CG-273-34

TECHNICAL MANUAL

for

RADIO RECEIVER R-649/UR

N2ZD

THE HALLICRAFTERS COMPANY
4401 W. Fifth Avenue
CHICAGO 24, ILLINOIS

U.S. COAST GUARD TREASURY DEPARTMENT

CG-273-34

TECHNICAL MANUAL

for

RADIO RECEIVER R-649/UR

THE HALLICRAFTERS COMPANY
4401 W. Fifth Avenue
CHICAGO 24, ILLINOIS

U.S. COAST GUARD TREASURY DEPARTMENT

Contract: TCG-39599

Approved by Commandant, U.S. Coast Guard: 21 November 1957

LIST OF EFFECTIVE PAGES

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
Title Page	Original	4-1 to 4-4	Original
A to C	Original	5-1 to 5-2	Original
i to v	Original	6-1 to 6-3	Original
1-0 to 1-3	Original	7-0 to 7-34	Original
2-0 to 2-12	Original	8-1 to 8-19	Original
3-1 to 3-6	Original	i-0 to i-4	Original

UNITED STATES COAST GUARD

8 January 1957

ADDRESS REPLY TO:
COMMANDANT
U. S. COAST GUARD
HEADQUARTERS
WASHINGTON 25, D. C.

LETTER OF PROMULGATION

1. CG-273-34 is the Technical Manual for Radio Receiver R-649/UR and is in effect upon receipt. The two copies furnished with the equipment are parts thereof and shall always accompany the basic equipment.

2. Extracts from this publication may be made to facilitate the preparation of other technical manuals and handbooks.

3. Copies of this publication may be obtained by requisition to the Commanding Officer, Coast Guard Supply Center, Brooklyn, New York.

4. Corrections to this publication will be made by serially numbered amendments. They shall be entered promptly by the responsible personnel.

K. K. COWART
Rear Admiral, U. S. Coast Guard
Engineer-in-Chief
By direction of the Commandant

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (cont)

LIST OF TABLES

INDEX

GUARANTEE

The Contractor guarantees that at the time of delivery thereof the articles provided for under this contract will be free from any defects in material or workmanship and will conform to the requirements of this contract. Notice of such defect or nonconformance shall be given by the Government to the Contractor within two years of the delivery of the defective or nonconforming article, or within one year of the date it is placed in service, whichever expires first. To the extent the equipment, including all parts and spare parts, as defined above, is of the Contractor's design or is of a design selected by the Contractor, it is also guaranteed, subject to the foregoing conditions, against defects in design with the understanding that if ten percent (10%) or more of any such said item, but not less than two of any such item, of the total quantity comprising such item furnished under the contract, are found to be defective as to design, such item will be conclusively presumed to be of defective design and subject to one hundred percent (100%) correction or replacement by a suitably redesigned item. If required by the Government the Contractor shall with all possible speed correct or replace the defective or nonconforming article or part thereof. When such correction or replacement requires transportation of the article or part thereof, shipping costs, not exceeding usual charges, from the delivery point to the Contractor's plant and return, shall be borne by the Contractor; the Government shall bear all other shipping costs. This guaranty shall then continue as to corrected or replacing articles or, if only parts of such articles are corrected or replaced, to such corrected or replacing parts, until one year after re-delivery. If the Government does not require correction or replacement of a defective or nonconforming article, the Contractor, if required by the Contracting Officer within a reasonable time after the notice of defect or nonconformance, shall repay such portion of the contract price of the article as is equitable in the circumstances.

INSTALLATION RECORD

Contract Number TCG-39599 Date of Contract, 22 April 1954

Serial Number of equipment ....

Date of acceptance by the Coast Guard ....

Date of delivery to contract destination ....

Date of completion of installation ....

Date placed in service ....

Blank spaces on this page shall be filled in at time of installation.

REPORT OF FAILURE

Report of Failure of any part of this equipment, during its entire service life, shall be made to the Commandant via channels in accordance with current instructions using form CG-2643 (revised). The report shall cover all details of the failure and give data of installation of the equipment.

ORDERING PARTS

All requests or requisitions for replacement material should include the following data:
1. Stock Number.
2. Name and short description of part.

If the appropriate stock number is not available the following shall be specified:
1. Equipment model or type of designation, circuit symbol, and item number.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN, MIL or Navy type number.

DESTRUCTION OF ABANDONED MATERIAL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment, and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED, OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:
1. Explosives, when provided.
2. Hammers, axes, sledges, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper or wood.
4. Burying all debris, where possible and when time permits.
5. Throwing overboard or disposing of in streams or other bodies of water.

Procedure:
1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch and instrument boards.
3. Destroy all controls, switches, connections and meters.
4. Smash every electrical or mechanical part, whether rotating, moving or fixed.
5. Break up all operating instruments such as keys, phones, microphones, etc.
6. Bury or scatter all debris.

DESTROY EVERYTHING!

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of the Bureau of Ships Manual or superseding instructions on the subject of radio-safety precautions to be observed.

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS:

Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties always remove power and discharge and ground circuits prior to touching them.

DON'T SERVICE OR ADJUST ALONE:

Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

DON'T TAMPER WITH INTERLOCKS:

Do not depend upon door switches or interlocks for protection but always shut down motor generators or other power equipment. Under no circumstances should any access gate, door, or safety interlock switch be removed, short-circuited, or tampered with in any way, by other than authorized maintenance personnel, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR, OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE COAST GUARD SUPPLY CENTER, BROOKLYN, NEW YORK.

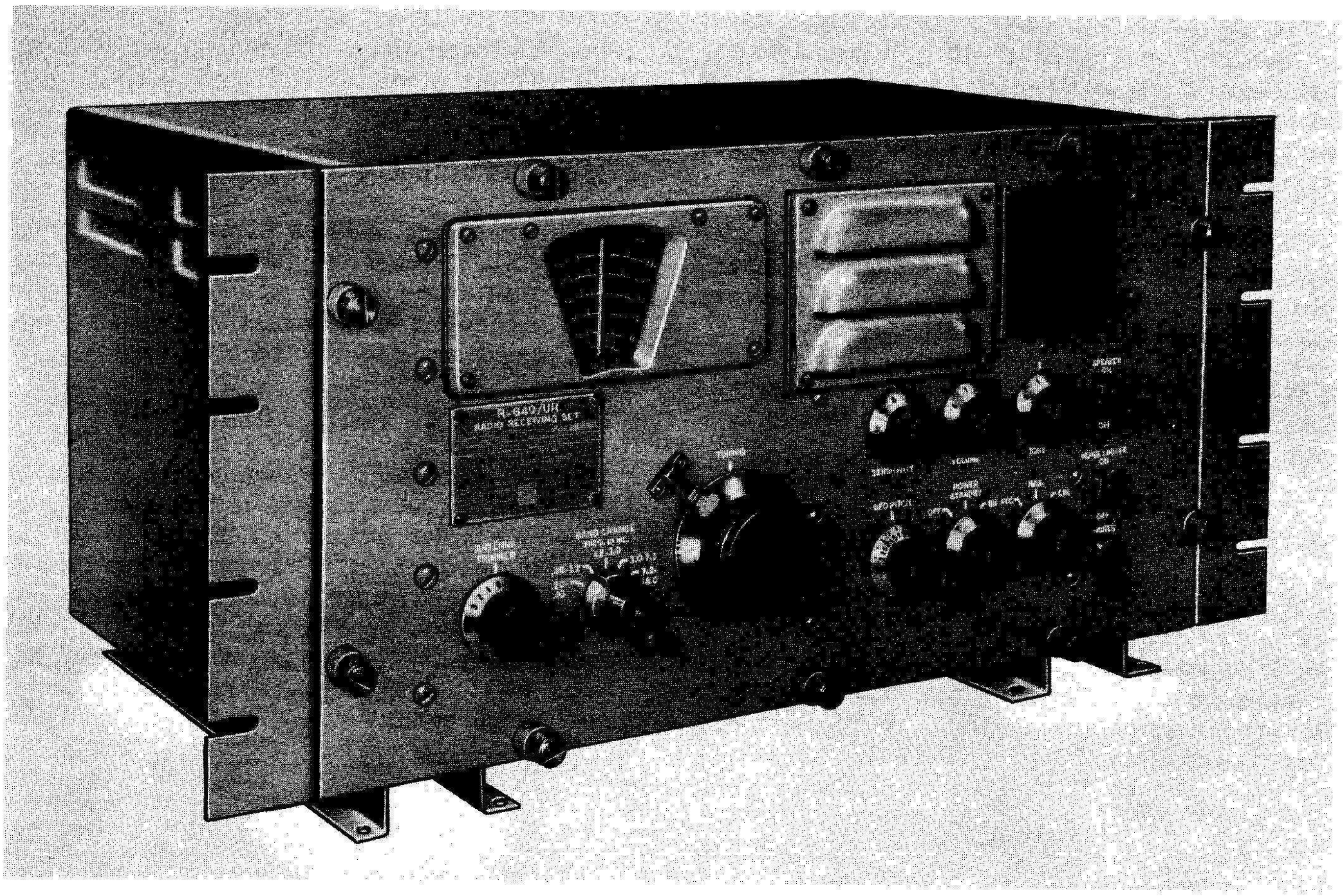


Figure 1-1. Radio Receiver R-649/UR

SECTION 1

GENERAL DESCRIPTION

1. PURPOSE AND BASIC PRINCIPLES.

a. Radio Receiver R-649/UR (figure 1-1) described in this technical manual is intended to be used in ship and shore installations of the U.S. Coast Guard. The receiver provides coverage through portions of the low frequency, medium high frequency and high frequency ranges.

b. Conventional radio frequency and audio frequency circuits are employed; the built-in power supply differs from the conventional power supply in its ability to function on either an alternating or direct current input.

c. Except for an antenna and connections to an external power source, the receiver is self contained, including loudspeaker. A phone jack and output terminals are provided for connecting headphones and external speakers.

d. A1 (cw), A2 (mcw) and A3 (am) signals can be received in two frequency ranges; 0.20 mc to 0.40 mc, and 0.49 mc to 18 mc.

e. The receiver can be mounted on a desk or table; it is also provided with gussets for rack mounting.

f. The receiver is designed for use under conditions of high humidity, temperature and vibration.

2. DESCRIPTION OF UNIT.

a. Radio Receiver R-649/UR is a 15 tube, superheterodyne receiver designed for the reception of cw, mcw and amplitude-modulated voice (A1, A2, A3) signals in five bands. Power requirements are 115 volts, 60 cycles per second, single phase, or 115 volts dc at 75 watts.

b. The chassis can be released from its steel cabinet and pulled forward for inspection or servicing. A release on the chassis allows the chassis to be completely removed from the cabinet.

c. The over-all dimensions of the cabinet are 20 inches wide by 14-1/4 inches deep by 10-1/2 inches high. When mounted on channel brackets the over-all height of the receiver is 12 inches. When provided with gussets for rack mounting, the over-all width of the receiver is 24 inches.

d. All tuning controls are located on the front panel. All fuses and power input terminals are located on the rear panel.

e. A beat frequency oscillator (BFO) is incorporated in the set to allow the reception of c-w (continuous wave) signals.

f. An automatic noise limiter (ANL) is provided for the reduction of noise impulses.

3. REFERENCE DATA.

a. The equipment covered in this technical manual is Radio Receiver R-649/UR.

b. The equipment is manufactured under Treasury Department Contract No. TCG-39599 dated 22 April 1954.

c. The set is manufactured by The Hallicrafters Company, 4401 West Fifth Avenue, Chicago 24, Illinois.

d. Cognizant Coast Guard inspector, e.g. Inspector of Electronic Material, U.S. Coast Guard Supply Center, 31st St. and 3rd Ave., Brooklyn 32, N.Y.

e. Each complete unit includes two packages, including spare parts.

f. Each receiver occupies 1.7 cu. ft. uncrated and 3.8 cu. ft. crated.

g. Each receiver weights 84 lbs. uncrated and 110 lbs. crated.

h. The frequency ranges of the receiver are 0.20 mc to 0.40 mc, and 0.49 mc to 18 mc.

i. Five tuning bands are provided:

Band 1.	.20 mc	to	.40	mc.
Band 2.	.49 mc	to	1.2	mc.
Band 3.	1.2 mc	to	3.0	mc.

Band 4. 3.0 mc to 7.3 mc.
Band 5. 7.3 mc to 18 mc.

j. The receiver is a superheterodyne type.

k. The receiver intermediate frequency is 455 kc.

l. The audio outputs are:

(1) 2 watts to the internal 6-ohm loudspeaker.

(2) 2 watts to a 600-ohm external loudspeaker.

(3) 10 milliwatts to 600-ohm headphones.

m. The receiver can receive cw (A1), mcw (A2), and voice (A3) signals.

n. The receiver input impedance is 300 ohms. Satisfactory reception can be achieved with an antenna impedance varying between 50 and 1000 ohms.

o. Maximum audio output is a minimum of two watts with less than ten percent distortion.

p. The terminal board labeled 600 and GRD, located on the rear of the receiver, is used for connecting a 600-ohm speaker. The 6-ohm internal speaker can be activated by switching the SPEAKER ON-OFF switch to the ON position. Either the internal or external speaker should be connected at all times. The PHONES jack on the front panel provides a means for connecting 600-ohm headphones.

TABLE 1-1. EQUIPMENT SUPPLIED

Quantity	Nomenclature	Length x Width x Height (Inches)	Weight (Pounds)
1	Radio Receiving Set, Coast Guard Model R-649/UR.	14-1/2 x 20 x 10-1/2	84
1	Isolation Transformer. (shipped in spare parts box)	4-9/16 x 3-1/16 x 6	6-5/8
1	Spare Parts Box (contains isolation transformer T101, spare parts and tubes; see table 8-2 for listing).	18 x 12 x 9	44

TABLE 1-2. EQUIPMENT REQUIRED BUT NOT SUPPLIED

Quantity	Nomenclature	Required Use	Required Characteristics
1	115-volt d-c input power	Receiver power	---
	or		
1	115-volt, single phase, 60 cps a-c power.	Receiver power	---
1	Receiving Antenna.	Reception of radio signals	50 to 1000 ohms
1	External speaker.	Reception	600 ohms
1	Headphones.	Reception	Any impedance

TABLE 1-3. SHIPPING DATA

Number of Boxes	Contents	Volume (Cu. Ft.)	Length x Width x Height (Inches)	Weight Packed (Pounds)
1	Radio Receiving Set, Coast Guard Model R-649/UR.	3.8	24-7/8 x 18-1/8 x 14-3/8	110
1	Spare parts box	2.1	20-7/8 x 14-7/8 x 11-1/2	45

TABLE 1-4. ELECTRON TUBE COMPLEMENT

Stage	JAN 6BH6	JAN 6BJ6	12AL5	12AV6	JAN 12AX7	JAN 12BE6	JAN 35L6GT	JAN 35Z5GT	JAN OA3	Total No. of Tubes
R.F. Ampl.	1									1
Mixer						1				1
Local Osc.		1								1
1st I.F. Ampl.	1									1
2nd I.F. Ampl.		1								1
3rd I.F. Ampl.		1								1
A.V.C.				1						1
B.F.O.		1								1
Detector, ANL			1							1
1st Audio Ampl. Phase Inverter					1					1
Audio Output							2			2
Rectifier								2		2
Voltage Reg.									1	1
Total Number of Each Type.	2	4	1	1	1	1	2	2	1	15

SECTION 2

THEORY OF OPERATION

1. GENERAL.

a. Radio Receiver R-649/UR is a superheterodyne receiver having a frequency range of 0.20 mc to 0.40 mc, and 0.49 mc to 18 mc. The signal path through the receiver is shown in the block diagram (figure 2-1). The signal from the antenna is transformer coupled to r-f amplifier V1. The amplified output of V1 is transformer coupled to the mixer (V2) where it is heterodyned with the signal from local oscillator V3 to generate an intermediate frequency (i-f) of 455 kc. This i-f output is transformer coupled to the 1st, 2nd and 3rd i-f amplifiers (V4, V5 and V6). The i-f output of V6 is coupled to the detector (V9A) where it is demodulated and fed into either audio amplifier V10B or the ANL (automatic noise limiter) V9B.

b. The ANL can be switched in series with the detector output and the audio amplifier when the reduction of noise or other electrical disturbances is desirable. The single-ended audio output is converted to push-pull in order to drive the push-pull audio output tubes V11 and V12. This is accomplished by using a paraphase amplifier consisting of audio amplifier V10B and phase inverter V10A, whose outputs are 180^{o} out of phase and substantially equal in amplitude. The output of audio amplifier V10B is applied to audio output tube V12; the output of phase inverter V10A is applied to audio output tube V11. The audio output tubes operate push-pull and amplify the signal to a power level sufficient to operate headphones and a speaker, or to feed a 600-ohm audio transmission line.

c. Reception of c-w (continuous wave) signals is provided by the BFO (beat-frequency oscillator) circuit (V8) which applies a signal to the 3rd i-f amplifier to beat with the i-f signal at an audio rate. Tube V7 operates in a delayed AVC (automatic volume control) circuit. The AVC circuit varies the bias on V1, V4, V5 and V6 in proportion to the incoming signal. This produces a self-balancing arrangement in which the audio output signal is held fairly constant even though the r-f signal strength varies greatly from station to station.

d. The d-c voltages for all stages are provided by the rectifier tubes (V13 and V14). The rectifier tubes are arranged to operate on either an a-c or d-c input. Plate voltage for tubes V1, V2, V3, and V8 is maintained at a constant voltage by regulator tube V15.

2. CIRCUIT ANALYSIS.

a. BANDSWITCHING.—Five sets of antenna, mixer, and local oscillator coils are used to tune the five bands covered by the receiver. In order to prevent stray coupling and resonant effects of the coils not in use, certain coils are short-circuited when not in use. The antenna transformers, T1 through T5, each have a primary and secondary winding. All unused primary windings of these transformers are short-circuited when not in use (figure 2-2). The secondary windings of T1 through T5, the primary and secondary windings of the mixer transformers, T10 through T14, and the local oscillator transformers T15 through T19 have their adjacent lower frequency coils short-circuited for all settings of BAND CHANGE control. For example, if the BAND CHANGE control is in the 1.2 - 3.0 position, all coils for the .49 - 1.2 band are short-circuited, as described above.

b. R-F AMPLIFIER. (Figure 2-3)

(1) The tuned circuits in this receiver, selected by BAND CHANGE switch S1, are essentially similar to each other in function; therefore, all discussions and illustrations relating to circuit analysis will assume that band 1 (0.20 mc to 0.40 mc) has been selected. The r-f amplifier stage (V1, a type 6BH6 tube) is coupled to the antenna circuit and amplifies the selected r-f signal while isolating the following stages from the antenna. Transformer T1 and capacitor C1 couple the grid to the antenna circuit.

(2) TUNING capacitor C41D and ANTENNA TRIMMER capacitor C40 resonate the secondary of T1 to the desired signal and provide the proper tracking of the r-f amplifier stage with the mixer and local oscillator stages. Inductance L9 prevents the BFO signal from entering the r-f amplifier circuit. The grid of V1 is con-

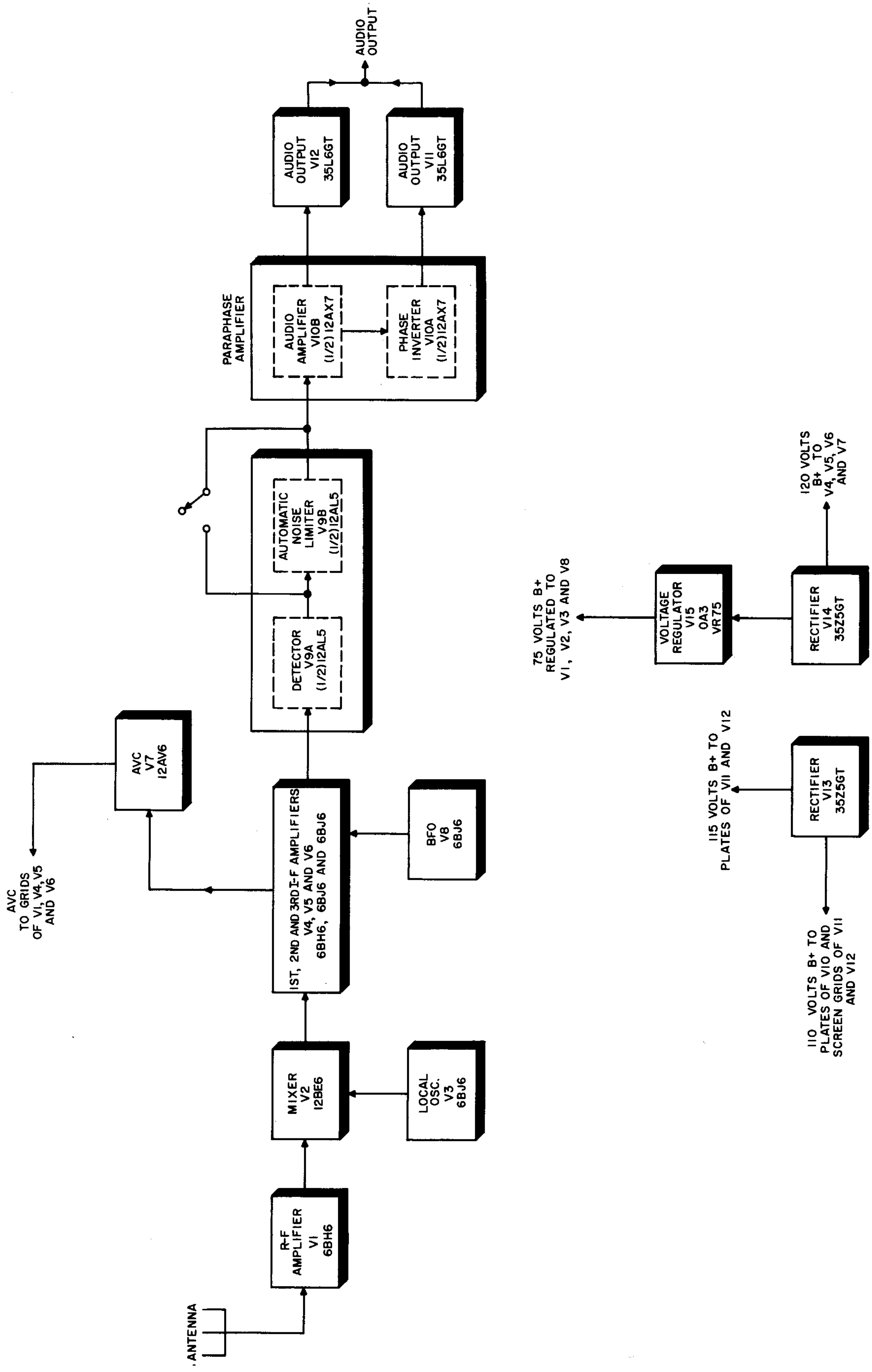


Figure 2-1. Radio Receiver R-649/UR, Block Diagram

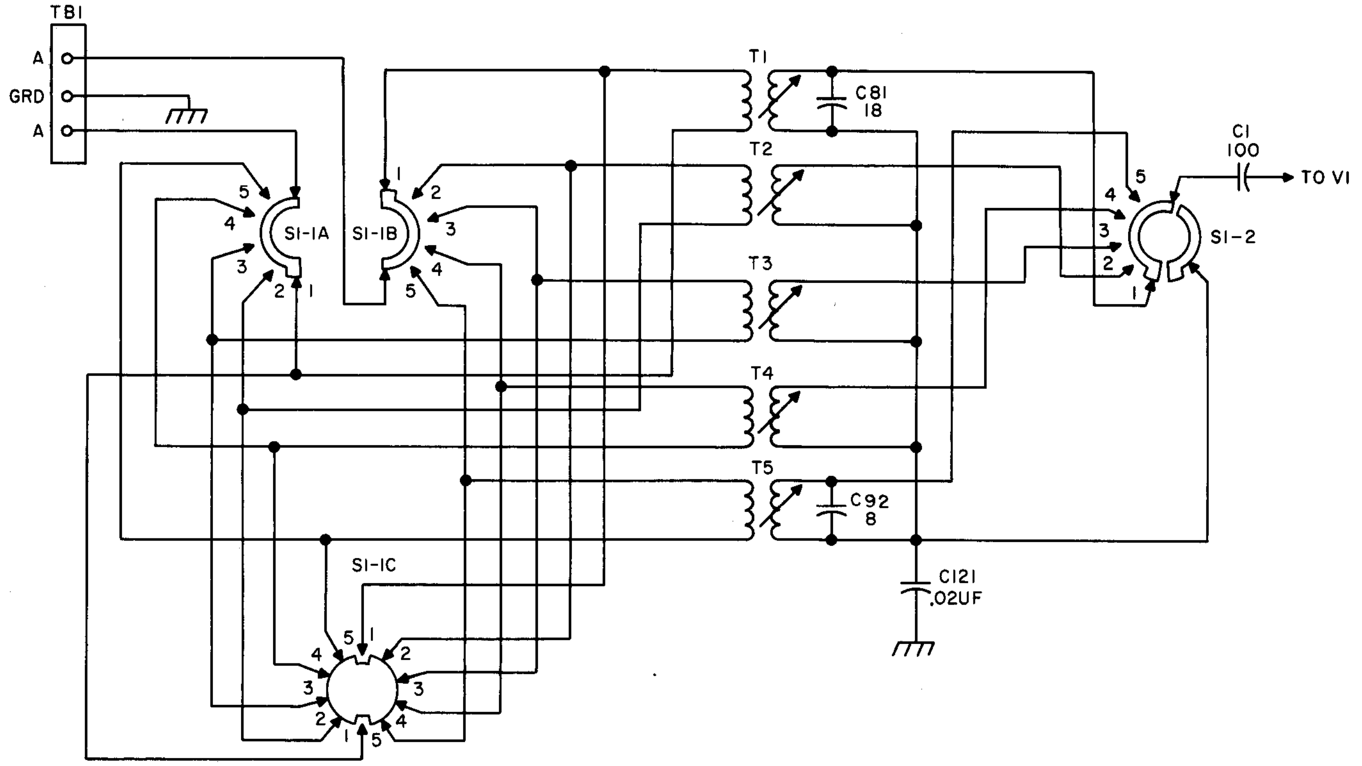


Figure 2-2. R-f Section Bandswitching

nected to B- through resistor R1, feedthrough capacitor C112 and the AVC circuit. Cathode bias is provided by resistor R2 and SENSITIVITY potentiometer R3. The cathode is held at a positive potential with respect to the grid by cathode current flow through R3 and R2 and B+ current flow through R3 and R4.

(3) The receiver sensitivity can be varied by varying the resistance of R3 and thus varying the bias. Resistor R4 is in series with R3 to provide a voltage dividing network. The amplified signal appearing in the plate circuit of tube V1 is coupled to the mixer tube V2, through transformer T10. Resistor R50 and capacitor C84

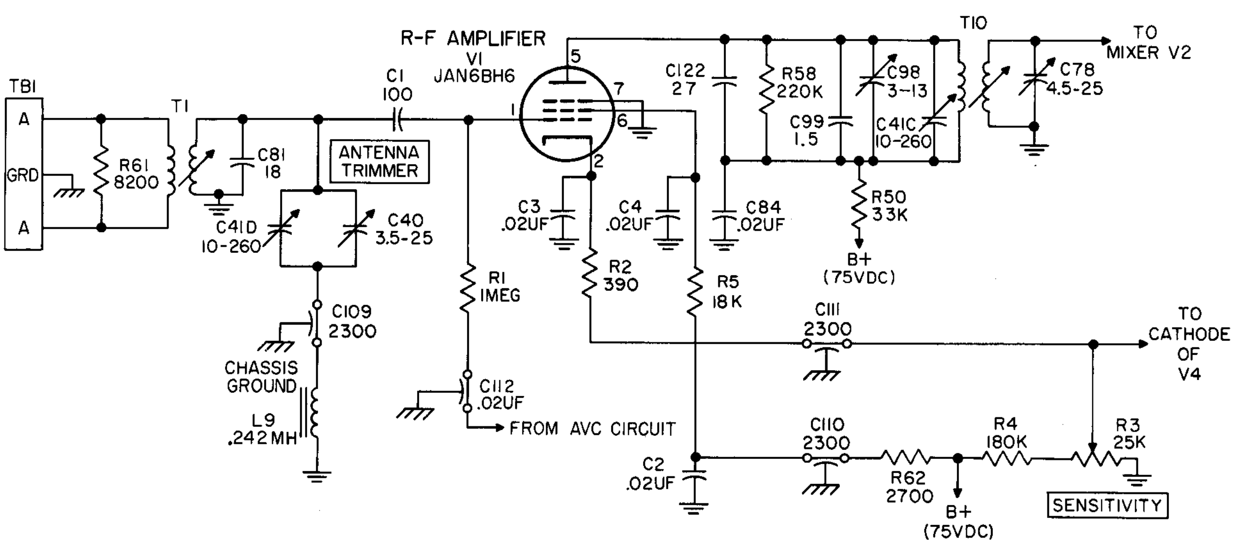


Figure 2-3. R-f Amplifier Simplified Schematic Diagram

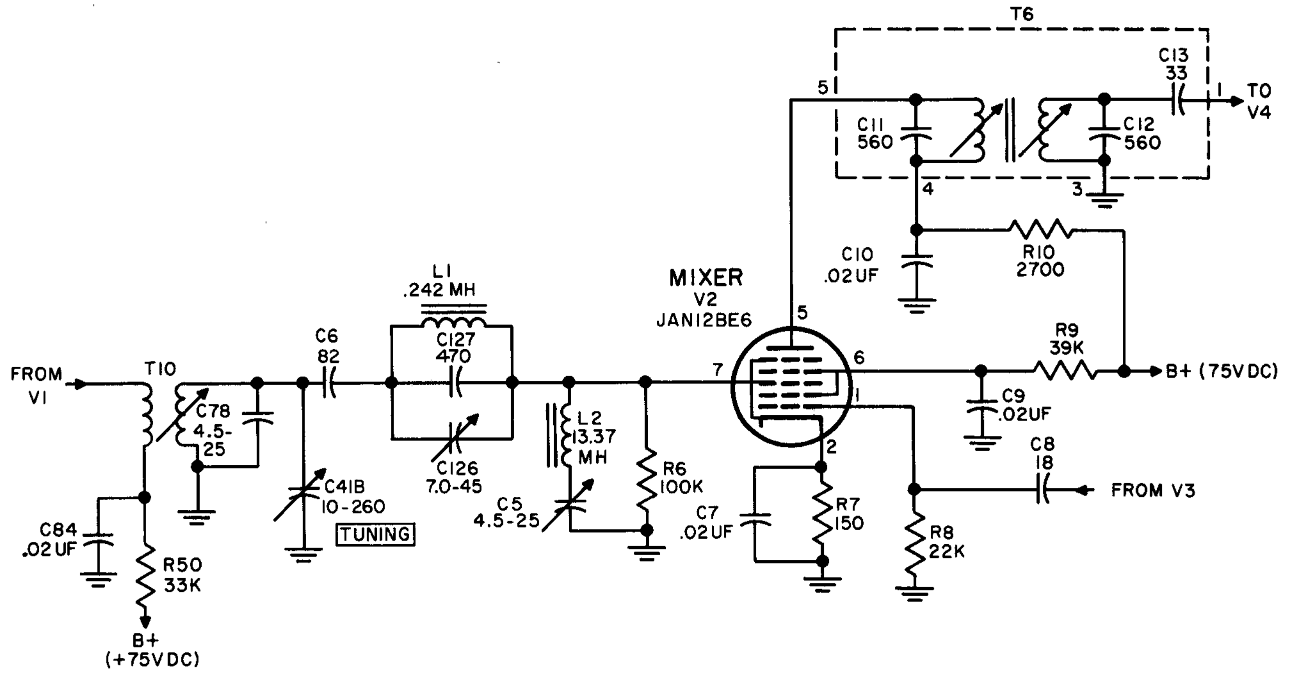


Figure 2-4. Mixer Simplified Schematic Diagram

form the plate decoupling network. Resistor R5 is the screen dropping resistor and C4 is the screen r-f bypass capacitor. Capacitor C41C tunes the primary of r-f transformer T10.

c. MIXER. (Figure 2-4)

(1) The 12BE6 mixer tube (V2) heterodynes the amplified r-f signal from V1 and the signal from the local oscillator to produce sum and difference frequencies. The output of the r-f amplifier is coupled to the signal grid of V2 through a resonant tank circuit consisting of T10, C78 and TUNING capacitor C41B.

(2) Capacitor C6 isolates the 455-kc traps from the tank circuit. Inductance L1, capacitor C127 and capacitor C126 form a parallel-resonant trap having a maximum impedance at 455 kc. Inductance L2 and capacitor C5 form a series resonant circuit offering a low impedance to a 455-kc signal, thereby shunting the 455-kc signal to ground. Since 455 kc is the intermediate frequency of this receiver, these traps prevent 455-kc signal from the receiver (and other receivers) from interfering with the selected signal. R6 is the grid return to ground. C7 is the cathode r-f bypass capacitor, and cathode bias is provided by R7. The local oscillator signal from V3 is coupled to the oscillator grid of V2 through capacitor C8.

(3) Resistor R8 permits the proper operating bias to be developed on the injection grid by the local oscillator signal. R9 is the screen voltage dropping resistor and C9 is the screen r-f bypass capacitor. Plate decoupling is provided by resistor R10 and capacitor C10. Transformer T6 is tuned to 455-kc and transfers the signal to the grid of the 1st i-f amplifier.

d. LOCAL OSCILLATOR. (Figure 2-5)

(1) A Hartley oscillator circuit provides the required local oscillator signal injection into mixer tube V2. This circuit is recognizable by the cathode feedback tap on the coil T15. A triode-connected type 6BJ6 tube is used in this circuit.

(2) Tuning is accomplished with gang capacitor C41A, and adjustable trimming and padding is provided by C42 and C43, respectively. In addition, the inductance of T15 is adjustable with the adjustable tuning core in the coil. Temperature compensation is provided with C52 and C53. The padding provided by C43 and C53 is required because the local oscillator operates 455 kc above the r-f frequency. Consequently, a given change in the oscillator TUNING capacitor would provide a larger change in frequency than the tuning gang capacitors for the r-f and mixer stages. The series capacitance of C43 and C53 in series with C42 and C52 effectively reduces

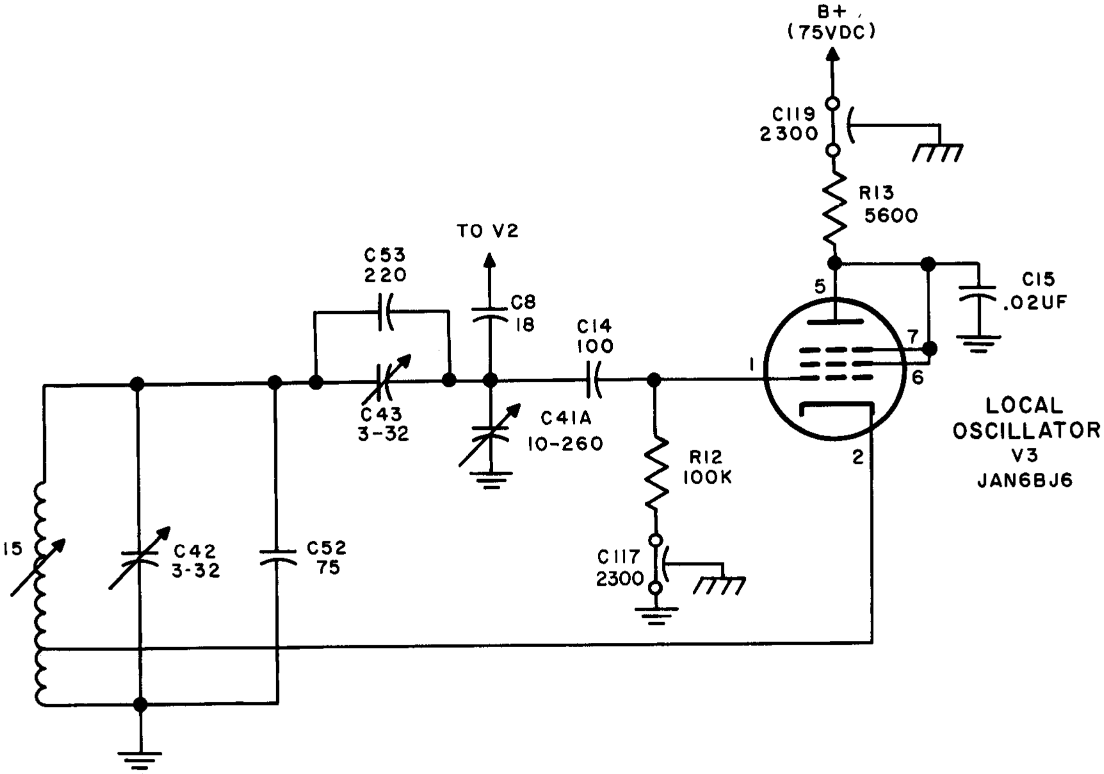
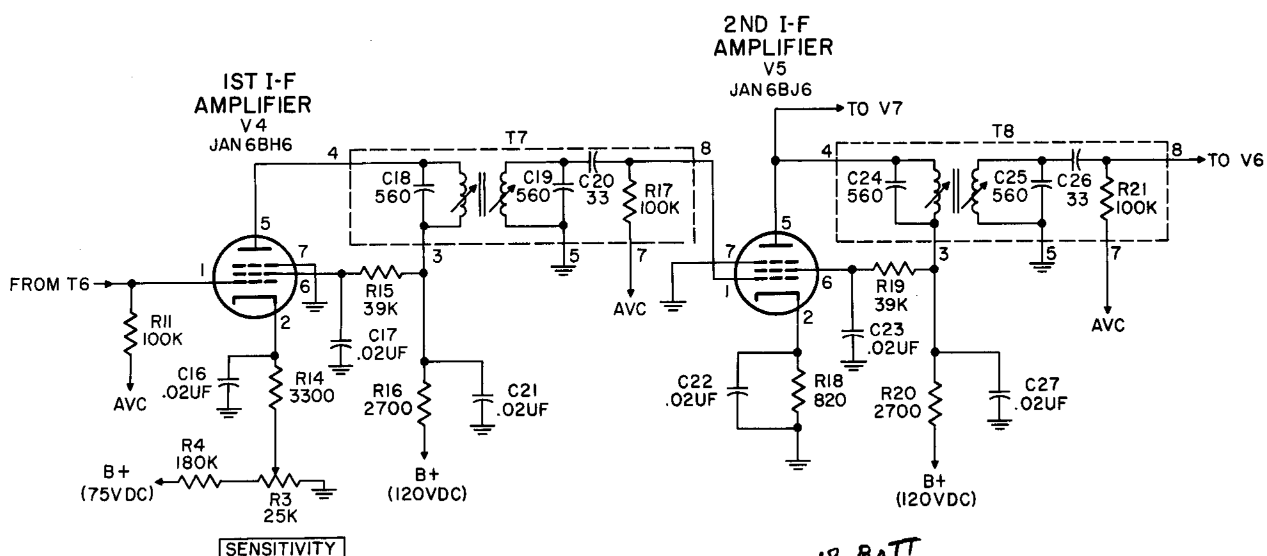


Figure 2-5. Local Oscillator Simplified Schematic Diagram

the equivalent tuning capacitance of C41A across T15 so that the local oscillator tuning tracks with the tuning of the r-f and mixer stages.

