TM 11-878A

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RADIO RECEIVER R-96A/SR

DEPARTMENT OF THE ARMY • *JUNE 1950*

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United States Government Printing Office
Washington : 1950

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *2 June 1950*

TM 11–878A is published for the information and guidance of all concerned.
[AG 413.44 (31 Mar 50)]

BY ORDER OF THE SECRETARY OF THE ARMY:

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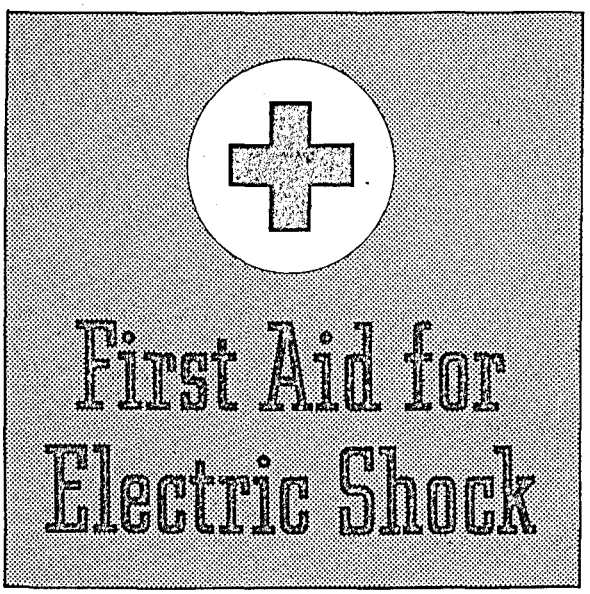
For explanation of distribution formula, see SR 310–90–1.

WARNING

Voltages used in the operation of
this equipment may give
a dangerous shock.

Damage to test equipment or to the
receiver may result if operating personnel
fail to observe safety precautions.

CONTENTS



RESCUE.

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire. Use extreme caution to avoid the resulting electric flash.

SYMPTOMS.

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breath center recovers after a while and normal breathing is resumed, provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT.

a. Start artificial respiration immediately. At the same time send for a medical officer, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only*, remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. If the method of transportation prohibits the use of the Shaeffer prone pressure method, other methods of resuscitation may be used. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth-to-mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing.

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be ever watchful to see that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such manner that:

(*1*) the operator's arms and thighs will be vertical while applying pressure on the small of the victim's back;

(*2*) the operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib;

(*3*) the heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim;

(*4*) the operator's elbows are straight and locked.

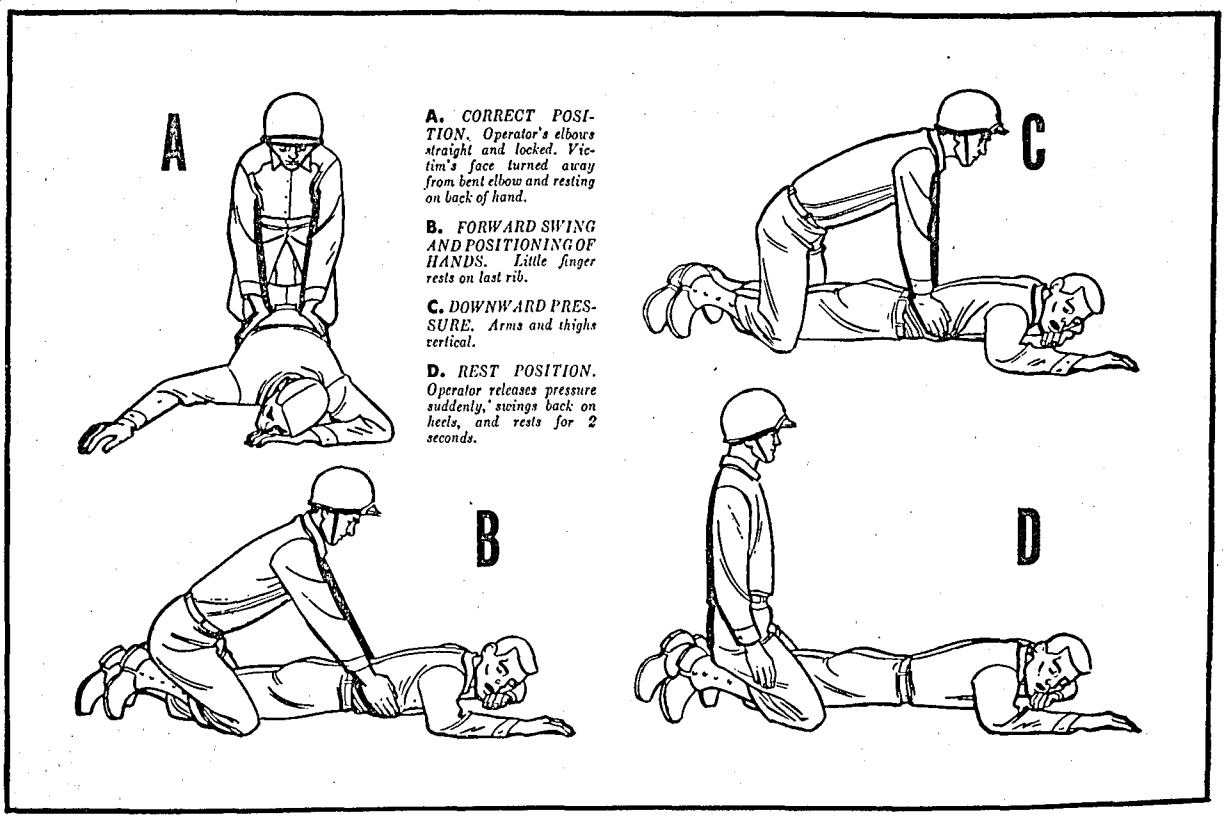
f. The resuscitation procedure is as follows:

(*1*) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(*2*) Swing back, suddenly releasing pressure, and sit on the heels.

(*3*) After 2 seconds rest, swing forward again, positioning the hands exactly as before, and apply pressure for another second.

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires 1 second. The release and backward swing require 1 second. The addition of the 2-second rest makes a total of 4



A. *CORRECT POSITION. Operator's elbows straight and locked. Victim's face turned away from bent elbow and resting on back of hand.*

B. *FORWARD SWING AND POSITIONING OF HANDS. Little finger rests on last rib.*

C. *DOWNWARD PRESSURE. Arms and thighs vertical.*

D. *REST POSITION. Operator releases pressure suddenly, swings back on heels, and rests for 2 seconds.*

seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, etc.

h. Artificial respiration should be continued until the victim regains normal breathing or is pronounced dead by a medical officer. Since it may be necessary to continue resuscitation for several hours, relief operators should be used if available.

RELIEVING OPERATOR.

The relief operator kneels beside the operator and follows him through several complete cycles. When the relief operator is sure he has the correct rhythm, he places his hands on the operator's hands without applying pressure. This indicates that he is ready to take over. On the backward swing, the operator moves and the relief operator takes his position. The relieved operator follows through several complete cycles to be sure that the new operator has the correct rhythm. He remains alert to take over instantly if the new operator falters or hesitates on the cycle.

STIMULANTS.

a. If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostril for comfortable breathing. Be sure that the inhalant is not held any closer to the victim's nostrils, and then for only 1 or 2 seconds every minute.

b. After the victim has regained consciousness, he may be given hot coffee, hot tea, or a glass of water containing ½ teaspoon of aromatic spirits of ammonia. *Do not give any liquids to an unconscious victim.*

CAUTIONS.

a. After the victim revives, keep him LYING QUIETLY. Any injury a person may have received may cause a condition of shock. Shock is present if the victim is pale and has a cold sweat, his pulse is weak and rapid, and his breathing is short and gasping.

b. Keep the victim lying flat on his back, with his head lower than the rest of his body and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim must be watched carefully as he may suddenly stop breathing. *Never leave a resuscitated person alone until it is CERTAIN that he is fully conscious and breathing normally.*

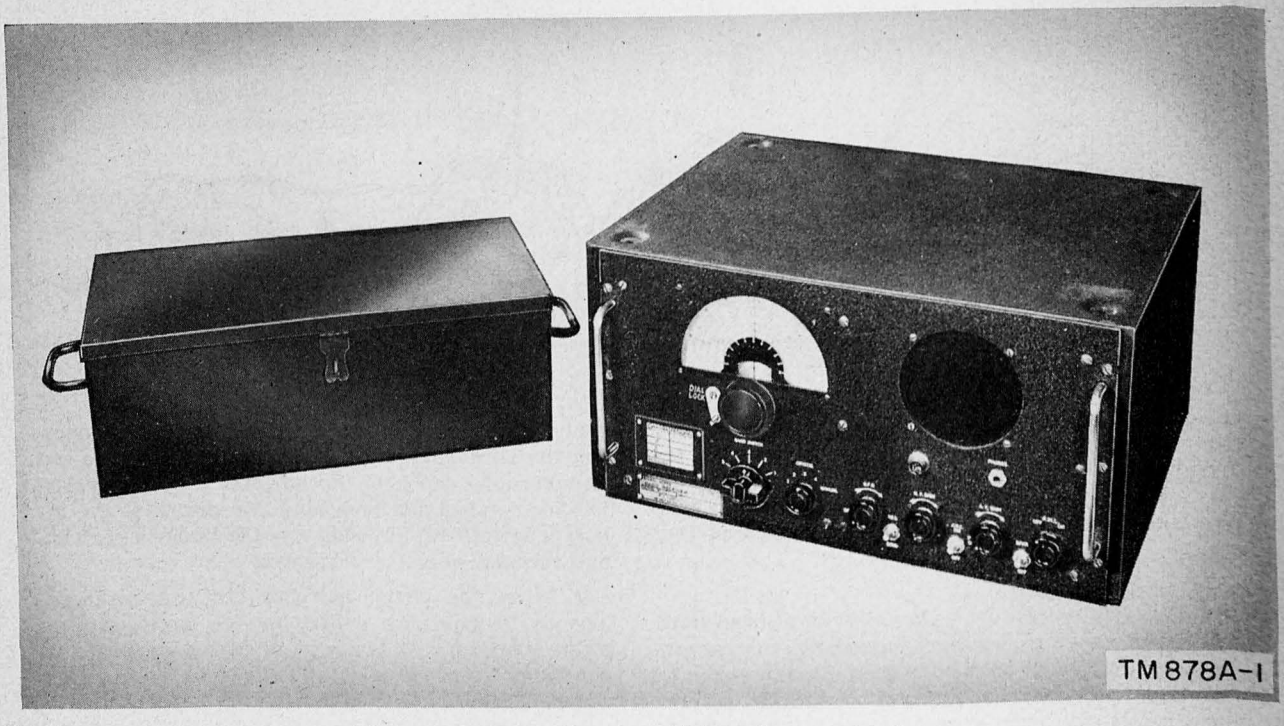


Figure 1. Radio Receiver R–96A/SR and spare parts box.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions for the installation, operation, maintenance, and repair of Radio Receiver R–96A/SR (figs. 1 and 2). In addition to these instructions, there are two appendixes covering a list of references and an identification table of parts.

b. This manual covers only Radio Receiver R–96A/SR. For the operation, maintenance, and repair of Radio Receiver R–96/SR, refer to TM 11–878.

2. Forms and Records

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

a. DD Form 6 (Report of Damaged or Improper Shipment) will be filled out and forwarded as prescribed in SR 745–45–5.

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

c. Use other forms and records as authorized.

d. Make proper entries in the ship's radio room log as required by prevailing instructions and regulations.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Radio Receiver R–96A/SR (fig. 1) is an 11-tube superheterodyne receiver designed for marine use on harbor and seagoing vessels. The power supply is self-contained within the receiver, making the unit completely independent. The receiver is designed for satisfactory operation under the extreme conditions of temperature, humidity, and vibration, which are often encountered in marine service. It is specially treated to resist the attacks of fungi which may be encountered in tropical areas. An outside case (dust cover) is provided with each receiver so that it can be mounted on a desk or table.

b. The receiver is commonly used in conjunction with Radio Transmitter T–83/SR, but may be used separately if transmitter facilities are not required. Provisions are made for interconnection between the receiver and Radio Transmitter T–83/SR, so that both receiver and transmitter operation can be controlled from the press-to-talk switch on the microphone or handset. Radio Receiver R–96A/SR also may be used with transmitters other than Radio Transmitter T–83/SR.

c. The receiver operates in the frequency ranges of 135 to 510 kc (kilocycles) and 1 to 12 mc (megacycles) in five bands, manually tuned. In addition, it has four crystal-controlled channels in the 1,700-kc to 8,700-kc frequency range.

d. It will receive cw (continuous wave), icw (interrupted continuous wave), voice (phone), or tone (mcw (modulated continuous wave)). A bfo (beat-frequency oscillator) stage is incorporated for c-w reception. Either manual control or avc (automatic volume control) may be used on any of the above types of reception.

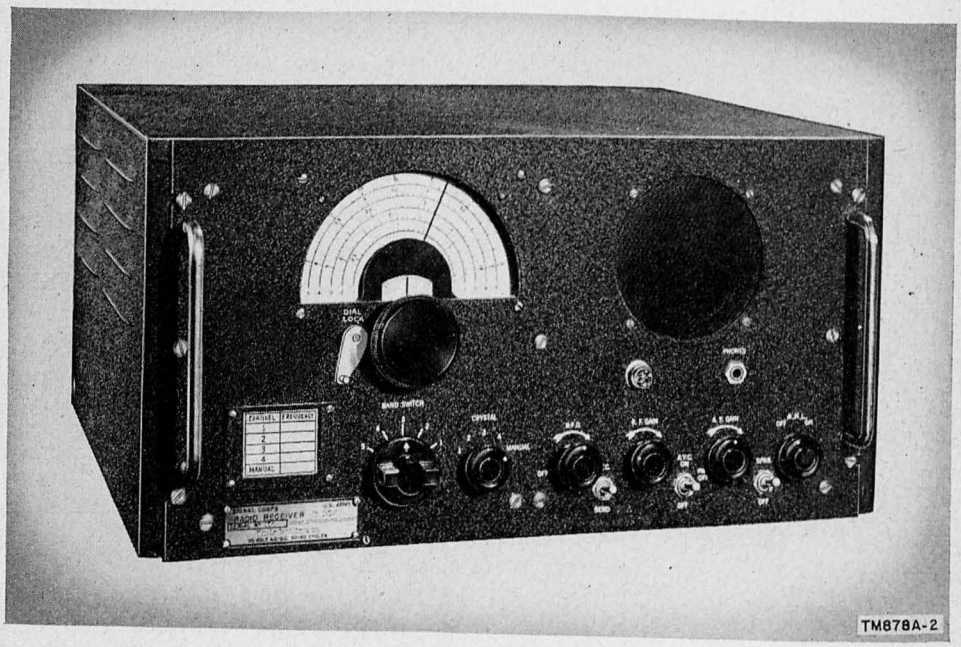


Figure 2. Radio Receiver R–96A/SR, front view.

4. Application

C-w and a-m (amplitude-modulated) signals of practically all radio frequencies normally used for marine communications are covered by this receiver. The outside case should remain on the receiver if it is to be used on shipboard. However, the cover is removed easily and the receiver can be mounted on a standard 19-inch rack panel, when the receiver is operated in shore stations. The cover should not be removed unless slightly more radiation than the minimum FCC (Federal Communications Commission) requirements is allowable. A send-receive switch (SW–4) allows convenient operation of an antenna switching relay which may be on the associated transmitter. The antenna leads between the relay and the receiver input terminals should be well shielded.

5. Technical Characteristics

Frequency range:	
Band 1	135 to 260 kc.
Band 2	260 to 510 kc.
Band 3	1.0 to 3.0 mc.
Band 4	3.0 to 6.0 mc.
Band 5	6.0 to 12.0 mc.
Crystal-controlled channels	Four in the frequency range of 1,700 kc to 8,700 kc.
Crystal type	Crystal Unit CR–18/U.
Receiver type	Superheterodyne.
Types of signals which can be received.	C-w, tone, and a-m voice.
Number of tubes	11.
I. f. (intermediate frequency).	550 kc.
Power input	115-volt, 50- to 60-cycle ac (alternating current), 100 watts. 115-volt dc (direct current), 100 watts.
Antenna	Single wire.
Weight	69.5 pounds.

6. Packaging Data

a. Description. Radio Receiver R–96A/SR is packed in a nailed wooden shipping container; the size is listed in *b* below. Running spare parts are packed in an additional metal container, which in turn is packed in the large wooden box containing the receiver. The receiver is packed for export shipment as shown in figure 6. Z-pads and a wooden cover plate surround the receiver along with six silica gel pads. These are packed in a corrugated fiberboard inner carton which is sealed. This carton then is placed in a moisture-vaporproof barrier, which in turn is sealed and placed in an outer fiberboard carton. The outer fiberboard carton is placed inside a waterproof barrier (bag) along with the spare parts carton. The bag then is placed inside a nailed wooden shipping container. All loose wires and cables are packed and secured against their respective units before packaging.

b. Export Packaging Data.

Item	Carton or box	Number of cartons	Outside dimensions (in.)	Volume (cu ft)	Gross weight (lb)
Radio Receiver R–96A/SR.	Inner carton.	1	22¼ x 21 x 10¾.	3. 52	-----
	Outer carton.	1	23¾ x 21¾ x 11½.	4. 39	-----
	Wooden carton.	1	33¾ x 23¾ x 11¾.	7. 64	-----
Spare parts box.	Metal box.	1	9¾ x 21½ x 11½.	1. 67	-----

7. Table of Components (fig. 1)

Component	Req No.	Height (in.)	Depth (in.)	Length (in.)	Volume (cu. ft)	Weight (lb)
Radio Receiver R–96A/SR	1	10	17½	20⅞	2. 11	69. 5
Spare parts box	1	11	8¼	21¼	1. 08	22. 19

8. Description of Radio Receiver R–96A/SR

a. Radio Receiver R–96A/SR is an 11-tube superheterodyne receiver designed to receive a-m and c-w signals in the frequency ranges of 135 to 510 kc and 1 to 12 mc to cover the operating frequencies of the standard marine bands, as well as many land-based and airborne transmitters. This is necessary to facilitate complete shipboard reception for all types of military operations. Four crystal-controlled channels also are provided in the 1,700 to 8,700 kc frequency range. A speaker is contained within the set and a phone jack is provided on the front panel for headset operation. An anl (automatic noise limiter) circuit assists in reception during pulse type noise interference. All operating controls are located on the front panel (fig. 2). The receiver is provided with a cabinet suitable for desk or shelf mounting. The cabinet is designed to support the weight of Radio Transmitter T–83/SR when it is used in conjunction with the receiver. If required for installation, the receiver may be removed from the cabinet and

mounted in a standard 19-inch relay rack. This should not be done on shipboard, as removing the set from its cabinet changes the radiation characteristics of the receiver. The receiver will not pass the specifications of the FCC if removed from its cabinet.

b. The receiver can be removed from the dust cover by removing six screw-head bolts. The bolts are located at the ends of the front panel in line with the two handles (fig. 2). After the bolts are unscrewed, grasp the handles and pull the chassis outward from the dust cover.

c. Access to the fuses, antenna and terminal strip connections, and power input connection can be made by removing the four Dzus fasteners which hold the rear access plate to the receiver. A rear view of the receiver with the access plate removed is shown in figure 3. The polarized power plug is located on the top of the chassis (fig. 10). A 1½-inch hole has been made on the right side (towards the rear) of the dust cover in order that the power line can be brought through the dust cover to the chassis. A 1½-inch hole is necessary to allow room for the power plug to pass through the dust cover.

9. Running Spares and Included Parts

a. A group of spare parts, packed within a spare parts chest, is included with each radio receiver. Spares are provided for all normally expendable items such as tubes, fuses, pilot lamps, etc. Following is a list of these running spares:

Description	*Quantity*
Tube JAN-6SA7	2
Tube JAN-6SJ7	4
Tube JAN-6H6GT	2
Tube JAN-6SQ7GT	2
Tube JAN-6SK7	8
Tube JAN-25L6GT	2
Tube JAN-25Z6GT	2
Lamp, neon, General Electric NE-51	2
Lamp, Mazda #47	2
Fuse FU-50	10

b. The following parts included with the radio receiver are not expendable:

Description	*Quantity*
Headset H-16/U	2
Cord CD-307 (headset extension cord)	2
Cord, power	1

10. Additional Equipment Required

No additional equipment is required for the operation of this receiver as a single unit, assuming proper power supply leads and antenna connections are available. If the receiver is used in conjunction with Radio Transmitter T-83/SR, a special connecting cable must be used. This cable (fig. 4) is supplied with the transmitter.

11. Differences in Models

Radio Receiver R-96A/SR is similar to Radio Receiver R-96/SR. However, Radio Receiver R-96A/SR has been made largely with JAN components and has other minor differences. For data on Radio Receiver R-96/SR, see TM 11-878.

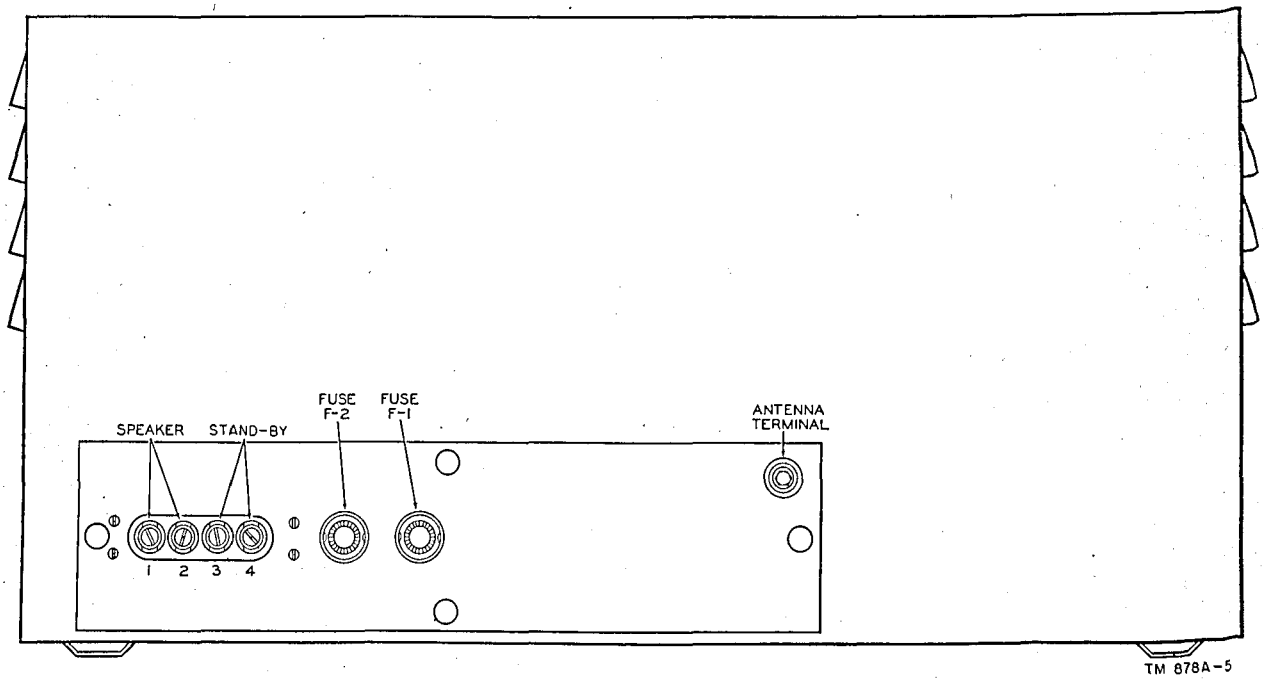


Figure 3. Radio Receiver R-96A/SR, rear view.

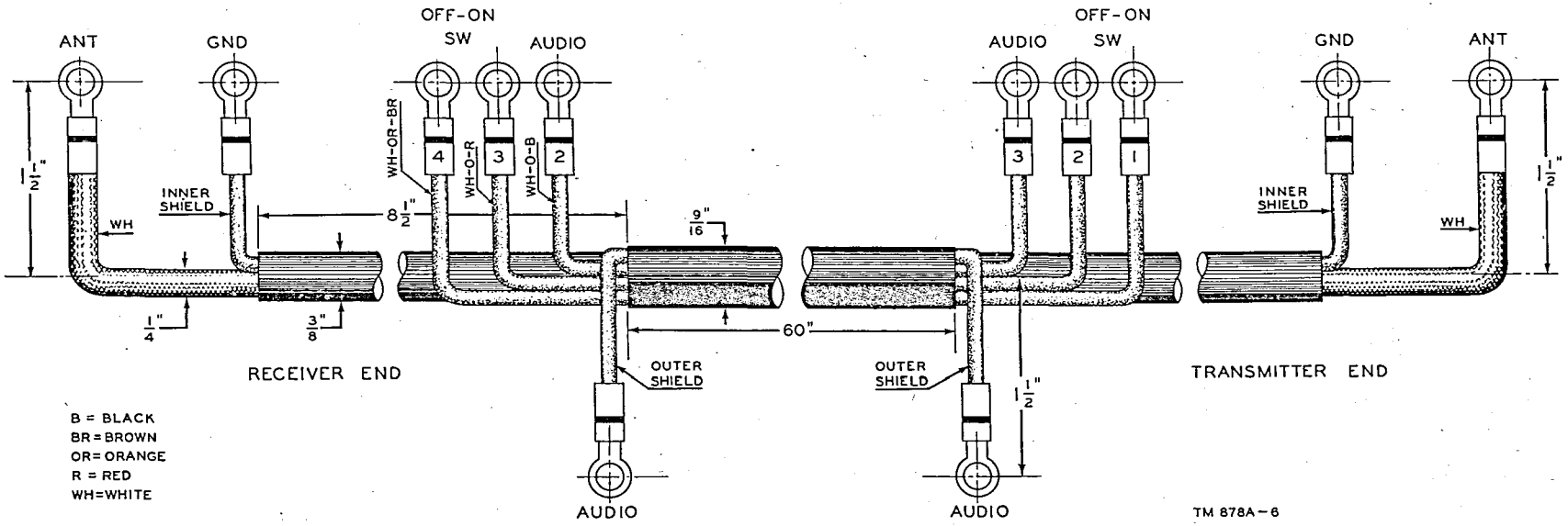


Figure 4. Interconnection cable used with Radio Receiver R-96 A/SR and Radio Transmitter T-83/SR.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. INSTALLATION OF RADIO RECEIVER R–96A/SR

12. Siting

a. Since Radio Receiver R–96A/SR is mounted on shipboard for marine use, there generally is not much choice as to the best siting location. In most cases, the antenna already has been installed on the ship or landing boat, and the radio location has been predetermined.

b. In the event this receiver is to be installed on a ship that has no predetermined antenna location, the antenna should be located as high above the deck of the ship as possible. Figure 5 shows a method of installation that is often used.

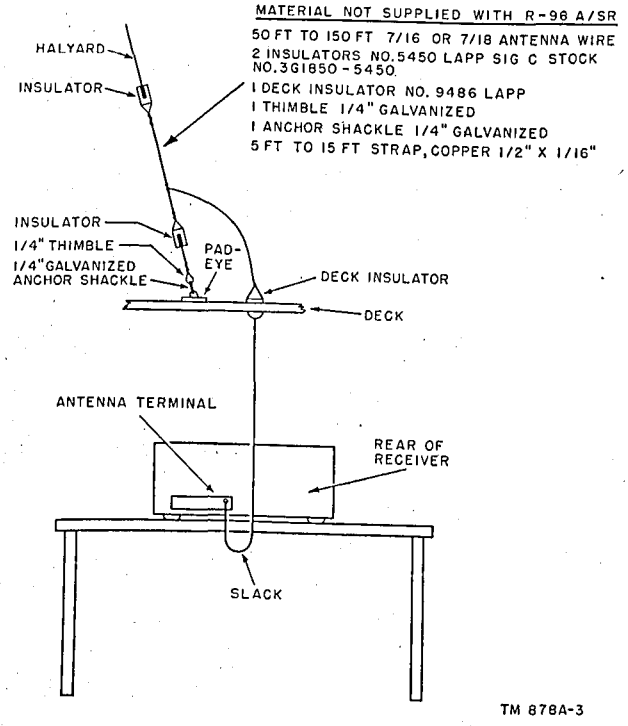


Figure 5. A method of installing a ship antenna.

c. If the receiver location has not been predetermined, it should be as far as possible from any electrical interference, such as the ship's motors. An operating position should be chosen which will have an approximately even temperature and low humidity.

13. Uncrating, Unpacking, and Checking New Equipment

Caution: This radio receiver and the spare parts may be easily damaged during the unpacking process. Be extremely careful not to drop or damage the units. Avoid thrusting pinch bars or any other unpacking tools, such as a screw driver, into the interior of any fiberboard shipping container. Do not unpack in a location where dust, dirt, or excessive moisture may affect the equipment. Follow closely the unpacking instructions given below. Figure 6 illustrates the packaging of Radio Receiver R–96A/SR and its spare parts box.

a. UNPACKING.

(1) Cut the metal straps surrounding the wooden box. The best method of cutting metal straps is to use a heavy pair of side cutters or to twist or bend the strap until it crystallizes and breaks.

(2) Using a nail puller, remove the nails in the top of the wooden shipping container. Remove the nails in the four wooden edge strips that hold the cover to the sides. Remove the top cover.

(3) Remove the excelsior or wadding from the top of the waterproof barrier.

(4) Lift out the waterproof bag containing the radio receiver and spare parts box.

(5) Slit the waterproof bag and remove the spare parts box and the outer carton containing the receiver.

(6) Slit the seams of the fiberboard carton and open the flaps.

(7) Lift the inner vaporproof bag and slit it open.

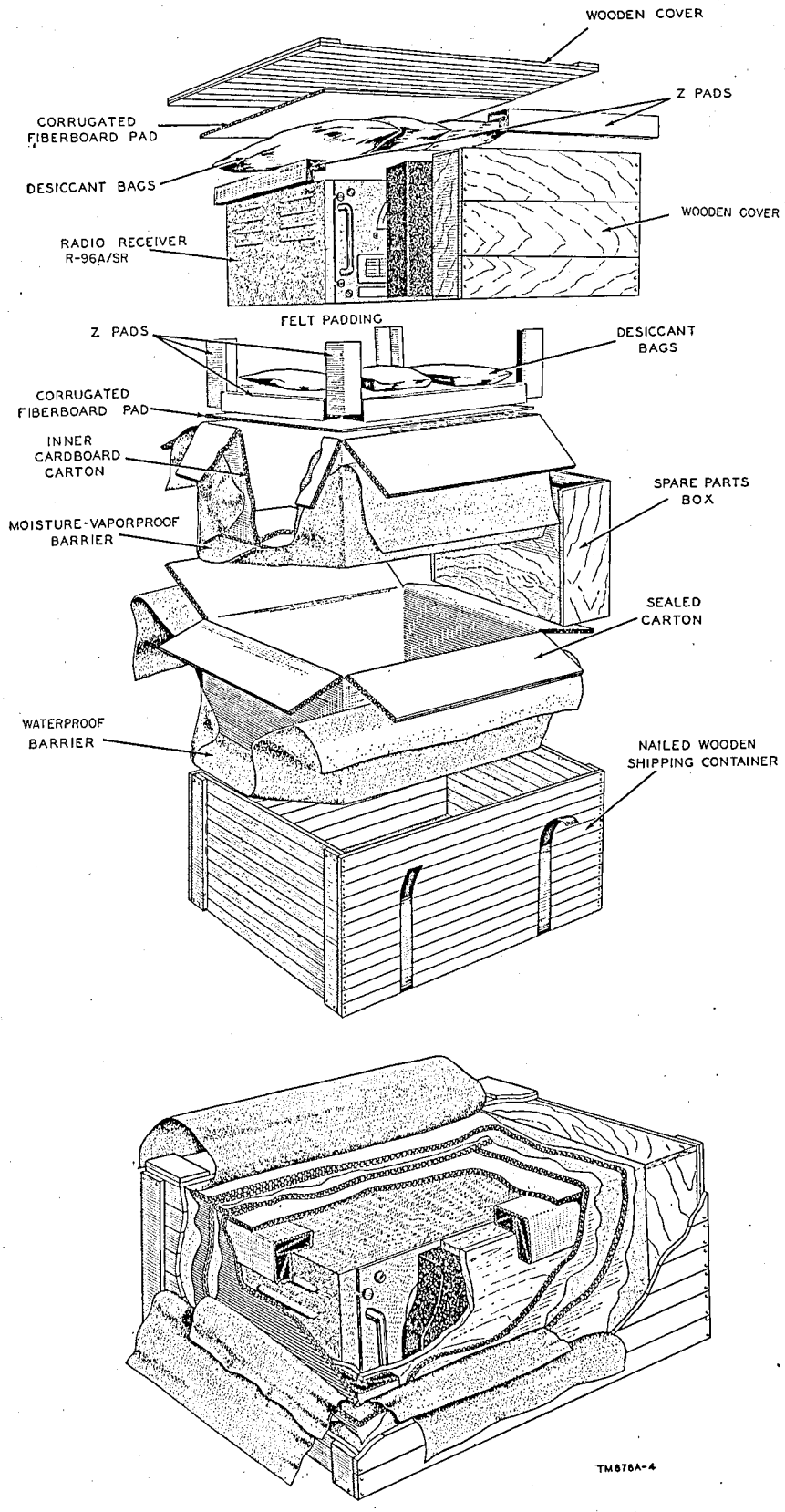


Figure 6. Packaging and packing Radio Receiver R-96A/SR.

(8) Remove the inner fiberboard carton, slit the seams, and open the flaps.
(9) Remove the Z-pads and the dehydrating agent contained in the bags.
(10) Remove the receiver from the fiberboard carton.
(11) Break the bands surrounding the unit that hold the plywood protection board over the face of the unit.
(12) Remove the plywood protection board.
(13) The unit now is unpacked and ready for installation.
(14) Save all of the packaging material except the bags of dehydrating agent. Store all of the cartons in order in the wooden shipping container.

b. CHECKING. After unpacking the equipment, thoroughly check it for damage that may have occurred during shipment. Compare the packing slip with the unpacked equipment.

c. REPACKING. If it is necessary to repack the equipment, repack it in the reverse order of unpacking (*a* above).

14. Installation of Receiver

Radio Receiver R–96A/SR is designed primarily for marine use and shipboard installation. It should be installed at a point as far from salt water spray and moisture as possible. However, it must be installed in a convenient place from the operational standpoint, and leads between it and the power supply, ground, antenna, or other connecting units should be kept to a minimum. All tubes are shipped in their sockets; therefore, it is necessary only to check each one to see that it is firmly located in its socket. Figure 7 shows the location of each tube on the chassis. Check to see that each tube is in its proper location.

a. When not used in conjunction with any other unit, the receiver can be mounted on top of a desk or operation table or in a rack. When it is to be mounted on a table or desk, the dust cover is used. Remove the receiver from the dust cover (par. 8*b*) and carefully set it aside. Place the dust cover in the desired location, and mark on top of the desk the location of the four leg projections in each

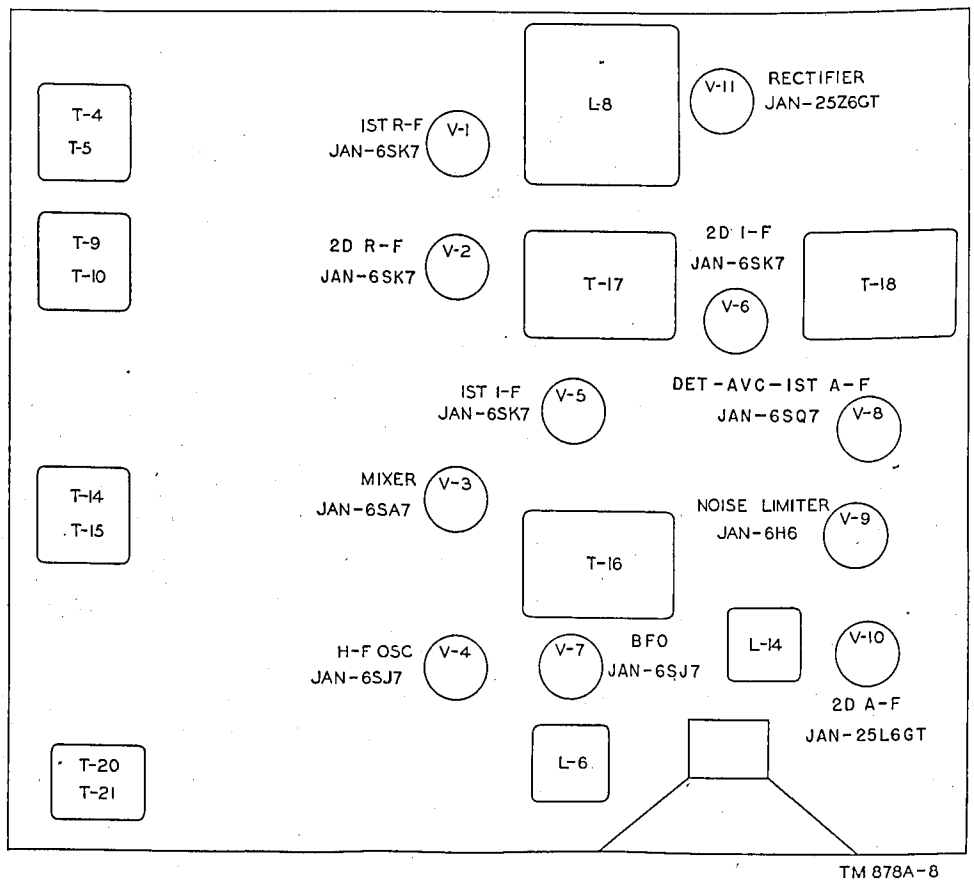


Figure 7. Radio Receiver R–96A/SR, tube location chart.

corner of the cover. These projections have holes in them so that the desk or table top can be marked easily by pencil from the inside of the cover. If the table or desk top is metal, drill holes through the top and firmly bolt the dust cover to it. If the desk or table top is wood, attach the dust cover to it with wood screws. After the cover has been secured, replace the receiver in it. It is essential that the receiver be mounted firmly on the desk to prevent it from moving about and being damaged in the event that the ship pitches or rolls in heavy seas. The antenna may be connected as shown in figure 5.

b. When the receiver is used in conjunction with Radio Transmitter T–83/SR, the transmitter is mounted on top of the radio receiver. The receiver dust cover is designed to carry this weight. Bulkhead mounting brackets, bolts, nuts, and lockwashers are included in the spare parts box of the transmitter. Parts also are available from this source for securing the transmitter to the receiver. No shock mounting brackets are necessary for either the transmitter or the receiver.

c. For rack mounting, Radio Receiver R–96A/SR (with dust cover removed) is designed to fit a standard 19-inch rack. The six bolts which hold the receiver to the dust cover can be used for mounting the receiver on the rack. The receiver should not be removed from its cabinet if the radiation characteristic is important.

15. Connections and Interconnections

Radio Receiver R–96A/SR may be used as an individual receiver, or it may be used in conjunction with Radio Transmitter T–83/SR. In either case, it is necessary to remove the terminal strip cover plate on the rear of the receiver. The plate is fastened to the receiver by four Dzus fasteners. These fasteners can be removed by turning them one-half turn in a counterclockwise direction with an ordinary screw driver of adequate size. When the cover plate is removed, access to the terminal strip, the antenna binding post, and the power plug is accomplished (fig. 3).

a. It is possible to connect the power plug without removing the chassis from the dust cover. This is done by inserting the female socket end of the power cord in the hole provided on the left (looking at the receiver from the rear) side of the receiver. Insert the plug through the dust cover. It now can be grasped through the terminal opening in the rear and connected to the male socket located in the top of the chassis. See figure 10 for the location of the power socket.

b. When the receiver is used as an individual unit and not in conjunction with the transmitter, connect the antenna wire to the antenna binding post located at the rear of the receiver inside the terminal cover plate. The ground wire should be connected to a suitable grounding point, such as a pipe or ground terminal on board the ship.

