



hallicrafters

OPERATING AND SERVICE INSTRUCTIONS

**FOUR-BAND
COMMUNICATIONS RECEIVER
MODEL SX-122**

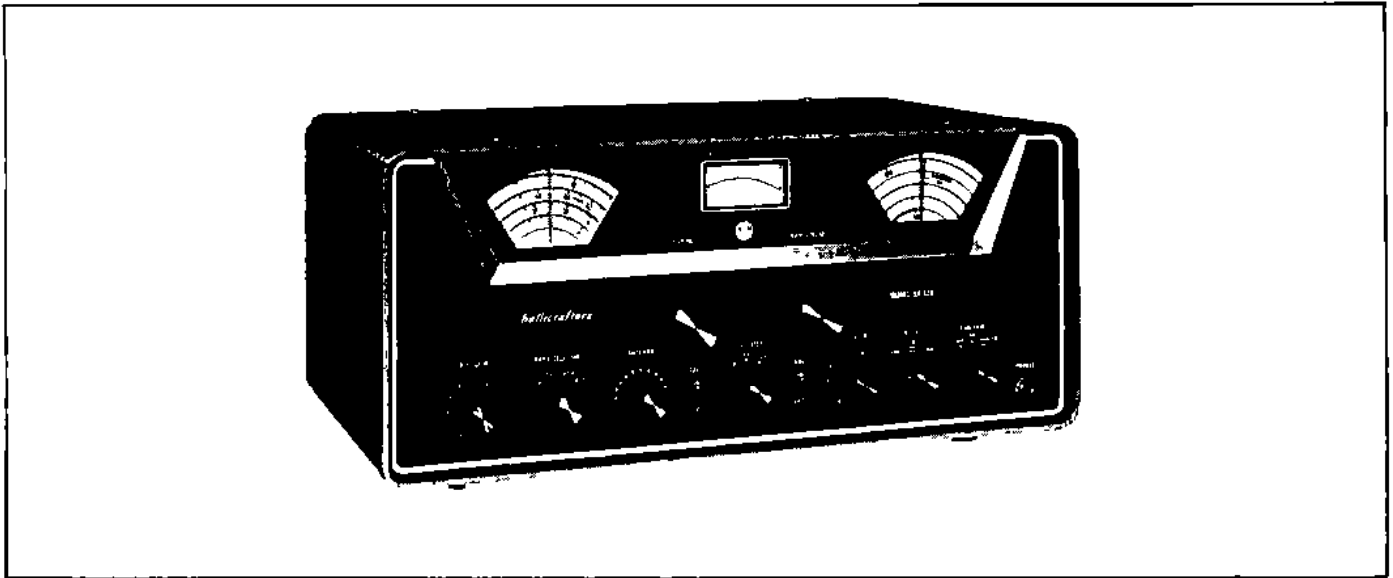


Figure 1. Hallicrafters' Model SX-122 Receiver.

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SECTION I GENERAL DESCRIPTION

The Hallicrafters' Model SX-122 Communications Receiver is a four-band dual-conversion super-heterodyne receiver tuning from 540 to 1600 kilocycles (KC) and 1.75 to 34 megacycles (MC) with calibrated electrical bandspread provided on the 80, 40, 20, 15, 10 meter and citizens bands. The frequency range covers foreign and domestic short-wave broadcasts, amateurs, aircraft, and marine plus standard AM broadcasts. The receiver provides for the reception of code (CW), voice (AM), and single-sideband (SSB) signals over its entire tuning range, the upper or lower sideband being readily selectable by means of a front-panel control. This feature greatly simplifies tuning of single-sideband signals.

The SX-122 Receiver employs dual conversion on all bands to obtain optimum image rejection. A high order of selectivity is made possible by the use of a 50-KC second-IF system with four high-Q, permeability-tuned circuits. Receiver selectivity is variable in three steps: 0.5 KC, 2.5 KC, and 5 KC at 6 DB down.

A tuned-RF stage assures maximum sensitivity and a high signal-to-noise ratio for outstanding reception of weak and distant signals. A manual RF gain control prevents overloading by strong signals. An antenna trimmer, adjustable from the front panel, permits peaking of the RF stage to compensate for loading effects of various antennas.

Outstanding frequency stability is achieved by the use of: 1) ceramic trimmers and coil forms in the first-conversion oscillator, 2) extensive temperature compensation, 3) voltage regulation of

oscillators, and 4) a crystal-controlled, second-conversion oscillator.

Tuning is accomplished by a precision tuning mechanism to insure close calibration and accurate resettability. Smooth flywheel tuning affords maximum traverse speed and operating ease.

Provisions have been incorporated to accept, as an accessory, a 100-KC Crystal Calibrator, Model HA-7. This crystal calibrator provides marker signals at every 100 KC on the dial for checking calibration accuracy.

An automatic series noise limiter circuit, controlled by a switch on the front panel, reduces interference from electrical equipment, ignition noise, and other forms of pulse-type noise.

