INSTRUCTION BOOK

FOR

OSCILLATOR GROUP AN/URA-13(XC-1)

MANUFACTURED BY

COLLINS RADIO COMPANY

ORDER NO. 10111-PH-51-91

1 OCTOBER 1954

WARNING

HIGH VOLTAGE
EXISTS
IN
THIS EQUIPMENT

DEATH ON CONTACT

may result if operating personnel fail to observe safety precautions.

C O N T E N T S

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (cont)

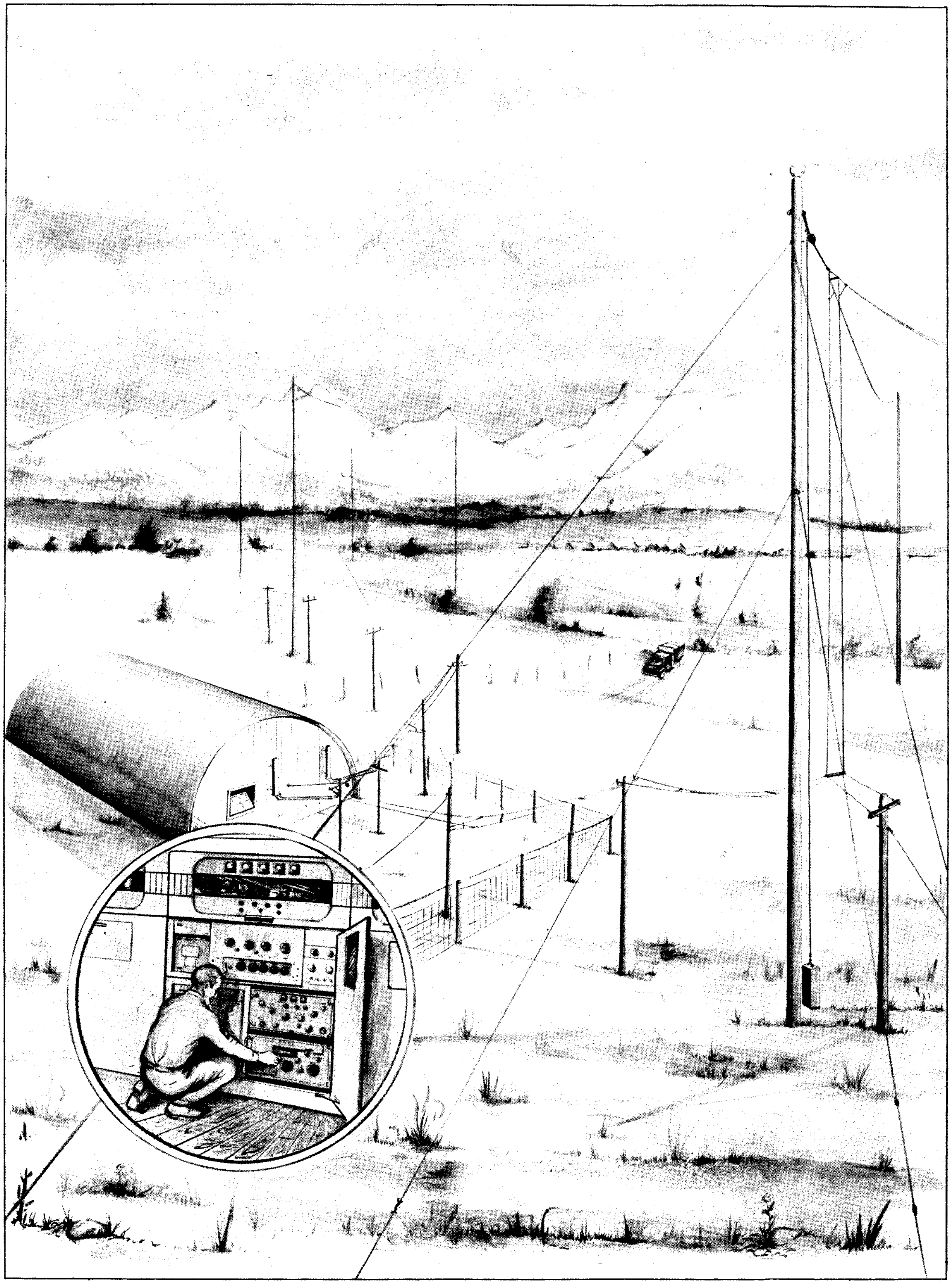


Figure 1. Fixed transmitting station using
Oscillator Group AN/URA-13

This instruction book will be replaced by TM 11-5057 which, when published, will be listed in SR-310-20-4 and SR 310-20-2

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

This instruction book contains instructions for the installation, operation, maintenance, and repair of Oscillator Group AN/URA-13. Oscillator Group AN/URA-13 includes Radio Frequency Oscillator O-152/URA-13 and Radio Receiver R-390/URR. Maintenance and repair of Radio Frequency Oscillator O-152/URA-13 are contained in this instruction book. Maintenance and repair of Radio Receiver R-390/URR are contained in the instruction book covering that unit.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army materiel and equipment.

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR745-45-5 (Army), Navy Shipping Guide, Articl 1850-4, and AFR 71-4 (Air Force).

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

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

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

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

f. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose

a. Oscillator Group AN/URA-13 is a stabilized rf exciter, with a variable rf output within the frequency range of 1.5 to 32 megacycles (mc). The oscillator group is used as an rf exciter for an associated transmitter operating in the same frequency range. Line input circuits are provided to handle signals for continuous wave (cw) operation, facsimile (fax) operation, frequency shift keying (fsk) and phase modulation (pm) on phone operation. Local input circuits are provided to handle signals for cw operation and phone operation.

b. The equipment consists of Radio Frequency Oscillator O-152/URA-13, which produces a stabilized radio frequency oscillation, and Radio Receiver R-390/URR, which produces an if. signal on which the radio frequency oscillator stabilizes. A number of additional components, listed in par. 7, is also included with the group. The operating components set up for operation are shown in figures 2 and 3.

4. System Application

Figure 4 is a block diagram of an AN/URA-13 frequency controlled transmitting system. The system establishes a transmitted rf signal to match the frequency to which the radio receiver is tuned.

a. Tuning to Frequency. When the radio receiver is manually tuned, the Electrical Special Purpose Cable Assembly CX-1619/U transfers frequency control information from the radio receiver to the radio frequency oscillator. This frequency control information indicates that megacycle band which includes the frequency to which the radio receiver is tuned. With the frequency control information, the radio frequency oscillator automatically seeks the frequency to which the radio receiver is tuned. There is no rf output to the transmitter during this positioning operation. The radio frequency oscillator positioning operation requires two steps. First, the radio frequency oscillator coarsely positions to the megacycle position below the radio receiver frequency. Then fine positioning continues until the rf output to the radio receiver produces an if. output from the radio receiver. At this time the system stabilizes on the frequency which produces a 455 kilocycle (kc) if. output from the radio receiver, and the rf output is made available to the transmitter. The associated transmitter must be tuned separately, either manually or automatically, to the proper frequency.

b. Maintaining Tuned Frequency. Following stabilization, the radio frequency oscillator maintains the frequency to which the radio receiver is tuned. The 455 kc if. indicates that the radio frequency signal matches the tuned radio receiver frequency. Variation of the if. from 455 kc results in compensative, fine retuning by the radio frequency oscillator to re-establish the if. at 455 kc. Therefore, variation from the established rf output, with no change in receiver tuning, results in immediate re-establishment of the rf output. Slowly changing the radio receiver tuning also produces a variation from the 455 kc if. Here, again the radio frequency signal changes to re-establish the 455 kc if. In so doing, the automatic radio frequency oscillator tuning follows the slow, manual tuning of the radio receiver. Rapid tuning of the radio receiver results in the loss of the if. signal since the automatic tuning of the radio frequency oscillator will not keep pace. Loss of the if. output from the radio receiver, regardless of the cause, results in loss of the rf output to the transmitter. The radio frequency oscillator then repositions on the radio receiver frequency and, upon stabilization, again, makes available the rf output to the transmitter.

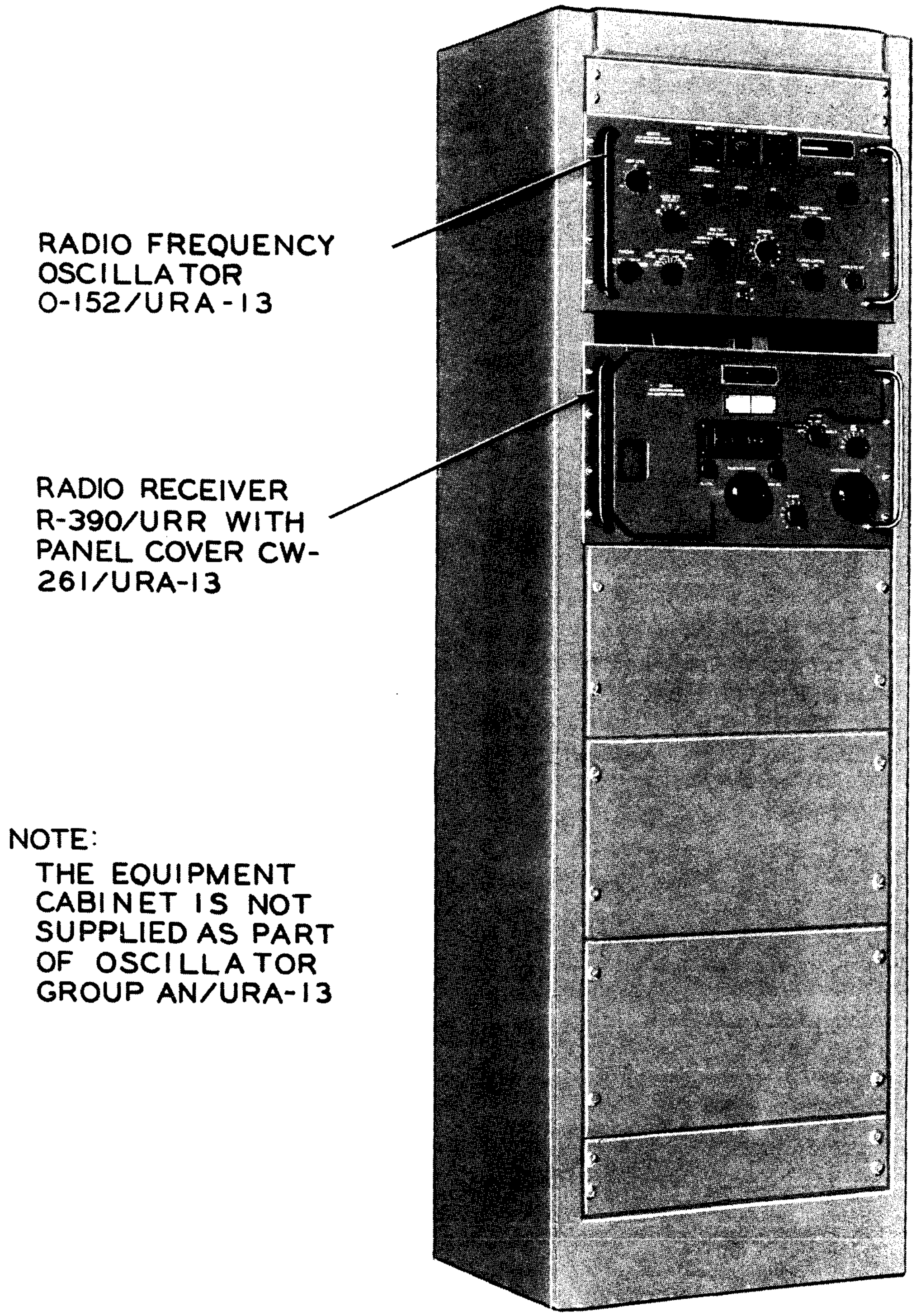


Figure 2. Oscillator Group AN/URA-13,
equipment cabinet installation, front view

NOTE:
THE EQUIPMENT
CABINET IS NOT
SUPPLIED AS
PART OF
OSCILLATOR GROUP
AN/URA-13

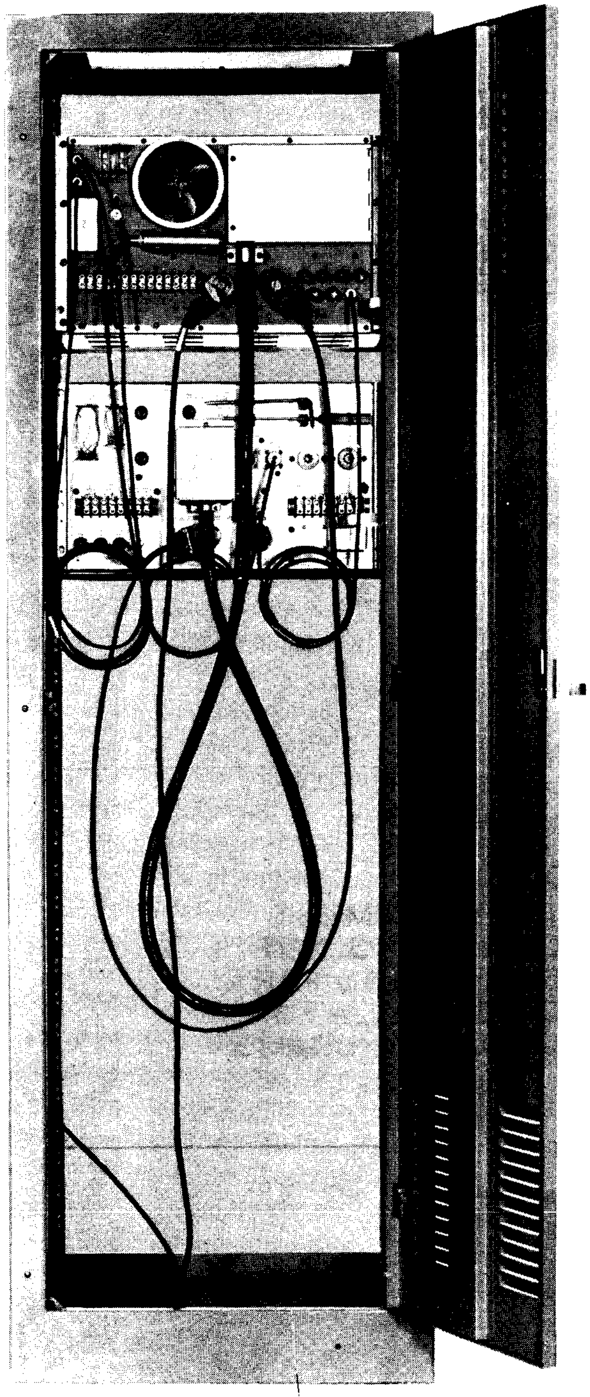


Figure 3. Oscillator Group AN/URA-13,
equipment cabinet installation, rear view

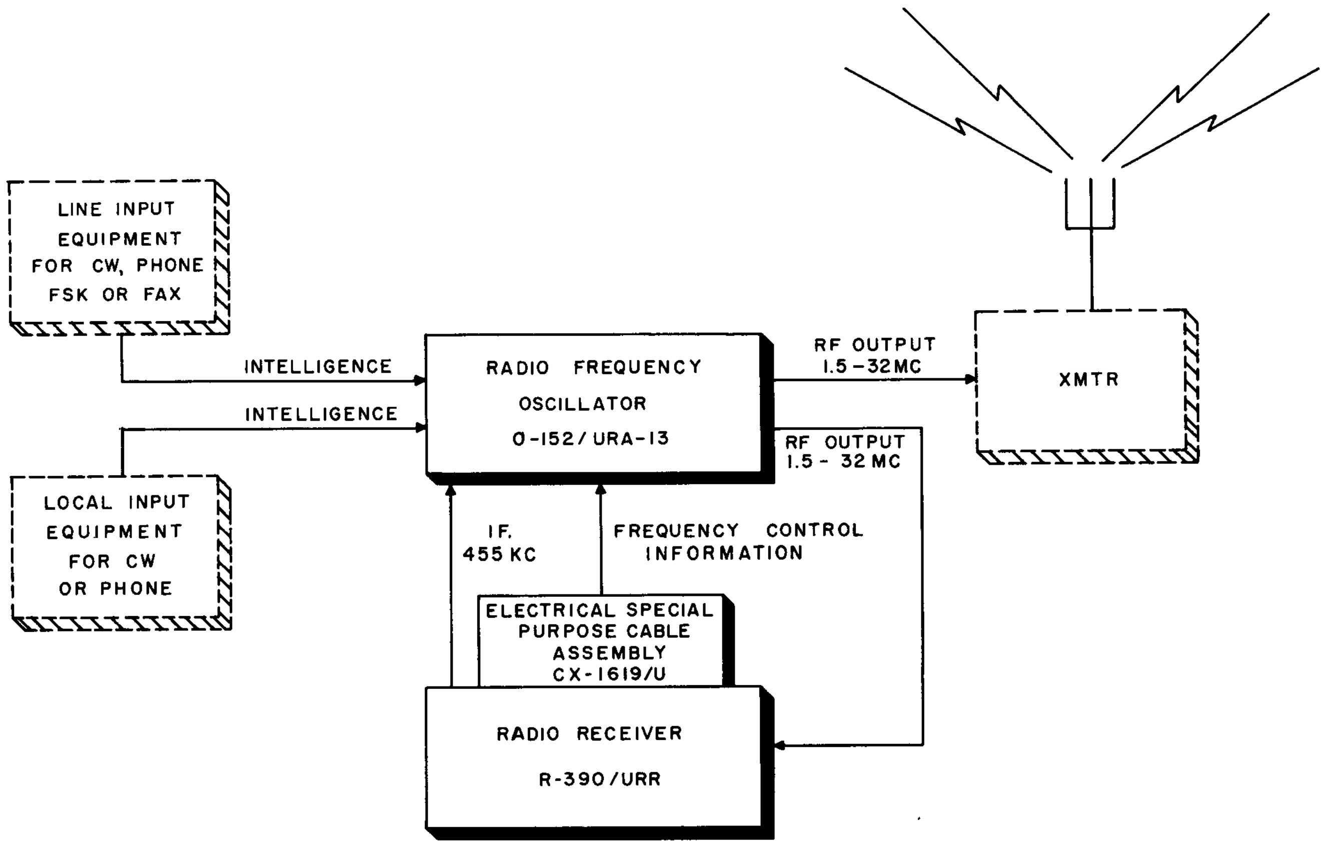


Figure 4. AN/URA-13 frequency controlled transmitting system, block diagram.

c. Effect of Modulation. The cw, phone, fsk or fax input signal to the radio frequency oscillator controls or modulates the rf output through keying relays and modulating circuits within the radio frequency oscillator. Modulation of the rf output results in variations in the if. output from the radio receiver. A modulation canceling circuit within the radio frequency oscillator prevents this expected variation from appearing as an undesirable frequency shift. Therefore, no instability arises from frequency changes due to modulation.

5. Technical Characteristics

a. Radio Receiver R-390/URR.

Type of circuit	Triple conversion superheterodyne on eight lowest frequency bands; double-conversion superheterodyne on all other bands.
Frequency range	.5 mc to 32 mc (in 32 steps).
Types of signals received	A1-cw, A2-mcw, A3-voice, F1-frequency-shift keying.
Type of tuning	Continuous; frequency read directly on counter-type indicator.
Method of calibration	Built-in crystal-controlled calibration oscillator.
Calibration points	Every 100 kc.
Audio Power output:	
600-ohm unbalanced line	500 mw.
600-ohm balanced line	10 mw.
Phones	5 mw.
If. selectivity bandwidth	100 cps to 16-kc in 6 steps.
If. frequencies:	
First variable if. (used on eight lowest frequency bands)	9 to 18 mc.
Second variable if. (all bands) . . .	2 to 2.5 mc on lowest steps, 2 to 3 mc on all other steps.
Third (fixed) if.	455 kc.
Sensitivity:	
Am. signals	3 uv or better.
Cw signals	1 uv or better.
Power source	115/230-volts ac ± 10%, 48-62 cps through Power Supply PP-621/URR.
Power input:	
115/230 volts ac	270 watts total, 170 watts with oven heaters off.
Number of tubes	33 (including ballast tube RT-512).

Antennas:	
Unbalanced	Random length vehicular-mounted whip or straight-wire
Balanced	125-ohm nominal terminating impedance; matches 70-to 200-ohm lines or unbalanced transmission lines using adapters.
Weight	80 lb (including Power Supply PP-621/URR).

b. <u>Radio Frequency Oscillator O-152/URA-13</u>.

Frequency range	1.5 - 32 mc (continuous).
Method of modulation	Reactance-tube oscillator.
Types of Service available:	
Line input	cw, fsk, fax and phase modulation for phone.
Local input	cw and phase modulation for phone.
Input impedance (if.)	100K.
Power output (rf)	3 watts to 50-ohm load.
Input frequency for afc operation:	
Nominal	455 kc.
Range for afc operation	452 to 458 kc.
Input voltage for afc operation . .	10 mv (minimum).
Power input:	
115/230 v ac, 48-62 cps	285 watts.
Number of tubes	29.
Weight	97 lbs.

6. **Packaging Data**

a. When packed for shipment, the component units of Oscillator Group AN/URA-13 are wrapped in paper and placed in an inner corrugated cardboard carton. Each component is wrapped and packed separately. Cleated wooden pallets hold the units securely within the inner cartons to prevent damage to controls and connectors. Cable and other accessories are also packed in the inner carton as well as the desiccant. The inner carton is then sealed in a moisture-vaporproof barrier and placed in a second corrugated cardboard carton. The two instruction books are wrapped in a separate pouch which is taped to the top of the second cardboard carton. This package is then placed in the outer plywood box and padded with excelsior. The separate package of running spares is placed in the outer plywood box along with the component. The outer plywood box is secured with steel straps. Each of the two complete packages is approximately 20 inches high, 27 inches wide and 32 inches long, giving it a volume of approximately 10 cubic feet. The radio receiver package weighs approximately 178 lbs. and the radio frequency oscillator package weighs approximately 200 lbs. Figure 15 is an exploded view of the radio receiver or radio frequency oscillator package.

<u>Note</u>: Items may be packaged in a manner different from that shown, depending upon the supply channel.

7. Table of Components

Component	Required No.	Height (in.)	Depth (in.)	Length (in.)	Volume (cu. ft.)	Unit Wt. (lb.)
Radio Receiver R-390/URR	1	10-1/2	17-1/4	19	2.0	80
Rf Oscillator 0-152/URA-13	1	10-1/2	17-5/16	19	2.0	97
Electrical Special Purpose Cable Assembly CX-1619/U	1			78		
Radio Frequency Cable Assembly CG-833/U	1			74		
Cord CG-409C/U	1			74		
Cord CG-409C/U	1			122		
Electrical Power Cable Assembly CX-2405/U	1			78		
Electrical Power Cable Assembly CX-1358/U	1			96		
Panel Cover CW-261/URA-13 (for R-390/URR)	1					
Electrical Dummy Load DA-85/U	1					
Running Spares (with each component)	1 set					
Instruction books (with each component)	2					

8. Description of Radio Receiver R-390/URR
(figs. 5 and 6)

a. Radio Receiver R-390/URR is a 33-tube superheterodyne receiver designed for reception of continuous-wave (cw), modulated continuous-wave (mcw), voice and radio-teletype signals within a range of .5 to 32 mc. In its application in Oscillator Group AN/URA-13, this receiver controls the radio frequency output of Radio Frequency Oscillator O-152/URA-13. This receiver is designed for mounting in a standard, floor-mounted 19-inch rack such as Electrical Equipment Cabinet CY-1119/U, for fixed station use. The receiver may also be mounted in a shock-mounted 19-inch rack, such as Electrical Equipment Cabinet CY-1216/U for mobile installation. The structural parts of the receiver are of aluminum.

b. All operating controls are on the front panel (fig. 26), which has a gray semigloss finish. Two handles at the outer edges of the front panel facilitate withdrawal of the receiver from the rack. In the application of Radio Receiver R-390/URR in the AN/URA-13 group, the top and left-hand side of the radio receiver front panel is covered by Panel Cover CW-261/URA-13 (par. 11). This makes inaccessible those front panel controls which do not enter into the operation of the radio receiver as part of the radio frequency oscillator set. The following front panel controls remain uncovered and operatable. The two large knobs at the bottom of the panel marked MEGACYCLE CHANGE and KILOCYCLE CHANGE, provide frequency tuning of the receiver. A counter-type frequency indicator is above the KILOCYCLE CHANGE knob. The number shown indicates the frequency in kilocycles to which the receiver is tuned. The MEGACYCLE CHANGE control operates the two left-hand number wheels of the frequency indicator and the KILOCYCLE CHANGE control operates the three right-hand number wheels. Uncovered and distributed about the panel are 5 bar knobs which control the necessary functions of the receiver. These controls include the FUNCTION switch, antenna trimmer (ANT. TRIM) control, kilocycle control DIAL LOCK, frequency-indicator zero-adjustment (ZERO ADJ), and RF GAIN control.

c. On the rear panel of the receiver (fig. 27) are mounted special tools, antenna input connectors, operating and spare fuses, POWER and REMOTE CONTROL connectors, an IF OUTPUT connector, an OVENS OFF-ON control, terminal strips for connection of external circuits and, under a protective cover, trimmer adjustments for the crystal oscillators. The SYNC XTAL OSC adjusting slot on the rear panel provides for aligning the 32-position crystal selector switches, S401, S402, S403 and S404, with the MEGACYCLE CHANGE control mechanical linkage. Electrical Special Purpose Cable Assembly CX-1619/U mechanically couples to the MEGACYCLE CHANGE control mechanical linkage at the SYNC XTAL OSC adjusting slot (par. 10a).

Figure 5. Radio Receiver R-390/URR, front view

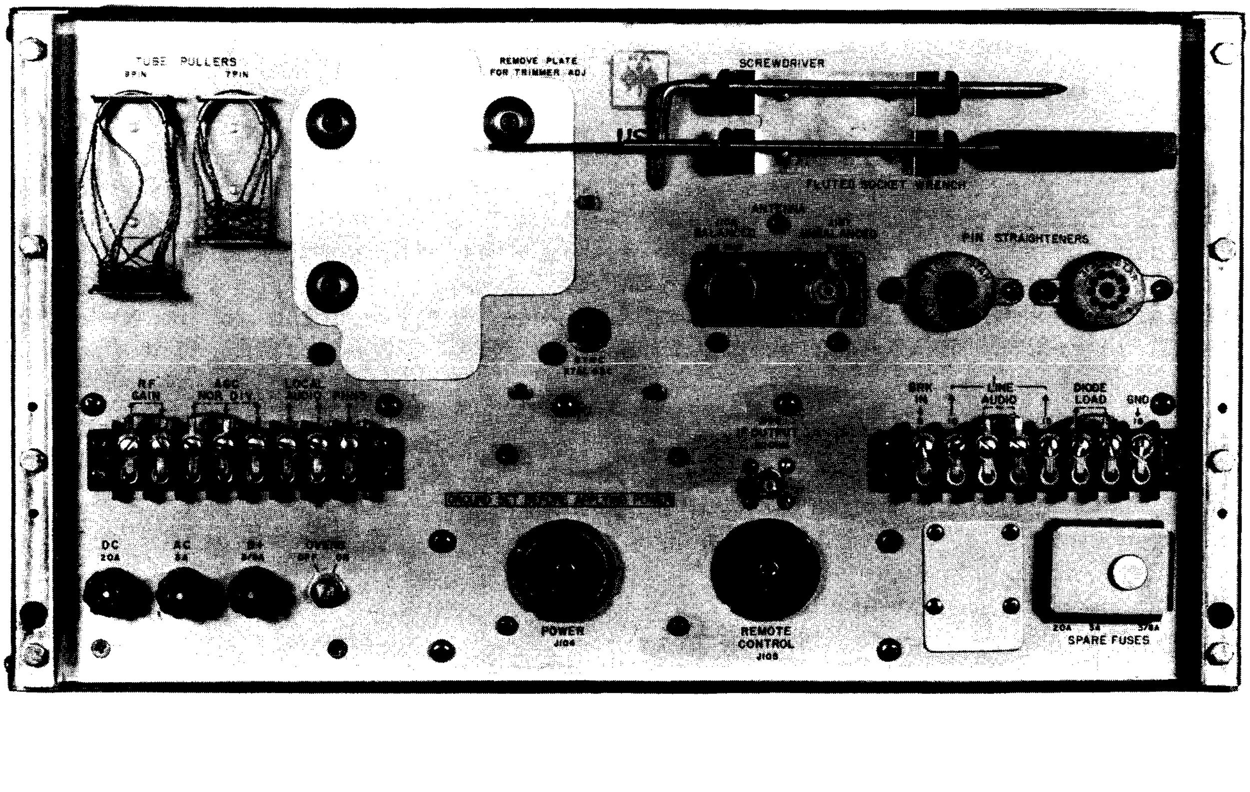


Figure 6. Radio Receiver R-390/URR, rear view

d. The receiver is permeability tuned by varying the degree of insertion of powdered-iron cores into the tuning coils through a system of gears, cams and racks. The calibration of Radio Receiver R-390/URR is accurate to within .3 kc. It is this calibration accuracy which permits use of the receiver as the frequency control of Oscillator Group AN/URA-13.

e. Radio Receiver R-390/URR is assembled from a number of subassemblies including the main frame and seven removable subchasses. The rf subchassis, if. subchassis, and crystal-oscillator subchassis are mounted on the upper deck of the main frame. Mounted in three compartments on the lower deck are the variable frequency oscillator (vfo) subchassis, audio frequency (af) subchassis, calibration-oscillator subchassis, and Power Supply PP-621/URR (ac power supply). The subchassis are connected to the main frame or to each other by cables terminating in locking-type connectors. Mounted on the rf subchassis are the gears, cam-shafts, and racks of the mechanical tuning system.

9. Description of Radio Frequency Oscillator O-152/URA-13
(figs. 7 and 8)

a. Radio Frequency Oscillator O-152/URA-13 is a 29 tube rf oscillator designed to operate in conjunction with Radio Receiver R-390/URR to produce a stabilized, modulated, exciting frequency, within the frequency range of 1.5-32 mc, to an associated transmitter operating in the same frequency range. This radio frequency oscillator is designed for mounting in a standard, floor mounted 19-inch rack, such as Electrical Equipment Cabinet CY-1119/U, for fixed station use. The radio frequency oscillator may also be mounted in a shock-mounted, 19-inch rack, such as Electrical Equipment Cabinet CY-1216/U, for mobile installations. The structural parts of the radio frequency oscillator are of aluminum.

b. All operating controls are on the front panel (fig. 24). Two handles at the outer edges of the front panel facilitate withdrawal of the radio frequency oscillator from the rack. The front panel meters are the AUDIO LEVEL meter which indicates the phase deviation in radians during phone (pm) operation; the CAL IND meter which indicates the input level of the if. input signal during normal operation and indicates frequency deviation during calibration; and the LINE CURRENT meter which indicates the fsk relay current. Bar knob controls control the various functions of the radio frequency oscillator. These include the FUNCTION switch, the SERVICE SELECTOR switch for selecting FAX, FSK, PM (phone) or CW operation, the MOD TEST switch with switch lock, the DEVIATION control with control lock, the CARRIER CONTROL for selecting LOCAL or LINE operation, the ASSOC XMTR FREQ MULT switch for compensating for transmitter frequency multiplying, POLAR NEUTRAL selector for selecting fsk operating mode, AUDIO LEVEL control, and the LINE CURRENT control for adjusting the fsk relay current. The indicator lamps include the red POWER indicator which indicates that the line power is on, the yellow OVEN ON indicator lamp which indicates the discriminator oven is on, the green AFC indicator lamp which indicates that the radio frequency oscillator is tuned to the radio receiver frequency. The POWER ON-OFF toggle switch turns the line power on to both the radio frequency oscillator and the radio receiver. The LOCAL MIKE KEY jack at the lower right of the front panel provides connections for local microphone or key.

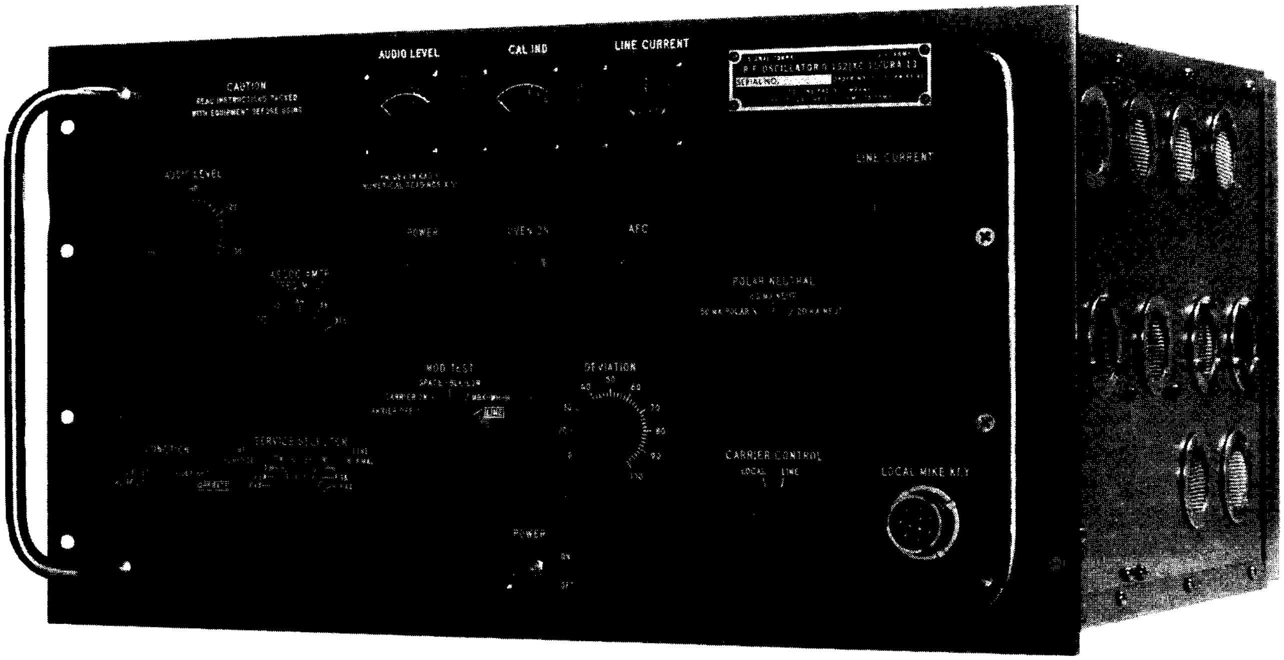


Figure 7. Radio Frequency Oscillator O-152/URA-13, front view

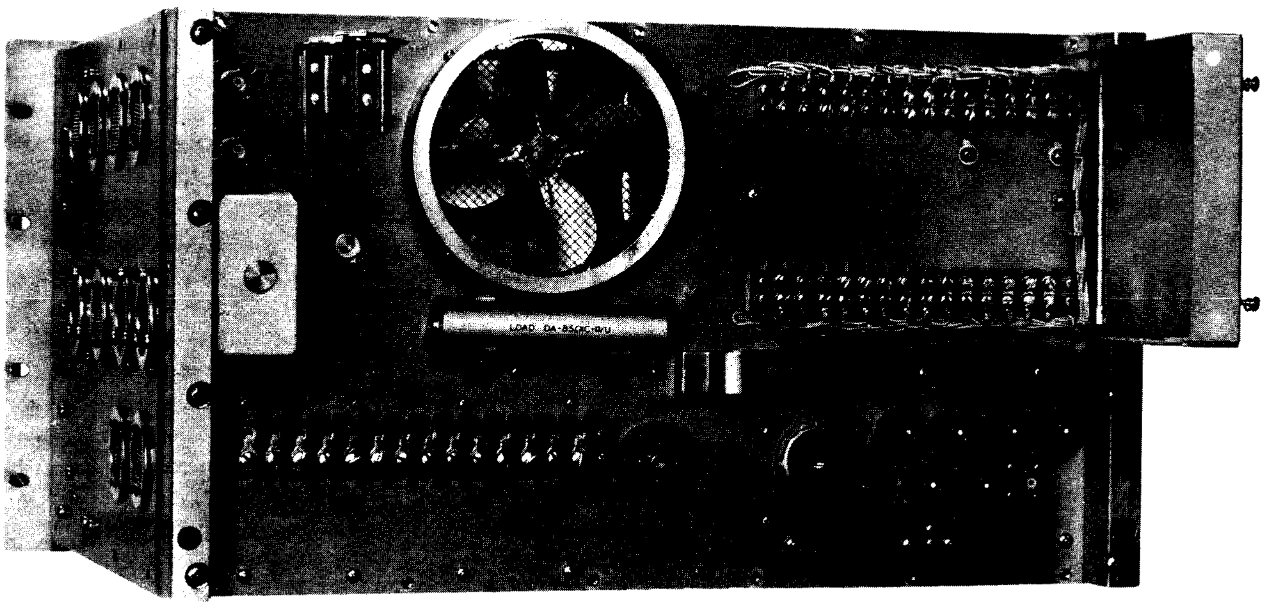


Figure 8. Radio Frequency Oscillator O-152/URA-13, rear view

c. On the rear panel of the radio frequency oscillator (fig. 25) are mounted special tools, operating and spare fuses, and terminal boards and jacks. The input lines terminal board TB802 provides connections for line input signals. Under a protective, hinged cover are TB803 and TB804 upon which the frequency control information lines of Electrical Special Purpose Cable Assembly CX-1619/U terminate (par. 10a). Line power for Oscillator Group AN/URA-13 connects through the LINE PWR jack on the rear panel of the radio frequency oscillator and line power for the radio receiver is from the REC PWR jack. The rf output from the radio frequency oscillator to the radio receiver is from the REC ANT jack. The rf output to the associated transmitter is from the 50 OHM OUT jack. The if. input from the radio receiver is to the 455 KC INPUT jack. Electrical Dummy Load DA-85/U (par. 12) clips to the rear panel for storage.

d. Radio Frequency Oscillator O-152/URA-13 is assembled from a number of subassemblies including the main frame, gear plate and eight subchassis. The rf amplifier subchassis, relay subchassis and power rectifier subchassis are mounted on the upper deck of the main frame (fig. 9). The if. amplifier subchassis, discriminator subchassis, servo amplifier subchassis, audio amplifier subchassis and variable frequency oscillator (vfo) subchassis are mounted on the lower deck of the main frame (fig. 10). The subchassis are connected to the main frame and to each other by cables. Mounted directly behind the front panel is the gear plate on which is mounted the gear train of the automatic tuning system along with various electrical components.

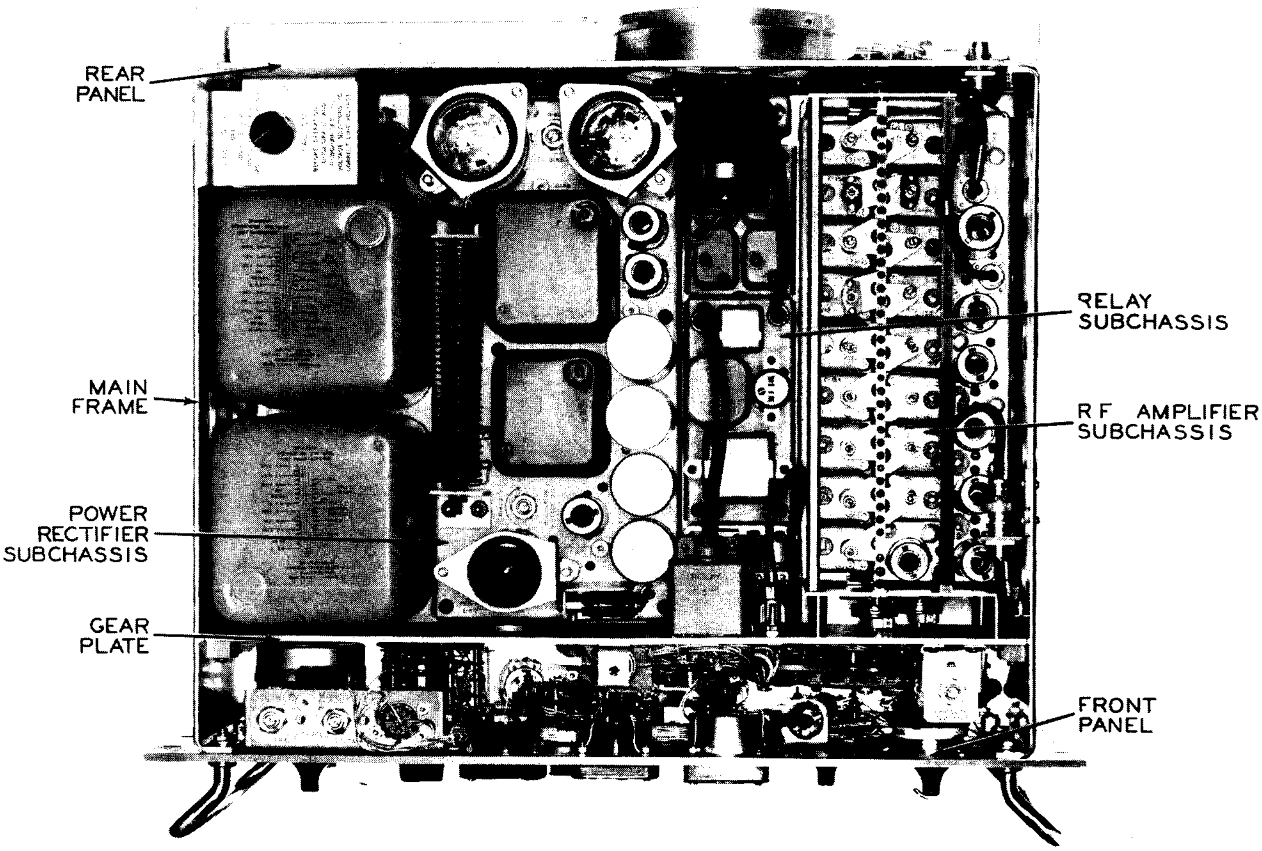


Figure 9. Radio Frequency Oscillator O-152/URA-13 showing top deck location of subchassis.

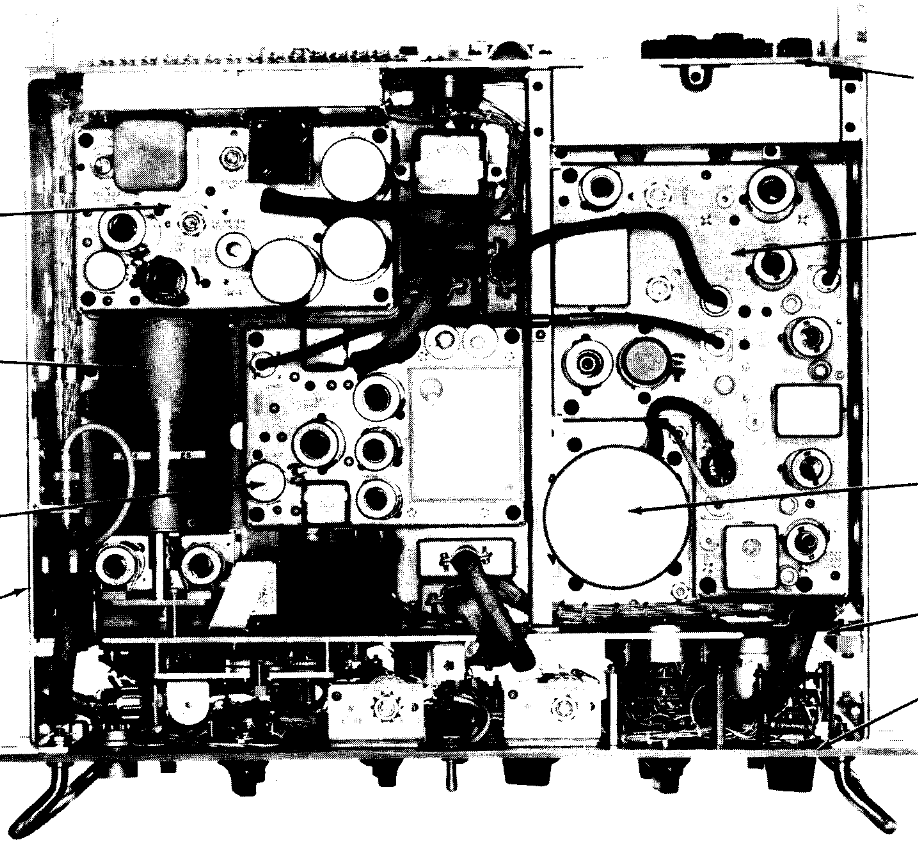


Figure 10. Radio Frequency Oscillator O-152/URA-13, showing bottom deck location of subchassis

10. Description of Cable Assemblies. (fig. 11)

a. Radio Frequency Oscillator O-152/URA-13. The following five cables are supplied as part of the radio frequency oscillator.

(1) Electrical Special Purpose Cable Assembly CX-1619/U is a 78 inch, 28-conductor cable terminating in two fanning strips on one end and a band switch adapter on the other end. Only 26 of the 28 conductors are used. This cable carriers frequency control information from Radio Receiver R-390/URR to Radio Frequency Oscillator O-152/URR. The band switch adapter of this cable assembly attaches to the rear panel of Radio Receiver R-390/URR so that the mechanical coupler engages the MEGACYCLE CHANGE control mechanical linkage of the receiver through the SYNC XTAL OSC adjusting slot (par. 8c). The two fanning strips of this cable assembly attach to two terminal boards on the rear panel of Radio Frequency Oscillator O-152/URA-13 (par. 9c). The band switch adapter of this cable assembly contains a band switch assembly (fig. 23). These band switches are operated, because of the mechanical coupling, by the MEGACYCLE CHANGE control of Radio Receiver R-390/URR. Therefore, the circuits closed by the band switch indicate the megacycle band to which the radio receiver is tuned. From this frequency control information, the radio frequency oscillator automatically positions its tuning linkage to the same megacycle band and ultimately to the same frequency.

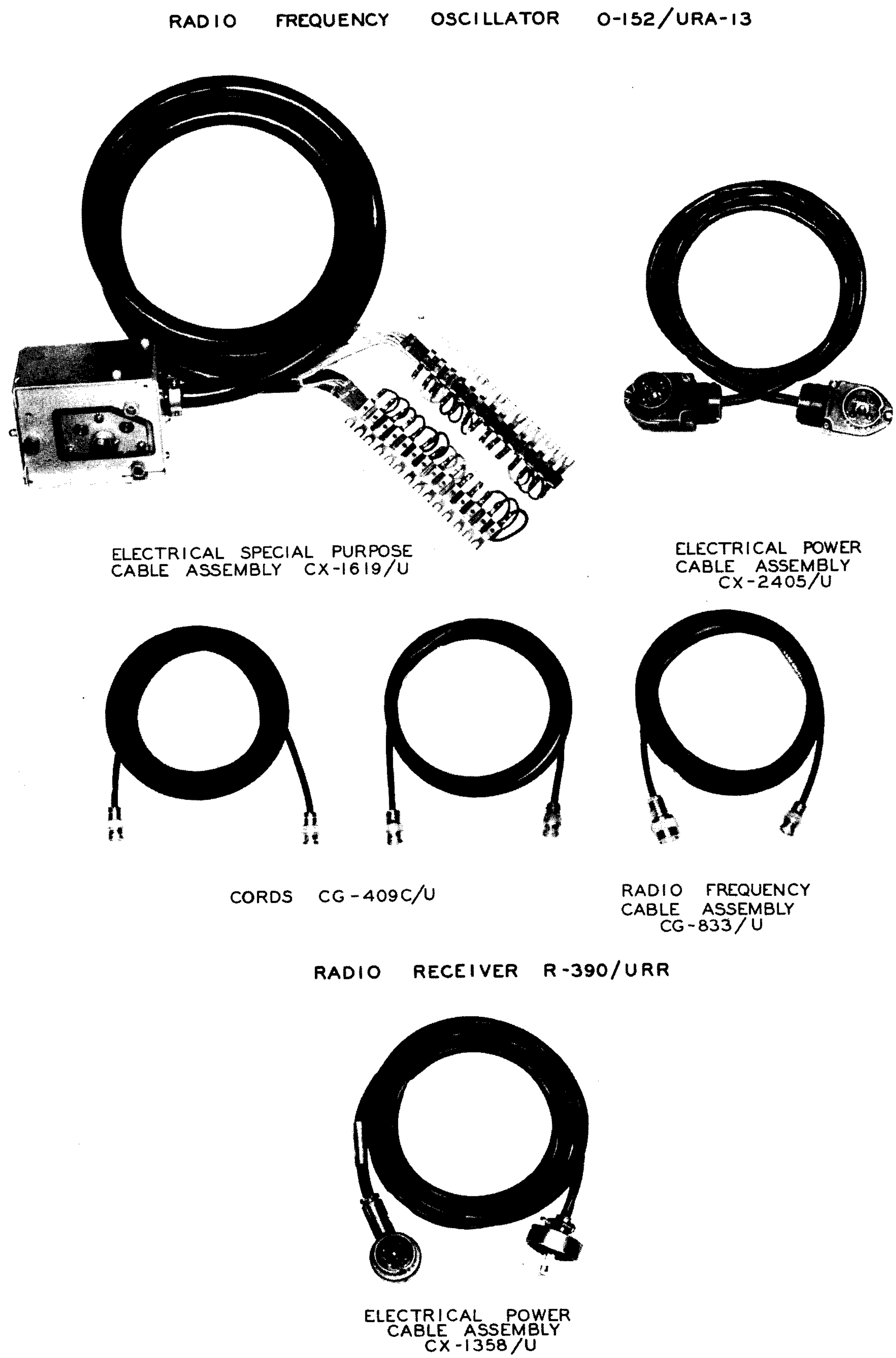


Figure 11. Cable Assemblies

(2) One Radio Frequency Cable Assembly CG-833/U is supplied. This cable connects the rf output from the radio frequency oscillator to the antenna input at the radio receiver. The cable consists of 74 inches of Radio Frequency Cable RG-58C/U which is a 50-ohm coaxial cable. One end of the cable terminates in Radio Frequency Plug UG-88/U and the other end in Radio Frequency Plug UG-709/U.

(3) Two Cords CG-409C/U are supplied. One of these cables, the 122-inch cable, connects the rf output from the radio frequency oscillator to the associated transmitter. The other of these cables, the 74-inch cable, connects the if. output from the radio receiver to the radio frequency oscillator. These cables consist of Radio Frequency Cable RG-58C/U, which is 50-ohm coaxial cable, terminated on each end with Radic Frequency Plug UG-88/U.

(4) One Electrical Power Cable Assembly CX-2405/U is supplied. This cable connects ac power from the radio frequency oscillator to the radio receiver. The cable consists of 78-inches of two-conductor #18 awg rubber sheated power coaxial. One end of the cable terminates with Amphenol plug type 1164-201-1P and the other end with Amphenol plug type 164-201-1S.

b. Radio Receiver R-390/URR. One Electrical Power Cable Assembly CX-1358/U is supplied. This cable connects the ac power from the power receptacle to the radio frequency oscillator. The cable consists of eight feet of two-conductor cable terminated in a screw-locking plug at one end and a standard parallel-prong ac plug at the other end. The screw locking plug has a center lead screw for securing the cable plug to jack J809 of the radio frequency oscillator.

11. Description of Panel Cover CW-261/URA-13
(fig. 12)

Panel Cover CW-261/URA-13 is provided to adapt Radio Receiver R-390/URR for Oscillator Group AN/URA-13 operation. The panel cover is a metal cover which mounts over the radio receiver front panel to cover those controls of the radio receiver which are not required. The panel cover covers the controls to the left side and to the top of the front panel. The panel cover attaches to the front of the radio receiver with the same phillips oval head screws that are used for rack mounting the equipment.

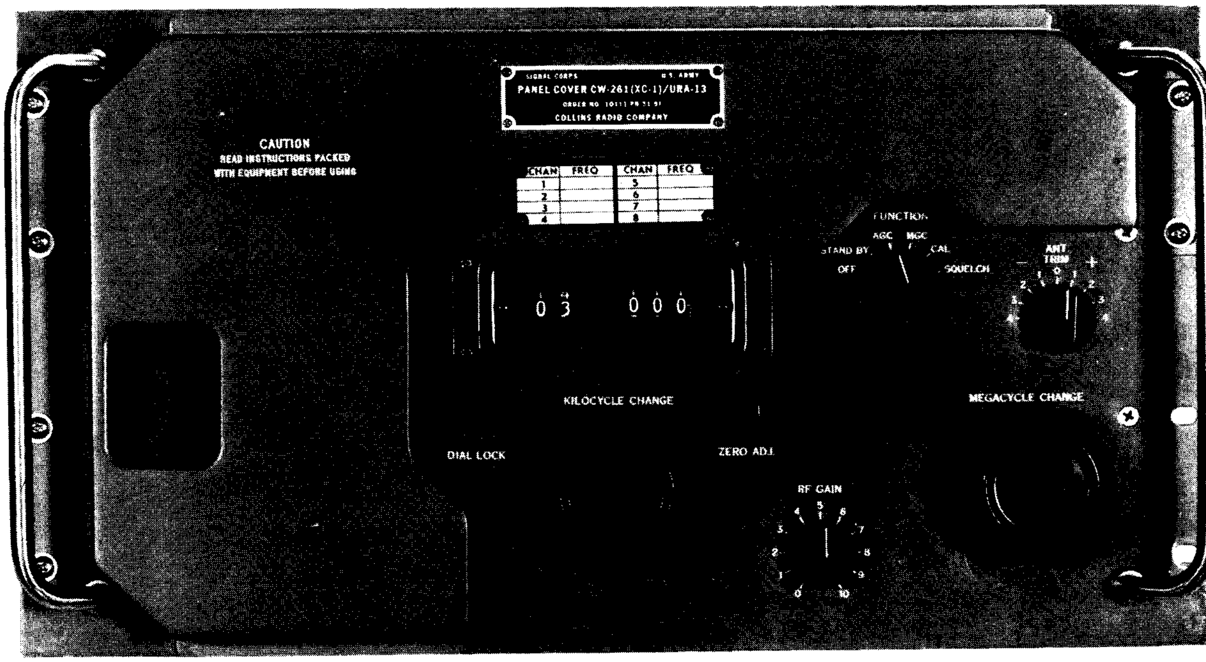


Figure 12. Panel Cover CW-261/URA-13, mounted on Radio Receiver R-390/URR

12. Description of Electrical Dummy Load DA-85/U (fig. 13)

Electrical Dummy Load DA-85/U is supplied so that Oscillator Group AN/URA-13 may be used with transmitters which do not have a 50-ohm input jack. The dummy load is also used during test operations as the load. The dummy load clips into a bracket on the rear panel of Radio Frequency Oscillator O-152/URA-13 for storage (fig.8). The dummy load consists of two paralleled 100-ohm, 4 watt resistors to give the 50-ohm load. The input jack of the dummy load is a coaxial bayonet-type connector. When used, this jack connects to Cord CG-409C/U from the 50 OHM OUT

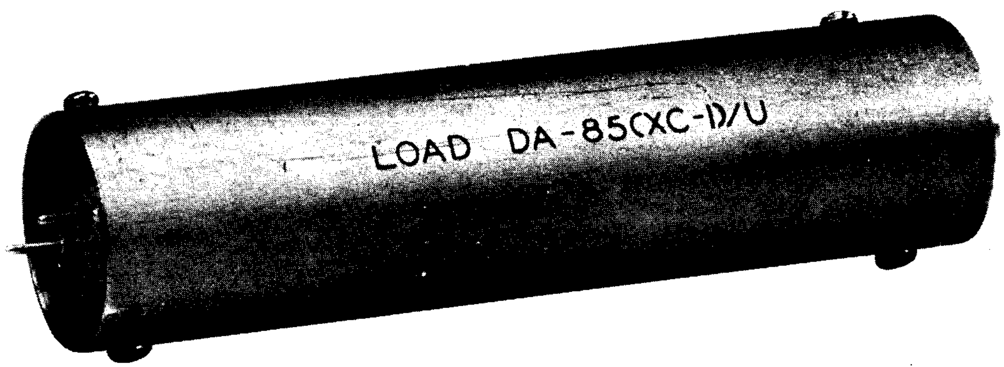


Figure 13. Electrical Dummy Load DA-85/U

jack of Radio Frequency Oscillator O-152/URA-13. The output jack of the dummy load is a 2-pin connector designed to fit a standard crystal socket of a transmitter. One pin, identifiable by the glass lead-through insulator, carries the rf signal voltage, and the other terminal is grounded. This polarity must be observed when inserting the dummy load into a transmitter crystal socket. If the dummy load is inserted incorrectly into a transmitter crystal socket, the transmitter will receive no rf signal since the signal will be grounded out. This will not damage the radio frequency oscillator even though the oscillator is working into a short circuit.

13. Running Spares

A group of running spares is furnished with each component of Oscillator Group AN/URA-13. Following is a list of running spares.

a. Radio Receiver R-390/URR

2 tubes, type 3TF7
6 tubes, type 6AJ5
2 tubes, type 6AK6
1 tube, type 6BH6
3 tubes, type 6BJ6
2 tubes, type 6C4
1 tube, type 12AT7
3 tubes, type 12AU7
1 tube, type 26Z5W
1 tube, type 5651
4 tubes, type 5749/6BA6W
1 tube, type 6082
4 dial lamps, type GE 327
6 fuses, 3/8-ampere, 125 volt, slow blow,
MS type F02D3R00B
6 fuses, 3-ampere, 125 volt, slow blow,
MS type F02D3R00B

b. Radio Frequency Oscillator O-152/URA-13

1 tube, type OB2
1 tube, type 5R4WGY
2 tubes, type 6AK6
2 tube, type 6AU6
1 tube, type 6X4W
1 tube, type 12AL5
1 tube, type 12AT7
2 tubes, type 12AU6
1 tube, type 12AW6
1 tube, type 12AX7
1 tube, type 12AY7
1 tube, type 5726/6AL5W
1 tube, type 5763
1 tube, type 5814
1 tube, type 6005/6AQ5W
1 tube, type 6080
2 pilot lamps, type GE47

6 fuses, 1/4 ampere, type 3AG
6 fuses, 1/2 ampere, type 3AG
18 fuses, 2 ampere, type MS, slow blow
F02D2R00B
6 fuses, 10 ampere, type 4AG
1 chopper, type Stevens Arnold CH-#364(MOD)
2 keying relays, type Sigma 7J0
1 set brushes for B102
1 set brushes for B103
1 set brushes for G101

14. Additional Equipment Required.

The following equipment is not supplied as part of Oscillator Group AN/URA-13 but is required for its operation in a frequency controlled transmitting system.

Transmitter, operating in the frequency range of 1.5 to 32 mc, complete with transmitting antenna.

Line input equipment for LINE operation.
Radioteletype signal for operating fsk relay for FSK operation.
Facsimile signal for FAX operation.
Continuous wave (cw) signal for operating keying relay for CW operation.
Phone signal for PM operation.

Local input equipment for LOCAL operation.
Carbon microphone, complete with input cable assembly terminating with Amphenol plug 164-8 or equivalent, for FM operation.
Telegraph key, complete with input cable assembly terminating with Amphenol plug 164-8 or equivalent, for CW operation.

Electrical equipment cabinet for housing Radio Receiver R-390/URR and Radio Frequency Oscillator O-152/URA-13.
Electrical Equipment Cabinet CY-1119/U, 19-inch rack-type cabinet, or equivalent for fixed station installation for both units.
Electrical Equipment Cabinet CY-1216/U, 19-inch rack-type cabinet, or equivalent for mobile installations.

15. Differences in Models

Service test models of Oscillator Group AN/URA-13 are indicated by the parenthetical nomenclature designator "(XC-1)". Thus service test models of Radio Frequency Oscillator O-152/URA-13 are designated O-152(XC-1)/URA-13. Also Panel Cover CW-261/URA-13 is designated CW-261(XC-1)/URA-13 on service test models. Only one instruction book and no running spares are supplied with service test models of Oscillator Group AN/URA-13.

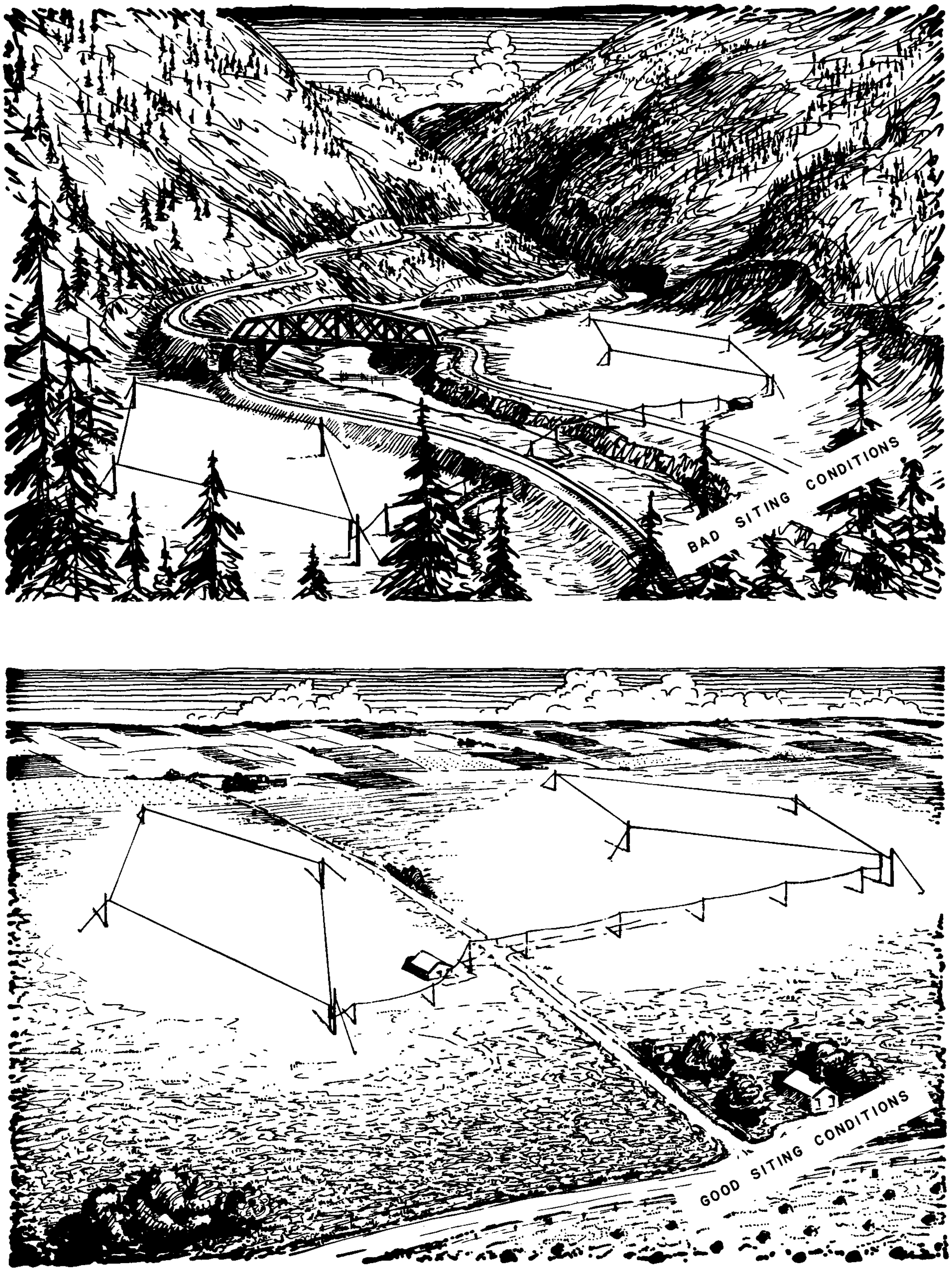


Figure 14. Siting

CHAPTER 2

INSTALLATION INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

16. Siting
(fig. 14)

a. External Requirements. The best location for the radio equipment depends on the tactical situation and local conditions, such as the following; the need to house the equipment where its shelter cannot be seen, the type of housing available, the terrain, and the need of easy access to messengers. Oscillator Group AN/URA-13 operates as an rf exciter for an associated transmitter. The external requirements for an AN/URA-13 controlled transmitting system are, therefore, determined by the transmitter. In general, any transmitter has a greater range if the antenna is high and clear of hills, buildings, cliffs, densely wooded areas, and other obstructions. Valleys and other low places are poor locations for a radio transmitter because the surrounding high terrain absorbs rf energy. Weak or otherwise undesirable signals are to be expected if the transmitter is operated close to steel bridges, underpasses, power lines or power installations. Choose, if possible, a hilltop location for the transmitter. Flat ground is also desirable. Normally, transmission over water is better than over land. See that drainage is adequate to prevent flooding the interior of the shelter. If the transmitter is part of a communication center but is not installed within the center, locate the equipment nearby. In locating the transmitting antenna, avoid obstructions which are 2° or 3° above the horizontal plane of the antenna in the direction of desired transmission. This is approximately 200 to 300 feet at a distance of one mile from the antenna.

b. Internal Requirements. Oscillator Group AN/URA-13 may be used as fixed station equipment or as mobile, communication van equipment. The shelter for the equipment must meet the following requirements:

(1) The floor must be capable of withstanding the weight of the equipment in a level position (par. 7).

(2) For fixed station installation, if the equipment is installed in a rack type cabinet such as Electrical Equipment Cabinet CY-119/U, there must be sufficient ceiling height to permit permanent installation. Also there must be sufficient space behind the cabinet to open the door and sufficient space on one side of the cabinet for walking to the rear of the cabinet.

(3) For communication van installation, the equipment should be installed in a shockmounted, 19-inch rack-type cabinet such as Electrical Equipment Cabinet CY-1216/U.

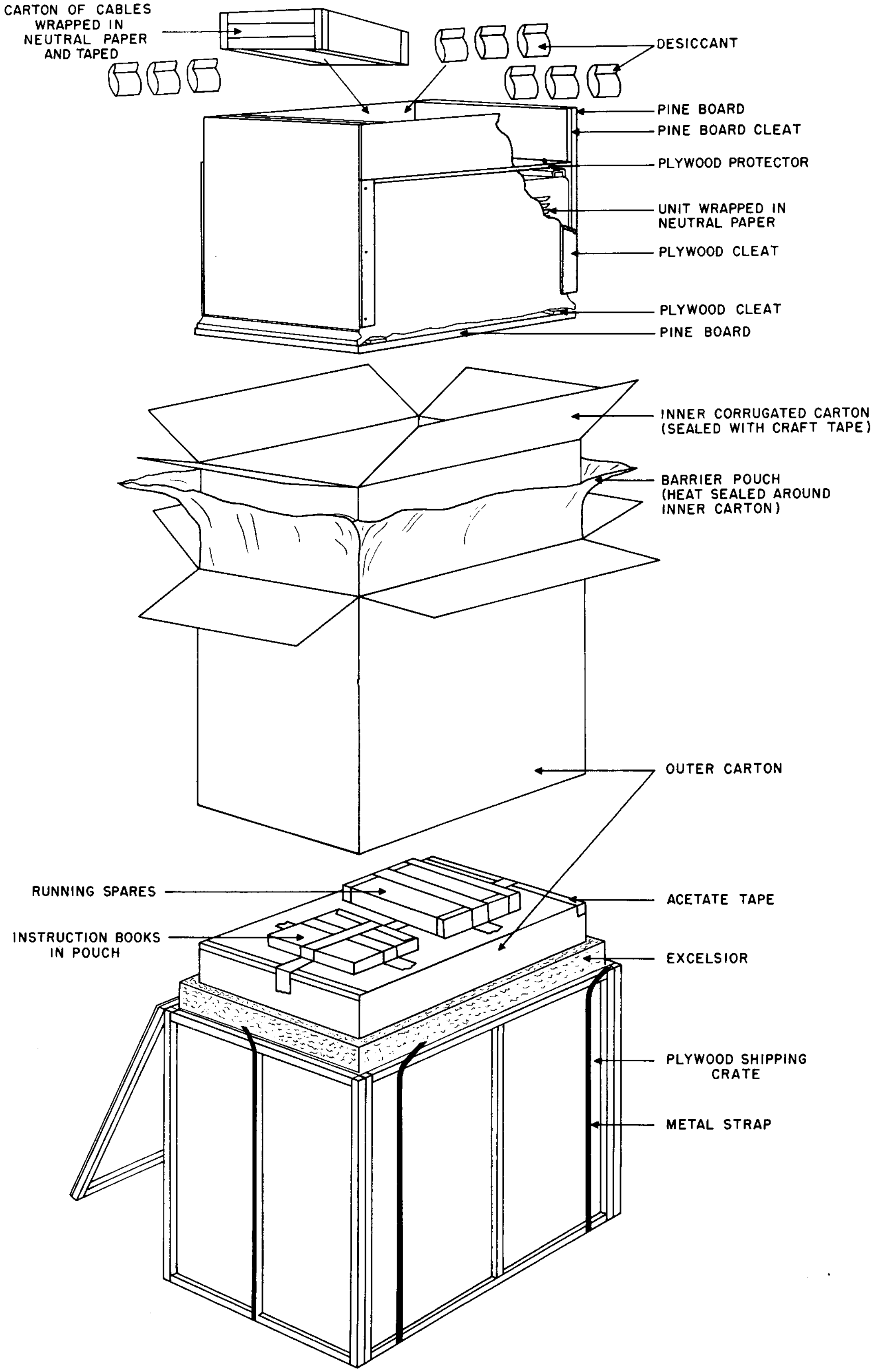


Figure 15. Oscillator Group AN/URA-13, typical component packaging diagram

(4) Sufficient space must be available for repair work on the equipment. Such space is necessarily limited in mobile installations.

(5) The equipment must be located close to its associated transmitter. If not so located, provisions must be made for an interconnecting cable.

(6) Adequate lighting must be provided for day and night operation. Position the cabinets so that the panel designations are easily readable. Artificial lighting fixtures should be located so that the light falls directly on the panels. A portable drop lamp and an extension cord are convenient accessories for operating and maintaining the equipment.

(7) Adequate ventilation must be provided. If necessary remove the dust covers from the units.

17. Uncrating, Unpacking, and Checking New Equipment (fig. 15)

Note. For used or reconditioned equipment, refer to paragraph 20.

a. General. The component units of Oscillator Group AN/URA-13 are packed identically for both export and domestic shipment. Upon receipt of the equipment, select a location where the equipment may be unpacked without exposure to the elements and location which is close to the permanent or semipermanent installation of the equipment. Both units of the radio frequency oscillator set are unpacked in the same manner.

b. Step-by-step Instructions for Uncrating and Unpacking Component Units of Oscillator Group AN/URA-13

(1) Place the packing cases containing the component units as near as possible to the operating location.

(2) Cut and fold back the metal straps.

(3) Remove the nails with a nail puller. Remove the top and one side of the wooden crate. Do not pry off the side and top because it may damage the equipment.

(4) Remove the excelsior from around the cartons and then take the cartons out of the packing case. The smaller carton contains the running spares and the larger carton contains the component.

(5) Remove the pouch containing the instruction book which is taped to the top of the component carton.

(6) Open the outer corrugated cardboard carton containing the component and remove the inner carton which is enclosed in the moisture-vapor-proof barrier.

(7) Slit open the seams of the moisture-vaporproof barrier and remove the inner corrugated cardboard carton.

(8) Open the inner carton and remove the wooden pallets, the bags of desiccant, and the package containing the cables and accessories.

(9) Withdraw the paper-wrapped unit from the inner carton, place it on a workbench or near its final location, and remove the paper wrapping.

Note. Save the original packing cases and containers as they can be used again when the equipment is repacked for storage or shipment.

c. Checking.

(1) Check the contents of each crate against the master packing slip.

(2) Check the front panel of each unit for damaged controls or meters.

(3) Operate the control knobs and examine for looseness. Rough operation or binding indicates a damaged control.

(4) Remove the top and bottom dust covers of each unit and inspect for loose tube shields or broken tubes. Check the gear trains for the radio frequency oscillator for smoothness of operation by manually operating the gear train.

(5) Remove the fuses from the rear panel, one at a time, and check them for proper rating. See that the fuses are properly seated after replacing them.

Note. Do not use a fuse rated above the specified value or the equipment may be damaged.

(6) Inspect for broken or bent connectors on the rear panel.

(7) Check the running spares for missing or damaged parts.

18. Installation of Components in Oscillator Group AN/URA-13

a. General. Oscillator Group AN/URA-13 may be installed in any standard 19-inch rack-type cabinet for either fixed station or mobile operation. Figures 16 and 17 show a rack installation for fixed station operation. No equipment rack is supplied as part of the equipment.

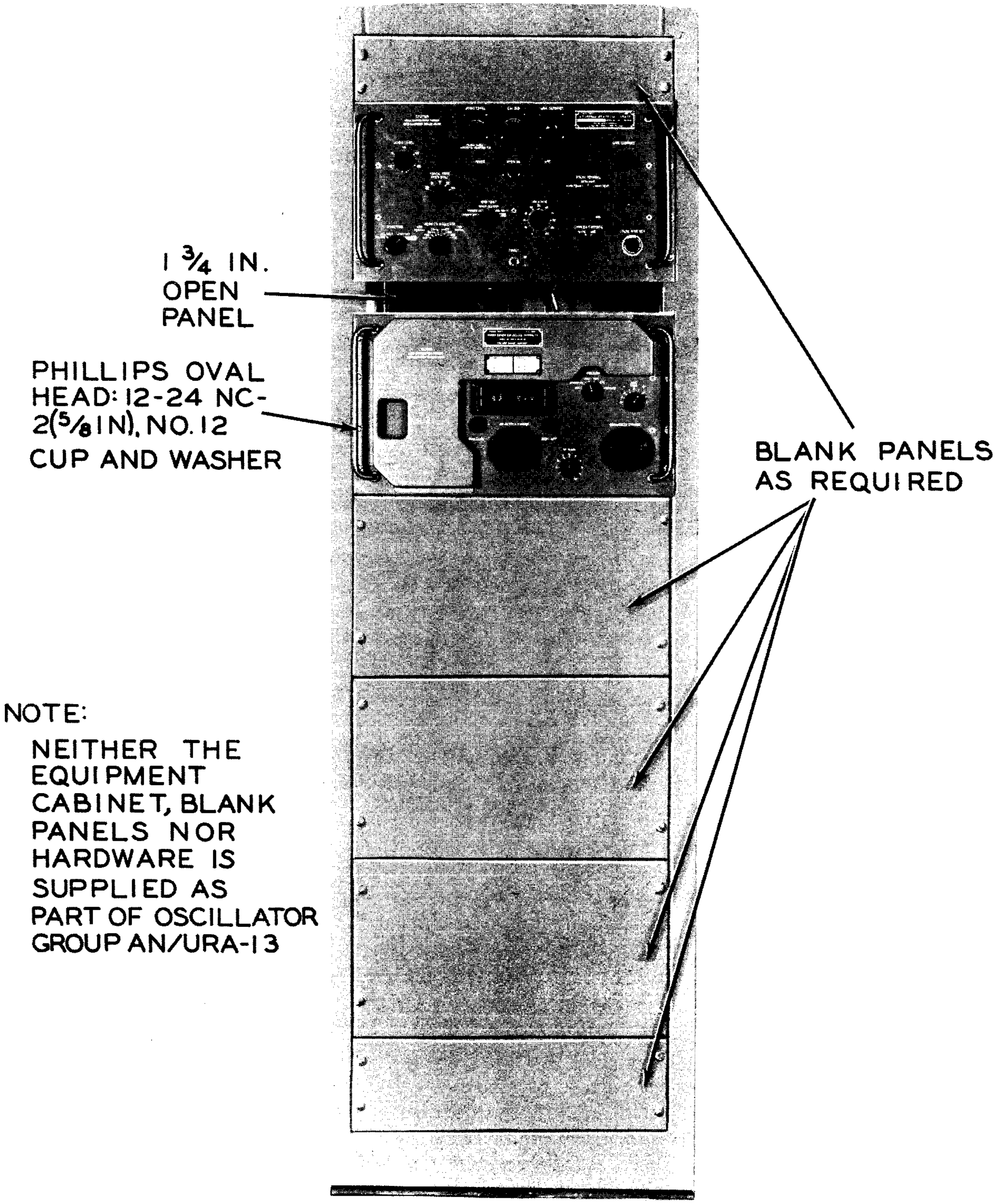


Figure 16. Installation diagram, front view.

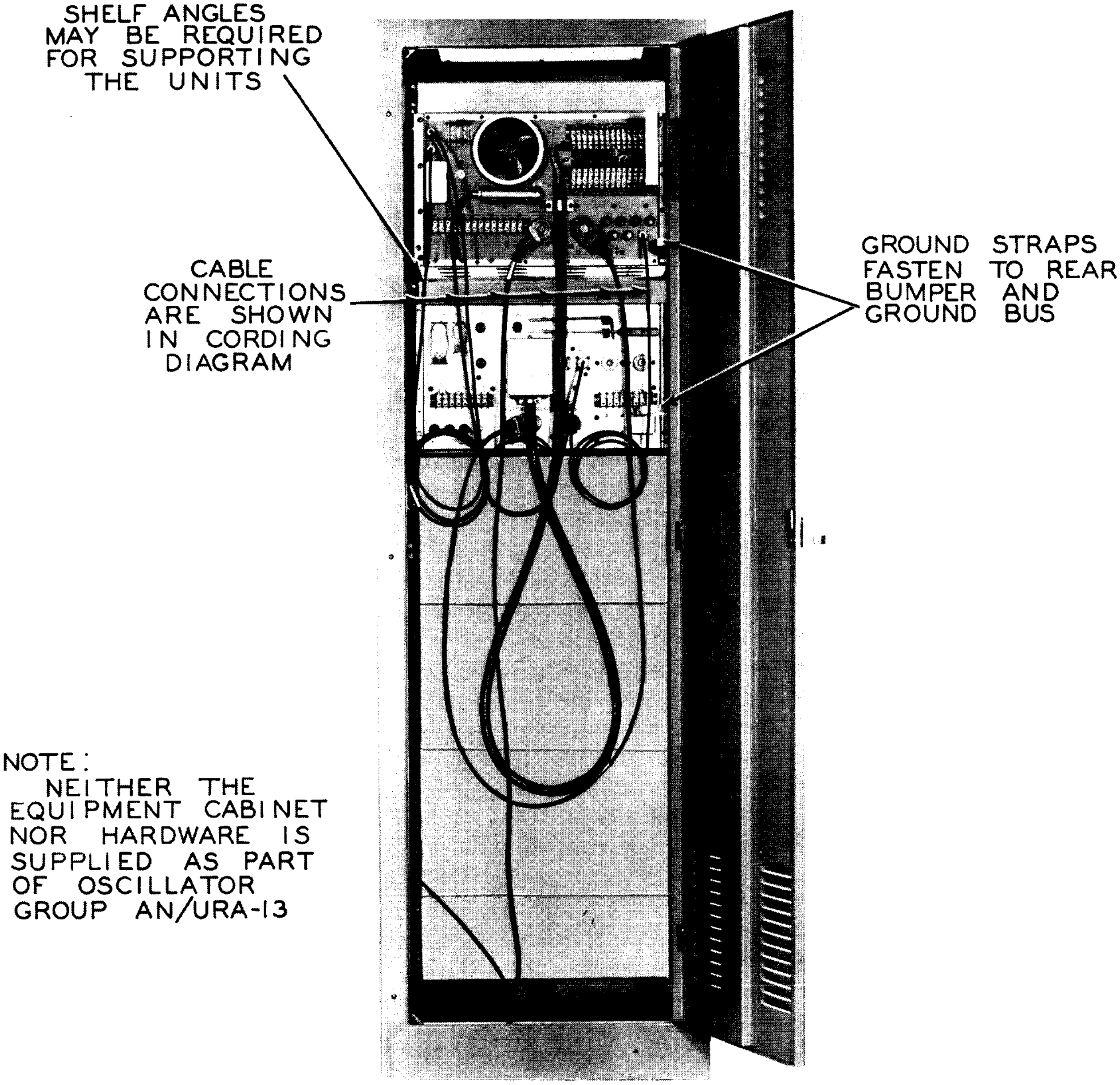


Figure 17. Installation diagram, rear view.

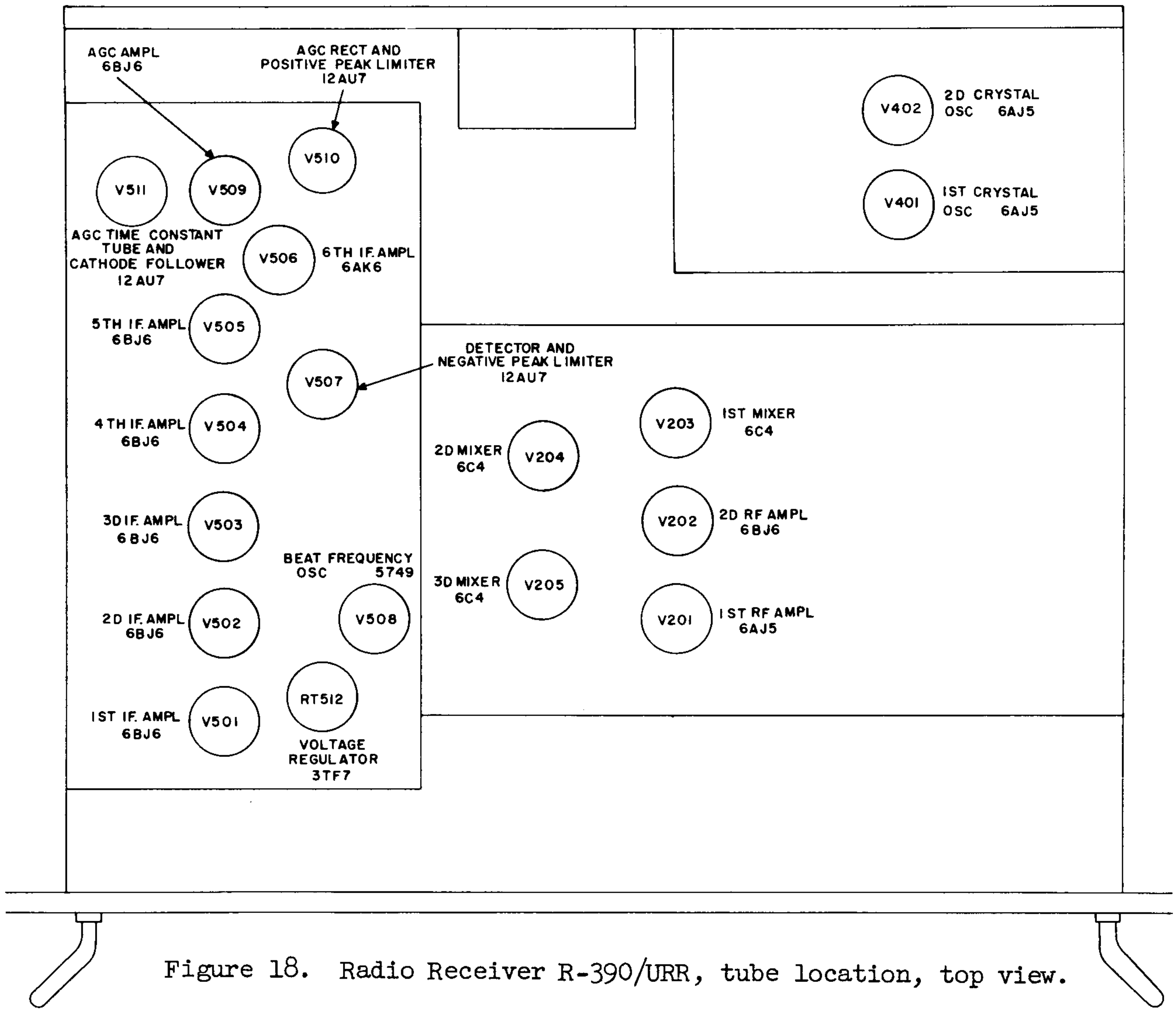


Figure 18. Radio Receiver R-390/URR, tube location, top view.

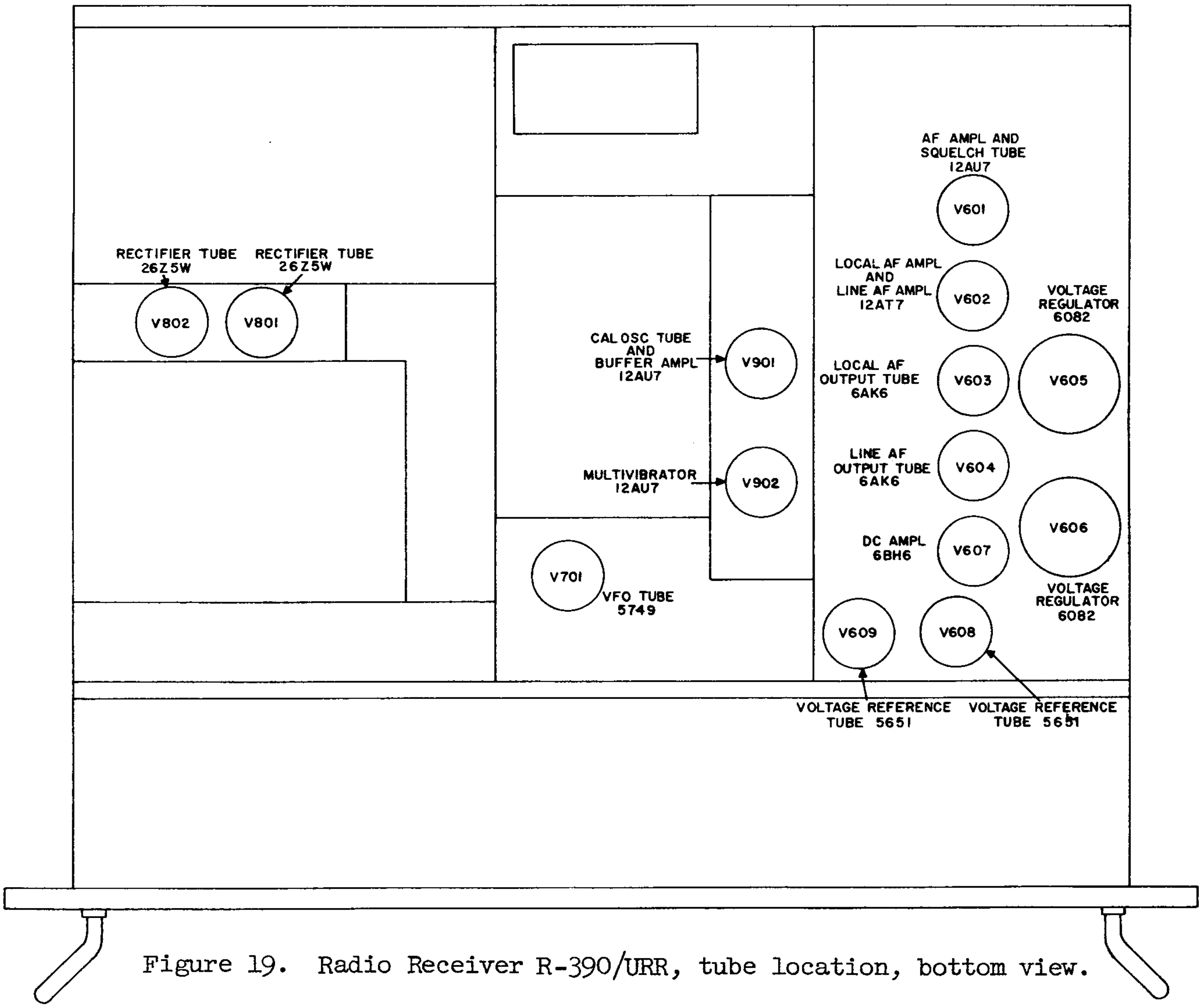


Figure 19. Radio Receiver R-390/URR, tube location, bottom view.

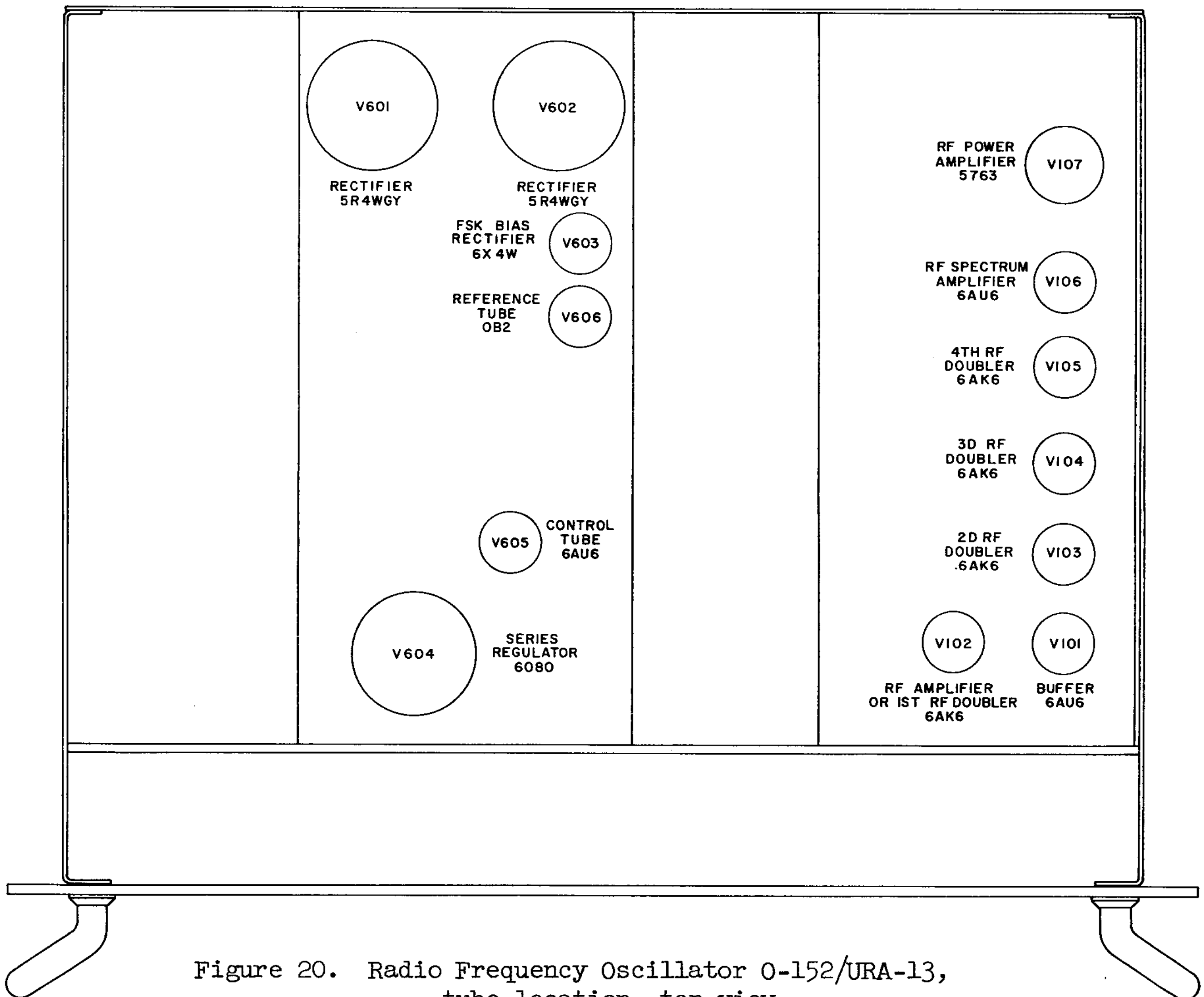


Figure 20. Radio Frequency Oscillator O-152/URA-13, tube location, top view.

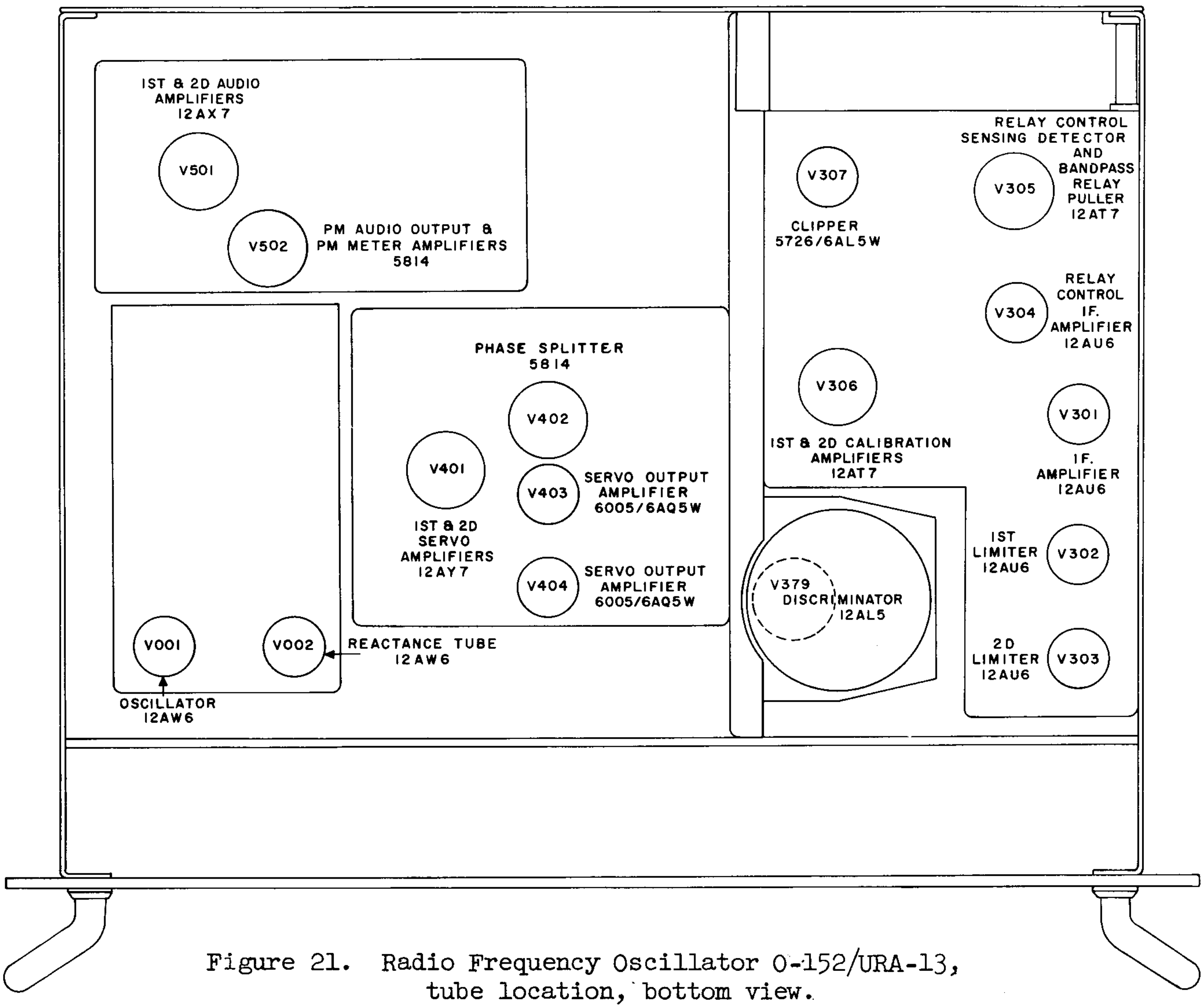


Figure 21. Radio Frequency Oscillator O-152/URA-13, tube location, bottom view.

b. Radio Receiver R-390/URR. Before installing the receiver, check all tubes to see that they are firmly seated in their correct sockets (figs. 18 and 19). Set the front panel controls to the following positions:

LINE METER to the OFF position.
LINE GAIN to the 0 position.
AGC to the MED position.
LIMITER to the OFF position.
AUDIO RESPONSE to the MED position.
BREAK IN to the OFF position.
BANDWIDTH to the 16 KC position.
BFO to the OFF position.
BFO PITCH setting is of no consequence.
LOCAL GAIN to the 0 position.

These settings are shown on the back of Panel Cover CW-261/URA-13.

After setting the front panel controls, install the radio receiver in the equipment rack below where the radio frequency oscillator will be installed. Allow for a minimum of 1 1/2 inches of open panel space between the radio receiver and the radio frequency oscillator to provide adequate ventilation for the radio receiver. Install Panel Cover CW-261/URA-13 over the pre-set front panel controls of the radio receiver. The screws and the washers which hold the radio receiver in the equipment rack also hold the panel cover on the radio receiver.

c. Radio Frequency Oscillator O-152/URA-13. Before installing the radio frequency oscillator, check all tubes to see that they are firmly seated in their correct sockets (figs. 20 and 21). Install the radio frequency oscillator in the equipment rack above the radio receiver.

19. Connections

a. Interconnections.

(1) After installing the units as described in paragraph 18, connect the cables to the units as shown in the cording diagram (fig. 22). The table below lists the inner connections between Radio Frequency Oscillator O-152/URA-13 and Radio Receiver R-390/URR.

Cable Assembly	FROM RADIO FREQUENCY OSCILLATOR O-152/URA-13	TO RADIO RECEIVER R-390/URR
Radio Frequency Cable Assembly CG-833/U	REC ANT J813	ANTENNA UNBALANCED WHIP J107
Electrical Special Purpose Cable Assembly CX-1619/U	TB 803-E901 TB 804-E902	SYNC XTAL OSC (mechanical coupling, see subpar. (2) below)
Cord CG-409C/U 74-inch	455 KC INPUT J812	IF OUTPUT 50 OHM J106
Electrical Power Cable Assembly CX-2405/U	REC PWR J810	POWER J104

(2) Electrical Special Purpose Cable Assembly CX-1619/U is connected in the following manner. The call-outs mentioned refer to figure 23.

(a) Remove the cover of the band switch adapter by unscrewing the seven cover securing screws (A).

(b) Loosen, but do not remove, the three pairs of face-plate securing screws (B). (One pair of these is not visible in figure 23.)

(c) Set S901 section B to the 1-mc position. This terminal is the first terminal in the clockwise direction, when viewed from the end opposite the driven end, from the sole terminal which has no soldered connection. The switch can be rotated by rotating the coupler.

(d) Set the MEGACYCLE CHANGE control of the radio receiver to the 1-mc position.

(e) Set the KILOCYCLE CHANGE control of the radio receiver to the 000-kc position.

(f) Engage the coupler of the band switch adapter with the slotted SYNC XTAL OSC shaft of the radio receiver. If the coupler does not align with the shaft, loosen the coupler set screw and reposition the coupler; then tighten the set screw. When this is done, the three tapped stand-offs on the rear panel of the radio receiver should insert into the three stand-offs on the face-plate of the band switch adapter. If either the coupler or the stand-offs do not engage properly, reposition the coupler longitudinally on its axis.

(g) Tighten the three main-frame securing screws (C) from the rear of the face-plate so that the band switch adapter is held securely to the rear panel of the radio receiver. (Two of these screws are not visible in figure 23.)

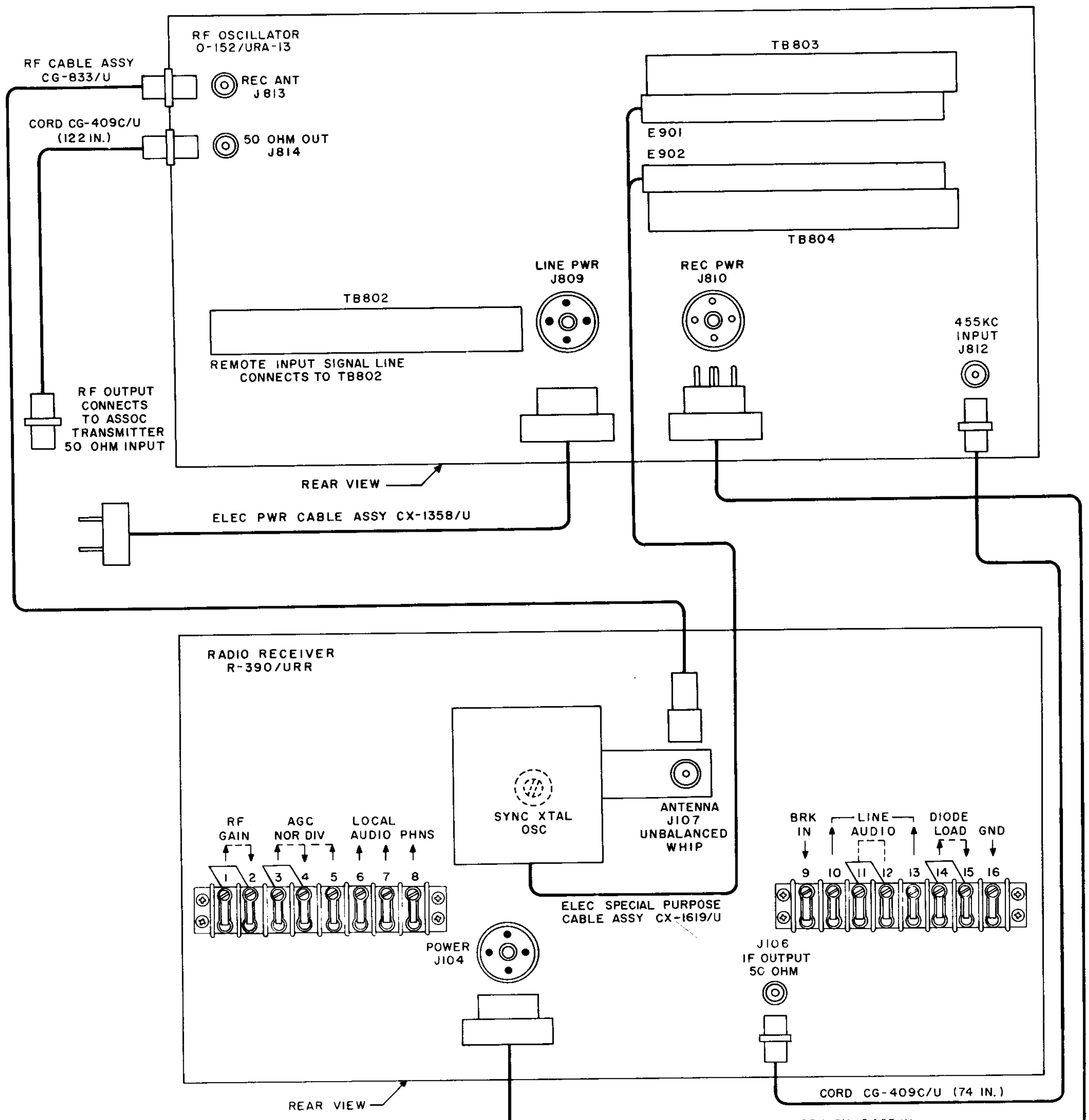


Figure 22. Oscillator Group AN/URA-13, cording diagram.

(h) Tighten the three face-plate securing screws (B) to hold the band switch assembly firmly to the housing frame.

(i) Replace the cover of the band switch adapter.

(j) Open the hinged door, labeled TERMINATION OF FREQUENCY INFORMATION LINES FROM ELECTRICAL POWER CABLE ASSEMBLY CX-1619/U, on the rear panel of radio frequency oscillator by unscrewing the two captivated screws.

(k) Connect fanning stip E901 of CX-1619/U to TB803 on the radio frequency oscillator. This fanning strip has the longest lead-out from the end of the cable insulation, and it mates with the upper terminal board.

(l) Connect fanning strip E902 of CX-1619/U to TB804 on the radio frequency oscillator. This fanning strip has the shortest lead-out from the end of the cable insulation, and it mates with the lower terminal board.

(m) Ground the shield of CX-1619/U to the rear panel of the radio frequency oscillator using the screw and lockwasher located between TB803 and TB804.

(n) Secure the cable using the cable clamp on the rear panel of the radio frequency oscillator.

(o) Close and secure the hinged door.

b. Transmitter connection. The radio frequency output feeds the transmitter through Cord CG-409C/U(122-inch). This cable connects from the 50 OHM OUT J814 of the radio frequency oscillator to a 50-ohm input jack of the transmitter. In the event that the transmitter has no 50-ohm input jack, a 50-ohm input circuit can be provided by use of Electrical Dummy Load DA-85/U. For this connection J906 of the dummy load connects to the cable from the radio frequency oscillator. J905 of the dummy load then connects directly to the crystal socket of the transmitter. With this hook-up, the pin of J905 which is mounted in the glass lead-through insulator carries the rf signal, and the other pin must be grounded. This polarity must be observed when plugging the dummy load into a transmitter crystal socket. If the polarity is reversed the rf signal is grounded out. This will not damage the radio frequency oscillator. The dummy load is also used as a load during testing the oscillator group. When so used it is connected as previously described with Cord CG-409C/U no ground need be provided since ground is supplied through the cord.

c. Input signal line connection.

(1) Remote input signal lines connect to TB802 located on the rear panel of Radio Frequency Oscillator O-152/URA-13. The rear panel markings indicate clearly the terminals for CW,PM (phone), FSK and FAX (facsimile) remote input signals. For PM (phone) operation jumper CARRIER CONTROL terminal 12 to GND terminal 14 unless external carrier contol is provided. If the identity of the signal

ITEM	QTY.	DESCRIPTION
A	7	COVER SECURING SCREWS
B	3 PR	FACE-PLATE SECURING SCREWS
C	3	MAIN-FRAME SECURING SCREWS

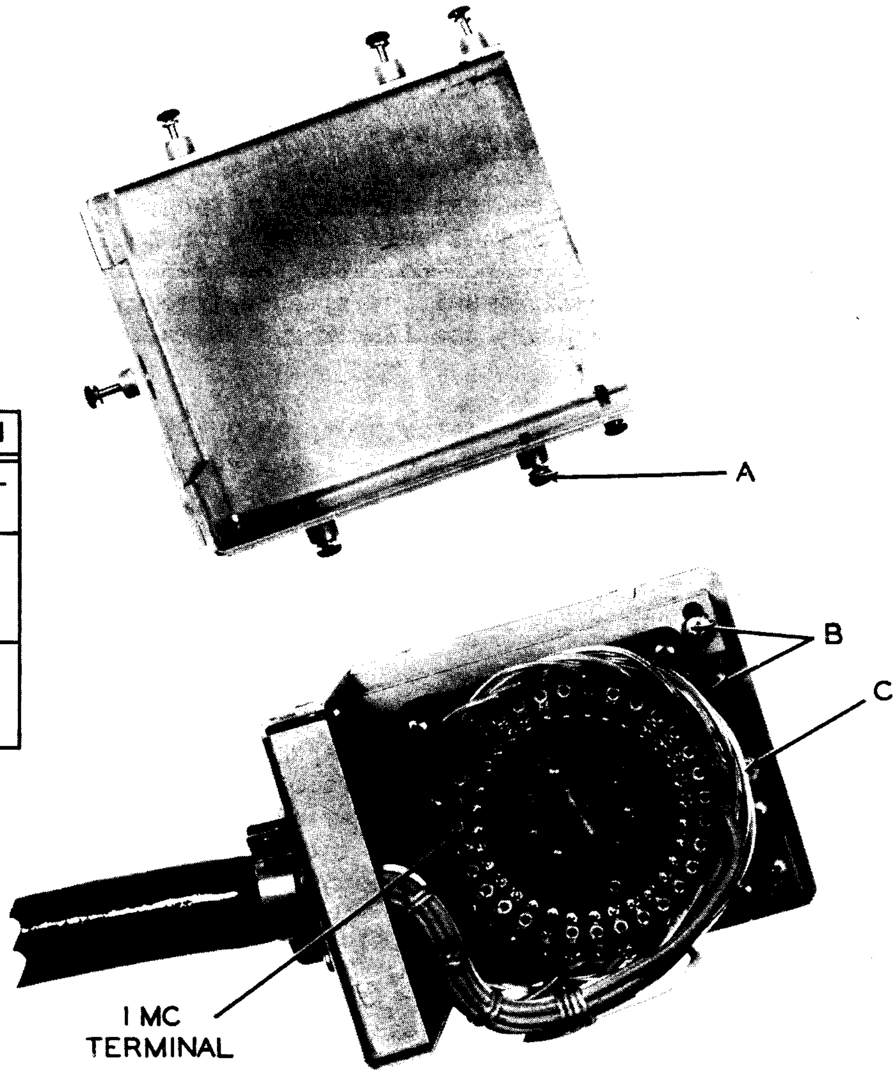


Figure 23. Band switch adapter of Electrical Special Purpose Cable Assembly CX-1619/U, cover removed.

carried by the remote input line is unknown, connect the signal line to the TWO WIRE terminals 2 and 3 and select the proper operating mode by trial and error with the SERVICE SELECTOR switch on the front panel.

(2) Local input signal lines connect to the LOCAL MIKE KEY jack J701 located on the front panel of Radio Frequency Oscillator O-152/URA-13. This input line must terminate in an Amphenol 164-8 type plug. For local phone operation, the input signal must be to terminal C of the plug with terminals E and H providing the ground return. For local cw operation the input signal must be to terminal F of the plug with terminals E and H providing the ground return.

d. Grounding. For equipment cabinet installations, ground each component of Oscillator Group O-152/URA-13 to the cabinet. This is best accomplished by connecting a grounding strap from the rear bumper of each component to the cabinet. Make sure that the grounding strap makes good electrical connections; that is, connections which are free from paint, grease, dirt, etc.

e. Ac Power Connections.

CAUTION. Check to see that the 115/230 VAC switch S801 on Radio Receiver R-390/URR and the LINE VOLTAGE selector S901 on Radio Frequency Oscillator O-152/URA-13 are in the proper position for operation from the available power source. The radio receiver switch is accessible with the bottom dust cover removed. The radio frequency oscillator switch is accessible with the top dust cover removed.

Power input to the Oscillator Group AN/URA-13 is through Power Cable Assembly CX-1358/U. Before connecting the ac power, check to see that the POWER switch of the radio frequency oscillator is in the OFF position. Connect Power Cable Assembly CS-1358/U to LINE PWR jack J809 on the rear panel of the radio frequency oscillator. Connect the other end of the cable into the power source. In rack-type cabinet installations this cable may connect to the rack ac bus. In this case the bus is energized from the ac source.

20. Service Upon Receipt of Used or Reconditioned Equipment

Follow the instructions in paragraph 17 for uncrating, unpacking and checking the equipment. Check used or reconditioned equipment for tags or other indications pertaining to changes in the wiring of the equipment. If changes have been made, note the changes in this instruction book, preferably on the applicable schematic. Perform the installation and connection procedures given in paragraphs 18 and 19.

Section II. INITIAL ADJUSTMENT OF EQUIPMENT

Note. Personnel performing the procedures described in this section should be familiar with the use of controls and instruments and with the operating procedures described in chapter 3.

21. Extent of Initial Adjustments

The procedures given in paragraphs 22 and 23 must be performed before the oscillator group can be used for the routine operation described in chapter 3. Whenever the assigned operating frequency is changed the radio receiver should be calibrated using the procedure given in paragraph 22. Normally the standard deviation must be reset when the operating frequency is changed. The standard deviation need not be reset if cw transmission only is used.

22. Radio Receiver Calibration

Execute the starting procedure given in paragraph 30 before proceeding with the following operations.

a. Set ASSOC XMTR FREQ MULT switch to X1 position.

b. Set radio frequency oscillator FUNCTION switch to CAL REC position.

c. Set radio receiver FUNCTION switch to CAL position.

d. Turn radio receiver RF GAIN control to position 10.

e. Set KILOCYCLE CHANGE control for a reading on the frequency indicator at the 100-kc point nearest the frequency desired for transmission.

Note: The MEGACYCLE CHANGE control is set to the desired position, during the execution of the starting procedure which precedes the execution of this calibration procedure.

f. Turn ZERO ADJ clockwise as far as it will go to lock KILACYCLE CHANGE dial.

g. Tune KILOCYCLE CHANGE control to give ZERO reading on radio frequency oscillator CAL IND meter.

h. Turn ZERO ADJ counterclockwise to stop.

i. Set radio receiver RF GAIN control to position 4.

j. Set radio receiver FUNCTION switch to AGC position.

k. Return KILOCYCLE CHANGE control to its initial setting. When this is done the desired operating frequency is indicated on the frequency indicator.

l. Set radio frequency oscillator FUNCTION switch to OPERATE position. The green AFC indicator will relight.

