



OPERATING AND SERVICE INSTRUCTIONS

**COMMUNICATIONS
RECEIVER
MODEL SX-146**

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

Serial No. 146001 602009

Purchased 8-8-66



Figure 1. Hallicrafters' Model SX-146 Receiver.

156-005901

SECTION I GENERAL DESCRIPTION

The Model SX-146 is an SSB-CW-AM communications receiver having the following features:

- Single signal conversion with pre-mixing on 40, 15 and 10 meters.
- Transceive operation with companion Model HT-46 transmitter/exciter.
- Six section 2.1 KC crystal lattice filter for maximum selectivity on single sideband.
- Provisions for plugging in 0.5 KC CW filter and 5.0 KC AM filter.
- 9.0 MC IF system virtually eliminates image signals.
- Crystal controlled beat frequency oscillators.
- Coverage of most frequencies between 3.5 and 30.0 MC (with external variable or crystal controlled oscillator).
- Constant tuning rate on all bands.
- A high order of electrical and mechanical stability.
- Smooth flywheel tuning.
- Frame grid RF amplifier.
- Low noise triode mixer.
- Excellent cross-modulation and overload characteristics.
- Product detector for SSB/CW; envelope detector for AM.
- Series type AM noise limiter.
- Compact in size, light in weight.

SECTION II TECHNICAL SPECIFICATIONS

Tuning Ranges:

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

*Crystals not supplied with receiver (optional).

IF Frequency	9.0 MC (8999.5 for 0.5KC filter).
Reception Modes	AM-CW and SSB.
Sensitivity AM	Less than 1 microvolt for 10 DB S/N ratio (30% modulation).
Sensitivity SSB/CW	Less than 1/2 microvolt for 20 DB S/N ratio.
Selectivity	3 positions: 500 cycles @ 6 DB down (not supplied). 2.1 KC @ 6 DB down. 5.0 KC @ 6 DB down (not supplied).
Stability	Less than 500 cycles drift in the first hour, after fifteen minutes warmup, and less than 100 cycles per hour thereafter.
IF Rejection	Better than 50 DB.
Spurious Rejection	Better than 50 DB.
In Band Tweets	Less than 0.25 microvolt equivalent CW signal, except 1 microvolt @ 21.33 MC.
Audio Power Output	3/4 watt with less than 10% distortion.
Power Source	105 to 125 volts, 50/60 cycles.
Power Consumption	55 watts.
Number of Tubes	10 (including calibrator tube), plus 4 diodes (including calibrator diode).
Antenna Input	50 to 70 ohms unbalanced; rear mounted jack accepts RCA type phono plug.

Audio Output Impedance	3.2 ohms; rear mounted screw terminals.
Headphone Output	50 ohms to 2000 ohms; panel mounted jack accepts standard 1/4 inch phone plug.
Mute	Rear mounted screw terminals; short to receive, open to mute.
Slave Output	See Model HT-46 Instruction Manual for connections.
Internal/External Switch	Rear mounted slide switch must be set to internal for normal operation-(down position).
External Oscillator Input	Accepts RCA type phono plug. The slide switch must be set to external when an external oscillator is used (up position).
	NOTE: The HT-46 cannot be slaved in this position.
Dimensions	5-7/8 inches high, 13-1/8 inches wide, and 11 inches deep.
Net Weight	18 pounds.
Shipping Weight	20 pounds.

TUBES AND FUNCTIONS

6JD6	RF amplifier.	6GW8	Audio amplifier and audio output.
12AT7	Signal mixer and cathode follower.	6BA6	Variable frequency oscillator.
6AU6A	9 MC IF amplifier.	6EA8	Crystal heterodyne oscillator and pre-mixer.
6AU6A	9 MC IF amplifier.	6AU6A	100 KC crystal calibrator oscillator.
12AT7	AM detector - AVC rectifier - product detector.		Also contains diode power supply rectifier, ANL diode and AVC gate diode.
12AT7	USB - LSB crystal oscillators.		Harmonic generator diode, part of HA-19 crystal calibrator.

SECTION III INSTALLATION

3-1. UNPACKING.

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

3-2. LOCATION.

The receiver may be placed in any location that will permit free air circulation through the ventilation holes in the cabinet. Avoid excessively warm locations such as those near radiators and heating vents. Also, avoid direct blasts of

air from circulating fans, etc. Do not place any object on top of the cabinet in a manner that will impair natural ventilation.

3-3. ANTENNAS.

The Model SX-146 uses an input circuit designed for an unbalanced 50 to 70 ohm input. Any of the popular dipole or beam antennas will give good results. It should be remembered, however, that these antennas will give optimum results over a limited frequency range. Generally speaking, the same rules that apply to transmitting antennas will hold true for receiving antennas. For further information on this subject, refer to the "Radio Amateur's Handbook" or the "ARRL Antenna Book", both published by the American Radio Relay League.

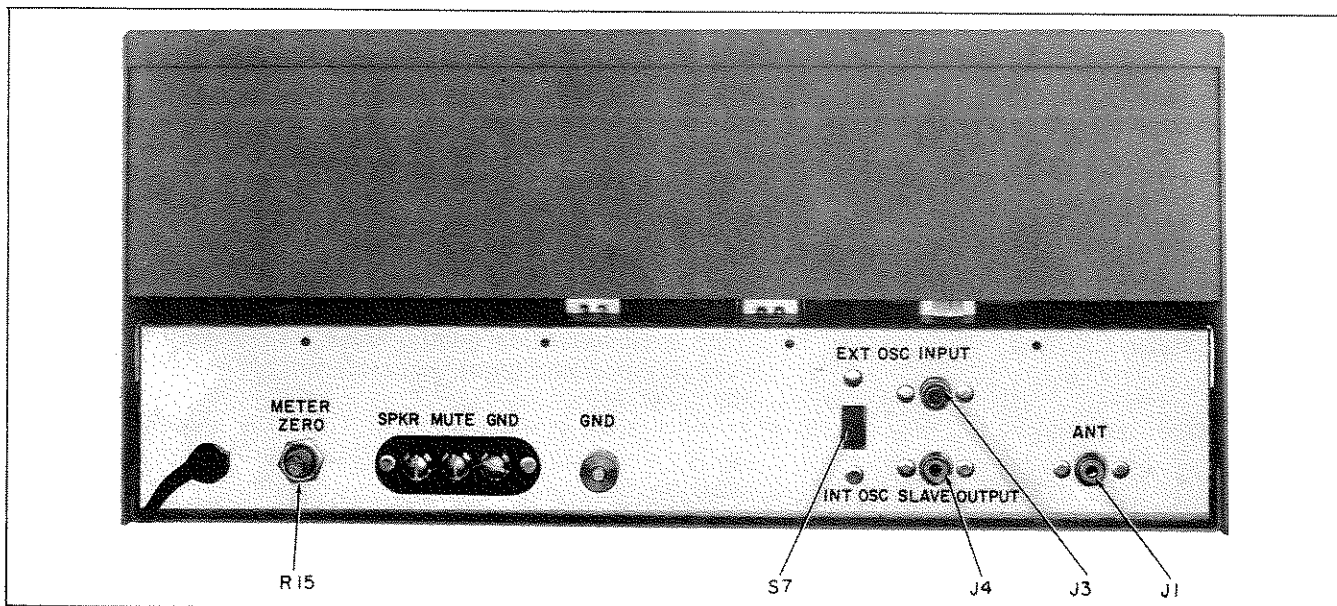


Figure 2. Rear View of Receiver.

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IMPORTANT

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

3-4. GROUNDS.

All station equipment should be bonded together with heavy copper wire or braid and connected to a cold water pipe or earth ground. An external chassis ground terminal is provided on the SX-146 rear chassis apron for this purpose.

3-5. POWER SOURCE.

The SX-146 is designed to operate from a 105/125 volt, 50/60 cycle AC power source. Power consumption is 55 watts.

NOTE

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 can cause extensive damage to the unit.

3-6. SPEAKER.

Terminals marked 3.2 and GND are provided on the rear chassis apron (figure 2) for connecting an external speaker. Any permanent magnet type speaker with a 3.2 ohm voice coil can be used by connecting two leads from the voice coil to the terminals marked 3.2 and GND.

Hallicrafters Model R-47 speaker is particularly suited for voice and CW reception. Model R-48A speaker, with its two position VOICE-FIDELITY switch will give excellent results in all reception modes.

3-7. HEADPHONES.

The headphone jack marked PHONES is located on the front panel and is wired so that the speaker output is automatically disabled when the headphone plug is inserted. The impedance is not critical, and any headphones in the 50 to 2000 ohm range will give satisfactory performance.

3-8. RECEIVER MUTING.

The receiver may be disabled from a remote location by removing the jumper between the terminals marked MUTE and GND and connecting a SPST switch or relay between these terminals. The switch or relay contacts should be so wired as to close in Receive and open in Transmit.

3-9. ACCESSORY INSTALLATION.

The accessories mentioned are available and may be ordered from your Hallicrafters dealer.

FILTER INSTALLATION

To install a 0.5 KC CW filter (Part No. 049-000321) or a 5.0 KC AM filter (Part No. 049-000319), it will be necessary to remove the cabinet top (refer to paragraph 8-2).

The correct socket for each filter is marked on the chassis and these markings should be observed before filter insertion is attempted.

Both filters are polarized, i.e., will fit into the socket in one direction only. After proper orientation of the filter with respect to its socket, carefully push filter into socket. Do not use excessive force.

10 METER CRYSTAL INSTALLATION

Three additional crystals will be required for full 10 meter coverage. To install these crystals it will be necessary to remove the top portion of the cabinet (refer to paragraph 8-2). Chassis markings will indicate their location.

Crystals required are:

32.0 MC (Part No. 019-201963) for 28.0 to 28.5 MC

33.0 MC (Part No. 019-201965) for 29.0 to 29.5 MC
 33.5 MC (Part No. 019-201966) for 29.5 to 30.0 MC

100 KC CRYSTAL CALIBRATOR INSTALLATION

The HA-19 calibrator is available to provide 100KC calibration check points throughout the tuning range of the receiver.

