANGE switch to the "15" position.

(3) Set the transmitter and receiver tuning dials to 21.0 mc and adjust L221, L227 and L234 for maximum "S" meter reading.

(4) Set the transmitter and receiver tuning dials to 21.4 mc and adjust C252, C304 and C267 for maximum "S" meter indication.

(5) Repeat steps (3) and (4) until tracking is accomplished.

e. LOW 10-METER TRACKING (See NOTE* below.)

(1) Repeat steps (1), (2), (3) and (4) of paragraph 5.2.3.5.a. above.

(2) Set the BAND CHANGE switch to the "10" low position.

(3) Set the transmitter and receiver tuning dials to 28.1 mc and adjust L221, L227 and L234 for maximum "S" meter indication.

(4) Set the transmitter and receiver tuning dials to 28.9 mcs and adjust C255, C301 and C265 for maximum "S" meter readings.

(5) Repeat steps (3) and (4) until tracking is accomplished.

f. 11-METER TRACKING. (See NOTE* below.)

(1) Repeat steps (1), (2), (3) and (4) of paragraph 5.2.3.5.a. above.

(2) Set the BAND CHANGE switch to the "11" position.

(3) Set the transmitter and receiver tuning dials to 27.1 mc and adjust C254, C302 and C266 for maximum "S" meter indications.

g. HIGH 10-METER TRACKING. (See NOTE* below.)

(1) Repeat steps (1), (2), (3) and (4) of paragraph 5.2.3.5.a. above.

(2) Set the BAND CHANGE switch to the "10" high position.

(3) Set the transmitter and receiver tuning to 29.4 mc and adjust C256 and C257 for maximum "S" meter indication.

***NOTE**

The 10 low, 11 and 10 high bands must be aligned in the order given above.

****NOTE**

The driver stage must be neutralized before tracking of the plate circuit is attempted or the stage will probably oscillate. The tracking procedure will be resumed at paragraph 5.2.3.7. below. If oscillation persists, check to see that screws in shields are tight and check bypass condensers for broken leads.

5.2.3.6. NEUTRALIZING.

a. GENERAL. If the shorting wire is still across L701 from the tracking procedure above, remove the wire. The driver (6CL6) grid-plate

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neutralizing, and the PA grid-plate neutralizing are done with all filaments energized, the driver plate on but the PA plate voltage off. The driver (6CL6) grid-cathode neutralizing is done with all filaments excited and the driver and PA plate voltage on.

b. DRIVER (6CL6) GRID-PLATE NEUTRALIZATION.

(1) Set the EMISSION to CAL and BAND CHANGE to 15M.

(2) Couple a receiver lightly to 6CL6 GRID test point, J207, and adjust CARRIER LEVEL for about midscale "S" meter reading.

(3) Swing 6CL6 plate tuning capacitor C713 thru resonance and note reaction on "S" meter.

(4) Adjust neutralization capacitor C283 for minimum meter reaction as the plate is tuned thru resonance.

c. PA GRID-PLATE NEUTRALIZATION.

(1) Set EMISSION to CAL and BAND CHANGE to 15M.

(2) Couple a receiver to antenna output jack, J401.

(3) With PA plate off, adjust CARRIER LEVEL until a signal is heard in receiver.

(4) Tune the PA TUNING and PA LOADING controls until the signal is strongest (see tuning chart in section III for approximate settings).

(5) Reduce the CARRIER LEVEL to 1/2 scale on receiver "S" meter.

(6) Loosen screws on PA neutralizing capacitor and slide it in slot until the signal is minimum.

(7) Tighten the neutralizing capacitor screws.

d. DRIVER (6CL6) GRID-CATHODE NEUTRALIZATION.

(1) Couple the PA into a dummy load and load the transmitter to 1 kw input on 15 meters.

(2) Lightly couple a receiver to the 6CL6 GRID test point, J207, and reduce the CARRIER LEVEL to about midscale on the receiver "S" meter.

(3) Rock the PA TUNING control C407 and note reaction on "S" meter.

(4) Adjust cathode neutralizing capacitor, C715, for minimum receiver "S" meter reaction as PA is tuned through resonance.

e. 80-METER NEUTRALIZATION.

(1) Set EMISSION to CAL and BAND CHANGE to 80M (at 3.5 mc).

(2) Lightly couple a receiver into the 6CL6 GRID test point, J207.

(3) Set CARRIER LEVEL for about 1/2 scale on "S" meter (PA PLATE OFF).

(4) Swing the 80-meter 6CL6 plate tuning capacitor, C710, through resonance and note reaction on "S" meter.

(5) Adjust C322, 80-meter neutralizing capacitor, for minimum reaction as the plate is tuned through resonance.

5. 2. 3. 7. DRIVER (V206/V207) TRACKING.

NOTE

The preceding exciter stages should be tracked and all neutralizing procedures completed before the driver plates are tracked, otherwise some instability may be experienced.

a. Connect VTVM set up to read r-f volts to J201.

b. Set EMISSION switch in CAL position.

c. Adjust CARRIER LEVEL for one-fourth scale indication on VTVM.

d. Adjust the following trimmers at the frequencies indicated with the BAND CHANGE switch set at the bands indicated. Adjust for maximum indication on VTVM.

TABLE 5-3

DRIVER PLATE ALIGNMENT

BAND CHANGE (BAND)	COIL	FREQ. (MC)	CAPACITOR	FREQ.
80	L701	3.10	C710	3.90
40	L703	7.0	C711	7.3
20	L702	14.0	C712	14.3
15	L704	21.0	C713	21.4
*Low 10	L705	28.1	C708	28.9
* 11			C707	27.1
*High 10			--	29.4

*NOTE: The low 10, 11 and high 10-meter bands must be aligned in this order.

5.2.3.8. BALANCED MODULATOR ADJUSTMENT.

- Set the EMISSION selector switch to SSB.
- Connect the communications receiver to J201.
- Set the BAND CHANGE switch to 80.
- Set the KILOCYCLES dial to 3500 kc.
- Set SIDEBAND SELECT to LOWER.
- Tune the receiver until the carrier is heard, bfo off, and carrier showing on "S" meter.
- Adjust R112 and C112 for minimum indication on "S" meter.
- Repeat step g.

5.2.3.9. VFO ALIGNMENT.

a. GENERAL. The vfo is calibrated and sealed at the factory and should require adjustment only at widely separated intervals. If the calibration error becomes excessive for operation or beyond the point where the vernier dial corrector (ZERO SET control) cannot correct, the following procedure should be followed to make correcting adjustments.

b. TEST EQUIPMENT REQUIRED.

- Precision frequency measuring gear capable of measuring 2750 kc and 3750 kc (or harmonics thereof) or:
- A precisely calibrated receiver capable of receiving 2750 kc and 3750 kc (or harmonics thereof) or:
- A Collins 75A-2, 3 or 4 calibrated at 27.5 mc (11-meter band) and at 30 mc (10-meter band).

c. PROCEDURE.

- Connect the frequency measuring device to J203. Use loose coupling if listening to the fundamental or low harmonic of the oscillator.
- Turn the transmitter to CAL emission and turn on the frequency measuring equipment and allow them to warm up for about 1 hour.
- Very carefully calibrate the frequency measuring equipment using WWV as a frequency standard. (If 75A's are used, adjust calibration oscillator against WWV then calibrate KILOCYCLES dial and bfo.)
- Select LOWER sideband with SIDEBAND SELECT control.
- Set BAND CHANGE control to 80.
- Turn KILOCYCLES dial to 3.0 mc (2750 kc vfo frequency). Tune for zero beat in frequency measuring equipment.

NOTE

If 75A is used, the 10th harmonic (27.5 mc) of 2750 kc should be used here and the 8th harmonic (30 mc) used at the 3750 kc point. (3 and 4 respectively on the transmitter KILOCYCLES dial.)

(7) Set the ZERO SET (fiducial) to 0 on KILOCYCLES dial (3000 kc). Note the dial reading if the fiducial cannot go to 0.

(8) Rotate the KILOCYCLES dial to 4.0 mc (3750 kc vfo frequency) and tune to exact zero beat on frequency measuring equipment (30.0 mc on 75A receivers).

NOTE

If the harmonic at 30 mc is used, it would be well to check on the 80-meter band at 3750 kc to see that a signal is actually there. This prevents the possibility of using the wrong harmonic.

Do not readjust ZERO SET control. The calibration error is then the number of dial divisions more or less than the 10 turns it should take to cover the range between the two test frequencies. Usually, the error tends to be toward more rotation of the KILOCYCLES dial than the 10 turns that should be required. To correct the error, proceed as follows:

(9) Rotate the KILOCYCLES dial towards and through dial zero (4000 kc) until a total of 2 times the dial division error has been counted.

(10) Engage the trimmer adjusting stud with a strong thin wire (such as a straightened-out paper clip) and turn until zero beat in the frequency measuring equipment is restored.

(11) The ZERO SET (fiducial) can now be adjusted until it is set at dial zero (4000 kc).

(12) This completes the procedure in most cases. To check, retune the KILOCYCLES dial and frequency measuring equipment to the 2750 kc end of the range and check the dial division error. If the adjustments have been done carefully, less than 1/2 division error will be found. The above procedure can be repeated until satisfactory results are obtained. This endpoint adjustment restores factory accuracy to the intermediate points, also.

(13) In most cases, the dial reading will again be centered in the window. If this is not so and it is desired to center the dial reading, set the KILOCYCLES dial to zero beat at 3 mc and carefully loosen the setscrews in the mechanical stop side of the flexible coupler and turn the dial so that 3 mc is straight up. Tighten the setscrews.

5.3. MECHANICAL MAINTENANCE.

5.3.1. DIAL CORD REPLACEMENT.

a. GENERAL. Two dial cords are used in this equipment, - one for the MEGACYCLES dial drum and one for the MEGACYCLES dial pointer. Refer to figure 5-2. In either case the front panel must be removed to gain access to the dial cords.

b. FRONT PANEL REMOVAL.

(1) Remove the following knobs: BAND CHANGE, KILOCYCLES tuning, PA TUNING, PA LOADING and SIDEBAND SELECT.

(2) Remove six panel screws (three on each side).

(3) Pull the panel forward and off the extended control shafts. Allow it to tip forward - being careful to prevent breakage of connecting wires.

c. POINTER CORD. (See figures 5-2 and 6-3.)

(1) Obtain a type 432 1018 00 Collins dial cord. This cord is cut to correct length and has securing loops already tied in the ends (as does the drum cord).

(2) Scribe a mark on the KILOCYCLES tuning shaft and the dial hub to mark their relative positions and remove the KILOCYCLES dial.

(3) See figure 5-2. Turn the KILOCYCLES tuning shaft to the clockwise stop.

(4) Start at point X in the drawing with the cord hooked to one end of the spring (Collins Part Number of this spring is 503 1240 001).

(5) Bring cord around pulley C to pulley B.

(6) Wrap around pulley B clockwise, through the deep slot, around the tab, and back through the shallow slot. Wrap around pulley B two times clockwise.

(7) Wrap cord around pulley A and loop the end on the free end of the spring.

(8) Fasten the pointer to the cord.

(9) Replace the KILOCYCLES dial and match the scribe marks (added in step (2)) and tighten the setscrews.

(10) Back the KILOCYCLES dial to where O is straight up.

(11) Slide the pointer to the first major mark at the right-hand edge of the drum.

(12) Check by turning the KILOCYCLES dial shaft through its entire range.

(13) Replace panel - be sure KILOCYCLES dial plate is in the correct position on its shaft so that there is no binding and so that the DIAL DRAG works correctly.

(14) Replace the knobs.

d. DRUM CORD. (See figures 5-2 and 6-3.)

(1) Obtain a Collins Type 532 1020 00 dial cord.

(2) Turn the BAND CHANGE to the 3-4 mc band (80 meter).

(3) Turn pulley E approximately one turn and hold tension spring taut. (The front

panel must have been removed as in paragraph b. above.)

(4) Make approximately 3/4 turn around pulley D and hook cord to tab.

(5) Extend the cord around the inside of the idler pulley F and go around pulley E to the tab and hook the cord to it. Release the tension spring.

(6) Replace the panel and knobs.

(7) Loosen the setscrew in the drum hub opposite the coil tension spring and align the drum calibration to the 80-meter band then tighten the setscrew.

TABLE 5-4

TUBE PIN VOLTAGE TO GROUND

Readings taken with VTVM
Set in CALIBRATE - No Carrier - 40 Meter Band

PIN TUBE	1	2	3	4	5	6	7	8	9
V001	-3.2	0	+36	+36	+200	+88	0	-	-
V101	+41	0	+0.6	0	0	+125	0	+1.7	6.3 AC
V102	+165	+16.5	+23	0	0	+75	0	+.75	6.3 AC
V103	+90	-0.12	+0.8	0	0	+285	0	+9.3	6.3 AC
V104	+120	-13	0	0	0	+285	+11	+50	6.3 AC
V105	+108	0	IC	0	+108	IC	0	-	-
V106	+215	+108	IC	+108	+215	IC	+108	-	-
V107	0	0	0	6.3 AC	+.53	NC	-.6	-	-
RT101	NC	+36	+36	NC	NC	NC	+36	+36	NC
V201	+200	-0.1	+2.1	0	0	+200	-0.4	+2.1	6.3 AC
V202	0.01	2.8 - 3.3	0	6.3 AC	+270	+130	2.8 - 3.3	-	-
V203	0	+3.1	0	6.3 AC	+280	+140	+3.1	-	-
V204	+185	0	+2.15	0	0	+185	0	+2.15	6.3 AC
V205	0	+7.8	0	6.3 AC	+140	+140	+7.8	-	-
V206	+1.6	-3.8	+215	0	6.3 AC	+285	0	+215	-3.8
V207	+1.6	-3.8	+215	0	6.3 AC	+285	0	+215	-3.8
V208	-1.3	0	0	6.3 AC	+280	+47	0	-	-
V209	0	+5	0	6.3 AC	+280	+160	+5	-	-

TABLE 5-5

TUBE PIN RESISTANCES TO GROUND

Readings taken with VTVM
Set in CALIBRATE - No Carrier - 40 Meter Band

PIN TUBE	1	2	3	4	5	6	7	8	9
V001	82K	0	60K	60K	12.6K	62K	0.1 Ω	-	-
V101	240K	100K	680	0	0	85K	470K	1000	.05 Ω
V102	37K	720K	4500	0	0	115K	0-880K	330	.05 Ω
V103	100K	1M	330	0	0	23K	0	680	.05
V104	52K	470K	0	0	0	9K	500K	4900	.05
V105	∞	0	IC	0	∞	IC	0	-	-
V106	11K	∞	IC	∞	11K	IC	∞	-	-
V107	100K	100K	0	.05	860K	NC	860K	-	-
RT101	NC	58K	58K	NC	NC	NC	58K	58K	NC
V201	18.2K	100K	220	0	0	18.2K	60K	220	.05
V202	920K	220-320	0	.05	10K	19K	220-320	-	-
V203	930K	220	0	.05	9.8K	19.8K	220	-	-
V204	19K	100K	220	0	0	19K	100K	220	.05
V205	27	220	0	.05	13K	13K	220	-	-
V206	7.5	22K	13.5K	0	.05	9K	0	13.5K	22K
V207	7.5	22K	13.5K	0	.05	9K	0	13.5K	22K
V208	100K	0	0	.05	13.5K	480K	7.5	-	-
V209	0.3	390	0	.05	9.6K	19.5K	390	-	-

SECTION VI PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C-101	RF filter for audio input	CAPACITOR: mica; 47 mmf p/m 10%; 500 wv	912 0471 00
C-102	V101A plate equalizer	CAPACITOR: mica; 510 mmf p/m 10%; 300 wv	912 0546 00
C-103	V101B grid coupling	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-104		CAPACITOR: electrolytic; 3 sect; 15, 15 and 10 mf minus 10% plus 50%; 450 v	183 1091 00
C-104A	V101A plate decoupling	p/o C-104	
C-104B	B plus bypass	p/o C-104	
C-104C	V102A plate bypass	p/o C-104	
C-105	V103A grid coupling	CAPACITOR: ceramic; 10,000 mmf 500 wv	913 1188 00
C-106	V102A cathode output	CAPACITOR: paper; 0.5 mmf minus 10% plus 20%; 200 wv	931 0189 00 0205
C-107	Mechanical filter input tuning	CAPACITOR: mica; 220 mmf p/m 2%; 500 wv	912 0517 00
C-108	Mechanical filter output tuning	CAPACITOR, fixed: mica; 91 mmf p/m 2%; 500 dc working v	912 0490 00
C-109	Modulator divider	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-110	Modulator divider	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-111	V101B plate equalizer	CAPACITOR: mica; 510 mmf p/m 10%; 300 wv	912 0546 00
C-112	Carrier balance	CAPACITOR, variable: ceramic; 5.0 to 37.5 mmf; 350 dc working v	917 1073 00
C-113	V107A plate coupling	CAPACITOR: paper; 100,000 mmf p/m 10%; 400 wv	931 0299 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C-114	V107A cathode filter	CAPACITOR: paper; 0.2 mmf minus 10% plus 20%; 200 wv	931 0167 00
C-115	V107B cathode coupling	CAPACITOR: paper; 100,000 mmf p/m 10%; 400 wv	931 0299 00
C-116	V107B plate filter	CAPACITOR: paper; 0.5 mmf minus 10% plus 20%; 200 wv	931 0169 00
C-117	Carrier level output coupling	CAPACITOR: ceramic; 1,000 mmf; 500 wv	913 1186 00
C-118	V102A grid filter	CAPACITOR: mica; 100 mmf p/m 10%; 500 wv	912 0495 00
C-119	V104B plate bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-120	V104 plate feedback	CAPACITOR: mica; 470 mmf p/m 10%; 300 wv	912 0543 00
C-121	V104 plate bypass	CAPACITOR: mica; 100 mmf p/m 10%; 500 wv	912 0495 00
C-122		Not used	
C-123		Not used	
C-124	V102A grid decoupler	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-125	Mechanical filter coupling	CAPACITOR: mica; 220 mmf p/m 2%; 500 wv	912 0517 00
C-126		Not used	
C-127	Keying filter network	CAPACITOR: paper, 0.1 mf p/m 10%; 150 wv	931 0333 00
C-128	V104B cathode coupling	CAPACITOR, fixed: ceramic; 1000 mmf guaranteed min; 500 dc working v	913 1186 00
C-129	Keying filter network	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-130	V104B grid coupling	CAPACITOR: ceramic; 27 mmf p/m 10%; 500 wv	912 0453 00
C-131	V104B grid bypass	CAPACITOR: mica; 180 mmf p/m 10%; 500 wv	912 0513 00
C-132	V102A grid coupling	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-133	V102A cathode divider	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00