(3) Resistor R12 and capacitor C14 provide grid leak bias for tube V3. The plate circuit is bypassed to ground through C15, and thereby provides the feedback path required to promote and sustain oscillation. The signal developed by the local oscillator is coupled to the mixer tube V2 through capacitor C8. Plate circuit decoupling is provided by the combination of feedthrough



18 BoTT

Figure 2-6. First and Second I-f Amplifiers Simplified Schematic Diagram

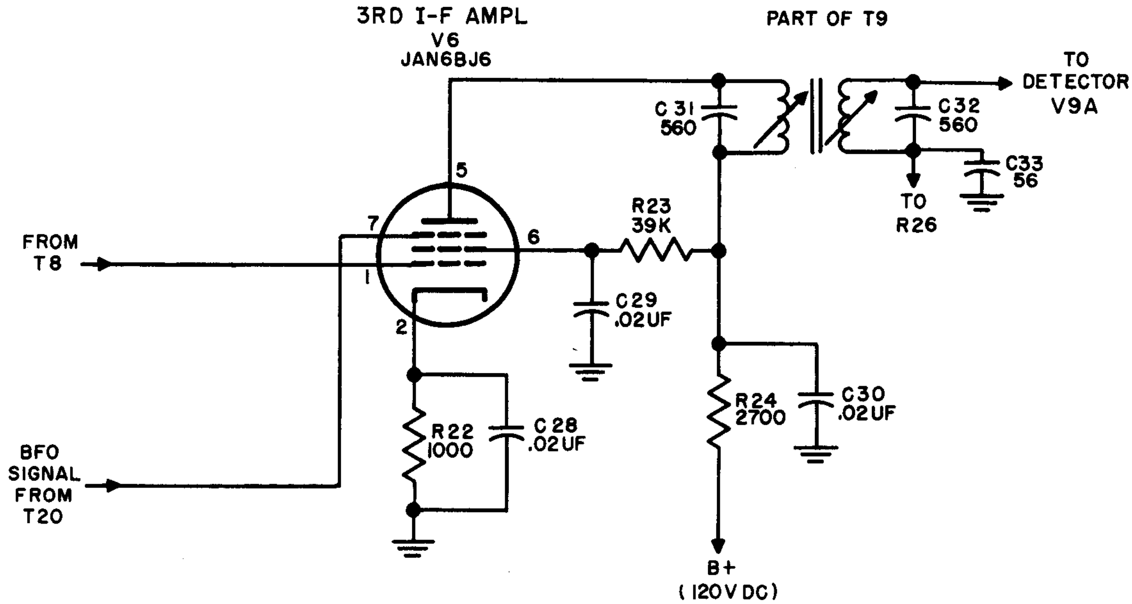


Figure 2-7. Third I-f Amplifier Simplified Schematic Diagram

capacitor C119, resistor R13 and the plate r-f ground return capacitor C15, previously mentioned.

e. FIRST AND SECOND I-F AMPLIFIER. (Figure 2-6)

(1) The i-f output of the mixer stage is amplified by three i-f amplifier stages operated in cascade. These stages amplify the i-f signal and attenuate any undesired frequencies that may be present in the mixer output. This paragraph discusses the 1st and 2nd i-f amplifiers as a single stage since they differ only in minor details. The explanation of the circuit components of the 1st i-f amplifier will apply to similar components of the 2nd i-f amplifier.

(2) The i-f signal from mixer V2 is inductively coupled to the grid of 1st i-f amplifier V4, a type 6BH6, through transformer T6. Resistor R11 is the grid resistor and it returns the grid circuit to ground, directly or through the AVC circuit. Capacitor C16 is the cathode bypass capacitor and resistor R14, in conjunction with resistor R3, develops the cathode bias. Resistor R15 is the screen dropping resistor and capacitor C17 provides a ground for r-f.

(3) The amplified i-f signal appearing in the plate circuit is coupled to the 2nd i-f amplifier through transformer T7. Capacitors C18, C19 and the variable inductances are resonated at the intermediate frequency of 455 kc. Capacitor C20 prevents the AVC voltage from being shorted to ground through the variable inductance. Resistor R17 is the grid return to ground either directly or through the AVC circuit. Capacitor C21 and resistor R16 provide plate decoupling. The 2nd i-f amplifier stage is identical in function to the 1st i-f stage and differs only in the cathode circuit. Cathode bias is provided by current flow through resistor R18. The SENSITIVITY control does not affect cathode bias on this stage. Capacitor C22 bypasses the i-f signal to ground. The i-f signal appearing on the plate circuit of V5, a type 6BJ6, is coupled to the 3rd i-f stage through transformer T8.

f. THIRD I-F AMPLIFIER. (Figure 2-7)—The third i-f amplifier is the last stage of intermediate frequency amplification. The 455-kc signal from the preceding i-f amplifier stage is applied to the control grid (pin 1) of V6, amplified and coupled to the detector through transformer T9. When c-w reception is desired, the beat frequency oscillator (BFO) is energized and generates a frequency that differs from the intermediate frequency by a few hundred cycles. This signal is applied to the suppressor grid (pin 7) of V6. Mixing action occurs producing sum and difference frequencies in the output circuit of V6. Resistor R24 and capacitor C30 form the plate and screen grid decoupling network. Capacitor C29 places the screen grid at ground potential while resistor R23 lowers the screen voltage to the correct operating value and adds additional decoupling. Cathode bias is provided by resistor R22 and the r-f component is grounded by capacitor C28.

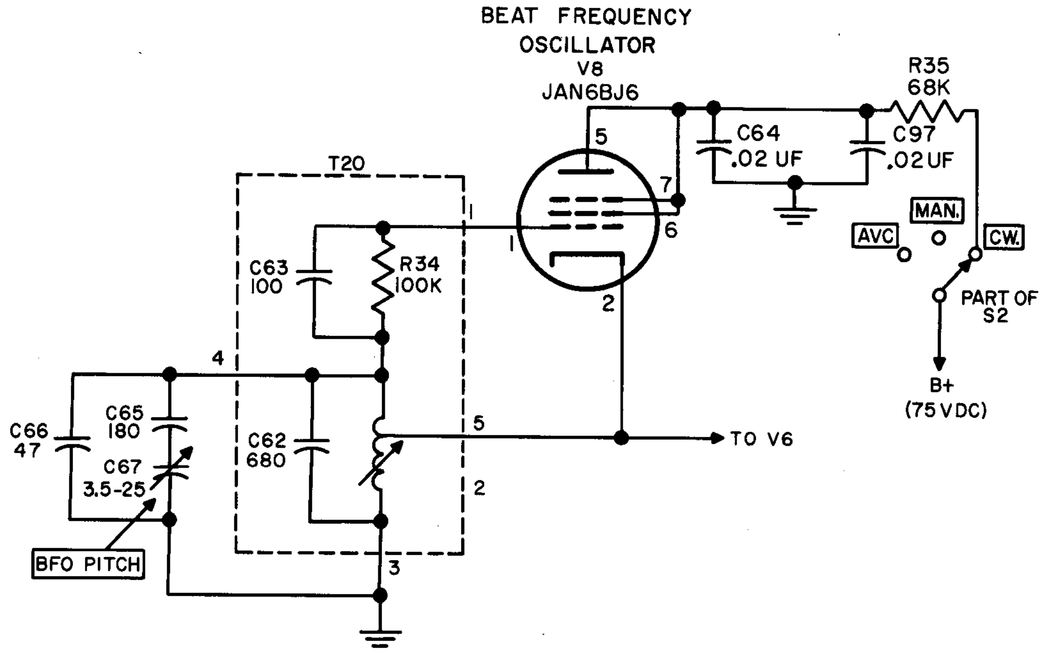


Figure 2-8. BFO Simplified Schematic Diagram

g. BEAT FREQUENCY OSCILLATOR (BFO). (Figure 2-8)—The beat frequency necessary to produce audible reception of a c-w signal is generated by tube V8, a triode connected type 6BJ6, operating in a Hartley oscillator circuit. Plate voltage is applied to V8 when the AVC-MAN.-CW. switch in the CW. position. Resistor R35 is the plate voltage dropping and de-coupling resistor. The r-f component of plate circuit is returned to ground through capacitors C64 and C97. Resistor R34 and capacitor C63 develop the grid leak bias. Capacitors C66, C65, C67 and C62, in combination with the variable inductance of T20, form a tank circuit resonant in

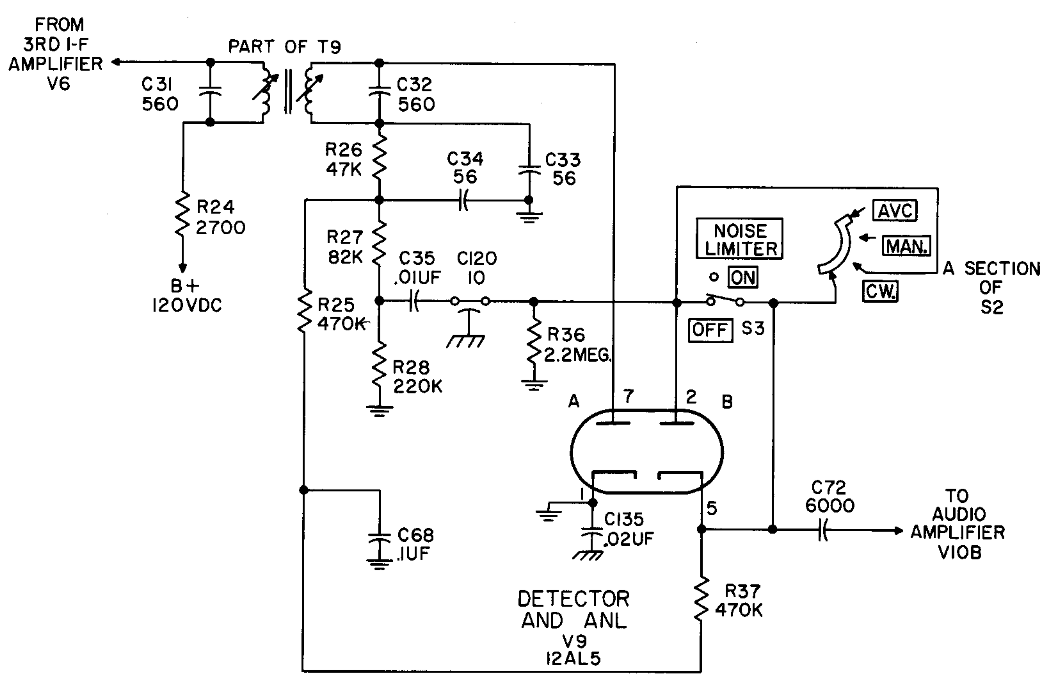


Figure 2-9. Detector and ANL Simplified Schematic Diagram

the vicinity of the 455-kc intermediate frequency. Capacitor C67 (BFO PITCH control) varies the resonant frequency a few kc above or below 455 kc. Capacitor C65, is in series with C67, limits the range of this control to a small degree. The signal output of this circuit is obtained from the cathode tap on the inductance in T20 and applied to the suppressor grid of V6.

h. DETECTOR AND AUTOMATIC NOISE LIMITER. (Figure 2-9)

(1) The i-f signal from the 3rd i-f amplifier is demodulated by the detector stage. Noise pulses are clipped prior to being fed to the audio stages of the receiver by the automatic noise limiter (ANL) stage when the noise limiter circuit is operative. These two stages are discussed together since they are closely related.

(2) The i-f signal is inductively coupled to the plate (pin 7) of the detector (V9A) by the secondary of T9. Diode action causes a flow of rectified current through the detector load resistors R26, R27, and R28. Resistor R26 and capacitors C33 and C34 provide a low-pass filter to shunt i-f signals to ground. Resistors R27 and R28 form a voltage divider network. The audio voltage developed across R28 will be applied directly to audio amplifier V10B if the AVC-MAN.-CW. switch S2 is in the CW. position or if the NOISE LIMITER switch S3 is set to OFF. If switch S2 is rotated to AVC or MAN. position and if the NOISE LIMITER switch is set to ON, the ANL stage (V9B) will be placed in series with the detector output and the audio amplifier V10B. The plate (pin 2) of the ANL stage is normally less negative than its cathode due to current flow through R27, R28 and R36.

(3) During periods of normal operation, the long time constant of resistor R25 and capacitor C68 hold the cathode at a constant voltage level. The plate voltage follows the signal voltage developed across R28; current flow through the ANL tube follows the audio voltage output of the detector stage. The voltage appearing across cathode resistor R37, R25, R27 and R28 is applied to the audio amplifier stage through coupling capacitor C72.

(4) A sudden noise pulse appearing at the junction of R27 and R28 will cause the plate (pin 2) to swing negative with respect to the cathode since the long time constant of R25 and C68 prevents the cathode from also swinging negative immediately. The noise pulse will cutoff V9B for the duration of the noise pulse. An increase in average modulation level will not be blocked by V9B since the time constant functions to adjust the cathode potential to an average level with respect to the plate. This type of noise limiter circuit is very effective in clipping noise peaks such as those caused by the electrical ignition systems in gasoline engines, and similar pulse type noises.

i. AUTOMATIC VOLUME CONTROL. (Figure 2-10)

(1) A nearly constant signal level is maintained in the receiver output by the use of a delayed AVC (automatic volume control) circuit. The developed AVC bias is proportional in amplitude to the incoming signal strength. The delayed action of this circuit prevents attenuating the very weak signals, thereby retaining maximum sensitivity of the receiver.

(2) The signal from 2nd i-f amplifier V5 is coupled through C36 to the grid of V7 (a 12AV6, double-diode triode tube). The triode section of this tube amplifies the i-f signal and isolates the diode from V5 to prevent loading of that stage. The amplified i-f signal developed across plate load resistor R31 is applied to the AVC diode plate through coupling capacitor C37. The diode plate (pin 5) will pass current when the amplitude of this i-f voltage exceeds the bias voltage developed across cathode resistor R30 and its bypass capacitor C38. When the diode conducts, a voltage negative with respect to B- ground is developed across the AVC detector load resistor R33. The i-f component is bypassed to ground through resistor R32 and capacitor C39 to provide a d-c AVC bias voltage on the grid circuits of V1, V4, V5 and V6. The AVC voltage is shorted to B- ground when switch S2 is in the MAN. or CW. position.

j. AUDIO AMPLIFIER AND PHASE INVERTER. (Figure 2-11)

(1) The single-ended output of the detector stage must be converted to push-pull to properly drive the push-pull audio output tubes. Push-pull output is obtained with resistance coupling by using a phase inverter. Tube V10, a dual triode, type 12AX7, is an audio voltage amplifier and a phase inverter.

(2) The signal from the detector is applied to the VOLUME control R39 through coupling capacitor C72. The variable arm on the VOLUME control selects the magnitude of signal being applied to the control grid of audio amplifier V10B. Capacitor C73 and TONE control R38 provide a network that controls the attenuation of

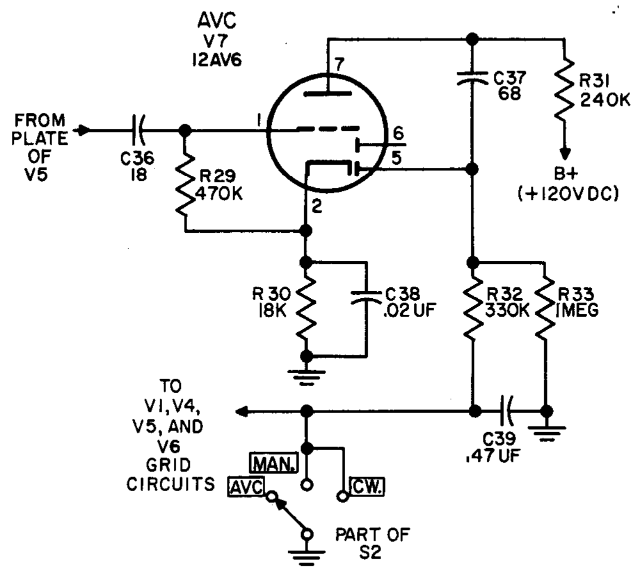


Figure 2-10. AVC Simplified Schematic Diagram

high-frequency audio response. Capacitor C93 and resistor R49 form a high-frequency compensating network which gives the higher audio frequencies a slight boost. The signal voltage applied to the grid of V10B is amplified and appears across R44 and R46. The voltage across R46 is applied to the grid of V10A, amplified and developed across R45 and R46. This voltage is 180° out of phase with the voltage on the plate of V10B, thus giving push-pull output.

(3) The voltage from V10A appearing across R46 will oppose the voltage from V10B, thus reducing the voltage applied to the grid of V10A. This will regulate the voltage being applied to V10A and make the output of each stage substantially equal. Cathode bias for both stages is provided by resistor R40. Capacitor C74 is an audio frequency bypass. Resistor R43 and capacitor C76 form a plate decoupling network for V10A and V10B. Resistors R41 and R42 are plate load resistors and C77 and C75 are coupling capacitors. Capacitor C94 and resistor R57 apply positive feedback to the control grid of V10B to increase the high frequency gain of the audio amplifier.

k. AUDIO OUTPUT. (Figure 2-12)

(1) The audio frequency voltages present in the output of the audio amplifier and phase inverter are applied to push-pull audio output tubes V11 and V12. These tubes are power amplifiers and are capable of providing at least two watts of audio power to drive the self-contained speaker LS1, or external speakers.

(2) The signals from V10 are coupled to the grids of V11 and V12 by coupling capacitors C75 and C77. The grid voltage for V11 is developed across resistors R45 and R46. The grid voltage for V12 is developed across resistors R44 and R46. Cathode bias resistor R47 provides the

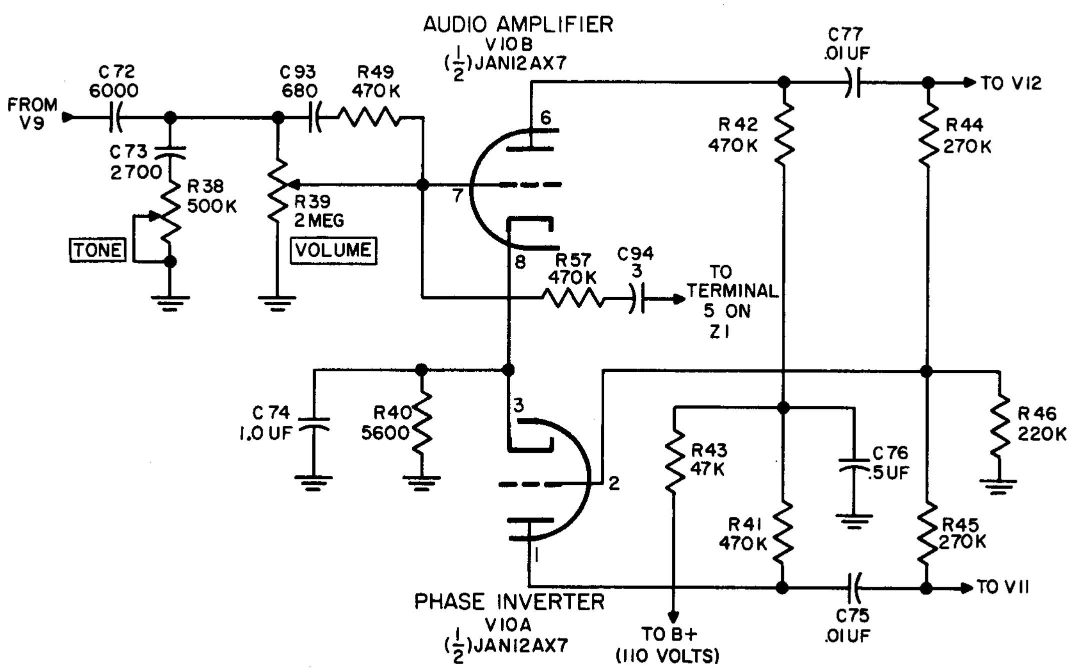


Figure 2-11. Audio Amplifier and Phase Inverter Simplified Schematic Diagram

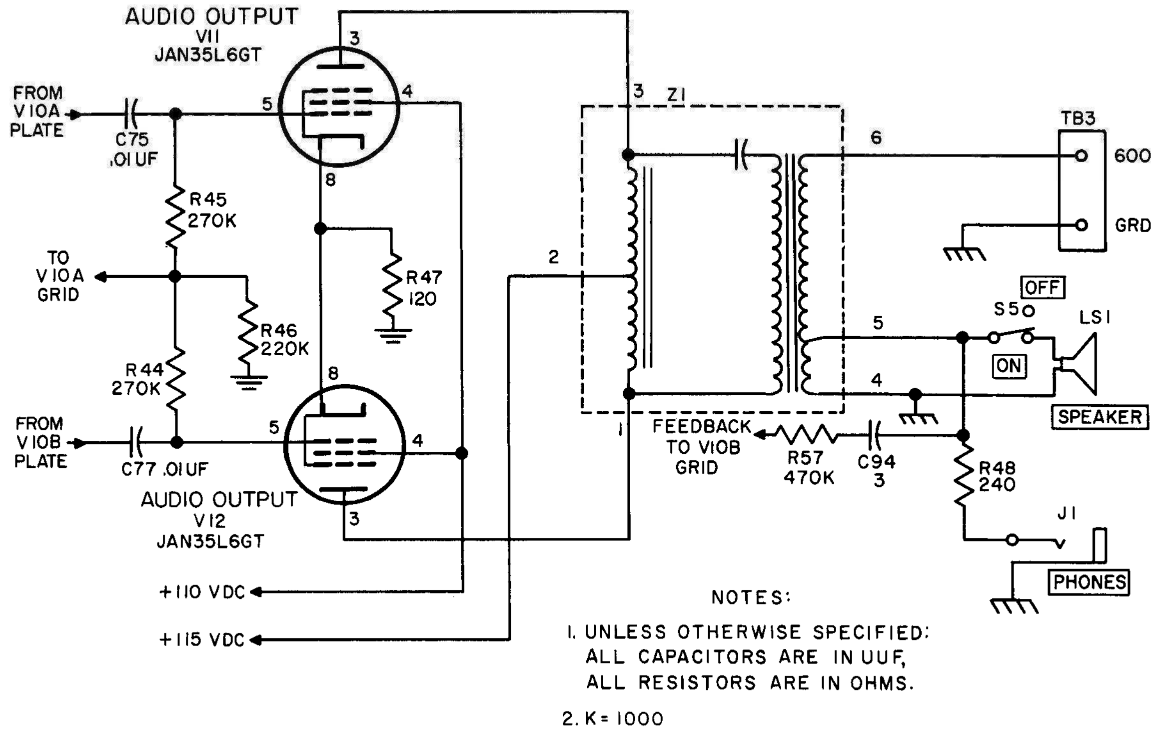


Figure 2-12. Audio Output Simplified Schematic Diagram

proper bias for Class A operation. No cathode bypass is required since the audio frequency voltages developed across R47 are 180° out of phase and tend to cancel each other. The small amount of degeneration that occurs aids in reducing audio distortion.

(3) The plates of V11 and V12 are connected to Z1, a bandpass filter. The filter is designed to maintain a flat response between 200 and 4000 cps and to drop off 20 db at 100 cps. Filter Z1 also functions as a matching device between the push-pull audio output tubes and the speaker and headphones. A proper load for the audio output tubes is provided when 600 ohms is connected across the 600-ohm secondary of Z1, or when the internal speaker LS1 is connected by virtue of the SPEAKER switch S5 being set at the ON position. The secondary of Z1 is tapped for a six ohm output to loudspeaker LS1. When using an external speaker, remove LS1 from the circuit by means of switch S5. An external 600-ohm speaker, or several speakers connected to provide a 600-ohm load, may be connected to terminals 600 and GRD on terminal board TB3. Either the internal or external speaker should be connected at all times in order to load the audio output correctly. The PHONES jack J1 is connected through R48 to the six-ohm tap on Z1. Resistor R48 is selected to be 240 ohms in order that a 2-watt output level to the speaker will correspond to a 10 milliwatt output to 600-ohm headphones. A speaker or 600-ohm resistive load should be used to load the audio output circuit whenever headphones are used.

l. PLATE AND SCREEN GRID VOLTAGE SUPPLY. (Figure 2-13)

(1) In order to furnish plate and screen grid voltage to the tubes in the receiver two type 35Z5GT rectifiers are used. Since the plate current drawn by the push-pull audio output tubes V11 and V12 consumes approximately 85 milliamperes, it is necessary that two separate rectifier tubes are used.

(2) The 115-volt a-c or d-c input power is connected to the proper terminals on TB2. When dc is used, it is imperative that the correct polarity be observed, otherwise the receiver will not operate, even though the tube filaments light.

(3) The input power is fed through filter coils L5 through L8 which prevents noise and interference pickup through the power line. The bypass capacitors C100 through C104 serve a similar function in that they bypass noise and interference.

(4) Each side of the power line is fused with fuses F1 and F2, which are located on the rear

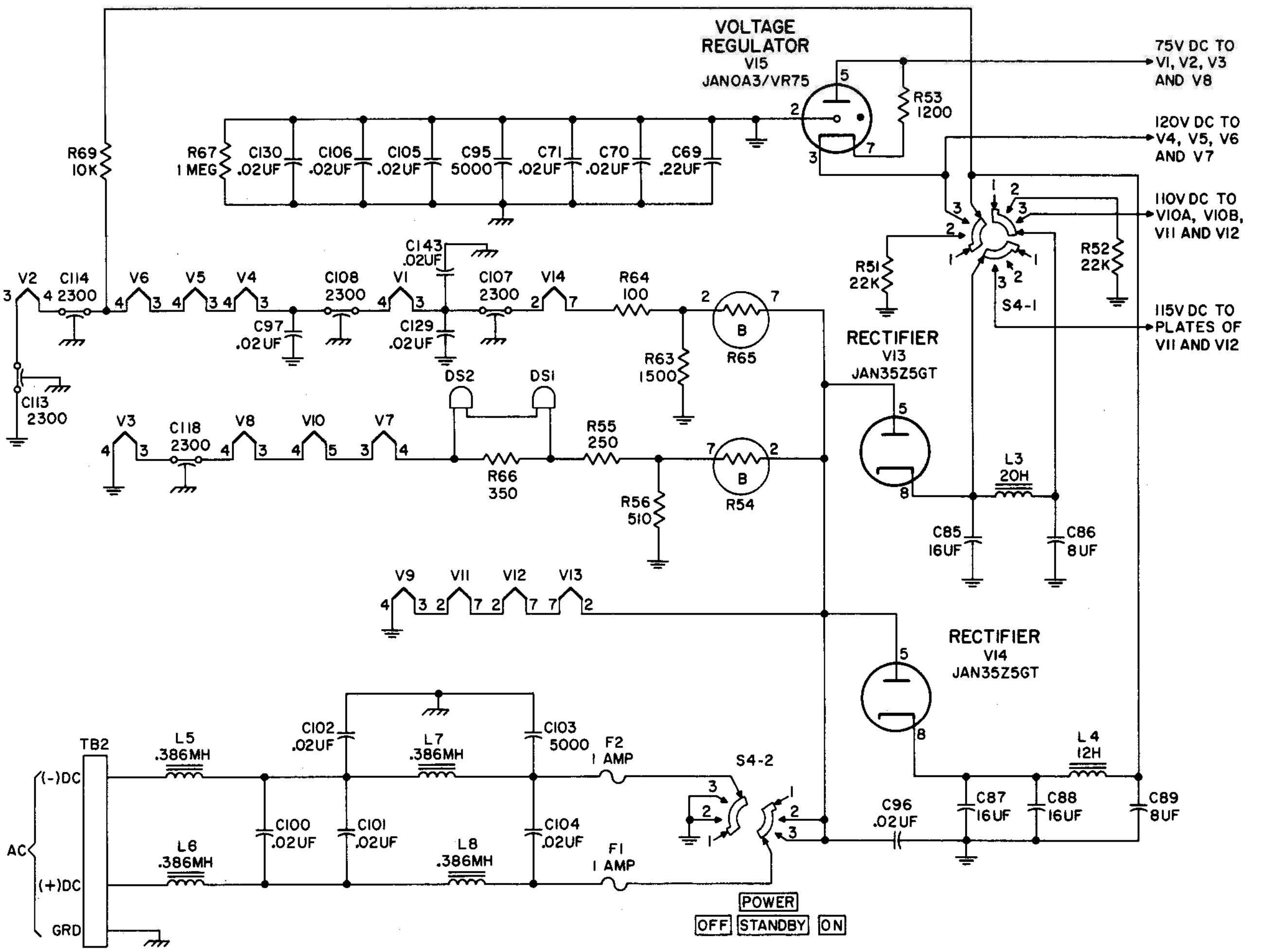


Figure 2-13. Plate, Screen Grid and Filament Circuits, Simplified Schematic Diagram

panel of the receiver. The power line is switched with the POWER switch S4-2. There are three positions on this switch. In the OFF position all power is disconnected from the receiver. In the STANDBY position power is applied to the filament circuits of the receiver and a-c voltage is applied to the plates of the rectifiers. In the ON position both the filament circuits and the rectifier circuits are energized. The other half of this switch S4-1, disconnects the B+ voltage from the receiver circuits when in STANDBY, but loads the rectifiers with resistors R51 and R52. When this switch is in the ON position, B+ voltage is applied to the receiver circuits.

(5) Filter choke L3 and capacitors C85 and C86 provide ripple filtering for rectifier V13, and filter choke L4 with capacitors C87, C88, and C89 provide ripple filtering for rectifier V14. A regulated source of 75 volts is provided by the voltage regulator tube V15. Resistor R53 allows for an approximate 45-volt drop because the voltage regulator tube maintains a constant 75-volt drop across it. The jumper in tube V15 is connected so that the regulated 75-volt supply is disabled if the regulator tube is accidently removed from the circuit. Resistors R51 and R52 place a load on the two rectifier circuits when the POWER switch is on STANDBY. This keeps the filter capacitors from charging up to the peak a-c line voltage of the rectified a-c voltage.

m. FILAMENT CIRCUITS. (Figure 2-13)

(1) The tube filaments in the receiver are series connected in three separate strings. This is done to allow operation of the receiver on either 115 volts, ac or dc. Since a parallel connection of the tube filaments would require a low-voltage high-current filament supply, it is most

practical to connect the tube filaments in the series-parallel combination in order to satisfy the filament requirements at a higher potential and a lower current.

(2) There are three strings of series-connected filaments. The first consists of tubes V9, V11, V12 and V13. The voltage drop across each tube in this string allows the individual tubes to operate with the proper voltage. The second string of series-connected tubes consists of tubes V3, V8, V10 and V7 all in series with the panel lamps DS1 and DS2, resistor R55 and Ballast tube R54. Resistor R66 is placed across the panel lamps to prevent them from drawing excessive current, especially during the first few seconds the receiver is first turned on. This initial surge of current through the tube filaments is normal when their filaments are cold, but Ballast tube R54 absorbs most of this excessive current. The panel lamps are therefore protected against premature burnout, and their service life is greatly prolonged. Resistor R56 causes the Ballast tube R54 to draw additional current and thereby assures that it will have a proper operating characteristic. Feedthrough capacitor C118 is a filament r-f bypass to ground.

(3) The third filament string consists of tube filaments of V2, V6, V5, V4, V1 and V14. This string also contains resistor R64 and Ballast tube R65. Resistor R63 is used to increase the current through the Ballast tube R65 in order to achieve proper operating characteristics. This filament string is bypassed to ground for r-f signals by feedthrough bypass capacitors C113, C114, C108, and C107.

(4) Resistor R69 is connected between the connection of the filaments of V2 and V6 and a B-plus point in the power supply. This is done to minimize 60-cycle hum which would result from the a-c on the tube filaments in this series-connected filament string.

(5) Capacitors C69, C70, C71, C95, C105, C106 and C130 connect the B-minus line and the receiver chassis together for r-f voltages, while

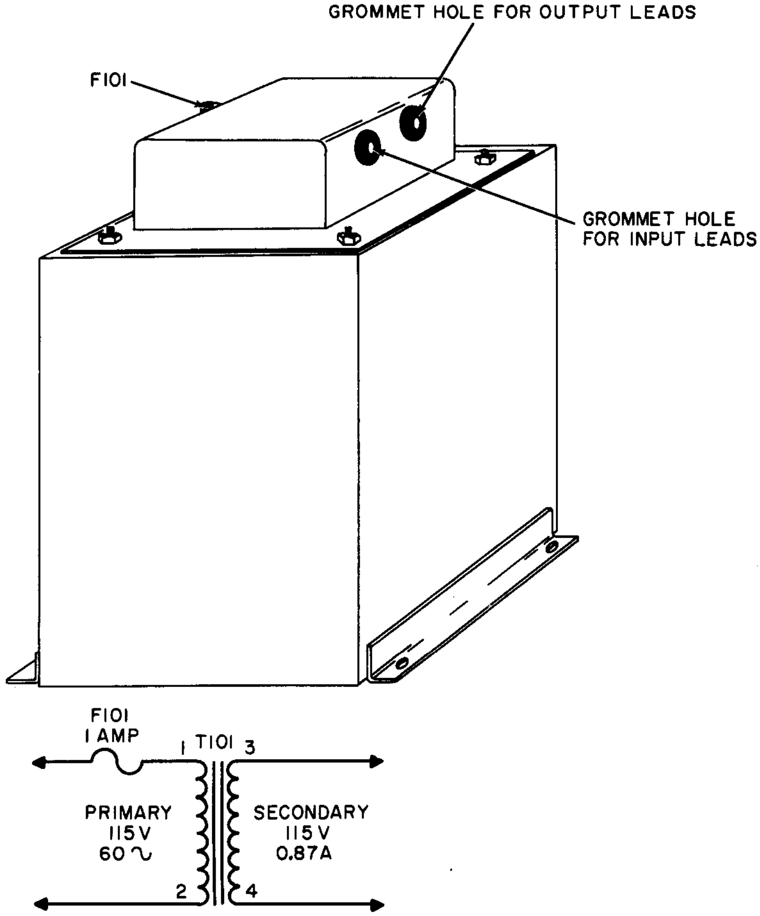


Figure 2-14. Isolation Transformer T101

keeping the two points isolated as far as the operating power is concerned.

n. ISOLATION TRANSFORMER. (see figure 2-14)

(1) Isolation Transformer T101 is furnished with the receiver for the purpose of lessening the possibility of electrical shock to operating and servicing personnel, and also to reduce a-c power line hum. A removable cover is fitted on the transformer top to mount the one-ampere fuse F101 and to provide a protective cover for the transformer input and output terminals. Two grommet holes in the cover are provided for connecting the input and output lead wires.

(2) The one-ampere fuse F101 protects the transformer, and receiver, against overloads, and also against the possibility of damage due to accidental connection to a d-c power source. The primary of the transformer is designed for 115-volt, 60-cps input; the output is 115-volts at 0.87 ampere, maximum, which is suitable for Radio Receiver R-649/UR.

SECTION 3

INSTALLATION

1. UNPACKING.

CAUTION

Be extremely careful not to drop or damage the receiver or spare parts. Avoid jabbing pinch bars or any other unpacking tools into the interior of any fiberboard shipping container. Do not unpack in a location where dust, dirt, or excessive moisture may affect the equipment. Figure 3-1 indicates the sequence in which the containers are placed around the receiver and spare parts. Follow the unpacking instructions in the order given to provide the most rapid means of safely removing the receiver and spare parts from the crate. If space permits, retain the packing materials for future repacking.

Note

Unpacking instructions include data for export packed wood cases. Domestic packing generally does not include a wood case, therefore omit steps a through e for domestic packed components.

a. Cut the metal bands which encircle the wooden box. Use a pair of tin snips or a large pair of diagonal cutting pliers.

b. Pry open the top cover, or still better, use a nail puller, if available, being careful not to force the prying instrument too far into the package. Remove the top cover and save it for possible repacking (save all the packaging material for this reason).

c. Remove the excelsior or wadding from the top of the waterproof barrier.

d. Lift out the waterproof bag containing the receiver.

e. Slit the waterproof bag, remove the carton containing the receiver.

f. Slit the seams of the fiberboard carton and open the flaps.

g. Remove the moisture and vaporproof bag and slit it open along the edge of its seal.

h. Remove the inner fiberboard carton, slit the seams, and open the flaps.

i. Remove the corrugated fiberboard pads and dehydrating agent from the carton.

j. Remove the receiver from the fiberboard carton.

k. Cut the bands that hold the plywood protection over the face of the radio receiving set.

l. Remove the plywood protection board.

m. Unpack the spare parts carton by slitting the seams and removing the metal spare parts box.

n. The unpacking procedure is now complete and the receiver is ready for installation.

2. INSPECTION PRIOR TO INSTALLATION.

a. GENERAL.—Prior to installing the new or re-conditioned receiver, either for bench, table top or rack installation, it should be thoroughly inspected for damage which may have occurred during shipment or handling. This inspection consists of a visual and mechanical inspection, and should be done prior to the application of power to the receiver.

CAUTION

Support the receiver chassis so it does not drop out of the cabinet. Do not set the receiver on its rear panel because the fuse holders and terminal boards may be damaged.

b. EXTERNAL VISUAL INSPECTION.—Inspect the front panel of the receiver for damaged dials, knobs, and marred finish. Examine the rear panel of the receiver for damaged fuse holders, terminal boards, dented panels, and obliterated markings. Examine the sides, top and bottom for scratches and dents.

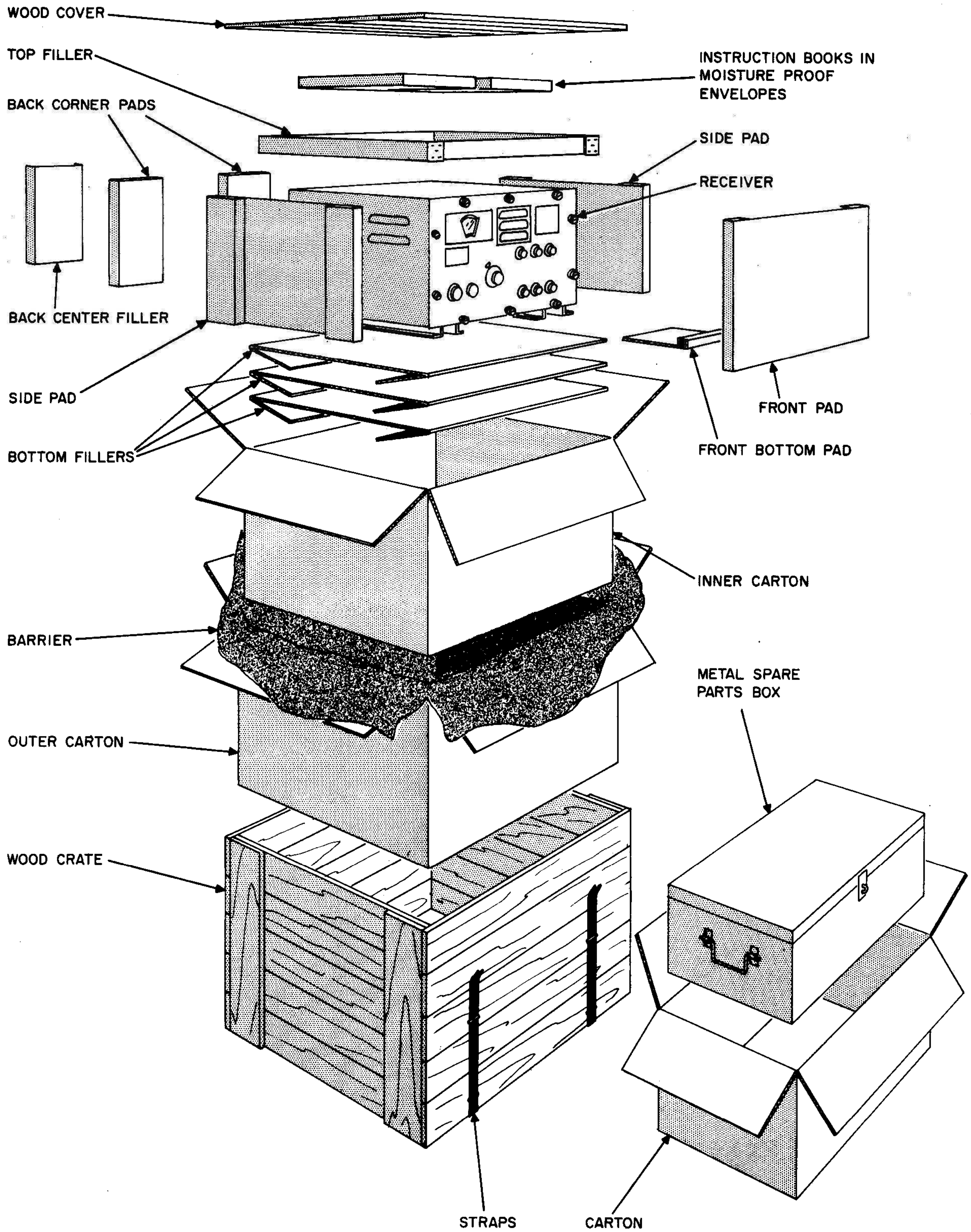


Figure 3-1. Radio Receiver R-649/UR, Packing Details

c. INTERNAL VISUAL INSPECTION.—Remove the receiver from the cabinet. This is done by loosening ten knurled screws on the front panel and pulling the chassis outward. After the receiver chassis is withdrawn approximately half way one lock lever on each side of the chassis must be pressed downward to release the chassis from the cabinet (see figure 3-2). Set the receiver chassis on a bench or sturdy table and inspect the top of the chassis for broken, loose or missing tubes and dial lamps. Turn each knob on the front panel and check for freeness of movement of the potentiometers and positive detent action of all the switches. Loosen the dial lock on the TUNING control and turn it from stop to stop while examining the tuning gear train. The motion should be smooth and free from binding and backlash. Check that the end limits of the dial agree with the end limits on the tuning mechanism. Set the receiver on one of its sides and examine the chassis bottom for irregularities such as dirt, broken wires and mechanical damage.

d. ISOLATION TRANSFORMER AND SPARE PARTS INSPECTION.—Open the spare parts box and remove isolation transformer T101 if the receiver is to be operated on a 115-volt a-c power source. The contents of the spare parts box can be checked against table 8-2, if so instructed.