23. Setting Standard Deviation of 425 cps.

Execute the starting procedure given in paragraph 30 before proceeding with the following operations.

a. Set ASSOC XMTR FREQ MULT switch to X1 position.

b. Set radio frequency oscillator FUNCTION switch to CAL EXC position.

c. Set MOD TEST switch to CARRIER ON position.

d. CAL IND meter will go to zero.

e. Set radio frequency oscillator FUNCTION switch to DEV SET position.

f. Set MOD TEST switch to SPACE-BLACK-LOW position.

g. Unlock DEVIATION control by turning the dial lock counterclockwise.

h. Adjust DEVIATION control until CAL IND meter reads 42.5 (425 cps).

i. Set MOD TEST switch to CARRIER ON position.

j. Set radio frequency oscillator FUNCTION switch to CAL EXC psiiton.

k. CAL IND meter will go to zero.

l. Set radio frequency oscillator FUNCTION switch to DEV SET.

m. Set MOD TEST switch to MRK-WH-HI.

n. Adjust DEVIATION control until CAL IND meter reads 42.5 (425 cps).

o. Set MOD TEST switch to CARRIER ON position.

p. Set radio frequency oscillator FUNCTION switch to CAL EXC position.

q. CAL IND meter will go to zero.

r. Repeat operations given in subparagraphs e through q, above, until no further adjustment of DEVIATION control is required to make CAL IND meter read 42.5 (425 cps) during the operations given in subparagraphs h and n.

s. Lock DEVIATION control by turning the dial lock clockwise.

t. Set MOD TEST switch to the Line position.

u. Set the radio frequency oscillator FUNCTION switch to the OPERATE position.

CHAPTER 3

OPERATING INSTRUCTIONS

Section I. CONTROLS AND INSTRUMENTS

Note. This section locates, illustrates, and describes and use of the various controls and instruments that are provided for the proper operation of the equipment. Haphazard operation or improper setting of the controls can cause damage to electronic equipment. For this reason, it is important to know the function of every control. The actual operation of the equipment is discussed in the next section of this chapter.

24. Radio Frequency Oscillator O-152/URA-13 Front Panel Controls and Instruments

The following table lists the front panel controls and instruments of the radio frequency oscillator and indicates their function.

Control	Function
POWER switch (S706)	In ON position, connects radio frequency oscillator and radio receiver to ac power source. In OFF position, disconnects ac power.
POWER indicator (1701)	Indicates line power is on (red lens).
CAL IND meter (M703)	The FUNCTION switch switches this meter. When the FUNCTION switch is in the OPERATE position, the meter indicates the relative level of the if. input signal to the radio frequency oscillator. A meter reading of 0 indicates no input signal. A meter reading of 10 ua indicates a normal, 100 mv input signal. When the FUNCTION switch is in either the CAL REC, CAL EXC or DEV SET position, the meter indicates the difference between the frequency of the if. input signal and the 455 kc standard of the discriminator. A meter reading of 0 indicates an if. input of 455 kc. A meter reading of 40 ua indicates an if. input 400 cps above or below 455 kc.
FUNCTION switch (S707)	Selects desired radio frequency oscillator function by switching various operating voltages and the CAL IND meter. The positions and functions are as follows.

Control	Function
	Position / **Function**
	frequency reduction is equivalent to the radio-teletype "space" signal or the facsimile "black" signal.
	MRK-WH-HI — Applies negative test modulation voltage to reactance tube to increase the frequency of the rf output. The frequency increase is equivalent to the radio teletype "mark" signal or the facsimile "white" signal.
	LINE — Connects the input modulation signal to the reactance-tube oscillator from the input circuits. The switch is in this position during normal operation.
MOD TEST switch movable dial stop	Prevents MOD TEST switch from being placed in the CARRIER OFF position unless the stop is depressed.
DEVIATION control (R706)	Controls deviation voltage applied to reactance tube.
DEVIATION control dial lock	Locks DEVIATION control to prevent accidental change of setting.
ASSOC XMTR FREQ MULT switch (S703)	Adjusts the deviation voltage applied to the reactance tube and adjusts the band switching circuit to compensate for frequency multiplication by the transmitter.
POLAR NEUTRAL switch (S701)	Switches bias voltages to the fsk relay coils for various modes of operation. In the 30 MA POLAR position both relay coils must carry 30 ma for operation. In the 60 MA NEUTRAL position one relay coil is so biased that the other coil must carry 60 ma for operation. In the 20 MA NEUTRAL position one relay coil is so biased that the other coil must carry 20 ma for operation.
LINE CURRENT control (R701)	Adjusts fsk relay current to the value indicated by the setting of the POLAR NEUTRAL switch.
LINE CURRENT meter (M701)	Indicates line current through fsk relay.
AUDIO LEVEL control (AT701)	Controls the phase deviation effected by a phone input signal.

Control	Function
AUDIO LEVEL meter (M702)	Indicates phase deviation effected by a phone input signal. The meter is calibrated from 0-100. During PM operation the phase deviation in radians equals the meter reading multiplied by 0.01.
LOCAL MIKE KEY jack J701	Provides access to input circuits for local phone and key operation. Pin F is to the cw circuit, Pin C to the pm circuit, pins E and H are to ground and the remaining pins are not connected.
CARRIER CONTROL switch (S705)	Switches input circuit from LOCAL (through LOCAL MIKE KEY jack) to LINE (through TB802).
AFC indicator (I702)	Indicates that the radio frequency oscillator is tuned to the frequency of the radio receiver (green lens).
OVEN ON indicator (I703)	Indicates that the discriminator oven heater is on (amber lens).

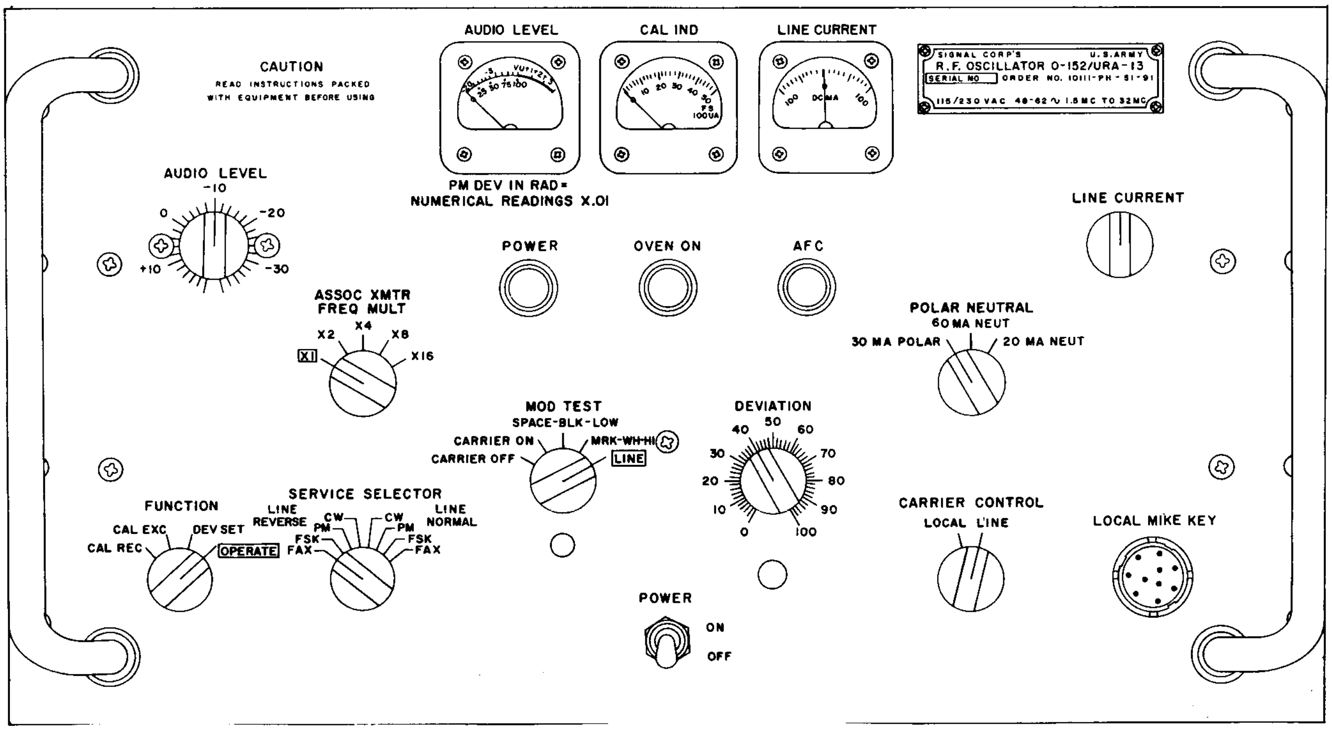


Figure 24. Radio Frequency Oscillator O-152/URA-13, front panel controls.

25. Radio Frequency Oscillator O-152/URA-13 Rear Panel Controls

The following table lists the rear panel terminal boards and jacks on the radio frequency oscillator and indicates their function.

Control	Function
Terminal board TB802	Provides access to input circuits for line operation. Terminals are provided for CW, PM (for phone), FSK and FAX signals. A two-wire input signal line which may carry different type signals at different times may be connected to the TWO WIRE terminals and the proper operating mode selected, with the SERVICE SELECTOR, by trial and error. The CARRIER CONTROL terminal provides for external carrier control during PM operation only. This terminal is jumpered to the GND terminal during pm operation unless external carrier control is desired. During cw operation the CARRIER CONTROL terminal must not be grounded. The SIMPLEX terminal provides a terminating circuit for a three-wire simplex circuit. The PM or TWO WIRE terminals provide the other two terminals when the SERVICE SELECTOR is in the PM position.
Terminal board TB803 and Terminal board TB804	These terminal boards are located behind the hinged cover labeled TERMINATION OF FREQUENCY INFORMATION LINES FROM ELECTRICAL POWER CABLE ASSEMBLY CX-1619/U. Fanning strips E901 and E902 of CX-1619/U terminate on TB803 and TB804 respectively.
LINE PWR jack (J809)	Line voltage input for both the radio frequency oscillator and the radio receiver.
REC PWR jack (J810)	Line voltage output to the radio receiver. Line voltage to the radio receiver from this jack is turned off and on by the POWER switch of the radio frequency oscillator.
455 KC INPUT jack (J812)	This is the input jack for the rf signal (nominal frequency 455 kc) from the radio receiver.
REC ANT jack (J813)	This is the output jack for the rf signal to the radio receiver.
50 OHM OUT jack (J814)	This is the output jack for the rf signal to the associated transmitter.

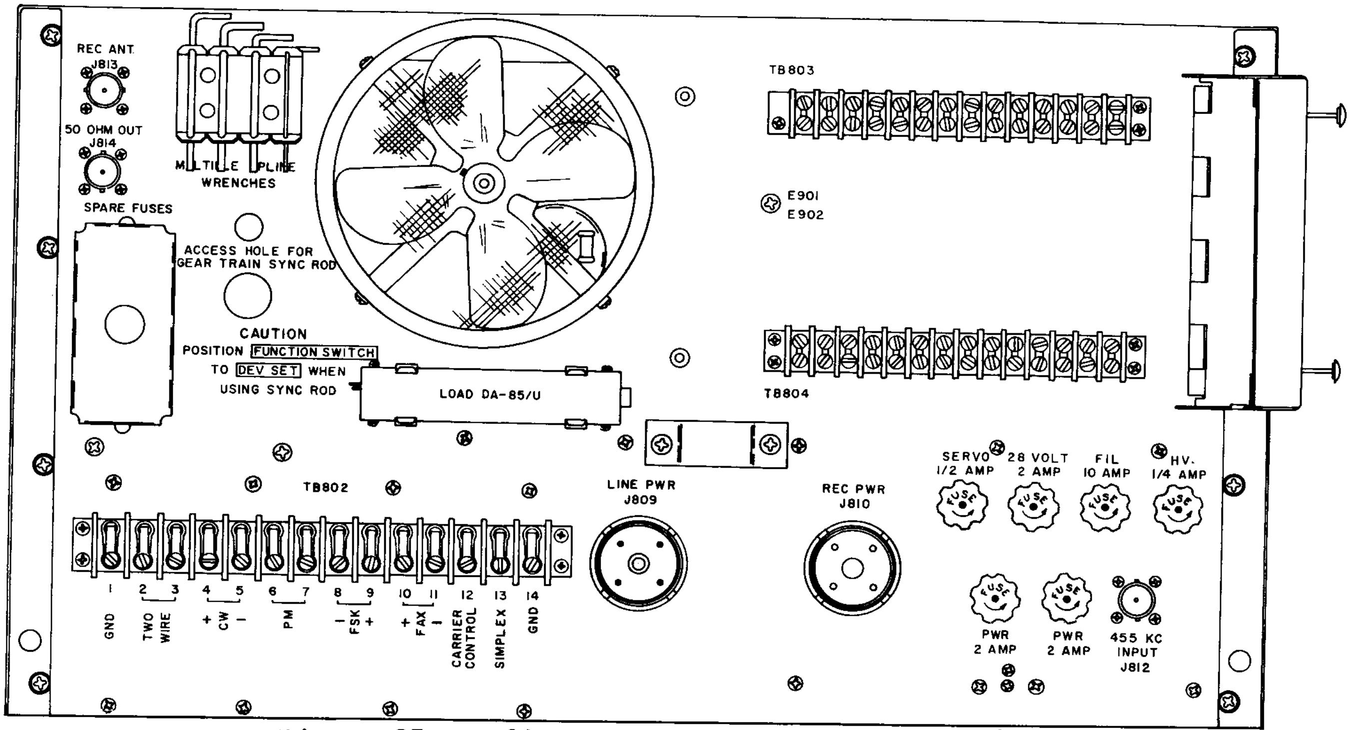


Figure 25. Radio Frequency Oscillator O-152/URA-13, rear panel controls

26. Radio Receiver R-390/URR Front Panel Controls and Instruments.

The front panel of the radio receiver is partially covered with Panel Cover CW-261/URA-13. The front panel controls covered by the panel cover are preset before the panel cover is installed (par. 18b). The following table lists the front panel controls and instruments of the radio receiver which are not covered. The function of the controls and instruments is also listed.

Control	Function
MEGACYCLE CHANGE tuning control	Selects one of the 32 tuning steps and changes the reading of the first two digits of the frequency indicator.
KILOCYCLE CHANGE tuning control	Tunes the radio receiver to the frequency within the megacycle band selected by the MEGACYCLE CHANGE control and also changes the reading of the last three digits of the frequency indicator. The frequency range of the control is slightly greater than 1 mc. When the control is tuned to a frequency higher or lower than that indicated by the first two digits of the frequency indicator, a plus or minus sign appears between the mc and the kc readings. This indicates, respectively, that 1 mc must be added to or subtracted from the mc reading to obtain the true reading.
DIAL LOCK	Locks the KILOCYCLE CHANGE control to prevent the accidental change of the setting.
ZERO ADJ	When turned clockwise, disengages the frequency indicator from the KILOCYCLE change control for calibration purposes.

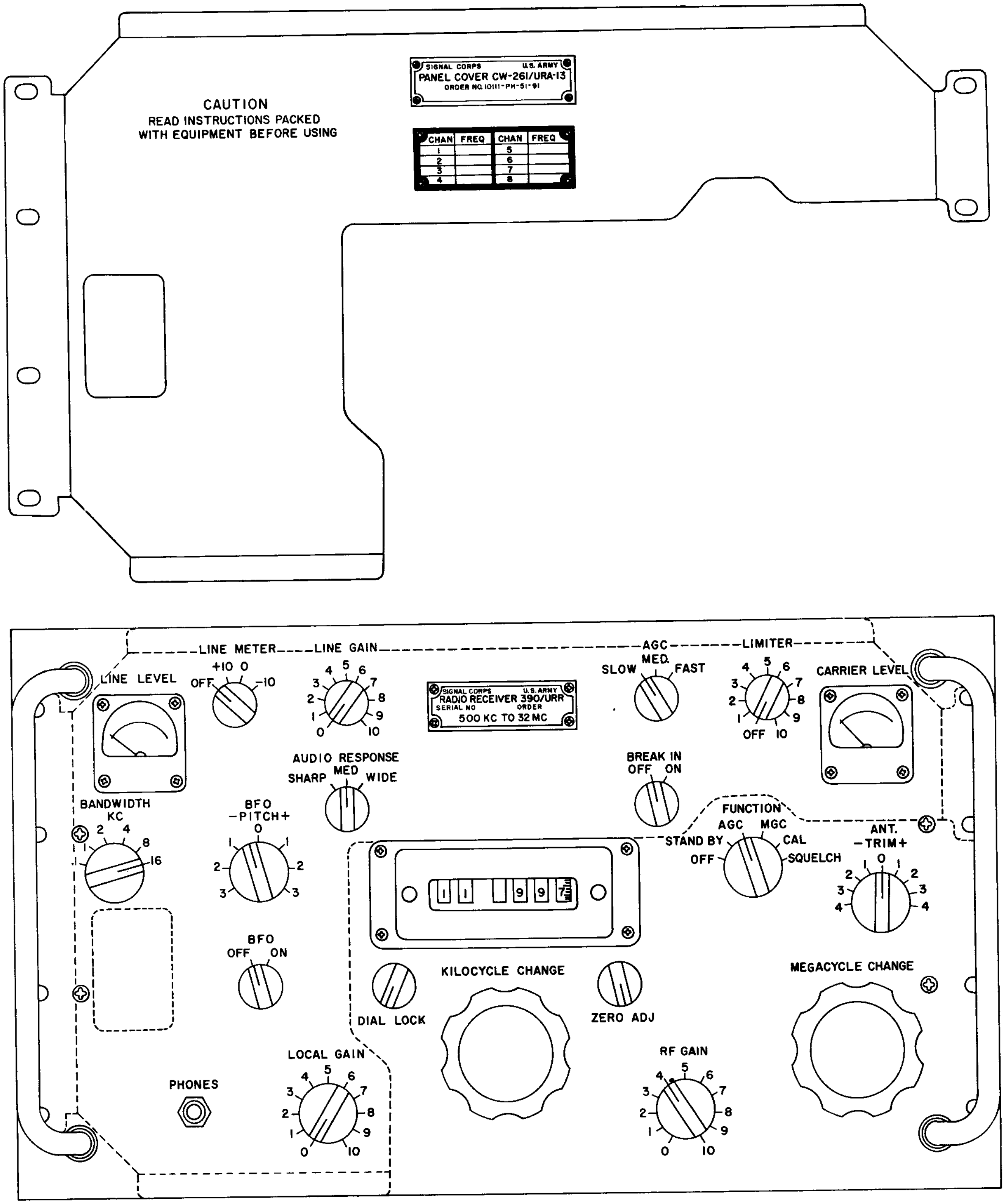


Figure 26. Radio Receiver R-390/URR, front panel controls,

Control	Function
FUNCTION switch (S107)	When rotated to any position other than OFF, this switch connects the radio receiver to the power source and selects the desired function. The positions and functions are as follows.
	Position — **Function**
	STAND BY — Radio receiver disabled but filaments remain on and oscillators remain on. The radio receiver is ready for instant use.
	AGC — Gain is controlled automatically for normal operation.
	MGC — Gain is controlled manually by RF GAIN control or an external gain control.
	CAL — Calibration oscillator enabled to supply signals at 100-kc points.
	SQUELCH — Squelch circuit is connected for silencing receiver when the input signal falls below the threshold determined by the setting of the RF GAIN control.
RF GAIN control (R123)	Controls gain of rf and if. amplifiers. When the squelch circuit is operative, controls squelch threshold. Permits maximum agc when in the minimum clockwise direction.
ANT. TRIM	Tunes out the reactive component of the antenna.

27. Radio Receiver R-390/URR Rear Panel Controls

The following table lists the rear panel controls, jacks and terminal boards, of the radio receiver and indicates their function.

Control	Function
SYNC XTAL OSC adjusting slot	This screwdriver adjusting slot permits synchronizing the crystal oscillator switches with the radio receiver mechanical tuning system. The band switch adapter termination of Electrical Special Purpose Cable Assembly CX-1619/U mechanically couples to the radio receiver tuning linkage at this point.

Control	Function
POWER jack J104	Line voltage input to the radio receiver from the radio frequency oscillator.
IF OUTPUT 50 OHM jack J106	Provides if. signal (nominal frequency 455 kc) to the radio frequency oscillator.
ANTENNA UNBALANCED WHIP jack J107	Connection for whip or random length antennas. The radio receiver receives the rf signal from the radio frequency oscillator through this jack.
ANTENNA BALANCED 125 OHM J108	Connection for balanced antenna or unbalanced low-impedance transmission lines.
OVEN switch (S108)	Screwdriver switch to apply voltage to crystal and vfo ovens. In OFF position oven can not operate. In ON position ovens are under thermostatic control.
Terminal boards TB101 and TB102, terminal 1 through 16.	These terminal boards provide connections for various external control circuits and signals. For use in Oscillator Group AN/URA-13, terminal 1 is jumpered to terminal 2 and terminal 3 is jumpered to terminal 4 on TB102. Terminal 11 is jumpered to terminal 12 and terminal 14 is jumpered to terminal 15 on TB101.
Remote Control jack J105	This jack provides connections for various remote control circuits and signals.

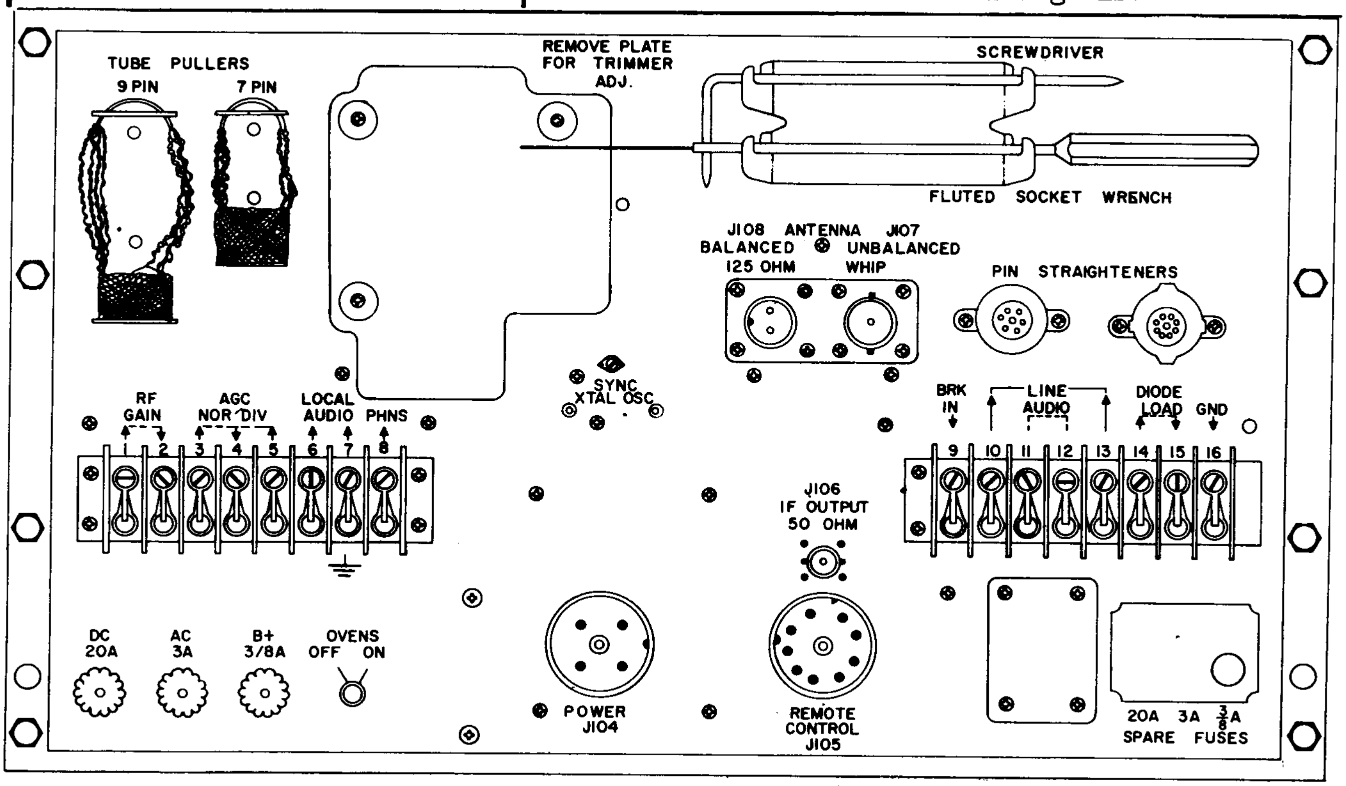


Figure 27. Radio Receiver R-390/URR, rear panel controls.

Section II. OPERATION UNDER USUAL CONDITIONS

28. Modes of Operation

The input intelligence signal to Oscillator Group AN/URA-13 may be from either a local or a line source. With a local signal, phone or cw transmission is possible. With a line input signal, phone, cw, fsk or facsimile transmission is possible. To operate the equipment in any particular mode, perform the preliminary starting procedure to select the operating mode (par. 29), the starting procedure (par. 30), the tuning procedure (par. 33), if necessary, and the stopping procedure (par. 34).

29. Preliminary Starting Procedure to Select the Operating Mode.

a. Selection of Cw Operation with a Line Input Signal.

(1) Connect the remote cw line to TB802 CW terminals 4 and 5 on the rear panel of the radio frequency oscillator.

(2) Remove jumper, if it is present, between CARRIER CONTROL terminal 12 and GND terminal 14 of TB802.

(3) Set the SERVICE SELECTOR switch to the CW-LINE NORMAL position.

Note: In the event that the input connections are reversed to TB802, correct the signal polarity by setting the SERVICE SELECTOR switch to the CW-LINE REVERSE position.

(4) Set the CARRIER CONTROL switch to the LINE position.

b. Selection of Phase Modulation Operation for Phone Transmission with a Line Input Signal.

(1) Connect the remote line which carries the voice signal to TB802 PM terminals 6 and 7 on the rear panel of the radio frequency oscillator.

(2) Connect jumper from CARRIER CONTROL terminal 12 to GND terminal 14 of TB802.

Note: If external carrier control is employed, connect the external carrier control line to terminal 12 of TB802 rather than jumpering this terminal to ground. This provides "push-to-talk" control.

(3) Set the SERVICE SELECTOR switch to the PM-LINE NORMAL position.

(4) Set the CARRIER CONTROL switch to the LINE position.

c. Selection of FSK Operation with a Line Input Signal.

(1) Connect the remote fsk line input to TB802 FSK terminals 8 and 9 on the rear panel of the radio frequency oscillator.

(2) Set the SERVICE SELECTOR switch to the FSK-LINE NORMAL position.

Note: In the event that the input connections are reversed to TB802 correct the signal polarity by setting the SERVICE SELECTOR switch to the FSK-LINE REVERSE position.

d. Selection of Facsimile Operation with a Line Input Signal.

(1) Connect the remote facsimile line input to TB802 FAX terminals 10 and 11 on the rear panel of the radio frequency oscillator.

(2) Set the SERVICE SELECTOR switch to the FAX-LINE NORMAL position.

Note: In the event that the input connections are reversed to TB802, correct the signal polarity by setting the SERVICE SELECTOR switch to the FAX-LINE REVERSE position.

e. Selection of CW Operation with a Local Input Signal.

(1) Connect the local cw line to the LOCAL MIKE KEY jack.

(2) Remove jumper, if it is present, between CARRIER CONTROL terminal 12 and GND terminal 14 of TB802.

(3) Set the SERVICE SELECTOR switch to the CW-LINE NORMAL position.

(4) Set the CARRIER CONTROL switch to the LOCAL position.

f. Selection of Phase Modulation Operation for Phone Transmission with a Local Input Signal.

(1) Connect single button carbon microphone line to the LOCAL MIKE KEY jack.

Note: "Push-to-talk" carrier control is provided through the LOCAL MIKE KEY jack, J701 terminal C. If "push-to-talk" control is not desired, jumper carrier control terminal 12 of TB802 to GND terminal 14.

(2) Set the SERVICE SELECTOR switch to the PM-LINE NORMAL position.

(3) Set the CARRIER CONTROL switch to the LOCAL position.

30. Starting Procedure

a. Set the Radio Receiver R-390/URR front panel controls as follows:

(1) Turn the ANT. TRIM Control to the 0 position.

(2) Set the FUNCTION switch to the AGC position.

(3) Turn the RF GAIN control to position 4.

(4) Turn the KILOCYCLE CHANGE and MEGACYCLE CHANGE control until desired frequency is indicated.

b. Set the Radio Frequency Oscillator O-152/URA-13 front panel control as follows.

(1) Set the MOD TEST switch to the CARRIER ON position.

(2) Set the FUNCTION switch to the OPERATE position.

(3) Set the ASSOC XMTR FREQ MULT switch to the X1 position.

Note. If frequency multiplication is carried out in the transmitter, follow the procedure given in par. 31 after completion of the starting procedure.

(4) Set the POWER switch to the ON position.

(5) After the green AFC indicator lights, set the MOD TEST switch to the LINE position.

c. The radio frequency oscillator requires not more than two minutes to warm up and tune to the frequency set up on the radio receiver. When the radio frequency oscillator is in tune, the green AFC indicator lights. When the green AFC indicator lights, the rf exciting signal is available to the transmitter.

31. Operation with transmitter which multiplies the rf output from the radio frequency oscillator.

Where the transmitter used in conjunction with Oscillator Group AN/URA-13 multiplies the rf excitation frequency provided by the radio frequency oscillator, perform the following operations after the starting procedure has been executed. These operations provide the transmitter with a subharmonic of the frequency shown by the frequency indicator of Radio Receiver R-390/URR. Upon multiplication by the transmitter circuits, the rf output of the transmitter is the frequency shown by the frequency indicator of Radio Receiver R-390/URR.

a. Perform starting procedure (par. 30).

b. Set the FUNCTION switch of the radio frequency oscillator to the DEV SET position.

c. Set ASSOC XMTR FREQ MULT switch of the radio frequency oscillator to the appropriate multiplier (X2, X4, X8, or X16).

d. Advance RF GAIN control of the radio receiver to position 8.

e. Return the FUNCTION switch of the radio frequency oscillator to the OPERATE position.

32. Operating Procedure.

a. Cw Operation. There is no special operating procedure to follow after the execution of the preliminary starting procedure to select cw operation (either local or line) and after the starting procedure.

b. Phase Modulation Operation for Phone Transmission. After executing the starting procedure, adjust the AUDIO LEVEL control of the radio frequency oscillator to keep the peak phase deviation, as indicated by the AUDIO LEVEL meter, below 1.0 radian. The lower scale reading of this meter, the scale calibrated from 0-100, times 0.01 equals the phase deviation in radians.

c. Fsk Operation. After executing the starting procedure, perform the initial adjustment of setting the standard deviation (par. 23), then set the POLAR NEUTRAL switch of the radio frequency oscillator to the position which agrees with the type of keying signal, i.e., 60 MA NEUT, 20 MA NEUT or POLAR. Adjust the LINE CURRENT control so that the LINE CURRENT meter indicates the current which is required for the particular type of keying. That is, for a 30 MA POLAR setting of the POLAR setting of the POLAR NEUTRAL switch, the LINE CURRENT meter should read 30 ma; for a 60 ma NEUT setting, the LINE CURRENT meter should read 60 ma; for 20 MA NUET setting, 20 ma.

d. Facsimile Operation. There is no special operating procedure to follow after the preliminary starting procedure to select facsimile operation and after the execution of the starting procedure. The initial adjustment of setting the standard deviation (par. 23) should be performed before beginning to operate.

33. Tuning Procedure.

To tune Oscillator Group AN/URA-13, first set the MOD TEST switch to the CARRIER ON position. Then set the MEGACYCLE CHANGE control and the KILOCYCLE CHANGE control of Radio Receiver R-390/URR to indicate the desired frequency on the frequency indicator. Radio Frequency Oscillator O-152/URA-13 will automatically tune to the frequency set up on the radio receiver. The radio frequency oscillator will require not more than 50 sec. to retune to a new frequency. During this process of retuning the green AFC indicator may go out. This indicates that the radio frequency oscillator is not on frequency. When the AFC indicator relights, the radio frequency oscillator is again on frequency. After the radio frequency oscillator is on frequency, return the MOD TEST switch to the LINE position. (Setting the MOD TEST switch to the CARRIER ON position during tuning, removes modulation from the reatance tube.) If the green AFC indicator remains lighted during the execution of a tuning procedure, the radio frequency oscillator has then tracked the tuning change and has remained on frequency throughout the change. The associated transmitter must be separately tuned, either manually or automatically, to the proper frequency.

34. Stopping Procedure.

a. To place the oscillator group in a stand-by condition (no rf output to transmitter), turn the MOD TEST switch to the CARRIER OFF position. The movable dial stop must be depressed before the switch can be set in this position.

b. To remove power from Oscillator Group AN/URA-13, set the POWER switch of the radio frequency oscillator to the OFF position.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

35. General.

The operation of Oscillator Group AN/URA-13 may be difficult in regions where extreme cold, heat, moisture, sand, etc., prevail. Procedures for minimizing the effect of these unusual operating conditions are outlined in paragraphs 36, 37 and 38, following.

36. Operation in Arctic Climates.

The cold arctic climates effect the efficient operation of the equipment. Take the following precautions when operating the equipment under such conditions.

a. Keep the equipment warm and dry. If the equipment is not in a heated inclosure, construct an insulated box for it. Keep resistor heaters, if supplied, turned on providing they do not overtax the power supply. If it is impractical to use resistor heaters, keep the filaments of the tubes lighted constantly unless this also overtaxes the power supply.

b. Locate the equipment inside a heated inclosure so that there is no danger of a cold draft striking the glass tubes when a door is opened. Such a sudden draft may shatter the glass envelope of a heated tube. If the inclosure is so constructed that this precaution is impossible, place a blanket or some other barrier between the source of the draft and the equipment.

c. Equipment will sweat when brought into a warm room after being exposed to the cold. This condition may also arise when the equipment warms up after exposure during a cold night. If sweating occurs, dry the equipment thoroughly after the equipment has reached room temperature and the sweating has stopped.

37. Operation in Tropical Climates.

When operated in a tropical climate, the equipment may be installed in tents, huts, or, when necessary, in underground dugouts. When equipment is installed below ground level or when it is set up in swampy areas, moisture conditions are more acute than those normally met in the tropics. Ventilation usually is poor, and the temperature of the equipment becomes lower than the sourrounding air. To minimize this condition, place lighted electric bulbs under the equipment. The equipment never should be enclosed to such an extent that adequate circulation of air is prevented.

38. Operation in Desert Climates.

a. Sand, dust, or dirt entering moving parts of the equipment is the main problem that arises when operating radio equipment in desert climates. The best precaution against this is to make the housing for the equipment as dustproof as possible. Hang wet sacking over the windows and doors; cover the inside walls with heavy paper; secure the side walls of tents with sand to prevent their flapping in the wind.

b. Never tie power cords, signal cords, or other wiring to either the inside or the outside of a tent. Desert areas are subject to sudden wind squalls which may jerk the connections loose or break the lines.

c Keep the equipment as free from dust as possible. Make frequent preventive maintenance checks (chapter 4). Pay particular attention to the lubrication, since sand which combines with grease or oil forms a grit which will damage the equipment.

d. Cover the equipment with a tarpaulin or similar material at night to protect it from the condensation of moisture caused by the drastic fall in temperature at night.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. TOOLS AND EQUIPMENT

39. General

The tools, parts, supplies, and test equipment necessary to perform organizational maintenance are authorized by appropriate publications. Additional tools and testing facilities may be supplied with any particular radio set.

40. Tools and Materials Required for Oscillator Group AN/URA-13

Tools and materials required for organizational maintenance of the radio set are listed in subparagraphs a. and b. below. Items contained in Tool Equipment TE-41 are listed in Department of the Army Supply Manual SIG 6-TE-41.

a. Tools.

1 tool equipment TE-41
1 tube puller for 7-pin miniature tubes
1 tube puller for 9-pin miniature tubes
1 right-angle phillips screwdriver, #8
1 fluted socket wrench, #8
1 pin straightener for 9-pin miniature tubes
1 pin straightener for 7-pin miniature tubes
1 set of multiple spline wrenches

b. Materials.

Solvent, Dry Cleaning (SD) (Fed spec No. P-S-66/a).
Paper, sand, flint #0000.

c. Test Equipment

Electron Tube Test Set TU-7/U (TM 11-5083, when published)
Multimeter TS-352/U, TM 11-5527.

41. Special Tools Supplied with Equipment

a. Special Tools Supplied with Radio Receiver R-390/URR. The special tools supplied with the radio receiver are mounted on the rear panel. The tools supplied are one tube puller and one pin straightener for 9-pin miniature tubes, one tube puller and one pin for straightener 7-pin miniature tubes, one #8 right-angled phillips screwdriver, and one #8 fluted socket wrench. Refer to the instruction book for Radio Receiver R-390/URR for instructions covering the use of these tools.

b. Special Tools Supplied with Radio Frequency Oscillator O-152/URA-13. One set of multiple spline wrenches is supplied with each radio frequency oscillator. These wrenches are mounted on the rear panel. These wrenches are used for removing front-panel bar knobs and for loosening the collars which secure the cam shafts and gears in the mechanical tuning system. A special tuning tool and a gear train synchronizing rod are also supplied with the radio frequency oscillator, but these tools are not required for organizational maintenance. The tuning tool is clipped to the top of the rf amplifier subassembly. It is used specifically for adjusting timing capacitors and adjusting tuning coils. The gear train synchronizing rod is clipped to the underside of the top dust cover. It is used to align the gear train.

Section II. PREVENTIVE MAINTENANCE SERVICES

42. Definition of Preventive Maintenance

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

43. General Preventive Maintenance Techniques

a. Use #0000sandpaper to remove corrosion.

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

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

Caution. Repeated contact of carbon tetrachloride with the skin and prolonged breathing of the fumes are dangerous. Make sure adequate ventilation is provided.

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

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

Caution. When using compressed air, always direct the first blast of the air line toward the floor. This clears condensed moisture from the line.

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

44. Use of Preventive Maintenance Forms

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

b. Circled items on figures 28 and 29 are partially or totally applicable to Oscillator Group AN/URA-13.

45. Performing Preventive Maintenance

a. Performing Exterior Preventive Maintenance.

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

(1) Check for completeness and general condition of the oscillator group. The components of the group are listed in paragraph 7.

(2) Check suitability of location and installation for normal operation.

(3) Clean dirt and moisture from microphone, key, jacks, plugs, and component panels.

(4) Inspect the seating of fuses and connectors on the rear panel of each component (figs. 25 and 27).

(5) Inspect all controls for binding, scraping, excessive looseness, worn or chipped gears, misalignment, and positive action.

(6) Check for normal operation (par. 52).

(7) Clean and tighten all cable connectors in the system (fig. 22).

(8) Inspect cabinet and external metal surfaces for rust, corrosion and moisture.

(9) Inspect cables for breaks, fraying, deterioration, kinks and strain (fig. 22).

(10) Inspect switches, knobs, indicator lamp assemblies and meters for looseness (figs. 24 and 26).

(11) Clean all nameplates and meter windows (figs. 24 and 26).

(12) Inspect all meter cases and windows for possible damage (figs. 24 and 26).

(13) Inspect shelters and covers for adequacy of weatherproofing (par. 47).

Note. If deficiencies are not corrected during inspection, indicate corrective action taken.

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

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.

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

DAILY

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

WEEKLY

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

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

DA FORM 1 MAY 51 11-238 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

Figure 28. DA form 11-238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.

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

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

DA FORM 1 MAY 51 11-239 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE. e6—16—64282-1

Figure 29. DA Form 11-239.

b. Performing Interior Preventive Maintenance.

Caution: Disconnect all power from the oscillator group before performing the following operations. Upon completion, reconnect power and check for satisfactory operation

(1) Inspect electron tubes for loose envelopes, cracked sockets, and insufficient socket spring tension; clean out dust and dirt carefully; check emission of receiver type tubes (figs. 18-21).

(2) Inspect fixed capacitors for leaks, bulges and discoloration.

Note. When checking tubes, remove and replace one tube before proceeding to the next tube. Interchanging tubes, even though the tube types are identical, can cause misalignment of the equipment.

(3) Inspect relays for loose mountings.

(4) Inspect resistors for chipping, blistering, discoloration and moisture.

(5) Inspect terminals of large fixed capacitors and resistors for corrosion, dust, and loose contacts.

(6) Clean and tighten switches, terminal boards and subchassis.

(7) Inspect terminal boards for loose connections cracks, and breaks.

(8) Clean and tighten connections and mountings of transformers, chokes, and potentiometers.

(9) Inspect power transformers for overheating and leakage.

(10) Check adequacy of moistureproofing and fungiproofing.

Note. If deficiencies are not corrected during inspection, indicate corrective action taken.

Section III. LUBRICATION AND WEATHERPROOFING

46. Lubrication

No lubrication is to be performed on either Radio Receiver R-390/URR or Radio Frequency Oscillator O-152/URA-13 at the organizational maintenance level. Refer to paragraph 134 for lubrication at the field maintenance level.

47. Weatherproofing Procedures and Precautions

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

b. Tropical Maintenance. AA special mositure proofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13 and TB SIG 72. The equipment is given the moistureproofing and fungiproofing treatment at the factory and it is necessary to repeat the treatment only when parts are replaced or repaired.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 56 and TB SIG 219.

d. Desert Maintenance. Special precaution necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained in TB SIG 75.

48. Rustproofing and Painting

a. When the finish on the case has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use #00 or #000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

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

b. When a touch-up job is necessary, apply paint with a small brush. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section IV. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL.

49. Extent of Instructions

a. Trouble shooting at an organizational level is limited to localizing defective parts that are readily replaceable at an organizational level (tubes, fuses, cables, etc.), or to sectionalizing defective units that must be replaced as a unit (receiver or radio frequency oscillator). The outlined procedures attempt to determine the defective unit first and then to determine the nature of the fault within the unit. If the fault can be determined through organizational procedures, corrective measures or the need for repair at a field maintenance level is indicated. If the fault cannot be determined through organizational procedures, reference is made to the necessary field maintenance instructions.

b. The techniques utilized for organizational trouble shooting include visual inspection, operational test, tube test, and simple continuity checks. The material is presented in the order which the repairman would normally employ in servicing defective equipment. When the procedures indicated are not sufficient to determine the source of trouble, trouble shooting at a field maintenance level (ch. 6) is required.

50. Visual Inspection

a. When failure occurs and the cause is not immediately apparent, visually check as many of the items listed in subparagraph b. as is practical before continuing with the performance check (par. 51). Do not disassemble the equipment for complete visual inspection without some knowledge of operational symptoms. Obtain available information from the operator of the equipment regarding performance at the time trouble occurred.

b. Failure of the oscillator group often may be caused by the following faults.

(1) Worn, broken, or disconnected power cords.

(2) Blown fuses (figs. 25 and 27).

(3) Defective tubes (check voltage regulator tubes first).

(4) Improperly connected interconnecting cables (Fig. 22).

(5) Loose connection to terminal boards on rear panel of the radio frequency oscillator.

(6) Line voltage not applied or very low.

c. When visually inspecting the tubes for burned-out filaments, it may be discovered that more than one tube is not lighted. This condition will arise when a single filament burns out in a series filament circuit. Both the radio receiver and the radio frequency oscillator employ some series filament circuits. Refer to the over-all schematic diagrams (figs. 110 and 111) of the two units for the filament circuits.

51. Trouble Shooting by Using Equipment Performance Checklist

a. Purpose and Use. The equipment performance checklist is the beginning of a systematic trouble-shooting technique to isolate with a minimum effort. Operate the equipment as directed in the checklist and check for a normal indications listed. If an abnormal induction occurs, follow the corrective measure outlined in the final column of the checklist.

b. Corrective Measures. In a few cases the abnormal indications permit immediate localization of the trouble to a particular part. In these cases the corrective measure indicates the specific part to be repaired or replaced. In most cases, however, the abnormal indications provide only for sectionalizing the trouble to a particular unit or subchassis within a unit. In these cases the corrective measure calls for the performance of additional testing procedures to localize the trouble. When the procedure referred to is beyond the scope of organizational maintenance personnel, trouble shooting at field maintenance level is indicated by making a reference to paragraph 126.

52. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indication	Corrective measure
	1	Cording	All connections properly made (fig. 22).		
	2	Dummy electrical load	Connected as test load.		
P	3	FUNCTION switch (receiver)	Set to AGC position.		
R E	4	RF GAIN control (receiver)	Set to position 4.		
P	5	ANT. TRIM (receiver)	Set to position 0.		
A R	6	TB 802 (oscillator)	Remove jumper from CARRIER CONTROL terminal 12 to GND terminal 14 if present.		
A T	7	MOD TEST switch (oscillator)	Set to LINE position.		
O	8	FUNCTION switch (oscillator)	Set to DEV SET position.		
R Y	9	ASSOC XMTR FREQ MULT switch (oscillator)	Set to position X1.		
	10	SERVICE SELECTOR switch (oscillator)	Set to CW-LINE NORMAL position.		

52. Equipment Performance Checklist (Contd)

	Item No.	Item	Action or condition	Normal indication	Corrective measure
PREPARATORY	11	AUDIO LEVEL control (oscillator)	Set to position -30 dbm.		
	12	DEVIATION control (oscillator)	Leave at previous setting.		
	13	CARRIER CONTROL switch (oscillator)	Set to LINE position.		
	14	POLAR NEUTRAL switch (oscillator)	Set to NEUTRAL position.		
	15	LINE CURRENT control (oscillator)	Turn counterclockwise to stop.		
START	16	POWER switch (oscillator)	Set to ON position	POWER indicator (red) lights and fan operates.	Check power cable to oscillator. Check two fuses PWR 2 AMP and fuse FIL 10 AMP. Check indicator lamp. Refer to par. 126.
				OVEN ON indicator (amber) lights.	Check fuse 28 VOLT 2 AMP. Check indicator lamp. Refer to par. 126. If OVEN ON indicator comes on but does not cycle after 15 minutes, remove the power from the equipment. Faulty oven switch.

52. Equipment Performance Checklist (Contd)

	Item No.	Item	Action or condition	Normal indication	Corrective measure
START	16 (Contd)			Radio receiver frequency indicator lamp lights	Check power cable from oscillator to receiver. Check dial lamps. Refer to instruction book for receiver.
	17	MEGACYCLE CHANGE control (receiver)	Set to 2 mc, then 4 mc, then 7 mc, then 13 mc, then 25 mc, leaving control in position other than its initial position (either the 2 mc or 3 mc position.)	Bandswitch motor runs quickly to the correct band and stops.	Refer to par. 126.
EQUIP	18	FUNCTION switch (oscillator)	Set to OPERATE position.	Coarse positioning motor drives gear train at very rapid rate (whir of gears audible).	Refer to par. 126.
				Then servo motor drives gear train at slower rate. (Gear noise may be audible when servo motor initially takes over but noise will diminish as driving speed reduces.	Check fuse SERVO 1/2 AMP and fuse HV 1/4 AMP. Refer to par. 126.

52. Equipment Performance Checklist (Contd)

	Item No.	Item	Action or condition	Normal indication	Corrective measure
EQUIPMENT	18 (Contd)			AFC indicator of oscillator (green) lights.	Check rf cable assemblies between oscillator and receiver.
					Check indicator lamp.
				CAL IND meter reads above 50.	Check radio receiver FUNCTION switch to make sure it is in the AGC position.
PERFORMANCE	19	TB802	Jumper CARRIER CONTROL pin 12 to GND pin 14.	Carrier turns on (rf voltage measurable across dummy load with VTVM.)	Defective rf power amplifier V107. Refer to par. 126.
	20	FUNCTION switch (oscillator)	Set to DEV SET position.		
	21	MOD TEST switch (oscillator)	Switch between SPACE-BLK-LOW position and MARK-WHT-HI position.	CAL IND meter reads same for both positions of switch.	Refer to par. 126.
				CAL IND meter reads 42.5.	Reset standard deviation (par. 23).
	22	FUNCTION switch (oscillator)	Return to OPERATE position.		

52. Equipment Performance Checklist (Contd)

	Item No.	Item	Action or condition	Normal indication	Corrective measure
EQUIPMENT PERFORMANCE	23	MOD TEST switch (oscillator)	Return to LINE position.		
	24	MEGACYCLE CHANGE control (receiver)	Set to 7 mc position.	Oscillator retunes (rf voltage across dummy load disappears then reappears.)	Defective 2d rf doubler V102; refer to par. 126.
	25	MEGACYCLE CHANGE control (receiver)	Set to 13 mc position.	Oscillator retunes(rf voltage across dummy load disappears and then reappears.)	Defective 3d rf doubler V104; refer to par. 126.
	26	MEGACYCLE CHANGE control (receiver).	Set to 25 mc position.	Oscillator retunes (rf voltage across load disappears then reappears.)	Defective 4th rf doubler V105; refer to par. 126.
	27	RF GAIN control (receiver)	Set to position 8.		
	28	ASSOC XMTR FREQ MULT switch (oscillator)	Set in turn, to positions X2, X4, X8, X16; then return to position X1.	Bandswitch operation but no retuning operation.	Rotate switch to clean contacts.
STOP	29	TB802	Remove jumper from CARRIER CONTROL pin 12 to GND pin 14.	Carrier to dummy load turns off.	
	30	POWER switch (oscillator)	Set to OFF position.	Both receiver and oscillator de-energized.	

CHAPTER 5

THEORY

Section I. THEORY OF RADIO RECEIVER R-390/URR

53. General

a. Radio Receiver R-390/URR provides reception over a frequency range of .5 to 32 mc for cw (continuous wave), mcw (modulated continuous wave) and am (amplitude modulation) radio transmission. The radio receiver is a multiple conversion superheterodyne using triple conversion for frequencies between .5 and 8 mc and double conversion for frequencies between 8 and 32 mc. The radio receiver operates from a self-contained power supply with a nominal input of 115 v ac or 230 v ac. Permeability tuning (insertion of powdered-iron cores into coils) and a system of gears and cams provide linear tuning of the radio receiver over the entire frequency range.

b. In its application as part of Oscillator Group AN/URA-13, the radio receiver operates as a frequency control for the radio frequency oscillator. Electrical Special Purpose Cable Assembly CX-1619/U mechanically couples to the main tuning gear train of the radio receiver. Tuning the radio receiver provides frequency control information by positioning switches within the housing of the cable assembly. This provides the radio frequency oscillator with sufficient information to tune automatically to a coarse position near the frequency to which the radio receiver is set. The radio receiver receives its rf input directly from the radio frequency oscillator and, ultimately, as the tuning operation in the radio frequency oscillator approaches the frequency to which the radio receiver is set, the radio receiver develops an if. output. This if. output from the radio receiver feeds back to the radio frequency oscillator. The radio frequency oscillator develops a servo control signal from this if. signal and the servo signal continuously corrects the tuning of the radio frequency output to maintain the received if. signal at 455 kc. Thus, the rf output from the radio frequency oscillator is controlled by the frequency set on the radio receiver.

54. Block Diagram
(fig. 30)

a. The block diagram shows the signal path through the radio receiver from the antenna to the output. In its application as part of Oscillator Group AN/URA-13, only the signal path from the unbalanced antenna input to the IF OUTPUT 50 OHMS jack J106 is of importance.

b. Rf signals feed to the radio receiver from either a balanced or unbalanced antenna. Antenna relay K101 grounds the antenna input for break-in operation and during calibration. This relay also operates to protect the antenna circuits of the radio receiver during standby operation. From the balanced antenna input, the rf signals pass through one of several antenna transformers to the first rf amplifier V201. From the unbalanced antenna input, the rf signals capacitively couple to the secondary of the antenna transformers and feed through to the first rf amplifier.

c. The calibration oscillator subchassis, containing V901 and V902, supplies a signal at every 100-kc point within the frequency range of the receiver. A 1 mc crystal-oscillator stage, one-half of V901, provides a signal for synchronizing multivibrator stage V902 at 100 kc. The buffer amplifier, one-half of V901, isolates the multivibrator from the loading effects of the rf circuit and increases the strength of the higher 100-kc harmonics. When the FUNCTION switch is in the CAL position, B+ voltage enables the calibration oscillator circuits.

d. The output of the first rf amplifier V201 feeds the second rf amplifier V202. The RF GAIN control provides manual gain control and the automatic gain control voltage effects automatic gain control of the first and second rf amplifiers. Together, these stages amplify the rf signals before they pass to the mixer circuits. Depending on the MEGACYCLE CHANGE control setting, either the first or second mixer receives the output from the second rf amplifier. For frequencies from .5 to 8 mc, the rf signal mixes with the output of the first crystal oscillator V401 in the first mixer V203. This produces an if. signal between 9 and 18 mc. This if. signal further mixes with the output of the second crystal oscillator V402 in the second mixer V204 to produce an if. signal from 3 to 2 mc. Note that the if. output from the second mixer decreases in frequency as the frequency of the input signal to the stage increases. For frequencies from 8 to 32 mc, the rf signal feeds directly from the second rf stage to the second mixer where it mixes with the output of the second crystal oscillator to produce the if. signal from 3 to 2 mc. The if. output from the second mixer mixes with the output of the vfo tube V701 in the third mixer V205. The frequency of the vfo stage varies from 3.455 to 2.455 mc to result in a fixed frequency of 455 kc if. output from the third mixer.

e. The 455-kc output of the third mixer feeds the first if. amplifier V501 either directly or through crystal filter Z501. When the BANDWIDTH switch is in the .1 KC or the 1 KC positions, the if. signal feeds through the crystal filter. When the BANDWIDTH switch is in the 2 KC, 4 KC, 8 KC or the 16 KC positions, the if. signal feeds to the first if. amplifier directly. For the four high pass bands, the BANDWIDTH switch varies the coupling between the primary and secondary circuits of if. transformers. The if. amplifier consists of six stages, V501 through V506. The output of the fifth if. amplifier V505 divides to supply a 455-kc signal to the sixth if. amplifier V506, the agc amplifier V509 and the cathode follower, one-half of V511. The detector circuit, one-half of V507, demodulates the output of the sixth if. amplifier. An external diode load may be connected from DIODE LOAD terminal 14 to ground with the jumper between terminal 14 and 15 removed. The agc amplifier V509 amplifies the output from the fifth if. amplifier. Then the agc rectifier, one-half of V510, rectifies the output from the agc amplifier. When the FUNCTION switch is in the AGC position the dc voltage developed by the agc rectifier automatically controls the gain of the first and second rf amplifiers. With strong signals at the antenna, the grid bias of the two rf amplifiers becomes more negative and the gain decreases. With weak signals the grid bias becomes less negative and the gain increases. This keeps the output level of the radio receiver relatively constant and independent of signal strength variation at the antenna. The AGC switch, the agc time constant circuit and one-half of tube V511 provide control over the response rate of the agc circuits to satisfy different reception requirements. For MGC operation, the

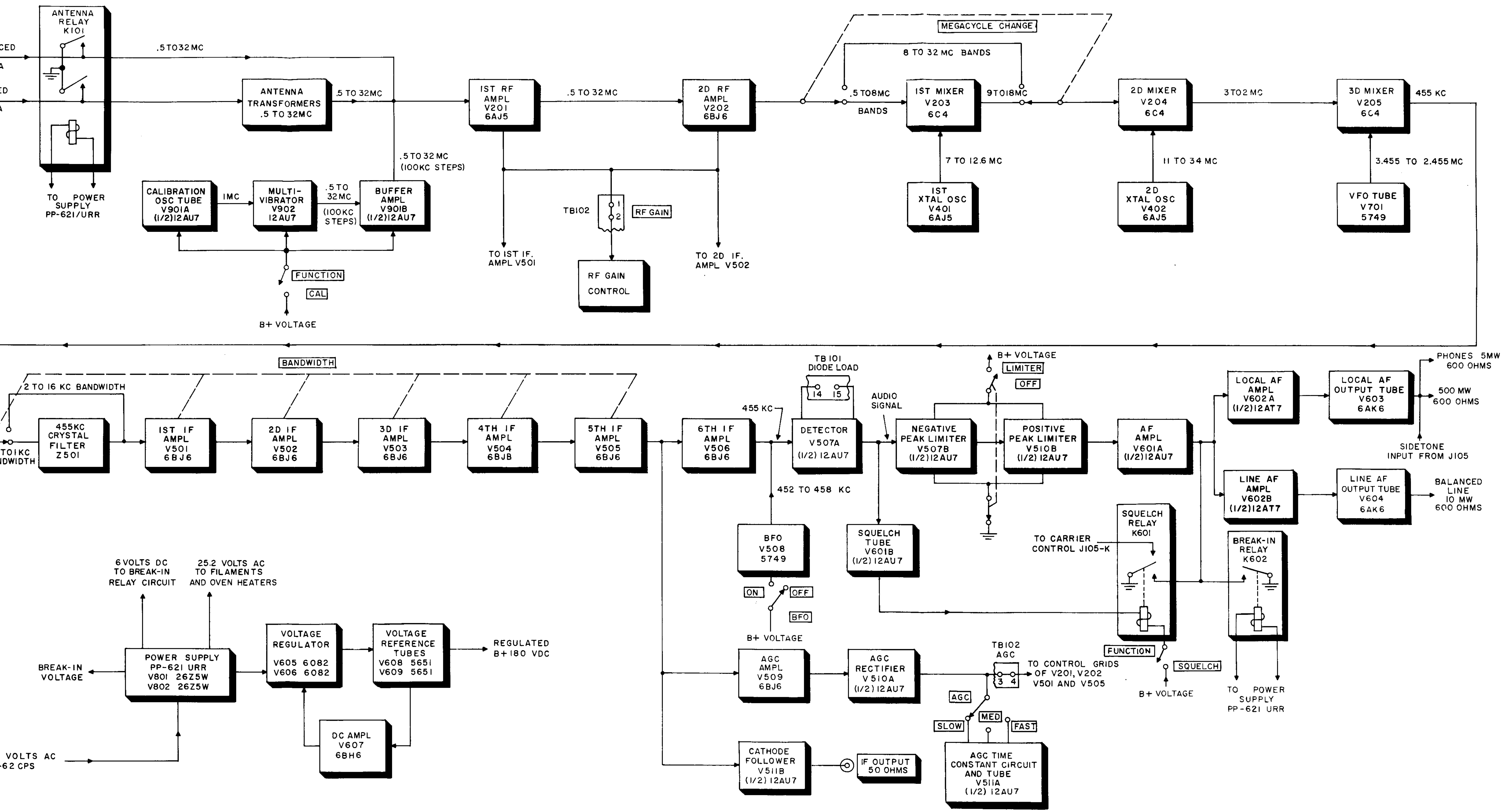
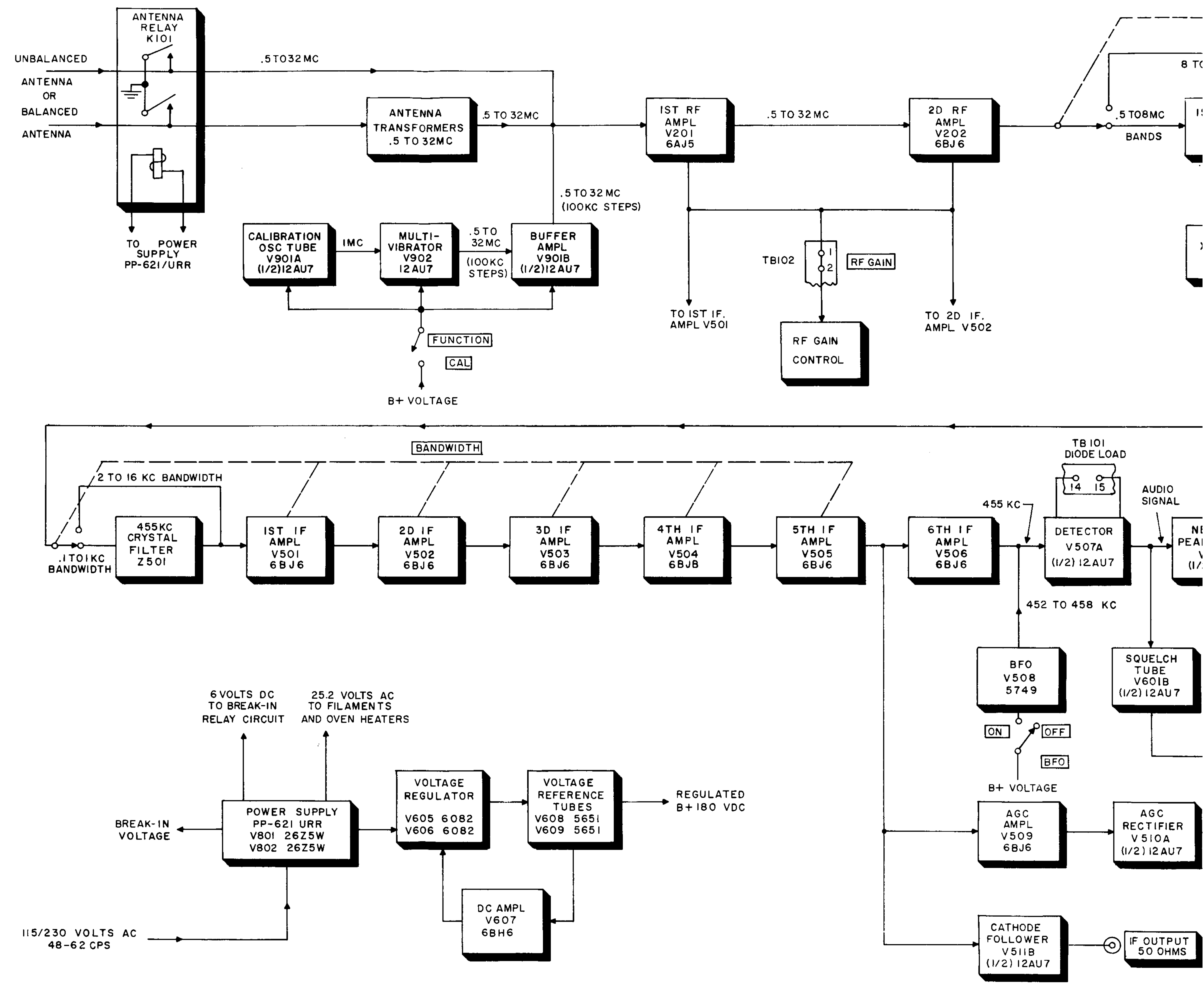


Figure 30. Radio Receiver R-390/URR, block diagram.


ANTENNA RELAY K101
UNBALANCED ANTENNA OR BALANCED ANTENNA
TO POWER SUPPLY PP-621/URR
.5 TO 32 MC
ANTENNA TRANSFORMERS .5 TO 32MC
.5 TO 32MC
IST RF AMPL V201 6AJ5
.5 TO 32 MC
2D RF AMPL V202 6BJ6
.5 TO 8MC
BANDS
8 TO
.5 TO 32 MC (100KC STEPS)
CALIBRATION OSC TUBE V901A (1/2)12AU7
IMC
MULTI-VIBRATOR V902 12AU7
.5 TO 32MC (100KC STEPS)
BUFFER AMPL V901B (1/2)12AU7
FUNCTION
CAL
B+ VOLTAGE
TO 1ST IF. AMPL V501
TB102
RF GAIN
RF GAIN CONTROL
TO 2D IF. AMPL V502
BANDWIDTH
2 TO 16 KC BANDWIDTH
.1 TO 1 KC BANDWIDTH
455KC CRYSTAL FILTER Z501
IST IF AMPL V501 6BJ6
2D IF AMPL V502 6BJ6
3D IF AMPL V503 6BJ6
4TH IF AMPL V504 6BJ8
5TH IF AMPL V505 6BJ6
6TH IF AMPL V506 6BJ6
455 KC
TB 101 DIODE LOAD
14 15
DETECTOR V507A (1/2) 12AU7
AUDIO SIGNAL
452 TO 458 KC
BFO V508 5749
ON
OFF
BFO
B+ VOLTAGE
SQUELCH TUBE V601B (1/2) 12AU7
AGC AMPL V509 6BJ6
AGC RECTIFIER V510A (1/2) 12AU7
CATHODE FOLLOWER V511B (1/2) 12AU7
IF OUTPUT 50 OHMS
6 VOLTS DC TO BREAK-IN RELAY CIRCUIT
25.2 VOLTS AC TO FILAMENTS AND OVEN HEATERS
BREAK-IN VOLTAGE
POWER SUPPLY PP-621 URR V801 26Z5W V802 26Z5W
115/230 VOLTS AC 48-62 CPS
VOLTAGE REGULATOR V605 6082 V606 6082
VOLTAGE REFERENCE TUBES V608 5651 V609 5651
REGULATED B+180 VDC
DC AMPL V607 6BH6

FUNCTION switch grounds the agc bus. The cathode follower, one-half of V511, provides a low-impedance (50 ohms) if. output for external use. In its application in Oscillator Group AN/URA-13, the if. output from the cathode follower feeds the discriminating and servo control circuits of the radio frequency oscillator. Bfo tube V508 provides a signal between 452 and 458 kc which mixes with the 455-kc if. output from the sixth if. amplifier. This produces an audio beat frequency in the output of the detector, one-half of V507. The af output from the detector feeds the af amplifier, one-half of V601, through a negative peak limiter, one-half of V510. These limiters prevent noise peaks from exceeding the average signal level. Operation without limiting may be selected with the LIMITER switch. The LIMITER switch disables the limiters for operation without limiting.

f. In addition to supplying a signal to the limiter, the dectector supplies a signal to the squelch tube, one-half of V601. The average dc output voltage of the squelch tube, which is an amplifier, varies in proportion to the average signal level. When the signal level drops below a noise level established by the RF GAIN control, and when the FUNCTION switch is in the SQUELCH position, the output of the squelch tube operates the squelch relay K601. This short-circuits the output of the af amplifier, one-half of V601, to remove the radio receiver output. The break-in relay K602 short-circuits the output of the af amplifier when the FUNCTION switch is in the STAND BY position. The break-in relay will also short-circuit the output of the af amplifier when the FUNCTION switch is in the MGC, AGC or SQUELCH positions, the BREAK-IN switch is in the ON position, and an external circuit provides a ground. The output of the af amplifier feeds the local af amplifier, one-half of V602, and the line af amplifier, the other half of V602. These af amplifier stages have separate gain controls. The output of the local af amplifier feeds the local af output tube V603 which has connections for a speaker or a headset and for sidetone signals from an associated transmitter to permit monitoring. The line af amplifier feeds the line af output tube V604 which has connections for a balanced line.

g. Power Supply PP-621/URR provides all operating voltages for the radio receiver. This includes dc for the antenna and break-in relays, ac to the filament and oven circuits, and B+ voltage to the votage-regulator circuit. All B+ voltages are regulated. The voltage-regulator circuit consists of series regulator V605 and V606, dc amplifier V607, and voltage-reference tubes V608 and

V609. The power supply consists of a transformer and rectifiers V801 and V802. Two primary windings of the transformer are connected in series for 230 v ac operation and in parallel for 115 v ac operation. Dc voltage for the break-in relay circuits is provided by dry-disk rectifier CR801.

Section II. THEORY OF RADIO FREQUENCY OSCILLATOR O-152/URA-13

55. General

Figure 31 is a block diagram of Radio Frequency Oscillator O-152/URA-13 and Electrical Special Purpose Cable Assembly CX-1619/U. This section covers only the signal paths through the radio frequency oscillator and the electrical special purpose cable without regard to circuit details. For circuit details refer to Section III and Section IV of this chapter. The radio frequency oscillator, in conjunction with Radio Receiver R-390/URR, operates as an rf exciter for an associated transmitter.

56. Modulation Signal

a. General. The modulation signal is the intelligence information signal which is transmitted by the associated transmitter. The modulation signal path is from the input lines terminal board TB802 for line input or from the LOCAL MIKE KEY jack for local input, then through service selection circuits to the proper modulation control circuits. From the modulation control circuits the modulation signal is to modulation canceling for mixing with the servo signal and to the reactance-tube oscillator for modulating the rf signal.

b. Modulation Signal Input.

(1) Line. The input lines terminal board TB802 provides access to the radio frequency oscillator for remote input modulation signals. Terminals are provided for a continuous wave keying signal (CW), a phone signal (PM), a radioteletype keying signal (FSK), and a facsimile modulation signal (FAX). Any two wire input may be connected to the terminals marked TWO WIRE. In this event the proper modulation circuit for the input signal is selected with the SERVICE SELECTOR switch. The SIMPLEX terminal

is the third terminal for a three wire simplex circuit, the other two terminals being either the PM terminals or the TWO WIRE terminals. The CARRIER CONTROL terminal affords external control of the cathode circuit of the rf output power amplifier V107. This terminal is jumpered to ground during PM operation unless such external carrier control is required. During FSK and FAX operation this terminal is jumpered to ground by an internal switching circuit. During CW operation this terminal must not be jumpered to ground.

(2) Local. The LOCAL MIKE KEY jack on the front panel provides access for local modulation signals. This jack is used for either a cw keying signal input or microphone input for phase modulation. The CARRIER CONTROL switch switches the input from LINE or LOCAL to the radio frequency oscillator.

c. Service Selection. The SERVICE SELECTOR switch on the front panel switches the modulation input signal to the proper modulation control circuit. The type of input modulation signal dictates the position of the SERVICE SELECTOR switch. When line input modulation signal is to either the CW, PM, FSK or FAX terminals of TB802, the SERVICE SELECTOR switch is set to the corresponding position. In addition the CARRIER CONTROL switch is set to the LINE position. When a remote input signal is to the TWO WIRE terminals, the SERVICE SELECTOR switch is set to correspond with the type of signal carried by the two wire input. For local input signals to the LOCAL MIKE KEY jack, the SERVICE SELECTOR switch is set to PM for microphone input or to CW for key input. In addition the CARRIER CONTROL switch is set to the LOCAL position. Polarity of remote input signals to the input lines terminal board may be reversed with the SERVICE SELECTOR switch, but polarity of local input signals are not reversible.

d. Modulation Control. The radio frequency oscillator provides modulation control for cw, phone, fsk and fax signals. The cw keying relay K202 provides cw control through the cathode circuit of the rf output amplifier V107. For cw operation the CARRIER CONTROL terminal (12) of the input lines terminal board TB802 must not be grounded. For cw operation the modulation input to reactance-tube oscillator V001 and V002 and to modulation canceling is grounded through the

SERVICE SELECTOR switch. The pm audio amplifier V501 and V502 produces a phase modulation voltage from a phone input signal. Phase modulation is used for phone transmission as a convenient way of obtaining a modulated rf signal from a variable frequency oscillator, such as the reactance-tube oscillator, which is detectable with an amplitude demodulator. For phase modulation operation the CARRIER CONTROL terminal (12) of the input lines terminal board TB802 must be grounded to complete the cathode circuit of the rf output amplifier V107, unless remote carrier control is desired. For radio teletype operation the fsk relay K801 provides frequency shift voltages from an internal fsk bias supply. Both polar and neutral frequency-shift keying are available. For facsimile operation the fax input signal is divided and applied to the reactance-tube oscillator and to modulation cancelling. For both local and remote input the proper modulation voltage is applied to modulation cancelling and to the reactance-tube oscillator V001 and V002 through the SERVICE SELECTOR switch, S704 section F, and through the MOD TEST switch when in the LINE position.

57. Radio Frequency Signal

a. General. The rf signal originates in the oscillator stage and is modulated by the action of the modulation voltage on the reactance tube. The rf signal path is from the oscillator, through the buffer, and through the necessary rf doubling circuits to the rf power amplifier and the rf spectrum amplifier. From the rf power amplifier the rf signal goes to the associated transmitter. From the rf spectrum amplifier the rf signal goes to Radio Receiver R-390/URR.

b. Reactance-tube Oscillator. The rf signal is generated by the oscillator V001 with a reactance tube V002 input. The modulation voltage is applied to the reactance tube. The reactance-tube circuit appears as a capacitive reactance in the tuned grid circuit of the oscillator stage. The modulation voltage varies the apparent capacitance of the reactance-tube, so the oscillating frequency varies as a result of the modulation voltage. Thus, the rf output from the reactance-tube oscillator is modulated. A negative input signal to the reactance tube causes an increase in frequency and a positive input signal to the reactance-tube causes a decrease in frequency. The fundamental frequency of the reactance-tube oscillator is variable between 1.5-3 mc. The reactance-tube oscillator is permeability tuned automatically by varying the degree of insertion of a powdered iron core in a tuning coil. The fundamental frequency is established so that the final frequency, after the required doubling, matches the frequency to which the associated radio receiver is tuned. Coarse and fine positioning of the powdered iron core is effected by the combined operation of the coarse positioning motor B102 and the servo motor B101. Fine tuning is effected by the servo motor. Once the carrier frequency is established to match the frequency to which the radio receiver is tuned, any tuning effected by the servo motor will be in the direction to maintain the established frequency.

c. Buffer, Rf Amplifier and Rf Doublers. The buffer V101 provides isolation between the oscillator stage and the rf amplifier so that loading changes do not reflect back to the oscillator. The rf amplifier V102 supplies a 1.5-3 mc rf output to the rf power amplifier V106 through band switch S101 sections C and G. No frequency doubling is required for this output. V102 may also operate as the 1st rf doubler to provide a 3-6 mc rf output through band switch S101 sections D and G to either the rf power amplifier or the second rf doubler. The second rf doubler V103 provides a 6-12 mc rf output through band switch S101 sections E and G to either the rf power amplifier or to the third rf doubler. The third rf doubler V104 provides a 12-24 mc rf output through band switch S101 section F and G to either the rf power amplifier or the fourth rf doubler. The fourth rf doubler V105 provides a 24-32 mc rf output through band switch S101 section G to the rf power amplifier. The position of band switch S101 establishes the final output rf by switching in the required rf doublers. The band seeking motor B103 drives the band switch to that position which selects the frequency band that includes the frequency to which the associated radio receiver is tuned. Automatic tuning by the coarse position motor B102 and the servo motor B101 tune the frequency doubling circuits of the rf doublers to produce a final rf output which matches the frequency to which the associated radio receiver is tuned. This tuning procedure is the same as for the reactance-tube oscillator.

d. Rf Output Amplifier and Impedance Matching. As the final stage, the rf power amplifier V107 provides the power for the rf output to the associated transmitter. The normally closed bandpass relay contact K401 in the cathode circuit disables the rf output amplifier in the event the radio frequency oscillator loses the frequency to which the radio receiver is tuned. In the event the frequency is lost, the bandpass relay energizes, thus removing the rf output to the transmitter. The rf is again available when the radio frequency oscillator retunes to the proper frequency and the bandpass relay de-energizes. The output from the rf power amplifier is through impedance matching networks to the associated transmitter. Three watts of rf power is supplied to a 50-ohm input load of a transmitter. Pi-L networks provide impedance matching between the final rf power amplifier and the 50-ohm transmitter load. Band switch S101 sections H and J switch in the required impedance matching network for the output radio frequency. The band switch is automatically operated by the band-seeking motor to select the proper network for the selected frequency. Permeability-tuned inductances in the networks are automatically tuned to produce the proper matching impedance. The coarse positioning motor and the servo motor provide this tuning.

e. Rf Spectrum Amplifier. The rf spectrum amplifier V106 receives the rf output from the rf amplifier and rf doublers. This is the same rf signal as received by the rf output amplifier V107. The rf spectrum amplifier enriches the harmonic components of the rf signal for input to the radio receiver UNBALANCED WHIP, ANTENNA jack. From this signal the radio receiver develops the if. signal which feeds back to the radio frequency oscillator. The distortion to enrich the harmonics in the rf signal is necessary because the receiver is tuned to a harmonic of the rf output in the event that frequency multiplication is carried out in the transmitter. For instance, if the transmitted frequency is 20 mc and the associated transmitter circuits are such that the rf exciting frequency is quadrupled, the radio receiver is tuned to 20 mc but the rf output from the radio frequency oscillator is only 5 mc. In this event, the radio receiver must develop an if. signal from the fourth harmonic of the rf signal. The rf input to the radio receiver must be rich in harmonics because circuits are available in the radio frequency oscillator to compensate for transmitter frequency multiplying factors of 2, 4, 8 and 16. The if. signal developed by the radio receiver from the rf signal received from the radio frequency oscillator feeds back to the radio frequency oscillator.

58. Servo Signal and Servo Control

a. General. The servo signal develops from the if. input signal to the radio frequency oscillator from the radio receiver. The path of the servo signal is through the if. amplifier, the limiters, the discriminator, modulation cancelling, servo damping, the chopper, and the servo amplifier to the servo motor. The servo signal controls the operation of the servo motor to maintain the radio frequency oscillator on frequency after operation on frequency has been established. This is a fine tuning operation.

b. If. Amplifier. The output from the IF OUTPUT jack of the radio receiver is to the 455 KC INPUT jack of the radio frequency oscillator. The if. amplifier V301 amplifies this if. signal and feeds it to the limiter stages. The relay control stages also receive the amplified if. signal. This signal path is discussed in paragraph 61b. There is an if. input to the radio frequency oscillator only when the rf output from the radio frequency oscillator to the radio receiver is within eight kilocycles of the frequency to which the radio receiver is tuned. The radio frequency oscillator is under servo control only when the rf output is within 3 kc of the radio receiver frequency.

c. First and Second Limiters. The first and second limiters, V302 and V303 respectively, provide two stages of limiting before the if. signal is discriminated. These two stages of limiting provide a constant 70 v ac output signal over approximately a 50 dbm range. Two-stage limiting removes undesirable amplitude modulation from the if. signal. This is necessary since the discriminator is sensitive to amplitude modulation. By removing any amplitude variation in the if. signal, the discriminator output is entirely dependent upon the frequency variation of the if. signal.

d. Discriminator. The discriminator V379, receives a constant amplitude if. input from the second limiter. The discriminator compares the frequency of the if. signal with a 455-kc standard. The output voltage from the discriminator is approximately 1 mv per cycle of deviation. The 455-kc standard of the discriminator is obtained from two tuned circuits. If the input frequency is greater than 455 kc, the discriminator output is positive. If the input frequency is less than 455 kc, the discriminator output voltage is negative. If the input frequency is exactly 455 kc, the discriminator output voltage is zero. The frequency modulation present in the input signal to the discriminator results in an output voltage which is proportional to the modulation signal. Therefore, except for cw operation, an output proportional to the modulation voltage is to be expected from the discriminator. In addition to the output due to modulation, the discriminator output will contain a dc component proportional to the deviation from the mean frequency. It is this component which is used for servo control. The modulation cancel circuit receives the discriminator output. The chopper also receives the discriminator output directly to develop a calibration signal.

e. Modulation Cancel. The modulation cancel circuit removes the component due to modulation from the discriminator output. A voltage division circuit does this. The modulation voltage is applied, through the SERVICE SELECTOR switch, to one end of a voltage divider and the discriminator output is applied to the other end. The modulation voltage is derived from and is in phase with the modulation voltage applied to the reactance tube V002. The modulation voltage varies inversely with the modulation it effects. Therefore, the modulation voltage is positive to produce a frequency deviation below the mean carrier frequency and negative to produce a frequency deviation above the mean carrier frequency. The discriminator voltage is in opposition to the modulation voltage. That is, a positive discriminator voltage indicates an increase in frequency and a negative voltage indicates a decrease in frequency. Therefore, the proper voltage division between these two inputs effectively cancels that component in the discriminator output due to the modulation. The output from modulation canceling will then indicate the deviation of the mean frequency irrespective of modulation. A positive voltage output from modulation canceling indicates a mean carrier frequency output from the radio frequency oscillator above that to which the radio receiver is tuned. A negative voltage output indicates a mean carrier frequency below that to which the radio receiver is tuned. It is this voltage, termed the correction voltage, which the servo control to the zero level by retuning the radio frequency oscillator. The dc output from modulation canceling is damped and then applied to the chopper G301 for conversion to an ac voltage.

f. Servo Damping. Servo damping prevents hunting by the servo control mechanism by damping the input with a feedback voltage from the rate generator. This damping feedback is proportional to the servo motor speed and of opposing polarity to the correction voltage from modulation canceling. Thus, the magnitude of the correction voltage is diminished as the servo motor accelerates. The dc damping voltage decreases to zero as the correction voltage decreases to zero.

g. Chopper. The chopper G301 is an electrical vibrator which operates from a 20 v ac supply to make and break a circuit synchronously with the alternation in the ac supply. It is used as a dc to ac converter. In its use here, the chopper grounds the damped output from the modulation canceling during the negative half cycle of the 20 v ac supply. The output from the chopper is a square wave, synchronous with the 20 v ac supply. It is important to note the phase relationships between the output from the chopper with the 20 v ac supply because the phase relationship establishes the direction of rotation of the servo motor. If the dc input to the chopper is positive, the output will be in phase with the 20 v ac supply becuase the output is grounded during the negative half of the 20 v ac cycle. If the dc input to the chopper is negative, the output will be 180° out of phase with the 20 v ac supply. Therefore, the correction voltage (60 cps) from the chopper has the following relationship between the 20 v ac supply and the rf output from the radio frequency oscillator. A correction voltage (60 cps) 180° out of phase with the 20 v ac supply indicates a mean rf output from the radio frequency oscillator below that to which the radio receiver is tuned. A correction voltage (60 cps) in phase with the 20 v ac supply indicates a mean rf output from the radio frequency oscillator above that to which the radio receiver is tuned. The servo amplifier receives the correction voltage (60 cps) from the chopper. The chopper also produces a 60 cps ac signal from the discriminator output signal (without modulation canceling) for use as a calibration signal. Therefore, for calibration purposes, a measure of the carrier deviation is avaiable. This deviation voltage is applied to the calibration amplifier V306.

h. Servo Amplifier. The servo amplifier receives the correction voltage (60 cps) from the chopper and amplifies the signal before applying it to the servo motor. The servo amplifier consits of two voltage amplification stages V401A and V401B, a phase-splitter stage V402, and a push-pull power amplifier stage V403 and V404. While the radio frequency oscillator is under the control of the servo signal the cathode of the first servo amplifier is grounded through a contact of the bandpass relay K401. However, with loss of the if. input signal and consequential loss of the servo signal, the bandpass relay energizes. This changes the ground circuit of the first servo amplifier and produces a cathode input signal.

to the servo amplifier. This cathode input signal to the servo amplifier is used during the positioning operation (par. 61b). In addition to amplifying the servo signal, phase-shifting circuits advance the phase of the signal 90°. A capacitor-resistor phase-shifting circuit in the second servo amplifier circuit and in the phase-splitter circuit each advance the phase of the signal 45°. The effect of the phase-shifting circuits is to vary the phase relationship between the 20 v ac reference and the servo signal. An effective phase shift of -90° for the servo signal results from the servo amplifier. This takes into account an odd number of 180° phase shifts produced by the four stages and the output transformer. Therefore, the phase relationship of the servo signal to the 20 v ac supply is as follows. If the ac signal developed by the chopper is in phase with the 20 v ac supply, the servo amplifier output signal lags by 90° the 20 v ac reference. This indicates that the mean rf output from the radio frequency oscillator is above that to which the radio receiver is tuned. If the ac signal developed by the chopper is 180° out of phase with the 20 v ac supply, the servo amplifier output signal leads by 90° the 20 v ac reference. This indicates that the mean rf output from the radio frequency oscillator is below that to which the radio receiver is tuned. The output voltage from the servo amplifier applies to the control winding of the servo motor.

i. Servo Motor. The servo motor B101 is a two-phase induction motor which couples, through electro-mechanical clutches, to the tuning linkage of the radio frequency oscillator. The tuning linkage positions the powdered iron cores of the tuned circuits in the reactance-tube oscillator and the rf amplifier. The phase relationship between the reference winding voltage and the control winding voltage determines the direction of rotation of the servo motor. When the control winding voltage is 90° leading the reference winding voltage, the servo motor rotates in the forward direction, this being the direction of rotation which drives the tuning linkage to tune up-band. When the control winding voltage is 90° lagging the reference winding voltage, the servo motor rotates in the reverse direction, this being the direction of rotation which drives the tuning linkage to tune down-band. The 20 v ac supply provides the reference winding voltage of the servo motor and the output from the servo amplifier provides the control winding voltage. Due to the manner in which the servo signal develops, when the mean carrier rf output from the radio frequency oscillator is above that to which the radio receiver is tuned, the output from the servo amplifier lags by 90° the 20 v ac supply voltage. Therefore, the servo motor drives the tuning linkage down-band to correct the error. Conversely, when the mean carrier rf output from the radio frequency oscillator is below that to which the radio receiver is tuned, the output from the servo amplifier leads by 90° the 20 v ac supply voltage. In this case, the servo motor drives the tuning linkage up-band to correct the error. Since the servo motor operates to maintain the rf output on the radio receiver frequency, if the radio receiver is manually tuned at a slow rate while the system is under automatic frequency control, the servo tuning of the radio frequency oscillator will track the manual tuning of the radio receiver. It must be remembered that automatic frequency control depends upon the presence of an if. output from the radio receiver. Therefore, if this if. signal is lost, due to rapid manual tuning of the radio receiver or for any other reason, the servo signal will also disappear and automatic frequency control will be lost. In this event a positioning operation will occur to bring the system under automatic frequency control again (par. 61). The servo motor also plays a part in the positioning operation. However, the control winding voltage develops from the fine positioning voltage, which originates in the band-pass relay puller V305B, rather than from the if. input signal from the radio receiver (par. 61b).

j. Rate Generator. The rate generator G101 is mechanically coupled to the servo motor and produces a dc voltage proportional to the speed of the servo motor. This dc output combines with the correction voltage in the servo damping circuit to damp the servo operation. This stabilizes the servo operation by preventing over shooting by the servo motor and consequential hunting. The polarity of the output of the rate generator is positive if the servo motor is rotating forward (up-band tuning) and negative if the servo motor is rotating in reverse (down-band tuning).

59. Electrical Special Purpose Cable Assembly CX-1619/U

The Electrical Special Purpose Cable Assembly CX-1619/U supplies frequency control information from the radio receiver to the radio frequency oscillator. The radio receiver end of this cable terminates in a band switch adapter which houses the mc position switch and the band position switch. The band switch adapter mechanically couples to the radio receiver so that the MEGACYCLE CHANGE control linkage of the radio receiver positions the switches housed by the band switch adapter. These switches, through the cable assembly wires, are integral parts of the coarse positioning motor control circuit and the band seeking motor control circuit of the radio frequency oscillator. The frequency control information carried by the cable assembly consists of a completed ground circuit in each of these motor control circuits. Since the motor control circuits of the radio frequency oscillator are "open circuit seeking" circuits, the band seeking motor and the coarse positioning motor are controlled by the MEGACYCLE CHANGE control of the radio receiver.

60. Band-Seeking Motor Control Circuit.

The band-seeking motor control circuit controls the operation of the band-seeking motor B103. The band-seeking motor drives the band switch S101 which switches the rf doublers and the impedance matching circuits in the rf amplifier circuit. The band switch selects five different frequency ranges of rf output. These frequency ranges are from 1.5-3 mc, 3-6 mc, 6-12 mc, 12-24 mc and 24-32 mc. When the megacycle position of the MEGACYCLE CHANGE control of the radio receiver is changed from one of these frequency ranges into another, the band-seeking motor control circuit closes due to the position change of the band position switch of Electrical Special Purpose Cable Assembly CX-1619/U. This operates the band-seeking motor which drives the band switch. The band-seeking motor continues to operate until the band-seeking switch is driven to the open circuit position. When the band-seeking motor stops, the band switch is in the new position dictated by the position of the MEGACYCLE CHANGE control of the radio receiver. At this time the proper rf doublers and impedance matching circuits are switched into the rf amplifier circuit to make possible an rf output in the frequency range which includes the frequency to which the radio receiver is tuned. The ASSOC XMTR FREQ MULT switch, included in the band-seeking motor control circuit, alters the effect of the position of the band position switch. This compensates for frequency multiplication in the associated transmitter. For instance, if a transmitter frequency of 20 mc is desired, the radio receiver is tuned to 20 mc. Now, if no frequency multiplying takes place in the transmitter, the band switch will be driven to the 12-24 mc position. However, if the input frequency to the transmitter is to be doubled by the transmitter circuits, as indicated by the position of the ASSOC XMTR FREQ MULT switch, the band switch will be driven to the 6-12 mc position. The end result is always the same. That is, that the frequency to which the radio receiver is tuned is the final output frequency of the transmitter.

61. Positioning Operation.

a. General. The coarse-positioning motor control circuit controls the positioning operation necessary to tune the radio frequency oscillator to the proper frequency. This circuit controls not only the coarse positioning motor B102 but also the operation of the electro mechanical clutches L125 and L126. This allows the tuning linkage to be driven at three different speeds. The tuning linkage is first coarsely positioned at a very rapid speed by the coarse positioning motor. Then through a clutch operation, the tuning linkage is finely positioned through a fast drive by the servo motor. During this fine positioning operation the servo motor is under the control of the fine positioning voltage which is developed in the bandpass relay puller V305B. Finally, through another clutch operation, the tuning linkage is driven by the servo motor through a normal drive. In this final condition, the radio frequency oscillator is under automatic frequency control and is held on frequency as a result of the servo signal. A positioning operation occurs whenever the if. input to the radio frequency oscillator disappears. The disappearance of the if. signal may be a consequence of changing the position of the MEGACYCLE CHANGE control of the radio receiver. Such a change also changes the position of the mc position switch of Electrical Special Purpose Cable Assembly CX-1619/U. Loss of the if. signal may also result from changing the position of the KILOCYCLE CHANGE control of the radio receiver at such a fast rate that the servo operation of the radio frequency oscillator cannot track the change. Loss of the if. signal may also result from unknown reasons when no change in tuning of the radio receiver has been made. Regardless of the reason for the loss of the if. signal, its loss initiates a positioning operation. The positioning operation begins when the relay control circuit detects the loss of the if. signal.

b. Relay Control. Relay control operates the bandpass relay in the absence of an if. input signal to the radio frequency oscillator. The circuit operates in the following manner. When an if. signal input is present from the radio receiver, this if. signal, amplified by the if. amplifier V301, feeds the relay control if. amplifier V304. After a second stage of amplification by V304 the if. signal feeds the sensing detector V305A. In the presence of an if. signal the output from the sensing detector is of negative potential which holds the control grid of the bandpass relay puller below cut-off. When this condition exists, the bandpass relay K401 remains de-energized and the system remains on frequency as a result of the correction voltage developed from the if. signal. However, when the system is not on frequency, there is no if. input signal. The sensing detector senses the absence of the if. signal and produces a positive output signal. This allows the bandpass relay puller to conduct current which energizes the bandpass relay. Also when the control grid of the bandpass relay puller goes positive, the 20 v ac signal applied to the cathode of the tube traverses the tube. This signal is termed the fine positioning voltage. This signal is blocked as long as the bandpass relay puller is not conducting. When the bandpass relay energizes, it alters the cathode-to-ground circuit of the first servo amplifier V401A to admit the fine positioning voltage for amplification by the servo amplifier. This signal, amplified by the servo amplifier, drives the servo motor during the fine positioning operation of the over-all positioning operation. When the bandpass relay energizes, indicating the absence of an if. input signal, the K401 contact closes in the coarse-positioning motor circuit. This initiates the coarse-positioning operation. Also, the K401 contact opens in the rf power amplifier V107 cathode circuit. This removes the rf output signal to the associated transmitter. Note, however, that the spectrum amplifier continues to operate to feed the rf signal to the radio receiver.

c. Coarse-Positioning Motor Control Circuit. When the bandpass relay K401 energizes, due to the loss of the if. signal from the radio receiver, the coarse positioning motor control circuit closes and the coarse positioning motor B102 operates. The coarse positioning motor drives the tuning linkage through the centrifugal clutch at a rapid rate in the forward, up-band, direction. The normally closed band seeking motor relay contact in the coarse positioning motor control circuit prevents the operation until the band switching operation is complete. Also, when the if. signal is lost, circuits in the coarse positioning motor control circuit operate the electro-mechanical clutches which completely disengage the servo motor from the tuning linkage. The coarse positioning motor continues to drive the tuning linkage up-band until the upper limit is reached. At this time the reverse and recycle relays energize. The reverse relay reverses the direction of rotation of the motor so that the motor drives the tuning linkage down-band. When the recycle relay K204 energizes, the oscillator position seeking switch S103 by-pass circuit opens. This leaves the coarse positioning motor under the sole control of the oscillator position seeking switch S103 and the mc position switch S901 section B. This control circuit determines the coarse position of the tuning linkage. The coarse positioning motor continues to tune down-band until the oscillator positioning switch opens the circuit established through the mc position switch. Since the position of the mc position switch is established through the mechanical coupling to the MEGACYCLE CHANGE control linkage of the radio receiver, the MEGACYCLE CHANGE control establishes the coarse position of the tuning linkage. The coarse positioning motor coarsely tunes the radio frequency oscillator to a frequency slightly below the megacycle indicated by the MEGACYCLE CHANGE control of the radio receiver. At this time a circuit in the coarse positioning motor control circuit operates the electro-mechanical clutches for the second time. This clutch operation couples the servo motor to the tuning linkage through a fast drive for the fine positioning operation. If the proper megacycle position is not located during the down-band tuning operation, the tuning linkage reaches its lower limit. At this time, the coarse positioning motor reverts to its forward direction and the cycle repeats.

d. Fine Positioning. The fine positioning operation continues from where the coarse positioning leaves off due to the clutch operation which couples the servo motor to the tuning linkage through a fast drive. During this operation the servo motor is driven in the forward, up-band, direction due to the fine positioning voltage developed in the bandpass relay puller V305B (subpar. b. above). The servo amplifier amplifies this signal in the same manner as it amplifies the correction voltage used for servo control (par. 59) except that the fine positioning voltage is a cathode input signal to the first servo amplifier. The fine positioning voltage output from the servo amplifier, which applies to the control winding of the servo motor, is 90° leading the 20 v ac supply voltage which applies to the reference winding of the servo motor. The effective 90° phase shift is accounted for by the inherent 180° phase shift of the second servo amplifier, the phase splitter, the servo output amplifier and the servo output transformer, plus the 90° phase advance due to the combined effect of the phase shifting circuits in the second servo amplifier and the phase splitter. There is no inherent 180° phase shift of this signal in either the bandpass relay puller or the first servo amplifier due to the cathode input of the signal. Since the fine positioning voltage of the control winding leads by 90° the 20 v ac supply voltage of the reference winding, the servo motor runs in the forward direction. This drives the tuning linkage up-band through a fast drive effected by the electro-mechanical clutches. This fast drive from the servo motor is much slower than the drive from the coarse positioning motor but much faster than the normal drive from the servo motor. The fine positioning operation continues up-band until the radio-frequency oscillator tunes near enough to the radio receiver frequency to produce an if. signal output from the radio receiver. At this point the radio frequency oscillator is sufficiently in tune with the radio receiver, within three kilocycles, for the received if. signal to develop into the correction voltage. Also, the if. signal detected by the relay control sensing detector, disables the bandpass relay puller. This de-energizes the bandpass relay and blocks the fine positioning voltage. When the bandpass relay de-energizes, the rf amplifier is again enabled to produce an rf signal to the associated transmitter, and the first servo amplifier is again enabled to receive the correction voltage for amplification. At the same time, the coarse positioning motor control circuit returns to its normal condition as the recycle relay contact opens and the bandpass relay contact closes. This results in a third electro-mechanical clutch operation which couples the servo motor to the tuning linkage through the normal drive. The radio frequency oscillator is again under the automatic frequency control of the servo signal as developed from the if. input signal. In the event that no if. input signal develops from the fine positioning operation, the servo motor continues to drive the tuning linkage, through the fast drive, until the upper limit is reached. Since the coarse positioning motor control circuit does not completely relinquish control until an if. signal is present, the positioning operation repeats when the upper limit is reached.

62. Calibration Circuit.

The calibration circuit consists of the calibration amplifier, clipper, rectifier and CAL IND meter. The circuit gives a relative indication of the discriminator output on the CAL IND meter. Depending upon the setting of the FUNCTION switch this is an indication of the radio receiver tuning error, the radio frequency oscillator tuning error, or the frequency deviation effected by the fsk circuits. When the FUNCTION switch is in the OPERATE position, the CAL IND meter reads the grid current drawn by the first limiter as an indication of the if. signal input level. The calibration amplifier amplifies the error voltage (60 cps) from the chopper. The clipper then clips the positive and negative peaks from this amplified signal. After clipping the meter rectifier rectifies the signal. When the FUNCTION switch is in either the DEV SET, CAL EXC or CAL REC position the CAL IND meter reads the output from the meter rectifier.

63. Power Supply.

The power supply supplies all of the necessary operating voltages for the radio frequency oscillator from a nominal 115/230 volt 48-62 cps line input to the LINE PWR jack. The power supply requires 285 watts of power for the operation of the radio frequency oscillator. The radio receiver receives line voltage from the REC PWR jack of the radio frequency oscillator. The radio frequency oscillator LINE VOLTAGE selector position must correspond with the line voltage. The 115 VAC switch S801 of Radio Receiver R-390/URR must also be in the position corresponding to the input voltage to the radio frequency oscillator since the radio receiver receives its line input from the same line. Power is turned on in both the radio frequency oscillator and the radio receiver by the POWER switch of the radio frequency oscillator in the ON position. The line voltage applies to the primaries of two power transformers through the LINE VOLTAGE selector in the radio frequency oscillator. The rectifiers V601 and V602 supply +250 v dc as B+ for the pm audio amplifier, servo amplifier, rf amplifier and doublers and rf

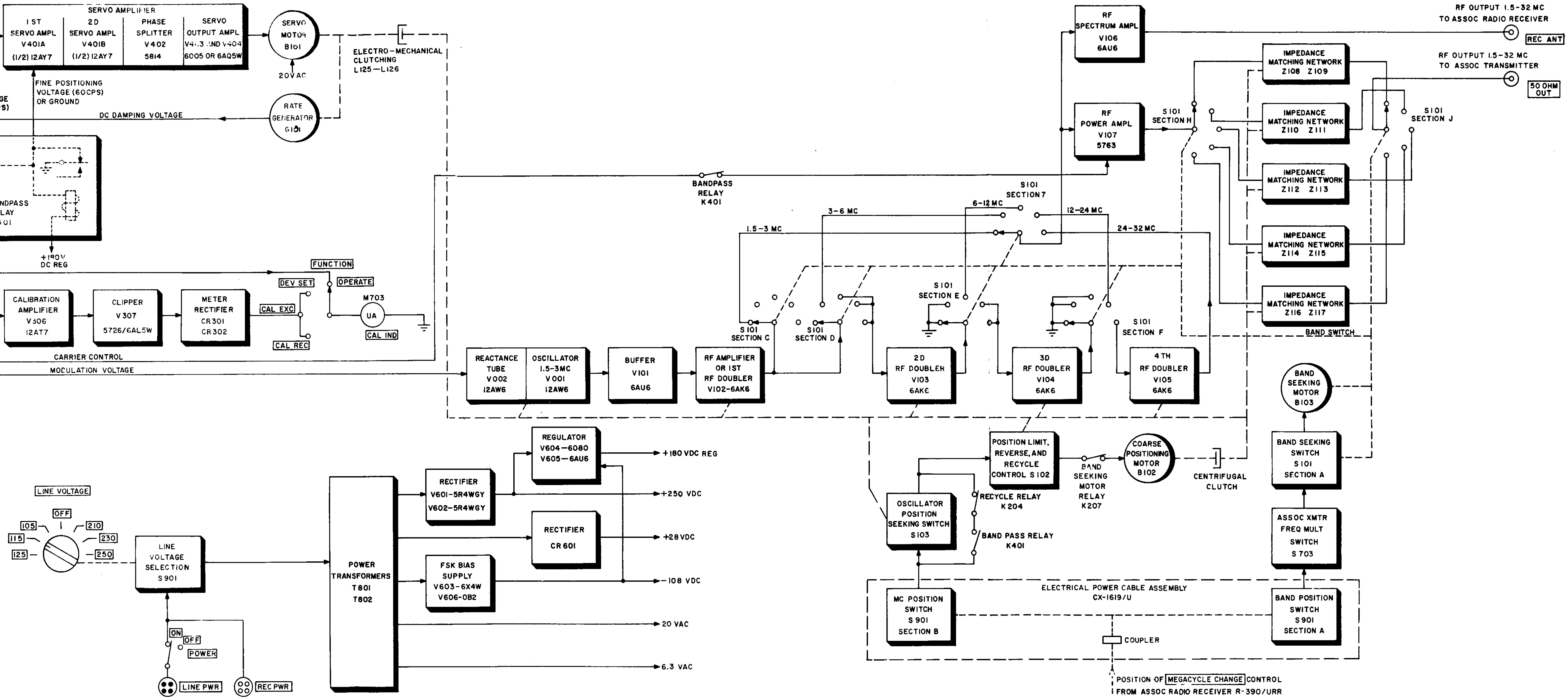
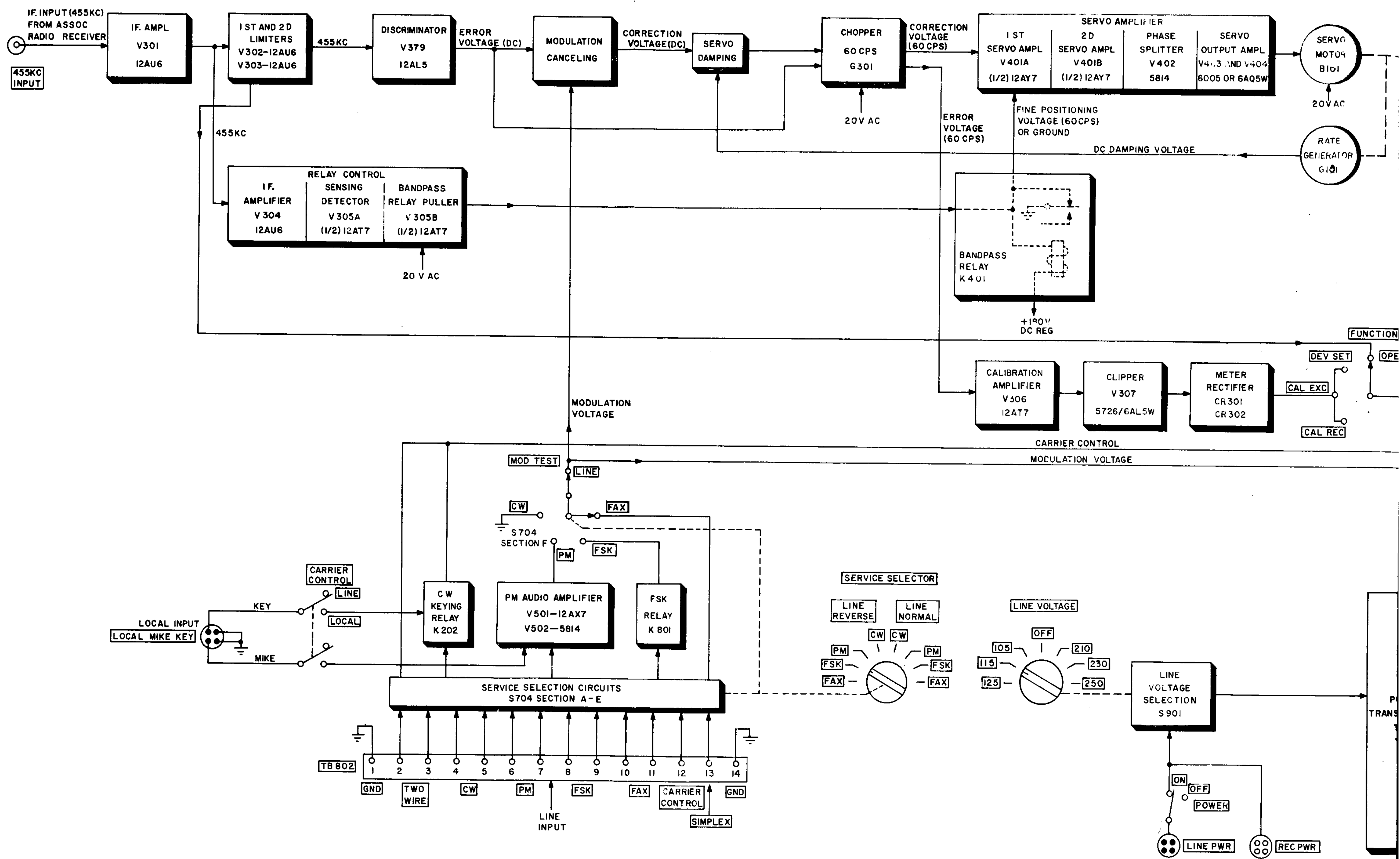
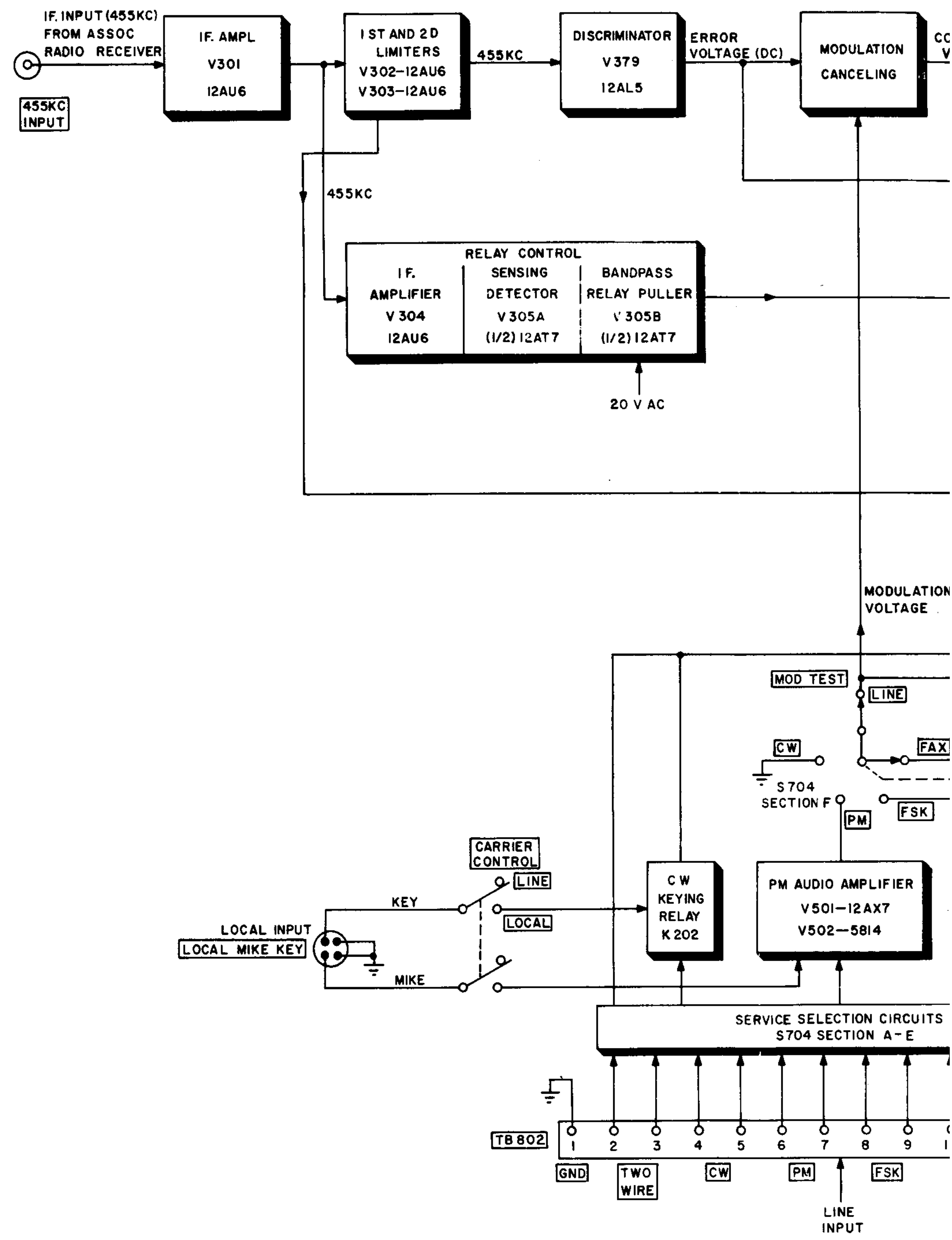


Figure 31. Radio Frequency Oscillator O-152/URA-13 and Electrical Special Purpose Cable Assembly CX-1619/U, block diagram.



IF. INPUT (455KC) FROM ASSOC RADIO RECEIVER
455KC INPUT
IF. AMPL V301 12AU6
1 ST AND 2D LIMITERS V302–12AU6 V303–12AU6
455KC
DISCRIMINATOR V379 12AL5
ERROR VOLTAGE (DC)
MODULATION CANCELING
CORRECTION VOLTAGE(DC)
SERVO DAMPING
CHOPPER 60 CPS G301
20 V AC
CORRECTION VOLTAGE (60 CPS)
SERVO AMPLIFIER
1 ST SERVO AMPL V401A (1/2) 12AY7
2D SERVO AMPL V401B (1/2) 12AY7
PHASE SPLITTER V402 5814
SERVO OUTPUT AMPL
6005 OR 6AQ5W
SERVO MOTOR B101
20 V AC
RATE GENERATOR
FINE POSITIONING VOLTAGE (60CPS) OR GROUND
DC DAMPING VOLTAGE
ERROR VOLTAGE (60 CPS)
RELAY CONTROL
I F. AMPLIFIER V 304 12AU6
SENSING DETECTOR V305A (1/2) 12AT7
BANDPASS RELAY PULLER V 305B (1/2) 12AT7
20 V AC
BANDPASS RELAY K 401
+190V DC REG
FUNCTION
DEV SET
CAL EXC
CAL REC
CALIBRATION AMPLIFIER V 306 12AT7
CLIPPER V 307 5726/6AL5W
METER RECTIFIER CR301 CR302
CARRIER CONTROL
MODULATION VOLTAGE
MODULATION VOLTAGE
MOD TEST
LINE
FAX
CW
S704 SECTION F
PM
FSK
CARRIER CONTROL
LINE
LOCAL
KEY
MIKE
LOCAL INPUT
LOCAL MIKE KEY
CW KEYING RELAY K 202
PM AUDIO AMPLIFIER V501–12AX7 V502–5814
FSK RELAY K 801
SERVICE SELECTION CIRCUITS S704 SECTION A–E
TB 802
1 2 3 4 5 6 7 8 9 10 11 12 13 14
GND
TWO WIRE
CW
PM
FSK
FAX
CARRIER CONTROL
GND
LINE INPUT
SIMPLEX
SERVICE SELECTOR
LINE REVERSE
LINE NORMAL
CW CW
PM
FSK
FAX
PM
FSK
FAX
LINE VOLTAGE
OFF
105
115
125
210
230
250
LINE VOLTAGE SELECTION S901
ON
OFF
POWER
LINE PWR
REC PWR


IF. INPUT (455KC) FROM ASSOC RADIO RECEIVER
455KC INPUT
IF. AMPL V301 12AU6
1ST AND 2D LIMITERS V302-12AU6 V303-12AU6
455KC
DISCRIMINATOR V379 12AL5
ERROR VOLTAGE (DC)
MODULATION CANCELING
455KC
RELAY CONTROL
I F. AMPLIFIER V 304 12AU6
SENSING DETECTOR V 305A (1/2) 12AT7
BANDPASS RELAY PULLER V 305B (1/2) 12AT7
20 V AC
MODULATION VOLTAGE
MOD TEST
LINE
FAX
CW
S 704 SECTION F
PM
FSK
CARRIER CONTROL
LINE
LOCAL
KEY
MIKE
LOCAL INPUT
LOCAL MIKE KEY
C W KEYING RELAY K 202
PM AUDIO AMPLIFIER V501-12AX7 V502-5814
SERVICE SELECTION CIRCUITS S704 SECTION A-E
TB 802
1 2 3 4 5 6 7 8 9
GND
TWO WIRE
CW
PM
FSK
LINE INPUT

output amplifier. The +250 v supply also supplies the voltage regulator V604 and V605. This regulator supplies +180 v dc regulated B+ for the calibration amplifier and clipper, the if. amplifier and limiters, relay control if. amplifier and sensing detector, the reactance tube oscillator, the buffer and the bandpass relay puller. The +180 v dc regulated voltage, through voltage dropping resistors, also supplies a series filament circuit. The full wave selenium rectifier CR701 provides +28 v dc operating voltage for the band seeking motor, course positioning motor, relays and electro-mechanical clutches. The fsk bias rectifier V603, provides -108 v dc as a bias voltage for the fsk modulation circuit as well as supplying the negative reference voltage for +180 v series regulator. The 20 v ac operates the chopper and supplies the reference winding voltage of the servo motor. The 20 v ac is also used as an input signal for operation of the servo motor during fine positioning. The 6.3 v ac supply is the filament supply for the parallel filament circuits.

