MODEL HW-104 Single Sideband Transceiver

HEATHKIT®

OPERATION MANUAL

HEATH COMPANY · BENTON HARBOR, MICHIGAN

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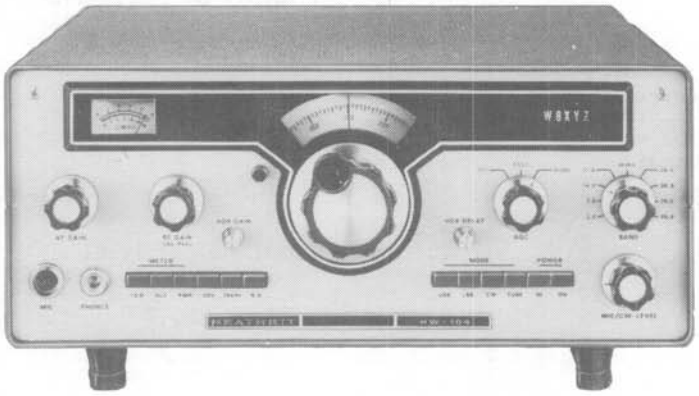
Operation
of the

HEATHKIT®

SINGLE SIDEBAND TRANSCEIVER

MODEL HW-104



HEATH COMPANY
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TABLE OF CONTENTS

TESTS AND ADJUSTMENTS
General Information 3
Preliminary Tests and Adjustments 5
Receiver Alignment 11
Transmitter Tests and Adjustments 18

FINAL ASSEMBLY 25

INSTALLATION
Fixed Station Installation 27
Mobile Station Installation 29

OPERATION
Control Functions 35
Tune-up 37
Receiving 38
Transmitting 39
Typical Operating Characteristics 40

TROUBLESHOOTING
Introduction 41
Localizing the Trouble 42
VFO/Buffer Troubleshooting Guide 42
Receiver Troubleshooting Guide 44
Transmitter Troubleshooting Guide 46
Voltage and Continuity Checks 48
Test Chart 49
Checking Transistors and Diodes 50

MAINTENANCE 51
Identification Charts 53
Circuit Board Service Policy 57
Calibrator Circuit Board 59
VFO and Buffer Circuit Boards 62
HFO/Premixer Circuit Board 66
Transmitter Audio/Reg Circuit Board 71
Transmitter IF Circuit Board 76
Driver Circuit Board 81
VFO Filter Circuit Board 84
ALC/Output Filter Circuit Board 86
Carrier Generator/Xtal Filter Circuit Board 90
Receiver Front End Circuit Board 95
Receiver IF/Audio Circuit Board 100
Power Amplifier Circuit Board 106

SPECIFICATIONS 111

THEORY OF OPERATION 115

CHASSIS PHOTOGRAPHS 117

SCHEMATIC . . . . . Fold-in

WARRANTY . . . . . Inside front cover

CUSTOMER SERVICE . . . . . Inside rear cover

TESTS AND ADJUSTMENTS

GENERAL INFORMATION

You should have only the VFO filter circuit board under the chassis and the circuit boards in the VFO assembly connected or installed at this time. You will install the remaining circuit boards as part of the "Tests and Adjustments" section of this Manual.

If you do not get the expected results after you insert each circuit board, refer to the boxed "Possible Cause Chart" which follows. If none of the difficulties listed is the cause of the malfunction, refer to the appropriate parts of the "Troubleshooting" and "Maintenance" sections.

A push-to-talk switch, as found on many microphones, is a convenient way to key the transmitter in the following steps. If your microphone cord is not already wired to an Amphenol 80MC2M connector (furnished with this kit) you should refer to Figure 2-5 in the "Installation" section of this Manual for the necessary wiring diagram.

When a voltmeter is required, use a meter which has a high input impedance (one megohm or more).

Refer to Figure 1-1 for the front panel locations and to Figure 1-2 for the rear panel connections.

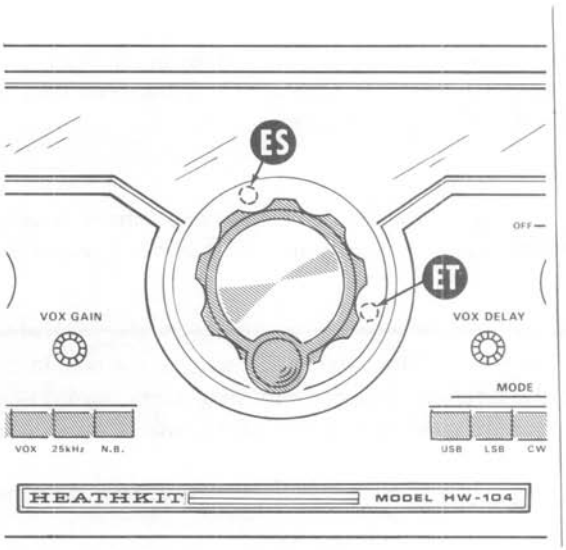


Figure 1-1

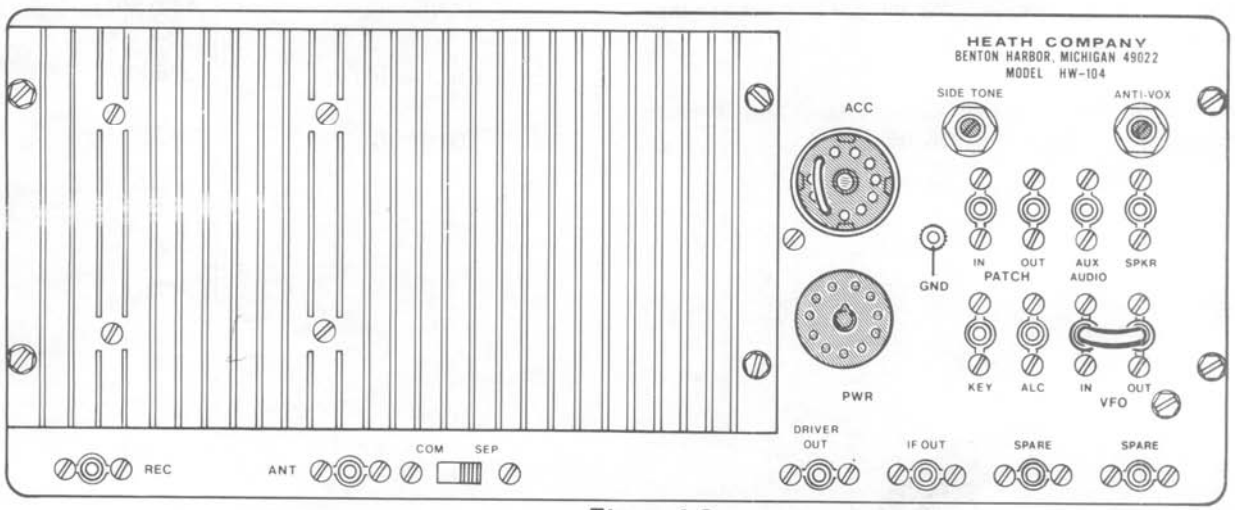


Figure 1-2

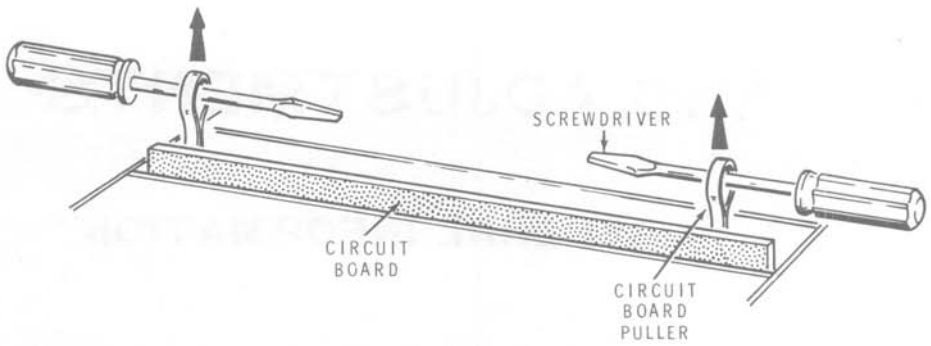


Figure 1-4

Refer to Figure 1-3 (in the "Illustration Booklet") to identify circuit boards, controls not mounted on the chassis, and some adjustment locations.

If you have difficulty in removing a circuit board, use screwdrivers in the board pullers as shown in Figure 1-4.

IMPORTANT: After you install any of the plug-in circuit boards, carefully inspect both sides to be sure no circuit component touches a metal shield, which could cause a short circuit.

PUSHBUTTON OPERATION

The pushbuttons on switches SW2 and SW3 operate in the following ways:

1. Push in to latch. To release, push again and remove your finger. Example: the ON switch.
2. Push in to latch. To release, depress another button in the same group. Example: the USB, LSB, CW group.
3. To release a depressed button in a group, gently push another button in the same group until the depressed button releases.

READING THE TUNING DIAL

The tuning dial is calibrated in divisions from 0 to 500. Each division represents 5 kHz. The dial reading (in kHz) is added to the BAND switch setting (in MHz) to determine the frequency to which the Transceiver is tuned. For example:

BAND switch	14.0 MHz
Dial reading	235 kHz
Frequency	14.235 MHz

PRELIMINARY TESTS AND ADJUSTMENTS

CHASSIS

( ) Depress the 13.8 and the USB pushbuttons on the front panel. All other pushbuttons should be released (out).

( ) Push the 11-pin socket on the power supply cable onto the PWR plug on the rear panel of the Transceiver. Make sure the keyway in the socket mates with the key on the plug.

( ) Connect the power supply to an electrical outlet.

( ) Depress the ON button until it latches. The pilot lamps should light and the meter should read halfway between 12 and 15 on its upper scale (13.8 volts).

( ) Depress the ALC button. The meter should read 0.

( ) Depress the PWR button. The meter should read 0.

( ) Release the ON button. It will require a few seconds for the power supply voltage to bleed down.

POSSIBLE CAUSE CHART

1. Pilot lamps do not light.
   - A. Power supply switch at OFF position.
   - B. Power plug wired incorrectly.
   - C. Power cable from power supply wired incorrectly.
   - D. Defective POWER switch.
   - E. In mobile installation, polarity of the power supply leads reversed.
   - F. Defective power supply.
   - G. Q1 installed incorrectly.

2. Meter does not read 13.8 volts.
   - A. Meter defective.
   - B. Meter switch wiring incorrect.
   - C. Chassis wiring incorrect.
   - D. 180 Ω resistor across meter missing.
   - E. Shorting wire across meter terminals not removed.
   - F. Supply voltage to Transceiver incorrect.

TRANSMIT AUDIO/REGULATOR

( ) Plug in circuit board B. Make sure it enters the two side guides properly and is pushed all the way down.

( ) Inspect both sides of the circuit board to be sure no circuit component touches a metal shield, which could cause a short circuit.

( ) Depress the ON button.

( ) On the bottom of the chassis, connect the common lead of your voltmeter to the chassis and measure approximately 11 volts DC at terminal B1.

POSSIBLE CAUSE CHART

1. 11 volts incorrect.
   - A. Chassis wiring.
   - B. IC203.
   - C. Q1.

( ) Connect your microphone to the MIC socket (see Figure 2-5 on Page 28 for microphone cable plug connections).

( ) Depress the HI button.

( ) Depress the PTT (push-to-talk) switch on your microphone (if your microphone does not have a PTT switch, short terminal 2 of the MIC connector to the chassis). You should hear a click as the relay closes, and another click when you release the switch and the relay opens.

POSSIBLE CAUSE CHART

1. T/R relay does not pull in.
   - A. Relay.
   - B. Chassis wiring of the relay circuit.
   - C. Q205, Q206, Q207, or Q208.

( ) Release the HI button.

( ) Depress the PTT switch. The relay should not operate (the PTT switch should operate the relay only when the HI button is depressed).

POSSIBLE CAUSE CHART

1. T/R relay operates in LO POWER position.
   - A. Check wiring of LO/HI POWER switch.

( ) Depress the VOX and the HI buttons.

( ) Speak into the microphone and rotate the VOX GAIN control slowly clockwise until the relay operates.

( ) Speak into the microphone and rotate the VOX DELAY control slowly clockwise until the relay holds in for the desired length of time after you cease talking and then drops out (opens).

( ) Release the VOX button.

POSSIBLE CAUSE CHART

1. VOX does not operate.
   - A. Chassis wiring.
   - B. Q203, Q204.
   - C. IC201.
   - D. D203, D204, D205.
   - E. Microphone not properly wired for VOX operation.

( ) Depress the TUNE button. The relay should click as it closes. If it does not click, check the installation of the diodes on switch SW3.

( ) Release the TUNE button.

( ) Close the relay with the PTT switch. Terminal H1 should measure .7 volts.

( ) Release the PTT switch. The voltage should be 0.

POSSIBLE CAUSE CHART

1. Voltage at H1 is not .7 volts.
   - A. D1 defective.
   - B. T/R relay wired incorrectly.

( ) Release the ON button and all other buttons.

NOTE: The microphone can be removed, if you desire.

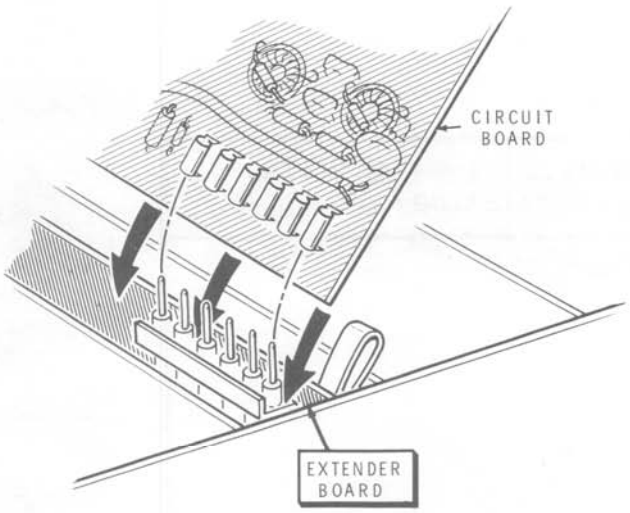


Figure 1-5

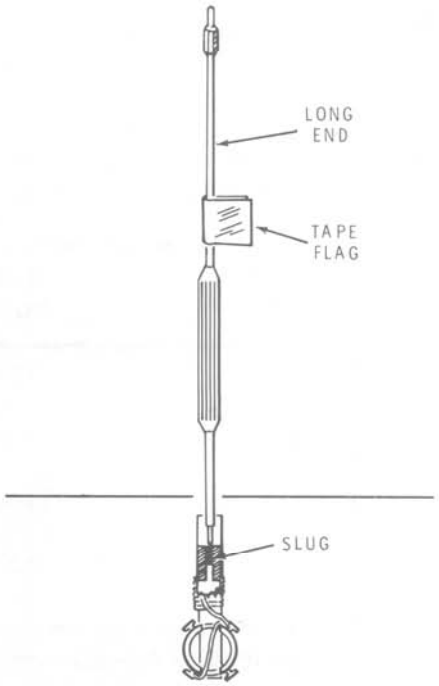


Figure 1-6

HFO COIL ADJUSTMENT

( ) Plug the extender board into compartment DD.

NOTE: Refer to Figure 1-5 for the method of plugging circuit boards into the extended board.

( ) Plug circuit board D into the extender board. First, remove the set of extender board pins on the left for which there are no sockets on board D.

NOTE: You will adjust the high frequency oscillator (HFO) coils in the following steps. Refer to Figure 1-6 for the method of inserting the alignment tool into the coil and making a "flag" out of tape for the alignment tool so you can count the turns of the tool. Rotate the tool until the voltage peaks on the meter scale. Then rotate the tool as shown in the HFO alignment chart.

( ) Set your voltmeter to its lowest +DC scale. Connect the meter common lead to the chassis and connect the other lead to the free lead of the 2200 Ω vertical resistor marked TP (near Q402).

( ) Depress the ON button.

( ) Adjust each HFO coil as described in the following chart. Before you adjust each coil for the peak voltage, turn the slug counterclockwise two full turns. Then rotate the slug further counterclockwise, if necessary, to 0 volts. Now rotate the slug clockwise for the peak voltage, which will be typically 0.2 VDC to 0.5 VDC.

BAND SWITCH	COIL NUMBER	ROTATE SLUG FOR PEAK VOLTAGE. THEN ROTATE SLUG AS DESCRIBED.
3.5	L401	1/2 turn CW*
7.0	L402	1 turn CCW**
14.0	L403	1 turn CW
WWV	L404	1/2 turn CW
21.0	L405	1 turn CW
28.0	L406	1 turn CW
28.5	L407	1 turn CW
NOTE: Perform the next two adjustments only if you have the 10 Meter Accessory installed in your Transceiver.		
29.0	L408	1 turn CW
29.5	L409	1 turn CW
		*clockwise **counterclockwise

POSSIBLE CAUSE CHART

1. HFO will not oscillate on one or more bands (meter remains at 0).
   - A. BAND switch.
   - B. Chassis wiring.
   - C. Refer to "HFO/Premixer Circuit Board" in the "Maintenance" section.

( ) Release the ON button.

( ) Disconnect the voltmeter and remove board D from the extender board.

( ) Remove the extender board.

( ) Replace the extender board pin assembly removed earlier.

( ) Plug board D into its compartment.

( ) Inspect both sides of the circuit board to be sure no circuit component touches a metal shield, which could cause a short circuit.

VFO LEVEL ADJUSTMENT

( ) Remove the VFO jumper, on the rear panel, from the VFO OUT jack. Then connect the plug on the end of the shielded cable coming from the RF probe assembly to the VFO OUT jack.

( ) Connect the alligator clip on the red wire coming from the RF probe assembly to the positive (+) meter terminal.

( ) Release all three METER pushbuttons.

( ) Connect the alligator clip on the gray wire coming from the RF probe assembly to the left side panel.

( ) Depress the ON button. The meter should read upscale.

( ) Turn the MAIN TUNING knob through its entire range and watch the meter. Then tune for the lowest meter reading.

( ) Use a screwdriver to adjust the VFO LEVEL ADJ control (R1232), on the left side of the VFO assembly for a meter reading of 6 on the bottom meter scale.

( ) Release the ON button.

( ) Disconnect the RF probe and set it aside.

( ) Reconnect the VFO jumper, on the rear panel, to the VFO OUT jack.

VFO FREQUENCY ADJUSTMENT

( ) Plug circuit board E into its compartment.

( ) Plug circuit board F into its compartment.

( ) Plug circuit board G into its compartment.

( ) Inspect both sides of each circuit board to be sure no circuit component touches a metal shield. Bend any component over slightly as necessary.

( ) Preset the front panel controls and switches as follows:

RF GAIN	Fully clockwise and pushed in.
13.8	Depressed.
AGC	Off.
BAND	21.0
USB	Depressed.

Buttons not mentioned should be released.

( ) Connect your station speaker to the SPKR phono socket on the rear panel.

( ) Depress the ON button.

( ) Turn the AF GAIN knob clockwise until you hear noise from the station speaker.

POSSIBLE CAUSE CHART

1. No sound from speaker.
   - A. Speaker connections.
   - B. AF gain control connections.
   - C. 13.8V missing at pin 19 of board F.
   - D. 11V missing at pin 17 of board F.
   - E. Refer to "Receiver IF/Audio Circuit Board" in the "Maintenance" section.

( ) If not already done, refer to Figure 1-3 and set the VFO LEVEL ADJUST control (through hole R1232 in the side of the VFO assembly) to the center of its rotation.

( ) Turn the main tuning knob clockwise until the dial stops rotating.

( ) Manually turn the square dial drive plate, located between the VFO assembly and the front panel, clockwise until the STOP mark near 500 aligns with the pointer.

( ) Turn the main tuning knob counterclockwise until the dial reads 200. Then remove the knob.

( ) Refer to Figure 1-1 on Page 3 and insert the long end of the coil alignment tool into hole ET in the front panel, and into the corresponding hole in the VFO enclosure, so the tool engages the slug in coil L1201.

NOTE: When you perform the following adjustment, you should be able to find the tone within 2 to 5 turns counterclockwise from the initial setting. If you do not hear a tone, turn the tool back and forth within this range until you find the tone. Be sure you find the loudest tone within this range.

( ) Turn the alignment tool very slowly until you hear a tone. It is not necessary to zero beat this tone.

( ) Release the ON button.

POSSIBLE CAUSE CHART

1. No tone.
   - A. Jumper cable not connected between VFO OUT and VFO IN sockets on rear panel.

( ) Plug circuit board A into its compartment. Be sure the circuit board is properly plugged onto its chassis connector and the left edge of the board is in its corresponding guide.

( ) Inspect both sides of the circuit board to be sure no circuit component touches a metal shield, which could cause a short circuit.

( ) Turn the BAND switch to 3.5 and pull out the RF GAIN knob.

( ) Replace the knob on the main tuning shaft.

( ) Depress the ON button.

( ) Turn the MAIN TUNING knob counterclockwise until the dial reads 0.

( ) If necessary, turn the MAIN TUNING slightly to either side of zero until you hear the calibrator signal. Note whether the signal occurred higher or lower in frequency than the zero mark on the dial.

( ) Return the dial to 0.

NOTE: Perform one of the next two steps. If one trimmer does not provide enough range, adjust both trimmers in the same direction.

( ) If the calibrate signal was lower in frequency, carefully adjust either VFO trimmer, through hole HJ or HK, counterclockwise until you hear the calibrator signal. Adjust the trimmer for zero beat.

( ) If the calibrate signal was higher in frequency, carefully adjust either VFO trimmer, through hole HJ or HK, clockwise until you hear the calibrator signal. Adjust the trimmer for zero beat.

( ) Turn the MAIN TUNING knob until the dial reads 500.

( ) Remove the MAIN TUNING knob.

( ) Adjust coil L1201 through hole ET slightly for zero beat.

( ) Replace the knob. Then turn the dial to 0.

( ) Adjust either VFO trimmer for zero beat.

( ) Repeat the preceding five steps as many times as necessary until zero beat occurs at zero and 500 on the dial. Be sure the last adjustment you make is to a VFO trimmer.

( ) Release the ON button.

LSB SHIFT ADJUSTMENT

( ) Preset the front panel controls and switches as follows:

BAND switch	3.5
ON	Depressed
Tuning dial	300
USB	Depressed
RF GAIN	Fully clockwise and pulled out

Buttons not mentioned should be out.

( ) Remove the MAIN TUNING knob.

( ) Turn the MAIN TUNING shaft for zero beat.

( ) Depress the LSB button.

( ) Insert a small screwdriver through hole ES in the front panel and carefully adjust capacitor C1211 for zero beat.

( ) Switch between LSB and USB and note whether zero beat occurs at the same dial setting. If not, repeat the "LSB Shift Adjustment."

( ) Replace the MAIN TUNING knob.

( ) Release the ON button.

RECEIVER ALIGNMENT

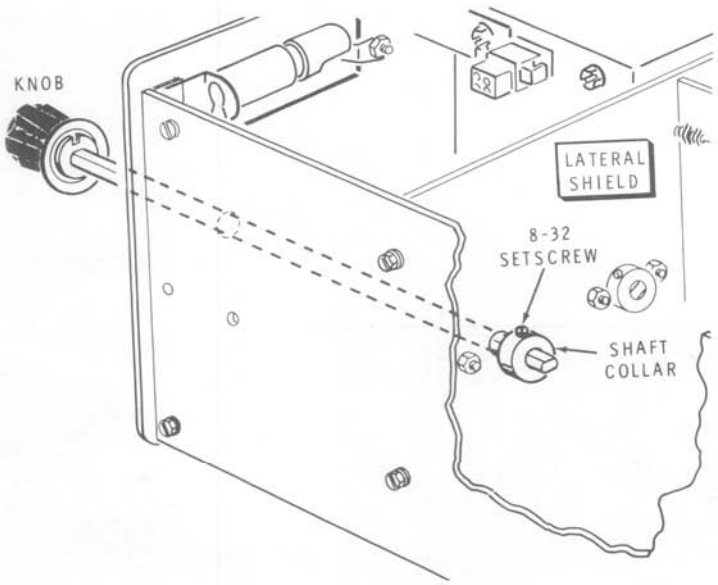
PREPARATION

Refer to Pictorial 12-37 (in the "Illustration Booklet") for the following steps.

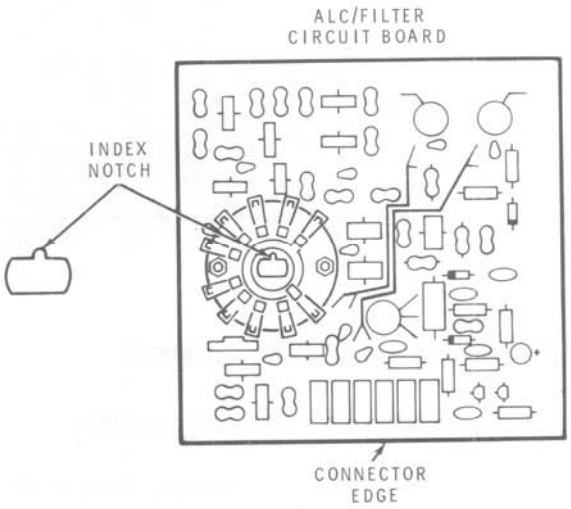
( ) Turn the BAND switch to 3.5.

( ) Loosen the setscrew in the band switch shaft collar.

( ) Refer to Detail 12-37A and pull the BAND switch knob and shaft forward until the end of the shaft extends through the lateral shield and shaft collar about 1".



Detail 12-37A



Detail 12-37B

( ) Refer to Detail 12-37B and position BOTH switch rotors on the ALC/filter circuit board so the flat sides of the openings are parallel to the connector edge of the board and so BOTH index notches point away from the connector edge.

( ) Plug the ALC/filter circuit board into connector K, just behind the lateral shield. Position the switch wafers on the side away from the front panel.

( ) Carefully push the BAND switch knob toward the front panel so the end of its shaft enters the two switch rotors on the ALC/filter circuit board. Position the circuit board up or down as required.

( ) Push the shaft collar snugly against the back of the lateral shield and tighten the setscrew against the flatted side of the shaft.

( ) Plug the OUT and IN coaxial cables coming from chassis cutout BL into the OUT and IN phono sockets on the ALC/filter circuit board.

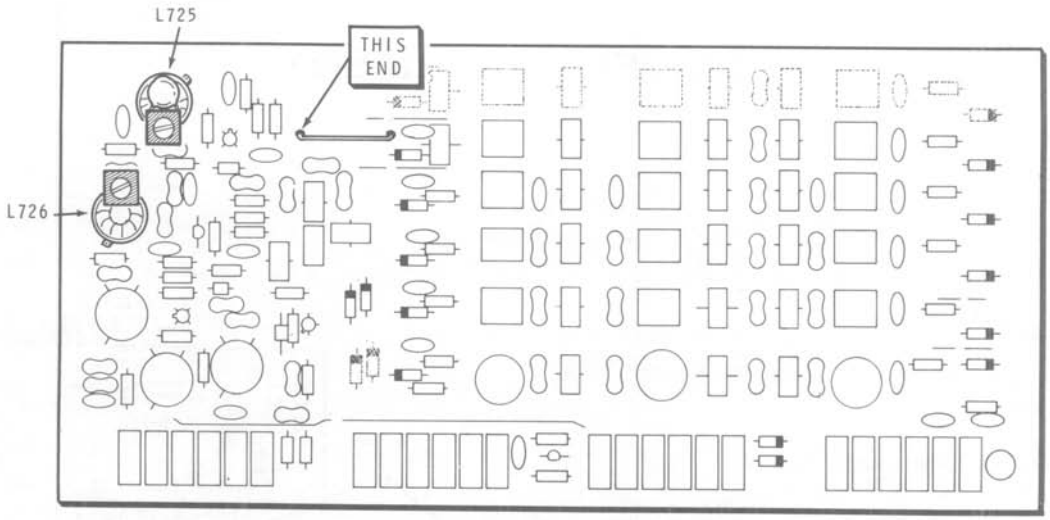


Figure 1-7A

8.65 BANDPASS FILTER ALIGNMENT

( ) Remove circuit board G from its compartment.

( ) Refer to Figure 1-7A and carefully unsolder from circuit board G the end of the jumper marked "this end." Pull the end of the jumper out of the circuit board hole.

( ) Prepare a 7-1/2" length of orange wire. Then connect the wire between the two foils indicated on the foil side of circuit board G. See Figure 1-7B.

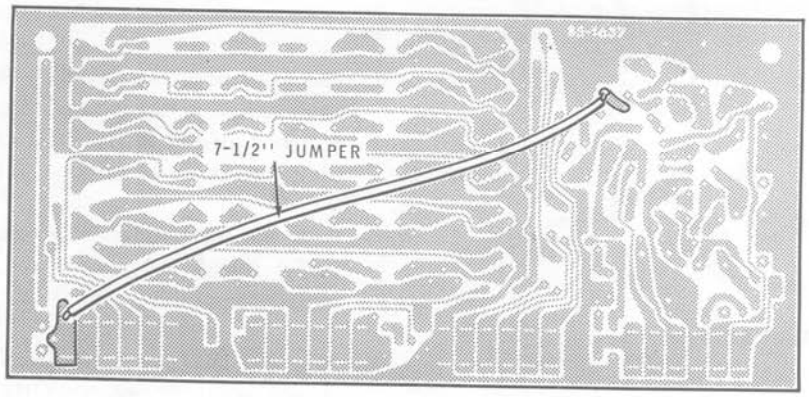
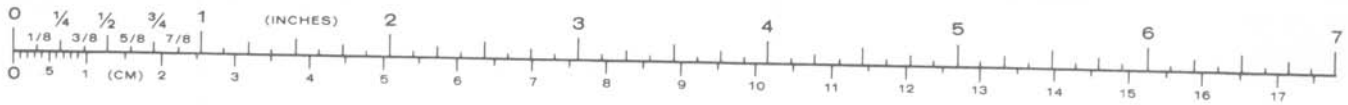


Figure 1-7B



( ) Install the extender board in compartment GG.

( ) Install circuit board G onto the extender board.

( ) Pull circuit board D up just enough to clear the connectors on the board's bottom edge.

( ) Set the front panel controls and switches as follows:

BAND	3.5
RF GAIN	Fully clockwise and pulled out.
ALC	Depressed
USB	Depressed
AGC	Fast
25 kHz	Depressed

IMPORTANT: ALWAYS turn the Transceiver OFF before you insert or remove a circuit board.

( ) Depress the ON button.

( ) Adjust the AF GAIN control for a comfortable listening level.

NOTE: When you tune the Transceiver to the calibrator signal, as in the next step, always tune for a maximum possible indication on the S meter.

( ) Tune the Transceiver to 3800 kHz. Then select the strongest calibrator signal (there may only be one) within 5 kHz of this frequency.

( ) Set the S-METER LEVEL ADJ control (see Figure 1-3 in the "Illustration Booklet") for an S-meter reading of S9+20.

( ) Tune the Transceiver to the calibrator signal near 3500 kHz.

( ) Write down the S-meter reading.

( ) Tune the Transceiver to the calibrator signal near 4000 kHz.

( ) Write down the S-meter reading.

( ) Repeat the above procedures at 3500 kHz and 4000 kHz and simultaneously adjust the trimmer capacitors on coils L725 and L726 until the two S-meter readings are as close together as you can conveniently get them. This will ensure as uniform a response as possible across the band. The readings will probably never coincide exactly. Two or three repetitions of the adjustment should be adequate.

( ) Release the ON button.

( ) Remove the wire on the foil side of circuit board G.

( ) Reinstall the free end of the jumper on the component side of circuit board G in its former position (S-1).

( ) Reinstall circuit board D.

NOTE: If you will perform the "Preselector Bandpass Filter Alignment" immediately, disregard the following two steps and leave the extender board and circuit board G in position GG.

( ) Remove circuit board G from the extender board and the extender board from compartment GG.

( ) Reinstall circuit board G in compartment GG.

PRESELECTOR BANDPASS FILTER ALIGNMENT

The object of this procedure is to adjust each bandpass filter for a uniform response across its frequency range. One filter is used for each band (unless the HWA-104-1 accessory is installed; in which case a separate filter is used for the upper two band segments of 10 meters). The alignment of a filter calls for a coarse adjustment to a center frequency, followed by equalizing adjustments at the band edges. Although the band edge responses will not be exactly equal, they will be reasonably close.

The following steps assume that the adjustment signal will be furnished by the calibrator (circuit board A) and that the S-meter will be used as a signal level indicator. You may be able to improve the filter response to a small degree if you have a signal generator and an audio voltmeter available which you can substitute as a signal source and a level indicator. The signal generator can be connected directly to the ANT jack and the audio voltmeter can be connected across the speaker terminals.

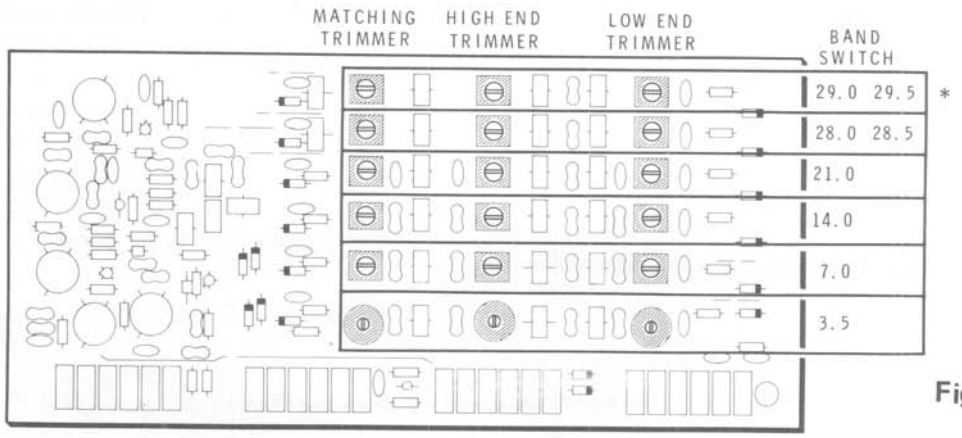


Figure 1-8

* ADJUST THESE TRIMMERS ONLY IF YOU HAVE THE HWA-104-1 ACCESSORY INSTALLED.

Figure 1-8 identifies the trimmer capacitors to be adjusted for each BAND switch position.

( ) Connect a 50 Ω dummy load to the REC jack on the rear panel (below the heat sink).

( ) Make sure the rear panel antenna switch is in the SEP position.

( ) If not already done, install the extender board and circuit board G in compartment GG.

( ) Adjust all trimmer capacitors on circuit board G so their slots are positioned as shown in Figure 1-8.

( ) Set the front panel controls as follows:

RF GAIN	Fully clockwise and pulled out
ALC	Depressed
AGC	Fast
USB	Depressed
ON	Depressed
25 kHz	Depressed

Buttons not mentioned should be released.

NOTES:

1. Use the RF GAIN control to keep the S-meter needle on the meter scale for the remainder of the "Tests and Adjustments."

