

NAVWEPS 16-30ARR41-502

Handbook  
Service Instructions  
RADIO RECEIVING SET  
AN/ARR-41

THIS PUBLICATION REPLACES NAVAER 16-30ARR41-502 DATED 1 JUNE 1956

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## INTRODUCTION

This service handbook is prepared for use by organizational and field maintenance personnel as an aid in understanding and performing installation, maintenance, and service procedures for Radio Receiving Set AN/ARR-41. Repair, replacements, adjustments, and recalibration data for the electronic equipment is limited to that capable of being performed by organizational and field maintenance activities using common tools, test equipment, and spare parts authorized in allowance lists and the specialized tools and test equipment listed in section II of this handbook. For further information concerning any detail part in this equipment, refer to NavAer 16-30ARR41-504

Illustrated Parts Breakdown. Radio Receiving Set AN/ARR-41. This handbook is compiled and printed in accordance with Specifications MIL-H-6757A(ASG) and MIL-H-5474A, and conforms to applicable portions of the following specifications:

JAN-STD-15	Electrical and Electronic Symbols
MIL-STD-16	Electrical and Electronic Reference Designations
MIL-STD-122	Color Code for Chassis Wiring for Electronic Equipment
ANA-261	Abbreviations and Contractions: Approved List of

## SECTION I DESCRIPTION AND LEADING PARTICULARS

### 1-1. SCOPE OF HANDBOOK.

1-2. This publication comprises service instructions for Radio Receiving Set AN/ARR-41, manufactured and supplied under Contract NOas55-821r and NOas57-438. Sections I through VII of this handbook apply to Radio Receiving Set AN/ARR-41. Additional models will be covered in section VIII by the use of Difference Data Sheets.

### 1-3. PURPOSE AND APPLICATION OF EQUIPMENT.

1-4. Radio Receiving Set AN/ARR-41, consisting of equipment listed in table I, is a general purpose

receiving set designed for mounting in larger types of aircraft and capable of receiving amplitude-modulated radiotelephony (A-3), unmodulated cw radiotelegraphy (A-1), and frequency-shift-keyed radioteletype (A-2) when an external converter is employed for operation of the printer. Frequency coverage is within the ranges of 190 to 550 kilocycles and 2 to 25 megacycles, which are covered in five bands.

### 1-5. EQUIPMENT SUPPLIED.

1-6. Equipment supplied with Radio Receiving Set AN/ARR-41 is listed in table I and illustrated in figure 1-1.

TABLE I. RADIO RECEIVING SET AN/ARR-41. EQUIPMENT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	ARMY-NAVY TYPE DESIGNATION	OVER-ALL DIMENSIONS (Inches)			WEIGHT (lb)	NUMERICAL SERIES OF REFERENCE SYMBOLS
			LENGTH	WIDTH	HEIGHT		
1	Radio Receiver	R-648/ARR-41	13-3/16	17	7-11/16	32.5	200-799 900-999 1300-1399 15000-15999
1	Mounting	MT-1518/ARR-41	13-3/8	17	3-1/4	3.5	100-199

**1-7. EQUIPMENT REQUIRED BUT NOT SUPPLIED.**

1-8. Table II lists the equipment required but not supplied as part of Radio Receiving Set

AN/ARR-41. When installed in an aircraft, the radio set will be connected to and used with auxiliary equipment generally similar to that shown in table II.

TABLE II. RADIO RECEIVING SET AN/ARR-41, EQUIPMENT REQUIRED BUT NOT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	ARMY-NAVY TYPE DESIGNATION	REQUIRED CHARACTERISTICS
1	Antenna	Fixed Aircraft	Fixed aircraft (with 50-ohm termination if Antenna Coupler CU-351/AR is not used); operating range, 0.19 to 25 megacycles.
1	Headset	H-1/AR or H-4/AR	Nominal impedance: 300 ohms minimum
1	Plug	UG-88/U	P302
1	Connector	AN3108B-16S-1S	P301
1	Interphone	AN/AIC-4 or equal	
1	Antenna Coupler	CU-351/AR or equal (optional)	
1	Primary Power Source		27.5-volt d-c; 4.5 amperes intermittent; 5.8 amperes continuous; 20 amperes surge.
1	Power Cable W301		Two each number 16 wires, length as required. Terminated by connector P301 and connector to be determined by using facility.
1	Radio Frequency Cable	RG-58/U	Coaxial; nominal impedance 53.5 ohms; nominal capacitance 28.5 uuf per foot. Terminated by connector suitable for connection to Antenna Coupler CU-351/AR.

**1-9. GENERAL PRINCIPLES OF OPERATION.**

1-10. Radio Receiving Set AN/ARR-41 is a super-heterodyne receiver capable of receiving r-f signals from 190 to 550 kilocycles and from 2 to 25 megacycles. Double conversion is used on all bands except band 2, the 2- to 4-megacycle band, which is single conversion. Two r-f stages, three i-f stages, and three audio stages are employed for amplification which brings the over-all sensitivity to at least 100 milliwatts output for less than 5 microvolts input. Selectivity is obtained through resonant circuits in all bands and through one of two magnetostriction mechanical filters in the i-f circuit. A built-in circuit consisting of a 500-kilocycle crystal-controlled oscillator and a multivibrator provides for frequency calibration, allowing frequencies to be set up

accurately at each 100-kilocycle check point throughout the range of reception. Cooling within Radio Receiving Set AN/ARR-41 is accomplished by a dynamotor fan and by convection through louvers. Modular, unitized construction is employed, greatly simplifying trouble-shooting and maintenance operations.

**1-11. GENERAL ELECTRICAL CHARACTERISTICS.**

1-12. POWER INPUT. The Radio Receiving Set AN/ARR-41 is designed to operate on 27.5 volts d-c with a nominal current of 3 amperes above 32 degrees Fahrenheit, and 5.8 amperes below 32 degrees Fahrenheit. The power source should be capable of withstanding a surge current of 20 amperes.

1-13. SENSITIVITY. The power output of the AN/ARR-41 is at least 100 milliwatts into 300 ohms for

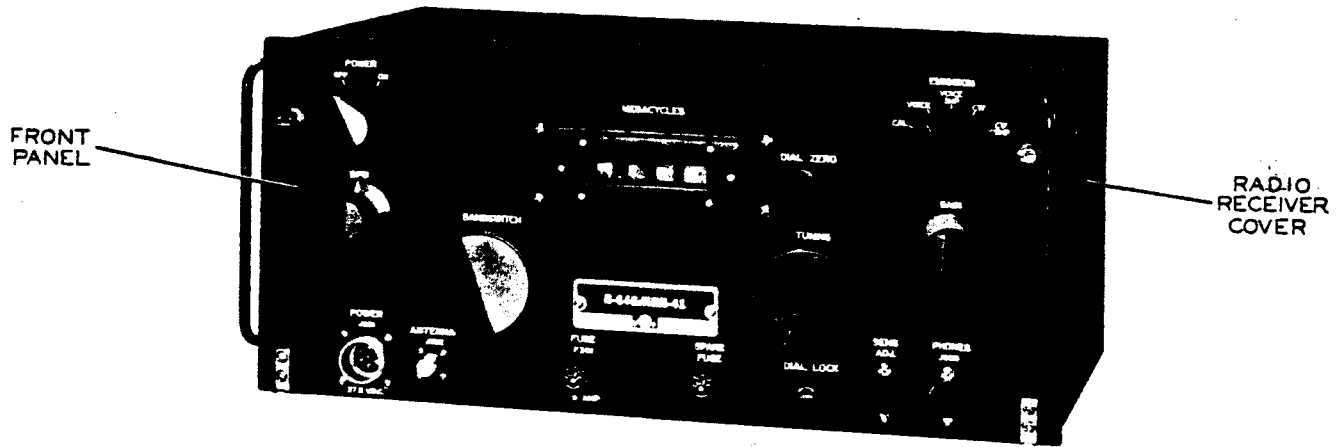


Figure 1-2. Radio Receiver R-648/ARR-41, Front Panel

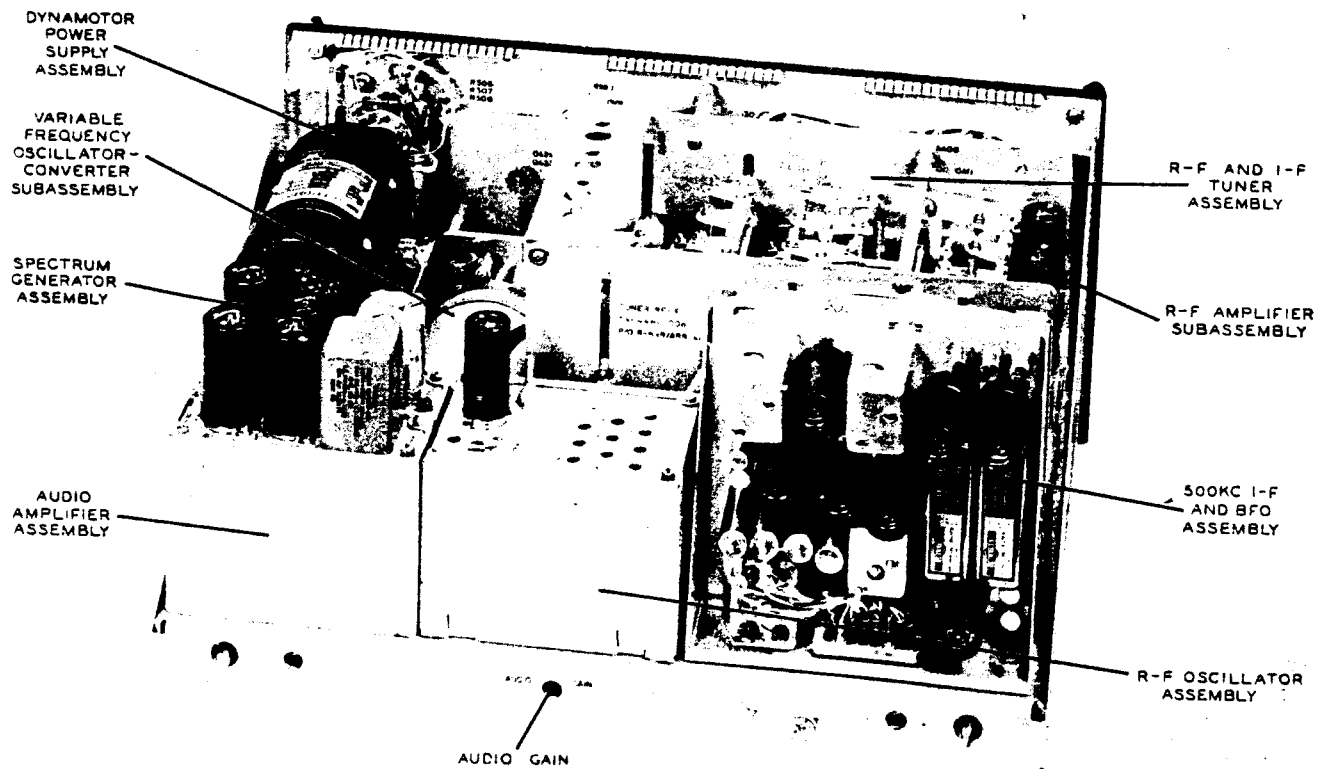


Figure 1-3. Radio Receiver R-648/ARR-41, Top Rear View, Cover Removed

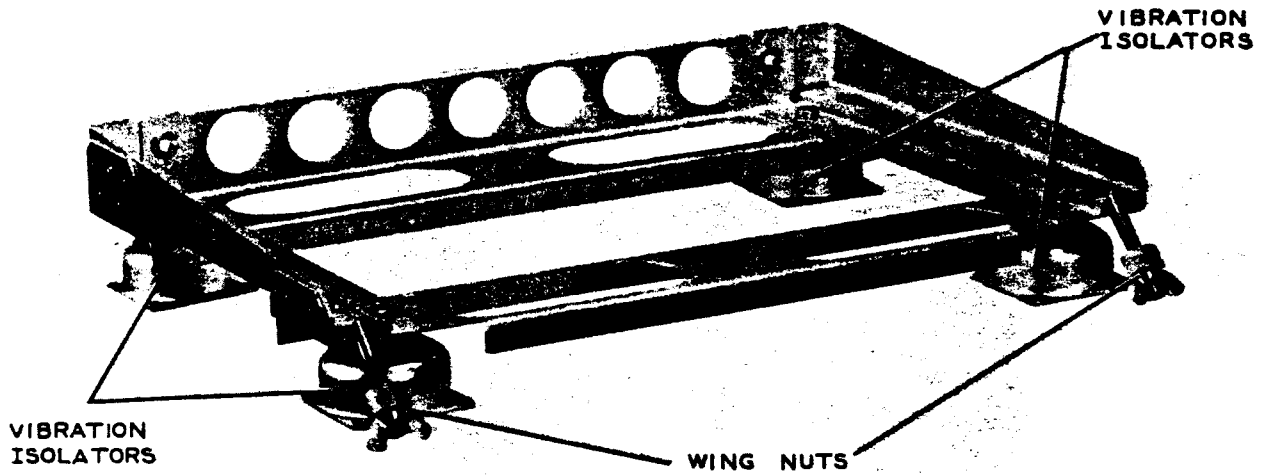


Figure 1-4. Mounting MT-1518/ARR-41, Top Oblique View

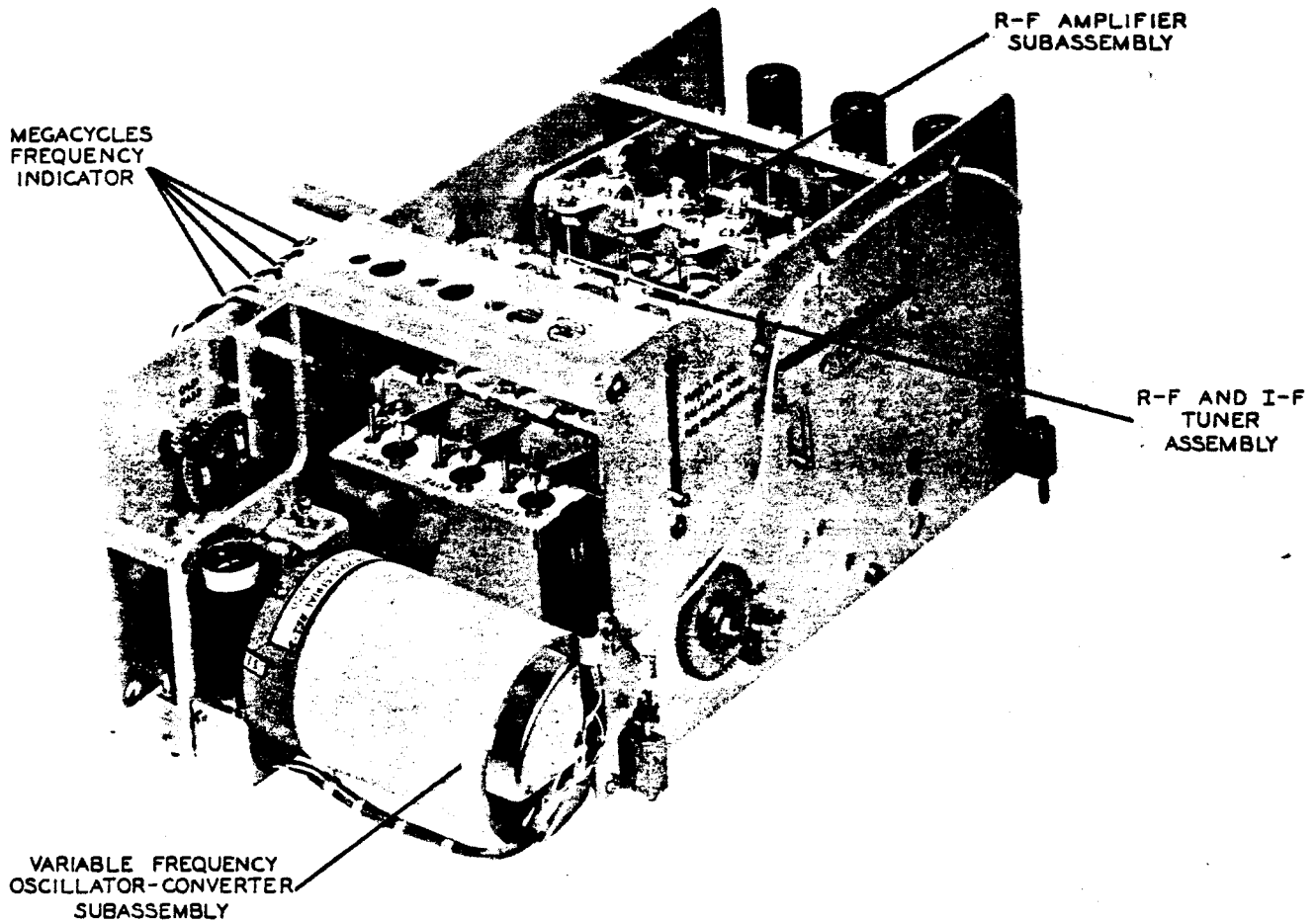


Figure 1-5. R-F and I-F Tuner Assembly, Rear Oblique View

an input of less than 5 microvolts, and will increase to as high as 500 milliwatts with stronger signals. The signal plus noise-to-noise ratio is at least 6 db for radiotelephone and 10 db for cw reception.

**1-14. FREQUENCY COVERAGE.** Frequencies of 190 to 550 kilocycles and 2 to 25 megacycles are covered in five bands. Stability is plus or minus 2.1 kilocycles for the low band (190 to 550 kilocycles), and plus or minus 1.9 kilocycles plus 0.01% for the four remaining bands. Spurious frequencies are attenuated 60 db below 5 microvolts.

**1-15. TEMPERATURE RANGE.** Radio Receiving Set AN/ARR-41 is designed to operate within the temperature ranges of minus 55 degrees centigrade (minus 67 degrees Fahrenheit) to plus 71 degrees centigrade (plus 160 degrees Fahrenheit).

**1-16. SELECTIVITY.** Selectivity is basically controlled by the 1.4-kilocycle and 6.0-kilocycle mechanical filters in the i-f section of Radio Receiver R-648/ARR-41. Both mechanical filters have a characteristic shape factor not greater than 2 to 1 from the 6 to 60 db points. The audio response characteristics of the R-648/ARR-41, as measured with a 500-milliwatt output into 300 ohms, will not vary more than  $\pm 3$  db from 300 to 2200 cps.

#### 1-17. DESCRIPTION OF COMPONENTS.

**1-18. RADIO RECEIVER R-648/ARR-41.** (Refer to figures 1-2 and 1-3.) Radio Receiver R-648/ARR-41

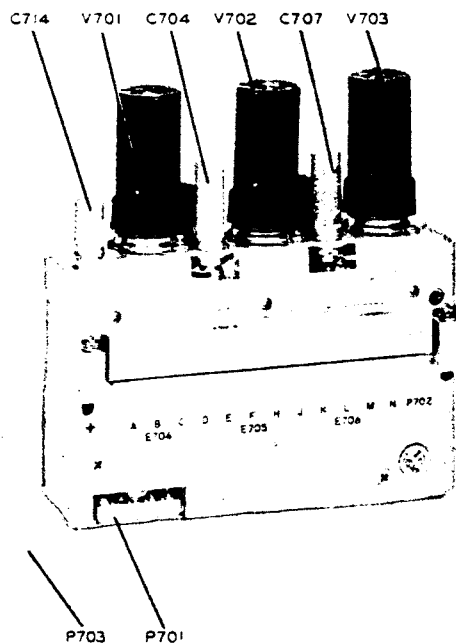


Figure 1-6. R-F Amplifier Subassembly, Right Side View

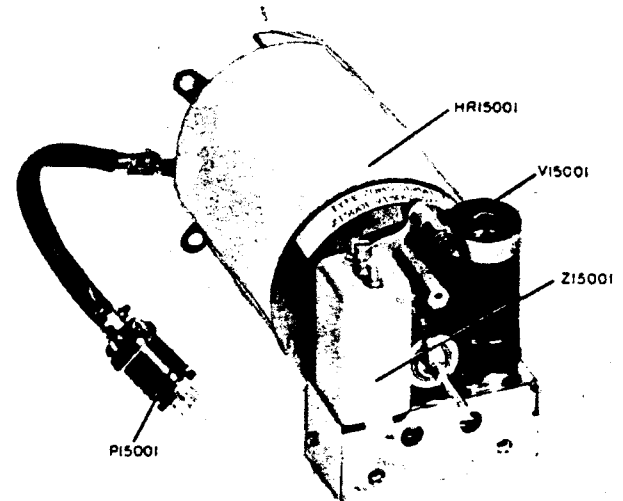


Figure 1-7. Variable Frequency Oscillator-Converter Subassembly, Top Front View

consists of a front panel, a main chassis frame, and five removable assemblies which are mounted to the chassis by means of captive screws. Electrical connections from these assemblies are provided by plugs on the assemblies which mate corresponding jacks on the chassis. All operating controls and all external connections are provided on the front panel. The entire component is designed to mount on Mounting MT-1518/ARR-41, which includes a locking mechanism to hold the chassis securely.

**1-19. MOUNTING MT-1518/ARR-41.** (Refer to figure 1-4.) Mounting MT-1518/ARR-41 is a corrosion-resistant aluminum mounting with steel spring-type vibration isolators mounted at each corner. The mounting is attached to a metal shelf by means of number 8 screws, lock washers, and nuts. Grounding straps are provided for mounting under the vibration isolator feet to provide good electrical contact.

#### 1-20. DESCRIPTION OF ASSEMBLIES.

**1-21. R-F AND I-F TUNER ASSEMBLY.** (See figure 1-5.) The r-f and i-f tuner assembly is located directly behind the front panel of the R-648/ARR-41 component. It is the largest of the plug-in assemblies and consists of the main assembly and two removable subassemblies. The main assembly consists of r-f and variable i-f resonant circuits and the associated slug racks. Tuning is accomplished by varying the inductance of these resonant circuits.

**1-22.** Figure 1-6 shows the r-f amplifier subassembly removed from the r-f and i-f tuner assembly. This subassembly consists of three tubes for r-f amplification and first mixing, and the associated circuits. Connectors P701 and P703 provide for interconnection with the other assemblies.

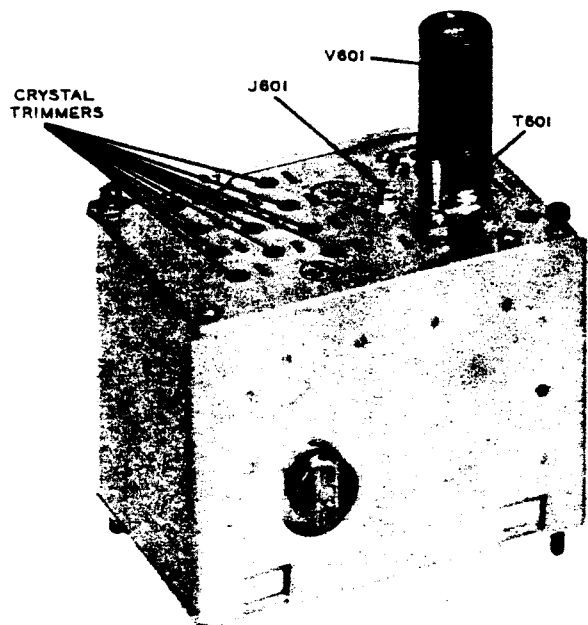


Figure 1-8. R-F Oscillator Assembly, Top Oblique View

1-23. Another subassembly of the r-f and i-f tuner assembly is shown in figure 1-7. This is the variable frequency oscillator-converter subassembly, whose function is to convert the variable i-f to a fixed i-f of 500 kilocycles. The subassembly consists of one 5750 tube, a variable transformer (Z15001), and associated detail parts, some of which are enclosed in a hermetically sealed chassis. A heating element is included, which operates at temperatures below zero degree centigrade (32 degrees Fahrenheit).

1-24. R-F OSCILLATOR ASSEMBLY. (See figure 1-8.) The r-f oscillator assembly is located at the rear of the chassis, between the audio amplifier assembly and the 500-kilocycle i-f and bfo assembly. A crystal-controlled oscillator is employed in the r-f oscillator assembly for the purpose of establishing the first injection frequency for use in the first mixer stage. Included in this assembly are ten crystals, an oscillator tube, multiplier tank circuits, and a selector switch.

1-25. 500-KC I-F AND BFO ASSEMBLY. (See figure 1-9.) The 500-kc i-f and bfo assembly is located directly behind the r-f and i-f tuner assembly and next to the spectrum generator assembly. The functions of the 500-kc i-f and bfo assembly are fixed

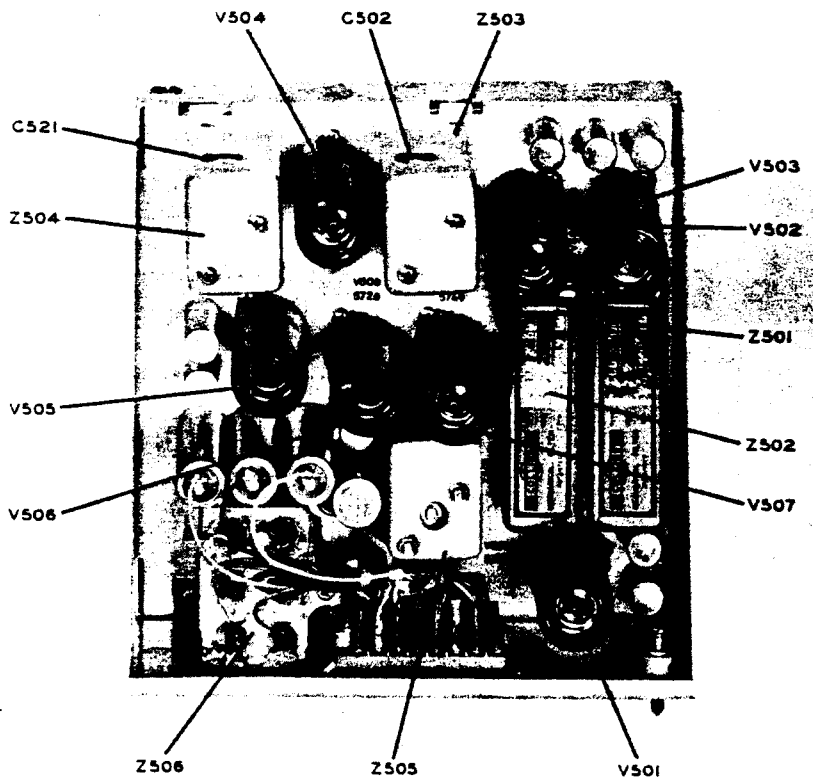


Figure 1-9. 500-Kc I-F and BFO Assembly, Top Oblique View

i-f amplification, wide and narrow band filtering, detection, supplying avc, and supplying a beat frequency for use with cw reception.

1-26. AUDIO AMPLIFIER ASSEMBLY. (See figure 1-10.) The audio amplifier assembly is located at the rear of the chassis, behind the dynamotor power supply assembly. The assembly consists of two audio amplifier tubes, with the associated circuitry, and an output transformer.

1-27. SPECTRUM GENERATOR ASSEMBLY. (See figure 1-11.) The spectrum generator assembly is of comparable size and shape to the audio amplifier assembly and is located between the dynamotor power supply assembly and the audio amplifier assembly. The spectrum generator assembly consists of a crystal-controlled oscillator, a multivibrator divider, a crystal control oven, and the associated circuits. The function of the assembly is to furnish a means of frequency calibration for the receiver.

1-28. DYNAMOTOR POWER SUPPLY ASSEMBLY. Figure 1-12 shows the dynamotor power supply assembly which includes the dynamotor, the voltage regulator tube, and the chassis upon which the dynamotor rests. This assembly is located directly behind the front panel. Included within the chassis of the dynamotor power supply assembly are the filter circuits and voltage divider circuits necessary to obtain the required voltages for use in the R-648/ARR-41.

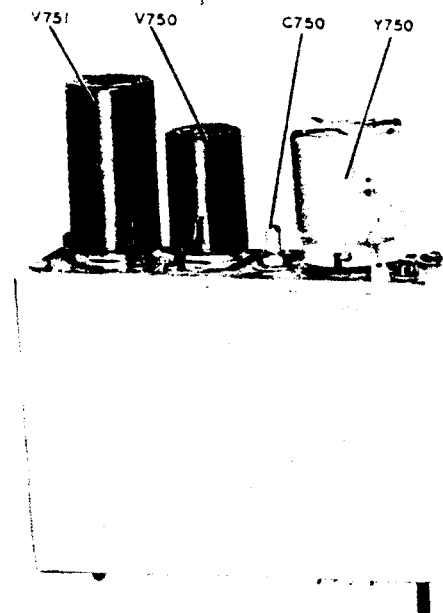


Figure 1-11. Spectrum Generator Assembly,  
Top Oblique View

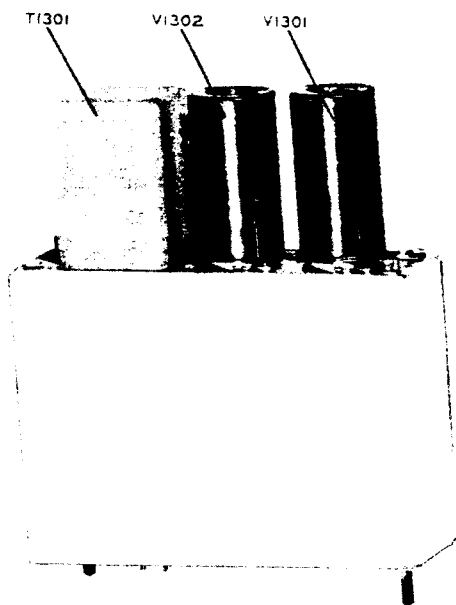


Figure 1-10. Audio Amplifier Assembly,  
Top Oblique View

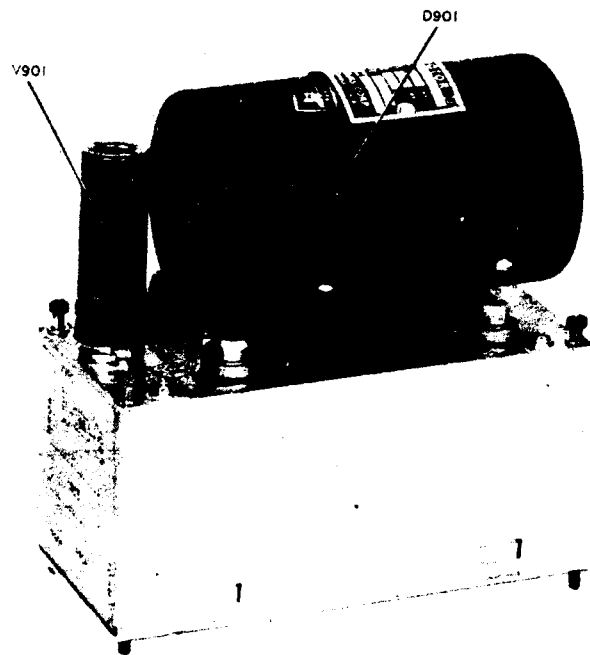


Figure 1-12. Dynamotor Power Supply Assembly  
Right Oblique View



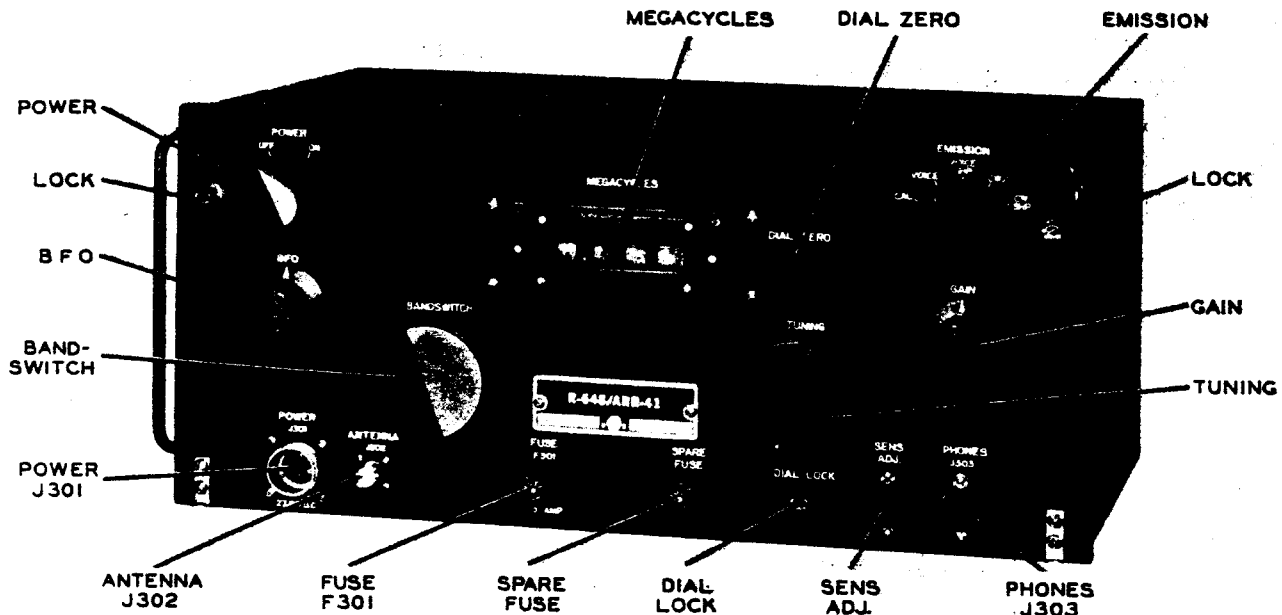


Figure 1-13. Radio Receiver R-648/ARR-41, Front Panel Controls

**1-29. OPERATING FUNCTION OF CONTROLS.**

1-30. Figure 1-13 illustrates the controls of Radio Receiving Set AN/ARR-41 and table III lists their function. All controls and connectors are located on the front panel as shown.

TABLE III. FUNCTION OF CONTROLS

NAME OF CONTROL	FUNCTION	TYPE OF CONTROL
POWER OFF-ON	Primary power control for filaments and dynamotor.	Two-position rotary switch.
EMISSION (CAL)	Connects spectrum generator indicator and disconnects avc circuit for frequency calibration.	One position of five-position rotary switch.
EMISSION (VOICE)	Connects broad-band filter for voice and disconnects calibration and bfo circuits. The avc is operative in this position.	One position of five-position rotary switch.
EMISSION (VOICE SHP)	Connections are the same as for VOICE except the narrow-band filter is used.	One position of five-position rotary switch.
EMISSION (CW)	Connects bfo and broad-band filter and disconnects avc and calibration circuits.	One position of five-position switch.

TABLE III. FUNCTION OF CONTROLS (Cont)

NAME OF CONTROL	FUNCTION	TYPE OF CONTROL
EMISSION (CW SHP)	Connections are same as for cw except the narrow-band filter is used.	One position of five-position switch.
BANDSWITCH	Drives the 4- to 25-megacycle tuning core elevator in one-megacycle increments. Drives r-f tuner bandswitch, and crystal selector switches of the r-f oscillator. Drives counter to indicate megacycle band in use.	Twenty-four-position mechanical drive.
TUNING	Drives the variable frequency oscillator, the low-band tuning core elevator, the variable i-f tuning core elevator, the 4- to 25-megacycle tuning core elevator over a one-megacycle increment, and drives the counter to indicate frequencies between zero and one megacycle.	Continuously variable mechanical drive.
GAIN	Controls gain of first audio amplifier for voice reception and gain of i-f and r-f amplifiers for cw reception and calibration.	Double-ganged potentiometer.
BFO	Varies bfo frequency around 500 kilocycles by varying impedance of diode (CR501).	Potentiometer.
SENS ADJ.	Varies bias on first i-f and first r-f amplifiers. Provides means of controlling i-f and r-f gain for voice reception.	Potentiometer, screwdriver adjustment.
DIAL ZERO	Disengages counter drive from the TUNING control and allows dial to be set when frequency is calibrated.	Setting Clutch.
DIAL LOCK	Locks the TUNING control at a desired setting.	Thumb Screw.
PHONES J303	Provides connection for headset.	Spring leaf telephone jack.
ANTENNA J302	Mates P302 of antenna cable.	Connector, one female contact.
POWER J301	Mates P301 of power cable.	Connector, seven male contacts.
LOCK	Locks the front panel to the chassis.	Thumb Screw.
FUSE F301	Overload protection.	5 ampere fuse.
SPARE FUSE	Spare for F301.	5 ampere fuse.
MEGACYCLES	Frequency Indicator.	Counter.
AUDIO GAIN	A preinstallation adjustment used to set the audio output level to 500 milliwatts with 1000 microvolts input 30% modulated at 1000 cps.	Potentiometer.

**1-31. ELECTRON TUBE COMPLEMENT**

1-32. Table IV lists all electron tubes required for operation of Radio Receiving Set AN/ARR-41.

**TABLE IV. RADIO RECEIVING SET AN/ARR-41, TUBE COMPLEMENT**

DESIGNATION	TYPE	DESCRIPTION	FUNCTION	LOCATION
V501	5749	Pentode	1st I-F Amplifier	500-Kc I-F and BFO Assembly
V502	5749	Pentode	2nd I-F Amplifier, Broad Band	500-Kc I-F and BFO Assembly
V503	5749	Pentode	2nd I-F Amplifier, Narrow Band	500-Kc I-F and BFO Assembly
V504	5749	Pentode	3rd I-F Amplifier	500-Kc I-F and BFO Assembly
V505	5726	Dual Diode	Detector and AVC Doubler	500-Kc I-F and BFO Assembly
V506	5726	Dual Diode	Noise Limiter and AVC Gate	500-Kc I-F and BFO Assembly
V507	5749	Pentode	Beat Frequency Oscillator	500-Kc I-F and BFO Assembly
V601	6AU6WA	Pentode	R-F Oscillator	R-F Oscillator Assembly
V701	5749	Pentode	1st R-F Amplifier	R-F Amplifier Subassembly
V702	5749	Pentode	2nd R-F Amplifier	R-F Amplifier Subassembly
V703	5750	Pentagrid	1st Mixer	R-F Amplifier Subassembly
V750	5654	Pentode	Spectrum Generator Oscillator	Spectrum Generator Assembly
V751	5814	Dual Triode	Multivibrator Divider	Spectrum Generator Assembly
V901	OA2WA	Gas Diode	Voltage Regulator	Dynamotor Power Supply Assembly
V1301	5814A	Dual Triode	Audio Amplifier	Audio Amplifier Assembly
V1302	5686	Pentode	Audio Amplifier	Audio Amplifier Assembly
V15001	5750	Pentagrid	Variable Frequency Oscillator-Converter	Variable Frequency Oscillator-Converter Subassembly

## SECTION II

### TEST EQUIPMENT AND SPECIAL TOOLS

#### 2-1. TEST EQUIPMENT REQUIRED.

2-2. The following test equipment, listed in table V, or equipment of equal or superior characteristics,

must be used in the performance of the tests required by this handbook. Table V lists the required test equipment by AN nomenclature and commercial type. A brief description is included.

TABLE V. TEST EQUIPMENT REQUIRED

ITEM NO.	DESCRIPTION	NOMENCLATURE	COMMERCIAL TYPE
1	R-F Signal Generator	AN/URM-25	Measurements Model 65B
2	Frequency Meter	AN/USM-26	
3	Multimeter	AN/PSM-4	Simpson 260
4	Vacuum Tube Voltmeter	TS-505/U	Hewlett-Packard 410B
5	Audio Oscillator	TS-382/U	Hewlett-Packard 200C
6	Output Meter	TS-585B/U	General Radio 583A
7	Headset	H-4/AR	
8	Tube Tester	TV-7/U	Hickok 547
9	Dummy 5749 tube, pins 5 and 6 removed		
10	Connector	A-47C	
11	0.1 Microfarad Blocking Capacitor		
12	Electronic Workbench	Model B. Type 602379	
13	Electronic Workbench	Model A. Type 601750	
14	Power Supply - Capable of delivering 27.5 volts d-c at 7 amperes continuously, 20 amperes surge. If a rectifier-type power supply is used, the a-c ripple component shall be less than 0.5 volt rms. The supply should be variable from 24 to 29 volts d-c for various tests on the R-648/ARR-41.		

#### 2-3. USE OF ALTERNATE TEST EQUIPMENT.

2-4. When a voltmeter is used in place of Output Meter TS-585B/U, a 300-ohm noninductive resistor should be placed in parallel with the voltmeter to afford proper loading.

**2-5. SPECIAL TOOLS.**

2-6. Special tools required in the performance of maintenance procedures are illustrated in figure 2-1 and listed in table VI. These tools are included with the AN/ARR-41 Radio Receiving Set and are located on the bottom of the R-648/ARR-41 chassis.

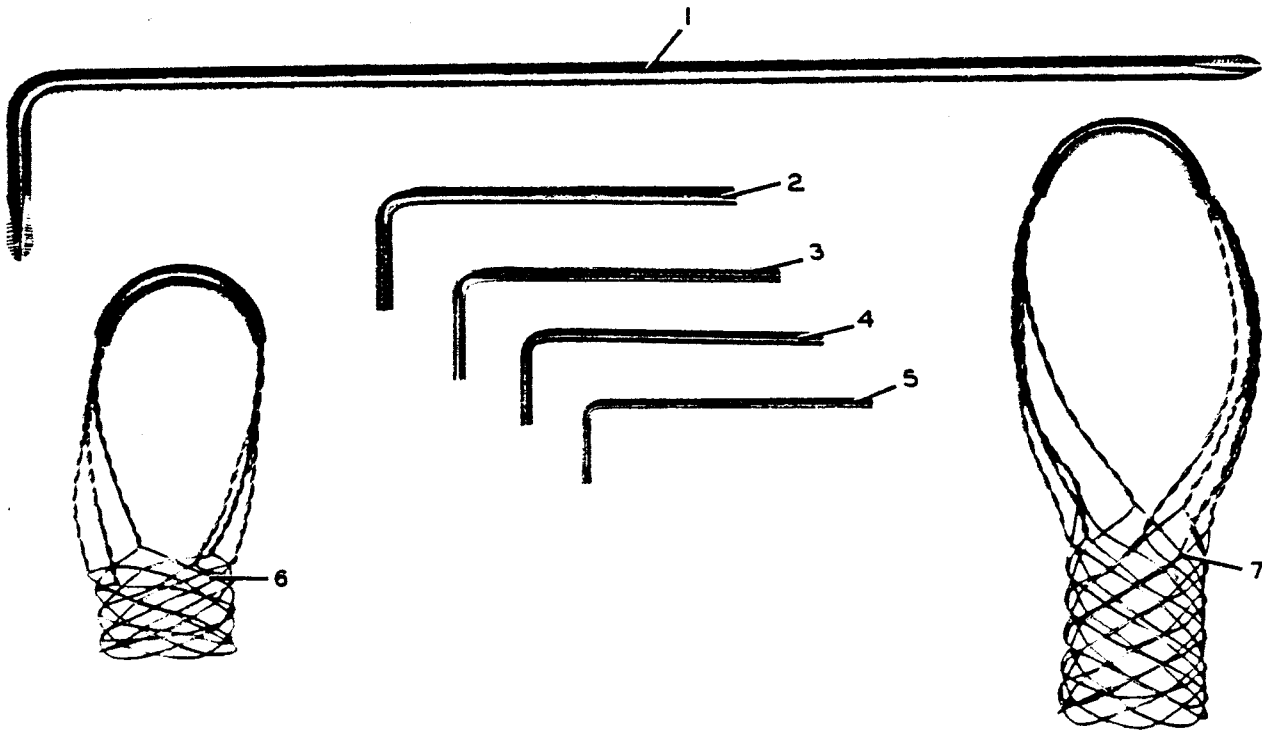


Figure 2-1. Special Maintenance Tools. Equipment Supplied

TABLE VI. SPECIAL MAINTENANCE TOOLS. EQUIPMENT SUPPLIED

REFERENCE NUMBER	PART NUMBER	NAME	APPLICATION
1	2061B 0050	Phillips screwdriver	Removal of assemblies, subassemblies, and coils
2	024 2900 00	#4 Bristo wrench	Removal of setscrews
3	024 9730 00	#6 Bristo wrench	Removal of setscrews
4	024 0019 00	#8 Bristo wrench	Removal of setscrews
5	024 9710 00	#10 Bristo wrench	Removal of setscrews
6	024 0128 00	Tube Puller (7 Pin)	Removal of tubes
7	024 0129 00	Tube Puller (9 Pin)	Removal of tubes

**2-7. TEST BENCH CABLE SET AN/ARM-21.**

2-8. Test Bench Cable Set AN/ARM-21 is used with Radio Receiving Set AN/ARR-41 to facilitate

trouble shooting the separable assemblies. Figure 2-2 and table VII illustrates and lists the equipment supplied with Test Bench Cable Set AN/ARM-21.

TABLE VII EQUIPMENT SUPPLIED, TEST BENCH CABLE SET AN/ARM-21

NOMENCLATURE AND INDEX NO.	DESCRIPTION	CONNECTORS	FUNCTION
Mounting	Mounting with a metal cradle, which may be tilted and locked with wing nuts; and a base for test bench mounting by screws.		Mounting and positioning main component. R-648/ARR-41, of Radio Receiving Set AN/ARR-41.
Radio Set Control	Control box with power switch, indicator lamp, input voltage jack, input current jack, audio output jack, and fuse.	Power input, J2001; Power output, J2002.	Provides for primary power control, measurement of input voltage and current, and measurement of audio power output.
W1	Two conductor cables covered by flexible sleeving.	P2001, mates J2001 of AN/ARM-21 control unit; plug supplied by using facility, mates primary power jack.	Provides coupling from power source to AN/ARM-21 Radio Set Control.
W2	Multiconductor cable covered by flexible sleeving.	P2002, mates J2002 of AN/ARM-21 control unit; P301, mates J301 of Radio Receiver R-648/ARR-41.	Provides primary power coupling from AN/ARM-21 Radio Set Control to Radio Receiver R-648/ARR-41.
W3	Multiconductor cable covered by flexible sleeving.	P1301, mates P1301 of audio amplifier assembly; J205, mates J205 of Radio Receiver R-648/ARR-41.	Interconnects audio amplifier assembly and Radio Receiver R-648/ARR-41.
W4	Multiconductor cable covered by flexible sleeving.	P750, mates P750 of spectrum generator assembly; J203, mates J203 of Radio Receiver R-648/ARR-41.	Interconnects spectrum generator assembly and Radio Receiver R-648/ARR-41.
W5	Multiconductor cable covered by flexible sleeving.	P501, mates P501 of 500-kc i-f and bfo assembly; J206, mates J206 of Radio Receiver R-648/ARR-41.	Interconnects 500-kc i-f and bfo assembly and Radio Receiver R-648/ARR-41.
W6	Multiconductor cable covered by flexible sleeving.	P901 mates P901 of dynamotor power supply assembly; J202, mates J202 of Radio Receiver R-648/ARR-41.	Interconnects dynamotor power supply assembly and Radio Receiver R-648/ARR-41.

NOTE

The r-f and i-f tuner assembly and the r-f oscillator assembly test cables are not included as part of the Test Bench Cable Set AN/ARM-21. These assemblies normally are not removed during maintenance

procedures due to the critical mechanical and electrical adjustments. Trouble shooting of these assemblies is accomplished while they are still connected to the R-648/ARR-41 chassis, as will be explained in section VI, paragraph 6-32 and 6-35 and tables XIII and XVI.

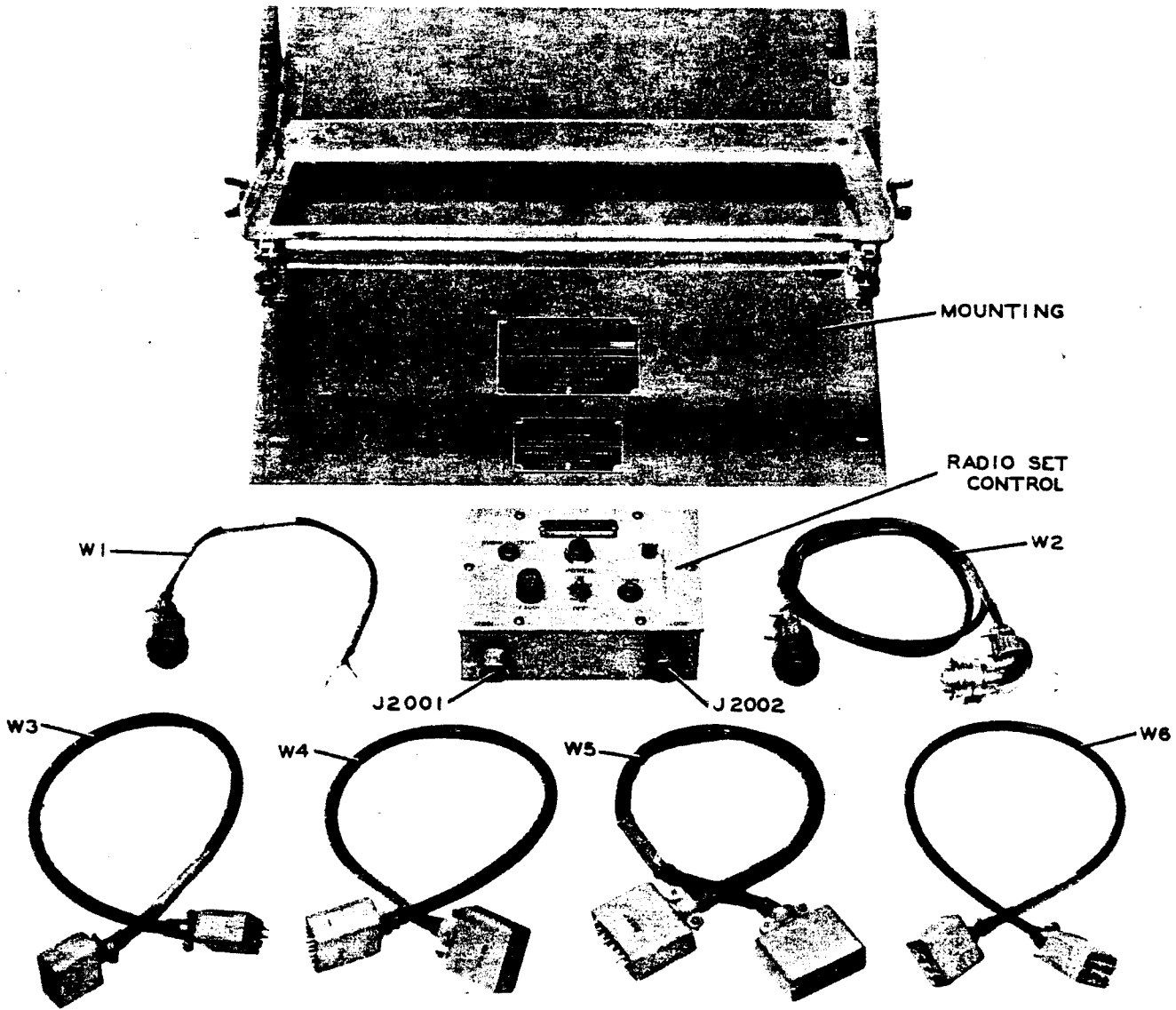


Figure 2-2. Equipment Supplied, Test Bench Cable Set AN/ARM-21

## SECTION III

### PREPARATION FOR USE AND RESHIPMENT

#### 3-1. UNPACKING AND INSPECTION OF EQUIPMENT.

3-2. Use care in unpacking the equipment; inspect it immediately for possible damage during shipment. Check the equipment shipped against the packing slip(s) and the list of equipment supplied. Table I of this handbook. This inspection should include both an external inspection to determine if the case is damaged or control knobs are loose on their respective shafts, and an internal inspection to determine whether all assemblies and subassemblies are fixed securely and all electron tubes are properly in place. All damage to the mechanical drives should be noted.