Section III. CIRCUIT ANALYSIS OF RADIO FREQUENCY OSCILLATOR O-152/URA-13

64. Cw Input Circuit (fig. 32)

Cw input to the radio frequency oscillator operates the cw keying relay K202 which, in turn, produces the cw output by making and breaking the cathode to ground circuit of the rf power amplifier. Both remote and local cw input are available.

a. Remote cw input is the the CW terminals of the input lines terminal board TB802 terminals 4 and 5 on the rear panel. The circuit continues to the SERVICE SELECTOR switch S704 section B through line filters. The SERVICE SELECTOR switch, selects the remote cw input when in either the CW-LINE NORMAL or the CW-LINE REVERSE position. Polarity of the remote cw input is reversible with this switch. Remote cw input to the TWO WIRE input of the input lines terminal board TB802 terminals 2 and 3 can also be selected with the SERVICE SELECTOR switch. This circuit continues to the SERVICE SELECTOR switch S704 section A through line filters. To select cw from a two wire input, the SERVICE SELECTOR must also be in either the CW-LINE NORMAL or the CW-LINE REVERSE position.

b. Local cw input is to the LOCAL MIKE KEY jack J701 on the front panel. Terminals E and H of J701 are the ground side of the local cw input and terminal F is the cw signal side of the local cw input. Polarity of a local cw input signal is not reversible.

c. Local or remote cw input is selected by the CARRIER CONTROL switch S705 front. In the LOCAL position the cw input circuit is complete from the LOCAL MIKE KEY jack J701 through the CARRIER CONTROL switch to the cw keying relay K202. Note that terminal F of J701 may also provide a ground to the cw keying relay during phone operation. This will turn the carrier on to provide "push-to-talk" carrier control during PM operation (par. 65). In the LINE position the cw input circuit is complete from the CW input of TB802, through the SERVICE SELECTOR switch when in the CW position and through the CARRIER CONTROL switch to the cw keying relay K202.

d. The cw keying relay K202, located on the relay subchassis, makes and breaks the cathode ground circuit of the rf power amplifier V107. One operating coil, terminals 1-8, of the cw keying relay K202 is normally energized from the

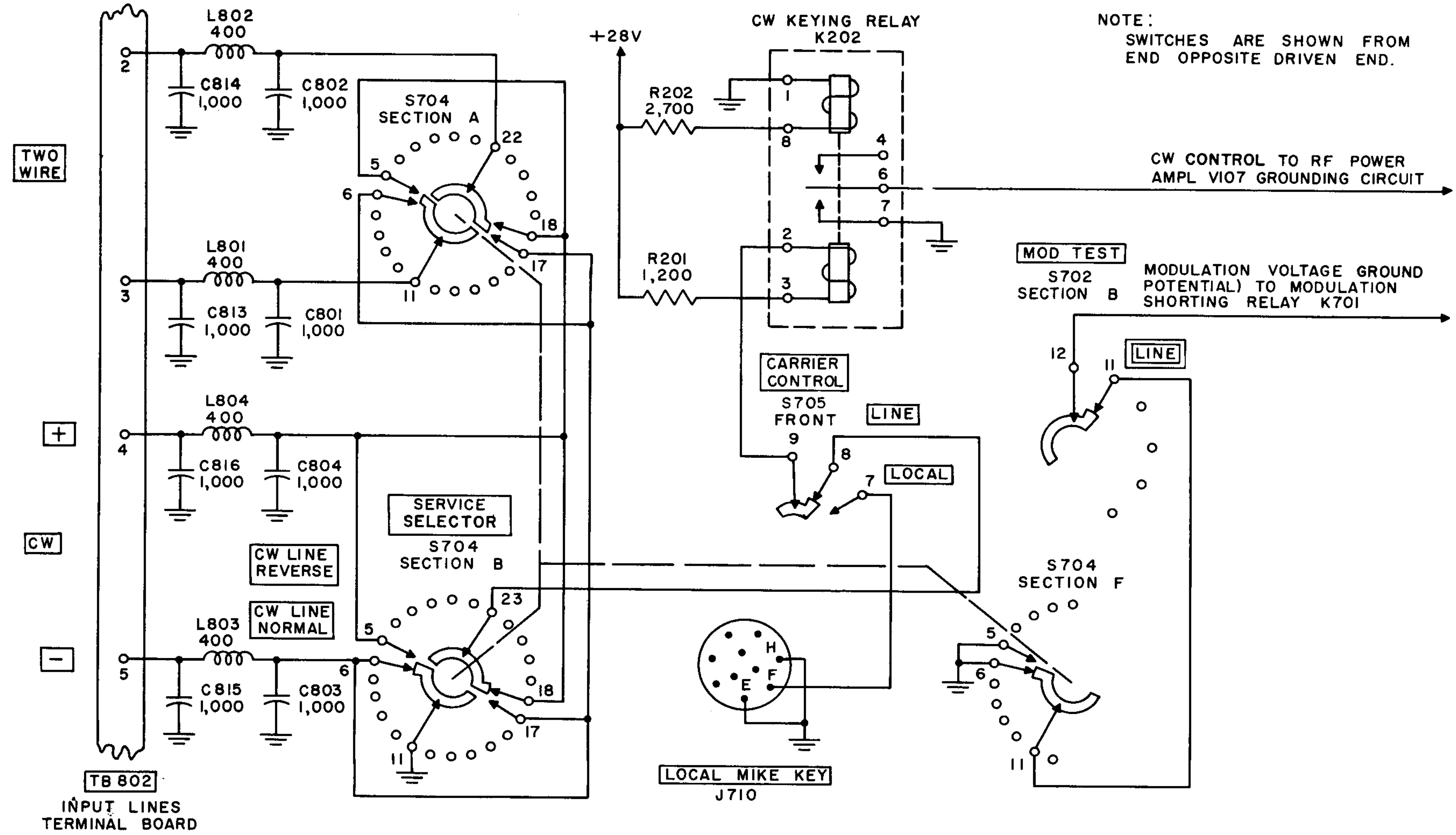


Figure 32. Cw input circuit, simplified schematic diagram.

+28 v supply through the 2700-ohm series resistor R202. This holds the contact 6-7 open which breaks the rf power amplifier cathode to ground circuit. When the cw input provides ground for the circuit of the opposing operating coil, K202 terminals 2-3, the opposing coil energizes from the +28 v supply through the 1200-ohm series resistor R201. Since the series resistor in the opposing coil circuit is smaller than the resistor in the circuit of the normally energized coil, the current drawn is larger, and the magnetic force exerted on the keying relay armature is greater. Thus the effect of the opposing operating coil, terminals 2-3, overrides the effect of the normally energized operating coil, terminals 1-8 and contact 6-7 closes. This provides ground for the rf power amplifier allowing the amplifier to operate as along as contact 6-7 is closed.

e. The modulation voltage during cw operation is ground (zero) potential. The SERVICE SELECTOR switch S704 section F provides this ground when in the CW-LINE NORMAL or the CW-LINE REVERSE position. The ground circuit is complete through the MOD TEST switch S702 section B in the LINE position to the modulation shorting relay K701.

65. Phone Input Circuit for Phase Modulation (fig. 33)

The pm audio amplifier of the radic frequency oscillator converts a phone input signal to a phase modulating to a signal which is an inverse function of the frequency of the input signal. Both remote and local phone input are available for phase modulation.

a. Remote phone input for phase modulation is to the PM terminals of the input lines terminal board TB802 terminals 6 and 7 on the rear panel. The circuit continues to the SERVICE SELECTOR switch S704 section C through line filters. Remote phone input for phase modulation is selected by the SERVICE SELECTOR switch when in either the PM-LINE NORMAL or the PM-LINE REVERSE position. Remote phone input for phase modulation to the TWO WAVE input of the input lines terminal board TB802 terminals 2 and 3 can also be selected with the SERVICE SELECTOR switch. This circuit continues to the SERVICE SELECTOR switch S704 section A through line filters. To select phase modulation from a two wire input, the SERVICE SELECTOR switch must also be in either the PM-LINE NORMAL or the PM-LINE REVERSE position.

b. Local phone input for phase modulation is from a carbon microphone to the LOCAL MIKE KEY jack J701 on the front panel. Terminals E and H of J701 are the ground side of the local phone input and terminal C is the signal side of the local phone input. Terminal F of J701 provides "push-to-talk" carrier control by energizing the cw keying relay K202 to turn the carrier on (par. 64, fig. 32). Carbon microphone voltage is from the +28 v supply through the CARRIER CONTROL switch S705 front to J701-C. This supply is filtered by choke L501 in series, capacitor C511 to ground, resistor R518 in series, and capacitor C510 to ground. The CARRIER CONTROL switch S705 front in the LOCAL position applies the filtered supply to J701-C. Microphone current is limited by resistor R727 and the filter.

c. Local or remote phone input for phase modulation is selected by the CARRIER CONTROL switch S705. In the LOCAL position the phone input circuit is complete from the LOCAL MIKE KEY jack J701 through the CARRIER CONTROL switch S705 rear to terminal 1 of the audio transformer T501 primary. Terminal 4 of the audio transformer primary is grounded through S705 rear. Capcaitor C704 is a coupling capacitor for the audio signal. In the LINE position the phone input circuit is

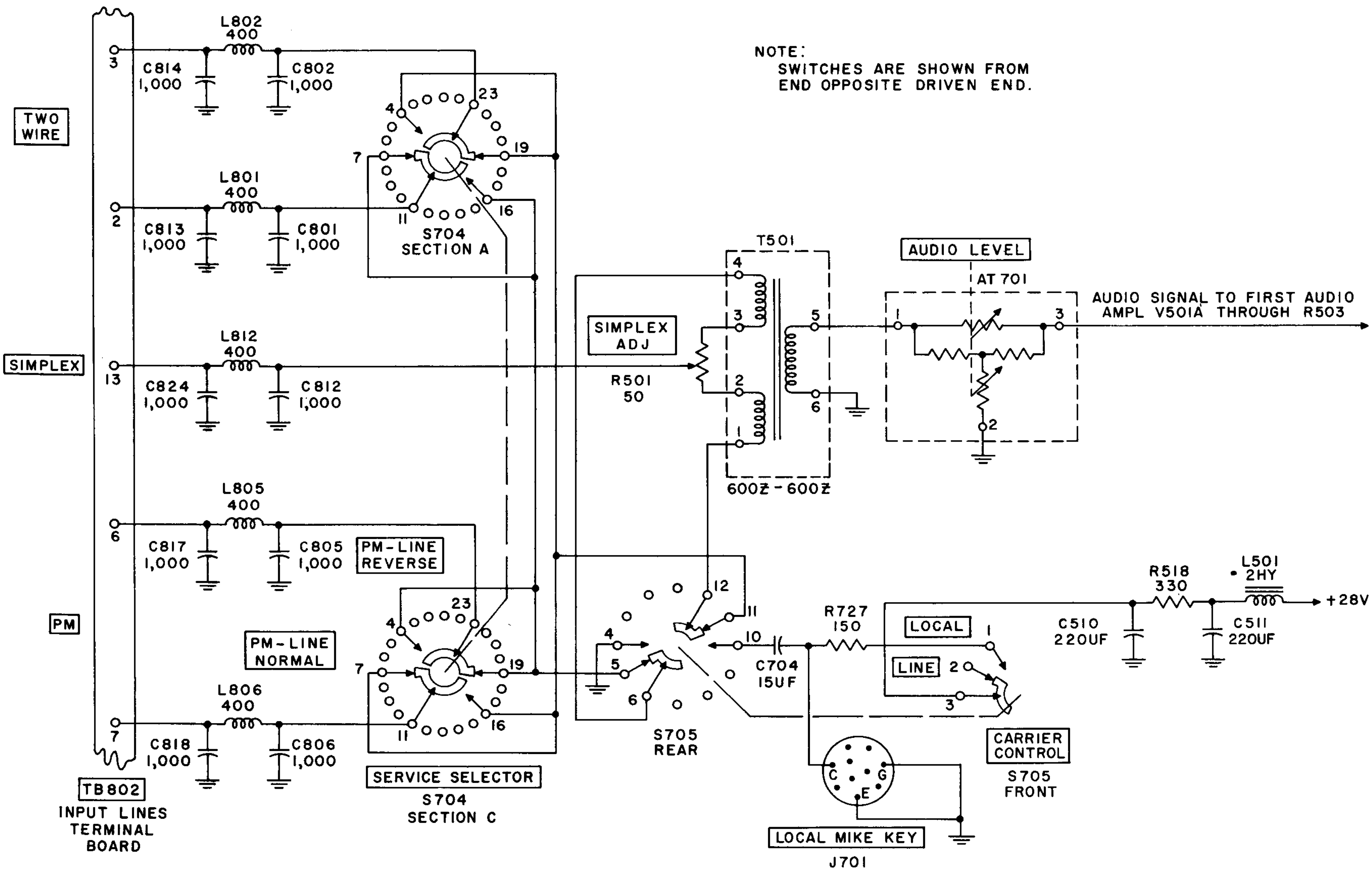


Figure 33. Phone input circuit for phase modulation, simplified schematic diagram.

complete from the PM input of TB802, through the SERVICE SELECTOR switch when in the PM position, and through the CARRIER CONTROL switch S705 rear to both primary terminals of the audio transformer primary.

d. The audio transformer output T501 is through the t-attenuator AT701 to the first audio amplifier V501A. The attenuator provides voltage level control of the input to the first audio amplifier. The AUDIO LEVEL control on the front panel operates the attenuator. While providing voltage level control, the attenuator maintains the circuit impedance, in both directions, at 600 ohms. Thus the impedance of the phone input circuit always matches the input impedance of the pm audio amplifier.

66. First Audio Amplifier V510A
(fig. 34)

The first audio amplifier increases the amplitude of the phone input signal. This amplifier is a common audio amplifier using half of a miniature twin-triode type 12AX7 which is located on the audio amplifier subchassis. The input to the first audio amplifier is from the audio transformer T501 through the attenuator AT701 to the PM DEV ADJ potentiometer R503. The PM DEV ADJ potentiometer is set to produce .92 radians deviation with a .025 v, 1000 cps input signal to the PM input of TB802. This is an alignment procedure (par. 146). The control grid (pin 2) of the first audio amplifier receives the phone signal from potentiometer R503. The resistor R502 provides the grid leak circuit to ground. The cathode resistor R504 provides tube bias and capacitor C501 bypasses the cathode (pin 3) to ground. The +250 v supply through the decoupling circuit of R516 and R517 in series and C508 and C509 to ground, and through the plate load resistor R505, provides voltage to the plate (pin 1). The control grid of the second audio amplifier V501B receives the output from the first audio amplifier through coupling capacitor C502.

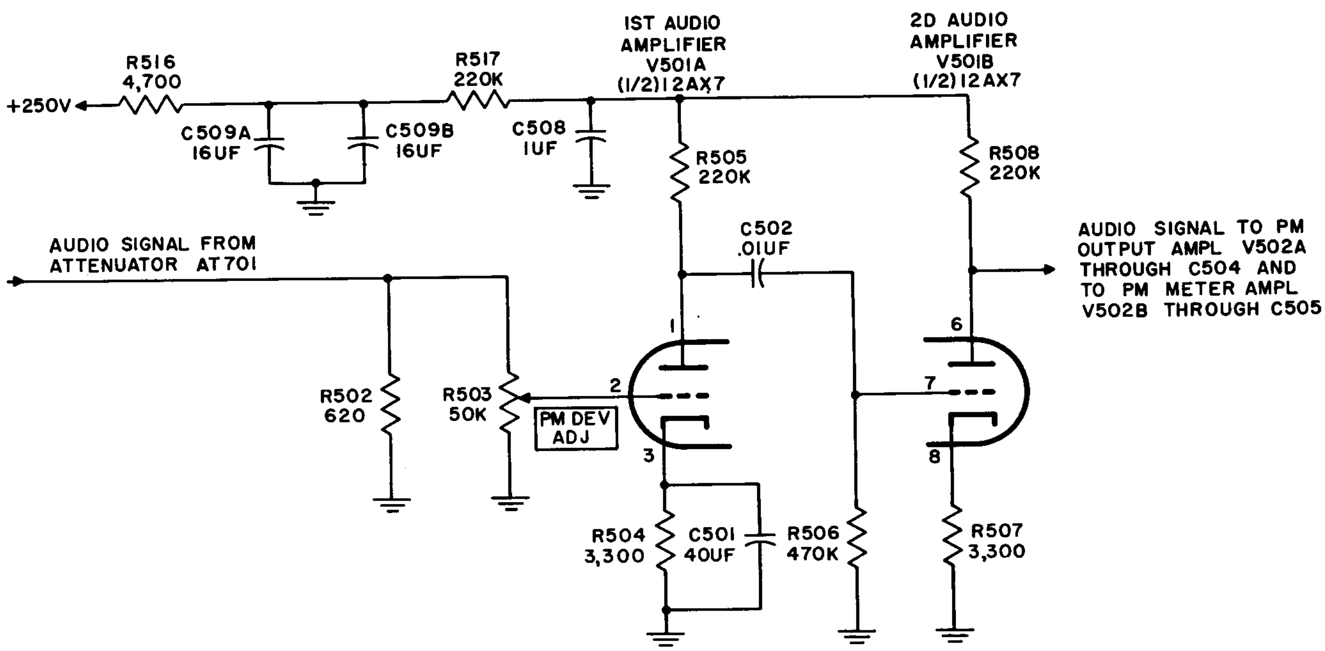


Figure 34. First and second audio amplifier, simplified schematic diagram.

67. Second Audio Amplifier V501B
(fig. 34)

The second audio amplifier provides an additional stage of amplification for the phone input signal. The second audio amplifier, like the first audio amplifier, is a common audio amplifier using half of a miniature twin-triode type 12AX7 which is located on the audio amplifier subchassis. The control grid (pin 7) of the second audio amplifier receives the output signal from the first audio amplifier through coupling capacitor C502. Resistor R506 provides the grid leak circuit to ground. Cathode resistor R507 provides tube bias. The plate voltage decoupling circuit for the second audio amplifier is in common with the decoupling circuit for the first audio amplifier. The +250 v supply provides plate voltage through the common decoupling circuit and the plate load resistor R508 to the plate (pin 6). The pm output amplifier V502A receives the audio output from the second audio amplifier through coupling capacitor C504. The pm meter amplifier V502B also receives this signal through coupling capacitor C505.

68. Pm Output Amplifier V502A and Pre-distortion Circuit
(fig. 35)

For phone transmission, the rf output from the radio frequency oscillator is a phase modulated wave. This provides a transmitted signal which can be demodulated by an amplitude demodulating circuit. Thus the phase modulated output from the radio frequency oscillator can be received by any am receiver. The pre-emphasis circuit converts the phone signal received from the second audio amplifier into a phase modulation voltage. This conversion of the phone signal is necessary because the reactance-tube oscillator, used as a modulating device, is inherently a frequency modulation circuit. The pm output amplifier then amplifies the phase modulation voltage. The pm output amplifier is half of a twin triode type 5814 and is located on the audio amplifier subchassis.

a. In a phase-modulated wave the frequency deviation is proportional to the modulating frequency. This is in contrast with a frequency-modulated wave where the frequency deviation is independent of the modulating frequency. Therefore, a phase-modulated wave can be obtained from a frequency modulator, such as the reactance-tube oscillator, by converting modulating voltage into a voltage which is proportional to the modulating frequency. The pre-emphasis circuit, series capacitor C504 and resistor R509, on the input side of the pm output amplifier tube provides this conversion. The pre-emphasis circuit is sensitive to audio frequency changes because the reactance in the audio frequency range of the coupling capacitor C504 is greater than the resistance of the grid leak resistor R509. As the frequency of the phone signal from the second audio amplifier V501B increases the capacitive reactance decreases while the resistance remains constant. Since the input voltage to the pre-emphasis circuit divides between the capacitive reactance and the resistance, as the capacitive reactance decreases the voltage across the resistor increases. Therefore, the input to the grid (pin 2) of the pm output amplifier increases as the frequency of the phone signal from the second audio amplifier increases.

b. Cathode resistor R510 provides tube bias for the pm output amplifier. Plate voltage is from the +250 v supply through load resistor R511 and decoupling resistor R516. The phase modulation voltage output from the plate (pin 1) is to

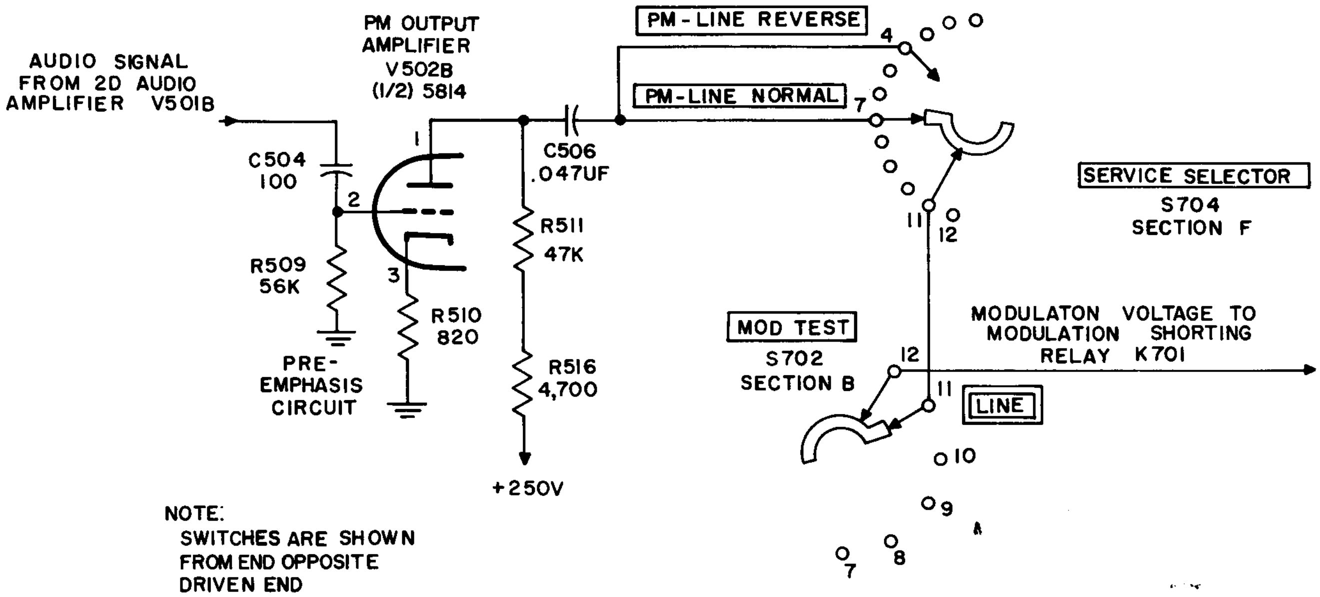


Figure 35. Pm output amplifier and pre-emphasis circuit, simplified schematic diagram.

the SERVICE SELECTOR switch S704 section F. The output circuit continues through this switch when it is in either the PM-LINE NORMAL or the PM-LINE REVERSE position to the MOD TEST switch S702 section B. The phase modulation voltage output circuit continues through the MOD TEST switch when in the LINE position to the modulation shorting relay K701. The phase modulation voltage is proportional to the frequency of the input phone signal to the radio frequency oscillator.

69. Pm Meter Amplifier V502B and AUDIO LEVEL Meter M702 (fig. 36)

The pm meter amplifier increases the amplitude of the phone signal received from the second audio amplifier so that the metered output indicates the phase deviation of the carrier that is produced by the phase modulation voltage output of the pm output amplifier. The pm meter amplifier is half of a twin triode type 5814 and is located on the audio amplifier subchassis.

a. The grid (pin 7) of the pm meter amplifier receives the voice signal from the second pm audio amplifier through coupling capacitor C505. This is the same signal received by the pm output amplifier, but no frequency emphasis results from this coupling circuit. VU METER ADJ potentiometer R512 provides the grid leak circuit to ground and provides a means of calibrating the AUDIO LEVEL meter M702. The VU METER ADJ control is initially adjusted so that an .025 v, 1000 cps input signal to the PM input terminals of TB802 produces a reading of .92 radians on the AUDIO LEVEL. This is an alignment procedure (par. 146). Cathode resistor R513 provides tube bias and the +250 v supply provides plate voltage through plate load resister R515.

b. The AUDIO LEVEL meter impedance matching circuit receives the output from the plate (pin 6) of the pm meter amplifier through coupling capacitor C507. The meter impedance matching circuit consists of R514, R519, R520 and the AUDIO LEVEL meter M702. The meter is calibrated to read the radians of phase displacement of the rf output from the phase that exists with no modulation. In terms of frequency deviation from the mean carrier frequency, the frequency deviation equals the radians of phase displacement times the frequency of the input signal to the PM terminals of TB802.

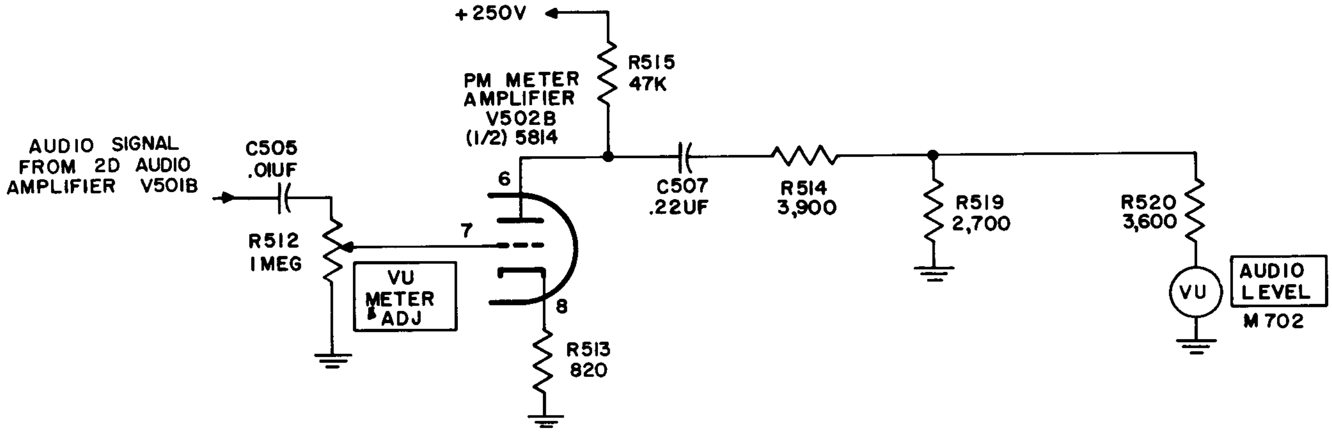


Figure 36. Pm meter amplifier and AUDIO LEVEL meter, simplified schematic diagram.

70. Fsk Input Circuit
(fig. 37)

Fsk input to the radio frequency oscillator operates the fsk relay which, in turn, produces the fsk signal to shift the rf output.

a. Fsk input is to the FSK terminals of the input lines terminal board TB802 terminals 8 and 9 on the rear panel. The circuit continues to the SERVICE SELECTOR switch S704 section D through line filters. Fsk input is selected by the SERVICE SELECTOR switch when in either the FSK-LINE NORMAL or the FSK-LINE REVERSE position. Polarity of the fsk input is reversible with this switch. Fsk input to the TWO WIRE input of the input lines terminal board TB802 terminals 2 and 3 can also be selected with the SERVICE SELECTOR switch. This circuit continues to the SERVICE SELECTOR switch S704 section A through line filters. To select fsk from a two wire input, the SERVICE SELECTOR must also be in either the FSK-LINE NORMAL or the FSK-LINE REVERSE position.

b. From one side of the SERVICE SELECTOR switch the fsk input circuit continues through the series LINE CURRENT potentiometer R701 and the LINE CURRENT meter M701 to one operating coil terminal 3 of the fsk relay K801. The fsk line current is adjusted with the front panel LINE CURRENT control and the LINE CURRENT meter.

c. The POLAR NEUTRAL switch S701 provides different operating conditions for different teletype loop characteristics. In the 30MA POLAR position the switch connects the operating coils of the fsk relay in series across the input. For this operating condition the two coils in series require 30 ma for operation. When the input to terminal 3 is positive and terminal 8 is negative, contact 4-6 is open and a "mark" signal results. Reversal of the polarity of the fsk input signal closes contact 4-6 and a "space" signal results. In the 60 NEUTRAL position S701 energizes one operating coil, terminals 1-8, with reverse polarity by connecting it to the +28 v supply through fsk bias resistor R709. The other operating coil connects across the input. This holds contact 4-6 open (mark position) in the absence of an input signal. Then when the input terminal 3 is negative and terminal 2 is positive, the operating coil, terminals 2-3, must draw 60 ma to close contact 4-6 to produce a "space" signal. In the 20 MA NEUTRAL position S701 energizes the one operating coil, terminals 1-8, by connecting it to the +28 v supply through the series fsk bias resistors R709 and R710, and connects the other operating coil, terminals 2-3, across the input. For this operating condition the operating coil, terminals 2-3, must draw 20 ma to close contact 4-6 to produce a "space" signal.

d. The fsk signal output is to the fsk and fax modulation voltage control circuit. This control circuit produces the fsk modulation voltage from the intelligence received from the fsk relay (par. 72).

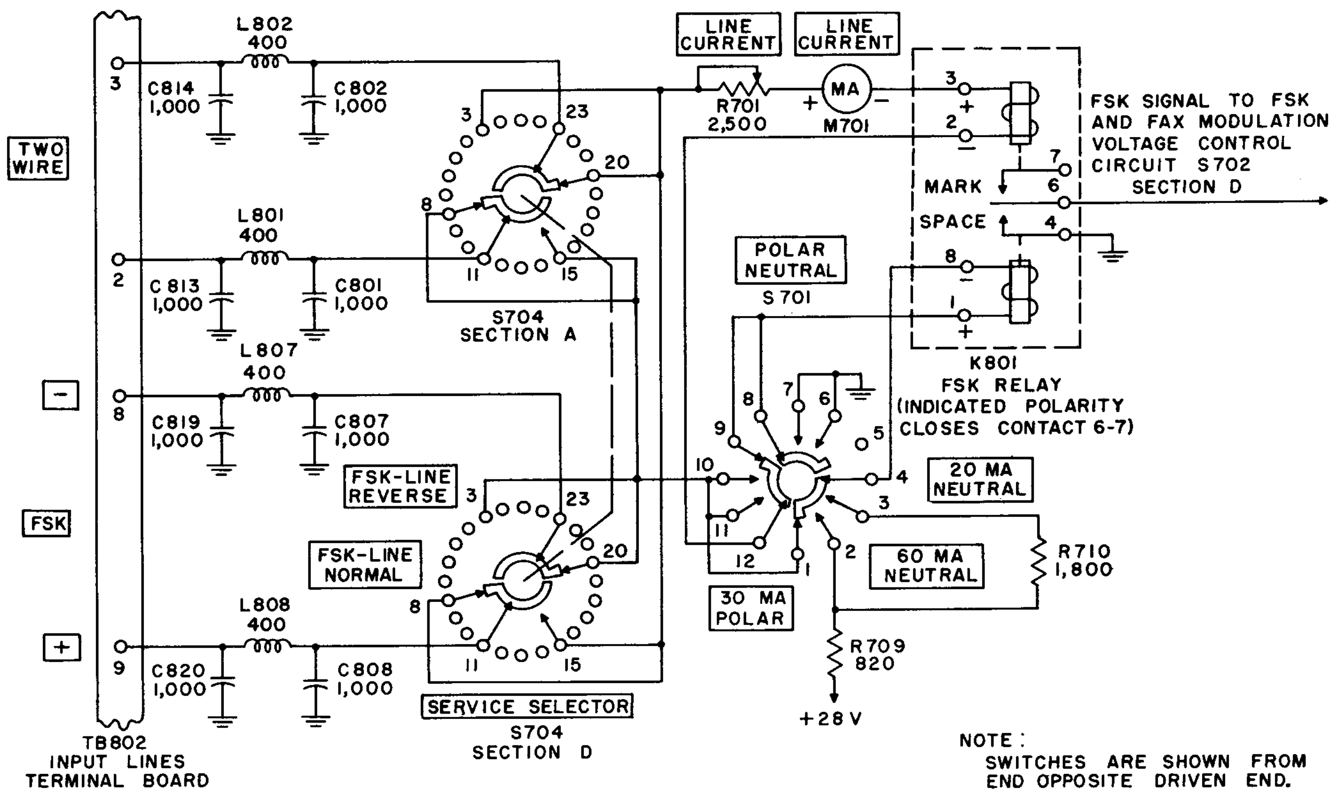


Figure 37. Fsk input circuit, simplified schematic diagram.

71. Fax Input Circuit (fig. 38)

Facsimile input is to the FAX terminals of the input lines terminal board TB802 terminals 10 and 11. The circuit continues to the SERVICE SELECTOR switch S704 section E through line filters. FAX input is selected by the SERVICE SELECTOR switch when in either the FAX-LINE NORMAL or the FAX-LINE REVERSE position. Polarity of the fax input is reversible with this switch. Fax input to the TWO WIRE

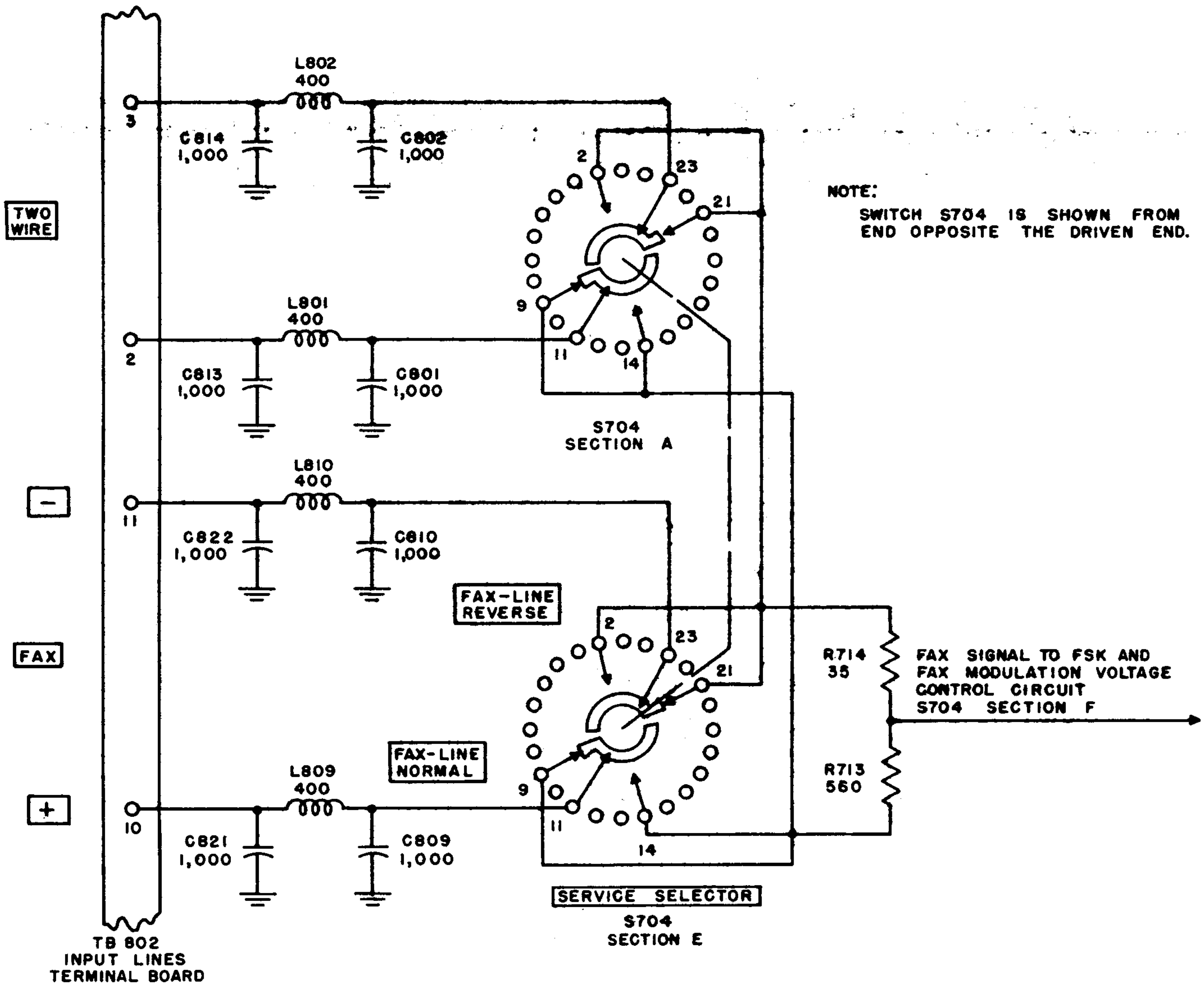


Figure 38. Fax input circuits, simplified schematic diagram.

input of the input lines terminal board TB802 terminals 2 and 3 can also be selected with the SERVICE SELECTOR switch. This circuit continues to the SERVICE SELECTOR switch S704 section A through line filters. To select fax from a two wire input, the SERVICE SELECTOR must also be in either the FAX-LINE NORMAL or the FAX-LINE REVERSE position. The input fax signal is divided by the voltage division circuit, R713 and R714, which is across the input. The fax output signal from the voltage division circuit is to the fsk and fax modulation voltage control circuit. This control circuit produces the fax modulation voltage from the intelligence received through the fax input circuit (par. 72).

72. Fsk and Fax Modulation Voltage Control Circuit
(fig. 39)

a. The radio frequency oscillator is aligned to provide biasing voltages in the fsk and fax modulation voltage control circuit so that the proper frequency shifts result from the fsk signal and the fax signal (par. 142-144). The FSK BIAS ADJ potentiometer R614 is set so that the frequency shifts resulting from the MOD TEST switch S702 positions MRK-WH-HI and SPACE-BLK-LOW are equal and opposite. During this adjustment the mean carrier frequency is produced by the MOD TEST switch in the LINE position. After the FSK BIAS ADJ is made, the DEVIATION CAL ADJ potentiometer R702 is adjusted so that the equal and opposite frequency shifts produced by the MOD TEST switch are reduced to 500 cps at 1.5 mc output from the radio frequency oscillator. The DEVIATION control potentiometer R706 is further adjusted so that the final frequency shift is reduced to 425 cps. Thus, with proper adjustment the rf output frequency shifts from 1.5 mc to 1.5 mc plus 425 cps as the MOD TEST switch is switched from the LINE position to the MARK-WH-HI position. The rf output frequency shifts from 1.5 mc to 1.5 mc minus 425 cps as the MOD TEST switch is switched from the LINE position to SPACE-BLK-LOW position. In the CARRIER ON and the CARRIER OFF position, the MOD TEST switch grounds the output from the fsk voltage circuit.

b. The MOD TEST switch S702 section A receives the "mark" and "space" fsk signals from the fsk relay K801 contacts. When in the LINE position the circuit connects into the fsk voltage circuit. The fsk voltage circuit is a series voltage division circuit which divides -108 v from the fsk bias supply (V603) to ground. This circuit consists of R613, R612, R611 and R614. When the fsk signal is "mark", contact 6-7 of the fsk relay K801 is closed so that the -108 v supply divides between R613 and R612 on one side and R611 and R614 on the other side. For this condition the output voltage to the SERVICE SELECTOR switch S704 section F is approximately -10 v. When the fsk signal is "space", contact 6-4 of the fsk relay is closed which shorts out R613. For this condition -108 v supply divides between R612 on one side and R611 and R614 on the other side to produce an output voltage of approximately -1 v. The output from the fsk voltage circuit is to the SERVICE SELECTOR switch S704 section F terminals 15 through 20 and to the MOD TEST switch S702 section B terminals 1 through 4.

c. The SERVICE SELECTOR switch S704 section F terminals 14 and 21 receives the fax signal directly from the voltage division circuit, R713 and R714, in the fax input circuit. When the SERVICE SELECTOR switch is in either the FAX-LINE NORMAL or the FAX-LINE REVERSE position, the fax signal circuit is complete to the MOD TEST switch S702 section B terminal 5. When the SERVICE SELECTOR switch is in either the FSK-LINE NORMAL or the FSK-LINE REVERSE position the fsk signal circuit is complete to S702 section B terminal 5. The MOD TEST switch in the LINE position continues the fax or the fsk signal circuit to the modulation voltage circuit R704. Note that for positions other than LINE of the MOD TEST switch, half of S704 section F is shorted out of the circuit. This completes the circuit from the fsk voltage circuit to the modulation voltage circuit for alignment procedures (subpar. a, above).

d. The modulation voltage circuit is a voltage dividing circuit the output of which varies between two extremes which are equal in magnitude and opposite in polarity. The +180 v from the regulated supply, divided between R708 and R707 on one side and R711 on the other side, provides a positive bias to R703, one end of the modulation voltage circuit. The fsk or the fax signal provides a negative voltage to R704, the other end of the modulation voltage circuit. The DEVIATION CAL ADJ potentiometer R702 connects between R703 and R704 to ground. This potentiometer along with the DEVIATION control potentiometer R706, is adjusted during alignment so that the frequency shifts produced in the rf output by the fsk or fax signal are 425 cps above and below a mean carrier frequency of 1.5 mc (subpar. a, above). The SERVICE SELECTOR switch S704 section F terminals 2, 3, 8 and 9 receives the fax or fsk modulation voltage from the modulation voltage circuit. The circuit continues through this switch when it is in the FAX-LINE NORMAL, FAX-LINE REVERSE, FSK-LINE NORMAL or FSK-REVERSE position to the MOD TEST switch S702 section B. The MOD TEST switch in the LINE position completes the circuit from the fax or fsk modulation voltage circuit to the

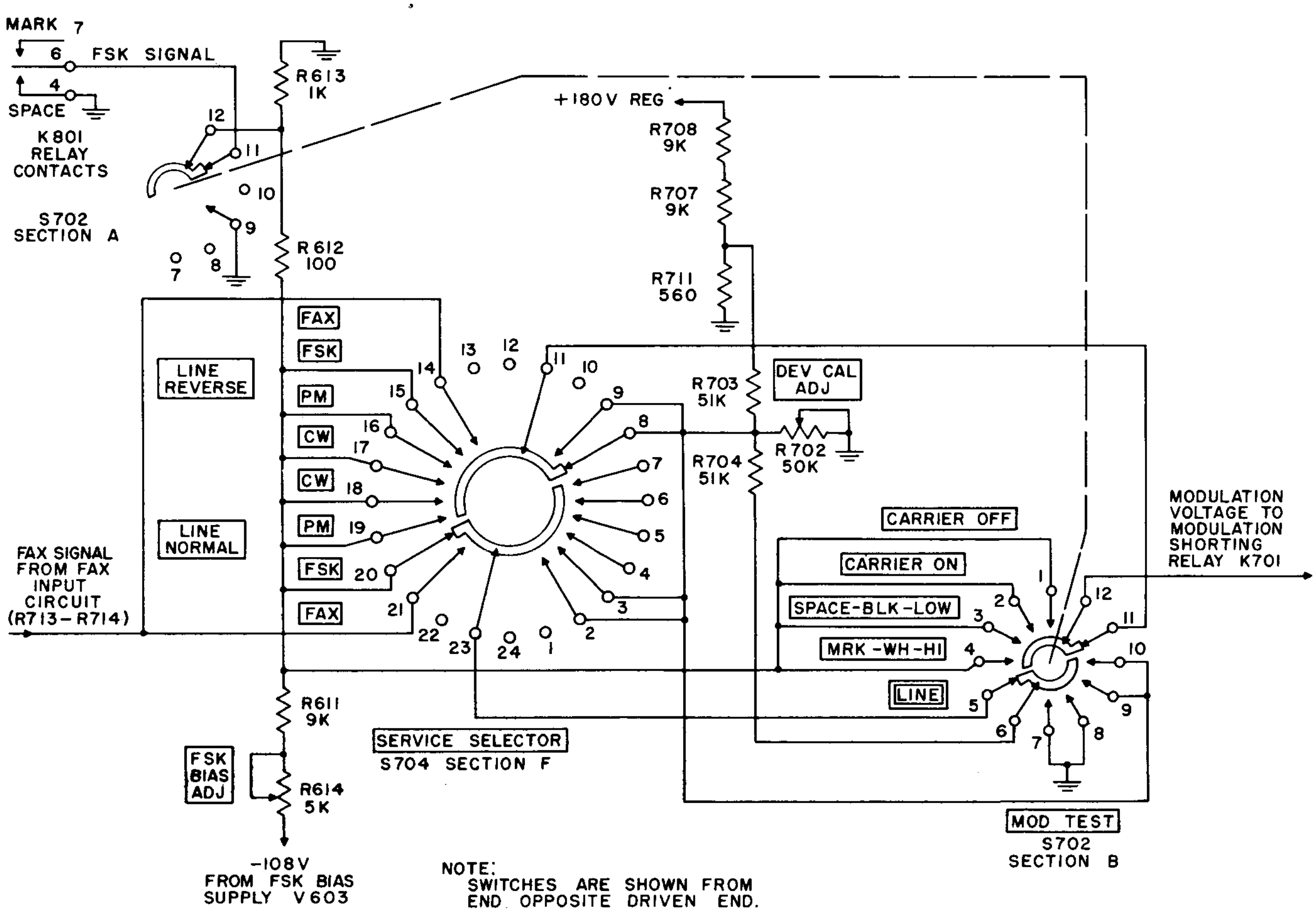


Figure 39. Fsk and fax modulation voltage control circuit, simplified schematic diagram.

modulation shorting relay K701. Note that for the MRK-WH-HI and the SPACE-BLK-LOW positions of the MOD TEST switch half of S704 section F is shorted out of the circuit, just as the other half of S704 section F is shorted out of the circuit. This completes the circuit from the fsk voltage circuit to the modulation shorting relay for alignment procedures. (Subpar. a, above.)

73. Modulation Shorting Relay K701
(fig. 40)

The modulation shorting relay shorts the modulation voltage to ground while the radio frequency oscillator is positioning on the frequency to which the radio receiver is tuned. This removes the effects of the modulation voltage from the circuits which control the positioning operation. Thus, while the radio frequency oscillator is positioning on a frequency, the modulation voltage input to the modulation canceling circuit and to the reactance-tube oscillator is ground potential. The modulation shorting relay K701 is located on the rear of the front panel. The +28 v supply provides relay operating voltage through the FUNCTION switch S707 section C when in the OPERATE position. The bandpass relay K401 controls operation of the modulation shorting relay. When the bandpass relay energizes, indicating the absence of the if. input to the radio frequency oscillator, the bandpass relay contact in the modulation shorting relay operating circuit closes to energize the modulation shorting relay. Energizing the modulation shorting relay grounds the modulation voltage signal line from the MOD TEST switch S702 section B. Thus when the radio frequency oscillator is not a frequency, the modulation voltage is shorted out. The modulation voltage remains shorted out until the radio frequency oscillator relocates the frequency to which the radio receiver is tuned. When this occurs, there is an if. input to the radio frequency oscillator and the bandpass relay de-energizes. This, in turn, de-energizes the modulation shorting relay to remove the ground from the modulation voltage signal line. The modulation voltage output from the modulation shorting relay is to the ASSOC XMTR FREQ MULT switch S703 section D and eventually to the reactance-tube oscillator. This output is also to the MOD CANCEL

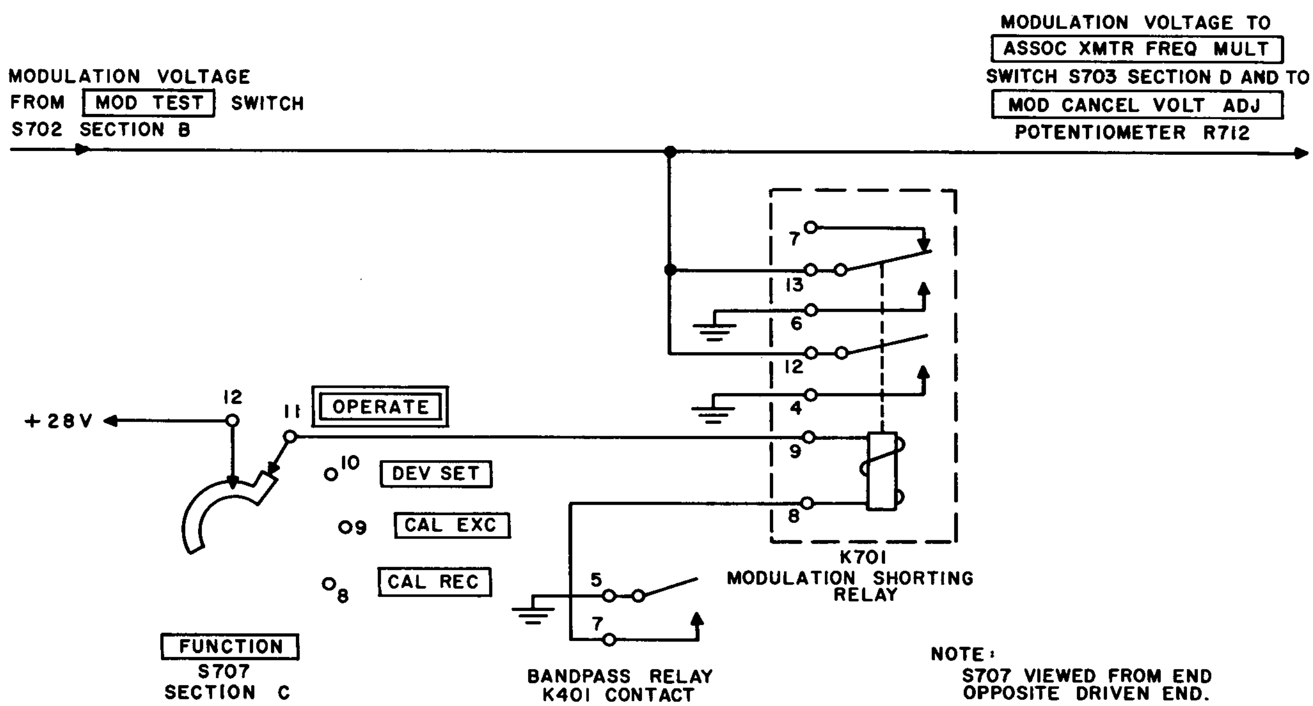


Figure 40. Modulation shorting relay, simplified schematic diagram.

VOLT ADJ potentiometer R712 which is part of the modulation canceling circuit (fig. 59).

74. ASSOC XMTR FREQ MULT Switch S703 Section D (fig. 41)

The ASSOC XMTR FREQ MULT switch S703 section D switches voltage division circuits which reduce the magnitude of the modulation voltage to compensate for external frequency multiplication in the associated transmitter. By reducing the modulation voltage by a factor equal to the transmitter frequency multiplier, the deviation of the rf output from the transmitter is held constant. S703 section D switches in the various voltage division circuits necessary to reduce the modulation voltage by a factor equal to the transmitter frequency multiplier. In the X1 position the circuit is straight through the switch from the modulation shorting relay to the deviation divider switch S101 section B. In the X2 position the modulation voltage divides between R722 on one side and R718 on the other side. In the X4 position the voltage divides between R717 and R721, in the X8 position between R716 and R720, and in the X16 position between R715 and R719. It appears as if the voltage division effected by these circuits is not strictly an inverse function of the switch setting. However, the output from terminal 6 of the switch is effectively shunted by the LINE BALANCE ADJ potentiometer R705 in series with the DEVIATION potentiometer R706 (fig. 43). With the proper adjustment of the LINE BALANCE ADJ potentiometer, the shunting resistance makes the output from the ASSOC XMTR FREQ MULT voltage division circuits an inverse function of the switch setting (par. 76).

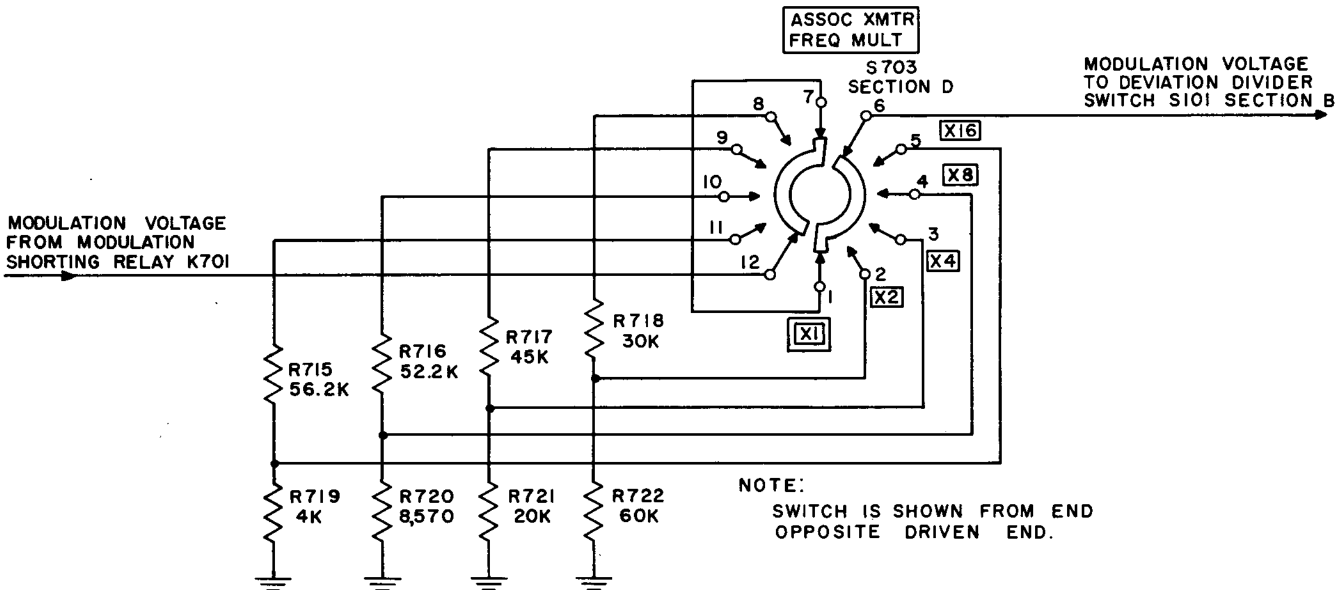
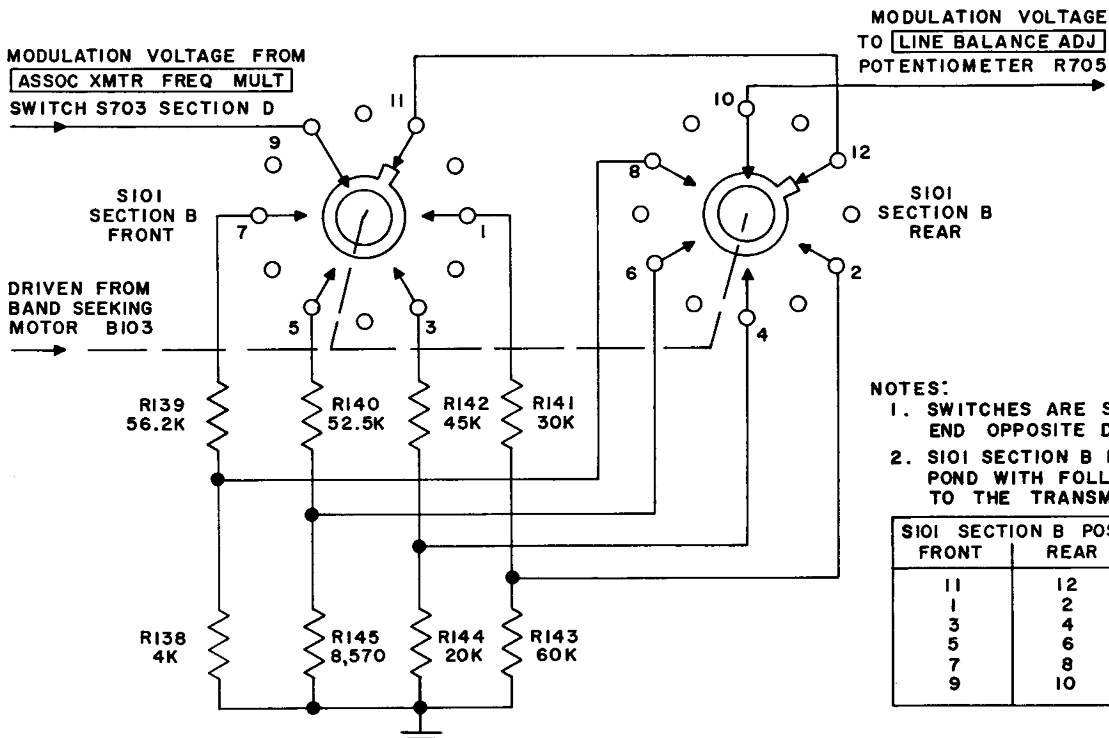


Figure 41. ASSOC XMTR FREQ MULT switch S703 section D, simplified schematic diagram.

75. Deviation Division Switch S101 section B (fig. 42)

The deviation division switch S101 section B front and rear switches voltage division circuits which reduces the magnitude of the modulation voltage to compensate for internal frequency multiplication in the radio frequency oscillator. This switch serves the same purpose for internal frequency multiplying as the ASSOC XMTR FREQ MULT switch S703 section D serves for external frequency multiplying (par. 74). S101 section B front and rear switches the various voltage division circuits necessary to reduce the modulation voltage by a factor equal to the frequency multiplying produced by the rf doublers. This maintains the frequency deviation constant over the entire frequency range of the radio frequency oscillator. The switch is driven by the band seeking motor B103 which positions the switch according to the rf output to the associated transmitter. If the output to the transmitter is between 1.5 mc to 3 mc no frequency doubling is required. In this case the modulation voltage circuit from the ASSOC XMTR FREQ MULT switch S703 section D is straight through S101 section B front and rear to the LINE BALANCE ADJ potentiometer R705 in the reactance-tube oscillator circuit. If the output is between 3 mc to 6 mc the rf output from the reactance-tube oscillator is doubled and the modulation voltage is divided between R141 and R143. Between 6 mc and 12 mc the modulation voltage divides between R142 and R144, between 12 mc and 24 mc the voltage divides between R140 and R145, and between 24 mc and 32 mc the voltage divides between R139 and R138. The LINE BALANCE ADJ potentiometer R705 adjusts the output from S101 section B rear so that the output is an inverse function of the internal frequency multiplication (par. 76).



NOTES:
1. SWITCHES ARE SHOWN FROM END OPPOSITE DRIVEN END.
2. S101 SECTION B POSITIONS CORRESPOND WITH FOLLOWING RF OUTPUT TO THE TRANSMITTER.

S101 SECTION B POS FRONT	S101 SECTION B POS REAR	RF OUTPUT
11	12	1.5-3 MC
1	2	3-6 MC
3	4	6-12 MC
5	6	12-24 MC
7	8	24-32 MC
9	10	NO OUTPUT

Figure 42. Deviation division switch S101 Section B, simplified schematic diagram.

76. Reactance Tube Oscillator V002 and V001 (fig. 43)

In the reactance-tube oscillator the modulation voltage controls the oscillator frequency. In this type fm oscillator the tuned control grid circuit of the oscillator is shunted by the plate-cathode circuit of the reactance tube. The reactance tube draws a reactive current, which varies with the modulation voltage, through the tuned oscillator circuit. The reactance tube thereby appears as a varying capacitance in the tuned control grid circuit of the oscillator. Therefore, the oscillator frequency changes as the modulation voltage changes. Both the reactance tube and the oscillator tube are miniature pentode tubes type 12AW6 located on the master oscillator subchassis.

a. The LINE BALANCE ADJ potentiometer R705 and the DEVIATION potentiometer R706 adjust the modulation voltage input to the reactance tube V002. These potentiometers are in parallel with the ASSOC XMTR FREQ MULT switch S703 section D circuits, the deviation division switch S101 section B circuits and the DEVIATION CAL ADJ potentiometer R702. The modulation voltage is adjusted with the LINE BALANCE ADJ so that equal modulation voltages appear across the DEVIATION CAL ADJ potentiometer R702 for all positions of switches S703 and S101 when the MOD TEST switch is in the MRK-WH-HI position (par. 140). The DEVIATION potentiometer R706 controls the magnitude of the modulation voltage input to the control grid of the reactance tube. The control grid (pin 1) receives the modulation voltage through grid leak resistor R005 and isolation resistor R007 from the DEVIATION potentiometer R706. In this input circuit the modulation voltage acts as an instantaneous control grid bias. The tuned grid circuit of the oscillator provides the exciting voltage to the control grid of the reactance tube. The voltage across the tuned circuit is shifted in phase by the phase shifting circuit C015 and R006. Since the capacitive reactance of C015 is very much larger than the resistance of R006 in the 1.5 mc to 3 mc frequency range, the exciting voltage from across the resistor leads the voltage across the tuned circuit by effectively 90°. The control grid (pin 1) receives this exciting voltage through coupling capacitor C012. Capacitor C011 is a filter to prevent feedback of the exciting voltage into the modulation voltage circuit. With the modulation voltage supplying the instantaneous control grid bias and an rf voltage, which is 90° leading the tuned circuit voltage, providing control grid excitation, the amplitude of the rf plate current drawn by the reactance tube is proportional to the modulation voltage while the phase is 90° leading the tuned circuit voltage.

b. The plate (pin 5) of the reactance tube couples back to the tuned control grid circuit of the oscillator. The +180 v supply provides plate voltage through the FUNCTION switch S707 section B when in the OPERATE, DEV SET or CAL EXC position, through the decoupling choke L003, and through the plate load choke L004. Since the chokes in the plate circuit of the reactance tube prevent the r-f plate current from flowing through the plate supply system, the rf plate current flows through the tuned control grid circuit of the oscillator. Since this current leads the voltage across the tuned circuit by 90° and is proportional to the modulation voltage, the reactance tube appears as an equivalent capacitor in parallel with the capacitive component C002 of the tuned control grid circuit of the oscillator tube. The value of this equivalent capacitor is proportional to the instantaneous modulation voltage. Mathematically expressed, the value of the equivalent capacitor is

$$C_{\text{equiv.}} = g_m RC$$

where g_m is the transconductance of the reactance tube and R and C are the resistive and capacitive values of the phase shifting circuit, R006 and C015. Since g_m varies directly with the control grid voltage, the relationship of the modulation voltage to the equivalent capacitance is valid. This means that the resonant frequency of the tuned control grid circuit of the oscillator changes as the modulation voltage changes. Since the equivalent capacity varies directly with the modulation voltage, the resonant frequency of the tuned circuit varies inversely with the modulation voltage.

c. The +180 v supply provides the screen grid voltage for the reactance tube through the FUNCTION switch S707 section B when in the OPERATE, DEV SET or CAL EXC position. The voltage division circuit R147 and R146 divides the +180 v and the screen grid receives voltage through the LINEARITY ADJ potentiometer R148 from the voltage division circuit. The LINEARITY ADJ potentiometer is initially adjusted so that the rf output shifts linearly with respect to an input signal to the control grid of the reactance tube (par. 141). Capacitor C009 is the screen grid bypass to ground. The cathode resistor R004 provides tube bias and capacitor C010 is the cathode bypass to ground.

d. The oscillator V001 is an electronically coupled oscillator where the cathode, control grid and screen grid operate in a Hartley oscillator circuit with the screen grid serving as the anode. The plate and screen grid are coupled by the electrons which bypass the screen grid and arrive at the plate. Although most of the electrons bypass the screen grid and arrive at the plate, the screen grid captures enough electrons to maintain the oscillation. This type oscillator is advantageous because the external plate load has negligible effect upon the frequency of oscillation. The control grid tuned circuit of the oscillator consists of series inductances L001 and L002 shunted by capacitors C004, C003 and C002. The inductance L002 is a permeability tuned trimming coil and L001 is a permeability tuned tuning coil. Capacitors C003 and C004 are temperature compensation capacitors which are chosen by individual tests for each oscillator. Capacitor C002 is the main capacitive element of the tuned circuit. In addition to these components, the equivalent capacitance of the reactance tube circuit shunts the tuned circuit. The cathode (pin 2) connects to the center tap of the inductance L001. Opposite ends of the tuned circuit connect to the control grid (pin 1) through coupling capacitor C005 and to ground. Resistor R001 provides the grid leak circuit to ground. The screen grid (pin 6) connects to ground through bypass capacitor C006. This provides for the 180° phase difference between the screen grid and the control grid which is necessary for oscillation. The suppressor grid (pin 7) is grounded. The +180 v supply provides plate and screen grid voltage through the FUNCTION switch S707 section B when in the OPERATE, DEV SET or CAL EXC position and through the decoupling circuit consisting of choke L003 and capacitor C008. The screen grid (pin 6) receives voltage from the decoupling circuit through screen grid voltage dropping resistor R002. The plate receives voltage from the decoupling circuit through load resistor R003. The buffer V101 receives the output from the plate (pin 5) of the oscillator through coupling capacitor C007. The servo motor B101 maintains the oscillator on frequency by varying, over a small range, the position of the powdered iron core of the tuning coil L001. During a positioning operation where the radio frequency oscillator is scanning the frequency spectrum, this core is positioned by the coarse positioning motor B102 and also by the servo motor. The oscillator can be tuned to frequencies between 1.5 mc and 3 mc. Frequencies up to 32 mc are obtained by frequency multiplying.

e. Since the resonant frequency of the tuned control grid circuit of the oscillator depends upon the equivalent capacitance of the reactance tube, the oscillator frequency changes as the equivalent capacitance changes. Since the equivalent capacitance varies directly with the modulation voltage input to the reactance tube, the oscillator frequency varies inversely with the modulation voltage. Therefore, the frequency deviation of the oscillator output varies inversely with the modulation voltage and the oscillator output is fundamentally frequency modulated. For phase modulation operation the frequency of the audio signal is pre-emphasized so that the oscillator output is phase modulated (par. 68).

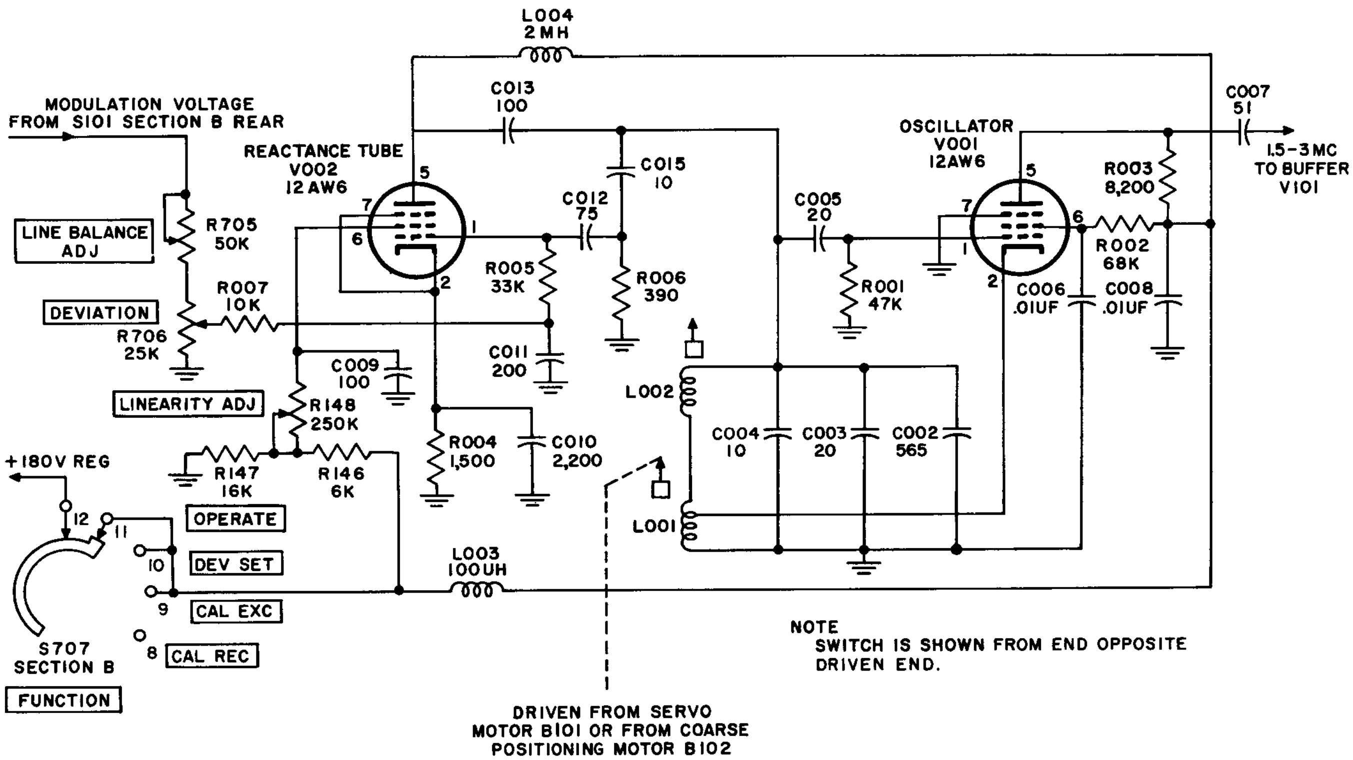


Figure 43. Reactance-tube oscillator, simplified schematic diagram.

77. Buffer V101 (fig. 44).

The buffer isolates the reactance-tube oscillator from the frequency doubling circuits. The buffer is a miniature pentode type 6AU6 located on the rf amplifier subchassis. The grid (pin 1) of the buffer receives the output from the oscillator V001 through coupling capacitor C007. Resistor R101 provides the grid leak circuit to ground. The tube operates with grid-leak bias provided by the coupling capacitor C007 and the grid-leak resistor R101. The cathode (pin 7) and the suppressor grid (pin 2) connect directly to ground. The buffer output develops across the load, R103 and L102 in parallel. The +180 v supply provides plate and screen grid voltage through the FUNCTION switch S707 section B when in the OPERATE, DEV SET or the CAL EXC position and through the filter circuit consisting of C184, L110, C178 and C179. The resistor R104 and capacitor C102 decouple the plate and screen grid circuits from the voltage supply. The resistor R102 is the screen grid voltage dropping resistor and capacitor C101 is the screen grid bypass to ground. The rf amplifier or the first rf doubler V102 receives output from the plate (pin 5) of the buffer through coupling capacitor C103. Since the output impedance of the buffer is small compared to the input impedance into which the buffer operates, the external load of the buffer has an insignificant effect on the output voltage of the buffer. Therefore, any change in the loading of the rf doublers does not reflect back through the buffer to the oscillator.

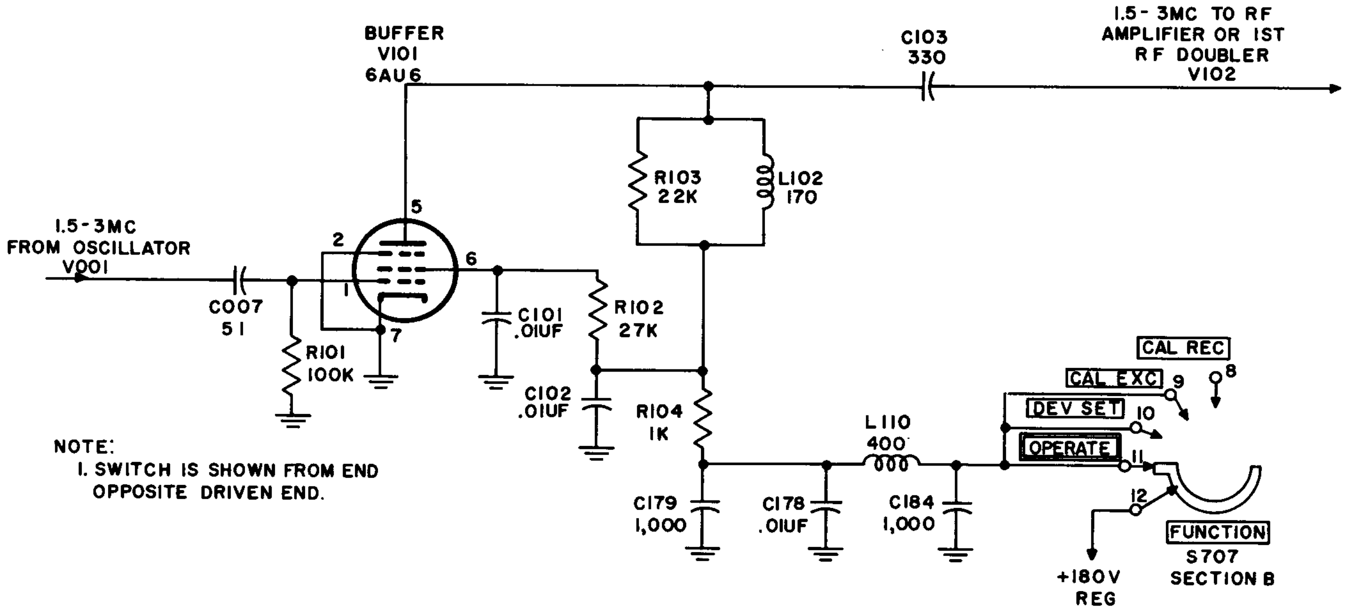
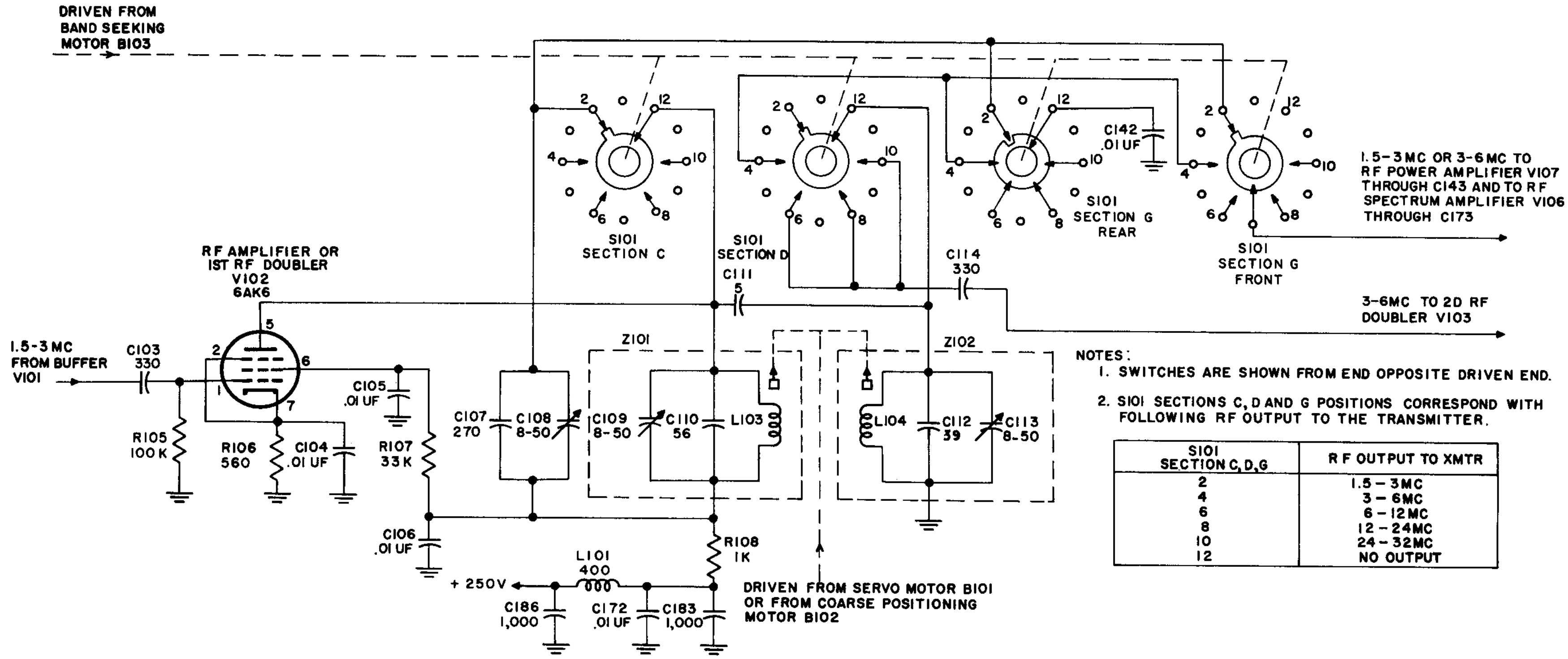


Figure 44. Buffer, simplified schematic diagram.

78. Rf Amplifier or First Rf Doubler V102 (fig. 45)

The tube V102 may operate as either an rf amplifier or an rf doubler depending upon the position of the band switch S101. The tube operates as a common rf amplifier with a tuned circuit as the plate load. This tube is a miniature pentode type 6AK6 located on the rf amplifier subchassis.

a. The grid (pin 1) receives the 1.5 - 3 mc rf from the buffer V101 through coupling capacitor C103. The resistor R105 provides the grid leak circuit to ground. The cathode resistor R106 provides tube bias and capacitor C104 provides the cathode bypass circuit to ground. The suppressor grid (pin 2) connects directly to the cathode (pin 7). The +250 v supply provides plate and screen grid voltage through the filter consisting of C186, L101, C172 and C183. Resistor R108 and capacitor C106 is the decoupling circuit for the screen grid and the plate circuit. The screen grid circuit continues from the decoupling circuit through voltage dropping resistor R107 to the screen grid (pin 4). Capacitor C105 provides the screen bypass circuit to ground. For an rf output between 1.5 mc and 3 mc from the radio frequency oscillator, the circuit operates as an rf amplifier and the plate load consists of the tuned circuit Z101 which is shunted by both capacitors C107 and trimming capacitor C108. The band switch S101 section C shunts these two capacitors with the tuned circuit Z101 for this frequency range. For an rf output



NOTES:
1. SWITCHES ARE SHOWN FROM END OPPOSITE DRIVEN END.
2. S101 SECTIONS C, D AND G POSITIONS CORRESPOND WITH FOLLOWING RF OUTPUT TO THE TRANSMITTER.

S101 SECTION C, D, G	RF OUTPUT TO XMTR
2	1.5 – 3MC
4	3 – 6MC
6	6 – 12MC
8	12 – 24MC
10	24 – 32MC
12	NO OUTPUT

Figure 45. Rf amplifier or first rf doubler, simplified schematic diagram.

above 3 mc from the radio frequency oscillator, the circuit operates as an rf doubler and the plate load consists of the double tuned circuit Z101 and Z102. Capacitor C111 provides complex coupling between the tuned circuits so that the mutual inductance changes with frequency. This complex coupling maintains a constant amplification by the circuit over the necessary frequency range.

b. The coarse positioning motor B102 and the servo motor B101 tune the inductance of the tuned circuits by properly positioning the powdered iron cores. V102 operates as an rf amplifier when the rf output from the radio frequency oscillator is between 1.5 mc and 3 mc. The tuned circuit Z101, which is shunted by C107 and C108, is tuned to the fundamental frequency of the oscillator V001. The band seeking motor B103 drives the band switch S101 which switches the output of V102. For an rf output between 1.5 mc and 3 mc, S101 sections C, D and G are in position 2. The output is then from Z101 through S101 section C, through S101 section G front to the rf power amplifier V107 and the rf spectrum amplifier V106. S101 section G rear provides a bypass circuit to ground through capacitor C142 for S101 section G.

c. V102 operates as an rf doubler when the rf output from the radio frequency oscillator is above 3 mc. In this case the double tuned circuit Z101 and Z102 is tuned to the second harmonic of the frequency of the oscillator V001. Thus the output from Z102 is double the oscillator frequency or between 3 mc and 6 mc. When the rf output from the radio frequency oscillator is between 3 mc and 6 mc, S101 sections C, D and G are in position 4 which completes the circuit from Z102 to the rf power amplifier and the rf spectrum amplifier. When the rf output is above 6 mc, S101 sections C, D and G are in position 6, 8 or 10 which completes the circuit from Z102 to the second rf doubler V103 through coupling capacitor C114.

/9. Second Rf Doubler V103
(fig. 46)

The operation of the second rf doubler is the same as that of the first rf doubler except for the effect of a grid trimming capacitor C115 and the effect of a neutralizing feedback voltage from the rf power amplifier V107 (par. 82). The second rf doubler V103 is a miniature pentode type 6AK6 located on the rf amplifier subchassis.

a. The grid trimming capacitor C115 is set so that the input capacitance of the second rf doubler is the same as the input capacitance of the rf power amplifier. This is necessary because the first rf doubler may work into either of these stages and the input capacitance into which the first rf doubler works affects the tuned circuit in the first rf doubler plate circuit. With equal input capacitances in the second rf doubler and the rf power amplifier, sharp tuning can be obtained with the trimming capacitor in the tuned circuit of the first rf doubler. Thus the output from the first rf doubler does not decrease when the output is switched from the second rf doubler to the rf power amplifier, or vice versa.

b. A neutralizing voltage feeds back to the output of the second rf doubler from the rf power amplifier V107 when the input to the rf power amplifier is from the second rf doubler. Neutralizing is necessary at higher frequencies because the transfer of energy between the control grid and the plate of the rf power amplifier is sufficient to distort the output from the rf power amplifier. This

NOTES:
1. SWITCHES ARE SHOWN FROM END OPPOSITE DRIVEN END.
2. S101 SECTIONS D, E, G, AND H POSITIONS CORRESPOND WITH FOLLOWING RF OUTPUT TO THE TRANSMITTER.

S101 SECTIONS D, E, G, AND H	RF OUTPUT TO XMTR
2	1.5 - 3 MC
4	3 - 6 MC
6	6 - 12 MC
8	12 - 24 MC
10	24 - 32 MC
12	NO OUTPUT

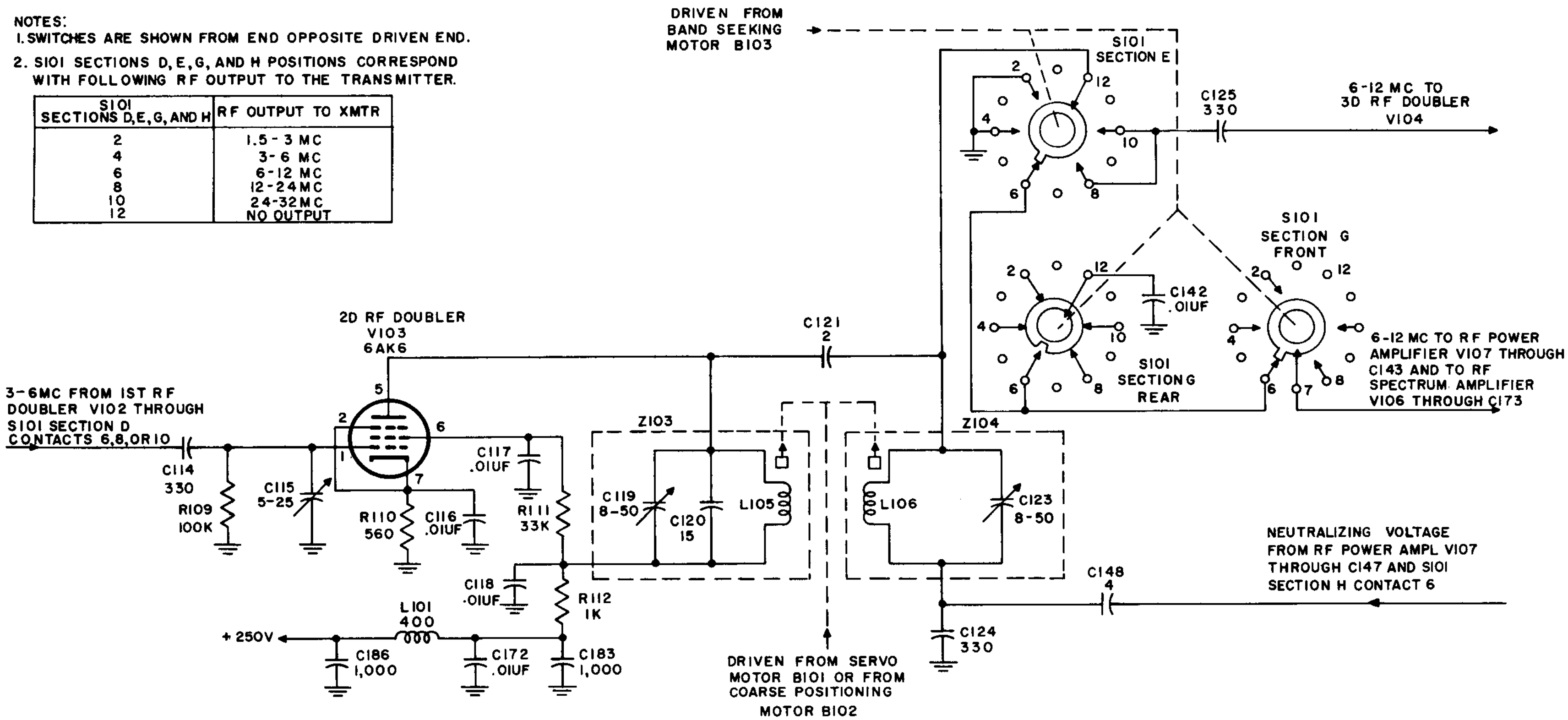


Figure 46. Second rf doubler, simplified schematic diagram.

transfer of energy is due to the current flowing through the interelectrode capacitance between the control grid and the plate of the rf power amplifier. The feed-back circuit from the plate to the input circuit cancels the effect of the grid to plate current through the interelectrode capacitance. Neutralizing feedback capacitor C148 and the neutralizing bridge capacitor C124 provide this feedback circuit through the tuned circuit Z104. This feedback circuit connects to the output circuit of the rf power amplifier through S101 section H when the output from the radio frequency oscillator is between 6 mc to 12 mc. The small neutralizing voltage is 180° out of phase with the signal developed across the tuned circuit due to the phase inversion effected by the rf power amplifier. The neutralizing voltage equals the voltage drop due to interelectrode capacitance, and since it is 180° out of phase, the interelectrode voltage drop is neutralized.

c. The input to the second rf doubler is between 3 mc and 6 mc from the first rf doubler V102. When the rf output from the radio frequency oscillator is above 3 mc the coarse positioning motor and the servo motor tune the double tuned circuit Z103 and Z104 to a resonant frequency between 6 mc to 12 mc. Thus the output frequency from the first rf doubler is redoubled by the second rf doubler. When the rf output is between 6 mc and 12 mc the band seeking motor drives the band switch S101 sections D, E, G and H to position 6. This completes the output circuit from the double tuned circuit, through S101 section E and S101 section G front, to the rf power amplifier V107 and the rf spectrum amplifier V106. S101 section H completes the neutralizing circuit back to Z104 from the rf power amplifier. When the rf output is above 12 mc, the band seeking motor drives the band switch S101 sections D, E, G and H to position 8 or 10 which completes the circuit from the second rf doubler to the third rf doubler V104 through coupling capacitor C125.

80. Third Rf Doubler V104 (fig. 47)

The operation of the third rf doubler is the same as that of the second rf doubler. The third rf doubler V104 is a miniature pentode type 6AK6 located on the rf amplifier subchassis. The input to the third rf doubler is between 6 mc and 12 mc from the second rf doubler V103. When the rf output from the radio frequency oscillator is above 12 mc the coarse positioning motor and the servo motor tune the double tuned circuit Z105 and Z106 to a resonant frequency between 12 mc and 24 mc. Thus the output frequency from the second rf doubler is re-doubled by the third rf doubler. When the rf output is between 12 mc and 24 mc the band seeking motor drives the band switch S101 sections E, F, G and H to position 8. This completes the output circuit from the double tuned circuit, through S101 section F and S101 section G front, to the rf power amplifier V107 and the rf spectrum amplifier V106. S101 section H completes the neutralizing circuit back to Z106 from the rf power amplifier. When the rf output is above 24 mc the band seeking motor drives the band switch S101 sections E, F, G and H to position 10 which completes the circuit from the third rf doubler to the fourth rf doubler V105 through coupling capacitor C136.

81. Fourth Rf Doubler V105 (fig. 48)

The operation of the fourth rf doubler is the same as that of the second rf doubler. However, in the fourth rf doubler a single tuned circuit Z107 replaces the double tuned plate circuit and the neutralizing bridge capacitor C140 serves

NOTES:

1. SWITCHES ARE SHOWN FROM END OPPOSITE DRIVEN END.
2. S101 SECTIONS E, F, G AND H POSITIONS CORRESPOND WITH FOLLOWING RF OUTPUT TO TRANSMITTER.

S101 SECTIONS E,F,G AND H	RF OUTPUT TO XMTR
2	1.5 - 3 MC
4	3 - 6 MC
6	6 - 12 MC
8	12-24 MC
10	24-32 MC
12	NO OUTPUT

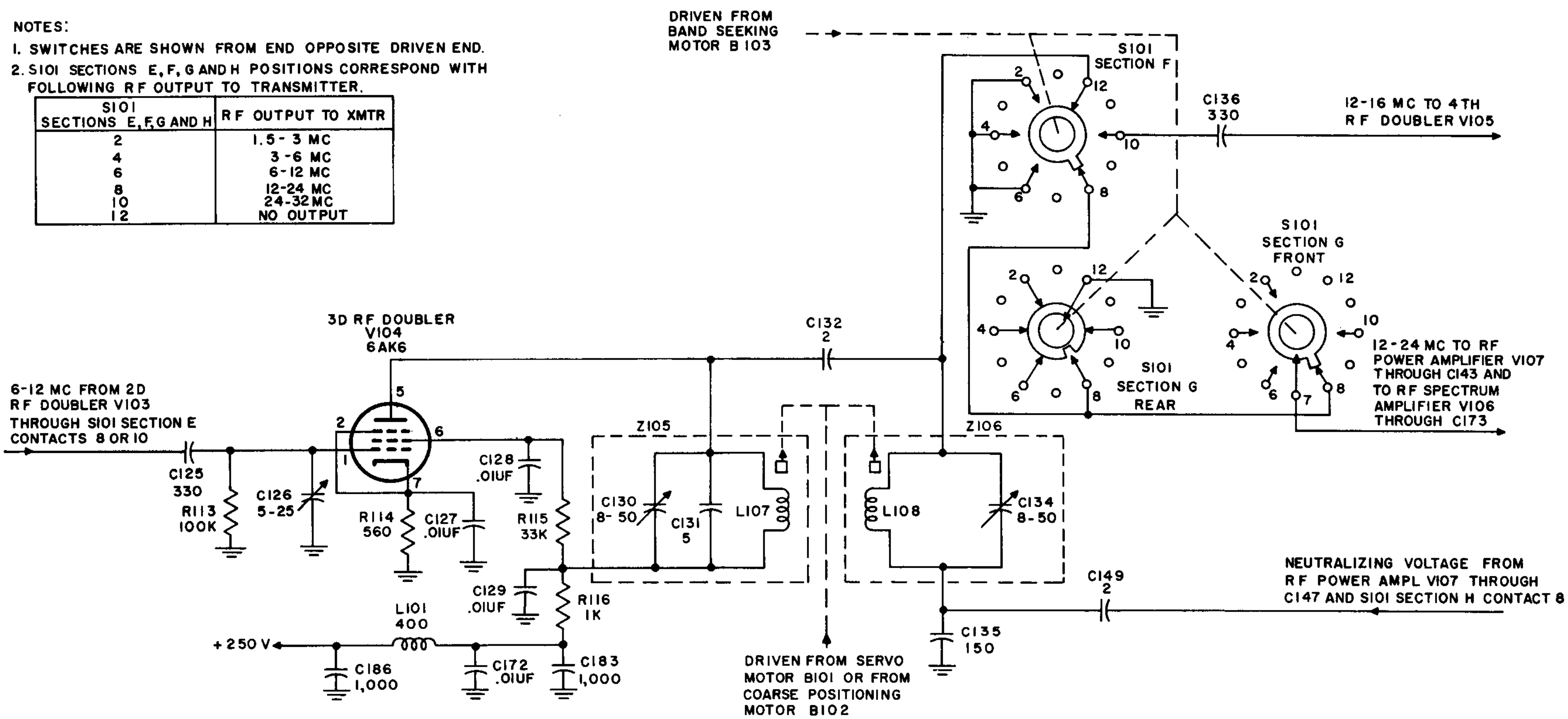
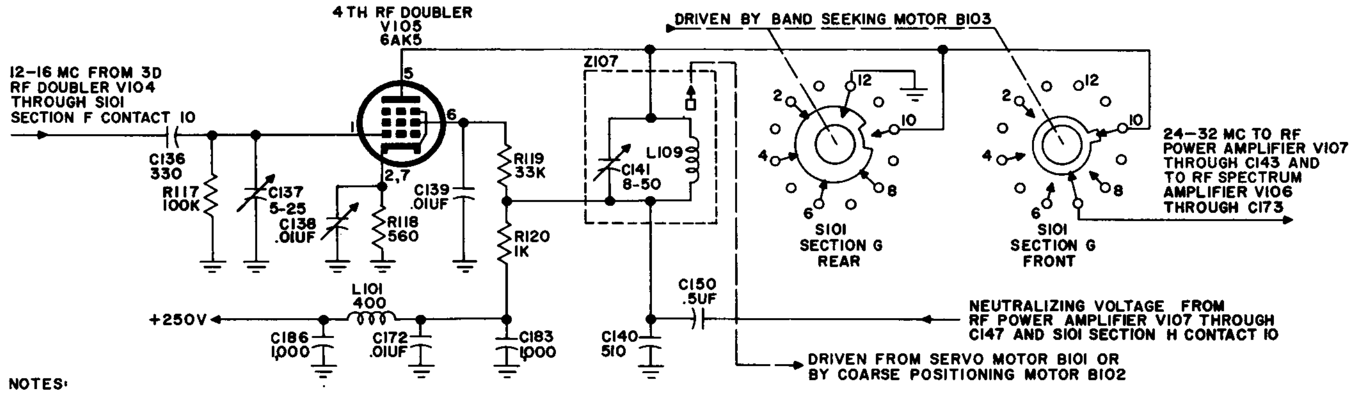


Figure 47. Third rf doubler, simplified schematic diagram.

also as the plate and screen grid supply voltage decoupling capacitor. The fourth rf doubler V105 is a miniature pentode type 6AK6 located on the rf amplifier subchassis. The input to the fourth rf doubler is from the third rf doubler. Since the upper frequency limit of the radio frequency oscillator is 32 mc, the input frequency to the fourth doubler is never more than 16 mc. When the output from the radio frequency oscillator is between 24 mc and 32 mc, the coarse positioning motor and the servo motor tune the tuned circuit Z107 to a resonant frequency between 24 mc and 32 mc. The band seeking motor drives the band switch S101 sections F, G and H to position 10. This completes the output circuit from the tuned circuit, through S101 section G front, to the rf power amplifier V107 and the rf spectrum amplifier V106. S101 section H completes the neutralizing circuit back to Z107 from the rf power amplifier.



NOTES:
1. SWITCHES ARE SHOWN FROM END OPPOSITE DRIVEN END.
2. S101 SECTIONS F,G AND H POSITIONS CORRESPOND WITH FOLLOWING RF OUTPUT TO TRANSMITTER.

S101 SECTION F,G,H	RF OUTPUT TO TRANSMITTER
2	1.5-3 MC
4	3-6 MC
6	6-12 MC
8	12-24 MC
10	24-32 MC
12	NO OUTPUT

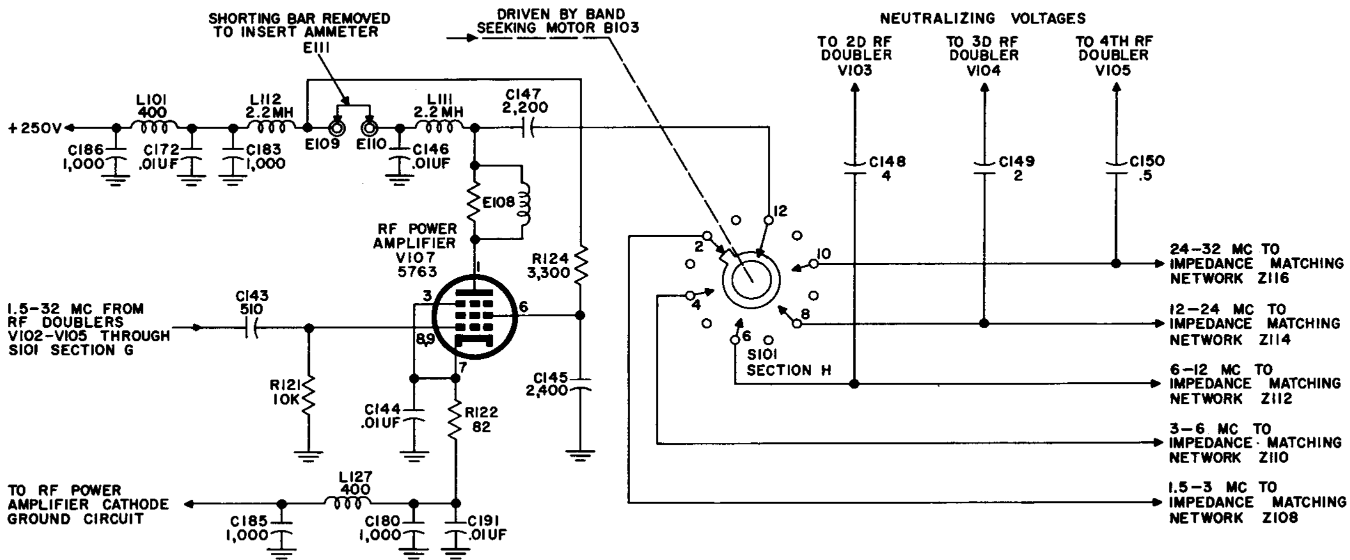
Figure 48. Fourth rf doubler, simplified schematic diagram.

82. Rf Power Amplifier V107 (fig. 49)

The rf power amplifier converts the rf signal voltage received from the rf doublers into a power output. The rf power amplifying tube V107 is a miniature power pentode type 5763 which operates class A and produces an output of three watts. This tube is located on the rf amplifier subchassis.

a. The control grid (pins 8 and 9) of the rf power amplifier receives the rf signal voltage from the rf doubler through S101 section G and through the coupling capacitor C143. Resistor R121 provides the grid leak circuit to ground. The cathode (pin 7) connects to the cathode ground circuit through the cathode resistor R122 and a filter consisting of C180, C191, L127 and C185. The cathode ground circuit provides on-off control over the rf power amplifier (par. 83). Although the cathode resistor is small, a large current flows through the resistor so that the cathode to grid bias is sufficient to limit the operation of the amplifier to the linear portion of the dynamic characterisitic. The filter in the cathode circuit prevents rf feedback to the cathode. Capacitor C144 provides the cathode bypass circuit to ground. The suppressor grid (pin 3) connects directly to the cathode. The +250 v supply provides the plate and screen grid voltage through the filter consisting of C186, L101, C172 and C183 and the decoupling circuit consisting of L112 and C146. The screen grid (pin 6) connects to the decoupling circuit through screen grid voltage dropping resistor R124. Capacitor C145 provides the screen grid bypass circuit to ground. The plate (pin 1) connects to the decoupling circuit through parasitic suppressor E108, the plate load inductance L111, and the shorting bar E111. The shorting bar jumpers the plate current meter jacks E109 and E110. This shorting bar is removed only when an ammeter is inserted in the plate circuit to measure the plate current of the rf power amplifier (par. 147).

b. The output from the rf power amplifier, through coupling capacitor C147, connects to a selected impedance matching network through the band switch S101 section H. The band seeking motor B103 positions S101 to select the matching network that matches the 50-ohm impedance into which the radio frequency oscillator works with the output impedance of the rf power amplifier at the frequency of operation. S101 section H also selects the neutralizing feedback circuit, through feedback capacitors C148, C149 or C150, to feedback a small portion of the output voltage from the rf power amplifier to the input circuit of the rf power amplifier (par. 79).



NOTES
1. SWITCH IS SHOWN FROM END OPPOSITE DRIVEN END.
2. S101 SECTION G AND H POSITIONS CORRESPOND WITH FOLLOWING RF OUTPUT TO THE TRANSMITTER

S101 SECTIONS G, H	RF OUTPUT TO XMTR
2	1.5-3 MC
4	3-6 MC
6	6-12 MC
8	12-24 MC
10	24-32 MC
12	NO OUTPUT

Figure 49. Rf power amplifier, simplified schematic diagram.

83. Rf Power Amplifier Cathode Ground Circuit
(fig. 50)

The rf power amplifier cathode ground circuit provides on-off control over the rf output to the transmitter from the rf power amplifier. Removal of the ground from the rf power amplifier V107 disables the amplifier, and thus interrupts the output from the amplifier. The ground circuit consists of two interrupting means in series, the bandpass relay K401 contact 2-3 and by the MOD TEST switch S702 section A, followed by three interrupting means in parallel, the SERVICE SELECTOR switch S704 section B, the CARRIER CONTROL terminal of the input lines terminal board TB802 and the cw keying relay K202 contacts. The bandpass relay maintains automatic control over the rf output from the rf power amplifier. In the normally closed position the relay contact 2-3 makes the circuit. However, in the event that the radio frequency oscillator is not on frequency the relay energizes and the relay contact opens the cathode ground circuit to disable the rf power amplifier. The cathode ground circuit remains open until the radio frequency oscillator has retuned to the proper frequency, which is indicated by the de-energization of the

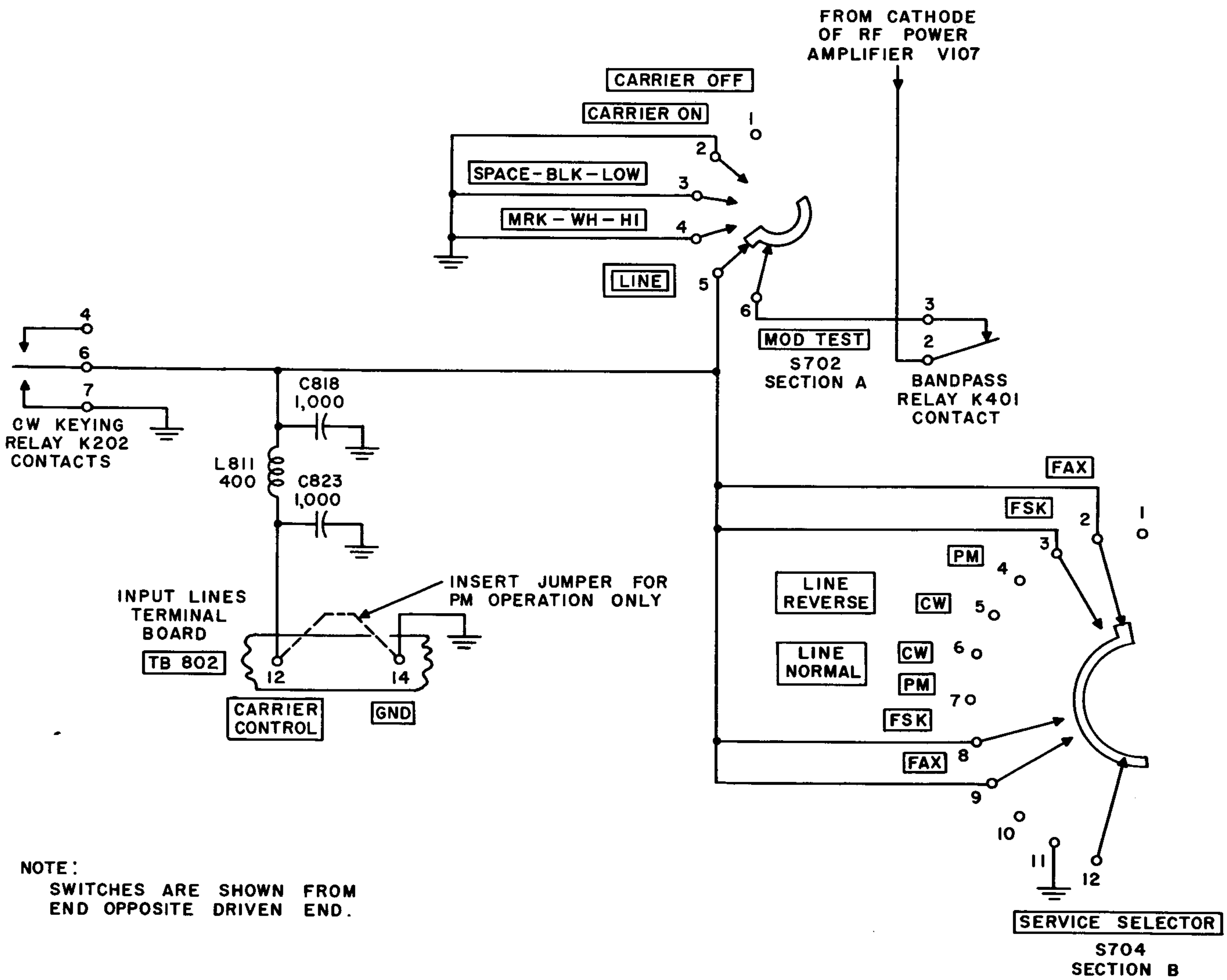


Figure 50. Rf power amplifier cathode ground circuit, simplified schematic diagram.

bandpass relay (par. 94). The MOD TEST switch S702 section A provides manual control over the rf output from the rf power amplifier. In the CARRIER OFF position the ground circuit is open and the rf power amplifier is disabled. In the CARRIER ON, SPACE-BLK-LOW and the MRK-WH-HI positions the switch provides the rf power amplifier ground for test operations. In the LINE position the switch continues the ground circuit to the other control circuits. The SERVICE SELECTOR switch S704 section B provides the cathode ground when in the FAX or FSK positions. The CARRIER CONTROL terminal 12 of the input lines terminal board TB802 provides the means for grounding the cathode of the rf power amplifier during remote phase modulation operation. During remote pm operation the CARRIER CONTROL terminal of TB802 must either be grounded remotely or jumpered to the GND terminal 14 of TB802. This jumper should be used only for remote pm operation. During local pm operation the cw keying relay is energized by the "push-to-talk" microphone control which turns the carrier on (par. 65). Terminal 12 grounded to 14 of TB802 provides the cathode through the line filter consisting of C823, L811 and C818. The cw keying relay K202 contacts 6-7 provides the cathode ground during cw operation. Thus the cw keying relay interrupts the rf output to the transmitter and produces the continuous wave output.

84. Impedance Matching Networks (fig. 51)

For maximum power transfer, impedance matching networks match the output impedance of the rf power amplifier V107 to a 50-ohm resistive load. The rf output from the rf power amplifier is through the band switch S101 section H, through an impedance matching network, and through S101 section J to the 50 OHM OUT jack J814. There are five impedance matching networks, one for each frequency band, located on the rf amplifier subchassis. The band seeking motor B103 drives S101 section H and J to select the proper network for the output frequency. Each network is designed as a pi-section on the input side followed by an L-section on the output side. Although this design feature exists, no physical separation exists between the capacitive branch to ground of the pi-section and the connecting capacitive branch to ground of the L-section. These two branches are lumped together. Each input capacitive branch to ground of the pi-sections contains a trimming capacitor, such as C151, which is trimmed to give maximum power output from the network (par. 147). The input capacitive branch to ground may or may not contain other parallel capacitors such as C152. Each series inductive element of the pi-sections, such as L113, is a permeability tuned inductance. The servo motor B101 and the coarse positioning motor B102 position the powdered iron core so that the impedance looking into the pi-section matches the impedance looking back into the rf amplifier at the operating frequency. The output capacitive branch to ground of the pi-section and the input capacitive branch to ground of the L-section are lumped together, such as C153, C154, C155, C156 and C157. Each series inductive element of the L-sections, such as L114, is also a permeability tuned inductance. The servo motor and the coarse positioning motor position the powdered iron core so that the impedance looking into the L-section from the 50 OHM OUT jack is 50 ohms resistive, and so that the impedance looking into the L-section from the opposite end matches the impedance looking back into the connecting pi-section. With the impedances so matched, the radio frequency oscillator delivers a minimum of three watts of power to a 50-ohm resistive load.

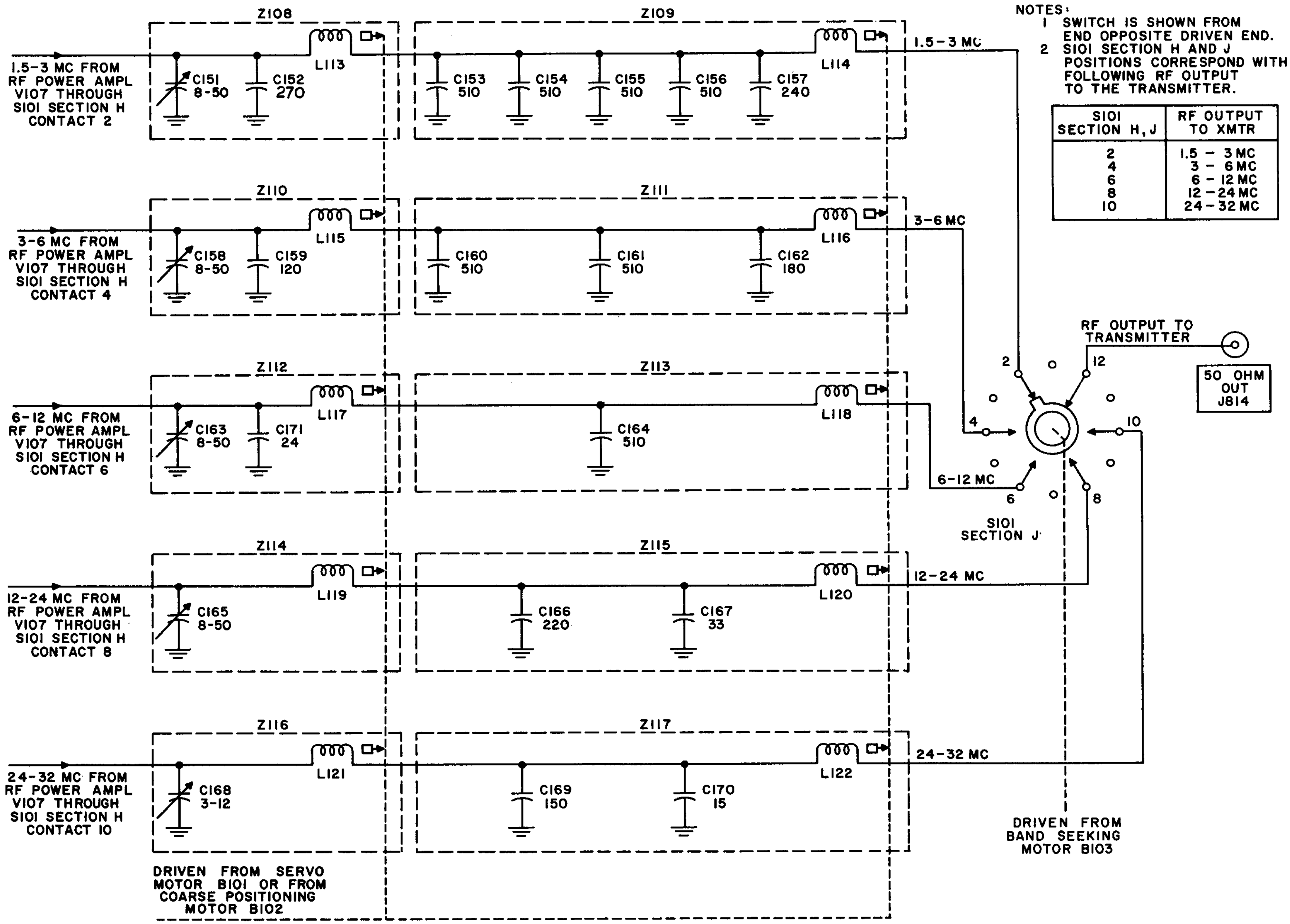


Figure 51. Impedance matching networks, simplified schematic diagram.