Section VI
C-134 - C-214

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C-134	Keying filter network	CAPACITOR: paper 0.1 mf $\pm 10\%$; 150 wv	931 0333 00
C-135	Carrier level coupler	CAPACITOR: mica; 75 mmf p/m 10%; 250 wv	912 0486 00
C-136	Modulator loading	CAPACITOR, fixed: mica; 39 mmf $\pm 2\%$; 500 dc working v	912 0463 00
C-137	V104B plus bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-201	V201 plate decoupler	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-202	Trimmer for L201	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-203	V201 voltage divider	CAPACITOR: mica; 240 mmf p/m 2%; 500 wv	912 0520 00
C-204		Not used	
C-205	V202 grid decoupler	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-206	Padder for L203	CAPACITOR: mica; 200 mmf p/m 2%; 500 wv	912 0516 00
C-207	Trimmer for L203	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-208	V202 grid coupling	CAPACITOR: ceramic; 2.0 mmf p/m 1/4 mmf; 500 wv	916 0075 00
C-209	V202 cathode bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-210	V202 screen bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-211	Trimmer for L204	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-212	Padder for L204	CAPACITOR, fixed: mica; 220 mmf p/m 2%; 500 dc working v	912 0517 00
C-213	V202 plate decoupling	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-214	B plus bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C-215	V203 grid decoupling	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-216	Padder for L206	CAPACITOR: mica; 200 mmf p/m 10%; 500 vdcw	912 0516 00
C-217	Trimmer for L206	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-218	V203 grid coupling	CAPACITOR: ceramic; 2.0 mmf p/m 1/4 mmf; 500 wv	916 0075 00
C-219	V203 cathode bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-220	V203 screen bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-221	Trimmer for L207	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-222	Padder for L207	CAPACITOR: mica; 150 mmf p/m 2%; 500 wv	912 0505 00
C-223		Not used	
C-224	B plus bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-225	ALC circuit filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-226	ALC circuit filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-227	Key line filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-228	Filament line filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-229	V201 plate trap	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-230	V201 voltage divider	CAPACITOR: mica; 430 mmf p/m 2%; 300 wv	912 0538 00
C-231	Padder for L201	CAPACITOR: mica; 39 mmf p/m 10%; 500 wv	912 0465 00
C-232	V204 grid coupling	CAPACITOR, fixed: mica; 62 mmf p/m 2%; 500 dc working v	912 0478 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C233	V208 cathode	CAPACITOR: mica; 150 mmf p/m 2%; 500 wv	912 0505 00
C-234	V208 feedback	CAPACITOR: mica; 15 mmf p/m 5%; 500 wv	912 0437 00
C-235	V208 screen bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-236	V204 grid filter	CAPACITOR: mica; 510 mmf p/m 10%; 300 wv	912 0546 00
C-237	Neutralizer padder	CAPACITOR: mica; 33 mmf p/m 10%; 500 wv	912 0459 00
C-238	Padder for L214	CAPACITOR: mica; 10 mmf p/m 5%; 500 wv	912 0431 00
C-239	V209 grid coupling	CAPACITOR: mica; 10 mmf p/m 5%; 500 wv	912 0431 00
C-240	Padder for L215	CAPACITOR: mica; 20 mmf p/m 5%; 500 wv	912 0443 00
C-241	Padder for L216	CAPACITOR: mica; 75 mmf p/m 2%; 500 wv	912 0484 00
C-242	Padder for L217	CAPACITOR: mica; 220 mmf p/m 2%; 500 wv	912 0517 00
C-243	B plus bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-244	V204 grid coupling	CAPACITOR: ceramic; 5.0 mmf p/m 10%; 500 wv	916 0429 00
C-245	V204 plate decoupling	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-246	B plus bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-247	40 M padder for L223	CAPACITOR: mica; 82 mmf p/m 10%; 500 wv	912 0489 00
C-248	40 M trimmer for L223	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-249	8 MC trap tuning	CAPACITOR: variable; 5.0 to 37.5 mmf; 350 wv	917 1073 00
C-250	20 M trimmer for L218	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C-251	Padder for L213	CAPACITOR: mica; 5 mmf p/m 10%; 500 wv	912 0429 00
C-252	15 M trimmer for L219	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-253	80 meter trap resonating	CAPACITOR: ceramic; 36 mmf p/m 2%; 500 wv	916 0460 00
C-254	11 meter trimmer for L221	CAPACITOR: variable; 5.0 to 37.5 mmf; 350 wv	917 1073 00
C-255	10 M trimmer for L221	CAPACITOR: variable; 3.0 to 18.0 mmf; 350 wv	917 1072 00
C-256	10 M trimmer for L221	CAPACITOR: variable; 3.0 to 18.0 mmf; 350 wv	917 1072 00
C-257	10 meter trimmer for L227	CAPACITOR: variable; 3.0 to 18.0 mmf; 350 wv	917 1072 00
C-258	V205 grid coupling	CAPACITOR: mica; 470 mmf p/m 2%; 300 wv	912 0541 00
C-259	V209 plate decoupling	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-260	V209 screen bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-261	V209 cathode bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-262	V208 plate blocking	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-263	V203 screen decoupling	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-264		CAPACITOR: Not Used	
C-265	10 M trimmer for L234	CAPACITOR: variable; 3.0 to 18.0 mmf; 350 wv	917 1072 00
C-266	11 M trimmer for L234	CAPACITOR: variable; 5.0 to 37.5 mmf; 350 wv	917 1073 00
C-267	15 M trimmer for L236	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-268	L207 bypass and voltage divider	CAPACITOR: mica; 20 mmf p/m 10%; 500 wv	912 0444 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C-269	20 M trimmer for L237	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-270	V205 plate decoupler	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-271	40 meter padder for L231	CAPACITOR: mica; 68 mmf p/m 2%; 500 wv	912 0481 00
C-272	40 meter trimmer for L231	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-273	V205 plate decoupling	CAPACITOR: mica; 100 mmf p/m 2%; 500 wv	912 0493 00
C-274		Not used	
C-275	V205 plate blocking	CAPACITOR: mica; 100 mmf p/m 2%; 500 wv	912 0493 00
C-276		Not used	
C-277	Driver neutralizer voltage divider	CAPACITOR: ceramic; 1.5 mmf p/m 1/4 mmf; 500 wv	916 0072 00
C-278	Driver screen bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-279	B plus bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-280		Not used	
C-281	Driver neutralizer voltage divider	CAPACITOR: mica; 5 mmf p/m 10%; 500 wv	912 0429 00
C-282		Not used	
C-283	Driver grid plate neutralizer	CAPACITOR: variable; 5.0 to 37.5 mmf; 350 wv	917 1073 00
C-284 thru C-289		Not used	
C-290	B plus RF filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-291	Filament line filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-292	Filament line filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C-293	V203 plate blocking	CAPACITOR: mica; 100 mmf p/m 2%; 500 wv	912 0493 00
C-294	B plus RF filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-295	V205 cathode bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-296	V205 screen bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-297	V202 ALC filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-298	PA neut voltage divider	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-299	Key line filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-300	B plus RF filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-301	10 M trimmer for L227	CAPACITOR: variable; 3.0 to 18.0 mmf; 350 wv	917 1072 00
C-302	11 meter trimmer for L227	CAPACITOR: variable; 5.0 to 37.5 mmf; 350 wv	917 1073 00
C-303	B plus bypass	CAPACITOR: paper; .033 mmf p/m 10%; 400 wv	931 0293 00
C-304	15 M trimmer for L229	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-305	Driver plate blocking	CAPACITOR: mica; 510 mmf p/m 10%; 300 wv	912 0546 00
C-306	20 M trimmer for L230	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-308	40 M trimmer for L225	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-309	40 M padder for L225	CAPACITOR: mica; 82 mmf p/m 10%; 500 wv	912 0489 00
C-310	Driver grid load blocking	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C312	V-208 plate decoupling	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00

Section VI
C-313 - C-334

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C-313	J102 RF filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-314	RF Bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-315		Not used	
C-316		Not used	
C-317	J201 blocking	CAPACITOR: mica; 5 mmf p/m 10%; 500 wv	912 0429 00
C-318	J207 blocking	CAPACITOR: mica; 5 mmf p/m 10%; 500 wv	912 0429 00
C-319	V-206 screen bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-320	V-206 screen bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-321	V-207 screen bypass	CAPACITOR: ceramic; 10,000 mmf; 500 wv	913 1188 00
C-322	80 M neutralizing cap	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-323	V-201 grid return bypass	CAPACITOR: mica; 510 mmf p/m 10%; 300 wv	912 0546 00
C-324 thru C-327		Not used	
C-328	PA bias line filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-329	Padder for L-218	CAPACITOR: mica; 15 mmf p/m 10%; 500 wv	912 0438 00
C-330	Padder for L-230	CAPACITOR: mica; 15 mmf p/m 10%; 500 wv	912 0438 00
C-331	Padder for C-707	CAPACITOR: mica; 15 mmf p/m 10%; 500 wv	912 0438 00
C-332	J102 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-333	J102 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-334	J102 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C-335	J102 rf filter	CAPACITOR: ceramic; 1000 mmf +80%, -20%, 500 wv	913 1292 00
C-336	J102 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-337	J102 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-338	J103 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-339	J103 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-340	J103 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-341	J103 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-342	J103 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-343	J103 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-344	J103 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-345	J103 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-346	J103 rf filter	CAPACITOR: ceramic; 1000 mmf +80% -20%, 500 wv	913 1292 00
C-347	J103 rf filter	SUPPRESSOR, electrical noise: 0.01 mf ±20%, 600 wv	241 0085 00
C-348	J103 rf filter	SUPPRESSOR, electrical noise: 0.01 mf ±20%, 600 wv	241 0085 00
C-349	J103 rf filter	SUPPRESSOR, electrical noise: 0.01 mf ±20%, 600 wv	241 0085 00
C-350	J103 rf filter	SUPPRESSOR, electrical noise: 0.01 mf ±20%, 600 wv	241 0085 00
C-351	J103 rf filter	SUPPRESSOR, electrical noise: 0.01 mf ±20%, 600 wv	241 0085 00
C-703	80 M padder for L701	CAPACITOR: mica; 390 mmf p/m 10%; 500 wv	912 0537 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C-704	40 M padder for L703	CAPACITOR: mica; 150 mmf p/m 2%; 500 wv	912 0505 00
C-707	11 M trimmer for L705	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-708	10 M trimmer for L705	CAPACITOR: variable; 5.0 to 37.5 mmf; 350 wv	917 1073 00
C-709		CAPACITOR: Not Used	
C-710	80 M trimmer for L701	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-711	40 M trimmer for L703	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-712	30 M trimmer for L702	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-713	15 M trimmer for L704	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
C-714	Driver cathode bypass	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 wv	913 1292 00
C-715	Driver cathode neutralizer	CAPACITOR: variable; 8.0 to 75.0 mmf; 350 wv	917 1075 00
CR-101	Part of balanced Mod.	CRYSTAL UNIT: rectifying; metallic; 75 peak inverse v; 1N67A	353 0147 00
CR-102	Part of balanced Mod.	CRYSTAL UNIT: rectifying; metallic; 75 peak inverse v; 1N67A	353 0147 00
CR-103	Part of balanced Mod.	CRYSTAL UNIT: rectifying; metallic; 75 peak inverse v; 1N67A	353 0147 00
CR-104	Part of balanced Mod.	CRYSTAL UNIT: rectifying; metallic; 75 peak inverse v; 1N67A	353 0147 00
CR-701	Filament meter rectifier	CRYSTAL UNIT: rectifying; metallic; 75 peak inverse v; 1N34A	353 0103 00
CR-702	Filament meter rectifier	CRYSTAL UNIT: rectifying; metallic; 75 peak inverse v; 1N34A	353 0103 00
E-201	V207 grid parasitic suppressor	SUPPRESSOR: parasitic; six turns #18 AWG wire wnd on 330 ohm 1 w resistor	540 5253 00
E-202	V206 grid parasitic suppressor	SUPPRESSOR: parasitic; six turns #18 AWG wire wnd on 330 ohm 1 w resistor	540 5253 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
E-203	V206 plate parasitic suppressor	SUPPRESSOR: parasitic; six turns #18 AWG wire wnd on 330 ohm 1 w resistor	540 5253 00
E-204	V207 plate parasitic suppressor	SUPPRESSOR: parasitic; six turns #18 AWG wire wnd on 330 ohm 1 w resistor	540 5253 00
FL-101	Sideband filter	FILTER: mech; 250 kc	522 9080 002
I-101	Kilocycle dial lamp	LAMP: incandescent; 6-8 v, 0.25 amp; bulb	262 0264 00
I-102	Megacycle dial lamp	LAMP: incandescent; 6.3 v, 0.15 amp; bulb	262 3240 00
I-103	Megacycle dial lamp	LAMP: incandescent; 6.3 v, 0.15 amp; bulb	262 3240 00
I-104	Meter lamp	p/o M-201	
I-701	Pilot lamp	p/o M-701	
J-101	Microphone connector	CONNECTOR: receptacle; two round female contacts; straight	369 1004 00
J-102	Control cable connector	CONNECTOR: receptacle; 15 round male cont; straight	372 1079 00
J-103	Power cable connector	CONNECTOR: plug; 20 round male cont; straight	372 1069 00
J-104	Phone patch input audio amplr V-101	JACK: phone; single round female cont	360 0088 00
J-201	6CL6 plate test point	CONNECTOR: receptacle; single round female cont; straight	357 9100 00
J-203	VFO injection test point	CONNECTOR: receptacle; single round female contact; straight	357 9100 00
J-204	250 KC injection test point	CONNECTOR: receptacle; single round female contact; straight	357 9100 00
J-205	Xtal injection test point	CONNECTOR: receptacle; single round female contact; straight	357 9100 00
J-206	VIF test point	CONNECTOR: receptacle; single round female contact; straight	357 9100 00
J-207	6CL6 grid test point	CONNECTOR: receptacle; single round female contact; straight	357 9100 00
J-208	6CL6 cathode test point	CONNECTOR: receptacle; single round female contact; straight	357 9100 00

Section VI
K-101 - L-215

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
K-101	Carrier control relay	RELAY: armature; cont arrangement, 1C, 2A and 1B	972 1353 00
L-102	V104 B plus choke	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-103	V104 B plate choke	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-104	V104 B cathode series choke	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-105	Mod. input choke	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-106	Mod. input choke	COIL, RF: choke single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-201	V201 plate coil	COIL: 80 mh	540 5270 002
L-202	B plus line filter	COIL, RF: 139 turns of #36 AWG wire	240 0134 00
L-203	V202 grid coil	COIL: 80 mh	540 5270 002
L-204	V202 plate coil	COIL: 80 mh	540 5270 002
L-205	B plus line filter	COIL, RF: 139 turns of #36 AWG wire	240 0134 00
L-206	V203 grid coil	COIL: 80 mh	540 5270 002
L-207	V203 plate coil	COIL: 80 mh	540 5270 002
L-208	V201 plate choke	COIL, RF: 139 turns #36 AWG wire	240 0134 00
L-209	80 meter trap coil	COIL, RF: choke; 47 uh; single layer wnd; #22 AWG enameled wire	240 0190 00
L-210	B plus line filter	COIL, RF: 139 turns #36 AWG wire	240 0134 00
L-211	V208 cathode choke	COIL, RF: choke; 112 turns #36 nylon enameled wire	240 0073 00
L-212	V208 26 mc tank	COIL, RF: 10 turns #26 AWG enameled wire	540 5254 00
L-213	V208 25 mc tank	COIL, RF: 10 turns #26 AWG enameled wire	540 5254 00
L-214	V208 23.4 mc tank	COIL, RF: 10 turns #26 AWG enameled wire	540 5254 00
L-215	V208 18 mc tank	COIL: tuning; 18 mc	540 5256 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
L-216	V208 11 mc tank	COIL: tuning; 18 mc	540 5256 00
L-217	V208 4 mc tank	COIL, RF: 25 turns #32 AWG enameled wire	540 5257 00
L-218	V204 20 M tank	COIL, RF: 19 turns #30 AWG enameled wire	540 5258 00
L-219	V204 15 M tank	COIL, RF: 13 turns #26 AWG enameled wire	540 5259 00
L-220	8 MC trap inductor	COIL, RF: choke; 47 uh; single layer wnd; #22 AWG enameled wire	240 0190 00
L-221	V204 11 and 10 M tank	COIL, RF: 11 turns #26 AWG enameled wire	540 5260 00
L-222	V204 plate choke	COIL, RF: 139 turns #36 AWG wire	240 0134 00
L-223	V204 40 M tank	COIL, RF: 6.58 turns #30 AWG wire	540 5271 002
L-224	V209 plate choke	COIL, RF: 139 turns #36 AWG wire	240 0134 00
L-225	V209 40 M tank	COIL, RF: 6.58 turns #30 AWG wire	540 5271 002
L-226		Not used	
L-227	V209 11 and 10 M tank	COIL, RF: 11 turns #26 AWG enameled wire	540 5260 00
L-228	V208 plate choke	COIL, RF: 139 turns #36 AWG wire	240 0134 00
L-229	V209 15 M tank	COIL, RF: 13 turns #26 AWG enameled wire	540 5259 00
L-230	V209 20 M tank	COIL, RF: 19 turns #30 AWG enameled wire	540 5258 00
L-231	V205 40 M tank	COIL, RF: 6.58 turns #30 AWG wire	540 5271 002
L-232	B plus line filter	COIL, RF: 139 turns #36 AWG wire	240 0134 00
L-233	V203 plate choke	COIL, RF: 139 turns #36 AWG wire	240 0134 00
L-234	V205 11 and 10 M tank	COIL, RF: 7 turns #26 AWG enameled wire	540 5325 00
L-235	V205 plate choke	COIL, RF: 139 turns #36 AWG wire	240 0134 00
L-236	V205 15 M tank	COIL, RF: 10 turns #26 AWG enameled wire	540 5254 00
L-237	V205 20 M tank	COIL, RF: 19 turns #30 AWG enameled wire	540 5258 00

Section VI
L-238 - L-261

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
L-238	Driver plate chokes	COIL, RF: 139 turns #36 AWG wire	240 0134 00
L-239	PA Bias line filter	COIL, RF: 139 turns #36 AWG wire	240 0134 00
L-240 thru L-245		Not used	
L-246	B plus line filter	COIL, RF: 139 turns #36 AWG wire	240 0134 00
L-247	ALC line filter	COIL, RF: 139 turns #36 AWG wire	240 0134 00
L-248	V205, V206, V207 filament line filter	COIL, RF: 20 turns #18 AWG wire	540 5252 00
L-249	Driver Cathode Choke	COIL, RF: choke, single wound, single layer wound; 0.22 uh $\pm 20\%$, 2000 ma max dc	240 0067 00
L-250	J102 rf filter	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-251	J102 rf filter	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-252	J102 rf filter	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-253	J102 rf filter	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-254	J102 rf filter	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
J-255	J102 rf filter	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-256	J103 rf filter	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-257	J103 rf filter	COIL, RF: choke, 20 turns No. 18 wire	540 5252 00
L-258	J103 rf filter	COIL, RF: choke, 20 turns No. 18 wire	540 5252 00
L-259	J103 rf filter	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-260	J103 rf filter	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00
L-261	J103 rf filter	COIL, RF: choke, single wound, 2.0 uh p/m 10% at 350 kc	240 0084 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
L-262	J103 rf filter	COIL, RF: choke, single wound, 2.0 mh p/m 10% at 350 kc	240 0084 00
L-263		Not used	
L-264	J103 rf filter	COIL, RF: choke, 20 turns, #18 wire	540 5252 00
L-265	J103 rf filter	COIL, RF: choke, 20 turns, #18 wire	540 5252 00
L-266	J103 rf filter	COIL, RF: choke, 20 turns, #18 wire	540 5252 00
L-267	J103 rf filter	COIL, RF: choke, 20 turns, #18 wire	540 5252 00
L-268	J103 rf filter	COIL, RF: choke, 20 turns, #18 wire	540 5252 00
L-269	J103 rf filter	COIL, RF: choke, 20 turns, #18 wire	540 5252 00
L-270	V204 plate loading	COIL, RF: choke; single wound, 2.0 mh ±10% at 350 kc	240 0084 00
L-271	J102 rf filter	COIL, RF: choke; single wound, 2.0 mh ±10% at 350 kc	240 0084 00
L-701	Driver 80 M tank	COIL: 80 mh	540 5673 002
L-702	Driver 20 M tank	COIL, RF: 10 turns #26 AWG enameled wire	540 5254 00
L-703	Driver 40 M tank	COIL, RF: 17 turns #28 AWG wire	540 5670 002
L-704	Driver 15 M tank	COIL: 15 mh	540 5671 002
L-705	Driver 11 and 10 M tank	COIL, RF: 5 turns #26 AWG wire	540 5672 00
L-706	Driver cathode choke	COIL, RF: choke; 112 turns #36 nylon enameled wire	240 0073 00
M-201	Multimeter	METER: signal level; 0-1 ma DC; 50 ohm p/m 20%	458 0238 00
M-701	PA plate current meter	METER: milliammeter; 0-800 ma DC	458 0293 00
P-102	Control cable plug	CONNECTOR: receptacle; 15 female cont; straight COVER: for 15 cont plug connector	372 1081 00 372 1083 00
P-103	Power cable plug	CONNECTOR: receptacle; 20 female cont; straight COVER: for 20 cont connector	372 1071 00 372 1073 00
P-104	Phone patch input audio amplr V-101	PLUG: phone; single round male cont	361 0045 00
P-402	High voltage plug	CONNECTOR: receptacle; single round female cont; straight	372 1490 00
R-101	Audio input rf filter	RESISTOR: 4700 ohm p/m 10%; 1/2 w	745 1380 00
R-102	V101A grid	RESISTOR: 100,000 ohm p/m 10%; 1/2 w	745 1436 00

Section VI
R-103 - R-126

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
R-103	V101A cathode	RESISTOR: 680 ohm p/m 10%; 1/2 w	745 1345 00
R-104	V101A plate	RESISTOR: 0.22 megohm p/m 10%, 1/2 w	745 1450 00
R-105	V101B grid	RESISTOR: 470,000 ohm p/m 10%, 1/2 w	745 1464 00
R-106	V101B cathode	RESISTOR: fixed: comp; 1000 ohm \pm 10%, 1/2 w	745 1352 00
R-107	V101 plate decoupling	RESISTOR: 27,000 ohm p/m 10%, 1/2 w	745 1412 00
R-108	V101B plate	RESISTOR: 56,000 ohm p/m 10%, 1/2 w	745 1426 00
R-109	Audio gain control	RESISTOR: variable; 1 megohm p/m 20%; 1/2 w	376 3528 00
R-110	V102A cathode	RESISTOR: 220 ohm p/m 10%; 1/2 w	745 1324 00
R-111	V102A plate dropping	RESISTOR: 27,000 ohm p/m 10%, 1/2 w	745 1412 00
R-112	Carrier balance	RESISTOR: variable; 100 ohm p/m 20%, 1/2 w	380 6271 00
R-113	VOX speech gain control	RESISTOR: variable; 1 megohm p/m 20%, 1/2 w	376 3513 00
R-114	V103A cathode	RESISTOR: 330 ohm p/m 10%, 1/2 w	745 1331 00
R-115	V103A plate	RESISTOR: 100,000 ohm p/m 10%, 1/2 w	745 1436 00
R-116	V107A plate	RESISTOR: 100,000 ohm p/m 10%, 1/2 w	745 1436 00
R-117	V103B grid	RESISTOR: 2.2 megohm p/m 10%, 1/2 w	745 1492 00
R-118	V103B cathode	RESISTOR: 680 ohm p/m 10%, 1/2 w	745 1345 00
R-119	V103 fixed bias series	RESISTOR: wire wound; 22,000 ohm p/m 10%; 10 w	710 0260 00
R-120	Receiver muting divider	RESISTOR: 68,000 ohm p/m 10%; 2 w	745 5729 00
R-121	Receiver muting divider	RESISTOR: 10,000 ohm p/m 10%; 1/2 w	745 1394 00
R-122	VOX speaker gain	RESISTOR: variable; 1 megohm p/m 20%; 1/2 w	376 3528 00
R-123	V102B cathode	RESISTOR: 330 ohm p/m 5%; 1/2 w	745 1331 00
R-124	V102B plate	RESISTOR: 100,000 ohm p/m 10%; 1/2 w	745 1436 00
R-125	V107B cathode	RESISTOR: 100,000 ohm p/m 10%; 1/2 w	745 1436 00
R-126	V103B grid	RESISTOR: 2.2 megohm p/m 10%; 1/2 w	745 1492 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
R-127	V104B grid	RESISTOR: 0.47 megohm p/m 10%; 1/2 w	745 1464 00
R-128	V102A grid decoupling	RESISTOR: 0.47 megohm p/m 10%; 1/2 w	745 1464 00
R-129	Carrier level control	RESISTOR: variable; 100,000 ohm $\pm 20\%$; 2 w	380 0631 00
R-130	V104A grid	RESISTOR: 0.47 megohm p/m 10%; 1/2 w	745 1464 00
R-131	Voltage regulator dropping	RESISTOR: wire wound; 1800 ohm $\pm 10\%$; 10 w	710 0227 00
R-132	Filament bias divider	RESISTOR: 470,000 ohm p/m 10%; 1/2 w	745 1464 00
R-133	Filament bias divider	RESISTOR: 68,000 ohm p/m 10%; 1/2 w	745 1429 00
R-134	V107A cathode	RESISTOR, fixed: comp; 1.5 megohm $\pm 10\%$; 1/2 w	745 1485 00
R-135	V107B plate	RESISTOR, fixed: comp; 1.5 megohm $\pm 10\%$; 1/2 w	745 1485 00
R-136	Keying filter	RESISTOR: 10,000 ohm p/m 10%; 1/2 w	745 1394 00
R-137	Keying filter	RESISTOR: 1 megohm p/m 10%; 1/2 w	745 1478 00
R-138	Keying filter	RESISTOR: 2700 ohm p/m 10%; 1/2 w	745 1370 00
R-139	Keying filter	RESISTOR: 100,000 ohm p/m 10%; 1/2 w	745 1436 00
R-140		Not used	
R-141	Keying filter	RESISTOR: 22,000 ohm p/m 10%; 1/2 w	745 1408 00
R-142		Not used	
R-143	V201 grid decoupling	RESISTOR: 47,000 ohm p/m 10%; 1/2 w	745 1422 00
R-144	Receiver muting divider	RESISTOR: 68,000 ohm p/m 10%; 2 w	745 5729 00
R-146	V104A plate load	RESISTOR: 47,000 ohm p/m 10%; 1/2 w	745 1422 00
R-147		Not used	
R-148	V104B cathode	RESISTOR: 4700 ohm p/m 10%; 1/2 w	745 1380 00
R-149	V104B cathode	RESISTOR: 220 ohm p/m 10%; 1/2 w	745 1324 00
R-150	Balanced modulator bridge	RESISTOR: 680 ohm p/m 10%; 1/2 w	745 1345 00
R-151	Balanced modulator bridge	RESISTOR: 680 ohm p/m 10%; 1/2 w	745 1345 00
R-152	V102A grid	RESISTOR: 0.22 megohm p/m 10%; 1/2 w	745 1450 00
R-153	V102A cathode load	RESISTOR: 4700 ohm p/m 10%; 1/2 w	745 1380 00