2. If you have the HWA-104-1 Accessory installed in your Transceiver, proceed to "Alignment #1." If you do not have the Accessory installed, proceed directly to "Alignment #2."

3. Some of the trimmers that you will adjust, in the following steps, tune quite broadly. Watch the S-meter needle closely and adjust each trimmer slowly for the highest possible meter indication.

Alignment #1

( ) Turn the BAND switch to 29.0.

( ) Tune the Transceiver to the calibrator signal near 29,400 kHz.

( ) Refer to Figure 1-8 and adjust the three trimmers for the 29.0 band to obtain the greatest deflection of the S-meter needle. Repeat the adjustment two or three times until no greater deflection can be seen. Use the insulated screwdriver for these adjustments.

( ) Tune to the calibrator signal near 29,000 kHz.

( ) Adjust the Low End trimmer for maximum S-meter deflection and write down the reading in the margin opposite this step.

( ) Turn the BAND switch to 29.5 and tune to 29,700 kHz.

( ) Adjust the HIGH END trimmer for maximum S-meter deflection. Note the meter reading.

( ) Compare the two S-meter readings and adjust the trimmers according to the following examples:

Examples:

1. If the meter reading at 29,700 kHz is lower than the 29,000 kHz reading, adjust the LOW END trimmer to increase the reading.

2. If the meter reading at 29,000 kHz is lower than the 29,700 kHz reading, turn the BAND switch to 29.0 and tune the Transceiver to 29,000 kHz. Then adjust the HIGH END trimmer to increase the meter reading.

( ) Repeat the preceding adjustments two or three times to obtain the most uniform response.

Proceed to "Alignment #2."

Alignment #2

( ) Turn the BAND switch to 28.0.

( ) Tune the Transceiver to the calibrator signal near 28,400 kHz.

( ) Refer to Figure 1-8 and adjust the three trimmers for the 28.0 band to obtain the greatest deflection of the S-meter needle. Repeat the adjustment two or three times until no greater deflection can be seen. Use the insulated screwdriver for these adjustments.

( ) Tune to the calibrator signal near 28,000 kHz.

( ) Adjust the LOW END trimmer for maximum S-meter deflection and write down the reading in the margin opposite this step.

( ) Turn the BAND switch to 28.5 and tune to 29,000 kHz.

( ) Adjust the HIGH END trimmer for maximum S-meter deflection. Note the meter reading.

( ) Compare the two S-meter readings and tune the Transceiver, if necessary, to the frequency of the lower reading. Then adjust the trimmer initially set at the opposite end of the band until the lower reading is increased to the reading at the opposite band end.

Examples:

1. If the meter reading at 29,000 kHz is lower than the 28,000 kHz reading, adjust the LOW END trimmer to increase the meter reading.

2. If the meter reading at 28,000 kHz is lower than the 29,000 kHz reading, turn the BAND switch to 28.0 and tune the Transceiver to 28,000 kHz. Then adjust the HIGH END trimmer to increase the meter reading.

( ) Repeat the preceding adjustments, if necessary, two or three times to obtain the most uniform response.

( ) Turn the BAND switch to 21.0 and tune the Transceiver to the calibrator signal near 21,100 kHz.

( ) Tune all three trimmers for this band for maximum S-meter deflection. Repeat the adjustments for the highest S-meter reading.

( ) Tune the Transceiver to the calibrator signal near 21,000 kHz.

( ) Adjust the LOW END trimmer for maximum S-meter deflection and note the meter reading.

( ) Tune the Transceiver to the calibrator signal near 21,400 kHz.

( ) Adjust the HIGH END trimmer for the greatest S-meter deflection and note the meter reading.

( ) Tune the Transceiver to the frequency having the lower meter reading, if necessary. If the 21,400 kHz frequency had the lower meter reading, adjust the LOW END trimmer to increase the reading. If the 21,000 kHz frequency had the lower reading, tune to 21,000 kHz and adjust the HIGH END trimmer to increase the meter reading.

BAND	FREQUENCIES		
	MID-BAND (ADJ. 3 TRIMMERS)	LOW END	HIGH END
*29.0 29.5	29 400	29 000	29 700
28.0 28.5	28 400	28 000	29 000
21.0	21 100	21 000	21 400
14.0	14 200	14 000	14 400
7.0	7 100	7 000	7 300
3.5	3 800	3 500	4 000

* ADJUST THESE TRIMMERS ONLY IF YOU HAVE THE HWA-104-1 ACCESSORY INSTALLED

Figure 1-9

( ) Repeat the adjustments, if necessary, to obtain the most uniform response across the band.

( ) Follow the same procedure and adjust the bandpass filters for the 14.0, 7.0 and 3.5 bands. The trimmers for each band are shown in Figure 1-8. Refer to Figure 1-9 for the three frequencies to use for the adjustment of each filter.

( ) Turn the RF GAIN control fully clockwise.

( ) Tune the Transceiver to the calibrator signal at 3800 kHz.

( ) Set the S-METER LEVEL ADJUST control (see Figure 1-3) for an S-meter reading of S9+50.

( ) Depress the 25 kHz pushbutton. If the S-meter now reads higher than it did in the previous step, readjust the S-METER LEVEL ADJUST control for a reading of S9+50.

( ) Release the ON button.

( ) Remove the dummy load from the REC jack on the rear panel.

( ) Remove the extender board and reinstall circuit board G in compartment GG.

RECEIVER 3.395 MHz TRAP ADJUSTMENT

( ) Cut each lead of an 18 pF disc capacitor to 1/2".

( ) Locate the RF detector you set aside earlier. Then unsolder the shielded cable from terminal strip lug 1. Use the shielded cable in the next step.

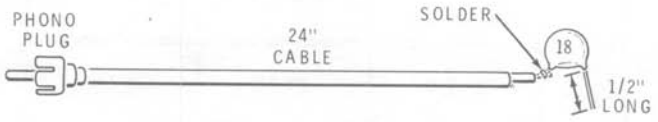


Figure 1-10

( ) Refer to Figure 1-10 and solder one lead of the 18 pF disc capacitor to the center conductor of the shielded cable as shown.

Refer to Figure 1-11 for the next five steps.

( ) Remove circuit board E from its compartment.

( ) Carefully unsolder from board E the end of resistor R645 marked "this end." Pull this lead of the resistor out of the circuit board hole.

( ) Tack solder a 1" jumper wire between the free end of resistor R645 and the indicated lead of resistor R664.

( ) Carefully unsolder from circuit board E the end of diode D603 marked "this end." Pull this lead of the diode out of the circuit board hole.

( ) Solder the free end of the 18 pF capacitor on the test cable to the free end of diode D603.

( ) Replace circuit board E into its compartment.

( ) Inspect both sides of the circuit board to be sure no component touches a metal shield, which could cause a short circuit.

( ) Insert the phono plug on the free end of the test cable coming from circuit board E into the REC jack on the rear panel. Be sure the antenna switch is in the SEP position.

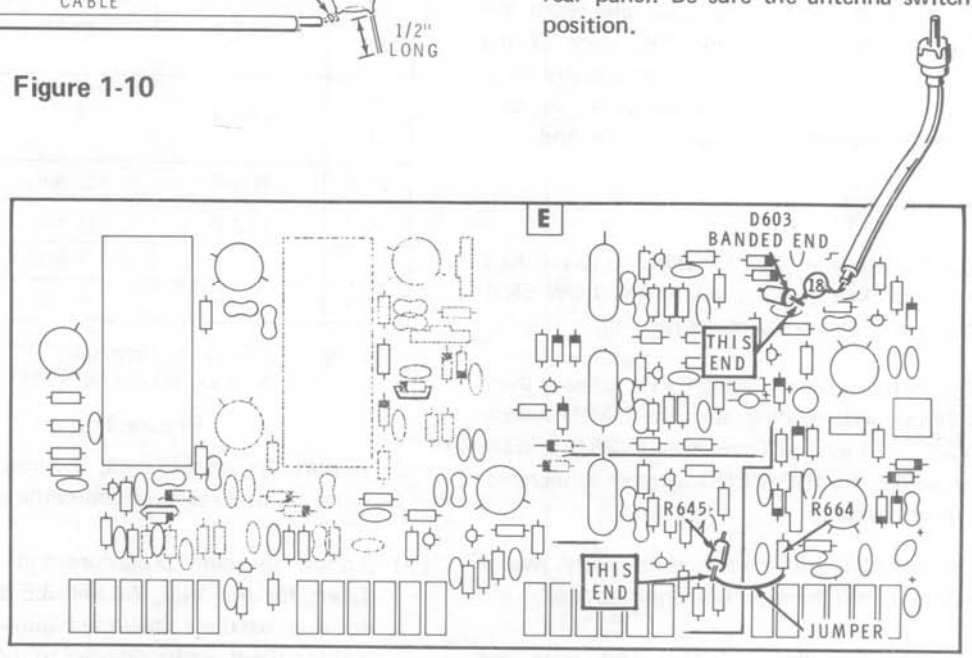
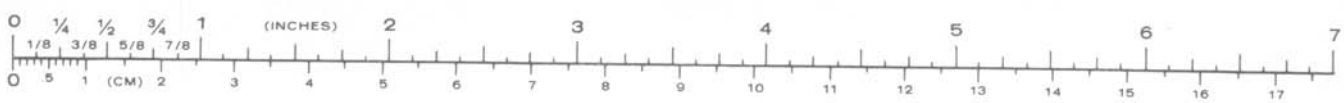


Figure 1-11



( ) Set the front panel controls as follows:

RF GAIN	Fully clockwise and pushed in
AF GAIN	As required
BAND	3.5
AGC	Off
DIAL	0
USB	Depressed
ON	Depressed

( ) Use the insulated screwdriver to adjust coil L704 on circuit board G for minimum tone coming from the speaker.

( ) Release the ON button.

( ) Remove circuit board E and reconnect the components in their original positions. Be sure to remove the test cable and the 1" jumper wire.

( ) Replace circuit board E into its compartment.

CALIBRATOR ADJUSTMENT

NOTE: You will now adjust the calibrator against the signal of station WWV, Colorado, on 15,000 kHz.

( ) Connect an antenna (suitable for the frequency of WWV) to the REC socket on the rear panel. Be sure the antenna switch on the rear panel is at SEP.

( ) Turn the BAND switch to WWV.

( ) Depress the ON button.

( ) Tune to zero beat station WWV in the vicinity of 15,000 kHz.

( ) Adjust the tuning so the voice announcements sound natural.

( ) Pull out the RF GAIN knob to turn on the calibrator.

( ) Adjust trimmer capacitor C101 on the top of circuit board A for zero beat.

POSSIBLE CAUSE CHART

1. Calibrator cannot be adjusted to agree with WWV.
   A. Y101 not within tolerance.
   B. C101 defective.

( ) Depress the 25 kHz button.

( ) Turn the MAIN TUNING knob clockwise and watch the tuning dial. You should hear the calibrate signal every 25 kHz.

POSSIBLE CAUSE CHART

1. Calibrate signal only at 100 kHz divisions.
   A. IC101 defective.
   B. Check wiring of 25 kHz switch.

( ) Release the ON button.

TRANSMITTER TESTS AND ADJUSTMENTS

LOW POWER TRANSMITTER CHECK

( ) Check coil L321 on circuit board C to be sure the coil slug is still flush with the bottom of the coil form (see Pictorial 5-12 on Page 81 of the Assembly Manual).

NOTE: When you install the circuit board in the next step, push down each end of the spring clip mounted to the coil shield until the board is completely seated.

( ) Plug in circuit board C. Visually check to make sure the peaking coils do not touch the metal shield. If necessary, bend them over enough to clear the shield.

( ) Refer to Pictorial 12-38 and mount the driver circuit board on the right side panel. Plug the circuit board into connector J and secure it to the three mounting holes at GG, GH, and GJ with 6-32 x 3/8" screws.

( ) Plug the HI and LO shielded cables coming from chassis cutout BL into their corresponding sockets on the driver circuit board.

( ) Connect a 50 Ω dummy load (capable of dissipating 100 watts) to the ANT (antenna) socket on the rear panel.

( ) Set the BAND switch to 3.5.

( ) Turn the MIC/CW LEVEL control fully counterclockwise.

( ) Turn the SIDE TONE and ANTI-VOX controls fully counterclockwise (rear panel view).

( ) Depress the ON, PWR, and TUNE buttons. All other buttons should be released.

CAUTION: Never change bands when the TUNE button is depressed.

( ) Advance the MIC/CW LEVEL control and check for power output at the middle of the band and about 25 kHz within the upper and lower band edges. The panel meter should read about 1 on the 0 to 15 (relative power) scale.

( ) Release the TUNE button.

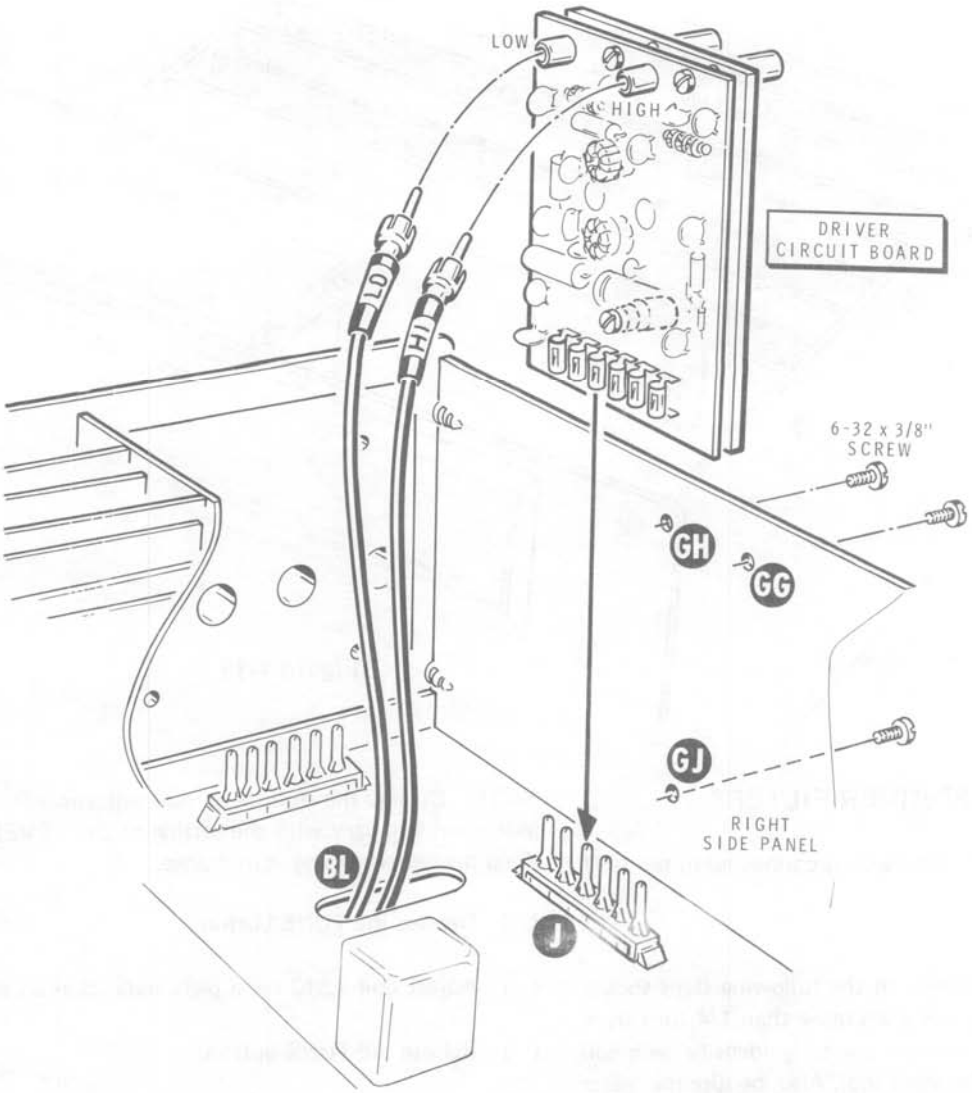
( ) Turn the BAND switch to the next higher frequency band, depress the TUNE button, and check for output in the middle of the band and at each band edge until you have checked all bands 3.5 through 21.0.

POSSIBLE CAUSE CHART

1. No meter indication.
   - A. Wiring of the meter switches.
   - B. Refer to the ALC/output filter, driver, or Transmitter IF circuit boards in the "Maintenance" section.

( ) Depress the ALC button and repeat the preceding step. The meter should show some ALC indication as you advance the MIC/CW-LEVEL control.

( ) Release the ON button.



PICTORIAL 12-38

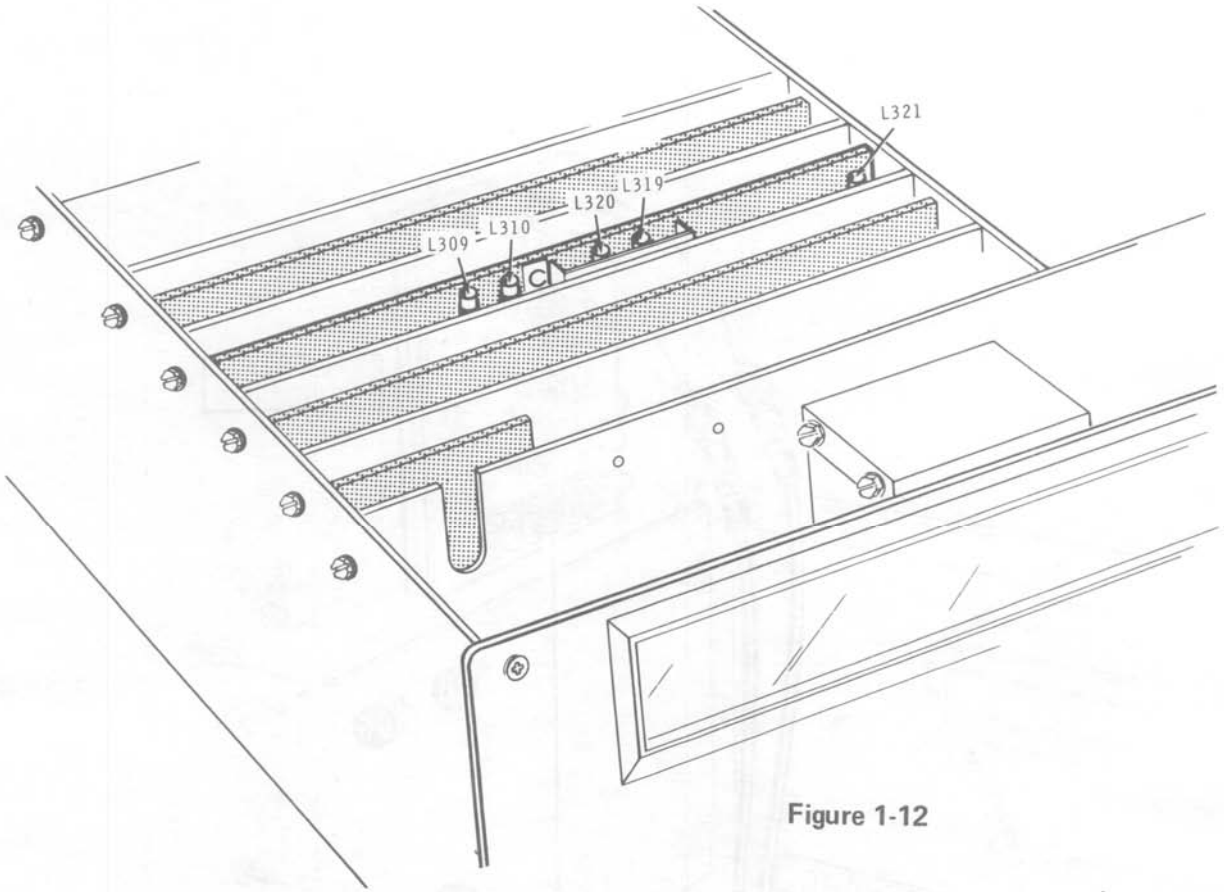


Figure 1-12

TEN METER IF/PREDRIVER FILTERS

( ) Make sure your dummy load is connected to the ANT socket.

NOTE: The coil adjustments in the following steps should not require turning the coil slugs more than 1/4 turn from the factory setting. Be sure to correctly identify each coil before you insert the alignment tool. Also, be sure the meter drops to 0 when the MIC/CW LEVEL control is fully counterclockwise.

( ) Depress the ALC and ON buttons.

Refer to Figure 1-12 for the following steps.

( ) Turn the BAND switch to 28.0.

( ) Tune the Transceiver to 28,100 kHz.

NOTE: During the following coil adjustments, the ALC indication will vary with the setting of the LEVEL control. Keep the meter reading at midrange.

( ) Depress the TUNE button.

( ) Adjust coil L310 for a peak indication on the meter.

( ) Release the TUNE button.

NOTE: If you have the HWA-104-1 Accessory installed in your Transceiver, perform the "Adjustments With 10 Meter Accessory." If you do not have the Accessory installed in your Transceiver, perform the "Adjustments Without 10 Meter Accessory."

Adjustments With 10 Meter Accessory

( ) Turn the BAND switch to 29.0 and tune the Transceiver to 29,100 kHz.

( ) Depress the TUNE button.

( ) Adjust coil L319 for a peak indication on the meter.

( ) Release the TUNE button.

( ) Turn the BAND switch to 29.5 and tune the Transceiver to 29,600 kHz.

( ) Depress the TUNE button.

( ) Adjust coils L309 and L320 for a peak indication on the meter. Repeat the adjustment until you cannot obtain a higher reading.

( ) Repeat the adjustments under "Ten Meter IF/Predriver Filters" until you are sure you have obtained the maximum reading.

( ) Release the TUNE and ON button.

( ) Proceed directly to "CW Check."

POSSIBLE CAUSE CHART

1. No ALC-indication.
   - A. Wiring of the METER switch.
   - B. Refer to the "Driver Circuit Board" in the "Maintenance" section.
   - C. Refer to "Transmitter IF Circuit Board" in the "Maintenance" section.
2. Response across one or more bands is not uniform.
   - A. Refer to "Transmitter IF Circuit Board" in the "Maintenance" section.

Adjustment Without 10 Meter Accessory

( ) Turn the BAND switch to 28.5 and tune the Transceiver to 29,000 kHz.

( ) Depress the TUNE button.

( ) Adjust coils L309, L319, and L320 for a peak indication on the meter.

( ) Release the TUNE button.

( ) Repeat the adjustments under "Ten Meter IF/Predriver Filters" two or three times until you are sure you have obtained the maximum reading.

( ) Release the TUNE and ON buttons.

POSSIBLE CAUSE CHART

1. No ALC-indication.
   - A. Wiring of the METER switch.
   - B. Refer to "Driver Circuit Board" in the "Maintenance" section.
   - C. Refer to the "Transmitter IF Circuit Board" in the "Maintenance" section.
2. Response across one or more bands is not uniform.
   - A. Refer to "Transmitter IF Circuit Board" in the "Maintenance" section.

CW CHECK

NOTE: Make sure that a 100 watt dummy load is connected to the ANT jack on the rear panel and that your speaker is connected.

( ) Plug a key into the KEY jack on the rear panel. A positive keying voltage is present at this jack so you must reverse the leads of any grid block keyer.

( ) Turn the MIC/CW LEVEL control fully counterclockwise.

( ) Turn the SIDE TONE control fully counterclockwise (rear panel view).

( ) Depress the PWR, VOX, CW, and ON buttons. All other buttons should be released.

( ) Turn the BAND switch to 7.0 and tune the Transceiver to approximately 7000 kHz.

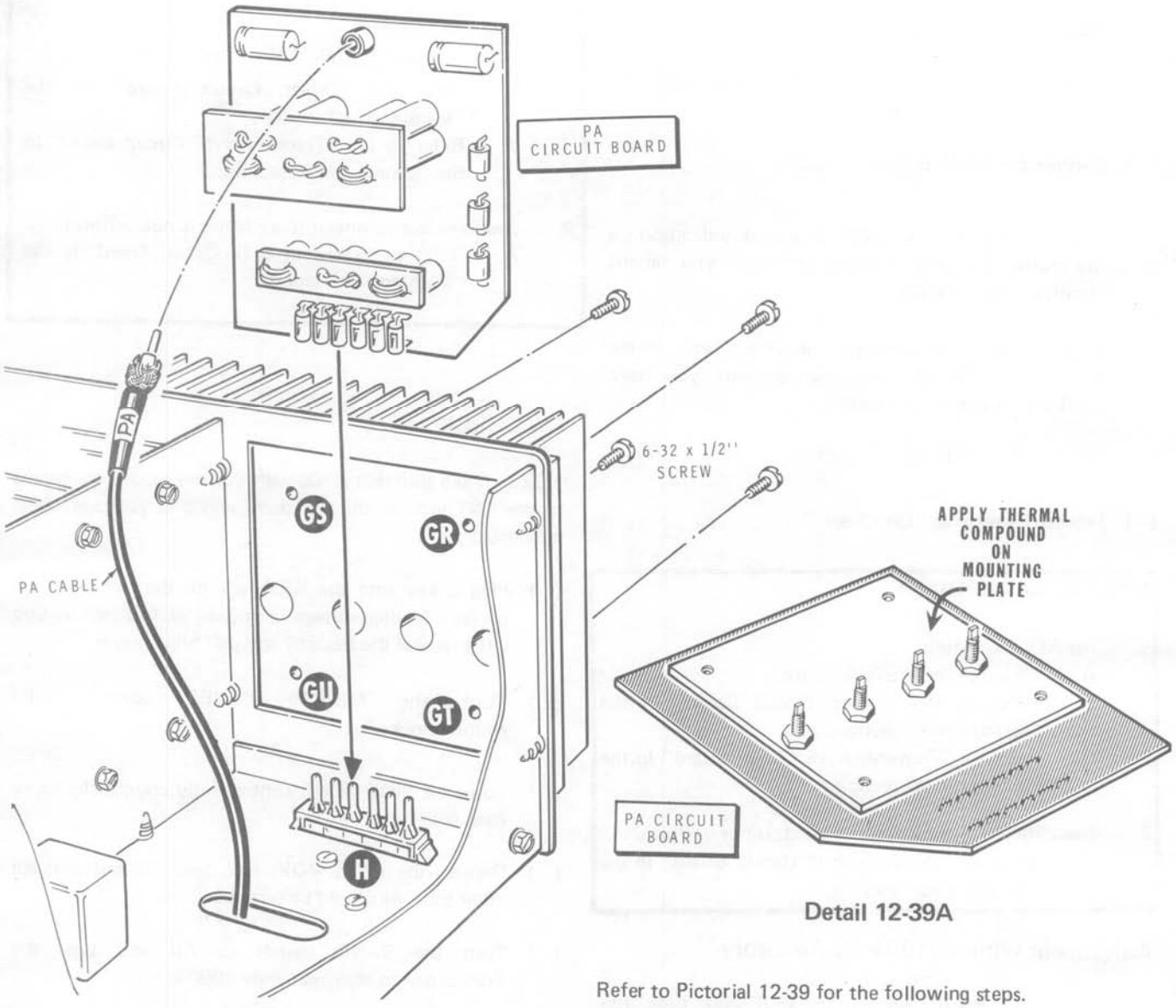
( ) Close the key. The meter should read between 1/2 and 1 as you advance the MIC/CW LEVEL control.

( ) Close the key and turn the SIDE TONE control clockwise (rear panel view) for a comfortable volume level.

( ) Release the ON button.

POSSIBLE CAUSE CHART

1. No CW output or no side tone output.
   - A. Refer to "Transmitter Audio/Reg Circuit Board" in the "Maintenance" section.



PICTORIAL 12-39

Detail 12-39A

P.A. (POWER AMPLIFIER) CIRCUIT BOARD

WARNING: You will be using Dow Corning 340 thermal heat sink compound in the next step and in several other steps in the Manual. Although the compound is not caustic, it may cause temporary discomfort if it gets into your eyes. Should this happen, rinse your eyes with warm water. If the compound gets into your clothing, the clothing may require professional cleaning. The compound contains Zinc Oxides, SiO_2, and slight traces of CO_2.

Refer to Pictorial 12-39 for the following steps.

( ) Refer to Detail 12-39A and position the P.A. circuit board with the aluminum mounting plate up. Then squeeze the contents of two thermal compound pods onto the mounting plate. Use your finger to distribute a thick coating over the plate. Keep the compound off the circuit board.

( ) WASH YOUR HANDS.

( ) Grasp the edges of the P.A. circuit board, tilt the top edge toward the front panel, and push the six circuit board connectors down onto connector H so the four power transistor studs fit into the four holes in the heat sink on the rear panel. Secure the assembly with four 6-32 x 1/2" screws at GR, GS, GT, and GU.

( ) Push the phono plug on the P.A. cable into the PA OUTPUT socket on the circuit board.

CAUTION: Check to make sure that all five cables in the P.A. compartment are properly connected. If you make an error at this point, you may have to replace the four power transistors.

( ) Set the front panel controls as follows. The position of the other controls is not important.

MIC/CW	
LEVEL	Fully counterclockwise
BAND	7.0
VOX DELAY	Fully counterclockwise

( ) Connect the 100 watt dummy load to the ANT socket.

CAUTIONS:

1. Do not exceed 30 seconds in HI power and TUNE.

2. Whenever the Transceiver is operated in both HI power and TUNE, the duty cycle requires an OFF period (receive mode) of five times the TUNE time (for example, 10 seconds TUNE followed by 50 seconds with TUNE button released). Observe this carefully in the following steps. Complete duty cycle information is shown in the "Operation" section of this Manual.

( ) Depress the following buttons; all other buttons should be released: PWR, HI, and ON.

( ) Depress the TUNE button.

( ) Advance the MIC/CW LEVEL control. The meter should read at least 10 on the upper scale.

( ) Depress the ALC button. The meter should read approximately full scale.

( ) Release the TUNE button.

( ) Perform the preceding four steps at each position of the BAND switch. (If you do not have the HWA-104-1 Accessory installed, do not make any adjustments with the BAND switch at the 29.0 and 29.5 positions.) Be careful to observe the duty cycle. There should be no output at the WWV position.

POSSIBLE CAUSE CHART

1. No output or low output.
   - A. P.A. transistors. Measure voltages as shown under P.A. on Page 48.
   - B. Transformers incorrectly wired or shorted. Use an ohmmeter to check for a short circuit from connector pins 5 and 6 to chassis.
   - C. Leads of L813 on ALC/Output Filter circuit board incorrectly wired.
   - D. Gray wire through L813 shorted.
   - E. Chassis wiring (particularly RG-58A/U).

2. No input from driver.
   - A. Check at connector pin 3 with RF probe.

( ) Release all buttons.

CARRIER SUPPRESSION

( ) Connect a 50 Ω dummy load to the ANT socket.

( ) Connect a microphone to the MIC jack.

( ) Depress the PWR, USB, HI, and ON buttons. Other buttons may be released.

( ) Turn the BAND switch to 7.0.

NOTES:

1. Key the transmitter (use the microphone PTT switch) for several short periods while you make the following adjustments. Prolonged keying of the Transceiver while you attempt to achieve an optimum setting causes an undesirable heat rise which could damage the output transistors.

2. Look down into compartment E along the right side of the circuit board and identify control R666 and trimmer capacitor C648. (See Carrier Suppression Controls in Figure 1-3). It may be necessary to bend the two disc capacitors apart to gain access to the screwdriver slot of C648.

( ) Turn the MIC/CW LEVEL fully counterclockwise.

( ) Key the transmitter for short periods and alternately adjust R666 and C648 for the best possible null (minimum meter deflection). The meter indication should be at, or near, zero.

( ) Depress the LSB button. If the meter indication is any higher, make the best possible compromise adjustment between USB and LSB.

NOTE: If you have a general coverage receiver, tune it to the carrier frequency and use its S-meter as a sensitive indication of maximum carrier suppression. If you do not have a receiver, proceed as follows:

( ) Unsolder the 18 pF disc capacitor from the 24" shielded cable (used during "Receiver Alignment"). Then resolder the free end of the cable to the bottom hole of lug 1 on the RF probe assembly (refer to Pictorial 12-36 in the Assembly Manual, if necessary).

( ) Disconnect the dummy load from the ANTENNA socket on the rear panel.

( ) Connect the phono plug on the end of the shielded cable to the ANTENNA socket on the rear panel.

( ) Connect the gray RF probe wire to the common lead of your VTVM and the red wire to the VTVM probe.

( ) Set the VTVM to a low DC range.

NOTE: Be sure to make the following adjustments carefully. Excessive RF voltage could damage the RF probe assembly.

( ) Key the transmitter and adjust C648 and R666 for the lowest possible meter indication on the VTVM. Reduce the VTVM voltage range as required while you make this adjustment.

( ) Switch between USB and LSB and adjust C648 and R666 for the best possible null in both modes.

( ) Release the ON button.

3.395 TRAP ADJUSTMENT

( ) Remove circuit board D.

( ) Preset the following controls as indicated:

BAND	3.5
LEVEL	Fully counterclockwise

( ) Depress buttons PWR, HI, and ON.

( ) Depress the TUNE button.

( ) Turn the MIC/CW LEVEL control fully clockwise.

NOTE: Carefully observe whether the meter needle moves upscale. If it does, follow procedure A; if not, follow procedure B.

Procedure A

( ) Adjust coil L321 on the right side of circuit board C (see Figure 1-12) for a null (least indication) on the meter. Turn the coil slug in a counterclockwise direction.

( ) Depress the LSB button and key the transmitter. If there is no meter indication, the adjustment is complete. If there is a meter indication, switch back and forth between USB and LSB and adjust L321 for the best possible null at both positions.

( ) Release the ON button.

( ) Reinstall circuit board D.

( ) Check the power output at 3500 kHz. If the output is less than you previously had, turn the slug of coil L321 counterclockwise just enough to return the power output to normal.

( ) Release the ON button.

This completes the "Test and Adjustments." Proceed directly to "Final Assembly."

( ) Check the power output at 3500 kHz. If the output is less than you previously had, turn the slug of coil L321 counterclockwise just enough to return the power output to normal.

Procedure B

( ) Release the ON button.

( ) Reinstall circuit board D.

( ) Depress the ON button.

( ) Tune the Transceiver to 3500 kHz.

( ) Key the transmitter and adjust the MIC/CW LEVEL control for a mid-scale meter reading.