85. Rf Spectrum Amplifier V106 (fig. 52)

The rf spectrum amplifier V106 receives the rf signal from the rf doublers, the same rf signal received by the rf power amplifier V107, and distorts this signal while amplifying it. The output from the amplifier is to the associated radio receiver. The signal is distorted to make it rich in harmonics. This allows the receiver to tune to a harmonic of the rf signal in the event external frequency multiplying is carried out by the transmitter. The rf spectrum amplifier is a sharp cut-off, miniature pentode type 6AU6 which is located on the rf amplifier subchassis.

a. The control grid (pin 1) receives the rf signal from the rf doublers through the band switch S101 section G and through coupling capacitor C173. Resistor R127 provides the grid leak circuit to ground. The suppressor grid (pin 2) connects directly to the cathode (pin 7) and the cathode connects directly to ground. With the cathode grounded the tube operates with only the small grid-leak bias developed by coupling capacitor C173 and grid-leak resistor R127. With such small bias, tube saturation results during the positive halves of the input signal. Consequently, the plate output from the tube is greatly distorted and rich in harmonics. The +250 v supply provides plate and screen grid voltage through a filter, consisting of C186, L101, C172 and C183, and through a decoupling circuit, consisting of R130 and C175. The plate (pin 5) receives voltage from the decoupling circuit through the load resistor R129. The screen grid receives voltage from the decoupling circuit through the screen grid voltage dropping resistor R128, and capacitor C174 provides the screen grid bypass circuit to ground. The output from the rf spectrum amplifier is from the plate (pin 5) through coupling capacitor C176 to REC ANT jack J813 and hence through Rf Cable Assembly CG-833/U to the ANTENNA-UNBALANCED WHIP jack J107 of the associated Radio Receiver R-390/URR.

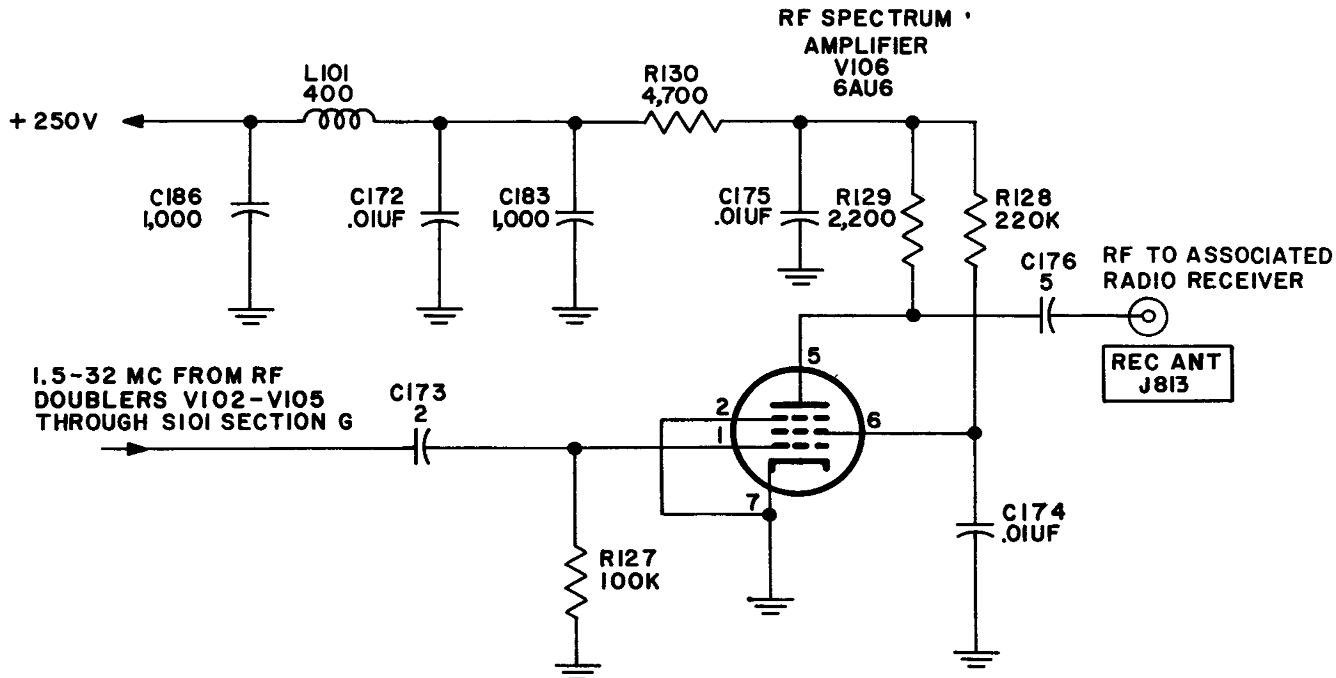


Figure 52. Rf spectrum amplifier, simplified schematic diagram.

b. In the event frequency multiplying is carried out in the transmitter, the radio receiver is tuned to the transmitter output frequency while the radio frequency oscillator tunes to a sub-harmonic of the transmitter output frequency. Since the radio receiver receives the same frequency as the transmitter, and since the radio receiver will be tuned to a multiple of this frequency, the radio receiver must tune on a harmonic frequency of the signal received in order to produce an if. input to the radio frequency oscillator. Therefore, it is essential that the rf signal from the radio frequency oscillator to the radio receiver be extremely rich in harmonics. Since the output from the rf power amplifier V107 is extremely pure, the separate rf spectrum amplifier is required to produce an output which is rich in harmonics. The rf spectrum amplifier output contains all even harmonics of the fundamental frequency so that the amplitude of all even harmonics, up to and including the 16th, is sufficient for reception by the radio receiver.

86. If. Amplifier V301 (fig. 53)

The first if. amplifier increases the amplitude of the nominal 455 kc if. input from the radio receiver before the signal reaches the limiters and the relay control if. amplifier. The first if. amplifier is a double-tuned amplifier using a miniature pentode, type 12AU6, which is operated class A and is located on the if. amplifier subchassis.

a. The if. input signal to the radio frequency oscillator is to the 455 KC INPUT jack J812 from Radio Receiver R-390/URR IF OUTPUT 50 OHM jack J106 through Cord CG-409C/U. This input is to the control grid (pin 1) of V301 through coupling capacitor C301. Resistor R301 provides the grid leak circuit to ground.

b. Cathode resistor R302 provides tube bias to the cathode (pin 7). The cathode bypass capacitor C302 bypasses the cathode resistor to ground. The suppressor grid (pin 2) connects directly to the cathode (pin 7). The +180 v regulated supply provides screen grid voltage through a decoupling circuit, composed of R304 and C304, and through the voltage dropping resistor R303. The capacitor C303 is the screen grid bypass to ground. Plate voltage is from the +180 v regulated supply through the same decoupling circuit, R304 and C304, as used in the screen grid circuit. From the decoupling circuit, plate voltage applies to the plate (pin 5) through the primary winding of the transformer T301.

c. The amplified output signal from the if. amplifier develops in the transformer T301 which is in the plate circuit. The transformer primary L301 is shunted with the capacitor C305 to make a tuned circuit. Likewise, the transformer secondary L302 is shunted with the capacitor C307 to make a second tuned circuit. Therefore, the transformer affords a double-tuned circuit which offers a high impedance plate circuit to frequencies centering around 455 kc. At the same time the plate circuit impedance is very low for any harmonic frequencies. Therefore, frequencies which lie in the pass band are amplified while frequencies which lie outside the pass band are rejected. The capacitor C306 couples the transformer windings to give the complex coupling necessary for equal amplification for all frequencies in the pass band range. The output from the if. amplifier is an amplified if. from the secondary of T301 to the first limiter V302. The relay control if. amplifier V304 also receives this output from the control grid circuit of the first limiter (par 92).

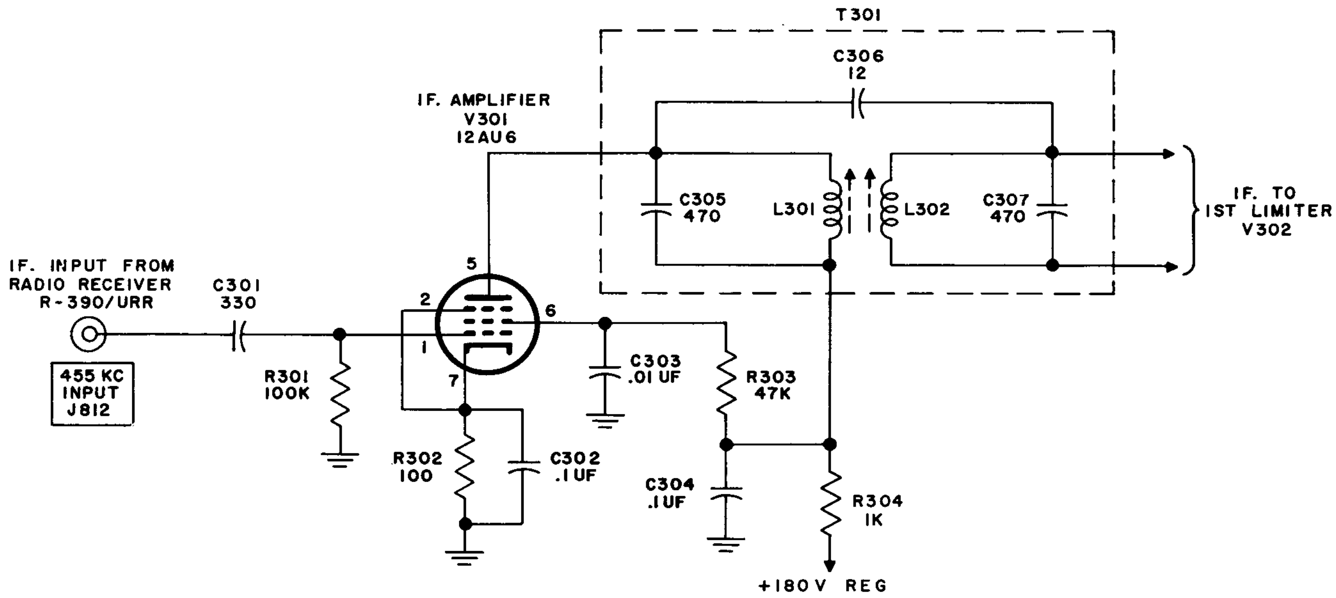


Figure 53. If. amplifier, simplified schematic diagram.

87. First Limiter V302 and Second Limiter V303 (fig. 55)

a. General. The double limiter circuit removes all amplitude variations from the if. signal before the signal reaches the discriminator. This limiting operation is necessary since the discriminator is sensitive to amplitude variations as well as to frequency variations. In the limiting operation the two limiter tubes operate with reduced plate voltage, reduced screen grid voltage and no cathode bias so that the negative peaks of the if. input signal produce cut-off and the positive peaks produce saturation. Thus, the output from the limiter is between constant limits. The double limiter gives a constant output over a range of 50 db signal rise. Both the first and second limiters use sharp cut-off miniature pentodes, type 12AU6, located on the if. amplifier subchassis.

b. First Limiter V302.

(1) The first limiter receives the if. signal on the control grid (pin 1) from the secondary of transformer T301. The capacitor C308 is the coupling capacitor. The grid leak resistor R305, in series with the parallel meter M703 and meter shunt R306, provides the grid leak circuit to ground. The relay control if. amplifier V304 also receives the if. signal from the secondary of transformer T301 through coupling capacitor C321.

(2) Since the first limiter will operate above the saturation level, grid current is expected. The amount of grid current drawn by the first limiter depends upon the amplitude of the input signal and is, therefore, an indication of the input signal strength. The CAL IND meter M703 meters the grid current through the FUNCTION switch S707 section A when in the OPERATE position. The paralleled meter and meter shunt R306 in

series with the grid leak resistor R305 meters the grid current. The capacitor C309 affords a meter bypass to ground. The CAL IND meter M703 measures the grid current of V302 only when the FUNCTION switch is in the OPERATE position. For other positions of this switch calibration currents are measures (par 106).

(3) The cathode is ground potential and the suppressor grid (pin 2) is connected directly to the cathode (pin 7). With no cathode bias, tube saturation occurs on the positive peaks of the input signal. Plate voltage is from the +180 v regulated supply through the plate load resistor R310 to the plate (pin 5). This reduced plate voltage, from the recommended +250 v for the type 12AU6 tube, makes the grid cut-off voltage less negative and results in cut-off on the negative peaks of the input signal. The reduced plate voltage also reduces the plate current drawn during tube saturation. The screen grid voltage is from the voltage division circuit R308 and R307 across the +180 v regulated supply to the screen grid (pin 6). This voltage division results in a screen grid voltage of approximately +105 v which is a reduction from the recommended 150 v for the type 12AU6 tube. This reduction in screen grid voltage makes the grid cut-off voltage less negative and consequently assists in cut-off on the negative peaks of the input signal. The capacitor C310 is the screen grid bypass to ground.

(4) The output signal from the first limiter is from the plate (pin 5) through the coupling capacitor C311 to the grid (pin 1) of the second limiter V303. The output from the first limiter is not constant over the input signal strength range of 50 db required for the operation of the equipment (fig. 54). The second limiter produces the required limiting range of 50 db.

c. Second Limiter V303. The second limiter operates in the same manner as the first limiter and differs primarily in that the plate load is a tuned circuit rather than a resistance load.

(1) The control grid (pin 1) of the second limiter receives the if. signal from the first limiter through coupling capacitor C311. Resistor R309 is the grid leak to ground. Capacitor C312 is a harmonic filter which removes the higher harmonic frequencies introduced into the if. signal due to the amplitude distortion produced in the first limiter.

(2) The cathode (pin 7) is at ground potential and the suppressor grid (pin 2) is connected directly to the cathode. Plate voltage is from the +180 v regulated supply through the plate load choke L303 to the plate (pin 5). Capacitor C315 is a decoupling capacitor to prevent if. feed back to the +180 v regulated supply. The screen grid voltage is from the same voltage division circuit, R308 and R307, as is used for the first limiter screen voltage. Capacitor C310 is the screen grid bypass to ground.

(3) The output from the second limiter is from the tuned circuit Z301 which is the plate load impedance for the tube. The variable capacitor C313 is the capacitive element of the tuned circuit and provides a means of trimming the tuned circuit. The choke L303 is the inductive element of

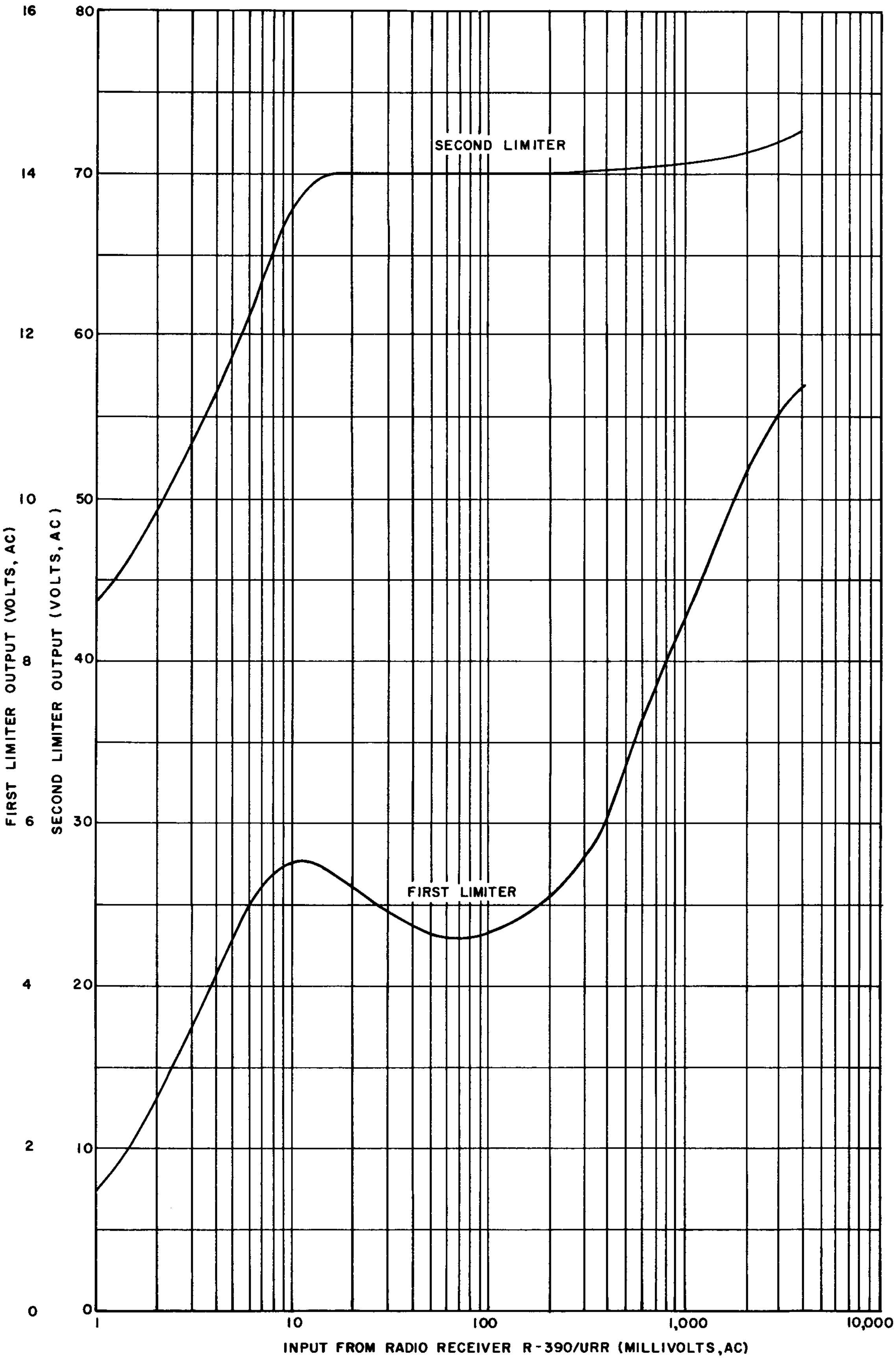


Figure 54. Limiter characteristics.

the tuned circuit. The swamping resistor R311 shunts the tuned circuit to broaden the frequency response sufficiently to accept the if. signal when it is at its widest deviation from the mean frequency of 455 kc. The output signal from the tuned plate circuit of the second limiter is to the discriminator. With a 455 kc input between 12 mv and 1200 mv from the radio receiver to the radio frequency oscillator, the output from the second limiter is essentially constant at 70 v. Figure 54, is a graph of limiter characteristics showing limiter output vs signal input from Radio Receiver R-390/URR. The output of both the first and second limiters is shown in this figure.

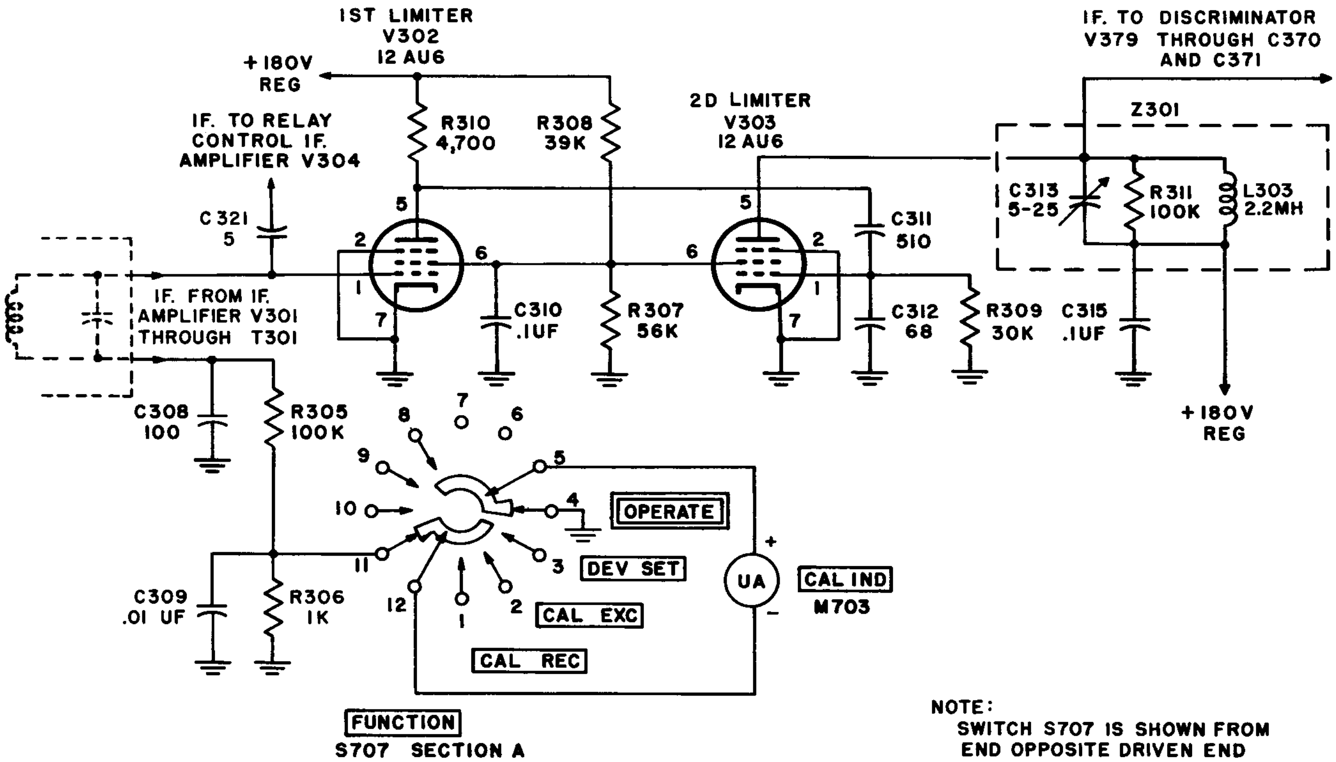


Figure 55. First limiter and second limiter, simplified schematic diagram.

88. Discriminator V379 (fig. 58)

The discriminator circuit demodulates the if. signal from the second limiter so that the error voltage output from the discriminator varies directly as the if. input varies above and below 455 kc. The discriminator output characteristic is reasonably linear over a frequency range of 3 kc above and below 455 kc and the output is approximately 1.4 mv per cycle change. The discriminator is located on a separate subchassis in a hermetically sealed unit. The sealed unit is insulated and contained in an outer can. The discriminator operating temperature is held constant at 75°C by a thermostatically controlled heater. The discriminator tube is a miniature twin diode type 12AL5.

a. The discriminator tube receives the if. signal from the second limiter on the plate (pin 2) of one half of the twin diode through coupling capacitor C371 and on the cathode (pin 1) of the other half of the twin diode through coupling capacitor C370. Consider first the action that takes place in the plate circuit (pin 2) of that side of the discriminator circuit which is responsive to frequencies slightly higher than 455 kc. The plate load for high frequency discrimination is a tuned circuit consisting of C375, C376, C377 and L371 all in parallel. This circuit is tuned to approximately 463 kc. Capacitor C375 is the main capacitive element in the tuned circuit. Capacitor C376 is a trimming capacitor which is set before the discriminator is hermetically sealed. Capacitor C377 is a temperature compensating capacitor, the value of which is determined by testing for individual discriminators. Inductance L371 is the inductive element in the tuned circuit. The amplitude of the input signal to the plate (pin 2) is a function of the frequency of the input signal since the impedance of the tuned plate circuit changes with frequency. The maximum plate voltage occurs at the resonant frequency 463 kc. As the frequency decreases from 463 kc the amplitude of the input signal likewise decreases. Therefore, the amplitude of the input signal to the high responsive half of the discriminator tube decreases as the frequency of the signal decreases from 463 kc. However, this is not a linear relationship. The amplitude of the input signal also decreases as the frequency of the signal increases from 463 kc but the discriminator does not operate in this range. Note that the higher harmonics of the input signal, which are due to distortion in the limiter, are bypassed to ground from the plate. This results because the reactance of the tuned circuit is predominantly capacitive at the harmonic frequencies and the capacitive reactance is very small when compared with the capacitive reactance of the coupling capacitor C371.

b. The output from the high responsive half of the discriminator tube appears on the cathode (pin 5) which is across the load resistor R371. This half of the discriminator tube operates as a detector with a positive envelope output. Capacitor C380 is a filter capacitor which maintains the output voltage at a high positive level, thus smooting out the envelope. Therefore, the output from the high responsive half of the discriminator circuit is positive and becomes more positive as the frequency of the input signal increases. The positive output signal is applied to the discriminator voltage division circuit, R372 and R373. Figure 56 shows the relative positive output from V379 pin 2 compared with other discriminator voltages.

c. The action that takes place in that side of the discriminator circuit which is responsive to frequencies slightly lower than 455 kc is essentially the same as for the high responsive side. However, the input and output connections are reversed as is the output voltage. In the low responsive side of the discriminator circuit the tuned circuit is the cathode load circuit. This circuit is tuned to approximately 447 kc. Capacitor C372 is the main capacitive element in the tuned circuit. Capacitor C373 is a trimming capacitor which is set before the discriminator is hermetically sealed. Capacitor C374 is a temperature compensating capacitor. Inductance L370 is the inductive element in the tuned circuit. The amplitude of the input signal to the cathode (pin 1) is a function of the frequency of the input signal since the impedance of the tuned circuit changes with frequency. The maximum cathode voltage occurs at the resonant frequency 447 kc and as the frequency increases from 447 kc the amplitude of the input signal decreases. Therefore, the amplitude of the input signal to the low responsive half of the discriminator tube decreases as the frequency of the signal increases from 447 kc. However, this is not a linear relationship. The amplitude of the input signal also decreases as the frequency of the signal decreases from 447 kc but the discriminator does not operate in this range. As in the high responsive half of the discriminator circuit, the higher harmonics of the input if. signal are bypassed to ground from the cathode.

d. The output from the low responsive half of the discriminator tube appears on the plate (pin 7) across the load resistor R370. This half of the discriminator tube operates as a detector with a negative envelope output. Capacitor C378 is a filter capacitor which maintains the output voltage at a high negative level, thus smooting out the envelope. Therefore, the output from the low responsive half of the discriminator circuit is negative and becomes more negative as the frequency of the input signal decreases. The negative output signal is applied to the discriminator voltage division circuit, R372 and R373. Figure 58 shows this negative output.

e. The positive voltage output from the cathode (pin 5) and the negative voltage output from the plate (pin 7) combine in the voltage division circuit, R372 and R373, to produce the error voltage output. One end of the voltage division circuit, R372, receives the negative voltage. This voltage varies nonlinearly from a negative maximum at 447 kc to nearly zero at 463 kc. The other end of the voltage division circuit, R373, receives the positive voltage. This voltage varies nonlinearly from a positive maximum at 463 kc to nearly zero at 447 kc. Thus opposite ends of the voltage division circuit receive voltages of opposite polarity. By taking the average voltage from the center of the voltage division circuit the nonlinear characteristic of the two input voltages cancel and the output is linear between certain frequency limits. The output voltage from the center of the voltage division circuit, between R372 and R371, is the error voltage and represents the deviation of the input signal from 455 kc. Figure 58 shows the results of averaging the positive and negative outputs from the discriminator. The capacitor C379 filters any harmonics from the output signal that may remain after the initial filtering by capacitors C378 and C380. The error voltage varies linearly from -4.2 v with a 452 kc input signal to +4.2 v with a 458 kc input signal. Therefore, a negative error voltage indicates an if. input signal below 455 kc to the radio frequency amplifiers; a positive error voltage indicates an if. input signal above 455 kc. The error voltage output from the discriminator circuit over this range is approximately 1.4 mc per cycle deviation. Figure 59 shows a typical discriminator characteristic. The error voltage from the discriminator results from either or both of two causes: (1) the mean carrier frequency output from the radio frequency oscillator is slightly different from the frequency to which the radio receiver is tuned, (2) frequency modulation or phase modulation is present. The latter of these is to be expected. Therefore, the modulation canceling circuit receives the error voltage and cancels out that portion due to modulation. The chopper G301 also receives the error voltage directly for conversion into an ac signal which is used during calibration (par. 91).

f. The discriminator circuit is a hermetically sealed unit which is kept at a constant 75°C operating temperature by a thermostatically controlled oven heater. The oven circuit is operated from the +28 v supply and consists of the OVEN ON indicator lamp I703, paralleled with a resistor R723, in series with the oven heater HR372 and the thermostat S370. When the oven temperature drops below 75°C the thermostat S370 closes the circuit to ground, thus turning on the oven heater and lighting the OVEN ON indicator. When the temperature reaches 75°C the thermostat opens the circuits. The capacitor C381 suppresses electrical noise so that it does not feed back into the +28 v supply.

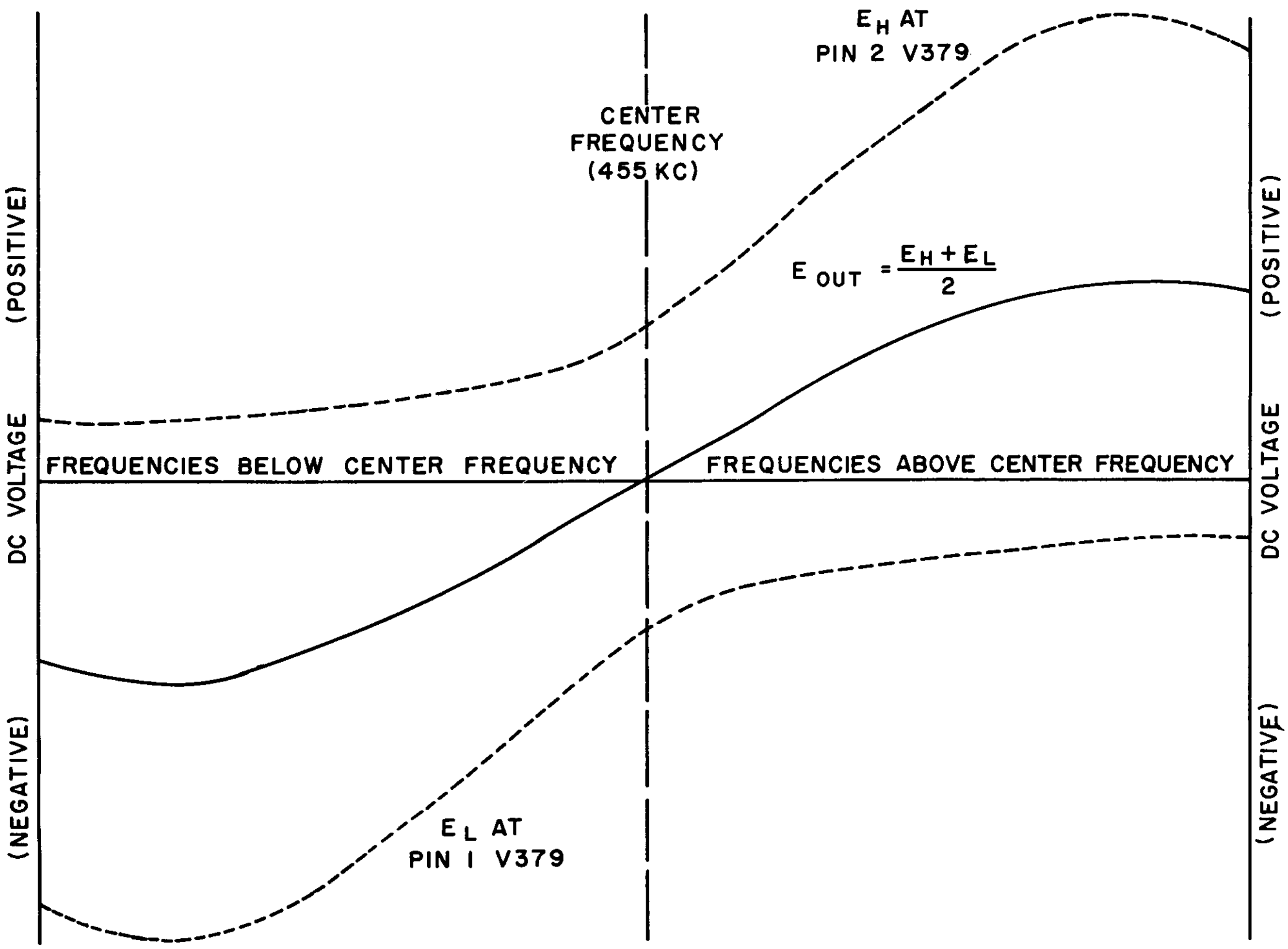


Figure 56. Variations of discriminator voltage with frequency.

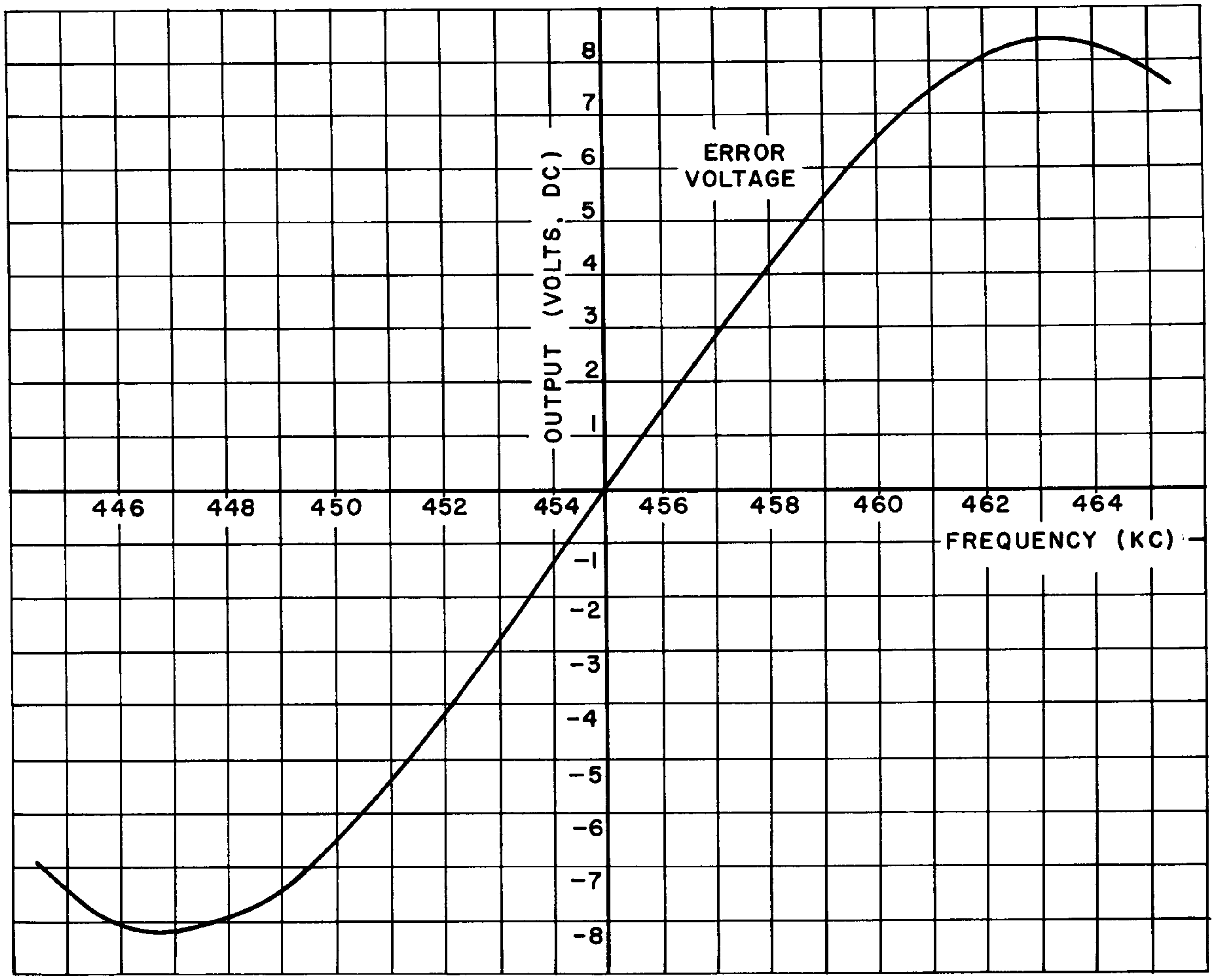


Figure 57. Discriminator characteristic curve.

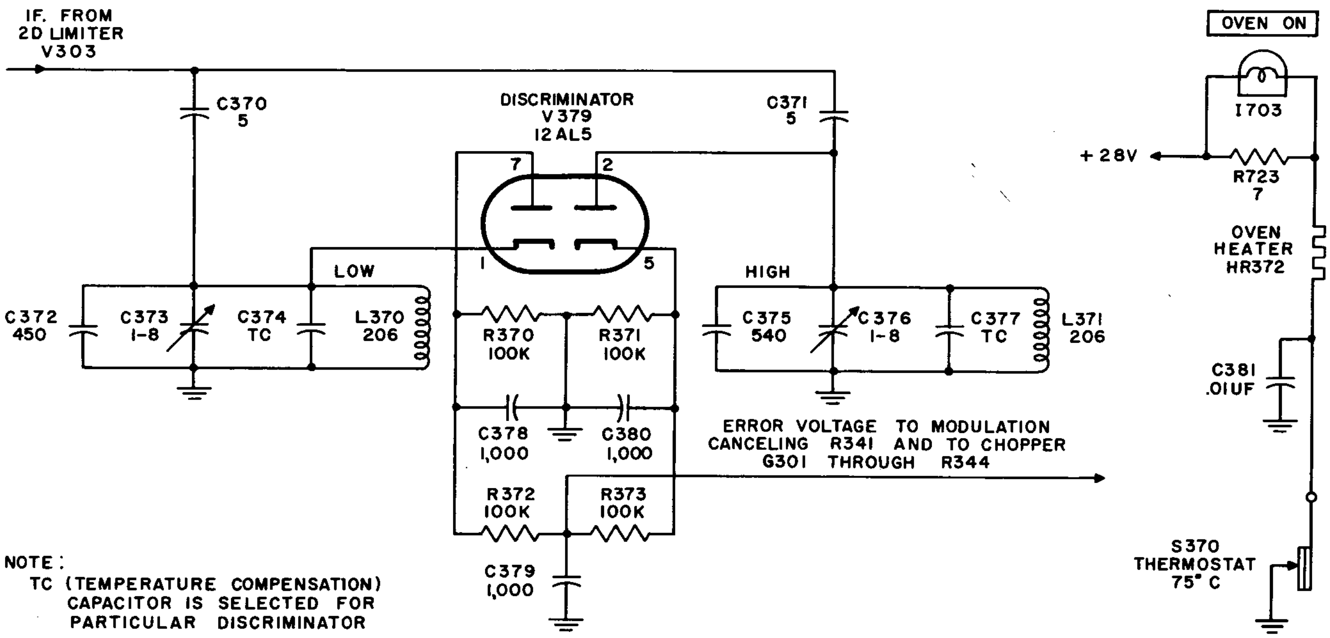


Figure 58. Discriminator, simplified schematic diagram.

89. Modulation Canceling
(fig. 60)

The modulation canceling circuit cancels that portion of the error voltage from the discriminator which is due to frequency modulation or phase modulation. The circuit is a voltage division circuit with the error voltage input to one end and the modulation voltage input to the other end. The output from the circuit represents the difference in frequency between the mean carrier frequency from the radio frequency oscillator and the frequency to which the radio receiver is tuned.

a. The modulation canceling circuit receives the error voltage from the discriminator at the top of the voltage division circuit on resistor R341. The error voltage is positive when the if. input to the radio frequency oscillator is above 455 kc and negative when the if. input is below 455 kc.

b. The modulation canceling circuit receives the modulation voltage across the MOD CANCEL VOLT ADJ potentiometer R712 from the modulation shorting relay K701. The MOD CANCEL VOLT ADJ potentiometer is aligned so that the modulation voltage component cancels out the error voltage when the radio frequency oscillator is in a stable condition (par. 145). The modulation phase adjusting circuit receives the modulation voltage from the MOD CANCEL VOLT ADJ potentiometer. The modulation phase adjusting circuit consists of resistor R726 in series with the MOD CANCEL PHASE ADJ potentiometer R725 which connects to ground through capacitor C701. The MOD CANCEL PHASE ADJ potentiometer varies the resistive component in this resistive-capacitive circuit which shifts the phase of the modulation voltage input. The MOD CANCEL PHASE ADJ potentiometer is aligned so that the modulation voltage component is in phase with the error voltage when the radio frequency oscillator is in a stable condition (par. 145). The bottom of the voltage division circuit, R343, receives the amplitude and phase adjusted modulation voltage. This voltage is equal in amplitude and 180° out of phase with that portion of the error voltage which is due to phase or frequency modulation. Therefore, the output voltage from the center of the voltage division circuit, between R341 and R343, is proportional to that component of the error voltage due to the difference between the mean carrier frequency output from the radio frequency oscillator and the frequency to which the radio receiver is tuned. This is the correction voltage which readjusts the tuned circuits so that the radio frequency oscillator output matches the frequency to which the radio receiver is tuned. The correction voltage is positive when the radio frequency oscillator output frequency is too high and negative when the output frequency is too low. Capacitor C342 filters the high frequency components from the correction voltage is applied to the servo damping voltage division circuit.

90. Servo Damping
(fig. 60)

The servo damping circuit is a voltage division circuit which reduces the correction voltage with a damping voltage from the rate generator. Reducing the correction voltage with the damping voltage prevents over-shooting by the servo tuning system and consequently prevents hunting by the servo tuning system. The servo damping circuit receives the correction voltage from the modulation canceling circuit at the top of the foltage division circuit on resistor R342. When the correction voltage is positive the servo system retunes the radio frequency oscillator down-band. When the correctionvoltage is negative the servo system retunes up-band. The servo damping circuit receives the servo damping voltage at the bottom of the voltage division circuit on resistor R401. When the servo system retunes down-band the servo damping voltage is negative and proportional to the speed of the servo motor. When the servo system retunes up-band the servo damping voltage is positive and proportional to the speed of the servo motor (par. 99). Therefore, the damping voltage is opposite in polarity from the correction voltage and varies as the speed of the servo tuning operation. The damped correction voltage output from the center of the voltage division circuit, between R342 and R341, is proportional to the average between the correction voltage and the damping voltage. The correction voltage approaches zero due to the corrective servo tuning operation. This, in turn, tends to slow down the servo tuning operation due to the decreased input signal. The damping voltage is of opposite polarity from the correction voltage and also approaches zero as the servo tuning operation slows down. By talking the damped correction voltage as the servo input signal, the servo input signal approaches zero at a slower rate during servo tuning. This prevents the servo tuning operation from over-shooting that position which produces zero correction voltage. The chopper receives the damped correction voltage from the servo damping circuit.

91. Chopper G301
(fig. 60)

a. The chopper is an electrical vibrator which makes and breaks a circuit at 60 cps and is used to conver the dc damped correction voltage into 60 cps square wave voltage. The chopper is located on the if. amplifier subchassis. The phase relationship between the output from the chopper and the 20 v ac power supply is important (fig. 59), since it is this phase relationship which determines the direction of the servo tuning operation. The 20 v ac power supply operates the chopper to make the contact (3-4) on the negative cycle and to break the contact (3-4) on the positive cycle. The chopper receives the damped correction voltage

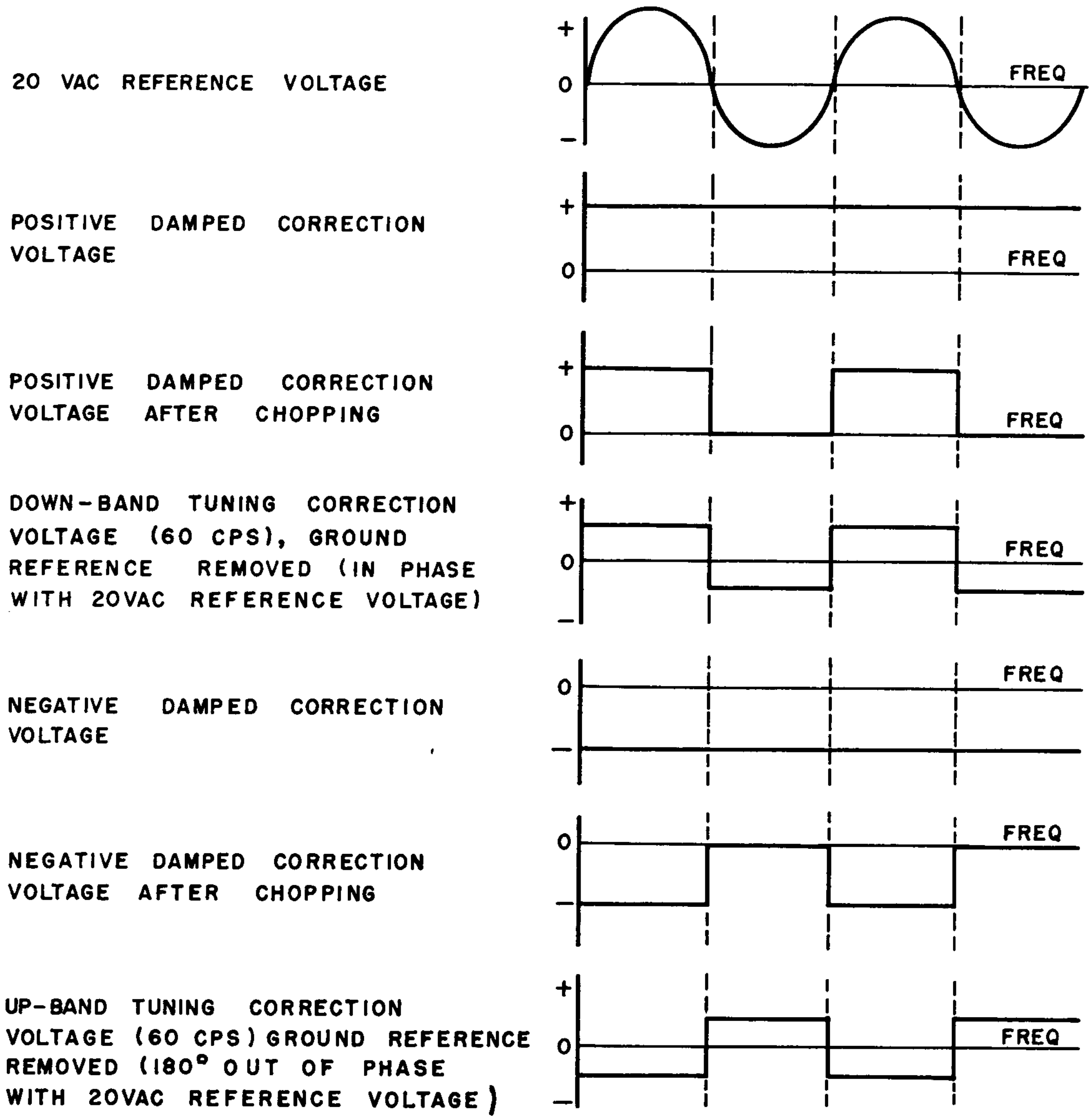


Figure 59. Phase relationship between chopper output and 20 v ac reference voltage.

from the servo damping circuit on terminal 4 and terminal 3 is grounded. Therefore, the damped correction voltage is grounded during the negative cycle of the 20 v ac reference. If the damped correction voltage is positive, indicating the necessity for down-band tuning, the output from the chopper is in phase with the 20 v ac reference following the removal of the ground reference by the coupling capacitor C401. If the damped correction voltage is negative, indicating the necessity for up-band tuning, the output from the chopper is 180° out of phase with the 20 v ac reference following the removal of the ground reference by the coupling capacitor C401. The servo amplifier amplifies the correction voltage (60 cps) output from the chopper before the servo motor receives the voltage. In so amplifying the correction voltage (60 cps) an effective 270° phase shift is introduced. Thus, if the damped correction voltage is positive, the servo motor receives a correction voltage which is 90° lagging the 20 v ac reference voltage and down-band tuning results. If the damped correction voltage is negative, the servo motor receives a correction voltage which is 90° leading the 20 v ac reference voltage and up-band tuning results (par. 99). The first servo amplifier V401A receives the damped correction voltage (60 cps) from the chopper through the coupling capacitor C401.

b. The chopper also receives the error voltage direct from the discriminator after the error voltage is reduced by the voltage division circuit R344 and R345. The chopper converts this dc voltage to an ac voltage for use during calibration. The first calibration amplifier V306B receives the error voltage (60 cps) from the chopper through coupling capacitor C344 (par. 104).

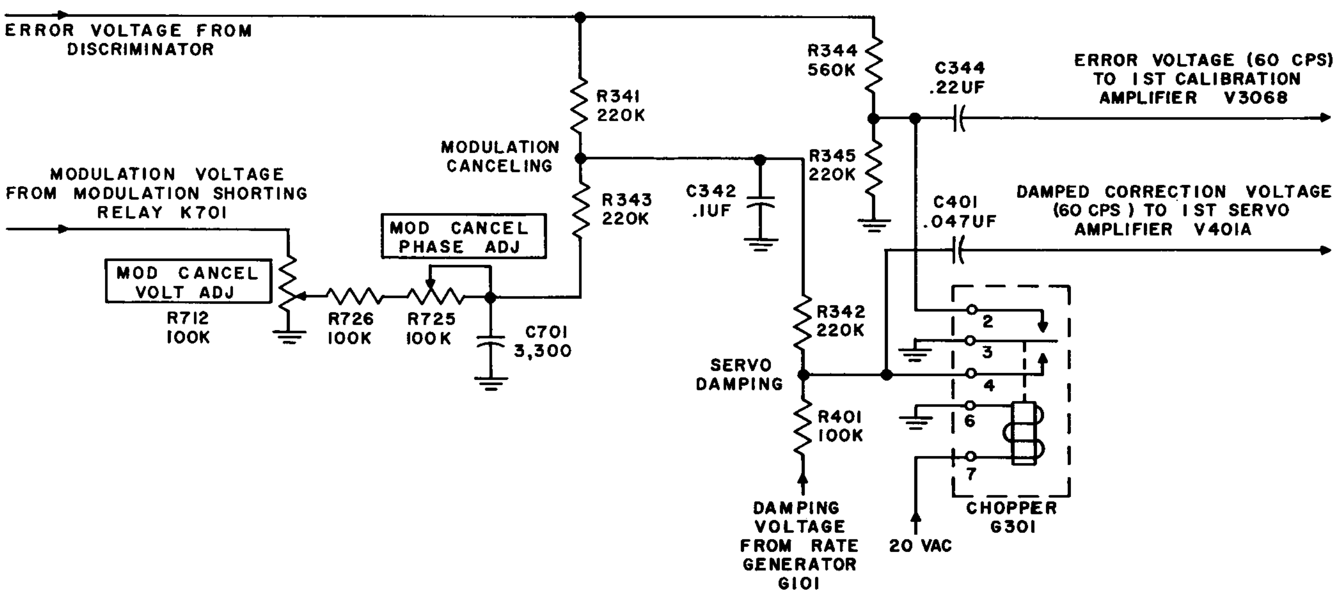


Figure 60. Modulation canceling, servo damping and chopper, simplified schematic diagram.

92. Relay Control If. Amplifier V304
(fig. 61)

The relay control if. amplifier V304 receives the if. signal and increases the amplitude of this signal for sensing by the relay control sensing detector V305A. This is a standard if. amplifier using a miniature pentode tube type 12AU6 and is located on the if. amplifier subchassis. The relay control if. amplifier receives the if. signal from the secondary of transformer T301. This is the output signal from the if. amplifier V301 and is the same signal received by the first limiter V302 (fig. 55). The control grid (pin 1) receives the signal through coupling capacitor C321. The grid leak circuit to ground is through resistor R321. The cathode resistor R322 provides tube bias. The suppressor grid (pin 2) is connected directly to the cathode (pin 7) and the cathode resistor is bypassed to ground by capacitor C322. Screen grid voltage is from the +180 v regulated supply through the decoupling circuit, R325 and C325, and through the plate load resistor R324. The output from the relay control if. amplifier is through the coupling capacitor C324 to the relay control sensing detector V305A. The presence of an if. signal to the sensing detector indicates that the radio frequency oscillator tuning circuit is under the control of the servo system. The absence of an if. signal to the sensing detector indicates that the servo circuit has lost control and that the radio frequency oscillator must scan the frequency spectrum and reposition at the frequency to which the radio receiver is tuned.

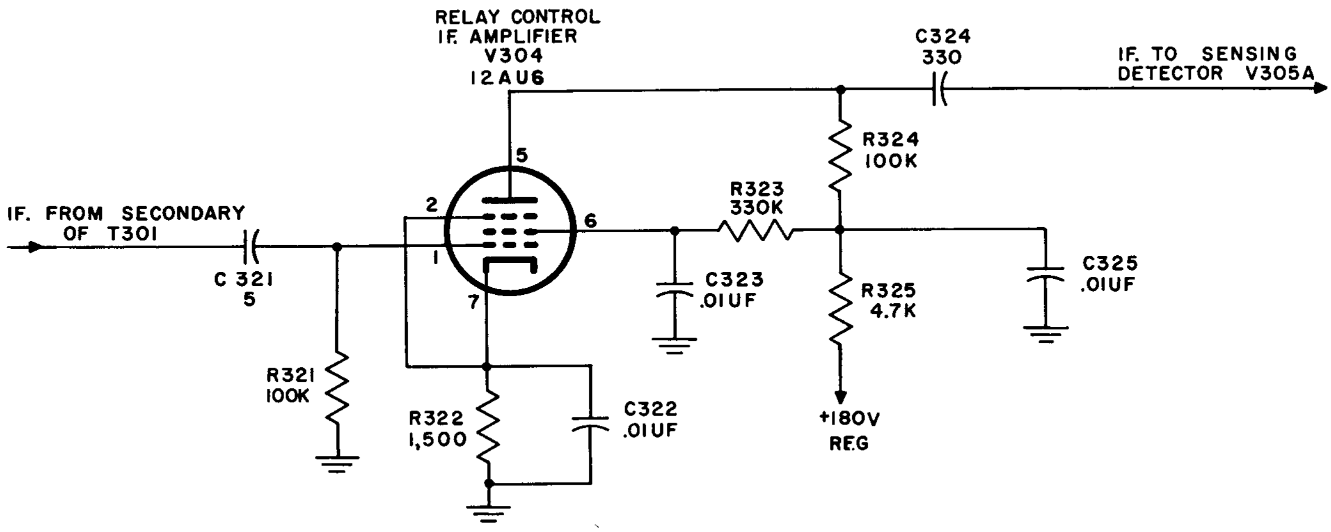


Figure 61. Relay control if. amplifier, simplified schematic diagram.

93. Relay Control Sensing Detector
(fig. 62)

The sensing detector senses for the presence or absence of an input if. signal. When an if. signal is present, the output from the sensing detector is negative. This holds the relay puller V305B below grid cut-off. When an if. input signal is absent, the output from the sensing detector is zero. This allows the relay puller to conduct. The sensing detector is half of a miniature twin triode type 12AT7 located on the if. amplifier subchassis. Cathode bias develops from the voltage division of the +180 v regulated supply across the voltage divider R326 and R327. Capacitor C326 bypasses the cathode (pin 3) to ground. The control grid (pin 2) and the plate (pin 1) are common so that the triode operates as a diode detector. The common grid-plate connects to ground through the load resistor R328. This is an inverted adaption of the common detector and gives the tube output a negative dc component when an input signal is present. With an if. signal to the common grid-plate, the sensing detector conducts on the positive half cycles of the input signal. In conducting dc plate current is drawn through the load resistor R328. This gives the plate voltage a negative dc component with respect to ground in addition to the input if. signal. This plate voltage develops across the filter R329 and C327. Since capacitor C327 of this filter has a small reactance for the if. component, the if. component of the signal is bypassed to ground from the control grid of the bandpass relay puller V305B. Therefore, the input signal to the bandpass relay puller consists only of the negative dc component developed in the sensing detector plate circuit. This negative dc component, although developed as negative pulses, is smoothed out by the action of the filter R329 and C327. Therefore, the relay puller V305B receives a negative dc voltage from the filter when there is an if. input signal to the radio frequency oscillator. In the absence of an if. input signal, the output from the relay control sensing detector is ground potential to the relay puller. This ground potential results from the grid circuit of the bandpass relay puller through resistors R329 and R328 to ground.

94. Bandpass Relay Puller V305B and Bandpass Relay K401 (fig. 62)

The bandpass relay puller V305B controls the operation of the bandpass relay. With an if. input signal to the radio frequency oscillator, the bandpass relay is de-energized and the servo system controls the fine tuning necessary to keep the radio frequency oscillator on frequency. In the absence of an if. input signal, the bandpass relay energizes to initiate a positioning operation. During a positioning operation the radio frequency spectrum is scanned in search of the frequency to which the radio receiver is tuned. Also in the absence of an if. input signal, an ac voltage is gated through the bandpass relay puller. This signal becomes the fine positioning voltage which operates the servo motor during the fine positioning part of the overall positioning operation.

a. The bandpass relay puller V305B is half of a miniature twin triode type 12AT7 located on the if. amplifier subchassis. The bandpass relay K401 is located on the servo amplifier subchassis. The plate (pin 6) of the bandpass relay puller connects to the +180 v regulated supply through the bandpass relay operating coil. The control grid receives a dc signal from the filter circuit, R329 and C327, of the sensing detector V305A. The cathode resistor R330 provides tube bias to the cathode (pin 8). The cathode also connects to the 20 v ac supply through the coupling capacitor C328.

b. With the presence of an if. input signal to the radio frequency oscillator, the control grid of the bandpass relay puller is held negative due to the action of the sensing detector. Thus the tube is cut-off and the 20 v ac signal applied to the cathode does not traverse the tube. With the bandpass relay puller cut-off, the bandpass relay is de-energized. With the bandpass relay de-energized, the first servo amplifier cathode is grounded through relay contact 5-6. This allows the servo amplifier to amplify the damped correction voltage and the servo system holds the radio frequency oscillator on frequency (par. 95). Also, with the bandpass relay de-energized, the rf. power amplifier cathode is grounded through relay contact 2-3. This allows the rf. power amplifier to produce an rf. output to the associated transmitter (par. 83).

c. In the absence of an if. input signal to the radio frequency oscillator, the control grid of the bandpass relay puller is grounded through resistors R330 and R328 in series because the sensing detector develops no negative signal (par. 93). Thus, the tube conducts and draws plate current through the bandpass relay coil to energize the relay. Also, when the tube conducts, the 20 v ac signal traverses the tube from the cathode to the plate. With the bandpass relay energized, the first servo amplifier ground circuit through the relay contact 5-6 is open and the amplifier receives the 60 cps fine positioning voltage from the plate of the relay puller through the coupling capacitor C413. When the bandpass relay opens this ground circuit of the first servo amplifier, the cathode resistor R405 provides the cathode bias from ground (par. 95). The energized bandpass relay also provides a ground for operating the modulation shorting relay K701 and for the coarse positioning motor control circuit. Thus the modulation voltage to the modulation canceling circuit and the reactance-tube oscillator is shorted out (par. 73). Also, the coarse positioning motor circuit is energized to initiate a positioning operation to locate the frequency to which the radio receiver is tuned (par. 103). Also, with the bandpass relay energized, the rf. power amplifier cathode ground circuit is opened. This disables the power amplifier to interrupt the rf. output to the associated transmitter during the positioning operation (par. 83).

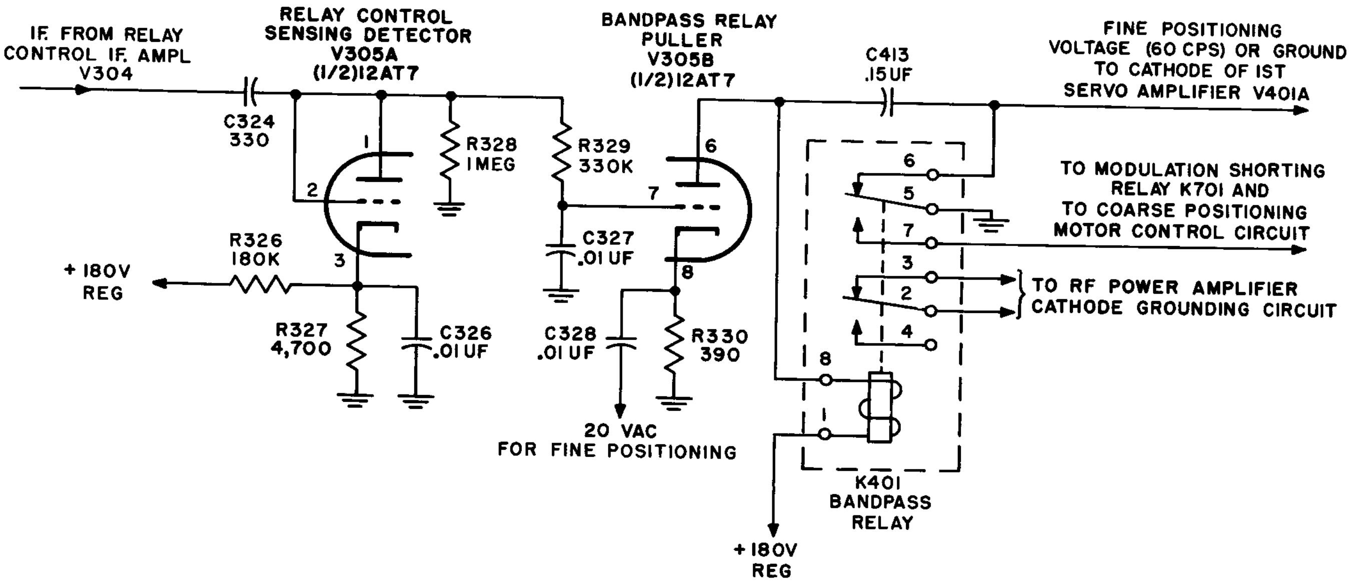


Figure 62. Relay control sensing detector, relay puller and bandpass relay, simplified schematic diagram.

95. First Servo Amplifier V401A (fig. 63)

The first servo amplifier increases the amplitude of either the damped correction voltage (60 cps) from the chopper G301 or the fine positioning voltage (60 cps) from the bandpass relay puller V305B. The first servo amplifier is half of a miniature twin-triode type 12AY7 located on the servo amplifier subchassis. The control grid (pin 2) receives the damped correction voltage (60 cps) from the chopper G301 through coupling capacitor C401. This signal is present only when there is an if. input signal to the radio frequency oscillator from the radio receiver. Grid leak resistor R404 and coupling capacitor C401 provide grid leak bias for the tube. With an if. input signal present, the cathode (pin 3) is grounded through bandpass relay K401 contact 5-6. In the absence of an if. input signal to the radio frequency oscillator, the cathode (pin 3) receives the fine positioning voltage (60 cps) from the bandpass relay puller V305B through coupling capacitor C413. When the fine positioning voltage is present, the bandpass relay K401 is energized which replaces the cathode ground with the cathode bias resistor R405 (par. 94). Plate voltage is from +250 v supply through the coupling circuit, which consists of resistors R416 and R410 and capacitors C406 and C404, and the plate load resistor R406. The second servo amplifier V401B receives the output from the first servo amplifier through coupling capacitor C402.

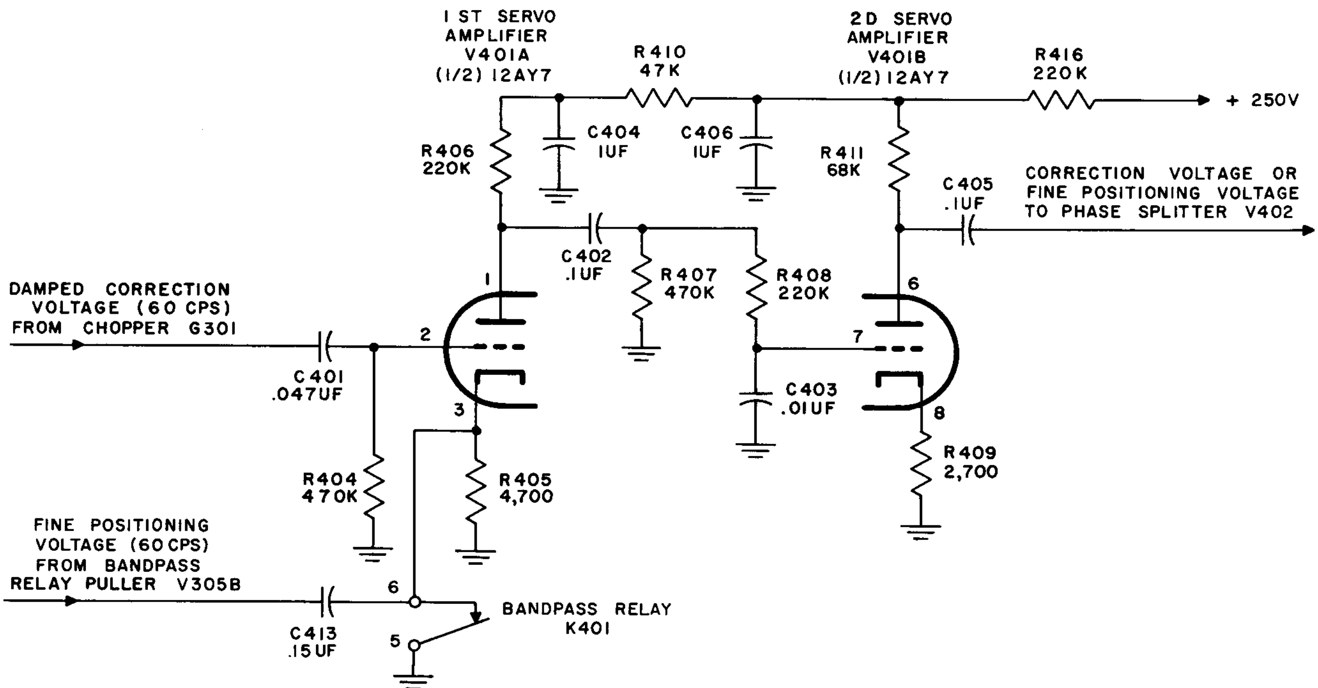


Figure 63. **First and second servo amplifiers, simplified schematic diagram.**

96. Second Servo Amplifier V401B (fig. 63)

The second servo amplifier provides a second stage of amplification for the damped correction voltage (60 cps) or the fine positioning voltage (60 cps) from the first servo amplifier. In addition, the phase of the input signal to the second servo amplifier is advanced 45° from the output signal of the first servo amplifier. The second servo amplifier is half of a miniature twin-triode type 12AY7, located on the servo amplifier subchassis. The phase-shifting circuit R408 and C403 receives the output signal from the first servo amplifier V401A through coupling capacitor C402. At 60 cps frequency the capacitive reactance of C403 approximately equals the resistance of R408. Therefore, the voltage across the capacitor is approximately 45° leading the voltage across the phase-shifting circuit. In addition, capacitor C403 tends to bypass higher harmonic frequencies to ground. This tends to make the servo signal a sine wave even though the original damped correction voltage was a square wave. The control grid of the second servo amplifier receives the phase-shifted signal. Resistors R407 and R408 provide a series grid leak circuit to ground. The cathode resistor R409 provides tube bias. Plate voltage is from the +250 v supply through decoupling resistor R416 and plate load resistor R411. Capacitor C406 provides decoupling to prevent ac feedback into the +250 v supply. The phase splitter V402 receives the correction voltage or fine positioning voltage from the second servo amplifier.

97. Phase Splitter V402
(fig. 64)

The phase splitter V402 receives the correction voltage or fine positioning voltage from the second servo amplifier and provides push-pull output to the servo output amplifier. In addition, the phase of the input signal to the phase splitter is advanced 45° from the output signal of the second servo amplifier. The phase splitter uses both halves of a miniature twin-triode type 5814 located on the servo amplifier subchassis.

a. The phase-shifting circuit R413 and C407 receives the output signal from the second servo amplifier V401B through coupling capacitor C405. At 60 cps frequency the capacitive reactance of C407 approximately equals the resistance of R413. Therefore, the voltage across the capacitor is leading the voltage across the phase-shifting circuit by approximately 45°. This phase shift along with the phase shift in the second servo amplifier circuit (par. 96) makes a total phase shift of approximately 90° from the original input signal to the first servo amplifier. Capacitor C407 also tends to bypass higher harmonic frequencies to ground. One control grid (pin 2) of the phase splitter receives the phase-shifted signal. Resistors R412 and R413 provide a series grid leak circuit to ground. The common cathode resistor R415 provides tube bias. Plate voltage is from the +250 v supply through the plate load resistor R417. The other control grid (pin 7) of the other half of the phase splitter receives a portion of the output voltage from the plate circuit of V402A. The voltage division circuit R419 and R420 receives the output from the plate (pin 1) of V402A through the coupling capacitor C408. The portion of this signal received by the control grid (pin 7) of V402B is such that the amplitude of the output from V402B equals the amplitude of the output from V402A. Resistor R420 provides the grid leak circuit to ground for V402B and the common cathode resistor R415 provides cathode bias. Plate voltage is from the +250 v supply through the plate load resistor, R418.

b. The amplitude of the output signal from the plate (pin 6) of V402B equals the amplitude of the output signal from the plate (pin 1) of V402A. However, since these two output signals are developed from the same input signal, and since the output from V402B is amplified by an additional stage, the two outputs are 180° out of phase. The servo output amplifier receives the correction voltage or fine positioning voltage push-pull output from the phase splitter. V403 receives the output from V402A through coupling capacitor C409 and V404 receives the output from V402B through couping capacitor C410. The voltage measured between these two outputs is twice the voltage measured from either output to ground.

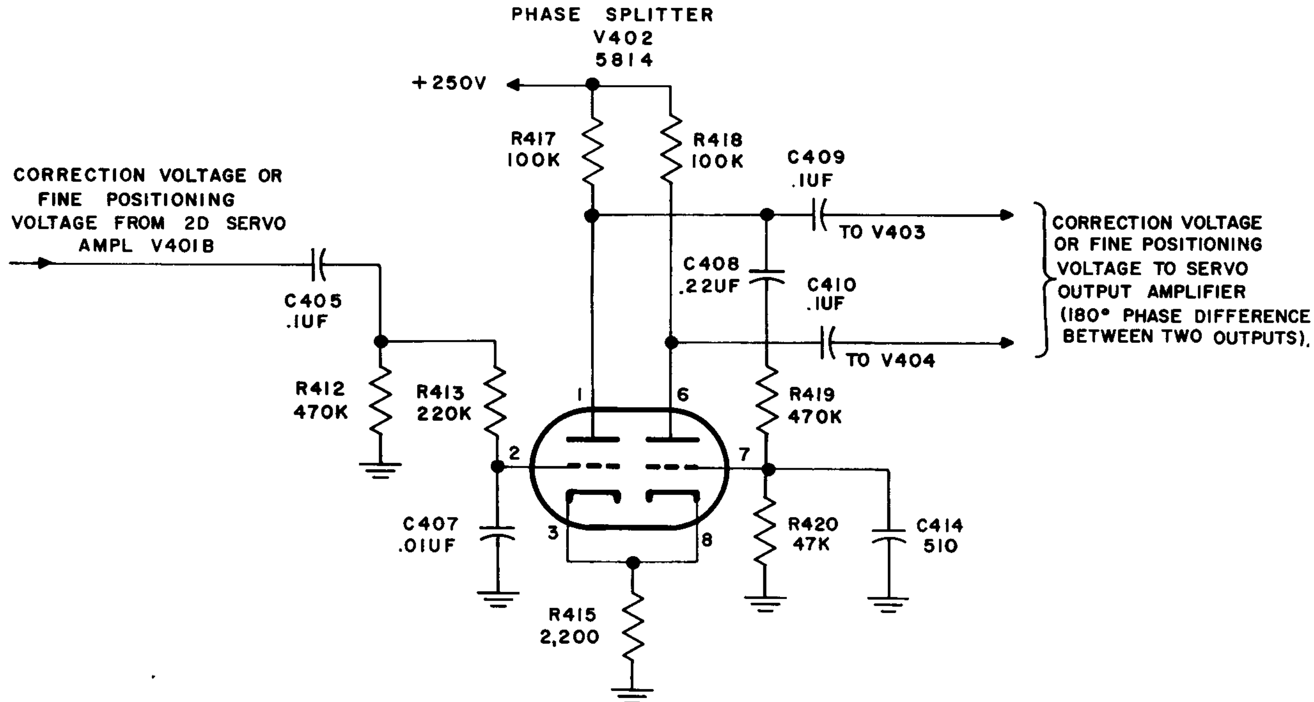


Figure 64. Phase splitter, simplified schematic diagram

98. Servo Output Amplifier V403 and V404
(fig. 65)

The servo output amplifier is a push-pull amplifier which receives the correction voltage or fine positioning voltage from the phase splitter and develops the power necessary to operate the servo motor. The servo output amplifier uses two miniature beam power tetrodes type 6005/6AQ5W located on the servo amplifier subchassis.

a. The control grid (pins 1 and 7) of V403 receives the output from phase splitter V402A and the control grid (pins 1 and 7) of V404 receives the output from phase splitter V402B. These two inputs are equal in amplitude and 180° out of phase. Resistors R421 and R422 provide grid leak circuits to ground for V403 and V404 respectively. Resistor R423 provides common cathode bias to both tubes. Screen grid voltage is from the +250 v supply through the common screen grid voltage dropping resistor R424 to the screen grid (pin 6) of both tubes. Plate voltage for V403 is from the +250 v supply through one half of the output transformer T401 primary to the plate (pin 5). Plate voltage for V404 is from the +250 v supply through the other half of the output transformer primary. Note that with this plate voltage supply, dc plate components are in opposite directions through the transformer primary. Thus the resulting magnetic fields due to the dc plate components cancel each other. This prevents magnetic saturation of the transformer core.

b. The servo output amplifier is a common push-pull type of power amplifier. Both tubes operate class A just above the point where the negative swing of the input signal will not produce grid cut-off. When operating in the lower, non-linear portion of their characteristic curves, the change in plate current during the negative half of the input signal is considerably less than the change in plate current during the positive half of the input signal. When the input signal to V403 is positive the plate current through V403 increases sharply and draws an increasing current through the primary of the output transformer T401 from the center tap to the plate of V403. While the input signal to V403 is positive the input signal to V404 is negative. The negative input signal to V404 decreases the plate current through V404 slightly and draws a decreasing current through the primary of the output transformer from the center tap to the plate of V404. These simultaneous current changes in the transformer primary produce opposing flux in the transformer; however, since the decreasing current change is much less than the increasing current change, the resultant flux change in the transformer depends primarily on the increasing current change. It can be shown graphically that the effect of the decreasing current change in the transformer, rather than being detrimental, actually cancels even harmonic components from the output. During the other half of the input signal, the input to V403 is negative while the input to V404 is positive. During this half of the input signal the operation of the push-pull amplifier reverses as the sharply increasing current change is present in the plate circuit of V404 while the slightly decreasing current change is present in the plate circuit of V403. Thus the resultant flux change in the transformer is reversed. The capacitor C411 across the primary of the transformer is a phase correction capacitor. The servo motor B101 and the afc indicator relay K402 receive the servo output from T401 which is the correction voltage or the fine positioning voltage.

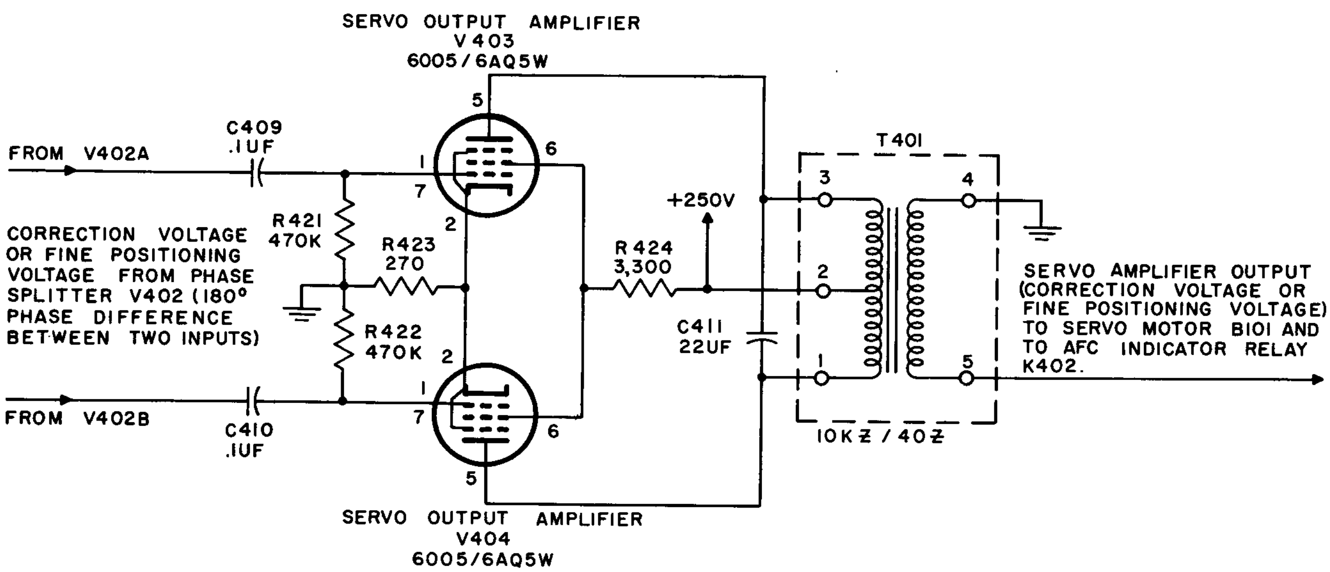


Figure 65. Servo output amplifier,
simplified schematic diagram.

99. Servo Motor B101 (fig. 66)

The servo motor receives the correction voltage or fine positioning voltage from the servo output transformer T401 and provides mechanical power to the tuning linkage. The servo motor is a two-phase induction motor mounted on the gear plate.

a. The 20 v ac supply provides the voltage for the reference winding of the servo motor through the FUNCTION switch S707 section C when the switch is in either the OPERATE or the CAL EXC position. High frequency voltages developed in the reference winding are bypassed to ground through capacitor C702. The correction voltage or fine positioning voltage from the servo amplifier output transformer T401 provides the voltage for the control winding of the servo motor. It is the phase relationship between the control winding voltage and the reference winding voltage that determines the direction of rotation of the servo motor. Consider the fine positioning voltage which operates the servo motor to tune the radio frequency oscillator up-band. This voltage initially develops in the bandpass relay puller V305B from the 20 v ac supply. No phase shift of this signal results from the amplification by the bandpass relay puller V305B or from the amplification by the first servo amplifier V401A since the signal is received on the cathodes of these two tubes. The phase-shifting circuit R408 and C403 of the second servo amplifier input circuit (fig. 63) advances the phase 45° and the amplification by the second servo amplifier V401B advances the phase an additional 180°. The phase-shifting circuit R413 and C407 of the phase splitter input circuit (fig. 64) advances the phase 45° and the phase splitter V402 advances the phase 180°. The push-pull servo output amplifier V403 and V404 advances the phase 180° as does the servo output transformer T401. The total phase shift during the development of the fine positioning voltage as received by the servo motor, is 810°, or effectively 90°. Thus, the fine positioning voltage is 90° leading the 20 v ac supply. Therefore, with the fine positioning voltage on the control winding of the servo motor and the 20 v ac supply on the reference winding, the servo motor runs in the direction to produce up-band tuning.

b. The phase relationship of the correction voltage to the reference voltage is developed in a similar manner. The correction voltage, as developed by the chopper G301, is initially in phase with the 20 v ac supply if down-band tuning is required (par. 91). A total phase shift of 990° results from the combined effect of the four stages of servo amplification, the two phase-shifting circuits, and the servo output transformer. Thus, the correction voltage applied to the control winding of the servo motor is effectively 90° lagging the 20 v ac reference voltage and the servo motor runs in the direction to produce down-band tuning. The correction voltage, as developed by the chopper, is initially 180° out of phase with the 20 v ac supply if up-band tuning is required. The 990° phase shift results in a 90° leading voltage being applied to the reference winding to produce up-band tuning.

c. The servo motor operates the mechanical tuning linkage which positions the powdered iron cores in the tuning coils of the reactance tube oscillator, the rf. doublers and the impedance matching networks. If the fine positioning voltage is present, the correction voltage is absent. In this event, the coarse positioning motor control circuit controls the tuning linkage as the radio frequency oscillator repositions at the frequency to which the radio receiver is tuned. During the fine positioning portion of this overall positioning operation, the servo motor supplies power to the mechanical tuning linkage through the "fast drive". After the positioning operation is complete, the fine tuning voltage is replaced by the correction voltage which holds the radio frequency oscillator on frequency. Thus, the servo system assumes control of the tuning and the servo motor delivers power to the mechanical tuning linkage through the normal drive. A system of interrelated clutches provides the means for shifting from the "fast drive" to the "normal drive" at the proper time (par. 103).

100. Afc Indicator Relay K402 (fig. 66)

The servo output from the servo output transformer T401 controls the afc indicator relay K402. This relay is located on the servo amplifier subchassis. When the rf output is within approximately 50 cps of the frequency to which the radio receiver is set, the correction voltage is not sufficient to operate the afc indicator relay so the relay remains de-energized. When de-energized, the afc indicator relay contact 2-3 completes the AFC indicator I702 circuit to ground. The 6.3 v ac supply provides voltage to the AFC indicator through the FUNCTION switch S707 section B when the switch is in either the OPERATE or the CAL EXC position. The lit AFC indicator indicates that the radio frequency oscillator is on frequency. If the rf output is not within approximately 50 cps of the frequency to which the radio receiver is tuned, the correction voltage is sufficient to operate the afc indicator relay. Although the correction voltage is ac, the crystal CR401 rectifies the input to the afc indicator and capacitor C412 maintains the rectified input at a high level. When energized the afc indicator relay contact 2-3 opens the AFC indicator circuit to extinguish the AFC indicator light. This indicates that the radio frequency oscillator is not on frequency. Also, when the afc indicator relay energizes, contact 2-4 closes to provide a ground which enables the coarse positioning motor control circuit. In the event that the correction voltage and the servo system bring the radio frequency oscillator back on frequency, the afc indicator relay de-energizes to disable the coarse positioning motor control circuit and no positioning operation occurs. In the event that the correction voltage and the servo system do not bring the radio frequency oscillator back on frequency, the fine positioning voltage replaces the correction voltage. The afc indicator relay remains energized and a positioning operation occurs (par. 103). Upon locating the proper frequency, the afc indicator relay de-energizes to open the ground circuit in the coarse positioning motor control circuit. This terminates the positioning operation.

101. Rate Generator G101 (fig. 66)

The servo motor B101 drives the rate generator which, in turn, produces the damping voltage. The damping voltage electrically damps the mechanical operation of the servo system. The rate generator is a dc generator located on the gear plate. The output from the rate generator opposes the correction voltage (dc) output from the modulation canceling circuit and is used in the servo damping circuit (par. 90). When the correction voltage (dc) is positive the servo motor tunes down-band. This produces a negative output from the rate generator proportional to the speed of the servo motor. When the correction voltage (dc) is negative, up-band tuning results and the output from the rate generator is positive and proportional to the speed of the servo motor. The

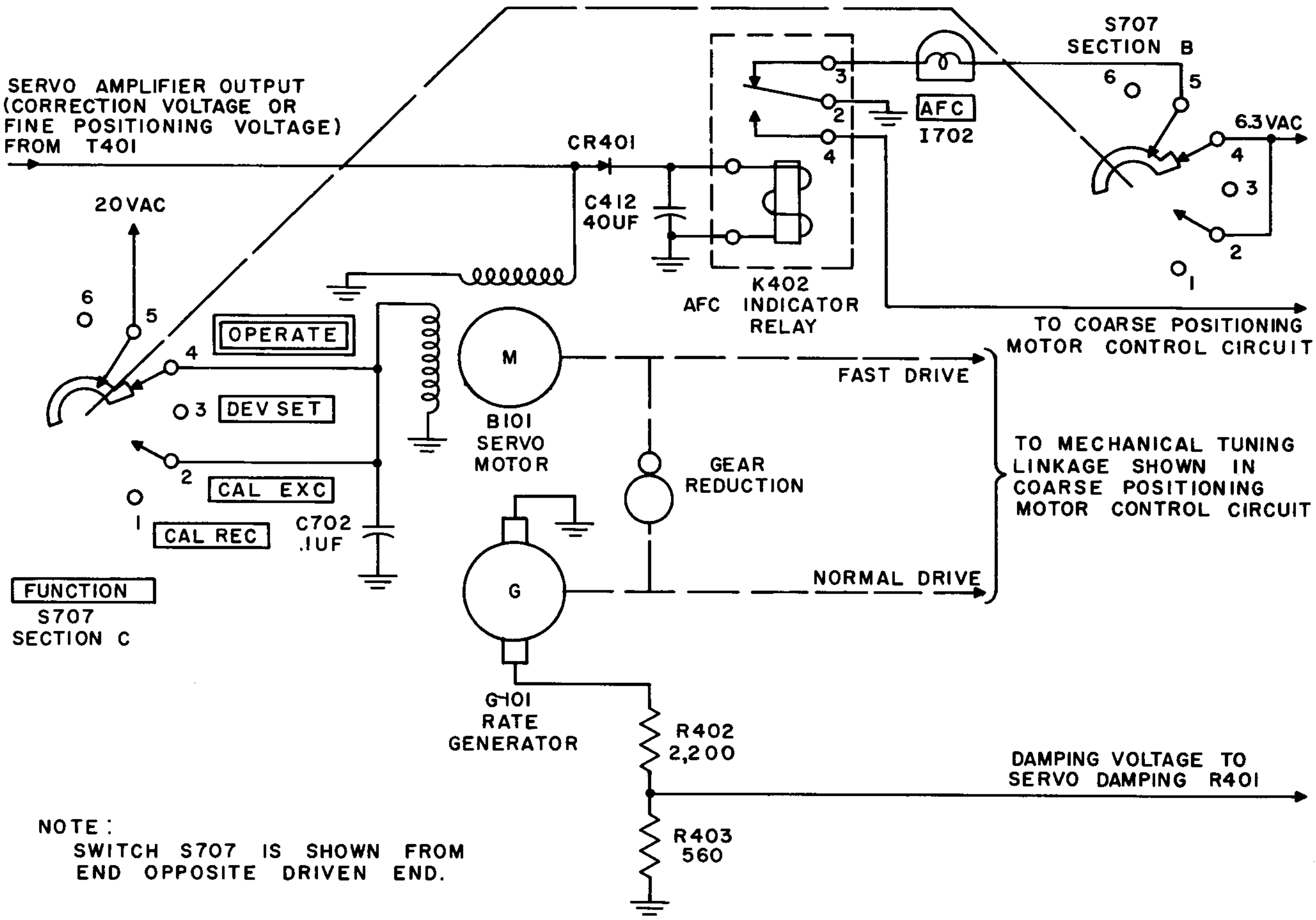


Figure 66. Servo motor, afc indicator relay and rate generator, simplified schematic diagram.

voltage division circuit R402 and R403 divides the rate generator output so that the servo damping voltage is only part of the actual output from the rate generator. The servo damping circuit combines the inverse damping voltage with the correction voltage so that the damped correction voltage approaches zero at the slow rate as the radio frequency oscillator corrects the frequency (par. 90). This prevents overshooting and hunting by the servo tuning system.

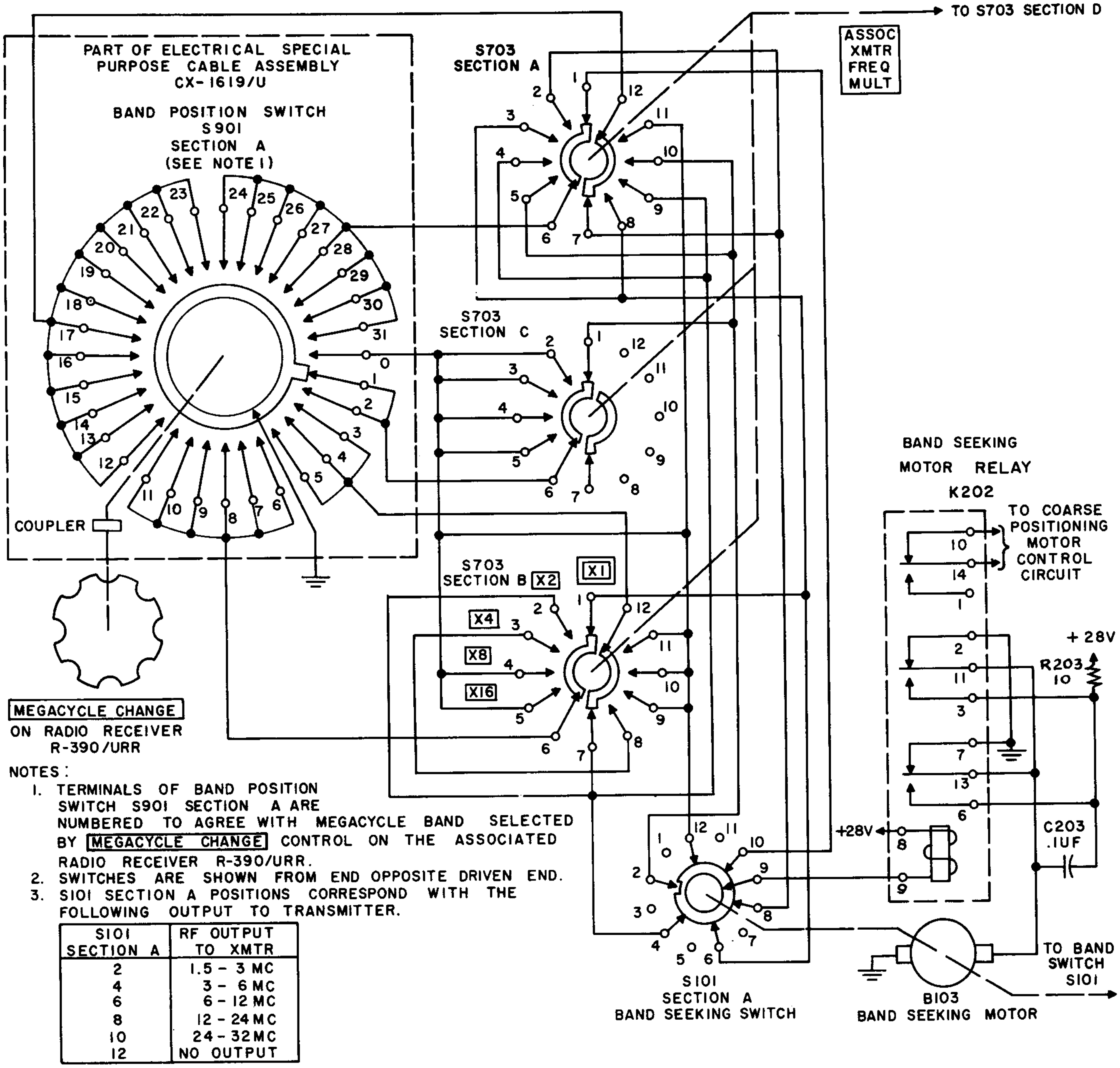
102. Band Seeking Motor Control Circuit (fig. 67)

The band seeking motor control circuit operates the band seeking motor B103 which drives the band switch S101. The band switch completes the circuit between the required rf doublers and the rf power amplifier V107 and the circuit between the rf power amplifier and the required impedance matching network to the 50 OHM OUT jack J814. The band seeking motor control circuit is a series control circuit consisting of the band position switch S901 section A, the ASSOC XMTR FREQ MULT switch S703 sections A, B and C, the band seeking switch S101 section A, and the band seeking motor relay K207.

a. The band position switch S901 section A is located in the band switch adapter termination of Electrical Special Purpose Cable Assembly CX-1619/U. This cable attaches to the rear of the associated Radio Receiver R-390/URR. The switch mechanically couples to the MEGACYCLE CHANGE control gear train of the radio receiver through the SYNC XTAL OSC shaft positioning slot on the rear of the radio receiver. The gear train of the radio receiver, along with gear linkage in the special purpose cable termination, translates the position of the MEGACYCLE CHANGE control of the radio receiver into one of 32 switch positions. In figure 67, terminal numbers of band position switch S901 section A indicate the megacycle position of the MEGACYCLE CHANGE control. The rotor of the band position switch provides the ground for the band seeking motor control circuit and the circuit continues from the terminals of the switch through the ASSOC XMTR FREQ MULT switch S703 sections A, B and C to the band seeking switch S101 section A. Changing the position of the MEGACYCLE CHANGE control results in a corresponding change in the rotor position of S901 section A. However, a band switching operation does not result when the MEGACYCLE CHANGE control is moved between 1 mc and 3 mc, between 3 mc and 6 mc, between 6 mc and 12 mc, between 12 mc and 24 mc, or between 24 mc and 32 mc.

b. The band seeking switch S101 section A is an open circuit seeking switch which continues the ground circuit to the band seeking motor relay K207 operating coil. With the operating coil grounded the relay energizes and the contacts 3-11 and 6-13 close the +28 v circuit of the band seeking motor B103. Thus the motor operates and drives S101 until S101 section A is in the position which opens the ground circuit of the operating coil of K207. At this time K207 de-energizes and replaces the +28 v supply to the motor with ground which dynamically brakes the motor. Capacitor C203 is an arc suppressing capacitor across the motor operating contacts of the relay. While operating, the band seeking motor drives the band switching sections of S101 sections B, C, D, E, F, G, H and J to positions corresponding to section A. Section B switches in the required modulation voltage division circuit (par. 75). Sections C through G switch in the required rf doublers (par. 78, through par. 81). Sections H and J switch in the required impedance matching network (par. 82 and 84). Normally closed contact 10-14 of relay K207 connects into the coarse positioning motor control circuit to prevent the initiation of a positioning operation until the conclusion of the band switching operation (par. 103).

c. The ASSOC XMTR FREQ MULT switch S703 sections A, B and C switches the ground input of the band position switch S901 section A to different terminals of the band seeking switch S101 section A to compensate for frequency multiplication in the transmitter. For instance, if the radio receiver is tuned to the 24-mc band and the associated transmitter quadruples the rf received from the radio frequency oscillator, the radio frequency oscillator must tune to the 6-mc band. In this case, the ground circuit from the band position switch is from the rotor through terminal 24 to terminal 6 of S703 section A. With the ASSOC XMTR FREQ MULT switch in the X4 position, the circuit continues from terminal 6 of S703 section A out terminal 3 to the band seeking switch S101 section A terminal 6. With the ground applied to terminal 6 the band seeking motor will drive S101 to switch the radio frequency oscillator to the 6 mc to 12 mc range. Thus the radio frequency oscillator will produce an rf output to the transmitter that is a subharmonic frequency of the frequency to which the radio receiver is tuned. After multiplication by the transmitter, the rf output from the transmitter will be the frequency to which the radio receiver is tuned. The ASSOC XMTR FREQ MULT switch compensates for frequency doubling by the transmitter when in the X2 position, quadrupling when in the X4 position, multiplication by eight when in the X8 position, and multiplication by 16 when in the X16 position.



S101 SECTION A	RF OUTPUT TO XMTR
2	1.5 - 3 MC
4	3 - 6 MC
6	6 - 12 MC
8	12 - 24 MC
10	24 - 32 MC
12	NO OUTPUT

Figure 67. Band seeking motor circuit, simplified schematic diagram.

When there is no frequency multiplication by the associated transmitter, the switch is in the X1 position and the radio frequency oscillator tunes to the frequency to which the radio receiver is tuned.

103. Coarse Positioning Motor Control Circuit (fig. 68)

a. General. The operation whereby the radio frequency oscillator circuits tune to the frequency set on the associated radio receiver is called a positioning operation. The coarse positioning motor control circuit controls the positioning operation. A positioning operation consists of three major parts. (1) First, the tuning linkage coarsely positions at the megacycle position below the desired frequency. (2) Second the tuning linkage finely positions to within a few kilocycles of the desired frequency. (3) Third the tuning linkage finely tunes to the exact desired frequency. The coarse positioning motor control circuit operates the coarse positioning motor B102 and controls the clutching mechanism between the mechanical output of the coarse position motor B102 and the servo motor B101. These two motors, through the clutching mechanism, drive the tuning linkage which positions the powdered iron cores of the permeability tuned coils in the reactance-tube oscillator, the rf doublers and the impedance matching networks. The main components in the circuit are as follows: (1) the mc position switch S901 section B which is located in the band switch adapter termination of Electrical Special Purpose Cable Assembly CX-1619/U and is mechanically coupled to the MEGACYCLE CHANGE control gear train of Radio Receiver R-390/URR so that the switch position indicates the megacycle position of the MEGACYCLE CHANGE control of the radio receiver; (2) the oscillator positioning switch S103 and the limit switch S102; (3) the motor operate relay K206, the reverse relay K205 and the recycle relay K204; (4) the coarse positioning motor B102; and (5) the mechanical clutches operated by operating coils L125 and L126. Normally open contacts of the band-pass relay K401 (par. 94) and the afc indicator relay K402 (par. 100) also play major roles in the operation of the circuit. The circuit receives +28 v operating voltage through the FUNCTION switch S707 section C when the switch is in the OPERATE position. When the FUNCTION switch is in either the DEV SET, CAL EXC or CAL REC position, the motor control circuit is disabled. The coarse positioning motor control circuit controls the operation of the coarse positioning motor B102 and the mechanical output from both the coarse positioning motor and the servo motor when the radio frequency oscillator tunes to the frequency to which the associated radio receiver is set. Subparagraphs b through e below are step by step discussions of the operation of the coarse positioning motor control circuit under various conditions. Subparagraph f below relates the position of oscillator positioning switch S103 with the rf output from the radio frequency oscillator.

b. Operation when MEGACYCLE CHANGE Control is Moved. Assume, for the following discussion, that a frequency of 16.5 mc output from the transmitter is required. If frequency multiplying is carried out in the transmitter, the ASSOC XMTR FREQ MULT switch S703 of the radio frequency oscillator is set to the appropriate position. However, this has no effect upon the operation of the coarse positioning motor control circuit. Assume further that the radio frequency oscillator is tuned on 1.5 mc. Thus the frequency indicator of the radio receiver reads 1500 kc.

(1) Change in position of MEGACYCLE CHANGE control is initiated.

(a) Motor delay relay K208 energizes through S901 section C rear and remains energized until the conclusion of the position change. This delay is due to the two second drop-out delay effected by suppression capacitor C177. Therefore, the coarse positioning motor B102 circuit is opened and remains open until K208 de-energizes.

(b) Motor operate relay K206 energizes through S901 section C front.

1. K206 contact 4-12 holds K206 energized through S103 and S901 section B due to the changed position of S901 section B.

2. K206 contact 6-13 closes in the circuit common to the reverse relay K205 and the clutch operating coil L126. This has no immediate effect on K205 since that circuit is broken by K205 contact 4-12. However, the L126 circuit is closed from +28 v through K206 contact 6-13 to L126 and from L126 directly to ground. Thus L126 energizes and disengages mechanical clutch A. Since L125 is not energized, mechanical clutch B is also disengaged. Therefore, the mechanical linkage from the servo motor B101 is completely disengaged from the tuning linkage.

3. K206 contact 2-11 in L125 circuit opens which prevents L125 from energizing.

4. K206 contact 1-14 in coarse positioning motor B102 circuit closes but motor does not operate due to open K208 contacts.

(c) Bandswitch motor relay K207 may energize as the bandswitching operation is initiated. This depends upon the necessity of a bandswitching operation (par. 102). If K207 does energize, contact 10-14 opens B102 circuit to disable the positioning operation until the conclusion of the band switching operation.

(d) Afc indicator relay K402 energizes as a result of the loss of the if. input (par. 100). This closes the K402 contact 2-4 in the recycle relay K204 circuit but it has no immediate effect. The AFC indicator I702 also goes out indicating the loss of automatic frequency control.

(e) Bandpass relay K401 energizes as a result of the loss of if. input to the radio frequency oscillator (par. 94).

1. This closes K401 contact 5-7 which is common to the clutch operating coil L125 circuit and the motor operate relay K206 circuit. This has no immediate effect in the L125 circuit since K206 contact 2-11 is open. However, this forms a closed holding circuit for K206.

2. Operation of the bandpass relay also energizes the modulation shorting relay K701 which shorts out the modulations voltage during a positioning operation (par. 73).

3. Operation of the bandpass relay also disables the rf power amplifier which removes the rf output to the transmitter during a positioning operation (par. 83).

(2) Change in position of MEGACYCLE CHANGE control is concluded. Assume that the MEGACYCLE CHANGE control is now at the 16 mc position. Approximately two seconds later the motor delay relay K208 de-energizes and the K208 contacts in the B102 circuit return to their normally closed position. This closes the B102 circuit providing the bandswitching motor relay K207 is not energized, and the coarse positioning motor operates to tune the radio frequency oscillator up-band. With the MEGACYCLE CONTROL in the 16 mc position, the mc position switch S901 section B is also in position 16.

(3) Bandswitching operation is concluded. At the conclusion of the band switching operation, the bandswitch motor relay K207 de-energizes and contact 10-14 returns to the normally closed position. If a band switching operation was not required contacts 10-14 have remained closed. With both K207 and K208 de-energized the coarse positioning motor circuit is closed from the +28 v supply, through K207 contact 10-14, through K206 contact 1-14, through K208 contacts, through K205 contact 10-14 through the line filter FL101, to B102. The return circuit is closed from B102, through FL101, through K205 contacts 7-13, to ground. This operates the motor in the forward direction which drives the radio frequency oscillator tuning linkage up-band.

(4) Coarse positioning motor B102 runs the radio frequency oscillator tuning linkage up-band at a rapid rate.

(a) When the coarse positioning motor runs, the centrifugal clutch on the motor engages the tuning linkage.

(b) While tuning up-band the motor operate relay K206 is held in by the normally closed K204 contact 7-13 and the closed bandpass relay K401 contact 5-7. Therefore, while running in the forward direction (up-band) the motor operate relay circuit through the oscillator positioning switch S103 and the mc position switch S901 section B has no control over the motor operate relay. If the new frequency is up-band from the previous frequency, the coarse positioning motor will drive the tuning linkage with such speed that the bandpass relay will not de-energize as the new frequency is passed over. Therefore, up-band tuning will continue to the upper limit.

(5) Radio frequency oscillator tuning linkage runs to upper limit which is the 3 mc position of the reactance-tube oscillator.

(a) Rotor of upper limit switch S102 front makes contact with terminals 12 and 11. Reaching terminal 12 of S102 front has no effect since K206 is held in by K204 contact 7-13 and K401 contact 5-7. Reaching terminal 11 of S102 front completes the circuit of reverse relay K205 operating coil, from ground through S102 front to reverse relay coil and from the coil through K206 contact 6-13 to +28 v. Thus the reverse relay energizes.

(b) Reverse relay K205 energizes.

1. K205 contact 4-12 closes to hold reverse relay energized through lower limit switch S102 rear.

2. K205 contacts 10-14 and 7-13 open while contacts 1-14 and 6-13 close to reverse direction of coarse positioning motor B102. Thus B102 operates in the reverse direction which drives the radio frequency oscillator tuning linkage down-band.

3. K205 contact 3-11 closes to complete the circuit of the recycle relay K204 operation coil. Thus the recycle relay energizes.

(c) Recycle relay K204 energizes.

1. K204 contacts 1-14 and 3-11 close to hold recycle relay energized through closed afc indicator relay K402 contact 2-4.

2. K204 contact 7-13 opens. This opens the motor operate relay K206 holding circuit through K204 contact 7-13 and the bandpass relay K401 contact 5-7. The motor operate relay is now under the control of the closed circuit from the relay K206 through contact 4-12, through oscillator positioning switch S103 and through the mc position switch S901 section B to ground.

(6) Coarse positioning motor B102 drives the tuning linkage down-band at a rapid rate to the megacycle position just below the required frequency; in this assumed case to 16 mc.

(a) At the beginning of the down-band tuning, the rotor of the upper limit switch S102 front loses contact with terminal 11 and 12. This has no effect on the reverse relay, K205 since it is held in by its own contact 4-12. This also has no effect on the motor operate relay since it is held in through S103 and S901 section B.

(b) When the coarse positioning motor drives the tuning linkage to the 16 mc position it drives the oscillator positioning switch S103 to position 14. This opens the motor operate relay K206 operating coil circuit through K206 contact 4-12, through S103 contact 14-23 which is open, through S901 section 3 terminal 16 to ground. Thus the motor operate relay de-energizes. In the event that the oscillator positioning switch S103 does not locate the open circuit position, B102 continues to drive the radio frequency oscillator down-band. See subparagraph e below for this special operation.

(c) Motor operate relay K206 de-energizes.

1. K206 contact 1-14 in coarse positioning motor B102 circuit returns to normally open position. This opens the coarse positioning motor circuit and the motor stops. When the motor stops the centrifugal clutch disengages the motor from the tuning linkage.

2. K206 contact 2-11 returns to normally closed position. This completes the clutch operating coil L125 circuit from +28 v to L125 and from L125, through K206 contact 2-11, through the closed contact of the bandpass relay K401, to ground. Thus L125 energizes.

3. K206 contact 4-12 returns to normally open position but it has no effect on the motor operate relay since the relay is already de-energized.

4. K206 contact 6-13 opens which opens reverse relay K205 operating coil circuit. Thus K205 de-energizes. When K206 contact 6-13 opens, clutch operating coil L126 also de-energizes. This does not engage mechanical clutch A since energized L125 holds mechanical clutch A disengaged. Capacitor C201 suppresses any arc across contact 6-13.

(d) L125 energizes to engage mechanical clutch B and to hold mechanical clutch A disengaged. With mechanical clutch B engaged and mechanical clutch A disengaged, the servo motor B101 drives the tuning linkage through a fast drive. This fast drive from the servo motor is considerably slower than the drive from the coarse positioning motor. The fast drive from the servo motor drives the tuning linkage in the up-band direction (par. 99); in this case from the 16 mc position.

(e) Reverse relay K205 de-energizes.

1. K205 contact 4-12 returns to normally open position to open self holding circuit of K205.

2. K205 contact 3-11 returns to normally open position but this has no effect on the recycle relay K204 since this relay is held in by its own contacts 3-11 and 1-14 in series with the closed contact of the afc indicator relay K402.

3. K205 contacts 1-14 and 6-13 open while contacts 10-14 and 7-13 close. This returns the coarse positioning motor circuit to its normal non-operating condition.

(7) The servo motor B101 runs the radio frequency oscillator tuning linkage up-band from the megacycle position toward the frequency to which the radio receiver is set. This is the fine positioning operation. The servo motor is under the control of the fine positioning voltage (par 94). The bandpass relay K401 and the afc indicator relay K402 now control the positioning operation. Upon approaching the frequency to which the radio receiver is set, the radio receiver produces an if. signal. When the radio frequency oscillator detects the if. signal, the bandpass relay de-energizes (par. 94). The afc indicator relay de-energizes when the if. input signal is within approximately 50 cps of the nominal 455 kc (par. 100).

(a) Bandpass relay K401 de-energizes.

1. Contact 5-7 opens to disable the motor operate relay circuit so that K204 contact 7-13 may close without re-energizing the motor operate relay.

2. Contact 5-7 opens to break the L125 circuit, through K206 contact 2-11 and K204 contact 7-13 to ground. Thus L125 de-energizes.

3. When the bandpass relay de-energizes the modulation shorting relay also de-energizes so that the modulation voltage is no longer shorted out (par. 73).

4. When the bandpass relay de-energizes the rf power amplifier V107 is enabled so that an rf signal to the transmitter is produced (par. 83).

(b) Clutch operating coil L125 de-energizes which releases mechanical clutches A and B. Mechanical clutch B disengages the servo motor B101 fast drive from the tuning linkage. Mechanical clutch A engages the servo motor normal drive with the tuning linkage. Mechanical clutch A engages since operating coil L126 has previously de-energized (subparagraph 6(c) above). The tuning linkage is now driven by the servo motor B101. The servo motor is under the control of the correction voltage which is derived from the if. signal from the radio receiver.

(8) After positioning near enough to the radio receiver frequency to produce an if. signal from the radio receiver, the servo motor B101 continues the tuning through the normal drive. This is the fine tuning operation. The correction voltage, which is derived from the if. signal from the radio receiver, now controls the servo motor. Tuning toward the radio receiver frequency continues until the correction voltage reaches zero. When the rf output is within approximately 50 cps of the frequency to which the radio receiver is set, the afc indicator relay K402 de-energizes (par. 100).

(a) The afc indicator relay K402 de-energizes as a result of the detected diminished correction voltage.

1. The afc indicator relay K402 contact 2-4 in the recycle relay K204 circuit returns to its normally open position. This opens the recycle relay holding circuit and the recycle relay de-energizes.

2. The AFC indicator I702 lights to indicate that the radio frequency oscillator is on frequency.

(b) The recycle relay K204 de-energizes.

1. K204 contact 7-13, in the motor operate relay K206 circuit, returns to its normally closed position.

2. Self holding contacts 3-11 and 1-14 of K204 return to their normally open position.

(c) In the event that no if. signal is detected as the servo motor drives the radio frequency oscillator tuning linkage up-band, the bandpass relay K401 does not de-energize. In this event the servo motor, through the fast drive, continues to drive the radio frequency oscillator tuning linkage up-band to the upper limit. For the special operations that occur for this situation, see subparagraph d. below.

c. Operation When If. Signal Is Lost But MEGACYCLE CHANGE Control Is Unmoved. Assume, for the following discussion, that a small but rapid shift in the frequency setting of the radio receiver is made. Such a shift would result from rapidly turning the KILOCYCLE CHANGE control from an indicated frequency of 16.2 mc to 16.5 mc. There would be no change in the MEGACYCLE CHANGE control, but the kilocycle change is so rapid that the radio frequency oscillator cannot follow the change. Then the if. input from the radio receiver to the radio frequency oscillator will disappear. Loss of the if. signal might result from other causes as well. Regardless of the cause, loss of the if. signal from the radio receiver, with no change in position of the MEGACYCLE CHANGE control, results in the following operations.

(1) If. signal from the radio receiver disappears but the position of the MEGACYCLE CHANGE control of the radio receiver is unchanged.

(a) The afc indicator K402 energizes as a result of the loss of the if. signal (par. 100). This closes the afc indicator relay contact in the recycle relay K204 circuit to ground. However, K204 does not energize since the circuit is held open by K204 contacts 3-11 and 1-14.

(b) Detection of the absence of the if. signal energizes bandpass relay K401 (par. 94).

1. Operation of the bandpass relay K401 closes the motor operate relay K206 circuit to ground through K204 contact 7-13 and through the bandpass relay K402 contact 5-7. Thus the motor operate relay K206 energizes. L125 will not energize because the K206 contact 2-11 opens to break the circuit (subparagraph c, following).

2. Operation of the bandpass relay also energizes the modulation shorting relay K701 which shorts out the modulation voltage during a positioning operation (par. 73).

3. Operation of the bandpass relay also disables the rf power amplifier V107 which removes the rf output to the transmitter during a positioning operation (par. 83).

(c) The motor operate relay K206 energizes.

1. K206 contact 6-13 closes in the circuit common to the reverse relay K205 and the clutch operating coil L126. This has no immediate effect on K205 since that circuit is broken by K205 contact 4-12. However, the L126 circuit is closed from +28 v through K206 contact 6-13 to L126 and from L126 directly to ground. Thus L126 energizes and disengages mechanical clutch A.

2. K206 contact 2-11 opens to prevent L125 from energizing. Since L125 is de-energized and L126 is energized, both mechanical clutches A and B are disengaged so that the mechanical linkage from the servo motor B101 is completely disengaged from the tuning linkage.

