TRAINEE'S GUIDE

for

ELECTRONICS TECHNICIANS

CLASS C

AN/SRC-20 AN/SRC-21

RADIO SETS

VOLUME 1

INFORMATION SHEETS

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FOREWORD

This Trainee's Guide has been designed to assist you in learning how to maintain the AN/SRC-20 and AN/SRC-21 equipments. However, it will not take the place of the equipment instructions or maintenance standards books. With the help of this book you will learn to use the technical manuals to maintain the equipment. It is approved for use in support of training in the AN/SRC-20 and AN/SRC-21 maintenance course.

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INFORMATION SHEET 1

INTRODUCTION TO THE COURSE

A. INTRODUCTION:

Welcome aboard. You are about to embark on a two-week training course. To help you make the most of this course, it is important that you understand the objectives, the methods, and course particulars. This information sheet outlines the objectives and course particulars and briefly covers the techniques or methods of instruction used.

B. REFERENCES:

NAVSHIPS 94695A, Technical Manual for Radio Sets AN/SRC-20 and AN/SRC-21. Specific chapters and pages will be referenced in each information sheet.

C. INFORMATION:

1. Objectives.

The primary objectives of this course are to provide the trainee with the necessary instruction and experience to qualify him for installation, checkout, operation, and maintenance of Radio Sets AN/SRC-20 and AN/SRC-21. During the course the trainee will receive sufficient classroom instruction to provide him with a good over-all understanding of the equipment, including detailed analysis of the theory of operation of the radio set circuitry. The trainee also will receive sufficient practical application, under on-the-job conditions, to enhance development of his skill in installing, checking out, operating, and maintaining the equipment.

2. Methods.

This course utilizes lectures, demonstrations, and practical laboratory applications. Each lecture is based on an information sheet, and each information sheet contains a companion assignment sheet. Job sheets are provided for practical application. The job sheets contain the necessary instruction for connection of test equipment and job setups to be accomplished. The job sheets also contain self-test questions to emphasize and cement the trainee's understanding of the job accomplished.

The information, assignment, and job sheets are assembled into one volume and comprise the trainee's workbook. Illustrations in the trainee's workbook together with chalkboard diagrams drawn by the instructor and various visual aids combine to develop a clear, concise view of the information presented during the course.

This course has been designed to present the necessary information to meet the course objectives in a logical step-by-step order.

Sufficient laboratory time under close instructor supervision will help to further develop the trainee's knowledge and skills.

3. Course Particulars.

This is an 80-hour course which is divided into two 5-day work weeks. Classes are in session for 8 hours a day. The daily schedule begins at 0800 and ends at 1700, with

scheduled breaks during the work day. Lunch break is from 1200 to 1300. Homework will be given consisting of 10 assignment sheets to complete.

A prescribed classroom and laboratory procedure is to be followed at all times. The classes will convene and break at scheduled times. Attentiveness and good discipline are required. The senior man in the class shall be designated as "class leader" and shall cooperate with the instructor in maintaining attendance and discipline at all times.

WARNING

When in laboratory, all safety procedures will be exercised at all times. Use extreme caution when working on the equipment, for dangerous voltages are present.

Testing shall be conducted in accordance with the U.S. Navy Bureau of Ships training specification TS695D-62-223(A) dated 29 January 1962. The tests shall be composed of multiple-choice, fill-in, completion, and true-false type questions. The tests will be designed, administered, and corrected by the instructors. The tests shall be administered on Fridays and will cover all information presented prior to the test.

D. SUMMARY:

This introduction has been designed to (1) provide the trainee with a view of the type of course he is about to begin, (2) to inform him of what information is to be presented and the methods of presentation to be utilized, and (3) to briefly preview types and methods of testing and the expected discipline. As pointed out in the introduction, safety procedures shall be observed at all times.

WEEKLY TRAINING SCHEDULE
(FIRST WEEK)
Radio Sets AN/SRC-20 and AN/SRC-21

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
0800	Introduction to the course IS-1	Functional block diagrams (Cont) IS-4	Operational controls and operating procedures (Cont) JS5-1J	Circuit analysis AN/URC-9 IS-7	Circuit analysis AN/URC-9, frequency selection circuits IS-8
0900	Functional description IS-2	Frequency scheme AN/SRC-20 and 21 IS-4			
1000	Description of units IS-3		Operator's maintenance IS-6		Circuit analysis C-3866/SRC IS-9
1100					
1200 - 1300	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
1300	Laboratory Familiarization with equipment layout and component location	Operational controls and operating procedures IS-5	Laboratory Operator's maintenance JS6-1J	Circuit analysis AN/URC-9 IS-7	Review, test, and critique
1400					
1500	Functional operation of the AN/SRC-20 and 21 block diagrams IS-4	Laboratory Operational controls and operating procedures JS5-1J			
1600					
1700					

WEEKLY TRAINING SCHEDULE
(SECOND WEEK)
Radio Sets AN/SRC-20 and AN/SRC-21

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
0800 0900	Circuit analysis AM-1565/ URC IS-10	Alignment and adjustment (Cont)	Laboratory Removal and repair, disassembly and assembly, mechanical synchronization, and lubrication	Laboratory Trouble shooting	Laboratory Trouble shooting
1000 1100	Laboratory Functional checks JS4-1J JS4-2J				
1200 - 1300	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
1300 1400	Laboratory Functional checks (Cont)	Installation IS-11	Laboratory Trouble shooting	Laboratory Trouble shooting	Review, test, and critique
1500 1600 1700	Laboratory Alignment and adjustment JS7-1J	Laboratory Installation, inspection, and adjustments JS11-1J JS11-2J			

NOTICE

SAFETY IS YOUR RESPONSIBILITY! Safety is everyone's responsibility. The personnel maintaining this equipment and the equipment have one thing in common; both have definite jobs to accomplish, but neither can accomplish them when safety procedures are disregarded. Disregard of safety procedures and precautions can lead to inury (or death) to personnel or damage to the equipment. A list of safety procedures for both personnel and equipment is provided here. Heed these rules and reap the rewards.

Personnel

1. NEVER WORK on equipment ALONE.
2. DO NOT make voltage or waveform checks haphazardly. The voltages present may be dangerous to life and limb.
3. DO NOT check high voltages except where specified, and in all cases, read instructions carefully FIRST.
4. BE SURE that all equipment and test equipment is grounded.
5. BE SURE that the deck or surface on which you are standing is dry.
6. Familiarize yourself with the latest methods of electrical shock treatment.
7. Familiarize yourself with the latest methods of artificial respiration.
8. ALWAYS use the correct tools.
9. Be extremely CAREFUL when making measurements or adjustments in the power supply.
10. NEVER become involved in horseplay while near the equipment.

Equipment

1. Keep equipment dry.
2. Do not allow equipment to be set in a precarious position.
3. Keep equipment clean.
4. ALWAYS refer to maintenance procedures BEFORE making an alignment or adjustment.
5. Refer to maintenance manual BEFORE cleaning, oiling, or refurbishing.
6. Do not allow unpainted portions to be unprotected for an extended period of time.
7. Replace all broken, chipped, cracked, sprung, stripped, etc. parts immediately.
8. Replace parts with approved, standard parts only.
9. Always use the correct tools for the job.
10. NEVER become involved in horseplay while near the equipment.

ABOVE ALL ELSE, USE COMMON SENSE and WHEN EVERYTHING ELSE FAILS, FOLLOW DIRECTIONS.

COURSE PLAN

I. COURSE TITLE:

Radio Sets AN/SRC-20 and AN/SRC-21. Checkout and maintenance.

II. COURSE OBJECTIVE:

The objective of this course is to prepare and qualify selected military electronic technicians to trouble shoot, maintain, repair, and check out Radio Sets AN/SRC-20 and AN/SRC-21.

III. LEARNERS:

A. Occupation:

The learners attending this course shall be military electronic technicians. These learners shall meet the following prerequisites:

1. Graduate of a trade school or of the Navy's apprentice training program.
2. Good working knowledge of electricity and electronics.
3. Basic knowledge of semiconductors.
4. At least one year work experience in installing, checking out, repairing, and maintaining electronic equipment.

B. Number to be trained: _____

C. Number per group: _____

D. Number of groups: _____

IV. SCHEDULE:

This checkout and maintenance course shall require two weeks. Each week shall consist of five work days. Each day will be eight hours long. The course has been constructed to provide at least 50-percent actual work experience on the equipment. See weekly training schedule.

V. INSTRUCTION:

The course shall be taught by qualified instructors. The instructional methods shall include lectures, demonstrations, and practical work. The instructional materials include the instructor's guide, trainee's workbook, graphic training aids, equipment and technical manuals, and handout sheets.

VI. TRAINING FACILITIES:

A. The training facilities shall be supplied by the Navy.

B. The training vehicles will be supplied by the Navy.

VII. COURSE COMPLETION REQUIREMENTS:

Students completing this course will have received instruction on the following topics:

A. Functional description.

1. Purpose of equipment.
2. Equipment capabilities.
3. Equipment operating characteristics.
4. Differences between the AN/SRC-20 and AN/SRC-21.
5. Composition of the AN/SRC-20 and AN/SRC-21.

B. Functional operation, functional block diagram, and frequency scheme.

1. Modes of operation.
2. Operating conditions.
3. System functional block diagram.
    a. Signal flow.
4. Functional block diagram of the AM-1565/URC.
    a. Frequency selection.
    b. Signal flow.
    c. R-f power regulation.
    d. Power supplies.
5. Functional block diagram of the AN/URC-9.
    a. Frequency selection.
    b. Signal flow (receive).
    c. Signal flow (transmit).
    d. Power supplies.
6. Functional block diagram of the C-3866/SRC.
    a. Start-stop circuits.
    b. Channel select dial.
    c. Indicator Control C-3868/SRC.
    d. Radio Set Control C-1138/URC.
    e. Audio matching circuits.
7. Frequency scheme.
    a. Frequency multiplier oscillator.
    b. 17- to 26-mc oscillator.
    c. 3.0- to 3.9-mc oscillator.

C. Operational controls and operating procedures.

1. Description of controls.
2. Modes of operation.
3. Turn-on procedures.
    a. AN/SRC-20.
    b. AN/SRC-21.
4. Squelch circuits.
5. Indicator presentations.
6. Emergency operation.

D. Block diagram analysis of the AN/SRC-20 and AN/SRC-21.

1. Frequency selection.
    a. C-3866/SRC.
    b. AM-1565/URC.
    c. AN/URC-9.
2. Signal flow (transmit).
3. Signal flow (receive).

E. Special circuit operating principles.

1. AN/URC-9 transmit.
2. AN/URC-9 receive.
3. AM-1565/URC.
4. C-3866/SRC.

F. Electromechanical operation.

1. Autopositioners*
    a. AN/URC-9.
    b. AM-1565/URC.
2. Channel dialing.
    a. C-3866/SRC.
    b. C-3868/SRC.

G. Installation.

1. AN/SRC-20 and AN/SRC-21

*Registered in U.S. Patent Office.

a. Primary power.

b. Site selection.

c. Equipment mounting.

d. Interconnecting cable assemblies.

(1) AN/SRC-20.

(2) AN/SRC-21.

e. Inspection and adjustment.

(1) Preinstallation checks.

(2) Postinstallation checks.

(3) Operational checks.

VIII. Students completing this course will be proficient in installing, checking out, and maintaining the radio sets and will have developed the necessary practical skills by

A. Familiarization with equipment and component location.

1. Inspecting units and locating controls and indicators.
2. Inspecting major subassemblies to locate and record physical layout of major components.

B. Operational controls and operating procedures.

1. Turning on equipment.
2. Viewing and recording meter presentations.
3. Selecting operating modes.
4. Selecting operating frequencies.
5. Adjusting squelch levels.
6. Turning off equipment.
7. Preparing equipment for emergency operation.

C. Installation inspection and adjustment.

1. Performing prescribed installations.
2. Performing simulated equipment installation.

D. Functional checks.

1. Performing specified functional tests on R-F Amplifier AM-1565/URC.
2. Performing specified functional tests on Radio Set AN/URC-9.
3. Performing specified functional tests on Radio Set Control C-3866/SRC.

E. Alignment and adjustment.

1. AM-1565/URC.

a. Adjusting the power amplifier voltages.
b. Adjusting and aligning the servo amplifier.
c. Adjusting automatic output control circuits.

2. AN/URC-9.

a. Aligning and adjusting the 3.0- to 3.9-mc oscillator.
b. Aligning and adjusting the 17- to 26-mc oscillator.
c. Aligning the second i-f amplifier.
d. Aligning the first i-f amplifier.
e. Aligning and adjusting the frequency multiplier oscillator.
f. Aligning the r-f and PA assembly.
g. Adjusting the audio transmit levels.
h. Adjusting the carrier squelch levels.
i. Adjusting the signal-plus-noise to noise ratio squelch.

3. C-3866/SRC.

a. Adjusting the programing relays.
b. Adjusting the stepping relay.

F. Removal and repair, disassembly and assembly, and mechanical synchronization.

1. Removal, disassembling, repairing, assembling, and mechanicaly synchronizing the following:

a. AM-1565/URC.

(1) Autopositioner.
(2) Front panel.
(3) Power amplifier.
(4) Servo amplifier.
(5) Case blower.

b. AN/URC-9.

(1) Power supply.
(2) R-f and PA assembly.
(3) Frequency multiplier oscillator.
(4) First i-f amplifier.
(5) Second i-f amplifier.

(6) Third i-f amplifier.

(7) Audio amplifier and modulator.

(8) Relay filter.

(9) Centrifugal-axial fan.

(10) 500-kc filter and low-pass filter.

(11) Front panel.

(12) Frequency selector.

G. Lubrication.

1. Lubrication of mechanical assemblies.

H. Corrective maintenance.

1. Detecting, isolating, and correcting malfunctions in the equipment.

INFORMATION SHEET 2

FUNCTIONAL DESCRIPTION OF RADIO SETS AN/SRC-20 AND AN/SRC-21

A. INTRODUCTION:

In this information sheet, we will discuss the composition of Radio Sets AN/SRC-20 and AN/SRC-21, and the differences between them, and some of the capabilities and limitations of the radio sets. We will also discuss the functional characteristics of the major units and functional sub units.

B. REFERENCES:

NAVSHIPS 94695A, Technical Manual for Radio Sets AN/SRC-20 and AN/SRC-21, Pages 1-1 through 1-11.

C. INFORMATION:

1. General.

Radio Sets AN/SRC-20 and AN/SRC-21 are shipboard or fixed station systems capable of simplex transmission and reception of amplitude-modulated, radiotelephone (A3) signals. The radio sets operate in the 225- to 399.9-mc (uhf) range; this range is covered in 0.1-mc steps over 1750 crystal-controlled channels. Nineteen of the 1750 channels can be preset for automatic selection. Complete control of the radio sets, including automatic selection of the preset channels, can be exercised from up to four remote points. Provisions also are included to (1) operate in conjunction with another set for automatic retransmission, (2) modulate the carrier with a 1000-cps signal which is used as a homing beacon, and (3) operate the radio set in conjunction with equipment requiring broad bandwidth characteristics.

The only difference between Radio Sets AN/SRC-20 and AN/SRC-21 is the use of a linear, 100-watt, r-f amplifier in the AN/SRC-20. Radio Set AN/SRC-20 is composed of three units (figure 3-1): (1) Radio Frequency Amplifier AM-1565/URC, (2) Radio Set AN/URC-9, and (3) Radio Set Control C-3866/SRC. Radio Set AN/SRC-21 is composed of two units (figure 3-2): (1) Radio Set AN/URC-9 and (2) Radio Set Control C-3866/SRC.

The minimum carrier output of Radio Set AN/SRC-20 is 100 watts with modulation capability of 80 percent; for Radio Set AN/SRC-21, the minimum carrier output is 16 watts with an 80-percent modulation capability.

2. Radio-Frequency Amplifier AM-1565/URC.

The AM-1565/URC (figure 3-3) is an automatically tuned, fixed-station, linear, uhf power amplifier which operates class AB_1. The amplifier provides a minimum carrier level of 100 watts over a frequency range of 225 to 399.9 mc and is continuously tunable over the entire range. A dial calibrated in frequency and a logarithmically calibrated dial are provided to allow presetting of channels. The cathode and plate-tuned circuits of the r-f amplifier are high-Q, coaxial cavities and are servo tuned to the desired frequency. Radio-frequency excitation is controlled automatically by a ferrite attenuator which compensates for variation in the exciter output. The linearity of this r-f amplifier minimizes interference due to transmitter intermodulation. An internal power supply operates from a 115- to 230-volt a-c, 50- to 60-cps source. The r-f amplifier and integral power supply is installed in the equipment case on a tilting slide mechanism; allowing the unit to be withdrawn from the case for servicing (figures 3-4 and 3-5). Major subassemblies, such as the power amplifier

and servo amplifier, can be removed from the chassis. An internal blower provides forced-air cooling. Connections are provided on the rear of the case for an antenna coupler, exciter, a-c power, and remote control.

Channel selection is accomplished by Autopositioners. The r-f amplifier is continuously tunable over the entire frequency range, with provisions for presetting 19 channels for remote or local selection. One additional channel allows manual tuning. All channel information of the power amplifier is made available to the associated exciter. The power amplifier can be controlled by a remote unit.

3. Radio Set AN/URC-9.

The AN/URC-9 (figure 3-6) functions as a triple-conversion, superheterodyne receiver during standby operation. When the microphone push-to-talk switch is closed, the T/R (transmit-receive) relays convert the unit to a transmitter. Many of the i-f, r-f, and audio circuits are used on both transmit and receive. Three crystal-controlled oscillators provide stable r-f and i-f frequencies on both transmit and receive. Receiver-Transmitter RT-581/URC-9 is automatically tuned by standard Autopositioners which can be controlled locally from the front panel or by remote control. Any one of the 19 preset channels can be selected from the front panel or by remote control, and any of the 1750 channels within the frequency range of the radio can be selected by use of the manual frequency control on the front panel.

Receiver-Transmitter Case CY-2959/URC-9 contains two compartments, one for Power Supply PP-2702/URC-9 and one for Receiver-Transmitter RT-581/URC-9. A centrifugal fan unit, mounted in the top of the power supply compartment, circulates cooling air around the heat exchanger case and through the power supply compartment. The louvered ports on the sides of the case are covered to make the equipment immersion proof during transit. During operation, the plates are removed and relocated above the louvered ports to make the equipment splashproof. A centrifugal-axial fan unit is mounted on the main chassis of the RT-581/URC-9 and supplies cooling air to the receiver-transmitter units; in particular, the power amplifier and the modulator output tubes.

Power Supply PP-2702/URC-9 provides all operating voltages required by the receiver-transmitter. The supply operates on 115- or 230-volt a-c single phase, 50 to 60 cycles per second. (The supply also can operate on 400 cps, single phase, but both fans must be changed to 400-cycle units before 400-cycle operation can be accomplished.)

4. Radio Set Control C-3866/SRC.

The C-3866/SRC (figure 3-7) is a control unit which permits local or remote operation of the radio set and provides automatic (dial) selection of any one of the 19 preset channels. When the correct combination of remote dialing and audio equipment is used, C-3866/SRC makes possible remote control from up to four remote stations.

The unit contains a pushbutton start-stop circuit which controls primary power for either the AN/SRC-20 or AN/SRC-21. All primary power is routed through this unit. A telephone-type dial is used to select any one of the 19 preset channels. Programing relays and a stepping relay are used to generate a 5-wire binary code to deliver channel information to the Autopositioners in the radio set. The stepping relay also provides d-c voltages for positioning the remote channel indicators (synchros), such as Indicator Control C-3868/SRC (figure 3-7). When the set is controlled from a remote location by Radio Set Control C-1138/URC (figure 3-7), the C-3866/SRC provides matching for the audio lines. Nineteen squelch level potentiometers are available in the C-3866/SRC for setting the squelch level of each preset channel. The unit also contains three relay power supplies.

D. SUMMARY:

Radio Sets AN/SRC-20 and AN/SRC-21 provide amplitude-modulated communications on any one of 1750 channels in the range of 225 to 399.9 mc. The only difference between the two sets is that the AN/SRC-20 utilizes a 100-watt linear r-f power amplifier (AM-1565/URC). Both radios incorporate capabilities to preset 19 channels, and both sets can be controlled from as many as four remote stations.

INFORMATION SHEET 3

QUICK REFERENCE DATA AND EQUIPMENT LIST

A. INTRODUCTION:

We will now present reference data or equipment specifications of Radio Sets AN/SRC-20 and AN/SRC-21. We will also mention which equipment is supplied to make up the AN/SRC-20 and AN/SRC-21 and those equipments which are required but not supplied.

B. REFERENCES:

NAVSHIPS 94695A, Technical Manual for Radio Set AN/SRC-20 and Radio Set AN/SRC-21, Section 1, Pages 1-7 through 1-11.

C. INFORMATION:

1. General Description.

Radio Sets AN/SRC-20 and AN/SRC-21, shown in figures 3-1 and 3-2, are designed for shipboard or fixed-station operation. These sets provide amplitude modulation (AM) on any of 1750 channels spaced 0.1 mc apart in the 225- to 399.9-mc range. Nineteen of the 1750 channels can be preset. Complete control, including the selection of preset channels, can be exercised from up to a maximum of four remote control points. In addition, circuits are incorporated which permit the connection of two sets for two-way automatic retransmission.

Radio Sets AN/SRC-20 and AN/SRC-21 differ in that Radio Set AN/SRC-21 does not incorporate the 100-watt uhf linear amplifier (AM-1565/URC) used by Radio Set AN/SRC-20 (see figure 3-1). In all other respects, the two sets are identical.

Radio Set AN/SRC-20 is composed of three units: (1) Radio-Frequency Amplifier AM-1565/URC, an automatically tuned fixed-station linear power amplifier operating from 225 to 399.9 mc; (2) Radio Set AN/URC-9, a 1750-channel triple-conversion superheterodyne transceiver operating from 225 to 399.9 mc; and (3) Radio Set Control C-3866/SRC, which permits selection of any one of 19 preset channels on Radio Set AN/URC-9. Each of these three basic units is described in more detail below.

Radio Set AN/SRC-21 is composed of only Radio Set AN/URC-9 and Radio Set Control C-3866/SRC.

2. Description of Units.

The basic units from which Radio Sets AN/SRC-20 and AN/SRC-21 are constructed are briefly explained in the following paragraphs:

a. Radio-Frequency Amplifier AM-1565/URC.

The AM-1565/URC, shown in figure 3-3, is an automatically tuned, fixed-station linear power amplifier which operates from 225 to 399.9 mc. The cathode and plate-tuned circuits of the r-f amplifier are high-Q coaxial cavities, servo tuned to the selected frequency. Because the r-f amplifier is linear, interference due to transmitter intermodulation is minimal. An internal power supply operates from a 115- to 230-volt, 50- to 60-cps power source.

The r-f amplifier, with integral power supply, is installed in the equipment cases on a tilting slide mechanism; this allows the unit to be withdrawn from the case for servicing.

Major subassemblies, such as the power amplifier and servo amplifier, can be removed from the chassis. An internal blower provides forced-air cooling. Connections for an antenna coupler, exciter, a-c power, and remote control are provided at the rear of the case.

Channel selection is accomplished by Autopositioners. The r-f amplifier is continuously tunable over the frequency range, with provisions for presetting 19 channels for remote or local selection. The twentieth channel allows manual tuning. All channel information is made available to the associated exciter. A remote control unit may be used to control the r-f amplifier.

b. Radio Set AN/URC-9.

The AN/URC-9 is the major unit of both the AN/SRC-20 and the AN/SRC-21.

The unit, shown in figure 3-6, functions as a triple-conversion, superheterodyne receiver during standby operation. When the microphone push-to-talk switch is depressed, a series of T/R (transmit-receive) relays convert the unit to a transmitter which uses many of the same r-f, i-f, and audio circuits used on receive. Three crystal-controlled oscillators provide stable r-f and i-f frequencies on both transmit and receive. Receiver-Transmitter RT-581/URC-9 is tuned automatically by standard Autopositioners which are controlled on the front panel or by remote control. Any of 19 preset channels from 225.0 to 399.9 mc can be selected from the front panel or the remote control. Any one of the 1750 channels within the frequency range can be selected automatically using the manual frequency control on the front panel.

Power Supply PP-2702/URC-9 provides all operating voltages required by the receiver-transmitter. The supply nominally operates on 115 or 230 volts, 50 to 60 cycles a-c. The power supply can also operate on 400 cycles single phase.

CAUTION

If Power Supply PP-2702/URC-9 is to operate on 400 cycles, the centrifugal fan in Receiver-Transmitter Case CY-2959/URC-9 and the blower fan in Receiver-Transmitter RT-581/URC-9 must be replaced with 400 cycle units.

The power supply also provides 115 volts a-c to a centrifugal fan and the blower within Receiver-Transmitter Case CY-2959/URC-9. The centrifugal fan mounts on the RT-581/URC-9 main frame and supplies cooling air to the receiver-transmitter subunits, particularly the power amplifier and the modulator output tubes.

Receiver-Transmitter Case CY-2959/URC-9 contains two compartments, one for Power Supply PP-2702/URC-9 and one for Receiver-Transmitter RT-581/URC-9. The blower in the top of the power supply compartment circulates cooling air around the heat exchanger case and through the power supply compartment. The louvered ports on each side of the case are covered with plates to make the equipment immersion proof during transit. During operation the plates are detached and relocated above the louvered ports to make the equipment splashproof.

c. Radio Set Control C-3866/SRC.

The C-3866/SRC, shown in figure 3-7, enables a radio operator to select any one of 19 preset radio channels on Radio Set AN/SRC-20 or AN/SRC-21. Remote control from up to

four distant points is possible when correct combinations of remote dialing and audio equipment are used. Remote channel dialing is accomplished with Indicator Control C-3868/SRC. Remote audio control can be accomplished with Radio Set Control C-1138/UR, Radio Set Control C-1207/UR, or their equivalent.

Radio Set Control C-3866/SRC contains a front-panel telephone-type dial, and the relays necessary to operate in internal stepping relay for channel selection. Nineteen squelch level potentiometers are available for setting the squelch level of each radio channel. The C-3866/SRC also contains three relay power supplies and the primary power control equipment for the remote-controlled transceiver and power amplifier. A local-remote switch transfers control functions to the parallel group of up to four remote stations, and audio transformers convert the unbalanced inputs from Radio Set AN/SRC-20 or AN/SRC-21 to the balanced output required by the remote stations.

3. Reference Data.

Detailed reference data for Radio Set AN/SRC-20 is given below by unit (that is, Radio-Frequency Amplifier AM-1565/URC, Radio Set AN/URC-9, and Radio Set Control C-3866/SRC). This data also applies to Radio Set AN/SRC-21 except for the data on Radio-Frequency Amplifier AM-1565/URC which is not included.

The data is given in tabular form for ease of reference. All data for each specific unit is contained in one table.