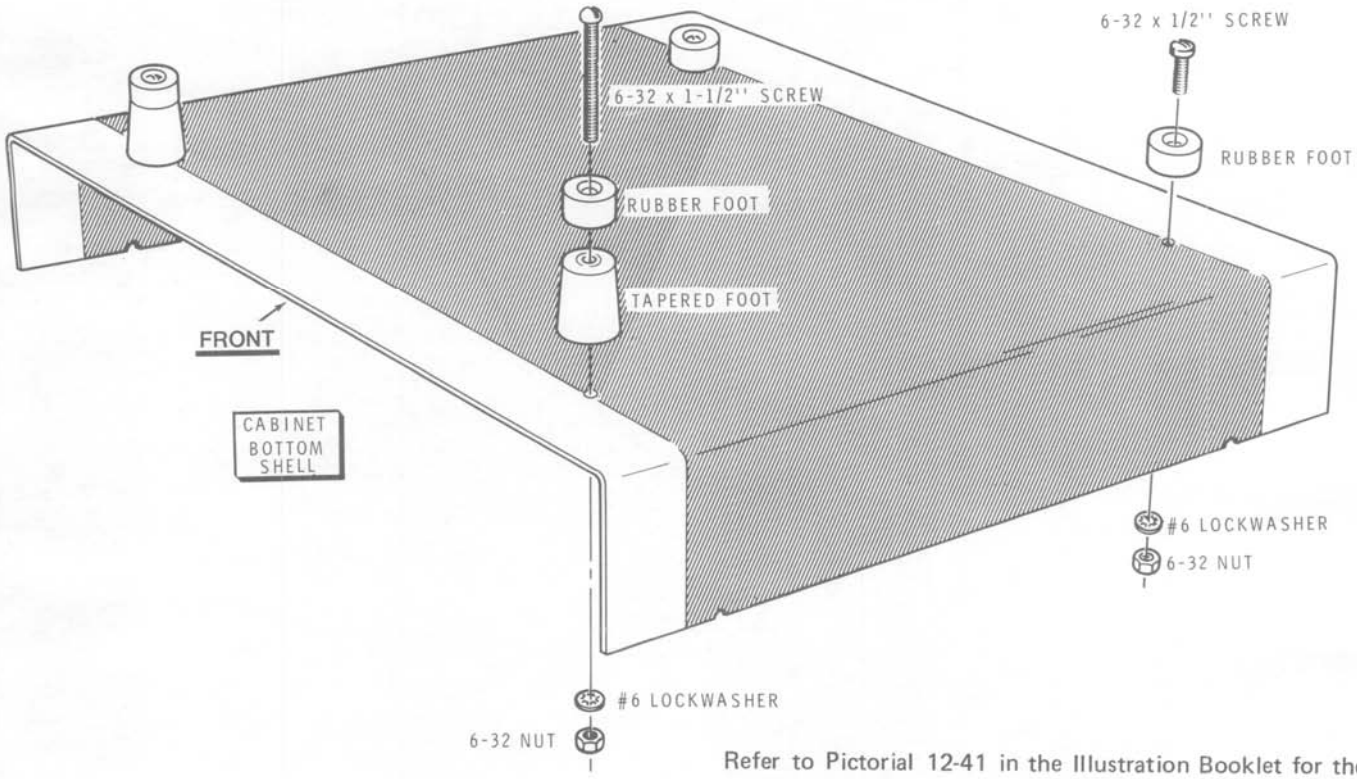
( ) Adjust the slug of coil L321 (see Figure 1-12) in a counterclockwise direction until a dip in meter indication is noticed. Continue turning the slug until the meter returns to the original reading.

( ) Adjust the slug of coil L321 clockwise until the meter indication just starts to decrease.

( ) Release the ON button.

This completes the "Test and Adjustments." Proceed to "Final Assembly."

FINAL ASSEMBLY



PICTORIAL 12-40

NOTE: The top and bottom cabinet shells are identical except that four holes are provided in the bottom shell for attaching the feet.

Refer to Pictorial 12-40 for the next two steps.

( ) If you wish to have the Transceiver cabinet sit level, install a rubber foot at each corner of the bottom cabinet shell. Use 6-32 x 1/2" hardware.

( ) If you wish the front panel tilted upward, install a rubber foot on each rear corner with 6-32 x 1/2" hardware. Install a tapered spacer and a rubber foot at each front corner with 6-32 x 1-1/2" hardware.

Refer to Pictorial 12-41 in the Illustration Booklet for the next four steps.

( ) Attach a cabinet retainer strip, with the brushed side out, to each side panel. Use a 10-32 x 1/2" screw and two #10 flat washers at holes GC and GK on the right side panel and holes GN and GP on the left panel. Leave the screws loose.

( ) Place the chassis in the cabinet bottom shell with the cabinet edge between the retainer strip and the #10 flat washers. The bodies of the 10-32 screws must rest in the half-circle cutouts in the cabinet edge.

( ) Similarly, place the top cabinet shell on the chassis with its lower edges between the retainer strip and the flat washers.

( ) Tighten the four 10-32 screws.

This completes the assembly of your Transceiver. Proceed to the "Installation" section.

INSTALLATION

The Transceiver should be placed where adequate air circulation is present in the area of the heat sink, as there is appreciable heat generated by the final transistors.

FIXED STATION INSTALLATION

NOTE: Figures 2-1, 2-2, and 2-3 are in the "Illustration Booklet."

Figure 2-1 shows basic fixed station connections. Figure 2-2 shows connections for various accessories that may be used with the Transceiver. Figure 2-3 shows the basic station connected to a linear amplifier. Cables (not furnished) can be prepared following the instructions in Figure 2-4. Make the cables to the lengths required for your installation. Several extra phono plugs are supplied with this kit.

IMPORTANT: Due to the dial calibration of the SB-644 External VFO, be careful that you operate within the amateur bands if you use that VFO with this Transceiver.

GROUNDING

A good earth or water pipe ground should be connected to the ground post on the rear apron of the Transceiver. Use the heaviest and shortest connection possible.

Before using a water pipe ground, inspect the connections around your water meter and make sure that no plastic or rubber hose connections are used which interrupt electrical continuity to the water supply line. Install a jumper around any insulating water connectors you find. Use heavy copper wire and pipe clamps. It is best to ground all equipment to one point at the operating position and then ground this point as discussed above.

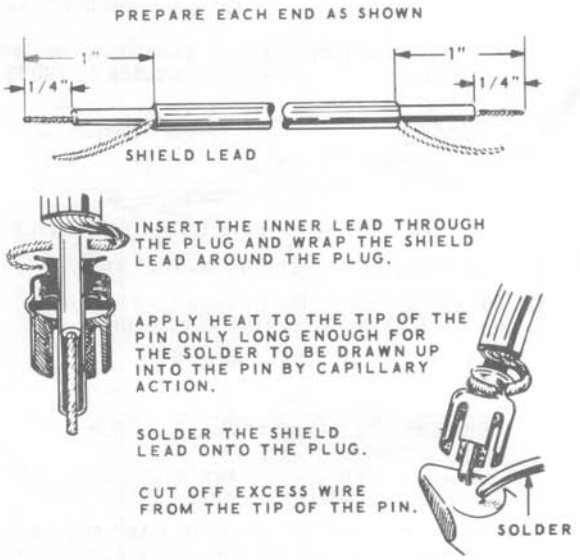


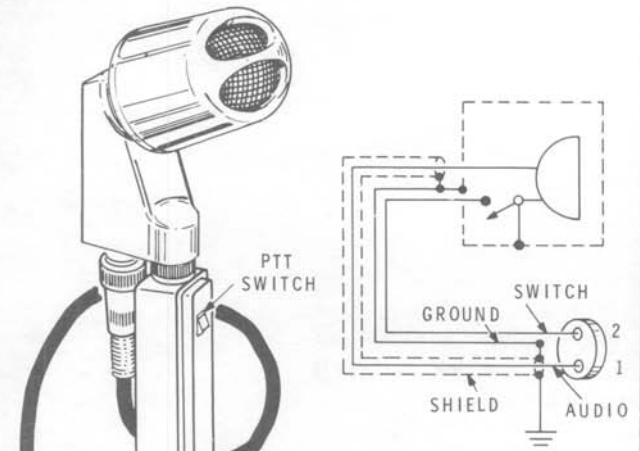
Figure 2-4

ACCESSORY PLUG

The Transceiver must have a jumper wire connected between pins 2 and 5 on the accessory plug. A cap is furnished for this plug.

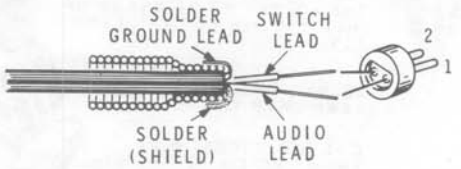
VFO IN AND OUT SOCKETS

A shielded jumper wire must be connected between the VFO IN and VFO OUT jacks unless you are using the accessory VFO.

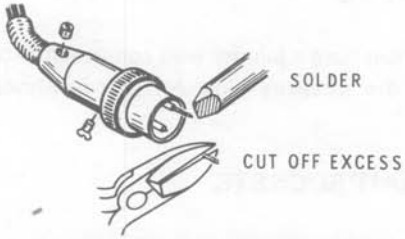


1. REMOVE 1-1/8" OF OUTER INSULATION.
2. REMOVE ALL BUT 1/4" OF THE BRAIDED SHIELD.
3. UNBRAID THE 1/4" OF SHIELD AND TWIST THE FINE SHIELD WIRES TO FORM A STRANDED LEAD.
4. TWIST THE FINE WIRES OF EACH LEAD TOGETHER AND APPLY A THIN FILM OF SOLDER TO THE END OF EACH LEAD.

5. SLIP THE HOUSING AND SPRING ON THE CABLE.
6. BEND THE BARE END OF THE GROUND LEAD AND THE SHIELD BACK OVER THE SPRING AND SOLDER.



7. PUSH THE AUDIO LEAD THROUGH PIN 1 AND THE SWITCH LEAD THROUGH PIN 2 OF THE CONNECTOR BASE (NOTE NUMBER INSIDE OF CONNECTOR BASE).
8. SOLDER BOTH PINS ON THE END, THEN CUT OFF THE EXCESS WIRE.



9. SLIP THE HOUSING OVER THE CONNECTOR BASE AND FASTEN WITH A SETSCREW. FASTEN THE SPRING WITH THE OTHER SETSCREW.

Figure 2-5

KEY CONNECTIONS

In the CW mode, a positive voltage is present at the KEY socket on the rear panel. If you use a key designed for grid block keying, the usual keyer leads should be reversed so the keyer output lead is connected to the shell of the phono plug and the keyer common, or ground, lead is connected to the pin of the phono plug. If your keyer uses a relay, the lead connections are usually immaterial, although its schematic diagram should be studied to insure proper connections.

LINEAR AMPLIFIER CONSIDERATIONS

Heath Amplifiers

Figure 2-3 (in the "Illustration Booklet") shows the installation of the Transceiver with a Heath amplifier.

ALC Connections

If your amplifier has ALC (automatic level control) output provisions, connect a cable between the ALC jack on the Transceiver and the linear amplifier. The ALC bias voltage from the amplifier helps prevent transmitter overloading and "splatter." Although protective circuitry of this nature is a valuable circuit element, it is not a substitute for proper adjustment of the exciter and its drive level to the amplifier.

Antenna Relay Connections

Many amplifiers have an internal transmit-receive relay which is actuated when the relay coil circuit is grounded. Heath amplifiers are of this type. This Transceiver has relay contacts available to operate the transmit-receive relay. The grounding connection may be made by a shielded cable (or other 2-conductor wire) connected to the accessory socket, pins 8 and 9. Use pin 9 for the ground connection and pin 8 for the relay coil.

MICROPHONE CONNECTIONS

A high-impedance microphone equipped with a push-to-talk switch should be used with the Transceiver so either the PTT or VOX methods may be used to turn on the Transmitter. A two-pin microphone connector (Amphenol 80MC2M) is furnished for this purpose. It should be connected to the microphone cable as directed in the following steps.

Heath Microphones

( ) Determine the desired length of your microphone cable, and cut off any excess.

( ) Perform the numbered steps in Figure 2-5.

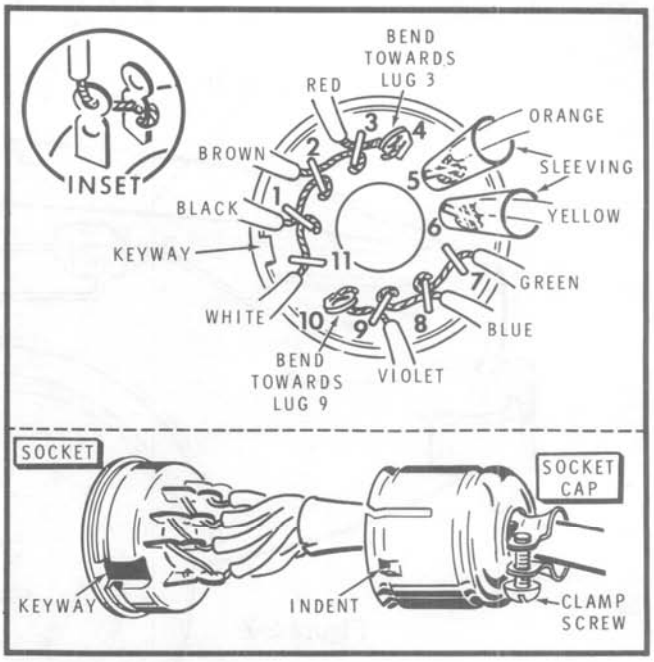
Other Microphones

If you use a microphone different than the one shown, connect the lead from the microphone element to pin 1 of the panel connector. If the microphone has a PTT switch, connect this lead to pin 2. Shield wires, to complete the ground side of the circuit, should be soldered to the spring as shown in Figure 2-5.

Other Power Supplies

Should you use a power supply for fixed station installation other than the one available from the Heath Company, follow the principles shown in Figure 2-6 which shows how the Heath power supply cable is connected.

This completes the "Fixed Station" installation instructions. If you are going to also use your Transceiver as a mobile station, proceed to the "Mobile Station Installation" section below. If you do not plan a mobile installation, proceed to the "Operation" section.



LUGS 11, 1, 2, 3, 4 ——— 13.8 VDC
LUGS 5, 6 ——— POWER SUPPLY CONTROL
LUGS 7, 8, 9, 10 ——— NEGATIVE TO CHASSIS

Figure 2-6

MOBILE STATION INSTALLATION

This section of the Manual will discuss the installation of the Transceiver in an automobile, but the same principles apply to installations in other types of conveyances, such as a boat or airplane.

A Mobile Mount is available for use with the Transceiver, and is recommended for Mobile operation. With this mount, the Transceiver can be quickly and easily installed or removed so it can be used for mobile and fixed station operation.

Make sure the voltage output of your battery charging system is at least 12.6 volts and does not exceed 16 volts under any circumstances. If the voltage is not within these limits, have the system adjusted.

CAUTION: Never reverse the polarity of the input voltage, as the transistors will be permanently damaged. It is strongly recommended that each of the wires from the battery to the Transceiver be permanently tagged, or otherwise marked as to polarity at the battery end, to minimize the possibility of transistor damage if the wires should ever be disconnected.

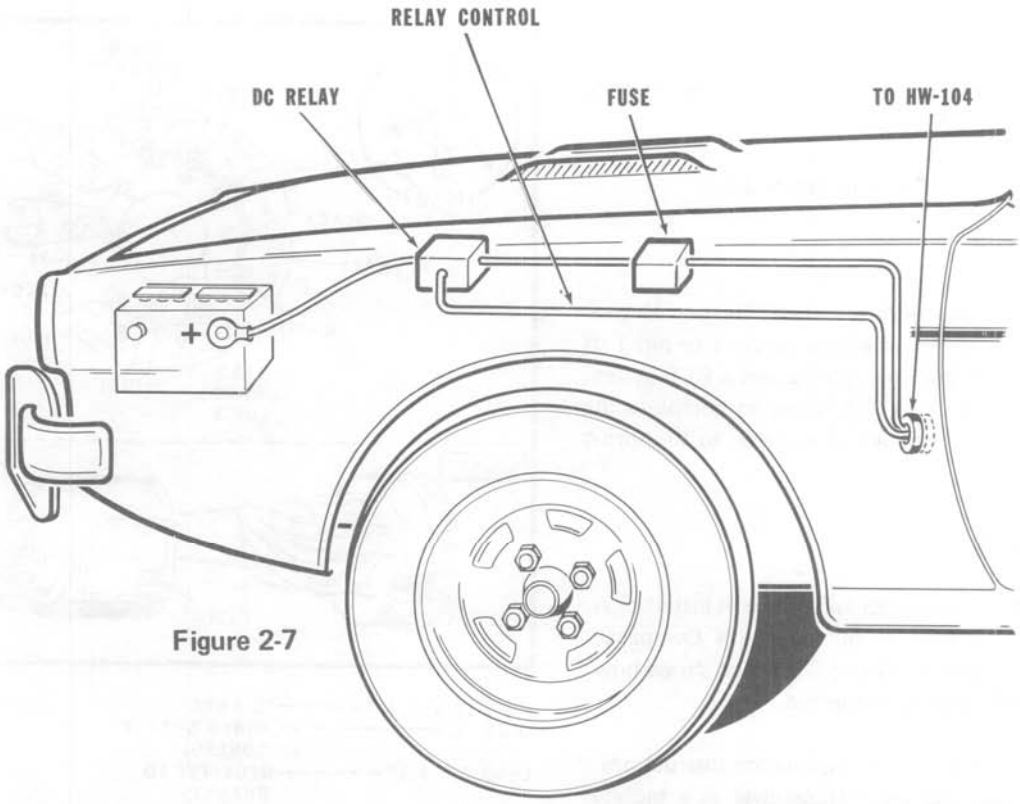


Figure 2-7

If you are not using the Heath mobile mount, refer to Figure 2-7 for a typical mobile installation, and to Figure 2-8 for a wiring diagram.

MOBILE ANTENNAS

Mount the antenna according to the manufacturer's instructions. Be sure to make a good ground connection between the shield of the coaxial cable and the car body at the antenna base.

Mobile antennas present loading situations which must be carefully handled for each band. Because whip antennas must be kept short for mobile use, they represent only a fraction of a wavelength on the lower frequency bands. Thus, their radiation resistance is extremely low and their reactance is capacitive. Therefore, loading coils must be used and the losses kept low to insure a minimum loss of radiated power in the form of heat in the loss resistances.

A good quality antenna will have low resistance losses, and with a high "Q" loading coil, its bandwidth on 75 meters could be less than the IF bandwidth of many receivers used for AM reception. A typical loading coil with a "Q" of 300 would have a bandwidth of 13 kHz to the half-power points at 3.9 MHz.

Because of this sharp tuning, deviation from the center frequency of the antenna will quickly introduce enough reactance to present an impossible loading situation to the transmitter. The antenna should be carefully adjusted for a low SWR before placing the transmitter in operation.

The following is a list of antenna considerations for each band of the Transceiver.

3.5-4 MHz

This band presents the greatest problem. The normal tuning range of a good antenna on this band is about 10 kHz on each side of the antenna's resonant frequency.

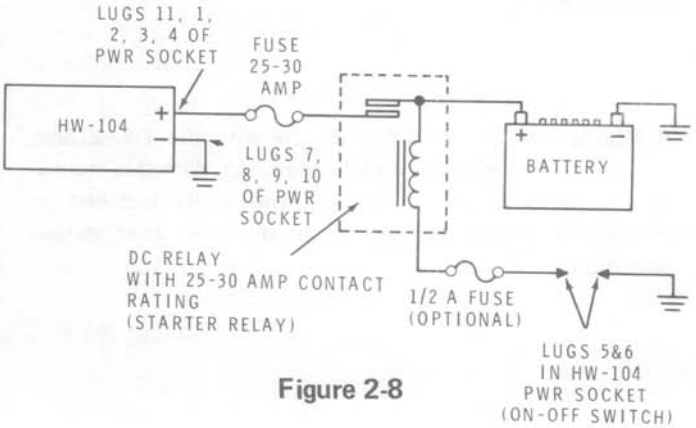


Figure 2-8

Actual measured resistance at the base of an antenna at these frequencies is 15 to 20 ohms; this represents an SWR of nearly 3 to 1. In order to get proper matching to the 50 ohm line, a 1000 pF mica capacitor should be connected between the inner conductor and shield of the coaxial line at the base of the antenna. Some antennas may require a different value, somewhere between 300 and 1500 pF.

The antenna tuning must be checked after the capacitor is installed. This capacitor is part of an L network that is used to get a 50 ohm match. The inductive portion of this network is formed by a portion of the loading coil.

7-7.3 MHz

This band ordinarily does not need a correcting network, and has a useful bandwidth of about 50 kHz.

14 MHz

No network needed. Bandwidth is approximately 100 kHz.

21 MHz

No network needed. Bandwidth is about 150 kHz.

28 MHz

The antenna for this band is normally cut to 1/4 wavelength, with no loading coil required. The bandwidth is about 200 kHz.

A Typical Tuning Procedure

A whip antenna that is properly tuned on 75 meters will have a high peak of receiver activity for about 25 kHz around the antenna's resonant frequency. Turn on the receiver and tune through the band to find the peak of receiver activity for the present setting of your antenna. Then adjust the length of the whip in 1/4" increments and retune the receiver until the peak of receiver activity is centered around the frequency at which you normally operate. The antenna can then be tuned as described in the following steps. The receiver peaking may not be noticeable on bands other than 75 meters.

( ) 1. Connect an SWR meter in series with the lead to your antenna.

( ) 2. Set the SWR meter to the "forward" position.

CAUTION: To avoid damage to the power transistors during the antenna tuning procedure, be sure to observe the duty cycle restrictions described in the "Operation" section of this Manual. Better, use low power output if you can obtain adequate meter deflection.

( ) 3. Depress the HI and TUNE buttons and adjust the LEVEL control for a full-scale meter indication on the SWR bridge.

( ) 4. Switch the SWR meter to the "reverse" position. Note the SWR reading.

( ) 5. Switch the SWR meter to the "forward" position. Then set the transmitter to higher and lower frequencies, and repeat steps 5 and 6 at each frequency, until you find the minimum SWR.

( ) 6. Set the transmitter to the desired operating frequency. Then adjust the length of the antenna as follows:

A. If the point of the lowest SWR is lower than the desired operating frequency, shorten the antenna as described below.

B. If the point of lowest SWR is higher than the desired operating frequency, lengthen the antenna as described below.

C. Change the antenna length in 1/4" increments and repeat steps 2, 3, and 4 at each new length until the minimum SWR is obtained. The SWR should be about 1.2 or less at the desired frequency. NOTE: It may be necessary to add a capacitor at the base of the antenna, as described previously, if you cannot get the SWR down to about 1.2.

NOISE SUPPRESSION

To obtain good noise suppression, you must suppress electrical interference at its source so it does not reach the input of the receiver. Once it has been radiated, noise cannot be suppressed by bypassing, etc.

Although all automobile ignition systems are similar, there are numerous differences – depending on make, model, year of manufacture, etc. We are therefore unable to offer specific advice on how to eliminate noise and interference originating from these systems. However, generally accepted noise suppression techniques are included here as a guide. The Heath Company cannot accept responsibility for any damage resulting from the use of this information.

It is difficult to determine the source of various types of noise, particularly when several items are contributing to the noise. Follow the procedure outlined below to isolate and identify the various items that may be producing the major noise interference.

In most cases, one source of interference will mask others. Consequently, it will be necessary to suppress the strongest item first, and then continue with the other steps. Figure 2-9 shows a typical ignition system and the suggested placement of noise suppression components.

1. Position the vehicle in an area that is free from other man-made electrical interference such as power lines, manufacturing processes, and particularly other automobiles.

2. With the Transceiver on, run the automobile at medium speed. Then let up on the gas, turn the ignition switch off and to the accessory position, and allow the vehicle to coast in neutral. This may not be possible on cars with automatic transmissions or power steering. If all noise stops, the major source of interference is from the ignition system.

3. If the noise has a "whine" characteristic and changes in pitch with varying engine speed and is still present with the ignition off, then the generator is the major source of interference.

4. A distinct but irregular clicking noise, or "hash" as it is sometimes called, that disappears with the engine idling, indicates the voltage regulator is at fault.

5. A steady popping noise that continues with the ignition off indicates wheel or tire static interference. This is more pronounced on smooth roads.

6. The same type of interference as in step 5, but more irregular when on bumpy roads, particularly at slow speeds, indicates body static.

Refer to the "Noise Suppression Troubleshooting Chart" and to Figure 29 (in the "Illustration Booklet") to help determine how to suppress most noise interference. Naturally, not all vehicles will require suppression to the extent shown in Figure 2-9, but some stubborn cases may require all the suppression components shown, plus shielding of the ignition system.

Grounding

A good ground to the automobile body is essential. Recognize that a layer of paint between adjoining parts and panels may cause a discontinuity in the ground path. A jumper between the parts may be required.

It may be necessary to bond various parts and body panels of the automobile to each other, starting from the hood and continuing to the trunk. This may include bonding of the transmission line every few feet.

Noise Suppression Troubleshooting Chart

TYPE OF NOISE	POSSIBLE CAUSE	RECOMMENDED REMEDY
Loud popping increasing to buzz with increased engine speed.	Ignition system.	1. Replace plugs with resistor type (recommended). 2. Loose crimped connections should be cleaned and soldered. 3. Place resistors in distributor system.
Whine – varies with engine speed.	Alternator or generator.	1. 0.1 μF coaxial type capacitor in series with the armature (A lead). 2. Clean commutator. 3. Replace brushes. 4. Ground generator shaft. 5. Parallel trap (#10 wire-coil and suitable capacitor) in series with armature A lead, tuned to operating frequency.
Distinct but irregular clicking noise.	Voltage regulator.	1. 0.1 μF coaxial type capacitor in series with the battery (B) and armature (A) leads. 2. A series combination of a .002 μF mica capacitor and a 4 Ω carbon resistor to ground from the field (F) terminal. All components should be mounted as shown in the diagram, close to the voltage regulator.
Same as above.	Energy transfer to primary system.	1. Bypass at the following points; coaxial bypass in lead to coil from ignition switch (0.1 μF). Battery lead to ammeter (.5 μF); to gas gauge (0.5 μF); to oil signal switch (0.5 μF); head and tail light leads (.5 μF); accessory wiring from engine compartment (.5 μF).
Loud popping noise that changes from one type road to another. Most pronounced on concrete.	Wheel static.	1. Installation of front wheel static collectors (available from most automotive distributors). These should be checked every 5000 miles for excessive wear.
Same as above.	Tire static.	1. Injection of anti-static powder into tire through valve stem.
Irregular popping noise when on bumpy roads, particularly at slow speeds.	Body static.	1. Tighten all loose screws. 2. Use heavy flexible braid and bond the engine to the frame and fire wall. Bond the control rods, speedometer cable, exhaust pipes, etc., to the frame.

If an extensive amount of suppression is required, the engine should be retimed and tuned up at a reputable garage.

OPERATION

NOTE: YOU MUST HAVE AN AMATEUR RADIO OPERATOR LICENSE AND A STATION LICENSE BEFORE PLACING THE TRANSMITTER SECTION OF THE TRANSCEIVER ON THE AIR. INFORMATION ABOUT LICENSING AND AMATEUR FREQUENCY ALLOCATIONS IS AVAILABLE FROM PUBLICATIONS OF THE FEDERAL COMMUNICATIONS COMMISSION OR THE AMERICAN RADIO RELAY LEAGUE.

Operation of the Transceiver has been simplified as much as possible to permit rapid adjustment by the operator. Once you make the initial settings, it should not be necessary to readjust most of the controls. Read the following information carefully. Good operating techniques will provide good clean signals and long trouble-free life of the Transceiver.

IMPORTANT: A transmitter that employs solid-state devices requires different operating techniques than one with vacuum tubes. For example, duty cycle restrictions must be strictly observed because power transistors are not as forgiving as tubes. If the operating parameters of solid-state devices are not exceeded, they will last indefinitely, but they can be easily destroyed by carelessness. As a result, *it is extremely important* that you read, comprehend, and observe these operating instructions. They are not complicated, and will become second nature after you go through them a few times.

A number of the actions listed in this section were covered earlier in this Manual, but are repeated here because they are essential for proper operation of your Transceiver.

CONTROL FUNCTIONS

Refer to Figure 3-1 (in the "Illustration Booklet") for a front panel view of the Transceiver and a concise explanation of control functions.

Figure 3-2 (in the "Illustration Booklet") shows rear panel controls and connections. Figure 1-3 is a top view of the Transceiver chassis which identifies circuit boards and subassemblies, as well as some additional controls. The following paragraphs describe the control functions more completely.

IDENTIFICATION

The station call letters can be displayed here or the space can be blanked out.

TUNING DIAL

The tuning dial is calibrated in divisions from 0 to 500. Each represents 5 kHz. The dial reading (in kHz) is added to the BAND switch setting (in MHz) to determine the frequency to which the Transceiver is tuned. For example:

BAND switch	14.0 MHz
Dial reading	235 kHz
Frequency	14.235 MHz

ZERO SET

Pushing this button while turning the MAIN TUNING knob locks the dial scale while the VFO frequency is being changed. This permits the TUNING DIAL to be calibrated at 100 kHz intervals.

AF GAIN

Increases the volume of the received signal with clockwise rotation.

RF GAIN/CAL-PULL

Clockwise rotation increases the receiver sensitivity. This control is usually positioned fully clockwise. Turn the control counterclockwise to reduce sensitivity when exceptionally strong signals are being received, or to reduce adjacent channel interference.

Pulling the knob out turns on the calibrator. The frequency of the calibration signal depends on the setting of the 25 kHz button (see below).

VOX GAIN

Adjusts the input level at which the voice-controlled relay circuits will operate. At this level, either microphone or CW input will silence the receiver circuits and place the transmit circuits in operation.

The VOX button must be depressed to activate the voice-control circuits.

VOX DELAY

Controls the length of time the voice-control circuits will hold the Transceiver in the transmit mode after the input has ceased.

AGC

Selects fast or slow decay time for the automatic gain control, or turns the AGC circuits off.

BAND

Selects the desired amateur band, or station WWV (National Bureau of Standards) at 15 MHz. The frequency printed on the panel is the low frequency end of each range, which extends 500 kHz upward in frequency. The WWV band is for receiving only.

IMPORTANT: Do not change bands when the Transceiver is in the transmit mode.

MIC

Connect a high-impedance microphone, preferably with a PTT (push-to-talk) switch. The microphone cable connector is furnished.

PHONES

Connect low impedance headphones through a phones plug. When the plug is inserted in this jack, the loudspeaker is automatically disconnected.

MIC/CW LEVEL

When the USB or LSB buttons are depressed, this control adjusts the audio drive. When the CW or TUNE buttons are depressed, this control adjusts the carrier level.

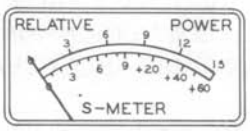


Figure 3-3

METER SWITCH

The meter face is shown in Figure 3-3. The meter gives the following indications with the designated switch button depressed.

13.8: Power supply voltage (upper scale).

ALC: 1. Receiving, meter gives an S-meter indication on the lower scale from 0 to S-9 + 60 dB.

2. Transmitting, ALC action should not exceed a total change of 6 units on the upper scale. In transmit, it is acceptable for the meter to read as high as 3 with no input.

PWR: Indicates relative power output on the upper scale.

VOX

When this button is released, the PTT microphone switch must be pushed to transmit.

When this button is depressed, the voice-control circuits are activated. The position of the USB, LSB, and CW buttons will determine whether the microphone or the key will cause transmission to occur.

25 kHz

When this button is depressed, the calibrator places markers every 25 kHz; when released, the calibrator places markers every 100 kHz.

NB

If the accessory noise blanker has been installed, it is activated when you depress this button.

USB, LSB, CW

Depress the appropriate button for upper sideband, lower sideband, or CW transmission.

TUNE

Depress this button to secure a carrier for tune-up.

HI

Depress this button for high power output. Release the button for low power output.

ON

Depress this button to turn the Transceiver ON. To turn the Transceiver OFF, push the button again and quickly remove your finger. This will release the button.

ANTI-VOX CONTROL (Rear Panel)

Turn this control clockwise to adjust the VOX circuit so a received signal from the speaker will not feed back into the microphone and cause unwanted transmission.

SIDETONE CONTROL (Rear Panel)

Controls the loudness of the sidetone signal when you are transmitting CW (or in the TUNE mode).

S-METER LEVEL CONTROL

This control on circuit board F adjusts the S-meter sensitivity. Instructions for setting this control will be found in the "Test and Adjustment" section under "Preselector Bandpass Filter Alignment" (Page 13).

CARRIER SUPPRESSION CONTROLS

These controls on circuit board E balance out the carrier. See "Test and Adjustment" section under "Carrier Suppression" (Page 23).

CALIBRATOR ADJUST CONTROL

This control on circuit board A adjusts the calibrator signal frequency. See "Test and Adjustment" section under "Calibrator Adjustment" (Page 17).

VFO SHIFT

A trimmer capacitor in the VFO to be adjusted so the frequency remains constant in either USB or LSB.

VFO FREQUENCY

A coil in the VFO which positions the VFO frequency range to properly cover the amateur bands.

TUNE-UP

NOTE: Once your Transceiver controls have been adjusted for either SSB or CW operation, all that is necessary to place your Transceiver on the air is to depress the ON button. Other than to select your frequency, no other action is required.

INITIAL ACTIONS

Before attempting to use the Transceiver, check to make sure all of the following connections have been completed.

1. An antenna for the band in use must be connected to the rear panel ANT socket. If a power amplifier is used, RG-58A/U coaxial cable should be used to connect the ANT socket to the amplifier input.

2. The ACC plug, with a jumper between pins 2 and 5 (or install the plug of the Accessory VFO), should be installed in the ACC socket on the rear panel.

3. The VFO jumper (or the Accessory VFO) should be installed between the VFO IN and VFO OUT sockets on the rear panel.

4. A 3.2 Ω to 16 Ω speaker should be connected to the SPKR socket on the rear panel, or headphones to the front panel PHONES jack.

5. The power supply cable socket should be connected to the PWR plug on the rear panel.

6. The Transceiver should be connected to a good ground.

7. If a power amplifier is being used,

   A. The amplifier's ALC output should be connected to the ALC socket on the rear panel.

   B. Providing the amplifier's transmit-receive relay is the type which is activated by grounding the relay coil, the amplifier's relay coil connection should be connected to pin 8 of the ACC socket. Pin 9 of the ACC socket must be grounded to complete the circuit.

8. If an external receiver is used which has a mute circuit which must be grounded to allow the receiver to operate, this circuit can be connected to pin 10 of the ACC socket. Pin 9 must be grounded. This will ground the mute circuit in the receive mode.

Preset the front panel controls as follows (CW means fully clockwise, CCW means fully counterclockwise):

MIC/CW LEVEL	CCW
RF GAIN	CW
AF GAIN	CCW
BAND	Any
VOX GAIN	CCW
VOX DELAY	CCW
AGC	Slow
METER	13.8
VOX	Released
25 kHz	Released
NB	Released
MODE	USB or LSB
TUNE	Released
HI	Released
ON	Released
ANTI-VOX (rear panel)	CCW*
SIDETONE (rear panel)	CCW*

*Viewed from the rear.

RECEIVING

The receiver is broad banded and no preselector tuning is required. For best results, the antenna should be designed for a 50 Ω impedance, or an antenna coupler should be used to match the antenna's impedance to 50 Ω.

