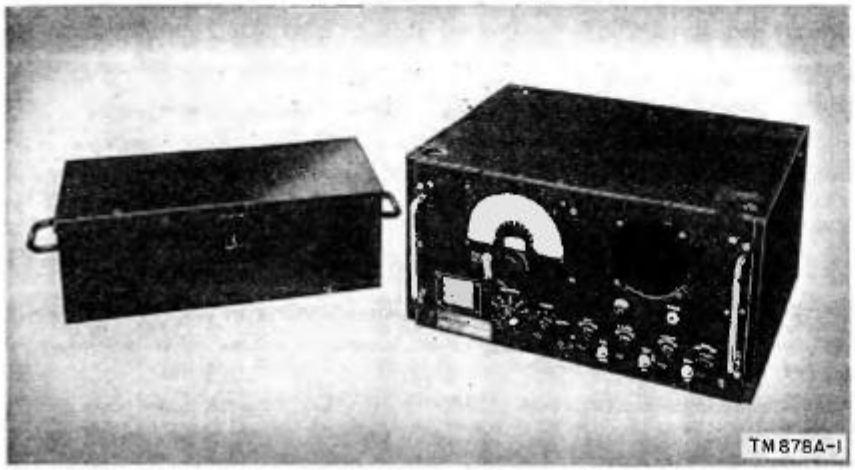

Figure 1. Radio Receiver R–96A/SR and spare parts box.

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.

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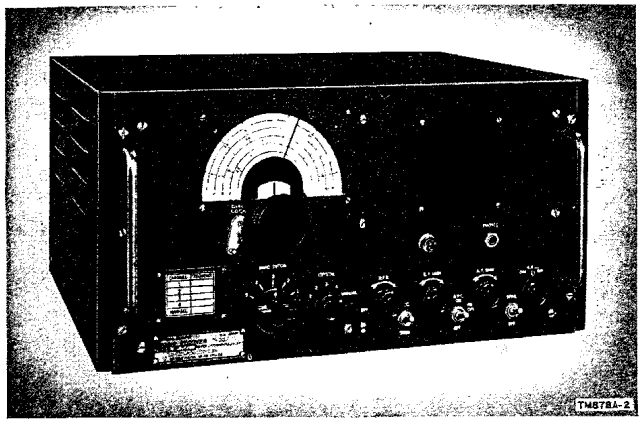

Figure 2. Radio Receiver R–96A/SR, front view.

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.

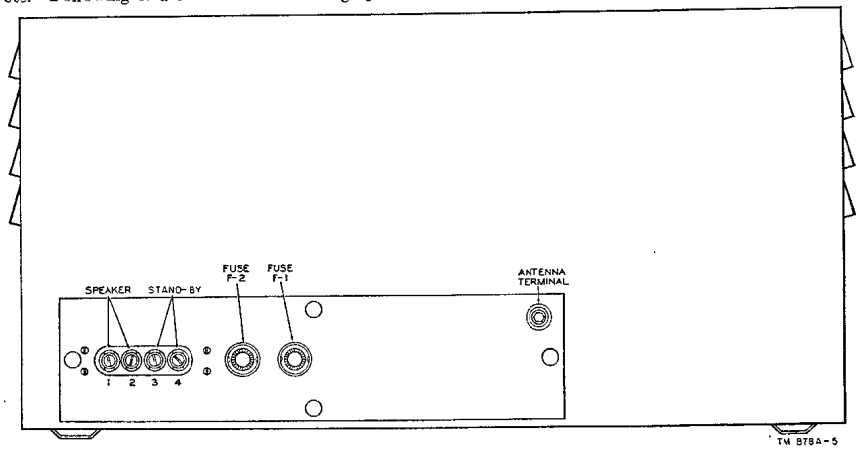

Figure 3. Radio Receiver R-96A/SR, rear view.

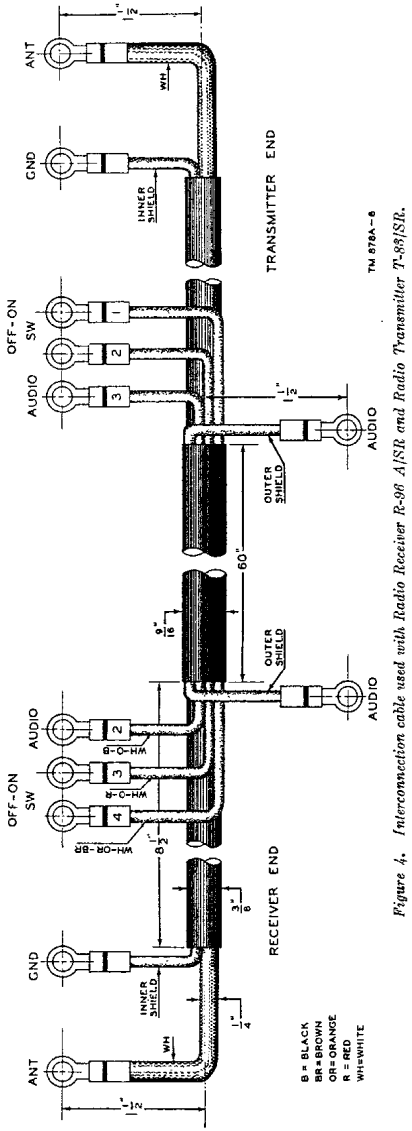

Figure 4. Interconnection cable used with Radio Receiver R-96 A/SR and Radio Transmitter T-83/SR.