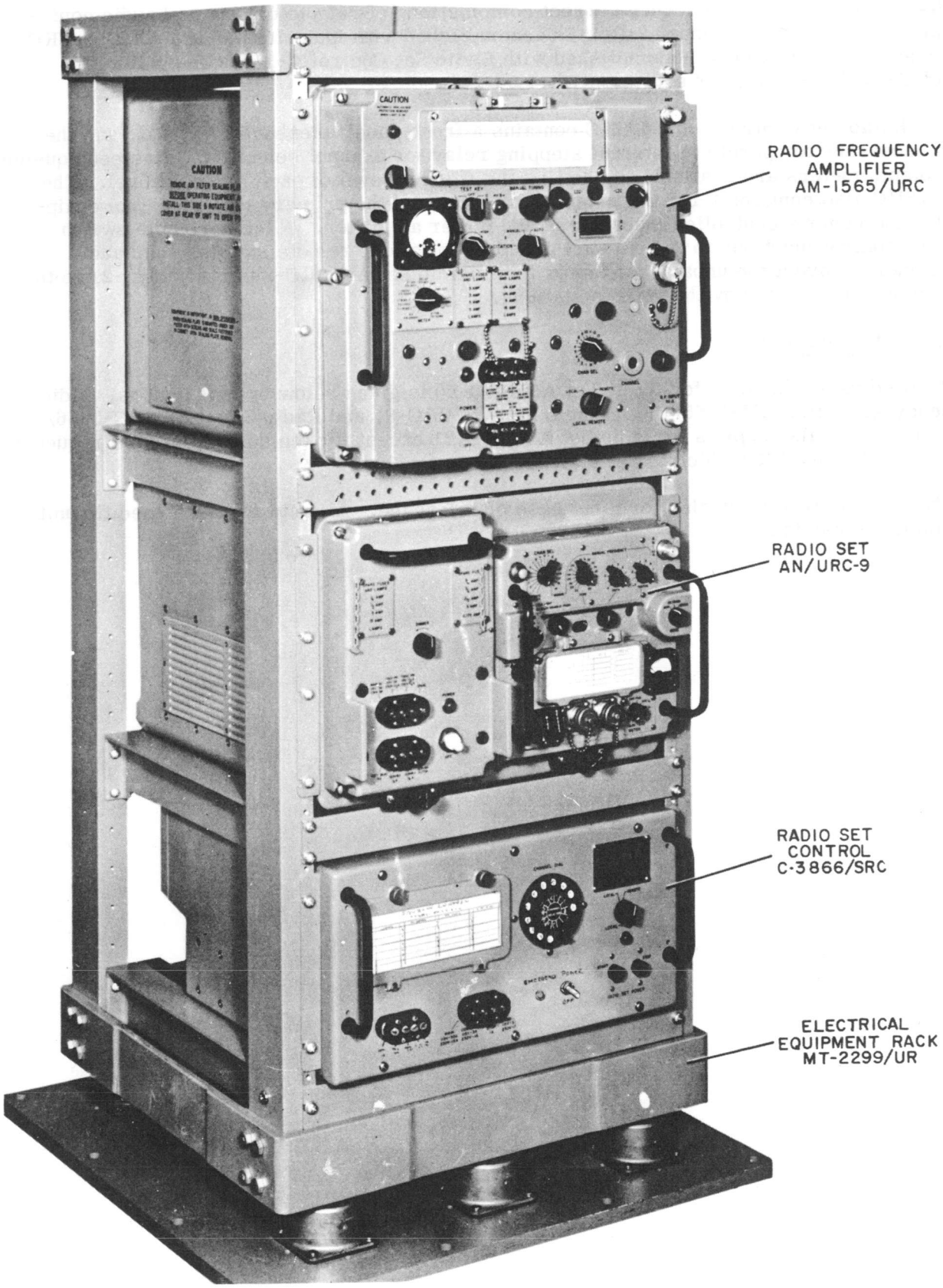

Figure 3-1. Radio Set AN/SRC-20

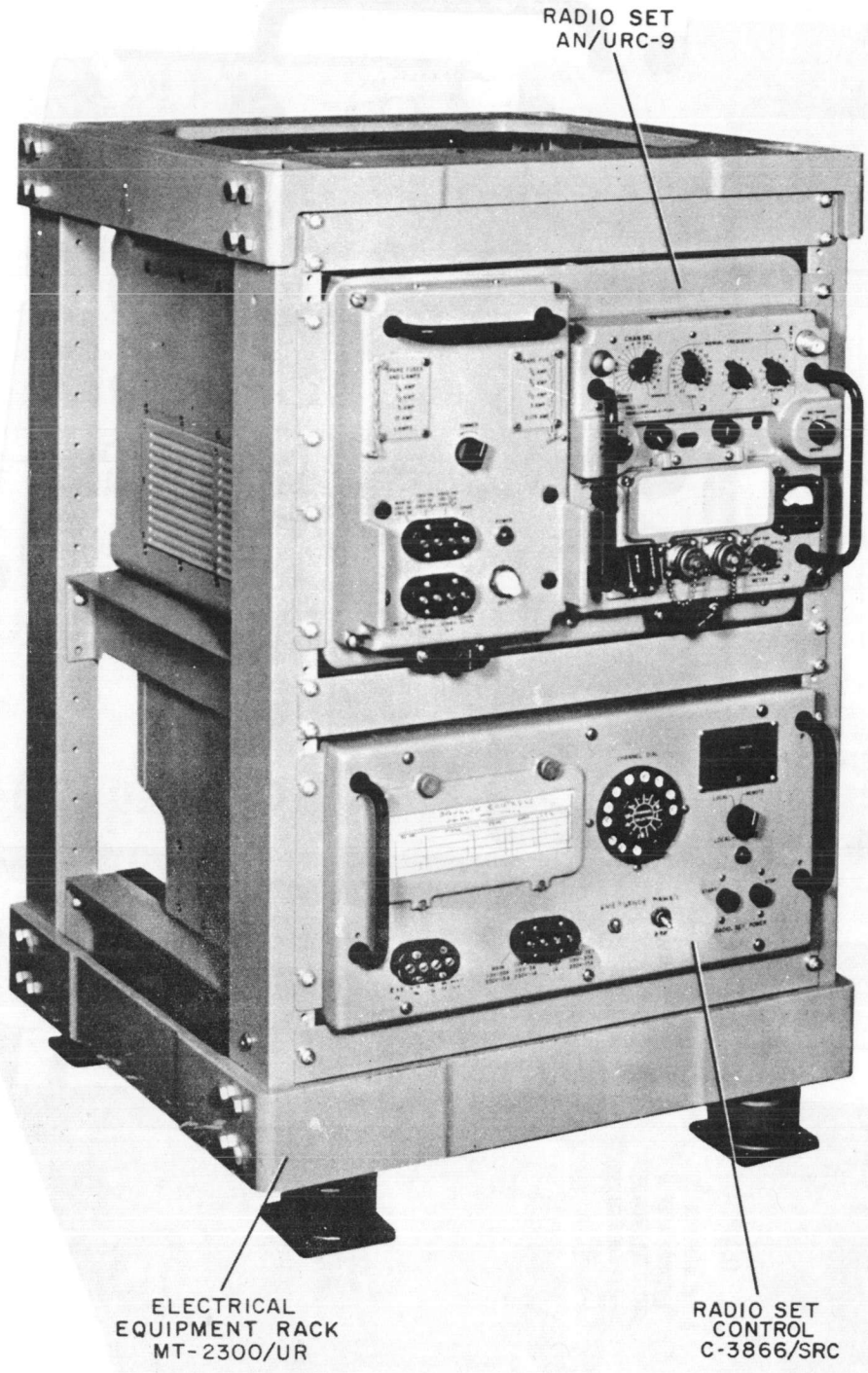

Figure 3-2. Radio Set AN/SRC-21

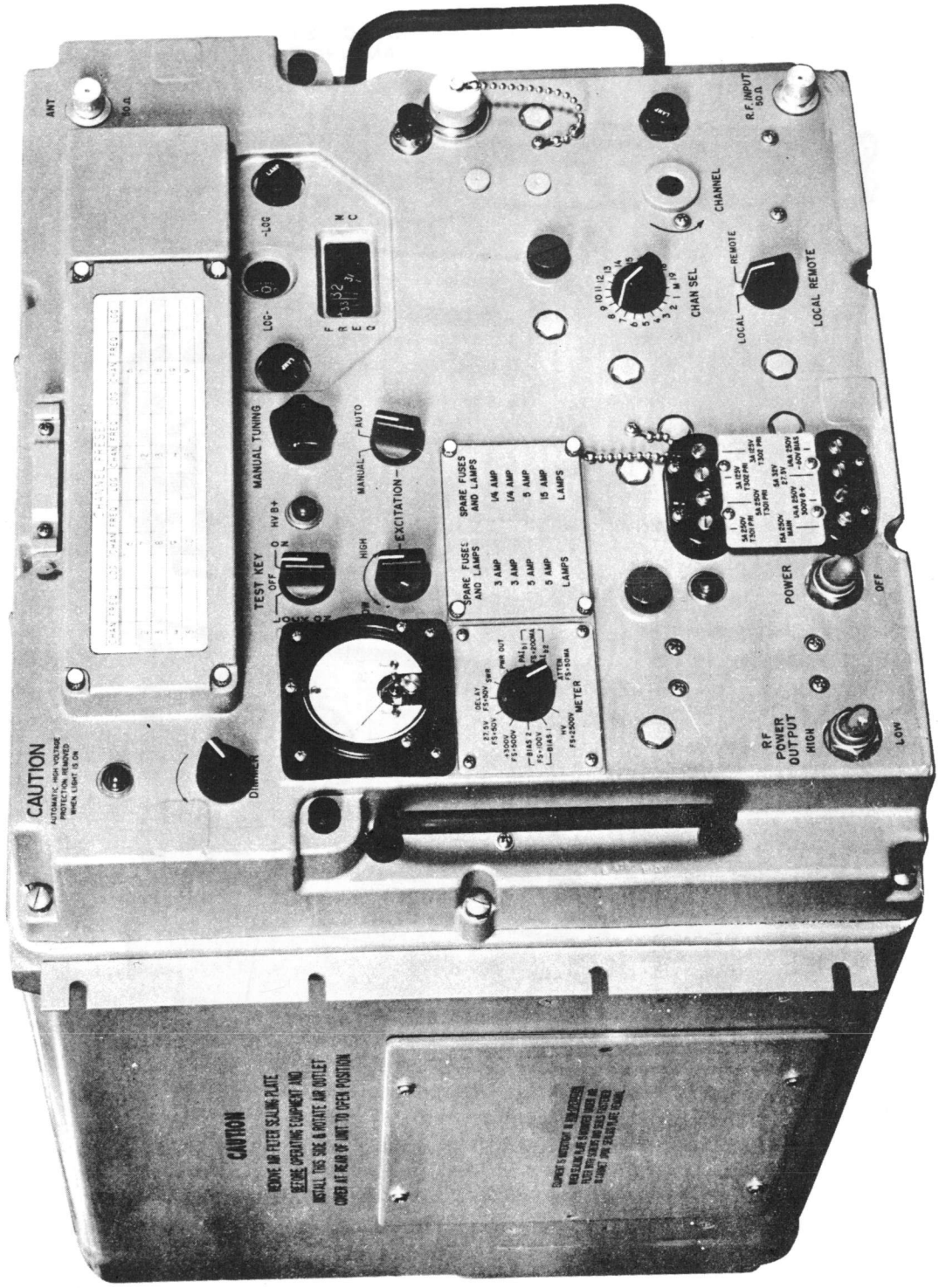

Figure 3-3. Radio-Frequency Amplifier AM-1565/URC

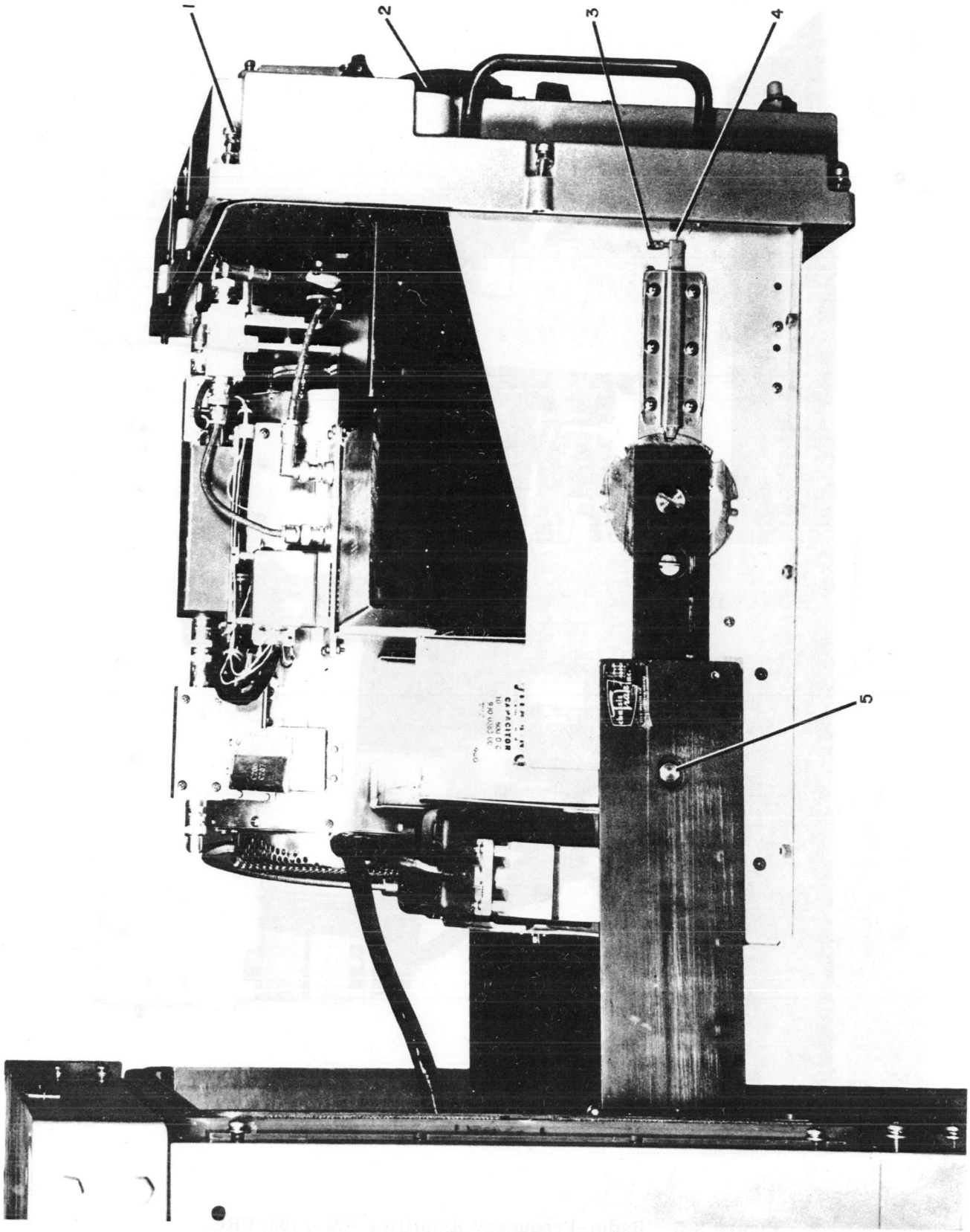

Figure 3-4. Radio-Frequency Amplifier AM-1565/URC, Extended on Slides

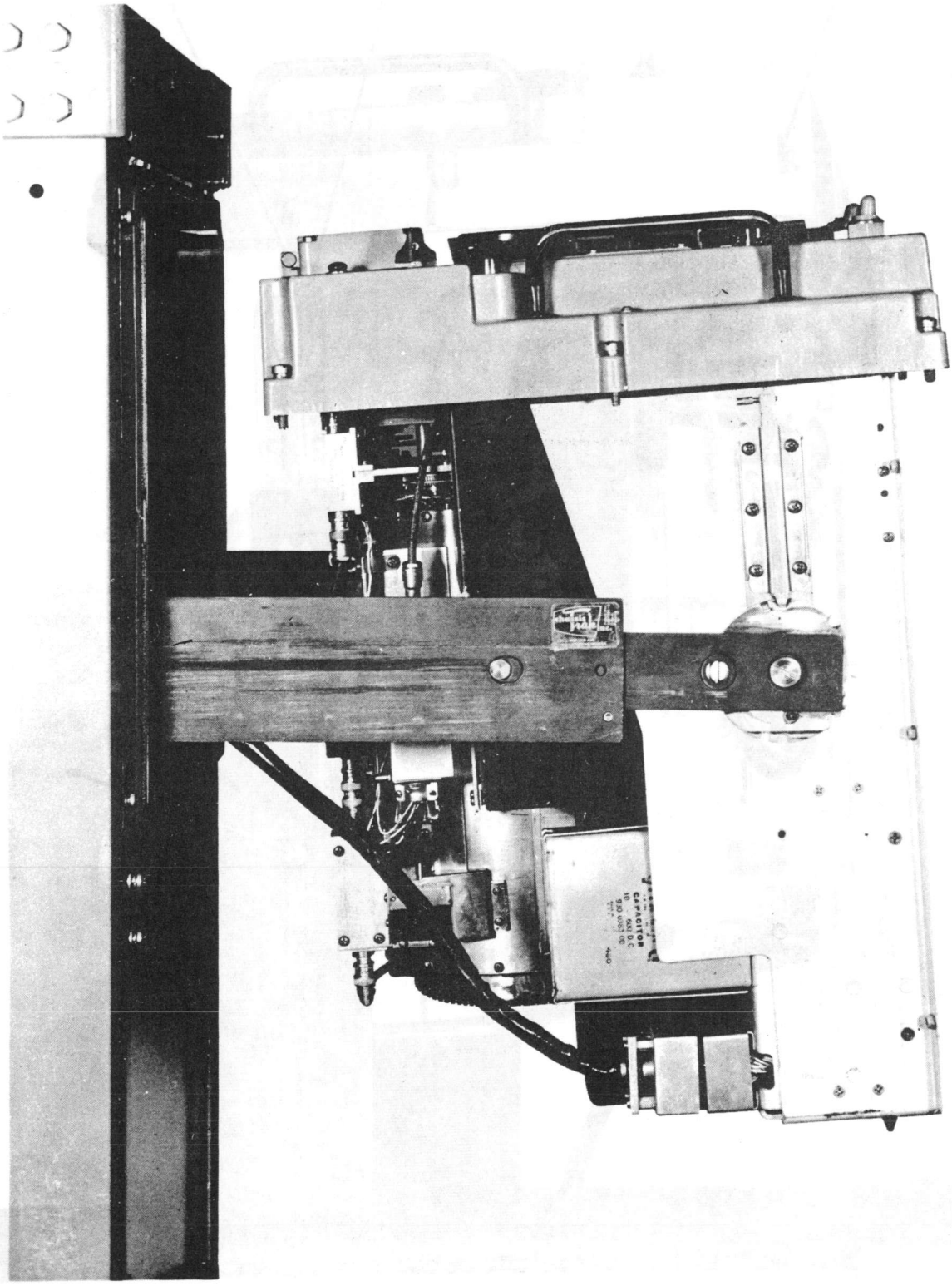

Figure 3-5. Radio-Frequency Amplifier AM-1565/URC, Extended and Tilted

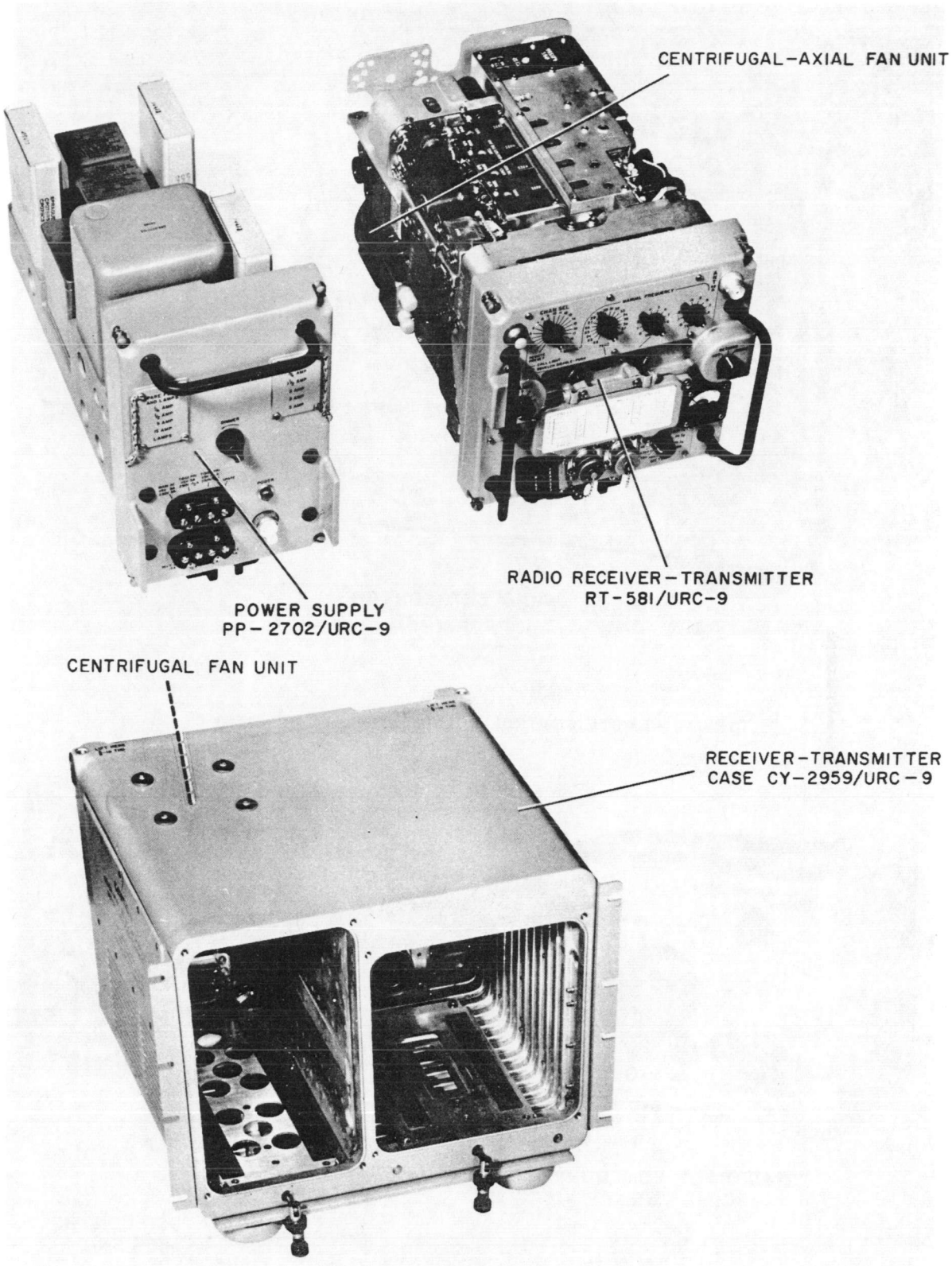

Figure 3-6. Radio Set AN/URC-9

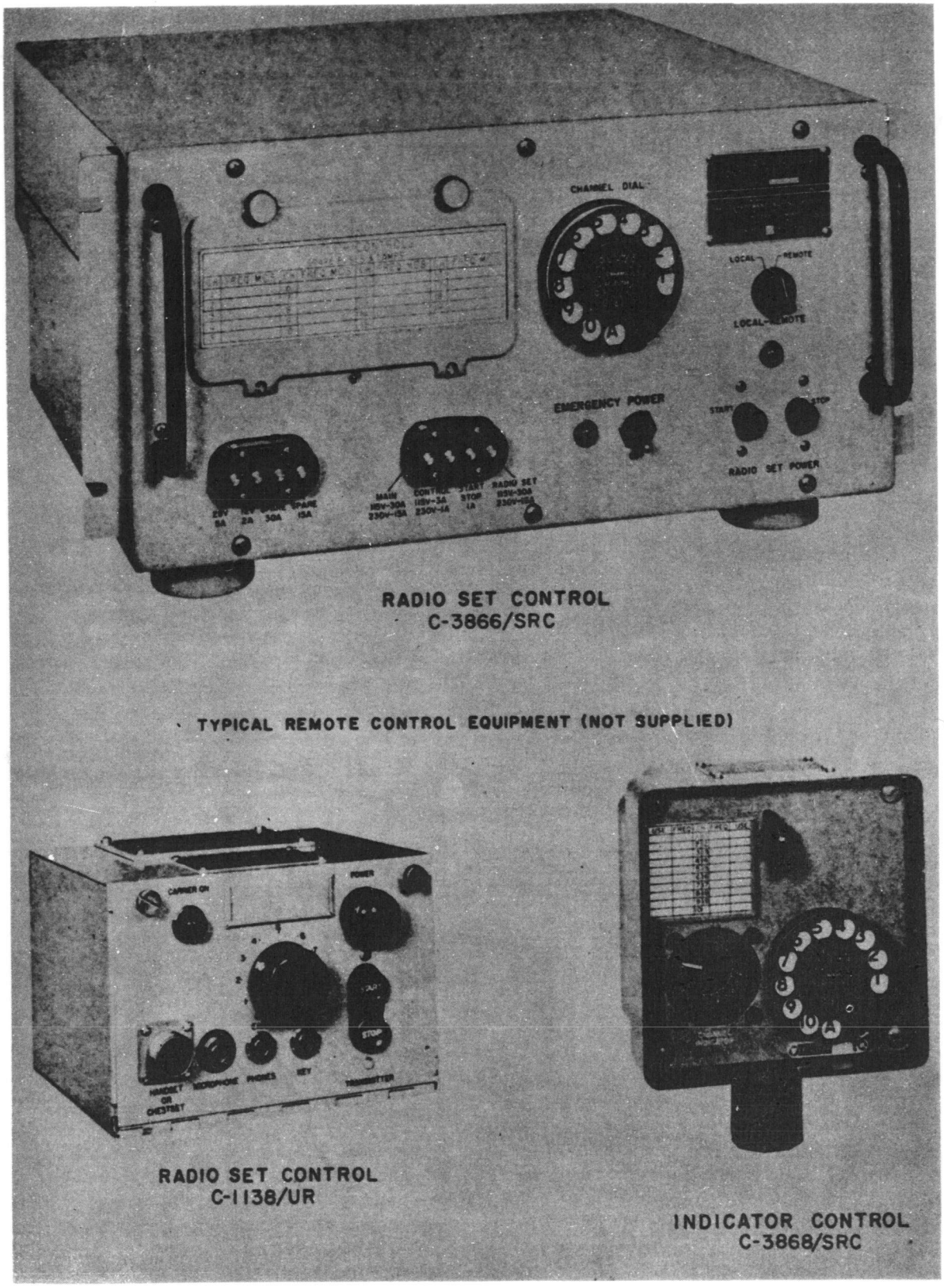

Figure 3-7. Radio Set Control C-3866/SRC and Typical Remote Control Station

TABLE 3-1. REFERENCE DATA FOR RADIO-FREQUENCY AMPLIFIER AM-1565/URC

CHARACTERISTIC	NUMBER, RANGE, AND/OR VALUE
Frequency	225.0 to 399.9 mc
Wavelength	1.4 to 0.76 meters
Tuning	
Channel spacing	Continuously tuned
Preset channels	19 plus one manual
Channel selection time	5 seconds max.
Preset single channel selection time	Approximately 10 seconds
Excitation required	16 watts
Impedance	50 ohms, nominal
Output data	
Minimum power	100 watts, average carrier
Impedance	50 ohms, nominal
Envelope distortion	4-percent maximum above drive signal distortion at 95-percent modulation.
Noise modulation	Not less than 30 db when driven by a source having a noise modulation at least 35 db below 80-percent modulation at 1000 cps.
Ambient temperature range	
Operating	-54°C to +65°C (-65°F to +149°F)
Storage	-62°C to +75°C (-79°F to +167°F)
Ambient humidity	0 to 95 percent
Altitude	Up to 10,000 feet

TABLE 3-2. REFERENCE DATA FOR RADIO SET AN/URC-9

CHARACTERISTIC	NUMBER, RANGE, AND/OR VALUE
Frequency	
Range	225.0 to 399.9 mc
Selection	1750 automatically selectable channels channels spaced 0.1 mc apart.
Channel presetting	19 preset channels available on local or remote control plus manual frequency selection on local control.
Accuracy	±12 kc from -30°C to +65°C (-22°F to +149°F), ±20 kc at -55°C (-67°F).
Crystal control	
First i-f amplifier (20.0 to 29.9 mc)	
Designation	Type CR-55/U
Type of cut	AT-cut
Frequency range	17.0 to 61.0 mc
Oscillation frequency	See table 3-3
Temperature coefficient	Classed as 0
Operating temperature	-55°C to 105°C (-67°F to +221°F)
Accuracy	±0.0005 percent
Stability	±0.005 percent over temperature range
Second i-f amplifier (3.0 to 3.9 mc)	
Designation	CR-18A/U
Type of cut	AT-cut
Frequency range	0.8 to 20.0 mc
Oscillation frequency	See table 3-3
Temperature coefficient	Classed as 0
Operating temperature	-55°C to +105°C (-67°F to +221°F)

TABLE 3-2. REFERENCE DATA FOR RADIO SET AN/URC-9 (Cont)

CHARACTERISTIC	NUMBER, RANGE, AND/OR VALUE
Accuracy	±0.0005 percent
Stability	±0.005 percent
Frequency multiplier oscillator	
Designation	CR-67/U
Type of cut	AT-cut
Frequency range	17.0 to 61.0 mc
Oscillation frequency	See table 3-3
Temperature coefficient	Classed as 0
Operating temperature	-55°C to 105°C (-67°F to +221°F)
Accuracy	±0.0025 percent
Stability	±0.0005 percent
Receiver characteristics	
Type	Triple-conversion superheterodyne, with automatic noise limiting and carrier-operated squelch relay circuits
Input impedance	50 ohms
Sensitivity	6 uv or less for 10-db signal-plus-noise to noise ratio
Selectivity (third i-f bandwidth)	80 kc (minimum) at 6-db attenuation 150 kc (maximum) at 60-db attenuation
Intermediate frequencies	20.0 to 29.9 mc (variable), 3.0 to 3.9 mc (variable), 500 kc (fixed)
Avc characteristics	Audio output constant within ±3 db from 6 uv to 100 uv, and within ±5 db from 100 uv to 0.5 volt
Frequency response	
Plain mode	Within ±2 db from 300 to 3000 cps, 1000 cps reference

TABLE 3-2. REFERENCE DATA FOR RADIO SET AN/URC-9 (Cont)

CHARACTERISTIC	NUMBER, RANGE, AND/OR VALUE
Broadband mode	Within ±3 db at 1000 cps to +7 db at 25,000 cps, 1000 cps reference
Audio outputs	
Speaker output	1 watt, 600 ohms
Headset output	250 mw, 600 ohms
Remote control output	600 mw, 600 ohms
Fixed level (retransmit) output	50 mw, 600 ohms
Extended range (broadband) output	2 mw, 600 ohms
Audio distortion	10-percent maximum
Audio fidelity	±3 db from 300 to 3500 cps
I-f frequencies	20.0 to 29.9 mc (variable) 3.0 to 3.9 mc (variable) 500 kc (fixed)
Squelch	
Normal operation	2 db signal-plus-noise to noise ratio
Retransmit or broadband operation	3 uv carrier level
Transmitter characteristics	
Power output	16 watts minimum into 52-ohm noninductive load
Modulation	Amplitude modulation
Frequency response	
Normal	Within ±2 db from 250 to 6000 cps, 1000 cps reference
Broadband	Within ±2 db from 250 to 25,000 cps, 1000 cps reference
Audio distortion	Less than 10 percent

TABLE 3-2. REFERENCE DATA FOR RADIO SET AN/URC-9 (Cont)

CHARACTERISTIC	NUMBER, RANGE, AND/OR VALUE
Spurious radiation	All spurious radiation suppressed 65 db below carrier level from 225.0 to 399.9 mc. Carrier harmonics above 500 mc attenuated at least 40 db below carrier level
Operating temperature	-55°C to +65°C (-67°C to +149°F)
Type of emission	Radiotelephone (A3)
Audio inputs	
Microphone	0.05 volt, 82 ohms nominal
Retransmission	0.12 volt
Broadband	30 volts peak-to-peak
Sidetone output	175 mw, 300 to 3500 cps, from 600 ohms receiver audio output
Fidelity	Within ±3 db from 300 to 3500 cps, 1000 reference
Duty cycle	Continuous transmission with 80-percent modulation at +65°C (+157°F)
Primary voltage requirements	115 volts a-c, 50 to 60 cps single phase or 230 volts a-c, 50 to 60 cps single phase
Power requirements	
AN/SRC-20	570 watts on receive 1520 watts on transmit
AN/SRC-21	270 watts on receive 420 watts on transmit

TABLE 3-3. FREQUENCY OF CONTROL CRYSTALS IN RADIO SET AN/URC-9

SECTION OF AN/URC-9	DESIGNATION	FREQUENCY (mc)
20.0 to 29.9 mc i-f stage	Y301	17.00000
	Y302	18.00000
	Y303	19.00000
	Y304	20.00000
	Y305	21.00000
	Y306	22.00000
	Y307	23.00000
	Y308	24.00000
	Y309	25.00000
	Y310	26.00000
3.0 to 3.9 mc i-f stage	Y-401	3.000000
	Y-402	3.100000
	Y-403	3.200000
	Y-404	3.300000
	Y-405	3.400000
	Y-406	3.500000
	Y-407	3.600000
	Y-408	3.700000
	Y-409	3.800000
	Y-410	3.900000
Frequency multiplier oscillator	Y-202	31.11111
	Y-204	32.22222
	Y-206	33.33333
	Y-207	34.44444
	Y-208	35.00000
	Y-209	35.55555
	Y-210	36.66666
	Y-211	37.77777
	Y-212	38.33333
	Y-213	38.88888
	Y-214	40.00000
	Y-215	41.11111
	Y-216	41.66666
	Y-217	43.33333
	Y-218	45.00000

TABLE 3-4. REFERENCE DATA ON RADIO SET CONTROL C-3866/SRC

CHARACTERISTIC	NUMBER, RANGE, AND/OR VALUE
Number of channels	19
Channel code	5 wire

TABLE 3-4. REFERENCE DATA ON RADIO SET CONTROL C-3866/SRC (Cont)

CHARACTERISTIC	NUMBER, RANGE, AND/OR VALUE
Channel selection	By modified telephone dial
Duty cycle	Continuous, unattended
Operating modes	Local or remote
Primary power switching	2300 watts maximum
Output power	12 volts d-c, either side grounded, 24 watts maximum
Ambient temperature range	-54°C to +65°C (-65°F to +149°F)
Ambient humidity range	Up to 95-percent relative humidity for 16 hours
Power requirements	20 watts on standby 60 watts on channeling

4. Equipment Supplied.

Table 3-4 lists all equipment and publications supplied with Radio Sets AN/SRC-20 and AN/SRC-21. Equipment included in Radio Set AN/SRC-20 but not in Radio Set AN/SRC-21 is indicated by a note at the end of the table.

