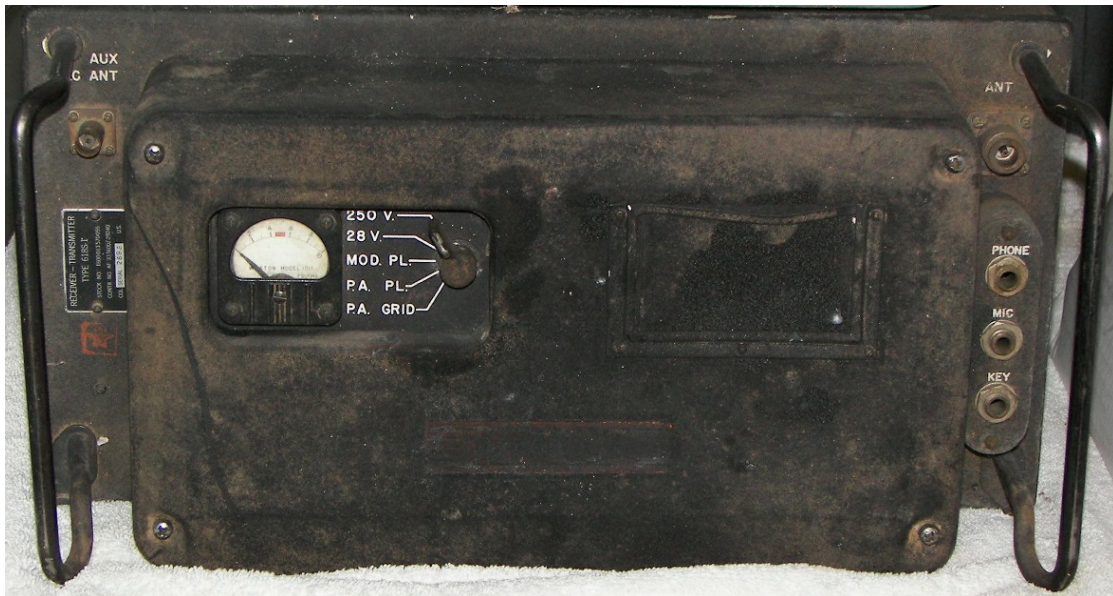


T.O. 12R2-4-6-2

# **COLLINS 618S-1 618S-1A HF TRANCEIVER**

**AM / CW, 2 TO 25MHz, 4 Bands, 144 Channels**



**Also in this document:  
Hookup and Channel Selection Notes  
ARC-38 PTO Schematic for Continuous Coverage  
BASIC Programs for Frequency and Crystal Calculations**

**Scanned by Patrick Jankowiak KD5OEI  
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M.O.A.  
 USB w/ARC-38  
 S.M.O.  
 1.75 - 3.5 MC  
 For cont. Tuning

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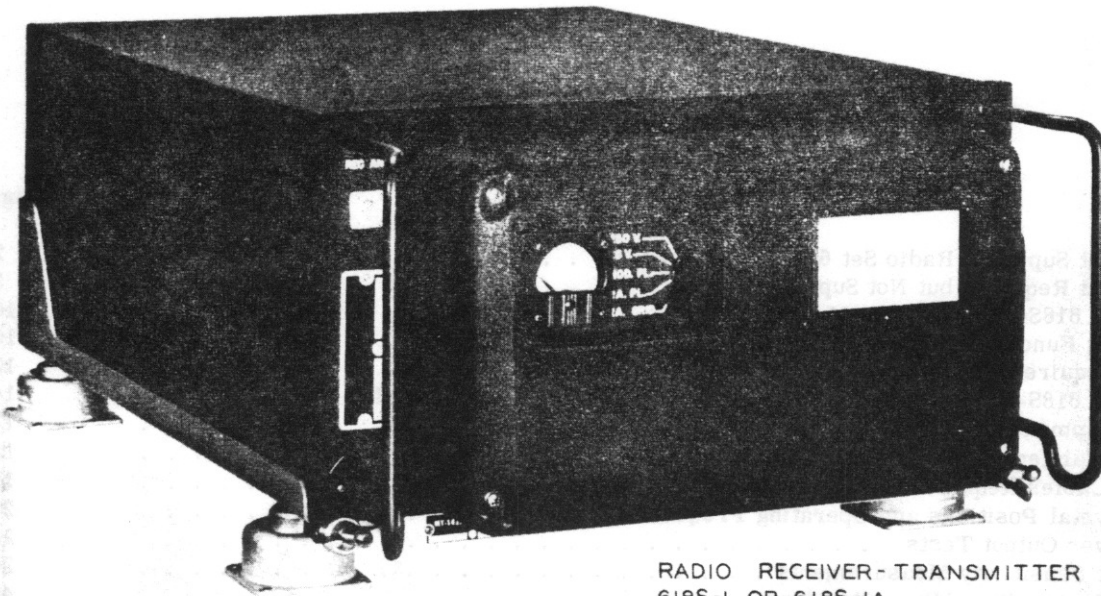
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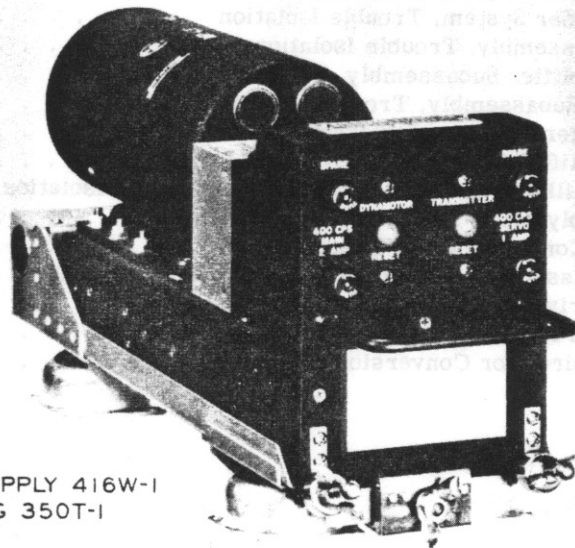
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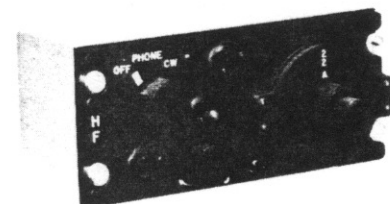
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RADIO RECEIVER-TRANSMITTER  
618S-1 OR 618S-1A  
MOUNTING 350S-1 OR 350S-3



POWER SUPPLY 416W-1  
MOUNTING 350T-1



RADIO SET CONTROL 614C-2

Figure 1-1. Radio Set 618S-1 and 618S-1A, Equipment Supplied



## 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 Set 618S-1 and 618S-1A. 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 those specialized tools and test equipment listed in section II of this handbook. For further information concerning any detail part in this equipment, reference is made to T.O. 12R2-4-6-4,

Illustrated Parts Breakdown, Radio Set 618S-1 and 618S-1A. 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-15	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 Set 618S-1, manufactured and supplied under Contracts AF 33(600)-26685 and AF 33(600)-29240 and Radio Set 618S-1A, manufactured and supplied under Contracts AF 33(600)-31045, AF 33(600)-31894, AF 33(600)-32978, AF 33(600)-33900, AF 33(600)-36629, AF 33(600)-37770, AF 33(600)-38251, and AF 33(600)-40935. Sections I through VII of this handbook apply to Radio Set 618S-1 and 618S-1A. Additional models will be covered in section VIII by the use of Difference Data Sheets.

#### NOTE

This handbook contains service instructions for Radio Set 618S-1, supplied under Contracts AF 33(600)-26685 and AF 33(600)-29240, and Radio Set 618S-1A, supplied under Contracts AF 33(600)-31045, AF 33(600)-31894, AF 33(600)-32978, AF 33(600)-33900, AF 33(600)-36629, AF 33(600)-37770, AF 33(600)-38251, and AF 33(600)-40935. The change of coupling devices on the power amplifier and tuner sub-assemblies and the bandchange autopositioner and servomotor B102 units from pin-type couplers to Oldham-type couplers necessitated the change in nomenclature from 618S-1 to 618S-1A. Since some units of equipment employing Oldham-type couplers were delivered on Contract AF 33(600)-29240 with 618S-1 name plates, it will be necessary to refer to

subassembly MOD stamping to identify the type of coupler in use. The coupler change is effective with serial number 1755 on Contract AF 33(600)-29240 and subassemblies affected are stamped: servomotor B102 unit MOD 1; bandchange autopositioner unit MOD 2; tuner subassembly MOD 7; and power amplifier sub-assembly MOD 3.

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

1-4. Radio Set 618S-1 and 618S-1A are designed to provide transmitting and receiving facilities between aircraft and ground station, or between aircraft, within the frequency range of 2 to 25 megacycles. A highly flexible system permits the selection of 144 crystal-controlled frequencies incorporating the use of a common crystal for transmitting and receiving. Two modes of operation are provided, radiotelephone (A-3) and radiotelegraph (A-1). The mode of operation and frequency are selected by the pilot or copilot by operation of Radio Set Control 614C-2. Provision is made in both the 618S-1 and the 618S-1A for adaption to fsk (radioteletype) transmission and reception.

1-5. The 618S-1 and 618S-1A normally is used with Automatic Antenna Tuner 180L-2/3. The 180L-2/3 is designed for automatic tuning of open, fixed-wire antennas between 45 and 100 feet in length. The 52-ohm output of the 618S-1 or 618S-1A is matched automatically to the fixed-wire antenna following rotation of the channel selector knobs of Radio Set Control 614C-2.

1-6. Circuitry is included within the 618S-1 and 618S-1A which automatically tunes both the receiver and transmitter circuits to frequencies determined by selected crystals. No adjustments or tuning procedures are necessary when a new transmitting-receiving frequency is desired.

**1-7. EQUIPMENT SUPPLIED.**

1-8. Equipment supplied with Radio Set 618S-1 and 618S-1A is illustrated in figure 1-1 and listed in table I.

TABLE I. EQUIPMENT SUPPLIED, RADIO SET 618S-1 AND 618S-1A

QUANTITY PER EQUIPMENT	NAME OF UNIT	AN TYPE DESIGNATION	OVER-ALL DIMENSIONS (INCHES)			WEIGHT (LB)	NUMERICAL SERIES OF REFERENCE SYMBOLS
			LENGTH	WIDTH	HEIGHT		
1	Radio Receiver-Transmitter	618S-1 or 618S-1A	23-7/16	15-7/16	7-25/32	55.0	101-499 601-699 801-1599
1*	Mounting	350S-1	25-3/16	16-3/8	6-13/16	9.0	1801-1899
1*	Mounting	350S-3	25-3/16	16-3/8	6-13/16	9.0	1801-1899
1	Power Supply	416W-1	18-1/16	4-7/8	6-3/4	22.0	1601-1699
1	Mounting	350T-1	17-9/16	5-7/8	3-15/16	4.0	1701-1799
1	Radio Set Control	614C-2	4-9/16	5-3/4	2-19/32	1.75	2601-2699

\*Alternate components in a normal installation.

Crystal positions and operating frequencies (in kc). Crystals supplied with Contract AF 33(600)-26685.

A-1 2868.0	B-1 4724.5	B-12 6730.5	C-8 13215.5
A-2 2910.0	B-2 4731.5	B-13 6738.0	C-9 13245.5
A-3 2931.0	B-3 5551.5	B-14 6753.0	C-10 13264.5
A-4 3023.5	B-4 5611.5	B-15 6760.5	C-11 13354.5
A-5 3032.0	B-5 5626.5	C-1 8871.0	C-12 8364.0
A-6 3095.0	B-6 5641.5	C-2 8888.0	D-1 15016.0
A-7 3137.0	B-7 5649.0	C-3 8913.5	D-2 15036.0
A-8 3144.0	B-8 5671.5	C-4 8930.5	D-3 17966.5
A-9 3432.5	B-9 5680.0	C-5 8947.5	D-4 17975.0
A-10 3446.5	B-10 5710.5	C-6 11180.5	D-5 17993.5
A-11 3481.5	B-11 6552.0	C-7 11228.0	

Crystal positions and operating frequencies (in kc). Crystals supplied with Contracts AF 33(600)-29240, AF 33(600)-31045, AF 33(600)-31894, AF 33(600)-32978, AF 33(600)-33900, AF 33(600)-36629, AF 33(600)-37770, AF 33(600)-38251, and AF 33(600)-40935.

A-1 3023.5	A-15 3481.5	A-24 3404.5	B-14 3453.5
A-3 2980.0	A-16 3467.5	B-1 5680.0	B-15 5551.5
A-5 3067.0	A-17 2966.0	B-3 5574.0	B-16 5604.0
A-6 3137.0	A-18 2987.0	B-4 4724.5	B-17 5506.5
A-7 3144.0	A-19 2931.0	B-5 4731.5	B-18 5521.5
A-11 2945.0	A-20 2889.0	B-7 5710.5	B-19 2973.0
A-12 2868.0	A-21 2952.0	B-11 5641.5	B-20 4696.5
A-13 2910.0	A-22 5499.0	B-12 5626.5	B-21 5619.0
A-14 2854.0	A-23 5611.5	B-13 4689.5	B-22 5566.5

TABLE I. EQUIPMENT SUPPLIED, RADIO SET 618S-1 AND 618S-1A (Cont)

Crystal positions and operating frequencies (in kc). Crystals supplied with Contracts AF 33(600)-29240, AF 33(600)-31045, AF 33(600)-31894, AF 33(600)-32978, AF 33(600)-33900, AF 33(600)-36629, AF 33(600)-37770, AF 33(600)-38251, and AF 33(600)-40935.

B-23	6612.0	C-20	6664.5	D-22	6567.0	E-19	11356.5
B-24	3411.5	C-21	8837.0	D-23	8956.0	E-20	13314.5
C-1	4890.0	C-22	6537.0	D-24	5581.5	E-21	13294.5
C-3	8905.0	C-23	8845.5	E-2	10000.0	E-22	13344.5
C-4	6753.0	C-24	3432.5	E-3	5559.0	E-23	13284.5
C-5	6760.5	D-2	5000.0	E-4	15016.0	F-2	15000.0
C-6	6730.5	D-3	3001.0	E-5	15036.0	F-3	8828.5
C-7	6738.0	D-4	11180.5	E-6	13215.5	F-6	17975.0
C-11	5671.5	D-5	11228.0	E-7	13245.5	F-7	17993.5
C-12	8888.0	D-6	9026.5	E-11	13264.5	F-11	17996.5
C-13	6582.0	D-11	8862.5	E-12	13324.5	F-13	8364.0
C-14	5589.0	D-12	8913.5	E-13	11299.5	F-15	17926.5
C-15	8930.5	D-13	8871.0	E-15	13334.5	F-17	17906.5
C-16	8879.5	D-14	8854.0	E-16	13304.5	F-20	17916.5
C-18	8939.0	D-20	8820.0	E-17	13354.5	F-22	17946.5
C-19	5544.0	D-21	10021.0	E-18	13274.5		

## NOTE

The frequencies listed correspond to the 618S-1 or 618S-1A operating frequencies and not the actual crystal frequencies. The listed operating frequencies are stamped on the top of each crystal supplied.

**1-9. EQUIPMENT REQUIRED BUT NOT SUPPLIED.**

1-10. Table II lists the equipment required for operation but not supplied as part of Radio Set

618S-1 or 618S-1A. When installed in the aircraft, the equipment will be connected to and used with auxiliary equipment generally similar to that listed in table II.

TABLE II. EQUIPMENT REQUIRED BUT NOT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	AN TYPE DESIGNATION	REQUIRED CHARACTERISTICS
1	Automatic Antenna Tuner	180L-2 or 180L-3	Provides automatic matching and loading of antenna. (Refer to paragraph 3-7.)
1	Mounting	350D-3	Provides mounting facilities for 180L-2 or 180L-3.
1	Primary D-C Power Source		Refer to table VII.
1	Primary A-C Power Source		Refer to table VII.
1	Antenna	Typical long wire	Fixed wire, 45-100 feet long.

TABLE II. EQUIPMENT REQUIRED BUT NOT SUPPLIED (Cont)

QUANTITY PER EQUIPMENT	NAME OF UNIT	AN TYPE DESIGNATION	REQUIRED CHARACTERISTICS
1	R-F Cable between J110 of 180L-3 and J101 of 618S-1 or 618S-1A, W1	RG-8/U	Coaxial cable. Refer to figure 2-3.
1	R-F Cable between J103 of 180L-3 and J109 of 618S-1 or 618S-1A, W2	RG-58/U	Coaxial cable. Refer to figure 2-3.
1	Cable between J102 of 180L-3 and TB1801 of 618S-1 or 618S-1A, W3		Cable to be made up from stock. Refer to paragraph 2-8 and figures 2-2 and 7-15.
1	Cable between J1601 of 416W-1 and TB1801 of 618S-1 or 618S-1A, W4		Cable to be made up from stock. Refer to paragraph 2-8 and figures 2-2 and 7-15.
1	Cable between J2601 of 614C-2 and TB1801 of 618S-1 or 618S-1A, W5		Cable to be made up from stock. Refer to paragraph 2-8 and figures 2-2 and 7-15.
1	Cable between J1601 of 416W-1 and power source, W6.		Cable to be made up from stock. Refer to paragraph 2-8 and figures 2-2 and 7-15.
1	Connector, P110	UG-21D/U	Refer to figure 2-3 for assembly instructions.
1	Connector, P109	UG-88/U	Refer to figure 2-4 for assembly instructions.
1	Connector, P102	UG-201/U	Refer to T.O. 31R2-4-38-1.
1	Headset	H-1/AR or H-4/AR	300 ohms internal impedance.
1	Microphone	ANB-M-C1 or equal	Hand-held microphone with push-to-talk button.
1	Interphone Amplifier	AN/A1C-4 or equal	

**1-11. GENERAL PRINCIPLES OF OPERATION.**

1-12. Radio Set 618S-1 and 618S-1A are remotely controlled complete transmitting and receiving systems with all necessary control and mounting equipment. Radio Receiver-Transmitter 618S-1 and 618S-1A are the main system components, which are controlled remotely from the pilot's position with the

use of Radio Set Control 614C-2. Any of 144 crystal-controlled frequencies may be selected by operation of Radio Set Control 614C-2, which activates the automatic channeling circuits of the 618S-1 or 618S-1A. Operation of the 614C-2 also energizes Automatic Antenna Tuner 180L-2/3, which correctly matches the 52-ohm output impedance to the aircraft antenna for any frequency within the range of 2 to 25 megacycles.

1-13. Basic frequencies within Radio Receiver-Transmitter 618S-1 and 618S-1A are generated by a temperature-compensated crystal oscillator, which maintains the radiated output signal to less  $\pm 0.007\%$  error. The output from the r-f crystal oscillator subassembly is used as both a basic frequency standard and as a means of driving a servo system for tuning all of the low-level circuits. A total of four bands are employed within Radio Receiver-Transmitter 618S-1 and 618S-1A, thus lowering the number of crystals required for operation on the entire 144 channels. Unitized modular construction is employed throughout the 618S-1 and 618S-1A, greatly simplifying trouble-shooting and maintenance procedures.

1-14. All a-c and d-c power requirements of the 618S-1 or 618S-1A systems are satisfied by Power Supply 416W-1. Power Supply 416W-1 is designed to operate on the standard 27.5-volt d-c and 115-volt a-c power source of the aircraft. Overload protection is afforded with fuses and circuit breaker switches located on the 416W-1 front panel.

#### 1-15. DESCRIPTION OF COMPONENTS.

1-16. RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A. Refer to figures 1-2 and 1-3. The main

components of the 618S-1 and 618S-1A systems are enclosed in a single case and mounted on a single main chassis. The case is removable by rotating two Dzus fasteners located at the rear of the units and pulling the chassis forward. The main chassis and front panel, form the mounting base for a number of plug-in subassemblies. All these subassemblies, shown in figure 1-3, are removable from the top of the chassis. Captive hold-down screws retain the individual subassemblies in place. All electrical connections to the plug-in subassemblies are made through receptacles mounted on the main chassis. The connections to the Power Supply 416W-1 and Radio Set Control 614C-2 are made through two connectors, mounted in the rear of the main chassis, which mate jacks located on Mounting 350S-1. Two wing nuts at the front of Mounting 350S-1 or 350S-3 retain the 618S-1 or 618S-1A securely in place.

1-17. The front panel cover, which is secured by four screws, houses the blower motor (B101), side tone and volume controls, and the positioning and tuning mechanism needed for remote control of the 618S-1 or 618S-1A main components. Individual plug-in units which require mechanical linkage to each other or to the front panel are built with quick disconnect, pin-type or Oldham couplers to allow removal

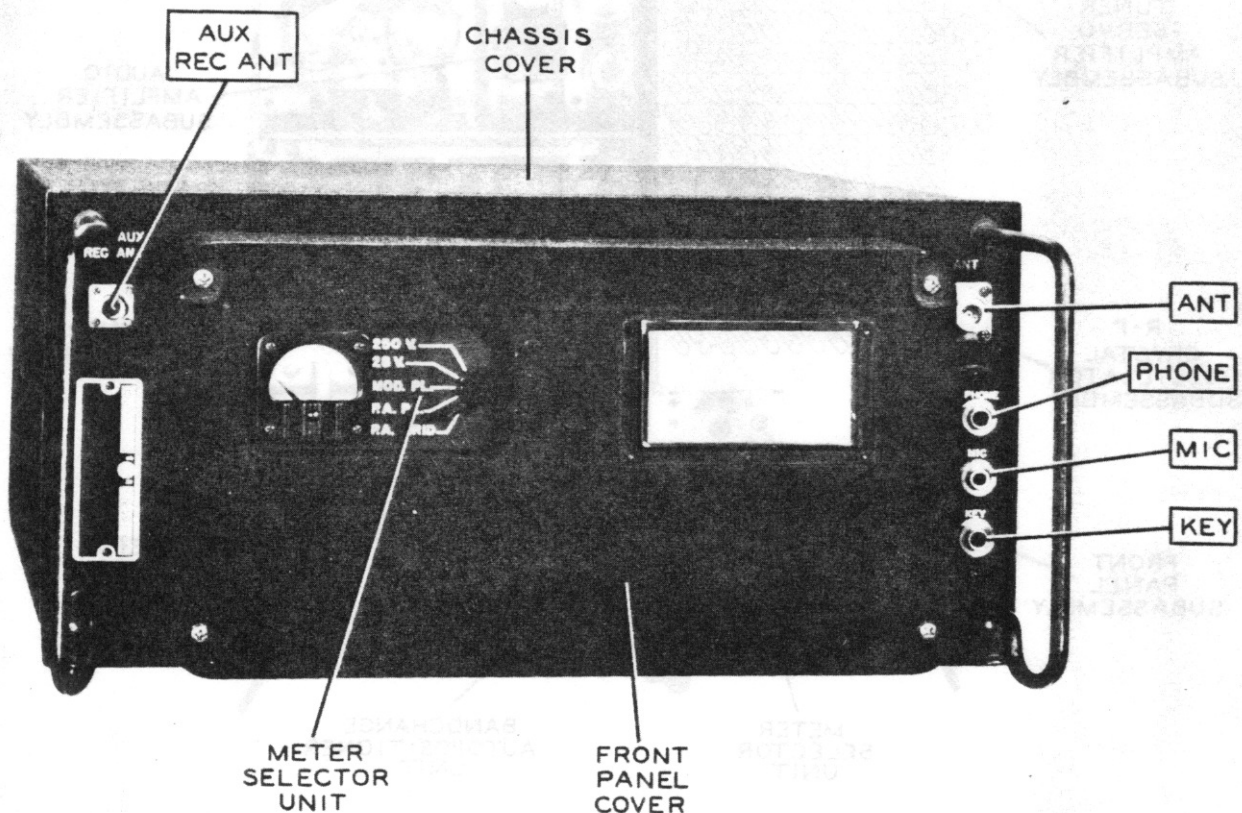


Figure 1-2. Radio Receiver-Transmitter 618S-1 and 618S-1A, Front Oblique View

of the units from the main chassis. Once these linkages are synchronized, it is possible to remove and replace units without additional mechanical alignment. A blower (B101), located on the front panel, draws air in through a filter and distributes the air to various parts of the equipment. The direction of

airflow is determined by the positioning of holes in various portions of the chassis. Located on the front panel, in addition, are the MIC, PHONE, and KEY jacks, the ANT and AUX REC ANT terminals, and a meter showing the following switch positions; 250 V., 28 V., MOD. PL., P.A. PL., and P.A. GRID.

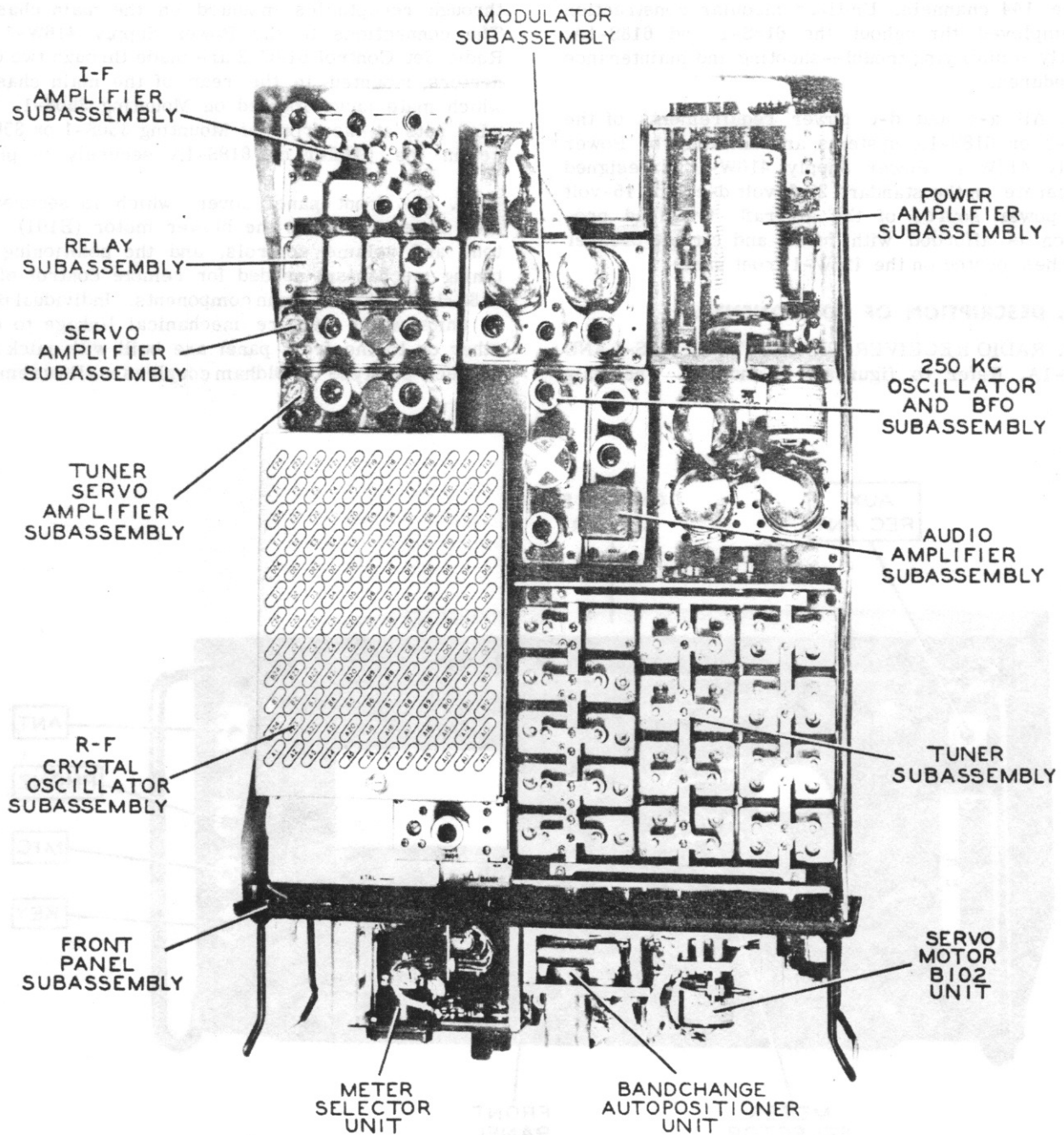


Figure 1-3. Radio Receiver-Transmitter 618S-1 and 618S-1A, Top View, Cover Removed

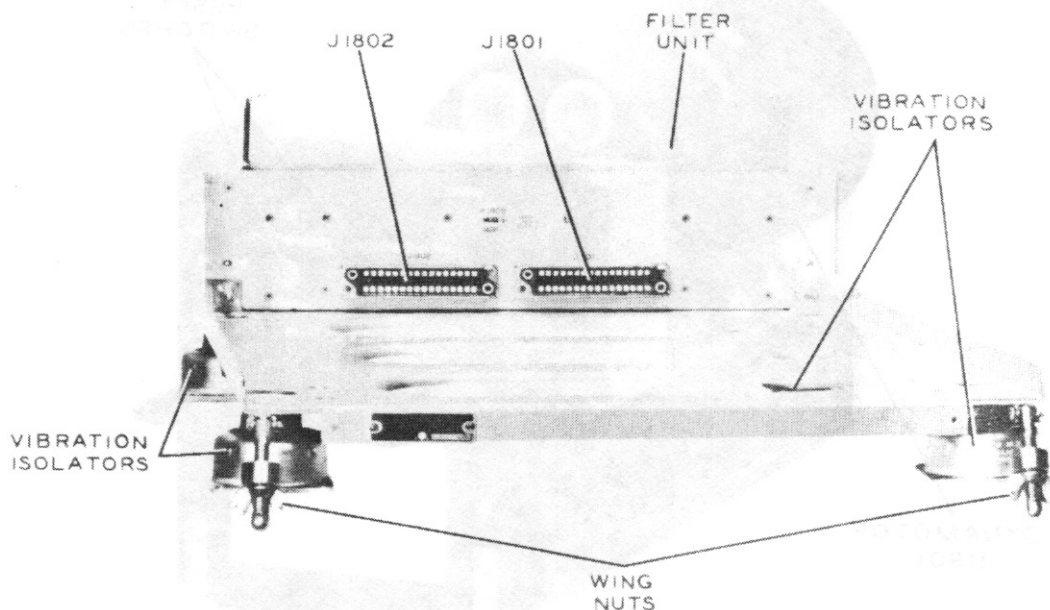


Figure 1-4. Mounting 350S-1 and 350S-3, Front Oblique View

1-18. MOUNTING 350S-1 AND 350S-3. Refer to figure 1-4. Mounting 350S-3 is identical to Mounting 350S-1 in appearance, weight, and mounting dimensions. The difference between the two units is in the method of removal of the filter unit. The filter unit of the 350S-3 is removable from both the front and top; whereas, it is removable only from the top in the 350S-1. The 350S-3 is, therefore, the preferred mounting, since additional space need not be allowed at the top of the 618S-1 or 618S-1A for removal and replacement of the filter unit. Vibration isolators and grounding straps are included on both mountings to assure vibration-free operation and good electrical contact.

1-19. POWER SUPPLY 416W-1 AND MOUNTING 350T-1. Power Supply 416W-1, figure 1-5, consists of a main chassis, a dynamotor, front panel, and associated detail parts. Power Supply 416W-1 provides 250 volts d-c, 600 volts d-c, 115 volts a-c, 18 volts a-c, 6.3 volts a-c, negative 65 volts d-c, and negative 50 volts d-c for operation of the 618S-1 and 618S-1A systems. Two fuses and two circuit breaker switches, each located on the 416W-1 front panel, afford overload protection. Power Supply 416W-1 is designed to mount on Mounting 350T-1, illustrated in figure 1-6.

1-20. AUTOMATIC ANTENNA TUNER 180L-2/3 AND MOUNTING 350D-3. Automatic Antenna Tuner 180L-2/3, figure 1-7, is enclosed in a single aluminum case, secured to the main mounting frame by machine screws. Power and control connections are made through a multicontact fixed plug (P102) at the lower

right of the mounting frame. The plug extends through a front panel cutaway area, as does the 52-ohm transmitter plug (P101). An SWR indicator is located adjacent to the r-f line connector and is viewed through a cutaway area. The antenna and auxiliary receiver connectors are located on a molded Fiberglass terminal at the upper right of the 180L-2/3 front panel. The entire 180L-2/3 component is retained on Mounting 350D-3 (see figure 1-8). Knurled fasteners at the front of the 350D-3 tighten clamps into a flange on the 180L-2/3 base plate to assure shakeproof installation. Complete service instructions for both the 180L-2/3 and the 350D-3 are included in the Handbook Service Instructions, T.O. 31R2-4-38-2. These instructions will not be repeated. All references to 180L-3 apply equally to 180L-2 except where noted. For complete information on Antenna Tuner 180L-2/3, refer to Handbook Service Instructions, Automatic Antenna Tuner 180L-2, 180L-3, T.O. 12R2-4-8-2.

1-21. RADIO SET CONTROL 614C-2. Refer to figure 1-9. Radio Set Control 614C-2 is designed to provide complete remote operation of the 618S-1 or 618S-1A systems. Provision is made for channel selection, gain control, bfo control, function selection, and tuning indication. A plastic front panel is included, which is edge lighted by two lamps to provide illumination of the switches and controls.

#### 1-22. DIFFERENCE BETWEEN RADIO SET 618S-1 AND RADIO SET 618S-1A.

1-23. The difference between Radio Set 618S-1 and Radio Set 618S-1A is the type of couplers used within

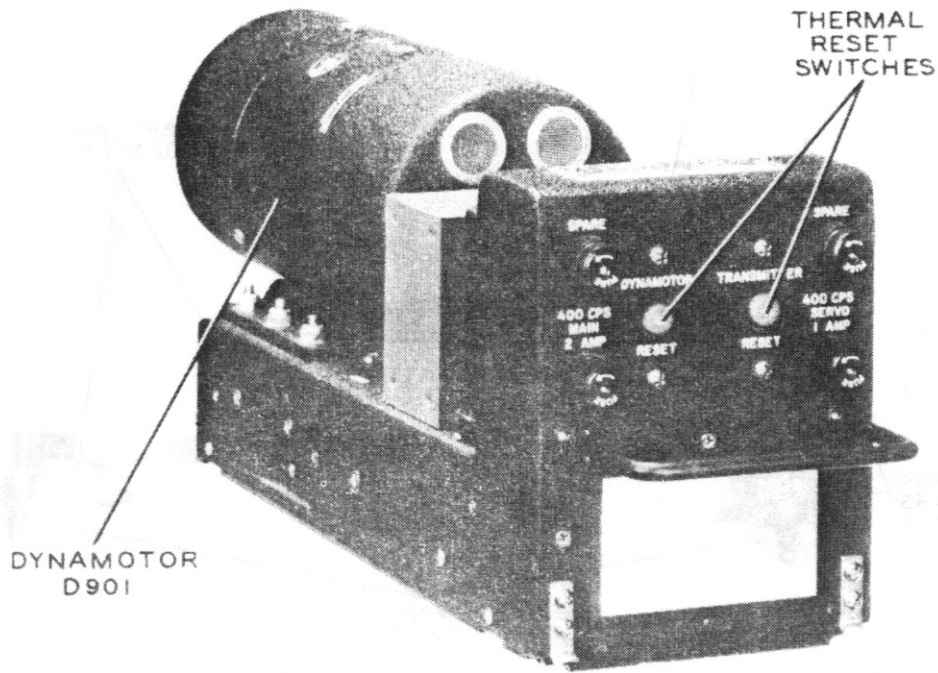


Figure 1-5. Power Supply 416W-1, Left Oblique View

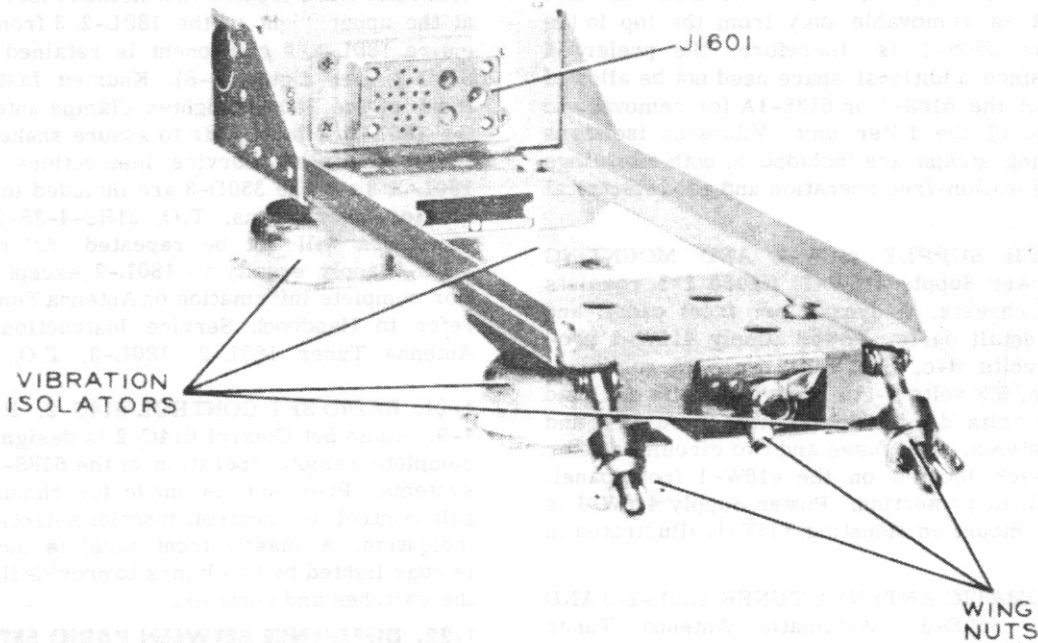


Figure 1-6. Mounting 350T-1, Left Oblique View



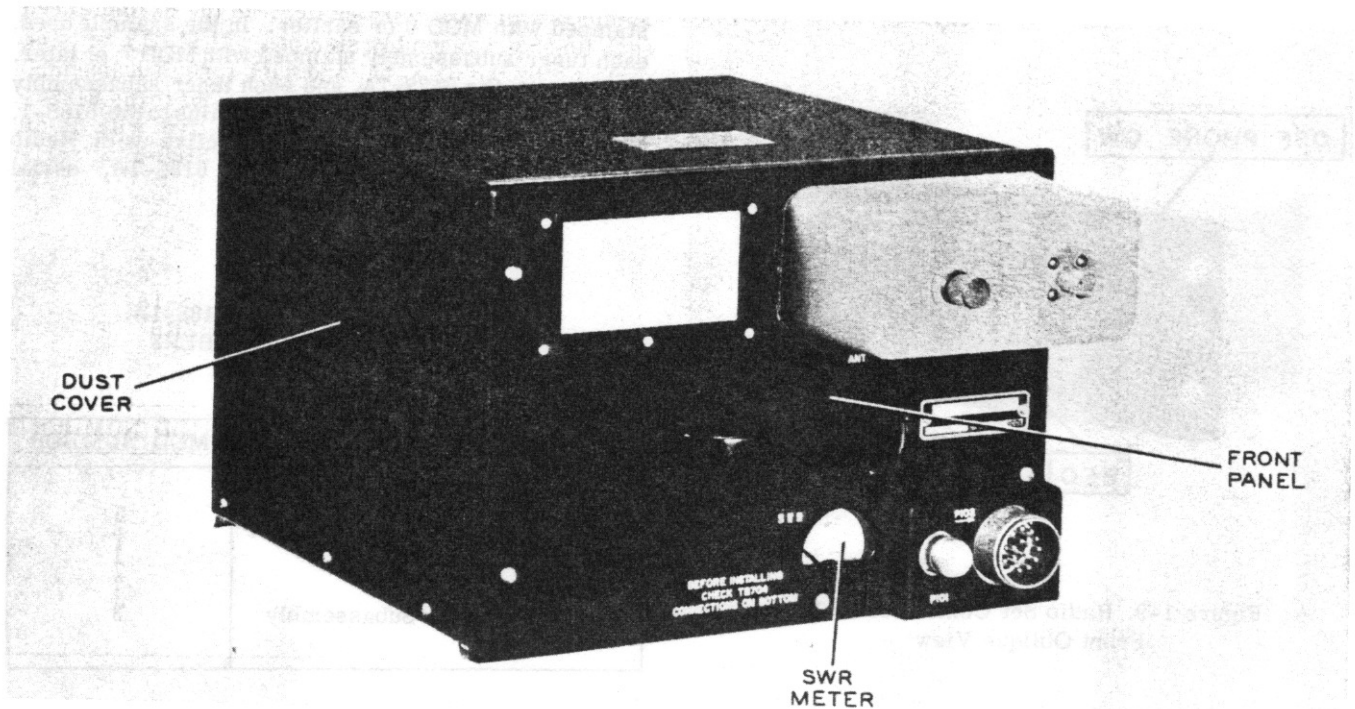


Figure 1-7. Automatic Antenna Tuner 180L-3, Left Oblique View

the main components. Radio Receiver-Transmitter 618S-1 employs pin-type couplers for the two drive motors (B102 and B103) and the tuner and power amplifier subassemblies. Radio Receiver-Transmitter 618S-1A uses Oldham couplers for these units. Oldham couplers eliminate the switch alignment problems inherent with pin-type couplers, and also are more rugged and easier to position. Paragraphs 6-88 through 6-94 of this handbook outline the method of converting Radio Receiver-Transmitter 618S-1 into Radio Receiver-Transmitter 618S-1A. Four units

of the 618S-1 are affected by the change to 618S-1A. These are the bandchange autopositioner unit, the servomotor B102 unit, the tuner subassembly, and the power amplifier subassembly. These units are stamped with MOD numbers on each chassis. These MOD numbers correspond to various modifications of each unit. Table III lists the MOD numbers of each unit affected by the coupler change. Any units which are stamped with the MOD numbers listed in table III, or with later MOD numbers, are units of Radio Receiver-Transmitter 618S-1A, and any units which

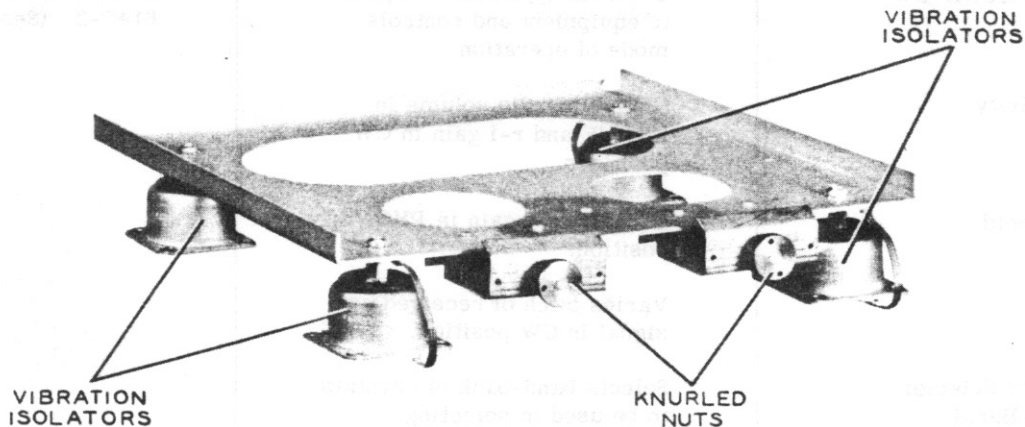


Figure 1-8. Mounting 350D-3, Left Oblique View

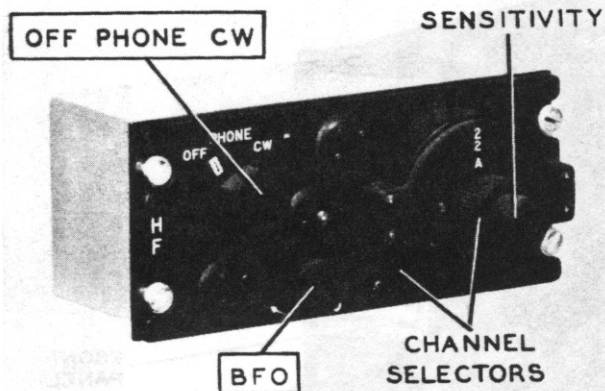


Figure 1-9. Radio Set Control 614C-2, Front Oblique View

stamped with MOD 6 or earlier. In the example used, each tuner subassembly stamped with MOD 7, or later, pertains to the 618S-1A, and each tuner subassembly stamped with MOD 6, or earlier, pertains to the 618S-1. The coupler change becomes effective with Radio Receiver-Transmitter 618S-1 or 618S-1A, serial number 1755.

TABLE III. RADIO SET 618S-1A, EFFECTIVE MOD NUMBERS

UNIT NOMENCLATURE	MOD NUMBER
Bandchange Autopositioner Unit	2
Servomotor B102 Unit	1
Tuner Subassembly	7
Power Amplifier Subassembly	3

are stamped with earlier MOD numbers are units of Radio Receiver-Transmitter 618S-1. For example; the tuner subassembly of Radio Receiver-Transmitter 618S-1A is stamped with MOD 7, and the tuner subassembly of Radio Receiver-Transmitter 618S-1 is

**1-24. OPERATING FUNCTION OF CONTROLS.**

1-25. Table IV lists the operating controls and connectors for each component of Radio Set 618S-1 and Radio Set 618S-1A and the function of each.

TABLE IV. OPERATING FUNCTION OF CONTROLS

NAME OF CONTROL	FUNCTION	LOCATION
<b>RADIO SET CONTROL 614C-2</b>		
OFF PHONE CW	Controls application of power to equipment and controls mode of operation.	Radio Set Control 614C-2. (See figure 1-9.)
Sensitivity	Controls audio volume in PHONE and r-f gain in CW positions.	
Threshold	Controls r-f gain in PHONE position.	
BFO	Varies pitch of received cw signal in CW position.	
Channel Selector (Band-Bank)	Selects band-bank of crystals to be used in selecting frequency.	
Channel Selector (Crystal)	Selects individual crystal within band-bank.	

TABLE IV. OPERATING FUNCTION OF CONTROLS (Cont)

NAME OF CONTROL	FUNCTION	LOCATION
<b>RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A</b>		
PHONE	Connection for headset.	Radio Receiver-Transmitter 618S-1 (See figure 1-2.)
MIC	Connection for microphone	
KEY	Connection for key	
250 V. - 28 V. - MOD. PL. - P.A. PL. - P.A. GRID	Selects function of multiple-use meter on front panel of 618S-1 and 618S-1A.	
ANT	Transmitter antenna jack.	
AUX REC ANT	Receiver antenna jack.	
<b>POWER SUPPLY 416W-1</b>		
RESET	Manual reset for 27.5-volt d-c circuit breaker switches.	Power Supply 416W-1 (See figure 1-5.)
<b>AUTOMATIC ANTENNA TUNER 180L-3</b>		
E102	Antenna Connector	Automatic Antenna Tuner 180L-3 (See figure 1-7.)
J103	Provides connection between the 618S-1 or 618S-1A AUX REC ANT jack and the 180L-3.	
J101	Provides connection between the 618S-1 or 618S-1A ANT jack and the 180L-3.	

**1-26. TECHNICAL SUMMARY.**

<b>RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A</b>	
Frequency Range:	2.0 mc to 25.0 mc
Number of Channels:	Up to 144
Type of Frequency Control:	Quartz crystal CR-18/U. Only one crystal required for transmitting and receiving. Crossband operation possible only by changing channel selectors of the 614C-2.
Frequency Change Method:	Autopositioner-type remotely controlled switching mechanism. Automatic resonating of tuner sub-assembly, power amplifier subassembly, and Automatic Antenna Tuner 180L-3.

## RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A (Cont)

Power Output, Transmit:	100 watts minimum from 2.0 mc to 14.2495 mc and 90 watts minimum from 14.250 mc to 25.0 mc.
Output Impedance, Transmit:	52 ohms.
Types of Emission, Transmit:	A-1 (cw telegraphy), A-3 (amplitude-modulated radiotelephony).
Modulation Capacity, Transmit:	95 per cent at rated power output.
Altitude Range, Transmit:	Full power up to 50,000 ft.
Audio Input, Transmit:	100-ohm input from standard aircraft microphone at 0.25 volt rms.
Speech Clipping, Transmit:	Up to 15 db.
Frequency Response, Transmit:	+1.5, -3.5 db from 300 to 3500 cps.
Distortion, Transmit:	Less than 10% at 60% modulation.
Frequency Stability, Transmit:	±0.007 per cent.
Channeling Time, Transmit:	8 seconds maximum, excluding 180L-3.
Spurious Radiation, Transmit:	The strength of any signal other than the desired frequency or its second harmonic will be at least 45 db below the desired frequency. The second harmonic shall be at least 35 db below the desired frequency. (Additional attenuation provided by Automatic Antenna Tuner 180L-3.)
Side Tone, Transmit:	Developed by rectification of the carrier for voice operation. Keyed 400-cps audio for monitoring of cw transmissions. Up to 20 mw available from side-tone output into 300-ohm load, or may be fed through receiver section audio stages.
Keying, Transmit:	Break in operation up to 30 words per minute using a common antenna for transmitting and receiving.
Sensitivity, Receive:	5 microvolt maximum input for 6-db signal-plus-noise to noise ratio with standard test signal modulated 30 per cent at 1000 cps, or for 10-db signal-plus-noise to noise ratio on cw reception.
Control of CW Sensitivity, Receive:	60-db range, with 5000-ohm external control.
AVC, Receive:	Maximum output variation of 3.5 db for signal input of 10 to 100,000 microvolts. No overload below 1 volt signal input.
Selectivity, Receive:	At 5.5 kc, maximum 6 db down; at 14 kc, minimum 60 db down.
I-F and Image Rejection, Receive:	80 db minimum.
Audio Power Output, Receive:	100 mw minimum into 300-ohm load.

RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A (Cont)	
Distortion, Receive:	10 per cent maximum
Response, Receive:	Not more than 3.5 db variation from 300 to 2500 cps. Not more than 10 db variation at 3000 cps.
Noise Limiting, Receive:	Series-type, biased peak noise limiter.
CW Reception:	Remote bfo control with $\pm 2000$ cps minimum, $\pm 4000$ cps maximum control range.
POWER SUPPLY 416W-1	
Dynamotor Manufacturer:	Wincharger Corporation.
Dynamotor Type:	4159
Dynamotor Catalogue:	SS6012
Dynamotor Input:	27.5 volts d-c at 21.6 amps, full load
Dynamotor Output:	600 volts d-c at 550 milliamperes; 250 volts d-c at 150 milliamperes.
Dynamotor Ambient Operating Temperature:	$-55^{\circ}\text{C}$ ( $67^{\circ}\text{F}$ ) to $+55^{\circ}\text{C}$ ( $+131^{\circ}\text{F}$ )

338W  
27.5W  
357W

1-27. POWER REQUIREMENTS. Table V lists the total power required by Radio Receiver-Transmitter 618S-1 or 618S-1A and Automatic Antenna Tuner 180L-3.

together with a spare for each. One protects the variable frequency 115-volt source and is rated at 2 amps, 250 volts. The other protects the 115-volt, 380-420 cps source and is rated at 1 amp, 500 volts.

1-28. FUSE COMPLEMENT. Two fuses are included with the 618S-1 and 618S-1A systems. Both are located on the front panel of Power Supply 416W-1

1-29. TUBE COMPLEMENT. Table VI lists the vacuum tubes, crystal rectifiers, and indicator lamps used in the 618S-1 and 618S-1A systems.

TABLE V. POWER REQUIREMENTS

27.5 VOLTS D-C		115 VOLTS, 380-420 CPS		115 VOLTS, 320-1000 CPS	
AMPS	WATTS	AMPS	WATTS	AMPS	WATTS
TOTAL POWER INPUT					
28	770	0.2	30	1.3	150
AUTOMATIC ANTENNA TUNER 180L-3					
2	55	0.13	15		
27.5-VOLT LINE, STANDBY					
6	165				

TABLE VI. RADIO SET 618S-1 AND 618S-1A,  
TUBE AND INDICATOR LAMP COMPLEMENT

DESIGNATION	TYPE	DESCRIPTION	FUNCTION	LOCATION
RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A				
V401	5654	Pentode	R-F Crystal Oscillator	R-F Oscillator Subassembly
V601	5651	Dual Triode	Servo Amplifier	PA and Tuner Servo Amplifier Subassemblies
V602	5686	Pentode	Servo Amplifier	PA and Tuner Servo Amplifier Subassemblies
V801	0A2WA	Gas Diode	Voltage Regulator	Relay Subassembly
V901	5749	Pentode	I-F Amplifier	I-F Amplifier Subassembly
V902	5749	Pentode	I-F Amplifier	I-F Amplifier Subassembly
V903	5749	Pentode	I-F Amplifier	I-F Amplifier Subassembly
V904	5726	Dual Diode	AVC-Detector	I-F Amplifier Subassembly
V905	5726	Dual Diode	AVC-Noise Limiter	I-F Amplifier Subassembly
V1001	5654	Pentode	Tuner Discriminator	Tuner Subassembly
V1002	5749	Pentode	Variable I-F Amplifier	Tuner Subassembly
V1003	5650	Pentagrid	2nd Transmitter Mixer	Tuner Subassembly
V1004	5650	Pentagrid	1st Transmitter Mixer	Tuner Subassembly
V1005	5750	Pentagrid	1st Receiver Mixer	Tuner Subassembly
V1006	5750	Pentagrid	2nd Receiver Mixer	Tuner Subassembly
V1007	5654	Pentode	Multiplier	Tuner Subassembly
V1008	5749	Pentode	1st R-F Amplifier	Tuner Subassembly
V1009	5749	Pentode	2nd R-F Amplifier	Tuner Subassembly
V1010	5686	Pentode	Driver	Tuner Subassembly
V1011	5686	Pentode	Driver	Tuner Subassembly
CR1001	1N198	Crystal Rectifier	P/O Tuner Discriminator	Tuner Subassembly

TABLE VI. RADIO SET 618S-1 AND 618S-1A,  
TUBE AND INDICATOR LAMP COMPLEMENT (Cont)

DESIGNATION	TYPE	DESCRIPTION	FUNCTION	LOCATION
RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A				
CR1002	1N198	Crystal Rectifier	P/O Tuner Discriminator	Tuner Subassembly
CR1003	1N198	Crystal Rectifier	P/O Tuner Discriminator	Tuner Subassembly
CR1004	1N198	Crystal Rectifier	P/O Tuner Discriminator	Tuner Subassembly
CR1005	1N198	Crystal Rectifier	P/O Tuner Discriminator	Tuner Subassembly
CR1006	1N198	Crystal Rectifier	P/O Tuner Discriminator	Tuner Subassembly
V1201	5749	Pentode	250 Kc Oscillator	250 Kc Oscillator and BFO Subassembly
V1202	5649	Pentode	BFO	250 Kc Oscillator and BFO Subassembly
CR1201	1N137A	Crystal Rectifier	BFO Rectifier	250 Kc Oscillator and BFO Subassembly
V1301	5814	Dual Triode	Audio Amplifier	Audio Amplifier Subassembly
V1302	5686	Pentode	Audio Output	Audio Amplifier Subassembly
V1401	5751	Dual Triode	Audio Amplifier	Modulator Subassembly
V1402	5726	Dual Diode	Clipper	Modulator Subassembly
V1403	5814	Dual Triode	Audio Driver	Modulator Subassembly
V1404	6159	Pentode	Modulator	Modulator Subassembly
V1405	6159	Pentode	Modulator	Modulator Subassembly
V1501	6159	Pentode	Power Amplifier	Power Amplifier Subassembly
V1502	6159	Pentode	Power Amplifier	Power Amplifier Subassembly
V1503	6159	Pentode	Power Amplifier	Power Amplifier Subassembly
CR1501	1N198	Crystal Rectifier	P/O PA Discriminator	Power Amplifier Subassembly
CR1502	1N198	Crystal Rectifier	P/O PA Discriminator	Power Amplifier Subassembly
CR1503	1N198	Crystal Rectifier	Side Tone Rectifier	Power Amplifier Subassembly

TABLE VI. RADIO SET 618S-1 AND 618S-1A,  
TUBE AND INDICATOR LAMP COMPLEMENT (Cont)

DESIGNATION	TYPE	DESCRIPTION	FUNCTION	LOCATION
POWER SUPPLY 416W-1				
CR1601		Selenium Rectifier	Voltage Doubling	416W-1
CR1602		Selenium Rectifier	Bias Rectifier	416W-1
CR1603		Selenium Rectifier	Voltage Doubling	416W-1
AUTOMATIC ANTENNA TUNER 180L-3				
V601	5751	Dual Triode	Loading-Phasing Amplifier	180L-3
V602	5751	Dual Triode	Loading-Phasing Amplifier	180L-3
V603	5814	Dual Triode	Loading-Phasing Amplifier	180L-3
RADIO SET CONTROL 614C-2				
I2601	AN3140-327	Indicator Lamp	Light Front Panel	614C-2
I2602	AN3140-327	Indicator Lamp	Light Front Panel	614C-2
I2603	AN3140-327	Indicator Lamp	Tuning Indication	614C-2



## SECTION II

### TEST EQUIPMENT AND SPECIAL TOOLS

**2-1. TEST EQUIPMENT REQUIRED.**

2-2. The following test equipment, listed in table VII.

or equipment of equal or superior characteristics, must be used in the performance of the tests required by this handbook.

TABLE VII. TEST EQUIPMENT REQUIRED

ITEM NO.	DESCRIPTION	NOMENCLATURE	COMMERCIAL TYPE
1	Multimeter	TS-352/U	Simpson 260
2	Test Set	AN/ARM-7	
3	R-F Indicator Probe	ID-263/U	
4	Interference Generator	SG-23/U	
5	Extension Rod (used with interference generator)	O-904	
6	Tube Tester	TV-3B/U	Hickok Model 539A
7	Signal Generator	AN/URM-25	Measurements Corp Model 65B or 82
8	Dynamotor Test Set	TS-414/U	
9	Vacuum Tube Voltmeter	TS-375/U	Hewlett-Packard Model 410B
10	Audio Oscillator	TS-382/U	Hewlett-Packard Model 200C
11	Oscilloscope	OS-8/U	DuMont Model 304A
12	Output Meter	TS-585B/U	Daven Model OP182
13	Frequency Meter	AN/USM-26	Hewlett-Packard Model 524B
14	Dummy Load; 51.5 ohms		Bird Model 82
15	Headset, cord and plug	H-4/AR or H-1/AR	
16	1 Megohm, 1/2 watt resistor		

TABLE VII. TEST EQUIPMENT REQUIRED (Cont)

ITEM NO.	DESCRIPTION	NOMENCLATURE	COMMERCIAL TYPE
17	Microphone, cord and plug	NAF-213264-6 or ANB-M-C1	
18	0.125/0.130 diameter test pin; used in alignment of tuner subassembly		
19	Capacitor, 0.01 microfarad		
20	Set of 10 crystals: 1.75, 2.0, 2.05, 2.25, 2.5, 2.75, 3.0, 3.09375, 3.25, and 3.5 megacycles.	Supplied with maintenance kit for 618S-1	
21	Gauge Block; 1-3/8 inches wide	Supplied with maintenance kit for 618S-1	
22	Dial Gauge; capable of measuring from zero to 0.8 inch in 0.001 inch increments.	Supplied with maintenance kit for 618S-1	
23	Monitor: A headset or loudspeaker with amplifier and volume control, if desired, including a transformer or other means for making the input impedance at least 10,000 ohms.		
24	Dummy Microphone: A device for connecting Audio Oscillator TS-382A/U to the microphone terminals of the 618S-1 or 618S-1A in such a manner as to simulate the action of a real microphone. See figure 2-1.		
25	Power Source: Capable of delivering 27.5 volts d-c at 28 amperes continuously and 100 amperes surge; and capable of delivering 115 volts, 380-420 cps at 1.025 amperes.		

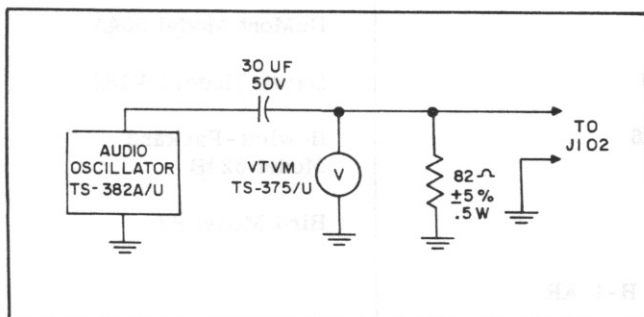


Figure 2-1. Dummy Microphone Circuit, Schematic Diagram

**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 listed in table VIII. These tools are included with the 618S-1 and 618S-1A, and are used for removal and replacement of electrical and mechanical parts.

TABLE VIII. SPECIAL MAINTENANCE TOOLS, EQUIPMENT SUPPLIED

PART NUMBER	NAME	APPLICATION
024 2900 00	#4 Bristo Wrench	Removal of setscrews
024 9730 00	#6 Bristo Wrench	Removal of setscrews
024 0019 00	#8 Bristo Wrench	Removal of setscrews
024 9710 00	#10 Bristo Wrench	Removal of setscrews

**2-7. CABLE FABRICATION.**

2-8. SYSTEM CABLING. Figure 2-2 illustrates a typical bench harness setup for preinstallation tests and adjustments. The power and control cables illustrated must be fabricated, using bulk supplies. Reference is made to the external wiring diagram, figure 7-15, for all necessary cabling information, such as AN nomenclature of plugs and connectors, functions of interconnecting wires, and wire sizes. Further information for fabricating cables may be obtained

from publication AN Connector Handbook AN03-5-90. Figures 2-3 and 2-4 illustrate the method of connecting the r-f cables to the r-f plugs.

2-9. SUBASSEMBLY CABLING. Table IX lists the cables required for maintenance and trouble-shooting procedures for the individual subassemblies of Radio Receiver-Transmitter 618S-1 and Radio Receiver-Transmitter 618S-1A. These cables should be fabricated from bulk supplies, as illustrated in figures 2-5 through 2-9. A length of approximately two feet should be allowed between the cable plugs in each case.

TABLE IX. SPECIAL CABLES REQUIRED FOR MAINTENANCE PROCEDURES

FIGURE REFERENCE	DESCRIPTION	APPLICATION
2-5	20-terminal extension cable with two plugs.	Provides power and control connections between the 618S-1 or 618S-1A main chassis and the tuner, power amplifier, i-f amplifier, and front panel subassemblies.
2-6	15-terminal extension cable with two plugs.	Provides power and control connections between the 618S-1 or 618S-1A main chassis and the modulator, pa servo amplifier, tuner servo amplifier, tuner relay, and front panel subassemblies.
2-7	11-terminal extension cable with two plugs.	Provides power and control connections between the 618S-1 or 618S-1A main chassis and the audio amplifier subassembly.
2-8	9-terminal extension cable with two plugs.	Provides power and control connections between the 618S-1 or 618S-1A main chassis and the bandchange Autopositioner unit.
2-9	7-terminal extension cable with two plugs.	Provides power and control connections between the 618S-1 or 618S-1A main chassis and the PHONE MIC KEY, servomotor B102, meter selector, and blower motor B101 units.

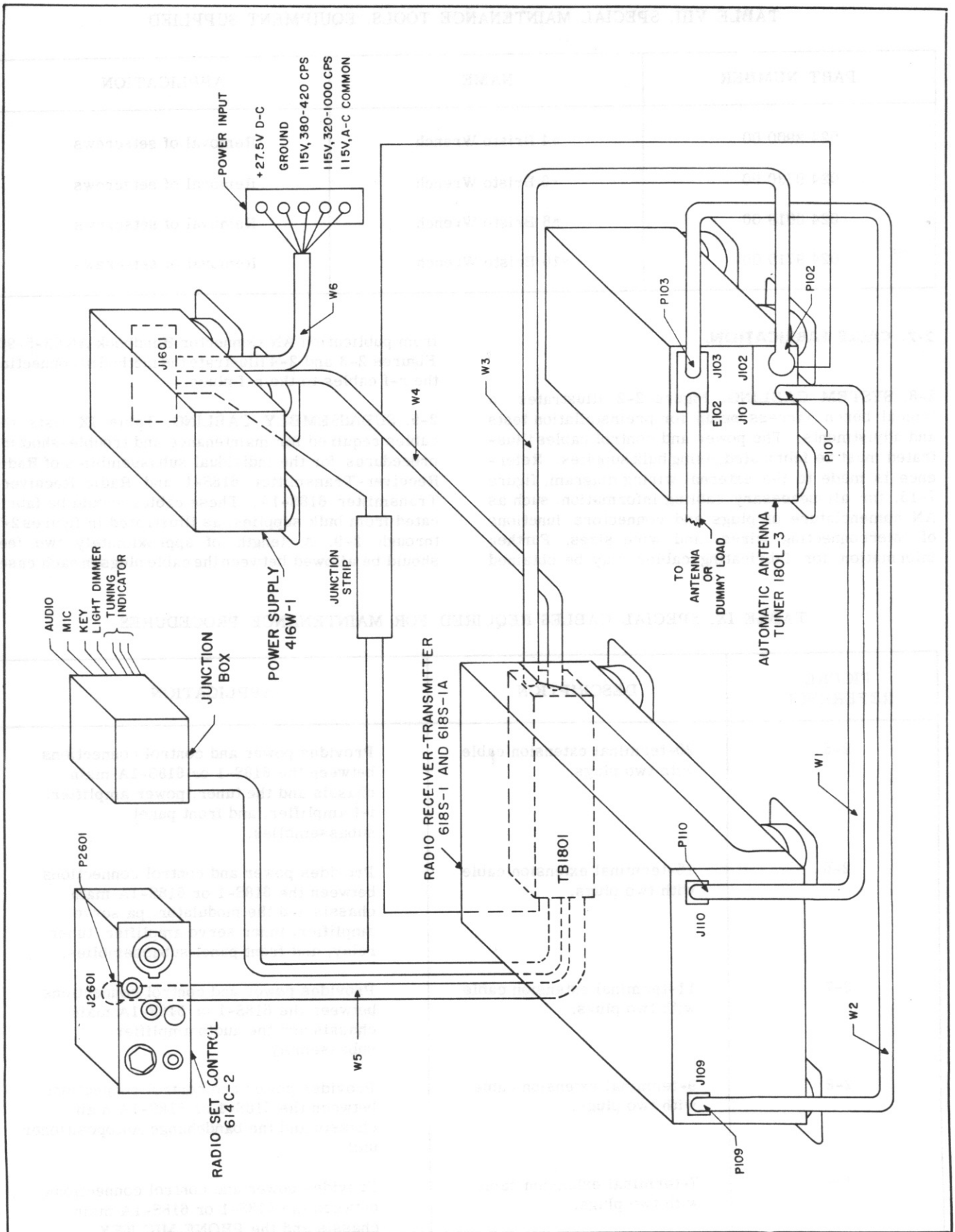


Figure 2-2. Radio Set 618S-1 and 618S-1A, System Cabling

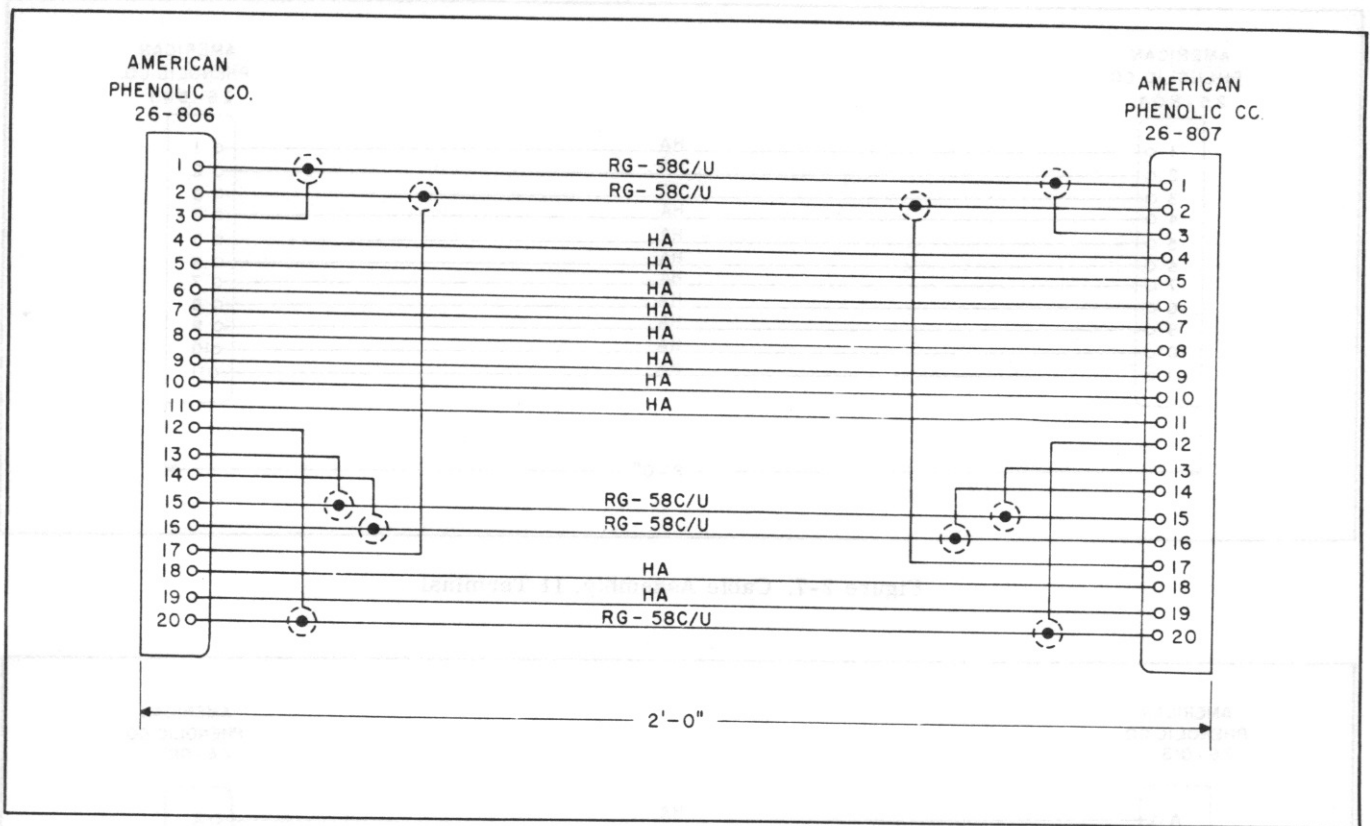


Figure 2-5. Cable Assembly, 20 Terminal

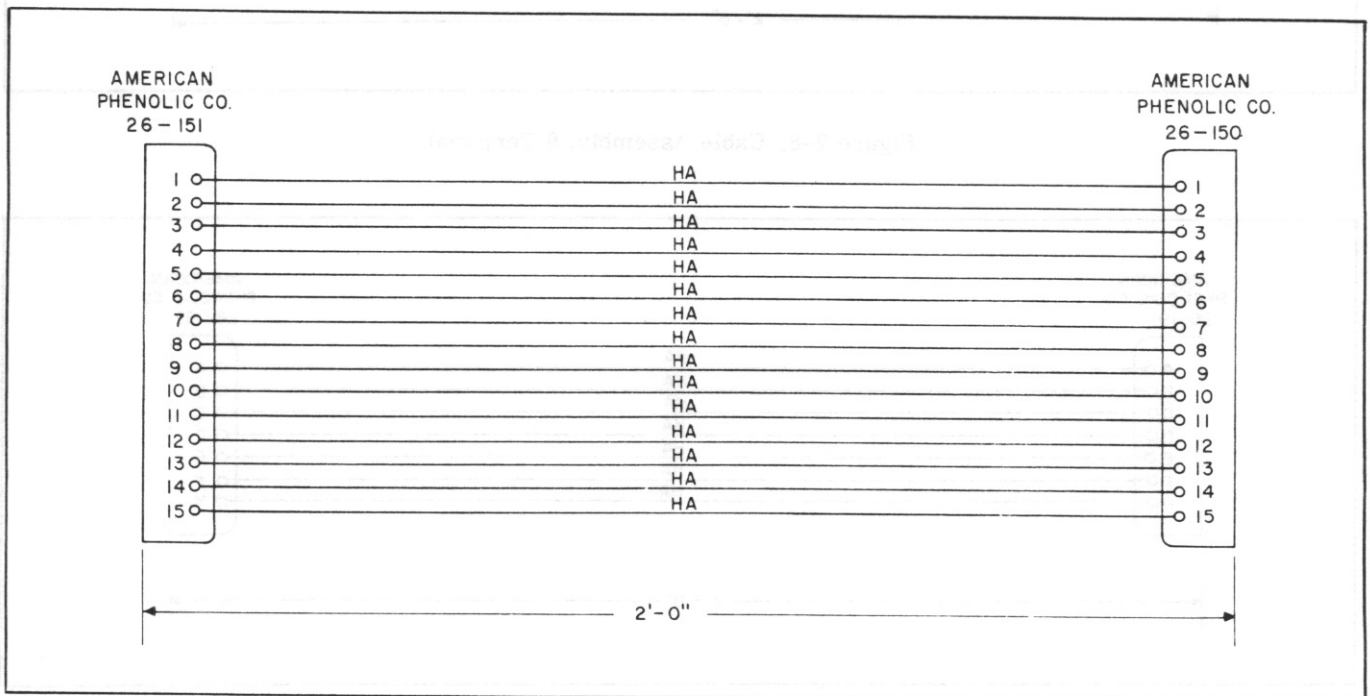


Figure 2-6. Cable Assembly, 15 Terminal

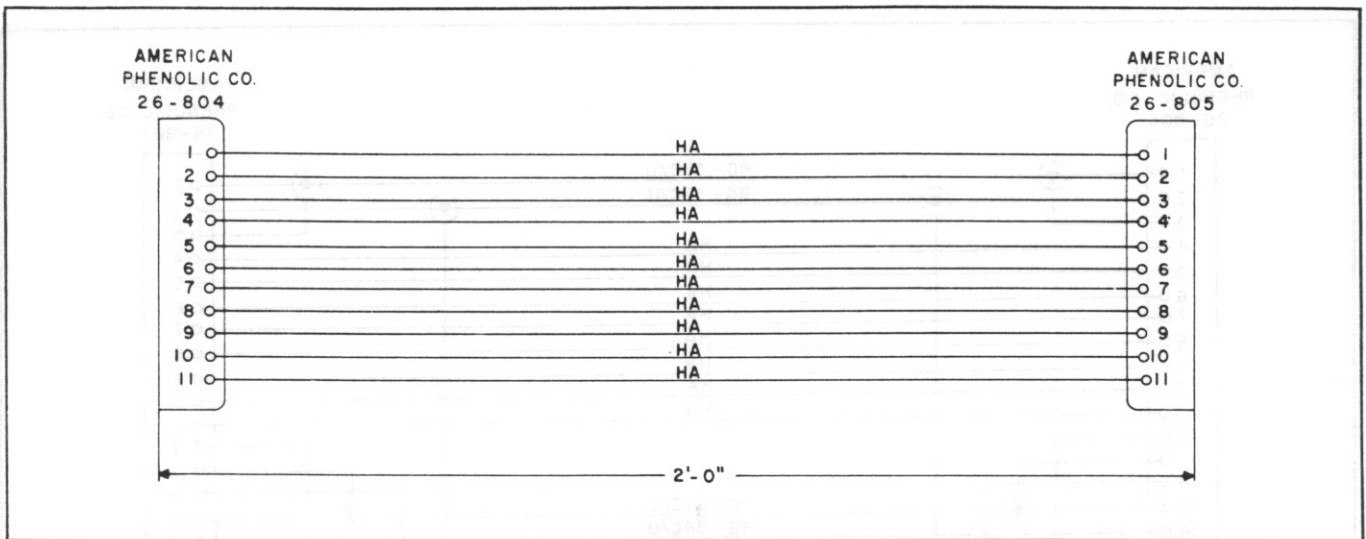


Figure 2-7. Cable Assembly, 11 Terminal

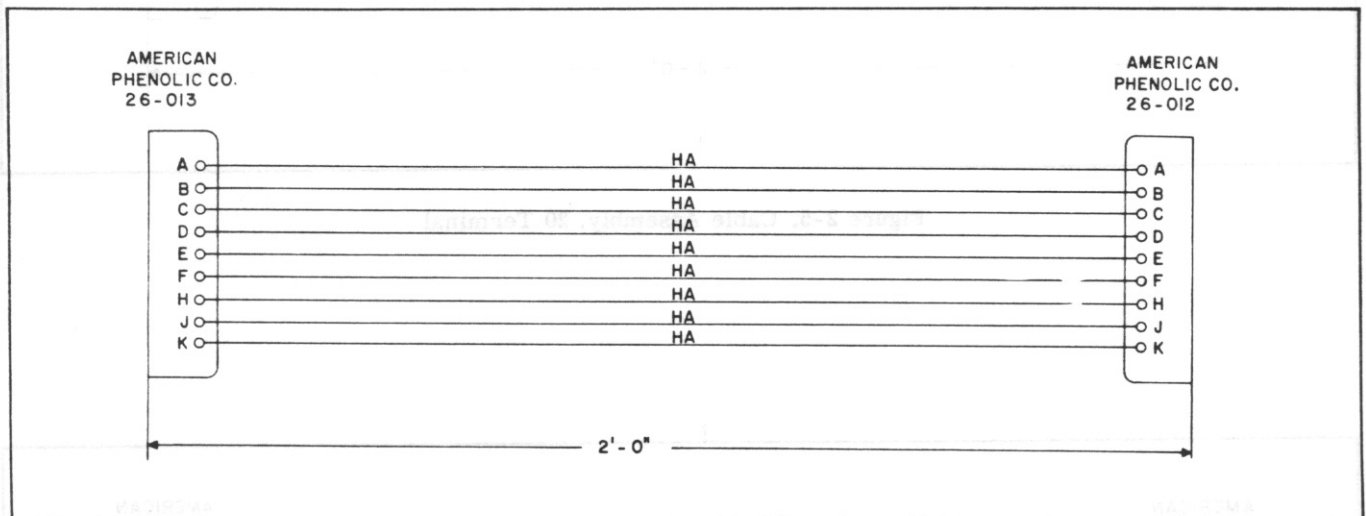


Figure 2-8. Cable Assembly, 9 Terminal

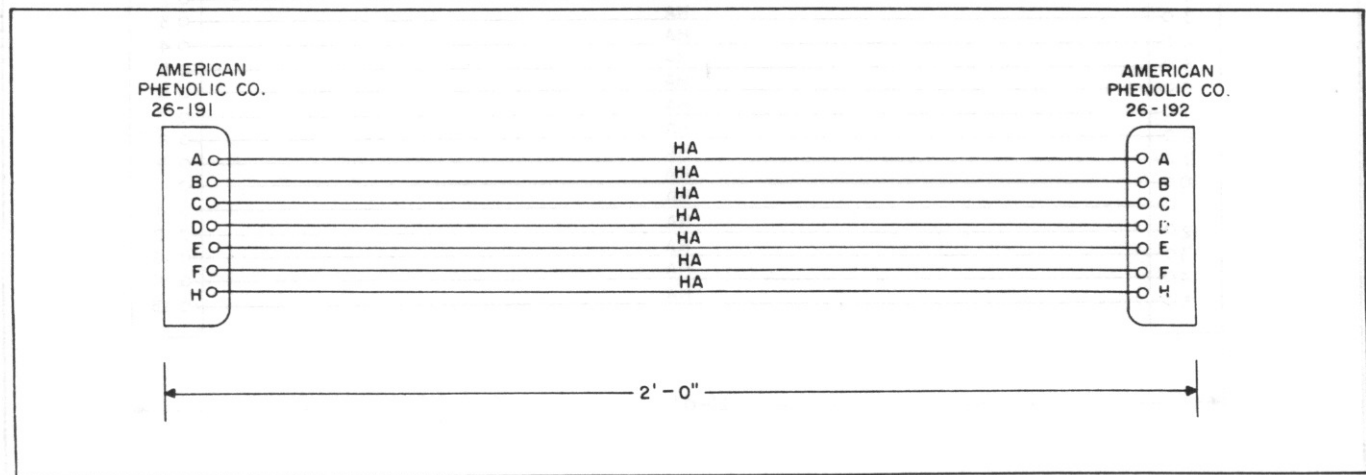


Figure 2-9. Cable Assembly, 7 Terminal

## SECTION III

### PREPARATION FOR USE AND RESHIPMENT

#### 3-1. UNPACKING AND INSPECTING THE EQUIPMENT.

3-2. The equipment should be handled and unpacked with extreme care. Inspect each unit for evidence of damage during shipment or missing components. The received equipment should be checked against the packing slip and the list of equipment supplied, table I of this handbook. Carefully remove the equipment from the packing boxes. Save all internal packaging, filler, blocking, and bracing to be used with the original packaging containers when the equipment is repacked for storage or shipment. Check the mechanical operation of the equipment by rotating the control knobs. All claims for damage in shipment must be filed promptly with the transportation company involved.

#### 3-3. VISUAL INSPECTION.

#### 3-4. RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A.

- a. Rotate the two Dzus fasteners located at the rear of the component and pull the chassis from the cover.
- b. Inspect all tubes for proper seating in their sockets, and check the tube shields for mechanical security.
- c. Inspect the redheaded captive screws of each sub-assembly for tightness.
- d. Inspect mechanical parts such as gears and rollers for evidence of damage.
- e. Remove the front panel cover by removing four screws.
- f. Inspect the main chassis and front panel units for dirt, metal scraps, or condensation.
- g. Inspect the roller coil (E1513), and adjust if necessary. Refer to paragraph 6-77.
- h. Inspect the connection between pins 2 and 4 of K1501. These pins are connected at the factory so that Radio Receiver-Transmitter 618S-1 or 618S-1A is properly wired for use with Automatic Antenna Tuner 180L-2. If Automatic Antenna Tuner 180L-3 is to be used with Radio Receiver-Transmitter 618S-1 or 618S-1A, the connection between pins 2 and 4 of K1501 must be removed.
- i. Replace the front panel cover and the main chassis cover.

#### 3-5. POWER SUPPLY 416W-1.

- a. Remove the bottom plate from Power Supply 416W-1. The bottom plate is secured by four screws.
- b. Inspect for loose or broken parts, dirt, metal scraps, and condensation.
- c. Replace the bottom plate.

#### 3-6. RADIO SET CONTROL 614C-2.

- a. Remove the rear cover from Radio Set Control 614C-2 by rotating the two Dzus fasteners.

- b. Inspect for loose or broken parts, dirt, metal scraps, and condensation.
- c. Operate all controls and check mechanical operation.
- d. Replace the cover.

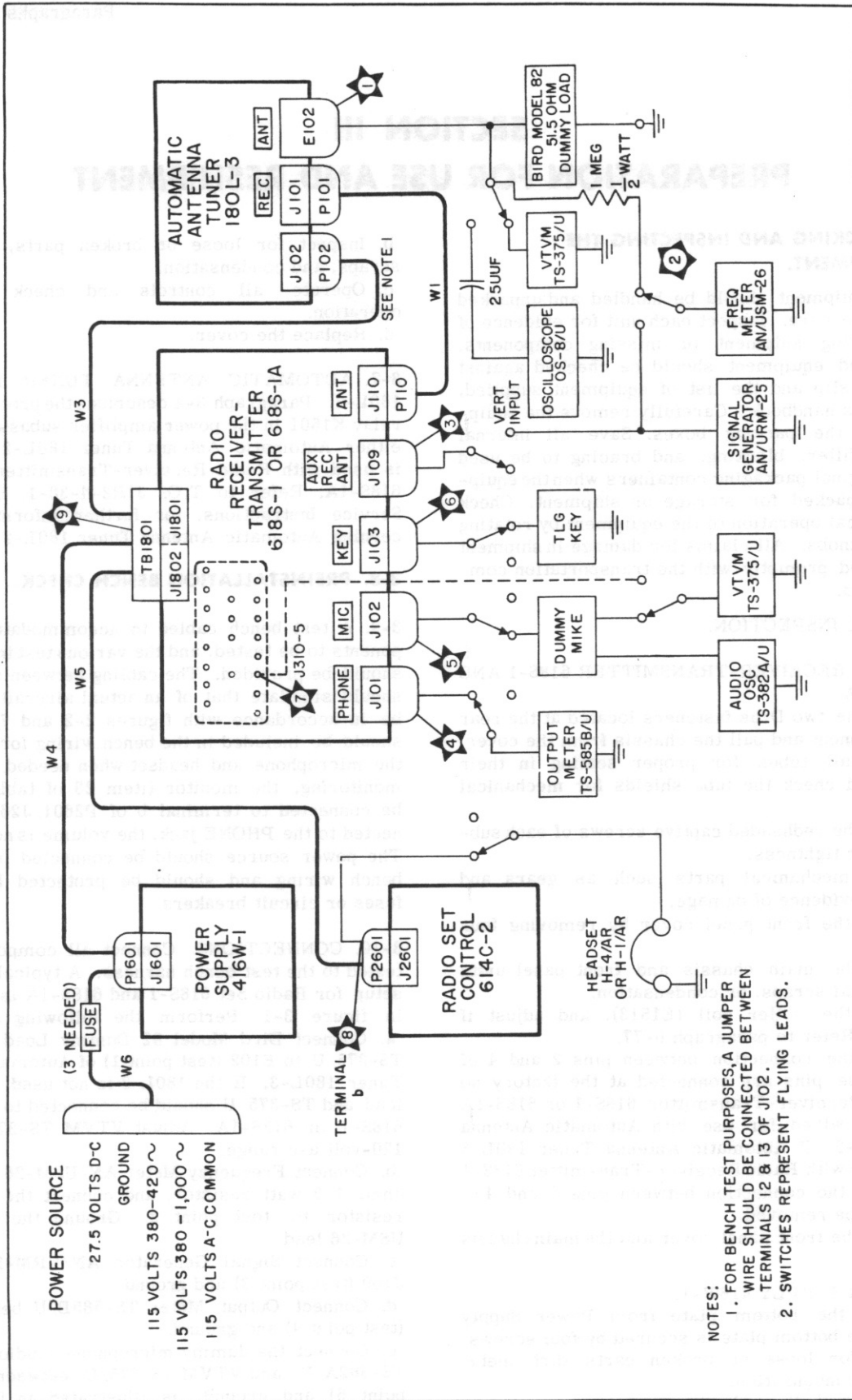
3-7. AUTOMATIC ANTENNA TUNER 180L-2 OR 180L-3. Paragraph 3-4 describes the proper wiring of relay K1501 in the power amplifier subassembly when either Automatic Antenna Tuner 180L-2 or 180L-3 is used with Radio Receiver-Transmitter 618S-1 or 618S-1A. Refer to T.O. 31R2-4-38-1, Handbook of Service Instructions, for further information concerning Automatic Antenna Tuner 180L-2 or 180L-3.

#### 3-8. PREINSTALLATION BENCH CHECK.

3-9. A test bench cabled to accommodate the components to be tested, and the various test instruments, should be provided. The cabling between components should simulate that of an actual aircraft and should be in accordance with figures 2-2 and 7-15. Jacks should be included in the bench wiring for connecting the microphone and headset when needed. For aural monitoring, the monitor (item 23 of table VII) may be connected to terminal b of P2601/J2601. If connected to the PHONE jack, the volume is not variable. The power source should be connected into the test bench wiring and should be protected by suitable fuses or circuit breakers.

3-10. CONNECTIONS. Connect all components to be tested to the test bench harness. A typical test bench setup for Radio Set 618S-1 and 618S-1A is illustrated in figure 3-1. Perform the following operations:

- a. Connect Bird Model 82 Dummy Load and VTVM TS-375/U to E102 (test point 1) of Automatic Antenna Tuner 180L-3. If the 180L-3 is not used, the dummy load and TS-375/U should be connected to J110 of the 618S-1 or 618S-1A. Adjust VTVM TS-375/U to the 120-volt a-c range.
- b. Connect Frequency Meter AN/USM-26 to a 1 megohm, 1/2 watt resistor, and connect the 1 megohm resistor to test point 2. Ground the other AN/USM-26 lead.
- c. Connect Signal Generator AN/URM-25 between J109 (test point 3) and ground.
- d. Connect Output Meter TS-585B/U between J101 (test point 4) and ground.
- e. Connect the dummy microphone, Audio Oscillator TS-382A/U, and VTVM TS-375/U, between J102 (test point 5) and ground, as illustrated in figures 2-1 and 3-1.
- f. Connect a telegraph key to J103 (test point 6).
- g. Complete cabling to components as illustrated in figure 3-1.



NOTES:  
 1. FOR BENCH TEST PURPOSES, A JUMPER WIRE SHOULD BE CONNECTED BETWEEN TERMINALS 12 & 13 OF J102.  
 2. SWITCHES REPRESENT FLYING LEADS.

Figure 3-1. Radio Set 618S-1 and 618S-1A, Test Bench Setup



3-11. FREQUENCY SELECTION TESTS. Perform the following operations:

a. Connect the ten test crystals to the r-f crystal oscillator subassembly and remove all other crystals. Refer to table X. crystal placement.

b. Connect the dummy load. VTVM TS-375/U. the 1 megohm resistor and Frequency Meter AN/USM-26 to E102 (test point 1) as illustrated in figure 3-1. All other test equipment should be disconnected at this time.

c. Press the RESET switches of Power Supply 416W-1 and operate the OFF PHONE CW switch of Radio Set Control 614C-2 to the PHONE position. Allow at least ten minutes for warmup.

d. Operate the channel selector switches of Radio Set Control 614C-2 to each position listed in table X. and observe output frequencies as read on Frequency Meter AN/USM-26. Frequencies should not vary over 0.007% of those listed in table X.

e. Check the time interval required for the tuning cycle to complete when operated from the A1 to the U9 position. Radio Receiver-Transmitter 618S-1 and 618S-1A should complete its tuning cycle in eight seconds or less. Automatic Antenna Tuner 180L-3 should complete its tuning cycle in 22 seconds or less.

#### NOTE

Do not attempt to channel the 618S-1 or 618S-1A more than once a minute. If channeled too frequently a time-delay relay (K711) in the 180L-3 will heat and prevent the 618S-1 or 618S-1A system from completing its tuning cycle. Relay K711 also will operate if the

total tuning time, following the centering cycle of the tuner subassembly, exceeds 45 seconds. If relay K711 does operate, wait at least one minute before rechanneling the equipment.

#### CAUTION

The maximum duty cycle of Automatic Antenna Tuner 180L-3 is five minutes r-f on and five minutes r-f off. To insure reliable operation, do not exceed this duty cycle.

#### 3-12. TRANSMITTER TESTS.

3-13. R-F POWER OUTPUT. Perform the following operations:

a. Connect the dummy load and the r-f probe of VTVM TS-375/U from test point 1 to ground. Remove the 1 megohm resistor and Frequency Meter AN/USM-26.

b. Connect a telegraph key to test point 6 or a microphone to test point 5. All other test equipment should be removed.

c. Operate the OFF PHONE CW switch to the CW position and allow at least 10 minutes for warmup.

d. Set the 614C-2 channel selectors to the A1 (2.0-megacycle position) and allow the 618S-1 or 618S-1A to complete its tuning cycle.

e. Depress the telegraph key or microphone push-to-talk button and observe indication on VTVM TS-375/U. Reading should be not less than 71.8 volts a-c, which corresponds to 100 watts power output.

TABLE X. TEST CRYSTAL POSITIONS AND OPERATING FREQUENCIES

CRYSTAL POSITION	PLACEMENT FREQ	(BAND 1)		(BAND 2)		(BAND 3)		(BAND 4)	
		FREQ POSITION	TESTS FREQ	FREQ POSITION	TESTS FREQ	FREQ POSITION	TESTS FREQ	FREQ POSITION	TESTS FREQ
A1	1.75	A1	2.00	G1	3.75	M1	7.25	U1	14.25
A2	2.00	A2	2.25	G2	4.25	M2	8.25	U2	16.25
A3	2.25	A3	2.50	G3	4.75	M3	9.25	U3	18.25
A4	2.50	A4	2.75	G4	5.25	M4	10.25	U4	20.25
A5	2.75	A5	3.00	G5	5.75	M5	11.25	U5	22.25
A6	3.00	A6	3.25	G6	6.25	M6	12.25	U6	24.25
A7	3.25	A7	3.50	G7	6.75	M7	13.25	U7	
A8	3.50	A8	3.75	G8	7.25	M8	14.25	U8	
A9	3.09375	A9		G9		M9		U9	25.00
A10	2.05	A10	2.30	G10	4.35	M10	8.25	U10	16.65

NOTE: All frequencies are in megacycles.

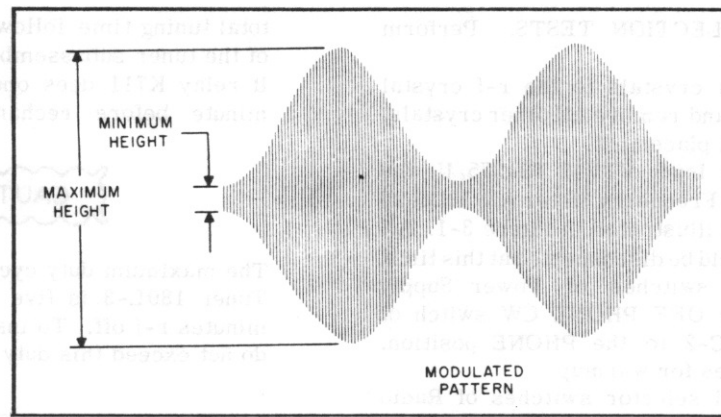


Figure 3-2. Oscilloscope Modulation Pattern

f. Operate the meter selector to the P.A. PL. position and observe indication. Meter should indicate within the red area.

g. Repeat steps e and f for all positions and frequencies listed in table XI. In each case, the TS-375/U should indicate as listed in table XI.

3-14. MODULATION. The operator must perform the following operations:

a. Connect the dummy microphone circuit to test point 5. Refer to figures 2-1 and 3-1.

b. Connect VTVM TS-375/U and Audio Oscillator TS-382A/U to the dummy microphone as illustrated in figure 2-1. Adjust the TS-382A/U to 0.25 volt a-c at 1000 cps.

c. Connect Oscilloscope OS-8/U across the dummy load through a 25-micromicrofarad capacitor and connect to E102 (test point 1). Adjust the OS-8/U for a horizontal sweep capable of reproducing two or three modulated cycles at 1000 cps.

d. Connect a telegraph key to test point 6.

e. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

f. Operate the 614C-2 to the A1 (2.00-megacycle position).

g. Key the 618S-1 or 618S-1A by operating the telegraph key.

h. Adjust the CLIPPING control (R1404 on the bottom of the modulator subassembly) to the maximum clockwise position.

i. Adjust the GAIN control (R1403 on the bottom of the modulator subassembly) for 80% modulation. Use the following formula to calculate the percentage of modulation. Refer to figure 3-2.

$$\% \text{ Modulation} = \frac{\text{Maximum} - \text{Minimum}}{\text{Maximum} + \text{Minimum}} \times 100$$

NOTE

The minimum percentage of modulation that is allowable depends upon the r-f power output and therefore upon the band of operation. Refer to figure 3-3 for the minimum percentage of modulation allowable for different values of r-f power output. Examination of figure 3-3 will illustrate that a minimum modulation percentage of 95% is allowable with 100 watts r-f power output.