To install, remove the top portion of the cabinet (refer to paragraph 8-2). The HA-19 is a plug-in unit requiring no additional wiring. Location and orientation is shown in figure 6.

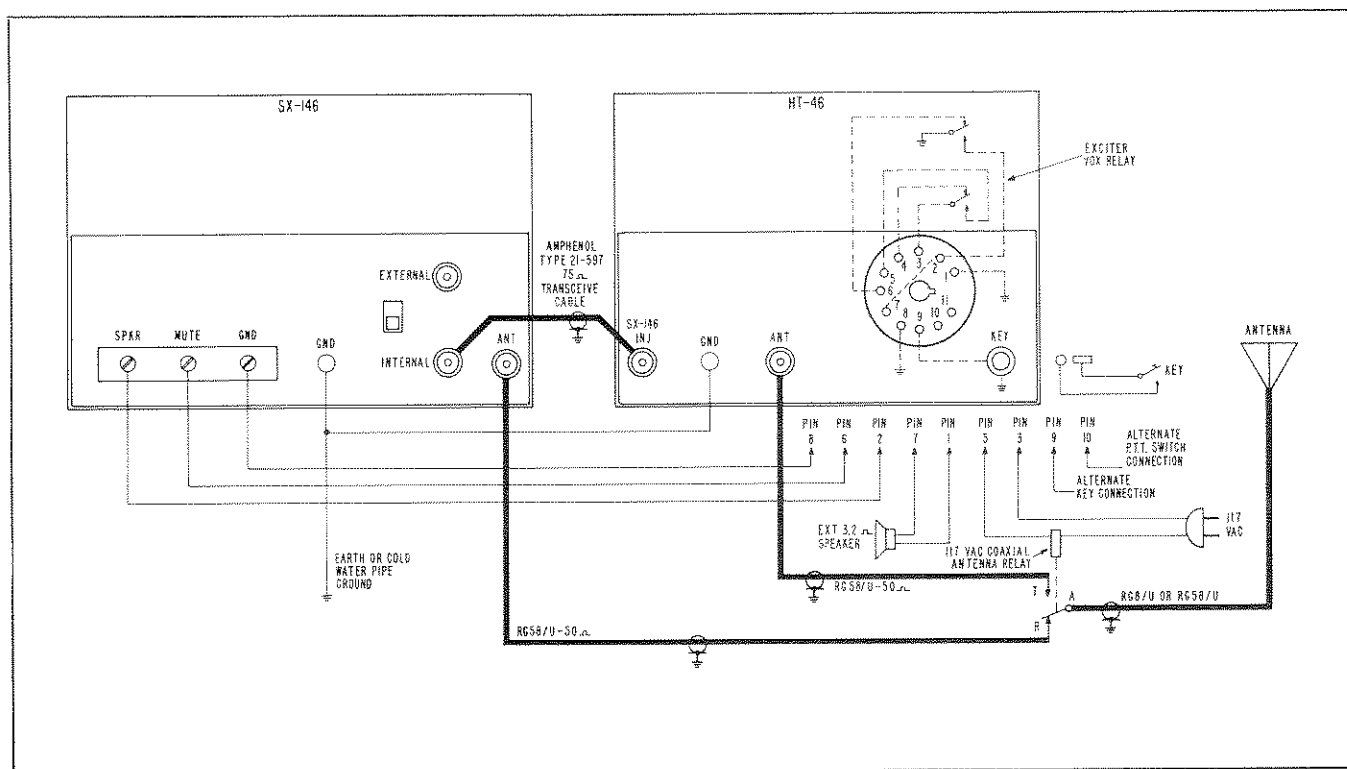


Figure 3. Typical Station Setup.

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SECTION IV FUNCTIONS OF OPERATING CONTROLS

4-1. RF GAIN CONTROL.

The RF GAIN control varies the gain of the RF amplifier and second IF amplifier. Maximum sensitivity is obtained with the control rotated fully clockwise. In this position, the tubes being controlled are operating at maximum gain with minimum cathode bias. As the control is rotated counterclockwise, the cathode bias is increased with a resultant decrease in gain.

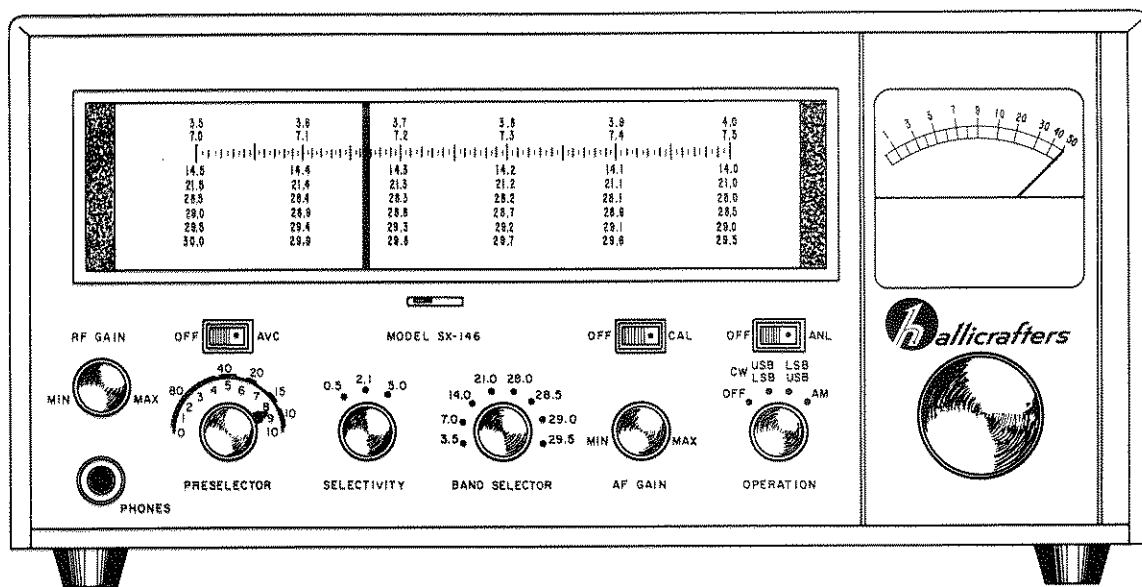
The setting of the RF GAIN control will vary with conditions. When searching for weak

signals, the control should be fully advanced. When copying strong signals under crowded or noisy conditions, it may be found desirable to reduce gain.

It should be remembered that the "S" meter calibration will be correct only with the RF GAIN control rotated fully clockwise.

4-2. AF GAIN CONTROL.

The AF GAIN control adjusts the audio output level in the speaker or headphones. Clock-



156-005980

Figure 4. Front Panel View of Receiver.

wise rotation increases the signal voltage applied to the grid of the audio amplifier, thus increasing the audio output.

4.3. PRESELECTOR CONTROL.

The PRESELECTOR control provides precise tuning of the antenna and mixer coils to give maximum gain and front end selectivity. It also provides coverage of most frequencies in the 3.5 to 30.0 MC range when used with an external oscillator.

Under certain conditions where excessive noise or interference is encountered, it may be found desirable to slightly detune the PRESELECTOR for optimum results.

4.4. OPERATION CONTROL.

The OPERATION control is a four position rotary switch performing the following functions:

Position	Function
OFF	Removes 117 volts from power transformer primary.
CW-USB-LSB	<ul style="list-style-type: none"> a. Connects 117 volts to power transformer primary. b. Completes cathode circuit of the 8998.7 KC crystal controlled beat frequency oscillator (9001.5 oscillator inoperative). c. Connects output of product detector to the AF GAIN control.

Position

Function

LSB-USB

- a. Completes cathode circuit of the 9001.5 KC crystal controlled beat frequency oscillator. (8998.7 oscillator inoperative).
- b. Also connects output of product detector to the AFGAIN control.

AM

- a. Opens cathode circuits of both crystal oscillators.
- b. Connects output of the AM detector/ANL circuit to the AF GAIN control.

NOTE

The USB-LSB positions of the OPERATION switch are color keyed to the BAND SELECTOR switch. If the BAND SELECTOR is set to a white number, the white markings on the OPERATION switch should be used.

If the BAND SELECTOR is set to a red number, the red markings on the OPERATION switch should be used.

For CW operation, the OPERATION switch should be set at the CW position regardless of the BAND SELECTOR setting.

4.5. SELECTIVITY SWITCH.

The SELECTIVITY switch is a three position rotary switch used for selection of any one of three crystal filters which determine the intermediate frequency bandwidth, or selectivity of the receiver.

The recommended selectivity position for various reception modes are as follows:

<u>Position</u>	<u>Mode</u>
0.5 KC	CW only
2.1 KC	SSB or CW. This position will, in most cases, be too narrow for satisfactory AM reception except under extremely adverse conditions.
5.0 KC	AM only

NOTE

0.5 and 5.0 KC filters not supplied (optional).

4.6. BAND SELECTOR SWITCH.

The BAND SELECTOR is an eight position rotary switch which selects the proper coils and crystal to cover the desired tuning range. Gain equalization is also switched in on 40 and 20 meters.

As mentioned in paragraph 4-4, the BAND SELECTOR is color keyed to the OPERATION switch. If the BAND SELECTOR is set at a red number, then the red markings on the OPERATION switch should be used.

4.7. TUNING CONTROL.

The TUNING control is used to vary the frequency of the VFO to allow selection of the desired signal. As the TUNING knob is rotated, the pointer will indicate the frequency of reception.

It should be noted that the frequency increases from left to right for the two bands whose numbers appear above the calibration marks. For those appearing below these marks, the frequency increases from right to left.

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

4.8. AVC ON/OFF SWITCH.

The AVC switch is used to disable the AVC circuitry. If this switch is placed in the OFF position, it will be necessary to control the receiver gain manually with the RF GAIN control to prevent overloading on strong signals.

NOTE

It is not necessary, and in most cases not desirable, to "turn off" the AVC when receiving CW or SSB signals. It is normal for the "S" meter to read slightly below zero when the AVC switch is in the OFF position.

