Refer to Pictorial 4-1 (Illustration Booklet, Page 33) for the location of the following test points.

NOTE: With the BAND switch in any position other than the one indicated in the step, the resistance should measure approximately 1000 Ω higher than shown. If you do not have the accessory bands (30-, 17-, 12-, or 10-meters) installed, omit the tests marked with an asterisk.

	BAND	TEST POINT	OHMMETER READING	POSSIBLE CAUSE
( )	80	R107	350 to 700	A. 9-volt line (U402).
( )	40	R109	350 to 700	B. Bandswitch wiring.
( )	30*	R111	350 to 700	C. Short in corresponding mixer filter (L101 – L117)
( )	20	R113	350 to 700	D. P101 wiring.
( )	17*	R115	350 to 700	
( )	15	R117	350 to 700	
( )	12*	R119	350 to 700	
( )	10*	R121	350 to 700	

( ) Return the BAND switch to 80 before you make the following tests.

	TEST POINT	OHMMETER READING	POSSIBLE CAUSE
( )	Point E (wire socket).	300 to 700	A. 9-volt line. B. Main tuning capacitor C1. C. P101 wiring.
( )	Unplug P101.		
( )	Point E (wire socket).	300 to 700	A. VFO circuit, L118, Q102—Q106.
( )	12 V pin (plug P101).	300 to 600	A. 12-volt line. B. BFO circuit, Q102. C. Mixer output, Q101. D. HFO output, Q111.

	TEST POINT	OHMMETER READING	POSSIBLE CAUSE
( )	Set your ohmmeter to R × 1000.		
( )	R12 pin.	15 kΩ to 30 kΩ	A. Q103 circuit.
( )	Set your ohmmeter to R × 100.		
( )	T12 pin.	800 to 1800	A. T12 foil shorted.
			B. BFO circuit, D141, Q114, Q115.
( )	CWL.	3000 to 6000	A. D143 reversed or faulty.
( )	Reconnect plug P101.		
( )	12 V pin.	300 to 600	A. Short on 12 V line, T/R board.
( )	R12 pin.	300 to 700	A. Short on R12 line.
			B. P101 wired wrong.
( )	T12 pin.	300 to 700	A. T12 line.
			B. CW LEVEL control wiring.
( )	9 V pin.	300 to 800	A. T/R board.
			B. U301, T302.
( )	CWL.	300 to 700**	A. CW LEVEL control wiring.
			B. T12 line from C/R board.
( )	TP104.	infinite	A. Shorted cable at OSC or BFO/IN.

( ) Turn the Transceiver over as shown in Pictorial 4-2 (Illustration Booklet, Page 33) and set your ohmmeter to the R × 1000 range. Then make the following tests.

** This indication should decrease as you turn the CW LEVEL control clockwise.

	TEST POINT	OHMMETER READING	POSSIBLE CAUSE
( )	AF GAIN (lug 2).	0 to 10 kΩ as you rotate the control clockwise.	A. Shorted cable. B. Wiring of AF GAIN control or SELECTIVITY switch.
( )	Sidetone In cable (inner lead).	Infinite	A. Shorted cable.
( )	Be sure the SELECTIVITY switch is in the WIDE position.		
	( ) Wide out cable (inner lead).	8 kΩ to 15 kΩ	A. Shorted cable. B. Selectivity switch wiring.
( )	Set the SELECTIVITY switch to NARROW.		
	( ) Narrow out cable (inner lead).	8 kΩ to 15 kΩ	A. Switch wiring or cable.
( )	Set your ohmmeter to R × 100.		
	( ) Case of Q424.	300 to 500	A. Soldering, or Q424.
	( ) Tx/In cable (inner lead).	300 to 500	A. Cable shorted or open. B. Oscillator board L137 shorted or open.

This completes the Initial Tests. Proceed to the "Alignment" section.

ALIGNMENT

An RF detector circuit is built into the Transceiver to aid you in the alignment procedure. The only equipment you will need is a VTVM or DVM with a 1 to 2 volts scale and a 15 volt scale, and a frequency counter with a range to 10 MHz and an accuracy of .01%.

INITIAL CONTROL SETTINGS

Refer to Pictorial 5-1 (Illustration Booklet, Page 34) and set the front panel controls and switches as follows:

( ) CW LEVEL – fully counterclockwise.

( ) RIT – center (detent) position.

( ) AF GAIN – fully counterclockwise (OFF).

( ) BAND switch – 80.

( ) TUNING DIAL – 250 KHz.

Refer to Pictorial 5-2 (Illustration Booklet, Page 34) and set the T/R circuit board controls as follows (as viewed from the front of the Transceiver):

( ) METER ZERO (R333) – 12 o'clock position.

( ) MUTE DELAY (R445) – 3 o'clock position.

( ) SIDETONE LEVEL (R368) – 3 o'clock position.

( ) AGC SET (R329) – 3 o'clock position.

Refer to Pictorial 5-3 (Illustration Booklet, Page 35) and set the oscillator circuit board controls as follows:

( ) TRANSMIT RETURN (R131) – 9 o'clock position.

( ) HFO Level (R173) – 3 o'clock position.

HFO ALIGNMENT

During the alignment, you will use the two test wires that you prepared earlier.

Refer to Pictorial 5-3 (Illustration Booklet, Page 35) for the following steps.

( ) Push the PCB connector on one end of the meter test lead (with an alligator clip on the other end) onto the circuit board pin at METER on the oscillator board.

( ) Connect the alligator clip of this test wire to the positive (+) lead of your VTVM (or DVM). Then connect the negative or common lead of your meter to the Transceiver chassis.

( ) Set your meter to measure 4-volts DC and turn the meter on.

( ) Push the PCB connector on one end of the test lead (assembled earlier) onto the pin at RF.

When a test point is called out in a step, insert the bare end of the test lead wire into the wire socket at that test point on the circuit board.