#### 3-3. CABLE FABRICATION.

3-4. The power cable and antenna cable are not furnished as part of the equipment of Radio Receiving Set AN/ARR-41 and must be fabricated from bulk supplies. Figure 3-1 illustrates the method of fabricating power cable, W301. Figure 3-2 illustrates the method of connecting antenna cable RG-58/U to plug P302. The type of antenna tuner plug to be used with antenna cable RG-58/U will depend upon the particular antenna tuner used.

#### 3-5. PREINSTALLATION BENCH TEST.

3-6. Before installation, a test of operation, over-all sensitivity, and calibration is advisable. Figure 3-3 illustrates the bench setup for these tests. The radio receiver cover must be removed to gain access to the assemblies and detail parts. A convenient means of mounting Radio Receiver R-648/ARR-41, the main component of Radio Receiving Set AN/ARR-41, is with the use of the Test Bench Cable Set AN/ARM-21

mounting. This mounting allows the R-648/ARR-41 chassis to be tilted at any convenient angle for access to the various parts.

3-7. GENERAL OPERATION TESTS. Perform the following tests:

- a. Connect Radio Receiver R-648/ARR-41 in accordance with figure 3-3.
- b. Operate the POWER OFF-ON switch to the ON position.
- c. Operate the EMISSION switch to each of its five positions and determine that individual functions are in proper order. Tune to appropriate signals by means of the BANDSWITCH and TUNING controls. (Rotate the BANDSWITCH clockwise for higher frequencies on all bands and the TUNING control counter-clockwise to increase frequency when tuned below 4 megacycles and clockwise when tuned above 4 megacycles.)
- d. Adjust the GAIN control to determine if the volume is variable.
- e. With the EMISSION switch in the VOICE or VOICE SHP positions, adjust the SENS ADJ. control with a screwdriver to determine if sensitivity is variable.
- f. With the EMISSION switch in CW and CW SHP positions, operate BFO control left and right of center to determine that pitch of tone may be varied.

3-8. CW SENSITIVITY TEST. Perform the following operations:

- a. Operate the POWER switch to the ON position, the EMISSION switch to the CW position, the GAIN and SENS ADJ. to maximum, the BANDSWITCH and TUNING controls for a reading of 0.19 on the MEGACYCLES frequency indicator, and center the BFO control.

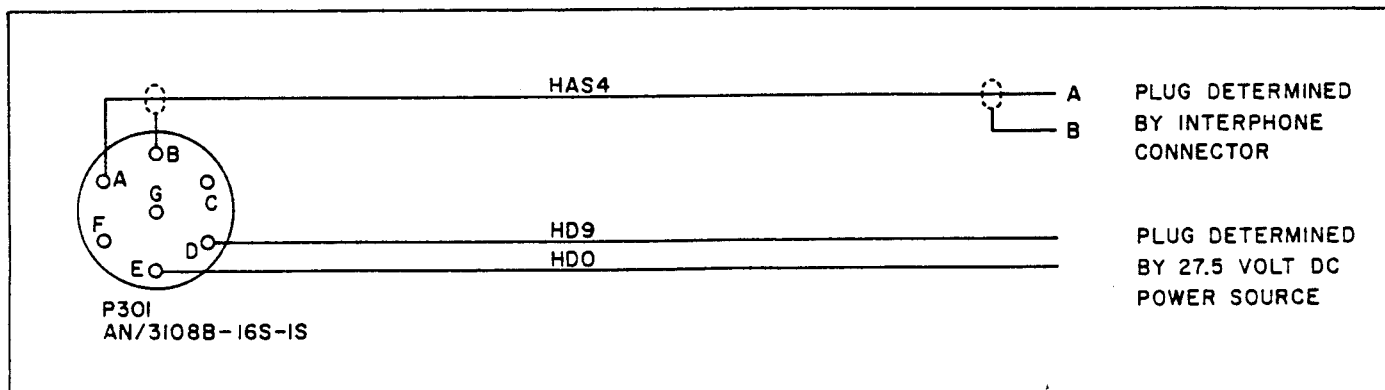
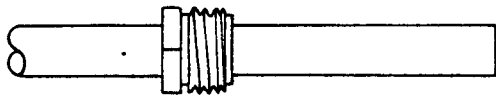
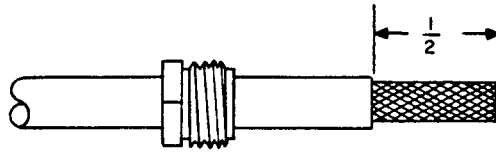


Figure 3-1. Power Cable W301, Fabrication

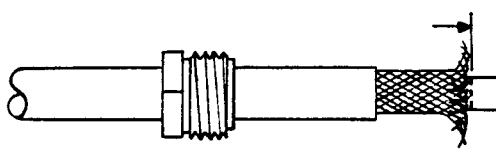




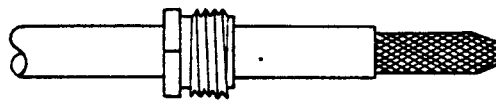
SLIDE NUT ONTO CABLE.  
CUT END OF CABLE EVEN.



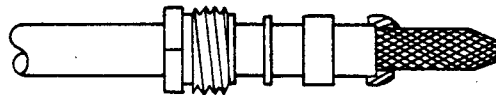
REMOVE VINYL JACKET FOR 1/2 INCH.  
DO NOT NICK BRAID.



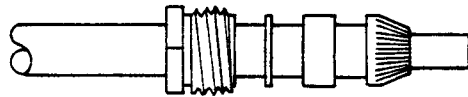
PUSH BRAID BACK AND REMOVE 1/8 INCH OF  
DIELECTRIC AND CENTER CONDUCTOR.



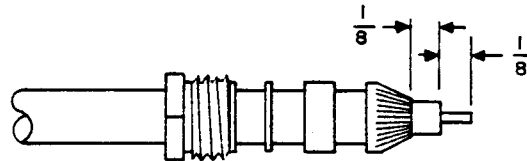
TAPER BRAID.



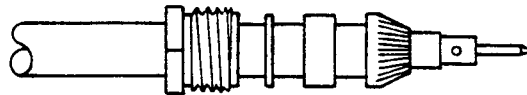
SLIDE WASHER, GASKET AND SLEEVE OVER TAPERED  
BRAID. FIT INNER SHOULDER OF SLEEVE SQUARELY  
AGAINST END OF JACKET.



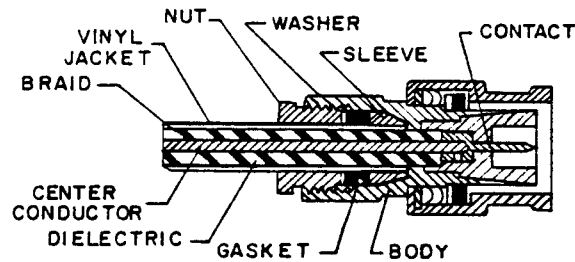
COMB OUT BRAID, FOLD BACK SMOOTH AS SHOWN  
AND TRIM 3/32 INCH.



BARE CENTER CONDUCTOR 1/8 INCH.  
DO NOT NICK CONDUCTOR.



TIN CENTER CONDUCTOR. SLIP CONTACT IN  
PLACE AND SOLDER. REMOVE EXCESS SOLDER.  
BE SURE THAT CABLE DIELECTRIC IS NOT HEATED  
EXCESSIVELY AND SWOLLEN SO AS TO PREVENT  
DIELECTRIC FROM ENTERING BODY.



PUSH INTO BODY AS FAR AS IT WILL GO. SLIDE  
GASKET, WASHER AND NUT INTO BODY. SCREW INTO  
PLACE, WITH WRENCH, UNTIL MODERATELY TIGHT.  
HOLD CABLE AND BODY RIGIDLY AND ROTATE NUT.

NOTE: ASSEMBLY PROCEDURE APPLIES  
TO BNC PLUGS. THE ASSEMBLY FOR JACKS  
IS THE SAME EXCEPT FOR THE USE OF  
FEMALE CONTACTS AND A JACK BODY.

Figure 3-2. Antenna Cable W302, Fabrication

b. Connect Signal Generator AN/URM-25 to ANTENNA J302, test point 1, on the front panel of Radio Receiver R-648/ARR-41.

c. Connect Output Meter TS-585B/U to PHONES jack J303, test point 3, on the front panel of Radio Receiver R-648/ARR-41.

d. Allow the equipment to warm up for five minutes.

e. Reduce the output of Signal Generator AN/URM-25 to zero by adjusting the attenuator of the signal generator. Hold the noise output to 10 milliwatts by adjusting the GAIN control.

f. Adjust for an output of 5 microvolts. Using Frequency Meter AN/USM-26, accurately adjust the frequency of the AN/URM-25 to 0.19 megacycles unmodulated. Adjust the BFO pitch control for approximately 1000 cps.

g. Measure the signal-plus-noise output level, measure the noise level with Signal Generator AN/URM-25 turned off, and calculate the signal-plus-noise to noise ratio.

h. Repeat steps e through g at 4.0 and 25 megacycles.

i. Output Meter TS-585B/U should read at least 100 milliwatts audio output with at least 10 db signal-plus-noise to noise with an r-f input of five microvolts.

### 3-9. CALIBRATE FUNCTION TEST.

a. Operate the POWER OFF-ON switch to ON, EMISSION switch to CAL, SENS ADJ. to maximum, and GAIN control to a comfortable headset level.

b. A signal should be heard on every 100-kilocycle check point throughout the tuning range of the R-648/ARR-41. Examples: 4.2, 4.3, 4.4, 4.5 megacycles, etc.

### 3-10. INSTALLATION.

3-11. LOCATION. In determining the location for Radio Receiving Set AN/ARR-41, take into account

convenience for the operator, clearance for cables and excursion of mounting, cooling requirements, and avoidance of electrical interference. Clearance above the equipment of 1/2 inch and of 5/8 inch at each side will permit free movement of the mountings. Cooling is accomplished in part by natural radiation and convection through louvers, therefore, favorable ventilation conditions are mandatory.

3-12. MOUNTING. (See figure 7-2; Radio Receiving Set AN/ARR-41, Outline and Mounting Dimensions.) Mounting MT-1518/ARR-41 is designed for rack panel mounting with No. 8 screws, lock washers, and nuts. The grounding straps should be secured to the metal shelf beneath the MT-1518/ARR-41 mounting feet. Radio Receiver R-648/ARR-41 is installed in Mounting MT-1518/ARR-41 by the following procedure:

a. Loosen the two forward locking mechanisms on the mounting by rotating the wing nuts as far as possible in a counterclockwise direction.

b. Place Radio Receiver R-648/ARR-41 on Mounting MT-1518/ARR-41 and push to the rear, making sure that the two pins at the rear of the R-648/ARR-41 enter the mating holes on Mounting MT-1518/ARR-41.

c. Tighten the two forward locking mechanisms over the mating right-angle brackets on the R-648/ARR-41. Rotate the wing nuts clockwise until they are secured firmly.

### 3-13. POSTINSTALLATION TEST.

3-14. After installation, a general operational test should be performed to determine if the equipment is still in operating condition. Perform the general tests, paragraph 3-7, and the calibration test, paragraph 3-9.

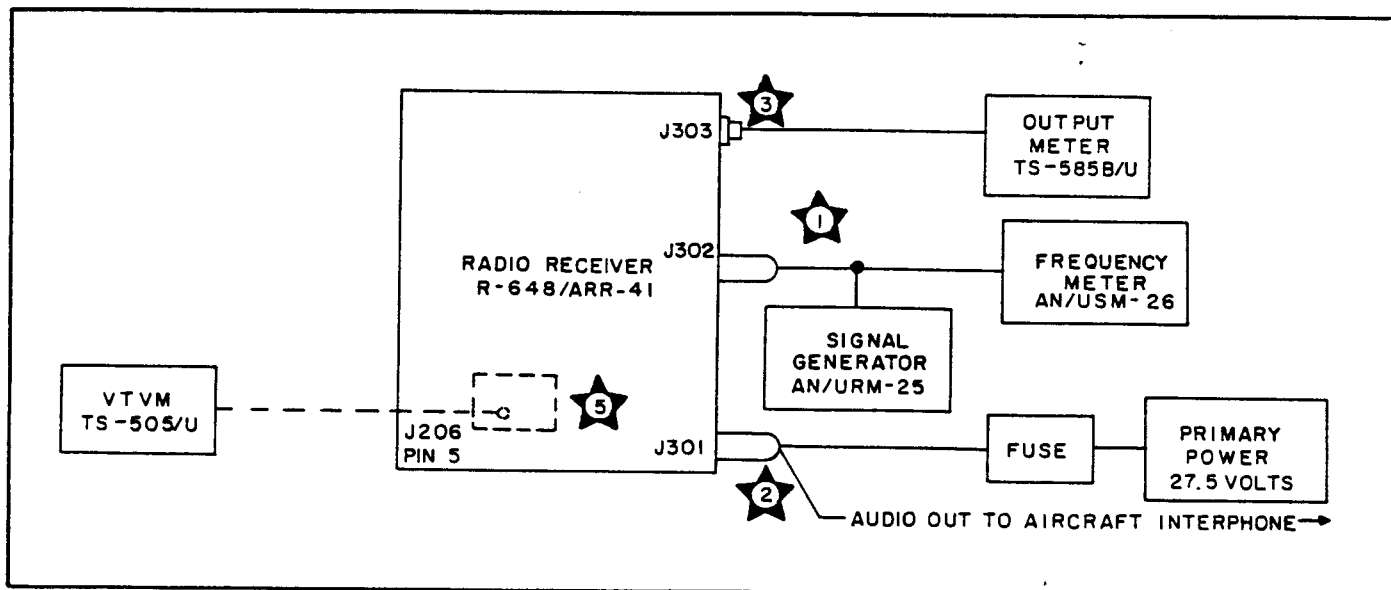


Figure 3-3. Radio Receiver R-648/ARR-41, Test Bench Setup

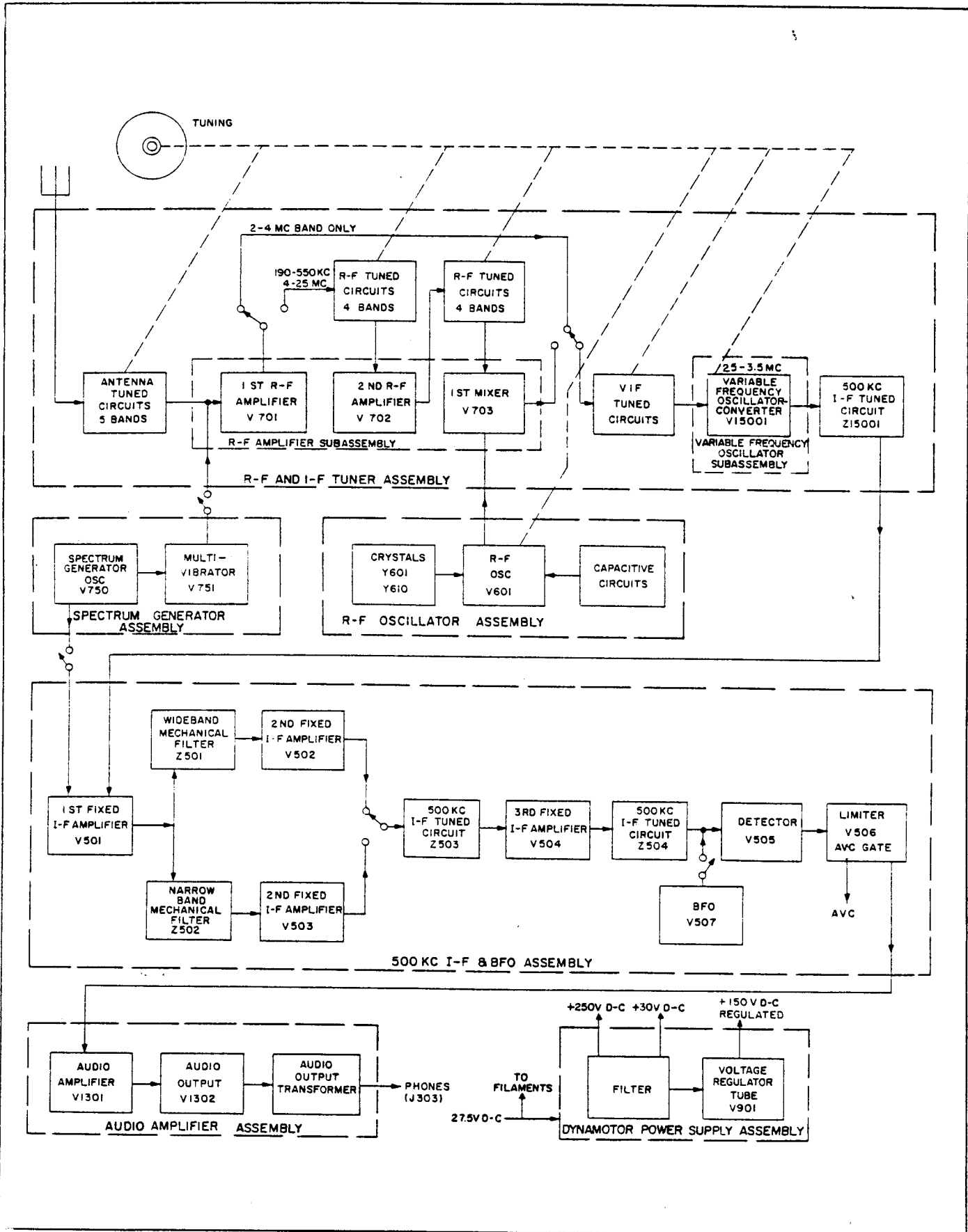


Figure 4-1. Radio Receiver R-648/ARR-41. Block Diagram

## SECTION IV

### THEORY OF OPERATION

#### 4-1. GENERAL DESCRIPTION.

4-2. BLOCK DIAGRAM. Figure 4-1 is a block diagram showing the over-all relationships of the various circuits employed in Radio Receiver R-648/ARR-41. The antenna is shown as coupled directly to the input; however, Antenna Coupler CU-351/AR or its equivalent may be used as an optional method. Paragraphs 4-3 through 4-5 provide a brief theory of operation based on the block diagram. A detailed theoretical discussion of each circuit is discussed beginning with paragraph 4-6.

4-3. SEQUENCE OF OPERATION. The incoming r-f signal is received by the antenna and applied to one of five tuned circuits, depending upon the band of reception. The signal is then applied to the grid of the first r-f amplifier, V701, for amplification. After first r-f amplification, frequencies within the range of bands 1, 3, 4, and 5 are applied through tuned circuits to the second r-f amplifier and then through more tuned circuits to the first mixer, V703. The function of the first mixer and the r-f oscillator, V601, is to heterodyne the incoming r-f and produce a variable i-f of 2 to 4 megacycles. Band 2 frequencies are 2 to 4 megacycles without heterodyning and, therefore, are switched around second r-f amplifier and first mixer circuits. All bands of frequencies are now within the range of 2 to 4 megacycles and are applied through the variable intermediate frequency-tuned circuits to the variable frequency oscillator converter, V15001. Mixer V15001 heterodynes the incoming 2- to 4-megacycle signal with a locally generated 2.5- to 3.5-megacycle signal, producing an output of 500 kilocycles, the fixed i-f frequency. The 500-kilocycle signal is applied to the grid of V501 for first i-f amplification. Output of V501 passes through either a broad- or narrow-band mechanical filter, depending upon the setting of the EMISSION switch, and through one of two second i-f amplifiers. The i-f signal is then applied through another tuned circuit to the grid of the third i-f amplifier, V504, the plate circuit of which is tuned by i-f tuned circuit Z504. Tuned circuit Z504 couples the output of i-f amplifier, V504, to the detector tube, V505. The functions of V505 are to recover the modulation component of the i-f signal, and to produce a negative voltage proportional to the carrier level for automatic volume control. The beat-frequency oscillator may be switched into the detector input by operation of the EMISSION switch to the CW or CW SHP positions. In this manner a beat note is produced with the 500-kilocycle i-f signal, which is a variable tone to be used for cw reception. Output from the detector is applied to V506, the limiter and avc gate. One half of dual diode, V506, functions as an avc gate control and prevents application of avc voltage to the various amplifiers

until full receiver sensitivity has been reached. The other half of V506 is a noise limiter which suppresses undesired noise pulses. Output of V506 is an audio voltage proportional to the modulation of the incoming r-f signal. Audio amplifier V1301 and audio output V1302 serve to amplify the audio signal. Phone jack J303 is connected to audio output transformer, T1301, and is available on the front panel of Radio Receiver R-648/ARR-41.

4-4. SPECTRUM GENERATOR. The spectrum generator consists of a crystal-controlled oscillator and a multivibrator divider circuit. The crystal-controlled oscillator, V750, serves to produce an accurate 500-kilocycle signal. The 500-kilocycle signal is applied to the grid of the first i-f amplifier, V501, and to one plate and grid of the multivibrator divider. The multivibrator fires on every fifth input pulse and produces an output to the first r-f amplifier of 100 kilocycles. This 100-kilocycle frequency is rich in harmonics and allows the r-f circuits to tune to a particular harmonic, depending upon the resonant frequency of the tuned circuits. A beat note is produced as a result of heterodyning the 500-kilocycle signal applied to the first i-f amplifier with the selected harmonic of the multivibrator. This beat note is heard when the R-648/ARR-41 frequency is varied around the selected multivibrator harmonic and the correct receiver frequency is known on the basis of the counter reading. The counter may then be set to the exact 100-kilocycle multiple and calibration is completed.

4-5. DYNAMOTOR POWER SUPPLY. The dynamotor power supply serves to convert the 27.5-volt d-c source voltage into a usable output for the screens and plates. The necessary filter and divider circuits are employed to produce a 250-volt d-c supply, a 150-volt regulated d-c supply, and a 30-volt d-c supply for avc delay bias.

#### 4-6. DETAILED CIRCUIT DESCRIPTION.

4-7. R-F AND I-F TUNER ASSEMBLY. Figure 4-2 illustrates, in block diagram form, the tuned circuit and switching arrangement of the r-f and i-f tuner assembly. The operation of the various switches are controlled by the mechanical drive of the BANDSWITCH on the front panel. The BANDSWITCH drives the r-f tuning core elevator in one-megacycle increments, operates r-f switches S401 and S402, and operates r-f oscillator switches S601 and S602. Switch S401A through S401H is operated only when the band of operation is changed and S402A through S402D is operated through each one-megacycle increment change. Assume, for example, that band 3, the 4- to 8-megacycle band, is to be used. Operation of the

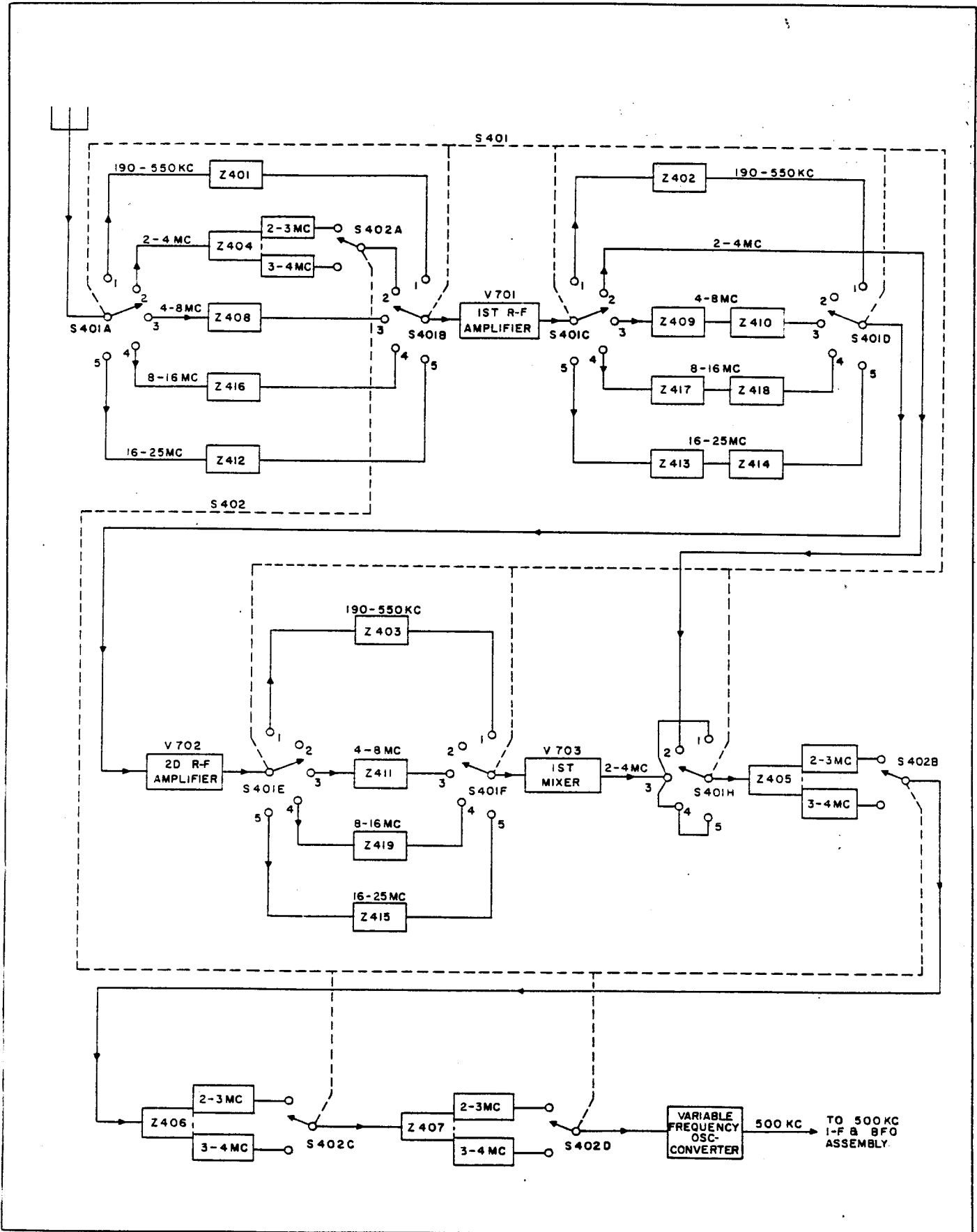


Figure 4-2. R-F and I-F Tuner Assembly. Block Diagram

BANDSWITCH drives switch S401A through S401H to the third position and drives the r-f slugs for a resonant frequency of 4 to 8 megacycles. At the same time, the BANDSWITCH operates the r-f oscillator switch, S601, and the correct crystal is chosen for an injection frequency of 7 megacycles. The variable intermediate frequency is now 2 to 3 megacycles and switch S402A through S402D is switched to the correctly tuned circuits for resonance within this range. The TUNING control is a mechanical drive which tunes the r-f tuned circuits over a one-megacycle range, tunes the variable i-f tuned circuits, and tunes the variable frequency oscillator from 2.5 to 3.5 megacycles. In this manner, the various tuned circuits are resonated and the fixed i-f frequency is the correct 500 kilocycles. The next operation of the BANDSWITCH drives the r-f slugs for a one-megacycle change, and switch S402A through S402D is operated to the 3- to 4-megacycle tuned circuit. Switch S401A through S401H remains in the same position and the resonant frequency is now within the range of 5 to 6 megacycles. The 9-megacycle r-f oscillator crystal is selected and the variable intermediate frequency is 3 to 4 megacycles. The TUNING control performs the function of tuning the r-f and variable i-f tuned circuits over a one-megacycle increment and tunes the variable frequency oscillator between 2.5 and 3.5 megacycles to produce the correct beat for a fixed intermediate frequency of 500 kilocycles. Operation of the BANDSWITCH to the next position drives the r-f slugs for

a resonant frequency of 6 to 7 megacycles, again selects the 9-megacycle r-f oscillator crystal, and operates switch S402A through S402D back to the 2- to 3-megacycle tuned circuits. Switch S401A through S401H again remains in the same position and the TUNING control performs the same function, that of tuning the r-f slugs through one megacycle, tuning the variable i-f tuned circuits, and tuning the variable frequency oscillator to produce a fixed i-f of 500 kilocycles. Operation of the BANDSWITCH to the next position repeats the process, switch S401A through S401H remains in the same position and the resonant frequency is in the range of 7 to 8 megacycles. The third band has now been completely covered in one-megacycle steps and the next operation of the BANDSWITCH will operate switch S401A through S401H to the fourth position, the 8- to 16-megacycle band. This band is covered in the same manner as band 3, that is, in one-megacycle steps. Bands 3, 4, and 5 differ from bands 1 and 2 in that several operations of the BANDSWITCH are necessary to cover each band. Band 1 is covered entirely by the TUNING control and band 2 is covered by the TUNING control and two full-detent positions of the BANDSWITCH, as the frequencies involved correspond directly to the variable intermediate frequency.

4-8. ANTENNA TUNED CIRCUITS. Figure 4-3 illustrates, in simplified schematic form, the antenna-tuned circuits of bands 1 and 2. For simplification,

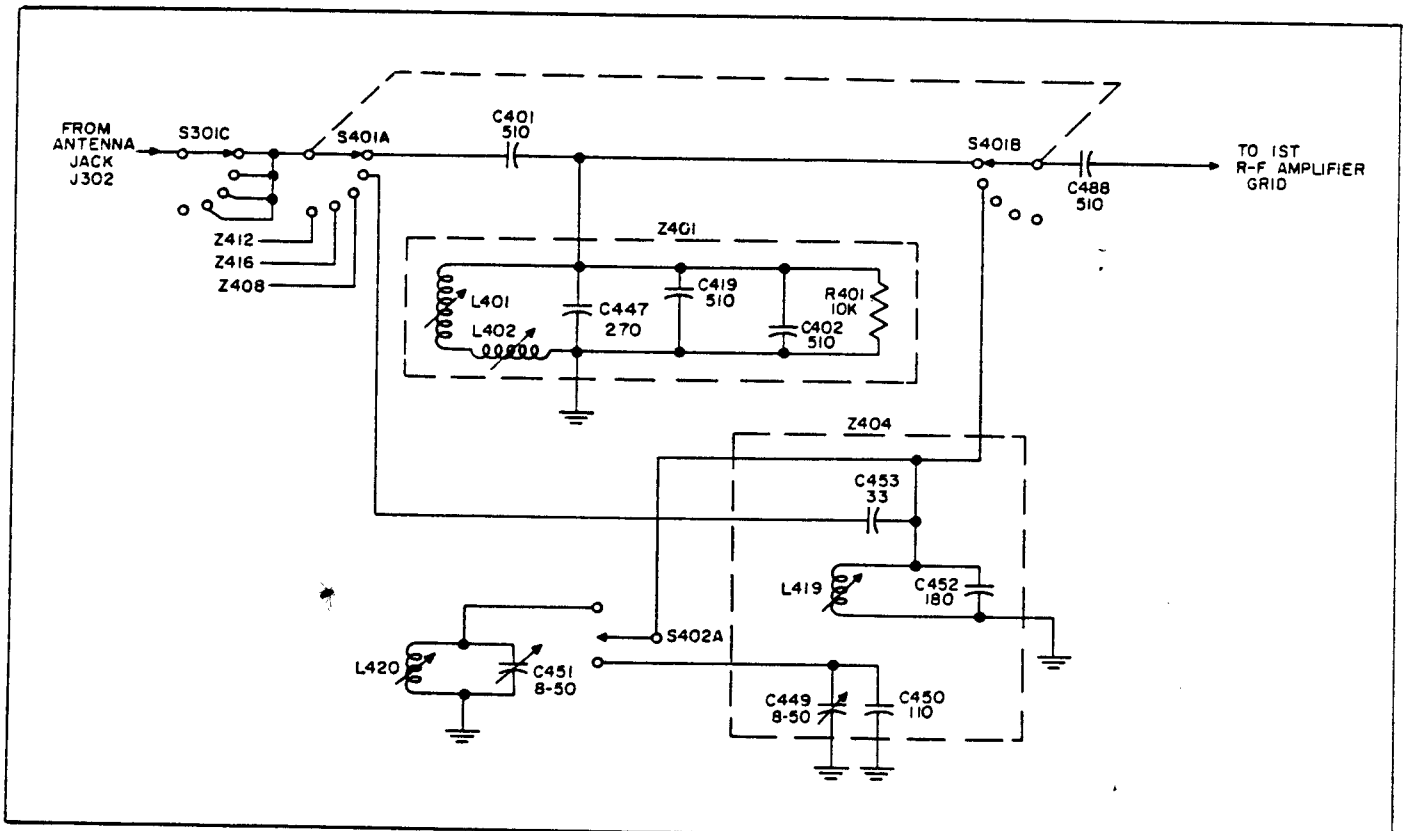


Figure 4-3. Antenna Tuned Circuits, Simplified Schematic Diagram

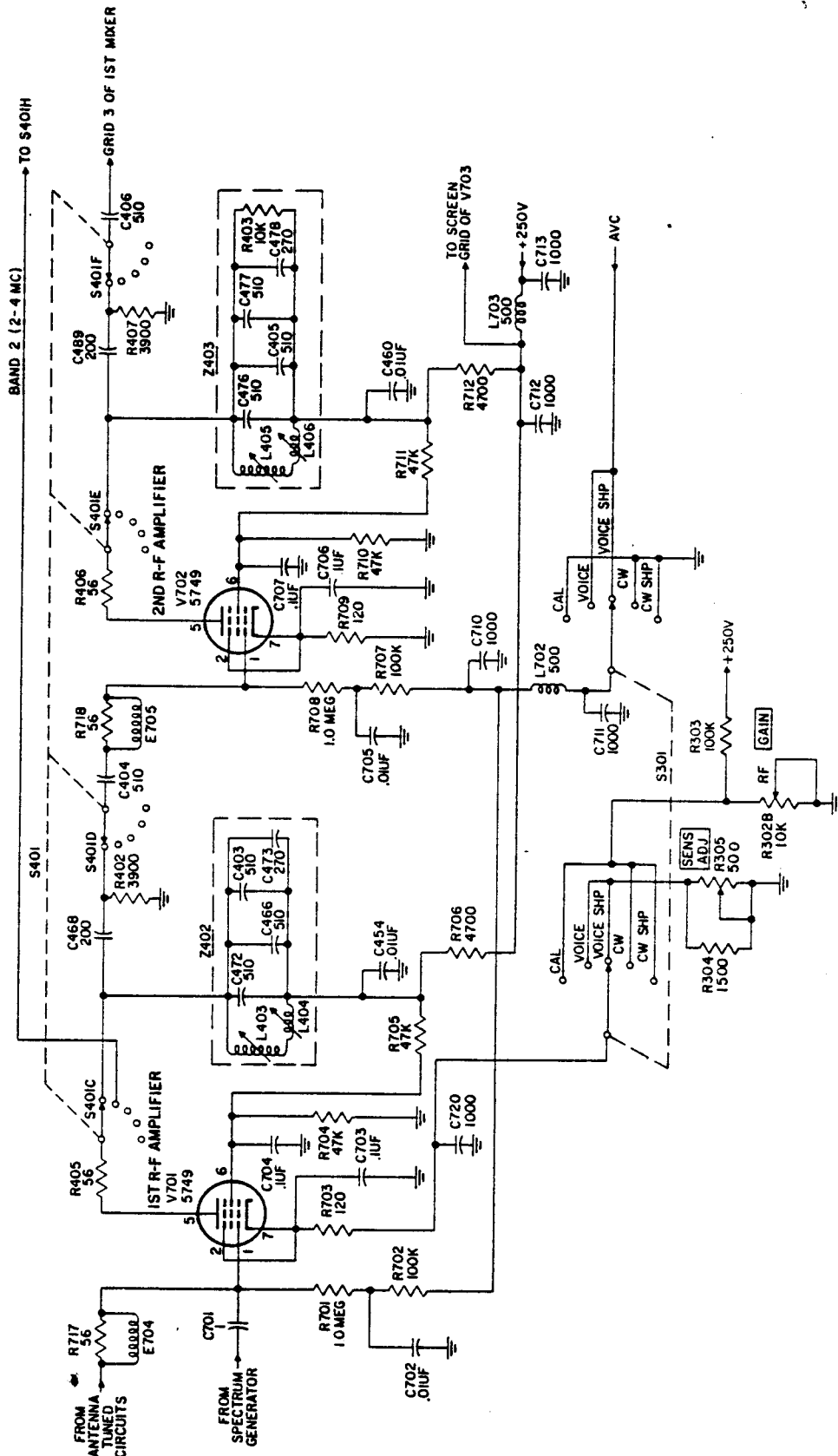


Figure 4-4. R-F Amplifiers, Simplified Schematic Diagram

tuned circuits of bands 3, 4, and 5 are not shown, however, they are basically the same as for band 1 and are illustrated in the main schematic, figure 7-6. All switches are shown in the correct position for band 1 reception.

4-9. The r-f signal from the antenna is fed through ANTENNA jack J302, through EMISSION switch wafer S301C, through BANDSWITCH wafer S401A, through coupling capacitor C401, and impressed across band 1, antenna-tuned circuit Z401. Tuned circuit Z401 consists of main tuning inductor L401, which is varied by the TUNING control; series trimming inductor L402, which is adjusted during alignment; paralleled capacitors C447, C419, and C402, which provide tank capacity; and loading resistor R401, which broadens the selectivity curve to include all frequencies within the range of band 1. Operation of switch S401 connects tuned circuits of other bands across the antenna input. The antenna-tuned circuit of band 2, Z404, consists of coupling capacitor C453, main tuning inductor L419, and tank capacitor C452. This tuned circuit is resonant at frequencies within the range of 2 to 4 megacycles. Switch S402A is controlled by the BANDSWITCH mechanical drive and selects the correct trimmer circuit to shunt across Z404. Capacitors C449 and C450 comprise one trimmer circuit, which resonates Z404 within the frequency range of 2 to 3 megacycles. Inductor L420 and capacitor C451 form the other trimmer, which brings the resonant frequency of Z404 within the range of 3 to 4 megacycles. Both trimmers are variable for purposes of alignment. The exact resonant frequency of Z404 is controlled by the TUNING control, which varies inductor L419. Antenna-tuned circuits of bands 3, 4, and 5 are similar to that of band 1 except that several operations of the BANDSWITCH are necessary to switch from one to the other. The BANDSWITCH varies the slugs of bands 3, 4, and 5 in one-megacycle steps and the TUNING control varies the slugs over a one-megacycle increment. Capacitor C488 is a coupling capacitor, common to all bands, which performs the function of coupling the r-f signal from the antenna-tuned circuits to the grid of the first r-f amplifier, V701.

4-10. R-F AMPLIFIERS. (See figure 4-4.) The r-f signal, after passing through the antenna-tuned circuits and coupling capacitor C488, passes through the parasitic suppressor arrangement of E704 and R717 and is applied to the grid of the first r-f amplifier. The grid is energized between load resistor R701 and r-f ground, supplied by capacitor C702. Avc voltage is applied to the first r-f amplifier grid through the decoupling arrangement of R702 and C702 and the pi-section filter arrangement of C710, L702, and C711. The avc line is disconnected when the EMISSION switch is operated to the CAL, CW, or CW SHP positions. The spectrum generator output also connects to the first r-f amplifier grid through capacitor C701 for purposes of calibration, which will be discussed in paragraph 4-28 of this section. Resistor R703 and capacitor C703 provide bias, made slightly variable by R305 or R302B, depending upon the setting

of the EMISSION switch. Capacitor C720 provides filtering for the bias varying resistors. The screen grid of V701 is held at r-f ground potential by capacitor C704. Resistor R704 stabilizes the screen grid circuit for d-c. After amplification, the r-f signal passes through parasitic suppressor R405 and is developed across tuned circuit Z402. Band 2 frequencies are bypassed around the second r-f amplifier and the first mixer, as the frequencies involved are in the correct range for conversion to the fixed i-f frequency. The impedance of band 1 tuned circuit Z402 increases with a change in its resonant frequency, which results in an undesirable variation in gain. This variation is compensated for by the shunting action of C468 and R402. As the resonant frequency is increased, the impedance offered by the series arrangement of C468 and R402 is decreased, thus changing the load on Z402 and compensating for the increased gain caused by the increase in resonant frequency. Tuned circuits of bands 3, 4, and 5 differ slightly from this in that the impedance remains constant throughout the resonant frequency range of the band of reception, and an external loading circuit is, therefore, not required. Also, both grid and plate circuits of bands 3, 4, and 5 are tuned between the first and second r-f amplifiers, as may be seen by reference to the main schematic diagram, figure 7-6. The r-f signal is then passed through switch wafer S401D, coupling capacitor C404, and the parasitic suppressor, consisting of E705 and R718 to the grid of V702, the second r-f amplifier control grid. Operation of the second r-f amplifier is identical with the first r-f amplifier stage. Band 1 frequencies are developed across tuned circuit Z403 and coupled through capacitor C489, contacts of S401F, and capacitor C406 to the first mixer stage, V703. Tuned circuits for bands 3, 4, and 5 are not shown in figure 4-4 for simplicity, but are identical in function to the band 1 tuned circuit, Z403.

4-11. FIRST MIXER. (See figure 4-5.) The r-f signal is coupled through capacitor C406 and applied to grid 3 of the first mixer stage. Resistor R719 and inductor E706 are parasitic suppressors and prevent unwanted oscillations. Pin 1 of V703 connects to the output of the r-f oscillator, whose function is to produce the first injection frequency for use in the mixer stage. The r-f oscillator will be discussed in paragraph 4-12 of this section. The screen grid, pin 6 of V703, connects to the 250-volt B+ line through dropping resistor R716 and the line filter consisting of C712, C713, and L703. Capacitor C709 holds the screen grid at r-f ground. Normal cathode bias is used in the first mixer stage, supplied by resistor R714 and capacitor C708. Heterodyning of the injection frequency and the incoming r-f signal takes place in the electron stream of V703. The plate circuit is tuned by Z405, Z406, and Z407 and the difference frequency is selected for bands 3, 4, and 5. For band 1 reception, the tuned circuits are resonated to the sum frequency. In the plate circuit of the first mixer, all frequencies are now within the range of 2 to 4 megacycles. Switches S401H, S402B, S402C, and S402D are controlled by the operation of the BANDSWITCH.



As was explained in paragraph 4-7 of this section, the correct trimmer circuit is chosen for variable r-f tuned circuits Z405, Z406, and Z407 for a resonant frequency of 2 to 3 megacycles or 3 to 4 megacycles, depending upon the setting of the BANDSWITCH. The main tuning slugs are varied throughout the 1-megacycle range by the TUNING control. The trimmer circuits are adjustable during alignment procedures. The 2- to 4-megacycle signal is applied to grid 3 of V15001, the variable frequency oscillator-converter stage.

4-12. R-F OSCILLATOR. (See figure 4-6.) The r-f oscillator is a crystal-controlled modified Colpitts oscillator, employing a pentode vacuum tube, V601. Feedback to the grid of the oscillator is taken from

the parallel combination of C604 and L601. Capacitor C603 is the main feedback capacitor and C602 is a trimmer capacitor which is factory adjusted. Resistor R603, in series with the grid loading resistor, is provided for the purpose of measuring grid current. Capacitor C601 is the r-f bypass for the meter. The output frequency of the oscillator is controlled by the selected crystal and by the tank circuit of the plate, which tunes to either the fundamental, the second harmonic, or the third harmonic of the crystal, depending upon the setting of switch S602. For simplicity, only one crystal and two plate tank trimmers are shown in figure 4-6. Reference is made to the main schematic diagram, figure 7-6, for a detailed view of the complete circuit. Switches S601 and S602 are connected to the BANDSWITCH mechanical drive. Operation of the BANDSWITCH selects the

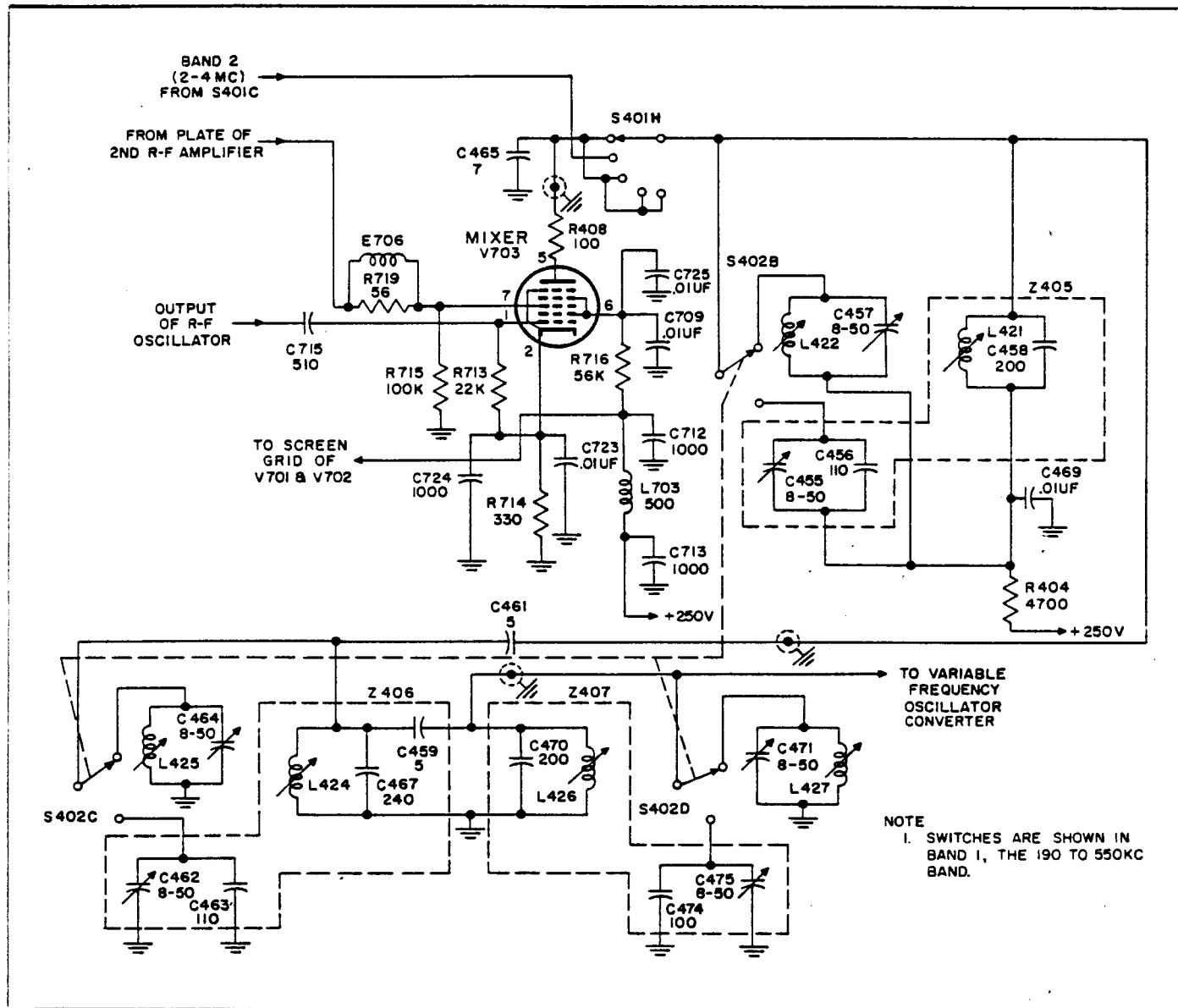


Figure 4-5. First Mixer, Simplified Schematic Diagram

proper crystal and the proper trimmer capacitor for the plate-tuned circuit. When the injection frequency above 9 megacycles is required, switch S602 rear is operated by the BANDSWITCH drive to the tap of transformer T601, thus reducing the inductance and raising the resonant frequency. Frequencies above 13 megacycles are produced by the harmonic selection of the plate-tuned circuit. The correct trimmer is selected to resonate with half of transformer T601, and the output frequency is either the second or third harmonic of the crystal. Figure 4-6 illustrates the crystal and trimmer used in band 1, the 190- to 550-kilocycle band. The 3-megacycle crystal is selected and the plate tank capacity is supplied by trimmer capacitor C610. Refer to table VIII for the r-f oscillator statistics for each output frequency.

4-13. VARIABLE FREQUENCY OSCILLATOR - CONVERTER. (See figure 4-7.) The variable frequency oscillator-converter performs the function of heterodyning the incoming 2- to 4-megacycle signal and producing an output of the fixed i-f frequency, 500 kilocycles. The oscillator portion of V15001 consists of grid 1 (pin 1), grids 2 and 4 (pin 6), and the cathode (pin 2). The oscillator is a series-fed Hartley, with grids 2 and 4 acting as the plate circuit.

Capacitor C15005 keeps the plate of the oscillator at r-f ground and resistor R15002 drops the B+ voltage the correct amount, with respect to the converter plate. Inductors L15003 and L15005 and capacitor C15008 form a B+ line filter for both the oscillator and converter plates. Feedback to the grid of the oscillator is accomplished by the autotransformer-type connection of the cathode to the tap of inductor L15001. The TUNING control varies the inductance of L15001, thereby effectively changing the position of the cathode tap and controlling the frequency of oscillation. Inductor L15002 is slightly adjustable to set the end points of the frequency range. The temperature-compensated parts of the oscillator are enclosed in a hermetically sealed case and temperature-controlled oven to insure stability. This case is sealed at the factory and should not be opened even in the event of maintenance operations.

4-14. Mixing of the incoming 2- to 4-megacycle signal and the variable frequency oscillator signal takes place in the electron stream of V15001. The difference frequency (500 kilocycles) is selected by plate-tuned circuit Z15001. Capacitor C15009 couples the output of the variable frequency oscillator-converter to the grid of the first i-f amplifier V501.