3. INSTALLATION. (Figure 3-3)

a. GENERAL.—The receiver should be located in a manner which will allow for air ventilation and access to the rear panel. A clearance of at least six inches at the rear of the receiver is adequate for ventilation, connection of a-c or d-c power, and external speakers, and the replacement of fuses.

b. CABINET INSTALLATION.—If the receiver is to be bench mounted in its cabinet the cabinet should be bolted to the bench top through the eight holes in the mounting channels. (See figure 3-3.) Be sure to allow adequate clearance. The receiver is reinstalled into the cabinet by simply sliding the chassis into the cabinet on the channels in the cabinet. The chassis will automatically lock with the lock levers on each side of the chassis. Tighten the ten knurled screws on the front panel of the receiver.

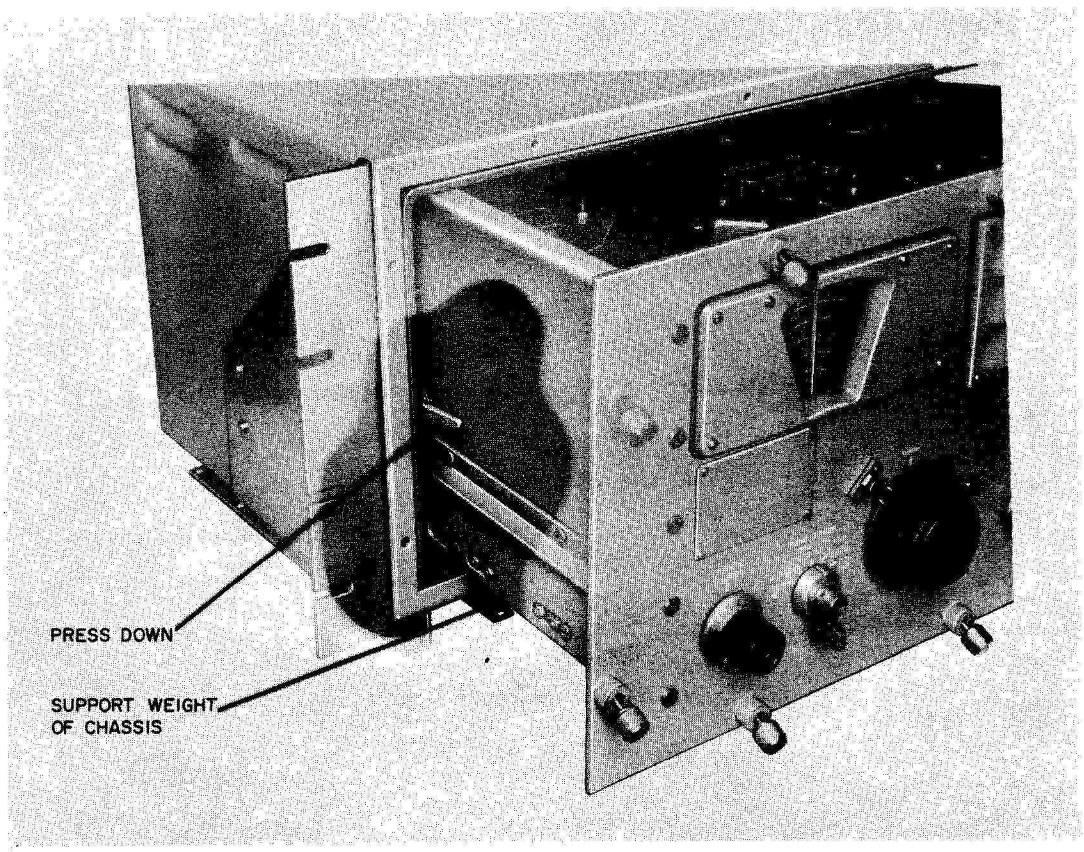
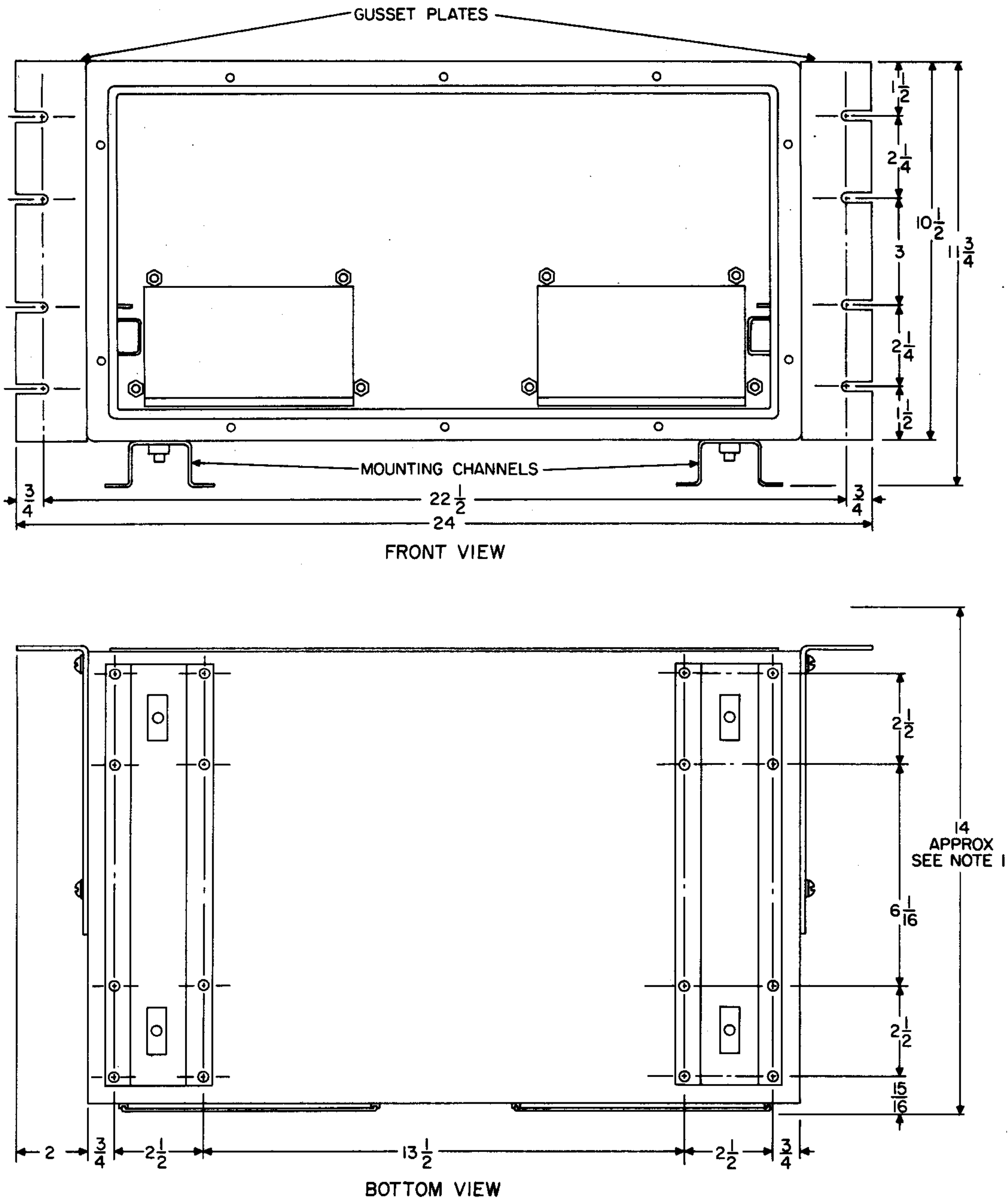


Figure 3-2. Removing Chassis from Cabinet



NOTES:

1. DEPTH APPROXIMATELY 14 INCHES INCLUDING KNOBS.
2. ALLOW AT LEAST 6 INCHES CLEARANCE AT REAR.

Figure 3-3. Installation Details

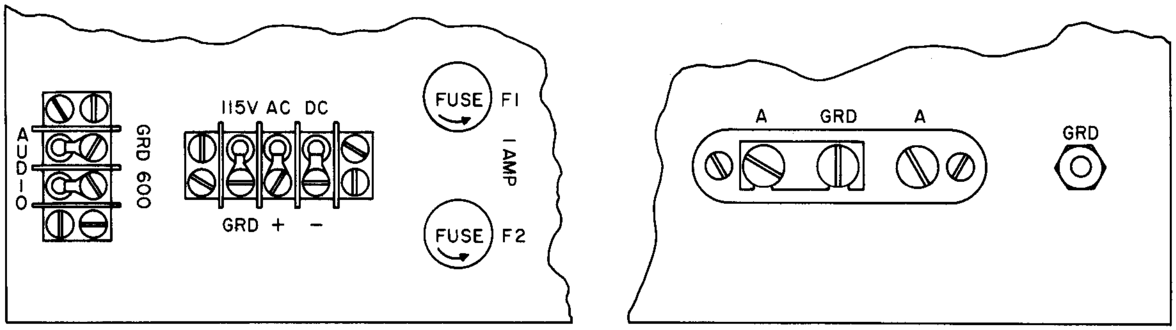


Figure 3-4. Speaker, 115-volt Power, and Antenna Connections

WARNING

Two men are required to assist when rack-mounting.

c. RACK INSTALLATION.—If the receiver is to be mounted in a 24-inch Coast Guard rack fasten the gusset plates to the sides of the receiver cabinet. This is done by removing five screws and lockwashers on each side of the cabinet and fastening the gusset plates to the cabinet with the same screws and lockwashers. If necessary, the cabinet bottom mounting channels should be removed by loosening and removing four bolts and lockwashers and the re-enforcing channels from the interior of the cabinet. The receiver and the cabinet now can be lifted and bolted to the rack with the slotted holes provided in the gusset plates.

d. SPEAKER AND ANTENNA CONNECTIONS TO THE REAR OF THE RECEIVER.—See figure 3-4. If an external 600-ohm speaker or speaker system is to be used with the receiver, connect it to the AUDIO 600 and GRD terminals at the lower left side on the rear of the receiver. Connect the antenna to the receiver as follows:

(1) If a single wire antenna is used, one of the antenna terminals marked A should be connected to the center terminal marked GRD with the jumper provided. The antenna lead connects to the other terminal marked A. Try each terminal marked A while grounding the other, and select that combination which gives the best results for any given antenna, band or frequency range. Ground the receiver chassis at the stud provided at the lower right hand corner of the rear panel.

(2) If an unbalanced coaxial antenna transmission line is to be connected to the receiver, connect it in the same manner as a single wire antenna, but in addition connect the shield braid to the terminal marked GRD.

(3) If a balanced transmission line such as 300-ohm twin lead is to be connected to the receiver, remove the jumper strap between the terminals marked A and GRD, and connect the balanced line to the two terminals marked A. Ground the receiver chassis at the stud at the lower right hand corner.

e. MOUNTING AND CONNECTING ISOLATION TRANSFORMER T101.—Install and connect the isolation transformer T101 as follows:

(1) Remove the cover from the isolation transformer, and remove and inspect the 1-ampere, type 3AG fuse. Replace the fuse.

(2) Mount the isolation transformer at a convenient point on a bulkhead, bench, etc., between the receiver and 115-volt a-c source. Four mounting holes are provided for this purpose.

(3) Connect and solder an a-c power cord to the transformer secondary terminals 3 and 4, and run this cord through the rubber grommetted cover hole marked OUT.

(4) Connect and solder the 2-1/2 inch lead which is connected to one of the two fuse holder terminals to transformer terminal 1.

(5) Run a second length of a-c power cord through the grommetted hole in the cover marked IN, and connect the cord to primary terminal 2 and the second terminal on the fuse holder.

(6) Replace the cover on the transformer, taking care not to twist or kink the power cords.

(7) Attach an a-c plug to the cord from the grommetted hole marked IN, but DO NOT plug

into the a-c power source until connections to the receiver have been made. See subparagraph f below.

f. POWER CONNECTIONS TO THE REAR OF THE RECEIVER.—The receiver can be operated from either 115-volt 60 cps ac or 115-volts dc. If a-c power is to be used, connect it to the 115 VOLT AC-DC terminals marked + and - through isolation transformer T101. See subparagraph e above. When ac is used, polarity is unimportant. If d-c power is used, connect it to the same terminals, but be sure the polarity is correct. Use a voltmeter to determine the polarity. If the wrong polarity is used, the filaments in the tubes will light, but no d-c plate voltage will be applied to the tubes, and the receiver will not operate.

4. INITIAL ADJUSTMENTS.

No initial adjustments are required.

SECTION 4

OPERATION

1. CAPABILITIES AND LIMITATIONS.

Radio Receiver R-649/UR is a five-band superheterodyne receiver suitable for use on shipboard or shore stations. Amplitude modulated (am) and continuous wave (cw) signals can be received in two frequency ranges; 0.20 mc to 0.40 mc, and 0.49 to 18 mc. The receiver is capable of operating from a power source supplying 115-volt 60-cycle ac or 115 volts dc. An internal speaker allows the receiver to be operated independently of external speakers. Connections are provided for the operation of external speakers and headphones when desired. An antenna (doublet or long wire) of 300 ohms impedance is recommended for optimum performance. Satisfactory performance may be obtained with antennas whose impedance varies between 50 ohms and 1000 ohms.

2. OPERATION OF EACH FUNCTION.

The operator should familiarize himself with the function and location of each control to obtain the best operating results. Refer to figure 4-1 and the following paragraphs to gain this familiarity.

a. ANTENNA TRIMMER.—The ANTENNA TRIMMER control varies capacitor C40 to compensate for the different loading affects presented by various antennas.

b. BAND CHANGE.—The BAND CHANGE switch selects tuned circuits which allow reception of signals with the five different bands of frequencies.

c. TUNING.—The TUNING control varies the tuning capacitor to select desired frequencies within the frequency bands.

d. SENSITIVITY.—The SENSITIVITY control adjusts the r-f and i-f gain of the receiver by varying the cathode bias of the r-f and 1st i-f amplifier.

e. BFO PITCH.—The BFO PITCH control provides adjustment of the audio tone of the receiver to be varied when a c-w signal is being received.

f. VOLUME.—The VOLUME control varies the level of the audio output signal by varying the signal voltage applied to the audio section of the receiver.

g. POWER.—The POWER switch applies and removes input power and allows the receiver to be placed in standby condition. The standby condition maintains the tube filament voltage but removes B+ from the circuits.

h. TONE.—The TONE control allows the operator to attenuate certain background noises by shunting the higher audio noise frequencies to ground.

i. AVC-MAN.-CW.—The AVC-MAN.-CW. switch should be placed in AVC position for reception of voice signals and in CW. position for reception of cw signals. The MAN. position may be used when receiving voice signals when it is desired to control the receiver sensitivity exclusively with the SENSITIVITY control. In this position the AVC circuit is disabled.

j. SPEAKER.—The SPEAKER switch controls the internal speaker. EITHER THE INTERNAL OR AN EXTERNAL SPEAKER SHOULD BE CONNECTED TO THE RECEIVER AT ALL TIMES. THE USE OF BOTH SPEAKERS WILL LOAD THE AUDIO OUTPUT CIRCUIT BEYOND THE POINT FOR WHICH THE CIRCUIT IS DESIGNED. See figure 3-4 for the external speaker connections.

k. NOISE LIMITER.—The NOISE LIMITER switch allows the automatic noise limiter stage to function when the switch is in the ON position and the AVC-MAN.-CW. switch is in the AVC or MAN. position. The automatic noise limiter circuit is disabled when the AVC-MAN.-CW. switch is in the CW. position. The automatic noise limiter stage clips noise pulses to provide freedom from excessively strong noise pulses.

l. PHONES.—The PHONES jack is connected to a six-ohm tap on the audio output transformer.

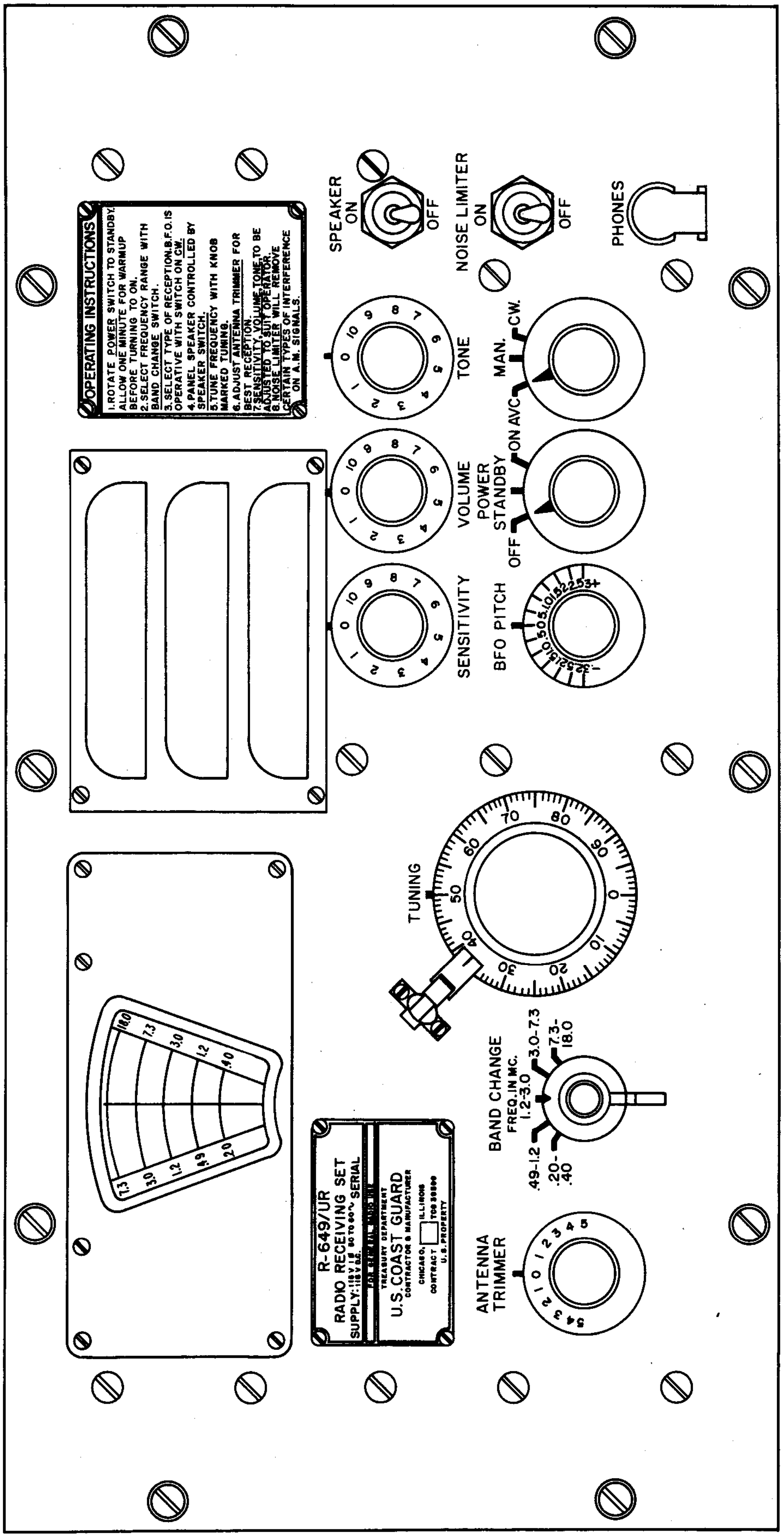


Figure 4-1. Radio Receiver R-649/UR, Front Panel Controls

EITHER THE INTERNAL OR AN EXTERNAL SPEAKER SHOULD BE CONNECTED WHEN USING HEADPHONES IN ORDER TO LOAD THE OUTPUT TRANSFORMER PROPERLY.

3. OPERATING ADJUSTMENTS.

The adjustments which must be made to place the receiver in operation and select the desired frequency are explained in the following subparagraphs. The adjustment procedure will vary according to the type of signal received and the operating conditions.

a. PRELIMINARY ADJUSTMENTS.—To place the receiver (figure 4-2) in operation for any type of reception, adjust the front panel controls as follows:

(1) POWER SWITCH.—Set to STANDBY and allow the tube filaments to warm up for at least one minute. The tuning dial lights will light.

(2) BAND CHANGE SWITCH.—Set to the desired frequency band.

(3) TUNING CONTROL.—Adjust the TUNING control until the desired frequency is indicated on the tuning dial.

(4) SPEAKER SWITCH.—Turn to ON if the self-contained loudspeaker is being used. Turn to OFF when using an external speaker.

b. ADJUSTMENTS FOR A-M RECEPTION.—To receive voice or mcw signals, perform the following procedure.

(1) POWER SWITCH.—Turn to ON.

(2) AVC-MAN.-CW. SWITCH.—Turn to the AVC position.

(3) SENSITIVITY CONTROL.—Rotate to the extreme clockwise position.

(4) VOLUME CONTROL.—Rotate clockwise until a signal or background noise is heard.

(5) NOISE LIMITER SWITCH.—Set to ON if background noise is excessive.

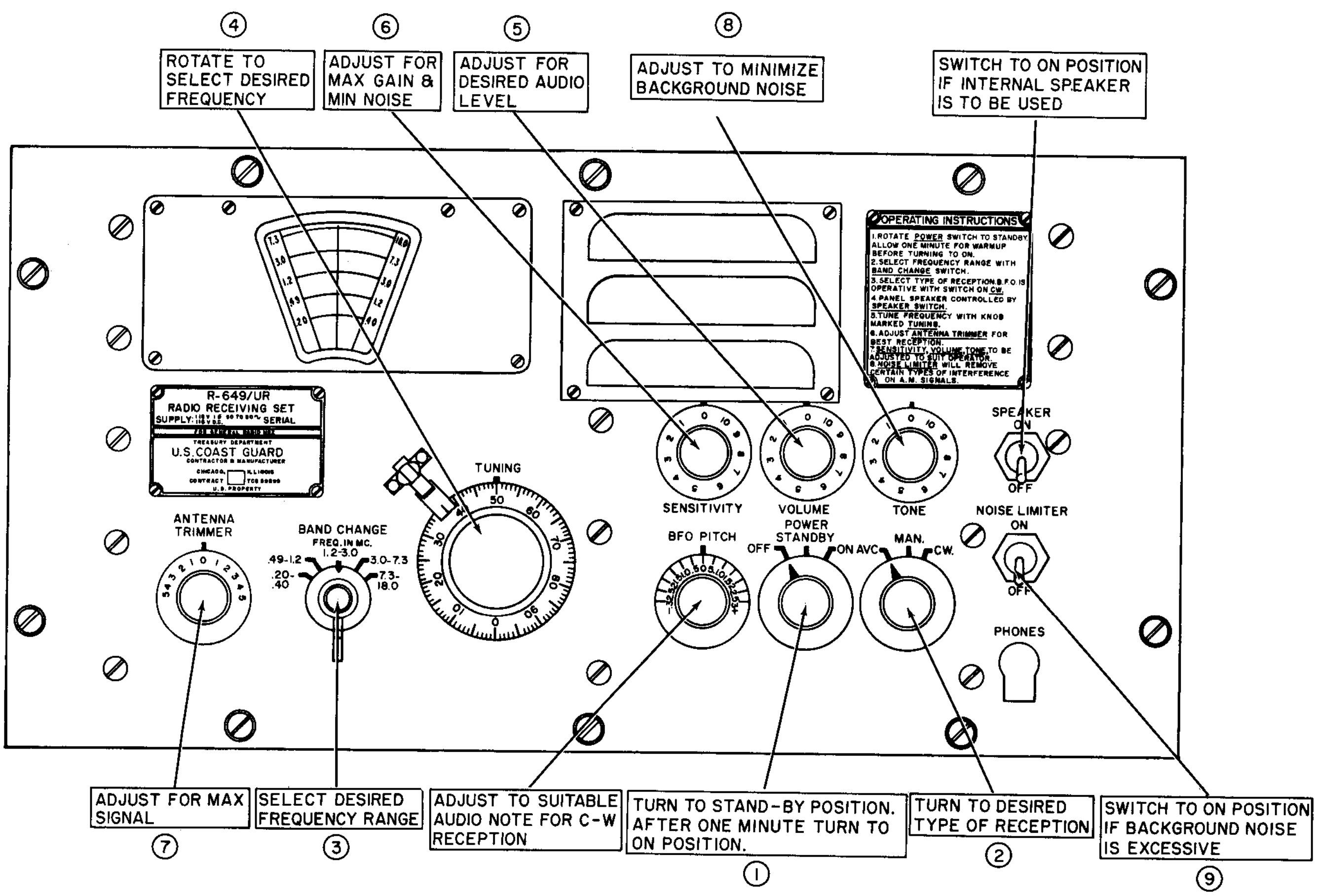


Figure 4-2. Operating Controls

(6) ANTENNA TRIMMER CONTROL.—Rotate to increase the signal to its maximum strength.

(7) TONE CONTROL.—Adjust to decrease background noise.

c. ADJUSTMENTS FOR C-W RECEPTION.—To receive c-w signals perform the following procedure.

(1) POWER SWITCH.—Turn to ON.

(2) AVC-MAN.-CW. SWITCH.—Turn to the CW. position.

(3) VOLUME CONTROL.—Rotate to a well advanced clockwise position.

(4) SENSITIVITY CONTROL.—Rotate clockwise until a signal or background noise is heard. For c-w signals, use this control to adjust speaker or headphone volume.

(5) ANTENNA TRIMMER CONTROL.—Rotate to increase the signal to its maximum strength.

(6) TONE CONTROL.—Adjust to decrease background noise.

(7) BFO PITCH CONTROL.—Adjust in conjunction with the TUNING control to produce the desired audio note.

4. SUMMARY OF OPERATION.

a. Power (115-volt 60-cycle ac or 115 volts dc) is applied to the receiver through the connections on the power input terminal board on the rear of the chassis. Antenna connections are made to the antenna terminal board on the rear of the chassis. The power and antenna connections should be checked before the POWER switch is turned to STANDBY.

b. The SPEAKER switch should be placed in the ON position when the internal speaker is being used and in the OFF position when an external speaker is in use. An external 600-ohm speaker or speaker system can be connected to the terminal board on the rear of the receiver. Headphones can be plugged into the PHONES jack on the front panel but should be used only with the internal or external speaker connected.

c. The SENSITIVITY control can be adjusted counterclockwise to reduce excessive background noise when the desired signals are strong. The optimum setting of this control is that which provides the best signal-to-noise ratio. This can be done for a-m signals as well as c-w signals, with some sacrifice of AVC action.

d. Use the TONE control to reduce background noise when the desired signals are weak.

e. The automatic noise limiter (ANL) is most effective under conditions of pulse type noise such as that caused by engine ignition systems. Set the NOISE LIMITER switch to OFF whenever operating conditions permit. The noise limiter circuit will clip the voice signals slightly and cause some noticeable distortion.

f. Place the AVC-MAN.-CW. switch in the AVC position to reduce the effects of fading. When extremely weak signals are being received it may be advantageous to place the switch in the MAN. position and control receiver sensitivity with the SENSITIVITY control.

g. When the POWER switch is placed in the STANDBY position, the receiver is disabled but filament voltage is maintained to all tubes.

h. The receiver is shut off when the POWER switch is placed in the OFF position.

SECTION 5

OPERATOR'S MAINTENANCE

1. ROUTINE CHECK.

A routine check of the receiver is performed as part of the receiver operation. The following periodic inspection will determine if the equipment is functioning properly.

a. While the receiver is in operation, adjust each front panel control to make certain it performs its function. Refer to Section 4 for operating instructions.

b. Make certain that the correct antenna is connected to the receiver, and the required external speaker and power source are likewise connected.

c. Inspect the antenna and lead-in or transmission line for broken or corroded elements.

d. Inspect the receiver for any obvious defects or irregularities. This includes inspection of the receiver chassis, if such inspection is authorized.

2. EMERGENCY MAINTENANCE.

a. NOTICE TO OPERATORS.—Operators shall not perform any of the following emergency maintenance procedures without proper authorization.

b. REPLACEMENT OF ELECTRON TUBES.—The filaments of the electron tubes in this receiver are connected in a series-parallel combination. An open filament in any one of the series circuits will remove the filament power from all of the electron tubes in that particular series circuit. This necessitates checking all of the electron tubes that do not glow in order to find the open filament. Ballast resistors R54 and R65 are in series with two of the series filament circuits, and if open, will render certain tube filaments inoperative. When replacing electron tubes, the following should be observed:

(1) Turn the POWER switch to OFF before reaching in to touch a tube.

(2) Refer to figure 5-1 for tube locations. Each tube and the type is listed in table 5-1.

(3) When removing hot tubes, use a cloth or tube puller to prevent burning the fingers.

(4) The following tubes and ballasts are series-connected in individual series circuits: V9, V11, V12 and V13; V3, V7, V8, V10 and R54; V1, V2, V4, V5, V6, V14 and R65.

Note

Tube V15 has an orange glow when operating normally and should not be taken as a sign of its being defective.

TABLE 5-1. ELECTRON TUBE LOCATION

Symbol Designation	Type	Function
V1	6BH6	R-f Amplifier
V2	12BE6	Mixer
V3	6BJ6	Local Oscillator
V4	6BH6	1st i-f Amplifier
V5	6BJ6	2nd i-f Amplifier
V6	6BJ6	3rd i-f Amplifier
V7	12AV6	AVC
V8	6BJ6	BFO
V9	12AL5	Detector and ANL
V10	12AX7	Phase Inverter and Audio Amplifier
V11	35L6GT	Audio Output
V12	35L6GT	Audio Output

TABLE 5-1. ELECTRON TUBE LOCATION (cont)

Symbol Designation	Type	Function
V13	35Z5GT	Rectifier
V14	35Z5GT	Rectifier
V15	OA3/VR75	Voltage Regulator

c. REPLACEMENT OF FUSES.—There are two fuses (F1 and F2) in this receiver. Each fuse is connected electrically between the POWER switch and one line of the power source. The fuses are rated at one ampere, 250 volts and are accessible at the rear panel of the receiver.

CAUTION

Never replace a fuse with one of a higher rating unless continued operation of the equipment is more important than probable damage. If a fuse burns out immediately after replacement, do not replace it a second time until the trouble has been corrected.

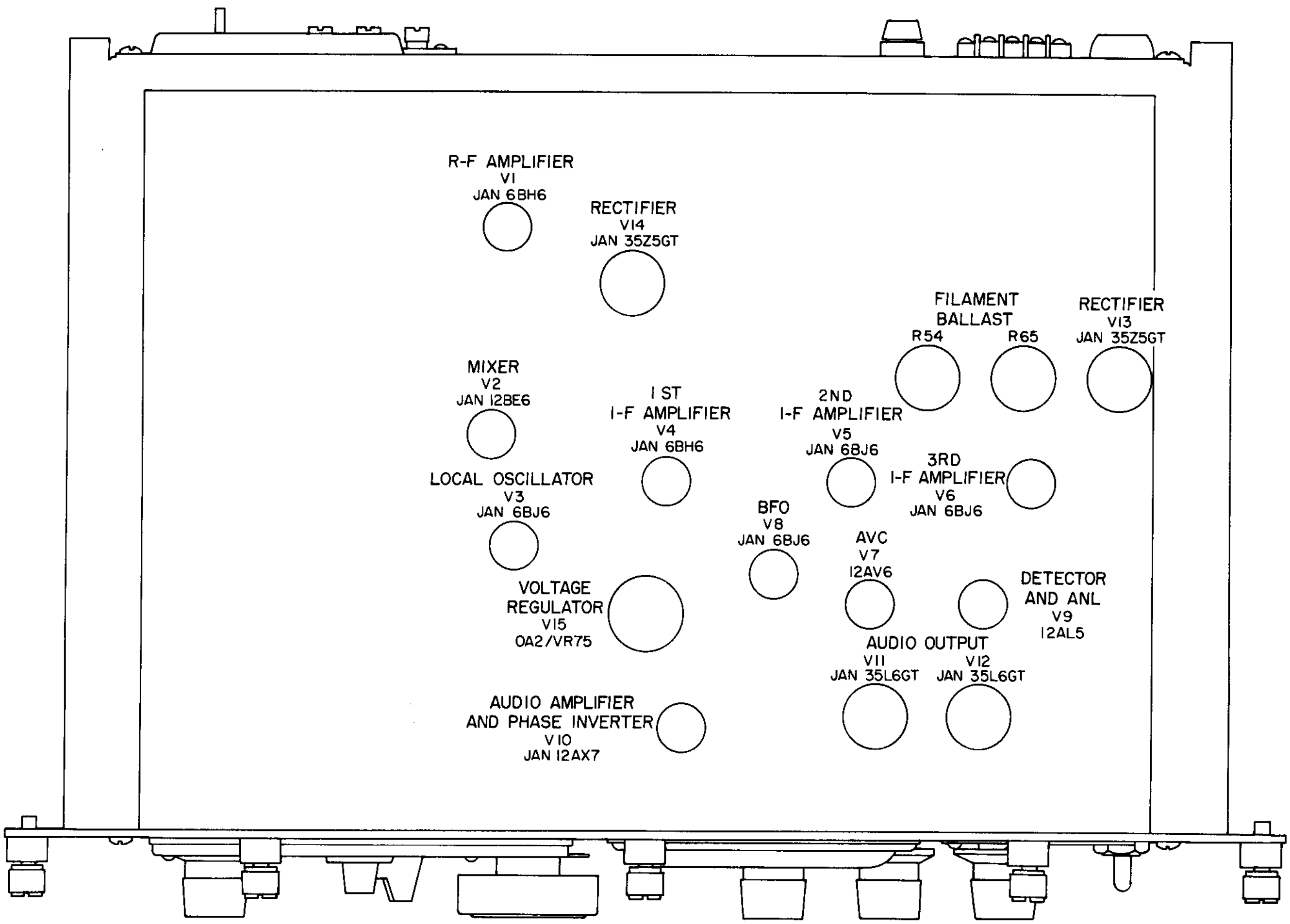


Figure 5-1. Radio Receiver R-649/UR, Tube Locations

SECTION 6

PREVENTIVE MAINTENANCE

1. DEFINITION OF PREVENTIVE MAINTENANCE.

Preventive maintenance is work performed on equipment, usually when the equipment is not in use, to keep it in such good working order that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to eliminate certain troubles before they occur. The importance of preventive maintenance cannot be overemphasized. It is important to properly maintain the equipment.

2. ROUTINE MAINTENANCE CHECK-CHART.

The check-chart which follows this paragraph shows the operator how to maintain the equipment and minimize the necessity of trouble shooting and repair. The check-chart indicates what to check, when to check, how to check and the precautions which should be taken before, during and after checking the equipment. The check-chart is self explanatory.

Note

Gasoline will not be used as a cleaning fluid for any purpose. Clean electrical contacts with trichlorethylene, Federal Specification O-T-634(1).

Note

THE ATTENTION OF MAINTENANCE PERSONNEL IS INVITED TO THE REQUIREMENTS OF CHAPTER 67 OF THE BUREAU OF SHIPS MANUAL, OF THE LATEST ISSUE.

TABLE 6-1. MAINTENANCE CHECK-CHART

What to Check	When to Check	How to Check	Precautions
1. Chassis and front panel.	Daily	a. Visually inspect outside of panel for corrosion and illegible markings. b. Check panel screws, illumination lamps, control knobs and switches for loose mountings. c. Check to make sure all connections are secure.	
2. Input and output cables and connectors.	Daily	a. Examine for loose mountings and dirty contacts. b. To remove dirt and corrosion, use crocus cloth and then a clean cloth.	
3. Fuse and fuse holders.	Weekly	a. Inspect fuse and holder for damage and corrosion. b. Clean fuse ends with emery cloth if necessary.	Remove source of power.

TABLE 6-1. MAINTENANCE CHECK-CHART (cont)

What to Check	When to Check	How to Check	Precautions
4. Tubes and sockets.	Monthly	a. Clean tubes. Use a clean, lint-free, dry cloth to remove dust and dirt from glass envelopes.	Do not handle tubes immediately after shutdown; severe burns may result.
		b. Inspect tube sockets when tubes are removed. If sockets and contacts are accessible, use fine brush to remove dust and dirt. Use a low pressure air jet if an air supply is available.	Do not use excessive pressure. Do not wiggle the tubes or partially withdraw them. Such movements tend to weaken tube and pins and spread the contacts in the socket. Be careful when removing tubes from their sockets.
5. Capacitors.	Monthly	a. Inspect fixed capacitors for signs of discoloration, leaks, bulges, dirt, corrosion, loose mountings and connections.	Remove source of power.
		b. Clean cases of fixed capacitors, insulated bushings and dirty or corroded connections. The cases and the bushings can usually be cleaned with a dry cloth. If deposits are hard to remove, moisten cloth in solvent.	
6. Resistors.	Monthly	a. Inspect coating of vitreous-enameled resistors for signs of cracks and chipping, especially at ends. Examine the bodies of all types of resistors for blistering, discoloration, and other signs of overheating.	Remove power source. Do not attempt to move resistors with pigtail connections. The connection may break at the point where it enters the body of the resistor. Such defects cannot be repaired.
		b. Inspect leads on all other connections for corrosion, dirt, dust, looseness, and broken strands in connecting wire.	
		c. Check security of all mountings.	
		d. Check the tightness of chassis-mounted resistors, connections and mountings if necessary.	Vibration may break the connection or damage the body if resistors remain loose.
		e. Clean carbon resistors with a small brush. Wipe vitreous-enameled resistors with a dry cloth. Dampen cloth with solvent	

TABLE 6-1. MAINTENANCE CHECK-CHART (cont)

What to Check	When to Check	How to Check	Precautions
		if deposits of dirt are unusually hard to remove. f. Resistors with discolored bodies cannot be cleaned. Bad discoloration indicates circuit trouble due to overheating.	

Note

In the event of operation in tropical areas where fungus growth may be encountered, frequent inspection of the receiver should be observed, particularly if the receiver has not been operating. Components showing signs of fungus growth should be cleaned and then coated with an approved fungus-resistant lacquer.

3. LUBRICATION.

The moving parts of the gear drive mechanism in the receiver are adjusted and lubricated at the factory with a low temperature grease (MIL-G-7421) which will provide satisfactory performance for several years under most conditions. If a periodic inspection shows that lubrication is required and considerable dirt has accumulated on the gear drive mechanism, the bearings, gears and other moving parts should be first cleaned with an approved solvent, and then relubricated with MIL-G-7421 low temperature grease. In some cases a "coarse feel" might be experienced when operating the TUNING control. This condition can be rectified by applying one drop of general purpose acid free instrument oil to each bearing, gear and cam. Rotate the TUNING control from end to end until the oil has been distributed evenly. In most cases this practice will suffice in lieu of a complete relubrication of the gear drive mechanism.

REPORT THE FAILURE OF ONLY ONE PART OR TUBE ON THIS FORM

1. REPORT NO.
2. REPORTING ACTIVITY
3. REPAIRED OR REPORTED BY (NAME)
4. DATE OF FAILURE
5. EQUIPMENT INSTALLED IN (TYPE AND NO.)
6. TIME METER READING OR INSTALLATION LOG TIME
7. WAS MISSION ABORTED? YES NO
8. OPERATIONAL CONDITION

EQUIPMENT	9. MODEL DESIGNATION AND MOD. NO.	10. SERIAL NO.	11. CONTRACTOR	12. CONTRACT OR ORDER NO.
COMPONENT (MAJOR UNIT)	13. MODEL DESIGNATION AND MOD. NO.	14. SERIAL NO.	15. CONTRACTOR	16. CONTRACT OR ORDER NO.
ASSEMBLY OR SUBASSEMBLY	17. ASSEMBLY AND MOD. NO.	18. SERIAL NO.	19. MANUFACTURER	20. (LEAVE BLANK)

PART DATA
21. PART NAME OR TUBE TYPE
22. STOCK NO. (FAILED ITEM)
23. PART REF. DESIG. (V-101, R-101, ETC.)
24. REPAIR TIME (MAN-HOURS)
25. HOURS IN SERVICE
26. MANUFACTURER OF FAILED PART
27. SERIAL NO.
28. WAS REPLACEMENT PART AVAILABLE LOCALLY YES NO

29. FIRST INDICATION OF TROUBLE
1 INOPERATIVE
2 INTERMITTENT
3 LOW PERFORMANCE
4 NOISY
5 OFF FREQUENCY
6 OUT OF ADJUSTMENT
7 OVERHEATING
8 UNSTABLE
9 OTHER

30. CHECK TYPE(S) OF TUBE OR PART FAILURE
007 ARCING
710 BEARING FAILURE
780 BENT
040 BINDING
070 BROKEN
720 BRUSH FAILURE
080 BURNED OUT
130 CHANGED VALUE
170 CORRODED
001 GASSY
300 GROUNDED
380 LEAKAGE
730 LOOSE
004 LOW GM OR EMISSION
750 MISSING
008 NOISY
450 OPEN
099 OTHER
790 OUT OF ADJUST.
006 SHORTED
770 SLIP RING OR COMMUTATOR FAILURE
018 TESTED OK DID NOT WORK
020 WORN EXCESSIVELY
SEE INSIDE FLAP FOR ADDITIONAL CODES

31. CAUSE OF FAILURE
2 FAULTY PACKAGING
5 MISHANDLING
6 INSPECTION OR TEST
1 NORMAL OPERATION
3 STORAGE
7 ASSOCIATED FAILURE-EXPLAIN
4 OTHER

32. WAS THE PART REPLACED DURING PREVENTIVE MAINTENANCE? YES NO

33. REMARKS *(Continue on reverse side if necessary)*

DD (1 AUG 54) 787

ELECTRONIC FAILURE REPORT
GPO 885057

Figure 7-1. Failure Report, Sample Form

SECTION 7

CORRECTIVE MAINTENANCE

1. FAILURE REPORT.

A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, Form CG-2643, which has been designed to simplify this requirement (see figure 7-1). The form must be filled out and forwarded in accordance with existing instructions.