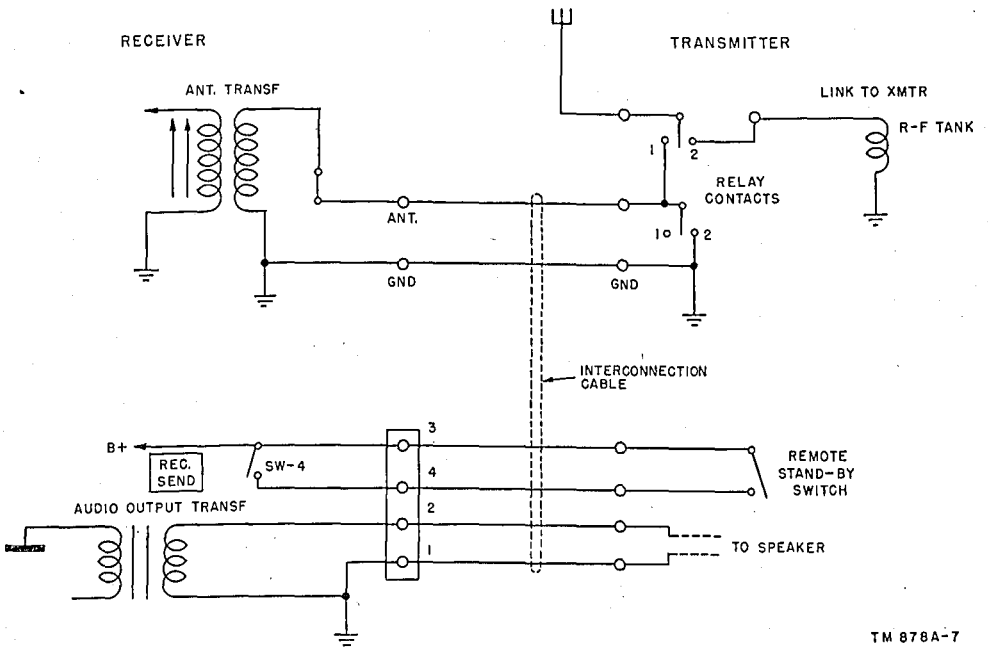


Figure 8. Interconnections between Radio Receiver R–96 A/SR and Radio Transmitter T–83/SR, schematic diagram.

c. When the receiver is used in conjunction with Radio Transmitter T–83/SR, an interconnecting cable between the two units, as shown in figures 4 and 8, must be used. This cable is supplied with the transmitter as a part of the spare parts components. It is connected between the receiver and transmitter and grounds the receiver input when the transmitter is in operation. It also allows sidetone operation of the transmitter and provides connections for the use of a remote speaker. Figure 8 is a schematic diagram that illustrates the interconnections between the two units. The cable connections to the receiver are indicated in figures 4 and 8. Make sure that all cable connections are secured firmly to the terminal board and the antenna binding post.

16. Service upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 13 for uncrating, unpacking, and checking equipment.

b. Check the used or reconditioned equipment for tags or other indications that pertain to changes in the equipment. If practical, it is preferable to have a new receiver for comparison while this check is being made. If any changes in wiring have been made, note them on the schematic diagram in this manual. Do not change or mutilate the schematic diagram; this would cause confusion if the schematic should be used with a receiver which had not been changed. Under FCC rulings, no changes are allowed in receivers intended for shipboard use.

Section II. CONTROLS AND TERMINALS

17. Front Panel Controls (figs. 2 and 9)

Control	Function
BAND SWITCH (SW–1)	Selects the band in which the desired frequency is located, as follows: Position 1. 0.135 to 0.260 mc. Position 2. 0.260 to 0.510 mc. Position 3. 1.0 to 3.0 mc. Position 4. 3.0 to 6.0 mc. Position 5. 6.0 to 12.0 mc.
Tuning control and dial	Selects the desired frequency in the band being used.
DIAL LOCK	Can be used to prevent the frequency from shifting as a result of vibration after the tuning control has been set.
CRYSTAL-MANUAL switch (SW–2)	Selects any one of the four crystal-controlled channels (in the 1.7- to 8.7-mc range) or the MANUAL tuning position. The proper crystal frequency is always 550 kc higher than the wanted signal frequency.
B. F. O.-OFF switch and control (SW–5 and R–20).	In the extreme counterclockwise position, turns the bfo off. When the bfo is on, this switch also regulates the amount of bfo voltage injection, making possible the selection of an optimum point when receiving a c-w signal.
R. F. GAIN control (R–10).	Varies the r-f (radio-frequency) sensitivity.
A. F. GAIN control and PWR. OFF switch (R–30 and SW–8).	In the extreme counterclockwise position, turns off both plate and filament voltages in the receiver. When on, regulates the volume of the speaker or headset.
A. N. L. OFF-ON switch (SW–7).	Turns the noise limiter off or on. The noise limiter is useful when interference due to gas ignition systems or other types of high noise peaks make normal reception difficult.
REG.-SEND switch (SW–4).	Is provided for use when the receiver is used with an associated transmitter. In the SEND position, makes the receiver inoperative but leaves the filaments on, so that the receiver is ready for instant use. It also operates the transmitter control relay.
A. V. C. ON–OFF switch (SW–3).	Turns the avc circuit on or off.
SPKR.-OFF switch (SW–9).	Turns the speaker on or off.
PHONES jack (J–1)	Is provided to allow the use of a headset, if desired.

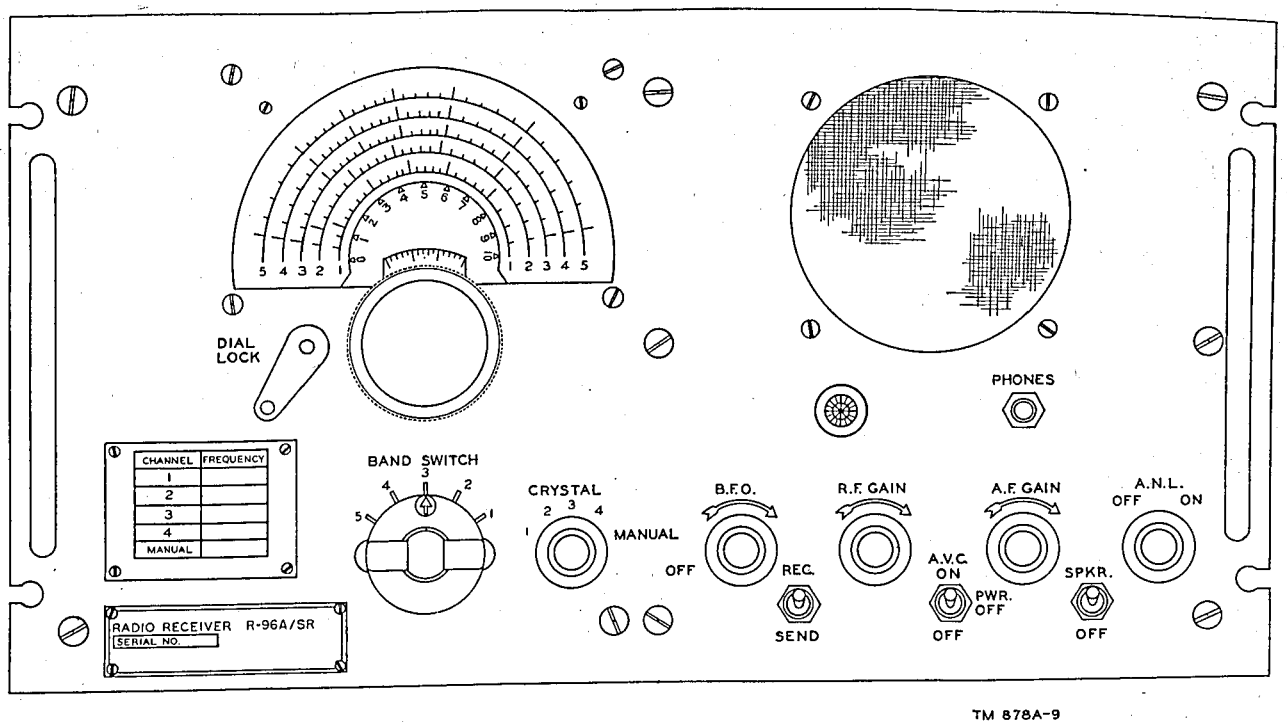


Figure 9. Radio Receiver R–96A/SR, front panel view.

18. Rear Terminal Connections (fig. 3)

Terminal	Function
1. (Ground)	Shield and audio return.
2. (Audio)	For external speaker or handset on associated transmitter.
3 and 4. (Stand-by)	Control leads to antenna relay on associated transmitter. Shorted on SEND position of switch SW–4.
Fuses F–1 and F–2	Main line fuses.
Antenna terminal	Connects antenna lead to first r-f transformer switch wafer SW–1A.

Section III. OPERATION UNDER USUAL CONDITIONS

19. Starting Procedure

a. PRELIMINARY. Set the front panel controls as follows:

Control	*Position*
B. F. O.-OFF	OFF.
R. F. GAIN	Maximum clockwise position.
A. F. GAIN-PWR. OFF	OFF.
A. N. L. OFF-ON	OFF.
REC.-SEND	REC.
A. V. C. ON-OFF	OFF.
SPKR.-OFF	SPKR. (on).

b. STARTING. Turn on the receiver by turning the A. F. GAIN-PWR. OFF control clockwise, advancing it to approximately midscale position. The pilot light will light and, after several seconds, noise or signals will be heard in the speaker. If the receiver does not operate, see paragraph 45 (equipment performance checklist).

20. Radiophone Reception

a. Set the BAND SWITCH to the band which covers the frequency of the signal to be received. Do this by rotating the band switch knob until the indicator points to the number corresponding to the desired band on the tuning dial (par. 17).

b. Unlock the dial by operating the DIAL LOCK lever.

c. Tune the receiver to the frequency desired in the selected band by rotating the tuning knob until the indicator shows the proper frequency on the calibrated dial.

d. If the desired signal is subject to objectionable fading, turn the A. V. C. ON-OFF switch to ON.

e. Turn the A. N. L. OFF-ON to ON if h-f (high-frequency) noise due to ignition interference, etc., is present.

f. If headset operation is desired, turn the SPKR.-OFF switch to OFF and insert the headset plug in the PHONES jack.

g. The receiver can be silenced by turning the REC.-SEND switch to SEND. This allows the receiver to be ready for instant service without having any noise present in the speaker or headset. Switching the REC.-SEND switch to the REC. position instantly places the receiver in operation.

h. When crystal operation of the h-f oscillator is desired, a crystal 550 kc higher than the desired signal frequency is inserted into any of the four jacks marked XTAL 1 through XTAL 4 (figs. 10 and 37). Up to four Crystal Units CR–18/U may be utilized in this receiver. Setting the CRYSTAL-MANUAL switch (SW–2) to the corresponding position on the front panel (CRYSTAL–1, 2, 3, or 4) will cause the h-f oscillator to operate at the crystal frequency. The signal frequency must be recorded on the channel chart. Crystal operation may be used for c-w reception.

21. Code Reception

For reception of c-w signals, turn the B. F. O.-OFF switch clockwise to its ON position and adjust for satisfactory reception. The other controls serve the same function during code reception as they do for radiophone reception (par. 20).

22. Stopping Procedure

Turn the receiver off by rotating the A. F. GAIN-PWR. OFF control to its extreme counterclockwise position.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

23. General

a. The operation of Radio Receiver R–96A/SR may be difficult in regions where extreme cold, heat, humidity and moisture, and sand conditions prevail. In the following paragraphs, instructions are given on procedures for minimizing the effects of these unusual operating conditions.

b. The same checks should be made as are made in paragraphs 32 and 45.

24. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions follow:

a. Handle the equipment carefully.

b. Keep the equipment warm and dry. If the set is not in a heated inclosure, construct an insulated box for the set. Keep resistor heaters (if supplied) turned on, provided this does not overtax the power source. If this method is impractical, turn A. F. GAIN-PWR. OFF clockwise until SW–8 closes (clicks). Keep the filaments of vacuum tubes lighted constantly by leaving the REC.-SEND switch in the SEND position when the equipment is not in operation, also provided this does not overtax the power source. The latter method is disadvantageous, since tube life will be shortened.

c. Wear a knitted woolen cap over the earpieces when operating in the open air with headsets that do not have rubber earpieces. Frequently, when headsets without rubber earpieces are worn, the edges of the ears may freeze without the operator being conscious of it. Never flex rubber earcaps, because this may render them useless. If water gets into the headset receiver, or if moisture condenses within it, the water may freeze and impede the actuation of the diaphragm. When this happens, remove the bakelite cap and remove the ice and moisture from the receiver.

d. When equipment which has been exposed to the cold is brought into a warm room, it will start to sweat and will continue to do so until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly. This condition also arises when equipment warms up during the day after exposure during a cold night.

25. Operation in Tropical Climates

When it is necessary to operate this receiver in tropical climates, where excessive heat can cause equipment failure, special care is required insofar as placement is concerned. The receiver should always be kept in an inclosure where the direct rays of the sun do not reach it. Power lines should not be run along the deck. If it is absolutely necessary to have the receiver in the open, extreme care must be observed to prevent the operator from burning himself on the metal case. When land-based and operated in tropical climates, radio equipment may be installed in tents, huts, or, when necessary, in underground dugouts. When installed below ground and frequently when set up in swampy areas, moisture conditions are more acute than normal in the tropics. Ventilation usually is very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the ambient air temperature. To minimize this action, place lighted electric bulbs in the cabinet. If the set is rack mounted, place the bulbs under the equipment.

26. Operation in Desert Climates

This receiver is not likely to be operated under desert conditions, because it is a marine receiver. In the event that it is, however, observe the following precautions.

a. Conditions similar to those encountered in tropical climates often prevail in desert areas. Use the same measures to insure proper operation of the equipment.

b. The main problem which arises with equipment operation in desert areas is the large amount of sand or dust and dirt which enters the moving parts of the equipment, such as variable capacitors and dial drive mechanisms. The ideal preventive precaution is to house the equipment in a dustproof shelter. Since, however, such a building seldom is available and would require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors, cover the inside walls with heavy paper, and secure the side walls of tents with sand to prevent their flapping in the wind.

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

d. Take care to keep the equipment as free from dust as possible. Make frequent preventive maintenance checks (par. 32). Pay particular attention to the condition of the lubrication of the equipment. Excessive amounts of dust, sand, or dirt that come into contact with oil and grease result in grit, which will damage the equipment.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND MATERIALS

27. Tools and Materials Issued for Use With Radio Receiver R–96A/SR

No tools or materials for maintenance purposes are supplied with the radio receiver. However, each ship's radio operator may draw maintenance materials, such as cleaning cloth, carbon tetrachloride, etc., from ship's supply. A marine operators tool kit, for minor repair and maintenance purposes, may be issued at the Port of Embarkation Signal Supply Shop. Ordinarily, only plug-in items, such as tubes, are changed by the using organization.

28. Special Tools

Two special Allen wrenches are fastened to the receiver by clips (on the shield wall near tube V–5 and transformer T–17); they can be used when working on the dial drive assembly or when removing the knobs from their respective shafts. No other special tools are required to maintain Radio Receiver R–96A/SR.

Section II. PREVENTIVE MAINTENANCE SERVICES

29. Definition of Preventive Maintenance

PM (preventive maintenance) is work performed on equipment (usually when the equipment is not in use) to keep it in such good working order that break-downs and needless interruptions in service will be kept to a minimum. PM differs from trouble shooting and repair since its object is to prevent certain troubles from occurring. For further information on PM techniques, refer to TB SIG 178.

Note. Operations described in this section are organizational maintenance. See TM 38-650.

30. General Preventive Maintenance Techniques

a. Use No. 0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with Solvent, dry-cleaning (SD); then wipe the parts dry with a cloth.

Caution: Under no circumstances will gasoline be used for cleaning purposes.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them dry with a dry cloth.

c. If available, dry compressed air may be used at a line pressure not exceeding 60 pounds per square inch to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result.

d. For further information on PM techniques, refer to TB SIG 178.

31. Preventive Maintenance Checklists

The checklists which follow (par. 32) show the operator how to maintain the equipment so that trouble shooting and repair will be reduced to a minimum. They indicate what to check, when to check, how to check, and the precautions which should be taken before, during, and after checking the equipment. The checklists are, in most cases, self-explanatory; and the operations and techniques do not require lengthy explanations.

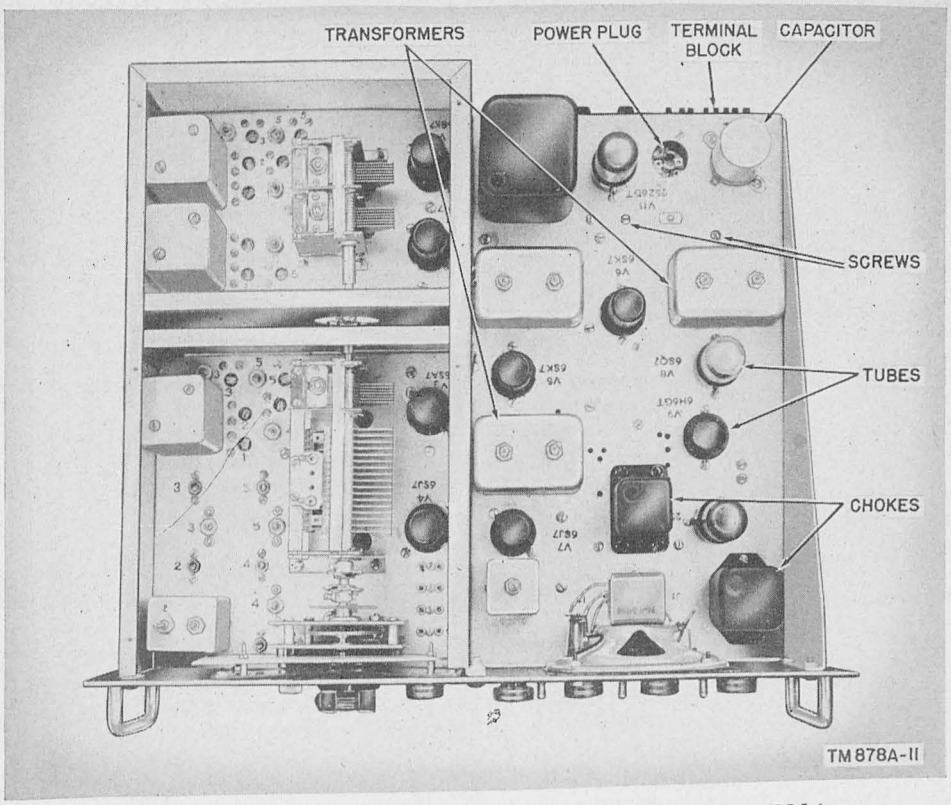


Figure 10. Radio Receiver R–96A/SR, top view showing typical PM items.

32. Preventive Maintenance Checklist for Radio Receiver R–96A/SR

a. EXTERIOR (fig. 2).

Item No.	What to check	When to check*	How to check	Precautions
1	Cabinet	W	Inspect inside and outside of cabinet. Check panel screws, pilot lamp, control knobs, and switches for loose mountings.	
		D	Check all connections.	
		D	Clean cabinet with a dry clean cloth.	
		W	Use compressed air to blow out accumulated dirt and dust. Repaint scratched, rusted, and chipped surfaces (par. 40).	
		W	Tighten loose mounting bolts, screws, knobs, and connections.	
2	Jack	W	Examine jack for loose mounting nut, dirty contacts, and improper spring tension. To remove dirt, use a brush and carbon tetrachloride. To remove corrosion, use crocus cloth and then a clean cloth. Increase spring tension, when necessary, and try the action of the jack after each adjustment. Keep soldered connections intact.	
3	Fuses	W	Inspect fuse caps for evidence of burning, charring, and corrosion; inspect fuse clips for accumulation of dirt and loss of tension.	

* D—daily; W—weekly; M—monthly.

Item No.	What to check	When to check*	How to check	Precautions
			Increase the tension of fuse clips (when necessary) by pressing sides closer together. Use pliers, if necessary. Clean fuse ends and clips with emery cloth. Wipe with clean cloth. Throw away all blown fuses.	
b. INTERIOR (figs. 10 and 11).				
1	Capacitors----	M	Inspect fixed capacitors for signs of discoloration, leaks, bulges, dirt, corrosion, loose mountings, and loose connections.	Turn all power off.
			Inspect plates of variable capacitors for dirt, dust, and lint. Examine the movable set of plates for signs of damage of misalinement that would cause them to touch the fixed plates during tuning.	
			Tighten loose terminals, mountings, and connections on capacitors, when necessary.	Be careful not to break the bushings or damage the gasket.
			Clean cases of fixed capacitors, insulated bushings, and dirty and corroded connections.	Dust, if present, may cause arcing.
			The cases and bushings usually can be cleaned with a dry cloth. If deposits of dirt are hard to remove, moisten cloth in solvent (SD).	
			Clean plates of variable capacitors with a small brush or pipe cleaner; remove all dust and lint. Lubricate as instructed in paragraph 34.	
2	Resistors.	M	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 extreme overheating. Inspect leads and all other connections for corrosion, dirt, dust, looseness, and broken strands in connecting wires. Check security of all mountings.	Do not attempt to move resistors with pigtail connections; the connections may break at the point where the wires enter the body of the resistor. Such defects cannot be repaired.
			Tighten resistor connections and mountings, if necessary--	If resistors remain loose, vibration may break the connections or damage the body.
			Clean carbon resistors with a small brush.	
			Wipe vitreous-enameled resistors with a dry cloth. Dampen cloth with solvent (SD) if deposits of dirt are unusually hard to remove. Resistors with discolored bodies cannot be cleaned. Discoloration may indicate trouble, probably circuit trouble due to overloading and overheating.	
3	Tubes and sockets.	M	Inspect glass and metal envelopes for accumulation of dirt and corrosion. Replace tubes which have loose envelopes. Inspect firmness of tubes in sockets when tubes are removed.	Be careful when removing tubes from their sockets. Never jar a warm tube.
			Clean tubes when necessary. Use a clean, lint-free, dry cloth to remove dust and dirt from glass and metal envelopes.	
			If sockets and contacts are accessible, use fine sandpaper to remove corrosion, oxidation, and dirt. Wipe off moisture with a clean dry cloth.	

*D—Daily; W—Weekly; M—Monthly.

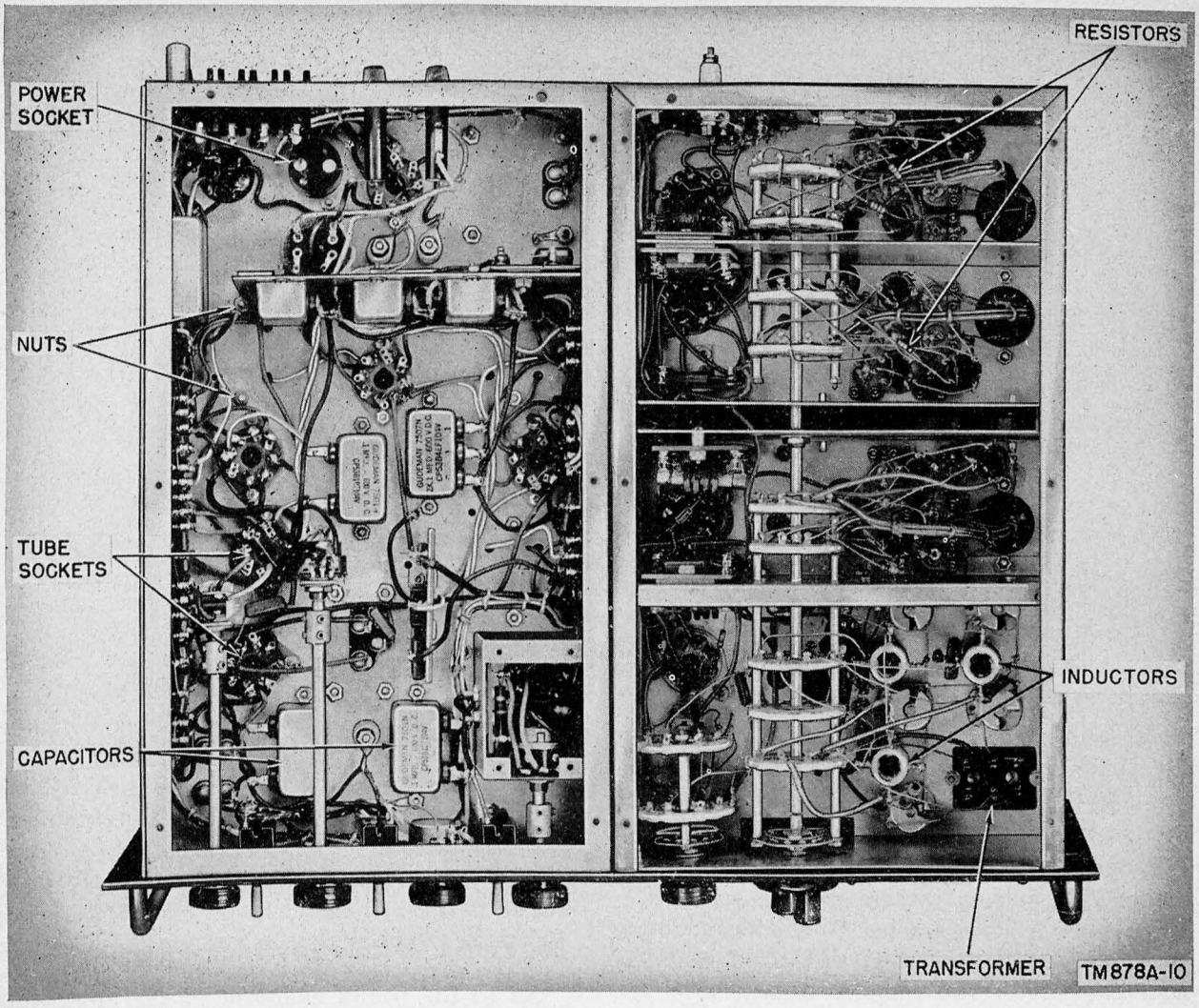


Figure 11. Radio Receiver R–96A/SR, bottom view showing typical PM items.

Section III. LUBRICATION

Note. A lubrication order has *not* been issued for Radio Receiver R–96A/SR.

33. Recommended Lubricants and Cleaner

Symbol	*Standard nomenclature*
PL-Special	Oil, lubricating, preservative, special.
GL	Grease, lubricating, special.
SD	Solvent, dry-cleaning.

34. Lubrication Instructions

a. The location of the points requiring lubrication and the type of lubricant to be used are shown in figures 12, 13, and 14. Lubrication is not required at any point not included in these illustrations. The recommended lubricants are suitable for all temperatures at which the receiver normally is operated.

b. Lubricate the equipment before storing it. Inspect and lubricate it again, if necessary, before putting it into operation after a period of storage. During a period of normal operation, lubricate the equipment at 3-month intervals. This time interval is based upon a normal usage of approximately 8 hours daily. Lengthen or shorten the interval according to actual operating conditions.

c. When lubricants are to be applied, use solvent (SD) to clean thoroughly the point to be lubricated and all other parts affected; dry with a lint-free cloth.

d. Apply all lubricants very sparingly. Use only 1 drop at each lubrication point when oil

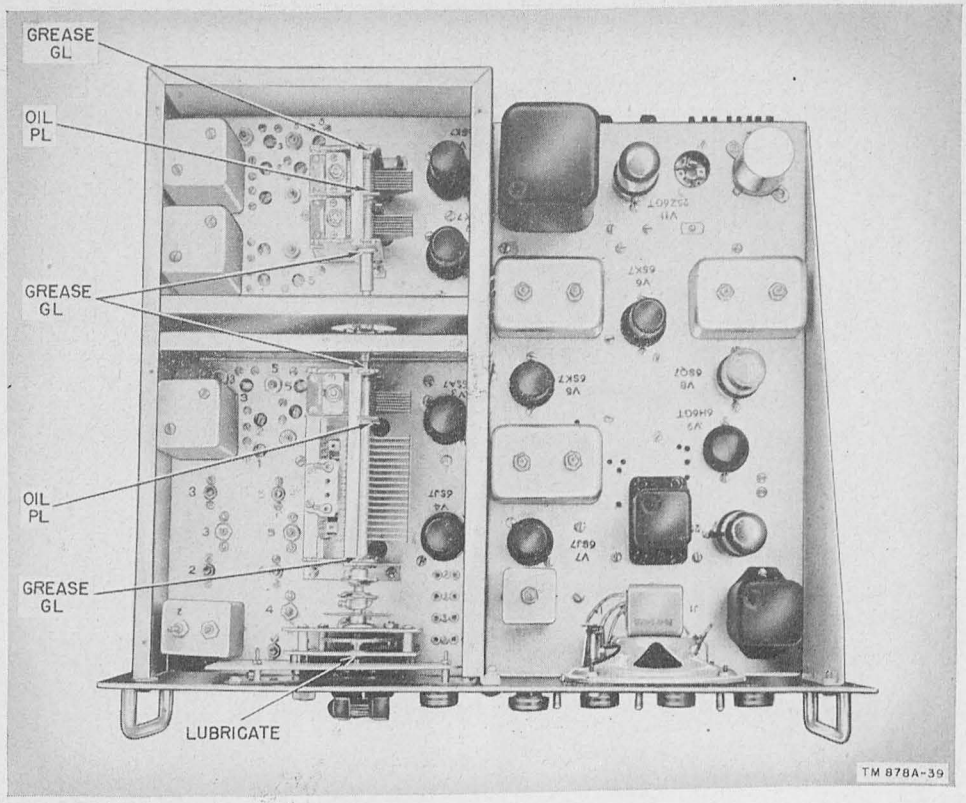


Figure 12. Lubrication of shafts, top view.

(PL-Special) is specified. Apply a thin coat of grease (GL) at points where grease is specified.

e. After the lubricant has been applied, rotate each affected control shaft (figs. 12 and 14) through at least two complete rotations to distribute the lubricant evenly.

f. Remove excess lubricant.

35. Cleaning and Lubricating Dial Drive

It is necessary to remove the chassis and front panel from the dust cover in order to lubricate the dial drive mechanism. The dial drive is located on the top of the r-f chassis. Clean the dial drive thoroughly with solvent (SD) before attempting relubrication. For location of the dial drive, see figure 12. After the dial drive gears have been thoroughly cleaned (fig. 13), lubricate them with grease (GL) and oil their shaft ends with oil (PL-Special).

36. Parts Lubricated by Manufacturer

All of the points indicated in the lubrication charts have been lubricated at the factory by the manufacturer.

37. Changes in Lubricants

This equipment requires no changes in lubricants because of climatic changes, unless specifically authorized by the field commander.

38. Lubrication Under Unusual Conditions

No special lubrication instructions ordinarily are necessary under unusual conditions; follow the procedure outlined in paragraphs 34 and 35.

Section IV. WEATHERPROOFING

39. Weatherproofing

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

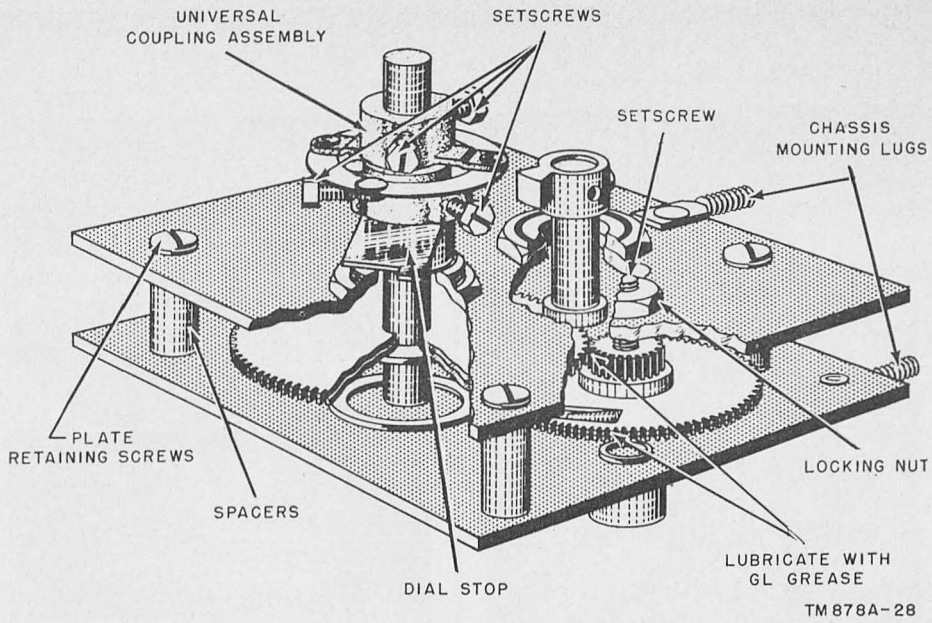


Figure 13. Radio Receiver R–96A/SR, lubrication of dial drive.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained fully in TB SIG 13 and TB SIG 72.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained fully in TB SIG 66.

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

e. Lubrication. The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69. Observe all precautions outlined in TB SIG 69 and pay strict attention to all applicable lubrication orders when operating equipment under conditions of extreme cold or heat. Refer to paragraphs 34, 35, and 38 for instructions.

40. Rustproofing and Painting

a. When the finish on the case has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use No. 00 or No. 000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

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

b. When a touch-up job is necessary, apply paint with a small brush. When numerous scars and scratches warrant complete repainting, remove the chassis and spray paint over the entire case. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations. See TM 9–2851.

Section V. TROUBLE SHOOTING ON ORGANIZATIONAL MAINTENANCE LEVEL

41. Scope

a. No matter how well equipment is designed and manufactured, faults occur in service. When such faults occur, the repairman must locate and correct them as rapidly as possible. The trouble shooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is necessarily limited in scope by the tools, test equipment, and replaceable parts issued and by the existing tactical situation.

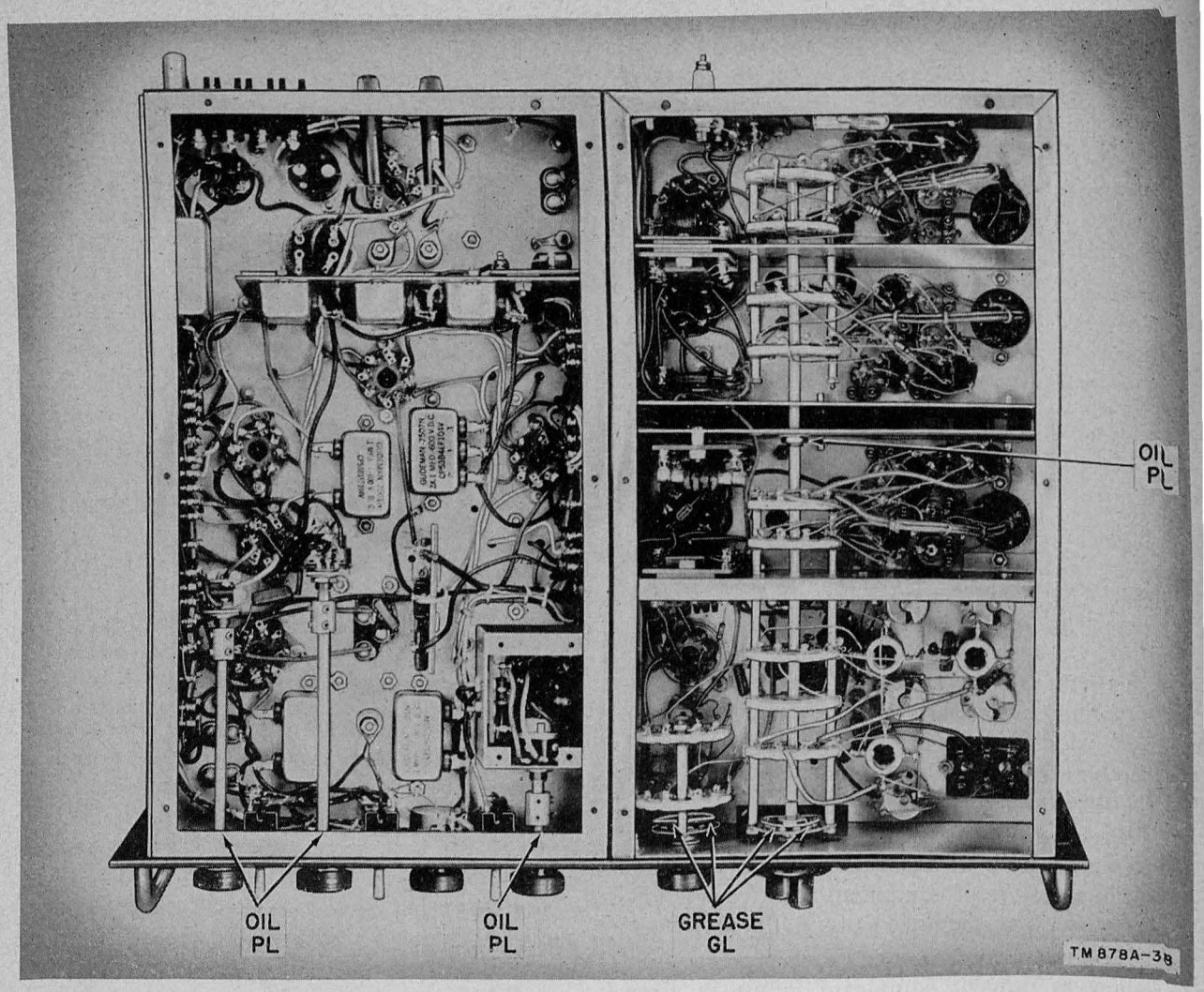


Figure 14. Lubrication of shafts, bottom view.

Accordingly, trouble shooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out tubes, cracked insulators, blown fuses, etc. (pars. 42 through 45). Tubes may be checked by substituting the spares, one at a time.

b. The following paragraphs in this section help in determining which of the components, such as a tube or a fuse, are at fault and in localizing the fault to the exact defective item.

42. Visual Inspection

a. Through visual inspection alone, the operator frequently may discover the source of trouble. Failure of this equipment to operate properly usually will be caused by one or more of the following faults:

(1) Improperly connected power cable.
(2) Worn, broken, or disconnected cords or plugs.
(3) Burned-out fuses.
(4) Bad receive-send or power switch.
(5) Wires broken because of excessive vibration. Broken connections to the tubes, sockets, plugs, and other components.
(6) Defective tubes.
(7) Inactive (dirty or cracked) crystal.
(8) Dirty band switch.
(9) Defective solder connections.

b. When failure is encountered and the cause is not immediately apparent, check as many of the above items as is practicable before starting a detailed examination of the component parts of the system. Check the following:

(1) Secureness of the power and control cables.

(2) Lighting of tube filaments. In some tubes the filaments cannot be seen. Check these types of tubes by carefully touching them to see if they are warm or hot.

Note. Tube filaments are series operated, hence, an open filament in one tube will prevent all others from lighting. Use an ohmmeter to test tube filaments for continuity in the absence of a tube checker.

(3) Examine for burned insulation, badly charred resistors, abnormal wax leakage, and discoloration of apparatus or wire due to extreme heat.

(4) Examine for bare wires touching the chassis or touching other bare wires.

Note. These symptoms may have been caused by a trouble previously repaired and serve only as a guide. In general, confine examination to parts readily visible with only the covers removed.

c. Visually inspect the antenna for obvious abnormalities. Check the insulators for salt deposits.

d. Be sure that the labels on the tubes in the various sockets correspond to the correct tube numbers for these positions as given in the manual (figs. 10 and 34). Replace or interchange any tubes which have the wrong numbers. Inspect for loose tube sockets or loose socket connections.

e. Inspect the fuses and check carefully for short circuits whenever a receiver with a blown fuse is found.

f. Inspect the dial assembly for bent gears or missing teeth. See that the dial works freely and that the tuning capacitor gang turns in conjunction with the dial drive assembly. Inspect for bent plates in the tuning capacitor gang. Use extreme care in straightening bent capacitor plates. If the tuning capacitor gang or dial assembly is corroded or bent beyond repair, replace it with a new unit.

g. Inspect the power socket and power cord. Replace missing parts, if possible; replace socket and cord if cord insulation is broken or socket prongs are broken.

h. Inspect for loose or missing screws. Replace missing screws with screws of the same size and thread. Tighten loose screws and nuts. *Do not mistake adjustment screws for securing screws.* The locations of alinement or adjustment screws can be found in figures 36 and 37.