An S meter is used to indicate the accuracy of tuning and the relative strength of received signals. The meter is calibrated in S units from 1 to 9, and in decibels above S9.

Provision has been made in the receiver for a remote receive-standby control.

Audio output connections include terminals for a 3.2-ohm speaker. A front-panel jack is also provided for using headphones and the speaker is automatically silenced when the headphone plug is inserted.

The receiver is designed to operate on 105 to 125 volt, 50/60 cycle, AC current.

SECTION II INSTALLATION

2-1. UNPACKING.

After unpacking the receiver, examine it closely for 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 damage. Carefully check all shipping labels and tags for instructions before removing or destroying them.

2-2. LOCATION.

The receiver may be placed in any location that will permit free air circulation through the ventilation holes and openings in the cabinet. Avoid excessively warm locations such as those near radiators and heating vents. The external speaker may be located in any convenient position, although it is recommended that it not be placed on top of the receiver for reasons of ventilation.

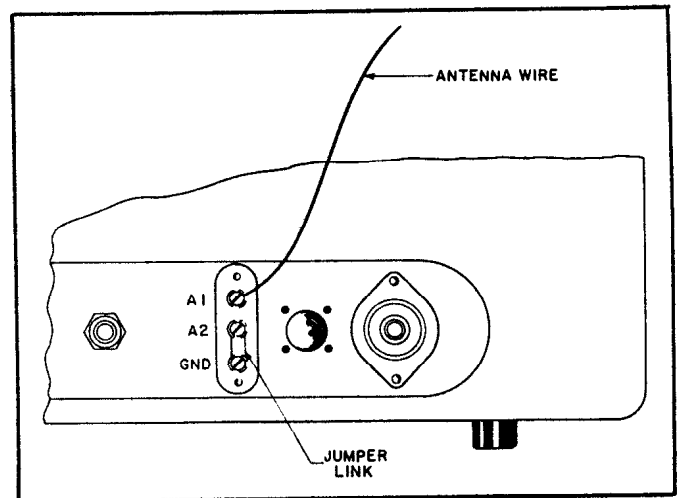
2-3. ANTENNAS.

The RF input of the receiver is designed for operation from either a single-wire antenna, a half-wave doublet, or other antenna with a transmission-line impedance from 50 to 600 ohms. Antenna connections are made to a three-terminal strip at the rear of the receiver marked A1, A2, and GND. Mounting holes are also provided, adjacent to the antenna terminals, for installation of an AN type SO-239 connector for coaxial-cable installations.

A. SINGLE-WIRE ANTENNA

The simplest antenna that will provide satisfactory results throughout the entire tuning range is a conventional single-wire antenna. In most localities, good results can be obtained with just the 15-foot length of antenna wire supplied with the receiver. (See figure 2.) Attach one end of the wire to terminal A1, connect the jumper link between terminals A2 and GND, and then extend the wire about the room in a convenient manner. If the receiver is operated in a steel-constructed building or where receiving conditions are exceptionally poor, an outside antenna, 50 to 100 feet long, may be necessary. The outside antenna should be erected as high as possible and kept free from surrounding objects.

In some locations, reception may be improved by connecting a ground wire (ordinary copper wire) from terminal GND to a cold-water pipe or outside ground rod. While the use of an outside ground rod installed in accordance with Insurance Underwriter's Laboratories requirements is adequate



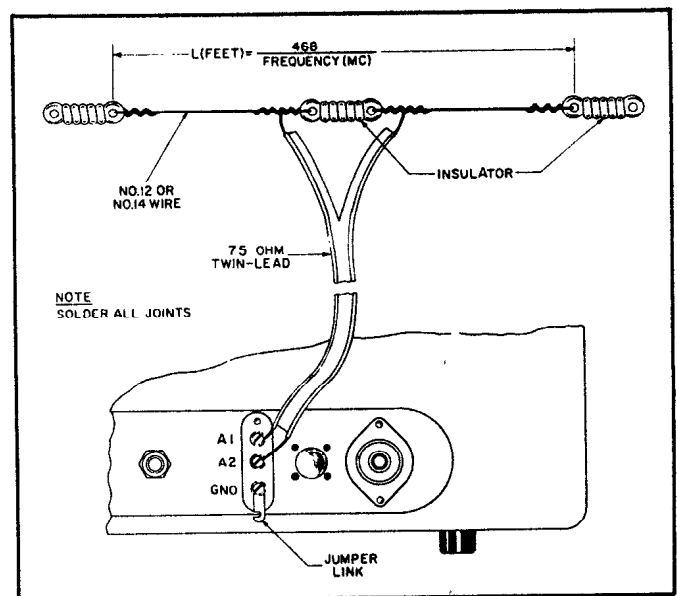
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Figure 2. Single Wire Antenna Installation.

protection against lightning, it is strongly recommended that an additional connection be made to the nearest cold-water pipe to eliminate any shock hazard.