Use great care in filling out the form to make certain, under "Circuit Symbol" use the proper circuit identification taken from the schematic diagrams, such as T8 in the case of an i-f transformer, or R47 for a resistor. Do not substitute brevity for clarity.

The purpose of this report is to inform the Commandant of the cause and rate of failures. The information is used by the Commandant in the design of future equipment and the maintenance of adequate supplies to keep the present equipment going. The forms you send in furnish us with a store of information permitting the Commandant to keep in touch with the performance of the equipment in your unit and all other units of the Coast Guard.

This report is not a requisition. You must request the replacement of parts in accordance with current instructions.

Make certain you have a supply of Failure Report Forms on board.

2. THEORY OF LOCALIZATION.

a. BASIC RECEIVER SECTIONS. —There are three basic sections in the receiver. Proceeding in the most general method of trouble localization for a receiver, they are: The audio section, intermediate frequency section, and the radio frequency section. The first check to make when the receiver fails to operate is a check of the external power source, receiver power supply and the antenna. Also make certain that the front panel controls are used properly, and all the tubes are installed properly and in their proper locations. Never assume anything without first investigating. Someone else may have had contact with the receiver, whether authorized or not. In general, after it has been ascertained that the tubes are lit and that the power supply is furnishing adequate voltage to the receiver, the trouble localization begins with the audio output circuit of the receiver and continues on towards the antenna input terminals.

b. RECEIVER SENSITIVITY.—One quick method of checking the receiver consists of operating the receiver on each band, and over the full range of each band. In addition, each control is operated to make sure that the particular circuit involved is functioning properly (par. 2, section 4). This requires previous experience with the receiver, or similar receivers in the case of experienced receiver technicians or operators. Refer back to Section 4 for information on the operation of the receiver. In some cases, this check will aid the technician in localizing the trouble; the defective circuit and part must be isolated by more detailed trouble shooting.

c. SIGNAL SUBSTITUTION. —Signal substitution consists of injecting an audio, i-f, or r-f signal into certain receiver circuits in order to determine the functional merit of those particular circuits. This practice requires a technician's skill because the correct frequencies and signal levels employed are just as important as the correct point of signal injection. Signal substitution usually allows the technician to isolate the trouble to one particular stage of the receiver.

d. VOLTAGE AND RESISTANCE MEASUREMENTS. —Voltage and resistance measurements are employed to locate the defective part in the receiver. Random voltage and resistance measurements will allow the technician to locate the defective part eventually, however the trouble should first be localized and isolated, otherwise much time will be wasted. When making voltage and resistance measurements, be sure the receiver controls are set as prescribed (par. 3, this section), otherwise measurements different from those specified in the voltage and resistance data might be obtained, and the results will be misleading.

3. UNIT TROUBLE SHOOTING, REPAIR, ALIGNMENT AND TESTING.

a. STANDARD CONDITIONS.—In order that all trouble shooting, alignment, repair and testing is accomplished under the same or similar conditions to the data contained herein, it is essential that standard test conditions are followed. Whenever possible, repair work on the receiver should be done in a shop or area that is at normal room temperature and humidity, free from dust, dirt and other contaminating influences. Preferably, the work should be accomplished in a screened room, or at least in a location free from strong r-f signals, except those signals introduced on a test antenna. The receiver controls should be set as follows, except where the specific test or operation instructs otherwise.

SENSITIVITY	fully clockwise
VOLUME	fully clockwise
TONE	fully counter-clockwise
BFO PITCH	0
POWER OFF-STANDBY-ON	ON
AVC-MAN.-CW.	MAN.
SPEAKER	ON
NOISE LIMITER	OFF
ANTENNA TRIMMER	0
BAND CHANGE	7.3-18.0, or as instructed
TUNING	any setting, or as instructed

The input power to the receiver, a-c or d-c, should be as close to the nominal voltage of 115 volts as is possible. If ac is used, the line voltage should be regulated with a Variac or similar autotransformer which allows control of the receiver input voltage.

b. TEST EQUIPMENT.—There are two general purpose test equipments that are essential for the testing, trouble shooting and aligning the receiver. An r-f signal generator that is capable of producing modulated and unmodulated r-f signals from 200 kc to 19 mc is required. The audio modulating signal in the signal generator should also be available for testing the audio circuits of the receiver. Signal Generator AN/URM-25 satisfies this requirement. A vacuum tube voltmeter such as an RCA Voltohmyst Jr. or a 20,000 ohms per volt multimeter such as the Simpson Model 260 is necessary for voltage and resistance measurements. In addition, the vtvm or multimeter can be used as the output meter when used on the a-c range and a 600-ohm resistive load used to terminate the receiver audio output. Other pieces of test equipment can be used; the extent of use of other equipment depends upon the availability of such equipment and the skill of the technician using the equipment.

c. SPECIAL TOOLS AND DUMMY ANTENNA. —A special double-ended alignment tool is furnished with the receiver. When not in use it is clipped to the tuning capacitor cover located on top of the receiver chassis. See figure 7-2. The small end of this tool is used for aligning the bottom slug in the i-f transformers by insertion through the top slug. The larger end of this tool is for aligning the top slug in the i-f transformers. Adjustment of the trimmer and padder capacitors and the slugs in the r-f section of the receiver is done with any suitable non-metallic alignment tool. The dummy antenna used for alignment and testing of the receiver consists of a small composition resistor and a small mica capacitor in series with the low impedance output of the r-f signal generator. The 0.20 to 0.40 mc (band 1) dummy antenna consists of a 300-ohm composition resistor and a 500 uuf mica capacitor in series with the r-f signal generator across the antenna input terminals. The dummy antenna for bands 2 through 5 is the same except a 200 uuf mica capacitor is substituted for the 500 uuf capacitor.

d. TROUBLE SHOOTING.—Table 7-1 is a trouble shooting chart that contains several general and basic symptoms, probable causes, and remedies or suggestions that are applicable to this receiver. This chart is by no means a complete listing of probable troubles, however it can be used as a guide in localizing various forms of receiver trouble. Subsequent information in this section can be used for further localization and isolation of trouble, as outlined in paragraph 2.

TABLE 7-1. TROUBLE SHOOTING CHART

Symptom	Probable Cause	Remedy
1. Receiver inoperative, tubes and panel lamps do not light.	1. 115-volt a-c or d-c power not energizing the filament and rectifier circuits.	1. a. Power not connected to TB2. b. F1 and/or F2 open. c. S4 defective.
2. Several tubes in receiver do not light. Panel lamps may or may not light.	2. One of the tube filaments in a certain series filament string is open.	2. a. Check filaments of tubes that do not light. b. Check ballast resistors and panel lamps with the aid of figure 7-2.
3. Receiver inoperative, and touching pin 7 of V10 with a screwdriver yields no audio noise or hum.	3. Defective audio circuits or tubes.	3. a. Touch the grids with a screwdriver (pin 5) of V11 and V12 and pin 2 of V10 to isolate defective stage. Locate defective part with the aid of voltage and resistance measurements. b. Use an audio oscillator if one is available.
4. Audio section operative, but no receiver output.	4. a. Defective i-f or detector stage or tube. b. Rectifier V14 defective.	4. a. Touch the grids (pin 1) of V6, V5 and V4 with a screwdriver to isolate defective stage. b. Use the r-f signal generator tuned to 455-kc and modulated with a 1000-cps audio signal. c. When defective stage is located, check voltages and resistances. d. Check rectifier tube V14.
5. Audio and i-f stages operative, but no receiver output.	5. R-f amplifier, or local oscillator stages or tubes defective.	5. a. Touch the antenna terminals with a screwdriver, or feed in a modulated r-f signal with a signal generator. Try each band, and be sure to tune the signal generator to the receiver dial frequency. b. Check that the local oscillator is operating. A negative voltage should be found on pin 1 of V3 if the stage is oscillating.

TABLE 7-1. TROUBLE SHOOTING CHART (cont)

Symptom	Probable Cause	Remedy
6. Receiver overloads on strong signals when AVC-MAN.-CW. switch is on AVC.	6. Avc circuit defective, or developed avc not getting to control grids of V1, V4, V5 and V6.	6. a. Check AVC tube V7. b. Check for negative voltage on pin 5 of V7. c. Check for negative avc bias at terminal 7 on T8 or T9. C39 could be shorted. d. Gassy or shorted V1, V4, V5, or V6.
7. Bfo does not operate.	7. Defective bfo tube V8 or circuit.	7. a. Check V8, switch S2, and bfo circuit with voltage and resistance tests. b. Bfo transformer T20 not tuned to or near 455 kc. Try adjusting slug in T20.
8. When NOISE LIMITER switch is set to ON, receiver output disappears.	8. One-half of V9 defective.	8. Check tube V9.

e. CIRCUIT PARTS LOCATIONS.—Figures 7-2 through 7-10 show various views of the receiver and are intended to aid in the location of the electrical parts and various test and alignment points. A familiarization with the physical layout of the receiver and its many parts will aid in aligning, testing, and trouble shooting the receiver.

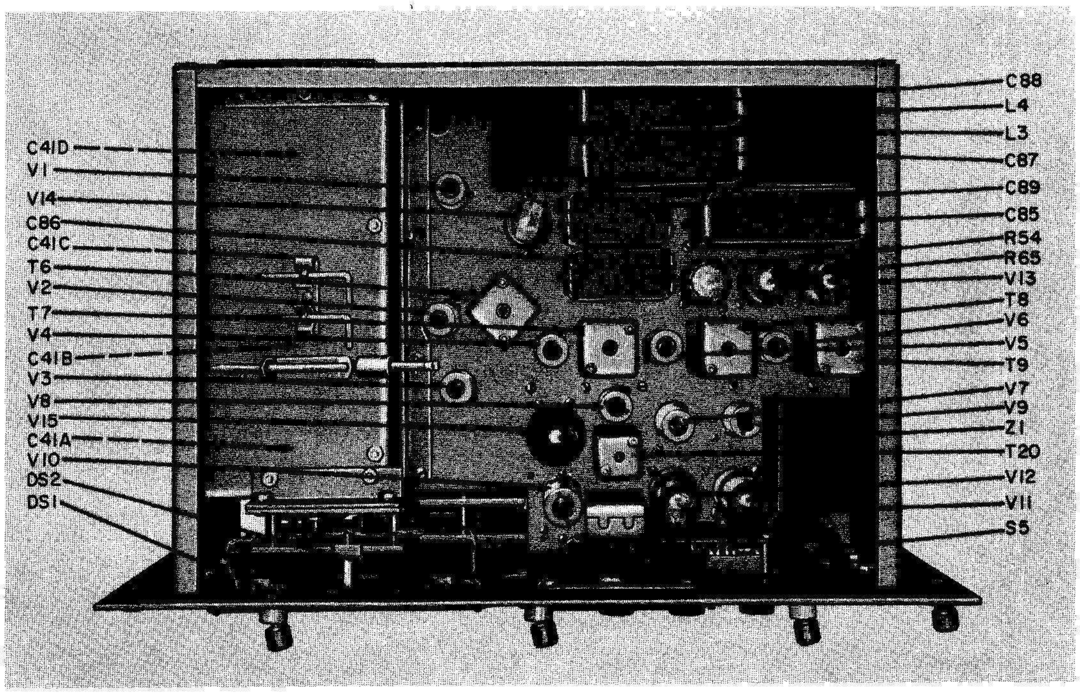


Figure 7-2. Radio Receiver R-649/UR, Top View

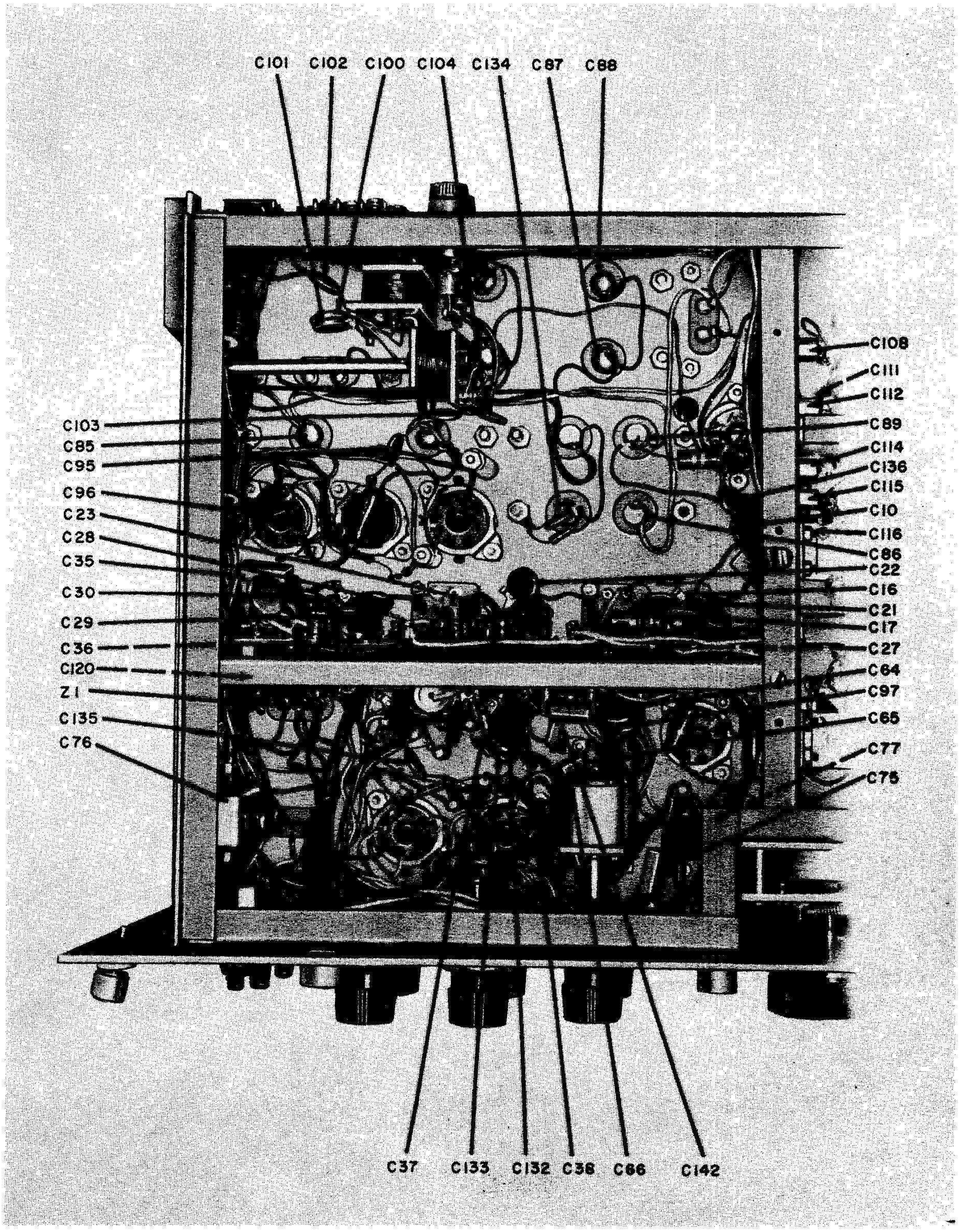


Figure 7-3. Radio Receiver R-649/UR, Bottom View, Audio and I-f Sections, Capacitor Identification

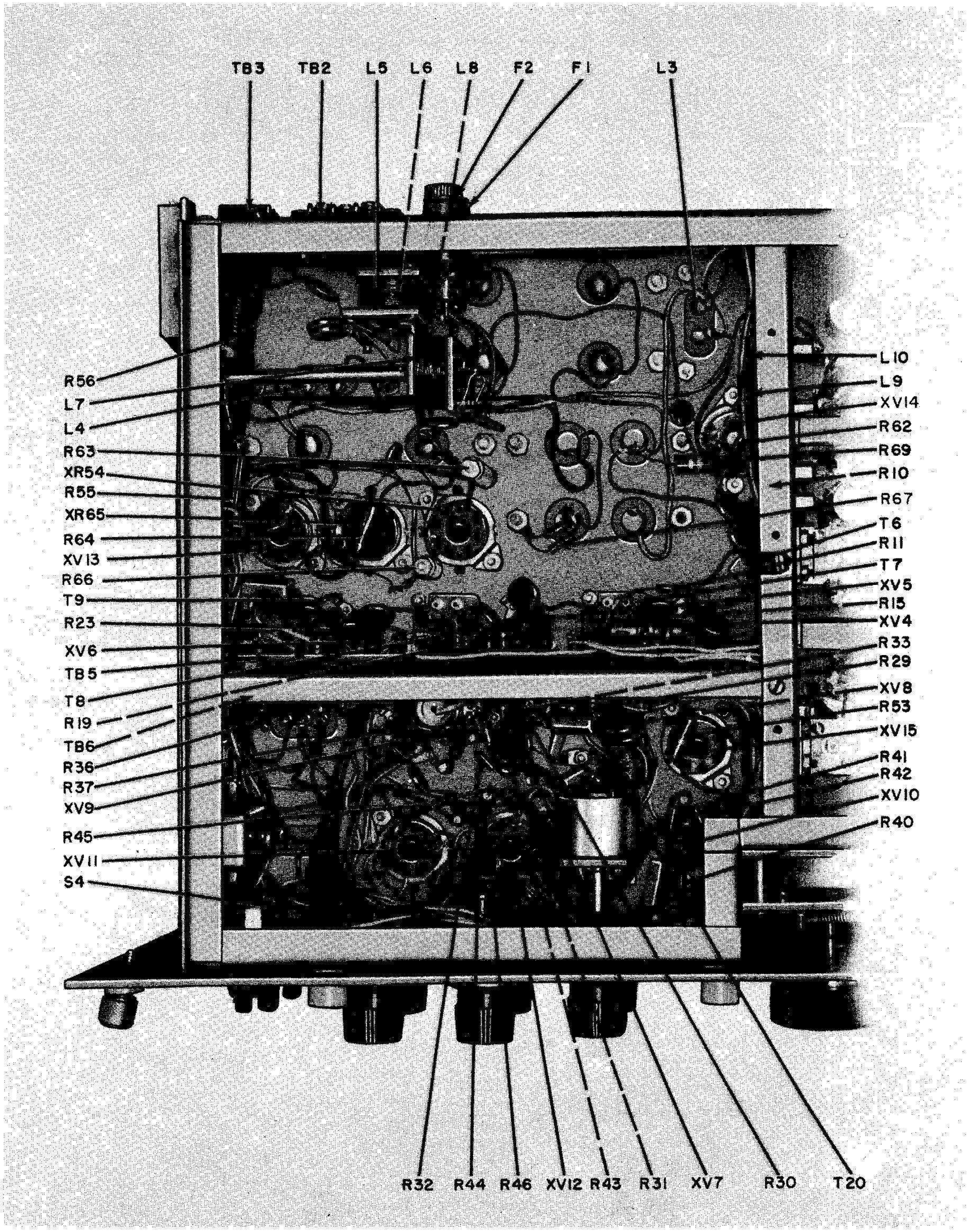


Figure 7-4. Radio Receiver R-649/UR, Bottom View, Audio and I-f Sections, Resistor Identification

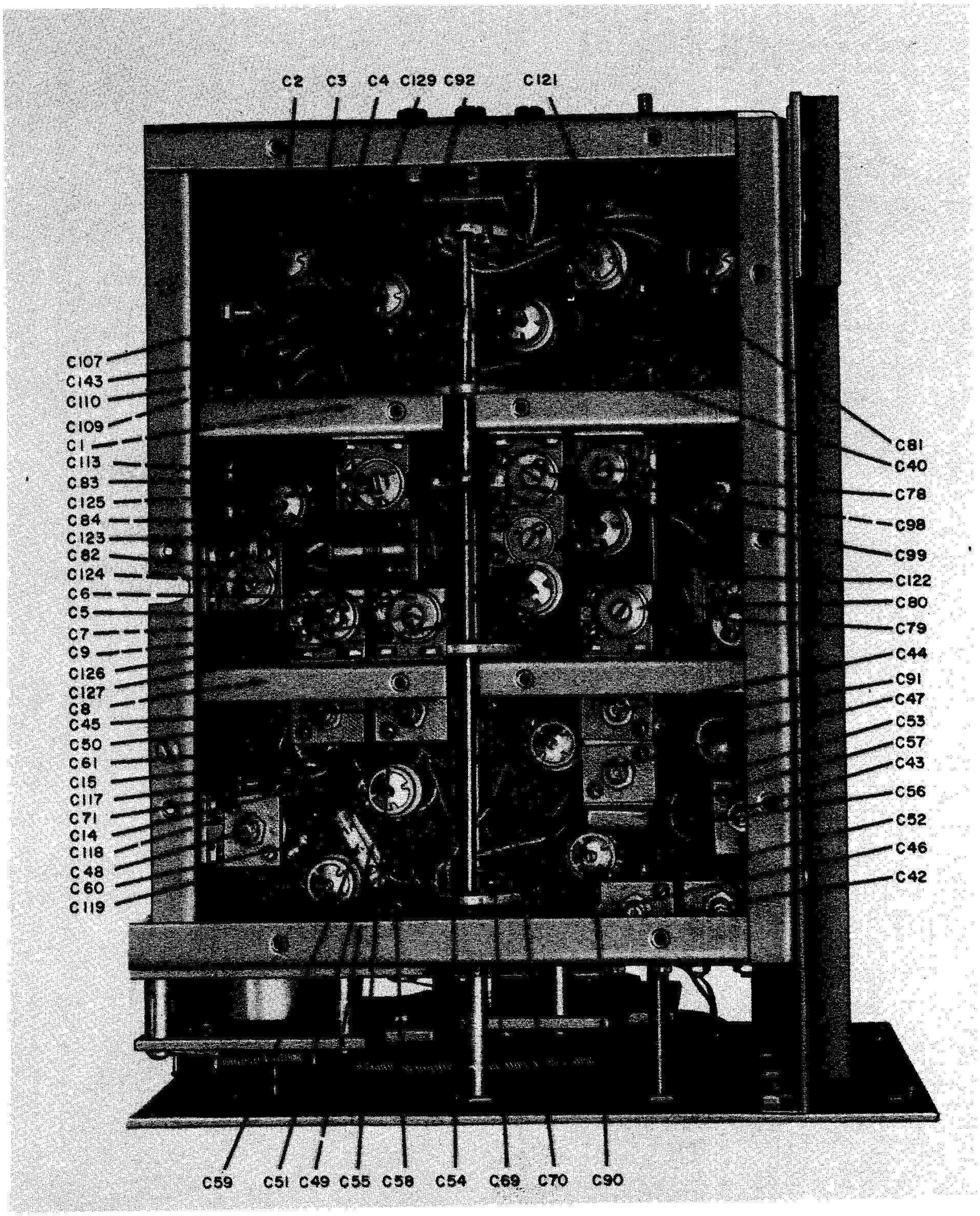


Figure 7-5. Radio Receiver R-649/UR, Bottom View, R-f Section, Capacitor Identification

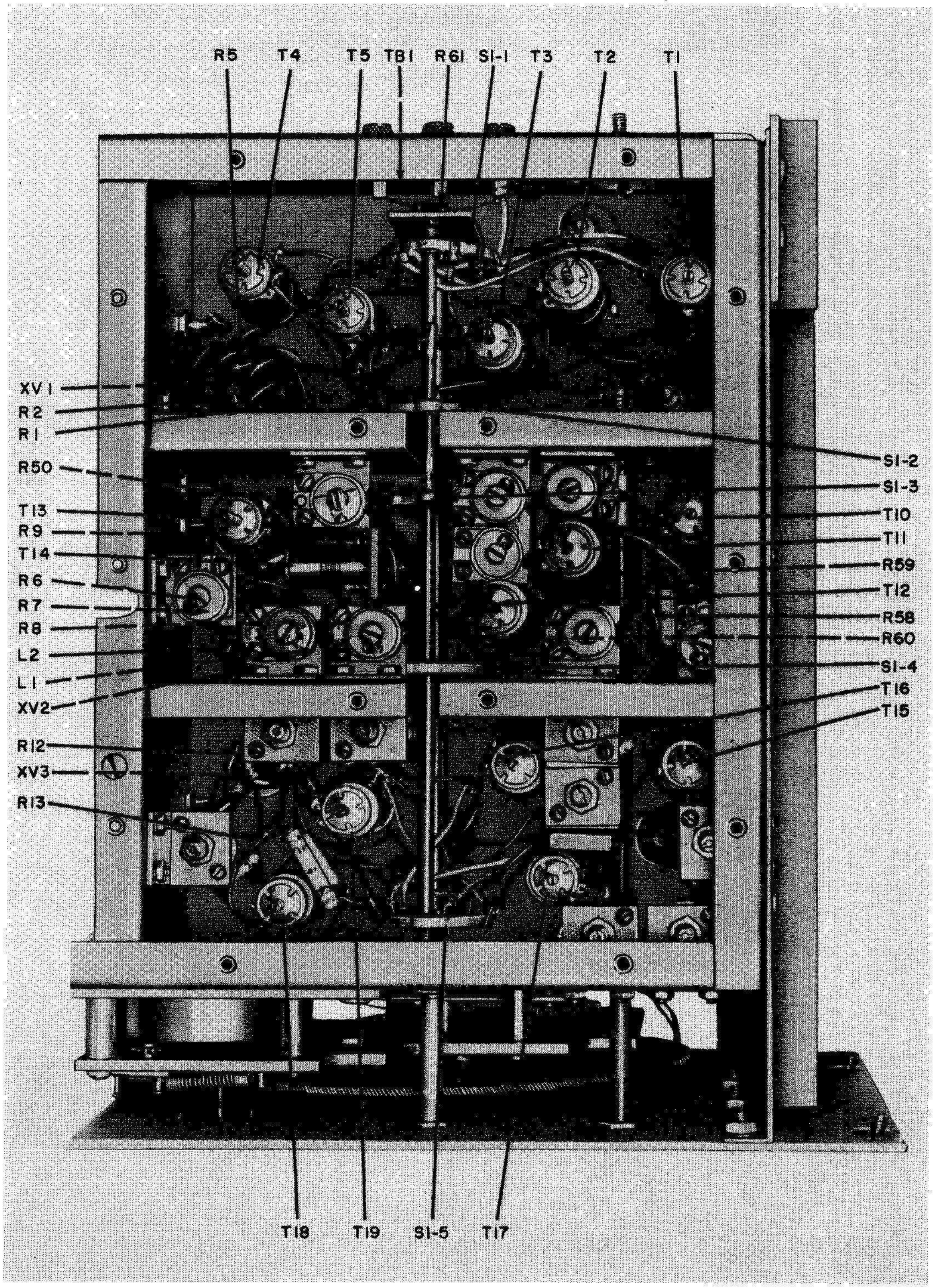


Figure 7-6. Radio Receiver R-649/UR, Bottom View, R-f Section, Transformer Identification

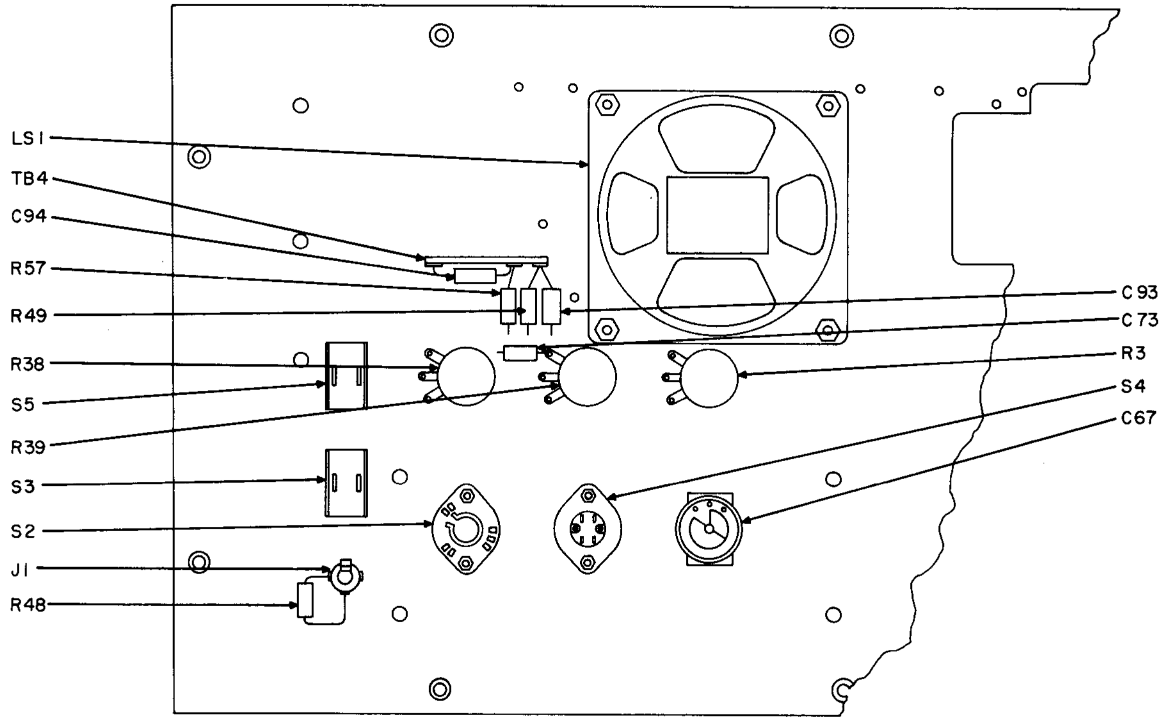


Figure 7-7. Front Panel

f. SIGNAL SUBSTITUTION. — The following is a procedure for trouble shooting the receiver by the injection of audio, i-f or r-f signals into the proper circuits for the purpose of determining whether or not the stages are functioning properly. Set the receiver controls as listed in paragraph 3a in this section and do not change them unless instructed otherwise.

Step 1. If an audio oscillator is available, or the audio output of the r-f signal generator, connect its hot lead through a 0.01 uf capacitor to terminals 1 and/or 3 of the audio output network Z1. Adjust the audio oscillator for full output. The audio signal heard in the speaker, or headphones, may be very weak, depending upon the output of the audio oscillator. If this test is successful, the audio output circuit can be assumed to be normal.

Step 2. Connect the output of the audio oscillator to pins 5 of the audio output tubes V11 and V12. If both these tubes are operating properly, there should be an increase in the audio output level, and it may be necessary to reduce the audio output level. If one of the push-pull tubes fails to give the expected gain, it may be defective. Substitute another 35L6GT tube, or switch the 35L6GT tubes and repeat this test.

Step 3. Connect the output of the audio oscillator to pin 1 and then to pin 6 of the audio amplifier-phase inverter tube V10. The signal level should be approximately the same as that obtained in step 2. If this test is successful, it indicates that the coupling capacitors are normal.

Step 4. Connect the output of the audio oscillator to pin 2 and then to pin 7 of V10. There should be an increase in the gain compared with the test in step 3, and it will be necessary to reduce the output of the audio oscillator.

Step 5. Connect the output of the audio oscillator to pin 2 of the detector and noise limiter tube V9. If the same level of audio signal is present, it can be assumed that the audio coupling capacitors between V9 and V10 are normal.

Step 6. With the same connection as in the previous step, throw the NOISE LIMITER switch to ON. This passes the audio signal through the noise limiter circuit. If the circuit is satisfactory, the audio signal should be about the same level as previously, except for some clipping that might occur in the noise limiter circuit. After the test is concluded, return the NOISE LIMITER switch to the OFF position. This concludes the audio signal substitution testing.

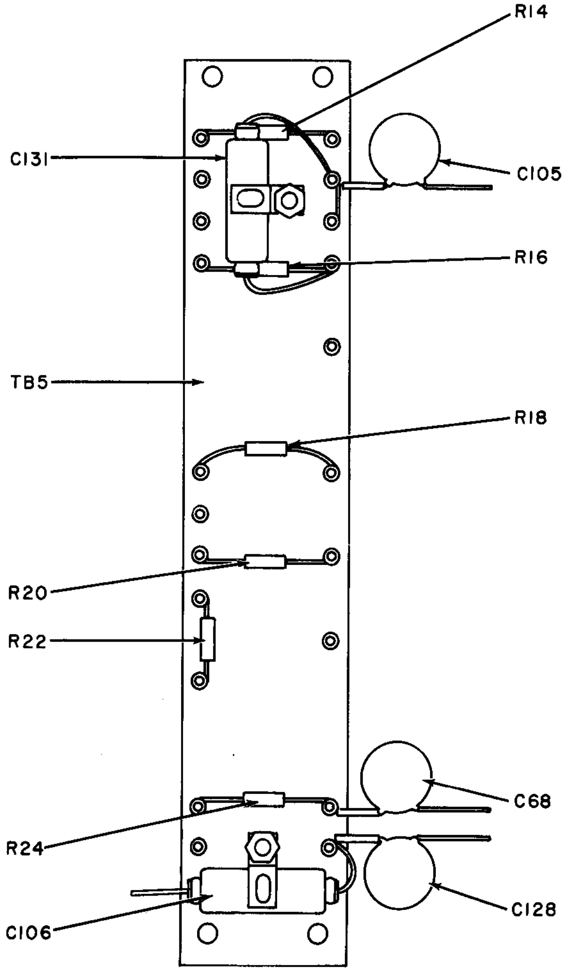


Figure 7-8. Terminal Board TB5

Step 7. Connect the output of the r-f signal generator (tuned to 455 kc) and modulated with an audio signal through a small mica capacitor (100 uuf is satisfactory) to pin 7 of the detector V9. It will be necessary to turn up the output of the signal generator to obtain any appreciable signal at this point. If this test is successful it indicates that the detector is operating properly.

Step 8. Connect the output of the signal generator to pin 4 of T9. If this test is satisfactory, it indicates that the output i-f transformer is good. Continue testing the i-f stages by applying the i-f signal to the grid (pin 1 of V6) and then to the plate of V5, and then to the grid of V5. Each time the 455-kc signal is moved from the plate of an i-f tube to the grid of the same tube it should be necessary to reduce the output of the signal generator if the stage is amplifying the signal properly. The last 455-kc point of injection is the signal grid of the mixer tube V2. It will be necessary to increase the r-f signal generator output at this point because the input circuit is tuned to the receiver frequency.

Step 9. To test the r-f section of the receiver by signal substitution it is necessary to have the receiver and the signal generator tuned to the same frequency. This is best accomplished by tuning the receiver and the signal generator to the selected frequency and then rocking the signal generator frequency back and forth to be sure that both are tuned to the same frequency. Begin by applying the r-f signal to the signal grid of the mixer V2. If this test is satisfactory it will be possible to pass the signal through the receiver with the output of the signal generator set to 1000 microvolts or less. If this test fails it may be an indication that the mixer is not operating properly, or that the local oscillator is not operating. To determine that the local oscillator is not functioning, feed a signal into the oscillator grid of the mixer tube (pin 1 of V2) which is 455 kc above the receiver frequency. This method substitutes the signal generator for the local oscillator.

Step 10. If the foregoing mixer and oscillator tests indicate that those stages are functioning properly, feed the r-f signal to the plate of the r-f amplifier tube V1, and then to the grid of this tube, and finally to the antenna input terminals. As in the cases of the audio and i-f amplifiers, each time signal injection is moved from the plate of a given tube to the grid of the same tube it can be expected that increased gain will result.

Step 11. A similar test can be conducted for the beat frequency oscillator. If the i-f stages are not aligned at or near 455 kc, or the bfo circuit is not aligned at or near 455 kc, it is possible that both circuits can be operating, but that no beat frequency signal will be audible. If it is not possible to obtain a beat frequency signal with the receiver bfo connect the 455-kc output signal of the r-f signal generator, without modulation, to pin 1 or pin 7 of the third i-f amplifier V6, and rock the signal generator frequency back and forth in the vicinity of 455 kc. The receiver also must be tuned to an r-f signal during this check. If a beat signal is obtained in this manner, it indicates that the bfo is not operating, or that the bfo frequency is far removed from 455 kc.

g. VOLTAGE AND RESISTANCE MEASUREMENTS.—The voltage measurements of all tubes at the chassis tube sockets are shown on the receiver schematic diagram, and also in figure 7-11. These readings are measured to the B-line. In addition, figure 7-11 gives the resistance readings of the tube sockets measured also to the B- line. In order to duplicate these readings it is necessary that the receiver front panel controls be set as instructed in paragraph 3a and figure 7-11. It should be noted that the rectified grid leak bias developed on the control grid of the local oscillator V3 will vary appreciably with the frequency band in use, and also with the setting of the tuning capacitor. The control grid voltage of V3 normally is between 1.5 and 6 volts negative, as measured to B-. The actual values will vary with the line voltage and the activity of the tube used as the local oscillator. When making resistance measurements be sure power is removed from the receiver.

CAUTION

Extreme care must be exercised when making voltage measurements. It is possible to burn out the series-connected tube filaments if the test probe short-circuits certain points in the receiver chassis. For this reason it is recommended that tube filament voltages should not be measured; employ resistance measurements for trouble shooting filament circuits.

b. ALIGNMENT AND REPAIR.

Note

When making repairs in the receiver, especially in the r-f amplifier, mixer or local oscillator sections, retain the original placement of parts and wires.

(1) GENERAL.—The receiver has been carefully aligned at the factory and should not require realignment unless its sensitivity is poor, off-frequency calibration of the dial exists or service work on one or more of its r-f and i-f amplifier stages has been done. Alignment should only be attempted by experienced personnel as peak performance is obtained by careful and correct alignment. See figures 7-12 and 7-13 for the location of the i-f and r-f alignment points.

Note

When the receiver is operated on ac, the isolation transformer in the a-c line of the receiver will minimize 60-cps hum and protect maintenance personnel from receiving a 115-volt shock between chassis and ground.

(2) TEST EQUIPMENT.—Refer to paragraph 3b.

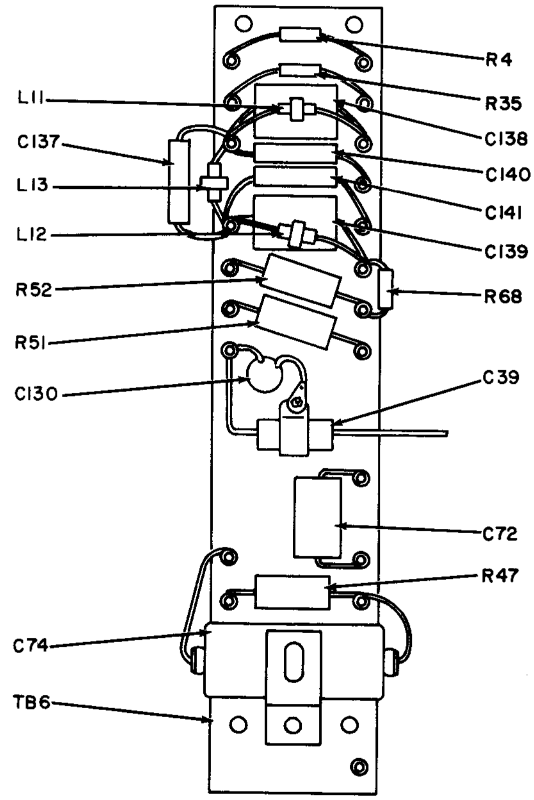


Figure 7-9. Terminal Board TB6

(3) ALIGNMENT TOOLS.—Refer to paragraph 3c.

(4) PRELIMINARY CONNECTIONS.—Connect a 600-ohm, noninductive resistor (5 watts or larger) across the terminals labeled 600 and GRD of terminal board TB3 located on the rear of the chassis. Connect the a-c meter across the resistor and use the 10-volt scale. Adjust the signal generator output to maintain an indication of 2.5 to 5.5 volts on the meter during the alignment procedure.

(5) I-F ALIGNMENT PROCEDURE.

