

**OPERATING AND
SERVICE INSTRUCTIONS
FOR...**

**COMMUNICATIONS
TRANSCEIVER
MODEL SR-400A**

the hallicrafters CO.



A Subsidiary of Northrop Corporation

K4XL's  **BAMA**

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SECTION I GENERAL DESCRIPTION

1-1. INTRODUCTION. Hallicrafters Model SR-400A (see figure 1) is a precision-built, high performance transceiver of advanced design. Complete coverage is provided for single-sideband (SSB) and continuous wave (CW) operation in the 80-, 40-, 20-, 15-, and 10-meter amateur bands. The transceiver utilizes 19 tubes, one voltage regulator tube, one transistor, one integrated circuit and 32 diodes in a double-conversion heterodyning system for both transmission and reception. A built-in 25-kHz crystal calibrator provides accurate frequency calibration.

NOTE

Do not attempt to place the SR-400A in operation before becoming familiar with operating procedures contained in this manual. Refer to Sections III and IV for installation and operating instructions.

The SR-400A, with appropriate power supply (Model PS-500A-AC or Model PS-500-DC), antenna, key and microphone, represents a complete desk-top or mobile amateur station.

A special feature of the SR-400A is the receiver incremental tuning control (RIT CONTROL). This control enables the operator to unlock the receiver frequency from the transmitter and tune the receiver approximately 2 kHz above or below the transmitter frequency without affecting transmitter tuning. Reference markings on the control provide the operator with a relative indication of receiver frequency.

Another useful design feature of the SR-400A is the amplified automatic level control (AALC). The AALC circuitry automatically prevents splatter due to severe flat-topping of the final amplifier signal by providing approximately 15 dB compression at the time flat-topping begins. The AALC is used only in the transmit mode of operation.



Figure 1. Model SR-400A Transceiver.

Other features of the SR-400A include:

- Noise blanker circuit operating ahead of the IF filter for effective noise blanking action.
- Choice of voice operated transmission (VOX) or push-to-talk (PTT) for SSB operation, and a choice of manual or automatic break-in control for CW operation.
- Upper sideband (USB) and lower sideband (LSB) operation with common suppressed carrier frequency on all bands.
- Sharp selectivity position for CW reception: 200 Hz bandwidth at 6 dB.
- Adjustable rejection notch filter to attenuate interfering heterodynes and CW signals.
- Accurately calibrated variable frequency oscillator (VFO) with excellent mechanical and temperature stability.
- Smooth, gear-driven tuning mechanism with 1 kHz readout display.
- Constant tuning rate on all bands.
- Crystal lattice 1650-kHz filter with six poles for optimum selectivity and single-sideband response.
- Product detector with crystal-controlled beat frequency oscillator (BFO) injection for maximum stability.
- Keyed sidetone for monitoring CW transmissions.
- Excellent cross modulation and overload characteristics.
- "S" meter for receiver, and RF output (RFO), AALC, and plate current metering for transmitter tuning and operating convenience.
- Built-in 25-kHz, crystal-controlled calibrator for exact dial calibration.
- Accessory fan kit available for cooler, more efficient operation.
- Balance control adjustment to match plate currents in the final amplifier tubes.
- Expanded scale PLATE MA meter for precise PA idling current adjustment.

- AF input/output jacks for phone patch operation.
- Rugged 6KD6 final amplifier tubes for increased output power.
- Provision for reception of station WWV for accurate frequency calibration.

1-2. TELEVISION INTERFERENCE (TVI) SUPPRESSION. The SR-400A Transceiver has been designed and constructed to suppress spurious radiation that may cause television interference. The TVI problem was given full consideration in the design and layout of the chassis. Components have been specifically selected to avoid undesired resonances and are arranged to prevent parasitic oscillations.

There are, however, some types of TVI that cannot be prevented within the transmitter itself. This is particularly true in fringe reception areas. In such cases, a good commercial low pass filter connected at the transceiver antenna connector is recommended. For a more complete discussion of measures that may be used to handle special problems of this type, refer to the "Radio Amateur's Handbook" published by the American Radio Relay League.

1-3. ACCESSORY ITEMS. The following items are available to complement the SR-400A in various installations and operating modes.

PS-500A-AC Power Supply.

Styled as a companion unit to the SR-400A, this power unit provides for base station operation from a 117/234 Vac, 50- to 60-Hz power source. The PS-500A-AC also contains a 4- x 6-inch speaker having a voice frequency response tailored to communications requirements.

- All power and audio circuitry are coupled between units by a multiconductor cable with a 12-pin power plug.
- AC receptacle for HA-60 Blower Kit.
- Solid-state silicon rectifiers are employed for cool, maintenance-free operation.
- Diode complement - nine silicon diodes.
- Input power requirements -
105/125 Vac, 50-60 Hz
210/250 Vac, 50-60 Hz
Transmit: 700 watts (maximum)
Receive: 170 watts.
- Dimensions (HWD) - 6-1/4 x 7-1/2 x 10 inches.
- Net weight - 22 pounds.
- Shipping weight - 28 pounds.

PS-500-DC Power Supply.

This power supply is designed for out-of-the-way engine compartment installations, permitting mobile operation from a 12-Vdc power source. The PS-500-DC requires a negative-ground source supplying a nominal potential of 13.6 Vdc under load.

- Solid-state components are employed for cool, maintenance-free operation.
- Transistor and diode complement - four transistors, two silicon bridge rectifier units, one silicon diode bias rectifier, and one protective diode.
- Input power requirements -
11.6-15.6 Vdc (13.6 Vdc nominal)
Transmit: 14 to 43 amperes (maximum)
Receive: 10 amperes.
- Dimensions (HWD) - 3-3/4 x 8-1/4 x 6 inches.
- Net weight - 8-1/4 pounds.
- Shipping weight - 10 pounds.

MR-400A Mobile Mounting Rack.

Designed to facilitate mobile installation of the SR-400A, the mounting rack permits transmission hump, floor, or under-dash mounting of the transceiver. The quick release design of the MR-400A assures ease in installing and removing the transceiver. All electrical interconnections between the power supply and the transceiver are provided on the mounting rack. The side panels of the mounting rack fold and lock in place when the transceiver is removed.

- Dimensions (HWD) -
7 x 15-3/4 x 8-1/2 inches (open)
7 x 15-3/4 x 3 inches (closed).
- Net weight - 11 pounds.
- Shipping weight - 13 pounds.

HA-60 Blower Kit.

This unit is intended to provide increased cooling of the SR-400A. The rear panel of the transceiver is prepunched for the blower housing and four mounting screws. Power for the HA-60 (figure 2) is obtained from the PS-500A-AC output receptacle. The kit includes a quiet running fan, finger guard, power cord with plug, and mounting hardware. The use of the HA-60 is highly recommended to obtain maximum tube life in the PA stage.

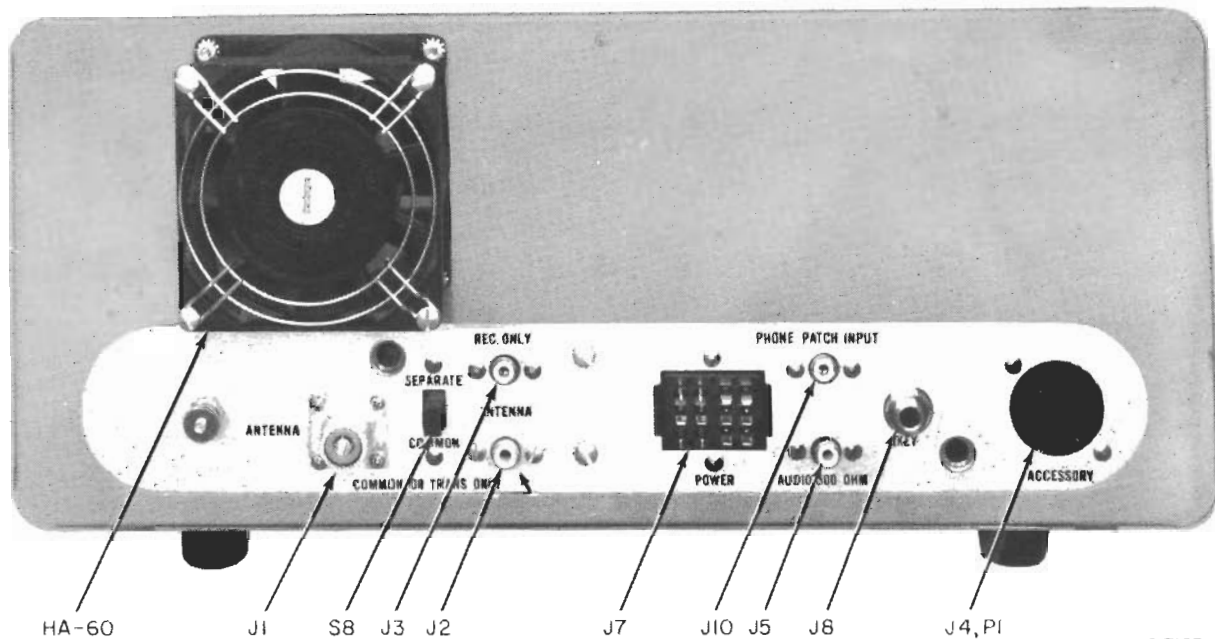


Figure 2. Model SR-400A Transceiver (Rear View).

HA-20 DX Adapter.

Styled to complement the SR-400A, the DX adapter contains a VFO unit equal to the VFO in the SR-400A and a VSWR bridge. The HA-20 provides the following functions when used with the SR-400A.

- Controls the transmit frequency while the transceiver VFO controls the receive frequency.
- Controls both transmit and receive frequencies (transceive).
- Allows the operator to select a position that will provide a dual simultaneous receive function. This feature permits the operator to monitor any two frequencies or any given band simultaneously.

The VSWR bridge metering and forward/reverse RF power switching are contained within

the DX adapter. The bridge module connected into the antenna transmission line is designed to handle the full peak envelope (PEP) output of the SR-400A. With a continuous VSWR check available, the operator knows at all times whether the antenna system is functioning properly.

The HA-20 contains its own power supply and operates from a 117 Vac, 60-Hz source. Control and signal circuits are coupled between the DX adapter and transceiver by a multiconductor cable and the ACCESSORY connector.

- Power requirements - 117 Vac, 60 Hz, 20 watts.
- Dimensions (HWD) - 7 x 10-5/8 x 8 inches.
- Net weight - 9 pounds.
- Shipping weight - 12 pounds.

SECTION II SPECIFICATIONS

Table 1. Tubes and Functions.

REFERENCE SYMBOL	TUBE TYPES	FUNCTION	REFERENCE SYMBOL	TUBE TYPES	FUNCTION
V1	12DK6	Receiver RF amplifier	V11	6AW8A	Second transmitter mixer and 25-kHz crystal controlled oscillator
V2	7059	Receiver and transmitter first mixer	V12	7056	Heterodyne oscillator
V3	6HL8	IF amplifier and AALC amplifier	V13	12BA6	VFO
V4	6AN8	Second receiver mixer and VFO amplifier	V14	12AT7	BFO/carrier oscillator and third MIC amplifier
V5	7059	Noise amplifier and pulse amplifier	V15	6AQ5A	Audio output
V6	6GX6	First 1650-kHz IF amplifier and blanker	V16	6KD6	Transmitter power amplifier
V7	7059	Second 1650-kHz IF amplifier and side tone amplifier	V17	6KD6	Transmitter power amplifier
V8	7059	AGC amplifier and meter amplifier	V18	7558	Transmitter driver
V9	12AT7	Product detector and first audio amplifier	V19	12AT7	First MIC amplifier and second MIC amplifier
V10	0A2	Voltage regulator	V20	12AT7	VOX amplifier and relay amplifier

Table 2. General Specifications.

Tuning Ranges	Full frequency coverage of the amateur bands in eight ranges as follows:																		
	<table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;"><u>Band (meters)</u></th> <th style="text-align: center;"><u>Frequency (MHz)</u></th> </tr> </thead> <tbody> <tr><td style="text-align: center;">80</td><td style="text-align: center;">3.5 to 4.0</td></tr> <tr><td style="text-align: center;">40</td><td style="text-align: center;">7.0 to 7.5</td></tr> <tr><td style="text-align: center;">20</td><td style="text-align: center;">14.0 to 14.5</td></tr> <tr><td style="text-align: center;">15</td><td style="text-align: center;">21.0 to 21.5</td></tr> <tr><td style="text-align: center;">10</td><td style="text-align: center;">28.0 to 28.5</td></tr> <tr><td style="text-align: center;">10</td><td style="text-align: center;">28.5 to 29.0</td></tr> <tr><td style="text-align: center;">10</td><td style="text-align: center;">29.0 to 29.5</td></tr> <tr><td style="text-align: center;">10</td><td style="text-align: center;">29.5 to 30.0</td></tr> </tbody> </table>	<u>Band (meters)</u>	<u>Frequency (MHz)</u>	80	3.5 to 4.0	40	7.0 to 7.5	20	14.0 to 14.5	15	21.0 to 21.5	10	28.0 to 28.5	10	28.5 to 29.0	10	29.0 to 29.5	10	29.5 to 30.0
<u>Band (meters)</u>	<u>Frequency (MHz)</u>																		
80	3.5 to 4.0																		
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10	28.0 to 28.5																		
10	28.5 to 29.0																		
10	29.0 to 29.5																		
10	29.5 to 30.0																		

Table 2. General Specifications (Contd).

Heterodyne Oscillator Crystals	Type CR-18A/U in HC 6/U Holder																		
	<table border="1"> <thead> <tr> <th><u>Range (MHz)</u></th> <th><u>Frequency (kHz)</u></th> </tr> </thead> <tbody> <tr> <td>3.5-4.0</td> <td>10,000.000</td> </tr> <tr> <td>7.0-7.5</td> <td>13,500.000</td> </tr> <tr> <td>14.0-14.5</td> <td>10,250.000</td> </tr> <tr> <td>21.0-21.5</td> <td>13,750.000</td> </tr> <tr> <td>28.0-28.5</td> <td>17,250.000 (crystal not supplied)</td> </tr> <tr> <td>28.5-29.0</td> <td>17,500.000</td> </tr> <tr> <td>29.0-29.5</td> <td>17,750.000 (crystal not supplied)</td> </tr> <tr> <td>29.5-30.0</td> <td>18,000.000 (crystal not supplied)</td> </tr> </tbody> </table>	<u>Range (MHz)</u>	<u>Frequency (kHz)</u>	3.5-4.0	10,000.000	7.0-7.5	13,500.000	14.0-14.5	10,250.000	21.0-21.5	13,750.000	28.0-28.5	17,250.000 (crystal not supplied)	28.5-29.0	17,500.000	29.0-29.5	17,750.000 (crystal not supplied)	29.5-30.0	18,000.000 (crystal not supplied)
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14.0-14.5	10,250.000																		
21.0-21.5	13,750.000																		
28.0-28.5	17,250.000 (crystal not supplied)																		
28.5-29.0	17,500.000																		
29.0-29.5	17,750.000 (crystal not supplied)																		
29.5-30.0	18,000.000 (crystal not supplied)																		
Types of emission	SSB - selectable USB/LSB with suppressed carrier CW - keyed RF carrier																		
Frequency control	Self-contained VFO for transmit and receive modes: Separate transmitter frequency control available with Model HA-20 DX Adapter unit																		
Transmission control	Single-sideband operation: MOX - manual (push-to-talk) VOX - voice control CW operation: MOX - manual VOX - automatic break-in																		
Dial calibration	1-kHz increments, 500-kHz tuning range																		
Calibration accuracy	Less than 2-kHz error across the dial after indexing at high frequency end of the dial; band-to-band cali- bration error less than ± 2 kHz Internal 25-kHz, crystal-controlled calibrator																		
Frequency stability	Less than 250-Hz drift in first hour, after a 15-minute warmup, and less than 100 Hz per hour thereafter																		
Tube complement	19 tubes plus one voltage regulator tube																		
Diode, transistor, and integrated circuit complement	32 diodes, one transistor, and one integrated circuit																		
Connector data	<u>Front Panel</u> MIC connector - Amphenol type 80-MC2M PHONES jack - standard 1/4-inch, two-conductor phone plug <u>Rear Cabinet</u> KEY jack - standard 1/4-inch, two-conductor phone plug COMMON OR TRANS ONLY ANTENNA connector - Mil. No. PL-259 (49190) UHF series or standard RCA type phono jack REC ONLY ANTENNA connector - standard RCA type phone jack																		

Table 2. General Specifications (Contd).

	AUDIO (500 OHMS) connector - standard RCA type phono jack
	PHONE PATCH connector - standard RCA type phono jack
	POWER connector - Cinch-Jones type S-312-CCTL (12-pin receptacle)
	ACCESSORY connector - Amphenol type 86-PM11 (11-pin socket)
Power supply	Model PS-500A-AC for 117/234 Vac, 50-60 Hz, base station operation
	Model PS-500-DC for 12-Vdc, mobile operation
Construction	Light-weight aluminum
Dimensions (HWD)	6-1/2 x 15 x 13 inches
Net weight	18 pounds
Shipping weight	22 pounds

Table 3. Transmitter Specifications.

Power input	SSB - 550 watts PEP maximum *CW - 350 watts maximum
Power output	SSB - 275 watts PEP minimum (slightly lower on the 15- and 10-meter bands) *CW - 175 watts minimum (slightly lower on the 15- and 10-meter bands)
Output impedance	50 ohms nominal; adjustable, 40 to 70 ohms essentially non-reactive
Type of sideband generation	Solid-state modulator with a 1650-kHz, 6-pole crystal filter (nominal 3 dB bandwidth - 2.1 kHz)
Microphone input	High impedance; input sensitivity of 5 mV or less for rated PEP output
Audio response, overall	500 to 2400 Hz (6 dB)
Distortion products	Intermodulation - 30 dB below PEP
Unwanted sideband rejection	40 dB below desired output at 500- to 2500-Hz input
Carrier suppression	50 dB below PEP output
Spurious emission	50 dB or more below PEP output (nonharmonic)
Harmonic suppression	40 dB below PEP output
CW sidetone	700 Hz nominal
*CW drive (RF level) must be adjusted to not exceed a maximum current of 450 mA in order to obtain rated power shown and be consistent with reasonable PA tube life. Actual single-tone test power input can be run up to 450 Wdc input, and CW power output will be 200 to 275 W.	

Table 4. Receiver Specifications.

Antenna input	50 ohms nominal
Audio output impedance	3.2 ohms and 500 ohms
Sensitivity	1 microvolt or less for 20-dB signal-to-noise ratio
Audio output	1 watt with less than 10% distortion
Dual conversion system	First IF - 6 to 6.5 MHz Second IF - 1650 kHz with crystal lattice filter
Crystal lattice filter	6-pole, symmetrical passband; center frequency - 1651.4-kHz bandwidth - 2.1 kHz (3 dB), 4.2 kHz (60 dB) SHARP CW filter - 200 Hz (6 dB) Notch rejection - up to 30 dB Carrier frequencies: USB - 1652.800 kHz LSB - 1650.000 kHz
AVC figure of merit	60 dB or more RF input change for less than 10 dB change in audio output
RIT frequency range	4 kHz minimum
Internal spurious	Less than 1 microvolt equivalent CW signal
First IF rejection	Better than 50 dB at 7.0 MHz; 60 dB minimum on all other bands
Image and spurious rejection	Better than 50 dB

SECTION III INSTALLATION

3-1. **UNPACKING.** Carefully remove the equipment from the carton and packing material and examine the unit for possible damage that may have occurred in transit. If the equipment has been damaged, file a claim immediately with the carrier, stating the extent of the damage. Carefully check all shipping labels and tags for special instructions before removing or destroying them.

3-2. **LOCATION.** The SR-400A Transceiver and PS-500A-AC Power Supply are designed to be placed side-by-side for operating convenience. The power supply may be located on either side of the transceiver unit as desired. It is very important that the transceiver be placed in an operating position that provides unobstructed circulation of air around the sides and top of the unit. Any object that might obstruct the normal flow of cooling air should not be placed on top of either cabinet. The PS-500-DC Power Supply, for mobile operation, is designed for engine compartment operation close to the battery supply.

3-3. **ANTENNA.** The SR-400A Transceiver is designed to terminate in a 50-ohm unbalanced transmission line.

While a nonreactive 50-ohm load is preferred for optimum results, a VSWR of 2:1 can be accommodated by the transmitter with acceptable results. Many of the popular dipole or beam antennas using 50-ohm transmission lines give excellent results.

For more detailed information on the subject of antennas, refer to the "Radio Amateur's Handbook" or the "ARRL Antenna Book", both published by the American Radio Relay League.

NOTE

Some form of lightning protection that complies with the local code requirements should be provided.

Antenna connections are provided at the rear of the transceiver, as shown in figure 2. If a common antenna is used for transmit and receive, the antenna switch (S8) must be in the COMMON (down) position and the antenna connected to either of the COMMON OR TRANS ONLY antenna connectors (J1 or J2). If separate antennas are used, the switch must be in the SEPARATE (up) posi-

tion, the receiver antenna connected to the top REC ONLY connector (J3), and the transmitter antenna connected to either of the COMMON OR TRANS ONLY connectors (J1 or J2).

Antenna connectors J2 and J3 mate with the RCA type phono connectors, and connector J1 mates with Mil. No. PL-259 (49190) UHF series coaxial connectors. Use 50-ohm Mil. No. RG-58/U coaxial cable or equivalent for the feed line to the station antenna system or linear power amplifier.

Station antenna systems with terminating impedances other than 50 ohms require an impedance matching device capable of safely handling at least 400 watts PEP RF power.

CAUTION

NEVER OPERATE THE SR-400A TRANSCEIVER AS A TRANSMITTER WITHOUT A MATCHED ANTENNA OR ADEQUATE DUMMY LOAD TERMINATION. ILLUMINATING LAMPS WILL NOT PRESENT A CONSTANT LOAD IMPEDANCE. DAMAGE TO THE POWER AMPLIFIER TUBE AND PI NETWORK COMPONENTS IS POSSIBLE IF THE EQUIPMENT IS OPERATED AS A TRANSMITTER UNLOADED. DO NOT OPERATE THE TRANSMITTER INTO AN ANTENNA SYSTEM HAVING A HIGH VSWR ON ITS TRANSMISSION LINE.

3-4. **GROUNDS.** In the interest of safety, it is strongly recommended that the SR-400A be grounded to a cold water pipe or good electrical earth ground. Station equipment that is left unbonded between units or between the equipment and ground may assume potential differences that could present a shock hazard. An external chassis ground terminal is provided on the SR-400A rear chassis apron for this purpose. A ground lead of No. 14 wire or 1/8-inch tubular braid is recommended.

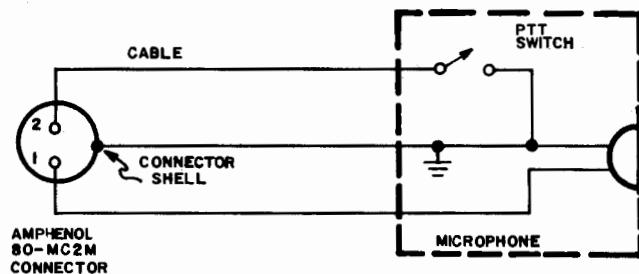
3-5. **ACCESSORY CONNECTOR.** As shipped from the factory, the SR-400A ACCESSORY receptacle has a jumper plug (P1) installed to permit normal operation of the transceiver. Should the HA-20 DX Adapter be added to the station setup, remove the jumper plug from the transceiver and connect the HA-20 cable connector. For more detailed information concerning the HA-20 DX Adapter, see Section XII.

3-6. **MICROPHONE.** Any good quality, high impedance crystal or dynamic type microphone may be used; however, best results will usually be achieved with a microphone designed especially for voice communication use.

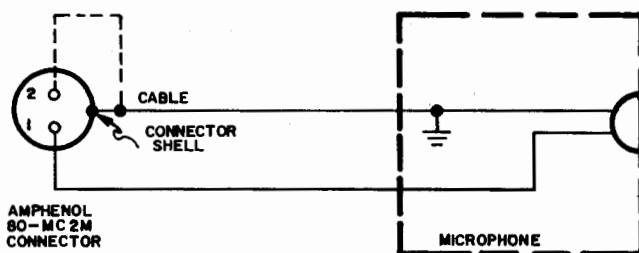
The MIC receptacle is located on the front panel. The microphone cable must be fitted with an Amphenol type 80-MC2M connector wired as shown in figure 3.

The microphone circuit shown with the PTT switch may also be used with VOX control; however, some microphones fitted with push-to-talk switches also mute the microphone element until the switch is pressed. Hence, VOX operation is not possible unless the microphone switch is altered accordingly.

Microphones without push-to-talk switching may be used with VOX. With the addition of the jumper wire shown in figure 3, these microphones may also be used when manual operation is desired. In this case, with the OPERATION control at MOX, the transmitter is on the air, and with the control at REC the transceiver is in the receive mode.



NOTE - THIS MICROPHONE MAY BE USED FOR VOX OPERATION IF MICROPHONE ELEMENT IS NOT DISABLED WHEN PTT SWITCH IS RELEASED.



NOTE - ADD JUMPER IF MANUAL CONTROL IN ADDITION TO VOX CONTROL IS DESIRED. SEE TEXT.

188-007375

Figure 3. Microphone Wiring (With and Without Push-to-Talk Switch).

3-7. **KEYER.** The station keyer is connected to the transceiver at the KEY jack (J8) located on the rear chassis apron. The key jack accepts a standard 1/4-inch phone plug. Wire the plug so that the key base connects to the plug sleeve which is at ground potential.

3-8. **PHONE PATCH.** The SR-400A is equipped with an RCA type phono jack to provide phone patch operation. This jack is connected in parallel with the MIC receptacle. For a detailed explanation of phone patch operation, consult the "Radio Amateur's Handbook."

3-9. **HEADPHONES.** A communications type headset of either high or low impedance may be used with the SR-400A to provide private listening or more exacting communications work. The PHONES jack requires a standard 1/4-inch phone plug. When the PHONES jack is utilized, the PS-500A-AC speaker is disabled; a 3- to 4-ohm external station speaker may also be connected to the PHONES jack.

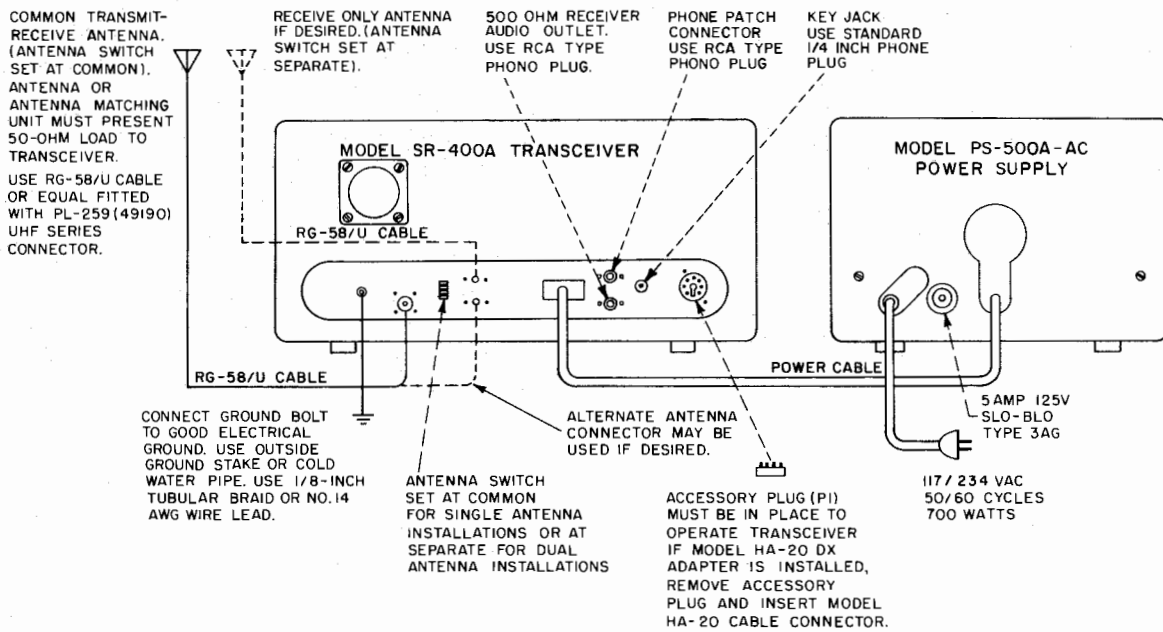
3-10. **BASE STATION INSTALLATION.** The SR-400A Transceiver may be operated as a base station with or without a linear power amplifier.