TABLE XI. R-F POWER OUTPUT TESTS

BAND	POSITION	FREQUENCY (MC)	R-F POWER VOLTS A-C	OUTPUT WATTS
1	A1	2.00	71.8	100
	A8	3.75	71.8	100
2	G1	3.75	71.8	100
	G8	7.25	71.8	100
3	M1	7.25	71.8	100
	M8	14.25	68.2	90
4	U1	14.25	68.2	90
	U9	25.00	68.2	90

j. Adjust the CLIPPING control for threshold at the 80% modulation point.

k. Increase the output level of Audio Oscillator TS-382A/U by 12 db. This may be accomplished by increasing the output voltage of the TS-382A/U to 1-volt a-c. The waveform, as observed on Oscilloscope OS-8/U, should be clipped below the 100% modulation point.

l. Lock the CLIPPING and GAIN controls in position.  
m. Reduce the TS-382A/U output level to that required for 60% modulation.

n. Vary the frequency of the TS-382A/U between 300 and 3500 cps, holding the audio input level constant. The modulation percentage should remain between 40% and 70%.

o. Adjust the frequency of the TS-382A/U to 5000 cps. The modulation percentage should be not less than 22%.

3-15. SIDETONE. With the equipment setup as described in the preceding paragraph, perform the following operations:

a. Connect a headset to the PHONE jack (test point 4) or to terminal b of P2601/J2601, and monitor the signal as the level and frequency of the TS-382A/U is varied. Signal should be audible.

b. Vary the PHONE SIDETONE control (R106 on the 618S-1 or 618S-1A front panel subassembly) and notice if the amplitude of the side-tone signal is variable.

c. With the TS-382A/U set for 1 volt at 1000 cps, adjust R106 for a comfortable headset level.

d. Operate the OFF PHONE CW switch to the CW position and listen for a 400-cps signal.

e. Vary the CW SIDETONE control (R107 on the 618S-1 or 618S-1A front panel subassembly) and notice if the amplitude of the side-tone signal is variable.

f. Adjust R107 for a comfortable headset level.

### 3-16. RECEIVER TESTS.

3-17. SENSITIVITY. The operator must perform the following operations:

#### NOTE

To assure reliability of the sensitivity tests outlined in the following steps, all procedures should be performed in a screen room to prevent man-made noise signals from interfering with results.

a. Connect Signal Generator AN/URM-25 to jack J109 (test point 3). Adjust for an output of 2.75 megacycles at 1000 microvolts, modulated 30% at 1000 cps. Use Frequency Meter AN/USM-26 to set the AN/URM-25 to the correct frequency.

b. Connect Output Meter TS-585B/U to test point 4 and adjust to the 500-milliwatt range with an internal impedance of 300 ohms.

c. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

d. Operate the 614C-2 channel selectors to the A4 position (2.75 megacycles).

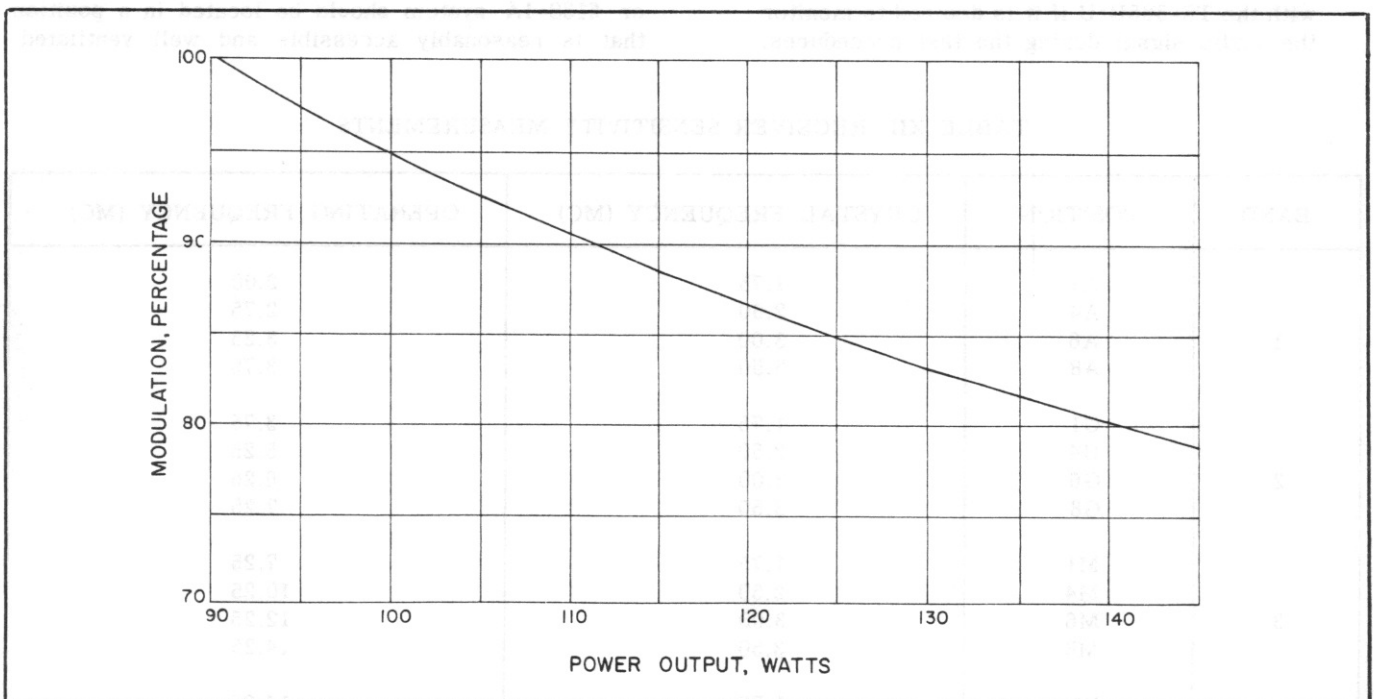


Figure 3-3. Radio Receiver-Transmitter 618S-1 and 618S-1A, Modulation Characteristics

- e. Adjust the sensitivity and threshold controls of the 614C-2 for maximum output. The threshold control (R2602) is a screw driver adjustment at the rear of the 614C-2 and the sensitivity control is the small knob on the 614C-2 front panel.
- f. Adjust the AUDIO control (R109 on the 618S-1 or 618S-1A front panel subassembly), for an audio power output of 300 milliwatts as read on Output Meter TS-585B/U.
- g. Reduce the output level of Signal Generator AN/URM-25 to 5 microvolts. Output Meter TS-585B/U should indicate not less than 100 milliwatts.
- h. Remove the modulation. The signal-plus-noise to noise ratio should be at least 6 db (modulation-on to modulation-off ratio of 4 to 1 as read on Output Meter TS-585B/U).
- i. Operate the OFF PHONE CW switch to the CW position and remove the modulation.
- j. Remove the TS-585B/U and connect a headset to terminal b of P2601/J2601.

**NOTE**

When a 300-ohm headset such as the H-1/AR or the H-4/AR is connected to either the PHONE jack or to terminal b of P2601, Output Meter TS-585B/U should be removed from the PHONE jack. The TS-585B/U and a low-impedance headset should not be connected across the audio output terminals at the same time or transformer T1301 will be mismatched and the test results will be inaccurate. A high-impedance monitor, such as described in table VII, item 23, may be used in parallel with the TS-585B/U if it is desired to monitor the audio signal during the test procedures.

- k. Adjust the 614C-2 BFO control for a signal of approximately 1000 cps.
- l. Remove the headset and replace the TS-585B/U. Observe the power output indication on the TS-585B/U with Signal Generator AN/URM-25 adjusted to 5 microvolts output. Output Meter TS-585B/U should indicate at least 100 milliwatts.
- m. With the modulation off, remove the r-f input signal and observe the indication on the TS-585B/U. The reading should change at least 10 db (indication in the r-f on position at least 10 times that in the r-f off position).
- n. Repeat the sensitivity measurements outlined in steps a through m (excluding step f) for frequencies listed in table XII.

**3-18. INSTALLATION OF EQUIPMENT.**

3-19. The individual components of Radio Set 618S-1 and 618S-1A must be mounted in a location convenient to the existing facilities of the aircraft. Every consideration must be given in the location of equipment and the design of installation details, to promote operator efficiency, ease of adjustment, and component replacement. No attempt is made in this handbook to present complete installation instructions, since the particular type of aircraft involved will determine the installation procedure. A general procedure is outlined in subsequent paragraphs. Figure 3-4 illustrates a typical 618S-1 or 618S-1A installation.

**3-20. RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A.**

3-21. LOCATION. The main components of the 618S-1 or 618S-1A system should be located in a position that is reasonably accessible and well ventilated.

**TABLE XII. RECEIVER SENSITIVITY MEASUREMENTS**

BAND	POSITION	CRYSTAL FREQUENCY (MC)	OPERATING FREQUENCY (MC)
1	A1	1.75	2.00
	A4	2.50	2.75
	A6	3.00	3.25
	A8	3.50	3.75
2	G1	1.75	3.75
	G4	2.50	5.25
	G6	3.00	6.25
	G8	3.50	7.25
3	M1	1.75	7.25
	M4	2.50	10.25
	M6	3.00	12.25
	M8	3.50	14.25
4	U1	1.75	14.25
	U4	2.50	20.25
	U9	3.09375	25.00

Adequate clearance for mounting the main component on Mounting 350S-1 or 350S-3 must be provided. Access to the front panel is necessary to permit removal of the 618S-1 or 618S-1A from the 350S-1 or 350S-3 and to permit checking operation by observation of the front panel meter.

**3-22. MOUNTING.** Normally, Radio Receiver-Transmitter 618S-1 or 618S-1A is mounted on Mounting 350S-1 or 350S-3. Figure 7-10 shows the outline and mounting dimensions of the main component mounted on the 350S-1 or 350S-3. Note that all power and control connections are made to terminals located on the filter unit at the rear of the 350S-1 or 350S-3. The 350S-1 or 350S-3 should be mounted to the radio shelf by means of No. 8 screws, nuts, and lock washers. The filter unit is held in place by four screws at the rear of Mounting 350S-1 or 350S-3. The cabling may be connected to the filter unit while removed from the 350S-1 or 350S-3. Make certain that the grounding straps are fastened securely under the vibration isolator feet of the 350S-1 or 350S-3 to assure good electrical connection. Perform the

following steps to mount Radio Receiver-Transmitter 618S-1 or 618S-1A on Mounting 350S-1 or 350S-3:

- a. Loosen the locking mechanisms by rotating the two wing nuts counterclockwise as far as possible.
- b. Place the 618S-1 or 618S-1A on the 350S-1 or 350S-3 and push toward the rear, making sure the plugs on the 618S-1 or 618S-1A chassis mesh properly with the jacks on the 350S-1 or 350S-3.
- c. Engage the locking mechanisms and tighten the two wing nuts.
- d. Safety-wire the locking mechanisms.

**3-23. POWER SUPPLY 416W-1.**

**3-24. LOCATION.** Power Supply 416W-1 may be placed at any convenient location that is accessible and reasonably well ventilated. Cabling requirements should be taken into consideration in choosing the location, since the 416W-1 provides power to both the 618S-1 or 618S-1A main component and Automatic Antenna Tuner 180L-3.

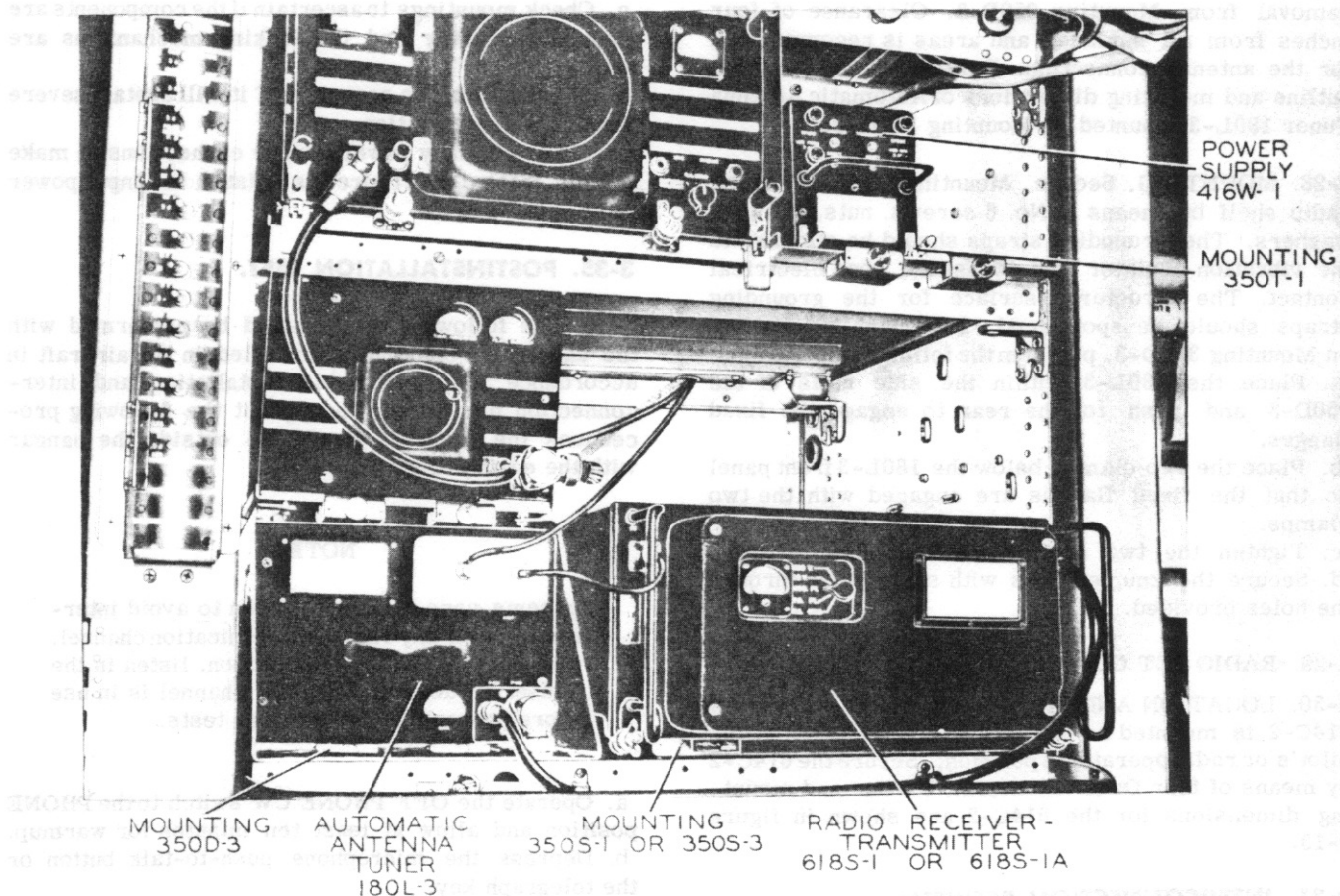


Figure 3-4. Radio Set 618S-1 and 618S-1A, Typical System Installation

3-25. MOUNTING. Power Supply 416W-1 normally is mounted on Mounting 350T-1. Figure 7-11 shows the outline and mounting dimensions of the 416W-1 installed on the 350T-1. The 350T-1 should be mounted on the radio shelf by means of No. 8 screws, nuts, and lock washers. The grounding straps should be fastened securely under the vibration isolators to assure good electrical contact. To install the 416W-1 on Mounting 350T-1, perform the following operations:

- a. Operate the extractor mechanism by rotating the middle thumbscrew as far as possible in a counter-clockwise direction.
- b. Place the 416W-1 on the 350T-1 and push toward the rear so that the front panel drops into the extractor slot.
- c. Rotate the middle thumbscrew clockwise until the rear connector is fully engaged.
- d. Engage, tighten, and safety-wire the locking mechanisms.

3-26. AUTOMATIC ANTENNA TUNER 180L-3.

3-27. LOCATION. Since Automatic Antenna Tuner 180L-3 requires no adjustments after installation, it may be located some distance from the other 618S-1 or 618S-1A components. The 180L-3 should be mounted in a space which is convenient to the antenna feedthrough insulator, or mast, and will allow easy removal from Mounting 350D-3. Clearance of four inches from all surfaces and areas is recommended for the antenna connection. Refer to figure 7-12 for outline and mounting dimensions of Automatic Antenna Tuner 180L-3 mounted on Mounting 350D-3.

3-28. MOUNTING. Secure Mounting 350D-3 to the radio shelf by means of No. 6 screws, nuts, and lock washers. The grounding straps should be attached to the vibration isolator feet to assure good electrical contact. The structural surface for the grounding straps should be spot-faced. To mount the 180L-3 on Mounting 350D-3, perform the following operations:

- a. Place the 180L-3 within the side rails of the 350D-3 and push to the rear to engage the fixed flanges.
- b. Place the two clamps below the 180L-3 front panel so that the fixed flanges are engaged with the two clamps.
- c. Tighten the two knurled nuts on both clamps.
- d. Secure the knurled nuts with safety wire through the holes provided.

3-29. RADIO SET CONTROL 614C-2.

3-30. LOCATION AND MOUNTING. Radio Set Control 614C-2 is mounted as part of the control panel at the pilot's or radio operator's position. Secure the 614C-2 by means of four Dzus fasteners. Outline and mounting dimensions for the 614C-2 are shown in figure 7-13.

### 3-31. INTERCONNECTION BETWEEN COMPONENTS.

3-32. Location of the individual components of the 618S-1 or 618S-1A is optional, since space allocation

is dependent upon the aircraft type; therefore, the interconnecting cables must be fabricated from bulk supplies. The physical cabling layout must be determined for each particular installation by the installing activity. The following general steps should be carried out when installing the cables between components.

- a. Allow sufficient slack in cables to avoid restricting movement on mountings, and to permit easy removal and replacement of the cable connectors.
- b. Run cables in positions that will reduce chances of damage due to vibration.
- c. Avoid running cables over sharp edges.
- d. Avoid sharp cable bends allowing, in general, a bending radius of at least 3-1/2 inches.
- e. Securely anchor cables to the aircraft structure using clamps or lacing.

### 3-33. POSTINSTALLATION INSPECTION.

3-34. A thorough check of the complete installation should be made before power is applied to the equipment and before adjustments or tests are begun.

- a. Check connections. Make sure the locking rings on connectors are tight.
- b. Check the wires entering multiple connectors to be sure the insulation has not been cut back too far, causing wires to short together.
- c. Check mountings to ascertain if the components are mounted securely and the locking mechanisms are tight.
- d. Check cabling to ascertain if it will sustain severe and prolonged vibration.
- e. Check primary power source connections to make certain that no short circuits exist in the input power lines.

### 3-35. POSTINSTALLATION TEST.

3-36. The following tests should be performed with the equipment completely installed in the aircraft in accordance with applicable installation and interconnection diagrams. Throughout the following procedures the aircraft should be outside the hangar with the engines running.

#### NOTE

Extreme care should be taken to avoid interference with any local communication channel. After each new channel selection, listen in the headset to determine if the channel is in use before proceeding with further tests.

- a. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.
- b. Depress the microphone push-to-talk button or the telegraph key.
- c. Operate the meter selector to the 250 V. position. Meter should indicate within the red area.
- d. Operate the meter selector to the 28 V. position. Meter should indicate within the red area.

- e. Operate the meter selector to the P.A. GRID position. Meter should indicate above the 3 mark.
- f. Operate the meter selector to the P.A. PL position. Meter should indicate within the red area.
- g. Operate the meter selector to the MOD. PL position. Speak normally into the microphone and watch the meter indication. The meter should show an increased indication. Speech should be heard in the headset through the side-tone circuits.
- h. Operate the OFF PHONE CW switch to the CW position. Key the 618S-1 or 618S-1A by operation of the telegraph key. A 400-cps side-tone signal should be heard in the headset when the telegraph key is depressed.
- i. Operate the OFF PHONE CW switch to the PHONE position and release the telegraph key. Characteristic hiss should be heard.
- j. Operate the channel selector of Radio Set Control 614C-2 to an active channel. With the small 614C-2 knob, determine if the sensitivity is variable.

- k. With the OFF PHONE CW switch in the CW position, select an active cw channel. Pitch of cw signal should be variable with the 614C-2 BFO control.
- l. Repeat steps c through i for at least one frequency within each band of operations. The bands are as follows: band 1, 2.0 to 3.75 megacycles; band 2, 3.75 to 7.25 megacycles; band 3, 7.25 to 14.25 megacycles; and band 4, 14.25 to 25.00 megacycles.

**3-37. PREPARATION FOR RESHIPMENT.**

3-38. Removal of the installed components of Radio Set 618S-1 and 618S-1A is accomplished by disconnecting cables and reversing the installation procedures, paragraphs 3-18 through 3-31. No special provisions for repacking the equipment are necessary beyond use of reasonable care. It is recommended that packing cases be used which are similar to those in which the equipment was received.

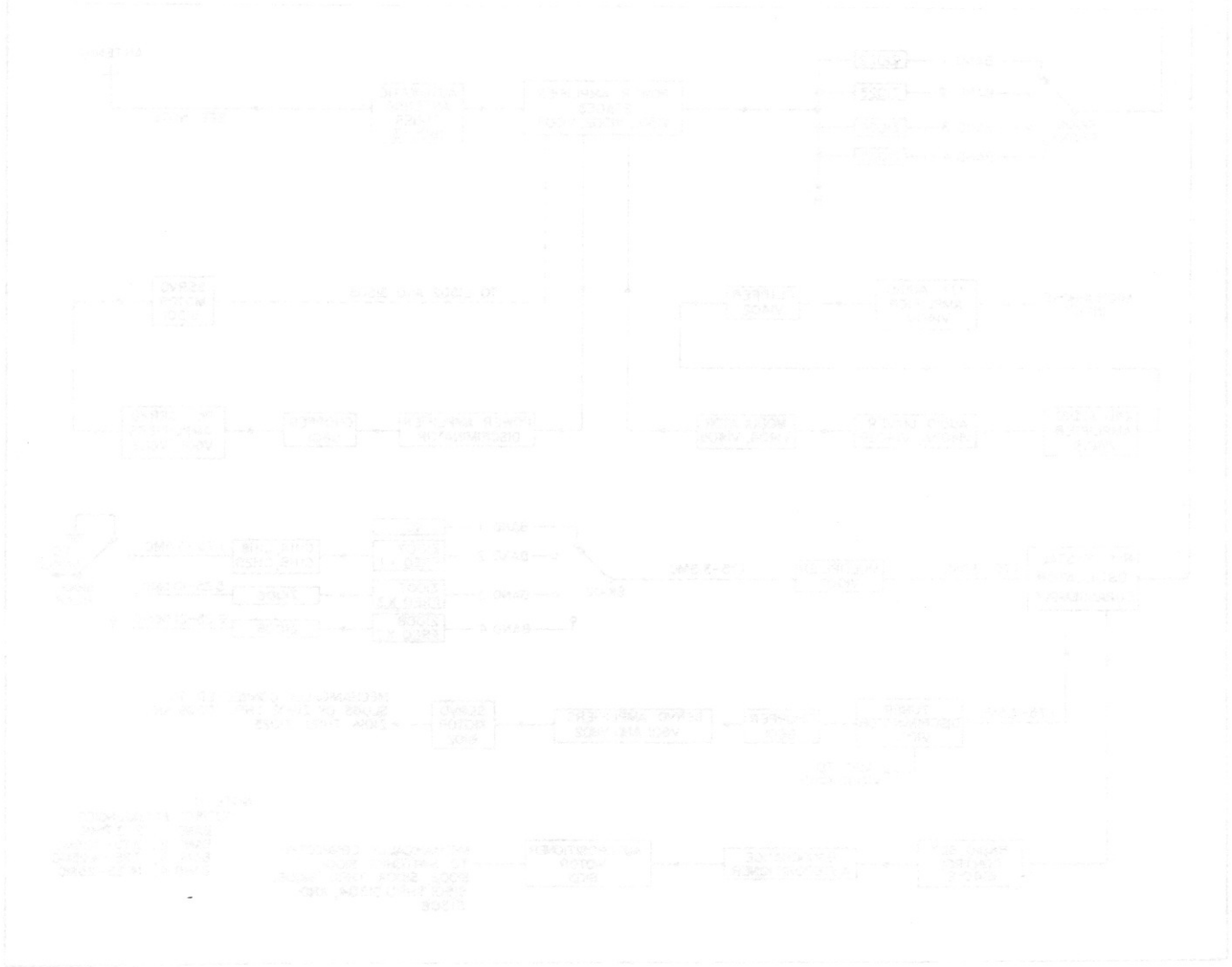


Figure 3-1. Radio Set 618S-1 and 618S-1A. Transmitter Section, Block Diagram

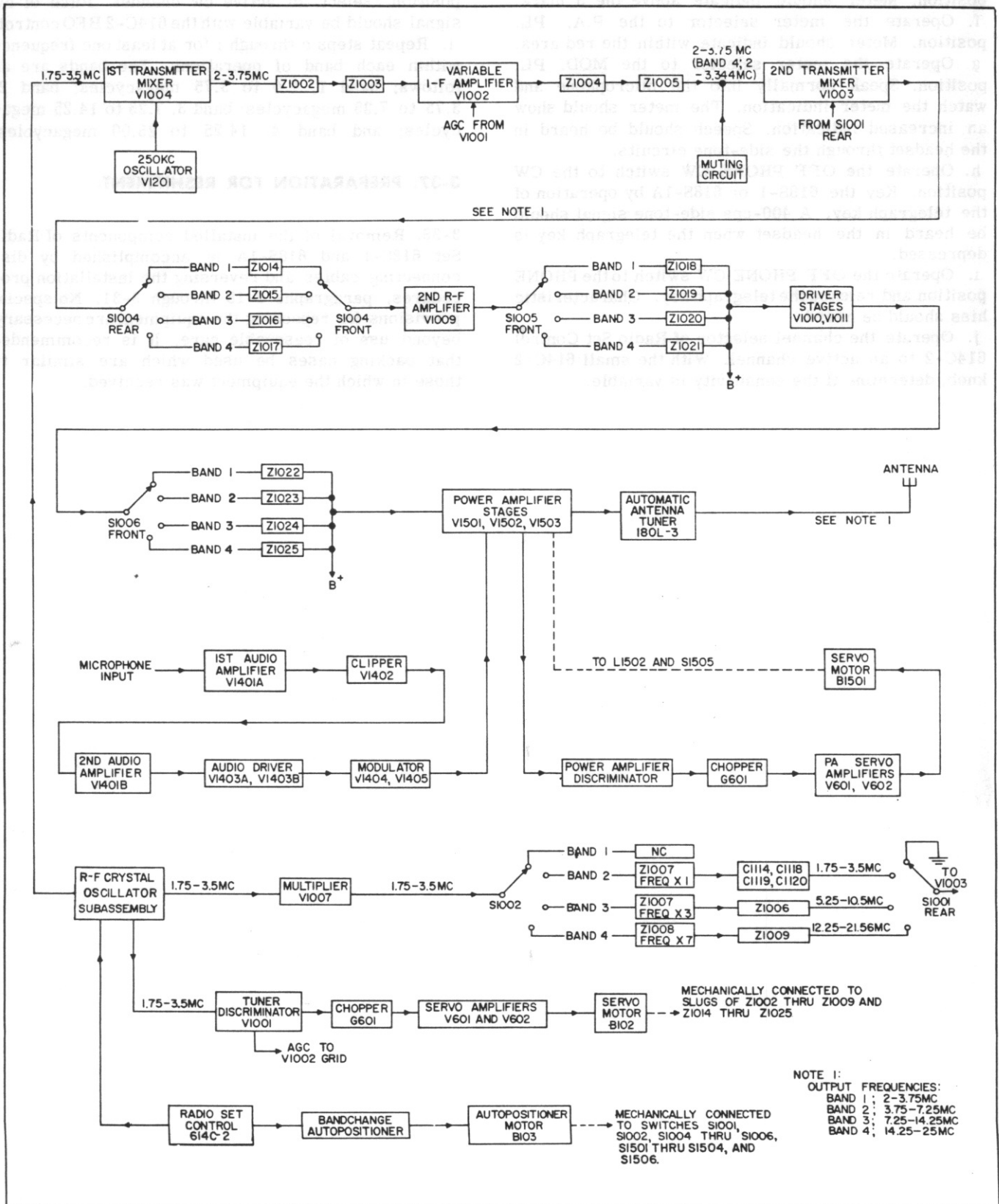


Figure 4-1. Radio Set 618S-1 and 618S-1A, Transmitter Section, Block Diagram



## SECTION IV

# THEORY OF OPERATION

### 4-1. GENERAL.

4-2. Radio Sets 618S-1 and 618S-1A include the necessary components to permit operation as both a transmitter and receiver. Radio Receiver-Transmitter 618S-1 or 618S-1A is the main component of the system, controlled by a separately housed control unit. Radio Set Control 614C-2 is used as a master control unit, from which 144 channels may be selected. The 52-ohm transmission line from Radio Receiver-Transmitter 618S-1 or 618S-1A is matched automatically to the antenna with the use of Automatic Antenna Tuner 180L-3. Reference is made to the Handbook Service Instructions, T.O. 31R2-4-38-1, for the theory of operation of Automatic Antenna Tuner 180L-3. The theory of operation of Radio Set 618S-1 and 618S-1A can be broken down into three general descriptive sections; the transmitter section, the receiver section, and the control section. The following discussion will, in general, follow this outline; however, since many of the 618S-1 and 618S-1A functions are interdependent, a certain amount of overlap is unavoidable.

### 4-3. TRANSMITTER SECTION.

4-4. Reference is made to the block diagram, figure 4-1. Fundamental frequencies within the range of 1.75 to 3.5 megacycles are generated in the r-f crystal oscillator. The exact frequency is dependent upon the selected crystal. Circuitry contained within Radio Set Control 614C-2 supplies the necessary information to the r-f crystal oscillator subassembly to select the correct crystal, as will be described in paragraphs 4-48 through 4-51. The r-f crystal oscillator has three distinct outputs; one which feeds a discriminator and servo system for purposes of tuning all the low-level tuned circuits; one which supplies the basic frequencies to multiplier circuits for the purpose of establishing an injection voltage to the second transmitter mixer; and one which supplies the fundamental frequency to the first transmitter mixer, V1004. The fundamental frequencies (1.75 to 3.5 megacycles) supplied to V1004 are mixed with an injection voltage of 250 kilocycles, supplied by V1201 and associated circuitry. The sum frequency is selected by tuned circuits Z1002 and Z1003 and amplified by variable i-f amplifier V1002. Tuned circuits Z1004 and Z1005 provide further selectivity of the variable i-f signal. The signal then is applied to the second transmitter mixer, V1003, to be mixed with the multiplier output frequencies. A muting circuit is included with V1003 to prevent spurious radiation during the channeling cycle. The two frequencies present at V1003 are mixed and the sum frequency selected by tuned

circuit Z1014, Z1015, Z1016, or Z1017, depending upon the band of operation. All band switching is accomplished by autopositioner motor B103 in conjunction with the bandchange autopositioner unit and Radio Set Control 614C-2. The r-f signal then is amplified by the second r-f amplifier, V1009, and developed across one of the four tuned circuits, Z1018 through Z1021, depending upon the band selected. Two tubes, V1010 and V1011, are connected in parallel for final amplification before the r-f signal is applied to the power amplifier stages. Selectivity for the driver stages is accomplished by tuned circuits Z1022 through Z1025. The signal is applied to the power amplifier, consisting of three type 6159 tubes, V1501, V1502, and V1503 connected in parallel. At this point, an audio signal from the modulator is used to vary the plate and screen voltage of the power amplifier tubes to accomplish amplitude modulation of the carrier. The power amplifier subassembly contains its own servo system, which adjusts the main tuning inductor, L1502, to the correct frequency, as established in the low-level circuits. Output of the power amplifier is applied to the antenna through Automatic Antenna Tuner 180L-3.

### 4-5. DETAILED TRANSMITTER FUNCTIONS.

4-6. R-F CRYSTAL OSCILLATOR. The r-f crystal oscillator, figure 4-2, employs a type 5654 pentode tube in an electron-coupled oscillator circuit. Radio Set Control 614C-2, in conjunction with the Auto-positioner system, selects the desired crystal whenever the channel selector is rotated, as will be described in paragraphs 4-48 through 4-51. The oscillator portion of V401 consists of the cathode, the control grid, and the screen grid. The screen grid acts as the oscillator plate circuit with coupling to the actual plate circuit taking place within the electron stream. In this manner, with the oscillator plate circuit isolated from the output plate circuit, frequency stability is improved. The oscillator plate (pin 6 of V401) is held at r-f ground potential by capacitor C405. The grid drive is controlled by the division ratio of capacitors C404 and paralleled capacitors C401 and C402. Capacitor C401 is factory adjusted for optimum grid drive. The 1.75- to 3.5-megacycle signal (exact frequency depending upon the selected crystal) is coupled through capacitor C407 to grid 3 of the first transmitter mixer, V1004. The signal also is applied to the control grid of the tuner discriminator, V1001, and is used to tune all of the low-level circuits, as will be explained in paragraphs 4-52 through 4-58 and 4-62 through 4-64. Provision is made for metering the grid voltage of V401 across the parallel arrangement of R402 and C403.

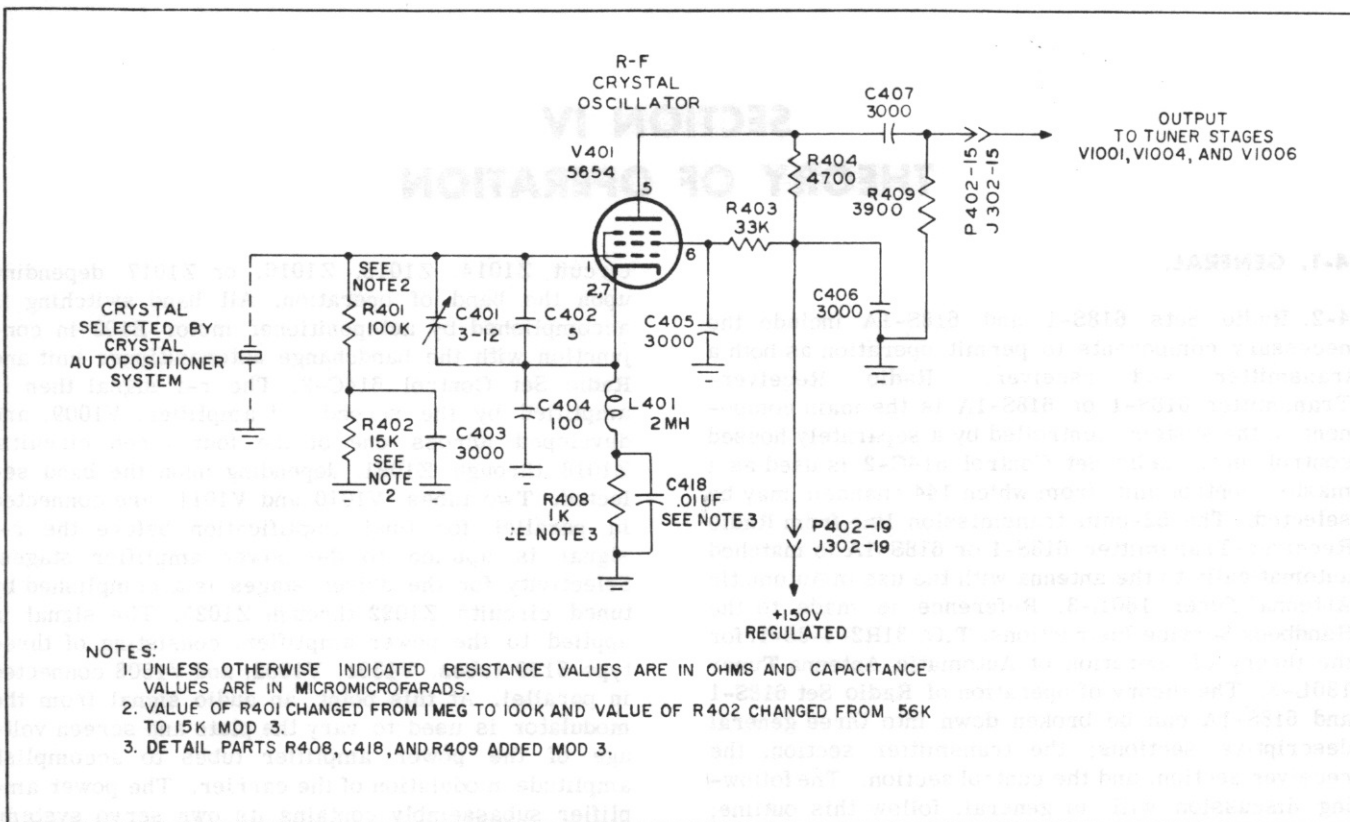


Figure 4-2. R-F Crystal Oscillator, Simplified Schematic Diagram

4-7. FIRST TRANSMITTER MIXER AND 250 KC OSCILLATOR. Refer to figure 4-3. The 1.75- to 3.5-megacycle signal from V401 is applied through capacitors C407 and C1086 to grid 3 of the first transmitter mixer, V1004. The signal is developed across resistor R1021. Another signal is injected into the control grid of V1004. This signal originates in the 250-kc oscillator stage, V1201. The 250 kc oscillator is crystal controlled, with temperature-compensated detail parts. Feedback is accomplished by the capacitance ratio of C1206 and C1201, in conjunction with the tank circuit formed by crystal Y1201. This ratio is slightly adjustable for alignment purposes, and may be used to set the frequency to the desired 250 kilocycles. The cathode is grounded through contacts of K804 and K1502 during transmission and open during reception. The oscillator portion consists of the screen and control grids and the cathode, with the screen acting as the plate of the oscillator. Coupling to the actual plate circuit is accomplished within the electron stream of V1201. Transformer T1201, consisting of inductors L1201 and L1202 and capacitors C1203 and C1204, inductively couples the 250-kc signal from the plate of V1201 to the control grid of V1004. Provision is made for resonating T1201 during alignment procedures by adjustable slugs within the inductors.

4-8. The two signals (1.75 to 3.5 megacycles and 250 kilocycles) are mixed in the electron stream of

V1004. The sum frequency (2 to 3.75 megacycles) is selected by plate tuned circuit Z1002. Tuned circuit Z1002 is resonated to the correct frequency by motor B102 in conjunction with the tuner servo amplifier, as will be explained in paragraphs 4-57 and 4-58. Output of the first mixer stage is capacitively coupled to the control grid of V1002.

4-9. VARIABLE I-F AMPLIFIER. Refer to figure 4-4. The variable i-f amplifier stage, V1002, employs a 5749 pentode to amplify the 2- to 3.75-megacycle signal produced in the first transmitter mixer. Two tuned circuits, Z1003 and Z1004, are used to resonate the grid and plate circuits to the particular frequency selected. Cathode bias is supplied by capacitor C1077 and resistor R1012. Resistor R1006, in series with the grid tuned circuit, is selected by factory experimentation for optimum results, and will differ with individual units. The output is capacitively coupled through C1015 to the second transmitter mixer, V1003.

4-10. SECOND TRANSMITTER MIXER AND MULTIPLIER. Refer to figure 4-5. The 2- to 3.75-megacycle signal from the variable i-f amplifier is developed across tuned circuit Z1005 and applied to the control grid of second transmitter mixer V1003. An injection voltage from the multiplier stage and associated tuned circuits is applied to grid three of V1003. The basic r-f crystal oscillator output frequency (1.75 to

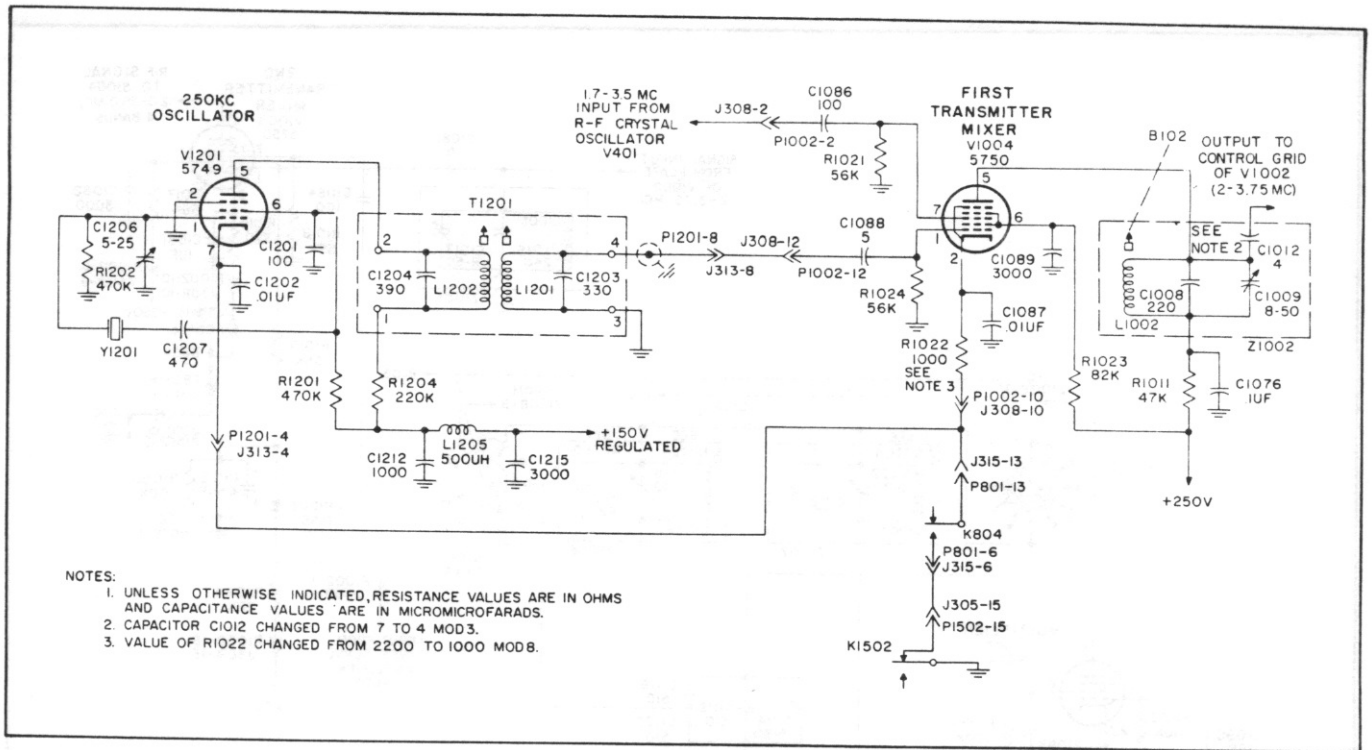


Figure 4-3. First Transmitter Mixer and 250 Kc Oscillator, Simplified Schematic Diagram

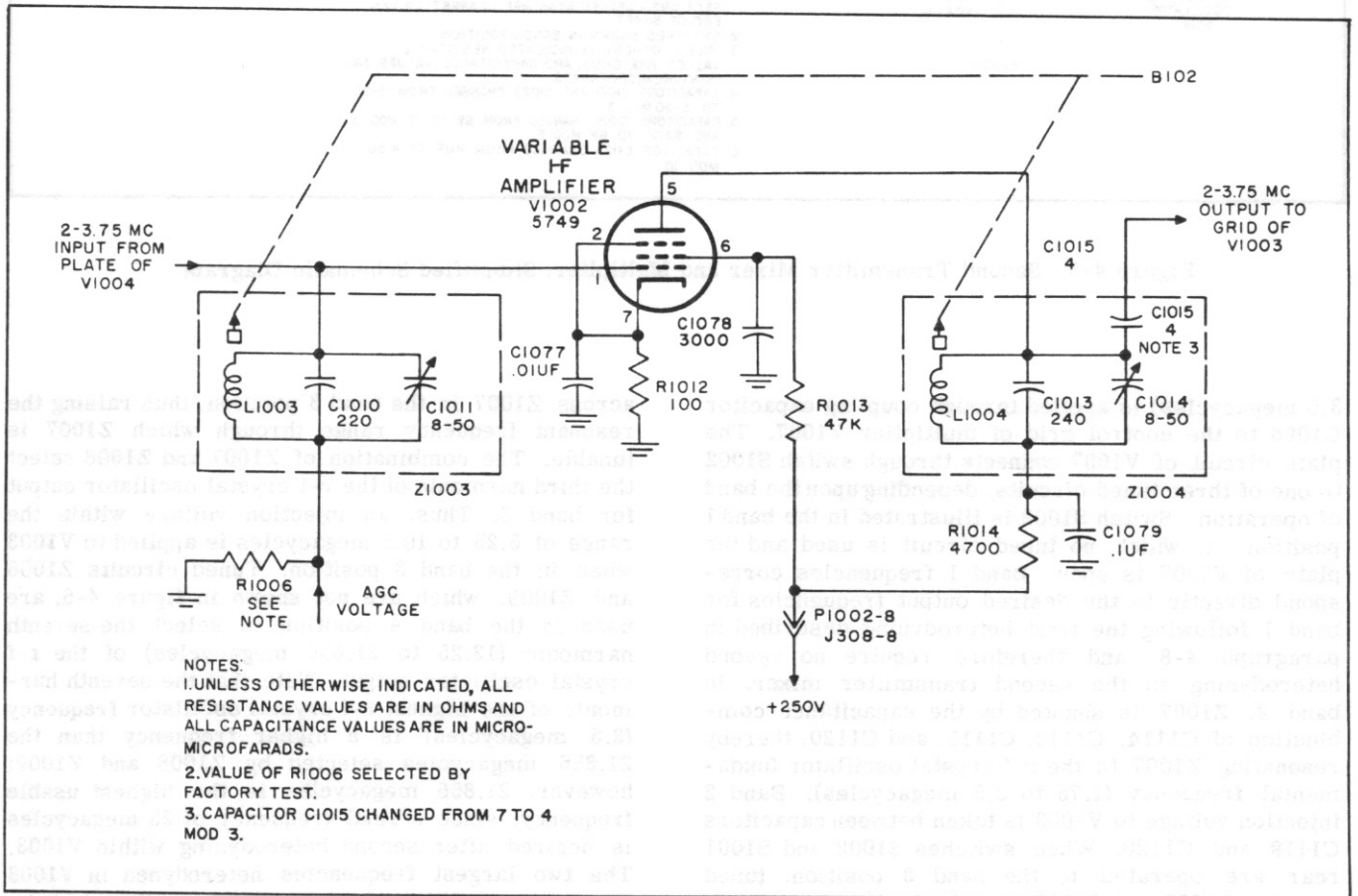


Figure 4-4. Variable I-F Amplifier, Simplified Schematic Diagram

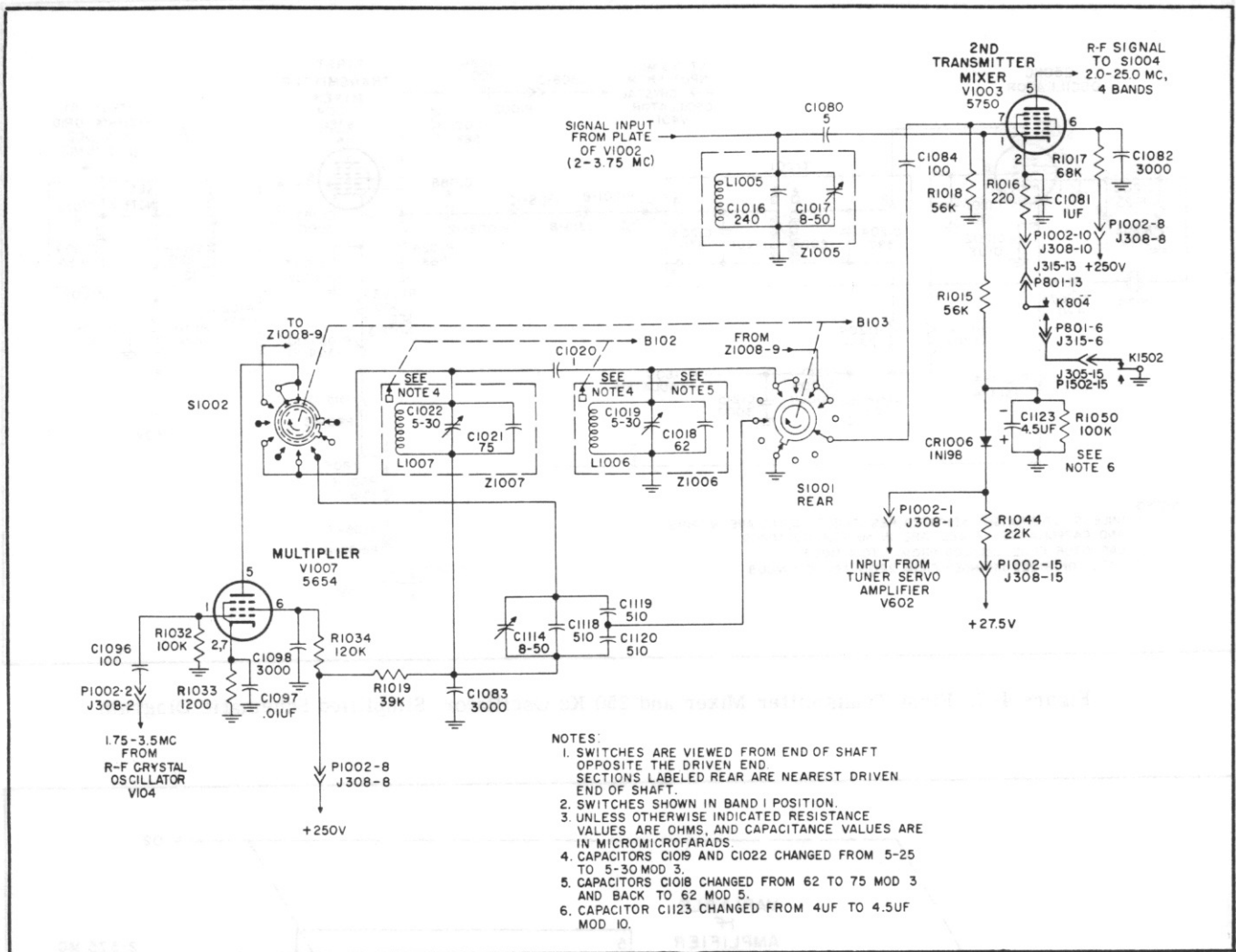


Figure 4-5. Second Transmitter Mixer and Multiplier, Simplified Schematic Diagram

3.5 megacycles) is applied through coupling capacitor C1096 to the control grid of multiplier V1007. The plate circuit of V1007 connects through switch S1002 to one of three tuned circuits, depending upon the band of operation. Switch S1002 is illustrated in the band 1 position, in which no tuned circuit is used and the plate of V1007 is open. Band 1 frequencies correspond directly to the desired output frequencies for band 1 following the first heterodyning described in paragraph 4-8, and therefore require no second heterodyning in the second transmitter mixer. In band 2, Z1007 is shunted by the capacitance combination of C1114, C1118, C1119, and C1120, thereby resonating Z1007 to the r-f crystal oscillator fundamental frequency (1.75 to 3.5 megacycles). Band 2 injection voltage to V1003 is taken between capacitors C1119 and C1120. When switches S1002 and S1001 rear are operated to the band 3 position, tuned circuits Z1007 and Z1006 provide the load impedance between V1007 and V1003. The capacitor combination of C1114, C1118, C1119, and C1120 is not shunted

across Z1007 in the band 3 position, thus raising the resonant frequency range through which Z1007 is tunable. The combination of Z1007 and Z1006 select the third harmonic of the r-f crystal oscillator output for band 3. Thus, an injection voltage within the range of 5.25 to 10.5 megacycles is applied to V1003 when in the band 3 position. Tuned circuits Z1008 and Z1009, which are not shown in figure 4-5, are used in the band 4 position to select the seventh harmonic (12.25 to 21.656 megacycles) of the r-f crystal oscillator output. Note that the seventh harmonic of the highest r-f crystal oscillator frequency (3.5 megacycles) is a higher frequency than the 21.656 megacycles selected by Z1008 and Z1009; however, 21.656 megacycles is the highest usable frequency, since a final frequency of 25 megacycles is desired after second heterodyning within V1003. The two largest frequencies heterodyned in V1003 are in the 21.656-megacycle signal mentioned, and a 3.344-megacycle signal from the r-f crystal oscillator and transmitter first mixer, V1004, thus producing

the desired 25-megacycle maximum frequency. The method of frequency selection will be discussed thoroughly in the control section, paragraph 4-46 and subsequent paragraphs.

4-11. Another injection voltage, which is applied to V1003 control grid, originates in the tuner muting

circuit. The tuner muting circuit consists of resistors R1044 and R1050, capacitor C1123, and crystal rectifier CR1006. A fixed bias of 27.5 volts d-c is applied to CR1006 at all times. Under normal conditions, CR1006 cannot conduct because of the bias voltage. During channeling, a signal from V602 of the tuner servo amplifier subassembly is applied across

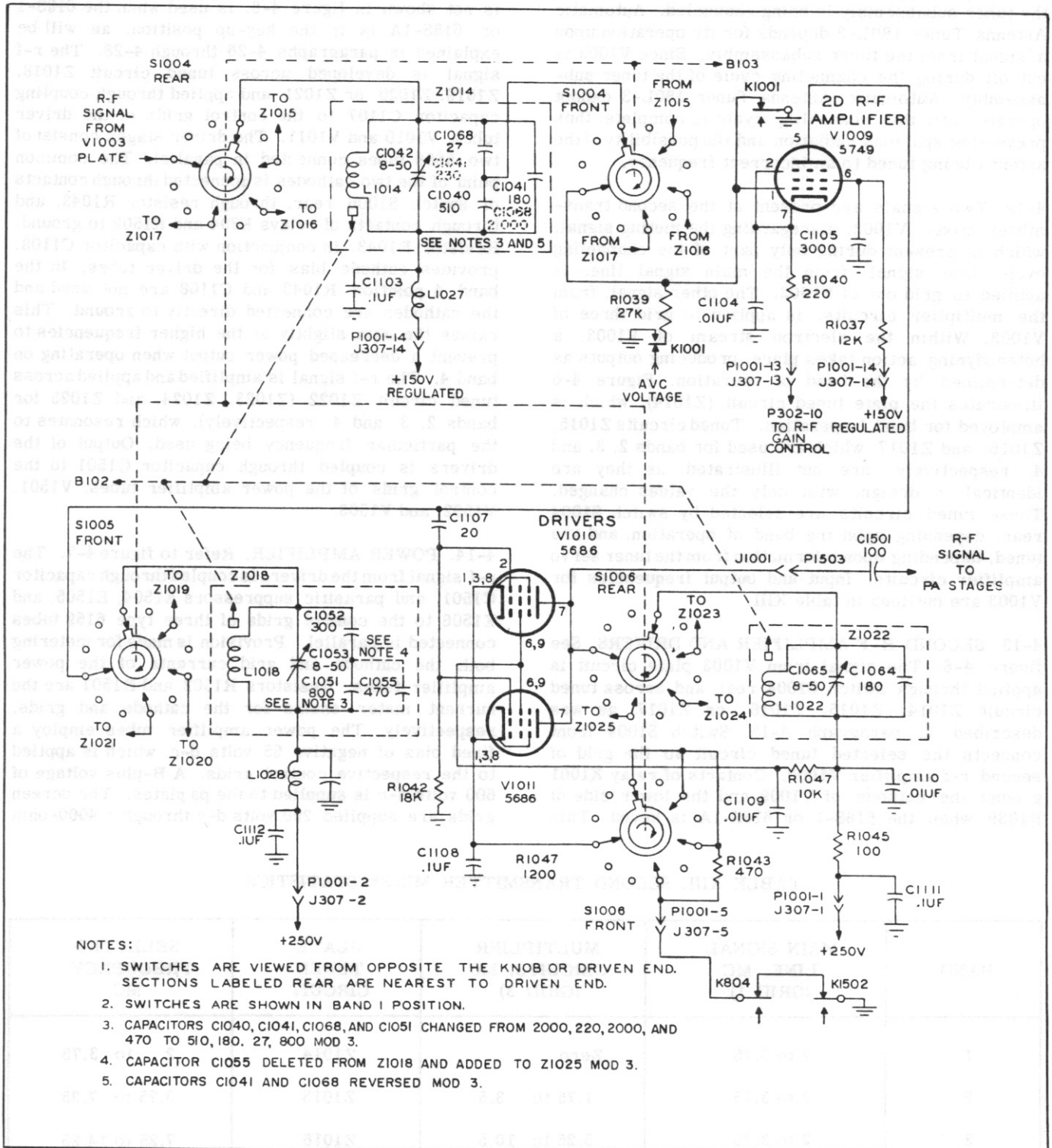


Figure 4-6. Second R-F Amplifier and Drivers, Simplified Schematic Diagram

CR1006. This signal is sufficient to overcome the 27.5-volt bias, causing CR1006 to conduct through the parallel combination of C1123 and R1050. The drop across C1123 and R1050 results in a negative voltage, sufficient for cutoff, being applied to V1003 control grid. The signal from V602 is applied across CR1006 only during the channeling cycle of the tuner sub-assembly, thus preventing V1003 from conducting while the tuner subassembly is being channeled. Automatic Antenna Tuner 180L-3 depends for its operation upon a signal from the tuner subassembly. Since V1003 is cut off during the channeling cycle of the tuner sub-assembly, Automatic Antenna Tuner 180L-3 cannot operate until this channeling cycle is complete, thus preventing spurious radiation and the possibility of the antenna being tuned to an incorrect frequency.

4-12. Two signals are present at the second transmitter mixer, V1003, disregarding the muting signal, which is present during only part of the channeling cycle. One signal, from the main signal line, is applied to grid one of V1003. The other signal, from the multiplier circuits, is applied to grid three of V1003. Within the electron stream of V1003, a heterodyning action takes place, producing outputs as determined by the band of operation. Figure 4-6 illustrates the plate tuned circuit (Z1014), which is employed for band 1 operation. Tuned circuits Z1015, Z1016, and Z1017, which are used for bands 2, 3, and 4, respectively, are not illustrated, as they are identical in design, with only the values changed. These tuned circuits are selected by switch S1004 rear, depending upon the band of operation, and are tuned, depending upon information from the tuner servo amplifier circuits. Input and output frequencies for V1003 are outlined in table XIII.

4-13. SECOND R-F AMPLIFIER AND DRIVERS. See figure 4-6. The signal from V1003 plate circuit is applied through switch S1004 rear and across tuned circuit Z1014, Z1015, Z1016, or Z1017, as was described in paragraph 4-15. Switch S1004 front connects the selected tuned circuit to the grid of second r-f amplifier V1009. Contacts of relay K1001 ground the cathode of V1009 and the lower side of R1039 when the 618S-1 or 618S-1A is keyed. This

increases the r-f gain slightly during transmission. The r-f signal, as listed in table XIII, is amplified by V1009 and applied through one of four plate-tuned circuits, depending upon the band of operation. Tuned circuit Z1018 (band 1) is the only plate-tuned circuit illustrated for the sake of simplicity. Tuned circuits Z1019, Z1020, and Z1021 are used when operating on bands 2, 3, and 4, respectively. Switch S1005, which is not shown in figure 4-6, is used when the 618S-1 or 618S-1A is in the key-up position, as will be explained in paragraphs 4-26 through 4-28. The r-f signal is developed across tuned circuit Z1018, Z1019, Z1020, or Z1021, and applied through coupling capacitor C1107 to the control grids of the driver tubes, V1010 and V1011. The driver stages consist of two 5686 tubes connected in parallel. The common point of the two cathodes is connected through contacts of switch S1006 rear, through resistor R1043, and through contacts of relays K804 and K1502 to ground. Resistor R1043, in conjunction with capacitor C1108, provides cathode bias for the driver tubes. In the band 4 position, R1043 and C1108 are not used and the cathodes are connected directly to ground. This raises the gain slightly at the higher frequencies to prevent a decreased power output when operating on band 4. The r-f signal is amplified and applied across tuned circuit Z1022 (Z1023, Z1024, and Z1025 for bands 2, 3, and 4, respectively), which resonates to the particular frequency being used. Output of the drivers is coupled through capacitor C1501 to the control grids of the power amplifier tubes, V1501, V1502, and V1503.

4-14. POWER AMPLIFIER. Refer to figure 4-7. The r-f signal from the drivers is coupled through capacitor C1501, and parasitic suppressors E1504, E1505, and E1506 to the control grids of three type 6159 tubes connected in parallel. Provision is made for metering both the cathode and grid currents of the power amplifier tubes. Resistors R1502 and R1501 are the current meter shunts for the cathode and grids, respectively. The power amplifier tubes employ a fixed bias of negative 65 volts d-c, which is applied to the respective control grids. A B-plus voltage of 600 volts d-c is supplied to the pa plates. The screen grids are supplied 250 volts d-c through a 4000-ohm

TABLE XIII. SECOND TRANSMITTER MIXER STATISTICS

BAND	MAIN SIGNAL LINE, MC (GRID 1)	MULTIPLIER CIRCUITS, MC (GRID 3)	PLATE TUNED CIRCUIT	SELECTED FREQUENCY, MC
1	2 to 3.75	Zero	Z1014	2 to 3.75
2	2 to 3.75	1.75 to 3.5	Z1015	3.75 to 7.25
3	2 to 3.75	5.25 to 10.5	Z1016	7.25 to 14.25
4	2 to 3.344	12.25 to 21.656	Z1017	14.25 to 25

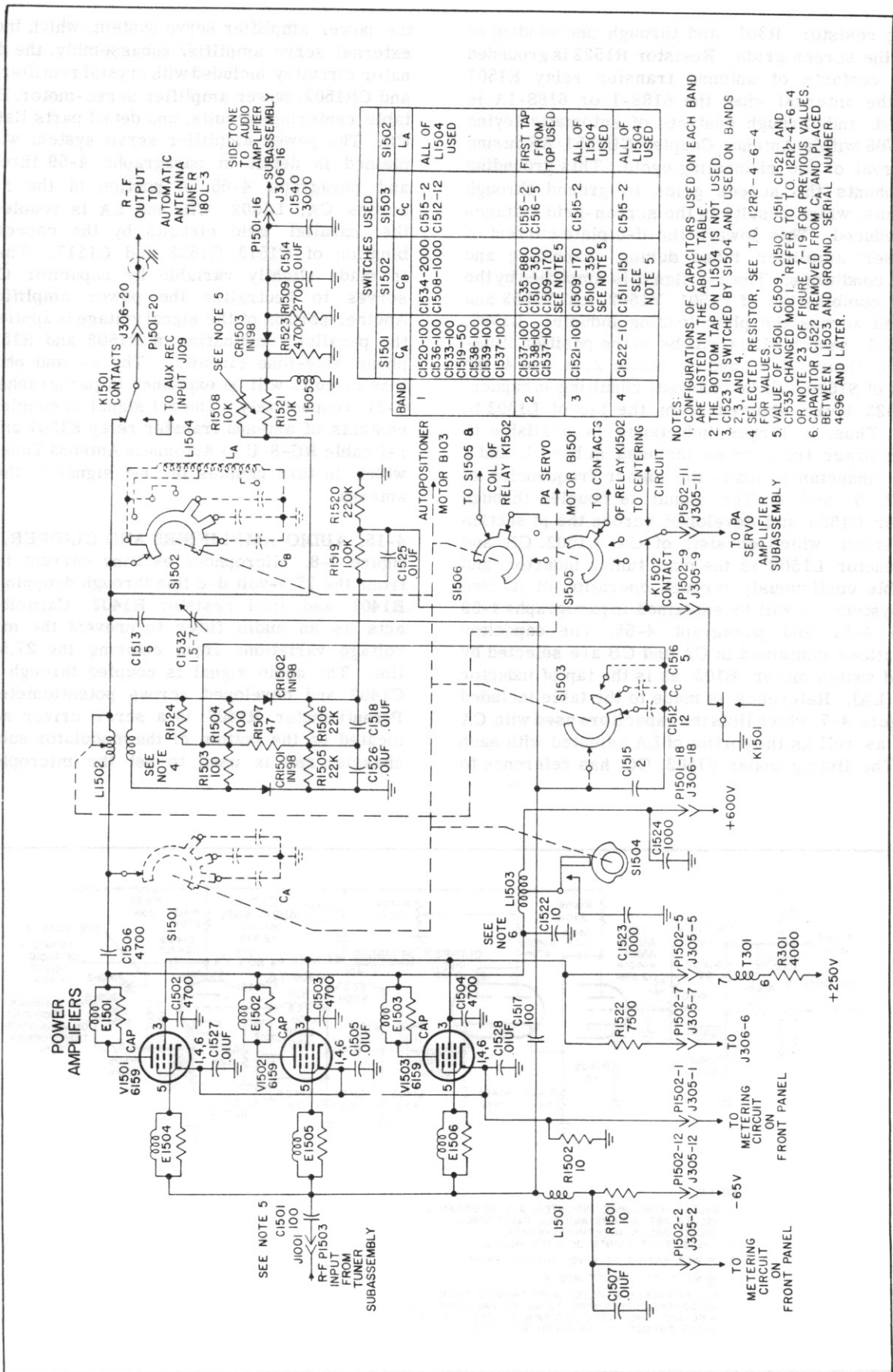


Figure 4-7. Power Amplifier, Simplified Schematic Diagram

dropping resistor, R301, and through one winding of T301 to the screen grids. Resistor R1522 is grounded through contacts of antenna transfer relay K1501 during the interval when the 618S-1 or 618S-1A is not keyed, and through contacts of automatic keying relay K708 within Antenna Coupler CU-351/AR during the interval of the channeling cycle. This grounding action shunts the screen grids to ground through 7500 ohms, which results in the screen-grid voltages being reduced. This lowers the d-c plate current of the power amplifier tubes during channeling and unkeyed conditions. The r-f signal is amplified by the parallel combination of V1501, V1502, and V1053 and developed across the plate loading inductor, L1503. On band 1, switch S1504 will be in the position illustrated in figure 4-7, and in bands 2, 3, and 4, the position of S1504 will be changed, resulting in capacitor C1523 being shunted from the tap of L1503 to ground. Thus, a larger inductance is available to load the lower frequencies included in band 1, and a smaller inductance loads the higher frequencies of bands 2, 3, and 4. The signal is coupled through capacitor C1506 and developed across the pi section tuned circuit, which consists of CA, L1502, CB, and LA. Inductor L1502 is the main tuning inductor, and is tunable continuously through operation of its own servo system, as will be explained in paragraphs 4-59 through 4-61 and paragraph 4-65. The capacitor combinations contained in CA and CB are selected by the band switch motor, B103, as is the tap of inductor L1504 (LA). Reference is made to the table included with figure 4-7, which lists the capacitors used with CA and CB as well as the portion of LA selected with each band. The listing under S1503, CC, has reference to

the power amplifier servo system, which includes an external servo amplifier subassembly, the discriminator circuitry included with crystal rectifiers CR1501 and CR1502, power amplifier servo-motor, B1501, the table centering circuits, and detail parts listed under CC. The power amplifier servo system will be explained in detail in paragraphs 4-59 through 4-61 and paragraph 4-65. A portion of the r-f signal across CA, L1502, CB, and LA is coupled back to the parallel grid circuits by the capacitor combination of C1513, C1532, and C1517. The voltage is made slightly variable by capacitor C1532 and serves to neutralize the power amplifier stage. Another portion of the signal voltage is applied through the parallel combination of R1508 and R1521 to the phone side-tone circuitry. The cw and phone side-tone circuits will be explained in paragraphs 4-20 and 4-21, respectively. The r-f signal is coupled through contacts of antenna transfer relay K1501 and through r-f cable RG-8/U to Automatic Antenna Tuner 180L-3, which in turn couples the r-f signal to the aircraft antenna.

4-15. AUDIO AMPLIFIERS AND CLIPPER. Refer to figure 4-8. Microphone exciting current is obtained from the 27.5-volt d-c line through dropping resistor R1401 and load resistor R1402. Capacitor C1401 acts as an audio filter to prevent the microphone voltage variations from entering the 27.5-volt d-c line. The audio signal is coupled through capacitor C1402 and developed across potentiometer R1403. Potentiometer R1403 is a screw driver adjustment located on the bottom of the modulator subassembly chassis, and is used to set the microphone level

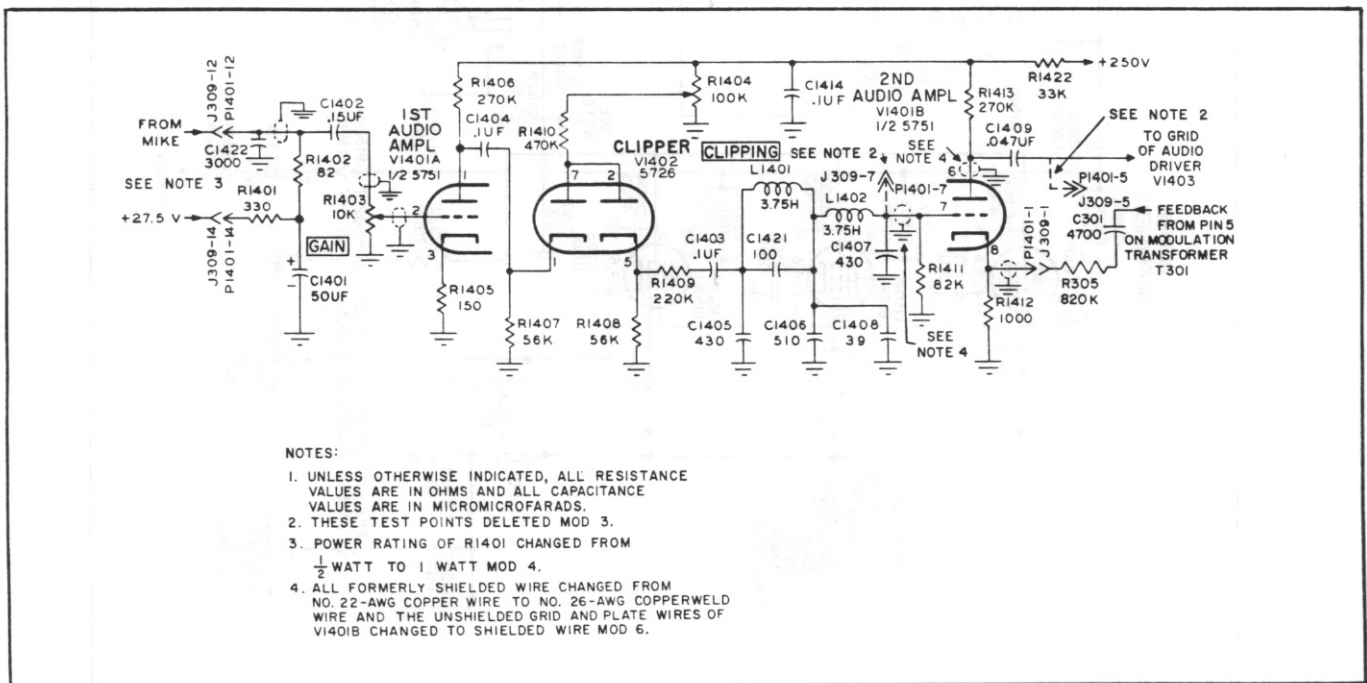


Figure 4-8. Audio Amplifiers and Clipper, Simplified Schematic Diagram



during alignment procedures. The signal is amplified by V1401A and coupled through capacitor C1404 to the cathode (pin 1) of the clipper stage, V1402.

4-16. The clipper stage, V1402, is a dual diode tube connected as a biased series clipper circuit. The clipping level may be adjusted by R1404, which is connected across the 250-volt d-c line. Assume, for purposes of explanation, that R1404 is set to the correct position for a level of plus 10 volts d-c at the plates of V1402. Under static conditions, the voltage at both cathodes also will be plus 10 volts d-c, and will remain so as long as both diode sections conduct. While the diodes are conducting, the plate resistance may be assumed to be zero, resulting in equal voltages at both the plates and cathodes of the diodes. When an alternating signal is applied across R1407, this signal will both add and subtract from the plus 10 volts d-c present at the input cathode. Assume the alternating signal has a peak-to-peak value of 10 volts. On the positive alternation, as the signal voltage rises from zero to plus 5 volts, the input cathode voltage will rise from the fixed 10 volts to a total of 15 volts. Since a short-circuit condition exists between the input cathode and its plate during conduction, this signal also will appear at the plate (pin 7) and will drive both plates to plus 15 volts. A short circuit also exists between the plate (pin 2) and the output cathode, which drives the output cathode, and therefore the output signal, to plus 15 volts. As the input alternating signal rises to its peak negative value, the negative 5 volts will subtract from the 10 volts present at the input cathode, driving the voltage to plus 5 volts. The short-circuit conditions still exist between all of the tube elements, and the voltage at the output cathode will follow this change to plus 5 volts. From this it may be seen that, as long as the input voltage (through coupling capacitor C1404) does not exceed the ten volts to which the dual diode is biased, the output signal will follow faithfully the input signal, and the clipper stage acts merely as a conductor. Clipping action will start as soon as the input voltage exceeds the plus 10 volts bias, or as soon as the input voltage exceeds a peak-to-peak value of 20 volts. Assume that a strong noise pulse with a peak-to-peak value of 30 volts is coupled through capacitor C1404 and applied to the input cathode. On the positive alternation (zero to plus 15 volts) the input cathode will follow the changing voltage, and will become positive a total of 25 volts (10 volts plus 15 volts). The plates are biased to plus 10 volts, resulting in the input cathode becoming positive 5 volts with respect to the plates. Since the input cathode must be slightly negative with respect to its plate for conduction, the input diode section will open. As long as the input signal was below plus 10 volts, the plate (pin 7) was able to follow the input cathode, and was driven to plus 20 volts (10 volts bias added to the 10 volts of signal). The plate (pin 7) and the plate (pin 2) cannot rise above this plus 20 volts, and will remain at this point until the input cathode voltage decreases to a value no greater than plus 20 volts. The output cathode continues to conduct, resulting in an output voltage of plus 20 volts, even

though the input cathode has risen to a total of plus 25 volts. On the negative alternation of the noise pulse, the input cathode is driven to negative five volts (plus 10 volts bias, minus 15 volts signal). The plate (pin 7) will follow this change to negative five volts, and will continue to conduct, because at no time is the input cathode positive with respect to the plate (pin 7). The plate (pin 2) also must become negative a total of 5 volts, as it is paralleled with the plate (pin 7). The output cathode will decrease to as far as zero voltage, at which point, its plate (pin 2) becomes negative, and the output diode circuit must cut off. In this manner, with double clipping action taking place, the output signal will follow the input signal only to the extent of a peak input of 10 volts (20 volts peak-to-peak), and any strong signal, such as a noise pulse, will be clipped off effectively.

4-17. The audio signal from the output cathode of V1402 is fed through resistor R1409, through capacitor C1403, and applied to the low-pass filter arrangement of L1401, L1402, C1421, C1405, C1406, C1408, and C1407. Resistor R1409 performs the function of isolating the filter from the changing impedance of the clipper stage. The low-pass filter is designed for a cutoff frequency of 3500 cps, at which point the maximum attenuation will not exceed 3 db. The minimum attenuation at 6500 cps is at least 17 db, thus, all harmonic frequencies introduced in the clipper stage are removed. The audio signal from the filter is developed across grid resistor R1411, and amplified by V1401B. A feedback voltage from pin 5 of the modulation transformer (T301) is applied through the phasing arrangement C301 and R305, and developed across cathode resistor R1412 of V1401B. This feedback voltage is degenerative in nature, and flattens the over-all frequency response throughout the range of the low-pass filter. The audio signal is amplified by V1401B and coupled through capacitor C1409 to the grid of V1403A.

4-18. AUDIO DRIVERS AND MODULATORS. Refer to figure 4-9. The audio signal from V1401B is developed across grid resistor R1414, causing the grid of V1403A to follow the signal variations. Capacitor C1413 bypasses the grid circuit to high-frequency voltage variations. The audio signal is amplified, and appears at the plate circuit of V1403A. The plate of V1403A is coupled through capacitor C1411 and resistor R1416 to the grid of V1403B. Since the capacitive reactance of C1411 is very small compared to the resistance of R1416 at audio frequencies, the phase of the signal developed across grid resistor R1417 is essentially in phase with the signal at the plate of V1403A and 180 degrees out of phase with the signal at the grid of V1403A. The phase is inverted in the plate circuit of V1403B, resulting in a 180-degree phase relationship between the signals at the plate of V1403A and the plate of V1403B. This phase relationship is necessary to drive the push-pull modulators, V1404 and V1405. The two signals (one from V1403A and the other from V1403B) are coupled through capacitors C1410 and C1412 to the grids of V1404 and V1405, respectively.

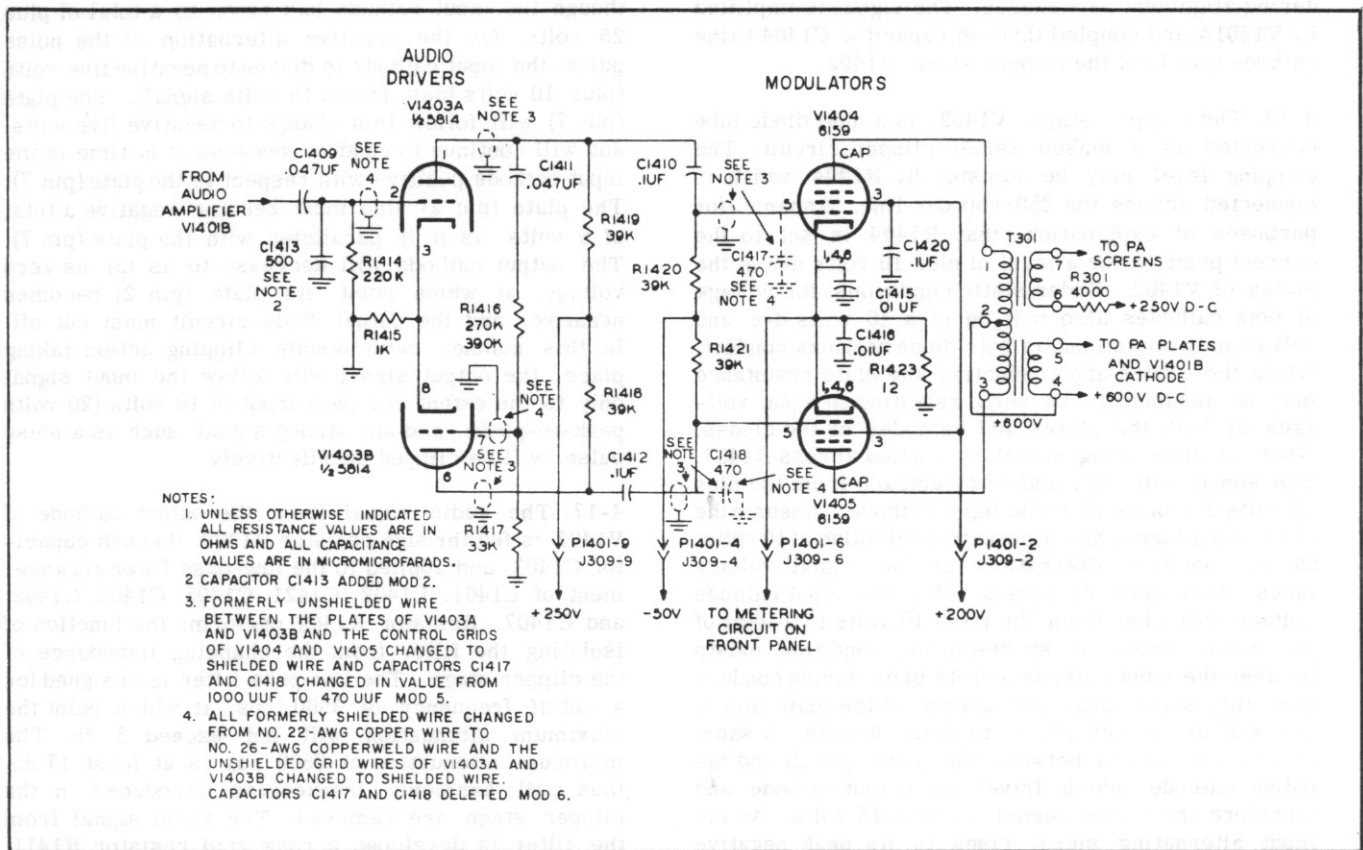


Figure 4-9. Audio Drivers and Modulators, Simplified Schematic Diagram

4-19. The audio signals from V1403A and V1403B are developed across grid resistors R1420 and R1421 of the modulator tubes, V1404 and V1405. The modulator tubes are connected for push-pull operation, under class AB2 conditions. Approximately 100 volts (grid to grid) of audio signal drives the modulator tubes to full output. Provision is made for metering the common cathode current of V1404 and V1405. Resistor R1423 is the current meter shunt, and capacitors C1415 and C1416 perform the dual functions of meter bypass and cathode bypass. The current meter is located on the front panel and may be connected to read the cathode current of V1404 and V1405 by operating the meter selector to the MOD. PL. position. The modulator grids are biased to negative 50 volts d-c from Power Supply 416W-1. The two audio signals present at the modulator grids are amplified and appear across the primary winding of T301. Considering the center tap as the common point, the audio signals at terminals 1 and 3 have a 180-degree phase relationship. Therefore, the signals at secondary terminals 5 and 7 are in phase, and are used to plate and screen modulate the power amplifier tubes. A part of the signal present at terminal 5 is fed back to the second audio amplifier,

V1401B, and is used to flatten the over-all frequency response, as was explained in paragraph 4-19.

4-20. SIDE-TONE CIRCUIT. Refer to figure 4-10. Side tone for cw operation is provided by 6.3 volts, 400 cps from Power Supply 416W-1; which is applied through the line filter arrangement of C1850, C1807, and L1807 to resistors R108 and R107. Resistor R107 is a potentiometer, which may be set for the desired cw side-tone amplitude. Relay K803 is energized when the OFF PHONE CW switch of Radio Set Control 614C-2 is operated to the CW position. Relay K804 is energized by operation of either a telegraph key or the microphone push-to-talk button. The 400-cps signal (amplitude dependent upon setting of R107) is coupled through capacitor C1301 and developed across resistor R1302. Resistors R1302 and R1303 form a voltage divider for both side-tone signals. Capacitor C1306 prevents spurious r-f signals from varying the grid voltage of first audio amplifier V1301A. The cw side tone is amplified by V1301A and passed on to the headset, as described in paragraph 4-35.

4-21. Side-tone voltage for voice operation is provided by the power amplifier stage. Resistors R1508

and R1521, in conjunction with the parallel arrangement of resistor R1523 and inductor L1505, perform the dual functions of dividing the r-f signal and isolating the power amplifier plate circuit from the varying impedance of CR1503. The r-f signal is rectified by CR1503 and filtered by the combination of R1509, C1514, and C1540, thus recovering the modulation envelope. The audio signal is made variable by resistor R106, which may be set for the desired side tone amplitude. The audio signal is applied through contacts of K803, at which point operation is identical with the cw side-tone circuit.

**4-22. RECEIVER SECTION.**

4-23. Reference is made to the block diagram, figure 4-11. An r-f signal, within the frequency range of 2 to 25 megacycles, is received by the antenna and applied through contacts of switch S1003 rear, through 1 of 4 tuned circuits, and through contacts of switch S1003 front to the control grid of V1008. Both sections of switch S1003, as well as all other band switches, are operated by autopositioner motor B103, which receives its information from Radio Set Control 614C-2, in conjunction with the bandchange autopositioner. The slugs of all tuned circuits within the receiver section of Radio Set 618S-1 and 618S-1A are driven by servomotor B102 whenever a new channel is selected. Servomotor B102 receives its information from the r-f crystal oscillator, and a discriminator and servo amplifier system, consisting of V1001, G601, V601, and V602. The r-f signal is amplified by V1008 and applied

through a similar tuned circuit and switching arrangement, consisting of Z1014 through Z1017 and switches S1004 front and rear. The signal is amplified by the second r-f amplifier, V1009, applied through Z1018, Z1019, Z1020, or Z1021, depending upon the position of S1005 front and rear, and applied to the control grid of the first receiver mixer, V1005. Another signal, which originates in the r-f crystal oscillator, is applied through the multiplier stage (V1007), through multiplier tuned circuits (Z1006 through Z1009), to grid 3 of V1005. Switches S1002 and S1001 rear select the correct tuned circuit arrangement for the following frequencies: band 1, zero megacycles; band 2, 1.75 to 3.5 megacycles; band 3, 5.25 to 10.5 megacycles; and band 4, 12.25 to 21.656 megacycles. The two signals (one from the antenna and r-f amplifiers, and the other from the r-f crystal oscillator and multipliers) are mixed in the electron stream of V1005, producing an output signal within the range of 2 to 3.75 megacycles. The 2- to 3.75-megacycle signal is applied through tuned circuits Z1002 and Z1003 to the control grid of variable i-f amplifier V1002. The variable i-f signal is amplified by V1002 and applied through tuned circuits Z1004 and Z1005 to the control grid of the second receiver mixer, V1006. An injection voltage from the r-f crystal oscillator within the frequency range of 1.75 to 3.5 megacycles is applied to grid 3 of V1006. The two signals (one of 2 to 3.75 megacycles from the main signal line and the other of 1.75 to 3.5 megacycles from the r-f crystal oscillator) are heterodyned in the electron stream of V1006 and applied through the mechanical filter, FL901. The mechanical

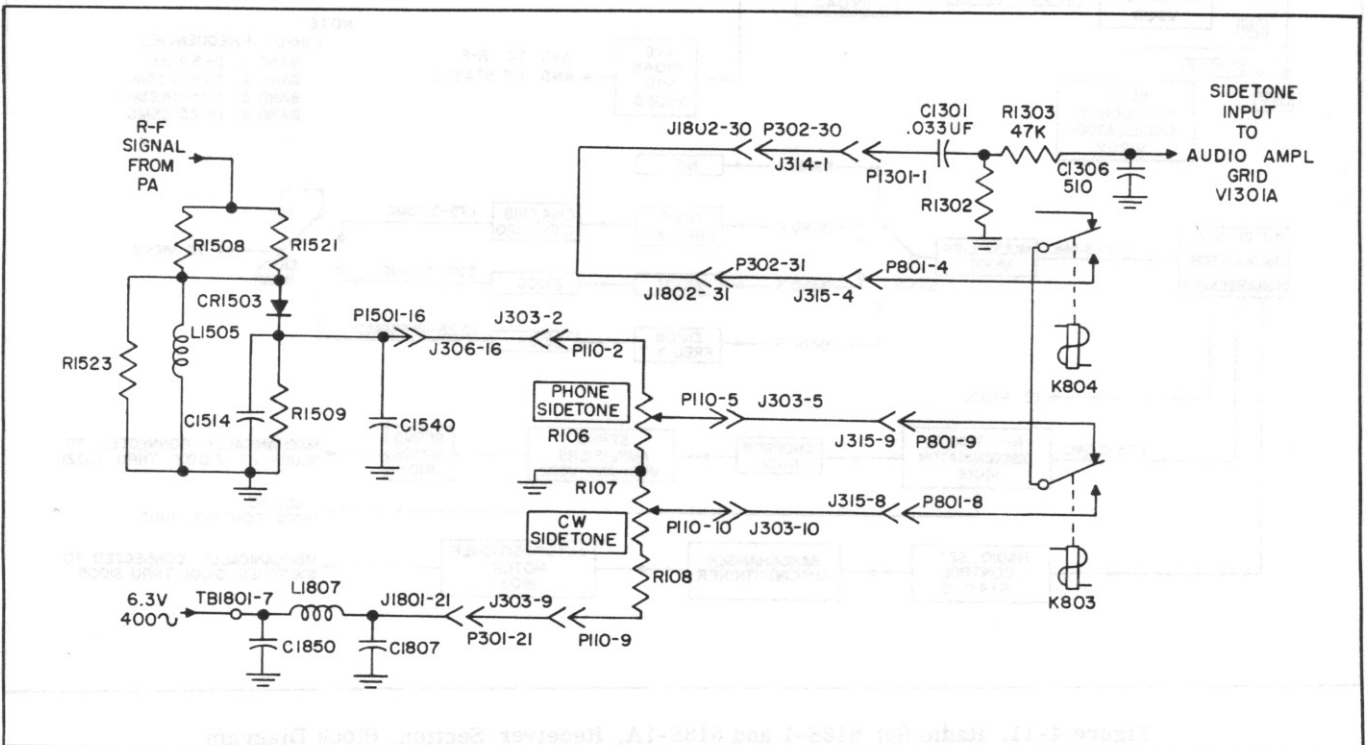


Figure 4-10. Side-Tone Circuit, Simplified Schematic Diagram

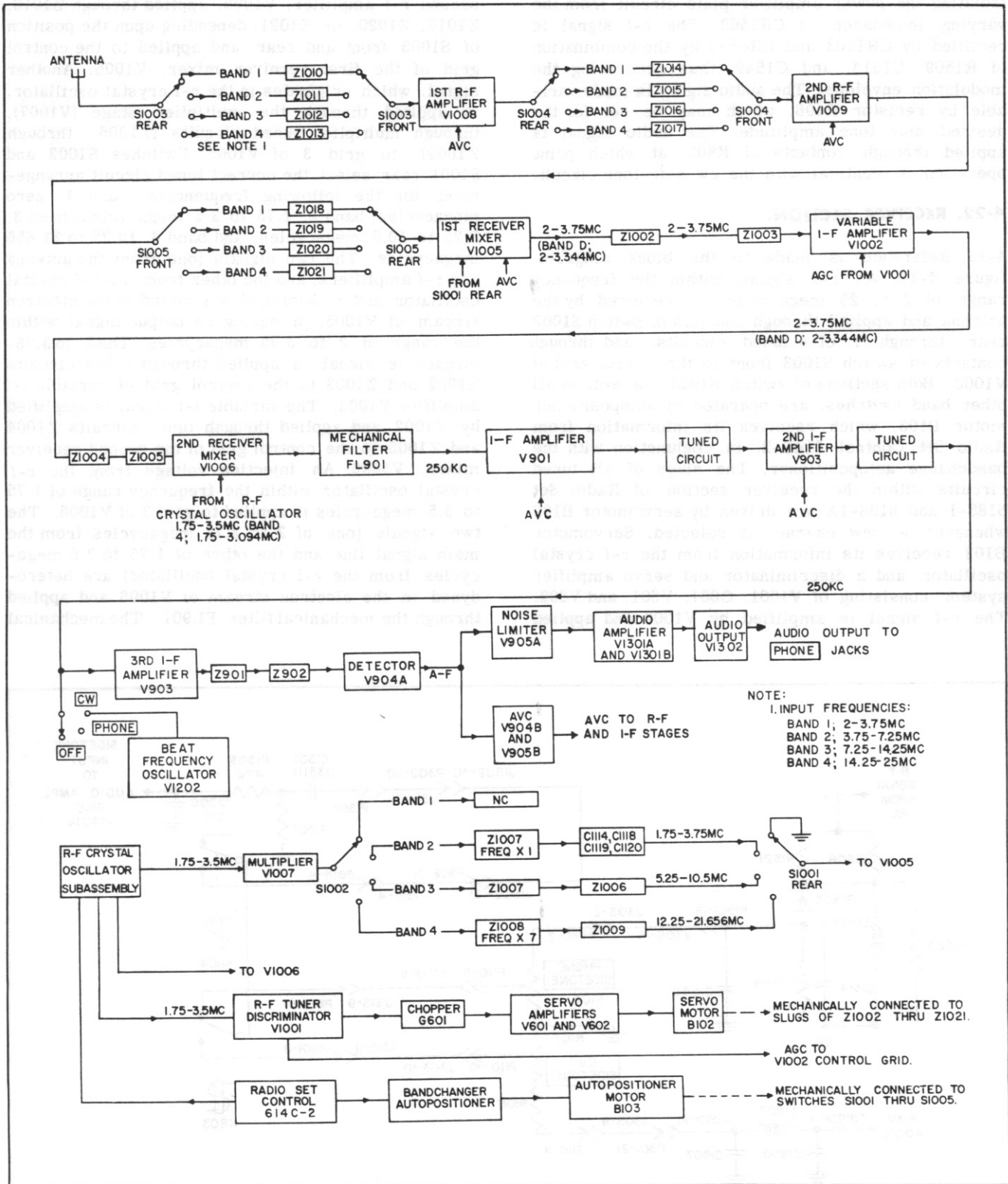


Figure 4-11. Radio Set 618S-1 and 618S-1A, Receiver Section, Block Diagram

filter has a center frequency of 250 kilocycles, which selects the difference frequency (2 to 3.75 megacycles and 1.75 to 3.5 megacycles). The 250-kilocycle resultant signal is amplified by V901 and applied through a tuned circuit to the control grid of the second i-f amplifier, V902. The signal is amplified by V902 and applied through a tuned circuit to V903. At this point, an injection signal is applied from the beat-frequency oscillator stage, V1202. The 250-kilocycle signal from V1202 is mixed with the fixed i-f signal, producing a beat note for use when receiving cw signals. Final i-f amplification takes place in V903 and the 250-kc signal is applied to the detector stage, V904A. The audio portion of the signal is recovered in the detector and applied to the avc and noise limiter stages. Avc voltage is supplied to the r-f amplifiers, the receiver mixers, and the first and second i-f amplifiers. The action of V904B and V905B prevents avc from being applied until full receiver sensitivity has been reached. The audio signal from V904A is applied also to the noise limiter, V905A, which clips strong noise pulses. The audio signal is amplified by V1301A and V1301B and applied to the control grid of the audio output stage, V1302. Output from V1302 is connected to PHONE jack, J101, which mates the plug of Headset H-1/AR and H-4/AR. The audio output signal also is applied through gain control circuits within Radio Set Control 614C-2 to the external interphone amplifiers.