( ) Connect the Transceiver to a 12.6-volt DC source. Then turn the AF GAIN control on the Transceiver clockwise until it clicks on.

( ) Connect the free end of the test lead wire to TP103 (near HFO Level control R173).

NOTES:

1. When you adjust the coils in the following steps, be careful not to exert any downward pressure on the slugs. Also do not turn the slugs more than two turns clockwise. Too much pressure, or turning the slug too far clockwise, could dislodge the slug from the coil.

2. Adjustments **must** be made in the following sequence for proper alignment. Use the small end of the red alignment tool to adjust each coil, in order, for a maximum reading on your meter (you may not have a reading when you start). Set the BAND switch to the band indicated for each adjustment. Some adjustments may seem very sharp; make them slowly and carefully. No coil should require more than 1-1/2 turns in either direction. Increase the range of your voltmeter as necessary. If you do not have the optional bands installed, omit the steps that have an asterisk.

	BAND	ADJUST
( )	80	L124
( )	40	L125
( )	30*	L126
( )	20	L127
( )	17*	L128
( )	15	L129
( )	12*	L131
( )	10*	L132

( ) Repeat the preceding steps until no further increase is indicated on your meter. Then disconnect the RF wire and your meter, and return the BAND switch to the 80 Meter position.

VFO ALIGNMENT

( ) Refer to Pictorial 5-2 (Illustration Booklet, Page 34) and use the blade of the shorter alignment tool to turn the trimmer of main tuning capacitor (C1) clockwise until it is just snug. Then turn the trimmer counterclockwise one full turn.

( ) Position all wires in the area of the VFO circuit away from coil L118 and the VFO tuning capacitor.

( ) Connect your frequency counter to test point TP102.

NOTE: The coil that you will adjust in the next step has been preset close to its correct setting at the factory. When you adjust this coil, be sure the slug remains in the lower half of the coil.

( ) Set the Transceiver TUNING DIAL at the 250 mark and adjust L118 for a reading of 5.7493 MHz.

( ) Turn the dial to the zero mark and adjust the trimmer of tuning capacitor (C1) for a reading of 5.9993 MHz.

( ) Repeat the previous two steps until your frequency counter indicates exactly 5.7493 MHz with the dial at 250, and 5.9993 MHz at zero. Then disconnect your frequency counter.

TRANSMIT RETURN ADJUSTMENT

( ) Set your VTVM or DVM to a 15 volt range and connect its positive (+) test lead to the lead of 33 kΩ resistor R127 nearest TRANSMIT RETURN control R131.

( ) Make sure the CW LEVEL control (on the front panel) is fully counterclockwise, and the RIT control is in the detent at the center of rotation. Then note the voltage indication on your meter.

( ) Key the transmitter by shorting the KEY input on the rear panel, or by holding down a regular key connected to the KEY input.

( ) Adjust TRANSMIT RETURN control R131 until the transmit voltage equals the voltage you observed in the receive mode. Then disconnect your meter.

This completes the VFO alignment and Transmit Return adjustment. Proceed to "BFO Alignment."

BFO ALIGNMENT

Refer to Pictorial 5-3 (Illustration Booklet, Page 35) for the location of the test point and adjustment used in the BFO alignment.

( ) Connect your frequency counter to TP104 on the upper right-hand side of the BFO shield.

( ) Insert your alignment tool through the L135 access hole in the top of the BFO shield and into the core of L135.

( ) Key the transmitter and adjust L135 for a frequency counter indication of 8.8307 MHz.

( ) Unkey the transmitter and the frequency indication should be about 8.8314 MHz. Disconnect the frequency counter from TP104 and remove the alignment tool.

8.8322 Audible tone

MIXER FILTER ALIGNMENT

( ) Push the PCB connector on one end of the meter test lead (with an alligator clip on the other end) onto the circuit board pin at METER on the oscillator board.

( ) Connect the alligator clip of this test lead to the positive (+) lead of your VTVM (or DVM). Then connect the negative or common lead of your meter to the Transceiver chassis.

( ) Set your meter to measure 1.5 volts DC.

( ) Push the PCB connector of the test lead onto the pin at RF and insert the bare end of the RF wire into the wire socket at TP101.

To align the mixer filters (L101 through L117), you will first adjust two coils for the 80 Meter band; L101 with the dial set at zero and L102 with the dial set at 250. Then you will repeat the two adjustments until the VTVM or DVM reading shows no further improvement before you proceed to adjust the next band. NOTE: The two readings on each band may or may not be the same.

Coils L101 through L106 will peak when the slugs are approximately 1/16" down from the top of the coil form. Coils L107 through L117 will peak with their slugs approximately 1/8" down. Preset these slugs in the following manner before you begin the filter alignment.

( ) Insert the alignment tool into the slug of the coil and turn the slug counterclockwise until it is even with the top of the coil form. Then turn the slug clockwise two complete turns for 1/16" (L101 through L106), or four turns for 1/8" (L107 through L117).

NOTE: If you do not have the optional bands installed, omit the steps that are marked with an asterisk.

BAND	DIAL 0	DIAL 250	
80	( ) L101	( ) L102	( ) Repeat
40	( ) L103	( ) L104	( ) Repeat
30*	( ) L105	( ) L106	( ) Repeat
20	( ) L107	( ) L108	( ) Repeat
17*	( ) L109	( ) L111	( ) Repeat
15	( ) L112	( ) L113	( ) Repeat
12*	( ) L114	( ) L115	( ) Repeat
10*	( ) L116	( ) L117	( ) Repeat

This completes the alignment of the circuits on the oscillator circuit board. Disconnect the test leads. Then proceed with "T/R Board Adjustments."

T/R BOARD ADJUSTMENTS

RECEIVE IF ALIGNMENT

This adjustment is located on the transmit/receive (T/R) circuit board as shown in Pictorial 5-4 (Illustration Booklet, Page 35).

