hallicrafters

OPERATING AND SERVICE INSTRUCTIONS

COMMUNICATIONS TRANSMITTER MODEL HT-46

WARRANTY

"The Hallicrafter's Company warrants each new radio product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of any unit of its manufacture which under normal installation, use and service discloses such defect, provided the unit is delivered by the owner to our authorized radio dealer, wholesaler, from whom purchased, or, authorized service center, intact, for examination, with all transportation charges prepaid within ninety days from the date of sale to original purchaser and provided that such examination discloses in our judgment that it is thus defective.

This warranty does not extend to any of our radio products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, or to use in violation of instructions furnished by us, nor extended to units which have been repaired or altered outside of our factory or authorized service center, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith not of our own manufacture.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized radio dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio products."

the **hallicrafters** co.

092-014555



156-006958

Figure 1. Hallicrafters' Model HT-46 Transmitter.

SECTION I
GENERAL DESCRIPTION

1-1. INTRODUCTION.

The Hallicrafters Model HT-46 Transmitter is a precision built compact, high performance transmitter of advanced design. The transmitter utilizes nine tubes and a single signal conversion heterodyning system for transmission of single-sideband (SSB) and continuous wave (CW) code signals on the 80, 40, 20, 15 and 10 meter amateur bands.

The versatility of the HT-46 transmitter permits operation as a self-contained station transmitter or may be used in conjunction with the Hallicrafters Model SX-146 communications receiver as a transceiver combination.

The transmitter is supplied with push-to-talk control with provision for the addition of the Hallicrafters Model HA-16 for voice controlled SSB operation.

Amplified Automatic Level Control (AALC) circuitry within the transmitter helps prevent "splatter" due to severe "flat-topping" of the final amplifier when unintentionally overdriven.

The Model HT-46 may be operated as a complete transmitter or as an exciter for driving a linear amplifier such as the HT-45, HT-33B, HT-41 or others. If others are used, they should be capable of supplying a 50 ohm termination for the Model HT-46 transmitter.

Other features of the Model HT-46 transmitter include:

- Optional operation as transceiver with companion Model SX-146 receiver or as self-contained transmitter/exciter unit.
- An accurately calibrated VFO with excellent mechanical and temperature stability.
- Constant tuning rate on all bands.
- Upper and lower sideband operation on all bands 80 through 10 meters.
- A crystal lattice filter with 6 poles for optimum single sideband response.
- Combination final amplifier plate current and RF output voltage metering for exact tuning.
- 70W to 100W PEP output covers exciter requirement for most 1 KW linear amplifiers.
- Keyed RF carrier for CW operation with shaping network in keying circuit.

1-2. TVI (TELEVISION INTERFERENCE) SUPPRESSION.

The HT-46 has been designed and constructed to suppress spurious radiations that may cause television interference. The TVI problem was given full consideration in the design and layout of the chassis. Components specifically selected to avoid undesired resonances and arranged to prevent parasitic oscillations have been used.

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 transmitter output 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.

IMPORTANT

Do not, under any circumstances, attempt to operate the Model HT-46 equipment before becoming completely familiar with the instructions contained within this manual.

SECTION II
TECHNICAL SPECIFICATIONS

TUBES AND FUNCTIONS

V1	12AT7	First and Second Microphone Amplifier	V5	12BY7A	Transmitter Driver
V2	12AT7	Carrier Oscillator and Third Microphone Amplifier	V6	6HF5	Transmitter Power Amplifier
V3	6EA8	9 MC IF Amplifier and AALC Amplifier	V7	6BA6	VFO
V4	6AH6	Transmitter Mixer	V8	6EA8	Heterodyne Crystal Oscillator and Mixer
			V9	OA2	Voltage Regulator

Tuning Ranges . . . . . Full frequency coverage of the Amateur bands in eight ranges as follows:

80M	3.5 to 4.0 MC
40M	7.0 to 7.5 MC
20M	14.0 to 14.5 MC
15M	21.0 to 21.5 MC
*10M	28.0 to 28.5 MC
10M	28.5 to 29.0 MC
*10M	29.0 to 29.5 MC
*10M	29.5 to 30.0 MC

*Heterodyne oscillator crystals not supplied with transmitter. (Transmitter will accommodate full set of crystals.)

Heterodyne Oscillator Crystals . . . . . Type CR-23/U in HC-6 Holder

Band	Frequency
* 7.0	21,500.000 KC
*21.0	25,000.000 KC
28.0	32,000.000 KC
*28.5	32,500.000 KC
29.0	33,000.000 KC
29.5	33,500.000 KC

*Supplied with Model HT-46.

Types of Emission . . . . . SSB - Selectable USB/LSB with suppressed carrier.

CW - Keyed RF carrier.

Frequency Control	Self-contained VFO or transceive operation with Model SX-146 receiver.
Type of Sideband Generation	Solid state modulator with 9 MC, 6 pole crystal filter (Nominal BW = 2.1 KC).
Transmission Control	SSB - Push-to-talk at microphone or through control outlet circuitry. VOX control is optional accessory. (Model HA-16.) CW - Manual. Rear key jack accepts standard 1/4-inch two conductor phone plug. Key circuit also at control outlet.
Dial Calibration	5 KC increments, 500 KC tuning range.
Calibration Accuracy	Less than one pointer width error across the dial after indexing at 3.5 MC.
Frequency Stability	Less than 500 cycles drift in first hour, after fifteen minute warm-up, and less than 100 cycles per hour thereafter.
Output Impedance	Fixed, 50 ohms. Rear chassis mounted receptacle accepts RCA type phono plug. (Supplied.)
Power Input	SSB - 175 Watts PEP Maximum CW - 150 Watts Maximum
Microphone Input	0.005V RMS into high impedance load. Panel connector accepts standard 1/4-inch three conductor phone plug.
Audio Response Overall	500 CPS (Max.) to 2200 CPS (Min.) at 6 DB.
Distortion Products	26 DB (Min.) below PEP reference.
Unwanted Sideband Rejection	50 DB (Min.) below PEP output at 800 to 2200 CPS input.
Carrier Suppression Capability	50 DB (Min.) below PEP output.
Power Supply Requirements	117V AC, 50/60 cycles, 350 Watts.
Station Control Outlet	Rear chassis mounted eleven-pin socket accepts Amphenol type 86-PM11 plug. (Supplied.) Provides relay contacts, speaker muting, receiver muting, transmitter control, etc.
VOX Unit Receptacle	Rear chassis mounted six-pin socket accepts Amphenol type 71-6S plug. (Supplied with jumper wire.) Provides power and control for VOX Adaptor, Model HA-16.
SX-146 Input	Rear chassis receptacle accepts RCA type phono plug. (Supplied.) Provides inter-connection for transceive operation with Model SX-146.
Transceive Cable Impedance	75 ohms. Use Amphenol cable NO. 21-597 or equivalent.
Number of Tubes	8 plus 1 voltage regulator and 15 diodes.
Dimensions Overall	5-7/8 x 13-1/8 x 11 inches (HWD).
Net Weight	26 pounds.
Shipping Weight	28 pounds (Approximately)
Accessories	VOX Control Unit Model HA-16. Designed for quick attachment to rear of Model HT-46 cabinet to provide voice controlled operation. (VOX) Power is derived from Model HT-46 through single plug-in connector. Contains three tubes and sensitive VOX relay. Net Weight - 3/4 pound. Shipping Weight - 1-1/2 pounds (approximately).
Fuse	3 amperes, slow blow, 3 AG type.

SECTION III
INSTALLATION

WARNING

LETHAL HIGH VOLTAGE IS PRESENT WITHIN THIS EQUIPMENT. BE CAREFUL WHEN INSTALLING THE UNIT OR PERFORMING CHECKS OR ADJUSTMENTS INSIDE THE CABINET.

3-1. UNPACKING.

Carefully remove the equipment from its carton and packing material and examine it for possible damage which may have occurred in transit. Should any sign of damage be apparent, immediately file a claim with the carrier stating the extent of the damage. Check all shipping labels and tags for special instructions before removing or destroying them.

3-2. LOCATION.

The transmitter may be installed in any location that will permit free circulation of air through the ventilation openings in the cabinet. Do not place any object on top of the cabinet in a manner that will obstruct normal ventilation. Avoid excessively warm locations such as those near radiators and heating vents.

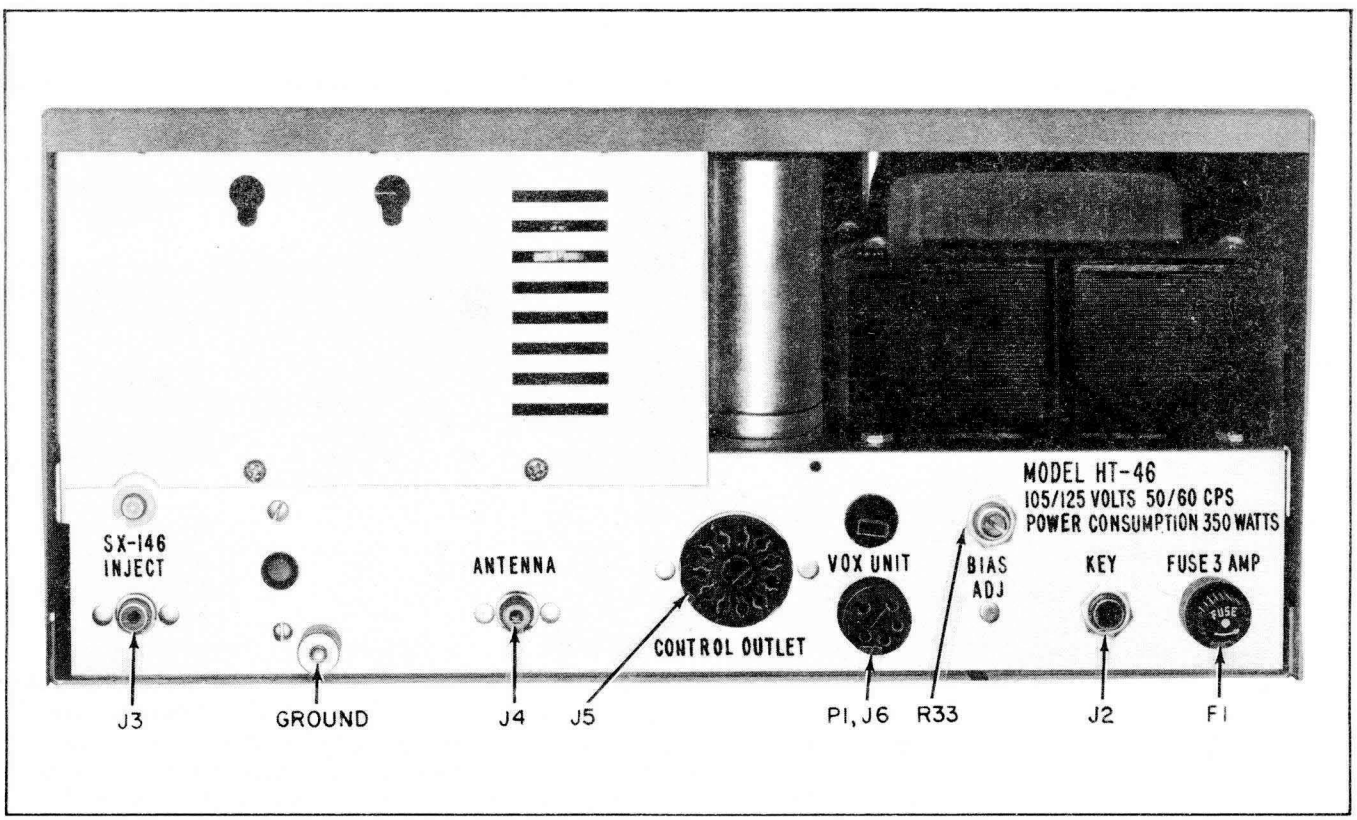
3-3. POWER SOURCE.

The Model HT-46 Transmitter is designed to operate from a 105/125V 50/60 cycle AC power source. Nominal line voltage for testing and measurements is 117V. The outlet should be capable of handling a 350 watt load with good regulation.

IMPORTANT

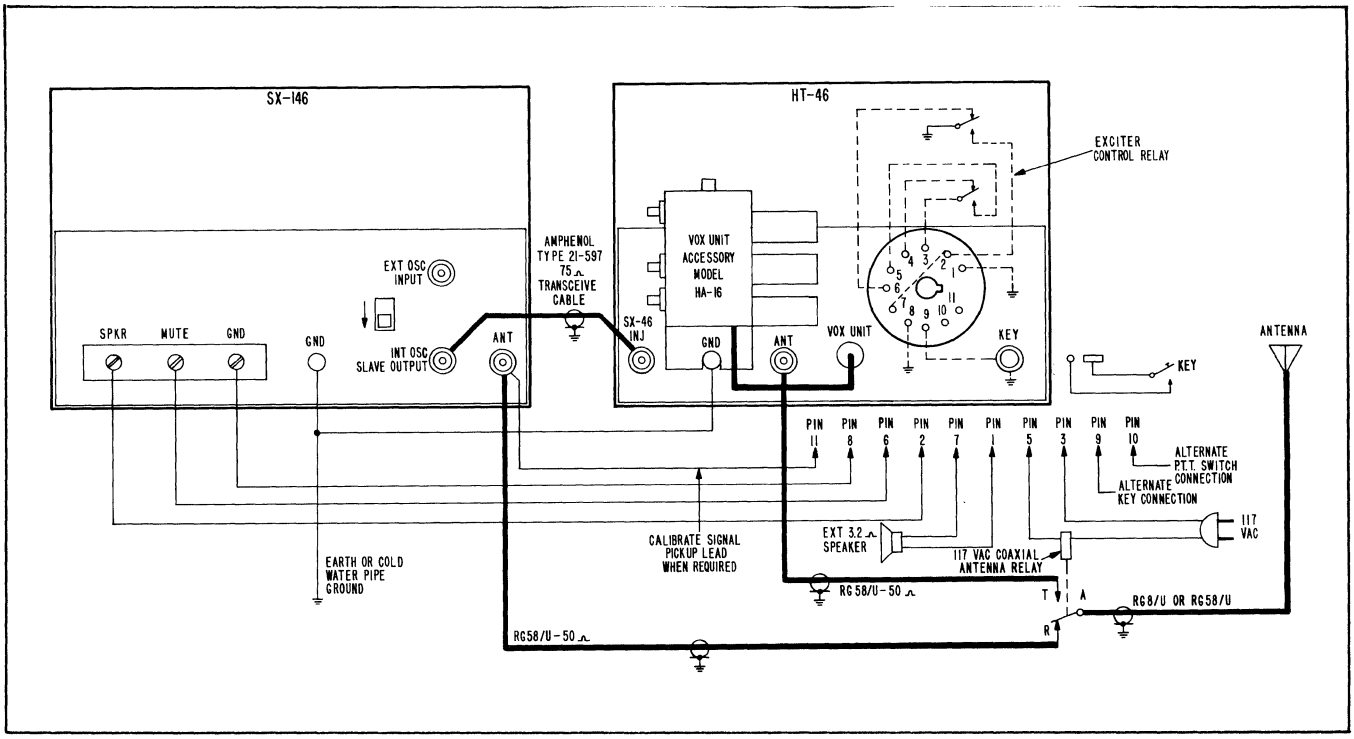
If in doubt about your power source, contact your local power company prior to inserting the power cord into any power outlet. Plugging the power cord into the wrong source of power can cause extensive damage to the transmitter.