The PS-500A-AC or an equivalent power supply is required to operate the SR-400A from a 117/234 Vac, single-phase, 50- to 60-Hz power source.

Connect the multiconductor plug from the power supply, to the POWER receptacle (J7) at the rear of the transceiver (see figure 4). Never insert or remove this plug when the power supply is connected to the AC power source.

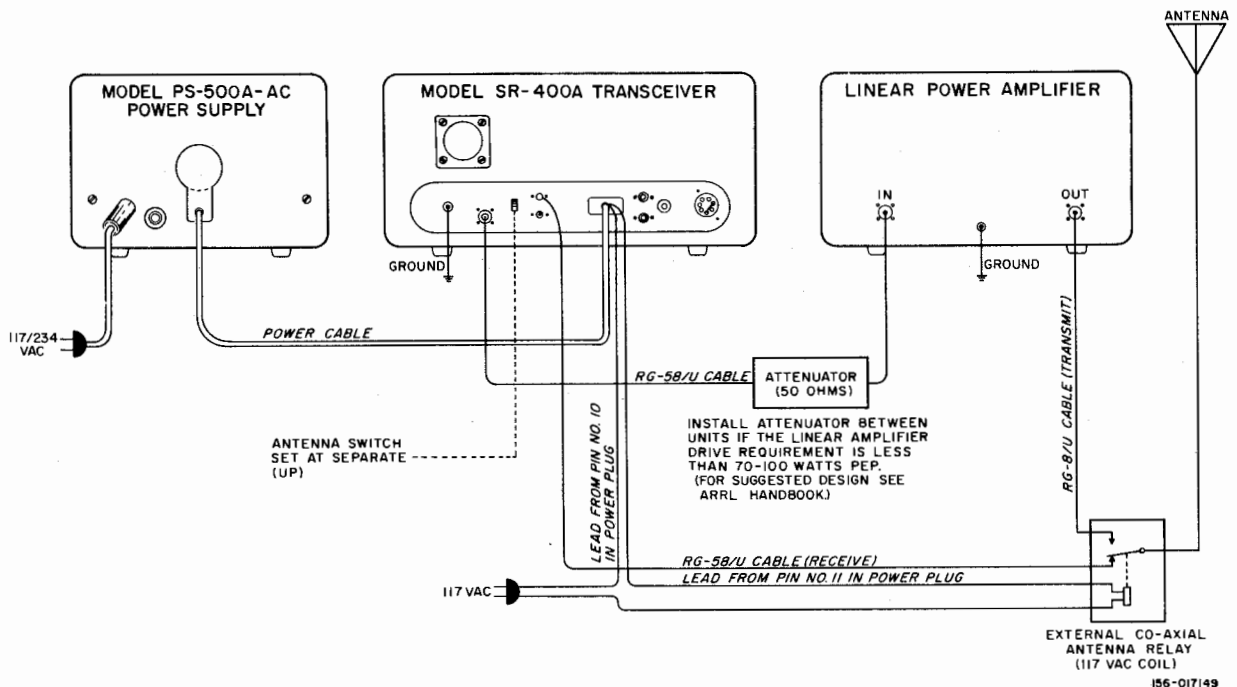
With the antenna system and ground wire connected to the transceiver, as outlined in paragraphs 3-3 and 3-4, the key or microphone connected to the respective receptacles, and the line cord of the power supply connected to the 117/234 Vac power source, the station is ready for operation. A speaker is contained within the power supply unit and is interconnected to the transceiver through the power cable.

Figure 5 presents a typical base installation cabling diagram, including a linear power amplifier with the SR-400A Transceiver. In the installation shown, the receiver input to the transceiver is connected directly to the station's antenna change-over relay through the top REC ONLY antenna connector (J3); the transmitter output of the transceiver is obtained through the COMMON OR TRANS ONLY antenna connector (J1 or J2 may be used) and fed to the linear amplifier input. The difference between the power output capability of the SR-400A and the drive level required by most linear amplifiers will dictate the use of some fixed amount of attenuation between the units, in the form of an RF power pad designed for 50-ohm input and output terminations.



156-017148

Figure 4. Typical Base Station Installation.



156-017149

Figure 5. Base Station Installation with Linear Amplifier.

Pins 10 and 11 of the POWER plug connect to the internal relay contacts on the VOX relay (K2) of the transceiver and may be connected into the circuit to control the external antenna change-over relay as shown. Push out the retaining pin in the cable connector housing and loosen the cable clamp to gain access to the POWER plug connections. Disconnect the power supply line cord from the wall outlet before exposing the power plug wiring.

NOTE

Before operating the SR-400A as a transmitter, the bias adjustment controls located on the front panel of the transceiver must be set. Refer to paragraph 5-4, C or paragraph 8-3 for details.

3-11. MOBILE INSTALLATION. The SR-400A Transceiver may be installed in vehicles having a 12-Vdc power source capable of supplying up to 43 amperes with good voltage regulation. To complete the mobile installation, a Model PS-500-DC Power Supply, a Model MR-400A Mobile Mounting Rack, and a mobile antenna system are required. If the installation is not wired into the automobile radio speaker system, Hallicrafters mobile speaker unit, Model R-49, is recommended for the separate speaker system.

The PS-500-DC Power Supply is wired for vehicles having the negative side of the battery grounded.

Before installing the equipment, it is necessary to set the exact position of the connectors at the rear of the mounting rack to properly index with the connectors of the transceiver unit. This alignment may be accomplished as follows:

A. Set the mounting rack, back side down, on a work bench and place the side panels in the open position. Make sure the four nuts securing the power and antenna connectors have been loosened to permit the connectors to "float".

B. Remove the transceiver chassis from the cabinet (see paragraph 7-1, C) and attach the two strike fittings to the cabinet sides with the 4-40 x 5/16 machine screws, nuts, and lock washers supplied with the Model MR-400A Mobile Mounting Rack. Install the transceiver chassis in the cabinet.

C. Hold the transceiver with the front panel up and very carefully slide the transceiver into the rack until the power and antenna connectors mate with those in the mounting rack. Use care in performing this step to avoid damaging the connectors through misalignment.

D. Snap the side fasteners in place to hold the transceiver securely in position. Turn the equipment onto one side and tighten the four nuts that secure the connectors to the mounting rack.

E. Unsnap the side fasteners, carefully remove the transceiver from the mounting rack, and proceed with the installation.

Base bracket and mounting straps are supplied for installing the Model MR-400A Mobile Mounting Rack under the dash or on the transmission hump (see figure 6). When selecting a location for installing the mounting rack, an open space should be allowed at the top or bottom to provide adequate ventilation for the transceiver. Before bolting the mounting rack in place, make the required antenna and power cable connections to the mounting rack connectors.

The Model PS-500-DC Power Supply may be installed in any convenient location. In the installation shown (figure 7), the power supply has been installed in the engine compartment close to the primary source of power.

It is recommended that the length of the primary leads to the power supply be kept short to minimize the voltage drop between the battery and the power supply (see figure 7). Mount the power supply securely, using thread forming screws or conventional hardware. Position the power supply in such a manner that the side with the terminal strip and bias adjustment control is readily accessible.

Install the multiconductor power cable, attached to the mounting rack, through the fire wall to the power supply. Since this cable is weather-proof, installation may be done underneath the vehicle if desired. Cut the cable to the desired length, attach the terminal lugs supplied, and connect these wires to the terminal strip on the power supply. (See figures 8 and 22 for color coding and terminal numbering.)

Install the antenna system in the manner recommended by the antenna manufacturer. Put the coaxial cable from the antenna through the hole in the right side of the mounting rack and solder the termination to the phono-plug type antenna connector at the rear of the mounting rack. Use care when soldering. Excess solder on the outside of the center pin must be removed to prevent possible damage to the female antenna connector in the transceiver unit. Prior to installing the mounting rack, a short length of coaxial cable may be connected from the phono-plug type connector on the rack to a type SO-239 UHF series coaxial connector, which is mounted in the cutout provided in the right side of the mounting rack. If this setup is used, the antenna cable may be connected to the mounting rack through a PL-259 UHF series connector.

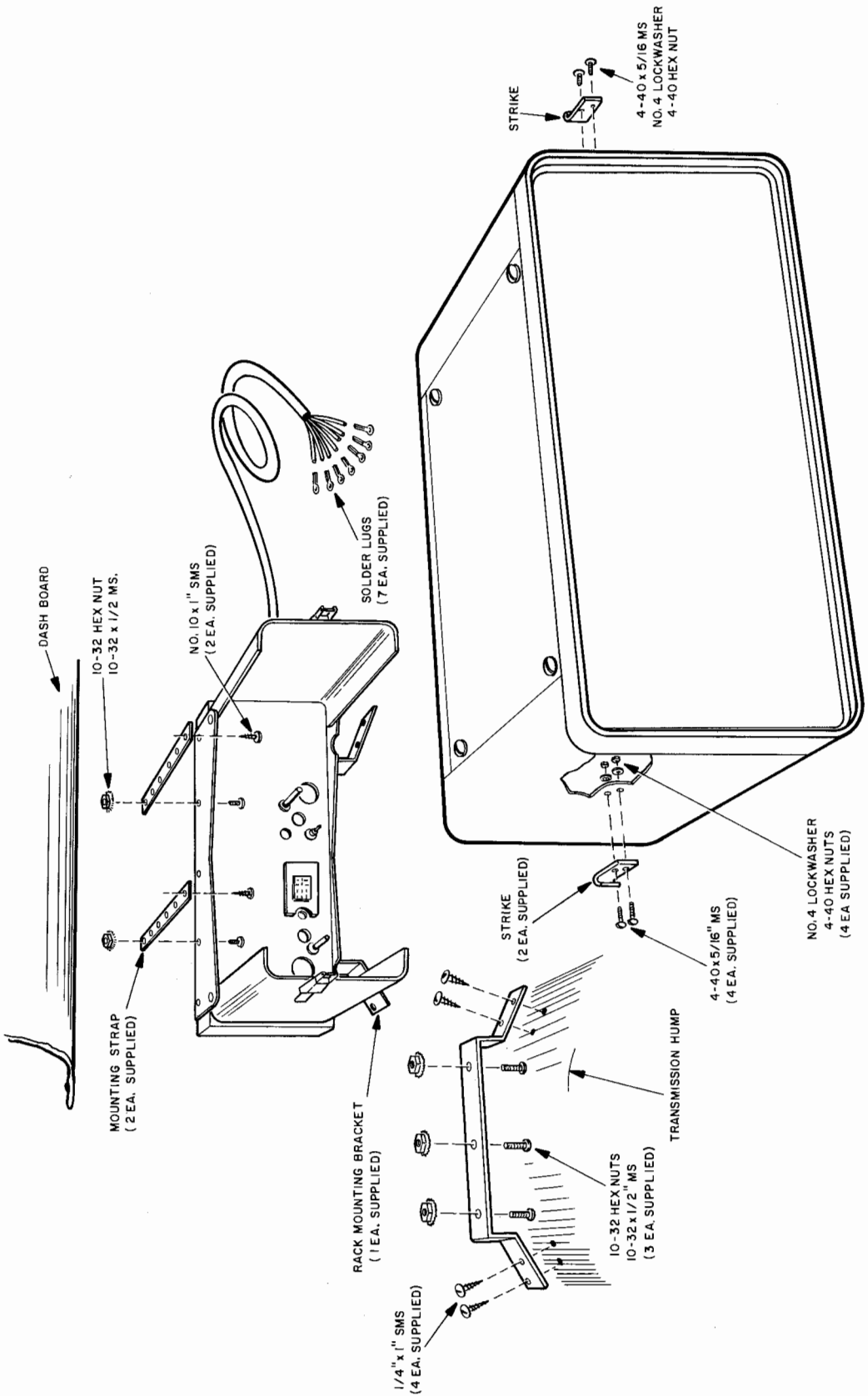


Figure 6. Mobile Installation of Transceiver Using MR-400A Mobile Mounting Rack.

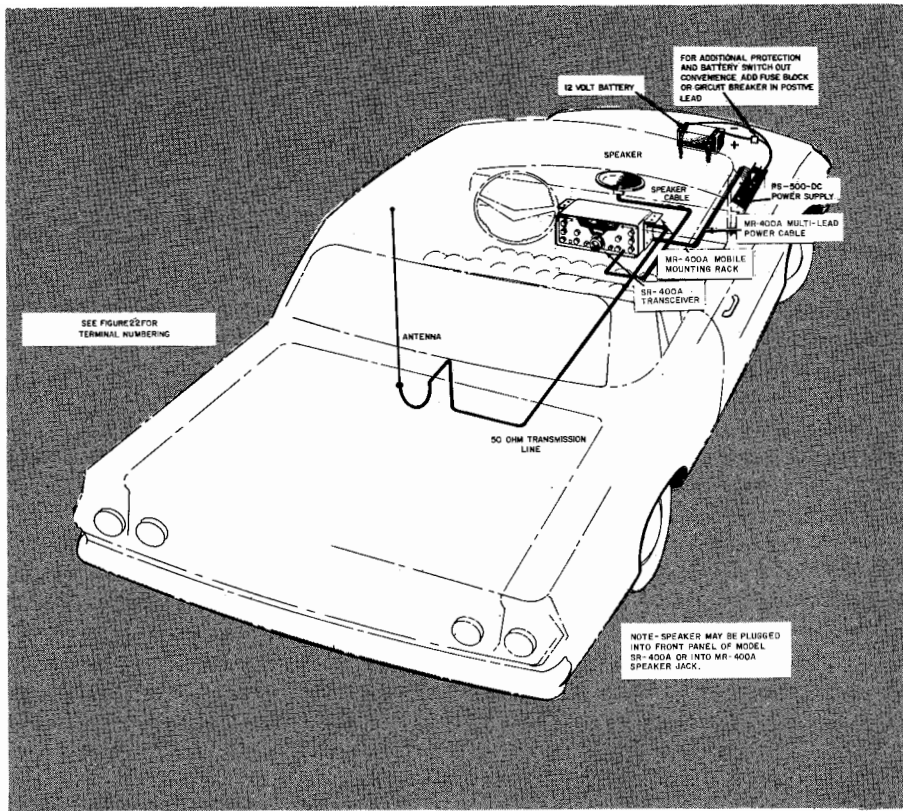
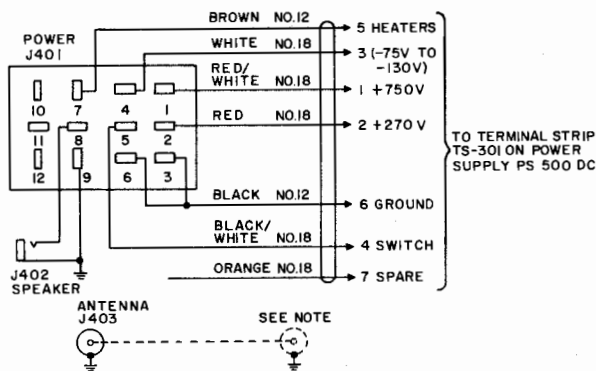


Figure 7. Wiring Diagram of Mobile Installation.



NOTE:
THE AREA DOTTED IN SHOWS WIRING NECESSARY IF A COAXIAL CONNECTOR IS AFFIXED TO THE SIDE OF THE MOUNTING RACK AND INTERNAL COAXIAL CABLE ADDED BETWEEN THIS CONNECTOR AND J403. IF DESIRED, THE ANTENNA MAY BE CONNECTED DIRECTLY TO J403.

156-008844

Figure 8. Wiring Diagram of the MR-400A Interconnecting Cable.

At this point, the mounting rack is bolted in place and the SR-400A Transceiver installed. Before placing the transceiver in the mounting rack, check the antenna selector switch position at the rear of the transceiver. The switch should be set at COMMON (down). Slide the transceiver into the MR-400A Mobile Mounting Rack making sure that the power and antenna connectors mate and seat properly. Secure the two units with the two spring loaded hasps at the sides of the mounting rack.

Connect the speaker to the phone jack provided at the right side of the mounting rack or to the PHONES jack on the front panel of the transceiver. A standard 1/4-inch, two-circuit phone plug mates with either jack. Use of the automobile radio loudspeaker is not recommended unless a selector switch is installed to disconnect the speaker from the automobile radio circuit when operating the SR-400A Transceiver. Hallicrafters mobile speaker unit Model R-49 is recommended when the installation incorporates a separate speaker system.

Connect a suitable microphone to the MIC receptacle on the front panel of the transceiver. The MIC receptacle mates with an Amphenol 80-MC2M cable connector. It is important that the internal wiring of the microphone be connected as shown in figure 3.

NOTE

Install the battery connections to the car battery last. Before connecting to the battery in the vehicle, check the transceiver to ascertain that the OPERATION switch is set at OFF. Make one final wiring check for possible errors.

Connect the two No. 8 AWG wires, supplied with the PS-500-DC Power Supply, to the battery. Connect the red wire to the positive (+) terminal of the battery and the brown wire to the negative (-) terminal of the battery. As a circuit refinement, the positive lead should be connected to the battery through a fuse block or circuit breaker (not supplied) with current capacity in excess of 43 amperes to protect the battery from accidental shorts and to provide a convenient means of switching out the battery supply. For convenience, the fuse block or circuit breaker should be located as close to the battery as practical.

CAUTION

BE CAREFUL WHEN MAKING CONNECTIONS TO THE BATTERY IN THE VEHICLE. THE POWER IN A BATTERY CAN CAUSE DANGEROUS BURNS AND EVEN EXPLOSION IF SHORT CIRCUITED.

Only after becoming familiar with the use and function of the controls, as outlined in Sections IV and V, should an operational check be performed. It is recommended that the automobile

engine be running while operating the SR-400A Transceiver to prevent draining power from the battery.

NOTE

Before operating the SR-400A Transceiver as a transmitter, make the bias adjustment by setting the panel BIAS ADJ control (R115) of the transceiver unit as outlined in paragraph 5-4, C or 8-3.

3-12. MOBILE NOISE SUPPRESSION. The built-in noise blanker circuitry is especially designed for ignition noise suppression and in most installations no additional suppression will be required. In extremely severe cases, however, the following suggestions may be helpful: Install resistor-type spark plugs and coaxial bypass capacitors in the ignition coil primary, and generator armature leads. At the voltage regulator, install bracket-mounted coaxial capacitors in the armature and battery leads to the voltage regulator and connect a series-connected, 0.002- μ F mica or disc capacitor and a 5-ohm resistor from the generator field lead to ground.

Hallicrafters has available a Mobile Noise Suppression Kit, Model HA-3, which can fulfill most suppression requirements.

Additional information, concerning the proper suppression of mobile noise, is available in the Handbook of Instructions for Hallicrafters Model HA-3 Mobile Noise Suppression Kit and in current handbooks on the subject, such as "The Mobile Manual for Radio Amateurs," published by the American Radio Relay League.

SECTION IV OPERATING CONTROLS

4-1. **GENERAL.** All controls utilized during normal operation of the SR-400A Transceiver are located on the front panel (see figure 9). A description of each control follows.

4-2. **TUNING CONTROL.** The tuning control knob is located at the center of the panel, just below the dial escutcheon. The control drives the VFO capacitor, which is the frequency determining element of the transceiver. The frequency to which the unit is tuned is displayed in the left-hand window and in the window above the knob. Metering information is displayed in the right-hand window.

The frequency dial in the left-hand window has two calibrated scales. The black scale is calibrated from 0 to 500 kHz, and the red scale is calibrated from 500 to 1000 kHz. The dial scales are color coded to the BAND SELECTOR calibrations, which also display the first digits of the operating frequency to the left of the decimal point.

Rotate the tuning knob and observe the two dial displays. The knob scale divides the 100-kHz increments of the main dial scale into 1-kHz increments.

The following examples will aid in developing the readout technique:

A. Set the BAND SELECTOR at 3.5 (red), and set the tuning knob so that the red scale indicates 650 near the fiducial and the knob dial scale indexes at 55 with the corresponding fiducial. The frequency then reads out as 3.655 MHz or 3655 kHz.

B. Set the BAND SELECTOR at 14, and leave the tuning knob set as before. The frequency now reads out as 14.155 MHz or 14,155 kHz, since the black dial scale on this band is being used. Basically, 14 MHz is obtained from the BAND SELECTOR calibration and 155 kHz is obtained from the black dial and knob dial scales.



156-017152

Figure 9. Front Panel View of SR-400A Transceiver.

The driving torque required to tune the transceiver is adjustable. The torque is at a minimum when there is clearance between the felt pad on the knob skirt and the panel. To increase the tuning torque (mobile operation), loosen the knob setscrews with a No. 8 Bristol setscrew wrench and position the knob on the shaft so that the felt pad engages the panel and develops the desired drag or tuning torque. Tighten the setscrews after obtaining the desired adjustment.

4-3. RIT CONTROL. The Receiver Incremental Tuning (RIT) control consists of two controls with concentric shafts. The ON/OFF function of the lever control places the variable-element RIT control either in or out of operation. This control, in the ON position, enables the operator to fine-tune the receiver plus or minus 2 kHz or more, by means of the RIT potentiometer (round knob), without disturbing the initial receiver or transmitter frequency. Returning the lever to the OFF position locks the receiver frequency to the transmitter frequency. The RIT control must be turned OFF to calibrate the dial or to operate the transmitter and receiver on a common frequency. The warning lamp to the right of the RIT control indicates that the RIT control is in operation.

4-4. RF GAIN/AF GAIN CONTROL. The RF GAIN and AF GAIN controls, located in the left-hand group, are two potentiometers mounted on concentric shafts. The RF GAIN control (lever) varies the gain of the receiver RF amplifier stage. Maximum receiver sensitivity is obtained with the lever set at 10 on the panel scale (fully clockwise).

The AF GAIN control (round knob) adjusts the audio output level from the speaker or headphones. Clockwise rotation of the control increases the audio output level.

4-5. OPERATION CONTROL. The OPERATION control is a four-position switch used to select the method of transceive control.

In the OFF position, all power is disconnected from the transceiver.

In the REC position, the receiver portion of the transceiver is placed in operation, and all circuits common to both receiver and transmitter are in the receive condition, while circuits used only in the transmit mode are either biased off or switched off by the control.

In the MOX position, when operating SSB, the receiver circuits remain in effect until the microphone push-to-talk (PTT) button is pressed. Closing the microphone switch transfers the circuitry from the receive to the transmit mode through the bias and relay switching. Releasing

the microphone button again restores receiver operation. When operating the transceiver as a CW station, the receiver circuits are disabled when the control is set at MOX, and the transmitter circuits are keyed for code transmission.

In the VOX position, the receiver circuits continue to function until the transmitter circuitry is energized by voice for single-sideband operation or by pressing the key for code transmission. In the absence of voice or keying, the transceiver is automatically returned to the receiver mode; hence, this position is used for automatic or break-in phone and CW control.

4-6. FUNCTION CONTROL. The FUNCTION control is a four-position switch used to select the mode of transmission or reception. The control is set to CW for code transmission, to TUNE when tuning the transmitter for CW or SSB operation, and to either USB or LSB for single-sideband operation, depending upon which sideband is selected for voice communication.

4-7. NOISE BLANKER CONTROL. The NOISE BLANKER control is a potentiometer which varies the operating bias voltage applied to the noise amplifier stage in the receiver IF amplifier system. Rotating the control fully counterclockwise disables the noise blanker operation, and the receiver functions in a conventional manner without noise immunity.

When noise immunity is desired, the NOISE BLANKER control is turned clockwise from the OFF position until the noise level begins to drop to an acceptable signal-to-noise ratio. For best overall performance, do not advance the control beyond this setting.

4-8. CAL ON/CAL ADJ CONTROL. The CAL ON/CAL ADJ control consists of a potentiometer with a pull switch mounted on the shaft. With the proper use of this control, the operator may check the dial calibration accuracy at the 25-kHz points on the dial.

The CAL ON pull switch is mounted on the CAL ADJ potentiometer. When pulled out, the CAL ON switch activates the 25-kHz crystal calibrator. Once the calibrator is activated, the dial calibration mark on the frequency of reception or transmission are made to coincide by the adjustment of the CAL ADJ potentiometer.

4-9. SHARP CW/NOTCH ADJ CONTROL. The SHARP CW/NOTCH ADJ control consists of a potentiometer with a pull switch mounted on the shaft.

The NOTCH ADJ potentiometer is used to set the notch frequency and may be set at any point in the IF passband to attenuate interfering

heterodynes or CW signals. When this control is in the fully counterclockwise position (recommended initial set position), the notch is removed from the passband. The control functions in all the receive modes.

When pulled out, the SHARP CW pull switch places the sharp CW filter into the circuit. When the switch is pushed in, the sharp CW filter is removed from the circuit and the receiver functions with the 2.1-kHz SSB filter. The sharp CW filter peaks at approximately 800 Hz in the CW and USB receive modes. In the LSB mode, the filter peaks at 1600 Hz, the 6-dB bandwidth is about 200 Hz, and the sharp CW filter is automatically switched out in all transmit modes.

4-10. BAND SELECTOR CONTROL. The BAND SELECTOR control is an eight-position rotary switch used to select the desired operating frequency range. The panel markings refer to the low frequency limit (indicated in megahertz) of that band. The switch positions in red indicate that the red dial scale is to be used on these bands, and the black dial scale is used for the remaining bands.

4-11. PRESELECTOR CONTROL. The PRESELECTOR control drives a three-section variable capacitor which tunes both receiver and transmitter circuits to a frequency within a given band. In the receive mode, the receiver RF amplifier and first mixer stages are tuned to frequency; while in the transmit mode, the control tunes the transmitter second mixer and driver stages to frequency. The segmented dial scale provides for an initial setting when changing bands.

For general receiver tuning, the control is adjusted for maximum receiver sensitivity; however, for transceive operation, the control is adjusted for maximum transmitter output during transmitter tune-up and should always be left at this setting for the receive mode.

4-12. RF LEVEL/MIC GAIN CONTROL. The RF LEVEL and MIC GAIN controls, located in the right-hand group, are two potentiometers mounted on concentric shafts. The RF LEVEL control (lever) varies the RF carrier level for CW operation or for tune-up purposes for both CW and SSB operation. Maximum CW output is obtained as the lever is turned clockwise toward 10 on the panel scale.

The MIC GAIN control (round knob) adjusts the audio level to the balanced modulator stage from the microphone amplifier stages. Clockwise rotation of the control knob increases the microphone sensitivity and reaches maximum sensitivity at 10 on the panel scale.

4-13. METER CONTROL. The METER control is a three-position switch used to select the metering information desired by the operator.

In the receive mode, the first two switch positions provide "S" meter information about the received signal strength. At S-9 on the meter scale, the received signal level represents approximately 50 microvolts at the antenna terminals. The third switch position functions only in the transmit mode.

In the transmit mode, the first switch position, marked RFO, provides an RF voltage measurement across the antenna terminals of the transmitter for tune-up purposes. Since the transmitter is always tuned for maximum RF voltage, the meter calibration, as such, is relative, and the operator may use either meter scale to keep track of normal output levels obtained for CW and SSB modes of operation.

In the AALC switch position, the meter monitors the amplified automatic level control voltage developed to control the final amplifier drive level for SSB operation. A large meter deflection in this position indicates that the voice peaks are probably causing "flat-topping" of the output signal. Excessive "flat-topping" during SSB transmission should be avoided by careful adjustment of the MIC GAIN control until a deflection of S-3 is obtained on average voice peaks.