1. Check the connections in "Initial Actions" (Page 37).

2. Connect the transmission line to the ANT socket on the rear panel.

3. The rear panel slide switch should be at COM when you are receiving and transmitting on the same antenna.

4. Depress the ALC and the ON buttons.

5. Depress the USB, LSB, or CW button.

6. Adjust the AF GAIN as desired.

7. If you will use VOX operation, depress the VOX button and place the microphone in the position it will occupy during normal operation, and tune in a strong station. The receiver will usually cycle on and off with the voice peaks of the strong station. Turn the ANTI-VOX control clockwise (as viewed from the rear) until the cycling action ceases. Do not advance the control beyond this point.

8. The AGC switch can be moved to another position, although most SSB operators prefer SLOW. CW operators may prefer FAST or OFF.

9. Depress the NB button to activate the noise blanker, if one is installed.

10. If you use a separate receiving antenna, connect it to the REC socket on the rear panel and set the adjacent slide switch at REC. Transmission will always use the antenna connected to the ANT socket.

TRANSMITTING

TRANSMITTER DUTY CYCLE RESTRICTIONS

The power transistors used in the power amplifier stage of this Transceiver are not as forgiving of overloading and misadjustment as vacuum tubes. The principal source of difficulty is overheating. If you observe the duty cycle parameters carefully, the transistors will last a long time; if you ignore or abuse these parameters, costly replacement will be required. Consequently, it is important that you carefully observe the duty cycle restrictions in the following table when using high power.

NEVER EXCEED 30 SECONDS WITH BOTH THE HI AND TUNE BUTTONS DEPRESSED.

MODE	TRANSMIT TIME	RECEIVE TIME	MAXIMUM CONTINUOUS TRANSMIT TIME
SSB	2 units	1 unit	1 hour
CW	1 unit	1 unit	15 minutes
TUNE	1 unit	5 units	30 seconds

EXAMPLES:

1. In CW, a one minute transmission should be followed by a one minute receive period. In TUNE and HI, a ten-second tune-up requires a 50-second off (receive) period.

2. The on/off times can be averaged over several transmit-receive cycles, but the maximum transmit times must always be observed. For instance, in the CW mode you should only transmit half the time (average) and should never exceed 15 minutes of continuous transmission.

ANTENNA COUPLER

1. If you use an antenna coupler which has an SWR meter, connect it between the ANT socket on the rear panel and your transmission line with RG-58A/U coaxial cable.

2. Connect the Transceiver as in "Initial Actions" (Page 37).

3. Depress the PWR, TUNE, and ON buttons (this is the LOW power output position).

4. Advance the LEVEL control until you get a meaningful SWR meter indication of forward power.

5. Adjust the antenna coupler for minimum VSWR.

6. Release the TUNE button.

7. Turn the LEVEL control fully counterclockwise.

NOTE: Use the following high power step only if the meter does not show an adequate reading when in low power. If high power is used, carefully observe the 30 second, high-power, TUNE duty cycle restriction.

8. Depress the HI and TUNE buttons. Then quickly repeat steps 4 through 7. Advance the LEVEL control only enough to get useful VSWR readings.

9. Record the antenna coupler dial readings for the amateur bands of interest to facilitate future adjustments.

NOTE: If you are adjusting an antenna coupler with a receiver only, adjust the coupler for greatest S-meter deflection.

SSB TRANSMISSION

1. Check the connections in "Initial Actions" (Page 37).

2. Depress the ALC, HI, USB (or LSB), and ON buttons.

3. For PTT (push-to-talk), use the switch on the microphone to operate the transmit-receive relay.

4. Set the BAND switch.

5. For VOX operation:

   a. Depress the VOX button.

   b. Speak into the microphone and advance the VOX GAIN until the relay pulls in reliably when you speak.

c. Advance the VOX DELAY clockwise until the relay holds in for the desired length of time after you cease talking.

6. Speak into the microphone and advance the MIC/CW LEVEL control until the panel meter kicks up a total of approximately 6 units (upper scale) on voice peaks. In transmit, it is acceptable for the meter to read as high as 3 with no input. CAUTION: Do not advance the MIC/CW LEVEL control beyond this point because it will not increase the power output, and the final stage may be overdriven, which will result in clipping of voice peaks and sideband "splatter."

7. For high power, depress the HI button.

8. This completes the SSB tune-up procedure and you can proceed to transmit. No warm up time is required.

CW TRANSMISSION

1. Preset the controls as in "Initial Actions" (Page 37).

2. Depress the PWR, VOX, CW, and ON buttons.

3. Leave the HI button released for low power operation. Depress the HI button for high power operation.

4. Advance the MIC/CW LEVEL control only to the point where the meter reading ceases to increase. CAUTION: A higher drive level will not increase the power output, but a keying "thump" will develop.

5. Adjust the VOX GAIN control so the relay pulls in instantly when the key is depressed. Adjust the VOX DELAY control for the desired hold-in time.

6. Adjust the SIDETONE control (rear panel) for sound volume with keying (or TUNE).

7. This completes the CW tune-up procedure.

AMPLIFIER

If you use this Transceiver with an amplifier, DO NOT advance the Transceiver's gain beyond the point where amplifier output ceases to increase with rotation of the LEVEL control.

OTHER MODES

This Transceiver has been designed for use only in the SSB and CW modes.

TYPICAL OPERATING CHARACTERISTICS

The following conditions are normal and you should not consider them as malfunctions.

1. The relay may activate briefly when you turn the Transceiver on.

2. The relay may activate briefly when you switch modes (LSB, USB, and CW) and the VOX pushbutton is depressed.

3. You may hear a pop from the speaker when you change modes.

4. The strength of the 100 kHz calibrator markers may change when you depress the 25 kHz pushbutton.

TROUBLESHOOTING

CONTENTS

Introduction 41
Localizing the Trouble 42
VFO/Buffer Troubleshooting Guide 42
Receiver Troubleshooting Guide 44
Transmitter Troubleshooting Guide 46
Voltage and Continuity Checks 48
Test Chart 49
Checking Transistors and Diodes 50

INTRODUCTION

The table of "Contents" above shows the different types of information that are available in this section to help you. Begin your troubleshooting by localizing the trouble to a specific area, as described on Page 42. Even if you are reasonably sure that you know the area your trouble is in, we suggest that you read through "Localizing the Trouble" for the additional information that is given here.

Because it is tied in very closely with this part of the Manual, you will often be referred to the "Maintenance" section (see Page 51) in the following pages. The "Maintenance" section has complete information on each circuit board, including a "Troubleshooting Chart," a "Circuit Board X-Ray View," a "Voltage Chart," a Schematic, and a "Circuit Description." You may also want to refer to the main Schematic for the entire Transceiver and to the "Chassis Photographs" (Page 117).

ASSISTANCE BY THE HEATH COMPANY

If you are unable to solve a difficulty, refer to the "Customer Service" information inside the rear cover of this Manual. Your Heathkit Warranty is inside the front cover.

If you know the trouble is on a specific circuit board, you can save expense by sending only that circuit board for repair to either the Heath factory or to one of the Heath Electronic Centers. See "Circuit Board Service Policy" on Page 57, which also contains the special Power Amplifier circuit board warranty.

REPLACEMENT PARTS

If you need a replacement part, whether or not it is within the warranty period, refer to the "Parts Lists" and to the "Customer Service" information inside the rear cover of this Manual.

LOCALIZING THE TROUBLE

Before you look for any other circuit malfunction, be sure you have the correct supply voltage. Do this by performing the first six steps under "Chassis" on Page 5.

Then localize your trouble to a particular area (a single circuit board for example) by using one or more of the following methods.

- Study the Functional Block Diagram (in the "Illustration Booklet") and the "Theory of Operation" (Page 115) carefully. Then use deductive reasoning to pinpoint your trouble to a specific area. (If neither the transmitter nor receiver is operating, for example, look for your trouble in one of the circuits that is common to both of them, such as the VFO, the HFO, or a carrier generator.)

- Check the wiring of the under-chassis terminals from the "Chassis Wiring Check List" in the Illustration Booklet.

- If you know your trouble is in the transmitter, or in the receiver, refer to one of the following sections:

"Receiver Troubleshooting Guide" . . . . . Page 44
"Transmitter Troubleshooting Guide" . . . Page 46

- If your Transceiver was in operation for a time and then a difficulty showed up, you can also refer to the "Test Chart" on Page 49.

After you localize the trouble to one area:

- Refer to the correct part of the "Maintenance" section (Page 51) to troubleshoot any of the circuit boards.

- Very carefully check the front panel, rear panel, and chassis for any wiring errors or poor solder connections.

- Read "Voltage and Continuity Checks" (Page 48) before you make any measurements. Also refer to "Checking Transistors and Diodes" (Page 50).

When you make repairs on the Transceiver, be sure to eliminate *both the cause and the effect* of the trouble. If, for example, you should find a damaged resistor, be sure you find out what caused the resistor to become damaged (wiring, error, etc.). If the cause is not eliminated, the replacement resistor may also be damaged when you turn the Transceiver on again.

VFO/BUFFER TROUBLESHOOTING GUIDE

LSB SHIFT ADJUSTMENT

If the LSB shift adjustment cannot be made, check the DC voltage at the anode (unbanded end) of D1201 on the oscillator circuit board. When this diode switch is working properly, the anode voltage will be approximately 0.3 VDC when the LSB pushbutton is depressed, and 0 VDC when the USB or CW button is depressed. Instructions for access to the VFO circuit board are included in the following section.

VFO OUTPUT VOLTAGE

This section is for use when there is no VFO output voltage, or the highest output voltage available is less than 0.35 VDC.

Use an RF voltmeter or an oscilloscope to make RF voltage checks. Be sure to use a high input impedance voltmeter (11 megohms or higher) when you make DC voltage measurements at transistor leads to avoid erroneous readings caused by loading the circuit.

If you get the correct RF voltage reading at the input lead of a component but not at the output lead, the component is probably faulty and should be replaced. If the DC voltages and the resistances measured at each lead (as shown in the table at the end of this section) indicate variations of more than ±20%, the resistors in the voltage path may have changed value, the supply voltage may be in error, or a transistor in the circuit could have an internal short circuit.

To check the components on the buffer circuit board, remove the VFO assembly from the chassis and remove the VFO shield so the circuit board is accessible. Reconnect the two 4-wire connectors if they were disconnected during disassembly.

If you are checking the VFO after it has operated satisfactorily in the Transceiver, remove the VFO jumper plug from the VFO OUT socket on the rear panel so the VFO will not be loaded during voltage measurements.

If you wish to make it easier to check the oscillator circuit board, remove the mounting nut from L1201, slide the 4-pin connector up out of its slot, and remove the VFO bracket so the entire VFO assembly can be removed from the VFO chassis. Then reconnect the 4-pin connector to its mating connector so the VFO can receive power and the LSB shift voltage. Refer to "VFO Enclosure" on Page 25 in the Assembly Manual when you reassemble the VFO.

Make the RF voltage checks in the following steps. In the Test Point column, B = base, C = collector, D = drain, G = gate, and S = source. The DC voltages and resistances to be expected at the transistor leads are given in the table at the end of the steps.

( ) Check for +11 VDC at the appropriate leads of R1226 on the buffer circuit board, and R1206 on the oscillator circuit board.

NOTE: In the following table, if your voltage reading agrees with that in the "RF Volts" column, follow the instructions in the Action column. If the RF voltage reading varies in excess of 20% from the column figure, disregard the "Action" column and proceed to the following step.

( ) Turn control R1232 on the buffer circuit board fully clockwise.

TEST POINT	RF VOLTS	ACTION
( ) VFO output	0	Proceed to following step.
( ) C of Q1205	1.25	Check continuity to Output connection. Check C1234 for a short circuit.
( ) B of Q1205	0.1	If all Q1205 VDC Voltage and resistance readings are correct, replace Q1205.
( ) C of Q1204	0.35	Check continuity to Q1205.
( ) B of Q1204	0.8	If all Q1204 DC voltage and resistance readings are correct, replace Q1204.
( ) S of Q1203	0.82	Check continuity to Q1204.
( ) G of Q1203	1.7	If all Q1203 DC voltage and resistance readings are correct, replace Q1203.
( ) D of Q1202	2.9	Check continuity to Q1203.
( ) S of Q1202	1.7	If all Q1202 DC voltages and resistance readings are correct, replace Q1202.

( ) Repeat the "VFO Level Adjustment" on Page 10.

TEST POINT	OHMS	DC RESISTANCE*	RF VOLTS	VOLTS
Q1205	Collector	0	0	1.25
	Base	21,000	9.2	.1
	Emitter	1,200	9.8	.3
Q1204	Collector	1,200	10.8	.35
	Base	1,200	1.3	.8
	Emitter	500	.7	.8
Q1203	Gate	3,000	0	1.7
	Source	1,300	2.8	.82
	Drain	1,200	10.8	
Q1202	Gate	2,300	0	
	Source	900	2.	1.7
	Drain	1,000	8.5	2.3

*Negative or common lead to chassis.

RECEIVER TROUBLESHOOTING GUIDE

Refer to the "Receiver Block Diagram," which shows how signals flow through the receiver circuits, as you go through the tests on the following pages. Each circuit board is outlined with a dashed line, and the circuit functions are shown as solid blocks inside the outlines.

This troubleshooting guide is divided into the following five tests: "Audio Output," "Product Detector and Preamplifier," "IF Amplifier and AGC," "Crystal Filter," and "Front End." When you get the correct result for a test, proceed to the next one. If you do not get the correct result, the last step will direct you to the proper part of the "Maintenance" section and will call your attention to some specific areas to check. When you turn to the "Maintenance" section (on Page 51):

1. Refer to any applicable parts of the "Troubleshooting Chart."
2. Refer to the "Voltage Chart" and check the voltages in your Transceiver at the areas mentioned in the last step. (Also see "Voltage and Continuity Checks," Page 48.)
3. Check any questionable diodes and transistors. See Page 50.
4. Be sure each circuit is correctly wired and that the correct parts are installed.
5. Read the "Circuit Description" and study the Schematic to better understand and analyze your problem.

AUDIO OUTPUT

( ) Turn the power ON.

( ) Turn the RF GAIN control fully clockwise.

( ) Turn the AF GAIN control to mid-range.

For the following steps, you will need an input signal source to connect to the AUX AUDIO socket on the rear panel. You can obtain this input in either of two ways:

1. Use a 1 kHz signal from an audio generator.
2. Connect a separate speaker to the free end of the 24" test cable (be sure to remove the 18 pF disc capacitor) prepared earlier during receiver alignment. Then, to provide the signal, tap on the cone of the speaker or scratch it with a fingernail.

( ) Connect your input signal source to the AUX AUDIO socket on the rear panel. You should hear a sound from your station speaker.

( ) If you do not hear any sound from your station speaker, proceed to "Receiver IF/Audio Circuit Board," Page 87. Check Q513 through Q518, IC502, and the associated circuitry.

( ) Disconnect the input signal source from the AUX AUDIO socket. If necessary, disconnect the speaker from the test cable and reconnect the 18 pF capacitor.

3.395 MHz TEST SIGNAL

In order to check the remaining stages in the receiver section you will need a 3.395 MHz test signal. You can make this signal available as follows:

( ) Locate the 24" test cable.

( ) Lift the end of 100 Ω resistor R645 (on board E), that forms a junction with the ferrite bead. To identify R645, refer to the X-ray view.

( ) Connect a 1" jumper wire between the free end of R645 and pin 20 of board E.

( ) Unsolder the banded end of diode D603 and pull this lead out of the circuit board.

( ) Solder the free lead of the 18 pF capacitor on the test cable to the banded end of diode D603.

( ) Replace board E. A 3.395 MHz signal is now available at the phono plug on the test cable.

PRODUCT DETECTOR AND PREAMPLIFIER

( ) Insert the phono plug on the test cable into the IF OUTPUT phono socket on the rear panel.

( ) Set the MODE switch to the LSB or USB position.

( ) You should hear a tone from the speaker.

( ) If you do not hear a tone, proceed to "Receiver IF/Audio Circuit Board," Page 87. Check T502, D506-D509, IC502 and associted circuitry.

( ) Disconnect the phono plug from the IF OUTPUT phono socket.

IF AMPLIFIER AND AGC

( ) Turn the AGC off.

( ) Hold the phono plug tip of the test signal cable against pin 1 of board F. A tone should be heard from the speaker.

( ) If you do not hear a tone, proceed to "Receiver IF/Audio Circuit Board," Page 87. Check Q501, IC501, Q502, Q503, and associated circuitry.

( ) Turn AGC to FAST.

( ) Again hold the test cable phono plug tip against pin 1 of circuit board F. If you do not hear a tone from the speaker, check Q504 through Q511.

CRYSTAL FILTER

( ) Inject a 3.395 MHz test signal at pin 1 on board E. A tone should be heard from the speaker.

( ) If you do not hear a tone, proceed to "Carrier Generator/Xtal Filter Circuit Board," on Page 90. Check Q601, Q603, the SSB filter and the associated circuitry.

DISCONNECTING THE TEST CIRCUIT

( ) Disconnect the 18 pF capacitor from diode D603.

( ) Resolder the free lead of diode D603 to its proper hole in the circuit board.

( ) Disconnect the jumper wire that is connected between resistor R645 and pin 20 of board E.

( ) Reconnect and solder the free lead of resistor R645 to the circuit board.

FRONT END

( ) Pull the RF GAIN knob out to turn on the calibrator.

( ) You should hear a tone at each 100 kHz point (3,500 kHz, 3,600 kHz, 3,700 kHz, etc.) on the tuning dial.

( ) If you do not hear a tone, refer to "Receiver Front End Circuit Board," on Page 95. Check Q701, Q702, Q703, Q704 and the associated circuitry, the bandpass filters, and the injection of VFO and HFO signals.

TRANSMITTER TROUBLESHOOTING GUIDE

Refer to the "Transmitter Block Diagram," which shows how signals flow through the transmitter circuits, as you go through the tests on the following pages. Each circuit board is outlined with a dashed line, and the circuit functions are shown as solid blocks inside the outlines.

This troubleshooting guide is divided into the following four sections: "Carrier Generator/Xtal Filter," "Transmitter IF," "Driver," and "Power Amplifier." When you get the correct result for a test, proceed to the next one. If you do not get the correct result, the last step will direct you to the proper part of the "Maintenance" section and will call your attention to some specific areas to check. When you turn to the "Maintenance" section on Page 51:

1. Refer to any applicable parts of the "Troubleshooting Chart."
2. Refer to "Voltage Chart" and check the voltages in your Transceiver at the areas mentioned in the last step. (Also see "Voltage and Continuity Checks," Page 48).
3. Check any questionable diodes and transistors. See Page 50.
4. Be sure each circuit is correctly wires and that the correct parts are installed.
5. Read the "Circuit Description" and study the Schematic to better understand and analyze your problem.

TEST CIRCUIT PREPARATION

When the transmitter IF circuit board is functioning properly, an RF signal will be present at the output and input. You can use the RF detector, set aside earlier, with a high input impedance voltmeter for tracing in some low level RF circuits.

Refer to Figure 4-1 and prepare the RF detector as follows:

( ) Prepare a 12" orange wire.

( ) Connect one end of the orange wire to the lower hole of the RF detector terminal strip lug 1 (S-1).

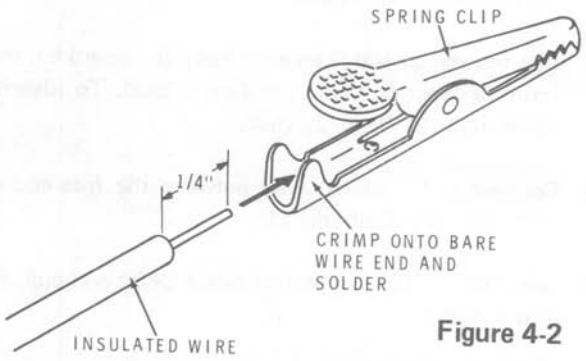


Figure 4-2

( ) Refer to Figure 4-2 and connect an alligator clip on the free end of the orange wire.

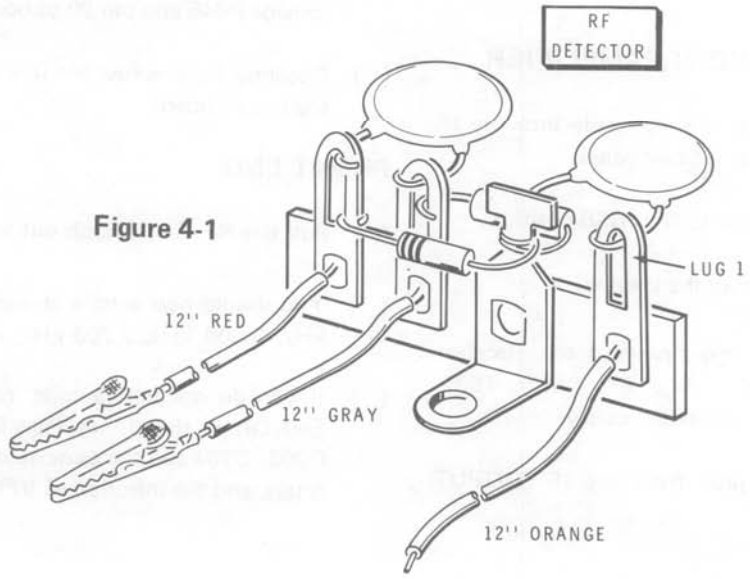


Figure 4-1

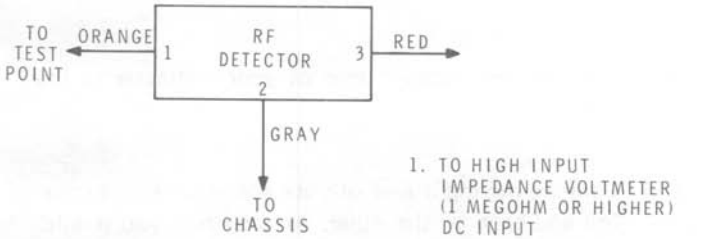


Figure 4-3

CAUTIONS:

DO NOT use the detector on circuits containing more than 30 VAC or 30 VRF.

DO NOT use the detector on the PA circuit board or its output.

To use the RF detector, connect it as shown in Figure 4-3. DO NOT permit the terminal strip lugs to touch anything while the detector is in use. The assembled terminal strip could be wrapped with tape to insulate it.

CARRIER GENERATOR/XTAL FILTER

( ) Connect a dummy load capable of dissipating 100 watts to the ANT socket on the rear panel.

( ) Set the BAND switch to 3.5.

( ) Set the rear panel slide switch to COM.

( ) Turn the LEVEL control fully clockwise.

( ) Depress the PWR, TUNE, and ON buttons. All other buttons should be released.

Refer to Figure 4-3 and connect the RF detector wires as follows:

( ) Red wire to a high input impedance voltmeter.

( ) Gray wire to the chassis of the Transceiver.

( ) Orange wire to pin 6 of board E.

( ) If there is no indication on your voltmeter, proceed to "Carrier Generator/Xtal Filter Circuit Board," Page 90. Use the RF detector to check for RF voltages at B of Q602, C of Q604, T601 (the terminal going to connector #22 is grounded), and C of Q611. The indications at the three terminals of T601 will be very low.

NOTE: DC voltage readings should only be made on board E when no RF voltage is present.

( ) Disconnect the gray wire from pin 6 of board E.

TRANSMITTER IF

( ) Connect the orange wire of the RF detector to pin 24 of board C.

( ) If there is no indication on your voltmeter, proceed to "Transmitter IF Circuit Board," Page 76. Check for RF voltages on the collectors of Q305, Q304, the emitter of Q301 and pin 4 of IC301 (very low at pin 4).

( ) Disconnect the orange wire from pin 24 of board C.

DRIVER

( ) Switch your voltmeter to a 10V or 15V range.

( ) Connect the orange wire of the RF detector to the anode (unbanded) end of diode D904 on the driver circuit board.

( ) If there is no indication on your voltmeter, proceed to "Driver Circuit Board," on Page 81. Use the RF detector to check for RF voltage at the cathode (banded) end of diode D904 and at terminal 2 of the connector. Make sure you have +12 VDC on pin 5 of the board.

( ) Disconnect the orange wire from diode D904.

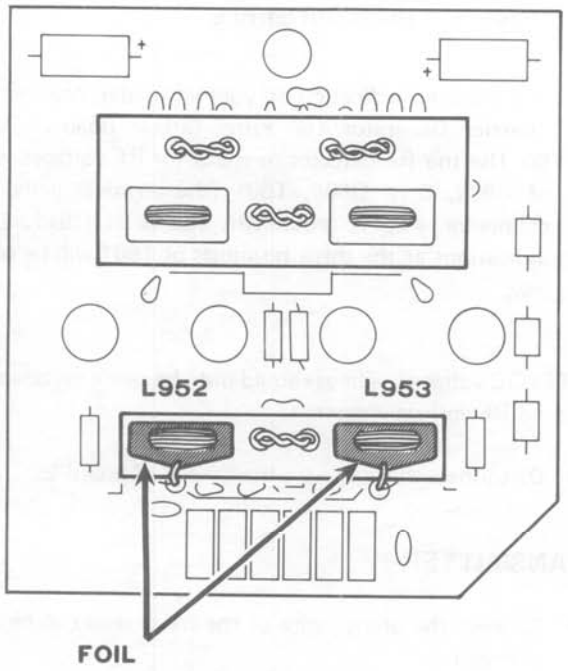


Figure 4-4

P.A.

Use the following check to see if the P.A. transistors are defective. Figure 4-4 shows the P.A. circuit board from the component side. The shaded areas are connected to the secondary center taps of coils L952 and L953.

( ) Push the HI PWR button in.

( ) Connect the common lead of your voltmeter to the chassis.

( ) Connect the input lead of your voltmeter first to one foil and then to the other. At each foil, you should obtain the following "normal" reading. If you obtain a "wrong" reading at either foil, all four final transistors should be replaced (these are only sold by Heath Company as a matched set of four transistors.)

	NORMAL	BAD
TX (HI PWR)	0.65V	1.2V
RX	0V	1.2V

Refer to "Power Amplifier Circuit Board," Page 106, for additional troubleshooting information about this section of the Transceiver.

Refer to "Power Amplifier Warranty" on Page 57 for the special one-year warranty on this circuit board.

VOLTAGE AND CONTINUITY CHECKS

To measure voltages, use a voltmeter with a high input impedance (11 megohms or higher). A meter with a low input impedance may load down a circuit and cause the readings to be abnormally low.

An ohmmeter is very useful for measuring resistors, determining the continuity of conductors and inductances, and making a rough check of the serviceability of diodes and transistors (as in "Checking Transistors and Diodes," Page 50).

First, before you check a component on any circuit board, check for the presence of the proper DC input voltage and check the ground connections from the circuit board connectors to the chassis. These are shown on the individual schematics for the circuit boards in the "Maintenance" section on Page 51 and on Figure 5-1(in the "Illustration Booklet").

Check all nongrounded circuit board connectors to make sure there is not a short circuit (zero resistance) to the chassis or to adjacent pins. Do this because one fine strand from a conductor can sometimes protrude and touch an unintended location, thus causing a short circuit. These are usually difficult to see.

When you are told to check a component, refer to the part of the "Maintenance" section which deals with the circuit board upon which the part is located; then measure the voltages around the component and check them against those shown in the "Voltage Chart." It will usually be necessary to use the extender board to gain access to the points to be measured. Any voltage deviation of more than 20% should be considered as possibly indicating some sort of malfunction.

There can be various causes of a voltage variation. For instance: the supply voltage may have changed, there may be a malfunction in the Transceiver's power supply, some resistor between the test point and the voltage source in the Transceiver may have changed value, or a bypass capacitor may have short circuited. Use your voltmeter and trace the voltage path back until you get a normal voltage reading. When this point is reached, the probable causes of trouble can be limited to a very few components, which can then be thoroughly investigated.

CAUTION: When you check transistors, be very careful that you do not touch two leads at the same time with the meter probe. This can destroy a transistor instantly.

The complete absence of a designated voltage indicates a poorly soldered connection, a break in the foil, a power supply failure, or a similar problem.

In such cases, turn the Tranceiver OFF and use your ohmmeter (on its R X 1 scale) to check the continuity of the path to the voltage source. Use the "X-Ray View" (see "Maintenance" section Page 51) and the schematic diagram to determine where the path is.

TEST CHART

This chart uses selected parts of the "Test and Adjustment" section to check circuit boards. It will be most useful for the type of difficulty that shows up after the Transceiver has been in operation for some time. Refer first to the "Function" column and locate the function that is not operating properly on your Transceiver. Then perform the proper tests (and adjustments in some cases) as described in the next column.

Be sure to see "After you localize the trouble to one area:" on Page 42.

BOARD	FUNCTION	DO TEST UNDER (see index Page 51)	PAGE
B	Transmitter audio amplifiers, Vox amplifiers, keying, relay driver, regulator	"Transmit Audio/ Regulator"	6
D	HF oscillators, Transmitter bandpass filters, LSB shift	"HFO coil Adjustments" "LSB Shift Adjustment"	7 10
K	ALC, filter	"Receiver Alignment"	11
E	LSB, USB, and CW generators, balanced modulator, SSB and CW filters		
F	Receiver IF, AF, AGC		
G	Receiver front end, bandpass filters		
A	Calibrator	"Calibrator Adjustment"	17
C	Transmitter IF amplifiers, ALC, bandpass filters	"Low Power Transmitter Check"	18
J	Driver		
H	Power Amplifier	"P.A. Circuit Board"	22

CHECKING TRANSISTORS AND DIODES

SILICON BIPOLAR TRANSISTOR CHECKING

To check a transistor accurately, you should use a transistor checker. However, if one is not available, you can use an ohmmeter to determine the general condition of any of the bipolar transistors in this kit. The ohmmeter used must have at least 1 volt DC at the probe tip to exceed the threshold of the diode junctions in the transistor being tested.

To check a transistor with an ohmmeter, proceed as follows. NOTE: Identify the transistor leads on the "Identification Charts" on Page 53.

1. Unsolder and remove the transistor from the circuit.
2. Set the ohmmeter to the RX1000 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.
4. Repeat step 3 with the test leads reversed.

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.

MOSFET AND JFET CHECKING

Insulated gate type MOSFET's are used at Q501 on the receiver/IF audio circuit board, and at Q701 and Q704 on the receiver front end circuit board. JFET's are used at Q1202 and Q1203 on the oscillator and buffer circuit boards. Usually, any defect in these devices is found to be an internal short circuit between the source and the gate of the JFET (between the source and one of the gates of the MOSFET). These devices can be checked for serviceability by one of the two following methods.

Method 1

1. Remove the device from the circuit.
2. Set your ohmmeter to the R X 10 K range.
3. Connect the common meter lead to the gate and the hot lead to the source.
4. If the device is good, a reading near infinity will be obtained. If you do not get this reading, reverse the meter leads.
5. If you do not get a reading near infinity with the meter leads connected either way, the device should be replaced.

Method 2

1. Remove the device from the circuit.
2. Set your ohmmeter to the R X 10 K range.
3. Connect the gate to the source.
4. Connect the common meter lead to the gate and source and connect the hot lead to the drain.
5. The meter reading should be in the lower part of the meter scale.
6. If the reading is not in the lower part of the meter scale, the device should be replaced.

DIODE CHECKING

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

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

MAINTENANCE

INDEX

Identification Charts 53
Circuit Board Service Policy 57
Calibrator Circuit Board (A) 59
VFO and Buffer Circuit Boards 62
HFO/Premixer Circuit Board (D) 66
Transmitter Audio/Reg Circuit Board (B) 71
Transmitter IF Circuit Board (C) 76
Driver Circuit Board (J) 81
VFO Filter Circuit Board 84
ALC/Output Circuit Board (K) 86
Carrier Generator/Xtal Filter Circuit Board (E) 90
Receiver Front End Circuit Board (G) 95
Receiver IF/Audio Circuit Board (F) 100
Power Amplifier Circuit Board (H) 106

This part of the Manual presents, for each circuit board, a section which contains the Schematic diagram, an "X-Ray View," a "Voltage Chart," a "Troubleshooting Chart," and a "Circuit Description." The "X-Ray View" permits you to simulate viewing both sides of the circuit board simultaneously so you can easily trace the foil pattern between components.

The "Identification Charts" provide a summarized reference to all the solid-state devices used in the Transceiver.

To find the Part Number of a component for the purpose of ordering a replacement part:

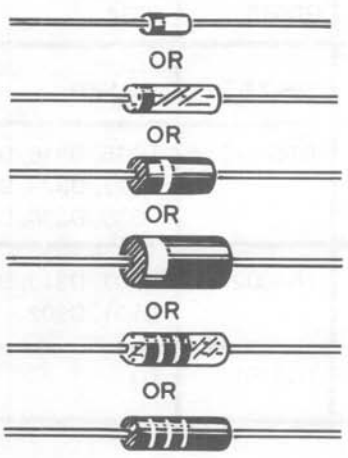
A. Find the circuit component number (R5, Q1, etc.) on the proper "X-Ray View" or the Schematic.

B. Locate this same number in the "Circuit Component Number" column of the proper "Parts List."

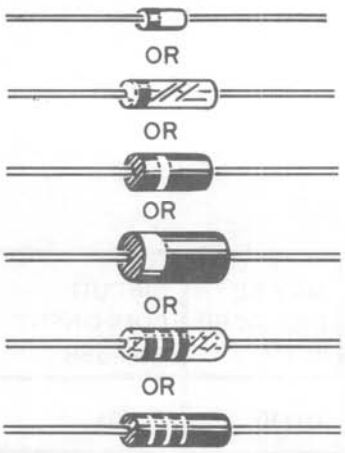
C. Adjacent to the circuit component number, you will find the Part Number and Description, which must be supplied when you order a replacement part.

Identification Charts

DIODES

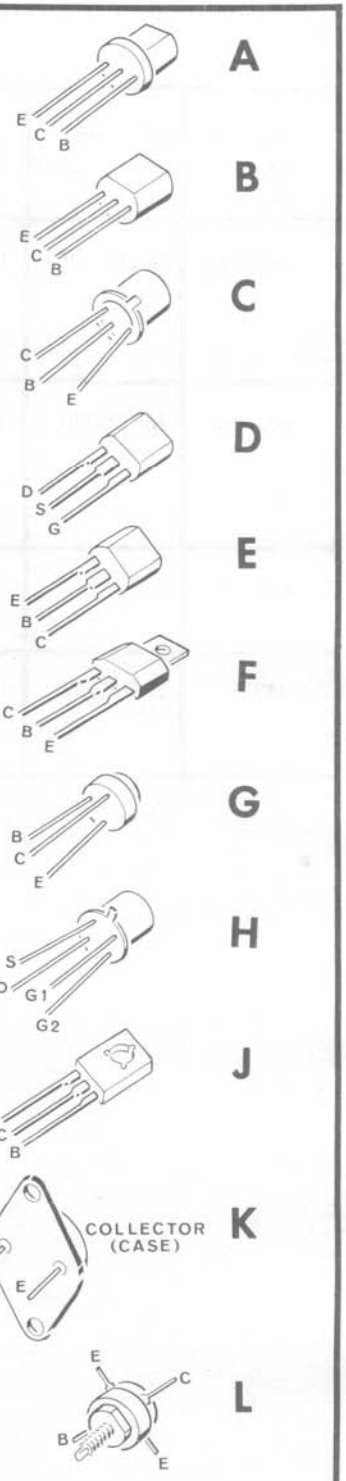
HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
56-6	1N710	ZD501	NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES. 
56-16	1N751	ZD101, ZD201, ZD203	
56-19	VR-9.1	ZD1, ZD202	
56-20	1N295	D801, D802, D803	
56-24	1N458	D4, D313, D314, D321, D322, D325, D326, D329, D330, D333, D334, D431, D432 D433, D434, D435, D436, D437, D438, D439, D440, D601, D602, D603, D604, D605, D606, D612, D613, D701,D702,D703,D704, D705,D706,D709,D710, D713,D714,D1201,D1255	
56-26	1N191	D426,D615,D905,D906, RF Det.	