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.

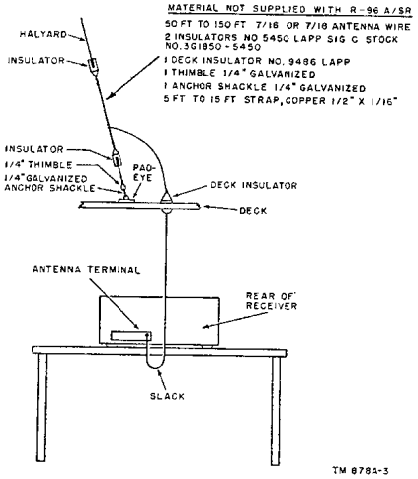

Figure 5. A method of installing a ship antenna.

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.

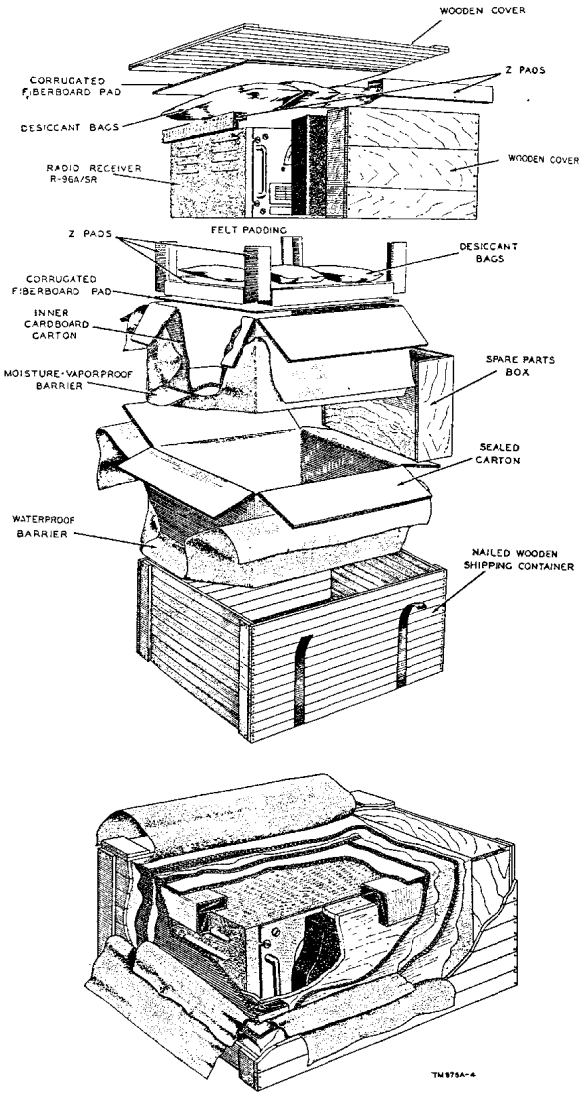

Figure 6. Packaging and packing Radio Receiver R–96A/SR.

(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 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.

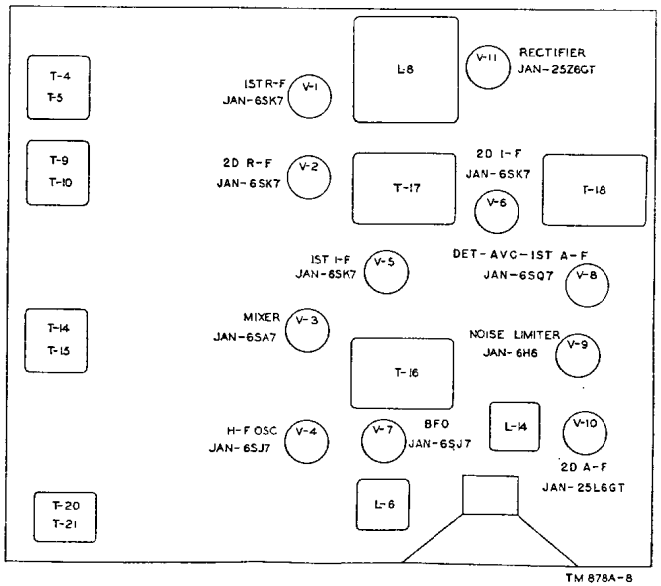

Figure 7. Radio Receiver R-96A/SR, tube location chart.

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.