( ) Connect a speaker to the SPEAKER jack on the rear panel, or connect headphones to the PHONES jack on the rear panel.

( ) Use the alignment tool to turn the slug in transformer T301 for the loudest noise. Then turn the slug counterclockwise 1/4 turn. NOTE: You may have to use an external antenna to hear a noticeable change in the noise (this is a broad adjustment).

( ) Adjust the AF GAIN control (on the front panel) until you hear noise in your speaker or headphones.

( ) Adjust transformer T302 for the loudest noise.

AGC ADJUSTMENT

( ) Observe the front panel meter and adjust METER ZERO control R333 until the meter pointer indicates zero.

( ) Slowly adjust AGC SET control R329 counterclockwise until the meter pointer just indicates above zero. Then turn the control clockwise until the meter again indicates zero. Now turn the control about 1/8-turn further clockwise.

( ) Turn the Transceiver off.

TRANSMIT BANDPASS ALIGNMENT

While you adjust the transmitter circuits in the following steps, we recommended that you connect a dummy load to the ANTENNA jack. This will reduce the possibility that you will cause interference on the air.

( ) Connect a 50-ohm load to the ANTENNA jack on the rear panel.

( ) Push the PCB connector on one end of the meter test lead (with the alligator clip on the other end) onto the pin marked "Meter" on the oscillator board. Then connect the alligator clip to the positive (+) lead of your VTVM or DVM.

( ) Connect your meter's common or negative lead to the chassis and set the meter to measure 15 volts DC.

( ) Push the PCB connector on one end of the test lead onto the pin marked "RF" on the oscillator board.

( ) Insert the bare end of the RF wire into the wire socket at TP on the T/R circuit board.

( ) Set the BAND switch to 80, the TUNING DIAL to 100, and the CW LEVEL control fully counterclockwise.

( ) Turn the Transceiver on.

( ) Key the transmitter as you observe your VTVM. If the meter indicates less than 1 volt, switch to a lower range or increase the CW LEVEL slightly. Then unkey the transmitter.

In the following steps you will adjust a pair of coils for each band. If you do not have the optional bands installed, omit the steps that have an asterisk.

Leave the dial set at 100 for all of these steps. Set the BAND switch as indicated, and then key the transmitter and adjust the listed coils alternately for a peak voltage reading. Repeat each step at least once until there is no further increase. Unkey the transmitter between steps while you change to the next band.

	BAND	ADJUST
( )	80	L401, L402
( )	40	L403, L404
( )	30*	L405, L406
( )	20	L407, L408
( )	17*	L409, L411

NOTE: For access to the 15-meter band coils, you must remove the shaft from the BAND switch. To do this, Refer to Detail 5-4A and perform the following steps.

( ) Turn the Transceiver off.

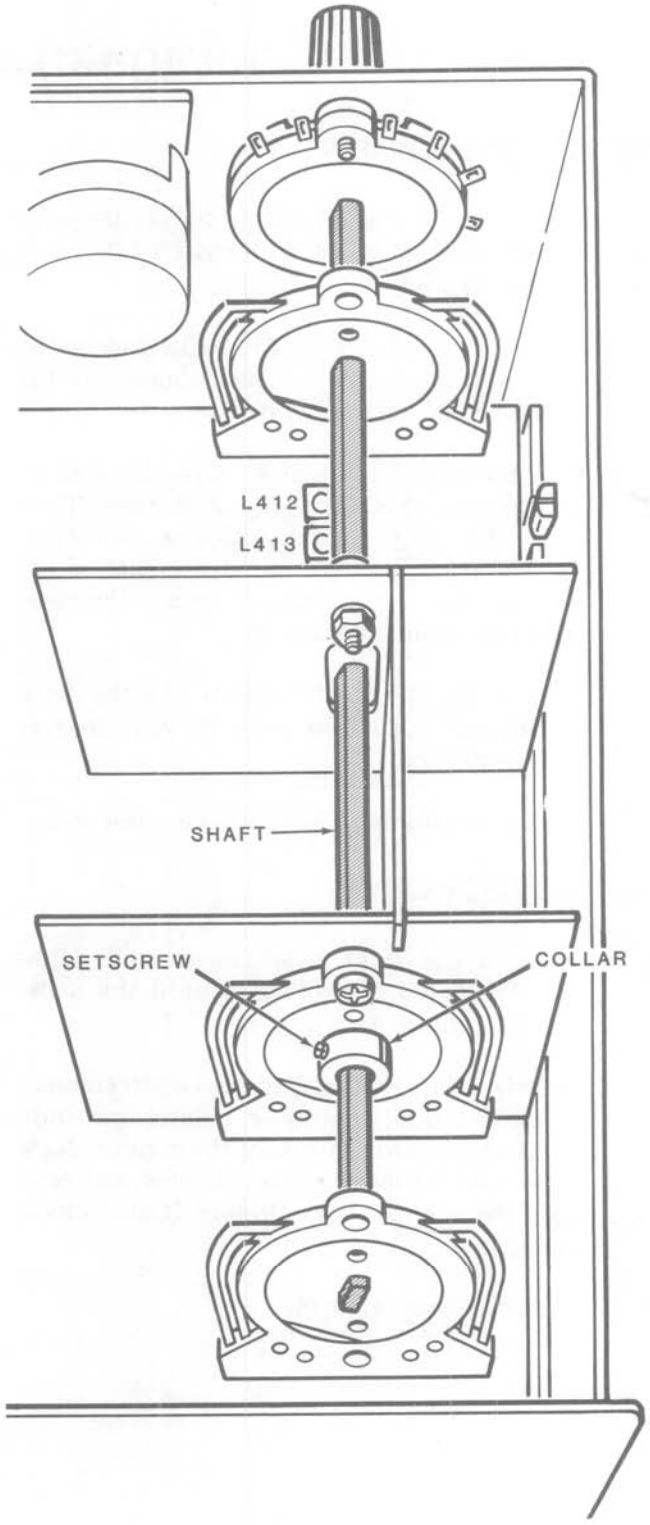
( ) Turn the BAND switch to 15 and loosen the setscrew in the collar on the bandswitch shaft.