B. HALF-WAVE DOUBLET ANTENNA

For top performance, especially on the short-wave bands, the use of a half-wave doublet or other type of antenna employing a 50 to 600 ohm transmission line is recommended. A typical doublet antenna installation is shown in figure 3. The doublet antenna should be cut to the proper length for the most used frequency or band of frequencies. The formula for determining the overall length in feet of a doublet antenna is included in figure 3.



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Figure 3. Typical Doublet Antenna Installation.

The doublet antenna is directional and should be erected with its entire length facing a desired station for maximum signal pickup.

The doublet antenna may be fed with either a balanced or unbalanced transmission line. When a balanced line such as *twin-lead* or *twisted pair* is used, the line connects to terminals A1 and A2 and the jumper link between A2 and GND is disconnected. (See figure 3.) When using an unbalanced line such as coaxial cable, the inner conductor connects to terminal A1, the outer braid connects to terminal A2, and the jumper link is connected between terminals A2 and GND. A ground wire may improve reception when using an unbalanced-type line.

The doublet antenna provides optimum performance only at or near the frequency for which it is cut. Therefore it may be desirable, for reception on frequencies remote from the antenna frequency, to utilize the doublet antenna as a single-wire type. This is accomplished by connecting the two transmission-line leads together and connecting them to terminal A1. The jumper link in this case should be connected between terminals A2 and GND.

In an installation where the receiver is used in conjunction with a transmitter, it may be advantageous to use the same antenna for receiving as for transmitting. This is especially true when a directional antenna is used, since the directive effects and power gain of the transmitting antenna are the same for receiving as for transmitting. Switching the antenna from the transmitter to the receiver may be accomplished with an antenna-changeover relay or a knife switch connected in the antenna leads.

For further information regarding antennas, refer to the *Radio Amateur's Handbook* or the *A.R.R.L. Antenna Book*, both published by the American Radio Relay League, West Hartford, Connecticut, U.S.A.

2.4. POWER SOURCE.

The receiver is designed to operate directly on 105 to 125 volt, 50/60 cycle AC current. Insert the power cord into any convenient AC power outlet of the proper rating. If in doubt about your power source, contact your local power company before connecting power to your receiver. The wrong power source can cause serious damage.

2.5. SPEAKER.

A three-terminal strip, marked GND, STDBY, and 3.2SPKR, is provided at the rear of the receiver for connecting the external speaker that is required with the receiver. (See figure 4.) Any permanent-magnet speaker with a 3.2-ohm voice coil can be used by simply connecting the two leads from the speaker voice coil to the terminals marked 3.2SPKR and GND.

Hallicrafters' Model R-48A Speaker is designed for use with this receiver and may be connected to the terminals marked 3.2SPKR and GND.

2.6. HEADPHONES.

The headphone jack, marked PHONES, is located on the front panel of the receiver and is wired so that the speaker is automatically silenced when the headphones are plugged in. The headphone impedance is not critical and any headphones ranging from 50 ohms to 5000 ohms will provide satisfactory performance.