Diodes (cont'd.)

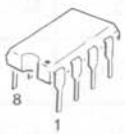
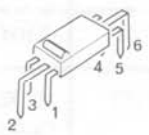
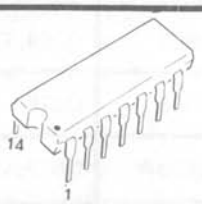
HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
56-56	1N4149	D2, D3, D201, D202, D203, D204, D205, D301, D302, D303, D304, D305, D317, D318, D319, D320, D401, D402, D403, D404, D405, D406, D407, D408, D409, D410, D411, D412, D413, D414, D419, D420, D421, D422, D501, D502, D503, D504, D505, D511, D512, D513,D514,D707,D708, D711,D712,D1202,D1203, D1251,D1252,D1253,D1254	NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES. 
56-59	1N750A	ZD301, ZD502	
56-87	FH1100	D306, D307, D308, D309, D427, D428, D429, D430, D506, D507, D508, D509, D607, D608, D609, D611	
56-89	GD510	D614	
56-97	VR-7.5	ZD1201	
57-64	DRS-110	D315, D316, D323, D324, D327, D328, D331, D332, D335, D336, D903, D904	
57-65	1N4002	D207, D310, D311, D312, D901, D902	
57-34	1N3491	D1	

TRANSISTORS

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	BASING DIAGRAM
417-118	2N3393	Q1204	A or B
417-154	2N2369	Q301, Q405, Q406, Q703	C
417-162	MHT9210	Q1	K
417-169	MPF105	Q1202, Q1203	D
417-172	MPS6521	Q401, Q402, Q403	E
417-201	X29A829	Q202, Q204, Q207, Q208, Q605, Q609, Q612	A or B
417-205	2N3866	Q304, Q305, Q407	C
417-233	2N3643	Q515	E or G
417-234	2N3638A	Q517, Q1205	E or G
417-235	2N4121	Q506, Q511, Q513, Q702, Q705	E or G
417-240	40673	Q501, Q701, Q704	H
417-263	SJE607	Q516	J
417-264	SJE608	Q518	J
417-801	MPSA20	Q101, Q102, Q201, Q203, Q205, Q206, Q209, Q210, Q302, Q303, Q502, Q503, Q504, Q505, Q507, Q508, Q509, Q512, Q514, Q601, Q602,Q603,Q604,Q606, Q607,Q608,Q611,Q613, Q801,Q802,Q1251	E
417-830	PT6619	Q901, Q902	L
417-831-1	CD-2664A (Set of 4 417-831)	Q951, Q952, Q953, Q954	L



INTEGRATED CIRCUITS

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
442-18	MC1350P	IC301, IC501	
442-48	MFC6030	IC203	
442-71	LM3900	IC201, IC502	
443-5	SN7473N	IC101	

Circuit Board Service Policy

IN WARRANTY – When any of the circuit boards listed below are returned to any Heath service facility within 90 days of the date of your invoice, defective parts will be replaced without charge for parts or labor. A circuit board that requires service due to causes other than defective parts will be repaired at the fixed charge listed below, plus the cost of parts replaced.

OUT OF WARRANTY – After your 90-day kit warranty expires, any of the circuit boards listed below will be repaired by a Heath service facility at the fixed charge listed plus the cost of parts replaced.

SERVICE FACILITIES – Service facilities are available at our factory and at Heathkit Electronic Centers to service the circuit boards used in this Transceiver.

CIRCUIT BOARDS – The Circuit Board Service Policy applies to the following circuit boards:

	CIRCUIT BOARD	SERVICE LABOR FEE*
	VFO/Buffer (entire assembly)	$15.00
A	Calibrator	5.00
B	Transmitter Audio/Reg	5.00
C	Transmitter IF	10.00
D	HFO/Premixer	5.00
E	Carrier Generator/Xtal Filter	5.00
F	Receiver IF/Audio	10.00
G	Receiver Front End	10.00
H	Power Amplifier	10.00
J	Driver	5.00
K	ALC/Output Filter	5.00

POWER AMPLIFIER WARRANTY – Within one year from the date of your invoice, the power amplifier circuit board, completed according to the instructions in the Assembly Manual, may be returned to the factory or to a Heathkit Electronic Service Center for repair or replacement, at our option. The power amplifier circuit board must be returned for warranty replacement of the output transistors.

*Plus parts charge when out of warranty.

After one year, a matched set of the four transistors used on the power amplifier circuit board may be purchased from the Heath Company. Since the transistor characteristics must be balanced, they are available only as a set of four.

HOW TO RETURN CIRCUIT BOARDS

A special circuit board packing carton (#380-846) has been included in Parts Pack #12 of your Transceiver. This is the collapsed carton which is packed flat and has red rectangles on the sides so it will be easily recognized among other pieces of incoming mail and receive priority handling. Save both the carton and some loose packing material for future use, should it be necessary. Include the following information in the package:

1. Your name, address, and zip code.
2. A letter describing the symptoms observed in your Transceiver, and copies of any prior correspondence.
3. The chassis series number (find this on the blue and white label).
4. Date of purchase and invoice number.
5. Authorization for us to return your circuit board COD for the service, parts, and shipping charges.

Ship the carton by insured parcel post to "Heath Company, Benton Harbor, Michigan, 49022" or to any one of the Heathkit Electronic Centers listed in the current Heathkit catalog.

IMPORTANT – The policy stated above applies only to the circuit boards named. If the problem appears to be elsewhere and cannot be resolved with the Manual troubleshooting suggestions, check with our Technical Consultants Section at the factory or at your nearest Heathkit Electronic Center before returning the kit or any components for service.

SCHEMATIC OF THE HEATHKIT® SINGLE SIDEBAND TRANSCEIVER MODEL HW-104

NOTES:

1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED. VALUES ARE IN Ω (OHMS). K=1,000 M=1,000,000.
2. CAPACITOR VALUES LESS THAN 1 ARE IN µF. VALUES OF 1 AND HIGHER ARE IN pF UNLESS OTHERWISE SPECIFIED.
3. THE BANDSWITCH IS SHOWN AT THE 3.5 MHz POSITION AND THE MODE SWITCH AT LSB.
4. REFER TO THE IDENTIFICATION CHARTS FOR INFORMATION CONCERNING TRANSISTORS, DIODES, AND INTEGRATED CIRCUITS (ICs).
5. REFER TO THE APPROPRIATE PARTS LIST FOR CROSS-REFERENCE BETWEEN SCHEMATIC COMPONENT DESIGNATIONS AND PART NUMBERS.
6. CHASSIS WIRING-SEE FIGURE 5-1 (IN THE "ILLUSTRATION BOOKLET").
7. SYMBOLS:


= A PLUG-IN CONNECTION.


= CIRCUIT BOARD GROUND.

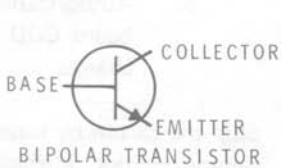

= CHASSIS GROUND.


= IDENTIFIED CIRCUIT BOARDS HOLES.

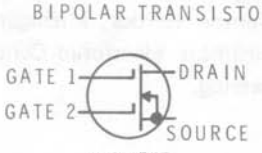

= CIRCUIT BOARD EDGE CONNECTOR.


= FERRITE BEAD.

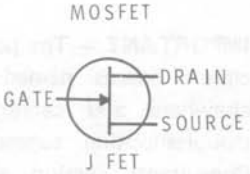

= PHONO SOCKET.



BIPOLAR TRANSISTOR

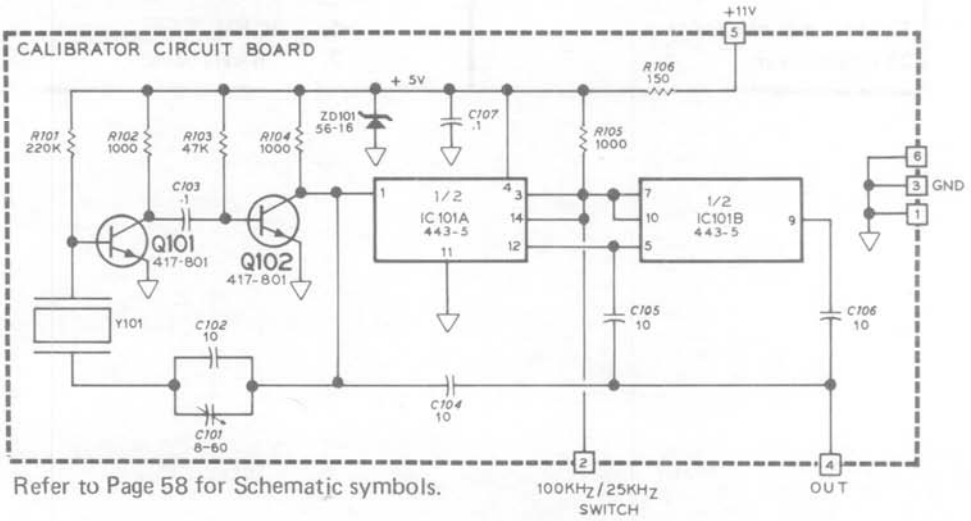


MOSFET



J FET

Calibrator Circuit Board*



Refer to Page 58 for Schematic symbols.

CALIBRATOR SCHEMATIC
* CIRCUIT BOARD A

CIRCUIT DESCRIPTION

This circuit generates the markers used to calibrate the tuning dial.

When the RF Gain knob is pulled out, 11 volts is applied to A5 on the calibrator circuit board. This is applied to ZD101, providing a regulated 5 volts. Q101 and Q102 form a 100 kHz astable multivibrator that is controlled by crystal Y101. When the 25 kHz button is depressed, A2 is disconnected from ground. This allows IC101A and B to function. Each divides by 2, adding markers at 25 kHz intervals.

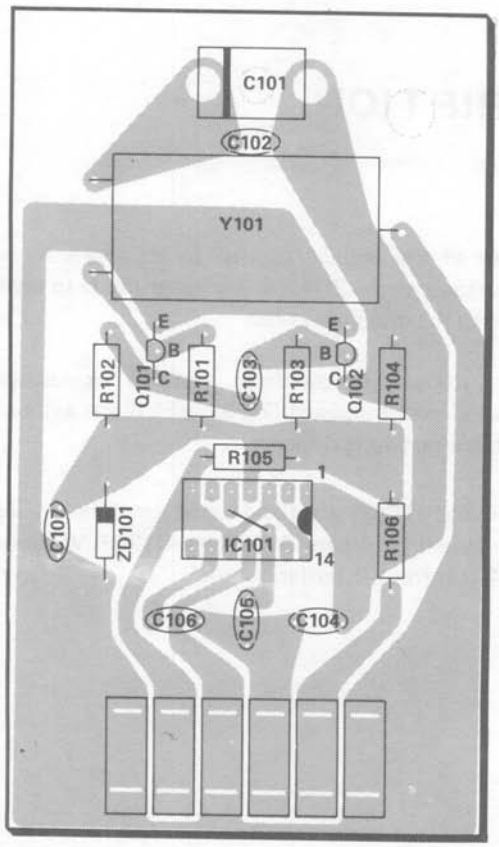
NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the "Parts List" starting on Page 59 of the Assembly Manual.

	QUAN-TITY	TYPE	HEATH PART NO.
ZD101	1	1N751	56-16
Q101, Q102	2	MPSA20	417-801
IC101	1	SN7473N	443-5

TROUBLESHOOTING CHART

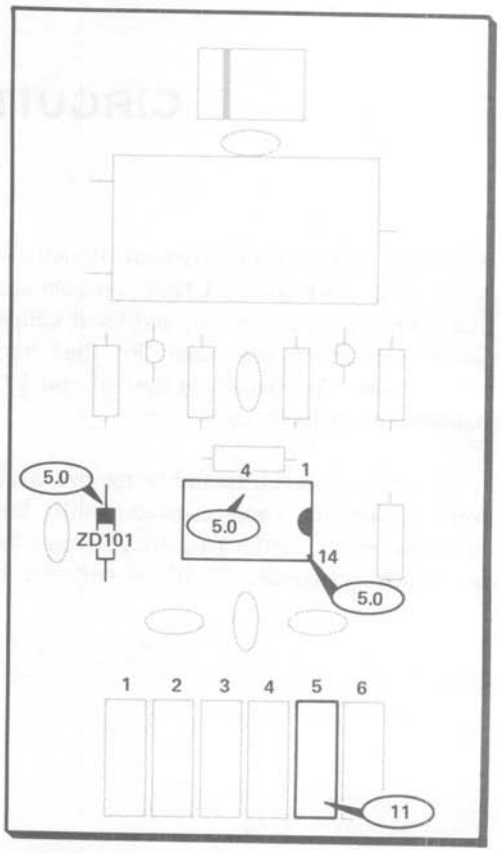
SYMPTOM	POSSIBLE CAUSE
No markers.	1. Check for 11 volts on A5 with the RF Gain knob pulled out. 2. Q101, A102, Y101.
100 kHz markers OK; no 25 kHz markers.	1. IC101. 2. 25 kHz switch.

X-RAY VIEW



(Shown from component side)

VOLTAGE CHART *



(Shown from component side)

*NOTES:

1. RF GAIN KNOB PULLED OUT.
2. 25 kHz BUTTON PUSHED IN.

◯ DC VOLTAGE IN RECEIVE MODE.

VFO and Buffer Circuit Boards

CIRCUIT DESCRIPTION

A field effect transistor is used in a type of Hartley oscillator circuit in the VFO. Part of coil L1201, variable capacitor C1201 (the main tuning capacitor), and fixed temperature compensating capacitors are used in the frequency determining circuits. The remaining part of coil L1201 is used for feedback to maintain oscillation.

Diode D1201 acts as a switch to add or remove C1209 and C1211 from the circuit. These capacitors shift the VFO frequency so the output carrier frequency remains the same when you switch sidebands. D1201 is switched by the polarity of the voltage applied to its anode by the LSB pushbutton switch. ZD1201 is a zener diode to regulate the voltage to the drain of Q1202.

The output of oscillator Q1202 is coupled to source-follower transistor Q1203, which acts as a buffer and impedance matching device.

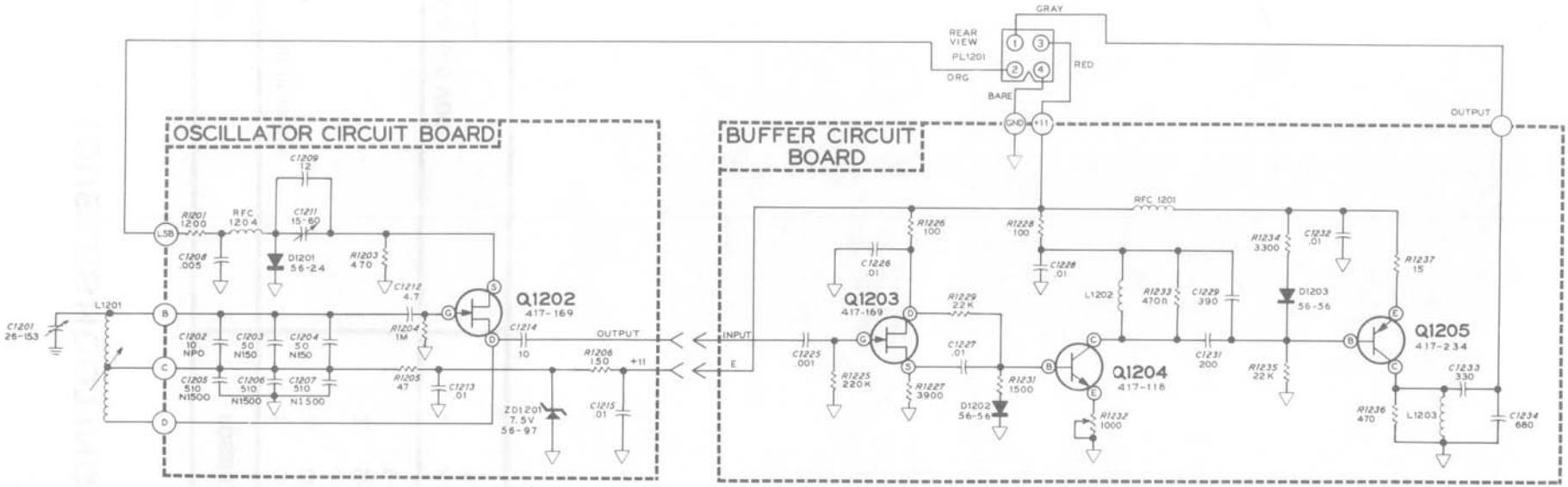
Q1204 and Q1205 are fixed-tuned amplifiers, temperature compensated by diodes D1202 and D1203. Variable resistor R1232 controls the buffer output.

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the "Parts List" starting on Page 11 of the Assembly Manual.

	QUAN-TITY	TYPE	HEATH PART NO.
D1201	1	1N458	56-24
D1202, D1203	2	1N4149	56-56
ZD1201	1	VR-7.5	56-97
Q1202,Q1203	2	MPF105	417-169
Q1204	1	2N3393	417-118
Q1205	1	2N3638A	417-234

SCHEMATIC

Refer to Page 58 for Schematic symbols.

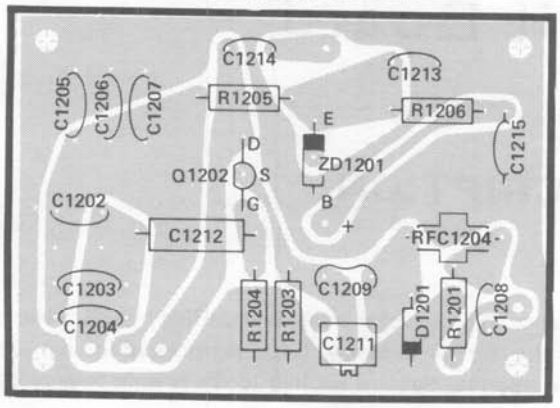


TROUBLESHOOTING CHART

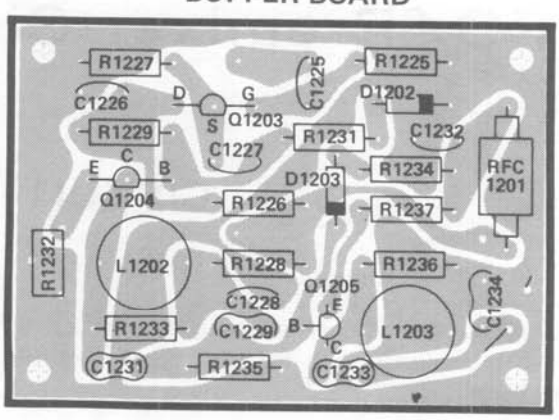
SYMPTOM	POSSIBLE CAUSE
Frequency drift or warble.	1. Check all mechanical connections. 2. Check cemented capacitors on oscillator circuit board. 3. Shorten wires to coil L1201 and resolder them securely.
Less than .4 to .5 VDC VFO output.	1. Refer to "VFO/Buffer Trouble-shooting Guide."

X-RAY VIEWS

OSCILLATOR BOARD

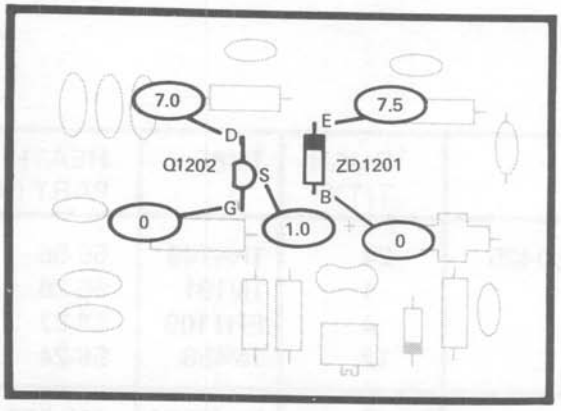


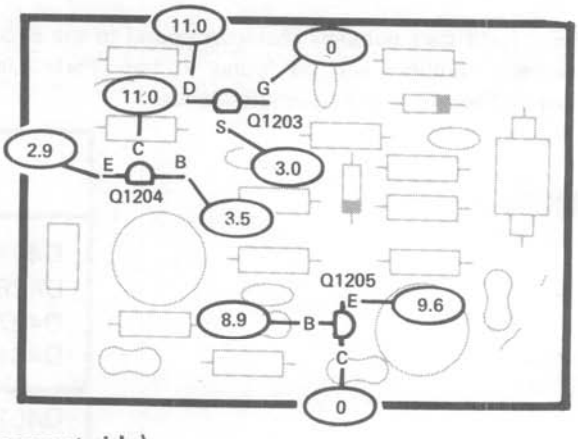
BUFFER BOARD



(Shown from component side)

VOLTAGE CHARTS





(Shown from component side)

TRANSMITTER VOLTAGES (±20%)

NOTES:

1. BANDSWITCH IN 3.5 POSITION
2. MODE SWITCH IN TUNE POSITION
3. METER SWITCH IN PWR POSITION
4. MIC/CW-LEVEL FULLY COUNTERCLOCKWISE

(○) DC VOLTAGE IN RECEIVE OR TRANSMIT MODES

HFO/Premixer Circuit Board

CIRCUIT DESCRIPTION

These circuits generate crystal-controlled injection signals and mix these signals with the VFO signal to obtain the premix signal.

Q401, Q402, and Q403 (and Q404, if the HWA-104-1 Accessory is installed) are used as oscillators. These oscillators are diode-selected, as are the proper oscillator crystals.

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the "Parts List" starting on Page 45 of the Assembly Manual.

The crystal oscillator signal is amplified by Q405 and routed to the receiver circuitry. Q406 provides additional gain, and the resulting signal is applied to the premix balanced mixer.

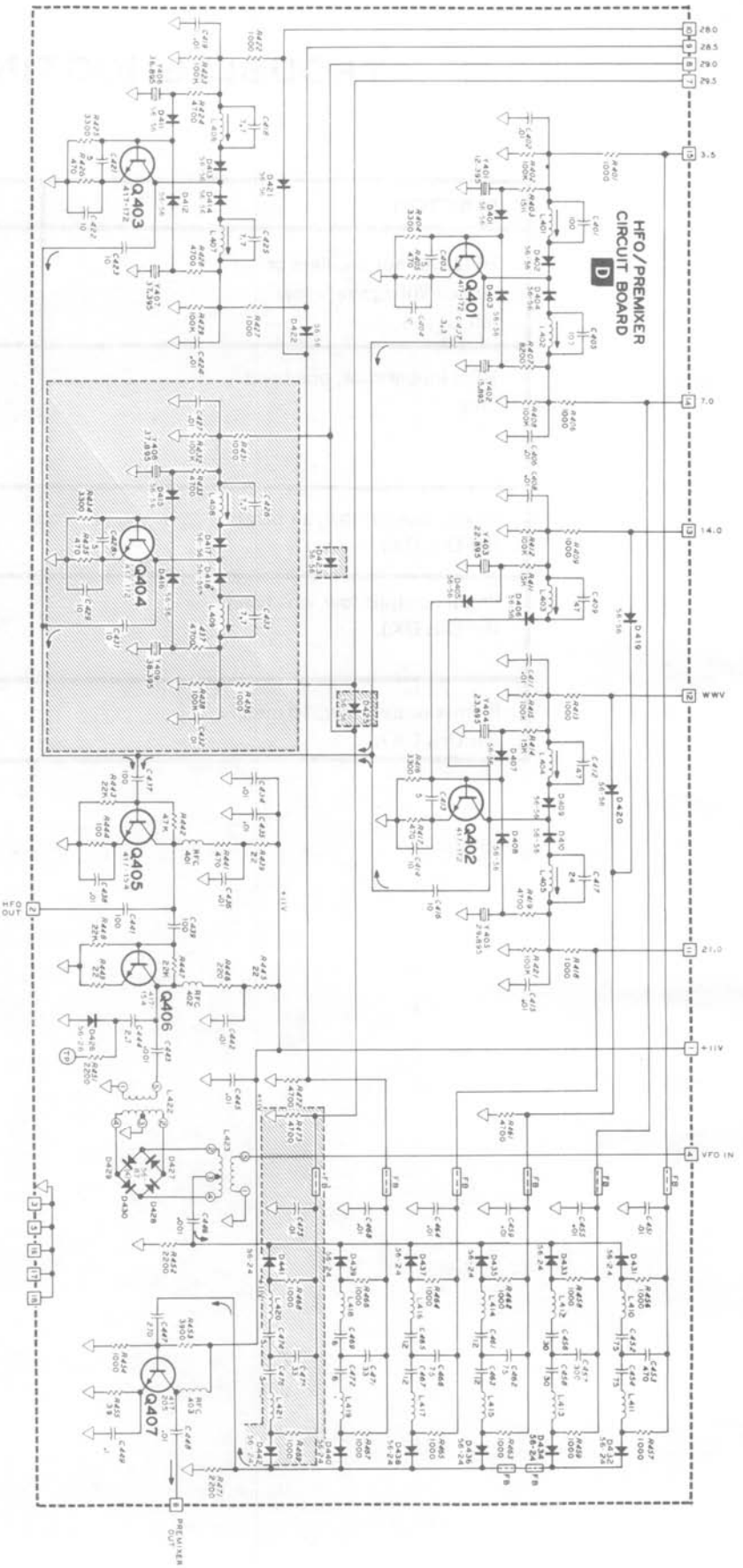
Diodes D427, D428, D429, and D420 form a balanced mixer, which combines the HFO and VFO signals to create the premix signal. The output of the balanced mixer is filtered by diode-selected bandpass filters and amplified by Q407. The resulting output is used to drive the transmitter circuits.

	QUAN-TITY	TYPE	HEATH PART NO.
D401-D423,D425	24	1N4149	56-56
D426	1	1N191	56-26
D427-D430	4	FH1100	56-87
D431-D442	12	1N458	56-24
Q401-Q404	4	MPS6521	417-172
Q405, Q406	2	2N2369	417-154
Q407	1	2N3866	417-205

NOTE: D415, D416, D417, D418, D423, D425, D441, D442, and Q404 are part of the HWA-104-1 Accessory.

HFO/PREMIXER SCHEMATIC

CIRCUIT BOARD D



Refer to Page 58 for Schematic symbols.

NOTE: The components in the shaded areas are part of the HWA-104-1 Accessory.

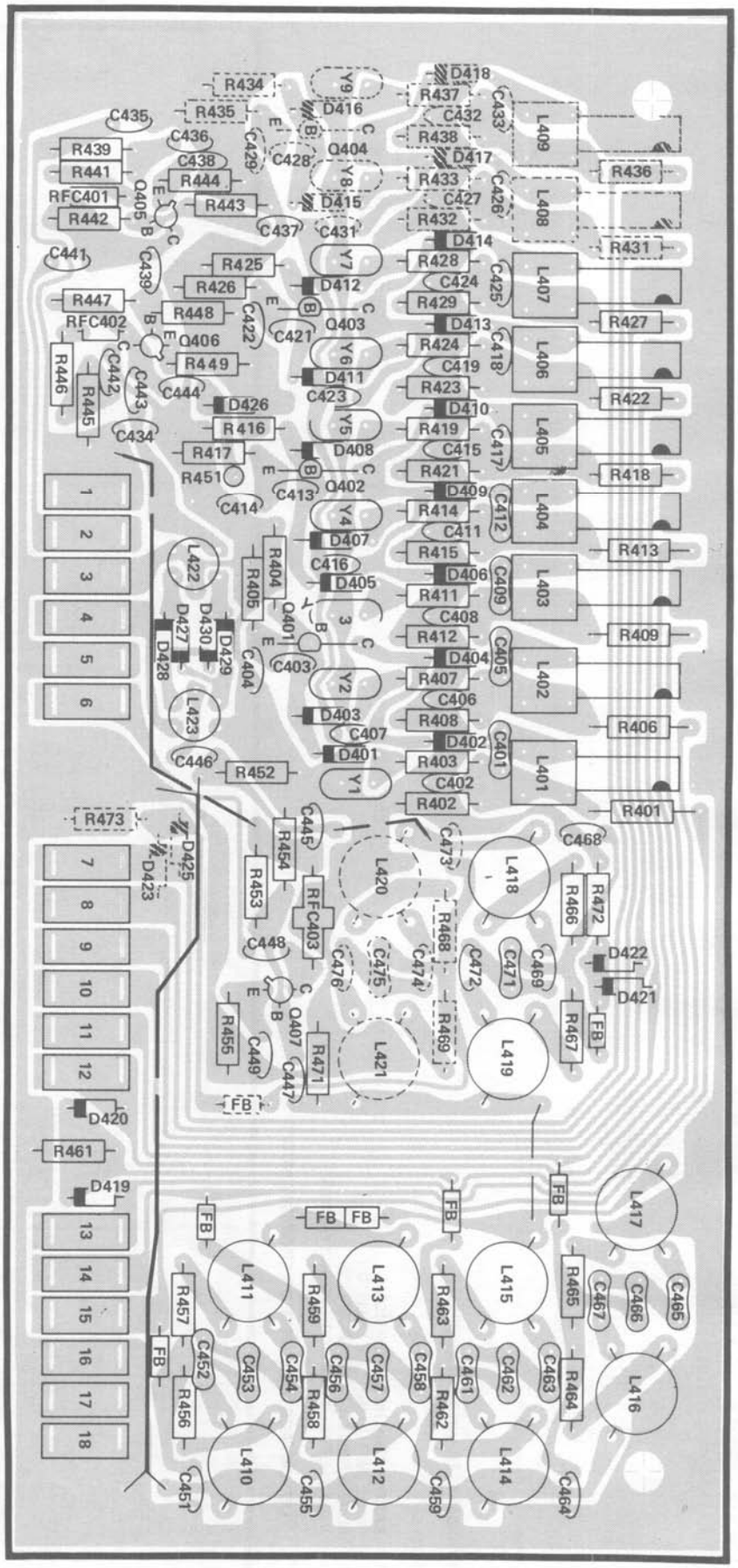
TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
HFO will not oscillate or output voltage very low (all bands).	1. Band switch wiring. 2. 11V missing. 3. Q405.
HFO inoperative, one band only.	1. Band switch. 2. For the band concerned, the associated crystal, transistor, switching diodes, coil.
Premix output low, all bands (HFO is OK).	1. VFO signal low or missing. 2. Q406, Q407.
Premix output low, one band (HFO is OK).	1. Band switch. 2. Filter components associated with the band.
Premix output low, 10 meters. (HFO is OK).	VFO filter board components.

X-RAY VIEW

(Shown from component side)

NOTE: The dashed-in components are part of the HWA-104-1 Accessory.



VOLTAGE CHART

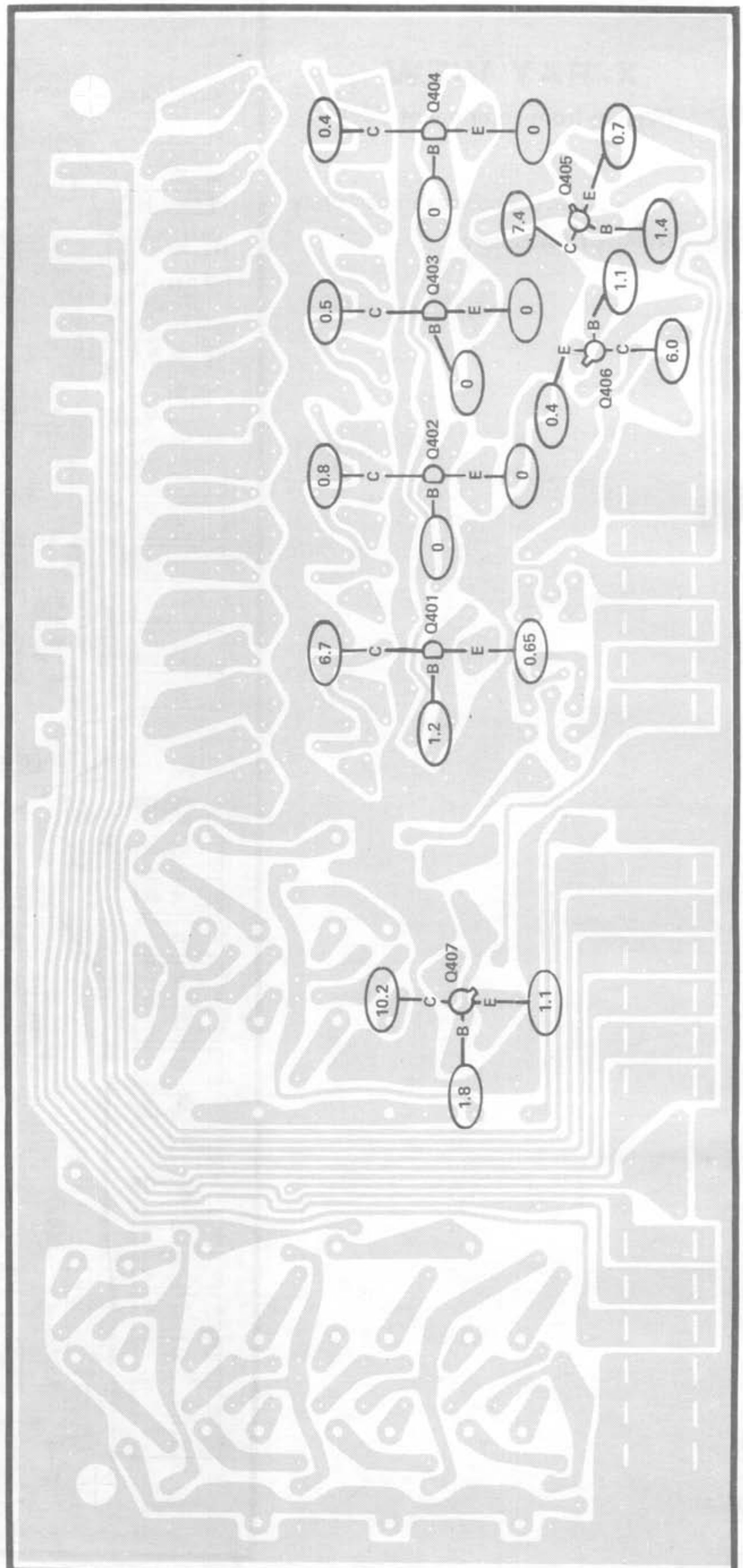
(Shown from foil side)

TRANSMITTER VOLTAGES (±20%)

NOTES:

1. BANDSWITCH IN 3.5 POSITION
2. MODE SWITCH IN TUNE POSITION
3. METER SWITCH IN PWR POSITION
4. MIC/CW-LEVEL FULLY COUNTERCLOCKWISE

◯ DC VOLTAGE IN RECEIVE OR TRANSMIT MODES



Transmitter Audio/Reg Circuit Board

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
11V missing or low.	1. 13.8V missing. 2. IC203,D207. 3. Q1 (11V source). 4. 11V line shorted. 5. C227 installed wrong or shorted.
No TX audio, no VOX, no sidetone.	IC201
NO TX audio, VOX OK.	1. IC201. 2. Q201. 3. Level control (Mic).
No VOX, TX audio OK, PTT OK.	1. IC201. 2. VOX button not depressed. 3. Depress VOX button. 4. Q203, Q204, ZD201.
PTT inoperative.	1. Q205, Q206, Q207, Q208. 2. ZD202.
Relay inoperative.	1. Relay coil. 2. Q207. 3. D204. 4. ACC plug jumper. 5. Switch SW3E.
No side tone, no tune mode, VOX OK.	1. IC201. 2. Q209, Q210.