Section VI
R-154 - R-225

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART. NO.
R-154	V102A grid divider	RESISTOR, fixed: comp; 0.47 megohm $\pm 10\%$, 1/2 w	745 1464 00
R-155	V103A grid series	RESISTOR, fixed: comp; 1.0 megohm $\pm 10\%$, 1/2 w	745 1478 00
R-156	Shunt for R-112	RESISTOR: 22 ohm p/m 10%; 1/2 w	745 1282 00
R-157	Shunt for R-112	RESISTOR: 22 ohm p/m 10%; 1/2 w	745 1282 00
R-201	V201 grid stabilizer	RESISTOR: 47 ohm p/m 10%; 1/2 w	745 1296 00
R-202	V201 cathode	RESISTOR: 220 ohm p/m 10%; 1/2 w	745 1324 00
R-203	V201 grid	RESISTOR: 100,000 ohm p/m 10%; 1/2 w	745 1436 00
R-204	V201 plate decoupling	RESISTOR: 10,000 ohm p/m 10%; 2 w	745 5694 00
R-205	V202 grid decoupling	RESISTOR: 47,000 ohm p/m 10%; 1/2 w	745 1422 00
R-206	V202 cathode	RESISTOR, fixed: comp; 220 ohm $\pm 10\%$, 1/2w	745 1324 00
R-207	ALC zero control	RESISTOR: wire wound; 100 ohm $\pm 10\%$, 1 w	377 0122 00
R-208	80 M driver load	RESISTOR: 8.2 kilohm p/m 10%; 2 w	745 5691 00
R-209	V202 screen divider	RESISTOR: 150 ohm p/m 10%; 1/2 w	745 1317 00
R-210	V202 screen divider	RESISTOR: 47,000 ohm p/m 10%; 1/2 w	745 1422 00
R-211	V202 screen	RESISTOR: 22,000 ohm p/m 5%; 1 w	745 3407 00
R-212	V202 plate decoupling	RESISTOR: 1000 ohm p/m 10%; 1/2 w	745 1352 00
R-213	V203 grid decoupling	RESISTOR: 47,000 ohm p/m 10%; 1/2 w	745 1422 00
R-214	V203 cathode	RESISTOR, fixed: comp; 220 ohm $\pm 10\%$; 1/2 w	745 1324 00
R-215	V203 screen bleeder	RESISTOR: 47,000 ohm p/m 10%; 1/2 w	745 1422 00
R-216	V203 screen	RESISTOR: 22,000 ohm p/m 5%; 1 w	745 3407 00
R-217	V203 plate decoupling	RESISTOR: 1000 ohm p/m 10%; 1/2 w	745 1352 00
R-218	V204 grid	RESISTOR: 100,000 ohm p/m 10%; 1/2 w	745 1436 00
R-219	V204 cathode	RESISTOR: 220 ohm p/m 10%; 1/2 w	745 1324 00
R-220	V204 grid	RESISTOR: 100,000 ohm p/m 10%; 1/2 w	745 1436 00
R-221	V208 screen	RESISTOR: 470,000 ohm p/m 10%; 1/2 w	745 1464 00
R-222	V208 plate decoupling	RESISTOR: 4700 ohm p/m 10%; 1/2 w	745 1380 00
R-223	V204 plate decoupling	RESISTOR: 10,000 ohm p/m 10%; 2 w	745 5694 00
R-224	V202 grid suppressor	RESISTOR, fixed: comp; 4700 ohm $\pm 10\%$, 1/2 w	745 1296 00
R-225	V205 cathode	RESISTOR: 220 ohm p/m 10%; 1/2 w	745 1324 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
R-226	V205 screen bleeder	RESISTOR: 47,000 ohm p/m 10%; 1/2 w	745 1422 00
R-227	V205 screen	RESISTOR: 22,000 ohm p/m 5%; 1 w	745 3407 00
R-228	V205 plate decoupling	RESISTOR: 4000 ohm p/m 10%; 10 w	710 1442 00
R-229	Driver grid	RESISTOR: 18,000 ohm p/m 10%; 1/2 w	745 1405 00
R-230	V209 plate decoupling	RESISTOR: 1000 ohm p/m 10%; 1/2 w	745 1352 00
R-231	Driver screen	RESISTOR: 4700 ohm p/m 10%; 2 w	745 5680 00
R-232	V209 screen	RESISTOR: 22,000 ohm p/m 5%; 1 w	745 3407 00
R-233	V208 grid	RESISTOR: 100,000 ohm p/m 10%; 1/2 w	745 1436 00
R-234	V209 screen bleeder	RESISTOR: 47,000 ohm p/m 10%; 1/2 w	745 1422 00
R-235	V209 cathode	RESISTOR: 560 ohm p/m 10%; 1/2 w	745 1342 00
R-236	Load for L230	RESISTOR: comp; 2700 ohm $\pm 10\%$, 1/2 w	745 1370 00
R-237	Load for L229	RESISTOR: comp; 2700 ohm $\pm 10\%$, 1/2 w	745 1370 00
R-238	40 M load for L231	RESISTOR: comp; 2700 ohm $\pm 10\%$, 1/2 w	745 1370 00
R-239	Load for L237	RESISTOR: comp; 2700 ohm $\pm 10\%$, 1/2 w	745 1370 00
R-240	Load for L236	RESISTOR: comp; 2700 ohm $\pm 10\%$, 1/2 w	745 1370 00
R-241	11 M load for L234	RESISTOR: comp; 2700 ohm $\pm 10\%$, 1/2 w	745 1370 00
R-242	10 M load for L234	RESISTOR: comp; 2700 ohm $\pm 10\%$, 1/2 w	745 1370 00
R-243	40 M load for L227	RESISTOR: comp; 2700 ohm $\pm 10\%$, 1/2 w	745 1384 00
R-244	V205 parasitic suppressor	RESISTOR: comp; 27 ohm $\pm 10\%$, 1/2 w	745 1286 00
R-245	V204 grid loading	RESISTOR, fixed: comp; 4700 ohm $\pm 10\%$, 1/2 w	745 1380 00
R-401		RESISTOR: comp; 22,000 ohm $\pm 10\%$; 1 w	745 3408 00
R-701	ALC bias divider	RESISTOR: comp; 4700 ohm $\pm 10\%$; 1 w	745 3380 00
R-702	ALC bias divider	RESISTOR: comp; 18,000 ohm $\pm 10\%$; 1 w	745 3405 00
R-703	ALC bias divider	RESISTOR: comp; 22,000 ohm p/m 10%; 1 w	745 3408 00
R-704	ALC adjust control	RESISTOR: comp; 10,000 ohm p/m 20%; 1/2 w at 80°C	376 3507 00
R-705	Multimeter shunt	RESISTOR: wire wound; 1 ohm p/m 3%; 2 w	747 9296 00

Section VI
R-706 - S-201I

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
R-706	R706A and R706B	(incl)	
R-706A	Multimeter shunt	RESISTOR: comp; 10 ohm p/m 10%; 1/2 w	745 1268 00
R-706B	Multimeter shunt	RESISTOR: comp; 10 ohm p/m 10%; 1/2 w	745 1268 00
R-707	Filament meter multiplier	RESISTOR: 4,320 ohm p/m 1%; 1/2 w	705 2146 00
R-708	Driver cathode	RESISTOR: 1000 ohm p/m 10%; 1/2 w	745 1352 00
R-709	PA screen bleeder	RESISTOR: wire wound; 20,000 ohm p/m 5%; 12 w	747 9246 00
RT-101	Oscillator filament voltage regulator	TUBE: 3TF4A	734 0004 00
S101A	Part of Emission selector switch	SWITCH: rotary; 6 circuit, 6 position; nonshorting	259 0659 00
S101B	Part of Emission selector switch	SWITCH: rotary; 6 circuit, 6 position; nonshorting	259 0659 00
S-101C	Part of Emission selector switch	SWITCH: rotary; 6 circuit, 6 position; nonshorting	259 0659 00
S-102	Sideband select switch	SWITCH: rotary; 1 circuit, 12 position shorting	269 1680 00
S-201A	Part of Band Change switch	SWITCH: rotary; 1 circuit, 12 position; nonshorting	269 1692 00
S-201B	Part of Band Change switch	SWITCH: rotary; 1 circuit, 12 position; nonshorting	269 1692 00
S-201C	Part of Band Change switch	SWITCH: rotary; 2 circuit, 12 position; nonshorting	269 1693 00
S-201D	Part of Band Change switch	SWITCH: rotary; 1 circuit, 12 position, nonshorting	269 1694 00
S-201E	Part of Band Change switch	SWITCH: rotary; 1 circuit, 12 position, nonshorting	269 1694 00
S-201F	Part of Band Change switch	SWITCH: rotary; 2 circuit, 12 position, nonshorting	269 1696 00
S-201G	Part of Band Change switch	SWITCH: rotary; 2 circuit, 12 position, nonshorting	269 1697 00
S-201H		Not used	
S-201I	Part of Band Change switch	SWITCH: rotary; 1 circuit, 12 position, nonshorting	269 1699 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
S-202		Not used	
S-203		Not used	
S-204	Tune-operate	SWITCH: toggle; SPST	266 0015 00
S-701	Multimeter	SWITCH: rotary; 2 circuit, 5 position, nonshorting	259 0673 00
TB-103	Keying network resistor board	BOARD: terminal; mtg strip for resistors	306 0296 00
V-101	Audio amplifier	TUBE: 12AT7	255 0205 00
V-102	Audio output/squelch amplr	TUBE: 12AT7	255 0205 00
V-103	VOX/relay amplr	TUBE: 12AT7	255 0205 00
V-104	Low freq. oscillator	TUBE: 12AT7	255 0205 00
V-105	Voltage regulator	TUBE: OB2	257 0058 00
V-106	Voltage regulator	TUBE: OB2	257 0058 00
V-107	VOX/squelch rectifier	TUBE: 6AL5	257 0018 00
V-201	1st Mixer	TUBE: 12AT7	255 0205 00
V-202	1st Amplifier	TUBE: 6BA6	255 0185 00
V-203	2nd Amplifier	TUBE: 6BA6	255 0185 00
V-204	2nd Mixer	TUBE: 12AT7	255 0205 00
V-205	4th Amplifier	TUBE: 6BA6	255 0185 00
V-206	Driver	TUBE: 6CL6	255 0216 00
V-207	Driver	TUBE: 6CL6	255 0216 00
V-208	Crystal oscillator	TUBE: 6AU6	255 0202 00
V-209	3rd Amplifier	TUBE: 6BA6	255 0185 00
XI-101	Socket for I-101	LAMPHOLDER: bracket for miniature bayonet base bulb	262 0150 00
XI-102	Socket for I-102	LAMPHOLDER: bracket for miniature bayonet base bulb	262 1210 00
XI-103	Socket for I-103	LAMPHOLDER: bracket for miniature bayonet base bulb	262 1210 00
XL-212	Socket for L-212	MOUNTING: coil and core holder	139 0184 00

Section VI
XL-213 - XV-107

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
XL-213	Socket for L-213	MOUNTING: coil and core holder	139 0184 00
XL-214	Socket for L-214	MOUNTING: coil and core holder	139 0184 00
XL-215	Socket for L-215	MOUNTING: coil and core holder	139 0184 00
XL-216	Socket for L-216	MOUNTING: coil and core holder	139 0184 00
XL-217	Socket for L-217	MOUNTING: coil and core holder	139 0184 00
XL-218	Socket for L-218	MOUNTING: coil and core holder	139 0184 00
XL-219	Socket for L-219	MOUNTING: coil and core holder	139 0184 00
XL-221	Socket for L-221	MOUNTING: coil and core holder	139 0184 00
XL-227	Socket for L-227	MOUNTING: coil and core holder	139 0184 00
XL-229	Socket for L-229	MOUNTING: coil and core holder	139 0184 00
XL-230	Socket for L-230	MOUNTING: coil and core holder	139 0184 00
XL-234	Socket for L-234	MOUNTING: coil and core holder	139 0184 00
XL-236	Socket for L-236	MOUNTING: coil and core holder	139 0184 00
XL-237	Socket for L-237	MOUNTING: coil and core holder	139 0184 00
XL-702	Socket for L-702	MOUNTING: coil and core holder	139 0184 00
XL-703	Socket for L-703	MOUNTING: coil and core holder	139 0184 00
XL-704	Socket for L-704	MOUNTING: coil and core holder	139 0184 00
XL-705	Socket for L-705	MOUNTING: coil and core holder	139 0184 00
XRT-101	Socket for RT-101	SOCKET: tube; 9 contact miniature; includes metal shield	220 1063 00
XV-101	Socket for V-101	SOCKET: tube; 9 contact miniature	220 1103 00
XV-102	Socket for V-102	SOCKET: tube; 9 contact miniature	220 1103 00
XV-103	Socket for V-103	SOCKET: tube; 9 contact miniature	220 1103 00
XV-104	Socket for V-104	SOCKET: tube; 9 contact miniature	220 1103 00
XV-105	Socket for V-105	SOCKET: tube; 7 contact miniature	220 1036 00
XV-106	Socket for V-106	SOCKET: tube; 7 contact miniature	220 1036 00
XV-107	Socket for V-107	SOCKET: tube; 7 contact miniature	220 1111 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
XV-201	Socket for V-201	SOCKET: tube; 9 contact miniature	220 1103 00
XV-202	Socket for V-202	SOCKET: tube; 7 contact miniature	220 1111 00
XV-203	Socket for V-203	SOCKET: tube; 7 contact miniature	220 1111 00
XV-204	Socket for V-204	SOCKET: tube; 9 contact miniature	220 1103 00
XV-205	Socket for V-205	SOCKET: tube; 7 contact miniature	220 1111 00
XV-206	Socket for V-206	SOCKET: tube; 9 contact miniature	220 1103 00
XV-207	Socket for V-207	SOCKET: tube; 9 contact miniature	220 1103 00
XV-208	Socket for V-208	SOCKET: tube; 7 contact miniature	220 1111 00
XV-209	Socket for V-209	SOCKET: tube; 7 contact miniature	220 1111 00
XY-201	Socket for Y-201	SOCKET: crystal; for CR-7 type crystal	292 0023 00
XY-202	Socket for Y-202	SOCKET: crystal; for CR-7 type crystal	292 0023 00
XY-203	Socket for Y-203	SOCKET: crystal; for CR-7 type crystal	292 0023 00
XY-204	Socket for Y-204	SOCKET: crystal; for CR-7 type crystal	292 0023 00
XY-205	Socket for Y-205	SOCKET: crystal; for CR-7 type crystal	292 0023 00
XY-206	Socket for Y-206	SOCKET: crystal; for CR-7 type crystal	292 0023 00
Y-101	Lower sideband crystal	CRYSTAL UNIT: quartz 251.65 kc	290 4458 00
Y-102	Upper sideband crystal	CRYSTAL UNIT: quartz 248.35 kc	290 4457 00
Y-201	Crystal of 10 M (hi) band	CRYSTAL UNIT: quartz 13,000.000 kc	291 8102 00
Y-202	Crystal for 10 M (lo) band	CRYSTAL UNIT: quartz; single crystal plate; holder HC-6/U; 12,500.000 kc	291 8141 00
Y-203	Crystal for 11 M band	CRYSTAL UNIT: quartz; single crystal plate; holder HC-6/U; 11,700.000 kc	291 8165 00
Y-204	Crystal for 15 M band	CRYSTAL UNIT: quartz; single crystal plate; holder HC-6/U; 9,000.000 kc	291 8083 00
Y-205	Crystal for 20 M band	CRYSTAL UNIT: quartz; single crystal plate; holder HC-6/U; 11,000.000 kc	291 8114 00
Y-206	Crystal for 40 M band	CRYSTAL UNIT: quartz; single crystal plate; holder HC-6/U; 4,000.000 kc	291 8131 00
Z-102	Contains L101, C122, C123 and C124	TUNING UNIT: cement; top, rolled plate; retainer ring; 250 kc	540 4060 00

Section VI
C-402 - E-403

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C-402	Negative feedback capacitor	CAPACITOR: ceramic; 5 mmf p/m 10%; 5000 WV	913 0092 00
C-403		Not used	
C-404	V-401 screen bypass	p/o XV401A	
C-405	V-402 screen bypass	p/o XV402A	
C-406	PA plate blocking	CAPACITOR: ceramic; 1000 mmf p/m 20%; 5000 WV	913 0101 00
C-407	PA tuning	CAPACITOR: variable, air; 23-235 mmf	540 5509 00
C-408	PA loading	CAPACITOR: variable, air; 25.2-570 mmf	540 5515 00
C-409	PA loading	CAPACITOR: variable air; 25.2-570 mmf	540 5515 00
C-410	ALC filter	CAPACITOR: ceramic; 10,000 mmf; 500 WV	913 1188 00
C-411	ALC rectifier feed	CAPACITOR: ceramic; 1 mmf p/m 0.5 mmf; 5000 WV	913 0756 00
C-412	ALC rectifier voltage divider	CAPACITOR: mica; 22 mmf p/m 5%; 500 WV	912 0446 00
C-413	V403 plate stabilizing	CAPACITOR: paper; 0.1 mf p/m 10%; 150 WV	931 0333 00
C-414	ALC bias line filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 WV	913 1292 00
C-415	PA screen line filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 WV	913 1292 00
C-416	PA plate line filter	CAPACITOR: paper; .01 mf minus 10% plus 30%; 2500 WV	241 0167 00
C-417	ALC output line filter	CAPACITOR: ceramic; 1000 mmf minus 20% plus 80%; 500 WV	913 1292 00
C-418	PA filament line filter	CAPACITOR: paper; 0.1 mf plus 20% minus 10%; 600 WV	241 0006 00
C-419	PA filament line filter	CAPACITOR: ceramic; 10,000 mmf; 500 WV	913 1188 00
C-420	ALC line filter	CAPACITOR: ceramic; 10,000 mmf; 500 WV	913 1188 00
E-403	V401 parasitic suppressor	SUPPRESSOR: parasitic; two turns #18 AWG wire wnd on 47 ohm 2 w resistor	540 5641 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
E-404	V402 parasitic suppressor	SUPPRESSOR: parasitic; two turns #18 AWG wire wnd on 47 ohm 2 w resistor	540 5641 00
J-401	Antenna connector jack	CONNECTOR: receptacle; single round female contact	357 9003 00
J-402	PA plate voltage input jack	CONNECTOR: plug; single round male contact	372 1489 00
L-401	PA tuning coil	INDUCTOR: rotary; 15 uh, 24 turns #12 AWG tinned copper	980 0111 00
L-402	PA loading coil	INDUCTOR: rotary; 10 uh, 17 turns #14 AWG tinned copper	980 0110 00
L-403	PA plate choke	COIL, RF: choke; 159 turns #27 chrome oxide wire	540 7979 00
L-404	Static drain choke	COIL, RF: 139 turns #36 AWG SNE wire	240 0134 00
L-405	PA screen choke	COIL, RF: choke; 500 uh; 112 turns #36 nylon enamel wire	240 0073 00
L-406	PA 10 meter inductor	COIL: double ear soldering lug; brass	540 5486 002
P-401	Antenna connection plug	CONNECTOR: plug; single round male contact	357 9040 00
P-402	PA plate voltage plug	CONNECTOR: receptacle; single round female contact	372 1490 00
R-405	V-403 cathode	RESISTOR: 47,000 ohm p/m 10%; 1/2 w	745 1422 00
R-406	V403 plate stabilizing	RESISTOR: 3300 ohm p/m 10%; 1/2 w	745 1373 00
R-407	V403 plate load	RESISTOR: 0.47 megohm p/m 10%; 1/2 w	745 1464 00
S-401	PA box lid interlock	SWITCH: sensitive; spdt; 15 amp, 115 vac	260 0839 00
V-401	Power amplifier	TUBE: 4X150A	256 0093 00
V-402	Power amplifier	TUBE: 4X150A	256 0093 00
V-403	ALC rectifier	TUBE: 6X4	255 0196 00
XV-401A	Socket for V401	SOCKET: tube; 8 contact	220 1174 00
XV-401B	Chimney for V401	CHIMNEY: for 8 contact tube	220 1150 00
XV-402A	Socket for V402	SOCKET: tube; 8 contact	220 1174 00
XV-402B	Chimney for V402	CHIMNEY: for 8 contact tube	220 1150 00
XV-403	Socket for V403	SOCKET: tube; 7 contact	220 1203 00