TABLE 3-5. EQUIPMENT SUPPLIED FOR RADIO SETS AN/SRC-20 AND AN/SRC-21

QTY PER EQUIP.	NOMENCLATURE		OVER-ALL DIMENSIONS (inches)			VOL CU FT	WT (lb)
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	*Radio-Frequency Amplifier	AM-1565/URC	15-3/4	17-1/4	21-3/4	3.36	215
1	Mounting Kit	MT-2037					
1	Radio Set	AN/URC-9	13-13/16	19	19-1/2	3.1	157
*Not included in Radio Set AN/SRC-21							

TABLE 3-5. EQUIPMENT SUPPLIED FOR RADIO SETS AN/SRC-20 AND AN/SRC-21 (Cont)

QTY PER EQUIP.	NOMENCLATURE		OVER-ALL DIMENSIONS (inches)			VOL CU FT	WT (lb)
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
	Including:						
	Receiver-Transmitter	RT-581/URC-9					
	Centrifugal Fan	Unit 1					
	Power Supply	PP-2702/URC-9					
	Receiver-Transmitter Case	CY-2959/URC-9					
	Mounting	Unit 2					
	Installation Kit	Unit 3					
1	Radio Set Control	C-3866/SRC	9-11/16	19	19-5/16	2.40	50
1 (AN/SRC-20)	Mounting Rack	MT-2299/UR	52-5/8	22-1/6	23-1/4		84
1 (AN/SRC-21)	Mounting Rack	MT-2300/UR	35-1/16	22-1/6	26-5/16		72
	Radio Set	AN/SRC-20				8.86	506
	Radio Set	AN/SRC-21				5.50	279
1	Technical Manual	NAVSHIPS 94695A	11.5	9.5	2		
1	Maintenance Standards Book	NAVSHIPS 94695.42	11	8.5			
1	Maintenance Standards Sheet	NAVSHIPS 94695.32					

5. Equipment Required but not Supplied.

A list of equipment required for Radio Sets AN/SRC-20 and AN/SRC-21, but not supplied, is given in table 3-5.

TABLE 3-6. EQUIPMENT REQUIRED BUT NOT SUPPLIED

QTY PER EQUIP.	NOMENCLATURE		REQUIRED USE	REQUIRED CHARACTERISTICS
	NAME	DESIGNATION		
1	Headset	NT-49985-A	Local operation of AN/SRC-20 or	600 ohms
and				
1	Microphone	M-58/U	AN/SRC-21	Carbon microphone
or				
1	Handset	H-51/U		82 ohms with push-to-talk button
As reqd	Channel Selector Unit	NT-23445	Remote channel selection	
As reqd	Radio Set Control	C-1138/UR or C-1207/UR	Remote control	
1	Indicator Control	C-3868/SRC	Remote control	
1	Radio-Frequency Wattmeter	AN/URM-43A	Radio frequency wattage check	
1	Multimeter	ME-26/U	Voltage check	
1	Signal Generator	AN/USM-44	Signal generation for checking	
1	Radio-Frequency Signal Generator Set	AN/URM-25D		

6. Factory or Field Changes.

From time to time it is possible that factory or field changes will be made on Radio Sets AN/SRC-20 and AN/SRC-21.

7. Equipment Similarities.

Radio Set AN/SRC-20 is composed of three basic units; Radio-Frequency Amplifier AM-1565/URC, is not included in the AN/SRC-21. The other two units, Radio Set AN/URC-9 and Radio Set Control C-3866/SRC, are included in both the AN/SRC-20 and AN/SRC-21.

8. Preparation for Reshipment.

The reshipment preparation of Radio Sets AN/SRC-20 and AN/SRC-21 does not require any out-of-the-ordinary precautions. The equipment should be placed in an air-cell padded carton with a sufficient amount of desiccant (silica gel).

This package should be placed in a water-resistant carton and sealed. For final packaging, the equipment is placed in a wooden crate (preferably the original shipping crate) which is nailed closed.

D. SUMMARY:

1. All reference data pertaining to the AN/SRC-20 and AN/SRC-21 has been presented. The data was given in tabular form.

2. A list of equipment supplied and a list of equipment required but not supplied for Radio Sets AN/SRC-20 and AN/SRC-21 was also presented.

INFORMATION SHEET 4

FUNCTIONAL OPERATION OF RADIO SET AN/SRC-20 AND AN/SRC-21

A. INTRODUCTION:

As previously discussed, Radio Sets AN/SRC-20 and AN/SRC-21 are shipboard uhf units capable of simplex reception and transmission of amplitude-modulated, radiotelephone signals; both sets operate in the frequency range of 225 to 399.9 mc. Radio Set AN/SRC-20 consists of (1) Radio-Frequency Amplifier AM-1565/URC, (2) Radio Set AN/URC-9, and (3) Radio Set Control C-3866/SRC; Radio Set AN/SRC-21 consists of (1) Radio Set AN/URC-9 and (2) Radio Set Control C-3866/SRC.

We shall now discuss the functional operation of the entire system on a block diagram level and then examine the functional block diagram of each unit. After determining the functional operation of the system and the units within it, we will discuss the frequency-conversion scheme for the system.

B. REFERENCES:

NAVSHIPS 94695A, Volume 2, Operator's Manual for Radio Sets AN/SRC-20 and AN/SRC-21.

C. INFORMATION:

1. General.

Radio Sets AN/SRC-20 and AN/SRC-21 have three modes of operation: (1) normal, (2) retransmit, and (3) tone. They can also operate with equipment requiring broad bandwidth capabilities. The mode of operation of the radio sets is determined by the MODE and BROADBAND switches on Receiver-Transmitter RT-581/URC-9.

a. Normal.

In the normal mode, the RT-581/URC-9 operates as a standard transceiver, with audio and receive-transmit control available at either the front panel of the unit or at a remote controlling station. When the CHANNEL SEL switch is in MANUAL, or one of the 19 preset channel positions, squelch control is exercised at the front panel. When the CHANNEL SEL switch is in REMOTE PRESET, the squelch level is determined by Radio Set Control C-3866/SRC. There are 19 squelch level controls on C-3866/SRC. This allows individual squelch control for each of the 19 preset channels. In normal operation, the squelch circuitry is controlled by the signal-plus-noise to noise ratio; the receiver audio output is squelched whenever the signal-plus-noise to noise ratio drops below a predetermined level. This squelch circuit may be disabled. Local audio output level is controlled by a front panel VOLUME control. Remote audio level is controlled by a VOLUME control on the remote equipment. During normal mode, the system is in standby unless the push-to-talk switch is closed. While in standby, the system functions as a receiver. When the push-to-talk switch is closed, the transmit-receive (T/R) relays convert the system to the transmit condition.

When using normal mode with the BROADBAND switch at the ON position, the following changes occur:

(1) The audio signals are rerouted through the broadband equipment.

(2) A carrier level squelch is used in place of the signal-plus-noise to noise ratio squelch.

(3) It is not possible to key the transmitter when a signal is being received.

(4) Normal sidetone is replaced by broadband sidetone.

b. Retransmit.

In the retransmit mode, the AN/SRC-20 or AN/SRC-21 can be operated with similar equipment for automatic message relaying. During standby both sets operate as receivers using carrier-controlled squelch. The receive-transmit controls of both sets are controlled by the carrier-controlled squelch relays. When one set receives a signal, the carrier-controlled squelch relay keys the other set to the transmit condition. The audio output of the receiving set is applied to the audio input of the transmitting set. The retransmit audio can be monitored at either the local or remote stations. When the push-to-talk switch is closed, both transmitters are keyed to transmit. The local or remote microphone signal is fed to both transmitters for simultaneous transmission.

c. Tone.

In the tone mode, a 1000-cycle tone is generated in the RT-581/URC-9 and used to modulate the carrier. This signal is used as a sounding or homing beam for aircraft and ships within reception distance.

2. System Functional Block.

Figure 4-1 is an over-all block diagram on Radio Sets AN/SRC-20 and AN/SRC-21 showing the relationship of the basic units to each other, and to external equipment. Figure 4-2 shows the RT-581/URC-9 as a receiver and then as a transmitter.

For ease of understanding, assume that (1) 19 channels have been preset, (2) the equipment is operating in the normal mode, and (3) the CHANNEL SEL switch is in the REMOTE PRESET position. Under these conditions, typical operation of the system is as follows:

Channel selection and transmit-receive control are initiated by Radio Set Control C-3866/SRC or one of the remote control stations. The desired channel is selected by use of a telephone-type dial. The 5-wire channel information is routed to an antenna coupler (if one is used) and to Radio-Frequency Amplifier AM-1565/URC where the Autopositioner is driven to select the desired frequency. The channel information is relayed from the AM-1565/URC to Radio Set AN/URC-9 where the frequency selection process is repeated. The transmit-receive control circuits are disabled, and the system is held in the receive condition until frequency selection is completed. After frequency selection is completed, the push-to-talk switch may be energized to convert the system to the transmit condition. During transmit, audio is routed from the C-3866/SRC through the AM-1565/URC to Radio Set AN/URC-9. In the AN/URC-9, the audio signal is amplified and used to modulate the r-f carrier. The output of the AN/URC-9 is a 16- to 24-watt uhf signal in the 225- to 399.9-mc range. The uhf signal is routed to the AM-1565/URC where it is amplified to a 100-watt minimum carrier level and routed through the directional coupler to the antenna (or multicoupler, if used).

An audio sidetone signal is generated during transmit and allows monitoring of the transmitted signal at all local and remote stations. Channel indication also is supplied to all local and remote stations. If the BROADBAND switch is in the ON position, the audio signal from local or remote microphone is coupled through the AN/URC-9 to the broadband equipment. The output of the broadband equipment is routed back to the AN/URC-9 and used to

modulate the r-f carrier. The output from the AN/URC-9 is routed to the AM-1565/URC. The operation of the AM-1565/URC in broadband is the same as in normal.

During normal receive, the received signal is routed through the AM-1565/URC to the AN/URC-9. In the AN/URC-9 the uhf signal is shifted down in frequency and detected to remove the audio intelligence. The audio signal is routed through the C-3866/SRC to the remote units. When the BROADBAND switch is in the ON position during normal receive operation, the received audio is routed through a broadband cathode follower in the AN/URC-9 to the broadband equipment. The audio from the broadband equipment is then routed to the audio amplifier circuits in the AN/URC-9 and can be monitored at all local and remote stations.

When the MODE switch (AN/URC-9) is in the RETRANS mode, the AN/SRC-20 or AN/SRC-21 is operated with a similar equipment to provide automatic retransmission facilities. During this mode of operation, the squelch circuits of the AN/SRC-20 or AN/SRC-21 are carrier controlled, and the transmit-receive circuits of each set are controlled by the squelch circuits of the other set. The audio output of each set is routed to the audio input of the companion set.

The received signal at the antenna is routed through the AM-1565/URC to the AN/URC-9. The receive circuits of the AN/URC-9 operate the same as in normal with the exception of the squelch circuits. When the carrier is detected, the squelch relays energize. These relays connect the audio output of the AN/URC-9 to the audio input of the companion set and place the companion set in the transmit condition. The audio then is automatically retransmitted. When the companion set receives a signal, the sequence is reversed; that is, the squelch circuits of that set places the AN/SRC-20 or AN/SRC-21 in the transmit condition and routes an audio signal to the audio input circuits.

The retransmit audio can be monitored at the local and remote stations, and if the push-to-talk switch is energized, both radio sets are placed in the transmit condition.

During tone operation of the AN/SRC-20 or AN/SRC-21, a 1000-cps signal is generated by a tone oscillator in the AN/URC-9 and transmitted as a "homing beam." All transmit circuits operate as in normal with the exception of the audio input.

3. Unit Functional Blocks.

a. Radio Set Control C-3866/SRC. (Refer to figure 4-3.)

The pushbutton start-stop circuit in the C-3866/SRC controls all primary power delivered to the AN/SRC-20 or AN/SRC-21. All primary power is fused through this unit.

A telephone-type dial is used to select 19 preset channels. The dial controls programing relays which, in turn, control a stepping relay used to generate a five-wire binary code. This code is used as channel information for the Autopositioner in the AM-1565/URC (in the AN/SRC-20) and the AN/URC-9. The stepping relay also provides d-c voltages for positioning remote channel indicators, such as Indicator Control C-3868/SRC.

When the set is controlled from a remote location (C-1138/UR), the dial on the C-3866/SRC is replaced by a dial on the remote unit, and the C-3866/SRC provides audio-matching facilities between the remote unit and the AN/URC-9. The C-3866/SRC also provides a five-wire binary code for an antenna coupler if one is used with the system.

Three d-c power supplies are included in the C-3866/SRC. These power supplies provide the necessary relay voltages.

b. Radio Set AN/URC-9. (Refer to figure 4-4.)

All of the functional blocks shown in figure 4-4 are contained in Receiver-Transmitter RT-581/URC-9. Power Supply PP-2702/URC-9 is a separate assembly. Both the receiver-transmitter and the power supply are housed in Receiver-Transmitter Case CY-2959/URC.

During normal receive, the signal passes from the AM-1565/URC (AN/SRC-20) or the directional coupler (AN/SRC-21) to the r-f and power amplifier assembly. The received signal is mixed with a signal from the crystal-controlled frequency multiplier oscillator, and the 20- to 29.9-mc difference frequency is routed to the first i-f amplifier. A crystal-controlled oscillator, in the first i-f amplifier, provides a 17- to 26-mc signal for mixing. The 20- to 29.9-mc signal (incoming) and the 17- to 26-mc oscillator signal are mixed to provide a 3.0- to 3.9-mc difference signal. The 3.0- to 3.9-mc signal is passed to the second i-f amplifier. A crystal oscillator in the second i-f amplifier provides the third mixing signal. (If the incoming signal is in the range of 3.0 to 3.4 mc, the output of the crystal oscillator is in the 3.5- to 3.9-mc range; if the incoming signal is in the 3.5- to 3.9-mc range, the oscillator output is 3.0 to 3.4 mc.) The 500-kc difference signal is routed through a 500-kc filter to the third i-f amplifier. In the third i-f amplifier, the signal is demodulated, passed through a noise limiter, amplified, and applied to the audio amplifier and modulator assembly. The audio signal is amplified and routed to the local and remote headsets. All tuning elements are controlled automatically by the frequency selector.

During normal transmit, the push-to-talk switch on the microphone operates relays which convert the RT-581/URC-9 to a transmitter. The transmit signal is generated by the 3.0- to 3.9-mc oscillator in the second i-f amplifier. Relay circuitry disables the 500-kc i-f amplifier and selects a crystal that is 500 kc different in frequency than the receive crystal. The 3.0- to 3.9-mc signal is mixed with the signal from the 17- to 26-mc crystal oscillator, producing a sum frequency in the 20- to 29.9-mc range. The sum signal is amplified and passed to the r-f and power amplifier assembly where it is mixed with a signal from the frequency multiplier oscillator. The output of the oscillator is 200 to 370 mc (18 frequencies in 10-mc steps). The resultant output is one of 1750 frequencies in the range of 225 to 399.9 mc, and is applied to the power amplifier. The power output is modulated by an audio signal from the audio amplifier and modulator assembly. The amplitude-modulated r-f signal then is routed through the AM-1565/URC (AN/SRC-20) or the directional coupler (AN/SRC-21) to the antenna.

Operation in the retransmission mode requires that two sets be interconnected, because a transceiver cannot send and receive concurrently. When two sets are connected in this manner, the reception of a signal of the proper level causes the alternate set to operate as a transmitter. This is done by connecting the squelch circuitry (in the audio amplifier and modulator assembly) to the audio detection circuits. When a signal is received on one set, it is used to modulate the transmitter output of the alternate set. The audio signal appears at the headsets of the receiving set, and an audio sidetone appears at the headsets of the transmitting set.

The third and final position of the MODE switch, TONE, causes a 1000-cps tone to be applied to the audio amplifier and modulator assembly. This 1000-cps signal is used to modulate the r-f carrier and is transmitted as a "homing beam."

Setting the controls for broadband operation causes the received audio signal to be routed to the input of the broadband equipment. The output of the broadband equipment is applied to the headsets. During transmit, the microphone signal is applied to broadband equipment. The output of the broadband equipment is connected to the audio amplifier and modulator assembly. The resultant signal then is transmitted in the normal manner.

c. Radio-Frequency Amplifier AM-1565/URC.

Radio-Frequency Amplifier AM-1565/URC is composed of the following functional groups: power amplifier, servo amplifier, drive control regulator, power supply, Autopositioner, and front panel.

Refer to the functional block diagram, figure 4-5. When the set is keyed to transmit, the signal from Radio Set AN/URC-9 passes through a variable attenuator to the r-f amplifiers. After amplification, the signal passes through a directional coupler and a low-pass filter, used to minimize harmonic radiation, to the antenna. During receive, the signal passes from the antenna to the input of Radio Set AN/URC-9 via the coaxial relays.

The drive regulator circuits, in conjunction with the ferrite attenuator and front panel controls, compensate for variations in exciter output and drive requirement over the frequency range. This is done by either using a part of the output of the r-f amplifier or a manual control to change the r-f conducting properties of the variable attenuator.

Automatic tuning of the r-f amplifier is performed by a servo system together with the Autopositioner and preset channel potentiometers. The Autopositioner, operated by front panel control, forms an unbalanced a-c bridge between the potentiometer of the desired channel frequency and the servo circuits. As the servo system seeks the new null position, the servo motor drives ganged plates in the resonant cavities of the r-f amplifiers until proper cavity length is obtained. The servo system uses a rate generator feedback system to prevent hunting and oscillation.

4. Functional Description of Frequency Conversion.

Figure 4-6 shows a functional block diagram of the frequency-conversion system in Radio Set AN/URC-9. On receive, the set operates as a triple-conversion superheterodyne receiver. The r-f amplifier is tuned in 0.1-mc steps to any frequency in the range from 225.0 to 399.9 mc. The frequency multiplier oscillator tunes in 10-mc steps in the frequency range from 200 to 370 mc. Frequencies in these ranges are mixed in the first mixer to produce a first intermediate frequency in the range of 20.0 to 29.9 mc. The i-f amplifiers are tuned to one of 100 frequencies spaced 0.1 mc apart in the 20.0- to 29.9-mc range. The oscillator in the first i-f amplifier generates one of ten frequencies in the range of 17 to 26 mc and mixes this frequency with the output of the first i-f amplifier (20.0 to 29.9 mc) to produce a second intermediate frequency in the range of 3.0 to 3.9 mc. The second i-f amplifier is tuned to one of ten frequencies spaced 0.1 mc apart. The oscillator in the second i-f amplifier generates one of ten frequencies in the range of 3.5 to 3.9 mc and 3.0 to 3.4 mc. On the lower half of the second intermediate frequency range (3.0 to 3.4 mc), the third injection system operates above the second intermediate frequency (3.5 to 3.9 mc) to produce a third intermediate frequency of 500 kc. On the upper half of the second intermediate frequency range (3.5 to 3.9 mc), the oscillator operates below the second intermediate frequency (3.0 to 3.4 mc) to produce a third intermediate frequency of 500 kc.

As an example, assume the receiver is tuned to 271.7 mc. The r-f amplifier, therefore, is tuned to 271.7 mc. The frequency multiplier oscillator generates 250 mc by multiplying the 41.66666-mc crystal frequency by six. The resulting first intermediate frequency is 21.7 mc. This signal is mixed with an 18.0-mc frequency to obtain a second intermediate frequency of 3.7-mc. The 3.7-mc second i-f signal is mixed with a 3.2-mc frequency to obtain a 500-kc i-f signal.

On transmit, the operating frequency is obtained by generating a low frequency and heterodyning to the uhf operating frequency. In the heterodyning process, all circuits except the oscillator in the second i-f amplifier operate on the same frequency for transmit as for receive; the latter oscillator is shifted 500 kc so that it operates on the same frequency as

the second i-f amplifier. Using the example above, when the equipment is keyed to transmit, the oscillator in the second i-f amplifier is switched from 3.2 mc to 3.7 mc. This signal is amplified by, and mixed with, an 18-mc signal generated in the first i-f amplifier. The resulting 21.7-mc signal is amplified in the r-f and power amplifier assembly and mixed with a 250.0-mc signal from the frequency multiplier oscillator to obtain the uhf operating frequency.

a. Electromechanical Tuning.

The frequency-conversion circuits of Radio Set AN/URC-9 are automatically tuned by an electromechanical frequency selector which contains three units called Autopositioners. The frequency selector unit is controlled by the manual frequency selector, the local channel selector, or the remote channel selector. The three Autopositioners output shafts correspond to the position of the 10-, 1-, and 0.1-mc positions of the frequency selector switches. The 10-mc shaft rotates in 18 incremental steps, each increment representing 10 mc. The 1-mc shaft rotates in 10 incremental steps, each increment representing 1 mc. The 0.1-mc shaft also rotates in 10 incremental steps, each increment representing 0.1 mc. The frequency selector unit combines the 0.1- and 1-mc shaft positions to obtain 100 incremental steps, each representing 0.1 mc. By combining the outputs of the 10-, 1-, and 0.1-mc shafts 1750 incremental steps, each representing 0.1 mc are obtained.

The 0.1-mc shaft tunes the crystal oscillator and amplifiers in the second i-f amplifier assembly in ten increments of 0.1 mc each. The 1.0-mc shaft tunes the crystal oscillator in the first i-f amplifier assembly in ten increments of 1 mc each. The combined 0.1- and 1.0-mc shaft tunes the amplifiers in the first i-f amplifier assembly in 100 increments of 0.1 mc each. The 10-mc shaft tunes the frequency multiplier oscillator in 18 increments of 10 mc each. The r-f and power amplifiers are tuned in 1750 increments of 0.1 mc each by combination of the 0.1-, 1.0-, and 10-mc shafts.

D. SUMMARY:

Radio Sets AN/SRC-20 and AN/SRC-21 can be operated in three different modes: normal, retransmit, and tone. The radio sets also can operate in conjunction with broadband equipment. During normal mode, the system operates as a transceiver. When in retransmit mode, the system operates with a similar radio set to provide automatic message relaying. In the tone mode, the system generates a 1000-cps signal which is transmitted as a "homing beam."

Functionally, the C-3866/SRC consists of (1) a channel selector dial, (2) programing relays, (3) stepping relay, (4) start-stop and primary power circuits, (5) d-c power supplies, and (6) audio matching transformers. The C-3866/SRC provides facilities to allow remote control of the radio sets from up to 4 remote locations.

The AN/URC-9 consists of the following functional units: (1) the r-f and power amplifier assembly; (2) the first, second, and third i-f amplifier assemblies; (3) a 500-kc filter; (4) the frequency multiplier oscillator; (5) the channel and frequency selectors; (6) the audio amplifier; and (7) the 1-kc tone oscillator. All of the above named assemblies are integral parts of the RT-581/URC-9. The RT-581/URC-9 is mounted in Receiver-Transmitter Case CY-2959/URC. Also mounted in the receiver-transmitter case is Power Supply PP-2702/URC-9. This unit supplies all of the d-c and filament voltages needed by the AN/URC-9.

The functional units of the AM-1565/URC are (1) the power amplifier, (2) the servo amplifier, (3) the drive control regulator, (4) the power supply, (5) the Autopositioner, and (6) the front panel.

All frequency generation and conversion is accomplished in the AN/URC-9. Channel selection can be initiated in the C-3866/SRC, and there is frequency selection in the AM-1565/URC, but all generation and conversion of frequencies is accomplished in the AN/URC-9.

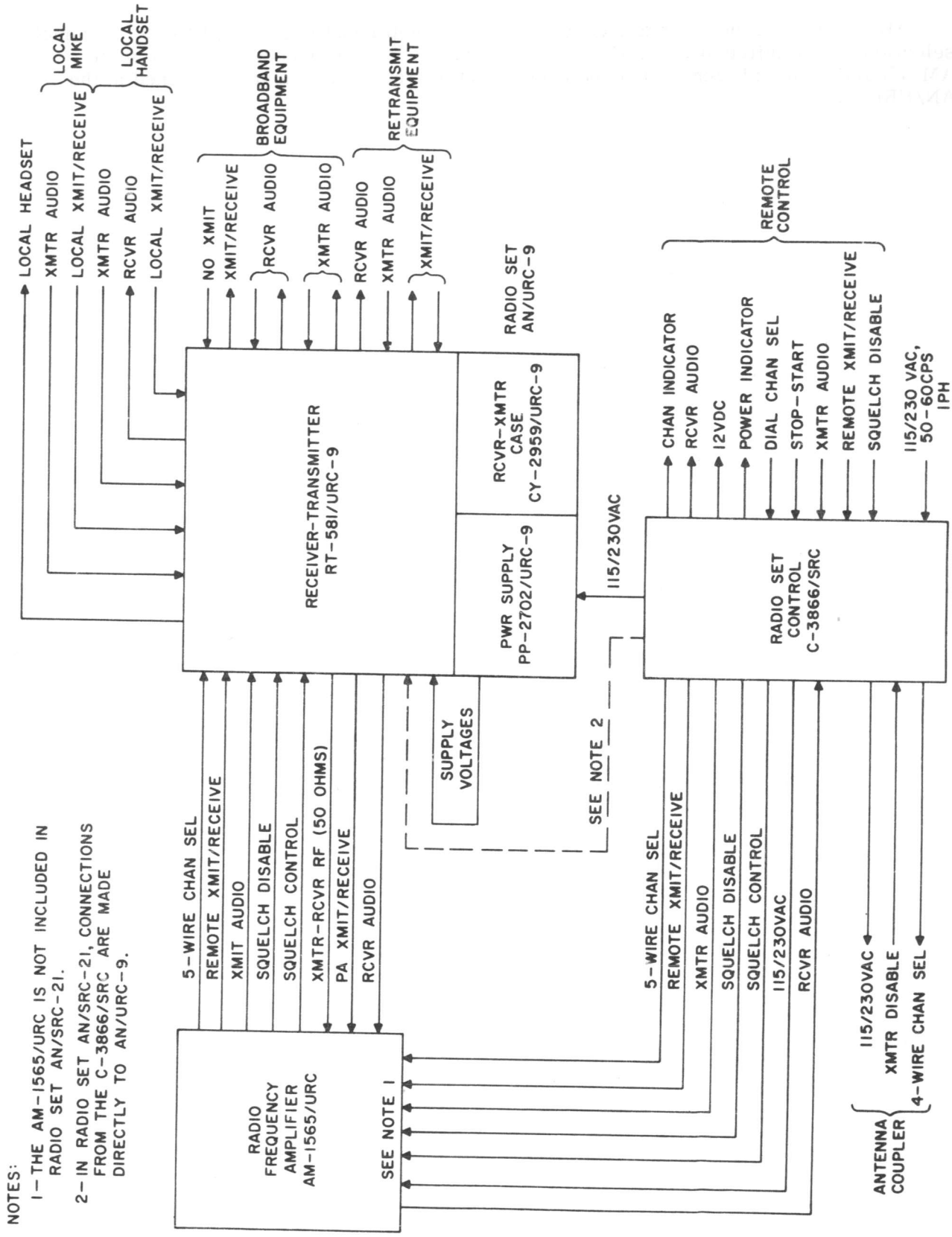

Figure 4-1. Over-all Functional Block Diagram for Radio Sets AN/SRC-20 and AN/SRC-21

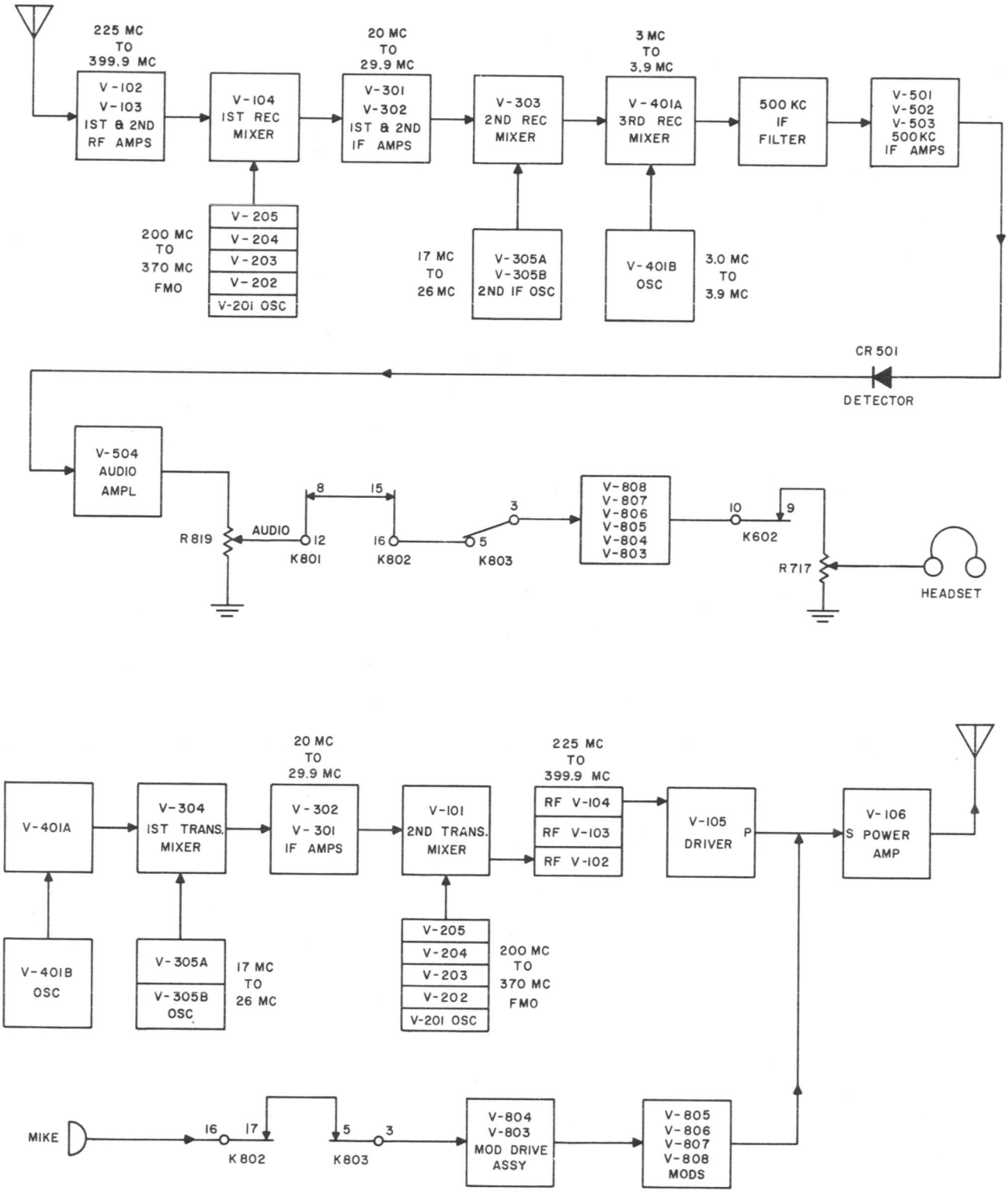

Figure 4-2. Receiver-Transmitter RT-581/URC Block Diagram as a Receiver and as a Transmitter

INFORMATION SHEET 5

OPERATIONAL CONTROLS AND PROCEDURES

A. INTRODUCTION:

The following information will describe the purpose of all controls and indicators associated with the AN/SRC-20 and AN/SRC-21. We will then discuss operating procedures.