In the PLATE MA position, the meter indicates the plate current drawn by the final amplifier tubes while transmitting. In the receive mode, the meter is disabled. For further information regarding the use of the plate current meter readings, refer to Section V, Tuning Procedure.

4-14. LOAD/PLATE CONTROL. The LOAD and PLATE controls consist of separate variable capacitors in the PI network circuitry of the final amplifier. The controls are driven through concentric shafts by two knobs; the round knob drives the plate capacitor, and the lever drives the load capacitor. A 1 to 10 panel scale provides the operator with a logging scale for presetting the capacitors when changing bands. For more specific information on the use of these controls, refer to Section V, Tuning Procedure.

4-15. BIAS ADJ CONTROL. The BIAS ADJ control sets the operating bias required by the final amplifier tubes. The control is a screwdriver-type adjustment to avoid disturbing the setting unintentionally. The bias adjustment must be made when the transmitter is first placed in operation, and then only an occasional check and possible adjustment is required thereafter. Refer to paragraph 5-4, C or 8-3 for details of adjustment procedure.

SECTION V

TUNING PROCEDURE

5-1. GENERAL. The operating procedure for the SR-400A Transceiver is not complicated; however, normal care should be exercised when operating the equipment to realize the true performance designed into the equipment. Before applying power to the equipment for the first time, recheck the critical items of the installation.

- Is the station antenna system connected and compatible with the load impedance requirements of the transceiver?
- Is the interconnecting cable between the transceiver and power supply in place? If the installation is mobile, are the power cable leads correctly connected to the DC power supply?
- Is the equipment bonded to a good electrical ground?

NOTE

Before operating the transmitter portion of the transceiver, the bias adjustment controls (BIAS ADJ), located on the transceiver panel, must be correctly set. Refer to the basic transmitter tune-up procedure (paragraph 5-4, C) or to the bias adjustment procedure (paragraph 8-3).

5-2. RECEIVER OPERATION. The transmitter group of controls, not specifically mentioned below, have no direct bearing on receiver operation and may be disregarded for receiver operation.

A. Preset the SR-400A front panel controls as follows:

RIT CONTROL. OFF
 RF GAIN. 10 (fully clockwise)
 AF GAIN. As required
 OPERATION OFF
 FUNCTION USB or LSB as desired
 NOISE BLANKER. .OFF (fully counterclockwise)
 CAL ON/CAL ADJ Off (push in)
 SHARP CW/NOTCH ADJ Off (push in)
 BAND SELECTOR Desired band
 PRESELECTOR. Set at band segment in use
 METER RFO/S

B. Connect the line cord plug to the power source outlet.

C. Set the OPERATION control to REC. The dial and meter faces on the transceiver will illuminate. Allow a few minutes for the equipment to reach operating temperature in order to stabilize.

D. Use of the PRESELECTOR control - As the receiver is tuned across the band, an occasional readjustment of the PRESELECTOR control is necessary. Always adjust the control for maximum "S" meter reading on signal or for maximum background noise without signals present. When the PRESELECTOR control has been set during transmitter tune-up on the frequency, the control must remain at that setting for the receive mode. The exact setting is more critical for transmitter operation than for receiver operation.

E. Use of the RFGAIN control - Normally, the RF GAIN control is set at 10 (fully clockwise) to obtain full Automatic Gain Control (AGC) action for uniform speaker output while tuning in stations of varying signal strengths across the band. While the AGC is customarily employed for SSB reception, the RF GAIN control may also be used to advantage for CW code reception. The control must be set at the fully clockwise position to obtain normal "S" meter operation. The operator will notice, however, that the "S" meter deflection falls off on signal as the RF GAIN control is rotated counterclockwise from the maximum setting. Manual control of the receiver sensitivity, at times, is desirable, and the operator may set the RF GAIN control as required for these occasions.

F. Tuning with the RIT CONTROL - There are situations, especially during CW operation, when it is advantageous to be able to tune the receiver a few kHz either side of the operating frequency without disturbing the transmitter frequency. The SR-400A Transceiver has this capability. To independently tune the receiver a few kHz either side of the operating frequency, switch the RIT CONTROL to the ON position (lever) and then tune the receiver with the RIT CONTROL (knob). The transmitter frequency remains at the dial frequency. Turning the RIT CONTROL knob clockwise increases the receiver frequency. Switching the RIT CONTROL to the OFF position returns the receiver to the dial frequency. The reference marks indicate approximately 1-kHz intervals.

Table 5. Model SR-400A Control Settings for 50-Ohm Resistive Load.

FREQUENCY (MHz)	PLATE		LOAD	
	NOMINAL	ACTUAL	NOMINAL	ACTUAL
3.5	2-1/4		4	
3.75	3		6	
4.0	3-1/2		8	
7.0	3-1/2		4-1/2	
7.3	4		5	
14.0	5		5	
14.35	5-1/2		5-1/2	
21.0	6-1/2		4-1/4	
21.45	7		4-1/2	
28.0	7-1/2		5-1/2	
29.7	8		7	

The above data is based on the average SR-400A PLATE and LOAD control settings when operated into a purely resistive 50-ohm load. These settings vary slightly with the loading variations presented by the operator's installation, and it is suggested that the operator make note in the appropriate column (actual of the final control settings required for use with the antenna system to facilitate a rapid initial adjustment when changing bands or frequency within the band.

transmitter. Check to see that the RF LEVEL control is set to zero and, if using the PS-500-DC, assure that the BIAS control on the power supply unit is set at the fully clockwise position for maximum bias voltage. Reset the OPERATION control to MOX and without delay rotate the BIAS ADJ control (screwdriver adjustment) until the meter pointer lines up with the SET BIAS arrow on the meter scale (70 MA).

D. Set the METER control to RFO/S and check to see that the final amplifier PLATE and LOAD controls are preset per table 5. Watching the meter, turn the RF LEVEL control slowly clockwise until the RFO meter indicates a low output level (S-3 to S-5) on the "S" meter scale. Adjust the PLATE control first, and then adjust the PRESELECTOR control for maximum RFO meter reading. Turn the RF LEVEL control counterclockwise if the RFO meter indicates above S-7 while tuning. The driver and final amplifier stages are now resonated, but the final amplifier stage requires a loading check and possible adjustment.

NOTE

During the next step of the transmitter tuning procedure, the final amplifier tubes operate at the highest plate dissipation. The plate dissipation at this time is higher than for continuous operation on either SSB or CW at full power

output. For this reason, it is recommended that full carrier power be applied only for the length of time needed to evaluate the loading adjustment. DO NOT APPLY FULL POWER WHEN TUNING FOR MORE THAN 20 SECONDS AT A TIME.

E. Set the METER control to PLATE MA. Watching the PLATE current indicator, slowly turn the RF LEVEL control clockwise until the plate current reaches 400 to 500 mA. Turn the RF LEVEL control counterclockwise to zero and consider the loading adjustment as follows:

1. Loading too light - If the RF LEVEL control reaches 10 (fully clockwise) with the plate current refusing to increase to within a range of 400 to 500 mA, the loading is too light and the LOAD control must be turned clockwise to increase the coupling or loading on the final amplifier stage.

2. Loading too heavy - If the plate current exceeds 500 mA as the RF LEVEL control setting is advanced, the loading is too heavy. To correct this condition, turn the LOAD control counterclockwise to reduce the loading.

3. Loading normal - When the plate current increases to within the range of 400 to 500 mA and levels off at this value as a maximum while the RF LEVEL control is turned clockwise,

the loading is considered normal. Each time the LOAD control setting is changed, the PLATE control must be returned to resonance or the loading check is not valid. The plate current does not always level off as the RF LEVEL control is advanced. Always check to assure that the plate current dip coincides approximately with maximum RFO. If not, see paragraph 8-7. Adjust the LOAD and PLATE controls for maximum RFO and simultaneous plate current dip, indicating resonance.

F. As the operating frequency is changed within the band, retune the transmitter with the PRESELECTOR and PLATE controls for maximum RFO voltage to keep the driver stage and final amplifier stage plate circuits at resonance. When a major change in frequency is required, that affects the final amplifier loading, the load check and a possible LOAD control adjustment must be made. An indication of the variation in the LOAD control setting with a frequency within a given band is obtained from the nominal settings listed in table 5.

G. Set the OPERATION control to REC to restore receiver operation.

5-5. CW OPERATION.

A. Before switching the OPERATION control from REC to MOX, make sure the following controls are correctly set for CW operation:

FUNCTION TUNE
 METER PLATE MA
 RF LEVEL Zero (fully counterclockwise)
 MIC GAIN Zero (fully counterclockwise)
 PLATE Adjusted per paragraph 5-4
 LOAD Adjusted per paragraph 5-4
 PRESELECTOR Adjusted per paragraph 5-4
 BAND SELECTOR Desired band
 TUNING CONTROL Set to desired frequency

B. Assuming that the transmitter has been properly loaded and tuned to frequency, as described in the basic transmitter tune-up procedure, switch the OPERATION control from REC to MOX. The plate current meter should indicate at the SET BIAS arrow. Advance the RF LEVEL control until the plate current reaches 450 mA maximum. Make one final adjustment with the PLATE control and PRESELECTOR control for maximum RFO voltage (METER control at RFO/S) to be sure the transmitter is in tune. Make this adjustment a habit - the tubes last longer, and a cleaner output signal is obtained.

C. Leave the RF LEVEL control set for 450 mA, and switch the FUNCTION control to CW. The transmitter output will drop to zero, provided the keyer circuit is open. Press the key and the

plate current should remain at 450 mA. While transmitting, the RFO voltage may be monitored when an "S" meter reading is also desired in the receive mode. (METER control set at RFO/S.)

D. Return the transceiver to the receive mode by switching the OPERATION control back to REC. This position is the manual control over the transmit-receive function. If automatic control is desired, set the OPERATION control to VOX. The receiver continues to operate until the key is closed. Open the key and observe the delay before the receiver is again active. This delay may be set as desired with the DELAY control (R155), located on the top of chassis (cover removed). The delay period increases as the DELAY control is turned clockwise.

E. The SR-400A Transceiver also provides a CW sidetone signal through the speaker or headphone output, which is keyed along with the transmitter, for monitoring purposes. The level may be varied as desired with the SIDE TONE control (R99), located on the top of chassis (cover removed).

5-6. PUSH-TO-TALK SSB OPERATION.

A. Before switching the OPERATION control from REC to MOX, make sure the following controls are correctly set for SSB operation.

FUNCTION USB or LSB as required
 METER PLATE MA
 RF LEVEL Zero (fully counterclockwise)
 MIC GAIN Zero (fully counterclockwise)
 PLATE Adjusted per paragraph 5-4
 LOAD Adjusted per paragraph 5-4
 PRESELECTOR Adjusted per paragraph 5-4
 BAND SELECTOR Desired band
 TUNING CONTROL Set to desired frequency

B. Assuming that the transmitter has been properly loaded and tuned to frequency as described in the basic transmitter tune-up procedure, switch the OPERATION control from REC to MOX. The plate current meter should indicate at the SET BIAS arrow. Advance the RF LEVEL control until the plate current reaches maximum. If the plate current increases to within a range of 400 to 500 mA, the loading is correct. Make one final adjustment of the PLATE control and PRESELECTOR control for maximum RFO voltage (METER control at RFO/S) to be sure that the transmitter is in tune. Make this adjustment a habit - the tubes last longer, and a cleaner output signal is obtained. Return the RF LEVEL control to zero (fully counterclockwise).

C. Switch the FUNCTION control to either USB or LSB depending upon the sideband to be used for transmission and reception. The plate current meter indicates to the left of zero, and the receiver is in operation.

D. Switch the METER control to the AALC position. Press the microphone push-to-talk switch. Speak into the microphone at a normal voice level and advance the MIC GAIN control until the meter pointer on the transceiver panel begins to kick up to about S-3 on voice peaks. This is the correct working level. Use this meter switch position when operating SSB to monitor the SSB transmissions. The microphone gain control setting is less critical because of the compression action of the AALC circuitry; however, the actual control setting still depends upon the type of microphone, the operator's voice characteristics, and operating habits. Sufficient microphone gain is built into the SR-400A Transceiver to handle the usual range of levels associated with communication type microphones. Do not attempt to judge PEP input by observation of plate current as meter damping allows current peaks of only 200 to 300 mA to indicate on the METER when running full input power. Higher readings simply indicate increased distortion, not useful power output.

E. Release the microphone switch button. The transceiver returns to the receive function. The meter on the transceiver now monitors the strength of the incoming signals in the usual "S" units of measurement; S-9 represents approximately a 50-microvolt signal.

5-7. VOICE CONTROLLED SSB OPERATION. The operating procedure outlined for basic transmitter tune-up (paragraph 5-4) and push-to-talk sideband operation (paragraph 5-6) also apply for voice-controlled, single-sideband operation. The following adjustments, therefore, are intended to apply only to the adjustment of the VOX control system.

A. To avoid unintentional transmission while adjusting the VOX system controls, set the MIC GAIN control to zero (fully counterclockwise).

B. Turn the four transceiver cabinet screws 1/4 turn counterclockwise to loosen the fasteners and remove the top cover to gain access to the VOX controls.

C. Initially set the VOX, DELAY, and ANTI-TRIP controls fully counterclockwise.

D. Set the OPERATION control to VOX and the FUNCTION control to either the USB or LSB position.

E. Turn the VOX control clockwise, while talking into the microphone, until the VOX control relay closes on the first syllable of speech. The transceiver switches from the receive mode to the transmit mode when the relay closes. Use just enough VOX gain to accomplish the desired results. Too much gain makes the system oversensitive to speaker feedback, and too little sensitivity creates a relatively high signal level at the antenna relay contacts when switching to the transmit mode.

F. Adjust the DELAY control for the desired drop-out delay. The delay period increases as the DELAY control is turned clockwise. The delay period should be long enough to prevent change-over between words, but not long enough to miss the other operator's quick reply.

G. Set the receiver AF GAIN control for the desired listening level and advance the ANTI-TRIP control clockwise until the received signals do not actuate the VOX control relay. Excessive anti-trip gain or a major increase in the established listening level may lock out the voice control system.

H. With the VOX controls adjusted, either method of control may be selected by setting the OPERATION control at MOX for manual control or at VOX for voice control. To place the transmitter in operation, speak into the microphone and reset the MIC GAIN control while observing the "S" meter (METER control in AALC position).

I. Replace the cabinet cover and turn the screws 1/4 turn clockwise to lock the cover in place.

NOTE

Some microphones, equipped for push-to-talk control, have shorting contacts in the switch to disable the microphone element when the push button is released. VOX operation is not feasible unless this circuitry is disconnected within the microphone.

SECTION VI

THEORY OF OPERATION

6-1. **GENERAL.** The SR-400A Transceiver consists of a double-conversion receiver and double-conversion transmitter. To achieve true, on frequency transceiver operation, the VFO, heterodyne crystal oscillator, and carrier frequency oscillators all contribute to the transmit and receive functions. In addition, the 6.0- to 6.5-MHz IF amplifier and 1650-kHz IF amplifier stage associated with the crystal lattice filter all function for both modes. Circuitry that compromises performance to accomplish common usage between the transmit and receive function is avoided in the design of the SR-400A. Refer to figure 10 for the block diagram of the system and to figure 31 for the schematic diagram.

6-2. **RECEIVER SECTION.** The signal (f_1) at the antenna connector is fed to the receiver RF amplifier stage (V1) through the antenna relay (K1) located in the transmitter final amplifier section. The signal is amplified and applied to the first receiver mixer (V2A), where the amplified signal is heterodyned to frequency (f_2), which is the difference between the heterodyne crystal oscillator (V12) frequency (X1) and the signal frequency (f_1). The resulting variable IF signal (f_2) falls between 6.0 MHz and 6.5 MHz. The RF amplifier and first mixer circuits are selected by the BAND SELECTOR control and tuned by the PRE-SELECTOR control.

The variable IF signal (f_2) is amplified by a broadband IF amplifier (V3A) and then heterodyned to the second IF frequency of 1650 kHz (f_2) by mixing with the VFO (V13 and V4B) in the second receiver mixer (V4A).

With the NOISE BLANKER control set to OFF, the second IF signal (f_2) is amplified by the first 1650-kHz IF amplifier and blanker stage (V6) in a conventional manner. When the NOISE BLANKER control is adjusted for maximum noise rejection, the noise amplifier stage (V5A) samples and amplifies the 6.0- to 6.5-MHz noises and signal (f_2). The signal and noise pulses in this path are detected and shaped into positive going pulses by diode (CR7). The detected signal, which is predominantly noise pulses, is amplified by the pulse amplifier stage (V5B). The negative going pulses are fed to grid No. 3 of the pentagrid-type, first 1650-kHz IF amplifier and blanker tube (V6) with diode (CR6) acting as a steering diode to prevent positive pulses from reaching grid No. 3. Pulse modulation of the IF amplifier and blanker stage, momentarily interrupts the

second IF signal (f_2) during noise bursts with no apparent discontinuity of reception because of the relatively short pulse duration.

The output of the first 1650-kHz IF amplifier (V6) is connected to a tuned circuit (L15, C54 and C59) to match the 500-ohm crystal filter (FL1) input impedance. Before reaching the crystal filter, the signal passes through a 1652,200-kHz quartz crystal (Y12), the SHARP CW filter, or a diode (CR23) that is connected across the crystal. In the case of normal SSB reception, the diode conducts to short-circuit the crystal (Y12) so that the IF passband is 2.1-kHz wide, as determined by the crystal lattice filter (FL1). When the SHARP CW switch is pulled out (on), the diode (CR23) does not conduct. In this condition the crystal (Y12) is connected in series with the crystal lattice filter. The IF passband is then 200 Hz wide at the 6-dB points. CR23 remains conductive in the transmit mode regardless of the position of the SHARP CW switch.

The 1650-kHz IF signal now passes through the crystal lattice filter (FL1) and a termination network consisting of L16, C63, C124 and R168 to the grid of the second 1650-kHz IF amplifier (V7A). At this grid a quartz crystal is connected in series with a varicap (CR27) to ground. The varicap bias is varied with the NOTCH ADJ control, which moves the series resonant frequency of the crystal to any point in the 2.1-kHz IF passband creating a notch which is moved out of the IF passband during transmit by switching the bias to the varicap, or during receive when the NOTCH ADJ control is turned fully clockwise. After being amplified by the second 1650-kHz IF amplifier (V7A), the signal path is split; one path feeds the signal to the product detector (V9A), the other path feeds the signal to the AGC amplifier (V8A).

The product detector stage (V9A) heterodynes the 1650-kHz signal (f_2) with one of the two carrier oscillator frequencies (X3) to shift the signal frequency to the audio frequency range. The choice of carrier oscillator frequency (X3) determines whether the upper sideband or lower sideband group of frequencies are detected, since the crystal lattice filter response relative to the carrier frequency (X3) causes the unwanted sideband group of frequencies in each case to be rejected before reaching the product detector.

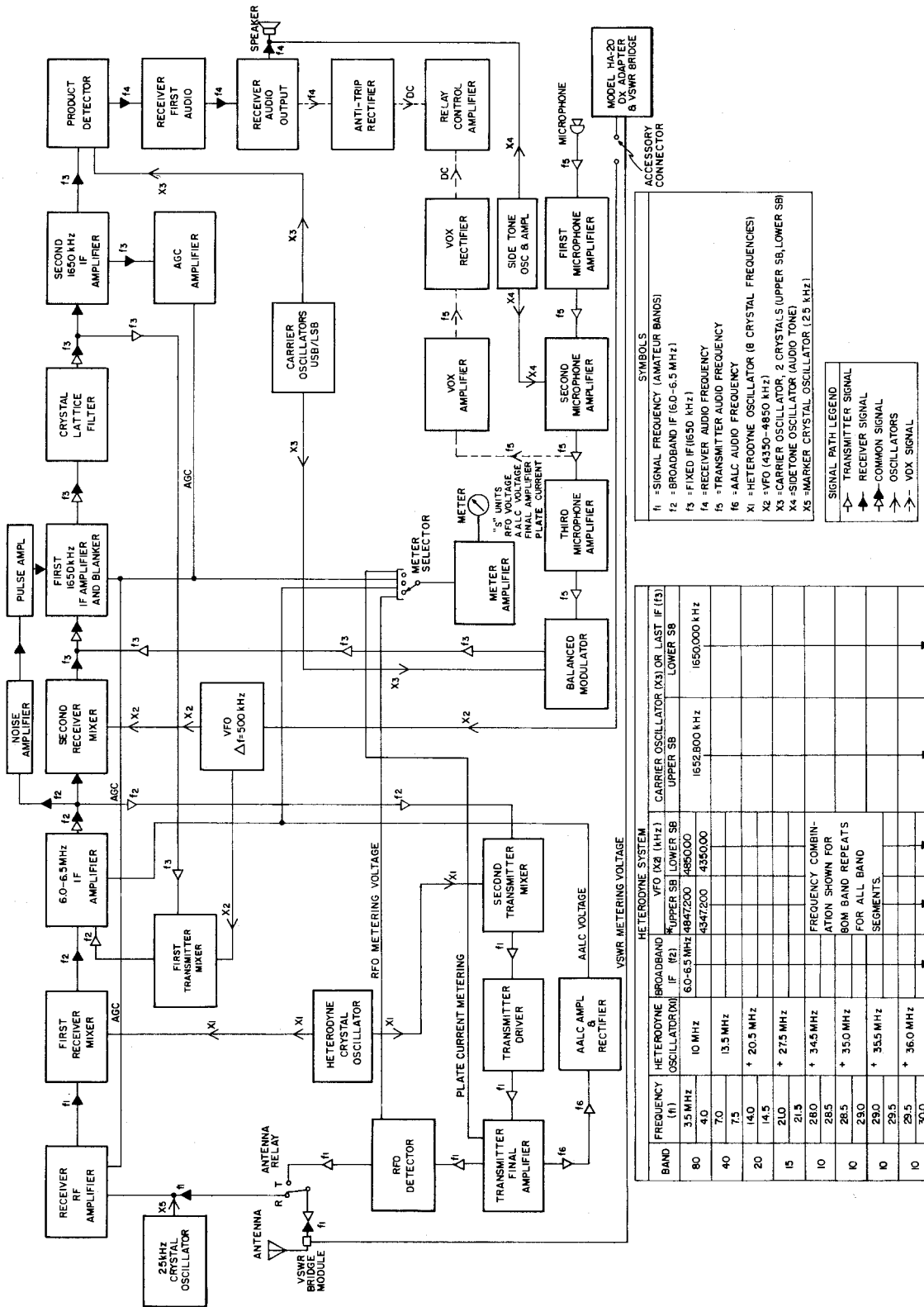


Figure 10. Block Diagram of SR-400A Transceiver.

Normally, shifting the carrier oscillator frequency (X3) to obtain upper and lower sideband reception would also entail shifting the receiver dial setting to receive the opposite sideband of a signal frequency (f_1) at the antenna input.

The SR-400A system shifts the VFO frequency (X2) electrically with capacitors C126 and C127 using diode switch CR12 and varicap CR13 when the 1652,800-kHz carrier oscillator frequency is switched on for upper sideband reception (or transmission). Shifting the VFO frequency by an amount equal to the difference between the two carrier oscillator frequencies (X3), or 2.8 kHz, the received suppressed carrier frequency (f_1) is received at the same dial setting for both upper and lower sidebands.

The 1650-kHz IF signal (f_3) fed to the AGC amplifier stage (V8A) is amplified and detected to supply the negative DC bias voltage (AGC) used to control the gain of the receiver RF amplifier stage (V1) and first 1650-kHz IF amplifier and blanker stage (V6). The signal level at which the gain control takes effect is controlled by the AGC THRESHOLD control (R46).

The detected signal amplitude is controlled by the AF GAIN control (R4B) and amplified to speaker level by the first audio amplifier stage (V9B) and audio output stage (V15). Two audio output impedances are available for external use: 500 ohms at the phono jack located on the rear chassis apron or 3.2 ohms at the PHONES jack on the front panel.

6-3. TRANSMITTER SECTION. The audio frequency signal (f_5) generated by the microphone is amplified by a three-stage audio amplifier (V19A, V19B, and V14B). The audio frequency signal (f_5) then modulates the selected (USB/LSB) carrier oscillator signal (X3) in the balanced modulator stage (CR19 and CR20) to produce a double-sideband suppressed carrier signal (f_3) near 1650 kHz. The double-sideband signal (f_3) is amplified by the first 1650-kHz IF amplifier and blanker stage (V6) with the blanker system disabled during the transmit mode of operation.

The unwanted sideband of the double-sideband signal is attenuated by more than 50 dB as the signal passes through the crystal lattice filter (FL1); therefore, a single-sideband suppressed carrier signal results. The signal is blocked for the transmit function, at the second 1650-kHz IF amplifier stage (V7A) with bias voltage switching, and the signal proceeds to the first transmitter mixer stage (V2B).

At the first transmitter mixer stage, the signal (f_3) is heterodyned with the VFO frequency (X2) to produce a signal frequency (f_2) in the

6.0- to 6.5-MHz frequency range. The signal frequency passes through the bandpass circuits of the 6.0- to 6.5-MHz IF amplifier (V3A) and on to the second transmitter mixer (V11A), because in the transmit mode the signal is blocked with switching bias at the second receiver mixer (V4A).

The intermediate frequency signal (f_2) is now heterodyned with the heterodyne crystal oscillator frequency (X1) to produce the final transmitter output signal frequency (f_1). The output signal frequency (f_1) is amplified by the transmitter driver stage (V18) and final amplifier stage (V16 and V17) to obtain the desired power level.

The output signal is fed through the PI network in the final amplifier stage to transform the impedance to the antenna transmission line impedance (50 ohms nominal), and from the output of the PI network the signal is conducted through the antenna relay (K1) to the common antenna connector.

6-4. RIT CONTROL. Receiver incremental tuning (RIT) is applied at the VFO stage, since this stage is one of the three frequency determining elements in the system for both the transmit and receive function.

The varicap (CR13) in the VFO stage is a solid-state device which has effective capacity that varies with the DC bias potential applied across its terminals. The source of this bias supply potential is regulated by zener diode (CR14) to insure frequency stability.

For normal operation as a transceiver system, the CAL ADJ potentiometer (R90) is used to set the VFO frequency as a dial calibration control. When Receiver Incremental Tuning is desired, the VFO frequency is controlled by setting the varicap bias voltage with the RIT panel control (R91). The varicap bias voltage is switched by the VOX relay (K2) so that the CAL ADJ potentiometer (dial calibration) sets the VFO frequency when transmitting, regardless of the RIT control setting. This adjustment keeps the transmitter at the dial frequency, but allows independent tuning of the receiver for a few kilohertz on either side of the dial frequency.

6-5. METERING. The transceiver circuits are metered by one multipurpose meter in the SR-400A Transceiver.

The multipurpose meter (M1) in the SR-400A Transceiver has a three-position selector switch (S2) which provides for metering the system as follows:

A. In positions 1 and 2, the meter is connected into a bridge circuit with the meter amplifier tube (V6B) forming one arm of the bridge and the METER ZERO control (R120) providing the meter zero adjustment arm for bridge balance.

1. When the transceiver is in the receive mode, the AGC voltage developed on signal is fed to the meter amplifier tube grid to unbalance the bridge and provide a log scale deflection for metering antenna signal levels. The meter is calibrated in the customary "S" units up to S-9 and in dB over S-9, with S-9 representing approximately 50 microvolts at the antenna terminals.

2. When the transceiver is in the transmit mode, switch position 1 connects the meter amplifier tube grid to the diode detector (CR16) circuit in the output of the final amplifier stage, which rectifies a portion of the RF voltage developed across the antenna transmission line. (Diode CR17 in this circuit is a directional gate used to keep resistor R103 from loading the AGC buss.) The meter scale is not calibrated in volts RMS for this application, since the tune-up procedure requires only that the operator knows when the maximum RF voltage across the antenna terminals is obtained.