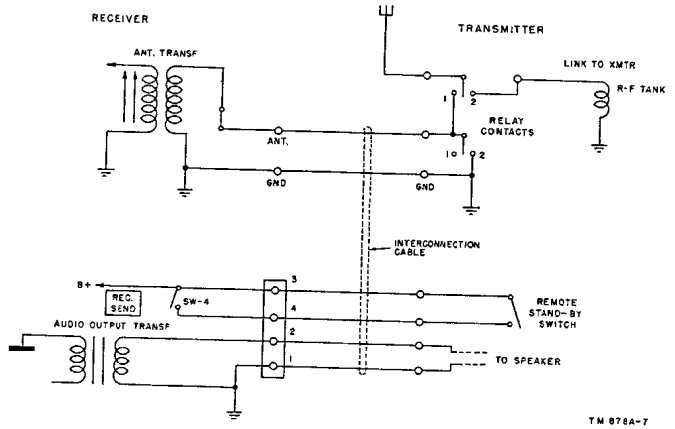

Figure 8. Interconnections between Radio Receiver R-96 A/SR and Radio Transmitter T-83/SR, schematic diagram.

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.
REC.-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.

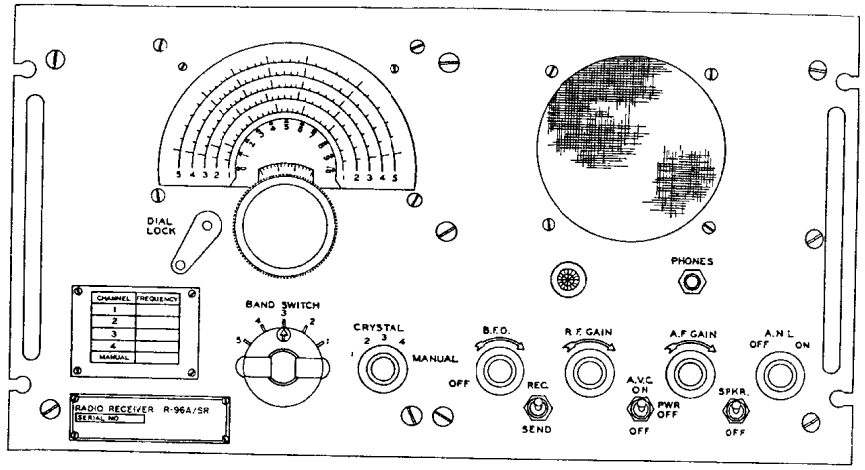

Figure 9. Radio Receiver R–96A/SR, front panel view.

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.

Terminal	Function
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.

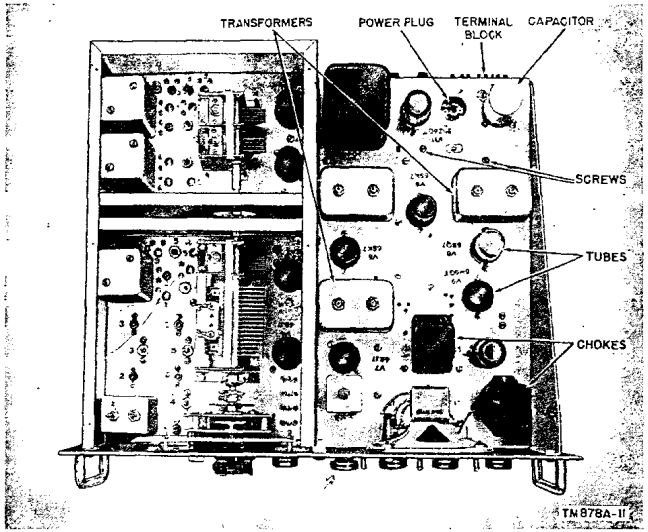

Figure 10. Radio Receiver R–96A/SR, top view showing typical PM items.

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. 401).	
		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.	
6. 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 or 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.

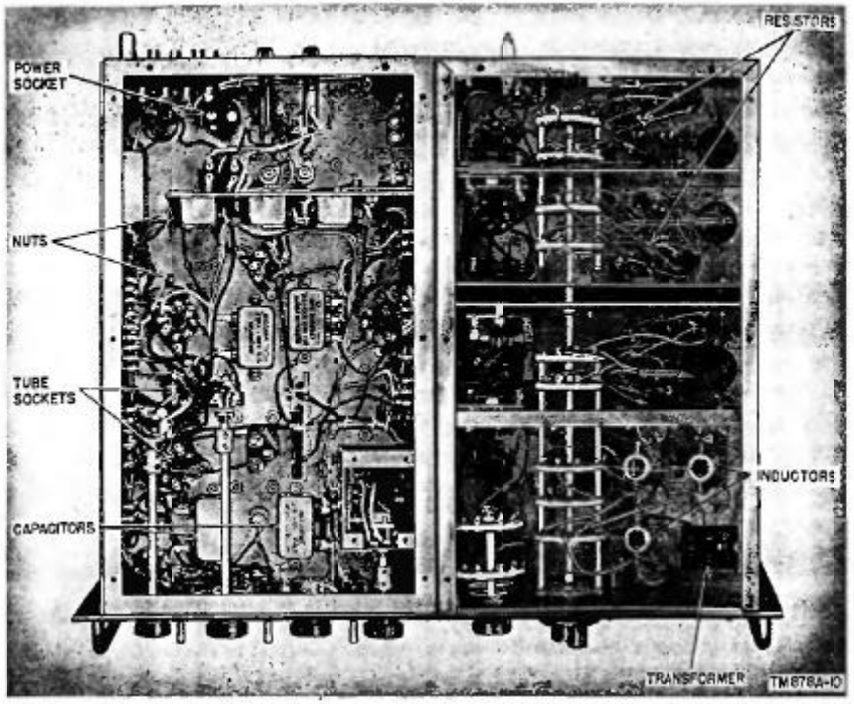

Figure 11. Radio Receiver R-96A/SR, bottom view showing typical PM items.