4.9. ANL ON/OFF SWITCH.

The ANL switch is normally kept in the OFF position and used when necessary to eliminate impulse noise in AM reception.

It will be found to be most effective when used in conjunction with the 5.0 KC filter and does not function when receiving CW or SSB.

4-10. CAL ON/OFF SWITCH.

The CAL switch is used to place the HA-19 100 KC crystal calibrator (optional) in operation.

This switch should always be in the OFF position except when calibrating the dial.

4-11. CAL RESET.

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

a. To use, place CAL switch in the ON position and tune receiver to the 100 KC check point nearest your operating frequency. Adjust CAL RESET as necessary to align dial calibration mark to pointer.

b. Turn 100 KC calibrator off.

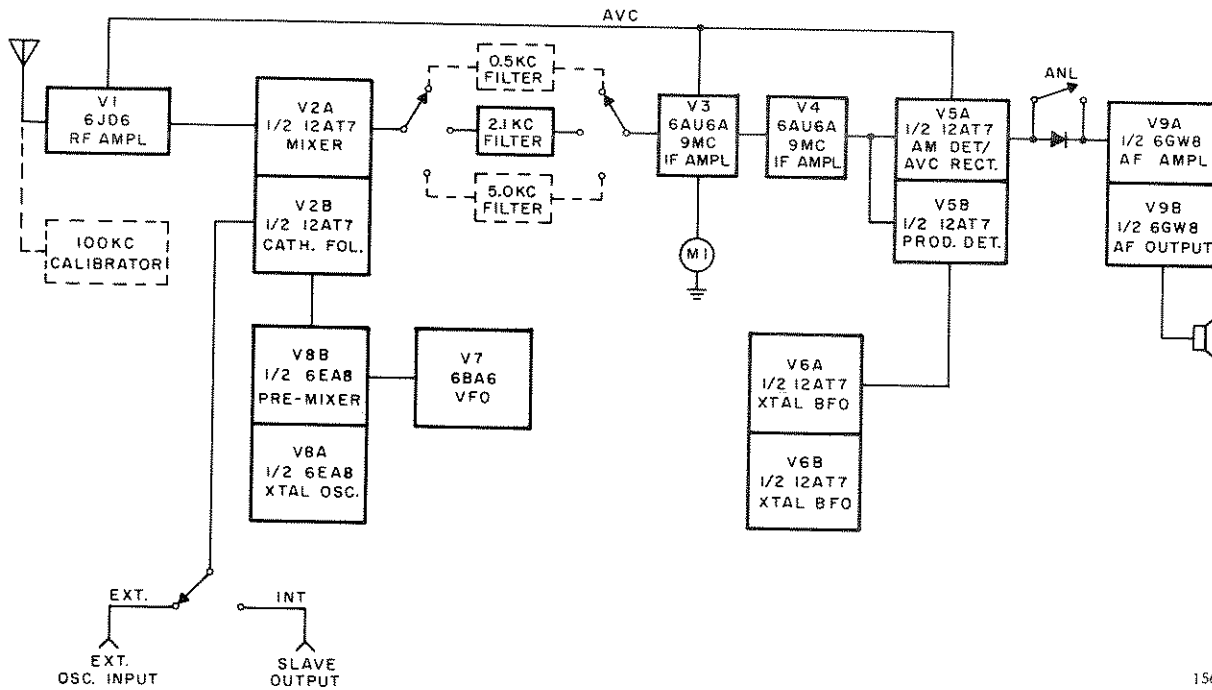


Figure 5. Block Diagram of Receiver.

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SECTION V THEORY OF OPERATION

The SX-146 is basically a single conversion superheterodyne receiver with a 9.0 MC filter type IF system. The VFO supplies injection directly on 80 and 20 meters and is pre-mixed with the output of an overtone crystal oscillator on 40, 15 and 10 meters.

The signal applied to the antenna terminals is stepped up in voltage by antenna transformer T1. This signal is applied to the grid of the RF stage (V1) where it is amplified. The output of this stage is transformer coupled (T2) to the grid of the triode mixer (V2A) where it is mixed with the cathode applied injection. Both T1 and T2, in combination with their associated series and shunt inductances, are tuned to resonance by the two section PRESELECTOR capacitor.

The 9.0 MC output of the mixer is fed through terminating coil L9 to one of three switch selected filters. The output of the filter is fed through terminating coil L10 to IF amplifier V3. The plate circuit of V3 is tuned to 9.0 MC by L11. From L11 the 9.0 MC IF signal is fed to IF amplifier V4 for further amplification.

The output of V4 is fed through a double tuned 9.0 MC transformer T3 to the AM detector/AVC rectifier (V5A) and through a capacity divider to the product detector (V5B).

The output of the product detector, or the AM detector, is selected by the OPERATION

switch and fed through the AUDIO GAIN control to V9A and V9B for audio amplification.

The output of V9B is transformer coupled through the PHONES jack to the 3.2 ohm speaker terminals.

Carrier re-insertion for CW or SSB is supplied by crystal oscillators V6A and V6B. These oscillators supply cathode injection to the product detector.

Diode CR1 is in series with the output of the AM detector to provide clipping of impulse type noise. This noise limiter functions only on AM and will be most effective when used in conjunction with the 5.0 KC filter.

Diode CR2 is used as a gate diode in the AVC circuit to prevent the positive bias applied to CR1 from appearing on the AVC line.

Injection for mixer V2A is supplied as follows: On 80 and 20 meters the output of the 5.0 to 5.5 MC VFO (V7) is coupled through the BAND SELECTOR switch to cathode follower V2B.

The output of V2B is connected to the cathode of mixer V2A and to the SLAVE OUTPUT or EXTERNAL OSC. INPUT receptacle, depending on the setting of the INTERNAL/EXTERNAL rear mounted slide switch.

For 40 meter operation, the output of the VFO is subtracted from the 21.5 MC output of crystal oscillator V8A in pre-mixer V8B. The output of pre-mixer V8B is fed through a 16.0 to 16.5 MC bandpass transformer (T4) to the cathode follower.

For 15 meter operation, the output of the VFO is added to the 25.0 MC output of crystal oscillator V8A in pre-mixer V8B. The output of pre-mixer V8B is fed through a 30.0 to 30.5 MC bandpass transformer (T5) to the cathode follower.

For 10 meter operation, the output of the VFO is added to the 32.0, 32.5, 33.0, or 33.5 output of crystal oscillator V8A in pre-mixer V8B. The output of pre-mixer V8B is fed through a 37.0 to 39.0 MC bandpass transformer (T6) to the cathode follower.

AVC voltage is applied to RF amplifier (V1) and IF amplifier (V3) to provide automatic gain control. An AVC ON/OFF switch is provided to disable the AVC circuit if desired.

A meter is connected in the cathode circuit of AVC controlled V3 for signal strength indication.

A unique feature of the meter circuit is that it is connected at a point which has extremely fast attack, fast release time constants that allow the meter to closely follow signal peaks. The long time constant AGC circuitry is applied to the RF stage and has little effect on meter operation.

Receiver muting is accomplished by inserting a 470K resistor in the cathode returns of V1, V2A and V4 to provide cut-off bias for these stages. The 470K resistor is shorted in normal operation.

RF gain, or receiver sensitivity, may be changed by varying the setting of the RF GAIN control. As this control is rotated counterclockwise from MAXIMUM, additional resistance is added in the cathode circuits of V1 and V4. This causes more bias to be developed, thus reducing the amplification of these stages.

An 82 ohm resistor and plug assembly is supplied and should always be plugged into the SLAVE OUTPUT jack except when the SX-146 is connected to the HT-46 transmitter, for slave (transceive) operation. This termination resistor is used to keep the mixer injection at the desired level when the receiver is used as an independent unit.

A slide switch located on the rear chassis apron, and marked INTERNAL/EXTERNAL OSC, is used to remove plate and screen voltage from the crystal oscillator and VFO. When placed in the EXTERNAL position, all internal injection is removed from mixer V2A allowing injection to be supplied from an external source through the EXTERNAL OSC jack to this mixer.

Band gain equalization is provided by automatically adding resistance in the cathode circuit of V1 on 40 and 20 meters.

SECTION VI OPERATION

6-1. SINGLE SIDEBAND RECEPTION.

Set panel controls as follows:

RF GAIN Usually full clockwise rotation (may be reduced as noise and interference dictate).

NOTE

"S" meter calibration will be correct only with RF GAIN fully advanced.

AF GAIN Advance approximately 1/3 rotation from minimum.

BAND SELECTOR To desired band segment.

OPERATION To desired sideband: Usually LSB on 80 and 40 meters, USB on 20, 15 and 10 meters.

SELECTIVITY 2.1 KC

TUNING To desired frequency.

PRESELECTOR Peak for maximum.

AVC ON

CAL. OFF

Slowly adjust the TUNING control until voice modulation sounds natural. Peak the PRESELECTOR for maximum "S" meter indication. Adjust the AF GAIN control for the desired output level.

It should be remembered that an SSB signal will convey intelligence only when the correct sideband position has been selected. If the signal does not tune in properly, place the OPERATION switch in the other sideband position and retune.

Tuning and dial calibration will change 2.8 KC when switching from one sideband to the other.

6-2. CW RECEPTION.

Set controls as described in paragraph 6-1. The only exception is that the OPERATION switch should always be in the CW position regardless of the band segment selected.

Carefully tune in the desired CW signal so that the audio output frequency is approximately 800 cycles. If the 0.5 KC filter is available and single signal reception is desired, set the SELECTIVITY switch to the 0.5 KC position.

Due to the narrow bandwidth of the 0.5 KC filter, it will be found advantageous to locate and tune in the desired signal in the 2.1 KC position and then switch to the 0.5 KC position.

6-3. AM RECEPTION.

Set controls as described in paragraph 6-1. The only exception is that the OPERATION switch should be in the AM position and the SELECTIVITY switch in the 5.0 KC position. Set the ANL switch to the ON position if impulse noise is present.

The 2.1 KC filter may be used under extremely adverse reception conditions; however, due to its narrow bandwidth, audio fidelity will be seriously impaired.