TABLE VIII. R-F OSCILLATOR STATISTICS

BANDSWITCH POSITION (MC COUNTER READING)	R-648/ARR-41 FREQUENCY, MC	SELECTED CRYSTAL, MC	SELECTED TRIMMER	SELECTED HARMONIC	OSCILLATOR OUTPUT, MC
0	0.190-0.550	3.0	C610	FIRST	3.0
2. 3	2-4	NONE	NONE	NONE	NONE
4	4-5	7.0	C611	FIRST	7.0
5. 6	5-7	9.0	C613	FIRST	9.0
7. 8	7-9	11.0	C614	FIRST	11.0
9. 10	9-11	13.0	C615	FIRST	13.0
11. 12	11-13	15.0	C617	FIRST	15.0
13. 14	13-15	8.5	C619	SECOND	17.0
15. 16	15-17	9.5	C621	SECOND	19.0
17. 18	17-19	7.0	C623	THIRD	21.0
19. 20	19-21	11.5	C625	SECOND	23.0
21. 22	21-23	12.5	C627	SECOND	25.0
23. 24	23-25	9.0	C628	THIRD	27.0

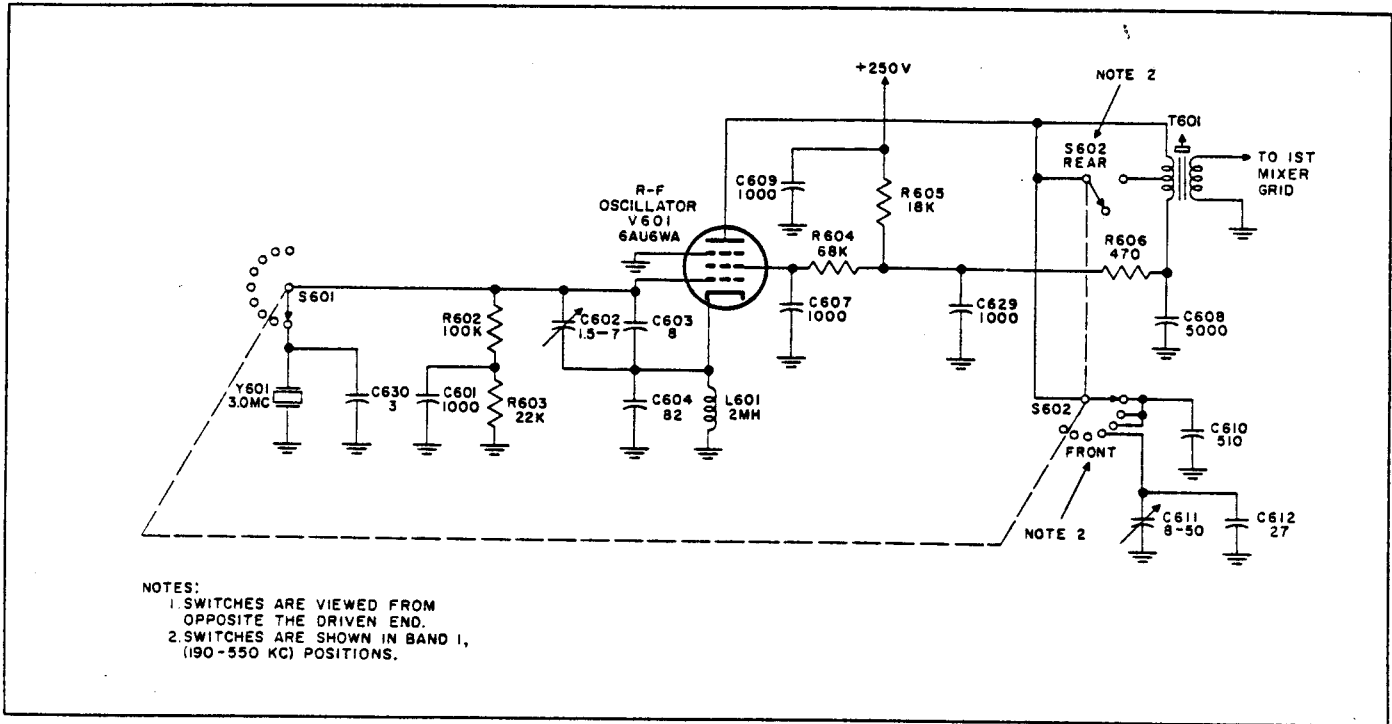


Figure 4-6. R-F Oscillator, Simplified Schematic Diagram

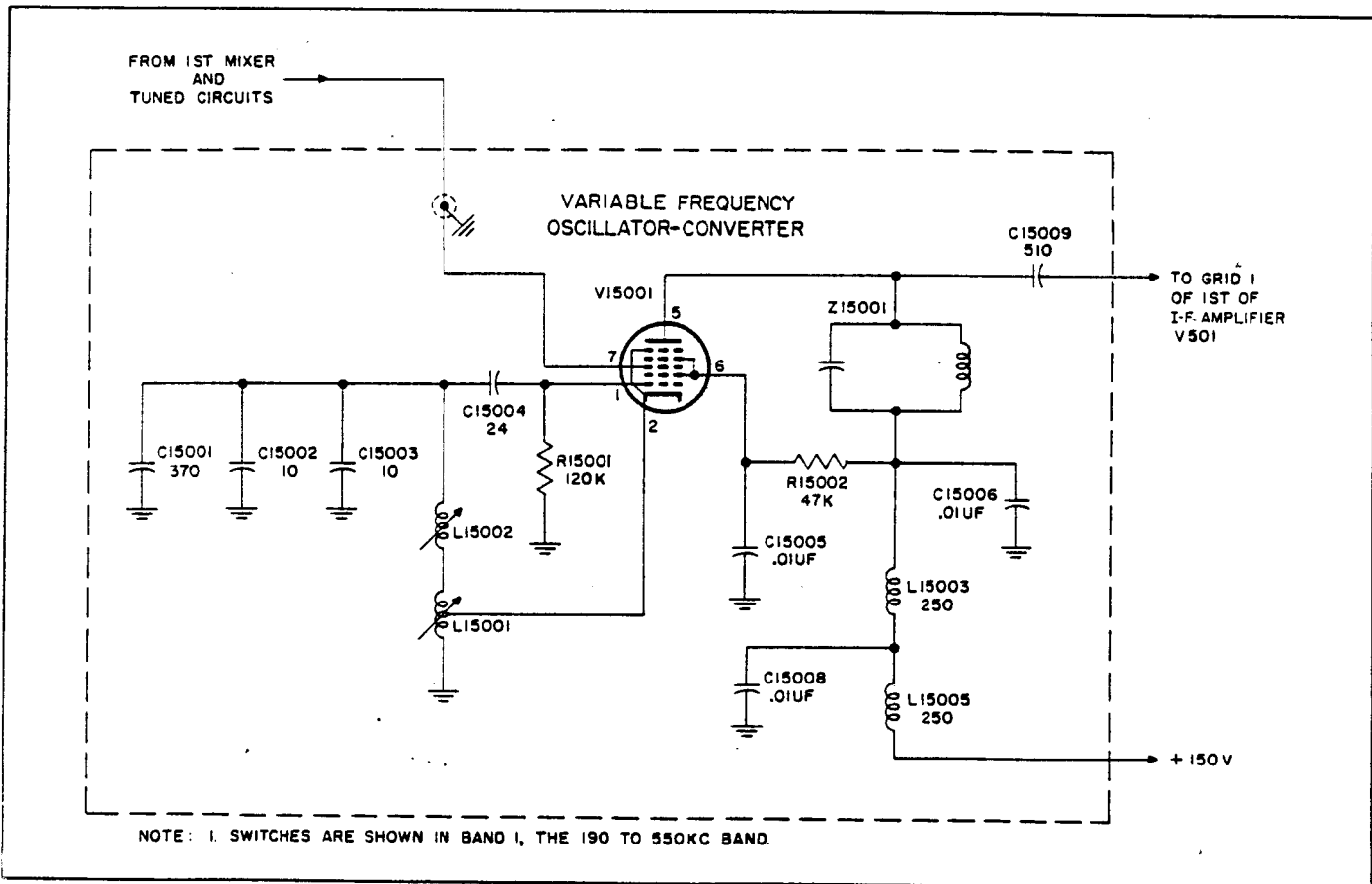


Figure 4-7. Variable Frequency Oscillator-Converter, Simplified Schematic Diagram

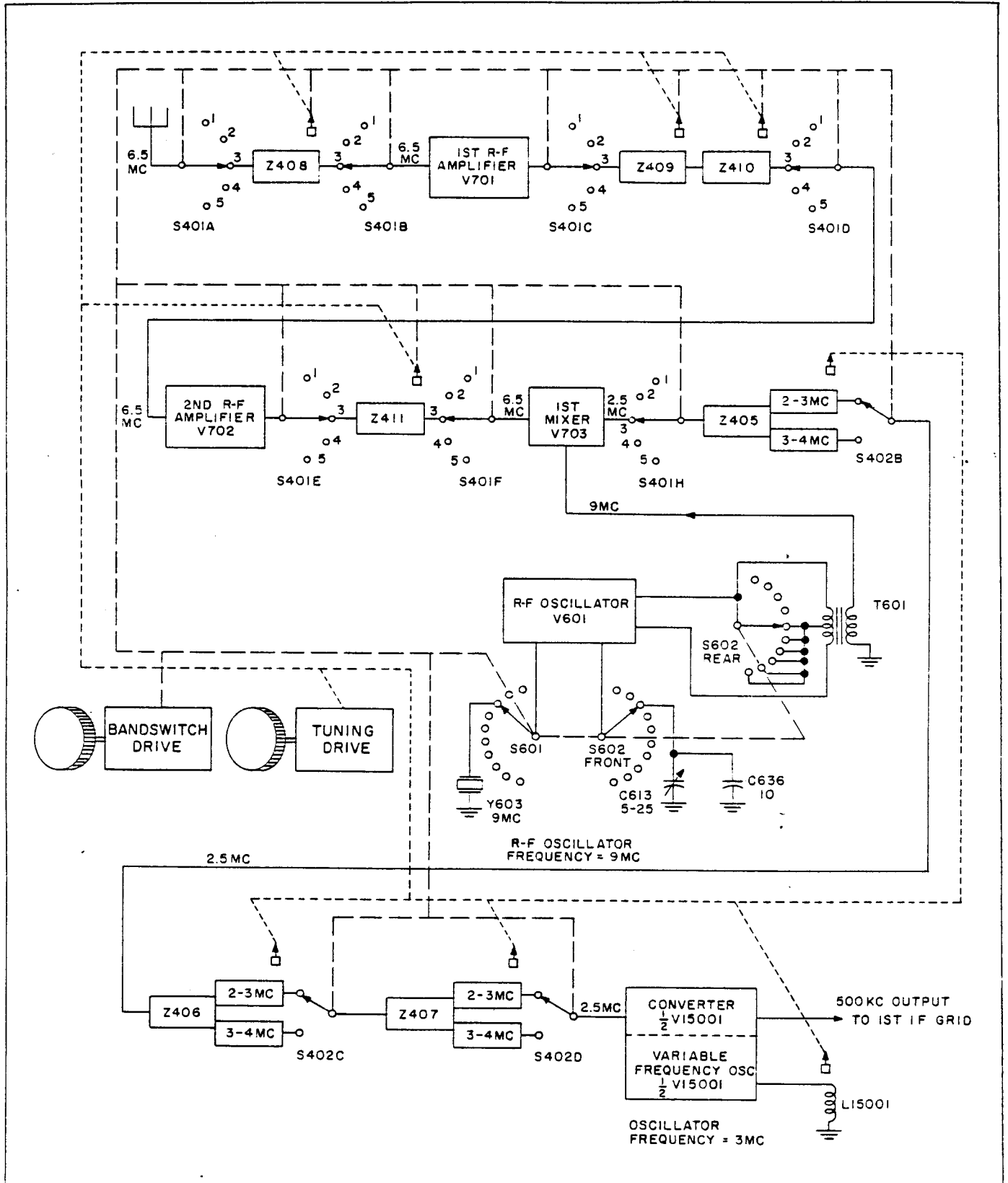


Figure 4-8. 500-Kc Fixed I-F Signal. Simplified Schematic Diagram

4-15. 500-KC FIXED I-F SIGNAL. In order to obtain a better understanding of the way the 500-kc fixed i-f signal is obtained, the following paragraph is a summary of the various heterodyning and tuning actions which take place, assuming the receiver is tuned to 6.5 megacycles. Refer to figure 4-8 for the following discussion.

4-16. Assume the R-648/ARR-41 is to be tuned to 6.5 megacycles. The BANDSWITCH is operated for a reading of 6 on the left-hand counter dial of the MEGACYCLES frequency indicator. Switches S401A through S401H are rotated to the band 3 position and switches S402B through S402D are rotated to the 2- to 3-megacycle position. Switches within the r-f oscillator assembly (S601 and S602 front and rear) select the correct crystal and plate impedance for the 6-megacycle frequency increment. Operation of the BANDSWITCH also results in the slugs of tuned circuits Z408 through Z411 moving to the 6-megacycle increment. The TUNING control is now operated until the reading on the MEGACYCLES frequency indicator is exactly 6.5 megacycles. This results in the slugs of Z408 through Z411 being set to 6.5 megacycles.

the slugs of Z405 through Z407 being set to 2.5 megacycles, and the slug of L15001 being set to 3 megacycles. Conditions are now correct for receiving signals at 6.5 megacycles. The 6.5 megacycle is applied through Z408, amplified by V701, applied through Z409 and Z410, amplified by V702, and applied through Z411 to the first mixer, V703. The 6.5 - megacycle signal is heterodyned with a 9-megacycle signal from V601, resulting in a frequency of 2.5 megacycles. The 2.5-megacycle signal is applied through Z405, Z406, and Z407 to the variable frequency oscillator-converter stage, V15001. The 2.5-megacycle signal is heterodyned with a 3-megacycle signal generated in V15001 and the difference frequency selected, which is the 500-kilocycle fixed i-f frequency. The switching and heterodyning actions described in this paragraph will be similar for all frequencies within bands 1, 3, 4, and 5 with different tuned circuits and crystals employed, depending upon the band. Band 2 frequencies, however, require no first heterodyning, and are switched directly from the first r-f amplifier output to the input of tuned circuit Z405. Table IX lists the conversion statistics for each frequency increment throughout the tuning range of Radio Receiver R-648/ARR-41.

TABLE IX. CONVERSION STATISTICS FOR ALL FREQUENCIES

MEGACYCLE COUNTER POSITION	R-648/ARR-41 FREQUENCY, MC	R-F TUNER BAND (S401 POSITION)	R-F OSC FREQUENCY MC	VARIABLE I-F FREQUENCY MC	VARIABLE FREQUENCY OSC. MC	FIXED I-F FREQUENCY KC
0	0.190-0.550	1	3	3.19-3.55	2.69-3.05	500
2	2-3	2	NONE	2-3	2.5-3.5	500
3	3-4		NONE	3-4	2.5-3.5	500
4	4-5	3	7	3-2	3.5-2.5	500
5	5-6		9	4-3	3.5-2.5	500
6	6-7		9	3-2	3.5-2.5	500
7	7-8		11	4-3	3.5-2.5	500
8	8-9	4	11	3-2	3.5-2.5	500
9	9-10		13	4-3	3.5-2.5	500
10	10-11		13	3-2	3.5-2.5	500
11	11-12		15	4-3	3.5-2.5	500
12	12-13		15	3-2	3.5-2.5	500
13	13-14		2 x 8.5	4-3	3.5-2.5	500
14	14-15		2 x 8.5	3-2	3.5-2.5	500
15	15-16		2 x 9.5	4-3	3.5-2.5	500
16	16-17	5	2 x 9.5	3-2	3.5-2.5	500
17	17-18		3 x 7	4-3	3.5-2.5	500
18	18-19		3 x 7	3-2	3.5-2.5	500
19	19-20		2 x 11.5	4-3	3.5-2.5	500
20	20-21		2 x 11.5	3-2	3.5-2.5	500
21	21-22		2 x 12.5	4-3	3.5-2.5	500
22	22-23		2 x 12.5	3-2	3.5-2.5	500
23	23-24		3 x 9	4-3	3.5-2.5	500
24	24-25	3 x 9	3-2	3.5-2.5	500	

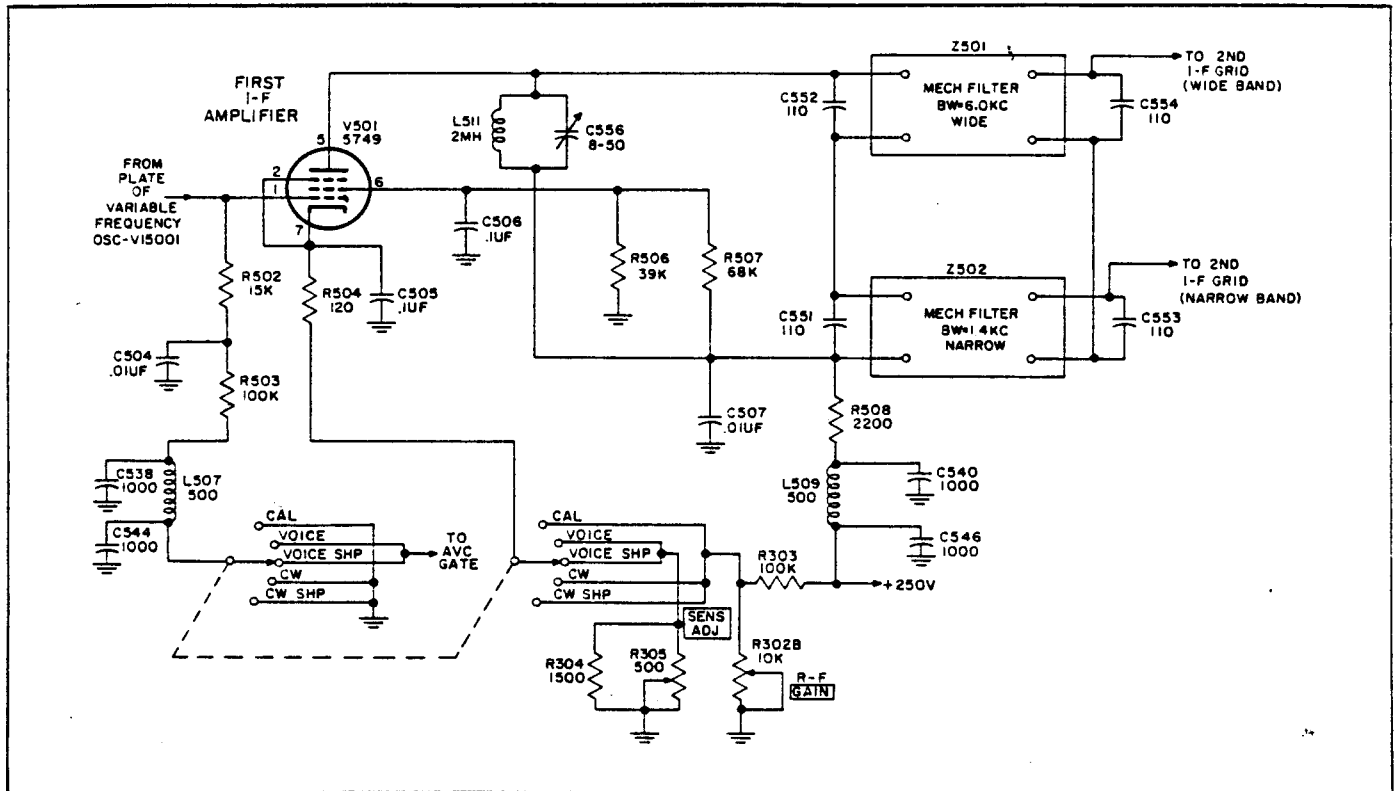


Figure 4-9. First I-F Amplifier, Simplified Schematic Diagram

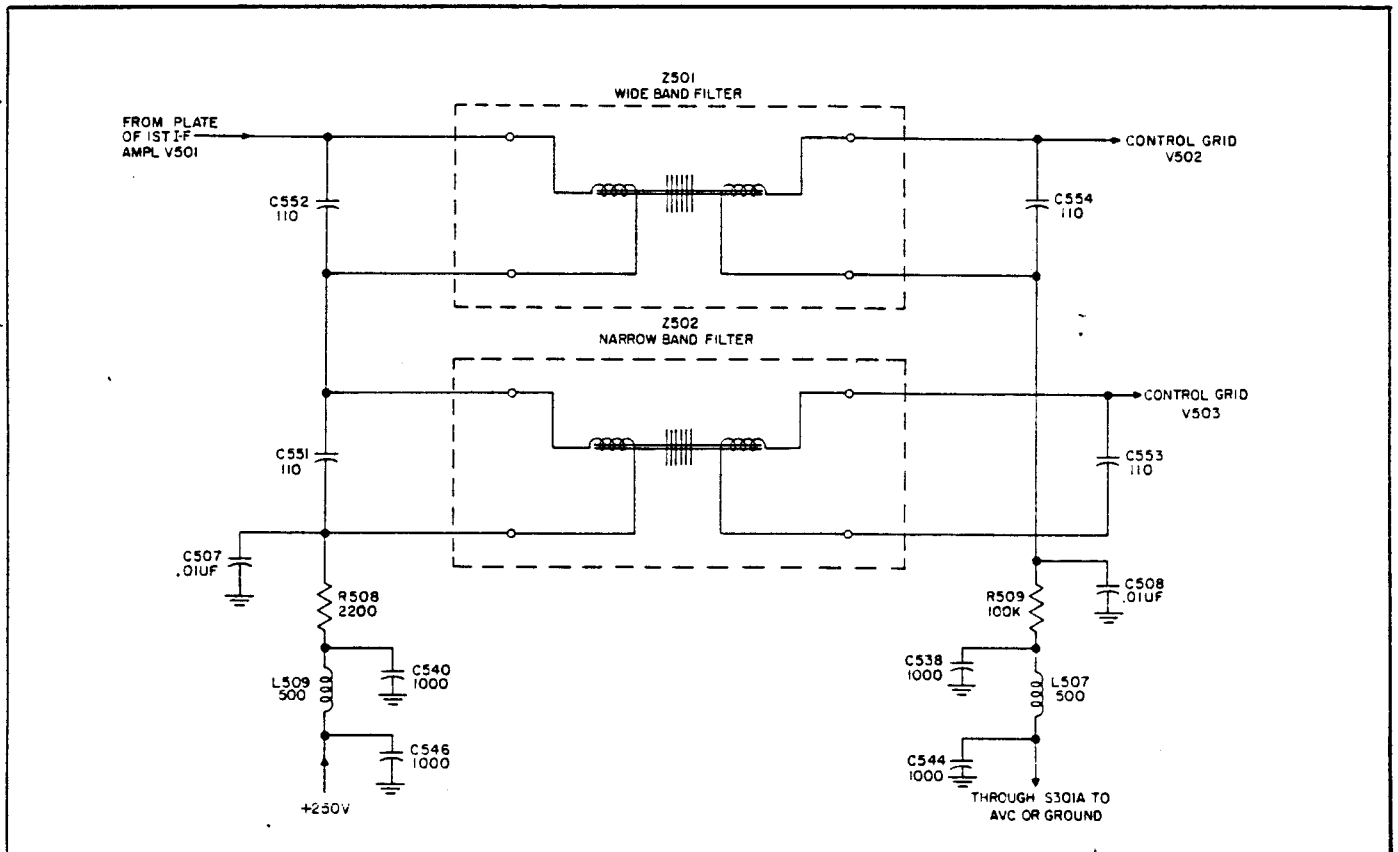


Figure 4-10. Mechanical Filters, Simplified Schematic Diagram

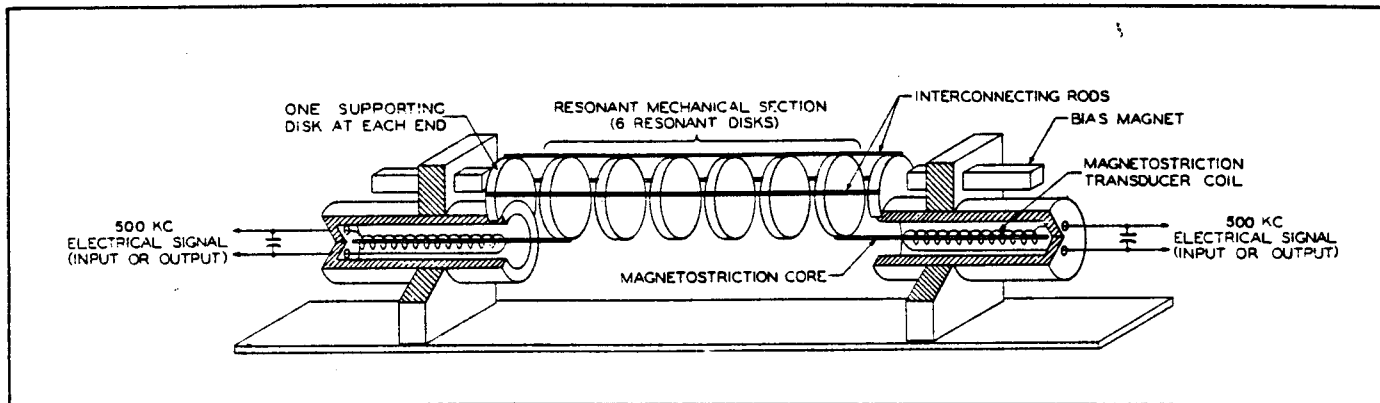


Figure 4-11. Mechanical Filters, Functional Diagram

4-17. FIRST I-F AMPLIFIER. (See figure 4-9.) The output of the variable frequency oscillator-converter is coupled through capacitor C15009 to the control grid of the first fixed i-f amplifier, V501. The 500-kc signal is developed across resistor R502. Avc voltage is applied to the control grid through contacts of switch S301A, through the avc filter composed of L507, C538, and C544, and through the avc decoupling network composed of R503 and C504. Cathode bias is employed in the amplifier and is made slightly variable through potentiometers R302B or R305, depending upon the setting of switch S301A. The i-f signal is amplified through V501 and appears across the parallel impedance composed of L511 and C556, whose function is to resonate with the stray capacity, thereby canceling the shunting effect of the signal caused by the stray capacity to ground. The signal is applied through the two mechanical filters, Z501 and Z502, and appears at the grids of the second i-f amplifiers. The mechanical filters will be discussed in the paragraph 4-18. The plate and screen voltage for the first i-f amplifier is applied through the B+ filter, consisting of L509, C540, and C546, and through the B+ decoupling arrangement of R508 and C507. Screen-grid voltage is dropped the correct amount by the voltage divider-filter arrangement of R507, R506, and C506.

4-18. MECHANICAL FILTERS. Figure 4-10 illustrates, in simplified schematic form, the circuitry within the mechanical filters. The 500-kc signal is resonated across the tuned circuit consisting of C552 and the wide-band transducer coil and across the tuned circuit consisting of C551 and the narrow-band transducer coil. A nickel wire within these coils is caused to vibrate mechanically from the changing flux of the transducer coils. This mechanical vibration is transferred to the first of six nickel alloy disks. The disks are coupled together by means of nickel interconnecting rods and vibrate in direct accordance with the 500-kc i-f signal. The last disk is mechanically connected to a nickel wire, identical to the wire used on the input side. Vibration of this wire sets up a changing flux, which is picked up by

the output transducer coils. An alternating current is set up in the output-tuned circuits, which is in direct accordance with the input current, and the signal is applied to the grids of the second i-f amplifiers. The process by which the electrical input signal is changed to a mechanical vibration, and the reverse process of mechanical to electrical is called magnetostriction.

4-19. Figure 4-11 illustrates the mechanical layout of the filters. Biasing magnets at each end polarize the resonant disks to prevent frequency doubling in much the same manner that biasing magnets in a headphone prevent the diaphragm from bending in the same direction for both halves of an a-c signal. Each of the nickel alloy disks has a resonant Q exceeding 2000. The disks are overcoupled to produce a response curve with a flat top and straight, almost vertical, sides. Thus, the filters pass a band of frequencies very little wider than the 6.0-kc and 1.4-kc flat top of the selectivity curves.

4-20. SECOND AND THIRD I-F AMPLIFIERS. (See figure 4-12.) The grid impedances for the second i-f amplifiers consist of the transducer output coils and capacitors C553 and C554, which form tuned circuits resonant at 500 kilocycles. Avc voltage is applied to the grids through contacts of S301A, through the avc filter, and through the avc decoupler consisting of R509 and C508. Only one of the second i-f amplifiers is operated at a time, depending upon which mechanical filter is selected. Contacts of switch S301A determine which of the two cathodes is to be grounded, and thereby which i-f amplifier is to be used. Both amplifiers employ cathode bias and a line filter consisting of two capacitors and one inductor. The i-f signal is amplified and impressed across tuned circuit Z503, which attenuates all frequencies except the 500-kilocycle i-f signal. The signal is passed through capacitor C514 and developed across resistor R516. Third i-f amplification takes place in V504, with V504 serving as the plate-tuned circuit. The signal is passed through capacitor C520 to the detector, V505.

4-21. DETECTOR, LIMITER, AND AVC GATE. (See figure 4-13.) Coupling capacitor C520 also acts as the charging capacitor of the voltage-doubling detector V505. On the positive portion of the modulation envelope, V505A conducts, charging C520. On the negative cycle, V505B conducts and V505A cuts off. The charge of capacitor C520 is also conducted through V505B, thus charging capacitor C522 to twice the peak of the signal. On the next positive cycle, V505B cuts off and V505A again conducts. Capacitor C522 partially discharges through resistors R521 and R520, and capacitor C520 charges to the peak of the modulation envelope. In this manner, with C520 discharging during the negative modulation peak and with C522 discharging through R520 and R521 on the positive modulation peak, the voltage appearing across the series combination of R520 and R521 is proportional to the modulation envelope and is twice as large.

4-22. The voltage appearing across R520 and R521 is a negative-going voltage, possessing both an a-c and a d-c component. The a-c component is proportional to the modulation and the d-c component is proportional to the carrier level. The d-c component is retrieved by the filter arrangement of R522 and C523, in the cathode circuit of the noise limiter, V506A. This d-c voltage is proportional to the carrier level and remains constant regardless of the percentage of modulation, thus holding the cathode of V506A at a constant negative voltage. The plate voltage of V506A normally is slightly positive with respect to the voltage appearing at the cathode. The drop across R521 serves to make the plate positive during normal modulation, that is, below 60% modulation of the carrier, and V506A conducts. The cathode voltage follows the conduction of V506A and capacitor C528 couples this voltage, which is the audio output, to the grid of the first audio amplifier, V1301A. Resistor

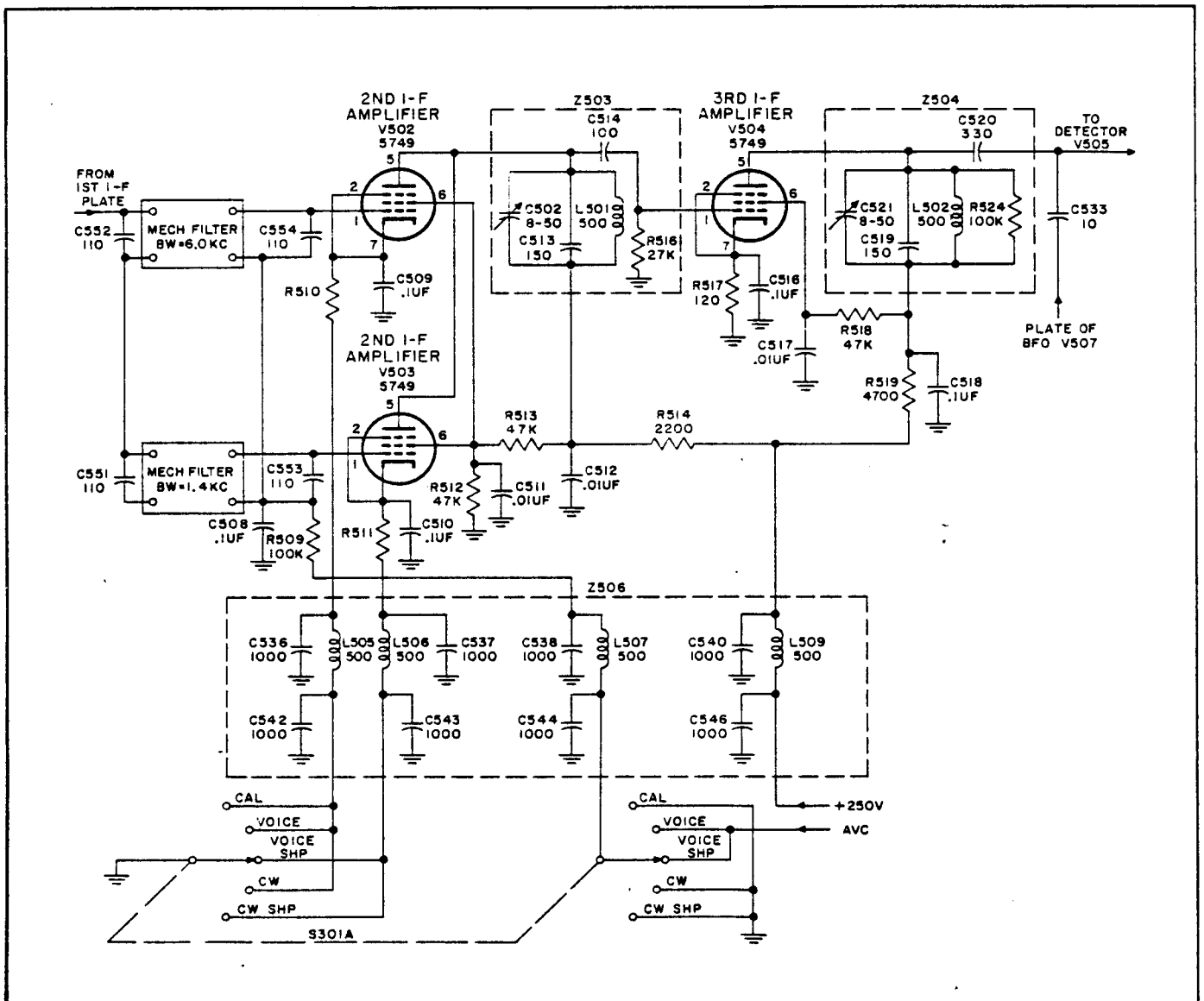


Figure 4-12. Second and Third I-F Amplifiers, Simplified Schematic Diagram



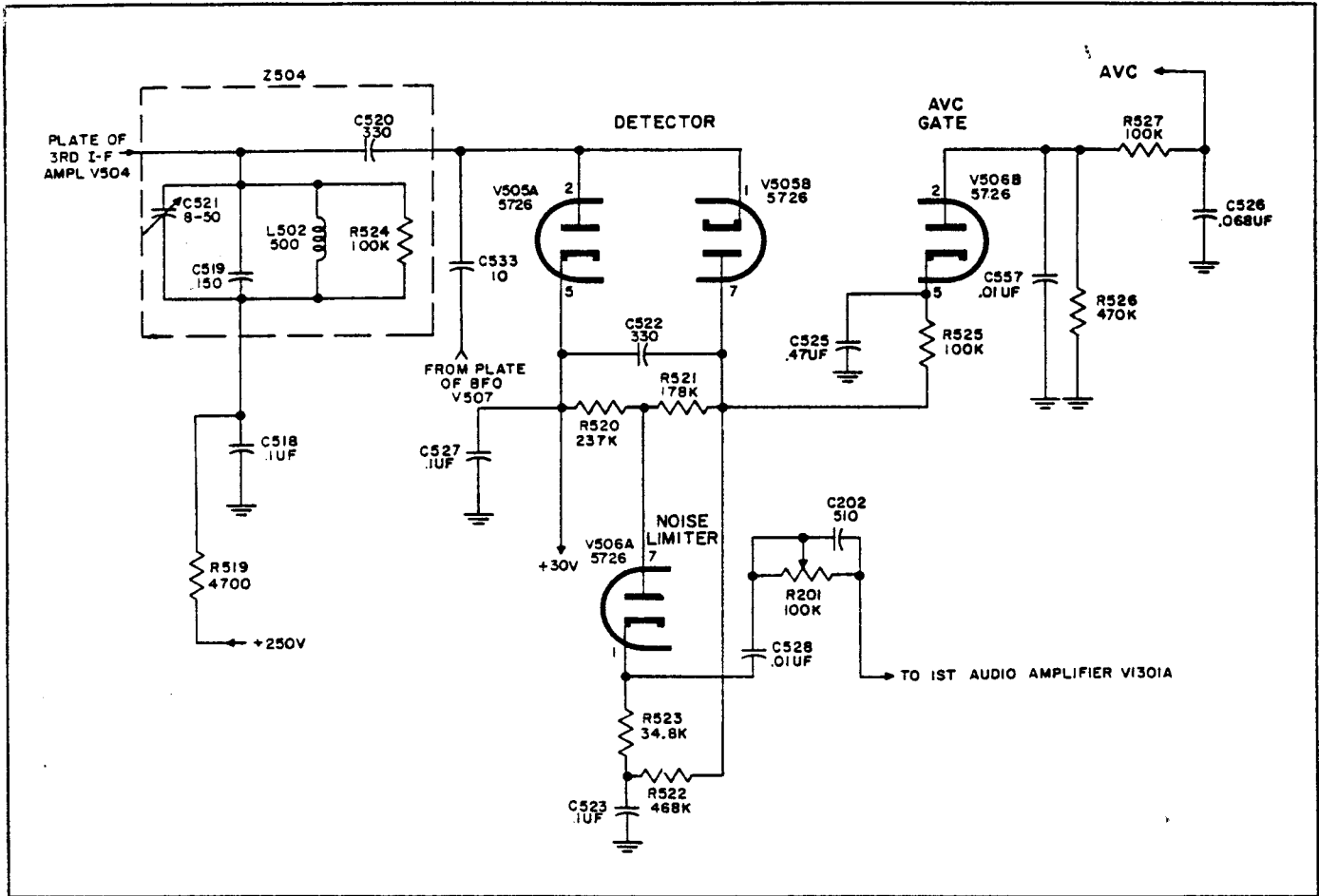


Figure 4-13. Detector, Limiter, and AVC Gate, Simplified Schematic Diagram

R201 is used to adjust the level of the audio output, and capacitor C202 is included to maintain the proper frequency equalization. Should the percentage of modulation suddenly increase, as would be the case for a strong noise pulse, the plate of V506A is driven negative by the drop across R520 and conduction is no longer possible. Thus, the action of noise limiter V506A, in conjunction with the voltage divider action of R520 and R521, serves to limit the audio output voltage to that contained within a 60% modulation component of the carrier. In this manner, a great amount of noise energy may be limited without adversely affecting the intelligibility of audio signals.

4-23. Application of avc voltage is delayed by the action of the gating stage, V506B, until full receiver sensitivity has been reached. The cathode of V506B is biased to 30 volts d-c through resistors R525, R520, and R521. Under static conditions V506B cannot conduct as the plate is negative with respect to the cathode. The drop across R521 and R520 serves to drive the cathode in the negative direction when the detector is in dynamic operation. As the signal increases in amplitude, the drop across R521 and R520 becomes greater, driving the cathode more negative, until finally the 30-volt bias is overcome and V506B conducts. The drop across resistor R526 drives the

plate negative with respect to ground. This negative voltage is the avc voltage and varies in amplitude with the strength of the incoming signal. Resistor R527 and capacitor C526 perform the function of decoupling the avc gate circuit from the avc line. The avc voltage is filtered by pi-section filters in the r-f and i-f amplifier stages, as illustrated in figures 4-4, 4-9, and 4-10. Resistor R525 and capacitor C525 filter the audio voltage applied to the cathode of V506B and effectively isolate the avc gating stage from the detector load circuit.

4-24. AUDIO AMPLIFIERS. (See figure 4-14.) The cathode of the limiter, V506A, capacitively coupled to the grid, pin 2, of the first audio amplifier. Tubes V1301A and V1301B and V1302 are ordinary resistance-coupled audio amplifiers. Bias for V1301A is made slightly variable by potentiometer R302A when the EMISSION switch is in the VOICE or VOICE SHP. positions, allowing a certain amount of control over the gain of the stage. Resistor R1305 provides bias when in the CW, CW SHP or CAL positions. After amplification by V1301A and V1301B, the audio signal is coupled to the grid of the audio output tube, V1302. The plate circuit of V1302 is coupled back to the plate of V1301B through resistor R1312. The feedback voltage from the audio output plate is 180

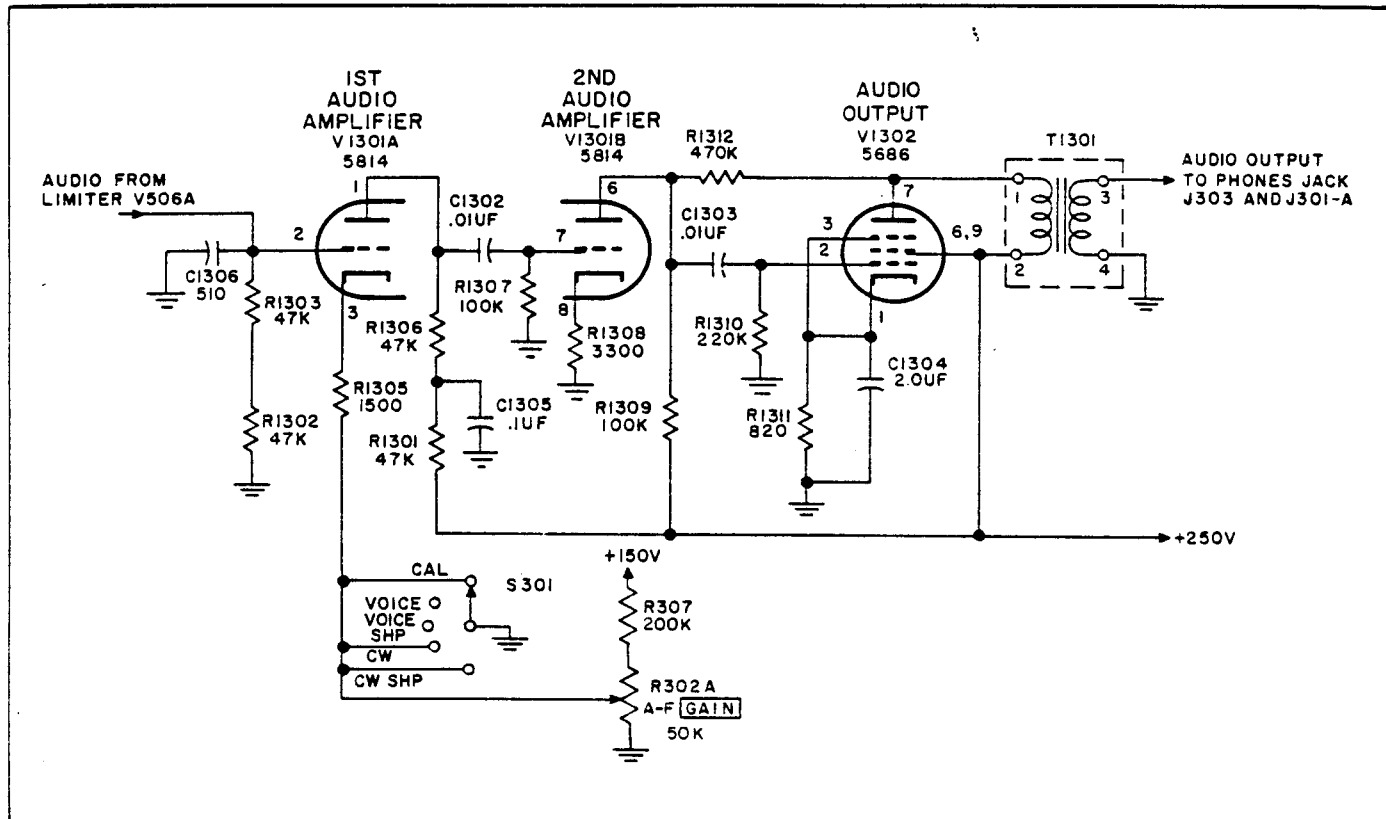


Figure 4-14. Audio Amplifiers, Simplified Schematic Diagram

degrees out of phase with the voltage at the plate of V1301B. Thus, a partial cancellation takes place, the amount of cancellation being dependent upon the amplitude of the feedback voltage. The value of resistor R1312 is chosen so that the cancellation effect is limited to that required to flatten the response curve and reduce distortion. The audio-output stage is capable of providing 500 milliwatts of audio power with less than 10% distortion. Audio output is taken from the secondary of transformer T1301 and applied to the PHONES jack, J303, on the front panel, and to the POWER jack, J301, on the front panel, for connection to the aircraft interphone.

**4-25. BEAT-FREQUENCY OSCILLATOR.** (See figure 4-15.) The beat-frequency oscillator, V507, employs a 5749 type pentode tube in a series-fed electron-coupled oscillator. This type oscillator functions in the same manner as a Hartley oscillator, with the screen grid acting as the plate circuit of the oscillator, and coupling to the actual plate circuit taking place in the electron stream. The basic advantage over a conventional Hartley oscillator is the fact that the output plate circuit is isolated from the oscillator plate circuit, and frequency stability is improved. The oscillator tank circuit consists of inductor L504 and capacitors C534A/B/C, C531, and C530. Capacitor C530 is made effectively variable by the action of the biased diode, CR501. A variable d-c voltage is

applied across CR501 through potentiometer R306. As the d-c bias voltage is altered, the impedance offered by CR501 is also altered, effectively changing the capacitive reactance of C530 and thereby varying the frequency of oscillation. Plate voltage for the bfo stage is applied through contacts of switch S301B, and is controlled by the EMISSION switch on the front panel. Plate voltage is applied only in the CW and CW SHP positions, therefore, there is no output except when reception of cw signals is desired. The beat-frequency oscillator has a resonate frequency of 500 kilocycles and is variable to plus or minus 3000 cycles. This 500-kilocycle signal is applied through capacitor C533 to the detector input for the purpose of establishing a beat note, made variable by the front panel BFO control.

**4-26. SPECTRUM GENERATOR OSCILLATOR.** (See figure 4-16.) The function of the spectrum generator oscillator is to provide a 500-kilocycle signal for use in frequency calibration of the receiver. A 5654 tube, V750, is employed in a modified, electron-coupled oscillator. Feedback is accomplished through capacitor C753. Capacitor C750 is nominally set at 32 micromicrofarads for the initial alignment, and may be varied later to set the oscillator frequency to exactly 500 kilocycles. Provision is made for grid voltage metering, accomplished by resistor R751, in series with the grid-loading resistor, R750. Capacitor C752 is the voltmeter bypass. Stability of the

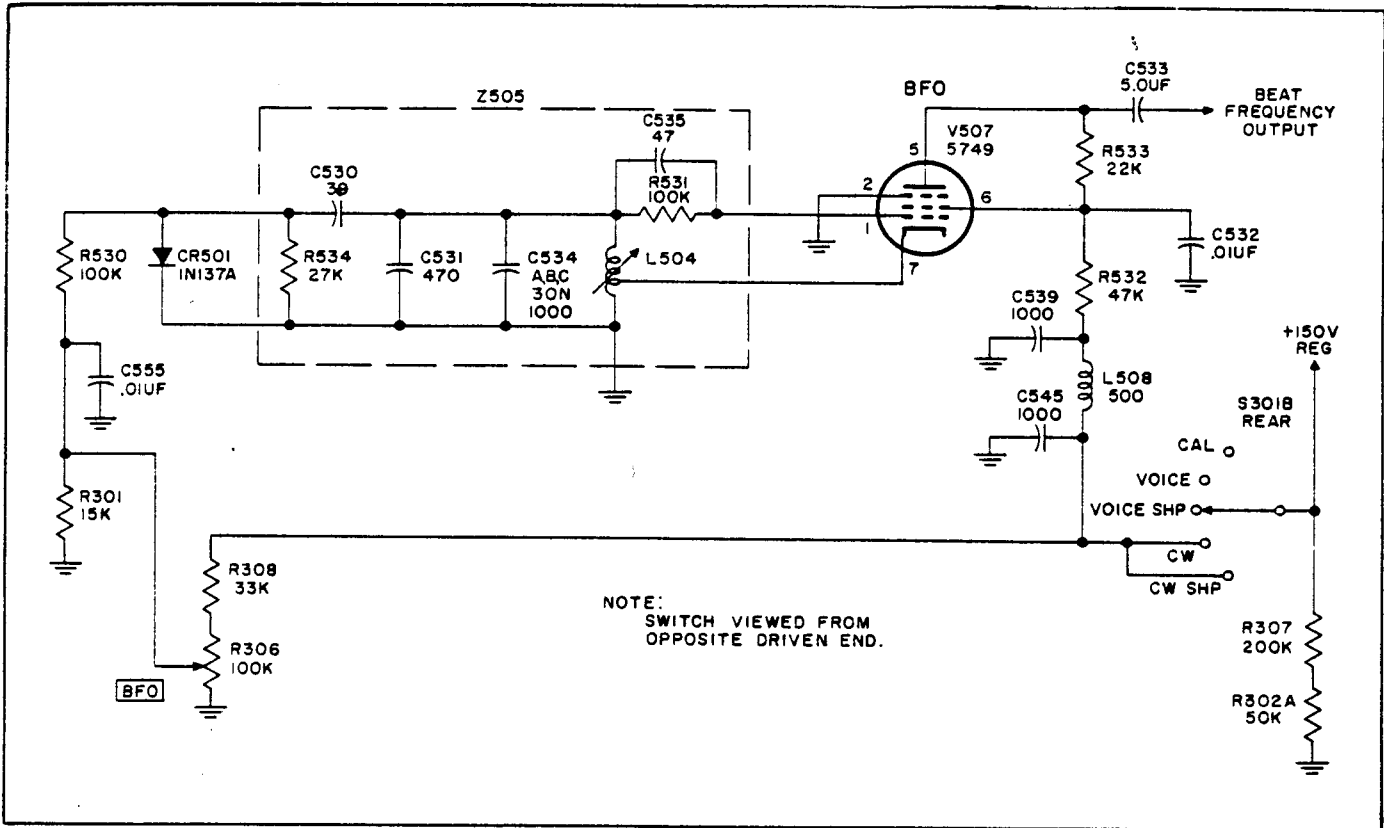


Figure 4-15. Beat Frequency Oscillator, Simplified Schematic Diagram

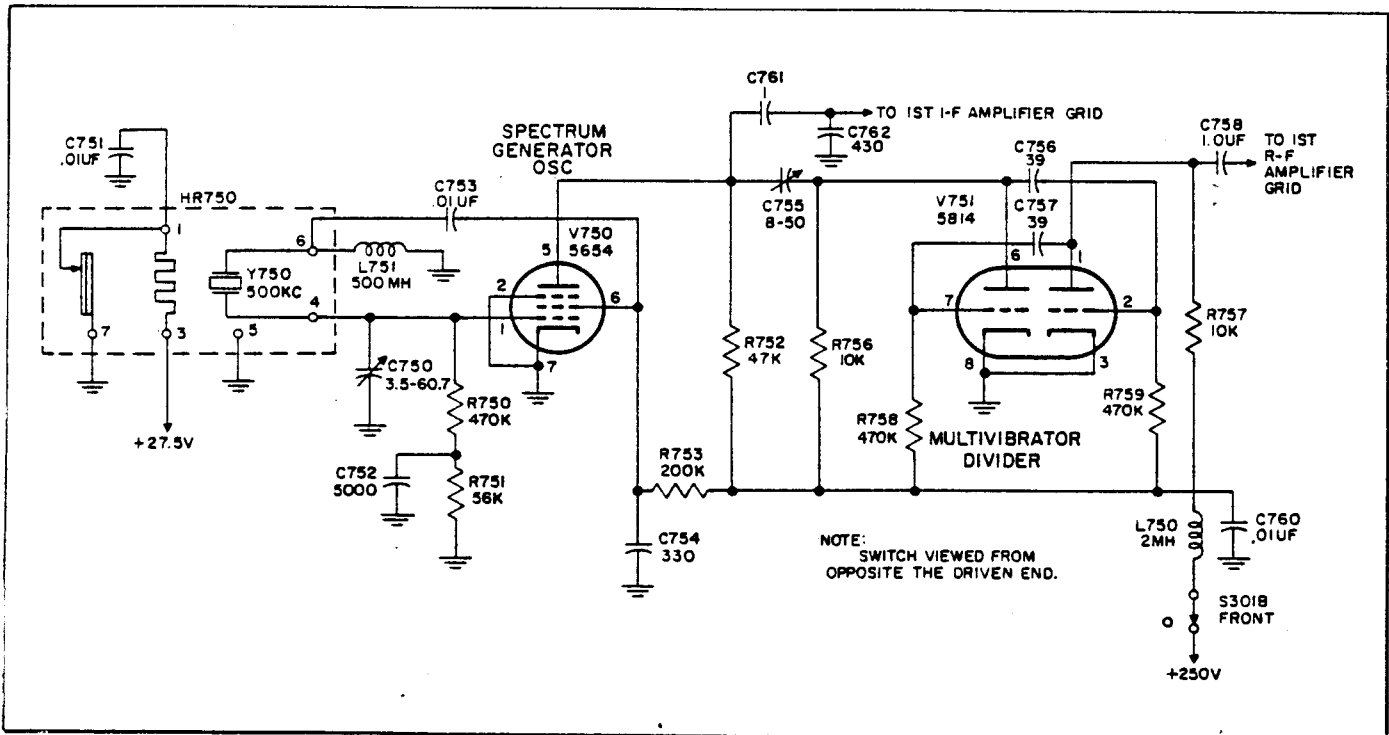


Figure 4-16. Spectrum Generator Oscillator, Simplified Schematic Diagram

oscillator is assured by enclosing the 500-kilocycle crystal, Y750, in a temperature-control oven, HR750. The 500-kilocycle output is applied to the control grid of the first i-f amplifier, V501, and to the multivibrator, V751. Capacitors C761 and C762 form a voltage-divider network for the oscillator output.