#### 4-24. DETAILED RECEIVE FUNCTIONS.

4-25. RECEIVER R-F AMPLIFIERS. Refer to figure 4-12. The incoming r-f signal from the front panel AUX REC ANT jack is applied through contacts of S1003 rear, through coupling capacitor C1028, and developed across tuned circuit Z1010. The r-f input signal is grounded through contacts of relay K1001 when the 618S-1 or 618S-1A is keyed, thus preventing reception when transmission is in progress. Tuned circuit Z1010 is used on band 1 (2.0 to 3.75 megacycles). Tuned circuits Z1011 through Z1013, which are not shown in figure 4-12, are used for bands 2 (3.75 to 7.25 megacycles), 3 (7.25 to 14.25 megacycles), and 4 (14.25 to 25 megacycles) respectively. The signal is applied through Z1010, which resonates to a particular band 1 frequency, through contacts of S1003 front, and applied to the control grid of V1008. The cathode of V1008 connects to the cathode of V1009 when the 618S-1 or 618S-1A is in the key-up position. When keyed, the first r-f amplifier is removed from the circuit and not used. The r-f signal is amplified by V1008, fed through contacts of S1004 rear, and developed across tuned circuit Z1014. Tuned circuits Z1015 through Z1017 are selected by S1004 rear for bands 2, 3, and 4, respectively. Capacitors C1068 and C1040 form an r-f voltage divider for the signal applied to the grid of second r-f amplifier V1009. The r-f signal is coupled through contacts of S1004 front and developed across grid resistor R1039. Avc voltage is supplied directly to V1008 and through contacts of K1001 to V1009. When receiving in the CW position, avc is grounded through resistor R807, thereby lowering the avc voltage and increasing the

gain of V1008 and V1009. When keyed, the grid and cathode circuits of V1009 are grounded through contacts of K1001, increasing the gain of V1009 further. When in the key-up position, the gain of both V1008 and V1009, as well as second i-f amplifier V902 and receiver input mixer V1005 (not shown in figure 4-12), is made variable through potentiometers in Radio Set Control 614C-2. Potentiometer R2602 is a 150-ohm variable resistor used to set the threshold level when in the PHONE position. The audio gain during PHONE reception is adjustable by the small 614C-2 knob, through potentiometers ganged with R2605. The audio circuits will be described in detail in paragraph 4-35. When in the CW position, potentiometer R2605 allows a large control over the receiver section r-f gain. The small 614C-2 knob controls the position of R2605 when in the CW position. The r-f signal is amplified by V1009 and applied through contacts of S1005 front and rear to the control grid of the receiver first mixer stage, V1005.

4-26. RECEIVER MIXERS AND VARIABLE I-F AMPLIFIER. Refer to figure 4-13. The r-f signal from the plate of V1009 is applied through contacts of S1005 front, through tuned circuit Z1018 (Z1019, Z1020, or Z1021 for bands 2, 3, or 4, respectively), through contacts of S1005 rear and coupling capacitor C1057, and developed across grid resistor R1027. Resistor R1027, in conjunction with capacitor C1122, forms a decoupler for the avc voltage. The avc is grounded through R807 and contacts of K803 when in the CW position. The cathode circuit of V1005 is connected through contacts of K1001 to the PHONE and CW gain controls described in paragraph 4-25. The cathode is opened and V1005 removed from the circuit when the 618S-1 or 618S-1A is keyed. An injection signal from the multiplier is applied through coupling capacitor C1084 to grid 3 of V1005. Figure 4-14 illustrates the multiplier circuit in the band A position. A 1.75- to 3.5-megacycle signal, which originates in the r-f crystal oscillator, is amplified by V1007, and the first, third, or seventh harmonic selected by combinations of tuned circuits. Tuned circuits Z1007 and Z1006, in conjunction with capacitors C1114, C1118, C1119, and C1120, select the first harmonic (1.75 to 3.5 megacycles) for band 2. In band 3, the shunt capacitors are not used and tuned circuits Z1007 and Z1006 resonate at the third harmonic (5.25 to 10.5 megacycles). Tuned circuits Z1008 and Z1009, which are not illustrated in figure 4-14, select the seventh r-f crystal oscillator harmonic (12.25 to 21.656 megacycles) when in the band 4 position. The multiplier signal is not used on band 1, as the frequencies involved correspond directly to the variable i-f frequency (2 to 3.75 megacycles), and no first heterodyning is necessary.

4-27. The injection signal is coupled through capacitor C1084 to grid 3 of the first receiver mixer, V1005. The two signals (one of 2 to 25 megacycles from the main signal line and the other of zero to 21.656 megacycles from the multiplier circuits) are heterodyned within the electron stream of V1005, and the difference frequency (2 to 3.75 megacycles) selected

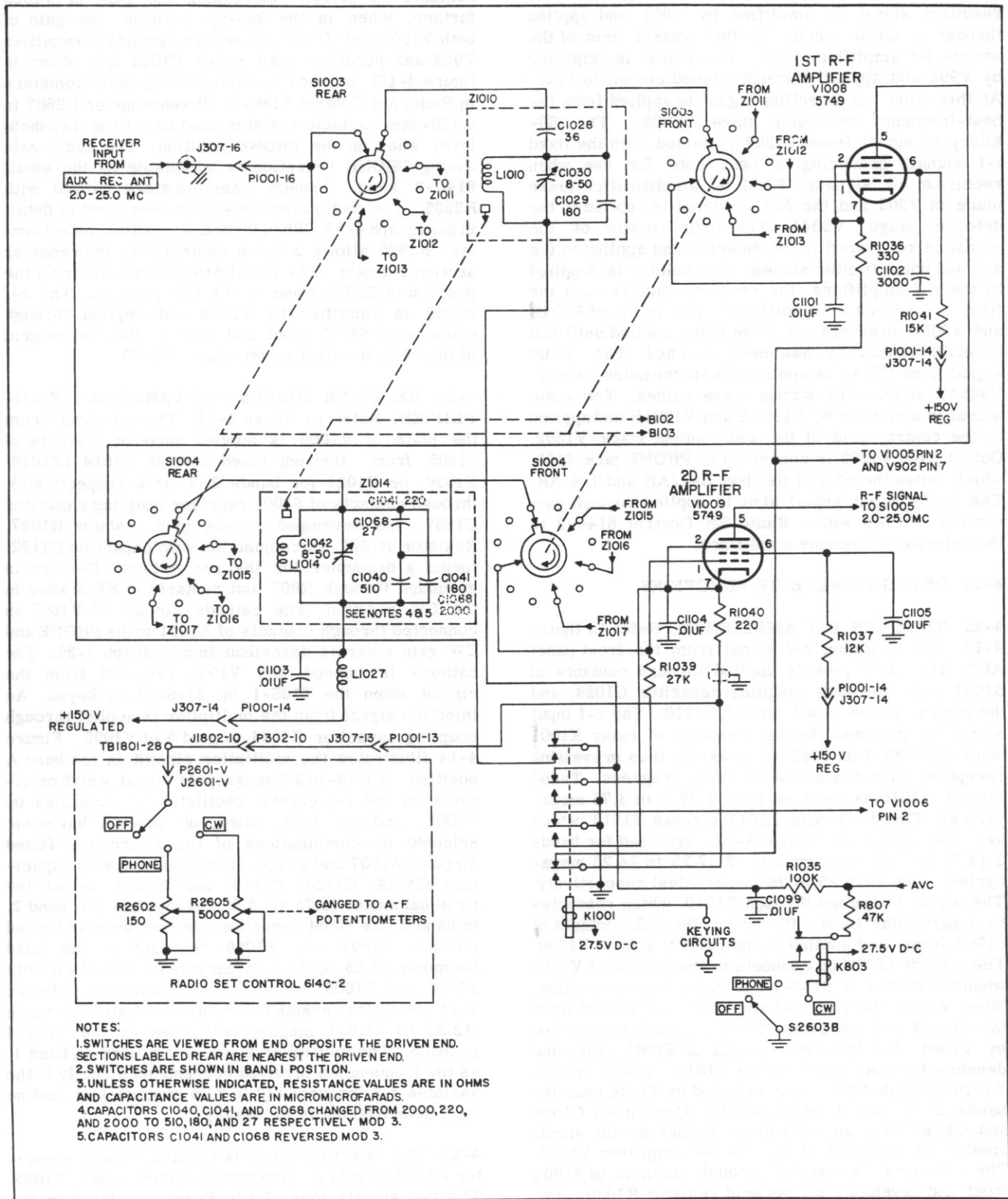


Figure 4-12. Receiver R-F Amplifiers, Simplified Schematic Diagram

by tuned circuits Z1002 and Z1003. The 2- to 3.75-megacycle signal is applied to the control grid of variable i-f amplifier V1002. The variable i-f signal is amplified by V1002 and developed across tuned circuits Z1004 and Z1005. The variable i-f amplifier stage, in conjunction with tuned circuits Z1002 through Z1005, is used during both transmission and reception. An agc voltage, which originates in the r-f crystal oscillator and tuner discriminator, is applied to the control grid of V1002. This agc voltage faithfully

follows the output level of the r-f crystal oscillator; thus, as the over-all gain tries to decrease as a result of a decreased r-f crystal oscillator output level, the gain of V1002 increases. In this manner, V1002 performs the dual functions of amplifying the variable i-f signal and maintaining a constant over-all gain with a varying r-f crystal oscillator signal.

4-28. Output from V1002 is developed across Z1004 and Z1005 and applied to the control grid of the

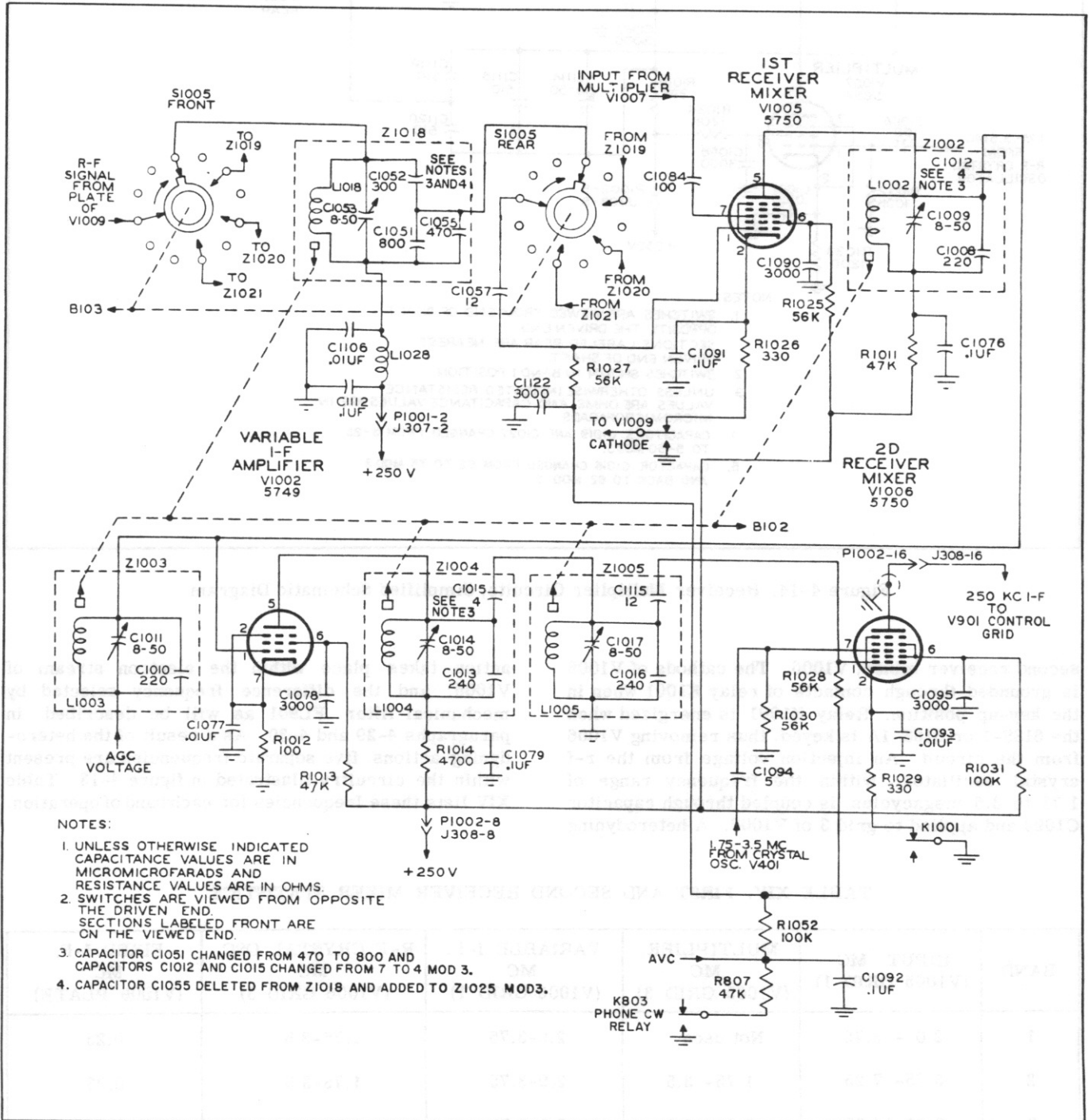


Figure 4-13. Receiver Mixers and Variable I-F Amplifier, Simplified Schematic Diagram

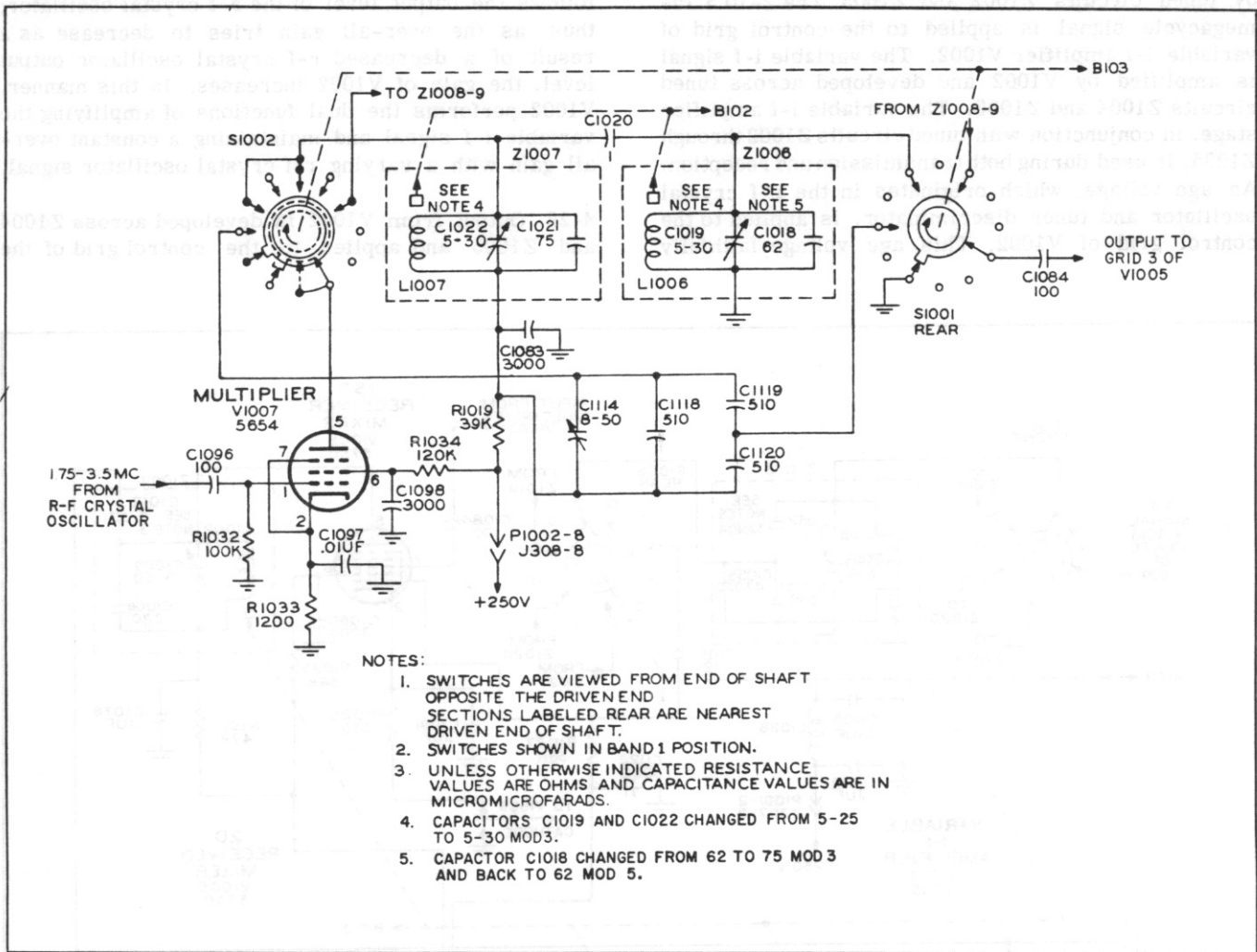


Figure 4-14. Receiver Multiplier Circuits, Simplified Schematic Diagram

second receiver mixer, V1006. The cathode of V1006 is grounded through contacts of relay K1001 when in the key-up position. Relay K1001 is energized when the 618S-1 or 618S-1A is keyed, thus removing V1006 from the circuit. An injection voltage from the r-f crystal oscillator, within the frequency range of 1.75 to 3.5 megacycles, is coupled through capacitor C1094 and applied to grid 3 of V1006. A heterodyning

action takes place within the electron stream of V1006, and the difference frequency selected by mechanical filter FL901 as will be described in paragraphs 4-29 and 4-30. As a result of the heterodyning actions, five separate frequencies are present within the circuitry illustrated in figure 4-13. Table XIV lists these frequencies for each band of operation.

TABLE XIV. FIRST AND SECOND RECEIVER MIXER STATISTICS

BAND	INPUT, MC (V1005 GRID 1)	MULTIPLIER, MC (V1005 GRID 3)	VARIABLE I-F, MC (V1006 GRID 1)	R-F CRYSTAL OSC, MC (V1006 GRID 3)	FIXED I-F, MC (V1006 PLATE)
1	2.0 - 3.75	Not used	2.0-3.75	1.75-3.5	0.25
2	3.75- 7.25	1.75- 3.5	2.0-3.75	1.75-3.5	0.25
3	7.25-14.25	5.25-10.5	2.0-3.75	1.75-3.5	0.25
4	14.25-25.00	12.25-21.656	2.0-3.344	1.75-3.095	0.25



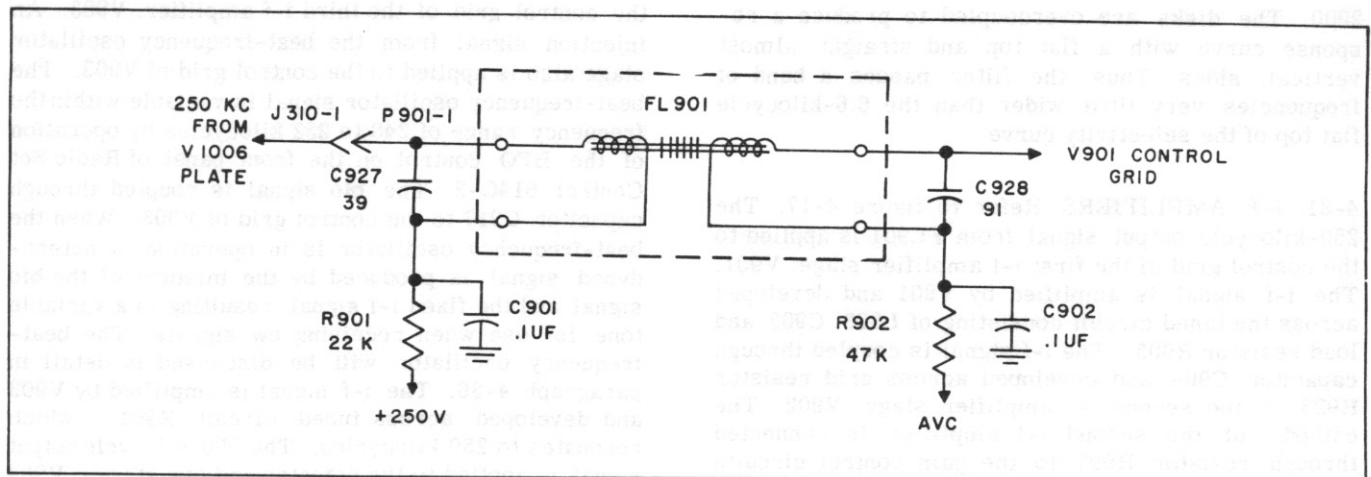


Figure 4-15. Fixed I-F Input Circuit, Simplified Schematic Diagram

## NOTE

On band 4, slugs within the tuner subassembly have a limited range of movement, necessitating frequencies as listed in table XIV.

**4-29. FIXED I-F INPUT CIRCUIT.** Refer to figure 4-15. The signal from the plate of V1006 is developed across the tuned circuit consisting of C927 and the input transducer coil of FL901. The mechanical filter, FL901, employs the principle of magnetostriction to convert electrical energy into mechanical energy and back again, as will be described in the following paragraph. Output from FL901 is developed across the tuned circuit, consisting of C928 and the output transducer coil, and applied to the control grid of the first i-f amplifier stage, V901. B-plus voltage for V1006 and avc voltage for V901 is applied through the transducer coils of FL901. The small d-c current through the transducer coils does not affect the 250-kilocycle signal characteristics.

**4-30. MECHANICAL FILTERS.** Refer to figure 4-16. The signal from the plate of V1006 is developed

across the tuned circuit, consisting of C927 and the input transducer coil, which resonates to the 250-kilocycle i-f frequency. A nickel wire within the input transducer coil is caused to vibrate mechanically from the changing flux created by the input tank current. 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 250-kilocycle input signal. The last disk is connected mechanically 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 coil. An alternating current is set up in the output tuned circuit, which is in direct accordance with the input current. 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. Biasing magnets at each end of the mechanical filter polarizes the resonant disks to prevent frequency doubling in much the same manner that biasing magnets in a head-phone 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

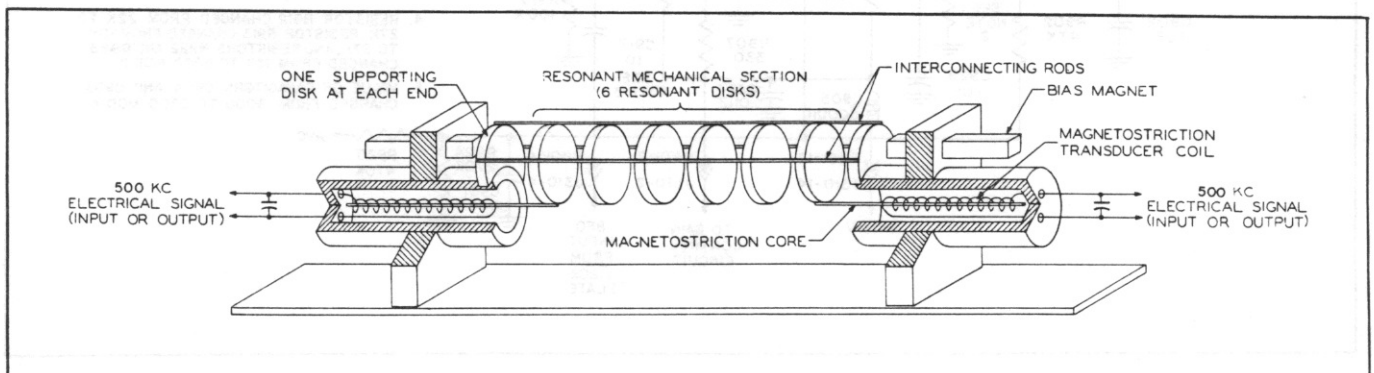


Figure 4-16. Mechanical Filter, Functional Diagram

2000. The disks are overcoupled to produce a response curve with a flat top and straight, almost vertical, sides. Thus, the filter passes a band of frequencies very little wider than the 6.6-kilocycle flat top of the selectivity curve.

4-31. I-F AMPLIFIERS. Refer to figure 4-17. The 250-kilocycle output signal from FL901 is applied to the control grid of the first i-f amplifier stage, V901. The i-f signal is amplified by V901 and developed across the tuned circuit consisting of L903, C903, and load resistor R905. The i-f signal is coupled through capacitor C904 and developed across grid resistor R925 of the second i-f amplifier stage, V902. The cathode of the second i-f amplifier is connected through resistor R907 to the gain control circuits described in paragraph 4-25. Avc voltage is applied to both the first and second i-f amplifier stages through the avc filter arrangement of R920, R924, and C931. The avc circuits will be described in detail in paragraphs 4-32 through 4-34 and paragraphs 4-37 and 4-38. The output from V902 is developed across the tuned circuit consisting of L904, C906, and load resistor R906, and coupled through capacitor C908 to

the control grid of the third i-f amplifier, V903. An injection signal from the beat-frequency oscillator stage also is applied to the control grid of V903. The beat-frequency oscillator signal is variable within the frequency range of 248 to 252 kilocycles by operation of the BFO control on the front panel of Radio Set Control 614C-2. The bfo signal is coupled through capacitor C917 to the control grid of V903. When the beat-frequency oscillator is in operation, a heterodyned signal is produced by the mixture of the bfo signal and the fixed i-f signal, resulting in a variable tone for use when receiving cw signals. The beat-frequency oscillator will be discussed in detail in paragraph 4-36. The i-f signal is amplified by V903 and developed across tuned circuit Z901, which resonates to 250 kilocycles. The 250-kilocycle output signal is applied to the detector and avc stages, V904 and V905.

4-32. DETECTOR, NOISE LIMITER, AND AVC. Refer to figure 4-18. One half of dual diode V904 is used as a detector. Signal voltage is coupled through C912 and applied to the cathode of V904A. Rectified voltage appears across resistors R909 and R916. A series-type noise limiter is employed. One half of dual

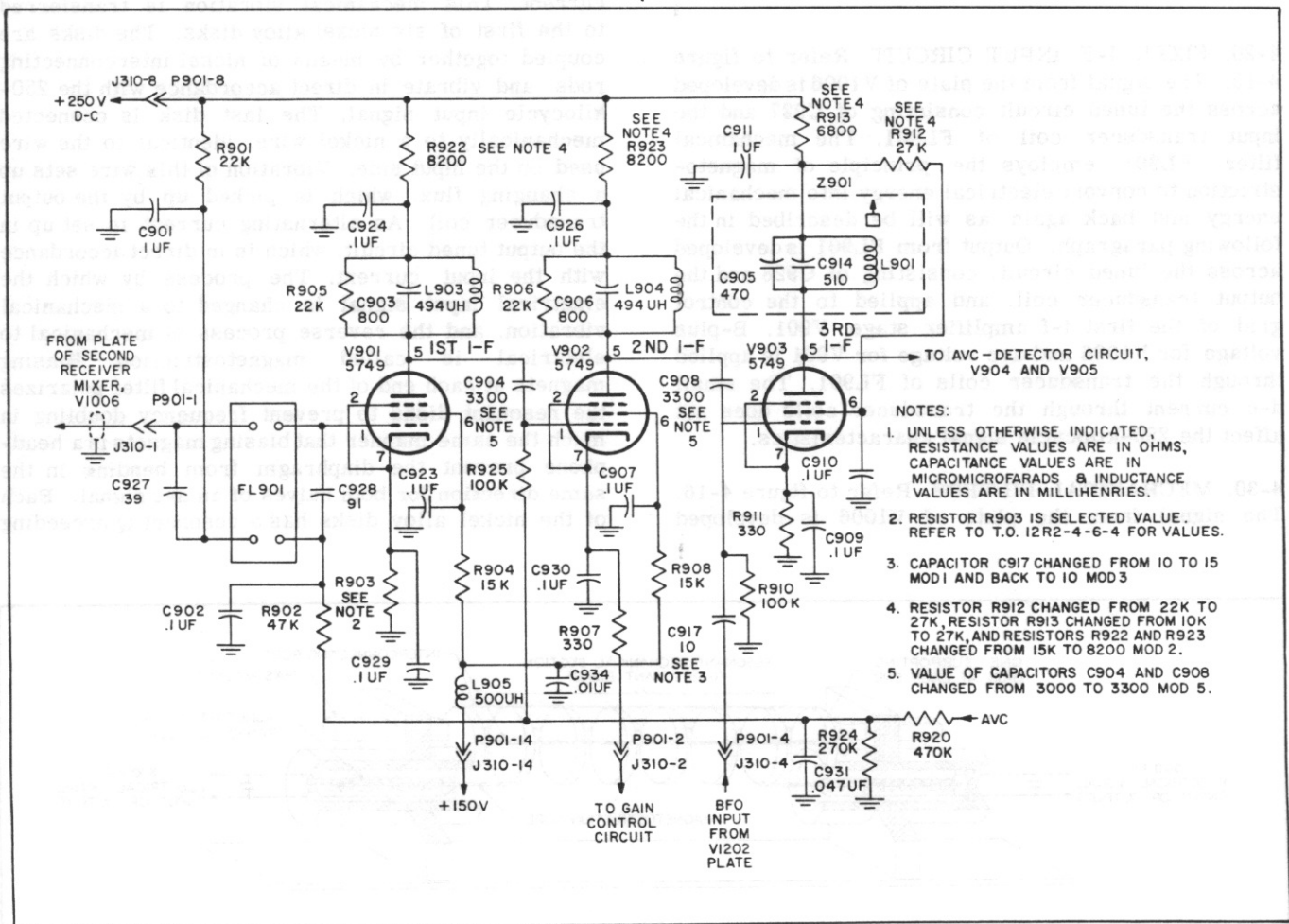


Figure 4-17. I-F Amplifiers, Simplified Schematic Diagram

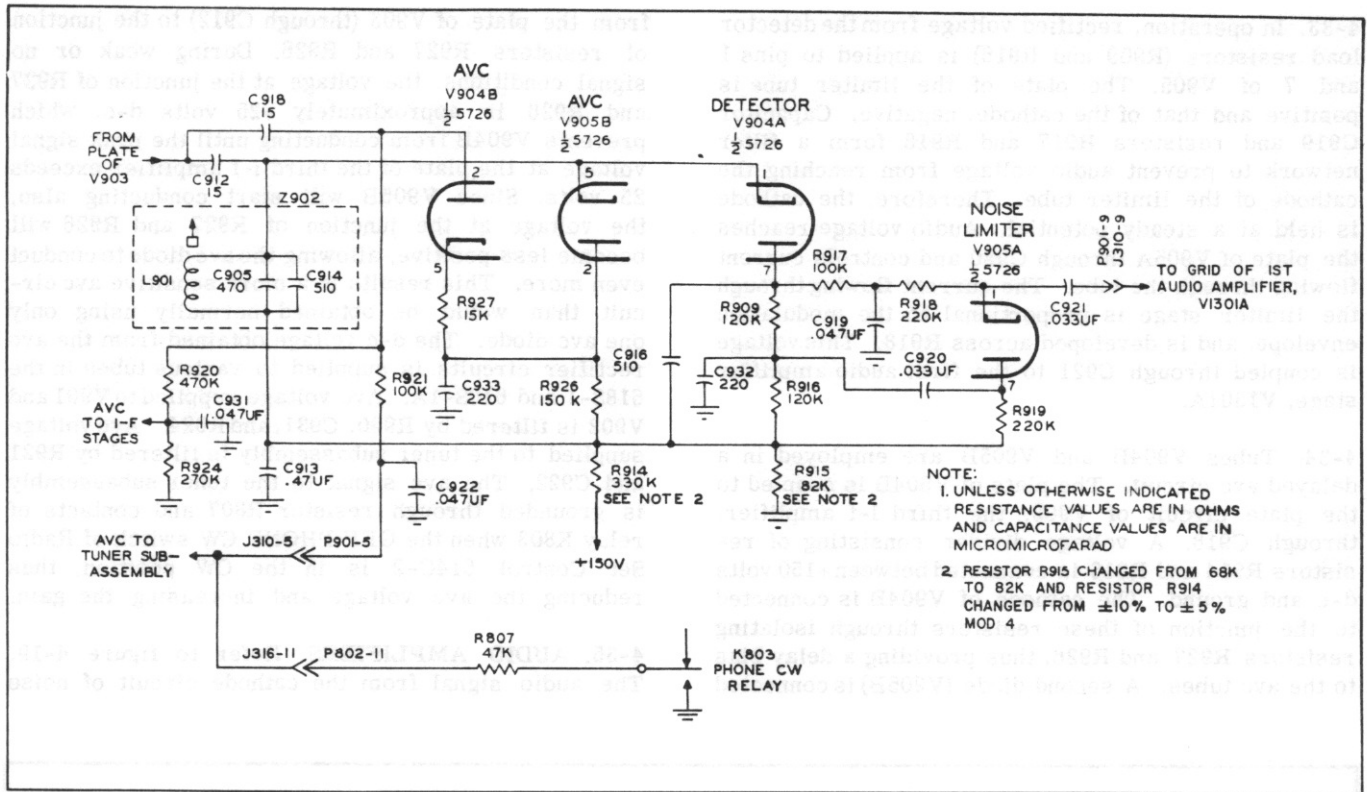


Figure 4-18. Detector, Noise Limiter, and Avc Stages, Simplified Schematic Diagram

diode V905 is connected with the first audio amplifier stage (V1301A) in the audio amplifier subassembly. Normal audio signals are coupled from the detector

output to V1301A control grid. Sharp, high amplitude noise impulses are limited in amplitude to a nominal 60% modulation characteristic.

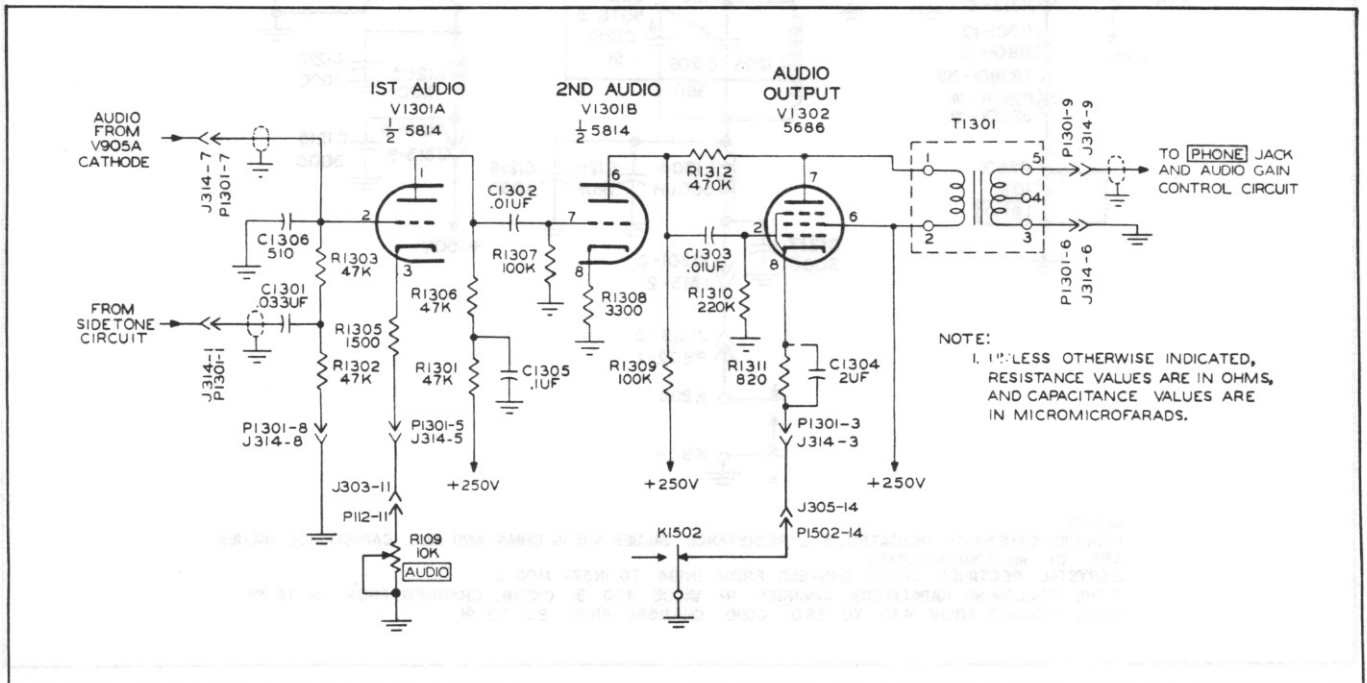


Figure 4-19. Receiver Audio Amplifiers, Simplified Schematic Diagram

4-33. In operation, rectified voltage from the detector load resistors (R909 and R916) is applied to pins 1 and 7 of V905. The plate of the limiter tube is positive and that of the cathode, negative. Capacitor C919 and resistors R917 and R918 form a filter network to prevent audio voltage from reaching the cathode of the limiter tube. Therefore, the cathode is held at a steady potential. Audio voltage reaches the plate of V905A through C920 and controls current flowing through the tube. The current flowing through the limiter stage is proportional to the modulation envelope, and is developed across R918. This voltage is coupled through C921 to the first audio amplifier stage, V1301A.

4-34. Tubes V904B and V905B are employed in a delayed avc circuit. The plate of V904B is coupled to the plate circuit of V903, the third i-f amplifier, through C918. A voltage divider consisting of resistors R914 and R915 is connected between +150 volts d-c and ground. The cathode of V904B is connected to the junction of these resistors through isolating resistors R927 and R926, thus providing a delay bias to the avc tubes. A second diode (V905B) is connected

from the plate of V903 (through C912) to the junction of resistors R927 and R926. During weak or no signal conditions, the voltage at the junction of R927 and R926 is approximately +25 volts d-c, which prevents V904B from conducting until the peak signal voltage at the plate of the third i-f amplifier exceeds 25 volts. Since V905B will start conducting also, the voltage at the junction of R927 and R926 will become less positive, allowing the avc diode to conduct even more. This results in a more sensitive avc circuit than would be obtained normally using only one avc diode. The d-c voltage obtained from the avc rectifier circuits is supplied to various tubes in the 618S-1 and 618S-1A. Avc voltage supplied to V901 and V902 is filtered by R920, C931, and R924. Avc voltage supplied to the tuner subassembly is filtered by R921 and C922. The avc signal to the tuner subassembly is grounded through resistor R807 and contacts of relay K803 when the OFF PHONE CW switch of Radio Set Control 614C-2 is in the CW position, thus reducing the avc voltage and increasing the gain.

4-35. AUDIO AMPLIFIERS. Refer to figure 4-19. The audio signal from the cathode circuit of noise

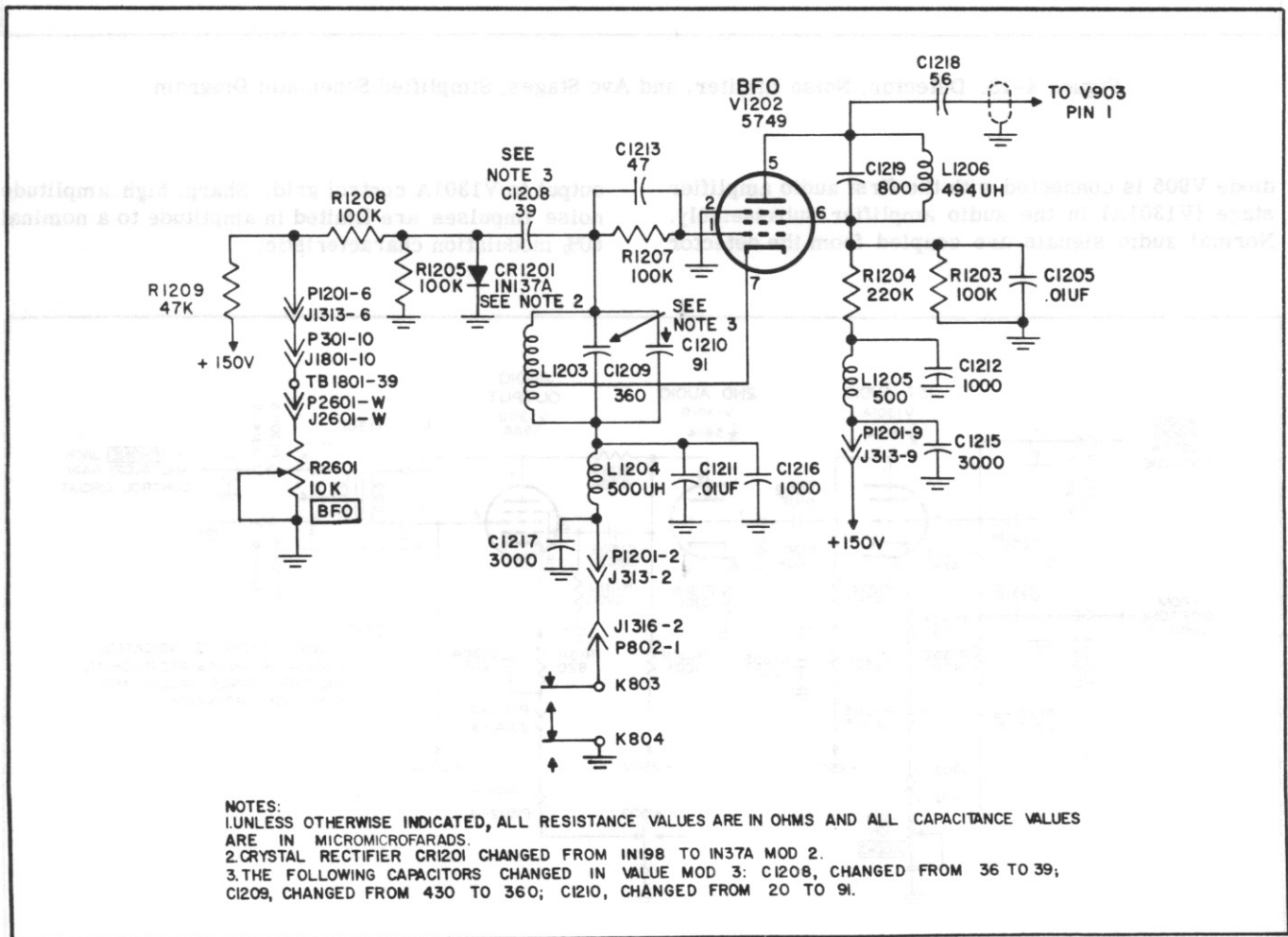


Figure 4-20. Beat-Frequency Oscillator, Simplified Schematic Diagram

limiter V905A is applied to the control grid of the first audio amplifier stage. The side-tone signal is coupled through capacitor C1301 and developed across grid resistor R1302. The audio side-tone signal or received signal, is amplified by V1301A and developed across the plate load resistor, R1306. A certain amount of control is obtainable over the amplification of V1301A. Resistor R109 is a screw driver adjustment, located on the front panel, and may be set during alignment procedures for the desired amount of audio gain. The audio signal is coupled through capacitor C1302 to the control grid of the second audio stage, V1301B. The plate circuit of V1301B is connected through resistor R1312 to the plate of the audio output stage, V1302. The resultant feedback voltage is of the opposite phase, and a slight amount of degeneration results. This degeneration helps to flatten the frequency response characteristics of the audio stages, and allows a more linear reproduction of the input signal. The cathode of V1302 is grounded through contacts of relay K1502. Relay K1502 is energized only during the centering cycle of the power amplifier subassembly, thus muting the audio output during this interval and preventing switching transients from being applied to the headset. The audio signal is amplified by V1302 and applied across the primary of transformer T1301. Approximately 500 milliwatts of audio power is available from V1302. The audio signal is coupled through T1301 and connected to the PHONE jack on the front panel of Radio Receiver-Transmitter 618S-1 and 618S-1A. The audio output signal also is connected to Radio Set Control 614C-2. Potentiometers within Radio Set Control 614C-2 allow control over the audio amplitude applied to the external interphone amplifiers while offering a constant impedance to transformer T1301, as will be explained in paragraph 4-68.

4-36. BEAT-FREQUENCY OSCILLATOR. Refer to figure 4-20. The beat-frequency oscillator stage, V1202, employs a type 5749 pentode tube in a series-fed, electron-coupled oscillator. The basic oscillator frequency is controlled by the parallel arrangement of inductor L1203, tuning capacitor C1209, and temperature-compensating capacitor C1210. The oscillator plate circuit consists of the screen grid of V1202, the parallel filter arrangement of C1205 and R1203, and the plate load resistor, R1204. Feedback to the grid is accomplished by the autotransformer-type connection of L1203 in the cathode circuit of V1202. The parallel arrangement of CR1201 and R1205 is in shunt with the oscillator tank circuit. Crystal rectifier CR1201 is connected through R1208, R1209, and L1205 to the 150-volt regulated line. The voltage across CR1201 is variable from zero to approximately 25 volts d-c by operation of the sliding arm of potentiometer R2601. Potentiometer Z2401C is operated through the BFO control on the front panel of Radio Set Control 614C-2. As the d-c voltage across CR1201 is varied, the impedance to ground also is varied, effectively changing the capacitive reactance of capacitor C1208, and altering the frequency of oscillation. In this manner, the pitch of the bfo signal is changed for monitoring of cw signals.

Output from the bfo stage is taken across the plate tank circuit, consisting of C1219 and L1206, and coupled through capacitor C1218 to the control grid of the third fixed i-f stage, V903. The bfo stage is removed from the 618S-1 or 618S-1A circuits when the OFF PHONE CW switch of Radio Set Control 614C-2 is in the PHONE position, which de-energizes relay K803 and opens the cathode circuit of V1202. The bfo stage also is removed from the circuit during transmission by contacts of relay K804.

4-37. AGC AND AVC CIRCUITS. Refer to figure 4-21. A portion of the signal from the plate circuit of the tuner discriminator, V1001, is coupled through capacitor C1071 and developed across the tuned circuit consisting of inductor L1026 and capacitor C1116. Capacitor C1116 and inductor L1026, in conjunction with the distributed capacity, resonate at the lower and middle frequencies of the r-f crystal oscillator (V401) range, thereby increasing the agc voltage throughout these frequency ranges. This is desirable to compensate for a varying r-f crystal oscillator output. The signal from V1001 is rectified by CR1005 and filtered by the parallel combination of C1072, R1007, and R1006. Resistor R1006 is selected by factory experimentation for optimum agc voltage for each 618S-1 or 618S-1A component. Agc is supplied to variable i-f amplifier V1002 during both transmission and reception, thereby compensating for a varying output level from the r-f crystal oscillator stage.

4-38. Avc voltage from V904B is filtered by resistor R921 and capacitor C922 and applied through contacts of K1001 to the control grid circuit of the second r-f amplifier stage, V1009. The avc signal is grounded through resistor R807 and contacts of K803 when in the CW position, thus lowering the avc and increasing the gain when receiving cw signals. Relay K1001 is energized whenever the microphone push-to-talk button or the telegraph key is depressed, which removes the avc and grounds the grid circuit of V1009 during transmission. The avc voltage is further filtered by the low-pass filter arrangement of C1092, C1099, C1122, R1035, and R1052 for the receiver first and second mixer stages and the receiver first i-f amplifier stage. During transmission, V1005, V1006, and V1008 are removed from the circuit and not used.

4-39. FILAMENT CIRCUIT. Refer to figure 5-1. All tubes within Radio Receiver-Transmitter 618S-1 and 618S-1A are connected in a series-parallel arrangement to obtain the proper operating voltages for the filaments. Balancing resistors are employed, where necessary, as voltage dividers. Bypass capacitors are used on each tube filament where the possibility of r-f coupling exists to prevent spurious oscillations and coupling to the power source. Figure 5-1 illustrates the series-parallel layout of each tube filament, as well as the voltages at each pin. Reference is made to paragraphs 5-23 and 5-24 for further details of the filament circuit.

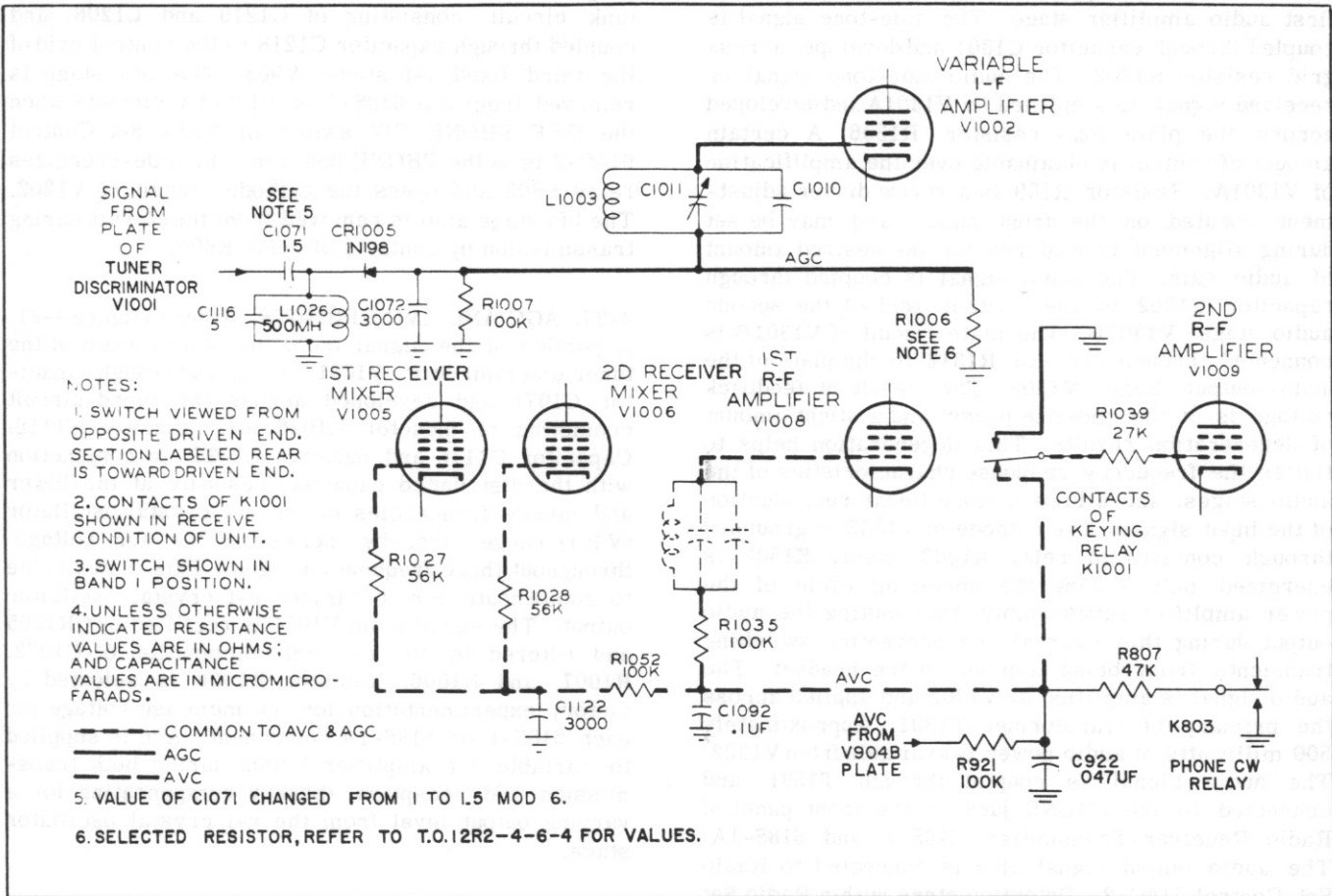


Figure 4-21. AGC and AVC Circuits, Simplified Schematic Diagram

4-40. POWER SUPPLY 416W-1. Refer to figure 7-16. Primary power for Dynamotor-Power Supply DY-118/ARC-38 is applied through terminal 23 of P1601, through contacts of thermal relay switch S1602, and through relays K1602 and K1603 to ground in Radio Set Control 614C-2. When the OFF PHONE CW switch is operated to the PHONE or CW positions, relays K1602 and K1603 are energized, which allows the selenium rectifier circuits of the DY-118/ARC-38 to operate.

4-41. Energizing of relay K1603 results in all the 400-cps voltages being applied to plug P1601 for distribution throughout the 618S-1 and 618S-1A systems. Transformer T1601 steps the 115 volts down to 6.3 volts and autotransformer L1606 steps the 115 volts down to 18 volts. Resistor R1606 and capacitor C1612 form a phase shift network for transformer T1601. The phase of the 6.3-volt, 400-cps power must be correct for proper operation of the 618S-1 and 618S-1A chopper coils, as will be described in paragraph 4-57.

4-42. After relay K1603 has been energized, a circuit exists through the surge current limiting resistor (R1601) to the 250-volt selenium rectifier supply. Parallel capacitors C1601A and C1601B form the

charging capacitor for the voltage-doubling arrangement of CR1601 and CR1603. On the negative alternation of the 400-cps input, C1601A and C1601B conduct through CR1601, driving the left side of C1601A and C1601B negative. On the positive alternation, the discharge path for C1601A and C1601B is through R1601, through contacts of K1603, through the 115-volt, 400-cps power source, through capacitor C1602A, and through CR1603. The discharge current of C1601A and C1601B adds to the current of the 400-cps supply on the positive alternation, resulting in capacitor C1602A becoming charged to twice the peak value of the 115-volt positive alternation. On the following negative alternation, capacitor C1602A cannot fully discharge because of the long time constant formed by L1602, C1602B, and R1602, and remains at practically a constant d-c voltage. In this manner, with the discharge current of C1601A and C1601B adding to the source current to charge C1602A, and with C1602A remaining charged on the following alternation, the d-c voltage across C1602A is proportional to twice the peak of the input signal. Output from the 250-volt selenium rectifier supply is taken across bleeder resistor R1602 and applied to terminal 8 of P1601 for use within the 618S-1 and 618S-1A.

4-43. The 115-volt, 400-cps power also is applied through surge current limiting resistor R1603 after

K1603 has been energized. The 400-cps voltage is rectified by CR1602 and filtered by the low-pass filter arrangement of C1605A, R1604, C1606, and R1605, producing a negative voltage of 65 volts d-c. The output of this supply is applied to terminal 10 of P1601, and is used as a bias supply for the 618S-1 and 618S-1A power amplifier tubes. The rectified voltage from CR1602 also is applied through the low-pass filter arrangement of C1605B, R1609, R1608, and C1611, producing a negative 50-volt bias supply for the 618S-1 and 618S-1A modulator tubes. The modulator bias supply is made slightly variable by potentiometer R1608, and may be set during alignment procedures. After the bias supplies have been energized, a current path exists through R1607 and K1604 to ground, thereby energizing K1604.

250 volts d-c and 600 volts d-c to the 618S-1 and 618S-1A systems. Before primary power is available to run dynamotor D1601, relays K1601, K1602, K1603, and K1604 must be energized and sequence relay K801 of the 618S-1 or 618S-1A must be de-energized. Relays K1602 and K1603 are energized after switches S1601 and S1602 are closed and the OFF PHONE CW switch of the 614C-2 is in either the PHONE or CW positions. Relay K1604 is energized after the -50 volt bias supply is functioning, and bias is applied to the modulator tubes. Sequence relay K801 is de-energized following the channeling cycle of the 618S-1 and 618S-1A. After relays K1602, K1603, K1604 have been energized and sequence relay K801 has been de-energized, 27.5 volts d-c is available at the field winding of K1601. The opposite side of the field winding obtains ground through contacts of switch S2603A within Radio Set Control 614C-2 or through the microphone push-to-talk button, depending upon

4-44. Dynamotor D1601, in conjunction with the associated filter inductors and capacitors, supplies

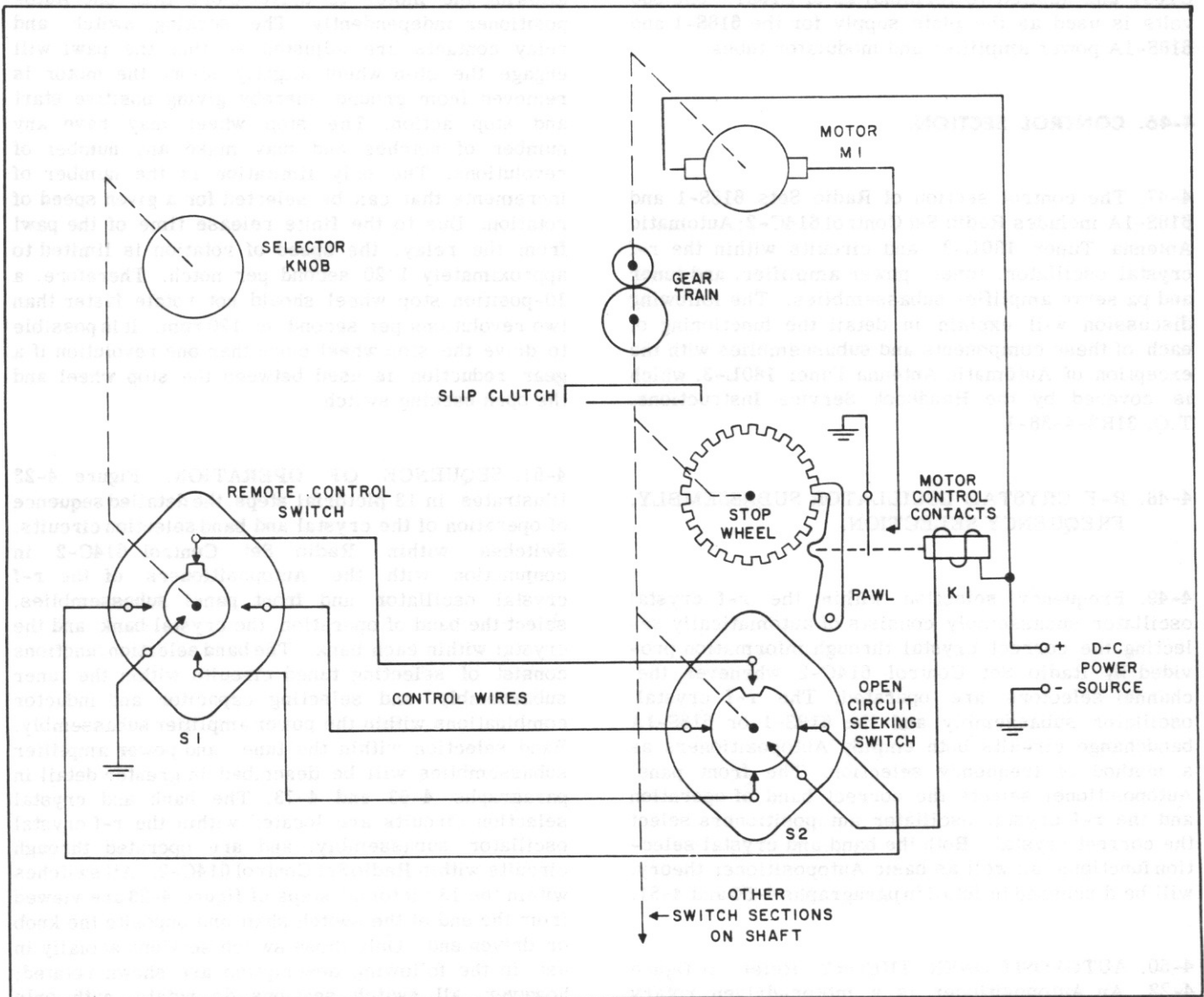


Figure 4-22. Typical Autopositioner System, Simplified Schematic Diagram

the mode of operation. When the 614C-2 OFF PHONE CW switch is in the PHONE position, ground is supplied for K1601 by operation of the microphone push-to-talk button, thus energizing K1601 and starting dynamotor D1601. When in the CW position, ground is supplied continuously through contacts of switch S2603A.

4-45. After relay K1601 has been energized, primary power is available through contacts of K1601 and through the input filter arrangement of C1604, L1603, and C1603 for the low-voltage field of dynamotor D1601. The 27.5 volts is stepped-up by D1601 to 250 volts and 600 volts d-c. The 250-volt output is filtered by L1604, L1601, and the parallel combination of C1608A and C1608B, and applied to terminal 20 of P1601. The 250 volts from D1601 is used as the plate supply for tubes within Automatic Antenna Tuner 180L-3 and Radio Receiver-Transmitter 618S-1 and 618S-1A. The 600-volt output is filtered by L1605 and C1607 and applied to terminal 22 of P1601. The 600 volts is used as the plate supply for the 618S-1 and 618S-1A power amplifier and modulator tubes.

#### 4-46. CONTROL SECTION.

4-47. The control section of Radio Sets 618S-1 and 618S-1A includes Radio Set Control 614C-2; Automatic Antenna Tuner 180L-3; and circuits within the r-f crystal oscillator, tuner, power amplifier, and tuner and pa servo amplifier subassemblies. The following discussion will explain in detail the functioning of each of these components and subassemblies with the exception of Automatic Antenna Tuner 180L-3, which is covered by the Handbook Service Instructions, T.O. 31R2-4-38-1.

#### 4-48. R-F CRYSTAL OSCILLATOR SUBASSEMBLY, FREQUENCY SELECTION.

4-49. Frequency selection within the r-f crystal oscillator subassembly consists of automatically selecting the correct crystal through information provided by Radio Set Control 614C-2 whenever the channel selectors are operated. The r-f crystal oscillator subassembly and the 618S-1 or 618S-1A bandchange circuits both employ Autopositioners as a method of frequency selection. The front panel Autopositioner selects the correct band of operation and the r-f crystal oscillator autopositioners select the correct crystal. Both the band and crystal selection functions, as well as basic Autopositioner theory, will be discussed in detail in paragraphs 4-50 and 4-51.

4-50. AUTOPOSITIONER THEORY. Refer to figure 4-22. An Autopositioner is a motor-driven rotary mechanism, providing for automatic selection of any of a given number of switch positions. The basic

elements of the type of Autopositioner systems employed in Radio Set 618S-1 and 618S-1A are illustrated in figure 4-22. The remote control switch (S1) is ganged to a remotely operated selector knob. When the selector knob is rotated, as would be the case for selection of a new channel, switch S1 is operated to a different position. After S1 has been rotated, a ground circuit is provided for the autopositioner relay K1. Relay K1 is energized, lifting the pawl from the stop wheel and closing the ground circuit for motor M1. Motor M1 operates, driving the gear train, the stop wheel, and open seeking switch S2. When switch S2 has been rotated to a corresponding position with switch S1, the ground circuit for relay K1 is removed, and the pawl and motor ground contact are released. The motor runs to a stop, dissipating its kinetic energy in the slip clutch. The Autopositioner system now is relaxed, and will remain so until the selector knob is rotated again. The slip clutch performs the dual functions of dissipating the kinetic energy of the motor and allowing the motor to drive more than one Autopositioner independently. The seeking switch and relay contacts are adjusted so that the pawl will engage the stop wheel slightly before the motor is removed from ground, thereby giving positive start and stop action. The stop wheel may have any number of notches and may make any number of revolutions. The only limitation is the number of increments that can be selected for a given speed of rotation. Due to the finite release time of the pawl from the relay, the speed of rotation is limited to approximately 1/20 second per notch. Therefore, a 10-position stop wheel should not rotate faster than two revolutions per second, or 120 rpm. It is possible to drive the stop wheel more than one revolution if a gear reduction is used between the stop wheel and the open seeking switch.

4-51. SEQUENCE OF OPERATION. Figure 4-23 illustrates, in 13 pictorial steps, the detailed sequence of operation of the crystal and band selection circuits. Switches within Radio Set Control 614C-2, in conjunction with the Autopositioners of the r-f crystal oscillator and front panel subassemblies, select the band of operation, the crystal bank, and the crystal within each bank. The band selection functions consist of selecting tuned circuits within the tuner subassembly, and selecting capacitor and inductor combinations within the power amplifier subassembly. Band selection within the tuner and power amplifier subassemblies will be described in greater detail in paragraphs 4-63 and 4-73. The bank and crystal selection circuits are located within the r-f crystal oscillator subassembly, and are operated through circuits within Radio Set Control 614C-2. All switches within the 13 pictorial steps of figure 4-23 are viewed from the end of the switch shaft and opposite the knob or driven end. Only those switch sections actually in use in the following description are shown rotated; however, all switch sections do rotate, with only those illustrated actually connected to the circuit.



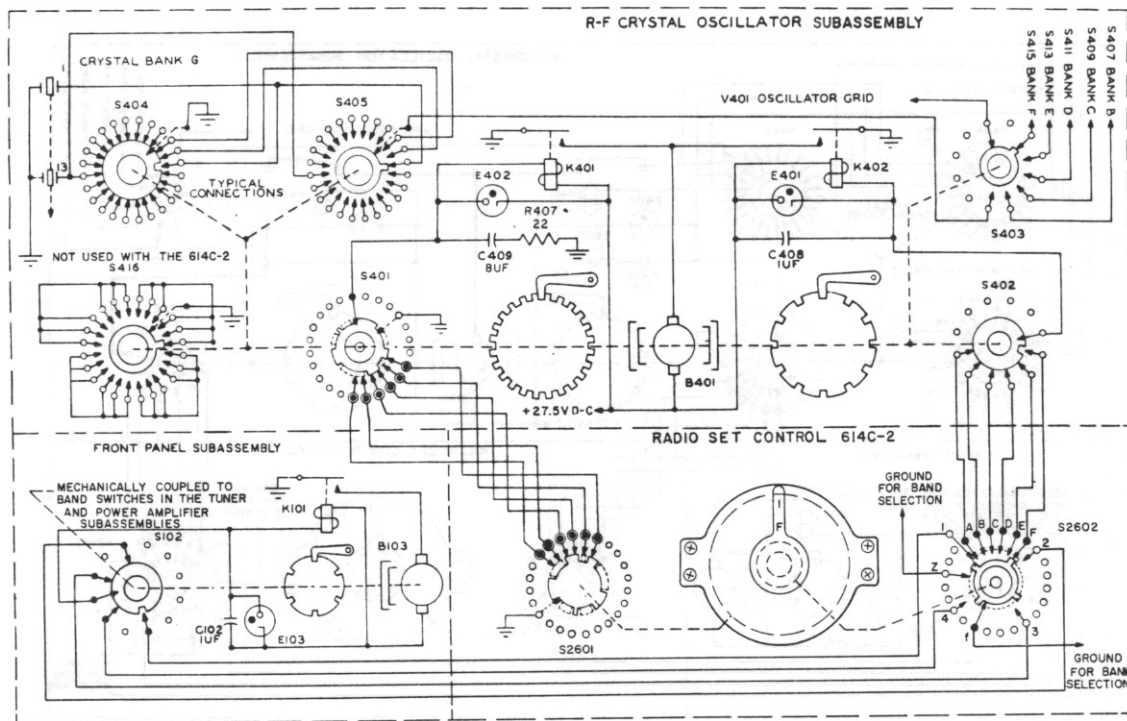


Figure 4-23. Autopositioner Sequence of Operation (Step 1 of 13 steps)

- a. It is desired to select a frequency corresponding to the G-13 crystal position.
- b. The Autopositioner systems are at rest in the previously selected position, F1. Note that the crystal shorting switch for bank F, S414, is not shown and

- the crystal selector switch for bank F, S415, is indicated.
- c. Voltage (27.5 volts d-c) is available to the control system. A ground must be supplied before system will operate.

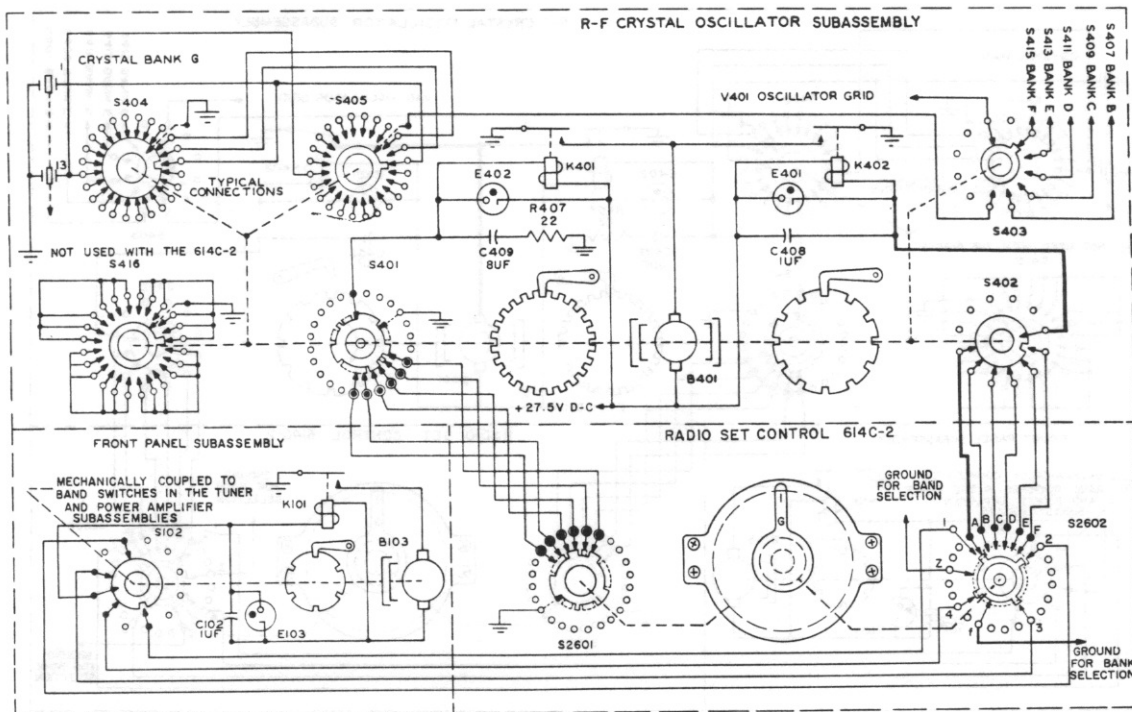


Figure 4-23. Autopositioner Sequence of Operation (Step 2 of 13 steps)

- d. Bank-band selector S2602 is rotated to the G position by operation of the middle 614C-2 knob.

- e. The field of relay K402 is grounded through contacts of S402 and the front section (solid lines) of S2602, energizing K402.

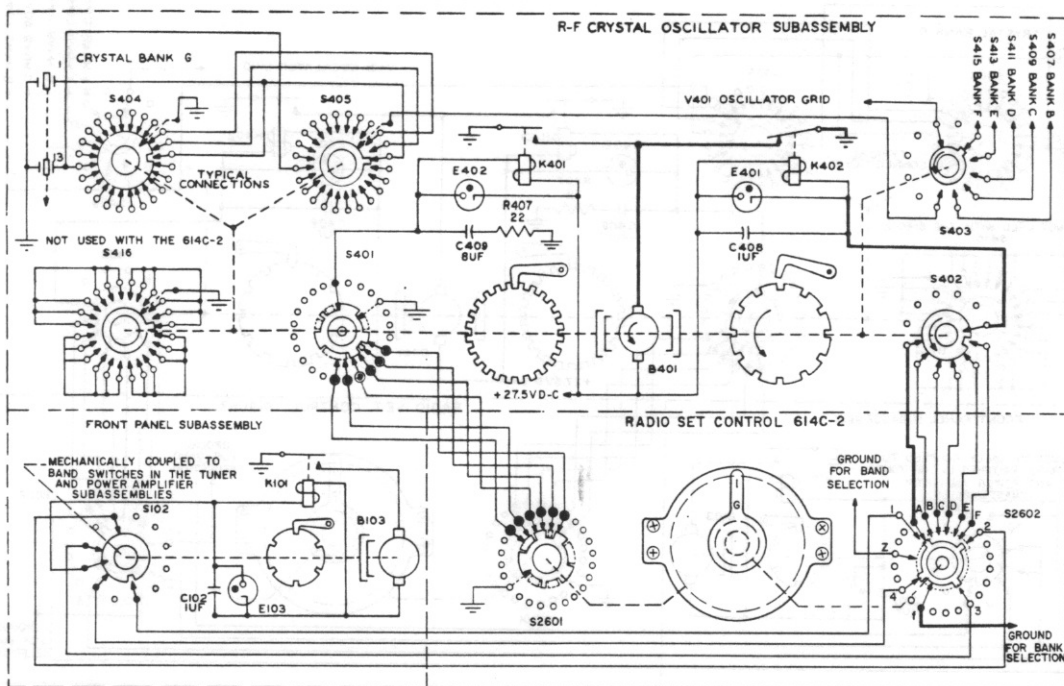


Figure 4-23. Autopositioner Sequence of Operation (Step 3 of 13 steps)

- f. Contacts of relay K402 energize motor B401 and lift the pawl from the bank selector stop wheel.
- g. Motor B401 rotates, driving switches S401 and S402 and the bank selector stop wheel.

- h. Clutch on the crystal selector autopositioner side of B401 slips.

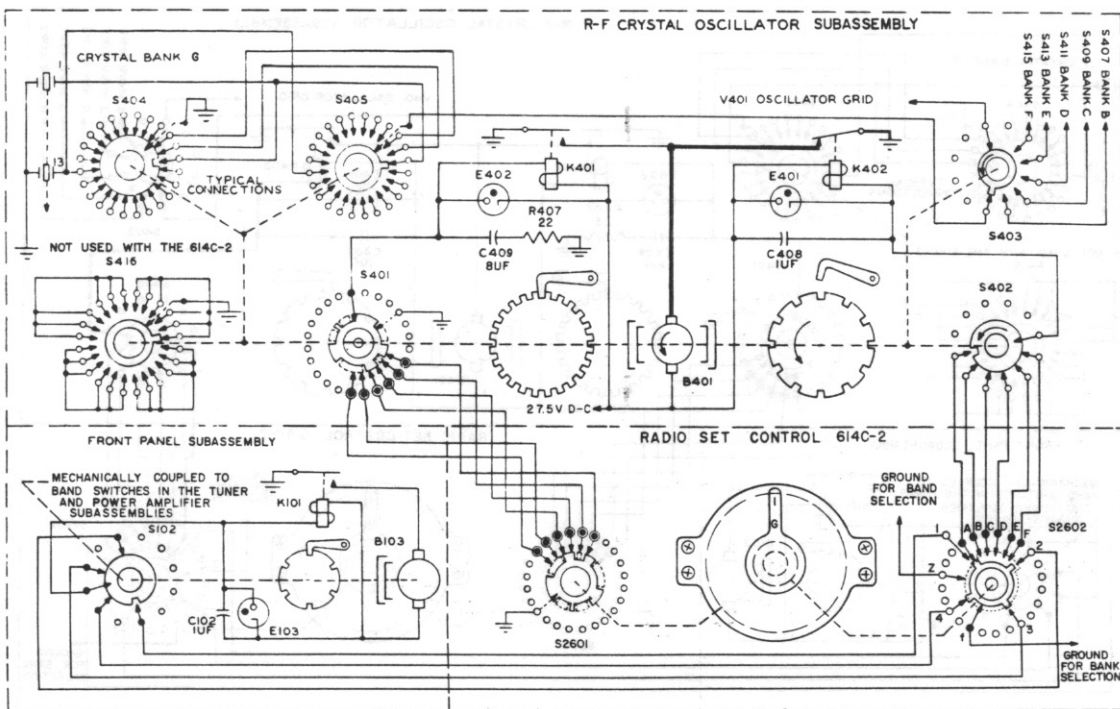


Figure 4-23. Autopositioner Sequence of Operation (Step 4 of 13 steps)

- i. Switch S402 finds an open circuit position, which corresponds to the bank G position.

- j. The field of relay K402 is opened from the ground circuit.

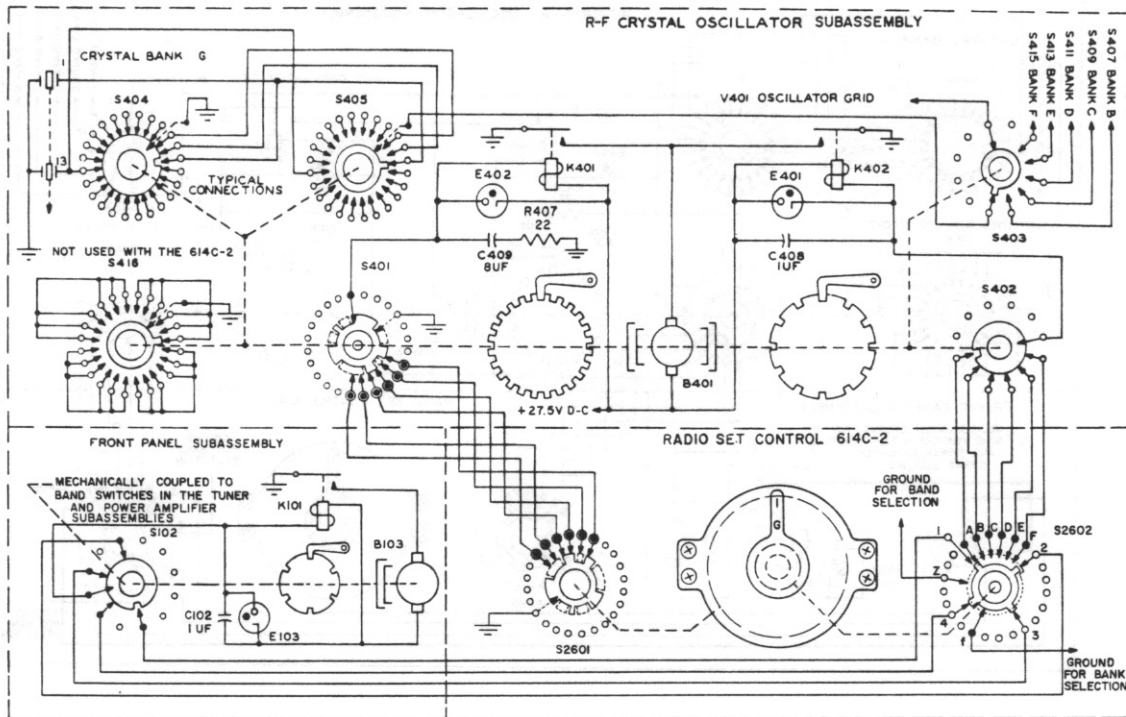


Figure 4-23. Autopositioner Sequence of Operation (Step 5 of 13 steps)

k. Relay K402 releases the pawl of the bank selector stop wheel and removes the 27.5-volt d-c from motor B401.

l. The kinetic energy of motor B401 is dissipated in the slip clutch and the bank selector autopositioner system comes to rest in the G position.

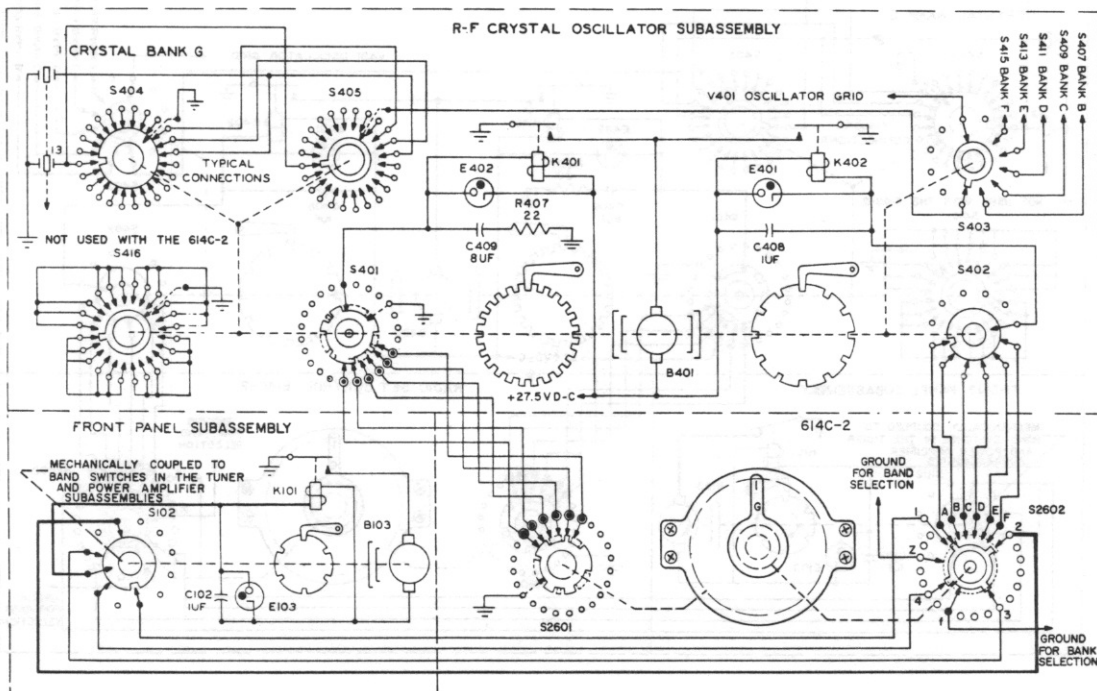


Figure 4-23. Autopositioner Sequence of Operation (Step 6 of 13 steps)

m. Rotation of the middle 614C-2 knob to the G position (step No. 2d) also results in the field of relay K101 being grounded through contacts of S102 and S2602.

K101 being grounded through contacts of S102 and S2602.

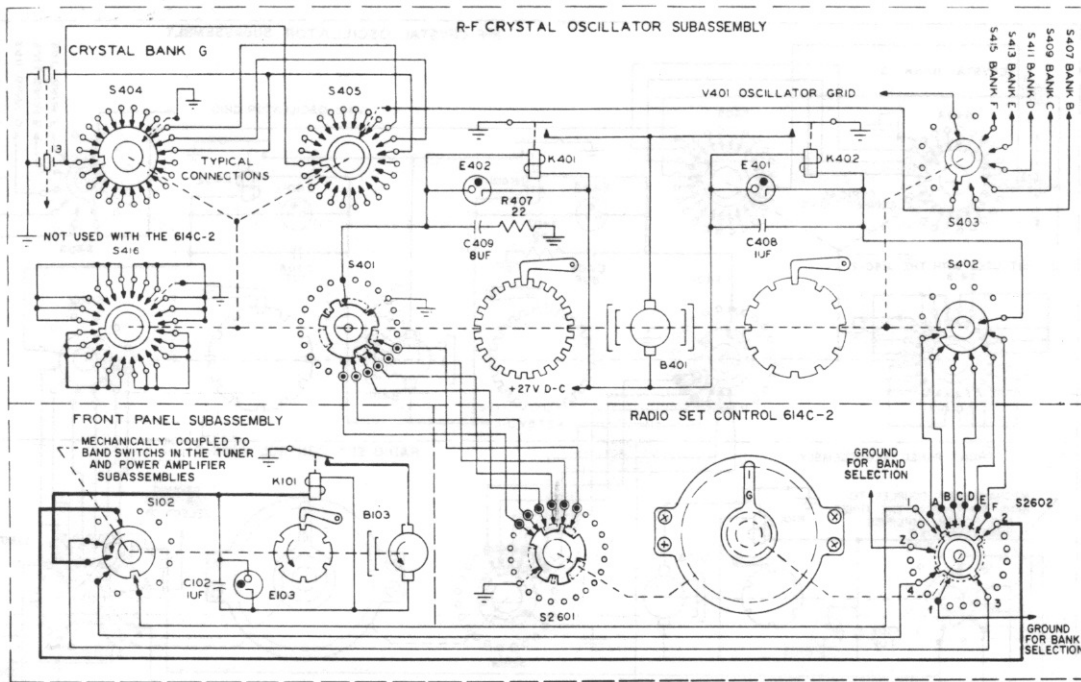


Figure 4-23. Autopositioner Sequence of Operation (Step 7 of 13 steps)

n. Contacts of relay K101 energizes motor B103 and lifts the pawl from the band selector stop wheel.

o. Motor B103 rotates, driving switch S102, the band selector stop wheel, and the bank selector switches of the 618S-1 or 618S-1A tuner and power subassemblies.

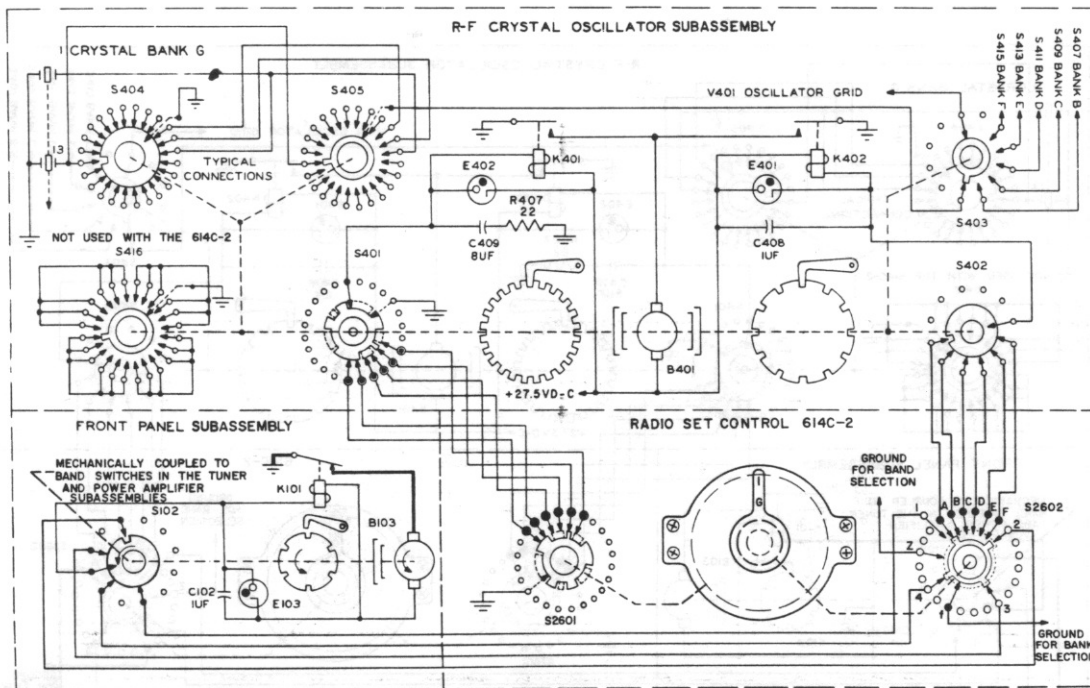


Figure 4-23. Autopositioner Sequence of Operation (Step 8 of 13 steps)

p. Switch S102 finds an open circuit position, which corresponds to the new band position (in this case, band 2).

q. The field of relay K101 is opened from the ground circuit.

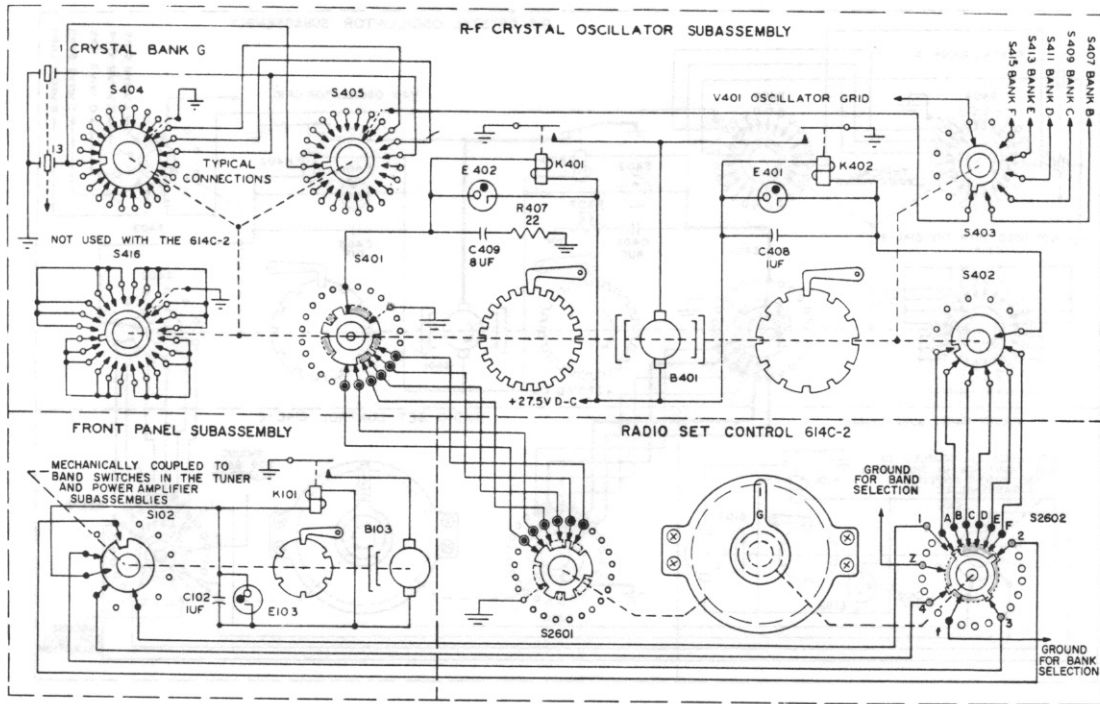


Figure 4-23. Autopositioner Sequence of Operation (Step 9 of 13 steps)

r. Relay K101 releases the pawl of the band selector stop wheel and removes the 27.5-volt d-c from motor B103.

s. The kinetic energy of motor B103 is dissipated in the slip clutch and the band selector autopositioner system comes to rest in the proper position.

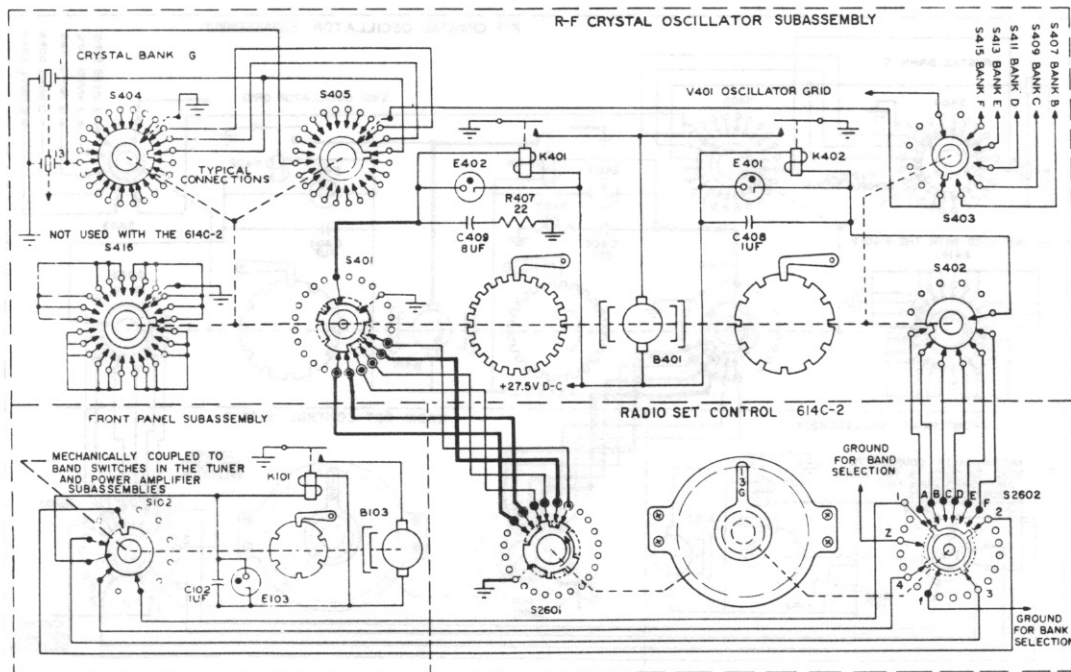


Figure 4-23. Autopositioner Sequence of Operation (Step 10 of 13 steps)

t. Crystal selector S2601 is rotated to the 13 position by operation of the large 614C-2 knob.

u. The field of relay K401 is grounded through contacts of S401 and S2601, energizing K401.

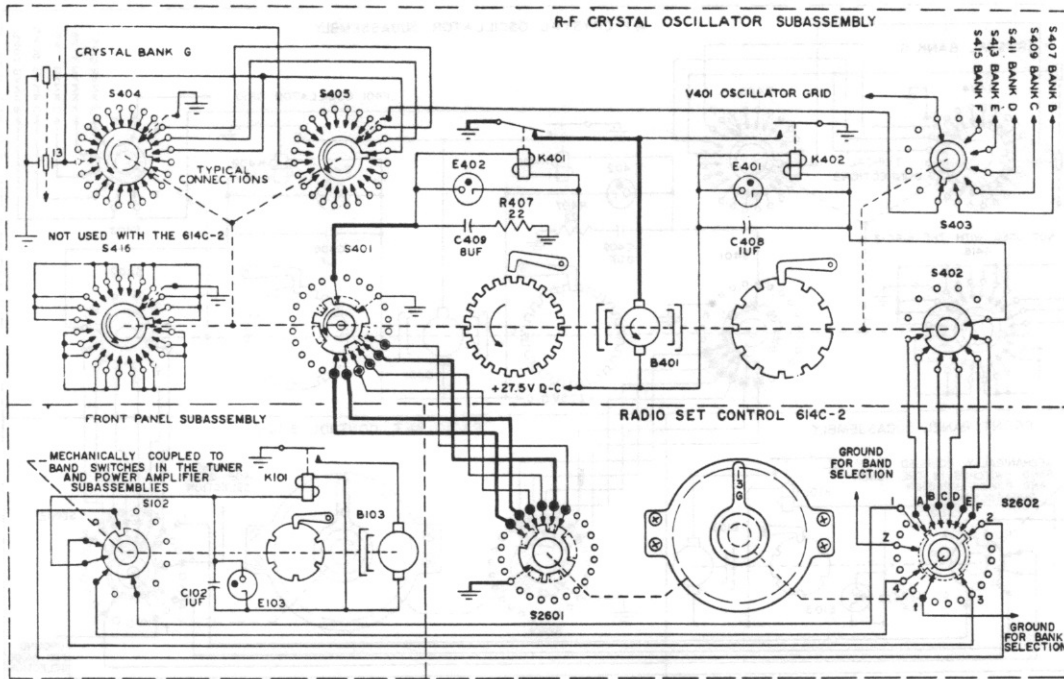


Figure 4-23. Autopositioner Sequence of Operation (Step 11 of 13 steps)

- v. Contacts of relay K401 energizes motor B401 and lifts the pawl from the crystal selector stop wheel.
- w. Motor B401 rotates, driving switches S401, S404, and S405, and the crystal selector stop wheel.

- x. Clutch on the bank selector autopositioner side of B401 slips.

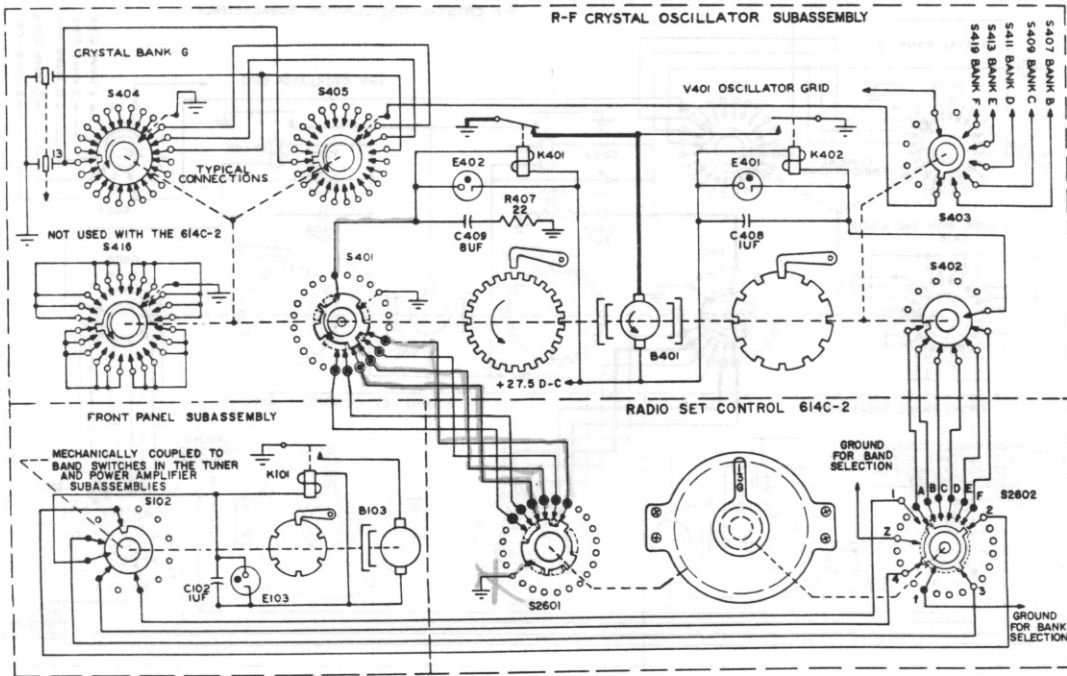


Figure 4-23. Autopositioner Sequence of Operation (Step 12 of 13 steps)

- y. Switch S401 finds an open circuit position, which corresponds to the crystal 13 position.