6-4. EXALTED CARRIER AM RECEPTION.

In short wave reception, it frequently happens that transmission conditions are different for waves of slightly different frequencies. As a result, in the case of voice modulated signals (AM particularly), which involve sideband frequencies differing slightly from the carrier frequency, the carrier and sideband components may not be received in the same relative amplitudes and phases that were present at the transmitter. This effect, known as selective fading, causes severe distortion of the signal.

This type of distortion can be reduced considerably by utilizing the sideband feature of the Model SX-146 receiver operating in an exalted carrier mode (i.e., the transmitted carrier is positioned out of the IF passband along with one sideband, producing a suppressed carrier single sideband signal). The carrier is subsequently reinserted by the receiver's BFO and the signal

is detected in the same manner as a single sideband signal.

6-5. USE AND ADJUSTMENT OF "S" METER.

The "S" meter provides a visual means of determining whether or not the receiver is properly tuned, as well as providing an indication of signal strength. The meter is calibrated in "S" units to S9 (50 microvolts) and in decibels to 50 DB above S9. The meter calibration will be correct only when the RF GAIN control is at maximum (full clockwise rotation).

For accurate readings, the meter zero should be checked periodically. To adjust the electrical zero on the meter, turn the RF GAIN control to minimum (fully counterclockwise) and set the AVC switch to the ON position. Rotate the meter zero control (located on rear chassis apron) as necessary so that the meter pointer is aligned with the last calibration mark on the left side of the meter scale.

6-6. GENERAL COVERAGE OPERATION.

The Model SX-146 may be used for reception of most frequencies between 3.5 and 30.0 MC by supplying injection, at the proper frequency and amplitude, from an external oscillator. This may be either a tuneable oscillator, or a crystal controlled oscillator, if fixed frequency operation is desired. This is accomplished by plugging the output of an external oscillator, capable of delivering approximately 0.5 volt RMS into an 82 ohm load, into the external oscillator jack.

NOTE

The rear mounted slide switch must be placed in the EXTERNAL position when an external oscillator is used.

To determine the injection frequency required for a particular signal frequency, add 9.0 MC to the signal frequency for all signal frequencies below 19 MC. For signal frequencies above 19 MC subtract 9.0 MC from the signal frequency.

The following chart indicates BAND SELECTOR and PRESELECTOR settings as well as required injection frequencies.

NOTE

Reception in the 8 to 10 MC range will be somewhat degraded due to the 9 MC IF rejection circuitry. Also, with the PRESELECTOR tuned near 9 MC, strong signals at 9 MC may be bothersome in certain areas.

Signal Frequency (MC)	Band Selector	Preselector	Injection (MC)
3.4	80M	0	12.4
4.0		4	13.0
4.5		6-1/2	13.5
5.0	40M	1	14
6.0		3-1/2	15
7.0		5	16
8.0		6	17
9.0		6-1/4	18
10.0		6-1/2	19
11.0		7	20
12.0		8	21
13.0	9	22	
14.0	20M	6	23
15.0		6-3/4	24
16.0		7-1/4	25
17.0		7-3/4	26
18.0		8-1/4	27
19.0	15M	6-1/4	10
20.0		7	11
21.0		7-3/4	12
22.0		8-1/2	13
23.0		9	14
24.0		9-1/2	15
25.0	10M	7-1/2	16
26.0		8	17
27.0		8-1/2	18
28.0		9	19
29.0		9-1/2	20
30.0		9-3/4	21

SECTION VII ALIGNMENT

7-1. GENERAL.

This receiver will not require alignment unless it is found necessary to replace a component directly affecting one of the tuned circuits.

Do not attempt to make any adjustments until all other causes of faulty operation have been eliminated.

7-2. TEST EQUIPMENT REQUIRED.

1. Two signal generators with 3.5 to 30.0 MC coverage, a calibrated output level meter, and 50 ohm termination.

2. Vacuum tube voltmeter with 0-1 volt range, high impedance input, and frequency response to 40 MC.

3. Frequency counter or highly accurate frequency meter.

4. Audio output meter with 3.2 ohm resistive load.

5. Non-metallic alignment tool such as General Cement's # 8606, small screwdriver, and special slotted wrench for adjusting the VFO trimmer.

6. Tracking wand (iron and brass).

7-3. INITIAL CONTROL SETTINGS.

BAND SELECTOR . . . As indicated in chart
 AF AND RF GAIN . . . Maximum
 SELECTIVITY 2.1 KC
 OPERATION CW position
 TUNING As indicated in chart
 PRESELECTOR . . . As indicated in chart
 AVC ON
 ANL OFF
 CAL OFF

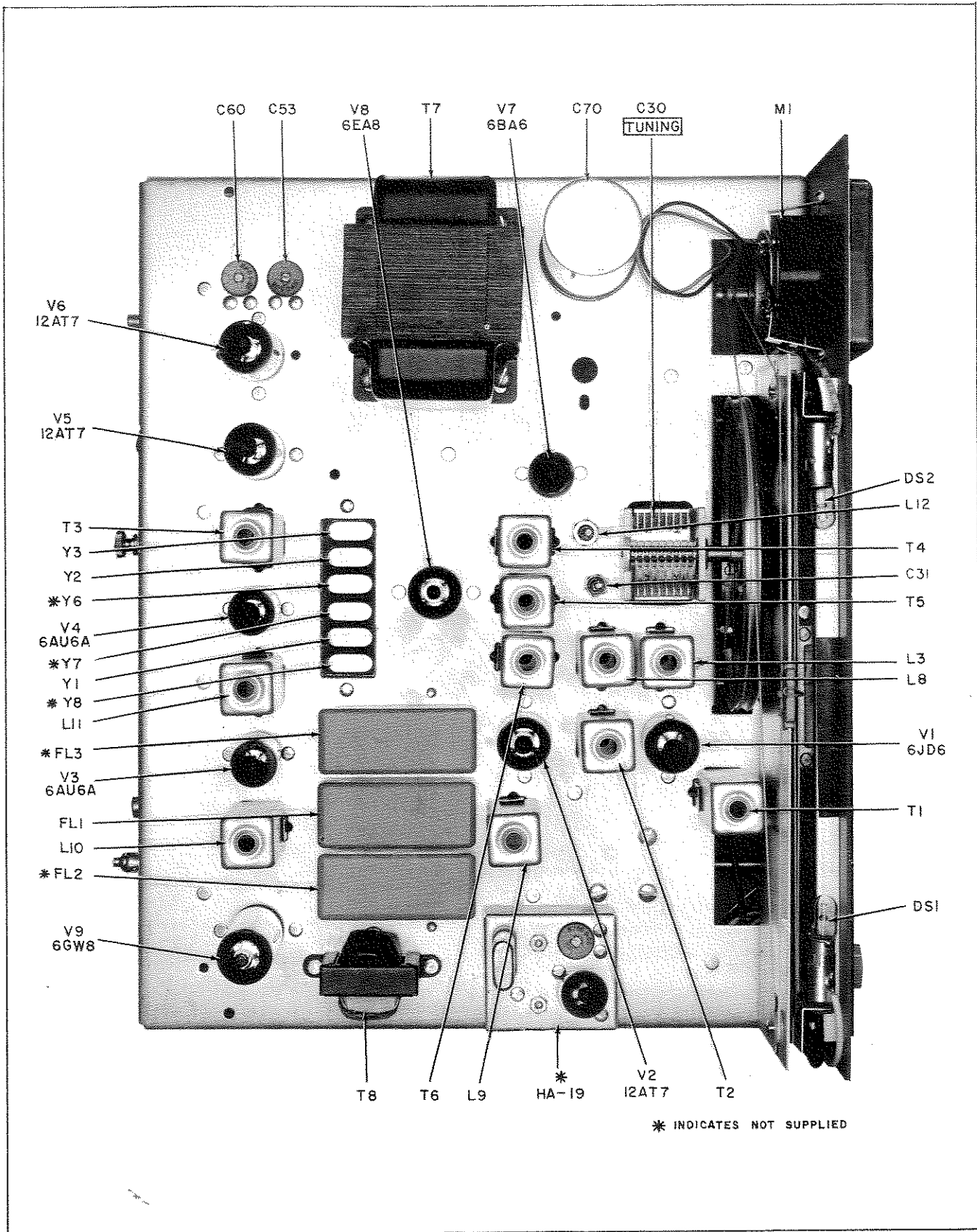


Figure 6. Top View of Receiver.

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7-4. IF ALIGNMENT PROCEDURE.

Step	Signal Gen. Conn.	Gen. Freq.	Band Selector	Output Connection	Adjustment
1	Highside to Pin 1 of V4	9.0 MC	80M	Output meter at 3.2 speaker terminals	Adjust top and bottom cores of T3 for max. audio.
2	Highside to Pin 1 of V3	9.0 MC	80M	Output meter at 3.2 speaker terminals	Adjust one core in L11.
3	Highside to Pin 2 of V2	9.0 MC	80M	Output meter at 3.2 speaker terminals	Adjust one core in L10 and one core in L9.
4		Carefully adjust gen. for approx. 1000 cycle audio beat note	80M	Output meter at 3.2 speaker terminals	Repeat all above core adjustments. Use lowest possible gen. output level (peak cores for max. output).

Carefully tune signal generator through the IF passband. Should variations in excess of 2 DB appear at the crest of the signal, carefully re-adjust L9 and L10 for smooth response.

7-5. RF ALIGNMENT PROCEDURE.

To properly align the PRESELECTOR circuitry, a second signal generator will be required to supply mixer injection at the frequencies required to establish high and low frequency end limits for the basic 40 meter tuning range. Proceed as follows:

1. Place rear mounted slide switch in EXTERNAL position.
2. Connect generator to EXTERNAL OSC input jack (referred to as the injection generator).
3. Connect the other generator to the ANTENNA jack (referred to as the signal generator).
4. Place BAND SELECTOR on 7.0 MC.
5. Rotate PRESELECTOR knob until the center of the pointer is exactly at the low end of the segment block marked 80M.