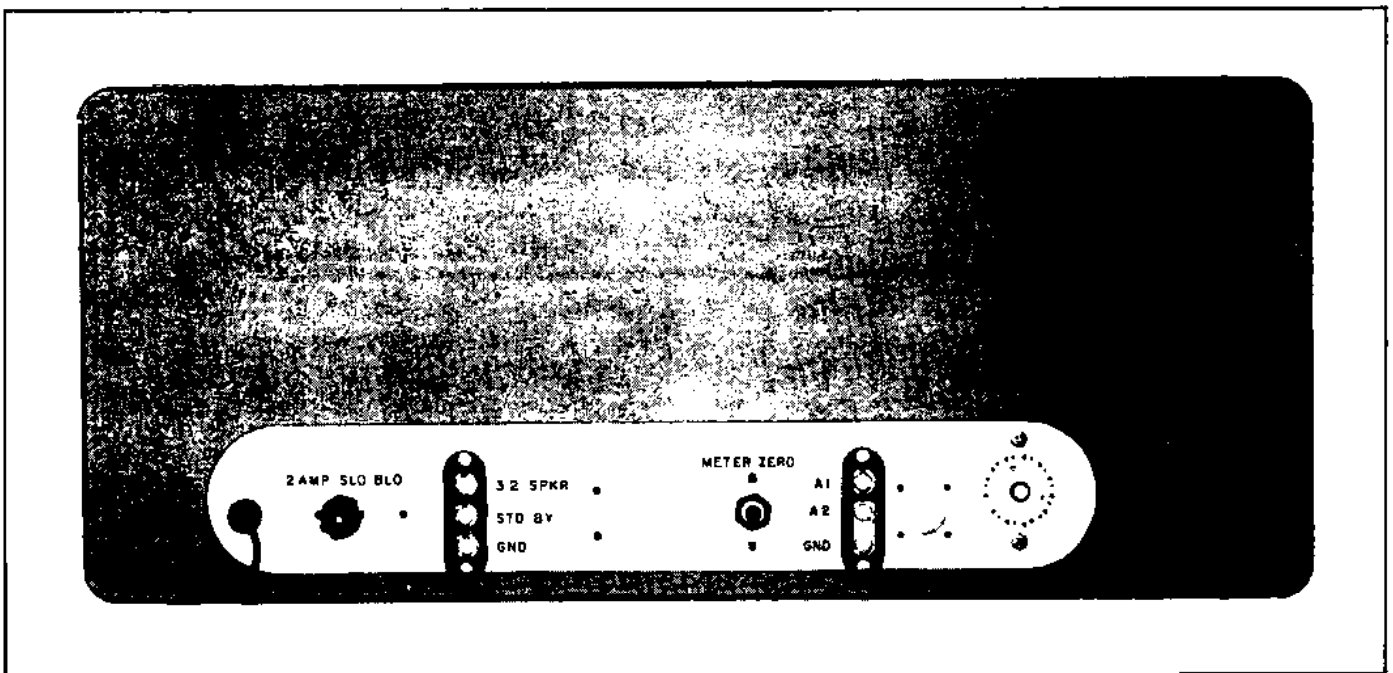


Figure 4. Rear View of Receiver.

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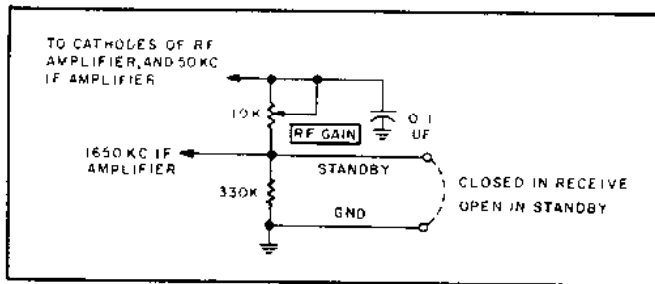


Figure 5. Remote Receive-Standby Circuitry.

2-7 REMOTE RECEIVE - STANDBY SWITCH.

The receiver may be disabled from a remote location by connecting a remote SPST switch or relay between the STDBY and GND terminals located at the rear of the receiver. (See figure 5.) To operate the receiver with the remote switch, the jumper link must be removed. The switch or relay should be so wired that the contacts will be closed in Receive and open in Standby.

SECTION III FUNCTIONS OF OPERATING CONTROLS

3-1 GENERAL.

The controls discussed in this section are identified in figure 6. Before operating your receiver take time to familiarize yourself with these controls, their positions on the panel, and their functions.

3-2. RF GAIN.

The RF GAIN control varies the gain of the RF amplifier and 50-KC IF amplifier stages. Maximum sensitivity is obtained with the control set at 10 (fully clockwise). In this position, the tubes being controlled are operated at maximum gain with minimum cathode bias. As the control is rotated counterclockwise, the bias on the tubes increases with a resultant decrease in gain.

3-3. BAND SELECTOR.

The BAND SELECTOR control operates the band switch to place the proper set of coils into the circuit to cover the desired frequency range. The frequency range covered by each position of the BAND SELECTOR control is indicated directly on the panel.

3-4. ANTENNA TRIMMER.

The ANTENNA trimmer control operates a variable capacitor connected across the secondary of the antenna coil in use. This capacitor adjustment compensates for the loading effects of various types of antennas.

It should be noted that the ANTENNA trimmer peak will appear broad as the receiver is tuned towards the low-frequency end of the dial and may not give a definite peak. This is a normal condition and does not indicate improper alignment.