43. Sectionalization and Localization of Trouble

The first step in servicing a defective radio set is to sectionalize the fault. Sectionalization means tracing the fault to the *major component or circuit* responsible for the abnormal operation of the set. The second step is to localize the fault. Localization means tracing the fault to the defective *part* responsible for the abnormal condition. Some faults such as burned-out resistors, r-f arcing, and shorted transformers can often be located by sight (par. 42), smell, and hearing. The majority of faults, however, must be localized by *checking voltage and resistance.*

a. Careful observation of the performance of the radio receiver on the various bands and while operating the various controls may sectionalize the fault to a particular stage or circuit. Paragraph 45, equipment performance checklist, shows normal operating indications. A voltage check may indicate whether or not the r-f and i-f stages are functioning.

b. Paragraphs 72 through 88 describe the method of localizing faults within the individual stages. These paragraphs are accompanied by a trouble-shooting chart which lists abnormal symptoms and their probable causes. The chart also gives the procedure for determining which of the probable locations of the fault is the exact one. In addition, there is a drawing (fig. 32) which shows the normal resistances and voltages at each socket pin connection.

c. Operate the radio set and observe its performance. See the equipment performance checklist (par. 45) for normal operating conditions.

d. If the entire radio set is dead, the trouble may be in the power source or the wiring between the power source and the set.

e. Check the fuses at an early stage in trouble shooting. Do not continue to burn out fuses before looking elsewhere to determine the basic source of the trouble.

f. If one receiver exhibits unsatisfactory performance, showing items such as excessive noise, howling, or weak signals, replace it with a good receiver. If the trouble disappears, the replaced receiver is defective. If the trouble persists, the trouble is not in the receiver but is either in the ship or is due to conditions external to the ship.

g. Remove the antenna from the antenna post. If the symptoms persist, the trouble is in the installation or the ship. If the removal of the antenna causes the symptoms to become less pro-

nounced or to disappear entirely, the trouble is in the antenna or is external to the ship.

44. Trouble Shooting by Using Equipment Performance Checklist

a. General. The equipment performance checklist (par. 45) will help the operator to determine whether the receiver is operating properly. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. *To use this list, follow the items given in numerical sequence.*

b. Action or Condition. For some items, the information given in the action or condition column consists of the setting of various switches and controls under which the item is to be checked For other items, it represents an action that must be taken to check the normal indication given in the normal indications column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator must apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator can make without turning in the equipment for major repairs. A reference in the table to chapter 6 indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is called for. If the set is completely inoperative and the recommended corrective measures do not yield results, trouble shooting is necessary. However, if the tactical situation requires that communication be maintained and if the set is not completely inoperative, the operator must maintain the set in operation as long as it is possible to do so.

e. Items 1 Through 11. Items 1 through 11 should be checked each time the equipment is put into operation.

f. Items 12 Through 22. The operator should familiarize himself with the operation of the equipment so that he knows the characteristics of its reception of normal signals. By becoming familiar with the operation of the receiver, the operator will know the normal position of the R. F. GAIN and A. F. GAIN controls. This will aid in an approximate determination of the sensitivity and amplification of the receiver.

g. Item 23. Item 23 is checked whenever the receiver is taken out of operation. Any abnormal indications at this time probably are caused by trouble in the set and should be corrected before the next expected period of operation.

45. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
P	1	Antenna.	Lead-in wire connected to antenna binding post.		
R					
E	2	Line cord.	Line cord inserted into chassis connector and into socket of 115-volt, 50- to 60-cycle a-c source or 115-volt d-c source.		
P					
A					
R	3	CRYSTAL MANUAL switch.	Set at MANUAL position.		
A					
T	4	B. F. O.-OFF switch.	Set fully counterclockwise to OFF position.		
O	5	R. F. GAIN control.	Set fully clockwise.		
	6	A. F. GAIN-PWR.	Set fully counterclockwise to		
R		OFF control.	PWR. OFF position.		
	7	A. N. L. OFF–ON	Set at OFF position.		
Y		switch.			
	8	REC.-SEND switch.	Set at REC. position.		
	9	A. V. C. ON-OFF switch.	Set at ON position		
	10	SPKR.-OFF switch.	Set at SPKR. (on) position		

	Item No.	Item	Action or condition	Normal indications	Corrective measures
START	11	A. F. GAIN-PWR. OFF control.	Turn clockwise until white dot on knob is approximately midscale.	Pilot lamp lights	Check screw-in fuses at rear of receiver. Check line cord.
				After several seconds, a rushing noise is heard in speaker or headset.	If rushing noise is heard and pilot lamp is not on, check pilot lamp. Check tubes.
EQUIPMENT PERFORMANCE	12	Tuning control	Set BAND SWITCH at any desired position. Tune across entire band by rotating main tuning control.	Signals heard in loudspeaker.	If signals are not obtained, or if they are weak, check antenna connection. Check tubes.
	13	BAND SWITCH	Check each of the tuning ranges. Use procedure given in item 12 above.		
	14	CRYSTAL - MANUAL switch.	Turn to MANUAL position	Signals should be heard at various frequencies on the dial.	Check oscillator tube V–4.
			Turn to CRYSTAL position	Signal should be heard at only one point on the dial when the dial is rotated to a frequency 550 kc below the crystal frequency.	
			Turn switch back to MANUAL.		
	15	B. F. O.-OFF control.	Turn control clockwise until white dot on knob is approximately midscale. Tune in a c-w carrier.	Beat-frequency audio signal is heard in loudspeaker.	Check bfo tube V–7.
			Vary the B. F. O.–OFF control setting.	Quality of bfo signal varies.	Check bfo tube V–7.
			After check, rotate B. F. O.-OFF control fully counterclockwise to OFF position.		
	16	R. F. GAIN control.	Tune in any station by rotating main tuning control. Then rotate R. F. GAIN control in either direction.	Strength of signal increases or decreases.	Refer to chapter 6.
	17	A. F. GAIN-PWR. OFF control.	Rotate control in either direction.	Strength of signal increases or decreases.	Refer to chapter 6.
	18	A. N. L. OFF–ON switch.	Turn switch to ON position.	Noise peaks, if present, are reduced in amplitude.	Refer to chapter 6.
	19	REC.-SEND switch.	Switch to SEND position. (When check is completed, return to REC. position.)	No sound is heard in speaker.	Refer to chapter 6.
	20	A. V. C. ON-OFF switch.	Switch to OFF position.	Strength of signal may increase. Fading is usually more apparent.	Refer to chapter 6.
	21	SPKR.-OFF switch	Switch to OFF position.	No sound is heard in speaker.	Refer to chapter 6.
	22	PHONES jack	Insert headset plug into PHONES jack. (Remove headset and return SPKR.-OFF switch to on (SPKR.) position.)	Signals are heard in headset.	Check headset cord and plug.
STOP	23	A. F. GAIN-PWR. OFF control.	Rotate control fully counterclockwise to PWR. OFF position.	Pilot lamp goes out. No noise or signals are heard in loudspeaker.	Check switch SW–8.

CHAPTER 4

AUXILIARY EQUIPMENT

46. Radio Transmitter T–83/SR

a. Radio Transmitter T–83/SR is a 50-watt telephone and telegraph marine radio transmitter. Either c-w or phone transmission is available on any of five preset channels in the frequency range between 1,700 and 8,700 kc. Three separate units house the entire transmitter installation (fig. 15). Provisions are made for remote control operation of the radio transmitter.

b. The transmitter is designed for operation from a 115-volt, 50- to 60-cycle a-c power source, and requires approximately 460 watts for radiotelephony or 390 watts for telegraphy. It usually is mounted on top of Radio Receiver R–96A/SR (par. 14).

47. Common Operation of Radio Receiver R–96A/SR and Radio Transmitter T–83/SR

a. A single antenna is used for both the receiver and transmitter. The antenna is connected to the antenna terminal on top of the transmitter. The interconnecting cable (fig. 4) is used between the receiver and transmitter. This cable is shipped with the transmitter. The cable has leads inside of it to bring the received audio signal to the handset receiver unit, to connect the transmitter antenna (switched by the switching relay inside of the transmitter) to the receiver, and to disable receiver reception and operate the antenna relay from the front panel of the receiver (by means of the REC.-SEND switch).

b. For further information on Radio Transmitter T–83/SR, refer to TM 11–837.

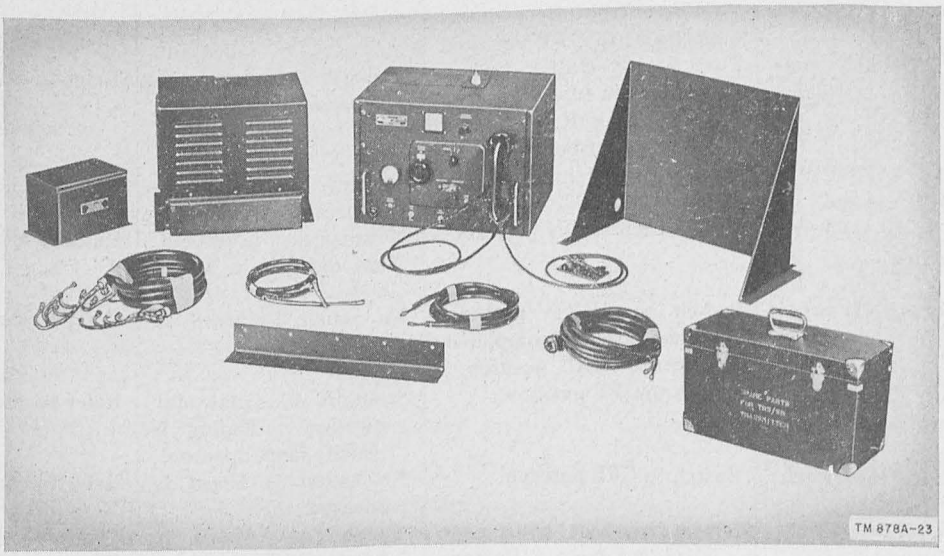


Figure 15. Components of Radio Transmitter T–83/SR.

CHAPTER 5

THEORY OF RADIO RECEIVER R-96A/SR

48. Introduction

a. It is an established fact that the more a repairman understands about a piece of equipment and how it functions, the more easily he will be able to locate and repair any trouble arising in it. This is especially true of highly complex equipment. It is for this reason that a section on the complete theory of the equipment is included in this manual. Trouble shooting, repair, and other maintenance data are included in subsequent chapters.

b. Radio Receiver R–96A/SR is of the superheterodyne type. It uses two stages of r-f and two stages of i-f amplification. It is capable of receiving and detecting a-m, c-w, mcw, and icw signals. The frequency ranges are from 135 to 510 kc and 1 to 12 mc. In addition, there are provisions for crystal control of the oscillator for four frequencies in the range from 1,700 to 8,700 kc.

Note. Information on the function of each component is given in the identification table of parts (app. II).

49. Block Diagram (fig. 16)

a. The signal from the antenna is coupled to the first r-f amplifier (V–1). After amplification in this stage, the signal is applied to the grid of the second r-f amplifier (V–2). These stages are designed to give not only signal amplification but also maximum off-channel selectivity and image rejection ratios. From V–2 (the second r-f amplifier), the signal goes into the mixer (V–3) grid, where it is combined with the r-f signals from the h-f oscillator, V–4. This oscillator is set to a frequency 550 kc higher than the signal received by the r-f stages. The combination of the selected incoming signal and that of the h-f oscillator produces the difference beat of the two signals (550 kc) in the output of the mixer. Since the i-f amplifier circuits are tuned to 550 kc, the selected signals are further amplified by the first and second i-f stages (V–5 and V–6).

b. After the second i-f stage, the amplified signal is sent to the diode detector (first half of V–8), where it is demodulated and fed into the first a-f (audio-frequency) amplifier (second half of V–8). From there the signal is coupled to the second a-f amplifier (V–10). Between the detector and first a-f amplifier, a noise limiter (V–9) may be switched into the circuit to reduce static pulses or other types of pulse-type electrical disturbance which might cause excessive noise in the headset or speaker. At the output of the second a-f amplifier, either a speaker or headset, or both, may be used to listen to the audio signals.

c. In order to accomplish avc action, a small amount of d-c voltage from the detector load is fed back to the grids of the r-f stages, the mixer stage, and the first i-f stage. This voltage varies the gain of those stages in inverse proportion to the signal strength of the incoming signal. Thus, when the incoming signal is strong, there is a greater voltage across the detector load, which, through avc action, biases the grids of the avc controlled tubes and reduces their amplification. When a weaker signal is received, there is less voltage on the avc controlled tubes, which allows them to further amplify the signal.

d. In order to hear the c-w signals, a beat-frequency oscillator (V–7) is used. It generates a signal that is combined with the incoming i-f signal in the second i-f stage (V-6), and these two combined signals then are detected, producing a beat note that is in the a-f range. This audio note is further amplified by the a-f amplifiers. The receiver operates from either 115 volts ac (50 to 60 cycles) or 115 volts dc by use of a half-wave rectifier (V–11). The chassis power line socket is polarized to aid in correct connection for d-c operation.

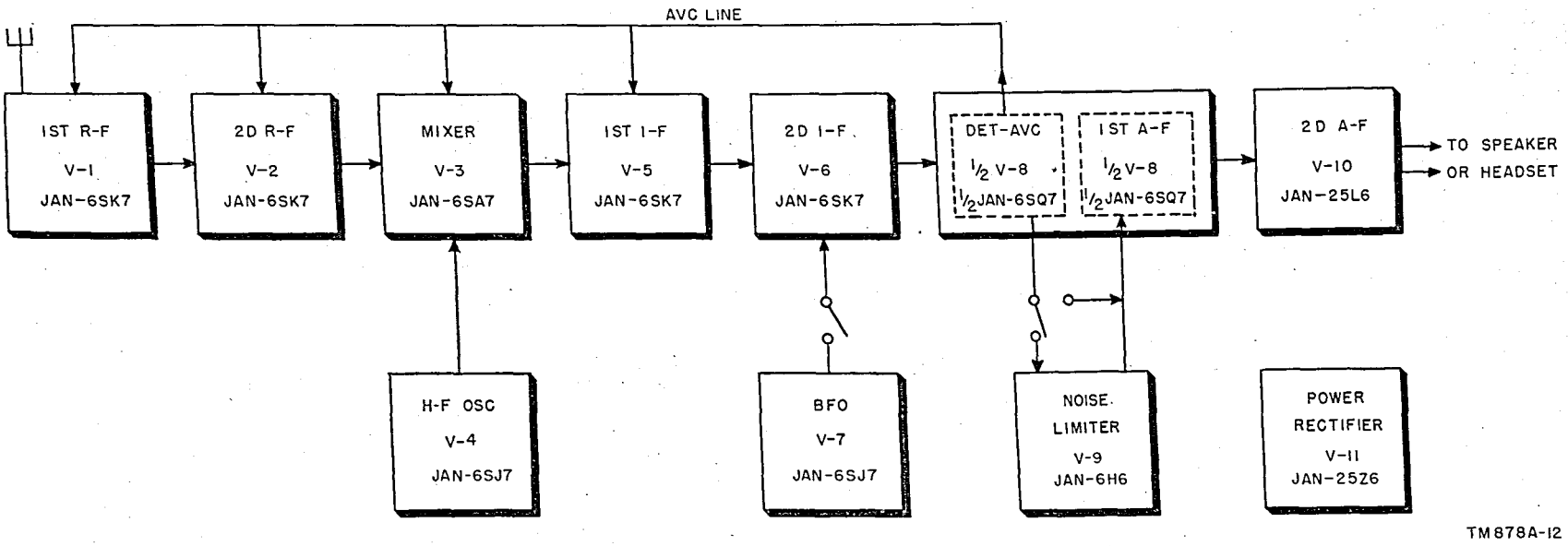


Figure 16. Radio Receiver R-93A/SR, block diagram.

50. R-f Amplifiers (figs. 17 and 40)

a. Since the r-f amplifiers are designed to cover well-separated frequencies, it is necessary to use a band switching arrangement. The BAND SWITCH is a nine-gang switch (SW–1) that switches to five positions; the band 5 position is shown in figure 17. To see all band switch positions, refer to the complete schematic diagram, figure 40. Note that the secondary of the input transformer of each r-f stage is tuned. At the input terminals of the antenna transformer (T–1), there is a neon bulb (E–2) which acts as a static drain to prevent damage to the antenna transformer. Neon tube E–2 grounds any excessive voltage which might appear on the antenna, due either to lightning flashes in the immediate vicinity or to excessive signal, by ionizing and allowing the excess charge to flow to ground. The secondary of the antenna transformer is tuned by variable capacitor C–10, one section of the ganged tuning capacitors. To make capacitor C–10 track properly, the h-f end is adjusted by the trimmer capacitor (C–1) and the l-f (low-frequency) end by the movement of a movable metal core inductor in the coil form itself (except for coils in bands 1 and 2). (This is designated by the arrowhead lines.) Capacitors C–2 through C–5 aline the h-f ends of transformers T–2 through T–5.

b. Coupling to the first r-f stage (V–1) grid is accomplished by capacitor C–6. This capacitor also decouples the avc circuit and prevents it from being grounded through the secondary of the antenna transformer. Avc voltage is brought to the r-f stage through avc decoupling resistor R–3. In the OFF position, the A. V. C. ON-OFF switch, SW–3, shorts the avc voltage to B— (fig. 40). This prevents avc from acting on the avc controlled tubes. The grid bias of tubes V–1 and V–2 is changed by varying the resistance of R. F. GAIN control potentiometer R–10 (fig. 40), in order to vary the gain of the r-f stages. The voltage from cathode to grid of V–1 is lowest when control R–10 is in its minimum resistance (maximum gain) position. Choke L–10 and capacitor C–9 are an r-f filter in the cathode circuit, to help prevent oscillation of the first r-f stage and also to lessen the amount of stray r-f frequency currents entering or leaving that stage. R-f transformer T–6 (fig. 17) couples the signals to the second r-f stage (V–2). Resistor R–2 supplies the proper voltage for the screen grid, and capacitor C–8 bypasses any r-f signal on the screen to cathode at that point. Decoupling of the plate circuit is accomplished by means of resistor R–4 and capacitor C–17.

c. The band switching, the grid, and the plate circuits of the second r-f amplifier are basically similar to those of the first r-f stage. The difference between the two stages lies in the values of coils and capacitors and in the fact that no cathode choke is used in the second r-f stage (V–2). The gain of the second r-f stage also is controlled by R. F. GAIN control R–10. The output of the second stage is coupled to the mixer (V–3) through r-f transformer T–11. Individual transformers T–3 and T–5 (fig. 42) in the input to the first r-f stage (V–1), T–6, T–7, and T–8 in the input of the second r-f stage, and T–11, T–12, and T–13, in the input to the mixer (V–3) have *twisted wire capacitors* added between their primaries and secondaries. A twisted wire capacitor consists of a few added turns of insulated wire which capacitively connects the primary to the secondary winding. The turns are not in metallic contact. Its chief purpose is to add a small amount of inductive, as well as capacitive, reactance to peak the coil and give it the desired value of Q over the frequency range which the coil, in conjunction with the tuning capacitor, is designed to cover.

d. Transformers T–1 through T–5 (fig. 40) couple the antenna to the first r-f amplifier grid (pin 4). They are alined at the h-f end of their bands by capacitors C–1 through C–5. Transformers T–1 through T–3 use metal core inductors for alining at the l-f end of the band. T–4 and T–5 have resistors (R–61 and R–62) across their secondaries which lower the secondary Q and cause the transformers to have a wider frequency passband.

e. Transformers T–6 through T–8 and T–11 through T–13 are the same as T–1 through T–3 (except for the twisted wire capacitors explained in *c* above), and T–9 and T–10 and T–14 and T–15 match (in operating theory) T–4 and T–5. Resistors R–63 and R–64 and R–65 and R–66 are analogous to R–61 and R–62. R–1 and R–6 are low-value cathode resistors for applying a minimum bias to V–1 and V–2, when the R. F. GAIN control is at minimum resistance (maximum gain). Without these (R–1 and R–6) the r-f amplifier stages would distort the received signal on the maximum gain setting.

f. Avc decoupling of the grid circuit of the second r-f stage is effected by means of resistor R–5 and capacitor C–18. The screen grid of the second r-f stage is kept at ground r-f potential by

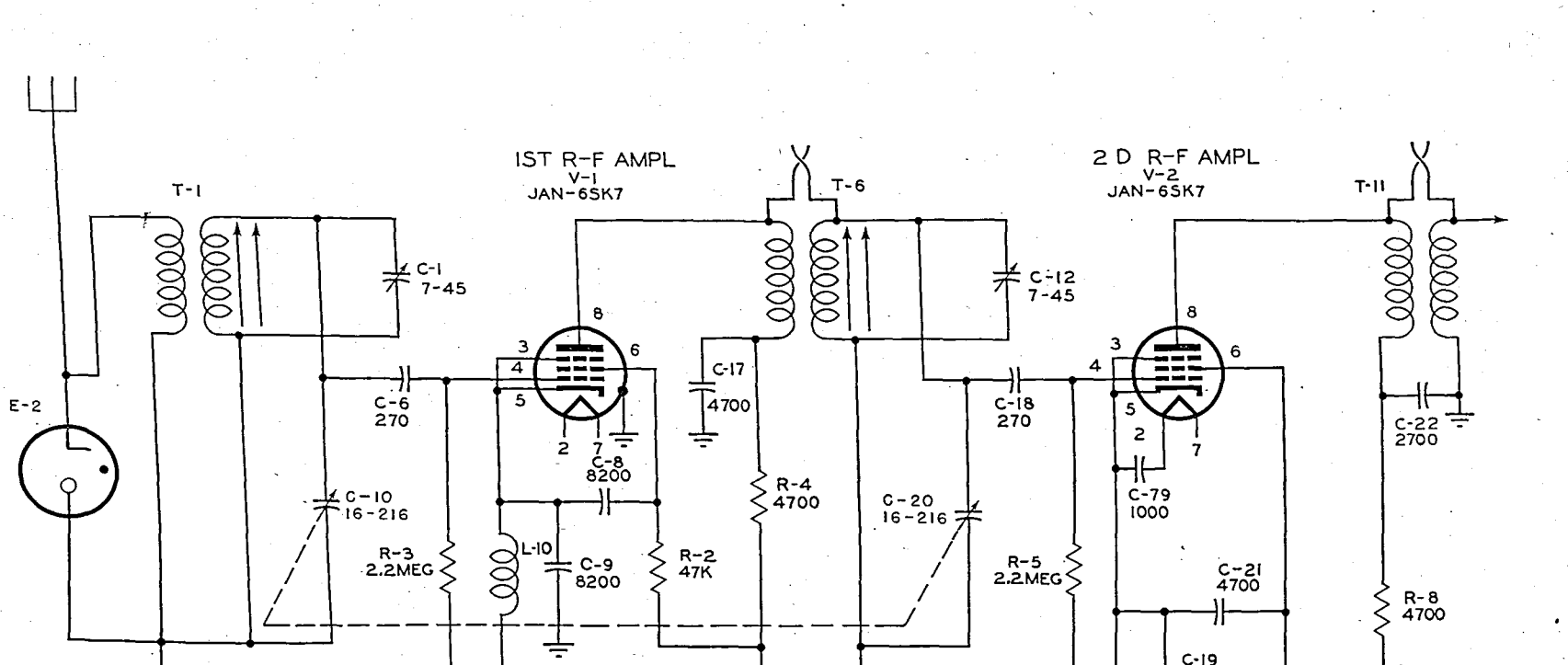


Figure 17. R–f stages

capacitor C–21. The cathodes of V–1 and V–2 are kept at ground r-f potential by means of capacitors C–9 and C–19. R–7 is the second r-f amplifier screen grid voltage-dropping resistor, and R–8 and C–22 act to decouple the second r-f amplifier plate circuit from the common impedance of the power supply. Capacitors C–12 through C–16 act as h-f trimmers for transformers T–6 through T–10, and C–24 through C–28 perform the same function for T–11 through T–15, respectively. Both stages use remote cut-off (super-control) type pentodes (Tubes JAN–6SK7).

51. Mixer (fig. 18)

a. The mixer stage (V–3), shown in figure 18, is of the electron-coupled type which isolates the h-f oscillator signal and prevents it from being injected into the preceding stages. The received (and amplified) r-f signal is brought into the mixer control grid (pin 8) through capacitor C–23. The control grid is coupled to the avc line through decoupling resistor R–9, which also acts as a part of the d-c return path for the control grid. A negative bias is created for necessary tube biasing by the cathode current flowing through cathode resistor R–11. R-f choke L–4 is in series with the ground end of cathode resistor R–11, and the combination is bypassed to ground by cathode bypass capacitor C–98 and r-f filter capacitor C–99; this combination forms an effective r-f filter. Resistor R–56 is the grid (pin 5) resistor and has the h-f oscillator r-f output voltage developed across it. Capacitor C–59 (fig. 40) couples the h-f oscillator (V–4) to the injection grid (pin 5) of the mixer tube.

b. The suppressor grid (pin 1) is returned to the junction of resistor R–11 and r-f choke L–4. This choke prevents r-f currents from entering the B— line. Capacitor C–99 bypasses any r-f potential that appears in the suppressor grid circuit to ground. In this type of mixer circuit, the second grid (pin 4) acts as a screen for the oscillator injection section, and the fourth grid acts as the screen grid for the remainder of the tube. The second and fourth grids (pin 4) are tied together internally and receive a positive d-c voltage directly from the B+ supply line through screen-dropping resistor R–50. Capacitor C–97 bypasses, to the cathode, any r-f that might tend to modulate these grids. The incoming signal and the h-f oscillator signal mix within the tube (V–3), and the resultant difference frequency of 550 kc appears in the plate circuit. Transformer T–16 (the first i-f transformer) is tuned to this frequency and therefore passes the intermediate frequency to the grid (pin 4) of the first i-f amplifier (V–5 in fig. 22). C–32 is the mixer (V–3) plate circuit bypass capacitor, and resistor R–13 acts as an isolation resistor to decouple the mixer from the B+ supply line. V–3 is a pentagrid Tube JAN–6SA7; the filament is bypassed to ground through capacitor C–94.

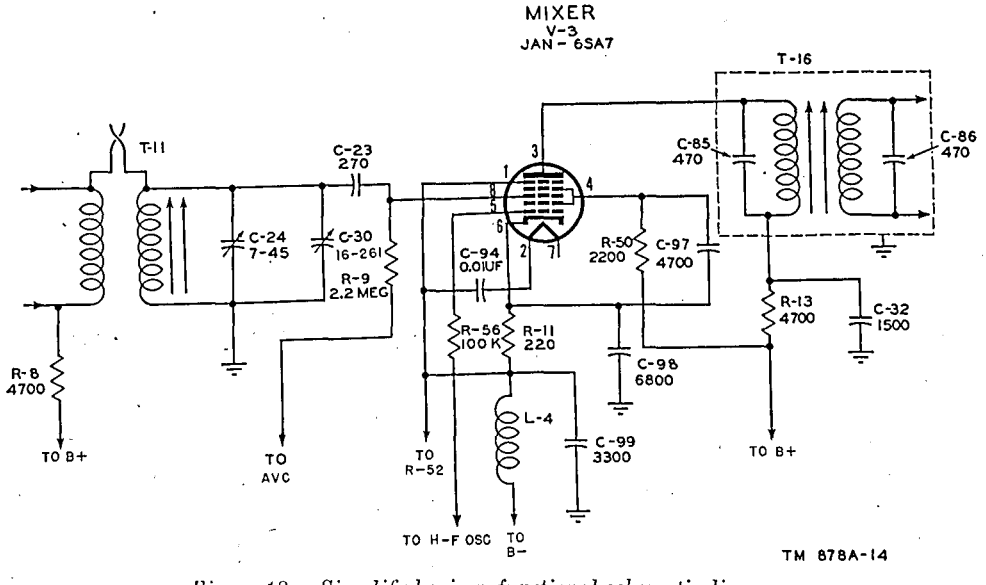


Figure 18. Simplified mixer, functional schematic diagram.

52. H-f Oscillator (figs. 19, 20, and 21)

a. General. Figures 19 and 20 show the h-f oscillator (V–4) whose output is fed into the mixer stage to produce an intermediate frequency of 550 kc. This oscillator, using a sharp cut-off pentode (Tube JAN–6SJ7), can be used either as a self-excited variable oscillator (fig. 19) or as a crystal-controlled oscillator (fig. 20). When the crystal frequencies are used, switch SW–2 (fig. 40), changes over to crystal operation and also selects the proper crystal to be used in any one of four preselected frequencies of operation.

b. Variable Frequency Oscillator.

(1) In figure 19, a simplified circuit is shown for explanation of manual operation of the h-f oscillator. All switching circuits have been eliminated for purposes of explanation. The tuned circuit of transformer T–22 and capacitors C–35, C–40, C–41, C–52, C–61, C–91, C–92, and C–100, located in the grid circuit, are the controlling factors for the oscillator frequency of operation. The plate (pin 8) and screen grid (pin 6) of V–4 are connected, forming a triode tube. By using the untuned winding of transformer T–22 as a feedback (plate-to-cathode) winding and locating the remainder of the transformer in the plate-to-grid circuit of the oscillator, self-excitation is maintained. In practice, this oscillator takes the form of a tuned-grid oscillator with inductive feedback in the cathode circuit. The oscillator frequency is always 550 kc *above* the received signal frequency. Capacitors C–58 and C–72 bypass the plate circuit to ground.

(2) Capacitor C–40 is part of the tuning capacitor gang, and it tunes T–22 to make the h-f oscillator track with the r-f amplifier circuits so that the h-f oscillator is always 550 kc higher in frequency than the incoming r-f signal. The h-f end tracking is adjusted by trimmer C–61 (C–62, C–63, C–64, and C–67 in the other four bands, as shown in figure 40). The l-f end is taken care of by the movable metal cores located in each of the five oscillator transformers T–20, T–21, T–22, T–23, and T–24. In figure 19 (the simplified schematic), this movable core is located in transformer T–22. Grid current through grid resistor R–58 builds up the proper bias for correct oscillator operation. The oscillator output is fed to the mixer stage through capacitor C–59. Capacitors C–68 and C–72 are d-c blocking capacitors.

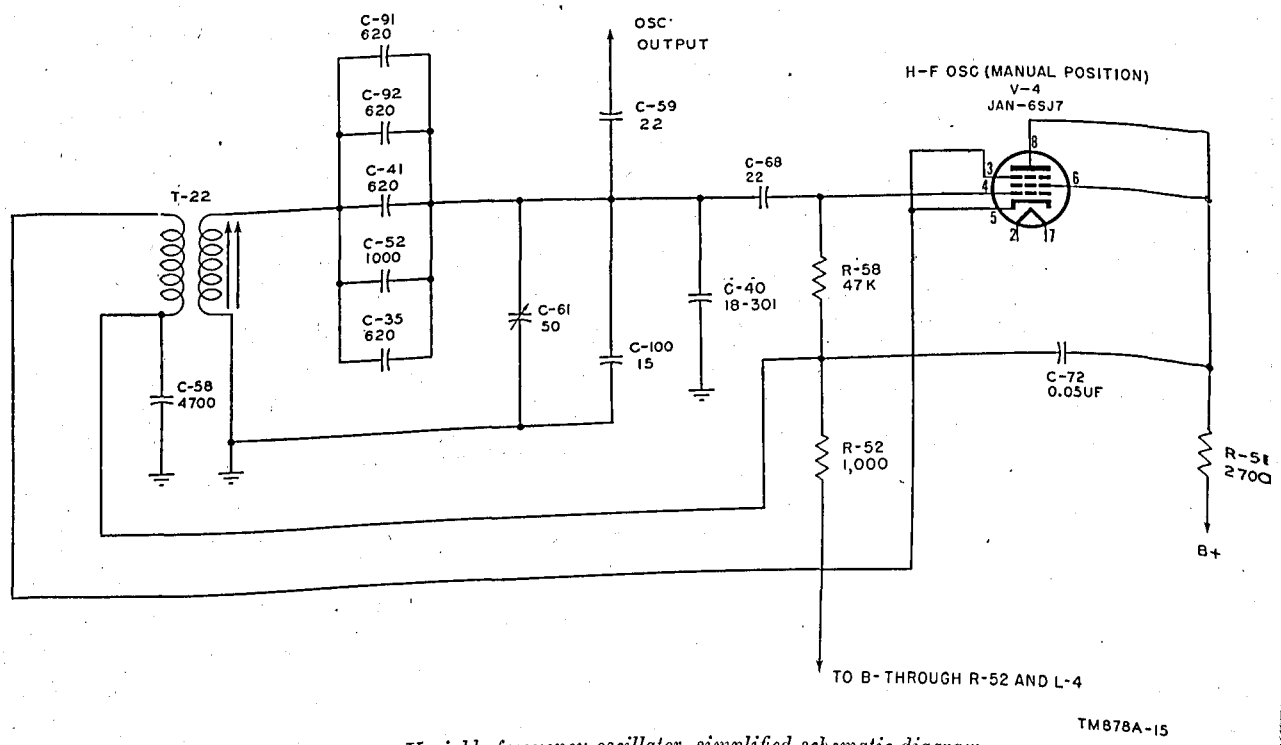


Figure 19. Variable frequency oscillator, simplified schematic diagram.

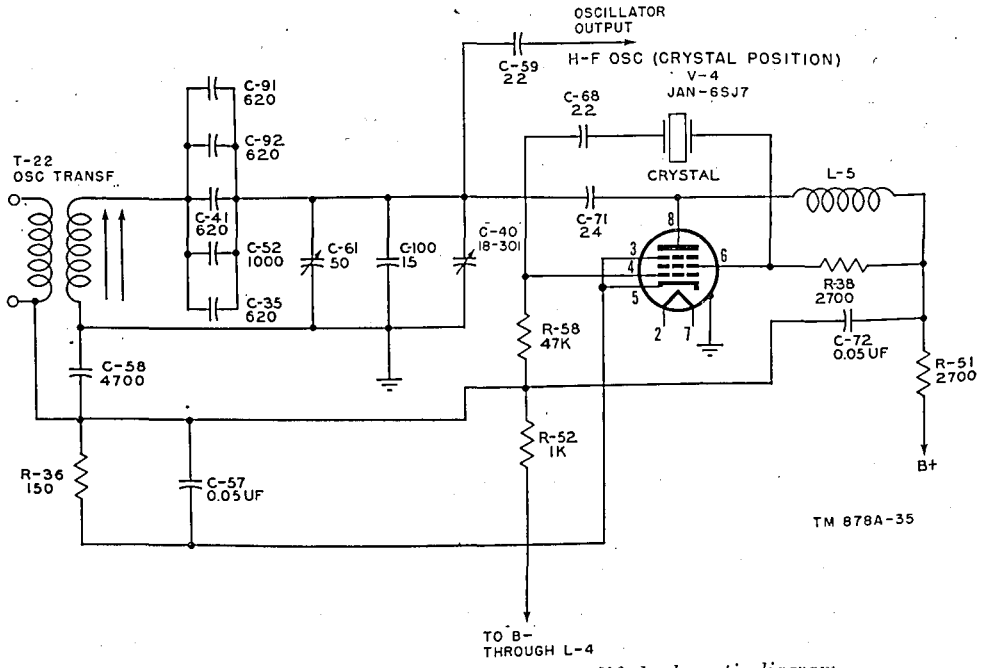


Figure 20. Crystal-controlled oscillator, simplified schematic diagram.

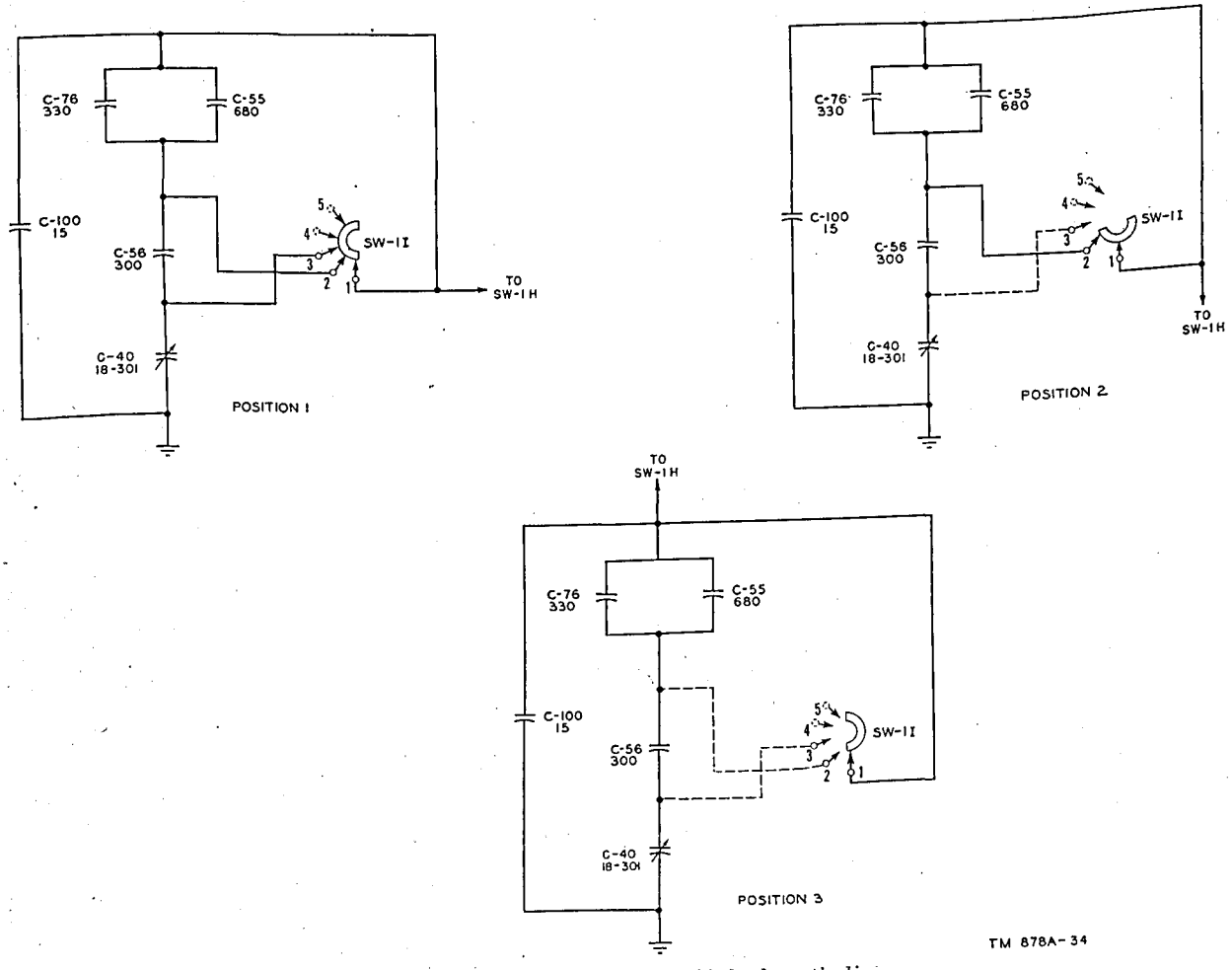


Figure 21. Padder switching, simplified schematic diagram.

c. Crystal-Controlled Oscillator. In this type of operation, the oscillator performs as an electron-coupled Pierce oscillator, the simplified circuit of which appears in figure 20. Switch SW–2 (fig. 40) has been placed in the crystal position, and only one crystal is shown. Resistor R–36 and capacitor C–57 provide a minimum bias for the oscillator. The crystal is connected between the control grid (pin 4) and the screen grid (pin 6) and is similar, insofar as functioning is concerned, to the basic electron-coupled oscillator principle where the screen grid is, in effect, the plate of the oscillator. Capacitor C–68 prevents dc from flowing through a crystal during CRYSTAL operation. The grid current flows through resistor R–58 and is returned to the cathode. While oscillating, the plate current through r-f choke L–5 varies, producing a voltage output across it. These oscillations are fed to the tuned output network consisting of C–35, C–40, C–41, C–52, C–61, C–91, C–92, and T–22 through coupling capacitor C–71. R–51 is the decoupling resistor and C–72 the decoupling capacitor for the plate circuit, and resistor R–52 and capacitor C–58 decouple the negative plate line (B—) from the oscillator. R–38 is the screen (acting as plate) dropping resistor. The crystals selected are always 550 kc higher in frequency than the wanted signal.

d. Oscillator Padding.