3. K206 contact 4-12 closes. This has no immediate effect but it readies the motor operate relay control circuit through the oscillator positioning switch S103 and the mc position switch S901 section B.

4. K206 contact 1-14 closes to complete the course positioning motor circuit from the +28 v supply, through K207 contact 10-14, through K206 contact 1-14, through K208 contacts, through K205 contact 10-14, through the line filter FL101, to B102. The return circuit is closed from B102, through FL101, through K205 contact 13-7, to ground. This operates the motor in the forward direction which drives the radio frequency oscillator tuning linkage up-band at a rapid rate.

(2) From this point on, the operation of the coarse positioning motor control circuit is identical to that given in subparagraph b.(4) through subparagraph b.(8), above. B102 drives the radio frequency oscillator tuning linkage to the upper limit. B102 then reverses and drives down-band to the megacycle position just below the desired frequency. Then the mechanical clutches operate and the servo motor B101 drives up-band, through the fast drive, until an if. signal is produced from the radio receiver. Another clutch operation takes place and the servo motor, through the normal drive, continues the tuning operation until the radio frequency oscillator is precisely on frequency. This final, fine tuning, operation results from the correction voltage which is derived from the if. signal. It continues until the AFC indicator lights and the correction voltage is zero.

d. Special Operation When Megacycle Position Is Located But No If. Signal Results From Fine Positioning. The coarse positioning motor B102 positions the tuning linkage at the megacycle position below the required frequency. The servo motor B101 then drives the tuning linkage, through the fast drive, toward the required frequency. This operation continues until the radio receiver develops an if. signal (subparagraph b(7), above). In the event that no if. signal develops the servo motor continues the fast drive operation and drives the tuning linkage over the required frequency position. In this event the servo motor, through the fast drive, maintains control and drives the tuning linkage to the upper limit of the frequency range. The following operations result.

(1) No if. signal develops so the servo motor B101 continues to drive the tuning linkage up band through the fast drive to the upper limit of the frequency range. Even though the oscillator positioning switch S103 is driven past the open circuit position, the motor operate relay K206 does not energize due to the open K206 contact 4-12 in the circuit.

(2) Tuning linkage reaches the upper limit under the control of the servo motor through the fast drive and the upper limit switch S102 front controls the operation.

(a) As the upper limit switch makes contact with terminal 12 the motor operate relay K206 is readied. No operation of K206 results due to open K206 contact 4-12 in the circuit.

(b) As the upper limit switch makes contact with terminals 12 and 11 the reverse relay K205 circuit is readied. No operation of the reverse relay occurs due to the open K206 contact 6-13 in the circuit.

(c) As the upper limit switch makes contact with terminals 9, 11, 12 the motor operate relay circuit is complete through S102 front terminal 9. Thus the motor operate relay K206 energizes.

1. K206 contact 4-12 closes. This holds in K206 through S102 front until the upper limit switch loses contact with terminal 12.

2. K206 contact 1-14 closes to start the coarse positioning motor.

3. K206 contact 6-13 closes. This energizes the reverse relay K205 since the K205 circuit is complete to ground through S102 front terminal 11-23 to ground. This also energizes the mechanical clutch operating coil L126. With L126 energized mechanical clutch A will remain disengaged after L125 de-energizes.

4. K206 contact 2-11 opens. This de-energizes the mechanical clutch operating coil L125. With L125 de-energized, mechanical clutch B disengages. Mechanical clutch A remains disengaged because L126 is energized. Thus the servo motor drive is disengaged.

(d) The reverse relay K205 energizes as a result of the motor operate relay operation.

1. K205 contact 4-12 closes to hold in K205 through S102 rear.

2. K205 contact 2-11 closes in the recycle relay K204 circuit. However, the recycle relay is already energized due to the closed afc indicator relay contact 2-4 and K204 contacts 1-14 and 3-11. (Since the afc indicator has not de-energized, neither has the recycle relay de-energized.)

3. K205 contacts 10-14 and 7-13 open while contacts 1-14 and 6-13 close. Therefore, the coarse positioning motor reverses and drives the tuning linkage down-band.

(3) The coarse positioning motor B102 drives the tuning linkage down-band at a rapid rate to the megacycle position just below the required frequency.

(4) From this point on, the operation of the coarse positioning motor control circuit is identical to that given in subparagraph b(6) through subparagraph b.(8), above.

e. Special Operation When Megacycle Position Is Not Located. The coarse positioning motor B102 drives the tuning linkage down-band to the megacycle position just below the required frequency. This position is indicated when the oscillator position switch S103 locates the position which opens the motor operate relay K206 circuit and de-energizes the motor operate relay (subparagraph b.(6), above). In the event that S103 does not locate an open position, down-band tuning continues and the following operations result.

(1) No megacycle position is located so the coarse positioning motor continues to drive the tuning linkage down-band to the lower limit of the frequency range.

(a) The lower limit switch S102 rear reaches position 3, the reverse relay K205 holding circuit opens and the reverse relay de-energizes.

(b) The reverse relay K205 de-energizes.

1. K205 contacts 1-14 and 6-13 open while contacts 10-14 and 7-13 close. This reverses B102 and causes it to drive the tuning linkage in the forward, up-band, direction.

2. K205 contact 3-11 opens but the recycle relay K204 remains energized, being held in by its own contacts.

3. K205 contact 4-12 opens to disable the reverse relay operating circuit. Thus as the lower limit switch moves forward from position 3, the reverse relay will not re-energize.

(2) The coarse positioning motor B102 drives the tuning linkage up-band to a position above the required frequency. The oscillator positioning switch S103 is aligned to position the tuning linkage at the megacycle position below the required frequency when the coarse positioning is done in the normal, down-band direction. This means that the position of the tuning linkage is determined by the leading edge of the circuit opening notch on the S103 rotor as the switch is driven down-band. In this case the switch is driven up-band so the opposite edge of the notch on the S103 rotor determines the position of the tuning linkage. Since the width of the notch represents a small tuning range, the coarse positioning motor positions the tuning linkage at a frequency above the required megacycle position. This does not make up-band positioning by the coarse positioning motor totally ineffective, but it reduces the possibility of locating the frequency during fine positioning by the servo motor since the lower portion of the megacycle band is bypassed.

(a) When the oscillator positioning switch S103 reaches the open circuit position, the motor operate relay K206 circuit opens and the motor operate relay de-energizes.

(b) Motor operate relay K206 de-energizes.

1. K206 contact 1-14 returns to normally open position. This opens the coarse positioning motor B102 circuit and the motor stops.

2. K206 contact 2-11 returns to its normally closed position. This completes the clutch operating coil L125 circuit, through the closed bandpass relay K401 contact 5-7 and L125 energizes. When L125 energizes it engages mechanical clutch B and holds mechanical clutch A disengaged. With mechanical clutch B engaged and mechanical clutch A disengaged, the servo motor B101 drives the tuning linkage up-band through the fast drive.

3. K206 contact 6-13 opens. This has no effect on the reverse relay K205 since the relay is already de-energized. However, when K206 contact 6-13 opens, clutch operating coil L126 de-energizes. This does not engage mechanical clutch A since energized L125 holds mechanical clutch A disengaged.

4. K206 contact 4-12 returns to normally open position. This has no effect on the motor operate relay since the relay is already de-energized.

(3) From this point on, the operation of the coarse positioning motor control circuit is identical to that given in subparagraph b.(7) through subparagraph b.(8), above. The likelihood of locating the required frequency is diminished since part of the megacycle band will not be scanned during the fine positioning operation as the servo motor drives the tuning linkage through the fast drive. This skip results from coarse positioning slightly above the desired megacycle position. However, if the frequency is located the radio receiver will develop an if. signal and the positioning operation will terminate. If the frequency is not located, no if. signal will develop and the servo motor will continue to drive the tuning linkage, through the fast drive, to the upper limit of the frequency range. In this event a new positioning operation will result (subparagraph d., above).

f. Mc Position Switch S901 Section B and Coarse Position Frequencies. There are 32 megacycle positions on the mc position switch S901 section B. The coarse positioning of the tuning linkage is such that the rf output from the radio frequency oscillator is just below the megacycle indicated by the mc position switch. The servo motor then drives the tuning linkage up-band during fine positioning. Since rf doubling is effected in the radio frequency oscillator, the coarse position of the tuning linkage is the same for a fundamental frequency as it is for harmonics of the same fundamental frequency. Therefore, the fundamental frequency produced by the oscillator tube V001 is identical for different rf outputs from the radio frequency oscillator. Sixteen coarse positions of the tuning linkage, combined with the proper frequency multiplying factor, are required to produce the 32 different output frequencies indicated by the mc position switch. The 16 used terminals of the oscillator positioning switch S103 determine the coarse position of the tuning linkage. The proper multiplying factor is obtained from the position of the band position switch S901 section A which determines the number of rf doublers necessary to multiply the oscillator tube V001 frequency to obtain the desired rf output. The table below gives the relationship between the position of the mc position switch S901 section B, the oscillator positioning switch S103, the oscillator tube V001 frequency, the frequency multiplier, and the output frequency after coarse positioning.

Position of mc position switch S901 section B	Position of oscillator positioning switch S103	Oscillator tube V001 frequency (mc)	Frequency Multiplier	Rf output (mc)
1	22	1.500	1	1.500
2	14	2.000	1	2.000
3	22	1.500	2	3.000
4	14	2.000	2	4.000
5	6	2.500	2	5.000
6	22	1.500	4	6.000

Position of mc position switch S901 section B	Position of oscillator positioning switch S103	Oscillator tube V001 frequency (mc)	Frequency Multiplier	Rf output (mc)
7	18	1.750	4	7.000
8	14	2.000	4	8.000
9	10	2.250	4	9.000
10	6	2.500	4	10.000
11	2	2.750	4	11.000
12	22	1.400	8	12.000
13	20	1.635	8	13.000
14	18	1.750	8	14.000
15	16	1.875	8	15.000
16	14	2.000	8	16.000
17	12	2.125	8	17.000
18	10	2.250	8	18.000
19	8	2.375	8	19.000
20	6	2.500	8	20.000
21	4	2.625	8	21.000
22	2	2.750	8	22.000
23	1	2.812	8	22.496
24	22	1.500	16	24.000
25	21	1.562	16	24.992
26	20	1.625	16	26.000
27	19	1.687	16	26.992
28	18	1.750	16	28.000
29	17	1.812	16	28.992
30	16	1.875	16	30.000
31	15	1.937	16	30.992
0	none	-----	--	------

The coarse position is actually slightly below those indicated in the table. This allows the fine positioning scan to cover the complete megacycle band. When frequency multiplying is carried on externally in the transmitter, the coarse position of the tuning linkage is unchanged. Rather, the frequency multiplier is divided by a factor equal to the transmitter multiplying factor. This operation is effected by the ASSOC XMTR FREQ MULTIPLIER switch S703 (par. 102). It will be noted that when the mc position switch is in the 23 mc position, the oscillator tube frequency is 2.812 mc and the rf output is only 22.496 mc. This low coarse position is necessary in this case because the oscillator tube frequency is near its upper limit. Since down-band coarse positioning begins at the three megacycle position of the oscillator, the coarse positioning operation can not be started and terminated quickly enough to consistently position the tuning linkage at a higher frequency position than the 2.812 mc position.

NOTES:
1. THE MC POSITION SWITCH S901 SECTION B IS SHOWN FROM THE END OPPOSITE THE DRIVEN END. THE SWITCH TERMINALS ARE NUMBERED TO AGREE WITH THE MEGACYCLE BAND SELECTED BY THE MEGACYCLE CHANGE CONTROL ON THE ASSOCIATED RADIO RECEIVER R-390/URR.
2. S102 IS SHOWN FROM THE DRIVEN END.
3. S707 IS SHOWN FROM THE END OPPOSITE THE DRIVEN END.
4. THE ARROWS ON S102 AND S103 INDICATE THE DIRECTION OF TRAVEL WHEN THE COARSE POSITIONING MOTOR B102 IS TURNING IN THE FORWARD, UP-BAND, DIRECTION.

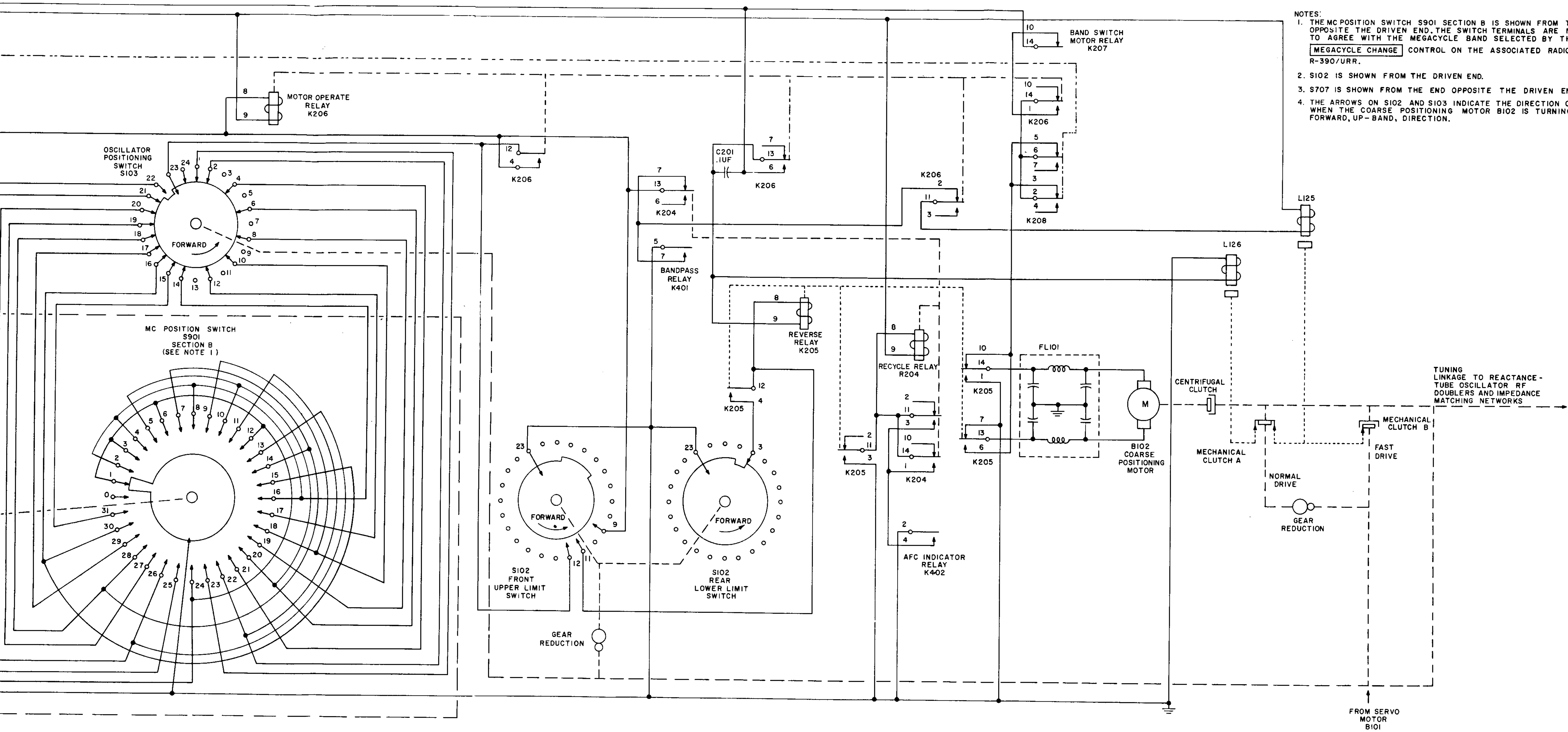
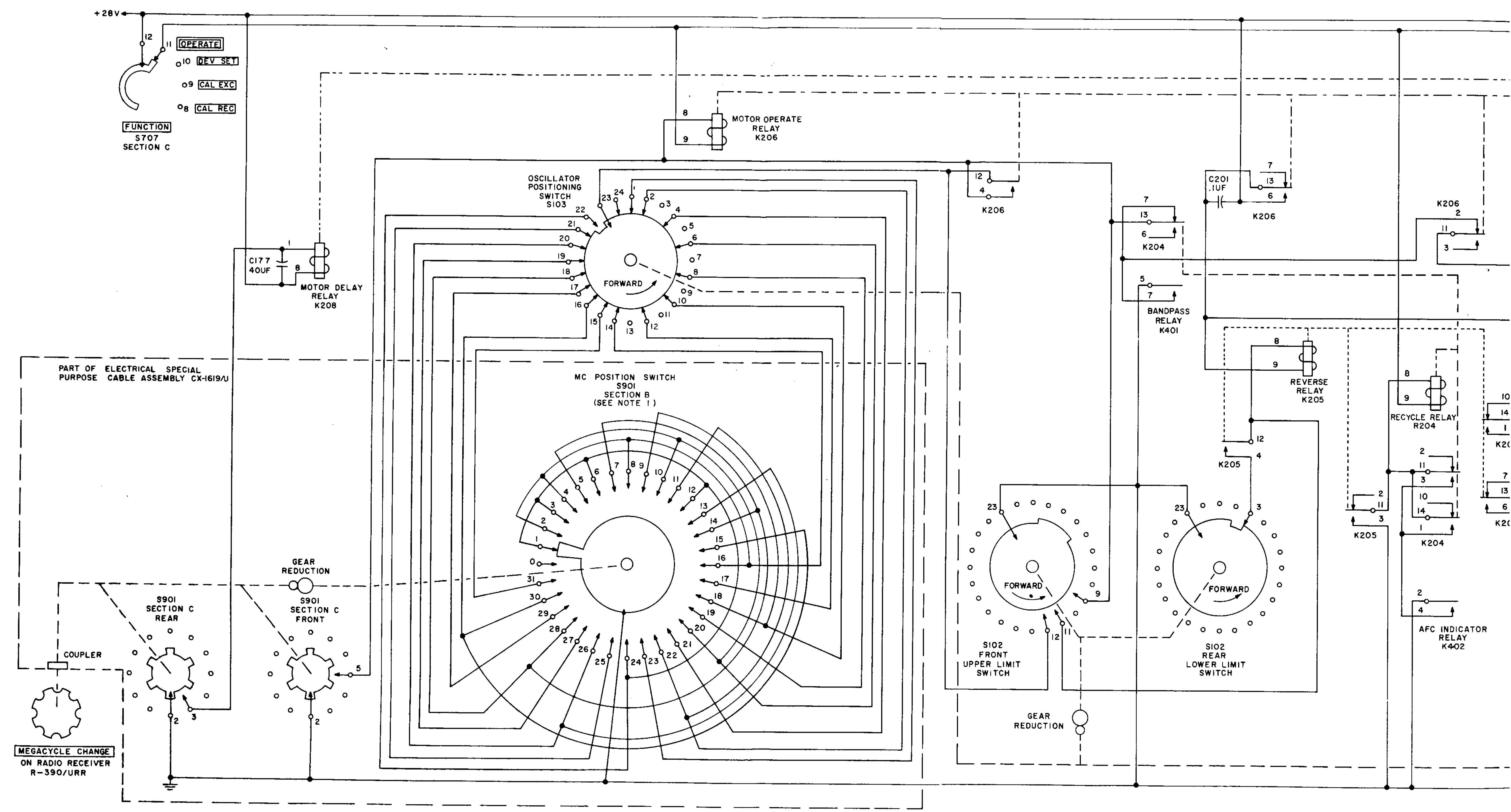


Figure 68. Coarse positioning motor control circuit, simplified schematic diagram.


+28V
FUNCTION
S707
SECTION C
OPERATE
DEV SET
CAL EXC
CAL REC
C177
40UF
MOTOR DELAY
RELAY
K208
MOTOR OPERATE
RELAY
K206
OSCILLATOR
POSITIONING
SWITCH
S103
FORWARD
K206
K204
BANDPASS
RELAY
K401
C201
.1UF
REVERSE
RELAY
K205
RECYCLE RELAY
R204
K205
AFC INDICATOR
RELAY
K402
PART OF ELECTRICAL SPECIAL
PURPOSE CABLE ASSEMBLY CX-1619/U
MC POSITION SWITCH
S901
SECTION B
(SEE NOTE 1)
GEAR
REDUCTION
S901
SECTION C
REAR
S901
SECTION C
FRONT
COUPLER
MEGACYCLE CHANGE
ON RADIO RECEIVER
R-390/URR
S102
FRONT
UPPER LIMIT
SWITCH
S102
REAR
LOWER LIMIT
SWITCH

104. First and Second Calibration Amplifiers V306B and V306A (fig. 69)

The first and second calibration amplifiers increase the amplitude of the discriminator output which has been converted to an ac voltage by the chopper G301. This signal is the error voltage (60 cps) and is used to calibrate the radio receiver, to set the frequency deviation for fsk.and facsimile operation, and to calibrate the r-f output from the radio frequency oscillator. The first and second calibration amplifiers are contained in one tube envelope, the tube being a miniature twin triode type 12AT7 located on the if. amplifier subchassis.

a. The control grid (pin 7) of the first calibration amplifier V306B receives the chopped discriminator output from the chopper G301 through coupling capacitor C344. The cathode (pin 8) connects directly to ground. Grid-leak resistor R346 and coupling capacitor C344 provide grid leak bias for tube operation. The +180 v regulated supply provides plate voltage through load resistor R347 and the output is from the plate (pin 6) through coupling capacitor C345 to the second calibration amplifier V306A.

b. The control grid (pin 2) of the second calibration amplifier V306A receives the output from the first calibration amplifier V306B through coupling capacitor C345. Resistor R348 provides the grid leak circuit to ground. The cathode (pin 3) connects to ground through cathode biasing resistor R349. The +180 v supply provides plate voltage through load resistor R350 and the error voltage (60 cps) output is from the plate (pin 1) to the clipper V307 through coupling capacitor C346.

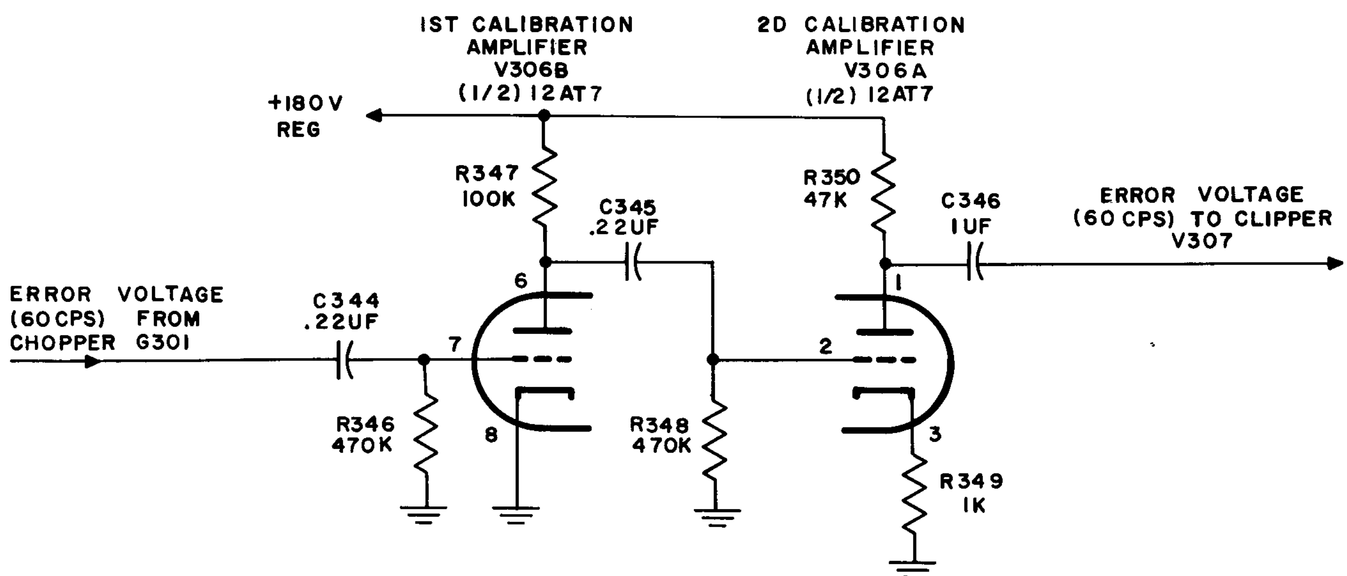


Figure 69. First and second calibration amplifiers, simplified schematic diagram.

105. Clipper V307 (fig. 70)

The clipper clips the positive and negative peaks off the calibration error voltage (60 cps) received from the second calibration amplifier so that the signal applied to the CAL IND meter is not sufficient to damage the meter. The clipper is a miniature twin diode type 5726/6AL5W which is located on the if. amplifier subchassis. The CLIPPER ADJ potentiometer R353 across the +180 v regulated supply provides diode plate bias through current limiting resistor R352 to the common plate connection (pins 2 and 7) of V307. Resistor R351 provides one diode load for V307B and also connects from the cathode (pin 1) to ground. The error voltage (60 cps) input to the clipper is to one cathode (pin 5) through coupling capacitor C346 and the output from the clipper is from the other cathode (pin 1) through coupling capacitor C347 to the meter rectifier. On the positive half cycles of the input voltage to the input cathode (pin 5), the plate voltage follows the cathode voltage until the input cathode voltage exceeds the applied plate voltage. Above this point an increase in input cathode voltage has no effect on the plate voltage. The output cathode (pin 1) follows the plate voltage through the positive half cycle of the input signals because the plate (pin 7) is more positive than the output cathode. Therefore, the positive peaks are clipped. On the negative half cycles of the input voltage to the input cathode, the plate follows the cathode even when the applied signal drives the input cathode negative with respect to ground. Therefore, the plate voltage varies from a positive value to a negative value with respect to ground during the negative half cycles of the input voltage. The output cathode follows the plate voltage until the plate voltage goes negative with respect to ground. Below this point a negative increase in plate voltage has no effect on the output cathode voltage because the cathode is more positive than the plate. Therefore, the negative peaks are clipped.

106. Meter Rectifier and CAL IND Meter M703 (fig. 70)

The meter rectifier is a full-wave rectifier with germaniam diodes type 1N67A providing the rectification. The diodes CR301 and CR302 are part of a bridge-type circuit with load resistors R356 and R357 completing the bridge. The METER ADJ potentiometer R355 provides the rectifier load and the meter shunt. The CAL IND meter M703 is a microammeter which connects across potentiometer R355 through the FUNCTION switch S707 section A when the switch is in either the CAL REC, CAL EXC or DEV SET position. The ac input to the rectifier is from the clipper V307 through coupling capacitor C347. During the positive half cycles of the input signal electrons flow from ground through R357 and through CR302 back to the clipper V307. This makes the junction point between R357 and CR302 positive with respect to ground, so electrons also flow from ground through R356 and through R355 to the junction point. Therefore, the variable terminal of R355 is positive with respect to the junction point between R356 and CR301 so electrons flow from the junction point, through S707 section A, through the CAL IND meter M703, back through S707 section A to the variable terminal of R355. During the negative half cycles of the input signal electrons flow from the clipper through CR301 and through R356 to ground. This makes the junction point between R356 and CR301 negative with respect to ground, so electrons also flow from the junction point through R355 and R357 to ground. Therefore, the variable terminal of R355 is positive with respect to the junction point between R356 and CR301 so electrons flow from the junction point, through S707 section A, through the CAL IND meter M703, back through S707 section A to the variable terminal of R355. The METER ADJ potentiometer is adjusted so that an error voltage representing a known 425 cps frequency deviation from the mean carrier frequency results in a CAL IND meter reading of 42.5 ua (par. 144). The CAL IND meter indicates frequency deviation only when the FUNCTION switch S707 is in the CAL REC, CAL EXC or DEV SET positions. When the FUNCTION switch is in the OPERATE position, the CAL IND meter indicates the signal strength of the input if. signal to the radio frequency oscillator (par. 87).

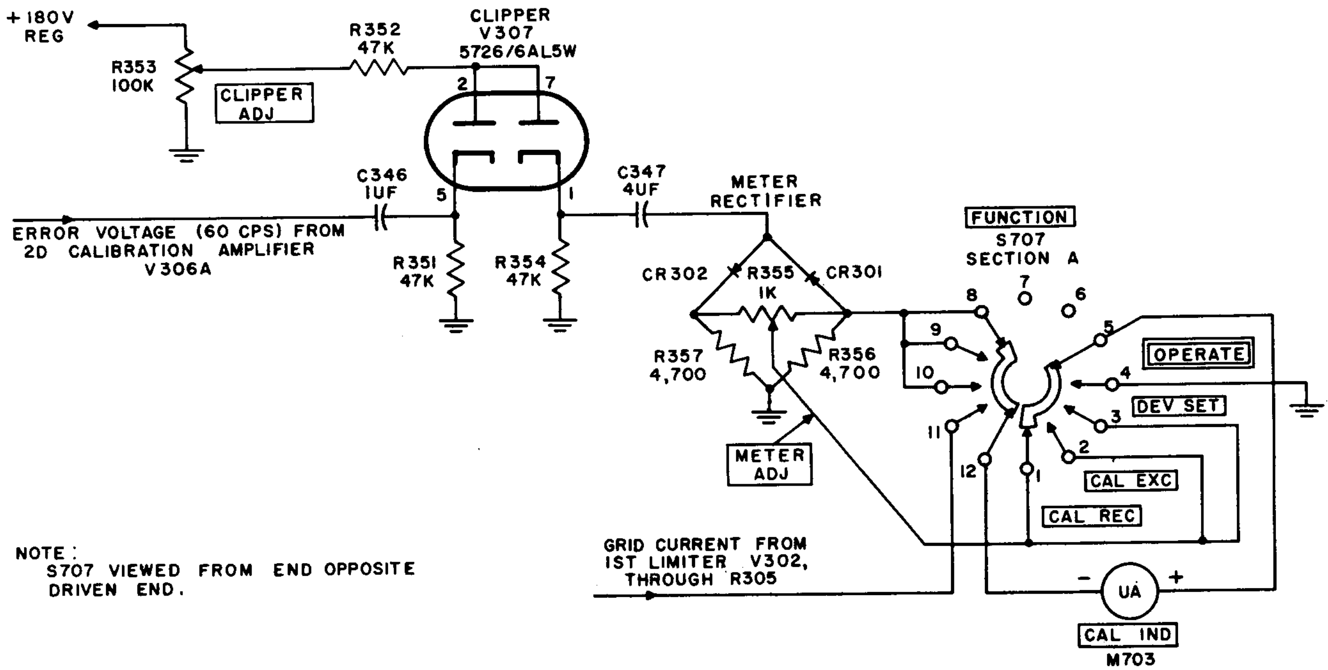


Figure 70. Clipper, meter rectifier and CAL IND meter, simplified schematic diagram.

107. Ac Power Input Circuit (fig. 71)

The radio frequency oscillator operates from an ac source of either 105 v, 115 v, 125 v, 210 v, 230 v or 250 v. The ac power input circuit consists of the switches and controls necessary to apply the input voltage to two power transformers T801 and T802. Line power input is to the LINE PWR jack J809 on the rear panel.

a. The LINE VOLTAGE selector switch S801 is set in either the 125, 115, 105, 210, 230 or 250 position for operation from corresponding voltage sources. Note that the LINE VOLTAGE selector of the radio frequency oscillator and the corresponding switch S801 of the associated Radio Receiver R-390/URR must be set to the correct line voltage before the POWER switch S706 of the radio frequency oscillator is switched to the ON position. Line voltage applies to the REC PWR jack J810 through the POWER

NOTE:
SWITCHES ARE SHOWN FROM END OPPOSITE DRIVEN END

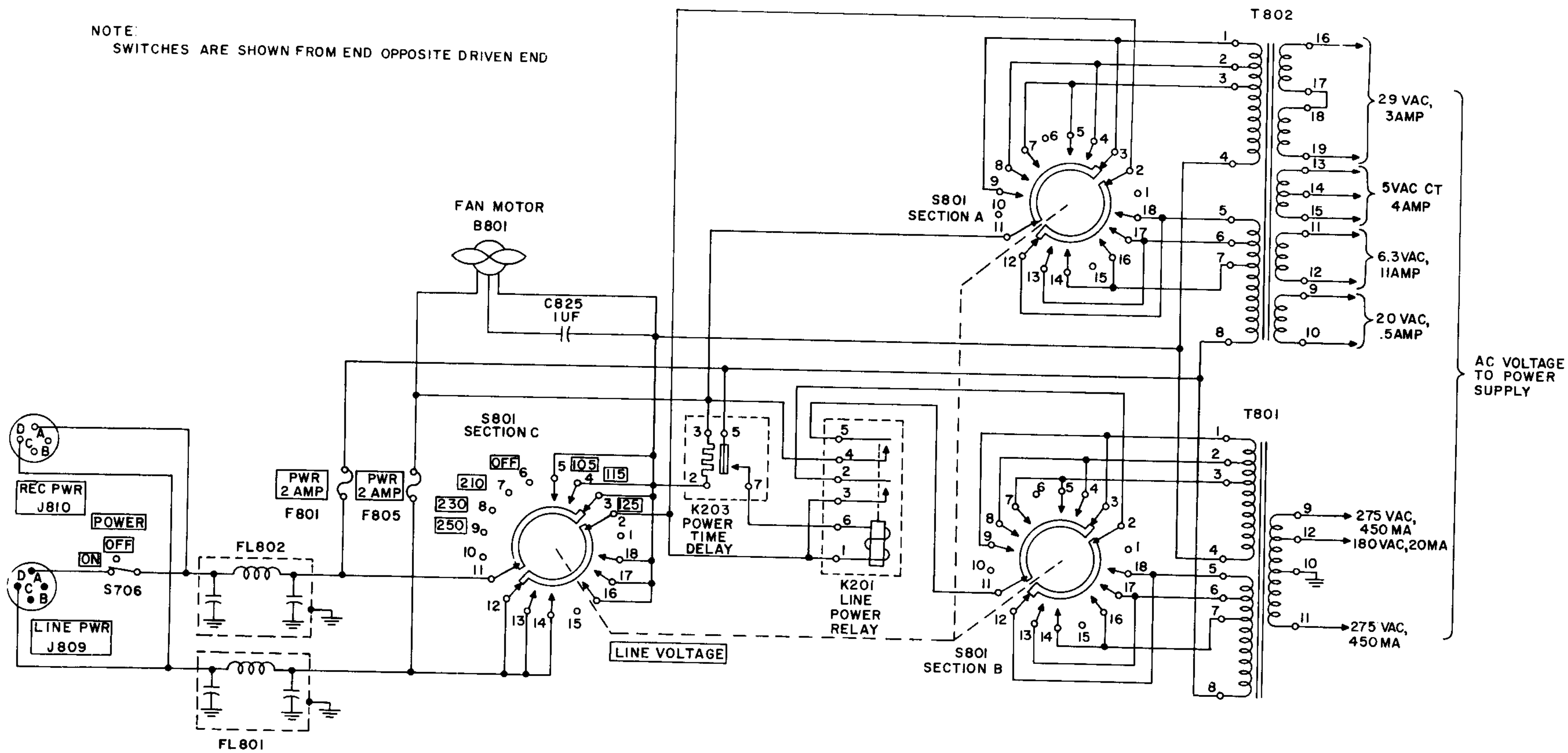


Figure 71. Ac power input circuit, simplified schematic diagram.

switch S706. The associated radio receiver receives line voltage from this jack through Electric Power Cable Assembly CX-2405/U to the POWER jack J104 of the radio receiver. Thus, the POWER switch S706 of the radio frequency oscillator turns power on and off for both the radio frequency oscillator and the radio receiver. Filters FL801 and FL802 filter noise from the power source before the line voltage feeds through to the radio frequency oscillator.

b. When the LINE VOLTAGE selector S801 is in either the 125, 115 or 105 position, the POWER switch is in the ON position line voltage applies to the blower motor B801 and the power time delay relay heater K203 through S801 section C. Capacitor C825 provides the capacitive phase shift for the capacitor start, capacitor run type blower motor. Line voltage also applies to the two primary windings in parallel of transformer T802 through S801 section C and S801 section A. By energizing transformer T802 before transformer T801, filament voltage, 6.3 v ac, is applied before plate voltage. After a 15 second time delay, K203 operates which in turn energizes the operating coil of the line power relay K201. When K201 energizes the contacts connect the two primary windings in parallel of transformer T801 across the line voltage, through S801 section B. The LINE VOLTAGE selector S801 sections A and B applies the line voltage to different primary taps of the transformers for the different settings of the switch. The power input circuit is fused with the two line fuses F801 2 AMP and F805 2 AMP. The outputs from transformer T802 are 29 v ac for the 28 v dc power supply, 5 v ac for the 250 v dc rectifier filaments, 6.3 v ac for the parallel filaments, 20 v ac for the 20 v ac power supply. The outputs from transformer T801 are 550 v ac for the 250 v dc and 180 v dc regulated supplies and 180 v ac for the fsk bias supply.

c. When the LINE VOLTAGE selector is in either the 210, 230 and 250 position and the POWER switch is in the ON position, line voltage applies to the two primary windings in series of transformer T802 through S801 section A and section C. The blower motor B801 and the power time delay heater K203 both connect in parallel across one of these primary windings, terminal 4 to the tap, through S801 section C. After a 15 second time delay K203 operates to connect the operating coil of the line power relay K201 across the other primary winding, terminal 8 to the tap, of transformer T802. When the K201 energizes the contacts connect the two primary windings of Transformer T801 in series across the line voltage through S801 section B and section C.

108. 250 v Power Supply V601 and V602
(fig. 72)

The +250 v power supply provides the plate and screen grid voltage for the audio amplifier tubes, the servo amplifier tubes; and the r-f amplifier tubes, except the buffer V101. In addition the +250 v power supply provides the power for the +180 v regulated power supply. The +250 v power supply uses two twin diodes type 5R4WGY in a full-wave rectifier circuit. The tubes are located on the power rectifier subchassis. Both plates (pins 4 and 6) of V601 receive 275 v ac from transformer T801 terminal 9. Both plates (pins 4 and 6) of V602 receive +275 v ac from transformer T801 terminal 11. The 275 v ac applied to the plates of the two rectifiers is 180° out of phase which results in full-wave rectification. Transformer T802 terminal 13 and 15 applies 5 v ac to the directly heated cathodes (pins 2 and 8) of both V601 and V602. The +250 v output from the full-wave rectifier is from the center-tap, terminal 14 of T802, of the heater supply winding. The series regulator tube V604 of the +180 v ac regulated supply receives this output through filter choke L601. The +250 v

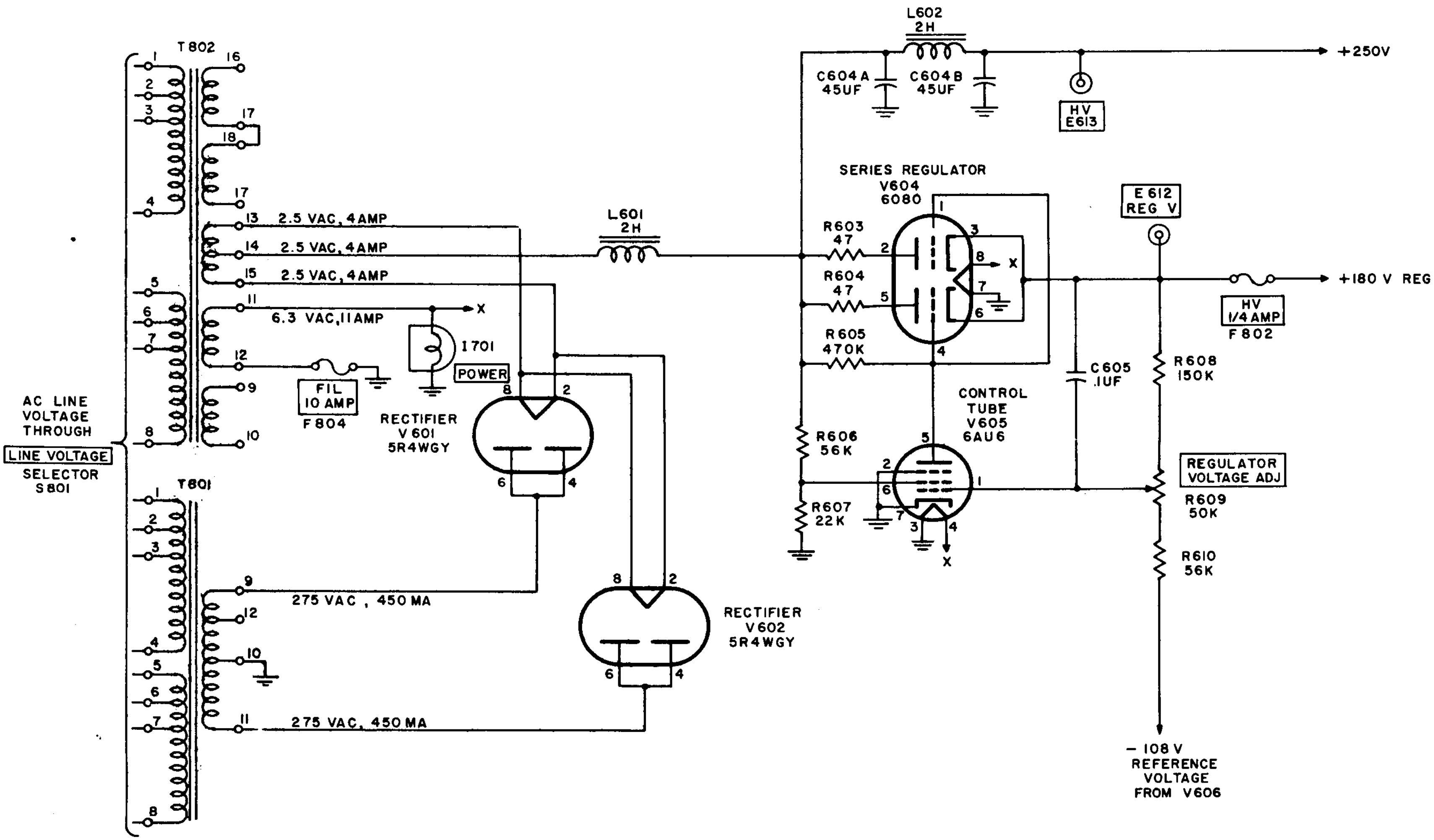


Figure 72. 250 v power supply and 180 v regulated power supply simplified schematic diagram.

output is further filtered by the filtering circuit consisting of C604A, L602 and C604B before being applied as the +250 v plate and screen grid voltage. The HV test point E613 provides a voltage metering test point for the +250 v supply.

109. 180 v Regulated Power Supply V604 and V605 (fig. 72)

The +180 v regulated supply provides a constant +180 v output regardless of load current changes or input voltage changes. The +180 v regulated power supply provides the plate and screen grid voltage for the if. amplifier tubes, the reactance-tube oscillator tubes, and the buffer V101, besides providing power for a series filament circuit. The +180 v regulated power supply uses a twin triode type 6080 as the series regulator V604 and a miniature pentode type 6AU6 as the control tube V605. These tubes are located on the power rectifier subchassis.

a. The twin triode V604 operates as two paralleled tubes with plate voltage from the +250 v rectifiers V601 and V602 through filter choke L601, and through current balance resistors R603 and R604. These resistors balance the current through the two halves of the tube. The +250 v supply through choke L601 also provides plate voltage to the regulating tube V605 though load resistor R605, and R606 and R607 divide this voltage to supply screen grid voltage for V605. The plate output voltage from V605 (pin 5) provides control grid voltage for V604 (pin 4). The +180 v regulated output is from the common cathode connection of V604 (pins 3 and 6) through HV 1/4 AMP fuse F802. The voltage output of V604 is divided by resistors R608, R609 and R610. They divide the voltage between the -108 v reference voltage and the output from V604. This provides control grid voltage (pin 1) for the control tube V605. Capacitor C605 provides compensative ripple feedback from the output of V604 to the control grid of V605. The suppressor grid (pin 2) of V605 connects directly to the cathode (pin 7) and the cathode connects directly to ground. The filament voltage of both V604 and V605 is from the filament supply winding of transformer T802. The REG V test point E612 provides a voltage metering test point for the +180 v regulated supply.

b. The series regulator V604 is effectively a variable series resistance which varies such that the plate voltage applied to the tube drops to +180 v at the cathode output of the tube, regardless of variations in tube current or small variations in applied voltage. The output from the plate of the control tube V605 to the control grid of the series regulator varies the effective resistance of the series regulator. For instance, an incremental decrease of the +180 v regulated voltage reduces the control grid voltage of the control tube. This, in turn, increases the output voltage of the control tube which increases the control grid voltage of the series regulator tube. When the control grid voltage of the series regulator increases, the effective resistance of the tube decreases so that there is less voltage drop across the tube. With less voltage drop across the series regulator, an incremental increase in output voltage results which compensates for the original incremental decrease. The series regulator and the control tube operate in a converse manner to compensate for an incremental increase of the +180 v regulated voltage. The capacitor C605 provides an ac circuit from the cathode output of the series regulator to the grid input of the control tube so that the action of the control tube compensates for any ripple voltage present in the output. The REGULATOR VOLTAGE ADJ potentiometer R609 adjusts the control grid voltage of the control tube V605 so that the output from the series regulator V604 is +180 v as measured between the REG V test point E612 and ground (par. 139).

110. Fsk Bias Supply V503 and V606
(fig. 73)

The fsk bias supply provides a -108 v bias to the fsk modulation voltage control circuit and a -108 v reference voltage to the +180 v regulator circuit. The fsk bias supply uses a twin diode type 6X4W rectifier tube in a half-wave rectifier circuit and gas filled, cold cathode voltage reference tube type OB2. The tubes are located on the power rectifier subchassis. The common cathode (pin 7) of the rectifier V603 receives 180 v ac from transformer T801 terminal 12. The filament voltage of V603 is from the filament supply winding of transformer T802. The output from the common plate connection (pins 1 and 6) connects to the cathode (pins 2, 4 and 7) of the reference tube V606 through two capacitive input filter sections. The input filter section consists of C601A and R602, and the output filter section consists of C602 and R601. The plate of V606 connects to ground. The output from the fsk bias supply is from the cathode of V606. As the input voltage to the cathode of the rectifier goes negative, the output from the plates goes sufficiently negative to cause ionization of the gas in the reference tube and the reference tube conducts. When conducting the reference tube presents a relatively

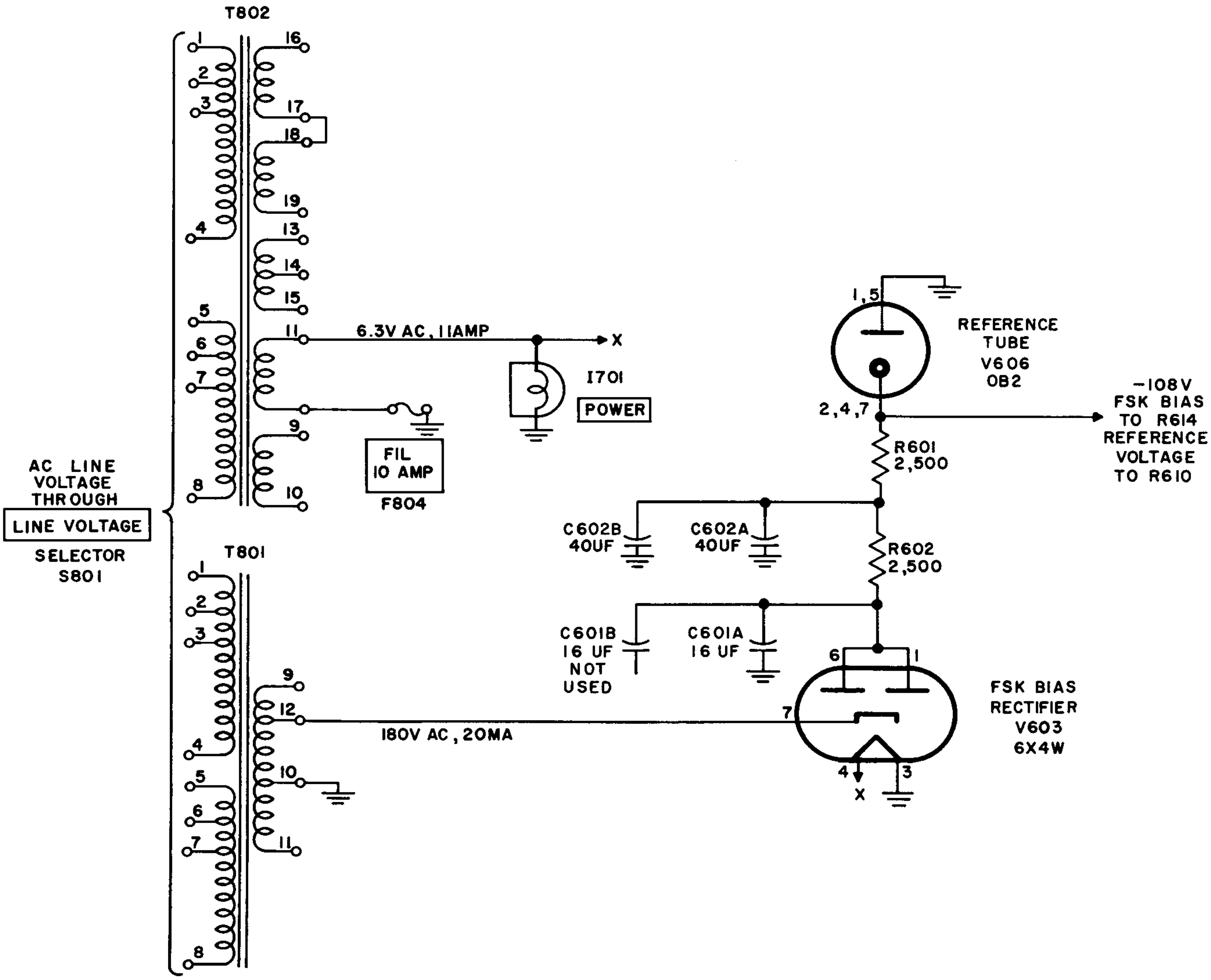


Figure 73. Fsk bias supply, simplified schematic diagram.

constant voltage drop of 108 v from the plate, which is ground, to the cathode. Therefore, the cathode voltage is -108 v with respect to ground. Also, as the plate of the rectifier goes negative, the capacitors of the filter sections charge negatively. As the input voltage to the rectifier goes positive, the rectifier does not conduct and the capacitors hold the cathode of the reference tube sufficiently negative to maintain conduction through the reference tube. Therefore, the output from the cathode of the reference tube is a constant -108 v.

111. 28 v Power Supply CR601
(fig. 74)

The +28 v power supply provides operating voltage for relays, the coarse positioning and band seeking motors, clutch operating coils, and bias for the local microphone input. The +28 v rectifier CR601 is a dry-disk, selenium rectifier connected as a bridge-type, full-wave rectifier. CR601 receives 29 v ac through 28 VOLT, 2 AMP fuse F806 from transformer T802 terminals 16 and 19 with terminal 17 connected to terminal 18. Capacitor C603 filters the output from the rectifier. Resistor R618 is a voltage dropping resistor.

112. 20 v ac Power Supply
(fig. 74)

The 20 v ac power supply provides operating voltage to the reference winding of the servo motor B101 and the chopper G301. The 20 v ac voltage is also used as a signal input through the relay puller V305 to supply the fine positioning voltage during the positioning operation of the radio frequency oscillator. Transformer T802 terminal 9 provides the 20 v ac power through SERVO 1/2 AMP fuse F803. The other terminal of the 20 v ac winding, terminal 10, is grounded.

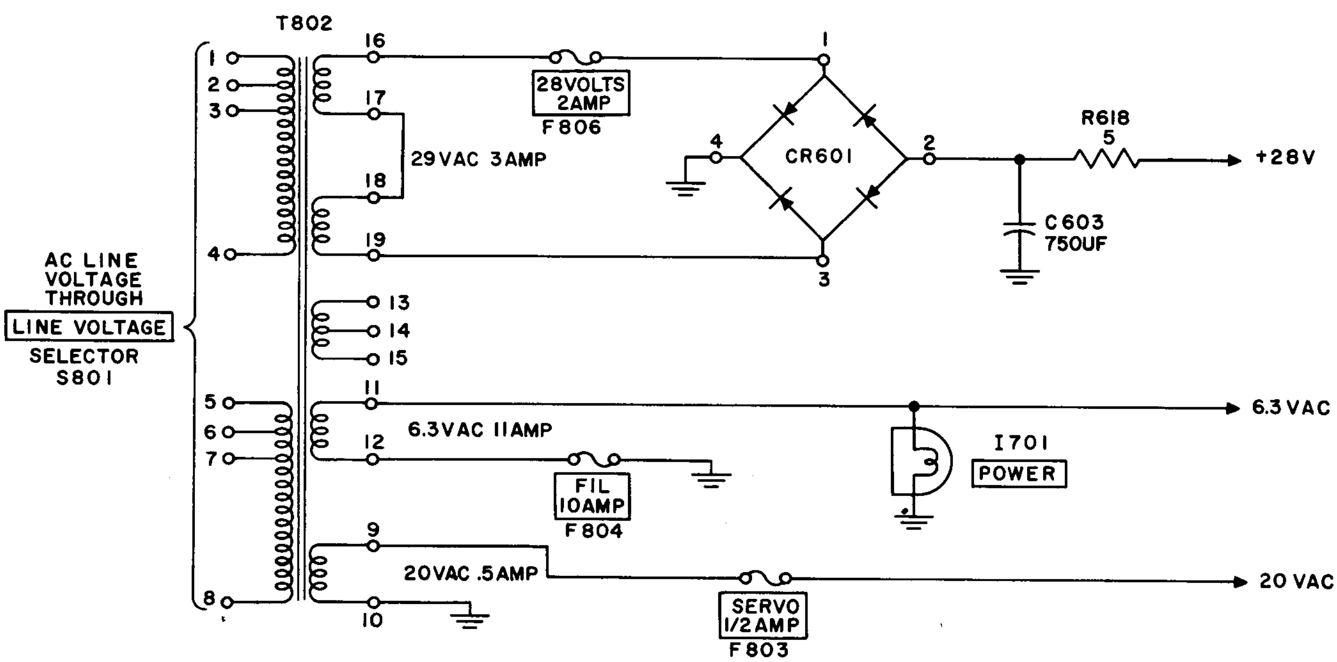


Figure 74. 28 v dc, 20 v ac and 6.3 v ac power supply, simplified schematic diagram

113. 6.3 v ac Power Supply (fig. 74)

The 6.3 v ac power supply provides operating voltage to the parallel filament circuits and operating voltage to the POWER indicator lamp I701 and AFC indicator lamp I703. Transformer T802 terminal 11 provides the 6.3 v ac power. The other terminal of the 6.3 v ac winding, terminal 12, is grounded through FIL 10 AMP fuse F804.

114. Filament Circuits (fig. 75)

The filament circuit of the radio frequency oscillator is a complex circuit consisting of both dc series and ac parallel filament circuits. The +180 v regulated supply provides the operating voltage for the series dc filament circuit and the 6.3 v ac supply provides the operating voltage for the four parallel ac filament circuits.

a. The series dc filament circuit operates from the +180 v supply off TB801-23, with resistors R617, R616 and R615 dropping the voltage to +90 v. The DC FIL test point E611 provides access for measuring the dc filament voltage and a voltage of +90 v to ground should be obtained from this test point. The circuit continues from TB801-22 and goes through the if. amplifier subchassis to the discriminator subchassis to pick up V379 and then returns to the if. amplifier subchassis. Resistor R358 in the if. amplifier subchassis shunts V379 in the discriminator subchassis. Shunting the discriminator tube filament reduces its operating voltage to approximately 9 v. This minimizes the current through that side of the diode which has the very low plate voltage but does not reduce the effectiveness of that side of the diode which has the high plate voltage. The over-all effect is to improve the accuracy of the discriminator circuit. After re-entering the if. amplifier subchassis the circuit picks up V303, V302, V301, V304 and V305, in that order. The circuit then enters the master oscillator subchassis and picks up V002 and V001, then terminates at ground. Capacitor C014 bypasses the rf from the oscillator tube V001 filament to ground.

b. The 6.3 v ac supply provides filament voltage for the remaining tubes of the radio frequency oscillator. V306 and V307 in the if. amplifier subchassis receive 6.3 v ac filament voltage from TB801-9. V502 and V501 in the audio amplifier subchassis receive 6.3 v ac filament voltage from TB801-10. The POWER indicator I701 is also on this circuit. The r-f amplifier subchassis receives 633 v ac filament voltage from TB801-7. This filament supply is filtered. The filament supply for the r-f power amplifier V107 is filtered by the filter consisting of C188, L128, C190 and C182. The filament supply for V102, V101, V103, V104, V105 and V106 is filtered by the filter consisting of C187, L129, C189 and C181. V401, V402 and V403 of the servo amplifier subchassis receive 6.3 v ac filament voltage from TB801-8. V605, V603 and V604 of the power rectifier subchassis receive 6.3 v ac filament voltage from the 6.3 v ac transformer T802. This circuit does not go through TB801 as the other filament supply circuits do.

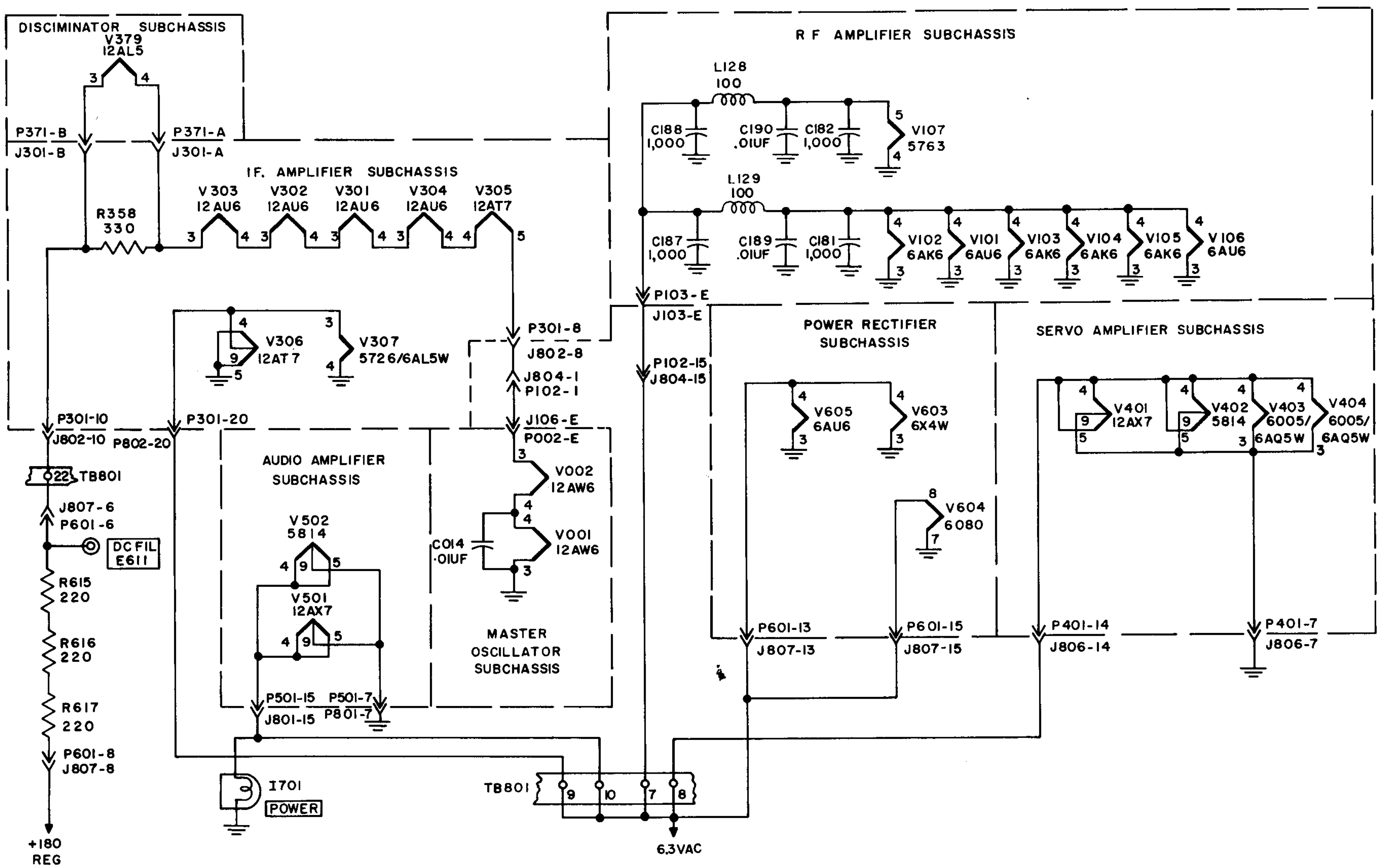


Figure 75. Filament circuits, schematic diagram.

Section IV. THEORY OF ELECTRICAL DUMMY LOAD DA-85/URA-13

115. General

Electrical Dummy Load DA-85/URA-13 is a 50-ohm resistive load into which Radio Frequency Oscillator O-152/URA-13 may operate. The dummy load clips onto the rear panel of the radio frequency oscillator for storage. When used as a load for the radio frequency oscillator, Cord CG-409C/U (122 in.) connects the r-f output from 50 OHM OUT jack J814 to jack J906 of the dummy load. When used to convert a high impedance transmitter input circuit to 50 ohms, the dummy load is similarly connected to the radio frequency oscillator. In addition, jack J905 of the dummy load is plugged into the transmitter crystal socket. The metal case of the dummy load is adjustable to fit either a projecting or flush crystal socket. This hook-up is used only where the transmitter has no 50-ohm input jack. Where the transmitter has a 50-ohm input jack, Cord CG-409C/U connects directly from the 50 OHM OUT jack J814 of the radio frequency oscillator to the 50-ohm input jack of the transmitter.

116. Circuit Theory of Dummy Load (fig. 76)

The dummy load consists of two paralleled 100-ohm resistors R901 and R902. This provides a 50-ohm resistive load. R-f power applies to the load through Cord CG-CG-409C/U which also carries ground from the radio frequency oscillator chassis to the metalic cover of the dummy load. An r-f voltage is present at one terminal of jack J905. This voltage may be used as an r-f exciting voltage for a high impedance transmitter input circuit. The r-f voltage is present on the terminal of jack J905 which is identifiable by the glass lead-through insulator. The other terminal of jack J905 is grounded to the metal cover of the dummy load. When the r-f voltage from the dummy load is used as an exciting voltage input to a transmitter, jack J905 plugs into the crystal socket of the transmitter. The polarity of J905 must be observed when plugging the dummy load into a crystal socket. If the polarity is not observed the r-f signal will be shorted to ground and the transmitter will receive no exciting signal. Shorting the r-f output to ground will not damage the radio frequency oscillator.

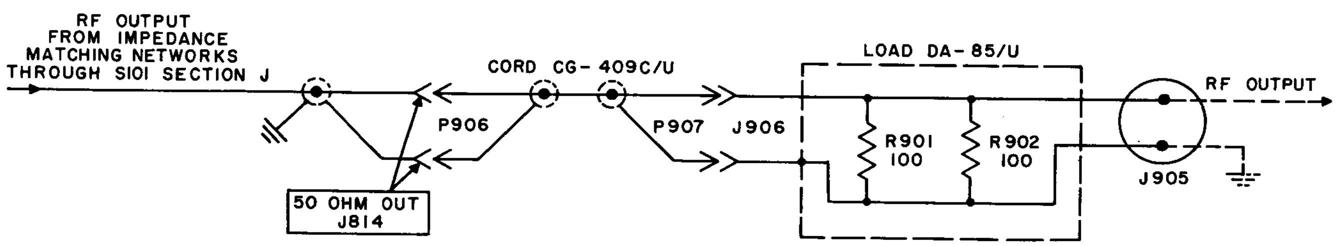


Figure 76. Electrical dummy load DA-85/URA-13, schematic diagram.

CHAPTER 6

FIELD MAINTENANCE INSTRUCTIONS

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

Section I. GENERAL TROUBLE-SHOOTING TECHNIQUES

Warning. When servicing the oscillator group avoid contact with the power supply circuits and the plate circuits. The high voltage present in these circuits can cause serious injury.

117. Extent of Instructions

Trouble-shooting at a field maintenance level consists of any technique required to isolate a defective part, including those techniques outlined for organizational maintenance (ch. 4). The field maintenance instructions continue from the organizational maintenance instructions of chapter 4. The systematic trouble-shooting procedure begins with the operational checks that can be performed at an organizational level (par. 53) and ends with the sectionalizing, localizing and isolating techniques described in sections II and III of this chapter.

118. Trouble-shooting Techniques

a. General. Trouble-shooting must be systematic to be effective. It is seldom possible to observe a symptom and diagnose the trouble immediately. Generally, a sequence of operational checks, observations, and measurements is required before the reason for the fault is apparent. The proper trouble-shooting technique is first to trace the fault to a unit, then to a portion of the unit, and finally to the defective component. This procedure is called sectionalizing, localizing and isolating.

b. Sectionalizing. The first aim in tracing a fault is to sectionalize the fault to either of the two units of the oscillator group. Determine the defective unit through visual checks or operational procedures (par. 121).

c. Localizing. After determining the defective unit, make additional checks to localize the fault to a portion of the unit, either a subassembly or a circuit. Use inspection, short-circuit checks and operational procedures first (ch. 4). Then use the specialized testing procedures given in the instruction book for Radio Receiver R-390/URR or in par. 124 through 126 of this instruction book.

Caution. Do not apply power to a unit unless the operational symptoms are known and are of such a nature to eliminate the possibility of further damage when power is applied. If the symptom is not known, or indicates the possible existence of short circuits, make short-circuit checks (par. 124) before applying power.

d. Isolating. After the fault has been localized to a portion of a unit, either a subassembly or a circuit, determine the defective component by visual inspection, voltage measurements or resistance measurements. Data and procedures for isolating defective components are detailed in paragraphs 127 and 128 of this instruction book and in the radio receiver instruction book

119. Trouble-shooting Data

Use the material supplied in this instruction book to assist in the rapid location of faults. The references listed below contain helpful information.

Ref.	Description
Figs. 20 through 21	Tube location diagrams
Fig. 22	Cording diagram
Par. 103f	List of coarse position frequencies of mc position switch S901 section B.
Par. 127	Stage gain measurements
Figs. 77 through 83	Voltage and resistance measurements
Par. 129	DC resistances of transformers and coils
Figs. 84 - 106	Subassembly views showing location of parts
Fig. 110	Radio Frequency Oscillator O-152/URA-13 over-all schematic
Fig. 111	Radio Receiver R-390/URR over-all schematic

120. Test Equipment and Tools Required for Trouble-Shooting.

a. The test equipment required for trouble-shooting Oscillator Group AN/URA-13 is listed below. The technical manuals associated with the test equipment are also listed where they are applicable.

Test Equipment	Technical Manual
VTVM-6A/U, or equal	
Electron Tube Test Set TV-7/U, or equal	TM 11-5083
RF Signal Generator AN/URM-25, or equal	TM 11-5521
Audio Oscillator TS-382/U, or equal	TM 11-2684
Multimeter TS-352/U, or equal	
VTVM ME-25A/U, or equal	
Frequency Meter AN/USM-26, or equal	

b. The tools and materials contained in Tool Equipment TE-113 are required for field maintenance of Oscillator Group AN/URA-13. In addition an rf tuning tool is provided with the radio frequency oscillator. The rf tuning tool clips to the top of the rf amplifier subchassis. A gear train synchronizing rod is also provided with the radio frequency oscillator and is clipped to the under-side of the top dust cover.

Section II. INTERUNIT TROUBLE-SHOOTING

121. General

If the operational checks (par. 52) fail to sectionalize a fault to the defective unit of Oscillator Group AN/URA-13, it is necessary to perform the sectionalizing procedures given in paragraph 123 to determine the defective unit of units.

122. Symptom of Interunit Trouble

The common symptom of an inoperative unit is the inability of the radio frequency oscillator to tune automatically to the frequency to which the radio receiver is set. This condition is indicated when the whir of the tuning gear train of the radio frequency oscillator repeats several times but the AFC indicator does not light.

123. Sectionalizing Procedures

Execute the following procedures to locate a malfunctioning unit of Oscillator Group AN/URA-13. The order of execution is not important. It is not necessary to remove the units from the equipment cabinet to perform the sectionalizing procedures.

Note. When performing sectionalizing procedures, disconnect Cord CG-409C/U from the associated transmitter and connect it to Electrical Dummy Load DA-85/U.

a. Check Radio Receiver If. Output.

(1) Turn POWER switch OFF and set FUNCTION switch of the radio frequency oscillator to the DEV SET position.

(2) Disconnect Cord CG-409C/U from the IF OUTPUT 50 OHMS jack J106 of the radio receiver.

(3) Connect Multimeter ME-25A/U to the IF OUTPUT 50 OHMS jack J106 of the radio receiver.

(4) Disconnect Radio Frequency Cable Assembly CG-833/U from the ANTENNA UNBALANCED WHIP jack J107 of the radio receiver.

(5) Turn POWER switch ON and allow set to warm up.

(6) Tune the radio receiver to the frequency of a known transmitter. (Provide an antenna for the radio receiver if necessary.)

(7) If the multimeter indicates the presence of an if. output, the radio receiver is operative. If no if. output is present, the radio receiver is inoperative. Refer to the Instruction Book for Radio Receiver R-390/URR for procedures to localize the trouble.

b. Check Radio Frequency Oscillator Rf Output.

(1) Turn the POWER switch to OFF.

(2) Disconnect Cord CG-409C/U from the REC ANT jack J813.

(3) Connect Multimeter ME-25A/U to the REC ANT jack J813.

(4) Set the MEGACYCLE CHANGE control of the radio receiver to 3 mc.

(5) Turn the FUNCTION switch of the radio frequency oscillator to the DEV SET position.

(6) Turn the POWER switch to ON and allow the set to warm up.

(7) Turn the FUNCTION switch of the radio frequency oscillator to the OPERATE position.

(8) If the multimeter indicates the presence of an rf output as the radio frequency oscillator sweeps over the 3 to 6 mc band the radio frequency oscillator is operative. If no rf output is present, the radio frequency oscillator is inoperative. Refer to section III of this chapter for procedures to localize the trouble.

Section III. TROUBLE-SHOOTING RADIO FREQUENCY OSCILLATOR O-152/URA-13.

Note. Trouble-shooting procedures for Radio Receiver R-390/URR are included in the instruction book for the radio receiver.

Caution. Do not remove parts or subassemblies before reading the instructions in Section IV of this chapter.

124. Checking Voltage Supply Circuits

a. When to Check. Applying power to a unit in which a short circuit exists will cause additional damage. When any of the following conditions apply, check first for short circuits and clear the trouble that is found before applying power.

(1) When servicing the radio frequency oscillator apart from the radio receiver and the symptoms of trouble are unknown.

(2) When trouble symptoms reported from operational tests indicate power supply trouble (items 16 and 18 of the equipment performance checklist, par. 52).

(3) When interunit sectionalizing (par. 123) indicates possible power trouble.

b. Preparation for checking. It is necessary to remove the radio frequency oscillator from the rack to check the voltage supply circuits (par. 131). Remove all power from the unit before proceeding with the check. Often a blown fuse will indicate the voltage supply circuit which is malfunctioning. In this eventbegin the check with the circuit indicated by the blown fuse.

c. Checking the +180v Regulated Supply Circuits. Use the following procedure for checking the +180v regulated supply circuit.

(1) Disconnect P102 from J804; P301 from J802, and P601 from J807.

(2) The dc resistance measured between P102-6 and ground should be approximately 23K ohms. If the resistance is less check for shorted capacitors in the reactance-tube oscillator, V001 and V002, or the buffer V101 plate and screen grid voltage supply circuits.

(3) The dc resistance measured between P301-11 and ground should be approximately 39K ohms. If the resistance is less check for shorted capacitors in the if. amplifier V301, first limiter V302, second limiter V303, relay control if. amplifier V304 or sensing detector V305A supply voltage circuits. If the resistance is greater check for an open dropping resistor in the same circuits.

(4) The dc resistance meausred between P601-5 and ground should be approximately 3,500 ohms. If the resistance is greater check for an open dropping resistor in the fsk bias circuit R611 through R614, or in the regulating tube V605 control grid circuit. If the resistance is less, check for a shorted capacitor C605 in the regulating tube control grid circuit.

(5) After the check is complete, reconnect P102 to J804, P301 to J802, and P601 to J807.

d. Checking the +250 v dc Supply Circuits. With all subchassis interconnected the dc resistance from HV test point E613 to ground should be approximately .75K ohms. If the resistance is lower, check for shorted decoupling capacitros in the rf power amplifier, rf spectrum aplifier, servo amplifier and pm audio amplifier circuits.

125. Test Set-up

Bench tests of the radio frequency oscillator require connections to an ac power source and to various test equipment. Unless otherwise specified, the radio frequency oscillator is hooked-up according to the cording diagram (fig. 22) with an accompany Radio Receiver R-390/URR, with the exception that Cord 409C/U connects to the dummy load rather than a transmitter. The built-in power supplies of the radio frequency oscillator and the radio receiver must be used during the bench test. Connect test equipment as specified for the particular test.

126. Localizing Trouble

a. General. The following chart is an outline of procedures for localizing troubles to the various sections of the radio frequency oscillator, as well as for localizing trouble to a stage within the sections. Depending on the nature of the trouble symptoms, one or more of the procedures will be necessary. When use of the procedures results in localizing the trouble to a particular stage, use the techniques oulined in paragraph 128 to isolate the trouble to a particular component.

b. Use of Chart. The trouble-shooting chart supplements the operational checks given in the equipment performance checklist (par. 52) and the interunit sectionalizing checks (par. 123). If previous operational checks have resulted in reference to this chart, go directly to the chart. If no operational symptoms are known, begin with the equipment performance check (par. 52) and proceed as directed.

Caution. If trouble symptoms are not known, or if they indicate the possiblity of short circuits within the radio frequency oscillator, check the voltage supply circuits as described in paragraph 124 before applying power to the unit.

c. Conditions for Tests. All checks outlined in the chart are to be conducted with the radio frequency oscillator connected as described in paragraph 125. Test equipment is to be used as directed in the chart. In addition, the front panel controls of the radio frequency oscillator and the radio receiver are to be set as given in paragraph 138 unless specified otherwise in a particular step.

d. Trouble-shooting Chart.

Item	Symptom	Possible Trouble	Checking Procedure	Corrective Measure
1.	POWER ON indicator fails to light when POWER switch is thrown to ON	Blown fuses	Inspect PWR 2 AMP fuses F801 and F805.	Replace fuses. If trouble re-occurs see item 2.
		Burnt out indicator lamp	Indicated if fan motor runs.	Replace POWER ON indicator lamp.
2.	POWER ON indicator lights briefly and then goes off when POWER switch is thrown to ON.	Fault in +250 v circuit if fan motor does not run	Pull subchassis plugs replace blown fuse, then insert subchassis plugs one by one to localize fault.	Check +250 v circuit in defective subchassis for shorts and defective capacitors.
		Fault in 6.3 v ac filament circuit if fan motor runs	Inspect FIL 10 AMP fuse F804.	Replace blown fuse. If fuse blows again, locate and correct fault.
3.	POWER ON indicator lights but equipment does not operate properly	Fault in +180 v regulated circuit	Check voltage at REG V test point E612. Inspect HV $\frac{1}{4}$ AMP fuse F802.	Voltage should be approximately 180 v. Find and correct fault. Replace fuse if necessary.
		Fault in series filament circuit	Check voltage at DC FIL test point E611. Check to see if V379, V301, V302, V303, V304, V305, V001, and V002 are lit.	Voltage should be approximately 90 v. Locate and replace defective tube.
4.	POWER ON indicator lights, but OVEN ON indicator is off and motors will not operate	Blown fuse	Inspect 28 VOLT 2 AMP fuse F806.	Replace fuse if necessary.
		Discriminator oven fault	Check discriminator oven for continuity between P371-C and ground.	Locate and correct fault.
		B102 or B103 fault	Indicated if 28 VOLT 2 AMP fuse F806 blows only when FUNCTION switch is in the OPERATE position.	Inspect circuits to B102 and B103. Replace defective motor if fault appears to be in the motor.
		Fault in +28 v circuits	Pull plug P102 and check +28 v circuits.	Locate and correct fault.

d. Trouble-shooting Chart (continued).

Item	Symptom	Possible Trouble	Checking Procedure	Corrective Measure
5.	No automatic frequency control by radio frequency oscillator (tuning cycle continues but does not terminate)	Receiver RF GAIN control set too low		Increase receiver rf gain to see if radio frequency oscillator will lock in on the signal.
		Receiver RF GAIN control set too high	Indicated if servo motor stops on spurious signals, is very noisy and is unstable.	Reduce rf gain of radio receiver.
		No rf output to radio receiver	Check for rf output at REC ANT jack J813. If none is measured and rf is present at 50 OHM OUT jack J814, check V106.	Check for grounds at J813. Replace V106 if defective. If no rf is present at J814, go to item 6.
		Defective radio receiver	Check for indication of rf input to radio receiver on CARRIER LEVEL meter.	Trouble-shoot radio receiver. (see Instruction Book for Radio Receiver R-390/URR.)
		Defective if amplifier, discriminator or chopper		See items 10 and 11.
6.	No rf output at 50 OHM OUT jack J814	Shorted rf cable	Check for ground at 50 OHM OUT jack J814	Clear ground on cable
		Keying line open	Ground V107 cathode circuit at R121	If grounding V107 cathode circuit produces rf output, check continuity of V107 cathode ground circuit through K401.
		No plate voltage supply to V107	Check to see that E111 is not pushed back.	Short E109 and E110 with E111.
			Check for plate supply voltage at J103-B and on L112.	If voltage appears at J103-B and not on L112, check FL102. Replace FL102 if necessary.
		Defective master oscillator	Check for rf voltage at J815 or on R101.	Check continuity of master oscillator circuit. Replace V001 if necessary.

d. Trouble-shooting Chart (continued)

Item	Symptom	Possible Trouble	Checking Procedure	Corrective Measure
6 (cont)		No rf drive to V107	Check for grid bias of V107 at R121.	If no grid bias is present check the other frequency bands to locate defective rf doubling stage. Replace tube of defective stage and re-align the rf amplifier.
7.	Coarse positioning motor B102 not operative	No +28v supply	Check for +28v at jack J107-14.	Check continuity of the +28v circuit back to the supply
		Open coarse positioning motor control circuit	Check to see that cable CX-1619/U is correctly in place. Check to see that gear plate plugs and relay plugs are properly seated.	Connect cable CX-1619/U properly and seat all plugs. Check continuity of the rest of the coarse positioning motor control circuit.
		Defective relays	Check continuity of circuit through K207, K206, K208 and K205 (K206 must be energized, K207, K208 and K205 de-energized).	Replace relay subchassis if possible, or replace defective relay.
		Defective motor B102	Check for +28v at motor plug P104-F and ground at P104-E	Inspect brushes of motor B102 and replace if necessary. Replace motor B102 if necessary.
8.	Coarse positioning motor runs but will not stop	Defective switches S102 or S901 section C	Check to see that switch S102 terminal 9 is not grounded.	Remove the ground by re-aligning S901 section C, or check for other grounds.

d. Trouble-shooting Chart (continued).

Item	Symptom	Possible Trouble	Checking Procedure	Corrective Measure
8 (cont)		Defective afc indicator relay K402	Pull plug P401 of servo amplifier to see if trouble continues.	If pulling plug P401 corrects trouble, correct K402 fault or replace K402.
		Defective crystal CR401	Indicated if AFC indicator remains lit throughout positioning cycle.	Replace crystal CR401.
9.	Coarse positioning motor runs then stops, but fine positioning does not continue the cycle	Blown fuse	See if servo motor B101 is trying to run. If not, check SERVO $\frac{1}{2}$ AMP fuse F803.	Replace fuse if necessary.
		Fault in + 28 v circuit to clutch operating coil L125	Check for + 28 v at L125	Check continuity of +28 v circuit back to supply.
		Jammed gear train	See if gear train is free to run.	Clear jams.
		Defective tube V305 or defective servo amplifier	Check for input 60 cps signal at TB101 terminals 1-2 and for input signal on cathode (pin 3) of V401.	If there is an input signal to V401 (pin 3) and not to TB101 terminals 1-2, check circuit through servo amplifier. Correct trouble or replace servo amplifier. If there is no input signal to V401 (pin 3), replace V305.
		Clutch operating coil L125 defective	Check for continuity through the coil L125.	Replace L125 if there is no continuity.
		Defective bandpass relay K401	Check to see that K401 is energized and for ground at J107-7	If K401 is energized and J107-7 is not ground, replace K401.
		Defective motor operate relay K206	Check continuity of circuit through K206 from plug P202-15 to P303-7.	If there is no continuity replace K206.

d. Trouble-shooting Chart (continued).

Item	Symptom	Possible Trouble	Checking Procedure	Corrective Measure
9 (cont)		Clutch not properly adjusted	Indicated if operating coil L125 energizes but gear train does not shift to fast drive from servo motor.	Re-adjust clutch link.
		Improper phasing to servo motor.		Reverse leads to TB101 terminals 1 and 2. If this does not correct trouble, replace leads as they were.
10.	Coarse positioning motor runs then stops, fine positioning continues the cycle but will not stop	Improper inter-unit cording	Check cording between radio receiver and radio frequency oscillator (fig. 22).	Correct improper cording.
		Defective radio receiver	Check for 455 kc input to 455 KC INPUT jack J812.	Trouble-shoot radio rec. (see Instruction Book for Radio Receiver R-390/URR).
		Defective if. amplifier stages	Check for 455 kc signal at test point E311.	If no if. signal is present, check tubes V301, V302 and V303. Replace defective tubes.
		Defective band-pass relay control stages	Tune the radio receiver to the frequency of the radio frequency oscillator so that an if. signal is present at test point E311. (Set the radio frequency oscillator FUNCTION switch to DEV SET to disable B101 and B102. Then check for a negative dc voltage at test point E314.)	Absence of negative dc voltage at E314 indicates defective tubes V304 and/or V305. Check V304 and V305 and replace if defective.
		Defective bandpass relay K401	Check to see that K401 is de-energized. Then check for ground at P401-2.	If K401 is de-energized and P401-2 remains grounded, K401 is defective. Replace K401.

d. Trouble-shooting Chart (continued).

Item	Symptom	Possible Trouble	Checking Procedure	Corrective Measure
10 (cont)		Defective servo amplifier	Check for proper operating voltages in the servo amplifier.	Correct fault or replace servo amplifier.
11.	Coarse positioning motor runs then stops, fine positioning continues the cycle and stops, but fine tuning does not continue to terminate the tuning cycle	Cable missing or improperly connected	Check cable W802 (fig. 104) between if. amplifier and servo amplifier.	Connect W802 between J304 and J401.
		Defective chopper G401 or fault in 20 v ac supply to chopper	Check chopper output at J304 to see if chopper is operating. Check 20 v ac supply at chopper socket XG401 pin 7 to ground.	If there is no 20 v ac supply, check continuity of supply circuit. If there is 20 v ac supply and chopper is inoperative, replace chopper G401.
		Defective discriminator or defective components in the modulation canceling circuit	Check for dc voltage at test points E312 and E313. Check for an if. signal at test point E311.	If there is an if. signal at E311 and no dc voltage at E312, the discriminator is defective. Replace the discriminator. If there is dc voltage at E312 but not at E313, check for defective R341, R342, R343 and C342. Replace defective components.
		Defective servo amplifier	Check for proper operating voltages in the servo amplifier.	Correct fault or replace servo amplifier.
12.	After tuning to frequency, servo motor "hunts" (indicated by AFC indicator blinking on and off)	Defective servo damping circuit Defective rate generator G101	Check R402, R403 and R404. Check TB101 terminals 8-7 or at R402 for dc feedback voltage.	Replace defective components. If there is no feedback voltage, check continuity of feedback circuit.

d. Trouble-shooting Chart (continued).

Item	Symptom	Possible Trouble	Checking Procedure	Corrective Measure
12 (cont)				Inspect the rate generator G401 for broken or worn brushes. Replace rate generator if necessary.
		Wrong polarity of feedback voltage		Reverse the leads from the rate generator to TB101 terminals 7 and 8. If this does not correct the trouble, replace the leads as they were.
13.	Improper or no keying on cw operation	V107 cathode ground circuit continuously grounded	Check for ground jumper between TB802 terminals 12 and 14.	Remove ground jumper.
		Fault in +28 v circuit to cw keying relay K202	Check continuity of +28 v circuit from K202 terminals 3 and 8 back to supply.	Correct fault.
		Defective cw keying relay K202	Listen for K202 operation.	Replace K202 if necessary.
14.	Improper or no keying on fsk operation	POLAR NEUTRAL switch in wrong position	Check position of POLAR NEUTRAL switch with type of keying signal.	Put POLAR NEUTRAL switch in proper position.
		Fault in + 28 v circuit to fsk relay K801 if neutral keying is used.	Check continuity of +28 v circuit from R709 back to supply.	Correct fault.

d. Trouble-shooting Chart (continued).

Item	Symptom	Possible Trouble	Checking Procedure	Corrective Measure
14 (cont)		Defective fsk relay K801	Listen for K801 operation.	Replace K801 if necessary.
		Defective frequency shift voltage supply circuit.	Put MOD TEST switch in MRK-WH-HI position then in SPACE-BLK-LOW position and check for proper keying shifts.	If proper shifts are not produced, check the continuity and voltages of the fsk circuit from the keying relay to the reactance tube V002.
15.	Improper modulation on fax operation.	Defective frequency shift voltage supply circuit.	Put MOD TEST switch in MRK-WH-HI position then in SPACE-BLK-LOW position and check for proper keying shifts.	If proper shifts are produced, check R714 and R713. If proper shifts are not produced, check the continuity and voltages of the fax circuit from the fax input to the reactance tube V002.
16.	Improper or no modulation on phone (pm) operation.	V107 cathode ground circuit open.	On remote phone operation if no external "push-to-talk" carrier control is used, check for jumper between TB802 terminals 12 and 14.	Insert jumper.
			On local phone operation, check cw keying relay K202 operation for "push-to-talk" carrier control.	See item 13.

d. Trouble-shooting Chart (continued).

Item	Symptom	Possible Trouble	Checking Procedure	Corrective Measure
16 (cont)		Improper setting of AUDIO LEVEL control.		Set AUDIO LEVEL control so that peak modulation is not more than 1 radian.
		Defective audio amplifier.	Check operation voltages of audio amplifier.	Correct fault or replace audio amplifier.

127. Localizing Trouble to Stage by Stage Gain Measurements

Stage gain measurements are given in subparagraphs a through d for the if. amplifier stages, the servo amplifier stages, the rf amplifier stages and the audio amplifier stages.

a. If. Amplifier Stage Gain Measurements. Measure the voltage gains for the if. amplifier with a .05 v ac, 455-kc input signal to V301 pin 1.

Input voltmeter connection	Input voltmeter reading	Output voltmeter connection	Output voltmeter reading	Stage gain (ratio)
V301 pin 1	.05 v ac	V301 pin 5	8.5 v ac	170
V302 pin 1	7.8 v ac	V302 pin 5	5 v ac	.63
V303 pin 1	4 v ac	V303 pin 5	100 v ac	25
V304 pin 1	1.0 v ac	V304 pin 5	17 v ac	17
V305				no gain
V306 pin 7	.7 v ac	V306 pin 6	25 v ac	35.7
V306 pin 2	25 v ac	V306 pin 1	25 v ac	1
V307				no gain

b. Servo Amplifier Stage Gain Measurements. Measure the voltage gains for the servo amplifier by setting the radio frequency oscillator FUNCTION switch to DEV SET position and then tuning the radio receiver off frequency enough to produce the given input signal strength to each stage.

Input voltmeter connection	Input voltmeter reading	Output voltmeter connection	Output voltmeter reading	Stage gain (ratio)
V401 pin 2	.004 v ac	V401 pin 1	.06 v ac	15
V401 pin 7	.035 v ac	V401 pin 6	.22 v ac	6.3
V402 pin 2	.1 v ac	V402 pin 1	3 v ac	30
V402 pin 7	.5 v ac	V402 pin 7	6 v ac	12
V403 pin 1,7	.25 v ac	V403 pin 5 to T401 terminal 2	40 v ac	160
V404 pin 1,7	.25 v ac	V404 pin 5 to T401 terminal 2	40 v ac	160

c. Audio Amplifier Stage Gain Measurements. Measure the voltage gains for the audio amplifier with a 300 cps and 3000 cps input signal to TB 802 terminals 6 and 7. Adjust the AUDIO LEVEL control to produce .0025 v ac at V501 pin 2. The AUDIO LEVEL meter should read 1 radian deviation at this point.

Input voltmeter connection	Input voltmeter reading	Output voltmeter connection	Output voltmeter reading	Stage gain (ratio)
V501 pin 2	.0025 v ac	V501 pin 1	.5 v ac	60
V501 pin 7	.15 v ac	V501 pin 6	4 v ac	27
V502 pin 2	.052 v ac at 300 cps	V502 pin 1	.5 v ac at 300 cps	9.6
V502 pin 2	.58 v ac at 3000 cps	V502 pin 1	4.5 v ac at 3000 cps	7.8
V502 pin 7	1.0 v ac	V502 pin 6	8.5 v ac	8.5

d. Rf Amplifier Stage Gain Measurements. A quick, over-all stage gain measurement can be made without removing the rf amplifier subchassis from the main frame. To do this, set the output frequency at 24.8 mc and allow the radio frequency oscillator to tune up. Then set the radio frequency oscillator FUNCTION switch to the DEV SET position and inject a 2 v ac, 1.55 mc signal through plug P105. The rf amplifier output, measured across the dummy load, should be 12.23 v ac. The rf amplifier output, measured from the REC ANT jack J813 to ground should be 1.5 v ac. For individual stage gain measurements the rf amplifier subchassis must be removed from the main frame (par. 132 d). Improvise a test cable from jack J103 to plug P103 to supply operating voltages. Tune the rf amplifier to 24.8 mc. This can be done by injecting a 2 v ac 1.55 mc signal to plug P105 and peaking the output measured across the dummy load. The band switch, S101 sections C through J, should be in position 10 so that all rf doublers are in the circuit and the output frequency is 24.8 mc. Measure the voltage gains with a 2 v ac, 1.55 mc signal input to plug P105.

Input voltmeter connection	Input voltmeter reading	Output voltmeter connection	Output voltmeter reading	Stage gain (ratio)
V101 pin 1	2 v ac	V101 pin 5	23 v ac	11.5
V102 pin 1	20 v ac	V102 pin 5	135 v ac	6.75
V103 pin 1	41 v ac	V103 pin 5	58 v ac	1.42
V104 pin 1	58 v ac	V104 pin 5	32	.55
V105 pin 1	30 v ac	V105 pin 5	24 v ac	.80
V106 pin 1	3.4 v ac	V106 pin 5	1.4 v ac	.41
V107 pin 8,9	20 v ac	V107 pin 1	28 v ac	1.40

128. Isolating Trouble Within a Stage

When trouble has been localized to a stage, either through operational checks (par. 52), localizing trouble-shooting procedures (par. 126) or stage gain measurements (par. 127), use the following techniques to isolate the defective component.

a. Test the tube involved, either in Tube Tester TV-7/U or by substituting a different tube of the same type which is known to be good.

Note. Do not substitute tubes for the discriminator V379 or the reactance tube V002. Changing these tubes will necessitate realignment of the equipment.

b. Make voltage measurements at the tube socket and other related points (figs. 77-83) in the malfunctioning stage.

c. If voltage measurements are abnormal, take resistance measurements (figs. 77-83) to isolate open and short circuits. Refer also to the table of dc resistances of transformer windings and coils (par. 129).

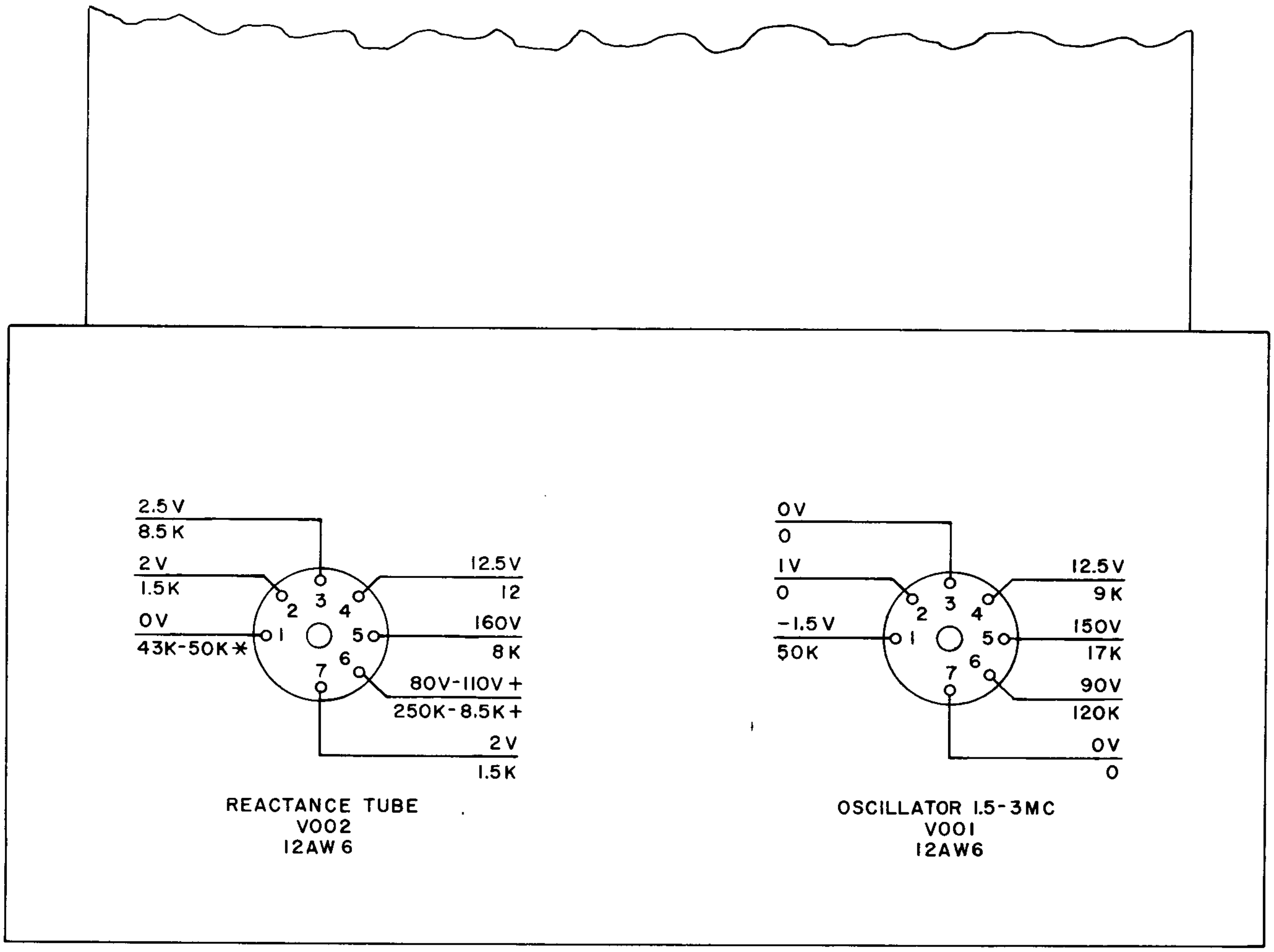
d. If signals are weak and all checks fail to indicate a defective component, check the alignment of the radio frequency oscillator (section V of this chapter).

129. DC Resistance of Transformer Windings and Coils.

The dc resistances of the transformer windings and the coils in the radio frequency oscillator are listed below.

Transformer or coil	Terminals	Dc resistance (ohms)
L003		44
L004		3
FL101	1-2	.5
	3-4	.5
FL102	1-6	2
	2-7	2
	3-8	2
	4-9	2
	5-10	2
L111		18
L112		18
Z101 through Z117		0

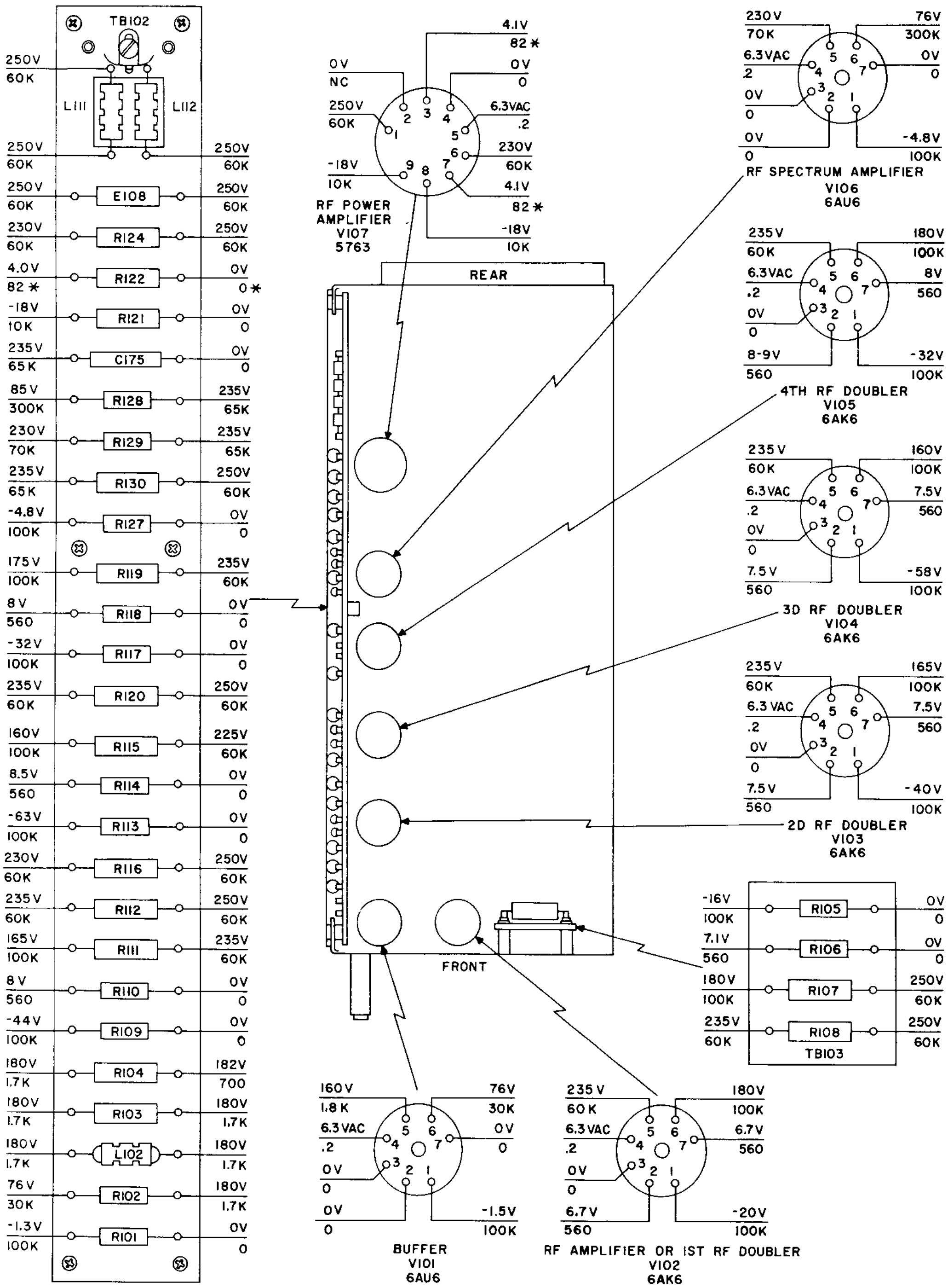
Transformer or coil	Terminals	DC resistance (ohms)
T301	V301 (pin 5) through coil to R303	.25
	V302 (pin 1) through coil to R305	.25
Z301		18
T401	1-2	200
	2-3	200
	4-5	2
L501		100
T501	1-2	15
	3-4	15
	5-6	25
L601		30
L602		30
FL801		.2
FL802		.2
L801 through L812		2
T801	1-2	.2
	2-3	.2
	3-4	2.2
	5-6	.2
	6-7	.2
	7-8	2.3
	9-10	16.
	10-11	14
	10-12	5.7
T802	1-2	.1
	2-3	.1
	3-4	1.2
	5-6	.2
	6-7	.2
	7-8	1.4
	9-10	.9
	11-12	.1
	13-14	.1
	14-15	.1
	16-17	.2
	18-19	.2



NOTE

1. RESISTANCES ARE IN OHMS MEASURED TO GROUND WITH VTVM SUCH AS MULTIMETER TS-505/U.
2. VOLTAGES ARE DC MEASURED TO GROUND WITH VTVM SUCH AS MULTIMETER TS-505/U.
3. RESISTANCES MEASURED WITH PARTICULAR TUBE REMOVED AND ALL OTHERS IN PLACE.
4. * INDICATES RESISTANCE VARIES WITH LINE BALANCE ADJ POTENTIOMETER R705.
5. + INDICATES RESISTANCE AND VOLTAGE VARIES WITH LINEARITY ADJ POTENTIOMETER R148.

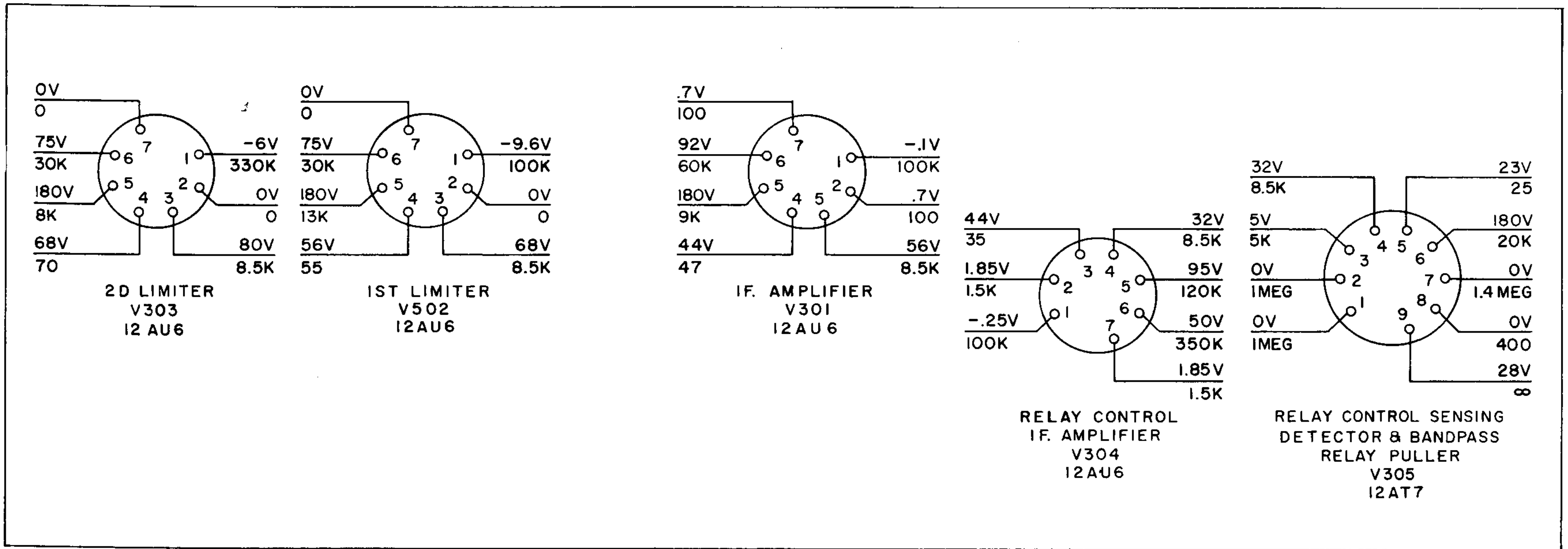
Figure 77. Voltage and resistance diagram, master oscillator subchassis.



NOTES:

1. RESISTANCES ARE IN OHMS MEASURED TO GROUND WITH VTVM SUCH AS MULTIPLIER TS-505/U.
2. VOLTAGES ARE DC UNLESS OTHERWISE SHOWN MEASURED WITH VTVM SUCH AS MULTIMETER TS-505/U.
3. RESISTANCE MEASURED WITH PARTICULAR TUBE REMOVED AND ALL OTHER TUBES IN PLACE.
4. * INDICATES RESISTANCE MEASURED WITH BANDPASS RELAY K401 ENERGIZED.

Figure 78. Voltage and resistance diagram, rf amplifier subchassis.



NOTES:

1. RESISTANCES ARE IN OHM MEASURED TO GROUND WITH VTVM SUCH AS MULTIMETER TS-505/U.
2. VOLTAGES ARE DC UNLESS OTHERWISE SHOWN MEASURED TO GROUND WITH VTVM SUCH AS MULTIMETER TS-505/U.
3. RESISTANCE MEASURED WITH PARTICULAR TUBE REMOVED AND ALL OTHER TUBES IN PLACE.
4. * INDICATES RESISTANCE VALUE DEPENDS UPON SETTING CLIPPER ADJ POTENTIOMETER R353.

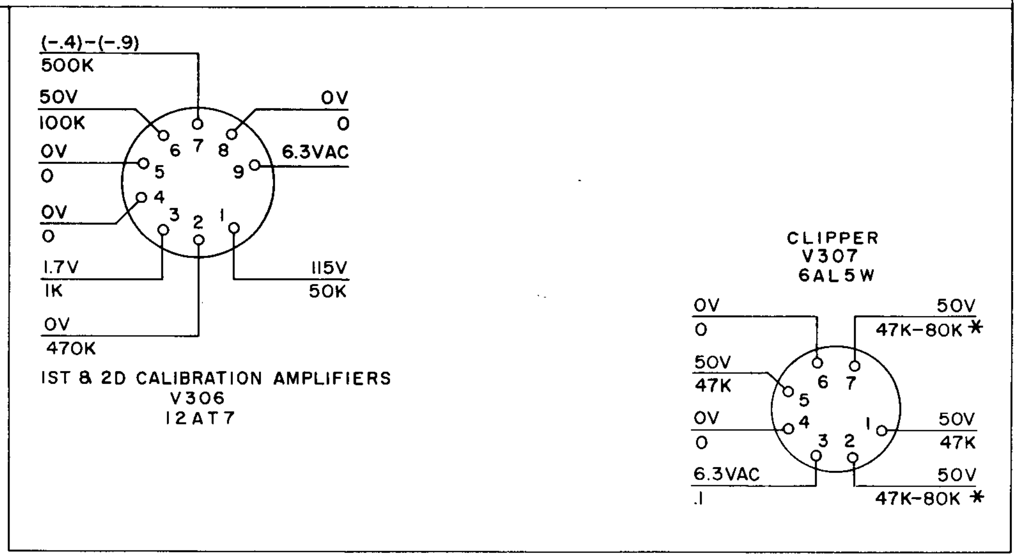
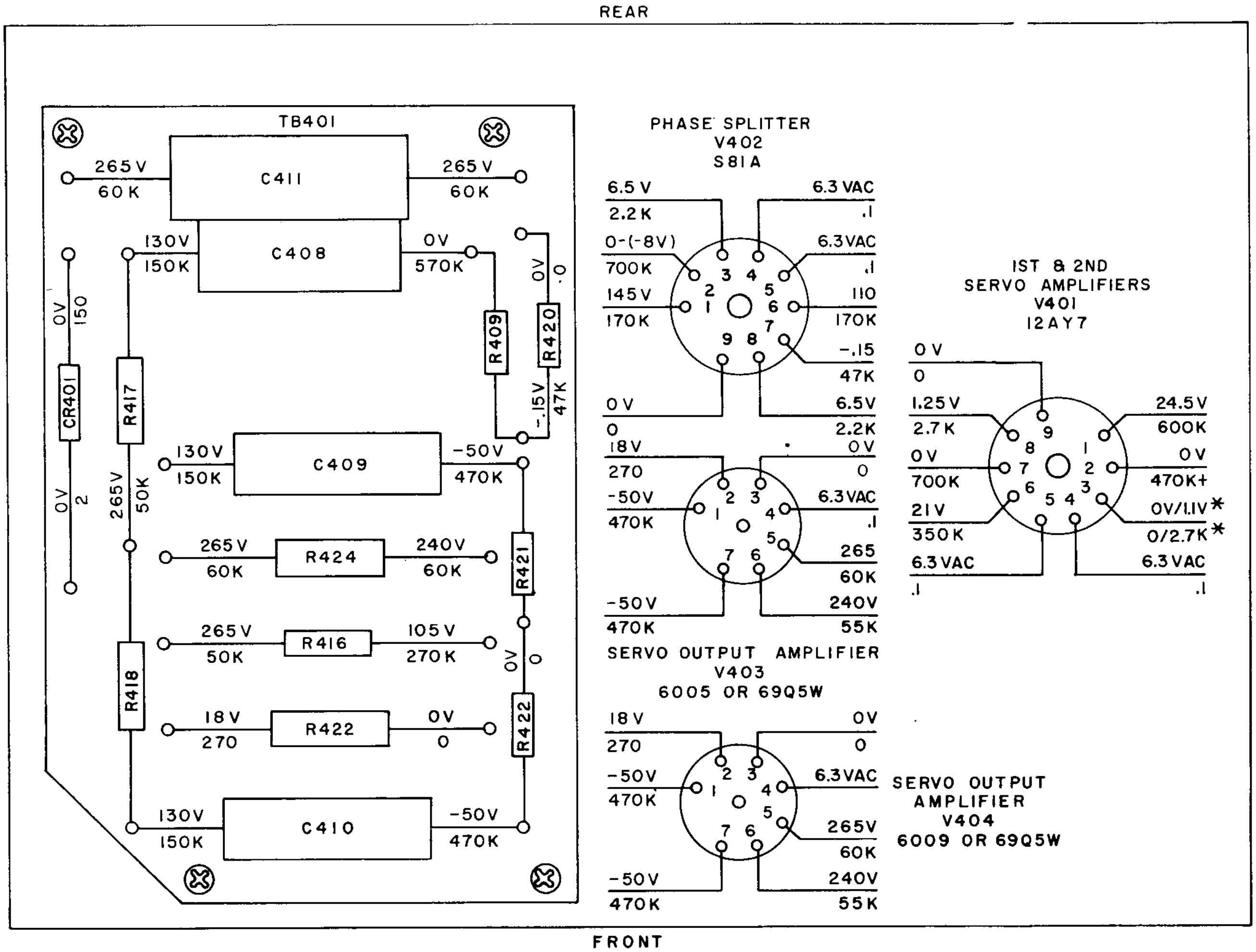


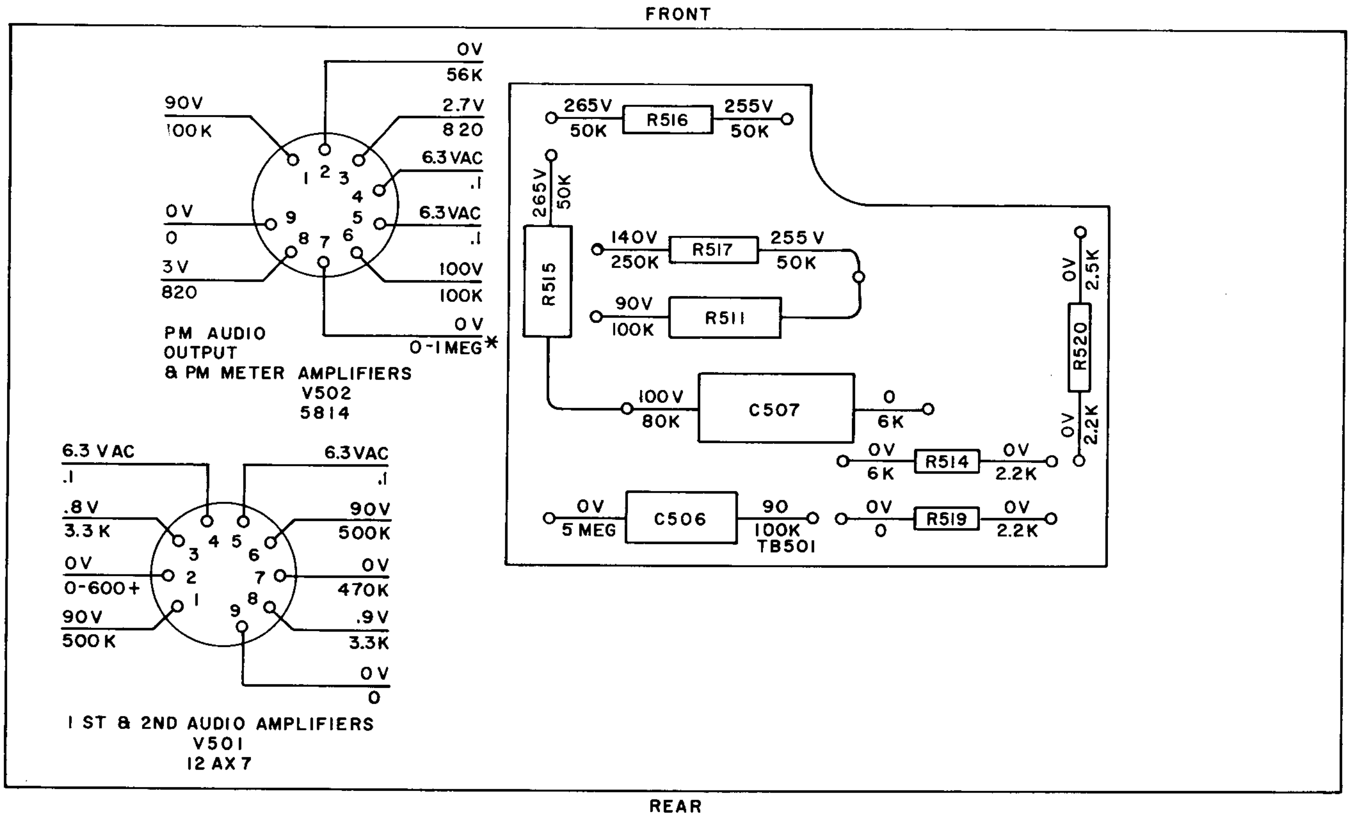
Figure 79. Voltage and resistance diagram, if. amplifier subchassis.