Set the OPERATION control at OFF (full counterclockwise) and make all installation connections before connecting the transmitter to a source of power.



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Figure 2. Rear View of Transmitter.



156-007044

Figure 3. Typical Interconnections for Model HT-46 and Model SX-146.

3-4. ANTENNA.

The Model HT-46 Transmitter is designed to terminate into a 50 ohm unbalanced transmission line. A non-reactive load is preferred for optimum results, however a VSWR of 2.5/1 can be accommodated by the transmitter with acceptable results. Any of the popular di-pole or beam antennas using 50 ohm transmission lines will give excellent results.

For further 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.

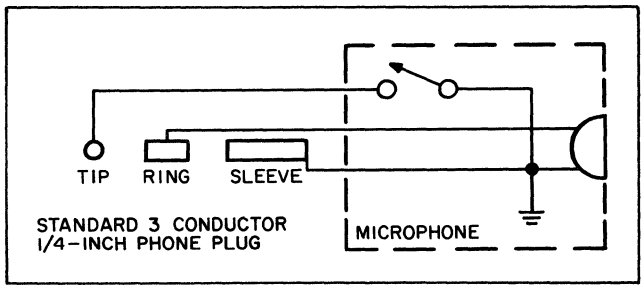
IMPORTANT

Some form of lightning protection should be provided which will comply with local code requirements.

The ANTENNA connector located on the rear chassis apron mates with an RCA-type phono connector. Use RG-58/U co-axial cable or equivalent for feed line to a linear amplifier or antenna changeover relay. Refer to Figures 2 and 3 for details.

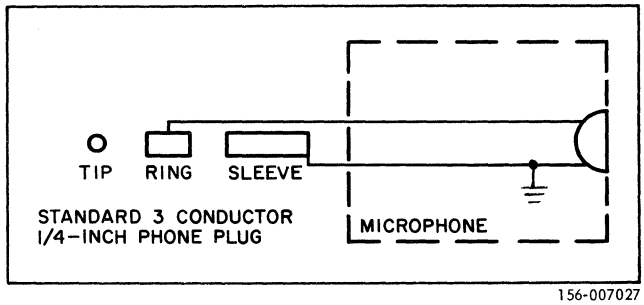
3-5. GROUNDS.

All station equipment should be bonded together with heavy copper wire or braid and connected to a cold water pipe or outside earth ground. An external chassis ground terminal is provided on the Model HT-46 rear chassis apron for this purpose.



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Figure 4. Microphone Wiring for Push-To-Talk Transmitter Control.



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Figure 5. Microphone Wiring for Transmitter Control with VOX Control Unit Model HA-16.

3-6. MICROPHONE.

The microphone receptacle is located on the front panel. The microphone cable should be fitted with a standard 1/4-inch, three conductor phone plug wired as shown in Figures 4 and 5. Any good high impedance crystal or dynamic type microphone may be used, however best results will usually be achieved with a microphone designed especially for voice communications use.

The microphone circuit shown in Figure 4 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.

3-7. KEY.

The station keyer may be connected to the transmitter at the closed circuit key jack at the rear chassis apron or at the CONTROL OUTLET. Refer to Figure 3. The key jack accepts a standard two conductor 1/4-inch phone plug. Wire the plug so that the key base connects to the plug sleeve which is at ground potential. Pin NO. 9 of the CONTROL OUTLET may be used to key the transmitter with Pins NO. 1 or NO. 8 used for ground connection to the keyer.

When the keyer is plugged into the KEY jack the keyer circuit must be closed for SSB or CW tune up in the CW-TUNE position of the OPERATION control.

When the keyer is wired into the CONTROL OUTLET, insert a dummy phone plug into the key jack to hold the circuit open for CW operation.

3-8. SX-146 INJECT.

Transceive type of operation is made available when a 75-ohm co-axial cable is connected between the Model HT-46 transmitter and the Model SX-146 receiver.

The cable is connected between the SX-146 INJECT receptacle on the transmitter and the SLAVE OUTPUT connector on the receiver after removing the 82 ohm dummy load plug in the receiver receptacle. The cable may be any convenient length to reach between the units and should be made up of 75-ohm co-axial cable with RCA-type phono plugs at each end. Small diameter 75-ohm co-axial cable made by Amphenol Corp (NO. 21-597) is recommended. Do not use shielded microphone type cable for this application.

3-9. CONTROL OUTLET.

The control outlet circuitry may or may not be required by the station installation. A typical station wiring circuit is shown in Figure 3. Note that the following facilities are available at the control outlet.

Speaker muting: Pins NO. 2 & NO. 8 and NO. 7 & NO. 1.

Receiver muting: Pins NO. 6 and NO. 8

Keying circuit: Pins NO. 9 and NO. 8

PTT control circuit: Pins NO. 10 and NO. 8

SPDT relay contacts: Pins NO. 3, NO. 4 AND NO. 5

Calibrate signal coupling: Pin NO. 11

3-10. FUSE.

Specifications: 3 amperes, slow blow, 3 AG type.

3-11. ACCESSORY INSTALLATION.

1. 10 Meter Band Crystals: Three additional crystals will be required for full 10 meter coverage. To install the crystals it will be necessary to remove the top portion of the cabinet (Refer to paragraph 7-2). Chassis markings will indicate their location. The crystals required are:

BAND	FREQUENCY	PART NUMBER
28.0	32,000.000 KC	019-201963
29.0	33,000.000 KC	019-201965
29.5	33,500.000 KC	019-201966

2. VOX Control Unit Model HA-16: The Model HA-16 adapter unit is available to provide voice control operation of the Model HT-46 Transmitter. It is installed on the rear of the transmitter cabinet as follows:

A. Remove the jumper plug (P1) presently installed in the VOX UNIT socket located on the rear chassis apron of the transmitter. Save the jumper plug for it must be replaced if the control unit is disconnected.

B. Loosen the ground bolt at the rear of the transmitter and space the flat washers about 1/8 inch apart.

C. Hook the Model HA-16 VOX control unit into the two key holes in the rear cabinet wall just above the ground bolt and insert the notched flange between the flat washers of the ground bolt. Tighten the ground bolt nut.

D. Plug the inter-connecting cable of the control unit into the VOX UNIT socket. The unit is now ready for adjustment and operation.

SECTION IV
FUNCTIONS OF OPERATING CONTROLS

4-1. TUNING CONTROL.

The tuning control is used to vary the frequency of the VFO to select the desired frequency of transmission when the transmitter is used as a separate unit. (VFO switch at XMTR.) When operating the transmitter as a transceiver with the Model SX-146 receiver (VFO switch at RCVR) this control is disabled and the frequency of transmission is controlled by the receiver.

Note that the frequency increases from left to right for two bands whose numbers appear above the calibration marks. For the remaining bands logged below these marks, the frequency increases from right to left.

The BAND SELECTOR setting indicates the lowest frequency of the band or band segment being tuned.

4-2. OPERATION CONTROL.

The OPERATION control is a six position switch which controls the mode of transmission as follows:

POSITION	FUNCTION
OFF	Removes all primary power from the transmitter.
STBY	Application of primary power places both heater and plate voltages on the tubes which are biased off in a stand-by condition. The transmitter control relay permits the receiver circuits to function at this time.
USB/LSB (Two positions)	In these two positions the transmitter is placed in operation for single sideband suppressed carrier mode of transmission. The color code indicates USB or LSB for the band in use and is so coded on the BAND SELECTOR panel markings.
CW-TUNE	This position places the transmitter on the air with carrier only to permit tuning the transmitter for SSB operation. In this same position, the transmitter may also be keyed for CW operation.
STBY	This is a second stand-by position which retains the heater and supply voltages and again permits the receiver circuits to function.

4-3. MIC GAIN.

This control sets the audio level to the balanced modulator stage from the microphone audio amplifier stages. The control has sufficient range to handle any high impedance high or low level microphone designed for voice communications.

4-4. DRIVER TUNE.

The DRIVER TUNE control resonates the tuned circuits of the signal frequency mixer and driver stages driving the final amplifier stage. The control is always tuned for maximum transmitter output when operating as a transmitter or as a transceiver with the SX-146 receiver.

4-5. CARRIER LEVEL.

The CARRIER LEVEL control sets the RF output level for CW operation and during the transmitter tuning process for CW or SSB operation. The control also functions when the CAL switch is set at ON to control the calibrate signal level.

4-6. BAND SELECTOR.

The BAND SELECTOR is an eight position rotary switch which selects the tuned circuits and crystals required to tune the frequency ranges shown on the dial. The color coded panel markings refer to the USB/LSB coding for the two side band positions on the OPERATION control.

4-7. FINAL TUNE.

The FINAL TUNE control drives a variable capacitor that tunes the pi-network used to couple the PA stage to the antenna load. The control is calibrated in band segments to permit presetting the capacitor near resonance during the tuning procedure.

4-8. METER SWITCH.

The METER switch selects either of two metered circuits in the transmitter.

1. At MA the meter is used to read the idle plate current when setting the BIAS ADJ. control, and to indicate final amplifier stage plate current on the 40 to 300 milliampere range.

2. At RFO, the meter indicates the RF voltage across the 50 ohm transmission line at the output of the transmitter. The scale is cali-

brated in percent of full scale and the meter serves to indicate maximum RF power output when tuning up and operating the transmitter.

4-9. CALIBRATE SWITCH.

The transmitter provides a low level CW carrier signal for frequency spotting purposes when the CAL switch is set at ON. (When operating in the CW mode, the key must be closed to obtain the calibrate signal.) The calibrate signal level may be varied with the CARRIER LEVEL control if desired. Setting the CAL switch at ON places the control relay in the transmitter in the standby position to place the station receiver in the receive mode to pick up the signal.

4-10. VFO SWITCH.

This two position switch selects the mode of operation when a Model SX-146 receiver is interconnected with the transmitter. If the transmitter is operated as a single unit the VFO switch is left in the XMTR position. With the SX-146 receiver interconnected, the two units may be operated together as a transceiver (VFO switch at RCVR) or as separate transmitter and receiver units. (VFO switch at XMTR). When operating in transceive mode the receiver VFO tuning also controls the transmitter frequency.

4-11. DIAL CALIBRATION.

This is a small lever extending through the panel directly below the center of the dial window. It moves the dial mechanism to the right or left, as necessary, to zero out any calibration error between the dial and pointer.

SECTION V
TUNING PROCEDURE

5-1. GENERAL.

The tuning procedure for the Model HT-46 transmitter is not complicated, however, care should be exercised in tuning to insure optimum performance. Tuning (peaking) should be performed on or near the intended operating frequency on all bands. If the VFO dial of the transmitter or receiver (when operating in transceive mode) is tuned an appreciable amount away from the frequency at which the transmitter was previously tuned, it will be necessary to repeak the DRIVER TUNE and FINAL TUNE controls for maximum output. (Meter switch at RFO). As experience is gained in the operation of the transmitter on the various bands, the operator will be able to judge when he has tuned far enough to require repeaking. In general, the lower frequency bands require more frequent retuning for the same shift in frequency on the dial.

The output of the transmitter must always be connected to a 50 ohm, resistive load such as a dummy load or suitable antenna having a 50 ohm termination at the operating frequency.

5-2. BIAS ADJ.

Before and while operating the transmitter check and if necessary, set the BIAS ADJ. control for an idle (no signal) plate current of 40 milliamperes. Refer to paragraph 8-3 for detailed instructions on setting the BIAS ADJ. control.

5-3. BASIC TRANSMITTER TUNE-UP.

Pre-set the following controls as indicated:

OPERATION	STBY
MIC GAIN	MIN (Full CCW)
DRIVER TUNE	Near band segment
CARRIER LEVEL	MIN (Full CCW)
BAND SELECTOR	Desired band
FINAL TUNE	Desired band segment
METER	Set at RFO
CAL	OFF
VFO	XMTR
TUNING DIAL	Desired frequency

1. Set OPERATION control at CW-TUNE and close the keyer circuit if a keyer is plugged into the KEY jack.

2. Turn CARRIER LEVEL control clockwise until a small RFO indication is observed on the meter. On some bands the preliminary DRIVER TUNE setting may require altering to obtain a meter reading.

3. Adjust the CARRIER LEVEL control to hold an RFO meter reading near mid scale and first tune the FINAL TUNE control for maximum RFO and then adjust the DRIVER TUNE for maximum RFO. Always resonate the final amplifier stage before applying high drive levels to the stage as may happen when the DRIVER TUNE or CARRIER LEVEL controls are adjusted.

5-4. CW OPERATION.

1. Tune up the transmitter as outlined in paragraph 5-3. When a keyer is plugged into the key jack, its key circuit must be closed to permit tuning for either CW or SSB operation. If the transmitter is set up to drive a linear amplifier, adjust the CARRIER LEVEL control for the drive level required by the linear amplifier. When operating into an antenna load, advance the CARRIER

LEVEL control to just below saturated drive level. In either case, repeak the FINAL TUNE and DRIVER TUNE controls at this level for maximum output.

2. Saturated drive level is determined in the following manner. Start from the full counter-clockwise CARRIER LEVEL control setting and slowly increase the carrier output level while observing the RFO meter reading. Set the control at a point where further rotation does not cause an appreciable increase in the RFO meter reading. This is saturated output. Back off the CARRIER LEVEL control setting and operate slightly below this level.