B. REFERENCES:

NAVSHIPS 94695A, Technical Manual for Radio Sets AN/SRC-20 and AN/SRC-21, Section 3, Pages 3-1 through 3-9.

C. INFORMATION:

1. Description.

Radio Set AN/SRC-20 is composed of all three basic units; Radio Set AN/SRC-21 is composed of only the latter two.

a. Radio-Frequency Amplifier AM-1565/URC.

This unit is a uhf linear power amplifier designed to supply a minimum of 100 watts of radiated power when driven by Radio Set AN/URC-9. The unit, which operates in the frequency range of 225.0 to 399.9 mc, is tuned to the desired preset frequency by a servo system. A calibrated dial and a counter permit the selection of preset channels with the amplifier off the air. Push-to-talk circuits are provided in the amplifier for either local or remote operation.

b. Radio Set AN/URC-9.

This AN/URC-9, which operates in the frequency range of 225.0 to 399.9 mc, has a transmitter power output of more than 15 watts with a modulation capability of greater than 80 percent. The frequency range is covered in 0.1-mc steps by 1750 crystal-controlled channels. The AN/URC-9 operates on the same frequency on both receive and transmit. Frequency selection is determined by the position of the CHAN SEL switch. The CHAN SEL switch has 19 preset channel positions, a MANUAL position, and a REMOTE PRESET position. The 19 channel frequencies can be preset to any one of the 1750 available channels by a memory drum accessible through a door in the front panel. When the CHAN SEL switch is in the REMOTE PRESET position, channel information is received from Radio Set Control C-3866/SRC.

When the CHAN SEL switch is in the MANUAL position, any one of 1750 channels can be selected using the three MANUAL FREQUENCY switches on the front panel.

The operating mode of the AN/URC-9 is determined by the position of the front panel MODE switch and the BROADBAND switch at the rear of the unit. In the normal mode of operation, the set operates as a standard receiver-transmitter with audio signals and receive-transmit control at the set or a remote control position. Squelch control is available at the front panel when the CHAN SEL switch is in the MANUAL or any of the 19 preset positions. Squelch control is available at Radio Set Control C-3866/SRC when the CHAN SEL switch is in the REMOTE PRESET position. Remote squelch operation will be discussed later. On standby the set operates as a receiver. The receive audio output is squelched whenever the signal-plus-noise to noise ratio is below a predetermined level. This squelch circuit may be disabled. The local audio output level is controlled by a front panel VOLUME control. When the local or remote microphone push-to-talk button is pressed, the set is keyed to transmit.

The broadband mode of operation is the same as the normal mode except for the following four differences:

(1) The audio signals are rerouted through the broadband equipment.

(2) A carrier level squelch is used in place of the signal-plus-noise to noise ratio squelch.

(3) It is not possible to key the transmitter while a signal is being received.

(4) Normal sidetone is replaced by broadband sidetone.

In the retransmit mode of operation, the AN/URC-9 can be operated with a similar set for automatic relaying operation. During standby, both sets operate as receivers with carrier-controlled squelch. When one set receives a signal, the carrier-controlled squelch relay of that set keys the other set to transmit. The audio output of the receiving set is fed to the audio input of the transmitting set. The retransmit audio can be monitored at the local or remote operating positions. When the press-to-talk button on a local or remote microphone is pressed, both sets are keyed to transmit for duplex operation.

c. Radio Set Control C-3866/SRC.

This unit allows operation of Radio Set AN/URC-9 and an antenna multicoupler by means of channel selector indicator unit, Navy type 23445, in conjunction with Radio Set Control C-1138/UR. The unit enables stop-start, receiver-transmit, and channel selection from as many as four remote control stations. When the AN/URC-9 CHAN SEL switch is in the REMOTE PRESET position, any one of the preset channels can be selected from the C-3866/SRC or a remote control station on a telephone-type dial. The C-3866/SRC contains a stepping switch and relays which convert the dial pulses into five-wire channel information for Radio Set AN/URC-9 and Radio-Frequency Amplifier AM-1565/URC and five-wire channel information for an antenna multicoupler. Channel information also is supplied to the remote control station channel indicators. A separate squelch level control is provided for each remote preset channel. These controls are accessible through a door in the C-3866/SRC front panel.

2. Operating Procedures.

This subsection lists and defines the controls, sequence of operation, tuning, and summary of operation for Radio Sets AN/SRC-20 and AN/SRC-21. Illustrative material is included to aid in understanding as well as to clearly relate the text to the equipment.

a. Description of Controls.

The controls and a description of their function is listed in table 5-1. The table is subdivided into three sections, one for each of the three basic units used in the AN/SRC-20 and AN/SRC-21 .

TABLE 5-1. DESCRIPTION OF CONTROLS FOR RADIO SETS AN/SRC-20 AND AN/SRC-21

UNIT	CONTROL NAME	FUNCTION
R-F Amplifier AM-1565/URC (See figure 5-1.)	POWER switch	Applies input power to r-f amplifier.
	POWER indicator	Indicates that primary power has been applied to the r-f amplifier.
	METER switch	Selects one of 11 functions to be monitored by front panel meter in checking performance of r-f amplifier. NOTE Red scale reads forward and reflected power. Black scale reads all other indications.
	DIMMER control	Controls brilliance of all front panel indicators but the caution indicators.
	CAUTION indicator	Indicates when high-voltage protection has been removed.
	TEST KEY switch	
	ON	Keys r-f amplifier to transmit for test purposes.
	OFF	Disables local key line.
	LOCK ON	Locks r-f amplifier in transmit condition for test purposes.
	HV B+ indicator	Indicates that high-voltage B+ is turned on. Lights when amplifier is keyed.
	MANUAL TUNING control	Provides continuous manual frequency control.
	EXCITATION	
	LOW-HIGH	Provides low or high excitation adjustment.
	MANUAL-AUTO	Provides manual or automatic excitation control.

TABLE 5-1. DESCRIPTION OF CONTROLS FOR RADIO SETS AN/SRC-20 AND AN/SRC-21 (Cont)

UNIT	CONTROL NAME	FUNCTION
R-F Amplifier AM-1565/URC (See figure 5-1.) (Cont)	ANT 50Ω coaxial connector	Provides 50-ohm output connection to antenna.
	RF INPUT 50Ω coaxial connector	Provides input to r-f amplifier from exciter.
	LOCAL REMOTE	Allows selection of local or remote control of desired frequency channels.
	Channel tuning potentiometers	Provides fine tuning of preset frequency channels.
	FREQ-MC meter	Indicates frequency in megacycles.
	LOG-LOG dial	Indicates log of frequency to permit preparation of a log vs frequency chart.
	RF POWER OUTPUT switch	
	HIGH	Couples 100-watt (average carrier) output of r-f amplifier to antenna.
	LOW	Couples 16-watt exciter output directly to antenna, bypassing r-f amplifier.
	POWER switch	Controls primary power. (In normal operation, POWER switch is left in POWER position, and equipment is turned on and off using START-STOP pushbuttons on Radio Set Control C-3866/SRC or C-1138/UR.
Radio Set AN/URC-9 (See figure 5-2.)	POWER indicator	Lights when primary power is applied.
	DIMMER control	Controls intensity of panel lights.

TABLE 5-1. DESCRIPTION OF CONTROLS FOR RADIO SETS AN/SRC-20 AND AN/SRC-21 (Cont)

UNIT	CONTROL NAME	FUNCTION
Radio Set AN/URC-9 (See figure 5-2.) (Cont)	CHAN SEL switch	A 21-position switch with positions as follows: REMOTE PRESET — Transfer control to the remote CHANNEL selector. Positions 1 through 19 — Select preset channels 1 through 19. MANUAL — Transfers frequency selection to MANUAL FREQUENCY switches.
	MANUAL FREQUENCY switches	Select operating frequency when CHAN SEL switch is in MANUAL position as follows: TENS switch — Selects first two digits. UNITS switch — Selects third digit. TENTHS switch — Selects fourth digit.
	Channel indicator	Indicates preset channel in use.
	Frequency indicator	Indicates frequency in use.
	SQUELCH control	Controls ability of the set to receive weak signals. Setting of SQUELCH control establishes minimum strength of signal required to operate receiver. When the SQUELCH control is in OFF position, squelch circuit is disabled and receiver sensitivity is maximum. When SQUELCH control is at maximum and MODE switch is in RETRANS, a 100-uv signal is required to operate the squelch circuit. SQUELCH control is disabled when CHAN SEL switch is in REMOTE PRESET position.

TABLE 5-1. DESCRIPTION OF CONTROLS FOR RADIO SETS AN/SRC-20 AND AN/SRC-21 (Cont)

UNIT	CONTROL NAME	FUNCTION
Radio Set AN/URC-9 (See figure 5-2.) (Cont)	SQUELCH DISABLE-PUSH switch	Disables squelch circuit when pressed. (Switch is inoperative when CHAN SEL switch is in REMOTE PRESET.)
	CALL LIGHT	Lights when squelch is disabled or signal strong enough to operate squelch is received.
	VOLUME control	Adjusts audio level to local speaker or headset.
	MODE switch	Selects following modes of operation: NOR — Normal operation. RETRANS — Automatic relaying operation. TONE — Modulates carrier with 1000 cps.
	Meter and METER switch	Meter monitors any one of 11 functions selected by METER switch as follows: (See table 3-2 for normal meter readings.) OFF — Meter disconnected. S METER — Indicates strength of received signal. SWR — Indicates reflected r-f power PWR — Indicates rf power output. DVR I_b — Indicates plate current of transmit driver tube. PA I_g — Indicates control grid current of transmit power amplifier tubes. PA I_b — Indicates plate current of transmit power amplifier tube.

TABLE 5-1. DESCRIPTION OF CONTROLS FOR RADIO SETS AN/SRC-20 AND AN/SRC-21 (Cont)

UNIT	CONTROL NAME	FUNCTION
Radio Set AN/URC-9 (See figure 5-2.) (Cont)		% MOD — Indicates modulator output. BIAS — Indicates voltage from -30-volt supply. +26.5V — Indicates voltage from +26.5-volt supply. +125V — Indicates voltage from +125-volt supply. +325V — Indicates voltage from +325-volt supply.
Radio Set Control C-3866/SRC (See figure 5-3.)	CHANNEL DIAL	Telephone-type dial for selecting preset channels when CHAN SEL switch on receiver-transmitter is in REMOTE PRESET position.
	LOCAL-REMOTE switch	Disables remote control units in LOCAL position and indicates at remote control station that local operation has been selected.
	EMERGENCY POWER switch	Controls primary power to entire system including C-3866/SRC. In the OFF position, start-stop circuit is disabled.
	EMERGENCY POWER indicator	Lights when EMERGENCY POWER switch is on.
	RADIO SET POWER pushbuttons	START button applies primary power to and STOP button removes primary power from equipment. In normal operation, the AN/URC-9 POWER switch and C-3866/SRC EMERGENCY POWER switch are on. Equipment is then turned on or off by pressing the START and STOP buttons.
	RADIO SET POWER indicator	Lights when START button has been pressed.

b. Sequence of Operation.

Radio Sets AN/SRC-20 and AN/SRC-21 can be operated in one of three modes: normal, retransmit, or broadband. The first step in the sequence is to select one of these modes, each of which is described below:

(1) Normal Operation.

Set MODE switch to the NORM (normal) position. When the microphone push-to-talk switch is pressed, the set is keyed to transmit. Squelch is affected by a signal-plus-noise to noise circuit.

(2) Retransmit Operation.

When the AN/SRC-20 or AN/SRC-21 is connected properly to a similar set, automatic relaying is performed by setting the MODE selector on each set to RETRANS (retransmit). The sets then will relay signals automatically in either direction. Both sets operate as receivers until one of the sets receives a signal strong enough to operate the squelch circuit. The squelch circuit of the receiving set is applied to the transmit audio input of the transmitting set. The audio signal can be monitored at the headset of each set. When the signal is no longer present, the transmitting set is returned to receive operation. When the microphone push-to-talk switch on either set is depressed, both sets are keyed to transmit and the microphone audio signal is fed to both sets for duplex operation.

NOTE

Avoid using the same channel frequency on both sets, as feedback between the respective antennas will prevent relaying of signals.

(3) Broadband Operation.

Broadband operation, selected by setting the switch at the rear of the unit to BROAD, is similar to normal operation except the audio signals are routed through broadband equipment. In addition, the squelch circuit is operated by the carrier. When the mode of operation has been selected, proceed as follows:

(a) Radio Set AN/SRC-20.

1. Turn-On Procedures.

Place the EMERGENCY POWER switch on the C-3866/SRC and the POWER switches on the AN/URC-9 and AM-1565/URC to the ON positions (see figures 5-1, 5-2, and 5-3).

Go to the AM-1565/URC front panel; set CHAN SEL switch to desired channel, the METER switch to the PWR OUT position, the LOCAL-REMOTE switch to LOCAL, and the EXCITATION control to AUTO (see figure 5-1).

CAUTION

The EXCITATION MANUAL-AUTO control should always be set to AUTO except during tuning procedures.

Depress RADIO SET POWER START button on C-3866/SRC; equipment is now energized. Check voltages by setting METER switch on AN/URC-9 to BIAS, +26.5V, +125V, and +325V positions. (On all other positions, meter should register near center mark; see table 5-3 for normal readings.) See figures 5-2 and 5-3.

NOTE

To de-energize equipment completely, place EMERGENCY POWER switch of C-3866/SRC to OFF position.

2. Operation.

Receive operation is performed by the AN/URC-9 whenever the microphone push-to-talk switches are left open. The audio output level is controlled by the VOLUME control; signal strength is monitored by setting the METER switch to S METER. See figure 5-2.

Transmit operation is performed in one of three modes: normal, broadband, and retransmit. Each of these modes is defined below:

For normal operation, key the set to transmit by depressing the push-to-talk switch on the microphone or handset. A sidetone audio signal from the modulator can be heard at the headset. Check the r-f power output and reflected r-f power by setting the METER switch to PWR and SWR. Monitor the modulation level by setting the METER switch to % MOD. (With an audio signal in the microphone, the meter peaks near the center of the scale.) Check the driver plate current, power amplifier grid current, and power amplifier plate current by setting the METER switch to the DVR I_b, PA I_g, and PA I_b positions (meter will read near center of scale).

For broadband operation, the procedure is the same for normal operation, except for the differences described in paragraph C.1.b. This mode is used only with auxiliary broadband equipment.

For retransmit operation, either set is keyed to transmit automatically by signals received from the alternate set.

NOTE

Automatic keying depends on proper adjustment of the squelch controls.

A normal audio signal is heard in the headset of the receiving set and a sidetone signal in the headset of the transmitting set. When the push-to-talk switch on the microphone of either set is depressed, both sets are keyed to transmit for duplex operation.

3. Frequency Selection.

Frequency can be selected manually, or a preset frequency channel can be selected either locally or by remote control. Each of these methods is described below.

Manual frequency selection is performed by setting the CHAN SEL switch on MANUAL position and selecting the desired frequency by the setting of three MANUAL FREQUENCY switches. These switches can select any of 1750 channel frequencies spaced 0.1 mc apart in the 225.0- to 399.9-mc frequency range. As an example refer to figure 5-2; the MANUAL FREQUENCY switches are set to 399.9 mc.

Local channel selection is accomplished by setting the CHAN SEL switch on the AN/URC-9 to any one of 19 preset channel positions. When the set completes the tuning cycle, the channel number appears on the channel indicator, and the selected frequency appears on the frequency indicator (see figure 5-2). The 19 channel frequencies are preset on a drum accessible at the front panel on the AN/URC-9.

Remote channel selection is accomplished by placing the CHAN SEL switch on the AN/URC-9 in REMOTE PRESET, setting the LOCAL-REMOTE switch to REMOTE on the C-3866/SRC, and dialing the CHANNEL DIAL on the remote unit. Any of the 19 preset channels can be dialed in this manner. Each channel has a squelch control accessible at the front panel of the C-3866/SRC.

4. Squelch Control.

The squelch circuit allows the elimination of noise in the speaker or headset when no signal is being received. Two kinds of squelch control are available: local and remote. These are described below.

Local squelch control is accomplished by placing the CHAN SEL switch on Radio Set AN/URC-9 to MANUAL or one of the 19 preset channels and then turning the SQUELCH control clockwise until noise is first eliminated (see figure 5-2). Next, move the CHAN SEL switch to each of the 19 preset channels, and check for elimination of noise at each. Then set the SQUELCH control to the lowest setting that will provide squelch action on MANUAL and all preset channels. To disable the squelch circuit, set the SQUELCH control to OFF, or depress the SQUELCH DISABLE-PUSH switch. (The CALL LIGHT indicator comes on when the squelch circuit is disabled or a signal with sufficient strength to operate the circuit is received.)

Remote squelch control is accomplished by setting the CHAN SEL switch on the AN/URC-9 in the REMOTE PRESET position (this will make the SQUELCH and SQUELCH DISABLE-PUSH controls inoperative). Each of the 19 remote preset channels has a separate squelch control accessible at the front panel of Radio Set Control C-3866/SRC.

(b) Radio Set AN/SRC-21.

The sequence of operation for Radio Set AN/SRC-21 is the same as that for the AN/SRC-20 except that procedures involving Radio-Frequency Amplifier AM-1565/URC are excluded.

c. Indicator Presentations.

Normal meter indications for the AN/SRC-20 are shown in tables 5-2 and 5-3. Indications for Radio Set AN/SRC-21 are shown in table 5-3.

TABLE 5-3. NORMAL METER READINGS ON RADIO SET AN/URC-9 (Cont)

METER SWITCH POSITION	SIGNAL FREQUENCY (mc)	NORMAL METER READING (100 FULL SCALE)			
		RECEIVE		TRANSMIT	
		NO SIGNAL	*SIGNAL	UNMODULATED	**MODULATED
S METER	399.9	0	30	-10	-10
	299.9	8	68	-10	-10
	225.0	32	65	-10	-10
SWR	399.9	0	14	14	14
	299.9	0	0	14	14
	225.0	0	0	8	8
PWR	399.9	0	0	49	47
	299.9	0	0	63	50
	225.0	0	0	55	49
DVR I_b	399.9	0	0	60	58
	299.9	0	0	48	48
	225.0	0	0	47	47
PA I_g	399.9	0	0	18	15
	299.9	0	0	38	35
	225.0	0	0	32	28
PA I_b	399.9	0	0	45	45
	299.9	0	0	45	42
	225.0	0	0	44	43
% MOD	399.9	18	25	14	47
	299.9	18	25	14	52
	225.0	18	25	14	50

*100 uv, 30-percent modulated at 1000 cps.
**90-percent modulated with 1000-cps tone.

3. Emergency Operation.

During emergency or battle conditions, should equipment operation become affected, use the following procedures:

a. Other Than Normal.

(1) During Remote Operation.

During abnormal conditions in remote operation, follow the sequence listed below.

(a) Dial an alternate preset channel with the remote CHANNEL DIAL.

(b) If step (a) does not allow operation, switch to local operation and perform the following steps:

1. Select an alternate preset channel with the CHAN SEL switch on the AN/URC-9; or

2. Set the CHAN SEL switch to MANUAL, and select a frequency with the MANUAL FREQUENCY switches.

(2) During Local Operation.

For abnormal conditions during local operation, perform the following steps:

(a) Select an alternate preset channel with CHAN SEL switch; or

(b) Set CHAN SEL switch to MANUAL, and select an alternate frequency with the MANUAL FREQUENCY switches.

b. Jamming.

If it appears that the equipment is being jammed, select a frequency at the extreme of the usable frequency range. For example, if jamming appears at 225.0 mc, select 399.9 mc.

D. SUMMARY OF OPERATING PROCEDURES:

Table 5-4 contains a summary of the procedures for operating Radio Sets AN/SRC-20 and AN/SRC-21 from local as well as remote controls. The sets may be operated by remote control from a unit such as Indicator Control C-3868/SRC in conjunction with Radio Set Control C-1138/UR.

TABLE 5-4. SUMMARY OF OPERATION FOR RADIO SETS AN/SRC-20 AND AN/SRC-21

OPERATION	FUNCTION	STEP
General preliminary settings	Mode of operation	1. Set MODE switch on AN/URC-9 to desired mode.
	Applying power	1. Set POWER switch on AN/URC-9 to on position. 2. Set AM-1565/URC for remote operation.* 3. Set EMERGENCY POWER switch on C-3866/SRC to EMERGENCY POWER.

TABLE 5-4. SUMMARY OF OPERATION FOR RADIO SETS AN/SRC-20 AND AN/SRC-21 (Cont)

OPERATION	FUNCTION	STEP
Remote operation	Preliminary settings	1. Perform general preliminary settings. 2. Set CHAN SEL on AN/URC-9 to REMOTE PRESET. 3. Set LOCAL-REMOTE switch on C-3866/SRC to REMOTE
	Start equipment	1. Depress START button on remote control.
	Receive	1. Dial any one of 19 remote preset channels with CHANNEL DIAL on the C-3868/URC remote unit. (Squelch is preset for each channel.) 2. Adjust VOLUME control for desired audio level in handset.
	Transmit	1. Depress push-to-talk button on remote handset.
	Stop equipment	1. Depress STOP button on remote control.
	Remove power	1. Set EMERGENCY POWER switch on C-3866/SRC to OFF.
Local operation	Preliminary settings	1. Perform general preliminary settings. 2. Set LOCAL-REMOTE switch on C-3866/SRC to LOCAL.
	Start equipment	1. Depress RADIO SET POWER START button on C-3866/SRC.
	Receive	1. Set CHAN SEL switch to MANUAL or one of the 19 preset channel positions. (In manual operation, set desired frequency on MANUAL FREQUENCY switches.) 2. Adjust VOLUME control for desired audio level in headset. 3. If necessary adjust SQUELCH control. 4. Alternately: a. Set CHAN SEL switch to REMOTE PRESET position. b. Dial any of 19 remote preset channels on C-3866/SRC as follows: dial the first 10 preset channels directly (1 to 10 on dial), allow two seconds before releasing dial; for channels 11 to 19, dial A first, then unit's position of channel number. With each dialing, hold finger against stop two seconds. (Squelch is preset for each channel.)

TABLE 5-4. SUMMARY OF OPERATION FOR RADIO SETS AN/SRC-20 AND AN/SRC-21 (Cont)

OPERATION	FUNCTION	STEP
Local operation (Cont)	Receive (Cont)	c. Adjust VOLUME control for desired audio level.
	Transmit	1. Depress push-to-talk button on local microphone or handset.
	Stop equipment	1. Depress RADIO SET POWER STOP button on C-3866/SRC.
	Remove power	1. Set EMERGENCY POWER switch on C-3866/SRC to OFF.
*Radio Set AN/SRC-20 only		

INFORMATION SHEET 6

OPERATOR'S MAINTENANCE

A. INTRODUCTION:

This information sheet describes the area of responsibility for the AN/SRC-20 and AN/SRC-21 operators. It outlines, on a limited basis, the routine maintenance, emergency maintenance, and adjustments which will be the operator's responsibility.

B. References:

NAVSHIPS 94695A, Technical Manual for Radio Sets AN/SRC-20 and AN/SRC-21, Section 3, Pages 3-12 through 3-16.

C. INFORMATION:

1. Operator's Maintenance.

a. Operator's Checks.

Periodically the following procedure should be performed on the AN/SRC-20 and AN/SRC-21 to ensure that the equipment is operating properly.

(1) Set equipment controls for local operation.

(2) Depress RADIO SET POWER START button on the C-3866/SRC. All panel indicators should light and blowers should operate. Check supply voltages by setting METER switch to +325V, +125V, +26.5V, and BIAS positions. (See table 5-3 for normal meter readings.)

(3) Set METER to % MOD position. Depress push-to-talk button on microphone or handset, and speak into microphone at normal level. Meter should peak in the normal.

(4) Set CHAN SEL switch to preset channel 1. After tuning cycle is complete, check that the number in the channel indicator window agrees with the CHAN SEL switch. Check that the frequency indicated in the frequency indicator windows agrees with the frequency recorded for the channel selected.

(5) Depress push-to-talk switch on microphone or headset, and set METER switch to SWR, PWR, DVR I_b, PA I_g, and PA I_b. See table 5-3 for normal meter readings.

(6) Repeat steps (4) and (5) setting the CHAN SEL switch to each of the preset channel positions and to the MANUAL position.

(7) Set CHAN SEL switch to REMOTE PRESET position. Dial preset channel 1 on the CHANNEL DIAL. After tuning cycle is complete, check that the number in the channel indicator window agrees with the channel dialed. Repeat procedure for each of the 19 remote preset channels.

b. Operator's Adjustments.

(1) To preset channel frequencies on Radio Set AN/SRC-20, use the following procedure:

(a) Radio Set AN/URC-9. (See figure 6-1.)

1. Set equipment controls for local operation.

2. Energize equipment by pressing RADIO SET POWER START button on C-3866/SRC.

3. Set CHAN SEL switch so that desired channel number on the memory drum appears directly above the chart. See figure 6-1. The proper CHAN SEL switch position can be determined from the chart; for example, to position memory drum for presetting channel 4, set CHAN SEL switch to MANUAL position.

4. Starting at the left, slide the pin for each digit of the assigned frequency to a position directly over the number corresponding to that digit. For example, if the assigned frequency for preset channel 4 is 366.6 mc, set the left pin over number 3, the left-center pin over 6, the right-center pin over 6, and the right pin over 6.

5. Record preset channel frequency on the front of the access door.

6. Repeat steps 3, 4, and 5 for each channel to be preset.

7. Set CHAN SEL switch to each preset channel position, and after tuning cycle is complete, check that proper frequency appears in the frequency indicator windows.

8. Close memory drum access door, and secure with four slotted-head screws.

NOTE

When any of preset channel frequencies are changed, the remote squelch adjustment for these channels should be checked. When the preset channel frequencies on the AN/URC-9 are changed, the SQUELCH control should be checked.

(b) Radio-Frequency Amplifier AM-1565/URC.

1. On the AN/URC-9, set POWER switch to on position; CHAN SEL switch to REMOTE PRESET; METER switch to PWR; and MODE switch to NOR (see figure 5-2).