3. When the transceiver is in the transmit mode, switch position 2 connects the meter amplifier tube grid to the AALC control grid voltage buss. During SSB operation, the meter measures the AALC grid voltage developed when the final amplifier stage is driven into the grid current levels.

B. In switch position 3, the meter circuit is active only in the transmit mode. The meter is disconnected from the meter amplifier tube bridge circuit and connected to a second metering bridge circuit consisting of the final amplifier tube cathode resistors (R106, R109, R197, and R198) and the reference voltage divider resistors (R118 and R121). When the correct idle (zero signal) plate current flows in the final amplifier tubes, the voltage across the cathode resistors equals the voltage drop across R118 of the reference voltage divider, and the meter indicates zero current (pointer rests at the SET BIAS arrow reference mark). When drive is applied to the final amplifier tubes, the increase in plate current flowing through the cathode resistors unbalances the bridge, and the resulting meter current then indicates the plate current flowing through the final tubes. This technique eliminates the relatively large metering error normally incurred in most equipment when measuring zero signal plate current.

6-6. AALC SYSTEM. The amplified automatic level control (AALC) circuits are utilized only in the transmit mode. To properly employ the peak capability of the linear power amplifier, the stage must operate up to and slightly into the control grid current region and yet not overdrive into unwanted distortion known as "flat-topping".

AALC action goes into effect when transmitting single-sideband signals at peak levels where the control grid current begins to flow in the final amplifier tubes (V16 and V17). The grid current pulses generate a small signal voltage across the resistance in the bias supply BIAS ADJ control (R115). The signal voltage is amplified to usable levels by the AALC amplifier tube (V3B) and rectified by diodes CR4 and CR5 to become a varying DC bias voltage. The bias voltage is fed to the 6.0- to 6.5-MHz IF amplifier stage (V3A) grid to reduce the stage gain as the AALC bias voltage increases. The control voltage is fed to the meter amplifier tube (V8B) grid to actuate the meter as a warning device (METER control set at AALC). The AVC action on the IF amplifier stage makes the transition from the desired drive level to the overdrive level less critical, which results in a more stable and powerful signal.

6-7. VOX CONTROL. The SR-400A Transceiver features automatic control of the receive-transmit changeover function for either SSB phone or CW code operation. For either mode of operation, the automatic control is utilized when the OPERATION control is set at VOX. When operating SSB, the changeover from receive to transmit starts with the first syllable spoken into the microphone. The audio signal (f_5) is amplified by the first and second microphone amplifier stages (V19A and V19B) and the VOX amplifier stage (V20A). The amplified audio signal (f_5), with the gain adjusted by the VOX control (R150), is rectified by diodes CR21 and CR22. The positive DC control voltage developed is applied to the grid of the relay amplifier stage (V20B) to actuate the VOX control relay K2, placing the transmitter on the air.

The diode load resistors R154 and R155 (DELAY control) and the storage capacitor C210 determine the dropout time or delay available to keep the transmitter active between the spoken words by sustaining the positive DC control voltage supplied to the relay tube grid.

The sound from the speaker that reaches the microphone during reception would normally trigger the VOX relay. To avoid this condition, a sample of the receiver audio (f_4) is taken from the plate of the receiver audio output tube (V15) and rectified with diode CR15 to develop a negative DC anti-trip voltage.

This potential, when adjusted for correct amplitude by the ANTI-TRIP control (R93) and fed to the grid of the relay tube (V20B), cancels the positive DC control voltage generated by the VOX diodes in the microphone amplifier stages. As a result, the relay does not close when the microphone picks up sound from the speaker. When the operator adds voice to the system, the positive DC control voltage developed by the VOX amplifier diodes increases and exceeds the established anti-trip potential, and the relay closes as desired.

When operating with keyed CW, the change-over from the receive to the transmit mode of operation starts with the closing of the key. The keying system operates on the blocked-grid keying principle; therefore, when the key is closed, several stages in the transmitter are keyed ON simultaneously; namely the transmitter driver stage (V18), the second transmitter mixer stage

(V11A), and the sidetone amplifier stage (V7B). The keyed sidetone signal (X4) is fed into the second microphone amplifier stage (V19B) and through the output transformer (T5) to the speaker for sidetone monitoring purposes. The sidetone signal fed to the second microphone amplifier stage (V19B) passes through the VOX amplifier and rectifier circuits to actuate the VOX control relay (K2) in the same manner as for the SSB VOX control. The anti-trip circuit is disabled by the OPERATION switch (S4A) in the CW position, since the function is not required for CW operation.

The VOX delay circuits, for CW operation, hold the transmitter in the active state between short breaks during CW keying, but release the control relay for receiver operation at the end of transmission. The delay period for the CW control is adjusted, in the same manner as for SSB, by the DELAY control (R155).

SECTION VII

SERVICE DATA

7-1. COVER AND CHASSIS REMOVAL.

A. Top Cover Removal - Loosen the four top-cover screws 1/4 turn only and remove the cover. To replace the cabinet cover, line up the plastic nuts with the cabinet slots, seat the cover and tighten the cover screws 1/4 turn only. The plastic nuts can be damaged by over tightening.

B. Bottom Cover Removal - Remove the four bottom-cover screws located near the cabinet feet and remove the cover. Should the mounting screws be misplaced, use 6-32 x 3/16 replacement screws. Screws longer than 3/16 inch will bottom against the chassis before securing the bottom cover.

C. Chassis Removal - Disconnect all rear chassis cables. Remove both top and bottom cabinet covers. Remove the four cabinet screws at the bottom of the cabinet near the corners of the chassis and carefully slide the chassis and panel assembly out the front of the cabinet.

7-2. TUBE AND DIAL LAMP REPLACEMENT. Access to all tubes, except the two final amplifier tubes, is obtained by removing the top cabinet cover. See paragraph 7-1, A.

To service the dial lamps, the panel and chassis assembly must be released from the cabinet and shifted forward far enough to expose the dial lamp assemblies. Remove the four cabinet screws at the bottom of the cabinet in the corners of the chassis to release the chassis assembly.

7-3. FINAL AMPLIFIER TUBE REPLACEMENT. Access to the final amplifier tubes is obtained by removing the top cabinet cover (paragraph 7-1, A) and the final amplifier compartment cover, held in place by three screws. Note, that the rear edge of the cover is clipped to the rear lip of the compartment structure. When replacing the cover, be sure to engage the clip properly before replacing the mounting screws.

The power tubes may be removed by pulling straight up and out of each socket after disengaging the plate clips and moving the parasitic suppressors to one side.

7-4. FINAL AMPLIFIER TUBE BALANCING. If either or both 6KD6 tubes are replaced, tube balancing should be performed.

The procedure for tube balancing is as follows:

CAUTION

IT WILL BE NECESSARY TO WORK WITH CIRCUITS WHICH NORMALLY HAVE HIGH VOLTAGE APPLIED. USE EXTREME CARE WHILE PERFORMING THE FOLLOWING OPERATIONS. USE A WELL INSULATED SCREWDRIVER OR OTHER SUITABLE TOOL TO SHORT-CIRCUIT THE 6KD6 PLATE CAPS TO THE CHASSIS BEFORE HANDLING THE TUBES.

A. Set the OPERATION switch to OFF and disconnect the power cable from J7.

B. Turn the four top cabinet retaining screws 1/4 turn counterclockwise and remove the top cover.

C. Remove the top cover from the final amplifier cage (three screws).

D. Remove the plate caps of the tube or tubes to be replaced and replace with new tube(s).

CAUTION

NOT ALL BRANDS OF 6KD6 TUBES CAN BE USED IN THE SR-400A. TUBES LABELED WITH A MANUFACTURERS CODE NUMBER 274 (RCA) ARE PREFERRED.

E. Connect the plate caps and replace the final amplifier cage cover.

F. Using a 20,000 ohm/volt DC voltmeter (Simpson 260 or equivalent set to the 2.5-volt range), adjust the final amplifier balance control (R193) for 0 volt. See figure 16 for location. Within several hours after initial adjustment, it is advisable to recheck the balance. Also, as the tubes age over several months, the balance adjustment should be performed.

G. Set the FUNCTION control to TUNE and the RF LEVEL control to zero (fully counterclockwise).

H. Set the OPERATION control to REC and allow at least 2 minutes for warmup.

I. Set the OPERATION control to MOX and adjust BIAS ADJ control on the transceiver panel to the set bias indication on the plate meter.

J. Tune the transmitter as outlined in Section V, and observe the voltage between J11 and J12 as the plate current meter indicates 300 mA. If the voltage is greater than 0.1V, the tubes are not balanced. This condition is found only in rare cases, such as when a new tube is being matched to an old tube, or with tubes having extreme differences in electrical parameters. For proper operation, the PA tubes MUST be properly balanced.

K. The final amplifier requires a neutralization check and possible adjustment after the new tubes are installed. Refer to paragraph 8-7 for the neutralization check and adjustment procedure.

7-5. LOAD CONTROL RESTRINGING PROCEDURE. Remove the cabinet top cover (paragraph 7-1, A) and final amplifier compartment cover (three screws) to gain access to the control drive mechanism. Note that the rear edge of the cover is clipped to the rear lip of the compartment structure. The restringing operation may be expedited if the final amplifier cage (secured to the chassis with three spade bolts and to the right side plate with four sheet metal screws) is lifted from the chassis.

Restring the LOAD control drive system with a 50-pound test dacron cord or equivalent, following the arrow and letter sequence in figure 11. Maintain a spring expansion of approximately 1/2 inch on the dial cord spring, while following the pulling orientation shown.

After completion of the stringing operation, rotate the LOAD control lever counterclockwise to 1 and check the loading capacitor to ensure that it is completely meshed (maximum capacity).

7-6. TROUBLESHOOTING. When designing this transceiver, full consideration was given to keep maintenance problems at an absolute minimum; therefore, maintenance and repair problems are generally confined to the checking and replacement of tubes and semiconductor devices which are defective. Malfunctions of this nature are for the most part easily isolated and corrected. However, it is entirely possible that a more obscure malfunction may arise. In this event, only thoroughly trained technical personnel should attempt to service equipment of this complexity.

A recommended aid to troubleshooting the SR-400A Transceiver is a general-coverage receiver which can be used to provide a quick check on the various oscillator circuits within the transceiver. A lead connected to the antenna of this receiver, when placed in the proximity of the oscillator tube in the circuit to be checked, determines the presence or absence of a signal from the stage in question.

If a malfunction occurs when operating on one particular band and/or mode of operation, the unit should be checked on all other bands and in all other modes of operation to isolate the difficulty. A careful study of the block diagram (figure 10) will give a quick clue as to which tubes should be checked. The voltage and resistance charts (figures 12 and 13) and schematic diagram (figure 31) will also aid in isolating and correcting a malfunction.

7-7. SERVICE AND OPERATING QUESTIONS. For further information regarding operation or servicing of the SR-400A Transceiver, contact the dealer from whom the unit was purchased. The Hallicrafters Co. maintains an extensive system of Authorized Service Centers where any required service is performed promptly and ef-

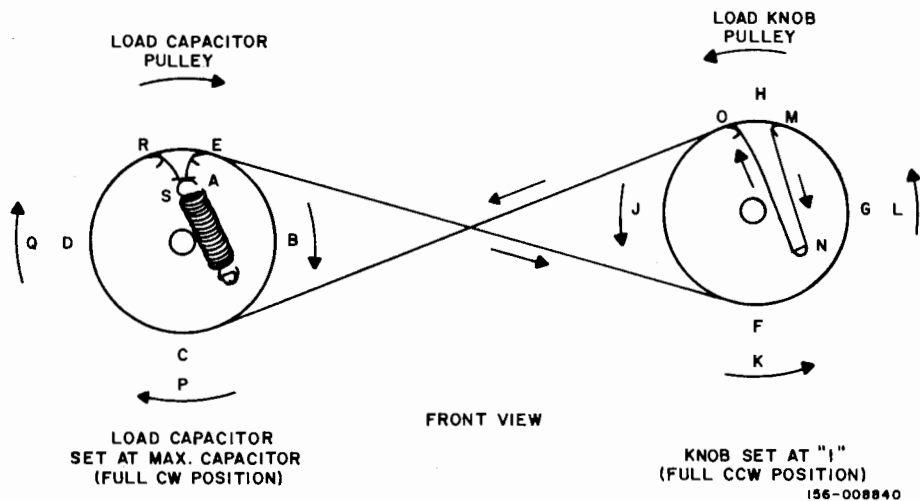


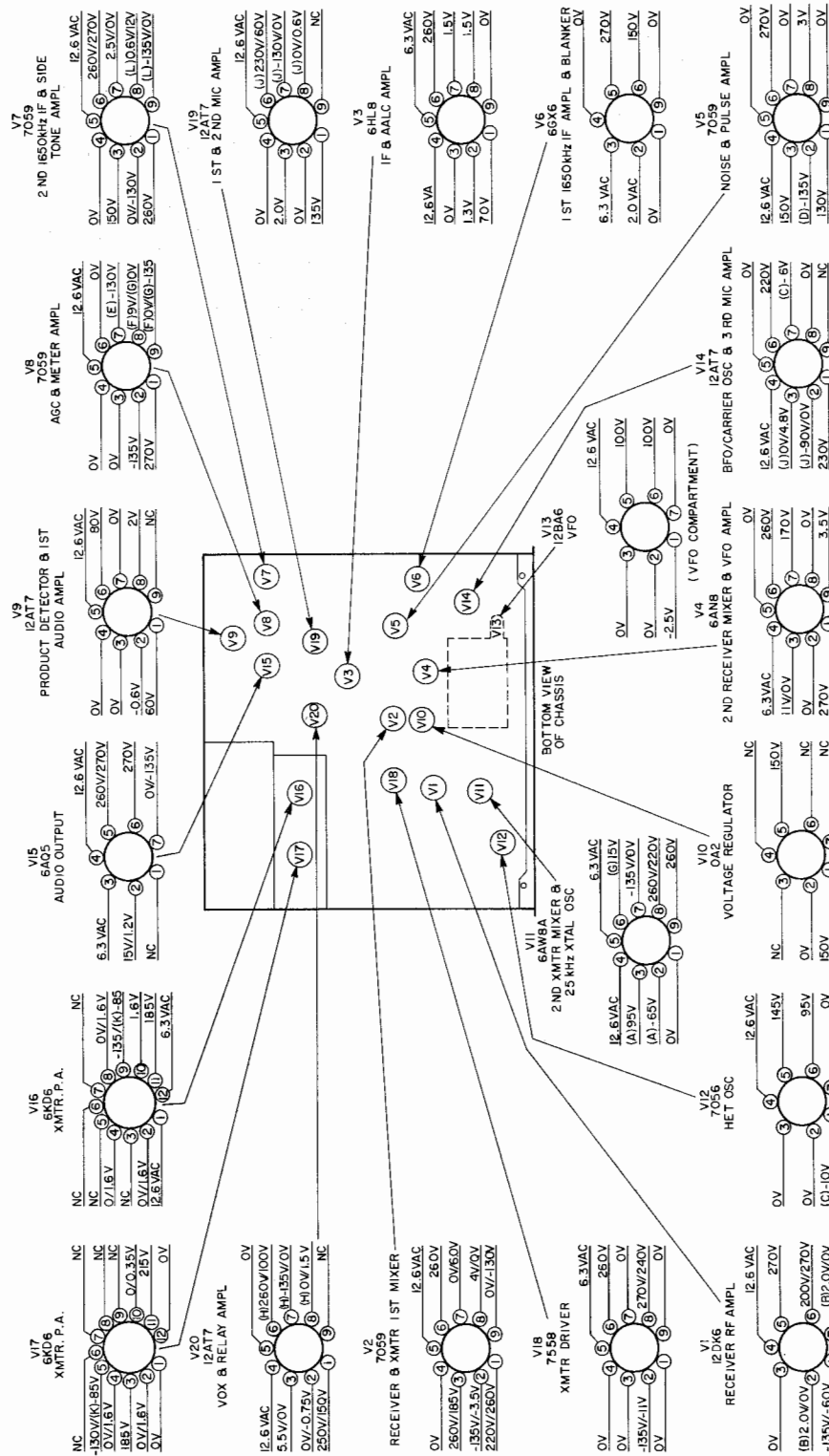
Figure 11. Load Control Restringing Diagram.

ficiently at no charge, if this equipment is delivered to the service center within 90 days from date of purchase by the original buyer and the defect falls within the terms of the warranty. It is necessary to present the bill of sale in order to establish warranty status. After the expiration of the warranty, repairs are made for a nominal charge. All Hallicrafters Authorized Service Centers display the sign shown below. For the location of the one nearest you, consult your dealer or your local telephone directory.

Make no service shipments to the factory unless instructed to do so by letter, as The Hallicrafters Co. will not accept responsibility for unauthorized shipments.

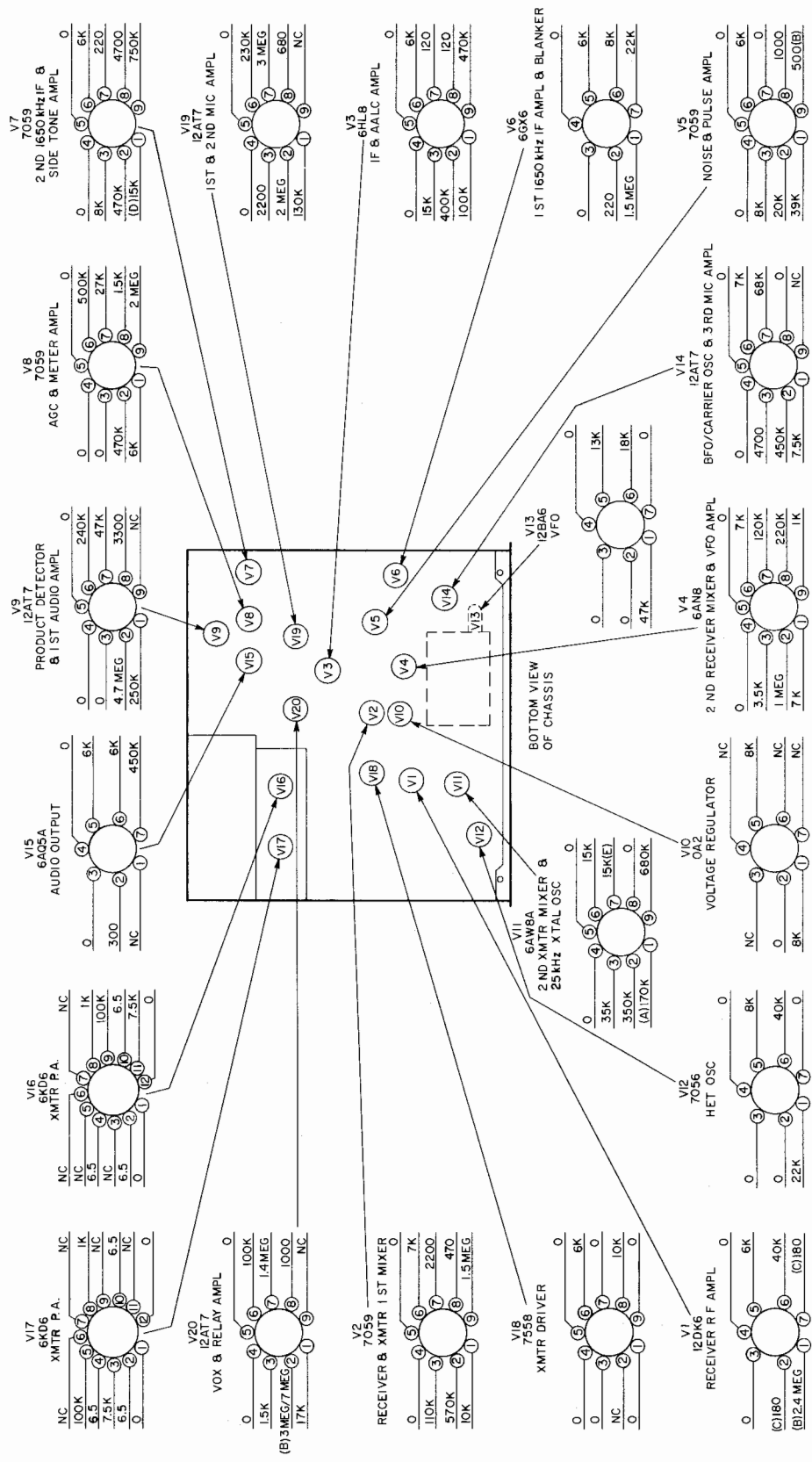
The Hallicrafters Co. reserves the privilege of making revisions in current production of equipment, and assumes no obligation to incorporate such revisions in earlier models.





- NOTES:
- POWER SOURCE - MODEL PS-500A-AC LINE VOLTAGE = 117 VAC OR 234 VAC.
 - MEASUREMENTS TAKEN FROM TUBE SOCKET PIN TO CHASSIS.
 - VOLTAGES SHOWN ARE POSITIVE DC UNLESS OTHERWISE SPECIFIED.
 - VOLTAGES TAKEN WITH ELECTRONIC TYPE VOLTMETER. ALL READINGS EXCEPT GRID VOLTAGES MAY BE OBTAINED WITH A 20,000 OHM/VOLT METER.
 - NC - NO CONNECTION (CAUTION - CIRCUIT VOLTAGES APPEAR ON SOME UNUSED PINS).
7. (CONT.)
- (F) VOLTAGE SHOWN FOR BFO/S AND AALC METER SWITCH POSITIONS (METER ZERO SET).
 - (G) VOLTAGE VARIES WITH TRANSMITTER RF CONTROL SETTING (R64A) VOLTAGE SHOWN FOR ZERO SETTING.
 - (H) FIRST VOLTAGE SHOWN IS FOR REC AND MOX POSITIONS OF OPERATION CONTROL. SECOND VOLTAGE SHOWN IS FOR REC AND MOX POSITIONS OF OPERATION CONTROL.
 - (I) VOLTAGE SHOWN IS FOR REC AND MOX POSITIONS OF FUNCTION CONTROL IN TRANSMIT MODE. SECOND VOLTAGE SHOWN IS FOR LSB OR TRANSMIT MODE.
7. (CONT.)
- (K) VOLTAGE VARIES WITH BIAS POT SETTING.
 - (L) FUNCTION CONTROL AT TUNE.

Figure 12. Tube Voltage Chart.



156-007147

4 NC = NO CONNECTION K = X1,000
 OC = OPEN CIRCUIT

5 SPECIAL CONDITIONS
 (A) - OFF/CAL SET AT CAL
 (B) - RESISTANCE DEPENDS ON POLARITY OF VOM.
 (C) - VARIES WITH RECEIVER RF GAIN CONTROL SETTING.
 (D) - VARIES WITH SIDETONE CONTROL SETTING.
 (E) - VARIES WITH TRANSMITTER RF CONTROL SETTING AND BAND SELECTOR CONTROL SETTING.

3 UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE SHOWN FOR THE FOLLOWING CONTROL SETTINGS

RIT CONTROL	OFF
RF GAIN/AF GAIN	ID
OPERATION	REC
FUNCTION	5SP
CALL BLANKER	5SP
CAL ADJ.	CENTERED
PULL/CAL	OFF
BAND SELECTOR	3.5
METER	RF/O/S
RF/AF (TRANS GROUP)	0
PRESELECTOR	OPTIONAL
PLATE LOAD	OPTIONAL
BIAS ADJ	SET

NOTES:
 1. RESISTANCE MEASUREMENTS MADE WITH LINE CORD AND POWER SUPPLY DISCONNECTED.
 2. ALL MEASUREMENTS ARE MADE FROM TUBE SOCKET PIN TO CHASSIS. READINGS LESS THAN ONE OHM ARE SHOWN AS ZERO.

Figure 13. Tube Resistance Chart.

SECTION VIII

ALIGNMENT PROCEDURE

8-1. **GENERAL.** The SR-400A Transceiver has been carefully aligned and tested at the factory and, with normal usage, should not require other than the usual attention given to electronic equipment. Service or replacement of a major component or circuit may require subsequent realignment, but under no circumstances should realignment be attempted unless the malfunction has been analyzed and definitely determined as misalignment. Service work should be performed by persons experienced in this work, using the proper test equipment.

CAUTION

NEVER OPERATE THE SR-400A TRANSCEIVER AS A TRANSMITTER WITHOUT A MATCHED ANTENNA OR ADEQUATE DUMMY LOAD TERMINATION. ILLUMINATING LAMPS WILL NOT PRESENT A CONSTANT LOAD IMPEDANCE. THE POWER AMPLIFIER TUBES AND PI NETWORK COMPONENTS CAN BE DAMAGED IF THE EQUIPMENT IS OPERATED AS A TRANSMITTER UNLOADED.

WARNING

THE VOLTAGES USED IN THE SR-400A TRANSCEIVER AND POWER SUPPLY ARE LETHAL. AVOID UNNECESSARY EXPOSURE TO HIGH VOLTAGE CIRCUITS WHEN MAKING CIRCUIT ADJUSTMENTS OR VOLTAGE CHECKS. SERIOUS RADIO FREQUENCY BURNS WILL RESULT IF THE PLATE OR ANTENNA OUTPUT ENDS OF THE FINAL AMPLIFIER PI NETWORK ARE CONTACTED WHILE TRANSMITTING.

NOTE

Do not make any adjustments unless the operation of the transceiver is fully understood and adequate test equipment is available. Refer to figures 14 and 15 for component locations and to figures 16 and 17 for the location of all alignment adjustments.

8-2. **EQUIPMENT REQUIRED.** The following equipment is required for the proper alignment of the SR-400A Transceiver.

- RF Signal Generator; Hewlett-Packard Model 606A, or equivalent, having up to 1 volt output at an impedance of 50 to 70 ohms and a frequency coverage up to 30 MHz.
- A Vacuum Tube Voltmeter (VTVM); Hewlett-Packard Model 410B, or equivalent, having an RF probe good to 40 MHz.
- A dummy load; 50 ohms nonreactive; rated at 500 watts average power. Bird Wattmeter or equivalent.

AF Signal Generator, Hewlett-Packard Model 200 AB, or equivalent.

- AF Voltmeter; Ballantine Model 300, or equivalent, capable of measuring 1- to 5-millivolt levels.
- A general coverage receiver covering the frequency range from 3 to 30 MHz with a 100-kHz calibrator.

8-3. **BIAS ADJUSTMENT.** The final amplifier bias must be checked and, if necessary, set before any extensive checks are made on the transmitter portion of the SR-400A Transceiver. Correctly setting the bias ensures normal plate dissipation for the final amplifier tubes. Adjust the BIAS ADJ control located on the front panel of the transceiver unit as follows:

A. Set the OPERATION control to REC and allow the transceiver time to reach operating temperature. Preset the following controls as indicated:

FUNCTION	SSB
RF LEVEL	At zero (fully counterclockwise)
MIC GAIN	At zero (fully counterclockwise)
METER	PLATE MA

NOTE

With the METER control set to PLATE MA, the meter pointer normally rests to the left of the meter scale zero when the transceiver is in the receive mode. This indication is normal for the type of meter circuit used in the transceiver.