3. The transmitter is now ready to key. To reactivate the receiver, set the OPERATION control at STBY.

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

1. Tune the transmitter as outlined in paragraph 5-3 and paragraph 5-4. Note the RFO meter reading obtained for maximum drive level to the linear amplifier or the maximum saturated output when operating into an antenna load.

2. Return the CARRIER LEVEL control to MIN and set the OPERATION control at the USB or LSB position desired. The customary use of the upper or lower side band changes from band to band in the amateur bands.

3. Depress the microphone push-to-talk switch, speak into the microphone in a normal voice level, and advance the MIC GAIN control until the RFO meter swings upward to approximately one-half the meter reading noted at maximum output during tune-up with carrier. The microphone gain control setting will be found to be less critical because of the compression action of the AALC circuitry; however, the knob setting still depends upon the type of microphone, the operator's voice characteristics, and his operating habits. Sufficient microphone gain has been built into the Model HT-46 to handle the usual range of levels associated with communications type microphones.

4. Releasing the microphone switch button will return the station to the receive condition.

5-6. VOICE CONTROLLED SSB OPERATION.

The Model HT-46 transmitter with the VOX control unit Model HA-16 installed will operate with voice control. When the accessory unit is installed and the station is wired per Figure 3, the following operating procedure will apply:

1. For push-to-talk operation, set the PTT-VOX selector switch of the VOX control unit at PTT.

2. To set up the VOX control unit, initially set the PTT-VOX selector switch at PTT, and set the three controls (SENS., DELAY, and ANTI-TRIP) at their full CCW positions. Reduce the audio gain on the station receiver to a relatively low level.

3. Use the tuning procedure outlined in paragraphs 5-3, 5-4 and 5-5 to ready the transmitter for SSB operation. With the OPERATION control on the transmitter set for SSB operation, set the selector switch on the VOX control unit at VOX and set the accessory unit controls as follows:

A. Advance the SENS. control (clockwise), while talking into the microphone, until the VOX relay closes on the first syllable of speech. (Use no more VOX gain than necessary for best results.)

B. Adjust the DELAY control for the desired drop-out delay. 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.

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

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 will not be feasible unless this circuitry is disconnected within the microphone.

5-7. TRANSCEIVE (SLAVE) OPERATION.

1. The Model HT-46 transmitter and Model SX-146 receiver must be inter-connected as shown in Figure 3 to perform the transceive function.

2. The INT. OSC/EXT. OSC. switch on the rear apron of the Model SX-146 receiver must be set at INT. OSC. to supply the required signal to the transmitter for transceive operation.

3. Before exact on frequency transceive operation can be accomplished with the two units, their carrier oscillator frequencies for upper and lower sideband operation must be matched within a few cycles. To synchronize the two oscillators, remove the top section of the receiver cabinet and proceed as follows:

A. Set the receiver controls as follows:

RF GAIN	MAX
AVC	ON
PRESELECTOR	Peak on signal from transmitter
SELECTIVITY	2.1 or 5.0 (If operating)
BAND SELECTOR	3.5
AF GAIN	As desired
CAL	OFF
ANL	OFF
OPERATION	Red USB
TUNING DIAL	3.8 MC

B. Set the transmitter controls as follows:

OPERATION	Red USB
MIC GAIN	MIN
DRIVER TUNE	Peak on signal
CARRIER LEVEL	MIN
BAND SELECTOR	3.5
FINAL TUNE	Peak on signal
METER	Optional
CAL	ON
VFO	RCVR
TUNING DIAL	Optional (non-operating)

C. Adjust the DRIVER TUNE, FINAL TUNE and CARRIER LEVEL controls on the transmitter and the PRESELECTOR and tuning controls on the receiver for maximum "S" meter reading on the receiver.

D. On some units the frequency difference between the receiver's 8998.7 KC detector oscillator and the transmitter's 8998.7 KC carrier oscillator may be so small that the beat between them can only be observed on the "S" meter, other units may be separated enough to hear a beat note in the receiver. Adjust the CARRIER LEVEL control on the transmitter for the loudest beat note or maximum pulsation of the "S" meter pointer.

E. Adjust the 8998.7 KC BFO trimmer (C53) on the receiver chassis for zero beat by watching the "S" meter and setting the trimmer for the slowest pointer oscillation possible. Do not reset the carrier oscillator frequency of the transmitter, its oscillators are matched to the transmitter's filter. See paragraph 8-14 for the carrier oscillator adjustment procedure for the transmitter.

F. Set the OPERATION controls on the transmitter and receiver to the opposite side band (Red LSB) and set the 9001.5 KC BFO trimmer (C60) on the receiver chassis for zero beat as in step E. The transmitter and receiver are now matched exactly for frequency of reception, and transmission when operated in the transceive mode. The procedure outlined in step 3 need not be repeated each time transceive operation is desired, only an occasional check may be required.

4. With the receiver BFO frequencies set as outlined in step 3, either separate transmitter control or transceive operation may be accomplished by setting the VFO switch on the transmitter at XMTR for separate control or at RCVR for transceive control. When operating the two units as a transceiver, the transmitter tune up and operating procedure remain unchanged in all respects except for the tuning control function which is now controlled by the receiver tuning. For this reason care should be exercised when tuning the receiver outside the American amateur bands to avoid transmitting on unauthorized frequencies.

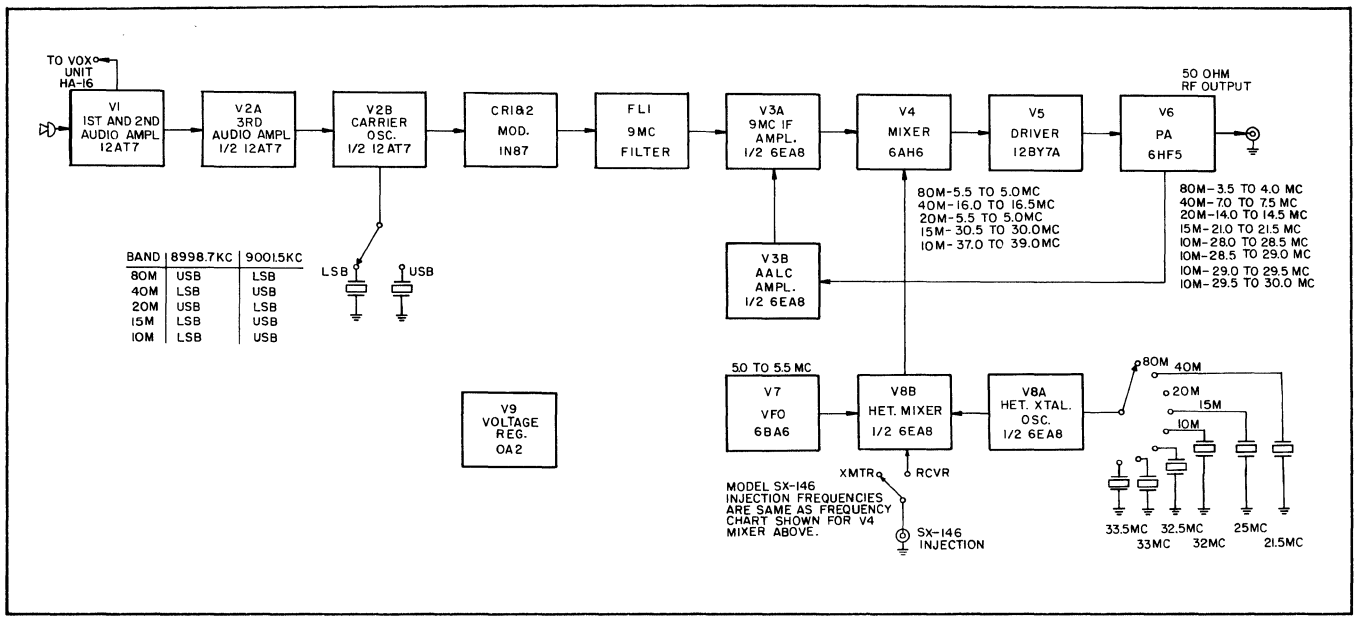
SECTION VI
THEORY OF OPERATION

6-1. GENERAL.

The Model HT-46 utilizes the solid state modulator followed by selective filter principle of sideband generation. Single conversion is used to translate the signal generation frequency (9000 KC) to the output frequency. The heterodyning signal is generated by the VFO directly on the 80 and 20 meter bands and indirectly by pre-mixing with the heterodyne crystal oscillator for the remaining bands. For "slave" or transceiver operation with the Model SX-146, the SX-146 pre-mixed injection is substituted for the transmitter's pre-mix stages and the carrier oscillator frequencies for the two units are matched within cycles to provide equal receive and transmit frequency.

6-2. SIDEBAND GENERATION.

The carriers for the upper and lower sideband signals are generated in tube V2B at a nominal frequency of 8998.7 KC and 9001.5 KC. These are the frequencies that fall 25 DB down the skirts of the 6 pole crystal filter which is centered at 9000 KC. The 8998.7 KC carrier, when modulated by the diode modulator CR1 and CR2 produce an



156-006856

Figure 6. Block Diagram of Model HT-46 Transmitter.

upper sideband suppressed carrier signal at 9000 KC. Conversely, the 9001.5 KC carrier when modulated produces a lower sideband signal at 9000 KC. The modulator is driven at audio frequency by the two triode stages of tube V1 and the cathode follower triode in tube V2. Audio for the VOX adapter Model HA-16 is taken from the plate of the first audio amplifier stage ahead of the MIC GAIN control.

The 9000 KC sideband signal is amplified by tube V3A and coupled to the signal mixer tube V4 where the information signal is translated to the operating frequency.

6-3. HETERODYNE SIGNAL GENERATION.

To translate the 9000 KC information signal to the operating frequency, a heterodyne frequency signal is generated either within the transmitter by tubes V7 (VFO) and V8 (Heterodyne Crystal Oscillator - Mixer) or for "slave" operation it is taken from the Model SX-146 receiver through the Heterodyne mixer tube V8B working as an RF amplifier stage. The plate circuit of the heterodyne mixer tube (V8B) is coupled to the signal mixer grid through bandpass transformers T2, T3 and T4 on 40M, 15M and 10M and through a broadly tuned 5 MC-5.5 MC tuned circuit L25 and R58 on 80M and 20M in order to accommodate the tuning range of the VFO.

The desired mixer product resulting from the 9000 KC information signal and the tunable heterodyne CW signal at the signal mixer grid is now amplified by the driver stage tube V5 and the power amplifier stage tube V6. The amplified signal is coupled to the antenna transmission line with a pi-network that is pre-adjusted to properly load the final amplifier tube when a 50 ohm antenna load is connected to the transmitter. The mixer and driver stage coils are gang tuned on each band by the two section capacitor C40A and C40B (DRIVER TUNE). The final stage pi-network is tuned on the input side by capacitor C67 (FINAL TUNE).

6-4. AALC (AMPLIFIED AUTOMATIC LEVEL CONTROL).

To protect the final amplifier stage from excessive "flat-topping" during SSB transmissions an Amplified Automatic Level Control (AALC) system is placed in operation in the following manner. When a small amount of grid current is developed in the final stage, a small ripple voltage at audio frequency is developed on the amplifier grid bias line in proportion to the amount of grid current developed by the over driven condition. This audio signal, which is not present at below grid current levels, is amplified by the triode section of tube V3B and rectified by diodes CR3 and CR4. The resulting DC voltage is then fed to the grid return of the 9000 KC IF amplifier tube V3A as a gain control grid bias.

6-5. METER CIRCUIT.

The metering circuits of the Model HT-46 transmitter are designed to provide an accurate means of determining the idle and operating plate current of the final amplifier tube and to monitor the RF voltage appearing across the output terminals of the transmitter for optimum tuning of the final and driving stages.

Since most milliameter calibration accuracy leaves much to be desired in the first third of the scale, a bridge circuit (R40, R41, R43 and R44) is used in the HT-46 which sets idle plate current at a zero meter current condition, hence the 40 milliampere calibration mark appears at the index point of the meter. When the final tube is driven to higher than 40 milliamperes of plate current, the meter circuit automatically causes the meter to swing up accordingly.

The METER switch S4 transfers the meter between the bridge circuit for plate current measurements and the diode load circuit for measuring RF voltage at the output of the transmitter. The RF voltage at the output of the transmitter is divided down by resistors R46 and R47 to a level which can be handled by the rectifier diode CR5. The resulting DC voltage is then metered by the DC milliameter on a percentage basis for tuning purposes.

6-6. VOX ACCESSORY CIRCUIT.

The VOX Control Unit Model HA-16 is an accessory item which will add voice control to the Model HT-46 transmitter for SSB operation.

The VOX adapter takes its power and circuit wiring from the Model HT-46 through the VOX UNIT connector on the transmitter. The VOX unit samples audio from the transmitter and amplifies the signal with tubes V401A and V402A. It also samples the audio signal at the speaker of the receiver and amplifies this signal with tube V403.

Normally the speaker output picked up by the microphone would cause the control relay to close, placing the transmitter on the air, but by properly setting the VOX sensitivity and ANTI-TRIP gain controls, the two signal levels in the VOX circuit may be matched so that the rectified DC voltages controlling the relay tube V401B cancel and hold the transmitter off the air.

When the operator speaks into the microphone the balance is upset. The audio signal from the transmitter overcomes the anti-trip signal from the receiver and the control relay turns the transmitter on.

To avoid having the control relay switch on and off between words while the operator is talking, a delay circuit consisting of the DELAY control R411 and capacitor C405 sets the time lapse between the last spoken word and the change over from transmit to receive.

SECTION VII
SERVICE DATA

7-1. SERVICE OR OPERATING QUESTIONS.

For further information regarding operation or servicing of this unit, contact the dealer from whom it was purchased. The Hallicrafters Company maintains an extensive system of Authorized Service Centers where any required service will be performed promptly and efficiently 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 will be made for a nominal charge. All Hallicrafters authorized service centers display the sign shown below. For 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 Company will not accept responsibility for unauthorized shipments.

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

7-2. CABINET REMOVAL.

Access to tubes, dial lamps, crystals and most adjustments may be had by removing the top portion of the cabinet only. This is done by removing three Phillips type screws on each side of the cover and lifting the cover straight up.