- z. The field of relay K401 is opened from the ground circuit.

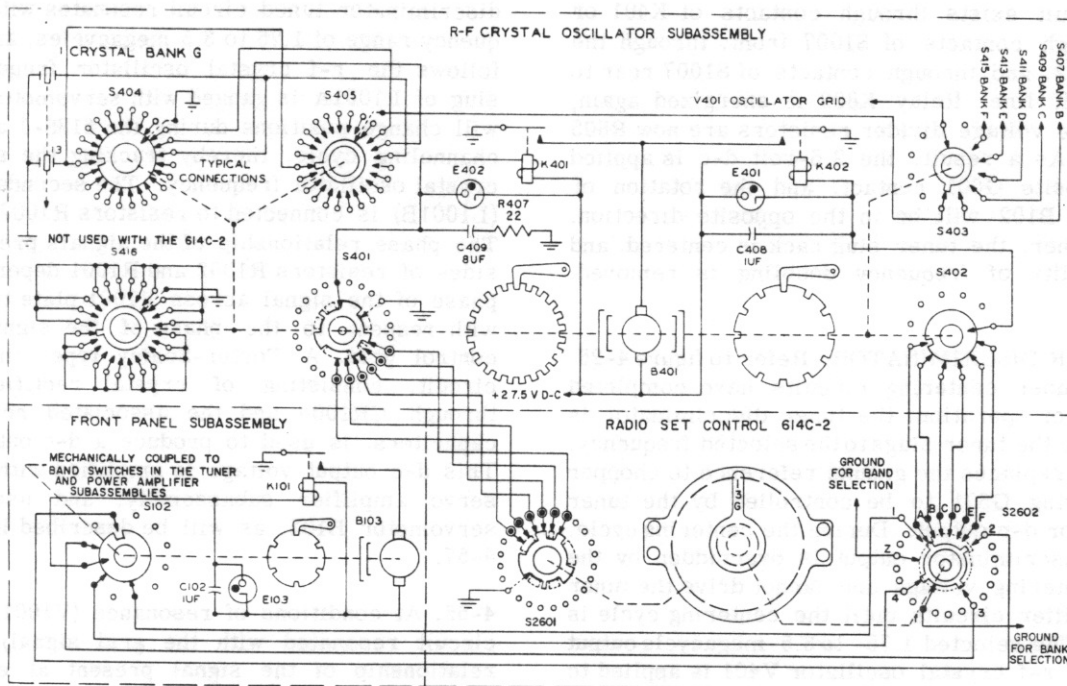


Figure 4-23. Autopositioner Sequence of Operation (Step 13 of 13 steps)

aa. Relay K401 releases the pawl of the crystal selector stop wheel and removed the 27.5-volt d-c from motor B401.

bb. The kinetic energy of motor B401 is dissipated in the slip clutch and the crystal selector autopositioner system comes to rest in the 13 position.

#### 4-52. TUNER SUBASSEMBLY, FREQUENCY SELECTION.

4-53. TUNER TABLE CENTERING CIRCUIT. The 1.75- to 3.5-megacycle signal from the r-f crystal oscillator stage, V401, is applied to the control grid of tuner discriminator V1001. The tuner discriminator, in conjunction with the tuner servo amplifiers (V601 and V602) and servomotor B102, performs the function of setting the tuner slugs to the correct operating position. With certain tuner slug positions, it might be possible to resonate the tuned circuits to the second harmonic of the master oscillator frequency. To prevent this from happening, the tuner table centering circuit, illustrated in figure 4-24, is used to assure the return of the tuner slugs to the center position before setting up. Switch wafers S1007 front and rear are illustrated in figure 4-24 in an open circuit condition. This is the position corresponding to the center position of the tuner slugs. When at rest at a certain frequency, switch wafers S1007 front and rear will be in a different position than illustrated; however, an open circuit for the 27.5-volt line will still exist until relay K401 or K402 is energized. Relay K401 is energized whenever a new crystal is selected and relay K402 is energized whenever a new bank or band is selected, as described in

paragraph 4-51 and figure 4-23. Assume that the tuner slug rack is at rest in such a position that S1007 front and rear are rotated one position clockwise and a new channel has been selected. A ground circuit now exists through contacts of K401 or K402 through contacts of S1007 rear, through the field of relay K802, and through contacts of S1007 front to the 27.5-volt d-c line. Relay K802 is energized and provides its own holding ground. Contacts of relay K802 connect to contacts of chopper G601 within the tuner servo amplifier subassembly. With S1007 front and rear rotated one position clockwise, one of the G601 contacts is connected between the voltage divider arrangement of R804 and R803, resulting in a d-c voltage of approximately 2.6 volts being applied between the G601 contact and ground. The other G601 contact is connected across the parallel arrangement of R806 and R805 to ground, and no voltage is present at this contact. Conditions now are correct for the tuner servomechanism to operate, and servomotor B102 rotates the tuner slug rack and switch S1007 front and rear. Operation of the tuner servomechanism and circuitry will be described in detail in paragraph 4-57. Switch S1007 front and rear will rotate until the wafers again are at an open circuit position, at which time the tuner slugs will be centered and relay K802 is de-energized. If, before the channel is changed, the tuner slug rack is at rest in such a position that the opposite direction of rotation of servomotor B102 is required to center the slugs, switch S1007 front and rear will be rotated in the opposite direction. This may be illustrated by assuming S1007 front and rear are rotated one position counterclockwise in figure 4-24. In this case, as soon as relays K401 or K402 are energized, a

ground circuit exists through contacts of K401 or K402, through contacts of S1007 front, through the field of K802, and through contacts of S1007 rear to the 27.5-volt line. Relay K802 is energized again; however, the voltage divider resistors are now R805 and R806. As a result, the 2.6-volt d-c is applied to the opposite G601 contact, and the rotation of servomotor B102 will be in the opposite direction. In this manner, the tuner slug rack is centered, and the possibility of frequency doubling is removed.

4-54. TUNER DISCRIMINATOR. Refer to figure 4-25. After the tuner centering circuits have completed their cycle of operation, the tuner discriminator is free to drive the tuner slugs to the selected frequency. Relay K802 replaces the ground reference to chopper G601, allowing G601 to be controlled by the tuner discriminator d-c output. During the centering cycle, the tuner discriminator output is overridden by the 2.6-volt centering voltage and cannot drive the tuner servo amplifier circuits until the centering cycle is complete. The selected 1.75- to 3.5-megacycle output signal from r-f crystal oscillator V401 is applied to the control grid of V1001 and to the common point of resistors R1001 and R1002. The 1.75- to 3.5-megacycle signal is amplified and developed across the tuned circuit consisting of the primary of T1001 and capacitors C1002, C1001, and C1124. The tuner

discriminator tuned circuit resonates within the frequency range of 1.75 to 3.5 megacycles, and therefore follows the r-f crystal oscillator frequency. The slug of L1001A is ganged with servomotor B102, and will change positions during the 618S-1 and 618S-1A channeling cycle, thereby tracking the selected r-f crystal oscillator frequency. The secondary of T1001 (L1001B) is connected to resistors R1002 and R1001. The phase relationship of the signals present at both sides of resistors R1002 and R1001 depends upon the phase of the signal across V1001 plate tuned circuit with respect to the phase of the signal at V1001 control grid. A Foster-Seeley type discriminator circuit, consisting of crystal rectifiers CR1001 through CR1004 and the associated resistors and capacitors, is used to produce a d-c output voltage. This d-c output voltage is amplified within the tuner servo amplifier subassembly, and used to drive servomotor B102, as will be described in paragraph 4-57.

4-55. At conditions of resonance (V1001 plate tuned circuit resonated with the grid signal), the phase relationship of the signal present at each side of L1001B will be 90 degrees removed from the signal at the junction point of R1001. (The voltage across R1001 is equal to the voltage across R1002 and is of the opposite phase.) The output of the tuner discriminator circuit, through the parallel arrangement of

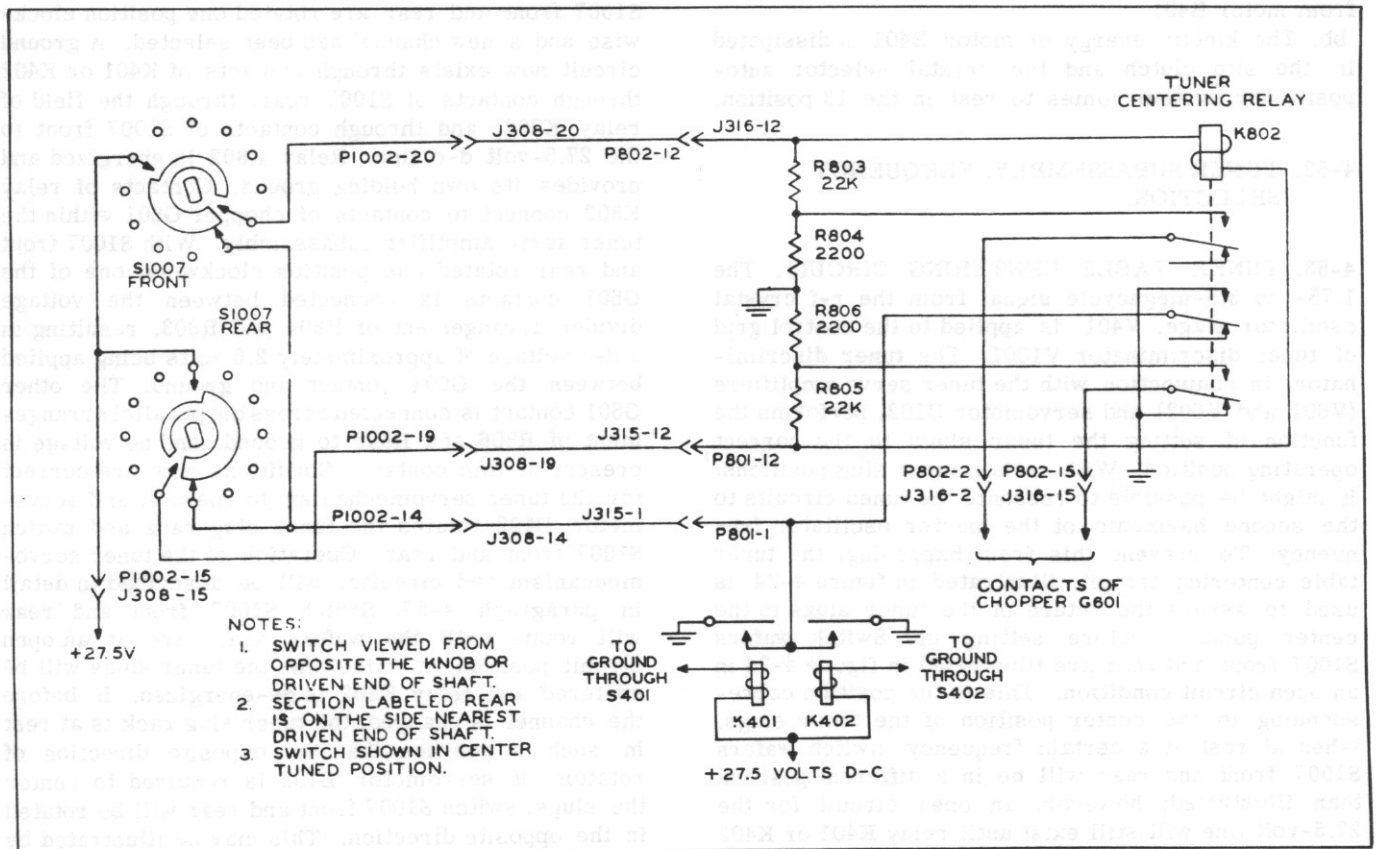


Figure 4-24. Tuner Table Centering Circuit, Simplified Schematic Diagram



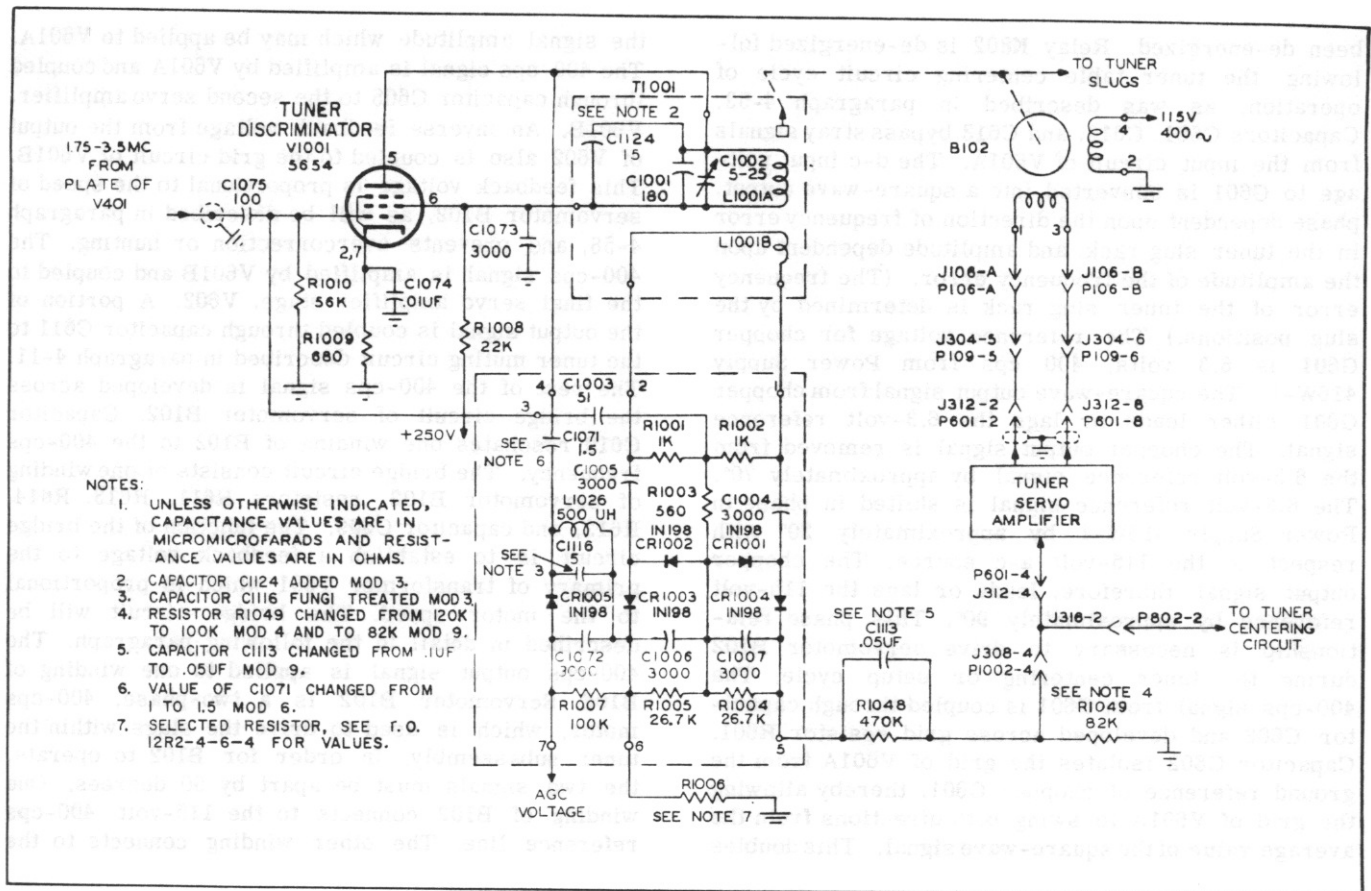


Figure 4-25. Tuner Discriminator and Servomotor B102, Simplified Schematic Diagram

C1113 and R1048, therefore is zero. If the slug of L1001 is not adjusted to the correct position for resonance with the grid signal, the balance condition will no longer exist. Assume the slug of L1001A is off resonance in a direction causing the voltage across R1001 to be larger than the voltage across R1002 because of the vector addition of the grid and plate signals. In this case, the charge path for C1005 is through CR1002, R1003, and R1001. On the following alternation of L1001B, C1005 will discharge through R1001, R1003, R1005, and CR1003. A voltage doubling action occurs, with the net C1005 current adding to the net L1001B current. The discriminator output voltage is no longer zero, but is a particular amplitude d-c, polarity dependent upon the direction off resonance and amplitude dependent upon the amount off resonance. If the slug of L1001A is off resonance causing the voltage across R1002 to be larger than the voltage across R1001, capacitor C1004 becomes the dominant capacitor. In this case, C1004 charges through CR1001, R1003, and R1002. The discharge path is through R1002, R1003, R1004, and CR1004, the current adding to the net L1001B current. The output d-c voltage is of the opposite polarity, amplitude dependent upon the distance off resonance. At resonance, there will be no net current, either from capacitors C1004 and C1005 or from L1001B. Therefore, as soon as the slug of L1001A is correctly set up, the tuner discriminator output

will be zero, and servomotor B102 no longer will operate. The d-c output is applied through the parallel combination of R1048 and C1113 and developed across R1049. The time constant formed by R1048 and C1113 will prevent overcorrection or hunting while not destroying the sensitivity of the frequency correction circuits.

4-56. A part of the signal from the plate of V1001 is coupled through capacitor C1071 and developed across a tuned circuit consisting of L1026 and C1116. This tuned circuit, in conjunction with the distributed capacity, is resonant at the lower and midrange of the r-f crystal oscillator frequency spectrum, and tends to increase the voltage across CR1005 for these frequencies. The signal is rectified by CR1005 and filtered by the parallel combination of capacitor C1007 and resistors R1006 and R1007. The resultant voltage is a negative d-c, amplitude dependent upon the input signal to V1001. This negative d-c voltage is used to provide agc to variable i-f amplifier V1002, and compensates for a varying r-f crystal oscillator output.

4-57. TUNER SERVO AMPLIFIER SUBASSEMBLY AND SERVMOTOR. Refer to figure 4-26. The d-c output from the tuner discriminator circuit is applied to the lower contact of chopper G601. The top contact of G601 is grounded after relay K802 has

been de-energized. Relay K802 is de-energized following the tuner table centering circuit cycle of operation, as was described in paragraph 4-53. Capacitors C601, C612, and C613 bypass stray signals from the input circuit of V601A. The d-c input voltage to G601 is converted into a square-wave output, phase dependent upon the direction of frequency error in the tuner slug rack, and amplitude dependent upon the amplitude of the frequency error. (The frequency error of the tuner slug rack is determined by the slug positions.) The reference voltage for chopper G601 is 6.3 volts, 400 cps from Power Supply 416W-1. The square-wave output signal from chopper G601 either leads or lags the 6.3-volt reference signal. The chopper output signal is removed from the 6.3-volt reference signal by approximately 70°. The 6.3-volt reference signal is shifted in phase in Power Supply 416W-1 by approximately 20° with respect to the 115-volt a-c source. The chopper output signal, therefore, leads or lags the 115-volt reference by approximately 90°. This phase relationship is necessary to drive servomotor B102 during the tuner centering or setup cycle. The 400-cps signal from G601 is coupled through capacitor C602 and developed across grid resistor R601. Capacitor C602 isolates the grid of V601A from the ground reference of chopper G601, thereby allowing the grid of V601A to swing both directions from the average value of the square-wave signal. This doubles

the signal amplitude which may be applied to V601A. The 400-cps signal is amplified by V601A and coupled through capacitor C605 to the second servo amplifier, V601B. An inverse feedback voltage from the output of V602 also is coupled to the grid circuit of V601B. This feedback voltage is proportional to the speed of servomotor B102, as will be described in paragraph 4-58, and prevents overcorrection or hunting. The 400-cps signal is amplified by V601B and coupled to the final servo amplifier stage, V602. A portion of the output signal is coupled through capacitor C611 to the tuner muting circuit described in paragraph 4-11. The rest of the 400-cps signal is developed across the bridge circuit of servomotor B102. Capacitor C610 resonates one winding of B102 to the 400-cps frequency. The bridge circuit consists of one winding of servomotor B102, resistors R611, R613, R614, R612, and capacitor C609. The function of the bridge circuit is to establish a feedback voltage to the primary of transformer T601 which is proportional to the motor speed. The bridge circuit will be described in detail in the following paragraph. The 400-cps output signal is applied to one winding of B102. Servomotor B102 is a two-phase, 400-cps motor, which is used to drive the slugs within the tuner subassembly. In order for B102 to operate, the two signals must be apart by 90 degrees. One winding of B102 connects to the 115-volt, 400-cps reference line. The other winding connects to the

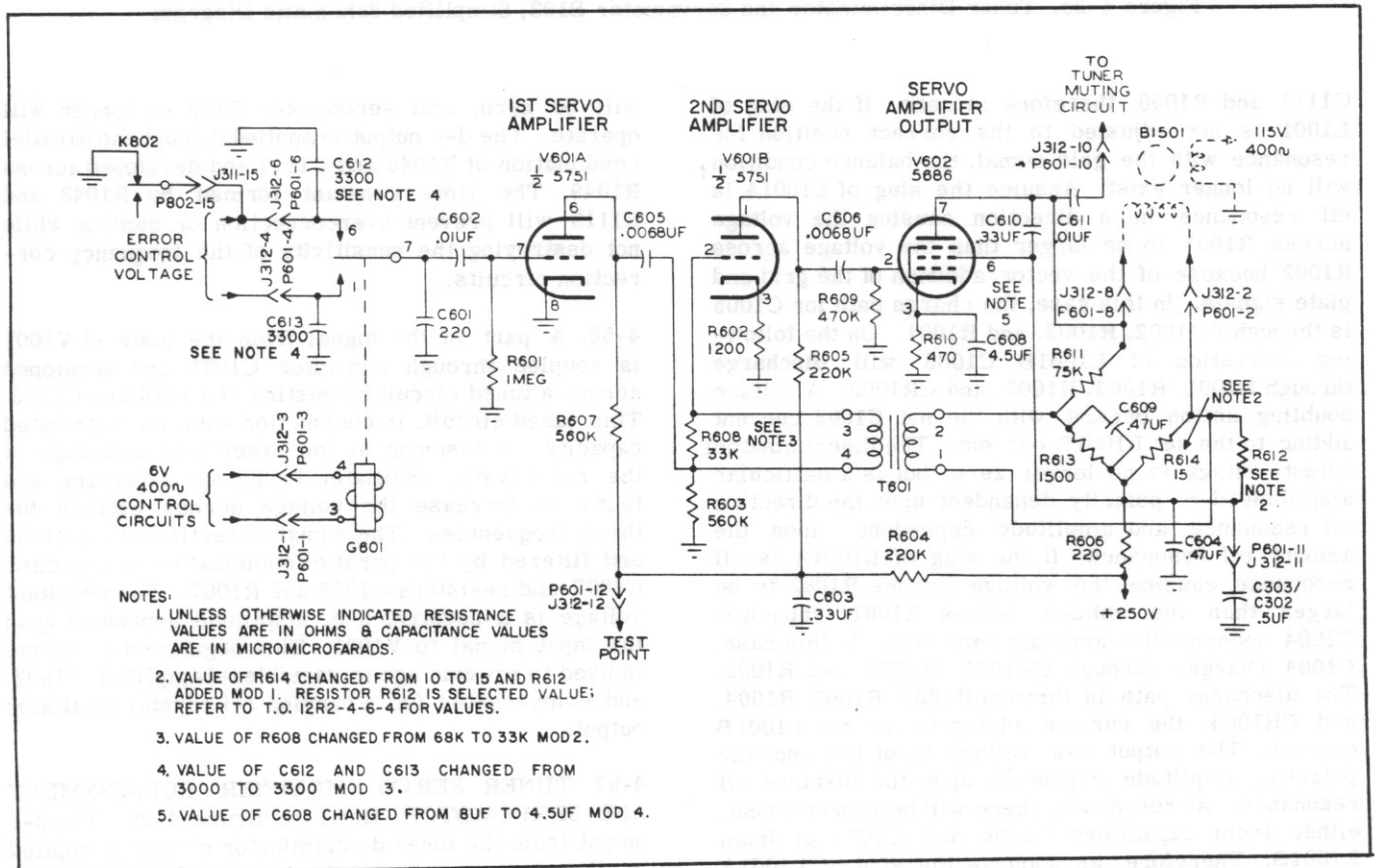


Figure 4-26. Tuner Servo Amplifier Subassembly and Servomotor B102, Simplified Schematic Diagram

servo amplifier output signal. The phase of the servo amplifier output signal with respect to the phase of the 115-volt reference voltage will be either leading or lagging 90 degrees. When the d-c input to chopper G601 is negative, B102 will rotate in one direction; when positive, B102 will rotate in the opposite direction. The polarity of the d-c input voltage is dependent upon the direction of frequency error, and therefore, B102 will drive the tuner slugs either up or down, depending upon the direction necessary to set up the tuned circuits. After the slugs have been driven to the setup position, the d-c voltage to chopper G601 is removed, and B102 stops. The servo amplifier circuits employed for the power amplifier subassembly are identical to those described in this paragraph. The origin of the d-c input voltage from the power amplifier subassembly will be described in detail in paragraphs 4-60 and 4-61. Otherwise, the operation is identical, and the output of V602 will drive servomotor B1501 to set up the power amplifier frequency. The mechanical operation of servomotors B102 and B1501 will be described in detail (figure 4-27) in paragraphs 4-59 through 4-61.

4-58. Reference is made to figure 4-27 for a functional diagram of the rate bridge circuits employed in the tuner servo amplifier subassembly. In this diagram, g represents the counter emf of servomotor B102;  $R_3$  and  $L_3$  represent the plate winding of B102;  $R_4$  represents the parallel combination of R614 and R612;  $R_2$  and  $C_2$  represent the parallel combination of R613 and C609, respectively; the power source represents the 400-cps output signal from V602; and V represents the signal applied to the primary of transformer T601. The circuit illustrated in figure 4-27 is electrically equivalent to the circuitry at the plate of V602. When the bridge circuit is balanced, zero voltage from the power source will be present between terminals V. It can be proved mathematically that two independent conditions for balance exist. These are:  $R_1 R_4 = R_2 R_3$  and  $R_1 R_4 C_2 = L_3$ .

Notice that the two equations have no frequency terms. Theoretically, the bridge is ideally balanced at all frequencies. With the bridge balanced, no voltage will be present from the power source; however, since g is in one leg only, a voltage proportional to the speed of motor B102 will be present between terminals V. The voltage between terminals V is applied to the primary of T601, and is used to limit the gain of V601B and V602.

#### 4-59. POWER AMPLIFIER SUBASSEMBLY, FREQUENCY SELECTION.

4-60. BAND CENTERING CIRCUITS. Reference is made to the simplified schematic diagram, figure 4-7. Rough tuning of the power amplifier subassembly consists of selecting the proper network values of inductance and capacitance for the band selected. Switches S1501 through S1504 perform these functions. Switches S1501 through S1504 and S1506 are operated by the band selector autopositioner motor, B103.

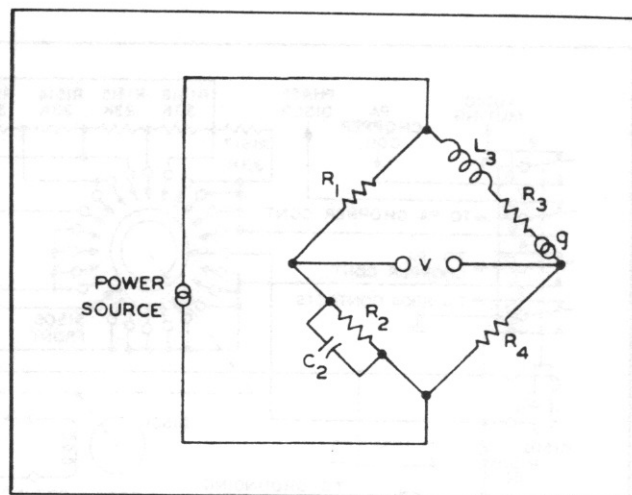


Figure 4-27. Rate Bridge, Functional Diagram

Switches S1506 and S1505 and the associated circuits perform the function of placing the roller of main tuning inductor L1502 to the center position of the band selected. Figure 4-28 illustrates the approximate tuning ranges for each band. The rear section of switch S1505 serves as a protective stop mechanism. If, for any reason, servomotor B1501 continues to rotate until the shorting roller of L1502 approaches either extreme end of travel, one of two sets of contacts of S1505 rear are shorted and the power amplifier band centering circuits recycle. Reference is made to figure 4-29 for the sequence of operation of the power amplifier band centering circuits.

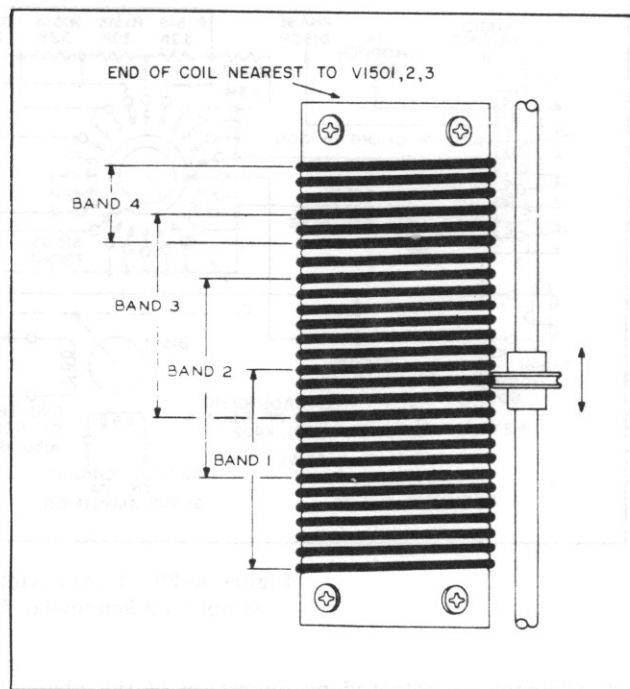


Figure 4-28. Inductor L1502, Approximate Tuning Ranges, Functional Diagram

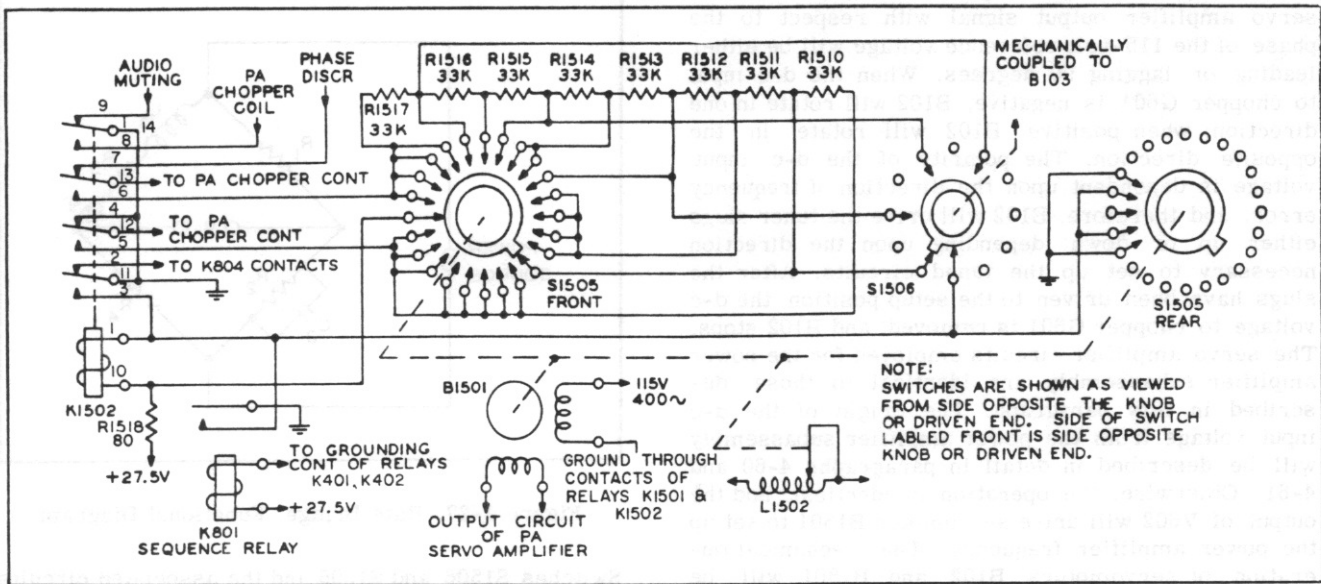


Figure 4-29. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Step 1 of 4 steps)

- a. A frequency in band 3 is to be selected.
- b. Centering circuits are at rest with switches in a position corresponding to the previously selected band; band 1 in this example.

- c. Voltage is available through R1518 to energize band centering mechanism. A ground circuit must be supplied before sequence relay K801 can be energized.

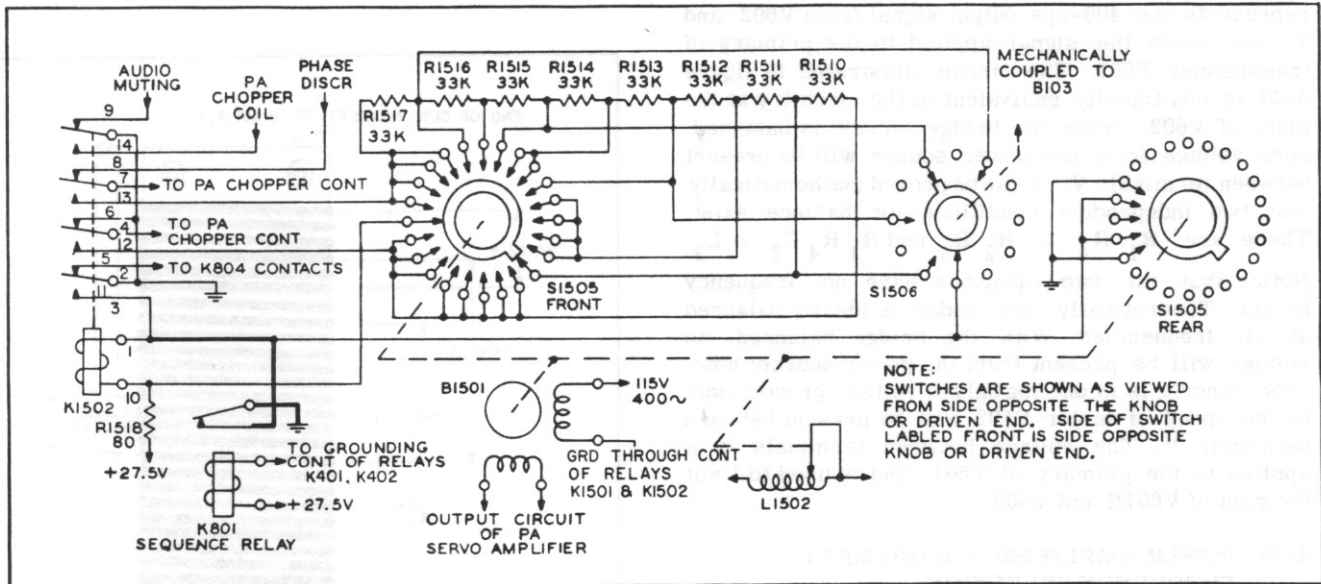


Figure 4-29. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Step 2 of 4 steps)

- d. Channel is selected by operation of the channel selectors of Radio Set Control 614C-2. This operates relay K401 and/or relay K402, which in turn grounds and energizes sequence relay K801.

- e. Contacts on sequence relay K801 close to supply a ground to relay K1502.
- f. Switch S1506 is rotated to the band 3 position by operation of the bandchange autopositioner and motor B103 on the front panel of the 618S-1 or 618S-1A.

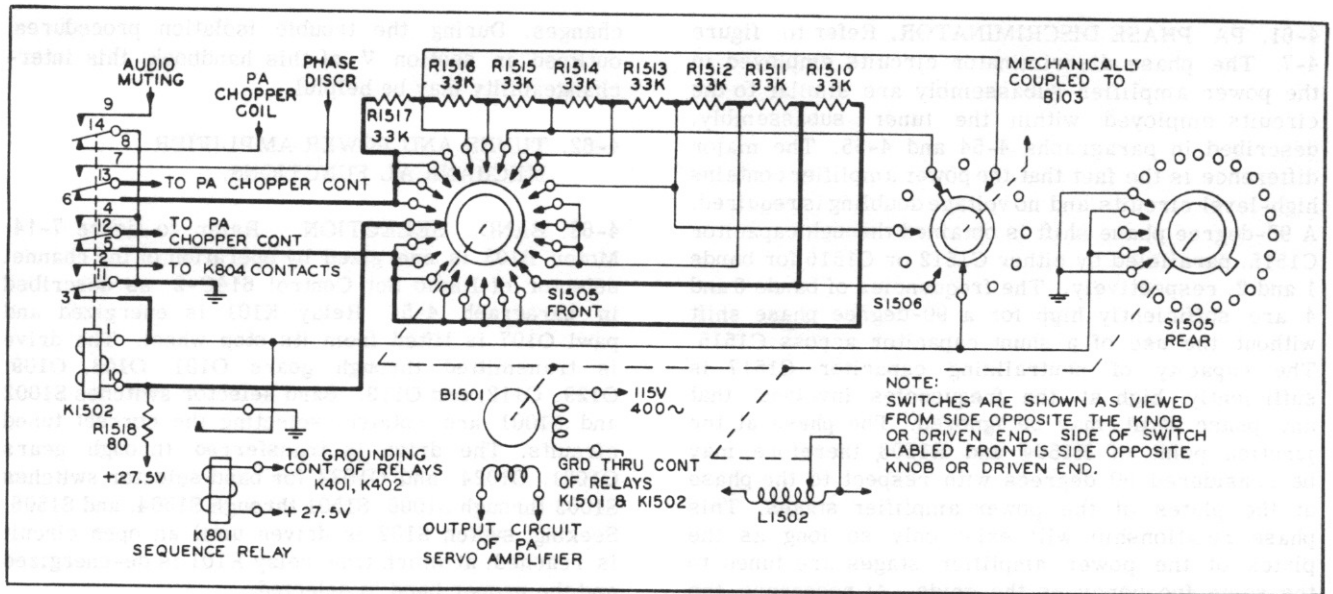


Figure 4-29. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Step 3 of 4 steps)

g. Relay K1502 operates, supplying its own ground. The ground supplied by relay K801 is removed when the correct frequency is selected in the r-f crystal oscillator subassembly.

h. One side of pa chopper G601 is grounded by contacts of K1502.

i. An unbalanced voltage is fed to contacts of pa chopper G601 through the action of S1505 front and resistors R1510 through R1517.

j. Contacts of K1502 remove ground from the cathode of audio output stage V1302, muting the audio output, and open the 618S-1 or 618S-1A keying circuits through contacts of relay K804 to prevent spurious radiation.

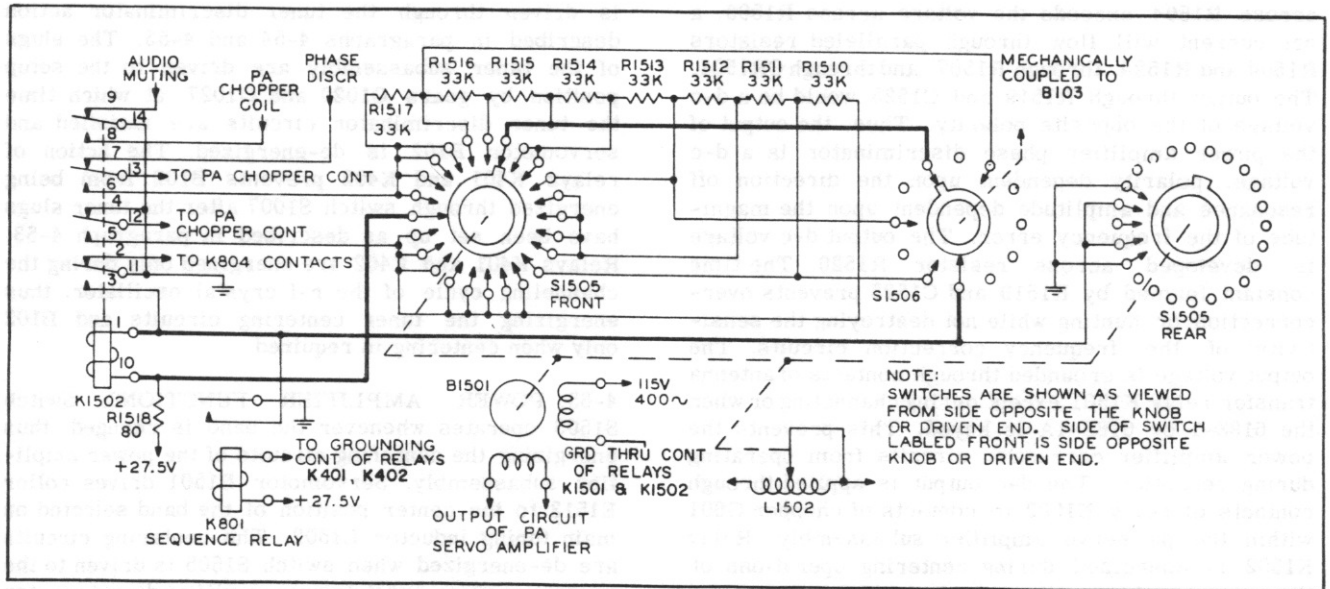


Figure 4-29. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Step 4 of 4 steps)

k. The unbalanced d-c voltage fed to G601 contacts causes the power amplifier servomechanism to function.

l. Operation of the power amplifier servomechanism includes rotation of servomotor B1501.

m. Rotation of B1501 drives S1505 front and rear to the band 3 position. The correct inductor and capacitor combinations are selected and the roller of L1502 is centered within the range of band 3.

n. Relay K1502 is shorted and de-energized.

4-61. PA PHASE DISCRIMINATOR. Refer to figure 4-7. The phase discriminator circuits employed in the power amplifier subassembly are similar to the circuits employed within the tuner subassembly, described in paragraphs 4-54 and 4-55. The major difference is the fact that the power amplifier contains high-level circuits and no voltage doubling is required. A 90-degree phase shift is obtained through capacitor C1515, paralleled by either C1512 or C1516 for bands 1 and 2, respectively. The frequencies of bands 3 and 4 are sufficiently high for a 90-degree phase shift without the use of a shunt capacitor across C1515. The capacity of neutralizing capacitor C1517 is sufficiently high at the frequencies involved that any phase shift may be ignored. The phase at the junction point of R1504 and R1503, therefore, may be considered 90 degrees with respect to the phase at the plates of the power amplifier stages. This phase relationship will exist only so long as the plates of the power amplifier stages are tuned to the same frequency as the grids. At resonance, the voltage across R1503 is equal to the voltage across R1504 and is of the opposite phase. Therefore, there will be no net voltage and the output through the parallel arrangement of R1519 and C1525 will be zero. Assume the plates of the power amplifier stages are off resonance in such a direction that the voltage across R1503 exceeds the voltage across R1504. In this case, a net current will flow through R1503, through R1507, and through CR1502, resulting in a net d-c voltage applied through the parallel arrangement of R1519 and C1525. If the plates are off resonance in such a direction that the voltage across R1504 exceeds the voltage across R1503, a net current will flow through paralleled resistors R1504 and R1524, through R1507, and through CR1501. The output through R1519 and C1525 would be a d-c voltage of the opposite polarity. Thus, the output of the power amplifier phase discriminator is a d-c voltage, polarity dependent upon the direction off resonance and amplitude dependent upon the magnitude of the frequency error. The output d-c voltage is developed across resistor R1520. The time constant formed by R1519 and C1525 prevents over-correction or hunting while not destroying the sensitivity of the frequency correction circuits. The output voltage is grounded through contacts of antenna transfer relay K1501 except during channeling or when the 618S-1 or 618S-1A is keyed. This prevents the power amplifier correction circuits from operating during reception. The d-c output is applied through contacts of relay K1502 to contacts of chopper G601 within the pa servo amplifier subassembly. Relay K1502 is energized during centering operations of the power amplifier subassembly, thus preventing the setup circuits from operating during the centering cycle. The servo amplifier subassembly employed within the power amplifier correction circuits is identical to the one used for the tuner subassembly, described in paragraphs 4-57 and 4-58. In this case, servomotor B1501 is employed, and the roller of L1502 is set up rather than the tuner slugs. The pa servo amplifier and the tuner servo amplifier subassemblies are interchangeable without wiring

changes. During the trouble isolation procedures, outlined in section V of this handbook, this interchangeability may be helpful.

#### 4-62. TUNER AND POWER AMPLIFIER MECHANICAL FUNCTIONS.

4-63. BAND SELECTION. Refer to figure 7-14. Motor B103 is energized by operation of the channel selector of Radio Set Control 614C-2, as described in paragraph 4-51. Relay K101 is energized and pawl O107 is lifted from its stop wheel. The drive is transmitted through gears O101, O103, O109, O129, O112, and O113. Band selector switches S1002 and S1001 are rotated, selecting the correct tuned circuits. The drive is transferred through gears O1021, O1024, and O1022 for band selector switches S1003 through S1006, S1501 through S1504, and S1506. Seeking switch S102 is driven until an open circuit is reached, at which time relay K101 is de-energized and the proper band is selected.

4-64. TUNER FUNCTIONS. Servomotor B102 is energized through the tuner table centering circuits, as described in paragraph 4-53. The drive from B102 is transferred through gears O124 through O128, and through coupler O132 to the main tuning shaft. Gears O1020 and O1027 are driven, driving the tuner slugs toward the center position. Switch S1007 is driven through gears O1026 and O1025 to an open circuit position, reached when the tuner slugs are in the center of their respective inductors. The tuner centering circuits are de-energized and motor B102 is driven through the tuner discriminator action described in paragraphs 4-54 and 4-55. The slugs of the tuner subassembly are driven to the setup position by gears O1020 and O1027, at which time the tuner discriminator circuits are satisfied and servomotor B102 is de-energized. The action of relays K401 and K402 prevents B102 from being energized through switch S1007 after the tuner slugs have been set up as described in paragraph 4-53. Relays K401 and K402 are energized only during the channeling cycle of the r-f crystal oscillator, thus energizing the tuner centering circuits and B102 only when centering is required.

4-65. POWER AMPLIFIER FUNCTIONS. Switch S1506 operates whenever the band is changed, thus energizing the centering circuits of the power amplifier subassembly. Servomotor B1501 drives roller E1513 to the center position of the band selected on main tuning inductor L1502. The centering circuits are de-energized when switch S1505 is driven to the correct position and the power amplifier discriminator circuits are free to operate. Servomotor B1501 is driven through the action of the power amplifier discriminator, and roller E1513 is driven to the setup position on L1502. The action of sequence relay K801, described in figure 4-29, prevents the centering and setup functions from overlapping. Gears O1512, O1518, and O1519 couple the drive from B1501 to main tuning inductor L1502 and switch S1505 in figure 7-14.

4-66. GAIN AND BFO CONTROL CIRCUITS.

4-67. R-F GAIN. Refer to figure 4-30. The gain of four of the 618S-1 and 618S-1A stages is made variable through potentiometers within Radio Set Control 614C-2. When the 618S-1 and 618S-1A is in the key-up position, the cathode circuits of the second i-f amplifier, the receiver first mixer, and the first and second r-f amplifier stages are connected through contacts of switch S2603A to the sensitivity and threshold controls of Radio Set Control 614C-2. When in the PHONE position, potentiometer R2602 allows a limited control over the r-f receiver gain. Potentiometer R2602 is a screw driver adjustment located

at the rear of the 614C-2 chassis, and is used to set the threshold level when receiving voice modulated signals. When in the CW position, potentiometer R2605 allows a large control over the r-f receiver gain. Potentiometer R2605 may be varied by operation of the small 614C-2 control knob. When the 618S-1 or 618S-1A is keyed, V902, V1005, and V1008 are removed from the circuit and the cathode circuit of V1009 is grounded through contacts of relay K1001.

4-68. AUDIO GAIN. The audio volume of the 618S-1 and 618S-1A is made variable through potentiometers within the 614C-2 for phone reception. No provision is made for audio volume control during cw reception.

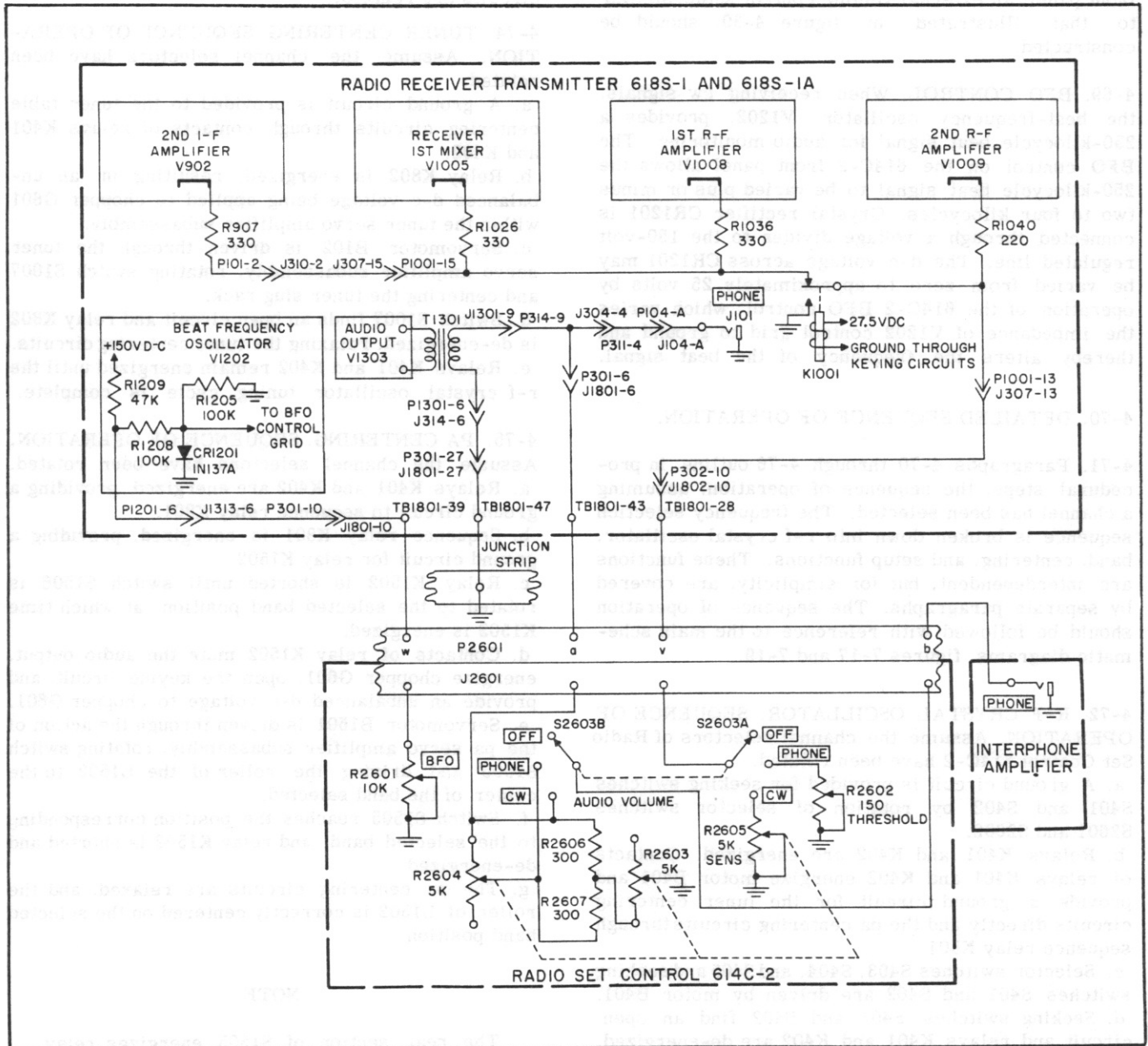


Figure 4-30. Gain and BFO Control Circuits, Simplified Schematic Diagram

as the gain is controlled in the r-f stages. When in the PHONE position, audio output transformer T1301 is connected through contacts of switch S2603B to potentiometers R2604 and R2603 and resistors R2606 and R2607. This resistor combination provides a means of varying the audio output level while maintaining a constant impedance across the secondary of T1301. Potentiometers R2604 and R2603 may be varied by operation of the small 614C-2 control knob. The output signal across R2604 and R2603 is applied to the PHONE jack of the external interphone amplifier. No provision is made for varying the audio output level applied to the 618S-1 or 618S-1A front panel PHONE jack. If it is desired to monitor the audio output directly from the 618S-1 or 618S-1A front panel, an external volume control setup, similar to that illustrated in figure 4-30, should be constructed.

4-69. BFO CONTROL. When receiving cw signals, the beat-frequency oscillator, V1202, provides a 250-kilocycle beat signal for audio monitoring. The BFO control on the 614C-2 front panel allows the 250-kilocycle beat signal to be varied plus or minus two to four kilocycles. Crystal rectifier CR1201 is connected through a voltage divider to the 150-volt regulated line. The d-c voltage across CR1201 may be varied from zero to approximately 25 volts by operation of the 614C-2 BFO control, which varies the impedance of V1202 control grid to ground and thereby alters the frequency of the beat signal.

#### 4-70. DETAILED SEQUENCE OF OPERATION.

4-71. Paragraphs 4-70 through 4-76 outline, in procedural steps, the sequence of operation, assuming a channel has been selected. The frequency selection sequence is broken down into r-f crystal oscillator, band, centering, and setup functions. These functions are interdependent, but for simplicity, are covered by separate paragraphs. The sequence of operation should be followed with reference to the main schematic diagrams, figures 7-17 and 7-19.

4-72. R-F CRYSTAL OSCILLATOR, SEQUENCE OF OPERATION. Assume the channel selectors of Radio Set Control 614C-2 have been rotated.

- a. A ground circuit is provided for seeking switches S401 and S402 by rotation of selector switches S2601 and S2602.
- b. Relays K401 and K402 are energized. Contacts of relays K401 and K402 energize motor B401 and provide a ground circuit for the tuner centering circuits directly and the pa centering circuits through sequence relay K801.
- c. Selector switches S403, S404, and S405 and seeking switches S401 and S402 are driven by motor B401.
- d. Seeking switches S401 and S402 find an open circuit and relays K401 and K402 are de-energized.
- e. Motor B401 comes to a stop, dissipating its kinetic energy in the slip clutches.
- f. The correct crystal and bank is selected and the circuit is relaxed in the new position.

4-73. BAND SELECTION, SEQUENCE OF OPERATION. Assume the channel selectors of Radio Set Control 614C-2 have been rotated.

- a. A ground circuit is provided for seeking switch S102 through switch S2602.
- b. Relay K101 is energized, providing a ground circuit for motor B103 and an alternate ground circuit for pa centering relay K1502. (A ground circuit also is provided for K1502 through K801, discussed in the preceding paragraph.)
- c. Switches S1001 through S1006, S1501 through S1504, and S1506 are driven by B103 to the correct band position.
- d. Seeking switch S102 finds an open circuit and relay K1502 is de-energized. The band selection circuits are relaxed.

4-74. TUNER CENTERING, SEQUENCE OF OPERATION. Assume the channel selectors have been rotated.

- a. A ground circuit is provided to the tuner table centering circuits through contacts of relays K401 and K402.
- b. Relay K802 is energized, resulting in an unbalanced d-c voltage being applied to chopper G601 within the tuner servo amplifier subassembly.
- c. Servomotor B102 is driven through the tuner servo amplifier subassembly, rotating switch S1007 and centering the tuner slug rack.
- d. Switch S1007 finds an open circuit and relay K802 is de-energized, relaxing the tuner centering circuits.
- e. Relays K401 and K402 remain energized until the r-f crystal oscillator tuning cycle is complete.

4-75. PA CENTERING, SEQUENCE OF OPERATION. Assume the channel selectors have been rotated.

- a. Relays K401 and K402 are energized, providing a ground circuit to sequence relay K801.
- b. Sequence relay K801 is energized, providing a ground circuit for relay K1502.
- c. Relay K1502 is shorted until switch S1506 is rotated to the selected band position, at which time K1502 is energized.
- d. Contacts of relay K1502 mute the audio output, energize chopper G601, open the keying circuit, and provide an unbalanced d-c voltage to chopper G601.
- e. Servomotor B1501 is driven through the action of the pa servo amplifier subassembly, rotating switch S1505 and driving the roller of the L1502 to the center of the band selected.
- f. Switch S1505 reaches the position corresponding to the selected band, and relay K1502 is shorted and de-energized.
- g. The pa centering circuits are relaxed, and the roller of L1502 is correctly centered on the selected band position.

#### NOTE

The rear section of S1505 energizes relay K1502 if the roller of L1502 approaches either extreme end of travel, thus recycling the pa centering circuits and preventing the roller from disengaging L1502.



4-76. TUNER SETUP, SEQUENCE OF OPERATION. The following sequence will follow the completion of the tuner centering cycle.

- a. Relay K802 is de-energized following the tuner centering cycle, grounding one contact of chopper G601.
- b. The tuner discriminator functions, applying a d-c voltage to one of the contacts of chopper G601.
- c. The d-c error voltage is amplified through the tuner servo amplifier subassembly, energizing servomotor B102.
- d. Servomotor B102 drives the tuner slug rack toward the setup position.
- e. The tuner slugs reach the setup position, and the tuner discriminator output becomes zero.
- f. Servomotor B102 stops, and the tuner setup circuits are relaxed.

4-77. PA SETUP, SEQUENCE OF OPERATION. The following sequence will follow the completion of the power amplifier centering cycle.

- a. Following the centering cycle, relay K1502 is de-energized, grounding one contact of chopper G601 and the cathode of V1302.
- b. Relay K1501 is energized following the setup of the r-f crystal oscillator through contacts of sequence relay K801 and relay K708 of Automatic Antenna Tuner 180L-3.
- c. Contacts of K1501 remove ground from the pa discriminator output and energize chopper G601.
- d. The d-c output from the pa discriminator circuit is now free to operate servomotor B1501 through chopper G601 and the pa servo amplifier subassembly.
- e. Servomotor B1501 is energized, driving the roller of L1502 toward the setup position.
- f. The roller of L1502 reaches the position corresponding to resonance and the pa discriminator output becomes zero, de-energizing servomotor B1501.
- g. Relay K708 is de-energized following the channeling cycle of Automatic Antenna Tuner 180L-3, which removes the ground from K1501 and the setup circuit is relaxed.

4-TO TURBO-PROP ENGINE OPERATIONAL  
 The following information is for the operation of  
 the engine at 1500 RPM.

4-1. Fuel: 8000 is an average fuel flow of about  
 4000 lbs. (1800 kg) per hour at 1500 RPM.

4-2. Oil: 2000 is an average oil flow of about  
 1000 lbs. (450 kg) per hour at 1500 RPM.

4-3. Air: 10000 is an average air flow of about  
 5000 lbs. (2250 kg) per hour at 1500 RPM.

4-4. Exhaust: 8000 is an average exhaust flow of about  
 4000 lbs. (1800 kg) per hour at 1500 RPM.

4-5. 2.7:1 Compression Ratio: The engine  
 has a 2.7:1 compression ratio. The  
 compression ratio is the ratio of the  
 volume of the mixture before compression  
 to the volume after compression.

4. Following the engine test, 8000 lb  
 of engine oil should be added to the oil tank  
 and the engine started.

5. After 1500 RPM is reached, the engine  
 should be idled for 10 minutes before  
 the 1000 RPM test is begun. Adjust  
 the engine to 1000 RPM and take the  
 test for 15 minutes.

6. Remove the 1500 RPM engine test  
 instrumentation and reassemble the  
 engine. The engine should be idled  
 for 10 minutes before the 1000 RPM  
 test is begun. Adjust the engine  
 to 1000 RPM and take the test for  
 15 minutes.

7. After 1000 RPM is reached, the engine  
 should be idled for 10 minutes before  
 the 8000 RPM test is begun. Adjust  
 the engine to 8000 RPM and take  
 the test for 15 minutes.

8. After 8000 RPM is reached, the engine  
 should be idled for 10 minutes before  
 the 4000 RPM test is begun. Adjust  
 the engine to 4000 RPM and take  
 the test for 15 minutes.

9. After 4000 RPM is reached, the engine  
 should be idled for 10 minutes before  
 the 2000 RPM test is begun. Adjust  
 the engine to 2000 RPM and take  
 the test for 15 minutes.

## SECTION V

# ORGANIZATIONAL MAINTENANCE

### 5-1. INTRODUCTION.

5-2. This section provides instructions essential for the maintenance of Radio Set 618S-1 and 618S-1A 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, references are made to meter indications, attenuator settings, etc. 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 components. 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 XV, 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 XV to isolate the trouble to a subassembly within Radio Receiver-Transmitter 618S-1 or 618S-1A. The purpose of this trouble analysis system is to determine quickly the subassembly 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 subassemblies which are defective should be exchanged for subassemblies known to be in good operating condition.

### 5-4. MINIMUM PERFORMANCE STANDARDS.

### 5-5. PREFLIGHT INSPECTION AND TESTS.

5-6. Certain operating checks must be made by the pilot or radio operator prior to actual operation. Careful observance of these procedures will reduce the chance of equipment failure in service, since any

abnormal conditions may be reported quickly to maintenance personnel if correction is beyond the scope of the operator. A thorough inspection of the complete installation should be made before power is applied to the equipment and before any adjustments or tests are begun.

5-7. PREFLIGHT INSPECTION. Inspect the 618S-1 or 618S-1A installation for the following:

- a. Antenna and terminal connections to Automatic Antenna Tuner 180L-3 must be secure.
- b. Connections between Automatic Antenna Tuner 180L-3, Power Supply 416W-1, Radio Set Control 614C-2, and Radio Receiver-Transmitter 618S-1 or 618S-1A must be secure.
- c. Cable connectors must be tightened properly. Tighten locking rings by hand if necessary. Inspect cables for broken wires and loose connections.
- d. Inspect installation Mountings 350S-1 or 350S-3, 350D-3 and 350T-1 to make certain they are anchored securely to the radio equipment shelf and capable of sustaining severe vibration.
- e. Make sure the component cover fasteners are tight.
- f. Microphone, headset, and key cords must be unbroken and securely in place.
- g. Check primary power source connections to make certain that no short circuits exist in the input power lines.

5-8. PREFLIGHT TEST. Test the 618S-1 or 618S-1A installation according to the procedures listed in steps a through m.

- a. Place the OFF PHONE CW switch in the PHONE position. Allow approximately 10 minutes warmup time for the equipment before beginning this portion of the test.
- b. Set the meter selector on the front panel of the 618S-1 or 618S-1A to the 28 V. position. The meter should indicate in the red portion of the scale. Check the 250 V. position. Indication should be within the red area.
- c. Select a band 1 channel (2 to 3.75 megacycles). Allow the equipment to complete its tuning cycle.

### NOTE

Extreme care should be taken to avoid interference with any local communication channel. After each new channel is selected, listen in the headphones to determine if the channel is in use before proceeding with the preflight test.

d. Turn the meter switch to the P.A. GRID position. Press the microphone push-to-talk button and check to see that the meter reading is 3 or greater.

e. Turn the meter selector to the P.A. PL. position and press the microphone push-to-talk button. The meter should read within the red area of the scale.

f. Turn the meter selector to the MOD. PL. position and press the push-to-talk button. The meter should read below 2 on its scale without modulation. Talk normally into the microphone and watch the meter for higher indications. Modulation peaks may show a meter indication of 6 or more. Listen in the headphones to monitor side tone while talking.

g. Release the microphone push-to-talk button and listen in the headset for background noise, an indication of normal receiver sensitivity. The 614C-2 sensitivity and threshold controls should be at maximum output for this check. The sensitivity control is the small 614C-2 knob, and the threshold control is a screw driver adjustment at the rear of the 614C-2 chassis.

h. Repeat the steps outlined above, selecting a channel in each of the remaining three bands. The bands are: band 1, 2 to 3.75 megacycles; band 2, 3.75 to 7.25 megacycles; band 3, 7.25 to 14.25 megacycles; and band 4, 14.25 to 25 megacycles.

i. If Automatic Antenna Tuner 180L-3 is located in a position where the SWR meter on its front panel can be observed, check this meter on each channel tested. The meter reading should be 3.5 or lower.

j. Operate the channel selector from the 2.00 mc channel to the 25.00 mc channel. Radio Receiver-Transmitter 618S-1 or 618S-1A should tune in 8 seconds or less; Automatic Antenna Tuner 180L-3 should complete its tuning cycle in 22 seconds or less.

#### NOTE

When checking cycling time, remember that the 618S-1 or 618S-1A must be keyed manually before the 180L-3 will function if the system is connected for "radio silence" operation.

k. If any tuning cycle continues 45 seconds or more without obtaining correct tuning conditions, a time delay relay (K711) in the 180L-3 will operate thermally, preventing further operation of the 618S-1 or 618S-1A system. If this occurs, wait for at least 60 seconds before attempting to start a new tuning cycle. If the system will not tune, check the antenna circuit for faults. Do not change channels more than once a minute. If channeling occurs at too frequent intervals, heat will build up in relay K711 preventing the 180L-3 from completing its tuning cycle.

#### CAUTION

The maximum duty cycle of Automatic Antenna Tuner 180L-3 is five minutes r-f on and five minutes r-f off. To insure reliable operation, do not exceed this duty cycle.

l. Place the OFF PHONE CW switch in the CW position and select an active CW channel. Operate the 614C-2 BFO control to determine if the cw tone is variable in frequency.

m. When tactical restrictions permit, check the 618S-1 or 618S-1A installation by two-way communication with a ground station or another aircraft.

#### 5-9. DAILY INSPECTION.

5-10. The daily inspection is included to determine the general condition of the equipment and detect any major maladjustments. The inspection is not designed to show slight wear or aging of components. Perform a preflight inspection as outlined in paragraph 5-8 for the daily inspection.

#### 5-11. 120-HOUR INSPECTION.

5-12. The 120-hour inspection includes a thorough inspection of all mechanical and electrical parts within the 618S-1 or 618S-1A system. Following a maximum of 120 hours service, the 618S-1 or 618S-1A components should be removed from the aircraft and placed in a well-equipped maintenance shop for complete bench checks. Steps a through p list the inspection procedures to be followed during each 120-hour inspection.

a. Remove all major components from the aircraft and place them on the test bench. To remove the 618S-1, 618S-1A, 180L-3, and 416W-1 from their mountings, disconnect all cables and unfasten the safety wires. Loosen the knurled fasteners or wing nuts and pull the equipment forward. The 614C-2 is removed by disconnecting the cable and unlocking the four Dzus fasteners.

b. Check mechanical operation of selector knobs and switches.

c. Remove the covers from the 618S-1 or 618S-1A, 180L-3 and 614C-2. To remove the 618S-1 or 618S-1A from its cover, loosen the two Dzus fasteners at the rear of the cover and pull the chassis forward. The 614C-2 cover is secured with two Dzus fasteners at the rear of the unit. The 180L-3 is removed from its case by loosening six machine screws located at the lower edges of the cover. The front panel cover is secured by four machine screws on the front of the 618S-1 or 618S-1A. The bottom plate of Power Supply 416W-1 should be removed by extracting four machine screws.

d. Remove dust from the inside of the components with a jet of clean, dry air.

e. Examine resistors, capacitors, wiring insulation, and cabling for evidence of overheating and cracking.

f. Check wiring and terminals for loose connections.

g. Remove the air filter from the 618S-1 or 618S-1A cover. Wash the filter in hot water and a solvent of strong soap solution. Rinse with clear water and dry. Dip the filter in (SAE-20) oil and drain for 24 hours.

h. Inspect gears and bearings for wear. If lubrication is necessary, follow the procedure outlined in paragraph 5-39.

i. Unfasten and remove the end bell covers of dynamotor D1601.

j. Remove dust and dirt from the dynamotor and end bell covers, using clean, dry air or a soft cloth.

k. Remove and inspect dynamotor brushes, being extremely careful not to nick or mark the edges of the brushes. Note the position and location from which each of the brushes is removed so that they may be replaced in the same position.

l. Check dynamotor commutators for excessive wear, dirt, and other defects. A highly polished commutator is desirable. However, a dark-colored commutator surface should not be mistaken for one which is burned. If the surface of the commutator is dirty, clean with a lint-free cloth moistened in carbon tetrachloride and wipe dry. If the commutator is grooved, replace the dynamotor. Avoid finger marks on the commutator.

m. Secure dynamotor brushes in their holders, making certain that they are replaced in exactly the same position from which they were removed.

#### NOTE

Replace brushes which are worn to approximately 1/4 inch or less. Check each new brush in its holder to see that it can move freely without being excessively loose.

n. Check dynamotor bearings to see that they are properly lubricated. If grease is needed, pack one third of ball race with MIL-G-3278 grease.

o. Reassemble the 618S-1 or 618S-1A components and replace in the aircraft.

p. Perform a preflight test, paragraph 5-8.

#### 5-13. DETAILED PERFORMANCE TESTS.

5-14. The following tests present a method of checking each function of the 618S-1 or 618S-1A system at the organizational maintenance level. The detailed performance tests may be used to verify defects of functions within a particular component and as a final test after isolation and correction of trouble. The tests are designed for use with the test equipment listed in section II, table VII of this handbook. The main 618S-1 or 618S-1A component should be removed from its cover and placed in a bench test setup similar to that illustrated in figure 3-1. The cabling between the 618S-1 or 618S-1A components should simulate that of an actual aircraft and should be in accordance with figure 7-15 and paragraph 2-8.

#### WARNING

Certain plate voltages used in the 618S-1 and 618S-1A equipment are dangerous to life (600 volts). When operating the 618S-1 or 618S-1A receiver-transmitter component removed from the cover, special care must be taken to avoid contact with tube plate caps and circuit wiring carrying high voltage. Keep

clothing, cleaning rags, etc, away from the mechanical drive of the 618S-1 or 618S-1A where there is a chance of these items being caught in the gear mechanisms. Always discharge high voltage filter capacitors before attempting work on any of the 618S-1 or 618S-1A components.

5-15. RECEIVER SENSITIVITY. Perform the following operations:

a. Connect test crystals to the r-f crystal oscillator subassembly as listed in table X, section III.

b. Connect Signal Generator AN/URM-25 to jack J109 (test point 3). Adjust for an output of 2.75 megacycles at 1000 microvolts, modulated 30% at 1000 cps. Use Frequency Meter AN/USM-26 to set the AN/URM-25 to frequency.

c. Connect Output Meter TS-585B/U to test point 4 and adjust to the 500-milliwatt range with an internal impedance of 300 ohms.

d. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

e. Operate the 614C-2 channel selectors to the A4 position (2.75 megacycles).

f. Adjust the sensitivity and threshold controls of the 614C-2 for maximum output. The threshold control (R2602) is a screw driver adjustment at the rear of the 614C-2, and the sensitivity control is the small knob on the 614C-2 front panel.

g. Adjust the AUDIO control (R109 on the 618S-1 or 618S-1A front panel) for an audio power output of 300 milliwatts as read on Output Meter TS-585B/U.

h. Reduce the output level of Signal Generator AN/URM-25 to 5 microvolts. Output Meter TS-585B/U should indicate not less than 100 milliwatts.

i. Remove the modulation. The signal-plus-noise to noise ratio should be at least 6 db (modulation on to modulation off ratio of 4 to 1 as read on Output Meter TS-585B/U).

j. Operate the OFF PHONE CW switch to the CW position and remove the modulation.

k. Remove the TS-585B/U and connect a headset to terminal b of P2601 (test point 8).

#### NOTE

When a 300-ohm headset such as the H-1/AR or the H-4/AR is connected to either the PHONE jack or to terminal b of P2601, Output Meter TS-585B/U should be removed from the PHONE jack. The TS-585B/U and a low-impedance headset should not be connected across the audio output terminals at the same time, or transformer T1301 will be mismatched, and the test results will be inaccurate. A high-impedance monitor, such as described in table VII, item 23, may be used in parallel with the TS-585B/U if it is desired to monitor the audio signal during the test procedures.

l. Adjust the 614C-2 BFO control for a signal of approximately 1000 cps.

m. Remove the headset and replace the TS-585B/U. Observe the power output indication of the TS-585B/U with Signal Generator AN/URM-25 adjusted to 5 microvolts output. Output Meter TS-585B/U should indicate at least 100 milliwatts.

n. Remove the r-f input signal and observe the indication of the TS-585B/U. The reading should change at least 10 db (indication in the r-f on position at least 10 times that in the r-f off position).

o. Repeat the sensitivity measurements outlined in steps a through m for frequencies listed in table XII of section III. It is not necessary to rotate the AUDIO control (step g) after it has been set correctly.

5-16. RECEIVER SELECTIVITY. The test crystals listed in table X of section III should be inserted for the following procedures. Perform the following operations:

a. Connect Output Meter TS-585B/U to the PHONE jack (test point 4) and adjust to the 500-milliwatt range with an internal impedance of 300 ohms.

b. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

c. Connect VTVM TS-375/U to terminal 5 of jack J310 (test point 7). Adjust the TS-375/U to read on the negative 3-volt scale.

d. Connect Signal Generator AN/URM-25 to jack J109, test point 3. Adjust the AN/URM-25 frequency to 2.75 megacycles with Frequency Meter AN/USM-26 and the output level to minimum r-f unmodulated.

e. Operate the 614C-2 channel selectors to the A4 position (2.75 megacycles).

f. Adjust the AN/URM-25 output level for a reading of exactly negative 1 volt d-c on VTVM TS-375/U.

g. Double the AM/URM-25 output level and detune both above and below 2.75 megacycles. Observe the frequencies on Frequency Meter AN/USM-26 where the reading on VTVM TS-375/U returns to negative 1 volt d-c. The difference between the two frequencies is an indication of the receiver bandwidth at the 6-db point and should be at least 5.5 kilocycles.

h. Increase the output level of the AN/URM-25 to 1000 times that determined in step f and detune both above and below 2.75 megacycles. Observe the frequencies on Frequency Meter AN/USM-26 where the reading on VTVM TS-375/U returns to negative 1 volt d-c. The difference between the two frequencies is an indication of the receiver bandwidth at the 60-db point and should be not greater than 14 kilocycles.

i. Repeat steps f through h with the 614C-2 channel selectors set to the following positions: position G4, 5.25 megacycles; position M4, 10.25 megacycles; position U4, 20.25 megacycles. For each position, Signal Generator AN/URM-25 should be adjusted to the operating frequency with Frequency Meter AN/USM-26.

5-17. FREQUENCY SELECTION. The test crystals listed in table X of section III should be inserted for the following procedures. Perform the following operations:

a. Connect the dummy load, VTVM TS-375/U, a 1-megohm resistor, and Frequency Meter AN/USM-26

to test point 1. All other test equipment should be disconnected.

b. Operate the 614C-2 OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

c. Refer to table X of section III. Operate the channel selector switches of Radio Set Control 614C-2 to each position listed and observe the output frequencies as read on Frequency Meter AN/USM-26. Frequencies should not vary over 0.007% of those listed in table X.

#### NOTE

Do not attempt to channel the 618S-1 or 618S-1A more than once a minute. If channeled too frequently, a time delay relay (K711) in the 180L-3 will heat and prevent the 618S-1 or 618S-1A system from completing its tuning cycle. Relay K711 will operate also if the total tuning time, following the centering cycle of the tuner subassembly, exceeds 45 seconds. If this happens, wait at least one minute before rechanneling.

d. Check the time interval required for the tuning cycle to complete when the channel selectors are operated from the A1 to the U9 position. Radio Receiver-Transmitter 618S-1 and 618S-1A should complete its tuning cycle in 8 seconds or less and Automatic Antenna Tuner 180L-3 should complete its tuning cycle in 22 seconds or less.

5-18. TRANSMITTER R-F POWER OUTPUT. The test crystals listed in table X of section III should be inserted for the following test. Perform the following operations:

a. Connect the dummy load and the r-f probe of VTVM TS-375/U from E102 of Automatic Antenna Tuner 180L-3 (test point 1) to ground.

b. Connect a telegraph key to test point 6 or a microphone to test point 5. All other test equipment should be removed for this test.

c. Operate the OFF PHONE CW switch to the PHONE position and allow at least 10 minutes for warmup. After warmup, rotate the OFF PHONE CW switch to the CW position.

d. Operate the 614C-2 channel selectors to the A1 position (2.0 megacycles) and allow the 618S-1 or 618S-1A system to complete the tuning cycle.

e. Depress the telegraph key or microphone push-to-talk button and observe the indication on VTVM TS-375/U. The reading should be not less than 71.8 volts a-c, which corresponds to 100 watts r-f power output.

f. Repeat step e for each frequency listed in table XI of section III. The test results are also listed in table XI.

5-19. MODULATION. The test crystals listed in table X of section III should be inserted for the following

test. Remove all test equipment except as called out in the following procedures.

a. Connect the dummy microphone circuit to the MIC jack (test point 5). Refer to figures 2-1 and 3-1.

b. Connect VTVM TS-375/U and Audio Oscillator TS-382A/U to the dummy microphone as illustrated in figure 2-1. Adjust the TS-382A/U to 0.25 volt a-c at 1000 cps.

c. Connect Oscilloscope OS-8/U across the dummy load through a 25-micromicrofarad capacitor and connect to E102 (test point 1). Adjust the OS-8/U for a horizontal sweep capable of reproducing two or three modulated cycles at 1000 cps.

d. Connect a telegraph key to the KEY jack (test point 6).

e. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

f. Operate the 614C-2 channel selectors to the A1 position (2.0 megacycles).

g. Key the 618S-1 or 618S-1A by operating the telegraph key.

h. Adjust the CLIPPING control (R1404 on the bottom of the modulator subassembly) to the maximum clockwise position.

i. Adjust the GAIN control (R1403 on the bottom of the modulator subassembly) for 80% modulation. Use the following formula to calculate the percentage of modulation: Refer to figure 3-2.

$$\% \text{ Modulation} = \frac{\text{Maximum} - \text{Minimum}}{\text{Maximum} + \text{Minimum}} \times 100$$

#### NOTE

The minimum percentage of modulation that is allowable depends upon the r-f power output and therefore upon the band of operation. Refer to figure 3-3 for the minimum percentage of modulation allowable for different values of r-f power output. Examination of figure 3-3 will illustrate that a minimum modulation percentage of 95% is allowable with 100 watts r-f power output.

j. Adjust the CLIPPING control for threshold at the 80% modulation point.

k. Increase the output level of Audio Oscillator TS-382A/U by 12 db. This may be accomplished by increasing the output voltage of the TS-382A/U to 1 volt a-c. The waveform, as observed on Oscilloscope OS-8/U, should be clipped below the 100% modulation point.

l. Lock the CLIPPING and GAIN controls in position.

m. Reduce the TS-382A/U output level to that required for 60% modulation.

n. Vary the frequency of the TS-382A/U between 300 and 3500 cps while maintaining the audio input signal constant. The modulation percentage should remain between 40% and 70%.

o. Adjust the frequency of the TS-382A/U to 5000 cps. The modulation percentage should be not less than 22%.

5-20. SIDE TONE. With the equipment setup as described in the preceding paragraph, perform the following operation:

a. Connect a headset to the PHONE jack (test point 4) or to terminal b of P2601.

b. Vary the level and frequency of Audio Oscillator TS-382A/U and notice if the varying signal can be heard in the headset.

c. Vary the PHONE SIDETONE control (R106 on the 618S-1 or 618S-1A front panel subassembly) and notice if the amplitude of the side-tone signal is variable.

d. With the TS-382A/U set for an output level of 1 volt at 1000 cps, adjust R106 for a comfortable headset level.

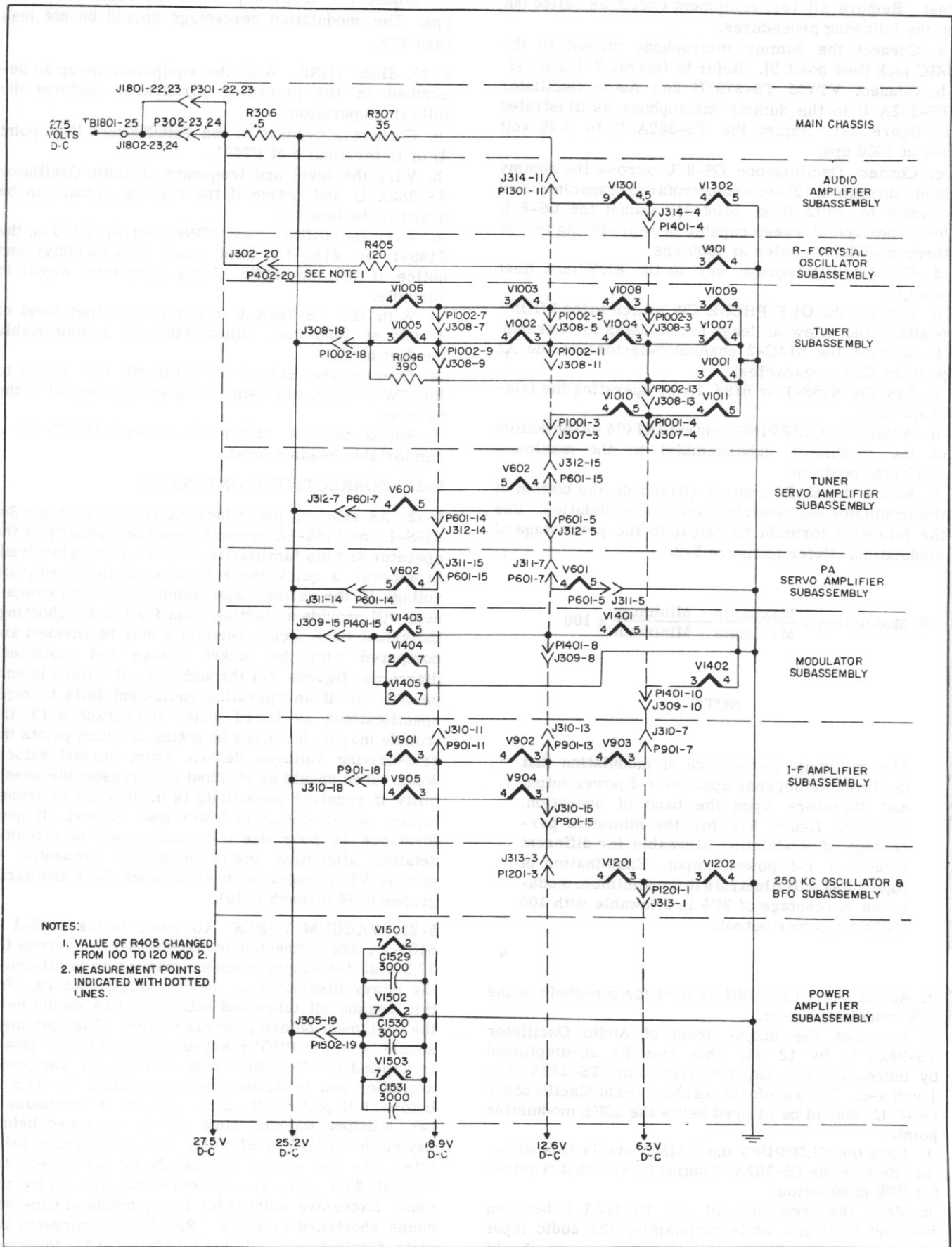
e. Operate the 614C-2 OFF PHONE CW switch to the CW position and listen for a 400-cps signal in the headset.

f. Adjust the CW SIDETONE control (R107) for a comfortable headset level.

#### 5-21. CORRECTIVE MAINTENANCE.

5-22. An efficient job of locating trouble in Radio Set 618S-1 and 618S-1A depends upon the ingenuity of the operator and his familiarity with the circuits involved. In general, a quick check for open heaters and plate voltage to the various subassemblies of each component will provide a starting point for trouble shooting. Individual tube socket potentials may be checked and compared with the socket voltage and resistance diagrams, figures 7-1 through 7-9. If failure is only partial, or if an operating equipment fails to meet specifications as listed under paragraph 5-13, the trouble may be localized by noting at which points the grid-driving voltages deviate from normal values. Weak tubes should be checked as a reasonable possibility if receiver sensitivity is insufficient or transmitter power output is lower than normal. If performance is poor due to misalignment of circuits, detailed alignment instructions are presented in section VI, paragraphs 6-46 through 6-88 and paragraphs 6-96 through 6-101.

5-23. VACUUM TUBES. All tubes in the 618S-1 or 618S-1A are connected in series parallel across the 27.5-volt d-c supply in such a manner as to minimize the power dissipated in the dropping resistors. For this reason all tubes and subassemblies should be in the equipment before power is applied. The equipment should be in the PHONE key-up position before power is applied to allow the large tubes within the power amplifier and modulation subassemblies to warm up before full plate voltage is applied. A minimum of two minutes warmup time is recommended before keying the 618S-1 or 618S-1A. To avoid damage to the tubes, the d-c supply voltage should not exceed the normal 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.



- NOTES:
1. VALUE OF R405 CHANGED FROM 100 TO 120 MOD 2.
  2. MEASUREMENT POINTS INDICATED WITH DOTTED LINES.

Figure 5-1. Radio Receiver-Transmitter 618S-1 and 618S-1A, Filament Circuit



5-24. TUBE REPLACEMENTS. Before any tube in the 618S-1 or 618S-1A equipment is removed for replacement or checking, make sure the 614C-2 OFF PHONE CW switch is in the OFF position. Check all replacement tubes carefully to be sure they are the correct type before replacing. If the tube failure is due to an open heater, it will cause an unbalance in the filament circuit, since the tubes are connected in series parallel. Measuring the voltage across the different sections of the heater circuits will sometimes help to locate which tube has failed. Reference is made to figure 5-1 for filament measurement points and voltages. The fastest method of finding the tube with an open heater is to disconnect the equipment from the 27.5-volt supply and apply a separate six-volt battery across the suspected section. Under this condition all tubes in the section should glow normally except the defective one. For this test it will be obvious that the six-volt battery must be free of ground, except when testing the grounded section of the heaters. Also, a dropping resistor may be necessary, depending upon the filament section under test. The connections can be temporarily made by clip leads to appropriate points in the equipment. If this method of heater testing is employed, the equipment must be turned off before connecting the battery, and the battery must be removed before the equipment is operated again. When an open heater is found, all tubes within the same series-parallel string as the defective one should be removed and checked on Tube

Tester TV-3B/U to determine if they are damaged from an excessive heater current. Examination of figure 5-1 will show the individual filament strings.

#### 5-25. SYSTEM TROUBLE ANALYSIS.

5-26. In trouble-shooting procedures, localization of the trouble to a specific component or subassembly of the 618S-1 or 618S-1A system must be accomplished first. Table XV, System Trouble Analysis, presents a complete step-by-step procedure to help isolate trouble within the equipment. The trouble analysis system is further amplified to include isolation of trouble to a detail part in section VI of this handbook. Radio Receiver-Transmitter 618S-1 or 618S-1A must be connected properly to Power Supply 416W-1, Radio Set Control 614C-2, and the primary power source in accordance with figure 7-15. Connection of the bench test setup must be in accordance with figure 3-1. Automatic Antenna Tuner 180L-3 may be used for the trouble isolation procedures if desired; however, the 180L-3 must be in proper operating condition. If trouble is suspected within the 180L-3, the Handbook Service Instructions, T.O. 31R2-4-38-1 should be consulted for applicable trouble-shooting procedures. The test crystals described in table X of section III should be inserted into the r-f crystal oscillator subassembly before proceeding with the steps outlined in table XV.

TABLE XV. SYSTEM TROUBLE ANALYSIS

STEP	TEST POINTS	TEST EQUIPMENT	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
1	Visual	None	Operate the OFF PHONE CW switch to the PHONE position and allow ten minutes for warmup. Then operate to the CW position.	Tube filaments light and blower motor B101 runs.	Proceed to step 3.	Proceed to step 2.
2	★ TB1801	Multimeter TS-352/U	Measure the voltage at each of the following TB1801 terminals; 2, 7, 11, 21, 25, 40, 44, 45.	2, 600 volts d-c; 7, 6.3 volts a-c; 11, 250 volts d-c; 21, 18 volts a-c; 25, 27.5 volts d-c; 40, -65 volts d-c; 44, -50 volts d-c; 45, 115 volts a-c; 46, 115 volts a-c.	Trouble is in filter unit or main component. If not located, proceed to step 4.	Trouble is in Power Supply 416W-1.
3	Visual	None	Select several random frequencies and notice if the	Readings should correspond. Note that the r-f	Proceed to step 5.	Proceed to step 4.

TABLE XV. SYSTEM TROUBLE ANALYSIS (Cont)

STEP	TEST POINTS	TEST EQUIPMENT	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
3 (cont)			channel selector settings correspond with the letter-number combinations in the r-f crystal oscillator subassembly window.	crystal oscillator letters are A through F and and the 614C-2 letters are A through Z. The letters A through F correspond to A through F, G through L, M through T, and U through Z.		
4	Visual	None	Replace the r-f crystal oscillator subassembly with one known to be in good operating condition and repeat step 3.	Same as step 3.	Trouble is in the original r-f crystal oscillator subassembly.	Trouble is in Radio Set Control 614C-2. Replace entire component.
5	Visual	None	Repeat step 3 and observe the tuner subassembly.	Tuner slugs should center and then move to the setup position.	Proceed to step 8.	Proceed to step 6.
6	Visual	None	Replace the tuner subassembly with one known to be in good operating condition and repeat step 3.	Same as step 5.	Trouble is in the original tuner subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Proceed to step 7.
7	Visual	None	Replace servomotor B102 unit with one known to be in good operating condition and repeat step 3.	Same as step 5.	Trouble is in original servomotor B102 unit.	Trouble is in the tuner servo amplifier subassembly or tube V401. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.
8	Visual	None	Keep the 618S-1 or 618S-1A and repeat step 3. Observe the power amplifier subassembly.	The roller of main tuning inductor L1502 should center and then move to the setup position.	Proceed to step 10.	Proceed to step 9.

TABLE XV. SYSTEM TROUBLE ANALYSIS (Cont)

STEP	TEST POINTS	TEST EQUIPMENT	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
9	Visual	None	Replace the power amplifier sub-assembly with one known to be in good operating condition and repeat step 8.	Same as step 8.	Trouble is in the original power amplifier sub-assembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace sub-assembly.	Trouble is in the pa servo amplifier sub-assembly. Test the tubes, and, if normal, replace the pa servo amplifier subassembly.
10	Visual	None	Select several band positions and observe the band switches of the tuner and power amplifier subassemblies.	Switches rotate and select the correct band position.	Proceed to step 12.	Proceed to step 11.
11	Visual	None	Replace the band-change autopositioner unit with one known to be in good operating condition and repeat step 10.	Same as step 10.	Trouble is in the original bandchange autopositioner unit.	Trouble is in Radio Set Control 614C-2.
12	☆ (J109), ☆ (J101)	Signal Generator AN/URM-25, Output Meter TS-585B/U, Frequency Meter AN/USM-26.	Perform steps b through f and h through i of paragraph 5-15, for one frequency of each band.	100 milliwatts and signal-plus-noise to noise ratio of 6 db.	Proceed to step 18.	Proceed to step 13.
13	Same as step 12.	Same as step 12.	Replace Radio Set Control 614C-2 with one known to be in good operating condition and perform steps b through f and h through i of paragraph 5-15, for one frequency on each band.	Same as step 12.	Trouble is in original Radio Set Control 614C-2.	Proceed to step 14.
14	Same as step 12.	Same as step 12.	Replace the r-f crystal oscillator subassembly with one known to be in good operating	Same as step 12.	Trouble is in original r-f crystal oscillator sub-assembly.	Proceed to step 15.

TABLE XV. SYSTEM TROUBLE ANALYSIS (Cont)

STEP	TEST POINTS	TEST EQUIPMENT	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
14 (cont)			condition, and perform steps b through f and h through i of paragraph 5-15 for one frequency on each band.		Test tube V401 in Tube Tester TV-3B/U, and, if normal, replace sub-assembly.	
15	Same as step 12.	Same as step 12.	Replace the tuner subassembly with one known to be in good operating condition, and perform steps b through f and h through i of paragraph 5-15, for one frequency on each band.	Same as step 12.	Trouble is in original tuner subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Proceed to step 16.
16	Same as step 12.	Same as step 12.	Replace the i-f amplifier subassembly with one known to be in good operating condition and perform steps b through f and h through i of paragraph 5-15.	Same as step 12.	Trouble is in original i-f amplifier subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Proceed to step 17.
17	Same as step 12.	Same as step 12.	Replace the audio amplifier subassembly with one known to be in good operating condition and perform steps b through i of paragraph 5-15.	Same as step 12.	Trouble is in original audio amplifier subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Trouble is in AUX REC ANT or PHONE connectors.
18	☆ (J109), ☆ (J101), ☆	Signal Generator AN/URM-25, Output Meter TS-585B/U, Frequency Meter AN/USM-26, Headset H-1/AR or H-4/AR	Set the AN/URM-25 frequency to 2.75 megacycles with Frequency Meter AN/USM-26 and connect the AN/URM-25 to test point ☆. Perform steps j through n of paragraph 5-15.	100 milliwatts and signal-plus-noise to noise ratio of 10 db.	Proceed to step 20.	Proceed to step 19.

TABLE XV. SYSTEM TROUBLE ANALYSIS (Cont)

STEP	TEST POINTS	TEST EQUIPMENT	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
19	Same as step 18.	Same as step 18.	Replace the 250 kc oscillator and bfo subassembly with one known to be in good operating condition.	Same as step 18.	Trouble is in original 250 kc oscillator and bfo subassembly. Test tube V1202 in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Trouble is in Radio Set Control 614C-2.
20	☆ (E102 or J110)	Bird Model 82 Dummy Load, VTVM TS-375/U	Perform steps a through f of paragraph 5-18.	71.8 volts a-c or 68.2 volts a-c; refer to table XI of section III.	Proceed to step 27.	Proceed to step 21.
21	Same as step 20.	Same as step 20.	Replace Radio Set Control 614C-2 with one known to be in good operating condition and perform steps a through f of paragraph 5-18.	Same as step 20.	Trouble is in original 614C-2.	Proceed to step 22.
22	Same as step 20.	Same as step 20.	Replace the r-f crystal oscillator subassembly with one known to be in good operating condition, and perform steps a through f of paragraph 5-18.	Same as step 20.	Trouble is in original tuner subassembly. Test tube V401 in Tube Tester TV-3B/U, and, if normal, replace tuner subassembly.	Proceed to step 23.
23	Same as step 20.	Same as step 20.	Replace the tuner subassembly with one known to be in good operating condition, and perform steps a through f of paragraph 5-18.	Same as step 20.	Trouble is in original tuner subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Proceed to step 24.
24	Same as step 20	Same as step 20.	Replace the power amplifier subassembly with one known to be in good operating condition, and	Same as step 20.	Trouble is in original power amplifier subassembly. Test the	Proceed to step 25.