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

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.

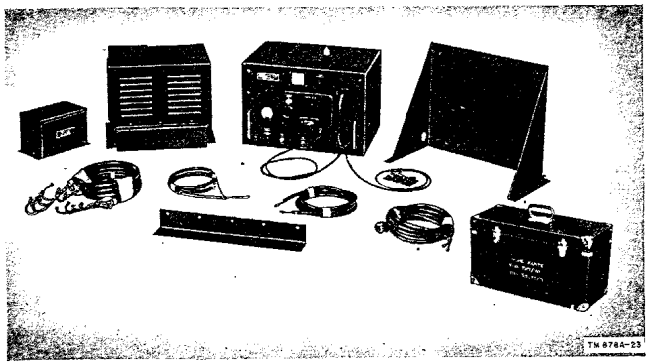

Figure 15. Components of Radio Transmitter T–83/SR.

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 outpnt 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.

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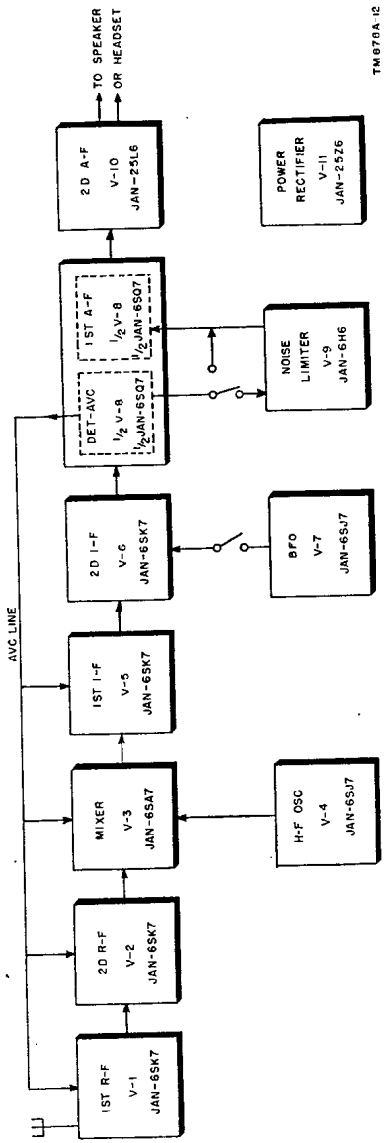


Figure 16. Radio Receiver R-98/URR, block diagram.

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

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 paralleled 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.*

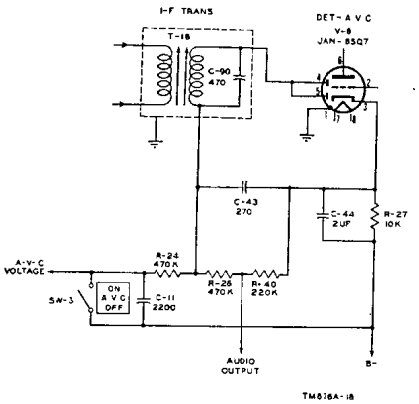


Figure 24. Detector and avc, simplified schematic diagram.

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

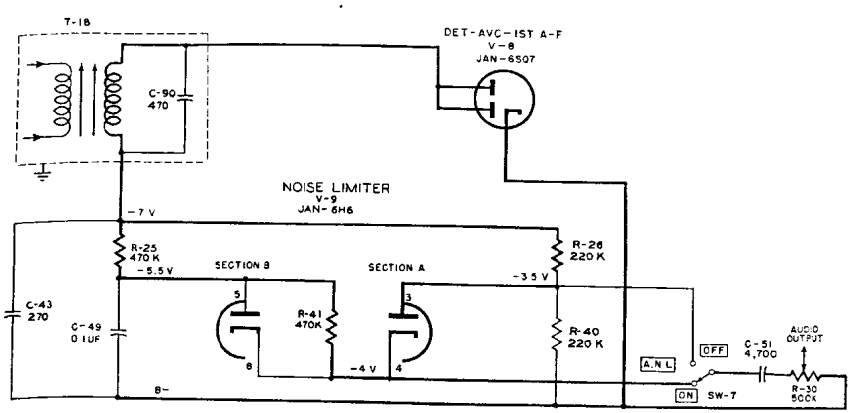


Figure 25. Noise limiter, simplified circuit diagram for preliminary explanation.