( ) Carefully slide the shaft part way out through the front panel and remove the collar from the shaft. Then slide the shaft out until coils L412 and L413 are exposed.

( ) Turn the Transceiver on.

( ) Adjust L412 and L413 for a maximum reading on your meter.

( ) Reinsert the bandswitch shaft all the way into the wafers. Do not reinstall the collar yet.



Detail 5-4A

NOTE: If you do not have the accessory bands installed, omit the next two steps.

( ) Turn the BAND switch to 12 and adjust L414 and L415 for a maximum indication on your meter.

( ) Turn the BAND switch to 10 and adjust L416 and L417 for a maximum indication.

( ) Turn the BAND switch to 80.

In the following steps, you will readjust coils L401 through L417, in pairs, with the dial alternately set at 250 and zero. For each step, select the band and set the dial at 250. Then key the transmitter and adjust the indicated coil. Change the dial to zero, key the transmitter, and adjust the second coil of the pair. Repeat the step until your meter readings are as high as possible and the two readings are nearly equal before you perform the next step. If the two readings are not close when you finish adjusting them, adjust the coil at the end of the band that produced the higher reading for a slightly lower reading (at its end of the band). Then readjust the other coil at the end of the band that produced the lower reading. When the readings at both ends of the band are nearly equal, proceed to the next step. Omit the steps that have an asterisk if you do not have the accessory bands installed.

BAND	DIAL 250	DIAL 0	
80	( ) L402	( ) L401	( ) Repeat
40	( ) L404	( ) L403	( ) Repeat
30*	( ) L406	( ) L405	( ) Repeat
20	( ) L408	( ) L407	( ) Repeat
17*	( ) L411	( ) L409	( ) Repeat

( ) Turn the BAND switch to 15 and slide the band switch shaft out through the front panel to expose coils L413 and L412.

15	( ) L413	( ) L412	( ) Repeat

( ) Turn the Transceiver off.

( ) Reinsert the bandswitch shaft into the switch wafers, with the collar on the shaft as shown. Press the collar against the wafer and tighten the setscrew.

( ) Turn the Transceiver on.

12*	( ) L415	( ) L414	( ) Repeat
10*	( ) L417	( ) L416	( ) Repeat

( ) Disconnect the test leads from the Transceiver.

This completes the bandpass alignment. Proceed to "BFO Filter adjustment."

BFO FILTER ADJUSTMENT

( ) Set the BAND switch to 80 and the CW LEVEL control to the center of its rotation.

( ) Key the transmitter and adjust the CW LEVEL control until you obtain a meter reading. Then adjust L137 (on the oscillator circuit board) until the front panel meter indicates as high as possible. Then adjust the coil in the opposite direction until the needle just starts to move down scale. Unkey the transmitter.

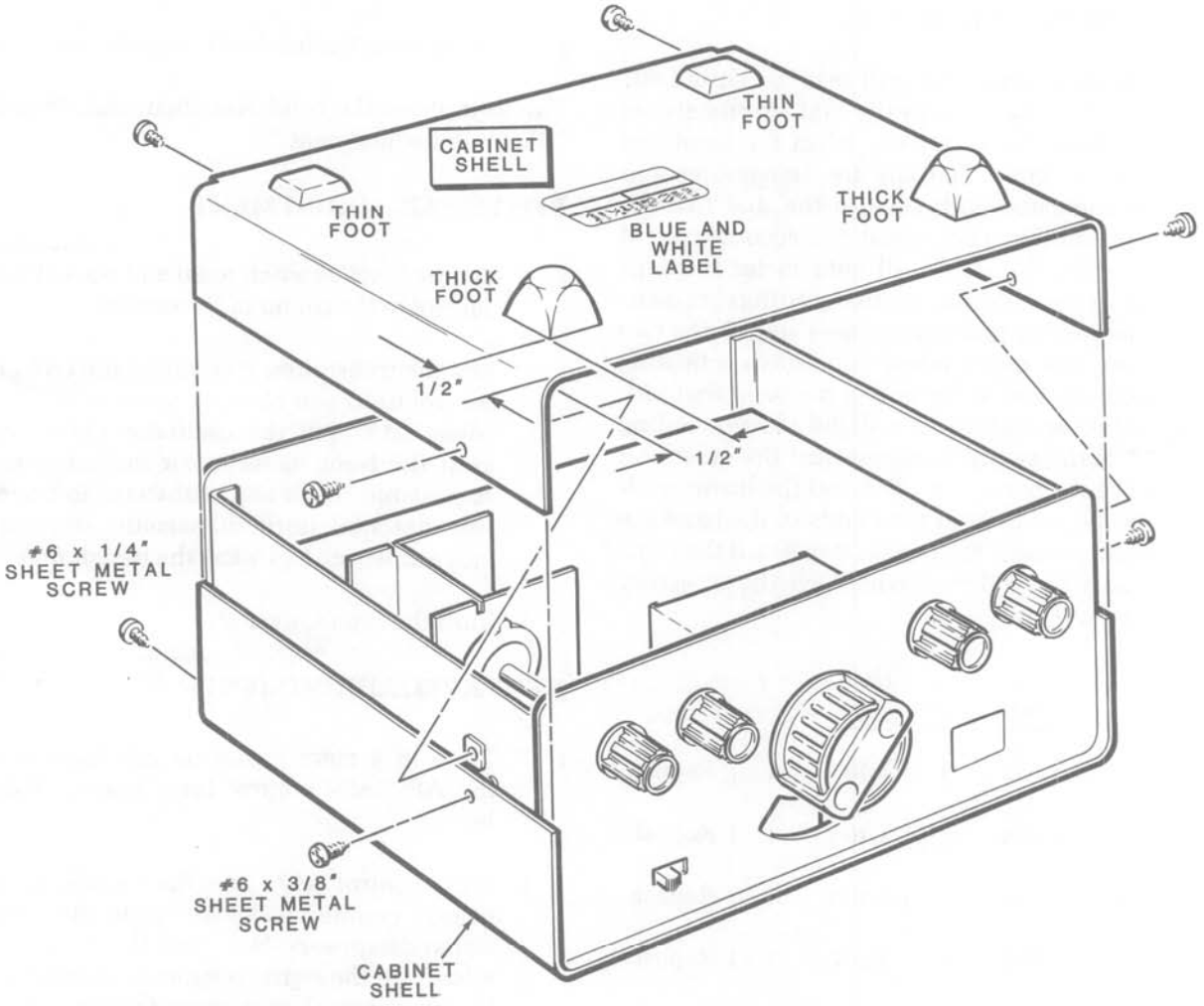
( ) Turn the Transceiver off.