NOTES:

1. RESISTANCES ARE IN OHMS MEASURED TO GROUND WITH VTVM SUCH AS MULTIMETER TS-505/U.
2. VOLTAGES ARE DC, UNLESS OTHERWISE SHOWN, MEASURED TO GROUND WITH VTVM SUCH AS MULTIMETER TS-505/U.
3. RESISTANCE MEASURED WITH PARTICULAR TUBE REMOVED AND ALL OTHER TUBES IN PLACE.
4. * INDICATES HIGH VALUES OBTAINED WITH BANDPASS RELAY K401 ENERGIZED; 0 VALUES OBTAINED WITH K401 DE-ENERGIZED.
5. + INDICATES VALUE OBTAINED WITH BANDPASS RELAY K401 DE-ENERGIZED.

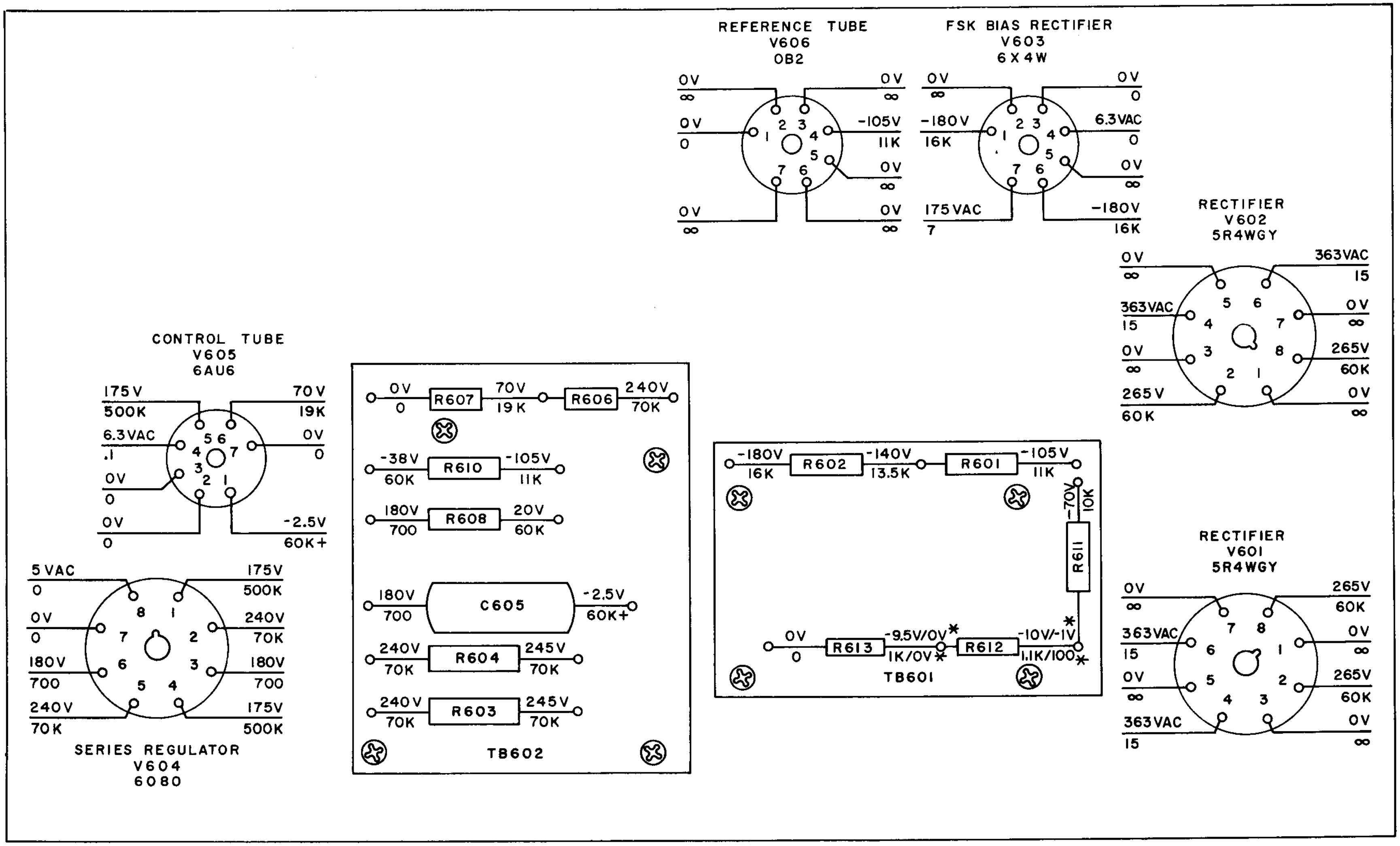
Figure 80. Voltage and resistance diagram, servo amplifier subchassis.



NOTES:

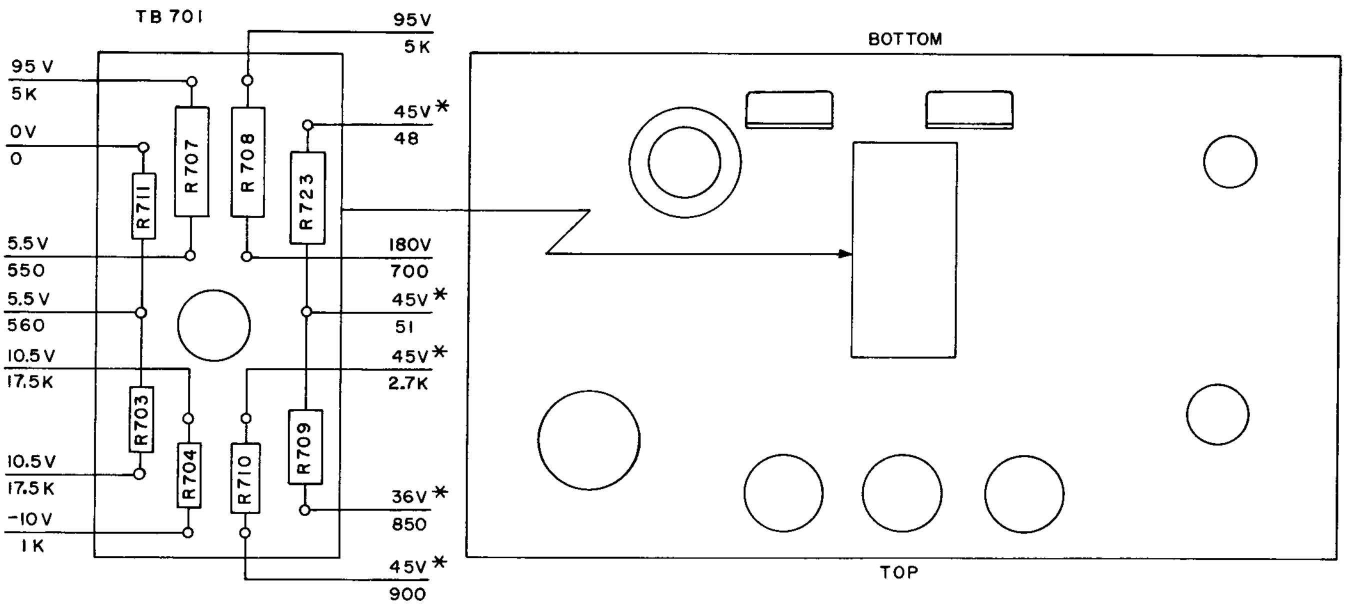
1. RESISTANCE VALUES ARE IN OHMS MEASURED WITH VTVM SUCH AS MULTIMETER TS-505/U.
2. VOLTAGES ARE DC UNLESS OTHERWISE SHOWN, MEASURED WITH VTVM SUCH AS MULTIMETER TS-505/U.
3. RESISTANCE MEASURED WITH PARTICULAR TUBE REMOVED AND ALL OTHER TUBES IN PLACE.
4. * INDICATES RESISTANCE VARIES WITH VU METER ADJ POTENTIOMETER R512.
5. + INDICATES RESISTANCE VARIES WITH PM DEV ADJ POTENTIOMETER R503.

Figure 81. Voltage and resistance diagram, audio amplifier subchassis.



NOTES:
1 RESISTANCES ARE IN OHMS MEASURED WITH VTVM SUCH AS MULTIMETER TS-505/U.
2 VOLTAGES ARE DC UNLESS OTHERWISE SHOWN MEASURED WITH VTVM SUCH AS MULTIMETER TS-505/U.
3 RESISTANCE MEASURED WITH PARTICULAR TUBE REMOVED AND ALL OTHER TUBES IN PLACE.
4 * INDICATES LARGER VALUES OF VOLTAGE AND RESISTANCE MEASURED WITH MOD TEST SWITCH IN MRK-WH-HI POSITION, SMALLER VALUES MEASURED IN SPACE-BLK-LOW POSITION.
5 + INDICATES RESISTANCE VALUES VARY WITH REG VOLTAGE ADJ POTENTIOMETER R609.

Figure 82. Voltage and resistance diagram, power rectifier subchassis.



NOTES :

1. RESISTANCES ARE IN OHMS MEASURED TO GROUND WITH VTVM SUCH AS MULTIMETER TS-505/U.
2. VOLTAGES ARE DC MEASURED TO GROUND WITH VTVM SUCH AS MULTIMETER TS-505/U.
3. * INDICATES VOLTAGES MEASURED WITH OVEN OFF AND NO MOTORS RUNNING.

Figure 83. Voltage and resistance diagram, front panel.

Section IV. REPAIRS

Note. Repairs for Radio Receiver R-390/URR are included in the instruction book for the radio receiver.

130. General Techniques for Replacement of Parts.

Most of the parts in Radio Frequency Oscillator O-152/URA-13 are readily accessible and easily replaceable. However, careless replacement of parts makes new faults inevitable. Observe the following precautions and techniques when replacing parts.

a. Before unsoldering a part, note the position of the leads. If there are a number of connections, tag each lead to the part.

b. Be careful not to damage other leads by pulling or pushing them out of the way.

c. Do not allow drops of solder to fall into the set as they may cause short circuits.

d. Make well-soldered joints. A poorly soldered joint is difficult to locate and will cause faulty operation.

e. When a part is replaced in the rf or if. circuits, the part must be placed in the exact position occupied by the old part. A part that has the same electrical value but different physical size may cause trouble in high-frequency circuits. Give particular attention to proper grounding. Use the same ground as in the original wiring. Failure to observe these precautions may result in decreased gain or in oscillation.

f. The rf amplifier circuits, the modulation voltage circuits, the modulation voltage canceling circuits, and the fsk voltage circuit must be precisely aligned for satisfactory operation of the radio frequency oscillator. If components in these circuits are replaced, realignment of the repaired circuit will be required. Section V of this chapter contains the alignment procedures.

g. If removal of the master oscillator subchassis is anticipated, make certain that the master oscillator is in the 3 mc before removal. After removal do not disturb the positions (par. 132 e). The 3 mc position of the oscillator is the mark position for alignment with the rf circuits. If the setting is disturbed the master oscillator must be externally retuned to 3 mc.

131. Removal of Radio Frequency Oscillator and Radio Receiver from Rack

Perform the following operations to remove the radio frequency oscillator and the radio receiver from the rack.

a. Disconnect Electrical Power Cable Assembly CX-1358/U from the line source and from the radio frequency oscillator.

b. Disconnect Cord CG-409C/U from the transmitter and from the radio frequency oscillator.

c. Disconnect any input signal line from TB802 of the radio frequency oscillator.

d. Disconnect E901 and E902 of Electrical Special Purpose Cable Assembly CX-1619/U from TB803 and TB804, respectively, of the radio frequency oscillator. Do not disconnect this cable assembly from the radio receiver.

e. Disconnect Radio Frequency Cable Assembly CG-833/U, Cord CG-409C/U, and Electrical Power Cable Assembly CX-2405/U from both the radio frequency oscillator and the radio receiver.

f. Remove the ground straps from both the radio frequency oscillator and the radio receiver.

g. Remove the eight Phillips-head screws which secure the front panel of the radio receiver to the rack (fig. 16) and remove the radio receiver from the front of the rack. If the rack does not include shelf angles for supporting the units, it will be necessary to have a second person support the radio receiver while the front panel screws are removed.

h. Remove the eight Phillips-head screws which secure the front panel of the radio frequency oscillator to the rack (fig. 16) and remove the radio frequency oscillator from the front of the rack. If the rack does not include shelf angles for supporting the units, it will be necessary to have a second person support the radio frequency oscillator while the front panel screws are removed.

132. Removal and Replacement of Subchassis of Radio Frequency Oscillator O-152/URA-13

All the subchassis of the radio frequency oscillator, except the relay subchassis, the rf amplifier subchassis and the gear plate, can be removed from the main frame without prior removal of any other subchassis.

a. Removal and Replacement of Front Panel.

(1) Remove the top and bottom dust covers from the radio frequency oscillator.

(2) Disconnect plug P106 (fig. 87) from jack J702 (fig. 103).

(3) Remove the two handles from the front panel by removing the nuts and washers at the rear of the panel which secure the handles.

(4) Place wooden blocks under the side plates of the main frame, behind the front panel, to hold the front panel clear of the bench.

(5) Remove the five flat-head Phillips screws that secure the front panel to the main frame. (There are two screws on each side of the front panel and one screw centered between the OVEN ON indicator and the POWER switch).

(6) Draw the front panel out from the main frame; replace the handles; and place the panel face down on the bench, resting on the handles. Do not allow the front panel to dangle over the edge of the bench, supported only by the connecting cable harnesses.

(7) To replace the front panel, remove the handles, align the front panel with the main frame, replace the five Phillips screws and the handles, and connect plug P106 to jack J702.

b. Removal and Replacement of Power Rectifier Subchassis. To remove the power rectifier subchassis, disconnect plug P601 (fig. 101) from jack J807 (fig. 103), loosen the six green color-coded captive screws from the top of the subchassis, and lift the subchassis out. The six green color-coded captive screws are located one at each corner of the subchassis one between the two chokes toward the dry-disk rectifier and one on the outboard side of V606. To replace the power rectifier subchassis, align the subchassis, tighten the six screws, and connect plug P601 to jack J807.

c. Removal and Replacement of Relay Subchassis. To remove the relay subchassis, first remove the power rectifier subchassis or the rf amplifier subchassis. (The power rectifier subchassis is the easiest to remove.) Then disconnect plug P202 (fig. 92) from jack J107 (fig. 88) and plug P201 (fig. 92) from jack J808 (fig. 103). Loosen the four green color-coded captive screws, one in each corner of the subchassis, and slide the subchassis out from under the fan motor. To replace the relay subchassis, slide it under the fan motor, align and tighten the four screws, and connect plug P202 to jack J107 and plug P201 to jack J808.

d. Removal and Replacement of rf Amplifier Subchassis.

(1) Remove the front panel (subpar. a, above).

(2) Disconnect plug P103 (fig. 89) from jack J103 (fig. 88).

(3) Disconnect plug P105 (fig. 89) from jack J815 (fig. 103).

(4) Remove jack J813 from the rear panel by removing the four Phillips-head screws which hold the jack in place.

(5) Remove jack J814 from the rear panel by removing the four Phillips-head screws which hold the jack in place.

(6) Remove the three Phillips head screws which secure the rf amplifier subchassis to the gear plate. Two of these screws secure the top of the subchassis to the gear plate; the third screw secures the lower right-hand side of the subchassis to the gear plate.

(7) Loosen the two green-color coded screws which secure the rear of the subchassis to the main frame.

(8) Slide the rf amplifier subchassis back to disengage the two Oldham couplers and lift the subchassis out of the main frame.

(9) Note the position of the rotor of band switch S101 sections C, D, E, F, G, H and J (which are in the rf amplifier) and the position of the rotor of deviation division switch S101 section B (which is on the gear plate). In replacing the rf amplifier subchassis it is necessary that the two parts of this switch assembly are in corresponding positions since it is possible to recouple the Oldham coupler flanges between the two parts in reverse. (For corresponding positions of the two parts of switch S101 assembly, see note 2 of figure 110).

(10) To replace the rf amplifier subchassis, use the following procedure.

(a) Position the Oldham coupler flange connected to the gear plate part of switch S101 assembly in the same relative position as the Oldham coupler flange connected to the rf amplifier part of switch S101 assembly (subpar. (9), above). Be certain that the two parts of switch S101 assembly are not 180° out of position.

(b) Position the gear plate tuning linkage in the 3 mc position. This is the highest frequency position of the tuning linkage. The tuning linkage is in this position when the open circuit position of the rotor of oscillator positioning switch S103 (fig. 87) is in position 24, and unused terminal. (Position 24 is the first position to the right of the switch rotor terminal 23, and position 24 is a blank terminal.)

Caution. If the master oscillator subchassis has been removed while the rf amplifier subchassis was out of the main frame, the gear train and master oscillator will require re-alignment. In this case, replace the master oscillator first unsing the procedure given in subparagraph e (7), following.

(c) Place the rf amplifier into the main frame and align the amplifier, fore-and-aft with the Oldham coupler flanges of the gear plate and the ACCESS HOLE FOR GEAR TRAIN SYNC ROD on the rear panel.

(d) With one hand, turn the cam of the rf amplifier to its highest position and, with the other hand, insert the gear train sync rod through the rear panel access hole, through the rf amplifier end-plates, and through the cams to the gear plate. The rod will hold the cams in the highest frequency position of the rf amplifier while mating the Oldham coupler flanges of the gear plate and the rf amplifier.

(e) Slide the rf amplifier subchassis forward to mate the Oldham coupler flanges of the amplifier with the floating disks which are held in place on the flanges of the gear plate. Providing that the master oscillator and gear train have not been electrically realigned (subpar. e (7), below). Turn the gear plate tuning linkage and/or the gear plate band switch linkage slightly for exact alignment of the flanges and disks. If the master oscillator and gear train have been electrically realigned to the 3 mc position loosen the Oldham coupler which drives the powdered iron cores on the rf amplifier and reposition the coupler for exact alignment.

(f) Replace the three Phillips head screws which secure the rf amplifier subchassis to the gear plate.

(g) Tighten the two screws which secure the rear of the subchassis to the main frame and remove the gear train sync rod.

(h) Connect plug P105 to jack J815 and plug P103 to jack J103.

(i) Replace the front panel (subpar. a, above).

e. Removal and Replacement of Master Oscillator Subchassis.

(1) Before removal, position the tuning linkage in the 3 mc position. This is the highest frequency position of the tuning linkage. The tuning linkage can be positioned in the 3 mc position by turning the linkage by hand until the gear train sync rod will pass through the rear panel access hole, the rf amplifier end-plate and the rf amplifier cams to the gear plate.

Caution. If the rf amplifier subchassis has been previously removed and the gear train is not in the 3 mc position, removal of the master oscillator subchassis will require electrical and mechanical alignment of the master oscillator and the gear train in order to replace the master oscillator subchassis. See subparagraph (7), below, for this procedure.

(2) Disconnect plug P001 (fig. 84) from jack J816 (fig. 104) and plug P002 (fig. 84) from jack J106 (fig. 87).

(3) Loosen the three yellow color-coded screws which secure the master oscillator subchassis to the gear plate.

(4) Remove the loading spring on the Oldham coupler. Take care to prevent the loss of the spring.

(5) Remove the master oscillator subchassis by sliding it back to disenagedthe Oldham coupler then lifting it out of the main frame. In removing the subchassis be careful not to disturb the position of the Oldham coupler flange on the subchassis.

Caution. Do not disturb the setting of the master oscillator from the 3 mc position while the subchassis is removed from the main frame . If the position of the Oldham coupler flange is changed, the master oscillator must be externally retuned to 3 mc before the subchassis can be replacedin the radio frequency oscillator (subpar (6) (c), following).

(6) To replace the master oscillator subchassis, use the following procedure providing the rf amplifier subchassis is in the main frame.

(a) Position the gear plate tuning linkage to the 3 mc position (subpar. (1), above). Always use the gear train sync rod to hold the gear plate tuning linkage in the 3 mc position. If the rf amplifier is not in the main frame, follow the procedure given in subparagraph (7) below, to replace the master oscillator subchassis.

(b) Lower the master oscillator subchassis into the main frame and slide it forward until the Oldham coupler flange mates with the floating disk and replace the loading spring. If the flange will not mate with the disk with the gear train sync rod holding the gear train tuning linkage in the 3 mc position, rotate the Oldham coupler flange of the suchassis very slightly to make the flange mate with the disk. If it is apparent that the position of the master oscillator Oldham coupler flange has been moved from the 3 mc position, the master oscillator must be retuned. Use the following procedure to retune the master oscillator to the 3 mc position.

1. Connect plug P002 to jack J106.

2. Connect the master oscillator output from plug P001, using a coaxial cable, to either a frequency meter (AN/USM-26) or to an accurately calibrated radio receiver, such as Radio Receiver R-390/URR.

3. Ground test point E130 (fig. 87).

4. Set the radio frequency oscillator FUNCTION switch S707 to DEV SET and turn the POWER switch to ON.

5. Tune the master oscillator by turning the Oldham coupler flange until a 3 mc output is obtained.

(d) Tighten the three screws which secure the master oscillator subchassis to the gear plate. Connect plug P001 to jack J816 and plug P002 to jack J106 and remove the gear train sync rod.

(e) Run the gear train by hand to the up-band stop and then to the down-band stop to see that the gear train stops are reached before the stops on the master oscillator shaft are reached.

Caution. Do not exert undue force on the master oscillator stops by driving the gear train too fast or too hard.

(f) If the gear train stops are not reached first, remove the master oscillator subchassis and use the procedure given in subparagraph (7), below to electrically and mechanically align the master oscillator and the gear train. This procedure can be used even though the rf amplifier subchassis is in place. However, after aligning the gear train and the master oscillator check the alignment of the rf amplifier subchassis with the gear train sync rod. If the gear train sync rod will not pass through the rf amplifier subchassis, loosen the set screw which secures the Oldham coupler which drives the powdered iron cores on the rf amplifier subchassis. Then position the slug rack by hand so that the gear train sync rod will pass through the rf amplifier subchassis and tighten the Oldham coupler set screw.

(7) To replace the master oscillator subchassis, use the following procedure when the rf amplifier subchassis is not in the main frame.

(a) Turn the gear train to the upper stop. The gear train travels forward as oscillator positioning switch S103 (fig. 87) travels clockwise when viewed from the front of the main frame.

(b) Turn the master oscillator shaft to the counterclockwise stop.

Caution. Do not exert undue force on the master oscillator stop.

(c) Back off the master oscillator shaft 1/4 turn clockwise.

(d) Lower the master oscillator subchassis into the main frame and slide it forward until the Oldham coupler flange mates with the floating disk and replace the loading spring. If the two flanges do not mate, loosen the set screw of the Oldham coupler flange on the gear plate and reposition this flange.

(e) Tighten the three screws which secure the master oscillator subchassis to the gear plate and connect plug P002 to jack J106.

(f) Run the gear train down band and check to see that the gear train stop is reached before the clockwise stop of the master oscillator shaft is reached.

(g) Tune the master oscillator to the 3 mc position. See subparagraph (5) (b), above, for this procedure. To tune the master oscillator, drive the gear train by hand.

(h) Connect plug P001 to jack J816.

(i) Replace the rf amplifier subchassis (subpar. d (10), above) while the gear train is in the 3 mc position. After the above realignment, if the Oldham coupler which drives the rf amplifier slug rack does not align with the gear plate flange when the gear plate sync rod is in place, loosen the set screw on the rf amplifier flange and reposition the flange.

f. Removal and Replacement of Audio Amplifier Subchassis. To remove the audio amplifier subchassis, disconnect plug P501 (fig. 99) from jack J801 (fig. 104). Loosen the four green color-coded screws, one located in each corner of the subchassis, and lift the subchassis out of the main frame. To replace the subchassis, align the subchassis, tighten the four screws and connect plug P501 to jack J801.

g. Removal and Replacement of Servo Amplifier Subchassis. To remove the the servo amplifier subchassis, disconnect plug P401 (fig. 97) from jack J806 (fig. 104) and plug P805 (fig. 104) from jack J401 (fig. 97). Loosen the four green color-coded screws, one located in each corner of the subchassis, and lift the subchassis out of the main frame. To replace the subchassis, align the subchassis and tighten the four screws. Then connect plug P401 to jack J806 and plug P805 to jack J401.

h. Removal and Replacement of Discriminator Subchassis. To remove the discriminator subchassis, disconnect plug P371 (fig. 96) from J301 (fig. 94) and plug P372 (fig. 96) from jack J303 (fig. 94). Loosen the four green color-coded screws, one located in each corner of the subchassis, and lift the subchassis out of the main frame. To replace the subchassis align the subchassis and tighten the four screws. Then connect plug P371 to jack J301 and plug P372 to jack J303.

i. Removal and Replacement of If. Amplifier Subchassis. To remove the if. amplifier subchassis, disconnect plug P803 (fig. 104) from jack J302 (fig. 94), plug P372 (fig. 96) from jack J303 (fig. 94), plug P371 (fig. 96) from jack J301 (fig. 94) and plug P301 (fig. 94), from jack J802 (fig. 104). Loosen the five green color-coded screws, one located in each outside corner of the subchassis, and lift the subchassis out of the main frame. To replace the subchassis, align the subchassis and tighten the five screws. Then connect plug P803 to jack J302, plug P372 to jack J303, plug P371 to jack J301 and plug P301 to jack J802.

j. Removal and Replacement of the Gear Plate.

(1) Remove the front panel (subpar. a, above).

(2) Remove the master oscillator subchassis (subpar. e, above) and set aside.

(3) Disconnect plug P202 (fig. 92) from jack J107 (fig. 88), plug P102 (fig. 87) from jack J804 (fig. 104), plug P101 (fig. 87) from jack J803 (fig. 104), and plug P103 (fig. 89) from jack J103 (fig. 88).

(4) Loosen the rf amplifier subchassis (subpar. d (6) and d (7), above) and slide the subchassis toward the rear of the main frame. It is not necessary to completely remove the rf amplifier subchassis.

(5) Remove the five screws and the front panel stand-off which secure the gear plate to the main frame floor panel. The screws and stand-off are located in a line just above TB101 (fig. 87) with three screws to the left of the stand-off, one to the right under L126, and one to the extreme right.

(6) Remove the two screws which secure the gear plate to the fore-and-aft stiffener of the bottom deck of the main frame. These screws are located to the right of the gear plate opening which accomodates switch S704.

(7) Remove the five screws on each side, from outside the main frame, which secure the gear plate to the main frame. These five screws are located in front of the first vertical row of ventilating ports and they anchor into the gear plate support bars.

(8) Move the gear plate forward until the protruding components on the rear of the gear plate clear the main frame. Then lift the gear plate out of the main frame.

(9) To replace the gear plate, use the following procedure.

(a) Lower the gear plate into the main frame, align the gear plate supporting bars with the main frame and replace the five screws on each side which secure the gear plate to the fore-and-aft stiffener of the bottom deck of the main frame.

(b) Replace the master oscillator subchassis (subpar. e (7), above).

(c) Replace the rf amplifier subchassis (subpar. d(10), above).

(d) Connect plug P202 to jack J107, plug P102 to jack J804, plug P101 to jack J803 and plug P103 to jack J103.

(e) Replace the front panel (subpar. a (7), above).

132.1 Disassembly, Assembly, Clutch Adjustment, and Alignment of Gear Train (fig. 112)

a. General. The gear train may be disassembled and assembled without removing the gear plate from the main frame, unless it is desired to remove those components which mount on the rear of the gear plate. These components which mount on the rear of the gear plate and cannot be removed without first removing the gear plate, or a subchassis, include the band switch motor B103, the coarse positioning motor B102, the servo motor B101 and servo motor drive pinion O122, the rate generator G101, and clutch operating coil L125. The Oldham couplers O173, O117 and O157 may be loosened from their driving shafts without removing the gear plate, but they cannot be removed without removing either the gear plate or some subchassis. These components remove simply by removing the mounting screws or loosening the set screws. The following disassembly and assembly procedure is valid if the gear plate is removed from the main frame (par. 132j); however, to execute the following procedures it is only necessary to remove the front panel (par. 132a) and to disconnect plug P002 (fig. 84) from jack J106 (fig. 87). Disassemble and assemble the gear train with the radio frequency oscillator resting on the rear panel bumpers.

b. Disassembly of Gear Train.

(1) Remove bearing plate A108.

(a) Remove E-retaining ring O166 and shim H110 from oscillator position gear O164 shaft.

(b) Remove bearing shaft support plate A109 (fig. 87) by removing the three mounting screws and lock washers.

(c) Remove E-retaining ring O186 and pin O185 of clutch speed-change arm assembly.

(d) Swing O187 and O188 of clutch speed-change arm assembly back out of the way.

(e) Remove E-retaining ring O132, washer H106, spring O134 and thrust collar O135 from coarse position clutch post. Exercise care in this disassembly as the assembly is spring loaded.

(f) Remove clutch interlock arm O183.

(g) Remove thrust collar O126 from speed-change clutch post.

(h) Remove thrust bearing O127 from the speed-change clutch post. (Use tweezers.)

(i) Remove E-retaining ring O180 from clutch operating coil L126 actuator post O181.

(j) Remove coarse positioning clutch arm O182, leaving actuator post O181 connected to the arm.

(k) Remove thrust bearing O140 from the coarse position clutch post. (Use tweezers.)

(l) Remove the retaining roll pin from the stop washer collar O153. Use a short, smaller-size pin to push out the roll pin, applying pressure with pliers and being careful not to bend the shaft. Note the position of the stop washer collar O153 so that in reassembling, the collar can be repositioned in the same position. This will assure that the pinning hole in the collar aligns with the pinning hole in the shaft.

Caution. Hammering out the roll pin or using undue pressure to remove the roll pin will bend the oscillator drive gear shaft.

(m) Remove the stop washer collar O153.

(n) Remove the 14 stop washers O154 and the 14 shims H108.

(o) Loosen the lock nut on lever bearing O184 and screw out the lever bearing O184.

(p) Remove the cable clamp in the upper left-hand corner of bearing plate A108 and the preceding cable clamp on the same cable assembly which is located on the main gear plate.

(q) Remove the four corner mounting screws and lock washers of bearing plate A108.

(r) Lift bearing plate A108 off. In doing so, keep the bearing plate perfectly level so that there is no binding at the corner posts, shafts or switches. The bearing plate is press fitted onto the corner posts. To start the bearing plate, it may be necessary to inch the bearing plate up the corner posts alternately a little at a time.

Caution. Use extreme care in removing the bearing plate as any binding will damage the gears and switches. Do not force the bearing plate off with any tool used as a lever. Use only the hands to remove the bearing plate.

(s) After the bearing plate is clear, tie or support the bearing plate in a vertical position, being careful not to damage the cable assemble to the bearing plate. This gives access to the gears mounted on the main gear plate.

(2) Remove the coarse positioning clutch and gear assembly O139.

(3) Remove the coarse positioning clutch tension washer O138.

(4) Remove the coarse positioning clutch and gear assembly O137.

(5) Remove the speed-change clutch and gear assembly O128.

(6) Remove the speed-change clutch tension washer O129.

(7) Remove the speed-change clutch and gear assembly O130.

(8) Remove the speed-change clutch thrust bearing O131.

(9) Remove the centrifugal clutch O147 by loosening two set screws.

(10) To remove oscillator drive gear O155 and shim H114, first loosening Oldham coupler O157 on the rear of the gear plate.

(11) To remove reverse idler gear O143, first remove E-retaining ring O141 and shims H105 and H118.

(12) To remove the first coarse positioning idler gear O146, first remove E-retaining ring O144 and shim H107.

(13) To remove thrust bearing O136, use tweezers.

(14) To remove the first servo idler gear O125, first remove E-retaining ring O124 and shim H104.

(15) To remove the cam-shaft drive gear O171, loosen Oldham coupler O173 on the rear of the gear plate.

(16) To remove band switch drive gear assembly O115, first loosen Oldham coupler O117 on the rear of the gear plate.

(17) To remove the second band switch idler gear O105, first remove E-retaining ring O107 and shim H102.

(18) To remove the third band switch idler gear O108, first remove E-retaining ring O110 and shim H103.

(19) To remove the band switch motor pinion O101, loosen two set screws.

(20) To remove the first band switch idler gear O102, first remove E-retaining ring O104 and shim H101.

(21) To remove limit switch gear O174, first remove E-retaining ring O175 and shim H111.

(22) Remove gears on bearing plate A108.

(a) Remove E-retaining ring O159, shim H108 and then oscillator position idler gear O158.

(b) Loosen the set screw in oscillator position switch sleeve O163 and remove O163. Then remove oscillator position gear O164.

c. Assembly of Gear Train.

Note. In replacing E-retaining rings during the assembly of the gear train, place the burred edge of the E-retaining ring toward the end of the shaft and the smooth edge of the E-retaining ring toward the preceding shim.

(1) Replace gears on bearing plate A108.

(a) Replace oscillator position gear 0164, then oscillator position switch sleeve 0163 and tighten the set screw.

Note. Oscillator position gear 0164 drives oscillator position switch S103. Switch S103 must be adjusted before the assembly is complete (par. 132.1e, following).

(b) Replace oscillator position idler gear 0158, then shim H108 and retain with E-retaining ring 0159. Before replacing, oil the bearing of 0158 with one drop of oil AN/06.

(2) Replace limit switch gear 0174, then shim H111 and retain with E-retaining ring 0175. Before replacing, oil the bearing of 0174 with one drop of oil AN/06.

Note. Limit switch gear 0174 drives limit switch S102. Switch S102 must be adjusted before the assembly is complete (par. 132f, following).

(3) Replace the first band switch idler gear 0102, then shim H101 and retain with E-retaining ring 0104. Before replacing, oil the bearing of 0102 with one drop of oil AN/06. Shim H101 should shim this assembly for minimum end-play. If it does not, replace shim H101 with a thicker shim or add additional shims.

(4) Replace the band switch motor pinion 0101 and tighten the two set screws. The teeth of band switch idler gear 0102 should face fully on the teeth of band switch motor pinion 0101. The over-lapping collar of band switch motor pinion 0101 should not bind on the face of the idler gear 0102. Adjust the meshing of 0101 and 0102 for a minimum of back-lash and no binding over the entire circumference of the gears. Moving band switch motor B103 in the oversize mounting holes will alter the meshing. B103 mounting screws are accessible from the front of the gear plate. Due to allowed manufacturing tolerances, the two gears may loosely mesh in one position and bind in another position. If this is the case, compromise the difference to obtain optimum meshing.

(5) Replace the third band switch idler gear 0108, then shim H103 and retain with E-retaining ring 0110. Before replacing, oil the bearing of 0108 with one drop of oil AN/06.

(6) Replace the second band switch idler gear 0105, then shim H102 and retain with E-retaining ring 0107.

(7) Replace band switch drive gear assembly 0115, but do not tighten Oldham coupler 0117 until the band switch is properly aligned (par. 132.1g(2), following).

(8) Replace the cam-shaft drive gear 0171, but do not tighten Oldham coupler 0173 until the rf amplifier subchassis cam drive is properly aligned (par. 132.1g(3), following).

(9) Replace the servo idler gear 0125, then shim H104 and retain with E-retaining ring 0124. Before replacing, oil the bearing of 0125 with one drop of oil AN/06. The teeth of servo idler gear 0125 should face fully on the teeth of servo motor pinion 0122. The over-lapping collar of the pinion should not bind on the under face of the idler gear. To adjust the fore-and-aft position of the pinion, it is necessary to remove the servo motor B101, adjust the pinion position with the set screw, then replace the servo motor and check the position. (It is necessary to remove the servo amplifier subchassis to gain access to the servo motor unless the gear plate has previously been removed from the main frame.) Adjust the meshing of gear 0125 and pinion 0122 for a minimum of back-lash and no binding over the entire circumference of the gears. Moving servo motor B101 in the oversize mounting holes will alter the meshing. The mounting screws of B101 are accessible from the rear of the gear plate with the servo amplifier removed. Due to allowed manufacturing tolerances, the two gears may loosely mesh in one position and bind in another position. If this is the case, comprise the difference to obtain optimum meshing.

(10) Replace thrust bearing 0136, oiling the bearing with one drop of oil AN/06.

(11) Replace the first coarse positioning idler gear 0146, then shim H107 and retain with E-retaining ring 0144. Before replacing, oil the bearing of 0146 with one drop of oil AN/06.

(12) Replace reverse idler gear 0143, then shims H105 and H118 and retain with E-retaining ring 0141. Before replacing, oil the bearing of 0143 with one drop of oil AN/06. Shims H105 and H118 should shim this assembly for minimum end-play. Use as many shims as required to do this, or use thicker shims.

(13) Replace oscillator drive gear 0155 and shim H114 but do not tighten Oldham coupler 0157 until the master oscillator is properly aligned (par. 132.1g(1), following).

(14) Replace the centrifugal clutch 0147 and tighten the two set screws. The teeth of the first coarse positioning idler gear 0146 should face fully on the teeth of the clutch gear 0147. The over-lapping collar of the clutch gear 0147 should not bind on the face of 0146. Adjust the meshing of the clutch gear and the driven gear for a minimum of back-lash and no binding over the entire circumference of the gears. Moving coarse positioning motor B102 in the oversize mounting holes will alter the meshing. To do this, it is necessary to remove the clutch 0147 to gain access to the motor mounting screws from the front of the gear plate. Due to allowed manufacturing tolerances, the two gears may loosely mesh in one position and bind in another position. If this is the case, compromise the difference to obtain optimum meshing.

(15) Replace the speed-change clutch thrust bearing 0131, oiling the bearing with one drop of oil AN/06.

(16) Replace the speed-change clutch and gear assembly O130. Before replacing, oil the bearing of O130 with one drop of oil AN/06 and make certain that the face of the clutch is free from oil and dirt.

(17) Replace the speed-change tension washer O129.

(18) Replace the speed-change clutch and gear assembly O128. This gear should slide smoothly onto the shaft with no binding. Before replacing, oil the bearing of O128 with one drop of oil AN/06 and make certain that the clutch face is free from oil and dirt.

(19) Replace the coarse positioning clutch and gear assembly O137. Before replacing, oil the bearing of O137 with one drop of oil AN/06 and make certain that the face of the clutch is free from oil and dirt.

(20) Replace the coarse positioning clutch tension washer O138.

(21) Replace the coarse positioning clutch and gear assembly O139. Before replacing, oil the bearing of O139 with one drop of oil AN/06 and make certain that the clutch face is free from oil and dirt. The clutch gear O139 should face fully on the teeth of the rate generator pinion O148 with the coarse positioning actuator L126 arm in both the operated and unoperated positions. O148 is adjusted by loosening the set screw and moving the pinion fore-and-aft on the generator shaft. Adjust the meshing of the clutch gear and the pinion gear for a minimum of backlash consistent with freedom of clutch movement and no binding over the entire circumference of the gears. Moving the rate generator bracket in the oversize mounting holes will alter the meshing. (It is necessary to remove the servo amplifier subchassis to gain access to the rate generator bracket unless the gear plate has previously been removed from the main frame.) Due to allowed manufacturing tolerance, the two gears may loosely mesh in one position and bind in another position. If this is the case, compromise the difference to obtain optimum meshing.

(22) Replace bearing plate A108.

(a) Untie the bearing plate A108.

(b) Before lowering bearing plate A108 into position, set the two sections of band switch S101 to the 1.5-3 mc band position. This will assure that the two sections of the switch are in the proper relative positions and not 180° out of phase with each other. When in the 1.5-3 mc band position, the rotor of the exposed side of the ceramic wafer (the top wafer) makes contact with the first terminal counterclockwise (when viewed from the front) from the top mounting screw (terminal 12). The notch of the rotor of the exposed side of the bakelite wafer (the bottom wafer) opens the circuit to the first terminal clockwise (when viewed from the front) from the top mounting screw (terminal 2 since terminal 1 is blank).

(c) Lower the bearing plate A108 into position keeping it in a perfectly level position and with a very slight rocking motion, drop the bearing plate in place. Be sure that the shaft of the band switch drive assembly 0115 centers with the hole in the rotor of band switch S101 as it is possible to break the switch wafer with undue pressure from the shaft. Do not force the bearing plate over any shaft or onto the corner posts. With the bearing plate resting in position but not pressed onto the corner posts, mesh oscillator position gear 0164 with the camshaft drive gear 0171 and the oscillator position idler gear 0158 with the oscillator drive gear 0155. This is done by jogging 0155 and 0171 until the bearing plate drops into mesh. After the gears have meshed, seat the bearing plate against the mounting posts by simultaneously pressing all four corners of the bearing plate.

Warning. Use extreme care in replacing the bearing plate as any binding will damage the gears and switches. Do not force the bearing plate on with any tool used as a hammer. Use only the hands to seat the bearing plate onto the mounting posts.

(d) Secure the bearing plate A108 with the four corner mounting screws and lock washers.

(e) Replace the cable clamp in the upper left-hand corner of bearing plate A108 and the preceding cable clamp on the same cable assembly which is located on the main gear plate.

(f) Replace thrust bearing 0127 on the speed-change clutch post, oiling the bearing with one drop of oil AN/06 before replacing.

(g) Replace thrust collar 0126 on the speed-change clutch post.

(h) Replace lever bearing 0184 by first screwing the lock nut onto 0184 as far as it will go. Then place the lock washer on 0184 and screw 0184 into the mounting post of the bearing plate A108 as far as it will go. Back off the lever bearing 0184 until it aligns with 0191 of the clutch speed-change arm. 0187 and 0188 should ride loosely in the two slots of thrust collar 0126. Then lock the nut of lever bearing 0184, maintaining the alignment and the loose fit of 0187 and 0188 in the thrust collar.

(i) Replace pin 0185 and retain with E-retaining ring 0186 of the clutch speed-change arm assembly to secure 0187 and 0188 to lever bearing 0184. The loose fit of 0187 and 0188 in the thrust collar 0126 must still remain after this assembly procedure.

(j) Replace thrust bearing 0140 on the coarse positioning clutch post, oiling the bearing with one drop of oil AN/06 before replacing.

(k) Replace coarse positioning clutch arm 0182 on the pivot post of bearing plate A108 and the coarse positioning clutch post.

(l) Secure actuator post 0181 to coarse positioning clutch operating coil L126 arm with E-retaining ring 0180. The coarse positioning clutch arm 0182 must teeter-totter freely without binding on the pivot post or the coarse positioning clutch post. If binding is apparent, remove the binding by repositioning operating coil L126 in the oversized mounting holes. (It is necessary to remove the relay subchassis to gain access to L126 mounting screws unless the gear plate has been previously removed from the main frame.)

(m) Replace clutch interlock arm 0183. The end with the wider opening fits into the circumferential groove of thrust collar 0126.

(n) Replace thrust collar 0135, spring 0134, washer H106 and retain with E-retaining ring 0132 on the coarse positioning clutch post. Thrust collar 0135 interlocks with clutch interlock arm 0183. This assembly must be held in place during assembly because it is spring loaded. This concludes the clutch linkage assembly but the linkage must be adjusted (par. 132.1d, following).

(o) Replace the bearing shaft support plate A109 (Fig. 87) and secure with the three lock washers and mounting screws. This assembly procedure need not be executed until the oscillator position switch S103 is adjusted (par. 132.1e, following).

(p) Replace shim H110 and E-retaining ring 0166 on oscillator position gear 0164 shaft. Shim H110 should shim this assembly for minimum end-play. If it does not, replace shim H110 with a thicker shim or add additional shims. This assembly procedure need not be executed until the oscillator position switch S103 is adjusted (par. 132.1e, following).

(q) Replace the 14 stop washers 0154 and the 14 shims H108 on the oscillator drive gear 0155 shaft. This assembly begins with a shim H108 and ends with a stop washer 0154. The stop washers are placed on the shaft so that the projecting stops of the washers curve downward, toward the bearing plate. Stagger adjacent stops to prevent binding. All stop washers and shims must move freely on the shaft with no binding. During assembly, place one drop of oil AN/06 between each shim and stop washer.

(r) Replace the stop washer collar 0153 on the oscillator drive gear 0155 shaft in the same position as it was before disassembly (subparagraph 132.1b(1)(i), above). The projecting stop of the last stop washer replaced fits into the notch in collar 0153.

(s) Replace the roll pin to lock the stop washer collar 0153 on the oscillator drive gear 0155 shaft. The roll pin should be pressed in with pliers after ascertaining that the hole in the stop washer collar aligns with the hole in the oscillator drive gear 0155 shaft.

Caution. Hammering or the use of undue pressure to replace the roll pin will bend the oscillator drive gear shaft.

d. Clutch Linkage Adjustment.

(1) Loosen the adjusting screw of interlock arm 0183 so that the rounded end of the screw does not contact bearing plate A108.

(2) Adjust the linkage screw that connects the actuator arm of clutch operation coil L125 to O191 of the speed-change arm assembly. This linkage is adjusted to obtain .010-.020 in. between the facing of clutch gear O130 and the plate of clutch gear O128. After adjusting, lock the adjusting screw with the lock nut. Check to see that the outward side of clutch gear O128 does not contact the inward side of the clutch plate on gear O137. Also check to see that the rounded end of the adjusting screw of interlock arm O183 does not contact bearing plate A108.

(3) With the actuator arm of clutch operating coil L126 pressed down (equivalent to energizing L126), adjust actuator post O181 for .010-.020 in. clearance between clutch facing on gear O139 and the clutch plate of gear O137. Use the hex-nut on actuator post O181 to make this adjustment. After adjusting, check to see that the rounded end of the adjusting screw of interlock arm O183 does not contact bearing plate A108.

(4) Adjust the adjusting screw of interlock arm O183 for a slight clearance (approximately .003 in.) between the rounded end of the adjusting screw and bearing plate A108. After adjusting, lock the adjusting screw in position with the lock nut.

(5) If the following conditions are not met, repeat the clutch linkage adjustments, keeping within the given tolerances.

(a) With L125 and L126 both in the energized position, the coarse position clutch (O137-O139) should be closed and the speed-change clutch (O128-O130) should be open.

(b) With L125 in the de-energized position and L126 in the energized position, both clutches (O128-O130 and O137-O139) should be open.

(c) With L125 in the energized position and L126 in the de-energized position, the coarse position clutch (O137-O139) should be open and the speed-change clutch (O128-O130) should be closed.

e. Oscillator Positioning Switch S103 Adjustment.

(1) Turn oscillator drive gear O155 counterclockwise (viewed from the front) until the gear is firmly against the stop. The shaft of the oscillator drive gear O155 may be turned with the stop washer collar O153 if clutch actuator L126 arm is held down in the energized position.

(2) Loosen the set screw in oscillator position switch sleeve O163. It may be necessary to remove the bearing support plate A109 (par. 132.1b(1)(a) and (b), above) to gain access to the set screw.

(3) Set oscillator position switch S103 so that the notch of the exposed side of the rotor aligns with the fourth terminal counterclockwise from the rotor-contacting terminal. (The fourth terminal counterclockwise from the rotor-contacting terminal is terminal 19 of the exposed side of switch S103.)

(4) Tighten the set screw in oscillator position switch sleeve O163.

(5) Replace the bearing shaft support plate A109 (fig. 87) and secure with the three lock washers and mounting screws.

(6) Replace shim H110 and E-retaining ring 0166 on oscillator position gear 0164 shaft.

f. Limit switch S102 Adjustment.

(1) Turn oscillator drive gear 0155 counterclockwise (viewed from the front) until the gear is firmly against the stop. The shaft of the oscillator drive gear 0155 may be turned with the stop washer collar 0153 if clutch actuator L126 arm is held down in the energized position.

(2) Remove E-retaining ring 0175, shim H111 and then limit switch drive gear 0174.

(3) Position the limit switch S102 rotor so that the broad rotor contact centers in between the four consecutive terminals of the exposed side of the switch. These four terminals are in the upper right-hand quadrant of the switch wafer. (These are terminals 9, 10, 11 and 12 of S102 front.) The broad rotor contact should make contact across all four terminals. In the event that the rotor contact is slightly short, the rotor contact should make contact with the terminal 12 and come just to the outside edge of terminal 9.

(4) Replace limit switch drive gear 0174, shim H111 and retain with E-retaining ring 0175, keeping the position of S103 as near as possible to the set position when meshing 0174 with 0171.

g. Coupling Drives from Gear Train to the Rf Amplifier Subchassis and Master Oscillator Subchassis.

(1) Before tightening the set screw of Oldham coupler 0157 which couples the drive to the master oscillator subchassis, electrically and mechanically align the master oscillator according to the procedure given in paragraph 132e(7).

(2) Before tightening the set screw of Oldham coupler 0117 which couples the drive to the band switch S101 sections which are located in the rf amplifier subchassis, align the switch sections in the rf amplifier according to the procedure given in paragraph 132d(10). The switch sections in the rf amplifier should be placed in the 1.5-3 mc position to agree with the position of the switch sections on the gear plate, as previously positioned (par. 132.1c(22)(b), above).

(3) Before tightening the set screw of Oldham coupler 0173 which couples the drive to the camshaft of the rf amplifier subchassis, align the camshaft of the rf subchassis according to the procedure given in paragraph 132d(10).

Caution. Coupling the gear train drives to the master oscillator subchassis and the rf amplifier subchassis without aligning the subchassis will damage the gear train and the subchassis.

133. Replacement of Brushes

a. Replacement of Brushes on Band Switch Motor B103 and Coarse Positioning Motor B102. To replace brushes on the band switch motor B103 and the coarse positioning motor B102 (fig. 88), it is first necessary to remove the relay subchassis (par. 132 (c)). Then remove the two screws on the rear of the motor and remove the case from the motor. To remove the brushes from their holders, relieve the brush spring tension and lift the brush out using the brush lead. Unsolder the brush lead from the lug using a pencil-type solder iron and solder the new brush in its place. Replace the new brush in the brush holder and replace the brush spring. Then replace the motor cover and the relay subchassis.

b. Replacement of Rate Generator G101 Brushes. To replace brushes on the rate generator G101 (fig. 88), it is first necessary to remove the servo amplifier subchassis (par. 132 (g). Then remove the rate generator bracket from the gear plate by removing the two screws on each side of the rate generator. Disengage the rate generator drive wheel from the gear train and remove the rate generator and bracket. The brushes are accessible after the rate generator is removed from the bracket. To remove the brushes from their holders, relieve the brush spring tension and lift the brush out using the brush lead. Unsolder the brush lead from the lug using a pencil-type solder iron and solder the new brush lead in its place. Replace the new brush in the brush holder and replace the brush spring. Then replace the rate generator in its bracket, screw the bracket onto the gear plate and replace the servo amplifier subchassis.

134. Lubrication of Radio Frequency Oscillator AN/URA-13

The mechanical tuning system is all that requires lubrication. This is initially lubricated at the factory and should be lubricated every six months under normal operating conditions. The lubrication interval should be shortened if inspection indicates the need or if abnormal conditions are encountered. Over lubrication can cause more harm than too little lubrication. Check for lack of lubrication and gritty grease whenever the unit is serviced.

Caution. Never lubricate the sealed master oscillator. Unstable operation of the oscillator may result.

a. Cleaning Before Lubrication. Use a thin long-handled brush having medium bristles dipped in Solvent, Dry Cleaning (SD) to remove dirt and oil from gears, cams, guide slots and bearings. Rotate the gear train by hand to gain access to all of the gear teeth while cleaning. After dipping the brush in the solvent, remove the excess to prevent the solvent from dripping onto electrical parts and wiring. Use a clean, lint-free cloth moistened with the solvent to remove grease from the chassis. After cleaning with solvent, wipe all parts thoroughly with a clean, dry, lint-free cloth before lubricating.

b. Lubrication Schedule. Perform the following lubrication schedule each six months.

(1) Lubricate all bearings on the gear plate with lubrication oil AN/06. Operate the gear train by hand to spread the oil and remove excess oil with a lint-free cloth.

(2) Lubricate sparingly all tuning mechanism gears on the gear plate with grease (AN/G25). Operate the gear train to spread the grease and remove excess grease with a lint-free cloth.

(3) Lubricate the cam rollers and guide rollers of the rf amplifier sub-chassis with one drop of lubrication oil (AN/06). Operate the rolles to spread the oil.

(4) Lubricate the rf amplifier cam bearings and band switch bearings with one drop of oil An/06.

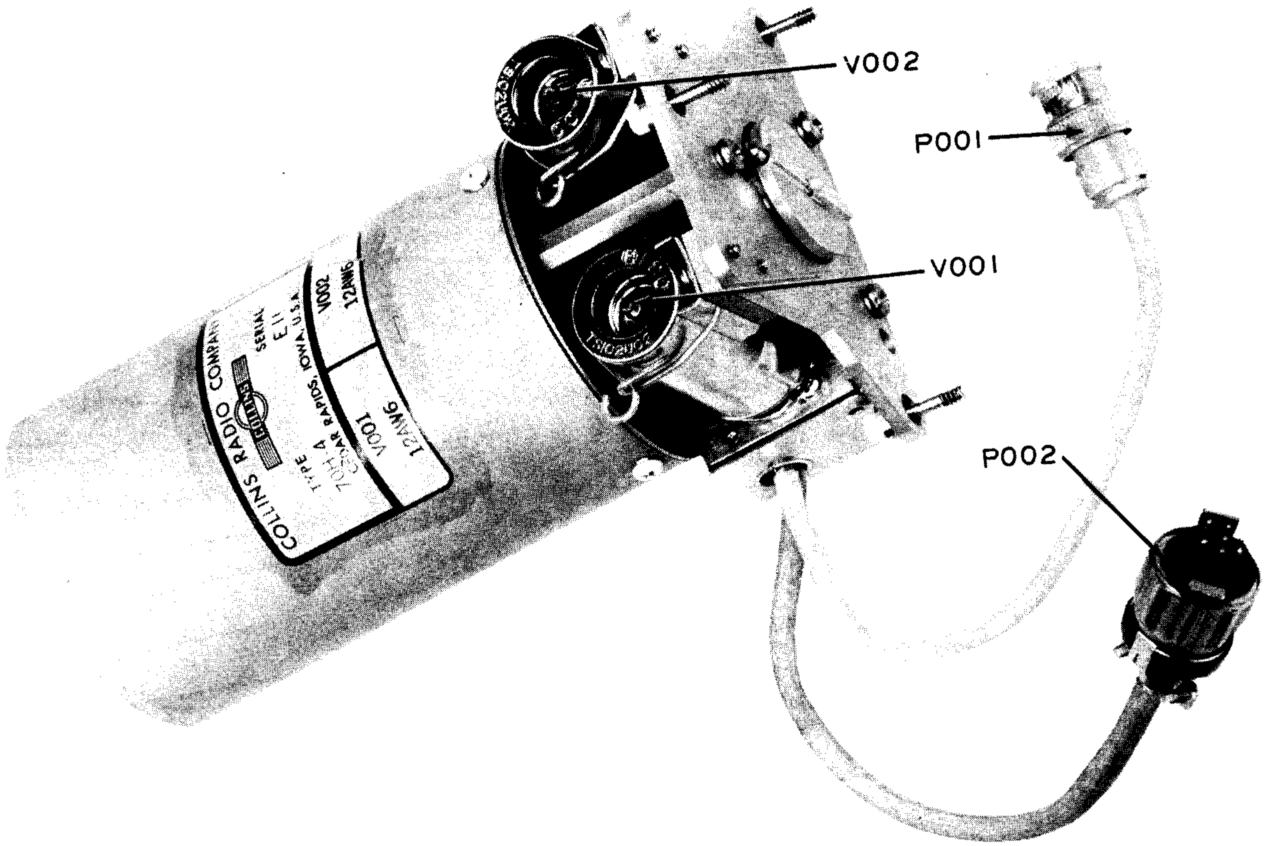


Figure 84. Master oscillator (type 70H-4), assembled.

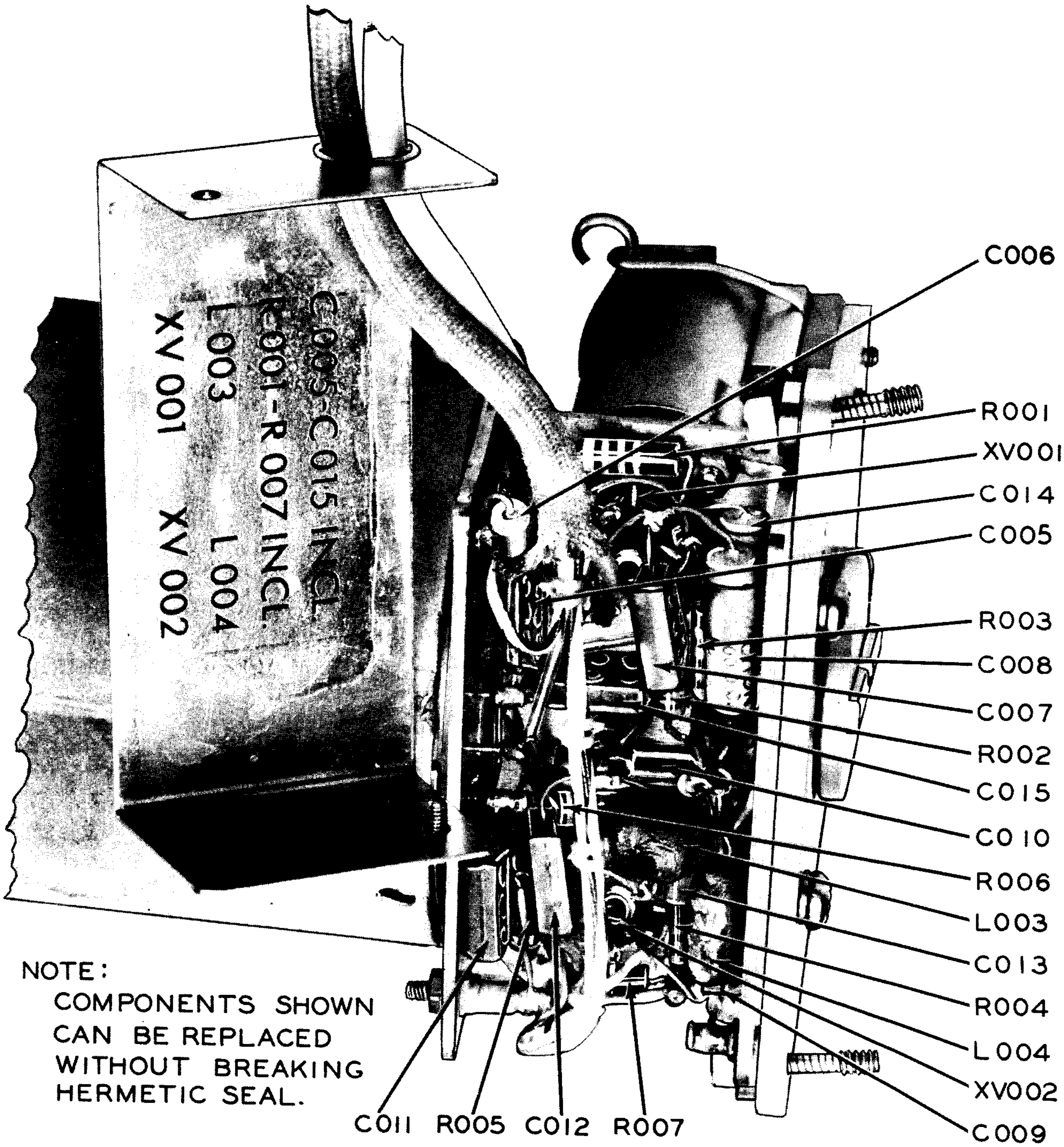


Figure 85. Master oscillator (type 70H-4), replaceable parts.

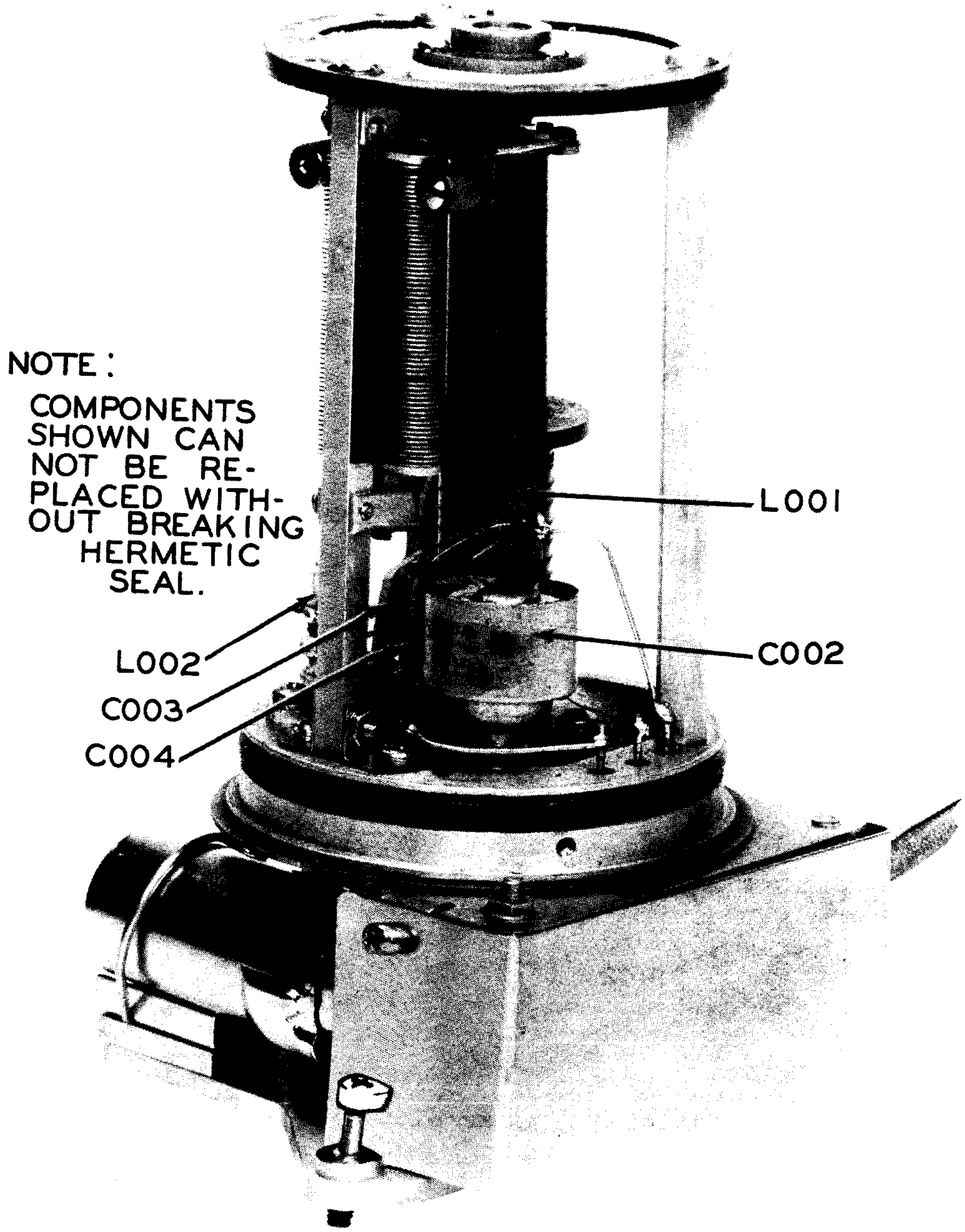


Figure 86. Master oscillator (type 70H-4), non-replaceable parts.

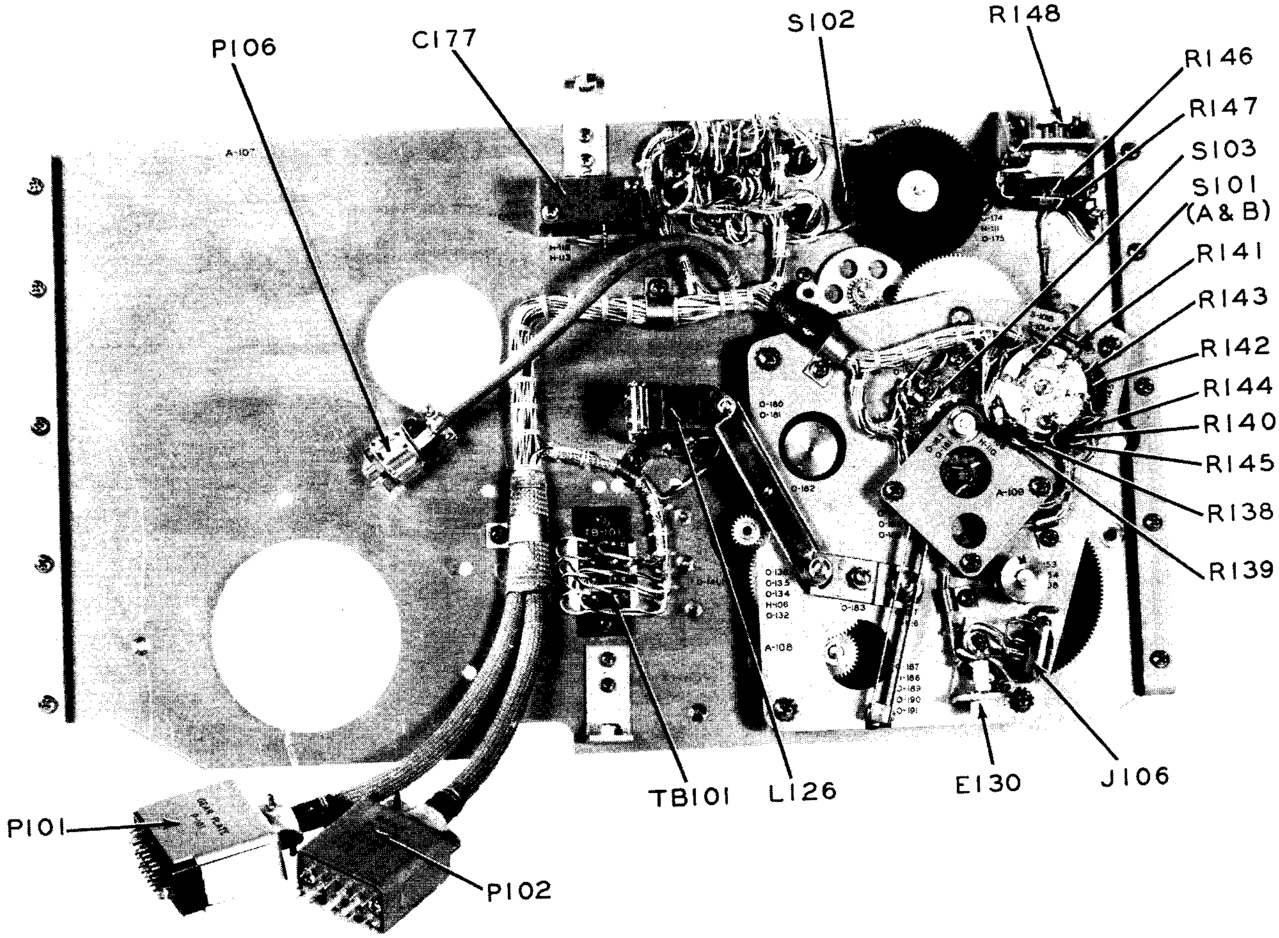


Figure 87. Gear plate, front.

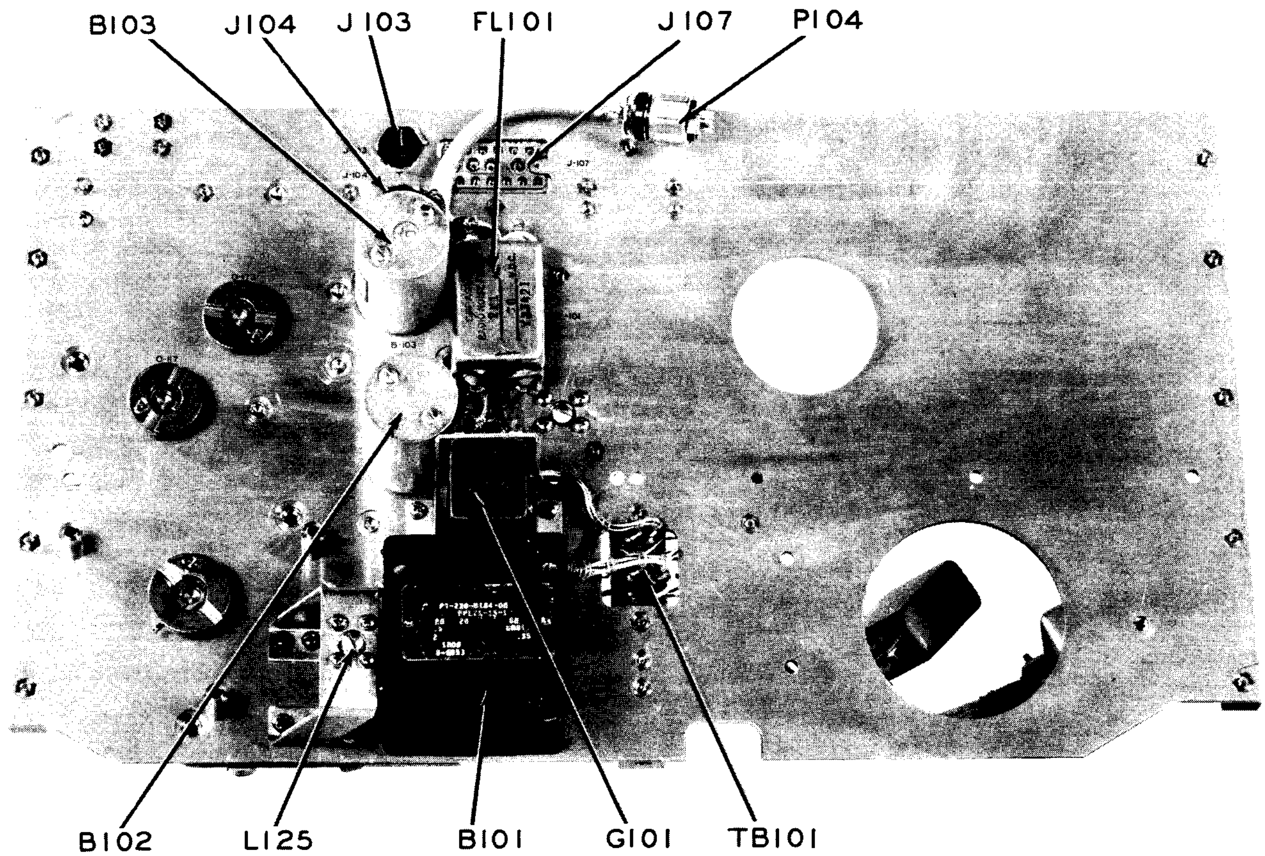


Figure 88. Gear plate, rear.

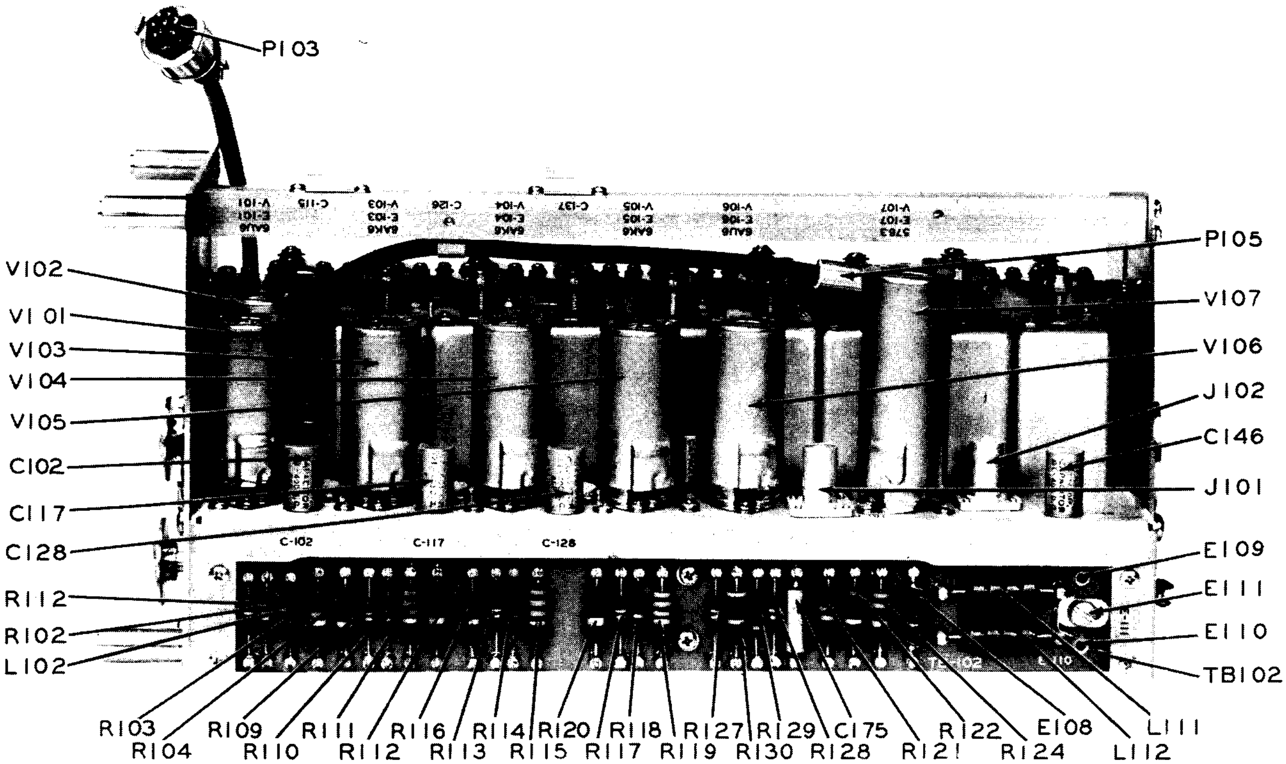


Figure 89. Rf amplifier, right side.

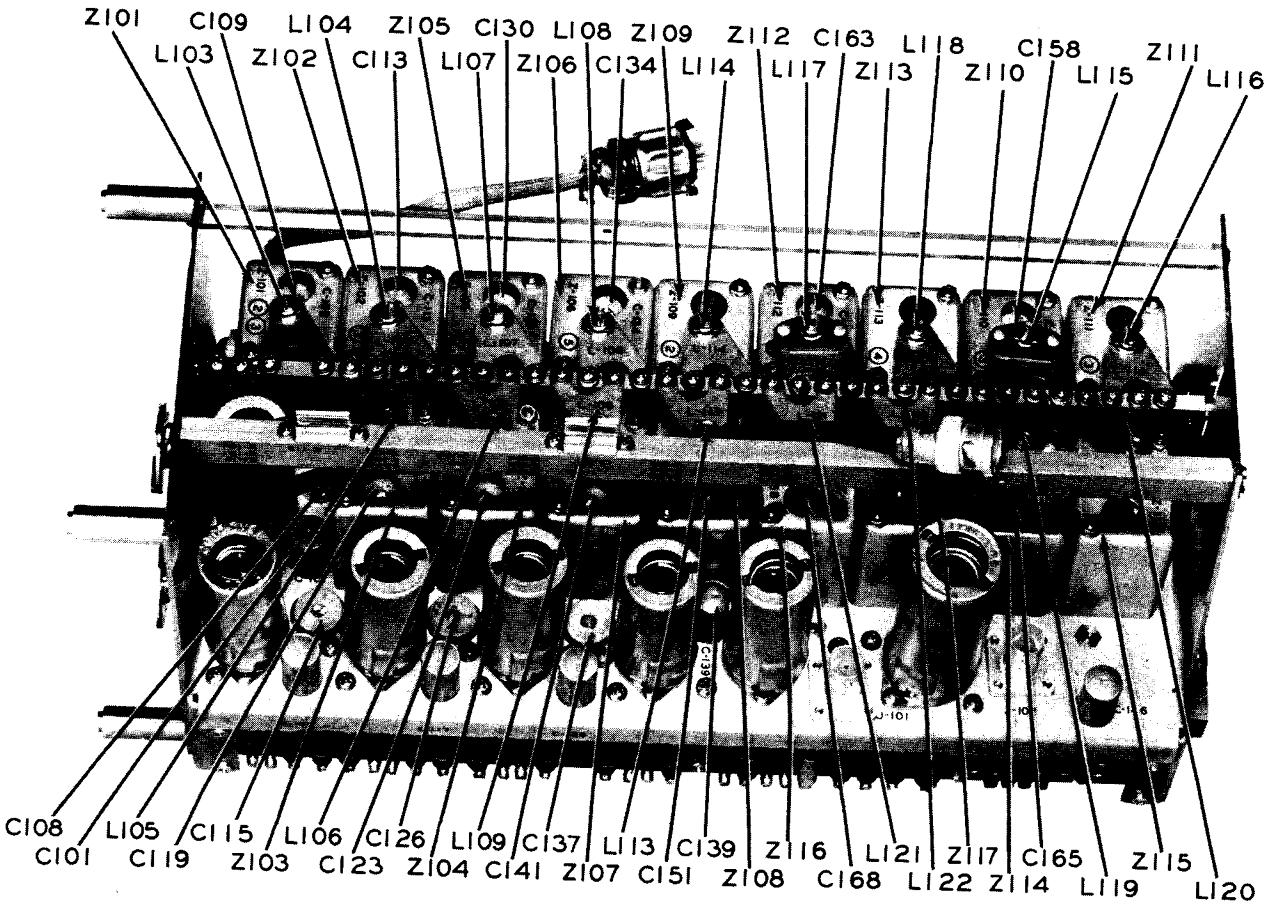


Figure 90. Rf amplifier, top.

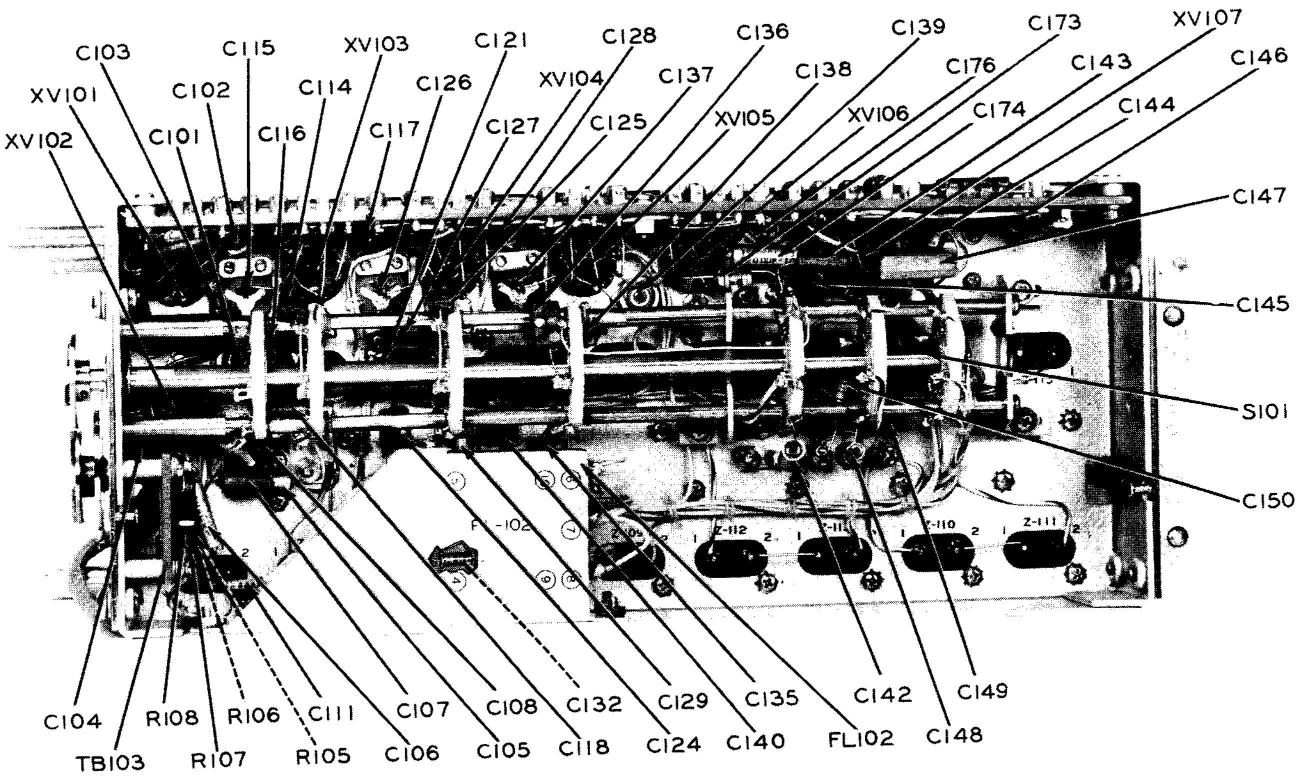


Figure 91. Rf amplifier, bottom.

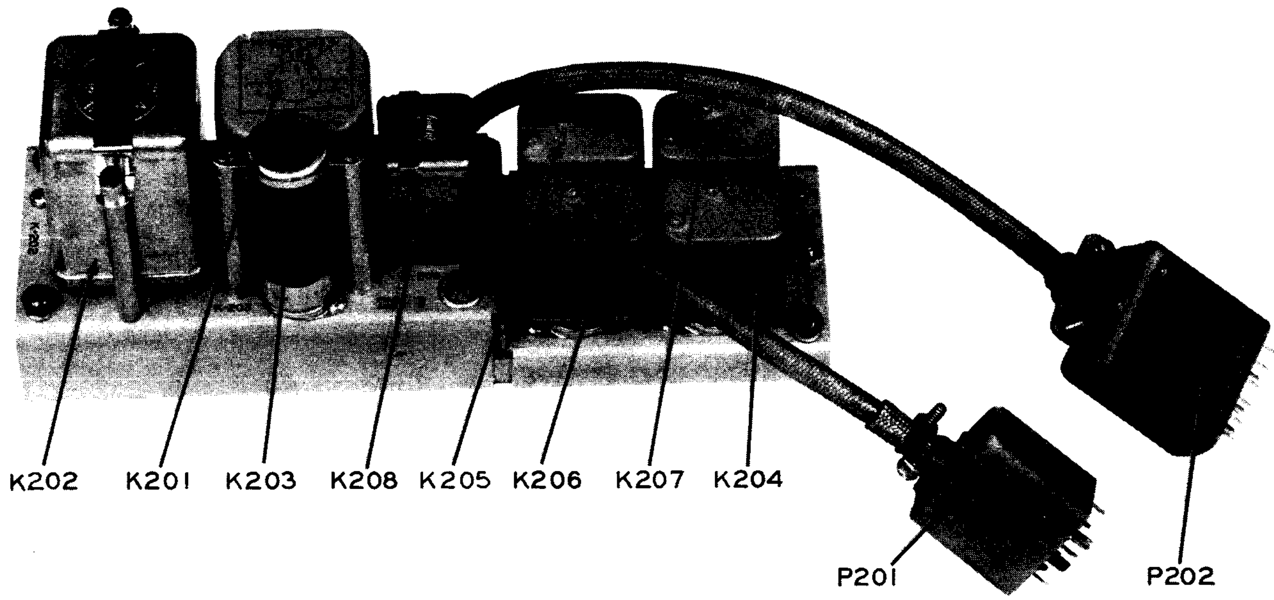


Figure 92. Relay subchassis, top.

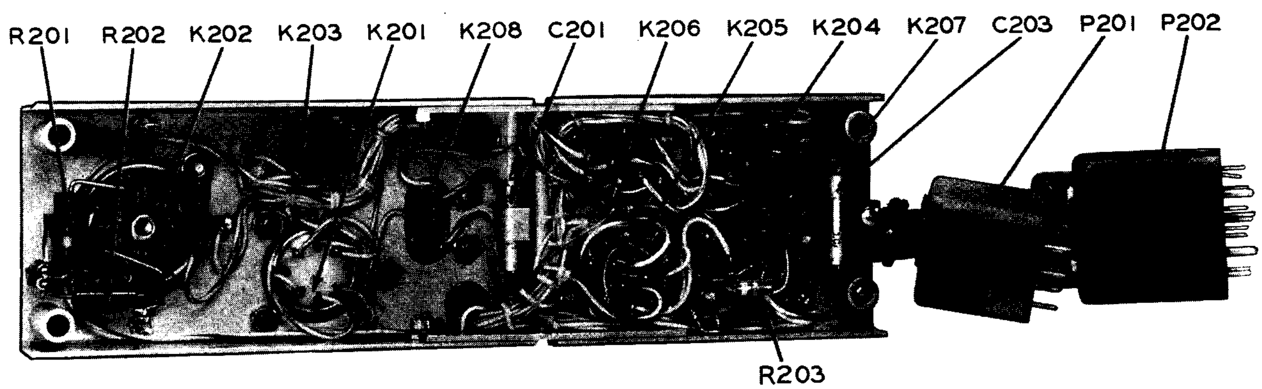


Figure 93. Relay subchassis, bottom.

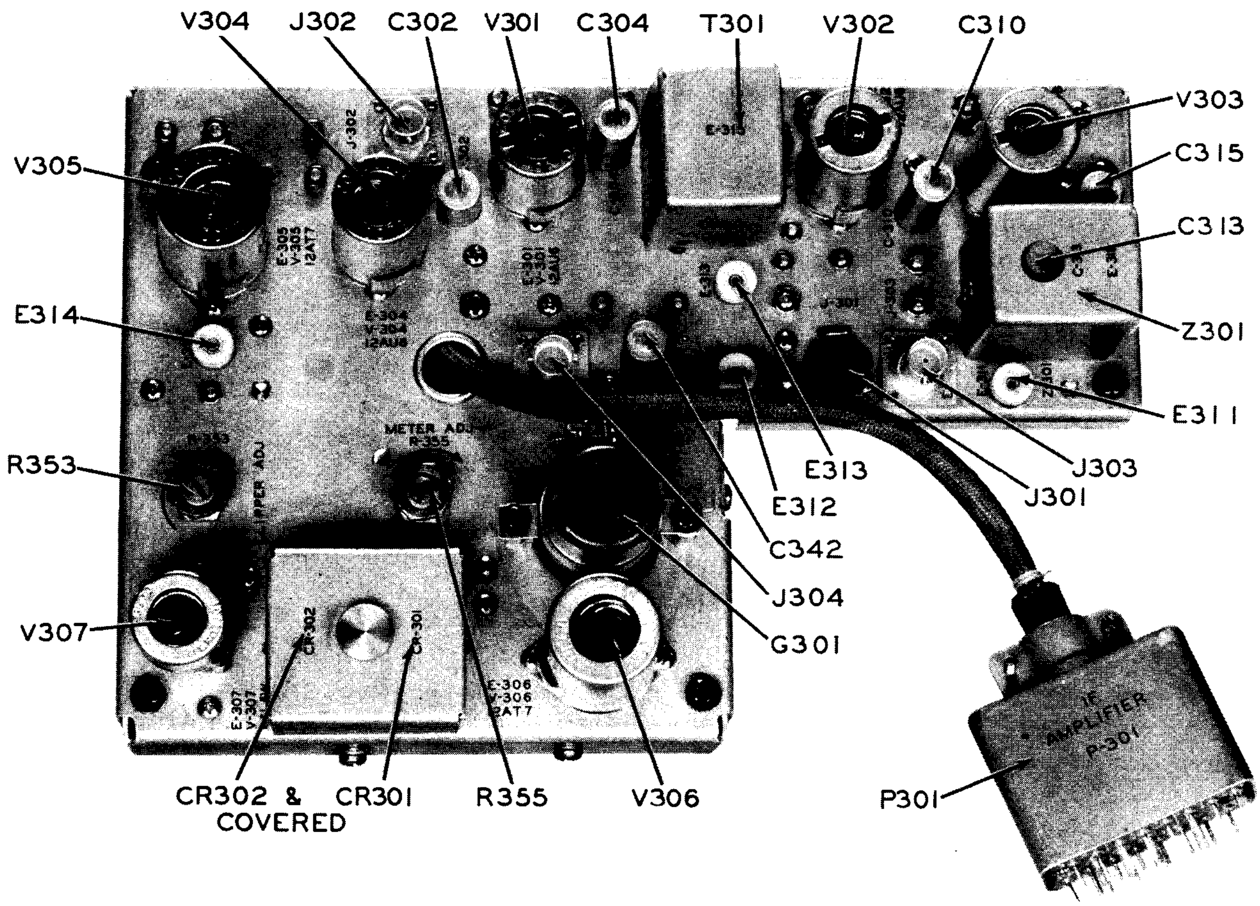


Figure 94. If. amplifier, top.

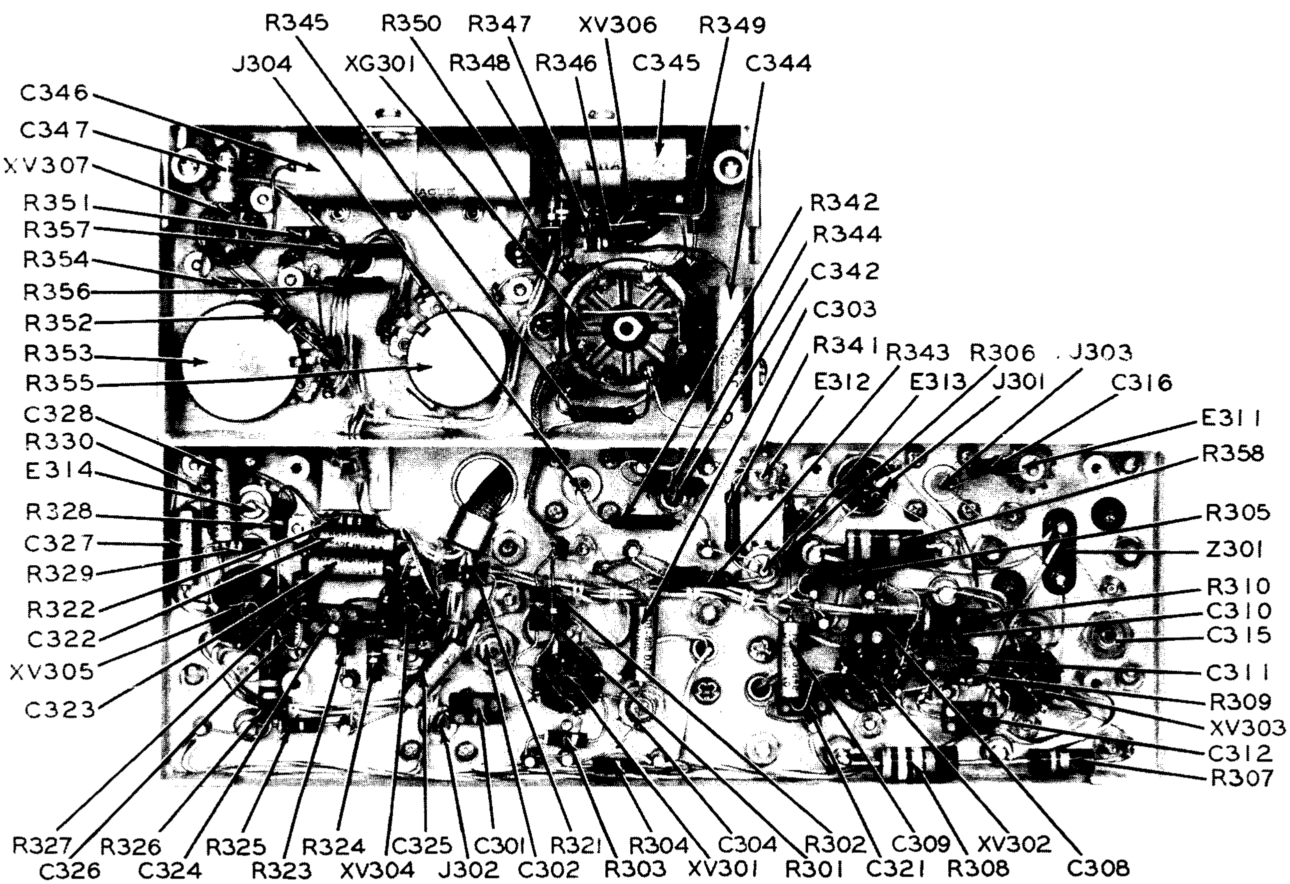


Figure 95. If. amplifier, bottom.

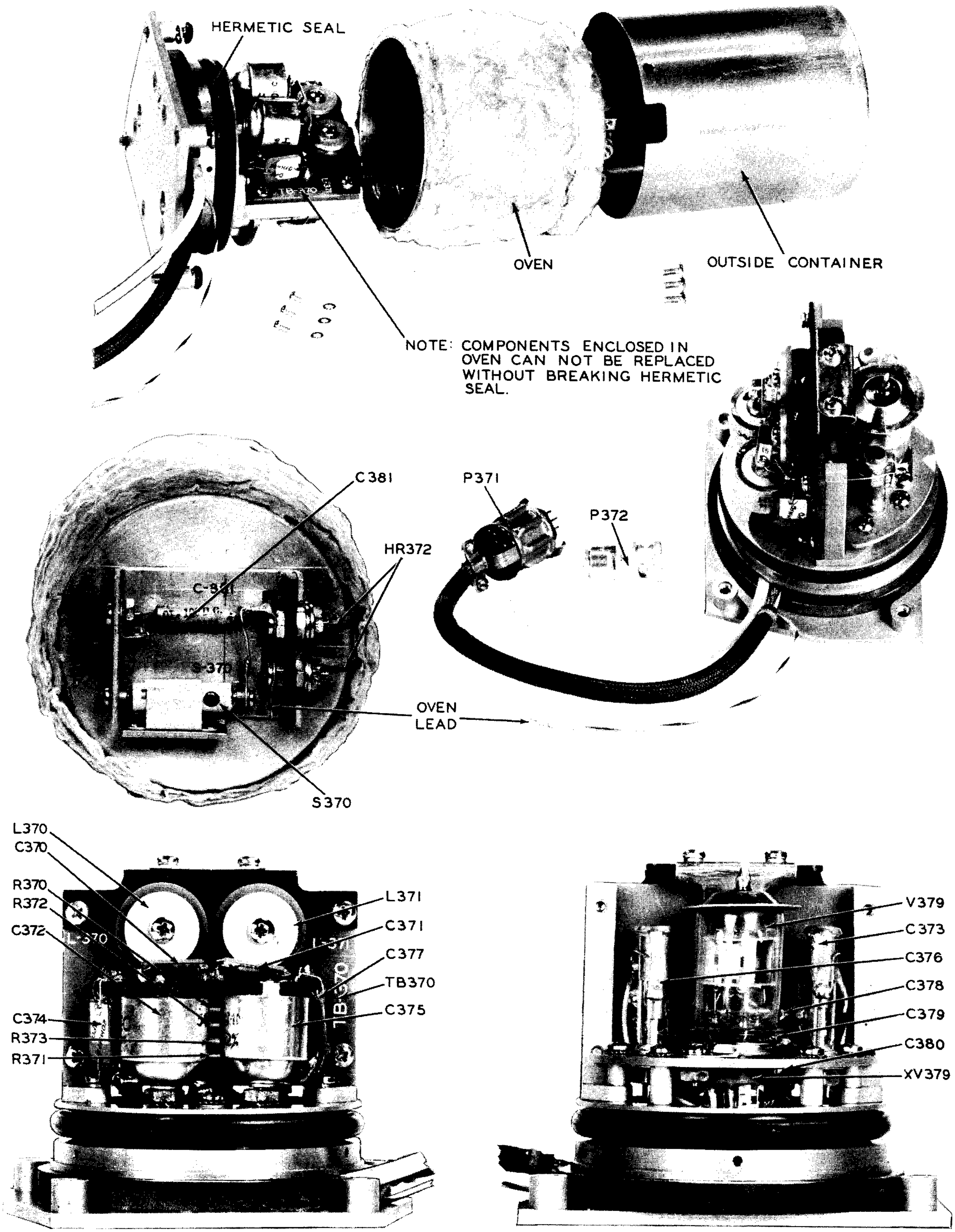


Figure 96. Discriminator, disassembled.

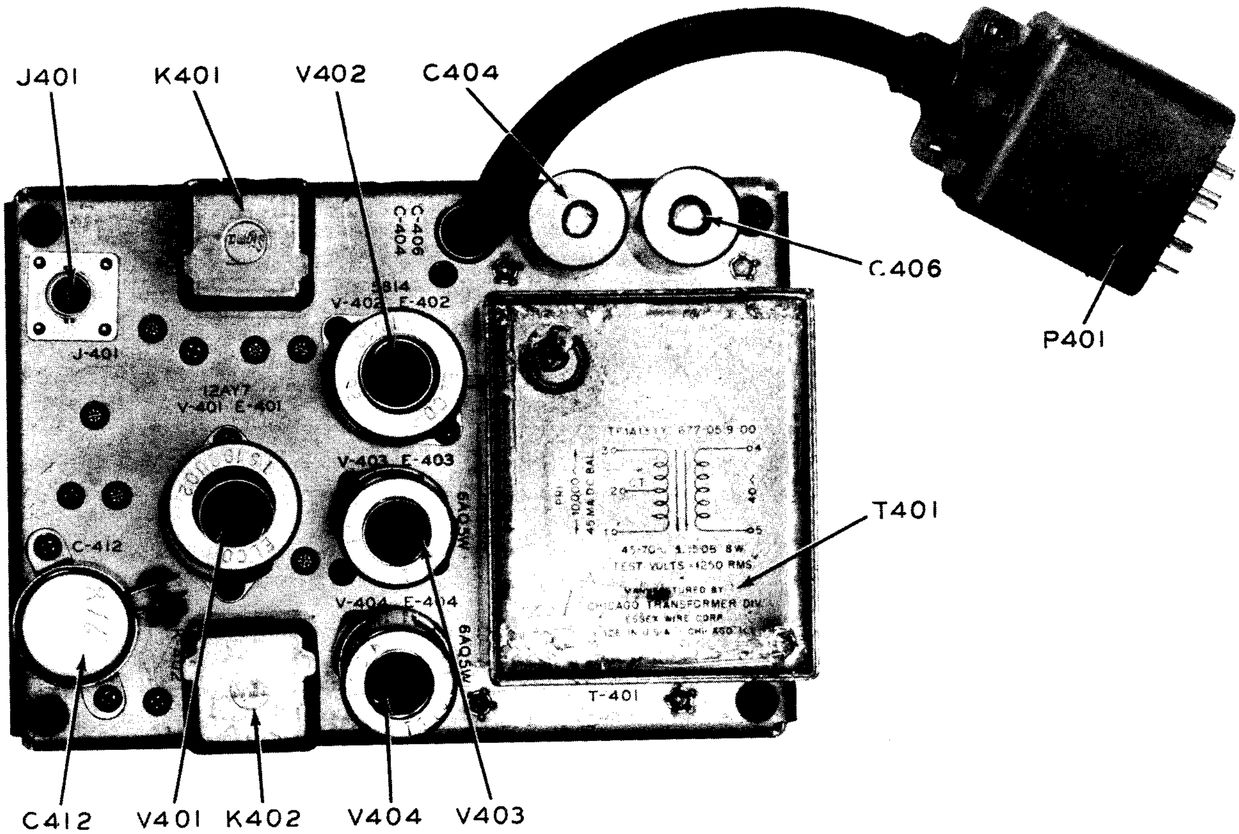


Figure 97. Servo amplifier, top.

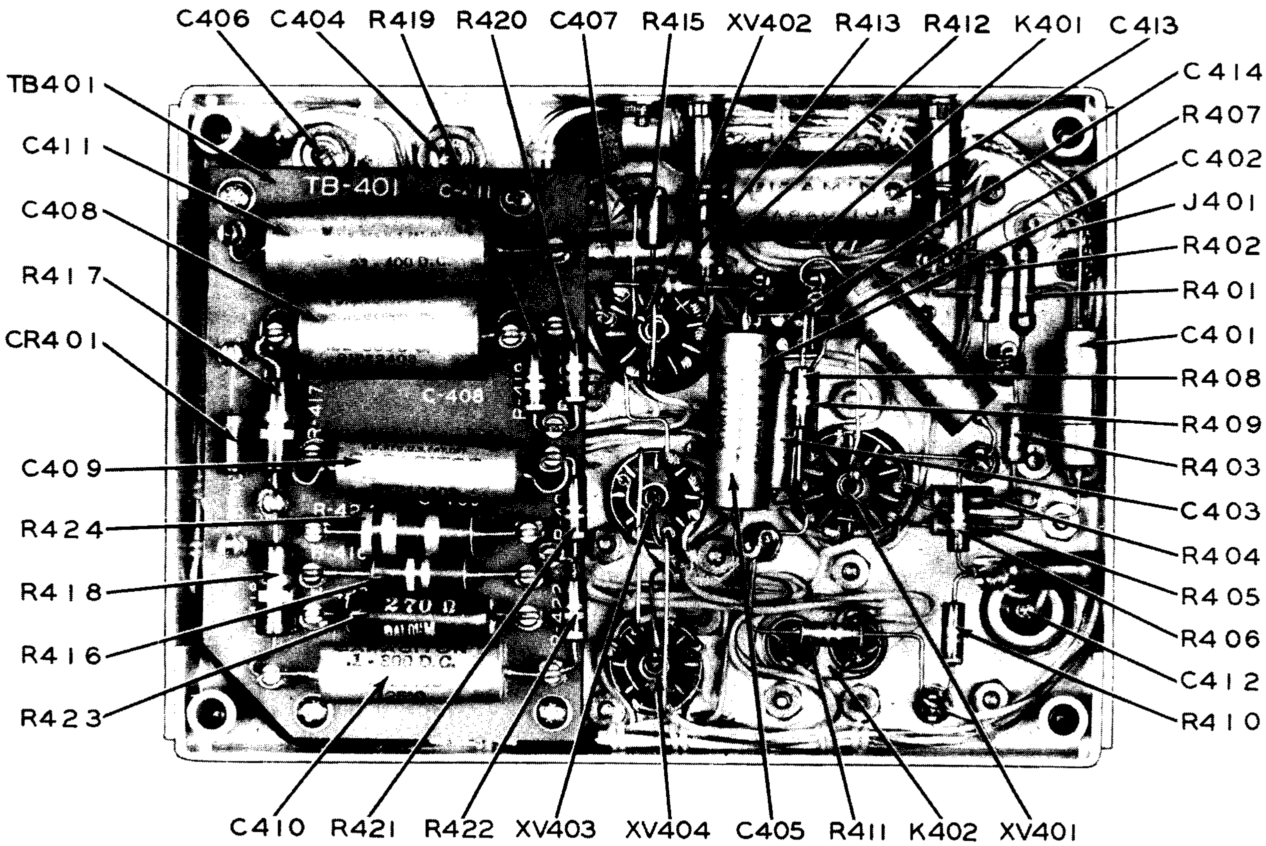


Figure 98. Servo amplifier, bottom.

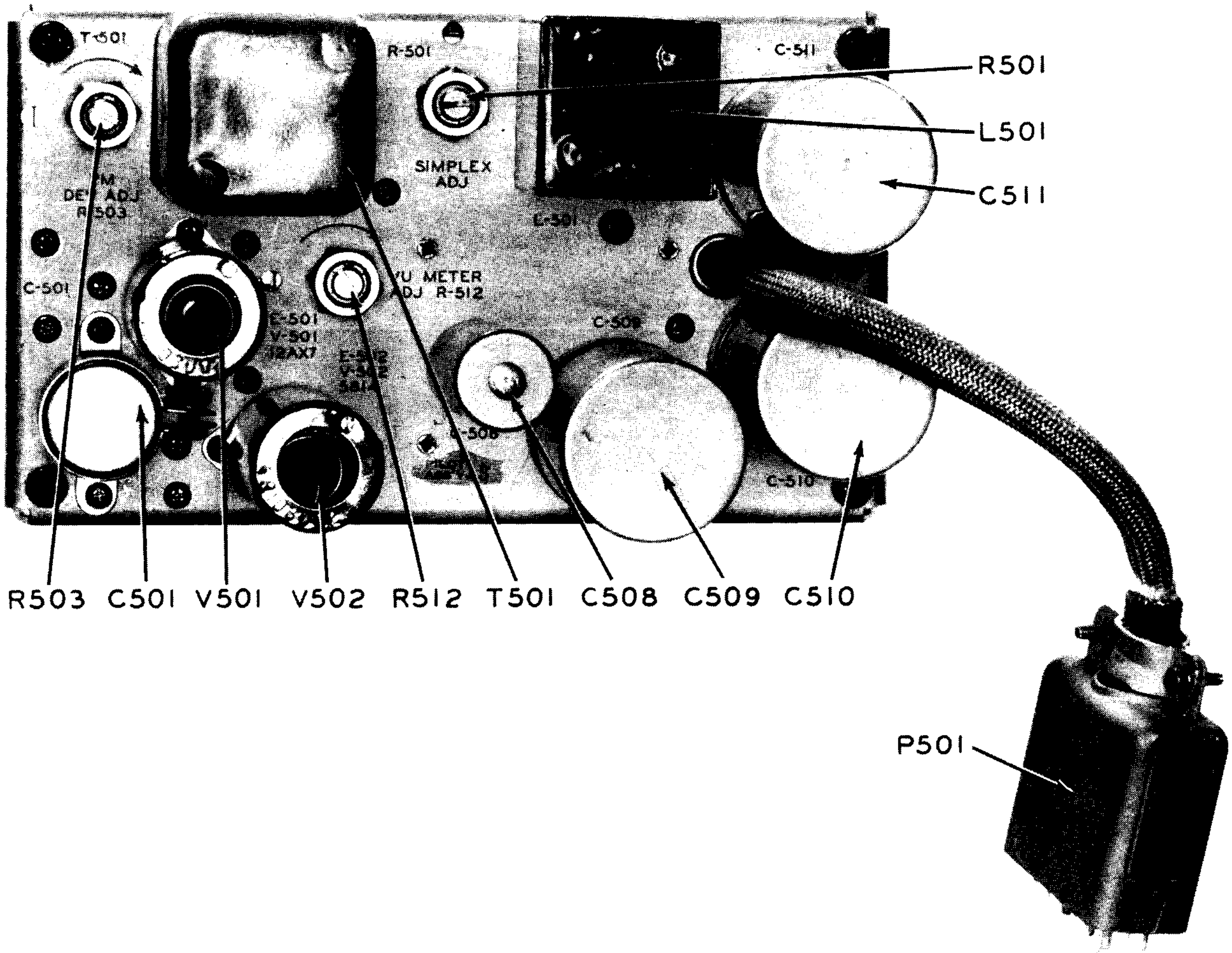


Figure 99. Audio amplifier, top.

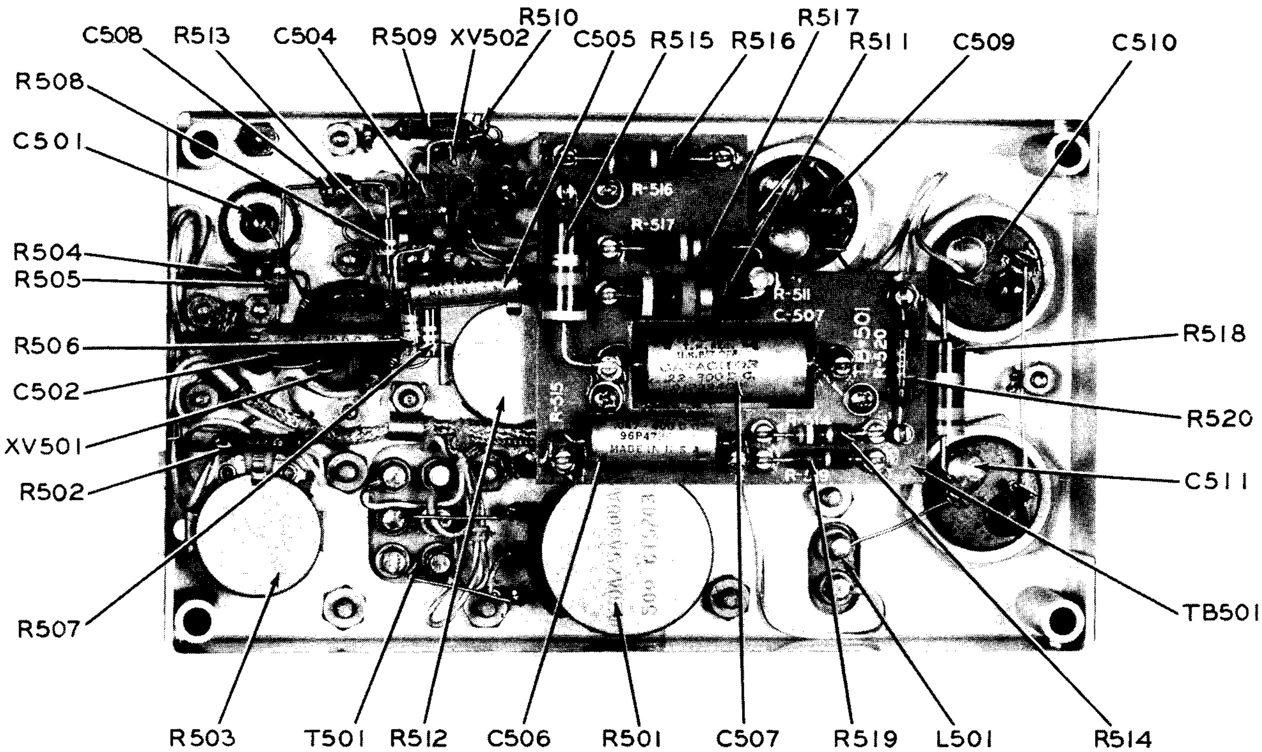


Figure 100. Audio amplifier, bottom.