2. Turn AM-1565/URC EXCITATION switch to MANUAL and TEST KEY switch to OFF (see figure 5-1).

3. Loosen the four screws that secure the channel potentiometer cover, and lift the cover upward. (see figure 6-2).

4. Loosen the lock nut on channel 1 potentiometer so shaft can turn freely.

5. Set CHAN SEL on AM-1565/URC to 1.

6. Turn channel 1 potentiometer until FREQ-MC dial on AM-1565/URC reads desired channel frequency.

7. Remove output loading access cap, and turn the output loading screw clockwise to the stop.

8. Turn LOW-HIGH EXCITATION control to middle of range.

9. Turn METER switch to PWR OUT position and TEST KEY to LOCK ON.

10. Adjust channel 1 potentiometer for maximum power output; if meter indicates above 150 watts with EXCITATION control in MANUAL, reduce excitation to 100 watts.

11. Turn EXCITATION switch to AUTO, and adjust output loading screw for 140 watts indication on meter.

12. Place EXCITATION on MANUAL, and adjust channel 1 potentiometer for peak indication on meter.

13. Place EXCITATION switch to AUTO, and readjust output loading screw for 140 watts. Repeat steps 11 and 12 until both conditions are satisfied.

NOTE

EXCITATION switch must be in MANUAL when varying channel potentiometers and AUTO when adjusting output loading screw.

14. Tighten channel 1 lock nut; to set other channels, repeat steps 7 through 14.

15. Place EXCITATION switch in AUTO position, then turn meter switch first to PA I_{b1} position; in each case, meter should indicate less than 180 ma.

16. Close channel potentiometer cover, and secure the four screws.

17. Insert FREQ and LOG dial readings after proper channel number on channel potentiometer cover.

18. Replace output loading access cap.

(2) To preset channel frequencies on Radio Set AN/SRC-21, follow the procedure given in paragraph C.1.b. for Radio Set AN/URC-9 only.

(3) To set remote squelch controls, use the following procedure for the remote preset channels. The controls are accessible at the front of the C-3866/SRC.

(a) Set equipment controls for local operation, and depress RADIO SET POWER START button on C-3866/SRC; then set CHAN SEL switch on AN/URC-9 to REMOTE PRESET.

(b) Dial desired remote preset channel on CHANNEL DIAL; then loosen screws in squelch control access door and open door (see figure 6-3).

(c) For normal mode, use the following steps:

1. Set proper channel squelch control potentiometer to maximum counterclockwise position. (CALL LIGHT should stay off.)

2. Turn VOLUME control to maximum; a barely audible noise should be heard.

3. If the CALL LIGHT is on and a loud noise exists in the headset with no signal, rotate the potentiometer clockwise until CALL LIGHT goes out and noise is no longer heard.

4. Next, rotate control slowly counterclockwise until noise is heard and CALL LIGHT comes on.

5. Then, rotate control clockwise slowly in small increments (10 to 15 degrees); allow one second of time at end of each increment; stop rotation where CALL LIGHT goes out and stays out with no signal present. (This procedure is necessary due to the one-second time delay inherent in operating the signal-plus-noise to noise ratio squelch.)

6. Repeat for each remote channel.

(d) For retransmission and broadband modes, use the following steps:

1. Repeat steps 1 and 2 for normal mode.

2. Turn potentiometer clockwise until there is no noise in the headset. CALL LIGHT goes out when squelch operates.

NOTE

Set potentiometer to the lowest (counterclockwise) position that provides squelch action: higher settings reduce sensitivity unnecessarily.

(e) Close access door and secure.

c. Emergency Maintenance.

While equipment normally is maintained by technicians, it may be necessary for the operator to perform simple trouble shooting and repair during an emergency. The following information is presented for this purpose:

(1) Procedure for Simple Repair.

Emergency repair consists basically of locating and replacing a defective tube or blown fuse. In most cases, these faults can be determined by observation. However, before any attempt is made to repair equipment, be sure that the fault is not due to improper control settings. Table 6-1 lists the symptoms and probable causes of trouble as they would occur during normal operation.

If after replacing a blown fuse, the fuse blows again, have fault corrected before again replacing fuse.

If it is necessary to check tubes use the following sequence:

(a) For the AM-1565/URC:

1. Remove the eight flathead screws around the outside edge of the front panel.

2. Depress the two black release buttons directly above the handles on each side of the front panel. The chassis can now be extended on its slides and tilted.

3. Energize equipment and check that all tube filaments light; replace unlighted tubes.

4. If all tube filaments light, but malfunction still appears to be defective tube, have tube checked, or replace tube.

5. When repair is complete, slide chassis into case, making sure that release buttons lock, and replace screws.

(b) For Receiver-Transmitter RT-581/URC-9 of Radio Set AN/URC-9:

1. Loosen four slotted head screws in corners of front panel.

2. Extract unit by turning extractor screw counterclockwise; when unit is as far forward as possible, rotate extractor clockwise until it falls free.

3. Pull unit out of case by handles and connect to case with propoer cable. Make sure that antenna system is connected to antenna jack.

4. Repeat steps 3 and 4 for AM-1565/URC.

5. When repair is complete, replace unit in case; return extractor screw and panel screws and secure.

WARNING

Before removing or replacing tubes, de-energize equipment by placing EMERGENCY POWER switch on C-3866/SRC to OFF.

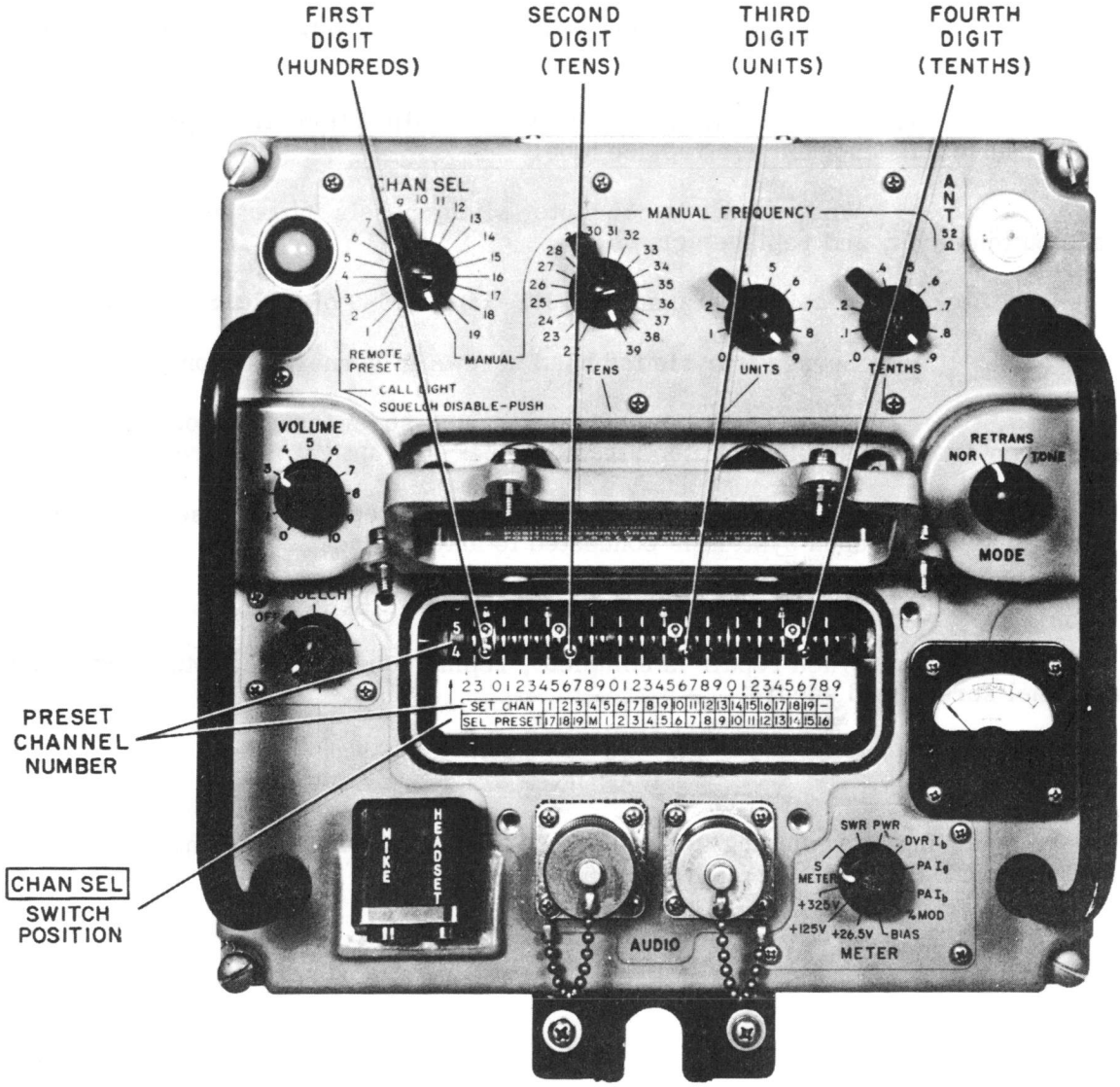

Figure 6-1. Preset Channel Memory Drum, Radio Set AN/URC-9

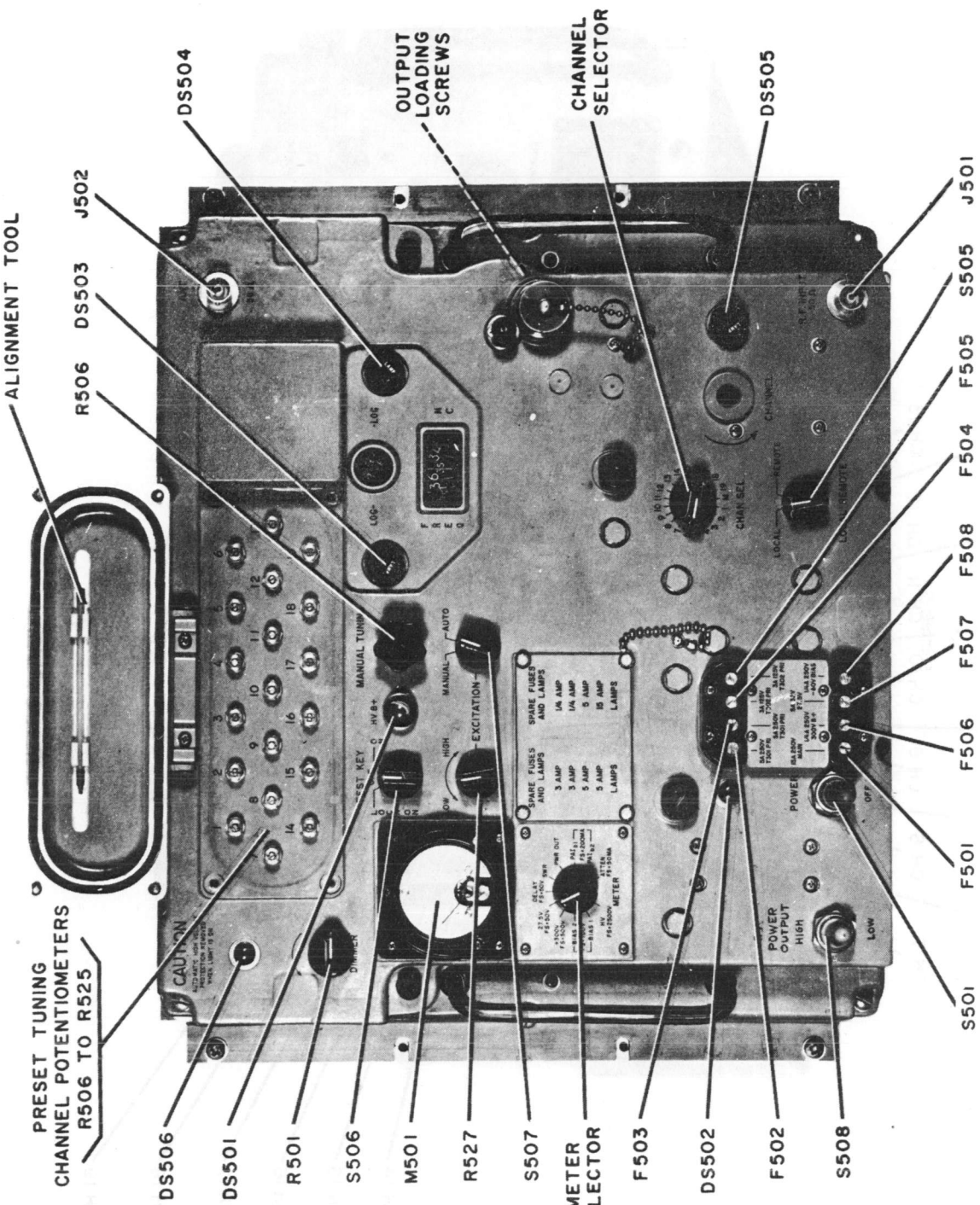

Figure 6-2. Preset Tuning Potentiometer, Radio-Frequency Amplifier AM-1565/URC

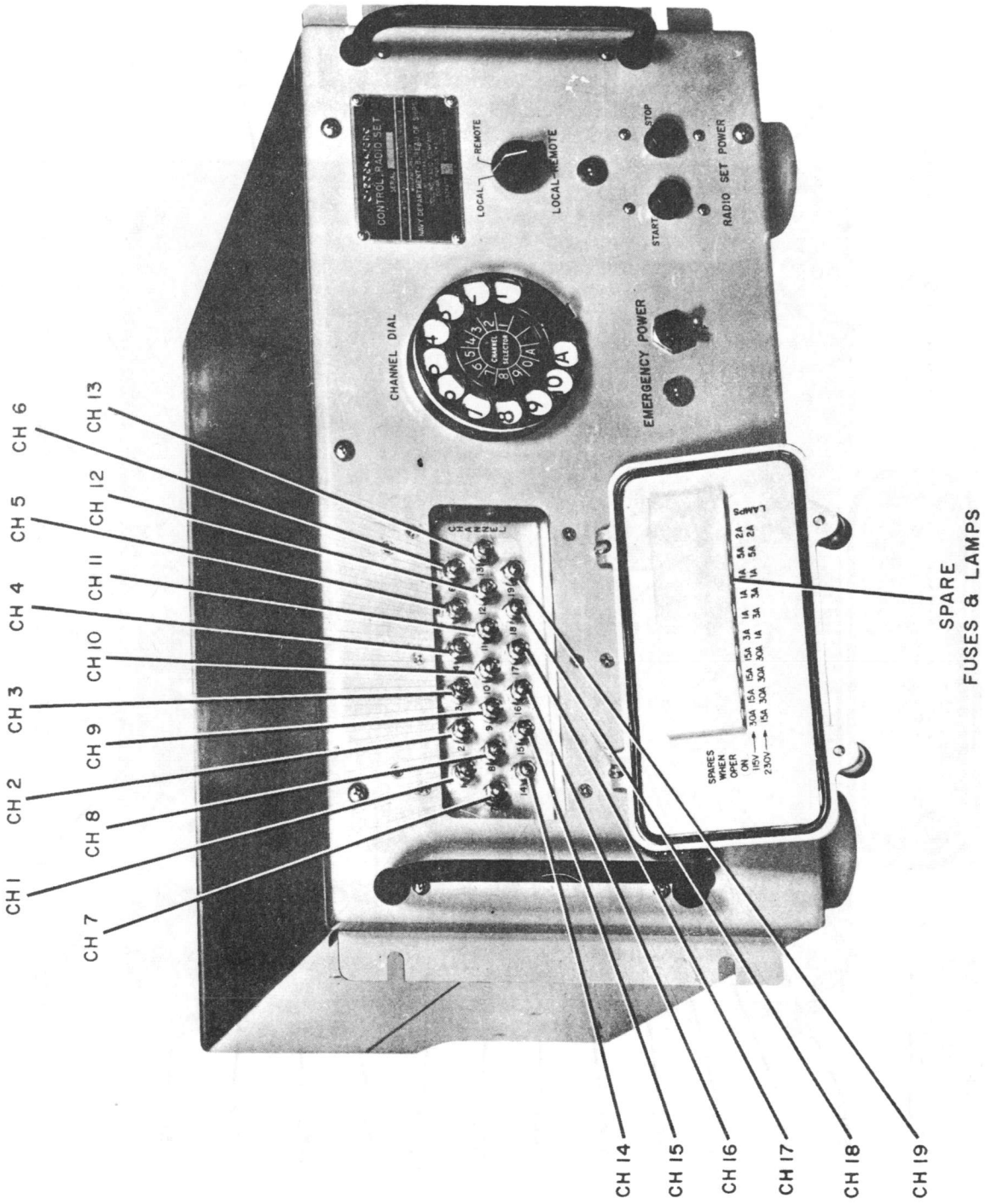

Figure 6-3. Squelch Controls, Radio Set Control C-3866/SRC

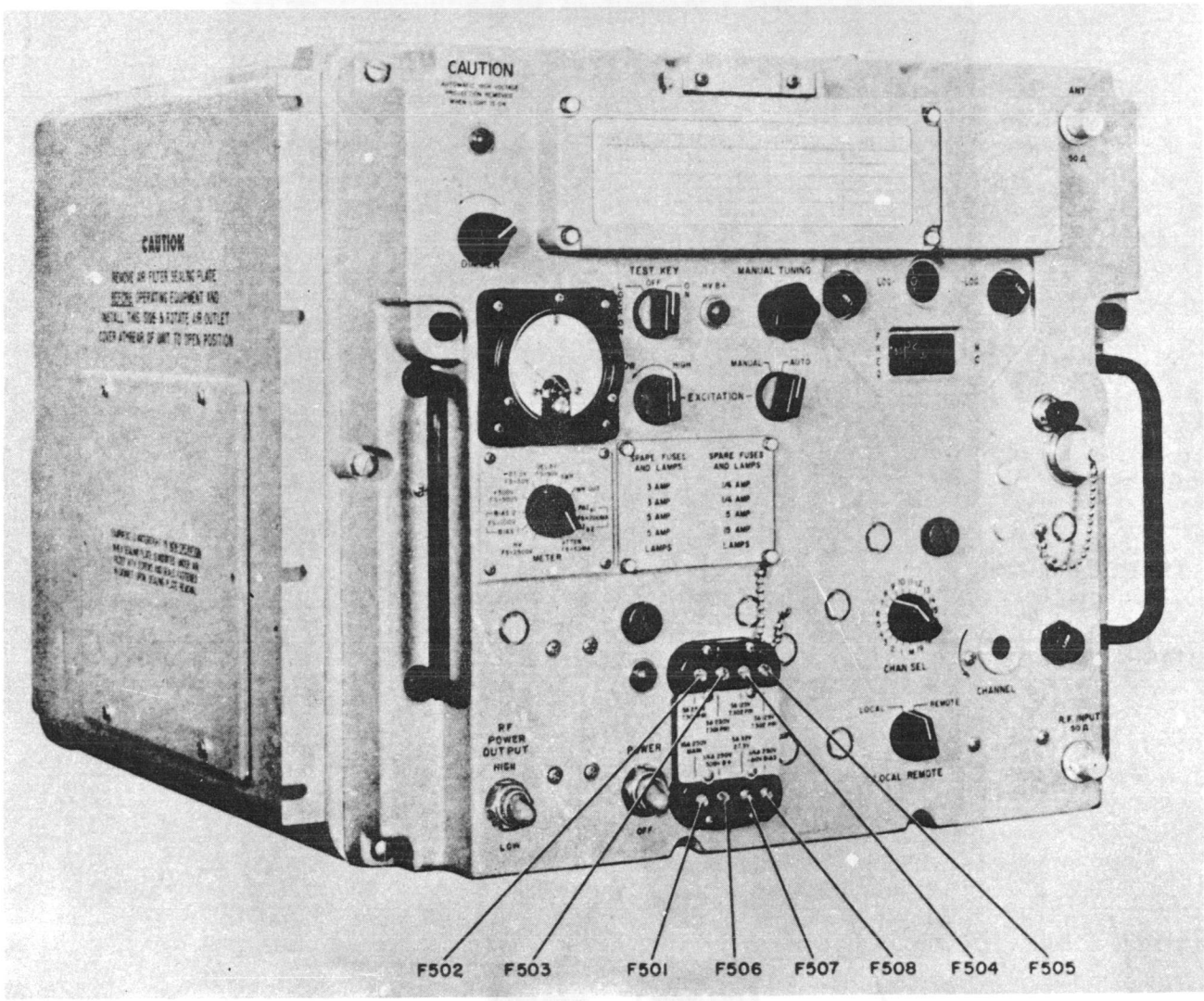

Figure 6-4. Radio-Frequency Amplifier AM-1565/URC, Fuse Location

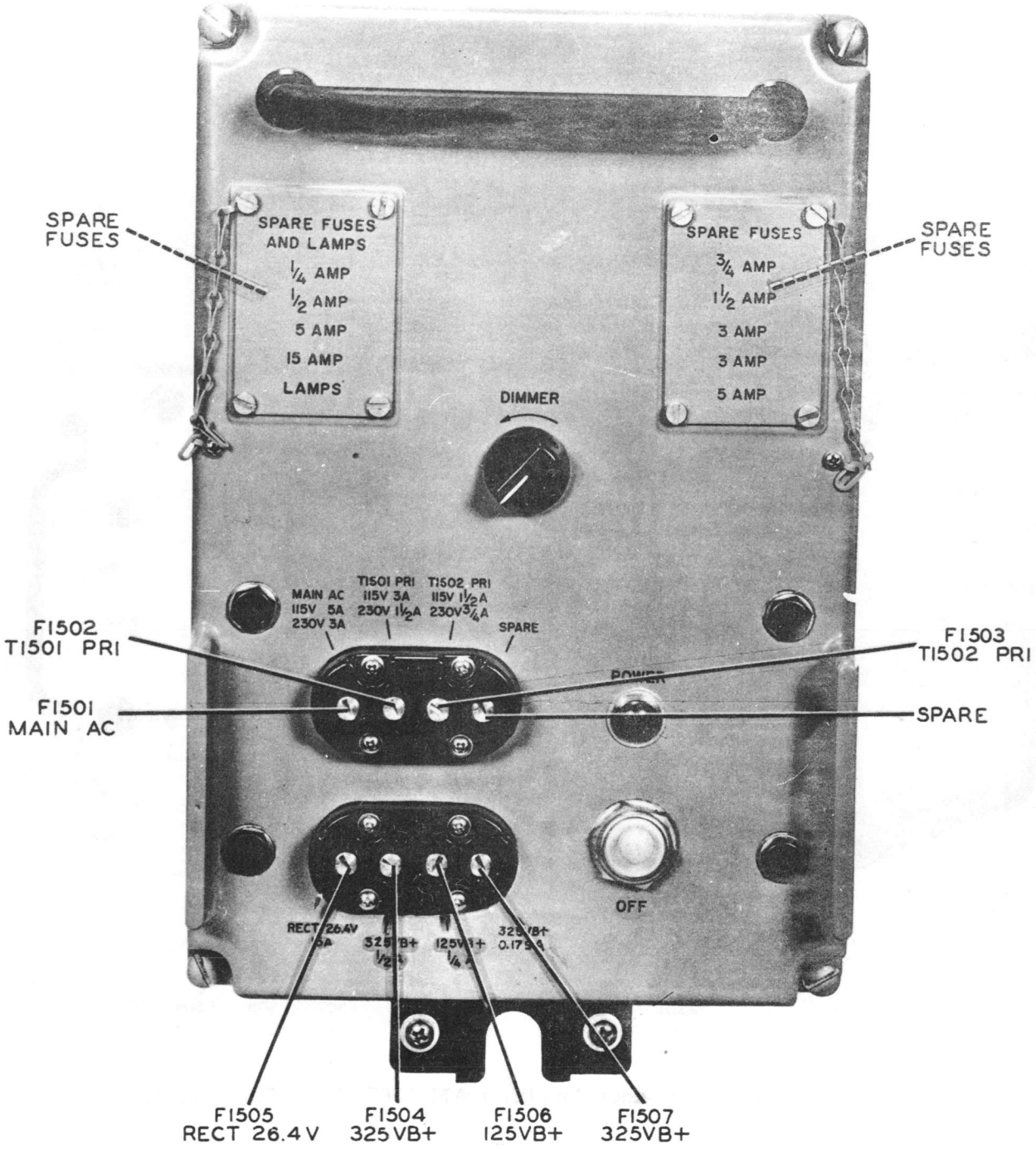

Figure 6-5. Radio Set AN/URC-9, Fuse Location

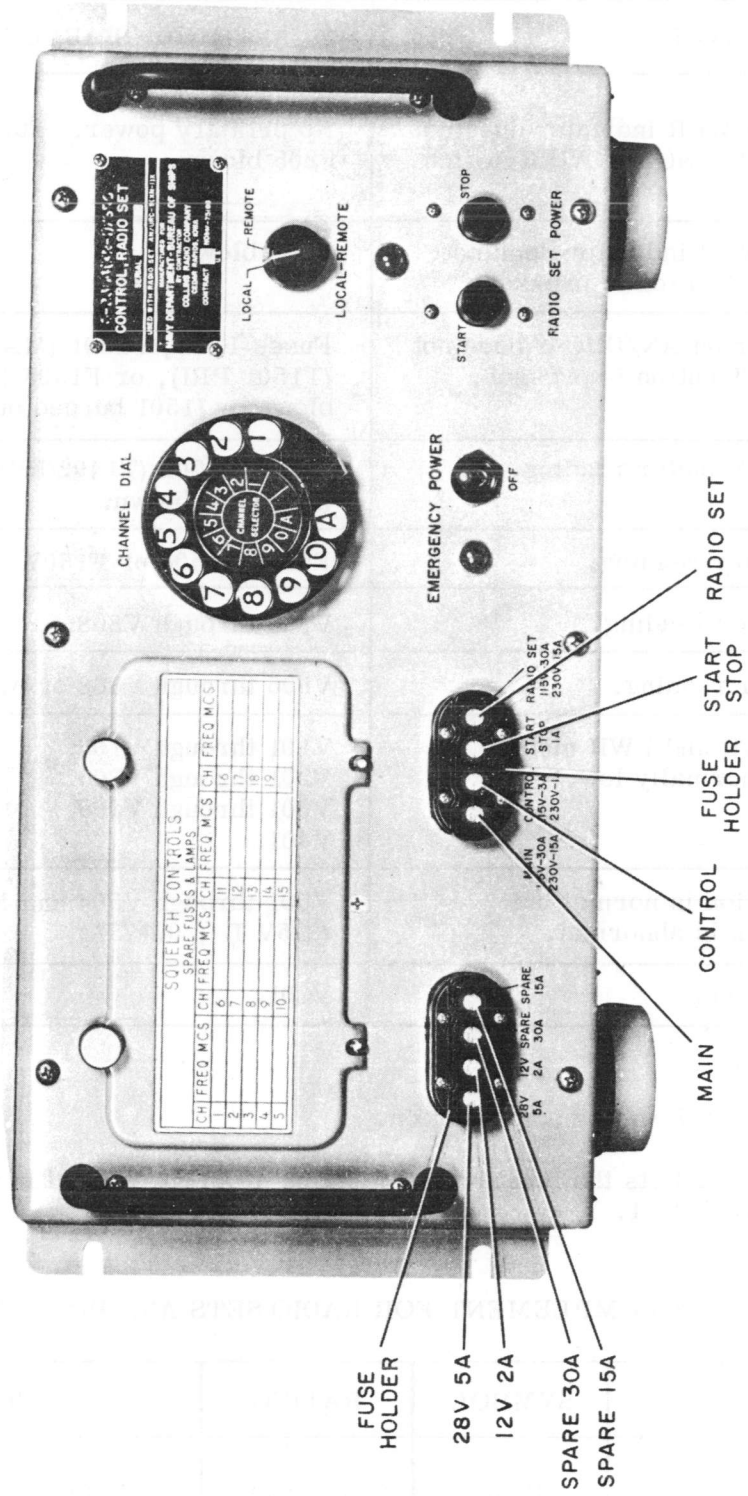

Figure 6-6. Radio Set Control C-3866/SRC, Fuse Location

TABLE 6-1. OPERATOR'S TROUBLE-SHOOTING PROCEDURE

SYMPTOM	PROBABLE CAUSE
EMERGENCY POWER indicator does not light when EMERGENCY POWER switch is turned on.	No primary power. Fuses F204 or F205 blown.
RADIO SET POWER indicator does not light when START button is pressed.	F203 blown.
POWER indicator on AN/URC-9 does not light when START button is pressed.	Fuses F206, F1501 (MAIN AC), F1502 (T1501 PRI), or F1505 (RECT. 26.4V) blown or I1501 burned out.
No BIAS or +125V meter reading.	Fuses F1503 (T1402 PRI) or F1506 (125V B+) blown.
No +325 volt meter reading.	Fuses F1504 or F1507 (+325V B+) blown.
Low % MOD meter reading.	V802 through V808.
No % MOD meter reading.	V805 through V808 or preceding fuses.
On transmit, SWR and PWR meter readings are abnormally low.	V101 through V106. V201 through V205. V301 through V305. V401.
Transmit operation is normal but receive operation is abnormal.	V501 through V504 and F1507 (325V B+, 0.175A).
Squelch inoperative.	V801.

(2) Fuse Location and Function.

Table 6-2 lists the function and location of all fuses used in the Radio Sets AN/SRC-20 and AN/SRC-21.

TABLE 6-2. FUSE COMPLEMENT FOR RADIO SETS AN/SRC-20 AND AN/SRC-21

UNIT	SYMBOL	RATING	FUNCTION
Radio-Frequency Amplifier AM-1565 (See figure 6-4)	F501	250V, 15A	Main fuse.
	F502	250V, 5A	Primary fuse for 230-volt a-c connection.
	F503	250V, 5A	Primary fuse for 230-volt a-c connection.