The bottom portion of the cabinet may be removed only after the top portion has been removed. To remove the bottom cover unit, turn the set upside down. Remove seven Phillips type screws and lift bottom clear.

7-3. DIAL CORD RESTRINGING.

Remove the cabinet top cover (refer to paragraph 7-2). Follow the arrow and lettered sequence in Figure 7. Maintain a spring expansion of 1/4-inch to 1/2-inch on the dial cord

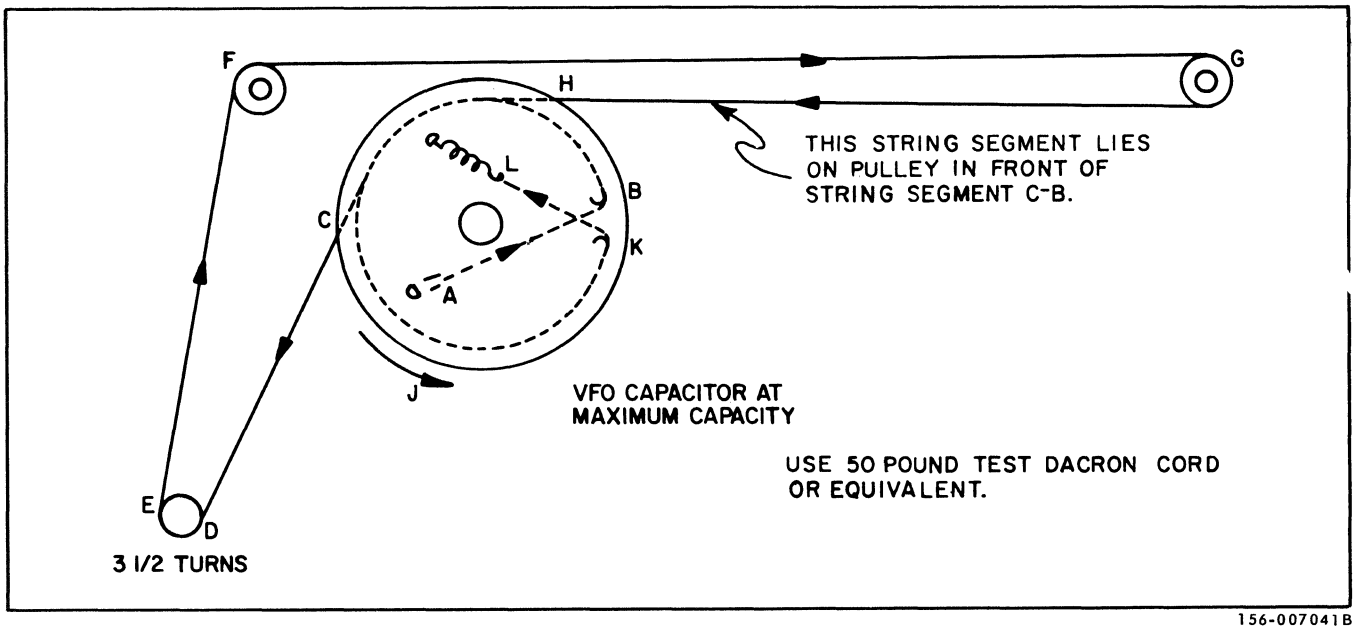


Figure 7. Dial Cord Restringing Diagram.

spring. After completing the stringing operation, place the pointer on the rail and engage the dial cord with the pointer clips. The pointer should be adjusted to just miss the nylon pulleys at the two extremes of its travel. After the pointer is adjusted, apply a drop of rubber cement to the dial cord and the pointer clip to hold the clip in place.

7-4. TROUBLE SHOOTING.

In the design of this transmitter, full consideration was given to keep maintenance problems at an absolute minimum. As in all well-designed electronic equipment, maintenance and repair problems are generally confined to the checking and replacement of tubes and semi-conductor devices which may become defective. Malfunctions of this nature are usually 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 trouble shooting the Model HT-46 transmitter is a general coverage receiver which can be used to provide a quick check on the various oscillator circuits within the HT-46. A lead connected to the antenna of this receiver, when placed in the proximity of the oscillator tube in the circuit to be checked, can determine 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 6) will give a quick clue as to which tubes should be checked. The voltage chart and resistance chart (Figures 10 and 11) and schematic diagrams (Figures 14 and 15) will also aid in isolating and correcting a malfunction.

SECTION VIII
ALIGNMENT PROCEDURE

8-1. GENERAL.

The Model HT-46 Transmitter has been accurately aligned and calibrated at the factory and, with normal usage, will not require realignment for extended periods of time. Service or replacement of a major component or circuit may require subsequent alignment, but under no circumstances should realignment be attempted unless the malfunction has been analyzed and definitely traced to mis-alignment. Alignment should only be performed by persons experienced in this field, using the proper test equipment.

> NOTE
>
> Do not make adjustments unless the operation of the transmitter is fully understood and adequate test equipment is available. Refer to figures 8 and 9, the top and bottom views of the transmitter, for the location of all adjustments.

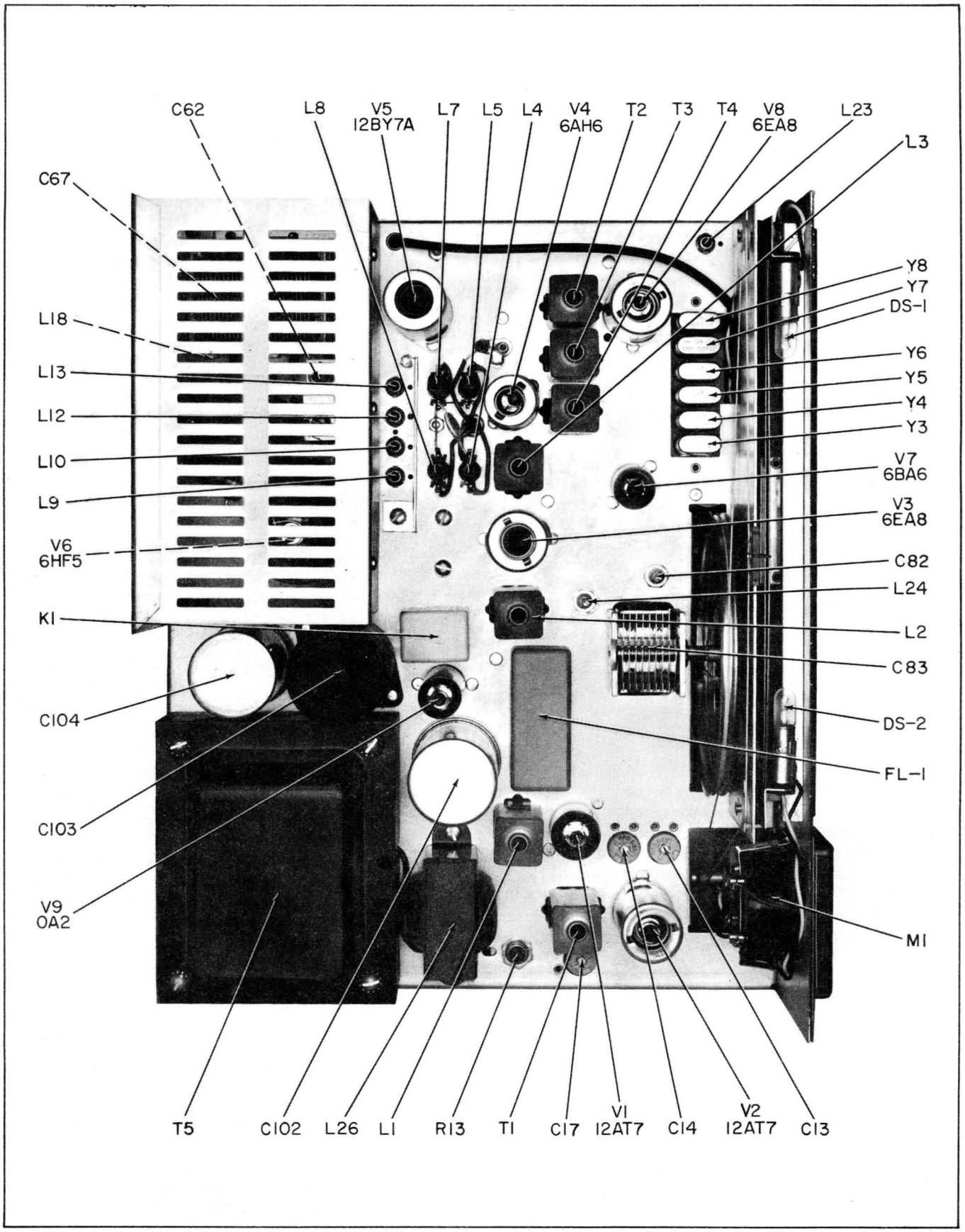


Figure 8. Model HT-46, Top View.

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8-2. EQUIPMENT REQUIRED.

1. RF Signal Generator; Hewlett-Packard Model 606A or an equivalent signal generator having up to one volt output at an impedance of 70 ohms or less and a frequency range to 40 MC.

2. A Vacuum Tube Voltmeter (VTVM); Hewlett-Packard Model 410B, or equivalent VTVM having an RF probe good to 40 MC.

3. A dummy load; 50 ohms non-reactive, rated at 100 watts. Bird Wattmeter or equivalent. The load may be made up of carbon resistors totaling 100 watts dissipation.

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

5. AF Voltmeter; Ballentine Model 300 or equivalent, capable of measuring 1 to 5 millivolt level.

6. A general coverage or amateur band coverage receiver with 100 KC crystal calibrator.

8-3. BIAS ADJUSTMENT.

The final amplifier bias must be set before any extensive checks are made on the transmitter. Properly setting the bias will insure normal operating plate dissipation for the tubes in the final amplifier and driver stages. Adjust the BIAS ADJ. control located on the rear chassis apron as follows:

1. Set the OPERATION control at STBY and allow at least ten minutes for the unit to warm up. Note that the meter pointer swings to the left of its normal rest position with the METER switch at MA and returns to its rest position with the switch set at RFO. Set the METER switch at MA and the MIC GAIN control full CCW.

2. Set the OPERATION control at one of the two USB/LSB positions, press the microphone switch to place the transmitter in operation, and set the BIAS ADJ. control for 40 milliamperes. Release the microphone switch and note that the meter pointer swings to the left against its mechanical stop. If the microphone switch does not place the transmitter in operation check to see that the jumper plug is in the VOX UNIT connector on the rear chassis apron.

NOTE

If the VOX Control Unit Model HA-16 has been installed. Set the PTT-VOX switch at PTT.

3. Set the METER switch at RFO and press the microphone switch. The meter pointer should remain at rest. If it indicates RF output, reset the carrier balance adjustment per paragraph 8-4 and repeat the bias adjustment procedure.

NOTE

The idle plate current may rise to 50 or 60 milliamperes after an extended transmission period. This is normal and it will return to 40 milliamperes after a cooling off period. A rising plate current may indicate that the idle plate current was set up too soon after turning on the transmitter; correct by setting the BIAS ADJ. control as outlined above.

8-4. CARRIER BALANCE.

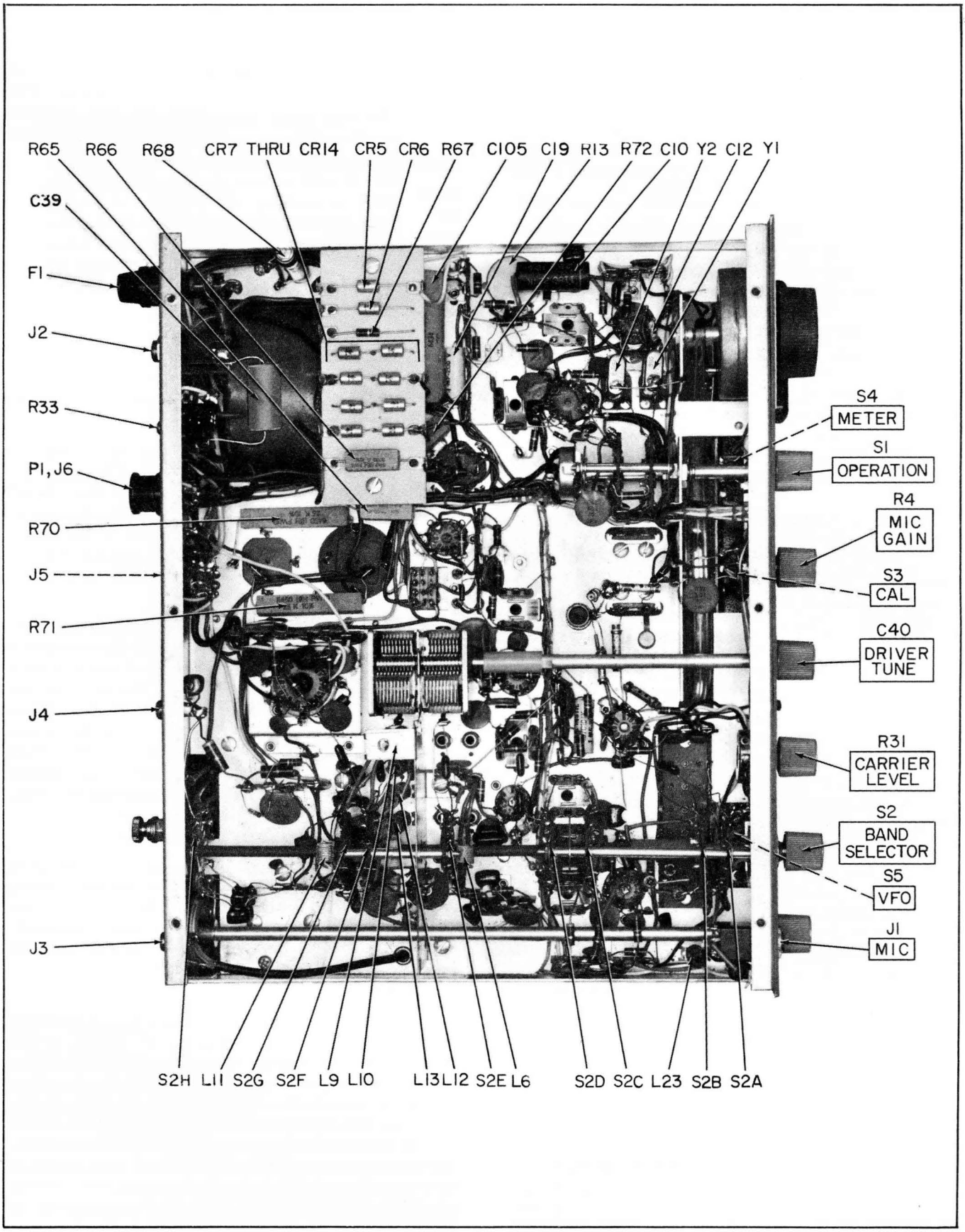
Adjust the carrier balance controls as follows:

1. The transmitter should be allowed to reach operating temperature before making the carrier balance adjustments. Remove the cabinet cover from the transmitter as described in paragraph 7-2. With the chassis resting on the table, right side up, and connected to a dummy load or antenna load, tune the unit for SSB operation. (Refer to paragraph 5-5.)