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

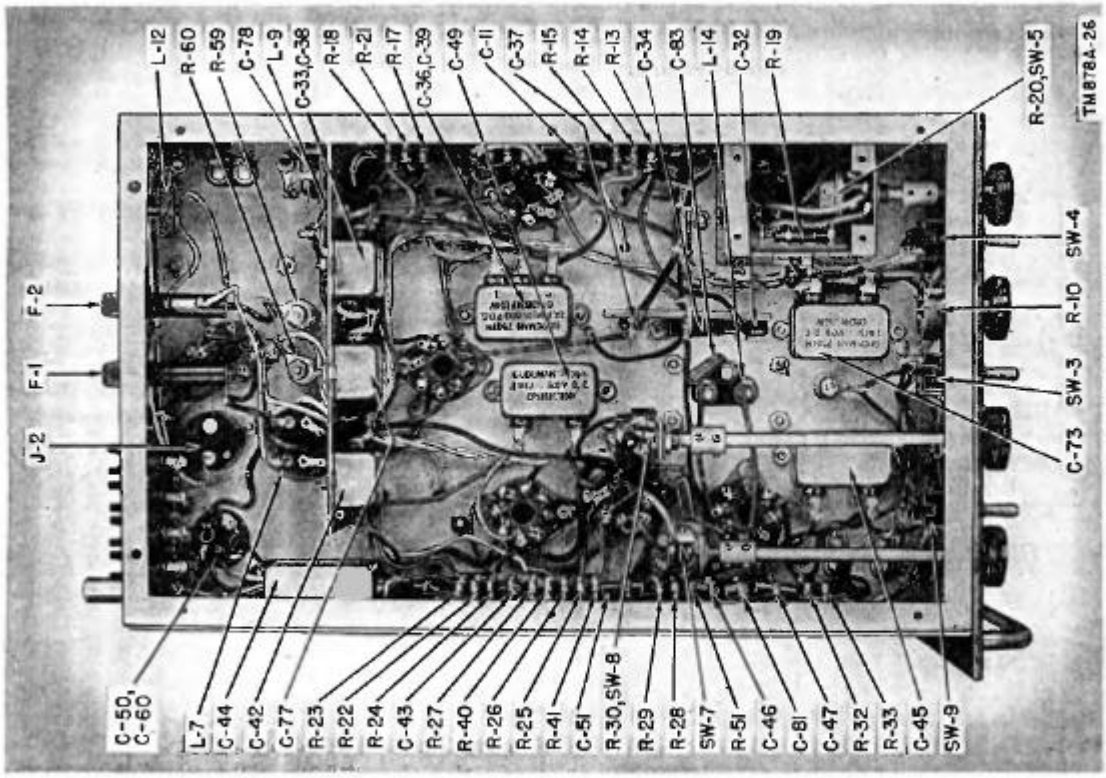


Figure 81. Audio chassis, bottom view.

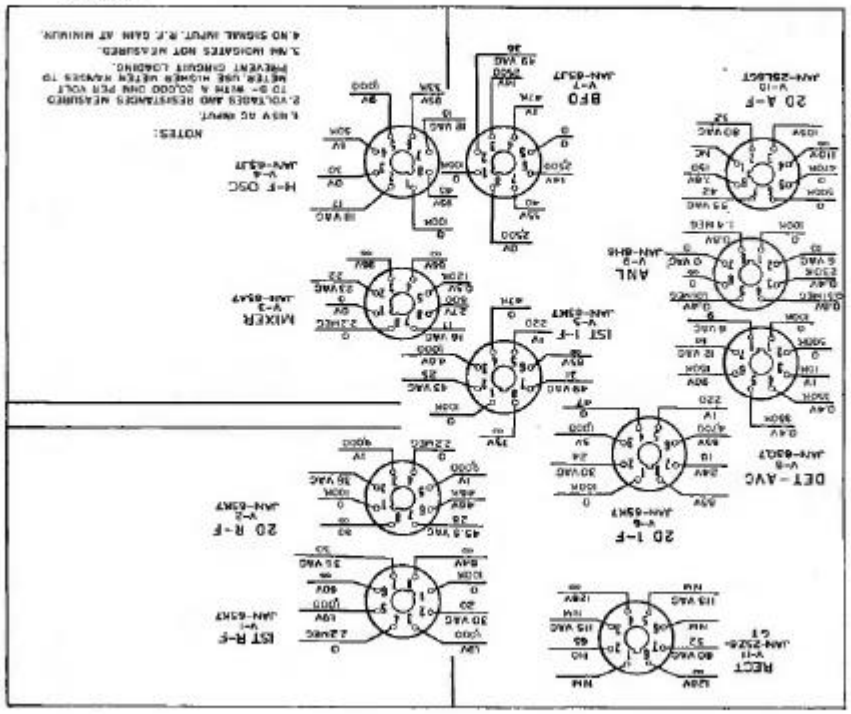


Figure 82. Radio Receiver R-108/URR, voltage and resistance measurements.

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

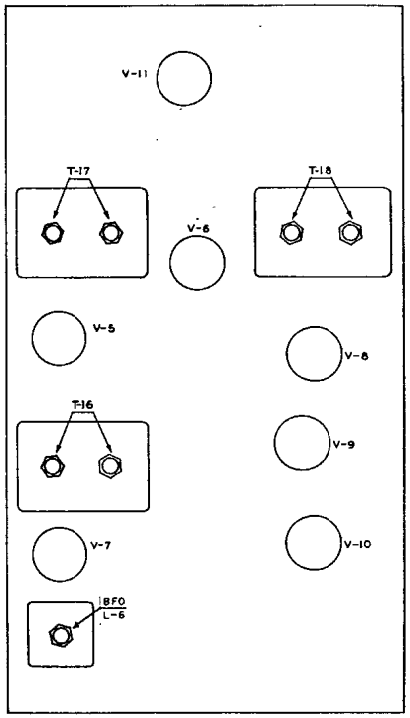


Figure 36. I-f alinement diagram.