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the "Parts List" starting on Page 35 of the Assembly Manual.

CIRCUIT DESCRIPTION

These circuits process the transmitter audio input, provide the transceiver T/R control functions, and regulate the 13.8 volt input voltage to 11 volts for use throughout the Transceiver.

IC201 is a quad-operational amplifier (there are four op amps in one package). One section is used as a microphone preamplifier. Phone patch inputs are also processed through this stage, which is disabled in the CW and Tune modes to prevent microphone audio from being transmitted illegally. The microphone preamplifier feeds to controls on the chassis – the MIC/CW Level and Vox Gain controls.

The wiper of the audio section of the MIC/CW Level control is connected to the second section of IC201, which provides additional gain for the transmit audio. This amplifier is disabled in the receive mode for muting purposes. Q201 is an emitter follower which provides impedance matching to the balanced modulator audio input (circuit board E).

The wiper of the Vox Gain control is connected to the third section of IC201, which drives the Vox circuitry. The front panel Vox switch enables this amplifier. The output is detected by diodes D201 and D202, and the resulting DC voltage drives the Vox switch, which consists of Q203, Q204, Q205, and Q206. Q207 is a switch for driving the chassis-mounted T/R relay, and Q208 provides for PTT operation.

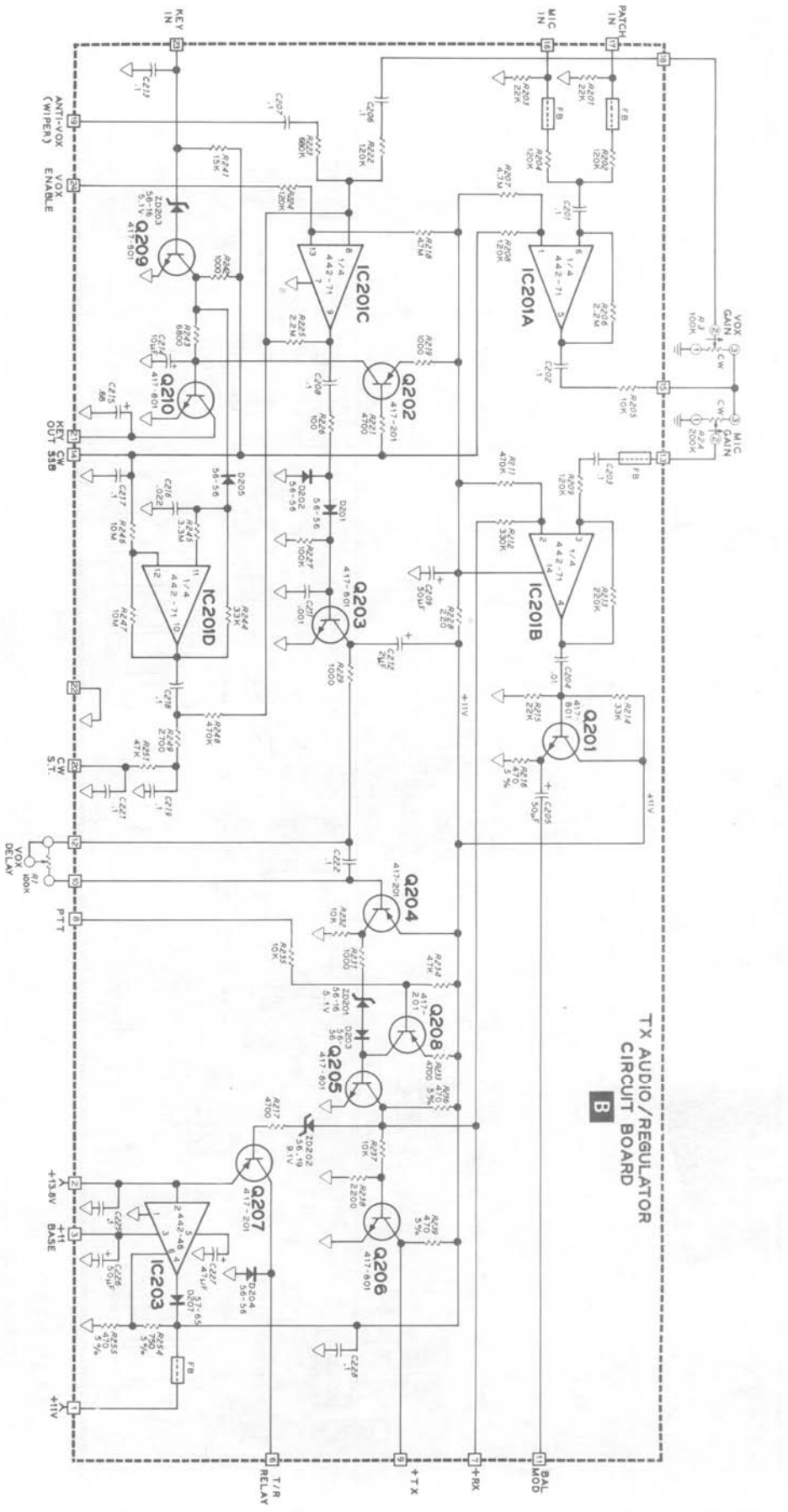
The fourth section of IC201 is a side tone oscillator. This oscillator and keying transistors Q209 and Q210 are enabled in the CW mode. The output of the sidetone oscillator is connected to the sidetone level control on the rear panel, and to the Vox amplifier, where it provides tone-keyed T/R switching in the CW mode.

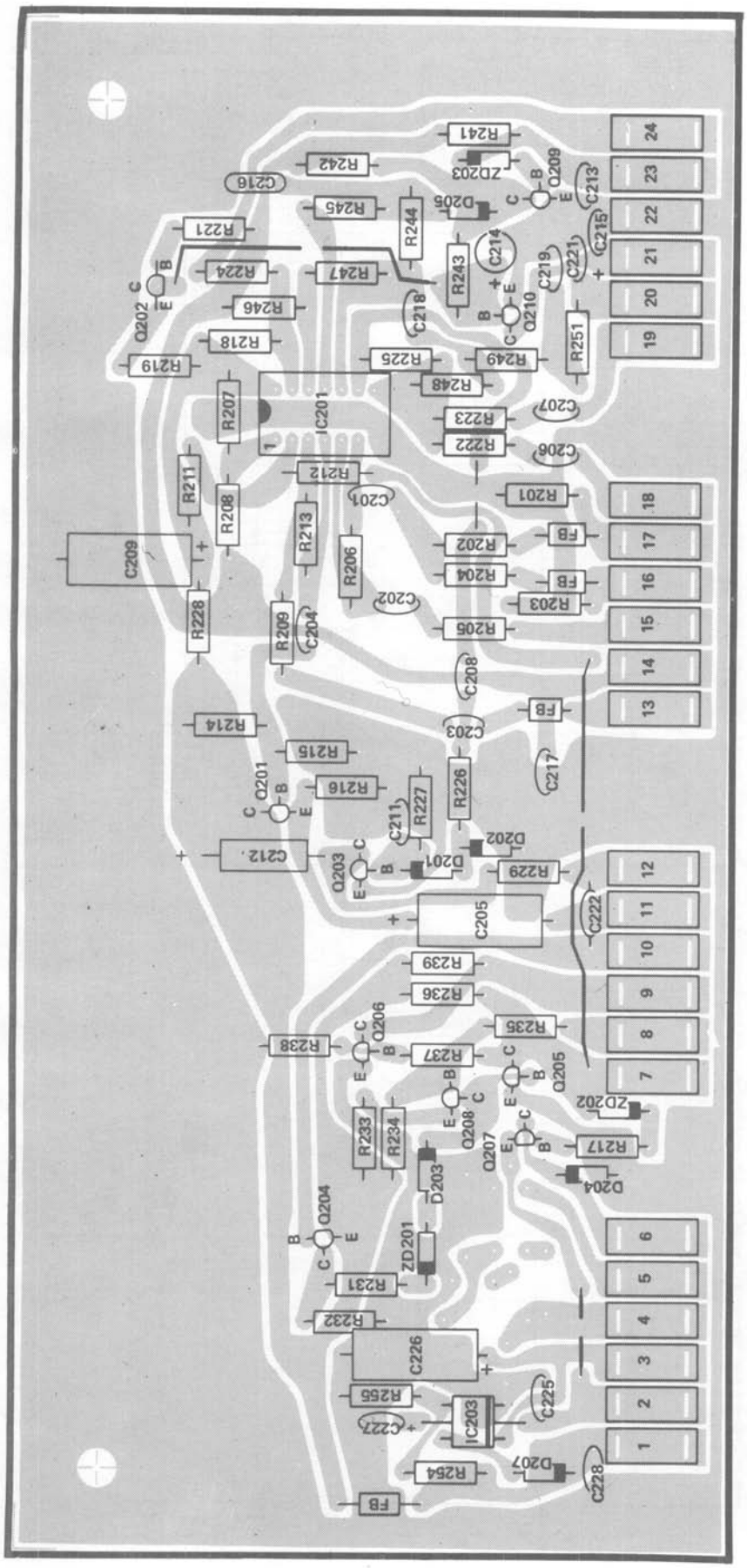
IC203 is the 11-volt regulator. An external chassis-mounted pass transistor (Q1) is used with this regulator to increase the current-handling capacity.

	QUAN-TITY	TYPE	HEATH PART NO.
D201-D205	5	1N4149	56-56
D207	1	1N4002	57-65
ZD201, ZD203	1	VR-5.1	56-16
ZD202	1	VR-9.1	56-19
Q201, Q203, Q205, Q206 Q209, Q210,	6	MPSA20	417-801
Q202, Q204, Q207, Q208	4	X29A829	417-201
IC201	1	LM3900	442-71
IC203	1	MFC6030	442-48

TRANSMITTER AUDIO/REG SCHEMATIC

CIRCUIT BOARD B





X-RAY VIEW

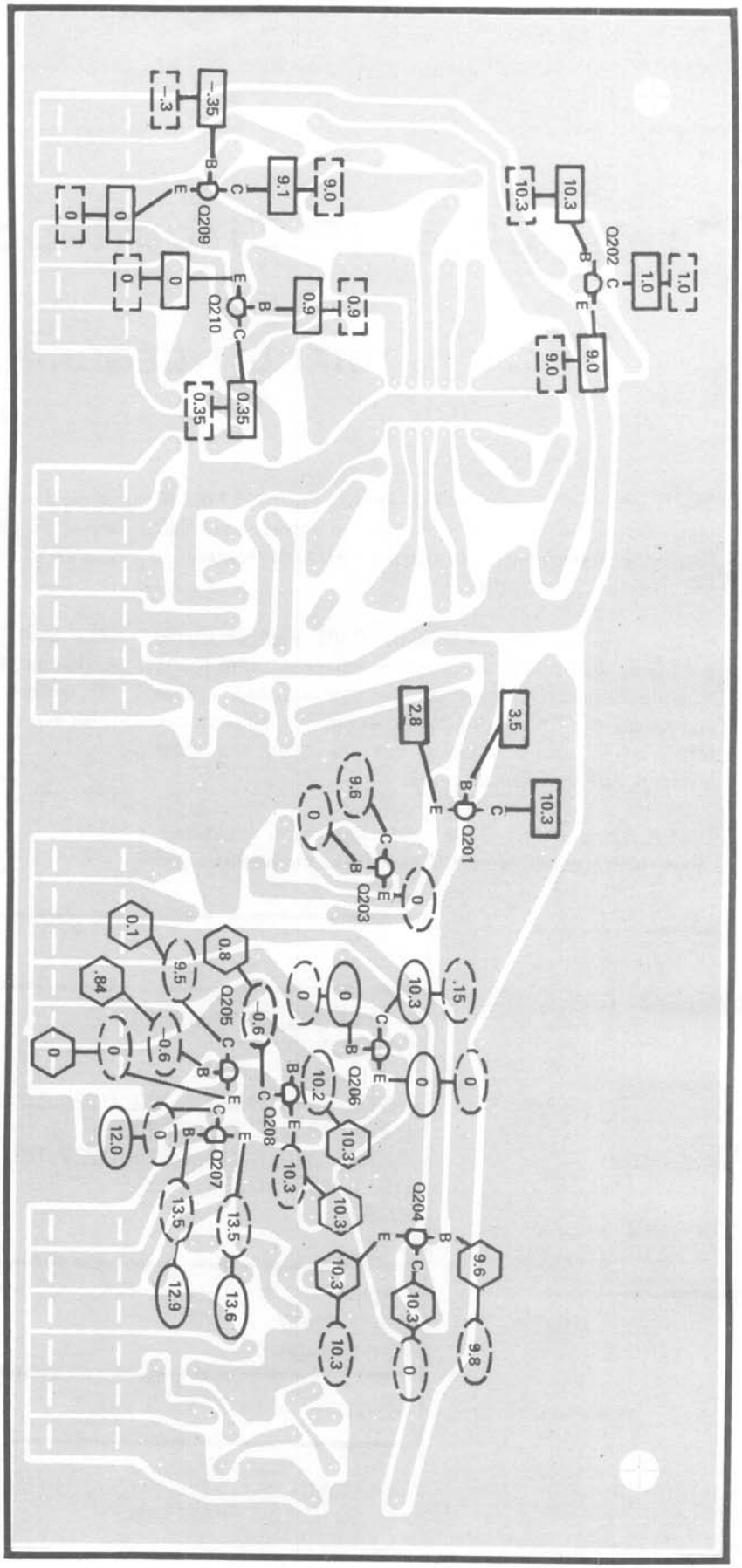
(Shown from component side)

BASE DIAGRAM
TOP VIEW

IC203

VOLTAGE CHART

(Shown from foil side)



RECEIVER VOLTAGES (±20%)

NOTES:

1. POWER SUPPLY AND 4Ω SPEAKER CONNECTED
2. ANTENNA NOT CONNECTED
3. BAND SWITCH IN 3.5 POSITION
4. RF GAIN MAXIMUM CLOCKWISE
5. AF GAIN MAXIMUM COUNTERCLOCKWISE
6. DC VOLTAGES MEASURED WITH 20 KILOHM INPUT VOM TO CHASSIS

( ) DC VOLTAGE WITH MODE SWITCH IN USB, LSB, OR CW POSITION

TRANSMITTER VOLTAGES (±20%)

NOTES:

1. BANDSWITCH IN 3.5 POSITION
2. MODE SWITCH IN TUNE POSITION
3. METER SWITCH IN PWR POSITION
4. MIC/CW-LEVEL FULLY COUNTERCLOCKWISE

▭ DC VOLTAGE WITH MODE SWITCH IN USB OR LSB POSITION

[ ] DC VOLTAGE WITH MODE SWITCH IN CW POSITION

⬠ DC VOLTAGE WITH MODE SWITCH IN USB, LSB, OR CW POSITION

⬭ DC VOLTAGE IN RECEIVE OR TRANSMIT MODES

Transmitter IF Circuit Board

CIRCUIT DESCRIPTION

The function of this circuit is to amplify the 3.395 MHz IF signal, mix it with the premix injection to the desired output frequency, and amplify this signal to the level required by the driver (circuit board J).

IC301 amplifies the IF signal. Q303 and associated components provide ALC control, which is applied to IC301 to control transmitter gain. Q302 samples the ALC voltage and drives the front panel meter to indicate ALC action. Q301 is an emitter follower, used to match the input impedance of the balanced mixer.

Diodes D306, D307, D308, and D309 form a balanced mixer, which combines the IF signal and the premix signal to create an on-frequency transmit signal. The output of this mixer is filtered by diode-selected bandpass filters and applied to the input of the predriver.

Q304 and Q305 form the predriver circuit. Transmitter keying in CW is accomplished in this circuitry by switching the emitter DC return on and off. The output of the predriver is filtered by dioded-selected bandpass filters.

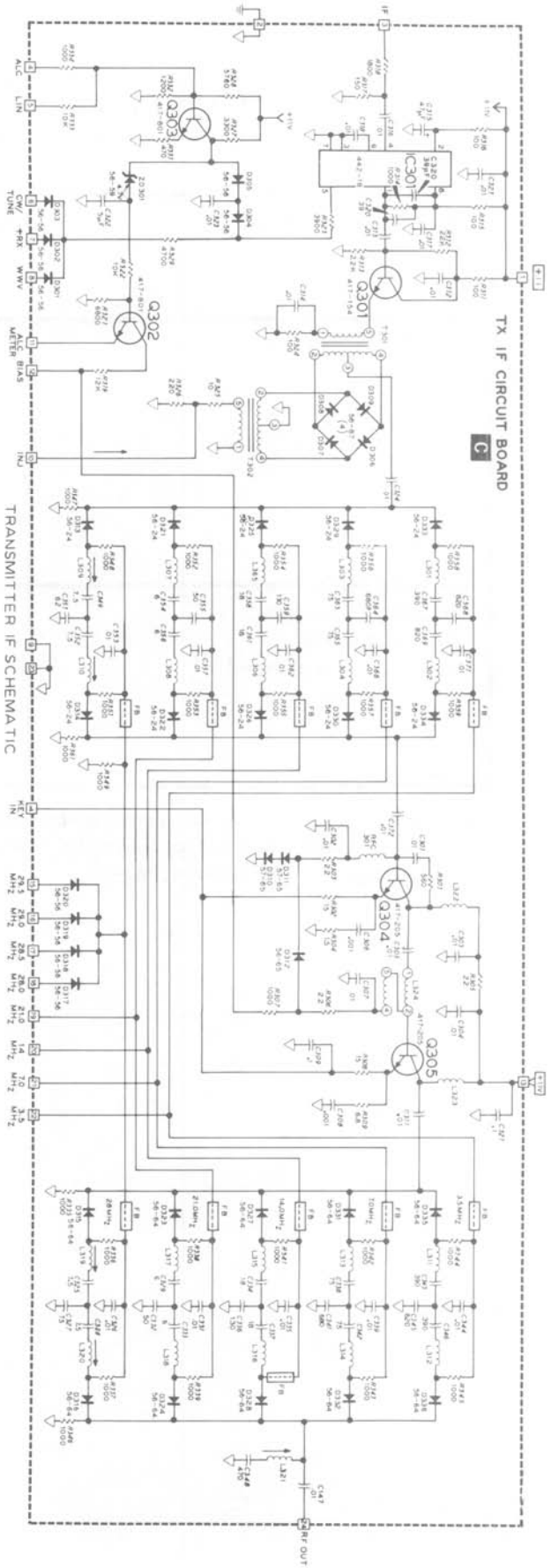
L321 and C348 form a 3.395 MHz trap, used to reduce the amplitude of a spurious output at that frequency on 80 meters.

	QUAN-TITY	TYPE	HEATH PART NO.
D301-D305, D317-D320	9	1N4149	56-56
D306-D309	4	FH1100	56-87
D310-D312, D313, D314, D321, D322, D325, D326	3	1N4002	57-65
D329, D330, D333, D334, D315, D316, D323, D324, D327, D328	10	1N458	56-24
D331, D332, D335, D336	10	DRS-110	57-64
ZD301	1	1N750A	56-59
Q301	1	2N2369	417-154
Q302, Q303	2	MPSA20	417-801
Q304, Q305	2	2N3866	417-205
IC301	1	MC1350P	442-18

TRANSMITTER IF SCHEMATIC

CIRCUIT BOARD C

Refer to Page 58 for Schematic symbols.



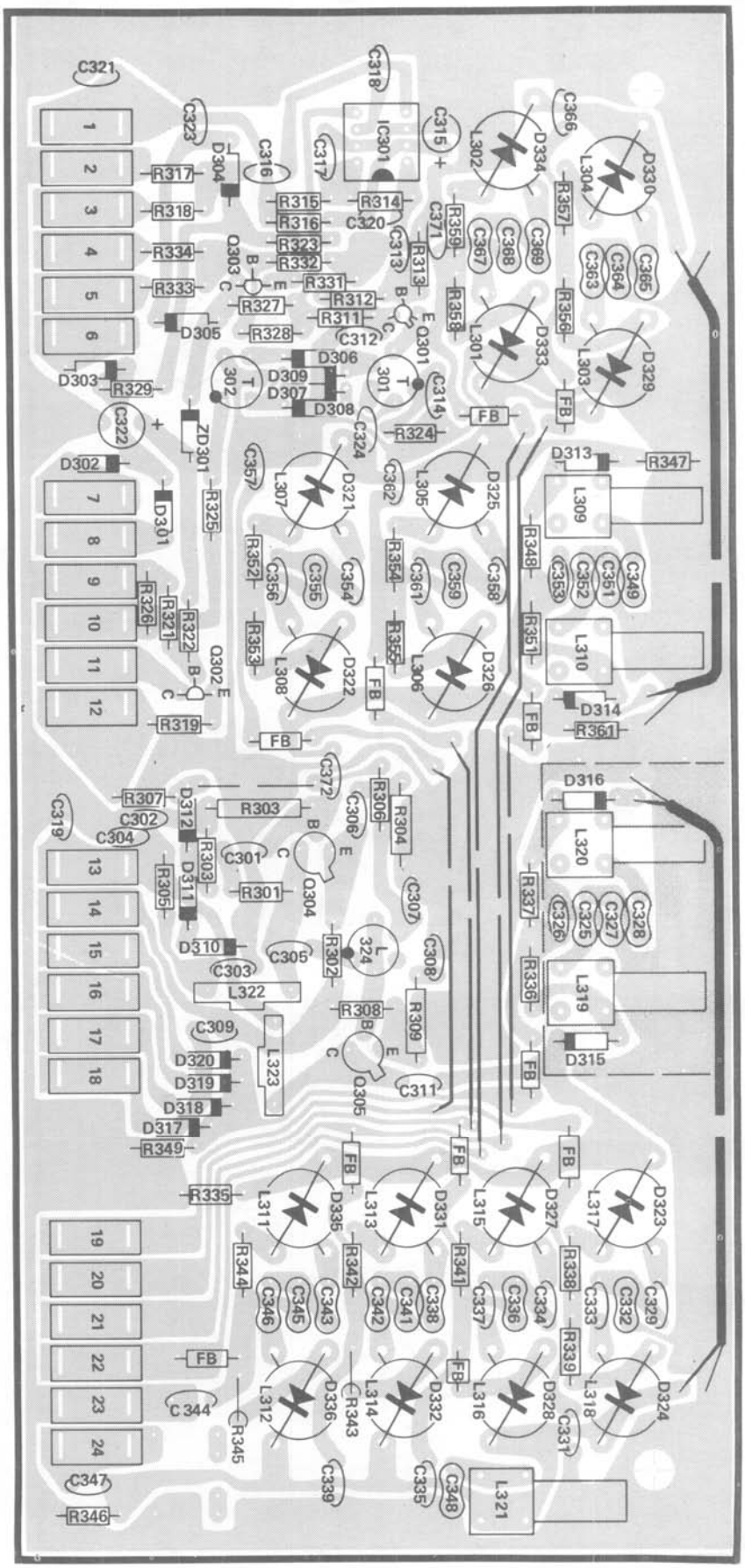
TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
No output on any band.	1. Q301, Q304, Q305, IC301. 2. 11V missing. 3. Premix missing. 4. No IF input (from board E).
No output on one band.	1. Premix missing. 2. Defective component in bandpass filter or bandswitch. 3. 3.395 MHz trap misadjusted (80 meters). 4. L309, L310, L319, L320 require alignment (10 meters).
ALC inoperative (power output too low or high, no ALC meter indication).	1. Q302, Q303. 2. IC301. 3. Filter/ALC (board K). 4. ALC line shorted to chassis. 5. Insufficient drive to develop ALC.

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the "Parts List" starting on Page 65 of the Assembly Manual.

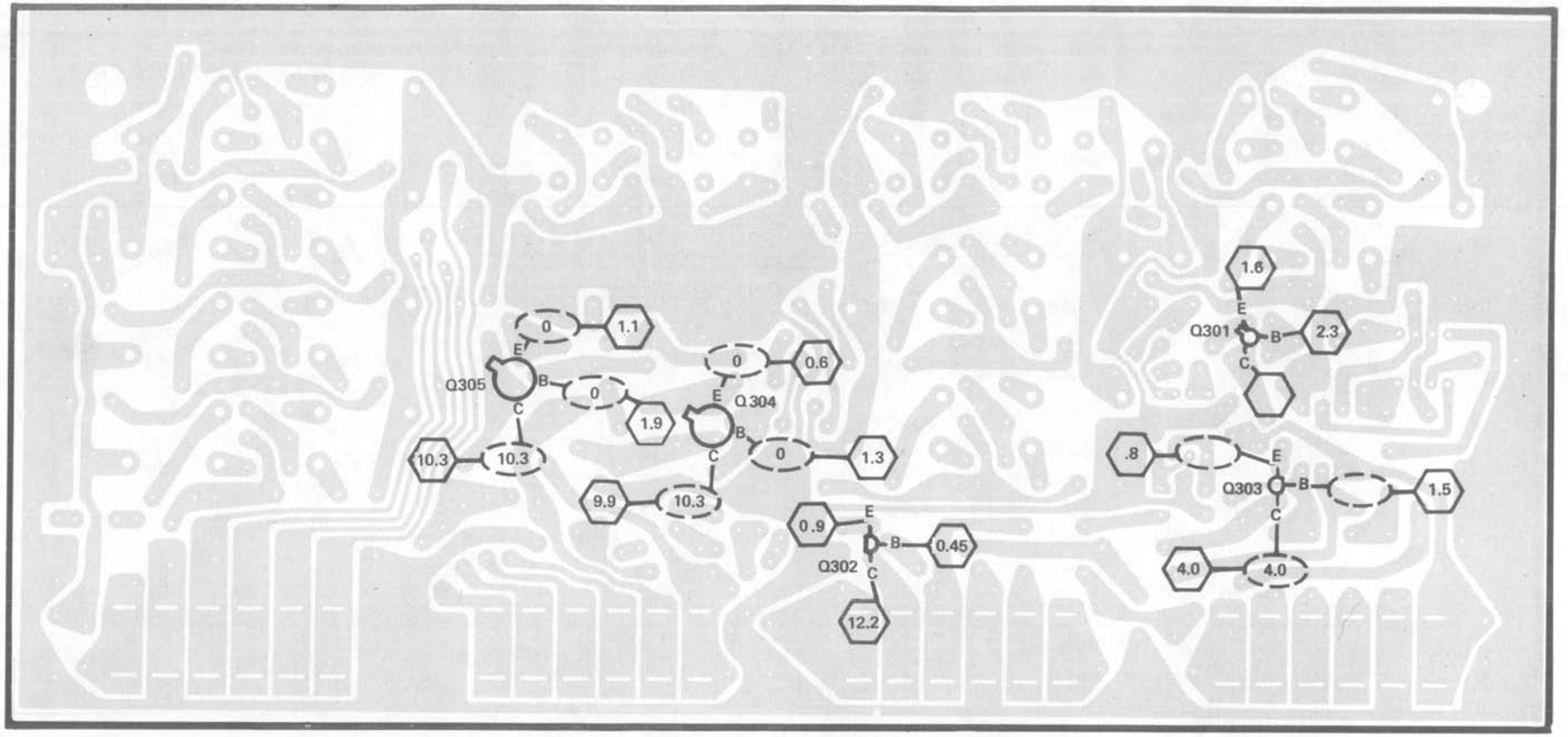
X-RAY VIEW

(Shown from component side)



VOLTAGE CHART

(Shown from foil side)



RECEIVER VOLTAGES (±20%)

NOTES:

1. POWER SUPPLY AND 4Ω SPEAKER CONNECTED
2. ANTENNA NOT CONNECTED
3. BAND SWITCH IN 3.5 POSITION
4. RF GAIN MAXIMUM CLOCKWISE
5. AF GAIN MAXIMUM COUNTERCLOCKWISE
6. DC VOLTAGES MEASURED WITH 20 KILOHM INPUT VOM TO CHASSIS

( ) DC VOLTAGE WITH MODE SWITCH IN USB, LSB, OR CW POSITION

TRANSMITTER VOLTAGES (±20%)

NOTES:

1. BANDSWITCH IN 3.5 POSITION
2. MODE SWITCH IN TUNE POSITION
3. METER SWITCH IN PWR POSITION
4. MIC/CW-LEVEL FULLY COUNTERCLOCKWISE

⬡ DC VOLTAGE WITH MODE SWITCH IN USB, LSB, OR CW POSITION

Driver Circuit Board

CIRCUIT DESCRIPTION

This circuit amplifies the transmitter IF output to a level sufficient to drive the power amplifier.

Transistors Q901 and Q902 are used in a push-pull, class AB linear configuration. D901 and D902 are used to provide proper operating bias. Gain flatness across the range is provided by the network at the input of the driver.

Diodes D903 and D904 route the driver output to the low-pass filter (low power mode) or to the power amplifier (high power mode). These diodes are contolled by the relay switching line in conjuction with the HI switch.

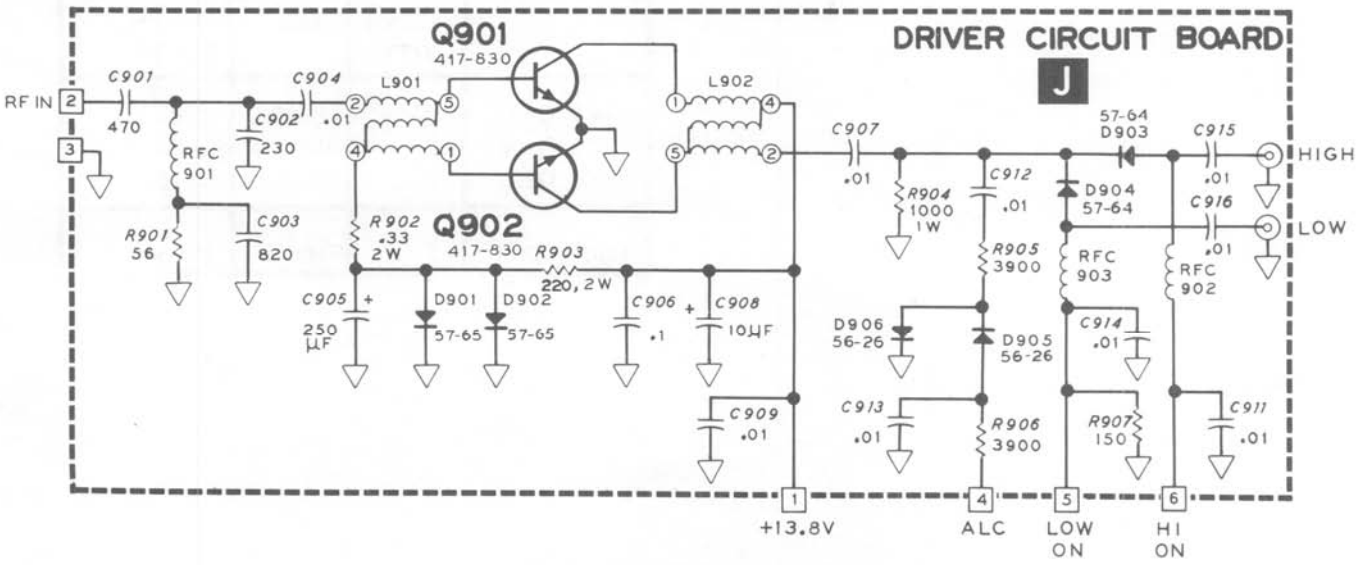
Diodes D905 and D906 sample and rectify a portion of the driver output, producing a voltage used for ALC in the low power mode.

	QUAN-TITY	TYPE	HEATH PART NO.
D901, D902	2	1N4002	57-65
D903, D904	2	DRS-110	57-64
D905, D906	2	1N191	56-26
Q901, Q902	2	PT6619	417-830

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
Low output.	1. 13.8V missing. 2. Q901, Q902. 3. L901, L902. 4. D903, D904.
ALC inoperative.	1. Low input from TX IF (board C). 2. D905, D906. 3. Improper load impedance.

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the Parts List starting on Page 83 of the Assembly Manual.