Step 1. Connect a 0.01 uf capacitor to the r-f output lead of the signal generator. By means of a small clip, connect the other end of this capacitor to the control grid (pin 1) of V4. Refer to figures 7-2 through 7-10 and 7-12 and 7-13 for location of necessary component parts and alignment points. Connect the ground lead of the r-f signal generator to B-.

Note

The chassis is not B-. The B- bus is connected to the chassis through capacitors.

Step 2. Allow 15 or 20 minutes for the receiver and test equipment to warm up. Set the front panel controls as instructed in paragraph 3a.

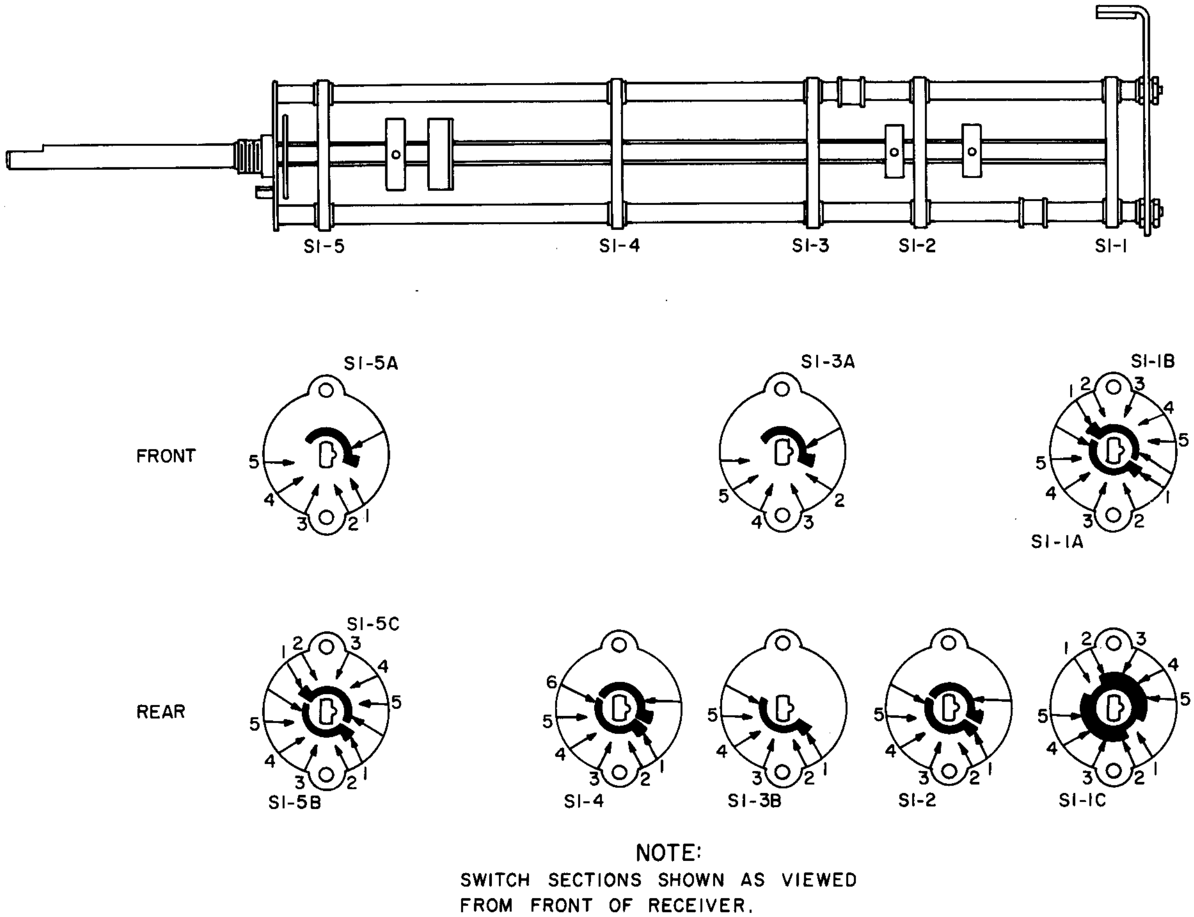


Figure 7-10. Band Switch Details

Step 3. Set the signal generator frequency to 455 kc and turn on the 400 or 1000-cps modulation. Always begin by feeding a minimum signal into the receiver, increasing the signal generator output until an indication is seen on the output meter. Maintain an indication of 2.5 to 5.5 volts on the output meter throughout these alignment procedures to prevent overloading the receiver.

Step 4. Adjust the secondary and then the primary of T9 from the top (see par. 3c) for a maximum indication on the output meter. Do the same for T8 and T7. Readjust the above transformers in their given order until subsequent adjustments do not increase the output meter indication.

Step 5. Disconnect the 0.01-uf capacitor and ground lead of the signal generator from pin 1 of V4 and B-. Connect the capacitor to the ungrounded antenna terminal and the ground connection to the chassis ground on the receiver. Set BAND CHANGE switch to .49-1.2 and TUNING control to 510 kc.

Step 6. Inject a 455-kc, 400 or 1000-cps modulated carrier signal and adjust the secondary and primary of T6 for a maximum indication on the output meter.

Step 7. Alignment of the 455-kc trap in the mixer circuit is accomplished by rotating C5 and C126 for a minimum in the output indication. When certain that a minimum indication has been achieved, increase the signal generator output, being careful not to overload the receiver. Repeat these adjustments until no further minimum indication results.

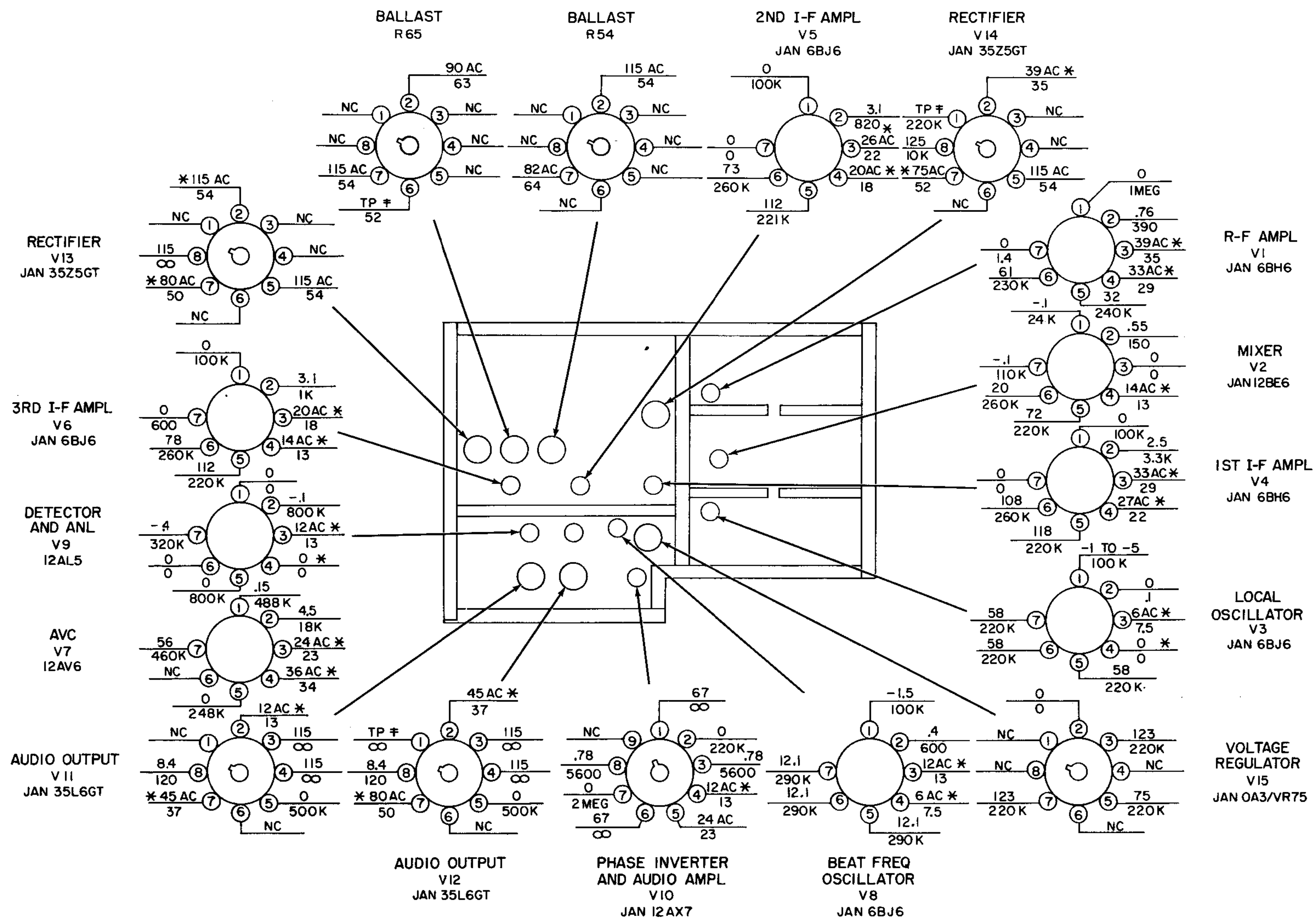
(6) BFO ALIGNMENT PROCEDURE.

Step 1. Shut off the signal generator modulation.

Step 2. Be sure the BFO PITCH control is at "0" and the AVC-MAN.-CW. switch is at CW.

Step 3. If a beat note is not heard, adjust the slug in T20 until a beat note is obtained.

Step 4. Turn the VOLUME control counterclockwise to adjust receiver volume to a com-



NOTES:

1. REFER TO PARAGRAPH 3, SECTION 7 FOR FRONT PANEL CONTROL SETTINGS.
2. 115 VAC LINE VOLTAGE.
3. WHEN MEASURING RESISTANCES TURN [POWER] SWITCH TO [OFF].
4. RESISTANCE READINGS AT V10, PIN 7 VARIES WITH SETTING OF [VOLUME] CONTROL.
5. VOLTAGE READINGS ARE ON TOP OF LINE, RESISTANCE READINGS ARE BELOW LINE.
6. * DENOTES FILAMENT CONNECTIONS. DO NOT MEASURE VOLTAGE AT THESE POINTS. ‡ DENOTES TIE POINTS.
7. WHEN MEASURING VOLTAGE ON V8, PINS 5, 6, AND 7 TURN [AVC-MAN.-CW.] SWITCH TO [CW.].
8. WHEN MEASURING VOLTAGE ON V9, PINS 2 AND 7, TURN [NOISE LIMITER] SWITCH TO [ON].

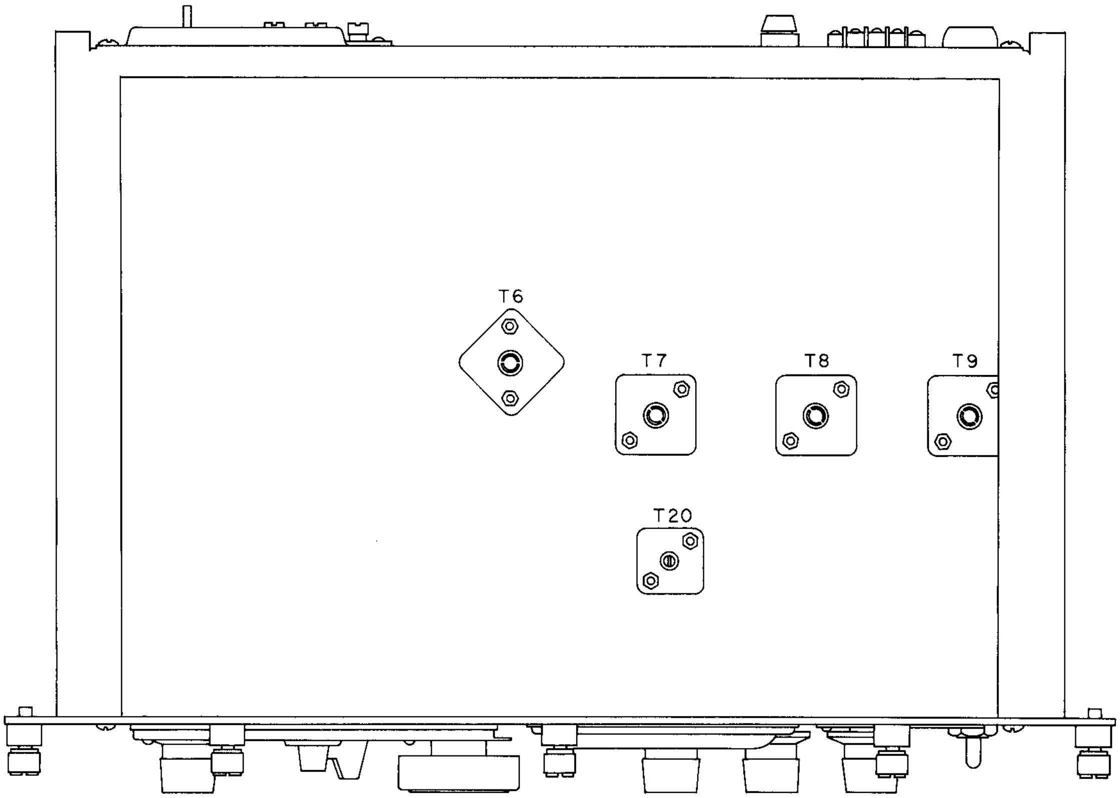


Figure 7-12. I-f Alignment Points

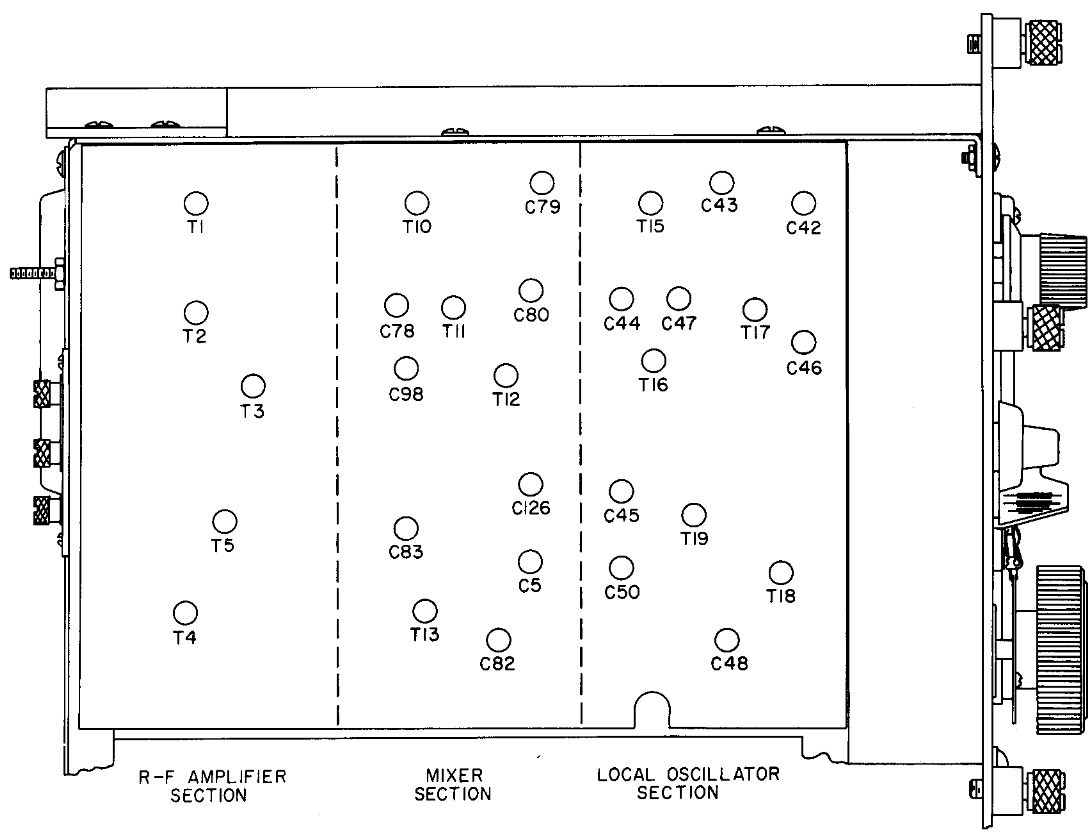


Figure 7-13. R-f Alignment Points

fortable level and use just enough signal generator output to produce a clean beat note.

Step 5. Adjust T20 until a zero beat is obtained.

Step 6. Check the bfo by turning the BFO PITCH control to the right and left of 0. An audio note that increases in frequency with rotation should be heard on each side of the 0 mark.

(7) LOCAL OSCILLATOR ALIGNMENT.— The r-f signal generator should be checked against a frequency standard before beginning the local oscillator alignment. If a frequency standard is not available, the signals from local stations can be used for checking the signal generator frequency accuracy, providing their frequency accuracy is reliable. If station WWV can be received, use those test frequencies at 2.5, 5.0, 10.0 and 15.0 megacycles for checking the calibration accuracy.

Step 1. Connect the ground lead of the signal generator to the grounded terminal labeled A on TB1. Connect the r-f output lead of the signal generator to the other terminal A on TB1 through the dummy antenna. Refer to paragraph 3c.

Step 2. Set the receiver front panel controls as instructed in paragraph 3a except set the TUNING control to 18.0 mc.

Step 3. Set the r-f signal generator to 18.0 mc and turn on the 400 or 1000-cps modulation. Increase the output of the signal generator until 2.5 to 5.5 volts is indicated on the meter. Maintain this output throughout the entire alignment procedure by adjusting the signal generator output. Adjust trimmer C50 for a maximum indication on the output meter.

Step 4. Set the signal generator and receiver to 7.3 mc. Adjust T19 for a maximum indication on the output meter. Maintain 2.5 to 5.5 volts output.

Step 5. Set the signal generator and receiver to 18.0 mc. and readjust C50 for a maximum indication on the output meter.

Step 6. A check is necessary at this time to make certain that the local oscillator frequency is 455 kc above the signal frequency. Set the generator to the image frequency of 18.91 mc. (The image frequency is equal to the radio frequency plus twice the intermediate frequency.) With the receiver set at 18.0 mc, increase the output of the signal generator until a signal indication appears on the output meter. Rock the signal generator frequency control back and forth near 18.91 mc to find the image. The presence of a signal indication indicates that the oscillator frequency is above the signal frequency, as required. The absence of an indication necessitates rotating trimmer C50 until an indication occurs. Once an indication is obtained, set the signal generator to 18.0 mc, decrease the output of the signal generator, and adjust trimmer C50 for a maximum indication on the output meter, and repeat steps 3, 4 and 5.

Step 7. A check of the local oscillator frequency at the low end of the band is also necessary. Set the signal generator to 8.21 mc and the receiver to 7.3 mc. Increase the signal generator output and, if necessary, rotate slug T19 until a signal indication appears on the output meter. Decrease the signal generator output and repeat step 4.

Step 8. Repeat steps 3 and 4 until further adjustment does not increase the indication on the output meter.

Step 9. Set signal generator to 7.3 mc. Set the receiver BAND CHANGE switch to the 3.0-7.3 mc position. Set the TUNING control to 7.3 mc. Adjust trimmer C48 for a maximum indication on the output meter.

Step 10. Set signal generator and receiver to 3.0 mc. Adjust slug T18 for a maximum indication on the output meter.

Step 11. To check the frequency of the local oscillator, set the signal generator to the image frequency of 8.21 mc. With the receiver set at 7.3 mc, increase the output of the signal generator and rock the signal generator frequency until a signal indication is present on the output meter. If a signal is not present, rotate trimmer C48 until an indication appears. After rotating trimmer C48, set the signal generator to 7.3 mc, decrease the output of the signal generator and adjust trimmer C48 for a maximum indication on the output meter.

Step 12. The procedure used in step 11 also applies to step 12. The only deviation is that the signal generator is set to the image frequency of 3.91 mc, the receiver to 3.0 mc and slug T18 rotated until a signal indication appears on the output meter.

Step 13. Repeat steps 9 and 10 until further adjustment does not increase the output indication.

Step 14. Observe the order given in the following alignment table for the 1.2-3.0, .49-1.2, and .20-.40 bands when making the remaining local oscillator adjustments. See table 7-2. Set the BAND CHANGE switch to the desired frequency range. Set the signal generator and receiver TUNING control to the high frequency within that range. Rotate the specified adjustment until a maximum indication on the output meter is obtained. Set the signal generator and receiver TUNING control to the low frequency within that range. Rotate the adjustment indicated on the alignment chart until a maximum output is obtained. Set the signal generator and receiver TUNING control to the middle frequency of each frequency range. Rotate the specified adjustment until a maximum indication is obtained. Repeat the other adjustments in that particular band until further adjustment does not increase the indication on the output meter.

TABLE 7-2. LOCAL OSCILLATOR ALIGNMENT

BAND CHANGE Switch	TUNING and Signal Generator Frequency	Oscillator Adjustments to be Peaked
7.3-18.0	18.0 mc 7.3 mc	C50 trimmer T19 slug
3.0-7.3	7.3 mc 3.0 mc	C48 trimmer T18 slug
1.2-3.0	3.0 mc 1.2 mc 1.85 mc	C46 trimmer T17 slug C47 pad
.49-1.2	1200 kc 490 kc 750 kc	C44 trimmer T16 slug C45 pad
.20-.40	400 kc 200 kc 290 kc	C42 trimmer T15 slug C43 pad

(8) MIXER AND R-F ALIGNMENT.—The signal generator remains connected as it was for local oscillator alignment. When making adjustments for r-f alignment, observe the order given in table 7-3. Set the receiver BAND CHANGE switch to the desired frequency range. Set the r-f signal generator and the receiver TUNING control to the high frequency indicated in table 7-3. Rotate the mixer and r-f adjustments until a maximum indication on the output meter is obtained. Set the r-f signal generator and receiver TUNING control to the low frequency within the range indicated in alignment table 7-3 and rotate the specified mixer and r-f adjustments until a maximum indication on the output meter is achieved. Repeat these adjustments until further adjustment does not increase the indication on the output meter. Check the over-all alignment of the receiver on each frequency range by performing a sensitivity check. Refer to paragraphs 4e and 4f.

TABLE 7-3. MIXER AND R-F ALIGNMENT

BAND CHANGE Switch	TUNING and Signal Generator Frequency	Mixer Adjustments	R-f Adjustments
3.0-7.3	7.1 mc 3.1 mc	C82, C98 T13	C40* T4
7.3-18.0	17.5 mc 7.6 mc	C83, (C123)∅	C40* T5
1.2-3.0	2.9 mc 1.25 mc	C80 T12	C40* T3
.49-1.2	1175 kc 510 kc	C79 T11	C40* T2
.20-.40	400 kc 206 kc	C78 T10	C40* T1

*C40 is the ANTENNA TRIMMER control.
∅Trimmer C123 located adjacent to trimmer C98 is adjusted at the factory to overcome variations in distributed capacity. This trimmer will need adjustment only when service work has been done in the mixer section. To adjust, remove r-f section shield plate which is held in place with fifteen screws and lockwashers. With receiver and signal generator tuned to 17.5 mc, rotate C123 for maximum indication on the output meter. Replace r-f section shield plate and proceed with r-f alignment in accordance with table 7-3.

(9) FINAL ALIGNMENT OF 455-KC TRAPS.

Step 1. Turn on the 400- or 1000-cps modulation and set the signal generator to 455 kc.

Step 2. Set receiver BAND CHANGE switch to .49-1.2 mc.

Step 3. Set receiver TUNING control to the low-frequency end of the tuning dial and rotate C5 and C126 alternately until a maximum dip occurs in the output indication.

Step 4. If it was necessary to make any adjustments in step 3, realign the r-f and mixer sections with the BAND CHANGE switch in the .20-.40 and the .49-1.2 mc positions.

i. REMOVAL AND REPLACEMENT OF PARTS.

(1) REMOVAL OF FRONT PANEL ASSEMBLY.

(a) Remove two screws and lockwashers holding the dial lock and spacer block, and the dial lock will fall free.

(b) Loosen the two set screws in each knob. Remove knobs.

(c) Remove rubber shaft seals from all panel controls except for the ANTENNA TRIMMER, BAND CHANGE and SENSITIVITY; only loosen the above shaft seals.

(d) Remove PHONE jack cover by removing mounting nut.

(e) Remove four screws and lockwashers from OPERATING INSTRUCTIONS plate. Remove plate.

(f) Remove one screw, lockwasher and nut securing terminal board TB4 to front panel. Remove terminal board behind front panel.

(g) Remove the spacer located between front panel and heat shield by removing one screw, lockwasher and nut.

(h) Unsolder three wires from speaker terminals and four wires from panel lights.

Note

Make wiring sketch of speaker and panel lights before unsoldering leads.

(i) Remove twelve screws, lockwashers and nuts securing front panel to chassis.

(j) Carefully pull the front panel away from the chassis, taking care not to damage speaker or dial assembly.

(k) Replacement of the front panel is the reverse of removal procedure.

(2) REMOVAL OF GEAR ASSEMBLY.

(a) Remove the front panel as instructed in paragraph 3i(1).

(b) Remove tuning capacitor shield by removing screws, lockwashers and nuts.

Note

An offset screwdriver is required to remove the three screws located at front of shield.

(c) Loosen front two screws on nylon coupling that connect tuning capacitor to gear assembly.

(d) Remove frequency indicator index by loosening one set screw.

(e) Remove dial disc by loosening two set screws located in dial hole. Remove dial disc.

(f) Remove gear assembly by removing three remaining screws, lockwashers and nuts.

(3) REPLACING GEAR ASSEMBLY.—The procedure for replacing the gear assembly is essentially the reverse of the removal procedure except for the following:

(a) Place a 0.010 inch shim beneath the fiber rotor brace on the tuning capacitor and turn the plates as far counterclockwise as the shim allows. Do not apply pressure.

(b) Turn dial disc to the extreme clockwise position.

(c) Tighten the front two set screws on the nylon coupling between tuning capacitor and gear assembly.

(d) Replace the front panel as instructed in paragraph 3i(1).

4. RECEIVER TESTING.

a. GENERAL.—The following tests may be used as additional trouble shooting information, or they may be used to determine if the receiver is operating properly following extensive repair or alignment. The following procedures are based upon the manufacturer's testing requirements for a new receiver. The test equipment, bench set-up and initial control settings are listed in paragraph 3a and will not be repeated for each procedure.

b. AUDIO OUTPUT TEST PROCEDURE.

(1) Adjust the receiver controls as instructed in paragraph 3a.

(2) Connect the r-f signal generator to the receiver antenna input terminals through the dummy antenna, and connect the audio output meter to the external speaker connections marked 600 and GRD.

(3) Adjust the r-f signal generator for a 500 microvolt signal, 30% modulated with a 1000-cps audio signal, and tune the receiver and signal generator to 250 kc. Set the AVC-MAN.-CW. switch to AVC to prevent overloading.

(4) Read the indication on the output meter. It should be at least 2 watts. (34.6 volts across 600 ohms.)

(5) Connect the output meter to the PHONES jack and adjust the load to 500 ohms. The output power at this point should be at least 10 milliwatts. (2.24 volts across 500 ohms.)

c. OVERALL AUDIO RESPONSE TEST PROCEDURE.—(This test requires the use of an audio oscillator with a range from 50 cps to 15,000 cps.)

(1) Adjust the receiver controls as instructed in paragraph 3a, except set the AVC-MAN.-CW. switch to AVC.

(2) Connect the r-f signal generator to the antenna input terminals through the dummy antenna and tune the r-f signal generator and receiver to 510 KC on Band 2. Do not change the r-f signal generator or receiver tuning for the remainder of this test.

(3) With an audio oscillator used to modulate the r-f signal generator, adjust it to 1000 cps, 30% modulation. Adjust the r-f signal generator for an output of 500 microvolts and adjust the SENSITIVITY control on the receiver for an output level of 2 watts.

(4) Adjust the audio oscillator frequency to 100, 200, 3000, and 4000 cps successively, each time recording the output on the output meter.

(5) The receiver response should be at least 20 db down at 100 cps, less than 2 db down at 200 cps, at least 3 db down at 3000 cps, and at least 9 db down at 4000 cps. (DB = 10 log P1/P2, 2 db corresponds to 1250 milliwatts, 3 db corresponds to 1000 milliwatts, 9 db corresponds to 250 milliwatts, and 20 db corresponds to 20 milliwatts).

d. RECEIVER HUM TEST PROCEDURE

(1) Adjust the receiver controls as instructed in paragraph 3a.

(2) Connect the output meter to the receiver as instructed in paragraph 4b.

(3) Adjust the SENSITIVITY control on the receiver fully counterclockwise.

(4) Measure the hum present at the receiver output. It should not exceed 0.2 milliwatt (40 db).

e. CW SENSITIVITY TEST PROCEDURE.

(1) Adjust the receiver controls as instructed in paragraph 3a, except set the AVC-MAN.-CW. switch to CW.

(2) Connect the r-f signal generator and output meter to the receiver as instructed in paragraph 4b, except the r-f signal should not be modulated.

(3) Check the high, middle, and low ends of each band by applying a 5-microvolt signal to the antenna input terminals and with the BFO PITCH control adjusted for an audio signal of approximately 1000 cps.

(4) Adjust the SENSITIVITY control until 2 watts is read on the output meter which is connected across the 600 and GRD output terminals.

(5) Remove the signal from the signal generator and short circuit the antenna terminals. Observe the output meter reading. If it is more than 15 db lower than 2 watts (less than 60 milliwatts) repeat (2) through (5), each time reducing the signal generator output slightly and advancing the SENSITIVITY control to obtain 2 watts of audio

output. Do this until the signal to noise difference is 15 db.

(6) Record the input level which accomplishes this 15 db level. The receiver c-w sensitivity should be 3 microvolts or less on bands 2 and 4, and 5 microvolts or less on band 1 (0.20 to 0.40 mc). Band 3 sensitivity should be 4.2 microvolts or less on the low end, and 3 microvolts or less at the middle and high end. Band 5 sensitivity should be 3 microvolts or less at the high end, 4.2 microvolts or less at the low end, and 5 microvolts or less at the middle of the band.

f. AM SENSITIVITY TEST PROCEDURE.

(1) Adjust the receiver controls as instructed in paragraph 3a.

(2) Connect the r-f signal generator to the receiver through the dummy antenna, and connect the output meter to the speaker terminals (paragraphs 3b and 3c, this section).

(3) Adjust the signal generator for 30% modulation at 1000 cps.

(4) Check the high, middle, and low ends of each band as instructed in the following steps.

(5) Adjust the signal generator for an 8-microvolt output, and adjust the SENSITIVITY control for an output meter reading of 2 watts.

(6) Remove the 1000-cps modulation and observe the output meter reading. If it is more than 10 db (less than 200 milliwatts) lower than 2 watts, repeat the procedure each time lowering the input signal level slightly and advancing the SENSITIVITY control until a 10 db ratio is accomplished. The AM sensitivity on the high, middle, and low ends of bands 2 and 4 should be 5 microvolts or less, and 8 microvolts or less on band 1. Band 3 sensitivity should be 7 microvolts or less at the low end, and 5 microvolts or less at the middle and high ends. Band 5 sensitivity should be 5 microvolts or less at the high end, 7 microvolts or less at the low end and 8 microvolts or less at the middle of the band.

g. SELECTIVITY TEST PROCEDURE.

(1) Adjust the receiver controls as instructed in paragraph 3a.

(2) Connect the r-f signal generator to the receiver, and adjust it for a 10 microvolt signal with 1000 cps 30% modulation. Connect the output meter to the receiver as outlined in paragraph 4b.

(3) Tune the r-f signal generator and receiver to 2.0 mc.

(4) Adjust the SENSITIVITY control for a receiver audio output of 1 watt.

(5) Double the signal output of the r-f signal generator (20 microvolts).

(6) Detune the r-f signal generator to the high side of the previous frequency until the output meter once again reads 1 watt. Record this frequency and tune the r-f signal generator to the low side of the original frequency until the output is once again 1 watt. Record this frequency also. The receiver bandwidth is the difference between the high frequency reading minus the low frequency reading. The bandwidth limits are 5 kc to 7 kc.

(7) Repeat steps 2 through 6 to calculate additional points on the receiver selectivity curve. This is done by adjusting the r-f signal generator output as shown below and checking the bandwidth limits indicated opposite the r-f signal generator output settings.

R-f Signal Generator Output	Bandwidth Limits
3 times figure from step (2), (30 uv)	6 kc - 8 kc
10 times figure from step (2), (100 uv)	7 kc - 11 kc
100 times figure from step (2), (1000 uv)	18 kc max.
1000 times figure from step (2), (10,000 uv)	26 kc max.

h. IMAGE REJECTION TEST PROCEDURE.

(1) Set the receiver controls as instructed in paragraph 3a.

(2) Connect the r-f signal generator and the output meter to the receiver as instructed in paragraph 4b.

(3) Tune the r-f signal generator and the receiver to the same frequency on the high end of each band and establish the figure for the minimum r-f signal modulated at 30% with 1000 cps necessary to obtain an output of 2 watts. (Be

sure to peak the ANTENNA TRIMMER for each band.) Refer to paragraph 4f for the method.

(4) Tune the r-f signal generator 910 kc higher than the receiver, and advance the r-f signal generator output to maximum. Rock the r-f signal generator frequency back and forth to obtain maximum output. (Do not readjust the ANTENNA TRIMMER control.) Adjust the signal generator output to keep the reading on the output meter on scale.

(5) Adjust the r-f signal generator output so that the receiver output as read on the output meter is exactly 2 watts. The r-f signal generator output should be at least 60 db above the r-f signal generator output established in step (3) on bands 1 and 2, 56 db on band 3, 55 db on band 4, and 40 db on band 5. These figures correspond to signal generator output increases as follows: 60 db corresponds to a factor of 1000, 56 db corresponds to a factor of 630, 55 db corresponds to a factor of 562, and 40 db corresponds to a factor of 100.

i. I-F FREQUENCY REJECTION TEST PROCEDURE.

(1) Set the receiver controls as instructed in paragraph 3a.

(2) Connect the r-f signal generator and the output meter to the receiver as instructed in paragraph 4b.

(3) Tune the r-f signal generator and the receiver to 395 kc on the .20-.40 MC band and establish the figure for the minimum r-f signal modulated at 30% with 1000 cps necessary to obtain an output of 2 watts. (Be sure to peak the ANTENNA TRIMMER). Refer to paragraph 4f for the method.

(4) Tune the r-f signal generator to the i-f frequency of 455 kc and adjust the r-f signal generator output to that level which produces 2 watts. (Do not touch any of the receiver controls). The r-f signal generator output should be at least 42 db above the r-f signal generator output established in step (3). This figure corresponds to a signal generator output increase of 126 times.

(5) Repeat steps (3) and (4) with the signal generator and receiver tuned to 510 kc on the .49-1.2 MC band. The signal generator output increase with the 455 kc signal should be at least 57 db. This figure corresponds to a signal generator output increase of 710 times.

j. REGENERATION AND STABILITY TEST PROCEDURE.—This test consists of operating the receiver on all bands and over the full range of each band and observing if the receiver i-f stages have a tendency to oscillate. The SENSITIVITY control should be advanced fully clockwise and the AVC-MAN.-CW. switch set at MAN. There exists a possibility that i-f oscillations might occur as a result of circuit repairs in the i-f stages. Whenever making such repairs be sure that all leads, wires and parts are placed as close to the original location as possible, and that all the circuit bypass capacitors are included in the circuit. When the AVC-MAN.-CW. switch is on MAN. and the SENSITIVITY control is fully clockwise a slight trace of regeneration might be noticeable when tuning across extremely weak signals. This condition is acceptable and is normally due to the high gain resulting from the three-stage i-f amplifier.

k. AVC CIRCUIT TEST PROCEDURE.

(1) Set the receiver controls as instructed in paragraph 3a, except set the AVC-MAN.-CW. switch to AVC.

(2) Connect the r-f signal generator and output meter to the receiver as instructed in paragraph 4b.

(3) Adjust the r-f signal generator output to 100,000 microvolts, modulated 30% with 1000 cps. Adjust the VOLUME control for an audio output of exactly 2 watts.

(4) Decrease the r-f signal generator output to 16 microvolts. The decrease in the audio output reading must not exceed 7 db from the original reading. This corresponds to an audio output decrease from 2 watts to not less than 0.4 watt.

(5) Starting at an input of 16 microvolts, slowly decrease the r-f signal generator output while watching the output meter.

(6) Between the range of 16 microvolts down to 1 microvolt there should be an indication that the receiver AVC circuit drops out of operation. This will occur when receiver output begins to drop off rapidly as the signal generator output is reduced.

(7) An alternate method of checking where the AVC takes over consists of connecting the vtvm to the avc line in the receiver (terminal 7 of T7 or T8 are convenient points) and varying the r-f signal generator input from 1 microvolt to 16 microvolts.

(8) At some point within this 1 microvolt to 16 microvolt range the vtvm should begin to indicate a negative potential, indicating that avc voltage is being developed.

l. GENERAL VISUAL AND MECHANICAL INSPECTION.

(1) GENERAL.—The following items can be used as a check-list to be applied following an overhaul or general reconditioning of the receiver.

(2) WORKMANSHIP.—Examine all parts such as chokes, capacitors, transformers, coils, resistors, etc., for outward signs of damage. Check wire leads for proper dress and freedom from crossed wires. Check all metal assemblies for damage. Inspect all wire leads for burned or frayed insulation, and all solder connections for crossed solder, cold solder, or no solder.

(3) PAINT FINISH.—Check all painted surfaces for scratches, chips and lack of paint. If any of the painted surfaces have been repainted or touched up the color of the new paint should be compatible in color and texture. Check all painted panel designations for legibility and completeness.

(4) PLATED SURFACES.—Check plated surfaces for discoloration and deep scratches that may penetrate the surface plating. Such scratches go down to the bare metal and in time will rust, especially in the presence of salt air.

(5) HARDWARE.—Check all attaching parts such as screws, nuts, washers, brackets, etc., for damage or being missing. Replace these missing and damaged parts so that the structural strength of the receiver will not be impaired.

5. COMPONENT CHARACTERISTICS

a. ELECTRON TUBES.—Table 7-4 lists typical tube operating voltages and currents, and table 7-5 lists the receiver tube characteristics.

Note

All tubes of a given type supplied with the equipment shall be consumed prior to employment of tubes from general stock.

TABLE 7-4. TUBE OPERATING VOLTAGE AND CURRENT

TUBE TYPE	FUNCTION	PLATE VOLTAGE	PLATE CURRENT MA	SCREEN GRID VOLTAGE	SCREEN GRID CURRENT MA	SUPPRESSOR GRID VOLTAGE	CATHODE VOLTAGE	CONTROL GRID VOLTAGE	FILAMENT VOLTAGE A-C
JAN 6BH6	R-F Amplifier	32	1.24	61	0.58	0	0.76	0	6.3
JAN 12BE6	Mixer	72	0.74	20	1.38	-	0.55	0	12.6
JAN 6BJ6	Local Oscillator	58	2.85	--	---	-	0	-1 to -5	6.3
JAN 6BH6	1st I-F Amplifier	118	0.49	108	0.21	0	2.5	0	6.3
JAN 6BJ6	2nd I-F Amplifier	112	2.75	73	0.95	0	3.1	0	6.3
JAN 6BJ6	3rd I-F Amplifier	112	2.26	78	0.89	0	3.1	0	6.3
12AV6	AVC	56	0.26	--	---	-	4.5	0.15	12.6

TABLE 7-4. TUBE OPERATING VOLTAGE AND CURRENT (cont)

TUBE TYPE	FUNCTION	PLATE VOLT-AGE	PLATE CUR-RENT MA	SCREEN GRID VOLT-AGE	SCREEN GRID CUR-RENT MA	SUP-PRESSOR GRID VOLT-AGE	CATH-ODE VOLT-AGE	CON-TROL GRID VOLT-AGE	FILA-MENT VOLT-AGE A-C
(1/2) 12AL5	Detector	0	0	--	---	-	0	-	12.6
(1/2) 12AL5	ANL	0	0	--	---	-	0	-	
JAN (1/2) 12AX7	Audio Amplifier	67	0.1	--	---	-	0.78	0	12.6
JAN (1/2) 12AX7	Phase Inverter	67	0.1	--	---	-	0.78	0	
JAN 35L6 GT	Audio Output	113	36	113	3.0	-	8.4	0	35
JAN 35L6 GT	Audio Output	113	36	113	3.0	-	8.4	0	35
JAN 35Z5 GT	Rectifier V13	115ac	----	--	---	-	115	-	35
JAN 35Z5 GT	Rectifier V14	115ac	----	--	---	-	125	-	35
JAN OA3/ VR-75	Voltage Regulator	OPERATING VOLTAGE (PIN 5) 75 VOLTS (PINS 3 AND 7 ARE SHORTED INTERNALLY).							
JAN 6BJ6	Beat Frequency Oscillator	12.1	0.91	--	---	-	0.4	-1.5	6.3

TABLE 7-5. TUBE CHARACTERISTICS

TUBE TYPE	FILAMENT		PLATE VOLT-AGE	CON-TROL GRID VOLT-AGE	SCREEN VOLT-AGE	PLATE CUR-RENT MA	SCREEN CUR-RENT MA	PLATE RESIST-ANCE OHMS	TRANS-CONDUC-TANCE MICRO-MHOS	AMPLI-FICATION FACTOR
	VOLTS	MA								
JAN 6BH6	6.3	150	250	-1	150	7.4	2.9	1.4 meg	4600	---
JAN 6BJ6	6.3	150	250	-1	100	9.2	3.3	1.3 meg	3800	---
12AL5	12.6	150	Maximum a-c voltage per plate: 117 volts. D-c output current per plate: 9 ma.							
12AV6	12.6	150	250	-2	---	1.2	---	62500	1600	100
JAN 12AX7	12.6	150	250	-2	---	1.2	---	62500	1600	100
JAN 12BE6	12.6	150	250	-1.5	100	3.0	7.8	1 meg	475	---
JAN 35L6GT	35	150	110	-7.5	110	40	3	13800	5800	---
JAN 35Z5GT			Maximum a-c voltage per plate: 125 volts. Maximum d-c output current per plate: 100 ma.							
OA3/ VR-75	----	---	Minimum Supply Voltage: 105 volts. Operating Voltage: 75 volts. Operating Current: 5-40 ma.							

b. WINDING DATA.—Table 7-6 contains data on the coils and transformers in the receiver. Use it when trouble shooting and repairing the receiver.

c. DRAWINGS.