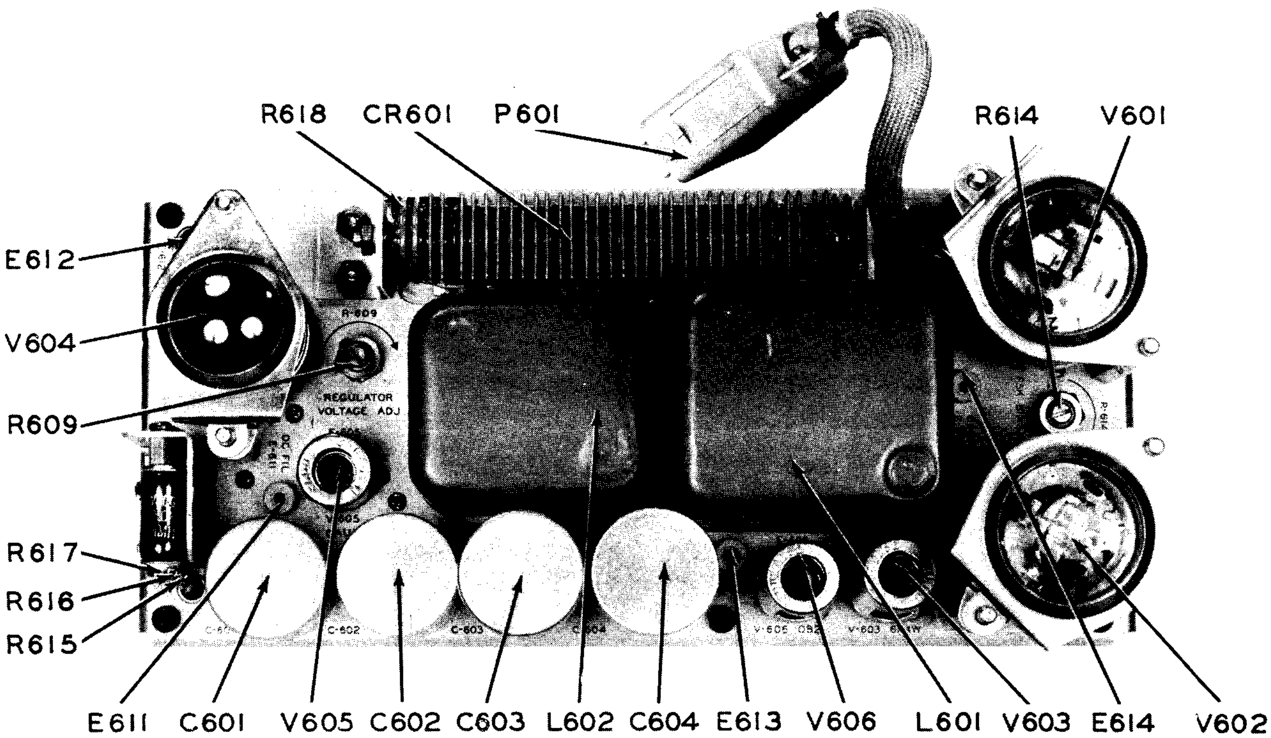


Figure 101. Power rectifier, top.

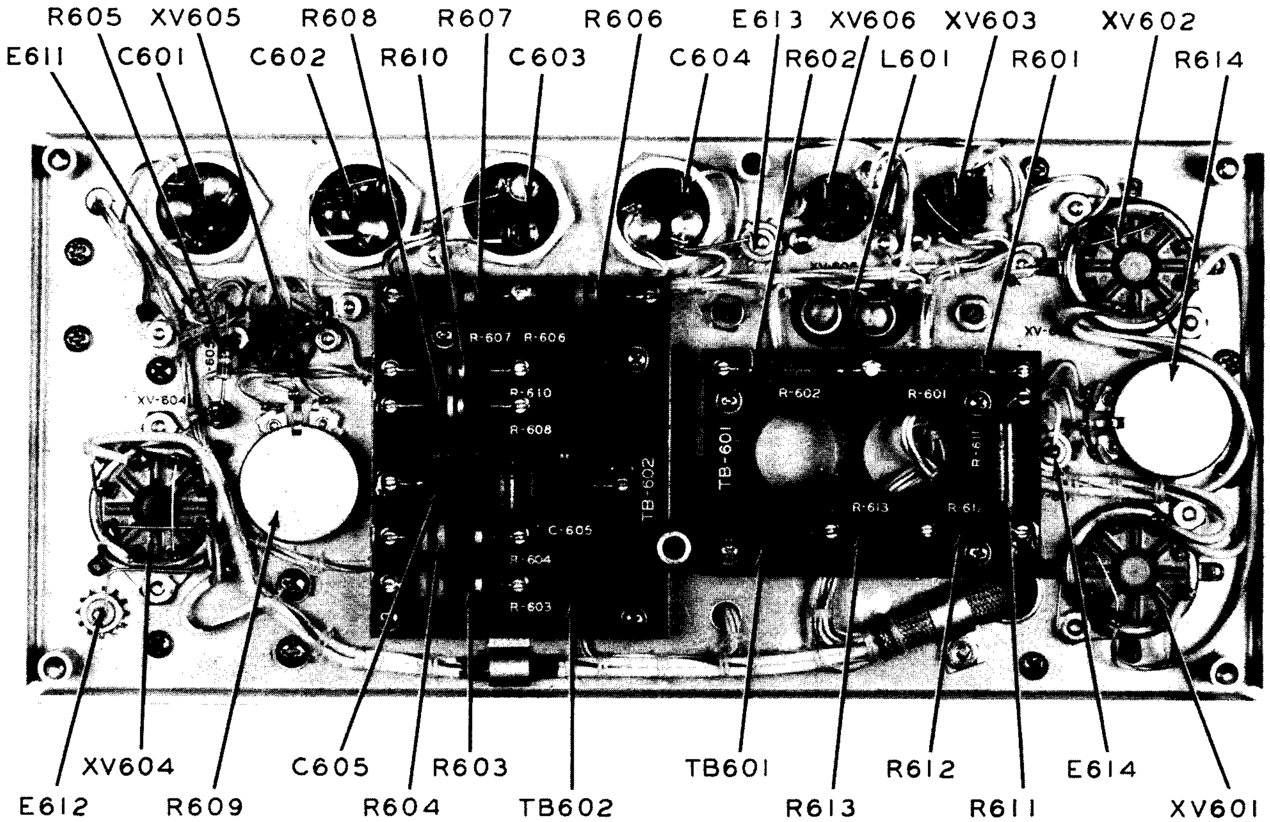


Figure 102. Power rectifier, bottom.

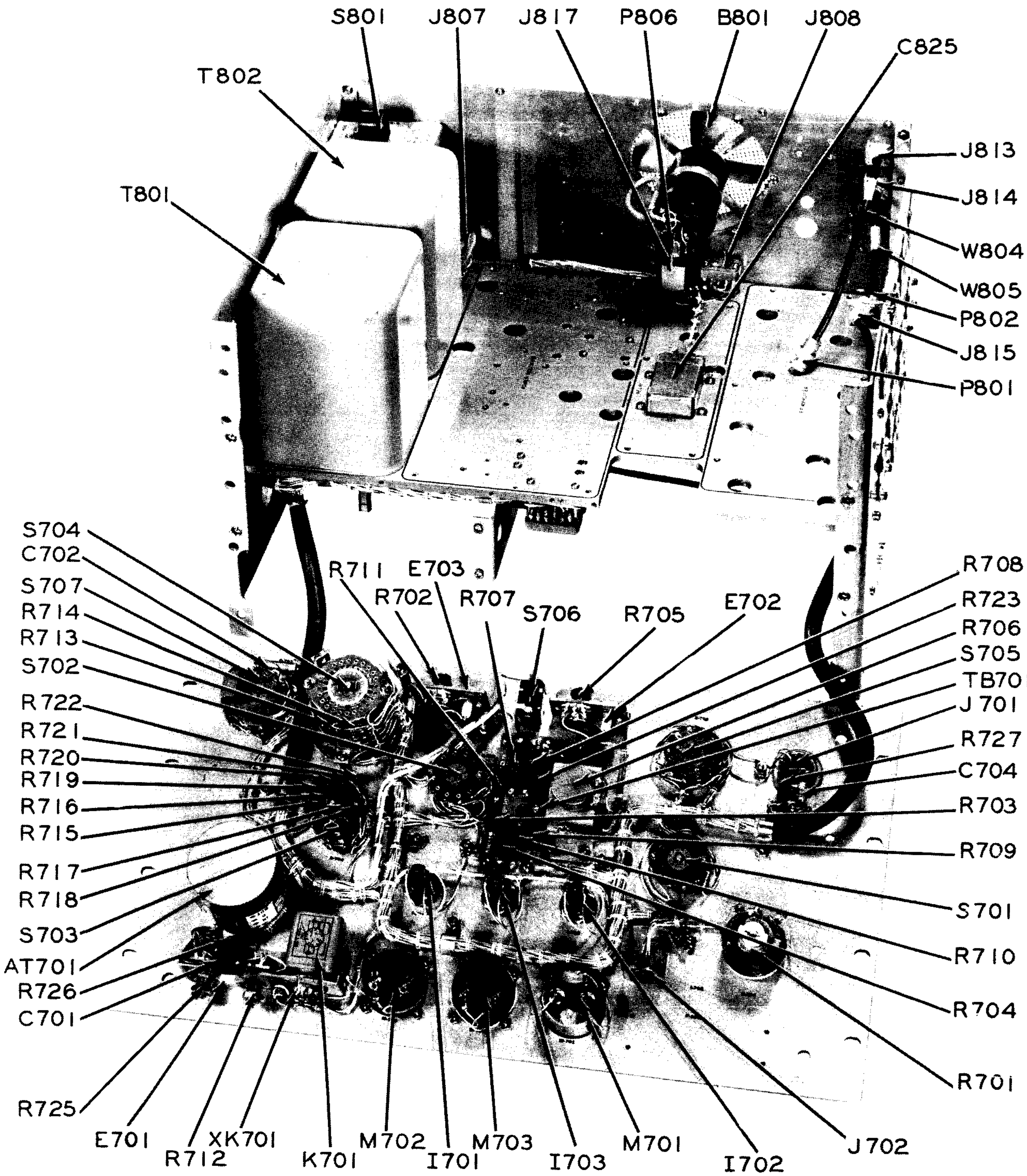


Figure 103. Main frame, top, and front panel, rear.

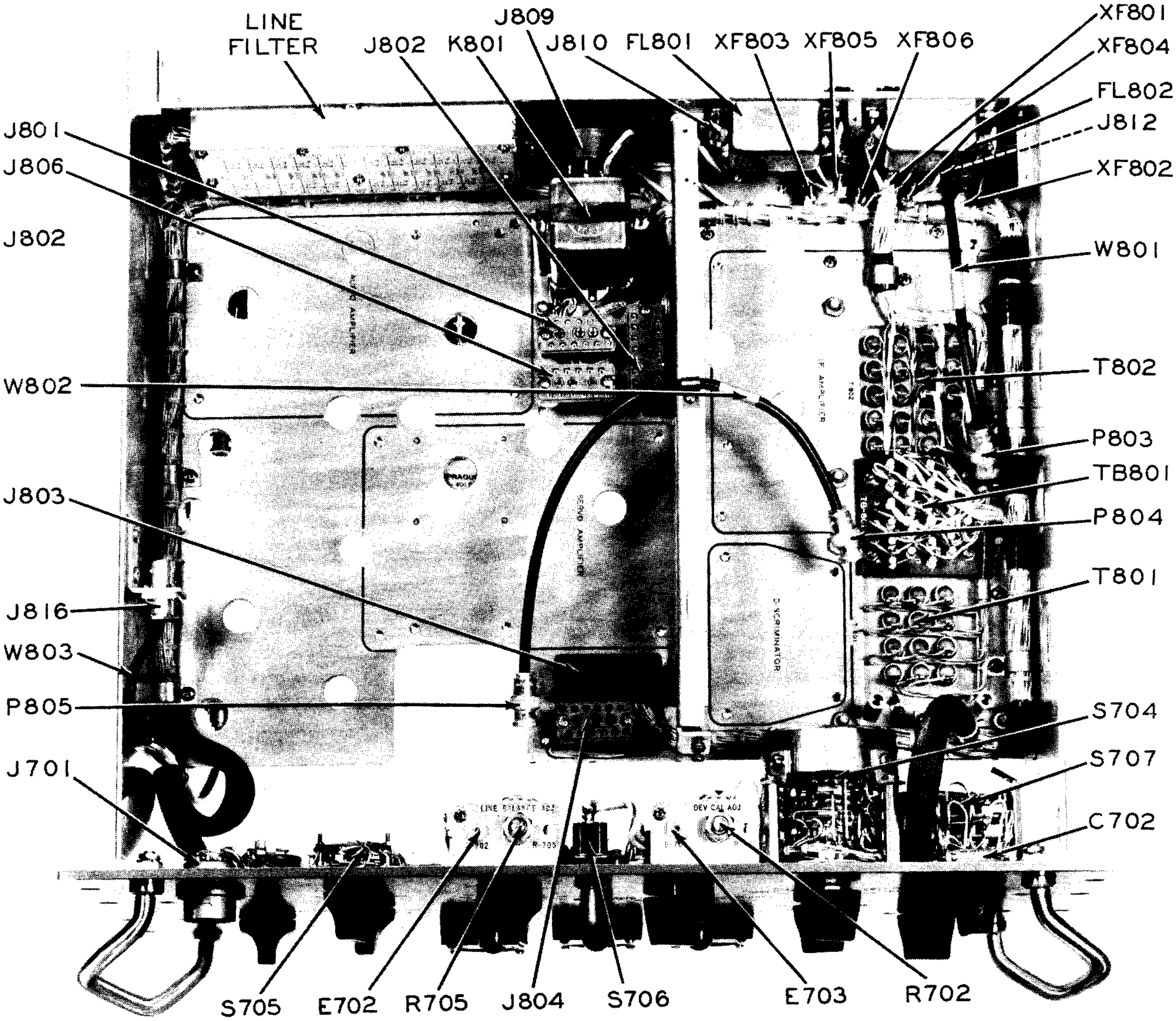


Figure 104. Main frame and front panel, bottom.

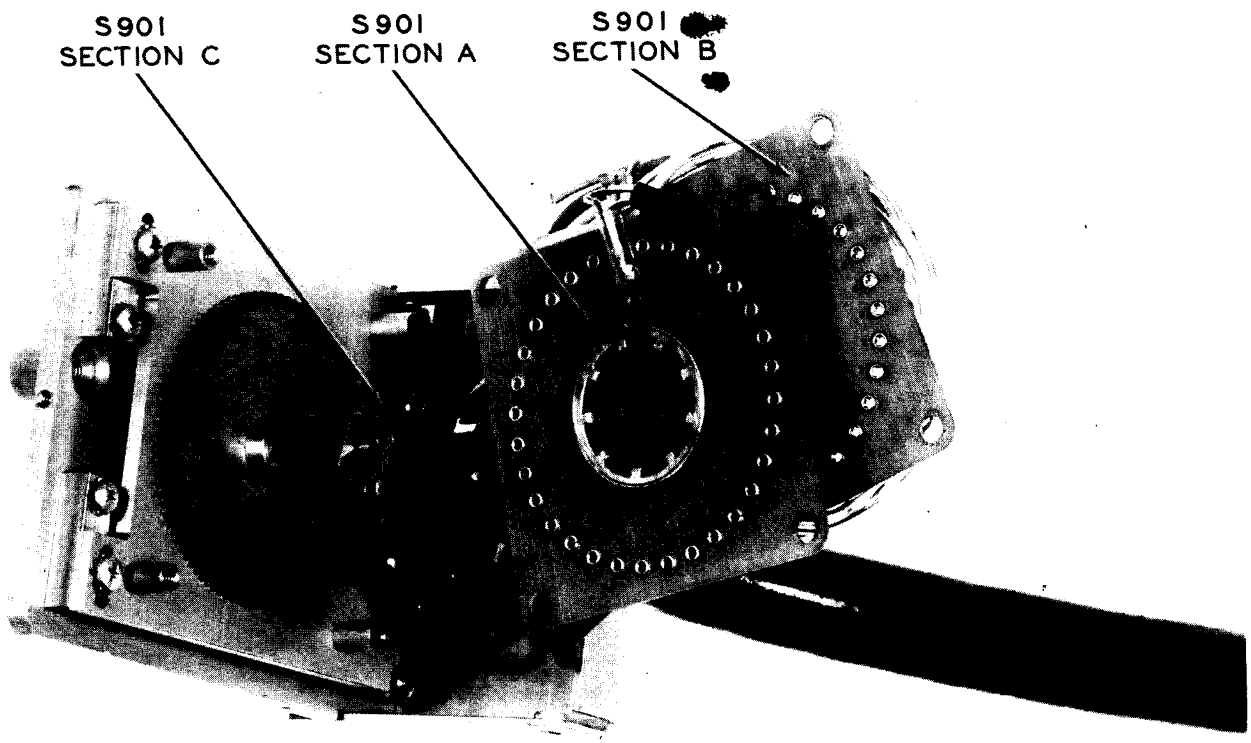


Figure 105. Electrical Specail Purpose Cable Assembly CX-1619/U, band switch adapter, disassembled.

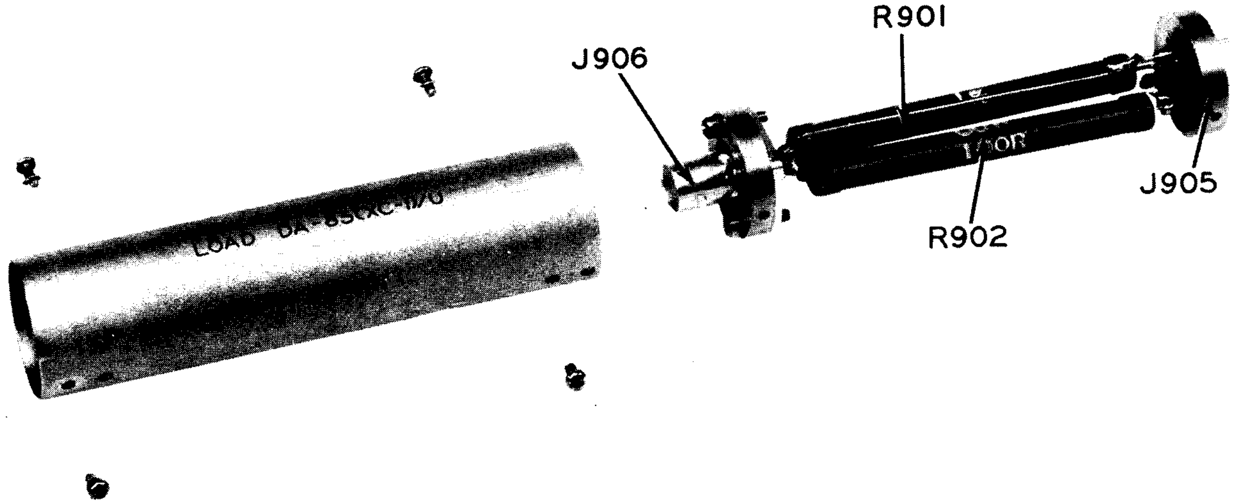


Figure 106. Electrical Dummy Load DA-85/U, disassembled.

Section V. ALIGNMENT AND ADJUSTMENT

135. General

Complete alignment and adjustment procedures for Radio Receiver R-390/URR exist in the instruction book covering that equipment. Refer to the instruction book covering the radio receiver for these procedures. Paragraphs 138 through 147 of this instruction book contain complete alignment and adjustment procedures for Radio Frequency Oscillator O-152/URA-13.

136. Test Equipment Required for Alignment and Adjustment of Radio Frequency Oscillator O-152/URA-13.

Alignment and adjustment of the radio frequency oscillator requires the following test equipment.

Test Equipment	Technical manual
Audio Oscillator TS-382/U, or equal.	TM 11-2684
Multimeter TS-352/U, or equal	
Frequency Meter AN/USM-26, or equal	
VTVM ME-25A/U, or equal	
Multimeter TS-505/U, or equal	
Radio Receiver R390/URR, or equal	
Reactance tube linearity test set (fig. 107)	

137. Tools Required for Alignment and Adjustment of Radio Frequency Oscillator AN/URA-13

The tools required for the alignment and adjustment of Radio Frequency Oscillator AN/URA-13 are provided with the equipment, except for an ordinary screw-driver. These include an rf tuning tool which clips to the top of the rf amplifier subchassis and a gear train synchronizing rod which clips to the under-side of the top dust cover.

138. Connections and Control Positions for Alignment and Adjustment

For the alignment and adjustment procedures which follow (par. 139 to par. 146) Oscillator Group AN/URA-13 must be connected according to the cording diagram (fig. 22) with RF Cable Assembly CG-409/U connected to Electrical Dummy Load DA-85/U. Ground both units adequately. The front panel controls should be set according to the following tables. When an adjustment or alignment procedure requires a different control position from those indicated, the new position will be indicated in the procedure concerned.

Radio Receiver R-390/URR Control Positions	
Control	Position
BANDWIDTH	16KC
BFO	OFF
LOCAL GAIN	0
LIMITER	OFF
AUDIO RESPONSE	MED
LINE GAIN	0
AGC	MED
LINE METER	OFF
BREAK-IN	OFF
ANT. TRIM	0
FUNCTION	ACG
RF GAIN	4

Radio Frequency Oscillator Control Positions	
Control	Position
FUNCTION	OPERATE
SERVICE SELECTOR	CW-LINE NORMAL
ASSOC XMTR FREQ MULT	X1
AUDIO LEVEL	-30 dbm
MOD TEST	LINE
DEVIATION	Leave in previous position
CARRIER CONTROL	LINE
POLAR NEUTRAL	30 MA POLAR
LINE CURRENT	To the counterclockwise stop
VOLTAGE SELECTOR	To agree with the available line voltage
POWER	ON
TB802	Jumper CARRIER CONTROL terminal 12 to GND terminal 14

139. Adjustment of +180v Regulated Voltage Supply

a. Set front panel controls and connect cables as indicated in paragraph 138. Allow the set to warm up before proceeding.

b. Using the dc probe, connect a VTVM TS-505/U between E703 and ground.

c. Unlock REGULATED VOLTAGE ADJ potentiometer R609 (fig. 101).

d. Adjust the REGULATED VOLTAGE ADJ potentiometer R609 to give a meter reading of +5.5 v dc (± .1v dc).

e. Voltage measured between E612 REG V (fig. 101) and ground should be + 182v dc (±3.5v dc).

f. Voltage measured between E611 DC FIL (fig. 101) and ground should be approximately 90v dc.

g. Lock shaft of REGULATED VOLTAGE ADJ potentiometer R609.

h. Recheck voltage at E703 (subpar. d., above) to make certain that locking the shaft has not shifted the voltage.

140. Adjustment of LINE BALANCE ADJ

a. Set front panel controls and connect cables as indicated in par. 138. Allow the set to warm up before proceeding.

b. Unlock DEV CAL ADJ potentiometer R702 (fig. 104).

c. Set DEV CAL ADJ potentiometer R702 to the clockwise stop.

d. Lock DEV CAL ADJ potentiometer R702.

e. Set the MOD TEST switch S702 to the MRK-WH-HI position..

f. Set the FUNCTION switch S707 to the DEV SET position.

g. Using the dc probe, connect a VTVM (TS-505/U) between E701 (fig. 103) ground.

h. Unlock LINE BAL ADJ potentiometer R705 (fig. 104).

i. Adjust the LINE BAL ADJ potentiometer R704 to give identical VTVM readings for all frequency bands. The five frequency bands are obtained by setting the MEGACYCLE CHANGE control of the radio receiver to the 1 mc, 3 mc, 6 mc, 12 mc and 24 mc positions in turn. (Usually adjusting for the 1 mc and the 24 mc positions will be sufficient.)

j. Lock the shaft of LINE BAL ADJ potentiometer, R705.

l. Recheck the LINE BALANCE ADJ setting by repeating the step of subparagraph i to make certain locking the shaft of the potentiometer has not shifted the setting.

141. Adjusting the LINEARITY ADJ

a. Set front panel controls and connect cables as indicated in paragraph 138. Allow the set to warm up before proceeding.

b. Set the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls of the radio receiver to 1.5 mc and allow the radio frequency oscillator to tune up.

c. Set the FUNCTION switch S707 to the DEV SET position.

d. Unlock the LINEARITY ADJ potentiometer R148 (fig. 87).

e. Short test point E701 (fig. 103) to ground.

f. Connect a frequency meter (AN/USM-26) across Electrical Dummy Load DA-85/U. Note the carrier frequency indicated.

g. Connect the reactance tube linearity test set (fig. 107) from test point E130 (fig. 87) to ground.

h. Apply a negative voltage with the reactance tube linearity test set so that the frequency meter indicates a 2500 cps deviation above the carrier frequency. Note the negative dc voltage applied.

i. Reverse the dc voltage applied by the reactance tube linearity test set and apply an equal positive dc voltage. Note the deviation indicated by the frequency meter. (The deviation should be 2500 cps below the carrier).

j. Adjust the LINEARITY ADJ potentiometer R148 to make up half of the difference between the positive deviation and the negative deviation.

k. Recheck the carrier frequency with zero volts applied by the reactance tube linearity test set. If the carrier frequency has shifted from that noted in subparagraph f., retune the radio frequency oscillator by turning the gear train by hand.

l. Repeat the steps of subparagraphs h. through k. until the deviations above and below the carrier frequency both equal 2500 cps. Adjustment should continue until the balance is within 3 or 4 cps. (It will probably be necessary to make numerous adjustments since this control is extremely sensitive.)

m. For a check on the linearity adjustment, repeat the steps of subparagraphs h. and i., applying, in turn, equal and opposite dc voltages from the reactance tube test set to produce 3500 cps, 1500 cps and 500 cps deviations above and below the carrier frequency. The deviations caused by the plus and minus voltages should be within 1% of one another for these deviations.

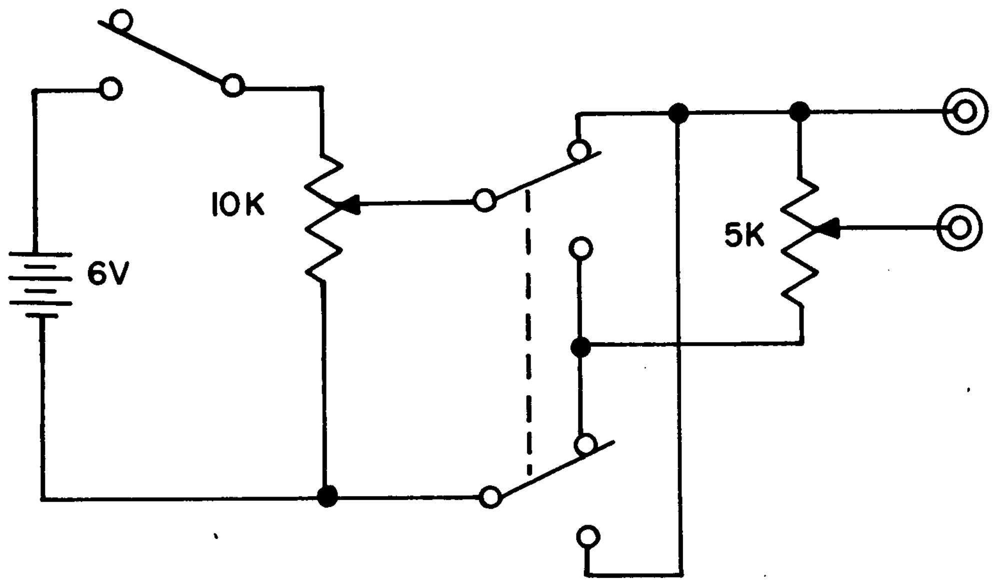


Figure 107. Reactance tube linearity test set, schematic diagram.

n. Lock the shaft of the LINEARITY ADJ potentiometer R148.

o. Recheck the deviation to make certain that locking the shaft has not shifted the voltage.

p. Remove the reactance tube linearity test set and the shorting lead from test point E701 to ground.

142. Adjusting the FSK BIAS ADJ

a. Set front panel controls and connect cables as indicated in paragraph 138. Allow the set to warm up before proceeding.

b. Set the MEGACYCLE CHANGE and the KILOCYCLE CHANGE controls of the radio receiver to 1.5 mc and allow the radio frequency oscillator to tune up.

c. Set the FUNCTION switch S707 to the DEV SET position.

d. Unlock the front panel DEVIATION control.

e. Set the DEVIATION control to the clockwise stop.

f. Unlock the DEV CAL ADJ potentiometer R702 (fig. 104).

g. Set the DEVIATION CAL ADJ potentiometer R702 to the clockwise stop.

h. Connect a frequency meter (AN/USM-26) across Electrical Dummy Load DA-85/U. Note the carrier frequency.

i. Set the MOD TEST switch to the MRK-WH-HI position. Note the deviation above the carrier frequency.

j. Set the MOD TEST switch to the SPACE-BLK-LOW position. Note the deviation below the carrier frequency.

k. Unlock the shaft of FSK BIAS ADJ potentiometer R614 (fig. 101).

l. Adjust the FSK BIAS ADJ potentiometer R614 to make up half of the difference between the deviation noted in subparagraph i and subparagraph j.

m. Set the MOD TEST switch to the LINE position and check the carrier frequency. If the carrier frequency has shifted from that noted in subparagraph h, retune the radio frequency oscillator by turning the gear train by hand.

n. Repeat the steps of subparagraphs i, j, m and n until the deviations above and below the carrier frequency are equal.

o. Lock the shaft of FSK BIAS ADJ potentiometer R614.

p. Recheck the deviation by repeating steps of subparagraphs i, j and n to make certain locking the shaft of the potentiometer has not shifted the setting.

143. Adjustment of DEV CAL ADJ.

a. Set front panel controls and connect cables as indicated in paragraph 138. Allow the set to warm up before proceeding.

b. Set the MEGACYCLE CHANGE and the KILOCYCLE change controls of the radio receiver to 1.5 mc and allow the radio frequency oscillator to tune up.

c. Set the FUNCTION switch to the DEV SET position.

d. Connect a frequency meter (AN/USM-25) across Electrical Dummy Load DA-85/U. Note the carrier frequency.

e. Set the MOD TEST switch to the MRK-WH-HI position.

f. Unlock DEV CAL ADJ potentiometer R702 (fig. 104).

g. Adjust DEV CAL ADJ potentiometer R702 until a deviation of 500 cps above the carrier frequency is indicated by the frequency meter.

h. Set the MOD TEST switch to the SPACE-BLK-LOW position. The frequency meter should indicate 500 cps below the carrier frequency.

i. Set the MOD TEST switch to the LINE position and check the carrier frequency. If the carrier frequency has shifted from that noted in subparagraph d., retune the radio frequency oscillator by turning the gear train by hand. Then repeat the steps of subparagraphs g, h and i.

j. Lock the shaft of DEV CAL ADJ potentiometer R702.

k. Recheck the deviation by repeating subparagraphs e, h and i to make certain that locking the shaft of the potentiometer has not shifted the setting.

144. Adjustment of CAL IND meter and DEVIATION control.

a. Set front panel controls and connect cables as indicated in paragraph 138. Allow the set to warm up before proceeding.

b. Set the MEGACYCLE CHANGE and the KILOCYCLE change controls of the radio receiver to 1.5 mc and allow the radio frequency oscillator to tune up.

c. Connect frequency meter (AN/USM-25) across Electrical Dummy Load DA-85/U.

d. Set the FUNCTION switch to the CAL EXC position. The CAL IND meter, M703 will read zero when the automatic frequency control system of the radio frequency oscillator is on frequency. Note the frequency indicated on the frequency meter.

e. Unlock the shaft of CLIPPER ADJ potentiometer R353 (fig. 94).

f. Unlock the shaft of METER ADJ potentiometer R355 (fig. 94).

g. Unlock the front panel DEVIATION control.

h. Set the CLIPPER ADJ potentiometer R353 to the clockwise stop.

i. Set the FUNCTION switch to the DEV SET position.

j. Set the MOD TEST switch to the SPACE-BLK-LOW position.

k. Turn the CLIPPER ADJ potentiometer R353 counterclockwise until the CAL IND meter M703 needle is just over full scale but not touching the stop. If the needle will not swing far enough, turn the METER ADJ potentiometer R355 clockwise.

l. Turn the MOD TEST switch to the CARRIER ON position and check the frequency indicated by the frequency meter. If the frequency is different from that noted in subparagraph d, set the FUNCTION switch to the CAL EXC position and allow the radio frequency oscillator to retune. When the radio frequency oscillator retunes to the frequency noted in subparagraph d, return the FUNCTION switch to the DEV SET position and the MOD TEST switch to the SPACE-BLK-LOW position.

m. Turn the front panel DEVIATION control counterclockwise until the frequency meter indicates a deviation of 425 cps below the carrier frequency noted in subparagraph l.

n. Lock front panel DEVIATION control.

o. Adjust the METER ADJ potentiometer R355 until the CAL IND meter M703 needle indicates 42.5.

p. Set the MOD TEST switch to the CARRIER ON position.

q. Set the FUNCTION switch to the CAL EXC position.

r. Allow the radio frequency oscillator to correct the carrier frequency. That the radio frequency oscillator is on frequency is indicated by a zero reading of the CAL IND meter M703.

s. Set the FUNCTION switch to the DEV SET position.

t. Set the MOD TEST switch to the MRK-WH-HI position.

u. The CAL IND meter M703 should read 42.5, the same reading as obtained in subparagraph o. If the reading obtained is not 42.5, readjust the METER ADJ potentiometer R355 until the CAL IND meter M703 reads 42.5. Then repeat the steps of subparagraphs p, q, r, s, j and o, in that order.

v. Continue the procedure in subparagraphs s through u until the CAL IND meter M703 reads 42.5 when the MOD TEST switch is in both the MRK-WH-HI position and the SPACE-BLK-LOW position.

w. Lock the shaft of the CLIPPER ADJ potentiometer R353.

x. Lock the shaft of the METER ADJ potentiometer R355.

y. Recheck the deviation indicated by the CAL IND meter M703 by repeating, in order, subparagraphs p, q, r, i, j, then subparagraphs p, q, r, s, t, to make certain that locking the shafts has not shifted the settings.

145. Adjusting Modulation Canceling.

a. Set front panel controls and connect cables as indicated in paragraph 138. Allow the set to warm up before proceeding.

b. Set the SERVICE SELECTOR switch to the FSK-LINE NORMAL position.

c. Set the MEGACYCLE CHANGE and the KILOCYCLE change controls of the radio receiver to 1.5 mc and allow the radio frequency oscillator to tune up.

d. Connect an audio oscillator (TS-382/U) to the FSK input terminals 8 and 9 of TB802.

e. Set the output of the audio oscillator to 50 cps.

f. Adjust the output of the audio oscillator until the fsk keying relay K801 can be heard operating.

g. Connect a VTVM (TS-505/U) between test point E313 (fig. 94) and ground. Use shielded leads for the ac voltmeter connections.

h. Unlock the MOD CANCEL PHASE ADJ potentiometer R725 (fig. 103).

i. Turn the MOD CANCEL PHASE ADJ potentiometer R725 to the counterclockwise stop.

j. Unlock the MOD CANCEL VOLT ADJ potentiometer R712 (fig. 103).

k. Set the MOD CANCEL VOLT ADJ potentiometer R712 to the point where the ac voltmeter reading is a minimum.

l. Turn the MOD CANCEL PHASE ADJ potentiometer R725 clockwise a small amount.

m. Again set the MOD CANCEL VOLT ADJ potentiometer R712 to the point where the ac voltmeter reading is a minimum.

n. Repeat the steps of subparagraphs l and m until the minimum ac voltmeter reading is below 1 mv.

o. Connect frequency meter (AN/USM-26) across Electrical Dummy Load DA-85/U.

p. Set the MOD TEST switch to the carrier on position.

q. Set the FUNCTION switch to the CAL EXC position.

r. Note the frequency indicated on the frequency meter.

s. Set the FUNCTION switch to the DEV SET position.

t. Set the MOD TEST switch to the MRK-WH-HI position.

u. Note the frequency indicated on the frequency meter.

v. If the frequency noted in subparagraph u is 425 cps above the carrier frequency noted in subparagraph r, continue the procedure by going to subparagraph w. If the frequency noted in subparagraph u is not 425 cps above the carrier frequency, unlock the front panel DEVIATION control and set the deviation to 425 cps above the carrier frequency. Then lock the front panel DEVIATION control and repeat the steps of subparagraphs l through v.

w. Lock the shaft of the MOD CANCEL PHASE ADJ potentiometer R725.

x. Lock the shaft of the MOD CANCEL VOLT ADJ potentiometer R712.

y. Recheck the ac voltage for the minimum reading to make certain that locking the shafts has not shifted the settings.

146. Adjusting Phase Modulation Circuits of the Audio Amplifier.

a. Set front panel controls and connect cables as indicated in paragraph 138. Allow the set to warm up before proceeding.

b. Set the SERVICE SELECTOR switch to the PM-LINE NORMAL position.

c. Set the MEGACYCLE CHANGE and the KILOCYCLE CHANGE controls of the radio receiver to 1.5 mc and allow the radio frequency oscillator to tune up.

d. Set the FUNCTION switch of the radio frequency oscillator to the DEV SET position.

e. Connect an audio oscillator (TS-382/U) to the PM terminals 6 and 7 of TB802.

f. Set the output of the audio oscillator at .025 v rms at 1000cps.

g. Monitor the rf output of the radio frequency oscillator at the 6th harmonic of its output (9.0mc) with a radio receiver such as Radio Receiver R-390/URR. This can be done by feeding the rf signal from the REC ANT jack J813 to ANTENNA-UNBALANCED WHIP jack J107 of Radio Receiver R-390/URR and monitoring the radio receiver output with a headset. The CARRIER LEVEL meter of the radio receiver provides visual monitoring. The radio receiver should be set to its sharpest selectivity (.1KC).

h. Unlock the shaft of PM DEV ADJ potentiometer R503 (fig. 99) and turn it to the counterclockwise stop.

i. Unlock the shaft of VU METER ADJ potentiometer R512 (fig. 99) and turn it to the counterclockwise stop.

j. Turn the PM DEV ADJ potentiometer R503 slowly clockwise until the second carrier null is heard on the headset or observed on the CARRIER LEVEL meter. At this position the deviation is .92 radians.

k. Lock the shaft of PM DEV ADJ potentiometer R503 and check with the headset to make certain that locking the shaft has not altered the setting.

l. Turn the VU METER ADJ potentiometer R512 clockwise until AUDIO LEVEL meter M703 reads 92. (.92 radians).

m. Lock the shaft of VU METER ADJ potentiometer R512 and check meter reading to make certain that locking the shaft has not altered the setting.

n. The setting of the PM DEV ADJ potentiometer R503 and the VU METER ADJ potentiometer R512 can be checked by setting the frequency of Oscillator Group AN/URA-13 to 5 mc and monitoring the rf output at the first null. The AUDIO LEVEL meter M703 should then read 48 (.48 radians).

147. Rf Amplifier Alignment

a. Set front panel controls and connect cables as indicated in paragraph 138. Allow the set to warm up before proceeding.

b. Set the MEGACYCLE CHANGE and the KILOCYCLE CHANGE controls of the radio receiver to 3.0 mc and allow the radio frequency oscillator to tune up.

c. Set the FUNCTION switch of the radio frequency oscillator to the DEV SET position.

d. Attempt to pass the gear train sync rod through the hole provided in rear panel of the radio frequency oscillator, through the cam holes and through the end plates of the rf amplifier to the gear plate. If the rod will pass all the way to the gear plate, the mechanical alignment is all right. In this event, skip the procedures in subparagraphs e through g and go to the procedure in subparagraph h. If the rod will not pass all the way to the gear plate, mechanical alignment is necessary. In this event continue with the procedure in subparagraph e.

e. Loosen the Oldham coupler on the gear plate which drives the cams on the rf amplifier subchassis.

f. Rotate the cam shaft by hand until the alignment rod passes through to the gear plate.

g. Tighten the Oldham coupler.

h. Remove the alignment rod.

> Caution. Remove the gear train sync rod before the radio frequency oscillator FUNCTION switch is returned to the OPERATE position. If this is not done, the radio frequency oscillator will attempt to automatically retune while the tuning linkage is locked with the rod and serious damage will result.

i. Set the radio frequency oscillator FUNCTION switch to the OPERATE position.

j. Turn the POWER switch of the radio frequency oscillator to the OFF position.

> WARNING. Make certain that the power is turned off before proceeding to connect the meter. The plate supply voltage is present on the meter jacks.

k. Connect an 0-50 ma dc milliameter (TS-352/U) with the positive lead to meter jack E110 (fig. 89) and the negative lead to meter jack E109 (fig. 89). The removable center-rear port on the right-hand side of the radio frequency oscillator provides access to the meter jacks E110 and E111. This milliameter measures the plate current (I_b) of the rf power amplifier V107.

l. Push shorting bar E111 (fig. 98) toward the rear of the radio frequency oscillator as far as possible. This removes the short from the milliameter. The removable center-rear port on the right-hand side of the radio frequency oscillator also provides access to the shorting bar E111.

m. Turn the POWER switch of the radio frequency oscillator to the ON position.

n. Connect an rf VTVM (ME-25A/U) across Electrical Dummy Load DA-85/U. This voltmeter measures the output voltage (E_o) of the radio frequency oscillator.

o. Trim the capacitors and inductances in the rf amplifier in the order and at the frequencies given in the alignment order table of subparagraph s. Use the special tuning tool which is clipped to the top of the rf subchassis of the radio frequency oscillator. In the procedure for trimming the capacitors and inductances given in the table, advantage is taken of the ability of the ASSOC XMTR FREQ MULT switch to divide the rf output of the radio frequency oscillator by a factor equal to the switch setting. In using the ASSOC XMTR FREQ MULT switch for this purpose it is necessary to advance the RF GAIN control of the radio receiver for the higher setting of the ASSOC XMTR FREQ MULT switch.

p. Following alignment turn the POWER switch of the radio frequency oscillator to the OFF position.

> WARNING. Make certain that the power is turned off before proceeding to remove the meter. The plate supply voltage of 250 v dc is present on the meter jacks into which the meter is connected.

q. Disconnect the milliameter from meter jack E109 and E110.

r. Push the shorting bar E111 toward the front of the radio frequency oscillator as far as possible. This shunts meter jacks E109 and E110.

s. Following is an alignment order table for the rf amplifier.

	Control Settings		Adjustments			
ALIGNEMENT ORDER	MC CHANGE and KC CHANGE	ASSOC XMTR FREQ MULT	TRIM TO MINIMUM PLATE CURRENT (I_b)[2]	TRIM TO MAXIMUM PLATE VOLTAGE (E_o)[1]	TRIM TO MAINTAIN PLATE CURRENT BETWEEN 41-45 ma (I_b)[2]	REMARKS
1	24.8 mc	X8	C158	C109, C113		RF output is 3.1 mc
2	24.8 mc	X16	C151	C108		RF output is 1.55 mc
3	24.8 mc	X4	C163	C119, C123		RF output is 6.2 mc
4	24.8 mc	X2	C165	C130, C134		RF output is 24.8 mc
5	24.8 mc	X1	C168	C141		RF output is 24.8 mc
6	23.2 mc	X4	L115	L103, L104		RF output is 5.8 mc
7	23.2 mc	X8	L113			RF output is 2.9 mc
8	23.2 mc	X2	L117	L105, L106		RF output is 11.6 mc
9	23.2 mc	X1	L119	L107, L108		RF output is 23.2 mc
10	24.8 mc	X4		C115		Repeat alignment order 3
11	24.8 mc	X2		C126		Repeat alignment order 4
12	24.8 mc	X1		C137		Repeat alignment order 5
13	23.2 mc	X4			L116	Repeat alignment order 6
14	23.2 mc	X4			L114	Repeat alignment order 7
15	23.2 mc	X2			L118	Repeat alignment order 8
16	23.2 mc	X1			L120	Repeat alignment order 9
17	31.2 mc	X1	L121	L109	L122	RF output is 31.2 mc
18						Repeat alignment order 1 through 17 until no gain in output voltage (E_o) or plate current (I_b) is noted.

1. It will be necessary to advance the RF GAIN control of the radio receiver with the higher settings of the ASSOC XMTR FREQ MULT switch.

2. Plate current (I_b) is measured with dc milliamenter connected between radio frequency oscillator meter jacks E110 (positive) and E109 (negative) with shorting bar E111 pushed toward the rear of the unit.

3. Output voltage (E_o) is measured with an rf VTVM across Electrical Dummy Load DA-85.

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

148. Disassembly

Use the following instructions as a guide for preparing the oscillator group for shipment and storage.

a. Remove all outside leads such as input signal lines and cabling to the associated transmitter.

b. Disconnect all cabling.

c. Remove the radio receiver and the radio frequency oscillator from the cabinet.

149. Repacking for Shipment or Limited Storage

The procedure for repacking the oscillator group for shipment or limited storage depends on the materials available and the conditions under which the equipment is to be shipped or stored. Figure 15 illustrates an adequate package. Follow, in reverse order, the instructions given in paragraph 17 when repacking. Whenever practicable, place a desiccant such as silica gel inside the container. Wrap the units and spare parts in corrugated paper and protect each package with a waterproof barrier. Seal the seams of the barrier with a waterproof tape. Pack the sealed equipment in a wooden case using at least three inches of excelsior padding between the equipment and the case.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

150. General

Use the demolition procedures given in paragraph 151 to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be carried out only upon the order of the commander.

151. Methods of Destruction

a. Smash. Smash the meters, controls, tubes, coils, switches, capacitors, transformers, and headsets, with sledges, axes, handaxes, pickaxes, hammers, crowbars or other heavy tools.

b. Cut. Cut cords, headsets, and wiring, using axes, handaxes or machetes.

c. Burn. Burn cords, resistors, capacitors, coils, wiring and instruction books, using gasoline, kerosene, oil, flame throwers or incendiary grenades.

d. Bend. Bend panels, cabinets and chassis.

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

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

g. Destroy. Destroy everything.

APPENDIX I

IDENTIFICATION TABLE OF PARTS

1. Requisitioning Parts

The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O&E, T/A, SIG 7&8, list of allowances of expendable material, or another authorized supply basis. For an index of available supply manuals in the Signal portion of the Department of the Army Supply Manual, see the latest issue of SIG 1, introduction and Index.

2. Identification of Parts for Oscillator Group AN/URA-13(XC-1)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 2	OSCILLATOR GROUP: 1.5 to 32.0 mc, 3 watts RF output power, 50 ohms output impedance; controls c/o 1 on-off switch, 1 service selector switch, 1 function switch, 1 FSK deviation control switch; AC, 115-230 v, 50-60 cps, single phase, 250 watts; no special markings; moisture and fungus proof, may be cabinet mounted for mobile use; grouping of components and/or accessories: 1 RF Oscillator O-152( )/URA-13, 1 Radio Receiver R-390/URR, 1 Electrical power cable assembly CX-1358/U (8ft. lg.), 1 electrical power cable assembly CX-1619( )/U (6ft. lg.),1 electrical power cable assembly CX-2405( )/U (6 ft. lg.) 1 RF Cable assembly CG 409( )/U (10ft. lg.), 1 RF cable assembly CG-833( )/U (6ft. lg.), 1 Dummy electrical load DA-85( )/U, 1 Panel cover CW-261( )/URA-13 and 1 RF cable assembly CG-409( )/U (6ft. lg.); provides RF signal for exciting any external transmitter, provides for CW, PM, FSK, facsimile modulation; Sig C Oscillator Group (cont.)	Automatic frequency controlled rf exciter	522 0159 002	2C4565-13

2. Identification of Parts for Oscillator Group AN/URA-13(XC-1) (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 2 (cont.)	AN/URA-13( ); Sig C specification SCL-1289A. Collins Rad part/dwg #522 0159 002.			

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig 7	OSCILLATOR, RADIO FREQUENCY: 1.5 to 32.0 mc frequency range, 5 bands; 3 power output; Hartley type of oscillator with AFC; AC, 115-230 v, 50-60 cps, single phase, 250 W; integral power supply; integral coils; 19" long, 17-1/8" over handles, 10-1/2" high over-all dimensions; rack mounted; contains all circuits necessary to terminate remote signal input lines for freq shift keying, CW, phase modulation and facsimile; also includes facilities for use of local microphone and key, stabilization of output freq accomplished by automatic frequency control means; Sig C RF Oscillator O-152( )/URA-13; Sig C specification SCL-1289A; Collins Rad part/dwg #522 0158 006	RF exciter	522 0158 006	2C2710-152
001-099 Series	OSCILLATOR, RADIO FREQUENCY: 1.5 to 3 mc frequency range, 1 band; 5 to 14 v output; Hartley circuit; AC or DC filament, 25.2 v, 60 cycle, 300 ma current drain, single phase, DC plate, 180 v; external power supply; integral coils; 3-1/8" lg, 3-5/8" wide, 6-1/2" h approx over-all dim.; mounts by three captive screws threaded	Master oscillator assembly	522 0067 004	

	no. 6-32 x 5/8" lg in mounting plate; w/2 "warning" decals and one nameplate decal cemented to shield; Collins Rad part/dwg #522 0067 004.			
101-199 Series	AMPLIFIER, RADIO FREQUENCY: 1.5 to 32 mc frequency range; 3 W power output, 50 ohms output impedance; 100,000 ohms input impedance; DC, 250 v and 180 v; aluminum case; chromate dipped; 10-7/32" lg, 4-1/2" wide, 1-25/32" h over-all dim.; eight tapped no. 8-32 holes for mounting; Collins Rad part/dwg #540 3090 006.	Radio frequency amplifier assembly	540 3090 006	
101-199 Series	GEAR ASSEMBLY, SPEED DECREASER: reduction type; 3 input shafts for band switch and frequency control gear train; 4 output shafts for band switch and frequency control gear train; 300 to 1 ratio band switch gear train; input to output constant, 14,500 to 1 ratio input to output frequency control gear train; spur gear type; self-lubricating; straight shaft 1/8" dia input, straight shaft 1/4" dia output; 1/300 of HP input; Collins Rad part/dwg #540 3297 006.	Gear plate tuning assembly	540 3297 006	
201-299 Series	RELAY ASSEMBLY: c/o eight relays - 4, RBM Co. Armature type HSM, 1 Sigma Instr Armature part no. 22RJCC8000-G, 1 RBM Co. Armature, 1 G-V Controls Inc. Thermal type RM, 1 Sigma Instr Hi-Speed polarized type 7JO; aluminum chassis; chromate dipped; 8-7/32" lg, 2-3/8" wide, 4-3/32" h approx over-all dim.; mounts by four threaded no. 8-32 captive screws; silk screened w/ 200 Series symbols; Collins Rad part/dwg #540 3589 002.	Relay control assembly	540 3589 002	
301-369 Series	AMPLIFIER, INTERMEDIATE FREQUENCY: 455 kc operating frequency; 8 kc bandwidth; 2000 input to output over-all gain, 10 mv rms input; 100,000 ohms input impedance; (cont.)	If. amplifier assembly	540 3452 005	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
301-369 Series (cont.)	DC, 180 v; 9-5/16" lg, 6-1/4" wd, 1-27/32" h approx over-all dim.; chassis mounted; Collins Rad part/dwg #540 3452 005			
370-399 Series	**TRANSFORMER, DISCRIMINATOR**: 455 kc peak frequency range; shielded; 3-1/2" lg, 2.748" wide, 2-7/8" h approx over-all dim.; incl 2 tuning capacitors as the tuning device; screw mounted by four threaded no. 4-40 screws, spaced on 3" x 2.093" mounting centers; 5 terminals, 4 solder lug type and 1 post type; Collins Rad part/dwg #540 3507 005.	Frequency discriminator assembly	540 3507 005	
401-499 Series	**AMPLIFIER, SYNCHRO SIGNAL**: servo motor type of receiver, single phase AC type of input synchro signal, 60 cycle frequency input of signal; double phase AC type of output synchro signal, 60 cycle frequency of output signal; one, Diehl AC Low Inertia servo motor no. FPE21-15-1 output synchro; 250 v DC operating power requirement; 6" lg, 4-3/8" wide, 2" h approx over-all dim.; mounts by four captive screws, threaded no. 8-32; Collins Rad part/dwg #540 3438 004.	Servo signal amplifier assembly	540 3438 004	
501-599 Series	**AMPLIFIER, AUDIO FREQUENCY**: 15,000 gain one circuit, 13,000 gain other circuit; DC, 50 v operating power requirement; 200 to 3500 cycle per sec normal operating range 20 db per decade gain one circuit, +1 db other circuit; one input channel, 600 ohms impedance; integral loudspeaker not incl; enclosed in aluminum, chromate dipped chassis; mounts to oscillator 0152 by four captive screws threaded no. 8-32; 6-3/4" lg,	A-f amplifier assembly	506 9573 005	

	3-29/32"w, 3-13/32" h approx over-all dim.; Collins Rad part/dwg #506 9573 005.			
601-699 Series	POWER SUPPLY: electronic and metallic, full wave; DC output, 250 v, 180 v, at 200 ma, 90 v at 150 ma, 30 v at 810 ma -10; AC input, 375 v, 30 v, 60 cycles nom; over-all dim, 11-1/2" lg, 5-3/8" wide, 3-3/36" high, filter incl; mounted by 6 tapped no. 8-32 holes; Collins Radio part/dwg #540 3612 005.	Power supply assembly	540 3612 005	
701-799 Series	PANEL, CONTROL: front; aluminum, zinc chromate primer, followed by pay semi glass enamel panel; c/o 3 capacitors, 7 switches, 1 variable attenuator, 5 connectors, 19 resistors, 3 meters, 1 Armature Relay and socket, 3 light indicators and sockets, and 11 knobs mounted to panel; rectangular shape, 19" lg, 10-15/32" w, 3-23/32" h approx over-all dim; silk screened w/ 700 Series symbols and controls information; mounts by eight 17/64" w x 25/64" lg holes, four ea end; Collins Rad part/dwg #540 3646 006.	Front panel	540 3646 006	
801-899 Series	PANEL, CONTROL: rear; aluminum, chromate dipped panel; c/o 1 motor and 1 fan, 2 electrical noise suppressors, 6 fuses in use w/ holders and 6 spare fuses, 2 connector receptacles, 1 motor cable and 1 filter line mounted to panel; rectangular shape; 17" lg, 9-7/8" wide, 4-5/32" h approx over-all dim; mounts by 12 tapped no. 6-32 mounting holes spaced around edge of panel; silk screened w/ 800 Series symbols; Collins Rad part/dwg #540 3682 005.	Rear panel	540 3682 005	
801-899 Series	CHASSIS: main chassis for RF oscillator; aluminum, chromate dipped chassis; (cont.)	Main frame chassis	540 3550 006	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
801-899 Series (cont.)	c/o 1 capacitor, 2 transformers, 1 interconnecting main cable, 1 power supply cable, 1 oscillator output cable, 1 terminal board, 1 connector receptacle, 1 band change switch and accom hardware mounted to chassis; w/ one partition; 17-1/4" lg, 14" wide, 10-1/16" h approx over-all dim; Collins Rad part/dwg #540 3550 006.			
	ABSORBER, shock: tube support springs; berylco; 0.003 in. thk, 2-1/4" lg x 1" wd x 0.055" h; corrugated; Collins Rad part/dwg #506 7315 002.	Support for V 001 and V 002	506 7315 002	
0165	ADAPTER, shaft: type 303 SS; one slot 1/32" wd x .187 in. d; one groove 3/64" wd x 0.156" dia; 7/16" dia x 3/16" thk o/a; one 6-40 NF-2 tapped hole in center; Collins part/dwg #540 3333 002.	S-103 sleeve	540 3333 002	
0187 0188	ARM: clutch; type 302 SS; 3.109" lg x 1/4" wd x 0.031 in thk; two 0.125" dia holes, one on ea end; Collins part/dwg #540 3313 002.	Speed change clutch arm Speed change clutch arm	540 3313 002	
AT701	ATTENUATOR, variable: "T" network; impedance 600 ohms/600 ohms SS, plain or brass nickel pl. case, 2-1/16" lg x 2-11/32" dia; shaft 1/4" dia x 15/16" lg from case; attenuation per step 2.0 db except last step 60 db min; 30 steps; cont spacing 11.25°; two #8-32 NC-2 tapped mtg holes on 3/4" centers; Davenco type #T-732-G; Collins Rad part/dwg #378 0325 00.	Audio input level control	378 0325 00	

0127 0131 0136 0140	**BEARING**, ball: single row, angular; plain; light duty 0.380" od x 0.125" wd; 8 balls; 1/16" dia; bronze retainer; flat races; gnd thrust; Nice #6256; Collins Rad part/dwg #309 0222 00.	Thrust collar bearing Clutch thrust bearing Course pos. clutch bearing C P clutch bearing	309 0222 00	
0113 0114 0151 0152 0169 0170	**BEARING**, sleeve: shaft; porous bronze; 11/64" lg x 15/32" OD x 0.251" ID; Chrysler type #F-346; Collins Rad part/dwg #309 0086 00.	BS gear train - (A-107) BS gear train - (A-108) OSC shaft bearing (A-107) OSC shaft bearing (A-108) Cam shaft bearing (A-107) Cam shaft bearing (A-108)	309 0086 00	2Z581-103
0162	**BEARING**, sleeve: shaft; porous bronze; 11/64" lg x 15/32" OD x 0.1885" ID; Chrysler type #F-347; Collins Rad part/dwg #309 0079 00.	S-103 bearing (A-108)	309 0079 00	2Z581-135
0163	**BEARING**, sleeve: shaft; porous bronze; 0.141" lg x 5/16" OD x 0.126" ID; Chrysler type #F-219; Collins Rad part/dwg #309 0131 00.	S-103 bearing (A-109)	309 0131 00	
B802	**BLADE**, fan: aluminum, anodized, CW, std hub, 4" dia x 11/16" deep, 2, 10-32 NF-2 set screws, Torrington Mfg Co., type #0-429-4; Collins Rad part/dwg 009 1173 00.	Cooling of 0-152	009 1173 00	3H-345-5
TB802	**BOARD**, terminal: barrier type; 14 single screw type terms, 7/16" c to c w/barrier; Mica filled phenolic type MFE ins; 6-7/8" lg x1-1/8" wd x 15/16" thk o/a; brass, nickel plated screws and double eyelet;(cont.)	Mod. lines input	367 0573 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
TB802 (cont.)	brass hot tinned dipped, solder terms; Jones H B type #141; Collins Rad part/dwg 367 0573 00.			
TB803 TB804	BOARD, terminal: barrier type; 14 double screw terms, 3/8" c to c w/barriers; Micro-filled phenolic type MFE inc; 5-7/8" lg x 7/8" wd x 3/8" thk o/a, brass, Nickel plated term; Jones H B type #140; Collins Rad part/dwg #367 0520 00.	Freq. control lines input Freq. control lines input	367 0520 00	
0184	BOLT, machine: sq. hd; type 303 steel; 8-32 NC-2 thd; 7/16" min lg; 23/32" lg; 1/4" sq hd; 0.1259" dia hole in ctr; Collins Rad part/dwg #540 3312 002.	Speed change clutch arm bearing	540 3312 002	
E131 E132 E133 E134	BRUSH SET, electrical contact: replaceable electrical contact brushes; carbon; 2 electrical contact brushes Collins Rad part/dwg #234 0190 00; ea brush 5/16" lg x 0.122" w x 0.1550" h; ea brush w/ 11/16" lg wire lead; 60 mv contact resistance drop at 2 amp; Collins Rad part/dwg #540 3936 001.	Brush set for B-102 and B-103	540 3936 001	
E135 E136	BRUSH SET, electrical contact: replaceable electrical contact brushes; carbon henrite grade 2885-B; 2 electrical contact brushes Collins Rad part/dwg #234 0270 00; ea brush 1/4" lg x 1/8" w x 1/8" h; ea brush w/ 1" wire lead; used on Diehl FD6-21 27-1/2 v miniature DC permanent magnet motor; Collins Rad part/dwg #540 3937 001.	Brush set for G101	540 3937 001	
0150	BUSHING: bearing thimble; type 302 steel; 0.500" OD x 0.357" ID x 0.135" thk; Collins part/dwg #540 3329 002	Osc. shaft brg thimble (A-108)	540 3329 002	

0161	BUSHING: bearing thimble; type 303 SS; 7/16" OD x 0.3139" ID x 0.093" thk; Collins part/dwg #540 3332 002.	S-103 bearing thimble (A-109)	540 3332 002	
XF801A XF802A XF803A XF804A XF805A XF806A	COVER: for extractor post fuse holder w/ test hole in knob; phenolic type CFG; approx 5/8" lg x 0.690" dia; Littlefuse Inc., no. 342003-SA-2; Collins Rad part/dwg #265 1043 00.	Fuse holder cap	265 1043 00	
C002	CAPACITOR, fixed: ceramic metal cup; 565 mmf +1% tol; 500 vdc; pf 0.1% max; 3/4" lg x 3/4" dia; hermetically sealed brass case; 1 radial, 1 axial solder lug term; mtg by 6-32 NC-2 stud 9/32" lg; Collins Rad part/dwg #913 1788 00.	Osc tank capacitor	913 1788 00	
C003 C004 C374 C377	CAPACITOR, fixed: ceramic; 10 mmf ± 1.0 mmf tol; 500 vdc; 0 ± 30 PPM/°C; 0.520" lg; x 0.395" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0043 00. (p/o Capacitor Kit). * This capacitor chosen per operational requirements of Oscillator 70 H-4. **This capacitor chosen per operational requirements of Discriminator.	T C tank trimmer* T C tank trimmer* Tank compensating** Tank compensating**	913 0043 00	3D9010-186
C003 C004 C374 C377	CAPACITOR, fixed: ceramic; 10 mmf ± 1.0 mmf tol; 500 vdc; -200 ±15% PPM/°C; 0.520" lg; x 0.395" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0044 00. (p/o Capacitor Kit). *This capacitor chosen per operational requirements of Oscillator 70 H-4. ** This capacitor chosen per operational requirements of Discriminator.	T C tank trimmer* T C tank trimmer* Tank compensating** Tank compensating**	913 0044 00	3D9010-170

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
C003 C004	CAPACITOR, fixed: ceramic; 10 mmf ±1.0 mmf tol; 500 vdc; -400 ± 15% PPM/°C; 0.520" lg; x 0.203" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0045 00. (p/o Capacitor Kit). * This capacitor chosen per operational requirements of Oscillator 70 H-4.	T C tank trimmer* T C tank trimmer*	913 0045 00	3D9010-187
C003 C004 C374 C377	CAPACITOR, fixed: ceramic; 10 mmf ±1.0 mmf tol; 500 vdc; -600 ±15% PPM/°C; 0.520" lg; x 0.203" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0046 00. (p/o Capacitor Kit). *This capacitor chosen per operational requirements of Oscillator 70 H-4. ** This capacitor chosen per operational requirements of Discriminator.	T C tank trimmer* T C tank trimmer* Tank compensating** Tank compensating**	913 0046 00	3D9010-173
C003 C004	CAPACITOR, fixed: ceramic; 10 mmf ±1.0 mmf tol; 500 vdc; -800 ±15% mmf/mf/°C; .520" lg x .203" wd x 3/32" thk; 2 axial wire lead term 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0047 00. (p/o Capacitor Kit). *This capacitor chosen per operational requirements of Oscillator 70 H-4.	T C tank trimmer* T C tank trimmer*	913 0047 00	3D9010-172
C003 C004 C374 C377	CAPACITOR, fixed: ceramic; 10 mmf ±1.0 mmf tol; 500 vdc; -1000 ±15% mmf/mf/°C; .520" lg x .230" wd x 3/32" thk; 2 axial wire lead term 1-1/2" lg; Centralab to Collins Rad part/dwg #913 0048 00. (p/o Capacitor Kit). *This capacitor chosen per operational requirements of Oscillator 70 H-4. **This capacitor chosen per operational requirements of Discriminator.	T C tank trimmer* T C tank trimmer* Tank compensating** Tank compensating**	913 0048 00	3D9010-217

C003 C004	CAPACITOR, fixed: ceramic; 10 mmf +1.0 mmf tol; 500 vdc; -1200 +15% mmf/mf/°C; .520" lg x .203" wd; x 3/32" thk; 2 axial wire lead term 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0049 00. (p/o Capacitor Kit). *This capacitor chosen per operational requirements of Oscillator 70 H-4.	T C tank trimmer* T C tank trimmer*	913 0049 00	3D9010-169
C003 C004	CAPACITOR, fixed: ceramic; 10 mmf + 1.0 mmf tol; 500 vdc; -1400 +15% mmf/mf/°C; .520" lg x .203" wd x 3/32" thk; 2 axial wire lead term 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0050 00. (p/o Capacitor Kit). *This capacitor chosen per operational requirements of Oscillator 70 H-4.	T C tank trimmer* T C tank trimmer*	913 0050 00	3D9010-174
C005	CAPACITOR, fixed: ceramic; CC30CH200J; 20 mmf +5% tol; temp coef 0 PPM/°C pos tol 60 PPM/°C; 500 vdc; 0.460" lg x 0.240" dia; 2 radial wire lead term; uninsulated; Collins Rad part/dwg #928 4188 00.	Osc. grid coupling	928 4188 00	3D9020-37
C111 C176	CAPACITOR, fixed: ceramic; CC20CH050C; 5.0 mmf +1/4 mmf tol; 500 vdc; temp coef 0 PPM/°C pos tol 60 PPM/°C; 0.400" lg x 0.200" dia; 2 radial wire lead term; Collins Rad part/dwg #916 0117 00.	Coupling cap. from Z-101 to V102 Output coupling	916 0117 00	
C121 C132 C149 C173	CAPACITOR, fixed: ceramic dielectric; CC20CK020C; 2.0 mmf + 1/4 mmf tol; 500 vdc; 0 mmf/mf/°C + 250 PPM/°C; 0.400" lg x 0.200" dia; 2 radial wire lead term; Collins Rad part/dwg #916 0075 00.	Z103 to Z104 coupling Z105 to Z106 coupling Neutralization feed-back Coupling		

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
C131	CAPACITOR, fixed: ceramic; 5 mmf ±.5 mmf tol; 500 vdc; -1200 ±15% PPM/°C; 0.520" lg; x 0.203" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0041 00.	Z105 temp compensating	913 0041 00	
C148	CAPACITOR, fixed: ceramic; CC20CH040C; 4.0 mmf ± 1/4 mmf tol; 500 vdc; temp coef 0 PPM/°C pos tol 60 PPM/°C; .400" lg x 0.200" dia; 2 radial wire leads term; Collins Rad part/dwg #916 0113 00.	Neutralization Feedback	916 0113 00	
C179	CAPACITOR, fixed: ceramic, Feed-thru type, high K dielectric; 1000 mmf, Guan. min tol; 500 vdc; 15/32" lg x .443 dia; uninsulated; 3 solder lug terms spaced at 120° rad; Centralab type #906; Collins Rad part/dwg #913 1476 00.	RF line filter	913 1476 00	
C180		RF line filter		
C181		RF line filter		
C182		RF line filter		
C183		RF line filter		
C184		RF line filter		
C185		RF line filter		
C186		RF line filter		
C187		RF line filter		
C188		RF line filter		
C801		Emission lines filter		
C802		Emission lines filter		
C803		Emission lines filter		
C804		Emission lines filter		
C805		Emission lines filter		
C806		Emission lines filter		
C807		Emission lines filter		
C808		Emission lines filter		
C809		Emission lines filter		
C810		Emission lines filter		
C811		Emission lines filter		
C812		Emission lines filter		
C813		Emission lines filter		
C814		Emission lines filter		

C815 C816 C817 C818 C819 C820 C821 C822 C823 C824		Emission lines filter Emission lines filter Emission lines filter Emission lines filter Emission lines filter Emission lines filter Emission lines filter Emission lines filter Emission lines filter Emission lines filter		
C316	CAPACITOR, fixed: ceramic; CC20RK010D; 1.0 mmf +1/2 mmf; Neg temp coef 220 PPM/°C pos tol ±250 PPM/°C; 500 vdc; 0.400" lg x 0.200" diam; 2 radial wire lead term; uninsulated; Collins Rad part/dwg #928 0029 00.	Limiter test point coupling	928 0029 00	
C370 C371	CAPACITOR, fixed: ceramic; 5 mmf +.5 mmf tol; 500 vdc; 0 + 30 PPM/°C; 0.520" lg x 0.203" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0035 00.	Input capacitor Input capacitor	913 0035 00	
C374 C377	CAPACITOR, fixed: ceramic; 5 mmf +.5 mmf tol; 500 vdc; 0 + 30 PPM/°C; 0.520" lg x 0.203" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0035 00. (p/o Capacitor Kit). *This capacitor chosen per operational requirements of Discriminator.	Tank compensating* Tank compensating*	913 0035 00	
C372 C375	CAPACITOR, fixed: ceramic; 540 mmf ±2% tol; 500 vdc; Neg temp coef 0 min, 60 max; 3/4" lg x 3/4" dia; 1 axial, 1 radial lug term; mtg by 6-32 NC-2 thd stud 9/32" lg; uninsulated; Herlec Corp type B01; Collins Rad part/dwg #913 0922 00.	Tank capacitor Tank capacitor	913 0922 00	
C374 C377	CAPACITOR, fixed: ceramic; 5 mmf ±.5 mmf tol; 500 vdc; -200 ±15% PPM/°C; (cont.)	Tank compensating Tank compensating	913 0036 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
C374 C377 (cont.)	0.520" lg; x 0.203" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0036 00. (p/o Capacitor Kit). This capacitor chosen per operational requirements of Discriminator.			
C374 C377	CAPACITOR, fixed: ceramic; 5 mmf ±.5 mmf tol; 500 vdc; -1000 ±15% PPM/°C; 0.520" lg; x 0.203" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0040 00. (p/o Capacitor Kit). This capacitor chosen per operational requirements of Discriminator.	Tank compensating Tank compensating	913 0040 00	
C374 C377	CAPACITOR, fixed: ceramic; 20 mmf ±1.0 mmf tol; 500 vdc; 0 ±30 PPM/°C; 0.520" lg; x 0.395" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0051 00. (p/o Capacitor Kit). This capacitor chosen per operational requirements of Discriminator.	Tank compensating Tank compensating	913 0051 00	
C374 C377	CAPACITOR, fixed: ceramic; 20 mmf ±1.0 mmf tol; 500 vdc; -200 ±15% PPM/°C; 0.520" lg; x 0.395" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated Centralab to Collins Rad part/dwg #913 0052 00. (p/o Capacitor Kit). This capacitor chosen per operational requirements of Discriminator.	Tank compensating Tank compensating	913 0052 00	
C374 C377	CAPACITOR, fixed: ceramic; 20 mmf ±1.0 mmf tol; 500 vdc; -1000 ±15% PPM/°C; 0.520" lg; x 0.395" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0056 00. (p/o Capacitor Kit). This capacitor chosen per operational requirements of Discriminator.	Tank compensating Tank compensating	913 0056 00	

C377	CAPACITOR, fixed: ceramic; 5 mmf ±.5 mmf tol; 500 vdc; -1600 ±15% PPM/°C; 0.520" lg; x 0.203" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0222 00. (p/o Capacitor Kit). This capacitor chosen per operational requirements of Discriminator.	Tank compensating	913 0222 00	
C377	CAPACITOR, fixed: ceramic; 10 mmf ±1.0 mmf tol; 500 vdc; -2400 +15% PPM/°C; 0.520" lg; x 0.203" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0231 00. (p/o Capacitor Kit). This capacitor chosen per operational requirements of Discriminator	Tank compensating	913 0231 00	
C377	CAPACITOR, fixed: ceramic; 20 mmf ±2.0 mmf tol; 500 vdc; -2000 ±15% PPM/°C; 0.520" lg; x 0.395" wd x 3/32" thk; 2 axial wire lead terms 1-1/2" lg; insulated; Centralab to Collins Rad part/dwg #913 0234 00. (p/o Capacitor Kit). This capacitor chosen per operational requirements of Discriminator.	Tank compensating	913 0234 00	
C509 C601	CAPACITOR, fixed: dry-electrolytic, JAN type #CE42C160Q, dual sect, 16-16 mf, 400 v DC, -40°C to +85°C, 2-1/4" h x 1-3/8" diam, 3 solder lug terms, Collins Rad part/dwg #184 3086 00.	B+ filter Bias input filter	184 3086 00	
C510 C511	CAPACITOR, fixed: dry-electrolytic, JAN type #CE41C221G, single sect, 220 mf, 50 v DC, -40°C to +85°C, 2-1/4" h x 1-3/8" diam 2 solder lug terms, Collins Rad part/dwg #184 2002 00.	Mike line filter (28v) Mike line filter (28v)	184 2002 00	
C602	CAPACITOR, fixed: dry-electrolytic, JAN type #CE42C400K, dual sect, 40-40 mf, 200 v DC, -40°C to +85°C, 2-1/4" h x 1-3/8" diam, 3 solder lug terms, Collins Rad part/dwg #184 3032 00.	Bias output filter	184 3032 00	
C603	CAPACITOR, fixed: dry-electrolytic, JAN type #CE41C751G, single sect, 750 mf, (cont.)	28 v DC filter	184 2001 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
C603 (cont.)	50 v DC, -40°C to +85°C, 4-1/4" h x 1-3/8" diam, 2 solder lug terms; Collins Rad part/dwg #184 2001 00.			
C604	CAPACITOR, fixed: dry-electrolytic, JAN type #CE42C450Q, dual sect, 45 mf, 400 v DC, -40°C to +85°C, 4-1/4" h x 1-3/8" diam, 3 solder lug terms; Collins Rad part/dwg #184 0004 00.	HV filter	184 0004 00	
C177	CAPACITOR, fixed: electrolytic; 1 sect; 40 mf -10% +100% tol; 50 v DC at 125°C, 60 v DC at +85°C; oper temp -55°C to +125°C, 1/2" lg x 7/8" dia; tantalum foil; 2 solder lug terms, 1 neg; Mallorytype #XT; Collins Rad part/dwg #184 7061 00.	Time constant for motor delay	184 7061 00	
C347 C503	CAPACITOR, fixed: electrolytic, 1 sect, 4 mf, -15% +50%, 60 v DC, 31/64" lg x 5/16" diam, -55°C to +85° C, 2 wire lead terms, Fansteel Metallur, type #PP4B60-A2; Collins Rad part/dwg #184 7000 00.	RF coupling Cathode bypass	184 7000 00	
C412 C501	CAPACITOR, fixed: electrolytic; 1 sect; 40 mf -10% +100% tol; 50 v DC at 125°C, 60 v DC at +85°C; oper temp -55°C to +125°C; 1/2" lg x 7/8" dia; tantalum foil; 1 solder lug term; Mallory type #XT; Collins Rad part/dwg #184 7060 00.	Rectifier smoothing Cathode bypass	184 7060 00	
C704	CAPACITOR, fixed: electrolytic, 1 sect, 15 mf -15% +50%, 15 v DC, -55°C to +85°C, 31/64" lg x 15/16" diam, 2 wire lead terms, Fansteel Metallur, type #PP15B5A2; Collins Rad part/dwg #184 7005 00.	Mike input coupling	184 7005 00	

C007	CAPACITOR, fixed: mica dielectric; 51 mmf ±5% tol; 500 vdc; molded case; 33/64" lg x 19/64" wd x 3/16" thk; 2 radial wire lead terms 1-1/4" min lg; Electro Motive type #605; Collins Rad part/dwg #912 0473 00.	Coupling Osc. output	912 0473 00	
C009 C013	CAPACITOR, fixed: mica dielectric; 100 mf ±2% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0493 00.	Screen bypass, reactance tube Plate coupling RT	912 0493 00	
C011	CAPACITOR, fixed: mica dielectric; 200 mmf ±5% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0515 00.	Grid bypass, RT	912 0515 00	
C012	CAPACITOR, fixed: mica dielectric; 75 mmf ±5% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0485 00.	Phase shift	912 0485 00	3D9075-51
C015	CAPACITOR, fixed: mica dielectric; 10 mmf, ±10% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire leads 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0431 00.	Grid phase shift RT	912 0431 00	
C103 C114 C124 C125 C136 C301 C324	CAPACITOR, fixed: mica dielectric; 330 mmf ±10% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0531 00.	Coupling Coupling Neutralization bridge Coupling Coupling RF coupling RF coupling	912 0531 00	3D9330-32
C107	CAPACITOR, fixed: mica dielectric; 270 mmf ±5% tol; 500 vdc; 33/64" lg x 19/64" (cont.)	Band #2 tank	912 0524 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13(cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
C107 (cont.)	wd x 3/16" thk; 2 axial wire lead term 1-1/4"lg; Electro Motive type #605; Collins Rad part/dwg #912 0524 00.			
C110	CAPACITOR, fixed: mica dielectric; 56 mmf ±2% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0475 00.	Tank cap Z101	912 0475 00	
C112	CAPACITOR, fixed: mica dielectric; 39 mmf ±2%; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term, 1-1/4" min lg; Electro Motive type #605; Collins Rad part/dwg #912 0463 00.	2102 tank cap	912 0463 00	
C120 C170	CAPACITOR, fixed: mica dielectric; 15 mmf ±5% tol; 500 vdc; 33/64" lg x 19/34" wd x 3/16" thk; 2 axial wire lead terms 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0437 00.	Z103 tank cap Z117 "L" cap	912 0437 00	
C135 C169	CAPACITOR, fixed: mica dielectric; 150 mmf ±5% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0506 00.	Neutralization bridge Z117 "L" cap	912 0506 00	3D9150-92
C140 C143 C311 C414	CAPACITOR, fixed: mica dielectric; 510 mmf ±2% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0544 00.	Neutralization bridge and decoupling Coupling RF coupling Paracitic suppressor	912 0544 00	3D9510-30

C145	CAPACITOR, fixed: mica dielectric; 2400 mmf ±20% tol; 500 vdc; .465" lg x .463" dia; brass, silver pl; 2 solder lug terms, 1 on top, 1 on end; mtg by 3-48 NC-2, 1/8" d tapped hole; Sangamo type #M72; Collins Rad part/dwg #912 0738 00.	Screen bypass	912 0738 00	
C147	CAPACITOR, fixed: mica dielectric; CM30B222K; 2200 mmf ±10% tol; 500 vdc; 53/64" lg x 53/64" wd x 9/32" thk; molded case; 2 wire lead term 1-1/8" lg; Collins Rad part/dwg #935 4067 00.	Output coupling	935 4067 00	3K3022221
C152	CAPACITOR, fixed: mica dielectric; 270 mmf ±2%; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead terms, 1-1/4" min. lg; Electro Motive type #605; Collins Rad part/dwg #912 0523 00.	Z-108 "Pl" cap	912 0523 00	
C153 C154 C155 C156 C160 C161 C164	CAPACITOR, fixed: mica dielectric; 510 mmf ±1% tol; 300 vdc; temp coef 0 ±40 PPM/°C; 33/64" lg x 19/64" wd x 3/16" thk, molded case; 2 axial wire lead term 1-1/8" lg; Electro Motive type #605; Collins Rad part/dwg #912 1007 00.	Z109 "L" cap Z109 "L" cap Z109 "L" cap Z109 "L" cap Z111 "L" cap Z111 "L" cap Z113 "L" cap	912 1007 00	
C157	CAPACITOR, fixed: mica dielectric; 240 mmf ±2% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0520 00.	Z109 "L" cap	912 0520 00	
C159	CAPACITOR, fixed: mica dielectric; 120 mmf ±2% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0499 00.	Z110 cap ("Pl")	912 0499 00	
C162	CAPACITOR, fixed: mica dielectric; 180 mmf ±2% tol; 500 vdc; 33/64" lg x 19/64" (cont.)	Z111 "L" cap	912 0511 00	3D9180-38

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
C162 (cont.)	wd x 3/16" thk; 2 axial wire leads 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0511 00.			
C166	CAPACITOR, fixed: mica dielectric; 220 mmf ±2% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0517 00.	Z115 "L" cap	912 0517 00	
C167	CAPACITOR, fixed: mica dielectric; 33 mmf ±2% tol; 500 vdc; 33/64" lg x 19/64" wd 3/16" thk; 2 wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0457 00.	Z115 "L" cap	912 0457 00	
C171	CAPACITOR, fixed: mica dielectric; 24 mmf ±5%; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term, 1-1/4" min lg; Electro Motive type #605; Collins Rad part/dwg #912 0449 00.	Z112 "Pl" cap	912 0449 00	3D9024-74
C305 C307	CAPACITOR, fixed: mica dielectric; 470 mmf ±1% tol; 300 vdc; temp coef +40 PPM/°C; 33/64" lg x 19/64" wd x 3/16" thk; molded case; 2 axial wire lead term 1-1/8" lg; Electro Motive type #605; Collins Rad part/dwg #912 1006 00.	I F primary tuning I F secondary tuning	912 1006 00	
C306	CAPACITOR, fixed: mica dielectric; 12 mmf ±5% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead terms 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0434 00.	I F coupling	912 0434 00	

C308	CAPACITOR, fixed: mica dielectric; 100 mmf $\pm$5% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0494 00.	R F coupling	912 0494 00	3D9100-294
C312	CAPACITOR, fixed: mica dielectric; 68 mmf $\pm$2% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire lead term 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0481 00.	Harmonic filter	912 0481 00	
C321	CAPACITOR, fixed: mica dielectric; 5 mmf, $\pm$10% tol; 500 vdc; 33/64" lg x 19/64" wd x 3/16" thk; 2 axial wire leads 1-1/4" lg; Electro Motive type #605; Collins Rad part/dwg #912 0429 00.	R F coupling	912 0429 00	
C504	CAPACITOR, fixed: mica dielectric; 51 mmf $\pm$2% tol; 500 vdc; $\pm$100 PPM/^{o}C max temp coef; 33/64" lg x 19/64" wd x 3/16" thk; molded case; 2 axial wire lead terms 1-1/4" min lg; Electro Motive type #605; Collins Rad part/dwg #912 0472 00.	Pre-emphasis coupling between stages	912 0472 00	
C701	CAPACITOR, fixed: mica dielectric; CM30E332J; 3300 mmf $\pm$5% tol; 500 vdc; -20 to +100 PPM/^{o}C; cap drift $\pm$0.1% + 0.1 mmf; 53/64" lg x 53/64" wd x 9/32" thk; molded case; 2 wire lead term 1-1/8" lg; Collins Rad part/dwg #935 4250 00.	Modulation canceling	935 4250 00	
C006 C008 C014	CAPACITOR, fixed: paper dielectric; .01 mf $\pm$20% tol; 300 vdc; HS metal case; 3/4" lg x .235" dia; high-temp impr; 2 axial wire leads 1-1/2" lg; both ends floating; Sprague type #96P10303S4; Collins Rad part/dwg #931 2556 00.	Osc. screen bypass Decoupling B bypass Filament bypass	931 2556 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
C010	CAPACITOR, fixed: paper dielectric; .0022 mf ±20% tol; 200 vdc; HS metal case; 3/4" lg x .235" dia; high-temp impr; 2 axial wire lead terms 1-1/2" lg; both ends floating; Sprague type #96P22202S4; Collins Rad part/dwg #931 2512 00.	Cathode bypass, react tube	931 2512 00	
C101	CAPACITOR, fixed: paper dielectric; .01 mf ±20% tol; 400 vdc; HS metal case; 11/16" lg x .400" dia; high-temp impr; 1 axial wire lead term 1-1/2" lg; 1 end gnded; Sprague type #86P10304S5; Collins Rad part/dwg #931 0639 00.	Screen bypass	931 0639 00	
C102		Decoupling		
C117		Screen bypass		
C128		Screen bypass		
C139		Screen bypass		
C146		Decoupling		
C104	CAPACITOR, fixed: paper dielectric; .01 mf ±20% tol; 400 vdc; HS metal case; 11/16" lg x .235" dia; high-temp impr; 2 axial wire lead terms 1-1/2" lg; 1 end gnded connections; Sprague type #86P10304S1; Collins Rad part/dwg #931 0509 00.	Cathode bypass		
C116		Cathode bypass		
C127		Cathode bypass		
C138		Cathode bypass		
C189		R F filter		
C190		R F filter		
C191		R F filter		
C309		Meter bypass		
C322		Cathode bypass		
C326		Cathode bypass		
C327		R F filter		
C381		Thermostat suppressor		
C403		Phase shifter		
C407		Phase shifter		
C105	CAPACITOR, fixed: paper dielectric; .01 mf ±20% tol; 400 vdc; HS metal case; 11/16" lg x .235" dia; high-temp impr; 2 axial wire lead term 1-1/2" lg; one gnd connections; Sprague type #86P10304S1; Collins Rad part/dwg #931 0547 00	Screen bypass	931 0547 00	3DA10-588
C106		Decoupling		
C118		Decoupling		
C129		Decoupling		
C142		Cathode bypass		
C144		Cathode bypass		

C172 C174 C175 C178 C303 C323 C325		Filter Screen bypass Decoupling Filter 180 V line Screen bypass Screen bypass B plus decoupling		
C201 C203 C702	CAPACITOR, fixed: paper dielectric; .10 mf ±20% tol; 100 vdc; HS metal case; 7/8" x 0.312" dia; high-temp impr; 2 axial #22 AWG wire lead term 1-1/2" lg; No int gnd connections; Sprague type #96P10401S2; Collins Rad part/dwg #931 0404 00.	Arc suppressor Arc suppressor Transit suppressor	931 0404 00	3DA100-1089
C302 C342	CAPACITOR, fixed: paper dielectric; .10 mf ±20% tol; 200 vdc; HS metal case; 13/16" lg x .400" dia; high-temp impr; 1 axial wire lead term 1-1/2" lg; one end gnded; Sprague type #86P10402S5; Collins Rad part/dwg #931 0607 00.	Cathode bypass R F filter	931 0607 00	
C304 C310 C315	CAPACITOR, fixed: paper dielectric; .10 mf ±20% tol; 400 vdc; HS metal case; 1-5/16" lg x .400" dia; high-temp impr; 1 axial wire lead term 1-1/2" lg; 1 end gnded; Sprague type #86P10404S5; Collins Rad part/dwg #931 0645 00.	B plus decoupling Screen bypass Limiter tank bypass	931 0645 00	
C328	CAPACITOR, fixed: paper dielectric; .01 mf ±20% tol; 200 vdc; HS metal case; 3/4" lg x 0.235" dia; high-temp impr; 2 axial #22 AWG wire lead term 1-1/2" lg; no int gnd connections; Sprague type #96P10302S2; Collins Rad part/dwg #931 0417 00.	R F coupling	931 0417 00	
C344	CAPACITOR, fixed: paper dielectric; .22 mf ±20% tol; 100 vdc; HS metal case; 1-1/8" lg x 0.400" dia; high-temp impr; 2 axial #20 AWG wire lead term 1-1/2" lg; no int (cont.)	R F coupling	931 0406 00	3DA220-32

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
C344 (cont.)	gnd connections; Sprague type #96P22401S2; Collins Rad part/dwg #931 0406 00.			
C345 C408 C507	CAPACITOR, fixed: paper dielectric; 22 mmf ±20% tol; 300 vdc; HS metal case; 1-1/8" lg x .562" dia; high-temp impr; 2 axial #20 AWG wire lead term 1-1/2" lg; no int gnd connections; Sprague type #96P22403S2; Collins Rad part/dwg #931 0444 00.	R F coupling Coupling to output tube V U meter ampl. output coupling	931 0444 00	
C346	CAPACITOR, fixed: paper dielectric; 1.00 mf ±20% tol; 300 vdc; HS metal case; 2-1/8" lg x .750" dia; high-temp impr; 2 axial #20 AWG wire lead term 1-1/2" lg; no int gnd connections; Sprague type #96P10503S2; Collins Rad part/dwg #931 0448 00.	R F coupling	931 0448 00	
C378 C379 C380	CAPACITOR, fixed: paper dielectric; .001 mf ±20% tol; 100 vdc; HS metal case; 11/16" lg x .175" dia; high-temp impr; 2 axial wire lead term 1-1/2" lg; one gnd connection; Sprague type #86P10201S1; Collins Rad part/dwg #931 0484 00.	Load filter Load filter Load filter	931 0484 00	
C401	CAPACITOR, fixed: paper dielectric; .047 mf ±20% tol; 100 vdc; HS metal case; 7/8" lg x .312" dia; high-temp impr; 2 axial #22 AWG wire lead term 1-1/2" lg; no int gnd connections; Sprague type #96P47301S2; Collins Rad part/dwg #931 0402 00.	Input coupling	931 0402 00	
C402 C405	CAPACITOR, fixed: paper dielectric; .10 mf ±20% tol; 300 vdc; HS metal case; 1-1/8" lg x .400"dia; high-temp impr; 2 axial #20 AWG wire lead term 1-1/2" lg; no int gnd	Coupling to second stage Coupling to third stage	931 0442 00	

C409 C410	connections; Sprague type #96P10403S2; Collins Rad part/dwg #931 0442 00.	Coupling to output tube Coupling to output tube		
C404 C406 C508	CAPACITOR, fixed: paper dielectric; 1.00 mf ±20% tol; 300 vdc; HS metal case; 2-1/16" lg x .750"dia; high-temp impr; 1 axial wire lead term 1-1/2" lg; one end gnded; Sprague type #86P10503S5; Collins Rad part/dwg #931 0632 00.	B+ decoupling B+ decoupling B+ filter	931 0632 00	
C411	CAPACITOR, fixed: paper dielectric; 22 mf ±20% tol; 400 vdc; HS metal case; 1-3/8" lg x .562" dia; high-temp impr; 2 axial #20 AWG wire lead term 1-1/2" lg; no int gnd connections; Sprague type #96P22404S2; Collins Rad part/dwg #931 0463 00.	Output phase correction	931 0463 00	3DA220-28
C413	CAPACITOR, fixed: paper dielectric; .15 mf ±20% tol; 400 vdc; HS metal case; 1-1/8" lg x .562" dia; high-temp impr; 2 axial #20 AWG wire lead term 1-1/2" lg; no int gnd connections; Sprague type #96P15404S2; Collins Rad part/dwg #931 0462 00.	Cathode coupling for scan voltage	931 0462 00	
C502 C505	CAPACITOR, fixed: paper dielectric; .01 mf ±20% tol; 400 vdc; HS metal case; 3/4" lg x .235" dia; high-temp impr; 2 axial #22 AWG wire lead term 1-1/2" lg; no int gnd connections; Sprague type #96P10304S2; Collins Rad part/dwg #931 0455 00.	Coupling between stages Coupling to V U ampl.	931 0455 00	3DA10-648
C506	CAPACITOR, fixed: paper dielectric; .047 mf ±20% tol; 400 vdc; HS metal case; 7/8" lg x .400" dia; high-temp impr; 2 axial #20 AWG wire lead term 1-1/2" lg; no int gnd connections; Sprague type #96P47304S2; Collins Rad part/dwg #931 0459 00.	Audio output coupling	931 0459 00	3DA47-34

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
C605	CAPACITOR, fixed: paper dielectric; .1 mf ±10% tol; 400 vdc; pf 2% for 1000 cyc at 25°C; molded phenolic case; 1-1/2" lg x 1/2" dia; wax impr; 2 axial wire lead term 2" lg; no int gnd connections; Sprague type 67P; Collins Rad part/dwg #931 0299 00.	Control tube grid filter	931 0299 00	3DA100-961
C825	CAPACITOR, fixed: paper dielectric; 1.0 mf ±10% tol; 400 vdc; HS metal can; 2-15/64" lg x 1-5/16" wd x 41/64" d excl term; mineral oil impr; 2 solder lug term; no int gnd connections; accom mtg bkt; Sangamo type #60; Collins Rad part/dwg #930 0204 00.	Fan motor phasing cap	930 0204 00	3DB1-373
C150	CAPACITOR, fixed: tubular ceramic; CC20CK0R5C; 0.5 mmf ±1/4 mmf tol; 500 vdc; 0 PPM/°C temp coef, ±250 PPM/°C positive tol; 0.400" lg x 0.200" dia; 2 radial wire lead term; 1-1/4" min x 0.032" or 0.025" dia wire; uninsulated; Collins Rad part/dwg #916 0067 00.	Neutralization feedback	916 0067 00	309000.5-1
	CAPACITOR KIT: c/o capacitors, qty 1 ea of Collins Rad part/dwg #'s 913 0043 00 thru 913 0050 00, symbols C-004 and qty of 1 ea of Collins Rad part/dwg #'s 913 0051 00 thru 913 0058 00, symbols C-003. *These capacitors chosen per operational requirements of 70H-4 Oscillator; Collins Rad part/dwg #540 3932 002.	Oscillator Capacitor Kit*	540 3932 002	
	CAPACITOR KIT: c/o capacitors, qty 2 ea of Collins Rad part/dwg #'s 913 0035 00, 0043 and 0051, symbols C-374 and C-377, qty 1 ea of Collins Rad part/dwg #'s 913 0036 00,	Discriminator Capacitor Kit**	540 3933 002	

	0044, 0046, 0048, 0056, 0222, 0231 and 0234, symbols C-377 and qty 1 of Collins Rad part/dwg #913 0052 00, symbol C-374; **These capacitors chosen per operational requirements of Discriminator; Collins Rad part/dwg #540 3933 002.			
C373 C376	CAPACITOR, variable: ins adj core; 1.0 to 8.0 mmf; 500 vdc; 1-29/32" lg min cap; 1-13/32" max cap x 11/32" dia; 1 rigid wire lead 1" lg; ins, glass; mtg by 1/4-32 NEF-2 bushing; Corning Glass #682063; Collins Rad part/dwg #922 0150 00.	Tank trimmer Tank trimmer	922 0150 00	
C108 C109 C113 C119 C123 C130 C134 C141 C151 C158 C163 C165	CAPACITOR, variable: ceramic; rotary, 1 sect; 8 to 50 mmf; 350 vdc; 0 mmf/mf/°C; 15/64" lg x 1/2" dia less mtg fl; 2 solder lug term; mtg by two 0.120" dia holes in fl spaced 5/16" mtg c; scdr slot adj; phenolic base; Erie type #557; Collins Rad part/dwg #917 1038 00.	Band #2 tank trimmer Z101 trimmer Z102 trimmer Z103 trimmer Z104 trimmer Z105 trimmer Z106 trimmer Z107 trimmer Z108 trimmer Z110 trimmer Z112 "Pl" trimmer Z114 "Pl" cap	917 1038 00	3D9050V-117
C115 C126 C137 C313	CAPACITOR, variable: ceramic; rotary; 1 sect 5 to 25 mmf; 350 vdc; 0 mmf/mf/°C; 15/64" lg x 1/2" dia less mtg fl; 2 solder lug term; mtg by two 0.120" diam holes in fl spaced 5/16" mtg/c; scdr slot adj; phenolic base; Erie type #557; Collins Rad part/dwg #917 1036 00.	Grid trimmer Grid trimmer Grid trimmer Limiter tank trimmer	917 1036 00	3D9025V-93
C168	CAPACITOR, variable: ceramic; rotary, 1 sect; 3 to 12 mmf; 350 vdc; 0 mmf/mf/°C; 15/64" lg x 1/2" dia less mtg fl; 2 solder lug term; mtg by two 0.120" dia (cont.)	Z116 "Pl" trimmer	917 1035 00	3D9012V-25

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
C168 (cont.)	holes in fl spaced 5/16" mtg/c; scdr slot adj; phenolic base; Erie type #557; Collins Rad part/dwg #917 1035 00.			
L003	COIL, RF: choke; universal wnd, 3 pie, 50 turns ea, spaced 1/32" of #36 AWG; unshielded; 100 uh ±15% at 25 MC, nom cur rating 25 ma DC; 5/8" lg x 5/16" dia max; mtg, 2 axial #20 AWG tinned leads 1-3/8" lg; Collins Rad part/dwg #240 0089 00.	B+ decoupling	240 0089 00	
G301	CHOPPER: electromechanical, modulation or demodulation single ph 10-500 cps; input power 18.0 V RMS ±10% at 45 ma RMS; HS metal case; 8 terms; 2-5/16" lg x 1.010 inch diam excl term; Stevens Arnold Inc. type CH-#364 (Mod); Collins Rad part/dwg #354 1017 00.	Modulator disc output	354 1017 00	
H112	CLAMP: bottom capacitor mtg; plastic laminated paper; moisture and fungus resistant varnish; 1-1/2" lg x 21/32" wd x 1/2" h o/a; four 0.120" dia holes spaced 1.187" x 0.343" mtg/c; Collins Rad part/dwg #540 3303 002.	Clamp for C177	540 3303 002	
H113	CLAMP: top capacitor mtg; plastic laminated paper; moisture and fungus resistant varnish; 1-1/2" lg x 21/32" wd x 9/16" h; two 0.120" dia holes spaced diagonally; Collins Rad part/dwg #540 3302 002.	Clamp for C177	540 3302 002	
O003 O116 O156	CLAMP: shaft coupling; extruded aluminum 75 ST 6; anodized; w/ one 6 flute socket head cap screw w/ tapped #4-40 NC-2 sq nut;	B.S. coupler clamp w/screw	540 3931 001	

0172	0.664" dia x 0.200" thk; 0.116" dia mtg hole to accom screw; 0.312" dia mtg shaft hole; Collins Rad part/dwg #540 3931 001.			
0147	CLUTCH; friction: centrifugal; #303 SS; consists of retaining shell and drive pin; 61 teeth, 96 pitch; .6354 PD output gear and driven disk; driving disk and flat washer; plastic weight spacing disk and copper tension washer; centrifugal hub; #440 SS ball bearing 3/32" dia; shim washer; 0.812" dia x 9/16" lg; Collins Rad part/dwg #540 3336 002.	Centrifugal clutch	540 3336 002	
L301 L302	COIL, IF: choke; single wnd; universal wnd; unshielded; 455 KC; 126 turns of #40 AWG Litz wire; 0.406" lg x 7/16" dia; plastic form; mts in half shell; two 1-1/4" lg wire leads; Collins Rad part/dwg #506 6016 002.	I F transformer primary I F transformer secondary	506 6016 002	
L125 L126	COIL, relay: electromagnetic; laminated phenolic ins; corrosion resistant metal; 26.5 V DC nom, 32.0 V DC max oper voltage, 50 ohms $\pm 10\%$ resistance; $-55^{\circ}C$ to $+85^{\circ}C$ ambient oper temp; Auto Elec to Collins Rad part/dwg #410 0102 00.	Speed change clutch Course position clutch	410 0102 00	
L001	COIL, RF: Single winding, single layer wnd, 28 turns of #30 and #32 AWG copper wire; unshielded; tuning coil; 2" lg x 1.125" dia o/a; phenolic form; mtg by three 0.125" dia holes spaced 0.756" x 0.655" mtg/c; 2 wire term soldered to studs and 1 wire tapped; Collins Rad part/dwg #506 2710 002.	Oscillator tank	506 2710 002	
L002	COIL, RF: 3 turns, 60TPl, #30 AWG wire; unshielded; tuning coil; 18.2 MC and 22.6 MC; powdered iron and brass core; ceramic coil form; 1-3/16" lg x 25/64" dia; (cont.)	Oscillator trimmer	506 4522 002	

3. Identification Table of Parts for Radio Frequency Oscillator 0-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
L002 (cont.)	plate mtd by two 0.124" dia holes spaced 0.768" c to c; wire lead term; Collins Rad part/dwg #506 4522 002.			
L004	COIL, RF: choke; single wnd, 3 pie wnd, 225 turns ea of #40 AWG; unshielded; 2.0 uh ±10% at 350 KC; resonates with 100 mmf cap. at 350 KC ±20 KC; 1/2" lg x 3/8" dia; mtg, 2 axial wire leads 1-3/8" lg; Mepco to Collins Rad part/dwg #240 0084 00.	R T plate load	240 0084 00	3C357-95
L101	COIL, RF: choke; single wnd, 4 pie wnd, 60 turns ea of #30 AWG; unshielded; 400 uh at 1 MC, 3 mmf cap; 1-11/16" lg x 3/8" dia o/a; powdered iron core; mtg, 2 axial #16 AWG tinned leads; Sickle type FW; Collins Rad part/dwg #240 0023 00.	250 V line filter	240 0023 00	
L110		180 V line filter		
L127		180 V line filter		
L801		Mod line filter		
L802		Mod line filter		
L803		Mod line filter		
L804		Mod line filter		
L805		Mod line filter		
L806		Mod line filter		
L807		Mod line filter		
L808		Mod line filter		
L809		Mod line filter		
L810		Mod line filter		
L811		Mod line filter		
L812		Mod line filter		
L102	COIL, RF: choke; universal wnd, 3 pie section, 65 turns ea, 3/32" wd spaced 1/32" apart of #36 AWG; 170 mh nom, resonates at 1.2 MC with 100 uuf ±5%, 55 min. at 1.2 MC; 1/2" lg x 0.280" dia; powdered iron core; mtg, 2 axial #22 AWG tinned leads 1-3/8" lg; Collins Rad part/dwg #240 0140 00.	Buffer plate load	240 0140 00	

L107 L108	COIL, RF: choke; 19.0 turns 16.89 TPI; solid CU,DE no 24 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic laminated paper; 2 wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3165 002.	Z105 tank Z106 tank	540 3165 002	
L103 L104	COIL, RF: choke; 49.5 turns at 44.0 TPI; solid CU,DE no 26 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic laminated paper; two wire lead term 1" lg vacuum impregnated form; Collins Rad part/dwg #540 3164 002.	Z101 tank Z102 tank	540 3164 002	
L105 L106	COIL, RF: choke; 32.5 turns 28.89 TPI; solid CU, DE no 24 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic laminated paper; two wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3176 002.	Z103 tank Z104 tank	540 3176 002	
L109	COIL, RF: choke; 9.0 turns, 8.0 TPI; solid CU, DE no 28 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic laminated paper; 2 wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3175 002.	Z107 tank	540 3175 002	
L111 L112 L303	COIL, RF: choke; universal wnd, 4 pie of 139 $\pm$2 turns ea, sect 1/8" wd spaced 1/16" apart of #36 AWG; unshielded; apparent inductance 2.0 mh nom at 350 KC, 80 nom at 350 KC; 3/4" lg x 3/4" dia; mtg, 2 axial #19 AWG tinned leads 1-1/2" lg; Electro Assemblies, Inc to Collins Rad part/dwg #240 0134 00.	Plate load Decoupling Limiter plate choke	240 0134 00	
L113	COIL, RF: choke; 61.5 turns, 54.6 TPI;solid CU, DE no 28 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic (cont.)	Z108 "Pl" Net	540 3174 002	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
L113 (cont.)	laminated paper; 2 wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3174 002.			
L114	COIL, RF: choke; 36.5 turns, 32.4 TPI; solid CU, DE no 26 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic laminated paper; 2 wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3166 002.	Z109 - "L" Net	540 3166 002	
L115	COIL, RF: choke; 42.5 turns; 37.808 TPI; solid CU, DE no 24 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic laminated paper; 2 wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3169 002.	Z110 pl Net	540 3169 002	
L116	COIL, RF: choke; 28.0 turns, 24.9 TPI; solid CU, DE no. 28 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic laminated paper; 2 wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3170 002.	Z111 "L" Net	540 3170 002	
L117	COIL, RF: choke; 30.5 turns; 27.083 TPI; solid CU, DE no 28 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic laminated paper; 2 wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3167 002.	Z112 "Pl" Net	540 3167 002	
L118	COIL, RF: choke; 19.5 turns, 17.3076 TPI; solid CU, DE no 28 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic	Z113 - "L" Net	540 3168 002	

	laminated paper; 2 wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3168 002.			
L119	COIL, RF: choke; 21.0 turns, 18.66 TPI; solid CU, DE no 24 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic laminated paper; 2 wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3172 002.	Z114 "Pl" Net	540 3172 002	
L120	COIL, RF: choke; 14.0 turns, 12.43 TPI; solid CU, DE no 28 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic laminated paper; 2 wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3171 002.	Z115 "L" Net	540 3171 002	
L121	COIL, RF: choke; 14.0 total turns, 4.0 at 14 TPI, 6.0 at 18 TPI, 4.0 at 16 TPI; solid CU, DE no 26 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic laminated paper; 2 wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3177 002.	Z116 "Pl" Net	540 3177 002	
L122	COIL, RF: choke; 9.5 turns, 8.45 TPI; solid CU, DE no 28 ft wire; unshielded; 1-11/16" lg x 0.460" dia o/a; plastic laminated paper; 2 wire lead term 1" lg; vacuum impregnated form; Collins Rad part/dwg #540 3173 002.	Z117 "L" Net	540 3173 002	
L128 L129	COIL, RF: choke; single winding, 3 layer wnd, 78 turns #22 AWG annealed copper wire; unshielded; 100 uh; 1" lg x 13/32" dia excl term; powdered iron core 1" lg x 1/4" dia; two #16 AWG tinned copper wire lead term; Collins Rad part/dwg #540 3251 002.	Filament filter Filament filter	540 3251 002	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
L370 L371	COIL, RF: toroid inductor; single layer, close wnd 209 ± 5 turns of #38 AWG; unshielded; 206 mh nom at 600 KC, 90 nom at 600 KC; 11/16" OD x 3/8" ID x 0.187" thk; powdered iron core, Stackpole G-5; two 2 in. min tinned leads; Lenkurt Elec Co to Collins Rad part/dwg #240 0139 00.	Tank coil Tank coil	240 0139 00	
O153	COLLAR: locking; steel; 11/16" OD x 0.2500" ID x 7/32" thk; Centerbore to 0.515" dia x 0.040" d; one slot 0.109" wd x 0.125" d; Collins Rad part/dwg #540 3307 002.	Mech. limit collar	540 3307 002	
O126	COLLAR, shaft: clutch thrust; #303 SS; round; 7/16" OD x 0.192" ID x 21/64" thk; 2 slots 0.033" wd x 0.125" d; spaced 0.250" apart; Collins Rad part/dwg #540 3306 002.	Actuator link	540 3306 002	
O135	COLLAR, shaft: clutch thrust; #303 SS; round; 3/8" OD x 0.192" dia x 1/8" thk; 1 slot 0.125" wd x 0.062" d; Collins Rad part/dwg #540 3309 002.	Actuator link	540 3309 002	
O111 O112 O149 O160 O167 O168	COLLAR, spacing: bearing thimble; #302 SS round, 1/2" OD x 0.357" ID x 0.150" thk; fits in 0.377" dia mtg hole; Collins Rad part/dwg #507 5618 001.	BS gear train (A107) BS gear train (A108) Osc. gear bearing (A107) S103 bearing thimble (A108) Cam shaft thimble (A107) Cam shaft thimble (A108)	507 5618 001	

J103 J104 J106 J301 J702 J817	CONNECTOR, receptacle: female 7 cont, rd, pol; straight type; 9/16" across flats of hex x 11/32" dia excl term; 5 amps, 500 v AC RMS; rd phenolic body; plastic MFE ins; brass, silver pl conts; mtg by 1/2-20UNF-2A thd; Amphenol to Collins Rad part/dwg #372 1124 00.	R F ampl. power 28 v DC motor power 70 H-4 M.O. power Disc. power connector Reactance tube lines jack Fan motor power mates P806	372 1124 00	
J803	CONNECTOR, receptacle: female; 34 cont, rd, straight type; 2" lg x 3/4" wd x 23/64" h less guide pins; cur rating, 3 amps; rectangular melamic body; bronze silver pl term; four mtg holes to pass #4 screw spaced on 1.687" x 15/32" mtg/c; incls 2 pol guide pins; Winchester Electronics Inc. #MRE34S-G; Collins Rad part/dwg #372 1047 00.	Freq control lines to gear plate mates with P101	372 1047 00	
P001 P372	CONNECTOR, plug: male, 1 cont, rd; straight type; RF; cylindrical shape, metal, silver pl, locking type, 31/32" lg x 9/16" dia; teflon insert; 0.212" dia cable opening; use w/ RG-58 and RG-58A/U RF cable; Collins Rad part/dwg #357 9143 00.	Osc. R F connector R F input connector	357 9143 00	
P101	CONNECTOR, plug: male, 34 cont, straight type; 2" lg x 3/4" wd x 23/64" h less guide pins and cont; 3 amp cur rating; rectangular melamic ins; four mtg holes to pass #4 screws spaced on 1.687" x 15/32" mtg/c; incls 2 pol guide pins; brass silver pl term; Winchester Electronics Inc. #MRE34P-G; Collins Rad part/dwg #372 1048 00.	Osc. Pos. info	372 1048 00	
P102 P202 P401	CONNECTOR, plug: male, 15 cont, rd; straight type; 1-1/2" lg x 3/4" wd x 0.320" h excl terms and conts; cur rating, 3 large conts 0.093" dia 15 amps, 12 small (cont.)	Gear plate power Relay chassis motor circuits Servo amp power input	372 1079 00	2Z3035-31

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
P501 (cont.)	conts 0.040" dia 5 amps; brass conts; rectangular, phenolic ins, mtg by 2 hole 0.156" dia #6 screw spaced 1.188" c to c; Amphenol type #26-151; Collins Rad part/dwg #372 1079 00.	Audio ampl. power		
P105	CONNECTOR, plug: UG-88/U; male, 1 cont, round; straight type; RF, 52 ohms nom impedance; cylindrical shape, metal, bayonet locking, 1-1/32" lg x 0.563" dia; teflon insert; 0.206" cable opening; Amphenol type UG-88/U. Collins Rad part/dwg #357 9018 00.	R F ampl. VFO input	357 9018 00	
P801		Spectrum ampl output (Used on W804 mates J101)		
P802		R F ampl 50 v output (Used on W805, mates J102)		
P803		455 KC input to I F ampl. (Used on W801 mates J302)		
P804		Output from 60 v chopper (Used on W802 mates J304)		
P805		Input to Servo ampl. (Used on W802 mates J401)		
P201	CONNECTOR, plug: male, 11 conts, rd; straight type; 1.171" lg x 0.750" wd x 0.406" h excl term and conts; cur rating large conts 15 amps, small conts 5 amps; 500 v AC; rectangular, phenolic ins; brass conts, 2 at 0.093" dia, 9 at 0.040" dia; mtg by two holes 0.125" dia, 0.864" c to c; Amphenol #26-804; Collins Rad part/dwg #372 1074 00.	Relay chassis power	372 1074 00	2Z3031-10
P301	CONNECTOR, plug: male 20 conts, rd, straight type; 1.937" lg x 3/4" wd x 13/32" h; small 5 amps, large 15 amps, 500 v AC;	I F amp. power input	372 1069 00	2Z3072-7
P601		Power plug		

P-601 (cont.)	rectangular, phenolic ins; mtg by 2 holes 1/8" dia, 1.620" c to c; brass cont, 4 at 0.093" dia, 16 at 0.040" dia; Amphenol #26-806; Collins Rad part/dwg #372 1069 00.			
E130 E311 E312 E313 E314 E611 E612 E613 E614 E701 E702 E703	CONNECTOR, receptacle: female, 1 cont, rd; straight type; used w/ 0.081" dia male cont; 29/32" lg x 3/8" dia o/a; molded nylon ins; beryllium copper, silver pl cont; incls lockwasher and mtg nut 1/8" thk; color white; Johnson EF #105-601-1; Collins Rad part/dwg #360 0061 00.	R.T. grid test point Test point, output limiter Test point, output disc. Test point, mod cancel Test point, pin 7, V305 Test point, DC filament Test point, Reg. V Test point, H. V. Test point, Bias Test point, mod circuits Test point, mod circuits Test point, Ref. voltage plus 5.5 v	360 0061 00	
J101 J102 J302 J303 J304 J401	CONNECTOR, receptacle: UG-290/U; male, 2 cont, rd; polarized, straight type; cylindrical, phenolic, locking type, 1-1/16" x 11/16" wd x 11/16" h o/a; teflon insert; 0.348" cable opening; mtg, metal fl w/ four #3-56 JF-2 holes 1/2" x 1/2" mtg/c; Collins Rad part/dwg #357 9054 00.	Spectrum amp. output R F output 455 KC input Limiter output Chopper output Servo error input jack	357 9054 00	2Z7390-290
J107 J801 J804	CONNECTOR, receptacle: female, 15 conts rd; straight type; 1-1/2" lg x 3/4" wd x 15/32" h; cont ratings large cont 15 amps, small conts 5 amps, 500 v AC; rectangular, phenolic ins; mtg by 2 holes 0.156" dia spaced 1.188" c to c; copper term; (cont.)	Motor control circuit Audio ampl. power mates with P501 Gear plate power mates with P102		