**4-27. MULTIVIBRATOR DIVIDER.** (See figure 4-16.) Capacitor C755 couples the output of V750 to the multivibrator plate and grid. The 500-kilocycle drive is made slightly variable through capacitor C755. The multivibrator is a plate-coupled astable version, with the grids returned to the B+ supply to increase slightly the free-running frequency. The free-running frequency is basically determined by the time constants of capacitors C756 and C757 and resistors R759 and R758. For an explanation of the operation, assume that the right half of the tube is cut off. Under these circumstances the plate (pin 1) is at B+ voltage and the grid (pin 2) is highly negative as a result of capacitor C756 discharging through resistor R759; the plate (pin 6) is conducting heavily and the grid (pin 7) is positive. At this time the rate of discharge of capacitor C756 through resistor R756 starts to decrease, allowing the grid (pin 2) voltage to rise slowly. When this voltage passes cutoff in the positive direction, the right-hand triode fires, the plate (pin 1) current begins to rise lowering the plate voltage, and this lowering of plate voltage is transmitted effectively through capacitor C756, thus driving the grid (pin 7) in the negative direction. The plate (pin 6) voltage begins to rise as a result of the increased bias on the grid (pin 7), and this voltage rise is transmitted effectively through capacitor C757 to the grid (pin 2), driving it more in the positive direction and decreasing the plate voltage (pin 1) still more. At this time the plate (pin 1) and the grid (pin 7) are becoming more negative, while the plate (pin 6) and the grid (pin 2) are becoming more positive. This action will continue until the left-hand tube is beyond plate current cutoff. When cutoff is reached, the plate (pin 6) jumps to the B+ voltage and the plate (pin 1) conducts very heavily. The rate of discharge of capacitor C757 through resistor R758 now begins to decrease slowly, allowing the grid (pin 7) to rise in the positive direction, toward plate current cutoff. When cutoff is reached in this direction, the left-hand triode fires, the plate (pin 6) current rises dropping the plate voltage, and this dropping of plate voltage is transmitted effectively through capacitor C756 to the grid (pin 2), driving this grid in the negative direction. As the grid (pin 2) becomes more negative, the plate (pin 1) becomes more positive as a result of the increased bias. The plate (pin 1) will climb slowly to the B+ voltage, reached when its control grid is past cutoff, and the plate (pin 2) will decrease in voltage as a result of its grid becoming positive. The multivibrator now has gone through a complete cycle of operation. If allowed to operate independently, this cycle will be repeated over and over, the frequency depending upon the time constants previously mentioned. The free-running frequency of the multivibrator is slightly below 100 kilocycles, which allows for synchronization at exactly 100 kilocycles.

Capacitor C755 couples the 500-kilocycle output of the spectrum generator oscillator to the plate (pin 6) and the grid (pin 2) of the multivibrator. The synchronizing action functions in the following manner: the plate (pin 1) is at B+ voltage and the grid (pin 2) is below cutoff. Capacitor C756 begins to discharge more slowly through resistor R759, allowing the grid to become positive, slowly rising toward plate current cutoff. As the grid voltage approaches the cutoff point, the 500-kilocycle signal coupled from the spectrum generator oscillator has more effect on the shape of the grid waveform. Before capacitor C756 has discharged sufficiently through resistor R759 to allow the grid (pin 2) to reach cutoff, a pulse from the 500-kilocycle input drives the grid past cutoff and the right-hand triode fires. During the next cycle of operation this process is repeated, and for each succeeding cycle of operation. The drive from the spectrum generator oscillator is such that the multivibrator is synchronized on every fifth pulse, thus the multivibrator frequency is exactly 100 kilocycles and is controlled by the temperature-compensated crystal, Y750.

**4-28. FREQUENCY CALIBRATION.** The 500-kilocycle output of the spectrum generator oscillator is coupled through capacitor C761 to the grid of the first i-f amplifier, V501, and the multivibrator 100-kilocycle output is coupled to the grid of the first r-f amplifier, V701, through coupling capacitor C758. The multivibrator signal is rich in harmonics, allowing the r-f tuned circuits to resonate at a particular harmonic frequency. The selected harmonic frequency passes through the various amplifiers, mixers, and tuned circuits, finally appearing at the grid of the first i-f amplifier as a 500-kilocycle signal. The two 500-kilocycle signals, one from the spectrum generator oscillator and the other from the heterodyned multivibrator harmonic signal, mix to produce a beat note. This beat note is audible through the headphones, and when heard, establishes an exact 100-kilocycle multiple frequency for calibration purposes.

**4-29. DYNAMOTOR POWER SUPPLY.** (See figure 4-17.) The dynamotor power supply supplies all voltages needed for operation of the R-648/ARR-41 Radio Receiver. The power input is supplied by a 27.5-volt d-c source. The 27.5-volt input is filtered by a parallel resonant circuit, consisting of L903 and C909, and by a pi-section filter, consisting of L904, C903, and C908. These filters prevent interference originating in the dynamotor from being coupled to the R-648/ARR-41 circuits and the primary power line. The filtered d-c is applied across the dynamotor low-voltage field, and the stepped-up output from the high-voltage field applied across the output filter, consisting of inductors L901 and L902 and capacitors C901, C902, and C904. The output of this filter is 250 volts d-c, which is used directly to supply the various plate voltages throughout the R-648/ARR-41, and is dropped to 30 volts by the divider arrangement of R902 and R901 for use in the avc gating circuit. Resistor R905 and capacitor C905 perform the function

of decoupling the screen grid circuits of V701, V702, and V703 from the dynamotor power supply. A regulated 150-volt d-c voltage is obtained between voltage regulator V901 and dropping resistor R904.

**4-30. DETAILED MECHANICAL FUNCTIONS.**

**4-31. GENERAL.** The mechanical drive of the BANDSWITCH and TUNING controls perform the functions of operating the frequency indicator, operating the r-f and variable i-f switches, and driving the r-f and variable i-f slugs. Permeability tuning is employed in both the r-f and variable i-f stages. The BANDSWITCH drive operates the r-f slugs over one-megacycle increments, operates the r-f and variable i-f switches, and operates the left-hand frequency counter. A sixty-degree rotation of the BANDSWITCH will result in a one-megacycle frequency change, and will be indicated in the frequency-indicator window. The TUNING control drives the variable-frequency oscillator, the band one tuning core elevator, the

variable i-f tuning core elevator, the r-f tuning core elevator through a one-megacycle increment, and the three right-hand frequency counters. One complete revolution of the TUNING control is necessary to change the variable frequency oscillator frequency 100 kilocycles.

**4-32. BANDSWITCH FUNCTIONS.** (See figure 7-3.) The frequency spectrum of the R-648/ARR-41 is divided into four distinct cycles of travel of the r-f slugs. These cycles correspond to the following frequency spectrums: cycle 1. 0 to 4 megacycles; cycle 2. 4 to 8 megacycles; cycle 3. 8 to 16 megacycles; cycle 4. 16 to 24 megacycles. Rotation of the BANDSWITCH knob results in the r-f tuning core elevator being driven either upward or downward, depending upon the cycle of operation. In this manner, the BANDSWITCH and associated gearing tunes the r-f coils in one-megacycle steps. The BANDSWITCH drive also operates the r-f and variable i-f switches, and operates the left-hand counter wheel to indicate the megacycle frequency in operation.

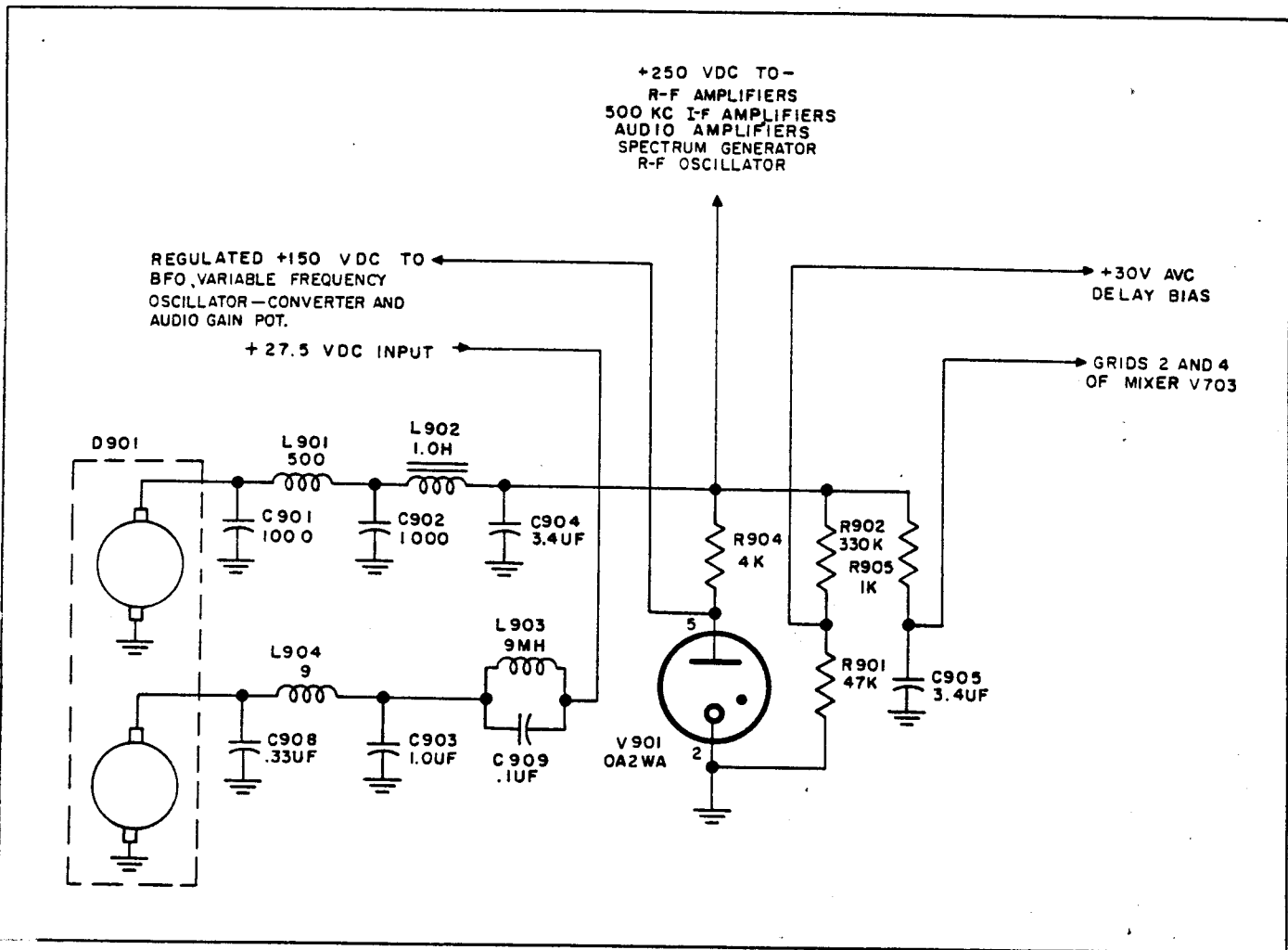


Figure 4-17. Dynamotor Power Supply. Simplified Schematic Diagram

4-33. R-F TUNING. A face cam, cam follower, sector gear, and core elevator driver together with detent wheels are employed for intermittent driving of the r-f tuning core elevator. The sections of the face cams used for each of the four cycles are illustrated in figure 7-3. As the BANDSWITCH knob is rotated in a clockwise direction, beginning with the 0 megacycle position, the band change input gear is driven counterclockwise, shaft C and face cam are driven counterclockwise, the rotation of the face cam causes the cam follower to rotate the sector gear clockwise, and the core elevator driver is caused to rotate counterclockwise. This results in shaft A rotating counterclockwise which drives the r-f tuning core elevator downward. The coarse and fine positioning detents perform the function of locking the BANDSWITCH knob, and the various gears controlled by the BANDSWITCH, in position after a predetermined increment of travel. Two more rotations of the BANDSWITCH are necessary to complete the cycle 1 function. Throughout the frequency range of cycle 1 (0 to 4 megacycles), the variable coils operated by the r-f tuning elevator are not used. All tuning of band 1 frequencies (190 to 550 kilocycles) and band 2 frequencies (2 to 4 megacycles) is accomplished by the variable i-f and low-band tuning core elevators which are controlled by the TUNING knob. However, the BANDSWITCH does control the cycle 1 band change functions of r-f and variable i-f switching and operation of the frequency indicator. These functions will be explained in paragraphs 4-34 and 4-35 of this section. When the BANDSWITCH has been rotated to the 4-megacycle position, the r-f

tuning cores are at the bottom of their travel. Rotation of the BANDSWITCH to the 5-megacycle position causes the face cam to continue to rotate counterclockwise, the cam follower causes the sector gear to rotate counterclockwise (its direction is reversed), shaft A rotates counterclockwise, the core elevator driver is caused to rotate counterclockwise, and the r-f tuning core elevator is driven upward (cycle 2). It should be noted that throughout the operation of cycle 2, the r-f tuning core elevator is caused to move upward. The frequency range of cycle 2 is 4 to 8 megacycles, covered in 1-megacycle steps. The frequency range of cycle 3 is 8 to 16 megacycles and of cycle 4 is 16 to 24. Cycles 3 or 4 are covered in eight 1-megacycle steps. Changing the BANDSWITCH 1 megacycle in cycle 2 causes the rack detent wheel and shaft A to rotate twice as far as for cycle 3 or 4. The reason for this is, cycle 2 contains four 1-megacycle steps while cycle 3 or 4 contains eight 1-megacycle steps for the same distance of travel of the r-f tuning core elevator. The rack detent wheel has eight positions. In cycle 3 or 4 all eight of the detent positions are used. In cycle 2 the rack detent arm falls into every second detent position. Rotation of the BANDSWITCH to the 9-megacycle position causes the r-f tuning core elevator to move downward (cycle 3) just as in cycle 1. Rotation of the BANDSWITCH to the 17-megacycle position causes the r-f tuning core elevator to move upward again (cycle 4) as in cycle 2. Table X lists the four cycles of operation of the r-f tuning core elevator, the frequency controlled by each, and the direction of movement of shaft A and r-f tuning core elevator.

TABLE X. R-F TUNING, BANDSWITCH FUNCTION

CYCLE	FREQUENCY (MC)	BAND	SHAFT A ROTATION (DIRECTION)	R-F TUNING CORE ELEVATOR (DIRECTION)
1	0 to 4	(See note)	Counterclockwise	Downward
2	4 to 8	3	Clockwise	Upward
3	8 to 16	4	Counterclockwise	Downward
4	16 to 24	5	Clockwise	Upward

## NOTE:

All frequencies within the range of cycle 1 (0 to 4 megacycles) are tuned by operation of the TUNING control. The downward movement of the r-f tuning core elevator is only a mechanical action, as the r-f coils are switched out of the circuit during cycle 1. The BANDSWITCH functions of r-f and variable i-f switching and operation of the frequency indicator are still employed.

4-34. R-F AND VARIABLE I-F SWITCHING. Rotation of the BANDSWITCH also results in the r-f and variable i-f switches being operated to the correct positions. The intermittent bandswitch drivers (mounted on shaft C), in conjunction with the intermittent bandswitch idlers (mounted on shaft D), perform the function of operating the r-f switch sections. These driver and idler gears are so designed that the correct r-f tuned circuits will be switched in upon rotation of the BANDSWITCH to a certain band of frequencies. The variable i-f switches and the r-f oscillator switches are operated by the BANDSWITCH through shafts E, F, and G. Variable i-f tuned circuits Z404, Z405, Z406, and Z407 resonate at either 2 to 3 or 3 to 4 megacycles, depending upon the trimmers across each. The correct trimmers are selected by the operation of the variable i-f switches. The correct crystal and tuned circuit is selected for the r-f oscillator by rotation of shaft G, upon which are mounted the r-f oscillator switch sections.

4-35. FREQUENCY INDICATOR AND SLIDING MASK. The left-hand frequency counter and the sliding mask are both operated by the BANDSWITCH control knob. In the positions shown in figure 7-3, with the megacycle frequency counter reading zero and the sliding mask held to the right by the mask spring, assume the BANDSWITCH is to be rotated clockwise, thereby increasing the frequency. The mask actuating lever pivots on the mask actuating pin, and in the position shown, the roller of the mask actuating lever is held in the groove of the mask actuating cam by the mask spring pressure. As a result, the sliding mask is pivoted to the right-hand position. The BANDSWITCH knob is rotated clockwise, driving the mask actuating cam counterclockwise through the gearing involved. The roller on the mask actuating lever rolls across the groove in the mask actuating cam until the BANDSWITCH knob has been driven three increments of travel. Upon the fourth increment of rotation of the BANDSWITCH knob, the roller will be driven out of the mask actuating cam groove, pivoting the mask actuating lever on the pin, and driving the sliding mask to the left-hand position. Throughout cycle 1 (0 to 4 megacycles), the mask is in the right-hand position, while in the other three cycles, the mask is in the left-hand position. This is necessary because of the method of operation of the TUNING control. The TUNING knob is turned counterclockwise for an increase in frequency in the range of cycle 1, and clockwise for an increase in frequency in the other cycles. Two sets of numbers are included on the counter wheels controlled by the TUNING knob. These numbers increase in opposite directions, thereby compensating for the different directions of rotation of the TUNING knob. The sliding mask covers the numbers not in use. Mounted on the same shaft as the mask actuating cam is the megacycle counter drive gear, which turns the left-hand counter wheel, thereby indicating the megacycle frequency selected.

4-36. TUNING FUNCTIONS. The TUNING knob, in conjunction with the various gears and clutches, performs the functions of operating the low-band tuning

core elevator, tuning the variable frequency oscillator, operating the r-f tuning core elevator through one megacycle, and operating the three right-hand counter wheels in the MEGACYCLES frequency indicator. The TUNING knob is prevented from turning beyond 10-1/2 revolutions by the 10-1/2 turn stop gear illustrated in figure 7-3.

4-37. VFO TUNING. The variable frequency oscillator is tunable within the range of 2.5 to 3.5 megacycles by the permeability tuned inductor, L15001. Shaft H, which is rotated by the TUNING knob, is connected to the drive shaft of L15001. One complete revolution of the TUNING knob is necessary to change the variable frequency oscillator frequency 100 kilocycles.

4-38. LOW-BAND TUNING. All frequencies within the range of band 1 (190 to 550 kilocycles) are tuned by the low-band tuning core elevator. The TUNING knob is rotated counterclockwise for an increase in frequency throughout this range. The low-band tuning core elevator operates independently of the variable i-f and r-f tuning functions. The continuous idler (figure 7-2) is mounted on shaft I with a bearing, and may rotate independently of the shaft rotation. A smaller number of rotations of the TUNING knob is necessary to drive the low-band tuning core elevator throughout its range than is necessary for the variable i-f tuning core elevator. Therefore, it is necessary to lock the low-band tuning core elevator from further movement beyond a predetermined increment of travel. This is accomplished by the low-band driver and the intermittent idler. Figure 4-18 illustrates these two gears in functional form. The solid line of the low-band driver is the locking disk. This disk covers only a small portion of the thickness of the low-band driver gear. Two of the intermittent idler gear teeth are only half thickness, as illustrated. When the end of the cogged portion of the low-band driver gear is reached, one of the half-thickness intermittent idler gears falls beside the locking disk. The full-thickness teeth of the intermittent idler cannot pass the locking disk and are held in place. As the TUNING knob is rotated further, the intermittent idler slides around on the locking disk. The intermittent idler cannot turn during this interval, and the low-band tuning core elevator remains stationary. The low-band tuning core elevator operates throughout all frequency ranges, however, the tuned circuits are switched in the circuit only when the BANDSWITCH is in the zero-megacycle position.

4-39. VARIABLE I-F TUNING. Power to drive the variable i-f tuning core elevator is transmitted through the TUNING knob, through the various gears, and finally to the variable i-f input gear. The variable i-f input gear will rotate in the same direction as the TUNING knob (clockwise or counterclockwise). When driven counterclockwise, as is the case for increasing frequency from 0 to 4 megacycles, the variable i-f tuning core elevator will move upward. When driven clockwise, the variable i-f tuning core elevator will move downward. The correct shunting

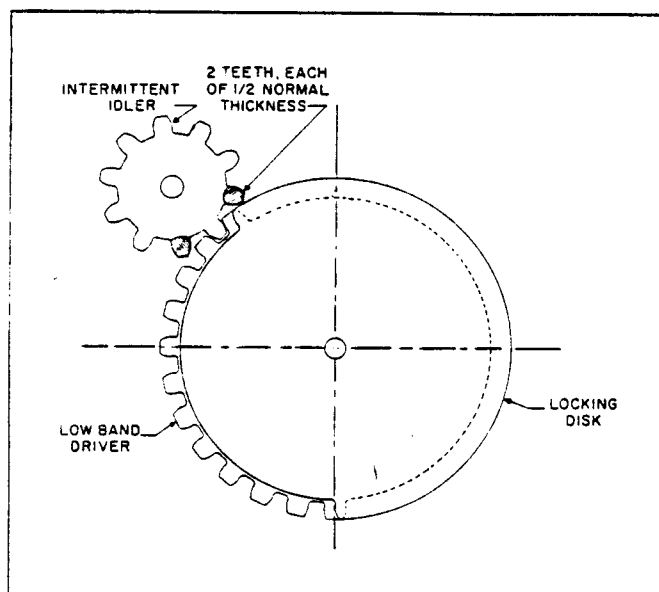


Figure 4-18. Low-Band Driver and Intermittent Idler, Functional Diagram

circuits are selected by the BANDSWITCH to allow the variable i-f tuned circuits to tune to either 2 to 3 or 3 to 4 megacycles. Tuning throughout this one-megacycle range is accomplished by the movement of the variable i-f tuning core elevator.

4-40. R-F TUNING THROUGH ONE MEGACYCLE. Tuning of the r-f coils throughout a one-megacycle increment is accomplished by the TUNING knob and associated gearing. When frequencies of 4 to 25 megacycles are desired, the BANDSWITCH, in conjunction with the r-f switches, selects the correctly tuned circuit and the TUNING control drives the r-f coils throughout a one-megacycle increment. Within the frequency range of 4 to 25 megacycles, the TUNING knob is rotated clockwise for an increase in frequency, rotating the variable i-f input gear clockwise and driving the rocker arm upward. Shaft A is supported rigidly by bearings in the front and rear plates of the r-f and i-f tuner assembly, and therefore, acts as a fulcrum for the rocker arm. Shaft B is supported only by bearings in the front and rear rocker arms (only the front rocker arm is shown in figure 7-3). As the TUNING knob is rotated, the rocker arm moves and the r-f tuning core elevator is rocked on axis X. The r-f coil slugs are moved, and the frequency of the r-f tuned circuits is changed. The

frequency is variable over a range of one megacycle by the TUNING knob.

4-41. MEGACYCLES FREQUENCY INDICATOR. The three right-hand counter wheels are operated by the TUNING knob to indicate frequencies of less than one megacycle. The extreme right counter wheel is equipped with a pointer located on the sliding mask. This allows the frequency to be read to the nearest 100 cycles. Assume the BANDSWITCH is tuned to the zero position. The TUNING knob now may vary the frequency from 190 to 550 kilocycles. The TUNING knob is rotated counterclockwise to increase the frequency. The right-hand counter wheel will rotate clockwise, as viewed in figure 7-3. The sliding mask is to the right, exposing the numbers on the right side of the counter wheels. The right-hand counter wheel is fastened rigidly to shaft J and will turn when the shaft is driven. The other two low-frequency counter wheels are free to slide around on shaft H. Therefore, the right-hand counter wheel will rotate independently of the other two. As the TUNING knob is rotated further, the right-hand counter gear teeth will engage with the rotating right-hand counter wheel. This will rotate the second counter wheel the correct distance to indicate the next larger number, which will correspond to the next higher frequency. As an illustration, assume both the right-hand and middle counter wheels are indicating zero. As the TUNING knob is rotated, the right-hand wheel will indicate 1, then 2, then 3, etc., until 9 is reached. On the next movement of the right-hand counter wheel, the right-hand counter gear will engage, and the middle counter wheel will be rotated to the number 1. The third counter wheel operates in a similar manner, that is, for every ten numbers covered by the middle counter wheel, the third counter wheel will rotate one number. The counter wheel on the extreme left side operates independently of the TUNING knob, and is controlled entirely by the BANDSWITCH knob.

4-42. DIAL ZERO FUNCTIONS. The DIAL ZERO control is used in conjunction with the spectrum generator to set the frequency indicator dial for exact frequencies. The TUNING knob and gears are disengaged with operation of the DIAL ZERO knob to prevent movement of the tuning core elevators during calibration. When the DIAL ZERO knob is depressed, two clutches are operated. One engages the DIAL ZERO knob and the other disengages the TUNING gears. These clutches are illustrated in figure 7-3. The DIAL ZERO knob is rotated, and the frequency indicator counter wheels are operated, as was described in paragraph 4-41.



## SECTION V

# ORGANIZATIONAL MAINTENANCE

### 5-1. INTRODUCTION.

5-2. This section provides instructions essential for the maintenance of Radio Receiving Set AN/ARR-41 by organizational maintenance personnel. Before attempting to service and test this equipment, maintenance personnel should be thoroughly familiar with the physical makeup of the equipment and reasonably familiar with its theory of operation. Throughout this section, reference is made to meter indications and attenuator settings of various pieces of test equipment. These indications are not necessarily equipment specifications, but are approximate values encountered on a large number of properly operating units. It is possible that the equipment will operate properly with varied indications from those stated, since many variable factors are involved. It is absolutely essential, however, that the test equipment in use be properly calibrated, properly terminated, and otherwise in excellent condition.

5-3. GENERAL. Organizational maintenance of the equipment is based on periodic inspections, immediately before the equipment is put into use, to insure continuity of operation. The periodic inspections and tests have been developed on the premise that the equipment has been installed and checked in accordance with the installation instructions presented in section III. Defects disclosed during these inspections, and by faulty operation of the equipment, should be corrected by use of the systematic troubleshooting procedure, table XI, and by means of adjustment methods. To facilitate trouble-shooting procedures at the organizational maintenance level, a step-by-step procedure is presented in table XI to isolate the trouble to an assembly within the R-648 ARR-41 Radio Receiver. The purpose of this trouble analysis system is to determine quickly the assembly in which trouble exists, and to point out some of the most likely causes of trouble. When the trouble has been so analyzed, maintenance personnel can determine what action, depending upon the time element involved, should be taken to correct the trouble. To prevent excessive delays, those assemblies which are defective should be exchanged for assemblies known to be in good operating condition.

### 5-4. MINIMUM PERFORMANCE STANDARDS.

#### 5-5. RADIO RECEIVING SET AN/ARR-41 PREFLIGHT INSPECTION AND TEST.

5-6. The purpose of this test is to provide acceptance specifications for Radio Receiving Set AN/ARR-41, to determine if the equipment is operating satisfactorily and ready for use in flight.

- a. Check all connections in aircraft interwiring. Make sure that locking rings on connectors are tight.
- b. Inspect Headset H-1/AR or H-4/AR for possible damage and insert the plug in the PHONES jack, J303.
- c. Make sure Radio Receiver R-648/ARR-41 is properly seated in Mounting MT-1518/ARR-41. (Refer to paragraph 3-13.)
- d. Make sure the R-648 ARR-41 cover is fastened securely.
- e. Check the primary power source connections to make certain that no short circuits exist in the input power lines.
- f. Turn the POWER switch to ON.
- g. Operate all controls in order to determine that they function properly.
- h. Tune in several signals, both phone and cw. Characteristic hiss should be heard between signals.
- i. Check operation of the BFO control. Frequency of cw signal should be variable.
- j. Turn the EMISSION switch to the CAL position. A signal should be heard at every 100-kilocycle check point throughout the range of reception, such as 8.1, 8.2, 8.3 megacycles.

### 5-7. DAILY INSPECTION AND TEST.

5-8. The preflight test, paragraph 5-6, provides acceptable standards for the daily test of Radio Receiving Set AN/ARR-41. Steps a through j outline checks for phone, cw, and calibration, and should be performed daily.

### 5-9. NAVY 120-HOUR INSPECTION.

5-10. The Navy 120-hour inspection includes tests of sensitivity, selectivity, calibration, and mechanical functioning. Paragraphs 5-11 through 5-17 detail these periodic tests.

#### NOTE

During all tests and trouble-shooting procedures of Radio Receiver R-648 ARR-41, the audio output connector (J303) on the front panel should be terminated in a noninductive resistance of 300 ohms or Headset H-1 AR or H-4/AR. This is not necessary when Output Meter TS-585B/U is used as this resistance is built into the meter chassis, and may be selected by operation of the impedance selector switch to the 300-ohm position.

5-11. VISUAL INSPECTION.

- a. Remove Radio Receiver R-648/ARR-41 from Mounting MT-1518/ARR-41 by loosening the two wing nuts at the front of the mounting until the R-648/ARR-41 can be lifted free.
- b. Remove the radio receiver cover to gain access to the assemblies, subassemblies, and detail parts.
- c. Remove all dust from inside the R-648/ARR-41 with a jet of clean, dry air.
- d. Thoroughly inspect all cables and connectors for indication of burned or broken wiring and loose connections.
- e. Check all mechanical parts for evidence of rust or corrosion, bent pins, or other mechanical damage.

5-12. DYNAMOTOR SERVICING. At each 120-hour inspection, the dynamotor should be removed for cleaning and inspection. Proceed as follows:

- a. Remove the dynamotor power supply assembly from the R-648/ARR-41 Radio Receiver as described in paragraph 5-30.
- b. Remove end covers from dynamotor.
- c. Remove dust and dirt from dynamotor and end covers, using clean, dry, compressed air or a soft brush.
- d. Loosen, gently remove and inspect brushes, being extremely careful not to nick or mar edges of the brushes. Note the location and position from which each brush is removed so that they can be replaced later in exactly the same position.
- e. Check commutators for excessive wear, dirt, and other defects. A highly polished commutator surface is desirable, but a dark-colored commutator should not be mistaken for one which is burned. If surface of any commutator is dirty, clean with a lint-free cloth moistened in carbon tetrachloride, and wipe dry. If commutator is grooved, replace dynamotor. Avoid fingermarking the commutator surface.
- f. Secure all brushes in their holders, making certain they are replaced in exactly the position from which they were removed.

NOTE

When brushes are worn to approximately 1/4 inch in length, replace with the following types: low voltage plus or minus, Collins part number 234 0697 00; high voltage plus or minus, Collins part number 234 0698 00.

- g. Replace end covers on dynamotor and replace dynamotor power supply assembly in Radio Receiver R-648/ARR-41.

5-13. MECHANICAL INSPECTION. The mechanical tuning mechanism within the R-648/ARR-41 and the mechanical parts of Mounting MT-1518/ARR-41 should be checked at each 120-hour inspection, paying particular attention to the following points:

- a. Check all front panel controls for binding and/or excessive backlash.
- b. Inspect all gear teeth for evidence of chipping or wear.

c. Check slug racks and tuning core elevators for evidence of excessive looseness. When detented, there should be only a slight amount of lateral motion, and practically no vertical motion of the slug racks and tuning core elevators.

d. With the R-648/ARR-41 installed in Mounting MT-1518/ARR-41, a certain amount of spring should be noted by pressing down on the top of the R-648/ARR-41. This is an indication of the condition of the vibration isolators of Mounting MT-1518/ARR-41. If this characteristic spring is not present, Mounting MT-1518/ARR-41 should be replaced.

5-14. DETAILED PERFORMANCE TEST.

5-15. OVER-ALL SENSITIVITY. (Refer to figures 5-1, 5-2, and 5-3 for test point identification and the necessary bench setup.) Perform the following operations:

NOTE

Remove Radio Receiver R-648/ARR-41 from Mounting MT-1518/ARR-41 and install in the mounting included with Test Bench Cable Set AN/ARM-21. This allows the R-648/ARR-41 chassis to be tilted at any convenient angle, providing access to the various test points.

a. Operate the POWER switch to the ON position, the EMISSION switch to the CW position, the GAIN and SENS ADJ. to maximum, and the BANDSWITCH and TUNING controls for a reading of 0.19 on the MEGACYCLES frequency indicator.

NOTE

When the EMISSION switch is placed in the CW position, the AVC is not connected to the various r-f and i-f amplifiers. This is desirable for the purposes of these tests; however, a dummy bfo tube with the screen and plate pins (pins 6 and 5) clipped off, should be inserted in the bfo tube socket to prevent the bfo from operating.

b. Connect Signal Generator AN/URM-25 to ANTENNA connector J302, test point 1, on the front panel. Adjust for an output of 5 microvolts.

c. Using Frequency Meter AN/USM-26, accurately adjust the frequency of the AN/URM-25 to 0.19 megacycles.

d. Insert the insulated lead of Frequency Meter AN/USM-26 within the tube shield of V15001. Connect the other AN/USM-26 lead to ground. Adjust the TUNING control for a reading of 2.69 megacycles on the AN/USM-26 and then remove the lead from V15001 tube shield.

e. Connect the d-c probe of VTVM TS-505/U to terminal 5 of J206 (test point 5) on the bottom side of the R-648/ARR-41 chassis. Adjust the TS-505/U to read on the negative 3-volt scale.

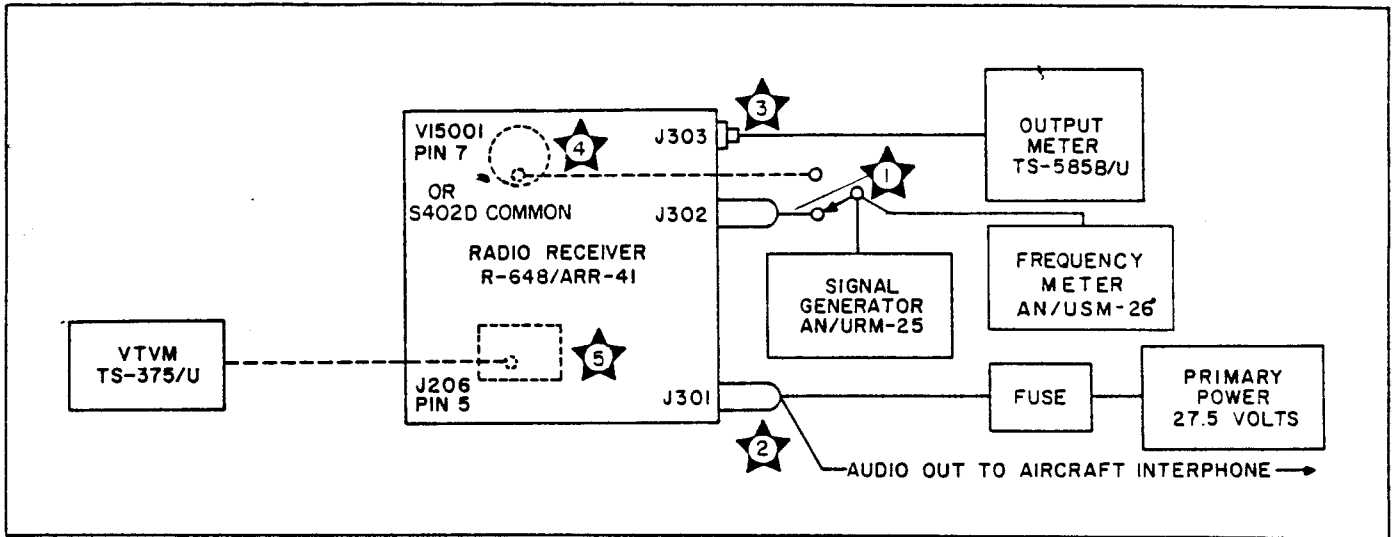


Figure 5-1. Radio Receiver R-648/ARR-41. Test Bench Setup

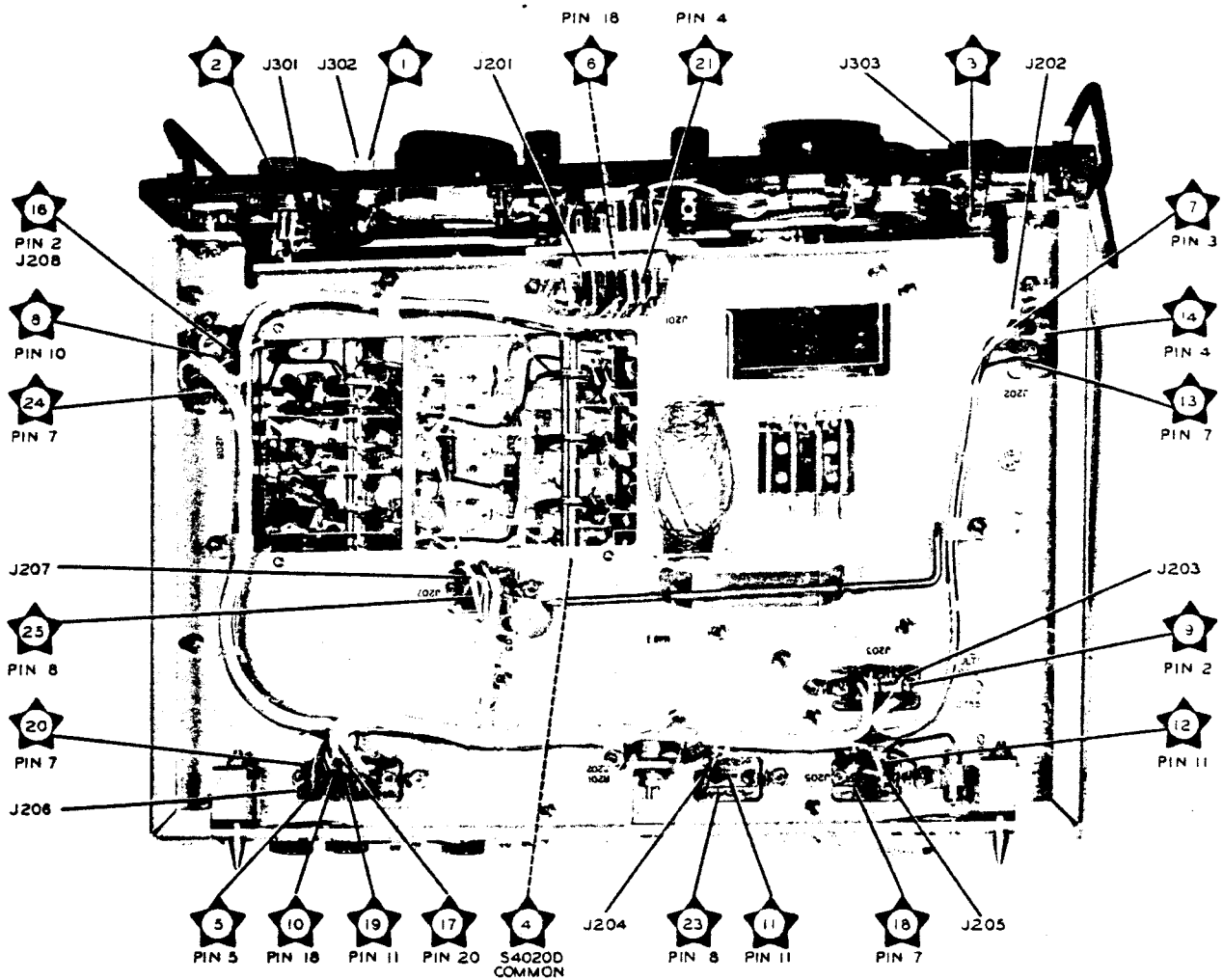


Figure 5-2. Radio Receiver R-648/ARR-41. Test Points. Bottom View

- f. Carefully rock the frequency of Signal Generator AN/URM-25 for a peak reading on VTVM TS-505/U.
- g. Adjust the r-f output level of Signal Generator AN/URM-25 until VTVM TS-505/U reads exactly minus 1 volt d-c. The r-f output voltage of the AN/URM-25 thus is an indication of sensitivity, and should not exceed 5 microvolts for an avc voltage of minus 1 volt d-c, as read on the TS-505/U.
- h. Connect Output Meter TS-585B/U to PHONES jack J303, test point 3, on the front panel.
- i. Modulate the r-f output of Signal Generator AN/URM-25 30% at 1000 cycles.
- j. Output Meter TS-585B/U should read at least 100 milliwatts.
- k. Repeat steps a through j for at least one frequency on all five bands of operation. Refer to table IX, section 4 for the correct frequency settings. For example, on band 2 the following frequencies may be used; set Signal Generator AN/URM-25 to 2 megacycles (listed under RECEIVER FREQUENCY, MC), operate the TUNING control and adjust to 2.5 megacycles (listed under VARIABLE FREQUENCY OSC, MC).

**5-16. 500-KC I-F SENSITIVITY AND SELECTIVITY TEST.**

- a. Operate the POWER OFF-ON switch to the OFF position, the EMISSION switch to the CW position, and the GAIN and SENS ADJ. controls to maximum. The dummy bfo tube should be inserted in the V507 socket.
- b. Connect the d-c probe of VTVM TS-505/U to test point 5 and adjust to read on the negative 3-volt scale.

- c. Connect Output Meter TS-585B/U to PHONES jack, J303, test point 3, on the front panel.
- d. Connect Signal Generator AN/URM-25 to test point 4.
- e. Using Frequency Meter AN/USM-26, accurately adjust the AN/URM-25 Signal Generator output to 500 kilocycles.
- f. Operate the POWER OFF-ON switch to the ON position.
- g. An output of 200 microvolts from Signal Generator AN/URM-25 should produce an avc voltage of at least negative 1 volt and a power output of at least 100 milliwatts as read on VTVM TS-505/U and Output Meter TS-585B/U respectively.
- h. Set Signal Generator AN/URM-25 output for a reading of exactly negative 1 volt on VTVM TS-505/U.
- i. Double the output level of Signal Generator AN/URM-25 and detune above the set frequency of 500 kilocycles. Observe the frequencies where the avc voltage returns to negative 1 volt. The difference between the upper and lower frequencies should be approximately 9.4 kilocycles, which corresponds to the 6-db bandwidth point, and is thus an indication of selectivity. Repeat with the EMISSION switch in the CW SHP position, in which case the bandwidth should be approximately 1.4 kilocycles.

**5-17. CALIBRATE FUNCTION TEST.**

- a. Replace a good bfo tube in the V507 socket. Operate the POWER OFF-ON switch to ON, EMISSION switch to CAL, SENS ADJ. to maximum, and GAIN to a comfortable headset level.

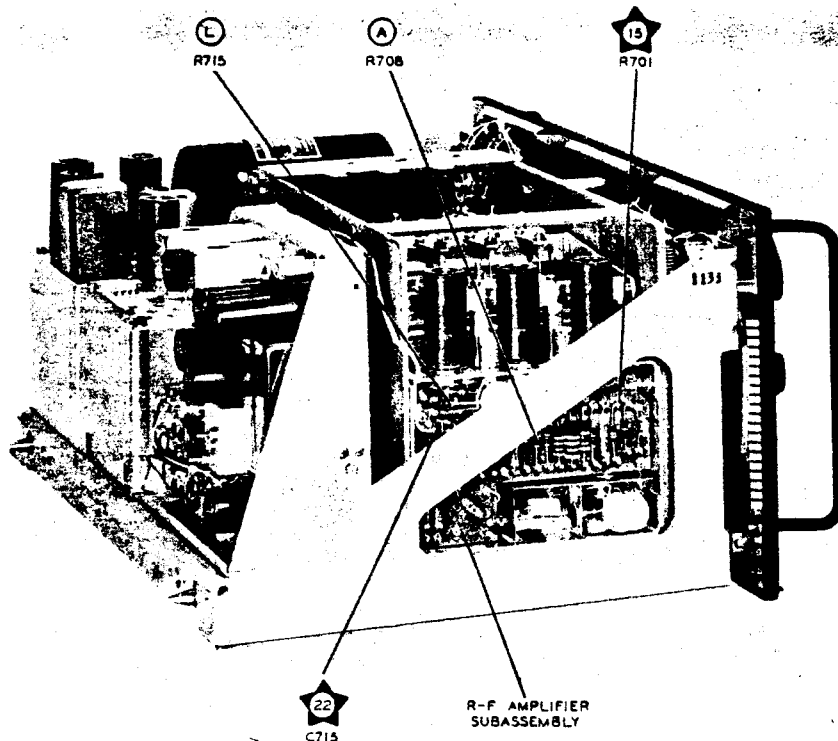


Figure 5-3. Radio Receiver R-648/ARR-41. Test Points. End View

b. A signal should be heard on every 100-kilocycle check point throughout the tuning range of the R-648/ARR-41 Radio Receiver. Examples: 4.2, 4.3, 4.4, 4.5 megacycles, etc.

**5-18. CORRECTIVE MAINTENANCE  
(ORGANIZATIONAL LEVEL).**

5-19. An efficient job of trouble shooting the AN/ARR-41 equipment depends upon the ingenuity of the technician and his familiarity with the circuits involved. In general, a quick check for open heaters in the vacuum tubes is a good starting point. If the AN/ARR-41 equipment fails to pass the tests listed in paragraphs 5-4 through 5-17, the trouble should be isolated to a particular assembly by the use of the various tests listed in table XI.

5-20. VACUUM TUBES. All tubes in Radio Receiver R-648/ARR-41 are connected in series parallel. For this reason, all tubes and assemblies must be in the equipment before power is applied. Power to the R-648/ARR-41 should not exceed the normal voltage of 27.5 volts d-c by more than five to ten per cent. Excessive voltage for long periods of time will cause shortened tube life. Rated plate currents and plate dissipation should not be exceeded for the same reason.

5-21. VACUUM TUBE REPLACEMENT. When Radio Receiver R-648/ARR-41 is in operation, the quickest way to find a tube with an open filament is by visual inspection. After a burned-out tube has been located,

all tubes connected in parallel with it should be tested on Tube Tester TV-7/U for proper emission. Figure 5-4 illustrates the filament circuits of Radio Receiver R-648/ARR-41. The indicated voltages may be read on either Vacuum Tube Voltmeter TS-505/U or Multimeter AN/PSM-4, from the indicated point to ground.

**5-22. EQUIPMENT TROUBLE ANALYSIS.**

5-23. If the R-648/ARR-41 Radio Receiver fails to pass any of the tests included in the Navy 120-hour inspection, the tests included in table XI, Equipment Trouble Analysis, should be performed. The use of this table will isolate the trouble to a particular assembly within the R-648/ARR-41 Radio Receiver. Upon finding the faulty assembly, it should be removed and replaced with an assembly known to be in proper working order. Directions for removing and replacing the various assemblies are included in paragraphs 5-26 and 5-31.

**NOTE**

The Equipment Trouble Analysis Chart, table XI, assumes that all vacuum tubes and fuses have been checked previously and are in good operating condition. When trouble is encountered, the fuses should be checked for continuity and the vacuum tubes checked in Tube Tester TV-7/U before proceeding with the steps listed in table XI.