(1) Series padder capacitors are necessary in the h-f oscillator (V–4) circuit to make the oscillator track properly with the r-f and mixer stages. The inductance of the oscillator coil and the trimmer capacity determines two points at which the oscillator circuit will track perfectly with the r-f and mixer stages. A third tracking point can be achieved by inserting the proper capacitance in series with the tuning capacitor. These three points are so arranged that they will fall at both ends of the band and in the center. Capacitors C–35, C–41, C–52, C–91, and C–92 are padder capacitors for band 5, as shown in figure 19. Several capacitors are connected in parallel to obtain the exact capacitance needed for this band. As the frequency is decreased, the amount of capacity needed in series for padding also decreases.

(2) Switch SW–1I (fig. 40) is used to switch capacitors C–55, C–56, and C–76 in and out of the circuit to provide the best tracking possible on each band. Figure 21 shows the three different positions for the shorting contact of switch SW–1I. Position 1 of switch SW–1I would give the same results for bands 3, 4, and 5. That position shorts out capacitors C–55, C–56, and C–76 to allow the padder capacitors of those bands to be utilized as shown in figure 40. Position 2 of switch SW–1I removes the short from across capacitor C–56 and allows it to be used as the series padder for band 2. Position 3 of switch SW–1I removes the short from capacitors C–76 and C–55, putting the parallel combination in series with capacitor C–56 to pad band 1.

53. I-f Amplifiers (fig. 22)

a. Two i-f amplifiers are used to amplify the signal further and to increase the selectivity of the receiver before the signal is presented to the detector. The signal enters the first i-f amplifier (V–5) from transformer T–16, which couples the mixer plate circuit to the first i-f amplifier grid (pin 4). From the plate (pin 8) of the first i-f amplifier, the signal is injected into the grid of the second i-f amplifier (V–6) through a similar transformer, T–17. The signal path continues through the third i-f transformer T–18, to the detector. The three i-f transformers are tuned to the intermediate frequency (550 kc) by movement of the movable powdered iron cores in their coil forms. Resistor R–14 is a decoupling resistor for the avc voltage that is applied to the first i-f amplier control grid.

b. The cathode resistor of V–5 (the first i-f amplifier) is bypassed by capacitor C–34. Notice that the first i-f amplifier gain is controlled in the same manner as the first and second r-f amplifier stages (V–1 and V–2) by potentiometer R–10 (R.F. GAIN). Resistor R–15 maintains a minimum amount of bias on the first i-f amplifier regardless of the position of potentiometer R–10. R–17 is the place and screen voltage-dropping and isolating resistor with capacitor C–36 providing the proper plate circuit and screen grid bypassing. The plate voltage is less than the screen voltage by an amount equal to the voltage drop across transformer T–17.

c. In the second i-f amplifier, resistor R–23 and capacitor C–42 are for plate circuit and screen

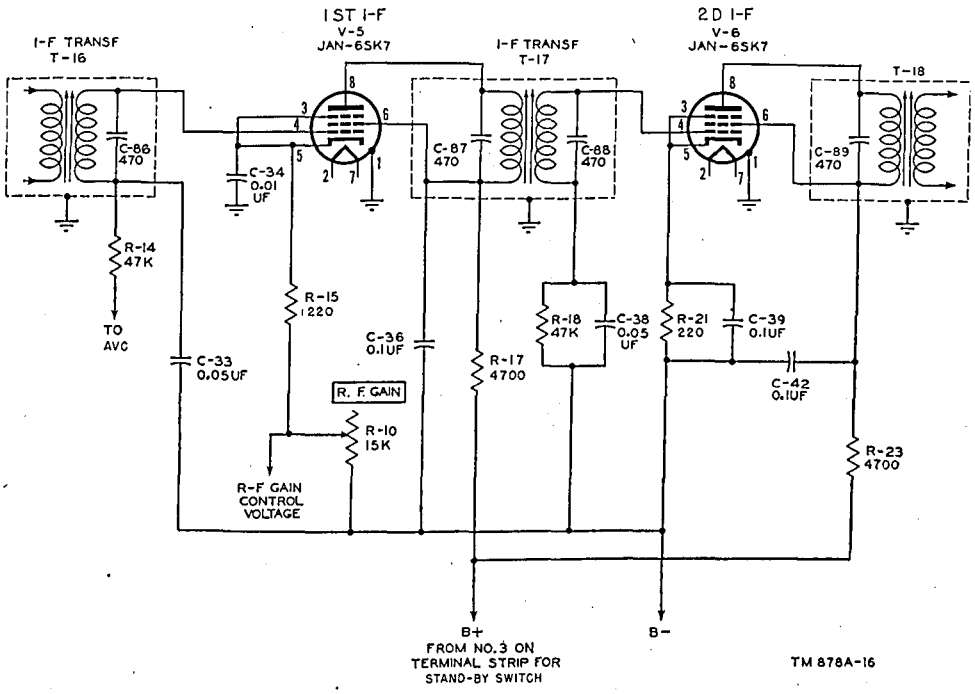


Figure 22. I-f amplifiers, simplified schematic diagram.

grid voltage dropping and decoupling. The cathode bias for the second i-f amplifier is obtained across resistor R–21 with bypass capacitor C–39 keeping the cathode at r-f ground potential. Resistor R–18 introduces a negative voltage between the grid and cathode of the second i-f amplifier when very strong signals would overload the detector (V–8). This negative voltage is due to rectified grid current. This, in effect, provides limiting action. Both i-f stages use remote cut-off (super-control) type pentodes (Tubes JAN–6SK7).

54. Beat-frequency Oscillator (fig. 23)

a. Continuous waves or keyed continuous waves are made audible after they are received by means of the circuit shown in figure 23. This is the beat-frequency oscillator, V–7, which produces an r-f signal about 1,000 cycles above or below the inter-

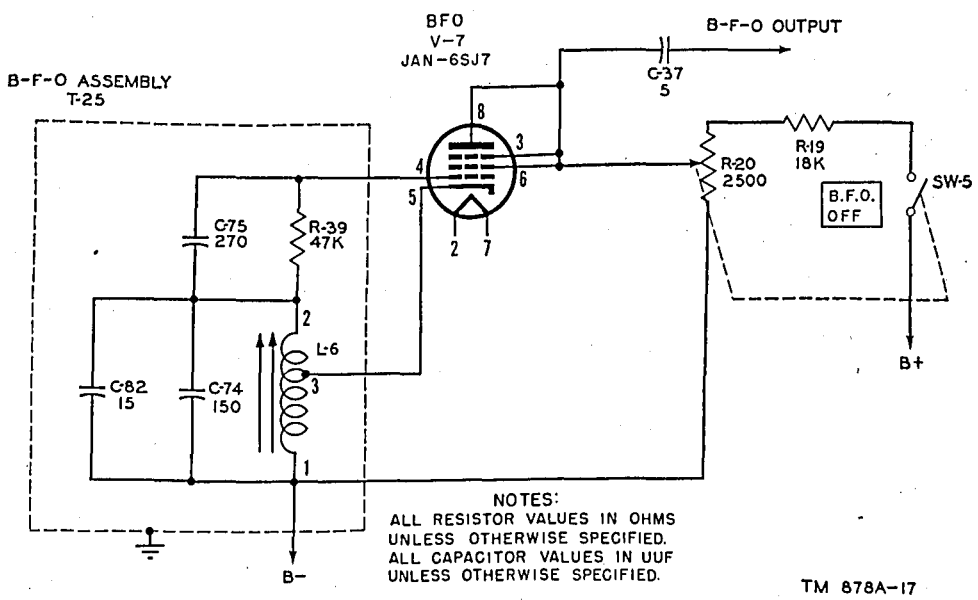


Figure 23. Beat-frequency oscillator, simplified schematic diagram.

mediate frequency of 550 kc. By injecting this signal into the second i-f amplifier grid (fig. 40), together with the unmodulated incoming signal, the difference frequency of the two signals is detected at the detector to give an audio voltage across the detector load. The circuit uses a modified Hartley type oscillator. The resonant circuit consists of tapped inductance L–6 and capacitors C–74 and C–82.

b. The cathode current flows through the ground end of the inductance (from tap 1 to tap 3) to produce the required feedback voltage for oscillation. Resistor R–39 and capacitor C–75 are the grid-leak self-bias resistor and bypass capacitor. B+ voltage is applied to the plate (plate, screen, and suppressor grids are tied together to make a triode) through resistor R–19 and potentiometer R–20. Potentiometer R–20 varies the plate voltage, thereby controlling the amount of signal injected into the second i-f stage control grid (pin 4) through the slight coupling of capacitor C–37. Switch SW–5 turns the bfo circuit on and off by making or breaking the positive d-c plate supply line to Tube JAN–6SJ7 (V–7). Capacitor C–82 is of the temperature compensating type. It assists in keeping the bfo frequency output constant despite changes in ambient temperature.

55. Detector and Avc (fig. 24)

a. The detector (V–8) is of the diode type and is in the same envelope as the first audio amplifier. The two diode plates of Tube JAN–6SQ7 are used for detection. When the secondary of the third i-f transformer supplies i-f voltage, current flows through resistors R–26 and R–40. Current flows between cathode and the parallelled diode plates when the signal voltage drives the diodes positive, and a voltage is developed across these resistors. Capacitor C–43 bypasses the i-f ripple so that only d-c and audio voltages are left. The d-c voltage is used as the negative avc voltage. Audio voltages are taken from the junction of the two load resistors, R–26 and R–40, and fed to the A.F. GAIN control (R–30) through capacitor C–51 (fig. 40). The movable arm of the A.F. GAIN control is connected to the grid of the first audio amplifier so that the voltage applied to the grid (pin 2) of V–8 may be varied; this, in turn, varies the audio volume in the speaker or headset.

b. The avc system used is similar to the type used in many communication receivers. However, it does not make use of any *delaying action.*

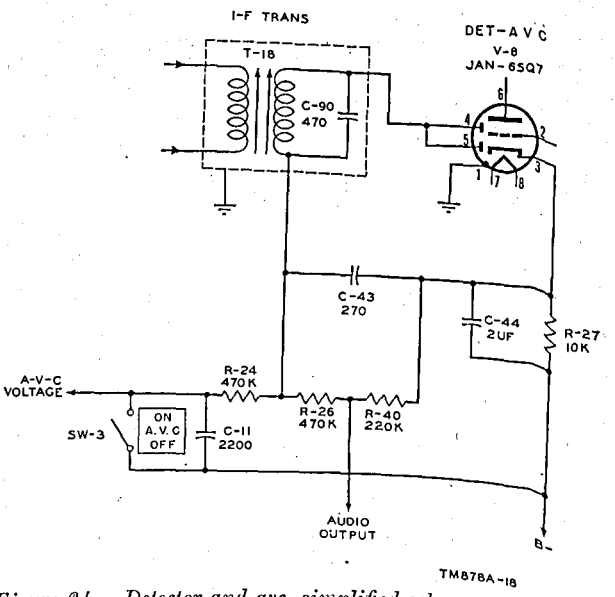


Figure 24. Detector and avc, simplified schematic diagram.

The pulsating d-c voltage developed across the detector load resistors, R–26 and R–40, is taken off through resistor R–24. It is used as the avc voltage to control the first four stages of the receiver.

c. Resistor R–24 and capacitor C–11 comprise the network that filters the pulsating d-c voltage to make it have a steady d-c value instead of pulsating at an a-f rate. Switch SW–3 grounds the avc line to B— when it is in the A.V.C.-OFF position.

56. Noise Limiter (figs. 25 and 26)

a. General. The noise limiter (V–9) is of the series type and is designed to suppress any pulse type of noise interference which is picked up by the antenna and amplified through the radio receiver up to the detector. A.N.L. OFF-ON switch SW–7, shown in figure 25, switches the noise limiter twin diode either into the circuit or out of the circuit. With this switch in the OFF position, the audio output from the detector stage is taken from the junction of the two detector load resistors, R–26 and R–40, and applied through the audio coupling capacitor C–51 across A. F. GAIN control R–30. The movable contact of R–30 applies the af to the grid of the triode audio section of tube V–8. The detector circuit then functions similarly to the detector circuit in a conventional radio receiver, using a normal half-wave diode detector. However, when the noise limiter switch is in the ON

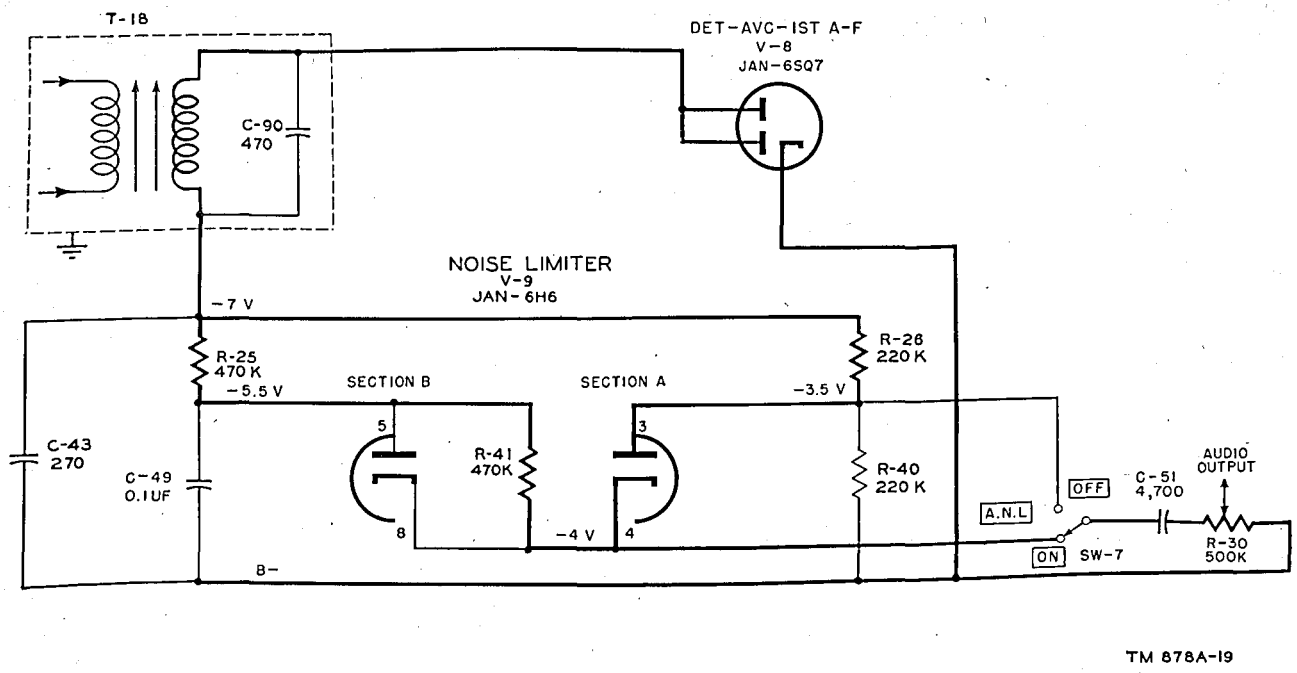


Figure 25. Noise limiter, simplified circuit diagram for preliminary explanation.

position, the audio signal must travel through section A of tube V–9 (pins 3 and 4) to reach capacitor C–51 and the gain control. This diode acts as an automatic switch; opening on short, strong noise pulses to prevent the noise from reaching the first audio amplifier stage. Resistor R–27 (fig. 40) is the cathode resistor of the triode audio section of tube V–8, and C–44 is the cathode bypass capacitor; these parts are not shown in the simplified circuits of figures 25 and 26 because they are not important to the function of the noise limiter circuit.

b. Operation.

(1) Figure 25 shows the noise limiter in operation when there is a normal signal present but no noise. Rectification of the i-f signal in the detector (V–8) causes a direct current to flow through load resistors R–26 and R–40. Note that the series-parallel combination of resistors R–25 and R–41 and diode section A of tube V–9 is in parallel with load resistor R–26. Current flows through resistor R–26 in the proper direction to make the cathode of diode section A more negative than the plate; hence, this diode will conduct and there will be a small current flow through resistor R–25. Since diode section A conducts, the audio signal developed across detector load resistor R–40 will be applied through diode section A to output coupling capacitor C–51.

(2) There is also a small current flow through R–25 and R–41. Under the above condition of no noise, the polarity across R–41 is such that the plate (pin 5) of diode section B of tube V–9 is negative with respect to the cathode (pin 8), and this diode section is cut off. Capacitor C–49 charges up to the maximum carrier modulation level through resistor R–25. Resistor R–41 serves to isolate the audio output from capacitor C–49.

(3) At the moment a noise pulse exceeds the maximum carrier modulation level, the plate (pin 3) of diode section A of tube V–9 instantaneously will be driven more negative than it was before. Figure 26 shows proper polarities and some assumed voltages for this condition. The cathode of diode section A (pin 4), however, cannot instantly go to a more negative potential, because of the comparatively long charging time of capacitor C–49 through resistor R–25. The charge on capacitor C–49, then, keeps the potential at the cathode of diode section A practically unchanged; the result is that the plate of diode section A is more negative than its cathode, and conduction in the

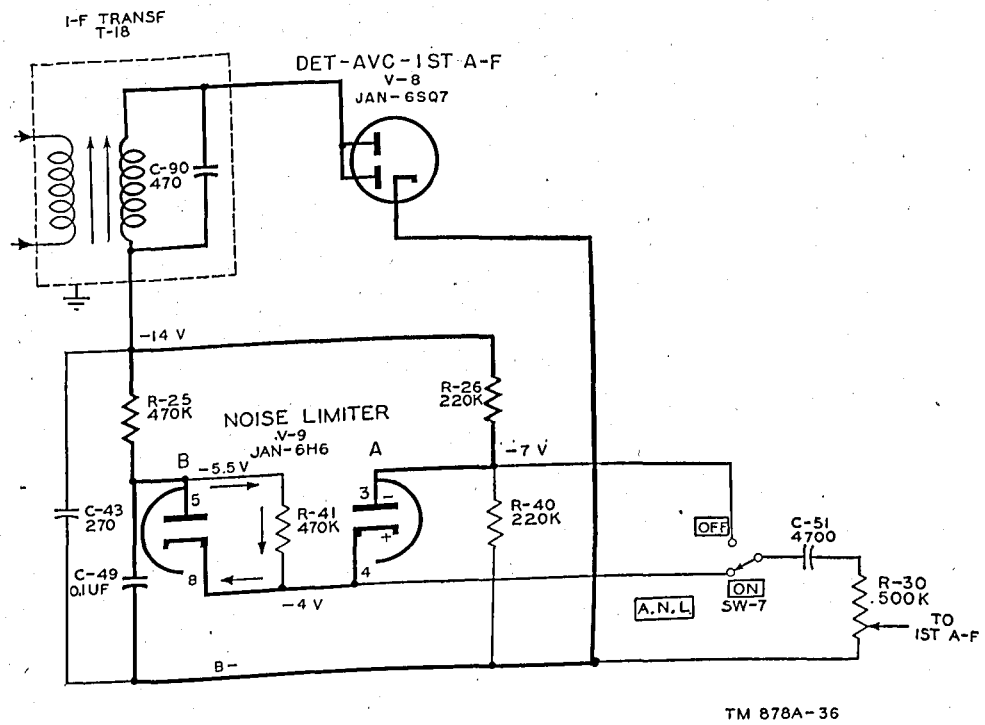


Figure 26. Noise limiter, simplified circuit diagram.

tube ceases during the time the noise pulse is present. As a result, the output circuit is opened and the noise pulse (also the relatively unimportant portion of the audio signal during this short time) will not appear in the output circuit.

(4) Diode section B of tube V–9 is in the circuit to prevent the noise limiter from generating noise of its own. In normal operation of the noise limiter, when no noise pulse is present, a small current flows through resistor R–41 in such a direction as to make the plate of section B (pin 5) negative with respect to the cathode (pin 8). Thus, diode section B normally is cut off while section A is conducting.

(5) When a sharp noise pulse suddenly stops the conduction of diode A, it breaks the circuit that caused current flow through resistor R–41. Normally, then, the end of resistor R–41, which is connected to the high potential side of audio output coupling capacitor C–51, would change polarity in a negative direction, causing a noise pulse in the output circuit. To prevent this transient from being heard, diode section B is connected across resistor R–41. Since the current flow through R–41 which caused diode section B to be cut off has ceased, diode section B now is free to act as a sort of generator (contact potential) to maintain a current flow through R–41 of such magnitude that the potential drop across this resistor remains relatively unchanged. Diode section B acts in this manner—free charges (emitted electrons) on the cathode (pin 8) flow to the plate (pin 5) and through resistor R–41 back to the cathode. This action of diode section B, in preventing potential change across resistor R–41 when diode section A opens to eliminate a noise pulse, prevents the noise limiter stage from generating its own noise. Quite effective series noise limiter circuits are in use without the addition of diode section B; however this additional diode improves the performance of the circuit in reducing noise.

(6) As soon as the noise pulse disappears, the limiter diodes will return to normal operation; and the audio signal will be restored to the a-f amplifiers. Action of

the noise limiter is automatic; this means there is no adjustment necessary for different signal levels, modulation percentages, or different types of noises.

57. A-f Amplifiers (figs. 27 and 28)

a. Audio signals from the A. F. GAIN control R–30, feed into the grid (pin 2) of the first audio amplifier (V–8) where they are amplified and appear across the plate load resistor, R–28. Capacitor C–81 is an i-f bypass capacitor to prevent i-f voltages from being amplified any further or from their causing oscillation in the output stage. Resistor R–29 and capacitor C–45 form a plate circuit decoupling network. The amplified signal then is coupled to the grid (pin 5) of second (output) audio amplifier V–10 through capacitor C–47. In this last amplifier of the receiver, the output of the beam power tetrode type Tube JAN–25L6 is sent to the speaker and headset. Impedance differences between the tube and speaker are matched with the aid of output transformer T–19. Switch SW–9 is provided to turn the speaker off or on and, in the OFF position, to substitute load resistor R–34 for the speaker voice coil. Jack J–1 is for connection of the headset. Resistor R–32 is the grid resistor for the second audio amplifier. Resistor R–33 is for cathode bias with capacitor C–48 across it to prevent degeneration. Resistor R–31 and capacitor C–46 provide inverse feedback voltage for the last audio stage. This inverse feedback voltage assists the stage in producing amplification with less audio distortion.

b. The audio system of Radio Receiver R–96A/SR is intended to reproduce mostly voice frequencies or audio tones up to about 2,000 cps (cycles per second). A special audio filter circuit is inserted between the first and second a-f amplifiers (V–8 and V–10) to cut off unwanted frequencies. The curve in B, figure 28 shows the typical response of the audio amplifiers after this filter is added. The major component is choke L–14 (fig. 27 and A, fig. 28), which is used with capacitors C–83 and C–84 to produce a curve similar to the one shown in B, figure 28. Resistors R–32 and R–35 give the curve a gentle *rolloff* so that it does not have abnormal peaks at certain frequencies or sharp cut-offs. The values are chosen to give a slight rise just past the 1,000-cycle point, dropping off to about −6 db (decibels) near 2,000 cycles (point C), with nearly a 14-db drop at 3,000 cycles (point D). Higher in frequency than 3,000 cycles, the response is almost flat but very low output is obtained. This assists greatly in lowering h-f noise.

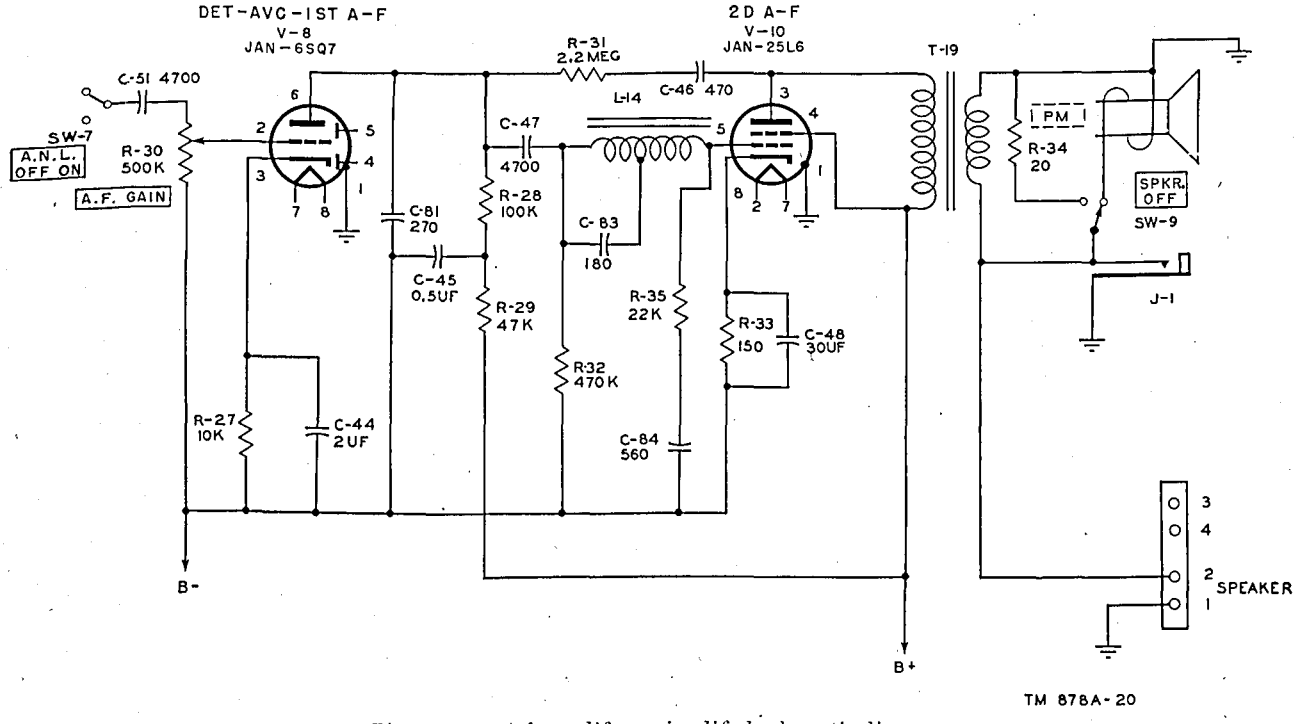


Figure 27. A-f amplifiers, simplified schematic diagram.

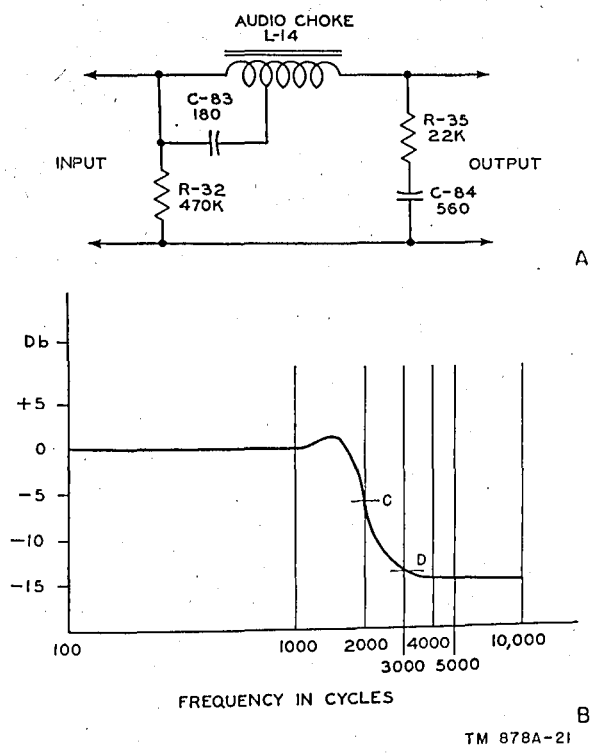


Figure 28. Audio filter circuit and response curve.

58. Power Supply (fig. 29)

a. Figure 29 is a schematic diagram of the power supply and filament circuit. Power for Radio Receiver R–96A/SR is brought in through polarized socket J–2 and filtered well before being distributed to the various circuits. Fifty-or sixty-cycle ac is sent through a line filter and then a rectifier where it is changed to dc and filtered again. From socket J–2, the ac passes through a fuse on each side of the line (F–1 and F–2). These fuses protect the entire receiver in case of an unusually heavy current drain or accidental short. Chokes L–7 and L–12 are series r-f chokes that reduce line noise which might enter the receiver and reduce the possibility that any r-f noise or oscillator output created in the receiver might be sent into the power line. C–77 is a bypass capacitor which is placed across the line to reduce r-f interference further. Capacitor C–80 is used to provide an r-f path between B— and chassis ground. The combination of inductance L–9 and capacitor C–78 resonates in a series tuned circuit to offer a low-impedance path for r-f currents of the intermediate frequency between B— and chassis ground. There is always line voltage across the line filter system, because the line switch, SW–8 (PWR. OFF), is connected on the receiver side of the filter.

b. The positive side of the line (in the case of a d-c line) is connected to the plates of the twin diode rectifier (V–11). Both sections of this tube are tied in parallel to form a half-wave rectifier

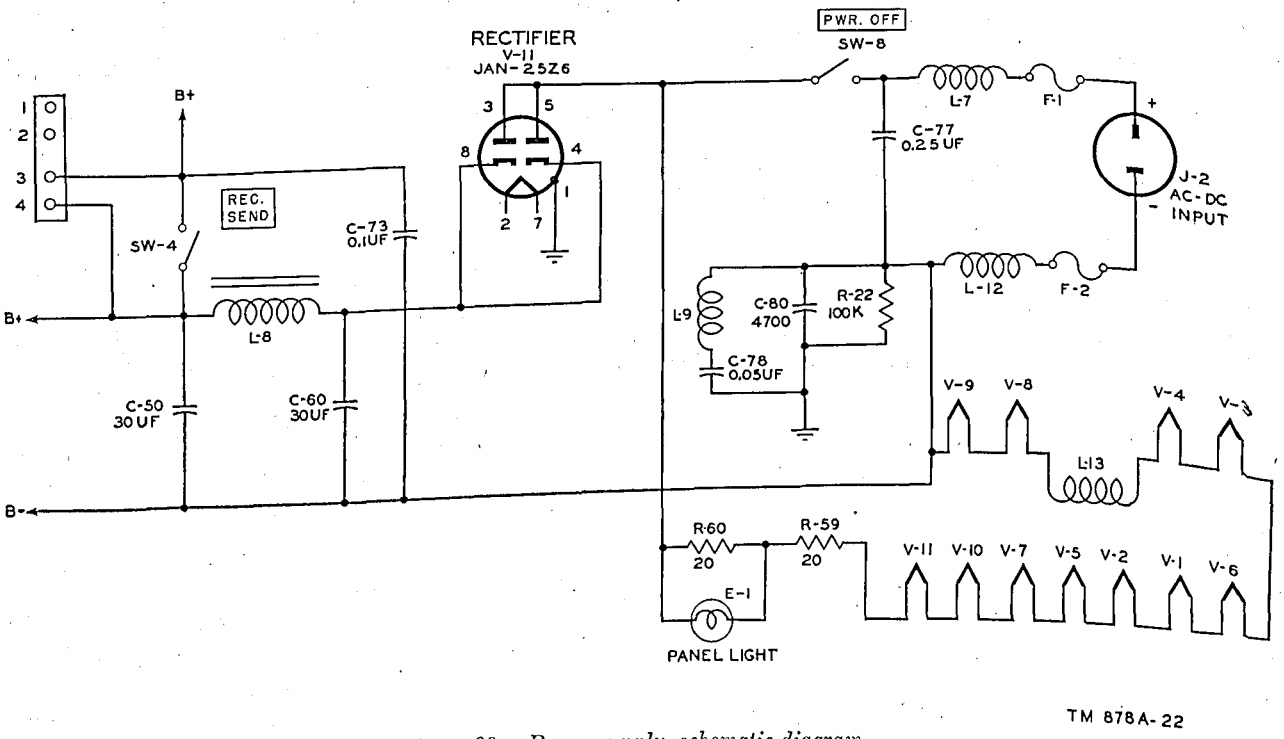


Figure 29. Power supply, schematic diagram.

The cathodes are connected to a filter choke, L–8, which has an input filter capacitor, C–60. On the output side of the filter choke, L–8, there is another filter capacitor, C–50. B+ voltage is taken from across the output capacitor, C–50, and distributed to the plate and screen circuits of the receiver. The stand-by switch, SW–4, cuts off the B+ voltage to the r-f, mixer, h-f oscillator, and bfo stages when it is placed in the SEND position (fig. 40). Capacitor C–73 is a filter capacitor used only when stand-by switch SW–4 is in the REC. position. Tube filaments are connected in series, and the proper voltages are obtained by dropping resistors R–59 and R–60. The panel lamp is placed in parallel with dropping resistor R–60. R-f choke L–13 is inserted in series with the h-f oscillator (V–4) filament to reduce r-f radiation from the oscillator into the power line.

59. Control Circuits

a. Stand-By Operation. REC.-SEND switch SW–4 is used to provide stand-by operation. Figures 29, 33, and 40 show the switch as it is connected in the B+ circuit. The SEND position of the switch disconnects the B+ voltage from the plate and screen grids of the first r-f amplifier (V–1), the second r-f amplifier (V–2), the mixer (V–3), the h-f oscillator (V–4), and the bfo (V–7) (when the bfo is used) stages. This effectively silences the receiver. While switch SW–4 is in the SEND position, the tube filaments are warmed up and the receiver is ready for instant operation. When switch SW–4 is placed in the REC. position, the receiver is set for normal operation. The SEND position of the REC.-SEND switch is used during a transmission or a waiting period of no reception.

b. Reception of Signals.

(1) Mcw, icw, or voice reception is accomplished with the B. F. O.-OFF switch, SW–5, in the OFF position. The B. F. O.-OFF switch is physically located on the rear of the bfo injection control, R–20 (figs. 2 and 40). Turning the control fully counterclockwise until a click is heard turns the B. F. O. switch OFF. This action stops the bfo from oscillating, and no audio beat is heard in the speaker or headset when the modulated continuous waves are received. Instead, the audio portion of the detected signal is heard.

(2) Continuous waves are heard by turning the bfo injection control clockwise, thereby switching the B. F. O.-OFF switch on. Advancing bfo injection control R–20 clockwise increases the amount of bfo signal fed to the control grid (pin 4) of the second i-f stage and thus controls the strength of the bfo signal in relation to the station carrier signal in the i-f stage. The beat produced by the two signals is heard as an audio note of approximately 1,000 cycles at the audio output of the receiver. The frequency of this note can be varied to some extent depending upon the amount of injection voltage used.

(3) Crystal or manual operation can be used as desired by turning switch SW–2. The MANUAL position is the variable h-f oscillator position. One of four different crystal frequencies may be selected when the switch is turned to one of the CRYSTAL positions.

(4) Automatic noise limiting is achieved when the A. N. L. OFF-ON switch, SW–7, is set to the ON position. The OFF position switches the output of the detector directly to the first audio amplifier grid (pin 2).

(5) Power to the receiver is controlled by the power line switch, SW–8, located on the A. F. GAIN control. To turn the power on, turn the A. F. GAIN control clockwise. After the switch is turned on, further clockwise rotation of the control does not affect the switch but controls audio volume. To turn the power off, turn the control fully counterclockwise to the PWR. OFF position.

(6) Avc is turned on or off by means of A. V. C. ON-OFF switch, SW–3. The OFF position shorts the avc voltage to B—.

CHAPTER 6
FIELD AND DEPOT MAINTENANCE

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

Section I. PREREPAIR PROCEDURES

60. Tools, Materials, and Test Equipment

Tools, materials, and test equipment for reconditioning, adjusting, and repairing Radio Receiver R96A/SR are given in the tables below.

a. TOOLS AND MATERIALS.

Signal Corps stock No.	Name of item and description	Used to
6R15650	SCREW DRIVER: TL–16; 7½″ lg; 4″ blade.	Tighten and loosen screws.
	SCREW DRIVER: 3″ blade; ⅛″ tip; 6″ lg over-all.	Do.
6R4603	PLIERS TL–103: diagonal; w/cutters; 5″ lg; steel; straight nose.	Perform usual functions.
	PLIERS: 6″ long-nose; side cutting.	Do.
6R5502	WRENCH SET: TL–483/U; ¼″ drive. Allen wrenches included in receiver.	Tighten and loosen small nuts. Remove knobs and dial drive assembly.
	SOLDERING IRON: electric; 110 v 100 w; ⅜″ diam tip; wooden handle.	Solder electrical connections.
6Z1989	CLOTH, textile: 16.3 yd per lb; 36″ wd.	Clean equipment.
6Z7500–0000	PAPER, sand: flint #0000; 9″ x 11″ sheets; Fed spec No. P–P–111.	Clean contact surfaces.
	SOLDER: wire, 50% tin, 50% lead; rosin core; 0.092″ diam; Kester Mfg Co No. 66.	Make electrical connections.
	CLEANING FLUID: Solvent, dry-cleaning (SD); Fed spec P–S–661a.	Clean greasy surfaces.
	CARBON TETRACHLORIDE: Electrical cleaning grade.	Clean current-carrying surfaces.

b. TEST EQUIPMENT.

Signal Corps stock No.	Name of equipment and description	Used to
	TUBE TESTER I–177: mutual conductance type.	Test tubes.
	MULTIMETER TS–352/U: ac-dc multimeter and ohmmeter.	Measure voltage and resistance values.

61. Inspecting

a. Make a visual inspection of the equipment when it is returned for repair. If it is determined that the equipment merely requires trouble shooting and replacement of defective parts, refer to section III of this chapter.

b. If there is no urgent need for the equipment and the repair involved would amount to a rebuilding operation, with the replacement of many expensive parts and components, the equipment should be salvaged. If it is salvaged, strip the equipment of all usable parts and place them in stock for re-use.

c. If it is determined that complete overhaul and repair of the equipment are necessary, perform the procedures indicated in paragraphs 62 through 66.

62. Stripping

The pluck-out parts referred to in this paragraph are parts which are easily removed and which do not require unsoldering, such as tubes and crystals.

a. REMOVING TUBES. The chassis must be taken out of the cabinet in order for the tubes to be removed. Unscrew and remove the six large-head machine screws at the left and right edges of the front panel. The front panel and chassis can be pulled out if all wiring connections to the rear of the chassis which do not have enough slack are

disconnected. Removing the screws that secure the cover plate to the r-f section shield will provide access to the r-f stages, mixer, and h-f oscillator tubes. Pull directly upward when removing a tube from its socket; this will prevent breaking the center guide pin or bending the tube pins. Label each tube as soon as it is removed so that it can be replaced later in its proper socket.

b. Removing Chassis Parts.

(1) *Fuses.* Two fuses are located in bakelite holders at the rear of the chassis alongside the speaker-stand-by switch terminal strip. The holder cap can be unscrewed and the fuse removed.

(2) *Panel lamp.* Unscrew the jewel guard of the panel lamp on the front panel and remove the bayonet base lamp by pushing in and turning counterclockwise.

(3) *Neon lamp E–2.* Neon lamp E–2 is located underneath the r-f chassis near the antenna terminal. It is removed by pushing in and turning counterclockwise.

63. Cleaning

After the pluck-out parts are removed from the receiver, clean the receiver and the removed parts. Use carbon tetrachloride and a semistiff bristle brush. Wipe dry with a clean cloth. See paragraph 32 for specific items to check.

64. Testing

a. Tubes should be tested for the proper mutual conductance on Tube Tester I–177. Check the physical condition and see whether there are any cracks in the glass, bent pins, broken center guides, or loose elements in the tubes. Replace all tubes found to be defective. If replacements for tubes with bent pins or broken center guides are not available, the pins may be straightened. Caution should be used in replacing a tube with a broken center guide; do this only under conditions of extreme emergency.

b. The panel lamp may be tested with an ohmmeter or by applying approximately 6 volts across it.

c. Neon lamp E–2 is tested by applying a voltage of approximately 100 volts to it through a 1-megohm current limiting resistor. The lamp will glow if it is good. A darkening of the inside of the glass envelope usually is noted when the lamp is nearly worn out.

65. Lubrication

Radio Receiver R–96A/SR requires a minimum of lubrication. For complete lubrication instructions see paragraphs 33 through 38.

66. Reassembling the Receiver

a. Replace the tubes, fuses, pilot lamp, neon bulb, and the crystals in the receiver. Be sure that the tubes are put back in the correct sockets (fig. 7).

b. Replace the power cord. Do not plug it into a live receptacle until actual tests are to be made which require the set to be turned on.