HFO LEVEL ADJUSTMENT

( ) Tune in a clear signal on any band and set the AF GAIN control for a normal listening level.

( ) Turn control R173 (on the oscillator circuit board) counterclockwise until the received signal disappears. Now turn the control clockwise until the signal reappears. Continue turning the control clockwise to a point where there is no further increase, and 1/8 turn beyond. NOTE: Do not turn this control any further clockwise than the 3 o'clock position (as viewed from the front of the control).

This completes the Alignment of your Transceiver. Proceed to "Final Assembly."



PICTORIAL 6-1

FINAL ASSEMBLY

Refer to Pictorial 6-1 for the following steps.

( ) Position one of the cabinet shells onto the bottom of the chassis as shown in the Pictorial. Then use two #6 × 1/4" and two #6 × 3/8" sheet metal screws to secure the shell onto the chassis as shown. Use the #6 × 1/4" screws in the back edge of the cabinet shell and the #6 × 3/8" screws in the sides.

( ) Carefully peel the backing paper from one of the thick feet. Then press the foot onto the bottom cabinet shell near one of the front corners as shown.

( ) Similarly press a thick foot onto the bottom cabinet shell near the remaining front corner.

( ) Similarly press thin feet onto the bottom cabinet shell near the two rear corners.

( ) Carefully peel the backing paper from the blue and white label. Then press the label onto the bottom cabinet shell in the area shown. Be sure to refer to these numbers in any communications you may have with the Heath Company about your kit.

( ) Turn the chassis over and install the remaining cabinet shell onto the chassis. Use two #6 × 1/4" and two #6 × 3/8" sheet metal screws. Use the #6 × 1/4" screws in the back edge of the cabinet shell and the #6 × 3/8" screws in the sides.

This completes the assembly and adjustment of your QRP Transceiver. Proceed to "Installation and Operation."

INSTALLATION AND OPERATION

This section of the Manual first describes the connections on the rear panel of your Transceiver and then describes the operation of the front panel controls. If you install and operate your unit as described, you will achieve the greatest satisfaction from your Transceiver.

REAR PANEL CONNECTIONS

Refer to Pictorial 7-1 (Illustration Booklet, Page 36) for the locations of the following rear panel connections.

GROUND

This binding post is provided so you can ground your Transceiver. Use #18 (or heavier) wire and connect it securely to a grounded water pipe or other earth ground. If you use a water pipe, be sure there are no plastic pipes or connectors between the Transceiver and the earth.

ANTENNA

This Transceiver will provide satisfactory results with almost any dipole or inverted vee antenna that has a 50- to 75-ohm impedance and a low VSWR. Such antennas are easy to construct from lightweight hookup wire, and they are inexpensive. However, antennas of the beam or quad type will provide a significant improvement in performance. An efficient antenna will produce more reliable and enjoyable contacts.

METER ZERO

This control is accessible through a hole in the rear panel and allows you to set the S-meter pointer to zero when no signal is being received.

MUTE DELAY

This control is accessible through a hole in the rear panel and allows you to set the delay between the time you release the CW key and the receiver unmutes.

SIDETONE LEVEL

This control is accessible through a hole in the rear panel and allows you to set the side tone to the desired level.

Comprehensive reference material about antennas and transmission lines is presented in the ARRL Antenna Handbook and similar publications, available at most electronic hobby stores or public libraries.

Once you have selected and installed your antenna, connect its lead-in to the coaxial jack on the rear panel.

DC POWER

Your Transceiver is designed to operate from a 12.6-volt DC source such as the Heathkit Model PSA-9 Accessory Power Supply, an automobile battery, or other stable source that will supply 12.6 volts at 1 ampere. If you have the Model PSA-9 Power Supply, its output connector will plug directly into the DC POWER connector on the rear panel of your Transceiver.

For connection to a car battery or other 12.6-volt source, refer to Detail 7-1A and perform the following steps.

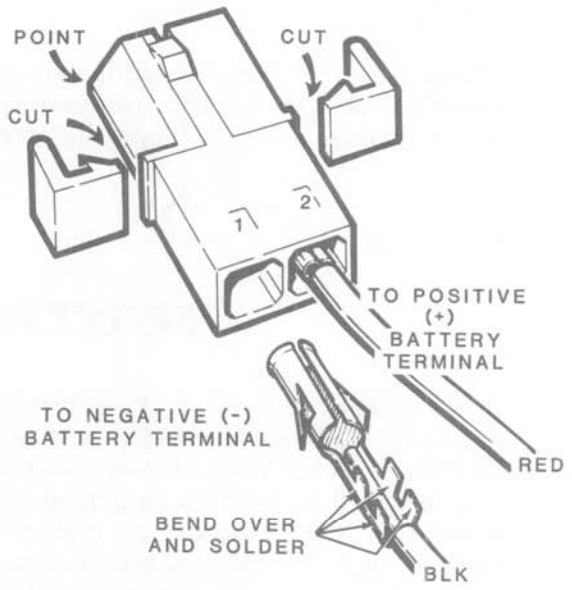
( ) Locate the 2-pin plug shell and two female connector pins that were supplied with your Transceiver kit. Then cut the ears from the connector shell as shown.