2. Turn the MIC GAIN control fully counterclockwise to remove all audio from the modulator stage. With the OPERATION control set at either of the USB/LSB positions, close the microphone switch and adjust the CARRIER BALANCE controls (capacitor C17 and potentiometer R13) for minimum RFO voltage. (Meter switch at RFO.) With an antenna or dummy load connected to the transmitter, the meter will drop to zero near the null. Release the microphone switch.

3. Disconnect the antenna load and again close the microphone switch and repeat the balance adjustment. The meter will still drop to zero, but will be more sensitive with the load removed. Take care not to feed excessive carrier through the system with the load removed.

4. A more exacting balance can be obtained by tuning a receiver, having an "S" meter, to the transmitter frequency. Adjust the CARRIER BALANCE controls for minimum "S" meter reading and then switch the OPERATION control to the opposite sideband and check the "S" meter reading. If it increased, touch up the balance controls, switching between USB and LSB until both sideband carrier frequencies produce equal "S" meter readings. If the selectivity of the receiver is sharp, it may be necessary to retune the receiver slightly since the two carrier oscillators are approximately 2.8 KC apart.



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Figure 9. Model HT-46, Bottom View.

8-5. FINAL AMPLIFIER NEUTRALIZATION.

1. Neutralization check. With the Model HT-46 transmitter in its cabinet (all hardware in place) and connected to a dummy load, tune the transmitter at 28,750 KC in the CW mode as described in paragraphs 5-3 and 5-4. Adjust the CARRIER LEVEL control for 50 volts RMS output (approximately 50% on the RFO meter if an RF voltmeter is not available). Carefully tune the FINAL TUNE control through resonance and observe the plate current dip and output voltage maximum. If both occur at the same setting, the amplifier is neutralized. Neutralization may be checked on 15M, 20M, 40M and 80M by switching bands and tuning up at the same VFO dial setting.

2. Neutralizing the Model HT-46. If the check outlined above indicates a need for neutralization, remove the cabinet cover to adjust the neutralizing capacitor C62. Proceed as outlined for the neutralization check and adjust neutralizing capacitor C62 in 1/2 turn or 1/4 turn steps until the plate current dip and output voltage maximum coincide at the center of the 10M band and remain in close agreement at the 28,000 KC and 29,700 KC band edges. The cabinet cover does not have to be in place for the test, however the final amplifier compartment cover and the cabinet bottom plate must be in place.

CAUTION

HIGH VOLTAGE APPEARS ON THE ADJUSTMENT SCREW OF THE NEUTRALIZING CAPACITOR AT ALL SETTINGS OF THE OPERATION CONTROL EXCEPT OFF.

NOTE

When neutralization is required and the heterodyne crystal oscillator crystals for the 28.0 and 29.5 band segments of the 10 meter band are not available, the neutralization procedure may be carried out on the 15 meter band. Neutralization should be checked at 21,000 KC and 21,500 KC for equal run out on this band.

8-6. VFO MECHANICAL INDEX.

With the dial reset lever centered in its panel slot, the pointer over travel at each end of the dial should be equal and the pointer should not engage the nylon pulleys at the extremes of travel.

8-7. VFO CALIBRATION ALIGNMENT.

The frequency range of the VFO, over the calibrated portion of the dial, is 5.0 MC to 5.5 MC. The VFO frequency may be picked up on a general coverage receiver or the VFO frequency may be translated to the 80M band by operating the transmitter in CW mode, and the 80M signal picked up on an amateur band coverage receiver. The receiver should have an accurate 100 KC crystal calibrator to check the dial calibration at every 100 KC point across the dial of the transmitter.

1. Trimmer adjustment only. A trimmer capacity correction is indicated if the dial calibration check across the dial, at the 100 KC check points, consistently falls to one side of the pointer and cannot be corrected by the dial reset lever. Recalibrate the VFO as follows:

A. Set the dial reset lever at the center of its slot.

B. Set the dial at 3500 KC (5500 KC VFO frequency) and tune up the transmitter in CW mode (OPERATION control at CW-TUNE, VFO switch at XMTR) on the 80M band. With the CARRIER LEVEL control set full CCW enough 80M signal will be present to be heard in the amateur band receiver.

C. With a general coverage receiver tuned to 5500 KC, or an amateur band coverage receiver tuned to 3500 KC, adjust VFO trimmer C82 for zero beat with the 100 KC calibrator in the receiver.

D. Check across the dial at the 100 KC check points. If the frequency error is less than approximately 3 KC, the calibration is within acceptable limits. If the error increases and exceeds 3 KC at the high frequency end of the dial (VFO = 5000 KC), the VFO will require a coil adjustment in addition to the trimmer adjustment.

2. Trimmer and coil adjustments. If the check carried out in step D above indicates a need for both trimmer and coil adjustment, proceed as follows:

A. Set the dial at 4000 KC (VFO = 5000 KC), tune up in CW mode on the 80M band and adjust coil L24 for zero beat with the 100 KC calibrator in the receiver.

B. Repeat the trimmer adjustment at 3500 KC (VFO = 5500 KC) and the coil adjustment at 4000 KC (VFO = 5000 KC) until the two dial settings are exactly on frequency.

C. Check the calibration across the dial at the 100 KC points. If the frequency error is less than one pointer width, the calibration is within acceptable limits. If the error is in excess of one pointer width at any of the mid points, with the end limits on frequency, the VFO capacitor C83 should be "knifed". This operation should not be attempted by other than qualified personnel, thoroughly familiar with the technique.

8-8. HETERODYNE CRYSTAL OSCILLATOR ALIGNMENT.

Before changing the core setting of coil L23, check the injection voltage between test point B and chassis. The following procedure should be used to check and adjust the heterodyne crystal oscillator.

1. Remove the VFO tube V7 to disable the VFO injection.

2. Set the OPERATION control at CW-TUNE, CAL switch at OFF and VFO switch at XMTR.

3. Connect the VTVM probe to the grid (Pin 2) of heterodyne mixer tube V8B (Test point B) and ground clip to chassis.

4. Rotate the BAND SELECTOR control through all positions and note the RMS AC injection voltages obtained. Normal injection voltages are as follows:

3.5	Zero
7.0	0.9V to 1.4V
14.0	Zero
21.0	0.6V to 0.8V
*28.0	0.8V to 1.0V
28.5	0.9V to 1.1V
*29.0	0.6V to 0.9V
*29.5	0.8V to 1.1V

*NOTE

These bands will have zero injection voltage if crystals Y3, Y4 and Y6 have not been plugged into the transmitter.

5. If adjustment is required, set the BAND SELECTOR control at 29.5, the highest frequency segment of 10M. (If crystal Y6 has not been added set the band selector at 28.5.) Adjust core of coil L23 for approximately 90% of maximum injection voltage on the gentle slope side of resonance. Switch through the bands and check injection. A small touch up on the core will yield the injection pattern shown in step 4. Replace VFO tube V7.

8-9. HETERODYNE MIXER BAND-PASS TRANSFORMER ALIGNMENT.

Adjustment of transformers T2, T3 and T4 should not be attempted unless the injection voltage varies more than 30% at test point C when the VFO is tuned across the amateur band or the transformers have been replaced and require complete alignment. Bandpass transformers are not used for the 80M and 20M bands and no adjustment on these bands is required.

1. To check injection or make minor adjustments on the bandpass transformers T2, T3 or T4 proceed as follows:

A. Set CARRIER LEVEL control full CCW, VFO switch at XMTR, CAL switch at OFF and set OPERATION control at CW-TUNE.

B. Connect VTVM probe to Pin 1 of tube V4 (test point C) and ground clip to the chassis.

C. Set BAND SELECTOR at 7.0 to check transformer T2; 21.0 for transformer T3; and 28.0, 28.5, 29.0 and 29.5 to check transformer T4. For this method of checking transformer T4 over the complete 10M band it will be necessary to have crystals Y3, Y4 and Y6 installed and the heterodyne crystal oscillator aligned per paragraph 8-8.

D. Tune the VFO across the amateur band and observe the variation in injection voltage. If the variation is less than 30% the transformer is OK. In general, the injection voltage on 80M, 40M, 20M, and 15M bands will run between 0.3V RMS and 0.5V RMS. The 10M band injection will run between 0.7V RMS to slightly over 1.0V RMS (No 9 MC signal injection present).

E. If the difference in injection voltage over the band exceeds 30%, set the VFO dial for the lowest injection voltage. To avoid upsetting the band pass response completely, move the cores in very small increments, noting the direction and degree of rotation. Adjust only the core that increases the injection voltage and set it for approximately 1/2 the variation in injection voltage. Again tune the VFO across the band and evaluate the variation in injection voltage before touching the cores again. Repeat the procedure until the injection voltage level is uniform across the band.

On the 10M band a check on all four segments is required to evaluate a core adjustment rather than just looking at the variation in injection across only one segment of the 10M band.

2. If a new transformer is installed or a major transformer adjustment is required, the use of a signal generator for alignment is recommended. Alignment of the bandpass transformer with the use of a signal generator is as follows:

A. Connect the signal generator to the SX-146 INJECT connector at the rear apron of the transmitter.

B. Connect the VTVM probe to Pin 1 of tube V4 (test point C) and ground clip to the chassis.

C. Set the VFO switch at RCVR, CAL switch at OFF, CARRIER LEVEL full CCW, OPERATION control at CW-TUNE, and set BAND SELECTOR for band associated with bandpass transformer to be aligned. (7.0 for T2, 21.0 for T3 and 28.5 for T4.)

D. Refer to the table for signal generator frequency versus band in use and adjust signal generator output for 1V RMS at test point C. (Approximately 0.25V to 0.5V RMS.)

E. Adjust primary and secondary cores for maximum voltage at test point C and uniform response across the frequency range specified. A correctly adjusted transformer will produce equal voltage at the frequency limits of the pass band and equal amplitude peaks within the tuning ranges of transformers T2 and T4 which are slightly over coupled. The frequency calibration of the signal generators must be above average to insure uniform injection to the 6AH6 mixer grid over the entire band. The use of a crystal marker check on the generator frequency is recommended.

BAND	TRANSFORMER	GENERATOR FREQ. RANGE
7.0	T2	16.0 to 16.5 MC
21.0	T3	30.0 to 30.5 MC
28.5	T4	37.0 to 39.0 MC

8-10. CARRIER OSCILLATOR TRANSFORMER ALIGNMENT.

1. Before adjusting transformer T1, connect the VTVM probe to test point A and ground clip to chassis. Set OPERATION control at CW-TUNE, CARRIER LEVEL full CCW, CAL switch at OFF, and VFO switch at XMTR. A carrier oscillator output voltage of 1.7V to 2.0V RMS is normal. Close the microphone switch and check for equal carrier oscillator output voltages for both sideband positions of the OPERATION control.

2. If adjustment is required, set the core of transformer T1 for approximately 80 to 90% of the maximum voltage obtained. Adjust the core for the high frequency side of the peak core setting, that is, turn the core to back it out of the transformer winding.

8-11. TRANSMITTER MIXER AND DRIVER STAGE ALIGNMENT.

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 9000 KC signal generating stages of the transmitter are functioning properly. Using the internally generated signal of the transmitter, the mixer and driver stages are aligned as follows with the bottom cover and final amplifier compartment covers in place.

1. Connect a 50 ohm dummy load to the ANTENNA jack. Set the OPERATION control at CW-TUNE with the CARRIER LEVEL control set full CCW (Minimum output).

2. If the trimmer on the driver tune capacitor C40 has not been pre-set, set it approximately 1/2 turn from tight.

Set the BAND SELECTOR at 3.5, the VFO dial at 3500 KC, and index the DRIVER TUNE control at the left hand edge of the 80 meter band segment on the panel.

3. Advance the CARRIER LEVEL control and adjust the FINAL TUNE control for resonance in the 80 meter band segment. Maintain an output signal level of approximately 50V RMS across the 50 ohm load (approximately 50% RFO meter reading) as the alignment progresses.

4. Adjust cores of coils L4 and L9 for maximum output meter reading. The 80M coils are common to the remaining bands circuitry, therefore, they must be in alignment before the higher frequency bands can be aligned.

5. Set the BAND SELECTOR at 7.0 and without changing the setting of the VFO or DRIVER TUNE controls, adjust the cores of coils L8 and L13 for maximum output at 7000 KC on the 40M band.

6. Set the VFO dial at 7400 KC and adjust the FINAL TUNE and DRIVER TUNE controls for maximum output. Adjust trimmer C40C for maximum output while tuning the DRIVER TUNE control for maximum output to obtain the best tracking possible between the mixer and driver stages.

7. After setting the trimmer, repeat the core adjustment for coils L4 and L9 on the 80M band at 3500 KC and for coils L8 and L13 on the 40M band at 7000 KC.

8. Proceed with the core adjustment of coils L7 and L12 on the 20M band and coils L5 and L10 on the 10M band, indexing the DRIVER TUNE control at the left band edge of each band segment in turn. Refer to the tuning chart for the appropriate data.

Band	Final Tune Segment	Adjust Coils at	Adjust Coils for Max. Output
3.5	80	3500	L4, L9
7.0	40	7000	L8, L13
14.0	20	14000	L7, L12
28.0	10	28000	L5, L10

9. The 15 meter band coils L6 and L11 are adjusted only after the 10 meter band coils have been aligned. Normally, these coils should not require re-adjustment. To check alignment on 15 meters, tune up at 21,000 KC and by introducing an iron core and brass core wand alternately

into the field of the coils determine whether an adjustment is required. If there is an increase in output with this test, knife the coils accordingly to track the mixer and driver stages. The DRIVER TUNE knob setting at 21,000 KC will fall very close to the setting obtained for 28,000 KC on the 10 meter band.