Section VI
C-501 - I-501

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
C-501	L501 tuning	CAPACITOR: paper; 0.15 mmf p/m 10%; 10,000 wv	930 0035 00
C-502		Not used	
C-503	HV filter	CAPACITOR: paper; 4 mmf p/m 10%; 3000 wv	930 4340 00
C-504	HV filter	CAPACITOR: paper; 4 mmf p/m 10%; 3000 wv	930 4340 00
C-505	Screen supply filter	CAPACITOR: electrolytic; 40 mmf -15% +100%; 500 wv	183 1124 00
C-506	Regulated supply stabilizer	CAPACITOR: paper; 0.022 mmf p/m 10%; 400 wv	931 0291 00
C-507	Bias supply filter	CAPACITOR: electrolytic; 10 mf +50% -10%; 450 wv	183 1085 00
C-508	Bias supply filter	CAPACITOR: electrolytic; 10 mf +50% -10%; 450 wv	183 1085 00
C-509	LV supply filter	CAPACITOR: dry electrolytic; dual section 40 mf each section, -15% +100%; 450 dc working v	183 1009 00
C-510	Antenna relay supply filter	CAPACITOR: electrolytic; 10 mf +100% -10%; 150 wv	183 1040 00
CR-501	Antenna relay supply rectifier	RECTIFIER: metallic; selenium; input 130 v ac, 60 cps; output 52 v dc min	353 0186 00
E-501	HV output post	INSULATOR: standoff; round post shape; grade L-4 ceramic	190 0024 00
E-501A	HV terminal	STUD: cadmium plate, 10-32 stud, 1" long	312 3040 00
E-502	Ground terminal	STUD: cadmium plate, 10-32 stud, 1" long	312 3040 00
F-501	Plate transformer fuse	FUSE: cartridge; 20 amp,	264 4160 00
F-502	Plate and screen transformer fuse	FUSE: cartridge; 10 amp, 25 v	264 4140 00
F-503	Filament and blower fuse	FUSE: cartridge; 3 amp, 250 v	264 4080 00
F-504	Filament LV transformer fuse	FUSE: cartridge; 3 amp, 250 v	264 4080 00
F-505	Screen fuse	FUSE: cartridge; 1/4 amp	264 4020 00
F-506	HV plate fuse	FUSE: HV; 1 amp	264 0252 00
I-501	Filament pilot lamp	BULB: LIGHT; candelabra base	262 3320 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
I-502	Plate pilot lamp	BULB: LIGHT; candelabra base	262 3320 00
K-501	Plate contactor	RELAY: power; contact rating 15 amp; noninductive at 115 v ac	401 1194 00
K-502		Not used	
K-503	Time delay	RELAY: thermal; contact rating 3 amp 150 v dc, 3 amp 250 v ac	402 0211 00
L-501	HV filter choke	REACTOR: filter; 55 ohms nominal; 120 cps	668 0153 00
L-502	LV filter choke	REACTOR: filter choke; 4 hy, 230 ma, 100 ohm dc resistance; 1600 v rms test; enclosed metal case	668 0147 00
L-503	Screen filter choke	REACTOR: filter; 12 hy; 375 nominal ohm	668 0004 00
L-504	LV filter choke	REACTOR: filter choke; 4 hy, 230 ma, 100 ohm dc resistance; 1600 v rms test; enclosed metal case	668 0147 00
R-501	K503 heater series	RESISTOR: 4700 ohm p/m 10%; 2 w	745 9083 00
R-502	HV bleeder	RESISTOR: 25,000 ohm p/m 10%; 160 w	710 6254 00
R-503	HV bleeder	RESISTOR: 25,000 ohm p/m 10%; 160 w	710 6254 00
R-504	V504 plate	RESISTOR: 470,000 ohm p/m 10%; 1/2 w	745 1464 00
R-505	V504/V505 cathode series	RESISTOR: 4700 ohm p/m 10%; 2 w	745 5680 00
R-506	V504/V505 cathode series	RESISTOR: 4700 ohm p/m 10%; 2 w	745 5680 00
R-507	V504/V505 cathode series	RESISTOR: 3900 ohm p/m 10%; 2 w	745 5677 00
R-508	V504/V505 cathode series	RESISTOR: 3900 ohm p/m 10%; 2 w	745 5677 00
R-509	Screen adjust series	RESISTOR: 560,000 ohm p/m 10%; 1/2 w	745 1468 00
R-510	Screen adjust dropping	RESISTOR: 47,000 ohm p/m 10%; 2 w	745 5722 00
R-511	Screen adjust	RESISTOR: 25,000 ohm p/m 20%; 2 w	380 5765 00
R-512	Screen adjust divider	RESISTOR: 22,000 ohm p/m 10%; 1 w	745 3408 00
R-513	PA bias dropping	RESISTOR: 4700 ohm p/m 10%; 2 w	745 5680 00
R-514	PA bias divider	RESISTOR: 3300 ohm p/m 10%; 2 w	745 5673 00
R-515	PA bias adjust	RESISTOR: variable; comp; 5000 ohm p/m 20%; 2 w	380 0614 00

Section VI
R-516 - S-505

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
R-516	Plate meter shunt	RESISTOR: 50 ohm p/m 10%; 25 w	710 3502 00
R-517	Meter divider	RESISTOR: 1.0 megohm p/m 1%; 1/2 w	705 2203 00
R-518	Meter divider	RESISTOR: 1.0 megohm p/m 1%; 1/2 w	705 2203 00
R-519	Meter divider	RESISTOR: 1.0 megohm p/m 1%; 1/2 w	705 2203 00
R-520	Meter divider	RESISTOR: 1.0 megohm p/m 1%; 1/2 w	705 2203 00
R-521	Meter divider	RESISTOR: 1.0 megohm p/m 1%; 1/2 w	705 2203 00
R-522	Meter divider	RESISTOR: 10,000 ohm p/m 10%; 1 w	745 3394 00
R-523	V507 grid divider	RESISTOR: 12,000 ohm p/m 10%, 1 w	745 3398 00
R-524	TUNE-OPERATE screen dropping	RESISTOR: 27,000 ohm p/m 10%; 2 w	745 5712 00
R-525	V507 grid divider	RESISTOR: fixed, comp; 47,000 ohm p/m 10%; 1 w	745 3422 00
R-526	V507 grid divider	RESISTOR: 1.0 megohm p/m 10%; 500 ww	745 5778 00
R-527	V507 grid divider	RESISTOR: 1.0 megohm p/m 10%; 500 ww	745 5778 00
R-528	V507 grid series	RESISTOR: fixed, comp; 27,000 ohm p/m 10%; 1 w	745 3412 00
R-529	Bias supply filter	RESISTOR: fixed, comp; 470 ohm p/m 10%; 1/2 w	745 1338 00
R-530	Bias supply filter	RESISTOR: fixed, comp; 470 ohm p/m 10%; 1/2 w	745 1338 00
R-531	LV supply bleeder	RESISTOR: fixed, comp; 68,000 ohm p/m 10%; 2 w	745 5729 00
R-532	Ant relay supply filter	RESISTOR: 100 ohm p/m 10%; 1/2 w	745 1310 00
R-533	V507 bias series	RESISTOR: fixed, comp; 0.10 megohm p/m 10%; 1 w	745 3436 00
R-534	Surg damper	RESISTOR: fixed, 50 ohms $\pm 10\%$, 10w	710 1502 00
S-502	PLATE switch	SWITCH: toggle; SPST	266 3005 00
S-503	Door interlock	SWITCH: interlock	
S-503A	p/o S503	SWITCH: interlock; 2 male contact	260 4040 00
S-503B	p/o S503	SWITCH: interlock; 2 female contact	260 4050 00
S-504	FILAMENT switch	SWITCH: DPST; toggle	266 3057 00
S-505		Not used	

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
S-506	FILAMENT VOLTAGE	SWITCH: rotary; 1 circuit, 7 position, nonshorting	259 0665 00
S-507	S-507A and S-507B		
S-507A	Part of HV grounding interlock	WASHER: contact; cad plate, brass, 2" lg x 3/4" thk	504 9553 001
S-507B	Part of HV grounding interlock	BRACKET: shorting; steel-cold rolled, bright cad plate	540 5441 002
S-508	Rear-door interlock	SWITCH: interlock	
S-508A	p/o S-508	SWITCH: interlock; 2 male contact	260 4040 00
S-508B	p/o S-508	SWITCH: interlock; 2 female contact	260 4050 00
T-501	PA filament	TRANSFORMER: filament; pri 115 v, secd 6.3 v, 6.6 amp; 1000 TV, 50/60 cps	662 0156 00
T-502	HV rectifier filament	TRANSFORMER: power; fil type; input 115 v or 230 v; single output winding; output 2.5 v center tapped input 2500 v rms test	672 0399 00
T-503	HV plate	TRANSFORMER: plate; input 115 v or 230 v rms, 50/60 cps, single phase; 5000 TV	662 0155 00
T-504	Screen power	TRANSFORMER: power pri 115 v, secd 980 v ct; 1900 TV, 50/60 cps	662 0157 00
T-505	Filament	TRANSFORMER: filament; pri 107 v, secd #1: 5 v, 4.0 amp, secd #2: 6.3 v, 3.6 amp; 2500 TV; 50/60 cps	662 0158 00
T-506	Low voltage supply	TRANSFORMER: power; filament and plate type, pri 115 v, secd #1: 1840 v, 225 MADDC, ct; secd #2: 400 v 10 MADDC; secd #3: 5.0 v, 4.0 A p/m 3%, secd #4: 6.6 v, 9.0 A p/m 3%; secd #5: 12.6 v, 0.3 A, p/m 5%; 1600 rms test	662 0146 00
TB-501	Output connector	TERMINAL STRIP: 10 term	367 0438 00
TB-502	Low voltage output connector	TERMINAL STRIP: 10 term	367 0438 00
TB-503	Line input connector	TERMINAL STRIP: 3 term	367 0643 00
TB-504	External functions connector	TERMINAL STRIP: 16 term	367 0444 00
TB-505	Blower connector	TERMINAL STRIP: 2 term	367 0001 00
V-501	HV rectifier	TUBE: 866A/866	256 0049 00

Section VI
V-502 - XV-508

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NO.
V-502	HV rectifier	TUBE: 866A/866	256 0049 00
V-503	Screen rectifier	TUBE: 5Y3GT	255 0157 00
V-504	Screen regulator	TUBE: 6AS7G	255 0203 00
V-505	Screen regulator	TUBE: 12AX7	255 0201 00
V-506	Screen regulator	TUBE: OB2	257 0058 00
V-507	Screen protect	TUBE: 2D21	257 0065 00
V-508	LV rectifier	TUBE: 5U4GB	257 0109 00
V-509	Bias rectifier	TUBE: 2X2/879	257 0019 00
XC-509	For C505 and C509	WASHER: special type; phenolic used for mounting 1-3/8 in. dia electrolytic capacitor	310 0064 00
XF-501	Holder for F501	HOLDER: fuse; extractor post type; for 3AG fuse	265 1002 00
XF-502	Holder for F502	HOLDER: fuse; extractor post type; for 3AG fuse	265 1002 00
XF-503	Holder for F503	HOLDER: fuse; extractor post type; for 3AG fuse	265 1002 00
XF-504	Holder for F504	HOLDER: fuse; extractor post type; for 3AG fuse	265 1002 00
XF-505	Holder for F505	HOLDER: fuse; extractor post type; for 3AG fuse	265 1002 00
XK-503	Socket for K503	SOCKET: tube; octal	220 1005 00
XI-501	Holder for I501	LAMPHOLDER: candelabra	262 0255 00
XI-502	Holder for I502	LAMPHOLDER: candelabra	262 0255 00
XV-501	Socket for V501	SOCKET: tube; 4 prong bayonet lock	220 1218 00
XV-501B	Part of XV501	COVER: tube socket	220 1219 00
XV-502	Socket for V502	SOCKET: tube; 4 prong bayonet lock	220 1218 00
XV-502B	Part of XV502	COVER: tube socket	220 1219 00
XV-503	Socket for V503	SOCKET: tube; 8 prong octal	220 1005 00
XV-504	Socket for V504	SOCKET: tube; 8 prong octal	220 1005 00
XV-505	Socket for V505	SOCKET: tube; 9 contact miniature	220 1103 00
XV-506	Socket for V506	SOCKET: tube; 7 contact miniature	220 1111 00
XV-507	Socket for V507	SOCKET: tube; 7 contact miniature	220 1112 00
XV-508	Socket for V508	SOCKET: tube; 8 prong octal	220 1005 00