TABLE 6-2. FUSE COMPLEMENT FOR RADIO SETS AN/SRC-20 AND AN/SRC-21 (Cont)

UNIT	SYMBOL	RATING	FUNCTION
Radio-Frequency Amplifier AM-1565 (See figure 6-4) (Cont)	F504	125V, 3A	Primary fuse for 115-volt a-c connection.
	F505	125V, 3A	Primary fuse for 115-volt a-c connection.
	F506	250V, 1/4A	300-volt B+ fuse.
	F507	32V, 5A	-27.5 volts to operate relays.
	F508	250V, 1/4A	+60 volts for bias.
Radio Set AN/URC-9 (see figure 6-5)	F1501	230V, 3A 115V, 5A	Primary a-c power.
	F1502	230V, 1-1/2A	Primary power to +325-volt and +26-volt power supply.
	F1503	230V, 3/4A 115V, 1-1/2A	Primary power to +125-volt, bias, and filament power supply.
	F1504	1/2A	325-volt B+ output.
	F1505	15A	+26-volt d-c output for +26.5-volt rectifier.
	F1506	1/4A	125-volt B+ output.
	F1507	0.175	325-volt B+ (receive output).
Radio Set Control C-3866/SRC (See figure 6-6)	F201	250V, 5A	Relay supply fuse.
	F202	250V, 2A	12-volt a-c supply fuse.
	F203	250V, 1A	START-STOP circuit fuse.
	F204	125V, 30A 230V, 15A	Main primary power fuse.
	F205	250V, 3A	Primary power to control.
	F206	125V, 30A 230V, 15A	Primary power to equipment.

(3) Tube Location and Function.

Table 6-3 lists the function and location of all tubes in Radio Sets AN/URC-20 and AN/URC-21.

TABLE 6-3. TUBE COMPLEMENT FOR RADIO SETS AN/SRC-20 AND AN/SRC-21

UNIT	SYMBOL	TYPE	FUNCTION
Radio-Frequency Amplifier AM-1565/URC	V201	4CX250K	R-f amplifiers.
	V203	6173	Output regulator.
	V401	5751	Amplifier.
	V402	5751	Phase inverter.
	V403 V404	6BQ5	Power amplifiers.
	V405	5814	Voltage regulator power amplifier.
	V406	5751	Voltage regulator amplifier.
	V407	OA2	Voltage regulator.
Radio Set AN/URC-9	V101	6J4WA	Second transmit mixer.
	V102	6J4WA	R-f amplifier.
	V103	6J4WA	R-f amplifier.
	V104	7554	First receive mixer and transmit r-f amplifier.
	V105	GL6442	Transmit r-f driver.
	V106	4X150D	Transmit r-f power amplifier.
	V201	5670	Frequency multiplier oscillator unit, oscillator.
	V202	5654	Frequency multiplier oscillator tripler.
	V203	6J4WA	Frequency multiplier oscillator amplifier.
	V204	6J4WA	Frequency multiplier oscillator amplifier.
	V205	6J4WA	Frequency multiplier oscillator amplifier.
	V301	5654	20.0- to 29.9-mc i-f amplifier.
	V303	5654	20.0- to 20.9-mc i-f amplifier.
	V303	5654	First transmit mixer.
	V304	5654	Second receive mixer.
	V305	5670	17 to 26-mc crystal oscillator.
	V401	5670	Third receive mixer or transmit 3.0- to 3.9-mc buffer amplifier and 3.0- to 3.9-mc crystal oscillator.
	V501	5654	Receive 500-kc i-f amplifier.
	V502	5654	Receive 500-kc i-f amplifier.
	V503	5654	Receive 500-kc i-f amplifier.
	V504	5654	Receive first audio amplifier.
	V801	5670	Squelch control amplifier.
	V802	5670	Broadband cathode follower and modulator compression rectifier.
	V803	5654	Modulator input amplifier.
	V804	5670	Modulator driver.
	V805	7558	Modulator output amplifier.
	V806	7558	Modulator output amplifier.
	V807	7558	Modulator output amplifier.
	V808	7558	Modulator output amplifier.

D. SUMMARY:

1. It will be the responsibility of the operator to perform minor checks and adjustments. The operator will make:

a. Operational checks.

(1) Meter readings.

(a) Receive operation.

(b) Transmit operation.

(2) Indicators.

(a) Lamps.

(b) Channel indicator windows.

(3) Channel dialing.

b. Adjustments.

(1) Preset channel adjustments.

(2) Squelch (local and remote).

(3) PA tuning (AM-1565/URC only).

2. The operator also will be capable of performing minor corrective maintenance.

a. Blown fuse.

b. Defective tube.

INFORMATION SHEET 7

CIRCUIT ANALYSIS FOR RADIO SET AN/URC-9

A. INTRODUCTION:

The circuit configuration of the AN/URC-9 allows dual use of most subassemblies; that is, the same circuits are used during both transmit and receive. In most cases the operation of the circuits is basically the same during transmit and receive operations. Relay control circuitry provides the changes necessary to convert. The system utilizes the three different modes of operation and an additional broadband function, as previously discussed. During circuit analysis of the AN/URC-9, you will find that the primary difference between the three modes is the audio input and output signals and the configuration of the audio and transmit-receive control circuits.

B. REFERENCES:

NAVSHIPS 94695A, Technical Manual for Radio Sets AN/SRC-20 and AN/SRC-21, Section 4, Pages 4-1 through 4-72.

C. INFORMATION:

1. Normal Receive. (Refer to figure 7-13.)

During normal receive, the uhf signal from the antenna (AN/SRC-21) or the AM-1565/URC (AN/SRC-20) is routed through the directional coupler to the r-f and power amplifier assembly. Antenna relay K101 is de-energized on receive and couples the signal to Z101, a parallel tuned r-f input tank, through C106. Resistor R117 provides a d-c path to ground for static charges developed on the antenna. Capacitor C110 couples the signal voltage developed across the tuned tank to the cathode of the first r-f amplifier, V102. The cathode network of V102 consists of parallel tuned circuit Z102 and 47-ohm resistor R122. The tuned circuit (resonant in the 225- to 399.9-mc range) provides a high coupling impedance for the r-f signal. The resistor provides cathode bias for the tube. Resistor R104 connects the control grid of V102 to the r-f avc bus and, in conjunction with C109, isolates the r-f signal from the avc bus. Plate voltage of +125 volts d-c is supplied through L105 and dropping resistor R116. Capacitor C113 isolates r-f signals from the +125-volt supply. Capacitor C114 couples the r-f signal to the plate tank, Z103. Capacitor C117 couples the r-f signal to the second r-f amplifier, V103, which provides a second stage of r-f amplification. Cathode resistor R123 is unbypassed and provides degeneration. This degeneration provides added linearity. The plate load of V103 is L107. This provides a high impedance to the r-f signal and also blocks the r-f signal from the power supply. Capacitor C120 provides additional filtering and isolation of the r-f signal from the power supply. Grid resistors R105 and R110 connect the grid of V103 to the r-f avc bus. Capacitor C116 isolates the r-f from the avc bus. The network between V103 and V104 (C121, Z105, C123) couples the amplified r-f signal to the cathode of the first receive mixer tube, V104. (In transmit, this tube is an r-f amplifier.) The cathode circuit of V104 consists of r-f coupling choke L110, cathode bias resistor R111, and C125, which bypasses R111. Capacitor C137 grounds the control grid of V104 to r-f. Capacitor C144 provides additional filtering in the grid circuit on receive. (In transmit, R107 is shorted out by T/R relay K602.) The cathode of V104 receives a signal in the 200- to 370-mc range from the frequency multiplier oscillator through T/R relay K102 and capacitor C136. This signal mixes with the incoming r-f signal producing a difference frequency in the range of 20 to 29.9 mc. The difference frequency is coupled to J102 through L109 and K102. V104 receives plate voltage from the +125 volt d-c power supply through L109, L113, and resistor R607 in the relay assembly. (In transmit, T/R relay K602 shorts R607.)

When tank circuits Z102, Z103, and Z105 are tuned by the frequency selector, both capacitance and inductance are varied. This provides very linear frequency control. By that we mean for each turn of the tuning shaft, the frequency will change the same amount, thus giving us a linear or measured frequency change. This also improves sensitivity of the tanks by maintaining a high tank efficiency over the entire 225 to 399.9 mc frequency range. Trimmer capacitors C107, C115, and C122 set the minimum capacity point for the tank circuit.

The 200- to 370-mc injection signal at V104 is generated in the frequency multiplier oscillator. This unit generates frequencies in the 200- to 270-mc range during both transmit and receive operation. These frequencies are injected into the r-f and power amplifier assemblies. The purpose of this injection is to provide an operating frequency of 225 to 399.9 mc during transmit and a frequency in the first i-f amplifier range of 20 to 29.9 mc during receive; both results are accomplished by heterodyning. The operation of the frequency multiplier oscillator is identical during both receive and transmit modes of operation. Crystal oscillator V201 is a crystal-controlled, cathode-coupled oscillator especially designed for use with overtone crystals. V201 is a twin triode; one half acts as a grounded-grid amplifier capacitively coupled to the other half which acts as a cathode follower. Capacitor C207 couples with signal from the plate (pin 4) of the grounded-grid amplifier to the control grid (pin 7) of the cathode follower. The crystal, which couples the output from the cathode (pin 8) of the cathode follower to the cathode (pin 2) of the grounded amplifier, operates at series resonance providing low-impedance coupling with zero phase shift. The phase shift through the amplifier is also zero; thus, an in-phase signal is fed back to the grounded-grid amplifier, and conditions for sustained oscillation are satisfied. Inductor L220 resonates with the crystal socket capacity canceling its effect on operation of the circuit. Trimmer coils L201 to L218, inclusive, adjust the frequency of oscillation to compensate for finishing tolerances in the crystals. Capacitor C201 prevents the plate voltage on pin 4 of V201 from being grounded through the trimmer coils. Capacitor C236 is a temperature-compensating capacitor. The grid (pin 3) of the grounded-grid amplifier is grounded through parasitic suppressor R202. Resistors 4203 and R204 provide the coupling impedances at the cathodes and provide bias for the two halves of V201. Plate voltage for the cathode follower is supplied through step tuner Z201, trimmer coil L222, and parasitic suppressor R206. The step tuner is tuned by the 10-mc frequency selector so that when the set operates in the 220- to 299.9-mc range the tank circuit is tuned to the second harmonic of the crystal frequency, and in the 300- to 399.9-mc range, the tank circuit is tuned to the third harmonic. Thus, the output of the oscillator is either two or three times the crystal frequency, depending upon the operating frequency of the set. Capacitor C210 couples the r-f signal to the control grid of V202; crystals Y202, Y204, and Y206 through Y218 have one common side connected to pin 2 of V201 through C204. Thus, since the crystal cases are grounded, a large capacity to ground exists at pin 2 of V201. L219 resonates with this capacity and cancels its effect.

The next stage of the frequency multiplier oscillator V202 operates as a frequency tripler. This is done by tuning the plate tank circuit, Z202, to the third harmonic of the signal applied to the grid. Thus the signal in the plate tank is either six or nine (200 to 370 mc) times the frequency of the selected crystal in master oscillator V201. Test point J201 provides an indication of the drive to V202. C211 bypasses the r-f signals to ground preventing them from interfering with the d-c measurements being made at J201. The cathode of V202 is grounded; thus the tube depends entirely upon the voltage across the grid leak circuit for bias. Plate voltage of +125 volts d-c is supplied through R213 and L224. Screen grid voltage is supplied through R213 and R209. C212 and C213 provide filtering to isolate the r-f from the power supply. Capacitor C214 couples the r-f signal to parallel tuned tank Z202. Trimmer capacitor C215 sets the minimum capacity point of the tank circuit. Capacitor C216 couples the r-f signal from the plate tank to the cathode of grounded-grid amplifier V203.

Unbypassed cathode resistor R215 provides degeneration and linearity. V203 receives +125 volts d-c plate voltage through R210 and L226. Decoupling capacitor C219 isolates the r-f from the power supply. The output signal is coupled through C220 to plate tank Z204. Capacitor C221 determines the minimum capacity of the plate tank. Capacitor C222 couples the signal to the cathode of V204.

V204 and V205 and their associated circuits provide two additional stages of amplification identical to V203. Capacitors C234 and C235 form a voltage divider through which the uhf signal is injected into the r-f and power amplifier assembly via J205 and K102. Test points J202, J203, and J204 provide for either measuring the r-f signals at the cathode of the amplifier (for alignment purposes) or for injecting a signal to locate a defective stage. Tank circuits Z202 and Z204 and Z206 and Z208 are tuned by the 18-position shaft of the frequency selector system. When the tanks are tuned, both inductance and capacitance are varied, providing a very linear change in frequency. The signal injected into the r-f and power amplifier is used as a mixing signal to accomplish the heterodyning action required to develop the 20- to 29.9-mc i-f signal discussed previously.

The i-f output of V104 is coupled through K102, J102, and C301 to the tuned tank circuit Z301. Capacitor C303 couples the i-f signal to the adjacent parallel-tuned tank Z302. The avc blocking capacitor, C305, couples the i-f signal to the control grid of amplifier V301 through parasitic suppressor R324. Resistor R301 and bypass capacitor C236 isolates the i-f signal from the avc bus. Resistor R302 and capacitor C319 form the cathode bias network for V301. Series resistors R304, R305, and R303 form a voltage divider to provide proper plate and screen grid voltages to V301. Resistor R304 is connected to the +125-volt supply, and R303 is grounded by T/R relay K602. (In transmit, T/R relay K602 opens the ground circuit for R303 and raises the screen voltage to V301.) Parallel-tuned tank Z303 is the plate load for V301. Capacitor C308 couples the i-f signal to the next parallel tuned tank, Z304. The avc blocking capacitor, C311, couples the signal to the grid of V302 through parasitic suppressor R307. Resistor R306 connects the control grid of V302 to the avc bus. Capacitor C326 provides isolation of the i-f from the avc bus. Resistor R323, capacitor C323, resistor R308, and capacitor C322 form the cathode circuit of V302. A portion of the cathode signal is tapped off at the top of R308 and coupled to the function meter M701. This signal may be monitored in the signal position of the meter selector switch and will give an indication of the level of the received signal. Resistors R309, R325, and R326 form a voltage divider between +125 volts and ground to provide the proper plate and screen grid potentials for V302. Capacitor C347 is the screen bypass capacitor. Capacitor C324 and capacitor C328 provide filtering to isolate the i-f from the power supply. The plate load of V302 is parallel-tuned tank Z305. This tank is tuned to 20 to 29.9 mc, and the output signal of V302 is coupled through C314, Z306, and C316 to the control grid of the second receive mixer V303. Parallel-tuned circuits Z301, Z302, Z303, Z304, Z305, and Z306 are permeability tuned by the 100-position shaft of the frequency selector system. Trimmer capacitors C302, C304, C306, C309, C312, and C317 are adjusted to set the L/C ratio for proper tracking.

The cathode of V303 is supplied a frequency in the 17- to 26-mc range from the second crystal oscillator V305. The 17- to 26-mc oscillator signal mixes with the 20- to 29.9-mc signal to produce a difference frequency in the range of 3.0 to 3.9 mc. This i-f signal is coupled to the second i-f amplifier through J401. The plate of V303 receives +125 volts through K602, R401, Z401, P304, and L312.

V305 is a cathode-coupled, crystal-controlled oscillator. Crystal switches S301 and S302 select the proper crystal according to the setting of the frequency selector. V205A is a grounded-grid amplifier working into a parallel tuned tank, Z307, which constitutes its plate load. The tank is ganged with the crystal switches and driven by the 10-position 1.0-mc shaft of the frequency selector system. Capacitor C343 couples the output from the plate

(pin 6) of grounded-grid amplifier V405A to the control grid (pin 3) of cathode follower V305B. The crystal couples the output from the cathode (pin 2) of the cathode follower to the cathode (pin 8) of the grounded-grid amplifier. The crystals operate at series resonance providing low-impedance coupling with zero phase shift. The phase shift through the amplifier is also zero; thus, an in-phase voltage is fed back to the grounded-grid amplifier, and conditions for sustained oscillation are satisfied. Inductor L311 resonates with a crystal socket capacitance and prevents it from affecting the operation of the circuit. Resistors R321 and R322 provide the coupling impedances at the cathode and bias for the two sections of the tube. Test point J305 provides for measuring the d-c bias developed across R320. Resistor R318 isolates J305 from the control grid of the cathode follower and prevents loading of the grid circuit by test instruments. The plate, pin 4 of the cathode follower, receives voltage from the +125-volt supply through R315. Capacitor C330 isolates the oscillator signal from the power supply. The plate, pin 6 of grounded-grid amplifier V305A, receives voltage from the +125-volt supply through R313 and Z307. Capacitor C329 is a fine filter for the power supply. The output of the oscillator is taken from the cathode of the cathode follower and fed to the cathode of the second receive mixer, V303, through C325.

The 3.0- to 3.9-mc i-f signal from V303 is coupled to parallel resonant tank Z401 through J401. This tank circuit is the plate load for V303 in the first i-f amplifier. The signal is coupled through two more parallel resonant tank circuits, Z402 and Z403, by C403 and C407. The signal is then coupled to the cathode of the third receive mixer, V401A, through C411. The three parallel resonant tank circuits, Z401, Z402, and Z403, form a 3.0- to 3.9-mc band-pass filter. The 10-position, 0.1-mc shaft of the frequency selector turns this filter by positioning powdered iron cores in the main tuning coils, L401, L403, and L405. Trimmer coils L402, L404, and L406 are adjustable for proper tracking.

Oscillator V401B injects the proper frequency to V401A. The oscillator is controlled by crystals Y401 through Y410 inclusive. T/R relay K401 connects crystal selector switch S401 to the control grid of V401B. Switch S401 is driven by the 10-position, 0.1-mc shaft of the frequency selector system and selects the proper crystal to provide a 500-kc (0.5 mc) difference between the oscillator frequency and the 3.0- to 3.9-mc i-f. When the 0.1-mc frequency selector is set to a frequency in the 0.0- to 0.4-mc range, the oscillator frequency is in the 3.5- to 3.9-mc range, and the i-f is in the 3.0- to 3.4-mc range. When the 0.1-mc frequency selector is set to a frequency in the 0.5- to 0.9-mc range, the oscillator frequency is in the 3.0- to 3.4-mc range, and the i-f is in the 3.5- to 3.9-mc range. A tuned circuit consisting of the selected crystal, C412, and C413 (plus the grid-to-ground capacitance and the cathode-to-ground capacitance of V401B) forms a Colpitts-type oscillator with the crystal acting like an inductance. The values of these capacitors are such that oscillation is maintained at the fundamental frequency of the crystal. Cathode resistor R404 provides additional bias to protect V401B is case oscillation stops. Inductor L407 isolates bias resistor R404 from the oscillator circuit and prevents loading of the crystal which might stop oscillation. Oscillator V401B receives plate voltage from the +125-volt supply through R407 and filter FL404. Test point J404 provides for measurement of the voltage developed across R403. Resistor R402 isolates J404 from the crystal circuit. C417 couples the signal from the cathode of V401B to the control grid of V401A. The i-f and oscillator signals are mixed in V401A to the control grid of V401A. The i-f and oscillator signals are mixed in V401A producing a difference frequency of 500 kc which is coupled to a 500-kc filter through C410 and J403. V401A receives plate voltage from the voltage divider, R410 and R409, through R408. Resistor R405 provides cathode bias and the coupling impedance for the injection signal from the 3.0- to 3.9-mc band-pass filter. Test point J402 provides for measurement of the injection signal. The 500-kc signal from the second i-f amplifier passes first through FL901; a 500-kc filter consisting of nine parallel resonant circuits in cascade, capacitively coupled. The signal is coupled through the filter and P502 to the control grid of the first 500-kc amplifier V501. Resistor R501 connects the control grid of V501 to the i-f avc bus. Screen bypass capacitor

C504 provides a low-impedance path from the screen grid to the cathode. The plate of V501 receives voltage through L501 and R504 from the +125-volt supply. Capacitor C502 couples the 500-kc i-f signal to the control grid of the second amplifier, V502, which provides a second stage of amplification identical to the first. The control grid of the third amplifier, V503, is connected to ground through grid leak resistor R509. The cathode circuit is practically identical to that of V501 and V502. V503 receives plate voltage through R512 and the primary of i-f output transformer T501 from the +125-volt supply. The output of V503 is coupled through transformer T501 to the detector and noise limiter. The audio signal is coupled from series noise limiter CR503 to the grid of first audio amplifier V504 by C522, C530, and R514. The plate of V504 receives voltage from the +125-volt supply through plate load resistor R527. The amplified audio signal is coupled to the audio amplifier and modulator assembly through C517.

Test point J503 and J505 provide a means of injecting a signal for trouble shooting. Test point J504 allows measurement of the i-f avc voltage developed in the detector circuit. Test point J508 provides for measuring the detected signal voltage and the voltage applied to the grid of broadband cathode follower V802 and the audio amplifier and modulator assembly. For discussion of the audio detection and noise-limiting circuit, refer to the simplified schematic in figure 7-1. The main signal path is shown by the heavy black line.

The 500-kc signal is coupled from the plate of V503 to detector CR501 by transformer T501. CR501 demodulates the 500-kc i-f signal and produces an audio-frequency signal across load resistors R518, R517, and R516. The normal audio signal is coupled from the junction of R517 and R518 to the control grid of amplifier V504 through R538, CR503, C522, R514, and C530. The signal is amplified by V504 and coupled through C517 through the normal receive control, R819, in the audio amplifier and modulator assembly. C520 and C521 filter the r-f components from the demodulated signal.

The audio signal for broadband equipment is coupled from T501, pin 2, through R515 to broadband cathode follower V802 in the audio amplifier and modulator assembly.

Series noise limiter CR503 clips audio peaks exceeding 60-percent modulation. The series noise limiter does not affect that part of the signal produced by modulation troughs. The cathode of diode CR503 is connected to the negative end of the detector load through resistors R519 and R520. Resistor R519, in conjunction with C523, filters the audio signal and produces at the junction of resistors R519 and R520, a negative d-c voltage proportional to the voltage at the negative end of the detector load, R516. The peak audio signal voltage at the anode of diode CR503 is approximately 90 percent of the average or d-c voltage at the negative end of the detector load. Thus, at modulation percentages up to approximately 60 percent, the cathode of diode CR503 is negative with respect to its anode, and the audio signal is reproduced faithfully across series limiter load resistor R520. When the modulation peaks exceed a value representing 60-percent modulation, the anode of CR503 goes negative with respect to its cathode, and the diode stops conducting. Thus, the part of the signal representing more than 60-percent modulation is clipped off. Resistor R538 and capacitor C521 form a low-pass RC filter which filters out the 500-kc carrier from the signal applied to the noise limiter anode. Approximately 4.5 volts, a positive bias, is supplied to the cathode of detector CR501 on receive. This voltage is obtained from a voltage divider consisting of R813, R814, and R816. The voltage at the negative end of the detector load is the algebraic sum of the positive bias and the negative voltage approximately equal to the average rms voltage of the i-f signal. This delays the development of the avc voltage until the signal reaches an amplitude sufficient to overcome the bias. I-f avc gate CR504 isolates the i-f avc line from the positive bias voltage. Resistor R531 is the load for the i-f avc gate. Resistors R529 and R530, in conjunction with capacitors C514 and C515, filter the audio signal from the i-f avc line. A bias voltage is applied to the i-f avc line through R531 by a voltage divider consisting of R715 in series with R716 and squelch control R702. On local

operation the bias level is adjusted by squelch R702. On remote operation, S705C connects a remote squelch control. The r-f avc gate, CR505, serves the same purpose as CR504 but is connected to a less negative point on the detector load. Thus the signal amplitude must be higher in order to overcome the delayed bias. This results in more delay for the r-f avc and improves the sensitivity of the set. Resistor R533 is a load resistor for CR505, and resistor R537, in conjunction with C526, filters the audio signal from the r-f avc line.

The audio signal from the series noise limiter, CR503, is coupled to the grid of the first audio amplifier V504 through C522, C530, and R514. Resistor R526 provides cathode bias for V504 and is bypassed by C529. V504 receives its screen-grid voltage from the +125-volt line through screen-grid voltage dropping resistor R528. Capacitor C516 grounds the screen grid to audio frequencies. The plate of V504 receives voltage from the +125-volt line through load resistor R527. The amplified audio signal from the plate of V504 is routed through C517 to the normal receive control, R819, in the audio amplifier and modulator assembly. The signal then passes through contacts 12 and 5 of the squelch relay K801, contacts 15 and 16 of T/R relay K802, and contacts 5 and 3 of broadband relay K803 to R826. The signal developed across R826 is coupled to the control grid of V803 through C809, C817, and R847. The plate voltage for V803 is obtained from the +125-volt supply through plate load resistor R830. Screen-grid voltage is obtained from the voltage divider consisting of R829 and R828 between the +125-volt supply and ground. C813 is a screen bypass capacitor. The audio output signal from the plate of V803 is coupled to the control grid of audio driver V804 through C814, C818, and parasitic suppressors R855 and R856. Potentiometer R831 adjusts the audio input level to V804 during normal operation. Audio driver V804 is a parallel-operated dual triode. The cathode bias for both sections is obtained from R832 which is bypassed by C815. The plate voltage for V804 is obtained from the +275-volt supply through the primary of phase-splitting transformer T801. The 180-degree phase difference between pins 1 and 2 of T801 provides the necessary phase splitting to drive the push-pull parallel output amplifier. A fixed bias of -11 volts is applied to the control grid of the output amplifier through the transformer center tap. Screen-grid voltage for the output amplifier is supplied from the +125-volt supply. On receive, plate voltage for the output amplifier is supplied from the +275-volt supply through the primary of T802. The receive audio outputs are obtained from the tapped secondary winding, pins 7, 8, and 9, of T802. The normal receive audio output is obtained from pin 7 of T802 and is coupled through contacts 9 and 10 of transmit receive relay K802 to the impedance-matching network consisting of R3, R705, R717, and the impedance of the headset. This impedance-matching network provides a fairly constant load of approximately 600 ohms for the audio output amplifier. The remote audio output is taken from the top of R717 and coupled to the remote monitoring stations.

The squelch amplifying circuit, shown in figure 7-2, receives control voltage from the signal plus noise-to-noise discriminator in the normal operating mode through R805 and S702B; in retransmit mode and during normal broadband, a carrier squelch signal is supplied from the negative end of the detector (R516) through R515, R541, and S702B. A voltage divider consisting of resistors R808, R807, and R806 provides operating voltages for V801A and V801B. The cathode of V801B is connected to the junction of resistors R807 and R808. Thus, the cathode of C801B is at a much higher positive potential than the cathode of V801A. The control grid of V801B and the plate of V801A are connected to the cathode of V801B through R809. The plate of V801B is connected to the +275-volt supply through the coil of squelch relay K801. When no signal is being received, there is a positive bias on the control grid of V801A. This bias is a result of the delay bias on the detector load or the reference bias on the sensing circuit (depending upon which squelch circuit is being used). V801A conducts drawing current through R809 which causes the control grid of V801B to go negative bias on its control grid. Relay K801 is de-energized, and the audio line from first audio amplifier V504 to audio amplifier V803 is open. When a signal is received, the negative voltage developed by the carrier across the detector load (carrier squelch) or the negative voltage developed in the sensing circuit (signal-plus-noise to noise squelch) biases the V801A to cutoff. No current through R809 results in no voltage drop across R809, and the grid of

V801B approaches the same potential as the cathode; V801B conducts and squelch relay K801 energizes. This closes the circuit from first audio amplifier V504 to audio amplifier V504 and to audio amplifier V803. The signal-plus-noise to noise squelch is put into operation automatically in normal mode when the grid, pin 3 of V801A, is connected to the slider of potentiometer R804. The voltage divider consisting of R816 and R814 provides a positive bias of approximately 2 volts d-c on receive. This 2 volts is supplied to the junction of crystal rectifiers CR801 and CR802. This positive bias also is felt across R804, and the setting of R804 provides the necessary bias to keep V801A conducting and V801B cut off with no signal in. A low-pass filter consisting of resistor R802 and capacitor C803 passes the audio to capacitor C804 which couples the audio to crystal rectifier CR801. CR801 rectifies the voltage and develops a negative voltage at CR801 and of R804. A high-pass filter consisting of capacitor C802 and resistor R803 passes the high-frequency noise to crystal rectifier CR802. CR802 rectifies the noise and develops a positive voltage at the CR802 end of R804. Thus, the voltage distribution across R804 is dependent upon the ratio of the amplitude of the audio signal to the amplitude of the noise (signal-plus-noise to noise ratio). The signal-plus-noise to noise ratio that will cut off V801A and energize the squelch relay is determined by the setting of R804. When the signal plus noise is of sufficient level to cause the potential at the wiper arm of R804 to change the conducting state of V801A and V801B, squelch relay K801 is energized. When K801 is energized, C808 is connected across the output of the signal-plus-noise to noise sensing circuit through R805. This switching of C808 provides a fast attack and slow release and the squelch operation. When C808 is not in the circuit, it is precharged to approximately 1.4 volts by a voltage divider consisting of R812 and R815. Precharging prevents C808 from disturbing the squelch circuit when it is switched in by K801.

When the squelch relay operates, the 12 and 5 contacts connect the output of V504 to audio amplifier V803 through relays K802 and K803. The 8 and 14 contacts switch C808 into the circuit. C808, as previously mentioned, provides fast attack, slow release, squelch operation. Contacts 11 and 3 provide a ground for squelch indicator lamp DS703.

When S703, the SQUELCH DISABLE-PUSH switch is depressed, current flows from the -26.5-volt dimmed supply through DS703, S704, S705, and squelch relay to +275-volt supply. This energizes the squelch relay, and contacts 11 and 3 provide a ground through S704 and S705C keeping the relay energized for the duration of time that the pushbutton is depressed. The 11 and 3 contacts of K801 also provide a ground to DS703 energizing the lamp and indicating that the squelch circuitry has been disabled. When SQUELCH DISABLE-PUSH switch S703 is closed, it bypasses S704 and holds the squelch circuits in the disabled condition. During remote operation, S705C is switched and connects the remote squelch disabling circuits in place of the local circuits.