8-12. ALIGNMENT OF 9 MC IF AMPLIFIER PLATE COIL.

To adjust the core of coil L3 in the plate circuit of the 9 MC IF amplifier tube V3A, tune the transmitter in the CW mode at 29,000 KC in the 10 meter band. With the carrier level adjusted for 50V RMS (50% on RFO meter scale), adjust the core of coil L3 for maximum RF output. Back off the carrier level if the output rises much above 50V RMS during adjustment.

8-13. FILTER TERMINATION ALIGNMENT.

The filter alignment consists of adjusting the impedance matching coils L1 and L2 associated with the hermetically sealed crystal filter unit FL1.

1. The filter response should be checked as follows before any termination adjustments are attempted.

A. Tune the transmitter for SSB operation at 3800 KC into a dummy antenna load.

B. Connect the AF signal generator to the MIC connector and monitor the input voltage with the Ballantine voltmeter. Set the AF signal generator at 1000 CPS and adjust the generator level for 50V RMS RF output with the MIC GAIN control set near maximum gain setting.

C. Maintain constant AF signal generator input voltage and change the frequency of the generator above and below 1000 CPS, recording the frequency at which the transmitter RF output voltage drops to 25 volts RMS (-6 DB). Also note excursions between these two frequencies. A normal 6 DB frequency response will run 500 CPS or less at the low end, 2200 CPS or more at the high end, and less than 2 DB variation (10V RMS change) in the pass band.

2. If the check made in step 1 indicates a need for filter termination adjustment proceed as follows:

A. Tune the transmitter for CW operation at 3800 KC into a dummy antenna load. Turn the transmitter off completely and disconnect the crystal filter unit (FL1) input and output wires at the filter terminals, and disconnect the 680 ohm resistor R16 at the filter terminal end. Connect a 270,000 ohm resistor between the wires lifted from the filter terminals.

B. Turn the transmitter on and set the CARRIER control for approximately 10V RMS RF output, and adjust the cores of coils L1 and L2 for maximum RF output.

C. Remove the 270,000 ohm resistor and reconnect the filter and 680 ohm resistor. Check the filter response as outlined in step 1. If a major change occurred in the core setting of coil L2, recheck the alignment of the 9 MC IF amplifier coil L3. See paragraph 8-12.

8-14. CARRIER OSCILLATOR FREQUENCY ADJUSTMENT.

The two carrier oscillator frequencies have been set to match the filter unit FL1 in the transmitter and generally do not require resetting unless the trimmers have been disturbed or a new filter unit has been installed. Carrier oscillator transformer T1 and filter termination coils L1 and L2 must be in adjustment before the carrier oscillator can be set to exact frequency. The two carrier oscillators are set to frequency as follows:

1. Remove the cabinet cover and bottom cover of the transmitter.

2. Disconnect capacitor C12 at Pin 2 of tube V2B.

3. Tune up the transmitter in CW mode at 3800 KC into a dummy antenna load and monitor the RF voltage with a Model 410B RF voltmeter or equivalent.

4. Activate the transmitter for the following SSB operation by connecting a clip lead from the jumper wire in the VOX UNIT plug (P1) to the chassis.

5. Set OPERATION control at the white LSB position to activate the 8998.7 KC carrier oscillator. (VFO switch at XMTR, CAL switch at OFF.) Set MIC GAIN control full CCW.

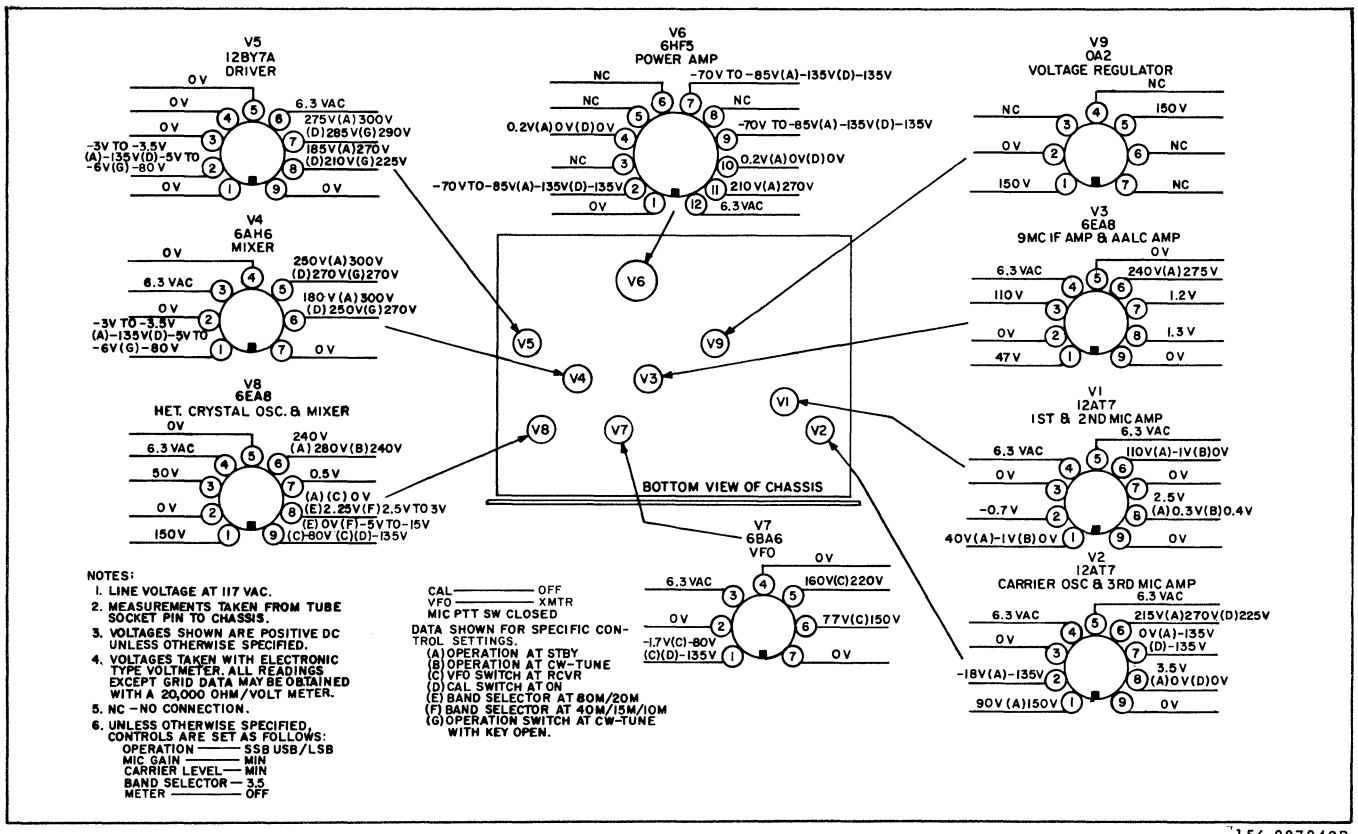
6. Mark the position of the 8998.7 KC warping trimmer C14, then turn the trimmer for maximum RF voltage at the dummy antenna load.

7. Unbalance the modulator sufficiently with the carrier balance potentiometer R13 to obtain 18V RMS at the dummy antenna load.

8. Turn off the transmitter, reconnect the capacitor C12 and turn the transmitter back on (OPERATION control set at white LSB setting).

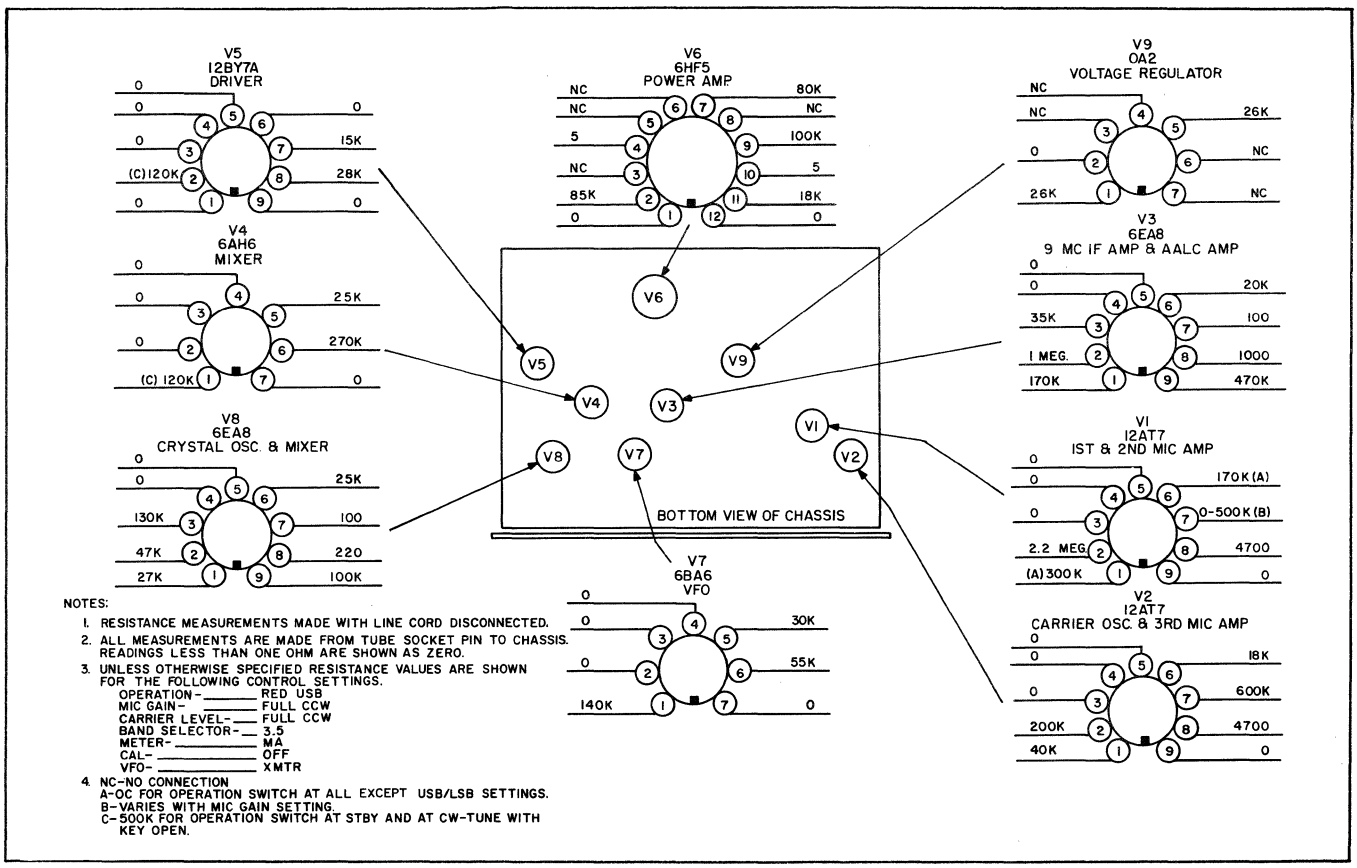
9. The RF output level in step 7 will now be somewhat less. Carefully adjust the 8998.7 KC warping trimmer Cp4 for 1V RMS. The carrier oscillator frequency is now 25 DB down the lower frequency skirt of the filter FL1.

10. Set OPERATION control at the white USB setting to activate the 9001.5 KC carrier oscillator.



156-007043B

Figure 10. Voltage Chart.



156-007042

Figure 11. Resistance Chart.

11. Mark the position of the 9001.5 KC warping trimmer C13, then turn the trimmer for maximum RF voltage at the dummy antenna load.

12. Adjust the carrier balance potentiometer R13 for 18V RMS reference and reset trimmer C13 for 1V RMS. The 9001.5 KC carrier oscillator frequency is now set 25 DB down the high frequency skirt of the filter FL1.

13. Set the transmitter right side up on the bench and rebalance the modulator with the carrier balance controls C17 and R13.

14. The above procedure, properly carried out, will set the two carrier oscillator frequencies 25 DB down the skirts of the filter and the adjusted frequencies will be at 8998.700 KC and 9001.500 KC within ±200 CPS which can be matched by the BFO adjustment in the Model SX-146 receiver for "slave" or transceiver operation.

SECTION IX
MODEL HA-16 VOX CONTROL UNIT

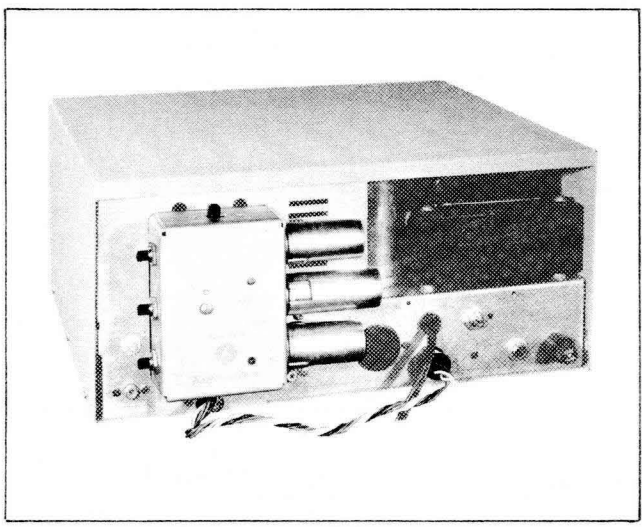


Figure 12. Model HA-16, Mounted on HT-46 Transmitter.

9-1. DESCRIPTION.

Hallicrafters Model HA-16 VOX Control Unit is an accessory unit for the Model HT-46 Transmitter. Installation of this unit on the transmitter will permit voice-controlled, single-sideband operation in addition to the normal push-to-talk control. The control unit may be attached or removed from the transmitter in a matter of minutes. With the accessory unit mounted and adjusted, the operator may select either mode of control as desired.

9-2. INSTALLATION.

1. Remove the jumper plug (P1) presently installed in the VOX UNIT socket located on the rear chassis apron of the transmitter. Save the jumper plug for it must be replaced if the control unit is disconnected.

2. Loosen the ground bolt nut at the rear of the transmitter and space the flat washers about 1/8 inch apart.

3. Hook the Model HA-16 VOX Control Unit into the two key holes in the rear cabinet wall just above the ground bolt and insert the notched flange between the flat washers of the ground bolt. Tighten the ground bolt nut.