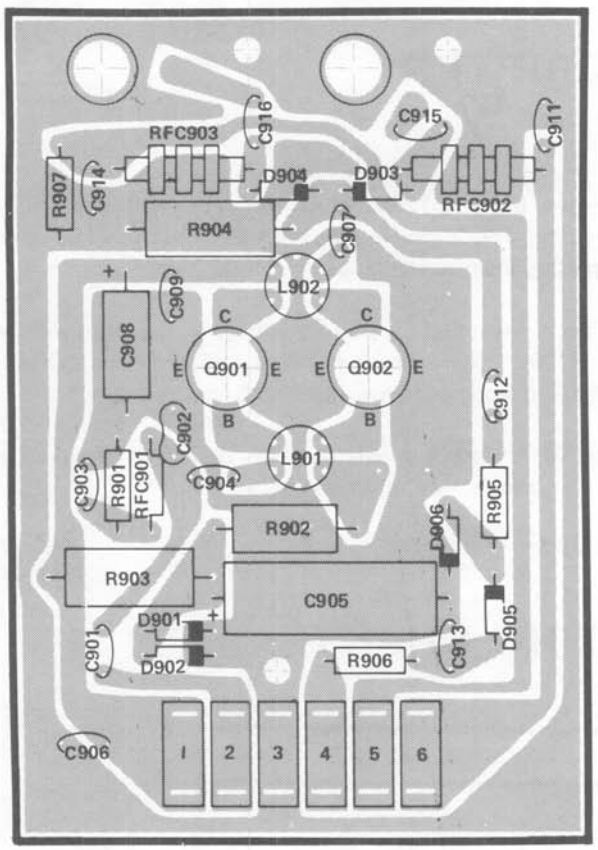


DRIVER SCHEMATIC

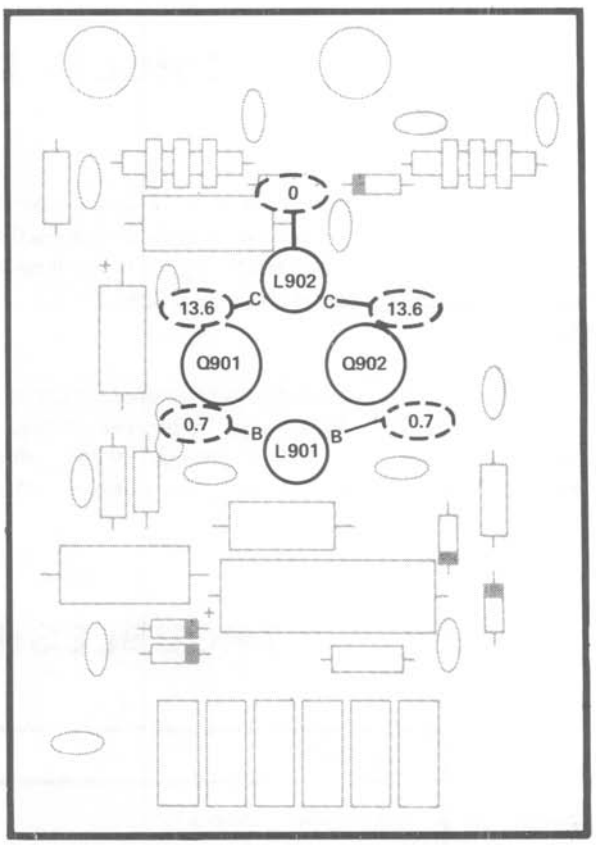
CIRCUIT BOARD J

Refer to Page 58 for Schematic symbols.

X-RAY VIEW



VOLTAGE CHART



(Shown from component side)

VOLTAGES (±20%)

NOTES:

1. POWER SUPPLY AND 4Ω SPEAKER CONNECTED
2. ANTENNA NOT CONNECTED
3. BAND SWITCH IN 3.5 POSITION
4. RF GAIN MAXIMUM CLOCKWISE
5. AF GAIN MAXIMUM COUNTERCLOCKWISE
6. DC VOLTAGES MEASURED WITH 20 KILOHM INPUT VOM TO CHASSIS

( ) DC VOLTAGE WITH MODE SWITCH IN USB, LSB, OR CW POSITION

VFO Filter Circuit Board

CIRCUIT DESCRIPTION

This circuit board acts as an automatic switch to increase the VFO signal injection to the premix circuits on the 28.0 to 29.5 MHz bands. On the other bands, the VFO signal passes through the attenuating pad formed by R1254, R1255, and R1266.

When the Band switch is turned to any of the four bands in the 28.0 through 29.5 MHz range, a positive voltage is applied to one of diodes D1251 through D1254, which causes it to conduct. Consequently, the positive voltage forward biases D1255, which conducts and permits the incoming VFO signal to pass through C1252 to C1254, thus bypassing the attenuating pad.

In the receive mode, a positive voltage is applied to the base of Q1251, which turns on hard and drops its collector voltage to a point too low for D1255 to conduct.

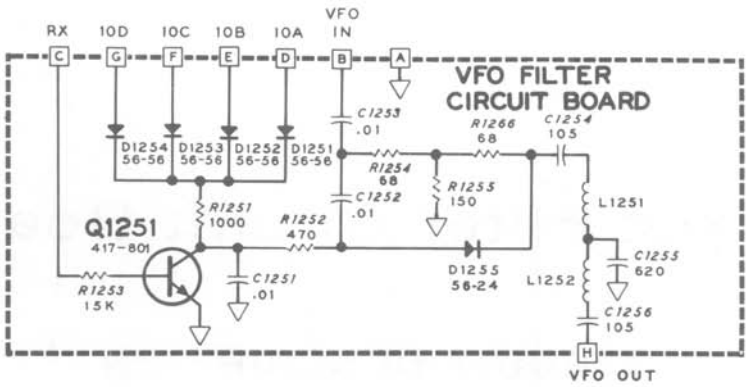
The VFO filter prevents spurious premix products from entering the receiver injection circuits.

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
Premix signal low on 10 meters.	1. D1254 thru D1255. 2. Q1251.
Premix signal low all bands (VFO missing).	1. L1251, L1252. 2. C1254, C1255, C1256.

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the "Parts List" starting on Page 83 of the Assembly Manual.

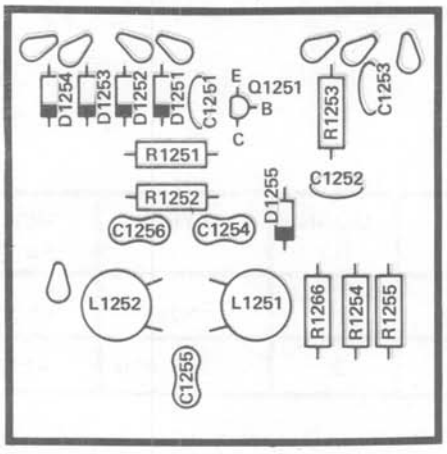
	QUAN-TITY	TYPE	HEATH PART NO.
D1251-D1254	4	1N4149	56-56
D1255	1	1N458	56-24
Q1251	1	MPSA20	417-801



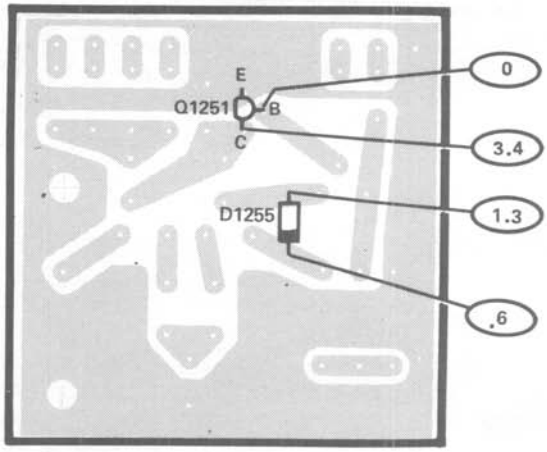
VFO FILTER SCHEMATIC

Refer to Page 58 for Schematic symbols.

X-RAY VIEW



VOLTAGE CHART



(Shown from component side)

VOLTAGES (±20%)

NOTES:

1. BANDSWITCH IN ANY 10-METER POSITION.
2. MODE SWITCH IN TUNE POSITON.
3. MIC/CW LEVEL FULLY COUNTERCLOCKWISE.

◯ DC VOLTAGES IN TRANSMIT MODE.

ALC/Output Filter Circuit Board

CIRCUIT DESCRIPTION

The function of the low pass filter/ALC circuit is to attenuate the harmonics present in the driver and power amplifier outputs to acceptable levels, and to provide ALC control voltage in the high power mode.

Four low-pass filters are used, one each for 80, 40, 20, and 15/10 meters. The 15 and 10 meter bands use one filter, as the second harmonic of 15 meters falls well above the 10 meter band. These filters are selected by a circuit board – mounted rotary switch, ganged with the main Band switch. This is the only bandswitching in the Transceiver which is not solid-state, due to the power levels involved.

From the filters, the output signal is routed through the directional coupler. This coupler provides outputs for forward and reflected power. These outputs are combined to form an ALC voltage, used in the high power mode. In this manner, higher ALC voltages are generated when the antenna line VSWR is high, reducing the transmitter output power to a level which will not damage the power amplifier.

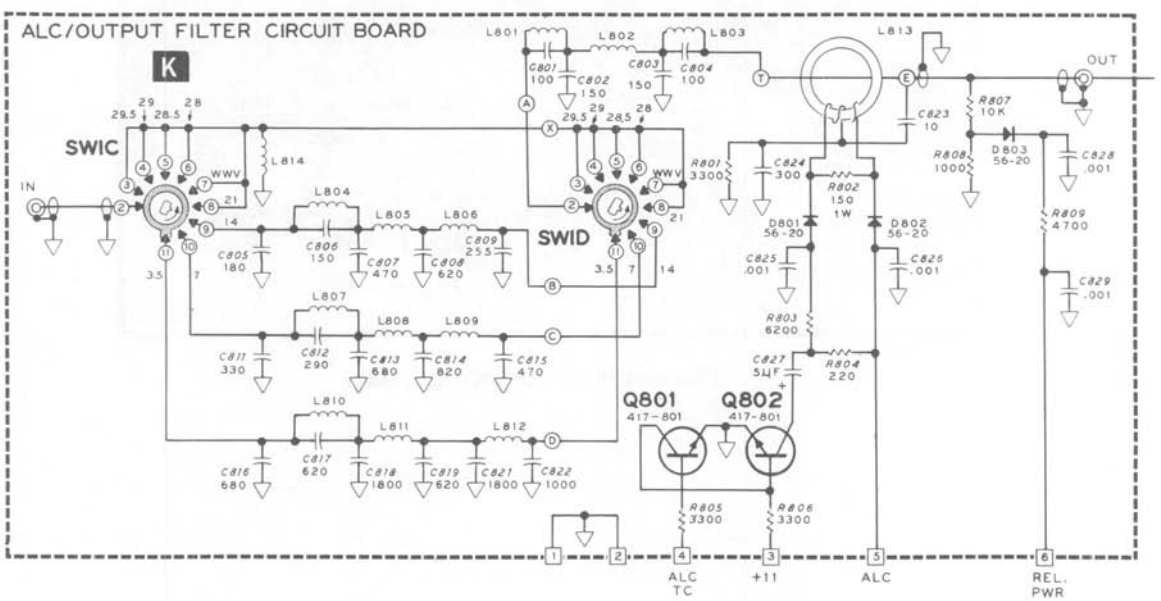
Q801 and Q802 form a switch which changes the ALC time constant between Slow (SSB) and Fast (CW and Tune). D803 is used to provide voltage for the relative power metering function.

	QUAN-TITY	TYPE	HEATH PART NO.
D801-D803	3	1N295	56-20
Q801, Q802	2	MPSA20	417-801

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the "Parts List" starting on Page 93 of the Assembly Manual.

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
High signal loss, all bands.	1. Band switch rotor positioned wrong. 2. Shorted coaxial cable. 3. 10/15 meter filter components.
High signal loss, one band.	Filter components for that band.
Low output in high power.	1. PA circuit board. 2. High line VSWR. 3. Leads of L813 reversed or L813 defective.

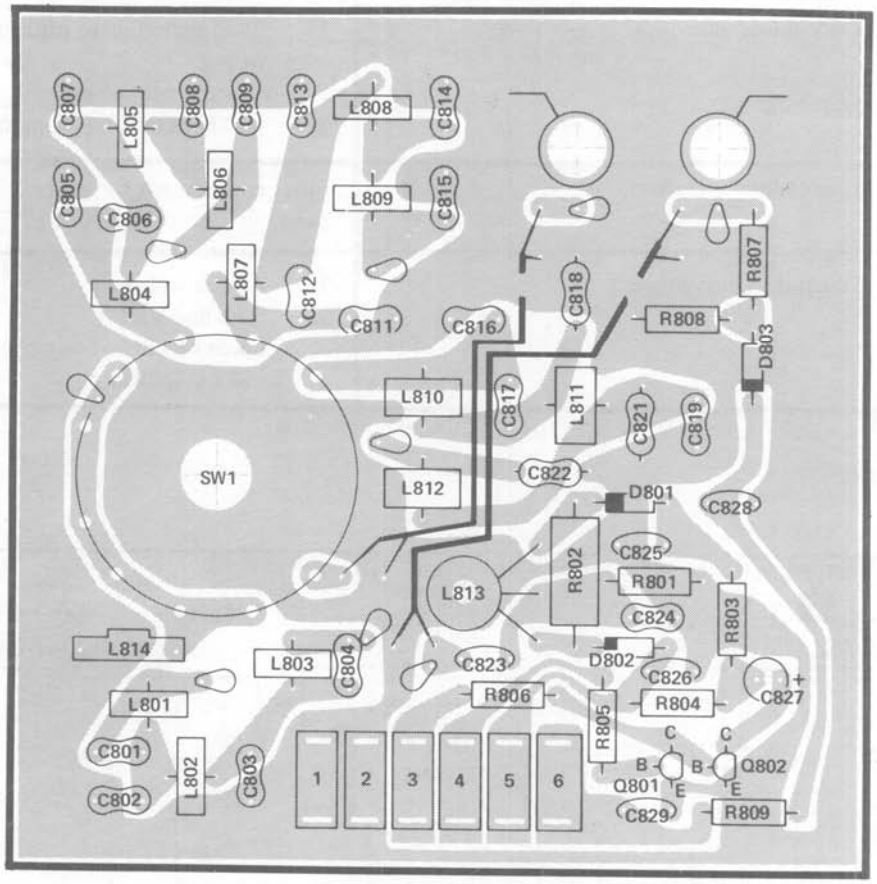


Refer to Page 58 for Schematic symbols.

ALC/OUTPUT FILTER SCHEMATIC

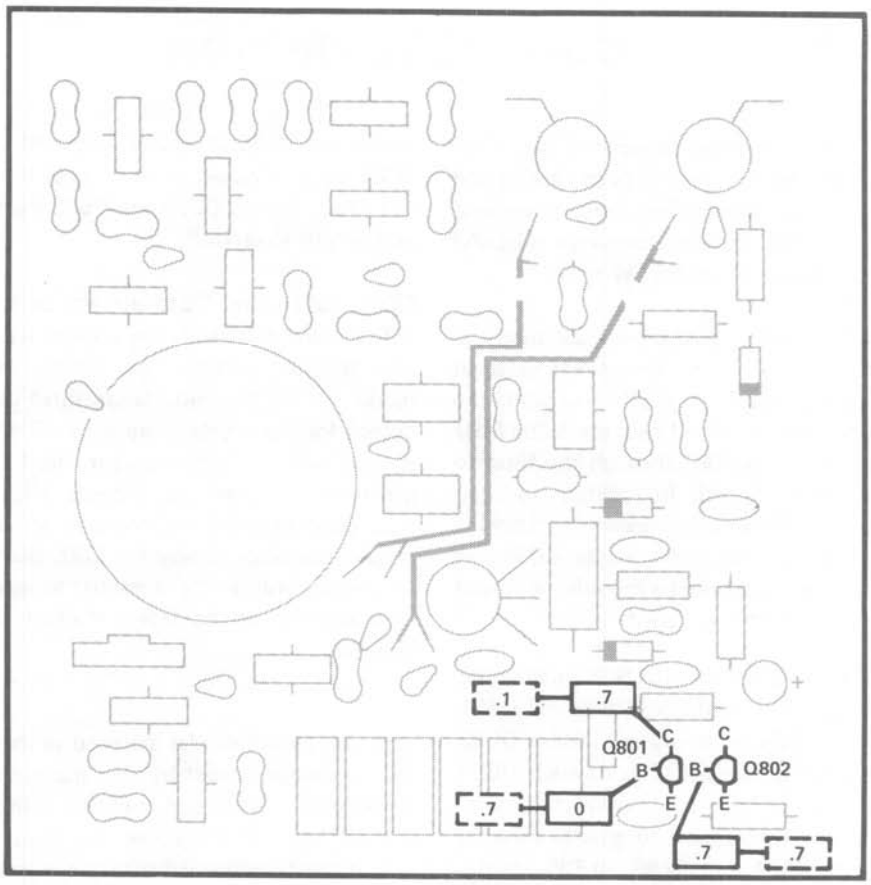
CIRCUIT BOARD K

X-RAY VIEW



(Shown from component side)

VOLTAGE CHART



TRANSMITTER VOLTAGES (±20%)

NOTES:

1. BANDSWITCH IN 3.5 POSITION
2. MODE SWITCH IN TUNE POSITION
3. METER SWITCH IN PWR POSITION
4. MIC/CW-LEVEL FULLY COUNTERCLOCKWISE

[ ] DC VOLTAGE WITH MODE SWITCH IN USB OR LSB POSITION

[ ] DC VOLTAGE WITH MODE SWITCH IN CW POSITION

Carrier Generator/Xtal Filter Circuit Board

CIRCUIT DESCRIPTION

These circuits provide highly selective filtering of the 3.395 MHz IF, and generate the BFO signals in both receive and transmit modes. Solid-state switching is employed to provide bilateral filtering and to select between the single sideband filter and the optional, narrow-bandwidth CW filter.

Two switches are used on each side of the crystal filters to direct the signal flow. One set of switches selects between transmit and receive paths. Transistors Q601 and Q603 are energized only in the receive mode and pass the 3.395 MHz signal from the second mixer (Q705) through the filter to the input of the receive IF board. In addition to their switching function, these stages provide impedance matching to the filter. During transmit operation, stages Q604 and Q602 serve the same function, passing the modulator output through the filter to the tranmitter IF board.

The second set of switches selects either the SSB filter or the CW filter. Un USB or LSB modes, diodes D678 and D681 are forward biased and the SSB filter is used. Diodes D683 and D685 are back biased by current flow through D684 and D686. This blocks signal flow to the CW filter and shunts any potential "blow by" signals to ground through the .01 μF capacitors at C681 and C686. in CW, diodes D683 and D685 are forward biased and diodes D678 and D681 reverse biased so that signal flow is now through the CW filter. Diodes D679 and D682 shunt the SSB filter input and output to ground.

Q608, Q611, and Q613 are the beat frequency oscillators (BFO's) which provide the appropriate mixing frequency to the product detector in receive and to the balanced modulator in transmit. These three oscillators are identical except for the crystal frequency. The CW generator (Q611) is used only in the transmit mode. In receive CW, the USB generator is used to provide the offset from center frequency required to produce an audio tone from the product detector. Transistor Q609 permits the CW generator to operate only in the transmit mode, and Q612 permits the USB generator to oscillate in transmit USB or in receive USB and CW.

Four hot carrier diodes are used in the balanced modulator. The carrier generated by the appropriate BFO is amplified by transistor Q607 and is mixed with an audio signal from the transmit audio board to produce the 3.395 MHz transmitter IF which is fed to the crystal filter.

	QUAN-TITY	TYPE	HEATH PART NO.
D601-D606, D612, D613,			
D676-D679,D681-D686	18	1N458	56-24
D607-D609, D611	4	FH1100	56-87
D614	1	GD510	56-89
D615	1	1N191	56-26
Q601-Q604, Q606-Q608	9	MPSA20	417-801
Q611, Q613			
Q605, Q609, Q612	3	X29A829	417-201

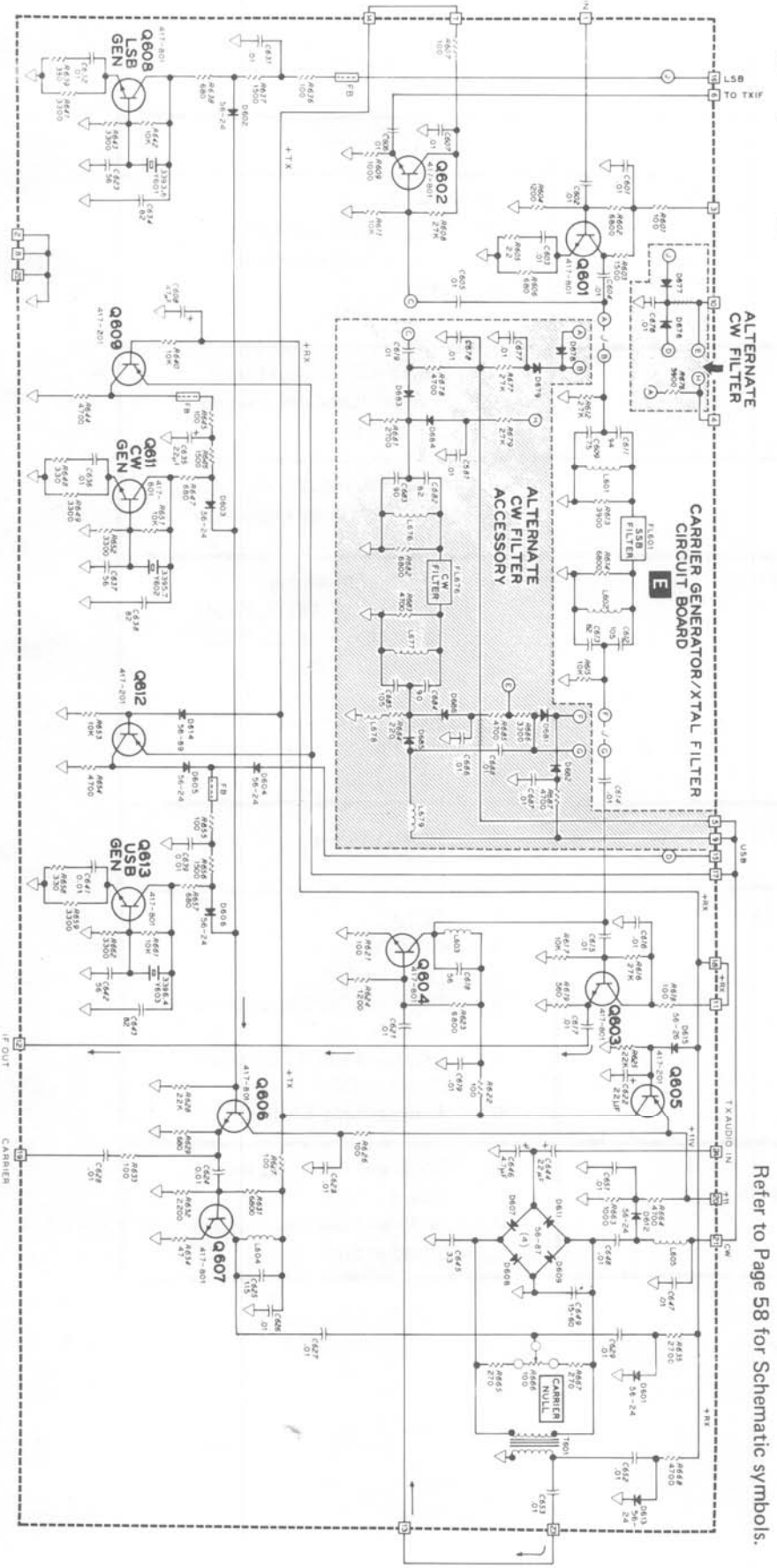
NOTE: Diodes D676-D679 and D681-D686 are part of the SBA-104-3 Accessory.

All resistors are 1/4 watt.

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the "Parts List" starting on Page 101 of the Assembly Manual.

CARRIER GENERATOR /XTAL FILTER SCHEMATIC

CIRCUIT BOARD E



Refer to Page 58 for Schematic symbols.

TROUBLESHOOTING CHART

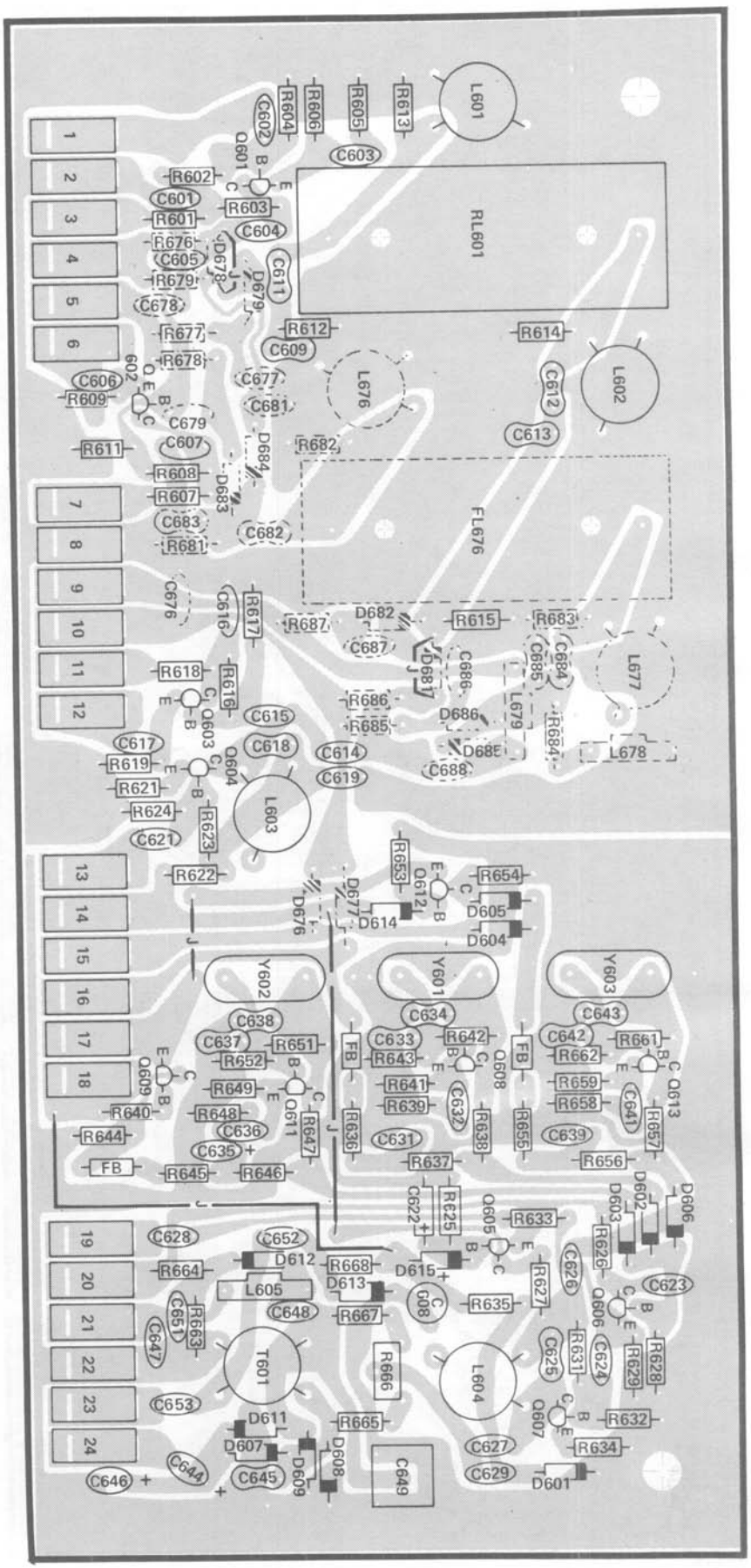
SYMPTOM	POSSIBLE CAUSE
No output in transmit, receiver OK.	1. Q607 2. D607,D608,D609,D611. 3. Carrier Null control R665. 4. T601. 5. Q601,Q604.
No output in transmit CW, receiver OK.	1. D612 not forward biased. 2. CW oscillator not running. Q611, Y602.
No output in SSB transmit, receiver OK.	1. No audio input at pin 24. 2. Positive voltage at anode of D612.
Receiver and transmitter not operable, any mode.	1. BFO's not running: a. LSB – Q608, Y601. b. USB – Q613, Y603. c. CW – Q611, Y602. 2. Q606. 3. SSB filter. 4. L602, L603.
Receiver inoperative, transmitter OK.	1. Q601, Q603.
No signal in receive CW, OK in SSB.	1. Q612. 2. CW filter.* 3. L676, L677.* 4. D683 and D685 not forward biased in CW.* 5. D686 and D684 not reverse biased in CW.* 6. Jumper wires missing.
No signal in SSB receive. Transmit OK, receive CW OK.	1. D678 and D681 not forward biased in SSB. 2. D679 and D682 not reverse biased in SSB.

*Only if the SBA-104-3 Accessory is installed.

X-RAY VIEW

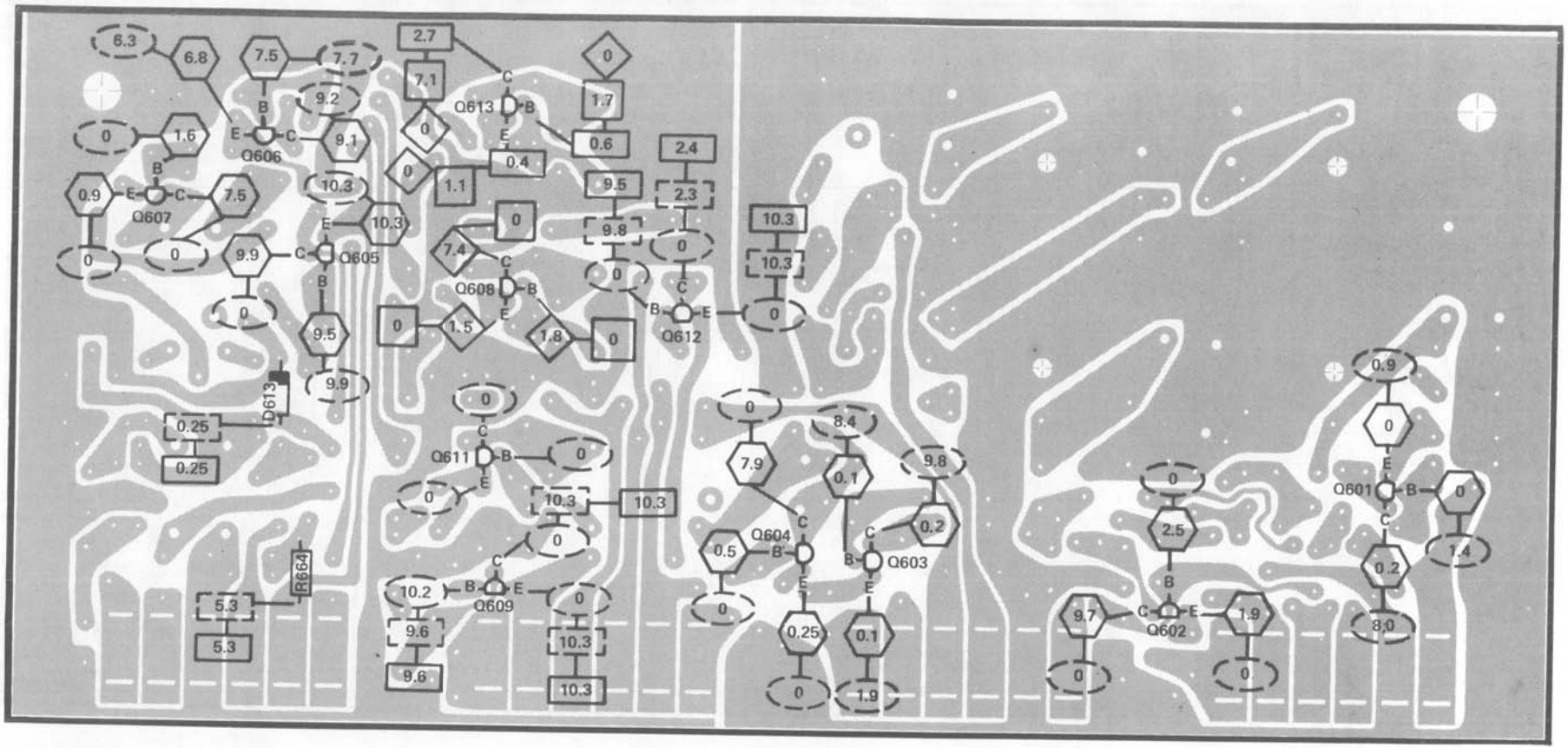
(Shown from component side)

NOTE: The dashed-in components are part of the SBA-104-3 Accessory.



VOLTAGE CHART

(Shown from foil side)



RECEIVER VOLTAGES (±20%)

NOTES:

1. POWER SUPPLY AND 4Ω SPEAKER CONNECTED
2. ANTENNA NOT CONNECTED
3. BAND SWITCH IN 3.5 POSITION
4. RF GAIN MAXIMUM CLOCKWISE
5. AF GAIN MAXIMUM COUNTERCLOCKWISE
6. DC VOLTAGES MEASURED WITH 20 KILOHM INPUT VOM TO CHASSIS

DC VOLTAGE WITH MODE SWITCH IN USB, LSB, OR CW POSITION

DC VOLTAGE WITH MODE SWITCH IN USB POSITION

DC VOLTAGE WITH MODE SWITCH IN LSB POSITION

TRANSMITTER VOLTAGES (±20%)

NOTES:

1. BANDSWITCH IN 3.5 POSITION
2. MODE SWITCH IN TUNE POSITION
3. METER SWITCH IN PWR POSITION
4. MIC/CW-LEVEL FULLY COUNTERCLOCKWISE

DC VOLTAGE WITH MODE SWITCH IN USB OR LSB POSITION

DC VOLTAGE WITH MODE SWITCH IN CW POSITION

DC VOLTAGE WITH MODE SWITCH IN USB, LSB, OR CW POSITION

Receiver Front End Circuit Board

CIRCUIT DESCRIPTION

The receiver front end establishes receiver sensitivity and converts the incoming frequency to the 3.395 MHz IF. Broadband preselector filters, diode switched for each band, feed the antenna input to the first receiver mixer where the input and HFO signals are mixed to produce an 8.395-8.895 MHz IF signal. This is then mixed with the VFO input in the second mixer to obtain the 3.395 MHz IF.

In the 80 meter position, the Band switch places +11 VDC at R702 and R703, forward biasing diodes D701 and D702. Diodes D703, D704, D705, D706, D709, D710, D713, and D714 (and D717 and D718 if the HWA-104-1 Accessory is installed) are back biased. This places the 80 meter filter, which consists of C702 through C712 (less C704 and C708) and L701 through L703, in the signal path and effectively removes all other filters from operation. Similarly, the filters for the 40 through 10 meter bands are selected with the Band switch in the appropriate position. During transmit operation, +11 VDC is applied at R701 and R711, back biasing all preselector filters.

From the preselector filter, the input signal is fed to gate 1 of Q701, the first receiver mixer. The HFO input from board D, the HFO/premix board, is amplified by Q703 and injected through the 5.0 – 5.5 MHz band reject filter, C785 through C787 and L731 through L733, to gate 2 of the first mixer. An 8.395 – 8.895 MHz bandpass filter; formed by L725 through L727 and C763, C764, C766, C767, C769, C771, C772, C773, and C774; serves as a load for the first mixer and couples the first IF signals to gate 1 of the second mixer, Q704. The VFO input is filtered by C776, C777, and L728 before being injected at gate 2 of Q704. The mixer drain is tuned to 3.395 MHz and feeds the crystal filter board from the capacitive divider of the tank circuit.

	QUAN-TITY	TYPE	HEATH PART NO.
D701-D706, D709, D710, D713, D714, D717, D718	12	1N458	56-24
D707, D708, D711, D712, D715, D716	6	1N4149	56-56
Q701, Q704	2	40673	417-240
Q702, Q705	2	2N4121	417-235
Q703	1	2N2369	417-154

NOTE: D715-D718 are components in the HWA-104-1 Accessory.

CIRCUIT BOARD G

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the "Parts List" starting on Page 115 of the Assembly Manual.