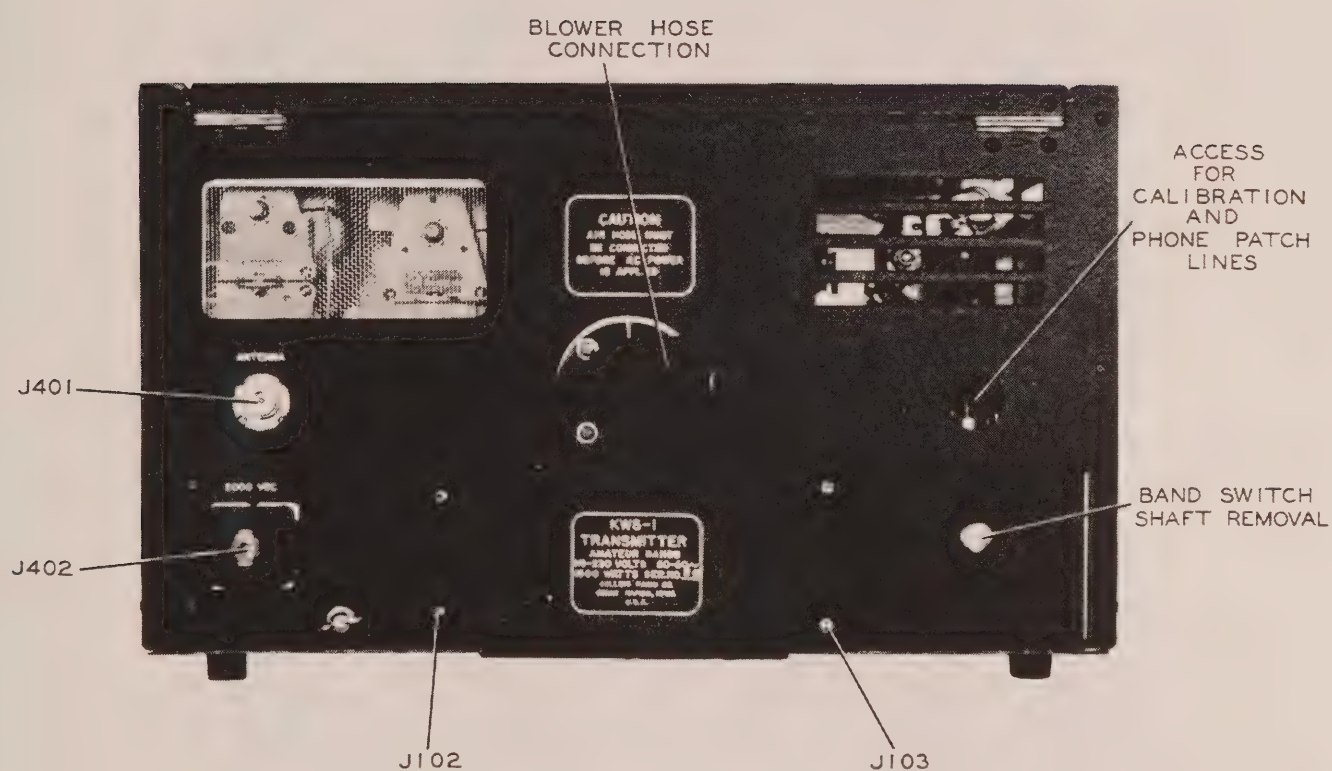


Figure 6-1. Exciter/Power Amplifier, Rear Panel

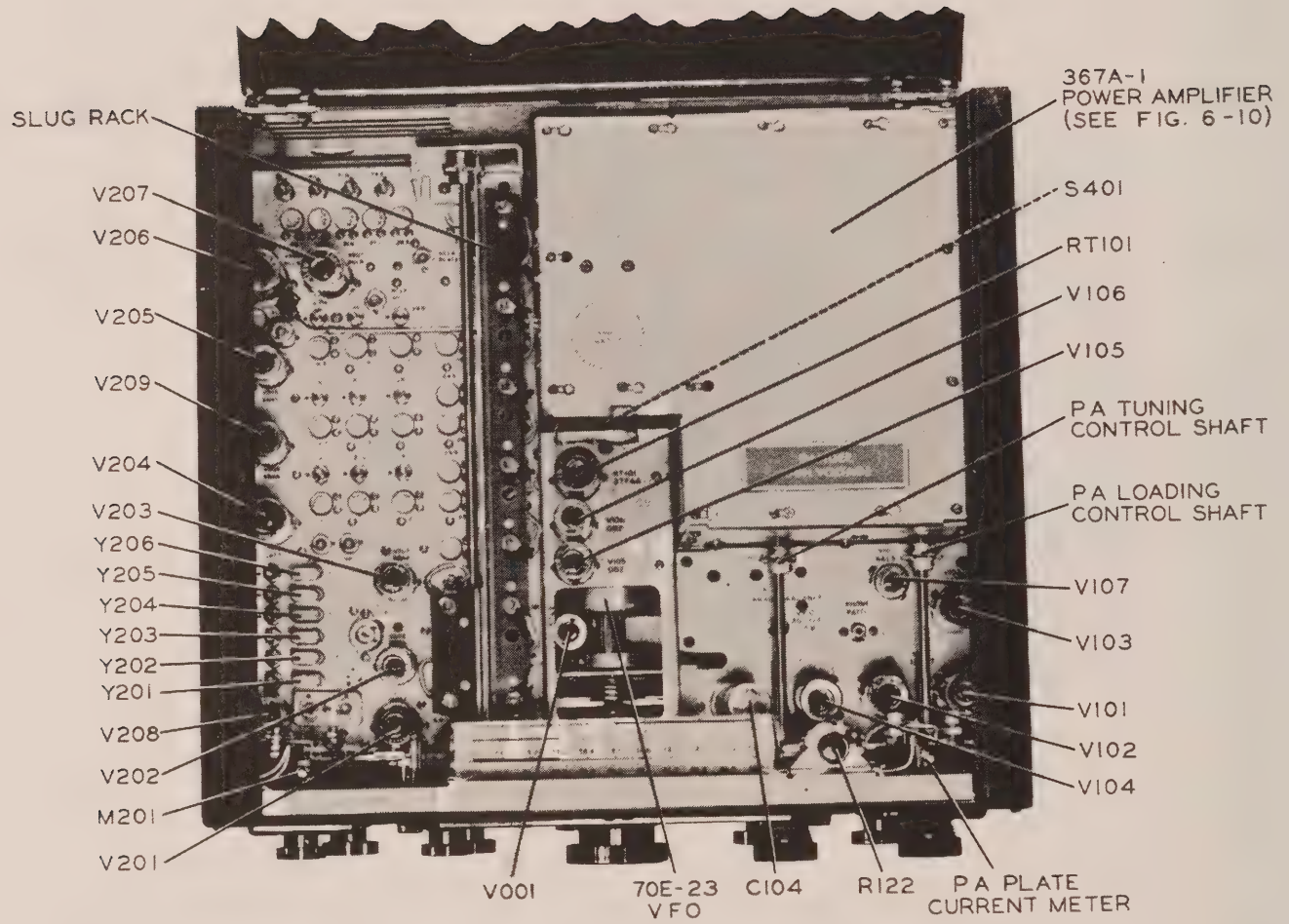


Figure 6-2A. Exciter/Power Amplifier, Top View, Top Cover Open

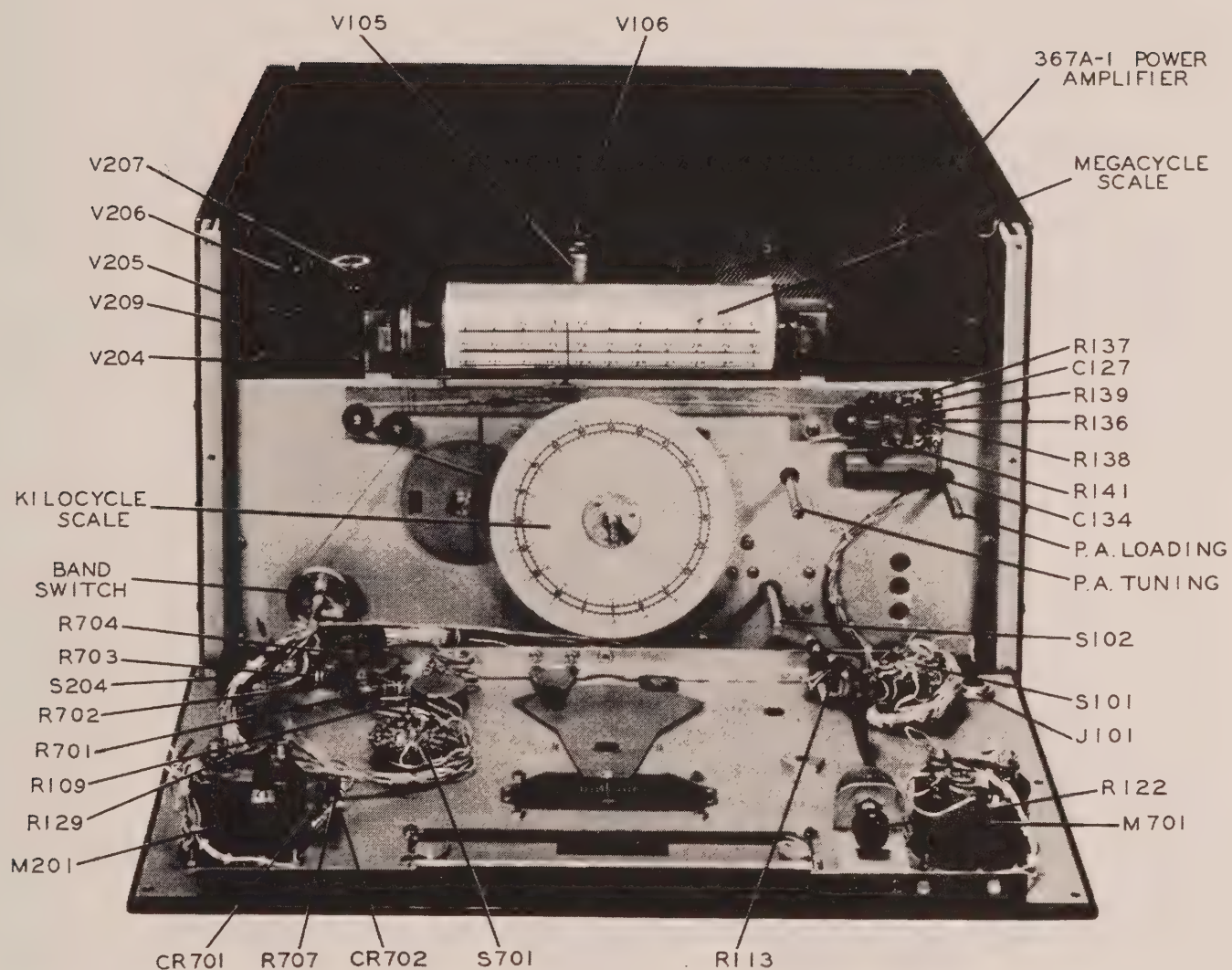


Figure 6-3. Exciter/Power Amplifier, Front Panel, Internal View

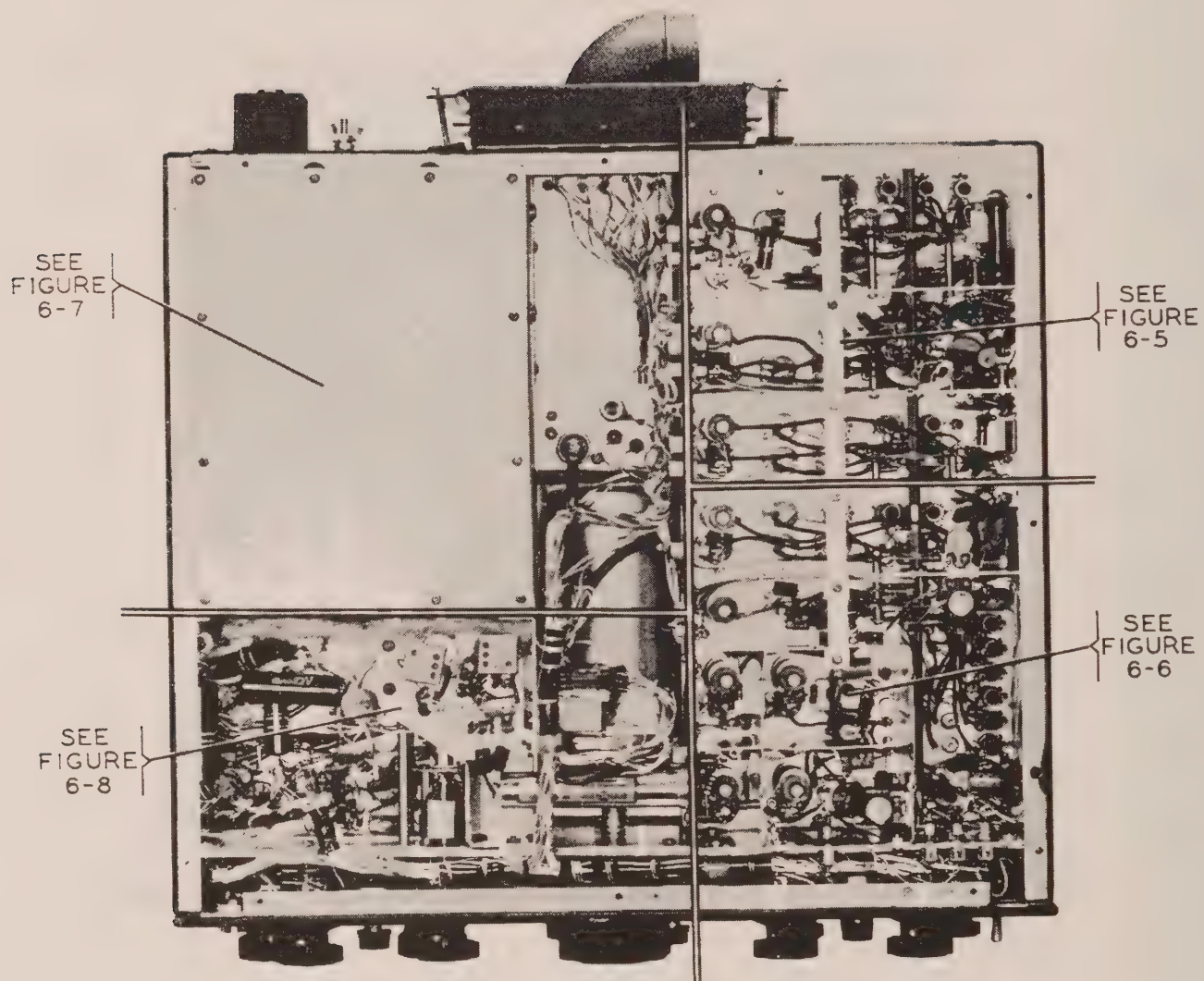


Figure 6-4. Exciter/Power Amplifier, Bottom View, Cover Removed

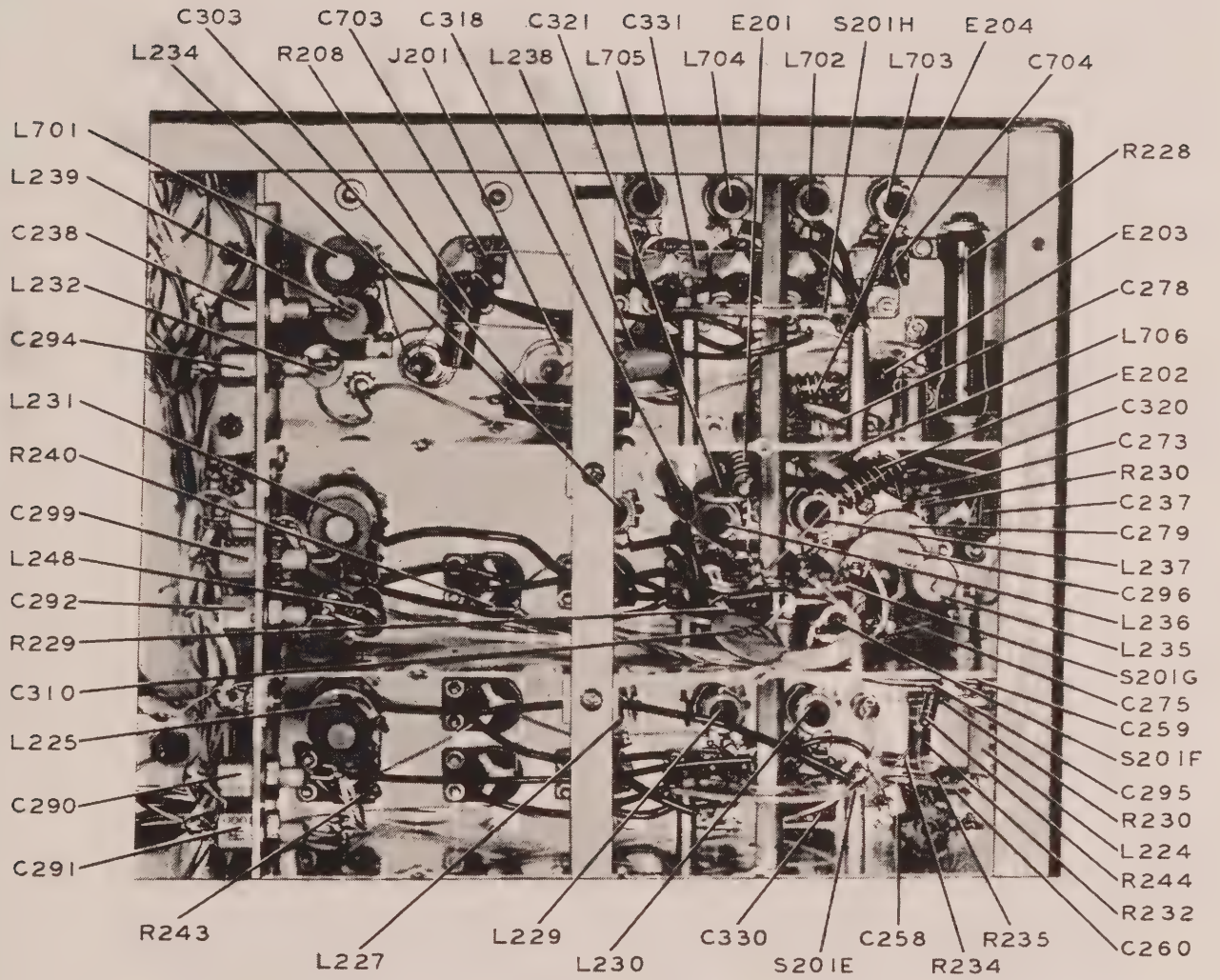


Figure 6-5. Exciter, Bottom View, (Upper Right Quarter)