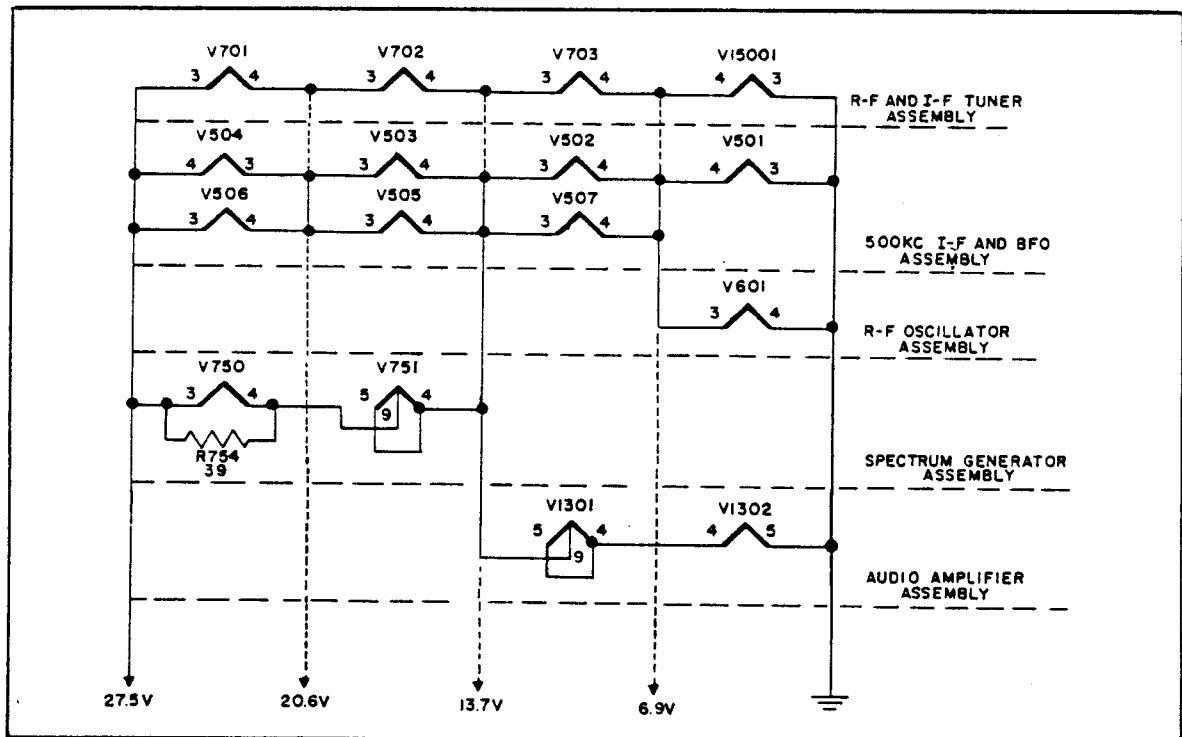


Figure 5-4. Radio Receiver R-648/ARR-41, Filament Circuit

TABLE XI. EQUIPMENT TROUBLE ANALYSIS

SYMPTOM	STEP	TEST POINTS	TEST EQUIPMENT	INSTRUCTIONS
1. Zero output or output below normal on all positions of EMISSION switch and BANDSWITCH.	a	Visual check	None	Refer to figure 7-3. Operate the BANDSWITCH and TUNING control. Observe movement of the r-f variable i-f tuning core elevators. Note operation of the r-f and variable i-f switch sections as the BANDSWITCH is rotated. Check mechanical condition of gears and springs.
	b	Visual check	None	Turn the POWER switch to ON. Visually inspect all connections and wiring.
	c	☆	VTVM TS-505/U	Connect VTVM TS-505/U from test point ☆ to ground.
	d	As instructed.	VTVM TS-505/U	Connect vtvm to test point ☆ if the dynamotor does not start. or to test points ☆ . ☆ . ☆ . ☆ . and ☆ if any of the tube filaments fail to light.
	e	☆ . ☆	VTVM TS-505/U	Measure output of dynamotor power supply assembly from test points ☆ and ☆ to ground.
	f	☆ . ☆	Signal Generator AN/URM-25; VTVM TS-505/U	Set GAIN and SENS ADJ. to maximum. EMISSION switch to VOICE. Connect AN/URM-25 to test point ☆ . Connect TS-505/U between test point ☆ and ground. adjusted to read on the negative 3-volt scale. Set R-648/ARR-41 and AN/URM-25 to 8 megacycles. Set AN/URM-25 to approximately 10 microvolts and vary the frequency slowly around 8 megacycles for a peak reading on VTVM TS-505/U. Decrease AN/URM-25 output and observe point where TS-505/U reading drops rapidly. which is the avc threshold level.
	g	☆ . ☆	Signal Generator AN/URM-25; VTVM TS-505/U	All settings and frequencies are the same as step e of symptom 1. with the following exceptions: Connect AN/URM-25 between test point ☆ and ground. Set AN/URM-25 output to approximately 15 microvolts and vary

TABLE XI. EQUIPMENT TROUBLE ANALYSIS

NORMAL INDICATION	IF NORMAL INDICATION	IF ABNORMAL INDICATION
<p>Operation of the BANDSWITCH should result in an upward or downward movement of the r-f tuning core elevator of approximately 0.1 inch per BANDSWITCH position. The TUNING control should move the variable i-f and low-band tuning core elevators smoothly, and rock the r-f tuning core elevator on its axis.</p> <p>All tube filaments light. Dynamotor starts.</p> <p>27.5 volts d-c.</p> <p>Test points ☆, ☆, ☆, and ☆ : 27.5 volts d-c. Test point ☆ : 6.9 volts d-c. Test point ☆ : 13.7 volts d-c.</p> <p>Test point ☆ : 150 volts d-c. Test point ☆ : 250 volts d-c.</p> <p>2.4 microvolts output of Signal Generator AN/URM-25</p> <p>9.5 microvolts output of Signal Generator AN/URM-25.</p>	<p>Proceed to step b.</p> <p>Proceed to step e.</p> <p>Proceed to step d.</p> <p>Trouble exists in the assembly with the tubes that fail to light. Replace defective assembly.</p> <p>Proceed to step f.</p> <p>Proceed to step m.</p> <p>Proceed to step h.</p>	<p>Repair as necessary or replace the r-f and i-f tuner assembly.</p> <p>Proceed to step c.</p> <p>Trouble exists in primary power source or in front panel detail parts S304, F301, C301, L302, or J301.</p> <p>Cable or connector is open. Repair as necessary.</p> <p>Replace dynamotor power supply assembly.</p> <p>Proceed to step g.</p> <p>Proceed to step i.</p>

TABLE XI. EQUIPMENT TROUBLE ANALYSIS (Cont)

SYMPTOM	STEP	TEST POINTS	TEST EQUIPMENT	INSTRUCTIONS
2. No output in VOICE and CW positions. output normal in all other				frequency slowly around 8 megacycles for a peak reading on VTVM TS-505/U. Decrease AN/URM-25 output and observe avc threshold level as read on VTVM TS-505/U.
	h	☆ . ☆	Multimeter AN/PSM-4	Turn the POWER switch to the OFF position. Adjust AN/PSM-4 to read low resistance. Measure continuity from test point ☆ to test point ☆
	i	☆ . ☆	Signal Generator AN URM-25; VTVM TS-505/U	All settings and frequencies are the same as step e of symptom 1. with the following exceptions: Connect AN/URM-25 between test point ☆ and ground. Set AN URM-25 output level to approximately 300 microvolts and vary frequency slowly around 8 megacycles for a peak reading on VTVM TS-505/U. Decrease AN/URM-25 output and observe avc threshold level as read on VTVM TS-505/U.
	j	None	Multimeter AN/PSM-4	Check cabling to the r-f and i-f tuner assembly. Check front panel detail parts S301A. S301B. R302A. R302B. R305. and R309.
	k	☆ . ☆	Audio Oscillator TS-382 U; Output Meter TS-585B U; VTVM TS-505/U	Set GAIN and SENS ADJ. to maximum. EMISSION switch to VOICE. Connect Audio Oscillator TS-382/U and VTVM TS-505/U from test point ☆ to ground. Connect Output Meter TS-585B/U to test point ☆ . Set TS-382/U frequency to 1000 cycles. Adjust TS-382/U level until Output Meter TS-585B/U reads 225 milliwatts. Observe a-c voltage reading of VTVM TS-505/U necessary for this power output.
	l	None	Multimeter AN/PSM-4	Check cabling to the 500-kc i-f and bfo assembly.
	m	None	Multimeter AN/PSM-4	Check cabling and connections to audio amplifier assembly. Check front panel detail parts J303. L301. C302. C303. S301A. and S301B.
	a	None	Multimeter AN/PSM-4	Check cabling and connections between the front panel and the 500-kc i-f and bfo assembly.



TABLE XI. EQUIPMENT TROUBLE ANALYSIS (Cont)

NORMAL INDICATION	IF NORMAL INDICATION	IF ABNORMAL INDICATION
<p>In the CAL position of EMISSION switch, open circuit. In all other positions of EMISSION switch, zero ohms.</p> <p>240 microvolts output of Signal Generator AN/URM-25.</p>	<p>Trouble is in antenna-tuned circuits in the r-f and i-f tuner assembly. Replace r-f and i-f tuner assembly.</p> <p>Proceed to step j.</p>	<p>Trouble is in connection from antenna to input of J208. Check cabling from J201 to J208 and front panel detail parts; J302, S301C, and P304.</p> <p>Proceed to step k.</p>
<p>All connections, especially from the front panel and the dynamotor power supply assembly should be secure.</p> <p>0.15 volt a-c output of Audio Oscillator TS-382/U.</p>	<p>Trouble is in r-f and i-f tuner assembly. Replace r-f and i-f tuner assembly.</p> <p>Proceed to step l.</p>	<p>Repair as necessary.</p> <p>Proceed to step m.</p>
<p>All connections, especially from the front panel and the dynamotor power supply assembly, should be secure.</p> <p>All connections, especially from the front panel and the dynamotor power supply assembly, should be secure.</p>	<p>Trouble is in the 500-kc i-f and bfo assembly. Replace 500-kc i-f and bfo assembly.</p> <p>Trouble is in the audio amplifier assembly. Replace audio amplifier assembly.</p>	<p>Repair as necessary.</p> <p>Repair as necessary.</p>
<p>All connections should be secure.</p>	<p>Trouble is in the 500-kc i-f and bfo assembly. Replace 500-kc i-f and bfo assembly.</p>	<p>Repair as necessary.</p>

TABLE XI. EQUIPMENT TROUBLE ANALYSIS (Cont)

SYMPTOM	STEP	TEST POINTS	TEST EQUIPMENT	INSTRUCTIONS
EMISSION switch positions. Also, no output in VOICE SHP and CW SHP positions. output normal in all other EMISSION switch positions.				Inspect switch S301A on the front panel. Turn off the power and check continuity if cabling is doubtful.
	3. No beat note or beat note not variable in CW and CW SHP positions. Normal operation on all other EMISSION switch positions.	a	☆	VTVM TS-505/U; Multimeter AN/PSM-4
4. Output normal on band 2 (2 to 4 megacycles). No output on all other bands.	b	☆ . ☆	VTVM TS-505/U; Multimeter AN/PSM-4	Connect VTVM TS-505/U from test point ☆ to ground. Measured d-c input voltage to plate of bfo tube, V507.
	a	☆	Frequency Meter AN/USM-26	Connect Frequency Meter AN/USM-26 test leads from test point ☆ to ground. Operate BANDSWITCH to the frequencies listed in table VIII under R-648/ARR-41 FREQUENCY, MC. Observe frequencies as read on Frequency Meter AN/USM-26 and compare with those listed in table VIII under OSCILLATOR OUTPUT, MC.
	b	☆ . ☆	Multimeter AN/PSM-4	Check cabling and connections to the r-f oscillator assembly. Inspect connector P703 for signs of wear. Turn off power and measure for continuity between test points ☆ and ☆
	a	☆ . ☆	Frequency Meter AN/USM-26	Turn EMISSION switch to CAL position. Connect Frequency Meter AN/USM-26 from test points ☆ and ☆ to ground.
5. Calibration signal not heard in CAL position. Normal operation on all other positions of EMISSION switch.	b	None	Multimeter AN/PSM-4	Check cabling and connections to the spectrum generator assembly. Inspect front panel switch S301B.

TABLE XI. EQUIPMENT TROUBLE ANALYSIS (Cont)

NORMAL INDICATION	IF NORMAL INDICATION	IF ABNORMAL INDICATION
<p>Zero volts in all but CW and CW SHP positions of EMISSION switch. In CW and CW SHP positions, the voltage should be variable from zero to approximately 42 volts d-c by operation of the BFO control.</p>	<p>Proceed to step b.</p>	<p>Trouble is in cabling between the dynamotor power supply assembly and the front panel, or in front panel detail parts S301B, R301, R306, or R308. Check for continuity, open resistors, etc., and repair as necessary.</p>
<p>250 volts d-c.</p>	<p>Trouble is in the 500-kc i-f and bfo assembly. Replace 500-kc i-f and bfo assembly.</p>	<p>Trouble is in cabling between front panel and 500-kc i-f and bfo assembly. Turn off power and check for continuity between test point ☆ and test point ☆. Repair as necessary.</p>
<p>As listed in table VIII under OSCILLATOR OUTPUT, MC.</p>	<p>Trouble is in r-f and i-f tuner assembly. Replace r-f and i-f tuner assembly.</p>	<p>Proceed to step b.</p>
<p>All connections and cabling should be secure. Test points ☆ and ☆ should have continuity.</p>	<p>Trouble is in the r-f oscillator assembly. Replace the r-f oscillator assembly.</p>	<p>Repair as necessary.</p>
<p>Test point ☆, 100 kilocycles; test point ☆, 500 kilocycles.</p>	<p>Trouble is in the r-f and i-f tuner assembly. Replace the r-f and i-f tuner assembly.</p>	<p>Proceed to step b.</p>
<p>All connections and cabling should be secure.</p>	<p>Trouble is in the spectrum generator assembly. Replace spectrum generator assembly.</p>	<p>Repair as necessary.</p>

#### 5-24. ASSEMBLY REMOVAL AND REPLACEMENT.

5-25. Directions for removing the various assemblies of Radio Receiver R-648/ARR-41 are given in paragraphs 5-26 through 5-31. During all removal and replacement procedures, care should be exercised to avoid damage to the connectors and gears. To avoid bending pins on the assembly plugs rock the plugs loose from their chassis sockets as the assembly is taken out. Insert the plugs cautiously when returning the assembly to the main chassis, checking for proper alignment between the pins and sockets. When loosening or tightening the captive screws, turn them alternately only a turn or two. Turning one screw all the way before the others may result in damage to the connectors. When replacing the assemblies, the procedures given in paragraphs 5-26 through 5-31 should be reversed.

#### WARNING

During all assembly replacement procedures, the primary power connector should be removed from the power source to avoid electrical shock.

#### 5-26. R-F AND I-F TUNER ASSEMBLY REMOVAL.

- a. Set the BANDSWITCH and TUNING controls for a reading of 0.190 on the MEGACYCLES frequency indicator.
- b. Loosen the two thumb nuts (labeled LOCK) on the upper right- and left-hand corners of the front panel.
- c. Swing the front panel out and down on its hinges. This action disengages the BANDSWITCH and TUNING couplers.
- d. Loosen the four redheaded captive screws at the corners of the r-f and i-f tuner assembly.
- e. Grasp the r-f and i-f tuner assembly by the end-plate spacers (illustrated in figure 1-5) and pull up, disengaging the assembly from jacks J207 and J208.

#### 5-27. 500-KC I-F AND BFO ASSEMBLY REMOVAL.

- a. Loosen the two redheaded captive screws securing the 500-kc i-f and bfo assembly to the R-648/ARR-41 chassis.
- b. Lift vertically with a rocking motion to disengage plug P501.

#### 5-28. AUDIO AMPLIFIER ASSEMBLY REMOVAL.

- a. Loosen the two redheaded captive screws at diagonal corners on the audio amplifier assembly.
- b. Lift vertically with a rocking motion to disengage plug P1301.

#### 5-29. R-F OSCILLATOR ASSEMBLY REMOVAL.

- a. Set the BANDSWITCH and TUNING controls for a reading of 0.190 on the MEGACYCLES frequency indicator.

b. Remove plug P703 from jack J601 on the top of the r-f oscillator assembly chassis.

c. Loosen the two redheaded captive screws at diagonal corners of the r-f oscillator assembly.

d. Lift the r-f oscillator assembly vertically with a rocking motion to disengage plug P601.

#### 5-30. DYNAMOTOR POWER SUPPLY ASSEMBLY REMOVAL.

a. Loosen the four redheaded captive screws at each corner of the dynamotor power supply assembly.

b. Lift vertically with a rocking motion to disengage plug P901.

#### 5-31. SPECTRUM GENERATOR ASSEMBLY REMOVAL.

a. Loosen the two redheaded captive screws at diagonal corners of the spectrum generator assembly.

b. Lift vertically with a rocking motion to disengage plug P750.

#### CAUTION

Further disassembly, other than is described in paragraphs 5-26 through 5-31, should not be performed by organizational maintenance personnel. Due to the critical mechanical and electrical adjustments, all assemblies known to be defective should be returned to field maintenance for the necessary repair and adjustments.

#### 5-32. LUBRICATION.

5-33. All gears and bearings requiring lubrication, except for one oilite bearing in the r-f oscillator assembly, are located on the r-f and i-f tuner assembly. At each 1000-hour interval, the r-f and i-f tuner assembly should be removed and all lubrication points checked. If the parts appear to be clean, sufficiently lubricated, and free-running, lubrication may be omitted until the following lubrication period. If old lubricant has become hard or dirty, clean the parts to be lubricated with carbon tetrachloride (0-C-141(4)) or Stoddard Solvent and dry with compressed air. Figures 5-5 through 5-8 illustrate the lubrication points and table XII lists the type of lubricant and method of application. The oilite bearings are located within each of the three plates of the r-f and i-f tuner assembly and within one plate of the r-f oscillator assembly. Figures 5-5 through 5-8 merely indicate the location of these bearings and it may be necessary to rotate the entire r-f and i-f tuner assembly to various angles to gain access for lubrication.

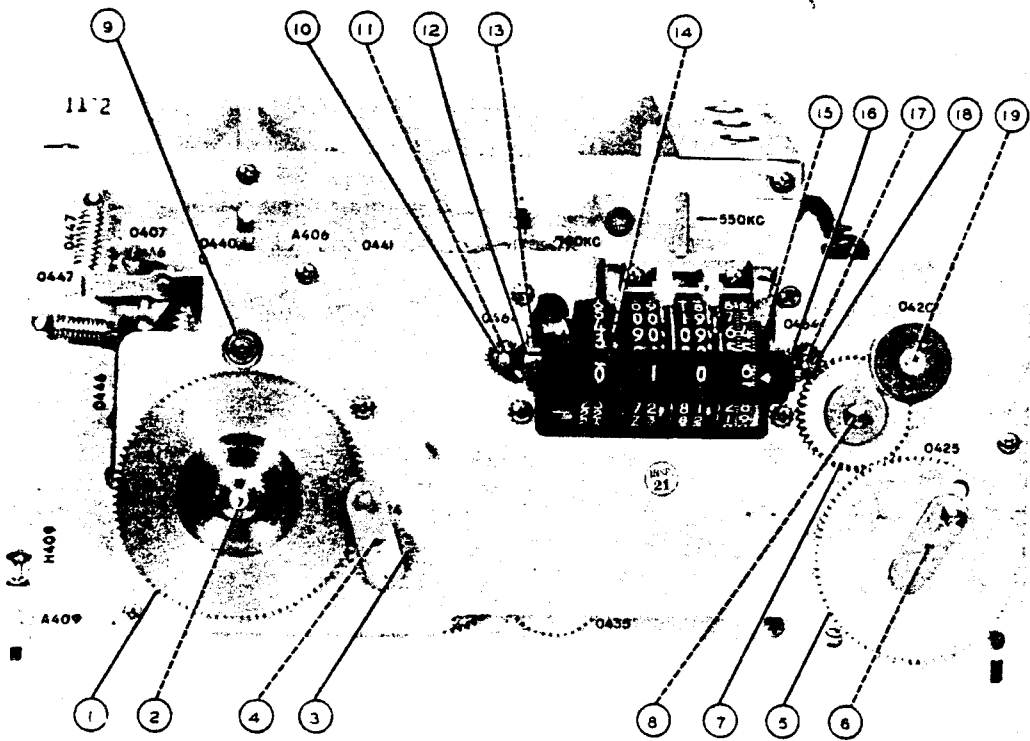


Figure 5-5. R-F and I-F Tuner Assembly, Front View, Lubrication Points

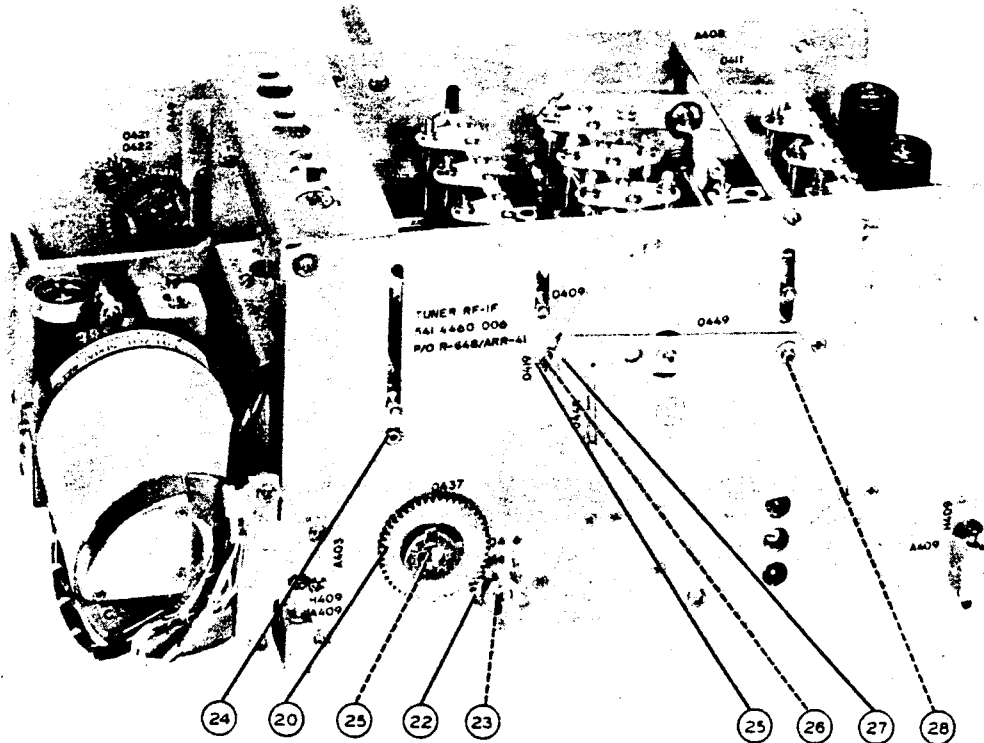


Figure 5-6. R-F and I-F Tuner Assembly, Rear View, Lubrication Points

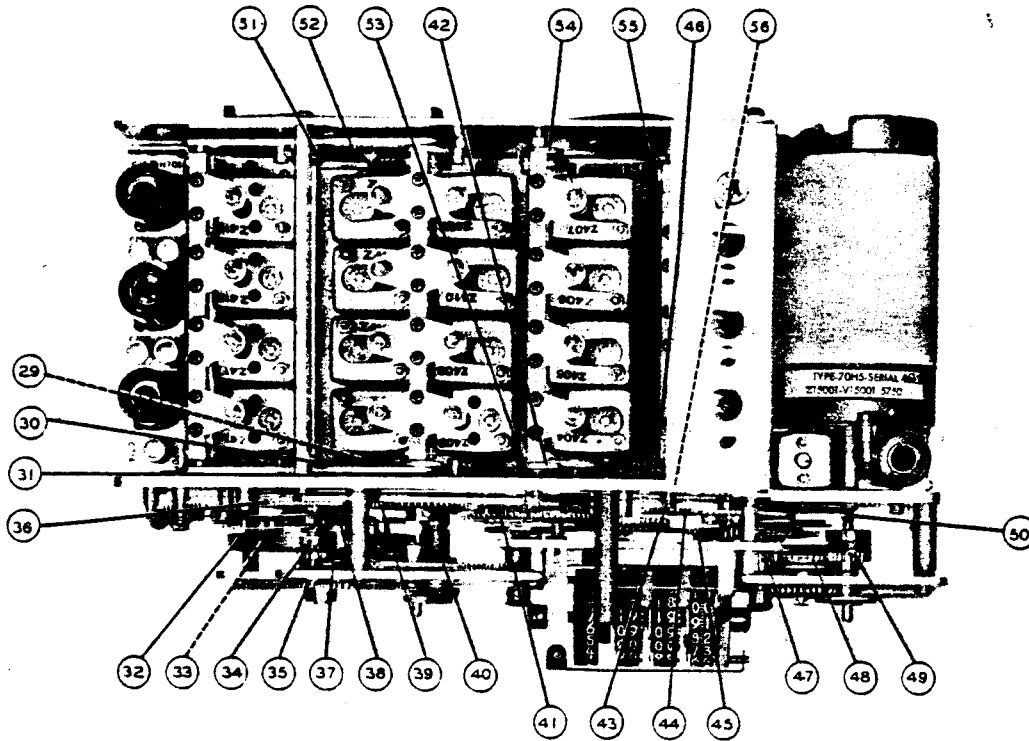


Figure 5-7. R-F and I-F Tuner Assembly, Top View, Lubrication Points

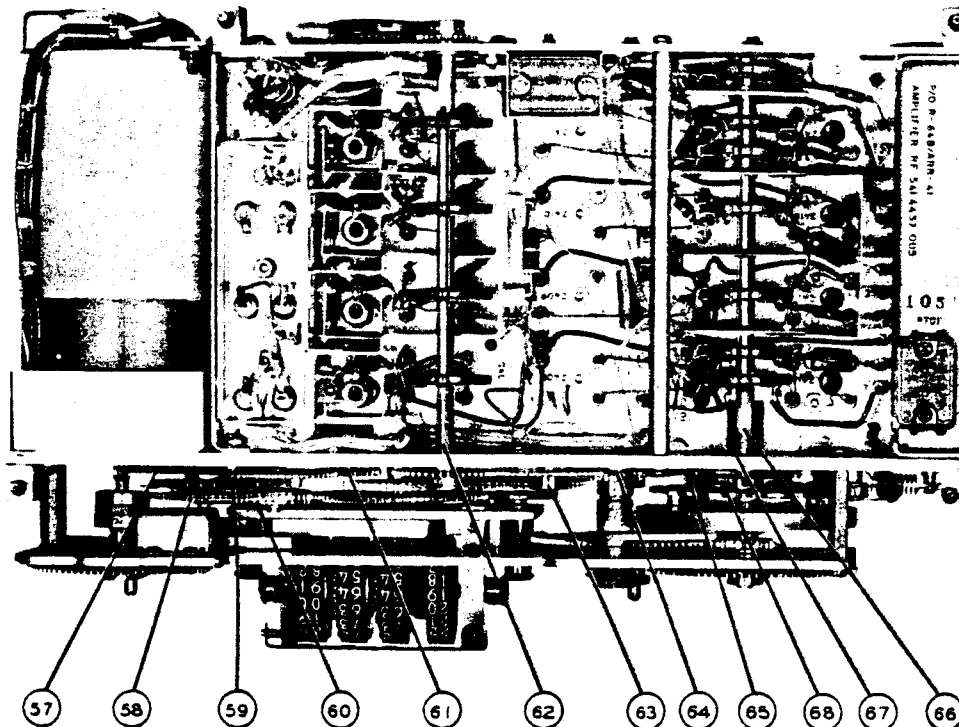


Figure 5-8. R-F and I-F Tuner Assembly, Bottom View, Lubrication Points

TABLE XII. R-F AND I-F TUNER ASSEMBLY, LUBRICATION

REFERENCE NUMBER	FIGURE NUMBER	PART	TYPE OF LUBRICANT	METHOD OF APPLICATION
1	5-5	Gear Teeth	MIL-G-3278	Brush
2	5-5	Bearing	MIL-L-7870	Dropper
3	5-5	Gear Teeth	MIL-G-3278	Brush
4	5-5	Bearing	MIL-L-7870	Dropper
5	5-5	Gear Teeth	MIL-G-3278	Brush
6	5-5	Bearing	MIL-L-7870	Dropper
7	5-5	Gear Teeth	MIL-G-3278	Brush
8	5-5	Bearing	MIL-L-7870	Dropper
9	5-5	Bearing	MIL-L-7870	Dropper
10	5-5	Gear Teeth	MIL-G-3278	Brush
11	5-5	Bearing	MIL-L-7870	Dropper
12	5-5	Gear Teeth	MIL-G-3278	Brush
13	5-5	Bearing	MIL-L-7870	Dropper
14	5-5	Bearing	MIL-L-7870	Dropper
15	5-5	Bearing	MIL-L-7870	Dropper
16	5-5	Gear Teeth	MIL-G-3278	Brush
17	5-5	Bearing	MIL-L-7870	Dropper
18	5-5	Gear Teeth	MIL-G-3278	Brush
19	5-5	Bearing	MIL-L-7870	Dropper
20	5-6	Gear Teeth	MIL-G-3278	Brush
21	5-6	Bearing	MIL-L-7870	Dropper
22	5-6	Gear Teeth	MIL-G-3278	Brush
23	5-6	Bearing	MIL-L-7870	Dropper
24	5-6	Bearing	MIL-L-7870	Dropper
25	5-6	Gear Teeth	MIL-G-3278	Brush
26	5-6	Bearing	MIL-L-7870	Dropper
27	5-6	Rocker Arm Teeth	MIL-G-3278	Brush
28	5-6	Bearing	MIL-L-7870	Dropper

TABLE XII. R-F AND I-F TUNER ASSEMBLY. LUBRICATION (Cont)

REFERENCE NUMBER	FIGURE NUMBER	PART	TYPE OF LUBRICANT	METHOD OF APPLICATION
29	5-7	Spur Rack Teeth	MIL-G-3278	Brush
30	5-7	Gear Teeth	MIL-G-3278	Brush
31	5-7	Bearing	MIL-L-7870	Dropper
32	5-7	Bearing Surface	MIL-L-7870	Dropper
33	5-7	Inner Cam Surface	MIL-G-3278	Brush
34	5-7	Gear Teeth	MIL-G-3278	Brush
35	5-7	Bearing	MIL-L-7870	Dropper
36	5-7	Gear Teeth	MIL-G-3278	Brush
37	5-7	Gear Teeth	MIL-G-3278	Brush
38	5-7	Gear Teeth	MIL-G-3278	Brush
39	5-7	Gear Teeth	MIL-G-3278	Brush
40	5-7	Gear Teeth	MIL-G-3278	Brush
41	5-7	Gear Teeth	MIL-G-3278	Brush
42	5-7	Spur Rack Teeth	MIL-G-3278	Brush
43	5-7	Bearing	MIL-L-7870	Dropper
44	5-7	Gear Teeth	MIL-G-3278	Brush
45	5-7	Gear Teeth	MIL-G-3278	Brush
46	5-7	Spur Rack Teeth	MIL-G-3278	Brush
47	5-7	Gear Teeth	MIL-G-3278	Brush
48	5-7	Gear Teeth	MIL-G-3278	Brush
49	5-7	Gear Teeth	MIL-G-3278	Brush
50	5-7	Gear Teeth	MIL-G-3278	Brush
51	5-7	Gear Teeth	MIL-G-3278	Brush
52	5-7	Spur Rack Teeth	MIL-G-3278	Brush
53	5-7	Bearing	MIL-L-7870	Dropper
54	5-7	Spur Rack Teeth	MIL-G-3278	Brush
55	5-7	Spur Rack Teeth	MIL-G-3278	Brush
56	5-7	Bearing	MIL-L-7870	Dropper



TABLE XII. R-F AND I-F TUNER ASSEMBLY, LUBRICATION (Cont)

REFERENCE NUMBER	FIGURE NUMBER	PART	TYPE OF LUBRICANT	METHOD OF APPLICATION
57	5-8	Gear Teeth	MIL-G-3278	Brush
58	5-8	Gear Teeth	MIL-G-3278	Brush
59	5-8	Bearing	MIL-L-7870	Dropper
60	5-8	Gear Teeth	MIL-G-3278	Brush
61	5-8	Gear Teeth	MIL-G-3278	Brush
62	5-8	Bearing	MIL-L-7870	Dropper
63	5-8	Gear Teeth	MIL-G-3278	Brush
64	5-8	Bearing	MIL-L-7870	Dropper
65	5-8	Detent	MIL-G-3278	Brush
66	5-8	Bearing	MIL-L-7870	Dropper
67	5-8	Bearing	MIL-L-7870	Dropper
68	5-8	Gear Teeth	MIL-L-3278	Brush

## SECTION VI

### FIELD MAINTENANCE

#### 6-1. INTRODUCTION.

6-2. This section provides instructions essential for the maintenance of Radio Receiving Set AN/ARR-41 by field maintenance personnel. Before attempting to service and test this equipment, maintenance specialists should be thoroughly trained in maintenance practices and familiar with the theory of operation of this equipment. Maintenance procedures presented in this section are limited to those practices which are performed with test equipment and tools authorized for field maintenance personnel.

6-3. GENERAL. Field maintenance of the equipment is based on a complete test procedure, designed to check completely an equipment assembly, and trouble isolation procedures, designed to isolate trouble to a detail part within an assembly or subassembly. Defects disclosed during the detailed performance tests should be corrected immediately by use of the trouble isolation tables or by adjustment or alignment procedures. A detailed alignment and tracking procedure of all assemblies is presented in paragraphs 6-44 through 6-64. Alignment and tracking procedures should not be attempted unless it has been established definitely that malfunction exists because a circuit is misaligned. Always check other possibilities before attempting to perform alignment or tracking procedures on an assembly. When reference is made to meter indications or attenuator settings on various pieces of test equipment, it should be remembered that these readings are only approximate values encountered on a large number of properly operating units. It is possible that the equipment will operate normally if the indications vary slightly from those stated. It is absolutely essential that the test equipment be properly calibrated, properly terminated, and otherwise in excellent condition.

**WARNING**

Voltages involved in Radio Receiving Set AN/ARR-41 can be dangerous to life. In performing maintenance operations, special care must be taken to avoid contact with these voltage points. Contact with all tube plate circuitry should be avoided when power is applied. From a mechanical standpoint, physical contact with the rotating parts should be avoided.

#### 6-4. MINIMUM PERFORMANCE STANDARDS.

6-5. GENERAL. The testing procedures described in paragraphs 6-9 through 6-22 provide minimum standards of performance for the R-648/ARR-41 Radio Receiver. The tests may be used as a means to analyze suspected trouble, or to test a particular assembly after repair procedures have been completed. The detailed performance tests, presented in paragraphs 6-9 through 6-22, differ from the performance tests in section V, paragraphs 5-9 through 5-17. The tests are run on a particular stage within an assembly, utilizing test procedures and equipment authorized for use by field maintenance personnel. Field maintenance personnel should perform all test procedures under organizational maintenance, paragraphs 5-9 through 5-17, and the necessary tests in table XI to determine the particular assembly in which trouble exists. The faulty assembly should be removed and the appropriate test, paragraphs 6-9 through 6-22, should be performed.

6-6. PREPARATORY. The equipment supplied with Test Bench Cable Set AN/ARM-21 should be used for testing and trouble shooting within the various assemblies of Radio Receiver R-648/ARR-41. Refer to section II, figure 2-2 and table VII, for an illustration and listing of the cables and test equipment supplied. Preparation for testing and trouble shooting within the R-648/ARR-41 assemblies consists of the following:

- a. Remove the R-648/ARR-41 from Mounting MT-1518/ARR-41 and install in the Test Bench Cable Set AN/ARM-21 mounting.
- b. Tilt the chassis to a convenient angle and tighten the locking mechanisms on each side of the AN/ARM-21 mounting.
- c. Remove the faulty assembly as per instructions given in paragraphs 5-24 through 5-31.
- d. Make certain the POWER switch of the AN/ARM-21 radio set control is in the OFF position.
- e. Connect test cable W1 from the 27.5-volt d-c power source to jack J2001 of the AN/ARM-21 radio set control.
- f. Connect test cable W2 from jack J2002 on the AN/ARM-21 radio set control to jack J301 of Radio Receiver R-648/ARR-41.
- g. Connect from Radio Receiver R-648/ARR-41 to the faulty assembly by means of the correct test cable. Refer to section II, table VII for the correct cables and connecting procedures for each removable assembly.

NOTE

Test cables for the r-f oscillator assembly and the r-f and i-f tuner assembly are not included with Test Bench Cable Set AN/ARM-21. Tests and trouble isolation procedures are performed on these assemblies while they are connected to the R-648 ARR-41 chassis.

6-7. STAGE GAIN TESTS. R-F AND I-F TUNER ASSEMBLY.

6-8. The stage gain tests, paragraphs 6-9 through 6-12, are designed to test the sensitivity and help to isolate trouble within the r-f and i-f tuner assembly. These tests should be performed after repair work, as a method of testing sensitivity, and may be used to isolate trouble to a stage or group of stages within the r-f and i-f tuner assembly. Refer to figures 5-2 and 5-3 for test point location and to figure 6-1 for the necessary test bench setup. The following preparatory operations should be performed for the tests described in paragraphs 6-9 through 6-12:

- a. Perform steps a, b, d, e, and f of paragraph 6-6. (The r-f and i-f tuner assembly is not removed during testing procedures.)
- b. Set the R-648/ARR-41 GAIN and SENS ADJ. to maximum. EMISSION switch to VOICE.
- c. Connect Output Meter TS-585B/U or a 300-ohm noninductive resistor to the AUDIO OUTPUT jack of Test Bench Cable Set AN/ARM-21 radio set control. (Ground is supplied internally.)

NOTE

Whenever Output Meter TS-585B/U is used, the impedance selector switch should be operated to the 300-ohm position.

d. Turn the AN/ARM-21 radio set control POWER switch to ON.

e. Connect VTVM TS-505/U from the VOLTS jack of the AN/ARM-21 radio set control to ground. Adjust the primary power source for a reading of exactly 27.5 volts d-c.

f. Connect VTVM TS-505/U from test point 5 to ground. Adjust to read a negative voltage of approximately 1 volt d-c.

g. Set the frequency of Radio Receiver R-648 ARR-41 to 8 megacycles as read on the MEGACYCLES frequency indicator.

6-9. STAGE GAIN. FIRST R-F AMPLIFIER. The following test should be performed after the preparatory operations of paragraph 6-8 have been completed:

- a. Connect Signal Generator AN/URM-25 from test point 15 to ground. Adjust for an output of 8 megacycles at approximately 15 microvolts.
- b. Vary the frequency of Signal Generator AN/URM-25 slowly around 8 megacycles for a peak reading on VTVM TS-505/U.
- c. Decrease the output of Signal Generator AN/URM-25 and observe point where VTVM TS-505/U reading drops rapidly, which is the avc threshold level. AN/URM-25 output should not exceed 9.5 microvolts for avc at threshold level.

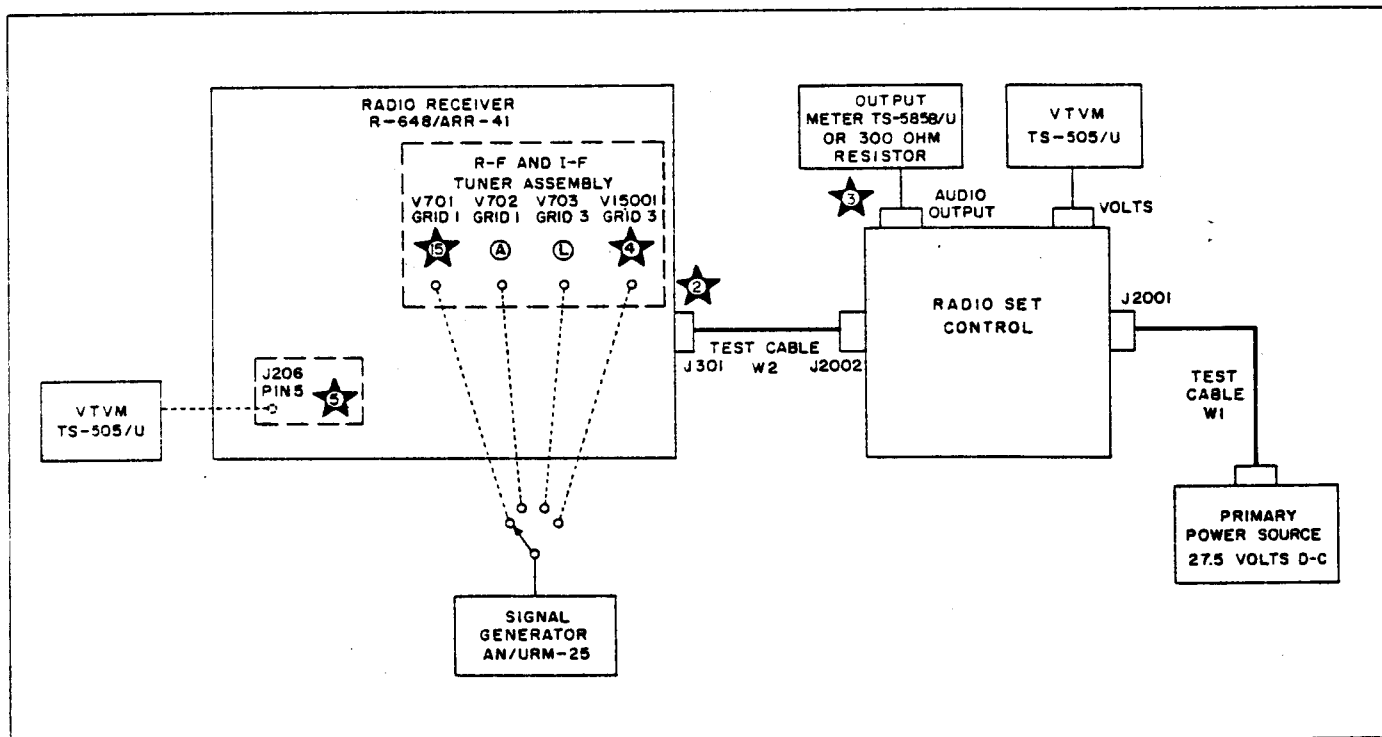


Figure 6-1. Stage Gain, R-F and I-F Tuner Assembly, Test Bench Setup

d. Repeat steps a through c with Signal Generator AN URM-25 and Radio Receiver R-648/ARR-41 set to the following frequencies: 0.19, 2, 4, and 16 megacycles. Avc threshold level should not exceed 9.5 microvolts for 0.19, 4, and 16 megacycles. The avc threshold level for the 2-megacycle test should not exceed 13.5 microvolts.

6-10. STAGE GAIN, SECOND R-F AMPLIFIER. The following test should be performed after the preparatory operations of paragraph 6-8 have been completed:

- a. Connect Signal Generator AN/URM-25 from test point A to ground. Adjust for an output of 8 megacycles at approximately 60 microvolts.
- b. Vary the frequency of Signal Generator AN URM-25 slowly around 8 megacycles for a peak reading on VTVM TS-505/U.
- c. Decrease the output of Signal Generator AN URM-25 and observe point where VTVM TS-505/U reading drops rapidly, which is the avc threshold level. AN/URM-25 output should not exceed 43 microvolts for avc at threshold level.
- d. Repeat steps a through c with Signal Generator AN URM-25 and Radio Receiver R-648/ARR-41 set

to the following frequencies: 0.19, 4, and 16 megacycles. Avc threshold level should not exceed 43 microvolts in each case. Band 2 frequencies (2 to 4 megacycles) do not pass through the second r-f amplifier stage.

6-11. STAGE GAIN, FIRST MIXER. The following test should be performed after the preparatory operations of paragraph 6-8 have been completed:

- a. Connect Signal Generator AN/URM-25 from test point L to ground. Adjust for an output of 8 megacycles at approximately 150 microvolts.
- b. Vary the frequency of Signal Generator AN/URM-25 slowly around 8 megacycles for a peak reading on VTVM TS-505/U.
- c. Decrease the output of Signal Generator AN/URM-25 and observe point where VTVM TS-505/U reading drops rapidly, which is the avc threshold level. AN/URM-25 output should not exceed 100 microvolts for avc at threshold level.
- d. Repeat steps a through c with Signal Generator AN/URM-25 and Radio Receiver R-648/ARR-41 set to the following frequencies: 0.19, 4, and 16 megacycles. Avc threshold level should not exceed 100

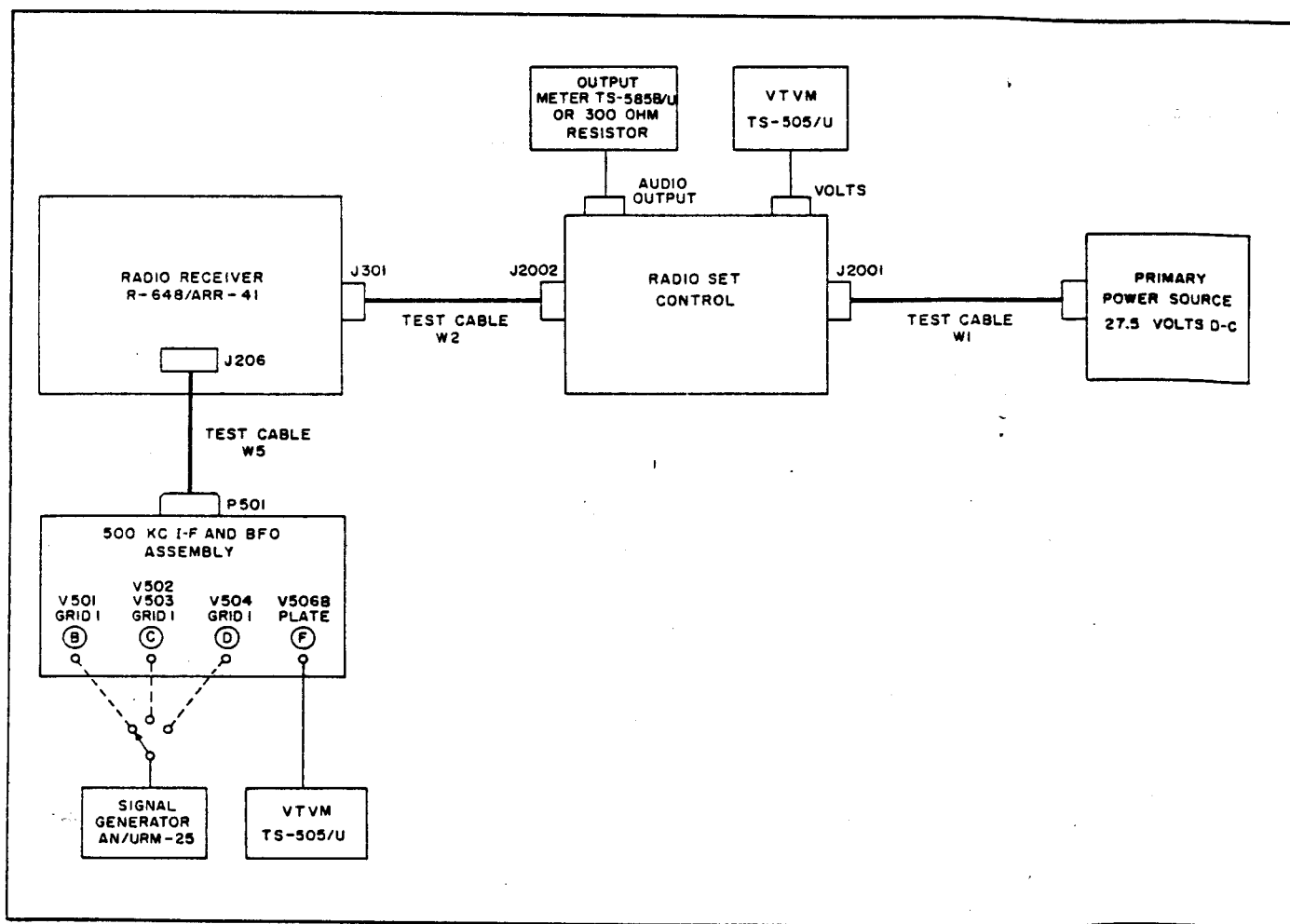


Figure 6-2. Stage Gain, 500-Kc I-F and BFO Assembly, Test Bench Setup

microvolts in each case. Band 2 frequencies (2 to 4 megacycles) do not pass through the first mixer stage.

**6-12. STAGE GAIN, VARIABLE FREQUENCY OSCILLATOR-CONVERTER.** The following test should be performed after the preparatory operations of paragraph 6-8 have been completed:

- a. Connect Signal Generator AN/URM-25 from test point 4 to ground. Adjust for an output of 3 megacycles at approximately 175 microvolts.
- b. Vary the frequency of Signal Generator AN/URM-25 slowly around 3 megacycles for a peak reading on VTVM TS-505/U.
- c. Decrease the output of Signal Generator AN/URM-25 and observe point where VTVM TS-505/U reading drops rapidly, which is the avc threshold level. AN/URM-25 output should not exceed 125 microvolts for avc at threshold level.
- d. Repeat steps a through c with Signal Generator AN/URM-25 set to 4 megacycles and Radio Receiver R-648/ARR-41 set to 9 megacycles. Avc threshold level should not exceed 125 microvolts.

**6-13. STAGE GAIN TESTS, 500-KC I-F AND BFO ASSEMBLY.**

6-14. The stage gain tests, paragraphs 6-15 through 6-17, are designed to test the sensitivity and help to isolate trouble within the 500-kc i-f and bfo assembly. These tests should be performed after repair work, as a method of testing sensitivity, and may be used to isolate trouble to a stage or group of stages within the 500-kc i-f and bfo assembly. Refer to figure 6-2 for the test bench setup and to figure 6-17 for the location of test points. The following preparatory operations should be performed for the tests described in paragraphs 6-15 through 6-17:

- a. Perform steps a through g of paragraph 6-6. (The 500-kc i-f and bfo assembly should be removed during testing procedures.)
- b. Set the R-648/ARR-41 GAIN and SENS ADJ. to maximum. EMISSION switch to VOICE.
- c. Connect Output Meter TS-585B/U or a 300-ohm noninductive resistor to the AUDIO OUTPUT jack of Test Bench Cable Set AN/ARM-21 radio set control. (Ground is supplied internally.)
- d. Turn the AN/ARM-21 radio set control POWER switch to ON.
- e. Connect VTVM TS-505/U from the VOLTS jack of the AN/ARM-21 radio set control to ground. Adjust the primary power source for a reading of exactly 27.5 volts d-c.
- f. Connect VTVM TS-505/U from test point F to ground. Adjust to read on the negative 3-volt scale.
- g. Set the frequency of Radio Receiver R-648/ARR-41 to 8 megacycles as read on the MEGACYCLES frequency indicator.

**6-15. STAGE GAIN, FIRST I-F AMPLIFIER.** The following test should be performed after the preparatory operations of paragraph 6-14 have been completed:

- a. Connect Signal Generator AN/URM-25 from test point B to ground. Adjust for an output of 500 kilocycles at approximately 300 microvolts.

- b. Vary the frequency of Signal Generator AN/URM-25 slowly around 500 kilocycles for a peak reading on VTVM TS-505/U.

- c. Decrease the output of Signal Generator AN/URM-25 and observe point where VTVM TS-505/U reading drops rapidly, which is the avc threshold level. AN/URM-25 output should not exceed 240 microvolts for avc at threshold level.

**6-16. STAGE GAIN, SECOND I-F AMPLIFIERS.** The following test should be performed after the preparatory operations of paragraph 6-14 have been completed:

- a. Connect Signal Generator AN/URM-25 from test point C to ground. Adjust for an output of 500 kilocycles at approximately 2000 microvolts.
- b. Vary the frequency of Signal Generator AN/URM-25 slowly around 500 kilocycles for a peak reading on VTVM TS-505/U.
- c. Decrease the output of Signal Generator AN/URM-25 and observe point where VTVM TS-505/U reading drops rapidly, which is the avc threshold level. AN/URM-25 output should not exceed 1500 microvolts for avc at threshold level.
- d. Steps a through c should be repeated for both second i-f amplifiers, V502 and V503.

**6-17. STAGE GAIN, THIRD I-F AMPLIFIER.** The following test should be performed after the preparatory operations of paragraph 6-14 have been completed:

- a. Connect Signal Generator AN/URM-25 from test point D to ground. Adjust for an output of 500 kilocycles at approximately 0.15 volt.
- b. Vary the frequency of Signal Generator AN/URM-25 slowly around 500 kilocycles for a peak reading on VTVM TS-505/U.
- c. Decrease the output of Signal Generator AN/URM-25 and observe point where VTVM TS-505/U reading drops rapidly, which is the avc threshold level. AN/URM-25 output should not exceed 0.12 volt for avc at threshold level.

**6-18. STAGE GAIN TESTS, AUDIO AMPLIFIER ASSEMBLY.**

6-19. The stage gain tests, paragraphs 6-20 through 6-22, are designed to test the sensitivity and help to isolate trouble within the audio amplifier assembly. These tests should be performed after repair work, as a method of testing sensitivity, and may be used to isolate trouble to a stage or group of stages within the audio amplifier assembly. Refer to figure 6-3 for the test bench setup and to figure 6-18 for the location of test points. The following preparatory operations should be performed for the tests described in paragraphs 6-20 through 6-22:

- a. Perform steps a through g of paragraph 6-6. (The audio amplifier assembly should be removed during testing procedures.)
- b. Set the R-648/ARR-41 GAIN and SENS ADJ. to maximum. EMISSION switch to VOICE.
- c. Connect Output Meter TS-585B/U to the AUDIO OUTPUT jack of Test Bench Cable Set AN/ARM-21 radio set control. (Ground is supplied internally.)

d. Turn the AN/ARM-21 radio set control POWER switch to ON.

e. Connect VTVM TS-505/U from the VOLTS jack of the AN/ARM-21 radio set control to ground. Adjust the primary power source for a reading of exactly 27.5 volts d-c.

6-20. STAGE GAIN, FIRST AUDIO AMPLIFIER. The following test should be performed after the preparatory operations of paragraph 6-19 have been completed:

a. Connect Audio Oscillator TS-382/U from test point G to ground. Adjust for an output of 1000 cycles.

b. Vary output level of Audio Oscillator TS-382/U for a reading of 225 milliwatts on Output Meter TS-585B/U.

c. Connect the a-c probes of VTVM TS-505/U across the TS-382/U output terminals.

d. Observe a-c output voltage of TS-382/U necessary for an output power of 225 milliwatts. Reading on VTVM TS-505/U should not exceed 0.15 volt a-c.

6-21. STAGE GAIN, SECOND AUDIO AMPLIFIER. The following test should be performed after the

preparatory operations of paragraph 6-19 have been completed:

a. Connect Audio Oscillator TS-382/U from test point H to ground. Adjust for an output of 1000 cycles.

b. Vary output level of Audio Oscillator TS-382/U for a reading of 225 milliwatts on Output Meter TS-585B/U.

c. Connect the a-c probes of VTVM TS-505/U across the TS-382/U output terminals.

d. Observe a-c output voltage of TS-382/U necessary for an output power of 225 milliwatts. Reading on VTVM TS-505/U should not exceed 0.9 volt a-c.

6-22. STAGE GAIN, THIRD AUDIO AMPLIFIER. The following test should be performed after the preparatory operations of paragraph 6-19 have been completed:

a. Connect Audio Oscillator TS-382/U from test point I to ground. Adjust for an output of 1000 cycles.

b. Vary output level of Audio Oscillator TS-382/U for a reading of 225 milliwatts on Output Meter TS-585B/U.

c. Connect the a-c probes of VTVM TS-505/U across the TS-382/U output terminals.