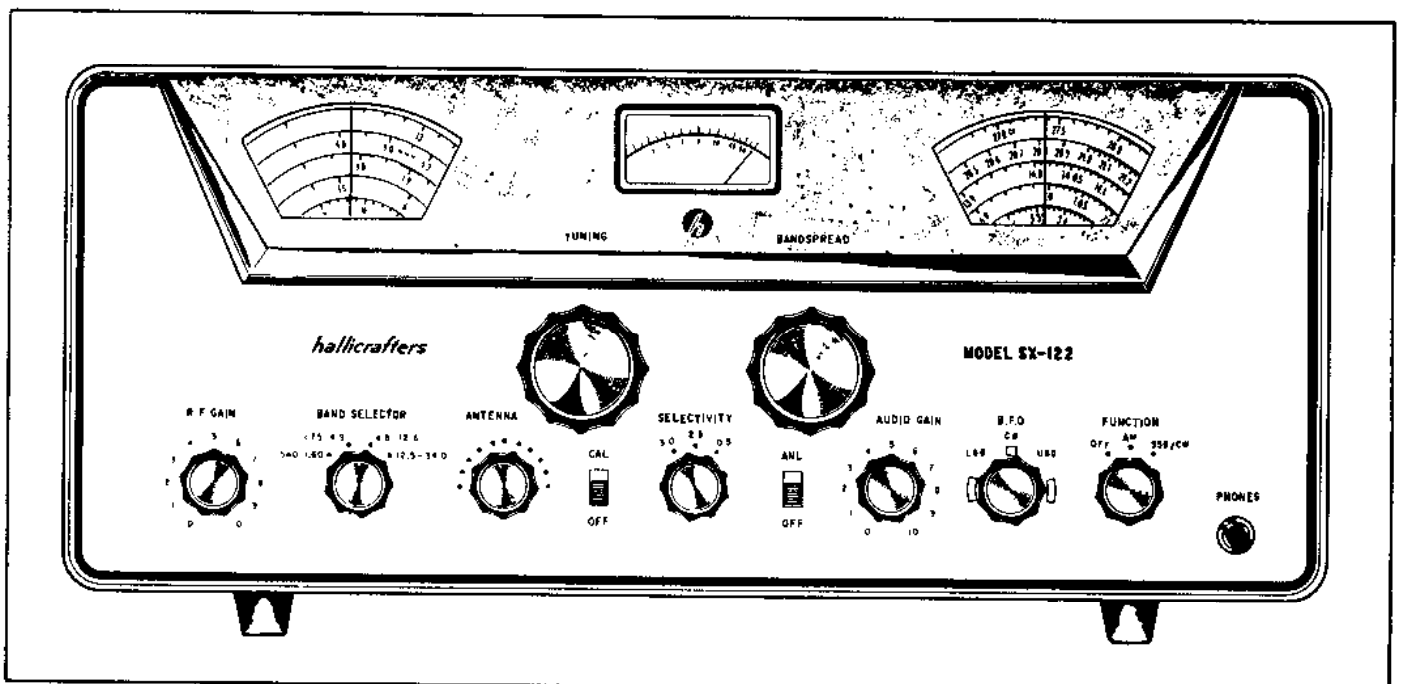


Figure 6. Front Panel Controls.

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3-5. AUDIO GAIN.

The AUDIO GAIN control adjusts the audio level at the speaker terminals and PHONES jack. Clockwise rotation of the control increases the signal applied to the grid of the audio amplifier tube, thus increasing receiver volume; counterclockwise rotation decreases volume.

3-6. NOISE LIMITER (ANL-OFF).

The ANL-OFF switch, when set at ANL, places the automatic series noise limiter circuit in operation to reduce pulse-type noise such as ignition noise and electrical interference. The limiter circuit allows the signal to pass unaffected through the receiver, but makes the receiver inoperative for noise amplitudes greater than those of the signal. It will work on AM signals only and is self-adjusting (i.e., it automatically adjusts itself to the signal level).

The noise limiter circuit chops noise peaks received at the detector by means of a biased diode which becomes non-conducting above a predetermined signal level. When the limiter circuit is in operation, the audio output of the detector must pass through the limiter diode to the grid of the audio amplifier. The limiter diode normally acts as a conductor for the audio signal as long as the anode is positive with respect to its cathode. When a noise peak is higher in amplitude than the signal, it instantaneously swings the cathode positive with respect to the anode, conduction ceases, and that portion of the signal is automatically cut off from the audio amplifier.

3-7. FUNCTION.

The FUNCTION switch performs the following functions:

1. Operates the AC ON/OFF switch.
2. Connects the AM detector to the audio amplifier and disables the BFO.
3. Connects the product detector to the audio amplifier, energizes the BFO and switches in the slow release AVC components.

3-8. SELECTIVITY.

The SELECTIVITY control is used to vary the selectivity of the receiver to fit receiving conditions. Three degrees of selectivity are available: 0.5 KC for CW reception under crowded-band conditions, 2.5 KC for SSB, and 5 KC for maximum fidelity during AM reception. The three selectivity positions are shown on the front panel adjacent to the SELECTIVITY control and indicate receiver selectivity at 6 DB down.