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.

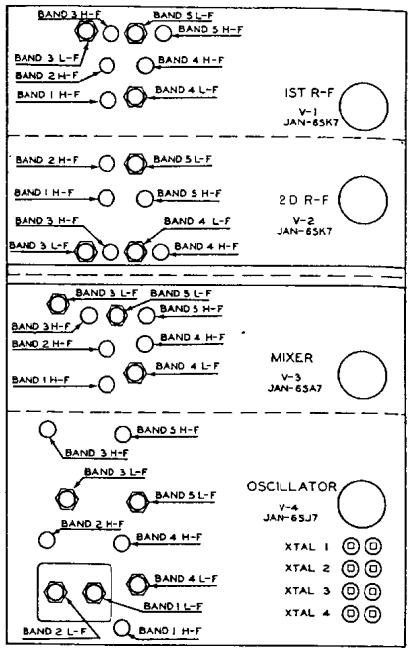


Figure 37. R-f alinement diagram.

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		

Section V. FINAL TESTING

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.
Ave 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.

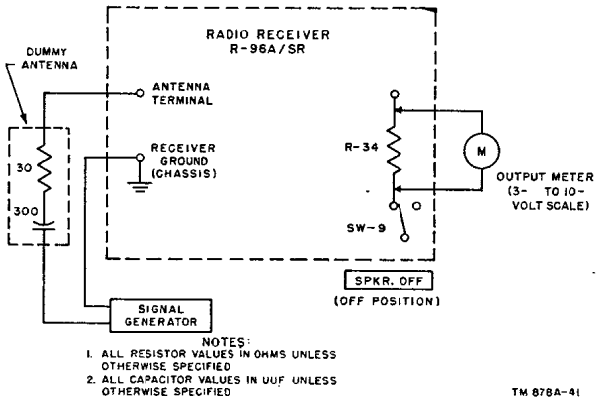


Figure 38. Over-all output check set-up.

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 diat	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 diat 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 coupting, leads too long, leads not properly dressed, or poor shield grounds.
Avc 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 avc 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-f 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.

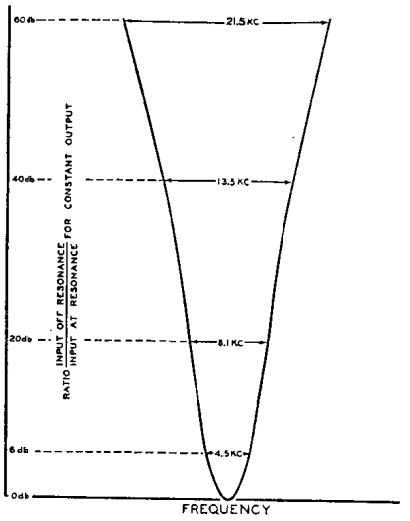


Figure 39. Selectivity curve.

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

	Function of part
	Allows operator to move about freely without removing headset.
	Changes audio signals into sound.
	Bfo (V-7) grid.
	Broadening frequency response of transformer.
	Broadening frequency response of transformer.
	Broadening frequency response of transformer.
	Broadening frequency response of transformer.
	Broadening frequency response of transformer.
	Broadening frequency response of transformer.
	Bfo (V-7) ON-OFF switch.
	Power ON-OFF switch.