NOTE

The end limits of the travel of this pointer must agree with the end limits of the 180° calibration arc at the PRESELECTOR. To adjust, exert side pressure on pointer as necessary to slip pointer into position.

6. Set injection generator to 4.3 MC and adjust generator output for approximately 0.5 volt.

7. Adjust signal generator to 4.7 MC where a signal should be heard (adjust generator output as necessary).

8. Adjust one core each in T1 and T2 for maximum audio output.

9. Rotate PRESELECTOR knob until the center of the pointer is exactly at the high end of the segment block marked 10M.

10. Set injection generator to 5.1 MC (0.5 volt output).

11. Set signal generator to 14.1 MC where a signal should be heard (adjust generator output as necessary).

12. Adjust both trimmers, located on the side of the two section preselector capacitor, for maximum audio output.

13. Repeat core and trimmer adjustments described above until no further increase in output is obtained.

14. Rotate BAND SELECTOR to 28.0 MC.

15. Rotate PRESELECTOR knob until the center of the pointer is exactly at the low end of the segment block marked 10M.

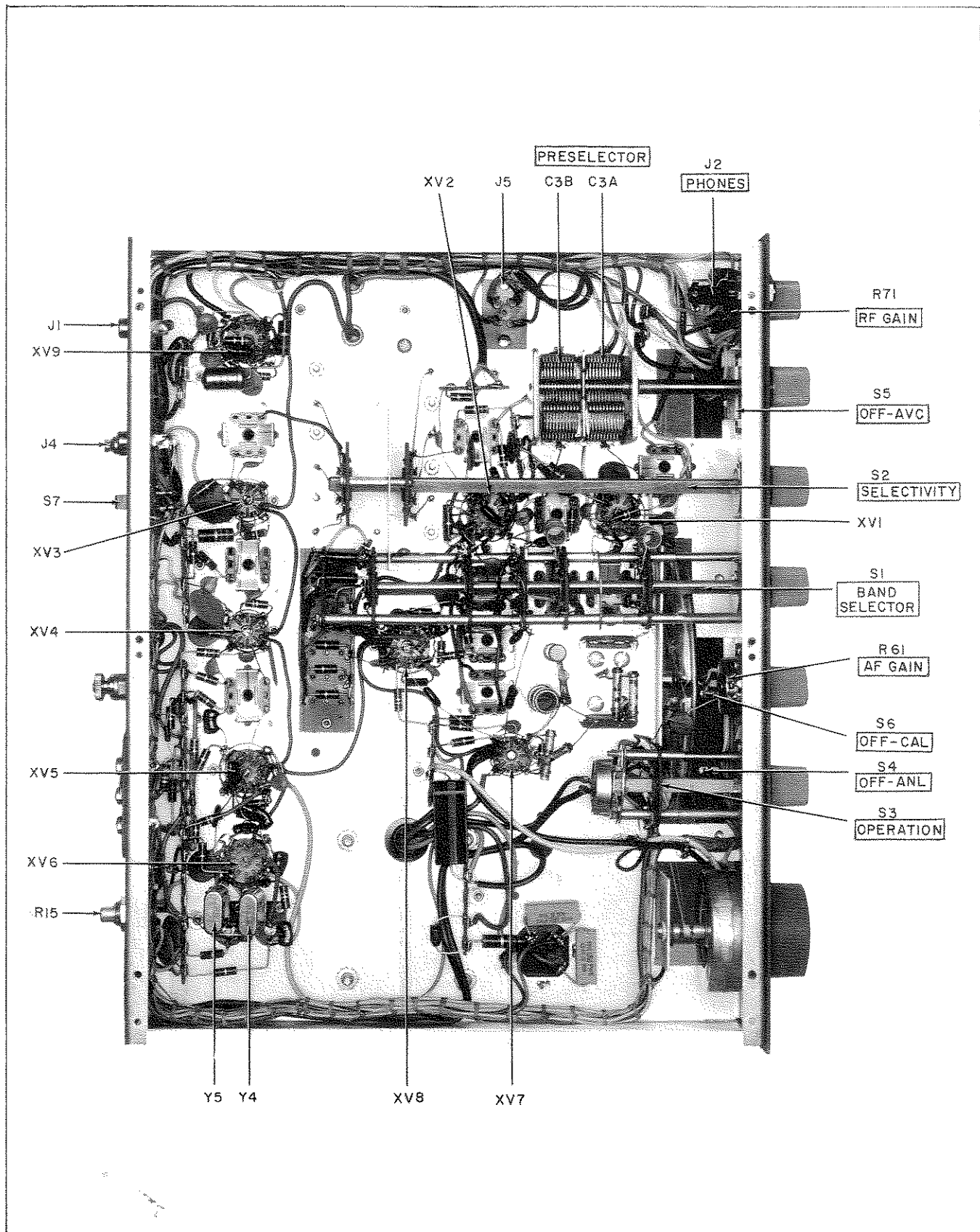


Figure 7. Bottom View of Receiver.

156-006107

16. Set injection generator to 19.0 MC (0.5 volt output).

17. Set signal generator to 28.0 MC where a signal should be heard (adjust generator output as necessary).

18. Adjust one core each in L3 and L4 for maximum audio output.

19. Disconnect injection generator and place slide switch in the INTERNAL position.

20. Place BAND SELECTOR at 14.0 MC.

21. Set receiver dial at 14.0 MC.

22. Set signal generator at 14.0 MC where a signal should be heard (reduce generator output to approximately 1 microvolt).

23. Peak PRESELECTOR for maximum output.

24. Insertion of the tracking wand, iron or brass, into either L1 or L6 should cause a decrease in output.

NOTE

L1-L2 and L6-L7 are self supporting coils mounted directly on the band switch.

25. If there is an increase in output when iron is inserted into L1, then L6 should be moved to decrease the coupling between L6 and L7 (located on the same switch wafer).

If the output increases when iron is inserted into L6, then the coupling should be decreased between L1 and L2 (located on the same switch wafer).

The PRESELECTOR should be peaked for maximum after each adjustment and before any further check is made.

7-6. INJECTION BANDPASS ALIGNMENT PROCEDURE.

No adjustment should be attempted unless T4, T5 or T6 have been replaced or it is found that the injection voltage varies by more than 30% from one end of an amateur band to the other. An adjustment should then be made only for that band. Band to band voltage will vary.

No transformer is used on 80 and 20 meters. T4 is used on 40 meters, T5 on 15 meters, T6 on 10 meters. Proceed as follows:

NOTE

Extreme care should be used in making these adjustments in order to avoid upsetting the bandpass completely. Move the cores in very small increments, noting each time the direction and degree of rotation. Usually, only one of the two cores will cause an increase in output voltage.

1. Injection voltage may be sampled at the SLAVE OUTPUT jack by connecting a high frequency RF type vacuum tube voltmeter into this jack. The 82 ohm termination must be maintained for this check.

2. For 40 meters, set the dial pointer at 7.05 MC (BAND SELECTOR on 7.0 MC) and record meter reading.

3. Move dial pointer to 7.45 MC and also record meter reading.

4. If the difference in readings is more than 30%, set the dial pointer at the check point giving the lowest output.

5. Adjust the core that will increase the output to the point where the increase is approximately one half of the difference between the two original readings.

6. Repeat checks as previously described and adjust as necessary to equalize the readings at the two check points.

For 15 meters, the procedure is the same except that the BAND SELECTOR should be set at 21.0 MC and the check points should be 21.05 MC and 21.45 MC.

For 10 meters, it will be necessary to install a 32.0 MC crystal for 28.0 MC operation and a 33.5 MC crystal for 30.0 MC operation. The BAND SELECTOR should be set at 28.0 MC and the check point should be 28.05 MC. For the other check point, the BAND SELECTOR should be set at 29.5 MC and the check point should be 29.95 MC.

If a new transformer is installed, a different procedure may be required.

A. Temporarily disconnect R40 from choke L16 (cathode of V8A).

B. Remove VFO tube (V7).

C. Connect signal generator lead to pin 2 of V8B (shield to chassis) and adjust for approximately 0.1 volt output.

D. Connect RF type vacuum tube voltmeter to SLAVE OUTPUT jack. (Do not remove 82 ohm termination.)

E. Set BAND SELECTOR to desired band.

F. Adjust both cores in transformer as necessary to give uniform voltage output across the specified frequency range. (See chart below.)

BAND	TRANSFORMER	GENERATOR FREQ. RANGE
7.0	T4	16.0 to 16.5 MC
21.0	T5	30.0 to 30.5 MC
28.0	T6	37.0 to 39.0 MC

G. Connect R40 and replace termination plug.

7-7. BFO CRYSTAL FREQUENCIES ALIGNMENT.

The exact frequencies of the two BFO crystals are very critical, particularly when the SX-146 is used with the HT-46 for slave operation. Any frequency error will show up as a difference between receive and transmit frequency.

The exact frequencies are set by the two ceramic trimmers (C53 and C60) located directly behind the power transformer. When the OPERATION switch is placed in the second position, CW-USB-LSB, the 8998.700 KC crystal will be activated. The trimmer nearest the power transformer is used for establishing this frequency (C53).

When the OPERATION switch is placed in the third position, LSB-USB, the 9001.500 KC crystal

will be activated. The trimmer nearest the rear of the chassis is used for establishing this frequency (C60).

These frequencies should be determined with a frequency counter or highly accurate frequency meter coupled through a 4.7 PF or smaller capacitor connected to pin 8 of V5B.

7-8. VFO ALIGNMENT.

The frequency range of the VFO, over the calibrated portion of the dial, is 5.0 to 5.5 MC. This may be translated directly to read 14.0 to 14.5 MC on 20 meters.

If a calibration error exists on all bands after the dial is indexed to the pointer at a 100 KC check point, proceed as follows:

When the error is small, a 100 KC calibrator may be used as a signal source. If the tuning range is unknown, a signal generator should be used for alignment.