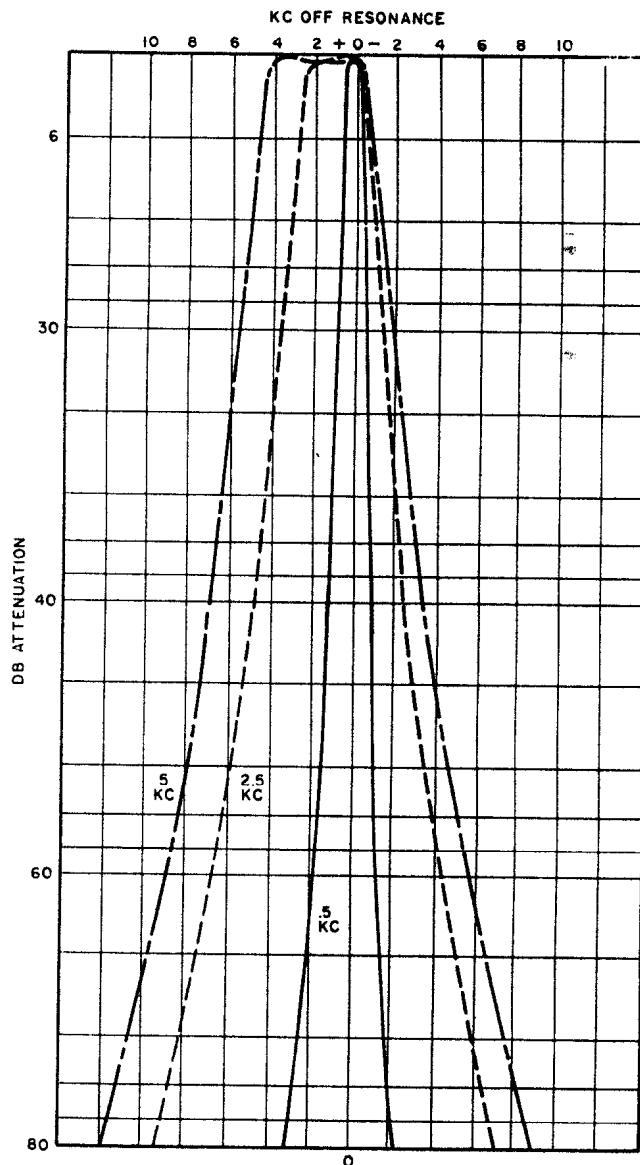


Figure 7. IF Selectivity Curves.

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The receiver IF selectivity curves are shown in figure 7. Note that as the selectivity is varied from a sharp to a broader position, the IF passband not only increases but also shifts to a slightly higher frequency.

It should be noted that two meter peaks will appear when tuning a signal with the SELECTIVITY control in the 5 (KC) position. The signal should be tuned in with the SELECTIVITY at 2.5 (KC) and then switched to the 5 (KC) position if desired.

For broadcast reception, the SELECTIVITY control is normally set at 5, the position affording broadest selectivity. Selectivity may be progressively increased by turning the control to the positions marked 2.5 and 0.5. For reception of the crowded short-wave bands, it is generally advisable to sacrifice fidelity for greater selectivity, since the added selectivity reduces both adjacent-channel interference and background noise by attenuating

the higher audio frequencies. Too much selectivity on AM signals, however, will attenuate the high audio frequencies to such an extent that the signal may become unintelligible as a result of excessive sideband cutting. When receiving CW signals, the sharpest selectivity position (0.5) may be used without the loss of intelligibility experienced in AM reception.

3-9. BEAT FREQUENCY OSCILLATOR (BFO).

The BFO is an inductively-tuned oscillator which re-inserts the carrier at the product detector for SSB or CW reception. The center frequency of the BFO is 50.85 KC and is variable over a range of ± 2 KC.

Placing the BFO frequency on the high-frequency slope of the IF passband allows frequencies below the BFO frequency to be accepted through the IF passband (lower-sideband reception).

Placing the BFO frequency on the low-frequency slope of the IF passband allows frequencies higher than the BFO frequency to be accepted through the IF passband (upper-sideband reception).

The correct settings for USB, LSB, and CW are shown on the panel. It should be noted that changing the BFO setting will affect receiver tuning. Therefore, the bandspread dial should be calibrated with the BFO control preset to the desired position.

The BFO control makes an excellent *fine tuning* control and will be found very useful as such for both CW and SSB reception under crowded conditions.

3-10. CALIBRATE (CAL-OFF).

The CAL-OFF switch controls the operation of the optional Model HA-7 Crystal Calibrator. When the switch is set at CAL, the crystal calibrator is turned on to provide marker signals at every 100 KC on the dial. The crystal calibrator employs a crystal-controlled, pentode oscillator circuit. The output of the crystal calibrator is capacitively coupled to the antenna input circuit. A trimmer capacitor, adjustable by the *Crystal Adj.* control on the top of the calibrator unit, permits adjustment of the calibrating crystal to exactly 100 KC by comparison with the frequencies transmitted by WWV. This capacitor has been set at the factory and normally should not require readjustment unless extreme calibration accuracy is required. If adjustment is required, proceed as outlined in paragraph 4-7.

NOTE

If the HA-7 calibrator is not used, the CAL-OFF switch should be left in the OFF position at all times.

3-11. TUNING AND BANDSPREAD.

The TUNING and BANDSPREAD controls are used in conjunction with one another to tune-in the desired signal. *Coarse tuning* is performed with the TUNING control and *fine tuning* with the BANDSPREAD control.

A. MAIN TUNING DIAL

The main-tuning or left-hand dial is operated by the TUNING control. This dial has five calibrated scales, one for each of the four frequency bands plus a logging scale. For normal tuning, the main-tuning dial is set for the desired station frequency after the BANDSPREAD control has been positioned at the *Bandspread Set* line.

IMPORTANT

The readings on the main tuning dial will correspond to the station frequencies only if the BANDSPREAD control is set at the *Bandspread Set* line. If it is set at any other position, the additional bandspread capacity added to the main tuning capacity will mis-calibrate the main tuning dial.

The dial settings for the 80, 40, 20, 15, and 10 meter band, which includes the citizens band (26.965 to 27.255 MC), are indicated on the main tuning dial by small circle dots. When tuning with the bandspread dial, the main-tuning dial must be set at the dot corresponding to the desired band. International short-wave broadcast bands are indicated by a double line and identified in meters.