TABLE XV. SYSTEM TROUBLE ANALYSIS (Cont)

STEP	TEST POINTS	TEST EQUIPMENT	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
24 (cont)			perform steps a through f of paragraph 5-18.		tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	
25	Same as step 20.	Same as step 20.	Replace the 250 kc oscillator and bfo subassembly with one known to be in good operating condition, and perform steps a through e of paragraph 5-18. (Test necessary only on one frequency.)	Same as step 20.	Trouble is in original 250 kc oscillator and bfo subassembly. Test tube V1201 in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Proceed to step 26.
26	Same as step 20.	Same as step 20.	Replace the relay subassembly with one known to be in good operating condition, and perform steps a through e of paragraph 5-18. (Test necessary only on one frequency.)	Same as step 20.	Trouble is in original relay subassembly. Replace defective part or entire subassembly.	Trouble is in ANT connector or system cabling.
27	☆ (E102 or J110) ☆ (J102) ☆ (J103)	VTVM TS-375/U, Audio Oscillator TS-382A/U, Oscilloscope OS-8/U, Bird Model 82 Dummy Load, Telegraph Key, Dummy Microphone	Perform steps a through o of paragraph 5-19.	Refer to steps k, n, and o of paragraph 5-19.		Proceed to step 28.
28	Same as step 27.	Same as step 27.	Replace the modulator subassembly and perform steps a through o of paragraph 5-19.	Same as step 27.	Trouble is in original modulator subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Trouble is in MIC, KEY, ANT connectors, or transformer T301.

**5-27. SUBASSEMBLY REMOVAL AND REPLACEMENT.**

5-28. Radio Receiver-Transmitter 618S-1 and 618S-1A consists of a group of 13 subassemblies or units which plug into receptacles on the main chassis frame. The individual plug-in units and subassemblies which require mechanical linkage to each other or to the front panel subassembly are built with quick-disconnect, flexible Oldham, or pin-type couplers to allow removal of the subassemblies or units from the main chassis. Once these linkages are synchronized, and the proper procedure is followed, it is possible to remove and replace units without additional mechanical alignment. All electrical connections to the plug-in subassemblies and units are made through receptacles mounted on the main chassis which facilitates easy removal without unsoldering wires. Captive hold-down screws hold the individual units and subassemblies in place. The front panel subassembly is constructed to make good electrical contact with a dust cover that is removable from the rear of the equipment.

5-29. When removing the main chassis from the case, disengage the two Dzus fasteners at the rear of the 618S-1 or 618S-1A main component. Place the 618S-1 or 618S-1A in a standing position on the floor, with the back plate flat against the floor. The main chassis then can be lifted out of the case by pulling straight up on the two front handles. The main chassis normally is not fitted into a jig, since all plug-in units and subassemblies are accessible from the top. To aid the technician in removing a unit or subassembly, the screws which secure the units and subassemblies are painted red. They must be loosened, but should not be removed completely, to free the subassemblies and units. It is important that a Phillips screw driver of the proper size be used to prevent damage to the heads of the screws. When the screws are loosened, they cause some extraction of the plugs and jacks which connect the subassemblies and units to the main chassis. This is desirable to prevent bending pins during removal. It is important to rock the subassemblies and units loose as they are extracted from the chassis. Insert the plugs carefully when returning the subassembly or unit to the main chassis, checking for proper alignment between the pins and sockets.

5-30. GENERAL. When removing the 250 kc oscillator and bfo, i-f amplifier, audio amplifier, relay, tuner servo amplifier, pa servo amplifier, modulator, r-f crystal oscillator, or tuner subassemblies, the following procedure should be followed.

- a. Loosen the redheaded captive screws until they turn freely. It will be observed that loosening the screws causes the connecting plug and jack to separate.
- b. Lift the subassembly straight up.
- c. The plate caps of the modulator tubes must be removed to free the modulator subassembly.
- d. When reinstalling any of the above-mentioned subassemblies, carefully line up the pins of the plug

with the mating jack. Make certain that the subassembly is not reversed by 180 degrees.

- e. Push the subassembly straight down firmly until it is fully seated.
- f. Tighten the redheaded captive screws alternately to secure the subassembly to the main chassis.

5-31. TUNER SUBASSEMBLY, 618S-1. Perform the following operations when removing and replacing the 618S-1 tuner subassembly. Refer to paragraph 5-32 for the 618S-1A tuner subassembly.

- a. Channel the 618S-1 equipment to the position corresponding to 2.0 megacycles.
- b. The fork and pin of the two front couplers should be in a downward position.
- c. Loosen the four redheaded captive screws until they turn freely.
- d. Disconnect plug P1503 from jack J1001.
- e. Lift the tuner subassembly straight up and out of the main chassis.
- f. When reinstalling the tuner subassembly, the pins on the bandchange autopositioner unit, servomotor B102 unit, and the power amplifier subassembly couplers should be pointing downward. The three forks on the couplers of the tuner subassembly also should point down with the slug rack near the bottom.
- g. Insert the tuner subassembly carefully, observing that all couplers are properly meshed.
- h. Tighten the four redheaded captive screws alternately to seat the tuner subassembly properly.

5-32. TUNER SUBASSEMBLY, 618S-1A. Perform the following operations when removing and replacing the 618S-1A tuner subassembly:

- a. Same as step a, paragraph 5-31.
- b. The red identification dots on the two front Oldham couplers should be straight up.
- c. Same as step c, paragraph 5-31.
- d. Same as step d, paragraph 5-31.
- e. Same as step e, paragraph 5-31.
- f. When reinstalling the tuner subassembly, the red dots on the two front Oldham couplers attached to the tuner subassembly should be straight. The long cutout on the slider portion of the couplers attached to the bandchange autopositioner unit and servomotor B102 unit, should be vertical and the pin toward the bottom. The rear coupler, attached to the power amplifier subassembly, should have the slider portion of the coupler vertical and the pin toward the bottom.
- g. Same as step g, paragraph 5-31.



The pin on the slider portion of the Oldham coupler must match the 90-degree cutout of the fixed portion of the Oldham coupler when installing a subassembly or unit.

- h. Same as step h, paragraph 5-31.

**5-33. POWER AMPLIFIER SUBASSEMBLY, 618S-1.** Perform the following operations when removing and replacing the 618S-1 power amplifier subassembly. Refer to paragraph 5-34 for the 618S-1A power amplifier subassembly.

- a. To remove the power amplifier subassembly, the 618S-1 equipment must be channeled to band 4. Any frequency in band 4 may be used.
- b. In this position, the fork and pin of the coupler is straight up.
- c. Loosen the four redheaded captive screws until they turn freely.
- d. Disconnect plug P1503 from jack J1001.
- e. Lift the subassembly straight up and out of the main chassis.
- f. When reinstalling the power amplifier subassembly, the pin of the power amplifier subassembly coupler and the fork on the tuner subassembly coupler should be pointing up.
- g. Insert the power amplifier subassembly carefully, observing that the couplers mesh properly.
- h. Tighten the four redheaded captive screws, taking each side up a little at a time in order to seat the subassembly properly.
- i. Insert plug P1503 into jack J1001.

**5-34. POWER AMPLIFIER SUBASSEMBLY, 618S-1A.** Perform the following operations when removing and replacing the 618S-1A power amplifier subassembly:

- a. Same as step a of paragraph 5-32.
- b. In this position, the green dot on the Oldham coupler should be straight up.
- c. Same as step c, paragraph 5-32.
- d. Same as step d, paragraph 5-32.
- e. Same as step e, paragraph 5-32.
- f. When reinstalling the power amplifier subassembly, the green dots of the Oldham couplers on the power amplifier and tuner subassemblies should be up.
- g. Same as step g, paragraph 5-32.
- h. Same as step h, paragraph 5-32.
- i. Same as step i, paragraph 5-32.

**5-35. SERVOMOTOR B102 AND BANDCHANGE AUTOPOSITIONER UNITS, 618S-1.** Perform the following operations when removing and replacing the 618S-1 bandchange autopositioner or servomotor B102 units. Refer to paragraph 5-36 for the 618S-1A bandchange autopositioner or servomotor B102 units.

- a. Channel the 618S-1 equipment to the A1 position (2.0 megacycles).
- b. To gain access to the bandchange autopositioner and servomotor B102 units, remove the four screws in the front panel cover and lift the cover off.
- c. Disconnect the plug or jack of the unit being removed from the front panel plug or jack. Disconnect P106 from J106 when removing servomotor B102 unit, and disconnect P107 from J107 when removing the bandchange autopositioner unit.
- d. Loosen the three redheaded captive screws and lift the unit free.
- e. When reinstalling servomotor B102 unit, hold the unit so that the back plate with the silk-screened TUNING DRIVE is facing you. Turn the coupler

clockwise as far as possible; then back off slightly until the coupler is vertical. This is the proper position for reinsertion.

- f. When reinstalling the bandchange autopositioner unit, the fork and pin of the tuner subassembly coupler should be down and the bandchange autopositioner unit coupler properly mated in this position.
- g. After the units have been replaced, tighten the red-headed captive screws alternately.
- h. Replace the applicable plug in the jack from which it was removed.

**5-36. SERVOMOTOR B102 AND BANDCHANGE AUTOPOSITIONER UNITS, 618S-1A.** Perform the following operations when removing and replacing the 618S-1A bandchange autopositioner or servomotor B102 units:

- a. Same as step a, paragraph 5-34.
- b. Same as step b, paragraph 5-34.
- c. Same as step c, paragraph 5-34.
- d. Same as step d, paragraph 5-34.
- e. When reinstalling servomotor B102 unit, hold the unit so that the back plate with the silk-screened TUNING DRIVE is facing you. Turn the coupler clockwise as far as possible; then back off slightly until the grooved portion of the coupler is in line with the line on the plate of the unit.
- f. When reinstalling the bandchange autopositioner unit, the pin on the slider portion of the coupler must match the 90-degree cutout of the fixed portion of the coupler.
- g. Same as step g, paragraph 5-34.
- h. Same as step h, paragraph 5-34.

**5-37. BLOWER MOTOR B101 UNIT.**

- a. To remove the blower motor B101 unit from either the 618S-1 or 618S-1A front panel, first remove the front panel cover to gain access to B101.
- b. Remove plug P105 from jack J105.
- c. Remove four Phillips-head screws securing the B101 unit to the front panel.
- d. To reinstall blower motor B101 unit, reverse steps a through c.

### **5-38. LUBRICATION.**

**5-39. GENERAL.** Components or subassemblies requiring lubrication, listed in table XVI, should be inspected at 1000-hour intervals. 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 O-C-141(4) or Stoddard solvent, and dry with compressed air. Refer to table XVI and figures 5-2 through 5-9.



The equipment should not be operated after having been cleaned with carbon tetrachloride until relubrication procedures have been performed.



## NOTE

The Oldham couplers illustrated in figures 5-3 through 5-9 are used on the 618S-1A

subassemblies; however, all indicated lubrication points are the same for both the 618S-1 and 618S-1A subassemblies.

TABLE XVI. LUBRICATION OF EQUIPMENT

COMPONENT OR SUBASSEMBLY	PART	REFERENCE NUMBER	FIGURE NO.	LUBRICANT	METHOD OF APPLICATION
RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A					
Blower Motor B101 Unit	Ball Bearings	1	5-2	MIL-G-3278	Brush
Bandchange Auto-positioner Unit	Gear Teeth	2	5-3	MIL-G-7421	Brush
	Ball Bearings	3	5-3	MIL-G-7870	Dropper
	Servomotor Bearings	4	5-3	MIL-G-7870	Dropper
Servomotor B102 Unit	Gear Teeth	5	5-4	None	Do not lubricate
	Ball and Motor Bearings	6	5-4	MIL-L-7870	Dropper
Tuner Subassembly	Gears	7	5-5, 5-6	MIL-G-7421	Brush
	Porous Bearings	8	5-5, 5-6	MIL-L-7870	Dropper
Power Amplifier Subassembly	Metal-to-Metal Gears	9	5-7	MIL-G-7421	Brush
	Porous and Ball Bearings	10	5-7	MIL-L-7870	Dropper
	Servomotor Bearings	11	5-7	MIL-L-7870	Dropper
R-F Crystal Oscillator Subassembly	Gear Teeth	12	5-8, 5-9	MIL-G-7421	Brush
	Porous Bearings	13	5-8, 5-9	MIL-L-7870	Dropper
	Ball Bearings	14	5-8, 5-9	MIL-L-7870	Dropper
MOUNTING 350S-1 OR 350S-3 AND MOUNTING 350T-1					
	Extractor Screw Shaft	15		MIL-G-7421 or MIL-G-3278	Brush
POWER SUPPLY 416W-1					
	Dynamotor Ball Bearings	16		MIL-G-3278	Brush
RADIO SET CONTROL 614C-2					
	Gears	17		MIL-G-7421	Brush
	Bearings	18		MIL-L-7870	Dropper
AUTOMATIC ANTENNA TUNER 180L-3					
Refer to Handbook Service Instructions, T.O. 31R2-4-38-1.					

subassemblies, however, all maintenance and  
 lubrication points are the same for both the 8188-1  
 and 8188-1A subassemblies.

NOTE  
 The Oilsman complete illustrated in figures  
 5-1 through 5-8 are used on the 8188-1A

TABLE XVI LUBRICATION OF EQUIPMENT

COMPONENT OR SUBASSEMBLY	PART NUMBER	REFERENCE NUMBER	LUBRICATION POINT
Blower Motor	8188-1	5-2	1
Blower Motor	8188-1A	5-2	1
Blower Motor	8188-1B	5-2	1
Blower Motor	8188-1C	5-2	1
Blower Motor	8188-1D	5-2	1
Blower Motor	8188-1E	5-2	1
Blower Motor	8188-1F	5-2	1
Blower Motor	8188-1G	5-2	1
Blower Motor	8188-1H	5-2	1
Blower Motor	8188-1I	5-2	1
Blower Motor	8188-1J	5-2	1
Blower Motor	8188-1K	5-2	1
Blower Motor	8188-1L	5-2	1
Blower Motor	8188-1M	5-2	1
Blower Motor	8188-1N	5-2	1
Blower Motor	8188-1O	5-2	1
Blower Motor	8188-1P	5-2	1
Blower Motor	8188-1Q	5-2	1
Blower Motor	8188-1R	5-2	1
Blower Motor	8188-1S	5-2	1
Blower Motor	8188-1T	5-2	1
Blower Motor	8188-1U	5-2	1
Blower Motor	8188-1V	5-2	1
Blower Motor	8188-1W	5-2	1
Blower Motor	8188-1X	5-2	1
Blower Motor	8188-1Y	5-2	1
Blower Motor	8188-1Z	5-2	1

Figure 5-2. Blower Motor B101, Lubrication Points

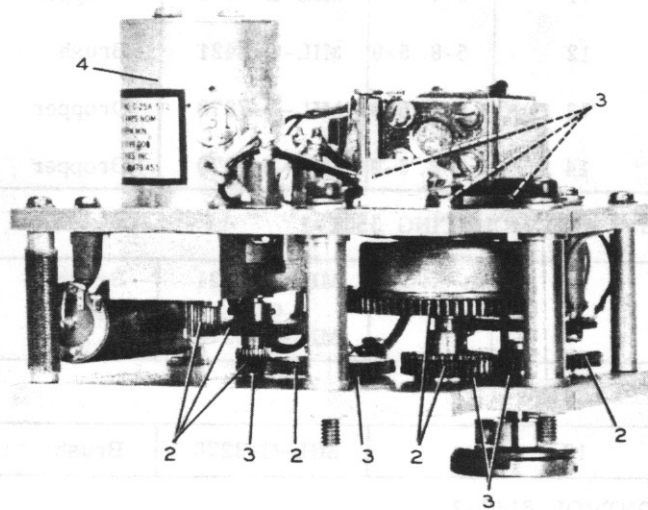


Figure 5-3. Bandchange Autopositioner Unit, Lubrication Points

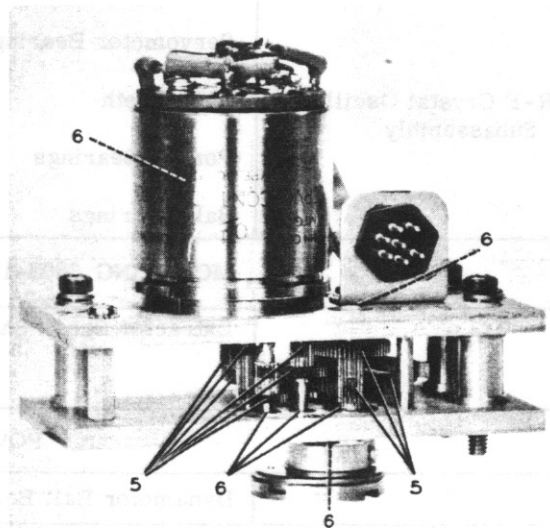


Figure 5-4. Servomotor B102 Unit, Lubrication Points

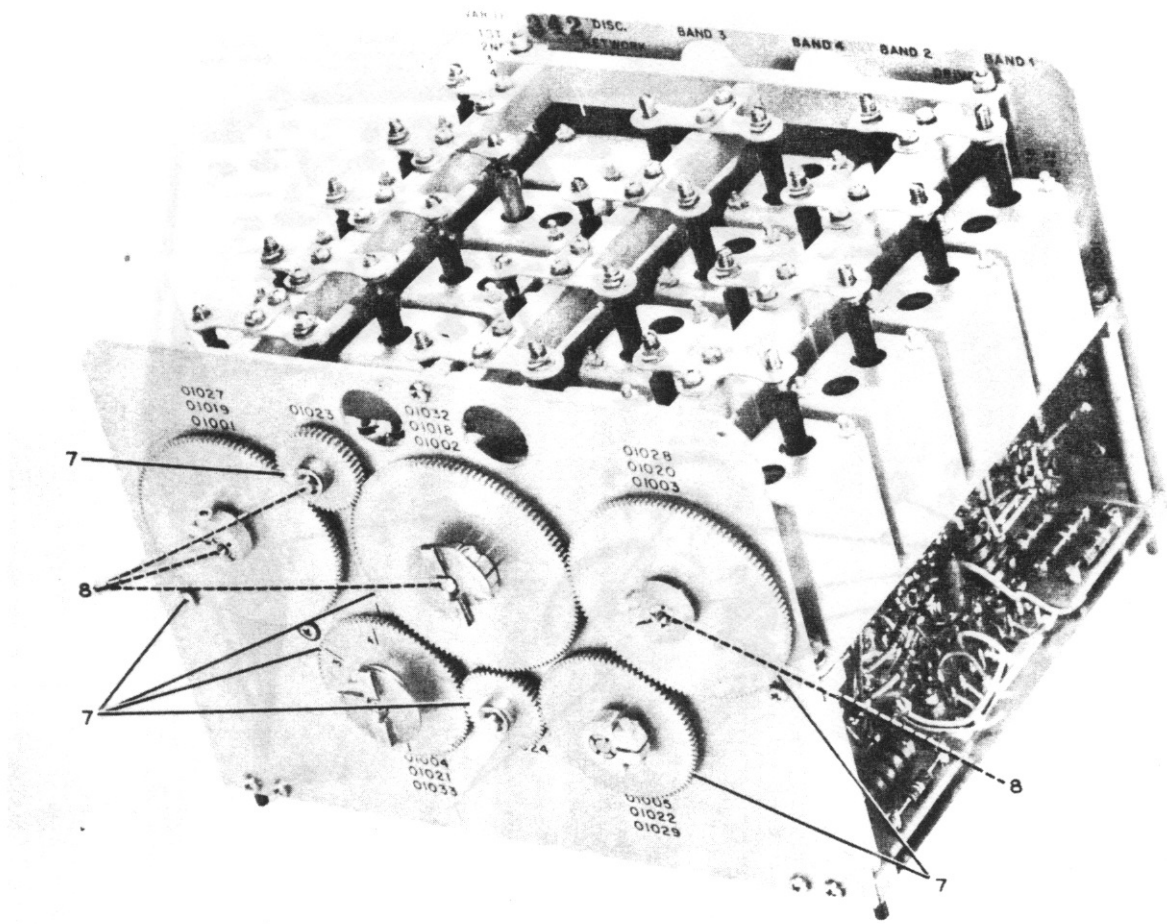


Figure 5-5. Tuner Subassembly, Front Oblique View, Lubrication Points

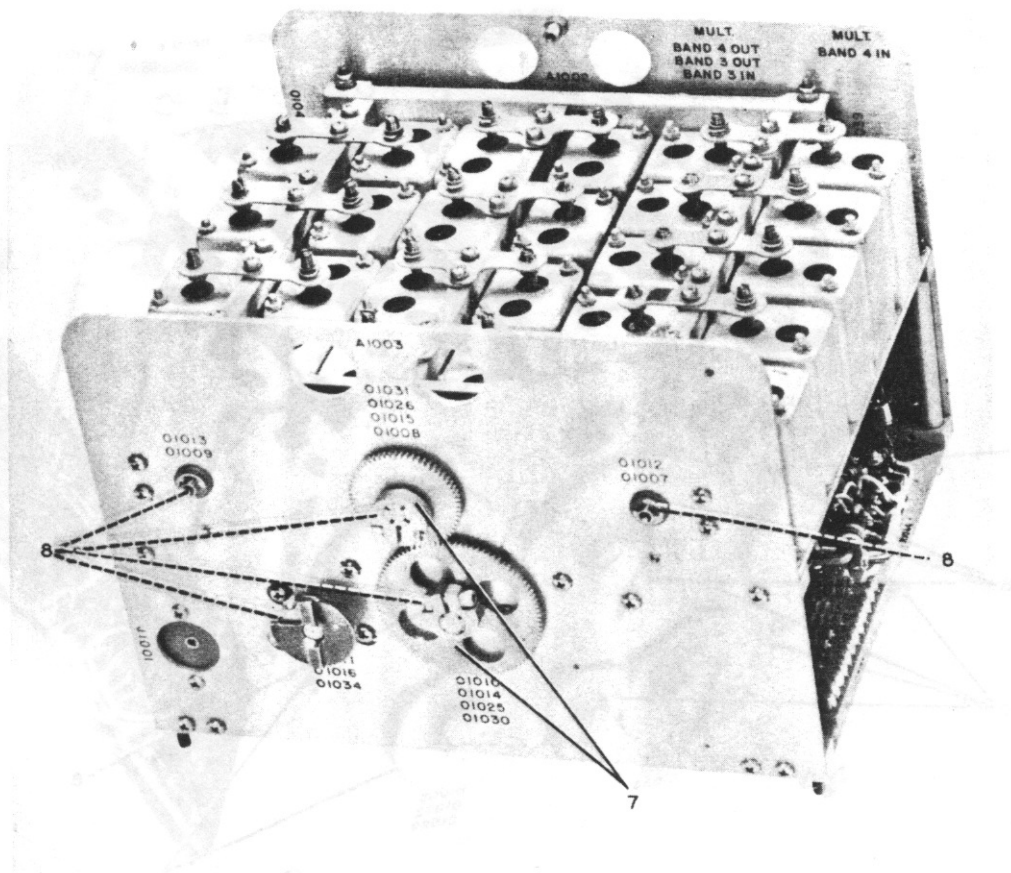


Figure 5-6. Tuner Subassembly, Rear Oblique View, Lubrication Points

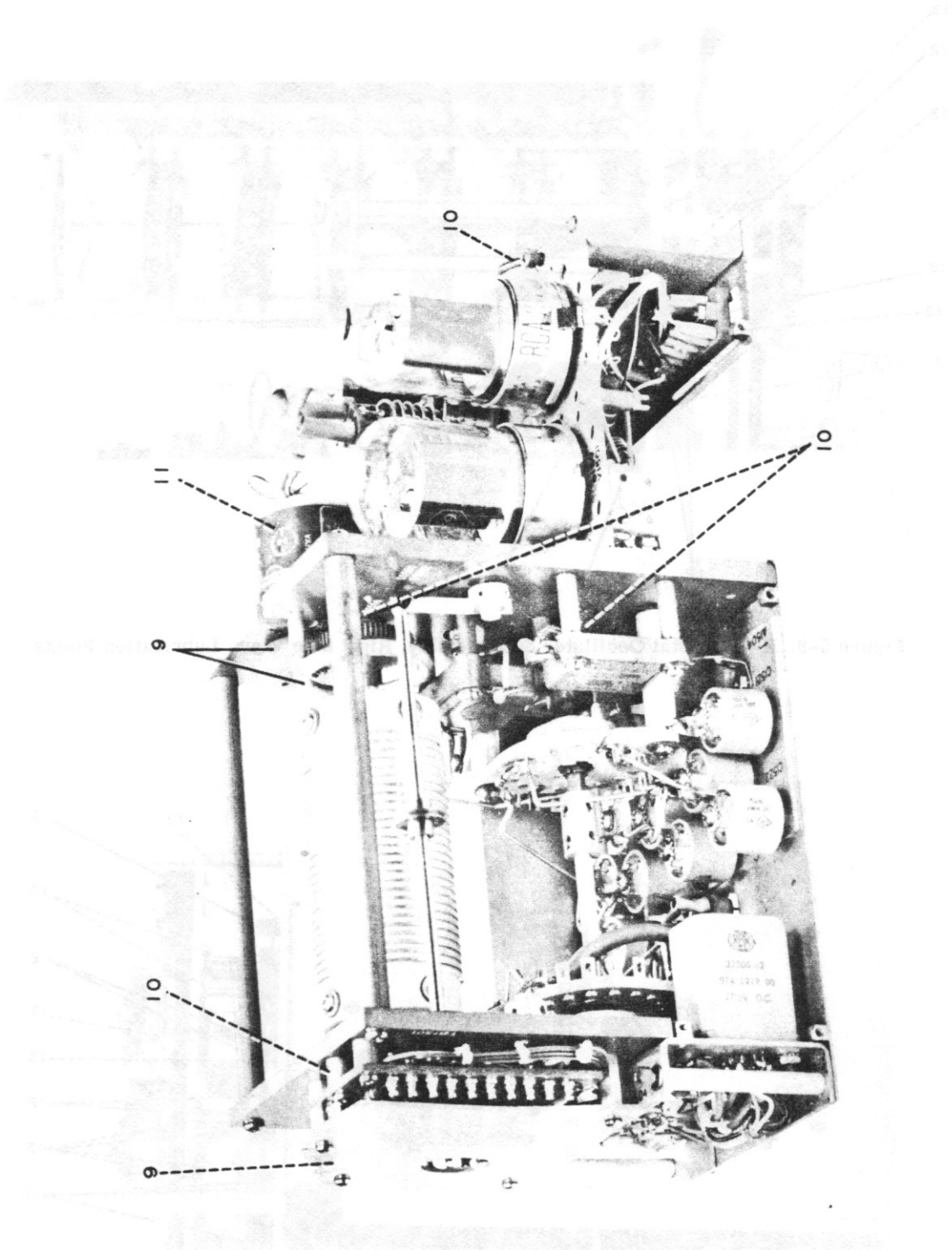


Figure 5-7. Power Amplifier Subassembly, Lubrication Points

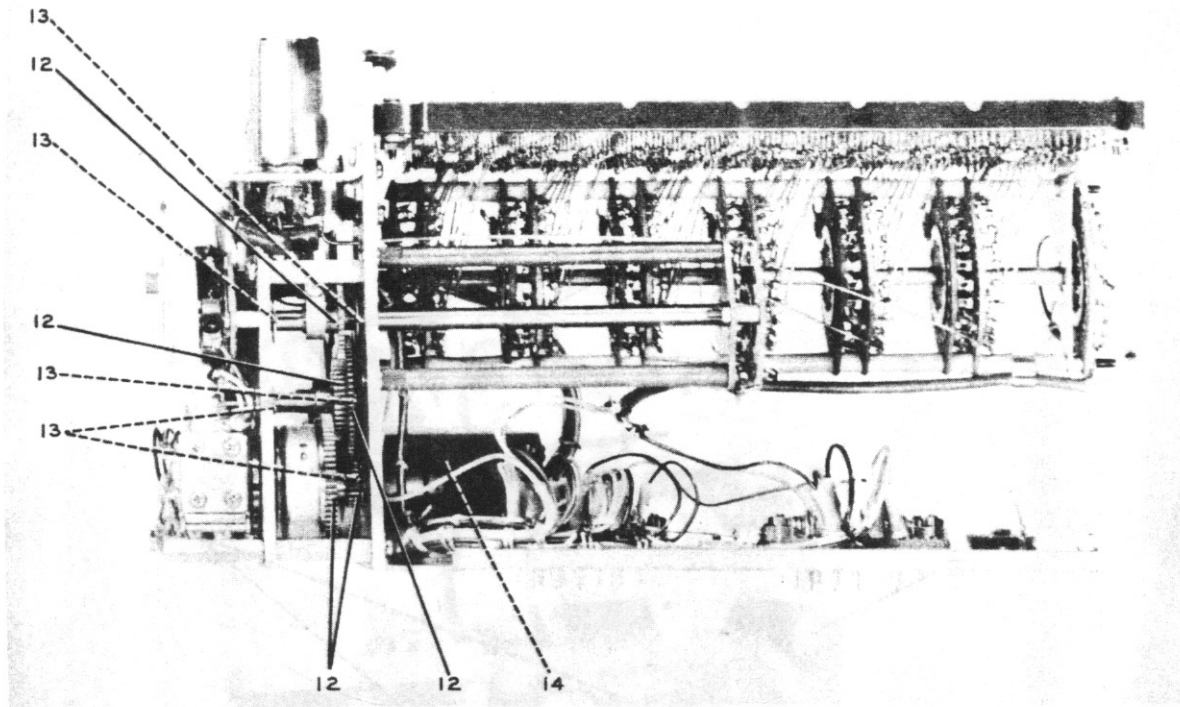


Figure 5-8. R-F Crystal Oscillator Subassembly, Right Side View, Lubrication Points

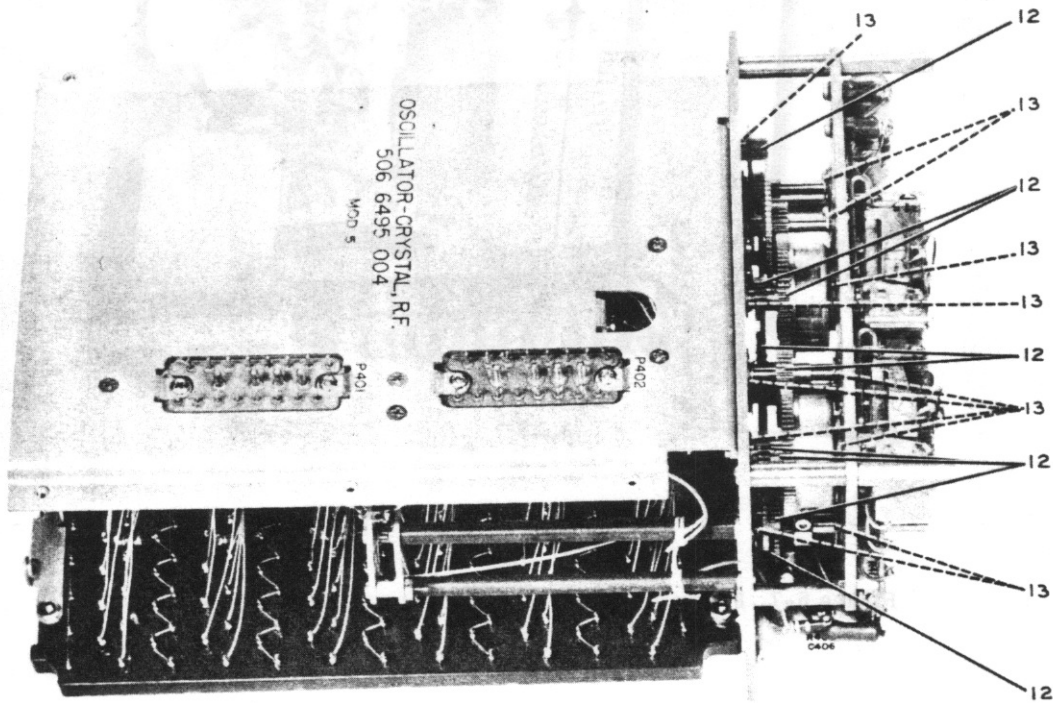


Figure 5-9. R-F Crystal Oscillator Subassembly, Bottom Oblique View, Lubrication Points

## SECTION VI

### FIELD MAINTENANCE

#### 6-1. INTRODUCTION.

6-2. This section provides instructions essential for the maintenance of Radio Set 618S-1 and 618S-1A by field maintenance personnel. Before attempting to service and test this equipment, maintenance personnel 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. Reference is made to T.O. 12R2-4-6-3, Handbook Overhaul Instructions, for maintenance procedures not covered in this handbook.

6-3. GENERAL. Field maintenance of the equipment is based on a complete test procedure designed to check completely an equipment component, and trouble isolation procedures, designed to isolate trouble to a detail part within a subassembly, or to a simple circuit within the equipment. 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 for all subassemblies is presented in paragraph 6-46 and subsequent paragraphs. Alignment and tracking procedures should not be attempted unless it has definitely been established that malfunction exists because a subassembly is misaligned. Always check other possibilities before attempting to perform alignment or tracking procedures on a subassembly. When reference is made to meter indications, attenuator settings, etc, 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.

6-4. In some instances it will be practical to examine and test a subassembly, with power applied, while it is removed from the main component. This can be accomplished by use of the two-foot extension cables described in section II. Refer to figures 2-5 through 2-9 and paragraph 2-9. Paragraphs 6-49 and 6-50 give a brief explanation of the use of Test Set 478H-1 and Maintenance Kit for 618S-1. If this test equipment is available, it may be included in the bench test setup.

#### WARNING

Operation of the 618S-1 or 618S-1A equipment involves voltages that are dangerous to life. When performing maintenance operations, special care must be taken to avoid contact with circuits carrying plate voltages. Also, clothing, rags, and test equipment should be kept free from the moving mechanical parts during the channeling cycle.

#### 6-5. MINIMUM PERFORMANCE STANDARDS.

6-6. GENERAL. The test procedures outlined in paragraphs 6-7 through 6-13 provide minimum standards of performance for a complete 618S-1 or 618S-1A installation. The tests may be used as a means to analyze suspected trouble, or to test the equipment after trouble-shooting procedures have been completed. The detailed performance tests differ from the detailed performance tests outlined in paragraph 5-4 of this handbook, in that they provide a more comprehensive and detailed check, utilizing test equipment authorized for use by field maintenance personnel. The following tests are designed to supplement the performance tests in section V of this handbook. Field maintenance personnel should perform all test procedures under Organizational Maintenance, section V, paragraph 5-4 and following, before performing the test procedures in this section.

6-7. PREPARATORY. The radio equipment under test must be placed in a bench test setup in accordance with the procedures outlined in paragraphs 3-9 and 3-10. If only a particular subassembly has been sent to a field maintenance depot for repair, that subassembly must be substituted in a 618S-1 or 618S-1A known to be in good operating condition. Isolation of trouble in Power Supply 416W-1 may be accomplished by use of table XXVI. If Radio Set Control 614C-2 is not functioning properly, refer to table XXVII. Since each subassembly of Radio Receiver-Transmitter 618S-1 or 618S-1A is an integral part of the complete component, an individual test for each subassembly cannot be given, but by observing the trouble isolation procedures in tables XVIII through XXVII trouble can be isolated to a detail part. When performing the tests outlined in paragraphs 6-8 through 6-13, the 614C-2 sensitivity and threshold control should be in the maximum clockwise position unless otherwise indicated.

6-8. AVC CHARACTERISTICS. Perform the following operations:

- a. Install the test crystals listed in table X of section III in the r-f crystal oscillator subassembly.
- b. Connect Output Meter TS-585B/U to J101 (test point 4). Adjust to the 500-milliwatt range with an internal impedance of 300 ohms.
- c. Connect Signal Generator AN/URM-25 to J109 (test point 3), and adjust to 2.75 megacycles with Frequency Meter AN/USM-26.
- d. Adjust the AN/URM-25 output level to 10 microvolts, modulated 30% at 1000 cps.
- e. Operate the OFF PHONE CW switch to the PHONE position, and allow at least ten minutes for warmup.
- f. Operate the channel selectors to the A4 (2.75 megacycle) position. Increase the output level of Signal Generator AN/URM-25 to 100,000 microvolts, and observe the change in power output as read on Output Meter TS-585B/U. The power output for 100,000 microvolts input should be not greater than 2.24 times that for 10 microvolts input which corresponds to a 3.5-db change.
- g. Set the AN/URM-25 level to 1000 microvolts and then increase to 1 volt. The indication on Output Meter TS-585B/U should increase not more than 4 to 1, which corresponds to a 6-db change.
- h. Perform the avc tests outlined in steps f and g for the following frequencies: 5.25 megacycles, position G4; 10.25 megacycles, position M4; and 20.25 megacycles, position U4.

6-9. FREQUENCY RESPONSE. Perform the following operations:

- a. Same as step a, paragraph 6-8.
- b. Same as step b, paragraph 6-8.
- c. Connect Signal Generator AN/URM-25 to J109 (test point 3), and adjust to 2.0 megacycles with Frequency Meter AN/USM-26.
- d. Adjust the AN/URM-25 output level to 100 microvolts, modulated 30% at 1000 cps.
- e. Same as step f, paragraph 6-8.
- f. Operate the channel selectors to the A1 (2.0-megacycle) position.
- g. Record the reading of Output Meter TS-585B/U.
- h. Change the modulation frequency to 300 cps, and observe the indication on the TS-585B/U. The indication should change not more than 3.5 db (2.24 to 1) from the recorded reading.
- i. Change the modulation frequency to 3000 cps, and observe the indication on the TS-585B/U. The indication should change not more than 10 db (10 to 1) from the recorded reading.
- j. Repeat the frequency response tests outlined in steps a through i for at least one frequency on each band of operations.

6-10. CW FREQUENCY RANGE. Perform the following range:

- a. Same as step a, paragraph 6-8.
- b. Same as step b, paragraph 6-8.
- c. Connect Signal Generator AN/URM-25 to J109 (test point 3) and adjust to 2.0 megacycles with Frequency Meter AN/USM-26.

d. Adjust the AN/URM-25 output level to 50 microvolts unmodulated.

e. Operate the OFF PHONE CW switch to the PHONE position, and allow at least 10 minutes for warmup. After warmup, operate the OFF PHONE CW switch to the CW position.

f. Connect Frequency Meter AN/USM-26 to J101 (test point 4) through a 1-megohm isolating resistor.

g. Operate the channel selectors to the A1 (2.0-megacycle) position.

h. Vary the BFO control throughout its range and observe the indication on Frequency Meter AN/USM-26. Frequency Meter AN/USM-26 should read between 2000 and 4000 cps on both sides of zero beat.

6-11. CW GAIN CONTROL. Perform the following operations:

- a. Same as step a, paragraph 6-8.
- b. Same as step b, paragraph 6-8.
- c. Connect Signal Generator AN/URM-25 to J109 (test point 3), and adjust to 2.0 megacycles with Frequency Meter AN/USM-26.
- d. Adjust the AN/URM-25 output level to 10 microvolts unmodulated.
- e. Operate the OFF PHONE CW switch to the PHONE position and allow at least 10 minutes for warmup. After warmup, operate the OFF PHONE CW switch to the CW position.
- f. Operate the channel selectors to the A1 (2.0 megacycle) position.
- g. Connect Frequency Meter AN/USM-26 to J101 (test point 4) through a 1-megohm isolating resistor, and adjust the BFO control for a reading of 1000 cps on the AN/USM-26.
- h. Observe the indication on the TS-585B/U with the 614C-2 sensitivity control at the maximum clockwise position.
- i. Increase the AN/URM-25 output level to 10,000 microvolts, and rotate the 614C-2 sensitivity control to the maximum counterclockwise position.
- j. Output Meter TS-585B/U should indicate less power than observed in step h.

6-12. SIDE-TONE POWER.

- a. Same as step a, paragraph 6-8.
- b. Connect the dummy microphone (figure 2-1) to J102 (test point 5).
- c. Connect Audio Oscillator TS-382A/U to the dummy microphone circuit. Set the TS-382A/U frequency to 1000 cps with Frequency Meter AN/USM-26.
- d. Connect the dummy load and Oscilloscope OS-8/U to E102 or J110 (test point 1).
- e. Connect Output Meter TS-585B/U to J101 (test point 4), and adjust to the 500-milliwatt range with an internal impedance of 300 ohms.
- f. Operate the OFF PHONE CW switch to the PHONE position, and allow at least 10 minutes for warmup.
- g. Operate the channel selectors to the A1 (2.0-megacycle) position.
- h. Insert a telegraph key into J103 (test point 6) and depress.
- i. Adjust the output level of Audio Oscillator TS-382A/U for 80% modulation of the carrier. Refer to step i of paragraph 3-14 and figure 3-2.



j. Adjust the front panel PHONE SIDETONE control (R106) for a power output of 300 milliwatts as read on Output Meter TS-585B/U.

k. Remove Audio Oscillator TS-382A/U and operate the OFF PHONE CW switch to the CW position.

l. Adjust the front panel CW SIDETONE control (R107) for a power output of 300 milliwatts as read on Output Meter TS-585B/U.

**6-13. MODULATION FIDELITY.** Perform the following operations:

a. Same as step a, paragraph 6-8.

b. Same as step b, paragraph 6-12.

c. Same as step c, paragraph 6-12.

d. Same as step d, paragraph 6-12.

e. Same as step e, paragraph 6-12.

f. Same as step f, paragraph 6-12.

g. Same as step g, paragraph 6-12.

h. Same as step h, paragraph 6-12.

i. Adjust the output level of Audio Oscillator TS-382A/U for 60% modulation of the carrier. Refer to step i of paragraph 3-14 and figure 3-2.

j. Keeping the output level of the TS-382A/U to that determined in step i, vary the TS-382A/U frequency between the limits of 300 and 3500 cps. The percentage of modulation should remain within the limits of 40% to 70%.

k. Keeping the TS-382A/U output level constant, change the modulation frequency to 5000 cps. The percentage of modulation should be not less than 21.8%.

l. Keeping the TS-382A/U output level constant, change the modulation frequency to 6500 cps. The percentage of modulation should be not more than 11.5%.

m. Perform the modulation fidelity tests outlined in steps a through l for at least one frequency on each band of operation.

#### **6-14. TROUBLE ISOLATION PROCEDURES.**

**6-15. GENERAL.** Trouble isolation procedures for Radio Set 618S-1 and 618S-1A 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 the system trouble analysis procedures, table XV, in section V of this handbook. Accurate determination of which section of the equipment is at fault is essential in the trouble-shooting procedure, since the following trouble isolation procedures are presented for various sub-assemblies and sections of the complete equipment.

#### **6-16. VOLTAGE DISTRIBUTION IN RADIO SET 618S-1 AND 618S-1A.**

**6-17. PRIMARY VOLTAGE DISTRIBUTION.** All voltages are supplied to the 618S-1 or 618S-1A through P1601/J1601 of Power Supply 416W-1. Figure 6-1 illustrates the distribution of voltages to the various connectors and relays. Measure voltages at the jacks when attempting to isolate trouble. Compare with the voltages indicated in figure 6-1. Careful study of this diagram will indicate that certain voltages are supplied to jacks and relays through contacts of other relays. The proper use of this information will reduce the time required for trouble isolation.

**6-18.** The +27.5 volt d-c enters Power Supply 416W-1 through J1601-23/P1601-23 and is connected to one side of switches S1601 and S1602 (silk-screened RESET). The other contact of S1601 is connected to one contact of K1601, and the other contact of S1602 is connected to one contact of K1602 and to one side of relays K1602 and K1603. Placing S2603 (located in Radio Set Control 614C-2) in the PHONE or CW position grounds one side of K1602 and K1603, thus energizing K1602 and K1603. Contacts of relay K1602 supply voltage to the filament circuit, while contacts of relay K1603 complete the a-c circuits in Power Supply 416W-1. Operation of the a-c circuits permits K1604 to operate, its contacts completing the circuit for K1601. K1604 is, therefore, a type of bias relay which prevents K1601 and dynamotor D1601 from operating until sufficient voltage has been supplied for proper operation of the equipment.

**6-19.** Dynamotor D1601 will operate only when three conditions are satisfied. First, the OFF PHONE CW switch of Radio Set Control 614C-2 must be in the PHONE or CW position. If in the PHONE position, the microphone push-to-talk button must be depressed. Secondly, K1604 and K1601 must be energized. In addition, 27.5 volts d-c must be supplied to P1601-19, the dynamotor interlock voltage point. The 27.5-volt d-c is supplied to this point from the keying relay interlock in the 180L-3 through contacts of relay K801 located in the relay subassembly of the 618S-1 or 618S-1A. Make sure to check these points if the dynamotor fails to operate. Also check F1601 and F1602 to make certain a-c voltage is being applied.

**6-20.** The a-c primary power source consists of 115 volts, 400 cps and 115 volts, 320-1000 cps. The variable frequency power source (115 volts, 320-1000 cps) is optional, and may be replaced with the 115-volt, 400-cps power source. The 115-volt power sources supply the following voltages to the 618S-1 or 618S-1A system: 6.3 volts, 400 cps; 18 volts, 400 cps; 115 volts, 400 cps; 250 volts d-c; -50 volts d-c; and -65 volts d-c. The 250-volt d-c supply is used within Radio Receiver-Transmitter 618S-1 or 618S-1A during both transmission and reception differing from the 250-volt d-c supplied by dynamotor D1601 which is used only during transmission. Transformer T1601 steps down the 115-volt a-c to 6.3 volts, and autotransformer L1606 steps down the 115-volt a-c to 18 volts a-c. The 6.3-volt a-c is used within the 618S-1 or 618S-1A as a reference voltage to chopper coils. The 18-volt a-c is not used in the 618S-1 or 618S-1A installation. The -50 and -65 volt d-c provide bias to the modulator and power amplifier tubes, respectively.

#### **NOTE**

The functions of all relays and circuits of Power Supply 416W-1 are covered in detail in the theory of operations section of this handbook, paragraphs 4-40 through 4-45.

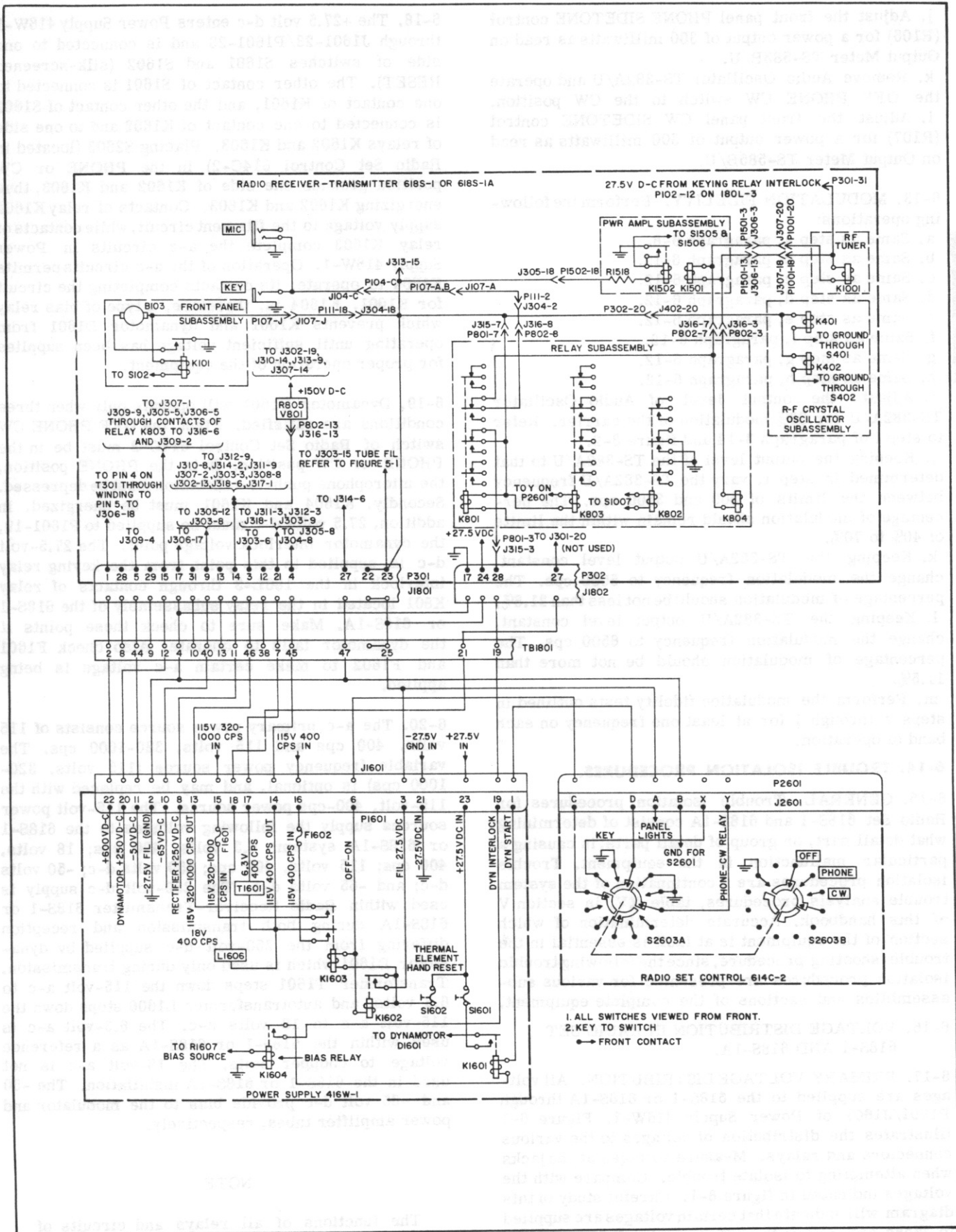


Figure 6-1. Radio Set 618S-1 and 618S-1A, Voltage Distribution

6-21. B-PLUS VOLTAGE DISTRIBUTION. Two 250-volt d-c supplies are employed, as stated in the preceding paragraph. One originates with the 27.5-volt d-c power source, which is stepped up by dynamotor D1601 to 250 volts d-c and applied through terminal 20 of P1601/J1601, through terminal 12 of TB1801, and through terminal 15 of J1801/P301 to subassemblies within Radio Receiver-Transmitter 618S-1 or 618S-1A. The other 250-volt supply originates in the 115-volt, 400-cps power source. This supply is rectified and filtered through circuits within Power Supply 416W-1 and applied through terminal 8 of P1601/J1601, through terminal 11 of TB1801, and through terminal 14 of J1801/P301 to subassemblies within Radio Receiver-Transmitter 618S-1 or 618S-1A.

6-22. The 600-volt d-c supply originates in the 27.5-volt d-c power source. The voltage is stepped up by dynamotor D1601, and applied through terminal 22 of P1601/J1601, through terminal 2 of TB1801, and through terminal 1 of J1801/P301 to the modulator and power amplifier plates.

6-23. The 150-volt regulated supply originates in the 115-volt, 400-cps power source. The 250-volt d-c

rectifier supply, described in paragraph 6-21, is applied through terminal 13 of J316/P802 to dropping resistor R801 and voltage regulator V801. The resultant 150-volt d-c supply is applied to jacks J302, J310, J313, and J307.

6-24. VOLTAGE AND RESISTANCE MEASUREMENTS. Voltage and resistance measurements for the various plug-in subassemblies are given in figures 7-1 through 7-9. Since the pins of the tubes are not readily accessible while the subassemblies are in place, tube socket adapters were used to obtain most of the measurements. By plugging the tube under measurement into the adapter and then plugging the adapter into the tube socket, measurements can be made from the top of the subassembly. In figures 7-1 through 7-9, voltages are indicated above the line and resistance values below. Table XVII lists the d-c resistances of the transformers and inductors used in the 618S-1 and 618S-1A systems. These resistance values are for information in case of emergency replacement or for trouble-shooting procedures and are not intended to be absolutely correct in measurement. Variations may occur when making measurements with the equipment still in excellent operating condition.

TABLE XVII, D-C RESISTANCE VALUES OF TRANSFORMERS AND INDUCTORS

SYMBOL NUMBER	LOCATION	TERMINALS	D-C RESISTANCE (OHMS)
B102	Front Panel Subassembly	1-3, 2-4*	150
T301	Main Chassis	1-2, 2-3 4-5 6-7	85 40 150
L401	R-F Crystal Oscillator Subassembly		43
T601	Tuner and PA Servo Amplifier Subassemblies	1-2 3-4	550 6500
FL901 L901, L903, L904 L905	I-F Amplifier Subassembly	Input and Output	170 7 7.5
L1026 L1027, L1028	Tuner Subassembly		7.5 18
L1201, L1202 L1203 L1204, L1205	250 Kc Oscillator and BFO Subassembly		17 15 9

TABLE XVII, D-C RESISTANCE VALUES OF TRANSFORMERS AND INDUCTORS (Cont)

SYMBOL NUMBER	LOCATION	TERMINALS	D-C RESISTANCE (OHMS)
T1301	Audio Amplifier Subassembly	1-2 3-4, 4-5	.1000 11
L1401, L1402	Modulator Subassembly		450
L1501, L1505 B1501	Power Amplifier Subassembly	1-3 2-5, 4-6	17 160 80
L1601, L1602 L1604 L1605 T1601	Power Supply 416W-1	1-2 3-4, 4-5	10 11 4 120 4

\*Terminals 5 and 6 must be jumpered.

6-25. TROUBLE ISOLATION TABLES.

6-26. The following trouble isolation tables are a continuation of the system trouble analysis procedures of section V. These tables provide a procedure for isolation of trouble to a detail part within a sub-assembly. Before proceeding to the steps outlined in tables XVIII through XXVII, trouble should be known to exist within the subassembly under test. Also, all test equipment, as well as the microphone and headset, should be in good operating condition. Perform all the test procedures outlined in the paragraph pertaining to the test subassembly and then proceed to the applicable table.

6-27. R-F CRYSTAL OSCILLATOR SUBASSEMBLY. After trouble has been isolated to the r-f crystal oscillator subassembly, the test procedures presented in this paragraph and the listings under table XVIII will help isolate trouble to a detail part or group of detail parts. The tests presented in this paragraph assume that all of the minimum performance standard tests in both sections V and VI of this handbook have been performed and trouble is known to exist within the circuitry of the r-f crystal oscillator sub-assembly. The equipment should be placed in a test bench setup similar to that illustrated in figure 3-1 and a tube adapter placed under tube V401. The tube

voltage and resistance measurements presented in figure 7-1 should be performed, as well as the checks presented in steps a through c. After completing steps a through c, and if the trouble has not yet been located, refer to table XVIII.

- a. With the 618S-1 or 618S-1A equipment in unkeyed operation in either the PHONE or CW positions, measure the voltage at terminal 2 of J302 (test point 10) with the r-f probe of VTVM TS-375/U. Reading should be approximately 1.8 volts d-c.
- b. If no reading is obtained in step a, try several random channels.
- c. If no reading is obtained in step b, check continuity of switches. Refer to figure 7-17.

NOTE

For purposes of simplicity, the Autopositioner system employed in the r-f crystal oscillator subassembly is covered by a separate trouble isolation table. If trouble is encountered within the circuitry of the r-f crystal oscillator subassembly, refer to table XVIII. If trouble is encountered within the r-f crystal oscillator autopositioner system, refer to table XIX.

TABLE XVIII. R-F CRYSTAL OSCILLATOR SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Readings obtained in step b of paragraph 6-27 but none in step a.	<ol style="list-style-type: none"> <li>1. Defective crystal.</li> <li>2. Defective switch S401, S402, S403 S404, or S405.</li> </ol>	<p>Replace defective crystal.</p> <p>Replace defective switch.</p>
2. No reading obtained in steps a or b of paragraph 6-27.	<ol style="list-style-type: none"> <li>1. Defective V401.</li> <li>2. Plugs P401 or P402 defective.</li> <li>3. Defective switch as determined in step c of paragraph 6-27.</li> <li>4. Defective detail part within the r-f oscillator circuit.</li> </ol>	<p>Replace V401.</p> <p>Replace or repair as necessary.</p> <p>Replace defective switch.</p> <p>Replace defective detail part.</p>
3. Filament of V401 does not light.	<ol style="list-style-type: none"> <li>1. Defective V401.</li> <li>2. Resistor R405 open.</li> <li>3. Detail part E402, E403, C408, K402, or K401 defective.</li> <li>4. Plug P402 defective.</li> </ol>	<p>Replace V401.</p> <p>Replace R405.</p> <p>Replace defective detail part.</p> <p>Replace or repair as necessary.</p>

6-28. AUTOPOSITIONER SYSTEM. When trouble is encountered within the Autopositioner system of the r-f crystal oscillator subassembly, the trouble isolation procedures outlined in table XIX should be performed. Before proceeding with the steps of table XIX, the detailed performance tests in sections V and VI of this handbook should have been performed. Make certain that the trouble exists within the r-f crystal oscillator subassembly, and the Autopositioner system, in particular. Before proceeding to table XIX, make

certain the bandchange autopositioner unit is in good operating condition. This may be accomplished by replacement with one known to be in good operating condition. Reference is made to paragraphs 5-35 and 5-36 for the removal and replacement procedures. If, after ascertaining the condition of the bandchange autopositioner unit and completing the tests and trouble isolation procedures in sections V and VI, the trouble has not yet been located, proceed to table XIX.

TABLE XIX. AUTOPOSITIONER SYSTEM, TROUBLE ISOLATION

SYMPTOM	CAUSE	REMEDY
1. Motor B401 continues to run after autopositioner sets up.	<ol style="list-style-type: none"> <li>1. Contacts bent on K401 or K402. Spring weak, pawl does not seat fully.</li> <li>2. Seeking switch out of synchronization, causing pawl to drop late and catch on far side of notch.</li> <li>3. Intermittent or continuous short on negative side of motor B401.</li> </ol>	<p>Straighten contacts. Replace relay, replace spring, or remove and bend spring to increase tension. Refer to paragraph 6-56.</p> <p>Adjust switch. Refer to figure 6-3 and paragraph 6-57.</p> <p>Remove cause of short.</p>

TABLE XIX. AUTOPOSITIONER SYSTEM, TROUBLE ISOLATION (Cont)

SYMPTOM	CAUSE	REMEDY
2. Autopositioner sets up on wrong channel occasionally.	1. Broken wire or poor connection on one or more control wires.	Note which channels give ambiguous results. Check control wires for those channels and correct defect.
3. Autopositioner sets up on one channel, but continues to run on others.	1. Control wire shorted to ground. 2. Switch out of synchronization, allowing pawl to drop too early or too late.	Note which channel sets up correctly and check control wire for that channel. Correct fault.  Check visually when set up. Realign as necessary. Refer to figure 6-3 and paragraph 6-57.
4. Autopositioner does not set up on any channel, stop wheel turns freely, relay opens momentarily each revolution of shaft.	1. Spring bent, pawl does not engage stop wheel with sufficient force to hold. 2. Switch out of synchronization. 3. Pawl sticks on its pivot.  4. Relay shifted. Does not allow pawl to seat properly. 5. Pawl tip shape severely altered; does not hold.	Replace relay, replace spring, or remove and bend spring to increase tension. Refer to paragraph 6-56.  Realign switch. Refer to figure 6-3 and paragraph 6-57.  Remove relay. Remove pawl and clean pivot pin. Reassemble pawl and lubricate pivot with MIL-L-644A oil. Replace and realign relay. Refer to paragraph 6-56.  Realign relay. Refer to paragraphs 6-55 and 6-56.  Remove relay. Replace pawl with new pawl. Reassemble and readjust relay. Refer to paragraph 6-56.
5. Autopositioner does not set up on any channel, stop wheel turns freely, relay remains energized continuously.	1. Wire from relay to seeking switch shorted to ground. 2. Several or all control wires shorted to ground.	Find and remove cause of short.  Find and remove cause of short.
6. Autopositioner does not set up, stop wheel does not turn freely, relay energized, motor B401 runs.	1. Pawl does not lift clear of notch. Relay shifted away from pawl. 2. Pawl does not lift clear of notch. Relay has insufficient travel. 3. Driven elements jammed by physical obstruction. 4. Gear jammed	Realign relay. Refer to paragraphs 6-55 and 6-56.  Readjust. Refer to paragraphs 6-55 and 6-56.  Find and remove obstruction.  Find and remove cause of jam.

TABLE XIX. AUTOPOSITIONER SYSTEM, TROUBLE ISOLATION (Cont)

SYMPTOM	CAUSE	REMEDY
6. (cont)	5. Pawl sticks on its pivot.  6. Improper lubrication on bearings at low temperature.  7. Insufficient clutch torque due to broken clutch springs.  8. Insufficient clutch torque due to glazing of clutch surfaces.	Remove relay and pawl. Clean pawl and pivot pin. Replace pawl and lubricate pivot with MIL-L-644A oil. Replace and realign relay. Refer to paragraph 6-56.  Disassemble and clean bearings as required. Lubricate in accordance with instructions in table XV.  Replace spring or entire r-f crystal oscillator subassembly.  Replace clutch drum and clutch shoe assembly or entire r-f crystal oscillator subassembly.
7. Autopositioner sets up, then recycles by itself.	1. Spring bent, does not hold pawl in notch properly.  2. Relay shifted. Pawl does not seat fully.  3. Pawl tip altered; excessive slope or radius causes pawl to be pushed out of slot.  4. Intermittent short circuit between control wires or from wires or switch to ground.  5. Switch out of synchronization, operation marginal.	Remove spring. Carefully bend spring to increase tension. Reassemble and readjust relay air gap. Refer to paragraph 6-56.  Realign relay. Check and readjust air gap, if necessary. Refer to paragraphs 6-55 and 6-56.  Remove relay. Replace pawl with new pawl. Reassemble and readjust relay. Refer to paragraph 6-56.  Find and remove cause of short.  Realign switch. Refer to figure 6-3 and paragraph 6-57.
8. Autopositioner relay closes, motor B401 does not operate.	1. Relay contacts bent, not closing motor B401 circuit.  2. Open circuit from relay to motor B401.  3. Contacts dirty.  4. No power on positive side of motor B401.	Adjust contacts. Refer to paragraphs 6-55 and 6-56.  Find and correct cause of open circuit.  Clean or replace contacts. Check contact adjustment and readjust to obtain proper contact spacing and pressure. Refer to paragraphs 6-55 and 6-56.  Find and correct cause of open circuit.

TABLE XIX. AUTOPOSITIONER SYSTEM, TROUBLE ISOLATION (Cont)

SYMPTOM	CAUSE	REMEDY
8. (cont)	5. Motor B401 armature burned out.	Replace motor B401.
	6. Reduction gears jammed.	Find and remove obstruction.
9. Autopositioner relay does not operate.	1. No power on positive side of relay.	Correct cause of open circuit.
	2. Open circuit from relay to seeking switch.	Correct cause of open circuit.
	3. Control wire circuit open.	Correct cause of open circuit.
	4. Relay coil burned out.	Replace relay coil.
	5. No air gap on relay.	Readjust air gap. Refer to paragraphs 6-55 and 6-56.

6-29. TUNER SUBASSEMBLY. Before undertaking any of the trouble-shooting steps for the tuner subassembly, make a visual inspection for mechanical faults, such as a sticky slug rack, weak or broken springs on the slugs, broken slugs, loose or unmeshed gears, broken leads, solder shorts, and overheated detail parts. Checktubes V1001 through V1011. In trouble-shooting the tuner subassembly, remember that several stages are common to both the receiving and transmitting circuits. This fact can be used in isolating troubles. If, for instance, the equipment functions properly during reception, but lacks drive to the power amplifier during transmission, the driver stages, V1010 and V1011, or the transmitter mixers, V1004 and V1003, are probably at fault. The preceding r-f tuner stages, V1008 and V1009, could not be defective and have the equipment function properly during reception. By a similar process of elimination, other faulty stages can be isolated.

6-30. Install tube adapters and measure r-f voltages at the grids and plates of the varioustubes. Compare

with those in 7-3. This will isolate the trouble to the defective stage in the tuner subassembly. After isolating the trouble to its stage, make voltage and resistance checks to determine the faulty component. Check the operation of the tuner discriminator circuit by measuring the d-c voltage at terminal 4 of J308 (test point 11). During channeling cycle, a d-c voltage, varying in amplitude and polarity, should be measured. A zero reading should be obtained after the channeling cycle is complete. If the tuner slug rack centers when a new frequency is selected but will not tune, the trouble is in the tuner discriminator circuit. If the slug rack will move in one direction only, a portion of the tuner discriminator network, Z1001, is defective. In isolating the trouble to a particular detail part, operate the equipment on several bands. This will aid in isolating troubles to one stage. If the trouble is found to be misalignment, perform applicable portions of paragraphs 6-62 through 6-73. Refer to table XX for trouble isolation procedures.

TABLE XX. TUNER SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	CAUSE	REMEDY
1. Slug rack centers but does not set up.	1. Defective V1001.	Replace V1001.
	2. Defective detail part within the tuner discriminator circuit.	Replace defective detail part.
	3. Plug P1002 defective.	Replace or repair as necessary.



TABLE XX. TUNER SUBASSEMBLY, TROUBLE ISOLATION (Cont)

SYMPTOM	CAUSE	REMEDY
2. Slug rack will not center or set up.	<ol style="list-style-type: none"> <li>1. Switch S1007 defective</li> <li>2. Plug P1002 defective.</li> <li>3. Defective mechanical drive.</li> </ol>	<p>Replace switch S1007.</p> <p>Replace or repair as necessary.</p> <p>Locate mechanical trouble and repair as necessary.</p>
3. Filaments do not light.	<ol style="list-style-type: none"> <li>1. Defective tube filament.</li> <li>2. Resistor R1046 defective.</li> <li>3. Plugs P1001 or P1002 defective.</li> </ol>	<p>Locate and replace defective tube. Refer to figure 5-1.</p> <p>Replace R1046.</p> <p>Replace or repair as necessary.</p>
4. Low or zero output at J1001 (test point 12). Output should be not less than 85 volts r-f during transmission.	<ol style="list-style-type: none"> <li>1. Defective V1004, V1007, V1003, V1002, V1009, V1010, or V1011.</li> <li>2. Defective detail part of V1004, V1007, V1003, V1002, V1009, V1010, or V1011.</li> <li>3. Plugs P1001 or P1002 or jack J1001 defective.</li> <li>4. Defective transmitter tuned circuit; Z1002 through Z1009 and Z1014 through Z1025.</li> </ol>	<p>Replace defective tube.</p> <p>Replace defective detail part.</p> <p>Replace or repair as necessary.</p> <p>Replace defective tuned circuit.</p>
5. No output during reception.	<ol style="list-style-type: none"> <li>1. Defective V1005, V1002, V1006, V1007, V1008, or V1009.</li> <li>2. Detail part of V1005, V1002, V1006, V1007, V1008, or V1009 defective.</li> <li>3. Plugs P1001 or P1002 defective.</li> <li>4. Defective receiver tuned circuit; Z1002 through Z1021.</li> </ol>	<p>Replace defective tube.</p> <p>Replace defective detail part.</p> <p>Replace or repair as necessary.</p> <p>Replace defective tuned circuit.</p>
6. Receiver and transmitter output varies with frequency.	<ol style="list-style-type: none"> <li>1. Tuned circuit Z1001 defective.</li> <li>2. Resistor R1006 defective.</li> </ol>	<p>Replace Z1001.</p> <p>Replace R1006.</p>

6-31. POWER AMPLIFIER SUBASSEMBLY. Before undertaking any of the trouble isolation procedures presented in table XXI, make a thorough visual inspection for mechanical faults such as loose or unmeshed gears, broken leads or connectors, solder shorts, and overheated detail parts. Test tubes V1501, V1502, and V1503 in Tube Tester TV-3B/U. Also, the detailed performance tests presented in sections V and VI of this handbook should have been performed.

Make certain that the trouble exists within the power amplifier subassembly, and not within another subassembly. The voltage and resistance measurements presented in table 7-4 should be made to help isolate the trouble to a detail part or group of detail parts. After completion of the tests and trouble isolation procedures presented in sections V and VI, and after the pa tubes have been tested and measured, proceed to table XXI if the trouble has not yet been located.

TABLE XXI. POWER AMPLIFIER SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	CAUSE	REMEDY
1. Tubes do not light.	1. Defective tube filament.  2. Resistor R306 open.  3. Plug P1502 defective.	Locate and replace defective tube. Refer to figure 5-1.  Replace R306.  Replace or repair as necessary.
2. R-f drive present at J1001/P1503 (test point 12) (85 volts minimum) but reverse grid current (P.A. GRID position of meter) with 618S-1 or 618S-1A keyed.	1. Grid-to-cathode short on V1501, V1502, or V1503.	Replace defective tube.
3. Low current reading on P.A. PL position of meter and zero output.	1. Plate or screen voltage not getting to tubes.  2. Defective contacts on relay K1501.  3. Dirty sliding contacts on L1502.  4. Coaxial cable to J110 (ANT) open or shorted to ground.	Locate source of trouble and repair. Check P1502, R1522, C1502, C1503, C1504, E1501, E1502, E1503, C1522, L1503, C1524, and P1501.  Replace relay K1501.  Clean and burnish contacts.  Repair or replace cable.
4. Power amplifier does not automatically tune to resonance.	1. D-c voltage from pa discriminator is not being supplied to the pa servo amplifier subassembly.  2. Defective detail part in discriminator circuit.  3. Defective mechanical drive.  4. No 400-cps voltage at terminal 4 of B1501.  5. Motor B1501 defective.	Locate and correct fault. Check pa discriminator circuit, relay K1502, relay K1501, plug P1501, and plug P1502.  Replace defective detail part.  Repair as necessary.  Locate break in 400-cps line and repair. Check P1502.  Replace B1501.

TABLE XXI. POWER AMPLIFIER SUBASSEMBLY TROUBLE ISOLATION (Cont)

SYMPTOM	CAUSE	REMEDY
5. Power amplifier subassembly does not set up to proper band. Observe the roller of L1502 (E1513) as the band position is changed. Refer to figure 4-28.	<ol style="list-style-type: none"> <li>1. Bandswitch S1501, S1502, S1503, S1504, or S1506 defective.</li> <li>2. Mechanical coupling between band switch drive and band switches loose or defective.</li> <li>3. Misaligned band switches.</li> <li>4. Motor B1501 defective.</li> </ol>	<p>Locate defective switch and repair or replace.</p> <p>Tighten loose coupler in correct position or repair as necessary.</p> <p>Realign switches. Refer to paragraph 6-76 and figures 6-12 and 6-13.</p> <p>Replace B1501.</p>
6. Parasitics in power amplifier circuits.	<ol style="list-style-type: none"> <li>1. Defective parasitic suppressor; E1501 through E1506.</li> <li>2. Open screen bypass capacitor; C1502, C1503, or C1504.</li> <li>3. Open neutralizing capacitor; C1517, C1532, or C1513.</li> </ol>	<p>Replace defective detail part.</p> <p>Replace defective capacitor.</p> <p>Replace defective capacitor</p>

6-32. MODULATOR SUBASSEMBLY. Table XXII presents a summary of the more probable troubles within the modulator subassembly. Before performing the isolation procedures outlined in table XXII, the performance tests in sections V and VI should have been completed, and the tube voltage and resistance measurements outlined in figure 7-5 should have been

made. Test all the modulator subassembly tubes in Tube Tester TV-3B/U, and if the trouble still has not been located, proceed to table XXII. When performing the trouble isolation procedures, watch closely for the following symptoms; no modulation, low modulation, and distorted modulation.

TABLE XXII. MODULATOR SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	CAUSE	REMEDY
1. No modulation; low current reading at meter position MOD. PL.	<ol style="list-style-type: none"> <li>1. No microphone d-c supply voltage.</li> <li>2. Gain and clipping controls misaligned.</li> <li>3. Open coupling capacitor C1409, C1410, or C1412.</li> <li>4. Defective tube V1401, V1402, V1403, V1404, or V1405.</li> <li>5. Defective modulation transformer T301.</li> <li>6. Open connection between terminals 2 and 4 of transformer T301.</li> </ol>	<p>Locate break in supply and repair. In the modulator subassembly, check P1401, R1401, R1402, C1401, and C1422.</p> <p>Refer to paragraph 6-85 for the alignment procedure.</p> <p>Locate and replace defective capacitor.</p> <p>Locate and replace defective tube.</p> <p>Replace T301. Refer to table XVII for winding resistances.</p> <p>Repair connection or replace T301.</p>

TABLE XXII. MODULATOR SUBASSEMBLY, TROUBLE ISOLATION (Cont)

SYMPTOM	CAUSE	REMEDY
2. No modulation; zero current reading at MOD. PL. position of meter.	1. No filament voltage.	Locate and repair break in filament supply. Refer to figure 5-1.
	2. Defective tube.	Check tubes. Replace defective tubes.
3. Insufficient modulation.	1. Controls misaligned.	Refer to paragraph 6-85.
	2. Low B-plus voltage.	Check P1401, T301, and the plate and screen detail parts of the modulator subassembly.
	3. Defective tube or tubes.	Check tubes and replace faulty tube, or tubes.
	4. Low microphone supply voltage.	Locate defect and correct. Check R1401, R1402, C1401, C1422, and P1401.
4. Excessive distortion.	1. Misaligned controls.	Refer to paragraph 6-85.
	2. Feedback circuit open, R305, C301, and circuit connections.	Check R305, C301, and circuit connections. Replace defective detail part or repair defective connections.
	3. Low B-plus voltage or voltages.	Check P1401, T301, and the plate and screen detail parts of the modulator subassembly.
	4. Defective tube or tubes.	Check tubes and replace defective tubes.

6-33. I-F AMPLIFIER SUBASSEMBLY. Table XXIII presents a summary of the more probable troubles encountered within the i-f amplifier subassembly. Before performing the trouble isolation procedures outlined in table XXIII, the detailed performance tests in sections V and VI of this handbook should be performed. Also, the tube voltage and resistance

measurements outlined in figure 7-6 should be made, and each of the i-f amplifiers subassembly tubes should be checked in Tube Tester TV-3B/U. If, after completion of the detailed performance tests and the voltage and resistance measurements, the trouble has not yet been located, proceed to table XXIII.

TABLE XXIII. I-F AMPLIFIER SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	PROBABLE CAUSE	REMEDY
1. No audio output, but normal avc voltage.	1. Defective tube, V904, or V905.	Check V904 and V905 and replace defective tube.
	2. Series noise limiter not opening.	Defective detail part; R917, R918, or C919. Replace defective detail part.
	3. Defective output coupling capacitor.	Check C921 and replace, if necessary.

TABLE XXIII. I-F AMPLIFIER SUBASSEMBLY, TROUBLE ISOLATION (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
2. No avc voltage; audio output normal.	1. Defective tube  2. Open coupling capacitor, C918.	Check V904 and V905. Replace defective tube.  Check C918 and replace, if necessary.
3. Avc voltage in i-f amplifier subassembly, but not in tuner subassembly; audio output normal.	1. Capacitor C922 shorted. 2. Resistor R921 open. 3. Plug P901 defective.	Replace C922.  Replace R921.  Replace or repair as necessary.
4. Avc voltage in tuner subassembly but not in i-f amplifier subassembly; audio output normal.	1. Capacitor C931 shorted. 2. Resistor R920 open, or resistor R924 shorted.	Replace C931.  Replace defective resistor.
5. Low i-f sensitivity.	1. Defective tubes V901, V902, or V903.  2. Improper screen-grid voltages.	Check V901, V902, and V903. Replace defective tube.  Check regulated 150-volt circuit and correct defects. Check screen resistors of V901, V902, and V903.
6. Distortion at high signal levels.	1. Tubes V904 or V905 defective.  2. Avc line open.	Replace defective tube.  Check avc line within the i-f amplifier subassembly and repair as necessary.

6-34. AUDIO AMPLIFIER SUBASSEMBLY. Table XXIV presents a summary of the more probable troubles encountered within the audio amplifier subassembly. Before performing the trouble isolation procedures outlined in table XXIV, the detailed performance tests in sections V and VI of this handbook should be performed. Also, the tube voltage and

resistance measurements outlined in table 7-7 should be made and each of the audio amplifier subassembly tubes should be checked in Tube Tester TV-3B/U. If, after completion of the detailed performance tests and the voltage and resistance measurements, the trouble has not yet been located, proceed to table XXIV.

TABLE XXIV. AUDIO AMPLIFIER SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	PROBABLE CAUSE	REMEDY
1. No audio output; side tone or receive.	1. Defective tube, V1301 or V1302.  2. No B-plus voltage.	Replace defective tube.  Refer to figure 7-19. Check wiring and the plate and screen detail parts of V1301 and V1302.

TABLE XXIV. AUDIO AMPLIFIER SUBASSEMBLY, TROUBLE ISOLATION (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
1. (cont)	3. Plug P1301 defective.	Replace or repair as necessary.
	4. Transformer T1301 defective.	Replace transformer T1301. Refer to table XVII for resistance values.
	5. Defective coupling capacitor, C1302, or C1303.	Replace defective capacitor.
	6. Defective detail part of V1301 or V1302.	Replace defective detail part.
2. Audio output during reception but not during transmission.	1. Plug P1301 defective. 2. Capacitor C1301 defective.	Replace or repair as necessary. Replace C1301.
3. Side tone audio output during transmission but no audio output during reception.	1. Plug P1301 defective. 2. Coaxial lead from terminal 7 of P1301 to pin 2 of V1301 open.	Replace or repair as necessary. Replace or repair as necessary.

6-35. 250 KC OSCILLATOR AND BFO SUB-ASSEMBLY. Table XXV presents a summary of the more probable troubles encountered within the 250 kc oscillator and bfo subassembly. Before performing the trouble isolation procedures outlined in table XXV, the detailed performance tests in sections V and VI of this handbook should be performed. Also,

the tube voltage and resistance measurements outlined in figure 7-2 should be made, and each of the 250 kc oscillator and bfo tubes should be checked in Tube Tester TV-3B/U. If, after completion of the detailed performance tests and the voltage and resistance measurements, the trouble has not yet been located, proceed to table XXV.

TABLE XXV. 250 KC OSCILLATOR AND BFO SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	PROBABLE CAUSE	REMEDY
1. No 250-kc oscillator output. (Output should be 1.75 volts a-c at terminal 8 of J313, test point ☆.)	1. Defective V1201	Replace V1201.
	2. Defective Y1203.	Replace Y1203.
	3. Filaments do not light.	Check tubes in series parallel branch and replace defective tube. Check filament voltage. Refer to figure 5-1.
	4. Defective detail part of V1201 circuit.	Replace defective detail part.
	5. Defective P1201.	Replace or repair as necessary.

TABLE XXV. 250 KC OSCILLATOR AND BFO SUBASSEMBLY, TROUBLE ISOLATION (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
2. No bfo output. (No beat note during cw reception.)	1. Defective V1202. 2. Filaments do not light. 3. Defective detail part of V1202 circuit. 4. P1201 defective	Replace V1202. Check tubes in series parallel branch and replace defective tube, check filament voltage. Refer to figure 5-1. Replace defective detail part. Replace or repair as necessary.

6-36. RELAY SUBASSEMBLY. When isolating trouble within the relay subassembly, the complete 618S-1 or 618S-1A system must be taken into account. Each of the four relays within the relay subassembly perform several functions which affect the entire system. Paragraphs 6-37 through 6-40 outline the functions of each relay. By observing the faults encountered within the 618S-1 or 618S-1A system, and by study of the relay functions presented in paragraphs 6-37 through 6-40, the relay or circuit at fault can be analyzed. When the faulty relay or other detail part has been located, the fault should be corrected either by replacement or repair as necessary. Field maintenance personnel should not attempt to burnish relay contacts or perform major overhauls on any of the relays. If a relay is found to be defective, the entire relay should be replaced and the defective relay returned to the overhaul base.

6-37. Steps a through d describe the functions of sequence relay K801. Sequence relay K801 is energized during the 618S-1 or 618S-1A channeling cycle. If trouble has been isolated to the relay subassembly, check the 618S-1 or 618S-1A functions against the functions of relay K801. In this manner, relay K801 and its circuit connections may be checked. Contacts of relay K801 perform the following functions after being energized:

- Provide a ground pulse to Automatic Antenna Tuner 180L-3, energizing the 180L-3.
- Open the keying circuit between the MIC and KEY jacks and keying relays K804, K1001, and K1501.
- Open the dynamotor start circuit, preventing dynamotor D1601 from running during the channeling cycle.
- Provide a ground to relay K1502, energizing the power amplifier centering circuit.

6-38. Steps a through c describe the functions of the tuner centering relay, K802. Relay K802 is energized during the channeling cycle through contacts of relays K401 or K402. If trouble has been isolated to the relay subassembly, check the 618S-1 or 618S-1A functions against the functions of relay K802. In this

manner, relay K802 and its circuit connections may be checked. Contacts of relay K802 perform the following functions after being energized.

- Provide a self-locking ground during the tuner centering cycle.
- Connect the tuner table centering circuit to the tuner servo amplifier subassembly, driving the tuner servo amplifier subassembly and servomotor B102.
- Provide a holding ground for relay K801 during the tuner centering cycle.

6-39. Steps a through d describe the functions of the phone-cw relay, K803. Relay K803 is energized through contacts of switch S2603B when the OFF PHONE CW switch is in the CW position. If trouble has been isolated to the relay subassembly, check the 618S-1 or 618S-1A functions against the functions of relay K803. In this manner, relay K803 and its circuit connections may be checked. Contacts of relay K803 perform the following functions after being energized:

- Remove the B-plus voltage from the screen grids of modulator tubes V1404 and V1405 and ground the modulator screen grids.
- Ground the avc voltage applied to the tuner subassembly through resistor R807, reducing the avc voltage during cw reception.
- Provide a ground circuit for the cathode of bfo tube V1202 through contacts of relay K804.
- Remove the phone side-tone circuit and complete the cw side-tone circuit.

6-40. Steps a through d describe the functions of keying relay K804. Relay K804 is energized whenever the telegraph key or microphone push-to-talk button is operated. If trouble has been isolated to the relay subassembly, check the 618S-1 or 618S-1A functions against the functions of relay K804. In this manner, relay K804 and its circuit connections may be checked. Contacts of relay K803 perform the following functions after being energized:

- Complete both the phone and cw side-tone circuits to the audio amplifier subassembly.

- b. Open the cathode circuit of bfo tube V1202.
- c. Provide a ground to choppers within Automatic Antenna Tuner 180L-3.
- d. Provide a ground circuit for tubes V1201, V1003, V1004, V1010, and V1011.

6-41. TUNER AND PA SERVO AMPLIFIER SUB-ASSEMBLIES. When trouble shooting either the tuner servo amplifier subassembly or the pa servo amplifier subassembly, the complete servo system must be taken into account. If, for example, the slug rack of the tuner subassembly remains at rest when a new channel has been selected, the tuner servo amplifier subassembly may have no output or the input from the discriminator may be missing. In general, follow a logical sequence in determining where the trouble is located.

6-42. Assuming that either of the servo amplifier sub-assemblies is at fault, the most logical trouble is a defective chopper or tube. Remove the tube shield and feel the chopper during the channeling. If no vibration is apparent, replace the chopper. If a replaced chopper does not operate, check the 6.3-volt, 400-cps source. Observe the tube filaments. If unlighted, refer to figure 5-1 and determine the filament arrangement. Check the tubes of the defective string in the Tube Tester TV-3B/U and replace the defective tube or tubes.

6-43. Other troubles in the servo amplifier sub-assemblies normally are of a more subtle nature, generally resulting from improper feedback conditions. Improper B-plus decoupling, for example, could cause this condition. Check capacitors C603 and C604 and replace if defective. An unbalanced bridge circuit also may result in feedback through transformer T601 and produce a drive to servomotor B102 or B1501 at a time when they normally are at rest. The motors then may oscillate. Use the following procedure to balance the bridge circuit.

- a. Remove the faulty servo amplifier subassembly from the chassis.
- b. Connect VTVM TS-375/U to terminals 3 and 4 of T601.
- c. Remove R612 and connect a decade box containing all values of R612 (150 to 470 ohms) across R612 location in the circuit.
- d. Procure values of R612 indicated in the Illustrated Parts Breakdown T.O. 12R2-4-6-4. These values are 150, 180, 220, 270, 330, 390, and 470 ohms.
- e. Replace the servo amplifier subassembly in the chassis.
- f. Operate the channel selectors and stall servomotor B102 or B1501 by blocking the gear coupler with a screw driver.
- h. Adjust the decade box for minimum voltage reading on VTVM TS-375/U. Read the decade box and insert resistor R612 of equal value into the circuit.

6-44. POWER SUPPLY 416W-1. Table XXVI presents a summary of the more probable trouble encountered within Power Supply 416W-1. Before performing the trouble isolation procedures outlined in table XXVI,

the detailed performance tests in sections V and VI of this handbook should be performed. Also, the output voltages listed in steps a through k of this paragraph should be measured at TB1801 (test point 9). If a faulty reading is obtained at TB1801, the indicated voltages also should be measured at J1601 of Power Supply 416W-1 to ascertain if the trouble is in the cabling between components. Refer to figure 7-15. If, after completion of the detailed performance tests and the tests outlined in steps a through k, the trouble has not yet been located, proceed to table XXVI. Perform the following operations:

- a. With the 618S-1 or 618S-1A system in a test bench setup (figure 3-1), operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup. After warmup, operate the OFF PHONE CW switch to the CW position.

**CAUTION**

Do not leave the OFF PHONE CW switch in the CW position for more than five minutes at a time. When in the CW position, dynamotor D1601 runs continuously, which is desirable for the following tests; however, damage may result if left on for longer than five-minute intervals. The duty cycle is five minutes on, five minutes off.

- b. Connect VTVM TS-375/U between the terminals listed in the following steps and ground. Adjust the TS-375/U to the correct a-c or d-c range in each case.
- c. Measure voltage at terminal 12 of TB1801. Normal indication, 250 volts d-c. If indication is abnormal, measure the indicated voltage at terminal 20 of J1601.
- d. Measure voltage at terminal 40 of TB1801. Normal indication, -65 volts d-c. If indication is abnormal, measure the indicated voltage at terminal 10 of J1601.
- e. Measure voltage at terminal 44 of TB1801. Normal indication, -50 volts d-c. If indication is abnormal, measure the indicated voltage at terminal 11 of J1601.
- f. Measure voltage at terminal 46 of TB1801. Normal indication, 115 volts a-c. If indication is abnormal, measure the indicated voltage at terminal 13 of J1601.
- g. Measure voltage at terminal 7 of TB1801. Normal indication, 6.3 volts a-c. If indication is abnormal, measure the indicated voltage at terminal 17 of J1601.
- h. Measure voltage at terminal 45 of TB1801. Normal indication, 115 volts a-c. If indication is abnormal, measure the indicated voltage at terminal 14 of J1601.
- i. Measure voltage at terminal 11 of TB1801. Normal indication, 250 volts d-c. If indication is abnormal, measure the indicated voltage at terminal 8 of J1601.
- j. Construct a voltage divider for the TS-375/U and measure voltage at terminal 2 of TB1801. Normal indication, 600 volts d-c. If indication is abnormal, measure the indicated voltage at terminal 22 of J1601.
- k. Measure voltage at terminal 25 of TB1801. Normal indication, 27.5 volts d-c. If indication is abnormal, measure the indicated voltage at terminal 3 of J1601.



TABLE XXVI. POWER SUPPLY 416W-1, TROUBLE ISOLATION

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Zero voltage at terminal 3 of J1601.	<ol style="list-style-type: none"> <li>1. Plug P1601 defective.</li> <li>2. One of the following detail parts defective; K1602, S1602, and C1615.</li> </ol>	<p>Replace or repair as necessary.</p> <p>Replace defective detail part.</p>
2. Zero voltage at terminal 17 of J1601.	<ol style="list-style-type: none"> <li>1. Plug P1601 defective.</li> <li>2. One of the following detail parts defective; T1601, R1606, K1603, and F1602.</li> </ol>	<p>Replace or repair as necessary.</p> <p>Replace defective detail part.</p>
3. Zero voltage at terminal 14 of J1601.	<ol style="list-style-type: none"> <li>1. Plug P1601 defective.</li> <li>2. One of the following detail parts defective; K1603 or F1602.</li> </ol>	<p>Replace or repair as necessary.</p> <p>Replace defective detail part.</p>
4. Zero voltage at terminal 10 of J1601.	<ol style="list-style-type: none"> <li>1. Plug P1601 defective.</li> <li>2. One of the following detail parts defective; R1604, CR1602, R1603, K1603, and F1601.</li> </ol>	<p>Replace or repair as necessary.</p> <p>Replace defective detail part.</p>
5. Zero voltage at terminal 11 of J1601.	<ol style="list-style-type: none"> <li>1. Plug P1601 defective.</li> <li>2. One of the following detail parts defective; R1608, R1609, CR1602, R1603, K1603, and F1601.</li> </ol>	<p>Replace or repair as necessary.</p> <p>Replace defective detail part.</p>
6. Zero voltage at terminal 8 of J1601.	<ol style="list-style-type: none"> <li>1. Plug P1601 defective.</li> <li>2. One of the following detail parts defective; L1602, CR1603, CR1601, C1601A, C1601B, R1601, K1603, and F1601.</li> </ol>	<p>Replace or repair as necessary.</p> <p>Replace defective detail part.</p>
7. Zero voltage at terminal 13 of J1601.	<ol style="list-style-type: none"> <li>1. Plug P1601 defective.</li> <li>2. One of the following detail parts defective; K1603 or F1601.</li> </ol>	<p>Replace or repair as necessary.</p> <p>Replace defective detail part.</p>
8. Zero voltage at terminal 20 of J1601.	<ol style="list-style-type: none"> <li>1. Plug P1601 defective.</li> <li>2. One of the following detail parts defective; L1601, L1604, D1601, L1603, K1601, S1601, K1603, and K1604.</li> <li>3. Detail part of the -50 volt bias supply defective.</li> </ol>	<p>Replace or repair as necessary.</p> <p>Replace defective detail part.</p> <p>Replace defective detail part.</p>

TABLE XXVI. POWER SUPPLY 416W-1, TROUBLE ISOLATION (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
9. Zero voltage at terminal 22 of J1601.	<ol style="list-style-type: none"> <li>1. Plug P1601 defective.</li> <li>2. One of the following detail parts defective; L1605, D1601, L1603, K1601, S1601, K1603, and K1604.</li> <li>3. Detail part of the -50 volt bias supply defective.</li> </ol>	<p>Replace or repair as necessary.</p> <p>Replace defective detail part.</p> <p>Replace defective detail part.</p>
10. Blows fuses.	<ol style="list-style-type: none"> <li>1. Refer to figure 7-16. Check detail parts such as, resistors and capacitors between voltage carrying lines and ground.</li> <li>2. Shorted turns on the following detail parts; T1601 and L1606.</li> </ol>	<p>Replace defective detail part.</p> <p>Replace defective detail part.</p>
11. No output or low output from dynamotor D1601.	<ol style="list-style-type: none"> <li>1. Poor commutation, resulting from a dirty commutator.</li> <li>2. Low input voltage</li> <li>3. Shims "end loading" bearings.</li> <li>4. Defective armature.</li> <li>5. Broken or sticky brushes.</li> </ol>	<p>Refer to Handbook Overhaul Instructions, T.O. 12R2-4-6-3. Replace D1601.</p> <p>Check input circuit for loose connections.</p> <p>Refer to T.O. 12R2-4-6-3. Replace D1601.</p> <p>Refer to T.O. 12R2-4-6-3. Replace D1601.</p> <p>Replace brushes. Refer to paragraph 5-12, steps k and m.</p>
12. Dynamotor D1601, noisy mechanically.	<ol style="list-style-type: none"> <li>1. Dry bearings.</li> <li>2. Bent shaft.</li> <li>3. High commutator bar.</li> <li>4. Dynamotor D1601 mounting not secure.</li> </ol>	<p>Refer to T.O. 12R2-4-6-3. Replace D1601.</p> <p>Refer to T.O. 12R2-4-6-3. Replace D1601.</p> <p>Refer to T.O. 12R2-4-6-3. Replace D1601.</p> <p>Tighten mounting screws.</p>
13. Dynamotor D1601 overheating.	<ol style="list-style-type: none"> <li>1. Bearings dry or damaged.</li> <li>2. Shims "end loading" bearings.</li> <li>3. Bent shaft.</li> <li>4. Sticking brushes</li> </ol>	<p>Refer to T.O. 12R2-4-6-3. Replace D1601.</p> <p>Refer to T.O. 12R2-4-6-3. Replace D1601.</p> <p>Refer to T.O. 12R2-4-6-3. Replace D1601.</p> <p>Refer to T.O. 12R2-4-6-3. Replace D1601.</p>

TABLE XXVI. POWER SUPPLY 416W-1, TROUBLE ISOLATION (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
14. Dynamotor D1601 noisy electrically.	1. Arcing at brushes.	Refer to T.O. 12R2-4-6-3. Replace D1601.
	2. Broken or cracked brushes.	Replace brushes. Refer to paragraph 5-12, steps k and m.
	3. Brushes sticking in holder.	Correct trouble.
	4. High commutator bar.	Refer to T.O. 12R2-4-6-3. Replace D1601.
	5. Dirty commutator	Clean commutator.
15. Excess vibration	1. Bent shaft	Refer to T.O. 12R2-4-6-3. Replace D1601. Refer to paragraph 5-12, step 1.
	2. Loose mounting	Tighten mounting screws.

6-45. RADIO SET CONTROL 614C-2. Table XXVII presents a summary of the more probable troubles encountered within Radio Set Control 614C-2. Before performing the trouble isolation procedures outlined in table XXVII, the detailed performance tests in sections V and VI of this handbook should be performed.

The trouble should be known to exist within the 614C-2 and not within the external wiring or within another of the 618S-1 or 618S-1A components. If, after completion of the detailed performance tests, the trouble has not yet been located, proceed to table XXVII.

TABLE XXVII. RADIO SET CONTROL 614C-2, TROUBLE ISOLATION

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Channel selected within the r-f crystal oscillator subassembly does not correspond to the setting of the 614C-2.	1. Switch S2601 defective.	Replace S2601.
	2. Switch S2602 defective.	Replace S2602.
	3. Switch S2601 or S2602 misaligned.	Realign switch. Refer to figure 6-15 and paragraph 6-88.
2. Motor B401 runs continuously.	1. Switch S2601 or S2602 shorted to ground.	Replace defective switch or repair as necessary.
	2. Control wire shorted to ground.	Locate and repair as necessary. Refer to figure 7-17.
	3. Jack J2601 defective.	Replace or repair as necessary.
3. Rotation of the 614C-2 channel selectors does not energize Autopositioner system.	1. Switch S2601 or S2602 defective.	Replace defective switch.
	2. Jack J2601 defective.	Replace or repair as necessary.
	3. Control wire or wires open.	Locate and repair as necessary. Refer to figure 7-17.