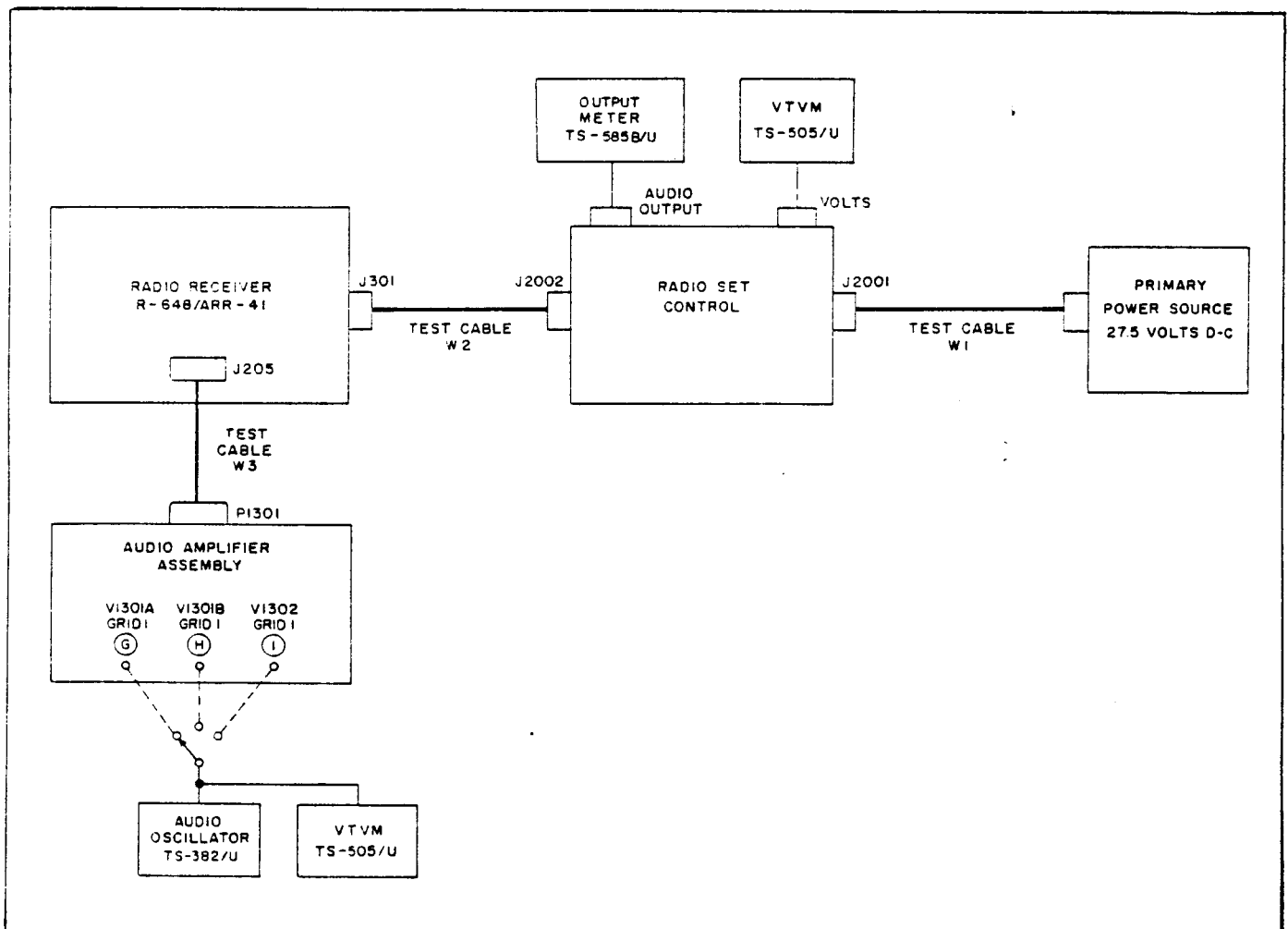


Figure 6-3. Stage Gain, Audio Amplifier Assembly, Test Bench Setup

d. Observe a-c output voltage of TS-382/U necessary for an output power of 225 milliwatts. Reading on VTVM TS-505/U should not exceed 2.8 volts a-c.

**6-23. TROUBLE ISOLATION PROCEDURES.**

**6-24. GENERAL.** Trouble isolation procedures for Radio Receiving Set AN/ARR-41 consist of determining what detail part, or group of detail parts, is causing a particular malfunction in the equipment. Trouble isolation procedures are a continuation of equipment trouble analysis procedures, table XI, in section V of this handbook. Accurate determination of which assembly of the AN/ARR-41 equipment is at fault is essential in the trouble shooting procedure, since the following trouble shooting procedures are presented for various assemblies of the equipment.

**6-25. VOLTAGE DISTRIBUTION.**

**6-26. PRIMARY VOLTAGE DISTRIBUTION.** Primary power is supplied to Radio Receiving Set AN/ARR-41 from a 27.5-volt d-c source. In aircraft installation, voltage is usually obtained from an engine-driven d-c generator which has a negative ground and is filtered by a 12-cell lead-acid storage battery. The AN/ARR-41 will draw a nominal current of 3 amperes at temperatures above zero degrees centigrade (32 degrees Fahrenheit) or 5.8 amperes at lower temperatures. The power source must be capable of withstanding a surge current of at least 20 amperes. For test bench installation, a 5-ampere fuse should be used in the primary power circuit.

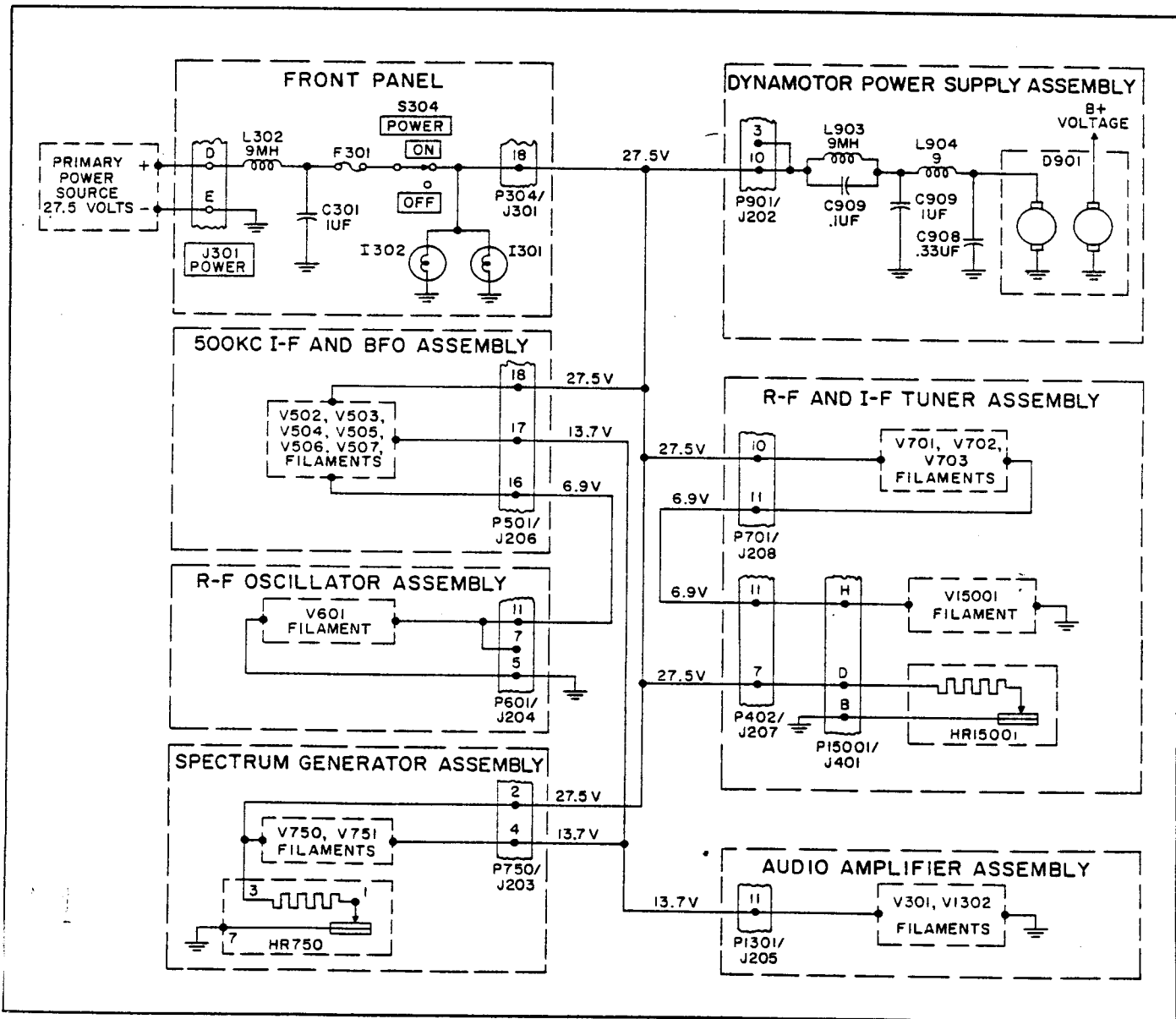


Figure 6-4. Radio Receiver R-648/ARR-41, Primary Voltage Distribution

6-27. A simplified schematic of the primary power distribution points is shown in figure 6-4. Primary voltage is applied between terminals D and E of jack J301, labeled POWER, on the front panel. Inductor L302 and capacitor C301 attenuate any high frequencies on the 27.5-volt line. Voltage is applied to indicator bulbs I301 and I302 and to terminal 18 of P304 J202 when switch S304 is closed. Terminal 18 of P304 J202 connects to terminals of the dynamotor power supply assembly, the r-f and i-f tuner assembly, the 500-kc i-f and bfo assembly, and the spectrum generator assembly. There is no direct connection to either the r-f oscillator assembly or the audio amplifier assembly. Because of the series-parallel filament connections (figure 5-4) this is not necessary. If trouble is suspected in the primary voltage circuits,

the voltages should be measured at the various plug and jack terminals as indicated in figure 6-6. This will give a quick check for open wires in the interconnecting cables and will help isolate trouble within a particular assembly.

6-28. THE 250-VOLT B-PLUS LINE. Figure 6-5 illustrates the various 250-volt connection from the dynamotor power supply assembly. The 27.5-volt d-c input to the dynamotor supply assembly is stepped up by dynamotor D901 and applied across the filter arrangement of L901, C901, C902, L902, and C904. The voltage at this point is used directly and is filtered by resistor R905 and capacitor C905 for the first and second r-f amplifier screens and plates and the mixer screen. B-plus voltage to

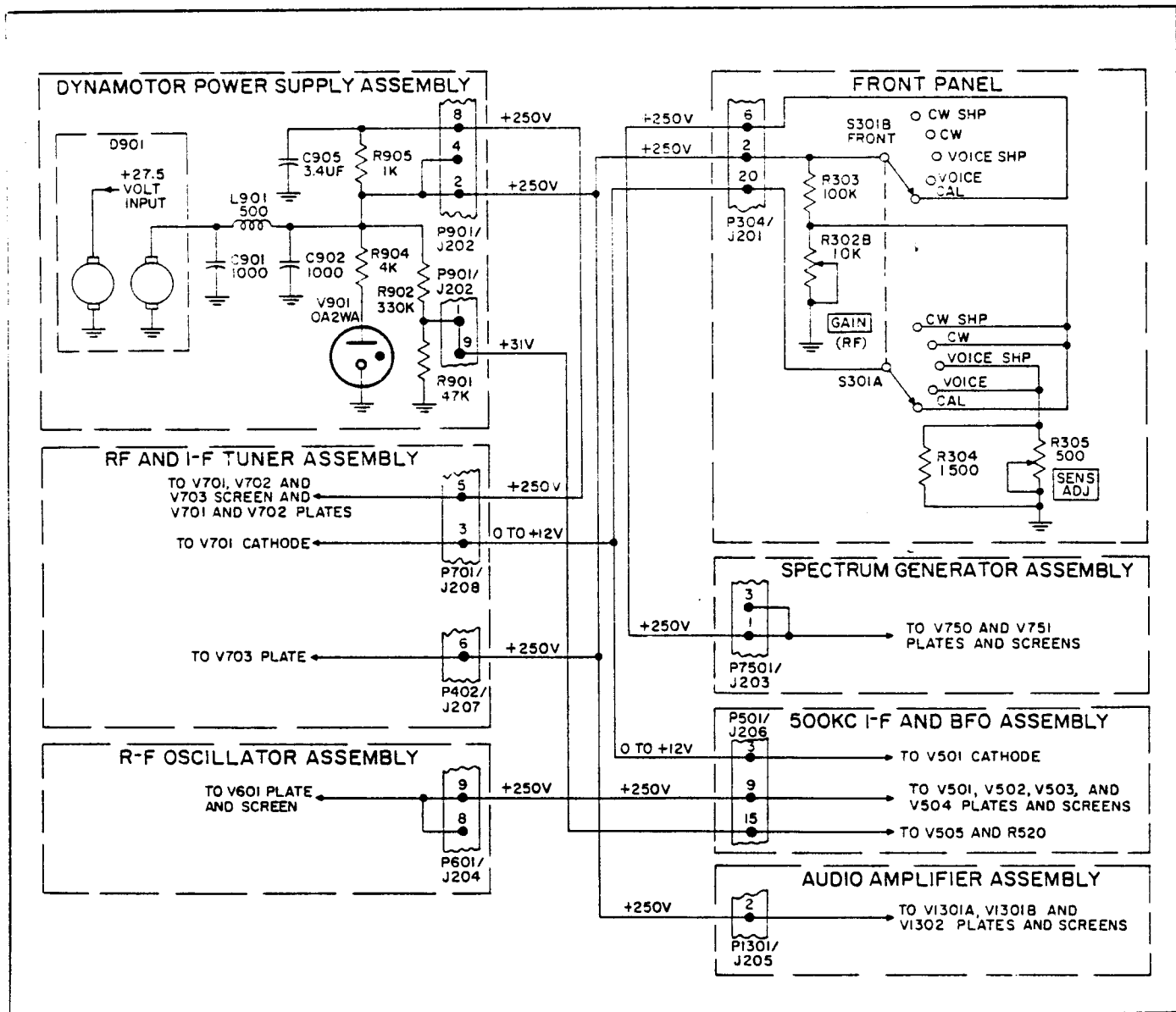


Figure 6-5. Radio Receiver R-648/ARR-41, 250-Volt B-Plus Line



Paragraphs 6-29 to 6-32

the spectrum generator assembly is applied only when the EMISSION switch (S301B front) is in the CAL position. When in the CAL, CW, or CW SHP positions, switch S301A connects a small variable voltage across potentiometer R302B. This provides a variable bias to the first r-f and i-f amplifier tubes. Potentiometer R305 provides a means of desensitizing the R-648 ARR-41 a small amount. Bias voltage for the detector stage is tapped off between R901 and R902.

6-29. THE 150-VOLT REGULATED LINE. (Refer to figure 6-6.) The 150-volt regulated voltage is provided by voltage regulator tube V901 and dropping resistor R904 in the dynamotor power supply assembly. Output to the r-f and i-f tuner assembly and the front panel is provided by terminals 5 and 7 of P901/J202. Resistor R302A and switch S301A on the front panel provide a means of varying the cathode bias of V1301A in the audio amplifier assembly when the EMISSION switch (S301A) is in the VOICE or VOICE SHP positions. Plate and screen voltage to the bfo tube is applied only when switch S301B is in either the CW or CW SHP positions, thus preventing the bfo from operating except during cw reception. Resistor

R306 on the front panel provides a means of varying the voltage across rectifier CR501, which varies the frequency of the beat note.

6-30. ASSEMBLY TROUBLE ANALYSIS.

6-31. PRELIMINARY. The assembly trouble analysis chart, tables XIII through XVIII, assumes that the necessary tests of table XI have been performed and trouble has been isolated to a particular assembly within the R-648/ARR-41. Also, the performance tests, paragraphs 6-7 through 6-22, should have been completed to help isolate the trouble to a particular stage within an assembly. After the trouble has been isolated to a stage or group of stages, the preparatory operations of paragraph 6-6 should be performed, allowing access to the detail parts of the faulty assembly.

6-32. R-F AND I-F TUNER ASSEMBLY, TROUBLE ANALYSIS. The r-f and i-f tuner assembly is not removed during the trouble isolation procedures, table XIII, until the defective detail part or group of detail parts has been determined. The performance tests, paragraphs 6-7 through 6-12, are used in table XIII as an indication of which stage trouble exists.

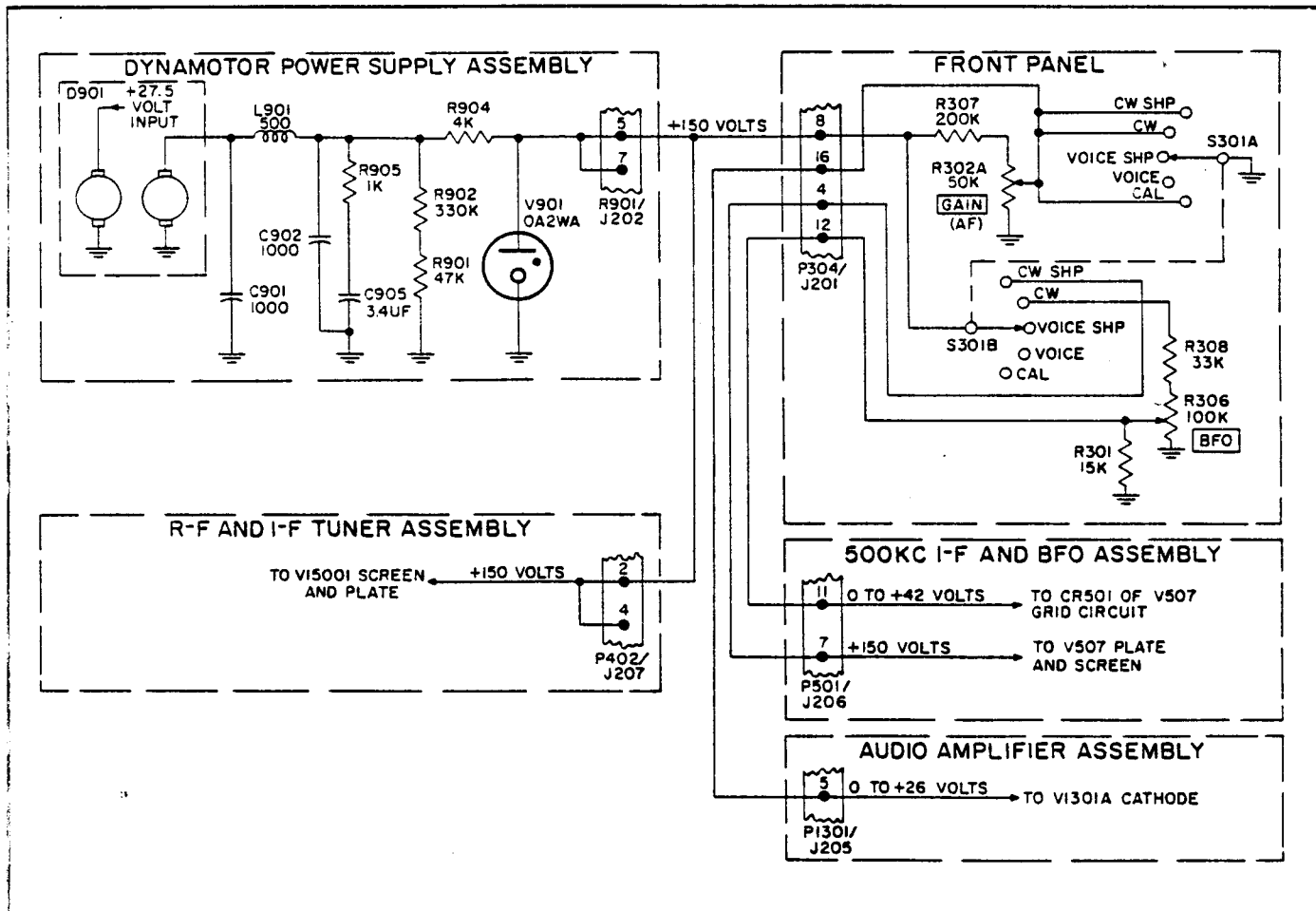


Figure 6-6. Radio Receiver R-648/ARR-41, 150-Volt Regulated Line

Upon finding the correct indication under the symptom column, the assembly should be removed and the indicated detail parts checked for faults. The faulty detail part should be replaced, and the r-f and i-f tuner assembly replaced in the R-648/ARR-41 chassis. Multimeter AN/PSM-4 should be used to check inductors for continuity, resistors for the correct value, and capacitors for shorts after the trouble has been isolated to a few detail parts.

## NOTE

If it is necessary to remove either the r-f amplifier subassembly or the variable frequency oscillator-converter subassembly from the r-f and i-f tuner assembly for replacement or checking, the appropriate removal and replacement procedure, paragraphs 6-40 through 6-42 should be conformed with.

TABLE XIII. R-F AND I-F TUNER ASSEMBLY. TROUBLE ANALYSIS

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Assembly satisfies first r-f amplifier stage gain test, paragraph 6-9, but trouble is known to exist in the r-f and i-f tuner assembly.	<ol style="list-style-type: none"> <li>1. Tuned circuit Z401, Z408, Z416, Z412, or Z404 defective, depending upon the band of operation.</li> <li>2. Switch wafer S401A, S401B, or S402A defective.</li> <li>3. Coupling capacitor C401, C407, C421, C435, or C453 defective, depending upon tuned circuit in operation.</li> <li>4. Coupling capacitor C488 open.</li> <li>5. Connectors J402/P702 defective.</li> </ol>	<p>Determine the correct tuned circuit by examination of figure 4-2 and check for open or shorted inductors and capacitors. Replace as necessary.</p> <p>Replace r-f and i-f tuner assembly.</p> <p>Replace defective capacitor.</p> <p>Replace capacitor C488.</p> <p>Repair or replace as necessary.</p>
2. Assembly satisfies first r-f amplifier stage gain test, paragraph 6-9. Calibration test, symptom 5 of table XI, proves trouble to exist in the r-f and i-f tuner assembly.	<ol style="list-style-type: none"> <li>1. Capacitor C701 open.</li> <li>2. Terminals 2 or 4 of connectors P701/J208 defective.</li> </ol>	<p>Replace capacitor C701.</p> <p>Repair or replace defective connector.</p>
3. Assembly satisfies second r-f amplifier stage gain test, paragraph 6-10. Output zero or below normal as determined by first r-f amplifier stage gain test, paragraph 6-9.	<ol style="list-style-type: none"> <li>1. Defective r-f amplifier tube V701.</li> <li>2. Tuned circuit Z402, Z409, Z410, Z417, Z418, Z413, or Z414 defective, depending upon the band of operation</li> <li>3. Switch wafer S401C or S401D defective.</li> <li>4. Coupling capacitor C468, C415, C429, or C443 open, depending upon tuned circuit in operation.</li> </ol>	<p>Replace V701.</p> <p>Determine the correct tuned circuit by examination of figure 4-2 and check for open or shorted inductors and capacitors. Replace as necessary.</p> <p>Replace r-f and i-f tuner assembly.</p> <p>Replace defective capacitor.</p>

TABLE XIII. R-F AND I-F TUNER ASSEMBLY. TROUBLE ANALYSIS (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
	<ol style="list-style-type: none"> <li>5. Coupling capacitor C404 or C468 open.</li> <li>6. Connectors J402/P702 or P701/J208 defective.</li> <li>7. Resistor R405 open.</li> <li>8. Resistor R705 or R706 open or resistor R704 shorted.</li> <li>9. Resistor R703 or capacitor C703 open.</li> </ol>	<p>Replace defective capacitor.</p> <p>Repair or replace as necessary.</p> <p>Replace resistor R405.</p> <p>Replace defective resistor.</p> <p>Replace defective detail part.</p>
<p>4. Assembly satisfies first mixer stage gain test, paragraph 6-11. Output zero or below normal as determined by second r-f amplifier stage gain test, paragraph 6-10.</p>	<ol style="list-style-type: none"> <li>1. Defective r-f amplifier tube V702.</li> <li>2. Tuned circuit Z403, Z411, Z419, or Z415 defective, depending upon the band of operation.</li> <li>3. Switch wafer S401E or S401F defective.</li> <li>4. Coupling capacitor C489 or C406 open.</li> <li>5. Resistor R406 open.</li> <li>6. Connectors J402/P702 defective.</li> <li>7. Resistor R711 or R712 open or resistor R710 shorted.</li> <li>8. Resistor R709 or capacitor C706 open.</li> </ol>	<p>Replace V702.</p> <p>Determine the correct tuned circuit by examination of figure 4-2 and check for open or shorted inductors and capacitors. Replace as necessary.</p> <p>Replace r-f and i-f tuner assembly.</p> <p>Replace defective capacitor.</p> <p>Replace resistor R406.</p> <p>Replace or repair as necessary.</p> <p>Replace defective resistor.</p> <p>Replace defective detail part.</p>
<p>5. Assembly satisfies variable frequency oscillator-converter stage gain test, paragraph 6-12. Output zero or below normal as determined by first mixer stage gain test, paragraph 6-11.</p>	<ol style="list-style-type: none"> <li>1. Defective mixer tube V703.</li> <li>2. Tuned circuit Z405, Z406, or Z407 defective, depending upon the band of operation.</li> <li>3. Switch wafer S401H, S402B, S402C, or S402D defective.</li> <li>4. Capacitor C465 shorted.</li> </ol>	<p>Replace V703.</p> <p>Determine the correct tuned circuit by examination of figure 4-2 and check for open or shorted inductors and capacitors. Replace as necessary.</p> <p>Replace r-f and i-f tuner assembly.</p> <p>Replace capacitor C465.</p>

TABLE XIII. R-F AND I-F TUNER ASSEMBLY. TROUBLE ANALYSIS (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
	5. Coupling capacitor C461 or C459 open. 6. Connectors P702/J402 or P701/J208 defective. 7. Resistor R716 open or capacitor C709 shorted. 8. Capacitor C715 open. 9. Resistor R714 or capacitor C708 open. 10. Resistor R715 shorted.	Replace defective capacitor. Replace or repair as necessary. Replace defective detail part. Replace capacitor C715. Replace defective detail part. Replace resistor R715.
6. Output zero or below normal on variable frequency oscillator-converter stage gain test. paragraph 6-12. Trouble known to exist in the r-f and i-f tuner assembly.	1. Defective oscillator tube V15001. 2. Filament capacitor C714, C716, C717, C718, C719, C721, or C15007 shorted. 3. Connectors P15001/J401 or P402/J207 defective. 4. Inductors L15003, L15005, or resistor R15002 open. 5. Impedance Z15001 defective. 6. Detail part within HR15001 defective. 7. Capacitor C15009 open. 8. BANDSWITCH or TUNING control mechanical drive malfunctioning. Check movement of tuning core elevators and operation of gears and switches. 9. Cabling or connectors defective. Check voltage distribution points by reference to figures 6-4 through 6-6.	Replace V15001. Replace defective capacitor. Replace or repair as necessary. Replace defective detail part. Replace Z15001. Replace HR15001. Replace capacitor C15009. Repair as necessary or replace r-f and i-f tuner assembly as a unit. Repair as necessary.
7. Output abnormally high and distorted as determined by stage gain tests. paragraphs 6-7 through 6-12.	1. Bypass capacitor C703, C706, or C708 shorted. 2. Biasing resistor R703, R709, or R714 shorted.	Replace defective capacitor. Replace defective resistor.

TABLE XIII. R-F AND I-F TUNER ASSEMBLY. TROUBLE ANALYSIS (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
	<p>3. No avc to first or second r-f amplifier grids. Capacitors C711, C710, C702, or C705 shorted.</p> <p>4. No avc to first or second r-f amplifiers. Inductor L702 or resistors R702, R701, R707, or R708 open.</p> <p>5. Connectors P701/J208 defective.</p>	<p>Replace defective capacitor.</p> <p>Replace defective detail part.</p> <p>Replace or repair as necessary.</p>
<p>8. Filaments do not light. Trouble known to exist in the r-f and i-f tuner assembly.</p>	<p>1. Connectors P701/J208 or P402/J207 defective.</p> <p>2. Inductor L701 or L15004 open.</p>	<p>Replace or repair as necessary.</p> <p>Replace defective inductor.</p>

6-33. 500-KC I-F AND BFO ASSEMBLY. TROUBLE ANALYSIS. The 500-kc i-f and bfo assembly should be removed from the R-648/ARR-41 chassis for the trouble isolation procedures given in table XIV. The preparatory operations of paragraph 6-6 should be performed, allowing the assembly to be set up for testing and trouble shooting. The 500-kc i-f and bfo assembly performance tests, paragraphs 6-13 through

6-17, are referred to in table XIV as an indication in which stage or group of stages the trouble exists. When the trouble has been isolated to a few detail parts, Multimeter AN/PSM-4 should be used to check inductors for continuity, resistors for the correct value, and capacitors for shorts, thereby determining the detail part at fault.

TABLE XIV. 500-KC I-F AND BFO ASSEMBLY, TROUBLE ANALYSIS

SYMPTOM	PROBABLE CAUSE	REMEDY
<p>1. Assembly satisfies first i-f amplifier stage gain test, paragraph 6-15. Trouble known to exist in the 500-kc i-f and bfo assembly.</p>	<p>1. Connectors P501/J206 defective.</p> <p>2. Cabling from terminal 20 of P501/J206 to grid 1 of V501 open.</p>	<p>Replace or repair as necessary.</p> <p>Repair as necessary.</p>
<p>2. Assembly satisfies second i-f amplifier stage gain test, paragraph 6-16. Output zero or below normal as determined by first i-f amplifier stage gain test, paragraph 6-15.</p>	<p>1. Defective i-f amplifier tube V501.</p> <p>2. Mechanical filter Z501 or Z502 defective.</p> <p>3. Resistor R504, R507, R508, or capacitor C505 open.</p> <p>4. Inductor L511 or capacitor C556 open or shorted.</p> <p>5. Resistor R506 shorted.</p>	<p>Replace V501.</p> <p>Replace defective mechanical filter.</p> <p>Replace defective detail part.</p> <p>Replace defective detail part.</p> <p>Replace resistor R506.</p>

TABLE XIV. 500-KC I-F AND BFO ASSEMBLY. TROUBLE ANALYSIS (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
<p>3. Assembly satisfies third i-f amplifier stage gain test, paragraph 6-17. Output zero or below normal as determined by second i-f amplifier stage gain test, paragraph 6-16.</p>	<ol style="list-style-type: none"> <li>1. Defective i-f amplifier tube V502 or V503.</li> <li>2. Tuned circuit Z503 defective.</li> <li>3. Resistor R510 or R511 open.</li> <li>4. Voltage dropping resistor R514 or R513 open</li> <li>5. Resistor R512 or capacitor C511 shorted.</li> <li>6. Capacitor C509 or C510 open.</li> <li>7. Connectors P501/J206 defective.</li> <li>8. Inductor L505 or L506 open.</li> </ol>	<p>Replace defective tube.</p> <p>Replace detail part or replace Z503 as a unit.</p> <p>Replace defective resistor.</p> <p>Replace defective resistor.</p> <p>Replace defective detail part.</p> <p>Replace defective capacitor.</p> <p>Replace or repair as necessary.</p> <p>Replace defective inductor or replace Z506 as a unit.</p>
<p>4. Output zero or below normal on third i-f amplifier stage gain test, paragraph 6-17. Trouble known to exist in the 500-ke i-f and bfo assembly</p>	<ol style="list-style-type: none"> <li>1. Defective i-f amplifier tube V504.</li> <li>2. Tuned circuit Z504 defective.</li> <li>3. Voltage dropping resistor R518 or R519 open.</li> <li>4. Capacitor C517 or C518 shorted.</li> <li>5. Detector tube V505 defective.</li> <li>6. Limiter and avc tube V506 defective.</li> <li>7. Detail part R520, R521, C522, or C527 defective.</li> <li>8. Capacitor C525 or C526 shorted.</li> <li>9. Resistor R525 or R527 open or resistor R526 shorted.</li> <li>10. Connectors P501/J206 defective.</li> <li>11. Inductor L509 or L510 open.</li> </ol>	<p>Replace V504.</p> <p>Replace detail part or replace Z504 as a unit.</p> <p>Replace defective resistor.</p> <p>Replace defective capacitor.</p> <p>Replace V505.</p> <p>Replace V506.</p> <p>Replace defective detail part.</p> <p>Replace defective capacitor.</p> <p>Replace defective resistor.</p> <p>Replace or repair as necessary.</p> <p>Replace defective inductor or replace Z506 as a unit.</p>

TABLE XIV. 500-KC I-F AND BFO ASSEMBLY. TROUBLE ANALYSIS (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
5. Blows fuses, trouble known to exist in the 500-kc i-f and bfo assembly.	<ol style="list-style-type: none"> <li>1. Capacitor C540, C546, C541, C547, C539, or C545 shorted.</li> <li>2. Capacitor C507, C512, or C518 shorted.</li> <li>3. Connectors P501/J206 defective.</li> <li>4. Filament capacitor C548, C549, or C550 shorted.</li> <li>5. Tube V501, V502, V503, V504, V505, V506, or V507 shorted.</li> <li>6. Bfo detail part C555, CR501, or R534 shorted.</li> </ol>	<p>Replace defective capacitor or replace Z506 as a unit.</p> <p>Replace defective capacitor.</p> <p>Replace or repair as necessary.</p> <p>Replace defective capacitor.</p> <p>Replace defective tube.</p> <p>Replace defective detail part.</p>
6. Output abnormally high and distorted as determined by stage gain tests, paragraphs 6-13 through 6-17.	<ol style="list-style-type: none"> <li>1. Limiter and avc tube V506 defective.</li> <li>2. Detail part R525, R526, R527, C525, or C526 defective, producing low avc voltage.</li> <li>3. Cathode biasing resistor R504, R510, or R517 shorted.</li> <li>4. Bypass capacitor C505, C509, C510, or C516 shorted.</li> <li>5. Connectors P501/J206 defective.</li> <li>6. Capacitor C536, C542, C537, or C543 shorted, allowing both second i-f amplifiers to operate simultaneously.</li> </ol>	<p>Replace V506.</p> <p>Replace defective detail part.</p> <p>Replace defective resistor.</p> <p>Replace defective capacitor.</p> <p>Replace or repair as necessary.</p> <p>Replace defective capacitor or replace Z506 as a unit.</p>
7. No beat note heard in CW and CW SHP positions of EMISSION switch. Trouble has been isolated to the 500-kc i-f and bfo assembly by symptom 3 of table XI, section V.	<ol style="list-style-type: none"> <li>1. Bfo tube V507 defective.</li> <li>2. Detail part within Z505 defective.</li> <li>3. Rectifier CR501 defective.</li> <li>4. Resistor R530 open.</li> <li>5. Resistor R533 or R532 open or capacitor C532 shorted.</li> <li>6. Inductor L508 open.</li> <li>7. Coupling capacitor C533 open.</li> <li>8. Connectors P501/J206 defective.</li> </ol>	<p>Replace V507.</p> <p>Replace defective detail part or replace Z505 as a unit.</p> <p>Replace rectifier CR501.</p> <p>Replace resistor R530.</p> <p>Replace defective detail part.</p> <p>Replace inductor L508 or replace Z506 as a unit.</p> <p>Replace capacitor C533.</p> <p>Replace or repair as necessary.</p>

6-34. AUDIO AMPLIFIER ASSEMBLY, TROUBLE ANALYSIS. The audio amplifier assembly should be removed from the R-648/ARR-41 chassis for the trouble isolation procedures given in table XV. The preparatory operations of paragraph 6-6 should be performed, allowing the assembly to be set up for testing and trouble shooting. The audio amplifier assembly performance tests, paragraphs 6-18 through

6-22, are referred to in table XV as an indication in which stage or group of stages the trouble exists. When the trouble has been isolated to a few detail parts. Multimeter AN/PSM-4 should be used to check inductors for continuity, resistors for the correct value, and capacitors for shorts, thereby determining the detail part at fault.

TABLE XV. AUDIO AMPLIFIER ASSEMBLY, TROUBLE ANALYSIS

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Assembly satisfies first audio amplifier stage gain test, paragraph 6-20. Trouble known to exist in audio amplifier assembly.	<ol style="list-style-type: none"> <li>1. Connectors P1301/J205 defective.</li> <li>2. Cabling from terminal 7 of P1301/J205 to pin 2 of V1301 open.</li> </ol>	<p>Replace or repair as necessary.</p> <p>Repair as necessary.</p>
2. Assembly satisfies second audio amplifier stage gain test, paragraph 6-21. Output zero or below normal as determined by first audio amplifier stage gain test, paragraph 6-20.	<ol style="list-style-type: none"> <li>1. One-half audio amplifier tube V1301 defective.</li> <li>2. Capacitor C1306 shorted.</li> <li>3. Resistor R1305, R1306, or R1301 open.</li> <li>4. Decoupling capacitor C1305 shorted.</li> <li>5. Coupling capacitor C1302 open.</li> <li>6. Connectors P1301/J205 defective.</li> </ol>	<p>Replace V1301.</p> <p>Replace capacitor C1306.</p> <p>Replace defective resistor.</p> <p>Replace capacitor C1305.</p> <p>Replace capacitor C1302.</p> <p>Replace or repair as necessary.</p>
3. Assembly satisfies third audio amplifier stage gain test, paragraph 6-22. Output zero or below normal as determined by second audio amplifier stage gain test, paragraph 6-21.	<ol style="list-style-type: none"> <li>1. One-half audio amplifier tube V1301 open.</li> <li>2. Coupling capacitor C1303 open.</li> <li>3. Resistor R1308 or R1309 open.</li> <li>4. Grid resistor R1307 open or shorted.</li> <li>5. Connectors P1301/J205 defective.</li> </ol>	<p>Replace V1301.</p> <p>Replace capacitor C1303.</p> <p>Replace defective resistor.</p> <p>Replace resistor R1307.</p> <p>Replace or repair as necessary.</p>
4. Output zero or below normal as determined by the third audio amplifier stage gain test, paragraph 6-22. Trouble known to exist in the audio amplifier assembly.	<ol style="list-style-type: none"> <li>1. Defective audio amplifier tube V1302.</li> <li>2. Audio output transformer T1301 open or shorted.</li> <li>3. Resistor R1309 or R1311 open.</li> </ol>	<p>Replace V1302.</p> <p>Replace transformer T1301.</p> <p>Replace defective resistor.</p>



TABLE XV. AUDIO AMPLIFIER ASSEMBLY, TROUBLE ANALYSIS (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
	<p>4. Resistor R1310 open or shorted.</p> <p>5. Connectors P1301/J205 defective.</p> <p>6. Connectors P1301/J205 defective.</p>	<p>Replace resistor R1310.</p> <p>Replace or repair as necessary.</p> <p>Replace or repair as necessary.</p>
<p>5. Output abnormally high and distorted as determined by stage gain tests, paragraphs 6-18 through 6-22.</p>	<p>1. Cathode bypass capacitor C1304 open.</p> <p>2. Cathode resistor R1308 or R1311 shorted.</p> <p>3. Feedback resistor R1312 open.</p>	<p>Replace capacitor C1304.</p> <p>Replace defective resistor.</p> <p>Replace resistor R1312.</p>
<p>6. Blows fuses, trouble known to exist in the audio amplifier assembly.</p>	<p>1. Connectors P1301/J205 defective.</p> <p>2. Tube V1301 or V1302 shorted.</p>	<p>Replace or repair as necessary.</p> <p>Replace defective tube.</p>

6-35. R-F OSCILLATOR ASSEMBLY, TROUBLE ANALYSIS. The r-f oscillator assembly is not removed during the trouble isolation procedures, table XVI, until the faulty detail part or group of detail parts has been determined. The trouble isolation procedures used in table XVI are based on the operational test given in this paragraph, as a means of isolating the trouble to a particular circuit. Upon finding the correct indication under the symptom column, the assembly should be removed and the indicated detail parts checked for faults. Multimeter AN/PSM-4 should be used to check inductors for continuity, resistors for the correct value, and capacitors for shorts after the trouble has been isolated to a few detail parts and

the r-f oscillator assembly has been removed. Perform the following operations before removing the r-f oscillator assembly.

- a. Connect Frequency Meter AN/USM-26 from test point 22 to ground. (See figure 5-3 for test point location.)
- b. Operate the BANDSWITCH to the various frequencies indicated in table VIII, section IV under the column R-648/ARR-41 FREQUENCY, MC.
- c. Observe frequency reading on Frequency Meter AN/USM-26 and compare with the frequencies listed under OSCILLATOR OUTPUT, MC of table VIII.
- d. Follow the steps listed in table XVI for an indication of faulty detail parts.

TABLE XVI. R-F OSCILLATOR ASSEMBLY, TROUBLE ANALYSIS

SYMPTOM	PROBABLE CAUSE	REMEDY
<p>1. No output on all BANDSWITCH positions.</p>	<p>1. R-f oscillator tube V601 defective.</p> <p>2. Switch wafer S601 or S602 defective.</p>	<p>Replace V601.</p> <p>Replace r-f oscillator assembly.</p>

TABLE XVI. R-F OSCILLATOR ASSEMBLY, TROUBLE ANALYSIS (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
	3. Transformer T601 defective. 4. Resistor R604, R605, or R606 open, thereby removing B-plus voltage. 5. Capacitor C607, C608, C609, or C629 shorted. 6. Feedback detail part L601 or C604 defective. 7. Detail part C602, C603, C601, R602, or R603 defective. 8. Connectors P601/J204 or P703/J601 defective.	Replace transformer T601. Replace defective resistor. Replace defective capacitor. Replace defective detail part. Replace defective detail part. Replace or repair as necessary.
2. Output zero on one position of BANDSWITCH. Correct output frequency on all other BANDSWITCH positions.	1. Trimmer capacitor defective. 2. Defective crystal. 3. Switch wafer S601 or S602 front defective. 4. Defective crystal padder.	Replace r-f oscillator assembly. Determine crystal in use by referring to table VIII under SELECTED CRYSTAL. MC. Replace defective crystal. Replace the r-f oscillator assembly. Replace the r-f oscillator assembly.
3. All output frequencies of 11 megacycles and above incorrect, all below correct. Also; all output frequencies below 11 megacycles incorrect, all above correct.	1. Switch wafer S602 rear defective. 2. Transformer T601 defective.	Replace the r-f oscillator assembly. Replace transformer T601.
4. Incorrect output frequencies on all positions of BANDSWITCH.	1. R-f oscillator switches improperly synchronized.	Resynchronize as per paragraph 6-49.
5. Blows fuses, trouble known to exist in the r-f oscillator assembly.	1. Decoupling capacitor C609 shorted. 2. Filament capacitor C637 shorted. 3. Tube V601 shorted. 4. Connectors P601/J204 defective.	Replace capacitor C609. Replace capacitor C637. Replace V601. Replace or repair as necessary.

6-36. SPECTRUM GENERATOR ASSEMBLY, TROUBLE ANALYSIS. The spectrum generator assembly should be removed from the R-648/ARR-41 chassis for the trouble isolation procedures given in table XVII. The preparatory operations of paragraph 6-6 should be performed, allowing the assembly to be set up for testing and trouble shooting. The trouble isolation procedures used in table XVII are based on the operational test given in this paragraph, as a means of isolating the trouble to a particular circuit. Multimeter AN/PSM-4 should be used to check inductors for continuity, resistors for the correct value, and capacitors for shorts after the

trouble has been isolated to a few detail parts. Perform the following operations:

- a. Turn the R-648/ARR-41 POWER switch to ON. EMISSION switch to CAL. Allow 15 minutes for warm up.
- b. Insert insulated lead of Frequency Meter AN/USM-26 inside the tube shield of V750, test point K. Ground the other lead of the AN/USM-26.
- c. Observe frequency of fundamental and twentieth harmonic. These should be 500 kilocycles and 10 megacycles respectively.
- d. Follow the steps listed in table XVII for an indication of the faulty detail parts.

TABLE XVII. SPECTRUM GENERATOR ASSEMBLY, TROUBLE ANALYSIS

SYMPTOM	PROBABLE CAUSE	REMEDY
<p>1. No output as indicated by Frequency Meter AN/USM-26.</p>	<ol style="list-style-type: none"> <li>1. Tube V750 defective.</li> <li>2. Crystal Y750 defective.</li> <li>3. Dropping resistor R752 or R753 open.</li> <li>4. Grid resistor R750 or R751 defective.</li> <li>5. Trimmer capacitor C750 defective.</li> <li>6. Feedback capacitor C753 open.</li> <li>7. Decoupling inductor L750 open.</li> <li>8. Connectors P750/J203 defective.</li> </ol>	<p>Replace V750.</p> <p>Replace crystal Y750.</p> <p>Replace defective resistor.</p> <p>Replace defective resistor.</p> <p>Replace capacitor C750.</p> <p>Replace capacitor C753.</p> <p>Replace inductor L750.</p> <p>Replace or repair as necessary.</p>
<p>2. Output frequency incorrect.</p>	<ol style="list-style-type: none"> <li>1. Crystal Y750 defective.</li> <li>2. Crystal control oven HR750 defective.</li> <li>3. Trimmer capacitor C750 misaligned.</li> <li>4. Detail part C753, C752, R750, or R751 defective.</li> </ol>	<p>Replace crystal Y750.</p> <p>Replace oven HR750.</p> <p>Observe twentieth harmonic frequency on Frequency Meter AN/USM-26. Adjust C750 for exactly 10 megacycles.</p> <p>Replace defective detail part.</p>
<p>3. Normal output, as indicated by Frequency Meter AN/USM-26. Trouble known to exist in the spectrum generator assembly.</p>	<ol style="list-style-type: none"> <li>1. Multivibrator divider tube V751 defective.</li> <li>2. Coupling capacitor C755 open.</li> </ol>	<p>Replace V751.</p> <p>Replace capacitor C755.</p>

TABLE XVII. SPECTRUM GENERATOR ASSEMBLY. TROUBLE ANALYSIS (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
	3. Resistor R756, R757, R758, or R759 defective. 4. Capacitor C756, C757, or C758 defective. 5. Connectors P750/J203 defective.	Replace defective resistor. Replace defective capacitor. Replace or repair as necessary.
4. Blows fuses, trouble known to exist in the spectrum generator assembly.	1. Decoupling capacitor C760 shorted. 2. Tube V750 or V751 shorted. 3. Filament capacitor C759 shorted. 4. Connectors P750/J203 defective.	Replace capacitor C760. Replace defective tube. Replace capacitor C759. Replace or repair as necessary.

6-37. DYNAMOTOR POWER SUPPLY ASSEMBLY. TROUBLE ANALYSIS. The trouble isolation procedures given in table XVIII are based on voltages at various terminals of connectors P901/J202. Multimeter AN/PSM-4 or VTVM TS-505/U should be used to measure the terminal voltages given in this paragraph and to check inductors for continuity, resistors for the correct value, and capacitors for shorts after the trouble has been isolated to a few detail parts. The following terminal voltages should be measured before removing the dynamotor power

supply assembly from the R-648/ARR-41 chassis.

- a. J202, terminal 3, 27.5 volts d-c.
- b. J202, terminal 7, 150 volts d-c.
- c. J202, terminal 4, 250 volts d-c.
- d. J202, terminal 8, 250 volts d-c.
- e. J202, terminal 1, 31 volts d-c.

After steps a through e have been completed, the preparatory operations of paragraph 6-6 should be performed, allowing the dynamotor power supply assembly to be removed from the R-648/ARR-41 chassis for trouble shooting the detail parts listed in table XVIII.

TABLE XVIII. DYNAMOTOR POWER SUPPLY ASSEMBLY. TROUBLE ANALYSIS

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Zero voltage at terminal 3 of J202. Trouble known to exist in the dynamotor power supply assembly.	1. Connectors P901/J202 defective.	Replace or repair as necessary.
2. Zero voltage at terminal 4 of J202. Normal input at terminal 3 of J202.	1. Dynamotor D901 defective. 2. Inductor L903, L904, L901, or L902 open. 3. Connectors P901/J202 defective.	Replace dynamotor D901. Replace defective inductor. Replace or repair as necessary.

TABLE XVIII. DYNAMOTOR POWER SUPPLY ASSEMBLY, TROUBLE ANALYSIS (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
3. Zero voltage at terminal 8 of J202. Normal output at terminal 4 of J202.	1. Resistor R905 open. 2. Connectors P901/J202 defective.	Replace resistor R905.  Replace or repair as necessary.
4. Zero voltage at terminal 7 of J202. Normal output at terminal 4 of J202.	1. Tube V901 shorted. 2. Resistor R904 open. 3. Connectors P901/J202 defective.	Replace V901.  Replace resistor R904.  Replace or repair as necessary.
5. Zero voltage at terminal 1 of J202. Normal output at terminal 4 of J202.	1. Resistor R904 open. 2. Resistor R901 shorted. 3. Connectors P901/J202 defective.	Replace resistor R904.  Replace resistor R901.  Replace or repair as necessary.
6. Voltage at terminal 7 of J202 higher than 150 volts d-c.	1. Tube V901 defective.	Replace V901.
7. Excessive ripple voltage at all output terminals.	1. Inductor L901, L902, L903, or L904 defective.  2. Capacitor C901, C902, C903, C904, C908, or C909 defective.	Replace defective inductor.  Replace defective capacitor.
8. Fluctuating voltage at all output terminals.	1. Low- or high-voltage brushes excessively worn or pitted.	Replace defective brushes.
9. Dynamotor D901 fails to start.	1. Low- or high-voltage brushes excessively worn or pitted.  2. Poor commutation due to dirty, oily, or rough commutator or high mica.  3. Worn bearings causing armature to strike pole faces or connections.  4. Connectors P901/J202 defective.	Replace defective brushes.  Replace dynamotor D901.  Replace dynamotor D901.  Replace or repair as necessary.
10. Excessive arcing at dynamotor D901 brushes.	1. Poor commutation due to dirty, oily, or rough commutator or high mica.  2. Low- or high-voltage brushes excessively worn or pitted.	Replace dynamotor D901.  Replace defective brushes.

TABLE XVIII. DYNAMOTOR POWER SUPPLY ASSEMBLY. TROUBLE ANALYSIS (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
	3. Commutator shorted. 4. Brush spring weak or defective.	Replace dynamotor D901. Replace brush spring or dynamotor D901.
11. Blows fuses. trouble known to exist in the dynamotor power supply assembly.	1. Filter capacitor C901, C902, C903, C904, C905, C908, or C909 shorted. 2. Short within dynamotor D901. 3. Tube V901 shorted. 4. Connectors P901/J202 defective.	Replace defective capacitor. Replace dynamotor D901. Replace V901. Replace or repair as necessary.

**6-38. REMOVAL AND REPLACEMENT.**

6-39. GENERAL. The procedures listed in paragraphs 6-40 through 6-42 pertain to the removal and replacement of subassemblies and tuned circuits. The assembly removal and replacement procedures are described in section V, paragraphs 5-24 through 5-31.

6-40. R-F AMPLIFIER SUBASSEMBLY REMOVAL AND REPLACEMENT. The following steps describe the procedure to be followed for removing the r-f amplifier subassembly from the r-f and i-f tuner assembly. This procedure should be reversed for replacement. Instructions for removing the r-f and i-f tuner assembly are given in paragraph 5-26.

- a. Disengage plug P703 from r-f oscillator assembly jack J601.
- b. Loosen the two green-headed captive screws evenly. These screws are located at the left-hand front and rear of the r-f amplifier subassembly.
- c. Pull the r-f amplifier subassembly straight up, with a rocking motion, to disengage plug P702 from jack J402.