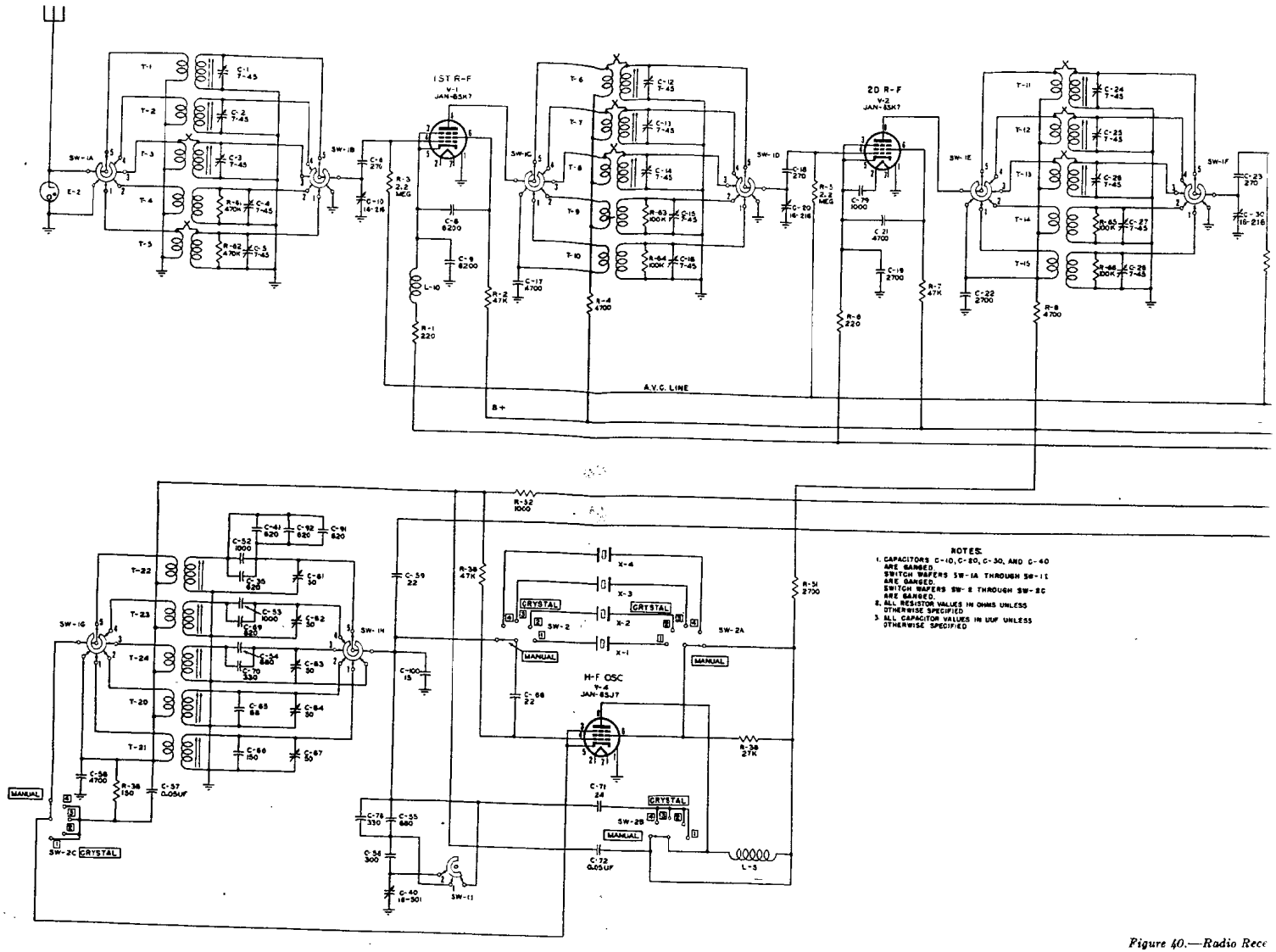


Figure 40.—Radio Rece

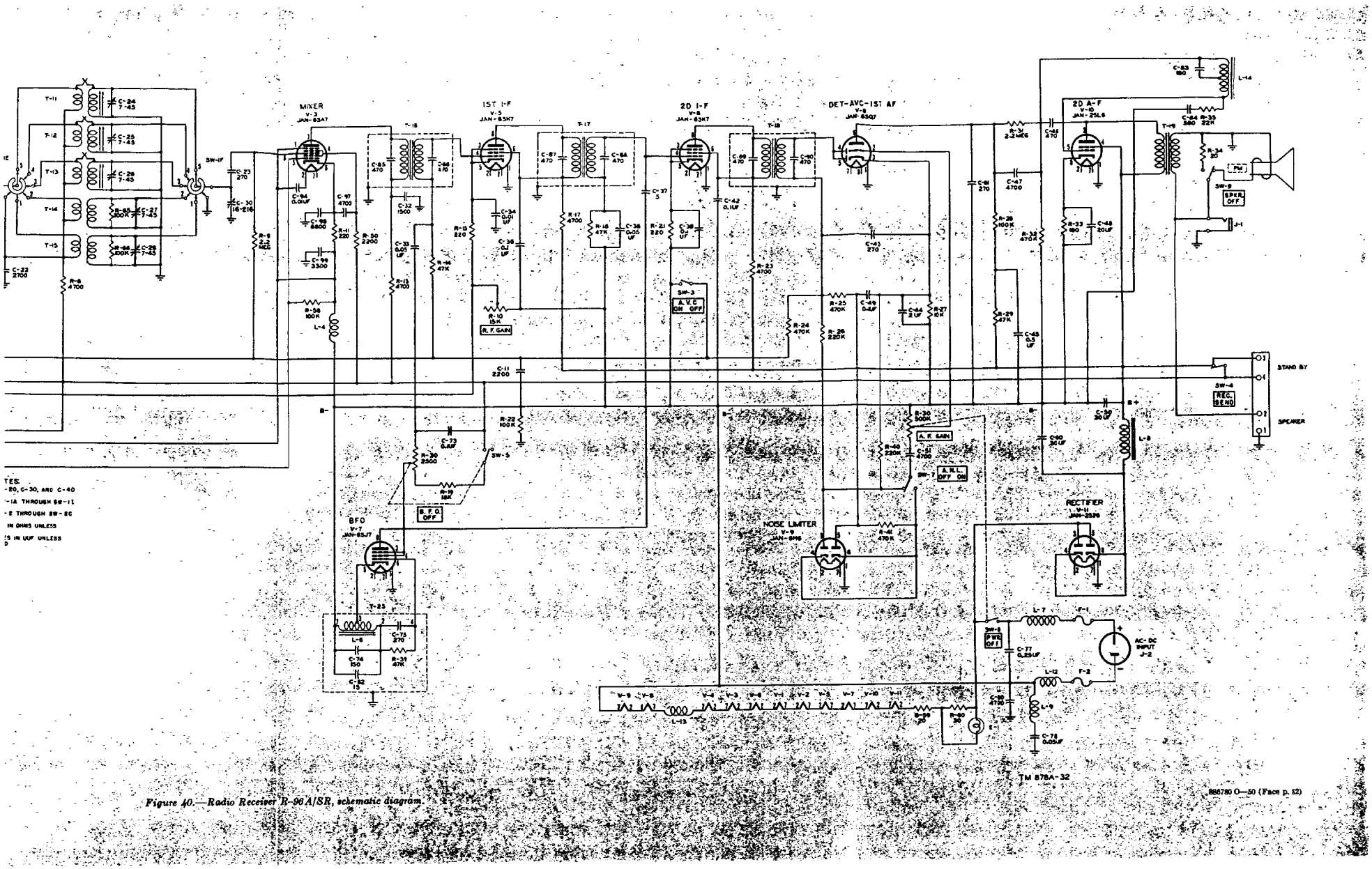
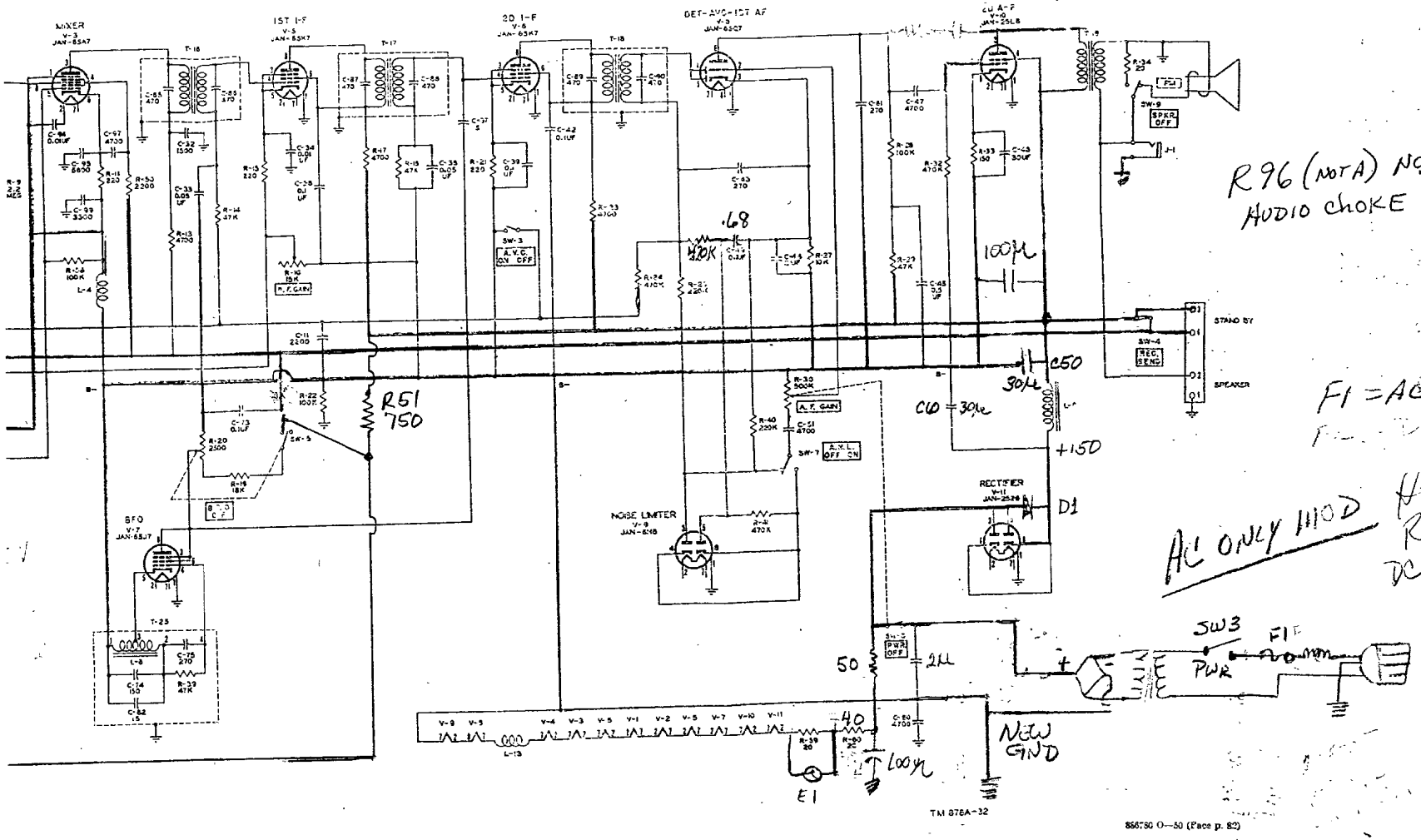


Figure 40.—Radio Receiver R-96A/SR, schematic diagram.



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ceiver R-98.1/SR, schematic diagram