TABLE XXVII. RADIO SET CONTROL 614C-2, TROUBLE ISOLATION (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
4. Dynamotor D1601 will not start.	1. Switch S2603 defective. 2. Jack J2601 defective.	Replace S2603. Replace or repair as necessary.
5. Beat signal not variable during cw reception.	1. Potentiometer R2601 defective. 2. Jack J2601 defective.	Replace R2601. Replace or repair as necessary.
6. Audio volume not variable.	1. Switch S2603 defective. 2. Potentiometers R2603 and/or R2604 of three-ganged potentiometer defective. 3. Resistor R2606 or R2607 defective. 4. Jack J2601 defective.	Replace S2603. Replace three-ganged potentiometer. Replace defective resistor. Replace or repair as necessary.
7. Gain not variable during cw reception.	1. Switch S2603 defective. 2. Potentiometer R2605 of three-ganged potentiometer defective. 3. Jack J2601 defective.	Replace S2603. Replace three-ganged potentiometer. Replace or repair as necessary.

**6-46. ALIGNMENT PROCEDURE.**

6-47. The procedures for precision alignment of Radio Set 618S-1 or 618S-1A are discussed in the following paragraphs. Follow these procedures exactly, aligning the plug-in subassemblies in the order that they appear in these instructions. When the alignment and tracking procedures have been completed, the 618S-1 or 618S-1A should be subjected to the detailed performance tests outlined in paragraphs 5-13 and 6-5. The alignment procedures assume that the 618S-1 or 618S-1A equipment is connected in a test bench setup, described in paragraphs 3-9 and 3-10. Refer to figure 3-1 and figures 6-21 through 6-23 for identification of test points used in subsequent paragraphs.

**WARNING**

The 618S-1 and 618S-1A equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment. Clothing, rags, and test equipment should be kept away from the moving parts during the channeling cycle.

**6-48. ALIGNMENT EQUIPMENT.**

6-49. TEST SET 478H-1. Test Set 478H-1 was specifically designed for trouble analysis and alignment of the plug-in subassemblies of Radio Receiver-Transmitter 618S-1 or 618S-1A. The 478H-1 consists of a chassis with a main panel, on which are mounted jacks for mating the plugs of the 618S-1 or 618S-1A subassemblies. The 478H-1 provides a method of making "go-no go" checks on the 618S-1 or 618S-1A subassemblies while removed from the main chassis. Also, each of the 618S-1 or 618S-1A subassemblies may be aligned while removed from the main chassis. Included with the 478H-1 is a band switch control, which provides a method of checking the operation of the Autopositioner system within the r-f crystal oscillator subassembly. Test Set 478H-1 is designed to operate with Power Supply 413F-1, which provides all power necessary for the 618S-1 or 618S-1A subassemblies, as well as the 478H-1. If Test Set 478H-1 is available to field maintenance personnel, it should be used throughout the following alignment procedures.

6-50. MAINTENANCE KIT FOR 618S-1. Maintenance kit for 618S-1 is designed for use with the 478H-1 to simplify trouble-shooting and alignment procedures.

The maintenance kit includes a set of test crystals, three tube adapters, a gauge block, a dial gauge, an alignment tool, and a test kit case. If both the 478H-1 and its maintenance kit are available, the alignment procedures will be simplified greatly.

**6-51. EXTENSION CABLES.** The 618S-1 or 618S-1A subassemblies may be inspected and tested with power applied while removed from the main chassis with the use of extension cables. These cables are illustrated in figures 2-5 through 2-9 and may be fabricated from bulk supplies. Refer to paragraph 2-9 and table IX.

**6-52. GAUGE BLOCK AND DIAL GAUGE.** For alignment of the tuner subassembly, it is necessary to have a gauge block made of nonmagnetic metal, exactly 1.375 inches wide, thin enough to slide between the coil shields of the tuner subassembly, and long enough to be placed under the tuning rack. Also, it is necessary to have a dial gauge. The dial gauge must be capable of measuring from 0 to 0.798 inch, and should be mounted on a clamp bracket for securing to the rear plate of the tuner subassembly. The placement and use of the gauge block and dial gauge will be described in paragraphs 6-66 and 6-67.

**6-53. ALIGNMENT OF R-F CRYSTAL OSCILLATOR SUBASSEMBLY.**

**6-54.** Alignment of the r-f crystal oscillator subassembly consists of Autopositioner mechanical adjustments and switch alignment. All electrical alignment procedures are performed at the factory and further adjustment in the field is not recommended. Before performing the mechanical alignment procedures outlined in paragraphs 6-55 through 6-57, the r-f crystal oscillator subassembly should be removed from the main chassis. Refer to paragraph 5-30 for the removal and replacement procedure.

**6-55. AUTOPOSITIONER RELAY ADJUSTMENT.** Steps a through f describe the adjustment procedures for the Autopositioner relays of the r-f crystal oscillator subassembly. These procedures also may be used for adjustment of the bandchange autopositioner relay, K101. Steps a through f describe the adjustment method which should be employed with the autopositioner relay still installed. Paragraph 6-56, steps a through h, describe the adjustment method which should be used when replacing an autopositioner relay.

- a. Loosen relay mounting screws.
- b. With the pawl engaged in one of the notches of the stop wheel, hold the pawl fully seated in the notch.
- c. Rotate the relay clockwise about the mounting screws so that the frame and armature contact the pawl projection to eliminate all lost motion in the relay.
- d. Tighten relay mounting screws in this position.
- e. Depress the relay armature, and check to see that the pawl lifts clear of the notch to allow free rotation of the stop wheel. Pawl should clear the stop-wheel teeth by about 1/64 of an inch. More than 1/32 of an inch clearance indicates excessive relay travel with a corresponding loss of power. Relay travel can be adjusted, if necessary, by loosening the two screws

near the hinge and sliding the hinge plate up or down slightly as required.

- f. The contacts on the relay should be adjusted to maintain contact when the pawl is resting on top of a stop-wheel tooth between positions with the relay de-energized. This is to insure that the motor will continue to drive until the pawl engages the proper notch, which opens the contacts by at least 0.025 inch. Contacts can be adjusted, if necessary, by bending the stationary contact arm.

**6-56. AUTOPOSITIONER RELAY REPLACEMENT AND ADJUSTMENT.** Steps a through h describe the adjustment procedures for the autopositioner relays of the r-f crystal oscillator subassembly, and also may be used for the bandchange autopositioner relay, K101. These adjustment methods should be used when it is necessary to replace and adjust an autopositioner relay. The steps of paragraph 6-55 describe the adjustment method to be used with the autopositioner still installed.

- a. Seat the pawl in a notch of the stop wheel. Turn the gear train by hand, and allow the pawl to seat fully.

- b. Place the relay so that the pawl finger comes between the relay spring and frame at about the middle of the spring.

- c. Line up the mounting hole farthest from the pawl, and start the mounting screw without applying any pull to the relay spring. That is, let the relay turn clockwise slightly.

- d. Turn the relay counterclockwise about this screw. This will let the pawl finger slide between the spring and relay arm. Start the second screw.

- e. Hold the pawl firmly seated in the stop-wheel notch, and hold the relay frame against the pawl finger. Tighten mounting screws. See that the pawl is firmly seated and the relay armature and arm have no appreciable free play. Reposition, if necessary, to meet these conditions.

- f. Depress the relay armature, and turn the relay manually to check the clearance between the pawl tip and the stop wheel. This should be 1/64 inch or less. If adjustment is required, loosen the two screws near the hinge point and slide the hinge plate up or down as required. Adjustment may be aided by placing a 0.020-inch feeler gauge between the armature and coil core. Be careful that the frame arm does not rub on the side of the frame and that the spring does not shift closer to the contacts when tightening the screws.

- g. Check the operation of the relay contacts. With power off, depress the armature of the relay and turn the gearing to let the pawl tip rest on the stop wheel between notches. In this position, the relay contacts should be closed, and the armature and arm should have a small amount of free play to permit full contact pressure at the contact points.

- h. If necessary, bend the stationary contacts in or out. Failure to make contact in this position may allow the autopositioner to set up on the wrong position, with the seeking switch circuit open, but with the pawl between notches. Excessive free play of the armature in this position indicates insufficient contact opening in the de-energized position.

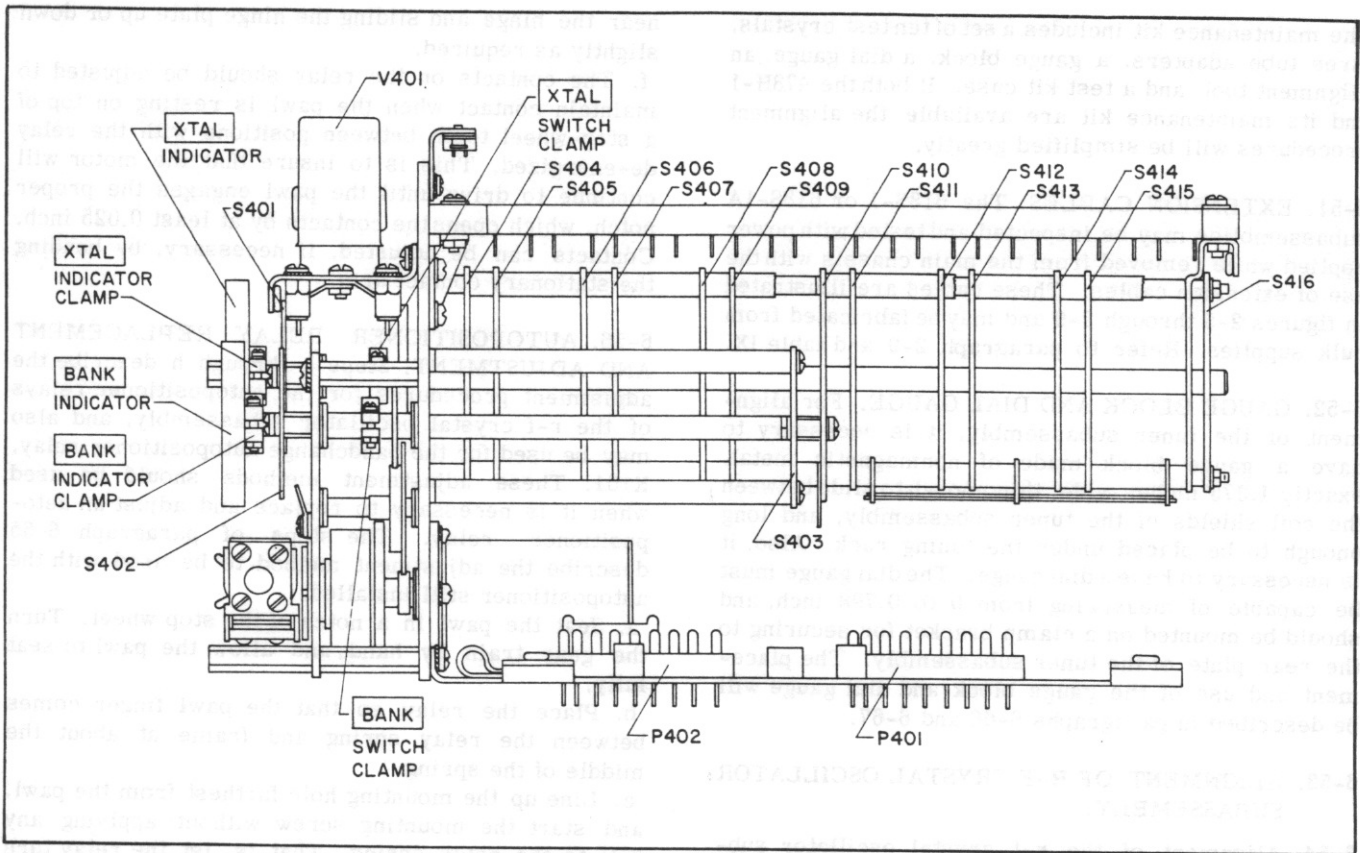


Figure 6-2. R-F Crystal Oscillator Subassembly, Right Side View, Switch Alignment Points

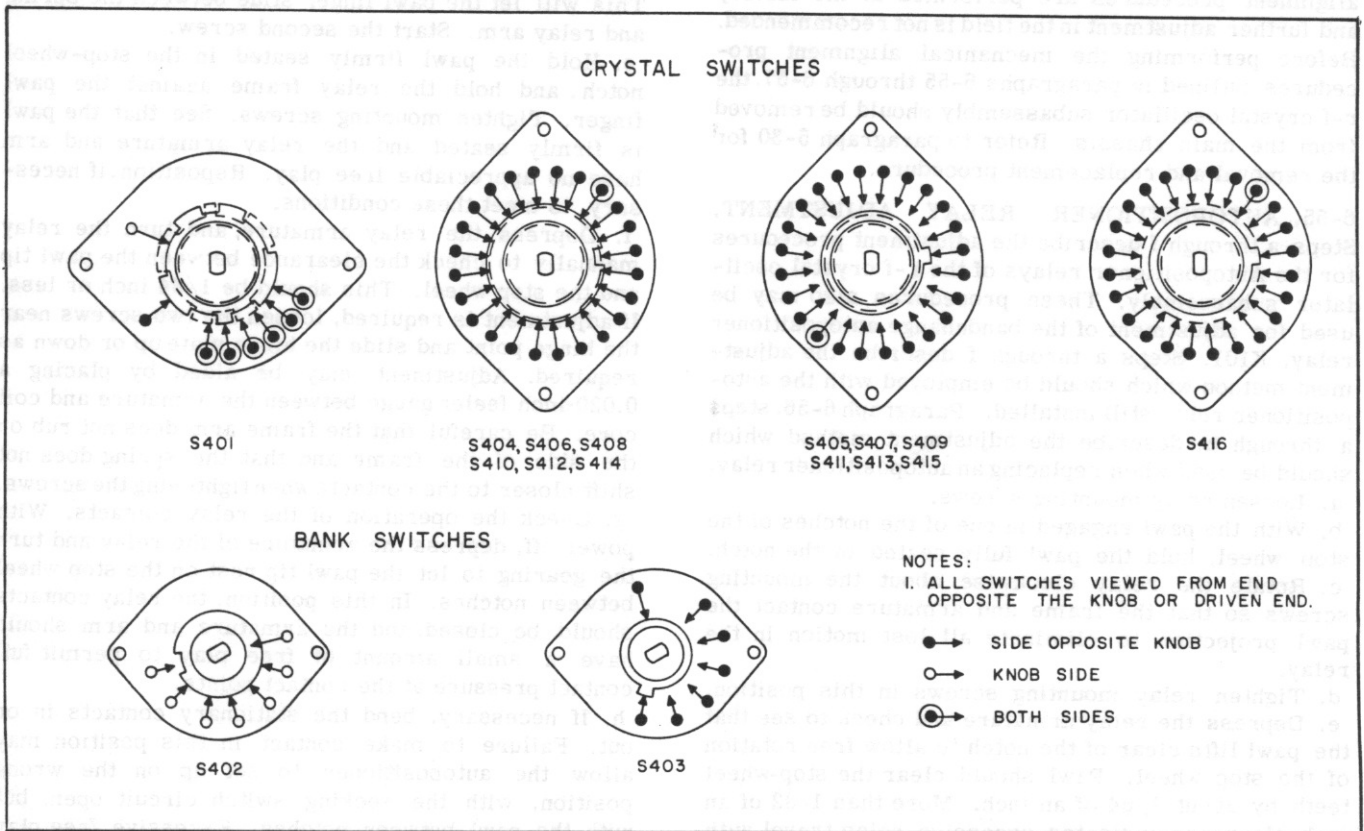


Figure 6-3. R-F Crystal Oscillator Subassembly, Correct Switch Alignment

6-57. SWITCH ALIGNMENT. If the trouble isolation procedures in sections V or VI indicate the r-f crystal oscillator switches are out of alignment, the applicable steps of this paragraph should be performed. When performing the switch alignment procedures, no electrical connections are necessary as all the procedures are mechanical. Before removing the r-f crystal oscillator subassembly from the test bench setup (figure 3-1), operate the channel selectors to the A1 position and observe the BANK and XTAL indicators. The BANK indicator should read A and the crystal indicator should read 1. If not, either the BANK or XTAL indicators or the associated switches are misaligned. After the A1 position has been selected, remove the r-f crystal oscillator subassembly from the main chassis and proceed with steps a through c. Refer to paragraph 5-30 for the removal and replacement procedure. When performing the following procedural steps, refer to figures 6-2 and 6-3 for parts location and switch alignment.

a. Remove the front cover from the r-f crystal oscillator subassembly. The front cover is secured by four Phillips-head screws.

b. Remove the crystal cover and rear cover from the r-f crystal oscillator subassembly. The rear cover is secured by nine Phillips-head screws; two at the front (upper right and left), two at the rear (above the BAND ASSIGNMENT SWITCH cover), and five at the bottom (three on the side of the plugs and two on the side opposite the plugs). The crystal cover is secured by one Dzus fastener, and is hinged to the rear cover.

c. Observe the switch positions and compare with figure 6-3. If either of the switch sections is misaligned, proceed to the applicable steps. Proceed to steps d through f if the switch section consisting of S402 and S403 is misaligned. Proceed to steps j through l if the switch section consisting of S401 and S404 through S416 is misaligned.

d. Loosen the BANK switch clamp with a No. 8 Bristo wrench.

e. Rotate the BANK indicator manually until the positions of switches S402 and S403 correspond with figure 6-3.

f. Tighten the BANK indicator clamp. The BANK indicator should now read A (observed from the top), and switches S402 and S403 should be in correct alignment. If the BANK indicator reads some letter other than A, and switches S402 and S403 are known to be in correct alignment, proceed to steps g through i. Otherwise, proceed to step p.

g. Loosen the BANK indicator clamp with a No. 8 Bristo wrench.

h. Rotate the BANK indicator for a reading of A on the top of the r-f crystal oscillator subassembly.

i. Tighten the BANK indicator clamp. Both the bank switches and the BANK indicator should now be correctly aligned. Proceed to step p.

j. Loosen the XTAL switch clamp with a No. 8 Bristo wrench.

k. Rotate the XTAL indicator manually until the positions of switches S401 and S404 through S416 correspond with figure 6-3.

l. Tighten the XTAL indicator clamp. The XTAL indicator should now read 1 (observed from the top), and switches S401 and S404 through S416 should be in correct alignment. If the XTAL indicator reads some number other than 1, and switches S401 and S404 through S416 are known to be in correct alignment, proceed to steps m through o. Otherwise, proceed to step p.

m. Loosen the XTAL indicator clamp with a No. 8 Bristo wrench.

n. Rotate the XTAL indicator for a reading of 1 on the top of the r-f crystal oscillator subassembly.

o. Tighten the XTAL indicator clamp. Both the crystal switches and the XTAL indicator now should be correctly aligned. Proceed to the following step.

p. Replace the rear cover, crystal cover, and front cover, and replace the r-f crystal oscillator subassembly in the main chassis. Refer to steps a and b of this paragraph and to paragraph 5-30.

#### 6-58. ALIGNMENT OF 250 KC OSCILLATOR AND BFO SUBASSEMBLY.

6-59. Paragraphs 6-60 and 6-61 describe the adjustment procedures for the 250 kc oscillator and bfo subassembly. If desired, the 250 kc oscillator and bfo subassembly may be removed from the main chassis before aligning. In this case, the proper extension cable, illustrated in figure 2-6, must be used to provide connection between the main chassis and the

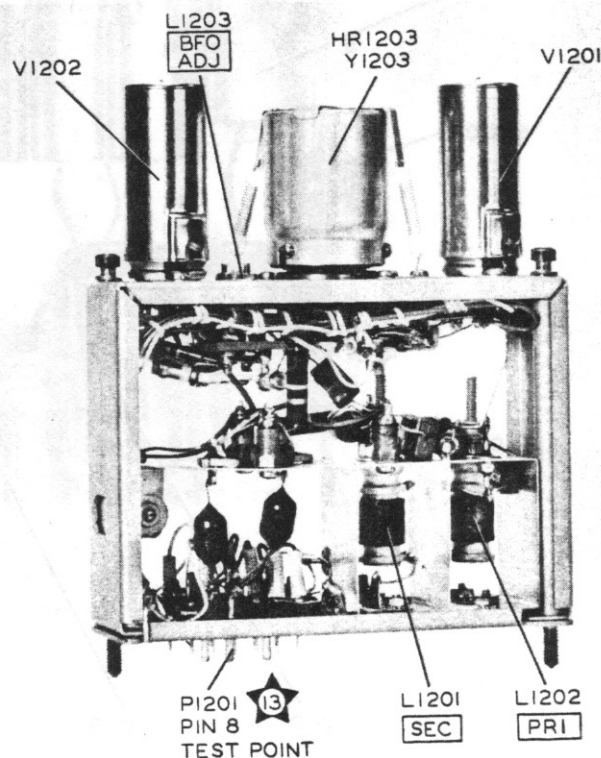


Figure 6-4. 250 Kc Oscillator and BFO Subassembly, Right Side View, Alignment Points

250 kc oscillator and bfo subassembly. Reference is made to paragraph 5-30 for the removal and replacement procedure. Before proceeding with the alignment procedure, connect the 618S-1 or 618S-1A system in a test bench setup similar to that illustrated in figure 3-1. All test points are identified on the main schematic diagram, figure 7-19, and on the bottom view of the 618S-1 or 618S-1A main chassis, figure 6-23. All alignment points are identified in figure 6-4.

6-60. 250 KC OSCILLATOR ADJUSTMENT. Perform the following operations:

a. Operate the OFF PHONE CW switch to the PHONE position, and allow at least ten minutes for warmup.

b. Connect VTVM TS-375/U between terminal 8 of J313 (test point 13) and ground. Adjust to the 3-volt a-c scale.

c. Operate the telegraph key or microphone push-to-talk button.

d. Adjust L1201 and L1202 for maximum indication on the TS-375/U. Inductors L1201 and L1202 are both adjustable from the bottom of the 250 kc oscillator and bfo subassembly. If the subassembly is being adjusted while installed in the main 618S-1 or 618S-1A chassis, inductors L1201 and L1202 are obtainable through two holes (silk screened SEC for L1201 and PRI for L1202).

e. Repeat the adjustment described in step d until no further peaking is obtainable.

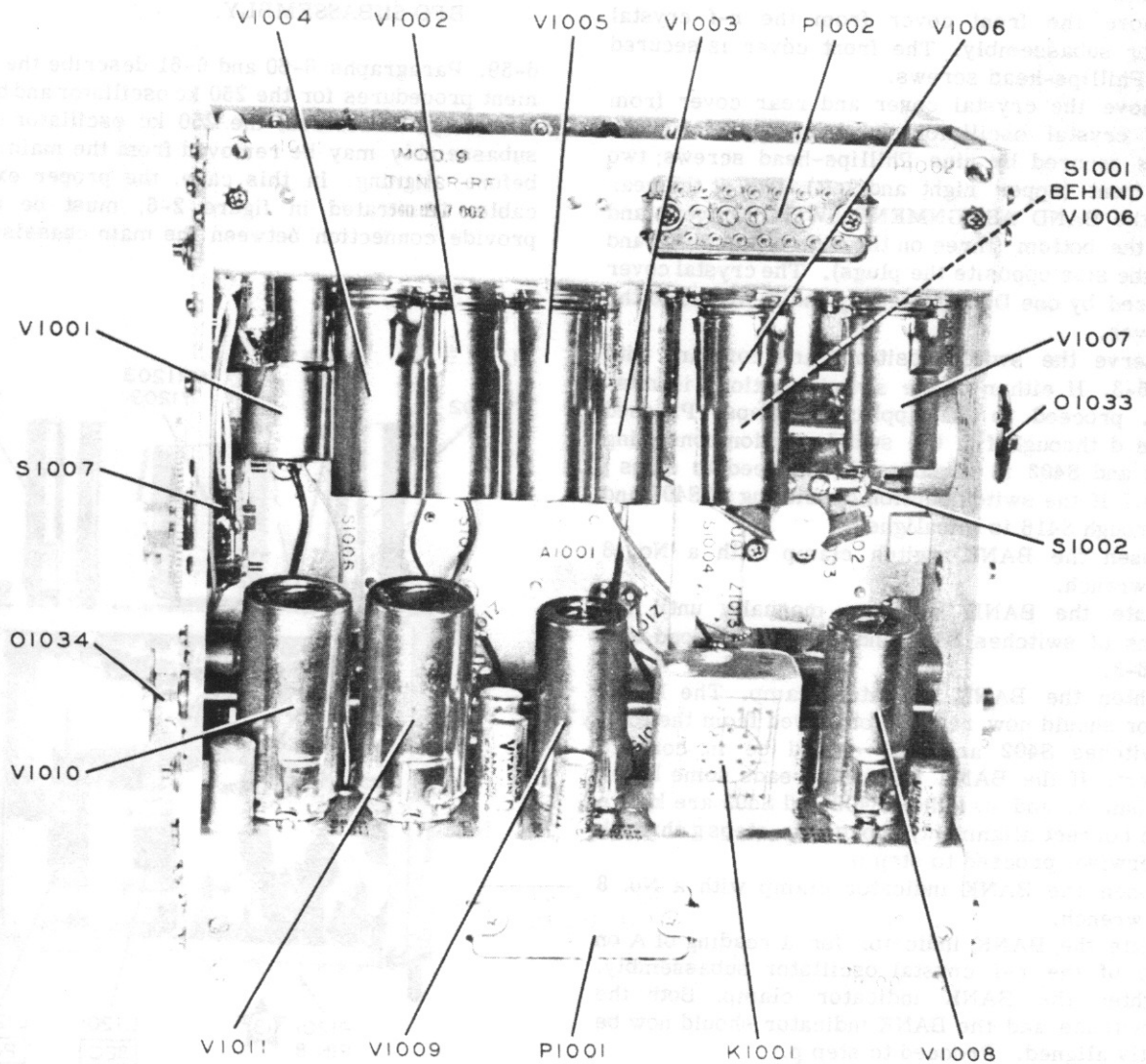


Figure 6-5. Tuner Subassembly, Bottom View, Switch and Tube Location



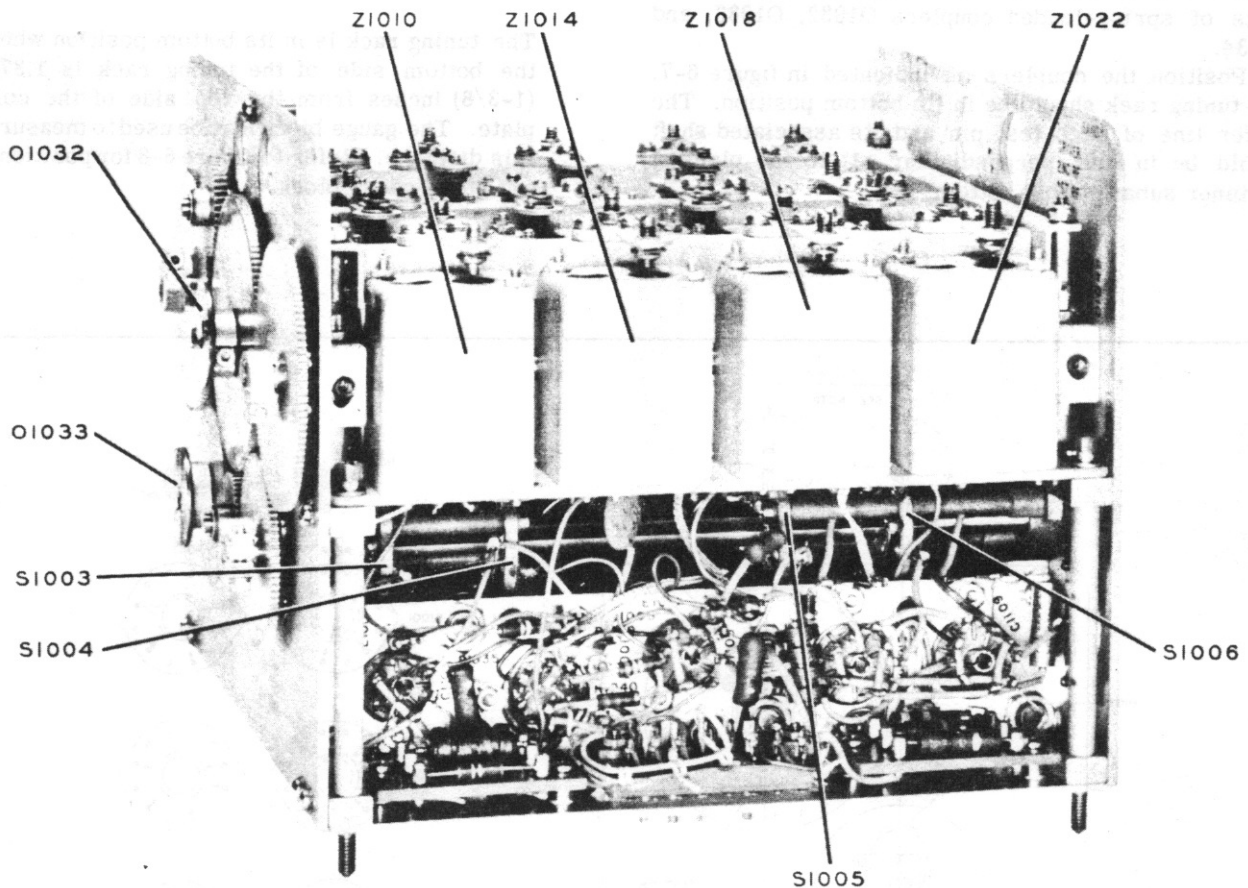


Figure 6-6. Tuner Subassembly, Right Side View, Switch and Coupler Location

f. Observe the tuner subassembly. If stamped MOD 8 or later, the secondary (L1201) should be detuned for a reading of 1.75 volts a-c on VTVM TS-375/U.

6-61. BFO ADJUSTMENT. Perform the following operations:

a. Operate the OFF PHONE CW switch to the PHONE position. Allow at least ten minutes for warmup. After warmup, operate the OFF PHONE CW switch to the CW position.

b. Connect Signal Generator AN/URM-25 to J109 (test point 3). Adjust to approximately 100 microvolts, unmodulated.

c. Connect a headset to terminal b of J2601 (test point 8).

d. Select a channel and tune the AN/URM-25 to the same frequency with Frequency Meter AN/USM-26.

e. Operate the BFO control throughout its range and determine the center position. Leave the BFO control in this position.

f. Adjust L1203 for zero beat. Inductor L1203 is adjustable from the top of the 250 kc oscillator and bfo subassembly. The adjustment is silk screened BFO ADJ.

#### 6-62. ALIGNMENT OF TUNER SUBASSEMBLY.

6-63. Paragraphs 6-64 through 6-73 describe the adjustment procedures for the tuner subassembly. The tuner subassembly should be removed during the mechanical alignment procedures and installed in the main chassis during the electrical alignment procedures. Reference is made to paragraphs 5-31 and 5-32 for the removal and replacement procedures. During electrical alignment, the 618S-1 or 618S-1A should be connected to a test bench setup similar to figure 3-1. All test points are identified on the main schematic diagram, figure 7-19, and on the bottom view of the 618S-1 or 618S-1A main chassis, figure 6-23. All electrical and mechanical alignment points are identified in figures 6-5 through 6-8 and figure 6-10.

6-64. COUPLER AND SWITCH ADJUSTMENTS, 618S-1. Refer to figures 6-5 through 6-9. Perform the following operations:

a. Place the 618S-1 or 618S-1A in the A1 position and remove from the main chassis. Refer to paragraphs 5-31 and 5-32.

- b. Insert a 0.125/0.130-inch diameter test pin in the forks of spring-loaded couplers O1032, O1033, and O1034.
- c. Position the couplers as indicated in figure 6-7. The tuning rack should be in its bottom position. The center line of each test pin and its associated shaft should be in line, perpendicular  $\pm 1^\circ$  to the plane of the tuner subassembly bottom.

NOTE

The tuning rack is in its bottom position when the bottom side of the tuning rack is 1.375 (1-3/8) inches from the top side of the coil plate. The gauge block may be used to measure this distance. Refer to figure 6-8 for positioning of the gauge block.

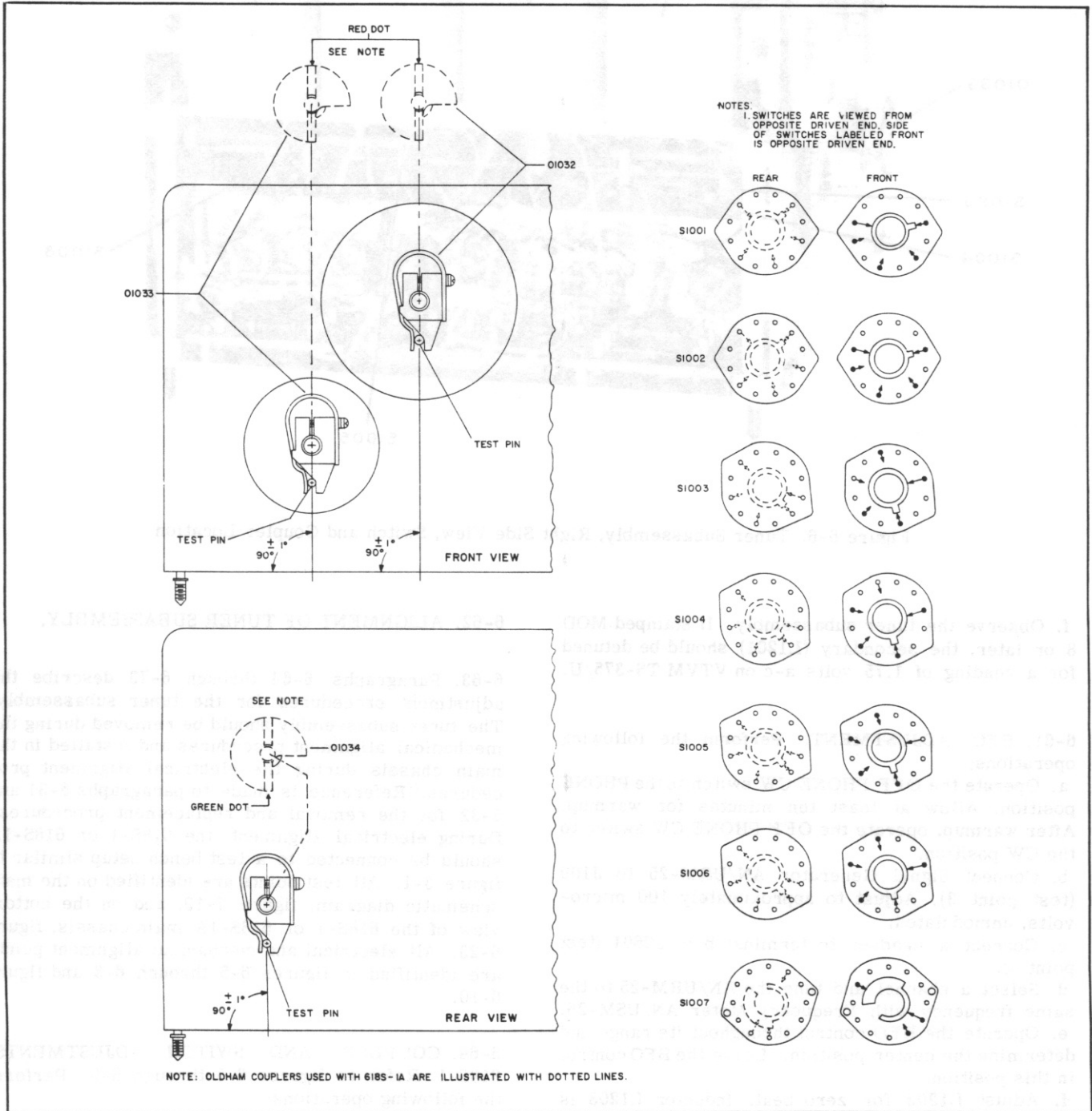


Figure 6-7. Tuner Subassembly, Switch and Coupler Alignment

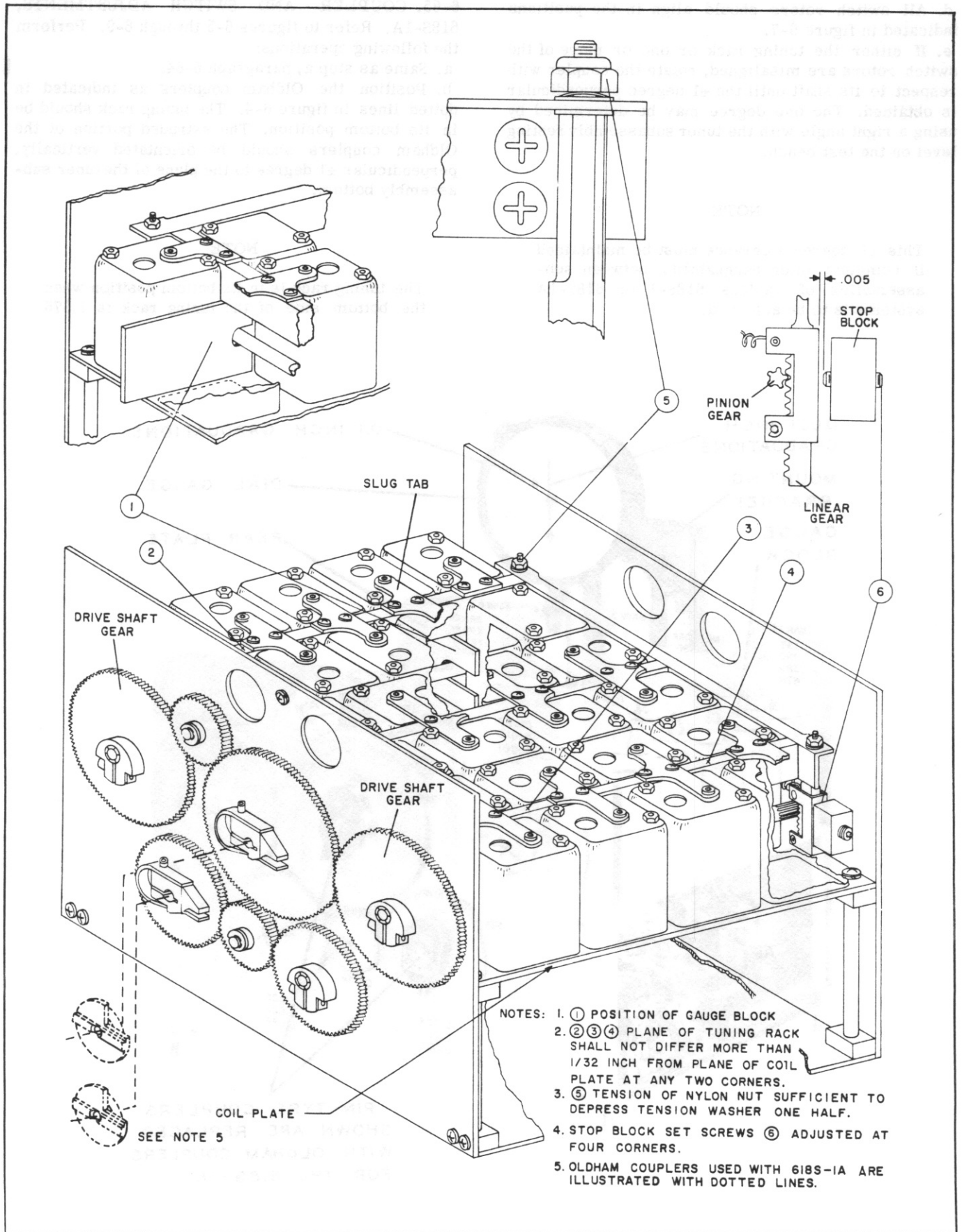


Figure 6-8. Tuner Subassembly, Mechanical Alignment Points

- d. All switch rotors should align in the positions indicated in figure 6-7.
- e. If either the tuning rack or one or more of the switch rotors are misaligned, rotate the coupler with respect to its shaft until the  $\pm 1$  degree perpendicular is obtained. The one degree may be determined by using a right angle with the tuner subassembly resting level on the test bench.

NOTE

This  $\pm 1$  degree tolerance must be maintained if complete interchangeability between sub-assemblies of various 618S-1 or 618S-1A systems is to be achieved.

6-65. COUPLER AND SWITCH ADJUSTMENTS, 618S-1A. Refer to figures 6-5 through 6-9. Perform the following operations:

- a. Same as step a, paragraph 6-64.
- b. Position the Oldham couplers as indicated in dotted lines in figure 6-4. The tuning rack should be in its bottom position. The extruded portion of the Oldham couplers should be orientated vertically, perpendicular  $\pm 1$  degree to the plane of the tuner sub-assembly bottom.

NOTE

The tuning rack is in its bottom position when the bottom side of the tuning rack is 1.375

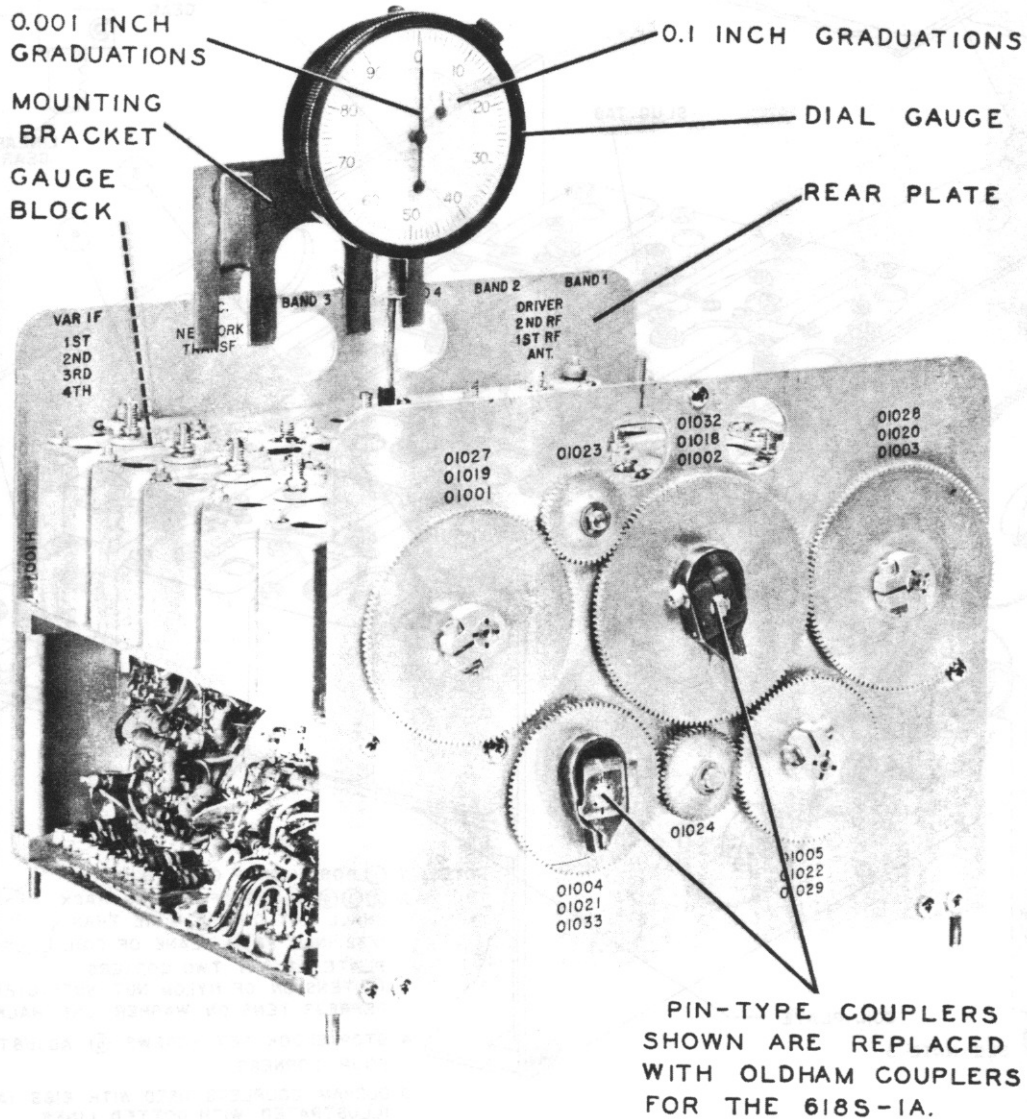


Figure 6-9. Tuner Subassembly, Dial Gauge in Place

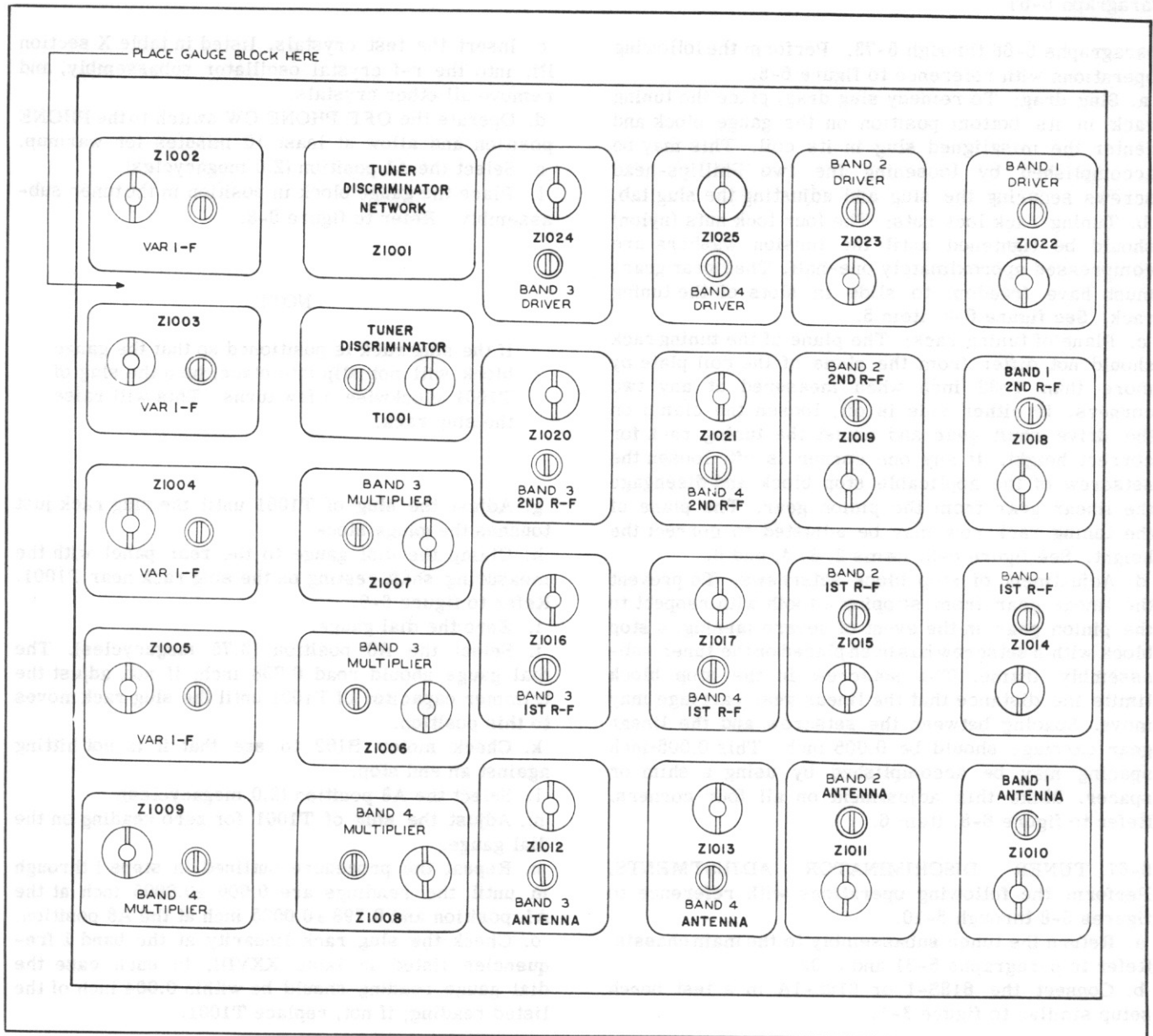


Figure 6-10. Tuner Subassembly, Electrical Alignment Points

(1-3/8) inches from the top side of the coil plate. The gauge block may be used to measure this distance. Refer to figure 6-8 for positioning of the gauge block.

c. All switch rotors should align in the positions indicated in figure 6-7.

d. If either the tuning rack or one or more of the switch rotors are misaligned, rotate the coupler with respect to its shaft until the  $\pm 1$  degree perpendicular is obtained. The one degree may be determined by using a right angle with the tuner subassembly resting level on the test bench.

## NOTE

This  $\pm 1$  degree tolerance must be maintained if complete interchangeability between sub-assemblies of various 618S-1 or 618S-1A systems is to be achieved.

6-66. TUNING RACK ADJUSTMENTS. Certain mechanical adjustments are necessary in addition to the coupler and switch alignment procedures described in paragraphs 6-64 and 6-65. These adjustments are very important and should be completed before advancing to the electrical alignment procedures.

paragraphs 6-68 through 6-73. Perform the following operations with reference to figure 6-8.

a. Slug drag: To remedy slug drag, place the tuning rack in its bottom position on the gauge block and center the misaligned slug in its coil. This may be accomplished by loosening the two Phillips-head screws securing the slug and adjusting the slug tab.

b. Tuning rack lock nuts: The four lock nuts (nylon) should be tightened until the tension washers are compressed approximately one-half. The linear gears must have freedom to slide in slots of the tuning rack. See figure 6-8, item 5.

c. Plane of tuning rack: The plane of the tuning rack should not differ from the plane of the coil plate by more than 1/32 inch when measured at any two corners. If either side is off, loosen the clamp on the drive shaft gear and adjust the tuning rack for correct height. If any one corner is off, loosen the setscrew of the applicable stop block and disengage the linear gear from the pinion gear. The plane of the tuning rack now may be adjusted to correct the height. See figure 6-8, items 2, 3, 4, and 6.

d. Adjustment of stop block setscrews: To prevent the linear gear from slipping a tooth with respect to the pinion gear in the event of severe jarring, a stop block with a setscrew has been placed on the tuner sub-assembly frame. The setscrew in the stop block limits the distance that the linear gear carriage may move. Spacing between the setscrew and the linear gear carriage should be 0.005 inch. This 0.005-inch spacing may be accomplished by using a shim or spacer. Make this adjustment on all four corners. Refer to figure 6-8, item 6.

6-67. TUNER DISCRIMINATOR ADJUSTMENTS. Perform the following operations with reference to figures 6-8 through 6-10.

a. Return the tuner subassembly to the main chassis. Refer to paragraphs 5-31 and 5-32.

b. Connect the 618S-1 or 618S-1A in a test bench setup similar to figure 3-1.

c. Insert the test crystals, listed in table X section III, into the r-f crystal oscillator subassembly, and remove all other crystals.

d. Operate the OFF PHONE CW switch to the PHONE position and allow at least 10 minutes for warmup.

e. Select the A1 position (2.0 megacycles).

f. Place the gauge block in position in the tuner sub-assembly. Refer to figure 6-8.

NOTE

If the slug rack is positioned so that the gauge block will not slip into place, turn the slug of T1001 clockwise a few turns. This will raise the slug rack.

g. Adjust the slug of T1001 until the slug rack just touches the gauge block.

h. Clamp the dial gauge to the rear panel with the measuring shaft resting on the slug rack near T1001. Refer to figure 6-9.

i. Zero the dial gauge.

j. Select the A8 position (3.75 megacycles). The dial gauge should read 0.798 inch; if not, adjust the trimmer capacitor of T1001 until the slug rack moves to this position.

k. Check motor B102 to see that it is not hitting against an end stop.

l. Select the A8 position (2.0 megacycles).

m. Adjust the slug of T1001 for zero reading on the dial gauge.

n. Repeat the procedure outlined in steps i through m until the readings are  $0.000 \pm 0.0005$  inch at the A1 position and  $0.798 \pm 0.0005$  inch at the A8 position.

o. Check the slug rack linearity at the band 1 frequencies listed in table XXVIII. In each case the dial gauge reading should be within 0.004 inch of the listed reading; if not, replace T1001.

TABLE XXVIII. TUNER SUBASSEMBLY, SLUG RACK LINEARITY MEASUREMENTS

CHANNEL SELECTOR POSITIONS	OPERATING FREQUENCY (MEGACYCLES)	DIAL GAUGE READING (INCH)
A1	2.00	0.000
A2	2.25	0.114
A3	2.50	0.228
A4	2.75	0.342
A5	3.00	0.456
A6	3.25	0.570
A7	3.50	0.684
A8	3.75	0.798

6-68. VARIABLE I-F ADJUSTMENTS. After completion of the mechanical adjustments on the tuner sub-assembly, paragraphs 6-64 through 6-67, the variable i-f tuned circuits should be adjusted. The tuner sub-assembly should be returned to the main chassis, and the 618S-1 or 618S-1A should be connected in the test bench setup. The test crystals, table X section III, should be inserted in the crystal sockets for the following adjustments. Refer to figure 6-10 for alignment point location.

a. Before applying primary power, remove tube V1003 and place a 7-pin tube socket adapter in the socket. Refer to figure 6-5.

b. Replace V1003 and apply primary power.

c. Connect VTVM TS-375/U between pin 1 of V1003 (test point 14) and ground. Adjust to the 3-volt a-c scale.

d. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

e. Operate the channel selectors to the A1 position (2.0 megacycles).

f. Operate the OFF PHONE CW switch to the CW position and depress the telegraph key or microphone push-to-talk button.

g. Adjust the slugs of Z1002, Z1003, Z1004, and Z1005 for maximum indication on the TS-375/U.

h. Operate the channel selectors to the A8 position (3.75 megacycles).

i. Adjust the trimmer capacitors of Z1002, Z1003, Z1004, and Z1005 for maximum indication on the TS-375/U.

j. Repeat steps e through i until no further peaking is attainable. After completion, the TS-375/U should indicate at least 1-volt a-c.

## NOTE

The agc voltage applied to the variable i-f stage (V1002) should hold the voltage at pin 1 of V1003 at a reasonable level throughout the preceding steps.

6-69. BAND 3 MULTIPLIER ADJUSTMENTS. Maintain the equipment setup established in the preceding paragraph throughout the following steps:

a. Connect VTVM TS-375/U to pin 7 of second transmitter mixer V1003. Select the 3-volt a-c range.

b. Select the channel corresponding to 7.25-megacycle operation (band 3, position M1).

c. Depress the telegraph key or microphone push-to-talk button.

d. Adjust the slugs of the Z1007 and Z1006 for maximum reading on the TS-375/U. Refer to figure 6-10.

e. Select the channel corresponding to 14.25-megacycle operation (band 3, position M8).

f. Adjust the capacitors of both band 3 multipliers (Z1007 and Z1006) for maximum reading on the TS-375/U.

g. Repeat steps c through f until no further peaking is attainable. Meter readings should be not less than 2.5 volts a-c.

6-70. BAND 4 MULTIPLIER ADJUSTMENTS. Maintain the equipment setup of paragraph 6-69 throughout the following steps:

a. Select the channel corresponding to 14.25 megacycles (band 4, position U1).

b. Depress the telegraph key or microphone push-to-talk button.

c. Adjust the slugs of the two-band 4-multiplier coils (Z1009 and Z1008) for maximum indication on the TS-375/U.

d. Select the channel corresponding to 25.0-megacycle operation (band 4, position U9).

e. Adjust the capacitors of the band 4 multipliers (Z1009 and Z1008) for maximum indication on the TS-375/U.

f. Repeat steps a through d until no further peaking is achievable. The meter readings should be at least 1 volt a-c.

## NOTE

The slug-adjusting screws should be approximately centered in the slug-holding nuts for the multiplier stages to be tuned to the correct harmonic. If possible, use an accurately calibrated wavemeter to check the tuning.

6-71. R-F AND DRIVER ADJUSTMENTS. Maintain the 618S-1 or 618S-1A equipment in the test bench setup throughout the following procedures. The 614C-2 sensitivity and threshold controls should be at the maximum clockwise positions. Perform the following operations:

a. Operate the OFF PHONE CW switch to the PHONE position and allow at least 10 minutes for warmup.

b. Connect VTVM TS-375/U between J1001 (test point 12) and ground. Adjust to the 120-volt a-c range.

c. Operate the channel selectors to the A1 position (2.0 megacycles).

d. Depress the telegraph key or microphone push-to-talk button and lock in position.

e. Adjust the slugs of Z1014, Z1018, and Z1022 for maximum indication on the TS-375/U.

f. Operate the channel selectors to the A8 position (3.75 megacycles).

g. Perform steps e, f, and g with the exception that the trimmer capacitors should be adjusted instead of the inductors. The trimmer capacitors are adjustable through holes in the top of the indicated tuned circuits.

h. Repeat step c and steps e through g until no further peaking is attainable. The TS-375/U should read at least 85 volts a-c after completion of step j.

i. Repeat the adjustments outlined in step c and steps e through h for the frequencies listed in table XXIX. In each case, adjust the inductor or trimmer capacitor of the listed tuned circuit. Upon completion, VTVM TS-375/U should indicate at least 85 volts a-c throughout all of the 618S-1 or 618S-1A channels. Check several channels on each band.

TABLE XXIX. R-F AND DRIVER ADJUSTMENTS, BANDS 2, 3, AND 4

BAND	CHANNEL SELECTOR POSITION	OPERATING FREQUENCY (MC)	TUNED CIRCUIT	TYPE OF ADJUSTMENT
2	G1	3.75	Z1015, Z1019, Z1023	Inductor
	G8	7.25	Z1015, Z1019, Z1023	Trimmer Capacitor
3	M1	7.25	Z1016, Z1020, Z1024	Inductor
	M8	14.25	Z1016, Z1020, Z1024	Trimmer Capacitor
4	U1	14.25	Z1017, Z1021, Z1025	Inductor
	U9	25.00	Z1017, Z1021, Z1025	Trimmer Capacitor

6-72. ANTENNA ADJUSTMENTS. Maintain the 618S-1 or 618S-1A in the test bench setup throughout the succeeding steps. The 614C-2 sensitivity and threshold controls should be set to the maximum clockwise positions. Perform the following operations:

- a. Operate the OFF PHONE CW switch to the PHONE position and allow at least 10 minutes for warmup.
- b. Connect VTVM TS-375/U between terminal 5 of J310 (test point 7) and ground.
- c. Terminate J101 (test point 4) in 300 ohms. Output Meter TS-585B/U may be used if operated to the 300-ohm, 500-milliwatt position.
- d. Connect Signal Generator AN/URM-25 to J109 (test point 3).
- e. Select the channel corresponding to 2.0-megacycle operation (position A1).
- f. Adjust the frequency of the AN/URM-25 to 2.0 megacycles, and set the output level to approximately 3000 microvolts. Use Frequency Meter AN/USM-26 to set the AN/URM-25 frequency.
- g. Adjust the band 1 antenna coil slug for maximum avc voltage. Refer to figure 6-10, Z1010.
- h. Select the channel corresponding to 3.75-megacycle operation (position A8), and change the AN/URM-25 frequency to 3.75 mc. Maintain the AN/URM-25 output level to approximately 3000 microvolts.

- i. Adjust the band 1 antenna trimmer capacitor for maximum avc voltage. Refer to figure 6-10, Z1010.
- j. Repeat the procedures outlined in steps a through i for the low and high end points of bands 2, 3, and 4, using 25.0 mc as the high end point on band 4. Table XXIX lists the proper positions and frequencies. Refer to figure 6-10, Z1011, Z1012, and Z1013.

6-73. AGC ADJUSTMENTS. Maintain the 618S-1 or 618S-1A in the test bench setup and adjust the 614C-2 sensitivity and threshold controls to maximum. Perform the following operations:

- a. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.
- b. Depress the telegraph key or microphone push-to-talk button.
- c. Connect VTVM TS-375/U between terminal 6 of J308 (test point 16) and ground. If desired, the TS-375/U may be connected across resistor R1006. Adjust the TS-375/U to the negative 12-volt range.
- d. Procure values of R1006 as stated in the Illustrated Parts Breakdown, T.O. 12R2-4-6-4. The values listed are as follows: 4.7K, 5.6K, 7.8K, 8.2K, 10K, 12K, and 15K.
- e. Select correct value of R1006 by replacement which will give the voltage readings listed in table XXX.

TABLE XXX. SELECTION OF R1006

CHANNEL SELECTOR POSITION	OPERATING FREQUENCY (MC)	VOLTAGE READING
A1	2.00	-4 to -8
A2	2.25	-4 to -8
A3	2.50	-3 to -7
A8	3.75	-1 to -3



**6-74. POWER AMPLIFIER SUBASSEMBLY.**

6-75. Paragraphs 6-76 through 6-78 describe the procedures for alignment of the power amplifier subassembly. During the mechanical alignment procedures, the power amplifier subassembly should be removed from the main chassis. Refer to paragraphs 5-33 and 5-34 for the removal and replacement procedures. During the electrical alignment procedures, paragraph 6-78, the power amplifier subassembly should be installed in the main chassis, and the 618S-1 or 618S-1A should be connected in a test bench setup similar to figure 3-1. Further electrical adjustments than those detailed in paragraph 6-78 are not recommended by field maintenance personnel. All electrical and mechanical alignment points are identified in figures 6-11 through 6-13. All test points are identified in figure 3-1 and figures 6-21 through 6-23.

**6-76. SWITCH ALIGNMENT AND ADJUSTMENTS.**

Before performing the procedures outlined in steps a through d, the power amplifier subassembly should be removed from the main chassis. Perform the following operations with reference to figures 6-11 through 6-13:

a. The contact pressure on S1504 should be 80-120 grams. Adjust the setscrews on both switch arms

for this pressure, using a gram gauge or similar instrument for measurement. The long switch arm of S1504 should clear the cam gear by 1/64 inch when this switch is in the closed position.

b. Synchronize S1503 and S1504, as shown in figure 6-13, so that S1504 is open when S1503 is in the band 1 position and closed in band positions 2, 3, and 4. It may be necessary to loosen the setscrew in gear O1513. Refer to figures 6-11 and 6-13 for location of this gear.

**NOTE**

It may be necessary to move capacitor C1523 in order to place a Bristo wrench in the setscrews. This can be accomplished by removing the screws, nuts, and spacers used to mount C1523, and the screw and nut holding the ground lead of C1523 in place. Capacitor C1523 then can be pushed aside during alignment.

c. Set S1503 in the band 4 position. Refer to figure 6-12. Position coupler O1521 and switches S1501, S1502, S1503, and S1506 as indicated in figure 6-12. To accomplish this, it may be necessary to loosen

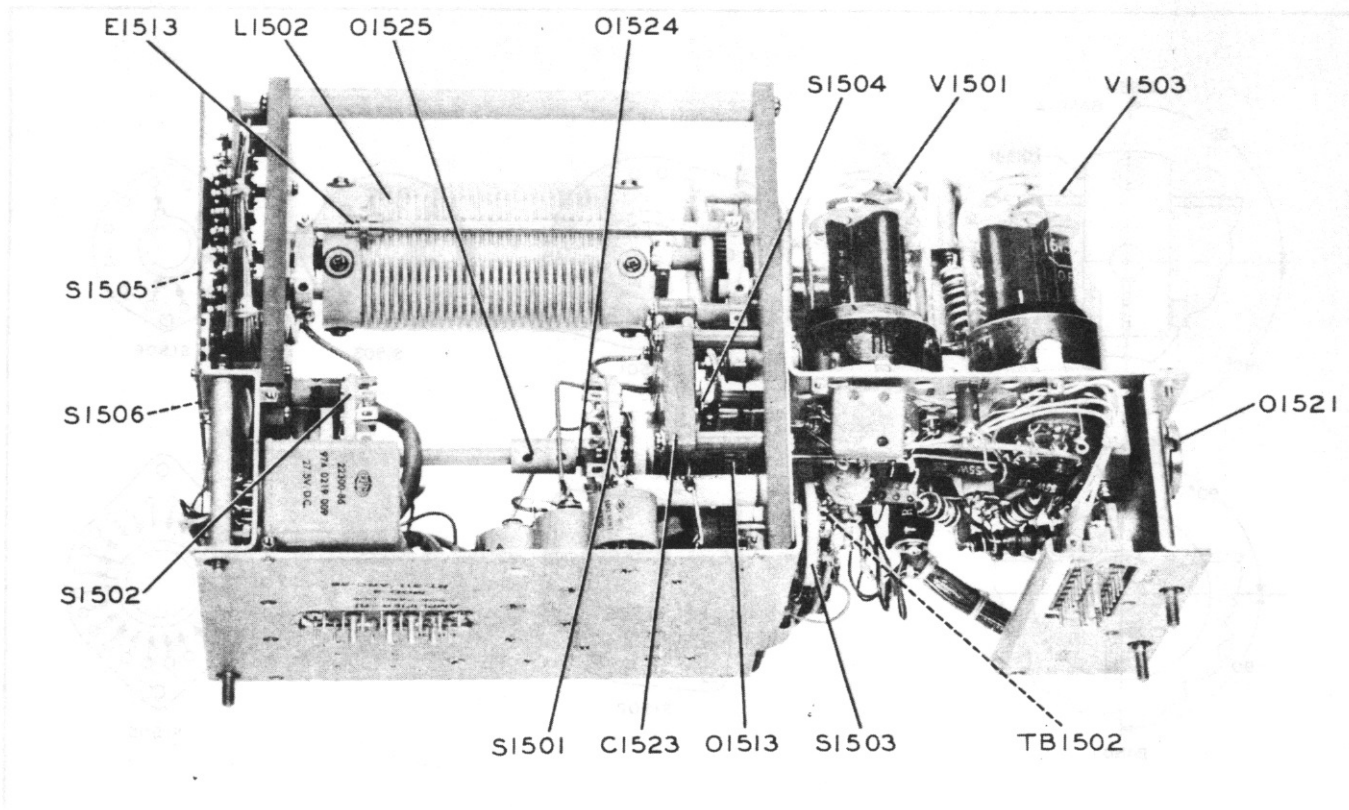


Figure 6-11. Power Amplifier Subassembly, Left Oblique View, Mechanical Alignment Points

setscrews in the clamp of coupler O1521 and rotate the switch shaft manually. Switch S1505 will be aligned according to the following paragraph.

d. Tighten all setscrews permanently after completing steps b and c.

**6-77. ROLLER COIL ADJUSTMENTS.** Steps a through c describe the mechanical adjustments necessary for synchronization of main tuning inductor L1502. Before performing the procedures outlined in steps a through c, the power amplifier subassembly should be removed from the main chassis. Perform the following operations with reference to figure 6-11.

a. The contact pressure on the front and back slip rings of L1502 should be 80-120 grams. Adjust the setscrews of each contact for this pressure, using a gram gauge or similar instrument for measurement. The pressure, at the point of contact between the roller inductor (L1502) and the roller wheel (E1513), should be 12-14 oz. Adjust for this pressure with the roller wheel at each end of L1502.

b. Rotate inductor L1502 until switch S1505 is in the position shown in figure 6-12.

c. Roller E1513 should make contact with L1502 approximately one turn from the end of L1502 (end toward S1505). Moving the roller along the shaft, adjust the position of roller E1513 by applying pressure to the roller shaft in a direction away from L1502.

**6-78. PA DISCRIMINATOR ADJUSTMENTS.** In the following steps, the power amplifier subassembly should be replaced in the main chassis, and the 618S-1 or 618S-1A should be connected in a test bench setup. Refer to paragraphs 5-33 and 5-34 for the replacement procedures and to figure 3-1 for a typical test bench setup. Perform the following operations:

a. Operate the OFF PHONE CW switch to the PHONE position and allow at least 10 minutes for warmup.

b. Depress the telegraph key or microphone push-to-talk button.

c. Remove the PA chopper (G601 of the pa servo amplifier subassembly).

d. Observe the front panel meter with the meter selector switch in the P.A. PL. position.

e. Rotate the roller inductor (L1502) with an insulated material, and observe if the meter indication can be reduced.

**CAUTION**

An insulated material must be used to rotate L1502. Do not use a material which will draw r-f or short out L1502.

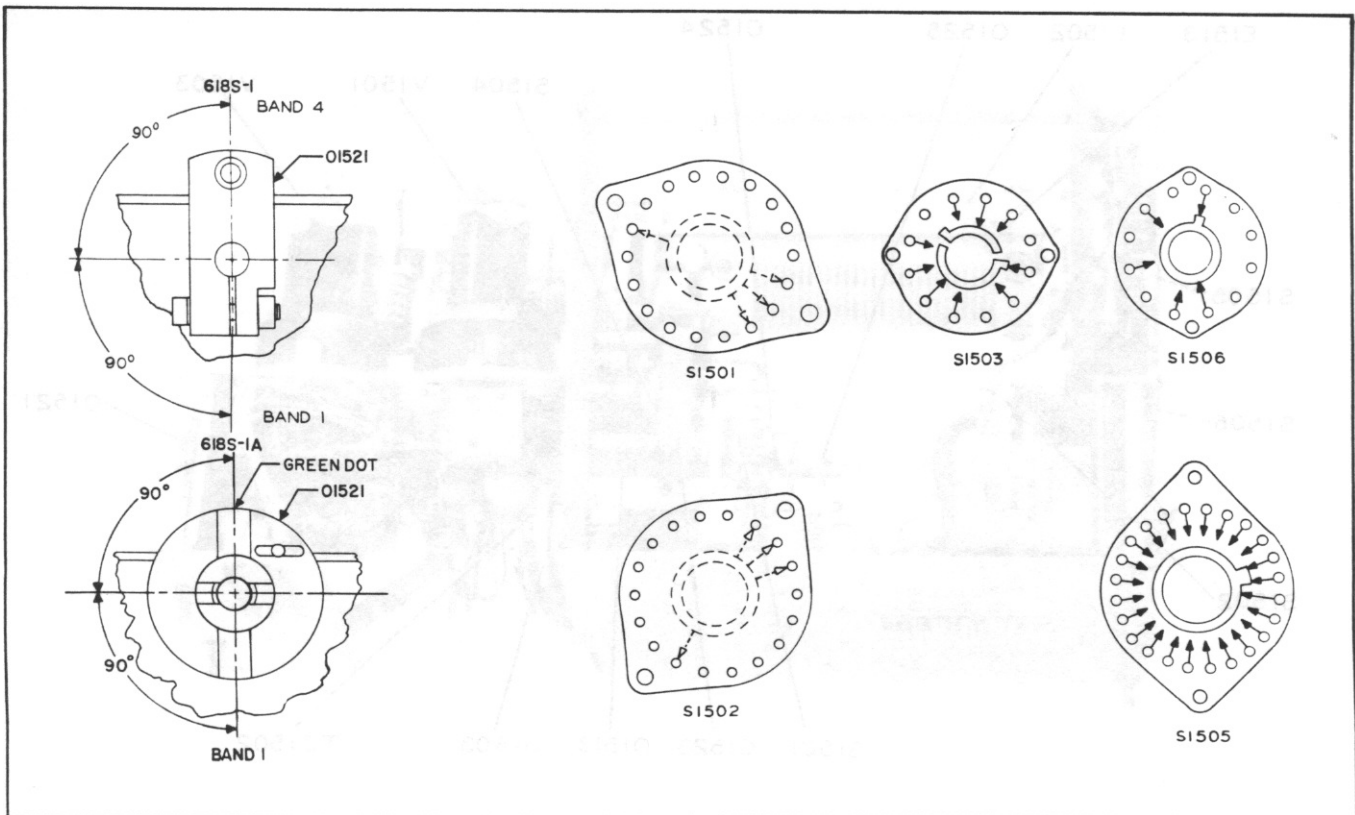


Figure 6-12. Power Amplifier Subassembly, Switch and Coupler Alignment

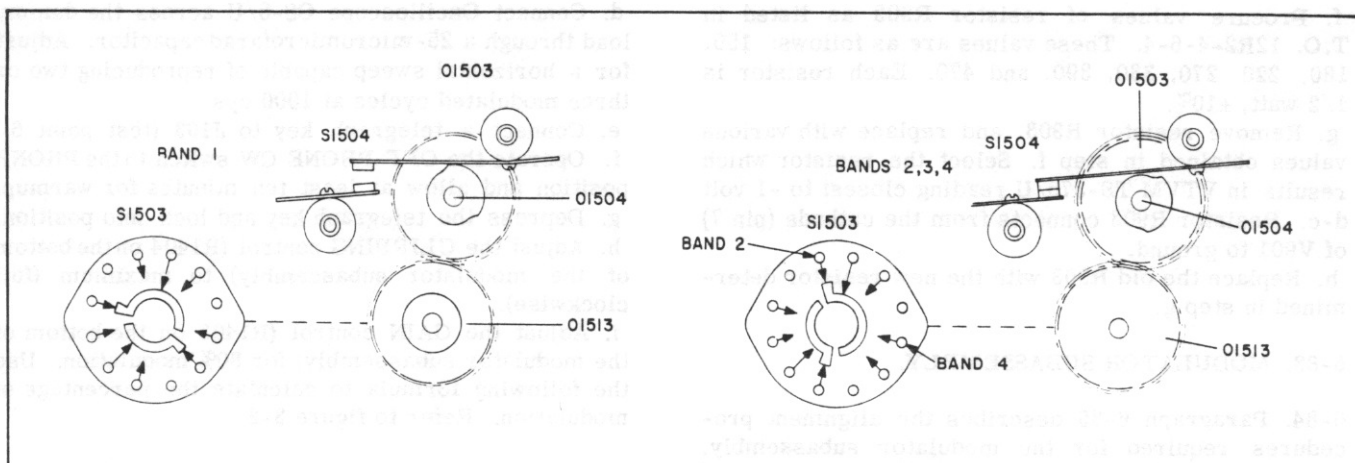


Figure 6-13. Power Amplifier Subassembly, Alignment of Switch S1504

f. If the current can be reduced by more than 1/5 scale division in step e, resistor R1524 should be replaced.

g. Procure values of R1524 as listed in the Illustrated Parts Breakdown, T.O. 12R2-4-6-4. These values are as follows: 1200, 1500, 1800, 2200, 2700, 3300, 3900, 5600, and 8200 ohms. Each resistor is 1/2 watt,  $\pm 10\%$ .

h. Remove resistor R1524 from terminal board TB1502, and replace with various values obtained in step g. Select a value which gives a scale reduction of less than 1/5 division on the front panel meter when L1502 is rotated throughout its range.

i. Replace the old R1524 with the new resistor determined in step h.

#### 6-79. I-F AMPLIFIER SUBASSEMBLY.

6-80. Paragraphs 6-81 and 6-82 describe the procedures for alignment of the i-f amplifier subassembly. All test points are indicated in figure 3-1, figures 6-21 through 6-23, and the main schematic diagram, figure 7-19. All alignment points are identified on figure 6-22.

6-81. TUNED CIRCUIT ADJUSTMENTS. Throughout the alignment procedures, steps a through h of this paragraph, the 618S-1 or 618S-1A should be connected to a test bench setup similar to figure 3-1. Perform the following operations:

a. Remove the second receiver mixer tube, V1006, from the tube socket, and insert a 7-pin tube socket adapter. Refer to figure 6-5 for the location of V1006.

b. Insert V1006 into the tube socket adapter, and connect Signal Generator AN/URM-25 from pin 1 (test point 17) to ground. Adjust the AN/URM-25 to 500 microvolts, modulated 30% at 1000 cps, and set the r-f frequency to 250 kilocycles with Frequency Meter AN/USM-26.

c. Connect VTVM TS-375/U between terminal 5 of J310 (test point 7) and ground. Adjust to the negative 12-volt scale.

d. Connect Output Meter TS-585B/U to the PHONE jack (test point 4). Adjust the TS-585B/U to the 500-milliwatt range with an internal impedance of 300 ohms. If desired, Headset H-4/AR or H-1/AR may be connected to either the PHONE jack or terminal b of P2601 for aural monitoring. However, to afford proper loading, the TS-585B/U and the H-4/AR or H-1/AR should not be used simultaneously.

e. Operate the OFF PHONE CW switch to the PHONE position, and allow at least ten minutes for warmup.

f. Adjust the slug of Z901 for maximum indication on VTVM TS-375/U. Tuned circuit Z901 is located on the forward left corner of the i-f amplifier subassembly.

g. Reduce the output level of the AN/URM-25 to 200 microvolts, but maintain the 1000-cps, 30%-modulation.

h. Adjust the slug of Z902 for maximum indication on Output Meter TS-585B/U. Tuned circuit Z902 is located next to Z901.

6-82. I-F GAIN ADJUSTMENTS. Maintain the 618S-1 or 618S-1A in the test bench setup, and leave all test equipment connected, as described in the preceding paragraph. Steps a through h of this paragraph will be performed more easily with the i-f amplifier subassembly removed from the main chassis and connected with the proper extension cable (figure 2-5). Perform the following operations:

a. With Signal Generator AN/URM-25 still connected to pin 1 (test point 17) of V1006, adjust the r-f level to 200 microvolts unmodulated. Reset the AN/URM-25 frequency to 250 kilocycles with Frequency Meter AN/USM-26.

b. Operate the 614C-2 sensitivity and threshold controls to the maximum clockwise positions.

c. With VTVM TS-375/U still connected to terminal 5 of J310 (test point 7), adjust to the negative 3-volt range.

d. Operate the OFF PHONE CW switch to the PHONE position, and allow at least 10 minutes for warmup.

e. Observe the indication on VTVM TS-375/U. The reading should be approximately -1 volt d-c.

f. Procure values of resistor R903 as listed in T.O. 12R2-4-6-4. These values are as follows: 150, 180, 220, 270, 330, 390, and 470. Each resistor is 1/2 watt, ±10%.

g. Remove resistor R903, and replace with various values obtained in step f. Select the resistor which results in VTVM TS-375/U reading closest to -1 volt d-c. Resistor R903 connects from the cathode (pin 7) of V901 to ground.

h. Replace the old R903 with the new resistor determined in step g.

#### 6-83. MODULATOR SUBASSEMBLY.

6-84. Paragraph 6-85 describes the alignment procedures required for the modulator subassembly. If desired, the modulator subassembly may be removed from the main chassis during the alignment procedures. Reference is made to paragraph 2-9 and figure 2-6 for the necessary cable fabrication data. The removal and replacement procedures are covered in paragraph 5-30. All test points are indicated in figure 3-1, figure 6-21, and figure 7-19, and all alignment points are indicated in figure 6-23.

6-85. GAIN AND CLIPPING ADJUSTMENTS. Connect the 618S-1 or 618S-1A in a test bench setup similar to figure 3-1, and perform the following operations:

a. Connect the dummy microphone (figure 2-1) to J102 (test point 5).

b. Connect VTVM TS-375/U and Audio Oscillator TS-382A/U to the dummy microphone as illustrated in figure 2-1. Adjust the TS-375/U to the 1.2-volt a-c range and the TS-382A/U for an output of 0.25 volt a-c at 1000 cps.

c. Connect the dummy load between E102 or J110 and ground (test point 1).

d. Connect Oscilloscope OS-8/U across the dummy load through a 25-micromicrofarad capacitor. Adjust for a horizontal sweep capable of reproducing two or three modulated cycles at 1000 cps.

e. Connect a telegraph key to J103 (test point 6).

f. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

g. Depress the telegraph key and lock into position.

h. Adjust the CLIPPING control (R1404 on the bottom of the modulator subassembly) to maximum (full clockwise).

i. Adjust the GAIN control (R1403 on the bottom of the modulator subassembly) for 80% modulation. Use the following formula to calculate the percentage of modulation. Refer to figure 3-2.

$$\% \text{ Modulation} = \frac{\text{Maximum} - \text{Minimum}}{\text{Maximum} + \text{Minimum}} \times 100$$

j. Adjust the CLIPPING control for threshold at the 80% modulation point.

#### 6-86. RADIO SET CONTROL 614C-2.

6-87. Paragraph 6-88 describes the mechanical alignment procedures required for Radio Set Control. All necessary electrical adjustments are covered in paragraph 6-96. All alignment points are indicated in figure 6-14, and all switch positions are illustrated in figure 6-15.

6-88. SWITCH ALIGNMENT. Steps a through l describe the procedures necessary for alignment of the channel selector switches (S2601 and S2602) and the OFF PHONE CW switches (S2603A and S2603B). Perform the following operations:

a. Operate the OFF PHONE CW switch to the OFF position and the channel selectors to the A1 position.

b. Turn the two Dzus fasteners at the rear of the 614C-2, and remove the cover.

c. View switches S2601, S2602, S2603A, and S2603B from the front and compare with figure 6-15. The positions should correspond; if not, proceed to the applicable steps. Switches S2603A and S2603B are adjusted in steps d through f, and switches S2601 and S2602 are adjusted in steps g through j.

d. Loosen the two setscrews of the OFF PHONE CW switch knob and remove knob.

e. Rotate the shaft of S2603A and S2603B until the positions correspond with figure 6-15. An alternate method is to replace the knob in a different position from which removed, and rotate to the OFF position. By trial and error, the alternate method may be employed until the switch positions correspond to the knob in the OFF position.

f. Replace the OFF PHONE CW switch knob and rotate to the OFF position. Proceed to step k.

g. Remove four Phillips-head screws securing the masking plate and remove the masking plate.

h. Loosen the setscrews securing the selector knobs and remove the selector knobs.

i. Rotate the shaft of S2601 and S2602 until the positions correspond with figure 6-15.

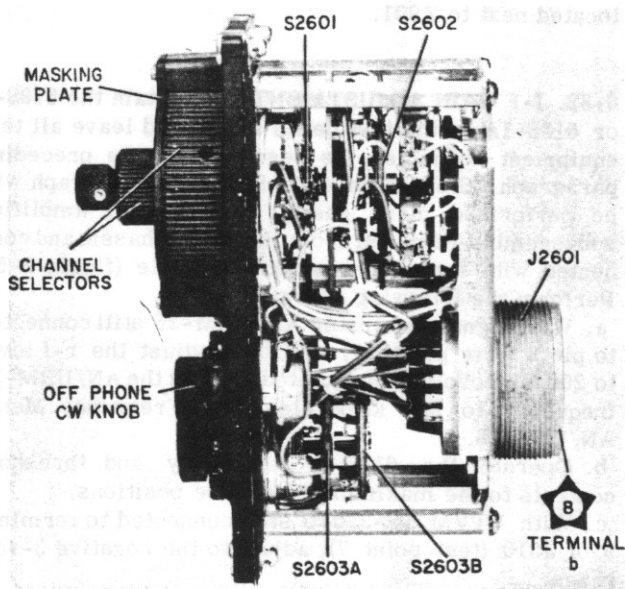


Figure 6-14. Radio Set Control 614C-2, Bottom View, Cover Removed

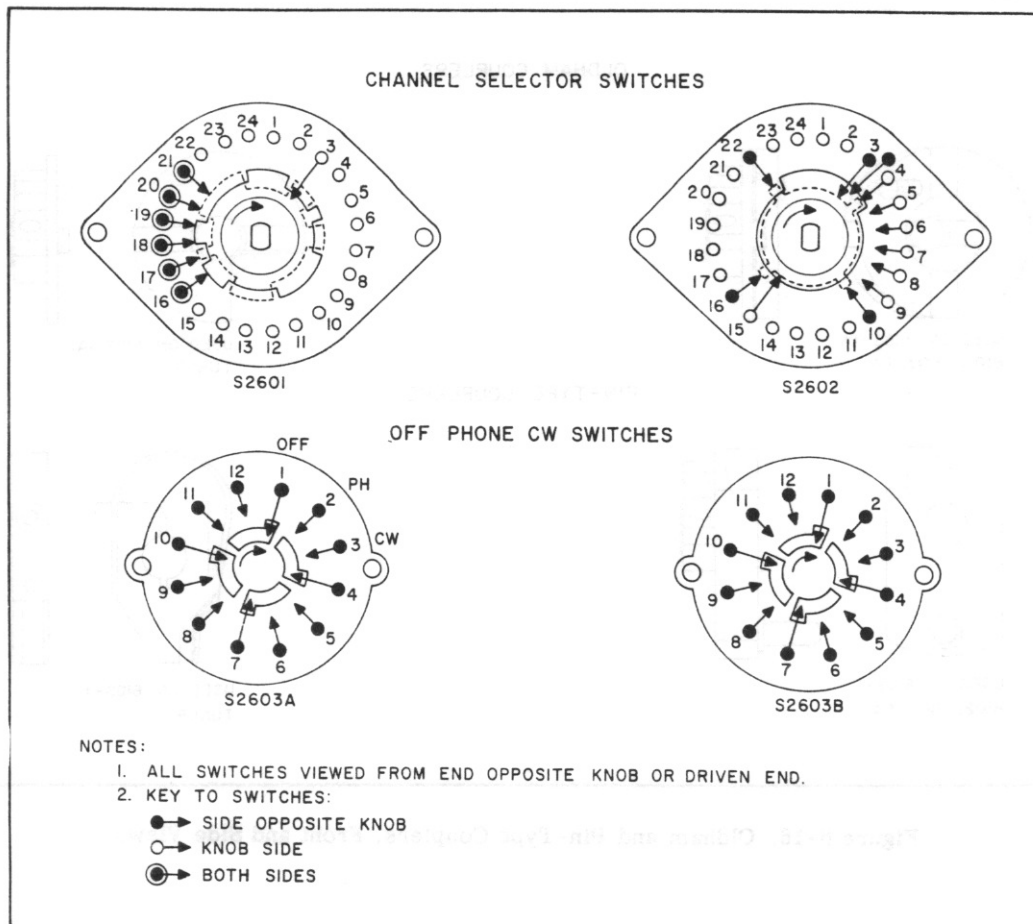


Figure 6-15. Radio Set Control 614C-2, Correct Switch Alignment

j. Replace the channel selector knobs and the masking plate. Make sure the channel selector knobs are in positions A and 1 when replaced. Proceed to step k.

k. Replace the cover and secure with the two  $\text{Dzus}$  fasteners.

1. After completion of the switch synchronization procedures, the 614C-2 should be tested. Perform the frequency selection tests outlined in paragraph 3-11.

#### 6-89. CONVERSION OF 618S-1 TO 618S-1A.

6-90. Conversion of Radio Set 618S-1 to Radio Set 618S-1A consists of removing the pin-type couplers from the tuner and power amplifier subassemblies and the bandchange autopositioner and servomotor B102 units, and replacing with Oldham couplers. The Oldham couplers employed differ from regular Oldham couplers in that the center guide (or slider) is held captive to one of the couplers by a pin. This pin, and a notch in the mating coupler, serve to assure non-ambiguity of coupler engagement. Figure 6-16 illustrates both the pin-type and Oldham couplers and the mating coupler of each. Reference is made to paragraph 1-23 and table III for a brief description of the affected units and subassemblies and the new MOD numbers. Paragraphs 6-91 through 6-95 describe

the method of conversion, as well as the interchangeability and part requirements involved.

6-91. INTERCHANGEABILITY. The four units which are affected, the tuner subassembly, the power amplifier subassembly, the bandchange autopositioner unit, and servomotor B102 unit, cannot be replaced directly. However, with the proper parts (table XXXI) and a hack saw, grinder, or file, conversion can be accomplished without too much difficulty.

#### 6-92. CONVERSION PROCESSES.

6-93. SHAFT LENGTH REDUCTIONS. The simplest method of shaft conversion is to reduce the shaft lengths. Using new shafts would require disassembly, whereas shafts may be shortened without removing them from the subassemblies or units. No changes are required on the tuner subassembly shafts. The pin-type couplers still may be used after the shaft reductions. Modify the power amplifier subassembly, bandchange autopositioner unit, and servomotor B102 unit shafts as follows:

- a. Reduce the shaft of servomotor B102 unit by cutting off  $3/32$  inch.
- b. Reduce the shaft of the bandchange autopositioner unit by cutting off  $5/64$  inch.
- c. Reduce the shaft of the power amplifier subassembly by cutting off  $1/8$  inch.

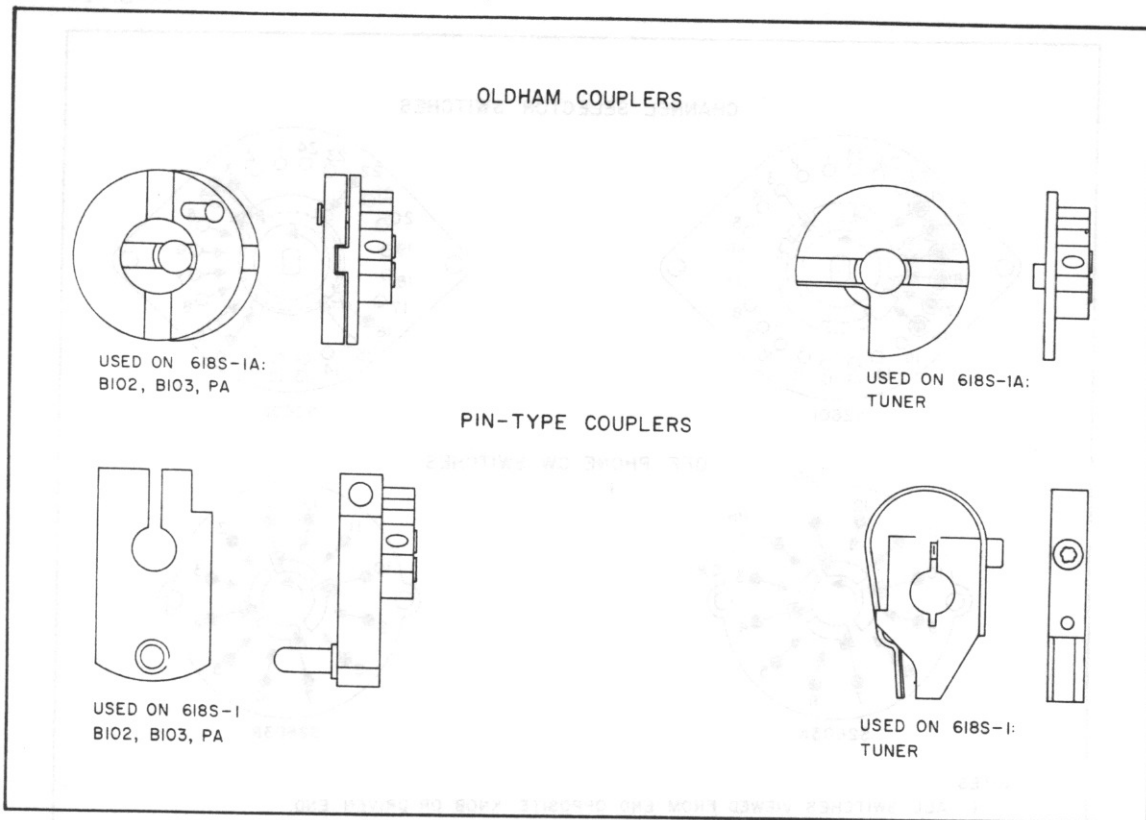


Figure 6-16. Oldham and Pin-Type Couplers, Front and Side Views

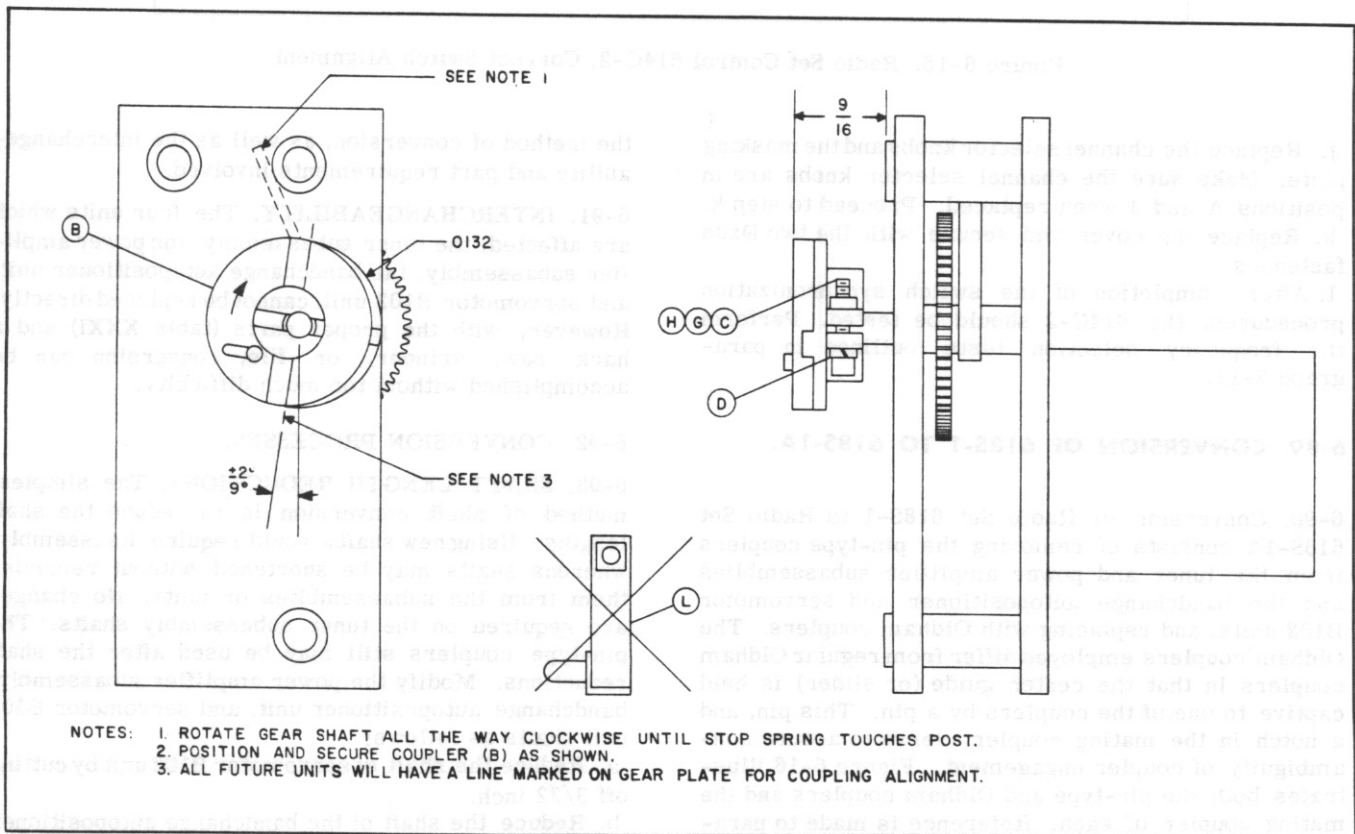


Figure 6-17. Installation of Oldham Couplers on Servomotor B102 Unit

TABLE XXXI. PARTS REQUIRED FOR CONVERSION OF 618S-1 TO 618S-1A

ITEM	QUANTITY REQUIRED	COLLINS PART NUMBER	DESCRIPTION
PARTS REQUIRED FOR CONVERSION			
A	3	540 7421 003	Coupler - Split Hub, 1 Dial, Notched
B	3	540 7420 003	Coupler - Split Hub, Riveted
C	5	504 7537 002	Clamp - Gear, 0.312 Diameter
D	6	310 3340 00	Washer - Spring Lock No. 4
E	2	310 0148 00	Washer - Tension
F	3	310 0059 00	Washer - Flat No. 10
G	6	324 0300 00	Screw - Cap, 4-40 x 1/2
H	6	334 0485 00	Nut - 3/16 Square, 4-40
J	1	540 9956 002	Clamp - Graduated
PARTS TO BE REMOVED			
K	3	506 6928 002	Coupler - Spring Loaded
L	3	506 6618 002	Clamp - Special
M	1	506 7416 002	Post - Spacing, 0.3125 x 0.200
N	2	506 5908 003	Washer - 0.0156 Thick x 0.255 Inside Diameter
USE OF THE FOLLOWING PARTS IS OPTIONAL			
P	1	540 7426 002	Gear - Switch, 64
R	1	506 6607 002	Gear - Shaft, 136
S	1	506 7389 002	Shaft - Switch, Cam

6-94. INSTALLATION OF OLDHAM COUPLERS. Remove old parts and install new parts as directed in the following steps. Refer to table XXXI and figures 6-17 through 6-20.

a. Servomotor B102 unit: Remove clamp (L) and install coupler (B) on shaft using clamp (C), washer (D), screw (G), and nut (H). Position coupler as shown in figure 6-17.

b. Bandchange autopositioner unit: Follow the same procedure as described in step a. Position coupler as shown in figure 6-18.

c. Tuner subassembly: Remove three couplers (K) and two of the three washers (N) on the rear of the tuner subassembly. Install three couplers (A) using clamps (C), washers (D), screws (G), and nuts (H). Position couplers as shown in figure 6-19. Reference

is made to figure 6-7 for band 1 switch positions.

d. Power amplifier subassembly: Remove clamp (L), post (M), and gear clamp. Install three washers (F), two washers (E), and coupler (B), on shaft using clamp (J), washer (D), screw (G), and nut (H). Position coupler as shown in figure 6-20. Reference is made to figure 6-12 for band 4 switch positions.