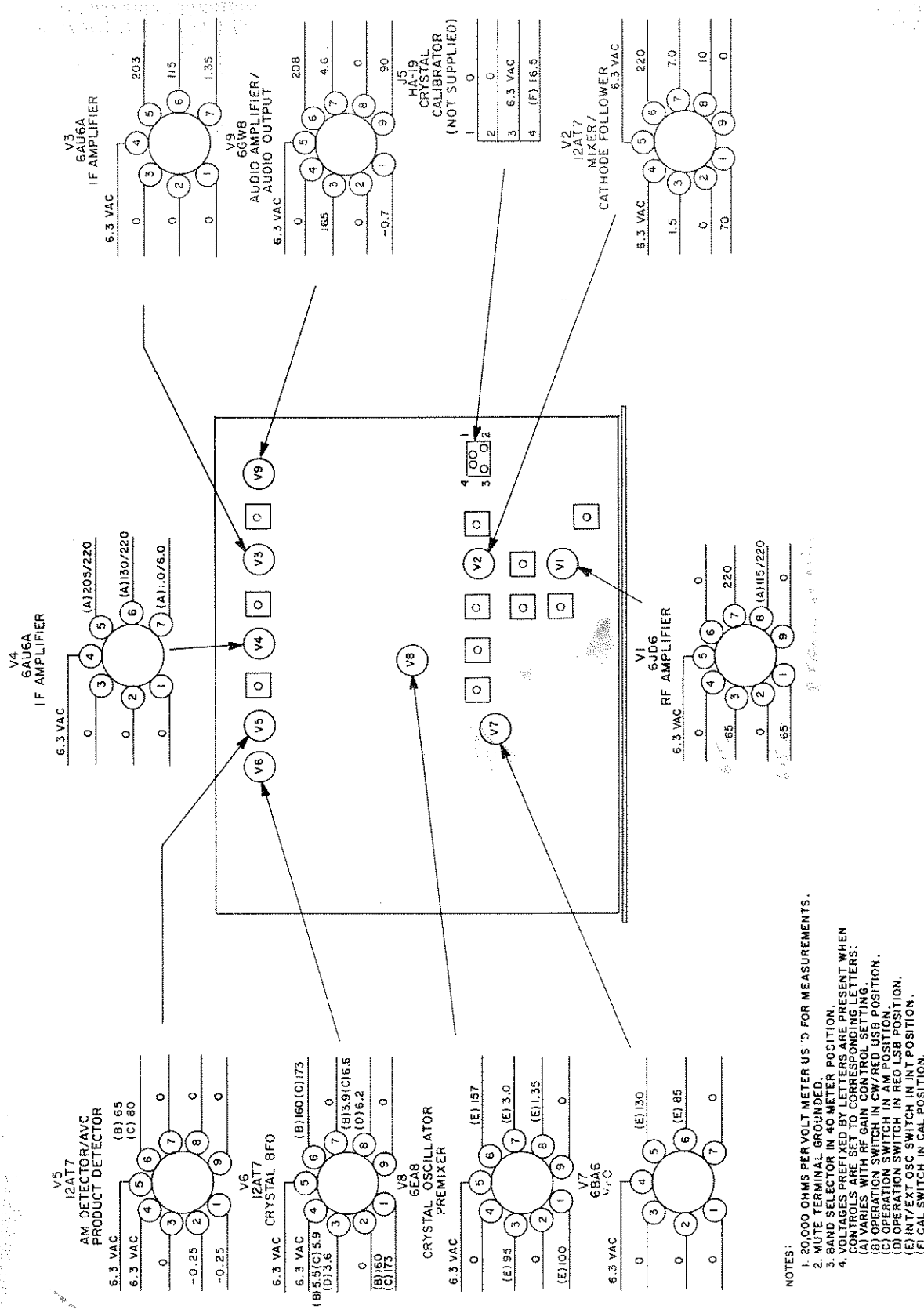
1. Connect signal generator to ANT input and feed in a 14.0 MC signal.
2. Set BAND SELECTOR at 14.0 (adjust PRESELECTOR as necessary).
3. Set CAL RESET lever at mid travel position and adjust receiver TUNING to exactly 14.0 MC.
4. Adjust core in L12 until a signal is heard.
5. Move generator and receiver tuning to exactly 14.5 MC and adjust trimmer (C31) until a signal is heard.
6. Repeat adjustments at 14.0 and 14.5 MC until exact calibration is established.

SECTION VIII SERVICE DATA

8-1. 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 at right. For the one nearest you, consult your dealer or your local telephone directory.





- NOTES:
1. 20,000 OHMS PER VOLT METER USED FOR MEASUREMENTS.
 2. MUTE TERMINAL GROUND.
 3. BAND SELECTOR IN 40 METER POSITION.
 4. VOLTAGES PREFIXED BY LETTERS ARE PRESENT WHEN CONTROLS ARE SET TO CORRESPONDING LETTERS:
 - (A) VARIES WITH RF GAIN CONTROL SETTING.
 - (B) OPERATION SWITCH IN CW/RED USB POSITION.
 - (C) OPERATION SWITCH IN AM POSITION.
 - (D) OPERATION SWITCH IN RED LSB POSITION.
 - (E) INT/EXT OSC SWITCH IN INT POSITION.
 - (F) CAL SWITCH IN CAL POSITION.

Figure 8. Voltage Chart.

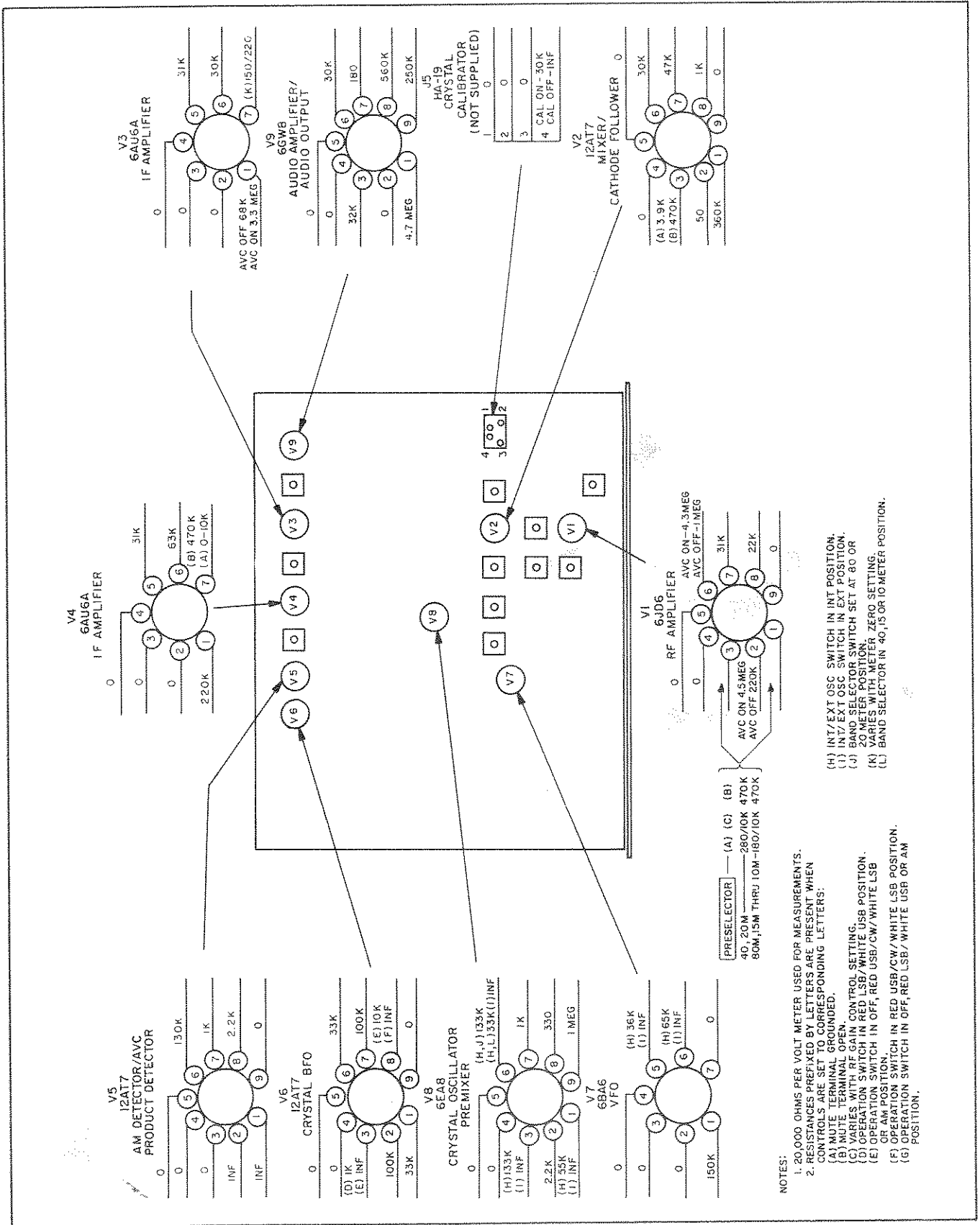


Figure 9. Resistance Chart.

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.

8-2. CABINET REMOVAL.

Access to tubes, pilot lights, 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 cover straight up.

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

8-3. DIAL CORD RESTRINGING.

Remove cabinet top cover (refer to paragraph 8-2). Follow the arrow and number sequence in figure 10. Maintain a spring expansion of 1/4 inch to 1/2 inch on the dial cord spring. After completing restringing 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.