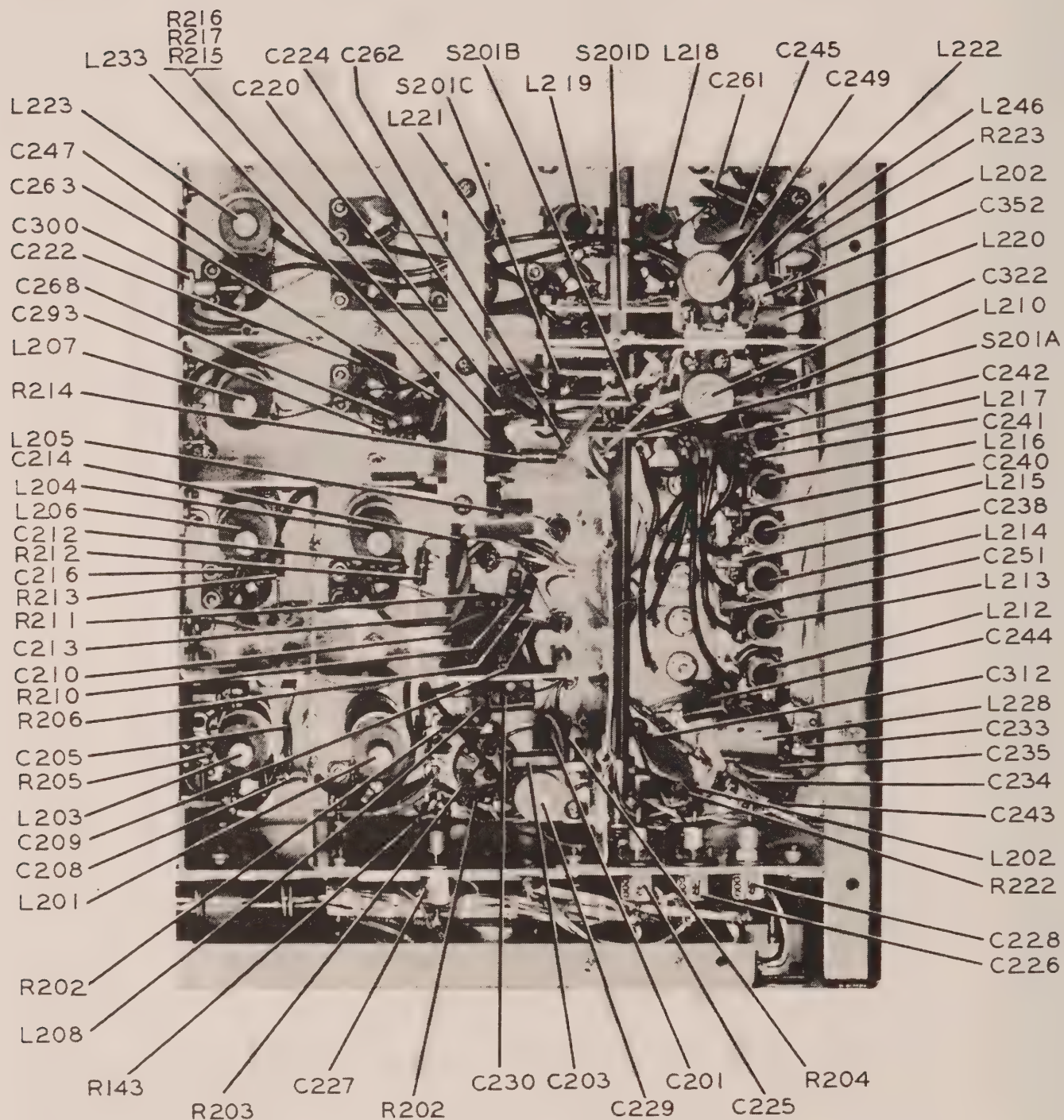


Figure 6-6. Exciter, Bottom View, Lower Right Quarter

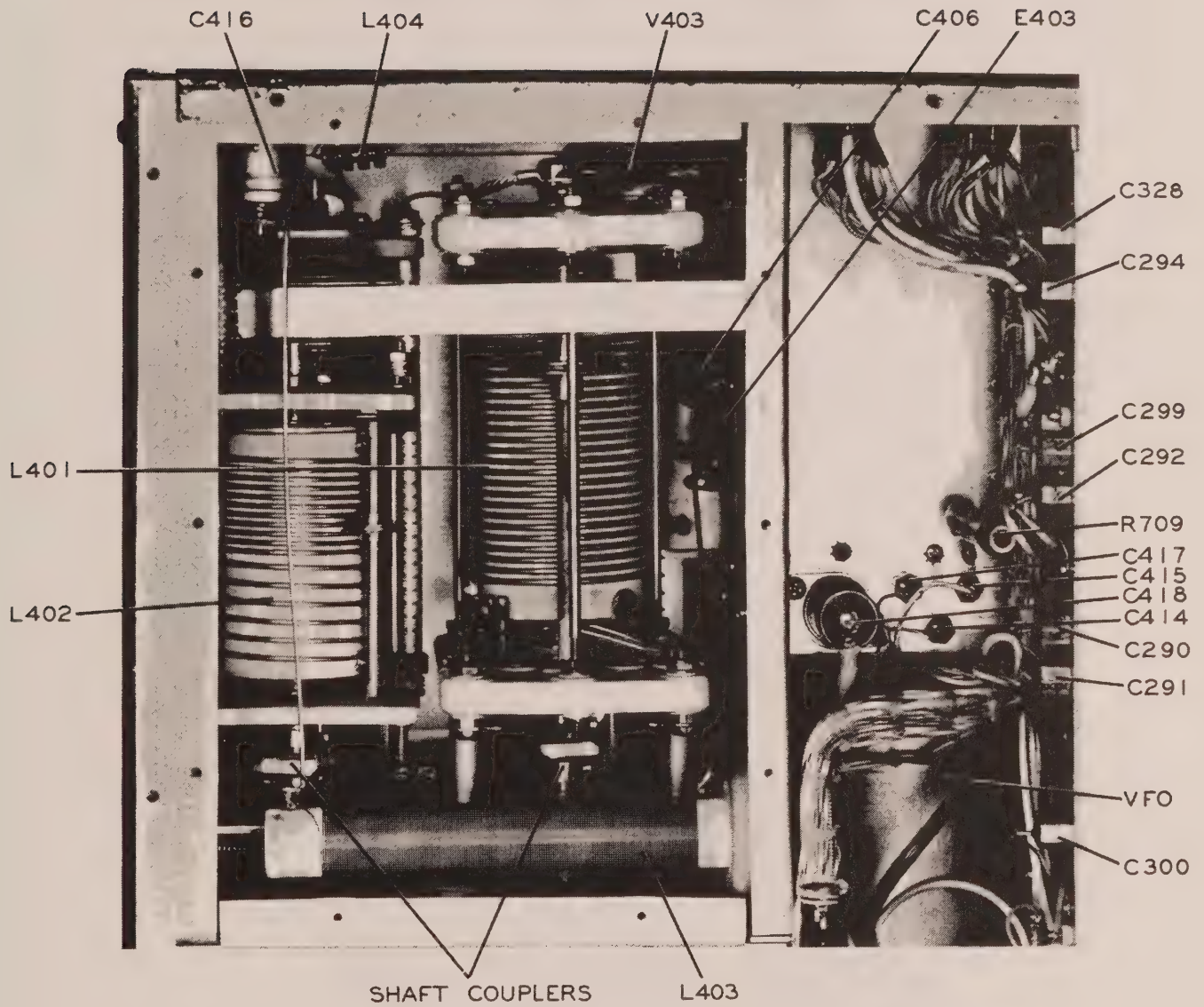


Figure 6-7. Exciter, Bottom View, Upper Left Quarter, Including Power Amplifier

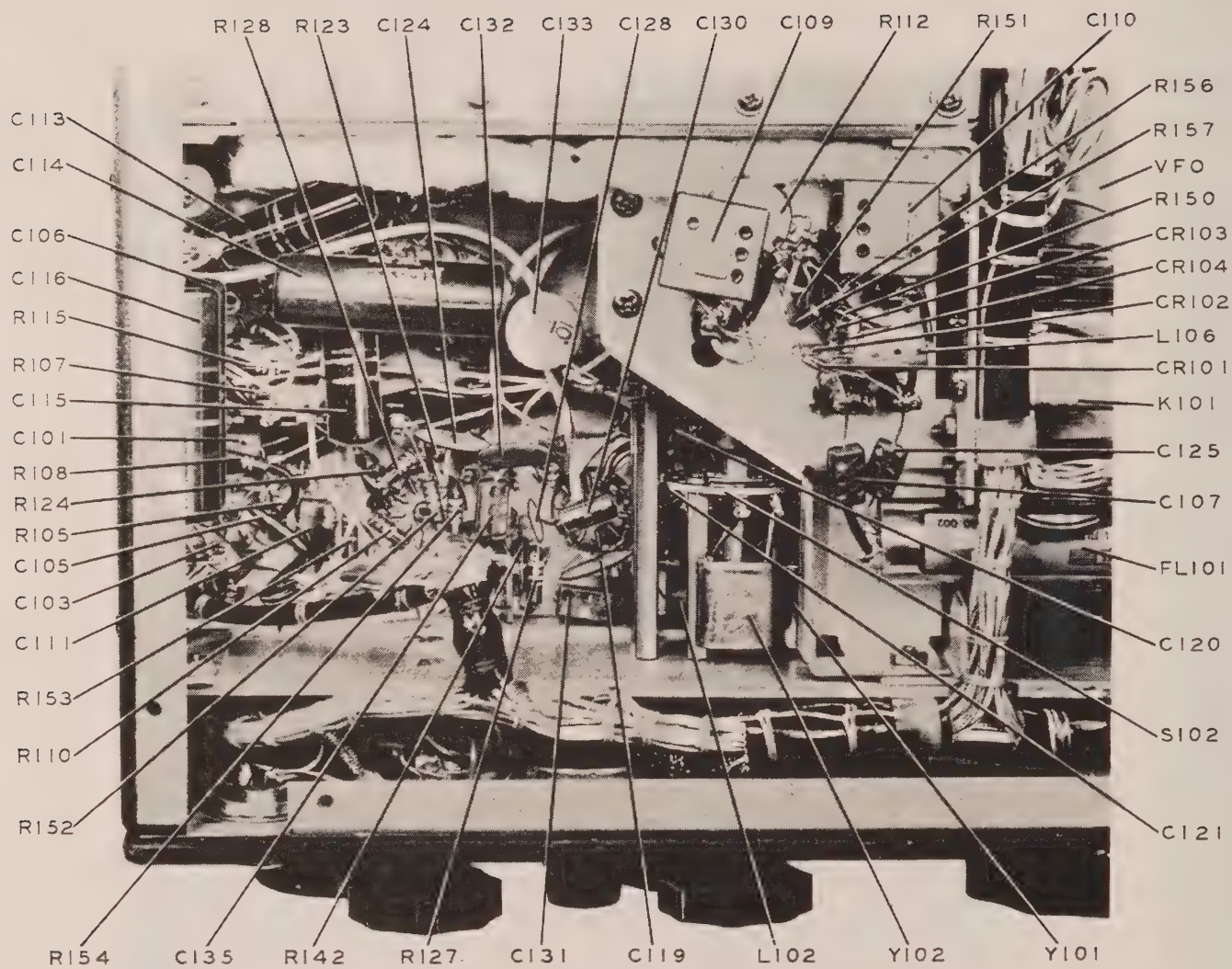


Figure 6-8. Exciter, Bottom View, Lower Left Quarter

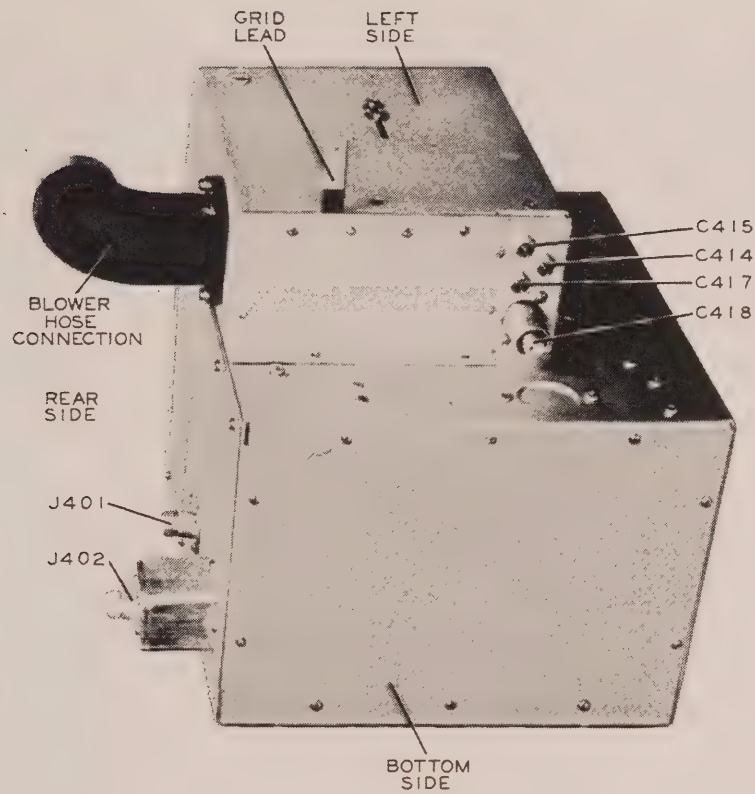


Figure 6-9. Power Amplifier, Bottom-Rear-Left View

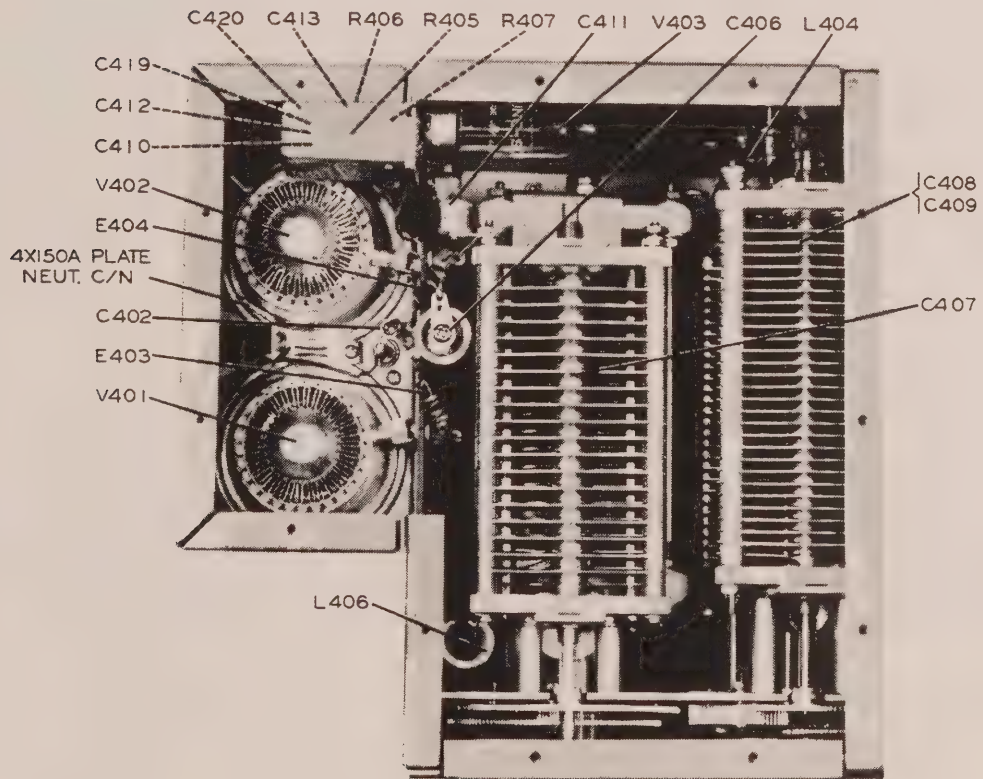


Figure 6-10. Power Amplifier, Top View, Cover Removed

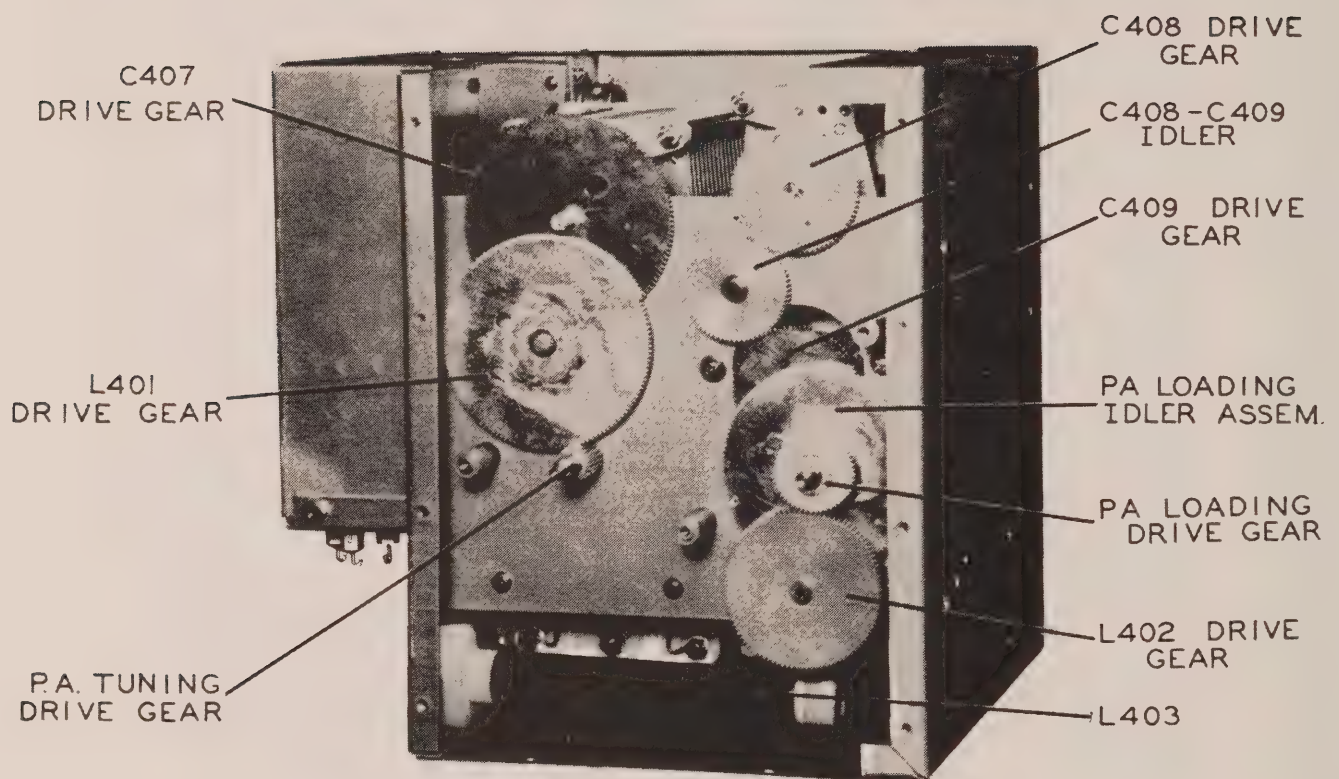


Figure 6-11. Power Amplifier, Front View, Cover Removed

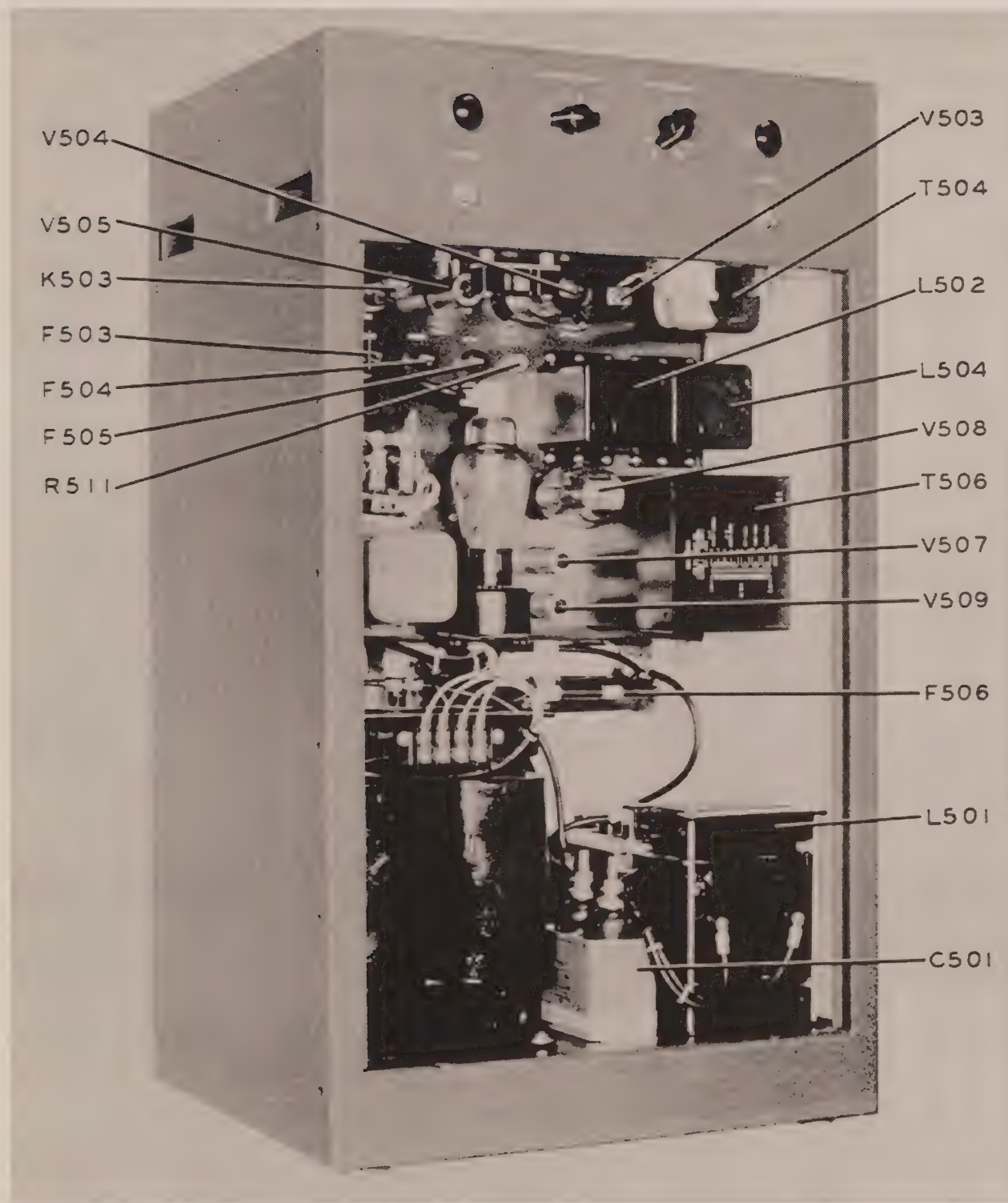


Figure 6-12. Power Supply, Front Left Oblique View, Panel Removed

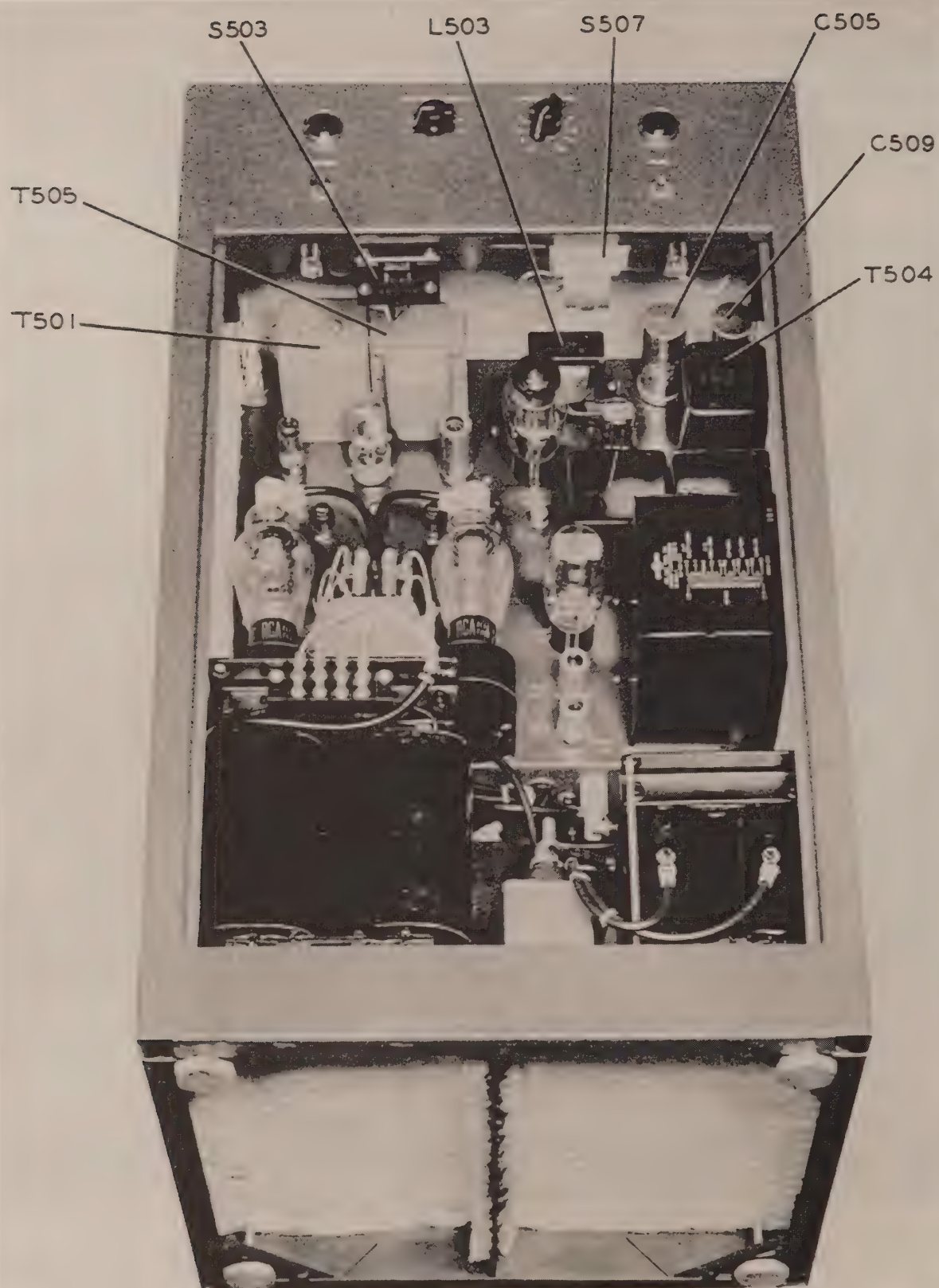


Figure 6-13. Power Supply, Front Vertical Oblique View, Panel Removed

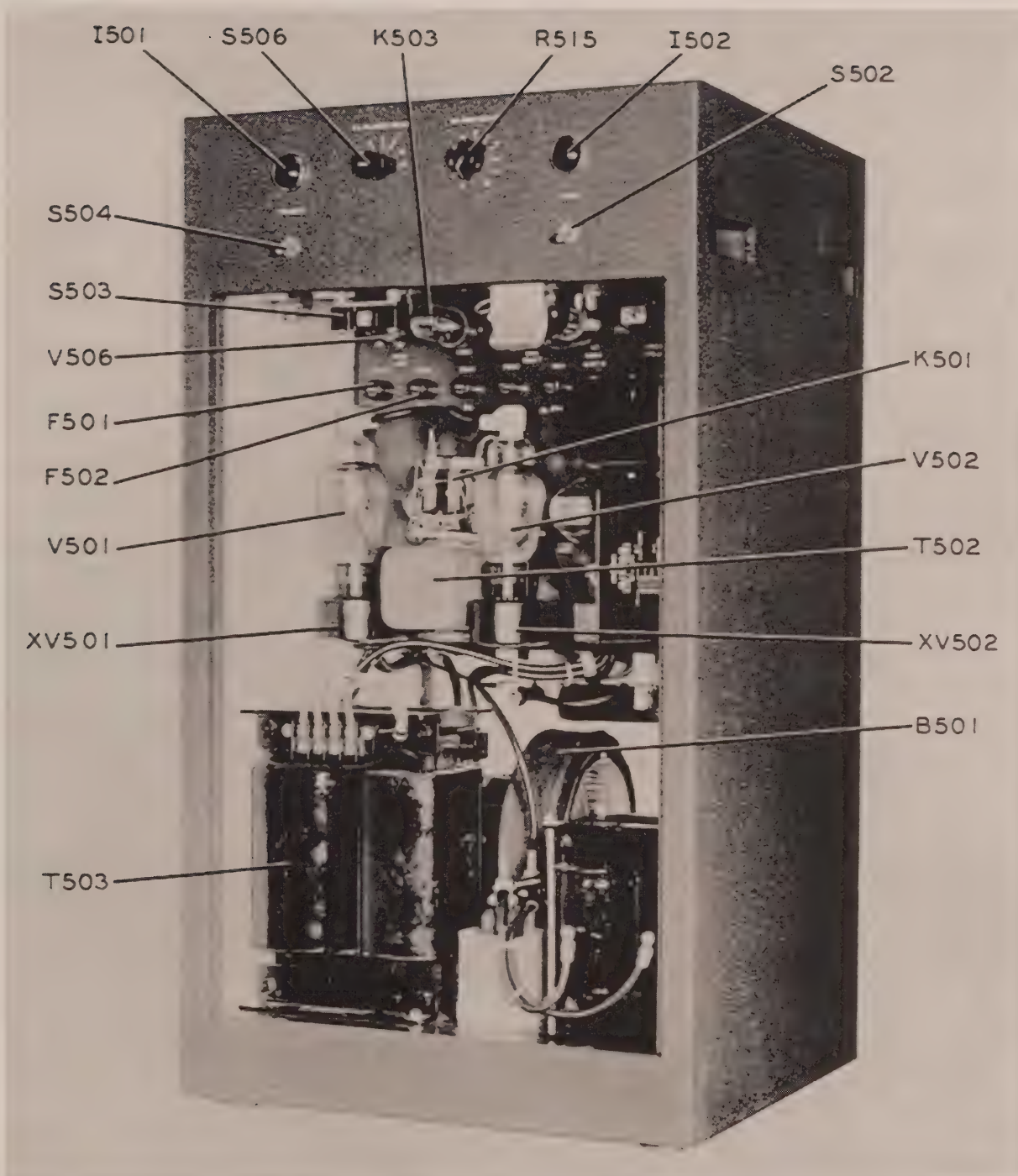


Figure 6-14. Power Supply, Front Right Oblique View, Panel Removed

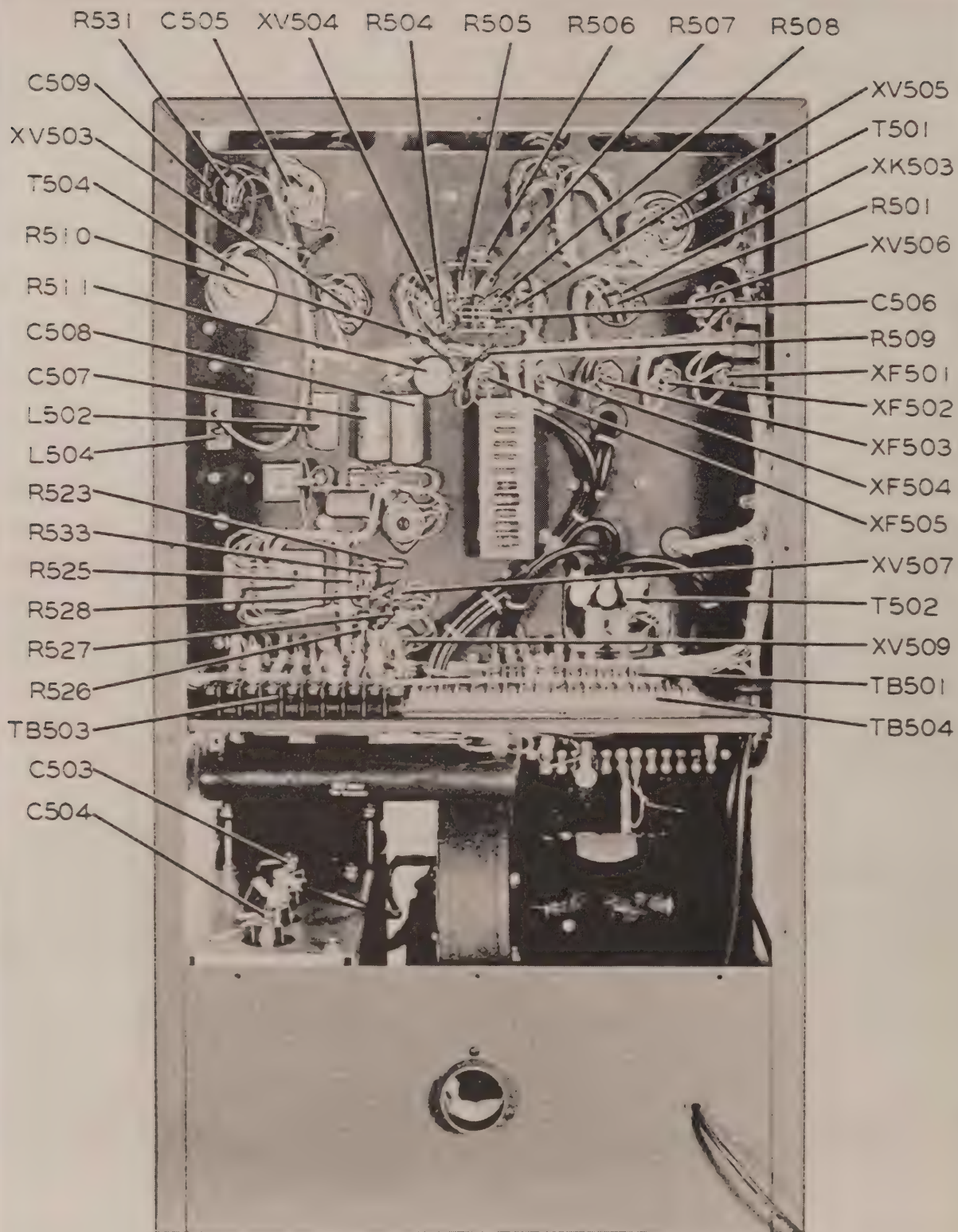


Figure 6-15. Power Supply, Rear View, Panel Removed

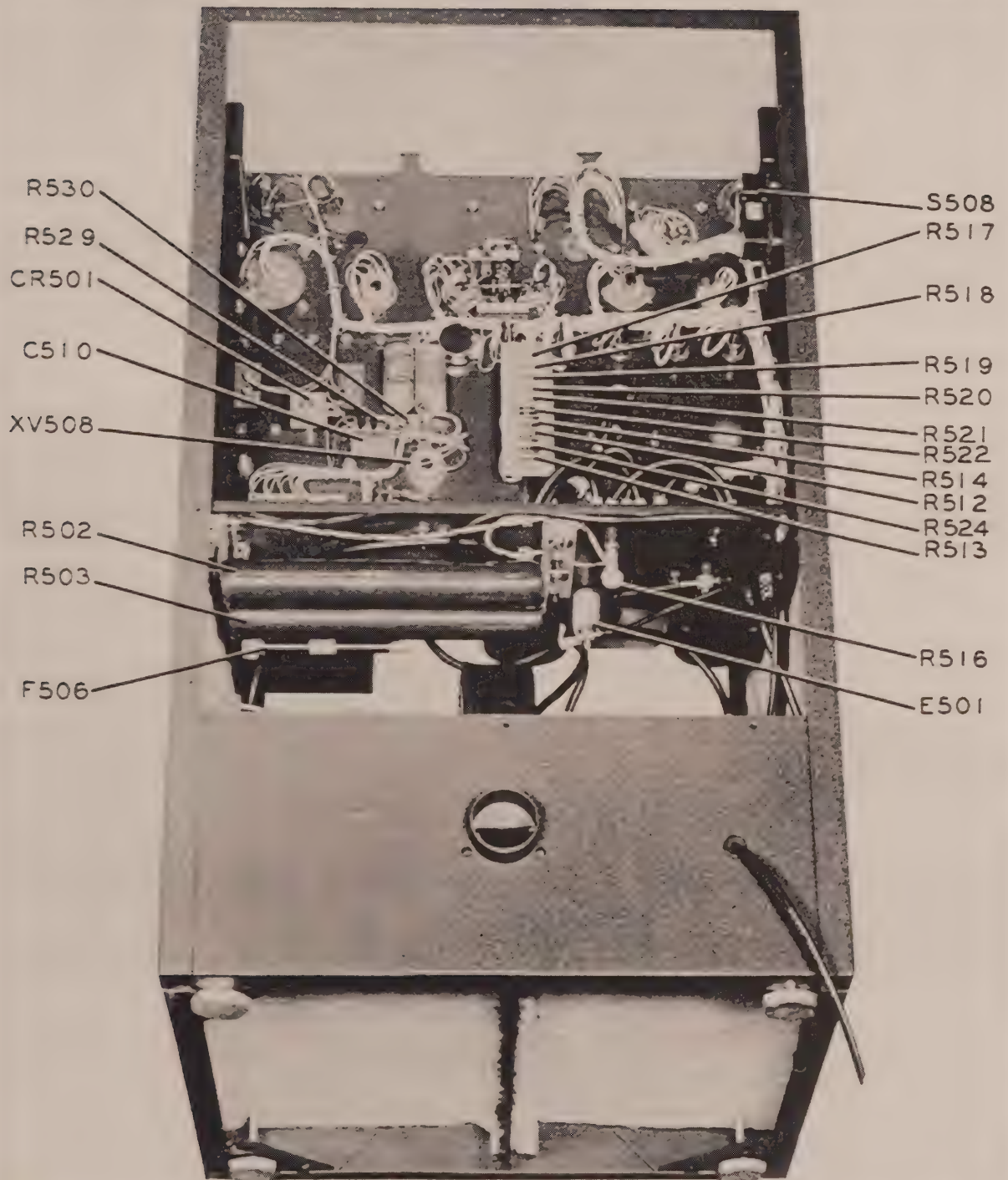


Figure 6-16. Power Supply, Rear Oblique View, Panel Removed

SECTION VII

ILLUSTRATIONS

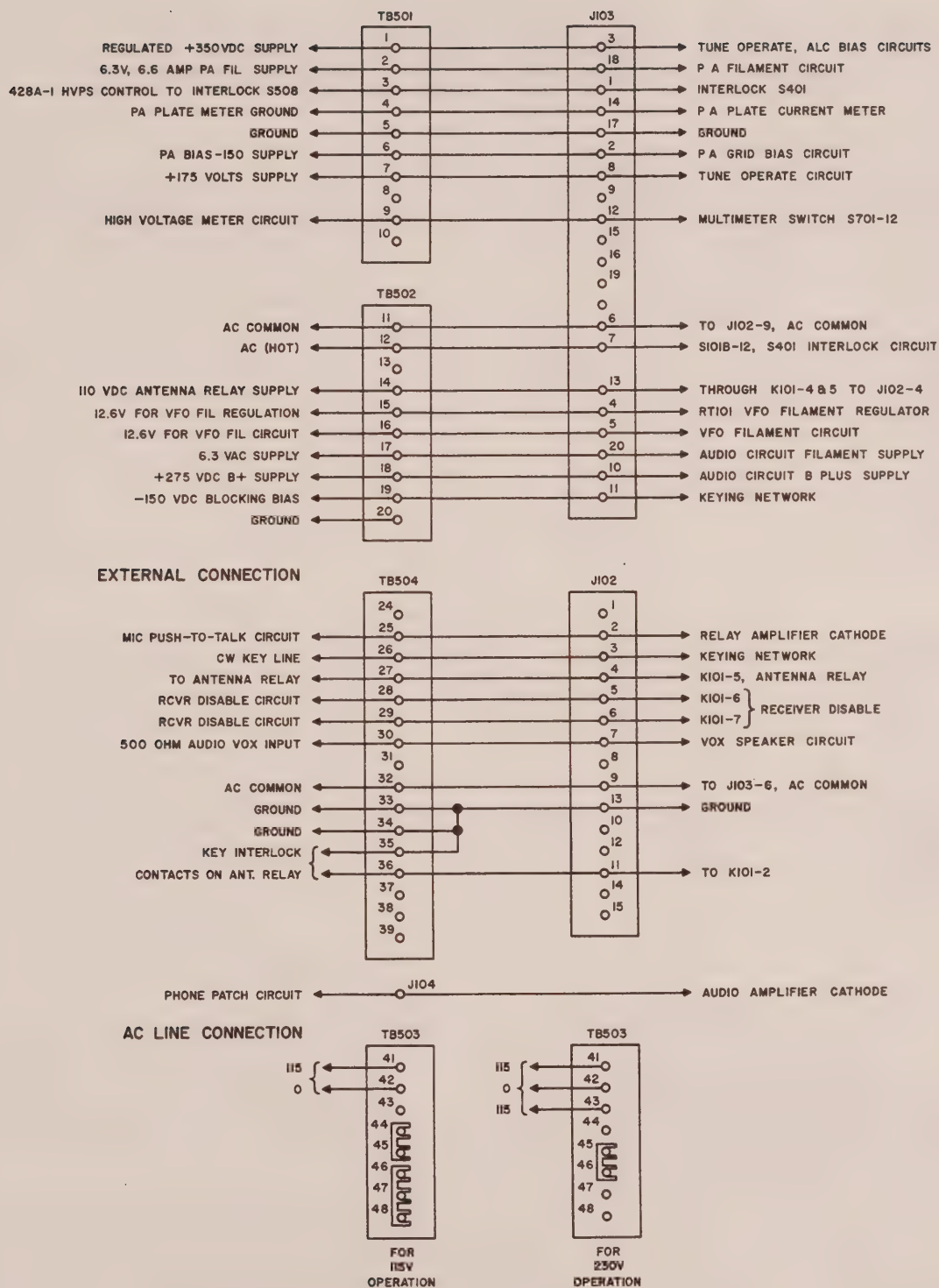
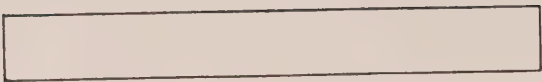
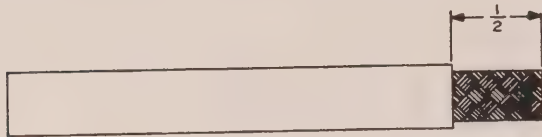


Figure 7-3. Interconnecting Cable Wiring Diagram

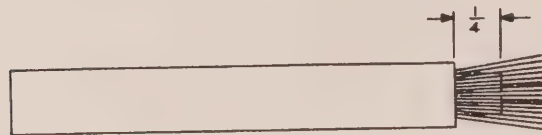
Section VII



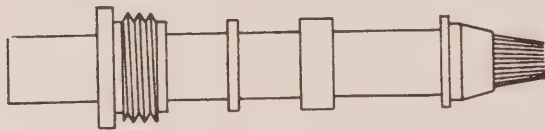
CUT END OF CABLE EVEN.



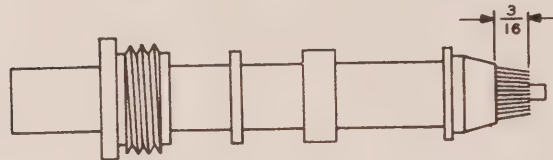
REMOVE VINYL JACKET $\frac{1}{2}$ INCH —
DON'T NICK BRAID.



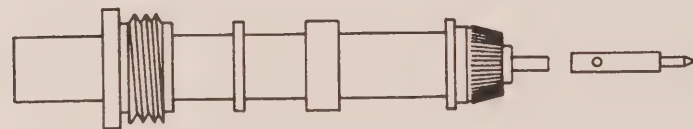
COMB OUT COPPER BRAID AS SHOWN.
BARE $\frac{1}{4}$ INCH OF CENTER CONDUCTOR—
DON'T NICK CONDUCTOR.



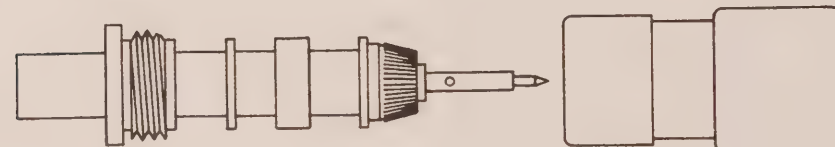
TAPER BRAID AS SHOWN. SLIDE NUT,
WASHER AND GASKET ON VINYL JACKET.
SLIDE CLAMP ON BRAID.



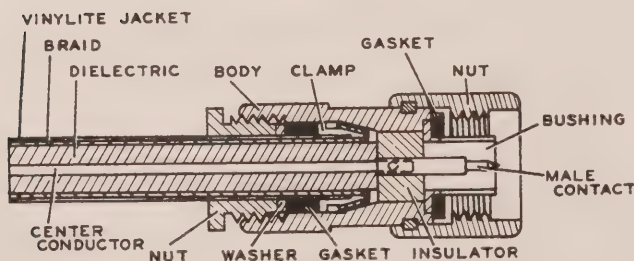
WITH CLAMP IN PLACE, TRIM BRAID
AS SHOWN.



FOLD COPPER BRAID BACK ON CLAMP.
TIN CENTER CONDUCTOR,
USING MINIMUM AMOUNT OF
HEAT.



HOLDING CONTACT WITH PLIERS,
SOFT SOLDER CONTACT TO
CENTER CONDUCTOR. IT IS
IMPERATIVE THAT BACK END
OF CONTACT BE FLUSH WITH
POLYETHYLENE DIELECTRIC. DO
NOT USE EXCESS SOLDER. WIPE
CLEAN—SEE THAT END OF
CABLE INSULATOR IS CLEAN
AND FREE OF SOLDER, ROSIN
AND FOREIGN MATERIAL.



SLIDE BODY INTO PLACE CAREFULLY SO
THAT CENTER CONDUCTOR ENTERS HOLE
IN INSULATOR. FACE OF CABLE DIE-
LECTRIC MUST FIT FLUSH AGAINST IN-
SULATOR. PROPERLY TIGHTEN BODY
AND NUT WITH WRENCHES.

NOTES: 1. THIS ASSEMBLY PROCEDURE APPLIES
TO TYPE N PLUGS. THE PROCEDURE
FOR JACKS IS THE SAME EXCEPT
FOR THE USE OF A FEMALE CONTACT
AND A JACK BODY.

Figure 7-4. RG-8/U Cable Assembly to Connectors

SECTION VIII

ANTENNAS WITH 52-OHM COAXIAL FEED LINES

8.1. GENERAL.

This section pertains to some antennas which may be used with the KWS-1 Transmitter.

The advantages of using these antennas are listed below:

(a) Broadband.

(b) Coaxial feed system provides shielding for better signal-to-noise ratio at the receiver input terminals.

(c) The half-wave dipole antennas attenuate spurious radiation and the half-wave dipole feed lines attenuate spurious radiation at TV frequencies.

(d) No added tuning controls are necessary.

(e) Coaxial connectors provide a convenient means of transferring antennas.

8.2. ANTENNA DETAILS.

The table following gives the nominal performance expected from the antennas described in this section.