B. BANDSPREAD DIAL

The bandspread or right-hand dial is operated by the BANDSPREAD control. This dial contains five scales calibrated for the 80, 40, 20, 15, 10 meter and citizens bands. These five scales are calibrated to read receiver frequency directly when the main-tuning dial has been set to the index dot of the desired band. For convenience in tuning, the amateur bands are indicated on the bandspread dial by double weight lines and the phone bands are indicated by triple-weight lines.

NOTE

Use 10-meter dot for citizens-band calibration.

The bandspread dial may also be utilized as a *fine tuning* adjustment over any portion of the receiver tuning range. Two methods of fine tuning are described on the next page.

a. The first method of fine tuning is used when it is desired to tune in a single signal with precision accuracy. First the BANDSPREAD control is set a few degrees from its *Bandspread Set* position, the desired signal is located with the TUNING control, and then the signal is accurately tuned in by *rocking* the BANDSPREAD control (turning it slightly to the left and right) until the signal is loudest and clearest.

b. The second method of fine tuning is used when it is desired to tune through a range of frequencies, such as a group of short-wave stations. Set the BANDSPREAD control fully counterclockwise, set the TUNING control for the high end of the selected range of frequencies, and then tune through the range with the BANDSPREAD control. Turning the BANDSPREAD control clockwise tunes the receiver progressively lower in frequency.

SECTION IV OPERATION

4-1. AM RECEPTION.

1. Set the front panel controls to their starting positions as outlined below.

RF GAIN 10 (*maximum sensitivity*).

BAND SELECTOR *At the desired band.*

AUDIO GAIN 2.

ANTENNA *Peak on signal.*

ANL-OFF OFF.

FUNCTION OFF.

SELECTIVITY 2.5 or 5.

CAL-OFF OFF.

2. Turn the receiver on by rotating the FUNCTION control clockwise to AM. The tuning dials will light up, indicating the receiver is operative. Rotate the AUDIO GAIN control clockwise for the desired volume level.

3. Set the bandspread-tuning gang near minimum capacity by rotating the BANDSPREAD control to *Bandspread Set*. To utilize the BANDSPREAD control as a *fine tuning* adjustment for the short-wave bands, refer to paragraph 3-11.

IMPORTANT

The calibration on the main-tuning (left-hand) dial will be correct only if the bandspread-tuning gang is set at *Bandspread Set*. If it is set at any other position, the additional bandspread capacity added to the main-tuning capacity will mis-calibrate the main-tuning dial.

4. Tune to the desired signal with the TUNING control, tuning for maximum clarity. After the signal has been accurately tuned in, readjust the AUDIO GAIN control as desired.

NOTE

The *S meter* will not give a true indication of the IF selectivity because the AVC bandwidth is approximately twice as wide as the signal bandwidth at the detector.

When tuning an AM signal, it will be found convenient to tune the signal with the SELECTIVITY set at 2.5 and then turn the SELECTIVITY control to 5 after tuning in the station.

5. Set the SELECTIVITY control for the desired degree of selectivity. For standard-broadcast reception (Band 1), the control is normally set to 5 for maximum fidelity. The positions marked 2.5 and 0.5 provide progressively increasing steps of selectivity. Note that as the selectivity of the receiver is increased, the background noise and interference from adjacent signals is reduced. Too much selectivity, however, may cause excessive sideband cutting. While sideband cutting reduces fidelity, it may frequently be preferable to sacrifice naturalness of reproduction in favor of communications effectiveness. When changing the position of the SELECTIVITY control from a broad to a narrower response, a slight readjustment of the tuning controls may be necessary to center the signal in the IF passband.

6. Use ANL (noise limiter) as noise conditions dictate.

4-2. EXALTED CARRIER AM RECEPTION.

In short-wave reception, transmission conditions frequently are different for waves of slightly different frequencies. In voice modulated transmissions (particularly AM), 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.

Selective fading can be reduced considerably by utilizing the selectable-sideband feature of the Model SX-122 Receiver operating in an exalted carrier mode (i.e., the transmitted carrier is positioned out of the receiver's IF passband along with one sideband, producing a suppressed carrier single-sideband signal). The carrier is subsequently re-inserted by the receiver's BFO and the signal is detected in the same manner as a single-sideband signal.

Controls should be set as for SSB reception. Either USB or LSB may be used.

4-3. SINGLE-SIDEBAND RECEPTION.

1. Set the front panel controls to their starting positions as follows:

RF GAIN 10 (*maximum sensitivity*).

BAND SELECTOR *At desired band.*

AUDIO GAIN *Approximately 2.*

FUNCTION SSB/CW.

BFO *Usually LSB for 40 and 80 meters
USB for 20, 15, and 10 meters.*

SELECTIVITY 2.5.

ANTENNA *Peak on signal.*

TUNING *Set at desired index dot if tuning
amateur band.*

BANDSPREAD *As desired.*

Slowly tune into the signal until the voice modulation sounds natural and adjust the *Audio Gain* control for desired volume.

It should be remembered that an SSB signal will convey intelligence only when the correct sideband position has been selected by the BFO control. If the signal does not tune properly, move the BFO control to the opposite sideband position and retune the receiver.