6-41. VARIABLE FREQUENCY OSCILLATOR-CONVERTER SUBASSEMBLY REMOVAL. The following steps describe the procedure to be followed for removing the variable frequency oscillator-converter subassembly from the r-f and i-f tuner assembly. Instructions for removing the r-f and i-f tuner assembly are given in paragraph 5-26. Refer to figures 6-12 and 6-13 for the location of gears referred to in steps a through i.

a. With the r-f and i-f tuner assembly installed in the R-648/ARR-41 chassis, observe coupler O444 with the BANDSWITCH and TUNING controls set for a frequency indication of 0.19 megacycle. Observe the positions of the two setscrews of O444 noticing that one is unobtainable with the TUNING control set for 0.19 megacycle, even if the r-f and i-f tuner assembly were removed.

b. Rotate the TUNING control until this unobtainable setscrew is in a convenient position to loosen. Use the number 10 Bristo wrench supplied with Radio Receiving Set AN/ARR-41 to loosen this setscrew.

c. Reset the TUNING control to exactly 0.19 megacycle and remove the r-f and i-f tuner assembly from the R-648/ARR-41 chassis as per instructions given in paragraph 5-26.

d. Disengage plug P15001 from jack J401.

e. Remove the two green-headed captive screws securing the variable frequency oscillator-converter subassembly to the r-f and i-f tuner assembly rear plate.

f. Remove the two flathead screws securing the bottom of the variable frequency oscillator-converter subassembly to the r-f and i-f tuner assembly middle plate.

g. Loosen the other setscrew of coupler O444.

h. The variable frequency oscillator-converter subassembly may now be pulled straight back from the r-f and i-f tuner assembly, disengaging 19-tooth pinion gear O456 from the variable frequency oscillator-converter shaft.

i. Coupler O429 and O444 and 19-tooth pinion gear O456 will pull away from coupling O428 after the variable frequency oscillator-converter subassembly has been removed.

NOTE

Care must be taken to avoid moving any of the r-f and i-f tuner assembly gears while the variable frequency oscillator-converter is removed. When the variable frequency oscillator-converter subassembly is replaced, the r-f and i-f tuner assembly gears should be in exactly the same position as when removed.

**6-42. VARIABLE FREQUENCY OSCILLATOR-CONVERTER SUBASSEMBLY REPLACEMENT.** The following steps describe the procedure to be followed for replacing the variable frequency oscillator-converter subassembly within the r-f and i-f tuner assembly. Refer to figures 6-12 and 6-13 for the location of gears and couplers referred to in steps a through g.

NOTE

When the shaft of the variable frequency oscillator-converter subassembly has been turned, or when a new subassembly is to be replaced, the frequency should be set as follows before installing in the r-f and i-f tuner assembly: With plug P15001 mated to jack J401 and the MEGACYCLES frequency indicator set to 0.19 megacycle, insert the insulated lead of Frequency Meter AN/USM-26 into V15001 tube shield. Adjust oscillator shaft for a reading of exactly 2.69 megacycles on Frequency Meter AN/USM-26.

- a. Slip 19-tooth pinion gear O456 into coupler O444. Make certain the grooves of 19-tooth pinion gear O456 are in such a position that the setscrews of coupler O444 will not strike them when tightened.
- b. Set the variable frequency oscillator-converter subassembly in the correct position and slip 19-tooth pinion gear O456 onto the shaft.
- c. Place coupler O429 into position between couplers O444 and O428 and push the variable frequency oscillator-converter subassembly forward, toward the r-f and i-f tuner assembly middle plate.
- d. Tighten setscrews of coupler O444.
- e. Fasten the variable frequency oscillator-converter subassembly to the middle plate by means of one of the flathead screws. Place the flathead screw in the lower left-hand screw hole, as viewed from the front of the r-f and i-f tuner assembly, but do not tighten completely.
- f. Using the flathead screw as a pivot axis, rock the variable frequency oscillator-converter subassembly so that 19-tooth pinion gear O456 meshes with the large gear (O455) with minimum detectable backlash.
- g. Replace and tighten all screws and engage plug P15001 in jack J401.

**6-43. R-F AND I-F TUNER ASSEMBLY TUNED CIRCUITS, REMOVAL AND REPLACEMENT.** The following steps describe the procedure to be followed for removing tuned circuits from the r-f and i-f tuner assembly. This procedure should be reversed for replacement.

- a. Unsolder the connections to the tuned circuit to be removed and identify leads for later replacement.
- b. Remove two Phillips head screws securing slugs. If a low-band tuned circuit is to be replaced, all slugs must be removed, requiring six Phillips head screws to be removed.
- c. Remove slug and identify position so it may be replaced in the identical position. If a new slug and tuned circuit is to be replaced, the alignment procedure, paragraphs 6-59 through 6-64, should be performed.
- d. Remove two Phillips head screws (six for low band) securing shield can.
- e. Remove shield can from tuned circuit being removed. If a low-band tuned circuit is being removed, the lid of the shield can must be removed.
- f. Remove one Phillips head screw located in the hole from which the slug was removed. If a band 4 tuned circuit (Z416, Z417, Z418, or Z419) is being removed, two Phillips head screws, located on opposite sides of the tuned circuit, must be removed.
- g. The tuned circuit now may be lifted out.

**6-44. ALIGNMENT PROCEDURE.**

**6-45. GENERAL.** The following paragraphs contain all procedural steps necessary to completely align all assemblies and subassemblies of Radio Receiving Set AN/ARR-41. In general, servicing will involve the realignment of one assembly; therefore, each assembly is considered separately in the following procedure. When alignment or tracking of an assembly has been completed, the unit should be subjected to the applicable detailed performance test, outlined in paragraphs 6-7 through 6-22. Refer to figures 5-2 and 5-3 for the location of test points used in subsequent paragraphs.

NOTE

During all alignment procedures, Radio Receiver R-648/ARR-41 should be allowed at least 15 minutes for warmup time.

**6-46. SYNCHRONIZATION OF R-F AND VARIABLE I-F SWITCHES.**

**6-47. SYNCHRONIZATION OF R-F SWITCH, S401.**

- a. Remove the r-f and i-f tuner assembly from the R-648/ARR-41 chassis. Refer to paragraph 5-26 for the removal procedure. Make certain the frequency is set to 0.19 megacycle before removal.
- b. Invert the r-f and i-f tuner assembly and observe the switch shaft coupler. Refer to figures 6-12 and 6-13, detail part O438.

- c. Loosen the four setscrews nearest the r-f and i-f assembly middle plate, allowing the r-f switch shaft to be rotated manually.
- d. With the r-f and i-f tuner assembly inverted, view the first r-f switch wafer (S401A) from the front.
- e. Counting clockwise from the side nearest the r-f and i-f tuner assembly chassis, and starting with the tab just right of center, rotate the r-f switch shaft until the two wipers are in positions 2 and 7. The switch wafer positions which do not have contacts should be counted also.
- f. Tighten the two setscrews previously loosened.

#### 6-48. SYNCHRONIZATION OF VARIABLE I-F SWITCH, S402.

- a. Remove the r-f and i-f tuner assembly from the R-648/ARR-41 chassis. Refer to paragraph 5-26 for the removal procedure. Make certain the frequency is set to 0.19 megacycle before removal.
- b. Loosen the setscrews of gear O436. Gear O436 is located at the rear of the r-f and i-f tuner assembly chassis, mounted on the variable i-f switch shaft.

#### NOTE

During synchronization of the variable i-f switch shaft, care should be exercised to avoid changing the position of gear O436, which meshes with gear O437 of the r-f oscillator assembly. If either of these gears are accidentally moved, the r-f oscillator switches should be resynchronized in accordance with instructions given in paragraph 6-49.

- c. Invert the r-f and i-f tuner assembly and observe gear O435 which connects to the variable i-f switch shaft.
- d. Loosen the setscrew of gear O435, allowing the variable i-f switch shaft to be rotated manually.
- e. With the r-f and i-f tuner assembly inverted, view the first variable i-f switch wafer (S402A) from the front.
- f. Counting clockwise from the side nearest the r-f and i-f tuner assembly chassis, and starting with the tab just right of the center, rotate the variable i-f switch shaft until one of the wipers is in position 3. The switch wafer positions which do not have contacts should be counted also.
- g. Tighten the setscrew previously loosened.

6-49. SYNCHRONIZATION OF R-F OSCILLATOR SWITCHES, S601 AND S602. The following steps describe a method of testing and synchronizing r-f oscillators for switches S601 and S602. It is not necessary to remove the r-f oscillator assembly from the R-648/ARR-41 chassis for any of the switch synchronization procedures.

- a. Set the POWER switch to ON, TUNING control to zero, and the BANDSWITCH to position 1 (190 to 550

kilocycles). Set the EMISSION switch to either the VOICE, VOICE SHP, CW, or CW SHP position. All other control settings are optional.

- b. Connect the input leads of Frequency Meter AN/USM-26 between test point 22 and ground. Refer to figure 5-3 for test point location.

c. Frequency Meter AN/USM-26 should read 3 megacycles. Rotate the BANDSWITCH to each position and observe the reading of Frequency Meter AN/USM-26. Compare with the frequencies listed in table IX, section IV, under R-F OSC FREQUENCY, MC.

- d. If any of the r-f oscillator frequencies prove to be off, leave the BANDSWITCH set at that position and proceed to step e.

e. Loosen the two setscrews of coupler O603. Coupler O603 is located directly against the r-f oscillator assembly front plate, and between the r-f oscillator assembly and the r-f and i-f tuner assembly.

- f. Refer to table IX, section IV. Note the listing under BANDSWITCH POSITION which corresponds to the incorrect r-f oscillator output frequency as determined in step c.

g. Rotate the BANDSWITCH to the position determined in step f.

h. The reading of Frequency Meter AN/USM-26 should now correspond with the setting of the BANDSWITCH, as determined by table IX. Tighten the setscrew previously loosened.

i. Rotate the BANDSWITCH slowly around the position synchronized in steps g and h to determine if the switch tab is correctly centered on the wiper. It may be necessary to repeat steps g and h to center properly the r-f oscillator switches.

j. Repeat the synchronization test, steps a through c, for each BANDSWITCH position. This synchronization should be performed for both directions of rotation of the BANDSWITCH, that is, with the R-648/ARR-41 frequency being both increased and decreased. If any of the r-f oscillator frequencies are still off, repeat steps d through i.

#### 6-50. ALIGNMENT OF 500-KC I-F AND BFO ASSEMBLY.

#### NOTE

Throughout the alignment procedures, paragraphs 6-51 through 6-64, Output Meter TS-585B/U or a 300-ohm noninductive resistor should be connected to the AUDIO OUTPUT jack to afford proper loading.

#### 6-51. ADJUSTMENT OF 500-KC I-F TUNED CIRCUITS.

a. Operate the POWER switch to ON, the EMISSION switch to VOICE, and the GAIN and SENS ADJ. to maximum. The frequency of Radio Receiver R-648/ARR-41 is optional.

- b. Connect VTVM TS-505/U from test point 5 to ground. Adjust to read a negative voltage of 1 volt d-c.



c. Connect Signal Generator AN/URM-25 from test point 4 to ground. Adjust AN/URM-25 frequency to 500 kilocycles with Frequency Meter AN/USM-26 and level to that required for a reading of negative 1 volt d-c on VTVM TS-505/U.

d. Adjust trimmer capacitor C521, located in the alignment hole of Z504, for maximum avc voltage. As resonance is approached, reduce output level of Signal Generator AN/URM-25 to maintain avc level at negative 1 volt d-c or less, as read on VTVM TS-505/U.

e. Adjust trimmer capacitor C502, located in the alignment hole of Z503, for maximum avc voltage. Maintain AN/URM-25 level for a reading of negative 1 volt or less on VTVM TS-505/U.

f. Adjust trimmer capacitor C556, located on the side of the 500-kc i-f and bfo assembly chassis, for maximum avc voltage. Maintain AN/URM-25 level for a reading of negative 1 volt or less on VTVM TS-505/U.

g. Repeat steps d through f until no further peaking of VTVM TS-505/U can be achieved.

#### 6-52. ADJUSTMENT OF BEAT FREQUENCY OSCILLATOR.

a. Operate the POWER switch to ON, the EMISSION switch to CW, the GAIN SENS ADJ. to maximum, and the VFO control to the center of its range. R-648/ARR-41 frequency is optional.

b. Connect Signal Generator AN/URM-25 from test point 4 to ground. Adjust frequency to 500 kilocycles with Frequency Meter AN/USM-26.

c. Connect Headset H-1/AR or H-4/AR to PHONES jack J303.

d. Adjust output level of Signal Generator AN/URM-25 for a comfortable headset level.

e. Adjust inductor L504, located in the alignment hole of Z505, for zero beat heard in the headset.

#### 6-53. ALIGNMENT OF R-F OSCILLATOR ASSEMBLY.

#### 6-54. ADJUSTMENT OF R-F OSCILLATOR OUTPUT TRANSFORMER.



Do not change the setting of capacitor C602. This capacitor is preset at the factory and needs no further adjustment.

a. Operate the POWER switch to ON, the BANDSWITCH to band 1 (190 to 550 kilocycles), and the EMISSION switch to either CW SHP, CW, VOICE SHP, or VOICE. Settings of all other controls are optional.

b. Set VTVM TS-505/U to the 12-volt a-c range and connect from test point 22 to ground.

c. Adjust the slug of T601 for maximum indication on VTVM TS-505/U.

#### 6-55. ADJUSTMENT OF R-F OSCILLATOR TRIMMER CAPACITORS.

a. Same as step a, paragraph 6-54.

b. Same as step b, paragraph 6-54.

c. Refer to table VIII, section IV. Rotate the BANDSWITCH control to each setting, listed under BANDSWITCH POSITION (MC COUNTER READING).

d. For each BANDSWITCH position, adjust the listed trimmer capacitor for a peak reading on VTVM TS-505/U. For example; for a reading of 9 megacycles on megacycle counter, adjust capacitor C615.

#### 6-56. ALIGNMENT OF SPECTRUM GENERATOR ASSEMBLY.

#### 6-57. ADJUSTMENT OF SPECTRUM GENERATOR OSCILLATOR.

a. Operate the POWER switch to ON and the EMISSION switch to CAL. All other control settings are optional.

b. Insert the insulated lead of Frequency Meter AN/USM-26 inside the shield of V750. Connect the other AN/USM-26 lead to ground.

c. Adjust trimmer capacitor C750 for a reading of 500 kilocycles on Frequency Meter AN/USM-26. Capacitor C750 is obtainable from the top of the spectrum generator assembly.

d. Adjust Frequency Meter AN/USM-26 to read 10 megacycles, which is the 20th harmonic of 500 kilocycles.

e. Adjust trimmer capacitor C750 for a reading of exactly 10 megacycles on Frequency Meter AN/USM-26.

f. Repeat steps d and e for the 40th harmonic (20 megacycles).

#### 6-58. ADJUSTMENT OF MULTIVIBRATOR DIVIDER.

a. Operate the POWER switch to ON, the EMISSION switch to CAL, and the BANDSWITCH and TUNING controls for a frequency of 0.2 megacycle. All other control settings are optional.

b. Connect Headset H-1/AR or H-4/AR to PHONES jack J303 on the front panel and adjust the GAIN control for a comfortable level.

c. Rotate trimmer capacitor C755 in both directions and notice when the note heard in the headset becomes erratic. By close approximation, set trimmer capacitor C755 midway between these two points. Trimmer capacitor C755 is located at the bottom of the spectrum generator assembly and is obtainable by inverting the R-648/ARR-41.

d. Check several other 100-kilocycle multiple frequencies by operating the TUNING control. Listen for the spectrum generator beat note at such frequencies as 0.3, 0.4, and 0.5 megacycle. Notice the spacing between the 100-kilocycle check points by observing the MEGACYCLES frequency indicator movement. Spacing should be exactly 0.1 megacycle. If not, the multivibrator divider (V751) may be dividing by 4 or 6, necessitating a readjustment of trimmer capacitor C755, as per step c.

## 6-59. ALIGNMENT OF R-F AND I-F TUNER ASSEMBLY.

## NOTE

The procedures of paragraphs 6-60 through 6-64 assume that the r-f and i-f tuner assembly is completely misaligned. In most cases, this will not be so, and it is permissible to perform only the procedures given in paragraphs 6-60 and 6-64, excluding paragraphs 6-61 through 6-63.

## 6-60. ADJUSTMENT OF VARIABLE FREQUENCY OSCILLATOR-CONVERTER OUTPUT.

a. Operate the POWER switch to ON, EMISSION switch to VOICE, and the GAIN and SENS ADJ. controls to maximum. All other control settings are optional.

b. Connect VTVM TS-505/U from test point 5 to ground. Adjust to read a negative voltage of 1 volt d-c.

c. Connect Signal Generator AN/URM-25 from test point 4 to ground. Adjust AN/URM-25 frequency to 500 kilocycles with Frequency Meter AN/USM-26 and level to that required for a reading of negative 1 volt on VTVM TS-505/U.

d. Adjust inductor of Z15001 for a peak reading on VTVM TS-505/U. As resonance is approached, reduce output level of Signal Generator AN/URM-25 to maintain the avc level at negative 1 volt or less, as read on VTVM TS-505/U.

## NOTE

In paragraphs 6-61 through 6-64, instructions are given to set the frequency of Radio Receiver R-648/ARR-41 to various points. Since it is important that these frequency points be set up accurately, it is advisable that the built-in calibrator (spectrum generator) be employed whenever the R-648/ARR-41 frequency is altered. Example; to calibrate for 2.999 megacycles, proceed as follows: Operate the EMISSION switch to CAL and the R-648/ARR-41 frequency to 2.900 megacycles (the nearest 100-kilocycle check point employing the same tuned circuits as 2.999 megacycles). Operate the TUNING control for zero beat of the calibration signal and observe the MEGACYCLES frequency indicator. If reading is not exactly 2.900 megacycles, depress and rotate the DIAL ZERO control to correct the reading. Reference is made to table XIX, which lists the nearest 100-kilocycle check point to be used when the R-648/ARR-41 is operated to any alignment frequency referred to in paragraphs 6-61 through 6-64.

TABLE XIX. 100-KILOCYCLE CHECK POINTS FOR ALIGNMENT OF R-F AND I-F TUNER ASSEMBLY

R-648/ARR-41 FREQUENCY MEGACYCLES	NEAREST 100- KILOCYCLE CHECK POINT. MEGACYCLES
0.190	0.200
0.550	0.500
2.000	2.000
2.999	2.900
3.000	3.000
3.999	3.900
4.000	4.000
7.999	7.900
8.000	8.000
15.999	15.900
16.000	16.000
24.999	24.900

## NOTE

A good starting point, when a complete re-alignment of the r-f and i-f tuner assembly is required, is to set the screwdriver slots of trimmer capacitors C451, C457, C464, and C471 parallel to the sides of the r-f and i-f tuner assembly (parallel with the r-f amplifier and variable frequency oscillator-converter subassemblies). Set the screwdriver slots of all other trimmer capacitors parallel to the front and rear plates of the r-f and i-f tuner assembly. The settings of all variable inductors should remain as they are until adjusted in accordance with the procedures of paragraphs 6-61 through 6-64.

## 6-61. ADJUSTMENT OF VARIABLE I-F TUNED CIRCUITS. Refer to figure 6-12.

a. Operate the POWER switch to ON, the EMISSION switch to VOICE, the GAIN and SENS ADJ. to maximum, and the BANDSWITCH to 2 megacycles. The TUNING control should be set to zero. Calibrate the R-648/ARR-41 at 2 megacycles.

b. Connect VTVM TS-505/U from test point 5 to ground. Adjust TS-505/U to read a negative voltage of 1 volt d-c.

c. Adjust Signal Generator AN/URM-25 to exactly 2 megacycles with Frequency Meter AN/USM-26 and connect AN/URM-25 to the ANTENNA connector, test point 1.

d. Maintain level of Signal Generator AN/URM-25 for a reading of negative 1 volt d-c on VTVM TS-505/U during all succeeding steps.

## Paragraphs 6-62 to 6-63

- e. Adjust L419, L421, L424, and L426 for a peak reading on VTVM TS-505/U.
- f. Adjust Signal Generator AN/URM-25 frequency to exactly 2.999 megacycles with Frequency Meter AN/USM-26. Set TUNING control to 2.999 megacycles and calibrate.
- g. Adjust C449, C455, C462, and C475 for a peak reading on VTVM TS-505/U.
- h. Repeat steps c through g until no further adjustment is necessary to peak VTVM TS-505/U.
- i. Set the BANDSWITCH to 3 megacycles and the TUNING control to zero and calibrate. Adjust Signal Generator AN/URM-25 frequency to exactly 3 megacycles with Frequency Meter AN/USM-26.
- j. Adjust L420, L422, L425, and L427 for a peak reading on VTVM TS-505/U.
- k. Adjust Signal Generator AN/URM-25 frequency to exactly 3.999 megacycles with Frequency Meter AN/USM-26. Set TUNING control to 3.999 megacycles and calibrate.
- l. Adjust C451, C457, C464, and C471 for a peak reading on VTVM TS-505/U.
- m. Repeat steps i through l until no further adjustment is necessary to peak VTVM TS-505/U.

#### 6-62. ADJUSTMENT OF LOW-FREQUENCY POINTS OF R-F TUNED CIRCUITS. Refer to figure 6-12.

- a. Operate the POWER switch to ON, the EMISSION switch to VOICE, the GAIN and SENS ADJ. to maximum, and the BANDSWITCH and TUNING controls to positions indicated in succeeding steps.
- b. Connect VTVM TS-505/U from test point 5 to ground. Adjust TS-505/U to read a negative voltage of 1 volt d-c.
- c. Connect Signal Generator AN/URM-25 from test point A to ground. Maintain output level of AN/URM-25 so that reading of VTVM TS-505/U never exceeds negative 1 volt d-c throughout all succeeding steps.
- d. Set Signal Generator AN/URM-25 frequency to 190 kilocycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 190 kilocycles and calibrate. Adjust inductor L405 for a peak indication on VTVM TS-505/U.
- e. Set Signal Generator AN/URM-25 frequency to 4 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 4 megacycles and calibrate. Adjust inductor L410 for a peak indication on VTVM TS-505/U.
- f. Set Signal Generator AN/URM-25 frequency to 8 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 8 megacycles and calibrate. Adjust inductor L414 for a peak indication on VTVM TS-505/U.
- g. Set Signal Generator AN/URM-25 frequency to 16 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 16 megacycles and calibrate. Adjust inductor L418 for a peak indication on VTVM TS-505/U.
- h. Connect Signal Generator AN/URM-25 from test point 15 to ground.
- i. Set Signal Generator AN/URM-25 frequency to 190 kilocycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 190

kilocycles and calibrate. Adjust inductor L403 for a peak indication on VTVM TS-505/U.

- j. Set Signal Generator AN/URM-25 frequency to 4 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 4 megacycles and calibrate. Adjust inductors L408 and L409 for a peak indication on VTVM TS-505/U.
  - k. Set Signal Generator AN/URM-25 frequency to 8 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 8 megacycles and calibrate. Adjust inductors L412 and L413 for a peak indication on VTVM TS-505/U.
  - l. Set Signal Generator AN/URM-25 frequency to 16 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 16 megacycles and calibrate. Adjust inductors L416 and L417 for a peak indication on VTVM TS-505/U.
  - m. Connect Signal Generator AN/URM-25 to ANTENNA connector J302, test point 1.
  - n. Set Signal Generator AN/URM-25 frequency to 190 kilocycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 190 kilocycles and calibrate. Adjust inductor L401 for a peak indication on VTVM TS-505/U.
  - o. Set Signal Generator AN/URM-25 frequency to 4 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 4 megacycles and calibrate. Adjust inductor L407 for a peak indication on VTVM TS-505/U.
  - p. Set Signal Generator AN/URM-25 frequency to 8 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 8 megacycles and calibrate. Adjust inductor L411 for a peak indication on VTVM TS-505/U.
  - q. Set Signal Generator AN/URM-25 frequency to 16 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 16 megacycles and calibrate. Adjust inductor L415 for a peak indication on VTVM TS-505/U.
- #### 6-63. ADJUSTMENT OF HIGH-FREQUENCY POINTS OF R-F TUNED CIRCUITS. Refer to figure 6-12.
- a. Operate the POWER switch to ON, the EMISSION switch to VOICE, the GAIN and SENS ADJ. to maximum, and the BANDSWITCH and TUNING controls to positions indicated in succeeding steps.
  - b. Connect VTVM TS-505/U from test point 5 to ground. Adjust TS-505/U to read a negative voltage of 1 volt d-c.
  - c. Connect Signal Generator AN/URM-25 to ANTENNA connector J302, test point 1. Maintain output level of AN/URM-25 so that reading of VTVM TS-505/U never exceeds negative 1 volt d-c throughout all succeeding steps.
  - d. Set Signal Generator AN/URM-25 frequency to 550 kilocycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 550 kilocycles and calibrate. Adjust inductors L402, L404, and L406 for a peak indication on VTVM TS-505/U.
  - e. Set Signal Generator AN/URM-25 frequency to 7.999 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 7.999 megacycles and calibrate. Adjust capacitors C409,

C414, and C418 for a peak indication on VTVM TS-505/U.

f. Set Signal Generator AN/URM-25 frequency to 15.999 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 15.999 megacycles and calibrate. Adjust capacitors C423, C425, C428, and C432 for a peak indication on VTVM TS-505/U.

g. Set Signal Generator AN/URM-25 frequency to 24.999 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 24.999 megacycles and calibrate. Adjust capacitors C437, C439, C442, and C446 for a peak indication on VTVM TS-505/U.

#### 6-64. TRIM ADJUSTMENTS OF R-F TUNED CIRCUITS. Refer to figure 6-12.

a. Operate the POWER switch to ON, the EMISSION switch to VOICE, the GAIN and SENS ADJ. to maximum, and the BANDSWITCH and TUNING controls to positions indicated in succeeding steps.

b. Connect VTVM TS-505/U from test point 5 to ground. Adjust TS-505/U to read a negative voltage of 1 volt d-c.

c. Connect Signal Generator AN/URM-25 to ANTENNA connector J302, test point 1. Maintain output level of AN/URM-25 so that reading of VTVM TS-505/U never exceeds negative 1 volt d-c throughout all succeeding steps.

d. Set Signal Generator AN/URM-25 frequency to 190 kilocycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 190 kilocycles and calibrate. Adjust inductors L401, L403, and L405 for a peak indication on VTVM TS-505/U.

e. Set Signal Generator AN/URM-25 frequency to 550 kilocycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 550 kilocycles and calibrate. Adjust inductors L402, L404 and L406 for a peak indication on VTVM TS-505/U.

f. Repeat steps d and e until no further adjustment is necessary to peak VTVM TS-505/U.

g. Set Signal Generator AN/URM-25 frequency to 4 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 4 megacycles and calibrate. Adjust inductors L407, L408, L409 and L410 for a peak indication on VTVM TS-505/U.

h. Set Signal Generator AN/URM-25 frequency to 7.999 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 7.999

megacycles and calibrate. Adjust capacitors C409, C411, C414, and C418 for a peak indication on VTVM TS-505/U.

i. Repeat steps g and h until no further adjustment is necessary to peak VTVM TS-505/U.

j. Set Signal Generator AN/URM-25 frequency to 8 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 8 megacycles and calibrate. Adjust inductors L411, L412, L413, and L414 for a peak indication on VTVM TS-505/U.

k. Set Signal Generator AN/URM-25 frequency to 15.999 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 15.999 megacycles and calibrate. Adjust capacitors C423, C425, C428, and C432 for a peak indication on VTVM TS-505/U.

l. Repeat steps j and k until no further adjustment is necessary to peak VTVM TS-505/U.

m. Set Signal Generator AN/URM-25 frequency to 16 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 16 megacycles and calibrate. Adjust inductors L415, L416, L417, and L418 for a peak indication on VTVM TS-505/U.

n. Set Signal Generator AN/URM-25 frequency to 24.999 megacycles with Frequency Meter AN/USM-26. Set the BANDSWITCH and TUNING controls to 24.999 megacycles and calibrate. Adjust capacitors C437, C439, C442, and C446 for a peak indication on VTVM TS-505/U.

o. Repeat steps m and n until no further adjustment is necessary to peak VTVM TS-505/U.

#### 6-65. ADJUSTMENT OF AUDIO GAIN, R201.

a. Operate the POWER switch to ON, the EMISSION switch to VOICE, and the GAIN and SENS ADJ. to maximum. Set Radio Receiver R-648/ARR-41 to 4.0 megacycles.

b. Connect Signal Generator AN/URM-25 to J302, test point 1. Connect Output Meter TS-585B/U to J303, test point 3.

c. Adjust the r-f output of the Signal Generator AN/URM-25 to 4.0 megacycles 1000 microvolts 30% modulated at 1000 cps. Use Frequency Meter AN/USM-26 to accurately adjust the frequency of Signal Generator AN/URM-25 to 4 megacycles.

d. Allow the equipment to warm up for five minutes.

e. Adjust potentiometer R201 to produce an output of 500 milliwatts -10 +20%.

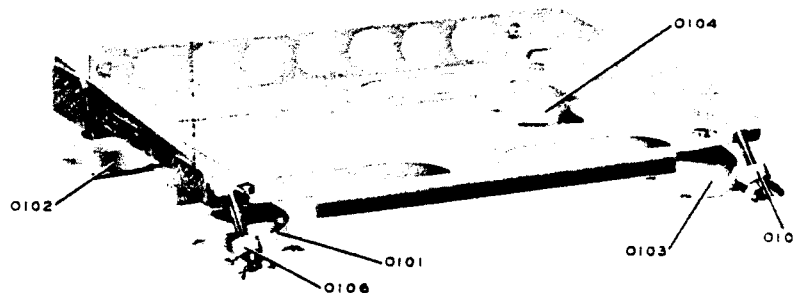


Figure 6-7. Mounting MT-1518/ARR-41. Top Oblique View

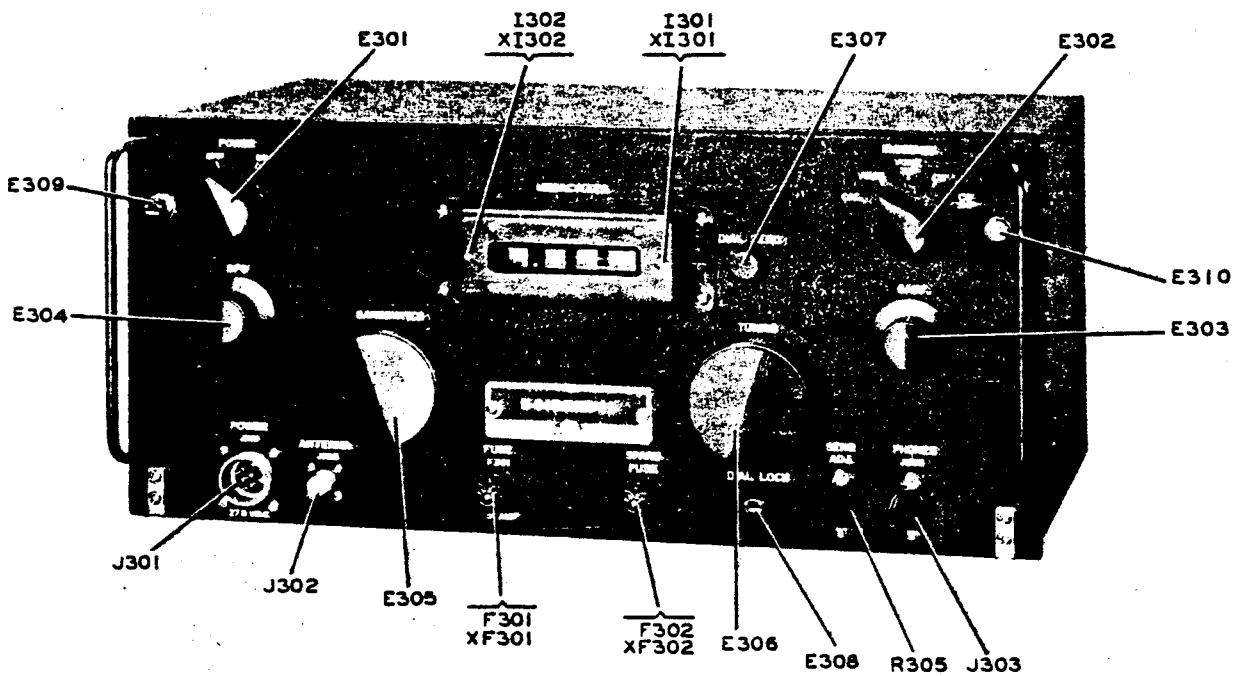


Figure 6-8. Radio Receiver R-648/ARR-41, Front Panel, Front View

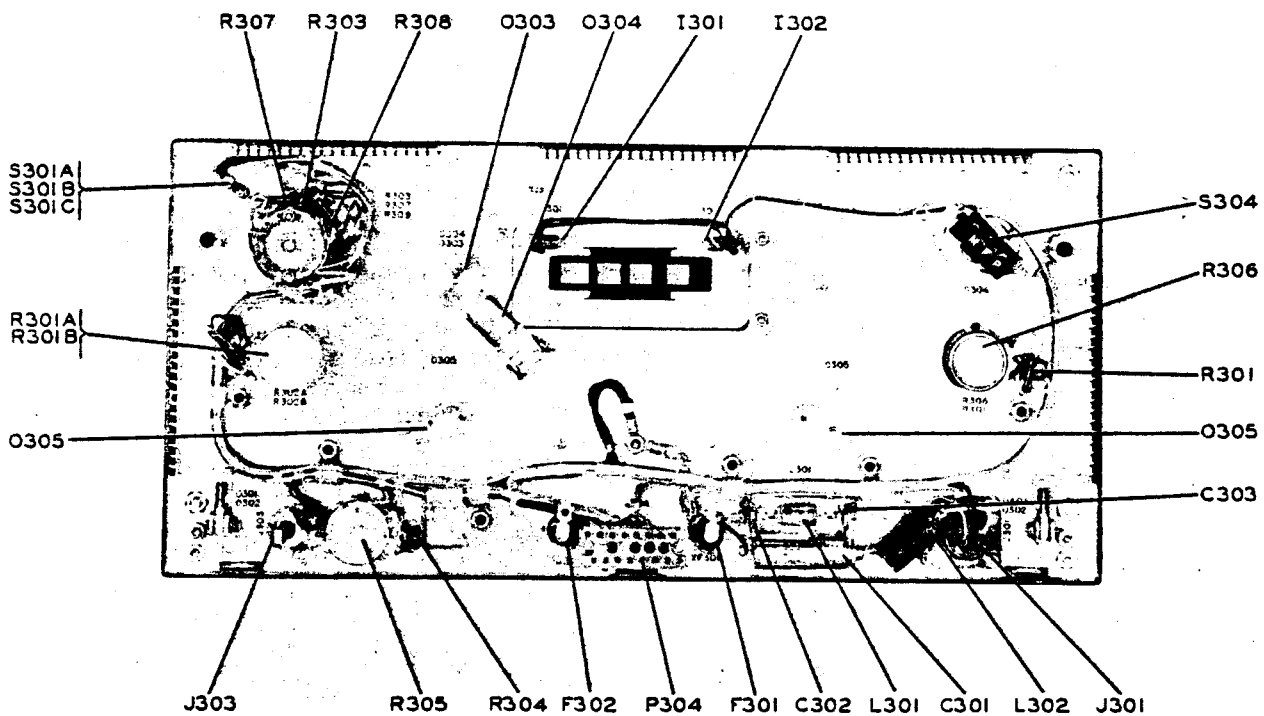


Figure 6-9. Radio Receiver R-648/ARR-41, Front Panel, Rear View

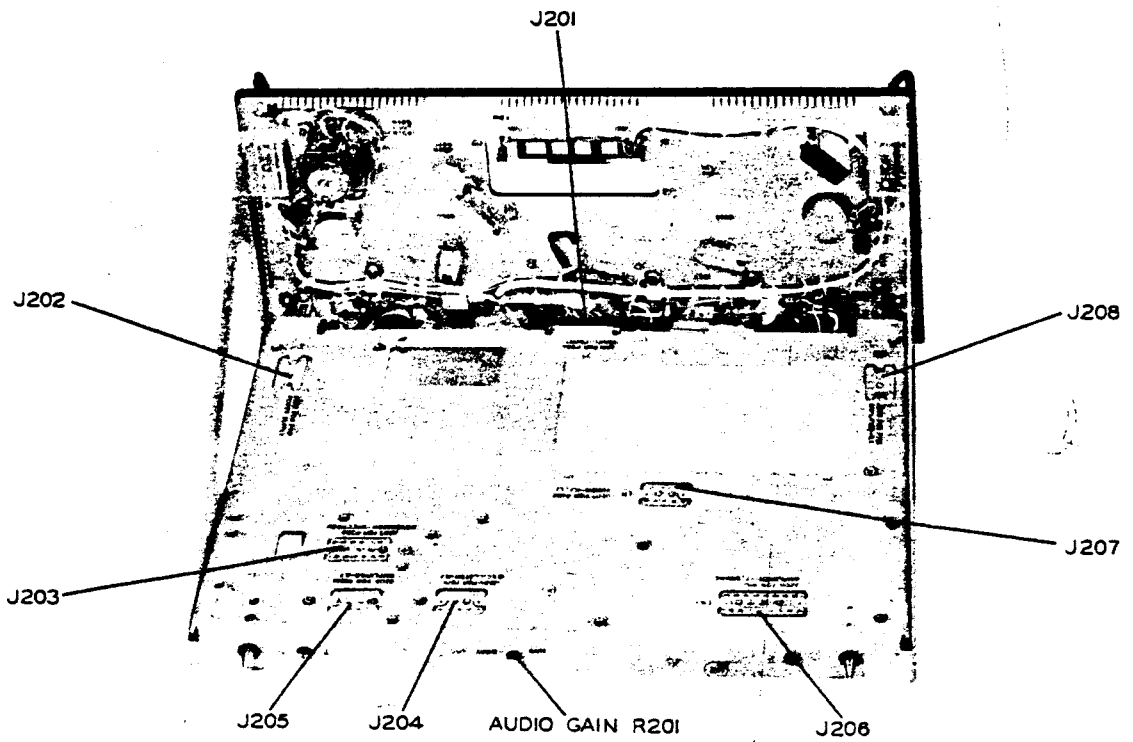


Figure 6-10. Radio Receiver R-648/ARR-41, Chassis Top View

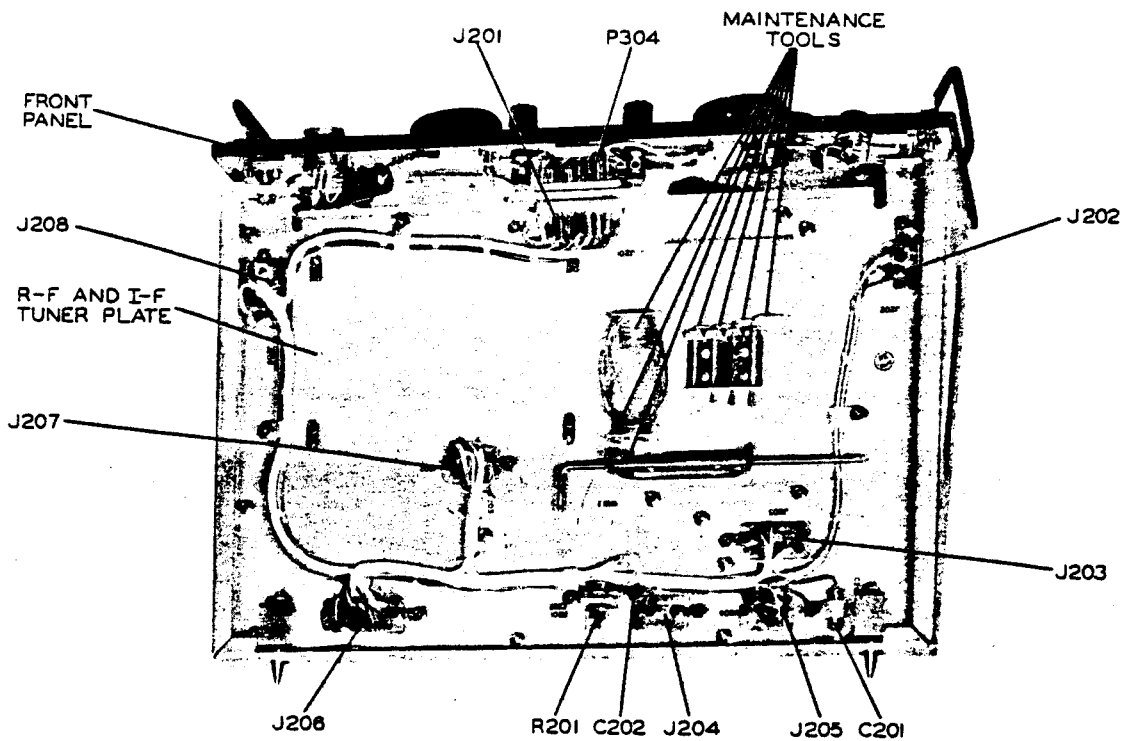


Figure 6-11. Radio Receiver R-648/ARR-41, Chassis, Bottom View

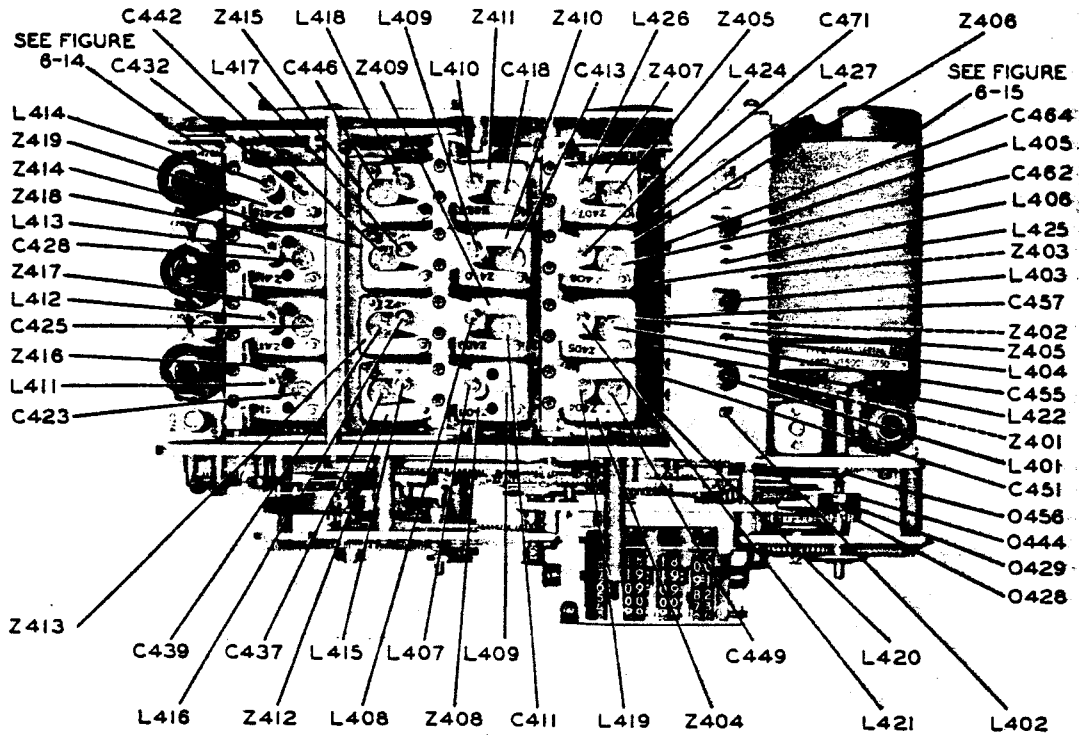


Figure 6-12. R-F and I-F Tuner Assembly, Top View

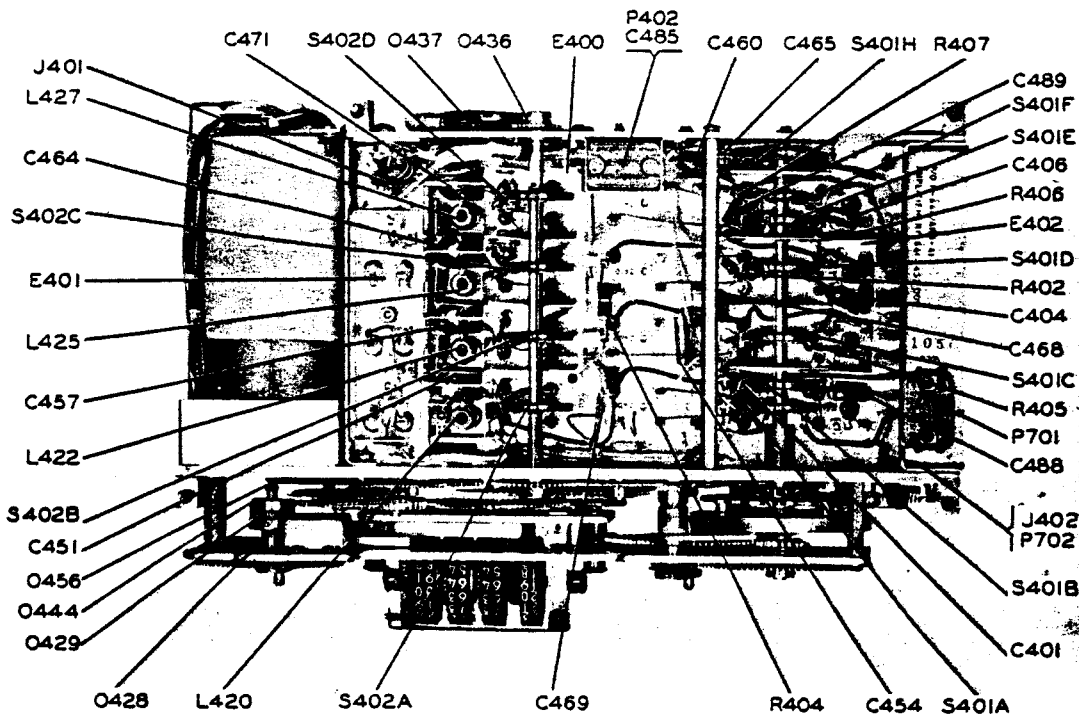


Figure 6-13. R-F and I-F Tuner Assembly, Bottom View

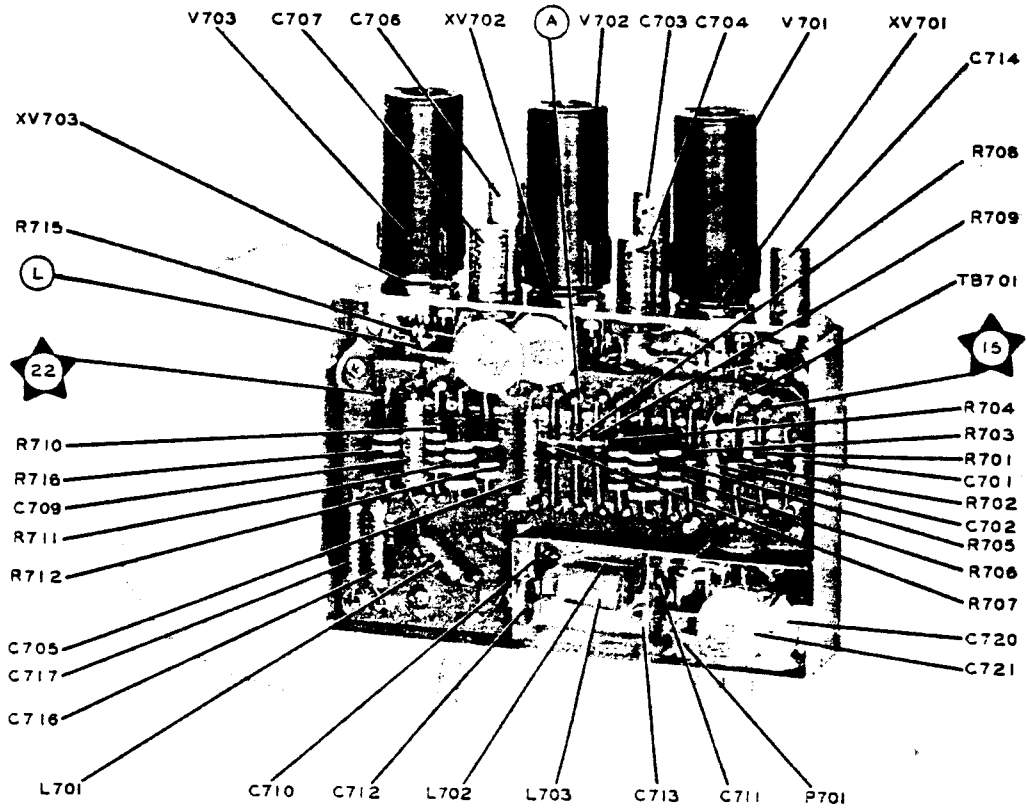


Figure 6-14. R-F Amplifier Subassembly, Left Side View

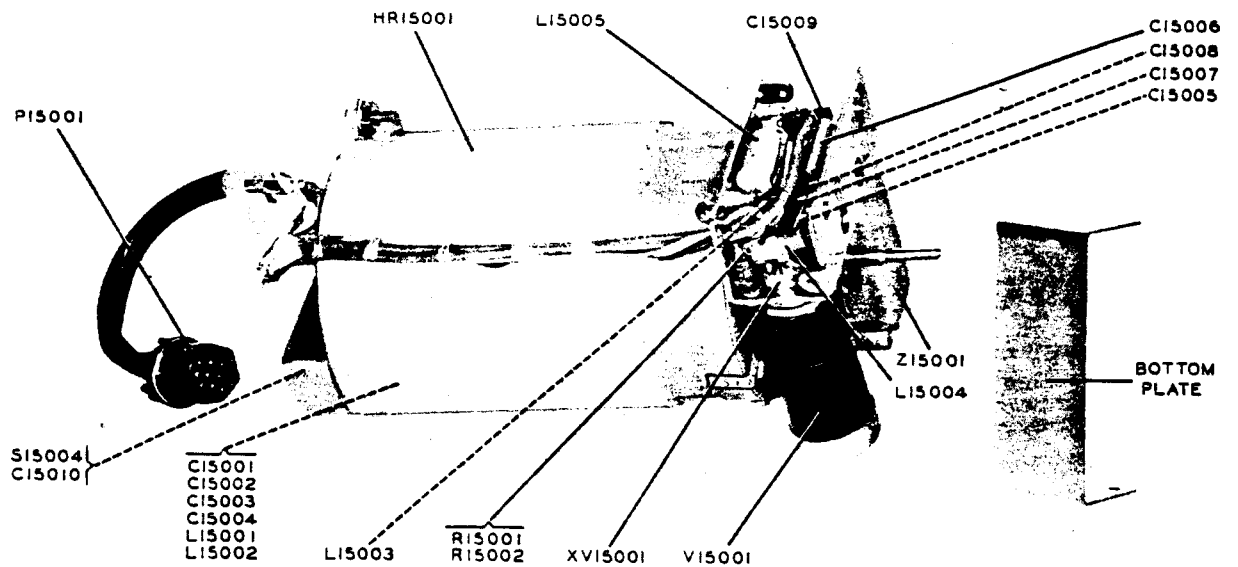


Figure 6-15. Variable Frequency Oscillator-Converter Subassembly, Plate Removed. Bottom View