Section II. TROUBLE SHOOTING AT FIELD AND DEPOT MAINTENANCE LEVEL

67. Precautions Against High Voltage

Certain precautions must be followed when voltages above a few hundred volts are being measured. Although no high voltages are used in this receiver, these precautions should be followed carefully if the installation includes Radio Transmitter T–83/SR. HIGH VOLTAGES ARE DANGEROUS AND CAN BE FATAL. When it is necessary to measure high voltages, observe the following rules:

a. Connect the ground lead to the voltmeter.

b. Place one hand in your pocket. This will eliminate the possibility of making accidental contact with another part of the circuit, thus causing the electricity to travel from one hand to the other through the body.

c. If the voltage is less than 300 volts, connect the test lead to the hot terminal (which may be either positive or negative with respect to ground).

d. If the voltage is greater than 300 volts, shut off the power, connect the hot lead, step away from the voltmeter, turn on the power, and note the reading on the voltmeter. Do not touch any part of the voltmeter, particularly when it is necessary to measure the voltage between two points which are above ground.

68. Trouble-shooting Procedures

The tests and procedures in paragraphs 69 through 88 are to assist in the isolation of trouble sources. When a receiver is serviced, no further damage to the receiver should occur. The procedure which the repairman is to follow also should assist in the reduction of time consumed for servicing, by localizing the stage that is causing the trouble. First, determine what operations of the receiver are affected; then, how many stages are involved. With the trouble isolated to this point, making voltage and resistance measurements usually will trace the fault to the defective component or components. The procedure to use in trouble shooting is broken down and simplified as follows:

a. VISUAL INSPECTION. Frequently troubles can be located by the serviceman through use of this inspection alone (par. 42). Visual inspection may prevent further damage to the receiver, because it can be accomplished without turning the power on. Always visually inspect the receiver before attempting to service it by some other method.

b. POWER SUPPLY TEST. The power supply test (par. 76) helps prevent further damage to the receiver and prevents its rectifier from having possible short circuits. This test cannot be considered completely preventive because operation of the circuit is a necessary part of the testing.

c. OPERATIONAL TEST. The operational test (par. 77) is important because it frequently indicates the general location of trouble. Information sometimes can be gained to determine the exact nature of the fault. The amount of information derived from this test depends on the interpretations of the symptoms of trouble. Understanding this equipment will allow the serviceman to interpret the meaning indicated by faulty operation of certain controls or circuits.

d. INTERMITTENTS. In all of these tests, do not overlook the possibility of intermittents. If present, this type of trouble often may be made to appear by tapping or jarring the set. It is possible that the trouble is not in the receiver itself but in the installation (mounting, antenna system, or local electrical equipment). It may possibly be due to conditions external to the receiver site. The installation should be tested by substituting a receiver that is known to be in good operating condition. Received noise may be checked by by disconnecting the antenna and grounding the antenna post.

69. Trouble-shooting Data

Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the following trouble-shooting data:

Figure	*Description*
7	Radio Receiver R–96A/SR, tube location chart.
13	Radio Receiver R–96A/SR, lubrication of dial drive.
30	R-f chassis, bottom view.
31	Audio chassis, bottom view.
32	Radio Receiver R–96A/SR, voltage and resistance measurements.
34	Chassis, top view.
35	Tuning assembly, cutaway view.
40	Radio Receiver R–96A/SR, schematic diagram.

70. Test Equipment Required for Trouble Shooting

The test equipment required for trouble shooting Radio Receiver R–96A/SR is listed in *a* below. The technical manuals associated with test equipment (when available as Signal Corps literature) are listed in *b* below.

a. TEST EQUIPMENT AND USE.

Signal Corps stock number	Name of equipment and description	Used to—
	MULTIMETER TS–352/U: ac-dc voltmeter and ohmmeter; battery operated.	Measure voltages and resistance values.
	OSCILLATOR I–151: af; variable frequency.	Test a-f amplifiers.
	TUBE TESTER I–177: mutual conductance type.	Test tubes.
	OUTPUT METER TS–585/U: 0.1–5,000 mw (milliwatts); impedance range 2.5 to 20,000 ohms, adjustable in 40 steps.	Make audio output checks.
	SIGNAL GENERATOR TS–588/U: r-f; variable frequency.	Aline r-f and i-f stages.

b. EQUIPMENT MANUALS AVAILABLE.

Equipment	*Technical manual*
Oscillator I–151–A	TM 11–2524
Tube Tester I–177	TM 11–2627
Output Meter TS–585/U	TM 11–5017
Signal Generator TS–588/U	TM 11–5018

71. Power Requirements

A power supply capable of supplying at least 100 watts at 115 volts dc or 115 volts, 50 to 60 cycles ac is necessary for the test and repair of this receiver. In addition, if Multimeter TS–352/U is used, batteries for this unit are required. One Battery BA–30 plus either three Batteries BA–31 or one Battery BA–413/U, depending on the model, are required.

72. Voltage Measurements

Voltage measurements are an almost indispensable aid, since most troubles either result from abnormal voltages or produce abnormal voltages. Voltage measurements are taken easily because they are always made between two points in a circuit and the circuit need not be interrupted.

a. Unless otherwise specified, voltages listed on the voltage chart (fig. 32) are measured between the indicated points and ground.

b. Always begin by setting the voltmeter on the highest range so that the voltmeter will not be overloaded. Then, if it is necessary to obtain increased accuracy, set the voltmeter to a lower range.

c. When checking cathode voltage, remember that a reading can be obtained when the cathode resistor is actually open, because the resistance of the meter may act as a cathode resistor. Thus, the cathode and ground voltage may be approximately normal only as long as the voltmeter is connected between cathode and ground. Before cathode voltage is measured, make a resistance check with the power off to determine whether the cathode resistor is normal.

73. Voltmeter Loading

Voltmeter resistance must be at least 10 times as great as the resistance of the circuit across which the voltage is measured. If the voltmeter resistance is nearly equal to the circuit resistance, the voltmeter will indicate a voltage LOWER than the actual voltage present when the voltmeter is removed from the circuit.

a. The resistance of a voltmeter on any range can be calculated by this simple rule—Resistance of the voltmeter equals its ohms-per-volt multiplied by the full-scale range in volts. For example—The resistance of a 1,000-ohm-per-volt meter on the 300-volt range is 300,000 ohms (R=1,000 ohms-per-volt times 300 volts=300,000 ohms).

b. To minimize voltmeter loading in high-resistance circuits, use the highest voltmeter range. Although only a small deflection will be obtained (possibly only 5 divisions on a 100-division scale), the electrical accuracy of the voltage measurement will be increased. The decreased loading of the voltmeter will more than compensate for the visual inaccuracy which results from reading only a small deflection on the voltmeter scale.

c. Close observation of the meter when switching voltage ranges will show whether the voltmeter is loading the circuit under test.

(1) EXTREMELY HEAVY LOADING is indicated when the deflection of the pointer on the meter (not the voltage reading) is nearly the same for different ranges.

(2) APPRECIABLE LOADING is indicated when the voltage readings (not the deflection) for different ranges do not agree.

(3) NEGLIGIBLE LOADING is indicated when the voltage readings (not the deflection) for different ranges do agree.

d. The ohm-per-volt sensitivity of the voltmeter used to obtain the readings recorded on the voltage and resistance chart in this manual is printed on each chart. Use a meter having the same ohm-per-volt sensitivity. Otherwise it may be necessary to consider the effect of loading.

74. Capacitor Tests

a. GENERAL. It often is necessary to check capacitors for leakage or open or short circuits which are caused by break-down of the dielectric between the plates. This applies only to capacitors of the tinfoil, paper, or mica type, since the dielectric film of wet electrolytic capacitors is self-healing.

b. OPEN CAPACITORS. To check a capacitor suspected of being open, place a good capacitor in parallel with it. In r-f circuits, keep the capacitor leads as short as those of the suspected capacitor. in l-f circuits (less than 1 mc), the test capacitor leads may be several inches long. Proper operation of the equipment after the auxiliary capacitor is added indicates that the suspected capacitor is open and should be replaced.

c. SHORTED OR LEAKY CAPACITORS. To check shorted or leaky capacitors, observe the kick indication on an ohmmeter. Before attempting to check the capacitor, remove one lead from the

circuit, since the capacitor is usually in parallel with some other circuit element. Adjust the ohmmeter to zero ohms (with the leads shorted) on its highest range and connect it across the capacitor. If the capacitor is good, the ohmmeter needle will flick over slightly and gradually drop back to infinity. This shows that the capacitor has taken a charge and is not shorted. If the test prods are now reversed, the needle will deflect twice as far and then return to the position indicating infinite resistance. If the needle does not go back to infinity, the capacitor is leaky and should be replaced. The flick of the needle will be small for small capacitors, and the test is not too reliable for capacitors which are smaller than about 0.05 uf (microfarad).

d. Electrolytic Capacitors. Electrolytic capacitors normally will show a resistance reading. When an ohmmeter is connected across an electrolytic capacitor, a resistance reading of less than about 30,000 ohms indicates a defective capacitor. If the prods are reversed, the resistance reading normally will fall to a low value, then build up as the plates are reformed in the opposite direction. Always take both polarity readings to make sure which reading is the higher one.

75. General Precautions

There are definite general precautions which should be observed when any radio set is being repaired. It is to the advantage of the repairman to observe these rules to the utmost during the repair process in order to save time and future repair of the set. These precautionary rules follow:

a. Be careful when the chassis is removed from the cabinet, especially of the under side. The under side of the chassis contains exposed connections with d-c voltages that may result in an unpleasant shock.

b. A part which has the same electrical value but different physical size may cause trouble in h-f circuits. Give particular attention to proper grounding when replacing a part. Use the same ground point as in the original circuit wiring. Since this receiver is an a-c, d-c type, the chassis ground is not the B—. The d-c returns are routed to the power supply through a B— wire. Some of the r-f returns are brought to the power supply through the chassis ground and others are returned through the B— wire (circuit ground).

76. Power Supply Test

Before making the power supply test or any other test requiring power to the receiver, check the line voltage with a voltmeter. The line voltage should be within 10 percent of 115 volts ac or dc. Be sure that the ac used is 50 to 60 cps. The receiver chassis must be removed from the cabinet for the power supply test.

a. With the receiver power off, make an ohmmeter check across capacitor C–60 (figs. 31 and 34). This capacitor is located next to the power socket, J–2, and is connected from the B— lead to the cathodes of the rectifier tube. A reading of at least 30,000 to 40,000 ohms will indicate no shorts and good or open capacitors. Some modern electrolytic capacitors have resistances of several hundred thousand ohms. Leaky or low-resistance capacitors will draw too heavy a current through the rectifier system. Note the polarity of the ohmmeter leads; do not check the electrolytic capacitors with reverse polarity. After all of these tests have been made and if correct indications are observed, it is safe to turn the PWR. OFF switch on. Check the power supply voltages against the V–11 socket voltages in figure 32.

b. Check to see whether the filaments of the glass tubes are all lighted or feel the metal tubes to determine whether they are warm. The tubes will neither light nor feel warm if there is an open filament or bad connection in the filament circuit. Tube filaments in this receiver are series connected. Hence, if one tube filament is open, all others will fail to light. Replace defective tubes, sockets, or wiring causing such open circuits. Do not dispose of tubes until they have been checked with a tube checker. Red hot plates of the rectifier or second audio amplifier indicate excessive current drain; if this is the case, shut off the receiver power immediately. Further trouble localizing is now necessary.

77. Operational Test

Operate the receiver as described in the equipment performance checklist (par. 45). Performing these operations will indicate the performance of each control and switch and will show any malfunction. The malfunctions can be associated with a specific circuit or circuits and traced to a particular component or components. If everything appears to be normal in the operational test, further testing is necessary for sensitivity and tuning calibration measurements. These latter

tests are to be made only after all receiver faults are repaired and if sufficient test equipment is available.

78. Trouble-Shooting Charts and Illustrations

The following chart is supplied as an aid in locating trouble in the radio receiver. This chart lists symptoms which the serviceman should observe, either by sight or by hearing. The chart also aids in localizing the trouble quickly in the audio, i-f, or r-f stage of the receiver. The signal substitution tests outlined in paragraphs 82 through 86 then can be used to supplement this procedure and determine the defective stage or component. A tube check and voltage and resistance measurements of this stage ordinarily should be sufficient to isolate the defective part. Test tubes before starting this procedure. To aid in trouble shooting and repair, refer to figures 30, 31, 32, 34, 36, 37, and 40.

79. Sectionalizing Trouble in Radio Receiver R-96A/SR

Symptom	Probable trouble	Correction
1. Receiver dead; pilot light not lit	1. Fuse F-1 or F-2 blown Open filament of one or more tubes. No power at receptacle Shorted capacitor C-77	1. Replace fuse. Replace defective tube. Correct power source. Replace capacitor.
2. Receiver dead; pilot light not lit	2. Open filament resistor R-60 or R-59.	2. Replace defective resistor.
3. Receiver dead; pilot light lit	3. Stand-by switch SW-4 open Defective stage Polarized power plug connections reversed.	3. Close switch. See localizing chart (par. 80). Reverse connections.
4. Receiver weak with antenna connected; strong signal with signal generator connected to antenna post.	4. Open antenna lead	4. Repair antenna lead.
5. Weak signal with signal generator connected to antenna post; strong signal with signal generator connected to control grid (pin 4) of tube V-1.	5. Antenna stage misalined Antenna stage defective	5. Aline stage. See localizing chart (par. 80).
6. Weak signal with signal generator connected to grid (pin 4) of tube V-1 but strong when connected to grid (pin 4) of tube V-2.	6. R-f stage misalined R-f stage defective	6. Aline stage. See localizing chart (par. 80).
7. 550-kc signal heard stronger when fed to grid (pin 4) of tube V-5 than when fed to grid (pin 8) of V-3.	7. First i-f stage misalined First i-f stage defective	7. Aline stage. See localizing chart (par. 80).
8. 550-kc signal heard stronger when fed to grid (pin 4) of V-6 than when fed to grid (pin 4) of V-5.	8. Second i-f stage misalined Second i-f stage defective	8. Aline stage. See localizing chart (par. 80).
9. Audio signals heard with headset connected to control grid (pin 5) of V-10 and B- but not heard at phone jack.	9. Defective tube V-10 Defective audio stage	9. Replace tube. See localizing chart (par. 80).
10. No received signals heard although 550-kc signal fed to antenna post is heard (receiver tuned to 520 kc).	10. Defective h-f oscillator	10. See localizing chart (par. 80).

80. Localizing Trouble in Radio Receiver R-96A/SR

Symptom	Probable trouble	Correction
1. Voltages at all pins of tube V-1 normal except:		
a. No voltage at plate (pin 8)	*a.* Open switch SW-1C	*a.* Repair or replace place switch SW-1C.
	Open primary of T-6, T-7, T-8, T-9, or T-10.	Replace defective coil.
	Open resistor R-4	Replace resistor.
	Shorted capacitor C-17	Replace capacitor.
b. No voltage at screen (pin 6)	*b.* Open resistor R-2	*b.* Replace resistor.
	Shorted capacitor C-8	Replace capacitor.
2. Signal heard strong when fed to grid (pin 4) of tube V-1 but weak or not at all when fed to antenna post.	2. Open or shorted switch SW-1A or SW-1B.	2. Repair or replace switch SW-1A or SW-1B.
	Open primary or secondary of transformer T-1, T-2, T-3, T-4, or T-5.	Replace defective coil.
	Capacitor C-6 open	Replace capacitor.
3. Voltages at all pins of V-2 normal except:		
a. No voltage at plate (pin 8)	*a.* Open switch SW-1E	*a.* Repair or replace switch SW-1E.
	Open primary of T-11, T-12, T-13, T-14, or T-15.	Replace defective coil.
	Open resistor R-8	Replace resistor.
	Shorted capacitor C-22	Replace capacitor.
b. No voltage at screen (pin 6)	*b.* Open resistor R-7	*b.* Replace resistor.
	Shorted capacitor C-21	Replace capacitor.
4. Signals heard strong when fed to grid (pin 4) of tube V-2 but weak or not at all when fed to grid (pin 4) of tube V-1.	4. Open or shorted switch SW-1D	4. Repair or replace switch SW-1D.
	Open transformer T-6, T-7, T-8, T-9, or T-10.	Replace defective transformer.
	Open capacitor C-18	Replace capacitor.
	Shorted capacitor C-12, C-13, C-14, C-15, C-16, or C-20.	Repair or replace capacitor.
5. Voltages normal at all pins of V-3 except:		
a. No voltage at plate (pin 3)	*a.* Open primary of transformer T-16.	*a.* Replace transformer T-16.
	Open resistor R-13.	Replace resistor R-13.
	Shorted capacitor C-32.	Replace capacitor.
b. No voltage at screen (pin 4)	*b.* Open resistor R-50	*b.* Replace resistor R-50.
	Shorted capacitor C-97	Replace capacitor.
6. 520-kc signal from signal generator fed to grid (pin 8) of tube V-3 heard strong, but heard weak, or not at all when fed to grid (pin 4) of tube V-2 (receiver tuned to 550 kc).	6. Open capacitor C-23	6. Replace capacitor.
	Open transformer T-11, T-12, T-13, T-14, or T-15.	Replace defective transformer.
	Shorted capacitor C-24, C-25, C-26, C-27, C-28, or C-30.	Repair or replace capacitor.
7. Voltages normal at all pins of tube V-5 except:		
a. No voltage at plate (pin 8)	*a.* Open primary of transformer T-17.	*a.* Replace transformer T-17.
b. No voltage at plate (pin 8) or screen (pin 6).	*b.* Open resistor R-17	*b.* Replace resistor R-17.
	Open connection	Repair open connection.
	Shorted capacitor C-36	Replace capacitor.
8. 550-kc signal heard stronger when fed to grid (pin 4) of tube V-5 than when fed to grid (pin 8) of tube V-3.	8. Open or shorted transformer T-16 or shorted capacitor C-85 or C-86.	8. Replace transformer T-16.
	Open resistor R-13 or R-14	Replace resistor.
	Open capacitor C-33 or C-97	Replace capacitor.

Symptom	Probable trouble	Correction
9. Voltages normal at all pins of tube V–6 except:		
a. No voltage at plate (pin 8)------	*a.* Open primary of transformer T–18.	*a.* Replace transformer T–18.
b. No voltage at plate (pin 8) or screen (pin 6).	*b.* Open resistor R–23----------	*b.* Replace resistor R–23.
	Shorted capacitor C–42------	Replace capacitor C–42.
10. 550-kc signal heard stronger when fed to grid (pin 4) of tube V–6 than when fed to grid (pin 4) of tube V–5.	10. Open or shorted transformer T–17, or shorted capacitor C–87 or C–88.	10. Replace transformer T–17.
	Shorted capacitor C–37--------	Replace capacitor.
	Open resistor R–18----------	Replace resistor.
	Open capacitor C–36 or C–38----	Replace capacitor.
11. No audio signals heard with headset connected across resistor R–30 (A. F. GAIN control).	11. Open resistor R–26, R–27, or R–40.	11. Replace defective resistor.
	Open or shorted capacitor C–43-	Replace capacitor.
	Shorted capacitor C–89 or C–90-	Replace capacitor.
	Open transformer T–18---------	Replace transformer T–18
	Open capacitor C–51----------	Replace capacitor.
12. No audio signals heard with headset connected from grid (pin 5) of V–10 to B—.	12. Open resistor R–27, R–28, R–29, or R–30.	12. Replace resistor.
	Open capacitor C–47 or C–51----	Replace capacitor.
	Shorted capacitor C–45, C–47, C–51, or C–81.	Replace capacitor.
	Open coil L–14----------	Replace coil.
	Defective switch SW–7---------	Replace switch.
13. Audio signals heard with headset connected from grid (pin 5) of V–10 to B— but not heard at J–1 and speaker.	13. Open output transformer T–19---	13. Replace transformer T–19.
	Open circuit at jack----------	Repair open circuit.
	Secondary of T–19 not grounded-	Ground secondary.
	Open resistor R–33----------	Replace resistor.
	Shorted capacitor C–48--------	Replace capacitor.
	Wrong side of T–19 grounded---	Reverse secondary connections.
14. No received signals heard although 550-kc signal fed to antenna post is heard (h-f oscillator not operating).	14. Open or shorted switch SW–1G, SW–1H, SW–1I, SW–2, SW–2A, SW–2B, or SW–2C.	14. Repair or replace defective switch.
	Open or shorted coil T–20, T–21, T–22, T–23, or T–24.	Replace coil.
	Open capacitor C–35, C–41, C–52, C–53, C–54, C–59, C–68, C–69, C–70, C–91, or C–92.	Replace capacitor.
	Shorted capacitor C–35, C–40, C–52, C–53, C–54, C–55, C–56, C–57, C–58, C–59, C–61, C–62, C–63, C–64, C–65, C–66, C–67, C–68, C–71, C–72, C–76, or C–100.	Replace capacitor. (C–57 will show up bad only on CRYSTAL position.)
	Open resistor R–36, R–38, R–52, or R–58.	Replace resistor.
	Open coil L–5----------	Replace coil.
	Defective crystal----------	Replace crystal.
15. No audible note on c-w reception with bfo turned on.	15. Open coil L–6----------	15. Replace coil.
	Open capacitor C–75 or C–37----	Replace capacitor.
	Open resistor R–19, R–20, or R–39.	Replace resistor.
	Shorted capacitor C–37, C–74, C–75, or C–82.	Replace capacitor.
16. Noise limiter not effective----------	16. Open capacitor C–49----------	16. Replace capacitor.
	Defective switch SW–7---------	Replace switch.
	Open resistor R–25 or R–41-----	Replace resistor.
	Defective Tube JAN–6H6, V–9--	Replace tube.

Symptom	Probable trouble	Correction
17. No plate or screen voltage on the receiver.	17. Open coil L–8	17. Replace coil.
	Shorted capacitor C–50, C–60, or C–73.	Replace capacitor.
	Open circuit in wiring	Repair open circuit.
	Incorrect voltage input	Check line voltage.
	Switch SW–4 grounded	Remove ground or replace switch
	Rectifier tube defective	Replace tube.

81. Coil Resistances

The d-c resistance of a number of the coils used in this receiver are listed below:

Reference symbol	*D-c resistance (ohms)*
L–4	35
L–5	35
L–7	0.6
L–8	200 maximum
L–12	0.6
L–14	970

82. Signal Substitution Notes

a. Sources of audio, i-f, and r-f signals are necessary for signal substitution. The signals may be produced by one or more units. If a single unit is used it must have adequate ranges to produce signals in the audio frequencies between 400 and 1,000 cycles and radio frequencies from 135 kc to over 12 mc.

b. A useful item is a standard headset. This is used for tapping in along the audio circuit.

c. After the faulty stage is detected, a voltohmmeter and tube tester are needed to locate the defective component.

d. For tests given in paragraphs 83, 84, 85, and 86, ground one side of the signal generator (shielded side of lead) and introduce the signal to the point as directed through a capacitor of about 0.05 uf.

e. Listen for the signal and determine whether it is normal. Comparison with another receiver of the same type is the best method; however, it is not always possible. If the signal is not normal, the headset can be moved from stage to stage until the signal is found to be normal again or until it is determined that the audio section is not at fault. When the audio section checks properly, move the signal generator from stage to stage to check the i-f and r-f stages.

f. Check the wiring and soldering in each stage during this procedure. Do not damage the wiring or components by pushing them during inspection. Be careful not to damage the receiver in any other way.

g. Misalinement of one or more of the stages can cause reduced sensitivity and selectivity. Misalinement of the h-f oscillator would cause the dial indication to be off, spotty reception, or no reception.

h. Test the tube of the stage where the trouble is localized. Next, measure the voltage and resistance at the tube socket of that stage.

i. Tube socket voltage and resistance measurements may not be changed even though the tube is not functioning properly. These notes should serve as a guide to develop other procedures useful in servicing this radio receiver. Individual techniques will vary on the voltage and resistance measurements of individual parts.

j. Remove only *one* tube at a time when testing. Check the type number of the tube, test the tube, and, if it is not defective, return it to its proper socket before removing another tube.

k. It is assumed at each step that all previous steps have been satisfactorily completed. Isolate and clear any trouble located before proceeding with any succeeding steps.

83. Signal Substitution

In the three paragraphs which follow (84, 85, and 86), the various locations and points for signal substitution will be found. It is essential that the repairman use these methods to reduce repair time and to service the receiver efficiently. Use figure 42 for following the signal through different stages.

84. A-f Tests

a. Terminal 3 of Tube V–10 (Plate of A-F Output). Apply an audio signal through a series capacitor (approximately 0.05 uf) to terminal 3 of tube V–10. Listen in at the speaker or headset for the signal, which may be rather weak. No

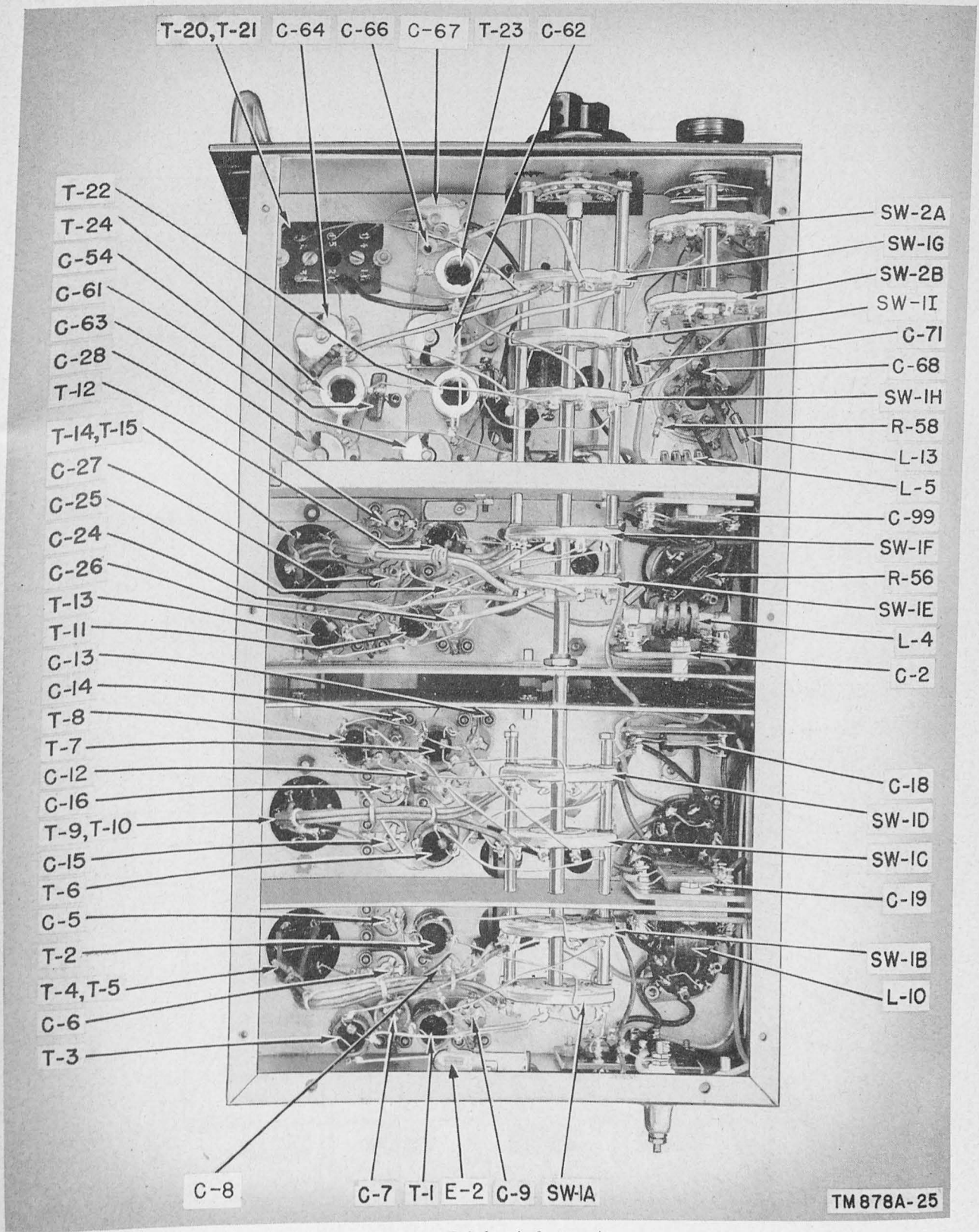


Figure 30. R-f chassis, bottom view.

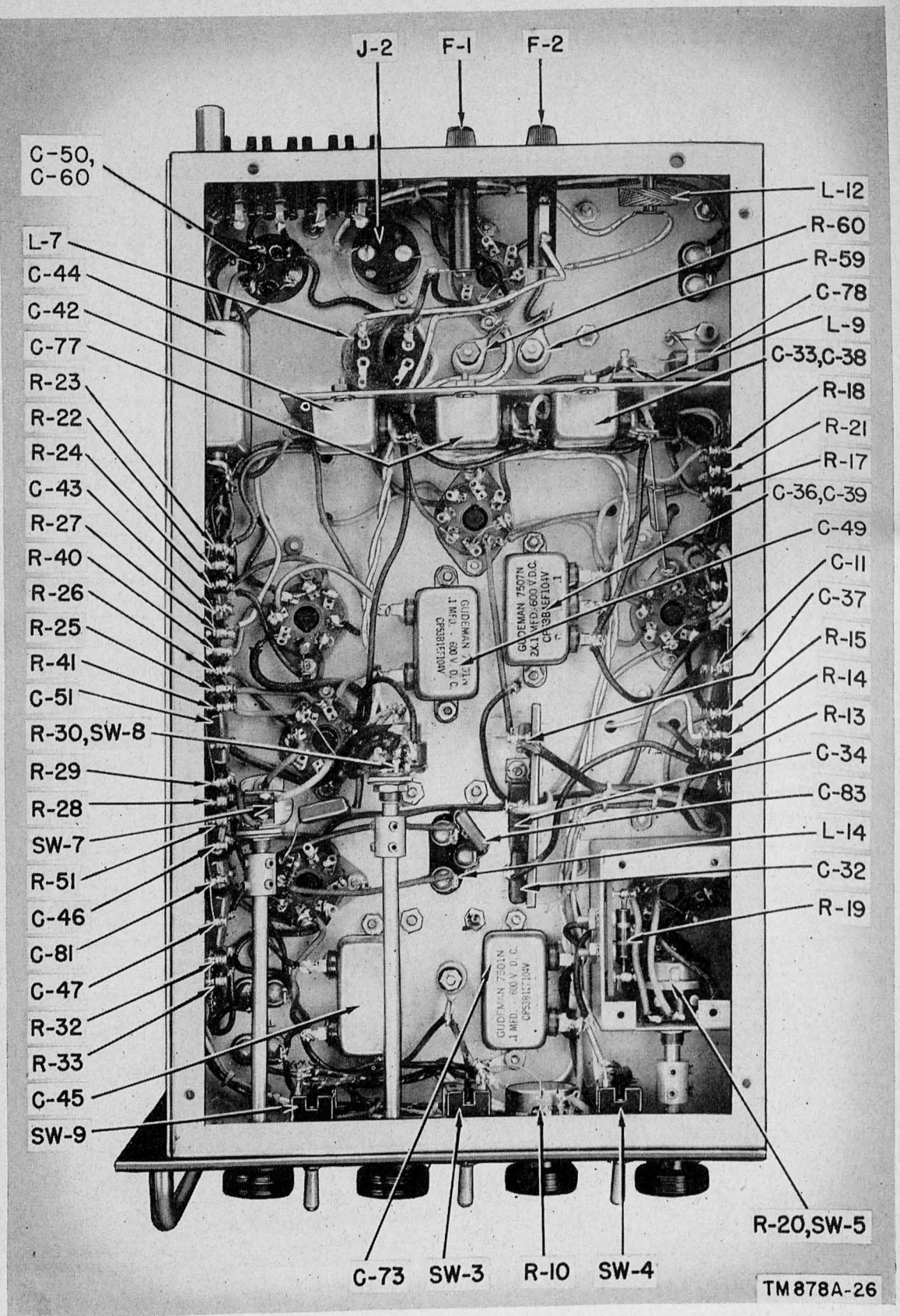


Figure 31. Audio chassis, bottom view.

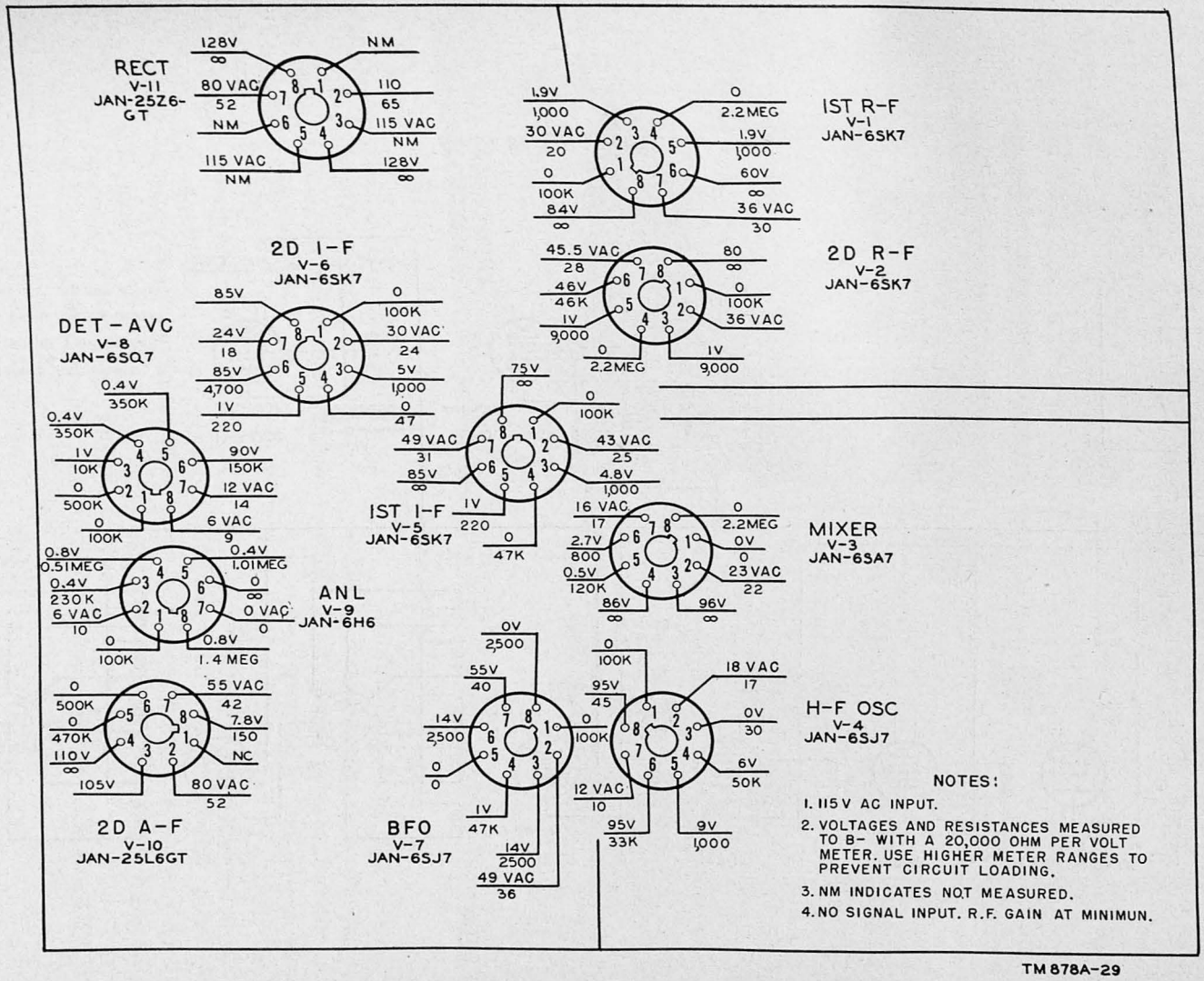
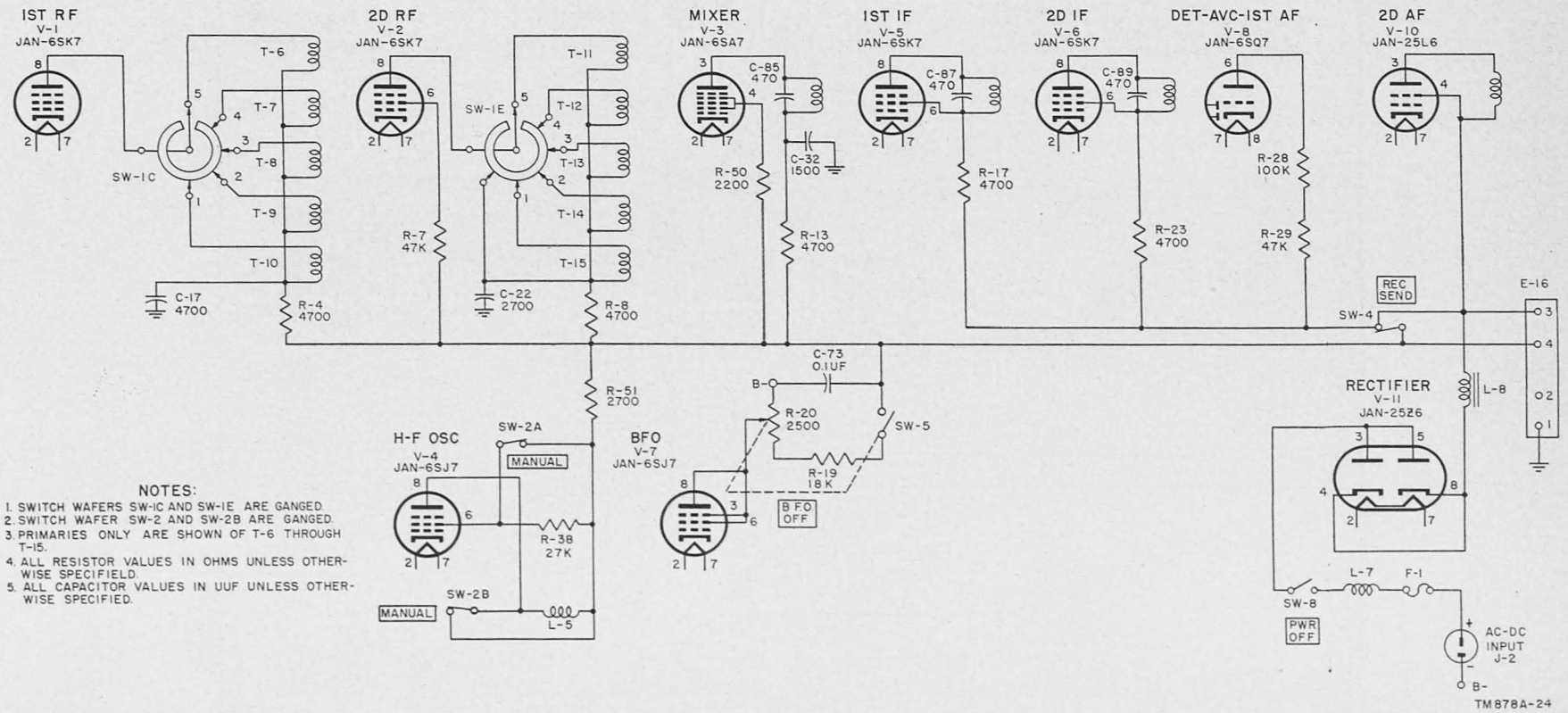


Figure 32. Radio Receiver R–96A/SR, voltage and resistance measurements.



NOTES:

1. SWITCH WAFERS SW-IC AND SW-IE ARE GANGED.
2. SWITCH WAFER SW-2 AND SW-2B ARE GANGED.
3. PRIMARIES ONLY ARE SHOWN OF T-6 THROUGH T-15.
4. ALL RESISTOR VALUES IN OHMS UNLESS OTHERWISE SPECIFIELD.
5. ALL CAPACITOR VALUES IN UUF UNLESS OTHERWISE SPECIFIED.

Figure 33. B+ voltage distribution.