6-95. REINSTALLATION PROCEDURES. The subassembly reinstallation procedures are covered in paragraph 5-27 and subsequent paragraphs of this handbook. However, certain precautions should be observed after completion of the conversion processes. These precautions are covered in steps a through e of this paragraph.

a. Tighten all screws (G) to 10-12 inch-pound.

b. The  $90 \pm 1/2$  degree angular setting of the couplers indicated in figures 6-17 through 6-20 may be obtained with sufficient accuracy by using any reasonably square object, or by eye if sufficient care is taken and if initial switch positioning is good. The  $9 \pm 2$  degree setting on servomotor B102 unit, figure 6-17, requires a simple tool or protractor.

c. The tuning rack on the tuner subassembly should be in the bottom position (refer to paragraphs 6-66 and 6-67). The coupler of servomotor B102 unit should be turned to the extreme clockwise position (when viewed from the shaft end) then rotated counterclockwise 9 degrees when being installed in the 618S-1 or 618S-1A main component.

d. The couplers on the units should be color coded (refer to notes on figures 6-17 through 6-20) to indicate proper angular positions when inserting or removing the units. When the red dots of the front tuner subassembly couplers (O1033 and O1034) are up, the tuner subassembly may be inserted or removed with all other units in place (band 1 switch position and tuning rack in bottom position). When the green dot on the rear tuner subassembly coupler (O1034) is up, the power amplifier subassembly may be inserted or removed with all other units in place (band 4 position).

**CAUTION**

Failure to have couplers properly positioned (pin engaged in notch) will prevent equipment from operating properly and may damage tubes. The couplers may be damaged also, when inserting or removing units.

e. Locating dimensions shown in figures 6-17 through 6-20 are approximate and couplers should be adjusted axially for proper engagement (approximately 0.010 inch running clearance) after units are installed. Care should be taken to avoid rotating the couplers out of position.

**6-96. FINAL ADJUSTMENTS.**

6-97. The adjustment procedures described in paragraphs 6-98 through 6-101 should be performed following completion of the alignment and testing procedures outlined in this section. The final adjustments consist of setting the AUDIO, PHONE SIDETONE, and CW SIDETONE controls of Radio Receiver-Transmitter 618S-1 or 618S-1A and setting the threshold control of Radio Set Control 614C-2.

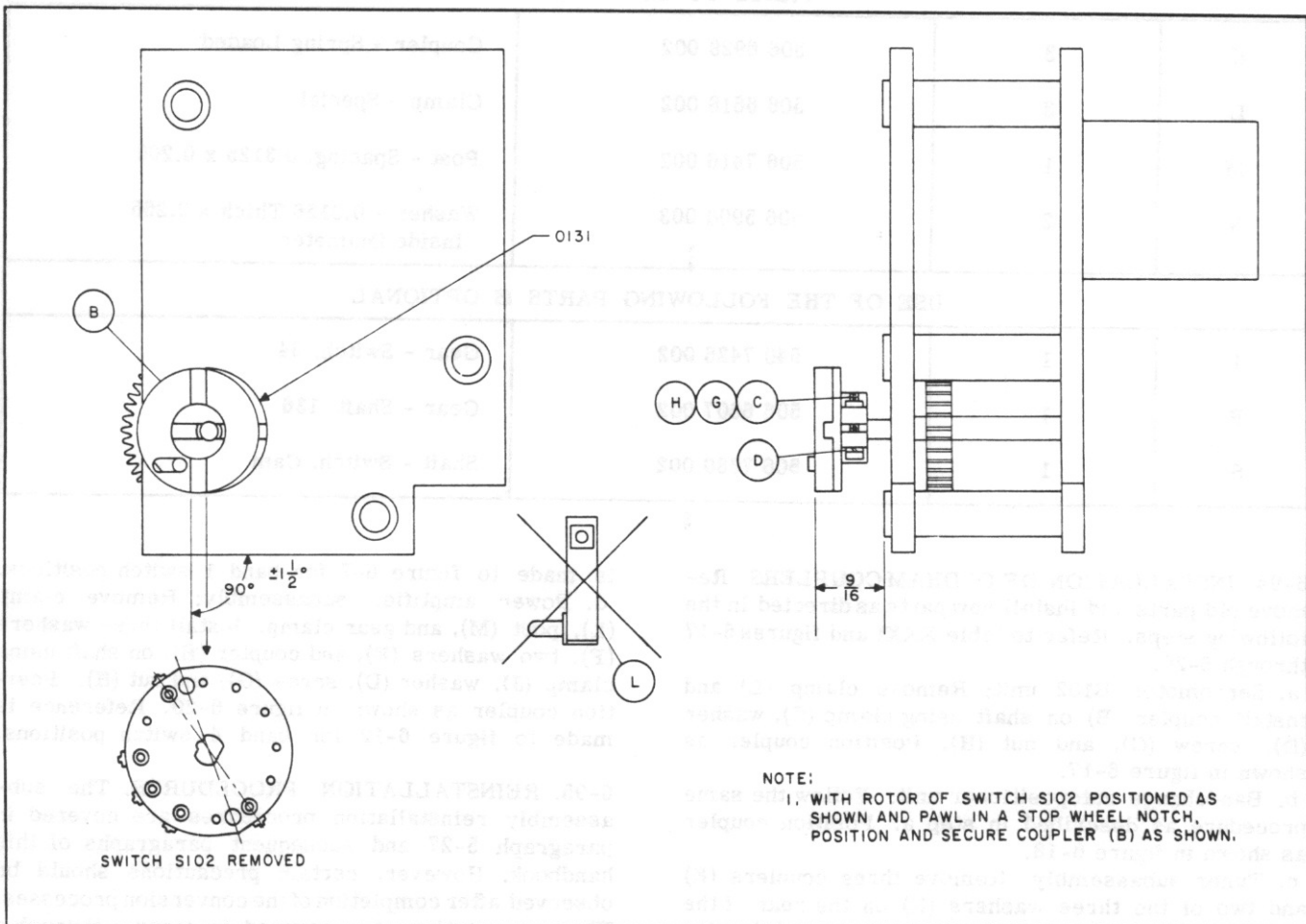


Figure 6-18. Installation of Oldham Couplers on Bandchange Autopositioner Unit



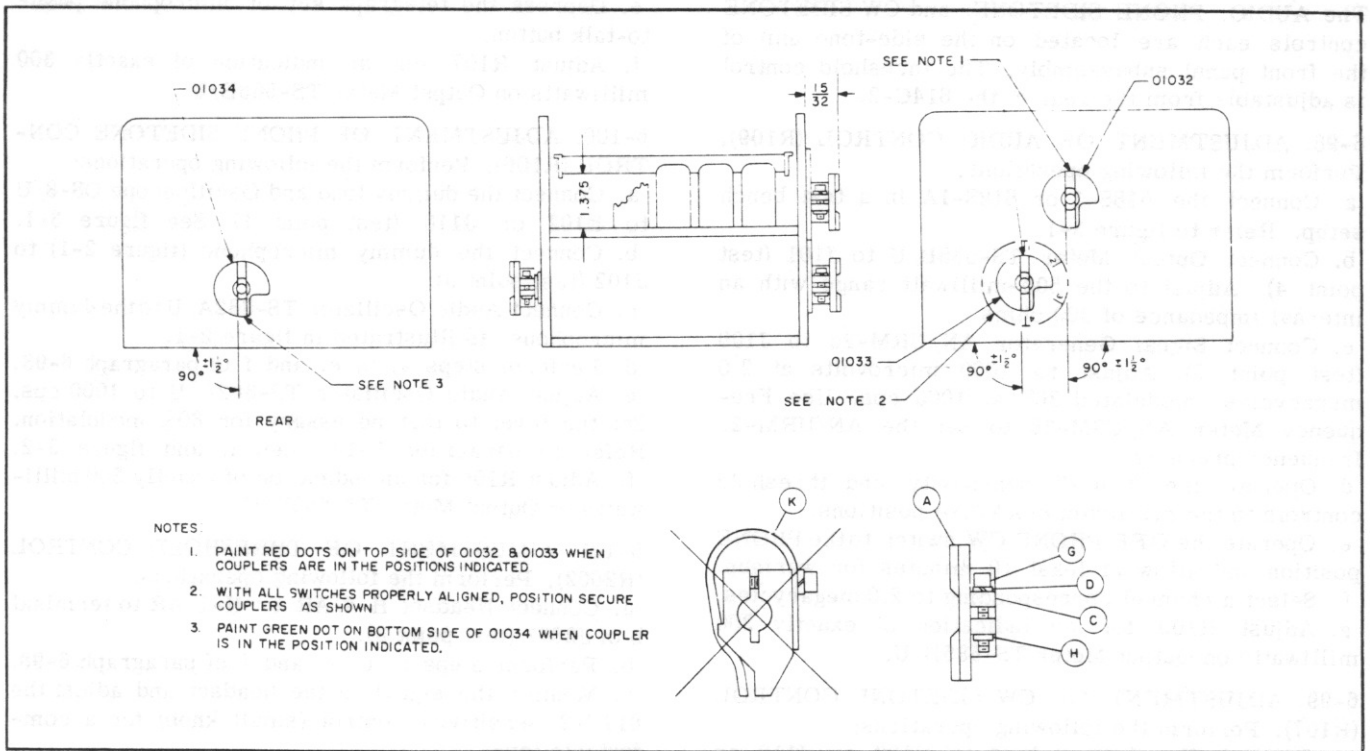


Figure 6-19. Installation of Oldham Couplers on Tuner Subassembly

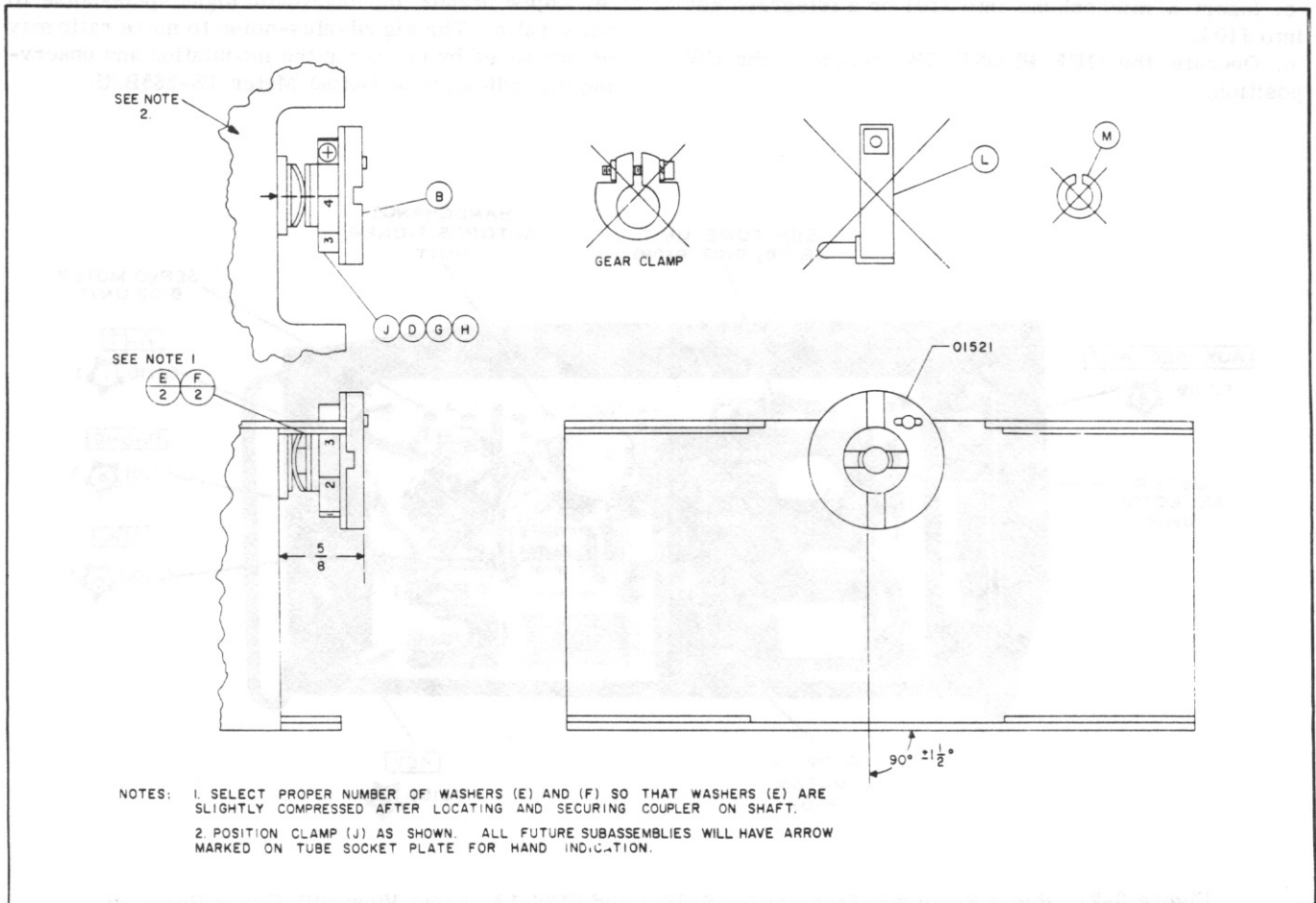


Figure 6-20. Installation of Oldham Couplers on Power Amplifier Subassembly

The AUDIO, PHONE SIDETONE, and CW SIDETONE controls each are located on the side-tone unit of the front panel subassembly. The threshold control is adjustable from the rear of the 614C-2.

**6-98. ADJUSTMENT OF AUDIO CONTROL (R109).**

Perform the following operations:

- a. Connect the 618S-1 or 618S-1A in a test bench setup. Refer to figure 3-1.
- b. Connect Output Meter TS-585B/U to J101 (test point 4). Adjust to the 500-milliwatt range with an internal impedance of 300 ohms.
- c. Connect Signal Generator AN/URM-25 to J109 (test point 3). Adjust to 1000 microvolts at 2.0 megacycles, modulated 30% at 1000 cps. Use Frequency Meter AN/USM-26 to set the AN/URM-25 frequency properly.
- d. Operate the 614C-2 sensitivity and threshold controls to the maximum clockwise positions.
- e. Operate the OFF PHONE CW switch to the PHONE position and allow at least 10 minutes for warmup.
- f. Select a channel corresponding to 2.0 megacycles.
- g. Adjust R109 for an indication of exactly 300 milliwatts on Output Meter TS-585B/U.

**6-99. ADJUSTMENT OF CW SIDETONE CONTROL (R107).** Perform the following operations:

- a. Connect the dummy load to E102 or J110 as illustrated in figure 3-1.
- b. Perform steps a, b, e, and f of paragraph 6-98.
- c. Insert a microphone into J101 or a telegraph key into J103.
- d. Operate the OFF PHONE CW switch to the CW position.

e. Depress the telegraph key or microphone push-to-talk button.

f. Adjust R107 for an indication of exactly 300 milliwatts on Output Meter TS-585B/U.

**6-100. ADJUSTMENT OF PHONE SIDETONE CONTROL (R106).** Perform the following operations:

- a. Connect the dummy load and Oscilloscope OS-8/U to E102 or J110 (test point 1). See figure 3-1.
- b. Connect the dummy microphone (figure 2-1) to J102 (test point 5).
- c. Connect Audio Oscillator TS-382A/U to the dummy microphone, as illustrated in figure 2-1.
- d. Perform steps a, b, e, and f of paragraph 6-98.
- e. Adjust Audio Oscillator TS-382A/U to 1000 cps. Set the level to that necessary for 80% modulation. Refer to paragraph 3-14, step i, and figure 3-2.
- f. Adjust R106 for an indication of exactly 300 milliwatts on Output Meter TS-585B/U.

**6-101. ADJUSTMENT OF THRESHOLD CONTROL (R2602).** Perform the following operations:

- a. Connect Headset H-4/AR or H-1/AR to terminal b of J2601 (test point 8).
- b. Perform steps a, c, e, and f of paragraph 6-98.
- c. Monitor the signal in the headset and adjust the 614C-2 sensitivity control (small knob) for a comfortable level.
- d. Disconnect the headset and connect Output Meter TS-585B/U to J101 (test point 4).
- e. Adjust R2602 for maximum signal-plus-noise to noise ratio. The signal-plus-noise to noise ratio may be measured by removing the modulation and observing the indication on Output Meter TS-585B/U.

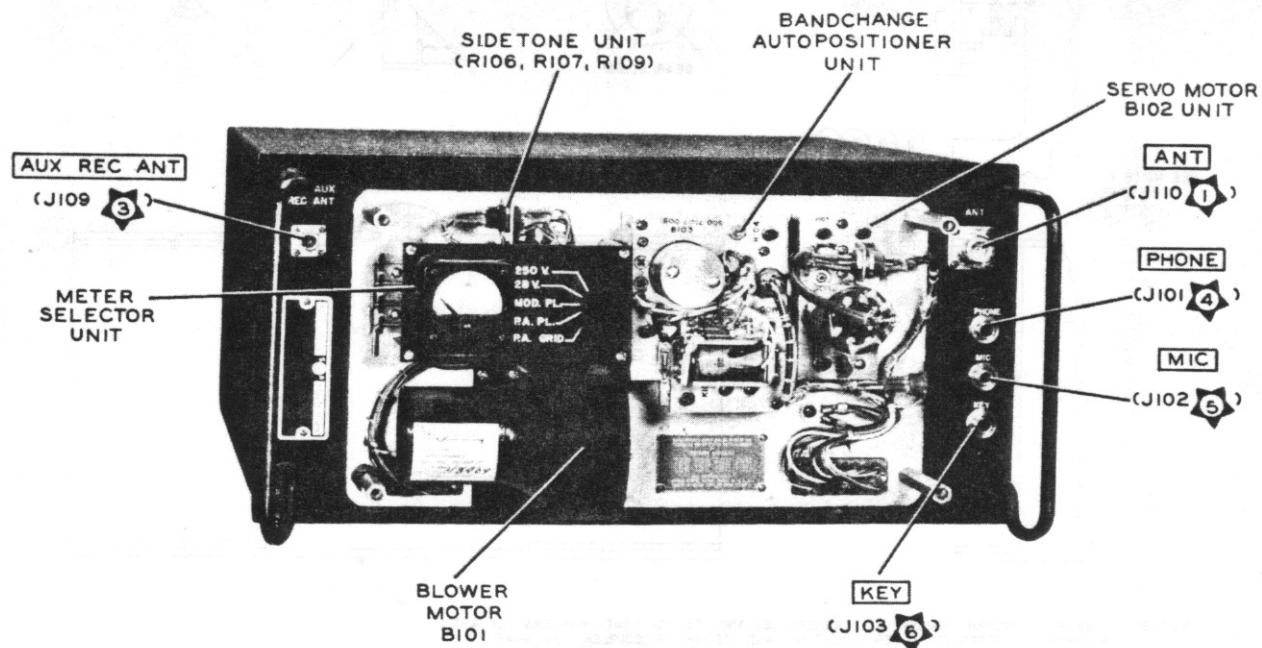


Figure 6-21. Radio Receiver-Transmitter 618S-1 and 618S-1A, Front View with Cover Removed, Test and Alignment Point Location

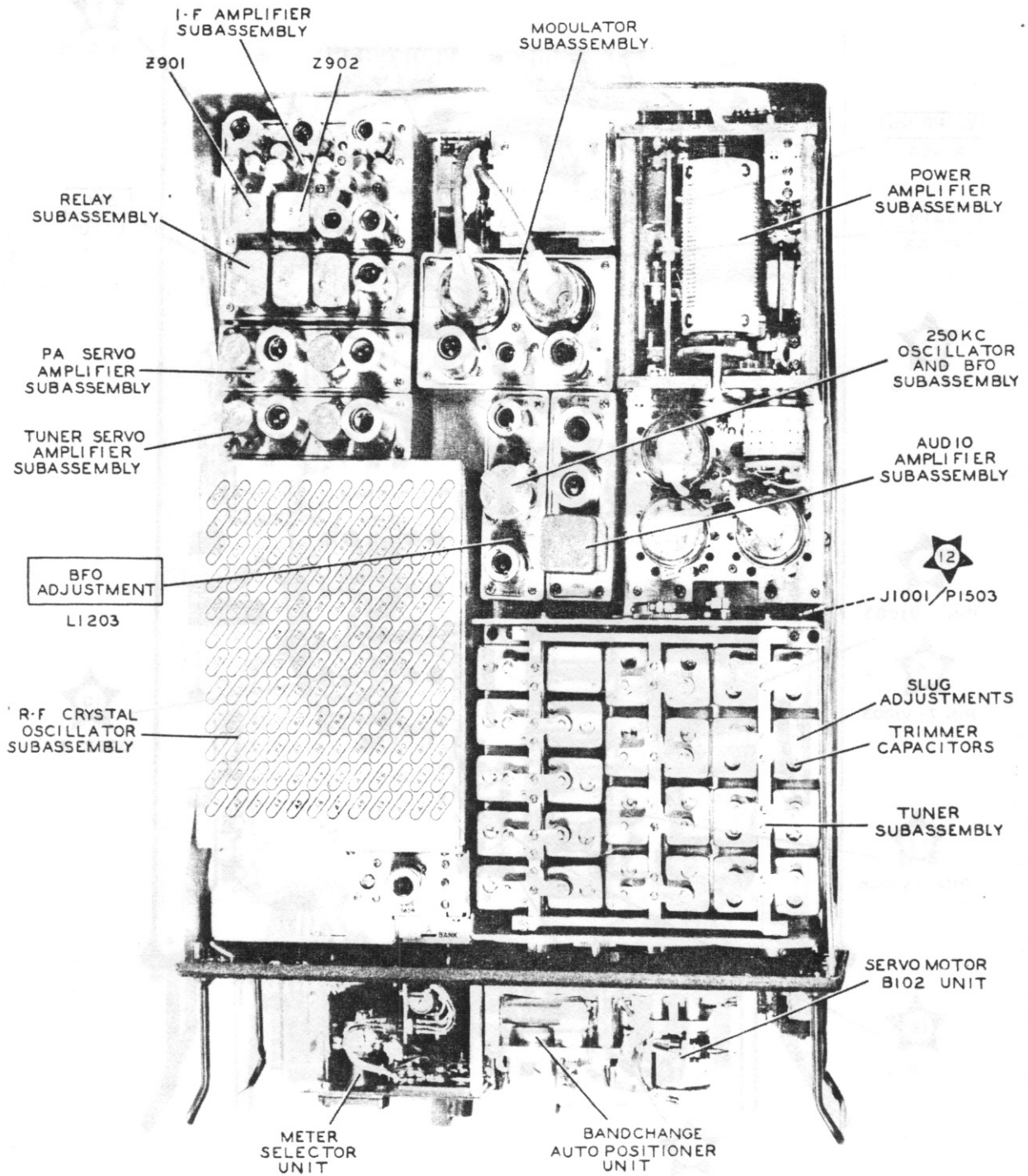


Figure 6-22. Radio Receiver-Transmitter 618S-1 and 618S-1A, Top View with Cover Removed, Test and Alignment Point Location

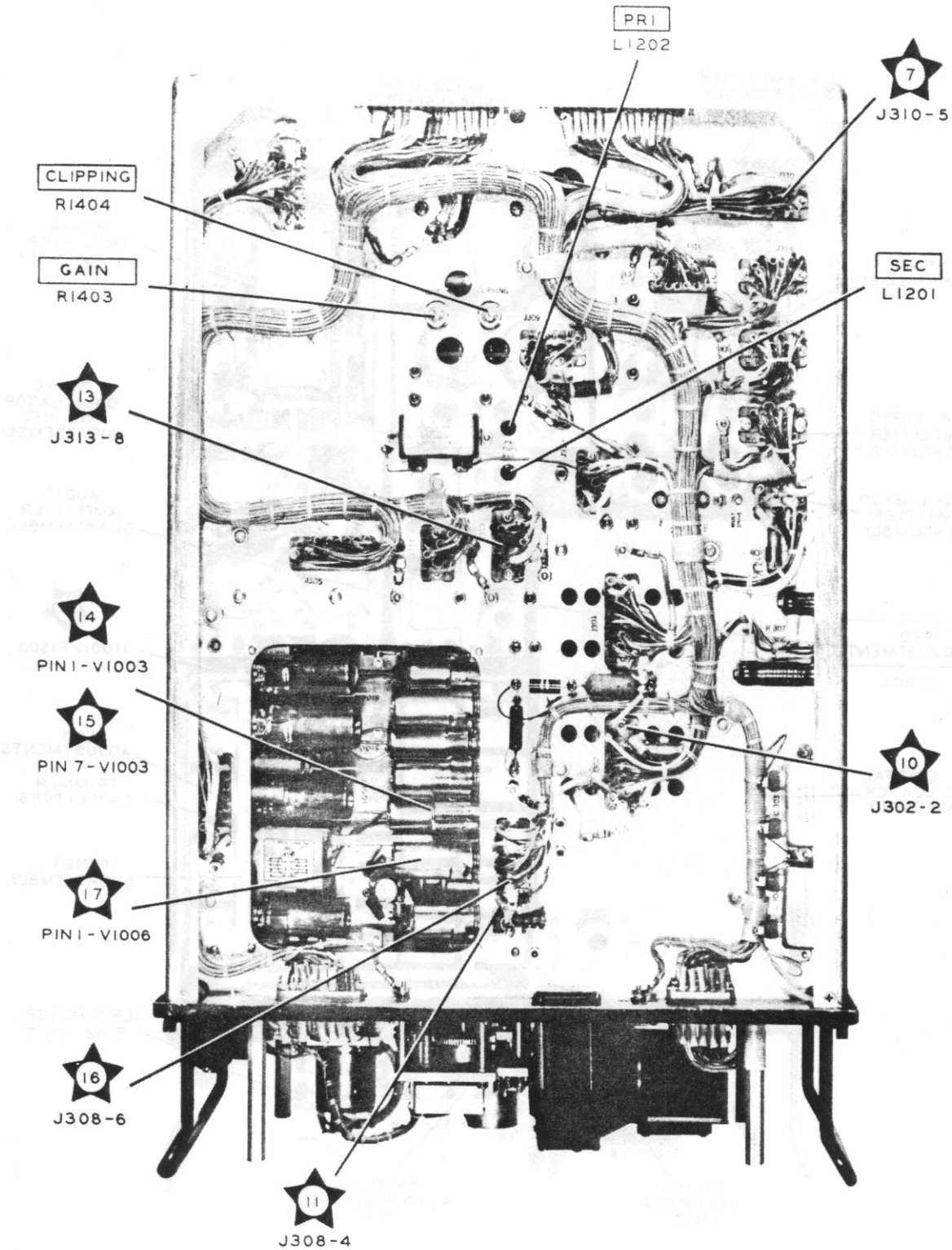


Figure 6-23. Radio Receiver-Transmitter 618S-1 and 618S-1A, Bottom View with Cover Removed, Test and Alignment Point Location

## SECTION VII DIAGRAMS

### 7-1 WIRE CODE LEGEND.

7-2. The characteristics of the hookup wire, used in this equipment, are indicated by groups of symbols on the diagrams. Each symbol group consists of a maximum of three letters followed by a maximum of three numerals. When three letters are used, the first indicates the type of wire, the second represents the size of wire, and the third is the letter "S," used

only when the wire is shielded. When two letters are used, the first and second letters indicate either the type and size of wire or the size of wire and shielding, respectively. When one letter is used, it indicates the wire size only. The first numeral indicates the color of the wire body and the second and third numerals, if any, represent the colors of tracers, all numerals being in accordance with the standard RTMA and JAN-C-76 color code. The symbols are assigned according to the following chart.



FIRST LETTER	TYPE OF WIRE	SECOND LETTER	AWG # WIRE SIZE	THIRD LETTER
A	AN-J-C-48	A	22	S      Shielded
B	Busbar round tinned copper	B	20	None      Unshielded
C	JAN type WL (600 volts)	C	18	
D	Miniature JAN wire (Prodelin)	D	16	
F	Extra flexible varnished cambric	F	12	
G	General Electric Deltabeston	G	10	
H	KEL-F (Monochlorotrifluoroethylene)	H	8	
K	Neon sign cable (15,000 volts)	K	4	
L	Silicone	L	2	
N	Single conductor stranded (not rubber)	N	0	
P	Single conductor stranded (rubber covered)	P	00	
R	JAN type SRIR (1000 volts)	Q	000	
T	Teflon (Polytetrafluoroethylene)	R	0000	
V	JAN type SRHV (2500 volts)	T	28	
		V	26	

BODY OR TRACER COLOR	NUMERAL
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9
a	Clear
b	Tan
c	Pink
d	Maroon
e	Light green
f	Light blue

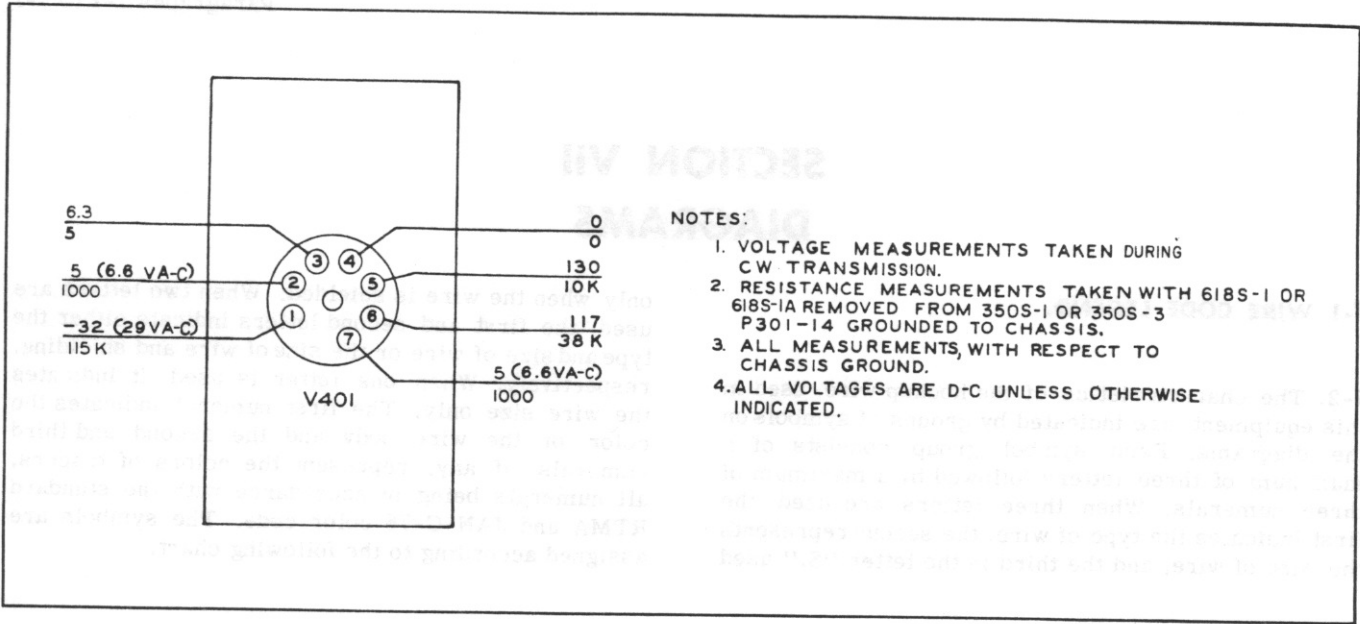


Figure 7-1. R-F Crystal Oscillator Subassembly, Tube Voltage and Resistance Diagram

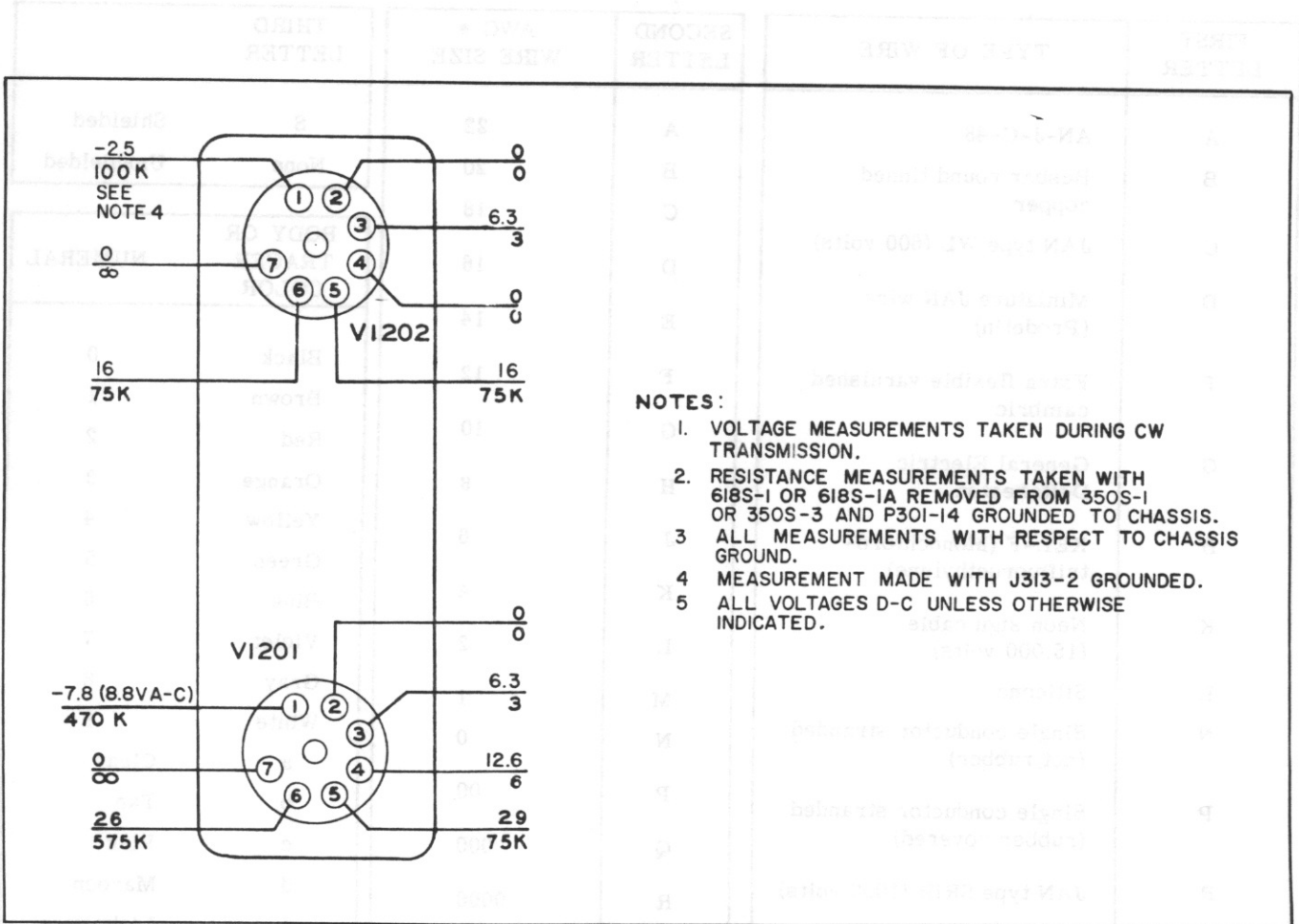
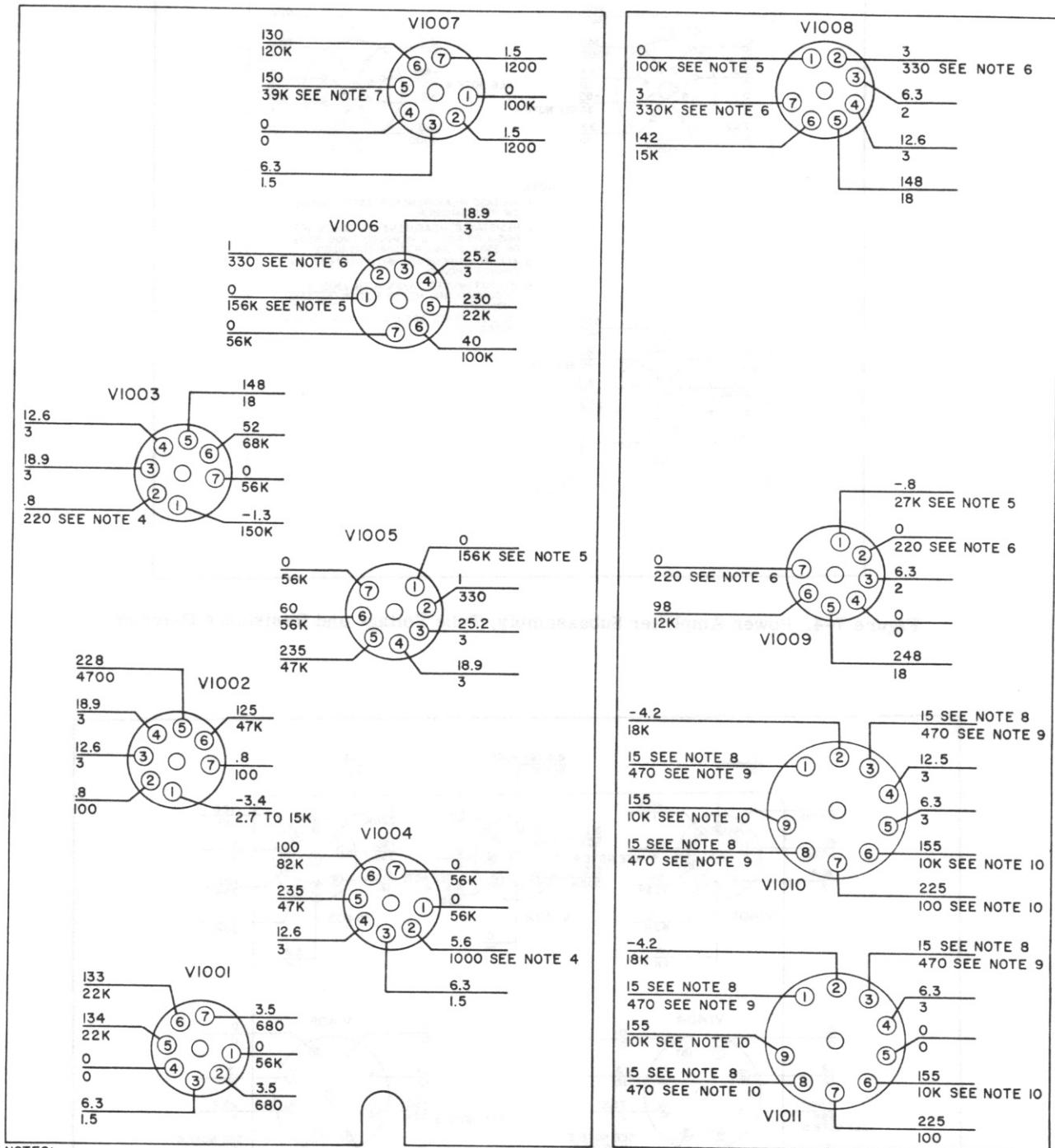


Figure 7-2. 250 Kc Oscillator and BFO Subassembly, Tube Voltage and Resistance Diagram



- NOTES:**
1. VOLTAGE MEASUREMENTS TAKEN DURING CW TRANSMISSION.
  2. RESISTANCE MEASUREMENTS TAKEN WITH 618S-1 OR 618S-1A REMOVED FROM 350S-1 OR 350S-3 AND P301-14 GROUNDED TO CHASSIS.
  3. ALL MEASUREMENTS WITH RESPECT TO CHASSIS GROUND.
  4. MEASUREMENT TAKEN WITH J308-10 GROUNDED TO CHASSIS.
  5. MEASUREMENT TAKEN WITH J307-11 GROUNDED TO CHASSIS.
  6. MEASUREMENT TAKEN WITH J307-15 GROUNDED TO CHASSIS.
  7. MEASUREMENT TAKEN IN BAND 3 POSITION.
  8. MEASUREMENT TAKEN IN BAND 1 POSITION.
  9. MEASUREMENT TAKEN IN BAND 1 POSITION WITH J307-5 GROUNDED TO CHASSIS.
  10. MEASUREMENT TAKEN WITH J307-1 GROUNDED TO CHASSIS.
  11. ALL VOLTAGES ARE D-C UNLESS OTHERWISE INDICATED.

Figure 7-3. Tuner Subassembly, Tube Voltage and Resistance Diagram

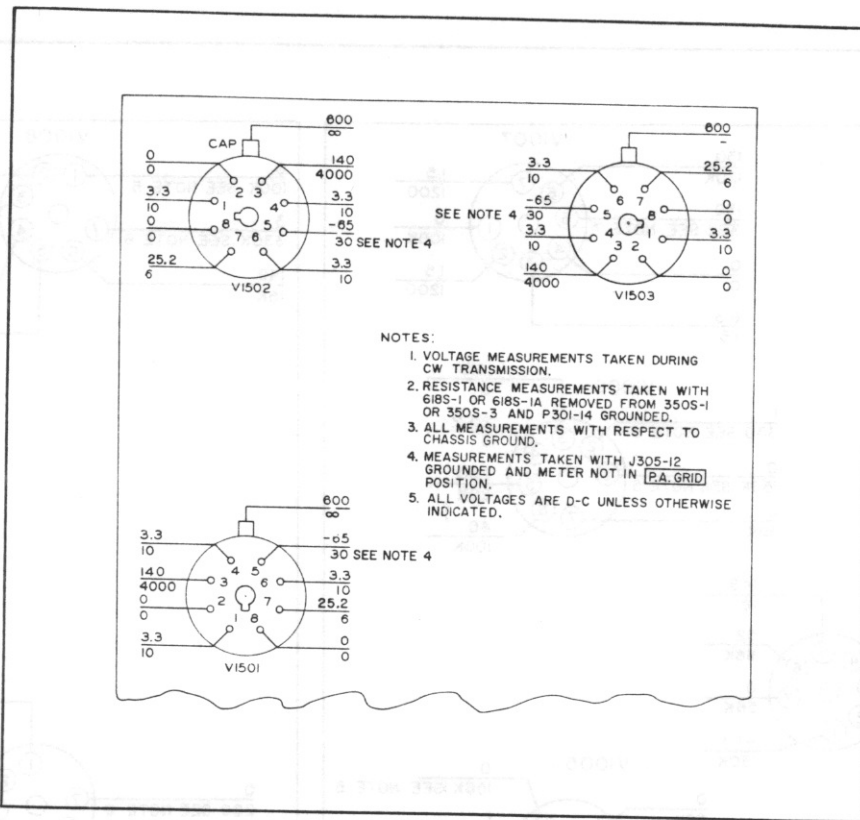


Figure 7-4. Power Amplifier Subassembly, Tube Voltage and Resistance Diagram

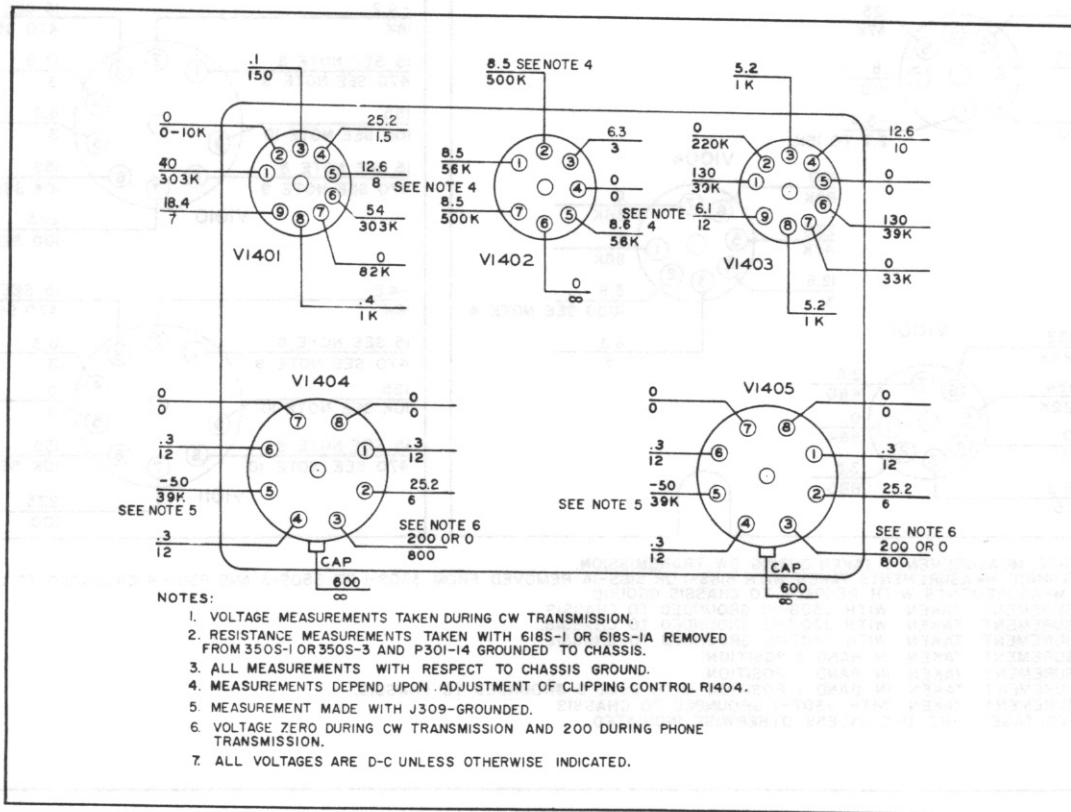


Figure 7-5. Modulator Subassembly, Tube Voltage and Resistance Diagram



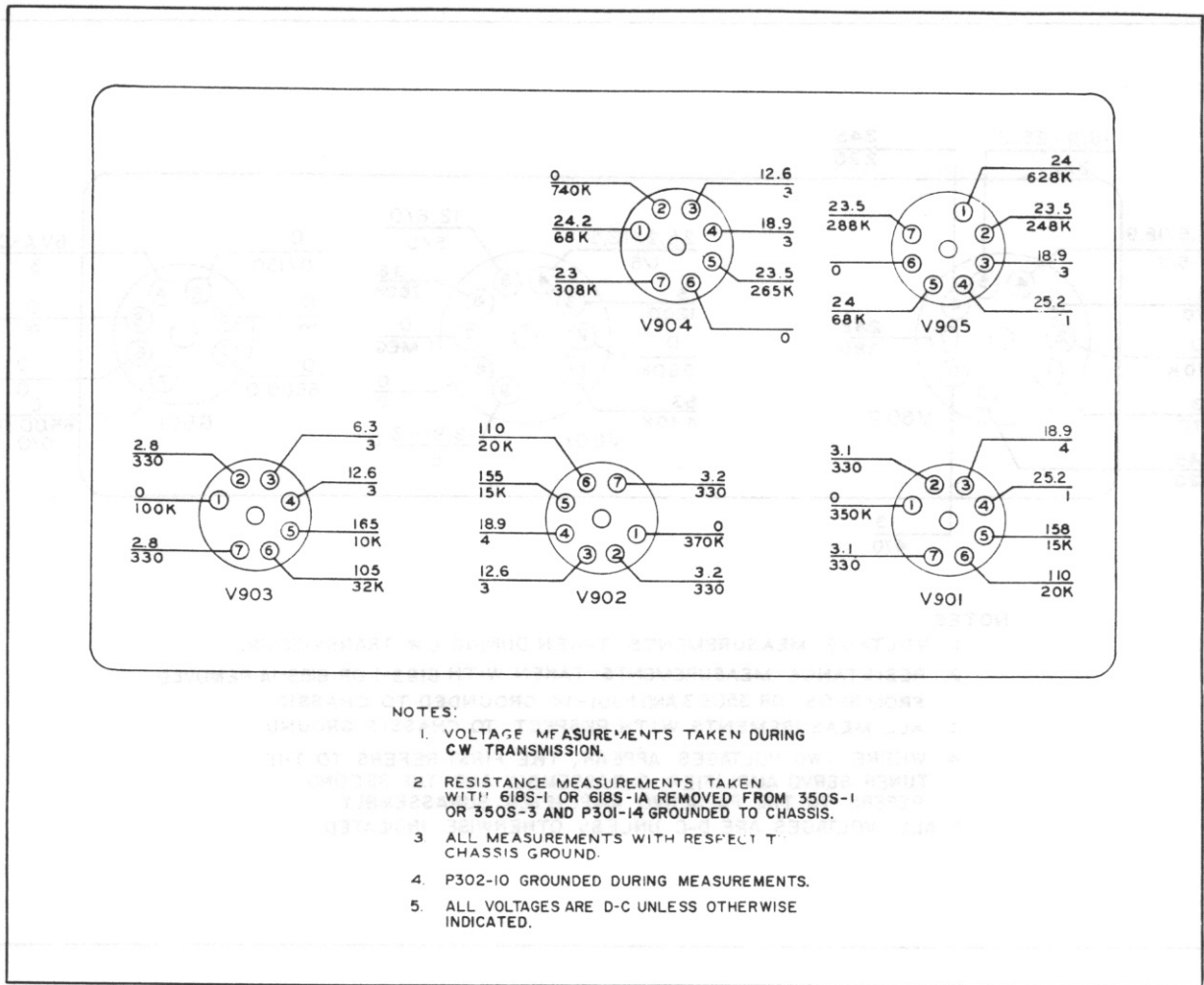


Figure 7-6. I-F Amplifier Subassembly, Tube Voltage and Resistance Diagram

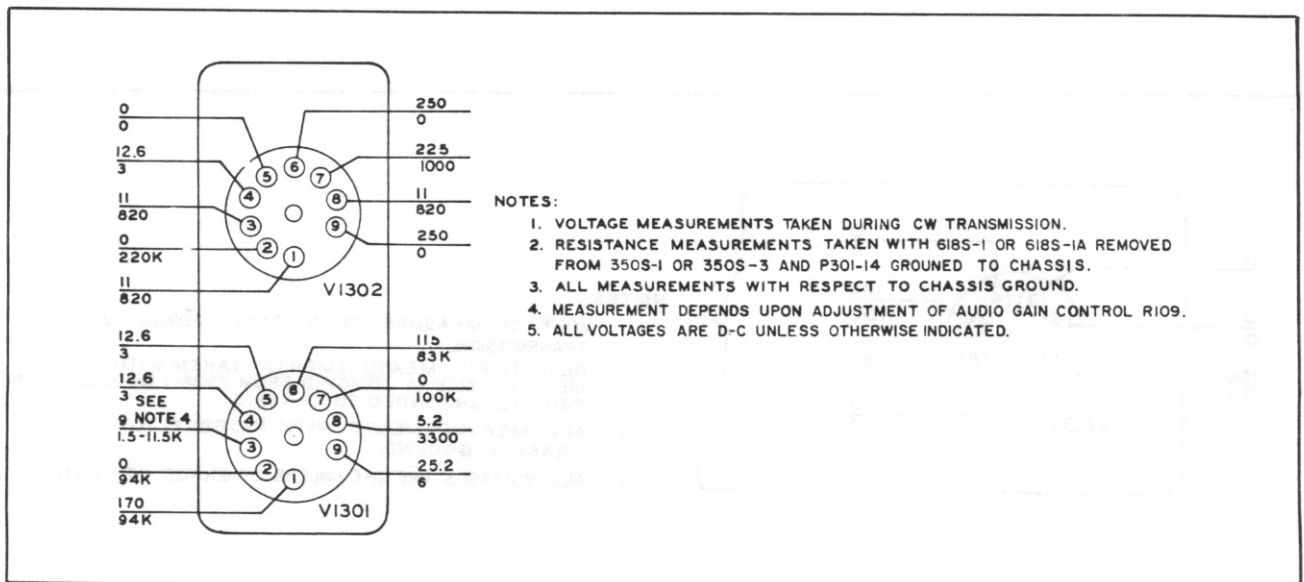


Figure 7-7. Audio Amplifier Subassembly, Tube Voltage and Resistance Diagram

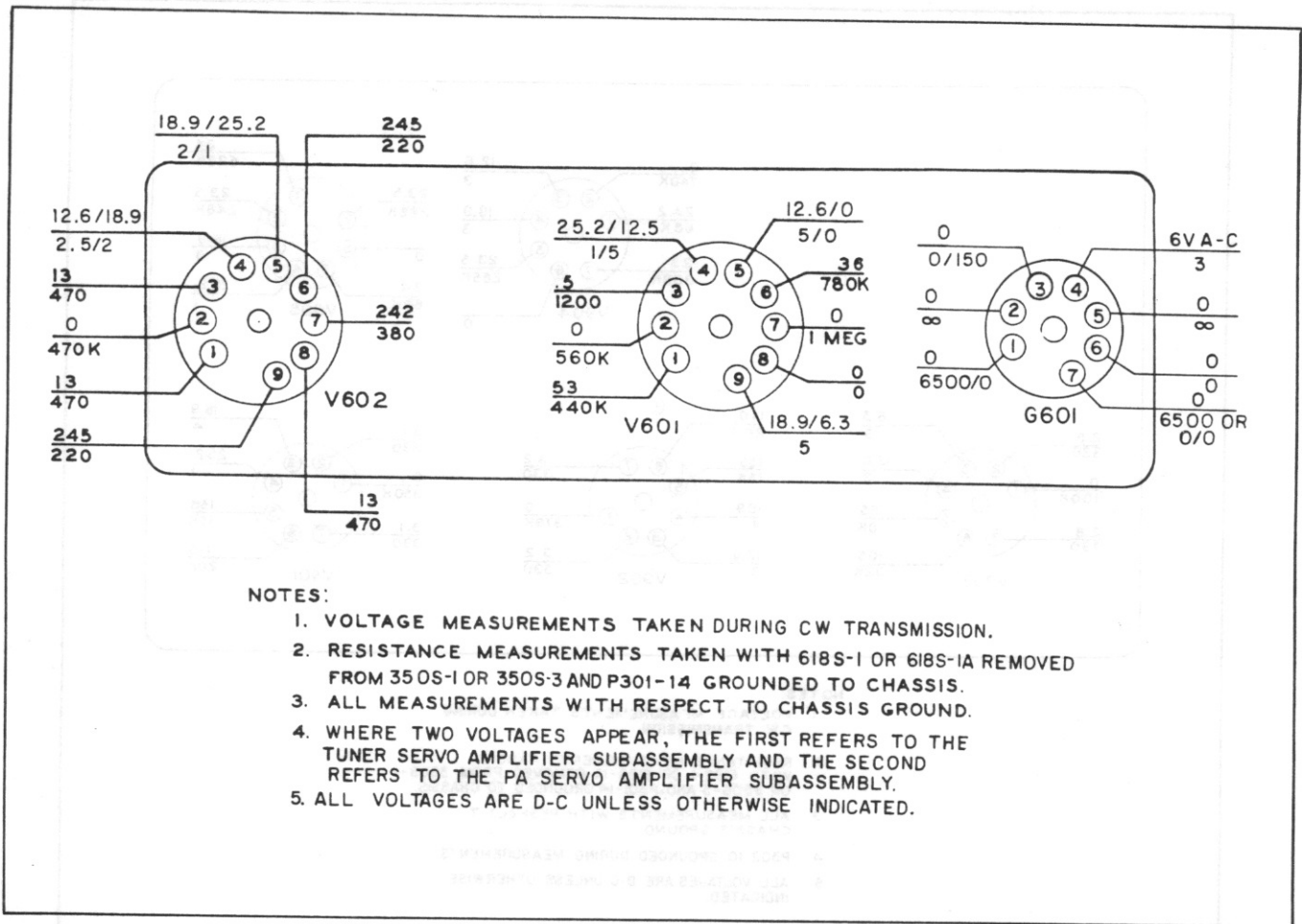


Figure 7-8. Tuner and PA Servo Amplifier Subassemblies, Tube Voltage and Resistance Diagram

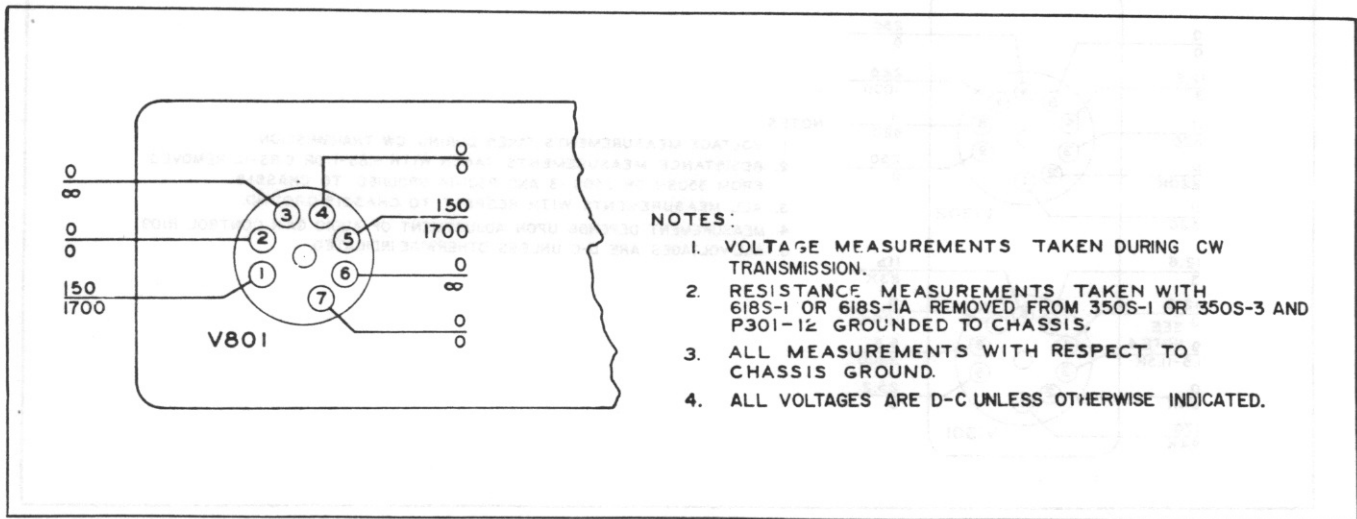
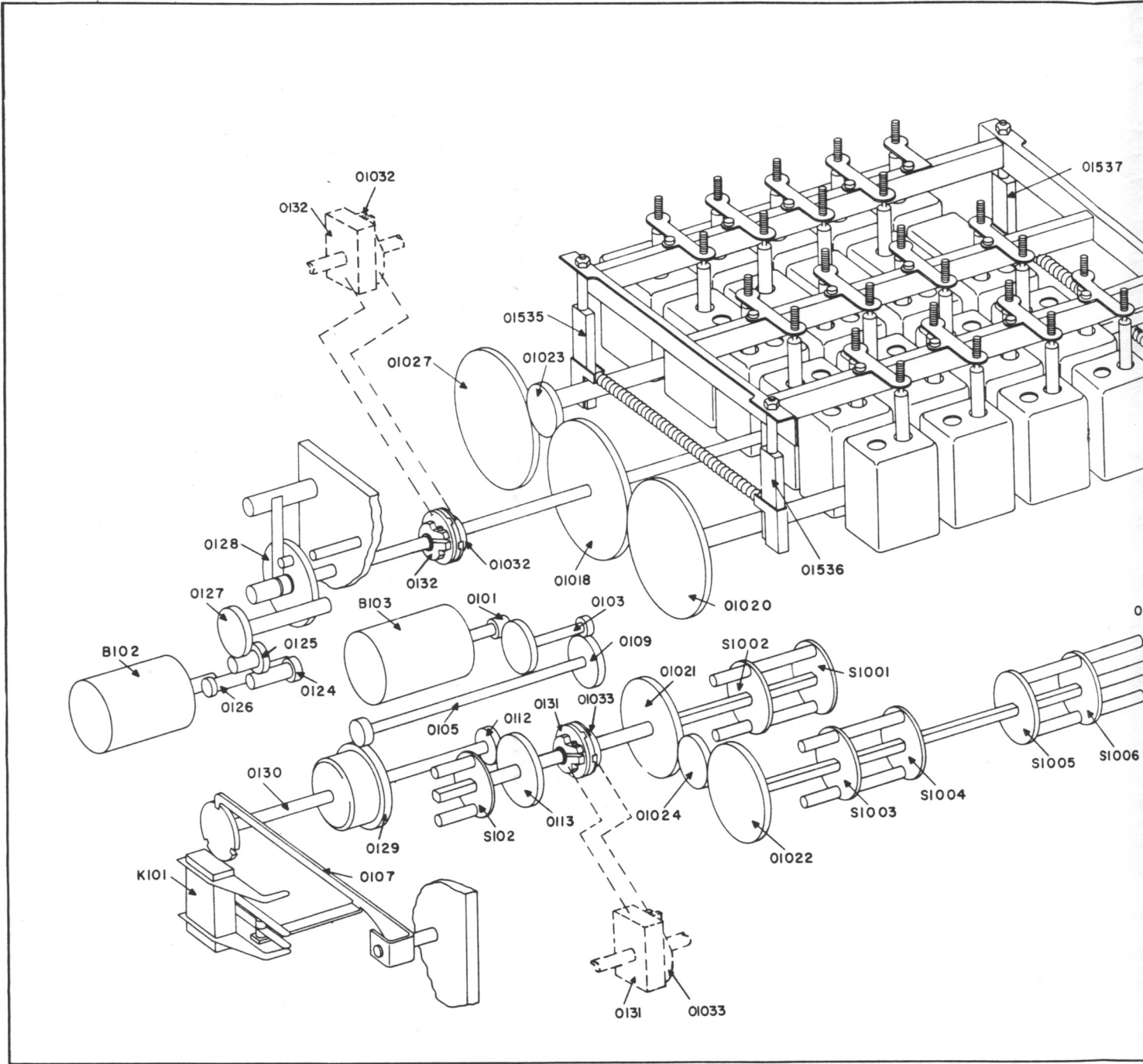


Figure 7-9. Relay Subassembly, Tube Voltage and Resistance Diagram



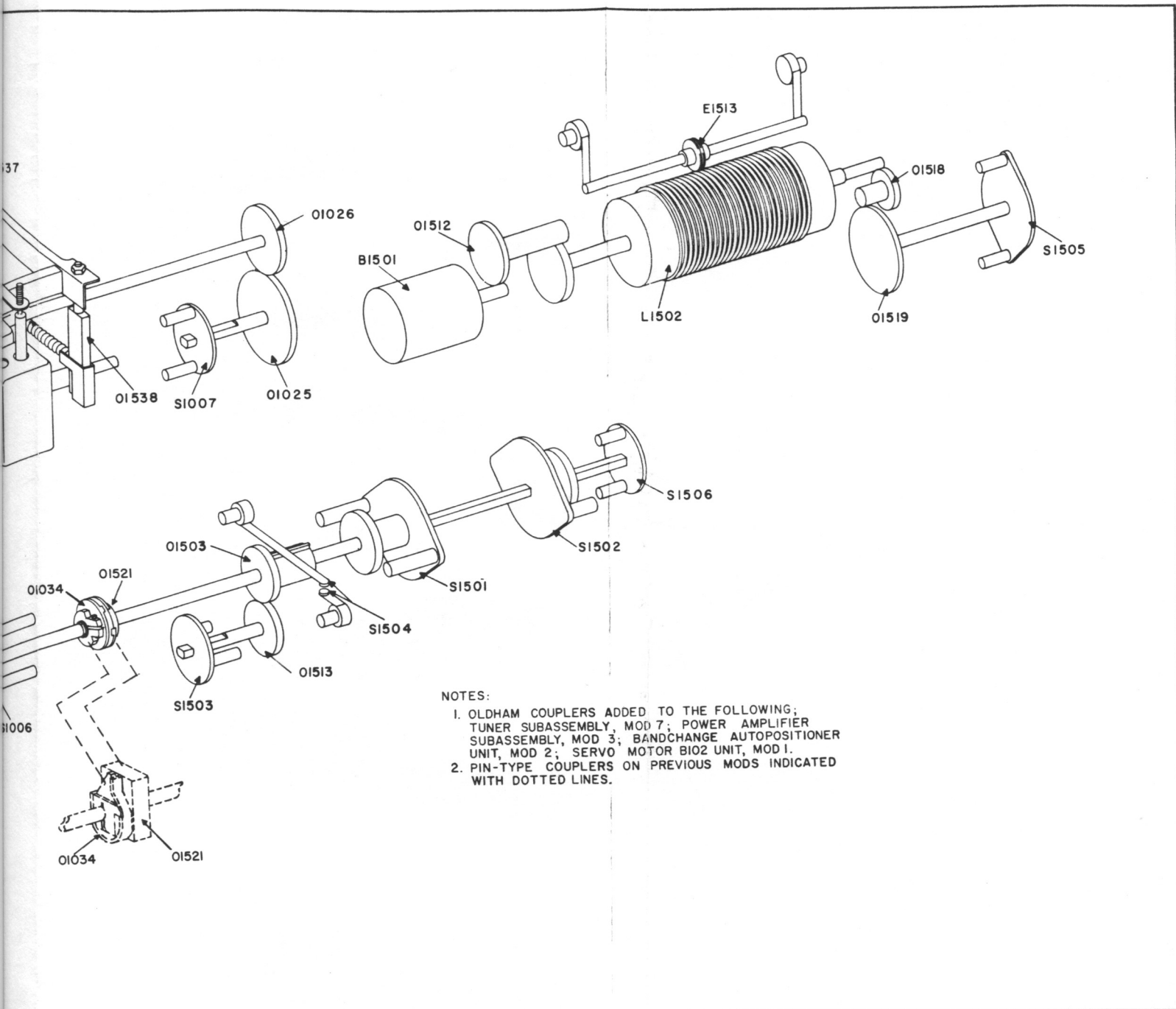


Figure 7-14. Tuner and Power Amplifier Subassemblies, Mechanical Functional Diagram

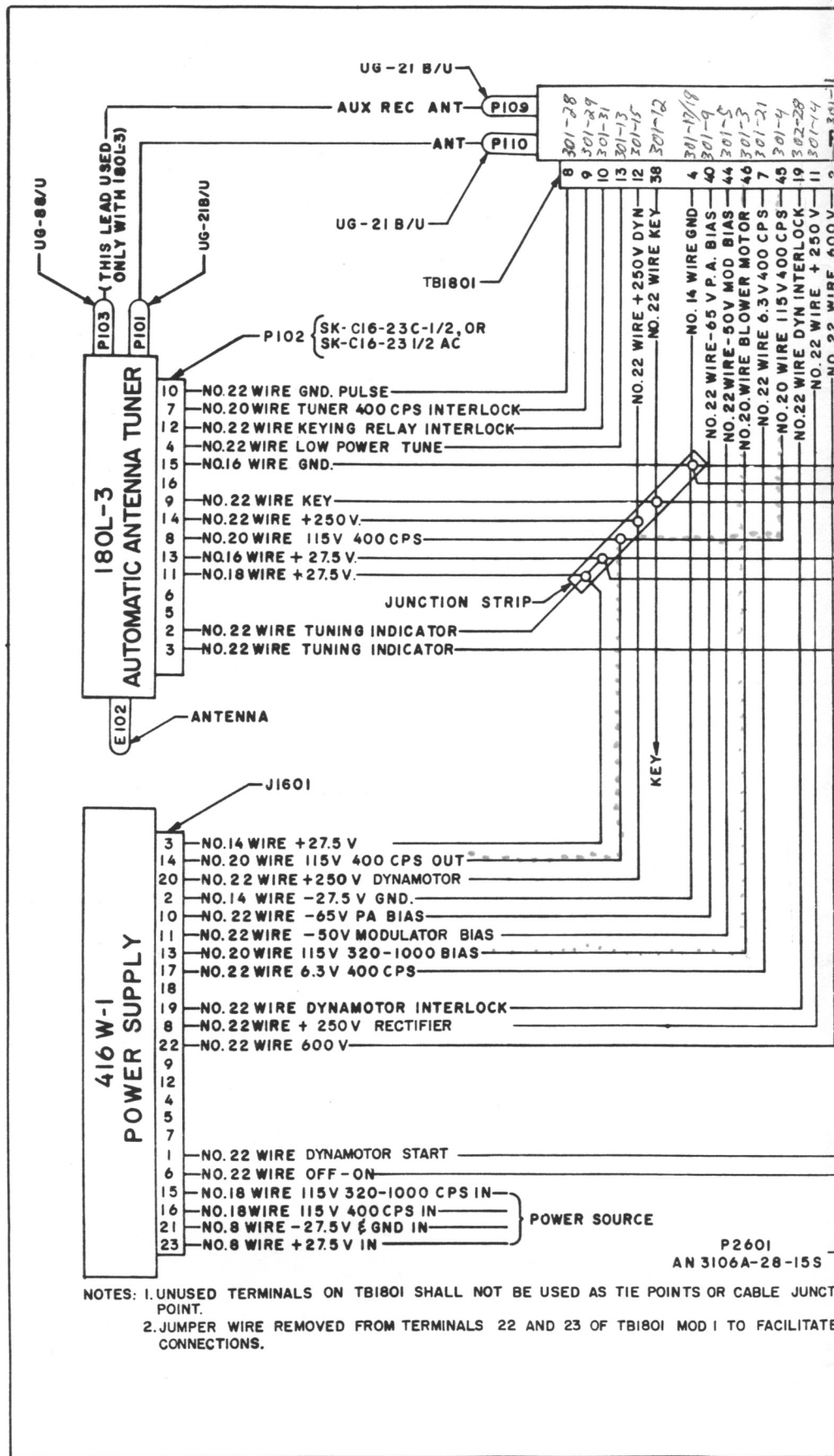
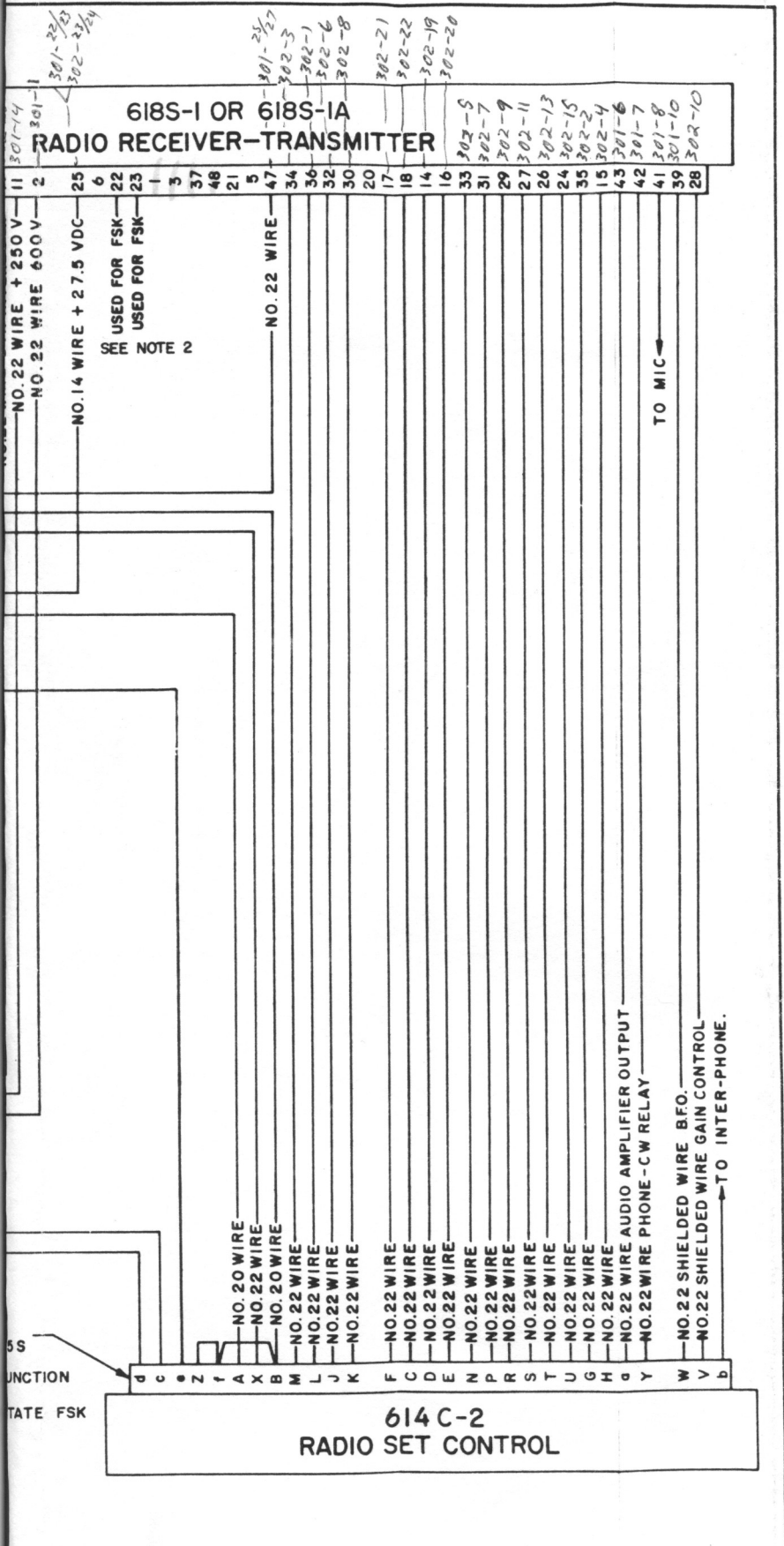
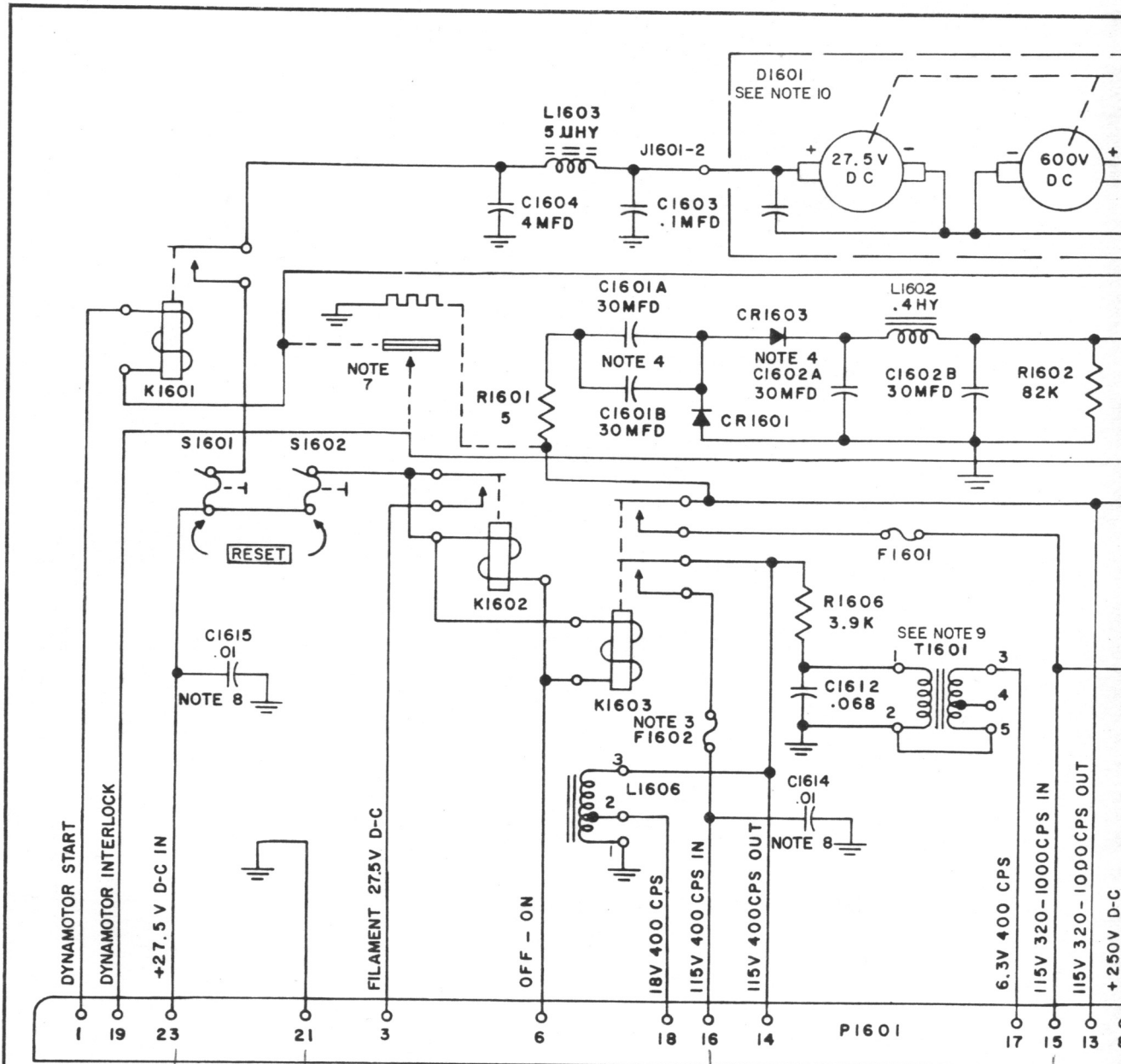


Figure 7-15. Radio Section



BAND SW.  
1 2 3 4  
1 3 37 48  
NOT USED.

Set 618S-1 and 618S-1A, External Wiring Diagram

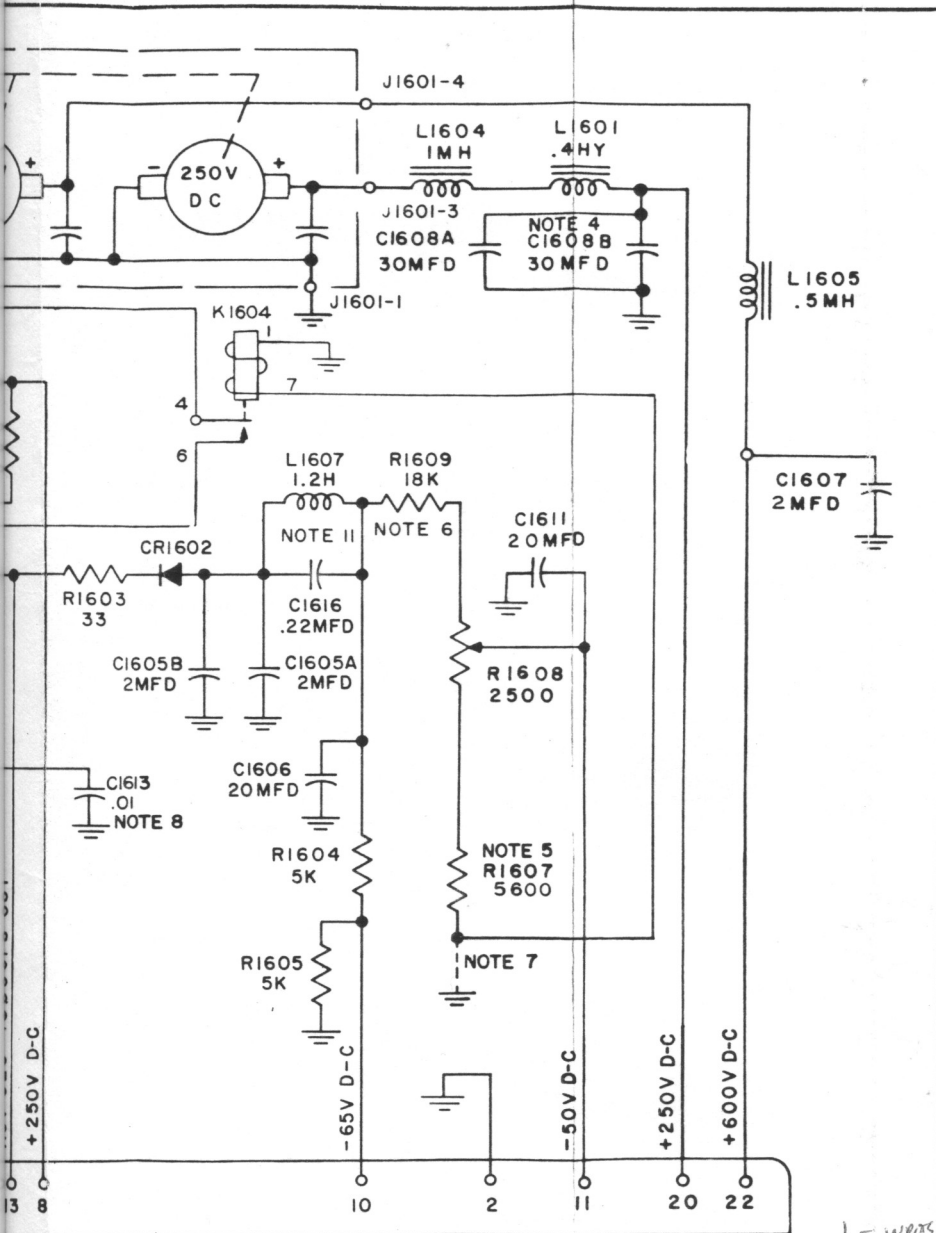


- NOTES: 1. UNLESS OTHERWISE SHOWN ALL RESISTANCE VALUES ARE IN OHMS.  
 2. CAPACITORS WITHIN DOTTED LINES ARE WITHIN DYNAMOMOTOR D1601.  
 3. FUSE F1602 CHANGED FROM 1/2 AMP TO 1 AMP MOD 1.  
 4. CAPACITORS C1601, C1602, AND C1608 TYPE CHANGED MOD 2.  
 5. RESISTOR R1607 CHANGED FROM 15K TO 3300 MOD 3 AND TO 5600 MOD 4.  
 6. VALUE OF R1609 CHANGED FROM 22K TO 18K MOD 3.  
 7. RELAY K1604 CHANGED MOD 3. OLD CIRCUIT SHOWN WITH DOTTED LINES.  
 8. CAPACITORS C1613, C1614, AND C1615 ADDED MOD 5 AND MOD 6.  
 9. TRANSFORMER T1601 CHANGED TYPE MOD 7.  
 10. DYNAMOMOTOR D1601 CHANGED TYPE MOD 8.

11. L1607 AND C1616 ADDED MOD 9. SEE FIGURE 6 FOR CIRCUIT PREVIOUS TO MOD 9.

Revised 1 August 1960

Figure 7-



1 = inputs

ADDED MOD 9. THE FOLLOWING ILLUSTRATES THE  
S TO MOD 9:

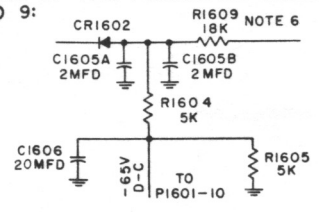


Figure 7-16. Power Supply 416W-1, Schematic Diagram



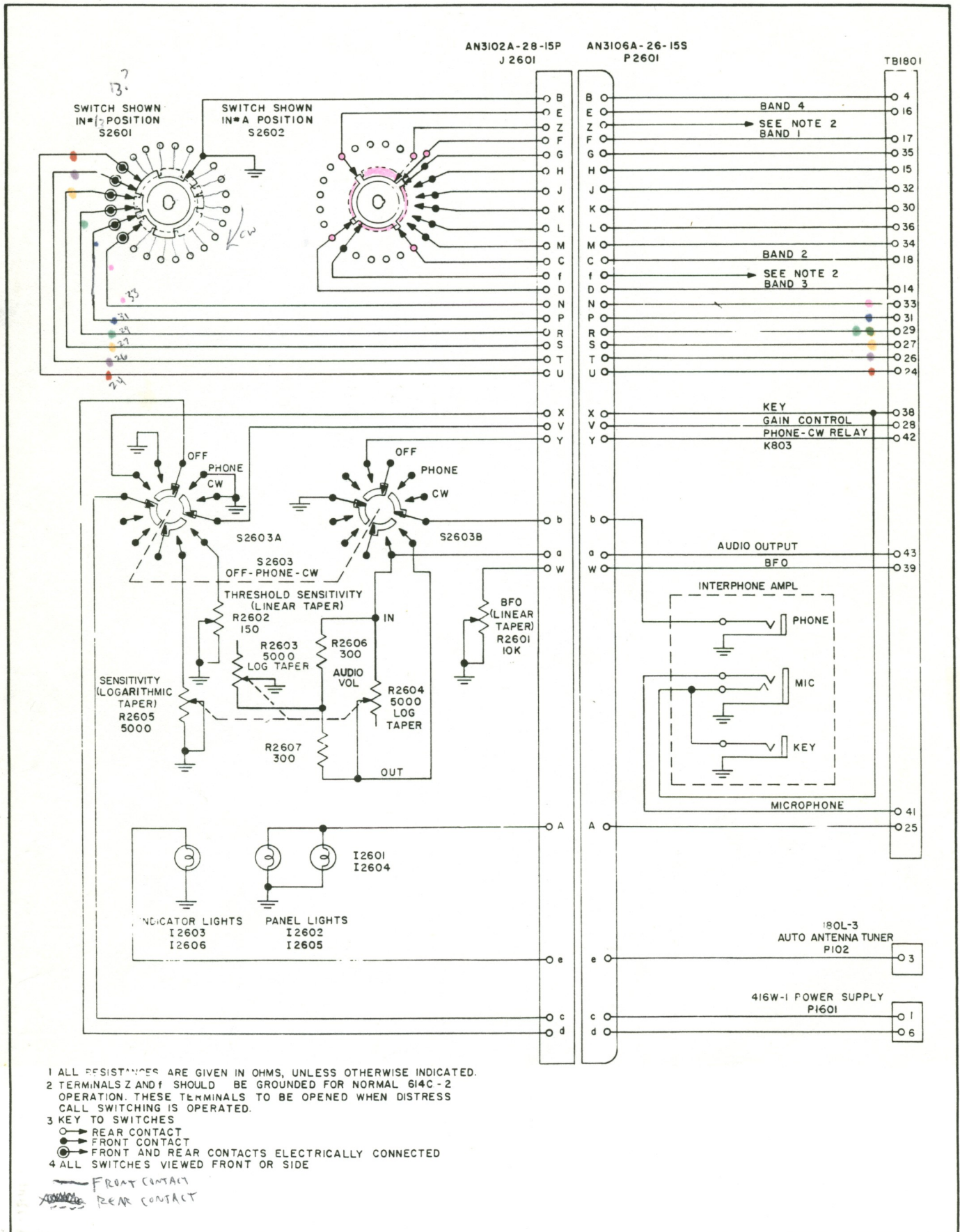
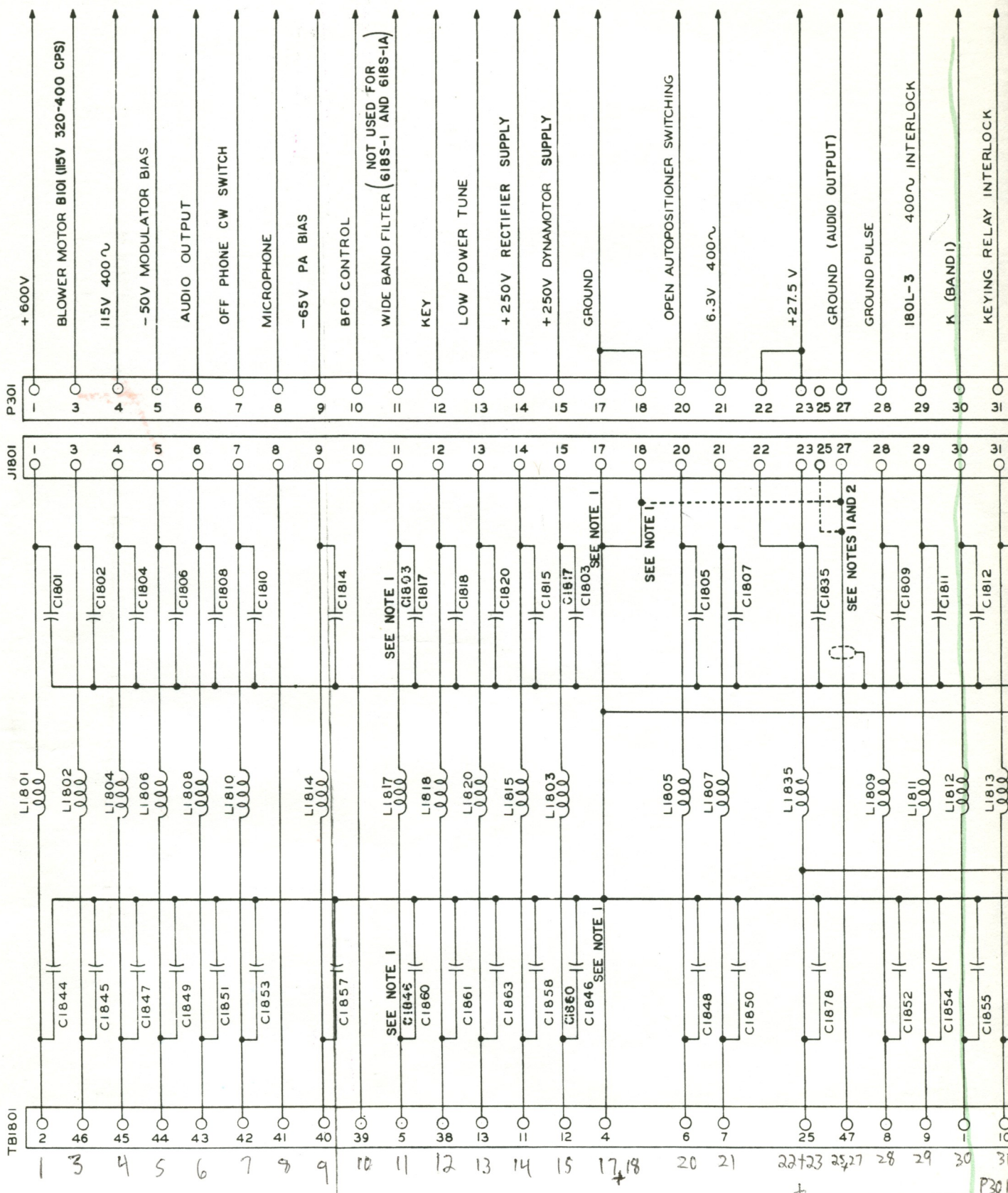


Figure 7-17. Radio Set Control 614C-2, Schematic Diagram



- 1 + 600V
- 2 BLOWER MOTOR B101 (115V 320-400 CPS)
- 3 115V 400~
- 4 -50V MODULATOR BIAS
- 5 AUDIO OUTPUT
- 6 OFF PHONE CW SWITCH
- 7 MICROPHONE
- 8 -65V PA BIAS
- 9 BFO CONTROL
- 10 WIDE BAND FILTER (NOT USED FOR 618S-1 AND 618S-1A)
- 11 KEY
- 12 LOW POWER TUNE
- 13 +250V RECTIFIER SUPPLY
- 14 +250V DYNAMOTOR SUPPLY
- 15 GROUND
- 17 OPEN AUTOPOSITIONER SWITCHING
- 18 6.3V 400~
- 22 +27.5 V
- 23 GROUND (AUDIO OUTPUT)
- 25 GROUND PULSE
- 27 180L-3 400~ INTERLOCK
- 28 K (BAND I)
- 29 KEYING RELAY INTERLOCK

TB1801 2 46 45 44 43 42 41 40 39 5 38 13 11 12 14 15 12 4 6 7 25 47 8 9 10 31

J1801 1 3 4 5 6 7 8 9 10 11 12 13 14 15 17 18 20 21 22 23 25 27 28 29 30 31

P301 1 3 4 5 6 7 8 9 10 11 12 13 14 15 17 18 20 21 22 23 25 27 28 29 30 31

23, 24  
P302

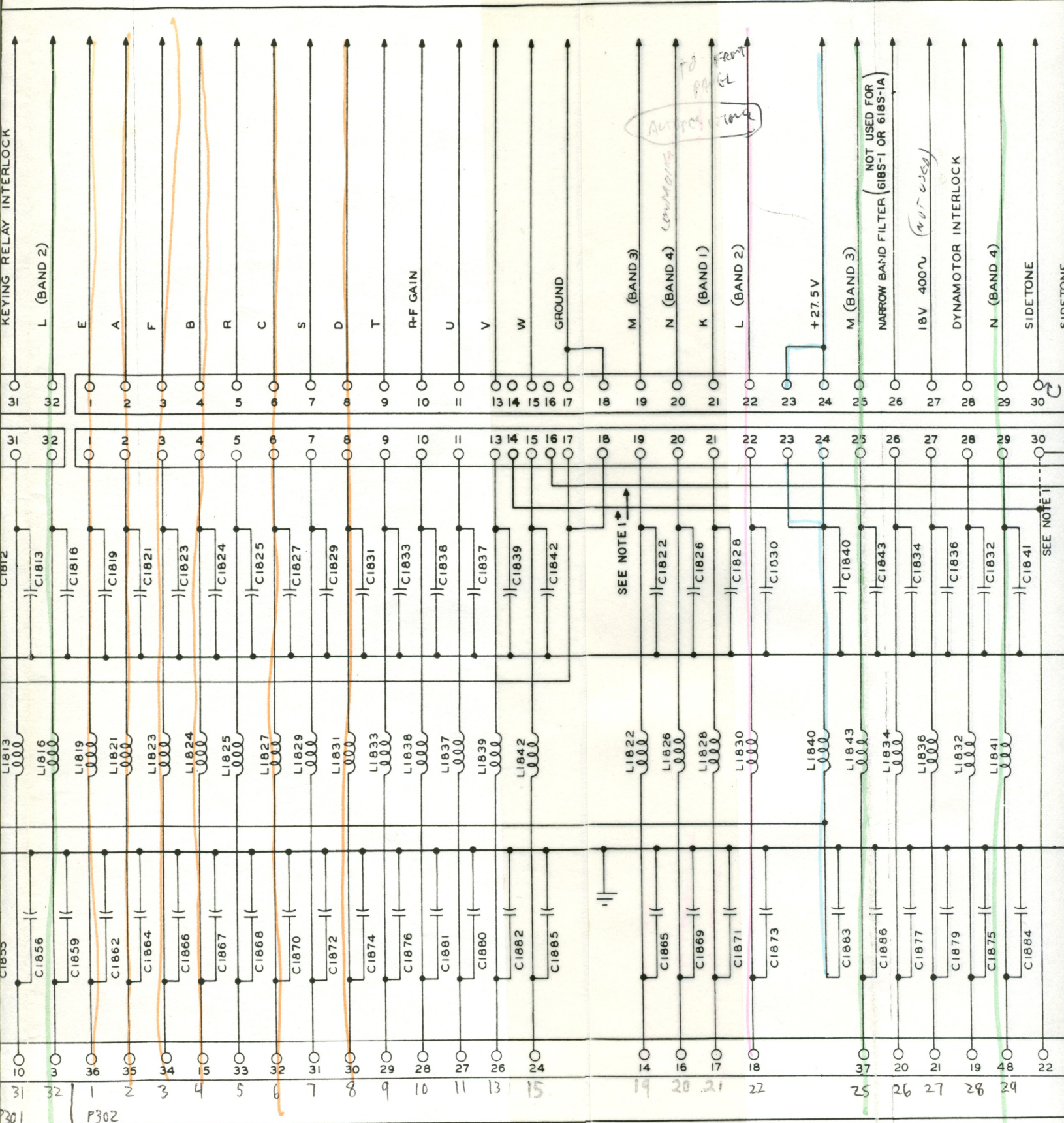
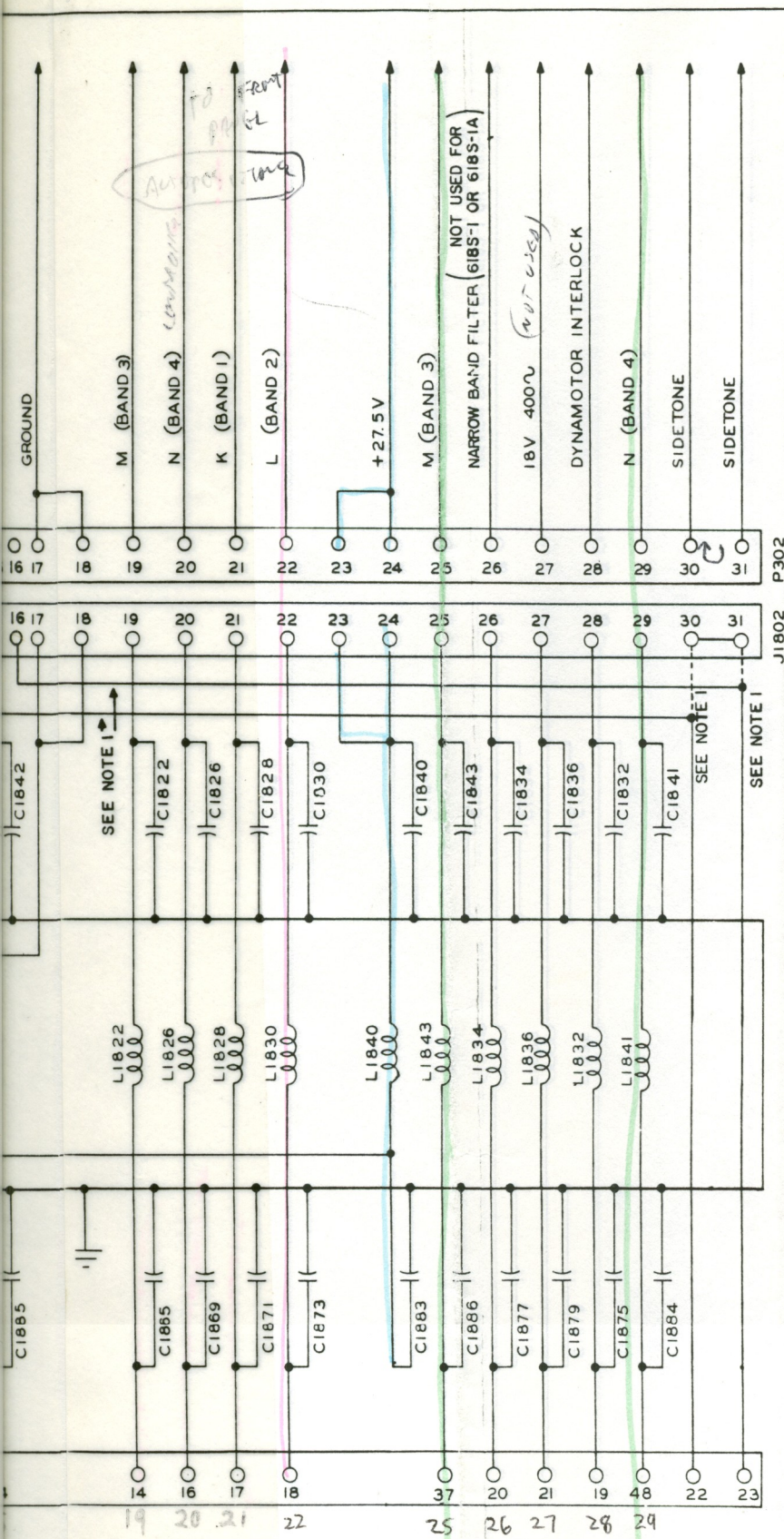


Figure 7-1

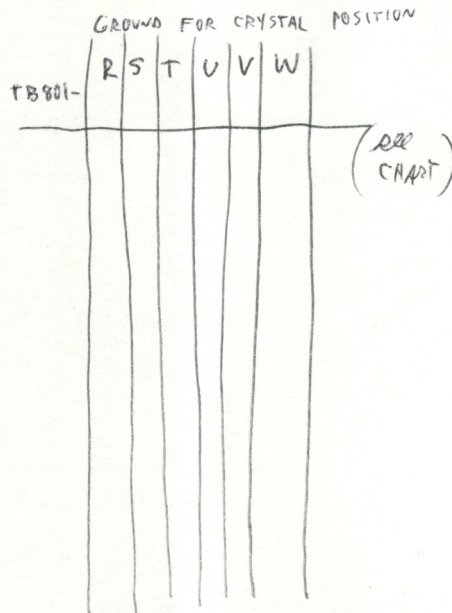


NOTES:

1. THE FOLLOWING CHANGES ARE EFFECTIVE MOD 1; CAPACITORS C1803 AND C1817 REVERSED; CAPACITORS C1846 AND C1860 REVERSED; WIRE TO TERMINAL 27 OF J1801 REMOVED AND CONNECTED TO TERMINAL 25 OF J1801; TERMINALS 17 AND 18 OF J1801 JUMPED TO TERMINAL 27 OF J1801; WIRE TO TERMINAL 30 OF J1802 REMOVED AND CONNECTED TO TERMINAL 14 OF J1802; WIRE TO TERMINAL 31 OF J1802 REMOVED AND CONNECTED TO TERMINAL 16 OF J1802; TERMINALS 30 AND 31 OF J1802 JUMPED.