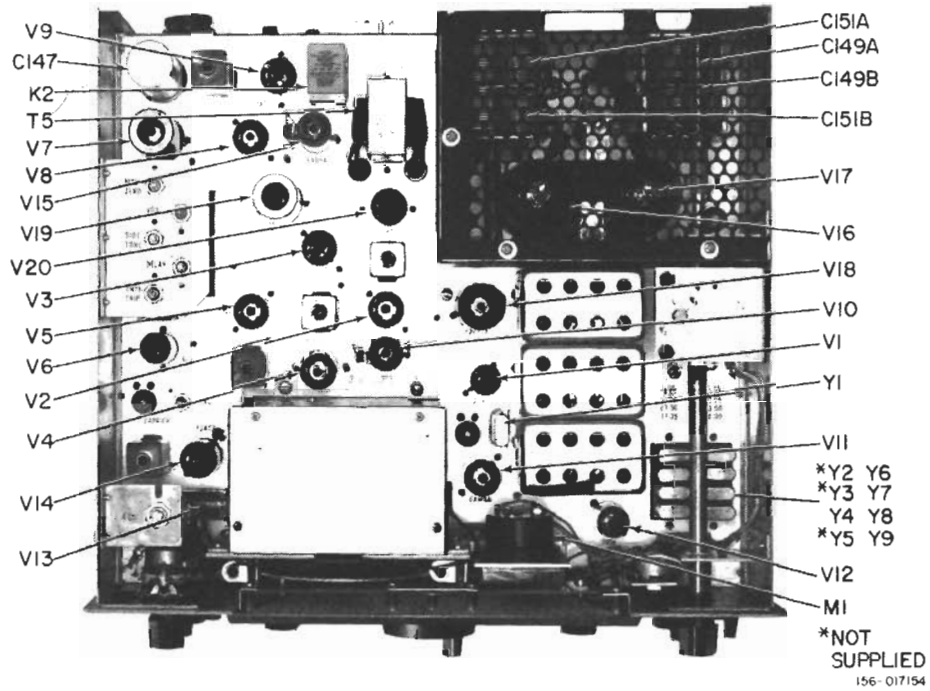


Figure 14. Component Locations on SR-400A (Top Inside View).

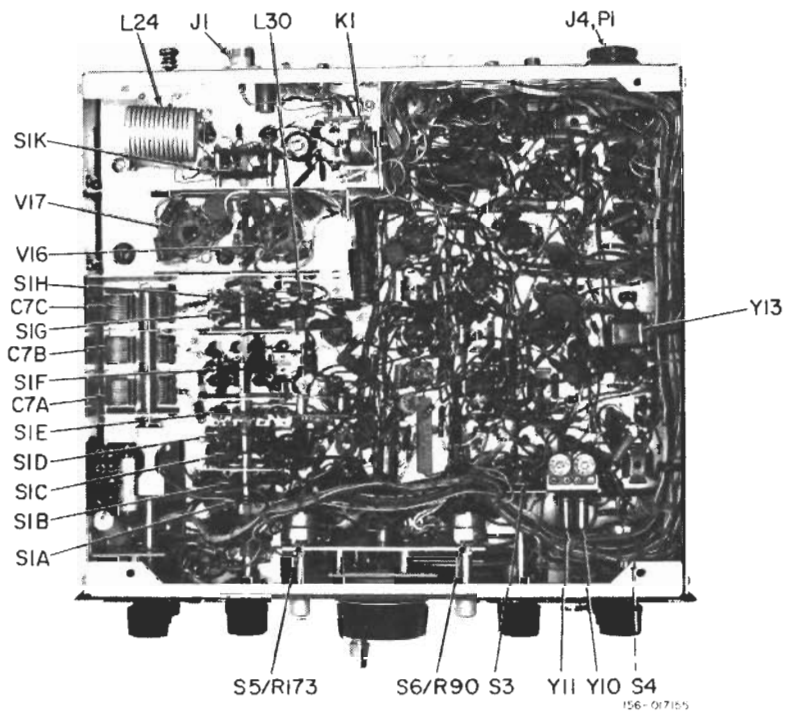


Figure 15. Component Locations on SR-400A (Bottom Inside View).

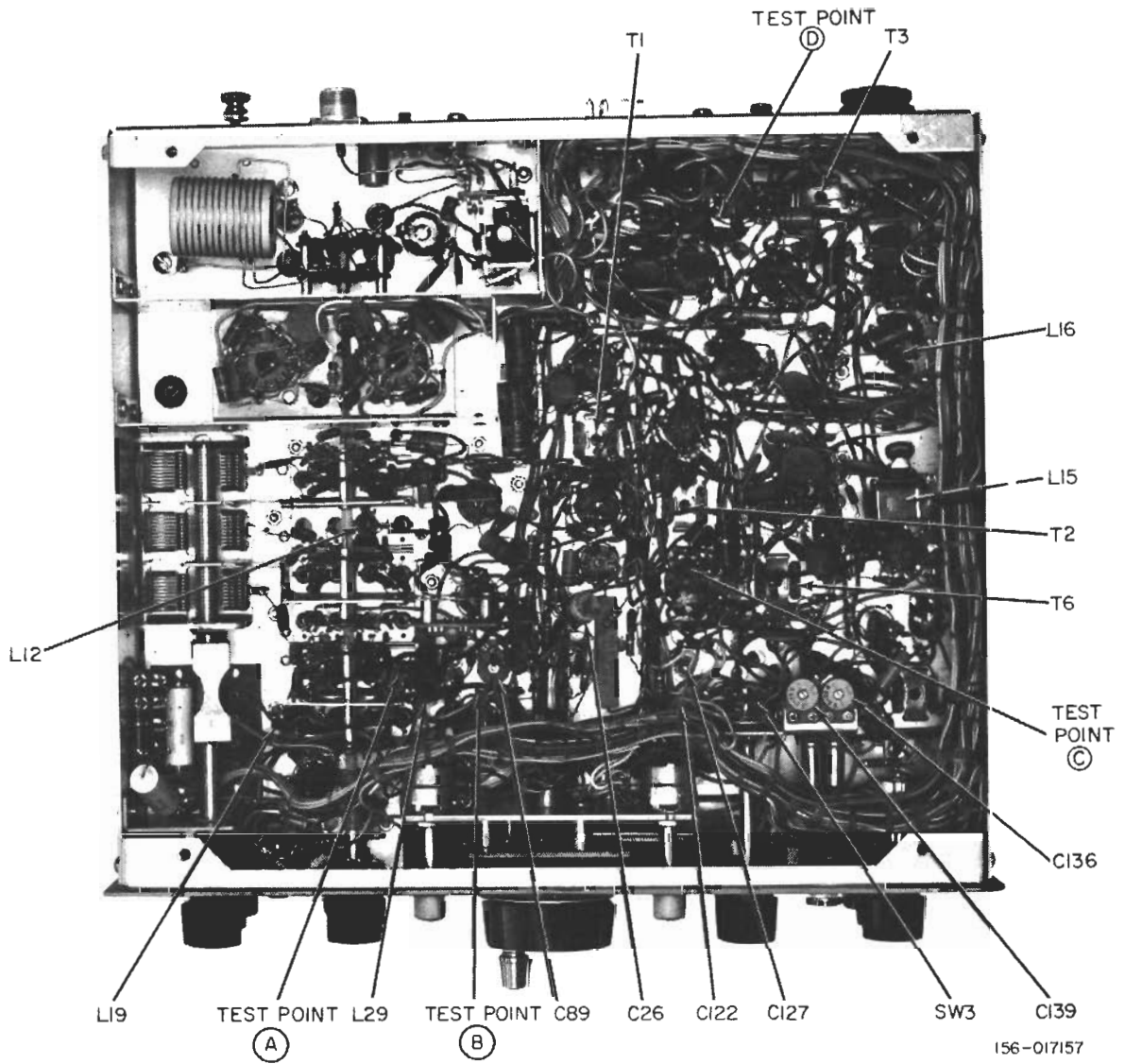


Figure 17. Alignment Adjustments on SR-400A (Bottom Inside View).

B. When using the PS-500-DC, check the setting of the BIAS ADJ control on the DC power supply. This control must be set for maximum bias voltage (fully clockwise).

C. Set the OPERATION control to MOX. The idle plate current of the final amplifier stage should cause the meter pointer to index with the SET BIAS arrow of the meter, if the bias voltage is correct.

If the plate current meter indicates above or below the SET BIAS mark, set the BIAS ADJ control on the panel of the transceiver (screw-driver adjustment) so that the pointer lines up with the arrow on the meter scale (70 mA).

8-4. "S" METER ZERO ADJUSTMENT. The "S" meter requires a zero adjustment if the meter does not indicate between zero and S-1 in the receive mode with the RF GAIN control fully counterclockwise, or if the meter does not indicate zero RFO in the transmit mode with zero RF output. The adjustment procedure is as follows:

A. Remove the cabinet cover per paragraph 7-1, A.

B. Place the transceiver in the transmit mode with the FUNCTION control set to SSB, OPERATION control set to MOX, and the RF LEVEL control set fully counterclockwise for zero output.

C. Set the METER control to RFO/S and adjust the METER ZERO control (R120) for zero on the "S" meter (pointer in the rest position).

D. Set the OPERATION control to REC and turn the RF GAIN control fully counterclockwise. The "S" meter should read between zero and S-1. If not, adjust the AGC THRESHOLD control (R46) for an "S" meter reading just above zero and less than S-1. Replace the cabinet cover.

8-5. CARRIER BALANCE. The transceiver should be allowed to reach operating temperature before making the carrier balance adjustment. Remove the top cabinet cover per paragraph 7-1, A to gain access to the carrier balance adjustments of C192 and R132 (see figure 16).

A. Tune-up the transceiver for SSB operation using an antenna load or dummy load for the transmitter.

B. Turn the MIC GAIN control fully counterclockwise to remove all audio from the modulator stage. With the FUNCTION control set to either USB or LSB, close the microphone push-

to-talk switch and adjust the carrier balance controls (capacitor C192 and potentiometer R132) for minimum RFO voltage (METER control at RFO/S).

C. The RFO meter on the transceiver will drop to zero near the true null. A more exacting balance may be obtained by connecting the Model HP410B VTVM RF probe across the transceiver antenna output and observing the RFO voltage on the 1V RMS scale, or by tuning a receiver having an "S" meter to the transmitted frequency. In either case, adjust the balance controls for minimum carrier level while switching the FUNCTION control back and forth between the two sideband positions to obtain a good null for both sidebands.

8-6. CRYSTAL CALIBRATOR ADJUSTMENT. The crystal calibrator trimmer (C89) is used to warp the 25-kHz crystal exactly to frequency with the signal transmitted by station WWV.

Remove the top cabinet cover (see paragraph 7-1, A) of the transceiver and place the transceiver in the receive mode (OPERATION control at REC). Set the CAL ON/CAL ADJ control to CAL (pull out) to actuate the crystal calibrator. Set the receiver frequency to 21,250 MHz and set the PRESELECTOR control to the center of the 15-20 position. With the RF GAIN and AF GAIN controls set fully clockwise, adjust the PRESELECTOR control and receiver frequency to receive station WWV. Connect one end of a wire lead to the general coverage receiver antenna terminal, and place the opposite end of the wire close to the 25-kHz crystal oscillator tube (V11). Proper coupling to the crystal oscillator produces a usable beat note between the 25-kHz oscillator harmonics and the signal from station WWV. Carefully adjust the calibrator trimmer (C89) until the 25-kHz oscillator harmonic is at zero beat with station WWV. This adjustment should be made only during periods when station WWV's signal is not modulated to avoid confusing beats with the modulation frequencies.

8-7. FINAL AMPLIFIER NEUTRALIZATION.

A. Neutralization Check - Run the neutralization check with the transceiver chassis in the cabinet (all hardware in place) and terminated with a dummy load (or antenna having low VSWR). Tune-up the transceiver in the CW mode (refer to paragraphs 5-4 and 5-5) at the following frequencies:

3900 kHz	21,300 kHz
7250 kHz	28,750 kHz
14,250 kHz	

Adjust the RF LEVEL control for approximately a 70V RMS RF output. (Approximately equal to S-5 on the RFO meter if an RF voltmeter is not

available.) Carefully tune the PLATE control through resonance and observe the plate current dip and RF output voltage maximum. If both occur at the same setting or with an error of less than 5V RMS out of the 70V RMS reference level, the amplifier stage is neutralized.

NOTE

If a VTVM is not available, set the meter control to RFO/S to observe the RFO voltage and connect a 0-500 mA meter to test points TP201 and TP202 (red terminal to meter +) on the Model PS-500A-AC power supply, or connect the meter in series with the HV lead (terminal 1) on the Model PS-500-DC power supply. For either power supply, the milliammeter must be well insulated from ground.

CAUTION

DO NOT OPEN THE FINAL AMPLIFIER COMPARTMENT WITH THE HIGH VOLTAGE CIRCUITS ENERGIZED. HIGH VOLTAGE IS PRESENT AT ALL SETTINGS OF THE OPERATION CONTROL EXCEPT OFF.

B. Neutralizing the SR-400A Transceiver- If the neutralization check outlined above indicates a need for adjustment, remove the top cabinet cover and the final amplifier compartment cover to gain access to the neutralizing capacitor (C171) located between the final amplifier stage tubes. Refer to paragraph 7-1, A for cover removal details. Proceed as outlined for the neutralization check and adjust the neutralizing capacitor until the plate current dip and the RFO maximum coincide at each of the frequencies shown in step A. Normally, when the SR-400A is neutralized at 28.750 MHz, all other bands are neutralized correctly. The top cabinet cover does not have to be in place for the neutralization check; however, the final compartment cover must be in place to provide the RF shielding required. The calibration of the PRESELECTOR control has an effect on the neutralization pattern. If only one or two check frequencies indicate a neutralization problem, a PRESELECTOR calibration correction may be necessary rather than a neutralizing capacitor adjustment. Refer to paragraph 8-12 for the mixer and driver stage alignment details.

8-8. VFO CALIBRATION ALIGNMENT.

A. Mechanical Index - As each 100-kHz mark on the main dial indexes with the corresponding fiducial, the zero mark on the knob dial should also index with the corresponding fiducial.

If there is a fixed error between these dials, remove the tuning knob with a No. 8 Bristol set-screw wrench to expose the knob dial bushing. Set the main dial to any 100-kHz mark. Loosen the knob dial setscrew with a No. 6 Bristol set-screw wrench and rotate the knob dial with respect to the knob shaft until the zero mark lines up with the fiducial. Tighten the setscrew. Replace the tuning knob leaving a clearance between the felt brake pad and the panel for minimum turning torque (base station operation), or position the tuning knob on the shaft so that the felt brake pad engages the panel and increases the turning torque as desired for mobile operation. If a service operation is involved in disconnecting the VFO gang from the gear drive, re-index the gang as follows:

1. Rotate the tuning knob clockwise to the mechanical stop.
2. Loosen the two No. 6 Bristol setscrews holding the drive gear to the VFO gang shaft.
3. Rotate the gang capacitor to fully mesh the capacitor and tighten one of the setscrews.
4. Rotate the knob exactly 30 kHz in the counterclockwise direction.
5. Loosen the setscrew again and, without disturbing the VFO gang setting, turn the knob clockwise to the knob dial zero. (The main dial will also be indexed at the high frequency end of the dial.)
6. Tighten both setscrews securely and replace the VFO compartment cover before recalibrating the VFO electrically.

B. VFO Calibration (Trimmer Adjustment Only) - A trimmer capacity correction is indicated if the dial calibration check across the dial, at the 100-kHz check points, consistently falls to one side of the fiducial and cannot be corrected by the CAL ADJ control. The main dial and knob dial must be correctly indexed as outlined in paragraph 8-8, A, and the calibration check should be made with the FUNCTION control set at LSB. Recalibrate the VFO as follows:

1. Remove the bottom cabinet cover per paragraph 7-1, B to gain access to the adjustment screw of trimmer C122. See figure 17 for location of the trimmer.
2. Preset the following controls as indicated:

RIT CONTROL OFF
 BAND SELECTOR 3.5
 OPERATION REC
 FUNCTION LSB
 PRESELECTOR 80
 CAL ON/CAL ADJ CAL (pull out)
 NOISE BLANKER OFF

3. Center the CAL ADJ control. The dot on the knob should fall at top dead center.

4. Set the dial for exactly 3500 kHz (red 500 on main dial and black zero on knob dial). Carefully adjust trimmer C122 for a zero beat.

5. Check the calibration across the dial at the 100-kHz check points. If the frequency error is less than approximately 2000 Hz, the calibration is within acceptable limits. If the error increases and exceeds 2000 Hz at the high frequency end of the dial, the VFO requires a coil adjustment in addition to the trimmer adjustment.

C. VFO Calibration (Trimmer and Coil Adjustment) - If the dial error progressively increases in the same direction with the high frequency end of the dial running out more than 2000 Hz, both coil L21 and trimmer C122 require adjustment. Recalibrate the VFO as follows:

1. Set the transceiver controls per steps 2 and 3 in paragraph 8-8, B.

2. Set tuning dial for exactly 4000 kHz (VFO = 4350,000 kHz) and adjust coil L21 for a zero beat.

3. Set tuning dial for exactly 3500 kHz (VFO = 4850,000 kHz) and adjust trimmer C122 for a zero beat.

4. Repeat steps 2 and 3 until both the 3500 kHz and 4000 kHz settings are exactly on frequency.

5. Check the calibration across the dial at the 100-kHz points. If the frequency error is less than 2000 Hz, the calibration is within acceptable limits. If the error is in excess of 2000 Hz at any of the midpoints, with the end limits at zero error, the VFO capacitor C120 should be "knifed". This operation should not be attempted by other than qualified personnel thoroughly familiar with the technique.

6. Set the dial at 3800 kHz and tune to the exact zero beat with the marker crystal. Switch the FUNCTION control from LSB to USB. If the frequency shifts more than 15 Hz, the VFO corrector trimmer C127 must be adjusted per paragraph 8-8, D.

D. VFO Corrector Adjustment - VFO corrector trimmer C127 shifts the VFO frequency approximately 3000 Hz to correct for the difference in frequency between the upper and lower sideband BFO/carrier crystal frequencies. The trimmer is switched into the VFO circuit in the upper sideband mode. To check the corrector trimmer setting, tune the transceiver, in the LSB mode, to zero beat with the 3800-kHz marker frequency. Switch to the USB mode. There should be less than a 15-Hz change in frequency. If the change is more than 15 Hz, carefully adjust trimmer C127 until the difference between USB and LSB is less than 15 Hz.

8-9. IF ALIGNMENT (1650 kHz). This operation consists of adjusting transformers T3 and T6 only. Do not adjust the filter terminations (L15 and L16) at this time. See paragraph 8-10 for the crystal filter alignment.

The signal source for alignment may be obtained from an RF signal generator set to 1650 kHz, or the transceiver can be tuned to the 25-kHz crystal calibrator signal in the 20M band (any 100-kHz marker). If an RF signal generator is used, connect the output to pin 2 (test point ©, see figures 17 and 31) of the second receiver mixer tube (V4A). The following procedure is used for IF alignment:

A. Set the OPERATION control to REC, FUNCTION control to either USB or LSB, NOISE BLANKER control to OFF, and METER control to RFO/S. Adjust the RF GAIN control or signal generator output (no modulation) for about S-7 on the "S" meter and tune either the transceiver or signal generator (whichever method is used) for maximum "S" meter deflection.

B. With the signal centered in the crystal filter passband, adjust transformer T3 (top and bottom cores) and transformer T6 (single core) for maximum "S" meter deflection. Maintain the S-7 level to avoid overloading effects. Do not turn the cores through the individual transformer windings (T3) so that either core rests between the windings, thus upsetting the coupling design.

8-10. CRYSTAL FILTER ALIGNMENT. Use the following procedure for alignment of crystal filter:

A. The filter response should be checked as follows to determine whether or not the filter termination coils L15 and L16 need adjustment.

1. Tune-up the transceiver (transmit mode) into a 50-ohm dummy load (3800 kHz is recommended).

2. Connect the AF signal generator to the microphone input and monitor the input voltage with the Ballantine voltmeter. Set the

AF signal generator to 1000 Hz and adjust the generator level for 50V RMS RFO with the MIC GAIN control set near maximum (approximately 9).

3. Set the FUNCTION control to LSB.

4. Maintain constant AF signal generator input voltage and adjust the frequency of the generator above and below 1000 Hz, recording the two frequencies at which the transmitter RFO drops to 25V RMS (-6 dB). Also, note the maximum and minimum RFO excursions between these two frequencies. A normal 6-dB frequency response will run 500 Hz or less at the low end and 2400 Hz or more at the high end, with less than a 2-dB variation (10V RMS change) in the passband.

5. Repeat the check made in step 4 with the FUNCTION control set at USB.

B. If the check made in the above paragraph (8-10,A) indicates a need for a filter termination adjustment, one of two methods may be employed.

1. The above test setup may be used to evaluate the passband ripple and the terminating coils (L15 and L16), then adjusted for minimum in-band ripple while maintaining maximum RFO. If the terminations are disturbed and a major increase in RFO is obtained with adjustment, reset the AF signal generator level to maintain the 50V RMS reference at 1000 Hz.

2. The passband ripple may also be observed by operating the transceiver in the receive mode. Tune-in the crystal calibrator at 3800 kHz and adjust the RF GAIN control for an S-7 meter reading. The NOTCH ADJ potentiometer must be in the fully counterclockwise position. Tune through the filter passband and adjust the filter termination coils (L15 and L16) for minimum in-band ripple while maintaining maximum "S" meter deflection. If the terminations are disturbed and a major increase in the "S" meter reading results, readjust the RF GAIN control to maintain the S-7 reference level.

C. Repeat the filter response check (paragraph 8-10, A) after adjusting the filter termination coils to verify the adjustment.

8-11. IF ALIGNMENT (6.0 to 6.5 MHz). This alignment is best performed using a sweep oscillator, marker generator and oscilloscope. If this equipment is not available, the following procedure, if carefully followed, can be used:

A. Remove the heterodyne oscillator tube (V12) and connect the HP410B VTVM RF probe to test point (B) (pin 7 of the second transmitter mixer tube V11A). See figures 17 and 31.

B. Place the transceiver in the transmit mode. Set the OPERATION control to MOX, FUNCTION control to TUNE, BANDSELECTOR control to 3.5, and adjust the RF LEVEL control for a VTVM indication of 1V RMS at the peak of the response.

C. Tune the VFO across the band and note the VTVM readings. If the response is essentially flat, with no more than 2- to 3-dB rolloff at each end of the band, the alignment is acceptable.

D. If adjustment is required, adjust transformers T1 and T2 (top and bottom cores) for maximum grid voltage, as well as a flat response across the band. Avoid a tilted response or a response that rolls off beyond the 2- to 3-dB limit at the edges of the VFO dial settings. Do not sacrifice gain by stagger tuning the transformers to obtain a constant grid voltage across the band or turn a core through the winding which would upset the coupling design. A properly aligned amplifier has equal drop in the response at each end of the band but does not exceed 3 dB (0.7V RMS).

E. Replace heterodyne oscillator tube V12 and disconnect the VTVM.

8-12. ALIGNMENT OF TRANSMITTER MIXER/DRIVER AND RECEIVER ANTENNA STAGES. The final amplifier bias adjustment must be properly set per paragraph 8-3 before extensive operation of the transmitter is attempted. It is assumed that the signal generating stages of the SR-400A Transceiver are functioning properly. Use the internally generated signal of the transceiver to align the transmitter mixer and driver stages, and the RF signal generator (no modulation) to align the receiver antenna stage as follows:

A. Connect the 50-ohm dummy load and the VTVM RF probe to the ANTENNA jack (J1 or J2). Connect the RF signal generator termination to test point (A) (see figures 17 and 31). Connect the signal lead to the receiver antenna coaxial cable termination at switch wafer S1D (fourth wafer from front) and the ground lead to the first shield plate. Connect the AF voltmeter across the 500-ohm audio output transformer winding at the AUDIO 500-OHM jack (J5) located at the rear chassis apron. This arrangement permits transmitter and receiver operation without connecting and disconnecting test equipment repeatedly during alignment.

B. If the trimmer capacitors on the three-section gang (C7) have not been previously aligned at the factory, preset trimmers C7D and C7E approximately 1/2 turn from tight.

C. Set the RF LEVEL control to zero, OPERATION control to MOX, and FUNCTION control to TUNE.

D. Set the BAND SELECTOR control to 28.5, the VFO to 29,000 kHz, the PRESELEC-TOR control to the center of the 10-15 segment, and the final amplifier LOAD control to 5-1/2. Advance the RF LEVEL control and adjust the final amplifier PLATE control for resonance. Maintain an output signal level of 50V RMS at the VTVM with the RF LEVEL control, and adjust trimmer C7E for maximum output at the dummy load. Rock the tuning of the PRESELEC-TOR control while making this adjustment to obtain best tracking.

E. Retune the transmitter to 28.5 MHz, readjusting the PRESELECTOR control to obtain resonance. Using the RF LEVEL control, reduce the transmitter output to zero.

F. Set the OPERATION control to REC, RF GAIN and AF GAIN controls to maximum (10), RIT control to OFF, and NOISE BLANKER control to OFF. Do not change the VFO or PRE-SELECTOR control settings indicated in step E. Tune the RF signal generator to 28,500 kHz and adjust for approximately a 1000-Hz beat note. Use enough signal generator output (approximately 1 μ V for an aligned unit) to keep from developing AVC voltage (no "S" meter indication). Adjust coils L1 and L7 for maximum audio output without developing AVC voltage.

G. Set the BAND SELECTOR control to 28.5, the VFO to 28,500 kHz, the final amplifier LOAD control to 7, and the OPERATION control to MOX. Advance the RF LEVEL control and tune the final amplifier PLATE and PRESELEC-TOR controls to resonance. Maintain an output signal level of 50V RMS at the VTVM with the RF LEVEL control, and adjust mixer coil L7 for maximum output at the dummy load. (If crystals for all 4- to 10-meter segments are available, adjust C7E at 30 MHz and L7 at 28 MHz for optimum tracking across the entire 10M band.) Reduce the transmitter output to zero with the RF LEVEL control.

H. Retune the transmitter to 29,000 kHz while carefully adjusting the PRESELECTOR control for peak output. Using the RF LEVEL control, reduce the transmitter output to zero.

I. Set the OPERATION control to REC and, without changing the VFO or PRESELEC-TOR control setting, tune the RF signal generator to 29,000 kHz to obtain the 1000-Hz beat note. Control the signal generator output and adjust trimmer C7D for maximum audio output at the AF voltmeter without developing AVC voltage (no "S" meter indication).

J. Set the BAND SELECTOR control to 3.5, the VFO to 3500 kHz, the PRESELECTOR to the left edge of the 80 segment, the final amplifier LOAD control to 4, the OPERATION control to MOX; advance the RF LEVEL control, and adjust the final PLATE control for resonance. Maintain the 50 V RMS output signal level with the RF LEVEL control and adjust coils L11 and L34 for maximum output at the dummy load. Using the RF LEVEL control, reduce the output to zero.

K. Set the OPERATION control to REC and, without changing the VFO or PRESELEC-TOR control settings, tune the RF signal generator to 3500 kHz and obtain the 1000-Hz beat note. Control the signal generator output and adjust coil L5 for maximum audio output at the AF voltmeter without developing AVC voltage.

L. Repeat the procedure given in steps J and K for the 40M, 20M, and 15M bands. Refer to the RF ALIGNMENT CHART for specific control settings and adjustments for each of the bands. When making adjustments on the 20M and 40M bands, set the PRESELECTOR control to the left edge of the band segment. When making adjustments on the 15M band, set the PRESELECTOR control to the center of the 10-15 segment.

M. Set the BANDSELECTOR control to 7.0, the OPERATION control to REC, and the VFO to 7000 kHz. Adjust the RF signal generator output for 2 μ V at 7000 kHz for the 1000-Hz beat note and tune the PRESELECTOR control for maximum AF voltage. Set the AF GAIN control for 10V RMS audio output. Reset the RF signal generator frequency to 6.5 MHz. Increase the signal generator output and adjust the frequency to obtain a 1000-Hz beat note. Adjust the 6.5 MHz trap coil L12 and trimmer C28 for minimum AF output. Adjust the output of the signal generator to 630 μ V (+50 dB), and carefully readjust C26 by decreasing capacitance until the AF output rises to the 10V RMS level. If the core adjustment in trap coil L12 is shifted considerably to achieve rejection, the setting of coil L10 may be affected. Repeat the alignment procedure shown in step L for coils L10, L33, and L3 in the 40M band to ensure correct alignment.