Under certain conditions, it may be found advantageous to reduce the RF GAIN setting for improved reception. It should be remembered that this will reduce AVC and also affect the *S meter* reading.

4-4. CW RECEPTION.

Set all controls as shown in single-sideband reception except for the BFO control which should be set to the CW position.

Under crowded-band conditions, it may be found desirable to set the SELECTIVITY switch to the 0.5 position for improved selectivity.

4-5. USE OF CRYSTAL CALIBRATOR.

The optional Model HA-7 100-KC Crystal Calibrator permits accurate checking of the dial calibration over any portion of the main and bandspread tuning dials by comparing the dial calibrations with the marker signals which appear at every multiple of 100 KC on the dial.

A. CALIBRATION OF THE BANDSPREAD DIAL

1. Set the bandspread-tuning dial at a convenient multiple of 100 KC at the high-frequency end of the band in use. For example: 4000 KC on 80 meters, 7300 KC on 40 meters, 14,300 KC on 20 meters, 21,400 KC on 15 meters, and 29,700 KC on 10 meters.
2. Set the main-tuning dial to the index dot of the desired band.
3. Set the FUNCTION switch to SSB/CW, the BFO switch to CW, and the CAL-OFF switch to CAL.
4. Very carefully adjust the TUNING control for the exact frequency as indicated by *zero beat*. The bandspread-tuning dial is now accurately calibrated and a *zero beat* should be obtained at every multiple of 100 KC on the band in use. For example, on the 80-meter band, a *zero beat* should be obtained at or close to 3500, 3600, 3700, 3800, 3900, and 4000 KC.
5. The procedure outlined in Steps 1 through 4 above provides average calibration accuracy over the entire frequency range of the band in use. For precise calibration accuracy over a particular section of the band, the procedure is identical except that the bandspread dial is set at a multiple of 100 KC near the desired frequency or range of frequencies, instead of at the high end of the band as in Step 1.

B. CALIBRATION OF THE MAIN TUNING DIAL

1. Turn the BANDSPREAD control counterclockwise until the dial pointer is aligned with the index marks at the high-frequency end of the dial (*Bandspread-Set* line).
2. Set the main-tuning dial at a convenient multiple of 100 KC near the desired frequency or range of frequencies. (The main-tuning dial is calibrated in MC.) To determine the nearest 100 KC multiple, simply remember that 100 KC is equal to 0.1 MC. For example, from 2.0 to 3.0 MC on band 2, the 100-KC multiples are 2.0 MC, 2.1 MC, 2.2 MC, 2.3 MC, etc.

3. Set the *FUNCTION* switch to *SSB/CW*. Then set the *CAL-OFF* switch to *CAL*. If a *zero beat* does not occur at the 100-KC check point, turn the *BANDSPREAD* control clockwise or counterclockwise as necessary to establish Main-Tuning dial calibration.

4-6. USE OF THE S METER.

The *S meter* provides a visual means of determining whether or not the receiver is properly tuned, as well as an indication of the relative signal strength. The *S meter* circuit consists of a DC milliammeter connected in series with the cathode lead to the 1650-KC IF amplifier tube, the grid of which is controlled by AVC voltage. Since the cathode current of this tube varies with the strength of the incoming signal, the meter will indicate relative signal strength. The *S meter* is calibrated in *S* units from 1 to 9 and in decibels above S-9. The indications on the *S meter* will be correct only when the *RF GAIN* control is set at 10 (maximum sensitivity).

NOTE

If the *RF GAIN* control is set at a reduced position, the *S meter* may read below zero under no signal conditions. This is a normal condition.

4-7. CRYSTAL CALIBRATOR CHECK.

The *Crystal Adj.* control on the optional Model HA-7 Calibrator chassis operates a trimmer capacitor connected across the 100-KC calibrating crystal. This trimmer capacitor permits adjustment of the calibrating crystal at exactly 100 KC by comparison with the frequencies transmitted by station WWV. This capacitor has been set at the factory and should not require readjustment unless extreme calibration accuracy is desired. If adjustment is required, proceed as follows:

Set the *FUNCTION* switch to *AM*, the *CAL-OFF* switch to *OFF*, and all other front-panel controls for normal *AM* reception. Tune in station WWV on any one of its operating frequencies (2.5, 5, 10, 15, 20, or 25 MC) and wait for the period during which the signal from WWV is unmodulated. Then switch on

the crystal calibrator by setting the *CAL-OFF* switch to *CAL* and adjust its frequency, by means of the *Crystal Adj.* control, until the crystal calibrator signal *zero beats* with the signal received from WWV. If the adjustment is attempted during periods that WWV is modulated, an erroneous *zero beat* may be obtained with the modulating frequency instead of the desired carrier frequency.

4-8. OPERATING AND SERVICE QUESTIONS.

For further information regarding operation or servicing of this equipment, contact the dealer from whom the unit 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 location of the one nearest you, consult your dealer or your local telephone directory.

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

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