2. THE FOLLOWING CHANGES ARE EFFECTIVE MOD 2; JUMPER BETWEEN TERMINALS 17 AND 18 OF J1801 AND TERMINAL 27 OF J1801 REMOVED; WIRE TO TERMINAL 25 OF J1801 REMOVED AND CONNECTED TO TERMINAL 27 OF J1801.

3. TEST POINT 9 INCLUDES THE FOLLOWING TERMINALS OF TB1801; 2,7,11,12,21,25,40,44,45,46.



GROUND FOR BAND #

1	2	3	4	(OTHERS OPEN)
17	18	14	16	

GROUND FOR BANK #

A	B	C	D	E	F
35	15	32	30	36	34

AUX BAND SW. OUT - NOT USED

- CORRESPONDING TO P301/2 CONNECTIONS

Figure 7-18. Filter Unit, Schematic Diagram

## NOTES

Unless otherwise indicated, all resistance values are in ohms, all capacitance values are in micro-microfarads, and all inductance values are in microhenries.

2. All switches viewed from rear (opposite knob or driven end). Front contacts and rings of switches are shown in broken lines.

3. Key to switches:

●→ Rear Contact

○→ Front Contact

⊙→ Front and rear contacts electrically connected.

4. All switches are shown in the A1 position.

5. Selected resistors; refer to T.O. 12R2-4-6-4 for values.

6. Value of R405 changed from 100 to 120; MOD 2 of r-f crystal oscillator subassembly.

7. Value of R401 changed from 1 MEG to 100K and value of R402 changed from 56K to 15K; MOD 3 of r-f crystal oscillator subassembly.

8. Detail parts R408, C418, and R409 added; MOD 3 of r-f crystal oscillator subassembly.

9. Value of C409 changed from 1 uf to 8 uf and resistor R407 added; MOD 4 of r-f crystal oscillator subassembly.

10. Value of C917 changed from 10 to 15 and back to 10; MOD 1 and MOD 3, respectively, of i-f amplifier subassembly.

11. Value of R912 changed from 22K to 27K, value of R913 changed from 10K to 6.8K, and value of R922 and R923 changed from 15K to 8.2K; MOD 2 of i-f amplifier subassembly.

12. Value of R915 changed from 68K to 82K and tolerance of R914 changed from  $\pm 10\%$  to  $\pm 5\%$ ; MOD 4 of i-f amplifier subassembly.

13. Detail parts C306, C307, C305, C304, L301, L302, R308, and R309 and wiring added to facilitate interchangeability of r-f crystal oscillator subassembly and stabilized master oscillator assembly; MOD 1 of main chassis.

14. Wiring added to facilitate fsk adaption; MOD 1 of main chassis.

15. Capacitor C1124 added; MOD 3 of tuner subassembly.

16. The capacitors listed in the following table are changed in value and/or tolerance; MOD 3 of tuner subassembly. Capacitors indicated with asterisk (\*) are changed in temperature compensation and/or anti-resistant qualities only.

CAPACITOR	PREVIOUS VALUE AND TOLERANCE	MOD 3 VALUE AND TOLERANCE
C1012	7 $\pm 1/2$ uuf	4 $\pm 1/2$ uuf
C1015	7 $\pm 1/2$ uuf	4 $\pm 1/2$ uuf
C1018	62 $\pm 2\%$	75 $\pm 5\%$
C1019	5-25	5-30
C1022	5-25	5-30
C1023	100 $\pm 20\%$	120 $\pm 2\%$
C1025*	10 $\pm 5\%$	10 $\pm 5\%$
C1032	82 $\pm 2\%$	100 $\pm 5\%$
C1033	8-50	5-30
C1036	5-25	5-30
C1039	5-25	5-30
C1040	2000 $\pm 20\%$	510 $\pm 5\%$
C1041	220 $\pm 2\%$	180 $\pm 5\%$
C1044	100 $\pm 2\%$	100 $\pm 5\%$
C1045	8-50	5-30
C1047*	10 $\pm 5\%$	10 $\pm 5\%$
C1048	5-25	5-30
C1050	5-25	5-30
C1051	470 $\pm 2\%$	800 $\pm 2\%$
C1055	470 $\pm 2\%$	10 $\pm 5\%$
C1056	8-50	5-30
C1060	24 $\pm 2\%$	30 $\pm 5\%$
C1063	5-25	5-30
C1067	47 $\pm 2\%$	56 $\pm 5\%$
C1067	8-50	5-30
C1068	2000 $\pm 2\%$	27 $\pm 5\%$
C1069	5-25	5-30
C1070	5-25	5-30
C1116*	5 $\pm 5\%$	5 $\pm 1/2$ uuf
C1121*	10 $\pm 5\%$	10 $\pm 5\%$

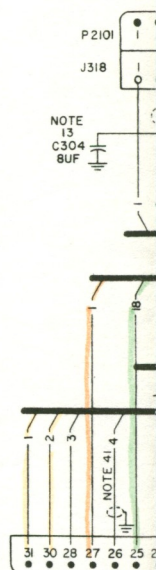
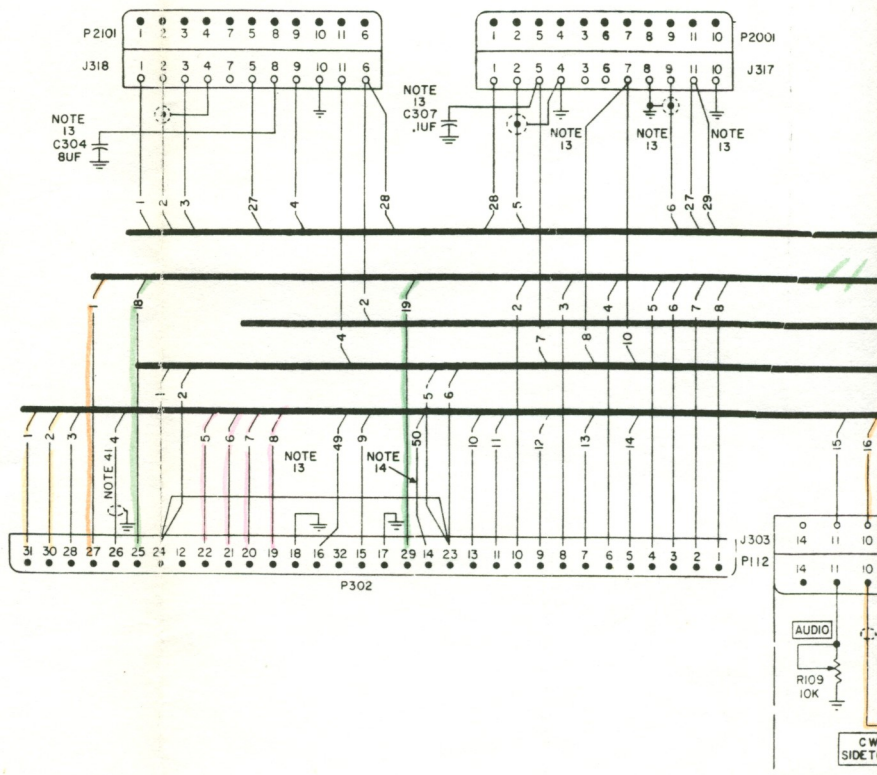
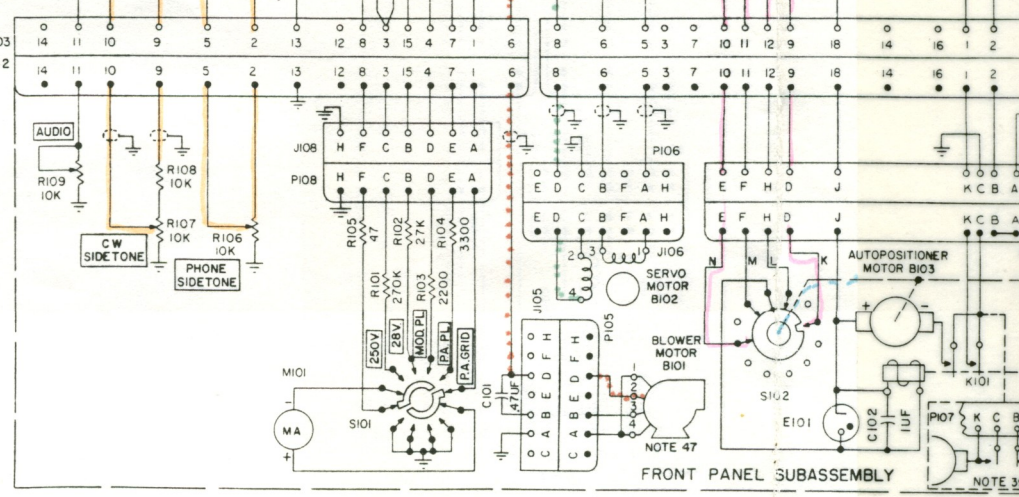
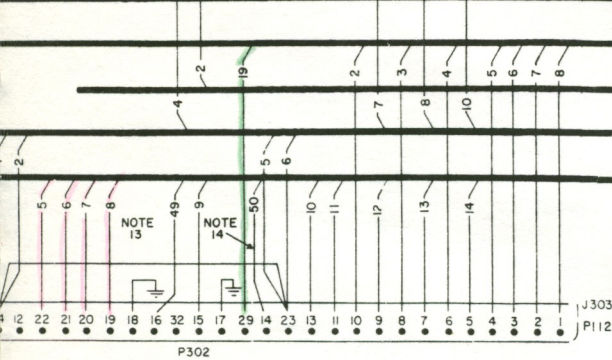
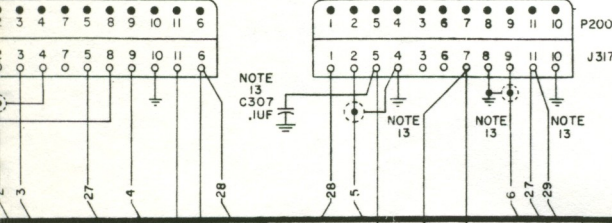
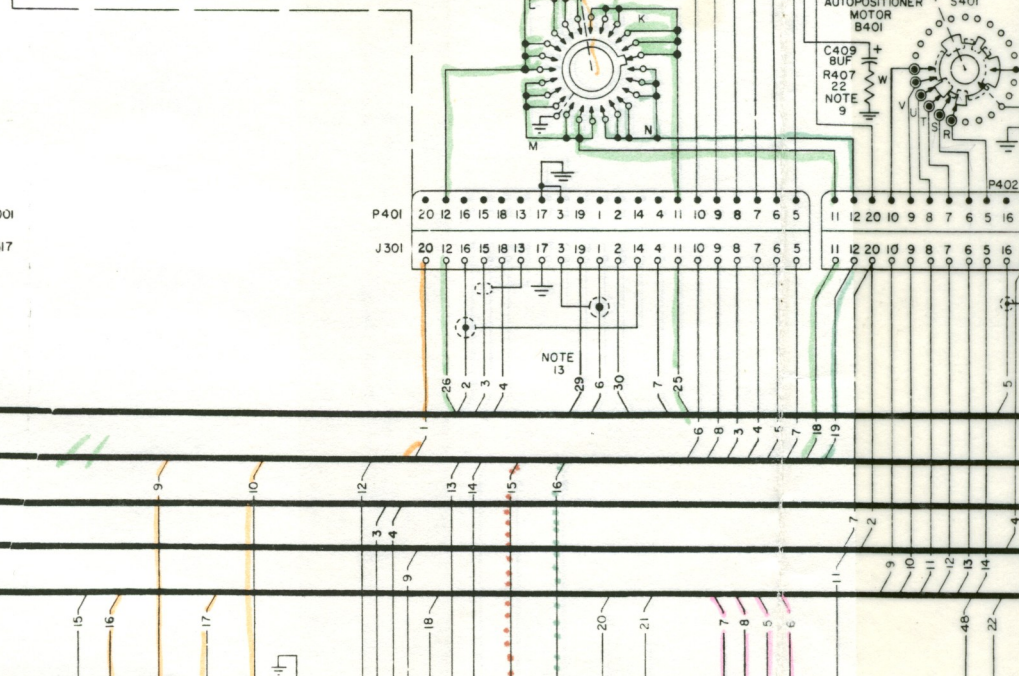
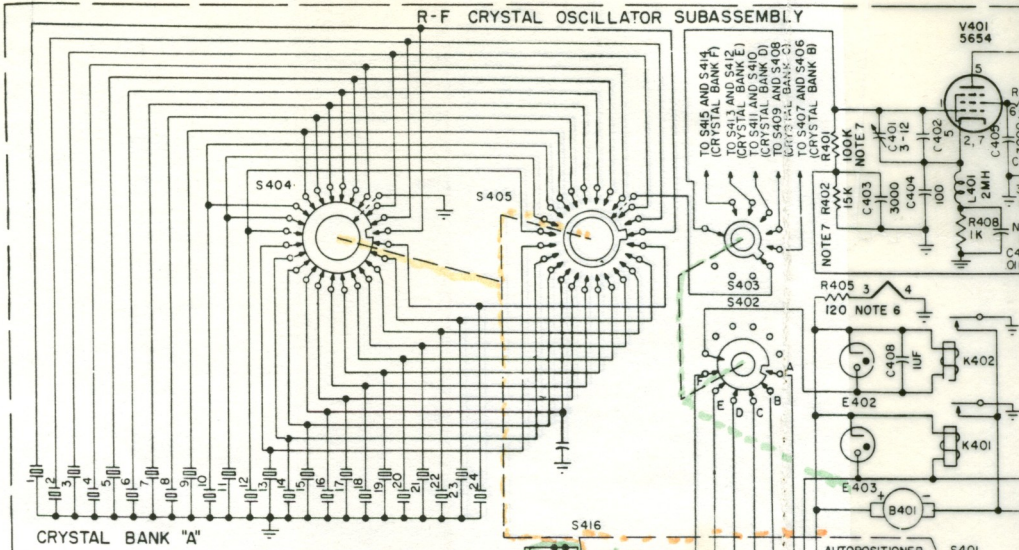


Figure 7-19. Radio Receiver-Transmitter 618S-1 and 618S-1A, Schematic Diagram (Sheet 1 of 2 sheets)

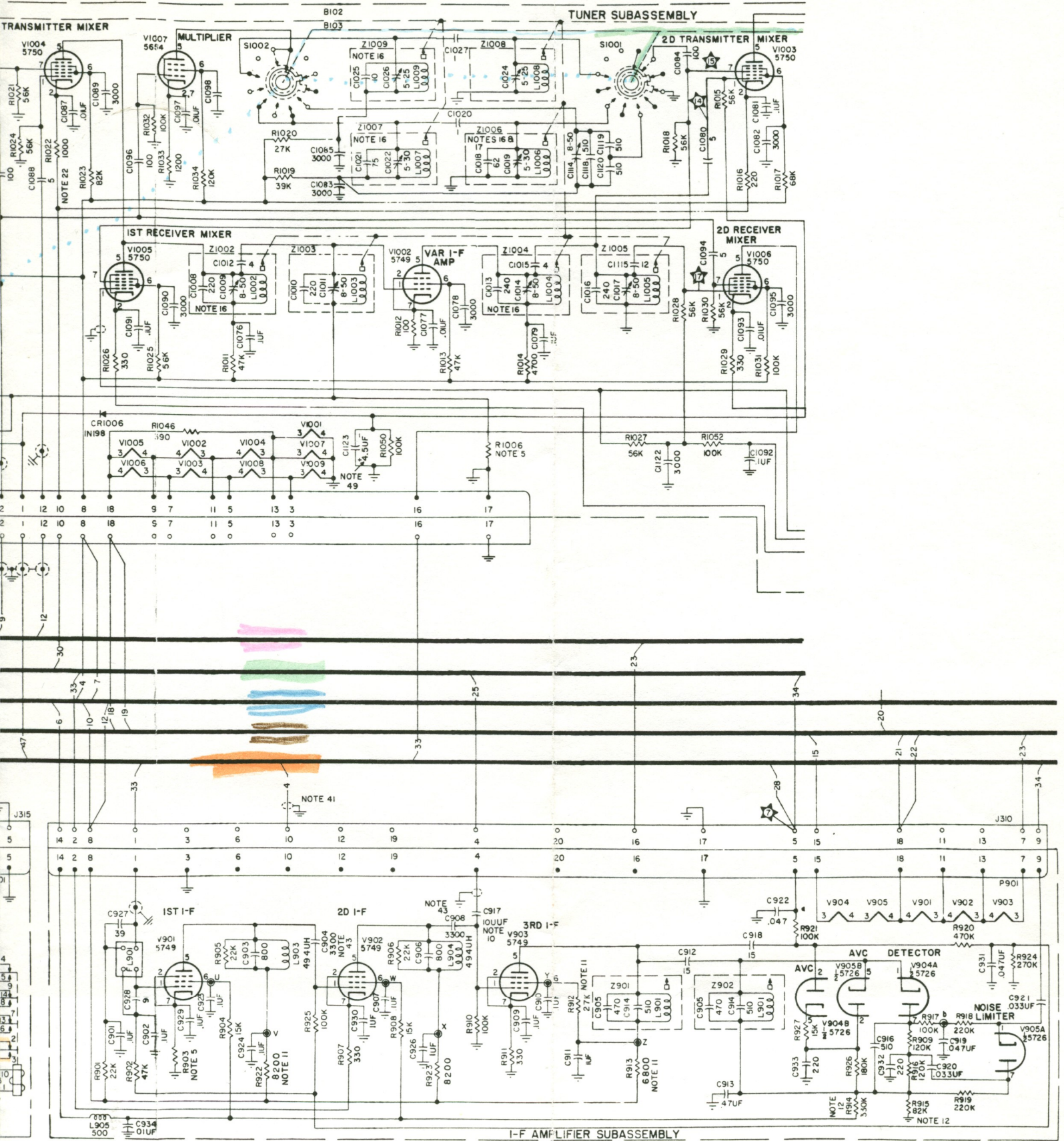
CAPACITOR	PREVIOUS VALUE AND TOLERANCE	MOD 3 VALUE AND TOLERANCE
C1012	7 ±1/2 uuf	4 ±1/2 uuf
C1015	7 ±1/2 uuf	4 ±1/2 uuf
C1018	62 ±2%	75 ±5%
C1019	5-25	5-30
C1022	5-25	5-30
C1023	100 ±20%	120 ±2%
C1025*	10 ±5%	10 ±5%
C1032	82 ±2%	100 ±5%
C1033	8-50	5-30
C1036	5-25	5-30
C1039	5-25	5-30
C1040	2000 ±20%	510 ±5%
C1041	220 ±2%	180 ±5%
C1044	100 ±2%	100 ±5%
C1045	8-50	5-30
C1047*	10 ±5%	10 ±5%
C1048	5-25	5-30
C1050	5-25	5-30
C1051	470 ±2%	800 ±2%
C1055	470 ±2%	10 ±5%
C1056	8-50	5-30
C1060	24 ±2%	30 ±5%
C1063	5-25	5-30
C1067	47 ±2%	56 ±5%
C1067	8-50	5-30
C1068	2000 ±2%	27 ±5%
C1069	5-25	5-30
C1070	5-25	5-30
C1116*	5 ±5%	5 ±1/2 uuf
C1121*	10 ±5%	10 ±5%



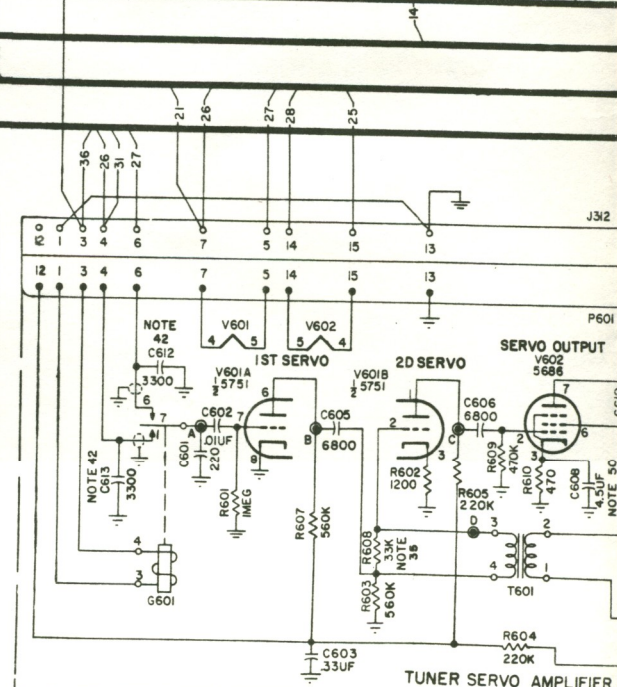
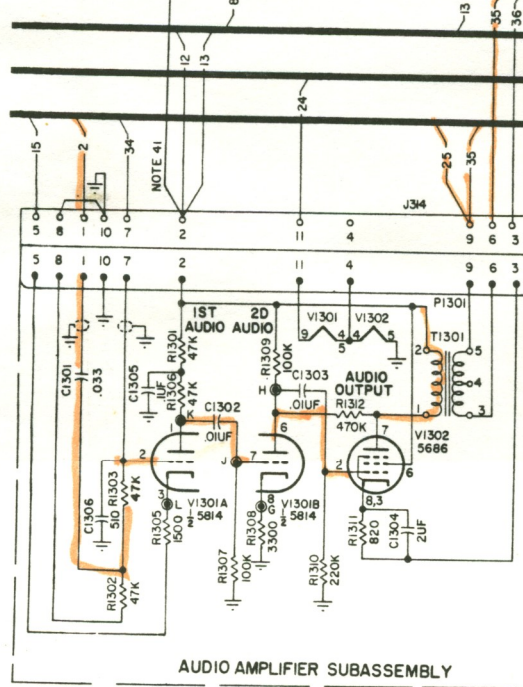
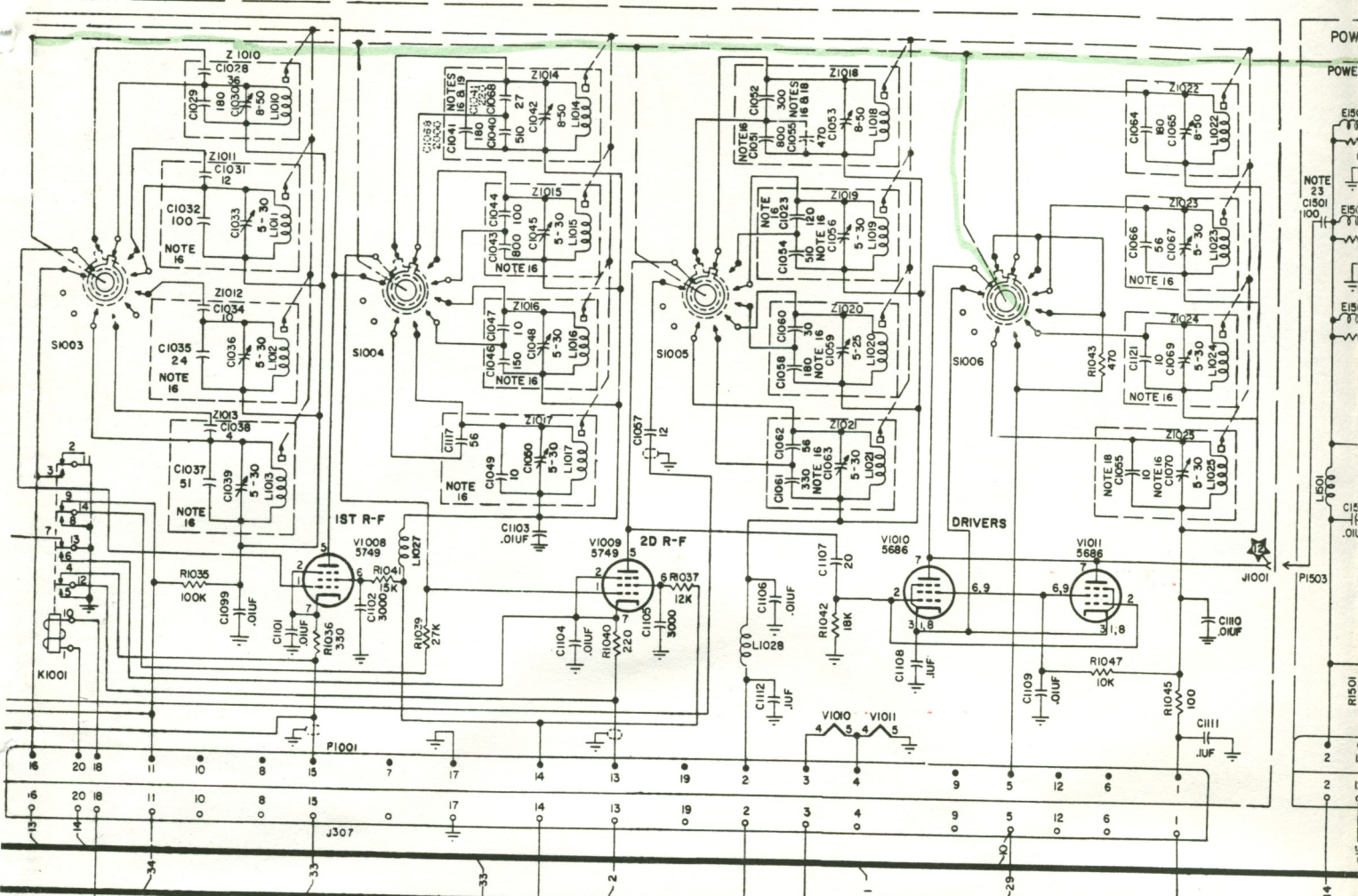


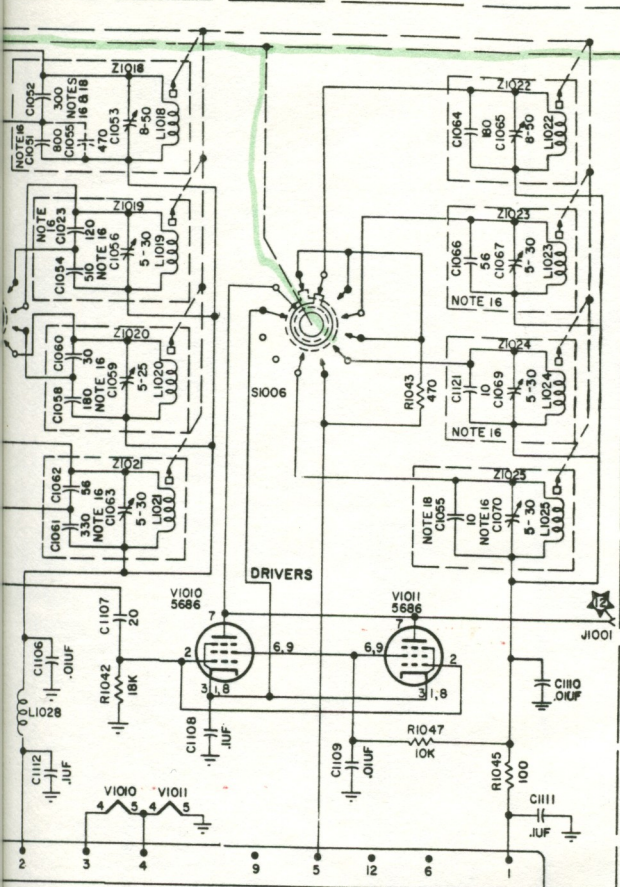




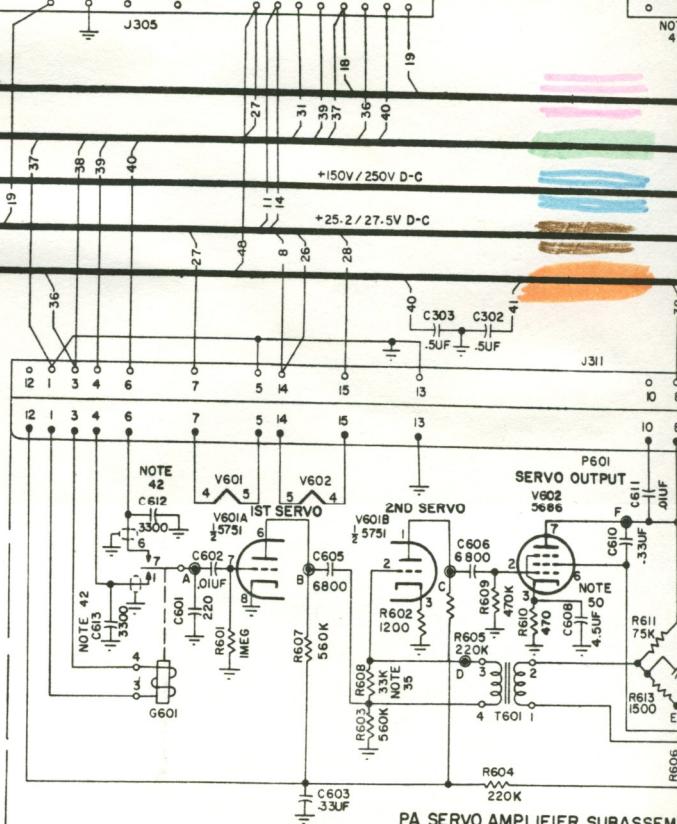
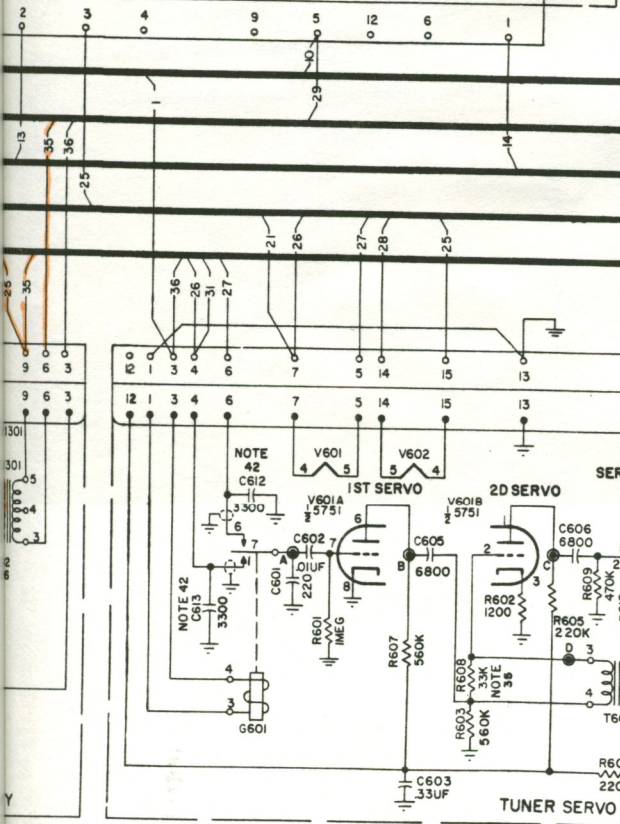
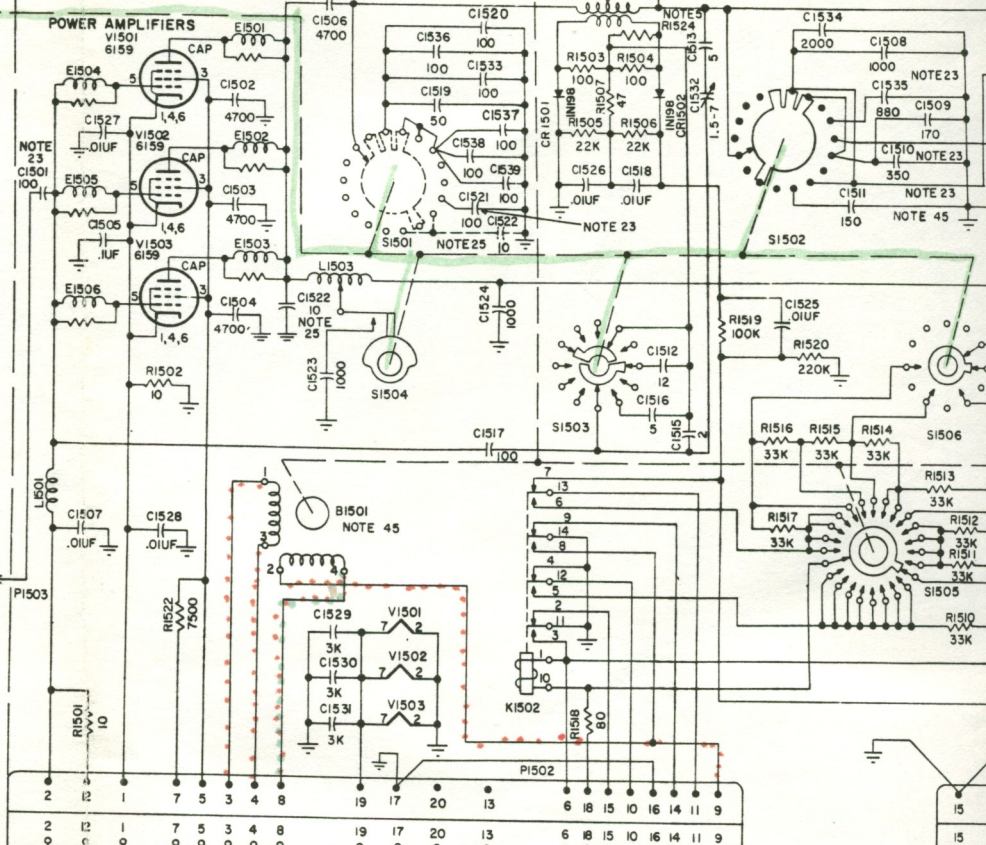


250 kHz I.F. / 6185-1

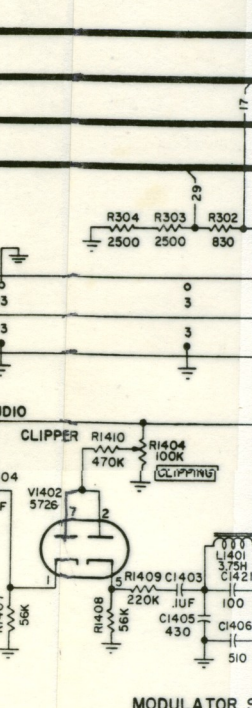
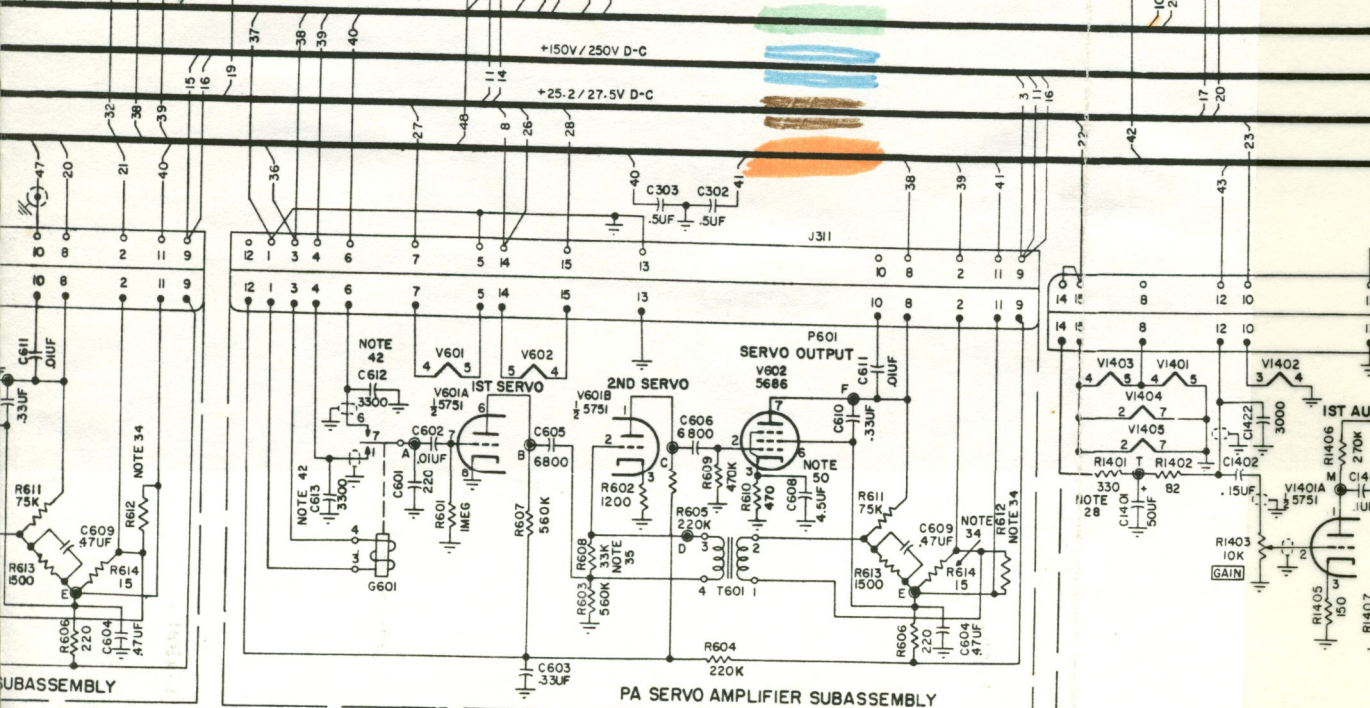
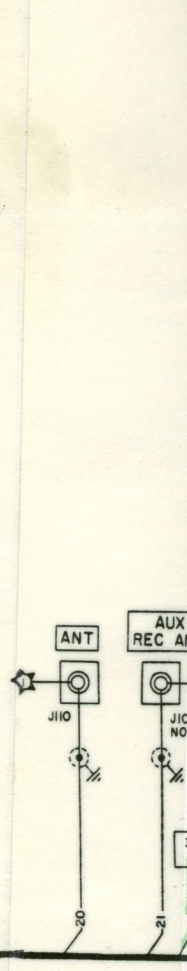
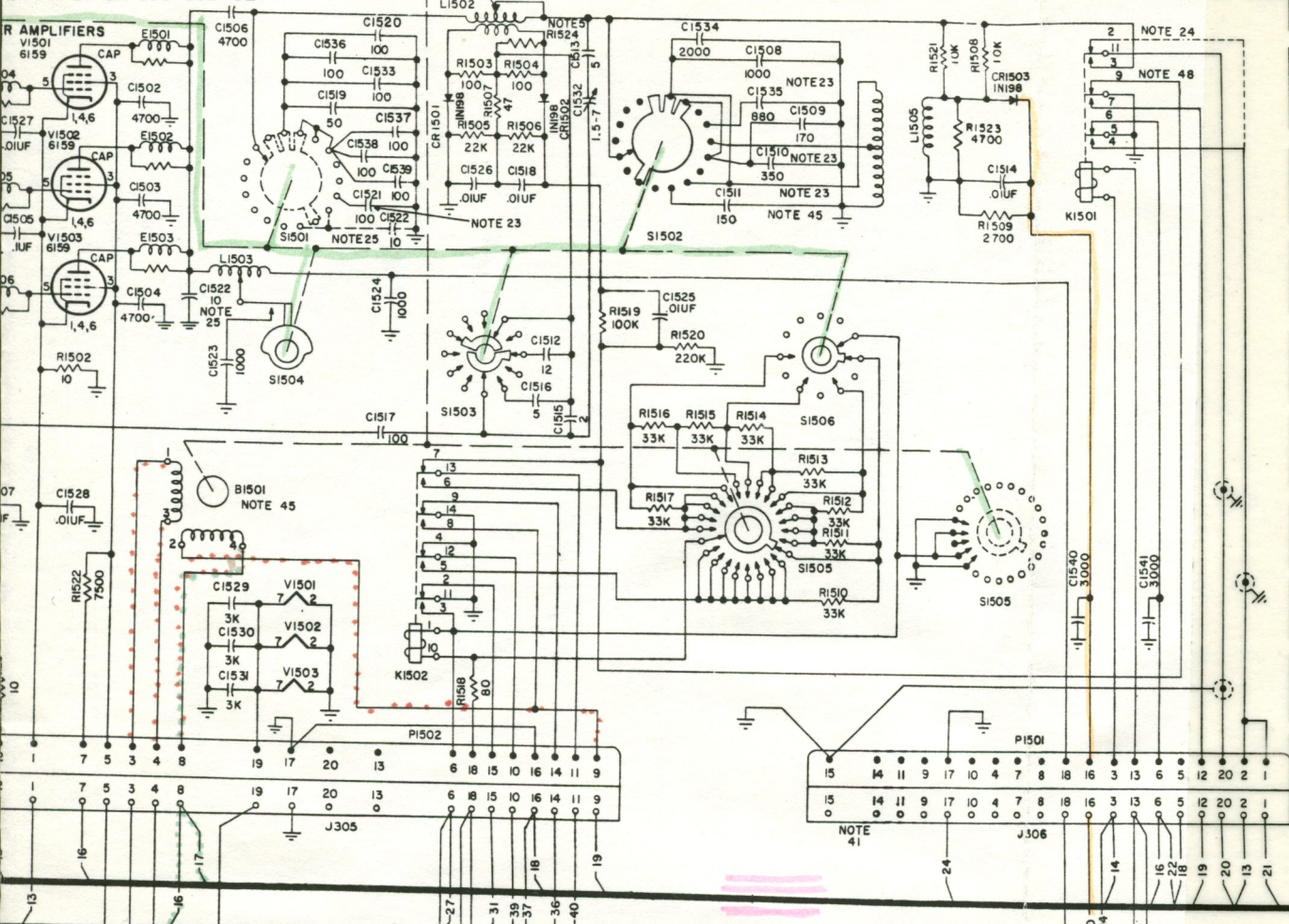




**POWER AMPLIFIER SUBASSEMBLY**



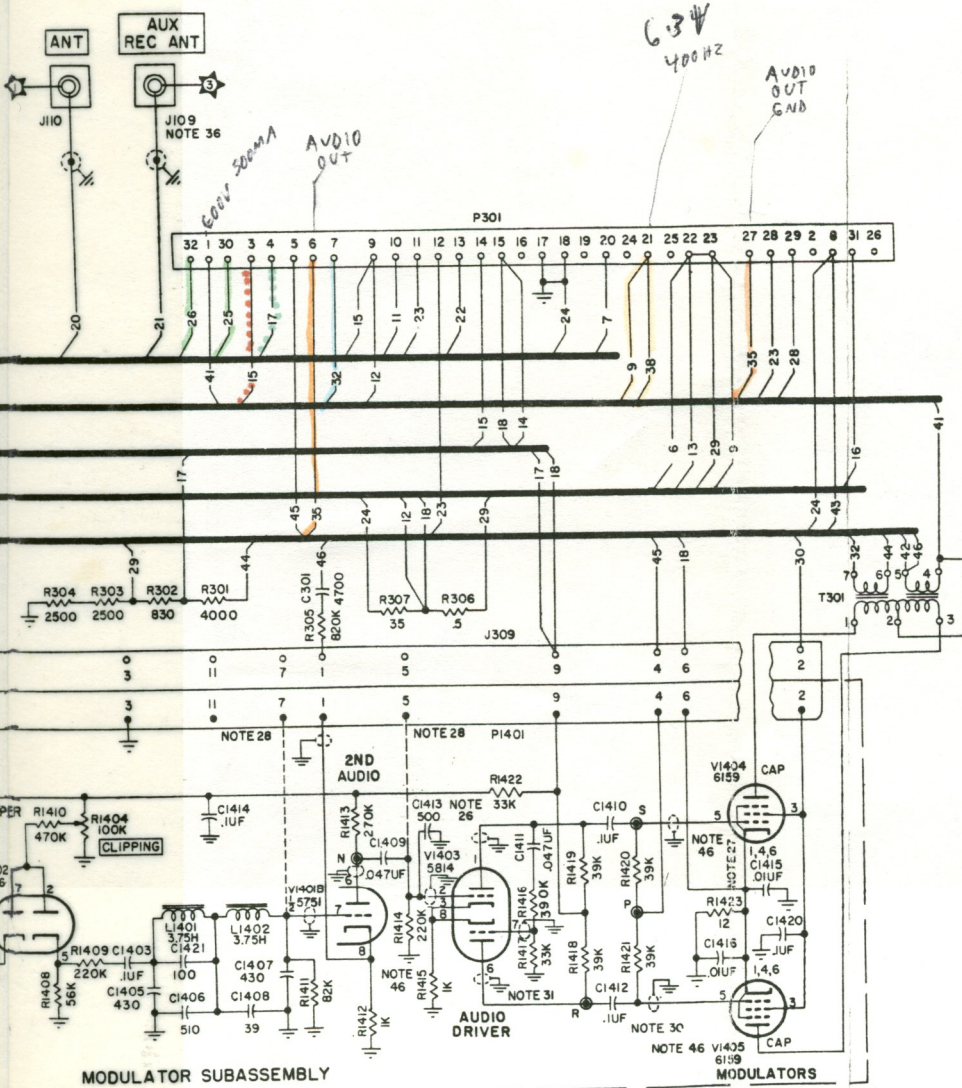
ER AMPLIFIER SUBASSEMBLY



SUBASSEMBLY

PA SERVO AMPLIFIER SUBASSEMBLY

MODULATOR SUBASSEMBLY



17. Value of C1018 changed from 62 to 75 and MOD 2; MOD 3 and MOD 5 respectively, of tuner subassembly.

18. Capacitor C1055 deleted from Z1018 and Z1025; MOD 3 of tuner subassembly.

19. Capacitor C1041 and C1068 reversed; tuner subassembly.

20. Value of R1049 changed from 120K to 182K; MOD 4 and MOD 9 respectively, of tuner subassembly. Value of C1113 changed from 0.05 uf; MOD 9 of tuner subassembly.

21. Value of C1071 changed from 1 to 1.5; tuner subassembly.

22. Value of R1022 changed from 2200 to 10K; MOD 2 of tuner subassembly.

23. The following capacitors changed intermodulation compensation capabilities and/or value and tolerance: C1501, 100 ±2%, changed to 100 ±5%; C1502, 1100 ±2%, changed to 170 ±2%; C1510, 400 ±2%, changed to 350 ±2%; C1511, 170 ±2%, changed to 150 ±2%; C1521, 63 ±5%, changed to 100 ±5%; and C1531, 100 ±5%, changed to 880 ±2%; MOD 1 of power amplifier subassembly.

24. Coax running from pin 2 of P1501 changed from terminal 2 to terminal 4; MOD 2 of power amplifier subassembly; paragraph 3-4.

25. Capacitor C1522 moved from S1501 to S1502; power amplifier subassembly modification with 618S-1A serial number 4696.

26. Capacitor C1413 added; MOD 2 of modulator subassembly.

27. Type of C1417 changed and value changed from 1000 to 470; MOD 2 and MOD 3 of modulator subassembly.

28. Test point wiring to P1401 deleted; MOD 2 of modulator subassembly.

29. Power rating of R1401 changed from 1 watt; MOD 4 of modulator subassembly.

30. Type of C1418 changed and value changed from 1000 to 470; MOD 2 and MOD 3 of modulator subassembly.

31. Shielded wires added between plates of control grids of V1404 and V1405; MOD 5 of modulator subassembly.

32. Crystal rectifier CR1201 changed from 1N37A; MOD 2 of 250 kc oscillator subassembly.

- 5 and back to  
of tuner sub-
- and added to
- nd; MOD 3 of
- 100K and to  
of tuner sub-  
m 0.1 uf to
- 5; MOD 6 of
- 1000; MOD 8
- temperature-  
nd/or toler-  
±5%; C1509,  
±2%, changed  
to 150 ±2%;  
35,140 ±2%,  
er amplifier
- 1 to K1501  
4 on K1501;  
ly. Refer to
- 1 to L1503;  
on, effective
- f modulator
- e of C1417  
d MOD 5 of
- ; MOD 3 of
- 1/2 watt to
- e of C1418  
d MOD 5 of
- f V1403 and  
5 modulator
- IN198 to  
and bfo
33. Value of the following capacitors changed: C1208, 36, changed to 39; C1209, 430, changed to 360; and C1210, 20, changed to 91; MOD 3 of 250 kc oscillator and bfo subassembly.
34. Value of R614 changed from 10 to 15 and R612 added; MOD 1 of tuner and pa servo amplifier subassemblies. Value of R612 is selected value; refer to T.O. 12R2-4-6-4 for values.
35. Value of R608 changed from 68K to 33K; MOD 2 of tuner and pa servo amplifier subassemblies.
36. Connector J109 changed to facilitate interconnection of the 618S-1 or 618S-1A with the 180L-3 without the necessity of using an external adapters on J109; MOD 1 of front panel subassembly.
37. Resistor R807 added; MOD 2 of relay subassembly.
38. Power rating of R801 changed from 5 watts to 8 watts; MOD 3 of relay subassembly.
39. Relay K101 type changed; MOD 1 of bandchange autopositioner unit. Old circuit indicated with dotted lines in figure 7-19.
40. Pawl of bandchange autopositioner unit type changed; MOD 3 of bandchange autopositioner unit.
41. The following wiring changes are made terminal 19 of J306 removed; shielded wire added between terminal 10 of J310 and terminal 26 of P302; wire added between terminal 5 of J313 and terminal 2 of J314; MOD 4 of main chassis.
42. Value of C612 and C613 changed from 3000 to 3300; MOD 3 of tuner and pa servo amplifier subassemblies.
43. Value of C904 and C908 changed from 3000 to 3300; MOD 5 of i-f amplifier subassembly.
44. Pin-type couplers deleted and Oldham couplers added to the following units: bandchange autopositioner unit, MOD 2; servomotor B102 unit, MOD 1; tuner subassembly, MOD 7; power amplifier subassembly, MOD 3. Refer to paragraph 1-23.
45. Motor B1501 changed type (refer to Illustrated Parts Breakdown, T.O. 12R2-4-6-4), wire removed from P1501-5 to K1501-7, wire removed from K1501-9 and connected to K1501-7, and shield braid on the three wires of B1501 grounded to P1502-17. The wire connected to B1501-2 removed and connected to K1502-8, wire removed from K1502-7 to P1502-9, wire to P1502-16 removed and connected to P1502-9, a jumper wire connected between P1502-16 and P1502-17, and capacitor C1511 changed type; MOD 5 of power amplifier subassembly and MOD 6 of main chassis.
46. Formerly unshielded wires from V1401B-6 to junction of R1413 and C1409, from V1401B-7 to junction of L1402 and C1407, from V1403-2 to C1409, and from V1403-7 to R1416 replaced with shielded wires originally shielded number 22-AWG copper wire from P1401-1 to V1401B-8, from P1401-12 to junction of R1402 and C1402, from V1403-1 to junction of C1411 and C1410, from V1403-6 to junction of R1418 and C1412, from R1403 (side opposite ground) to C1402 from R1403 (center arm) to V1401A-2, from V1405-1 to junction of C1412 and R1421, and from V1404-5 to junction of C1410 and R1420 replaced with shielded number 26-AWG copperweld wire; and capacitor C1417 and C1418 deleted; MOD 6 of modulator subassembly.
47. Blower motor B101 changed type; MOD 2 of front panel subassembly.
48. K1502-7 connected to K1501-9; MOD 6 of power amplifier subassembly.
49. Value of C1123 changed from 4 uf to 4.5 uf; MOD 10 of r-f tuner subassembly.
50. Value of C608 changed from 8 uf to 4.5 uf; MOD 4 of tuner and pa servo amplifier subassemblies.
51. For mechanical modifications, refer to Illustrated Parts Breakdown, T.O. 12R2-4-6-4.

Figure 7-19. Radio Receiver-Transmitter 618S-1 and 618S-1A,  
Schematic Diagram (Sheet 2 of 2 sheets)

capacitors changed: C1208, MOD 10, changed to 360; and MOD 3 of 250 kc oscillator

from 10 to 15 and R612 pa servo amplifier sub-selected value; refer to

from 68K to 33K; MOD 2 amplifier subassemblies.

to facilitate intercon-1A with the 180L-3 with-ternal adapters on J109; m- bly.

MOD 2 of relay subassembly.

changed from 5 watts to assembly.

; MOD 1 of bandchange unit indicated with dotted

topositioner unit type ge autopositioner unit.

changes are made terminal ed wire added between terminal 26 of P302; wire J313 and terminal 2 of

changed from 3000 to nd pa servo amplifier

changed from 3000 to subassembly.

and Oldham couplers units: bandchange auto- motor B102 unit, MOD 7; power amplifier sub- aragraph 1-23.

type (refer to Illustrated -4-6-4), wire removed e removed from K1501-9 and shield braid on the ded to P1502-17. The removed and connected om K1502-7 to P1502-9, d connected to P1502-9, between P1502-16 and 11 changed type; MOD 5 bly and MOD 6 of main

46. Formerly unshielded wires from V1401B-6 to junction of R1413 and C1409, from V1401B-7 to junction of L1402 and C1407, from V1403-2 to C1409, and from V1403-7 to R1416 replaced with shielded wires; originally shielded number 22-AWG copper wire from P1401-1 to V1401B-8, from P1401-12 to junction of R1402 and C1402, from V1403-1 to junction of C1411 and C1410, from V1403-6 to junction of R1418 and C1412, from R1403 (side opposite ground) to C1402, from R1403 (center arm) to V1401A-2, from V1405-5 to junction of C1412 and R1421, and from V1404-5 to junction of C1410 and R1420 replaced with shielded number 26-AWG copperweld wire; and capacitors C1417 and C1418 deleted; MOD 6 of modulator subassembly.

47. Blower motor B101 changed type; MOD 2 of front panel subassembly.

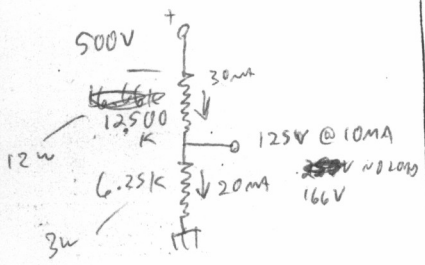
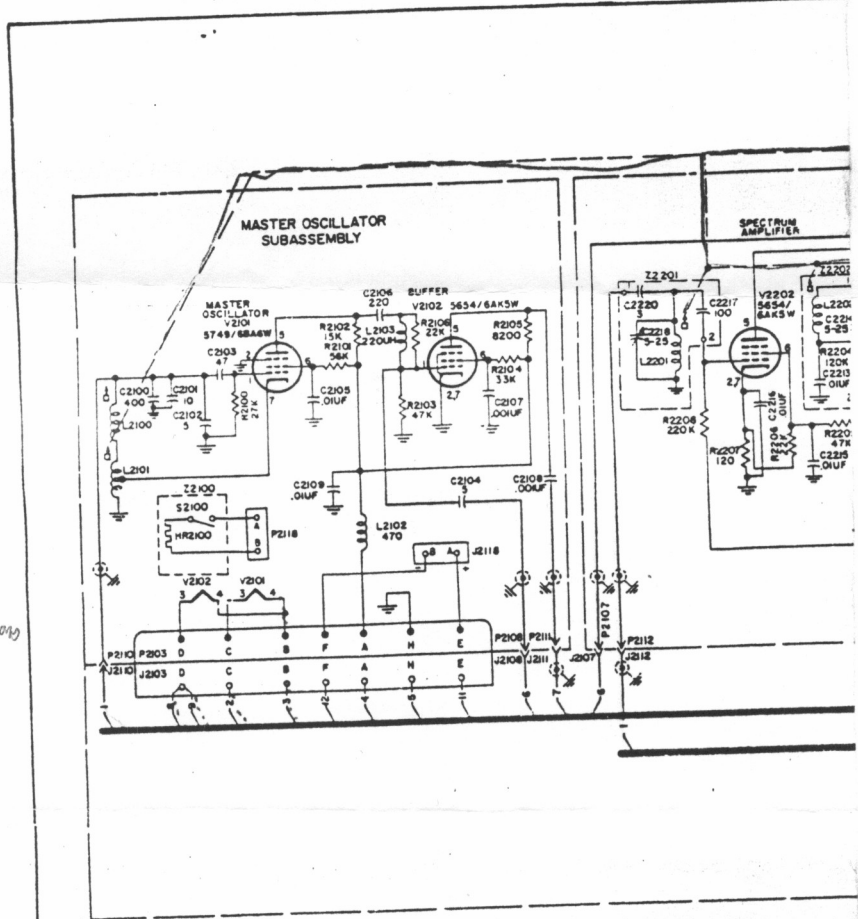
48. K1502-7 connected to K1501-9; MOD 6 of power amplifier subassembly.

49. Value of C1123 changed from 4 uf to 4.5 uf; MOD 10 of r-f tuner subassembly.

50. Value of C608 changed from 8 uf to 4.5 uf; MOD 4 of tuner and pa servo amplifier subassemblies.

51. For mechanical modifications, refer to Illustrated Parts Breakdown, T.O. 12R2-4-6-4.

Figure 7-19. Radio Receiver-Transmitter 618S-1 and 618S-1A, Schematic Diagram (Sheet 2 of 2 sheets)



S.M.O.  
 RED — 6.3V common  
 VIO+PMK — 6.3V supply  
 BLV — 100VDC IN  
 BLK — GND  
 RD/WT COAX — BUFFER OUT

10 TURNS  
 ↪ 1.75 TO 3.5 MHz

8.5mA 100V 24V  
 10mA 125V 31V  
 13.3mA 150V 38V out

~~P2102~~  
~~#15 S.M.O. OUT~~  
~~#13 BT 150V?~~

HEATER = GRN/BK WIRES  
 GN - + 12VDC  
 BK - (om)

Figure 7-26. Radio Receiver-Transmitter RT-311/ARC-38.





BELDEN

~~1) 350-4221 - STEREO.~~

~~2) 394-1509 - BIAW DEW HURST JVL.~~

I  
AMPHENOL  
CONNECTOR

COLLINS CONNECTOR

PIN#	FUNCT.	COLLINS
1	600V BT	301-1
3	GND	301-17
6	GND	301-18
7	BLOWER 115V 400HZ	301-3
8	115V 400HZ PWR.	301-4
9	6.34 400HZ	301-21
10	AUDIO GND.	301-27
11	+250V DYNAMOTOR	301-15
12	+250V RECTIFIER	301-14
13	27.5V	301-22
14	-50V MOD BIAS	301-5
15	27.5V	301-23

FEMALE  
PLASTIC  
MALE  
PINS

2, 4, 5 - UNUSED - see pin (2)

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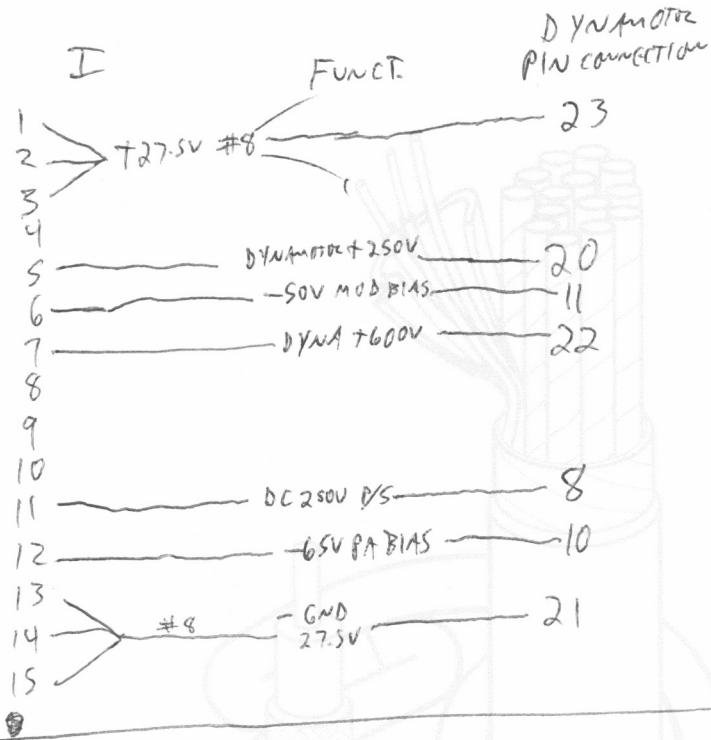
14651 North Dallas Parkway, Suite 144  
Dallas, Texas 75240  
(214) 788-4300

BEL-2870



BELDEN

DYNAMOTOR



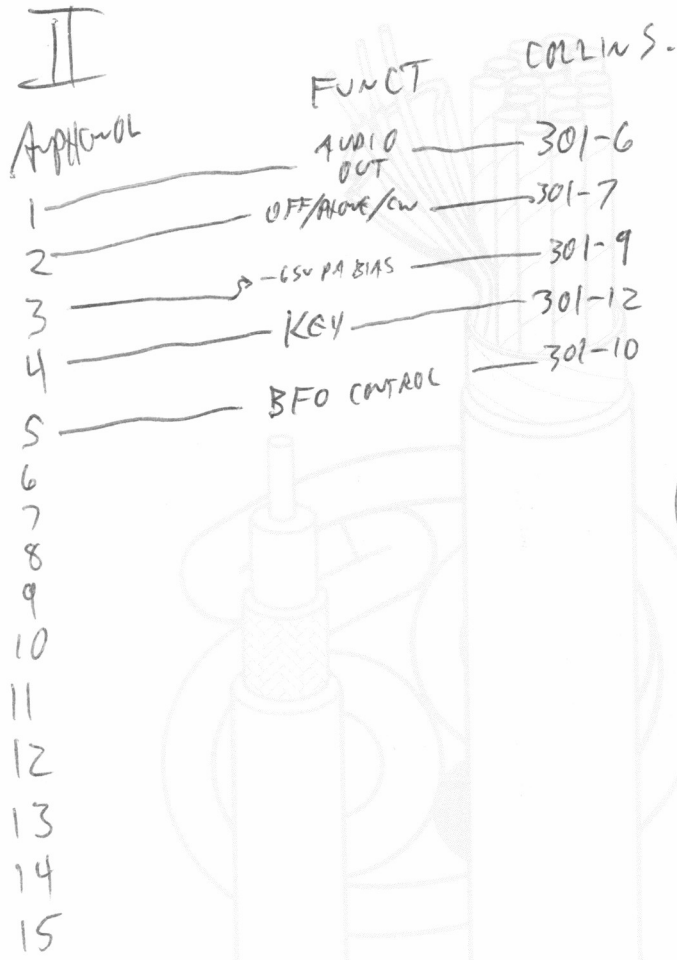
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BEL-2870



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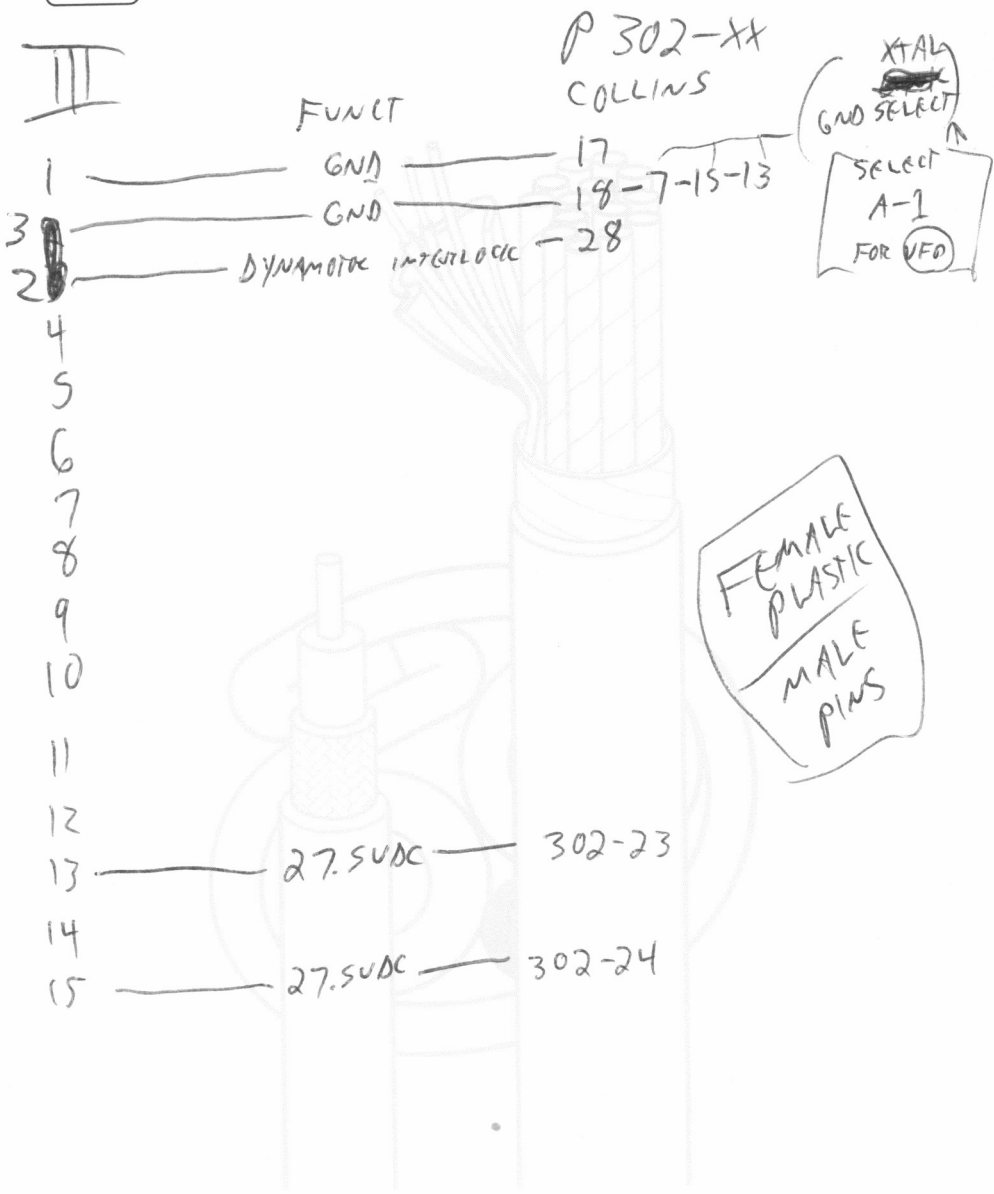


MALE  
PLASTIC  
MALE  
PINS

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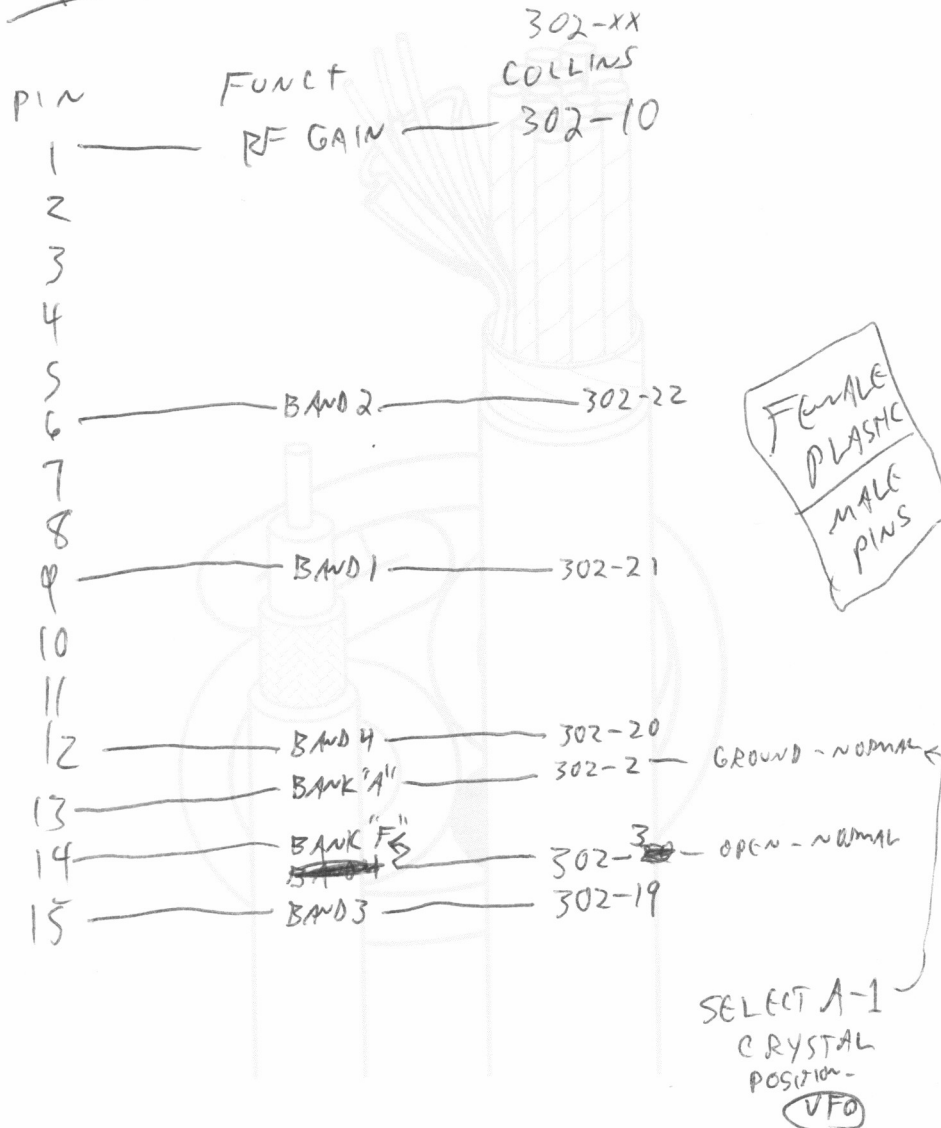
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BELDEN

P302-XX

# IV



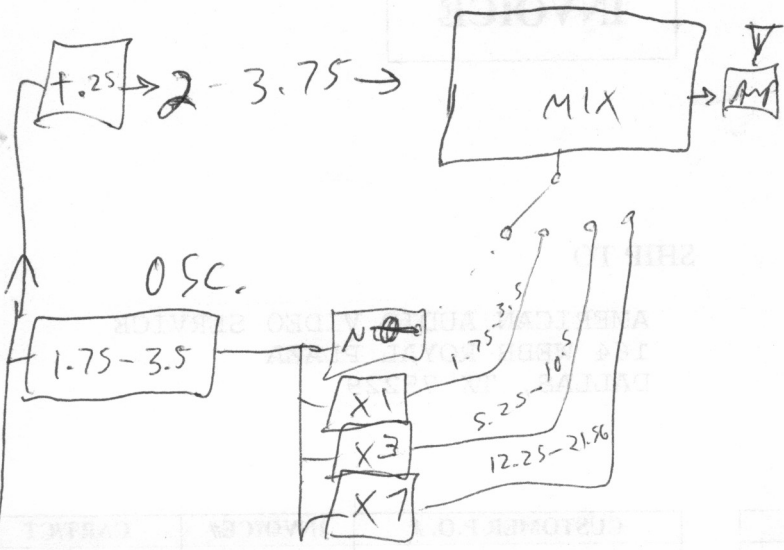
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$$\begin{array}{r} 2(1.56 \\ 3.75 \\ \hline 25.31 \end{array}$$

OUT @ TOP OF BAND

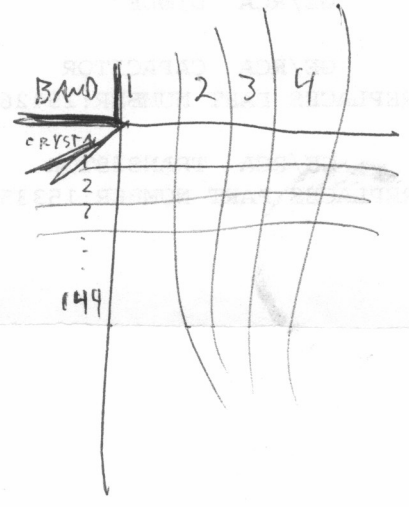
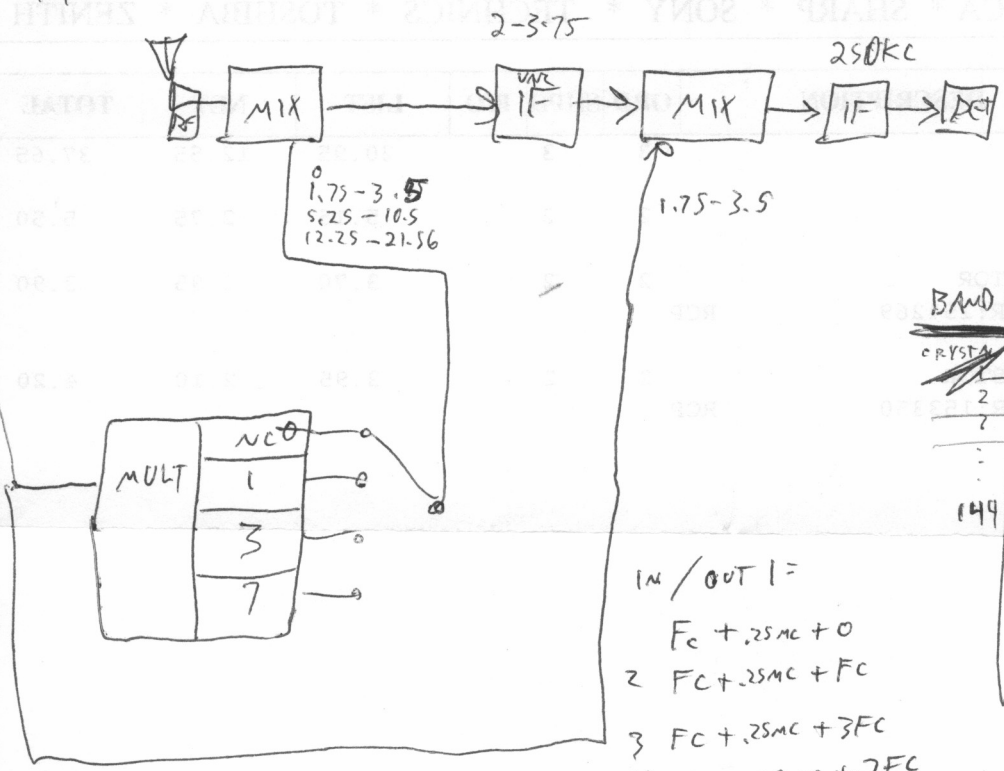
- 1  $3.75 + 0 = 3.75$
- 2  $3.75 + 3.50 = \del{7.25}$
- 3  $3.75 + 10.5 = 14.25$
- 4  $3.75 + 21.56 = 25.31$



IN @ TOP OF BAND

- ~~2-3.75~~
- 3.75-7.25
- 7.25-14.25
- 14.25-25.00

OSC.





- IN / OUT =
- 1  $F_c + .25MC + 0$
  - 2  $F_c + .25MC + FC$
  - 3  $F_c + .25MC + 3FC$
  - 4  $F_c + .25MC + 7FC$

$F_c = \text{XTAL FREQ.}$









CRYSTAL SELECTION - TB801 CONNECTIONS - GROUND TO SELECT

CRYSTAL POSITION

	R	S	T	U	V	W
	33	31	29	27	26	24
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						

GND =    
 = CONNECTED TOGETHER, NOT GROUNDED

~~101100~~  
~~101100~~

3 2 1 6 8 4 2 1  
       

BAND SELECT

TB801 - GND			
17	18	14	16
1	2	3	4
BAND			

BANK SELECT

TB801 - GND					
35	15	32	30	36	34
A	B	C	D	E	F
BANK					

# INSTALLED CRYSTALS

①  
3

2-3.75

3.75-7.25

7.25-14.25

14.25-25.0

OPERATING FREQUENCIES FOR COLLINS 6189-1 FOR CRYSTALS LISTED BELOW

XTAL FREQ.	BAND 1	BAND 2	BAND 3	BAND 4
A1 2.4375	2.6875	5.125	10	19.75
1.8355	2.0855	3.921	7.592	14.934
3.1835	3.4335	6.617	12.984	25.718
3.187	3.437	6.624	12.998	25.746
3.1905	3.4405	6.631	13.012	25.774
3.208	3.458	6.666	13.082	25.914
3.2535	3.5035	6.757	13.264	26.278
3.215	3.465	6.68	13.11	25.97
2.7045	2.9545	5.659	11.068	21.886
2.758	3.008	5.766	11.282	22.314
3.2635	3.5135	6.777	13.304	26.358
2.76525	3.01525	5.7805	11.311	22.372
2.17725	2.42725	4.6045	8.958999	17.668
2.165	2.415	4.58	8.91	17.57
2.16325	2.41325	4.5765	8.903	17.556
2.709375	2.959375	5.66875	11.0875	21.925
<del>1.258</del>	<del>1.508</del>	<del>2.766</del>	<del>5.282</del>	<del>10.314</del> MISTAKE
2.158	2.408	4.566	8.882	17.514
1.84375	2.09375	3.9375	7.625	15
3.27612	3.52612	6.80224	13.35448	26.45896
3.2735	3.5235	6.797	13.344	26.438
2.18675	2.43675	4.6235	8.997	17.744
2.708	2.958	5.666	11.082	21.914
2.824	3.074	5.898	11.546	22.842
A24 2.375	2.625	5	9.75	19.25
B1 2.617	2.867	5.484	10.718	21.186
2.1755	2.4255	4.601	8.951999	17.654
2.6275	2.8775	5.505	10.76	21.27
2.62825	2.87825	5.5065	10.763	21.276
2.6345	2.8845	5.519	10.788	21.326
3.2765	3.5265	6.803	13.356	26.462
2.6415	2.8915	5.533	10.816	21.382
2.64325	2.89325	5.5365	10.823	21.396
<del>0</del>	<del>.25</del>	<del>.25</del>	<del>.25</del>	<del>.25</del>
<del>0</del>	<del>.25</del>	<del>.25</del>	<del>.25</del>	<del>.25</del>
B12 2.652	2.902	5.554	10.858	21.466
B24 2.68086	2.93086	5.61172	10.97344	21.69688
2.68	2.93	5.61	10.97	21.69
2.223	2.473	4.696	9.142	18.034
2.6765	2.9265	5.603	10.956	21.662
2.6695	2.9195	5.589	10.928	21.606
2.666	2.916	5.582	10.914	21.578
2.6625	2.9125	5.575	10.9	21.55
2.66215	2.91215	5.5743	10.8986	21.5472
2.659	2.909	5.568	10.886	21.522
2.65825	2.90825	5.5665	10.883	21.516
2.6555	2.9055	5.561	10.872	21.494
2.6545	2.9045	5.559	10.868	21.486
C1 2.751	3.001	5.752	11.254	22.258
2.7735	3.0235	5.797	11.344	22.438
2.765	3.015	5.78	11.31	22.37
3.154	3.404	6.558	12.866	25.482
3.161	3.411	6.572	12.894	25.538
3.182	3.432	6.614	12.978	25.706
2.15312	2.40312	4.55624	8.86248	17.47496
3.2695	3.5195	6.789	13.328	26.406
3.217	3.467	6.684	13.118	25.986
3.231	3.481	6.712	13.174	26.098
3.238	3.488	6.726	13.202	26.154

EMPTY SOCKETS

B13-B23  
SKIPPED  
BY MISTAKE



MISTAKE

(2)  
3

OPERATING FREQUENCIES FOR COLLINS 6188-1 FOR CRYSTALS LISTED BELOW

XTAL FREQ.	BAND 1	BAND 2	BAND 3	BAND 4
2.212375	2.462375	4.67475	9.0995	17.949
2.211375	2.461375	4.67275	9.0955	17.941
2.70812	2.95812	5.66624	11.08248	21.91496
2.2195	2.4695	4.689	9.128	18.006
2.209375	2.459375	4.66875	9.087499	17.925
2.2125	2.4625	4.675	9.100001	17.95
2.208375	2.458375	4.66675	9.0835	17.917
2.207375	2.457375	4.66475	9.0795	17.909
3.2755	3.5255	6.801	13.352	26.454
3.2715	3.5215	6.793	13.336	26.422
3.245	3.495	6.74	13.23	26.21
D1-2.694	2.944	5.638	11.026	21.802
2.687	2.937	5.624	10.998	21.746
2.6975	2.9475	5.645	11.04	21.83
2.69575	2.94575	5.6415	11.033	21.816
2.701	2.951	5.652	11.054	21.858
3.166	3.416	6.582	12.914	25.578
2.7115	2.9615	5.673	11.096	21.942
2.715	2.965	5.68	11.11	21.97
2.73	2.98	5.71	11.17	22.09
2.646	2.896	5.542	10.834	21.418
2.702	2.952	5.654	11.058	21.866
3.13975	3.38975	6.5295	12.809	25.368
3.20735	3.45735	6.6647	13.0794	25.9088
3.19225	3.44225	6.6345	13.019	25.788
3.1885	3.4385	6.627	13.004	25.758
3.18	3.43	6.61	12.97	25.69
3.181	3.431	6.612	12.974	25.698
3.173	3.423	6.596	12.942	25.634
3.695	3.945	7.64	15.03	29.81
3.1625	3.4125	6.575	12.9	25.55
3.159	3.409	6.568	12.886	25.522
3.1555	3.4055	6.561	12.872	25.494
3.145	3.395	6.54	12.83	25.41
3.1435	3.3935	6.537	12.824	25.398
E1-2.0285	2.2785	4.307	8.364001	16.478
2.14225	2.39225	4.5345	8.819	17.388
2.14462	2.39462	4.53924	8.82848	17.40696
2.14575	2.39575	4.5415	8.833	17.416
2.14675	2.39675	4.5435	8.837	17.424
2.14887	2.39887	4.54774	8.84548	17.44096
2.151	2.401	4.552	8.854	17.458
3.2675	3.5175	6.785	13.32	26.39
2.15525	2.40525	4.5605	8.871	17.492
2.15737	2.40737	4.56474	8.879481	17.50896
2.15975	2.40975	4.5695	8.889	17.528
2.16162	2.41162	4.57324	8.896479	17.54296
2.15625	2.40625	4.5625	8.875	17.5
2.1545	2.4045	4.559	8.868	17.486
2.14925	2.39925	4.5485	8.847	17.444
2.1475	2.3975	4.545	8.84	17.43
2.144	2.394	4.538	8.826	17.402
2.17375	2.42375	4.5975	8.945	17.64
2.1765	2.4265	4.603	8.956001	17.662
2.17437	2.42437	4.59874	8.94748	17.64496
2.172	2.422	4.594	8.938	17.626
2.17025	2.42025	4.5905	8.931	17.612
2.165875	2.415875	4.58175	8.9135	17.577
2.16375	2.41375	4.5775	8.905	17.56
F1-1.932	2.182	4.114	7.978	15.706
2.43975	2.68975	5.1295	10.009	19.768
2.618	2.868	5.486	10.722	21.194
			10.75	21.25

2.639	2.889	5.528	10.806	21.362
2.44175	2.69175	5.1335	10.017	19.784
2.66	2.91	5.57	10.89	21.53
2.44375	2.69375	5.1375	10.025	19.8
2.44575	2.69575	5.1415	10.033	19.816
2.75725	3.00725	5.7645	11.279	22.308
2.76325	3.01325	5.7765	11.303	22.356
2.695	2.945	5.64	11.03	21.81
3.2655	3.5155	6.781	13.312	26.374
3.2615	3.5115	6.773	13.296	26.342
3.2595	3.5095	6.769	13.288	26.326
3.2575	3.5075	6.765	13.28	26.31
3.2555	3.5055	6.761	13.272	26.294
2.78525	3.03525	5.8205	11.391	22.532
2.77925	3.02925	5.8085	11.367	22.484
2.737	2.987	5.724	11.198	22.146
2.77325	3.02325	5.7965	11.343	22.436
2.716	2.966	5.682	11.114	21.978
2.76925	3.01925	5.7885	11.327	22.404
2.76725	3.01725	5.7845	11.319	22.388
3.579545	3.829545	7.40909	14.56818	28.88636

(3)  
/3

## 618S-1 Crystal and Frequency Calculators

Today, a spreadsheet would be used to do this. These were created back in ancient times when spreadsheet software (and most computers) cost so much no one could afford them. They are in the BASIC programming language which is easy to understand.

This program lets you put in a crystal frequency and then tells you what frequency the 618S-1 will be on.

```
10 CLS
```

```
20 SCREEN 1
```

```
30 PRINT"another fine program by Patrick Jankowiak KD5OEI"
```

```
40 PRINT"www.bunkerofdoom.com"
```

```
50 PRINT"free to public domain - calculator for 618S-1"
```

```
55 PRINT""
```

```
60 PRINT"OPERATING FREQUENCIES FOR SELECTED CRYSTAL  
FREQUENCIES FOR THE 618S-1"
```

```
70 PRINT"ENTER CRYSTAL FREQUENCIES FROM 1.75 TO 3.5 IN  
MEGAHERTZ"
```

```
80 LPRINT"OPERATING FREQUENCIES FOR SELECTED CRYSTALS FOR  
THE 618S-1"
```

```
90 PRINT"enter 0 to quit"
```

```
100 LPRINT"                by Patrick Jankowiak"
```

```
110 PRINT"CRYSTAL","BAND 1","BAND 2","BAND 3","BAND 4"
```

```
120 LPRINT"CRYSTAL","BAND 1","BAND 2","BAND 3","BAND 4"
```

```
130 INPUT FC
```

```
140 IF FC = 0 THEN GOTO 270
```

```
150 IF FC < 1.75 THEN GOSUB 240
```

```
160 IF FC > 3.5 THEN GOSUB 240
```

```
170 F1 = FC + .25
180 F2 = FC + .25 + FC
190 F3 = FC + .25 + (3 * FC)
200 F4 = FC + .25 + (7 * FC)
210 PRINT FC, F1, F2, F3, F4
220 LPRINT FC, F1, F2, F3, F4
230 GOTO 130
240 PRINT"SPECIFIED OSCILLATOR RANGE IS 1.75 TO 3.5 MHz"
250 LPRINT"specified range is 1.75 to 3.5 MHz"
260 RETURN
270 END
```

This program lets you put in a frequency and tells you what crystal to use.

10 CLS

20 SCREEN 2

30 PRINT"another fine program by Patrick Jankowiak KD5OEI"

40 PRINT"www.bunkerofdoom.com"

50 PRINT"free to public domain - calculator for 618S-1"

55 PRINT""

60 PRINT"CRYSTAL FREQUENCIES NEEDED FOR SPECIFIC 618S-1  
OPERATING FREQUENCIES"

70 PRINT"ENTER OPERATING FREQUENCIES IN MEGAHERTZ"

80 PRINT"ENTER 0 TO QUIT"

90 LPRINT"CRYSTAL FREQUENCIES NEEDED FOR 618S-1 OPERATING  
FREQUENCIES"

100 LPRINT"                    by Patrick Jankowiak"

110 PRINT"OPERATING FREQUENCY","CRYSTAL FREQUENCY"

120 LPRINT"OPERATING FREQUENCY","CRYSTAL FREQUENCY"

130 INPUT FO

140 IF FO = 0 THEN GOTO 300

150 IF FO<2 THEN GOSUB 240

160 IF FO>25 THEN GOSUB 270

170 IF FO<3.75 THEN FX=(FO-.25)

180 IF FO>3.74999999# THEN FX=(FO-.25)/2

190 IF FO>7.25 THEN FX=(FO-.25)/4

200 IF FO>14.25 THEN FX=(FO-.25)/8

210 PRINT FO,,FX:LPRINT FO,,FX

220 FO=0

230 GOTO 130

240 IF FO<2 THEN PRINT"the 618S1 Minimum frequency is 2 mhz.

250 IF FO<2 THEN LPRINT FO" MHz is below designed range of 618S1 by  
"(100-(100/(2/FO)))" %.

260 RETURN

270 IF FO>25 THEN PRINT"The 618S1 maximum frequency is 25 MHz."

280 IF FO>25 THEN LPRINT FO " MHz is above designed range of 618S1 by  
"(((FO/25)\*100)-100)" %.

290 RETURN

300 END