(1) SCHEMATIC DIAGRAM.—Figure 7-14 is a complete schematic diagram of the receiver.

(2) WIRING DIAGRAMS.—Figures 7-15 and 7-16 are wiring diagrams of the receiver.

TABLE 7-6. WINDING DATA

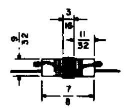
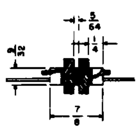
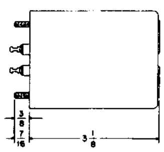
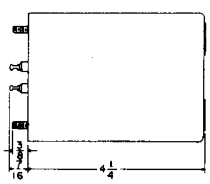
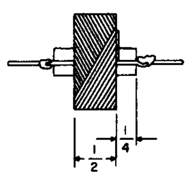
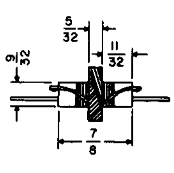
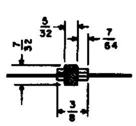
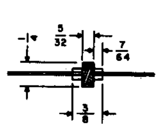
DESIG-NATION SYMBOL	CHL PART NO.	DIAGRAM	WINDING	WIRE SIZE	TURNS	D.C. RESIST-ANCE IN OHMS	IMPEDANCE RATIO	HIPOT AC VOLTS	REMARKS
L1	53B366		Single pi, universal wound	No. 40 S.N. H.F.	104	10	—	—	0.242 mh inductance, powdered iron coil form.
L2	53B365		2 pi, universal wound	No. 40 S.N. H.F.	1003	125	—	—	13.37 mh inductance, powdered iron coil form.
L3	56C202					350 ±15%	—	1.6 kv	20 henries inductance, 20 ma dc hermetical sealed metal case.
L4	56C201					100 ±10%	—	1.6 kv	12 henries inductance, 100 ma dc hermetical sealed metal case.
L5, L6, L7, L8	53B367		Single pi, universal wound	No. 22 S.N. F.	154	0.49	—	—	0.386 mh inductance, powdered iron core.
L9, L10	53B401		Single pi, universal wound	No. 30 S.N.E.	110	1.54	—	—	0.242 mh inductance, powdered iron core.
L11, L12	53B399		Single pi, universal wound	No. 40 S.N. H.F.	113	6.5	—	—	0.103 mh inductance, powdered iron core.
L13	53B400		Single pi, universal wound	No. 40 S.N. H.F.	212	13	—	—	0.344 mh inductance, powdered iron core.

TABLE 7-6. WINDING DATA (cont)

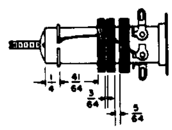
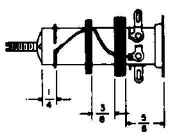
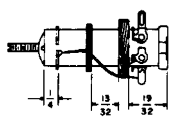
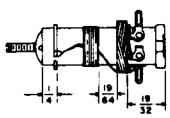
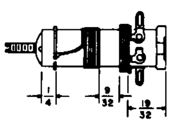
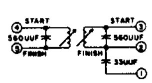
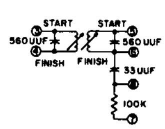
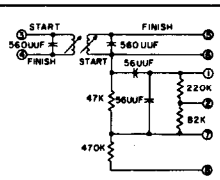
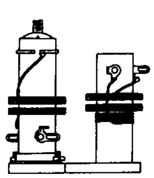
DESIG-NATION SYMBOL	CHL PART NO.	DIAGRAM	WINDING	WIRE SIZE	TURNS	D.C. RESIST-ANCE IN OHMS	IMPEDANCE RATIO	HIPOT AC VOLTS	REMARKS
T1	51B2048		Primary. Single pi, universal wound	No. 28 S.N.E.	86	1.15	–	–	200 kc to 400 kc design frequency range, uncased, nylon form, adjustable iron core located at top for secondary tuning.
			Secondary. 2 psi universal wound	No. 5/42 S.N.E.	315	22.2			
T2	51B2049		Primary. Single pi, universal wound	No. 34 S.N.E.	106	6	–	–	490 kc to 1200 kc design frequency range, uncased, nylon form, adjustable iron core located at top for secondary tuning.
			Secondary. single pi, universal wound	No. 5/42 S.N.E.	117	8.4	–	–	
T3	51B2050		Primary. Single pi, universal wound	No. 24 S.N.E.	38	0.21	–	–	1200 kc to 3000 kc design frequency range, uncased, nylon form, adjustable iron core located at top for secondary tuning
			Secondary. Single pi, universal wound	No. 5/42 S.N.E.	45	2.9	–	–	
T4	51B2051		Primary. Single pi, universal wound	No. 24 S.N.F.	25	0.13	–	–	3000 kc to 7300 kc design frequency range, uncased, nylon form, adjustable iron core located at top for secondary tuning
			Secondary. Solenoid wound	No. 32 S.N.F.	21	0.62	–	–	
T5	51B2052		Primary. Single pi, universal wound	No. 24 S.N.E.	15	0.78	–	–	7300 kc to 18 mc design frequency range, uncased, nylon form adjustable iron core located at top for secondary tuning.
			Secondary. Solenoid wound	No. 24 enamel	8-3/4	0.04	–	–	
T6	50C649		Primary. Single pi, universal wound	No. 10/41 S.N.E.	108	2.7	–	–	455 kc peak frequency, shielded, phenolic coil form, powdered iron core, double tuned, includes C11, C12 and C13.
			Secondary. Single pi, universal wound	No. 10/41	108	2.7	–	–	
T7 T8	50C650		Primary. Single pi, universal wound	No. 10/41 S.N.E.	108	2.7	–	–	455 kc peak frequency, shielded phenolic coil form, powder iron core, double tuned. T7 includes C18, C19, C20 and R17, T8 includes C24, C25, C26 and R21.
			Secondary. Single pi, universal wound	No. 10/41 S.N.E.	108	2.7	–	–	
T9	50C651		Primary. Single pi, universal wound	No. 10/41 S.N.E.	109	2.7	–	–	455 kc peak frequency, shielded phenolic coil form, powdered iron core, double tuned, includes C31, C32, C33, C34, R25, R26, R27 and R28.
			Secondary. Single pi, universal wound	No. 10/41 S.N.E.	109	2.7	–	–	
T10	51B2058		Primary. Single 2 pi universal wound	No. 5/42 S.N.E.	345	25.7	–	–	200 kc to 400 kc design frequency range, uncased, nylon form adjustable iron core located at top for secondary tuning.
			Secondary. Single 2 pi universal wound	No. 5/42 S.N.E.	315	22.7	–	–	

TABLE 7-6. WINDING DATA (cont)

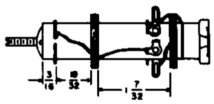
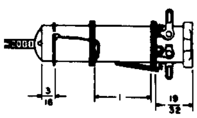
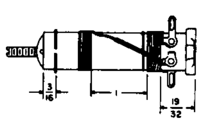
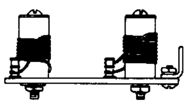
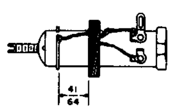
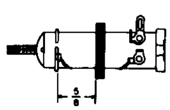
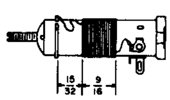
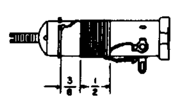
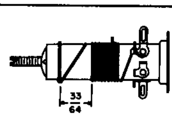
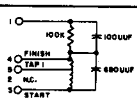
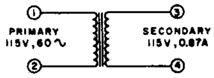
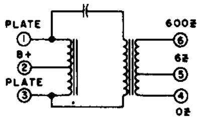
DESIG-NATION SYMBOL	CHL PART NO.	DIAGRAM	WINDING	WIRE SIZE	TURNS	D. C. RESIST-ANCE IN OHMS	IMPEDANCE RATIO	HIPOT AC VOLTS	REMARKS
T11	51B2059		Primary. Single pi, universal wound	No. 5/42 S.N.E.	127-1/2	9.3	—	—	490 kc to 1200 kc design frequency range, uncased, nylon form, adjustable iron core located at top for secondary tuning.
			Secondary. Single pi, universal wound	No. 5/42	120	8.6	—	—	
T12	51B2060		Primary. Single pi, universal wound	No. 5/42 S.N.E.	49	3.3	—	—	1200 kc to 3000 kc design frequency, uncased, nylon form, adjustable iron core located at top for secondary tuning.
			Secondary Single pi, universal wound	No. 5/42 S.N.E.	45	3.1	—	—	
T13	51B2061		Primary. Single pi, universal wound	No. 28 S.N.E.	24	0.3	—	—	3000 kc to 7300 kc design frequency, range, uncased, nylon form, adjustable iron core located at top for secondary tuning.
			Secondary. Single pi, universal wound	No. 28	21	0.26	—	—	
T14	51B2062		Primary. Single layer winding	No. 24 enamel	8	0.035	—	—	7300 kc to 18 mc design frequency range, uncased, two phenolic forms w/fixed powdered iron cores.
			Secondary. Single layer winding	No. 24 enamel	7	0.033	—	—	
T15	51B2053		Single pi, universal wound						200 kc to 400 kc design frequency range, uncased, steatite form, adjustable iron core located at top.
			Start to tap	No. 10/41 S.N.E.	16	0.41	—	—	
			Start to finish	No. 10/41 S.N.E.	102	3.1	—	—	
T16	51B2054		Single pi, universal wound						490 kc to 1200 kc design frequency range, uncased, steatite form, adjustable iron core located at top.
			Start to tap	No. 10/41 S.N.E.	16	0.41	—	—	
			Start to finish	No. 10/41 S.N.E.	79	2.3	—	—	
T17	51B2055		Solenoid Start to tap	No. 32 S.N.E.	10-1/2	0.33	—	—	1200 kc to 3000 kc design frequency, uncased, steatite form, adjustable iron core located at top.
			Start to finish	No. 32 S.N.E.	50-1/2	1.5	—	—	
T18	51B2056		Solenoid Start to tap	No. 32 S.N.E.	7	0.22	—	—	3000 kc to 7300 kc design frequency, uncased, steatite form, adjustable iron core located at top.
			Start to finish	No. 32 S.N.E.	22-1/2	0.68	—	—	
T19	51B2057		Solenoid Start to tap	No. 22 tinned	3	0.011	—	—	7300 kc to 18 mc design frequency range, uncased, steatite form, adjustable iron core located at top.
			Start to finish	No. 22 tinned	10-1/2	0.031	—	—	
T20	50C694		Single pi, universal wound	No. 10/41 S.N.E.	98	2.45	—	—	455 kc peak frequency, tapped at 37 turns, aluminum case, phenolic coil form, adjustable iron core includes C62, C63 and R34.

TABLE 7-6. WINDING DATA (cont)

DESIG-NATION SYMBOL	CHL PART NO.	DIAGRAM	WINDING	WIRE SIZE	TURNS	D.C. RESIST-ANCE IN OHMS	IMPEDANCE RATIO	HIPOT AC VOLTS	REMARKS
T101	52C466		Primary	—	—	30.55	—	500v	115 volt isolation transformer.
			Secondary	—	—	47.7	—	500v	
Z1	55C257		Primary.	—	—	—	—	—	Push-pull audio output matching device.
			1-3			96.5			
			1-2			53.6			
			2-3			42.9			
			Secondary.	—	—	—	—	—	
			4-6			52			
			4-5			0.508			

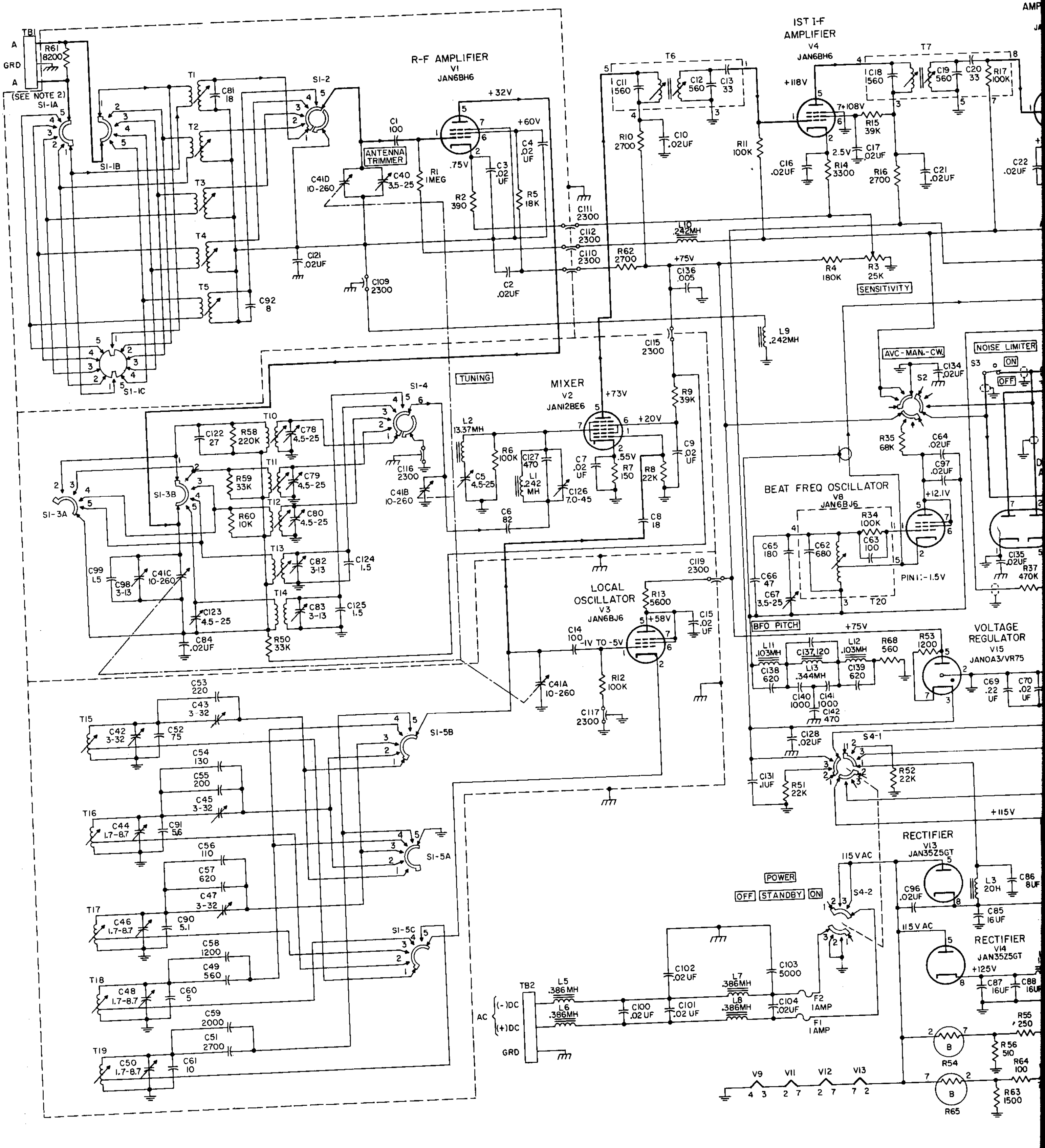
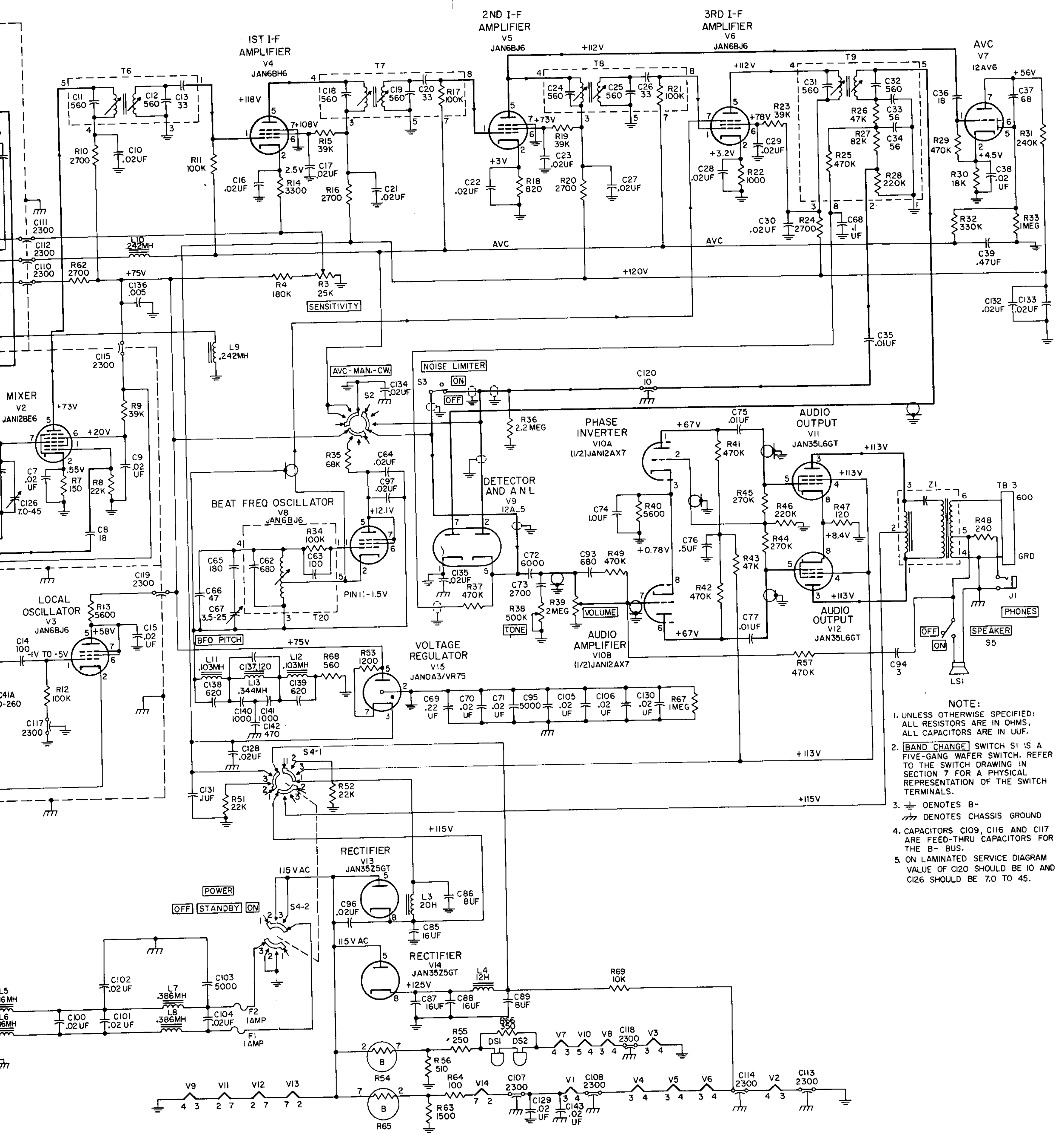


Figure 7-14. **Radio Receiver R-649/UR, Schematic Diagr**



NOTE:

1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS, ALL CAPACITORS ARE IN UUF.
2. BAND CHANGE SWITCH S1 IS A FIVE-GANG WAFER SWITCH. REFER TO THE SWITCH DRAWING IN SECTION 7 FOR A PHYSICAL REPRESENTATION OF THE SWITCH TERMINALS.
3. ⏚ DENOTES B-
   ⏚ DENOTES CHASSIS GROUND
4. CAPACITORS C109, C116 AND C117 ARE FEED-THRU CAPACITORS FOR THE B- BUS.
5. ON LAMINATED SERVICE DIAGRAM VALUE OF C120 SHOULD BE 10 AND C126 SHOULD BE 7.0 TO 45.

Figure 7-14. Radio Receiver R-649/UR, Schematic Diagram

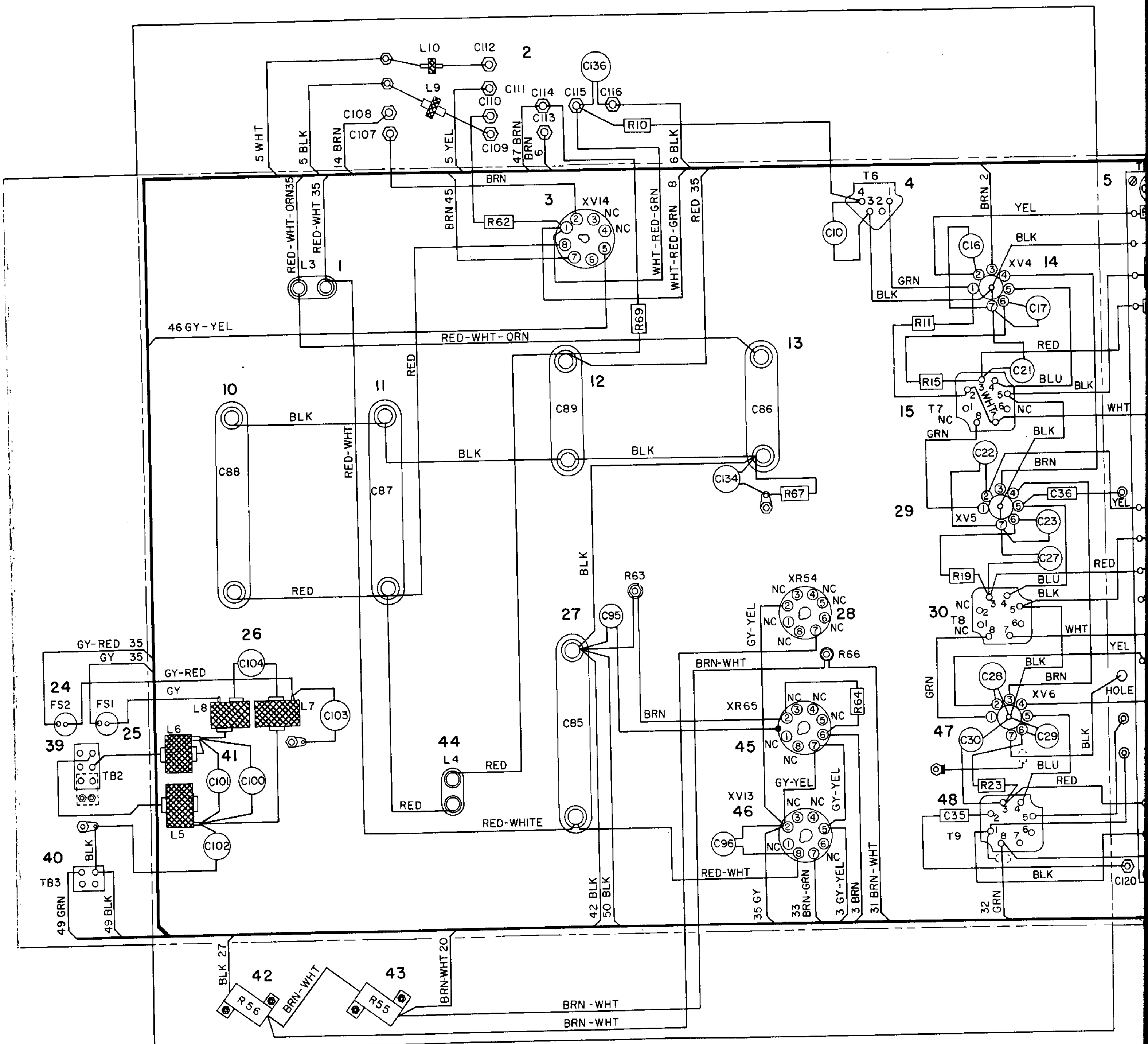

L10
C112
2
L9
C111
C110
C108
C107
C109
C114
C113
C115
C116
C136
R10
5 WHT
5 BLK
14 BRN
5 YEL
47 BRN
BRN 6
6 BLK
T6
4
BRN
3
XV14
NC
RED-WHT-ORN35
RED-WHT 35
BRN 45
R62
WHT-RED-GRN 8
WHT-RED-GRN
RED 35
C10
L3
1
R69
46 GY-YEL
RED-WHT-ORN
13
12
10
11
BLK
RED
RED-WHT
C88
C87
C89
C86
C134
R67
BLK
RED
R63
27
C95
GY-RED 35
GY 35
26
C104
GY-RED
GY
24
FS2
FS1
25
L8
L7
C103
L6
39
TB2
41
C101
C100
L5
C102
40
TB3
49 GRN
49 BLK
44
L4
RED
RED-WHITE
C85
BRN
XR54
28
GY-YEL
BRN-WHT
R66
XR65
R64
45
XV13
46
GY-YEL
C96
RED-WHT
42 BLK
50 BLK
35 GY
33 BRN-GRN
3 GY-YEL
3 BRN
31 BRN-WHT
BLK 27
42
R56
BRN-WHT
43
R55
BRN-WHT 20
BRN-WHT
BRN-WHT
BRN 2
YEL
BLK
C16
XV4
14
GRN
C17
R11
RED
C21
R15
BLU
15
T7
WHT
GRN
C22
29
C36
XV5
C23
C27
R19
30
T8
C28
XV6
HOLE
47
C30
C29
R23
48
C35
T9
C120
32 GRN
5

Figure 7

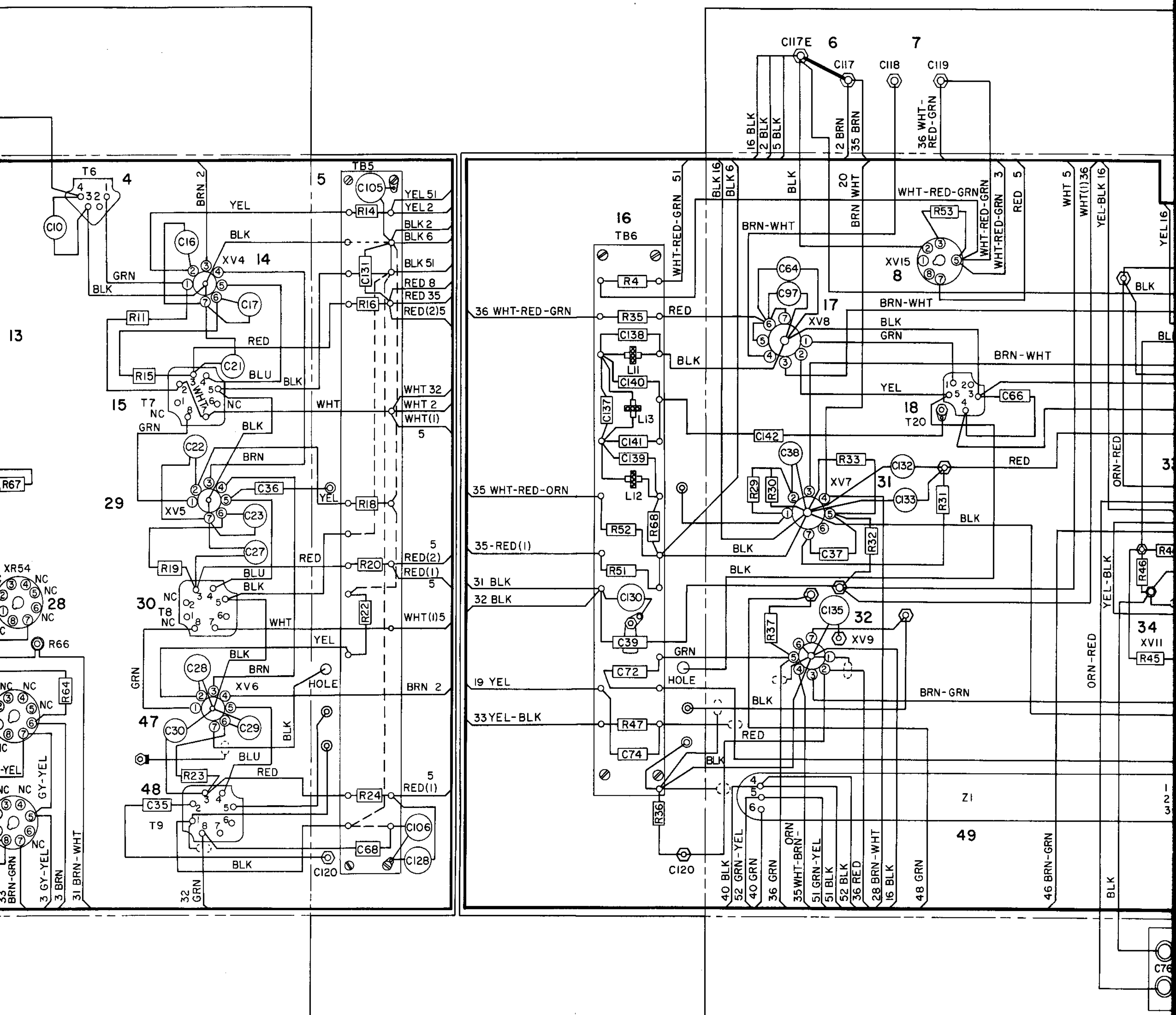
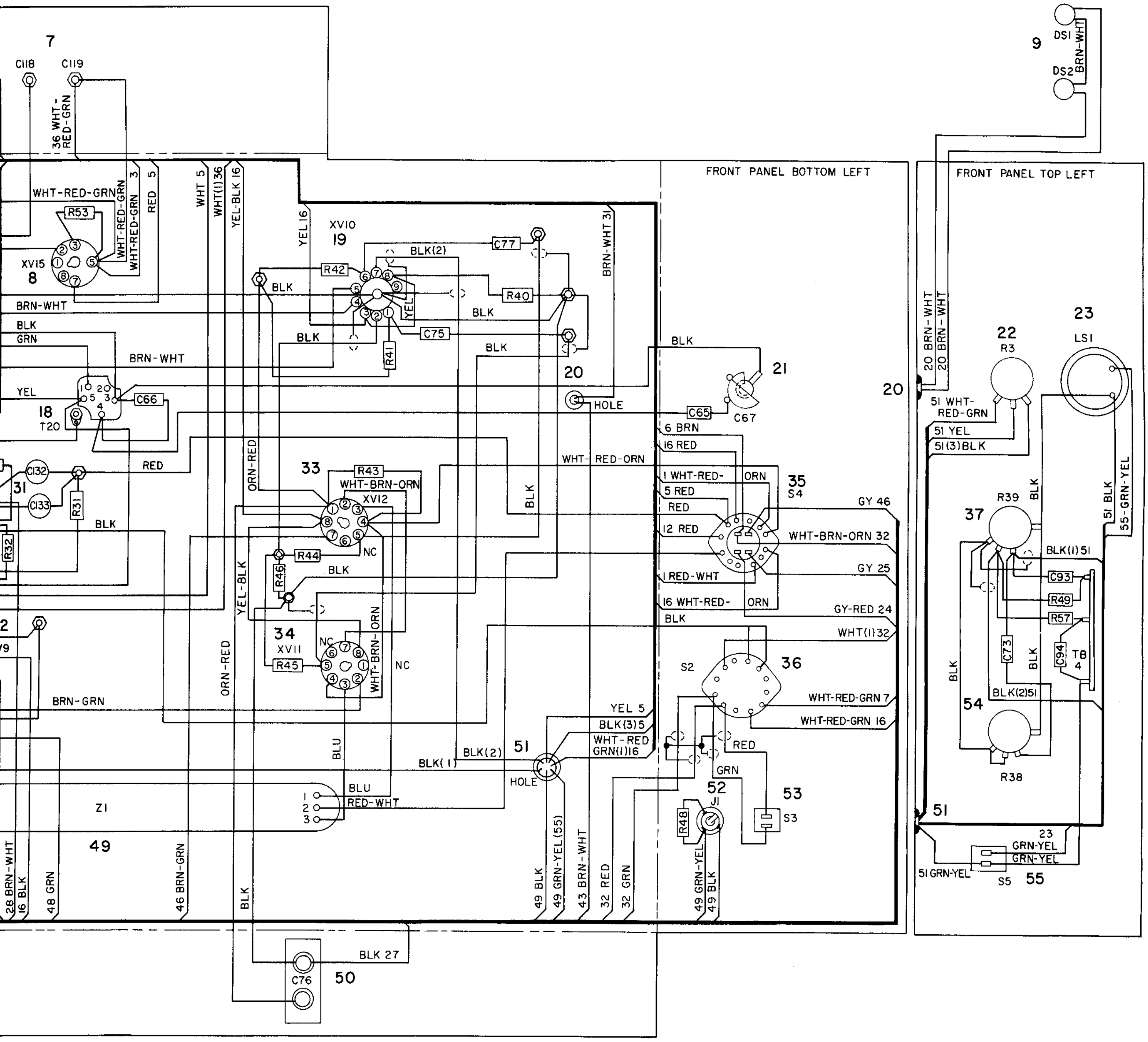


Figure 7-15. Radio Receiver R-649/UR, Wiring Diagram, Audio and I-f Sections


FRONT PANEL BOTTOM LEFT
FRONT PANEL TOP LEFT
XV10
19
XV15
8
XV12
33
34
XV11
T20
18
Z1
49
S4
35
S2
36
S3
53
J1
52
S5
55
R3
22
LS1
23
R39
37
R38
54
DS1
DS2
9
C118
C119
7
C76
50
HOLE
WHT-RED-GRN
BRN-WHT
WHT-BRN-ORN
ORN-RED
YEL-BLK
BRN-GRN
GY 46
WHT-BRN-ORN 32
GY 25
GY-RED 24
WHT(1)32
WHT-RED-GRN 7
WHT-RED-GRN 16
51 WHT-RED-GRN
51 YEL
51(3)BLK
BLK(1)51
BLK(2)51
51 GRN-YEL
23 GRN-YEL
GRN-YEL
20 BRN-WHT
BLK 27
49 BLK
49 GRN-YEL(55)
43 BRN-WHT
32 RED
32 GRN
46 BRN-GRN
48 GRN
28 BRN-WHT
16 BLK
YEL 5
BLK(3)5
WHT-RED GRN(1)16
51 BLK
55-GRN-YEL