N. Set the BAND SELECTOR control to 7.0, the OPERATION control to REC, and the VFO to 7250 kHz. Tune the RF signal generator to 7250 kHz for maximum audio output. Use a low level output from the signal generator (approximately 2 μ V), so that no AGC voltage is developed. Without changing any of the transceiver controls, reset the signal generator frequency to 6250 kHz and increase the output approximately 60 dB (2000 μ V). Adjust the generator frequency for maximum audio output. Adjust the 6.25-MHz trap coil (L29) for minimum audio output.

8-13. BFO/CARRIER OSCILLATOR ALIGNMENT. This operation consists of adjusting the core of carrier oscillator transformer T4 and setting crystal warping trimmers C136 and C139 to place the oscillator exactly on frequency.

A. Set the core of transformer T4 before setting the oscillators to frequency. Connect the VTVM RF probe at test point ① (pin 8 of the product detector tube V9A). (See figures 17 and 31.) Set the OPERATION control to REC and check the injection voltage at test point ① for the LSB and USB settings of the FUNCTION control. If the injection voltages measured are approximately 1.0 V RMS and the crystal oscillators start without hesitation in either sideband position, no adjustment should be necessary. If adjustment is required, adjust the core of transformer T4 counterclockwise from the peak injection voltage setting until the received background noise is maximum. Switch the FUNCTION control between USB and LSB to check the starting capabilities of the oscillators. If the core is set as described, both oscillators will start without hesitation and the injection voltage will be between 1.0 and 1.25V RMS.

B. The BFO/carrier oscillator frequencies have been accurately set at the factory to 1652.800 kHz (USB) and 1650.000 kHz (LSB) with the aid of an electronic counter connected to test point ①. If an electronic counter is available, set the OPERATION control to REC and the FUNCTION control to LSB. Set trimmer C136 for exact-

ly 1650.000 kHz. Set FUNCTION control at USB and set trimmer C139 for exactly 1652.800 kHz. Following the frequency adjustment, recheck the VFO corrector adjustment per paragraph 8-8, D. Without the use of an electronic counter, it is recommended to leave trimmers C136 and C139 untouched. If it is necessary to replace crystals Y10 and Y11 for any reason, make the VFO corrector adjustment per paragraph 8-8, D.

8-14. HETERODYNE CRYSTAL OSCILLATOR ALIGNMENT. The heterodyne crystal oscillator injection may be checked in the following manner to determine if the core of coil L19 requires adjustment. Connect the VTVM RF probe to test point ② (pin 7 of the second transmitter mixer tube V11A). (See figures 17 and 31.) Disable the VFO injection by removing VFO tube V13. Set the OPERATION control to MOX and the FUNCTION control to TUNE. Record the RMS injection voltage for all settings of the BAND SELECTOR control. Injection is normal if the injection voltage measures 2.0 to 2.5V RMS on the 80M and 40M segments; 1.0 to 1.2V RMS on the 20M and 15M segments; and 0.75 to 1.0V RMS on the 10M segment.

If adjustment is required, adjust the core of coil L19 to obtain 2 V RMS or more on the 80M and 40M segments and 0.75V RMS or more on the 10M segment. The 15M and 20M bands automatically fall into line around the 1 V RMS level.

Table 6. RF Alignment Chart (Mixer/Driver Stages).

BAND SELECTOR POSITION	TRANSCEIVER VFO SETTING (kHz)	FINAL AMPL LOAD SETTING	ADJUST FOR MAXIMUM RF OUTPUT IN TRANSMIT	
3.5	3500	4	L11	L34
7.0	7000	4-1/2	L10	L33
14	14000	5	L9	L32
21	21000	4-1/4	L8	L31
28	28000	5-1/2	L7	-
29.5	30000	7	C7E	-

Table 7. RF Alignment Chart (Receiver Antenna Stage).

BAND SELECTOR POSITION	TRANSCEIVER VFO SETTING (kHz)	RF SIGNAL GENERATOR (kHz)	ADJUST FOR MAXIMUM AF VOLTAGE IN RECEIVE
3.5	3500	3500	L4
7.0	7000	7000	L3
14	14000	14000	L2
21	21000	21000	L1
28	28000	28000	L5
29.5	30000	30000	C7D

SECTION IX

AC POWER SUPPLY MODEL PS-500A-AC



154-011432

Figure 18. Model PS-500A-AC Power Supply.

9-1. **DESCRIPTION.** Hallicrafters Model PS-500A-AC Power Supply (figure 18) is a complete, self-contained power unit designed to permit Hallicrafters Model SR-400A Transceiver to be operated from a nominal 117/234 volt AC source. This power supply, through a 12-pin power plug and cable at the rear, will furnish all the supply voltages required by the transceiver.

Power Supply PS-500A-AC operates from a 105- to 125-volt or 210- to 250-volt 50/60 Hz, AC source. The power supply also contains a 3.2-ohm permanent-magnet type speaker which connects to the SR-400A Transceiver through the 12-pin power plug and cable. Refer to figures 19 and 20.

WARNING

LETHAL HIGH VOLTAGE IS PRESENT WITHIN THIS EQUIPMENT. BE CAREFUL WHEN INSTALLING THE UNIT AND WHEN PERFORMING CHECKS.

9-2. **234-VOLT OPERATION.** The PS-500A-AC Power Supply is shipped ready for 117-volt operation. If 234-volt operation is desired, remove the back cover of the power supply; remove the switch-locking plate from S201, and slide the switch to the opposite position. Turn the locking plate so that 234 VAC is visible and fasten in place over the switch. The 5-ampere, 125-V SLO-BLO fuse (F201) should be replaced with a 3-ampere, 250-V SLO-BLO fuse. Replace the back cover of the power supply. The PS-500A-AC Power Supply is now ready to operate from a 234-volt AC source.

Should 117-volt operation be desired after the PS-500A-AC has been set up for 234-volt operation, the above procedures concerning S201 and F201 should be reversed.

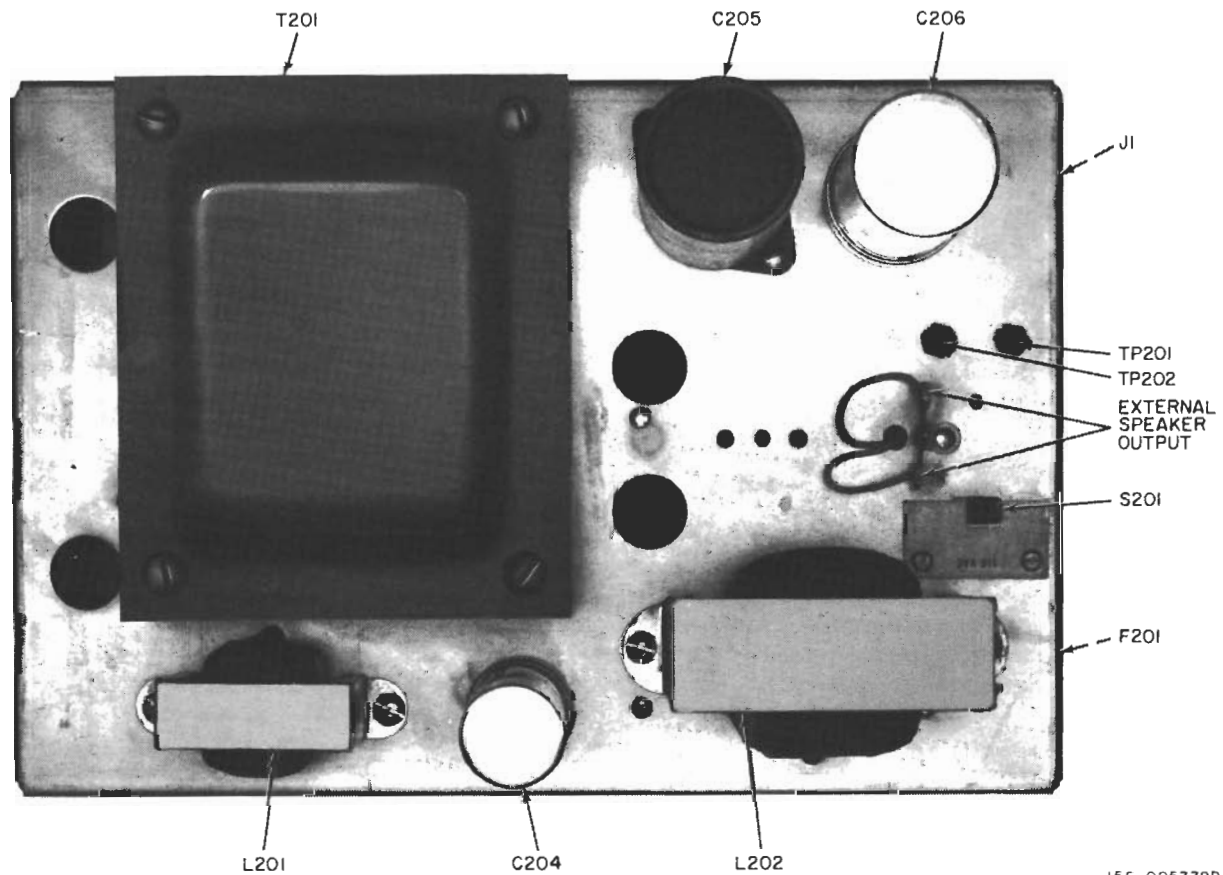
9-3. **CHASSIS REMOVAL.** To separate the PS-500A-AC chassis from the cabinet, remove the rear cover (two screws) and the six-hexagon head screws on the bottom (four are in the rubber feet and two are at the center, front and rear). Disconnect the speaker leads on the top rear of the chassis and slide the chassis out the rear of the cabinet.

REPAIR PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number
C201,202	Capacitor, 0.01 μ F, 1400V, Ceramic Disc	047-200752
C203	Capacitor, 0.001 μ F, 3000V, Ceramic Disc	047-100397
C204A & B	Capacitor, 2 x 30 μ F, 350V, Electrolytic	045-000902
C205	Capacitor, 90 μ F, 500V, Electrolytic	045-001337
C206	Capacitor, 90 μ F, 500V, Electrolytic	045-001338
C207,208	Capacitor, 20 μ F, 250V, Electrolytic	045-000903
C209	Capacitor, 0.22 μ F, 600V, Paper	046-001434-464
CR201 thru CR208	Diode, 1N3195	019-002770
CR209	Diode, 1N3194	019-002769
F201	Fuse, 5 Amperes, 125 Volts, 3 AG (Slow-Blow)	039-000791
J1	AC, Receptacle, Accessory Fan	010-004211
J201	Connector, Power (12-pin)	010-002613
L201	Choke, Filter	056-000595
L202	Choke, Filter	056-000585
R201,202	Resistor, 20K Ohms, 10%, 10 Watts, Wire-wound	445-032203
R203	Resistor, 100 Ohms, 10%, 1/2 Watt, Composition	451-252101
R204	Resistor, 4700 Ohms, 10%, 2 Watts, Composition	451-652472

REPAIR PARTS LIST (CONTD)

Schematic Symbol	Description	Hallicrafters Part Number	Schematic Symbol	Description	Hallicrafters Part Number
R207	Resistor, 10 Ohms, 5%, 5 Watts, Wirewound	445-011100		Baffle Board	078-001711
R208	Resistor, 1500 Ohms, 10%, 10 Watts, Wirewound	445-032152		Baffle, Felt	014-000476
R209	Resistor, 33K Ohms, 10%, 1 Watt, Composition	451-352333		Cabinet	066-003437
R210	Resistor, 250 Ohms, 10%, 5 Watts, Wirewound	445-012251		Cable (9-Conductor)	087-008370
T201	Transformer, Power	050-003481		Cable Assembly	087-008369
TP201	Tip Jack, Red	036-060304		Cable Clamp	076-202744
TP202	Tip Jack, Blue	036-000307		Foot, Rubber (4)	016-201072
				Front Panel	068-002255
				Fuse Holder	006-200837
				Line Cord	087-104690
				Lock, Line Cord	076-100953
				Rear Panel	068-002257
				Speaker, 4- x 6-inch PM, 3.2 Ohms	085-000218
			S201	Switch, Slide (DPDT)	060-003457

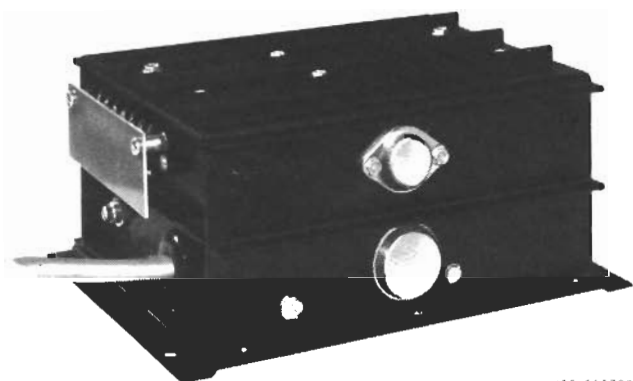


156-005779B

Figure 19. Component Locations on PS-500A-AC (Top Inside View).

SECTION X

DC POWER SUPPLY MODEL PS-500-DC



156-065786

Figure 21. Model PS-500-DC Power Supply.

10-1. DESCRIPTION. Hallicrafters Model PS-500-DC Power Supply (figure 21) is a complete, compact, self-contained power unit designed to permit Hallicrafters Model SR-400A Transceiver to be operated from a 12-volt DC source. This power supply is designed for operation in conjunction with a negative-grounded power source.

The PS-500-DC Power Supply is designed to operate from an 11.6- to 15.6-volt DC source with 13.6 volts as nominal voltage.

All connections are made to the power supply through a two-conductor cable and terminal strip on one side of the unit (see figures 8 and 22). The two-conductor cable is used for connection to the 12-volt source through the wires supplied. The seven-connector strip (TS301) is used to supply the operating voltages to the transceiver and connects to the transceiver through the cable supplied with the Model MR-400A Mobile Mounting Rack, available as an accessory. Refer to figure 23 for schematic diagram.

WARNING

LETHAL HIGH VOLTAGE IS PRESENT WITHIN THIS EQUIPMENT. BE CAREFUL WHEN INSTALLING THE UNIT AND WHEN PERFORMING CHECKS.

10-2. BIAS ADJUSTMENT. After interconnecting the power supply to the proper power source and to the transceiver, the transmitter bias must be adjusted to achieve optimum transceiver performance. Before setting the BIAS ADJ control on the panel of the transceiver (see paragraph

5-4 or 8-3), set the bias adjustment control (R309) on the power supply for maximum bias voltage (turn the control fully clockwise).

10-3. COVER REMOVAL. Remove the ten screws holding the base plate of the unit and lift the plate. This procedure will provide visual inspection for all the components in the power supply. The end extrusions and component board may be further exposed by removing the mounting screws as required.

REPAIR PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number
C301	Capacitor, 2000 μ F, 15V, Electrolytic	120-002142
C302	Capacitor, 50 μ F, 150V, Electrolytic	120-002143
C303,304	Capacitor, 40 μ F, 450V, Electrolytic	120-002144
C305	Capacitor, 20 μ F, 450V, Electrolytic	120-002145
CB301	Circuit Breaker	120-002146
CR301	Diode (200V @1A)	120-002147
CR302	Diode (600V @1A)	120-002428
CR303	Bridge, Rectifier Assembly (600V @1A)	120-002148
CR304	Bridge, Rectifier Assembly (1200V @1A)	120-002149
R301,303	Resistor, 1500 Ohms, 10%, 1/2 Watt, Composition	451-252152
R302,304	Resistor, 150 Ohms, 10%, 1/2 Watt, Composition	451-252151
R305,306,314,315	Resistor, 0.47 Ohm, 10%, 2 Watts, Wirewound	453-032000-47
R307	Resistor, 5.6 Ohms, 10%, 2 Watts, Wirewound	453-032056
R308	Resistor, 0.5 Ohms, 10%, 5 Watts, Wirewound	120-002158
R309	Resistor, Variable, 10K Ohms, Bias Adj	120-002150
R310	Resistor, 22K Ohms, 10%, 1/2 Watt, Composition	451-252223
R311,312,313	Resistor, 100K Ohms, 10%, 2 Watts, Composition	451-652104

REPAIR PARTS LIST (CONTD)

Schematic Symbol	Description	Hallicrafters Part Number	Schematic Symbol	Description	Hallicrafters Part Number
K301	Relay, Primary Switch	120-002151	Q303,304	Transistor, Type MHT 1810	120-002156
K302	Relay, Starting	120-002152	TS301	Terminal Strip Cable (2-Conductor)	120-002157
T301	Transformer, Exciter	120-002153			120-002429
T302	Transformer, Power	120-002154			
Q301,302	Transistor, Type 2N555	120-002155			

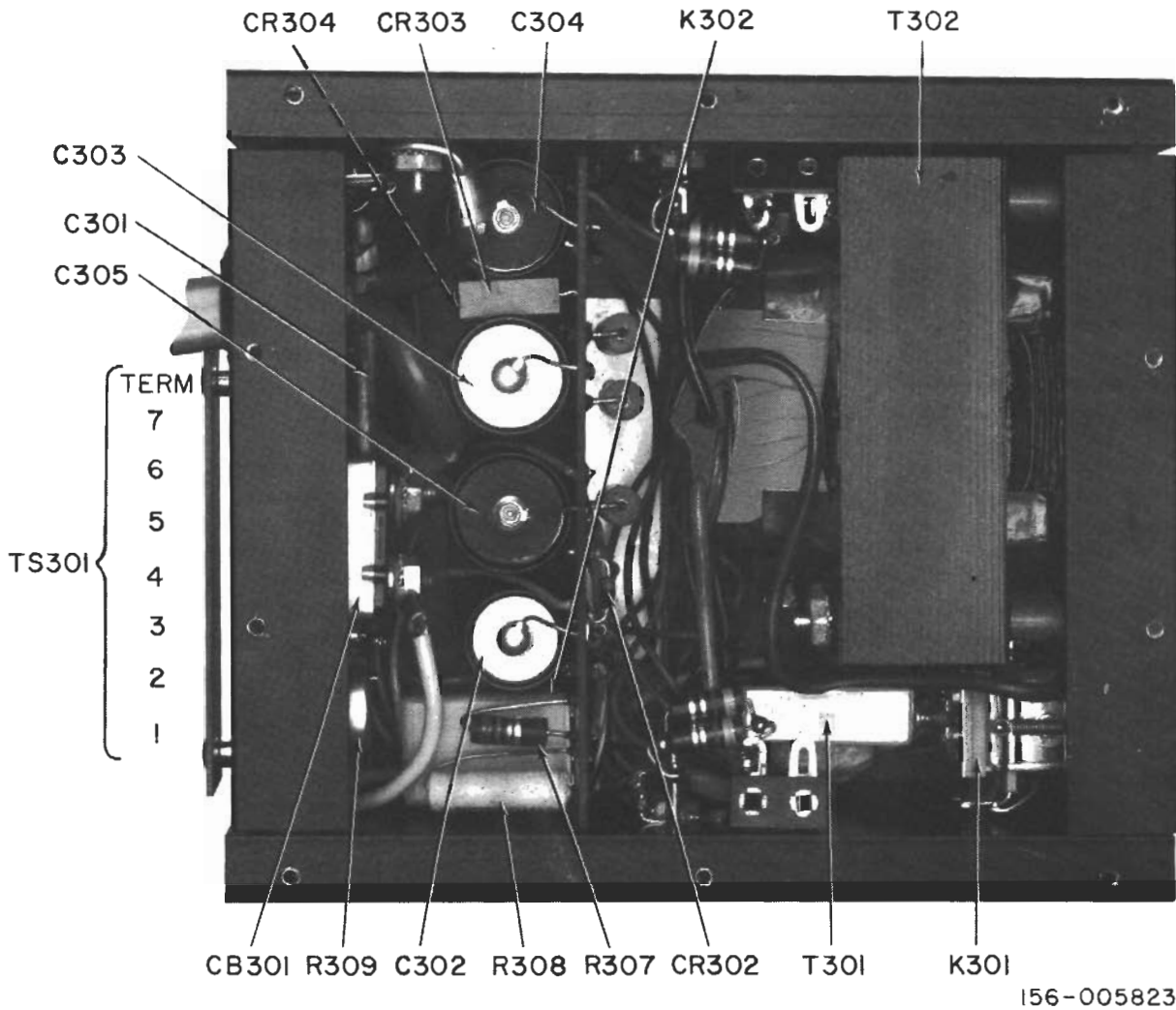
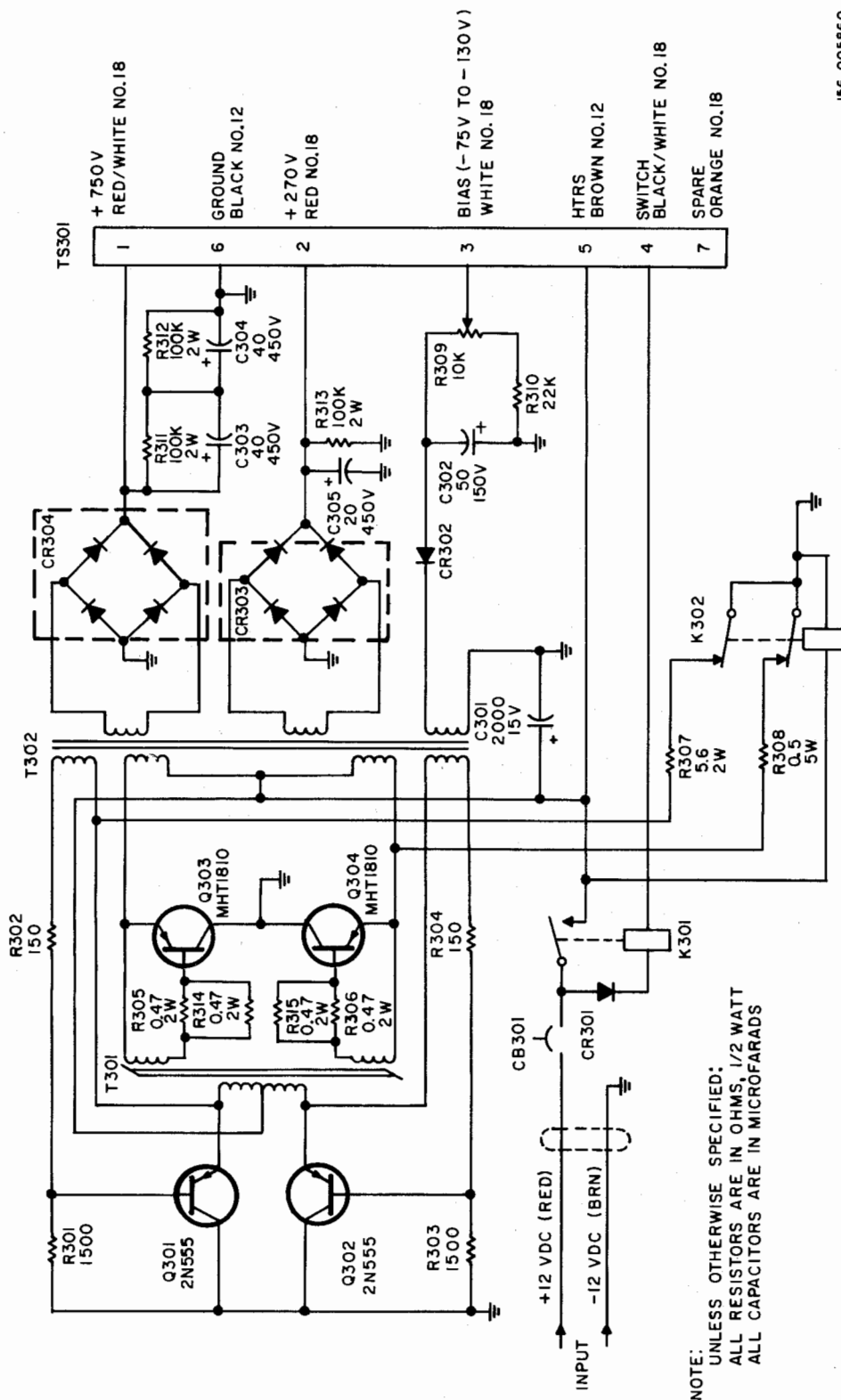


Figure 22. Component Locations on PS-500-DC (Bottom Inside View).

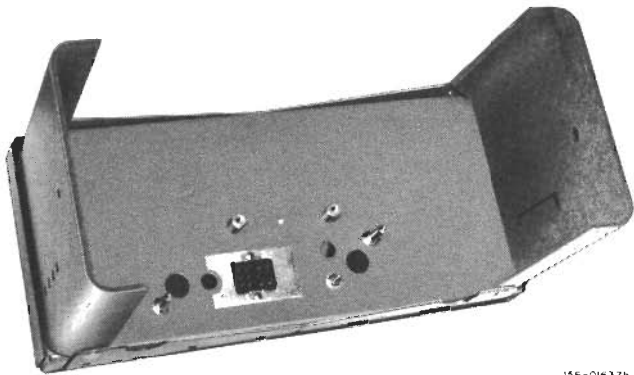


156-005660

Figure 23. Schematic Diagram of PS-500-DC.

SECTION XI

MOBILE MOUNTING RACK MODEL MR-400A



156-016375

Figure 24. Model MR-400A Mobile Mounting Rack.

11-1. DESCRIPTION. Hallicrafters Model MR-400A Mobile Mounting Rack (figure 24) is a sturdy, compact unit designed to facilitate mobile installation of the Model SR-400A Transceiver. This mounting rack, with mounting bracket and straps supplied, permits transmission hump, floor, and/or under dash mounting of the transceiver (see figures 6 and 7).

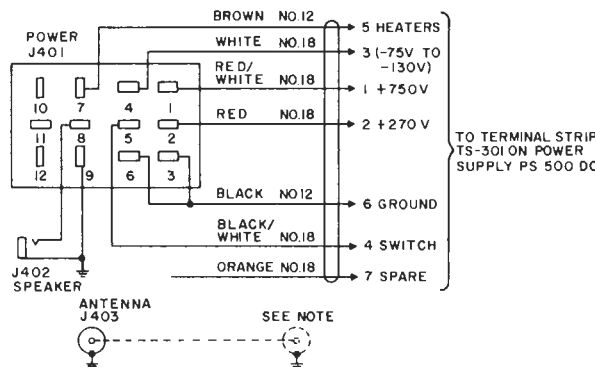
The rack is equipped with a cable for connection to the PS-500-DC Power Supply, an audio connector mounted on the side for a speaker connection, and provisions for convenient connection to the mobile antenna cable. Refer to figure 25 for wiring diagram of the interconnecting plug on the MR-400A.

The padded side panels of the mounting rack fit snugly against the transceiver for a secure installation. Spring loaded hasps secure the transceiver in the rack for ready installation or removal of the transceiver without the use of tools.

11-2. INSTALLATION. Details for installing this equipment in a vehicle are described in paragraph 3-10 of this manual.

REPAIR PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number
	Bracket, Mounting	067-010870
	Strap, Mounting	076-003202
	Cable, Power (192 inches)	087-007656
	Clamp, Cable	076-002744
	Grommet, Rubber	016-002339
J401	Connector, Power (12-pin)	010-002585
J402	Connector, Phone Type (Speaker)	036-000338
J403	Connector, RF Type (Antenna)	035-200082
	Guide Pin	074-002792
	Catch	030-000932-001
	Strike	030-000932-002
	Pad, Side Bracket	014-000517



NOTE:
THE AREA DOTTED IN SHOWS WIRING NECESSARY IF A COAXIAL CONNECTOR IS AFFIXED TO THE SIDE OF THE MOUNTING RACK AND INTERNAL COAXIAL CABLE ADDED BETWEEN THIS CONNECTOR AND J403. IF DESIRED, THE ANTENNA MAY BE CONNECTED DIRECTLY TO J403.

156-008844

Figure 25. Wiring Diagram of MR-400A Interconnecting Plug.

SECTION XII

MODEL HA-20 DX ADAPTER

12-1. DESCRIPTION. The Model HA-20 DX Adapter (figure 26) is a self-powered accessory unit for use with the SR-400A Transceiver. The unit enables the operator to select transmit and receive frequencies that are separated by as much as 500 kHz within any band segment. A choice of two transceive frequencies is provided when the OPERATION switch is positioned between R & T and STBY. The HA-20, also, provides a position (DUAL R) that permits the operator to monitor two receive frequencies simultaneously, separated by as little as 5 kHz or as much as 500 kHz. In this position, the transmitter portion of the transceiver is inoperative.