TABLE 8-1

NOMINAL ANTENNA PERFORMANCE SPECIFICATIONS

	FIGURE 8-2	FIGURE 8-3	FIGURE 8-4	FIGURE 8-5
ANTENNA ITEM	10-Meter Beam	20-Meter Beam	40-Meter Dipole	80-Meter Dipole
Frequency range	29.96 to 29.7 mc	14.0 to 14.4 mc	7.0 to 7.3 mc	3.5 to 4.0 mc
Front to back ratio	4 to 1	10 to 1	----	----
Gain over half-wave dipole	6.75 db	5.1 db	----	----
SWR	1.1 at band ctr. 2.1 at band ends	1.8 at band ends	1.8 at band ends	2.5 at band ends

The KWS-1 Amateur Transmitter is designed with an unbalanced output to secure the advantages of pi and L networks.

The KWS-1 Amateur Transmitter antenna output circuits are designed to work into an unbalanced resistive load of 52 ohms with a maximum standing wave ratio of 2.5 to 1. Hence, the transmission line must incorporate a method of line balancing in order to match between the unbalanced output circuits and a balanced radiator. Figures 8-2 and 8-3 show

construction details of beams for use on 10 or 11 and 20 meters. Each beam is constructed with a balanced to unbalanced transformer (balun) to match the beams to a coaxial feed line. Figures 8-4 and 8-5 show construction details of horizontal dipoles for use on 40 and 80 meters. Each dipole is constructed with a balun to match the dipole to a coaxial feed line. If it is desired to use shorter length baluns than those shown for the 40 and 80-meter dipoles, refer to figure 8-6, Short Balun for 40 80 Meters.

Section VIII
Paragraphs 8.2. - 8.4.

The 100 mmf ceramic capacitor used in the 10 and 20-meter beams is described below. The r-f current flowing in this capacitor at 10 meters is 6 amperes; at 20 meters, 3 amperes.

CAPACITOR: Ceramic, 100 mmf $\pm 10\%$, 5000-vdcw. Collins part number 913 0821 00 or Centralab Type 850A.

8.3. TRANSMISSION LINE.

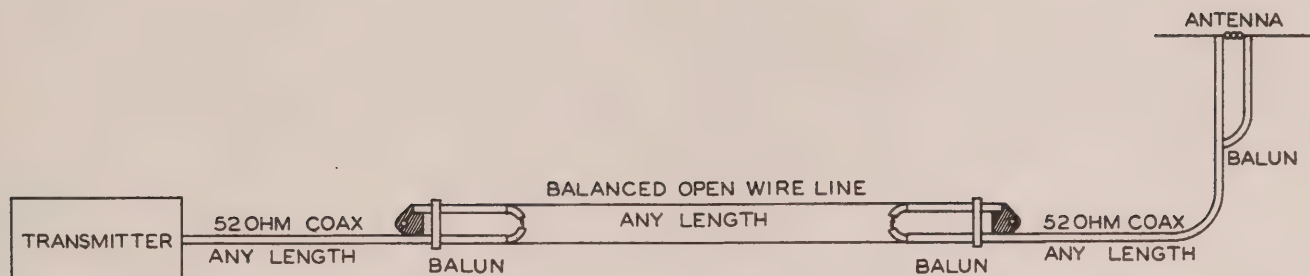
At some installations a long transmission line will be necessary. For lowest transmission line losses, a high impedance open wire balanced line is recommended. To secure the advantage of the low losses of an open wire line, it is necessary to use an unbalanced to balanced impedance matching transformer (balun) to transfer from the unbalanced low impedance output termination, provided on the transmitters to a high impedance open wire balanced

line. Figure 8-1 indicates the construction details of a balun for this purpose.

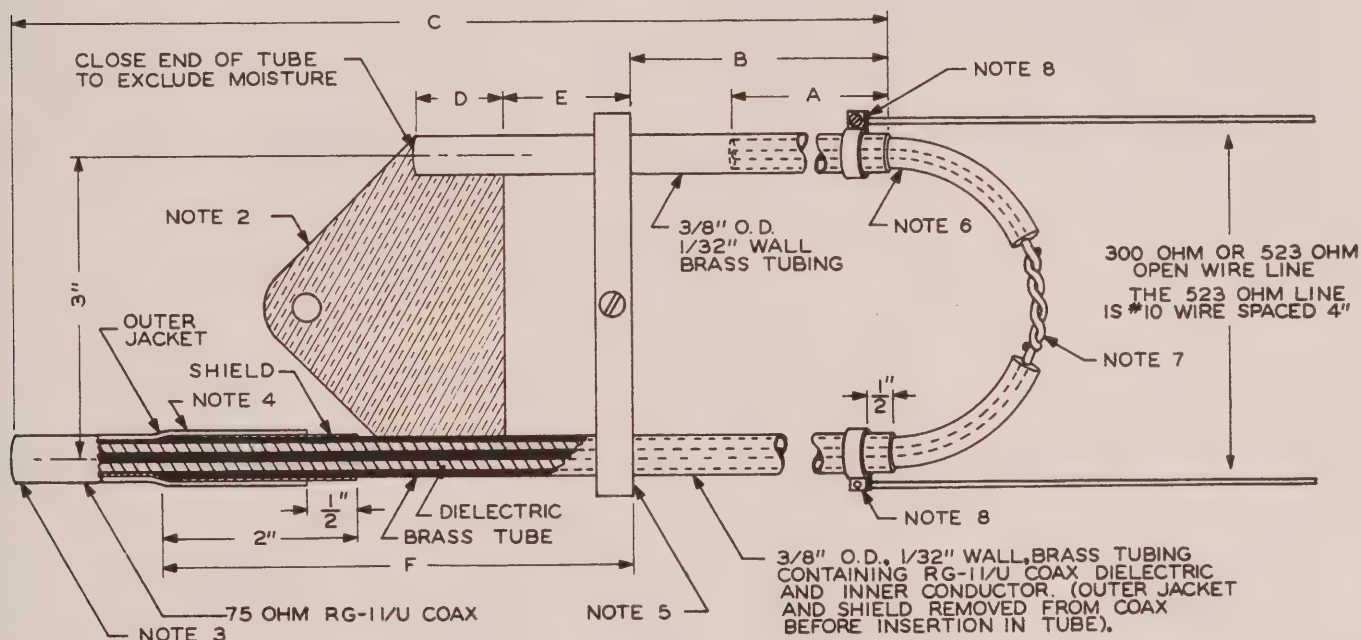
8.4. TEST INFORMATION.

All baluns mentioned in this discussion are resonant circuits. The baluns are cut to operate at the center frequency of the band specified.

If it is desired to check any balun, disconnect the antenna from the balun, and the center conductor of the feed cable from the shield of the opposite cable. Use a grid dip meter, or other means, to check for resonance. If the balun is off frequency, correction may be made by either changing the length of the balun or changing the value of the capacity used. The resonant frequency may also be varied by altering the spacing between cables. The length of the balun must not exceed one quarter wavelength, and baluns shorter than those given in figure 8-6 are not recommended.



THIS SYSTEM PERMITS USE OF A BALANCED OPEN WIRE LINE TO REDUCE LOSSES ON LONG TRANSMISSION LINES. CONSTRUCTION DETAILS OF THE UNBALANCED TO BALANCED IMPEDANCE MATCHING TRANSFORMER (BALUN) USED BETWEEN THE OPEN WIRE LINE AND THE 52 OHM RG-8/U COAXIAL CABLE ARE SHOWN BELOW.