4. Plug the inter-connecting cable of the control unit into the VOX UNIT socket. The unit is now ready for adjustment and operation.

9-3. OPERATION.

Set the PTT-VOX switch on the control unit to PTT and check the transmitter for normal push-to-talk control. With the switch in this position, the transmitter should continue to operate as before from the microphone switch.

Before proceeding with VOX operation, a word of caution is in order. Some microphones equipped for push-to-talk control have shorting contacts in the switch to disable the microphone element when the pushbutton is released. VOX operation will not be feasible unless this circuitry is disconnected within the microphone.

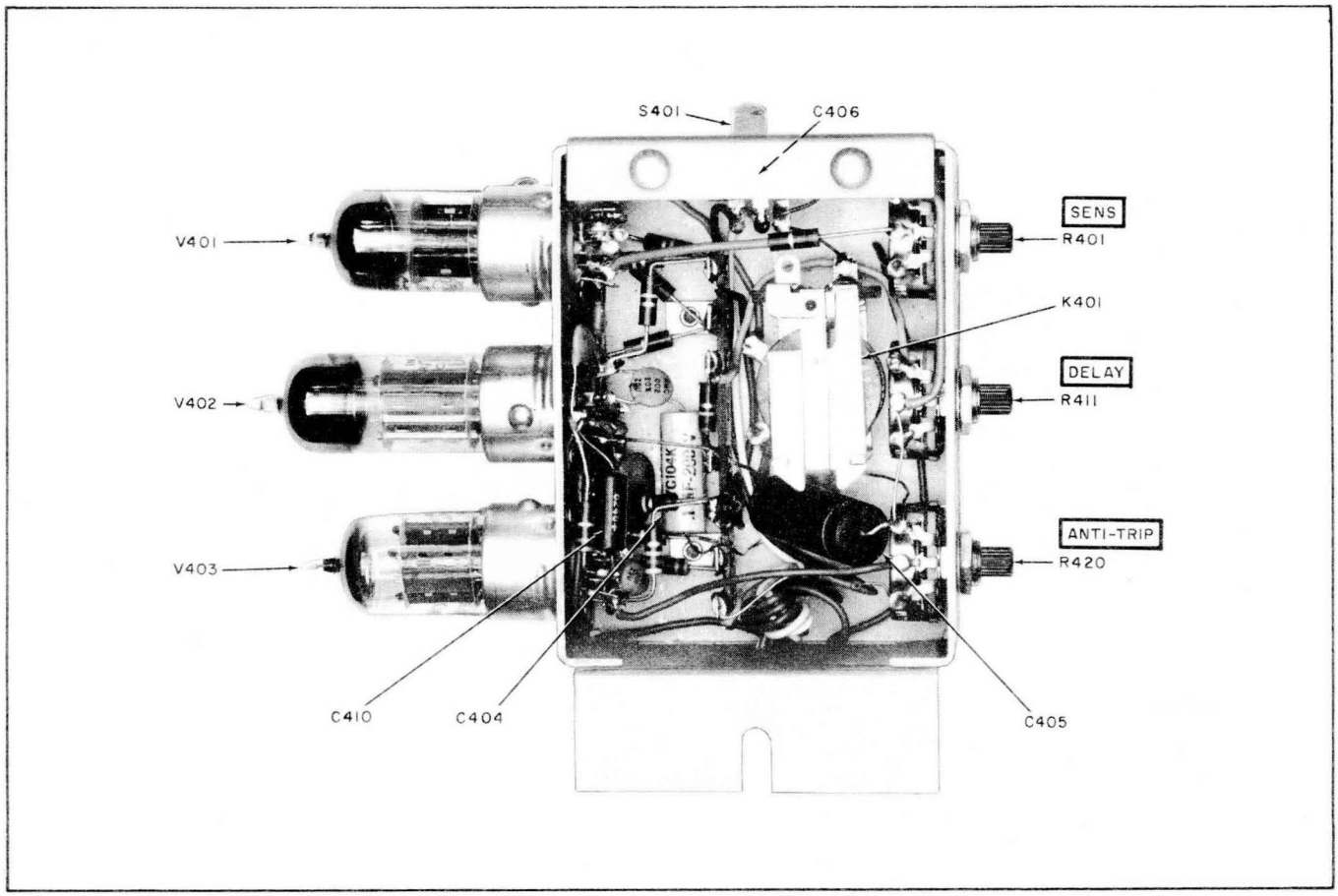
To set up the VOX Control Unit for voice control operation, proceed as follows:

1. Set the three controls (SENS., DELAY, and ANTI-TRIP) at their full counterclockwise positions.

2. Set the AF GAIN control on the receiver fully counterclockwise.

3. To prevent modulation of the transmitter during the following adjustments, set the MIC GAIN control fully counterclockwise.

4. With the OPERATION control on the transmitter set at SSB, set the PTT-VOX selector switch on the control unit at VOX and set the remaining control unit controls as follows:



156-003539

Figure 13. Model HA-16, Internal View.

A. Advance the SENS. control (clockwise) while talking into the microphone, until the VOX relay closes on the first syllable of speech. VOX operation will be the smoothest when no more VOX gain than necessary is used.

B. 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 changeover between words but not long enough to miss the other operator's quick reply.

C. Set the receiver AF GAIN control for the desired listening level and advance the ANTI-TRIP sensitivity control (clockwise) until the received signals do not actuate the VOX relay. Excessive anti-trip gain or a major increase in the established listening level may lock out the voice control system. To obtain the greatest margin of anti-trip control range, the following rules apply:

(1) Avoid setting the microphone close to and directly in front of the speaker.

(2) Turn the active side of the microphone away from the speaker and select a communication type microphone with a high front-to-back sensitivity ratio.

With the VOX Control Unit adjusted, either method of control may be selected by simply setting the selector switch for either PTT or VOX. Do not forget to reset the MIC GAIN control after setting up the voice control circuits. The VOX SENS. and the MIC GAIN controls are entirely independent of each other, and may be adjusted accordingly.

9-4. CHASSIS COVER REMOVAL.

The VOX Control Unit must be disconnected from the transmitter unit to gain access to the internal circuitry. Remove two Phillips head screws, located at the base of the unit, and lift the cover plate clear of the housing.

If live circuit testing must be done on the control unit, a clip lead is connected between the VOX unit and the transmitter ground bolt to provide the required ground return for both power and signal circuits.

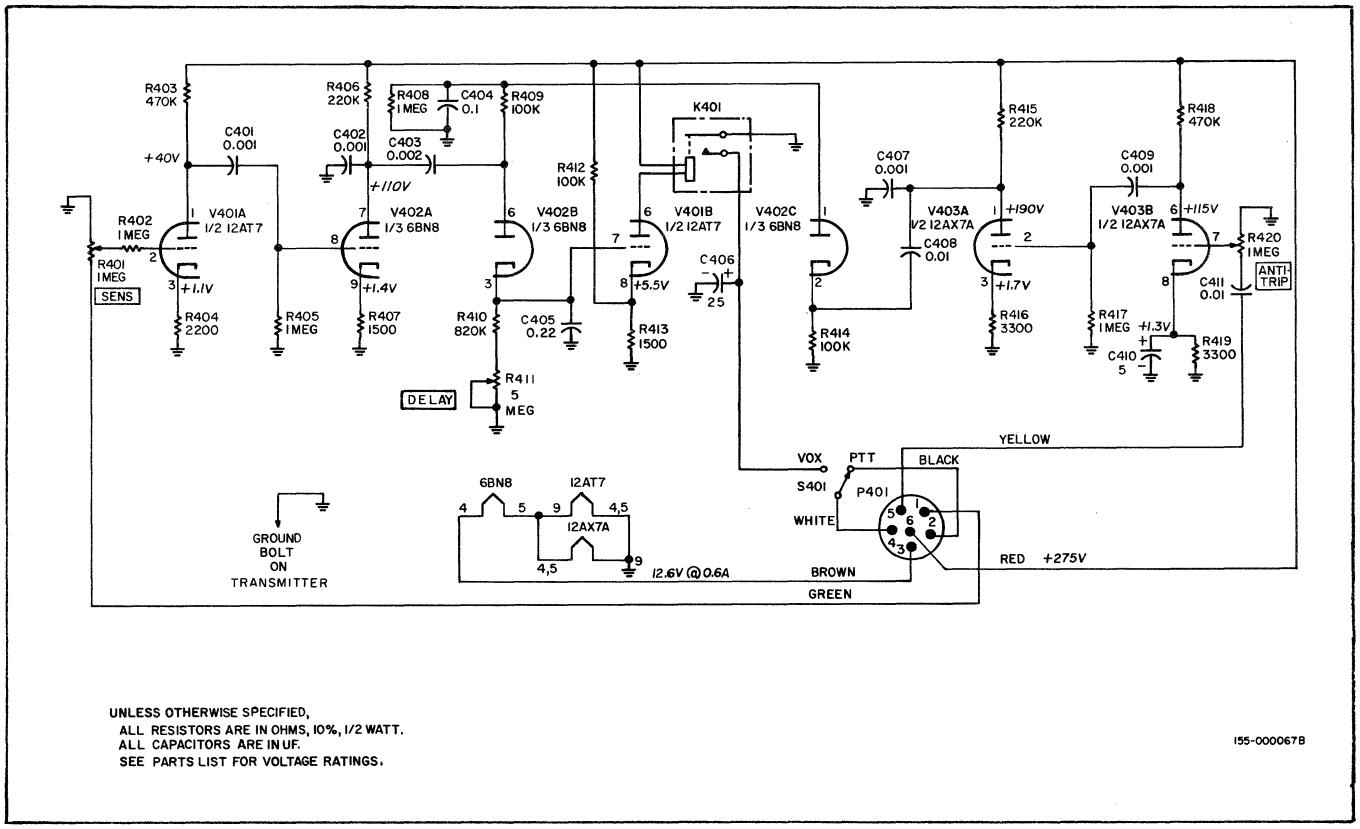
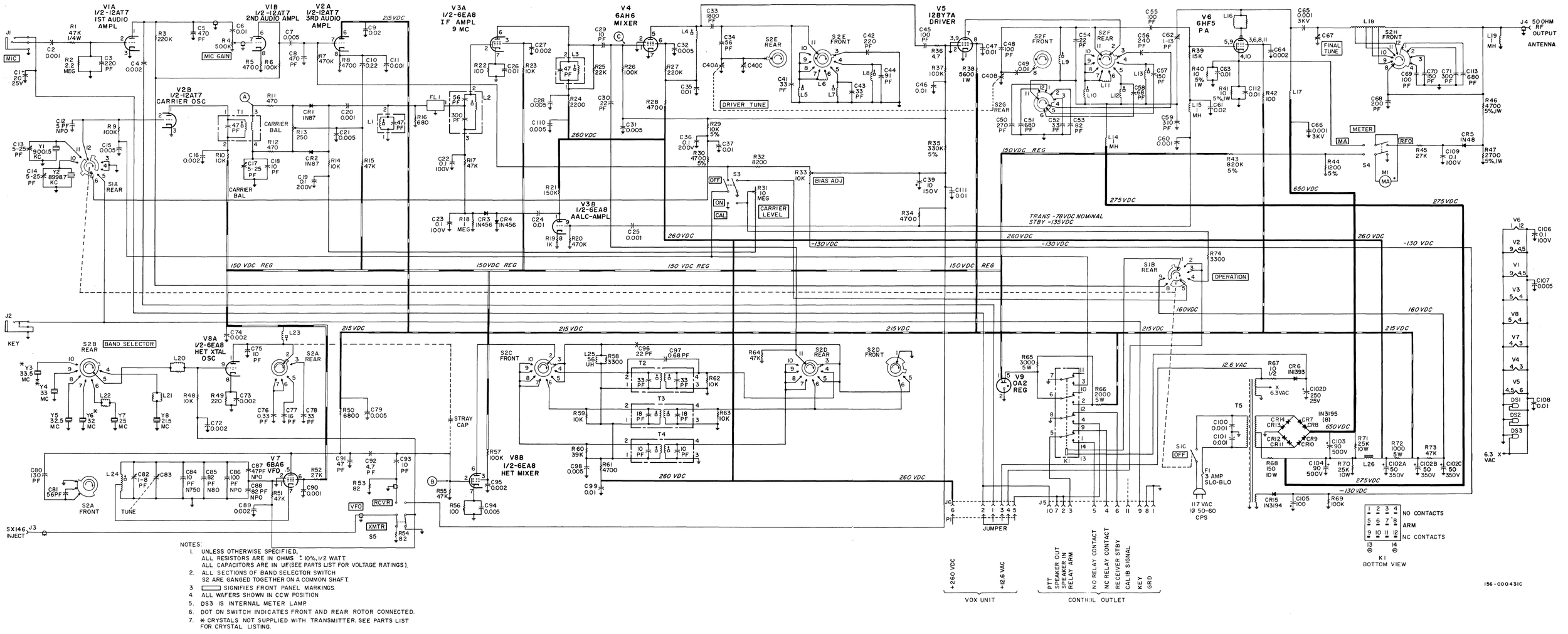


Figure 14. Model HA-16, Schematic Diagram.

PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number
C401,402, 407,409	Capacitor, Ceramic, 0.01 μF, 20%, 500V	047-001671
C403	Capacitor, Ceramic 0.002 μF, 20%, 500V	047-100395
C404	Capacitor, Molded Paper, 0.1 μF, 10%, 200V	046-001294-004
C405	Capacitor, Molded Paper, 0.22 μF, 10%, 200V	046-001298-004
C406	Capacitor, Electrolytic, 25 μF, 25V	045-000883
C408,411	Capacitor, Ceramic, 0.01 μF, 20%, 500V	047-100354
C410	Capacitor, Electrolytic, 5 μF, 25V	045-000938
K401	Relay, VOX	021-000754
P401	Plug, 6-Pin Interconnecting	035-000088
R401,420	Resistor, Variable, 1 Megohm, 30%, 1/4 watt, SENSitivity and ANTI-TRIP	025-002359
R402,405, 408,417	Resistor, Carbon, 1 Megohm, 10%, 1/2 watt	451-252105
R403,418	Resistor, Carbon, 470K ohm, 10%, 1/2 watt	451-252474
R404	Resistor, Carbon, 2200 ohm, 10%, 1/2 watt	451-252222
R406,415	Resistor, Carbon, 220K ohm, 10%, 1/2 watt	451-252224
R407,413	Resistor, Carbon, 1500 ohm, 10%, 1/2 watt	451-252152
R409,412, 414	Resistor, Carbon, 100K ohm, 10%, 1/2 watt	451-252104
R410	Resistor, Carbon, 820K ohm, 10%, 1/2 watt	451-252824
R411	Resistor, Variable, 5 Megohm, 30%, 1/4 watt, DELAY	025-002360
R416,419	Resistor, Carbon, 3300 ohm, 10%, 1/2 watt	451-252332
S401	Switch, Slide, SPDT, VOX-PTT	060-002463
V401	Tube, Type 12AT7	090-900034
V402	Tube, Type 6BN8	090-001465
V403	Tube, Type 12AX7A	090-001458
	Cover	066-004196
	Shield, Tube (V401,403)	069-201190
	Shield, Tube (V402)	069-201189



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS ±10%, 1/2 WATT. ALL CAPACITORS ARE IN UFISEE PARTS LIST FOR VOLTAGE RATINGS).
2. ALL SECTIONS OF BAND SELECTOR SWITCH S2 ARE GANGED TOGETHER ON A COMMON SHAFT.
3. ▭ SIGNIFIES FRONT PANEL MARKINGS.
4. ALL WAFERS SHOWN IN CCW POSITION
5. DS3 IS INTERNAL METER LAMP.
6. DOT ON SWITCH INDICATES FRONT AND REAR ROTOR CONNECTED.
7. * CRYSTALS NOT SUPPLIED WITH TRANSMITTER. SEE PARTS LIST FOR CRYSTAL LISTING.

Figure 15. Model HT-46 Schematic Diagram.

SERVICE REPAIR PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number
	CAPACITORS	
C1	20 μF, 25V, Electrolytic	045-001147
C2,11,20, 25,60,90	0.001 μF, ±20%, 500V Ceramic	047-001671
C3,42	220 PF, ±2%, 500V, Mica	493-110221-334
C4,16,27, 64,72,73, 74,89,95	0.002 μF, ±20%, 500V, Ceramic	047-100395
C5,8	470 PF, ±5%, 500V, Mica	493-110471-234
C6,24,26, 35,37, 46,47,49, 63,99,108, 111,112	0.01 μF, ±20%, 500V, Ceramic	047-100354
C7,15,21, 28,31,32, 79,94,98, 107,110	0.005 μF, ±20%, 500V, Ceramic	047-100442
C9,61	0.02 μF, ±20%, 500V, Ceramic	047-100471
C10	0.22 μF, ±10%, 200V, Paper	046-001298-004
C12	5 PF, ±0.25 PF, 500V, NPO, Ceramic	491-001050-022
C13,14,17	Variable, 5-25 PF, Trimmer	044-200545
C18,29, 75,93	10 PF, ±2%, 500V, Mica	493-110100-331
C19,36	0.1 μF, ±10%, 200V, Paper	046-001294-004
C22,23, 106,109	0.1 μF, +80%, -20%, 100V, Ceramic	047-001428
C30,54,96	22 PF, 2%, 500V, Mica	493-110220-333
C33	1800 PF, ±5%, 500V, Mica	493-310182-234
C34,81	56 PF, ±2%, 500V, Mica	493-110560-334
C39	10 μF, 150V, Electrolytic	045-200307
C40A,B, C	Variable, DRIVER TUNE	048-000609
C41,43, 52,78	33 PF, ±2%, 500V, Mica	493-110330-333
C44	91 PF, ±2%, 500V, Mica	493-110910-334
C45,48, 55,69	100 PF, ±2%, 500V, Mica	493-110101-334
C50	270 PF, ±2%, 500V, Mica	493-110271-334
C53	82 PF, ±2%, 500V, Mica	493-110820-333
C56	240 PF, ±2%, 500V, Mica	493-110241-334
C57,70	150 PF, ±2%, 500V, Mica	493-110151-334
C58	68 PF, ±2%, 500V, Mica	493-110680-334
C59	310 PF, ±2%, 500V, Mica	493-110311-334
C62	Variable, 1-13 PF, Trimmer	044-000520
C65,66	0.001 μF, ±20%, 3 KV, Ceramic	047-100397
C67	Variable, FINAL TUNE	048-000610
C68	200 PF, ±2%, 500V, Mica	493-210201-334
C71	300 PF, ±2%, 500V, Mica	493-110301-334
C76	0.33 PF, ±10%, 500V, Ceramic	047-000403-016
C77	16 PF, ±2%, 500V, Mica	493-110160-331
C80	130 PF, ±2%, 500V, Mica	493-210131-334
C82	Variable, 1-8 PF, Trimmer	044-000593
C83	Variable, VFO	048-000595
C51	680 PF,5%,500V,Mica	493-210681-234

Schematic Symbol	Description	Hallicrafters Part Number
	CAPACITORS (CONT)	
C84	10 PF, ±0.25 PF, 500V, N750, Ceramic	491-001100-093
C85	82 PF, ±2%, 500V, N80, Ceramic	491-054820-042
C86	100 PF, ±2%, 500V, NPO, Ceramic	491-054101-022
C87	47 PF, ±2%, 500V, NPO, Ceramic	491-024470-022
C88	82 PF, ±2%, 500V, NPO, Ceramic	491-054820-022
C91	47 PF, ±2%, 500V, Mica	493-110470-333
C92	4.7 PF, ±2%, 500V, Mica	493-240470-331
C97	0.68 PF, ±10%, 500V, Ceramic	047-000403-001
C100,101	0.001 μF, -0%, +100%, 1400V, Ceramic	047-002217
C102A,B, C,D	3 x 50 μF, 350V; 250 μF, 25V, Electrolytic	045-001370
C103	90 μF, 500V, Electrolytic	045-001337
C104	90 μF, 500V, Electrolytic	045-001338
C105	100 μF, 150 VDC, Electrolytic	045-001371
C113	680 PF,2%,300V,Mica	493-110681-324
	*RESISTORS	
R1	47K ohm, 1/4 Watt	451-152473
R2	2.2 Megohm, 1/4 Watt	451-152225
R3,27	220K Ohm	451-252224
R4	Variable, 500K Ohm, ±30%, 1/8 Watt, MIC GAIN	025-002528
R5,8,28, 34,61	4700 Ohm	451-252473
R6,9,26, 37,57,69	100K Ohm	451-252104
R7,20	470K Ohm	451-252474
R10,14, 23,48,59, 62,63	10K Ohm	451-252103
R11,12	470 Ohm	451-252471
R13	250 Ohm, ±20%, 1/4 Watt CARRIER BAL.	025-002527
R15,17, 51,55,64, 73	47K Ohm	451-252473
R16	680 Ohm	451-252681
R18	1 Megohm	451-252105
R19	1000 Ohm	451-252102
R21	150K Ohm	451-252154
R22,42, 56	100 Ohm	451-252101
R24	2200 Ohm	451-252222
R25	22K Ohm	451-252223
R29	10K Ohm, 5%	451-251103
R30	4700 Ohm, 5%	451-251472
R31	10 Megohm, -20%, +40%, 1/8 Watt, CARRIER LEVEL	025-002531
R32	8200 Ohm	451-252822
R33	10K Ohm, ±20%, 3/4 Watt, BIAS ADJ	025-002330
R35	330K Ohm, 5%	451-251334
R36	4.7 Ohm	451-252047
R38	5600 Ohm, 1 Watt	451-352562
R39	15K Ohm	451-252153
R40,41	10 Ohm, 5%, 1 Watt	451-351100
R43	820K Ohm, 5%	451-251824
R44	1200 Ohm, 5%	451-251122
R45,52	27K Ohm	451-252273
R46	4700 Ohm, 5%, 1 Watt	451-351472
R47	2700 Ohm, 5%, 1 Watt	451-351272
R49	220 Ohm	451-252221
R50	6800 Ohm	451-252682
R53,54	82 Ohm	451-252820
R58,74	3300 Ohm	451-252332
R60	39K Ohm	451-252393
R65	3000 Ohm, 5 Watt	445-012302
R66	2000 Ohm, 5%, 5 Watt	445-011202

Schematic Symbol	Description	Hallicrafters Part Number
	*RESISTORS (CONT)	
R67	10 Ohm	451-252100
R68	150 Ohm, 5%, 10 Watt	024-001607
R70,71	25K Ohm, 10 Watt	445-032253
R72	1000 Ohm, 5%, 5 Watt	445-011102

*ALL RESISTORS are carbon type, 10%, 1/2 watt, unless otherwise specified.

	COILS AND TRANSFORMERS	
L1,3	Coil, IF	050-002159
L2	Coil, Filter Termination	050-002161
L4	Coil, Mixer, 80 Meter	050-002114
L5	Coil, Mixer, 10 Meter	050-002110
L6	Coil, Mixer, 15 Meter	050-002111
L7	Coil, Mixer, 20 Meter	050-002112
L8	Coil, Mixer, 40 Meter	050-002113
L9	Coil, Driver, 80 Meter	050-002119
L10	Coil, Driver, 10 Meter	050-002115
L11	Coil, Driver, 15 Meter	050-002116
L12	Coil, Driver, 20 Meter	050-002117
L13	Coil, Driver, 40 Meter	050-002118
L14,15,19	Choke, 1.0 MH	050-001044-005
L16	Choke, Parasitic	050-002103
L17	Choke, RF	050-002106
L18	Coil, PI Output	050-002105
L20	Coil, Warping	051-002892
L21,22	Coil, Warping	051-002893
L23	Coil, Het. Xtal. Oscillator	050-002120
L24	Coil, VFO	050-002109
L25	Choke, RF, 15 μH	050-002311
L26	Choke, Filter	056-000786
T1	Transformer, Carrier Oscillator Plate	050-002158
T2	Transformer, Bandpass, 40 Meter	050-002145
T3	Transformer, Bandpass, 15 Meter	050-002146
T4	Transformer, Bandpass, 10 Meter	050-002147
T5	Transformer, Power	050-002104
	ELECTRON TUBES AND DIODES	
V1,2	Tube, Type 12AT7	090-900034
V3,8	Tube, Type 6EA8	090-901350
V4	Tube, Type 6AH6	090-900793
V5	Tube, Type 12BY7A	090-901192
V6	Tube, Type 6HF5	090-901653
V7	Tube, Type 6BA6	090-901112
V9	Tube, Type OA2	090-900001
CR1,2	Diode, Type 1N87	019-002941
CR3,4	Diode, Type 1N456	019-002964
CR5	Diode, Type 1N48	019-101877
CR6	Diode, Type 1N3193	019-002768
CR7 thru CR14	Diode, Type 1N3195	019-002770
CR15	Diode, Type 1N3194	019-002769
	SWITCHES	
S1	Switch, Rotary, OPERATION	060-002802
S2	Switch, Rotary, BAND SELECTOR	060-002803
S3,4,5	Switch, Slide, DPDT	060-000544
	CRYSTALS	
Y1	9001.5 KC	019-003653
Y2	8998.7 KC	019-003652
Y3	33.5 MC (Not Supplied)	019-201966
Y4	33 MC (Not Supplied)	019-201965
Y5	32.5 MC	019-201964
Y6	32 MC (Not Supplied)	019-201963
Y7	25.0 MC	019-201961
Y8	21.5 MC	019-201960

Schematic Symbol	Description	Hallicrafters Part Number
	CONNECTORS	
J1	Jack, Three circuit, MIC	036-000391
J2	Jack, Two circuit, KEY	036-000390
J3	Jack, Phono, SX-146 INJECT	036-000396
J4	Jack, Phono, ANTENNA	036-100041
J5	Socket, 11-pin	005-200707
J6	Socket, 6-pin	006-001096
P1	Plug, 6-pin	035-000088
	Plug, 11-pin	035-100043
	Plug, Phono (SX-146 INJECT and ANTENNA)	010-000221
	MISCELLANEOUS	
	Angle, Window Mounting	067-012996
	Bracket, Piston Capacitor Mounting	067-012948
	Bracket, Socket Mounting	067-012946
	Cabinet, Bottom	066-004622
	Cabinet, Bottom Rivet Assembly	150-009410
	Cabinet, Cover	066-004621
	Chassis Rivet Assembly	150-008752
	Coupler, Driver Tune	029-000564
	Coupler, Shaft	029-001061
	Cover, Final Tank	066-004557
	Escutcheon, Meter	007-000922
	Escutcheon, Panel	007-000861
FL1	Filter, Crystal, 2.1 KC	049-000320
	Flywheel	071-000212-002
	Foot, Front	016-001469
	Foot, Rear	016-002446
	Front Panel Assembly	150-009409
F1	Fuse, 3 ampere, SLO-BLO	039-100390
	Fuseholder (F1)	006-200837
	Knob; OPERATION, MIC GAIN, DRIVER TUNE, CARRIER LEVEL, BAND SELECTOR, FINAL TUNE	015-001844
	Knob, MAIN TUNING	015-001751-003
DS1,2	Lamp, Dial, NO. 47	039-100004
	Lock, Line Cord	076-004546-005
M1	Meter	082-000676
	Pointer, Dial	082-000667
	Pulley, Brass	028-200052-011
	Pulley, Nylon	028-000530-002
	Rectifier Board Assembly	150-008756
K1	Relay	021-000831
	Shaft, BAND SELECTOR	074-003074
	Shaft, DRIVER TUNE	074-003075
	Shaft, FINAL TUNE	074-003076
	Shaft, TUNING	074-003055
	Shield, Final Tank	067-012945
	Shield, Heat Insert Tube	069-101020
	Shield, Switch	067-012947
	Shield, Tube (V2,3,8)	009-000855
	Shield, Tube (V4)	069-000097
	Shield, Tube (V5)	069-000863
	Socket, Pilot Light (Left Side)	086-000735
	Socket, Pilot Light (Right Side)	086-000734
	Socket, Tube, 9-pin (V1)	006-001112
	Socket, Tube, 9-pin (V2,3,5,8)	006-000395
	Socket, Tube, 7-pin (V4)	006-200633
	Socket, Tube, 12-pin (V6)	006-001131
	Socket, Tube, 7-pin (V7,9)	006-001094
	Spring, Dial Cord	075-000893
	Spring, Dial Plate	075-001011
	Window, Dial	022-000745
	Shield, Fiber	069-002123
	Shield, RF	069-002633

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