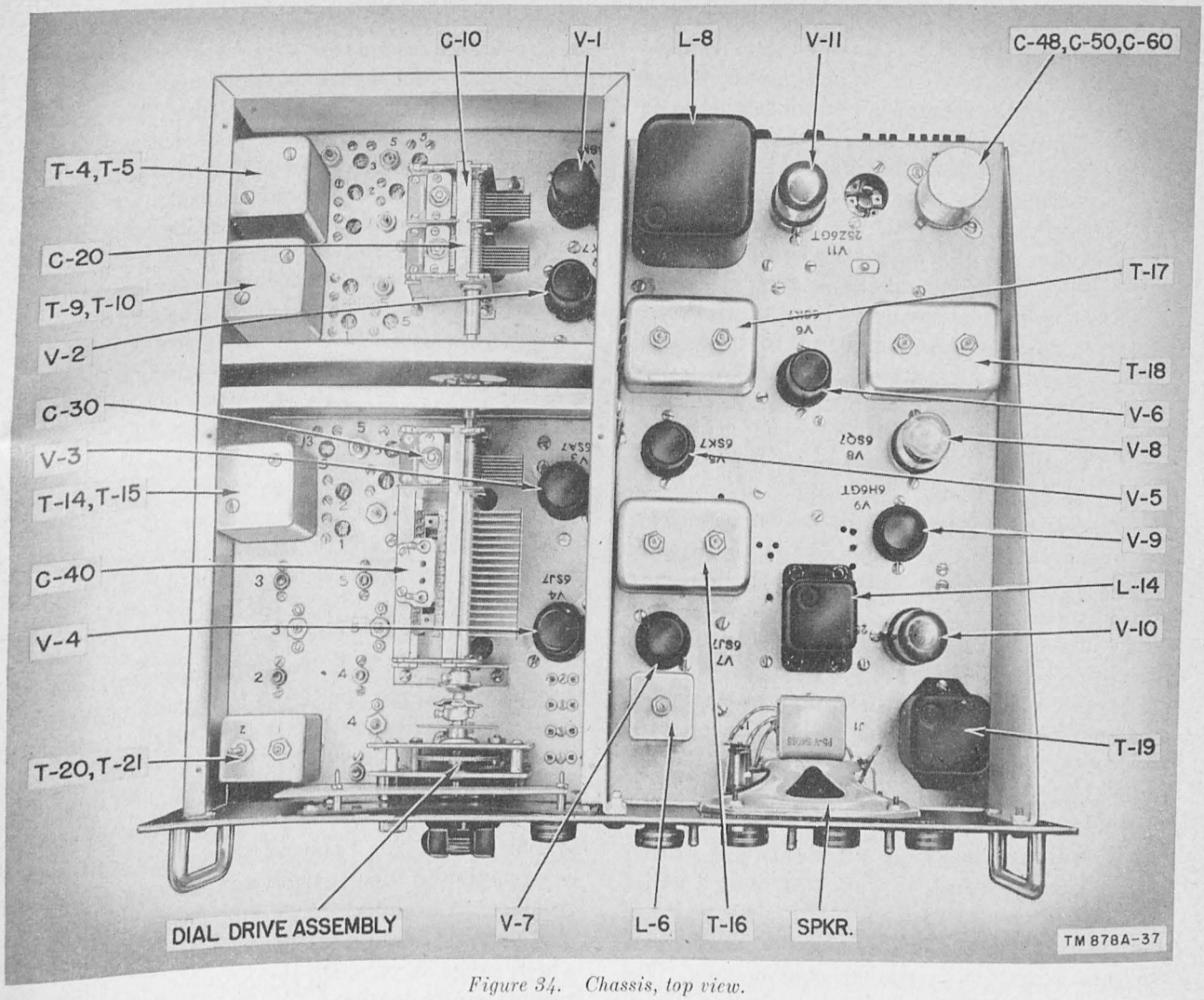


Figure 34. Chassis, top view.

signal at this point would indicate that transformer T–19 is open, tube V–10 is shorted, or that there is an open or shorted wiring connection. Check for open connection and test tube V–10.

b. Terminal 5 of Tube V–10 (Grid of A-F Output). Introduce an audio signal to terminal 5 of tube V–10. The output heard in the speaker or headset should be louder than that in the preceding test. If the signal is weaker, test tube V–10 and cathode bias resistor R–33 and capacitor C–48. Capacitor C–47 might be shorted, or the plate or screen voltage may be low.

c. Terminal 6 of Tube V–8 (Plate of First Audio). Apply the audio signal across capacitor C–81, which is connected from terminal 6 of tube V–8 to B—. If the signal is much weaker than the preceding step, check for shorted capacitor C–81, open coil L–14, or open capacitor C–47. Test tube V–8 for a short circuit.

d. Terminal 2 of Tube V–8 (Grid of First Audio). Placing a signal across A. F. GAIN control R–30 should give an increase in volume over tests performed in the above paragraphs. The volume can be varied by turning the control. If the signal is not increased, check the control for opens and see whether the plate voltage is correct. Low plate voltage may be due to defective resistor R–27, R–28, or R–29 or shorted capacitor C–44 or C–45. A high plate voltage will indicate an open cathode resistor R–27.

85. I-f Tests

a. Terminal 8 of Tube V–6 (Plate of Second I–F).

(1) Receiver controls are set the same as for stage gain measurements (par. 88). The signal generator output should be kept

to a value that does not overload the stage but is high enough so that changes in volume level can be recognized. These receiver and signal generator settings also are to be used in the r-f and mixer tests.

(2) Apply a modulated 550-kc i-f signal to terminal 8 of tube V–6 through the series capacitor (0.05 uf). A slightly smaller value for the capacitor can be used if 0.05 uf is not available. A relatively strong signal should be heard in the headset or speaker compared to the signal heard in the a-f tests. Lack of signal or a weak signal can be traced to defective i-f transformer T–18, open capacitor C–43 or C–51, or defective load resistor R–26 or R–40. Test tube V–6.

b. Terminal 4 of Tube V–6 (Second I-F). Inject a modulated i-f signal of 550 kc to terminal 4 (control grid) of tube V–6 and note whether there is an increase of volume. A reduction or only a very slight increase may be caused by shorted capacitor C–37, C–39, or C–88. Check the plate and screen voltages. Zero voltage at the plate or screen will occur if resistor R–23 is open or if capacitor C–42 is shorted. High plate voltage would indicate that either resistor R–18 or R–21 is open.

c. Terminals 8 and 4 of Tube V–5 (First I-F). The same test used on terminals 8 and 4 of tube V–6 can be used on terminals 8 and 4 of tube V–5. The circuit is similar and may create the same troubles in similar components. The audio output should increase progressively. Check tube V–5.

d. Beat-Frequency Oscillator Tube V–7. The bfo is tested by removing the modulation from the signal generator and turning B. F. O.-OFF switch SW–5 on. Turn the bfo control to increase the oscillator injection, and listen for an audio note. The absence of a signal will indicate that the bfo is out of alinement or that the oscillator is not oscillating. Realine, if necessary, or test tube V–7. Oscillator components may be open or shorted. Be sure to check capacitor C–37 for a short.

86. R-f Tests

a. Terminal 8 of Tube V–3 (Mixer). A modulated 550-kc i-f signal should be fed in to terminal 8 (signal grid) of tube V–3. The output noted usually is approximately the same or slightly greater than that heard with a signal injected at terminal 4 (control grid) of tube V–5. Low plate or screen voltage might be caused by a defective resistor R–13 or R–50 or a shorted capacitor C–32 or C–97. High plate or screen voltage may be caused by an open resistor R–11 or open choke L–4. No signal or a very weak signal can be traced to the above faults or to a defective i-f transformer T–16. Test tube V–3.

b. Terminal 4 of Tube V–2 (Second R-F). Apply a modulated r-f signal to terminal 4 (control grid) of tube V–2. The frequency of the signal should be within the range of the band being checked, and the tuning indicator should be set to the correct frequency to receive this signal. If no signal is heard, the voltages of tube V–2 should be checked (fig. 32). With correct voltage readings obtained, the h-f oscillator should be checked to see that it is oscillating. To check oscillation, check the voltage across grid resistor R–58 with a VTVM (vacuum-tube voltmeter). A voltage of approximately 6 to 9 volts is normal. No voltage indicates that the h-f oscillator is not functioning. It must be put into operation before continuing with the r-f tests. Follow the suggestions given in the trouble charts of paragraphs 79 and 80. The r-f stages are similar in construction to the i-f stages and present the same troubles. Checking the signal from the mixer grid to the r-f stage to the antenna will indicate which stage is causing the trouble so that the trouble can be localized.

87. Stage Gain Chart Usage

a. Average stage gain is listed in the stage gain charts given in paragraph 88. Use these charts to check the over-all gain of the receiver and the gain of each r-f or i-f stage or groups of stages. Low output at any point checked indicates a loss of gain in some stage or stages. Checking the gain per stage localizes the trouble. These charts can be used in the signal substitution or signal tracing methods of trouble shooting. The reference level of output for the microvolt inputs listed in the charts is 50 mw. To read the output in the measurements, SPKR.-OFF switch SW–9 is placed in the OFF position. Resistor R–34, a 20-ohm resistor, then is the output load, and the voltage is read across it with the output

meter. A reading of 1 volt will be read with 50-mw output, and the 3- or 5-volt output meter range should be used. If the signals have to be monitored, the headset can be used.

b. The speaker should not be used during the stage gain measurements since the voice coil would not give the proper load for a 1-volt output at 50 mw. The signal generator used for gain checks must have a calibrated output. To get accurate readings at low inputs such as 1 to 10 microvolts, the r-f leakage of the signal generator must be very low. This can be checked by turning the attenuator to the lowest output and disconnecting the signal generator lead from the receiver. Leakage will be indicated by the signal coming through even though the signal generator is turned to its lowest output and is not connected to the receiver.

88. Stage Gain Charts

Note. The following settings will be used for all stage gain measurements:

Receiver settings:

A. F. GAIN	Fully clockwise.
R. F. GAIN	Fully clockwise.
A. V. C. ON-OFF control	ON.
SPKR.-OFF control	OFF.
A. N. L. OFF-ON control	OFF.

Signal generator settings:

Modulation frequency	1,000 cycles.
Percent of modulation	30.

a. RADIO RECEIVER R–96A/SR, R-F STAGES.

Signal generator output connection						
Antenna binding post.	Control grid, first r-f stage, Tube JAN–6SK7.		Control grid, second r-f stage, Tube JAN–6SK7.		Mixer grid, mixer Tube JAN–6SA7.	
Band	Freq (kc)	Signal generator output (microvolts)				Output meter reading (volts)
1	200	1. 0	6. 0	40	380	1. 0
2	380	1. 5	8. 0	36	300	1. 0
3	2, 250	1. 4	9. 5	51	410	1. 0
4	4, 500	2. 4	15. 0	58	425	1. 0
5	9, 000	3. 2	20. 0	60	450	1. 0

b. RADIO RECEIVER R–96A/SR, I-F STAGES.

Signal generator frequency (kc)	Signal generator output connection	Signal generator output (microvolts)	Output meter reading (volts)
550	Mixer grid	160	1. 0
550	First i-f grid	1, 700	1. 0
550	Second i-f grid	39, 000	1. 0

Note.—Detector sensitivity is 0.7 volt for 50 mw output.

Section III. REPAIRS

89. Replacement of Parts

Careless replacement of parts makes new faults inevitable. Note the following points:

a. Before a part is unsoldered, note the position of the leads. If the part, such as a transformer, has a number of connections, tag all of the leads so that they can be identified when the part is reinstalled.

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

c. Do not allow drops of solder to fall into the set, since they may cause short circuits if not removed.

d. A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints, since a poorly soldered joint is one of the most difficult faults to find.

e. When a part is replaced in r-f or i-f circuits, it must be placed exactly as the original one. Failure to observe this precaution may result in decreased gain or possibly in oscillation of the circuit.

90. Replacing Special Parts

a. TUNING KNOB. It is sometimes necessary to replace the spring that acts as a friction lever in the tuning knob. Its adjustment is explained in paragraph 91.

b. GEAR DRIVE. Replacing the gear drive mechanism is explained in paragraphs 93 and 94.

c. TUNING CAPACITOR. First loosen the coupling shaft that connects the capacitors to the gear drive mechanism. The nuts that hold the capacitor to the chassis (located on the underside of the chassis) should be removed from the spade bolts. Be careful, when replacing the new capacitor, that all connections to these bolts that were originally connected to the old capacitor are replaced.

d. Band Switch (SW–1). The replacement of a wafer section or sections demands extreme care.

(1) To replace switch decks (figs. 30 and 34), first remove the center ½-inch Cinch button of the three Cinch buttons on the back of the chassis. Loosen the shaft coupling next to the switch shaft and remove the shaft through the ½-inch hole in the back of the chassis. To replace the switch deck in the front section, unsolder the wire from the defective switch deck, tagging each lead as it is removed. Unscrew the No. 5–40 nut from the back of the last switch deck and pull the threaded shaft through the ⅜-inch hole in the front panel until the defective deck is clear. Take care not to lose the metal spacers and phenolic washers. To replace the switch decks in the rear switch section, unsolder the leads from the defective switch deck and tag each lead as it is removed. Remove the two ⅜-inch Cinch buttons from the back of the chassis. Unscrew the No. 5–40 nuts from the front of the threaded shafts and pull the threaded shafts through the ⅜-inch hole in the back of the chassis until the defective switch deck is clear. Take care not to lose the metal spacers and phenolic washers.

(2) To replace the BAND SWITCH, first remove the front panel from the chassis. Then remove the front plate from the r-f tuning section; be careful not to damage the dial. Unsolder the 10 leads that come from the r-f section to the i-f section through the terminal board. Unsolder the lead from the plate (pin 3) of Tube JAN–6SA7. Locate and remove the three screws that hold the chassis to the r-f chassis. Loosen the coupling between detent switch sections of the BAND SWITCH. Remove the antenna feed-through insulator. Remove the screws from the r-f shield that holds the r-f chassis in place.

(3) To remove the front switch assembly, take out the three screws from the back plate of the r-f chassis and slide the plate back until the end of the switch is clear. To remove the front section of this switch assembly, unsolder all leads to the switch (tagging them as removed) and the four leads to the metal case capacitors mounted on the sides of the baffle shield, and remove the baffle shield as part of this switch assembly.

(4) The back decks of the rear switch assembly may be removed by removing the nuts from the through-bolts.

e. Parts Mounted on Terminal Boards.—Those parts which are accessible can be removed with the terminal boards in position. For the parts not accessible, loosen the terminal board, taking care that the nuts and bolts used (in some cases) to secure the terminal board are not lost.

91. Tuning Knob Adjustment

To make the required adjustments on the tuning knob, first remove the cover plate. To remove the cover plate, pry it off with the blade of a screw driver. This will expose the locking nut and rectangular band spring which applies pressure to the tuning knob. The locking nut presses against the spring which, in turn, holds the knob tight to the dial assembly shaft. Tighten the locking nut until enough pressure is exerted by the spring to prevent the tuning knob from slipping. Use a ⅜-inch wrench to turn the locking nut. If the locking nut is too loose, the tuning knob will turn without revolving the tuning capacitor gang. Tighten the locking nut until one-half of the spring bow is removed. Do not tighten the locking nut too much; the spring might break.

92. Tuning Indicator Recalibration (figs. 2, 9, and 34)

a. The tuning indicator will require recalibration if the gear drive assembly is removed and replaced or if the set has been subjected to excessive shocks which have loosened some adjustment in this mechanism. Lack of calibration is evidenced by the dial pointer reading the wrong frequency when the set is tuned to a station of a known frequency. Recalibration consists of making the dial pointer point to the correct frequency mark on the dial when the tuning capacitor gang also is set to that frequency. First loosen the setscrews on the tuning gang end of the flexible coupling. The tuning gang now can be turned to the fully meshed position (plates closed). With the tuning gang in this position, the dial gear drive is turned so that the dial pointer moves to the right until the mechanical stop reaches the end of its travel.

b. The dial gear drive is rotated by turning the tuning knob. The flexible coupling setscrews now can be tightened. Leaving the tuning gang still fully meshed, the dial pointer should be to the right and parallel with the bottom edge of the dial opening in the cabinet. If the pointer is in any other position, loosen the screw holding it to its shaft and place it in the correct position; then retighten the screw. The vernier dial should be set to 0 while the tuning gang and dial pointer are in the recalibration position. The tuning dial should be turned through its entire range and checked for freedom of action to see that the dial pointer does not "hang up" at any point. If it does, the pointer should be checked to see that it is not rubbing against the dial face. If this is not the source of trouble, check the tuning knob spring tension and the gear drive mechanism. Instructions on their adjustment and repair can be found in paragraphs 91, 93, and 94. If, after the above adjustment has been completed, the calibration is still incorrect, it will be necessary to re-aline the receiver in accordance with the instructions given in paragraphs 96 through 102.

93. Gear Drive Removal (figs. 34 and 35)

Removal of the dial gear drive assembly involves disassembly of other parts within the receiver. To facilitate removal of the dial gear drive assembly, proceed as follows:

a. To remove the chassis and front panel from the cabinet, first remove the six large-head machine screws from the left and right edges of the front panel. Remove the rear connections to the chassis; then pull the chassis and front panel from the cabinet. This exposes the dial gear drive.

b. To remove the knob, use the special Allen type wrench contained within the chassis. Two wrenches suitable for this operation are secured

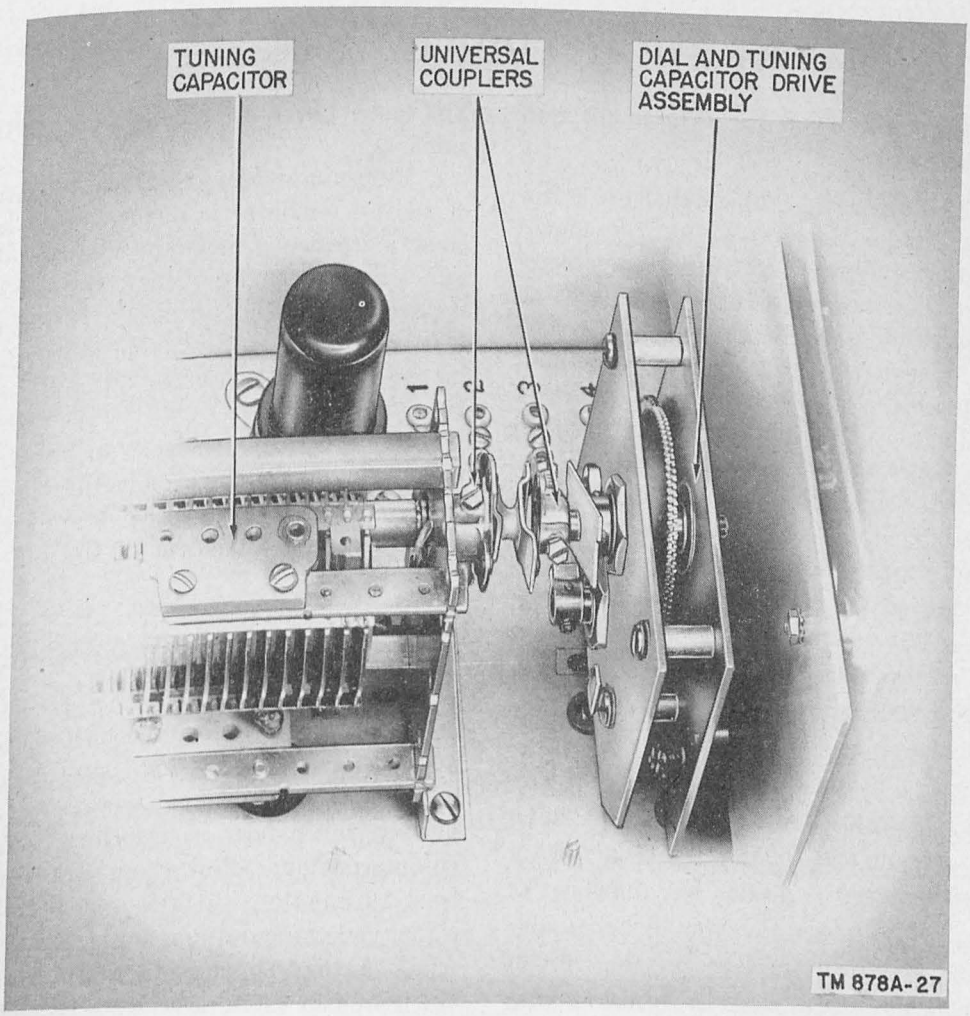


FIGURE 35. *Tuning assembly, cutaway view.*

by clips on the side of the r-f shield wall directly above tube V–5. Insert the wrench into the Allen screws and turn counterclockwise to loosen the screws enough to remove the knobs from their shafts.

c. To remove the dial lock lever, unscrew the pivot screw and pull the lever away from the panel.

d. To remove the front panel, take off the toggle switch nuts and all screws which hold the panel to the chassis members. Leave the speaker, panel lamp, and PHONES jack secured to the panel. Be careful, at this point, to prevent the weight of the front panel from damaging the dial gear drive. After all the screws that fasten the dial gear drive assembly to the panel are removed, the flexible coupling and the screw lugs under the dial drive are the only fastenings holding the dial drive to the chassis. By loosening the setscrews on the flexible coupling and taking the nuts from the mounting lug screws underneath the chassis, the dial drive can be removed. Rock the assembly gently, at the same time lifting upward at the front end. When the lug screws are clear of their chassis holes, the assembly can be pulled from the tuning gang shaft. The unit now can be worked on or replaced.

94. Gear Drive Replacement

To replace the dial gear drive, follow in reverse order the procedure outlined in paragraph 93. When replacing the assembly, do not use too much force. Forcing may result in breaking or bending component parts.

95. Refinishing

Instructions for refinishing badly marred panels or exterior cabinets are given in TM 9–2851. Minor scratches should be taken care of to prevent rust and corrosion (par. 40).

Section IV. ALINEMENT PROCEDURES

96. Test Instruments Used for Alinement and Adjustment

a. Signal Generator. The signal generator used to aline Radio Receiver R–96A/SR should be an accurately calibrated instrument capable of producing audio tone modulated r-f signals. It should cover the frequencies from 135 to 12,000 kc. Signal Generator I–72 is an instrument capable of producing these frequencies. A satisfactory output is about 100 microvolts, and an output impedance of 100 ohms will provide the required match for alining the r-f circuits. The output impedance and attenuator calibration is not very important for alinement of the i-f stages. Dial calibration of the receiver can be made only as accurate as the calibration of the signal generator unless a frequency meter is used. For best results in alinement and stage gain measurements, the signal generator and receiver should be located in a screen room, if one is available.

b. Output Meter. An a-c type output meter capable of responding to the signal generator modulating frequency is needed for alinement of the receiver. The meter also should be capable of indicating half-scale voltage on the 10-volt range. An output meter such as furnished with Test Set I–56 is satisfactory for this purpose. The meter resistance should be greater than 500 ohms.

c. Frequency Meter. More accurate settings of the h-f oscillator frequencies can be made by using a frequency meter in conjunction with the signal generator. Frequency Meter Set SCR–211 is adequate for this purpose. If Rectifier Power Unit RA–133 is not available with this frequency meter, four Batteries BA–30 and six Batteries BA–2 are needed.

d. Headset. A headset can be used for alinement and signal generator calibration, if desired.

e. Alinement Tool. A standard alinement tool is used for alinement of the r-f, i-f, and bfo circuits.

97. Calibration of Signal Generator

Accurate alinement of the h-f oscillator (V–4) in the receiver requires the use of the frequency meter to check the signal generator setting, as follows: Place the signal generator and the frequency meter near each other. Turn on both equipments and allow them to warm up for at least 15 minutes. Attach a piece of wire to the signal generator output connection and place the wire near the frequency meter antenna. Calibrate the frequency meter according to instructions furnished with the meter. Set the frequency meter

to the exact frequency at which the signal generator is to be used. While listening to the headset, which is connected to the frequency meter, tune the signal generator to the approximate frequency until a zero beat is heard. The signal generator now is set for the exact frequency desired. Turn off the frequency meter and remove the wire attached to the signal generator output connection.

98. I-f Stage Alinement Procedure

Band receiver is set for i-f alinement to—	Signal generator frequency	Dummy load	Connect signal generator to—	Adjust for maximum (in order given)
2	550 kc	None	Stator plate of mixer capacitor C–30	T–18, T–17, and T–16. Two adjustments on each transformer. Repeat.

Note. See figure 36 for location of i-f adjustments.

99. Bfo Alinement Procedure

a. Apply i-f signal without modulation.

b. Turn B. F. O.-OFF switch SW–5 to on position.

c. Turn bfo injection control clockwise to approximately the midposition.

d. Adjust the slug screw on the top of coil L–6 (fig. 34) until the desired audio frequency is obtained (approximately 1,000 cycles).

Note. See figures 34 and 36 for location of bfo adjustment.

100. H-f Oscillator Alinement

H-f oscillator alinement can be accomplished by one of two methods. One method is to use a modulated signal and adjust the oscillator for maximum voltage on the output meter. The other method involves alining the bfo (L–6) for zero-beat before starting the h-f oscillator adjustment, then setting the receiver and signal generator to the proper frequency, and adjusting the h-f oscillator for a zero-beat at the prescribed frequencies. After h-f oscillator alinement, realine the bfo as shown in paragraph 99. The signal used for h-f oscillator alinement is unmodulated when the zero-beat method is used. See figure 37 for adjustment locations.

101. R-f and Mixer Alinement

The alinement of the r-f and mixer stages is similar to the i-f stage alinement. Maximum output will be obtained when the adjustments are peaked. A modulated signal is used in the alinement of the r-f and mixer stages. See figure 37 for adjustment locations

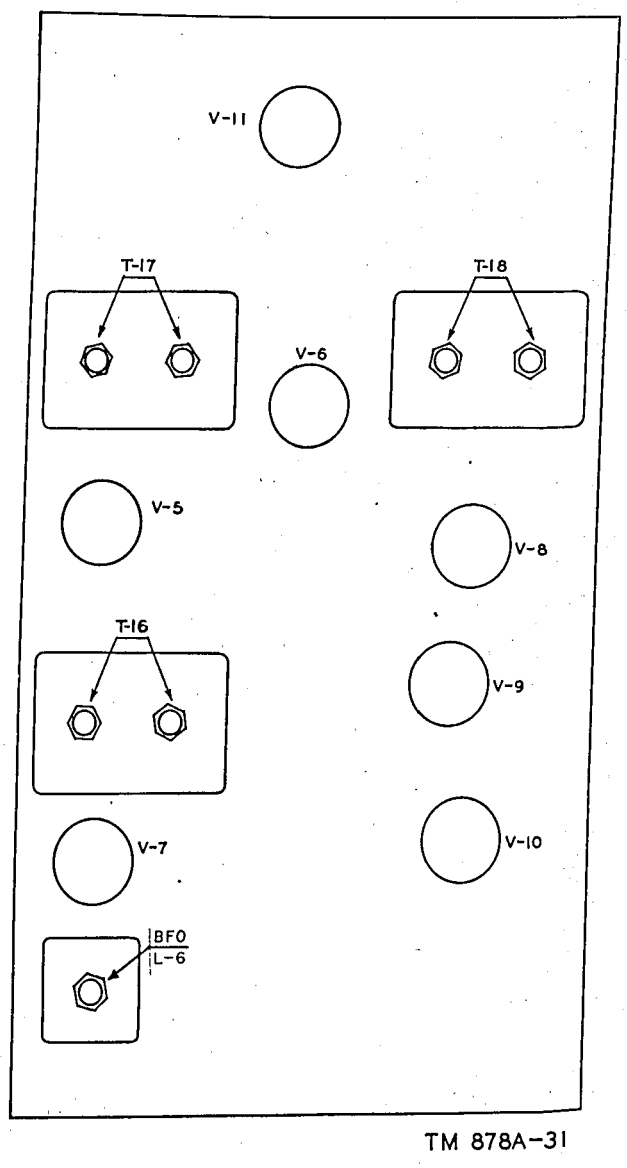


Figure 36. I-f alinement diagram.

102. H-f Oscillator, Mixer, and R-f Alinement Procedure and Chart

a. H-f oscillator, mixer, and r-f alinement procedure follows the order listed below for each band:

(1) H-f oscillator adjustment on the high end of the band.
(2) Mixer adjustment on the high end of the band.
(3) Second r-f adjustment on the high end of the band.
(4) First r-f adjustment on the high end of the band.
(5) H-f oscillator adjustment on the low end of the band.
(6) Mixer adjustment on the low end of the band.
(7) Second r-f adjustment on the low end of the band.
(8) First r-f adjustment on the low end of the band.

Note. There are no adjustments on the l-f end of the r-f and mixer coils (T–4, T–5, T–9, T–10, T–14, and T–15).

b. The h-f oscillator adjustments may have enough range to tune to both the higher and lower values which give the proper intermediate frequency at the mixer stage. This receiver is designed to operate correctly when the oscillator is tuned to the higher frequency. If tuned to the lower frequency, the oscillator will not track with the r-f and mixer stages and may cause images.

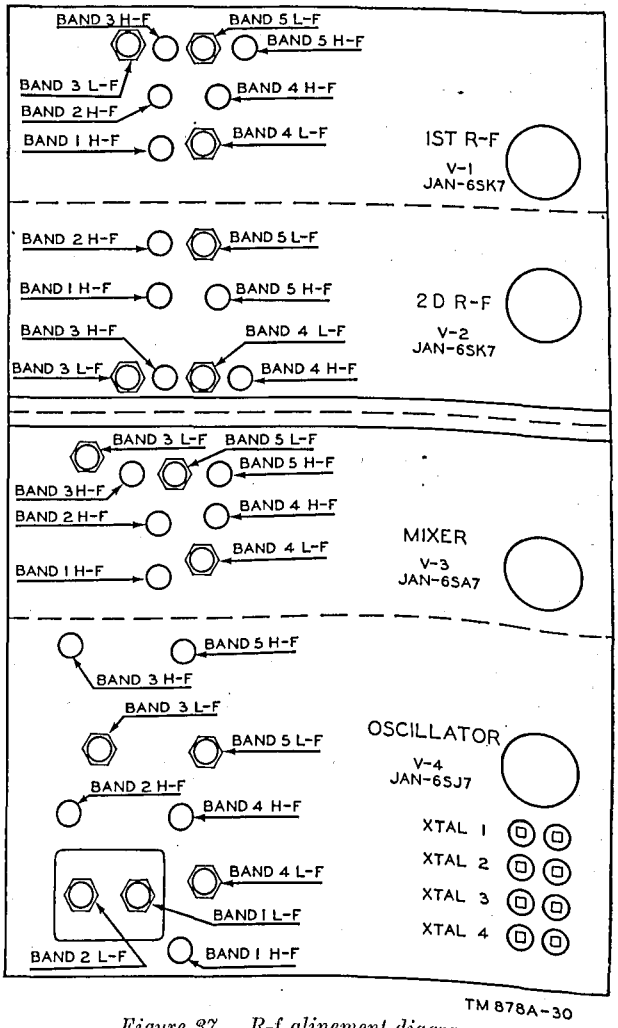


Figure 37. R-f alinement diagram.

c. The h-f oscillator, mixer, and r-f alinement chart is given below:

	End of band	Band No. 5	4	3	2	1
Dial setting frequency	High	11. 5 mc	5. 8 mc	2. 8 mc	480 kc	240 kc
	Low	6. 5 mc	3. 5 mc	1. 6 mc	280 kc	140 kc
Signal generator frequency	High	11. 5 mc	5. 8 mc	2. 8 mc	480 kc	240 kc
	Low	6. 5 mc	3. 5 mc	1. 6 mc	280 kc	140 kc
Oscillator adjustments to be peaked	High	C–61	C–62	C–63	C–64	C–67
	Low	T–22	T–23	T–24	T–20	T–21
Mixer adjustments to be peaked	High	C–24	C–25	C–26	C–27	C–28
	Low	T–11	T–12	T–13		
Second r-f adjustments to be peaked	High	C–12	C–13	C–14	C–15	C–16
	Low	T–6	T–7	T–8		
First r-f adjustments to be peaked	High	C–1	C–2	C–3	C–4	C–5
	Low	T–1	T–2	T–3		

103. General

Receiver performance sometimes is impaired slightly when replacements have been made, if the receiver recently has been moistureproofed and fungiproofed, or if the receiver has been in use for a long time without readjustment. The receiver must meet the minimum standards required of Signal Corps class A equipment. When the performance is thought to be below standard, follow the final testing explained in paragraphs 104 through 115. The following tests are explained:

Beat-frequency oscillator.
Dial calibration accuracy.
Sensitivity (a-m signal).
Selectivity.
Image rejection ratio.
Avc characteristics.
Power output.
Frequency response.

104. Test Conditions

a. Before making these final tests, make sure the proper test equipment is available. The test equipment should cover the bands of frequencies to be tested and should have calibrated outputs. Warm up the receiver and test equipment for 1 hour prior to making final tests. Unless otherwise specified, the standard test condition is used to provide a basis for the performance of the equipment.

b. Apply an r-f signal modulated 30 percent at 400 cycles to the antenna terminals; through a dummy antenna consisting of 30 ohms and 300 uuf (micromicrofarads) in series. Set the A. F. GAIN and the R. F. GAIN controls to their fully clockwise positions. Tune the receiver to resonance with the signal from the signal generator and adjust the output of the generator to produce 50 mw in the output load. This load is a 20-ohm resistor (R–34) placed across the secondary of the audio output transformer when the speaker (SPKR.-OFF) switch is in the OFF position. An a-c output meter is used for the indicator unless a milliwatt meter is available. A voltage of 1 volt will be indicated on the output meter when 50 m-w output is being dissipated in the load resistor. Refer to figure 38 for connections of signal generator and output meter to receiver. Check alinement before any final testing. A headset can be used for listening to the signal.

105. Positions of Controls

For any tests not involving a bfo or noise limiter, set the controls as follows:

Control	*Setting*
A. F. GAIN-PWR. OFF	Fully clockwise, or as instructed.
R. F. GAIN	Do.

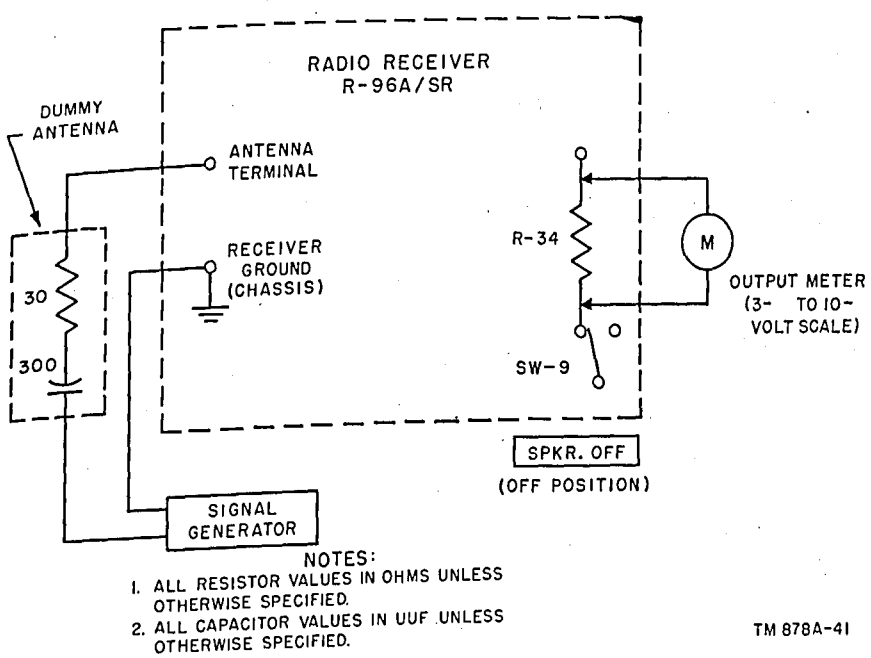


Figure 38. Over-all output check set-up.

Control	*Setting*
A. V. C. ON-OFF	ON.
A. N. L. OFF-ON	OFF.
SPKR.-OFF	Do.
REC.-SEND	REC.
B. F. O.-OFF	OFF.
DIAL LOCK	Do.
Main tuning dial	As desired.
BAND SWITCH	Do.
CRYSTAL-MANUAL	Do.

106. Test Sources of Trouble

During the final testing with the necessary test equipment, troubles may show up that normally are not encountered. Test equipment must be rigidly inspected to see that it is accurate. Be sure that the power supplies are correct for all pieces of equipment. Check connections for good contacts and proper routing.

Test	*Possible trouble causes*
Beat-frequency oscillator	Does not oscillate close enough to intermediate frequency.
Dial calibration accuracy	Signal generator not accurate, alinement off, or dial drive off.
Sensitivity	Low voltages, low emission, or alinement off.
Signal-to-noise ratio	Microphonic tubes, loose connections, or poor contacts.
Selectivity	I-f alinement off.
Image rejection ratio	Interstage coupling, leads too long, leads not properly dressed, or poor shield grounds.
Ave characteristic	Alinement off.
Audio power output	Low emission of tubes or alinement off.
Frequency response	Alinement off or audio filter components changed in value.

Note. For further causes of trouble refer to paragraphs 79 and 80.

107. Beat-frequency Oscillator

a. Inject an unmodulated signal of 550 kc (the i. f.) into the dummy antenna of the receiver.

b. Turn the B. F. O.-OFF switch on. An audio output signal of about 1,000 cycles should be heard.

c. No signal indicates either trouble in the i-f or bfo circuits.

108. Dial Calibration Accuracy

a. The design of the tuning dial results in very high tuning accuracy. If several settings across the band to be tested are checked, an accuracy of 1.03 percent should be attained. The accuracy of calibration when taken at several points along any scale, for the fine ranges, should be within ± 1 percent.

b. Connect a suitable frequency meter or crystal calibrator to the receiver input and check the tuning accuracy of each of the five bands. Make sure the frequency meter or the calibrator is more accurate than 1 percent.

c. Set the B. F. O.-OFF switch to ON.

d. Tune receiver and calibrator to several points in each band. A 1,000-cycle audio signal will be present if the settings are correct.

109. Sensitivity

a. The sensitivity figure of a receiver is a measure of its ability to receive weak signals and is the signal input necessary to produce rated power output at a 10 to 1 signal-plus-noise to noise ratio. The three different test frequencies picked should be at the center, high, and low ends of each band. Refer to the stage gain charts in paragraph 88 for test points.

b. The signal generator is connected to the receiver through a dummy antenna (fig. 38) suitable for the unbalanced input of this receiver. The receiver output is measured with an output meter adjusted to match the output impedance of the receiver. The output of the signal generator is 30 percent modulated at 400 cps. The ave is turned off and the R. F. GAIN control adjusted to a setting at which there is no change in receiver output as the A. V. C. ON-OFF switch is turned ON and OFF. With the test signal tuned in on the receiver, the A. F. GAIN and signal generator output are adjusted to a condition which produces the specified audio power output (50 mw) with the signal modulated and 5 mw with the modulation removed. The generator output in microvolts is the sensitivity figure.

c. The a-c or d-c power input to the receiver should remain constant throughout these tests. A higher sensitivity will be noted with the receiver operating on ac. D-c operation may vary the sensitivity to a maximum of 20 percent lower than with a-c operation.

110. Selectivity (fig. 39)

a. The controls are set the same as listed in paragraph 105, with the exception of the A. V. C. ON-OFF switch which is turned to the OFF position during the actual checks.

b. Connect an r-f signal generator to the receiver dummy antenna (fig. 38). Adjust the r-

generator to emit an unmodulated 10-microvolt, r-f signal.

c. Connect a VTVM across the diode load resistors, R–26 and R–40. Make note of the reference level at resonance (receiver tuned to maximum output after the signal generator has been adjusted to 10 microvolts).

d. Adjust the r-f generator to 20 microvolts output. The VTVM should register a decided increase in the output voltage. Detune the signal generator to either side of the center test frequency. The output voltage should drop. When the VTVM reads the exact reference voltage level (*c* above), the signal generator frequency at that point is the bandwidth limit on one side of the test frequency.

e. Detune the signal generator in the reverse direction until the reference level again is reached. This will be when the VTVM voltage reading passes through its peak and drops to the reference level, and will indicate the bandwidth limit on the other side of the center test frequency.

f. The difference between the frequency on each side of the resonant center frequency is the bandwidth in kc or mc. Since the r-f signal voltage was doubled, this is the bandwidth at the 6 d-b points.

g. Reset the r-f generator to 100 microvolts output and check the bandwidth by noting how far from the center frequency (resonance) it is necessary to go, to each side, before the reference levels are reached.

h. Repeat at 1,000 and 10,000 microvolts; 10,000 microvolts corresponds to 60 db if the original reference level was checked with a 10-microvolt signal input. In-between steps may be taken until enough points are noted to draw a smooth selectivity curve.

i. If the r-f generator frequency calibration is not accurate enough for the desired purpose, check each step (center and side points) with a frequency meter, such as Frequency Meter Set SCR–211. Disable the output of the frequency meter before noting the reference level or making any readings on the VTVM.

j. If an oscilloscope and an audio oscillator are available, leave the frequency meter on the center frequency (turned off when reference level is being taken). After the side points are located, the frequency meter may be turned on and the beat note from the receiver fed into the horizontal input of the oscilloscope. This beat note is formed by the mixing of the detuned signal generator signal and the center frequency of the frequency meter signal. The vertical oscilloscope input is connected to the output of the audio oscillator. By variation of the audio oscillator frequency, the pattern (Lissajous figures) on the oscilloscope may be made to show a 1 to 1 frequency ratio. The 1 to 1 ratio can be recognized by the appearance of a straight line, an ellipse, or a circle, depending on the phases of the input voltages. The difference between the side point and the center frequency may be read directly on the audio oscillator scale. The total bandwidth will be the sum of the two separate center-to-side frequency differences.