I-f Sections

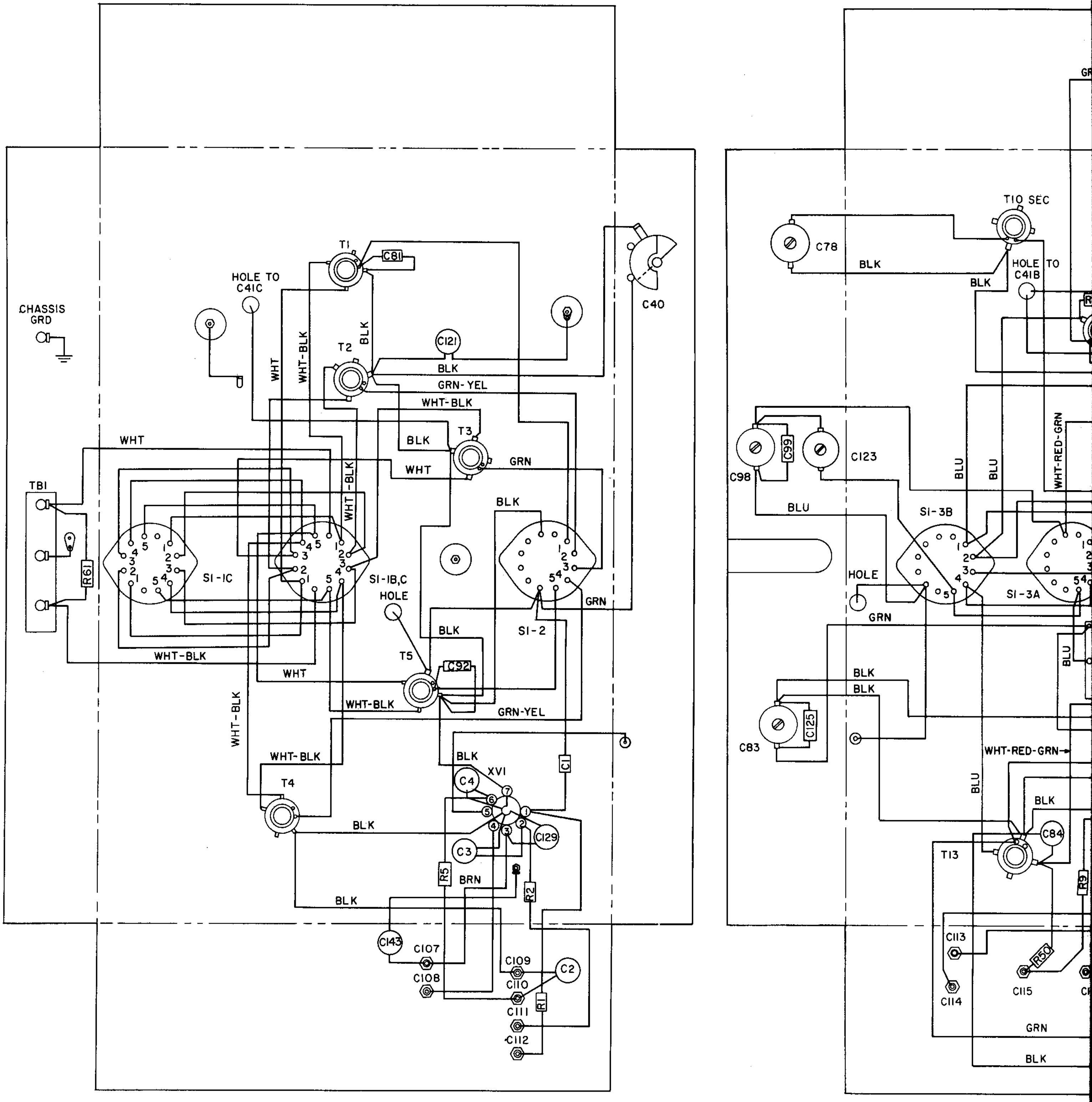


Figure 7-16. Radio Receiver R-6

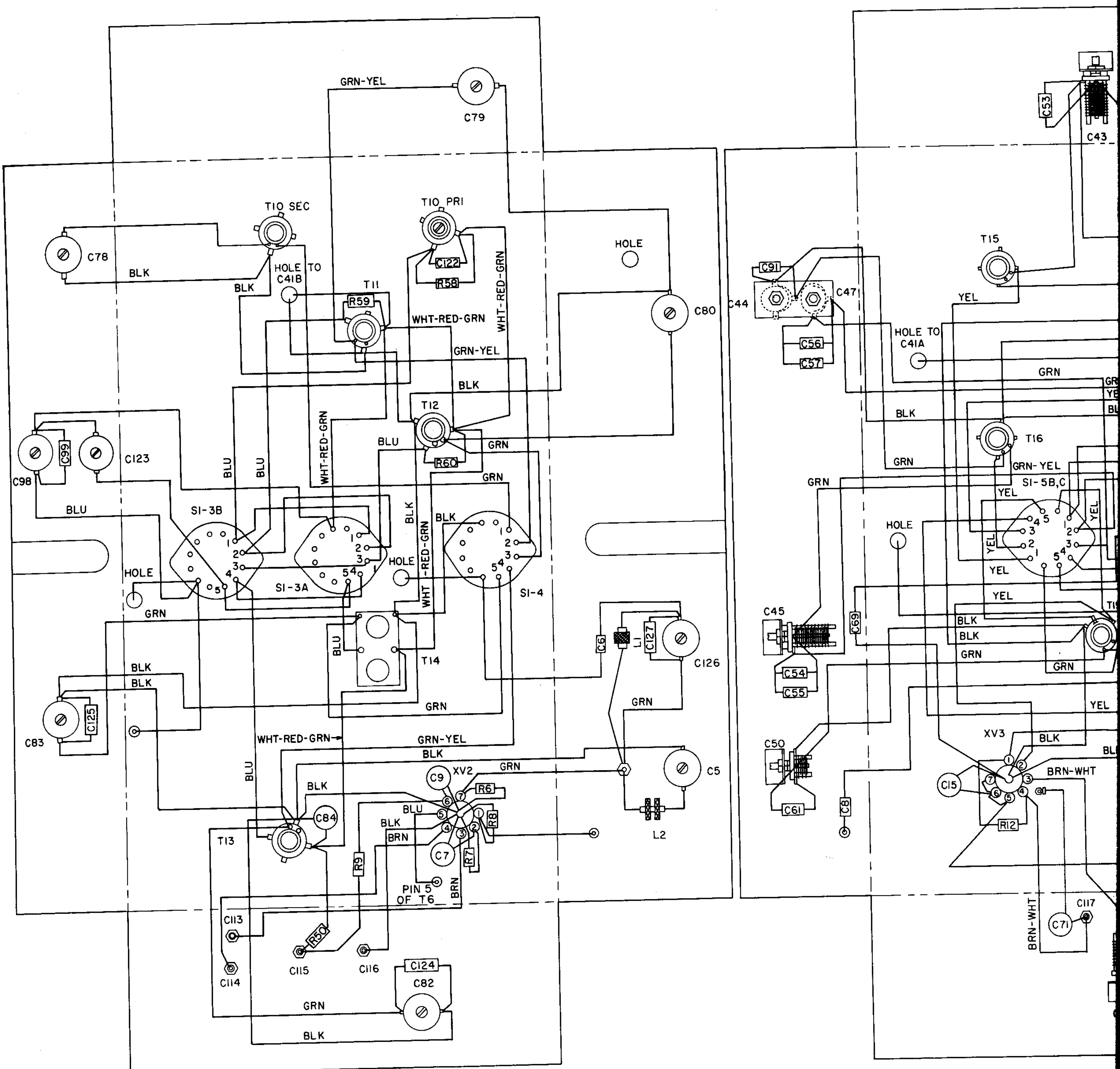
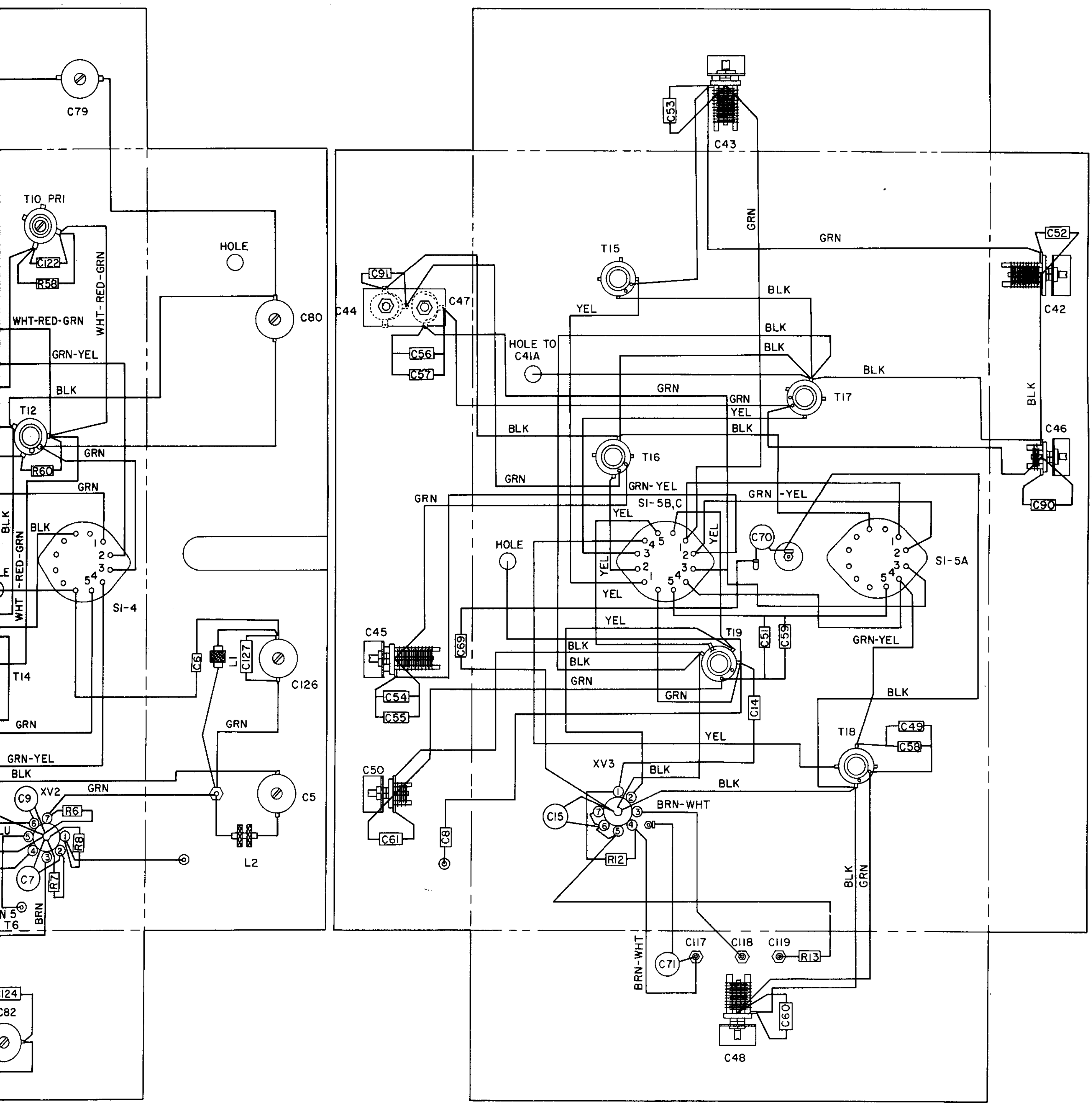


Figure 7-16. Radio Receiver R-649/UR, Wiring Diagram, R-f Section



, *Wiring Diagram, R-f Section*

SECTION 8
PARTS LIST

This section contains the following tables:

Table 8-1. Maintenance Parts List.

Table 8-2. Stock Number Identification and List of Parts Supplied.

Table 8-3. Stock Number Cross Reference.

Table 8-4. List of Manufacturers.

TABLE 8-1. MAINTENANCE PARTS LIST

REFERENCE DESIG-NATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
		RECEIVER, RADIO: A1, A2, and A3 reception, MBCA Ref Dwg Group 5; 200 to 400 kc and 490 to 18,000 kc frequency range; 5 bands; 115 v ac, 60 cycles, single phase or 115 v dc; mounted in steel cabinet; 20 in. wide by 10-15/32 in. h x 14 in. deep; 15 electron tubes; superheterodyne circuit; built-in speaker; Coast Guard Spec No. RRS-401; Coast Guard Radio Receiving Set Type No. R-649/UR; CHL part no. 1X2080. FSN (5280-644-4503)	Communications receiver.
A1 to A4		Not used.	
A5		CLAMP, ELECTRICAL: capacitor mounting bracket, MIL type CP07SC3, Spec MIL-C-25A.	Clamp for capacitor C85.
A6		Same as A5.	Clamp for capacitor C85.
A7		Same as A5.	Clamp for capacitor C87.
A8		Same as A5.	Clamp for capacitor C87.
A9		Same as A5.	Clamp for capacitor C88.
A10		Same as A5.	Clamp for capacitor C88.
A11		CLAMP, ELECTRICAL: capacitor mounting bracket, MIL type CP07SB3, Spec MIL-C-25A.	Clamp for capacitor C86.
A12		Same as A11.	Clamp for capacitor C86.
A13		Same as A11.	Clamp for capacitor C89.
A14		Same as A11.	Clamp for capacitor C89.
C1		CAPACITOR, FIXED CERAMIC DIELECTRIC: 100 uuf ±5%, 500 v dcw; neg temp coef 750 ±120 uuf/uf/°C; JAN type CC25UJ101J, Spec JAN-C-20A.	V1 grid leak.
C2		CAPACITOR, FIXED CERAMIC DIELECTRIC: 0.02 uf +80 -20%, 500 v dcw; disc type; durez coated; 19/32 in. dia x 5/32 in. thk; CBN part no. DA145-001A; CHL part no. 47A666.	V1 screen decoupling.
C3		Same as C2.	V1 cathode bypass.
C4		Same as C2.	V1 screen bypass.
C5		CAPACITOR, VARIABLE CERAMIC DIELECTRIC: 4.5 uuf to 25.0 uuf, 500 v dcw; JAN type CV11A250, Spec JAN-C-81.	P/o 455-kc trap.
C6		CAPACITOR, FIXED CERAMIC DIELECTRIC: 82 uuf ±5%, 500 v dcw; neg temp coef 750 ±120 uuf/uf/°C; durez dipped; JAN type CC25UJ820J, Spec JAN-C-20A.	V2 grid leak.
C7		Same as C2.	V2 cathode bypass.
C8		CAPACITOR, FIXED CERAMIC DIELECTRIC: 18 uuf ±10%, 500 v dcw; neg temp coef 750 ±120 uuf/uf/°C; JAN type CC20UJ180K, Spec JAN-C-20A.	V3 coupling to V2.
C9		Same as C2.	V2 screen bypass.
C10		Same as C2.	V2 plate decoupling.
C11		CAPACITOR, FIXED MICA DIELECTRIC: 560 uuf ±10%, 300 v dcw; MIL type CM20D561K, Spec MIL-C-5.	P/o T6.
C12		Same as C11.	P/o T6.
C13		CAPACITOR, FIXED CERAMIC DIELECTRIC: 33 uuf ±10%, 500 v dcw; neg temp coef 750 ±120 uuf/uf/°C; JAN type CC20UJ330K, Spec JAN-C-20A.	P/o T6.
C14		Same as C1.	V3 grid leak bypass.
C15		Same as C2.	V3 plate decoupling.
C16		Same as C2.	V4 cathode bypass.
C17		Same as C2.	V4 screen bypass.
C18		Same as C11.	P/o T7.
C19		Same as C11.	P/o T7.
C20		Same as C13.	P/o T7.
C21		Same as C2.	V4 plate decoupling.
C22		Same as C2.	V5 cathode bypass.
C23		Same as C2.	V5 screen bypass.
C24		Same as C11.	P/o T8.
C25		Same as C11.	P/o T8.
C26		Same as C13.	P/o T8.

TABLE 8-1. MAINTENANCE PARTS LIST (cont)

REFERENCE DESIG- NATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C27		Same as C2.	V5 plate decoupling.
C28		Same as C2.	V6 cathode bypass.
C29		Same as C2.	V6 screen bypass.
C30		Same as C2.	V6 plate decoupling.
C31		Same as C11.	P/o. T9.
C32		Same as C11.	P/o T9.
C33		CAPACITOR, FIXED CERAMIC DIELECTRIC: 56 uuf ±5%, 500 v dcw; neg temp coef 750 ±120 uuf/uf/°C; JAN type CC20UJ560J, Spec JAN-C-20A.	P/o T9.
C34		Same as C33.	P/o T9.
C35		CAPACITOR, FIXED PAPER DIELECTRIC: 0.01 uf ±20%, 300 v dcw; A characteristic; MIL type CN22A103M, Spec MIL-C-91A.	A-f coupling from T9.
C36		Same as C8.	I-f coupling to V7.
C37		CAPACITOR, FIXED CERAMIC DIELECTRIC: 68 uuf ±10%, 500 v dcw; neg temp coef 470 ±60 uuf/uf/°C; JAN type CC25TH680K, Spec JAN-C-20A.	V7 triode to diode coupling.
C38		Same as C2.	V7 cathode bypass.
C39		CAPACITOR, FIXED PAPER DIELECTRIC: 0.47 uf ±20%, 200 v dcw; MIL type CP10A1EC474M, Spec MIL-C-25A.	Avc bypass and time constant.
C40		CAPACITOR, VARIABLE AIR DIELECTRIC: plate meshing type; 1 section; 3.5 to 25 uuf; 7 plates; CHC type APC; CHL part No. 48B256.	Antenna trimmer.
C41A		CAPACITOR, VARIABLE AIR DIELECTRIC: plate meshing type; 2 sections; each section 11 to 261 uuf; 17 plates per section; CHL part No. 48C340.	V3 tuning capacitor.
C41B		Same as C41A.	V2 tuning capacitor.
C41C		CAPACITOR, VARIABLE AIR DIELECTRIC: plate meshing type; 2 sections; each section 13 to 263 uuf; 17 plates per section; CHL part No. 48C339.	V2 tuning capacitor.
C41D		Same as C41C.	V1 tuning capacitor.
C42		CAPACITOR, VARIABLE AIR DIELECTRIC: plate meshing type; 1 section; 3 to 32 uuf: 28 plates; CEJ type 30M8, cat. No. 160-130; CHL part No. 44B470.	T15 trimmer.
C43		Same as C42.	T15 padder.
C44		CAPACITOR, VARIABLE AIR DIELECTRIC: plate meshing type; 1 section; 1.7 to 8.7 uuf; 9 plates; CHC type MAC-10; CHL part No. 44B469.	T16 trimmer.
C45		Same as C42.	T16 padder.
C46		Same as C44.	T17 trimmer.
C47		Same as C42.	T17 padder.
C48		Same as C44.	T18 trimmer.
C49		CAPACITOR, FIXED MICA DIELECTRIC: 560 uuf ±2%, 300 v dcw; MIL type CM20D561G, Spec MIL-C-5.	P/o T18 padding.
C50		Same as C44.	T19 trimmer.
C51		CAPACITOR, FIXED MICA DIELECTRIC: 2700 uuf ±2%, 500 v dcw; MIL type CM30E272G; Spec MIL-C-5.	P/o T19 padding.
C52		CAPACITOR, FIXED CERAMIC DIELECTRIC: 75 uuf ±2%, 500 v dcw; neg temp coef 80 ±30 uuf/uf/°C JAN type CC35LG750G, Spec JAN-C-20A.	P/o T15 temp comp trimming network.
C53		CAPACITOR, FIXED CERAMIC DIELECTRIC: 220 uuf ±1%, 500 v dcw; neg temp coef 220 ±60 uuf/uf/°C; JAN type CC35RH221F, Spec JAN-C-20A.	P/o T15 temp comp padding network.
C54		CAPACITOR, FIXED CERAMIC DIELECTRIC: 130 uuf ±1%, 500 v dcw; neg temp coef 220 ±60 uuf/uf/°C; JAN type CC32RH131F, Spec JAN-C-20A.	P/o T16 temp comp trimming network.
C55		CAPACITOR, FIXED MICA DIELECTRIC: 200 uuf ±2%, 500 v dcw; MIL type CM25E201G, Spec MIL-C-5.	P/o T16 padding.
C56		CAPACITOR, FIXED CERAMIC DIELECTRIC: 110 uuf ±1%, 500 v dcw; neg temp coef 2200 ±500 uuf/uf/°C; 0.400 in. lg x 0.200 in. dia; CHL part No. 47D20W111F.	P/o T17 temp comp padding network.
C57		CAPACITOR, FIXED MICA DIELECTRIC: 620 uuf ±2%, 500 v dcw; MIL type CM25E621G, Spec MIL-C-5.	P/o T17 padding.
C58		CAPACITOR, FIXED CERAMIC DIELECTRIC: 1200 uuf ±1%, 500 v dcw; neg temp coef 3300 ±500 uuf/uf/°C; 1.165 in. lg x 0.315 in. dia; CHL part No. 47D35X122F.	P/o T18 temp comp padding network.

TABLE 8-1. MAINTENANCE PARTS LIST (cont)

REFERENCE DESIG-NATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C59		CAPACITOR, FIXED CERAMIC DIELECTRIC: 2000 uuf ±2%, 500 v dcw; neg temp coef 4700 ±1000 uuf/uf/°C; 1.165 in. lg x 0.315 in. dia; CHL part No. 47D35Y202G.	P/o T19 temp comp padding network.
C60		CAPACITOR, FIXED CERAMIC DIELECTRIC: 5 uuf ±0.25 uuf, 500 v dcw; neg temp coef 470 ±120 uuf/uf/°C; JAN type CC20TJ050C, Spec JAN-C-20A.	P/o T18 temp comp trimming network.
C61		CAPACITOR, FIXED CERAMIC DIELECTRIC: 10 uuf ±0.25 uuf, 500 v dcw; neg temp coef 750 ±120 uuf/uf/°C; JAN type CC20UJ100C, Spec JAN-C-20A.	P/o T19 temp comp trimming network.
C62		CAPACITOR, FIXED MICA DIELECTRIC: 680 uuf ±10%, 500 v dcw; MIL type CM25D681K, Spec MIL-C-5.	P/o T20.
C63		CAPACITOR, FIXED CERAMIC DIELECTRIC: 100 uuf ±10%, 500 v dcw; neg temp coef 750 ±120 uuf/uf/°C; JAN type CC25UJ101K, Spec JAN-C-20A.	P/o T20.
C64		Same as C2.	V8 plate decoupling.
C65		CAPACITOR, FIXED MICA DIELECTRIC: 180 uuf ±2%, 500 v dcw; MIL type CM20C181G, Spec MIL-C-5.	P/o V8 tuning.
C67		Same as C40.	Bfo pitch control.
C66		CAPACITOR, FIXED CERAMIC DIELECTRIC: 47 uuf ±5%, 500 v dcw; neg temp'coef 750 ±120 uuf/uf/°C; JAN type CC20UJ470J, Spec JAN-C-20A.	P/o V8 tuning.
C68		CAPACITOR, FIXED PAPER DIELECTRIC: 0.1 uf ±20%, 200 v dcw; CG type No. 41F454BC2 or 41F454BK2; CHL part No. 46B628.	P/o Anl time constant.
C69		CAPACITOR, FIXED PAPER DIELECTRIC: 0.22 uf ±10%, 200 v dcw; CG type No. 41F458BC1; CHL part No. 46B525.	B- to chassis bypass.
C70		Same as C2.	B- to chassis bypass.
C71		Same as C2.	B- to chassis bypass.
C72		CAPACITOR, FIXED PAPER DIELECTRIC: 6000 uuf ±20%, 200 v dcw; A characteristic; MIL type CN20A602M; Spec MIL-C-91A.	A-f coupling to V10.
C73		CAPACITOR, FIXED MICA DIELECTRIC: 2700 uuf ±10%, 500 v dcw; MIL type CM30B272K, Spec MIL-C-5.	P/o tone control circuit.
C74		CAPACITOR, FIXED PAPER DIELECTRIC: 1.0 uf ±20%, 100 v dcw; CG type No. 41F466AC2; or 41F466AK2; CHL part No. 46B627.	V10 cathode bypass.
C75		Same as C35.	A-f coupling to V11.
C76		CAPACITOR, FIXED PAPER DIELECTRIC: 0.5 uf ±10%, 200 v dcw; MIL type CP54B1FC504K, Spec MIL-C-25A.	V10 plate decoupling.
C77		Same as C35.	A-f coupling to V12.
C78		Same as C5.	T10 trimmer.
C79		Same as C5.	T11 trimmer.
C80		Same as C5.	T12 trimmer.
C81		Same as C8.	P/o T1 tuned circuit.
C82		CAPACITOR, VARIABLE CERAMIC DIELECTRIC: 3.0 uuf to 13.0 uuf; 500 v dcw; JAN type CV11B130, Spec JAN-C-81.	T13 trimmer.
C83		Same as C82.	T14 trimmer.
C84		Same as C2.	V1 plate decoupling.
C85		CAPACITOR, FIXED PAPER DIELECTRIC: 16 uf ±10%, 200 v dcw; CG type No. 24F708-16; CHL part No. 46B310.	V13 B+ filter.
C86		CAPACITOR, FIXED PAPER DIELECTRIC: 8 uf ±10%, 200 v dcw; CG type No. 24F707-8; CHL part No. 46B309.	V13 B+ filter.
C87		Same as C85.	V14 B+ filter.
C88		Same as C85.	V14 B+ filter.
C89		Same as C86.	V14 B+ filter.
C90		CAPACITOR, FIXED CERAMIC DIELECTRIC: 5.1 uuf ±0.25 uuf, 500 v dcw; neg temp coef 1500 ±250 uuf/uf/°C; 0.400 in. lg x 0.200 in. dia; CHL part No. 47D20V051C.	P/o T17 temp comp trimmer network.
C91		CAPACITOR, FIXED CERAMIC DIELECTRIC: 5.6 uuf ±0.25 uuf, 500 v dcw; neg temp coef 2200 ±500 uuf/uf/°C; 0.400 in. lg x 0.200 in dia; CHL part No. 47D20W056C.	P/o T16 temp trimmer network.
C92		CAPACITOR, FIXED CERAMIC DIELECTRIC: 8 uuf ±0.5 uuf, 500 v dcw; neg temp coef 750 ±120 uuf/uf/°C; JAN type CC20UJ080D, Spec JAN-C-20A.	P/o T5 temp comp tuned circuit.
C93		CAPACITOR, FIXED MICA DIELECTRIC: 680 uuf ±10%, 300 v dcw; MIL type CM20B681K, Spec MIL-C-5.	P/o high freq a-f comp network.

TABLE 8-1. MAINTENANCE PARTS LIST (cont)

REFERENCE DESIG-NATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C94		CAPACITOR, FIXED CERAMIC DIELECTRIC: 3 uuf ±0.25 uuf; 500 v dcw; neg temp coef 750 ±120 uuf/uf/°C; JAN type CC20UJ030C, Spec JAN-C-20A.	P/o a-f feedback network.
C95		CAPACITOR, FIXED CERAMIC DIELECTRIC: 0.005 uf guaranteed min. capacity; 500 v dcw; disc type; 19/32 in. dia x 5/32 in. thk CBN type DD; CHL part No. 47A168.	B- to chassis bypass.
C96		Same as C2.	V13 bypass.
C97		Same as C2.	V8 plate bypass.
C98		Same as C82.	V1 plate circuit trimmer.
C99		CAPACITOR, FIXED CERAMIC DIELECTRIC: 1.5 uuf ±0.1 uuf; 500 v dcw; neg temp coef 4700 ±1000 uuf/uf/°C; 0.400 in. lg x 0.200 in. dia; CHL part No. 47D20Y015B.	V1 plate circuit temp comp.
C100		Same as C2.	115-volt line bypass.
C101		Same as C2.	115-volt line bypass.
C102		Same as C2.	115-volt line bypass.
C103		Same as C95.	115-volt line bypass.
C104		Same as C2.	115-volt line bypass.
C105		Same as C2.	B- to chassis bypass.
C106		Same as C2.	B- to chassis bypass.
C107		CAPACITOR, FIXED CERAMIC DIELECTRIC: 2300 uuf ±20%; 500 v dcw; 1.35 in. lg x 5/16 in. hex o/a; feedthru ceramicon; CER style 327; CHL part No. 47B609.	Filament feedthru bypass.
C108		Same as C107.	Filament feedthru bypass.
C109		Same as C107.	V1 feedthru bypass.
C110		Same as C107.	V1 plate circuit feedthru bypass.
C111		Same as C107.	V1 cathode circuit feedthru bypass.
C112		Same as C107.	V1 grid circuit feedthru bypass.
C113		Same as C107.	Filament feedthru bypass.
C114		Same as C107.	Filament feedthru bypass.
C115		Same as C107.	V2 screen circuit feedthru bypass.
C116		Same as C107.	V2 grid circuit feedthru bypass.
C117		Same as C107.	V3 grid circuit feedthru bypass.
C118		Same as C107.	Filament feedthru bypass.
C119		Same as C107.	V3 plate circuit feedthru bypass.
C120		CAPACITOR, FIXED CERAMIC DIELECTRIC: 10 uuf +80 -20%, 1000 v dcw; neg temp coef 330 ±500 uuf/uf/°C; feedthru ceramicon; CER style 327; CHL part No. 47B610.	A-f feedthru bypass.
C121		Same as C2.	V1 grid circuit bypass.
C122		CAPACITOR, FIXED MICA DIELECTRIC: 27 uuf ±5%, 500 v dcw; MIL type CM20C270J, Spec MIL-C-5.	P/o T10 tuned circuit.
C123		Same as C5.	P/o T14 tuned circuit.
C124		Same as C99.	P/o T13 tuned circuit.
C125		Same as C99.	P/o T14 tuned circuit.
C126		CAPACITOR, VARIABLE AIR DIELECTRIC: 7.0 uuf to 45.0 uuf; 500 v dcw; JAN type CV11D450, Spec JAN-C-81.	P/o V2 455-kc trap.
C127		CAPACITOR, FIXED MICA DIELECTRIC: 470 uuf ±2%, 500 v dcw; MIL type CM20D471G, Spec MIL-C-5.	P/o V2 455-kc trap.
C128		Same as C2.	B+ line bypass.
C129		Same as C2.	Filament bypass.
C130		Same as C2.	B- to chassis bypass.
C131		Same as C68.	B+ line bypass.
C132		Same as C2.	V7 plate circuit bypass.
C133		Same as C2.	V7 plate circuit bypass.

TABLE 8-1. MAINTENANCE PARTS LIST (cont)

REFERENCE DESIG-NATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C134		Same as C2.	B- to chassis bypass.
C135		Same as C2.	B- to chassis bypass.
C136		Same as C95.	+75 volt bypass.
C137		CAPACITOR, FIXED MICA DIELECTRIC: 120 uuf ±5%, 500 v dcw; MIL type CM20B121J, Spec MIL-C-5.	P/o bfo trap.
C138		CAPACITOR, FIXED MICA DIELECTRIC: 620 uuf ±5%, 300 v dcw; MIL type CM20B621J, Spec MIL-C-5.	P/o bfo trap.
C139		Same as C138.	P/o bfo trap.
C140		CAPACITOR, FIXED MICA DIELECTRIC: 1000 uuf ±5%, 300 v dcw; MIL type CM20B102J, Spec MIL-C-5.	P/o bfo trap.
C141		Same as C140.	P/o bfo trap.
C142		CAPACITOR, FIXED MICA DIELECTRIC: 470 uuf ±5%, 500 v dcw; MIL type CM20B471J, Spec MIL-C-5.	P/o 455-kc trap.
C143		Same as C2.	V1 bypass.
DS1		LAMP, INCANDESCENT: 6 to 8 volts 0.15 amp, miniature bayonet base; bulb T-3-1/4; 1-3/16 in. max o/a; GENERAL No. 47; CHL part No. 39A004.	Dial light.
DS2		Same as DS1.	Dial light.
E1		Not Used.	
E2		KNOB: round with lever; anodized aluminum; accommodates 1/4 in. dia shaft; mounted by two #8-32 set screws; 1-21/32 in. lg x 1.125 in. wide x 0.875 in. deep; bandswitch knob; CHL part No. 15B875.	Bandswitch knob.
E3		DIAL, CONTROL: knob type; scale 0 to 100 clockwise; graduated in 100 scale divisions, 360° arc; 1/4 in. dia shaft coupling; 1-1/4 in. lg x 2-3/4 in. dia.; mounted by two #8-32 set screws; black phenolic knob w/aluminum anodized plate; clutch type; CHL part No. 15B973.	Tuning knob.
E4		KNOB; round; black plastic knob w/anodized aluminum skirt; accommodates 1/4 in. dia shaft; mounted by two #6-32 set screws; brass insert, triangle indicator marking; 1-1/16 in. lg x 1-1/2 in. dia; CHL part No. 15B874.	Knob for switch S2.
E5		Same as E4.	Knob for switch S4.
E6		DIAL, CONTROL: knob type; scale -3 to 0 to +3 clockwise, graduated in increments of 0.5, 180° arc; 1/4 in. dia shaft coupling; 1-1/16 in. lg x 1-1/2 in. dia; mounted by two #6-32 set screws; black plastic knob w/anodized aluminum skirt; CHL part No. 15B941.	Bfo pitch knob.
E7		DIAL, CONTROL: knob type; scale 5 to 0 to 5 clockwise, graduated in increments of 1, 180° arc; 1/4 in. dia shaft coupling, 1-1/16 in. lg x 1-1/2 in. dia; mounted by two #6-32 set screws; black plastic knob w/anodized aluminum skirt; CHL part No. 15B942.	Antenna trimmer knob.
E8		DIAL, CONTROL: knob type; scale 0 to 10 counterclockwise, graduated in increments of 1, 315° arc; 1/4 in. dia shaft coupling; 1-1/16 in. lg x 1-1/2 in. dia; mounted by two #6-32 set screws; black plastic knob w/anodized aluminum skirt; CHL part No. 15B943.	Tone control knob.
E9		Same as E8.	Volume control knob.
E10		Same as E8.	Sensitivity control knob.
E11		SHIELD, ELECTRON TUBE: 1-3/8 in. h x 0.930 in. dia; JAN type TS102U01, Spec JAN-S-28A.	Electron tube protector.
E12		Not Used.	
E13 to E20		SHIELD, ELECTRON TUBE: 1-3/4 in. h x 0.930 in. dia; JAN type TS102U02, Spec JAN-S-28A.	Electron tube protector.
E21		Not Used.	
E22		SHIELD, ELECTRON TUBE: 1-15/16 in. h x 1.065 in. dia; JAN type TS103U02, Spec JAN-S-28A.	Electron tube protector.
E23		CONTACT, ELECTRICAL: ant. jumper; brass, nickel plated; 1-1/8 in. lg x 1/2 in. wide x 0.032 in. thick; CHL part No. 18A201.	Antenna jumper.
E24 to E37		TERMINAL, STUD: stand-off solder connection; melamine insulation; brass terminal and insert; WINCHESTER No. 766; CHL part No. 11A507.	Tie point.
F1		FUSE, CARTRIDGE: 1 amp, 250 v; quick acting; glass body; ferrule terminals; 1-1/4 in. lg x 1/4 in. dia o/a; Navy type No. 28032-1; CLF No. 312001; CHL part No. 39A306.	Line fuse.
F2		Same as F1.	Line fuse.
F101		Same as F1.	Line fuse in isolation transformer.
H1 to H10		SCREW, THUMB: stainless steel; knurled slotted head 9/16 in. dia x 1/2 in. h; flat point; 10-32 thread, 9/32 in. lg; 1-1/4 in. lg o/a; CHL part No. 3A3260.	Secure chassis to cabinet.

TABLE 8-1. MAINTENANCE PARTS LIST (cont)

REFERENCE DESIG-NATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
H11		SEAL, SWITCH: high pressure seal for standard toggle switches; silicone rubber boot and gasket rib chemically and mechanically bonded to metal nut threaded 15/32-32; 3/4 in. wide across flats of hex, 7/8 in. h; impervious to salt water, acids and ozone; AUTOMATIC part No. 1030; CHL part No. 16A400.	Moisture seal.
H12		Same as H11.	Moisture seal.
H13 to H20		BOOT, DUST AND MOISTURE SEAL: high pressure seal for 1/4 in. dia shaft; silicone rubber foot and gasket rib chemically and mechanically bonded to grooved metal nut threaded 3/8-32; 5/8 in. wide across flats of hex, 19/64 in. deep; impervious to salt water, acids and ozone; AUTOMATIC part No. 9030; CHL part No. 16A600.	Moisture seal.
H21		WRENCH: for #6 Allen head set screw; 0.062 in. wide across flats of hex; 5/8 in. h x 1-13/16 in. lg; steel, cad plate and iridite; "L" shape; CHL part No. 33B427.	Maintenance tool.
H22		WRENCH: for #8 Allen head set screw; 0.078 in. wide across flats of hex; 45/64 in. h x 1-61/64 in. lg; steel, cad plate & iridite; "L" shape; CHL part No. 33B428.	Maintenance tool.
H23		ALIGNMENT TOOL: 5-1/2 in. lg x 1/2 in. dia; phenolic handle and shank; stainless steel pins and tip; brass collar; CHL part No. 33B655.	Alignment tool for i-f and r-f stages.
J1		JACK, TELEPHONE: for two conductor plug; shank 1/4 in. dia x 1-7/32 in. lg; J4 contact arrangement; JAN type #JJ-089, Spec JAN-J-641.	Headphone connection.
L1		COIL, RADIO FREQUENCY: universal wound; 104 turns No. 40 SNHF wire; 0.242 mh inductance; powdered iron coil form; 7/8 in. lg x 11/32 in. dia o/a; wire lead terminals; CHL part No. 53B366.	P/o 455-kc trap.
L2		COIL, RADIO FREQUENCY: 2-pie universal wound; 1003 turns No. 40 SNHF wire; 13.37 mh inductance; powdered iron core; 7/8 in. lg x 9/16 in. dia o/a; wire lead terminals; CHL part No. 53B365.	P/o 455-kc trap.
L3		REACTOR: fixed inductance type; 20 henries inductance; 20 ma DC; 350 ohms DC resistance; hermetically sealed metal case; 2-5/16 in. lg x 2-1/16 in. wide x 3-1/8 in. h; four 6-32 studs on 1.687 in. x 1.437 in. mtg centers; 2 solder lug terminals; grade 1, class A, Spec MIL-T-27; CHL part No. 56C202.	B+ filter.
L4		REACTOR: fixed inductance type; 12 henries inductance; 100 ma DC; 100 ohms DC resistance; hermetically sealed metal case; 3-1/16 in. lg x 2-5/8 in. wide x 4-1/4 in. h; four 6-32 studs on 2.296 in. x 1.859 in. mtg centers; 2 solder lug terminals; grade 1, class A, Spec MIL-T-27; CHL part No. 56C201.	B+ filter.
L5 to L8		COIL, RADIO FREQUENCY: universal wound; 154 turns No. 22 SNF wire; 0.386 mh inductance; powdered iron core; 1 in. lg x 1-1/32 in. dia; wire lead terminals; line filter; CHL part No. 53B367.	Line filter.
L9		COIL, RADIO FREQUENCY: universal wound; 110 turns No. 30 SNE wire; 0.242 mh inductance; powdered iron core, 7/8 in. lg x 5/8 in. dia; wire lead terminals; CHL part No. 53B401.	R-f choke.
L10		Same as L9.	R-f choke.
L11		COIL, RADIO FREQUENCY: universal wound; 113 turns No. 40 SNHF wire; 0.103 mh inductance; powdered iron core; 3/8 in. lg x 7/32 in. dia; wire lead terminals; CHL part No. 53B399.	R-f choke.
L12		Same as L11.	R-f choke.
L13		COIL, RADIO FREQUENCY: universal wound; 212 turns No. 40 SNHF wire; 0.344 mh inductance; powdered iron core; 3/8 in. lg x 1/4 in. dia; wire lead terminals; CHL part No. 53B400.	R-f choke.
LS1		LOUDSPEAKER, PERMANENT MAGNET: 6 ohms voice coil impedance; 2 watts normal; 4 in. dia cone; 4.125 in. lg x 4.125 wide x 2.031 in. deep; four 0.200 in. dia mtg holes equally spaced on 4.687 in. dia circle; CJS part No. P4X-S6818; CHL part No. 85C178.	Audio output.
O1		GEAR ASSEMBLY, SPEED DECREASER: quadruple reduction type; one 1/4 in. dia straight input shaft; one 1/4 in. dia straight output shaft; 64.6 to 1 total ratio; helical knurl and spur gears; greased ball bearings; 3-3/16 in. lg x 7-3/16 in. wide x 8 in. h; 2-1/8 lb wt; assembly includes tuning dial; CHL part No. 41D29500.	Tuning mechanism.
O2		COVER, JACK: steel, enameled finish; 1-1/32 in. lg x 13/16 in. wide by 9/16 in. thk; mounts by clearance hole for 3/8 in. dia bushing; spring action; CHL part No. 66A1273.	Jack protector.
O3		GASKET: phone jack; rubber; 5/8 in. OD, 5/16 in. ID, 1/32 in. thk; CHL part No. 16A598.	Gasket for phone jack.
O4		SHAFT: 50% glass fiber content rod; 8-5/8 in. lg x 0.250 in. dia; CHL part No. 8A2854.	Antenna trimmer extension.
O5		SHAFT: 50% glass fiber content rod; 2 in. lg x 0.250 in. dia; CHL part No. 8A3222.	Bfo control extension.
O6		COUPLING SHAFT, FLEXIBLE: nylon insulator w/end bushings; bushings nickel plated; accommodates 3/8 in. dia round shaft ea end; 3/4 in. dia x 23/32 in. lg; mtd by two 8-32 set screws ea end; CHL part No. 41A31442.	Coupling for bfo control shaft.
O7		COUPLING SHAFT, RIGID: nylon w/brass inserts; for 3/8 in. round shaft one end, 1/4 in. round shaft other end; mounted by four 8-32 set screws; 1 in. dia x 1-1/8 in. lg; CHL part No. 29B257.	Coupling for antenna trimmer shaft.
O8		COUPLING SHAFT, RIGID: brass dull nickel plated; for 1/4 in. dia round shaft ea end; mounted by four 6-32 set screws; 3/8 in. dia by 5/8 in. lg; CHL part No. 29B277.	Antenna trimmer coupling.

TABLE 8-1. MAINTENANCE PARTS LIST (cont)

REFERENCE DESIG-NATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
O9		GASKET: escutcheon; rubber; black; 6-5/8 in. lg x 3-1/16 in. h x 3/32 in. thk o/a; 5-5/8 in. x 2-11/16 in. cutout; four 0.187 in. dia holes on 6 in. x 2-7/16 in. centers; CHL part No. 16B578.	Dial escutcheon gasket.
O10		GASKET: front panel; black rubber; "U" channel, 3/16 in. wide x 5/16 in. h x 54-5/8 in. lg; 1/16 in. wide slot; ATLANTIC part No. X-849; CHL part No. 16B579.	Front panel gasket.
O11		GASKET: speaker louver, black rubber; 4-7/8 in. wide x 3-3/4 in. h x 3/32 in. thk; four 0.187 in. dia holes on 4-1/4 in. x 3-1/8 in. mtg centers; 1-7/8 in. radius cutout with flat on one side; CHL part No. 16B580.	Speaker louver gasket.
O12		SPRING, HELICAL, TORSION: 1-3/4 right hand coils; .035 in. dia spring steel wire, corrosion resistant; 3/16 in. lg, less ends; 9/16 in. ID; lock lever; CHL part No. 75B362.	Right spring for chassis lock.
O13		SPRING, HELICAL, TORSION: 1-3/4 left hand coils; .035 in. dia spring steel wire, corrosion resistant; 3/16 in. lg, less ends; 9/16 in. ID; lock lever; CHL part No. 75B363.	Left spring for chassis lock.
O14		BUSHING: brass, nickel plated; 5/16 in. lg x 1/2 in. hex head 1/16 in. thk; 0.251 in. ID; threaded 3/8-32 NEF-2; CHL part No. 77A1016.	Bushing for antenna trimmer shaft.
O15		Same as O14.	Bushing for band change shaft.
O16		Same as O14.	Bushing for sensitivity control shaft.
O17		Same as O14.	Bushing for bfo pitch control.
O18		GROMMET: natural rubber, black color; 1/2 in. OD, 3/8 in. mtg dia; 3/64 in. thk flange; 3/16 in. x 1/8 in. oval hole; 3/16 in. thk; 3/32 in. wide groove; ATLANTIC part No. 203; CHL part No. 16B634.	Chassis grommet.
O19		GROMMET: natural rubber, black color; 7/8 in. OD. 3/4 in. mtg dia; 1/8 in. thk flange; 1/2 in. dia hole; 11/32 in. thk; 3/32 in. wide groove; ATLANTIC Part No. 452; CHL part No. 16B635.	Chassis grommet.
O20		Same as O8.	Bfo coupling.
R1		RESISTOR, FIXED COMPOSITION: 1 megohm ±10%, 1/2 watt; MIL type RC20BF105K, Spec MIL-R-11A.	V1 grid resistor.
R2		RESISTOR, FIXED COMPOSITION: 390 ohms ±5%, 1/2 watt; MIL type RC20BF391J, Spec MIL-R-11A.	V2 cathode bias.
R3		RESISTOR, VARIABLE: 25,000 ohms ±10%, 2 watts; std A taper; Allen Bradley "U" taper; 1-1/16 in. dia x 9/16 in. deep; 1/4 in. dia flatted shaft 1-29/32 in. lg; 3/8 in. lg bushing threaded 3/8-32; non-turn device located on 17/32 in. radius at 9 o'clock; CBZ type JU2531; CHL part No. 25B1133.	Sensitivity control.
R4		RESISTOR, FIXED COMPOSITION: 180,000 ohms ±10%, 1/2 watt; MIL type RC20BF184K, Spec MIL-R-11A.	P/o sensitivity control voltage divider.
R5		RESISTOR, FIXED COMPOSITION: 18,000 ohms ±10%, 1/2 watt; MIL type RC20BF183K, Spec MIL-R-11A.	V1 screen dropping.
R6		RESISTOR, FIXED COMPOSITION: 100,000 ohms ±10%, 1/2 watt; MIL type RC20BF104K, Spec MIL-R-11A.	V2 grid resistor.
R7		RESISTOR, FIXED COMPOSITION: 150 ohms ±5%, 1/2 watt; MIL type RC20BF151J, Spec MIL-R-11A.	V2 cathode bias.
R8		RESISTOR, FIXED COMPOSITION: 22,000 ohms ±10%, 1/2 watt; MIL type RC20BF223K, Spec MIL-R-11A.	V2 injection grid resistor.
R9		RESISTOR, FIXED COMPOSITION: 39,000 ohms ±10%, 1/2 watt; MIL type RC20BF393K, Spec MIL-R-11A.	V2 screen dropping.
R10		RESISTOR, FIXED COMPOSITION: 2700 ohms ±10%, 1/2 watt; MIL type RC20BF272K, Spec MIL-R-11A.	V1 plate decoupling.
R11		Same as R6.	V4 grid resistor.
R12		Same as R6.	V3 grid leak.
R13		RESISTOR, FIXED COMPOSITION: 5600 ohms ±5%, 1/2 watt; MIL type RC20BF562J; Spec MIL-R-11A.	V3 plate decoupling.
R14		RESISTOR, FIXED COMPOSITION: 3300 ohms ±5%, 1/2 watt; MIL type RC20BF332J; Spec MIL-R-11A.	V4 cathode bias.
R15		Same as R9.	V4 screen dropping.
R16		Same as R10.	V4 plate decoupling.
R17		Same as R6.	P/o T7.
R18		RESISTOR, FIXED COMPOSITION: 820 ohms ±5%, 1/2 watt; MIL type RC20BF821J; Spec MIL-R-11A.	V5 cathode bias.
R19		Same as R9.	V5 screen dropping.
R20		Same as R10.	V5 plate decoupling.