Calibration of the HA-20 may be checked with the 25-kHz crystal calibrator in the transceiver. A red panel light indicates that the HA-20 is controlling the frequency. With the OPERATION switch in the OFF or STBY position, normal transceiver operation is restored.

The HA-20 also has a VSWR indicator, complete with a calibrated VSWR meter, a METER switch and a METER SENS control. An external coupler is supplied for sampling the 50-ohm transmission line. The unit will handle the full power output supplied by the SR-400A and may be permanently connected in the line for a full-time indication of VSWR or relative transmitter power output. A check of other antenna systems (up to approximately 450 MHz) may also be accomplished. Power required for a full-scale forward meter reading varies with frequency and is approximately 90 watts at 1.8 MHz, and 1 watt at 450 MHz.

12-2. INSTALLATION. Utilize the following steps to install the HA-20 with the SR-400A:

A. Remove the 11-pin jumper plug from the ACCESSORY receptacle (rear of transceiver), and install the 11-pin cable plug (P2) from the HA-20 into this receptacle.



156-008219

Figure 26. Model HA-20 DX Adapter.

B. Connect the 50-ohm coaxial cable from the transceiver ANTENNA output to the VSWR coupler receptacle marked XMTR.

C. Connect the 50-ohm antenna cable to the VSWR coupler receptacle marked ANTENNA.

D. Connect the black wire from the VSWR coupler receptacle to the terminal marked FWD on the rear of the HA-20.

E. Connect the red wire from the VSWR coupler receptacle to the terminal marked REV.

F. Connect the outer shield of this two-conductor cable to the terminal marked GND.

G. Plug the AC line cord into a receptacle supplying 105/125 Vac, 60 Hz, 20 watts.

CAUTION

TO PREVENT METER DAMAGE, ROTATE METER SENS CONTROL COUNTERCLOCKWISE TO MIN UNTIL TRANSMITTER POWER OUTPUT LEVEL HAS BEEN ESTABLISHED. ROTATE CLOCKWISE AS NECESSARY TO OBTAIN DESIRED METER INDICATION.

12-3. OPERATION. Utilize the following steps for operating the HA-20 with the SR-400A:

A. Tune the transceiver on the desired band and set the OPERATION switch on the transceiver to REC.

B. Rotate the OPERATION switch on the HA-20 to the STBY position and allow several minutes for warmup.

C. Check the HA-20 dial calibration with the crystal calibrator in the transceiver.

D. Tune the transceiver dial to the 100-kHz point nearest the desired frequency and peak the PRESELECTOR.

E. Rotate the HA-20 OPERATION switch to R & T.

F. Tune the HA-20 dial to the 100-kHz point nearest the desired frequency and rotate the HA-20 CAL ADJ control as necessary to obtain a zero beat.

G. Turn off the crystal calibrator in the transceiver and tune the HA-20 dial to the desired frequency, peaking the PRESELECTOR control on the transceiver, if necessary.

H. Rotate the HA-20 OPERATION switch to T. At this time, the transceiver VFO is restored to operation. The HA-20 will control the transmit frequency, and the transceiver VFO will control the receive frequency. No further manual switching is required.

CAUTION

WHEN PHONE OPERATION IS USED, THE HA-20 MUST BE KEPT WITHIN THE PHONE PORTION OF THE BAND. THE PRESELECTOR SHOULD ALWAYS BE TUNED TO THE TRANSMIT FREQUENCY.

Some degradation in the receiver gain may be noted on the lower frequency bands, when receiving a frequency far removed from the frequency at which the transmitter is tuned. As stated above, the PRESELECTOR control should always be tuned to the transmit frequency.

To restore normal transceiver operation, rotate the HA-20 OPERATION switch to STBY or OFF.

12-4. VSWR METER OPERATION. Preliminary checks of any antenna system should be made at reduced power to avoid possible transmitter damage and to minimize QRM. Utilize the following steps when operating the VSWR meter:

A. Tune the transmitter to the desired operating frequency.

B. Rotate the HA-20 METER switch to CALIB position.

C. Adjust the HA-20 METER SENS control and/or transmitter output level for the exact full meter reading (CAL mark).

D. Without disturbing the level adjustments, rotate the HA-20 METER switch to VSWR and read the standing wave ratio on the upper scale of the meter.

Checks may be made at the low, middle and high frequency portions of the band to determine the antenna characteristics, so that proper matching adjustments may be made. Adjustments to the antenna system should always be made for the lowest possible VSWR reading at the normal operating frequency. Readings higher than 2:1 are considered to be excessive and steps should be taken to correct the antenna system. Never attempt to prune the coaxial feed-line; this adjustment must be made at the antenna.

As previously stated, the VSWR meter may be used for checking other antenna systems. No AC power is required for the HA-20 when using the VSWR meter; therefore, the unit may be used at any convenient location.

12-5. OPERATION SWITCH POSITION VS CIRCUIT FUNCTIONS.

OFF	117-Vac line open. Bias line to transceiver VFO grounded. Transceiver VFO operates in the received and transmit modes.
STBY	117 Vac applied to HA-20. Filament, B+ and dial lights on. Bias line to transceiver VFO grounded. HA-20 VFO biased off by transceiver. Transceiver VFO operates in the receive and transmit modes.
T	117 Vac supplied to HA-20. Filament, B+ and dial lights on. Transceiver VFO operates in the receive mode only. HA-20 VFO operates in the transmit mode only. Red panel light on in the transmit mode only.
R & T	117 Vac supplied to HA-20. Filament, B+ and dial lights on. Transceiver VFO turned off. HA-20 VFO controls both the transmit and receive frequencies. Red panel light on in the transmit and receive modes.
DUAL R	117 Vac supplied to HA-20. Filament, B+ and dial lights on. Transceiver VFO and HA-20 VFO operate in the receive mode only. Red panel light on in the receive mode only.

NOTE

In the DUAL R position, the transceiver VFO and HA-20 produces a beat note if tuned to less than 5 kHz apart.

12-6. CHASSIS REMOVAL. Remove the four retaining screws at the bottom of the cabinet and slide the chassis and panel assembly out of the front of the cabinet.

12-7. TUBE AND DIAL LAMP REPLACEMENT. All tubes and dial lamps are accessible after the chassis has been removed from the cabinet. Refer to figures 27 and 28 for location.

12-8. VFO CALIBRATION ADJUSTMENTS.

A. Mechanical Index. As each 100-kHz mark on the main dial indexes with the fiducial, the zero mark on the knob dial should also index with the corresponding fiducial. If there is a fixed error between these dials, remove the tuning knob with a No. 8 Bristol setscrew wrench to expose the knob dial bushing. Set the main dial to any 100-kHz mark. Loosen the knob dial setscrew with a No. 6 Bristol wrench and rotate the knob dial with respect to the knob shaft until the zero mark lines up with the fiducial. Tighten the setscrew and replace the knob leaving approximately a 1/32-inch clearance between the knob and panel. If a service operation is required, disconnect the VFO gang from the gear drive and re-index the gang as follows:

1. Rotate the tuning knob clockwise to the mechanical stop.
2. Loosen the two No. 6 Bristol setscrews holding the drive gear to the VFO gang shaft.
3. Rotate the gang capacitors to fully mesh and tighten one of the setscrews.
4. Rotate the tuning knob exactly 30 kHz in the counterclockwise direction.
5. Loosen the setscrew again and without disturbing the VFO gang setting, turn the tuning knob clockwise to the dial zero. The main dial is now indexed at the high frequency end of the dial.
6. Tighten both setscrews securely and replace the VFO compartment cover before recalibrating the VFO electrically.

B. VFO Calibration (Trimmer Adjustment Only). A trimmer capacity correction is indicated if the dial calibration checks across the dial, at the 100-kHz check points, consistently fall to one side of the fiducial and cannot be corrected by the CAL ADJ control. The main dial and the knob dial must be correctly indexed as outlined in paragraph 12-8, A, and a calibration check should be made with the transceiver FUNCTION switch set at LSB. Recalibrate the VFO as follows:

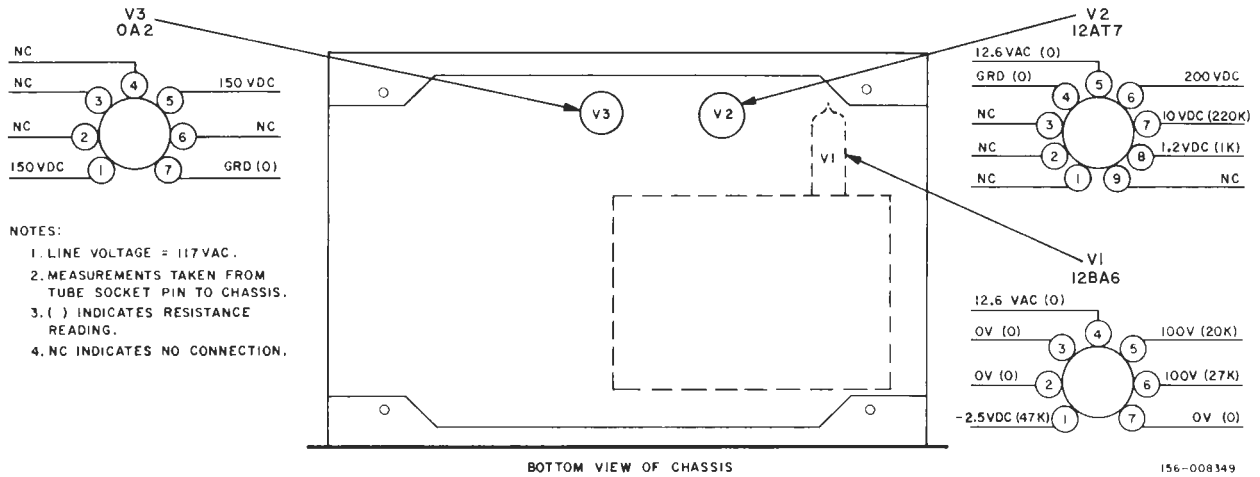


Figure 27. Tube Voltage and Resistance Chart.

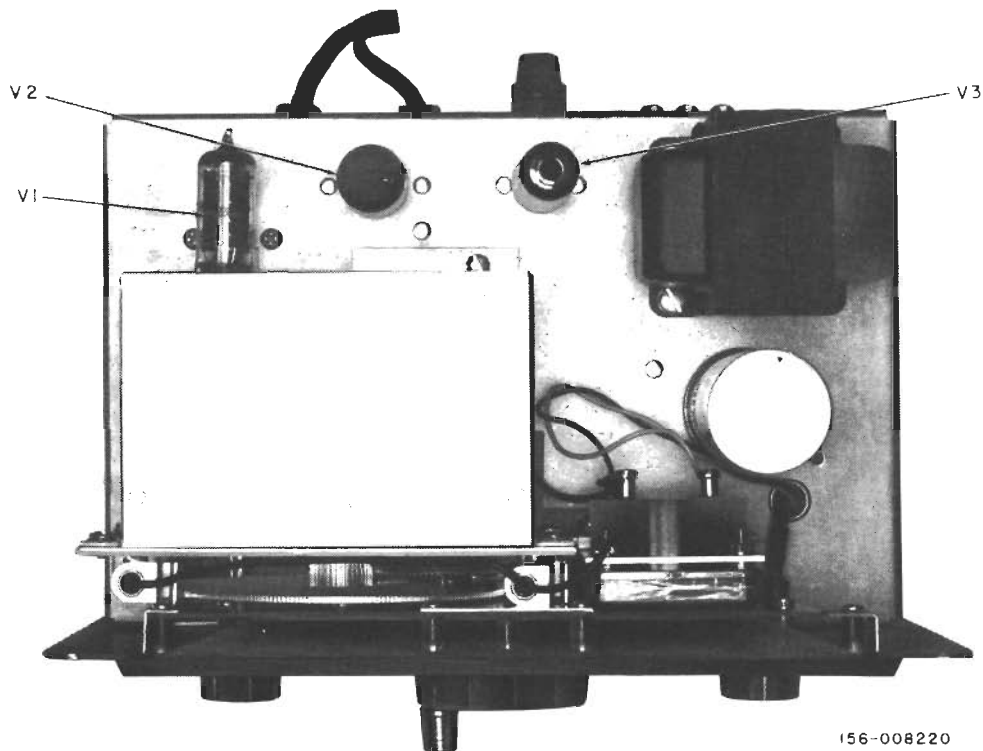


Figure 28. Tube Locations on HA-20 (Top Inside View).

1. Remove the chassis assembly from the cabinet (see paragraph 12-6) to gain access to the adjustment screw of trimmer C4. Refer to figure 29 for location and figure 30 for schematic diagram of HA-20.

2. Set the transceiver controls as follows:

BAND SELECTOR 3.5
OPERATION REC
FUNCTION LSB
PRESELECTOR 80M segment
CAL ON/CAL ADJ CAL (pull out)
NOISE BLANKER OFF
RIT CONTROL OFF

3. Center the CAL ADJ control on the HA-20. The dot on the knob should appear in the up-position (center).

4. Set the dial for exactly 3500 kHz (red 500 on the main dial and black zero on the knob dial). Rotate the HA-20 OPERATION switch to the R & T position. Carefully adjust trimmer C4 for a zero beat.

5. Check the calibration across the dial at the 100-kHz check points. If the frequency error is less than approximately 2000 Hz, the calibration is within acceptable limits. If the error increases and exceeds 2000 Hz at the high frequency end of the dial, the VFO will require a coil adjustment in addition to the trimmer adjustment.

C. VFO Calibration (Trimmer and Coil Adjustments). If the dial error progressively increases in the same direction with the high frequency end of the dial running out more than 2000 Hz, both the coil L1 and trimmer C4 require adjustment. Calibrate the VFO as follows:

1. Set the transceiver and HA-20 controls per steps 2 and 3 in paragraph 12-8, B.

2. Set the tuning dial for exactly 4000 kHz (VFO = 4350.000 kHz) and adjust coil L1 for a zero beat.

3. Set the tuning dial for exactly 3500 kHz (VFO = 4850.000 kHz) and adjust trimmer C4 for a zero beat.

4. Repeat steps 2 and 3 until both the 3500-kHz and 4000-kHz settings are exactly on frequency.

5. Check the calibration across the dial at the 100-kHz points. If the frequency error is less than 2000 Hz, the calibration is within acceptable limits. If the error exceeds 2000 Hz at any of the midpoints, with the end limits at zero error, the VFO capacitor C5 should be "knifed". This operation should not be attempted by other than qualified personnel thoroughly familiar with the technique.

6. Set the tuning dial to 3800 kHz and tune to an exact zero beat with the 25-kHz crystal calibrator in the transceiver. Switch the FUNCTION control on the transceiver from LSB to USB. If the frequency shifts more than 15 Hz, the VFO corrector trimmer C19 must be adjusted per paragraph 12-8, D.

D. VFO Corrector Adjustment. The VFO corrector trimmer C19 shifts the VFO frequency approximately 3000 Hz to correct for the difference in frequency between the upper and lower sideband BFO/carrier crystal frequencies. The trimmer is switched into the VFO circuit in the upper sideband mode. To check the corrector trimmer setting, operate the transceiver in the LSB mode and tune with the DX adapter (R & T position) to zero beat with the 3800-kHz marker frequency. Switch the transceiver to the USB mode. There should be less than a 15-Hz change in frequency. If the change is greater than 15 Hz, carefully adjust trimmer C19 until the frequency difference between USB and LSB is less than 15 Hz.

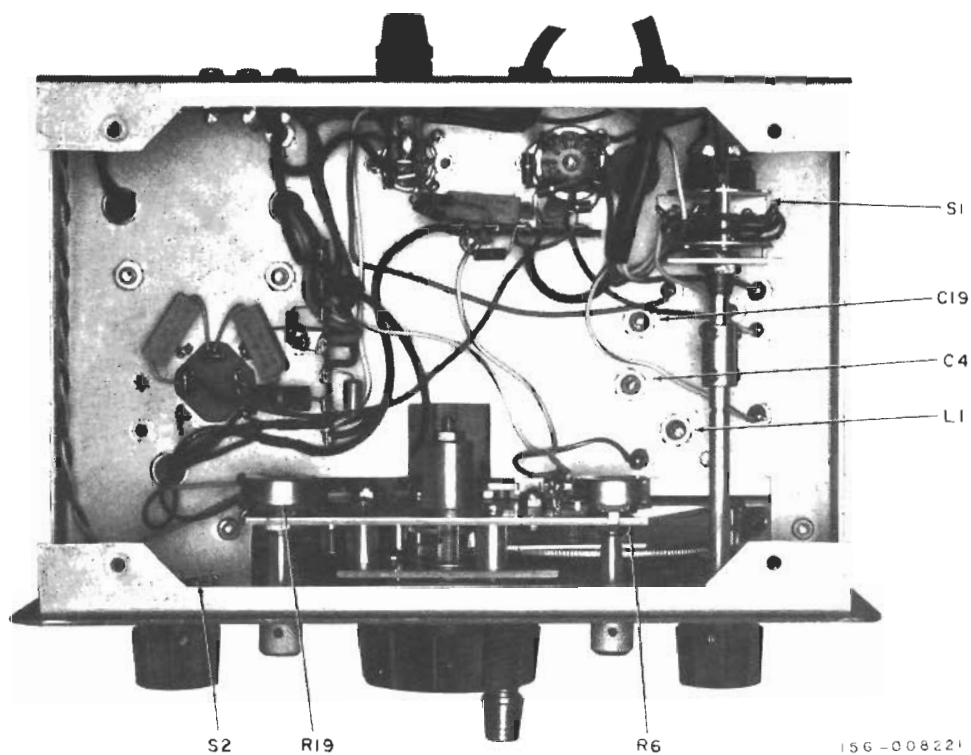


Figure 29. Adjustment Locations on HA-20 (Bottom Inside View).

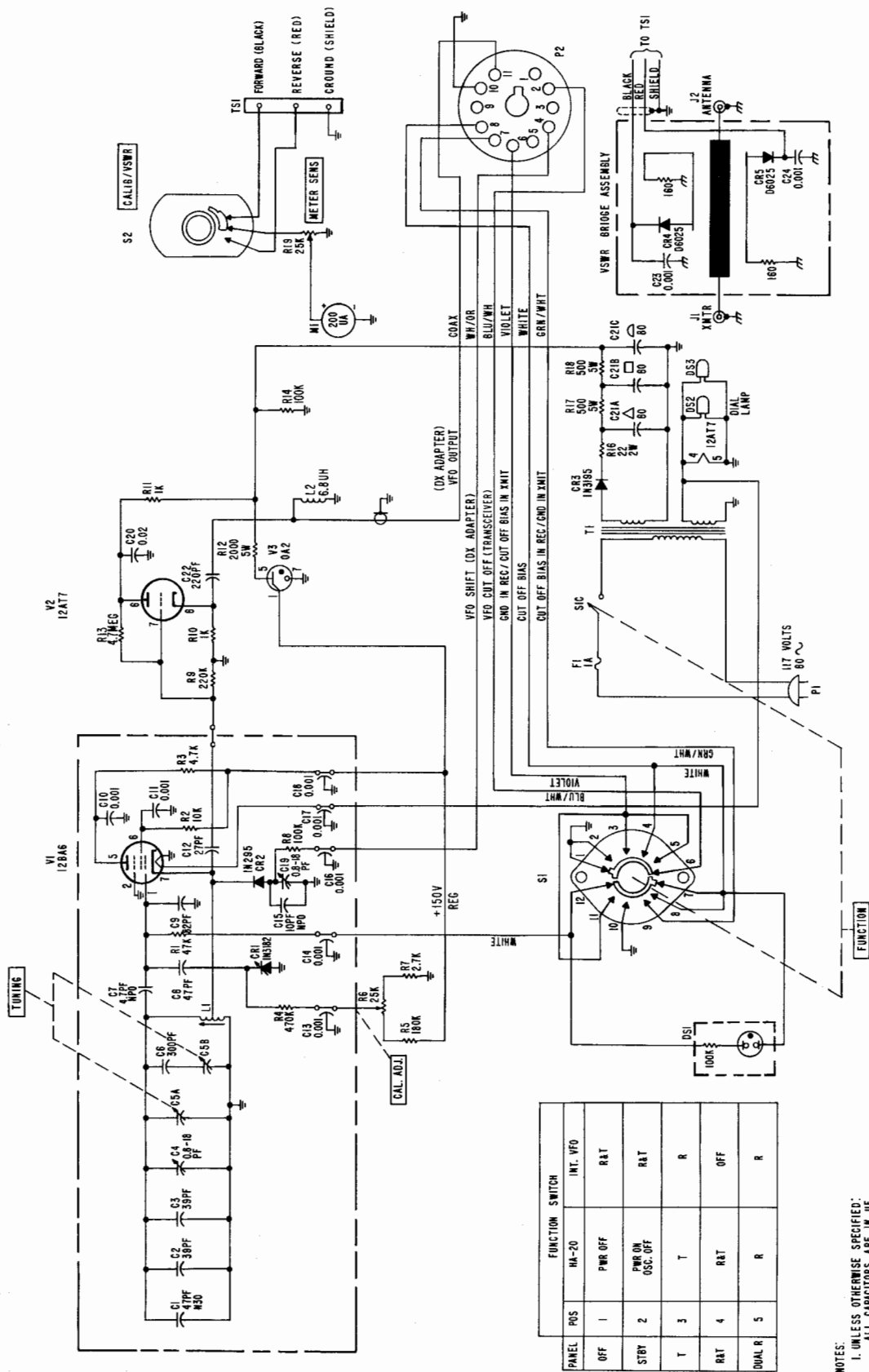


Figure 30. Schematic Diagram of HA-20.

- NOTES:
 1. UNLESS OTHERWISE SPECIFIED:
 ALL CAPACITORS ARE IN UF.
 ALL RESISTORS ARE IN OHMS,
 CARBON TYPE 10%, 1/2 WATT.
 2. FUNCTION SWITCH SHOWN IN OFF POSITION.
 3. VSWR SWITCH SHOWN IN FORWARD POSITION.

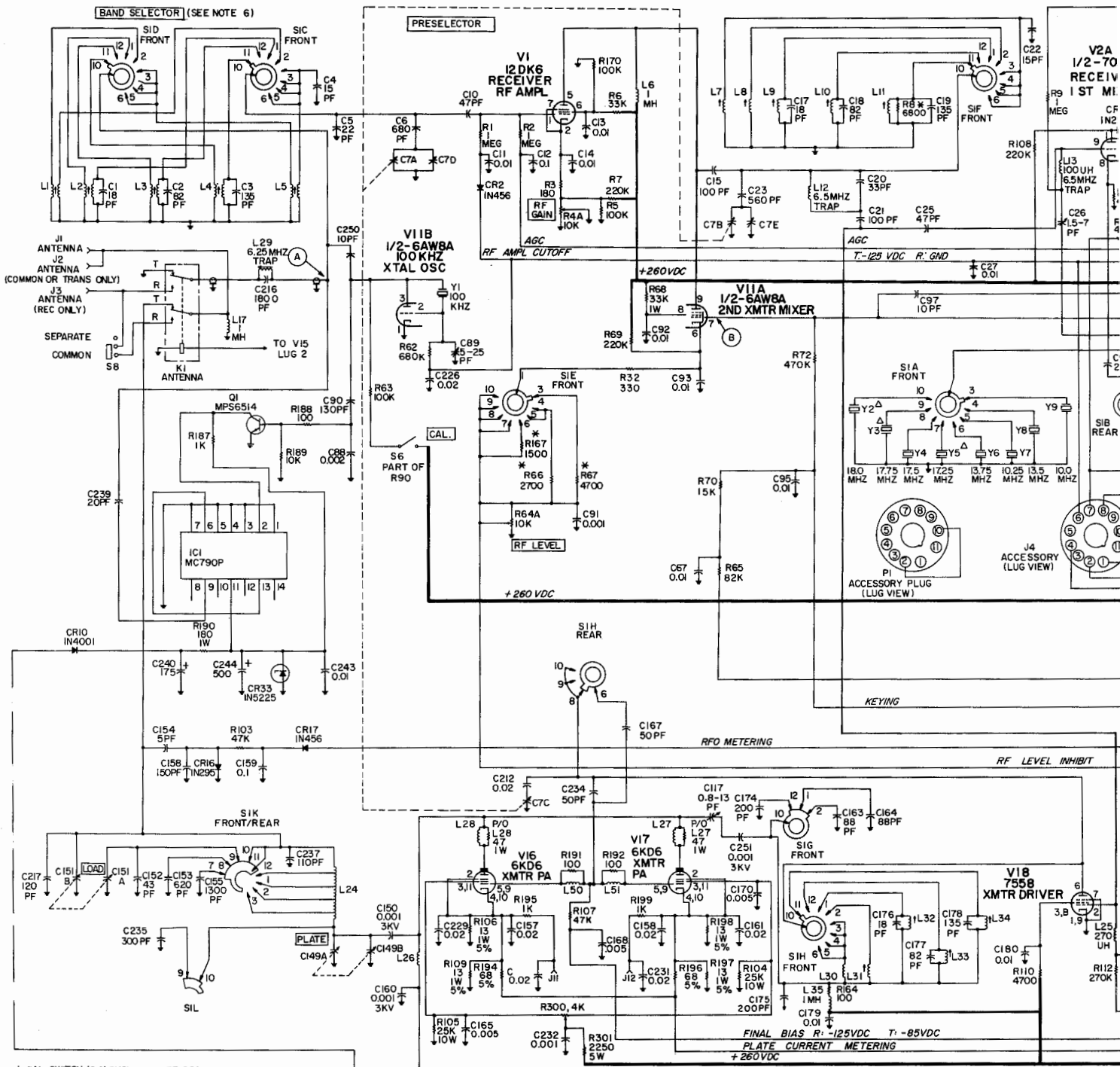
REPAIR PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number	Schematic Symbol	Description	Hallicrafters Part Number
CAPACITORS			ELECTRON TUBES AND DIODES		
C1	47 PF, 5%, N30, Ceramic	491-025470-032	V1	Tube, Type 12AB6	090-900039
C2,3	39 PF, 5%, N150, Ceramic	491-005390-051	V2	Tube, Type 12AT7	090-900034
C4	Variable, 0.8-18 PF, Piston Trimmer	044-000643	V3	Tube, Type OA2	090-900001
C5A,B	Variable, Tuning	048-000597	CR1	Diode, Type 1N3182	019-003316
C6	300 PF, 2%, Mica	493-110301-324	CR2	Diode, Type 1N295	019-301980
C7,8	47 PF, 5%, NPO, Ceramic	491-025470-022	CR3	Diode, Type 1N3195	019-002770
C9	82 PF, 5%, N80, Ceramic	491-055820-042	CR4,5	Diode, Type D6025 (Part of VSWR Bridge Assembly)	019-004112
C10,11,23,24	0.001 μ F, 500V, Mica	047-001671	CONNECTORS		
C12	27 PF, 5%, NPO, Ceramic	491-005270-022	J1,2	Jack, XMTR, ANTENNA	010-100056
C13,14,16,17,18	0.001 μ F, feed-thru, GMV, Mica	047-001308	P2	Plug, 11-Pin	035-100043
C15	10 PF, NPO, Ceramic	491-001100-022	SWITCHES		
C19	Variable, 0.8-13 PF, Piston Trimmer	044-000520	S1	Switch, Rotary, FUNCTION	060-002866
C20	0.02 μ F, 500V, Mica	047-100471	S2	Switch, Rotary, FORWARD/VSWR	060-002867
C21A,B,C	80/80/60 μ F, 300V, Electrolytic	045-001330	MISCELLANEOUS		
C22	220 PF, 10%, 500V, Mica	493-110221-134		Box, Bottom	066-005111
*RESISTORS				Cabinet	066-004836
R1	47K Ohm	451-252473		Chassis, Main	070-002635
R2	10K Ohm	451-252103		Chassis, VFO	070-002543
R3	4.7K Ohm	451-252472	F1	Cover	066-005113
R4	470K Ohm	451-252474		Cover, Gang VFO	066-004434
R5	180K Ohm	451-252184		Escutcheon	007-000903
R6,19	Variable, 25K Ohm METER SENS and CAL ADJ	025-002509		Foot, Rubber (4)	016-201072
R7	2.7K Ohm	451-252272		Fuse, 1 AMP, 3AG	039-100447
R8,14	100K Ohm	451-252104		Fuseholder (F1)	006-200845
R9	220K Ohm	451-252224		Gear	026-001002
R10,11	1K Ohm	451-252102		Gear, Dial	026-001172
R12	2K Ohm, 5 Watt	445-012202		Gear, Idler	026-001170
R13	4.7 Megohm	451-252475		Gear, Pinion	026-001171
R16	22 Ohm, 2 Watt	451-652220		Gear, Pinion Drive	026-001166
R17,18	500 Ohm, 5 Watt	445-012501		Gear, Spur	026-001089
COILS AND TRANSFORMERS				Gear, Spur, Fixed	026-001088
L1	Coil, VFO	050-002416		Handle, Knob	030-000793
L2	Choke, RF, 6.8 μ H	050-001245		Knob, FORWARD/ VSWR, FUNCTION	015-001775
T1	Transformer, Power	050-002590		Knob, Knurled, CAL ADJ, METER SENS	015-001755-002
*ALL RESISTORS are carbon type, 10%, 1/2 watt unless otherwise stated.				Knob, TUNING	015-001617
			DS2,3	Lamp, Pilot	039-000797
			DS1	Light, Indicator, Neon Medallion	086-000690 007-000850
			M1	Meter	082-000696
				Panel, Front	068-001724
				Plate, Front VFO	063-006821
				Plate, Gear	063-006830
				Plate, Idler Gear	063-006827

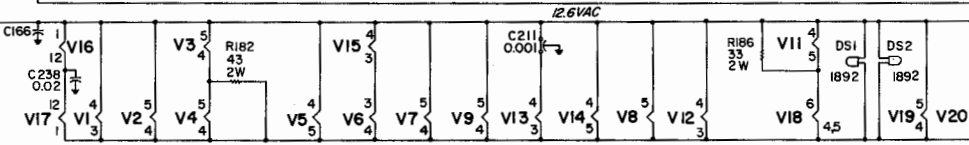
REPAIR PARTS LIST (CONTD)

Schematic Symbol	Description	Hallicrafters Part Number	Schematic Symbol	Description	Hallicrafters Part Number
MISCELLANEOUS (CONTD)			MISCELLANEOUS (CONTD)		
	Plate, Pivot	063-006828		Socket, Tube, 7-Pin (V1, V3)	006-001094
	Plate, Top Gang Cover	063-006889		Spur Gear, Dial Scale	026-001174
	Socket Assembly, Pilot Light	086-000743		Spur Gear, Pinion Shaft	026-001172
	Socket, Tube, 9-Pin (V2)	006-001112		Window, KC	022-000747
				Window (2 Top Dials)	022-000753

NOTES



1. CAL SWITCH (S6) SHOWN IN OFF POSITION.
2. OPERATION SWITCH (S4) IS SHOWN IN OFF (FULL CCW) POSITION.
3. FUNCTION SWITCH (S3) IS SHOWN IN CW (FULL CCW) POSITION.
4. BAND SELECTOR (S1) IS SHOWN IN 3.5MHz (FULL CCW) POSITION.
5. METER SWITCH (S2) IS SHOWN IN S/RFO (FULL CCW) POSITION.
6. ALL WAFERS OF BAND SELECTOR (S1) ARE MECHANICALLY GANGED.
7. RELAYS ARE SHOWN IN POWER OFF CONDITION.
8. UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS 10%, 1/2 WATT.
ALL CAPACITORS ARE IN UF (SEE PARTS LIST FOR VOLTAGE RATING).
- * RESISTANCE MAY VARY FROM VALUE SHOWN, IF REPLACEMENT IS NECESSARY, USE SAME VALUE AS PART REMOVED.
- ^ NOT SUPPLIED.