2. Normal Transmit.

Closing either the local or remote push-to-talk switch energizes the transmit-receive relays and places the AN/URC-9 into the transmit condition. Note in figure 7-3 that closing of the local push-to-talk switch provides a ground through the contacts of 5 and 8 of S702B and work relay K1 to transmit receive control K601. Closing the remote PUSH-TO-TALK switch energizes K207 in Radio Set Control C-3866/SRC. The 2 and 3 contacts of K207 connect a ground through S505 in the AM-1565/URC (in the AN/SRC-20) or directly (in the AN/SRC-21) to pin 5 of S702B. This ground is routed through switch S702B and through the closed contacts of the work relay K1, providing a ground to K601 and energizing it. As shown in figure 7-4, when K601 is energized, 26.5 volts is connected through the 8 and 3 contacts to energize K802, K401, K2, K102, K101, and K602 in the AN/URC-9.

It should be noted that during frequency selection, the 3 and 4 contacts of K1204 in the frequency selector assembly connect negative 26.5 volts to K1, energizing K1 and preventing the system from being placed in a transmit condition while frequency selection is being

accomplished. When the frequency selection is complete, K1204 and K1 de-energize and allow the system to be placed in the transmit condition. It should also be noted that when S505 is in the local position, S506 can be used to key the transmitter for tuning and adjustment.

As shown in figure 7-5, the local or remote audio signal is routed through the 1 and 4 contacts of S702A, T601, R605, the 9 and 12 contacts of S702B, the 17 and 16 contacts of K802, and the 5 and 3 contacts of K803 and coupled through C809 to the control grid of V803. The audio amplifier driver and modulator stages operate the same as on receive, except that the plate voltage for the driver and modulator stages are obtained from the +325-volt supply instead of the +275-volt supply (see figure 7-13). Modulator cathode resistor R834, in conjunction with function meter M701, provides an indication of the percent of modulation. Modulation B+ voltages for the r-f driver and r-f power amplifier are obtained from the primary of modulation transformer T802. An audio modulated +325 volts is obtained from pin 2 of T802 and coupled to the plate of r-f driver V105 through high-voltage relay K2 and R606. Audio modulation for the screen of r-f power amplifier V106 is obtained by coupling an audio signal from pin 3 of T802 to the screen supply voltage through K802 and C601. The modulated plate voltage for r-f power amplifier V106 is obtained from pin 1 of modulation transformer T802. This voltage is coupled through meter shunt R706 to the plate circuit of V106.

On transmit, relay K401 transfers the control grid circuit of oscillator V401B from crystal switch S401 to S402, thus selecting crystals Y401 through Y410 in order of frequency so that the oscillator operates on a straight 3.0- to 3.9-mc frequency instead of a frequency 500 kc removed from the incoming i-f signal as on receive. Relay K401 also disconnects R409 from R410 and raises the plate voltage to cathode follower buffer amplifier V401A. Capacitor C411 couples the signal from the cathode of V401A to the first tank circuit of band-pass filter Z403. On transmit, T/R relay K602 disconnects B+ from second receive mixer V303 and connects it to first transmit mixer V304. The 3.0- to 3.9-mc signal generated in the second i-f amplifier is coupled to the control grid of V304 through T304, L312, and C339. Test point J304 provides a means of measuring the 3.0- to 3.9-mc injection signal. Resistor R317 provides bias for V304 and coupling impedance for the 17- to 26-mc signal from the second oscillator V305. The oscillator signal is coupled to the cathode of V304 (from Z307) through the capacitive voltage divider consisting of C338 and C337. The 17- to 26-mc signal from the oscillator mixes with the 3.0- to 3.9-mc signal producing a sum frequency in the range of 20 to 29.9 mc. This sum signal is developed across R314 and L309, the plate load of V304, and coupled to the control grid of V301 through C335, L317, L316, C305, and R324. V301 and V302 operate similar to receive except that T/R relay K802 grounds the avc bus, and K602 removes the ground from R303 raising the screen-grid voltage to V301. After the two stages of i-f amplification, C315 couples the amplified signal through plug P302 to the plate of second transmit mixer V101 in the r-f and power amplifier assembly. Test point J302 provides for measuring the bias developed by drive to V302. A signal from the frequency multiplier oscillator in the range of 200 to 370 mc is applied to the cathode of the V101. A 20- to 29.9-mc signal from the first i-f amplifier feeds into the plate circuit of V101 through J101. Plate voltage for V101 is from the +125-volt supply through R115, L103, and L102. L102 presents a low impedance to the injection frequency from the first i-f amplifier and a high impedance to the mixer output frequency. Wire wound resistor R103 provides cathode bias for V101 and acts as an r-f coupling choke to the injection frequency from the frequency multiplier oscillator. The 200- to 370-mc signal and the 20- to 29.9-mc signal mix in V101 producing a sum frequency in the 225- to 399.9-mc range. This sum frequency is developed in the plate circuit of V101 and C105 couples it to parallel tuned tank Z101. Capacitor C110 couples the r-f signal to the cathode of first r-f amplifier V102. V102 and V103 provide two stages of r-f amplification, the same as in the receive operation, except that K102 grounds the r-f avc line.

After amplification, the 225- to 399.9-mc signal passes to the cathode of transmit r-f amplifier V104. Plate voltage for V104 is from the +125-volt supply through K602 and L109 and L113. Coil L113, in conjunction with capacitor C134, isolates r-f signals from the +125-volt supply. Capacitor C126 couples the r-f signal from the plate of V104 to parallel tuned tank Z106. Capacitor C139 couples the r-f signal to the cathode of transmit driver V105. J102 is disconnected from the output of V104 and grounded by K102 during transmit condition. Driver V105 receives the audio-modulated plate voltage from the plates of V805, V806, V807, and V808 through K2, R606, R121, L119, and Z107. Resistor R121 is a meter shunt for metering driver V105 plate current. The r-f plate load for V105 is a parallel-tuned circuit consisting of Z107, C145, and C141. Capacitor C128 couples the r-f signal to the grid of V106. The grid leak voltage developed across R109 is applied to the metering circuit to indicate power amplifier grid current. Fixed protective bias is applied to the grid of V106 through L114, R108, and R109. Resistor R108 is variable and provides a means of adjusting the plate current of V106. The screen-grid voltage for V106 is obtained from a variable bleeder circuit, consisting of R601, R602, and R603, connected between the +125- and +325-volt supplies. K602 connects these supplies to the circuit. Audio coupled from a tap on T802 is applied to the screen grid of V106 through K802, and C601 provides a maximum of approximately 80-percent modulation. V106 receives +325 volts of modulated plate voltage from T802 via an insulated wire passing through the inner conductor of the coaxial cavity Z108. The plate tank, a tuned circuit, consists of a coaxial cavity, and integral tuning capacitor ganged with the r-f amplifier tank is tuned by the 1750-position shaft of the frequency selector. Capacitor C131 couples r-f energy from the plate of V106 to the inner conductor of the cavity. Trimmer C132 sets the minimum capacity point. Inductor L111 couples the r-f energy through low-pass filter Z1101 and antenna relay K101 through the directional coupler to either the AM-1565/URC or the antenna. L111 is adjusted for optimum coupling and locked.

Test point J104 allows measuring of the developed grid bias due to uhf injection to V101; test point J105 allows measuring bias developed by the r-f drive to V103. Test point J110 allows measuring r-f signal voltage on the cathode of V103. (J110 is used only for preliminary adjustment of C107 and C115.) Test point J106 provides for measuring developed grid bias due to drive to V104. Test point J114 provides for measuring developed grid leak bias due to drive to V105, and test point J111 provides for measuring grid bias of V106.

3. Retransmit. (Refer to figures 7-6, 7-7, 7-8, and 7-9.)

During retransmit mode, all circuitry with the exception of squelch circuitry and the transmit-receive control circuits operate as in normal. When the MODE switch is placed in the RETRANS position, the following changes occur. (See figure 7-6.)

a. S702 disconnects the signal from the wiper arm of R804 (signal-plus-noise to noise discriminator output) and connects the negative end of the detector load to the grid of V801A through R515, R541, and contacts 2 and 4 of S702B.

b. S702B disconnects the T/R control line from transmit-receive control relay K601 and connects K601 to the retransmit key-in line.

c. S702B disconnects the signal from the audio transformer and routes the retransmit audio in to the grid of V803 through the 10 and 12 contacts of S702B, the 17 and 16 contacts of K802, and the 5 and 3 contacts of K803.

d. S702A connects the local and remote mikes to the primary of T601 during duplex operation through contacts 5 and 4 of K603.

e. S702A, contacts 6 and 8, connects the T/R control line to duplex relay K603. When the push-to-talk switch is closed, the duplex relay energizes and keys both sets to the transmit condition, and the 5 and 8 contacts of K603 connects the secondary of T601 to the grid of V803 through the 10 and 12 contacts of S702B.

As discussed previously, during retransmit mode, two systems are interconnected (figure 7-7) to provide automatic retransmission facilities. Operation of all receiving and transmitting circuits are the same as in normal mode, with exception of those changes mentioned previously and shown in figure 7-6. A description of circuit operation during retransmit follows (figure 7-13).

The received signal is routed through the directional coupler and antenna relay to V102 just as in normal. The operation of the remaining r-f and i-f circuitry up to the output of the 500-kc i-f amplifier is identical to normal operation. At the output of T501, a signal from the negative end of the audio detector is routed through R515, R541, and pins 2 and 4 of S702B to the grid of V801A. This negative signal (carrier) causes V801A to cut off and V801B to conduct. Conduction of V801B causes squelch relay K801 to energize. When K801 is energized, the 6 and 13 contacts provide the retransmit key out to the companion set, causing that set to convert to the transmit condition.

The audio output of V504 is coupled through C517 to R819, the NR receiver control. The signal tapped off at the wiper arm of R819 is routed through the 5 and 12 contacts of K801, the 15 and 16 contacts of K802, and the 3 and 5 contacts of K803 to the grid of V803. The operation of the audio amplifier and modulator assembly is identical to normal. The retransmit audio output (figure 7-8 and 7-9) is obtained from pin 8 of T802 and coupled through retransmit level control R608 and contacts 12 and 13 of K802 to the retransmit audio output line. (The output from pin 7 of T802 is routed through contacts 9 and 10 of K602 to the local and remote headsets.) The retransmit audio output signal is routed to the companion set to be transmitted. As previously covered, the companion set has been placed in the transmit condition by the retransmit key out from contacts 6 and 13 of K801.

When the companion set receives a signal, it routes a key pulse to pin f of P1 on the AN/URC-9. The key pulse is passed through contacts 6 and 8 of S702B and the normally closed contacts of work relay K1 to transmit-receive control relay K601. The energizing of K601 places the system in the transmit condition.

The retransmit audio from the companion set enters the AN/URC-9 at pin d of P1 (figure 7-13) and is routed through the 10 and 12 contacts of the S702B, the 17 and 16 contacts of K802, and the 5 and 3 contacts of K803 to the control grid of V803. The audio, carrier generation, and transmitting circuits operate identical to normal mode.

When the push-to-talk switch (figure 7-8) on either set is closed, both sets are keyed to transmit, and the audio input from the microphone is transmitted simultaneously by both sets. The key (ground) signal from the push-to-talk switch is routed through the 8 and 6 contacts of S702A to pin 9 of duplex relay K603. When K603 energizes, 1 and 2 contacts provide a retransmit key out; 10 and 11 contacts energize K601 through S702B, contacts 6 and 8, and the work relay; contacts 4 and 5 route the audio signal from T601 to the grid of V803 via contacts 10 and 12 of S702B, contacts 17 and 16 of K802, and contacts 5 and 3 of K802; and contacts 13 and 14 route the audio signal from T602 to the companion set.

4. Tone Operation. (Refer to figures 7-10 and 7-11.)

In the tone mode of operation, when the push-to-talk button is closed, the 5 and 4 contacts of K802 place a ground on the collector of tone oscillator Q701, and the 4 and 3 contacts of S702A place -11 volts on the emitter via the primary of T602. The 1000-cps oscillations are

coupled across T602, and from the secondary, they are routed via the 11 and 12 contacts of S702B, the 15 and 16 contacts of K802, and the 5 and 3 contacts of K803 to the control grid of V803. The output of V803 is transmitted just as in normal.

Receive operation in the TONE mode is the same as NORMAL receive.

5. Broadband Operation. (Refer to figure 7-12.)

The broadband function, as previously discussed, allows operation of the AN/URC-9 with a system requiring broad bandwidth capabilities.

When the BROADBAND switch is in the BROADBAND position, a ground is removed from pin 7 of K803, causing it to de-energize. When K803 de-energizes (figure 7-12), contacts 1 and 3 connect the broadband receiver to the control grid of V803 via contacts 9 and 10 of K802 and R848 and R849; contacts 6 and 8 connect the output of the broadband sidetone amplifier to the headset via R609, contacts 10 and 11 of K602, and R717 during transmit.

The received broadband signal is routed through the r-f and i-f receive circuits just as in normal operation. However, at the output of the 500-kc i-f amplifier, the signal is routed from the negative end of the detector via R515 to the broadband cathode follower. The output of the cathode follower is routed to the broadband equipment for decoding. After the signal is decoded, it is routed back to the AN/URC-9 and routed through contacts 9 and 10 of K802 and contacts 1 and 3 of K803 to the control grid of V803. Operation beyond V803 is the same as normal receive.

The transmit broadband signal may be generated at either the local and remote microphones of the AN/SRC-20 or AN/SRC-21 or at the broadband equipment. The signal from the local/remote microphone is routed through S702A contacts 1 and 4, T601, R605, S702B contacts 9 and 12, and pin j of P1 to the broadband equipment. The coded signal from the broadband equipment is routed back to the AN/URC-9 through pin k of P1 and through R851, R852, K802, and K803 to the audio amplifier and modulator assembly. The rest of the system operates identical to normal transmit.

D. SUMMARY:

The AN/URC-9 utilizes many circuits for dual purposes, both transmit and receive. The basic differences of the circuits for transmit and receive operation are the inputs and outputs, the frequency-conversion scheme, and the relay control circuits. The three operating modes make use of the same circuitry and differ primarily in the types of audio input and output signals and the methods of controlling the transmit-receive control circuits.

INFORMATION SHEET 8

CIRCUIT ANALYSIS FOR AN/URC-9 FREQUENCY SELECTOR

A. INTRODUCTION:

The following is a detailed description of the frequency selector. The frequency selector is a precision electromechanical device which is used for tuning various oscillators and amplifiers in the radio set. Read this section carefully so that you will have a thorough understanding of automatic frequency selection.

B. REFERENCES:

NAVSHIPS 94695A, Technical Manual for Radio Sets AN/SRC-20 and AN/SRC-21, Section 4, Pages 4-19 through 4-58.

C. INFORMATION:

1. Frequency Selector AN/URC-9.

The frequency selector subassembly provides automatic channel selection on 19 preset channels which may be selected from either the front panel or the remote control unit. Information is transferred electrically from the CHAN SEL switch to the frequency selector subassembly where it is converted to mechanical tuning information for tuning the various oscillators and amplifiers in the radio set. Five accurately positioned tuning shafts, driven by the frequency selector, automatically tune the set to the desired frequency. This process requires from one to five seconds, the exact time depending upon the sequence of frequency selection.

Refer to figure 8-1. For local preset channel selection, placing CHAN SEL switch S705 to the desired preset channel completes the circuit to the control relay K1204. K1204 energizes by means of the completed ground circuit through seeking switch S1205 and CHAN SEL switch S705. Relay K1204 performs the following functions: removes the 26.5-volt d-c supply from the other three positioner relays K1201, K1202, K1203 disabling these systems; applies 26.5-volts d-c to the tuning motor which causes it to run; and lifts the pawl from the detent wheel which allows the motor to drive the indicator and detent wheel, the preset channel memory drum, and the preset channel seeking switch, S1205. (As soon as the rotor of S1205 finds the one position that opens the ground circuit to K1204, relay K1204 de-energizes dropping the pawl into the detent wheel to position the memory drum accurately.) The K1204 contact returns to its normal position closing the circuit to the remaining three positioner relays.

NOTE

All positioning assemblies consisting of relay, detent wheel, and pawl are adjusted to prevent opening of the contact supplying power to the motor unless the pawl is in the notch in the detent wheel. The tuning motor drives the four positioner systems through slip clutches which permit the motor to run, when any or all of the positioners systems are at rest, without damaging the gear train.

When the CHAN SEL switch S705 is in the REMOTE PRESET position, the remote preset channel seeking switch S1206 replaces S1205 in the seeking circuit, and the CHAN SEL switch

in the remote control unit replaces CHAN SEL switch S705 on the front panel. Except for these substitutions, remote preset channel selection is the same as local preset channel selection.

2. Automatic Frequency Selection.

The 19 channel frequencies are preset on a direct reading memory drum accessible through the door in the front panel. Four pins must be positioned for each preset channel; reference numbers adjacent to the pin tracks indicate the preset channel; reference numbers adjacent to the pin tracks indicate the preset channel frequency. When the preset channel memory drum has been positioned, the four pins representing the selected preset channel frequency operate contacts on switch S1210. The left pin opens one of the two normally closed contacts of switch S1210A. The open contact represents the hundreds megacycle digit (2XX.X mc or 3XX.X mc) of the preset channel frequency. The left-center pin opens one of the ten normally closed contacts of switch S1210B. The open contact represents the tens megacycle digit (X0X.X mc, X1X.X, X2X.X, etc.) of the preset channel frequency. The right-center pin closes one of the ten normally open contacts of switch S1210C. The closed contact represents the units megacycle digit (XX0.X mc, XX1.X mc, XX2.X mc, etc.) of the preset channel frequency. The right pin closes one of ten normally open contacts of switch S1210D. The closed contact represents the tenths megacycle digit (XXX.0 mc, XXX.1 mc, XXX.2 mc, etc.) of the preset channel frequency.

Refer to figure 8-2. Assume that preset channel 19 is selected, that the preset channel selection cycle is completed, and that the preset channel 19 frequency is 399.9 mc. The left pin, representing the hundreds digit 3, removes the ground from terminal 7 on blanking switch S1202. Relay K1201 energizes due to the closed ground circuit through the closed contact of S1201 and terminal 2 on switch S1202. This applies power to the tuning motor and lifts the pawl from the 10-mc detent wheel. The tuning motor drives the 10-mc indicator; detent wheel; S1201; S1202; and the 18-position, 10-mc shaft. The left-center pin, representing tens digit 9, removes the ground from the positions designated 39 and 29 (these positions are in parallel) on S1201. Since the first and second digits of the assigned frequency are 3 and 9, the seeking system must find 39 and not 29. Switch S1202 rear prevents the system from stopping on 29; therefore, it can stop only on 39. Switch S1202 is driven through a gear reduction of 2-to-1, and the front section blanks out 180 degrees of rotation. This blanks out alternate cycles of seeking switch S1201 and is necessary because the uhf tuners tune only over 180 degrees.

Concurrently, the right-center pin, representing units digit 9, closes the contact on S1210 corresponding to terminal 9 of seeking switch S1203. This closes the ground circuit from the coil on relay K1202. Relay K1202 energizes closing the 26.5-volt d-c circuit to the tuning motor and releasing the 1.0-mc indicator and detent wheel. This permits S1203 and the 10-position, 1.0-mc tuning shaft to rotate. Switch S1203 rotates until the one open position on its front rotor finds the grounded contact. This opens the ground circuit to K1202, and the relay de-energizes, stopping the 1.0-mc detent wheel and the functions coupled to it. Relay K1201 is energized whenever S1203 rear goes through position B. Thus the 10-mc Autopositioner is recycled to prevent error in the 10 plus 1.0-mc differential which might be introduced when the differential cam follower goes over the high point of the cam as the 1.0-mc positioner goes from 0 to 9.

The operation of the 0.1-mc selector is the same as that of the 1.0-mc positioner. As S1204 rear rotates through position A, the 1.0-mc tuning system will recycle to the same frequency position and eliminate the possibility of error in the 1.0 plus 0.1-mc differential output. The differential cam follower (going over the high point on the cam as the 0.1-mc positioner passes from 0.0 to 0.9) introduces this possible error.

3. Manual Frequency Selection.

Refer to figure 8-3. When CHAN SEL switch S705 is in the MANUAL position, the channel memory drum rotates to the M position. In this position, a nylon bar opens all contacts on switches S1210A and S1210B (S1210C and S1210D are normally open). Switch S705A is operated by a cam to connect S706 in place of S1210A and S1210B. Switches S706, S707, and S708 now take the place of the memory drum switch S1210. Frequency selection is accomplished by setting switches S706, S707, and S708 to the digits of the desired frequency. The frequency selector subassembly operates as for automatic frequency selection, except that switches S706, S707, and S708 instead of S1210 control the operation. The Autopositioners in the frequency selector always rotate in the same direction, from a high-frequency position to a lower frequency position. The channel selector Autopositioner always rotates from a low channel number to a higher channel number. For this reason, tuning from a low frequency to a higher frequency takes longer than tuning in the opposite direction. Also, tuning from a high-numbered channel takes longer than when tuning in the opposite manner.

D. SUMMARY:

1. The frequency selector is an electromechanical device which provides automatic channel selection on 19 preset channels. Selection is accomplished from either the front panel or the remote units.

2. During manual operations, any one of 1750 channels can be selected.

3. While a channel is in the process of being chosen, five positioner shafts tune various oscillators and amplifiers in the radio set.

INFORMATION SHEET 9

CIRCUIT ANALYSIS FOR RADIO SET CONTROL C-3866/SRC

A. INTRODUCTION:

The following information describes how dial pulses are converted to the five-wire binary code which is used for channel selection. Primary power circuits which distribute 115 to 230 volts 60 cycles to the AN/URC-9 and AM-1565/URC also are discussed.

B. REFERENCES:

NAVSHIPS 94695A, Technical Manual for Radio Set AN/SRC-20 and Radio Set AN/SRC-21, Section 4, Pages 4-61 through 4-72.

C. INFORMATION:

1. Radio Set Control C-3866/SRC.

This unit provides all necessary control functions for local and remote control of Radio Set AN/SRC-20 or AN/SRC-21.

Refer to the functional block diagram shown in figure 9-1. The C-3866/SRC contains a pushbutton start-stop circuit which controls primary power delivered to either the AN/SRC-20 or the AN/SRC-21. All primary power is fused. A telephone-type dial is used to select any one of 19 preset channels. Programing relays and a stepping relay are used to generate the five-wire binary code used to deliver channel information to the Autopositioner deivces in the controlled radio set. The stepping relay also provides d-c voltage for positioning a remote channel indicator (synchro).

When the set is controlled from a remote location (by Radio Set Control C-1138/UR), the C-3866/SRC provides matching facilities for the audio lines used during receive and transmit.

2. Circuit Description.

a. Primary Power Circuits.

Refer to figure 9-2. Operation of the EMERGENCY POWER switch S206 will apply primary power to the primaries of T202. With the links on TB202 in the position shown, the primaries are in parallel. This condition is for 115-volt a-c operation. For 230-volt operation, the links would be adjusted so that the primaries are in series.

The secondary output across terminals 5 and 6 of T202 is rectified to supply a -27.5-volt d-c to the channel dialing relay circuits. The secondary output across terminals 7 and 8 of T202 is rectified to supply a 12-volt d-c to Radio Set Control C-1138/UR and T/R relay K207.

b. Refer to figures 9-2 and 9-3.

EMERGENCY POWER indicator DS202 is connected to a secondary winding of transformer T202 and is illuminated when the EMERGENCY POWER switch is on. Fuse F203 protects the primary circuit of start-stop transformer T201. Fuse F206 protects the controlled radio set, and fuse F205 protects Radio Set Control C-3866/SRC. Fuse F204 protects the entire installation.

c. D-C Power Supplies.

Refer to figure 9-2. Two power supplies are operated from the secondary of transformer T202. The first is a full-wave bridge rectifier made up of diodes CR205 through CR208. This power supply delivers unfiltered -27.5-volts d-c to the channel dialing relay circuit. The second supply is another full-wave bridge rectifier made up of diodes CR209 through CR212. This supply provides 12 volts d-c to the remote control stations (Radio Set Control C-1138/UR) through LOCAL-REMOTE switch S201. The output of this 12-volt supply is filtered by a dual-section choke input filter made up of inductors L201 and L202 and capacitors C202 and C203. Both sides of this supply are isolated from ground, but the positive side can be grounded through a link on TB201 if desired.

d. Start-Stop Circuit.

Refer to figures 9-3 and 9-10. When RADIO SET POWER START switch S204 is depressed, power is applied to the primary of transformer T201 through the normally closed contacts of RADIO SET POWER STOP switch S205. Winding 3-4 of T201 applies power to the full-wave bridge rectifier made up of diodes CR201 through CR204. The d-c voltage from this bridge energizes start-stop relay K208. When relay K208 is energized, contacts L3-T3 are closed and maintain power on the primary of T201, keeping the start-stop circuit energized after RADIO SET POWER START switch S204 is released. When start-stop relay K208 is energized, contact pairs L1-T1 and L2-T2 are closed and provide primary power to both units of Radio Set AN/SRC-20 or to the one unit of Radio Set AN/SRC-21. Power also is supplied to the remote control stations through connector J104-N to illuminate the POWER indicators. RADIO SET POWER indicator DS201 is connected to a secondary winding on transformer T201 and is lighted when the start-stop circuit is energized. When RADIO SET POWER STOP switch S205 is depressed, the primary winding of transformer T201 is short circuited, and relay K208 is de-energized. Contacts L3-T3 on relay K208 open and remove primary power from T201. Resistor R227 prevents the RADIO SET POWER STOP pushbutton from shorting the primary power line.

When LOCAL-REMOTE switch S201 is in the REMOTE position, the start-stop pushbuttons of the remote control station may be used to control primary power to Radio Set AN/SRC-20 or Radio Set AN/SRC-21. Operation of these switches is similar to the operation of the local RADIO SET POWER START-STOP switches, S204 and S205.

e. Channel Selecting Circuit.

Selection one of the 19 preset channels requires the use of the telephone-type dial, programing relays, and a stepping relay.

(1) Channel Dialing.

The local channel dialing circuit is made up of the programing relays and stepping relay K206. Refer to the simplified schematic shown in figure 9-4 (sheet 1).

Dial switch S202 contains two sets of contacts connected in series. The off-normal contacts are open when the dial is at rest. They close when the dial is moved from its home, or rest, position. The impulse contacts normally are closed when the dial is at rest and during the time the dial is turned clockwise to the finger stop. When the dial is released and allowed to return home, the impulse contacts are open and close so that one opening and reclosing is accomplished for each number. Impulse contacts are adjusted so that they remain open about 70 percent and closed about 30 percent of a period. Dial speed is adjusted for approximately 10 periods per second.

Refer to figures 9-4 (sheet 2) and 9-5 (sheet 2). As soon as the dial is moved off the finger stop, the off-normal contacts close and remain closed until the dial returns to the home position. The impulse contacts having been closed, remain closed until the dial starts moving counterclockwise away from the finger stop. At this time the impulse contacts will open and close once for each number dialed. Relay K201, which is in series with the impulse (and off-normal) contacts, will have the same trace except when the dial is at rest.

(2) Channel Selection.

To select channels 11 through 19, it is necessary to dial two digits. The first is the letter "A"; the second digit dialed would be the last number of the desired channel. When the letter "A" is dialed, the result is shown on figure 9-5 (sheet 1). The high trace level represents either closed contacts of a switch or an energized relay.

With the dial at rest, all relays are de-energized; the off-normal contacts are open, and the impulse contacts are closed; stepping relay K206 is at the last position dialed. When the operator moves the dial clockwise from the home position, off-normal contacts close; the impulse contacts remain closed; K201 is energized.

When contacts 2 and 3 of impulse relay K201 are closed, slow release relay K203 and reset indicator relay K205 are energized. Because of its built-in slow release time, slow release relay K203 remains energized for 0.2 second after current stops flowing through its coil. Since the dial will re-energize relay K201 once each 0.1 second, relay K203 will energize as soon as the dial is moved, and will remain energized after the dial returns to rest (only when A is dialed).

A ground on K203 contact 6 appears at K204 contact 2 and is applied to the solenoid of K206 through the off-normal and interrupter contacts. The off-normal contacts are closed for all positions of the stepper except home. The interrupter contacts normally are closed. When K206 energizes, the interrupter contacts open to remove voltage to the solenoid of K206; then K206 will de-energize. This is repeated until K206 arrives at the home position and the off-normal contacts open.

A ground on K203 contact 6 will energize transfer relay K209. As long as K203 remains energized K209 would also be energized.

When the operator removes his finger from the dial after it reaches the finger stop, the impulse contacts of S202 open, K201 de-energizes; contacts 4 and 5 of K201 close to energize interlock relay K202. Relay K202 is held energized through holding contacts 5 and 6 of K202. Ground is removed from contact 1 of K202 to de-energize K205.

Impulse contacts of S202 now close; K201 energizes. A ground is passed from contacts K201 2 and 3 to K202 2 and 3 and energizes pulse relay K204. (Relay K204 is energized when voltage is applied to terminals A-B and is maintained energized when voltage is applied to terminals D-C.) When pulse relay K204 is energized, the reset ground is removed from stepping relay K206 by opening contacts 1 and 2. The ground on contact K204-2 is transferred to contact 3 and holds pulse relay K204 energized. Note in figures 9-4 (sheet 1) and 9-5 (sheet 1) that relays K201, K202, K203, and K209 are now all energized.

When the dial switch opens again, impulse relay K201 de-energizes, and a ground is supplied by contact K201-2-1 to closed contacts K204-4-5. This ground energizes stepping relay K206.