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
J806 (cont.)	silver pl; Amphenol #26-150; Collins Rad part/dwg #372 1081 00.	Servo ampl. power mates with P-401		
J701	CONNECTOR, receptacle: female; 10 cont, audio, rd; straight type; 1.197" lg x 1.286" dia; molded thermosetting plastic type MFE ins; #303 SS shell; brass, silver pl contacts; for water proof applications; Amphenol, #164-7; Collins Rad part/dwg #369 1014 00.	Mike input receptacle	369 1014 00	
J802 J807	CONNECTOR, receptacle: female, 20 cont, rd; straight type; 1-15/16" lg x 3/4" wd x 13/32" h; small 5 amps, large 15 amps, 500 v AC; rectangular, phenolic ins; mtg by 2 holes 1/8" dia, 1.620" c to c; copper cont; 4 conts at 0.093" dia, 16 conts at 0.040" dia; Amphenol #26-807; Collins Rad part/dwg #372 1071 00.	I F ampl. power mates with P301 Pwr. rectifier recep. mates with p601	372 1071 00	2Z3081-10
J808	CONNECTOR, receptacle: female, 11 conts, rd; straight type; 1-11/64" lg x 3/4" wd x 15/32" h; cur rating 2 large conts 0.093" dia, 5 amps, 9 small conts 0.040" dia 15 amps, 500 v AC; rectangular, phenolic ins; mtg by 2 holes 1/8" dia, 0.864" c to c; Amphenol #26-805; Collins Rad part/dwg #372 1076 00.	Relay sub assy power mates with P201	372 1076 00	
J809	CONNECTOR, receptacle: male, 4 no. 12 conts, rd, pol; straight type; 1-9/32" lg x 1-1/2" dia; cylindrical, brass, cad pl; locking; plastic ins; cont rating 20 amps at 230 v AC, 35 amps at 115 v AC; brass, silver pl conts; mtg by 1-1/4-18 NEF-2A thd; waterproof; Winchester Electronics	A C power mates with CX1358/U	372 1109 00	

J809 (cont.)	Corp. type #R4S; Collins Rad part/dwg #372 1109 00.			
J810	CONNECTOR, receptacle: female, 4 no. 12 conts, rd, pol; straight type; 1-7/32" lg x 1-7/16" dia; cont rating 20 amps at 230 v AC, 35 amps at 115 v AC, 500 AC RMS; cylindrical, brass, cad pl; locking type; mtg by 1-1/4-18 NEF-2A thd; Amphenol #164-1; Collins Rad part/dwg #372 1110 00.	Recr. power mates with P902 on CX2405/U	372 1110 00	
J812	CONNECTOR, receptacle: UG-291/U; single, female, round; straight type; cylindrical, brass body threaded 3/8-32 NEF-2 for locking, 1-1/16" lg x 11/16" wd x 11/16" h o/a; teflon insert; 0.212" dia cable opening; metal mtg fl w/ four 3-56 NF-2 tapped holes on 1/2" x 1/2" mtg/c; Collins Rad part/dwg #357 9047 00.	455 KC input from Receiver I F (Used on W801 mates P910)	357 9047 00	
J813		Signal to recvr. ant. (used on W804 mates P908)		
J814		R F pwr 50 v output (Used on W805 mates P906)		
J815		R F ampl. input (Used on W803 mates P105)		
J816		R F output from VFO (Used on W803 mates P001)		
P002 P103 P104 P106 P371 P806	CONNECTOR, plug: male, 7 conts, rd, pol; straight type; 9/16" wd across flats of hex x 11/32" lg excl term; 5 amps, 500 v AC RMS; mica-filled phenolic insert; plastic type MFE ins; brass, silver plated cont; mtg by 1/2-20 UNF-2A thd; Amphenol 26-1059; Collins Rad part/dwg #372 1116 00.	Power connector R F ampl. power 2 fv DC motor power RT mod lines Power connector Fan motor power (mates J817)	372 1116 00	
E003	CORE, adjustable tuning; c/o ferrite type 1848 core, phosphor bronze insert w/ brass guide arm; 1-37/64" lg x 1-3/16" wide (cont.)	Frequency tuning	506 2723 003	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
E003 (cont.)	x 1.274" high; shaft mounted; Collins Rad part/dwg #506 2723 003.			
E112 E113 E114 E115 E116 E117 E118 E119 E121 E123 E125	CORE, adjustable tuning: powdered iron core, carbonyl HP side molded; 1-1/4" lg x 0.255" dia; mtg 0.2" lg bronze wire, crimped, spaded or coiled inserted in core and held in place by thermoset cement; core 3-1/4" lg incl spiral; Stackpole type #CF-7700; Collins Rad part/dwg #288 1095 00	Z101 tuning Z102 tuning Z103 tuning Z104 tuning Z105 tuning Z106 tuning Z107 tuning Z108 tuning Z110 tuning Z112 tuning Z114 tuning	288 1095 00	
E120 E122 E124 E126 E127 E128	CORE, adjustable tuning: powdered iron core, carbonyl E side molded; 1-1/4" lg x 0.255" dia; mtg 0.1-1/2" lg bronze wire, spaded, coiled or bent back, bonded to core with thermosetting cement; core 2-3/4" lg incl spiral; Aladdin type #560; Collins Rad part/dwg #288 1109 00.	Z109 tuning Z111 tuning Z113 tuning Z115 tuning Z116 tuning Z117 tuning	288 1109 00	
E316 E317	CORE, adjustable tuning: powdered iron core, carbonyl TH; 7/16" lg x 0.200" dia; threaded, silver pl insert with slotted end for screwdriver adj; molded into core 7/8" lg incl insert; Aladdin to Collins Rad part/dwg #288 1112 00.	Tuning adjustment for L301 Tuning adjustment for L302	288 1112 00	
E319 E320 E321 E322	CORE, adjustable tuning: powdered iron half shell; carbonyl TH; 0.562" OD x 0.241" ID x 0.187" thk; 2 groove 0.062" wd, freq. range 500 KC, cap 377 uuf; Aladdin to Collins Rad part/dwg #288 1113 00.	I F tank coil I F tank coil I F tank coil I F tank coil	288 1113 00	

0001	OSCILLATOR, SUBASSEMBLY: corrector bar assembly; c/o 94 SS type #302 curved spacers and 95 phosphorus bronze special spacers on SS type #303 adjusting screw in brass bracket mtd to aluminum post; 3.825" lg x 1/4" wd x 0.594" h o/a; mtd by two 0.096" dia holes in angle bracket; Collins Rad part/dwg #506 2704 002.	Linearity control	506 2704 002	
0002	COUPLING, rigid: split hub; 0.188" shaft size ea end; shaft mtg; 13/32" lg x 1-3/32" dia; 24S-T4 aluminum; incl type #7 groove pin for pinning to shaft; w/ four 0.032" wd slots equally spaced in hub; Collins Rad part/dwg #540 4063 002.	Oscillator coupling to gear train	540 4063 002	
0117 0173	COUPLING, rigid: split type; 0.125" dia shaft opening; compression mtd by clamp; 1" OD x 0.437" d; #303 SS; 4 slots 0.032" wd spaced at 90° apart; Collins Rad part/dwg #540 3315 002.	BS coupler Cam shaft coupler	540 3315 002	
0157	COUPLING, rigid: split type; 1/4" dia shaft opening; compression mtd by clamp; 1-3/32" OD x 0.468" d; 24ST4 aluminum, type #303 SS; 4 slots 0.032" wd spaced at 90° apart; Collins Rad part/dwg #540 3317 002.	Osc. coupler	540 3317 002	
A001 A103 A104 A106 A371 A801	COVER: for front and rear panel mt; 1-9/32" lg x 23/32" dia; brass, nickel pl; mica filled phenolic type MFE ins; mtg by 2 clamps; incls, cable clamp and locking sleeve; Amphenol type #26; Collins Rad part/dwg #372 1115 00.	Hood for P002 Cover for P103 Cover for P104 Cover for P106 Hood for P371 Cover and lock ring for P806	372 1115 00	
A101	COVER: connector; for 34 cont plug; aluminum; anodized and chromate sealed; 2-13/64" lg x 7/8" wd x 0.040" thk; mtg by 21/32" cable opening located in top; Winchester Electronics Ins MRE34H; Collins Rad part/dwg #372 1141 00	Cover for P101	372 1141 00	
A102 A202 A401 A501	COVER: connector; for 15 cont plug; aluminum, anodized chromate; 1-1/2" lg x 3/4" wd x 2-1/6" h o/a; mtg by two 6-32 NC-2 tapped holes spaced 1.188" c to c; 19/32" cable opening; Amphenol 26-932; Collins Rad part/dwg #372 1083 00.	Cover for P102 Cover for P202 Cover for P401 Cover for P501	372 1083 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
A201	COVER: connector; for 11 cont plug; aluminum, anodized and chromate sealed; 1.179" lg x 0.758" wd x 1-3/4" h o/a; mtg by two 4-40 NC-2 tapped holes spaced 0.864" c to c; 0.375" dia cable opening in top; Amphenol 26-947; Collins Rad part/dwg #372 1078 00.	Cover for P201	372 1078 00	
A301 A601	COVER: connector; for 20 cont plug; aluminum, anodized chromate; 1.945" lg x 0.758" wd x 2-1/16" h, o/a; mtg by two 4-40 NC-2 tapped holes spaced 1.620" c to c; 5/8" dia cable opening; Amphenol type 26-962; Collins Rad part/dwg #372 1073 00.	Cover for P301 Cover for P601	372 1073 00	
E372	NOT USED.			
E373	COVER: impact extruded, aluminum, plain, round, 4-15/16" lg x 3.000" OD x 2.900" ID; Alcoa to Collins Rad part/dwg #141 0198 00.	Oven cover	141 0198 00	
E323	COVER: crystal; c/o cover w/ mtg hdw; aluminum, chromate dipped cover; rectangular shape; 0.332" thk, 1.751" lg x 1.564" w x 1-1/8" h; incl SS type #303 screw and SS type #302 washer, hdw for mtg; silk screen w/ symbols CR301 and CR302; Collins Rad part/dwg #540 3934 001.	Cover for crystal I F amplifier	540 3934 001	
E802	COVER: fuse; c/o cover w/ mtg hdw; aluminum, chromate dipped cover; rectangular shape; 0.332" thk, 1.751" lg x 1.564" w x 1-1/8" h; incl SS type #303 screw and SS type #302 washer, hdw for mtg; Collins Rad part/dwg #540 3935 001	Spare fuse cover	540 3935 001	

CR301 CR302 CR401	CRYSTAL UNIT, rectifying: germanium crystal; 35 ma at 25°C, 4.0 ma forward cur at +1 V, 5.0 ma inverse cur at -5 V, 50 ma inverse cur at -50 V; temp range -50°C to +100°C; cylindrical body, 0.400" lg x 0.175" dia; 2 axial wire leads, 1" min lg x 0.021" dia; Raytheon type #IN67; Collins Rad part/dwg #353 0113 00.	Bridge rectifier Bridge rectifier AFC relay current rectifier	353 0113 00	
F801 F805 F806	FUSE, cartridge: glass enclosed, 1-1/4" lg x 1/4" dia; 3AG 2.00 amps, 250 v, 0.07 ohm; 10,000 amps at rated voltage DC; brass nickel pl. ferrules; Littlefuse #3AG; Collins Rad part/dwg #264 4070 00.	AC line AC line 28 volt line	264 4070 00	3Z260-226
F802	FUSE, cartridge: glass enclosed, 1-1/4" lg x 1/4" dia; 0.250 amps, 250 v, 3.275 ohms, 10,000 amps at rated voltage DC; brass nickel pl. ferrules; Littlefuse #3AG; Collins Rad part/dwg #264 4020 00.	180 v regulated line	264 4020 00	3Z2587
F803	FUSE, cartridge: glass enclosed, 1-1/4" lg x 1/4" dia; 0.500 amps, 250 v, 1.4 ohms; 10,000 amps at rated voltage DC; brass nickel pl. ferrules; Littlefuse #3AG; Collins Rad part/dwg #264 4030 00.	20 v AC servo line	264 4030 00	
F804	FUSE, cartridge: glass enclosed, 1-1/4" x .250" dia; 10 amp, 32 v, .014 ohms; blowing time, 110% life, 135% 0-1 hr, 300% 6 secs min; ferrule, brass nickel pl.; Littlefuse #4AG; Collins part/dwg #264 0011 00.	6.3 v filament	264 0011 00	
E005 E370 E371	GASKET: "O" ring, synthetic rubber, 3/8" OD x 1/4" ID x .070" thk, Goshen, type #6227-23; Collins Rad part/dwg #013 0248 00.	Trimmer seal Trimmer seal Trimmer seal	013 0248 00	
E374	GASKET: circular, synthetic rubber, 2-5/8" OD x 2-1/4" ID x .210" thk, Goshen type #AN-6227-34; Collins Rad part/dwg #200 0237 00.	O - ring head seal	200 0237 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
E382 E383 E384 E385 E386 E387 E388	GASKET: circular, synthetic rubber, 7/32" OD x 3/32" ID x .070" thk, Precision Rubber Prod. Co. type #90234; Collins Rad part/dwg #200 0233 00.	Feed-thru seal Feed-thru seal Feed-thru seal Feed-thru seal Feed-thru seal Feed-thru seal Feed-thru seal	200 0233 00	
E004	GASKET: syn rubber; single hole, 2-1/8" dia; round shape; 2-3/8" OD, 0.139" dia matl; color coded; Precision Rubber Prod. Co., #909-5; Collins Rad part/dwg #200 0219 00.	Head seal	200 0219 00	
O-101	GEAR: spur type; #303 SS; straight teeth; 27 teeth; 96 pitch, .2812 PD; 5/16" OD x 1/8" ID x 0.296" thk; 3/8" OD x 0.187" ID x 3/16" thk hub, #303 SS; mtg by two 4-48 NF-2 holes at 120°; Collins Rad part/dwg #540 3352 002.	B103 gear	540 3352 002	
O115	GEAR: spur type; brass; straight teeth; 96 teeth; 48 pitch 2.000 PD; 2-1/8" lg x 2" dia; straight face; SS type #303 hub, 0.531" lg x 1/2" dia; mtg by SS type #303 shaft and SS type #420 pin; Collins Rad part/dwg #540 3364 002.	Reduction gear	540 3364 002	
O122	GEAR: spur type; #303 SS; straight teeth; 28 teeth; 96 pitch; .2917PD; 5/8" OD x 0.157" ID x 0.312" thk; straight face; 13/32" OD x 0.218" ID x 0.187" thk hub; mtg by two 4-48 NF-2 holes at 120°; Collins Rad part/dwg #540 3368 002.	B101 gear	540 3368 002	

0137	GEAR: spur type; brass; straight teeth; 90 teeth; 48 pitch; 1.8750 PD; 1-15/16" dia x 7/32" thk o/a; straight face; incls one bronze brg; one SS type 303 hub; mtg by 0.188" dia ctr hole; Collins Rad part/dwg #540 3380 002.	Clutch gear	540 3380 002	
0139	GEAR: spur type; SS type 303; straight teeth; 32 teeth 96 pitch; .3333 PD; straight face; incls one SS type 303 clutch plate; one bronze brg; 1-1/2" dia x 7/16" thk o/a; mtg by 0.1875" dia ctr hole; Collins Rad part/dwg #540 3384 002.	Clutch gear	540 3384 002	
0143	GEAR: spur type; SS type 303; straight teeth; 54 teeth 96 pitch; .5625 PD; 5/8" dia x 3/16" thk; straight face; 3/16" lg x 0.314" OD x 0.188" ID bronze brg; mtg by 0.188" ctr hole; Collins Rad part/dwg #540 3387 002.	Idler gear	540 3387 002	
0148	GEAR: spur type; type 303 SS; straight teeth; 22 teeth; 48 pitch; .4583 PD; 1/2" OD x 0.249" ID x 0.125" thk; straight face; 3/8" OD x 0.120" ID x 21/32" lg hub; mtg by two 4-48 NF-2 holes spaced at 120°; Collins Rad part/dwg #540 3349 002.	G101 gear	540 3349 002	
0171	GEAR: spur type; brass; straight teeth; 96 teeth; 48 pitch; 2.000 PD; 2" dia x 1-1/8" thk; straight face; SS type 303 hub; 0.531" lg x 1/2" dia; mtg by SS type #303 shaft and SS type 420 pin; Collins Rad part/dwg #540 3403 002.	Camshaft gear	540 3403 002	
0174	GEAR: spur type; plastic laminated fabric, brass; straight teeth; 96 teeth; 48 pitch; 2.000 PD; 2-1/32" OD x .186" ID x .526" thk; 5/8" dia x 0.526" thk brass shaft; gear pressed onto shaft; Collins Rad part/dwg #540 3407 002.	Limit switch gear	540 3407 002	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
O102	GEAR ASSEMBLY: consists of one 135 tooth, 96 pitch; 1.4063 PD, straight tooth brass gear; one 21 tooth, 48 pitch; .4375 PD straight tooth #303 SS gear; 1 bronze brg 1/4" lg x 0.251" OD x 0.187" ID; mtg by 0.187" dia shaft hole; Collins Rad part/dwg #540 3355 002.	Reduction gear	540 3355 002	
O105	GEAR ASSEMBLY: consists of one 82 tooth, 48 pitch; 1.7083 PD straight tooth, brass gear, one 25 tooth, 48 pitch, .5208 PD straight tooth #303 SS gear; 1 bronze brg 1/4" lg x .251" OD x .1875" ID; mtg by .1875" dia shaft hole; Collins Rad part/dwg #540 3358 002.	Reduction gear	540 3358 002	
O108	GEAR ASSEMBLY: consists of one 96 tooth, 48 pitch, 2.000 PD, straight tooth brass gear; one 24 tooth, 48 pitch, .5000 PD, straight tooth SS type #303 gear; 1 bronze brg 1/4" lg x 0.251" OD x 0.187" ID; mtg by 0.187" dia shaft hole; Collins Rad part/dwg #540 3361 002.	Reduction gear	540 3361 002	
O125	GEAR ASSEMBLY: consists of one 175 tooth, 96 pitch, 1.8229 PD, straight tooth LE plastic gear; one 33 tooth, 48 pitch, .6875 PD, straight tooth #303 SS gear; one bronze brg 3/8" lg x 0.251" OD x 0.187" ID; 1-7/8" dia x 13/32" thk o/a; mtg by 0.187" dia shaft hole; Collins Rad part/dwg #540 3371 002.	Servo reduction gear	540 3371 002	
O128	GEAR ASSEMBLY: consists of one 96 tooth, 48 pitch, 2.0000 PD, straight tooth LE plastic gear; one 38 tooth, 48 pitch, .7917	Clutch gear (top)	540 3374 002	

	PD, straight tooth #303 SS gear; one bronze brg 1/4" lg x 0.251" OD x 0.187" ID; 2-1/16" OD x 9/32" thk o/a; mtg by 0.187" dia shaft hole; Collins Rad part/dwg #540 3374 002.			
0130	GEAR ASSEMBLY: consists of one 96 tooth, 48 pitch, 2.0000 PD; straight LE plastic gear; one 24 tooth, 48 pitch, .5000 PD, straight tooth, #303 SS gear; 1-7/8" dia friction washer; one bronze brg 3/16" lg 0.314" OD x 0.188" ID; 2.0625" dia x 1/4" thk; mtg by 0.188" dia shaft hole; Collins Rad part/dwg #540 3377 002.	Clutch gear (bottom)	540 3377 002	
0146	GEAR ASSEMBLY: consists of one 157 tooth, 96 pitch, 1.6354 PD, straight tooth, LE plastic gear; one 31 tooth, 48 pitch, .6458 PD, straight tooth SS type #303 gear; 1 bronze brg 1/4" lg x 0.251" OD x 0.187" ID; 1-45/64" dia x 17/64" thk o/a; mtg by 0.187" dia shaft hole; Collins Rad part/dwg 540 3389 002.	Oscillator drive gear	540 3389 002	
0155	GEAR ASSEMBLY: consists of one 132 tooth, 48 pitch, 2.7500 PD straight tooth LE plastic gear; one 27 tooth, 48 pitch, .5625 PD, straight tooth SS type #303 gear; SS type #303 hub, .531" lg x 1-1/16" dia; mtg by SS type #303 shaft; Collins Rad part/dwg #540 3428 002.	Oscillator shaft gear	540 3428 002	
0158	GEAR ASSEMBLY: consists of one 90 tooth, 48 pitch, 1.875 PD, straight tooth brass gear; one 30 tooth, 48 pitch, .625 PD, straight tooth type 303 SS gear; 1 bronze brg, 1/4" lg x .251" OD x .1875" ID; 1-59/64 in. OD x 0.266 thk o/a; mtg by .1875" dia shaft hole; Collins Rad part/dwg #540 3397 002.	S103 drive gear	540 3397 002	

3. Identification Table of Parts for Radio Frequency Oscillator 0-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
0164	GEAR ASSEMBLY: consists of one 90 tooth, 48 pitch, 1.875 PD straight tooth brass gear; one 60 tooth, 48 pitch, 1.250 PD straight tooth #303 SS gear pressed on #303 SS shaft 1-1/32" lg x 0.186" dia; 13/32" dia x 1.031" thk o/a; Collins Rad part/dwg #540 3399 002.	S-103 shaft gear	540 3399 002	
XF801 XF802 XF803 XF804 XF805 XF806	HOLDER, fuse: extractor post type, test hole in knob with 1-1/4" x 1/4" fuse; phenolic, type CFG ins. brass, cad pl. term; 15 amps, 250 v; 1.672" lg x 0.690" dia o/a; mts with nut and internal tooth lockwasher; Littlefuse #342003; Collins Rad part/dwg #265 1023 00.	Holder for F801 Holder for F802 Holder for F803 Holder for F804 Holder for F805 Holder for F806		
	KNOB: bar; black #201, zinc alloy; single flatted shaft 0.257" dia; mts by one 8-36 multiple spline cap pt set screw; 3/4" lg x 15/16" dia o/a; 5/8" d shaft hole; Doehler-Jarvis Corp to Collins Rad part/dwg #281 0094 00.	Front panel control knobs	281 0094 00	
E801	KNOB: bar; black #201, zinc alloy; single flatted shaft 0.257" dia; mts by one 8-36 multiple spline cup pt set screw; 3/4" lg x 15/16" dia o/a; 5/8" d shaft hole; Doehler-Jarvis Corp to Collins Rad part/dwg #281 0093 00.	Line voltage selector sw. knob	281 0093 00	
I701 I702 I703	LAMP, incandescent: 6.3 v, 0.15 amp; bulb T-3-1/4 clear; 1-1/8" lg x 7/16" dia; miniature bayonet base; tungsten filament; GE type #47; Collins Rad part/dwg #262 3240 00.	Power indicator AFC indicator Disc. oven indicator	262 3240 00	

XI701A XI702A XI703A	LIGHT, indicator: w/o lens; for miniature bayonet base T-3-1/4 bulb; enclosed shell, dull black metal finish; 1-19/32" lg x 11/16" dia; 45/64" mtg hole; 2 solder lug term on base of socket; Dialco #88410-11; Collins Rad part/dwg #262 0109 00.	Power indicator holder AFC indicator body Oven indicator holder	262 0109 00	
XI701B	LIGHT, indicator: 1/2" dia, red lens; for miniature bayonet base, enclosed shell, dull black finish; 21/32" x 5/8" dia; mts by 9/16-27NS-2 thread in 45/64" hole; Dialco #88410-10; Collins Rad part/dwg #262 0110 00.	Line power indicator lens	262 0110 00	
XI702B	LIGHT, indicator: 1/2" dia, green lens; for miniature bayonet base, enclosed shell, dull black finish, 21/32" x 5/8" dia; mts by 9/16-27NS-2 thread in 45/64" hole; Dialco #88410-11; Collins Rad part/dwg #262 0112 00.	AFC indicator lens	262 0112 00	
XI703B	LIGHT, indicator: 1/2" dia, amber lens; for miniature bayonet base, enclosed shell, dull black finish, 21/32" x 5/8" dia; mts by 9/16-27NS-2 thread in 45/64" hole; Dialco #88410-11; Collins Rad part/dwg #262 0111 00.	Oven indicator lens	262 0111 00	
0182	LINK, arm: clutch coarse positioning; #302 SS; 0.0375 in. thk; 3-3/32" lg x 17/32" wd x 3/8" h; incls one 6-32 NC-2 self-locking nut; mtg by one 0.126" dia ctr hole; Collins Rad part/dwg #540 3414 002.	Arm from clutch to L126	540 3414 002	
0183	LINK, arm: interlock; #302 SS; 0.0375" thk, 1.4375" lg x 5/8" wd x 0.062" h; mtg by 6-32 NC-2 x 3/8" screw w/ SS hex nut, plain #6 split lock washer, #303 SS captive nut; Collins Rad part/dwg #540 3410 002.	Inter lock between clutches	540 3410 002	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
0181	LINK, lever: adjusting; type #303 steel; 3/4" lg x 1/4" dia o/a; 6-32 NC-2 thd 1 end 7/16" lg; Collins Rad part/dwg #540 3311 002.	Clutch arm adj post	540 3311 002	
0191	LINK, lever: clutch arm; type 303 SS; 11/16" lg x 1/4 in. dia o/a; 1/4" sq hd; 0.1253" dia hole thru ctr; Collins Rad part/dwg #540 3308 002.	Actuator link	540 3308 002	
M701	METER, ammeter: DC; 100-0-100 ma; 1-1/2" sq black anodized aluminum molded plastic case; barrel, 1.510" dia, d behind fl 1" max, fl 1-27/32" lg x 1-27/32" wd x 23/64" thk; accuracy ±3%; scale zero ctr w/ markings every 10 ma; self-aluminum markings; case type MR-13; pointer type, lance; mtg by four 0.125" dia holes spaced 1.312" c to c; 2 stud terms; Collins Rad part/dwg #476 0064 00.	FSK line current meter	476 0064 00	
M703	METER, ammeter: DC; 0-100 ma; 1-1/2" sq black anodize aluminum; barrel, 1.510" dia, d behind fl 1" max, fl 1-27/32" lg x 1-27/32" wd x 23/64" thk; accuracy ±3% scale 0, 10, 20, 30, and 50 w/ 4 minor markings, self luminous; case type MR15; pointer type, lance; mtg by four 0.125 dia holes spaced 1.312 c to c; 2 stud terms; Collins Rad part/dwg #476 0104 00.	Calibration indicator	476 0104 00	
M702	METER, audio level: AF, calibration, volume units (VU) 0 to 3 cw, 0 to -20 cw; 1-1/2" sq aluminum, steel or plastic case; 1.510" dia barrel, 1-27/32" sq mtg fl. 1" d	V U meter	481 0001 00	

	to mtg surface; accuracy ±3%; black self-luminous, pointer; requires external multiplier; four 0.125" dia holes spaced 1.312" c to c for mtg; 2 stud terms; Collins Rad part/dwg #481 0001 00.			
B101	MOTOR, AC: low inertia servo motor; 2 phase, 4 pole; moment of inertia 0.026" oz. in. 2; 20/20 v 60 cps ea phase; 1500 RPM min at no load; 5.0 w output; ambient temp -55°C to +85°C, continuous; single or dbl shielded ball brgs; Diehl #FPE21-15-1; Collins Rad part/dwg #230 0184 00.	Servo Motor	230 0184 00	
B801	MOTOR, AC: capacitor start; 1/300 at 3000 RPM, 60 cps; 2 pole; 115 v 50/60 cps nom; CCW rotation; 3 solder lugs on term board; motor load, axial fan blade 4" dia, 4 blade; Induction Motor Corp, type #BC-1615-2; Collins Rad part/dwg #230 0169 00.	Fan motor	230 0169 00	
B102 B103	MOTOR, DC: permanent magnet type; 1/100 hp nom. output, no load speed 21,000 RPM; closed frame; oper temp -55°C to +85°C, intermittent, on 5 sec, rw 5 sec, off 20 secs, repeat; 27.5 v DC nom, max input cur. 0.6 amp alt up to 50,000 ft; face mtg; sealed lub. ball brgs; Globe Ind. #C-3A-1113; Collins Rad part/dwg #230 0179 00.	Osc. position motor Bandswitch motor	230 0179 00	
G101	MOTOR, DC: permanent magnet type; No load, 10,000 to 14,000 RPM, oper, 10,000 RPM; closed frame; ambient temp -50°C to +85°C; continuous; 27.5 v DC nom, 0.21 amp nom input cur, 2.0 w max output; Alt. up to 50,000 ft; fixed mtg; shielded ball brgs; Delco Appco #506 8571; Collins Rad part/dwg #230 0182 00.	Rate generator	230 0182 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Z301	LOAD, plate: incls one 5-25 uuf var capacitor; one 100,000 ohm fixed resistor; one 2.0 mh at 350 KC RF filter coil, top and bottom limiter filter pl; 1-1/4" lg x 1" wd x 2-1/32" h o/a; terminal mtg; Collins Rad part/dwg #540 3499 003.	Limiter filter	540 3499 003	
HR372	OVEN: incls one 0.01 uf fixed capacitor; chromate dip cover; thermostatic switch; one #2 and three #4 term lugs; asbestos ins; 250 aluminum single and double ear clamps; 2 positioning term tabs; 3-1/16" lg x 2.616" dia o/a; Collins Rad part/dwg #540 4074 004.	Discriminator oven	540 4074 004	
N701	PLATE, identification: aluminum; 3-1/2" lg x 1" wd x 1/32" thk; inscribed, RF Oscillator O-152(XC-1)/URA-13; markings white on dull black; four mtg holes 0.096" dia; Collins Rad part/dwg #280 0960 00.	O-152/URA-13	280 0960 00	
E375 E376 E377 E378 E379 E380 E381	POST, binding: Kovar-Glass feed-thru; 0.437" above mtg surface, 0.120 in OD of post; 0.040" dia wire hole; eyelet and conductor tin pl; Stupakoff type #95.0096. Collins Rad part/dwg #306 0135 00.	Disc. head feedthru Disc. head feedthru Disc. head feedthru Disc. head feedthru Disc. head feedthru Disc. head feedthru Disc. head feedthru	306 0135 00	
L501	REACTOR: filter; 1 sect; 2 hy at 50 ma DC, 10V, 60 cy AC; 150 ohms at 25°C DC resistance; 50 ma rated wr; 1000 VRMS test; hermetically sealed case, 1-15/16" lg x 1-5/16" wd x 1-3/4" h excl term; 2 solder lug terms spaced 5/16" c to c located on	Mike line filter	678 0521 00	

	one side; mtg by two 6-32 studs diagonally spaced 3/4" x 3/4" mtg/C. Chi Trans type #17040; Collins Rad part/dwg #678 0521 00.			
L601	REACTOR: filter; 1 sect; 2 hy at 450 ma DC, 10V, 60 cyc AC; 35 ohms at 25°C DC resistance; 450 ma rated cur; 1000 V RMS test; hermetically sealed MIL type HA case, 3-1/16" lg x 2-5/8" wd x 4-1/4" h excl term; 2 solder lug term 1/2" c to c located on one side; mtg by four 8-32 studs spaced 2-19/64" x 1-55/64" mtg/C; Chi Trans type #16726; Collins Rad part/dwg #678 0522 00.	H. V. filter	678 0522 00	
L602	REACTOR: filter; 1 sect; 2 hy at 250 ma DC, 10V, 60 cyc AC; 35 ohms at 25°C DC resistance; 250 ma rated cur; 1000 V RMS test; hermetically sealed MIL type GB, 2-3/4" lg x 2-3/8" wd x 2-13/16" h excl term; 2 solder lug terms 5/16" c to c located on one end; mtg by four 6-32 NC-2A studs 2.125" x 1.750" mtg/c; Chi Trans type #16727; Collins Rad part/dwg #678 0523 00.	H. V. filter	678 0523 00	
CR601	RECTIFIER, metallic: selenium, single phase full wave bridge; nom input voltage 30.0 v AC 60 cps over temp range, nom output, 28.5 v DC at 650 ma DC; 750 mf cap load; rectangular, 6-1/8" lg x 1-5/16" wd x 1" h o/a; 3 solder lug terms; mts by two, 10-32 studs one on ea end; GE type #6RS5GA125; Collins Rad part/dwg #353 0124 00.	28 v full-wave rect	353 0124 00	
K201	RELAY, armature: 2A, DP normally open; 5 amp at 130 v AC; 3/32" min dia silver conts; single wnd; 115 v AC, 60 cps nom, 130 v AC, 60 cps max; coil resistance 450 ohms +15%; solder lug terms on coil and conts; 1-5/8" lg x 1-7/16" wd x 2-15/32" h o/a; (cont.)	A C power relay	974 0498 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
K201 (cont.)	mtg by three 6-32 NC-2A studs spaced 1.188" x 0.938" mtg/C; hermetically sealed case; Collins Rad part/dwg #974 0498 00.			
K202 K801	RELAY, armature: SPDT, magnetic latching, cont rating 50 ma at 25 v DC, silver; coil data, dual windings w/ damping winding, trip cur .63 to 2.1 ma DC, reversal cur, 10 to 60 ma DC, resistance oper 150 ohms ±15%, damping 20 ohms ±10%; solder lug term on coil and cont; 1-19/32" lg x 1-19/32" wd x 3-3/16" h o/a; plug in type mtg; high-speed pol, hermetically sealed used for keying relay; Sigma Instr type #7JO; Collins Rad part/dwg #408 1022 00.	CW keying relay FSK relay	408 1022 00	
K204 K205 K206 K207 K701	RELAY, armature: 1A, 1C, 2C; 1.0A at 27.5 v DC, 5.0A at 27.5 v DC; palladium conts 1/8" dia; single wnd; 27.5 v DC nom, 18 v DC max pull in; max oper 32 v DC; ins; solder lug term on coil and conts; 1.332" lg x 0.960" wd x 2.257" h o/a; mtg by two 4-40 NC-2 studs spaced diagonally; HS case; RBM Co type #H-SM; Collins Rad part/dwg #974 0344 00.	Recycle relay Reverse relay C.P. motor operates relay B.S. motor operate relay Mod. shorting relay	974 0344 00	
K208 K401 K402	RELAY, armature: 2C, DPDT; 2 amps at 28 v DC-115 v AC; silver conts; single wnd; max oper cur 9.0 ma DC continuous; 11.0 ma DC intermittent; ins; solder lug terms on coil and conts; 1" lg x 1" wd x 2" h o/a; mtg by two 4-40 NC-2 studs spaced 1/2" c to c; HS case; Sigma Instr type #22RJCC; Collins Rad part/dwg #974 0464 00.	C.P. motor delay Bond pass relay AFC indicator relay	974 0464 00	

K203	RELAY, thermal: normally closed; 6 amps at 115 v AC; silver conts 5/32" dia; single wnd, 90-125 v oper; solder lug term on coil and cont; 2-3/8" lg x 3/4" dia; plug in mtg, std 7 pin miniature base; time delay 15 +2 sec; G-v controls Inc type RM; Collins Rad part/dwg #402 0218 00.	A C power time delay	402 0218 00	
R001 R303 R351 R352 R354 R410 R420	RESISTOR, fixed: 47,000 ohms, 1/2 w; composition; RC20GF473K; Collins Rad part/dwg #745 1422 00.	Grid leak Screen dropping Diode clipper load Clipper bias Diode clipper load B+ decoupling Grid leak	745 1422 00	3RC20GF473K
R002 R101 R105 R109 R113 R117 R127 R301 R321 R324 R347	RESISTOR, fixed: 0.10 megohms, 1/2 w; composition; RC20GF104K; Collins Rad part/dwg #745 1436 00.	Screen dropping Grid leak Grid leak Grid leak Grid leak Grid leak Grid leak Grid leak Grid leak Plate load Plate load	745 1436 00	
R003	RESISTOR, fixed: 8200 ohms, 1 w; composition; RC32GF822K; Collins Rad part/dwg #745 3391 00.	Plate load	745 3391 00	3RC32GF22K
R007	RESISTOR, fixed: 10,000 ohms, 1/2 w; composition; RC20GF103K; Collins Rad part/dwg #745 1394 00.	Isolation	745 1394 00	3RC20GF103K
R102	RESISTOR, fixed: 27,000 ohms, 1/2 w; composition; RC20GF273K; Collins Radpart/dwg #745 1412 00.	Screen dropping	745 1412 00	3RC20GF273K

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
R103	RESISTOR, fixed: 22,000 ohms, 1 w; composition; RC32GF223K; Collins Rad part/dwg #745 3408 00.	Plate load	745 3408 00	
R104 R108 R112 R116 R120	RESISTOR, fixed: 1000 ohms, 1 w; composition;RC32GF102K; Collins Rad part/dwg #745 3352 00.	Decoupling Decoupling Decoupling Decoupling Decoupling	745 3352 00	3RC32GF102K
R106 R110 R114 R118	RESISTOR, fixed: 560 ohms, 1/2 w; composition; RC20GF561K; Collins Rad part/dwg #745 1342 00.	Cathode bias Cathode bias Cathode bias Cathode bias	745 1342 00	
R107 R111 R115 R119	RESISTOR, fixed: 33,000 ohms, 1 w; composition; RC32GF333K; Collins Rad part/dwg #745 3415 00.	Screen dropping Screen dropping Screen dropping Screen dropping	745 3415 00	
R121	RESISTOR, fixed: 10,000 ohms, 1 w; composition; RC32GF103K; Collins Rad part/dwg #745 3394 00.	Grid leak	745 3394 00	3RC32GF103K
R122	RESISTOR, fixed: 82 ohms, 1 w; composition; RC32GF820K; Collins Rad part/dwg #745 3307 00.	Cathode bias	745 3307 00	
R124	RESISTOR, fixed: 3300 ohms, 1 w; composition; RC32GF332K; Collins Rad part/dwg #745 3373 00.	Screen dropping	745 3373 00	3RC32GF332K
R128 R406 R408 R413 R505 R508	RESISTOR, fixed: 0.22 megohms, 1/2 w; composition; RC20GF224K; Collins Rad part/dwg #745 1450 00.	Screen dropping Plate load Phase shifter Phase shifter Plate load Plate load	745 1450 00	3RC20GF224K

R129 R402 R415	RESISTOR, fixed: 2200 ohms, 1/2 w; composition; RC20GF222K; Collins Rad part/dwg #745 1366 00.	Plate load Rate generator input network Cathode bias	745 1366 00	3RC20GF222K
R130 R516	RESISTOR, fixed: 4700 ohms, 1 w; composition; RC32GF472K; Collins Rad part/dwg #745 3380 00.	Decoupling Stage decoupling	745 3380 00	3RC32GF472K
R146	RESISTOR, fixed: WW; 6000 ohms, ±3% tol, 5W; 1" lg x 5/16" dia excl terms; silicone coating; 2 axial wire lead terms; characteristic G; Tomore Elec Corp type Silicohm "S"; Collins Rad part/dwg #747 9409 00.	Screen bleeder	747 9409 00	
R147	RESISTOR, fixed: WW; 16,000 ohms ±3% tol, 5W; 1" lg x 5/16" dia excl terms; silicone coating; 2 axial wire lead terms; characteristic G; Tomore Elec Corp type Silicohm "S"; Collins Rad part/dwg #747 9413 00.	Screen bleeder	747 9413 00	
R201	RESISTOR, fixed: 1,200 ohms, 2W; composition; RC42GF122J; Collins Rad part/dwg #745 5655 00.	C W keying relay bias	745 5655 00	
R202	RESISTOR, fixed: 2700 ohms, 1W; composition; RC32GF272J; Collins Rad part/dwg #745 3369 00.	C W keying relay bias	745 3369 00	
R203	RESISTOR, fixed: 10 ohms; 1 W; composition; RC32GF100K; Collins Rad part/dwg #745 3268 00.	Voltage dropping	745 3268 00	
R302	RESISTOR, fixed: 100 ohms; 1/2 W; composition; RC20GF101K; Collins Rad part/dwg #745 1310 00.	Cathode resistor	745 1310 00	
R304 R349	RESISTOR, fixed: 1,000 ohms, 1/2 W; composition; RC20GF102K; Collins Rad part/dwg #745 1352 00.	Decoupling Cathode resistor	745 1352 00	3RC20GF102K

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
R307	RESISTOR, fixed: 56,000 ohms, 1W; composition; RC32GF563J; Collins Rad part/dwg #745 3425 00.	Screen bleeder	745 3425 00	3RC32GF563J
R308	RESISTOR, fixed: 39,000 ohms, 2W; composition; RC42GF393J; Collins Rad part/dwg #745 5718 00.	Screen dropping	745 5718 00	
R309 R323 R329	RESISTOR, fixed: 0.33 megohms, 1/2 W; composition; RC20GF334K; Collins Rad part/dwg #745 1457 00.	Grid leak Screen dropping AVC filter	745 1457 00	3RC20GF334K
R310	RESISTOR, fixed: 4700 ohms, 1W; composition; RC32GF472J; Collins Rad part/dwg #745 3379 00.	Plate load	745 3379 00	3RC32GF472J
R322	RESISTOR, fixed: 1500 ohms, 1/2 W; composition; RC20GF152K; Collins Rad part/dwg #745 1359 00.	Cathode resistor	745 1359 00	3RC20GF152K
R325 R327 R405	RESISTOR, fixed: 4700 ohms, 1/2 W; composition; RC20GF472K; Collins Rad part/dwg #745 1380 00.	Decoupling Cathode resistor Cathode bias	745 1380 00	3RC20GF472K
R326	RESISTOR, fixed: 0.18 megs, 1W; composition; RC32GF184K; Collins Rad part/dwg #745 3447 00.	Cathode bias resistor	745 3447 00	3RC32GF184K
R328	RESISTOR, fixed: 1.0 megs, 1/2 W; composition; RC20GF105K; Collins Rad part/dwg #745 1478 00.	Load resistor	745 1478 00	
R330	RESISTOR, fixed: 390 ohms, 1/2 W; composition; RC20GF391K; Collins Rad part/dwg #745 1335 00.	Cathode resistor	745 1335 00	3RC20GF391K

R346 R348 R404 R407 R412 R419 R421 R422 R506 R605	RESISTOR, fixed: 0.47 megs, 1/2 W; composition; RC20GF474K; Collins Rad part/dwg #745 1464 00.	Grid Leak Grid Leak Grid Leak Grid Leak Grid Leak Phase splitter grid divider resistor Grid leak Grid leak Grid leak Plate resistor	745 1464 00	
R350	RESISTOR, fixed: 47,000 ohms, 1W; composition; RC32GF473K; Collins Rad part/dwg #745 3422 00.	Plate load	745 3422 00	
R358	RESISTOR, fixed: 330 ohms, 2W; composition; RC42GF331J; Collins Rad part/dwg #745 5630 00.	Disc, filament shunt	745 5630 00	
R403	RESISTOR, fixed: 330 ohms, 1/2W; composition; RC20GF331K; Collins Rad part/dwg #745 1331 00.	Rate generator input network	745 1331 00	3RC20GF331K
R409 R519	RESISTOR, fixed: 2,700 ohms, 1/2W; composition; RC20GF272K; Collins Rad part/dwg #745 1370 00.	Cathode bias V U meter matching network	745 1370 00	3RC20GF272K
R411	RESISTOR, fixed: 68,000 ohms, 1/2 W; composition; RC20GF683K; Collins Rad part/dwg #745 1429 00.	Plate load	745 1429 00	3RC20GF683K
R416 R517	RESISTOR, fixed: 0.22 megs, 1W; composition; RC32GF224K; Collins Rad part/dwg #745 3450 00.	B+ decoupling B+ decoupling	745 3450 00	3RC32GF224K
R417 R418	RESISTOR, fixed: 0.10 megs, 1W; composition; RC32GF104K; Collins Rad part/dwg #745 3436 00.	Plate load Plate load	745 3436 00	3RC32GF104K

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
R424	RESISTOR, fixed: 3,300 ohms, 2W; composition; RC42GF332K; Collins Rad part/dwg #745 5673 00.	Screen dropping	745 5673 00	3RC42GF332K
R504 R507	RESISTOR, fixed: 3,300 ohms, 1/2 W; composition; RC20GF332K; Collins Rad part/dwg #745 1373 00.	Cathode bias Cathode bias	745 1373 00	3RC20GF332K
R510 R513	RESISTOR, fixed: 820 ohms, 1/2 W; composition; RC20GF821K; Collins Rad part/dwg #745 1349 00.	Cathode bias Cathode bias	745 1349 00	3RC20GF821K
R511 R515	RESISTOR, fixed: 47,000 ohms, 2W; composition; RC42GF473K; Collins Rad part/dwg #745 5722 00.	Plate load	745 5722 00	3RC42GF473K
R514	RESISTOR, fixed: 3,900 ohms, 1/2 W; composition; RC20GF392K; Collins Rad part/dwg #745 1377 00.	V U meter matching network	745 1377 00	3RC20GF392K
R518	RESISTOR, fixed: 330 ohms, 2 W; composition; RC42GF331K; Collins Rad part/dwg #745 5631 00.	Mike line filter	745 5631 00	3RC42GF331K
R603 R604	RESISTOR, fixed: 47 ohms, 2W; composition; RC42GF470K; Collins Rad part/dwg #745 5596 00.	Plate suppressor Plate suppressor	745 5596 00	
R606	RESISTOR, fixed: 56,000 ohms, 2W; composition; RC42GF563J; Collins Rad part/dwg #745 5725 00.	Screen resistor	745 5725 00	
R607	RESISTOR, fixed: 22,000 ohms, 2W; composition; RC42BF223J; Collins Rad part/dwg #745 5707 00.	Screen resistor	745 5707 00	

R608	RESISTOR, fixed: 0.15 megs, 1W; composition; RC30BF154K; Collins Rad part/dwg #745 3443 00.	Voltage divider	745 3443 00	3RC32GF154K
R610	RESISTOR, fixed: 56,000 ohms; 1W; composition; RC30BF563K; Collins Rad part/dwg #745 3426 00.	Voltage divider	745 3426 00	3RC32GF563K
R709	RESISTOR, fixed: 820 ohms, 2W; composition; RC42BF821J; Collins Rad part/dwg #745 5648 00.	FSK relay bias	745 5648 00	
R710	RESISTOR, fixed: 1800 ohms, 1W; composition; RC30BF182J; Collins Rad part/dwg #745 3362 00.	FSK relay bias	745 3362 00	
R727	RESISTOR, fixed: 150 ohms, 1W composition; RC42BF151K; Collins Rad part/dwg #745 5617 00.	Mike line load	745 5617 00	
R004	RESISTOR, fixed: composition; 1500 ohms, ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead terms; Collins Rad part/dwg #705 2135 00. IRC type #DCC.	Cathode load	705 2135 00	
R005	RESISTOR, fixed: composition; 33,000 ohms, ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; Collins Rad part/dwg #705 2167 00. IRC type #DCC.	Grid phase shift	705 2167 00	
R006	RESISTOR, fixed: composition; 390 ohms, ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC. Collins Rad part/dwg #705 2121 00.	Grid phase shift	705 2121 00	
R138 R719	RESISTOR, fixed: composition; 4000 ohms, ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2219 00.	Dev. divider Dev. divider	705 2219 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
R139 R715	RESISTOR, fixed: composition; 56,200 ohms, ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2259 00.	Dev. divider Dev. divider	705 2259 00	
R140 R716	RESISTOR, fixed: composition; 52,500 ohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2260 00.	Dev. divider Dev. divider	705 2260 00	
R141 R718	RESISTOR, fixed: composition; 30,000 ohms, ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead terms; IRC type #DCC. Collins Rad part/dwg #705 2166 00.	Dev. divider Dev. divider	705 2166 00	
R142 R717	RESISTOR, fixed: composition; 45,000 ohms, ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2261 00.	Dev. divider Dev. divider	705 2261 00	
R143 R722	RESISTOR, fixed: composition; 60,000 ohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2262 00.	Dev. divider Dev. divider	705 2262 00	
R144 R721	RESISTOR, fixed: composition; 20,000 ohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2162 00.	Dev. divider Dev. divider	705 2162 00	
R145 R720	RESISTOR, fixed: composition; 8,570 ohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2258 00.	Dev. divider Dev. divider	705 2258 00	

R305 R311 R401 R726	RESISTOR, fixed: composition; 0.10 megohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2179 00.	Grid leak Limiter swamping Servo ampl input Mod cancel decoupling	705 2179 00	
R306 R612	RESISTOR, fixed: composition; 1000 ohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part dwg #705 2131 00.	Meter shunt Voltage divider	705 2131 00	
R341 R342 R343 R345	RESISTOR, fixed: composition; 0.22 megohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2187 00.	Disc output filter Disc output filter Disc output filter Disc output filter	705 2187 00	
R344	RESISTOR, fixed: composition; 0.56 megohms ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2197 00.	Disc output divider	705 2197 00	
R356 R357	RESISTOR, fixed: composition; 4,700 ohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2147 00.	Bridge load Bridge load	705 2147 00	
R502	RESISTOR, fixed: composition; 620 ohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2126 00.	Line matching grid leak	705 2126 00	
R509	RESISTOR, fixed: composition; 56,000 ohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2173 00.	Pre-emphasis resis-tor	705 2173 00	
R520	RESISTOR, fixed: composition; 3,600 ohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2144 00.	V U meter matching network	705 2144 00	
R613	RESISTOR, fixed: composition; 100 ohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2107 00.	Voltage divider	705 2107 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
R703 R704	RESISTOR, fixed: composition; 51,000 ohms; ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2172 00.	FSK bridge balance FSK bridge balance	705 2172 00	
R711 R713	RESISTOR, fixed: composition; 560, ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2125 00.	FSK bias divider FAX line load	705 2125 00	
R714	RESISTOR, fixed: composition; 35 ohms, ±1% tol; 1/2 W; 19/32" lg x 0.162" dia; uninsulated; 2 wire lead term; IRC type #DCC; Collins Rad part/dwg #705 2263 00.	FAX line load	705 2263 00	
R370 R371 R372 R373	RESISTOR, fixed: palladium and gold film; 100,000 ohms, ±1% tol; 1/2 W; working voltage 425 v AC; 1/2" lg x 0.150" dia; hi-temp enamel finish; two #20 AWG axial wire lead term; Concarbon type #N.F.; Collins Rad part/dwg #714 0089 00.	Load resistor Load resistor Load resistor Load resistor	714 0089 00	
R423	RESISTOR, fixed: WW; 270 ohms, ±5% tol, 5 W; 1" lg x 5/16" dia excl term; silicone coating; 2 axial wire lead terms; characteristic G; Tomore Elec Corp type Silicohm "S"; Collins Rad part/dwg #747 9420 00.	Cathode bias	747 9420 00	
R601 R602	RESISTOR, fixed: WW; 2,500 ohms, ±5% tol, 5W; 1" lg x 5/16" dia excl terms; silicone coating; 2 axial wire lead terms; characteristic G; Tomore Elec Corp type Silicohm "S"; Collins Rad part/dwg #747 9415 00.	Bias filter Bias filter	747 9415 00	
R611 R707	RESISTOR, fixed: WW; 9000 ohms, ±1% tol, 5 W; 1" lg x 5/16" dia excl term; silicone	Voltage divider Voltage divider	747 9418 00	

R708	coating; 2 axial wire lead terms; characteristic G; Tomore Elec Corp type Silicohm "S"; Collins Rad part/dwg #747 9418 00.	Voltage divider		
R615 R616 R617	RESISTOR, fixed: WW; RW30G221; 220 ohms, ±5% tol, 8W dissipation; 1" lg x 19/32" dia excl terms; 2 radial tab terms; Collins Rad part/dwg #747 0156 00.	DC filament dropping DC filament dropping DC filament dropping	747 0156 00	
R618	RESISTOR, fixed: WW; RW30G5R0; 5.0 ohms, ±5% tol, 8W dissipation; 1" lg x 19/32" dia excl terms; 2 radial tab terms; Collins Rad part/dwg #747 0059 00.		747 0059 00	
R723	RESISTOR, fixed: WW; 7 ohms, ±5% tol, 5W; 1" lg x 5/16" dia excl term; silicone coating; 2 axial wire lead terms; characteristic G; Tomore Elec Corp type "S"; Collins Rad part/dwg #747 9430 00.	Pilot light current shunt	747 9430 00	
R148	RESISTOR, variable: composition; 1 sect, 250,000 ohms ±10% tol; 2W dissipation; 3 solder lug terms; metal case, 1-3/32" dia x 19/32" d, dustproof; slotted metal shaft w/ 0.047" wd x 0.063" d slot, 1/4" dia x 5/8" lg, normal torque; lin type; ins cont arm; no "off" position; mtg by 3/8-32 NEF-2 bushing 1/2" lg; CTS type #95; Collins Rad part/dwg #380 5788 00.	R.T. linearity adj.	380 5788 00	
R353	RESISTOR, variable: composition; 1 sect, 100,000 ohms ±10% tol; 2W dissipation; 3 solder lug terms; metal case, 1-3/32" dia x 19/32" d, dustproof; slotted metal shaft w/ 0.047" wd x 0.063" d slot,1/4" dia x 5/8" lg, normal torque; lin taper; ins cont arm; no "off" position; mtg by 3/8-32 NEF-2 bushing 1/2" lg; CTS type #95; Collins Rad part/dwg #380 5785 00.	Clipper level adjust	380 5785 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
R355	RESISTOR, variable: composition; 1 sect, 1,000 ohms, $\pm$10% tol; 1W dissipation; 3 solder lug terms; metal case, 1" dia x 19/32" d, dustproof; slotted metal shaft w/ 0.047" wd x 0.060" d slot, 1/4" dia x 5/8" lg, normal torque; lin taper; ins cont arm, no "off" position; mtg by 3/8-32 NEF-2 bushing 1/2" lg; CTS type #90; Collins Rad part/dwg #380 5279 00.	Meter adjust	380 5279 00	
R503 R702 R705	RESISTOR, variable: composition; 1 sect, 50,000 ohms, $\pm$10% tol; 1W dissipation; 3 solder lug terms; metal case, 1" dia x 19/32" d dustproof; slotted metal shaft w/ .047" wd x 0.063" d slot, 1/4" dia x 5/8" lg, normal torque; lin taper; ins cont arm, no "off" position; mtg by 3/8-32 NEF-2 bushing 1/2" lg; CTS type #90; Collins Rad part/dwg #380 5276 00.	Audio level adjust Deviation calibration adj Line balance adjust	380 5276 00	
R512	RESISTOR, variable: composition; 1 sect, 1,000,000 ohms; $\pm$10% tol; 1W dissipation; 3 solder lug terms; metal case, 1" dia x 19/32" d, dustproof; slotted metal shaft w/ 0.047" wd x 0.060" d slot, 1/4" dia x 5/8" lg, normal torque; lin taper; ins cont arm, no "off" position; mtg by 3/8-32 NEF-2 bushing 1/2" lg; CTS type #90; Collins Rad part/dwg #380 5283 00.	V U meter ampl. adjust	380 5283 00	
R609	RESISTOR, variable: composition; 1 sect, 50,000 ohms, $\pm$10% tol; 2W dissipation; 3 solder lug terms; metal case, 1-3/32" dia x 19/32" d dustproof; slotted metal shaft w/ 0.047" wd x 0.063" d slot, 1/4" dia x 5/8" lg, normal torque; lin taper; ins cont arm;	Reg voltage adjust	380 5783 00	

	no "off" position; mtg by 3/8-32 NEF-2 bushing 1/2" lg; CTS type #95; Collins Rad part/dwg #380 5783 00.			
R614	RESISTOR, variable: composition; 1 sect, 5,000 ohms, ±10%; 2W dissipation; 3 solder lug terms; metal case, 1-3/32" dia x 19/32" d, dustproof; slotted metal shaft w/ 0.047" wd x 0.063" d slot, 1/4" dia x 5/8" lg, normal torque; lin taper; ins cont arm; no "off" position; mtg by 3/8-32 NEF-2 bushing 1/2" lg; CTS type #95; Collins Rad part/dwg #380 5793 00.	FSK bias adj	380 5793 00	
R706	RESISTOR, variable: composition; 1 sect, 25,000 ohms, ±10% tol; 2W dissipation; 3 solder lug terms; metal case, 1-13/32" dia x 19/32" d, dustproof; flatted metal shaft, 1/4" dia x 1-1/2" lg, normal torque; lin taper; ins cont arm, no "off" position; mtg by 3/8-32 NEF-2 bushing 3/8" lg; CTS type #95; Collins Rad part/dwg #380 0605 00.	Deviation control	380 0605 00	
R712 R725	RESISTOR, variable: composition; 1 sect, 100,000 ohms, ±10% tol; 1W dissipation; 3 solder lug terms; metal case, 1" dia x 19/32" d, dustproof; slotted metal shaft w/ 0.047" wd x 0.060" d slot, 1/4" dia x 5/8" lg, normal torque; lin taper; ins cont arm, no "off" position; mtg by 3/8-32 NEF-2 bushing 1/2" lg; CTS type #90; Collins Rad part/dwg #380 5278 00.	Mod. cancel voltage adjust Mod. cancel and phase adj	380 5278 00	
R501	RESISTOR, variable: WW; RA20A2SA500AK; 50 ohms, ±10% tol. 2.0W; 3 solder lug terms; 0.62" lg x 1.28" dia; encl; slotted 1/2" lg x 1/4" dia shaft, built-in high torque; lin taper; no switch; mtg by 3/8-32 NEF-2 bushing 3/8" lg; Collins Rad part/dwg #750 0515 00.	Simplex adjust	750 0515 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
R701	RESISTOR, variable: WW; RP101FD252KK; 2500 ohms, ±10% tol; 25W, 0.10 amp; 3 solder lug terms; 1.410" lg x 1.680" dia; encl; flatted 7/8" lg x 1/4" dia shaft; lin taper; mtg by 3/8-32 NEF-2 bushing 3/8" lg; Collins Rad part/dwg #749 0003 00.	FSK line current adjust	749 0003 00	
0104 0107 0110 0124 0132 0141 0144 0159	Ring, retainer: type "E" retaining ring; steel, cadmium or zinc plated, chromate dipped; 0.335" dia x 0.025" thk o/a; to accom 0.145" dia shaft; shaft mtd; Waldes Kohinoor #5133-18; Collins Rad part/dwg #340 0090 00.	Gear retainer Gear retainer Gear retainer Gear retainer Clutch CP retainer Idler gear retainer Gear retainer Gear retainer	340 0090 00	2Z7858-154
0166 0175 0180 0186 0189	RING, retainer: type "E" retaining ring; steel, cadmium or zinc plated, chromate dipped; 0.230" dia x 0.015" thk o/a; to accom 0.094" dia shaft; shaft mtd; Waldes Kohinoor #5133-12; Collins Rad part/dwg #340 0087 00.	S103 shaft ret S102 gear retainer Clutch coil arm ret Pivot post ret Clutch arm pin ret	340 0087 00	
0185 0190	SHAFT: pivot post; type #303 steel; 13/32" lg x 7/32" dia o/a; one end fl 0.020" wd x 0.003" d x 7/32" dia; one end grooved 0.019" wd x 0.095" dia; Collins Rad part/dwg #540 3314 002.	Clutch arm pivot Clutch arm pivot	540 3314 002	
E403 E404 E603 E606	SHIELD, tube: miniature; copper, nickel pl; bayonet mtg; 2-1/4" h x 55/64" OD x 13/16" ID; Cinch #16G13597; Collins Rad part/dwg #141 0137 00.	Tube shield for V403 Tube shield for V404 Tube shield for V603 Tube shield for V606	141 0137 00	2Z8304.237
E001 E002	SHIELD, tube: 7 pin miniature; copper, nickel pl; 1-3/4" h x 0.930" dia x 0.018"	Shield for V001 Shield for V002	141 0144 00	2Z8304.276

E101 E102 E103 E104 E105 E106 E301 E302 E303 E304 E605	thk; JAN type TS102U02; Collins Rad part/dwg #141 0144 00.	Shield for V101 Shield for V102 Shield for V104 Shield for V105 Shield for V106 Shield for V301 Shield for V302 Shield for V303 Shield for V304 Shield for V605		
E315	SHIELD, transformer: I.F.; 3S.H14 aluminum, chromate dip; 0.020" thk; 1.312" lg x 1.062" wd x 1-31/32" h; mtg by two 6-32 NC-2 studs spaced 1/2" c to c; silk screened; Collins Rad part/dwg #540 3476 00.	Shield for T301	540 3476 00	
E107	SHIELD, tube: 9 pin miniature; copper, nickel pl; 2-3/8" h x 1.065" dia x 0.018" thk; JAN TS103U03; Collins Rad part/dwg #141 0148 00.	Shield for V107	141 0148 00	2Z8304.286
E305 E306 E401 E402 E501 E502	SHIELD, tube: 9 pin miniature; copper, nickel pl. 1-15/16" h x 1.065" dia x 0.018" thk; JAN TS103U02; Collins Rad part/dwg #141 0147 00.	Shield for V305 Shield for V306 Shield for V401 Shield for V402 Shield for V501 Shield for V502	141 0147 00	2Z8304.275
E307	SHIELD, tube: 7 pin miniature; copper, nickel pl; JAN type TS102U01; Collins Rad part/dwg #141 0143 00.	Shield for V307	141 0143 00	
XK202 XG301 XV601 XV602 XV604 XK801	SOCKET, tube: 8 contacts; JAN type #TSB8T101; 1 piece saddle mtg; copper, non-magnetic, silver; mica filled phenolic; 1-13/16" diam x 0.625" h; Collins Rad part/dwg #220 1121 00.	Socket for K202 Socket for G301 Socket for V601 Socket for V602 Socket for V604 Socket for K801	220 1121 00	

3. Identification Table of Parts for Radio Frequency Oscillator 0-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
XK204 XK205 XK206 XK207 XK701	SOCKET, tube: 14 contacts, copper, non-magnetic, silver, 1 piece saddle mtg; brass, nickel mtg; MFE mica filled phenolic ins; 1-3/8" lg x .734" w x 11/16" h; Amphenol, type #59-106; Collins Rad part/dwg #220 1166 00.	Socket for K204 Socket for K205 Socket for K206 Socket for K207 Plug in relay socket for K701	220 1166 00	
XV001 XV002 XV101 XV102 XV103 XV104 XV105 XV106 XK203 XV301 XV302 XV303 XV304 XV307 XV403 XV404 XV603 XV605 XV606	SOCKET, tube: 7 pin miniature; JAN type #TS102P01; one piece saddle mtg; two 0.125" dia holes; copper non-magnetic, silver pl conts MFE plastic body; 1-1/8" max dia x 5/8" h; Collins Rad part/dwg #220 1111 00.	Socket for V001 Socket for V002 Socket for V101 Socket for V102 Socket for V103 Socket for V104 Socket for V105 Socket for V106 Socket for K203 Socket for V301 Socket for V302 Socket for V303 Socket for V304 Socket for V307 Socket for V403 Socket for V404 Socket for V603 Socket for V605 Socket for V606	220 1111 00	2Z8677-171
XV107 XV305 XV306 XV401 XV402 XV501 XV502	SOCKET, tube: 9 pin miniature; JAN type TS103P01; one piece saddle mtg, 2 holes 0.125" dia; copper, non-magnetic, silver contacts; MFE plastic body; 1-3/8" dia x 5/8" thk; Collins Rad part/dwg #220 1103 00.	Sockets for V107 Sockets for V305 Sockets for V306 Sockets for V401 Sockets for V402 Sockets for V501 Sockets for V502	220 1103 00	2Z 8679.30
XV379	SOCKET, tube: 7 pin top mtg miniature tube; 1 piece saddle mtg; brass, nickel; copper,	Socket for V379	220 1152 00	

	silver pl cont; MFE phenolic ins; 1-1/8" lg x 13/16" w x 11/16" h; Amphenol, type #MFE; Collins Rad part/dwg #220.1152 00.			
0193	SPRING: helical torsion; replacement left brush spring; 0.018" dia beryllium copper wire; 31/64" free lgth; 0.136" ID of coil, 0.140" OD of coil; 17/32" short end, 31/64" lg end; 11 coils, RH turns, used on Collins Rad part/dwg #230 0182 00; Delco Appliance Div., #5069407; Collins Rad part/dwg #234 0426 00.	For G101 left brush	234 0426 00	
0194	SPRING: helical torsion; replacement right brush spring; 0.018" diam beryllium copper wire; 31/64" free lgth; 0.136" ID of coil, 0.140" OD of coil; 17/32" short end, 31/64" lg end; 11 coils, RH turns, used on Collins Rad part/dwg #230 0182 00; Delco Appliance Div., #5069408; Collins Rad part/dwg #234 0425 00.	For G101 right brush	234 0425 00	
0134	SPRING: helical compression; clutch spring; #23 ga type 302 SS wire, 18-8 spring temper; 27/32" free lgth x 0.225" ID x 27/64" solid h; 15 active turns; RH or LH wnd; closed ends; Collins Rad part/dwg #540 3310 002.	Course post. clutch spring	540 3310 002	
0192	SPRING: helical torsion; tension; 0.020" dia SS type #302 wire; 5/32" OD of coil; 1-7/32" max extended lgth; 15 coil, LH turns; Collins Rad part/dwg #540 3708 002.	Coupler loading spring	540 3708 002	
FL801 FL802	SUPPRESSOR, electrical noise: 2 term coil and capacitor type; 1-1/4" lg x 1" w x 2-1/2" h o/a; 1.5 amps at 250 v AC, 3 amps at 125 v AC, 50/60 cps; min. attenuation at 150 KC, 40 db; hermetically sealed (cont.)	AC line filter AC line filter	241 0073 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
FL801 FL802 (cont.)	metallic case; 2 solder lug terms; Sprague to Collins Rad part/dwg #241 0073 00.			
FL101	SUPPRESSOR, electrical noise: 4 term coil and capacitor type; 1-1/4" lg x 3/4" w x 2-1/2" h o/a; 1 amp at 30 v DC ea line; 2 ohms max ea line, min attenuation at 150 KC, 40 db; hermetically sealed metallic case; 4 solder lug term; Sprague to Collins Rad part/dwg #241 0074 00.	DC motor lines filter	241 0074 00	
E108	SUPPRESSOR, parasitic: 3/4" lg x 0.280" dia excl terms; 100 ohms ±10% tol, 1 w, insulated resistor; 7 full turns single layer #22 AWG annealed soft copper wire coil; Collins Rad part/ dwg #540 3105 002.	Parasitic suppressor	540 3105 002	
S801	SWITCH, rotary: 2 pole, triple deck, with 20° detent and stops limiting rotation; silver cont; Steatite Sect. grade L5B ins; 7-1/2 amps at 115 V, 60 cy rating; lug type term; 5.75" lg x 2-1/6" w x 2-13/16" h o/a; Centralab type #JV; Collins Rad part/dwg #259 0591 00.	Line voltage selector	259 0591 00	
S701	SWITCH, rotary: 3 ckt, 3 pole, 1 sect with 30° detent and stops limiting rotation to 3 positions; phenolic ins; non-shorting silver rotor blades; spring alloy clips bent 60°; 1-11/16" lg x 1-13/32" w x 1-9/16" h o/a; Oak, type #K; Collins Rad part/dwg #259 0639 00.	Polar-neutral switch	259 0639 00	
S702	SWITCH, rotary: 5 ckt, 5 pole, 3 sect with 30° detent and stops limiting rotation to 5	Mod. test	259 0640 00	

	positions; phenolic ins; silver rotor blades, sect A shorting type, sect B and C non-shorting; spring silver clips bent 60°; 2-3/8" lg x 1-13/32" w x 1-9/16" h o/a; Oak type #K; Collins Rad part/dwg #259 0640 00.			
S703	SWITCH, rotary: 7 circuit, 7 pole, 4 sect, with 30° detent and stops limiting rotation to 5 positions; phenolic ins; coin silver shorting type rotor blades; spring alloy clips bent 60°; 2-11/16" lg x 1-13/32" w x 1-9/16" h o/a; Oak, type #K; Collins Rad part/dwg #259 0637 00.	Assoc. tras. freq. mult.	259 0637 00	
S704	SWITCH, rotary: 12 ckt, 12 pole, 6 sect with detent and stops limiting to 8 positions; phenolic ins; non-shorting silver rotor blades; spring silver clips bent 60°; 3-9/16" lg x 1-31/32" w x 2-5/16" h o/a; Oak type #MF; Collins Rad part/dwg #259 0642 00.	Service selector	259 0642 00	
S705	SWITCH, rotary: 4 ckt, 4 pole, 1 sect with 30° detent and stops limiting rotation to 2 positions; phenolic ins; non-shorting silver rotor blades; spring silver clips bent 60°; 1-11/16" lg x 1-13/32" w x 1-9/16" h o/a; Oak, type #K; Collins Rad part/dwg #259 0641 00.	Carrier control	259 0641 00	
S707	SWITCH, rotary: 6 ckt, 6 pole, 3 sect with 30° detent and stops limiting rotation to 4 positions; phenolic ins; coin silver rotor blades; spring silver clips bent 60°; 2-3/8" lg x 1-13/32" w x 1-9/16" h o/a; Oak type #K; Collins Rad part/dwg #259 0638 00.	Function switch	259 0638 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
S370	SWITCH, thermostatic: single pair conts, open ov temp increase, close on decrease; adj temp range, 60°C to 90°C; 1 amp 27.5 v DC; ceramic grade L-4 body; 1.125" lg x 1/4" dia o/a; ferrule term; single 2-56 NC-2 tapped mtg hole on one end; side adj screw; Ulanet to Collins Rad part/dwg #292 0071 00.	Oven switch	292 0071 00	3Z9695-12.1
S706	SWITCH, toggle: SPST; JAN type ST42A; 250 v AC, 6 amp DC, 0.5 amp DC, 125 v AC, 15 amp DC, 0.75 amp, 30 v DC, 20 amp locking, 15 amp momentary; molded bakelite body, 1-1/16" lg x 41/64" wd x 1-9/64" h o/a; lug type term; 15/32"-32 NS-2 mtg bushing 15/32 in. lg; Collins Rad part/dwg #266 3072 00.	Line power	266 3072 00	3Z9863-42A
S101A	SWITCH SECTION, rotary: 1 ckt, 1 pole, 12 positions; 1-1/4" dia x 0.062" thk; Richardson T812 phenolic ins; coin silver shorting rotor blades; spring silver clips bent 75°; Oak type #F; Collins Rad part/dwg #269 1634 00.	B.S. motor pos.	269 1634 00	
S101B	SWITCH SECTION, rotary: 2 ckt, 2 pole, 12 positions; 1-1/4" dia x 1/8" thk; Grade L-4B Steatite ins; coin silver shorting rotor blades; spring silver clips bent 75°; Oak type #FC; Collins Rad part/dwg #269 1641 00.	Dev. divider	269 1641 00	
S101C S101D S101E S101F	SWITCH SECTION, rotary: 1 ckt, 1 pole, 12 positions; 1-1/4" dia x 1/8" thk; Grade L-4B Steatite ins; coin silver, shorting type rotor blades; spring silver clips bent	RF ampl switching RF ampl switching RF ampl switching RF ampl switching	269 1631 00	

S101H S101J	75°; Oak type #F; Collins Rad part/dwg #269 1631 00.	RF ampl switching RF ampl switching		
S101G	SWITCH SECTION, rotary: 2 ckt, 2 pole, 12 positions; 1-1/4" dia x 1/8" thk; grade L-4B Steatite ins; spring silver clips; coin silver, front shorting type rear non-shorting rotor blades; Oak type #F; Collins Rad part/dwg #269 1633 00.	RF ampl switching	269 1633 00	
S102	SWITCH SECTION, rotary: 2 ckt, 2 pole, 24 positions; 1-3/4" dia x 2-5/16" h; Richardsons T812 phenolic ins; coin silver shorting rotor blades; spring silver clips, front clips bent 75°, rear clips flat; Oak type #MF; Collins Rad part/dwg #269 1650 00.	Limit switch	269 1650 00	
S103	SWITCH SECTION, rotary: 1 ckt, 1 pole, 24 positions; 1-3/4" x 2-5/16" h; Richardson T812 phenolic ins; coin silver non shorting rotor blades; spring silver clips; Oak type #MF; Collins Rad part/dwg #269 1649 00.	Osc. position	269 1649 00	
T401	TRANSFORMER, AF: plate coupling type; pri, 45 ma bal; impedance, 10,000 and 40 ohms, test voltage 500 v, 45 cps +.5 DA, 60 cps 0 DA, 70 cps, ±.5 DB; power 8W; hermetically sealed metal case, 2-7/8" lg x 2-3/8" wd x 2-3/8" h excl term; 5 solder lug terms 1/4" dia; mtg by four 6-32 studs spaced 2-3/8" x 1-3/4" mtg c; Chi Trans #16730; Collins Rad part/dwg #677 0519 00.	Servo output trans	677 0519 00	
T501	TRANSFORMER, AF: line type; pri 50 ma ea winding, 600 ohms impedance, test voltage 1000 RMS, 300 cps ±0.5 DA, 1000 cps 0 DA, 3500 cps ±0.5 DB, oper level #20 db to -40 db; hermetically sealed metal case 1-9/16" lg x 1-9/16" wd x 2-1/8" h excl (cont.)	Audio line input	677 0520 00	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
T501 (cont.)	term; 6 solder lug terms spaced 5/16" x 5/16" mtg C in 3 rows of 2 ea; mtg by four 6-32 NC-2A studs spaced 1" x 1" mtg C; Chi Trans type #16759; Collins Rad part/dwg #677 0520 00.			
T301	TRANSFORMER, IF: incls two, fixed mica capacitors, one 470 uuf, one 12.0 uuf; two 455 KC unshielded coils; two adj tuning core, 4 half shell core; retainer plate; term post; two 2-56 NC-2 tapped mtg holes; 1-27/32" lg x 15/16" wd x 15/16" h; Collins sketch #540 3504 004.	IF transformer	540 3504 004	
T801	TRANSFORMER, power: plate; input in series 230 v AC, 50/60 cps, single phase, input is parallel 115 v AC, 50/60 cps, single phase; output 275 v DC at 450 ma; hermetically sealed metal case; case without terms 4-3/16" lg x 4-9/16" wd x 5-3/8" h; 12 solder lug terms spaced 1/2" x 1/2" mtg c in 4 rows of 3 ea; mtg by four 10-32 NF-2 studs spaced 3" x 3.375" mtg C; Chi Trans #16729; Collins Rad part/dwg #672 0525 00.	Plate power	672 0525 00	
T802	TRANSFORMER, power: filament type; input 115/230 v AC 50/60 cps, single phase; output 1.7 amps DC at 28 v DC; hermetically sealed metal case, case without terms 4-3/16" lg x 4-9/16" wd x 5-3/8" h; 19 solder terms spaced 1/2" x 1/2" mtg C in 5 rows of 4 and 3 ea; mtg by four 10-32 NF-2 studs spaced 3" x 3.375" mtg C; Chi Trans #16728; Collins Rad part/dwg #672 0526 00.	Filament power	672 0526 00	

V001 V002 V301 V302 V303 V304	TUBE, electron: RCA type 12AU6; pentode; Collins Rad part/dwg #255 0198 00.	Osc. RT IF amplifier 1st limiter 2nd limiter Relay control ampl	255 0198 00	
V001 V002	TUBE, electron: RCA type 12AW6; pentode; Collins Rad part/dwg #255 0206 00.	Oscillator Reactance tube	255 0206 00	
V101 V106 V605	TUBE, electron: JAN 6AU6; Collins Rad part/dwg #254 0797 00.	Osc. buffer Spectrum ampl Regulator control tube	254 0797 00	2J6AU6
V102 V103 V104 V105	TUBE, electron: JAN 6AK6; Collins Rad part/dwg #254 0632 00.	RF ampl doubler - band 3 Band 4 doubler Band 5 doubler Band 6 doubler	254 0632 00	
V107	TUBE, electron: JAN 5763; Collins Rad part/dwg #254 0817 00.	RF power ampl	254 0817 00	C2J5763
V305 V306	TUBE, electron: JAN 12AT7; Collins Rad part/dwg #254 0809 00.	Rect and Scan relay control 60 cycle ampl	254 0809 00	
V307	TUBE, electron: JAN 5726/6AL5W; Collins Rad part/dwg #254 0844 00.	Clipper	254 0844 00	2J5726/ 6AL5W
V379	TUBE, electron: RCA type 12AL5; twin diode; Collins Rad part/dwg #255 0197 00.	Rectifier	255 0197 00	
V401	TUBE, electron: GE type 12AY7; twin triode; Collins Rad part/dwg #255 0204 00.	Servo ampl voltage ampl	255 0204 00	
V402 V502	TUBE, electron: JAN 5814; Collins Rad part/dwg #254 0822 00.	Servo voltage ampl	254 0822 00	2J5814

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
V403 V404	TUBE, electron: JAN 6005/6AQ5W; Collins Rad part/dwg #254 0845 00.	Servo output tube Servo output tube	254 0845 00	
V501	TUBE, electron: JAN 12AX7; Collins Rad part/dwg #254 0790 00.	Audio Amplification	254 0790 00	2J12AX7
V601 V602	TUBE, electron: JAN 5R4WGY; Collins Rad part/dwg #254 0810 00.	Plate rectifier Plate rectifier	254 0810 00	
V603	TUBE, electron: JAN 6X4W; Collins Rad part/dwg #254 0811 00.	Bias rectifier	234 804 550	2J6X4W
V604	TUBE, electron: JAN 6080; Collins Rad part/dwg #254 0863 00.	Regulator tube	254 0863 00	
V606	TUBE, electron: JAN 0B2; Collins Rad part/dwg #254 0794 00.	Bias regulator	254 0794 00	2J0B2
Z101	TUNER, RF: No. 1; consists of one fixed mica 56 UUF capacitor; one variable ceramic 8-50 UUF capacitor; one RF coil, 49.5 turns, 44.0 TPl; top and bottom plate; supporting post; rack mtd; Collins Rad part/dwg #540 3270 003.	Bands 2 and 3 tank	540 3270 003	
Z102	TUNER, RF: No. 2; consists of one fixed mica 56 UUF capacitor; one variable ceramic 8-50 UUF capacitor; one RF coil, 49.5 turns at 44.0 TPl; top and bottom plate; supporting post; rack mtd; Collins Rad part/dwg #540 3271 003.	Band 3 tank	540 3271 003	
Z103	TUNER, RF: No. 17; consists of one fixed mica 15 UUF capacitor; one variable ceramic 8-50 UUF capacitor; one RF coil, 32.5 turns, 28.89 TPl; top and bottom plate; supporting	Band 4 tank	540 3286 003	

	post; rack mtd; Collins Rad part/dwg #540 3286 003.			
Z104	TUNER, RF: No. 16; consists of one flat ceramic 10 UUF capacitor; one variable ceramic 8-50 UUF capacitor; one RF coil; 32.5 turns, 28.89 TPl; top and bottom plate; supporting post; rack mtd; Collins Rad part/dwg #540 3285 003.	Band 4 tank	540 3285 003	
Z105	TUNER, RF: No. 3; consists of one flat ceramic 5 UUF capacitor; one variable ceramic 8-50 UUF capacitor; one RF coil; 19.0 turns at 16.89 TPl; top and bottom plate; supporting post; rack mtd; Collins Rad part/dwg #540 3272 003	Band 5 tank	540 3272 003	
Z106	TUNER, RF: No. 4; consists of one flat ceramic 10 UUF capacitor; one variable ceramic 8-50 UUF capacitor; one RF coil; 19.0 turns at 16.89 TPl; top and bottom plate; supporting post; rack mtd; Collins Rad part/dwg #540 3273 003.	Band 5 tank	540 3273 003	
Z107	TUNER, RF: No. 15; consists of one variable ceramic 8-50 UUF capacitor; one RF coil, 9.0 turns, 8.0 TPl; top and bottom plate; supporting post; rack mtd; Collins Rad part/dwg #540 3284 003.	Band 6 tank	540 3284 003	
Z108	TUNER, RF: No. 14; consists of one fixed mica 300 UUF capacitor; one variable ceramic 8-50 UUF capacitor; one RF coil, 61.5 turns, 54.6 TPl; top and bottom plate; supporting post; rack mtd; Collins Rad part/dwg #540 3283 003.	Band 2 Pl	540 3283 003	
Z109	TUNER, RF: No. 5; consists of one fixed mica 240 UUF capacitor; four fixed mica 510 UUF capacitors; one RF coil; 36.5 turns at 32.4 TPl; top and bottom plate; supporting post; rack mtd; Collins Rad part/dwg #540 3274 003.	Band 2 L	540 3274 003	
Z110	TUNER, RF: No. 8; consists of one fixed mica 120 UUF capacitor; one variable ceramic 8-50 UUF capacitor; one RF coil; (cont.)	Band 3 Pl	540 3277 003	

3. Identification Table of Parts for Radio Frequency Oscillator 0-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Z110 (cont.)	42.5 turns at 37.808 TPl; top and bottom plate; supporting post; rack mtd; Collins part dwg #540 3277 003.			
Z111	TUNER, RF: No. 9; consists of one fixed mica 180 UUF Capacitor; two fixed mica 510 UUF capacitor; one RF coil; 28.0 turns at 24.9 TPl; top and bottom plate; supporting post; rack mtd; Collins Rad part/dwg #540 3278 003.	Band 3 L	540 3278 003	
Z112	TUNER, RF: No. 6; consists of one fixed mica 24 UUF capacitor; one variable ceramic 8-50 UUF capacitor; one RF coil, 30.5 turns at 27.083 TPl; top and bottom plate; supporting post; rack mtd; Collins Rad part/dwg #540 3275 003.	Band 4 Pl	540 3275 003	
Z113	TUNER, RF: No. 7; consists of one fixed mica 510 UUF capacitor; one RF coil; 19.5 turns at 17.3076 TPl; top and bottom plate; supporting post, rack mtd; Collins Rad part/dwg #540 3276 003.	Band 4 L	540 3276 003	
Z114	TUNER, RF: No. 11; consists of one variable ceramic 8-50 UUF capacitor; one RF coil, 21.0 turns at 18.66 TPl; top and bottom plate; rack mtd; Collins Rad part/dwg #540 3280 003.	Band 5 Pl	540 3280 003	
Z115	TUNER, RF: No. 10; consists of one fixed mica 33 UUF capacitor; one fixed mica 220 UUF capacitor; one RF coil; 14.0 turns at 12.43 TPl; top and bottom plate; supporting post; rack mtd; Collins Rad part/dwg #540 3279 003.	Band 5 L	540 3279 003	

Z116	TUNER, RF: No. 13; consists of one variable ceramic 3-12 UUF capacitor; one RF coil, 14.0 total no. of turns, 4.0 at 14 TPl, 6.0 at 18 TPl, 40 at 16 TPl; top and bottom plate; supporting post; rack mtd; Collins Rad part/dwg #540 3282 003.	Band 6 Pl	540 3282 003	
Z117	TUNER, RF: No. 12; consists of one fixed mica 15 UUF one fixed mica 150 UUF capacitor; one RF coil, 9.5 turns at 8.45 TPl; top and bottom plate; supporting post; rack mtd; Collins part/dwg #540 3281 003.	Band 6 L	540 3281 003	
0129 0138	WASHER, curved: copper; Iridite #7 metcote; round; 9/16" OD x 7/32" ID x 0.003" thk; Collins Rad part/dwg #540 3305 002.	Clutch tension Clutch tension	540 3305 002	
H001	WASHER, flat: syn rubber; round; 0.020" ID; 11/32" OD, 1/16" thk; trimmer seal; Collins Rad part/dwg #506 6560 001.	Trimmer seal	506 6560 001	
H101 H102 H103 H104 H105 H107 H109	WASHER, flat: shim brass; round; 3/8" OD x 0.192" ID x 0.002" thk; Collins Rad part/dwg #500 1129 003.	Shimming Shimming Shimming Shimming Shimming Shimming Shimming	500 1129 003	
H106	WASHER, flat: #302 SS; round; 3/8" OD x 0.192" ID x 0.062" thk; Collins Rad part/dwg #500 1122 003.	Mounting hardware	500 1122 003	
H108	WASHER, flat: brass; round, 0.510" OD x 0.252" ID x 0.0105" thk; Collins Rad part/dwg #503 0644 00.	Stop ring spacers	503 0644 00	
H110 H111	WASHER, flat: shim brass; round; 5/16" OD x 0.133" ID x 0.005" thk; Collins Rad part/dwg #506 5928 003.	S103 shaft shim S102 shaft shim	506 5928 003	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
H114	WASHER, flat: brass; round; 0.437" OD x 0.255" ID x 0.003" thk; Collins Rad part/dwg #500 1086 003.	Shimming	500 1086 003	
O154	WASHER, flat: SS; round; 0.510" OD x 0.253" ID x 0.040" thk; Collins Rad part/dwg #503 0643 001.	Mech limit stop rings	503 0643 001	
O601	RETAINER, tube: beryllium copper; 2.999" lg x 1-3/4" w x 0.040" thk o/a; to accom tube 1-1/2" diam; two 0.193" mtg holes spaced 2.562" c to c; Collins Rad part/dwg #540 3633 003.	Retainer for V604	540 3633 003	
O602 O603	RETAINER, tube: beryllium copper; 2.999" lg x 1-3/4" w x 0.040" thk o/a; to accom tube 1-13/16" diam; two 0.193" mtg holes spaced 2.562" c to c; Collins Rad part/dwg #540 3634 003.	Retainer for V601 Retainer for V602	540 3634 003	
O604 O605 O606	SPRING: helical compression type; 0.042 oz spring steel; 0.285" OD x 1-1/8" lg o/a; 14 coils; RH turns; ends ground square; Lewis Spring to Collins Rad part/dwg #340 1020 00.	Tube retainer spring Tube retainer spring Tube retainer spring	340 1020 00	
H801	TOOL, alignment: SS type #303; 12-1/8" lg x 0.250" diam o/a; 1/8" x 30° chamfer on one end, opposite end plain; Collins Rad part/dwg #540 3704 002.	RF ampl alignment rod	540 3704 002	
H802	WRENCH: socket; 6 flute ea end; 0.094" across flats ea end; 1-31/32" lg x 0.094" dia one end; 45/64" lg x 0.094" diam other end at a 90° angle; steel, cad pl or zinc	#8 wrench	024 0019 00	

	pl; straight; for #8 Bristo set screw; The Bristol Co. to Collins Rad part/dwg #024 0019 00.			
H803	WRENCH: socket; 6 flutes ea end; 0.060" across flats ea end; 1-9/16" lg x 0.060" diam one end; 3/8" lg x 0.060" diam other end at a 90° angle; steel, cad or zinc pl; straight; for #4 Bristo set screw; The Bristol Co. to Collins Rad part/dwg #024 2900 00.	#4 wrench	024 2900 00	
H804	WRENCH: socket; 6 flutes ea end; 0.110" across flats ea end; 2-3/32" lg x 0.110" diam one end; 3/4" lg x 0.110" diam other end at a 90° angle; steel, cad pl or zinc pl; straight; for #10 Bristo set screw; The Bristol Co. to Collins Rad part/dwg #024 9710 00.	#10 wrench	024 9710 00	
H805	WRENCH: socket; 4 flutes ea end; 0.076" across flats ea end; 1-27/32" lg x 0.076" diam one end; 21/32" lg x 0.076" diam other end at 90° angle; steel cad or zinc pl; straight; for #6 Bristo set screw; The Bristol Co. to Collins Rad part/dwg #024 9730 00.	#6 wrench	024 9730 00	
H806	TOOL, alignment: c/o two plastic sleeves; one 26 ga beryllium copper insert, one 20 ga beryllium copper insert pinned to plastic tool handle; 4-9/16" lg x 5/16" diam o/a; used for tuning; Collins Rad part/dwg #540 3739 003.	General alignment	540 3739 003	
W802	CABLE ASSEMBLY, special purpose: servo input; RG-58C/U coaxial cable; single cond; stranded, 19 strands #17 AWG; tinned soft copper; 1900 v RMS max oper v; black vinyl jacket; 0.195" OD; 10-1/2" lg excl terminations; UG-88/U Connector Plug one ea (cont.)	Coaxial cable between J304 and J401	540 3726 002	

3. Identification Table of Parts for Radio Frequency Oscillator O-152(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
W802 (cont.)	end; w/ cable marker embossed w/ W802; Collins Rad part/dwg #540 3726 002.			
W803	CABLE ASSEMBLY, special purpose: osc output; RG-58C/U coaxial cable; single cond; stranded, 19 strands #17 AWG; tinned soft copper; 1900 v RMS max oper v; black vinyl jacket; 0.195" OD; 12-3/4" lg excl terminations; UG-291/U Connector Receptacle one ea end; w/ cable marker embossed w/ W803; Collins Rad part/dwg #540 3576 002.	RF coaxial cable between J815 and J816	540 3576 002	

4. Identification Table of Parts for Electrical Power Cable Assembly CX-1619( )/U

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 11	CABLE ASSEMBLY, POWER, ELECTRICAL: cable data - AN, type no. WM-4/U, 28 conductors, stranded, no. 22 AWG, in accordance with specification RE13A 737D, materials in sequence from insulated conductors out - cotton braid, shield braid, vinyl jacket, in accordance with Navy Spec RE 13A 737D; 77-13/16 in. lg. over-all dimensions; 2 Cinch Mfg. Co. fanning strips type 160 on first end, 1 Collins Radio Co. adapter box on second end; Sig C Cable assembly, power, electrical CX-1619( )/U; Sig C Specification SCL-1289A. Collins Rad part/dwg #522 0078 005	Transmit frequency control information from Radio Receiver R-390/URR to Rf oscillator O-152(XC-1)/URA-13	522 0078 005	
O-902 O-906 O-909 O-913	BEARING, sleeve: shaft; porous bronze; 11/64" lg x 15/32" OD x 0.1885" ID; Chrysler type #F-347; Collins Rad part/dwg #309 0079 00	Bearings	309 0079 00	2Z581-135
0915 0918	BEARING, sleeve: shaft; porous bronze; 11/64" lg x 15/32" OD x 0.251" ID; Chrysler type #F-346; Collins Rad part/dwg #309 0086 00	Friction Reduction Friction Reduction	309 0086 00	2Z581-103
W905	CABLE, special purpose: radio power and control; 8 ft 28 cond #22 ga copper wire; 7 strands ea of 0.010" copper wire; 0.020" min cond ins; cotton braid inner jacket; outer jacket .750 + .000 - .030" OD; Collins Rad part/dwg #424 0007 00.	Carries freq. info. lines	424 0007 00	
0923	CLAMP: shaft coupling; extruded aluminum 75 ST 6; anodized; w/ one 6 flute socket head cap screw w/ tapped #4-40 NC-2 (cont.)	Gear clamp with screw	540 3931 001	

4. Identification Table of Parts for Electrical Power Cable Assembly CX-1619( )/U

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
0923 (cont.)	sq nut; 0.664" dia x 0.200" thk; 0.116" dia mtg hole to accom screw; 0.312" dia mtg shaft hole; Collins Rad part/dwg #540 3931 001	Gear clamp with		
0903 0907 0910 0914 0916 0919	COLLAR, spacing: bearing thimble; #302 SS; rd; 1/2" OD x 0.357: ID x 0.150" thk; fits in 0.377" dia mtg hole; Collins Rad part/dwg #507 5618 001	Bearing Bushing Bearing Bushing Bearing Bushing Bearing Bushing Bearing Bushing Bearing Bushing	507 5618 001	
0901	COUPLING, rigid: split; two shaft openings one 0.187" dia, other 0.257" dia; 4 slots equally spaced 0.031" wd x 0.200" d; #303 SS; mtg by pin 0.375" lg x 0.063" dia; 0.578" lg x 3/8" dia o/a; Collins Rad part/dwg #506 9020 002	Shaft coupler	506 9020 002	
	COVER: switch; 3S-814 aluminum, chromate dipped; rectangular shape; 3-9/16" lg x 3" wide x 2-9/16" h; 5 mtg holes tapped #4-40 NC-2 and 0.140" dia for 5/32"; w/ 5 aluminum, chromate dipped pan head screws and 5 SS lock washers; Collins Rad part/dwg #540 1466 001	Switch cover	540 1466 001	
0905	GEAR: spur type; type #303 SS; straight teeth; 24 teeth; 48 pitch; .5000 PD; 0.5468" OD x 7/16" ID x 0.223" thk; 0.187" dia ctr shaft mtg hole; straight face; Collins Rad part/dwg #506 9010 002	Reduction drive gear	506 9010 002	
0912	GEAR: spur type; brass; straight teeth; 45 teeth; 48 pitch; .9375 PD; 15/64" lg x 1" dia; straight face; 0.22" lg x 0.187" dia	Reduction drive gear	506 9016 002	

	#303 SS hub; mtg by pressed onto hub; Collins Rad part/dwg #506 9016 002			
0920 0921	RING, retainer: spring steel; cad pl; rd; 0.250" OD x 0.225" free dia x 0.025" thk; shaft mtd; Waldes #5100-25; Collins Rad part/ dwg #340 0025 00	Mounting hdw. Mounting hdw.	340 0025 00	
0922	RING, retainer; steel; cadmium pl; "E" shape; 0.230" OD x 0.015" thk; shaft mtd; Waldes #5133-12	Mounting hdw.		
0904	SHAFT: drive; type #303 SS; 0.955" lg x .187" dia o/a; one groove 0.095" dia x 0.017" wd; Collins Rad part/ dwg #506 9009 002.	Drive shaft	506 9009 002	
0911	SHAFT: switch; #303 SS; with 18 tooth, 48 pitch, .3750 PD, straight teeth gear; drive collar, .187" lg x .248" wd x .156" thk; 7/16" lg x 27/32" dia o/a; Collins Rad part/dwg 506 9012 002.	S901C shaft	506 9012 002	
0917	SHAFT: switch, 32 position; type #303 SS; with 96 tooth, 48 pitch, 2.000 PD, straight tooth, brass gear, pressed on shaft; 1.437" lg x 2-1/16" dia o/a; Collins Rad part/dwg 506 9005 002	S901 A and B shaft	506 9005 002	
E901	STRIP, fanning: laminated phenolic type PBE; 14 term spaced 3/8" c to c; 5-15/16" lg x 1-15/32" wd x 1/4" thk; mtg by 0.144" dia hole; Jones HB #14-160-L; Collins Rad part/dwg #367 0622 00	Carries freq. info lines (Mates TB-803)	367 0622 00	
E902	STRIP, fanning: laminated phenolic type PBE; 14 terminals spaced 3/8" c to c; 5-15/16" lg x 1-15/32" wd x 1/4" thk; mtg by 0.144" dia hole; Jones HB #14-160-R; Collins Rad part/dwg #367 0602 00	Freq. info lines (Mates TB-804)	367 0602 00	

4. Identification Table of Parts for Electrical Power Cable Assembly CX-1619( )/U

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
S901A S901B	SWITCH, rotary: SPST, 32 positions; 1 sect; spring silver alloy clips; coin silver rotor blades; Richardson T-812 ins. 2.375" lg x 2.063" wd x 0.062" thk; mtg by four 0.155" dia holes spaced 2.063 mtg/c; Oak 10940; Collins Rad part/dwg #269 1489 00	Band switch info Osc MC positioning info	269 1489 00	3Z9903E-10.24
S901C	SWITCH, rotary: SPST, 12 positions; 1 sect; spring silver alloy clips; coin silver alloy rotor blades; phenolic ins; front non-shorting, rear, shorting type; 1-1/4" dia x 1-5/16" h x .062" thk; mtg by two #4 screws spaced 1.031" mtg/c; Oak type F; Collins Rad part/dwg #269 1637 00	Recycle switch	269 1637 00	

5. Identification Table of Parts for Electrical Power Cable Assembly CX-2405( )/U

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 11	CABLE ASSEMBLY, POWER, ELECTRICAL: cable data - Sig C type SJ, 2 conductors, stranded, no. 18 AWG, cotton separator, rubber insulation in accordance with Sig C specification 71-4945, materials in sequence from insulated conductors out - cotton filler, rubber jacket, 300 v rms max rated working voltage; 6 ft. 5-1/2 in. lg over-all dimension; 1 American Phenolic Co. male connector plug no. 164-201-1P (312) on first end, 1 American Phenolic Co. female connector plug no. 164-201-1S (320) on second end; 41 strands of no. 34 AWG conductor stranding; Sig C	Power input cable to oscillator Group AN/URA-13	522 0056 002	

	Power Cable Assembly CX-2405( )/U; Sig C specification SCL-1289-A. Collins Rad part/dwg #522 0056 002			
W904	CABLE, special purpose: power; 6 ft, 2 conds 41 strand ea of #34 AWG copper wire; cotton separator and rubber cond ins; 300 v AC rating; rubber jacket 0.300" OD; Alpha Wire part #1952SC; Collins Rad part/dwg #424 0022 00	Conducts power from 0152 to recr	424 0022 00	1B3018-2.28
P902	CONNECTOR, plug: male; 4 round conts polarized; straight; 1-11/16" lg x 1-1/2" wd x 2-3/32" h o/a; cont rating 20 amps at 230 v AC RMS, 35 amps at 115 v AC RMS; plastic ins; 0.312" cable opening; Amphenol #164-201-1P; Collins Rad part/dwg #372 1160 00	Connects recr power cord to 0152		
P903	CONNECTOR, plug: 4 round female conts, polarized; straight; 1-11/16" lg x 1-1/2" wd x 2-3/32" h o/a; cont; rating 20 amps at 230 v AC RMS, 35 amps at 115 v AC RMS; plastic ins; 0.312" cable opening; Amphenol #164-201-1S; Collins Rad part/dwg #372 1170 00	Connects power to recr	372 1170 00	

6. Identification Table of Parts for Rf Cable Assembly CG-409( )/U (10 ft)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 11	CABLE ASSEMBLY, RADIO FREQUENCY: cable data - AN, radio frequency cable, type no. RG-58C/U, coaxial, 50 ohms characteristic impedance, 1900 v rms max operating voltage, single conductor of 19 strands of no. (cont.)	Transmit rf signal from Rf Oscillator 0152(XC-1)/URA-13 to associated transmitter	522 0047 002	3E5999A-170

6. Identification Table of Parts for Rf Cable Assembly CG-409( )/U (10 ft)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 11 (cont.)	17 AWG tinned copper wire, 0.116 in. OD polyethylene dielectric, single tinned copper shield, round shape, 0.195 in. dia, black vinyl jacket; 10 ft 1-15/16 in. lg over-all dimensions, 10 ft. lg excluding terminations; two AN type no. UG-88/U connector plugs one ea end; impregnated with fungicidal varnish; Sig C Radio frequency cable assembly CG-409( )/U; Sig C specification SCL-1289A. Collins Rad part/dwg #522 0047 002			
W901	CABLE, RF: coaxial; 10 ft, 50.0 ±2 ohms impedance, 28.5 mmf/ft; 1900 v RMS; single braid tinned copper; 19 strand per cond; polyethylene dielectric; 0.195" dia jacket; Amphenol RG-58C/U; Collins Rad part/dwg #425 0042 00	50 v RF output cable	425 0042 00	
P906 P907	CONNECTOR, plug: RG-58/U; male; 1 cont; round; straight type; 1-1/32" lg x 0.563" dia; cylindrical; teflon insert; bayonet locking type; 0.206" cable opening; Amphenol UG-88/U; Collins Rad part/dwg #357 9018 00.	Connects to 50 v RF output (Mates J-814) Connects to 50 v load (Mates J906)	357 9018 00	

7. Identification Table of Parts for Rf Cable Assembly CG-409( )/U (6 ft)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 11	CABLE ASSEMBLY, RADIO FREQUENCY: cable data - AN, radio frequency cable, type no. RG-58C/U, coaxial, 50 ohms characteristic impedance, 1900 v rms max operating voltage, single conductor of 19 strands of no. 17 AWG tinned copper wire, 0.116 in. OD polyethylene dielectric, single tinned copper shield, round	Transmitt if. signal from Radio Receiver R-390/URR to Rf Oscillator O-152(XC-1)/URA-13	522 0049 002	3E5999A-169

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 11 (cont.)	shape, 0.195 in. dia, black vinyl jacket; 73-15/16 in. lg over-all dimensions, 6 ft lg, excluding terminations; 2 AN type no. UG-88/U connector plug one ea end; impregnated with fungicidal varnish; Sig C Radio Frequency Cable Assembly CG-409( )/U; Sig C Specification SCL-1289A. Collins Rad part/dwg #522 0049 002			
W902	CABLE, RF: coaxial; 50.0 ±2 ohms impedance; 28.5 mmf/ft; 1900 v RMS; single braid tinned copper, 19 strands per cond; polyethylene dielectric; 0.195" dia jacket; Amphenol RG-58C/U; Collins Rad part/dwg #425 0042 00	455 KC IF. sig from recr to 0152	425 0042 00	
P910	CONNECTOR, plug: RG-58/U; male; 1 cont; round; straight type; 1-1/32" x 0.563" dia; cylindrical; teflon insert; bayonet locking type; 0.206" cable opening; Amphenol UG-88/U; Collins Rad part/dwg #357 9018 00	Connector for IF input to 0152 (Mates I812)	357 9018 00	
P911		Connector to Recr output		

8. Identification Table of parts for Rf Cable Assembly CG-833( )/U

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 11	RADIO FREQUENCY CABLE ASSEMBLY: cable data - AN, radio frequency cable, type no. RG-58C/U, coaxial, 50 ohms characteristic impedance, 1900 v rms max operating voltage, single conductor of 19 strands of no. 17 AWG tinned copper wire, 0.116 in. OD polyethylene dielectric, single tinned copper shield, round shape, 0.195 in. dia, black vinyl jacket; 74-5/16" lg o/a dim, 6 ft lg excluding terminations; 1 AN type no. UG-88/U connector plug one end and 1 AN type no. UG-709/U connector other end; impregnated with fungicidal varnish; (cont.)	Transmit rf signal from Rf Oscillator O-152(XC-1)/URA-13 to Radio Receiver R-390/URR	522 0048 002	

8. Identification Table of Parts for Rf Cable Assembly CG-833( )/U

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 11 (cont.)	Sig C Radio Frequency Cable Assembly CG-833( )/U; Sig C specification SCL-1289A. Collins Rad part/dwg #522 0048 002			
W903	CABLE, RF: coaxial; 50.0 ±2 ohms impedance 28.5 mmf/ft; 1900 v RMS; single braid tinned copper; 19 strands per cond; polyethylene dielectric; 0.195" dia jacket; Amphenol RG-58C/U; Collins Rad part/dwg #425 0042 00	RF signal to recr	425 0042 00	
P908	CONNECTOR, plug: RG-58/U; male; 1 cont; round; straight type; 1-1/32" lg x 0.563" dia; cylindrical; teflon insert; bayonet locking type; 0.206" cable opening; Amphenol UG-88/U; Collins Rad part/dwg #357 9018 00	Connects RF sig to recr ant.(Mates J813)	357 9018 00	
P909	CONNECTOR, plug: single round male cont; straight type; 1-11/32" lg x 3/4" dia o/a; cylindrical body; brass, silver pl; Industrial Products Co. UG-709/U Collins Rad part/dwg #357 9167 00	Connects to recr whip antenna lead	357 9167 00	

9. Identification Table of Parts of Electrical Dummy Load DA-85( )/U

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 13	DUMMY, LOAD, ELECTRICAL: resistive impedance; 1.5 mc to 32 mc operating frequency range; 50 ohms input load impedance; 2 terminals, UG-290/U connector BNC type on first end, pins to fit crystal socket HC-6/U on second end, axial at ends; 4-7/32" lg, (excluding terminations), 1" dia o/a dim; crystal socket mounted;	Dummy load for Rf oscillator 0152(XC-1)/URA-13	522 0071 003	

	provides a 50 ohm termination for O-152( )/URA-13; Sig C Dummy, load, electrical DA-85( )/URA-13; Sig C specification SCL-1289A. Collins Rad part/dwg no. 522 0071 003			
J905	CONNECTOR, receptacle: male, round, 2 conts; straight type; 1" lg x 0.923" OD; brass, ternary pl (copper, tin and zinc) body; pins to fit crystal socket HC-6/U; mtd by two tapped #2-56 NC-2 x 3/16" d holes, one ea side; w/ one solder lug term; Collins Rad part/dwg #522 0071 023	Rf output from load	522 0071 023	
J906	CONNECTOR, receptacle: UG-290/U; male; round; 2 conts; polarized; straight type; 1-1/16" lg x 11/16" wd x 11/16" h o/a; phenolic; cylindrical; sq mtg fl; locking type; mtg by four #3-56 NF-2 holes spaced 1/2" mtg/c; Amphenol UG-290/U; Collins Rad part/dwg #357 9054 00	Connects CG-490/U to DA-85/U	357 9054 00	2Z7390-290
R901 R902	RESISTOR, fixed: oxide element, glass base; 100 ohm ±1% tol; 3-1/2 w at 85°C, temp coef -55°C to 100°C; 2-5/8" lg x 5/16" dia excl terms; high temp enamel finish; two 0.025 min dia x 1-1/4" lg min tinned copper leads; Corning Glass type EC; Collins Rad part/dwg #714 1124 00	Load for RF ampl. Load for RF ampl.	714 1124 00	

10. Identification Table of Parts for Panel Cover 261(XC-1)/URA-13

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 12	COVER, PANEL: aluminum; non wrinkle gray in accordance with Federal Spec TT-C-595; 19" length, 10-1/2" width, 1-1/8" height over-all dimensions; rack mounted; to mask unused knobs; Sig C Cover, panel (cont.)	Cover unused controls of Radio Receiver R-390/URR	522 0074 004	2Z3350.261

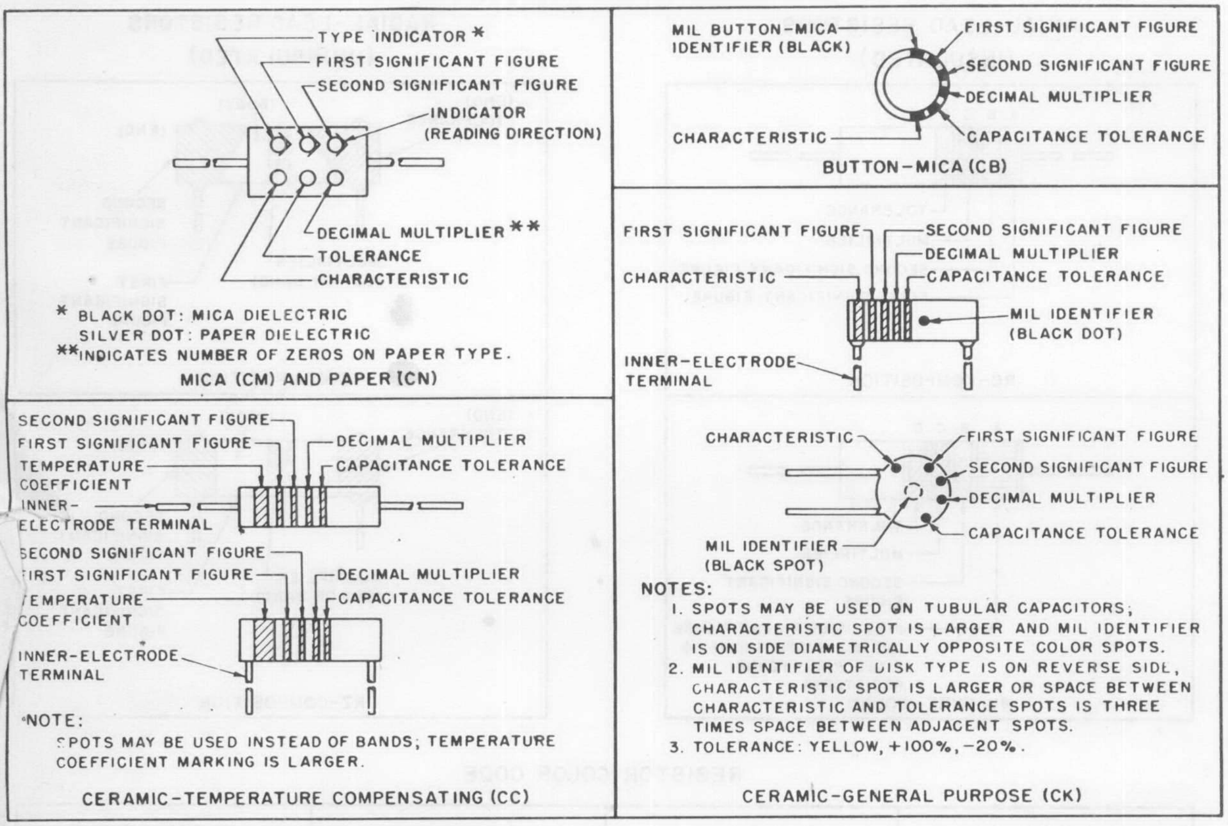
10. Identification Table of Parts for Panel Cover 261(XC-1)/URA-13 (cont.)

Ref symbol	Name of part and description	Function of part	Collins Rad part/dwg No.	Sig Corps stock No.
Fig. 12 (cont.)	CW-261( )/URA-13; Sig C specification SCL-1289A. Collins Rad part/dwg #522 0074 004			

11. Identification Table of Parts for Radio Receiver R-390( )/URR and Electrical Power Cable Assembly CX-1358( )/U

The identification table of parts for Radio Receiver R-390( )/URR and Electrical Power Cable Assembly CX-1358( )/U is included in the Instruction Book for Radio Receiver R-390/URR.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



CAPACITOR COLOR CODE

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

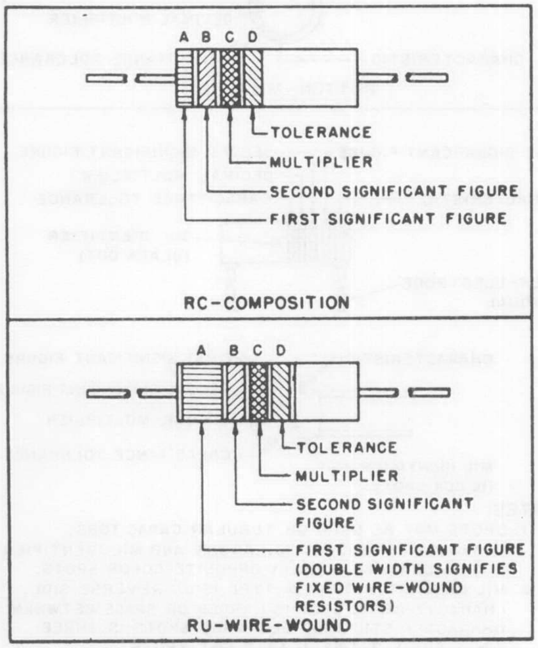
1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-C1

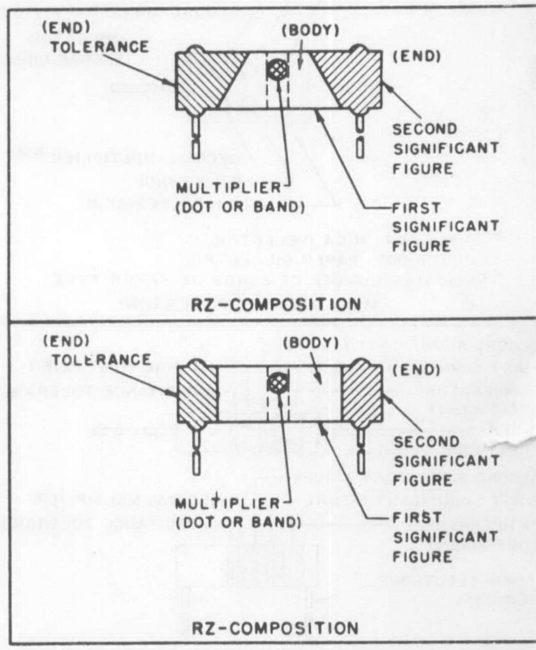
Figure 109. Capacitor color code.

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)



RADIAL-LEAD RESISTORS (UNINSULATED)



RESISTOR COLOR CODE

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

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

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

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

STD-R1

Army Ft Mon N. J.

Figure 108. Resistor color code.