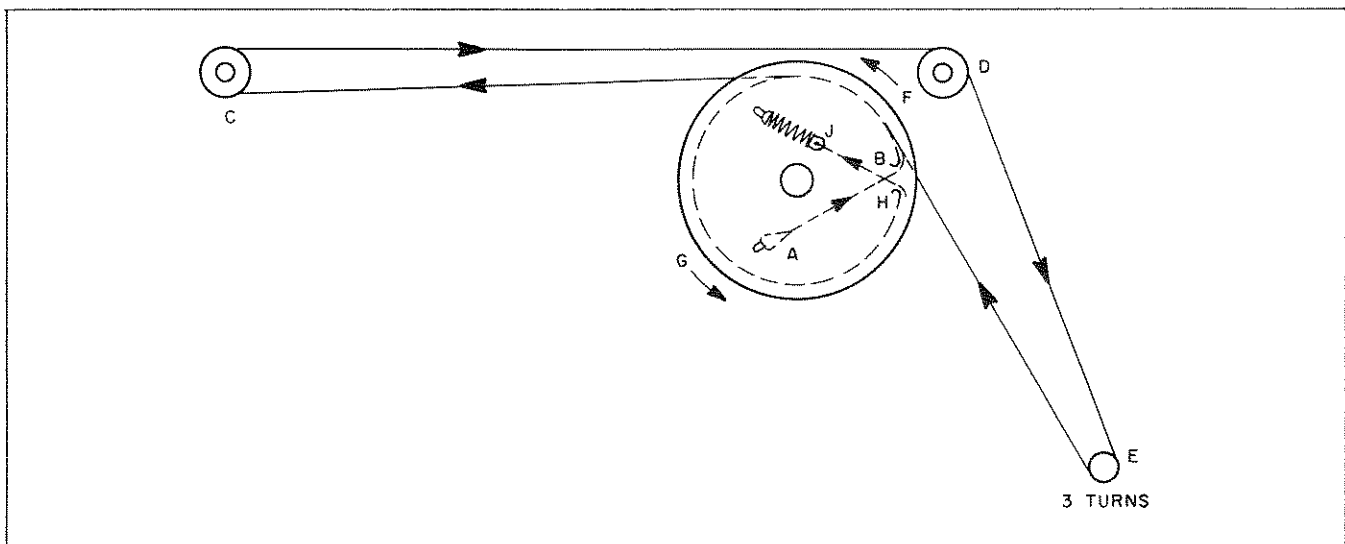


Figure 10. Dial Cord Restringing Diagram.

156-005903

SECTION IX 100KC CRYSTAL CALIBRATOR MODEL HA-19

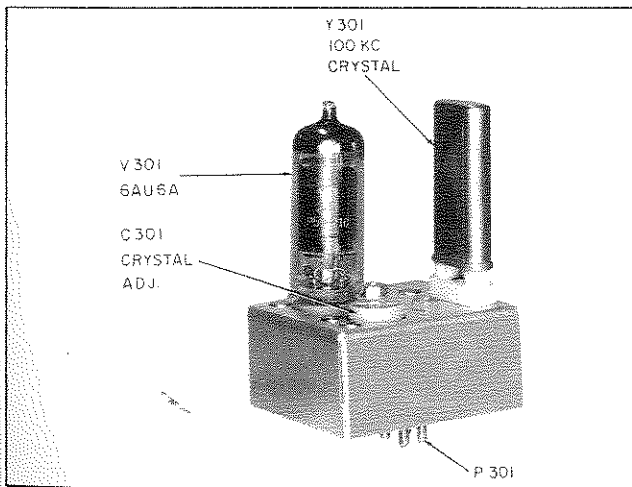


Figure 11. Model HA-19 Crystal Calibrator.

156-005982

9-1. GENERAL.

The Model HA-19 Crystal Calibrator is an accessory which provides marker signals at every 100 KC on the dial of the SX-146 enabling the operator to check calibration accuracy. The HA-19 is placed into operation by plugging it into the appropriate socket (J5) on the receiver chassis (see figure 11) and placing the front panel OFF-CAL switch in the CAL position.

IMPORTANT

The OFF-CAL switch should be returned to the OFF position after calibration to prevent spurious signal generation.

9-2. ADJUSTMENT.

A trimmer capacitor, C301, permits adjustment of the calibrating crystal to exactly 100KC.

This capacitor has been set at the factory and normally should not require readjustment unless extreme calibration accuracy is required.

HA-19 PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number	Schematic Symbol	Description	Hallicrafters Part Number
	100 KC Crystal Calibrator Assembly (Model HA-19)	001-004979	CR301	Diode, Type 1N295	019-301980
C301	Capacitor, Variable 8 to 50 PF	044-200404	P301	Plug, 4-pin (connects to J5 on SX-146)	010-003253
C302,304	Capacitor, 0.01 μ F, 20%, 500V, Ceramic Disc	047-100354	R301,304	Resistor, 220K Ohms, 10%, 1/2 watt, Carbon	451-252224
C303	Capacitor, 82 PF, 2%, 500V, Plastic Mica	493-110820-333	R302	Resistor, 4.7K Ohms, 10%, 1/2 watt, Carbon	451-252472
C305	Capacitor, 2.2 PF, 1/4%, 500V, Plastic Mica	493-140220-631	R303	Resistor, 100K Ohms, 10%, 1/2 watt, Carbon	451-252104
			V301	Electron Tube, Type 6AU6A	090-001495
			Y301	Crystal, Quartz, 100 KC	019-002712
				Socket, Crystal (Y301)	006-100320
				Socket, Tube (V301)	006-001094

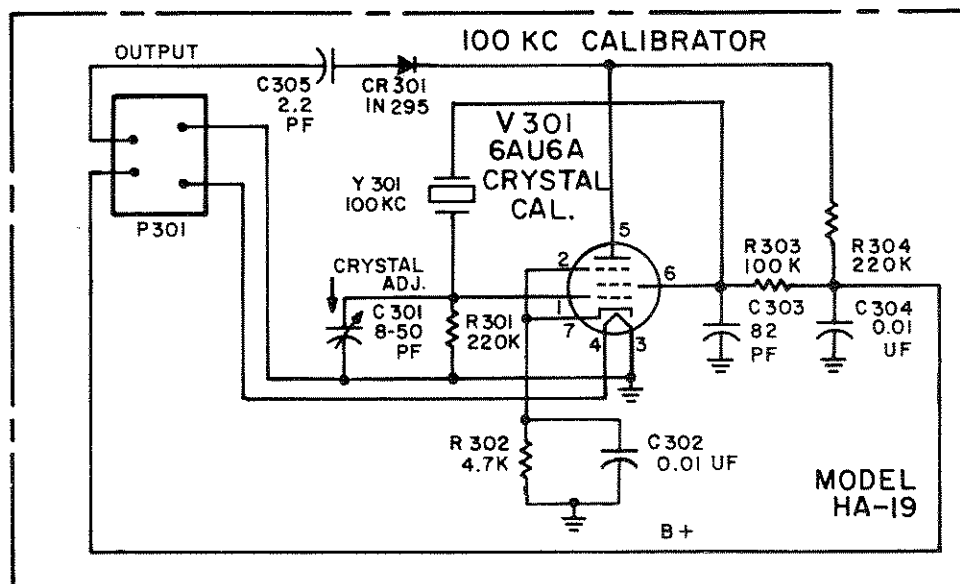


Figure 12. Schematic Diagram, Model HA-19 Crystal Calibrator.

155-000425

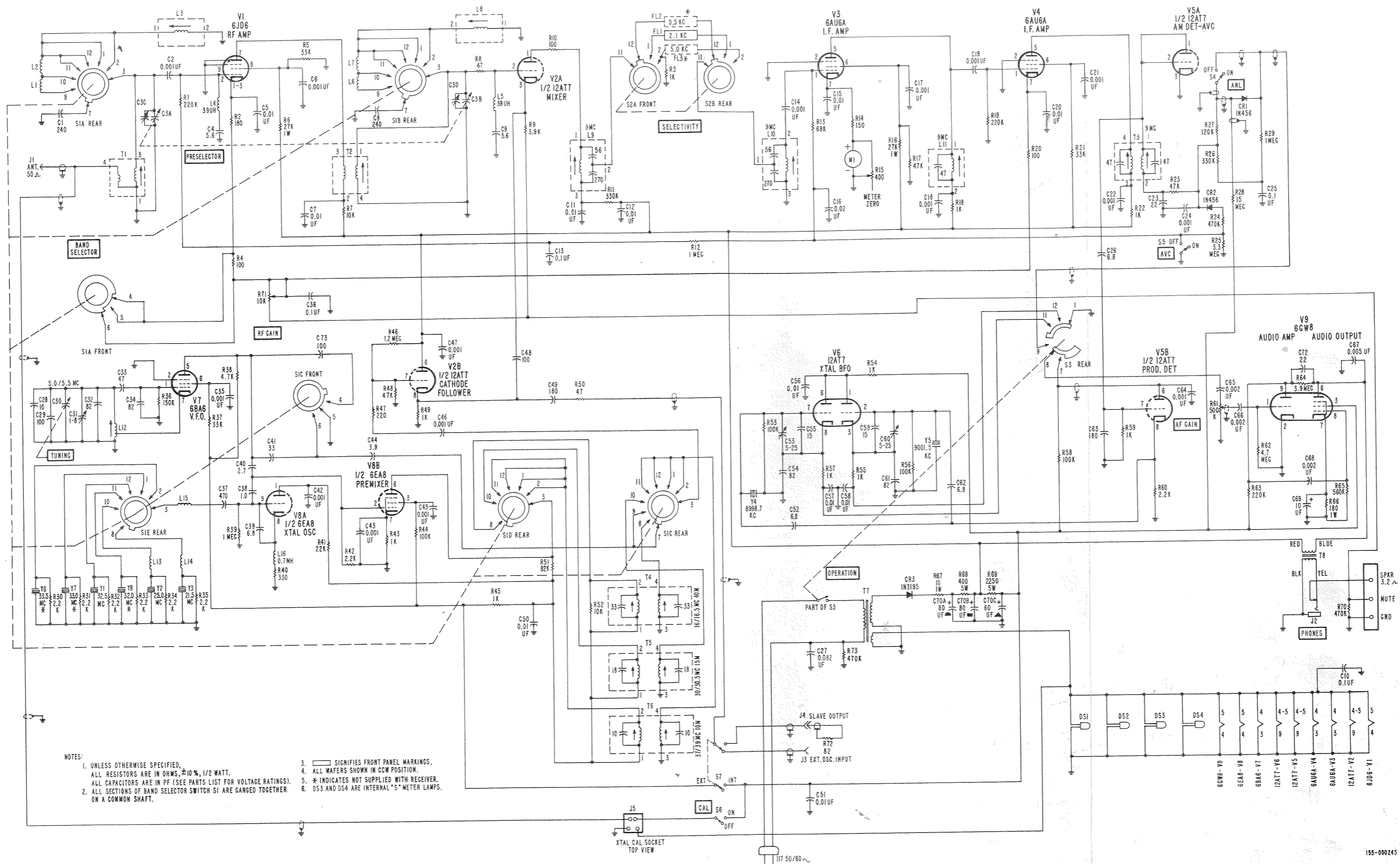


Figure 13. Schematic Diagram, Model SX-146 Receiver.