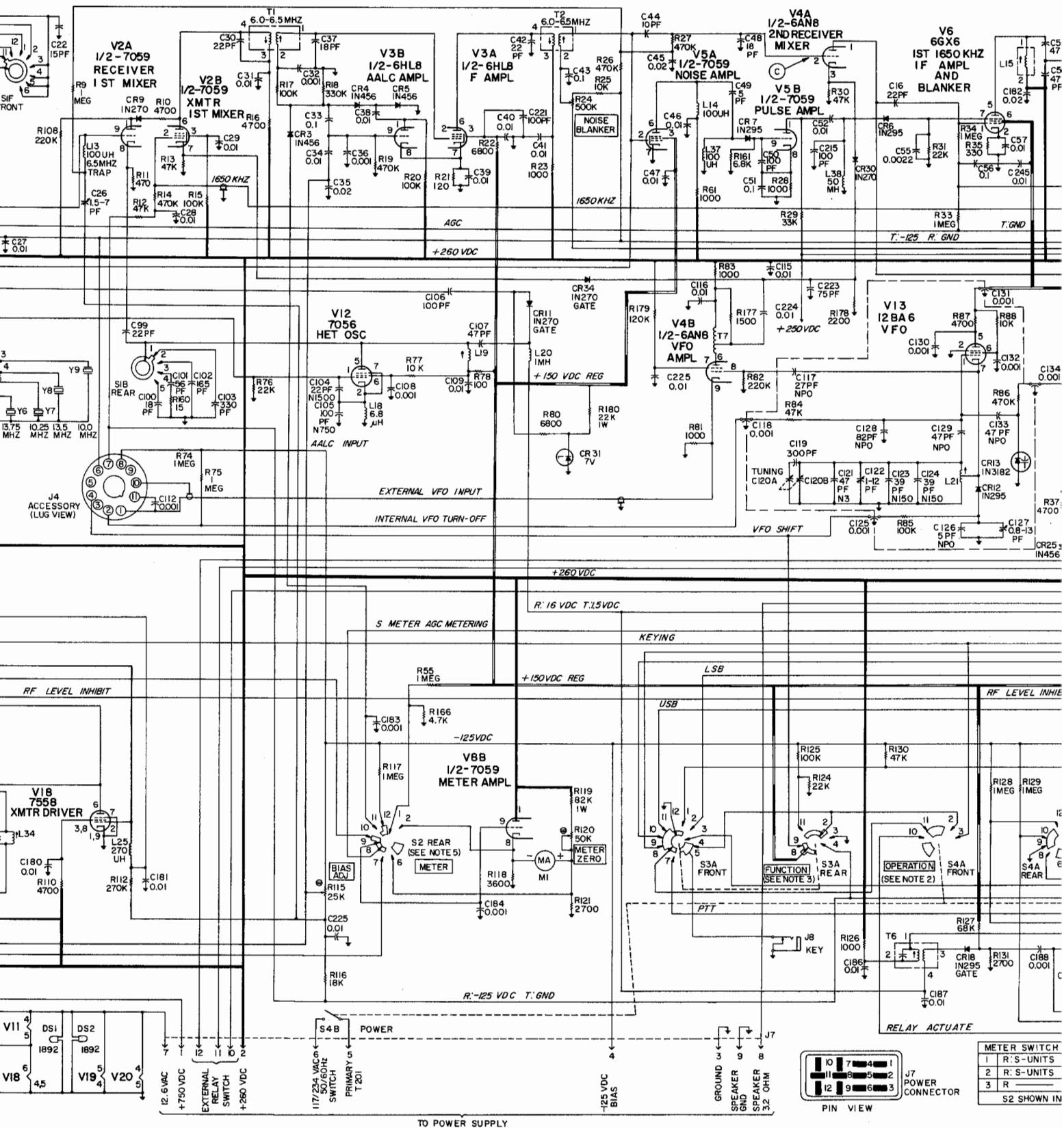


Figure 31. Schematic Diagram of SR-400A.

Schematic Symbol	Description	Hallcrafters Part Number
CAPACITORS		
C1,17,100,176	18 PF, 5%, 500 V, Mica	493-110180-231
C2,18,177	82 PF, 5%, 500 V, Mica	493-110820-233
C3,19,178	135 PF, 5%, 500 V, Mica	493-121350-234
C4,22	15 PF, 5%, 500 V, Mica	493-110150-231
C5,99	22 PF, 5%, 500 V, Mica	493-110220-231
C6,80	680 PF, 5%, 300 V, Mica	493-110681-224
C7A,B,C, D,E	Variable (PRESE-LECTOR)	048-000526
C8,35,45,79,141,144,182,212,222,226	0.02 μ F, 20%, 600 V, Ceramic	047-100471
C9,10,16,25,54,107	47 PF, 10%, 500 V, Mica	493-110470-133
C11,13,14,27,28,29,31,34,38,39,40,41,46,47,52,57,65,67,71,75,77,82,92,93,95,103,115,116,140,143,166,179,180,181,186,187,194,198,200,206,207,209,224,225,228,243	0.01 μ F, 20%, 500 V, Ceramic	047-100354
C12,33,43,51,56,61,62,159,172,173	0.1 μ F, +80%, -20%, 100 V, Ceramic	047-001428
C15,21,50,53,83,106,158,203,208,215,221	100 PF, 10%, 500 V, Mica	493-110101-134
C20	33 PF, 5%, 500 V, Mica	493-110330-233
C23	560 PF, 10%, 500 V, Mica	493-110561-131
C26	Variable, 1.5-7 PF, Trimmer	044-100457
C30,42,220	22 PF, 10%, 500 V, Mica	493-110220-131
C32,36,64,68,69,74,76,81,91,108,112,130,132,183,184,188,193,196,197,199,202,213,232	0.001 μ F, 20%, 500 V, Ceramic	047-001671
C37,48,191	18 PF, 10%, 500 V, Mica	493-110180-131
C44,72,97,138,201	10 PF, \pm 0.5 PF, 500 V, Mica	493-110100-531
C49,154	5 PF, 10%, 500 V, Mica	493-110050-131
C55	0.0022 μ F, 10%, 200 V, Paper	046-001273-004
C58,157,161,182,229,231,245	0.02 μ F, +80%, -20%, 500 V, Ceramic	047-000242
C59,66	470 PF, 10%, 500 V, Mica	493-110471-134
C63	310 PF, 5%, 300 V, Mica	493-110311-224
C70,218	5 μ F, -10%, +100%, 25 V, Electrolytic	045-000938
C73,114	120 PF, 10%, 500 V, Mica	493-110121-134
C78,88	0.002 μ F, \pm 20%, 500 V, Ceramic	047-000395
C89,136,139,192	Variable, 5-25 PF, Trimmer	044-100473
C90	130 PF, 10%, 500 V, Mica	493-110131-131
C94,137	0.1 μ F, 10%, 200 V, Paper	046-001294-004
C101	56 PF, 5%, 500 V, Mica	493-110560-233
C102	165 PF, 5%, 500 V, Mica	493-121650-234
C103	330 PF, 5%, 500 V, Mica	493-110331-234
C104	22 PF, 5%, N1500, Ceramic	479-015220
C105	100 PF, 5%, N750, Ceramic	047-002503-009
C117	27 PF, 5%, 500 V, NPO, Ceramic	047-002503-004
C118,125,131,134,211	0.001 μ F, GMV, Feed-thru	047-001308
C119	300 PF, 2%, 300 V, Mica	493-110301-324
C120A,B	Variable, Tuning	048-000597
C121	47 PF, 5%, 500 V, N30, Ceramic	047-002503-007
C122	Variable, 1.0-12 PF, Piston Trimmer	044-000643
C123,124	39 PF, 5%, 500 V, N150, Ceramic	047-002503-005

Schematic Symbol	Description	Hallcrafters Part Number
CAPACITORS (Continued)		
C126	5 PF, 5%, 500 V, NPO, Ceramic	047-002503-001
C127,171	Variable, 0.8-13 PF, Piston Trimmer	044-000520
C128	82 PF, 5%, 500 V, N80, Ceramic	047-002503-008
C129,133	47 PF, 5%, 500 V, NPO, Ceramic	047-002503-006
C146	25 μ F, -10%, +75%, 25 V, Electrolytic	045-001431
C147A,B	2 x 30 μ F, -10%, +100%, 350 V, Electrolytic	045-000902
C149A,B	Variable, PLATE	048-000639
C150,160	0.001 μ F, 20%, 3 KV, Ceramic	047-100397
C151A,B	Variable, LOAD	048-000667
C152	43 PF, 10%, 500 V, Mica	493-110430-131
C153	620 PF, 10%, 500 V, Mica	493-110621-131
C155	1300 PF, 10%, 500 V, Mica	493-310132-134
C163,164	86 PF, 10%, 500 V, Mica	493-110860-131
C165,168,170,190	0.005 μ F, 20%, 500 V, Ceramic	047-100442
C167,234	50 PF, 10%, 500 V, Mica	493-110500-131
C174,175	200 PF, 10%, 500 V, Mica	493-110201-131
C185,195	0.47 μ F, 250 V, Mica	047-002141-011
C205	220 PF, 10%, 500 V, Mica	493-110221-134
C210	0.22 μ F, 10%, 200 V, Paper	046-001298-004
C214	50 PF, 5%, 300 V, Mica	493-110500-221
C216	1800 PF, 2%, 300 V, Mica	493-310182-324
C217	120 PF, 10%, 500 V, Mica	493-110121-131
C223	75 PF, 10%, 500 V, Mica	493-110750-131
C237	110 PF, 10%, 500 V, Mica	493-110111-131
C239	20 PF, 10%, 500 V, Mica	493-110200-131
C240	175 μ F, -10%, +100%, 25 V, Electrolytic	045-001550
C244	500 μ F, -10%, +100%, 6 V, Electrolytic	045-001449
C251	0.001 μ F, 3 KV, Ceramic	047-002151-036
*RESISTORS		
R1,2,9,33,34,40,55,74,75,117,128,129,137,138,143,144,153,154	1 Megohm	451-252105
R3	180 Ohm	451-252181
R4A,B, R64A,B, R5,15,17,20,36,42,45,63,85,125,148,151,170,171	Variable, Dual 500 K & 10 K Ohm (RF & AF)	025-002063
R6,29,77, R7,39,57,58,69,82,95,96,108,141,145,147,177	100 K Ohm	451-252104
R8,22,80,98,161	33 K Ohm	451-252333
R10,16,37,43,47,60,67,71,87,110,166	220 K Ohm	451-252224
R11,133,134	470 Ohm	451-252471
R12,13,30,52,84,103,107,130	47 K Ohm	451-252473
R14,19,26,27,38,49,59,72,86,111,139	470 K Ohm	451-252474
R18,112, R21,180, R23,28,48,61,78,81,83,126,152,195,199	330 K Ohm	451-252334
R24	120 Ohm	451-252121
R25,32,54,70,88,123,169,172, R31,76,124,168	1 K Ohm	451-252102
R35	22 K Ohm	451-252223
R41	330 Ohm	451-252331
R44	2.2 Megohm	451-252225
R42	220 Ohm	451-252221

Schematic Symbol	Description	Hallcrafters Part Number
*RESISTORS (Continued)		
R46	Variable, 10 K Ohm, AGC Threshold	025-002330
R50	2 K Ohm, 10 Watt	445-032202
R51,149	2.7 Megohm	451-252275
R53	3.3 K Ohm	451-252332
R56	4.7 Megohm	451-252475
R62	680 K Ohm	451-252684
R65	82 K Ohm	451-252823
R66,79,92,121,131,135,174	2.7 K Ohm	451-252272
R68	33 K Ohm, 1 Watt	451-352333
R73,94,97,127	68 K Ohm	451-252683
R89	150 K Ohm, 1 Watt	451-352154
R90,173	Variable, 50 K Ohm, 30%, Potentiometer, CAL w/Pull Switch (S6 w/R90), (S5 w/R173)	025-003307
R91	Variable, 25 K Ohm, RIT (includes S7)	025-002510
R93,150	Variable, 1 Megohm, 30%, 2/10 Watt	025-002067
R99,120	Variable, 50 K Ohm, 20%, 2/10 Watt	025-002065
R100	47 Ohm, 1 Watt	451-352470
R102	1.5 K Ohm, 2 Watt	451-652152
R104,105	25 K Ohm, 10 Watt	445-032253
R106,109,197,198	13 Ohm, 1 Watt	451-352130
R115	Variable, 25 K Ohm, 20%, 1/3 Watt, BIAS ADJ	025-002698
R116	27 K Ohm	451-252273
R118	3.6 K Ohm, 5%	451-251362
R119,159	82 K Ohm, 1 Watt	451-352823
R132	Variable, 250 Ohm, 10%, 3/10 Watt	025-002064
R135,146	680 Ohm	451-252681
R142,201	2.2 K Ohm	451-252222
R155	Variable, 10 Megohm, 20%, 2/10 Watt	025-002066
R156	6.8 Megohm	451-252685
R157	3.3 Megohm	451-252335
R158,167,200	1.5 K Ohm	451-252152
R160	15 Ohm	451-252150
R163	8.2 K Ohm	451-252822
R164	100 Ohm	451-252101
R175	68 K Ohm, 1 Watt	451-352683
R178	150 K Ohm	451-252154
R179	120 K Ohm	451-252124
R180	120 Ohm	451-252121
R181	10 Megohm	451-252106
R182	43 Ohm, 2 Watt	451-452430
R186	33 Ohm, 2 Watt	451-452330
R188	100 Ohm, 1/4 Watt	451-152101
R189	10 K Ohm, 1/4 Watt	451-152103
R190	180 Ohm, 1 Watt	451-352181
R194,196	68 Ohm	451-252680
R280	22 K Ohm, 1 Watt	451-352223
R300	Variable, 4 K Ohm, 30%, 1 Watt	025-002914
R301	2250 Ohm, 5 Watt	024-0001799
*ALL RESISTORS are fixed composition, 10%, 1/2 Watt, unless otherwise stated.		
COILS AND TRANSFORMERS		
L1	Coil, Antenna, 15 Meter	051-003350
L2	Coil, Antenna, 20 Meter	051-003347
L3	Coil, Antenna, 40 Meter	051-003345
L4	Coil, Antenna, 80 Meter	051-003346
L5	Coil, Antenna, 10 Meter	051-003531
L6,17,20,35,40,44	Choke, RF, 1 MH	053-000580
L7	Coil, RF, 10 Meter	051-003532
L8,31	Coil, RF, 15 Meter	051-003349
L9,32	Coil, RF, 20 Meter	051-003342
L10,33	Coil, RF, 40 Meter	051-003340
L11,34	Coil, RF, 80 Meter	051-003341
L12	Coil, RF Trap, 6.25 MC	050-001068
L13,14,37	Choke, RF, 100 μ H	053-000644
L15,16	Coil, 1650 KC	050-000801
L18	Choke, RF, 6.8 μ H	050-001245
L19	Coil, Heterodyne Osc	050-002370
L21	Coil, VFO	050-002416
L24	Coil, Output	050-004097
L25	Choke, RF, 270 μ H	050-002692
L26	Choke, RF	053-200426
L27,28	Choke, Parasitic	050-001051
L29	Coil, Trap, 6.25 MC	050-003467
L30	Coil, RF, 10 Meter	050-004257
L38	Choke, RF, 50 MH	050-001044-009
L42	Choke, RF, 0.5 MH	050-003479
L43	Choke, RF, 0.7 MH	053-000530



IR PARTS LIST

Schematic Symbol	Description	Hallcrafters Part Number	Schematic Symbol	Description	Hallcrafters Part Number	Schematic Symbol	Description	Hallcrafters Part Number
COILS AND TRANSFORMERS (Continued)			MISCELLANEOUS (Continued)			MISCELLANEOUS (Continued)		
L50,51	Choke, Parasitic	053-004117	Bracket, Center	067-013337		Pulley	028-000572	
T1,2	Transformer, IF, Bandpass	050-001045	Pilot Light		K1	Relay, Antenna	021-000862	
T3	Transformer, IF, 1650 KC	050-000890	Bracket, Coil	067-203456	K2	Relay, VOX	021-000732	
T4,6	Transformer, Bal Mod	050-000881	Mounting (8)			Roller (2)	028-000550	
T5	Transformer, Audio Output	055-000469	Bracket, Escutcheon	067-013109		Shaft, BAND	074-003106	
T7	Coil, VFO, Output	050-004065	Bracket, Function Switch	067-012720		SELECTOR		
ELECTRON TUBES			Bracket, Meter	067-012597		Shaft, Cam	074-002997	
V1	Tube, Type 12DK6	090-001660	Switch & Bias Adj Pot			Shaft, Dial Gear	074-002996	
V2,5,7,8	Tube, Type 7059	090-001561	Bracket, Meter	067-012721		Shaft, Inner	074-003104	
V3	Tube, Type 6HL8	090-001737	Mounting			PLATE (Tuning)		
V4	Tube, Type 6AN8	090-001300	Bracket, Pilot Light	067-013338		Shaft, Outer LOAD	074-003105	
V6	Tube, Type 6GX6	090-001639	Bracket, Piston	067-013479		Shaft, Outer PRE-SELECTOR	074-002791-003	
V9,14,19,20	Tube, Type 12AT7	090-000034	Cap Mounting			Shaft, PRESE-LECTOR	074-002756-003	
V10	Tube, Type OA2	090-000001	Bracket, Pot	067-012712		Shield, Heat	067-018604	
V11	Tube, Type 6AW8A	090-901103	Mounting			Shield, Tube (V18)	069-001590	
V12	Tube, Type 7056	090-001642	Bracket, Pot	067-013483		Socket, 4-Crystal	150-003281	
V13	Tube, Type 12BA6	090-900039	Mounting			Socket, 11-Pin	006-200707	
V15	Tube, Type 6AQ5A	090-901331	Bracket, Spring Adj	067-012607		Socket, Dual Crystal	006-000984	
V16,17	Tube, Type 6KD6	090-001741	Bracket, Tube	067-013054		Socket, Pilot Light	086-000743	
V18	Tube, Typ3 7558	090-001361	Mounting			Assembly		
SEMICONDUCTORS			Cabinet Assembly	150-009999		Socket, Single	006-100320	
CR2,3,4,5	Diode, Type 1N456	019-002964	Cabinet, Top	150-005132		Crystal		
15,17,21,22,23,25,26,28,29	Diode, Type 1N295	019-301980	Assembly			Socket, Tube, 7-Pin (V1,6)	006-000946	
CR6,7,12,16,18	Diode, Type 1N270	019-005141	Cabinet Weld	150-010001		Socket, Tube, 7-Pin (V10,12,13,15)	006-001094	
CR9,11,30,34	Diode, Type 1N4001	019-003551	Connector, Antenna	010-100056		Socket, Tube, 9-Pin (V2,3,5,11)	006-200947	
CR10	Diode, Type 1N3182	019-003316	Connector, Mic w/hardware	010-101569		Socket, Tube, 9-Pin (V4,8,9,14,20)	006-001112	
CR13,27	Diode, Zener, Type VRI20	019-003407	Coupling, Insulator (Green)	029-001061		Socket, Tube, 9-Pin w/Shield (V7,19)	006-200395	
CR19,20	Diode, Type 1N87	019-002941	Coupling, Insulator (Yellow) (2)	029-200564		Socket, Tube, 12-Pin (V16,17)	006-001131	
CR31	Diode, Type V7A	019-004469	Cover, Cabinet (Bottom)	066-003141		Socket, Relay	006-001184	
CR33	Diode, Type 1N5225	019-004527	Cabinet, Bottom Rivet	150-007010		Spring, Anti-Backlash (2)	074-000841	
Q1	Transistor, Type MPS514	019-005006	Cover, Cabinet (Top)	066-003140		Spring, Cam	075-001007	
IC1	Integrated Circuit, MC790P	058-000586	Cover, Gang VFO	066-004434		Spring, Dial Cord	075-100012	
CRYSTALS			Cover, HV Shield	066-004884		Spring, Idler	075-200610	
Y1	Crystal, 100.000 KC	019-002712	Escutcheon	007-000903		Follower		
Y4	Crystal, 17.5 MC	019-003769-006	Filter, Crystal, 1650 KC	049-000851		Spring, Pivot Plate	075-001008	
Y6	Crystal, 13.75 MC	019-003769-004	Foot, Rubber (4)	016-201072		Window (Bottom)	022-000747	
Y7	Crystal, 10.25 MC	019-003769-003	Front Panel	150-009808		Window (Top)	022-000753	
Y8	Crystal, 13.5 MC	019-003769-002	Assembly					
Y9	Crystal, 10.0 MC	019-003769-001	Gear, Dial	026-001173				
Y10	Crystal, 1650.000 KC	019-003232	Gear, Idler	026-001170				
Y11	Crystal, 1652.800 KC	019-005044	Gear, Idler Spur	026-001002				
Y12	Crystal, 1652.200 KC	019-005046	Gear, Pinion	026-001171				
Y13	Crystal, 1651.700 KC	019-005042	Gear, Pinion Drive	026-001166				
CONNECTORS			Gear, Spur	026-001089				
J1	Jack, Antenna	010-100056	Gear, Spur, Dial	026-001174				
J2,3,5,10	Jack, Phono, Audio 500 Ohm	036-100041	Scale					
J4	Socket, 11-Pin, Accessory	006-200707	Gear, Spur (Flxed)	026-001088				
J6,8	Jack, PHONES & Key	036-200210	Gear, Spur, Pinion Shaft	026-001172				
J7	Receptacle, Power	010-002586	Handle, Knob	030-000793				
J9	Receptacle, MIC, w/hardware	010-101569	Indicator, Light Neon	086-000690				
P1	Plug, 11-Pin, Accessory	010-002932	Indicator, Knob	082-000576-001				
SWITCHES			PRESELECTOR					
S1A,E	Wafer, RF & Heterodyne Osc	062-000266	Knob Assembly, Main Tuning	015-001929				
S1B	Wafer, Osc Plate	062-000263	Knob, Bar, LOAD	015-001914-001				
S1C,D,F	Wafer, RF	062-000265	Knob, Bar, RIT	015-001740-001				
S1G	Wafer, PA Neut	062-000264	Control OFF-ON, RF GAIN & RF LEVEL					
S1H	Wafer, Driver	062-000355	Knob (Pull to On) (2), CAL ADJ, CW NOTCH ADJ	015-001755-002				
S1K	Wafer, PA	062-000269	Knob, Main Tuning	015-001617				
S1L	Wafer, PA	062-000351	Knob, NOISE	015-001930				
S2	Rotary, METER	060-002880	BLANKER & METER					
S3	Rotary, FUNCTION	060-002796	Knob, OPERATION, FUNCTION, & BAND SELECTOR	015-001760				
S4	Rotary, OPERATION (Refer to R173)	060-002795	Knob, PLATE (Tuning)	015-001933				
S5	(Refer to R90)		Knob, PRESE-LECTOR	015-001752-001				
S6	(Refer to R91)		Knob, RIT CONT, MIC GAIN & AF GAIN	015-001773				
S7	Slide, Antenna	060-000440	Lamp, Pilot (2)	039-000797				
MISCELLANEOUS			DS3	Lamp, Neon	086-000690			
Bracket		067-010855	DS4	Lamp, Neon	039-000874			
Bracket, Bearing (3)		067-013216	M1	Medallion	007-000850			
Bracket, Cap,		067-010032		Meter w/hardware	082-000699			
Mounting (2)				Panel, Front	068-001598			
				Plate, Front VFO	063-006821			
				Plate, Gear	063-006830			
				Plate, Idler Gear	063-006827			
				Plate, Left Chassis	063-007053			
				Plate, Pivot	063-006828			
				Plate, Right Chassis	063-007054			
				Plate, Top Gang	063-006889			
				Cover				
				Plug, 11-Pin	010-002932			
				Plug, 12-Pin	010-002586			