The next closing of dial switch S201 will energize K201 and de-energize stepping relay K206 and cause it to advance to the channel 1 position. Further rotation of the dial will cause another open, and the stepping relay will receive another pulse. This action is repeated until the dial returns to the home position. By this time K201 has energized 12 times causing K206 to advance to position 10. Normally slow release relay K203 would drop out after 0.2 second. However, in this one instance (A being dialed) K203 remains energized until after the second digit is dialed.

Now, with K206 in position 10, ground from contact 10 of deck 13 is applied to contact 4 of K209. K209 being energized passes the ground to the coil of K203 keeping it energized. K203 will therefore continue to hold K202, K204, and K209. As long as K204 is energized and K201 de-energized, K206 will be energized. So until the second digit is dialed, relays K202, K203, K204, K206, and K209 will be energized.

Figure 9-5 (sheet 2) shows what events take place when the second digit (in this case, 3) is dialed. When the operator moves the dial clockwise from the home position, off-normal contacts close; the impulse contacts remain closed; K201 is energized. Ground is removed from contact K201-1 to de-energize K206. K206 will advance to position 11. After the dial has reached the finger stop and start in the counterclockwise direction, impulse contacts on S202 open; K201 de-energizes; K206 energizes.

K201 energizes and de-energizes three more times which will cause K206 to advance to position 14. At this instant, K206 is energized.

After the dial comes to rest, the off-normal contacts open to keep K201 de-energized. K203, slow release relay, will remain energized for another 0.2 second. Two-tenths a second after the dial has come to rest, slow release relay K203 will de-energize, and relays K202, K204, stepping relay K206, and K209 will advance to position 15. With the stepping relay on position 15, radio channel 13 is being selected since positions 11 and 12 on the stepping are blank.

For selection of channels 1 through 10, take the first part of figure 9-5 (sheet 1) and the last part of figure 9-5 (sheet 2) of the channel dialing sequence diagram to determine the relay sequence. The number of pulses from the impulse contacts of S202 depends on the channel dialed.

The selection of channels 1 through 10 is not much different than what was described above. In this case only one digit is dialed. Refer to figure 9-5 (sheet 1). Initial operation of the programing relays would be the same. But if the first digit is any number but A, then K206 would not advance to position 10 which would ground contact 4 of K209 to keep K202, K203, K204, K206, and K209 energized. Instead, 0.2 second after the dial is at rest K202, K203, K204, K206, and K209 would de-energize. K206 would advance one position.

f. Stepping Relay K206.

Stepping relay K206 is a 13-deck, 26-position rotary switch which advances, one position at a time, each time the trailing edge of a voltage pulse is received. Interrupter contacts are incorporated with off-normal contacts to provide automatic resetting. (Refer to figure 9-9.) Decks 1 through 5 are used to generate the five-wire channel information required by Radio-Frequency Amplifier AM-1565/URC or Radio Set AN/URC-9. Decks 6 through 10 are used to generate the five-wire channel information required by an antenna coupler (not supplied). Decks 11 and 12 are used to form the resistance bridge which generates the synchro transmitter voltage for channel indications at Indicator Control C-3868/SRC. Deck 13 is used to switch preset squelch potentiometers and to permit dialing radio channels above channel 10.

K206 receives stepping pulses from K201. Each time the coil is energized, the driving pawl is pulled through one tooth on a ratchet. When the coil is de-energized (pulse removed), the driving pawl moves back to its de-energized position under spring pressure. The pawl engages in the ratchet and moves back to its de-energized position advancing K206 one position.

The relay is also wired on a configuration which allows it to be self-resetting.

The off-normal contacts are closed at all times except when stepping relay K206 is at the home position. The interrupter contacts normally are closed except when the coil of stepping relay K206 is energized. Decks 1 through 5 and 6 through 10 generate the five-wire channel code shown in figure 9-6. The shaded boxes indicate those contacts on the five decks which are wired together. This wiring determines the five-wire channel code. For any contact position the wipers will transfer either a ground or no ground. For example: position 7 of S206 will pass a ground to the wiper of deck 1; ground to wiper of deck 2; an open to the wiper of deck 3; ground to the wiper of deck 4; and ground to the wiper of deck 5. These conditions on the wipers are sent to the Autopositioners.

Decks 11 and 12 of relay K206 form a synchro transmitter using the resistive circuit shown in figure 9-7. This group of switched resistors is used to generate the synchro voltage required to position the remote channel indicator in Indicator Control C-3868/SRC.

g. Channel Indication.

For proper indication of the selection of one of the 19 preset channels, both locally and remotely, a synchro receiver and synchro transmitter are used. The synchro receiver is located at a remote location and the synchro transmitter is located in the C-3866/SRC.

(1) Synchro System.

A synchro receiver may be defined as a magnetized bar caused to rotate around its center by a magnetic field which varies in strength and voltage. A synchro system is shown symbologically in figure 9-8. Here, by adjusting the amplitude and polarity of the voltage across three windings placed 120 degrees apart, the rotor (channel indicator) may be positioned accurately at points throughout 360 degrees of rotation. Note also that the setting of the rotor is determined only by the ratio of the currents through the electromagnet windings. For this reason, the operation of synchro is independent of line voltage changes since all windings are affected concurrently.

(2) Synchro Transmitter.

The synchro transmitter used in the C-3866/SRC consists essentially of a resistance network, components of which are selected by two decks of contacts on stepping relay K206. A simplified schematic diagram of the switching arrangement is shown in figure 9-7. Decks 11 and 12 are wired so that the resistors are connected in a resistive circle and function to vary in fixed steps. The voltage is applied to the synchro receiver in essentially the manner illustrated by the tapped resistor shown in figure 9-8. The stepping relay moves through 19 steps. The resistor values (R202 to R225) are chosen so that, as the stepping relay contacts move up, one step at a time, the voltages applied to the synchro receiver will position the pointer at the number corresponding to the channel to which the control equipment is dialed.

When the radio set is controlled locally (remote circuit inoperative), an indication of this condition is provided by the synchro pointer of the remote control station (see figure 9-7). When the LOCAL-REMOTE switch is moved to LOCAL, power from the

wiper-arm circuit is removed to render it inoperative. At the same time voltage to the resistance network will cause the synchro to point to LOCAL on the indicator dials at the remote positions.

The synchro receiver also serves to indicate functions and conditions other than the channel selected. During the interval when the stepping relay resets, at the start of the dialing sequence, the synchro pointer will move to position itself at the long line between the LOCAL and CHANNEL 1 markings. This is accomplished by reset indicator relay K205. K205 will remain energized until K202 energizes. Refer to figure 9-5 (sheet 1). K202 will energize when the dial starts its counterclockwise rotation after it reaches the finger stop. Once K202 is energized it will continue to keep the pointer positioned at the long line. After relay K202 has been de-energized, (0.2 second after the dial has returned to reset), the pointer jumps to the channel number dialed (figure 9-7).

(3) Local-Remote Switch.

LOCAL-REMOTE switch S201 transfers several functions from local control at Radio Set Control C-3866/SRC to a remote control station.

Contacts S201-C-2-3-4 switch from local channel dial to remote channel dial.

Contacts S201-B-5-6-7 and C-8-9-10 switch synchro indicator voltages to show when the radio set is under LOCAL control.

Contacts S201-B-2-3-4 switch power to reset indicator relay K205 and prevent a reset indication from being shown at the remote control station when the radio set is under LOCAL control.

Contacts S201-B-11-12 disconnect the squelch disable line from the remote control station when the radio set is under LOCAL control.

Contacts S201-B-8-9-10 and S201-A-5-6-7 remove receiver and transmitter audio lines from the remote control station when the radio set is under LOCAL control.

Contacts S201-A-1-11-12 remove the 12-volt supply from the remote control station when the radio set is under LOCAL control.

Contacts S201-A-2-3-4 disable the START-STOP circuit at the remote control station when the radio set is under LOCAL control.

Contacts S201-A-8-9-10 disable the transmit-receive function at the remote control station when the radio set is under LOCAL control.

(4) Audio Circuits.

Radio Set Control C-3866/SRC contains two matching transformers to match the audio outputs of Radio Set AN/URC-9 to the remote control station (see figure 9-10).

Transformer T203 changes the 82-ohm unbalanced microphone line Radio Set AN/URC-9 to the 600-ohm balanced line required by the remote control station.

Transformer T204 changes the 600-ohm unbalanced receiver line of Radio Set AN/URC-9 to the 600-ohm balanced line required by the remote control station.

(5) Transmit-Receive Relay K207.

Refer to figure 9-10. Transmit-receive relay K207 enables the transmit-receive control lines from Radio Set AN/SRC-20 or Radio Set AN/SRC-21 to be controlled by the remote control station. Note that the circuit to the coil of relay K207 is completed through the antenna coupler, the LOCAL-REMOTE switch, and the remote control station. When the antenna coupler (if one is used) completes tuning, continuity will be provided between terminals J102-G-H. If the LOCAL-REMOTE switch is set to REMOTE, continuity will be provided between terminals S201-A-8-10. When these conditions exist, placing a ground on the transmit-receive line at the remote control station will key Radio Set AN/SRC-20 or AN/SRC-21 to transmit.

CAUTION

When no antenna coupler is used, a jumper must be installed between FL117 and FL118 to enable the transmit-receive circuit to function.

D. SUMMARY:

1. The C-3866 is used to provide necessary functions for local and remote control of the AN/SRC-20 and AN/SRC-21.

2. Primary power circuits in the C-3866/SRC transfer 115 to 230 volts a-c, 60 cycles to the AM-1565/URC and for AN/URC-9. The primary power circuits also can be controlled from a remote location.

3. Selection of one of the 19 preset channels is accomplished by the channel dialing circuits. Programing relays which are operated by impulses from the telephone dial cause a 13-deck stepper switch to be positioned. The Autopositioner in the AM-1565/URC or AN/URC-9 receives channel information from the stepper in the form of a five-wire binary code.

INFORMATION SHEET 10

CIRCUIT ANALYSIS FOR RADIO-FREQUENCY AMPLIFIER AM-1565/URC

A. INTRODUCTION:

Radio-Frequency Amplifier AM-1565/URC is a linear class AB_1 uhf power amplifier. The two ceramic tetrodes in the power amplifier operate in grounded-grid parallel to supply a minimum of 100-watt (average carrier) power over the frequency range of 225 to 399.9 mc when driven by a 16-watt exciter. The r-f amplifier is made up of an integral power supply, constructed on the chassis, and four removable plug-in subassemblies:

1. Power amplifier
2. Servo amplifier
3. Front panel
4. Autopositioner

B. REFERENCES:

NAVSHIPS 94695A, Technical Manual for Radio Sets AN/SRC-20 and AN/SRC-21, Section 5, Pages 5-1 through 5-10.

C. INFORMATION:

1. Power Supply.

a. Refer to figure 10-1. Application of power to the unit is controlled by POWER switch S501 and safety interlock switch S303. When the chassis is extended on its slides, interlock switch S303 is opened, and power is removed from unit. Interlock switch S303 can be bypassed manually to facilitate maintenance with the r-f amplifier extended on its slides. When the POWER switch is turned on, power is applied through MAIN fuse F501, interlock switch S303, contacts 1 and 2 of thermostat switch S1101, contacts 3 and 4 of time delay relay K302, and fuses F504 and F505 to the primaries of low-voltage transformer T302. Thermostat switch S1101 is closed unless the temperature inside the r-f amplifier case exceeds 100°C (212°F). Turning on the POWER switch also applies line voltage to the time delay relay clutch (winding of relay K302). Relay K302 has a 60-second delay after which the delay motor is removed from the circuit and the power connection to it is broken. The a-c contacts (3 and 4) on the time delay relay are paralleled by air-actuated switch S1001 in the power amplifier subassembly, which is closed by the air stream of power amplifier blower B1001 before the time delay relay contacts open. This configuration allows primary power to be applied to transformer T302 after the time delay (if adequate air is being supplied by power amplifier blower B1001). If power amplifier blower B1001 stops, switch S1001 opens, breaking the low-voltage transformer primary circuit and removing all power from the power amplifier tubes.

b. Refer to figure 10-2. Pin 1 of relay K303 is supplied with 27.5 volts d-c through the closed contacts of Autopositioner relay K501. Keying the r-f amplifier (by use of TEST KEY switch S506 or by keying the exciter) places a ground on pin 9 of relay K303 and energizes the relay which, in turn, energizes relay K301 and applies a-c power to the primary of high-voltage transformer T301, energizing relays K201 and K202. When relays K201 and K202 are energized, the r-f input signal is applied to the power amplifier.

c. Refer to figure 10-1. Transformers T301 and T302 each have two primary windings. The two windings are connected in series for operation from a 230-volt primary supply and in parallel for operation from a 115-volt primary supply. Power selector switch S301 permits the selection of either 115- or 230-volt operation. When selector switch S301 is set for 230-volt operation, resistor R313 is placed in series with time delay relay K302. With S301 in the 230-volt position, and upon operation of time delay relay K302, resistor R312 is connected in place of the time delay motor to maintain a constant 115 volts across the time delay clutch. Refer to figure 10-8. When power is applied to the primary windings of transformers T301 and T302, power is transformed to the secondary windings in proportion to the turns ratios. Terminal pairs 5-6 and 7-8 of T302 each supply 6 volts a-c to the filaments of power amplifier tubes V201 and V202. Terminals 9 and 11 of T320 supply 6.3 volts a-c to the servo amplifier and automatic drive regulator tubes. Center-tap terminal 10 of T302 is grounded to reduce hum. Terminals 12 and 13 of T302 supply 60 volts a-c to a bridge network composed of follow-up potentiometer R201 and one of the channel potentiometers. Terminals 14 and 15 of T302 supply power to a silicon diode bridge rectifier (CR333-CR336) which supplies -27.5 volts d-c to the r-f amplifier. Terminals 16 and 17 of T302 supply power to a silicon diode bridge rectifier (CR325-CR332) which supplies +300 volts d-c to the r-f amplifier. Terminals 18 and 19 of T302 supply power to a silicon diode bridge rectifier (CR338-CR341) which supplies -60 volts bias to the r-f amplifier. Terminals 20 and 21 of T302 supply power to a silicon diode bridge rectifier (CR342-CR345) which supplies +30 volts d-c to the r-f amplifier. Terminals 5 and 6 of T301 supply power to a silicon diode bridge rectifier (CR301-CR324) which supplies +1800 volts d-c to the power amplifier tubes.

2. Front Panel.

a. All indicators, fuses and switches are located on the removable front panel of the r-f amplifier. The Autopositioner plugs into the rear of the front panel. The ANT 50Ω jack, J502, and the RF INPUT 50Ω jack, J501, are located on the front panel. Fuses for transformer T301 and T302 primaries; the main a-c power line fuse; and the 27.5-volt d-c, 300-volt d-c, and 60-volt d-c power supply fuses are also located on the front panel. Spare fuses and lamps are located under a removable cover on the front panel.

b. Refer to figure 10-2. The TEST KEY switch allows the r-f amplifier to be keyed from the front panel for testing or maintenance. TEST KEY switch S506 has three positions; OFF, LOCK ON, and ON. Placing the TEST KEY switch in the spring-return ON position applies a ground to pin 9 of relay K303 to energize the relay which, in turn, energizes relay K301, applying a-c power to the primary of high-voltage transformer T301. Energizing K303 also energizes relays K201 and K202 to prepare the r-f amplifier for transmit operation. The LOCK ON position of S506 performs the same circuit changes as the ON position, but it is not spring loaded.

The EXCITATION controls allow selection of either manual or automatic excitation and high or low excitation. When the EXCITATION MANUAL-AUTO switch is set to the MANUAL position, the drive of the r-f amplifier is controlled by variable resistor R527, which is the EXCITATION LOW-HIGH control. The setting of R527 controls the bias on tube V406 of the servo amplifier.

The CHAN SEL control allows selection of automatic preset channels. The MANUAL TUNING control allows manual frequency tuning of the r-f amplifier. The RF POWER OUTPUT switch allows the output of the exciter to be transferred directly to the antenna, completely bypassing the r-f amplifier.

3. Meter Switching.

a. Figure 10-5 shows simplified schematic diagrams for the metering circuits connected in the various positions of METER switch S502. With METER switch S502 in the HV position, meter M501 indicates the output of the +1800-volt supply. Switch S502 connects the meter in series with R533 and across R302. When S502 is in the BIAS 1 position, the meter is placed in series with resistors R533 and R505 to measure the negative voltage applied to the control grid of output tube V201. With S502 in the BIAS 2 position, the meter is placed in series with R533 and R505, but the negative voltage applied to the control grid of output tube V202 is measured. The BIAS 1 reading is the voltage at the wiper arm of R304. The BIAS 2 reading is the voltage at the wiper arm of R303. With the METER switch in the +300V position, meter M501. in series with R533, is connected across resistor R504 to measure the output of the +300-volt supply. With switch S502 in the 27.5V position, M501, in series with R533, is connected across resistor R530 to indicate the output of the 27.5-volt supply. With switch S502 in DELAY, meter M501, connected in series with R533 and across R535, measures the delay voltage across Zener diode CR346. With the METER switch in SWR, the reflected power on the transmission line is indicated. Resistor R532 is used to calibrate the meter for this measurement. When switch S502 is in PWR OUT, meter M501 indicates the output power of the r-f amplifier. Resistor R531 is used to calibrate the meter for this measurement.

b. When switch S502 is in PAI_{b1}, meter M501 indicates the plate current of amplifier V201. The meter is in series with R533 across resistor R305, which is in series with the cathode of V201. When switch S502 is in PAI_{b2}, meter M501 indicates the plate current of amplifier V202. The meter is in series with R533 across R307, which is in series with the cathode of V202. With the METER switch in ATTEN, the meter is placed in series with R533 across R536, which is in series with AT401, to indicate the coil current in the attenuator.

4. Automatic Drive Regulator Circuitry.

a. The radio-frequency output of the r-f amplifier is maintained constant by means of a drive power regulator circuit. A simplified schematic diagram of the drive regulator is shown in figure 10-6. With EXCITATION MANUAL-AUTO switch S507 in MANUAL, the drive is controlled by EXCITATION LOW-HIGH control R527. Potentiometer R527 is a part of a network across capacitor C304 of the +30-volt d-c power supply. Zener diode CR346 is in series with resistor R311 directly across the output of the +30-volt d-c supply. Resistor R311 drops the 30-volt supply voltage to 19.0 volts, the Zener voltage of CR346. A fixed bias voltage of about -30 volts is applied to the junction of resistor R430 and V406A cathode resistor R429 in the servo amplifier subassembly. A net negative (with respect to the cathode) voltage is applied to the grid of voltage regulator amplifier V406A from EXCITATION LOW-HIGH control R527. When V406A conducts, the voltage across resistors R429 and R430 increases, decreasing the conduction of V406B. Section V406B is connected as a diode with resistor R432 as a plate load. The voltage across R432 is applied to the grids of voltage regulator power amplifier V405, a dual triode connected for parallel operation. The plate current of V405 flows through the coil of the variable magnetic ferrite attenuator AT401 creating a magnetic field in the ferrite material which controls its r-f power conducting properties. The amount of r-f attenuation is inversely proportional to the current flowing in the coil of AT401. The r-f drive to the amplifier is coupled through the attenuator and therefore controlled by the conduction of V405. The plate voltage supplied to tubes V405 and V406 is regulated by voltage regulator V407.

b. With the EXCITATION MANUAL-AUTO switch in AUTO, the theory of operation is similar to that discussed for manual operation, with one exception; in automatic operation, the delay voltage (+30 volts d-c) is applied to the cathode of V203 from the wiper arm of potentiometer R436 which is connected in series with R435 across Zener diode CR346. A

portion of the output power is applied to the plate of automatic delay diode V203 and rectified. When the output power is of sufficient value, the rectified voltage across R201 (load resistor for V203) overcomes the delay bias and produces a net voltage which is applied to the control grid of V406A causing it to conduct less. The operation of variable magnetic ferrite attenuator AT401 is the same as that during manual operation.

5. Servo Amplifier.

Refer to figure 10-7. The servo system is of the rate generator feedback loop type. The unbalance voltage, developed across the bridge circuit (the bridge is unbalanced temporarily after changing channels) formed by follow-up potentiometers R201 and a channel potentiometer, is clipped by diodes CR401 and CR402 and applied to the control grid of amplifier V401A. Amplifier V401A, resistor R405, and capacitor C404 cause the signal applied across AMP GAIN control R410 to be 90 degrees out of phase with the signal applied to the grid of V401A and the voltage applied to the fixed phase winding of the servo motor. The phase of the rate generator output is shifted by the network consisting of DAMP GAIN control R409, DAMP PHASE control R411, R412, R413, and C405 so the shifted signal is 180 degrees out of phase with the signal from V401A. These two signals are fed through isolation resistors R407 and R408 and added across AMP GAIN control R410. Sufficient rate feedback is added to the signal to limit the voltage across the servo motor to 300 volts a-c. The resulting signal is applied to the grid of amplifier V401B. The signal is amplified by V401B and applied to phase inverter V402A. The output of V402A is applied to the grid of phase inverter V402B and to power amplifier V403. The output of V402B is applied to power amplifier V404. The plates of V403 and V404 are connected to B+ through the servo motor so their conduction causes the motor to run. Follow-up potentiometer R201 is geared to the servo motor, and as the motor rotates, the wiper arm of R201 moves toward the null point of the bridge. When the null is reached, no signal is applied to V401A of the servo amplifier and the servo motor stops. Rate feedback prevents hunting and overshoot at the null point.

6. Power Amplifier.

a. Refer to figure 10-8. The two ceramic tetrode power amplifier tubes, V201 and V202, are connected in parallel and are operated as grounded-grid radio-frequency amplifiers. The r-f input signal from the associated exciter is fed into the power amplifier subassembly and to the contact of relay K201. Relays K201 and K202 are energized when the r-f amplifier is in the transmit condition. When relay K201 is energized, the r-f signal is coupled through variable attenuator AT401 to the input circuitry of the power amplifier. The r-f signal is applied to the cathodes of V201 and V202 through capacitors C212 and C213 respectively. Capacitor C215 is part of a network which maintains an input impedance that is essentially constant from 225.0 to 399.9 mc. The input resonant cavity is connected between the cathodes and grids of the two power amplifier tubes. A cavity enclosed by metal walls has an infinite number of natural frequencies at which resonance will occur. The particular frequency at which resonance will occur in any given circumstance is controlled by varying the length of the cavity by means of a movable piston. The resonant frequency is inversely proportional to the linear dimension of the cavity. The r-f signal is coupled into and out of the cavities by means of coaxial coupling devices.

b. The r-f signal is amplified by tubes V201 and V202 and is then applied to the high Q output resonant cavity through capacitors C202 and C203. The signal is coupled from the output cavity through an impedance-matching network, consisting of C208 and C209, which transforms the plate cavity impedance to the 50-ohm output line impedance. Capacitor C209 is variable to allow proper loading at any frequency. The output cavity is connected between the plates and grids of tubes V201 and V202. Capacitors C206 and C207 are connected

across the input cavity to ensure proper tracking between the input and output cavities. Low-pass filter FL201 minimizes harmonic radiation of the amplifier. Directional coupler DC201 allows monitoring of the forward and reverse antenna circuit power. A portion of the voltage developed across the output cavity is fed to the automatic drive regulator circuit.

7. Autopositioner.

a. The Autopositioner plugs into the back of the front panel. Figure 10-9 is a schematic diagram of the Autopositioner. The Autopositioner is a motor-driven, electrically controlled tuning mechanism which automatically tunes the r-f amplifier to the frequency controlled by the channel selector potentiometers. The basic elements of the Autopositioner are a motor and its gear reduction train, a slip clutch driving a rotor shaft which engages the notches in the stop-wheel, and a relay which controls the pawl and operates a set of electrical contacts to start and stop the motor. The control system for the Autopositioner consists of the selection switches located on the front panel of the r-f amplifier and electrically similar seeking switches that are driven by the Autopositioner shaft. The control system is the open-circuit seeking type. Whenever the control switches and seeking switches are not set to the same electrical position, the Autopositioner is energized and drives its shaft (and the tuning elements to which the shaft is coupled) to the proper position to open the motor circuit.

b. A typical cycle of the Autopositioner is as follows. The system is originally at rest with the control and seeking switches aligned (open circuit); relay K501 is in the de-energized position; the pawl is engaging a stop-wheel notch; and the motor is not energized. When the operator changes the position of the CHAN SEL switch or when channel information is fed to the r-f amplifier from the remote control unit, the control system energizes the relay, lifting the pawl out of the stop-wheel notch and closing the motor control contacts. The motor starts, driving the Autopositioner shaft, the rotor of the seeking switches, and the tuning elements of the tuned circuits. When the seeking switch reaches the point corresponding to the new position of the control switch, the relay is opened, and the pawl is dropped into a stop-wheel notch to stop the shaft rotation. The motor control contacts open, and the motor coasts to a stop. The seeking clutch of the control circuit is adjusted to open the relay circuit before the stop wheel reaches the point where the pawl engages the proper notch. The relay contacts controlling the motor are adjusted so that they do not open until the pawl drops into the notch.

c. Operation of CHAN SEL switch S504 or remote channel information connects contacts together or to ground in various combinations. Figure 9-6 shows the various switch combinations for channel selection. In any position, the CHAN SEL switch connects one side of Autopositioner relay K501 to ground through LOCAL-REMOTE switch S505 (when S505 is in LOCAL), and local seeking switch S503A. Operation of K501 lifts the stop pawl from its notch in the stop wheel and energizes solenoid L209, which pulls the shaft of capacitor C209 clear of the output loading screws and closes switch S201 causing motor B501 to rotate switch S503. Switch S503 rotates until the combination of contacts 2, 3, 4, 5, and 6 on the local seeking switch S503A are connected exactly as the corresponding contacts on CHAN SEL switch S504. When this happens, ground is removed from K501 allowing the stop pawl to fall into the stop-wheel notch, locking S503 into position. Power is removed from motor B501 and the motor coasts to a stop. A slip clutch located between the motor and switch S503 allows the motor to coast. Solenoid L209 is de-energized allowing the capacitor shaft to return against the output loading screw that has just come into position. Switches S503F and S505G connect one of the preset channel potentiometers, R506 through R252, as part of an unbalanced bridge network with follow-up potentiometer R201. This unbalanced bridge causes servo motor MG201 to operate until the bridge is balanced. Switch S503B supplies

information to the exciter, causing it to be set up on the same channel as the r-f amplifier. Switch S503E is the antenna coupler channel selector switch. Channel information is transferred between the exciter and r-f amplifier by means of a binary code on five control wires.

D. SUMMARY:

1. Radio-Frequency Amplifier AM-1565/URC is an automatically tuned, fixed-station linear power amplifier which operates from 225 to 399.9 mc. The cathode and plates, tuned circuits of the r-f amplifier, are high-Q coaxial cavities which are servo tuned to the selected frequency. Since the amplifier is linear, interference problems due to transmitter intermodulation are held to a minimum. An internal power supply operates from a 115- to 230-volt, 50- to 60-cps power source.

2. Channel selection is accomplished by Autopositioners. The amplifier is continuously tunable over the frequency range with provisions for presetting 19 channels.

INFORMATION SHEET 11

INSTALLATION

A. INTRODUCTION:

Radio Sets AN/SRC-20 and AN/SRC-21 are intended for shipboard fixed station installation. As previously discussed, the only difference between the sets is the use of an r-f power amplifier in the AN/SRC-20. Care must be taken before installation to ensure that (1) sufficient power is available; (2) a satisfactory site is available; and (3) all necessary equipment, tools, and interconnecting cables, etc. are readily accessible.

B. REFERENCES:

NAVSHIPS 94695A, Technical Manual for Radio Set AN/SRC-20 and Radio Set AN/SRC-21, Section 2, Pages 2-0 through 2-2.

C. INFORMATION:

1. Power Requirements.

Both the AN/SRC-20 and AN/SRC-21 can be operated from a primary power source of 115 to 230 volts a-c, 50 to 60 cps, or 400 cps, single phase. The radio sets are shipped from the factory wired for 115-volt a-c, 50 to 60-cps operation. To operate the equipment on 230 volts a-c, it is necessary to change the primary power fuses and the primary power switches; see paragraph 2-6a.(3) of NAVSHIPS 94695A. If the sets are to be used on 400 cps, the centrifugal fan in Receiver-Transmitter Case CY-2959/URC-9 and the fan in Receiver-Transmitter RT-581/URC-9 must be replaced with 400-cycle units.

Primary power distribution is shown in figure 5-87 of NAVSHIPS 94695A. Radio Set AN/SRC-20 requires 570 watts on receive, and 1520 watts on transmit; both at 0.9 pf. Radio Set AN/SRC-21 requires 290 watts at 0.92 pf on receive, and 440 watts at 0.95 pf on transmit.

2. Site Selection and Equipment Mounting.

The selected location should provide sufficient space and light to operate and maintain the equipment properly. Remember that sufficient space is required in front of the equipment to allow individual units to be extended or removed from the mounting rack.

The latest Bureau of Ships approved installation plans should be used for installation of the equipment. The installing personnel should be familiar with the operation of the radio sets before attempting installation.

Figure 2-1 of NAVSHIPS 94695A shows the outline and mounting dimensions for the AN/SRC-20. Figure 2-2 of NAVSHIPS 94695A shows the corresponding outline and mounting dimensions for the installation of the AN/SRC-21. The cable assemblies required for installation are listed in table 2-1 of NAVSHIPS 94695A. The installation inspections and adjustments are listed in NAVSHIPS 94695A, paragraph 2-6.

D. SUMMARY:

The installation of the Radio Sets AN/SRC-20 and AN/SRC-21 should be in accordance with the latest approved Bureau of Ships installation plans. The system is intended for fixed shipboard installation and is sent from the factory wired for 115-volt a-c, 50 to 60-cps single-phase power. It can be modified to utilize 230-volt a-c single-phase power or 400 cps with

minor changes. The equipment installation site should provide sufficient light and space for maintenance. The detailed installation inspection and adjustments as provided in NAVSHIPS 94695A should be accomplished.

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