SERVICE REPAIR PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number
CAPACITORS		
C1,8	240PF, 2%, 300V, Plastic Mica	493-110241-324
C2,6,14,17,18,19,21,22,24,35,42,43,45,46,47,64	0.001 μ F, 20%, 500V, Ceramic	047-001671
C3A & B	Variable, PRESELECTOR	048-000596
C4,9	5.6 PF, 5%, 300V, Plastic Mica	493-140560-221
C5,7,11,12,15,20,50,51,56,57,58	0.01 μ F, 20%, 500V, Ceramic	047-100354
C10,13,25,36	0.1 μ F, +80%, -20%, 100V Ceramic	047-001428
C16	0.02 μ F, 20%, 500V, Ceramic	047-100471
C23,72	22PF, 5%, 300V, Plastic Mica	493-110220-221
C26,39,52,62	6.8PF, 5%, 300V, Plastic Mica	493-140680-221
C27	0.082 μ F, 10%, 600V, Paper Tabular	046-001708
C28	10PF, 2%, N750, Ceramic Tubular	491-004100-094
C29	100 PF, 10%, NPO, Ceramic Tubular	491-026101-022
C30	Variable, TUNING	048-000595
C31	Variable, Trimmer, 1PF to 8PF	044-000593
C32,34	82 PF, 10%, N80, Ceramic Tubular	491-026820-042
C33	47PF, 10%, NPO, Ceramic Tubular	491-006470-022
C37	470PF, 2%, 300V, Plastic Mica	493-110471-224
C38	1PF, 10%, 500V, Composition	047-200403-002
C40	2.7PF, 5%, 300V, Plastic Mica	493-140270-221
C41	33PF, 5%, 300V, Plastic Mica	493-110330-223
C44	3.9PF, 5%, 300V, Plastic Mica	493-140390-221
C48,73	100PF, 5%, 300V, Plastic Mica	493-110101-224
C49,63	180PF, 5%, 300V, Plastic Mica	493-110181-224
C53,60	Variable, Trimmer, 5PF to 25PF	044-200473
C54,61	82PF, 5%, 300V, Plastic Mica	493-110820-223
C55,59	15PF, 5%, 300V, Plastic Mica	493-110150-221
C65,66,68	0.002 μ F, 20%, 500V, Ceramic	047-100395
C67	0.005 μ F, 20%, 500V, Ceramic	047-100442
C69	10 μ F, 25V, Electrolytic	045-000934
C70A,B & C	2 x 80 μ F, 300V; 60 μ F, 300V	045-001330
*RESISTORS		
R1,19,63	220K Ohms	451-252224
R2	180 Ohms	451-252181
R3,18,22,43,45,49,54,55,57,59	1K Ohms	451-252102
R4,10,20	100 Ohms	451-252101
R5,21,37	33K Ohms	451-252333
R6,16	27K Ohms, 1 Watt	451-352273
R7,52	10K Ohms	451-252103
R8,50	47 Ohms	451-252470
R9	3.9K Ohms	451-252392
R11,26	330K Ohms	451-252334
R12,29,39	1 Megohm	451-252105

Schematic Symbol	Description	Hallicrafters Part Number
RESISTORS (CONT)		
R13	68K Ohms	451-252683
R14	150 Ohms	451-252151
R15	Variable, 400 Ohms, 2 Watts, Wire Wound, "S" Meter Zero Adj.	025-002538
R17,23,48	47K Ohms	451-252473
R24,70,73	470K Ohms	451-252474
R25	3.3 Megohms	451-252335
R27	120K Ohms	451-252124
R28	15 Megohms	451-252156
R30,31,32,33,34,35,42,60	2.2K Ohms	451-252222
R36	150 K Ohms	451-252154
R38	4.7K Ohms	451-252472
R40	330 Ohms	451-252331
R41	22K Ohms	451-252223
R44,53,56,58	100K Ohms	451-252104
R46	1.2 Megohms	451-252125
R47	220 Ohms	451-252221
R51	82K Ohms	451-252823
R61	Variable, 500K Ohms, 30%, 1/8 Watt, AF GAIN	025-002506
R62	4.7 Megohms	451-252475
R64	3.9 Megohms	451-252395
R65	560K Ohms	451-252564
R66	180 Ohms, 1 Watt	451-352181
R67	10 Ohms, 1 Watt	451-352100
R68	400 Ohms, 5 Watts, Wire Wound	445-012401
R69	2250 Ohms, 5 Watts, Wire Wound	024-001557
R71	Variable, 10K Ohms, 20%, 1 Watt, RF GAIN	025-002505
R72	82 Ohms	451-252820
*All Resistors are carbon type, 10%, 1/2 watt, unless otherwise specified.		
COILS AND TRANSFORMERS		
T1	Transformer, Antenna	050-002143
T2	Transformer, Mixer	050-002144
T3	Transformer, IF (9 MC)	050-002150
T4	Transformer, Bandpass (40 meter)	050-002145
T5	Transformer, Bandpass (15 meter)	050-002146
T6	Transformer, Bandpass (10 meter)	050-002147
T7	Transformer, Power	050-002025
T8	Transformer, Output	055-000561
L1,6	Coil, Series (20 meter)	051-003495
L2,7	Coil, Series (15 meter)	051-003494
L3,8	Coil, Shunt (10 meter)	050-002151
L4,5	Choke, RF (39 μ H)	050-002156
L9	Coil, Filter Input (9 MC)	050-002148
L10	Coil, Filter Output (9 MC)	050-002157
L11	Coil, Interstage (9 MC)	050-002149
L12	Coil, VFO	050-002109
L13	Choke, Crystal Winding (15 meter)	050-002153
L14	Choke, Crystal Winding (40 meter)	050-002152
L15	Choke, Crystal Winding (10 meter)	050-002154
L16	Choke, RF (0.7 MH)	053-000530
ELECTRON TUBES, DIODES AND CRYSTALS		
V1	Tube, Type 6JD6	090-001627
V2,5,6	Tube, Type 12AT7	090-900034
V3,4	Tube, Type 6AU6A	090-001495
V7	Tube, Type 6BA6	090-901112
V8	Tube, Type 6EA8	090-001350
V9	Tube, Type 6GW8	090-001502
CR1,2	Diode, Type 1N456	019-002964

Schematic Symbol	Description	Hallicrafters Part Number
ELECTRON TUBES, DIODES AND CRYSTALS (CONT)		
CR3	Diode, Rectifier, Silicon, Type 1N3195	027-002770
Y1	Crystal, 32.5 MC	019-201964
Y2	Crystal, 25.0 MC	019-201961
Y3	Crystal, 21.5 MC	019-201960
Y4	Crystal, 8998.7 KC	019-003652
Y5	Crystal, 9001.5 KC	019-003653
Y6	Crystal, 33.5 MC (Not Supplied)	019-201966
Y7	Crystal, 33.0 MC (Not Supplied)	019-201965
Y8	Crystal, 32.0 MC (Not Supplied)	019-201963
MISCELLANEOUS		
Bracket, Meter Mounting Cabinet, Bottom Assembly		067-012996
Cabinet, Cover		066-004513
J1	Connector, Antenna	066-004543
J2	Connector, PHONES	036-100041
J3	Connector, Ext./Int. Oscillator	036-000390
J4	Connector, Slave Output	036-100041
J5	Connector, Xtal Cal.	010-003254
Connector, Ant and Slave Output (Male), Cord, Dial		010-100221
Core, Coil Tuning		038-100049
FL1	Filter, Crystal, 2.1KC	077-003198
FL2	Filter, Crystal, 0.5KC (Not Supplied)	049-000320
FL3	Filter, Crystal, 5.0KC (Not Supplied)	049-000321
Flywheel		049-000319
Foot, Mounting, Rear (2)		071-000210
Foot, Mounting, Front (2)		016-002446
Front Panel Assembly		016-001469
Knob, PRESELECTOR		150-008604
Knob, RF GAIN, SELECTIVITY, BAND SELECTOR, AF GAIN, OPERATION		015-001844-002
Knob, TUNING		015-001844
DS1,DS2	Lamp, Pilot, No.47	015-001751-003
Line Cord		039-100004
Lock, Line Cord		087-100078
Pointer, PRESELECTOR		076-004546-003
Pointer, Tuning		082-000671
M1	"S" Meter	082-000667
Shield, IF		082-000672
Shield, Light		069-002033
Shield, SELECTIVITY switch		069-002049
Socket, Pilot Light (Left Side)		069-002035
Socket, Pilot Light (Right Side)		086-000712
Socket, Six Crystal		086-000711
XV1,2,5,8	Socket, Tube, 9-pin	150-003283
XV3,4	Socket, Tube, 7-pin	006-000947
XV6,9	Socket, Tube, 9-pin	006-000946
XV7	Socket, Tube, 7-pin	006-001112
Spring, Dial Cord		006-001094
Spring, Dial Plate		075-000893
S1	Switch, Rotary, BAND SELECTOR	075-001011
S2	Switch, Detent, SELECTIVITY	060-002782
S3	Switch, Rotary, OPERATION	074-003074
S4,5,6	Switch, Slide (SPST), ANL, AVC, CAL	060-002783
S7	Switch, Slide (DPDT), Int./Ext. Osc	060-000440
Wafer, SELECTIVITY switch (Front)		060-000544
Wafer, SELECTIVITY switch (Rear)		062-000259
Window, Dial		062-000260
		022-000745