( ) Prepare a red wire and a black wire (preferably 16 gauge), long enough to reach from the Transceiver to your power source. Remove 1/4" of insulation from one end of each wire and install a female connector pin on the end of each as shown in the Detail.

( ) Position the 2-pin plug shell with its point as shown; then insert the pin on the end of the black wire into the hole at the pointed end. The pin is properly seated when it snaps into the shell.

( ) Similarly, insert the pin of the red wire into the other hole.

( ) Twist the wires to form a 2-conductor cable. Then remove sufficient insulation from the end of each wire to attach whatever battery connectors you will use, or to connect the wires directly to your source terminals.



Detail 7-1A

( ) Connect the black wire to the negative (−) source and the red wire to the positive (+) source.

CAUTION: Before you connect your power source to the Transceiver, recheck the connections to be sure the negative (−) source connects to the pointed end of the connector and the positive (+) source to the flat end. Reversed polarity will damage the Transistors in your Transceiver.

( ) Plug the connector into the DC POWER connector on the rear of your Transceiver.

NOTE: If you use your Transceiver in a boat or car, keep the power supply leads as short as possible to help reduce ignition noises. You may need to install a "hash filter" if the interference is severe. The ARRL Handbook contains valuable information on noise filtering.

SPEAKER

For loudspeaker listening, connect a 4- to 8-ohm speaker to the SPEAKER socket on the rear panel.

HEADPHONE

For headphone listening, plug your headphones into the HEADPHONE jack. The speaker is automatically cut off when a plug is inserted into the HEADPHONE jack.

KEY

Connect your telegraph key or keyer to the phono socket marked KEY. If one contact of your key connects to its frame, be sure to connect that lead to the outer shell of the phono jack. NOTE: There is a positive voltage present at this jack.

FRONT PANEL CONTROLS

Pictorial 7-2 (Illustration Booklet, Page 36) shows the front panel switches and controls, and briefly describes their function. The following paragraphs discuss the use of these controls in normal operation. As you read this discussion, set each switch and control to the indicated position. Be sure you have connected a power source to the DC POWER connector on the rear panel and have turned on the power source.

AF GAIN/OFF — Turns the Transceiver off and on and sets the audio level for comfortable listening.

Rotate the AF GAIN control clockwise to about the mid-point. You can readjust this control later if the audio level is too loud or too soft.

BAND switch — Selects the band for receiving and transmitting. These are the 80-, 40-, 20-, and 15-meter bands for the basic Transceiver, and also include the 30-, 17-, 12-, and 10-meter bands if you have the Model HWA-9 Accessory installed.

Set the BAND switch to the band you desire.

SELECTIVITY — Selects wide or narrow selectivity as an aid in tuning out unwanted signals on either side of the desired frequency.

Set the SELECTIVITY switch to WIDE for now. You can later change to NARROW to eliminate adjacent channel signals.

RIT — This control allows you to tune your receiver to a frequency that is up to 1 kHz above or below the transmitter frequency.

Set the RIT control to its midposition (detent).

TUNING DIAL — Selects the receive and transmit frequency. This dial is calibrated in divisions from 0 to 250, with each small mark indicating 5 kHz and each longer mark indicating 10 kHz. Thus, on the 80-meter band, for example, a tuning dial setting of zero corresponds to a frequency of 3.500 MHz, while one small division above zero corresponds to 3.505 MHz, etc.

Use the TUNING DIAL to tune in a station. Then calculate its frequency by adding the dial divisions to the band's base frequency.

RELATIVE SIGNAL — This meter is marked 0 to 60 and indicates relative signal level in S-units for received signals, and relative power when transmitting.

CW LEVEL — Adjusts the level of RF output supplied to the antenna.

Key the transmitter and adjust the CW LEVEL control to the point where the meter indication just stops increasing. Never, however, adjust this control so the RELATIVE SIGNAL meter indicates higher than 40. Then release the key. NOTE: An indication of 40 (half scale on 10 meters) results in rated power output (approximate).

Your Transceiver is now ready for "on-the-air" operation. Review the preceding operating control descriptions and become familiar with them by tuning in different stations and trying to make contact.

This completes the "Installation and Operation."

IN CASE OF DIFFICULTY

Begin your search for any trouble that occurs after assembly by carefully following the steps listed below in the "Visual Checks." After you complete the "Visual Checks," refer to the Troubleshooting Charts.

NOTE: Refer to the "Circuit Board X-Ray Views" (Illustration Booklet, Page 37) for the physical location of parts on the circuit boards.

VISUAL CHECKS

1. Recheck the wiring. Trace each lead with a colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something that you have consistently overlooked.

2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered as described in the "Soldering" section of the "Assembly Notes" on Page 6. Be sure there are no solder "bridges" between circuit board foils.

3. Check to be sure all transistors and diodes are in their proper locations. Make sure each lead is connected to the proper point. Make sure each diode band is positioned above the band printed on the circuit board.

4. Check electrolytic capacitors to be sure their positive (+) mark is at the correct position.

5. Check to be sure each IC is properly installed in its socket, and the pins are not bent out or under the IC. Also be sure the IC's are installed in their correct positions.

6. Check the values of the parts. Be sure in each step that you wired the correct part into the circuit, as shown in the Pictorial. It would be easy, for example, to install a 68 kΩ (blue-gray-orange) resistor where a 6800 Ω (blue-gray-red) resistor should be installed.

7. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

8. A review of the "Circuit Description" may also help you determine where the trouble is.

If you still have not located the trouble after the "Visual Checks" are complete, and a voltmeter is available, check voltage readings against those shown on the Schematic. Read the "Precautions for Troubleshooting" before you make any measurements. NOTE: All voltage readings were taken with a high impedance voltmeter. Voltages may vary as much as ±20%.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of this Manual. Your Warranty is located inside the front cover.

PRECAUTIONS FOR TROUBLESHOOTING

1. Use caution when you test IC and transistor circuits. Although they have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage or current than other circuit components.

2. Be sure you do not short any terminals to ground when you make voltage measurements. If the probe should slip, for example, and short across terminals or voltage sources, it is very likely to cause damage to one or more IC's, transistors, or diodes.

CHECKING TRANSISTORS AND DIODES

SILICON BIPOLAR TRANSISTORS

To check a transistor accurately, you should use a transistor tester. However, if one is not available, you can use an ohmmeter to determine the general condition of any one of the bipolar transistors in this kit. The ohmmeter you use must have at least 1 volt DC at the probe tips to exceed the threshold of the diode junctions in the transistor you are testing. Most vacuum tube voltmeters meet this requirement.

To check a transistor with an ohmmeter, proceed as follows:

1. Remove the transistor from the circuit.

2. Set the ohmmeter to the R × 100 range.

3. Connect one of the ohmmeter test leads to the base (B) of the transistor. Touch the other meter lead to the emitter (E) and then to the collector (C). Both readings should be the same, but may be either high or low. If one reading is high and the other low, the transistor should be replaced. (Use the Identification Chart on Page 102 to identify the transistor leads).

4. Interchange the test leads and repeat step 3.

NOTE: In the unusual case when the readings are all low, or all high, no matter which ohmmeter lead is connected to the base, the transistor should be replaced.

MOSFETS

An insulated gate type MOSFET is used at Q107 on the oscillator circuit board. Usually, any defect in these devices is an internal short circuit between the source and one of the gates. You can check them in the circuit with a high impedance voltmeter (10 megohms or higher). An abnormally low source voltage may indicate an internal short circuit.

DIODES

To check a diode, unsolder one end from the circuit board, pull the lead up and out of the circuit board hole, and proceed as follows:

1. Set the ohmmeter to the R × 1000 range.
2. Connect one of the ohmmeter test leads to the lead at the cathode (banded) end of the diode. Connect the other test lead to the other diode lead. Note the meter reading. Then interchange the meter leads and take another reading. One reading should be high and the other low (at least 10:1). If both readings are either high or low, the diode should be replaced.

TROUBLESHOOTING CHARTS

The following chart lists problems and possible causes of some troubles you might encounter. If a particular part is mentioned (Q103 for example) as a possible cause, check that part and other components connected to it to see that they are installed and/or wired correctly. Also check for solder bridge and poor connections in the surrounding area. It is also possible, on rare occasions, for a part to be faulty and require replacement.

CONDITION	POSSIBLE CAUSE
RIT Problem	
No control of RIT.	1. Q103, Q104. 2. Diode D118. 3. Broken wire or poor connection to RIT control or points D or C on the oscillator board.
S-Meter and Power Indicator Problems	
RF out but no power reading, S/Units okay.	1. Missing jumper at W415. 2. D408.
No S/Units or power reading, Transceiver operates okay.	1. Q302. 2. No 9-volt supply to Q302. 3. Meter wiring.
No S/Units reading, Transceiver operates okay.	1. D306.
Sidetone Problems	
No sidetone, receiver okay.	1. U304 not seated in socket. 2. D312. 3. Shorted cable, sidetone out. 4. Setting of Sidetone Level control (R368).

General Receiver Problems

No audio output, sidetone present, transmit okay but meter not working in receive.	1. U301. 2. AGC (pin 5 of U301) too high. 3. AGC Threshold (R329) misadjusted. 4. U302, Q301, D301, D302. 5. No R12 Volts on D301. (Q407, Q408). 6. L308 open.
No audio output, sidetone present, transmits okay, meter okay in receive.	1. U303, U304. 2. Shorted cables to Selectivity switch.
No audio or sidetone, meter okay in transmit and receive.	1. U303, U306. 2. Phone jack wiring, cables shorted.
Weak or low audio on all bands, transmits okay.	1. D301, D302, open L303. 2. Q301, U301, FL301. 3. T404 incorrectly wired or shorted. 4. D403, D404, D407. 5. AGC (R329) misadjusted.
Poor receiver sensitivity.	1. Q107. 2. Q301.

General Transmitter Problems

Low or no RF output on all bands, receive and sidetone okay.	1. CW Level control wiring. 2. Low or no TX Out from BFO (see "BFO Problems"). 3. D401, D402, L421. 4. Q401 through Q406.
No RF output or sidetone, receive okay.	1. Q408. 2. No T12 volt supply. 3. Wiring at Key jack or T/R board. 4. Broken lead in key cable.

Transmit and Receive Problems

No transmit or receive on any band, sidetone okay.	1. 9-volt supply, U402. 2. Antenna or cable connection. 3. Bandswitch wafer misaligned. 4. No HFO output (See "HFO Problems"). 5. Q101, Q107. 6. No BFO output (See "BFO Problems"). 7. Mixer filters.
No transmit or receive – one band.	1. HFO oscillator, mixer filter. 2. Band switch or switched 9-volt supply to oscillator. 3. Bandpass filter misaligned.

HFO Problems

No HFO signal, 80, 40, 30*, 20-meter bands.	1. D121 through D128. 2. Q108. 3. Jumpers W101, W102.
No HFO signal, 17*, 15, 12*. 10-meter* bands.	1. D129 through D137. 2. Wrong value capacitors at Q109. 3. Q109. 4. Jumper W104.
No HFO signal on any band.	1. Q111. 2. Open L133. 3. R173 misadjusted.
No HFO signal, one band.	1. Switched 9-volt supply. 2. Diode in defective circuit. 3. Misaligned oscillator tank circuit.