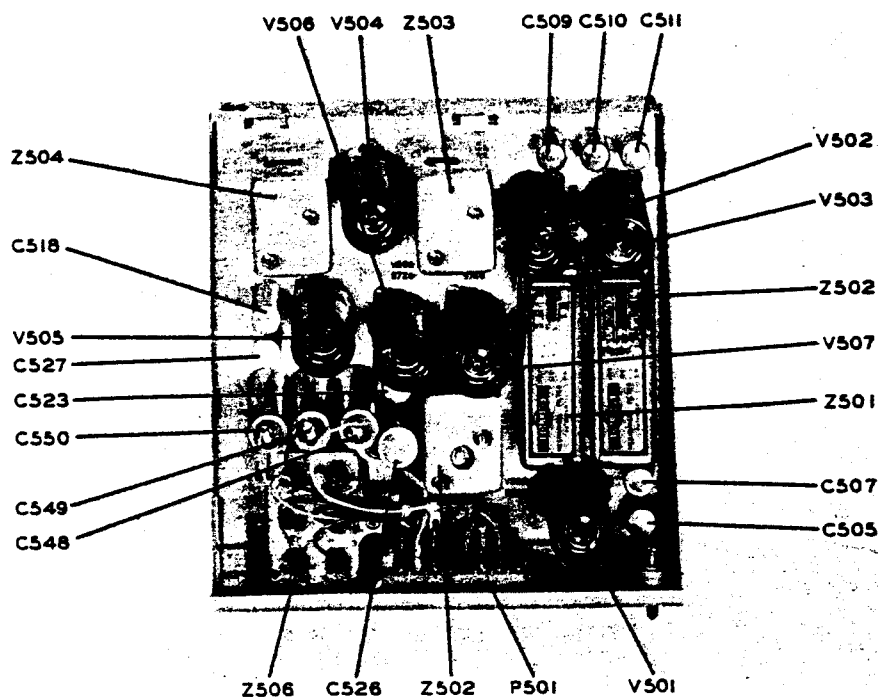


Figure 6-16. 500-Kc I-F and BFO Assembly, Front View

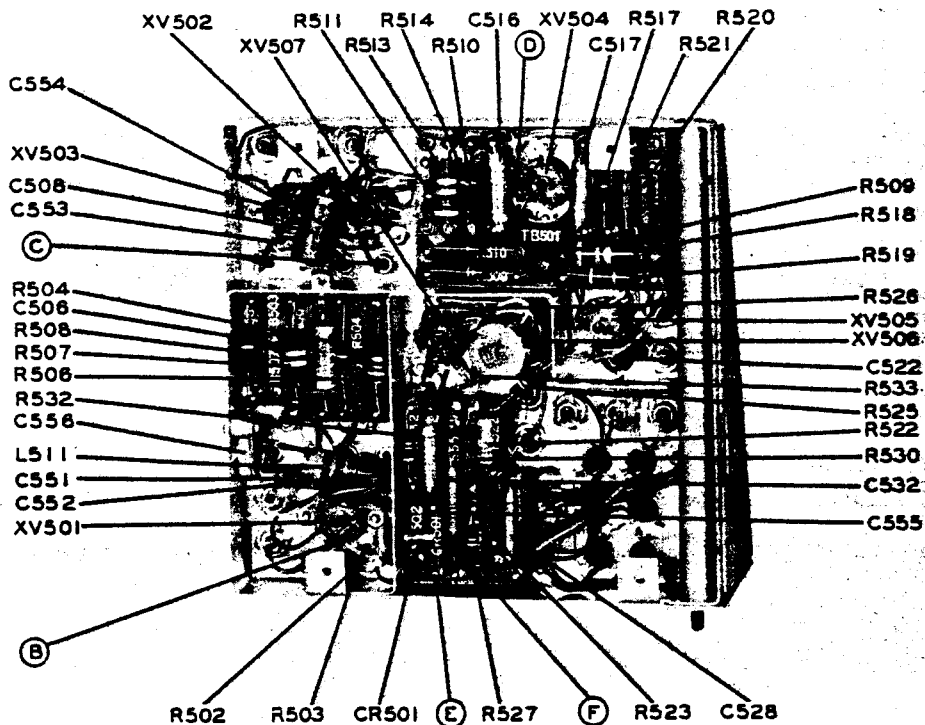


Figure 6-17. 500-Kc I-F and BFO Assembly, Rear View

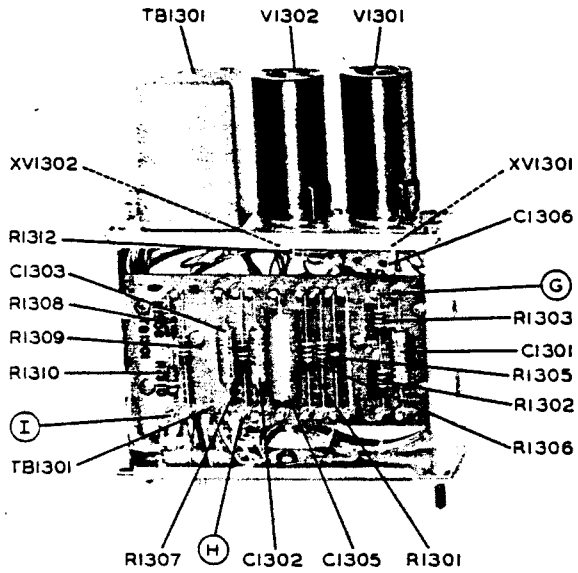


Figure 6-18. Audio Amplifier Assembly, Front View

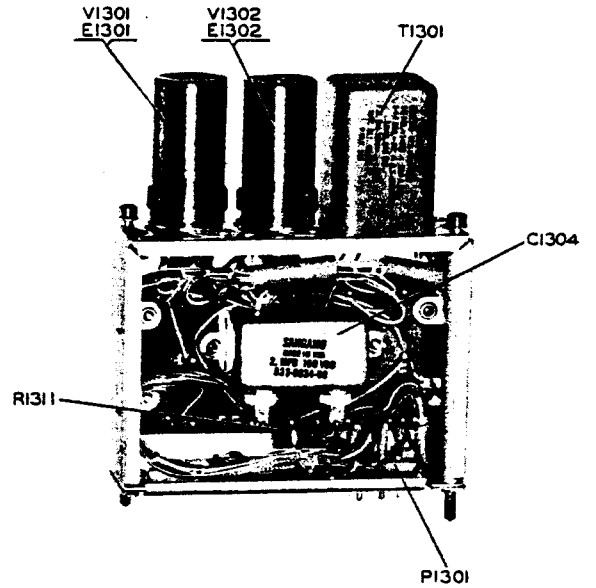


Figure 6-19. Audio Amplifier Assembly, Rear View

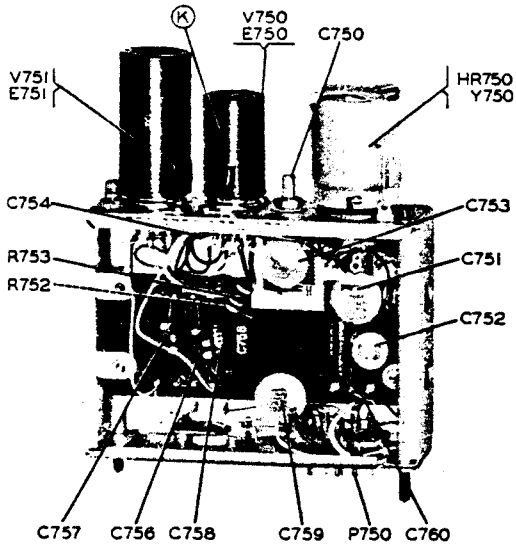


Figure 6-20. Spectrum Generator Assembly, Rear View

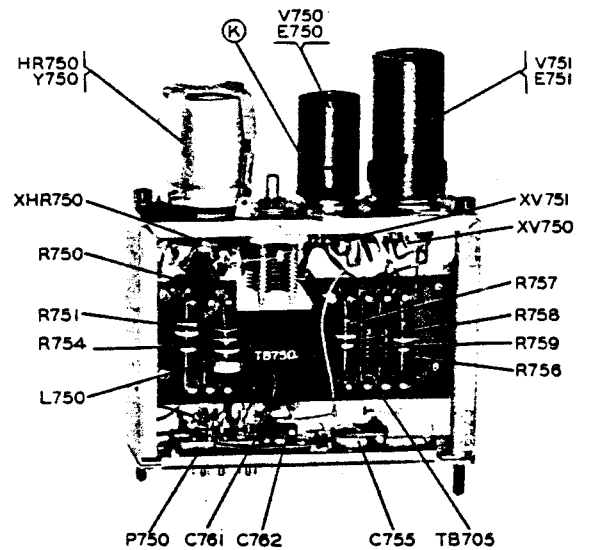


Figure 6-21. Spectrum Generator Assembly, Front View

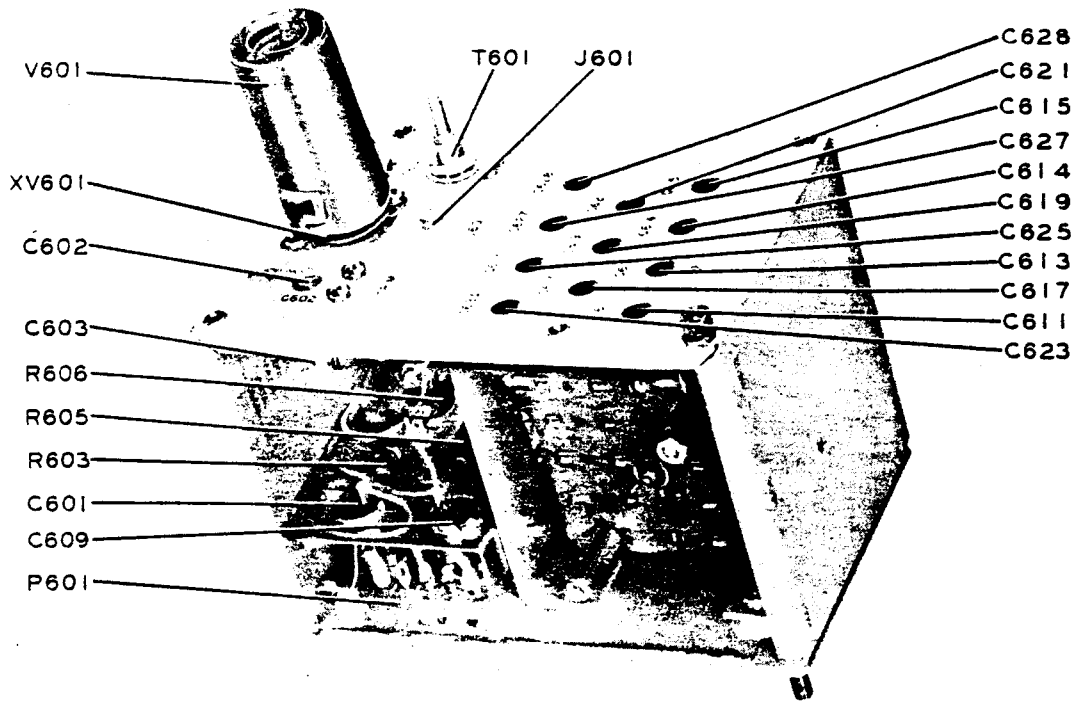


Figure 6-22. R-F Oscillator Assembly, Top Oblique View

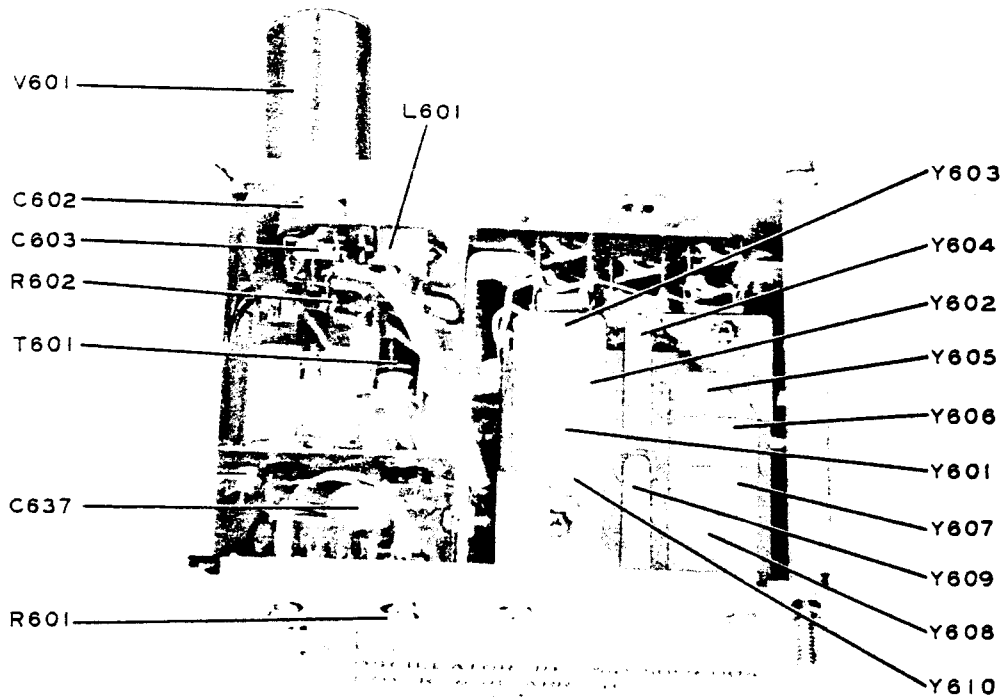


Figure 6-23. R-F Oscillator Assembly, Bottom Oblique View

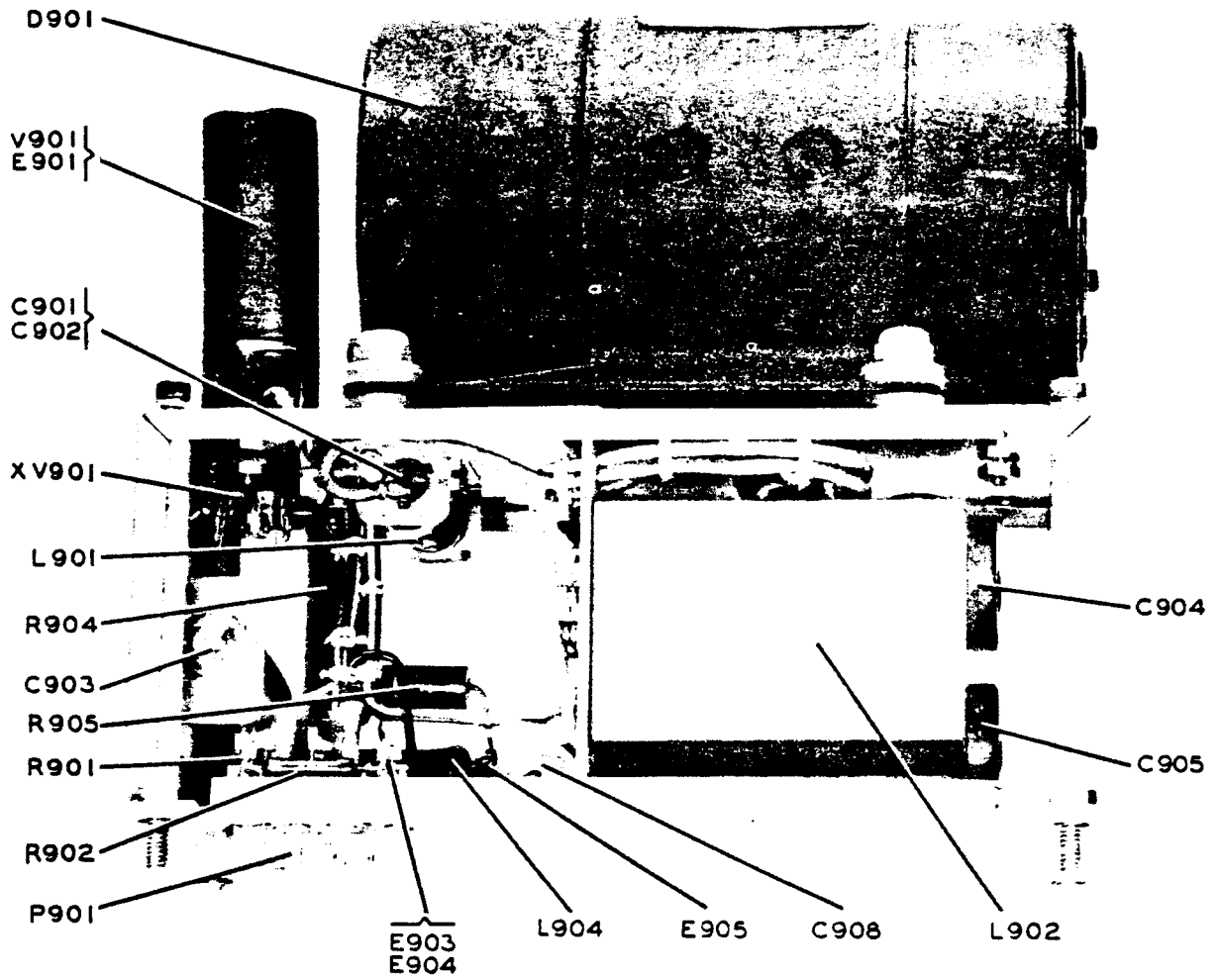
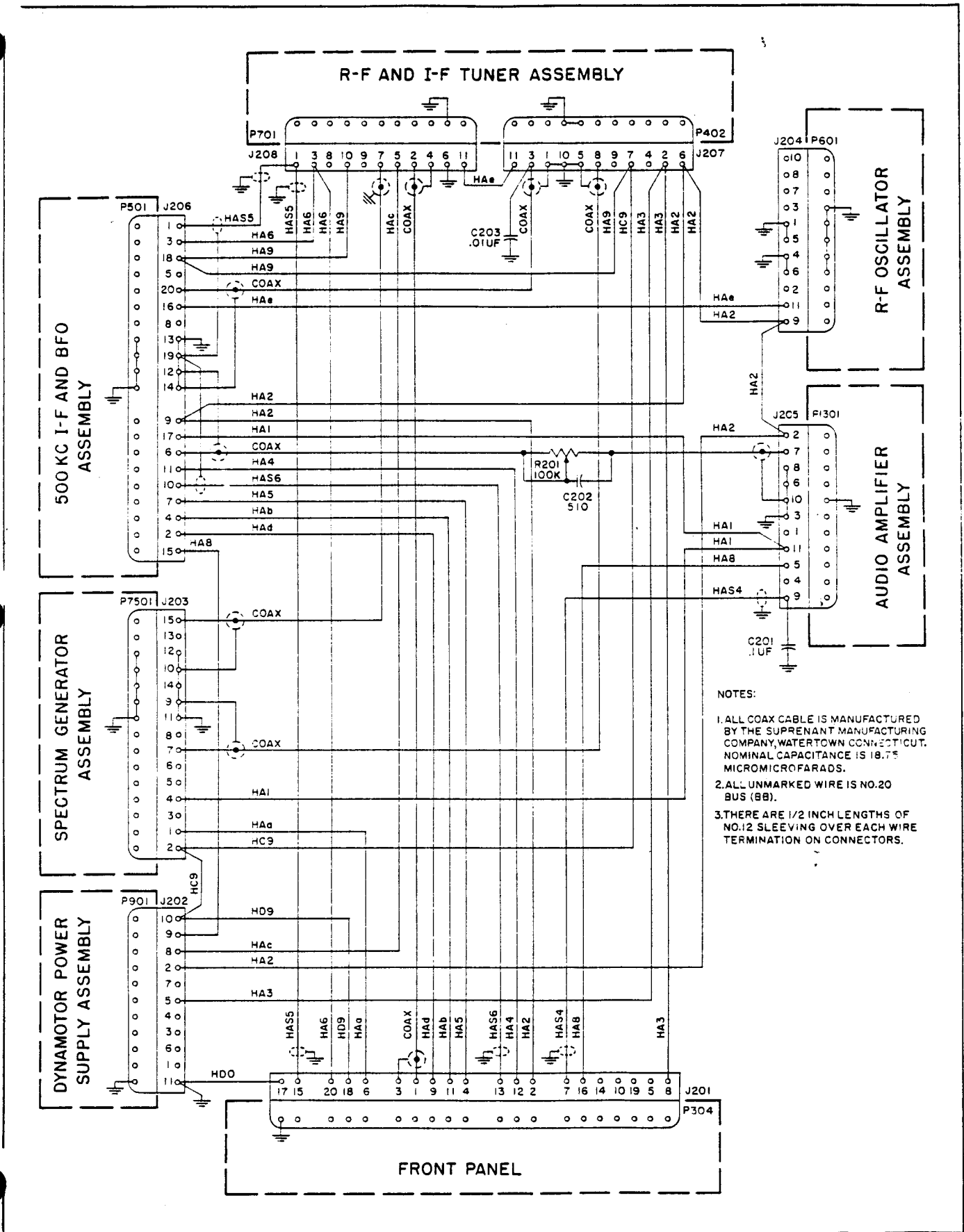


Figure 6-24. Dynamotor Power Supply Assembly, Right Side View



- NOTES:
1. ALL COAX CABLE IS MANUFACTURED BY THE SUPRENTANT MANUFACTURING COMPANY, WATERTOWN, CONNECTICUT. NOMINAL CAPACITANCE IS 18.75 MICROMICROFARADS.
  2. ALL UNMARKED WIRE IS NO.20 BUS (BB).
  3. THERE ARE 1/2 INCH LENGTHS OF NO.12 SLEEVING OVER EACH WIRE TERMINATION ON CONNECTORS.

Figure 7-4. Interassembly Cabling Diagram

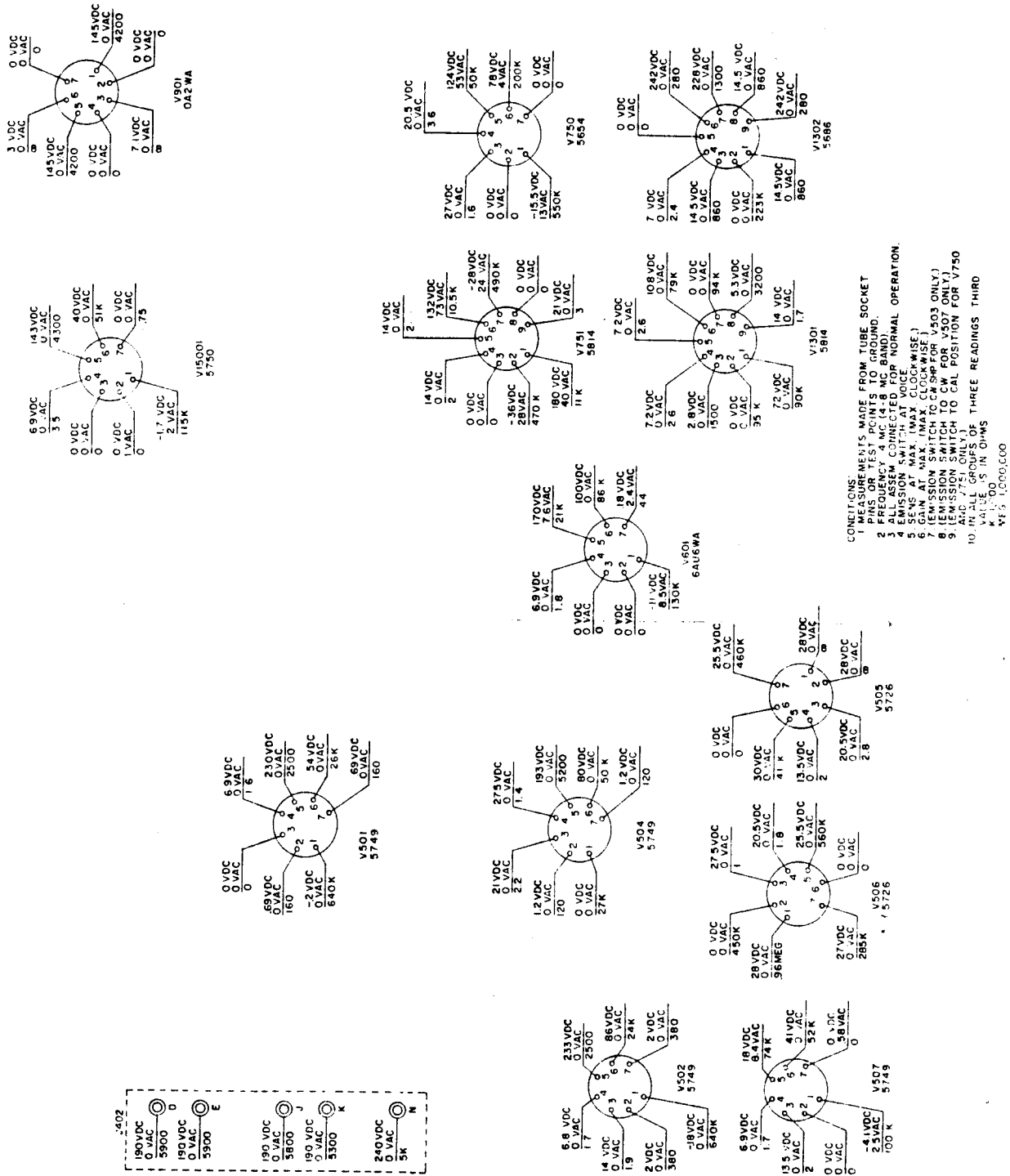
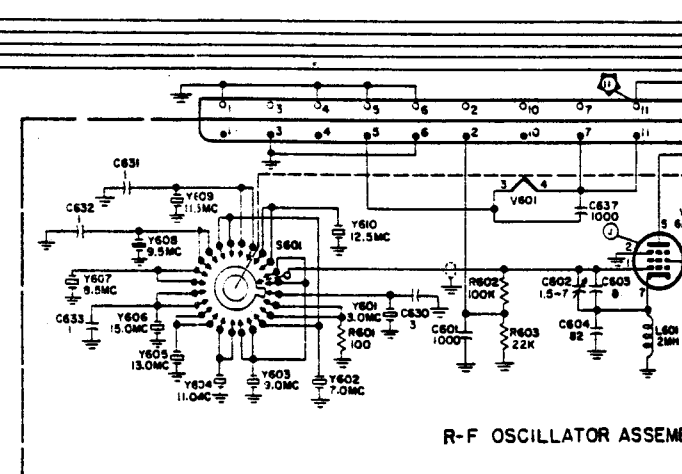
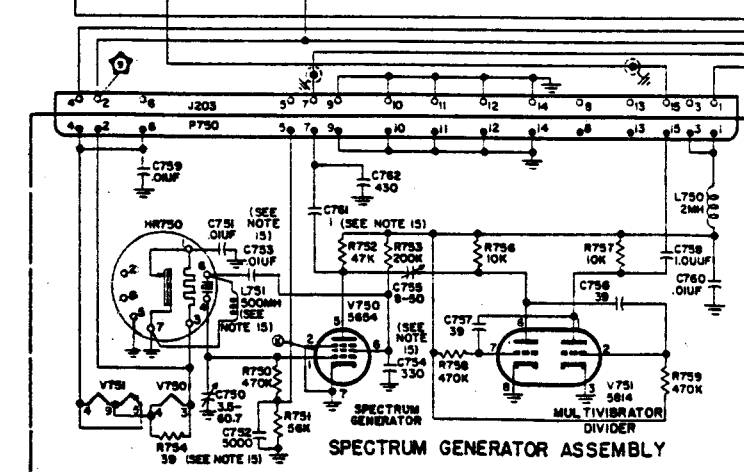
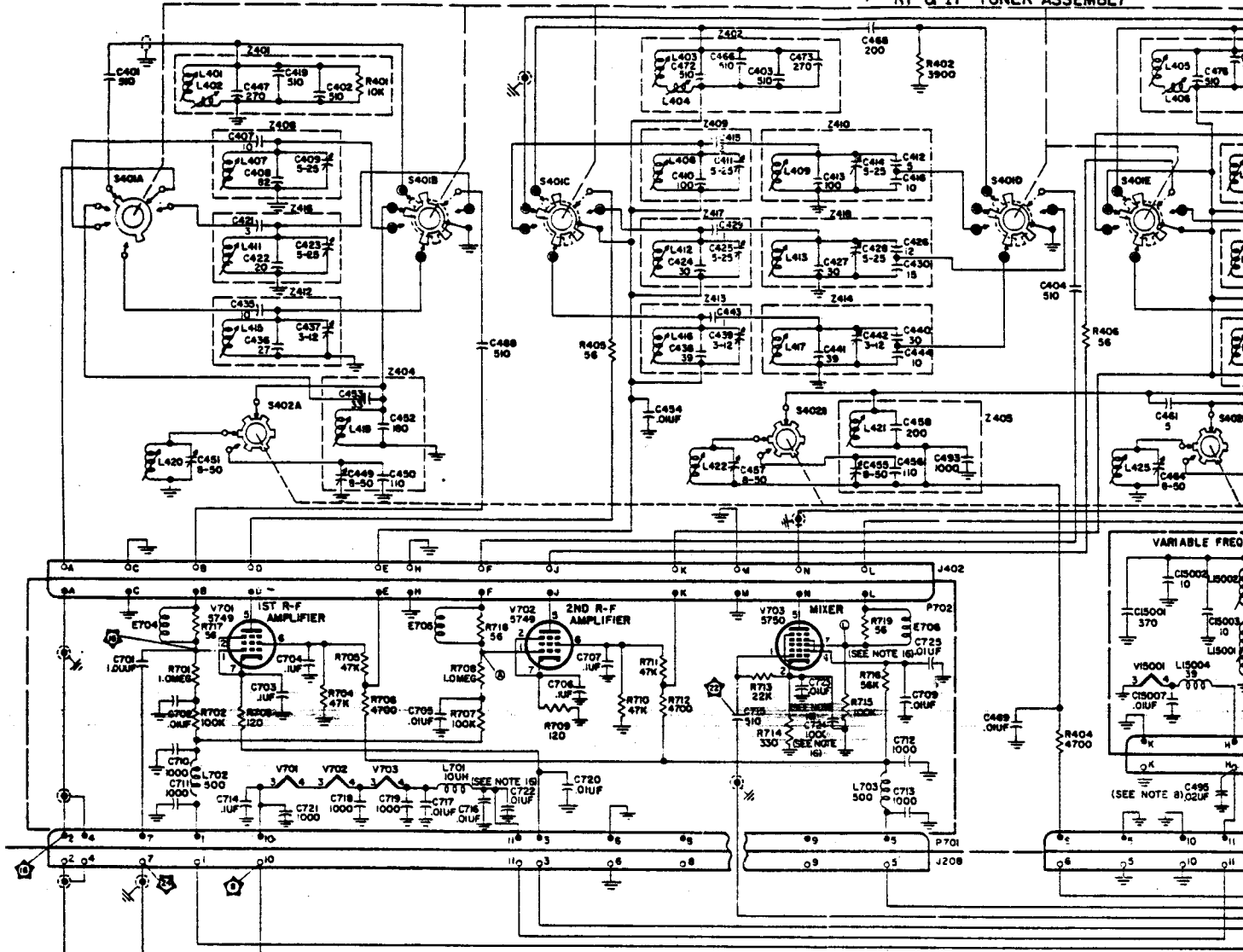


Figure 7-5. Terminal Voltage and Resistance Diagram

NOTES:

1. Switches are viewed from opposite the knob or driven end.
2. Viewed from opposite the driven end:
  - Switch contact at front.
  - ← Switch contact at rear.
  - ⊙ → Switch contact at front and rear.
3. Unless otherwise indicated, resistance values are in ohms, capacitance values are in micromicrofarads, and inductance values are in microhenrys.  
μf = microfarad.  
K = 1000 ohms.
4. Capacitor C202 (510 uuf), capacitor C203 (.01 uuf), and resistor R201 (100K) added to chassis (Effective Serial Number 1 of Contract NOAs 57-438).
5. Resistor R304 (1500 ohms) added to front panel (Effective Serial Number 102 of Contract NOAs 55-821r).
6. Resistors R307 changed from ~~240K~~ ohms to 200K ohms, and resistor R309 deleted; front panel (Effective Serial Number 12 of Contract NOAs 55-821r).
7. Resistor R302B changed from 5K ohms to 10K ohms; front panel (Effective Serial Number 1 of Contract NOAs 57-438).
8. Resistor R408 and capacitors C494 and C495 added: r-f and i-f tuner assembly (Effective Serial Number 12 of Contract NOAs 55-821r).
9. Mechanical filter Z501 changed from 9.4 kc to 6.0 kc bandwidth, and resistors R510 and R511 changed from 120 ohms to a selected value (refer to Illustrated Parts Breakdown, Radio Receiving Set AN/ARR-41, NavAer 16-30ARR41-504 for values of R510 and R511); 500 kc i-f and bfo assembly (Effective Serial Number 150 of Contract NOAs 55-821r).
10. Resistor R523 changed from 20K ohms to 56K ohms, capacitor C530 changed from 39 uuf to 47 uuf and capacitor C557 was added; 500 kc i-f and bfo assembly (Effective Serial Number 12 of Contract NOAs 55-821r).
11. Capacitor C526 changed from .1 uuf to .068 uf, resistor R520 changed from 240K ohms to 237K ohms, resistor R521 changed from 160K ohms to 162K ohms, and resistor R523 changed from 56K ohms to 34.8K ohms; 500 kc i-f and bfo assembly (Effective Serial Number 1 of Contract NOAs 57-438).
12. Resistor R521 changed from 162K ohms to 178K ohms and resistor R522 changed from 470K ohms to 468K ohms; 500 kc i-f and bfo assembly (Effective Serial Number 721 of Contract NOAs 57-438).
13. Capacitor C512 (.01 uf) ~~added; 500 kc i-f and bfo assembly (Effective Serial Number 100 of Contract NOAs 57-438).~~
14. Capacitor C608 changed from 3000 uuf to 5000 uuf; r-f oscillator assembly (Effective Serial Number 12 of Contract NOAs 55-821r).
15. Capacitor C752 changed from .01 uf to 5000 uuf, capacitor C753 changed from 510 uf to .01 uf, capacitor C754 changed from 200 uuf to 330 uuf, resistor R752 changed from 100K ohms to 47K ohms and inductor L751 added; spectrum generator assembly (Effective Serial Number 12 of Contract NOAs 55-821r).
16. Capacitors C722 (.01 uf), C723 (.01 uf), C724 (.001 uf), and C725 (.01 uf) added; r-f amplifier subassembly (Effective Serial Number 12 of Contract NOAs 55-821r). Capacitor C723 changed symbol number from C708.

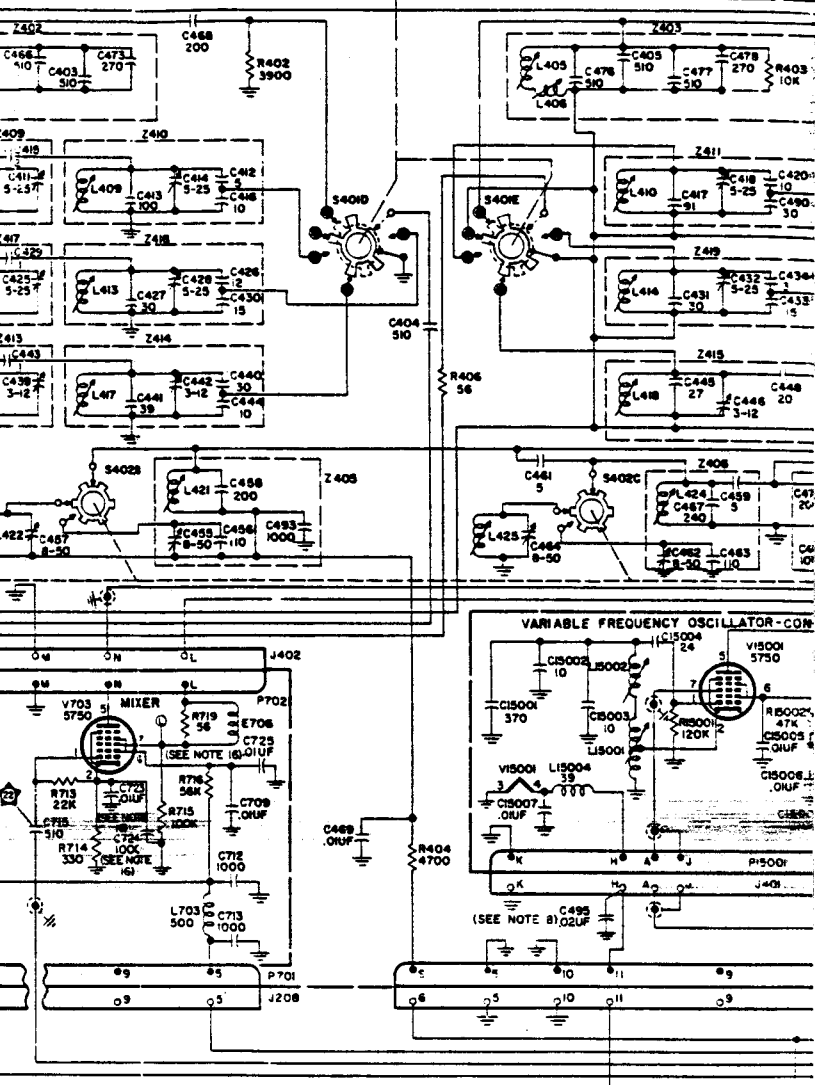
RF & IF TUNER ASSEMBLY



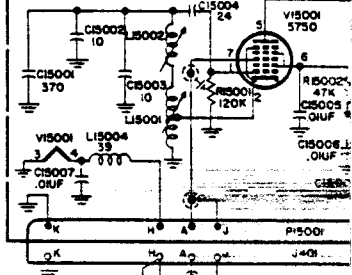
R-F OSCILLATOR ASSEMBLY



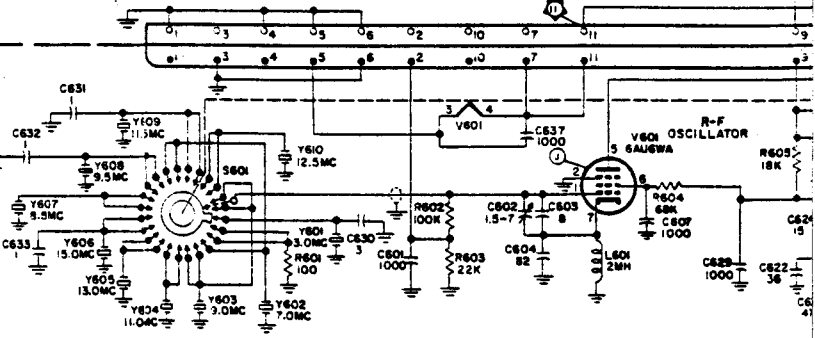
RF & IF TUNER ASSEMBLY



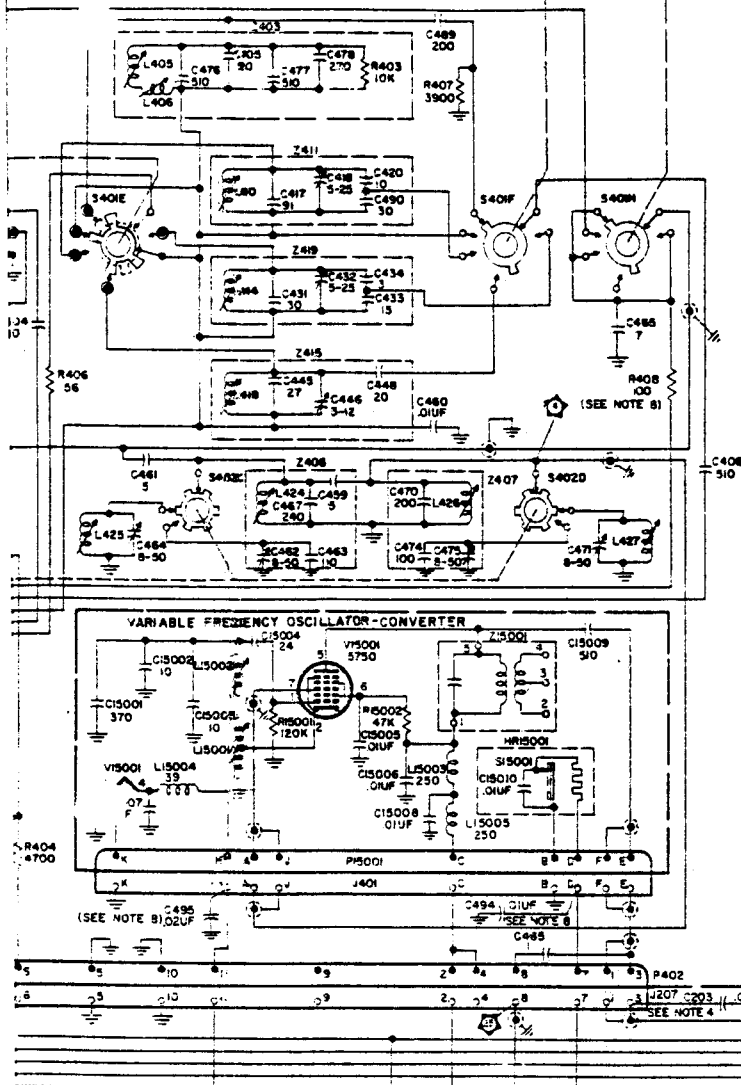
VARIABLE FREQUENCY OSCILLATOR - CON



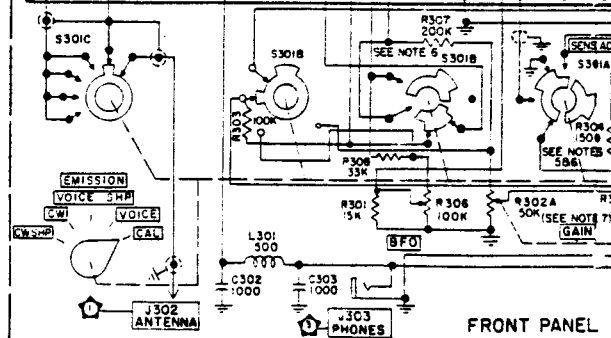
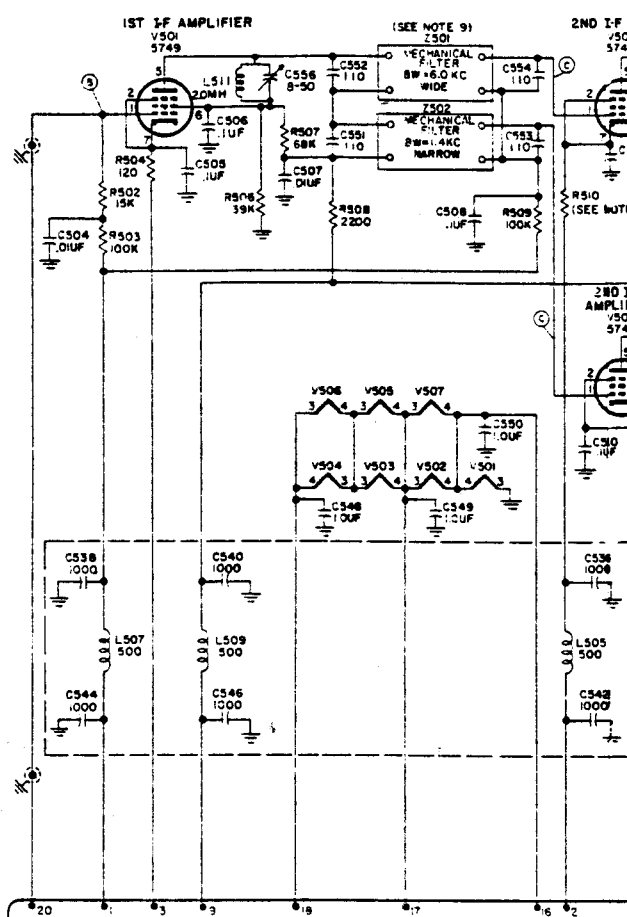
R-F OSCILLATOR ASSEMBLY



ASSEMBLY



R-F OSCILLATOR ASSEMBLY



FRONT PANEL  
(SEE NOTES 18 2)

500KC I-F & BFO ASSEMBLY

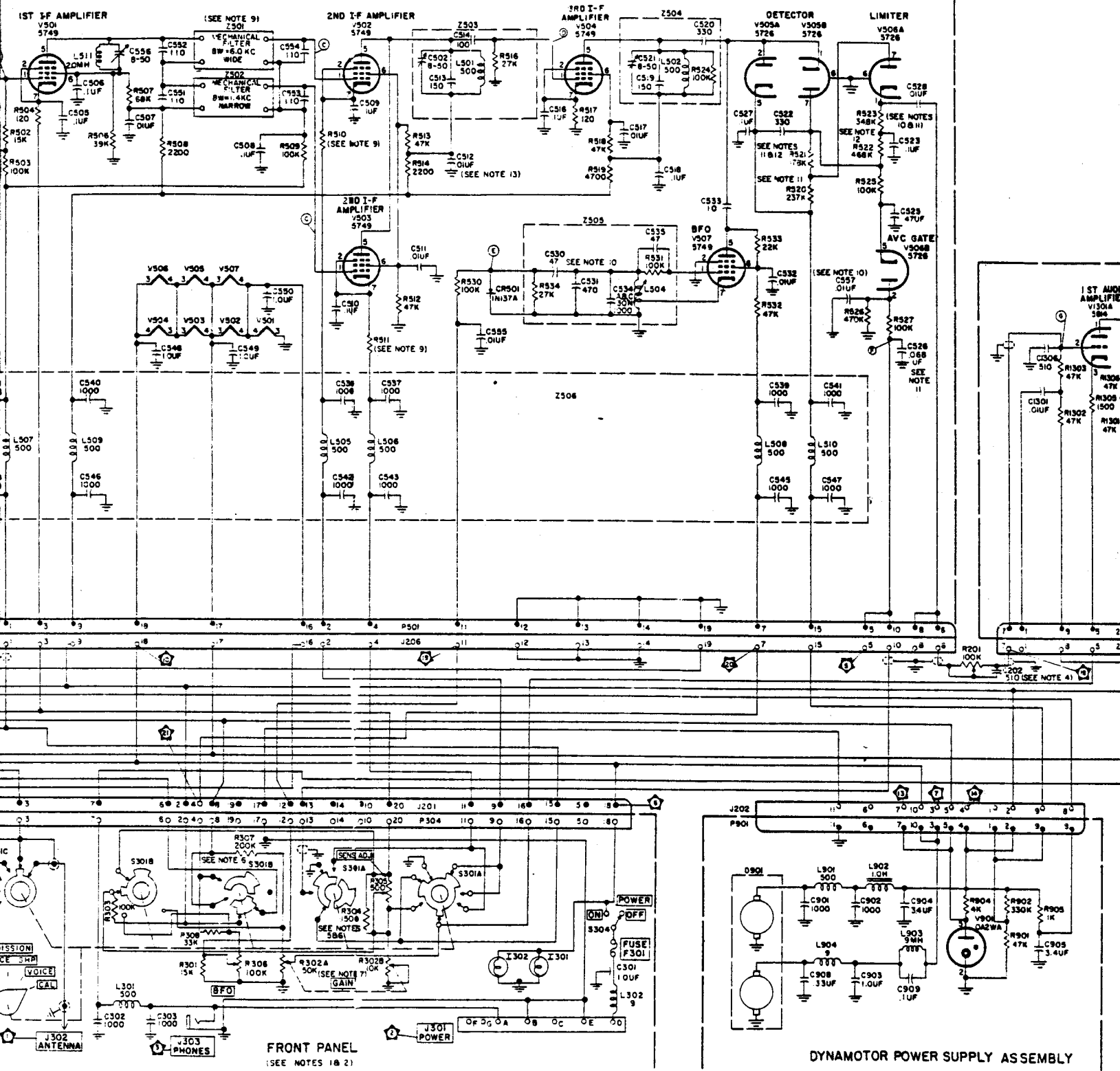


Figure 7-6. Radio Receiver R-648/ARR-41, S

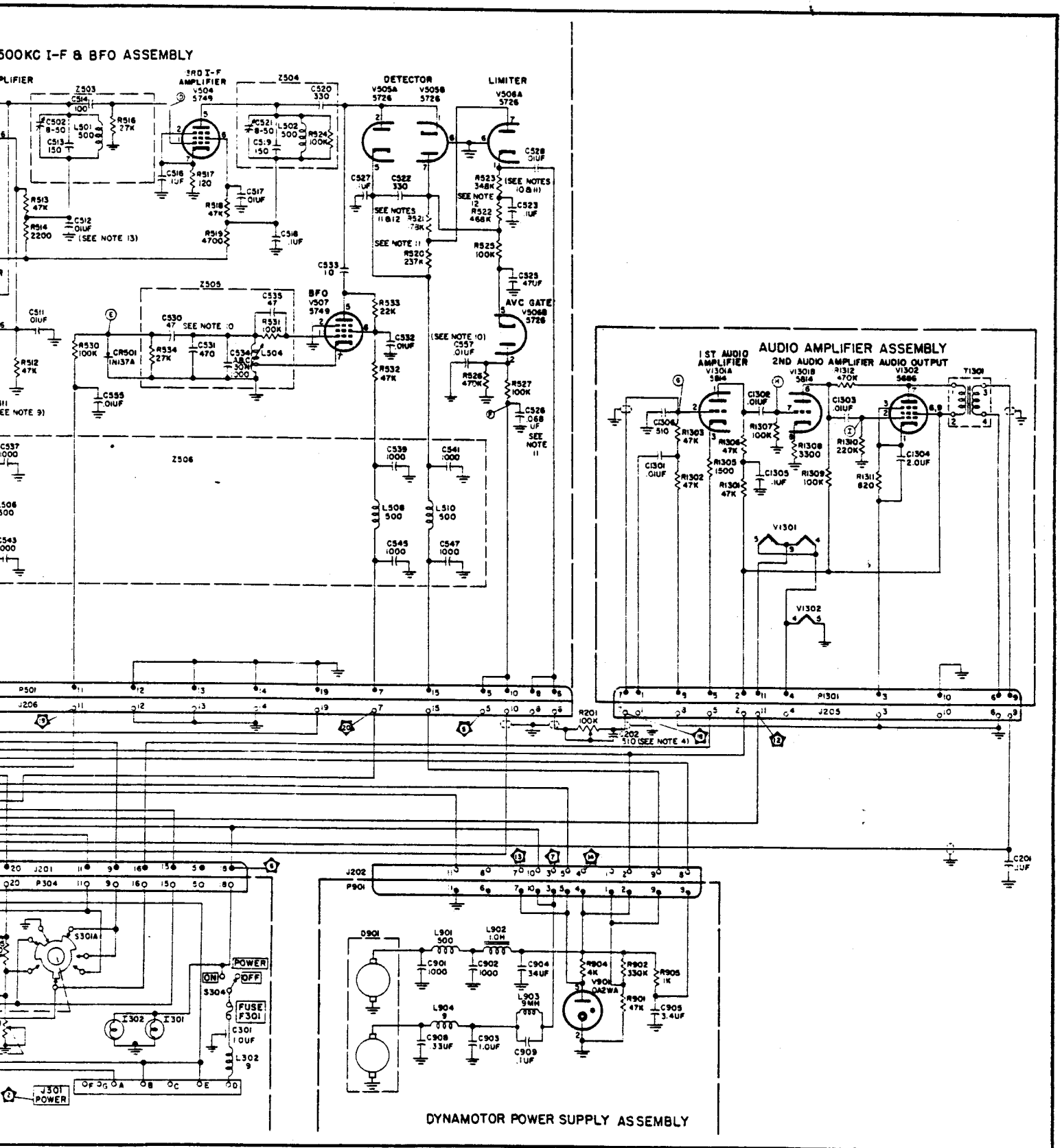


Figure 7-6. Radio Receiver R-648/ARR-41, Schematic Diagram