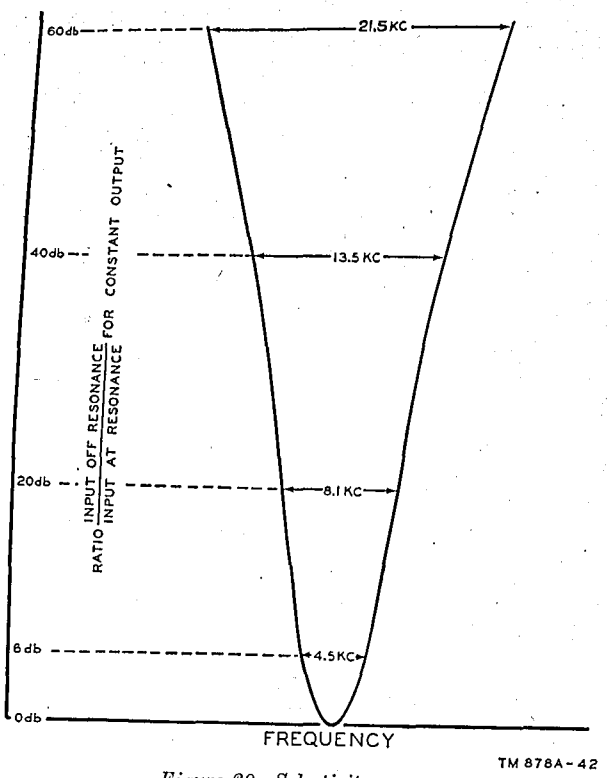


Figure 39. Selectivity curve.

k. Minimum requirements—

Signal increases (db)	*Total bandwidth*
6	Not more than 4.5 kc.
22	Not more than 8.1 kc.
40	Not more than 13.5 kc.
60	Not more than 21.5 kc.

111. Image Rejection Ratio

a. Minimum Requirements.

Test frequency (kc)	*Rejection ratio*
Lowest nominal frequency	25,000 to 1
510	2,000 to 1
1,500	3,000 to 1
2,500	1,500 to 1
5,000	1,000 to 1
10,000	600 to 1

b. SETTINGS. Follow the standard test procedure for connections of the signal generator and control settings (par. 105), with the following exceptions:

(1) A. V. C. ON-OFF switch at OFF position.
(2) A. F. GAIN, as needed.

c. PROCEDURE. Apply an r-f signal of 10,000 microvolts to the receiver at an image frequency. With the A. V. C. ON-OFF switch in the OFF position, adjust the volume control (A. F. GAIN) to just below the overloading (noticeable distortion) point. Note the output reading. Return the input signal to the fundamental frequency and adjust the input to give the same output as was obtained at the image frequency. The image frequency will be twice the intermediate frequency (2×550 kc$=1{,}100$ kc) plus the test frequency. To find the image ratio, divide the input voltage needed at the image frequency by the voltage needed at the test frequency.

112. I-f Rejection Ratio

a. The test frequencies and arrangement of test equipment are the same as used for the sensitivity measurements.

b. Apply an r-f signal of 10 microvolts modulated 400 cps at 30 percent, to the receiver through the dummy antenna (fig. 38).

c. Adjust the A. F. GAIN until 50 m-w output is obtained across the output resistor, R–34. Then, without changing the receiver controls, tune the signal generator to the intermediate frequency and increase the output until a power output of 50 mw again is obtained. The ratio of the receiver input at the intermediate frequency to the input at the test frequency is the i-f rejection ratio.

d. If unusual interference at the intermediate frequency is present in a receiver, the above check should be made. For reference levels, a receiver that is operating correctly at the same location should be checked in the same manner.

113. Avc Characteristic

a. Use the standard signal generator signal and control settings for testing the avc characteristics.

b. With a 10-microvolt, r-f signal, adjust the R. F. GAIN control to give an output of 50 mw. The input should then be increased to 500 microvolts and the output should not change more than 6 db. (Db scales on an a-f output meter may be read directly; note the proper range.)

c. Increasing the input further and up to 50,000 microvolts should not change the output more than 10 db.

114. Audio Output

The audio system is designed to deliver enough power to drive a smaller speaker and a headset with low distortion. This test is not absolutely necessary as long as speech modulated signals are received clearly.

a. The audio amplifiers are to be tested by the following method: Inject the output of an audio oscillator into the grid (pin 2) of the first audio amplifier. Turn the A. F. GAIN-PWR. OFF control fully clockwise. Adjust the input to the grid (pin 2) until the output across the load resistor is 1 watt. This can be checked with an a-c voltmeter; voltage squared divided by the resistance equals the wattage. The distortion can be measured by connecting a distortion analyzer across the load resistor.

b. The minimum requirements are shown in the following table:

Output	*Distortion (percent)*
1 watt	10

115. A-f Response

a. The a-f response is designed for the frequencies most used in voice communications. This restricts the frequency range at the upper end to about 3,000 cycles. Refer to B, figure 28 for the correct a-f response curve. A special audio filter is inserted in the grid circuit of the power output stage. This filter aids in the cut-off of the upper frequencies and the flatness of the curve below 1,500 cycles. In order to check fully the a-f response, the signal must be sent through the complete receiver. Use a signal generator provided with terminals for external modulation. Connect an audio signal generator to these terminals, and at each audio test frequency indicated in the table below, adjust the modulation level of the r-f signal generator to 30 percent. Insert at least ten microvolts r-f to the input of the receiver.

b. Requirements:

Change in frequency (cycles)	*Change in output (db)*
300	not more than −3
1,000	0
2,000	not more than −6
3,000	not more than −14

CHAPTER 7

SHIPMENTS AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND STORAGE

116. Disassembly

Remove headset, antenna, ground, power input cable, and interconnecting cables, if used. Carefully loosen and remove any mounting bolts on bottom of cabinet. Refer to paragraph 14 for possible aid regarding the original mounting procedures.

117. Repacking for Shipment or Limited Storage

a. The procedure in repacking for shipment or limited storage depends upon the material available and the conditions under which the equipment is to be shipped or stored. Refer to paragraphs 6 and 13 of this manual and follow the unpacking instructions given, in the reverse order. The circumstances involved in shipment and storage vary and, therefore, no definite procedure for repacking can be given.

b. Whenever practicable, place a dehydrating agent such as silica gel inside the packing. Protect the equipment with a waterproof sealing compound or tape. Pack the protected equipment in a padded wooden case, providing at least 3 inches of excelsior padding or some similar material between the paper barrier and the packing case.

Section II. DEMOLITION OF MATÉRIEL TO PREVENT ENEMY USE

118. General

The demolition procedures outlined in paragraphs 119 and 120 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished *only* upon order of the commander.

119. Methods of Destruction

a. Smash. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, and heavy tools.

b. Cut. Use axes, handaxes, and machetes.

c. Burn. Use gasoline, kerosene, oil, flame throwers, and incendiary grenades.

d. Explosives. Use firearms, grenades, and TNT.

e. Other. Use anything immediately available for destruction of this equipment.

f. Disposal. Bury in slit trenches, fox holes, and other holes. Throw in streams. Scatter.

120. Destruction of Components.

a. Smash crystals, tuning capacitor, tubes, coils, and switches.

b. Cut cords, headsets, transformers, and wiring.

c. Burn technical manuals, cords, capacitors, coils, and wiring.

d. Bend panel, shields, cabinet, and chassis.

e. Bury or *scatter* all the above pieces after destroying.

f. Destroy everything.

APPENDIX I

REFERENCES

Note. For availability of items listed, see SR 310-20-3, SR 310-20-4, and Department of the Army Supply Catalog SIG 1.

1. Army Regulations

AR 380-5	Safeguarding Military Information.

2. Supply Publications

SIG 1	Introduction and Index.
SIG 3	List of Items for Troop Issue.
SIG 4-2	Allowances of Expendable Supplies for Schools, Training Centers, Boards, and Fixed Installations.
SIG 10	Fixed Plant Maintenance Lists.
SB 11-6	Dry Battery Supply Data.
SB 11-76	Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.

3. Technical Manuals on Auxiliary Equipment and Test Equipment

TM 11-300	Frequency Meter Sets SCR-211-(*).
TM 11-303	Test Sets I-56-C, -D, -H, and -J.
TM 11-307	Signal Generators I-72-G, H, J, and K.
TM 11-321	Test Set I-56-E.
TM 11-837	Radio Transmitter T-83/SR.
TM 11-878	Radio Receiver R-96/SR.
TM 11-1067A	Oscilloscope TS-34A/AP.
TM 11-1209	Test Set I-157-A (Tube and Set Tester, Precision Model 920P).
TM 11-2524	Oscillator I-151-A.
TM 11-2526	Oscilloscope BC-1060-A.
TM 11-2613	Voltohmmeter I-166.
TM 11-2626	Test Unit I-176.
TM 11-2627	Tube Tester I-177.
TM 11-2654	Vacuum Tube Voltmeter (Hickok Model 110-B).
TM 11-2684	Audio Oscillator TS-312/FSM-1 (Hewlett-Packard Model 200 CR).
TM 11-5017	Output Meter TS-585/U.
TM 11-5018	Signal Generator TS-588/U.

4. Painting, Preserving, and Lubrication

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 69	Lubrication of Ground Signal Equipment.
TM 9-2851	Painting Instructions for Field Use.

5. Camouflage

FM 5-20	Camouflage, Basic Principles.

6. Decontamination

TM 3-220	Decontamination.

7. Demolition

FM 5-25	Explosives and Demolitions.

8. Packaging and Packing Instructions

a. JOINT ARMY-NAVY PACKAGING SPECIFICATIONS.

AN-D-169	Dessicants, Activated.

JAN–P–100	General Specifications.
JAN–P–106	Boxes, Wood, Nailed.
JAN–P–116	Preservation, Methods of.
JAN–P–125	Barrier Material, Waterproof.
JAN–P–131	Barrier Material, Moisture-Vaporproof, Flexible.

b. U. S. Army Specification.

100–2E	Marking Shipments by Contractors (and Signal Corps Supplement thereto).

c. Signal Corps Instructions.

720–7	Standard Pack.
726–15	Interior Marking.

9. Other Publications

FM 24–18	Radio Communication.
SR 310–20–3	Index of Field Manuals, Training Circulars, Firing Tables and Charts, Graphic Training Aids, Army Training Programs, JANAP's. Combined Communications Board Publications, Tables of Organization and Equipment, Tables of Allowances, and Tables of Basic Allowances.
SR 310–20–4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TB 11–300–3	Rectifier Power Unit RA–133 and RA–133–A.
TB 11–2627–2	Tube Test Data Cards for Use with Tube Tester I–177.
TB SIG 5	Defense against Radio Jamming.
TB SIG 25	Preventive Maintenance of Power Cords.
TB SIG 66	Winter Maintenance of Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TB SIG 123	Preventive Maintenance Practices for Ground Signal Equipment.
TB SIG 178	Preventive Maintenance Guide for Radio Communication Equipment.
TM 1–455	Electrical Fundamentals.
TM 9–2857	Storage Batteries Lead-Acid Type.
TM 11–314	Antennas and Antenna Systems.
TM 11–430	Storage Batteries for Signal Communication. Except those Pertaining to Aircraft.
TM 11–453	Shop Work.
TM 11–455	Radio Fundamentals.
TM 11–472	Repair and Calibration of Electrical Measuring Instruments.
TM 11–477	Fixed Station Radio Repair and Maintenance (Personnel Training Text).
TM 11–483	Suppression of Radio Noises.
TM 11–496	Training Text and Applicatory Exercises for Amplitude-modulated Radio Sets.
TM 11–499	Radio Propagation Handbook.
TB 11–499–( )*	Basic Radio Propagation Predictions.
TM 11–4000	Trouble Shooting and Repair of Radio Equipment.
TM 38–650	Basic Maintenance Manual.

10. Abbreviations

a-c	alternating-current
a-f	audio-frequency
a-m	amplitude-modulated
amp	ampere
AMPL	amplifier
anl	automatic noise limiter
avc	automatic volume control
bfo	beat-frequency oscillator
C	Centigrade
cps	cycles per second
c-w	continuous-wave
db	decibel
d-c	direct-current

*A new TB in this series is issued monthly which gives propagation predictions for 3 months in advance.

diam---------- diameter
E---------- enameled
EC---------- enameled and cotton covered
FCC---------- Federal Communications Commission
ft---------- foot
H-F, h-f---------- high-frequency
HS---------- hermetically sealed
h-v---------- high-voltage
icw---------- interrupted continuous waves
i-f---------- intermediate frequency
in---------- inch
ins---------- insulator
JAN---------- joint Army-Navy
k---------- kilo
kc---------- kilocycle
lb---------- pound
l-f---------- low-frequency
lg---------- long
ma---------- milliampere
max---------- maximum
mc---------- megacycle
mcw---------- modulated continuous waves
meg---------- megohm
min---------- minimum
mmf, mmfd---- micromicrofarad
mtg---------- mounting
mtg/c---------- mounting centers
mw---------- milliwatt
oper---------- operation
OSC---------- oscillator
PWR---------- power
r---------- ohms
req---------- required
r-f---------- radio-frequency
RMS---------- root mean square
SD---------- Solvent, dry-cleaning
secd---------- secondary
SLC---------- straight line capacity
SOP---------- standard operating procedure
term---------- terminal
thk---------- thick
UF, uf, mf---- microfarad
UUF, uuf, mmf- micromicrofarad
uv---------- microvolt
V, v---------- volt
VTVM---------- vacuum-tube voltmeter
w---------- watt
wd---------- wide
XTAL---------- crystal

11. Commercial Publication

Recommended Practice for Electric Installations on Shipboard (American Institute of Electrical Engineers, 33 West 39th Street, New York, N. Y.).

APPENDIX II
IDENTIFICATION TABLE OF PARTS

1. General

The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as T/O&E's, TA's, T/BA's, SIG 6, SIG 7 & 8, SIG 7–8–10, SIG 10, list of allowances of expendable material or another authorized supply basis. For an index of appropriate supply catalogs in the Signal portion of the Department of the Army Catalog, see the latest issue of SIG 1.

2. Identification Table of Parts for Radio Receiver R–96A/SR

Ref symbol	Name of part and description	Function of part
Fig. 1	RECEIVER, radio: Sig C Radio Receiver R–96A/SR; AM, CW, MCW, and ICW signals; 1700 to 8700 kc in 4 crystal controlled positions and 5th position for manual tuning over range 1–12 mc in 3 bands and 135–510 kc in 2 bands; input 115 v 50/60 cyc or 115 vdc; 61 w; std 19″ front panel suitable for rack mtg; provided with cabinet 21″ wd x 10″ h x 17½″ d; 11 tube superheterodyne ckt; includes built-in loudspeaker, power Cord CD–307–A, and built-in bfo; provisions for 4 crystals Sig C type Crystal Unit CR–18/U in Crystal Holders HC–6/U; Hallicrafters part #1X707.	For communications suitable for marine use in harbor and sea-going vessels.
E–3	BOARD, terminal: 8 silver pl brass turret type term; 2 rows of 4 term each with 2$\frac{1}{16}$″ between rows; JAN type LTS–E–2 natural phenolic board; 3½″ lg x 1⅝″ wd x $\frac{3}{32}$″ thk; two 0.156″ diam mtg holes on 3″ ctr; stamped with ckt symbols C–35, C–41, C–91, C–92; term board does not include capacitors; Hallicrafters part/dwg #88A582.	Capacitor mounting.
E–4	BOARD, terminal: total of 6 brass silver pl turret type term; 2 rows of 3 term spaced 1″ apart, rows on 1⅜″ ctr; natural phenolic JAN type LTS–E–2; 3″ lg x 1¾″ wd x $\frac{3}{32}$″ thk; mts by means of 2 right angle metallic riveted bkt; mtg ctr 1″; stamped with ckt symbols C–37, C–34, C–32; term board does not include capacitors; Hallicrafters part/dwg #88A580.	Do.
E–6	BOARD, terminal: 6 brass silver pl turret term, 2 rows of 3 term ea with 1⅜″ between rows and ⅞″ between term; natural phenolic JAN type LTS–E–2; 3$\frac{3}{32}$″ lg x 1¾″ wd x $\frac{3}{32}$″ thk; two $\frac{5}{32}$″ mtg holes 2.906″ c to c; stamped with ckt symbols C–99, C–98, C–97; term board does not include capacitors; Hallicrafters part/dwg #88A605.	Do.
E–7	BOARD, terminal: 6 brass silver pl turret term; 2 rows of 3 term ea with 1⅜″ between rows and ⅞″ between term; natural phenolic JAN type LTS–E–2; 3$\frac{3}{32}$″ lg x 1¾″ wd x $\frac{3}{32}$″ thk; two $\frac{5}{32}$″ mtg holes 2.906″ c to c; stamped with ckt symbols L–10, C–9, C–8; term board does not include inductor and capacitors; Hallicrafters part/dwg #88A606.	Capacitor and inductor mounting.

Ref symbol	Name of part and description	Function of part
E–8	BOARD, terminal: 6 brass silver pl turret term; 2 rows of 3 term ea with 1⅜″ between rows and ⅞″ between term; natural phenolic JAN type LTS–E–2; 3$^{9}/_{32}$″ lg x 1¾″ wd x $^{3}/_{32}$″ thk; two $^{5}/_{32}$″ mtg holes 2.906″ c to c; stamped with ckt symbols C–19, C–17, C–21; term board does not include capacitors; Hallicrafters part/dwg #88A607.	Capacitor mounting.
E–9	BOARD, terminal: 12 brass silver pl turret term; 2 rows of 6 term ea with 1⅜″ c to c, 2 ea spaced ¾″ c to c, 1 spaced ½″ c to c and 2 ea spaced ⅜″ c to c; JAN type LTS–E–2 natural phenolic board; 3⅝″ lg x 1¾″ wd x $^{3}/_{32}$″ thk; board supported by rt angle riveted aluminum bkt ctr on 1¾″ wd end, one 0.140″ mtg hole provided in bkt, $^{3}/_{16}$″ from opposite end and on ctr line of board is provided another 0.156″ mtg hole; stamped with ckt symbols L–4, C–22, C–23, R–9, R–8, and R–11; term board does not include inductor, capacitors, and resistors; Hallicrafters part/dwg #88A584.	Inductor, resistor, and capacitor mounting.
E–11	BOARD, terminal: 10 brass silver pl turret term; 2 rows of 5 term ea, 1⅜″ between ctr of rows and $^{5}/_{16}$″ between term, JAN type LTS–E–2 natural phenolic board; 2⅛″ lg x 1¾″ wd x $^{3}/_{32}$″ thk; board supported by rt angle riveted aluminum bkt ctr on 1¾″ wd end, two $^{3}/_{16}$″ mtg holes provided in bkt; stamped with ckt symbols C–18, R–5, R–6, R–7, and R–4; term board does not include capacitor and resistors; Hallicrafters part/dwg #88A583.	Capacitor and resistor mounting.
E–10	BOARD, terminal: 8 brass silver pl turret term; 2 rows of 4 term ea, 1$^{7}/_{16}$″ between rows and ⅜″ between term; JAN type LTS–E–2 natural phenolic board; 2⅜″ lg x 1$^{13}/_{16}$″ wd x $^{3}/_{32}$″ thk; two 0.156″ mtg holes on lg ctr line with 2″ c to c; stamped with ckt symbols R–1, R–2, R–3, C–6; term board does not include resistors and capacitors; Hallicrafters part/dwg #88A586.	Do.
E–12	BOARD, terminal: 29 brass silver pl turret term; JAN type LTS–E–2 natural phenolic board; 6¼″ lg x 2⅛″ wd x ⅛″ thk; 4 mtg holes of approx 0.156″ diam on 5.593″ x 1.750″ mtg/c; stamped with ckt symbols R–13, R–14, R–17, R–18, R–21, R–15, C–11; term board does not include resistors and capacitors; treated to resist moisture and fungus; Hallicrafters part/dwg. #88B587.	Resistor and capacitor mounting.
E–14	BOARD, terminal: 12 brass silver pl turret term; 2 rows of 5 term ea, 1⅜″ between rows and ⅜″ between term; JAN type LTS–E–2 natural phenolic board 3$^{9}/_{32}$″ lg x 1¾″ wd x $^{3}/_{32}$″ thk; two 0.156″ diam mtg holes 2.906″ c to c on lg ctr line; stamped with ckt symbols R–38, R–50, R–51, R–52, L–5; term board does not include resistors and inductor; Hallicrafters part/dwg #88A581.	Inductor and resistor mounting.
E–15	BOARD, terminal: 2 brass silver pl turret term; 1¼″ between ctr of term; JAN type LTS–E–2 natural phenolic board; 1¾″ lg x ½″ wd x $^{3}/_{32}$″ thk; two 0.156″ mtg holes on ½″ ctr; stamped with ckt symbol R–19; term board does not include resistor; Hallicrafters part/dwg #88A590.	Resistor mounting.
E–5	BOARD, terminal: 4 brass silver pl turret term; JAN type LTS–E–2 natural phenolic board; 2$^{1}/_{16}$″ lg x 1¾″ wd x $^{3}/_{32}$″ thk; two 0.140″ diam mtg holes 1.750″ c to c; stamped with ckt symbols L–9, C–78; term board does not include inductor and capacitor; Hallicrafters part/dwg #88A585.	Capacitor and inductor mounting.
E–13	BOARD, terminal: 54 brass silver pl turret term; term arranged in 3 rows of 18 ea with 1¼″ between term and ½″ between ctr lines of rows; JAN type LTS–E–2 natural phenolic board; 8″ lg x 2⅛″ wd x ⅛″ thk; mts by means of four 0.156″ diam mtg holes on 7.375″ x 1.750″ ctr; stamped with ckt symbols R–33, R–32, R–31, R–28, R–29, R–41, R–25, R–26, R–40, R–27, R–24, R–22, R–23, C–47, C–81, C–46, C–51, C–43; term board does not include resistors and capacitors; treated with fungus resistant lacquer; Hallicrafters part/dwg #88B588.	Capacitor and resistor mounting.

Ref symbol	Name of part and description	Function of part
E–16	BOARD, terminal: for remote control operation; eight #8–32 brass nickel pl screws make up 4 individual feed-thru term mts in molded phenolic strip which is held in a metal mtg plate; screws 5/8" c to c; 3" lg x 1" wd x 1¼" thk o/a; four 0.166" mtg holes on 3" x ½" mtg/c; Curtis Devel #FT–4.	For mounting remote control terminals.
H–1	BUTTON, plug: brass with black nickel plate; for use in 3/8" hole; 17/32" diam x 3/8" thk o/a; to withstand salt spray test; United Carr part #50704.	Closes shaft removal hole.
H–2	BUTTON, plug: brass; for use in 3/8" hole; 17/32" diam x 3/8" thk o/a; to withstand salt spray test; United Carr part #48140.	Do.
H–3	BUTTON, plug: brass; for use in ½" hole; 21/32" diam x 17/64" thk o/a; to withstand salt spray test; United Carr part #50652.	Do.
C–37	CAPACITOR, fixed: mica; JAN type CM20B050K; 5 mmf ±10% 500 vdcw.	Bfo (V–7) injection.
C–83	CAPACITOR, fixed: mica; JAN type CM20B181K; 180 mmf ±10% 500 vdcw.	Tuning audio filter.
C–84	CAPACITOR, fixed: mica; JAN type CM30B561K; 560 mmf ±10% 500 vdcw.	Do.
C–6, C–18, C–23, C–43, C–81	CAPACITOR, fixed: mica; JAN type CM20B271K; 270 mmf ±10% 500 vdcw.	C–6: First r-f stage grid coupling. C–18: Second r-f stage (V–2) grid coupling. C–23: Mixer (V–3) grid coupling. C–43: Detector (V–8) load r-f bypass. C–81: First a-f stage (V–8) plate r-f bypass.
C–46	CAPACITOR, fixed: mica; JAN type CM20B471K; 470 mmf ±10% vdcw.	A-f inverse feedback.
C–11	CAPACITOR, fixed: mica; JAN type CM30B222K; 2200 mmf ±10% 500 vdcw.	Avc timing.
C–32	CAPACITOR, fixed: mica; JAN type CM30B152K; 1500 mmf ±10% 500 vdcw.	Mixer (V–3) plate circuit bypass.
C–54, C–55	CAPACITOR, fixed: silver mica; JAN type CM25E681G; 680 mmf ±2%; temp coef −20 to +100 mmf/mf/°C; 500 vdcw.	C–54: H-f oscillator (V–4) padder, 1.485 to 3.03 mc. C–55: H-f oscillator (V–4) padder, 135 to 260 kc.
C–52, C–53	CAPACITOR, fixed: silver mica; JAN type CM25E102G; 1000 mmf ±2%; temp coef −20 to +100 mmf/mf/°C; 500 vdcw.	C–52: H-f oscillator (V–4) padder 5.94 to 12.2 mc. C–53: H-f oscillator (V–4) padder, 2.97 to 6.06 mc.
C–19, C–22	CAPACITOR, fixed: mica; JAN type CM30B272K; 2700 mmf ±10% 500 vdcw.	C–19: Second r-f stage (V–2) cathode bypass. C–22: Second r-f stage (V–2) plate circuit bypass.
C–17, C–21, C–47, C–51, C–58, C–80, C–97	CAPACITOR, fixed: mica; JAN type CM35B472K; 4700 mmf ±10% 500 vdcw.	C–17: First r-f stage (V–1) plate circuit bypass. C–21: Second r-f stage (V–2) screen grid bypass. C–47: Second a-f stage (V–10) grid coupling. C–51: First a-f stage (V–8) grid coupling. C–58: H-f oscillator r-f return to chassis. C–80: Chassis to ground (B−) return. C–97: Mixer stage (V–3) screen grid bypass.
C–8, C–9	CAPACITOR, fixed: mica; JAN type CM35B822K; 8200 mmf ±10% 300 vdcw.	C–8: First r-f stage screen grid bypass. C–9: First r-f stage cathode resistor bypass.
C–79	CAPACITOR, fixed: mica; JAN type CM25B102K; 1000 mmf ±10%; 500 vdcw.	Second r-f stage (V–2) filament bypass.

Ref symbol	Name of part and description	Function of part
C–59, C–68	CAPACITOR, fixed: ceramic; JAN type CC20UJ220K; 22 mmf ±10%; neg temp coef −750 mmf/mf/°C, +120 −350 mmf/mf/°C; 500 vdcw.	C–59: II-f oscillator (V–4) injection. C–68: II-f oscillator (V–4) grid coupling.
C–99	CAPACITOR, fixed: mica; JAN type CM30B332K; 3300 mmf ±10% 500 vdcw.	Mixer stage (V–3) cathode circuit bypass.
C–98	CAPACITOR, fixed: mica; JAN type CM35B682K; 6800 mmf ±10% 300 vdcw.	Mixer stage (V–3) cathode bypass.
C–69	CAPACITOR, fixed: ceramic; JAN type CC45UJ821G; 820 mmf ±2%; neg temp coef −750 mmf/mf/°C, +120 −350 mmf/mf/°C; 500 vdcw.	II-f oscillator (V–4) padder 2.97 to 6.06 mc.
C–100	CAPACITOR, fixed: ceramic; JAN type CC20UJ150K; 15 mmf ±10%; neg temp coef −750 mmf/mf/°C, +120 −350 mmf/mf/°C; 500 vdcw.	II-f oscillator (V–4) grid tuning stabilizing.
C–70, C–76	CAPACITOR, fixed: ceramic; JAN type CC32UJ331G; 330 mmf ±2%; neg temp coef −750 mmf/mf/°C, +120 −350 mmf/mf/°C; 500 vdcw.	C–70: II-f oscillator (V–4) padder, 1.485 to 3.03 mc. C–76: II-f oscillator (V–4) padder, 135 to 260 kc.
C–56	CAPACITOR, fixed: ceramic; JAN type CC45CG301G; 300 mmf ±2%; zero temp coef +30 −75 mmf/mf/°C; 500 vdcw.	II-f oscillator (V–4) padder, 255 to 510 kc.
C–65	CAPACITOR, fixed: ceramic; JAN type CC32LG680J; 68 mmf ±5%; neg temp coef −80 mmf/mf/°C, +30 −90 mmf/mf/°C; 500 vdcw.	Tuning for secondary T–20.
C–66	CAPACITOR, fixed: ceramic; JAN type CC35HG151J; 150 mmf ±5%; neg temp coef −30 mmf/mf/°C, +30 −105 mmf/mf/°C; 500 vdcw.	Tuning for secondary T–21.
C–57, C–72	CAPACITOR, fixed: paper; JAN type CP53B4EF503V; dual 0.05 mf +20 −10%; 600 vdcw.	C–57: II-f oscillator (V–4) cathode bypass. C–72: II-f oscillator (V–4) plate circuit bypass.
C–35, C–41, C–91, C–92	CAPACITOR, fixed: ceramic; JAN type CC45UJ621G; 620 mmf ±2%; neg temp coef −750 mmf/mf/°C +120 −350 mmf/mf/°C; 500 vdcw.	C–35: II-f oscillator (V–4) padder, 5.94 to 12.12 mc. C–41: II-f oscillator (V–4) padder, 5.94 to 12.12 mc. C–91: II-f oscillator (V–4) padder, 5.94 to 12.12 mc. C–92: II-f oscillator (V–4) padder, 5.94 to 12.12 mc.
C–71	CAPACITOR, fixed: ceramic; JAN type CC25CH240J; 24 mmf ±5%; zero temp coef +60− 120 mmf/mf/°C; 500 vdcw.	II-f oscillator (V–4) feedback.
C–74	CAPACITOR, fixed: silver mica; JAN type CM20E151J; 150 mmf ±5% 500 vdcw.	Bfo (V–7) tuning, part of T–25.
C–75	CAPACITOR, fixed: silver mica; JAN type CM20E271K; 270 mmf ±10% 500 vdcw.	Bfo (V–7) grid coupling, part of T–25.
C–82	CAPACITOR, fixed: ceramic; JAN type CC20UJ150K; 15 mmf ±10%; neg temp coef −750 mmf/mf/°C + 120−350 mmf/mf/°C; 500 vdcw.	Bfo (V–7) tuning stability, part of T–25.
C–85 through C–90	CAPACITOR, fixed: silver mica; JAN type CM20C471J; 470 mmf ±5%; temp coef +200 mmf/mf/°C; 500 vdcw.	C–85 and C–86: Part of T–16. C–87 and C–88: Part of T–17. C–89 and C–90: Part of T–18.
C–45	CAPACITOR, fixed: paper; JAN type CP53B1EE504V; 0.5 mf +20% −10% 400 vdcw.	First a-f stage (V–8) plate circuit decoupling.
C–36, C–39	CAPACITOR, fixed: paper; JAN type CP53B4EF104V; dual 0.1 mf +20% −10% 600 vdcw.	C–36: First i-f stage (V–5) screen grid bypass. C–39: Second i-f stage (V–6) cathode bypass.
C–44	CAPACITOR, fixed: paper; JAN type CP53B1EC205V; 2 mf +20% −10% 200 vdcw.	First a-f stage (V–8) cathode bypass.
C–42, C–49, C–73	CAPACITOR, fixed: paper; JAN type CP53B1EF104V; 0.1 mf +20% −10% 600 vdcw.	C–42: Second i-f stage (V–6) screen grid bypass. C–49: Anl bias. C–73: Power supply r-f bypass.

Ref symbol	Name of part and description	Function of part
C–77	CAPACITOR, fixed: paper; JAN type CP53B1EF254V; 0.25 mf +20% −10% 600 vdcw.	Line r-f filter.
C–48, C–50, C–60	CAPACITOR, fixed: electrolytic; JAN type CE33C300K; triple 30 mf; 200 vdcw.	C–48: Second a-f stage (V–10) cathode bypass. C–50: Power supply output filter. C–60: Power supply input filter.
C–34, C–94	CAPACITOR, fixed: paper; JAN type CN35A103M; 0.01 mf ±20% 600 vdcw.	C–34: First i-f stage (V–5) cathode bypass. C–94: Mixer stage (V–3) filament bypass.
C–78	CAPACITOR, fixed: paper; JAN type CN43A503M; 0.05 mf ±20% 400 vdcw.	Line r-f filter.
C–33, C–38	CAPACITOR, fixed: paper; JAN type CP53B4EF503V; dual 0.05 mf +20% −10% 600 vdcw.	C–33: First i-f stage (V–5) grid circuit decoupling. C–38: Second i-f stage (V–6) grid circuit decoupling and limiting control.
C–61, C–62, C–63, C–64, C–67	CAPACITOR, variable: air dielectric; plate meshing type; single sect; 6.5 to 50 mmf; SLC characteristic; 600 v RMS test; 15/16" lg x 15/16" wd x 1 3/32" h excluding shaft, shaft 1/4" diam x 2 9/64" lg, bushing 1/4", 3/32" lg; self-locking type; screwdriver adj; 11 aluminum plates; 180° clockwise or counterclockwise rotation; ceramic ins; 2 solder lug term; two 4–36 tap holes in base on 2 1/32" mtg/c; Amer Steel Pack type #J.	C–61: Trimmer for secondary T–22. C–62: Trimmer for secondary T–23. C–63: Trimmer for secondary T–24. C–64: Trimmer for secondary T–20. C–67: Trimmer for secondary T–21.
C–10, C–20	CAPACITOR, variable: air; plate meshing type; double sect; both sect 16 to 216.3 mmf; both MLF; 0.0185" air gap; 2.468" lg x 1 7/8" wd x 3 3/16" h excluding shaft; shaft diam 0.251" x 2 1/16" lg; locking type; extension shaft adj; 11 aluminum plates each sect; 180° clockwise rotation; ceramic ins; solder lug term; 2 mtg bkt with three 0.156" mtg holes on 2.875" mtg/c; Oak part/dwg #1729–2–50.	C–10: First r-f stage grid tuning. C–20: Second r-f stage grid tuning.
C–1 through C–5, C–12 through C–16, C–24 through C–28	CAPACITOR, variable: ceramic; JAN type CV11C450; 7.0 mmf to 45.0 mmf; neg temp coef 500 mmf/mf/°C.	C–1: T–1, secondary trimmer. C–2: T–2, secondary trimmer. C–3: T–3, secondary trimmer. C–4: T–4, secondary trimmer. C–5: T–5, secondary trimmer. C–12: T–6, secondary trimmer. C–13: T–7, secondary trimmer. C–14: T–8, secondary trimmer. C–15: T–9, secondary trimmer. C–16: T–10, secondary trimmer. C–24: T–11, secondary trimmer. C–25: T–12, secondary trimmer. C–26: T–13, secondary trimmer. C–27: T–14, secondary trimmer. C–28: T–15, secondary trimmer.
C–30, C–40	CAPACITOR, variable: air; plate meshing type; double sect; osc sect 18 to 301.5 mmf, mixer sect 16 to 261.3 mmf; both MLF; air gap, osc sect 0.041", mixer sect 0.0185"; 4.812" lg x 1 7/8" wd x 3 3/16" h excluding shaft, shaft 0.251" diam x 9/16" lg, self-locking; extension shaft adj; osc sect, 16 polished brass stator plates and 15 polished aluminum rotor plates; mixer sect, 9 polished aluminum plates; 180° clockwise rotation; ceramic ins; solder lug term; two mtg bkt w/two 0.156" mtg holes on 2.125" mtg/c; Oak part/dwg #1728–2–50A.	C–30: Mixer stage (V–3) grid tuning. C–40: H-f oscillator (V–4) grid tuning.

886780—50——6

Ref symbol	Name of part and description	Function of part
L–7, L–12	COIL, air core choke; AC line filter; unshielded; 30 uh at 1000 cyc test freq; 140 turns #22 DCC wire; 1½" lg x 1 7/16" diam o/a; air core; cylindrical; bakelite coil form with rectangular base 1" lg x 5/8" wd x 1/16" thk; mtg by means of #6–32 tapped hole in top of form, mtg screw should be 1/8" longer than panel thickness plus additional lg to receive nut; 350 v RMS ins test; 0.6 ohm DC resistance; 2 solder lug term on rectangular base; treated with fungus resistant lacquer; Hallicrafters part/dwg #53B166.	Line chokes.
T–4, T–5	COIL, RF: antenna; 4 wnd for two band; universal wnd; shielded; aluminum can 3.750" h x 1.750" sq; band 1 pri 600 turns #38 SNE, band 1 secd 467 turn #7/41 SNE, band 2 pri 280 turns #38 SNE, band 2 secd 215 turns #7/41 SNE; 3¾" lg x 7/8" OD x 1/32" thk; coil form as per JAN LTS–E–2 natural phenolic, air coil; mtg with 2 space bolts on 1.687" mtg/c; 6 solder lug term on bottom; can stamped with Hallicrafters part/dwg #51B1119; coil treated w/fungus resistant lacquer; Hallicrafters part/dwg #51B1119.	T–4: Antenna coupling to first r-f stage (V–1) grid, 255 to 510 kc. T–5: Antenna coupling to first r-f stage (V–1) grid, 135 to 260 kc.
T–25	COIL, RF: BFO assembly; incl L–6, C–74, C–75, C–82, R–39; rectangular aluminum shielded can 3" h x 1.375" sq: screwdriver adj thru top of can; mtg by two #6–32 spade bolts on 1.375" mtg/c; 4 solder lug term on bottom; Hallicrafters part/dwg #54B041.	Bfo tank coil.
L–13	COIL, RF: choke; one wnd single layer wnd; unshielded; 47 to 50 turns #30 wire; 3¾" lg x 0.187" diam o/a incl leads; dummy resistor form of molded phenolic; ¾" lg x 0.187" diam; mtg by two 1½" lg axial leads; treated with fungus resistant lacquer; Hallicrafters part/dwg #53A179.	H–f oscillator (V–4) filament r-f choke.
T–9, T–10, T–14, T–15	COIL, RF: RF and mixer transformer; 4 wnd for 2 bands; universal wnd; aluminum shielded can 3¾" h x 1¾" sq; band 1 pri 30 turns #38 SNE, band 1 secd 456 turns #7/41 SNE, band 2 pri 15 turns #38 SNE, band 2 secd 207 turns #7/41 SNE; 3¾" h x 7/8" OD x 1/32" thk; form as per JAN LTS–E–2 natural phenolic, air core; mtg by means of 2 spade bolts on 1.687" mtg/c; 6 solder lug term bottom; can stamped with Hallicrafters part/dwg #51B1121; coil treated w/fungus resistant lacquer; Hallicrafters part/dwg #51B1121.	T–9: R-f coupling between first and second r-f stages (V–1 and V–2) 255 to 510 kc. T–10: R-f coupling between first and second r-f stages (V–1 and V–2) 135 to 260 kc. T–14: R-f coupling between second r-f (V–2) and mixer (V–3) stages, 255 to 510 kc. T–15: R-f coupling between second and mixer stages (V–2 and V–3) 135 to 260 kc.
L–4, L–5	COIL, RF: choke; 4 pie universal wnd; unshielded; 2500 uh at 160 kc; ceramic dowel form and core; form 1¼" lg x 1 1/32" diam; 35 ohms DC resistance, 2500 uh, 400 mmf; mtg by means of two wire leads; two wire lead term; treated w/fungus resistant lacquer; Hallicrafters part/dwg #53B163.	L–4: B— r-f choke. L–5: H-f oscillator (V–4) plate r-f choke.
L–9	COIL, RF: choke; single wnd, single layer wnd; unshielded; 23½ turns #28 DSE wire; 3⅞" lg x 3/32" diam; 1.75 uh at 6.05 mc; 400 mmf; form dummy resistor (Stackpole DR–3 or equivalent); 2 axial tinned leads for mtg and term; impr w/fungus resistant lacquer; Hallicrafters part/dwg #53A165.	Tuned r-f choke.
L–10	COIL, RF: choke; 1 pie universal wnd; unshielded; 10 uh at 86 kc test freq, 300 mmf; 3⅞" lg; form dummy resistor (Stackpole DR–3 or equivalent); mtg by means of two axial wire leads 1½" lg; impr w/fungus resistant lacquer; Hallicrafters part/dwg #53A164.	First r-f stage (V–1) cathode r-f choke.