VFO Problems

No VFO output.	1. Q102, Q105, Q106. 2. L118 installed incorrectly. 3. Wrong values, C182 through C187. 4. VFO C1 not connected to hole E, or shorted to shield.

BFO Problems

No BFO signal at TP104.	1. Q112, Q113. 2. D142.
No TX/out signal, okay at TP104.	1. Q114, Q115. 2. D143. 3. CW Level control miswired. 4. No +T12 volts on CW Level control.
Improper or no transmit shift.	1. L134 open. 2. D141. 3. Wrong value of C205.

* WARC bands are part of the Model HWA-9 Accessory.

Mixer Filter Problems

No signal output at INJ/OUT.	1. Shorted cable to INJ/OUT. 2. Q101. 3. D101 through D117.
No signal, one band.	1. Improper alignment. 2. Defective filter. 3. Solder bridge on coil. 4. Diode in defective band.

SPECIFICATIONS

GENERAL

Frequency Readout	Analog dial.
Readout Accuracy	5 kHz divisions.
VFO Frequency Tuning Bandwidth	250 kHz minimum.
Tuning Backlash	Less than 100 Hz.
Frequency Tuning Rate	Approximately 40 kHz per knob revolution.
Frequency Coverage 80	3.5 MHz – 3.75 MHz.
40	7.0 MHz – 7.25 MHz.
30	*10.0 MHz – 10.25 MHz.
20	14.0 MHz – 14.25 MHz.
17	*18.0 MHz – 18.25 MHz.
15	21.0 MHz – 21.25 MHz.
12	*24.750 MHz – 25.0 MHz.
10	*28.0 MHz – 28.25 MHz.
Frequency Stability	Less than 150 Hz per hour after 30-minute warmup.
Power Requirement	11 – 16 VDC at 1 ampere (12.6 V specified).

* WARC bands are part of the Model HWA-9 Accessory.

Operating Temperature Range	0° to 40° C. All specifications referenced to 12.6 VDC at 25° C.
Front Panel Meter	Relative S-units in receive, relative power in transmit.
Modes – Transmit/receive	CW only.
Front Panel Controls	AF Gain with power off/on, Band switch, RIT control, Audio Filter wide/narrow, CW Level (drive), Main Tuning.
Rear Panel Connections	DC Power, Speaker, Headphones, Antenna, Key, Ground.
Optional Accessories	Model PSA-9 Accessory Power Supply. Model HWA-9 Accessory Band Pack.
Dimensions	4-1/4" H × 9-1/4" W × 8-1/2" D (10.8 × 23.5 × 21.6 cm).
Weight	4.7 lbs (2.1 kg).

RECEIVER

Sensitivity	Less than .5 μV for 10 dB S+N/N. Less than .2 μV for readable signal.
Selectivity, CW Audio Filter	Narrow – 250 Hz maximum at 6 dB. Wide – 1 kHz maximum at 6 dB.
Passband Center Frequency	700 Hz (approximate).
Audio Output	1 watt into 8-ohm load.
Dynamic Range	85 dB, measured in the Narrow filter mode.
Image rejection	60 dB minimum.
IF Rejection	60 dB minimum.
Internally Generated In-Band Spurious	Typically below 2 μV except at 3.695, 7.166, 10.150, 14.041, 14.083, 21.195, 21.249, 28.089, and 28.093 MHz.
Audio Hum and Noise	At least 60 dB below maximum output.
RIT	±1 kHz.

TRANSMITTER

RF Output Power	CW, 4 watts on all bands except 3 watts on 10 meters.
Transmitter Frequency Offset	700 Hz lower on all bands (approximate).
Antenna Load Impedance	At least 90% of rated power with less than 2:1 SWR. Protected against high SWR.
Harmonic Radiation	−35 dB minimum, at rated output.
Spurious Radiation	−40 dB minimum, at rated output.
T/R Operation	CW : Full break-in.
CW Sidetone	700 Hz (approximate) to speaker or headphones. Output level internally adjustable.

CIRCUIT DESCRIPTION

Refer to the Schematic (fold-in) while you read the following information. The component numbers are arranged in the following groups to help you locate specific parts on the schematic, circuit boards, and chassis.

1 – 99	Parts mounted on the chassis.
101 – 299	Parts mounted on the oscillator circuit board.
301 – 599	Parts mounted on the T/R circuit board and the RF probe.

RECEIVER SIGNAL FLOW

During receive, the incoming signals that are present at the antenna connector pass through a low-pass filter on the T/R (transmit/receive) circuit board. The Band switch selects the proper filter, which rolls off the high frequencies on each band. A diode switch routes this filtered signal through a bandpass filter. The resulting signal is mixed with a premix signal to produce an 8.83 MHz IF signal.

The 8.83 MHz IF signal is routed through another diode switch; then it is amplified and passed through a 4-pole IF filter. The signal is amplified again before it is routed to the product detector. An AGC (automatic gain control) voltage is produced at this point to keep the 2nd IF amplifier operating linearly.

The product detector converts the 8.83 MHz IF signal to audio frequencies, which then pass through either a wide or a narrow audio-active filter. An audio frequency amplifier then amplifies this filtered signal so it can drive an 8-ohm speaker or a set of headphones.

TRANSMITTER SIGNAL FLOW

Although the transmitter signals flow in a direction that is opposite to the receiver, the stages for both modes are very similar.

During CW transmissions, an 8.8307 MHz signal is coupled to the 2nd mixer where it is mixed with a premix signal from the oscillator circuit board to produce the desired transmitter signal. This signal is then filtered by the same bandpass filters that are used during the receive mode before it is pre-amplified and applied to the power amplifier.

The power amplifier is made up of two transistors in parallel to produce an RF output signal. This signal is filtered by the proper low-pass filter for the selected band to reduce harmonic radiation before it is applied to the antenna.

The following sections describe the operation of each circuit in greater detail.