TABLE 8-1. MAINTENANCE PARTS LIST (cont)

REFERENCE DESIG-NATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R21		Same as R6.	P/o T8.
R22		RESISTOR, FIXED COMPOSITION: 1000 ohms ±5%, 1/2 watt; MIL type RC20BF102J, Spec MIL-R-11A.	V6 cathode bias.
R23		Same as R9.	V6 screen dropping.
R24		Same as R10.	V6 plate decoupling.
R25		RESISTOR, FIXED COMPOSITION: 470,000 ohms ±10%, 1/2 watt; MIL type RC20BF474K, Spec MIL-R-11A.	P/o T9.
R26		RESISTOR, FIXED COMPOSITION: 47,000 ohms ±10%, 1/2 watt; MIL type RC20BF473K, Spec MIL-R-11A.	P/o T9.
R27		RESISTOR, FIXED COMPOSITION: 82,000 ohms ±10%, 1/2 watt; MIL type RC20BF823K, Spec MIL-R-11A.	P/o T9.
R28		RESISTOR, FIXED COMPOSITION: 220,000 ohms ±10%, 1/2 watt; MIL type RC20BF224K, Spec MIL-R-11A. (For replacement use MIL type RC20BF224J) (same as R46).	P/o T9.
R29		Same as R25.	V7 grid resistor.
R30		RESISTOR, FIXED COMPOSITION: 18,000 ohms ±5%, 1/2 watt; MIL type RC20BF183J, Spec MIL-R-11A.	V7 cathode bias.
R31		RESISTOR, FIXED COMPOSITION: 240,000 ohms ±5%, 1/2 watt; MIL type RC20BF244J, Spec MIL-R-11A.	V7 plate load.
R32		RESISTOR, FIXED COMPOSITION: 330,000 ohms ±10%, 1/2 watt; MIL type RC20BF334K, Spec MIL-R-11A.	Avc decoupling.
R33		Same as R1.	Avc load.
R34		Same as R6.	P/o T20.
R35		RESISTOR, FIXED COMPOSITION: 68,000 ohms ±10%, 1/2 watt; MIL type RC20BF683K, Spec MIL-R-11A.	V8 plate decoupling.
R36		RESISTOR, FIXED COMPOSITION: 2.2 megohms ±10%, 1/2 watt; MIL type RC20BF225K, Spec MIL-R-11A.	Anl load.
R37		Same as R25.	V9 cathode resistor.
R38		RESISTOR, VARIABLE: 500,000 ohms ±20%, 2 watts; std A taper; Allen Bradley "U" taper; 1-1/16 in. dia x 9/16 in. deep; 1/4 in. dia flatted shaft 1-1/16 in. lg; 3/8 in. lg bushing threaded 3/8-32; non-turn device located on 17/32 in. radius at 9 o'clock; CBZ type JU5042; CHL part No. 25B1134.	Tone control.
R39		RESISTOR, VARIABLE: 2.0 megohms ±20%, 2 watts; special taper 500 ohms at 5% rotation, 7500 ohms at 10% rotation, 55,000 ohms at 20% rotation, 200,000 ohms at 40% rotation, 640,000 ohms at 70% rotation, 1.4 megohms at 90% rotation, 1-1/16 in. dia x 9/16 in. deep; 1/4 in. dia flatted shaft 1-1/16 in. lg; 3/8 in. lg bushing threaded 3/8-32; non-turn device located on 17/32 in. radius at 9 o'clock; CBZ type J, Spec 3405; CHL part No. 25C1132.	Volume control.
R40		Same as R13.	V10 cathode bias.
R41		RESISTOR, FIXED COMPOSITION: 470,000 ohms ±5%, 1/2 watt; MIL type RC20BF474J, Spec MIL-R-11A.	V10A plate load.
R42		Same as R41.	V10B plate load.
R43		Same as R26.	V10 plate decoupling.
R44		RESISTOR, FIXED COMPOSITION: 270,000 ohms ±5%, 1/2 watt; MIL type RC20BF274J, Spec MIL-R-11A.	V12 grid resistor.
R45		Same as R44.	V11 grid resistor.
R46		RESISTOR, FIXED COMPOSITION: 220,000 ohms ±5%, 1/2 watt; MIL type RC20BF224J, Spec MIL-R-11A.	V11, V12 grid return.
R47		RESISTOR, FIXED COMPOSITION: 120 ohms ±10%, 2 watts; MIL type RC42BF121K, Spec MIL-R-11A.	V11, V12 cathode bias.
R48		RESISTOR, FIXED COMPOSITION: 240 ohms ±5%, 1/2 watt; MIL type RC20BF241J, Spec MIL-R-11A.	Audio limiting.
R49		Same as R25.	P/o high freq audio comp network.
R50		RESISTOR, FIXED COMPOSITION: 33,000 ohms ±10%, 1/2 watt; MIL type RC20BF333K, Spec MIL-R-11A.	V1 plate circuit decoupling.
R51		RESISTOR, FIXED COMPOSITION: 22,000 ohms ±10%, 2 watts; MIL type RC42BF223K, Spec MIL-R-11A.	B+ load.
R52		Same as R51.	B+ load.

TABLE 8-1. MAINTENANCE PARTS LIST (cont)

REFERENCE DESIG-NATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R53		RESISTOR, FIXED COMPOSITION: 1200 ohms ±10%, 2 watts; MIL type RC42BF122K, Spec MIL-R-11A.	V15 dropping resistor.
R54		RESISTOR, CURRENT REGULATING: AC/DC; 105 v threshold voltage; 0.29 to 0.32 amp nominal operating current; RMA type T-9 bulb; octal base; CAGK type No. 3A10; CHL part No. 24B1038.	Filament ballast.
R55		RESISTOR, FIXED WIRE WOUND: 250 ohms ±5%, 25 watts; 1-1/16 in. lg x 1-1/16 in. wide x 9/16 in. h; silicone sealed; 2 solder lug terminals; two 1/8 in. dia holes on 1.06 in. mtg centers; DALE type RH-25; CHL part No. 24DPA251J.	Filament dropping.
R56		RESISTOR, FIXED WIRE WOUND: 510 ohms ±5%, 25 watts; 1-1/16 in. lg x 1-1/16 in. wide x 9/16 in. h; silicone sealed; 2 solder lug terminals; two 1/8 in. dia holes on 1.06 in. mtg centers; DALE type RH-25; CHL part No. 24DPA511J.	Used/w R54.
R57		Same as R25.	Audio feedback resistor.
R58		Same as R28.	T10 loading.
R59		Same as R50.	T11 loading.
R60		RESISTOR, FIXED COMPOSITION: 10,000 ohms ±10%, 1/2 watt; MIL type RC20BF103K, Spec MIL-R-11A.	T12 loading.
R61		RESISTOR, FIXED COMPOSITION: 8200 ohms ±10%, 1/2 watt; MIL type RC20BF822K, Spec MIL-R-11A.	Antenna loading.
R62		Same as R10.	V1 plate voltage dropping and de-coupling.
R63		RESISTOR, FIXED WIRE WOUND: 1500 ohms ±5%, 10 watts; 1-3/4 in. lg x 3/8 in. dia; vitreous enamel coating; wire lead terminals; COM type BD; CHL part No. 24BG152D.	Used/w R65.
R64		RESISTOR, FIXED WIRE WOUND: 100 ohms ±5%, 5 watts; 1 in. lg x 3/8 in. dia; vitreous enamel coating; wire lead terminals; COM type BD, CHL part No. 24BF101D.	Filament dropping.
R65		RESISTOR, CURRENT REGULATING: AC/DC; 0.19 to 0.22 amp nominal operating current; 15 to 30 v drop; RMA type T-9 bulb; octal base; CAGK type No. 2A10; CHL part No. 24B1122.	Filament ballast.
R66		RESISTOR, FIXED WIRE WOUND: 350 ohms ±5%, 5 watts; 1 in. lg x 3/8 in. dia; vitreous enamel coating; wire lead terminals; COM type BD; CHL part No. 24BF351D.	Dial light protector.
R67		Same as R1.	B- to chassis discharge path.
R68		RESISTOR, FIXED COMPOSITION: 560 ohms ±10%, 1/2 watt; MIL type RC20BF561K, Spec MIL-R-11A.	V8 ground return. B- to chassis discharge path.
R69		RESISTOR, FIXED COMPOSITION: 10,000 ohms ±10%, 2 watts; MIL type RC42BF103K, Spec MIL-R-11A.	Filament hum bucking.
S1		SWITCH, ROTARY: 5 sections 5 positions plus 1 ground wafer; 12 poles, 5 throws, brass silver-plated non-shorting type contacts; steatite insulation; 9-1/4 in. lg x 1-3/8 in. wide x 1-19/32 in. h; bracket and bushing mtd; 1/4 in. dia flatted shaft 2-11/16 in. lg; GRIGSBY type 4MLWC, CHL part No. 60C658.	Band change switch.
S2		SWITCH, ROTARY: 1 section; 3 positions; 3 poles, 3 throws; brass silver-plated non-shorting type contacts; bakelite insulation; 1/2 in. lg x 1-3/8 in. wide x 1-19/32 in. h; mounted by bushing threaded 3/8-32; 1/4 in. dia shaft 1-1/32 in. lg; GRIGSBY type 4MLW; CHL part No. 60C675.	AVC-MAN.-CW. switch.
S3		SWITCH, TOGGLE: SPST; JAN type ST10A, Spec JAN-S-23.	Noise limiter switch.
S4		SWITCH, ROTARY: 1 section; 3 positions, 3 poles, 3 throws; brass silver-plated contacts; bakelite insulation; 1-1/4 in. lg x 1-3/8 in. wide x 1-19/32 in. h; mounted by bushing threaded 3/8-32; 1/4 in. dia shaft 1-1/32 in. lg; auxiliary DPST switch on rear making contact in positions 2 and 3; GRIGSBY type 4MLW; CHL part No. 60C674.	Power switch.
S5		Same as S3.	Speaker switch.
T1		TRANSFORMER, RADIO FREQUENCY: 200 kc to 400 kc design frequency range; 2 windings; primary 86 turns; no. 28-SNE wire; secondary 315 turns; no. 5/42 SNE wire; uncased; nylon form; 2 in. h x 7/8 in. dia; adjustable iron core located at top for secondary tuning; two 0.128 in. dia mtg holes spaced 7/8 in. C to C; 4 solder lug terminals; CHL part No. 51B2048.	V1 grid circuit.
T2		TRANSFORMER, RADIO FREQUENCY: 490 kc to 1200 kc design frequency range; 2 windings; primary 106 turns; no. 34 SNE wire; secondary 117 turns no. 5/42 SNE wire; uncased; nylon form; 2 in. h x 15/16 in. dia; adjustable iron core located at top for secondary tuning; two 0.128 in. dia mtg holes spaced 7/8 in. C to C; 4 solder lug terminals; CHL part No. 51B2049.	V1 grid circuit.
T3		TRANSFORMER, RADIO FREQUENCY: 1200 kc to 3000 kc design frequency range; 2 windings; primary 38 turns; no. 24 SNE wire; secondary 45 turns no. 5/42 SNE wire; uncased; nylon form; 2 in. h x 15/16 in. dia; adjustable iron core located at top for secondary tuning; two 0.128 in. dia mtg holes spaced 7/8 in. C to C; 4 solder lug terminals; CHL part No. 51B2050.	V1 grid circuit.
T4		TRANSFORMER, RADIO FREQUENCY: 3000 kc to 7300 kc design frequency range; 2 windings; primary 25 turns; no. 24 SNE wire; secondary 21 turns no. 32 SNE wire; uncased; nylon form; 2 in. h x 7/8 in. dia; adjustable iron core located at top for secondary tuning; two 0.125 in. dia mtg holes spaced 7/8 in. C to C; 4 solder lug terminals; CHL part No. 51B2051.	V1 grid circuit.

TABLE 8-1. MAINTENANCE PARTS LIST (cont)

REFERENCE DESIG-NATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
T5		TRANSFORMER, RADIO FREQUENCY: 7300 kc to 18 mc design frequency range; 2 windings; primary 15 turns; no. 24 SNE wire; secondary 8-3/4 turns no. 24 enamel wire; uncased; nylon form; 2 in. h x 3/4 in. dia; adjustable iron core located at top for secondary tuning; two 0.128 in. dia mtg holes spaced 7/8 in. C to C; 4 solder lug terminals; CHL part No. 51B2052.	V1 grid circuit.
T6		TRANSFORMER, INTERMEDIATE FREQUENCY: 455 kc peak frequency; input; shielded; shield dimensions 3-3/4 in. h x 1.415 in. sq; phenolic coil form; powdered iron core; double tuned; mtd by two 6-32 spade bolts spaced 1-5/16 in. C to C; 5 solder lug type terminals; includes capacitors C11, C12, and C13; CHL part No. 50C649.	I-f coupling.
T7		TRANSFORMER, INTERMEDIATE FREQUENCY: 455 kc peak frequency; interstage; shielded; shield dimensions 3-3/4 in. h x 1.415 in. sq; phenolic coil form; powdered iron core; double tuned; mtd by two 6-32 spade bolts spaced 1-5/16 in. C to C; 6 solder lug type terminals; T7 includes capacitors C18, C19, C20 and R17. T8 includes C24, C25, C26 and R21; CHL part No. 50C650.	I-f coupling.
T8		Same as T7.	I-f coupling.
T9		TRANSFORMER, INTERMEDIATE FREQUENCY: 455 kc peak frequency; output; shielded; shield dim. 3-3/4 in. h x 1.415 in. sq; phenolic coil form; powdered iron core; double tuned; mtd by two 6-32 spade bolts spaced 1-5/16 in. C to C; 8 solder lug type terminals; includes C31, C32, C33, C34, R25, R26, R27, and R28; CHL part No. 50C651.	I-f coupling.
T10		TRANSFORMER, RADIO FREQUENCY: 200 kc to 400 kc design frequency range; 2 windings; primary 345 turns; no 5/42 SNE wire; secondary 315 turns no. 5/42 SNE wire; uncased; two nylon forms; 2-3/16 in. lg x 1-3/16 in. wide x 2-5/32 in. h; adjustable iron core located at top of secondary coil; two 0.125 in. dia mtg holes 7/8 in. C to C; 4 solder lug terminals; CHL part No. 51B2058.	V2 grid circuit.
T11		TRANSFORMER, RADIO FREQUENCY: 490 kc to 1200 kc design frequency range; 2 windings; primary 127-1/2 turns; no. 5/42 SNE wire; secondary 120 turns no. 5/42 SNE wire; uncased; nylon form; 2-3/4 in. h x 7/8 in. dia; adjustable iron core located at top for secondary tuning, two 0.128 in. dia mtg holes spaced 7/8 in. C to C; 4 solder lug terminals; CHL part No. 51B2059.	V2 grid circuit.
T12		TRANSFORMER, RADIO FREQUENCY: 1200 kc to 3000 kc design frequency; 2 windings; primary 49 turns; no. 5/42 SNE wire; secondary 45 turns no. 5/42 SNE wire; uncased; nylon form; 2-1/2 in. h x 3/4 in. dia; adjustable iron core located at top for secondary tuning; two 0.128 in. dia mtg holes spaced 7/8 in. C to C; 4 solder lug terminals; CHL part No. 51B2060.	V2 grid circuit.
T13		TRANSFORMER, RADIO FREQUENCY: 3000 kc to 7300 kc design frequency range; 2 windings; primary 24 turns; no. 28 SNE wire; secondary 21 turns no. 28 SNE wire; uncased; nylon form; 2-1/2 in. h x 21/32 in. dia; adjustable iron core located at top for secondary tuning; two 0.128 in. dia mtg holes spaced 7/8 in. C to C; 4 solder lug terminals; CHL part No. 51B2061.	V2 grid circuit.
T14		TRANSFORMER, RADIO FREQUENCY: 7300 kc to 18 mc design frequency range; 2 windings; primary 8-1/4 turns; no. 24 enameled wire; secondary 7-3/4 turns no. 24 enameled wire; uncased; two phenolic forms with fixed powdered iron cores; 2-15/16 in. h x 1-1/8 in. wide x 1-15/32 in. deep; two 0.125 in. dia mtg holes spaced 7/8 in. C to C; 4 solder lug terminals; CHL part No. 51B2062.	V2 grid circuit.
T15		TRANSFORMER, RADIO FREQUENCY: 200 kc to 400 kc design frequency band; 1 winding; 102 turns no. 10/41 SNE wire; tapped at 16 turns; uncased; steatite form; 2 in. h x 15/16 in. dia; adjustable iron core located at top; two 0.128 in. dia mtg holes spaced 7/8 in. C to C; 3 solder lug terminals; CHL part No. 51B2053.	V3 grid circuit.
T16		TRANSFORMER, RADIO FREQUENCY: 490 kc to 1200 kc design frequency band; 1 winding; 79 turns no. 10/41 SNE wire; tapped at 16 turns; uncased; steatite form; 2 in. h x 13/16 in. dia; adjustable iron core located at top; two 0.128 in. dia mtg holes spaced 7/8 in. C to C; 3 solder lug terminals; CHL part No. 51B2054.	V3 grid circuit.
T17		TRANSFORMER, RADIO FREQUENCY: 1200 kc to 3000 kc design frequency band; 1 winding; 50-1/2 turns; no. 32 SNE wire; tapped at 10-1/2 turns; uncased; steatite form; 2 in. h x 5/8 in. dia; adjustable iron core located at top; two 0.128 in. dia mtg holes spaced 7/8 in. C to C; 3 solder lug terminals; CHL part No. 51B2055.	V3 grid circuit.
T18		TRANSFORMER, RADIO FREQUENCY: 3000 kc to 7300 kc design frequency band; 1 winding; 22-1/2 turns no. 32 SNE wire; tapped at 7 turns; uncased; steatite form; 2 in. h x 5/8 in. dia; adjustable iron core located at top; two 0.128 in. dia mtg holes spaced 7/8 in. C to C; 3 solder lug terminals; CHL part No. 51B2056.	V3 grid circuit.
T19		TRANSFORMER, RADIO FREQUENCY: 7300 kc to 18 mc design frequency band; 1 winding; 10-1/2 turns; no. 22 tinned wire; tapped at 3 turns; uncased; steatite form; 2 in. h x 5/8 in. dia; adjustable iron core located at top; two 0.128 in. dia mtg holes spaced 7/8 in. C to C; 3 solder lug terminals; CHL part No. 51B2057.	V3 grid circuit.
T20		TRANSFORMER, RADIO FREQUENCY: BFO; 455 kc design peak frequency; 1 winding; 98 turns; no. 10/41 SNE wire; tapped at 37 turns; aluminum case; phenolic coil form; case dimensions 2-1/2 in. h x 1-3/16 in. sq; adjustable iron core tuning located at top of case; mounted by two 6-32 spade bolts spaced 1 in. C to C; 5 solder lug terminals; includes C62, C63, and R34; CHL part No. 50C694.	Bfo transformer.
T101		TRANSFORMER, POWER ISOLATION: hermetically sealed metal case; primary 115 v, 60 cycles, 1 phase; secondary 115 v, 0.8 amp; 4 solder lug terminals; mounted by mounting feet on base; 4 studs on top for mounting cover; CHL part No. 52C466.	Used/w receiver.

TABLE 8-1. MAINTENANCE PARTS LIST (cont)

REFERENCE DESIG-NATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
T101*		TRANSFORMER AND COVER ASSEMBLY: same as T101 except complete with transformer cover assembly 41C32116, 4 no. 8 flat hd washers, 4 no. 8 split lock washers and 4 no. 8-32 hex nuts. Part No. 41C32116 consists of 2 cable clamps, one fuse (same as F1), one fuse holder (same as XF1), 2 grommets, attaching hardware and 2-1/2 in. no. 18 insulated stranded wire.	A-c power line isolation.
TB1		TERMINAL BOARD: plastic board; 3 thumb screw terminals on top and 3 solder lug terminals on bottom; 2-11/16 in. lg x 11/16 in. wide x 7/8 in. h; two 0.144 in. dia mtg holes spaced 2.250 in. C to C; CHL part No. 88B724.	Antenna terminals.
TB2		TERMINAL BOARD: mica filled phenolic board; 3 feed-thru type terminals; barrier style; 1-25/32 in. lg x 7/8 in. wide x 13/32 in. h; four 0.160 in. dia holes on 1-1/2 in. x 5/16 in. mtg centers; CJC No. 3-164-YD; CHL part No. 88B1029.	Power input.
TB3		TERMINAL BOARD: mica filled phenolic board; 2 feed-thru type terminals; barrier style; 1-13/32 in. lg x 7/8 in. wide x 13/32 in. h; four 0.160 in. dia holes on 1-1/8 in. x 5/16 in. mtg centers; CJC No. 2-164-YD; CHL part No. 88B1028.	Audio output.
TB4		TERMINAL BOARD: laminated plastic board; 3 solder lug type terminals; 1-1/2 in. lg x 15/32 in. wide x 3/8 in. h, o/a, less terminals; one 0.140 in. dia mtg hole; CHL part No. 88A1396.	Mounting for component parts.
TB5		TERMINAL BOARD: melamine board; 21 solder lug turret type terminals; 8-1/8 in. lg x 1-1/2 in. wide x 3/32 in. thk; five 0.157 in. dia mtg holes; CHL part No. 88B1033.	Mounting for component parts.
TB6		TERMINAL BOARD: melamine board; 23 solder lug turret type terminals; 7-1/8 in. lg x 1-1/2 in. wide x 3/32 in. thk; five 0.157 in. dia mtg holes; CHL part No. 88B1034.	Mounting for component parts.
V1		ELECTRON TUBE: receiving, miniature pentode; type MIL-6BH6, Spec MIL-E-1B.	R-f ampl.
V2		ELECTRON TUBE: receiving, pentagrid converter; type MIL-12BE6, Spec MIL-E-1B.	Mixer.
V3		ELECTRON TUBE: receiving, miniature pentode; RF remote cutoff; type MIL-6BJ6, Spec MIL-E-1B.	Local oscillator.
V4		Same as V1.	1st I-f ampl.
V5		Same as V3.	2nd I-f ampl.
V6		Same as V3.	3rd I-f ampl.
V7		ELECTRON TUBE: receiving; twin diode-high-mu triode, miniature; CHL part No. 90X12AV6.	AVC.
V8		Same as V3.	Bfo.
V9		ELECTRON TUBE: receiving, twin diode, miniature; CHL part No. 90X12AL5.	Detector and Anl.
V10		ELECTRON TUBE: receiving, twintriode, miniature; type MIL-12AX7, Spec MIL-E-1B.	Audio ampl.
V11		ELECTRON TUBE: beam power amplifier; octal; type MIL-35L6GT, Spec MIL-E-1B.	Audio output.
V12		Same as V11.	Audio output.
V13		ELECTRON TUBE: receiving, half-wave high-vacuum rectifier; type MIL-35Z5GT, Spec MIL-E-1B.	Rectifier.
V14		Same as V13.	Rectifier.
V15		ELECTRON TUBE: diode voltage regulator; type MIL-OA3, Spec MIL-E-1B.	Voltage regulator.
XDS1		LAMPHOLDER: accommodates miniature bayonet base lamp; 1-1/2 in. h x 7/16 in. wide x 33/64 in. deep, less terminals; 2 solder lug terminals; one 0.116 in. dia mtg hole in bracket; CHL part No. 86B187.	DS1 holder.
XDS2		Same as XDS1.	DS2 holder.
XF1		FUSEHOLDER: extractor post type; accommodates one 1-1/4 in. lg x 1/4 in. dia fuse; mica filled phenolic body and cap; panel mounted; CFA type HKP-BL; CHL part No. 6B374.	F1 holder.
XF2		Same as XF1.	F2 holder.
XF101		Same as XF1.	F101 holder.
XR54		SOCKET, ELECTRON TUBE: 8 contacts; octal; mica filled; phenolic body; CMG No. 12062; CHL part No. 6B495.	Socket for R54.
XR65		Same as XR54.	Socket for R65.
XV1		SOCKET, ELECTRON TUBE: 7 contacts; miniature size; ceramic body; JAN type TS102C01, Spec JAN-S-28A.	Socket for V1.
XV2		Same as XV1.	Socket for V2.
XV3		Same as XV1.	Socket for V3.
XV4		SOCKET, ELECTRON TUBE: 7 contacts; miniature size; molded plastic body; JAN type TS102P01, Spec JAN-S-28A.	Socket for V4.
XV5		Same as XV4.	Socket for V5.
XV6		Same as XV4.	Socket for V6.

TABLE 8-1. MAINTENANCE PARTS LIST (cont)

REFERENCE DESIG-NATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XV7		Same as XV4.	Socket for V7.
XV8		Same as XV4.	Socket for V8.
XV9		Same as XV4.	Socket for V9.
XV10		SOCKET, ELECTRON TUBE: 9 contacts; miniature size; molded plastic body; JAN type TS103P01, Spec JAN-S-28A.	Socket for V10.
XV11		SOCKET, ELECTRON TUBE: 8 contacts; octal; molded plastic body; JAN type TS101P01, Spec JAN-S-28A. (For replacement use 5935-259-3995) (same as XR-54)	Socket for V11.
XV12		Same as XV11.	Socket for V12.
XV13		Same as XR54.	Socket for V13.
XV14		Same as XR54.	Socket for V14.
XV15		Same as XR54.	Socket for V15.
Z1		FILTER, BAND PASS: 1000 cycles reference frequency; ±1.0 db from 200 to 4000 cycles; more than 20 db down at 100 cycles; 5000 ohms input, CT; 600 ohms output, tapped at 6 ohms; 2-3/4 in. lg x 2-3/8 in. wide x 2-13/16 in. h; rectangular metal case; four 6-32 mtg studs on 2.125 in. x 1.750 in. mtg centers; 6 solder lug type terminals; CHL part No. 55C257.	Bandpass filter.

TABLE 8-2. STOCK NUMBER IDENTIFICATION

REF. DESIG.	FEDERAL	STOCK NUMBERS STANDARD NAVY	SIGNAL CORPS	USAF	PARTS SUPPLIED
A5	5910-129-6115				
A11	5910-129-6116				
C1	5910-195-7572				2
C2	5910-644-0727				
C5	5910-126-1619				
C6	5910-643-8759				
C8	5910-197-1531				
C11	5910-666-6784				
C13	5910-101-4864				
C33	5910-643-8605				
C35	5910-112-7451				
C37	5910-666-5223				
C39	5910-642-6772				
C40	5910-667-6770				
C41A	5910-666-6184				
C41C	5910-666-6185				
C42	5910-667-6771				
C44	5910-649-3710				
C49	5910-636-2101				
C51	5910-190-8384				
C52	5910-666-0449				
C53	5910-666-0448				
C54	5910-666-0439				
C55	5910-190-9412				
C56	5910-644-7237				1
C57	5910-666-9145				
C58	5910-644-7240				1
C59	5910-666-5455				1
C60	5910-643-9916				
C61	5910-101-0525				
C62	5910-112-6986				
C63	5910-195-7572				
C65	5910-101-5579				
C66	5910-192-2118				
C68	5910-281-0107				
C69	5910-644-5921				1
C72	5910-644-3569				
C73	5910-101-5796				
C74	5910-644-7276				
C76	5910-250-0256				
C82	5910-126-1613				
C85	5910-643-9390				1
C86	5910-643-9283				1
C90	5910-665-4230				1
C91	5910-643-9294				1
C92	5910-101-0519				
C93	5910-636-3764				
C94	5910-192-2242				
C95	5910-643-9355				1
C99	5910-665-4036				1
C107	5910-643-9295				2
C120	5910-666-0440				1
C122	5910-160-1159				
C126	5910-197-6734				
C127	5910-170-4376				
C137	5910-101-5608				

TABLE 8-2. STOCK NUMBER IDENTIFICATION (cont)

REF. DESIG.	FEDERAL	STOCK NUMBERS STANDARD NAVY	SIGNAL CORPS	USAF	PARTS SUPPLIED
C138	5910-264-9448				
C140	5910-636-2134				
C142	5910-101-4890				
DS1	6240-155-8706				2
E2	5355-667-5510				
E3	5355-668-2303				
E4	5355-L01-1053				
E6	5355-668-1527				
E7	5355-519-7319				
E8	5355-668-2302				
E11	5960-262-0015				
E13	5960-272-9094				
E22	5960-264-3004				
E24	5940-665-4768				
F1	5920-280-4465				22
H11	5975-099-5747				
H13	5975-501-0469				
J1	5935-192-4789				
L1	5950-645-3068				
L2	5950-645-3070				
L3	5950-648-0759				1
L4	5950-648-0760				1
L5	5950-645-3071				1
L9	5950-538-6607				
L11	5950-538-6608				
L13	5950-538-6606				
LS1	5965-510-0524				
O1	5820-528-3868				
O6	3010-L01-1404				
O7	3020-528-6866				
O18	5325-641-3130				
O19	5325-290-1968				
R1	5905-192-0390				
R2	5905-279-1890				
R3	5905-192-7243				
R4	5905-192-0660				
R5	5905-279-3500				
R6	5905-195-6761				
R7	5905-107-5186				
R8	5905-171-2004				
R9	5905-279-3497				
R10	5905-279-1880				
R13	5905-195-6453				
R14	5905-195-9457				
R18	5905-114-2866				
R22	5905-195-6806				
R25	5905-279-2515				
R26	5905-254-9201				
R27	5905-195-9451				
R28	5905-192-0667				
R30	5905-279-3500				
R31	5905-239-0560				
R32	5905-109-0213				
R35	5905-171-1986				
R36	5905-190-8885				

TABLE 8-2. STOCK NUMBER IDENTIFICATION (cont)

REF. DESIG.	FEDERAL	STOCK NUMBERS STANDARD NAVY	SIGNAL CORPS	USAF	PARTS SUPPLIED
R38	5905-666-1081				
R39	5905-643-5407				1
R41	5905-279-2515				
R44	5905-190-8865				
R46	5905-192-0667				
R47	5905-279-2596				
R48	5905-279-2593				
R50	5905-171-1998				
R51	5905-239-0568				
R53	5905-256-8352				
R54	5905-644-7108				
R55	5905-539-3065				1
R56	5905-539-3064				1
R60	5905-185-8510				
R61	5905-239-0579				
R63	5905-101-7990				
R64	5905-299-1825				
R65	5905-296-7533				
R66	5905-299-1560				
R68	5905-195-6800				
R69	5905-185-8516				
S1	5930-L01-1076				
S2	5930-L01-1077				
S3	5930-239-0373				
S4	5930-L01-1078				1
T1	5950-645-4348				
T2	5950-645-4347				
T3	5950-645-4345				
T4	5950-645-4344				
T5	5950-645-5907				
T6	5950-645-4176				
T7	5950-645-4339				
T9	5950-645-4338				
T10	5950-645-5370				
T11	5950-645-5369				
T12	5950-645-5368				
T13	5950-645-5374				
T14	5950-645-5367				
T15	5950-645-5371				
T16	5950-645-5373				
T17	5950-645-4349				
T18	5950-645-4341				
T19	5950-645-4342				
T20	5950-645-4343				
T101	5950-L01-1410				
T101*	5950-L01-1567				1
TB2	5940-500-5745				
TB3	5940-500-5744				
V1	5960-188-3602				2
V2	5960-166-7646				1
V3	5960-188-6589				4
V7	5960-100-6026				1
V9	5960-188-0969				1
V10	5960-193-5145				1
V11	5960-100-7121				2

TABLE 8-2. STOCK NUMBER IDENTIFICATION (cont)

REF. DESIG.	FEDERAL	STOCK NUMBERS STANDARD NAVY	SIGNAL CORPS	USAF	PARTS SUPPLIED
V13	5960-100-7123				2
V15	5960-188-3565				1
XDS1	6250-669-6093				
XF1	5920-156-9233				
XR54	5935-259-3995				
XV1	5935-259-1944				
XV4	5935-257-6860				
XV10	5935-160-1365				
XV11	5935-259-3995				
Z1	5915-503-1911				1

TABLE 8-3. STOCK NUMBER CROSS REFERENCE

FEDERAL STOCK NO.	REFERENCE DESIGNATION	FEDERAL STOCK NO.	REFERENCE DESIGNATION	FEDERAL STOCK NO.	REFERENCE DESIGNATION
3010-L01-1404	O6	5910-101-5608	C137	5930-L01-1078	S4
3020-528-6866	O7	5910-101-5796	C73	5930-239-0373	S3
5325-290-1968	O19	5910-112-6986	C62	5935-160-1365	XV10
5325-641-3130	O18	5910-112-7451	C35	5935-192-4789	J1
5355-L01-1053	E4	5910-126-1613	C82	5935-257-6860	XV4
5355-519-7319	E7	5910-126-1619	C5	5935-259-1944	XV1
5355-667-5510	E2	5910-129-6115	A5	5935-259-3995	XV11
5355-668-1527	E6	5910-129-6116	A11	5940-500-5744	TB3
5355-668-2302	E8	5910-192-2242	C94	5940-500-5745	TB2
5355-668-2303	E3	5910-160-1159	C122	5940-665-4768	E24
5820-528-3868	O1	5910-170-4376	C127	5950-L01-1410	T101
5905-101-7990	R63	5910-190-8384	C51	5950-L01-1567	T101*
5905-107-5186	R7	5910-190-9412	C55	5950-538-6606	L13
5905-109-0213	R32	5910-192-2118	C66	5950-538-6607	L9
5905-114-2866	R18	5910-195-7572	C63	5950-538-6608	L11
5905-171-1986	R35	5910-197-1531	C8	5950-645-3068	L1
5905-171-1998	R50	5910-197-6734	C126	5950-645-3070	L2
5905-171-2004	R8	5910-250-0256	C76	5950-645-3071	L5
5905-185-8510	R60	5910-264-9448	C138	5950-645-4176	T6
5905-185-8516	R69	5910-281-0107	C68	5950-645-4338	T9
5905-190-8865	R44	5910-636-2101	C49	5950-645-4339	T7
5905-190-8885	R36	5910-636-2134	C140	5950-645-4341	T18
5905-192-0390	R1	5910-636-3764	C93	5950-645-4342	T19
5905-192-0660	R4	5910-642-6772	C39	5950-645-4343	T20
5905-192-0667	R46	5910-643-8605	C33	5950-645-4344	T4
5905-192-7243	R3	5910-643-8759	C6	5950-645-4345	T3
5905-195-6453	R13	5910-643-9283	C86	5950-645-4347	T2
5905-195-6761	R6	5910-643-9294	C91	5950-645-4348	T1
5905-195-6800	R68	5910-643-9295	C107	5950-645-4349	T17
5905-195-6806	R22	5910-643-9355	C95	5950-645-5367	T14
5905-195-9451	R27	5910-643-9390	C85	5950-645-5368	T12
5905-195-9457	R14	5910-643-9916	C60	5950-645-5369	T11
5905-239-0560	R31	5910-644-0727	C2	5950-645-5370	T10
5905-239-0568	R51	5910-644-3569	C72	5950-645-5371	T15
5905-239-0579	R61	5910-644-5921	C69	5950-645-5373	T16
5905-254-9201	R26	5910-644-7237	C56	5950-645-5374	T13
5905-256-8352	R53	5910-644-7240	C58	5950-645-5907	T5
5905-279-1880	R10	5910-644-7276	C74	5950-648-0759	L3
5905-279-1890	R2	5910-649-3710	C44	5950-648-0760	L4
5905-279-2515	R25	5910-665-4036	C99	5960-100-6026	V7
5905-279-2593	R48	5910-665-4230	C90	5960-100-7121	V11
5905-279-2596	R47	5910-666-0439	C54	5960-100-7123	V13
5905-279-3500	R5	5910-666-0440	C120	5960-166-7646	V2
5905-279-3497	R9	5910-666-0448	C53	5960-188-0969	V9
5905-279-3500	R30	5910-666-0449	C52	5960-188-3565	V15
5905-296-7533	R65	5910-666-5223	C37	5960-188-3602	V1
5905-299-1560	R66	5910-666-5455	C59	5960-188-6589	V3
5905-299-1825	R64	5910-666-6184	C41A	5960-193-5145	V10
5905-539-3064	R56	5910-666-6185	C41C	5960-262-0015	E11
5905-539-3065	R55	5910-666-6784	C11	5960-264-3004	E22
5905-643-5407	R39	5910-666-9145	C57	5960-272-9094	E13
5905-644-7108	R54	5910-667-6770	C40	5965-510-0524	LS1
5905-666-1081	R38	5910-667-6771	C42	5975-099-5747	H11
5910-101-0519	C92	5915-503-1911	Z1	5975-501-0469	H13
5910-101-0525	C61	5920-156-9233	XF1	6240-155-8706	DS1
5910-101-4864	C13	5920-280-4465	F1	6250-669-6093	XDS1
5910-101-4890	C142	5930-L01-1076	S1		
5910-101-5579	C65	5930-L01-1077	S2		

TABLE 8-4. LIST OF MANUFACTURERS

ABBREVIATION	PREFIX	NAME	ADDRESS
	CBZ	Allen-Bradley Co.	136 W. Greenfield Ave. Milwaukee 4, Wis.
ATLANTIC		Atlantic India Rubber Works, Inc.	571 Polk Street Chicago 7, Ill.
	CAGK	Amperite Co.	561 Broadway New York 12, N.Y.
AUTOMATIC		Automatic and Precision Mfg. Co.	252 Hawthorne Ave. Yonkers, N.Y.
	CFA	Bussmann Mfg. Co.	2528 W. University St. St. Louis 7, Mo.
	CMG	Cinch Mfg. Corp.	1026 S. Homan Ave. Chicago 24, Ill.
	CBN	Centralab Div. Globe-Union Inc.	914Y E. Keefe Ave. Milwaukee 1, Wis.
DALE		Dale Products Inc.	Box 136, Columbus, Nebr.
	CG	General Electric Co.	1 River Rd. Schenectady 5, N.Y.
GENERAL		General Electric Co., Lamp Div. Continental Sales District	Nela Park, Cleveland 12, Ohio
GRIGSBY		Grigsby-Allison Co., Inc.	407 N. Salem Ave. Arlington Heights, Ill.
	CHL	Hallicrafters Co., The	4401 W. Fifth Ave. Chicago 24, Ill.
	CHC	Hammarlund Mfg. Co.	460 W. 34th St. New York 1, N.Y.
	CJS	Jensen Mfg. Co.	6601 S. Laramie Ave. Chicago 38, Ill.
	CJC	Jones, Howard B. Div. Cinch Mfg. Corp.	1026 S. Homan Ave. Chicago 24, Ill.
	CEJ	Johnson, E.F. Co.	Waseca, Minn.
	CLF	Littelfuse Inc.	Des Plains, Ill.
	COM	Ohmite Mfg. Co.	3601 Howard St. Skokie, Ill.
WINCHESTER		Winchester Electronics	15 Crescent St. Glenbrook, Conn.
	CER	Erie Resistor Corp.	644 W. 12th St. Erie, Pa.