Ref symbol	Name of part and description	Function of part
L–6	COIL, RF: BFO coil; single tapped universal wnd; rectangular aluminum shielded can; full wnd 194 turns #7/41 SCelE; from start to tap 92 turns; shielded can 3″ lg x 1⅜″ sq; JAN LTS–E–1 natural phenolic form per JAN–P–13; G1 iron core adj; for full sced 400 mmf at 0.410 mc test freq; screwdriver adj thru top of can; 2 spade mtg bolts 1$^{15}/_{16}$″ mtg/c; 4 solder lug term on bottom can marked w/Hallicrafters part/dwg #54B041; impr w/fungus resistant lacquer; p/o T–25 which includes C–74, C–75, C–82, R–39; Hallicrafters part/dwg #54B04J.	Bfo (V–7) grid tuned circuit.
P–1	CONNECTOR, male contact: 2 pol twist type blades; 0.937″ lg x 1.625″ diam; 10 amp 250 v, 15 amp 125 v; steel mtg plate; round phenolic insert; two 0.156″ diam mtg holes on 1.375″ mtg/c; Hallicrafters part/dwg #10A337.	Power plug.
O–1	COUPLING, flexible: shaft; brass bushing and phosphor bronze spring; 1″ lg x 1⅛″ diam; 2 holes for 0.252″ shaft; to withstand salt spray test; Hallicrafters part/dwg #29A136.	Drive-shaft connector.
O–2	COUPLING, flexible: shaft; cad pl phosphor bronze; ultra steatite ins; 1⅜″ diam x 1″ thk o/a two axial holes for 0.250″ diam shaft; shaft fastened by means of 2 set screws; to withstand salt spray test; Johnson EF part/dwg #250.	Drive-shaft coupling.
O–3	COUPLING, shaft: u/w shaft extensions Hallicrafters part/dwg #74A268 and 74A269; cad pl steel; ⅝″ lg x 0.252″ ID x ½″ OD; mtg by means of four tapped #8–32 NC–2 holes; Hallicrafters part/dwg #29A138.	Drive-shaft coupling.
O–4	DRIVE, dial: 20 to 1 ratio; 2 cad pl split gears; 5½″ h x 6⅝″ wd x 2.547″ lg o/a; mtg with 2 spade bolts on front plate on 2¾″ mtg/c; and 1 spade bolt on rear plate ½″ to left of centerline; incl dial locking device, dial scale, dial pointer, and vernier; all parts finished to withstand salt spray test; Hallicrafters part/dwg #71D187.	Dial-drive reducing gear.
F–1, F–2	FUSE, cartridge: 3 amp; 250 v; one time; glass body; cap term; 1$^{7}/_{32}$″ lg x ¼″ diam; Littelfuse part #312003.	Power line fuse.
O–7	GRILL, speaker: perforated steel, black enamel finish; 4¾″ sq x 0.023″ thk; four 0.156″ diam mtg holes, 4.687″ diam mtg/c; Hallicrafters part/dwg #7B094.	
E–17, E–18	HOLDER, fuse: extractor post type; for type 3AG cartridge fuse; black bakelite; 2⅝″ lg x ¾″ diam o/a; $^{7}/_{16}$″ diam thd body for through panel mtg; 2 solder lug term; Littelfuse part/dwg #1075–A.	Fuse holder.
E–20 through E–25	INSULATOR, bushing: round post shape with ½″ diam flange on end; JAN LTS–E–1 natural phenolic; $^{3}/_{16}$″ h o/a; 0.144″ ID; treated with fungus-resistant lacquer; Hallicrafters part/dwg #8A908.	Insulator.
E–19	INSULATOR, feed-thru: conical shape; steatite; 1¾″ lg o/a; incl 2 washers, 4 nuts and 1 thd rod, all hardware brass; Johnson EF type #135–44.	Insulator.
J–1	JACK, telephone: per Sig C dwg #5C–D–2339 Jack JK–34–A; for 2 cond plug 0.25″ diam; $^{61}/_{64}$″ wd x 1.2″ lg o/a; J–1 tip and sleeve; ⅜″ mtg hole; Mallory type #SC–1A.	Output for headset use.
	KNOB: round; dull black molded phenolic; for 0.253″ diam shaft; fastens by two 8–32 Allen screws; 2″ diam x 1″ thk o/a; 0.343″ d hole for shaft; knob contains a friction clutch to prevent turning shaft past stop position; Hallicrafters part/dwg #15B178.	Knob.
	KNOB: round; black bakelite; for 0.252″ shaft; #8–32 tapped hole for mtg to shaft; arrow marking; 1¾″ diam x $^{13}/_{16}$″ thk o/a; brass ins; $^{7}/_{16}$″ d shaft hole; raised finger grips; Chicago Molded Products Corp part/dwg #M–2510.	Do.
	KNOB: round; dull black molded phenolic; for 0.252″ shaft; two #8–32 NC–2 thd tapped holes for set screws; white marking dot; 1⅛″ diam x 1⅝″ thk o/a; brass insert; shaft hole $^{7}/_{16}$″ d; Croname #6132.	Do.

Ref symbol	Name of part and description	Function of part
E–2	LAMP, glow: 65 v AC striking voltage; 90 v DC striking voltage; bulb T3–¼ clear; 1⅛″ lg o/a; resistorless type; single cont miniature bayonet base; burn any position; GE part #NE51.	Static drain.
E–1	LAMP, incandescent: 6 to 8 v 0.15 amp; bulb T3¼ clear; 1$^{3}/_{16}$″ lg o/a; miniature bayonet base; burn in any position; GE type #47.	Front panel lamp.
	LAMPHOLDER: miniature bayonet; steel; 6 v 150 ma; $^{1}/_{16}$″ lg x $^{7}/_{16}$″ OD; mtg by means of 0.156″ diam hole in bkt; flat rectangular mtg bkt welded to side of lampholder perpendicular to its axis, protruding to one side only; one ins wire lead from bottom of socket; Micarta Fab part/dwg #17.	Panel light holder.
I–1	LIGHT, indicator: with lens; ½″ diam green jewel lens; for T3¼ bayonet base bulb; open frame; cad pl; requires $^{11}/_{16}$″ hole for mtg ½″ max panel thk; mts horizontally, lamp replaceable from front of panel; faceted green jewel; 2 solder lug term at rear of socket; Gothard part/dwg #503.	Indicates receiver power is ON.
L–8	REACTOR: filter choke; 12 hy at 100 ma; 200 ohms max DC resistance; 275 v working voltage; HS metal case; 3¾″ lg x 2$^{45}/_{64}$″ wd x 2″ h; mtg by means of four ½″ lg #8–32 thd bolts attached to case; 1.880″ mtg/c; 2 solder lug term on the same end as mtg bolts; case stamped with Hallicrafters part number, Chi Trans part number and schematic; coil and core varnish baked to withstand extreme cold and heat; Chi part #13346.	Power supply filter choke.
L–14	REACTOR: AF filter; unit to be in accordance with JAN–T–27 spec's grade 1, class 1; 30 hy ±10% tapped at 15 hy; 971 ohms DC resistance; 1000 v RMS ins test voltage; HS metal case; 2$^{13}/_{16}$″ lg x 1½″ wd x 1½″ h o/a; four $^{3}/_{16}$″ diam mtg holes on 1″ x 2″ mtg/c; 3 solder lug term on mtg end of case; ckt diagram, electrical information and Hallicrafters part number to appear on same side as #3 term; term marked with numerals 1, 2, and 3; Chi Trans part #13806.	Audio filter choke.
R–3, R–5, R–9, R–31	RESISTOR, fixed: comp; JAN RC30BF225K; 2.2 meg ±10%; 1 w.	R–3: First r-f (V–1) stage grid coupling. R–5: Second r-f (V–2) stage grid coupling. R–9: Mixer (V–3) grid coupling. R–31: A-f inverse feed back.
R–2, R–7, R–14, R–18, R–29	RESISTOR, fixed: comp; JAN RC30BF473K; 47,000 ohms ±10%; 1 w.	R–2: First r-f (V–1) screen dropping. R–7: Second r-f (V–2) stage screen dropping. R–14: First i-f (V–5) d-c grid return. R–18: Second i-f stage (V–6) regenerative limiter. R–29: First a-f stage (V–8) plate circuit decoupling.
R–33, R–36	RESISTOR, fixed: comp; JAN RC30BF151K; 150 ohms ±10%; 1 w.	R–33: Second a-f stage (V–10) cathode bias. R–36: H-f oscillator (V–4) cathode bias.
R–1, R–6, R–11, R–21, R–52	RESISTOR, fixed: comp; JAN RC30BF221K; 220 ohms ±10%; 1 w.	R–1: First r-f (V–1) stage minimum cathode bias. R–6: Second r-f (V–2) stage minimum cathode bias. R–11: Mixer (V–3) cathode bias. R–21: Second i-f stage (V–6) cathode bias. R–52: H-f oscillator B-decoupling.

Ref symbol	Name of part and description	Function of part
R–4, R–8, R–13, R–17, R–23	RESISTOR, fixed: comp; JAN RC30BF472K; 4700 ohms ±10%; 1 w.	R–4: First r-f (V–1) stage plate circuit decoupling. R–8: Second r-f (V–2) stage plate circuit decoupling. R–13: Mixer (V–3) plate circuit decoupling. R–17: First i-f stage (V–5) plate circuit decoupling. R–23: Second i-f stage (V–6) plate circuit decoupling.
R–19	RESISTOR, fixed: comp; JAN RC30BF183K; 18,000 ohms ±10%; 1 w.	BFO plate dropping resistor and B+ bleeder network.
R–24, R–25, R–32, R–41	RESISTOR, fixed: comp; JAN RC30BF474K; 470,000 ohms ±10%; 1 w.	R–24: Ave timing. R–25: Anl stage (V–9) timing. R–32: Second a-f (V–10) d-c grid return. R–41: Anl (V–9) Second diode bias.
R–27	RESISTOR, fixed: comp; JAN RC30BF103K; 10,000 ohms ±10%; 1 w.	First a-f stage (V–8) cathode bias.
R–35	RESISTOR, fixed: comp; JAN RC20BF223K; 22,000 ohms ±10%; ½ w.	A-f filter and h-f compensation.
R–34, R–59, R–60	RESISTOR, fixed: WW; JAN RW30D200; 20 ohms ±5%; 8 w	R–34: A-f output transformer load (when speaker is off). R–59 and R–60: Filament dropping.
R–50	RESISTOR, fixed: comp; JAN RC30BF222K; 2200 ohms ±10%; 1 w.	Mixer (V–3) screen dropping.
R–51	RESISTOR, fixed: comp; JAN RC30BF272K; 2700 ohms ±10%; 1 w.	H-f oscillator plate circuit decoupling.
R–38	RESISTOR, fixed: comp; JAN RC30BF273K; 27,000 ohms ±10%; 1 w.	H-f oscillator (V–4) screen dropping.
R–15	RESISTOR, fixed: comp; JAN RC30BF102K; 1000 ohms ±10%; 1 w.	First i-f stage (V–5) minimum cathode bias.
R–22, R–28	RESISTOR, fixed: comp; JAN RC30BF104K; 100,000 ohms ±10%; 1 w.	R–22: Chassis-line bleeder. R–28: First a-f stage (V–8). plate load.
R–26, R–40	RESISTOR, fixed: comp; JAN RC30BF224K; 220,000 ohms ±10%; 1 w.	R–26: Detector (V–8) diode load. R–40: Detector (V–8) diode load.
R–58	RESISTOR, fixed: comp; JAN RC20BF473K; 47,000 ohms ±10% ½ w.	H-f oscillator grid.
R–56	RESISTOR, fixed: comp; JAN RC20BF104K; 100,000 ohms ±10%; ½ w.	Mixer injection grid.
R–30	RESISTOR, variable: comp; 500,000 ohms ±20%; 2.25 w at 70°C max continuous oper; 3 solder lug term; metal case 1⅛″ diam x ¾″ d, closed case; round metal shaft 0.248″ to 0.250″ diam x 1 17/32″ lg; Hallicrafters curve #9, 30,000 ohms at 35%, 50,000 ohms at 50%, 125,000 ohms at 65% clockwise rotation; ins cont arm w/o off position; normal torque shaft locking device; bushing ⅜″ lg x ⅜″–32 class 2 thd; SPST sw closed at zero position of shaft, 2 amps 125 v; 2 term; AB part JA5042 dwg #X–5020–D.	A-f gain control.
R–20	RESISTOR, variable: comp; max resistance 2500 ohms ±20%; 2.25 w, 70° C max continuous oper; 3 solder lug term; metal case 1 1/16″ diam x 1 7/64″ d, closed case; round metal shaft 0.248″ to 0.256″ diam x ⅞″ lg; taper as per Hallicrafters curve #5 dwg #93B192–A; 750 ohms at 35%, 1225 ohms at 50% and 1730 ohms at 65% clockwise rotation; ins cont arm; normal torque shaft locking type; bushing ⅜″ lg x ⅜″–32 x ⅜″ lg, nonturn device located at 1 7/32″ rad at 9 o'clock; SPST sw open at zero position of shaft; sw operates at 15% clockwise shaft rotation; 2 amp 125 v; 2 term; AB part #JU2521.	Bfo injection control.

Ref symbol	Name of part and description	Function of part
R–10	RESISTOR, variable: comp; 15,000 ohms ±20%; 2.25 w at 70° C max continuous oper; 3 solder lug term; metal case 1⅛" diam x ½" d; closed case; round metal shaft 0.248" to 0.250" diam x 1 1/16" lg; Hallicrafters curve #8 reversed, 4500 ohms at 35%, 2250 ohms at 50%, 1350 ohms at 65% clockwise rotation; ins cont arm without off position; normal torques; bushing ¼" lg x ⅜"–32 class 2 thd; shaft locking type; AB part #1532, dwg #Y–6021–D.	R-f gain control.
O–6	SHAFT: extension; cad pl steel; 4½" lg x 0.248" diam; to withstand salt spray test; Hallicrafters part/dwg #74A269.	Gain control shaft extension.
O–7	SHAFT: extension; cad pl steel; 1⅜" lg x 0.248" diam; to withstand salt spray test; Hallicrafters part/dwg #74A268.	Extension shaft for gain control.
X–12, X–13, X–14, X–15	SOCKET, crystal: beryllium copper cont with silver pl, glazed ceramic holder; no dimension is greater than 1"; one 0.125" mtg hole in ctr; to be used with crystals having 0.050" diam pins; Eby part/dwg #9006.	H-f oscillator crystal sockets.
X–1 through X–3, X–5 through X–11	SOCKET, tube: octal; saddle type mtg; two 5/32" diam mtg holes on 1½" mtg/c; round; high dielectric mica filled bakelite 1 7/64" diam; phosphor bronze or silver pl beryllium copper cont; pin numbers on back; Amphenol part #MIP8TM.	Tube sockets.
X–4	SOCKET, tube: octal; JAN S284; saddle type mtg; mtg by means of two 0.148" diam holes on 1 11/16" mtg/c; round steatite body 1¼" diam; phosphor bronze or silver pl beryllium copper cont; pin numbers marked on back of socket; Amphenol part #RSS8M.	Tube socket.
LS–1	SPEAKER, magnetic: cone diam 4¾"; PM field; 3½ w; voice coil impedance 3.2 ohms; 4¾" diam x 2⅝" thk o/a; does not include output transf; four 7/32" diam mtg holes on 4 11/16" diam mtg/c; stamped with Hallicrafters part #85B089, 0.0005 cad pl on metal parts; marine treated cone; Jenson part P5V S4088.	Reproduces audio signal.
SW–1	SWITCH, rotary: 5 positions; 9 sect; silver pl brass cont; ceramic body; 16" lg x 1 15/16" diam approx o/a; locking device; silver pl brass term; mtg by means of four thd brass rods; sw is composed of Oak part dwg #1607–2–50A and 1608–2–50.	SW–1A: Connects antenna to antenna transformer primary. SW–1B: Connects first r-f stage (V–1) grid to secondary of antenna transformer. SW–1C: Connects first r-f stage (V–1) plate to r-f transformer primary. SW–1D: Connects second r-f stage (V–2) grid to r-f transformer secondary. SW–1E: Connects second r-f stage (V–2) plate to r-f transformer primary. SW–1F: Connects mixer stage (V–3) grid to r-f transformer secondary. SW–1G: Selects oscillator transformer primary. SW–1H: Selects oscillator transformer secondary. SW–1I: Shorts padder capacitors when not in use.

Ref symbol	Name of part and description	Function of part
SW–2	SWITCH, rotary: 4 pole, 5 position; 2 decks; cont brass with silver pl; vacuum imp ceramic disks; 3 5/16" lg x 1 15/16" diam o/a; locking action; solder lug term; 1/4" lg x 3/8"–32 thd bushing; Oak part #HC, 2 sect.	SW–2: Connects h-f oscillator (V–4) grid to selected crystal or manual position. SW–2A: Connects h-f oscillator (V–4) plate to selected crystal, or manual position. SW–2B: Shorts out choke L–5 in MANUAL position. SW–2C: Disconnects primary of h-f oscillator (V–4) transformer in CRYSTAL positions.
SW–7	SWITCH, rotary: SPDT; 1 amp at 250 v and 3 amp at 125 v; silver pl brass cont; steel case; 1 1/2" wd x 1 1/4" lg; 3 solder lug term; 3/8" lg bushing with 1 1/32"–32 thd, 3/8" lg x 0.250" diam shaft; all metal parts pl, treated with fungus-resistant lacquer: AH&H part/dwg #1565.	Automatic noise limiter on and off.
SW–4, SW–9	SWITCH, toggle: SPDT; JAN ST42D; ? term; Hallicrafters part/dwg #60JST42.	SW–4: Cuts off B+ to front end of receiver in STAND-BY position. SW–9: Turns speaker ON or OFF. In the OFF position connects R–34 across the output transformer secondary.
SW–3	SWITCH, toggle: SPST; JAN ST42A; 2 term; Hallicrafters part/dwg #60JST42A.	Allows avc voltage to operate on the first four stages in the ON position. Grounds the avc line to B— on the OFF position.
T–19	TRANSFORMER, AF: plate coupling type; pri 2000 ohms impedance, secd 3.2 ohms impedance; steel case; 1 25/32" lg x 1 5/64" wd x 2 3/32" h; 2 w oper level; turns ratio 22.7 to 1; freq response 300 to 3000 cyc ±1 db; 4 solder lugs protruding from top; two 3/16" diam mtg holes on 2 1/8" mtg/c; Chi Trans part/dwg #13347.	Audio output coupling to speaker or headset.
T–18	TRANSFORMER, IF: 550 kc; 3d IF; shielded; 1 3/4" h x 3" wd x 2" d; two adj iron cores; double tuned; adj iron core tuning; mtg by 2 spade bolts on 1 15/16" mtg/c; 4 solder lug term with #22 stranded wire leads attached; treated with fungus-resistant lacquer; composed of Hallicrafters part #50B428 which includes C–89 and C–90.	I-f coupling between second i-f and detector stages (V–6 and V–8).
T–17	TRANSFORMER, IF: 550 kc; 2d IF; shielded; 1 3/4" h x 2" wd x 2" d; 2 adj powdered iron cores; tuned pri and secd; adj iron core tuning; mtg by two 6–32 spade bolts on 1 15/16" mtg/c; 4 solder lug term with #22 stranded wire leads attached; treated with fungus-resistant lacquer; composed of Hallicrafters part #50B427 which includes C–87 and C–88 JAN CM20C471J.	I-f coupling between first and second i-f stages (V–5 and V–6) 550 kc.
T–16	TRANSFORMER, IF: 550 kc; 1st IF input; shielded 1.750" h x 3.000" wd x 2.000" d; Stackpole G1 iron core; double tuned; adj iron core tuning; two 6–32 spade bolts on 1 15/16" mtg/c; 4 solder lug term with #22 stranded wire leads attached; includes C–85 and C–86; Hallicrafters part/dwg #50B426.	I-f coupling between mixer and first i-f stages (V–3 and V–5) 550 kc.
T–7, T–12	TRANSFORMER, variable RF: RF transformer and mixer; 2 wnd, pri universal wnd, secd single layer wnd; unshielded; pri 148 turns #38 SNE, secd 27 1/2 turns #20; 2 7/8" lg x 0.75" diam o/a; form as per JAN LTS–E–2 natural phenolic; powdered iron core; coil form 2.000" lg x 0.624" OD; adj iron core; screw driver adj thru bushing; mtg by means of brass bushing 0.234" diam 6–32 thd; 4 solder lug term on bottom; treated with fungus-resistant lacquer; transformer marked with Hallicrafters part/dwg #51B1123.	T–7: R-f coupling between first and second r-f stages (V–1 and V–2) 2.97- to 6.06-mc. T–12: R-f coupling between second and mixer stages (V–2 and V–3) 2.97- to 6.06-mc.

Ref symbol	Name of part and description	Function of part
T–20, T–21	TRANSFORMER, variable RF: osc; 4 wnd for 2 bands; pri for 2 bands universal wnd, secd for 2 bands single layer wnd; pri 50 turns of 10/44 SSE, secd 136 turns #38 SSE; aluminum shielded can 2.625″ h x 1.415″ wd x 1.852″ d water dip lacquer finish; form as per JAN LTS–E–2 natural phenolic; powdered iron core; coil form 2.250″ lg x 0.5″ OD; adjustable iron core; screwdriver adj thru top; the two coil forms mount to shielded can by brass bushing; shielded can mts by means of 2 spade bolts on 1.788″ mtg/c; 6 solder lug term on bottom of can; wnd treated with fungus-resistant lacquer; Hallicrafters part/dwg #51B1117.	T–20: H-f oscillator (V–4) grid tuning 1.485- to 3.03-mc. T–21: H-f oscillator (V–4) grid tuning 135- to 260-kc.
T–6, T–11	TRANSFORMER, variable RF: RF transformer and mixer; 2 wnd, pri universal wnd, secd single layer wnd; unshielded; pri 87 turns #38 SSE, secd 13½ turns #20 PE; 2⅞″ lg x ¾″ diam o/a with core screwed full in; form as per JAN LTS–E–2 natural phenolic; powdered iron core; form 2.000″ lg x 0.624″ OD; adj iron core; screwdriver adj from top; mts by means of brass bushing 0.234″ diam 6–32 thd; 4 solder lug term on bottom; treated with fungus-resistant lacquer; marked with Hallicrafters part/dwg #51B1124.	T–6: R-f coupling between first and second r-f stages (V–1 and V–2) 5.94- to 12.12-mc. T–11: R-f coupling between second and mixer stages (V–2 and V–3) 5.94- to 12.12-mc.
T–2	TRANSFORMER, variable RF: antenna; 2 wnd, pri universal, secd single layer wnd; unshielded; pri 43 turns #38 SSE, secd 27½ turns #20 PE; 2¾″ lg x ⅞″ diam o/a with core screwed full in; form as per JAN LTS–E–2 natural phenolic; powdered iron core; coil form 2″ lg x 0.624″ OD; adj iron core; screwdriver adj thru bushing; mts by means of brass bushing 0.234″ diam 6–32 thd; 4 solder lug term on bottom; treated with fungus-resistant lacquer; marked with Hallicrafters part/dwg #51B1126.	Antenna coupling to first r-f stage (V–1) grid 2.97- to 6.06-mc.
T–3	TRANSFORMER, variable RF: antenna; 2 universal wnd; unshielded; pri 98 turns of #38 SNE, secd 32 turns of #7/41 wire; 2.75″ lg x 0.175″ diam o/a with core screwed full in; form as per JAN LTS–E–2 natural phenolic; powdered iron core; adj iron core; screwdriver adj thru bushing; mtg by means of brass bushing 0.234″ diam 6–32 thd; 4 solder lug term on bottom; treated with fungus-resistant lacquer; marked with Hallicrafters part/dwg #51B1125.	Antenna coupling to first r-f stage (V–1) grid 1.485- to 3.03-mc.
T–1	TRANSFORMER, variable RF: antenna; 2 wnd, pri universal wnd and secd single layer wnd; unshielded; pri 26 turns of #38 SNE, secd 1342 turns of #20 PE; 2″ lg x ⅝″ OD o/a; form JAN LTS–E–2 natural phenolic; adj iron core; screwdriver adj from top of form; mtg by a single ¼–28 thd bushing; 4 solder lug term on bottom of form; marked with Hallicrafters part/dwg #51B1127.	Antenna coupling to first r-f stage (V–1) grid 5.94- to 12.12-mc.
T–8, T–13	TRANSFORMER, variable RF: RF transformer and mixer; 2 universal wnd; unshielded; pri 32 turns of #7/41 wire, secd 290 turns of #38 SSE wire; 2.78″ lg x 13/16″ diam o/a; with slug full in; form as per JAN LTS–E–2; natural phenolic; core material Stackpole G1 iron; form 2.000″ lg x 0.500″ ID x 0.612″ ID; adj iron core; screwdriver adjustment from top; mtg by means of brass bushing ¼″–25 thd; 4 solder lug term on bottom; treated with fungus-resistant lacquer; Hallicrafters part/dwg #51B1122.	T–8: R-f coupling between first and second r-f stages (V–1 and V–2) 1.485- to 3.03-mc.
T–22	TRANSFORMER, variable RF: osc; 2 single layer wnd; unshielded; pri 6½ turns of #34 SSE, secd 8½ turns of #26 EMW; form of Centralab #Zirconite 452; used with iron core, Hallicrafters part #3A1559; 2″ lg x ¾″ OD x ½″ ID; adjustable iron core; screwdriver adjustment thru bottom; mtg by means of two 6–32 NC2 thd spade bolts; 4 pillar type solder lugs at top; treated with fungus-resistant lacquer; transformer composed of iron core and coil, Hallicrafters part #51B1115.	H-f oscillator (V–4) grid tuning 5.94- to 12.12-mc.

Ref symbol	Name of part and description	Function of part
T-23	TRANSFORMER, variable RF: osc; 2 single layer wnd; unshielded; pri 14½ turns of #38 SSE, secd 17½ turns of #26 SSE; 2″ lg x ¾″ OD x ½″ ID; form Centralab #Zirconite 452; used with iron core; screwdriver adj from bottom; mtg by two 6-32 NC2 thd spade bolts; 4 pillar type solder lugs; treated with fungus-resistant lacquer; composed of coil, Hallicrafters part #51B1114 and iron core, Hallicrafters part #3A1559 ckt symbol 0-9.	H-f oscillator (V-4) grid tuning 2.97- to 6.06-mc.
T-24	TRANSFORMER, variable RF: osc; 2 single layer wnd; unshielded; pri 16½ turns of #38 SSE, secd 34½ turns of #30 SSE wire; form ¾″ OD x 2″ lg, Centralab #452 Zirconite body; air core; two 6-32 NC2 spade bolts on 0.812″ mtg/c; 4 pillar type lugs on bottom; treated with fungus-resistant lacquer; incl coil Hallicrafters part/dwg #51B1113 and iron core Hallicrafters part/dwg #3A1559 ckt symbol 0-9.	H-f oscillator (V-4) grid tuning 1- to 3-mc.
0-9	CORE, adjustable tuning: used with Hallicrafters osc coil part/dwg #51B1113, 51B1114, and 51B1115; Stackpole G3 iron; approx 1⅝″ lg x 0.309″ diam; mtg by brass nickel pl shaft with 6-32 NC2 thd; Stackpole part SK132; Hallicrafters part/dwg #3A1559.	
V-9	TUBE, electron: JAN 6H6; twin diode	Automatic noise limiter.
V-3	TUBE, electron: JAN 6SA7; pentagrid converter	Mixer.
V-4, V-7	TUBE, electron: JAN 6SJ7; RF pentode, sharp cut-off	V-4: H-f oscillator. V-7: Beat-frequency oscillator.
V-1, V-2, V-5, V-6	TUBE, electron: JAN 6SK7; RF pentode, remote cut-off	V-1: First r-f amplifier. V-2: Second r-f amplifier. V-5: First i-f amplifier. V-6: Second i-f amplifier.
V-8	TUBE, electron: JAN 6SQ7; duplex diode, high-mu triode	Detector, avc, and first audio amplifier.
V-10	TUBE, electron: JAN 25L6; beam-power pentode, Hallicrafters part/dwg #90J26L6.	Second a-f amplifier.
V-11	TUBE, electron: JAN 25Z6; twin diode rectifier	Rectifier.
H-4	WINDOW: label; plexiglass or other material in accordance with JAN-P-15, RTP-OII-1; flat sheet; 2.125″ lg x 1.765″ wd x 1/16″ thk; slides into a frame which is p/o the front panel; free from bubbles and scratches; Hallicrafters part/dwg #22A237.	Protects CHANNEL-FREQUENCY notation chart.
H-5	WINDOW: tuning dial; clear plexiglass with 1 coat clear lacquer; material to be in accordance with JAN-P-15, RTP-OII-1 specs; 6¼″ wd x 3¾″ h x 3/32″ thk flat sheet; mtg by means of four holes of approx diam 0.156″ on 5.750″ x 3.281″ ctr; 10 calibration marks and numerals to be screened in white, area adjacent to markings to be screened in black for good contrast; treated to resist fungus; to withstand salt spray test; Hallicrafters part/dwg #22C238.	Protects dial and dial pointer.
	MISCELLANEOUS PARTS	
W-1	CABLE ASSEMBLY, power: underwriters type SJ; two #16 stranded cond 26 x 30; 600 v working; 70″ lg excluding term; incl male connector and female connector ckt symbol J-3; Belden Code "Trump".	Connects receiver to power source.
J-2	CONNECTOR, female contact: two female pol curved cont; straight type; 1.187″ lg x 1″ diam o/a; 10 amp at 250 v or 15 amp at 125 v; molded black bakelite body; cable opening 0.218″ diam; includes cable grip; p/o cable assembly, power ckt symbol W-1; Hallicrafters part/dwg #10A338.	Power input socket.
P-2	CONNECTOR, male contact: two flat parallel pol blades; 0.625″ lg x 1.53″ diam shell; 10 amp at 250 v and 15 amp at 125 v; cad pl steel body; molded black bakelite insert; cable opening 0.296″ to 0.562″; cable clamp; p/o cable assembly, power ckt symbol W-1; Hubbell type #9973.	Power input plug.

Ref symbol	Name of part and description	Function of part
	MISCELLANEOUS PARTS—Continued	
W–2	CORD, headset extension: CD-307; 6 ft lg excluding terminations; Sig C dwg #SC–C–2019, JK–26 on one end PL–55 on the other end; Hallicrafters part/dwg #87B242.	Allows operator to move about freely without removing headset.
HS–1	HEADSET H–16/U: Spec 71–3128; c/o adjustable steel Army-Navy Headband MX–175/U w/suitable protective covering, fastened to one ea Earcup MX–239/U and Earcup MX–240/U, which contain acoustic coupling tubes for coupling Receiver R–30–U at base of cups to soft ear inserts; earcups w/soft cushions for comfort and as acoustic seal to exclude ext noise; incl short cord terminating in Plug PL–54, and impedance matching transformer at base of ea earcup to provide impedance of 8000 ohms at 1000 cps; u/w but not p/o Cord CD–307; Kellogg type H–16/U.	Changes audio signals into sound.
R–39	RESISTOR, carbon: 47,000 ohms	Bfo (V–7) grid.
R–61	RESISTOR, carbon: p/o T–4 secd	Broadening frequency response of transformer.
R–62	RESISTOR, carbon: p/o T–5 secd	Broadening frequency response of transformer.
R–63	RESISTOR, carbon: p/o T–9 secd	Broadening frequency response of transformer.
R–64	RESISTOR, carbon: p/o T–10 secd	Broadening frequency response of transformer.
R–65	RESISTOR, carbon: p/o T–14 secd	Broadening frequency response of transformer.
R–66	RESISTOR, carbon: p/o T–15 secd	Broadening frequency response of transformer.
SW–5	SWITCH: SPST; attached to R–20	Bfo (V–7) ON-OFF switch.
SW–8	SWITCH: SPST; attached to R–30	Power ON-OFF switch.

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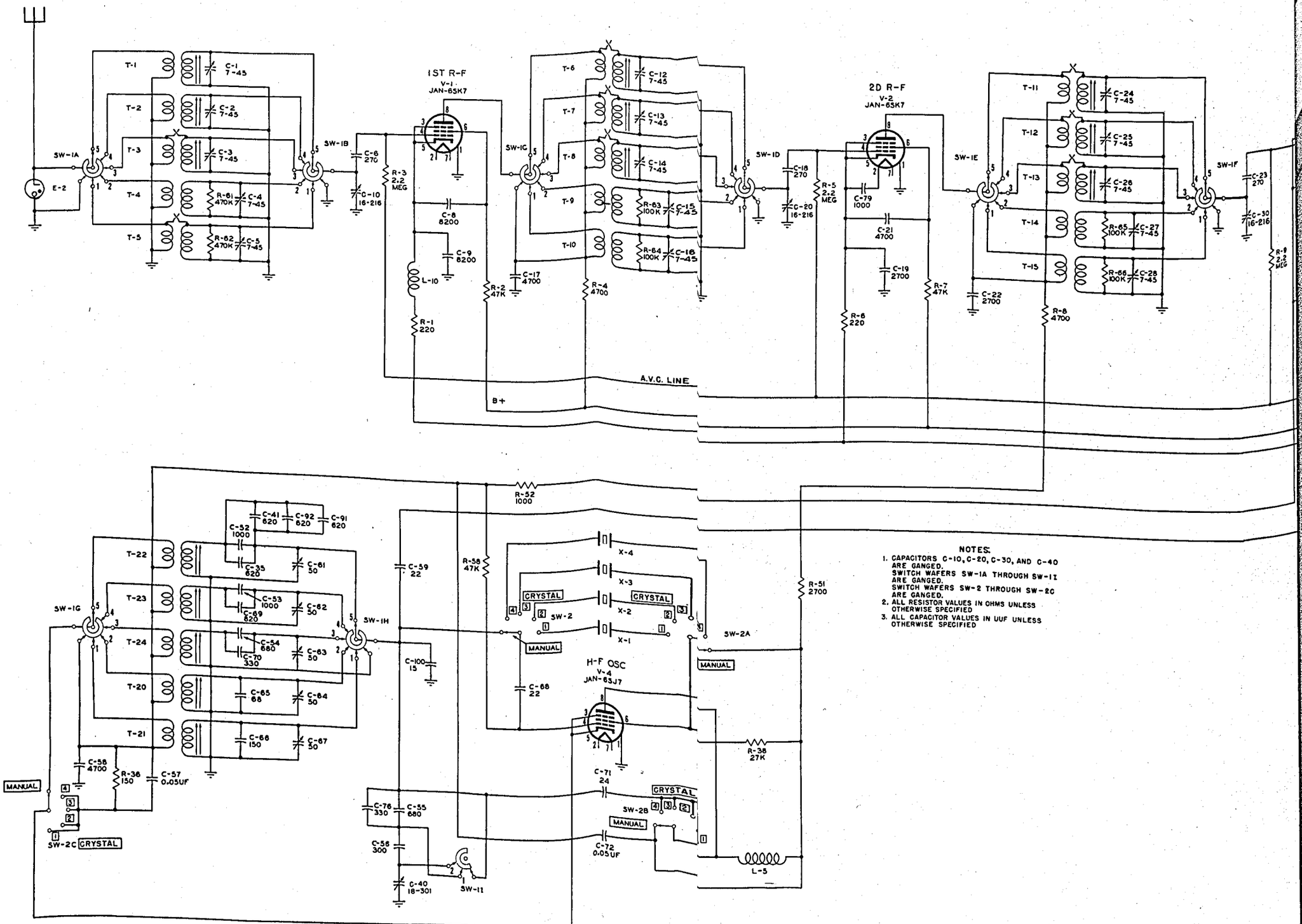
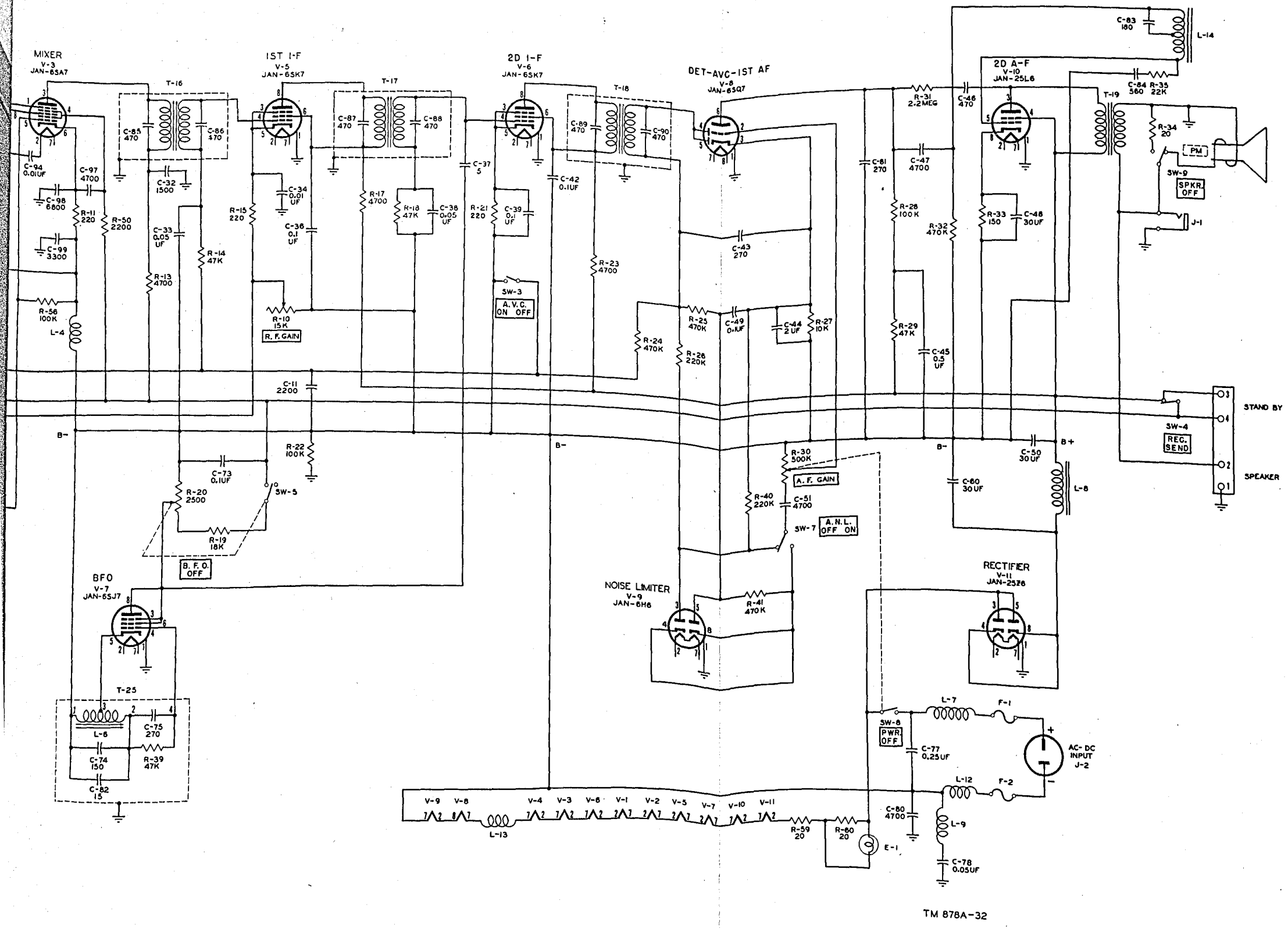


Figure 40.—Radio Receiver



TM 878A-32

-96A/SR, schematic diagram.