NOTES:

- | FREQ.
MC. | OPEN WIRE
LINE
IMPEDANCE | LENGTH - INCHES | | |
|--------------|--------------------------------|-----------------|--------|--------|
| | | A | B | C |
| 27 TO 29.7 | 300 OHMS | 15 3/8 | 38 1/4 | 69 5/8 |
| 27 TO 29.7 | 523 OHMS | 10 5/8 | 44 1/2 | 69 5/8 |
| 14 TO 14.3 | 523 OHMS | 21 1/4 | 92 1/4 | 139 |

DIMENSIONS D, E, AND F ARE NOT CRITICAL AND MAY BE ADAPTED TO THE INDIVIDUAL INSTALLATION. DIMENSION D SHOULD BE LONG ENOUGH TO PERMIT SILVER SOLDERING BRASS PLATE AND TUBES TOGETHER. DIMENSION E SHOULD BE LONG ENOUGH TO PERMIT ADJUSTMENT OF THE SHORTING BAR. DIMENSION F SHOULD BE LONG ENOUGH TO PROVIDE SUFFICIENT OVERHANG FOR CONNECTING THE RG-11/U CABLE.
- BRASS PLATE OF CONVENIENT SIZE SILVER SOLDERED TO THE TWO BRASS TUBES. PLATE MAY BE GROUNDED OR UNGROUNDED AND IS DESIGNED TO SECURE THE BALUN TO AN END SUPPORT.
- ATTACH A COAX CONNECTOR HERE TO PERMIT ATTACHING A LENGTH OF 52 OHM RG-8/U COAX.
- REMOVE OUTER JACKET AND SHIELD FROM A LENGTH OF RG-11/U 75 OHM COAXIAL CABLE. CUT THE OUTER JACKET 1/2 INCH SHORTER THAN THE SHIELD. BEVEL THE OUTER EDGE OF THE 3/8" O.D. BRASS TUBE. SLIDE THE DIELECTRIC INSIDE THE TUBE. FORCE THE BEVELED END OF THE BRASS TUBE BETWEEN THE DIELECTRIC AND THE SHIELD FOR A DISTANCE OF ABOUT 2 INCHES AS SHOWN. SOLDER THE SHIELD TO THE TUBE, USING A MINIMUM AMOUNT OF HEAT TO AVOID DAMAGING THE DIELECTRIC. COVER THE AREA WITH SCOTCH ELECTRICAL TAPE TO EXCLUDE MOISTURE.
- THIS SHORTING BAR SHOULD BE MOVABLE TO PERMIT ADJUSTING THE BALUN TO REDUCE THE OVERALL STANDING WAVE RATIO OF THE SYSTEM.
- REMOVE THE OUTER JACKET AND SHIELD FROM A LENGTH OF RG-8/U 52 OHM COAX. INSERT THE PROPER LENGTH OF BARE DIELECTRIC INSIDE THE TUBE.
- SOLDER INNER CONDUCTORS TOGETHER. COVER THE TUBE ENDS AND ALL OF THE CABLE BETWEEN WITH A CONTINUOUS WRAPPING OF SCOTCH ELECTRICAL TAPE TO EXCLUDE MOISTURE.
- INSTALL A BRACKET FOR ATTACHING THE OPEN WIRE LINE. IF BRACKET IS SOLDERED, BE VERY CAREFUL TO AVOID OVERHEATING AND DAMAGING THE DIELECTRIC.

BALUN WITH BALANCED OPEN WIRE LINE FOR REDUCTION OF LOSSES ON LONG TRANSMISSION LINES.

Figure 8-1. Balun With Balanced Open Wire Line for Reduction of Losses on Long Transmission Lines

Section VIII

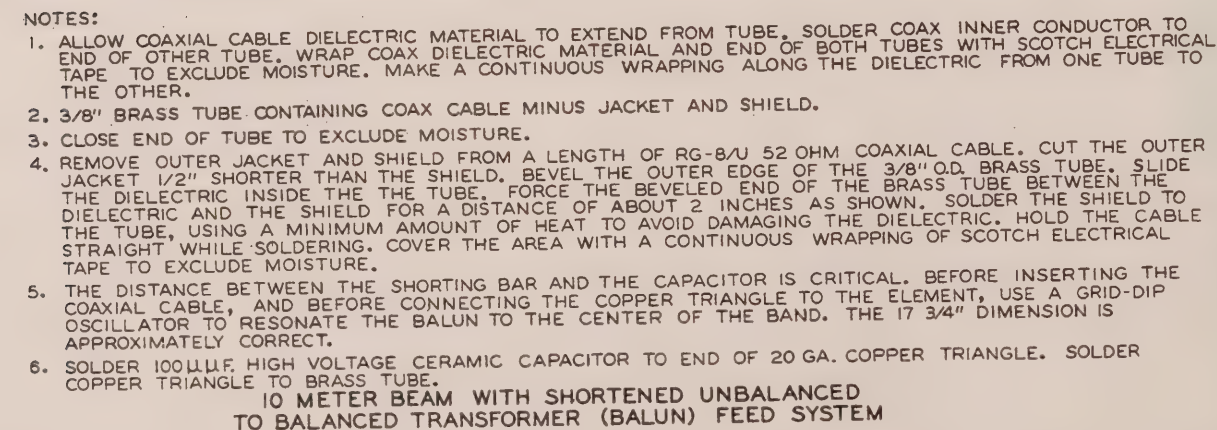
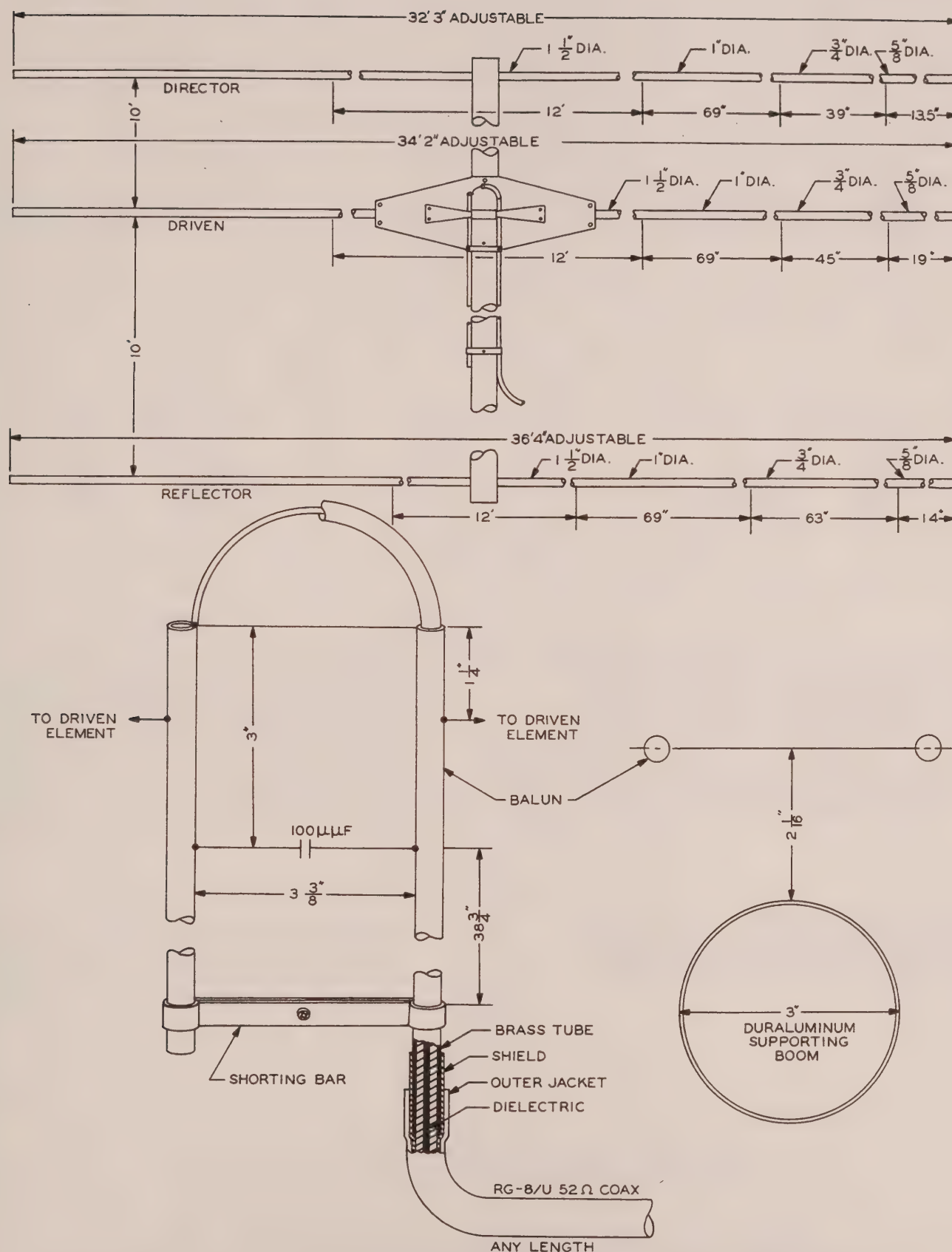
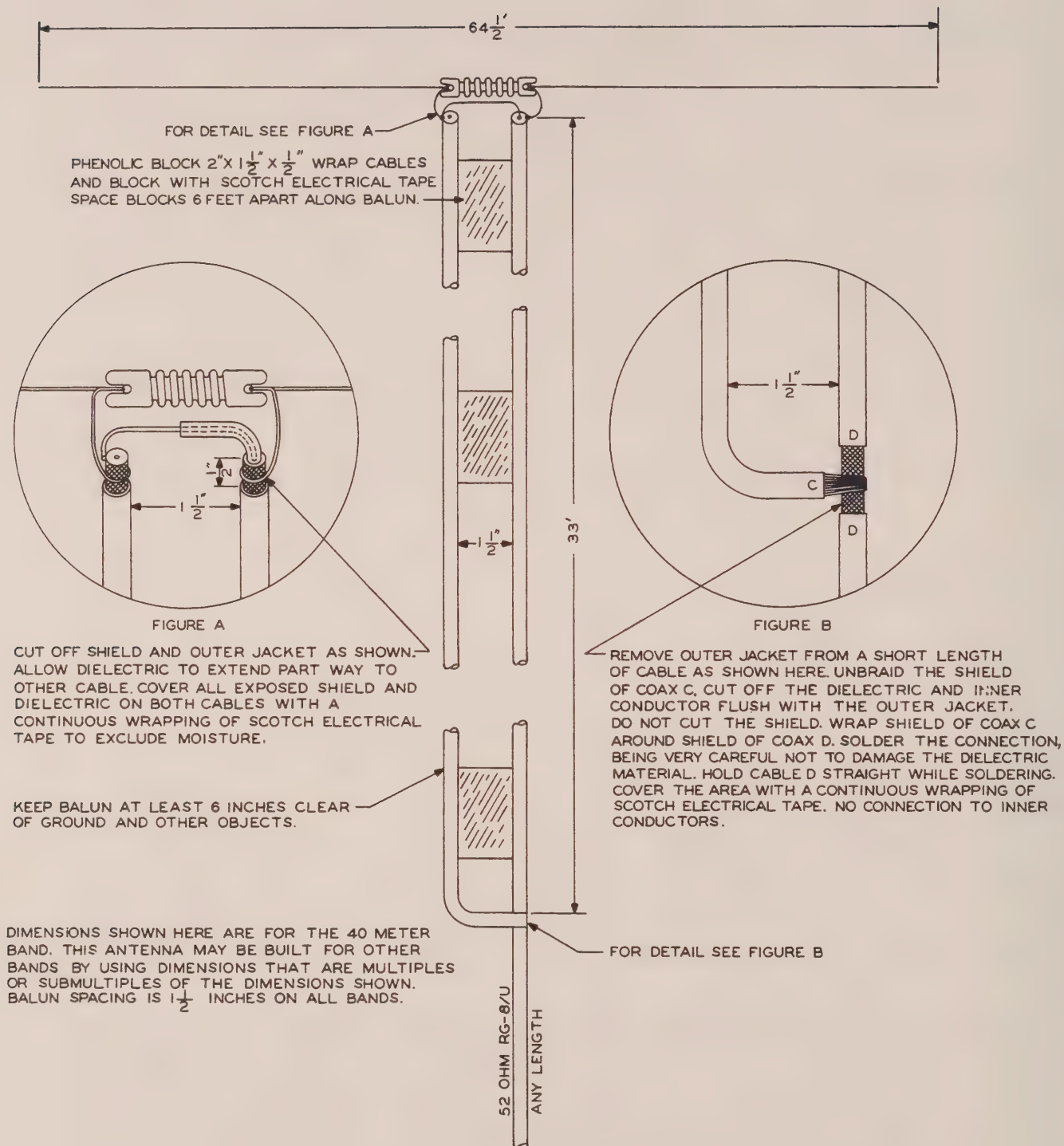


Figure 8-2. 10-Meter Beam With Shortened Unbalanced to Balanced Transformer (Balun) Feed System



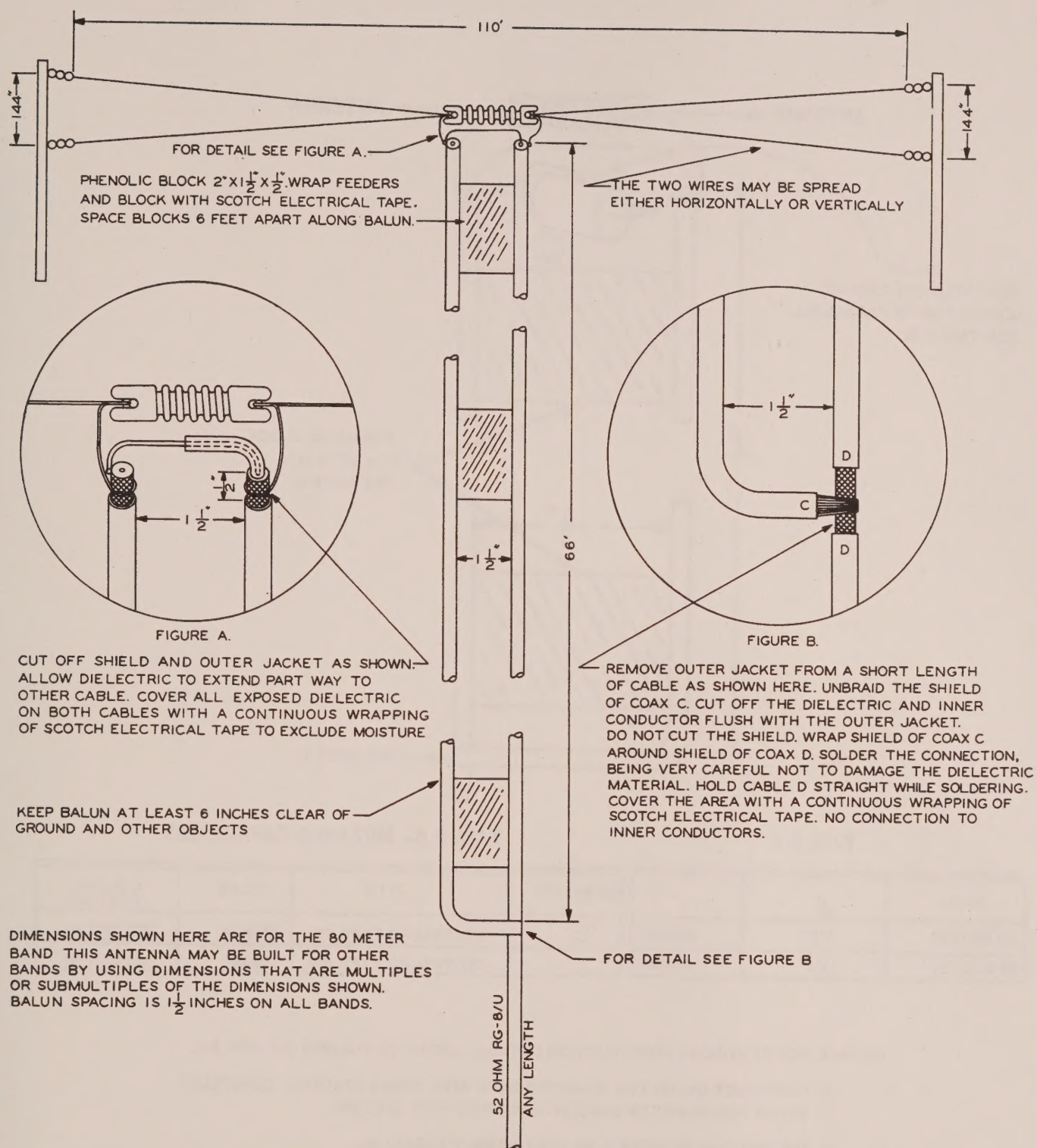
20 METER BEAM WITH SHORTENED UNBALANCED TO BALANCED TRANSFORMER (BALUN) FEED SYSTEM. GENERAL CONSTRUCTION IS THE SAME AS THE TEN METER BEAM.

Figure 8-3. 20-Meter Beam With Shortened Unbalanced to Balanced Transformer (Balun) Feed System



HALF WAVE ANTENNA WITH QUARTER WAVE UNBALANCED TO BALANCED TRANSFORMER (BALUN) FEED SYSTEM

Figure 8-4. Half-Wave Antenna With Quarter-Wave Unbalanced to Balanced Transformer (Balun) Feed System



BROADBAND ANTENNA WITH QUARTER WAVE UNBALANCED TO BALANCED TRANSFORMER (BALUN) FEED SYSTEM.

Figure 8-5. Broadband Antenna With Quarter-Wave Unbalanced to Balanced Transformer (Balun) Feed System

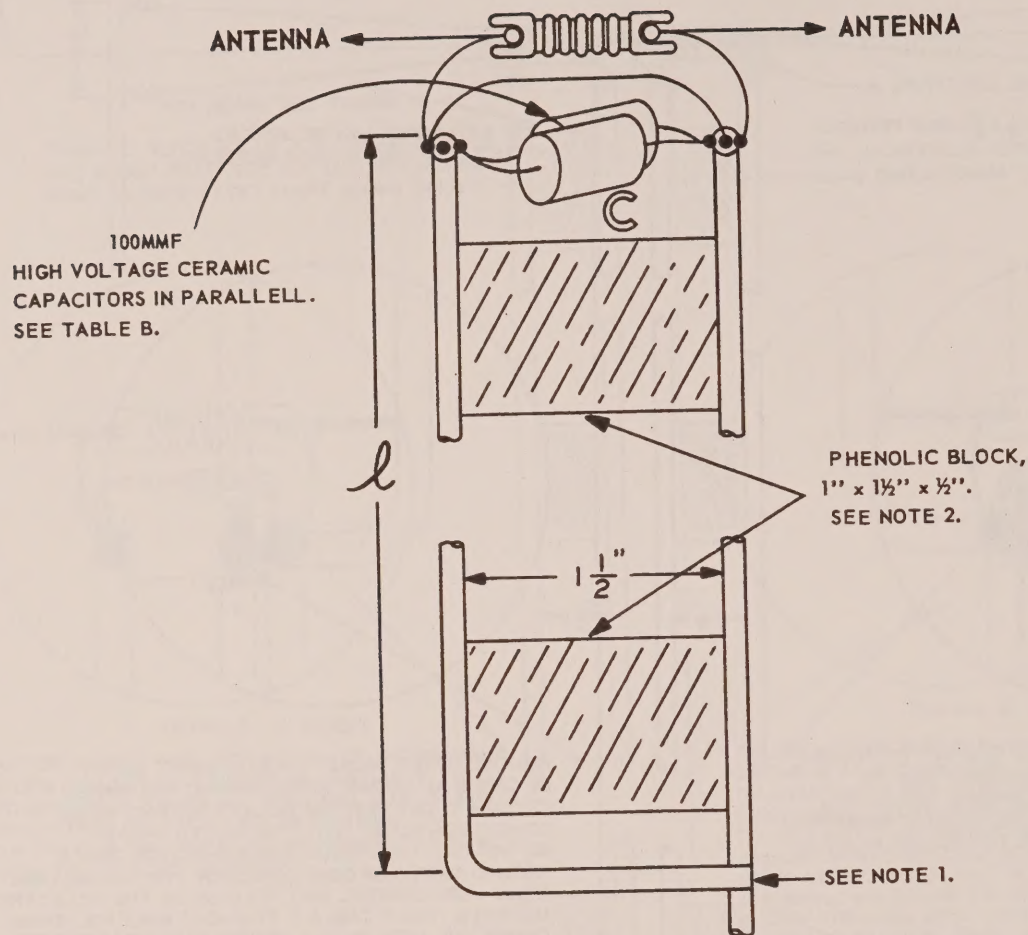


TABLE A

BAND	<i>l</i>	C
40 METERS	7'3"	200MMF
80 METERS	13'6"	400MMF

TABLE B- SUITABLE CAPACITORS

QUANTITY	TYPE	VALUE	COLLINS PART NO.
2	CENTRALAB TYPE 850	100MMF	913 0821 00
4	CENTRALAB TYPE 850	100MMF	913 0821 00

- NOTE: 1. FOR PERTINENT CONSTRUCTION DETAILS, REFER TO FIGURES 8-4 AND 8-5.
2. CONSTRUCT BALUN FOR 40-METER BAND WITH THREE SPACERS. CONSTRUCT BALUN FOR 80-METER BAND WITH FOUR OR FIVE SPACERS.
3. THE TWO CABLES SHOULD BE VERY NEARLY PARALLEL.

Figure 8-6. Short Balun for 40 and 80 Meters

COLLINS RADIO COMPANY

Cedar Rapids , Iowa