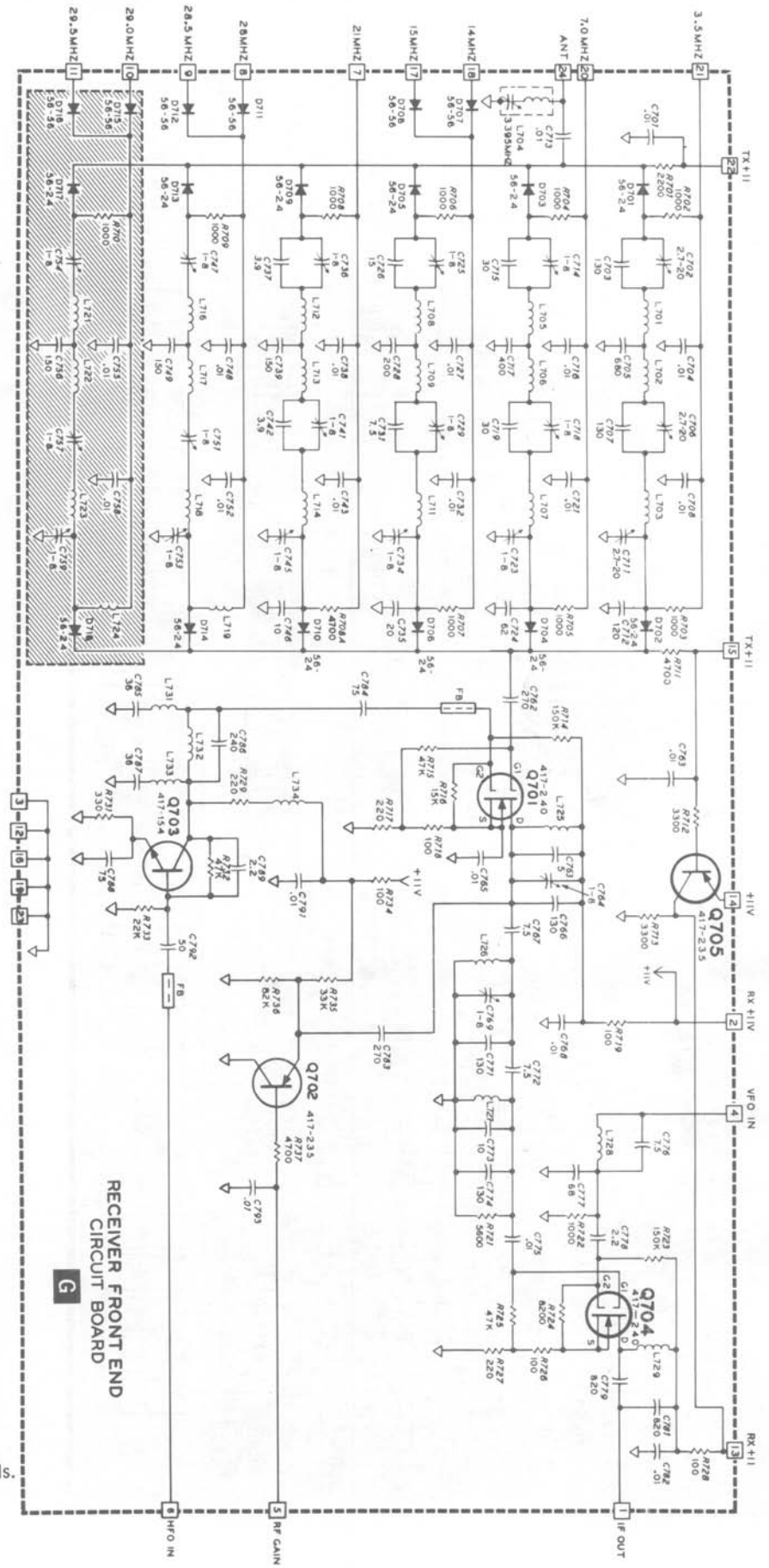
TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
Preselector filter or filters cannot be aligned properly.	1. Filter coils interchanged between filters. 2. Switching diodes installed backwards, defective, or not properly biased. D701 – D714.*
NO HFO injection at G2 of Q701.	1. Check pin 6. If no signal, interconnecting cable may be improperly installed or defective. Check pin 2 on board D. 2. Q703.
No VFO injection at G2 of Q704.	1. Check pin 4. If no signal, check at VFO output on rear panel. 2. L728, C777, C778.
No 8.65 MHz output at drain of Q701.	1. Q701. 2. No HFO injection at G2 Q701. 3. Q702.
No 3.395 MHz output at pin 1.	1. Q704. 2. L725, L726, L727, L729. 3. Q702.
No +11 V at pin 13 in receive mode.	1. Q705.

*D701-D718 if the HWA-104-1 Accessory is installed.

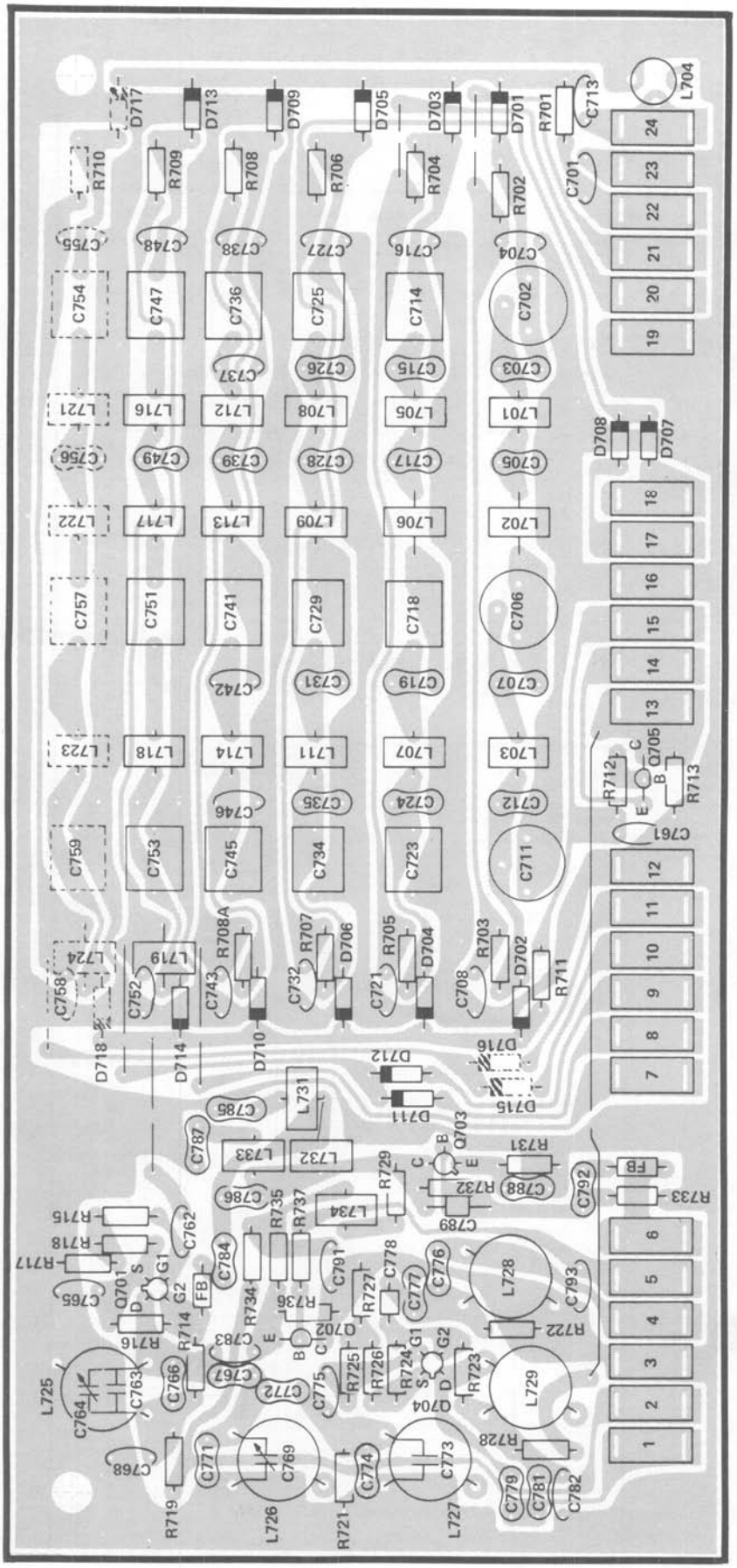
RECEIVER FRONT END SCHEMATIC

CIRCUIT BOARD G



NOTE: The shaded area is part of the HWA-104-1 Accessory.

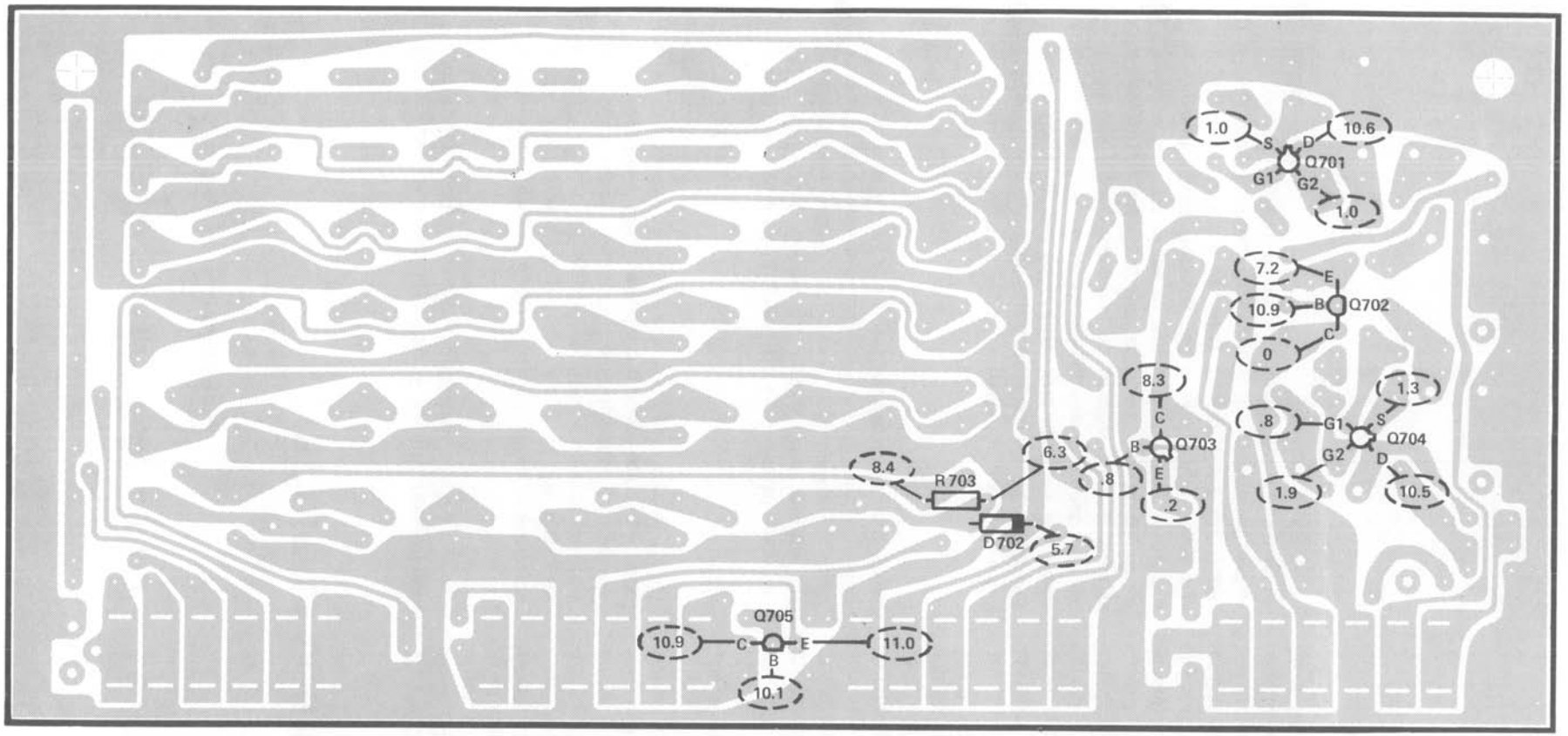
Refer to Page 58 for the Schematic symbols.



X-RAY VIEW

(Shown from component side)

NOTE: The dashed-in areas are part of the HWA-104-1 Accessory.



* Voltages at Q702 taken with RF Gain fully clockwise.

VOLTAGE CHART

(Shown from foil side)

RECEIVER VOLTAGES (±20%)

NOTES:

1. POWER SUPPLY AND 4Ω SPEAKER CONNECTED
2. ANTENNA NOT CONNECTED
3. BAND SWITCH IN 3.5 POSITION
4. RF GAIN MAXIMUM CLOCKWISE
5. AF GAIN MAXIMUM COUNTERCLOCKWISE
6. DC VOLTAGES MEASURED WITH 20 kΩ/VOLT INPUT VOM TO CHASSIS

( ) DC VOLTAGE WITH MODE SWITCH IN USB, LSB, OR CW POSITION

Receiver IF/Audio Circuit Board

CIRCUIT DESCRIPTION

These circuits provide 3.395 MHz IF amplification and gain control, detection, and audio amplification.

In the receive mode, a 3.395 MHz signal from board E (the crystal filter board) is fed to gate 1 of the dual gate MOSFET, Q501. The signal is amplified and passes to IC501 and Q502 where additional amplification is obtained. Emitter follower Q503 provides the power gain required to drive the product detector, automatic gain control (AGC) circuits, and the 50 ohm IF output.

The IF output level is sensed by a differential amplifier, Q504 and Q505. When the output level exceeds the threshold level, Q504 conducts and pulls the base of Q506 down on each positive peak of the IF output. Q506 conducts on each peak and places positive pulses on the base of Q507.

Q507 is an integrator which converts the pulses to a DC voltage. It has two time constants which set the attack and decay times for the AGC. R544 and C535 set the attack time constant and C535 discharges through either R546 or R545 and R546, depending on whether Fast or Slow is selected to set the decay time constant. This voltage, whose level is a function of the IF output level, is fed through the Darlington emitter follower, Q508 and Q509, where it is then applied to pin 5 of IC501 through R507 and D504. The gain of the integrated circuit is thus controlled so that the output remains relatively constant for varying input levels.

The AGC voltage is also used to drive the S meter. Zener diode ZD502 and R534 set the range for S-meter voltage which is fed through emitter follower Q512 to the front panel meter. Q511 is a DC amplifier which derives the AGC voltage for the dual-gate MOSFET. With increasing signal level, the voltage at Q509 emitter rises from approximately 4.5 to 7.0 volts. Given this input, Q511 provides (at the junction of R541 and R538) a level of from 2.0 volts to zero volts with increasing input signal. Amplified AGC voltage is applied to gate 2 of the first IF amplifier, Q501.

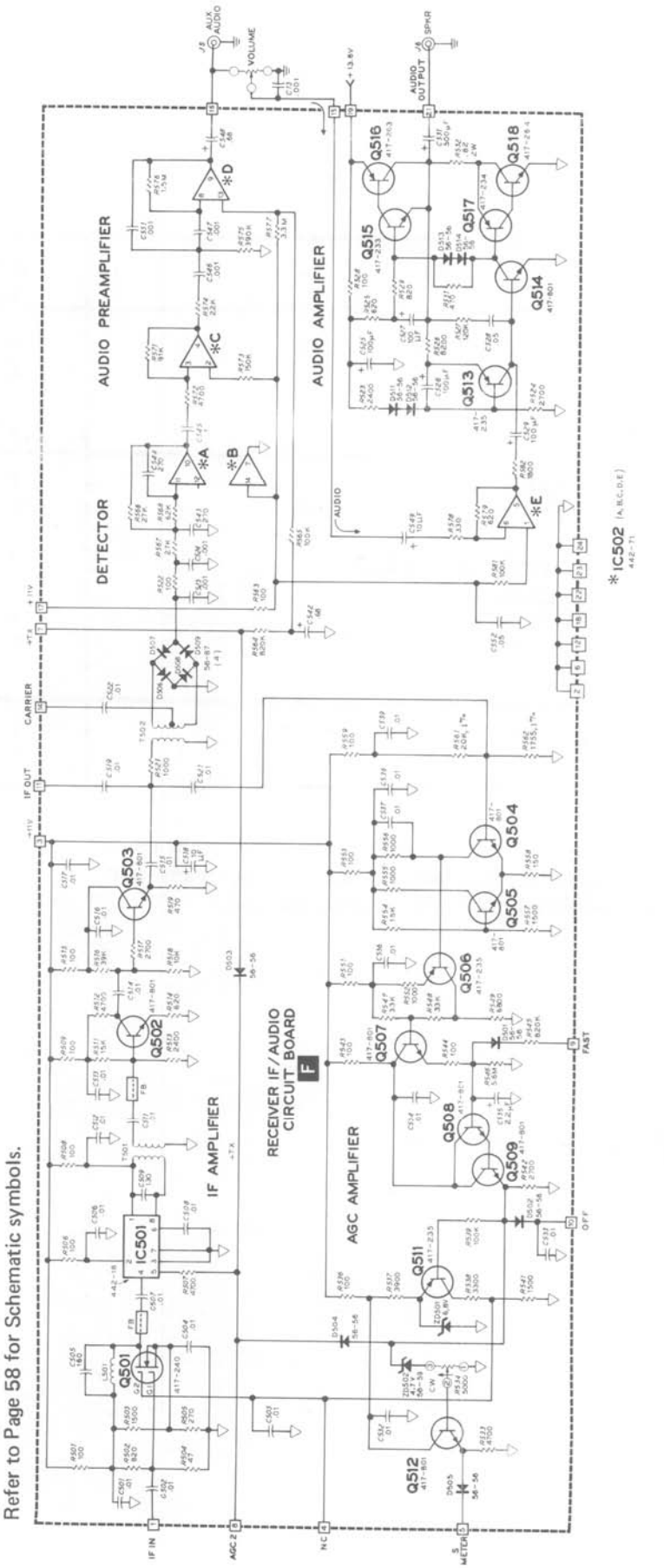
The IF signal is detected by a product detector formed by transformer T502 and diodes D506 through D509. Carrier injection through C522 mixes with the IF signal to produce the detected audio. After the IF is filtered out by R522, C523, and C524, the recovered audio goes to the audio bandpass filter and preamplifier. Both of these functions are accomplished in IC502, an integrated circuit made up of four operational amplifiers. The first amplifier, pins 10, 11, and 12, is used as a low pass filter. Amplifier two, pins 2, 3, and 4, is an audio amplifier. Amplifier three, pins 8, 9, and 13, is used as a high pass filter which, in cascade with the low-pass filter, sets the audio frequency response. The Volume control, between amplifiers three and four, sets the desired audio level from the front panel. After additional amplification by amplifier four (pins 1, 5, and 6), the audio signal is fed through R582 and C529 to the base of Q514. Amplifier Q514 drives a complementary output consisting of Q515, Q516, Q517, and Q518. The audio output to the speaker is taken from the collector of Q516 through C531. The frequency response of the audio amplifier is further established by a feedback circuit consisting of Q513, Q526, R526, R527, and C528.

	QUAN-TITY	TYPE	HEATH PART NO.
D501-D505, D511-D514	9	1N4149	56-56
D506-D509	4	FH1100	56-87
ZD501	1	1N710	56-6
ZD502	1	1N750A	56-59
Q501	1	40673	417-240
Q502-Q505, Q507-Q509 Q512, Q514	9	MPSA20	417-801
Q506, Q511, Q513	3	2N4121	417-235
Q515	1	2N3643	417-233
Q516	1	SJE607	417-263
Q517	1	2N3638A	417-234
Q518	1	SJE608	417-264
IC501	1	MC1350P	442-18
IC502	1	LM3900	442-71

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the "Parts List" starting on Page 129 of the Assembly Manual.

RECEIVER IF/AUDIO SCHEMATIC

CIRCUIT BOARD F



Refer to Page 58 for Schematic symbols.

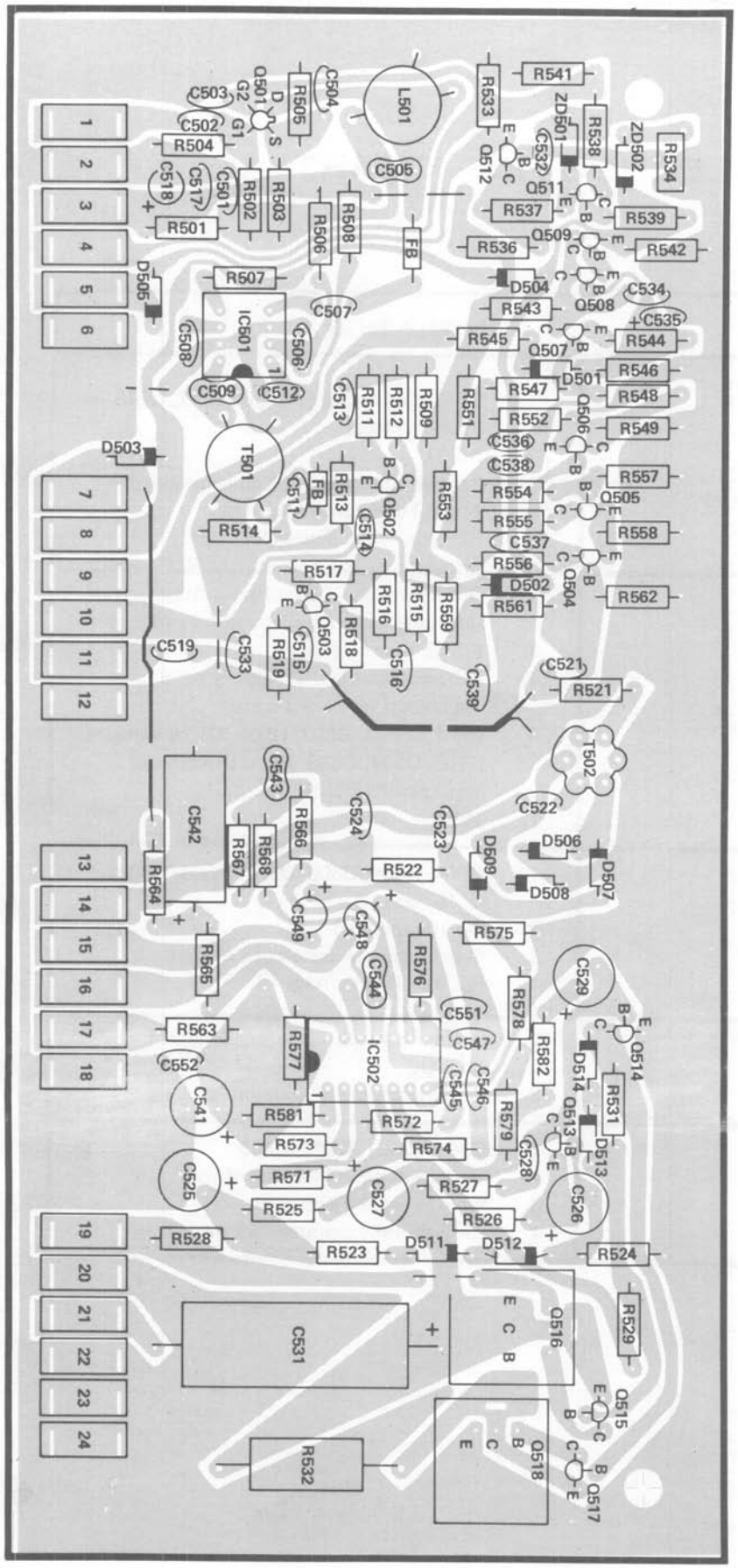
TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
No Audio output.	1. Q513, Q514, Q515, Q516, Q517, Q518. Check voltages. 2. IC502. 3. Positive voltage on +TX line in receive. 4. Audio Level control shorted. 5. RF Gain fully counterclockwise.
Audio distorted or weak.	1. Q513 through Q518. Check voltages. 2. Insufficient carrier injection (pin 14). 3. IC502. Check voltages. 4. AGC not working. Voltage at pin 8 does not change for strong signals. 5. Q501, IC501, Q502, Q503. Check voltages. 6. D506, D507, D508, D509 defective or improperly installed. 7. T502.
No AGC.	1. Q504, Q505, Q506, Q507, Q508, Q509, Q510, Q511. 2. Pin 10 grounded. 3. Coaxial jumper cable open or shorted. 4. R559 or R561 wrong value.
No S meter deflection.	1. S-meter control, R534, needs adjustment. 2. No AGC. 3. AGC switch in Off position.
No IF output.	1. Q501, IC501, Q502, Q503. 2. Voltage at pin 8 in excess of 6V. 3. Pin 4 at ground potential. 4. RF Gain fully counterclockwise.

HEATHKIT®

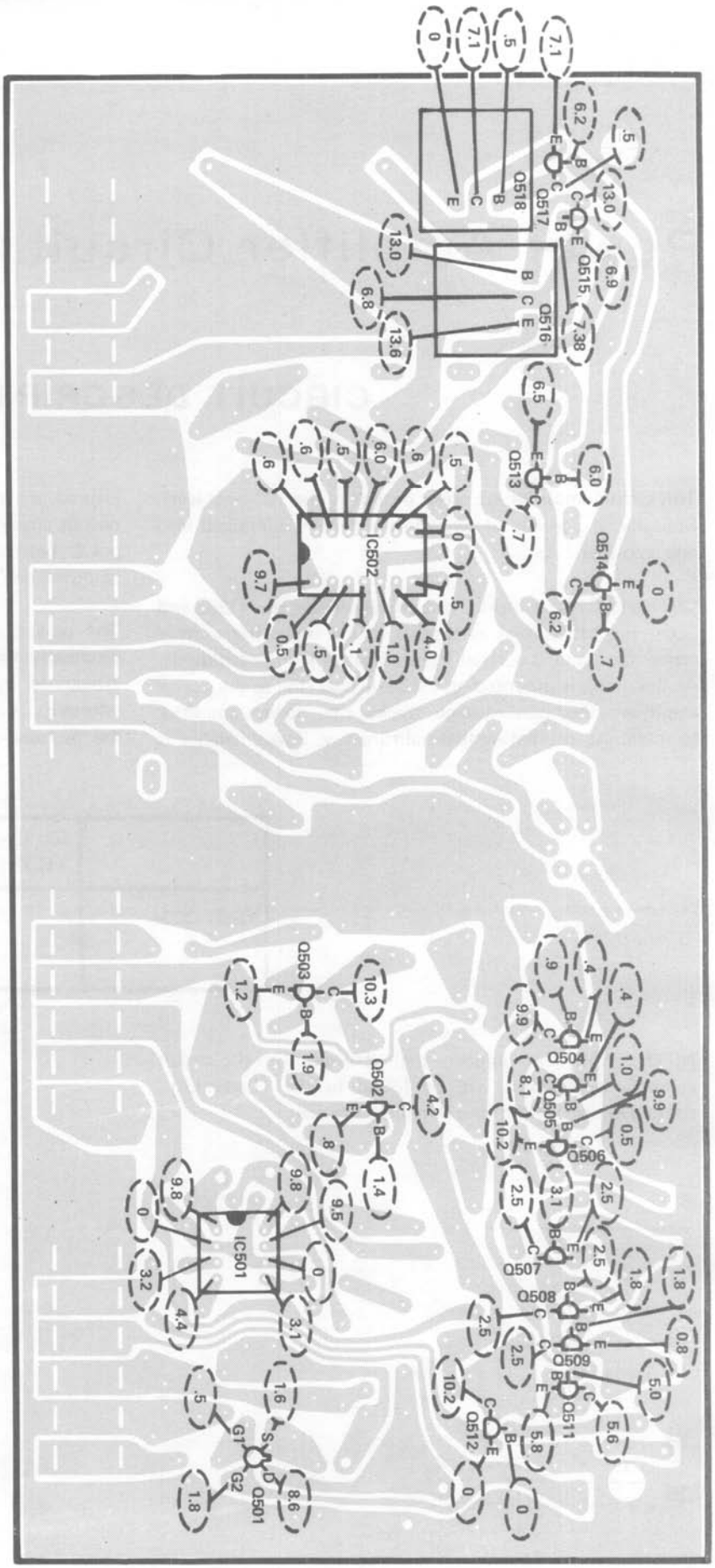
X-RAY VIEW

(Shown from component side)



VOLTAGE CHART

(Shown from foil side)



RECEIVER VOLTAGES (±20%)

NOTES:

1. POWER SUPPLY AND 4Ω SPEAKER CONNECTED
2. ANTENNA NOT CONNECTED
3. BAND SWITCH IN 3.5 POSITION
4. RF GAIN MAXIMUM CLOCKWISE
5. AF GAIN MAXIMUM COUNTERCLOCKWISE
6. DC VOLTAGES MEASURED WITH 20 kΩ/VOLT INPUT VOM TO CHASSIS

( ) DC VOLTAGE WITH MODE SWITCH IN USB, LSB, OR CW POSITION

Power Amplifier Circuit Board

CIRCUIT DESCRIPTION

This circuit amplifies the driver output to the 100-watt level. Basically, it consists of two push-pull pairs combined into one amplifier.

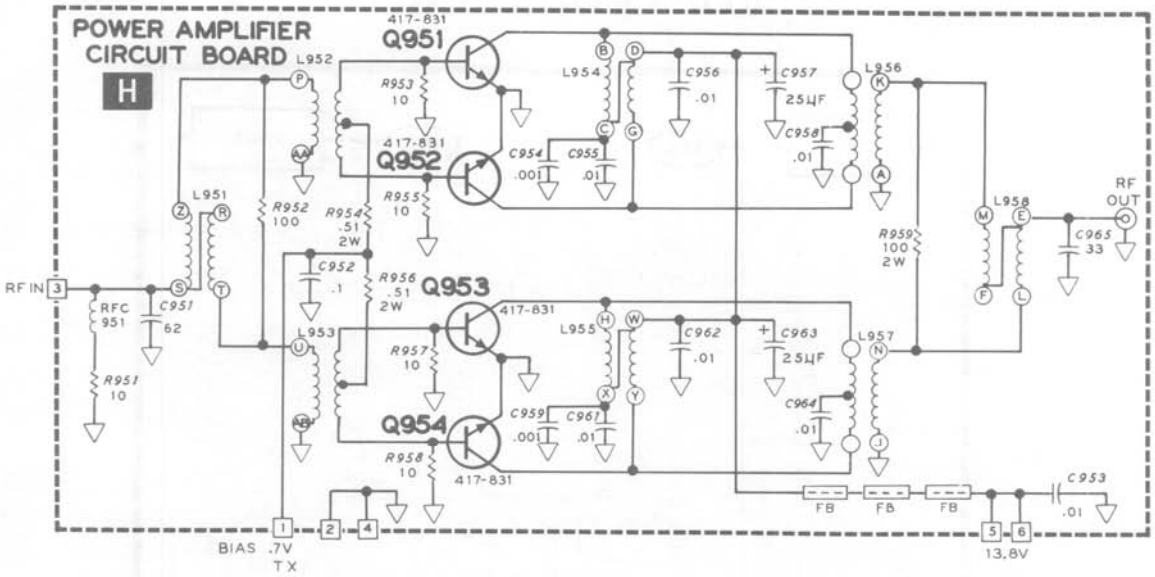
Q951 and Q952 comprise one push-pull pair, and Q953 and Q954 the other. Bias is applied to the input transformer center taps, and is derived from a heat-sink mounted diode. As the diode is mounted on the same heat sink as the power amplifier, the bias voltage tracks the power amplifier temperature, preventing thermal runaway. Power balance is assured by the 100 ohm resistors across the input and output circuits. Hybrid combiners are used to split the drive power between pairs and to combine the outputs of the two amplifier pairs.

The power amplifier, like the driver, is broadband, with essentially flat response from 3 to 30 MHz. Harmonics are attenuated by the low pass filter (board K), and additional selectivity is not required. It is this characteristic that makes the "no-tune-up" feature possible.

	QUAN-TITY	TYPE	HEATH PART NO.
Q951-Q954	4	2N6456 or CD-2664A	417-831

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the "Parts List" starting on Page 143 of the Assembly Manual.

Refer to Page 58 for Schematic symbols.



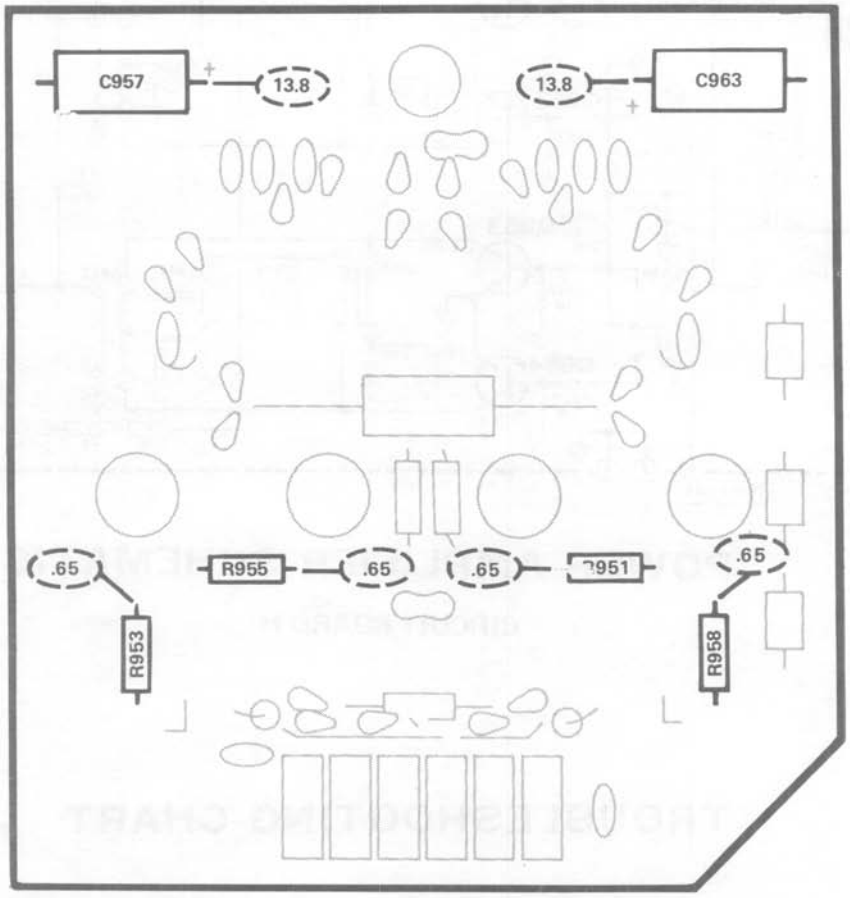
POWER AMPLIFIER SCHEMATIC

CIRCUIT BOARD H

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
No RF output.	1. Transistors. See "P.A. Transistor Check." 2. Inductors (coils) connected wrong. 3. No 13.8V at pins 5 and 6. 4. No .7V at pin 1. 5. Pins 2 and 4 not grounded.

VOLTAGE CHART



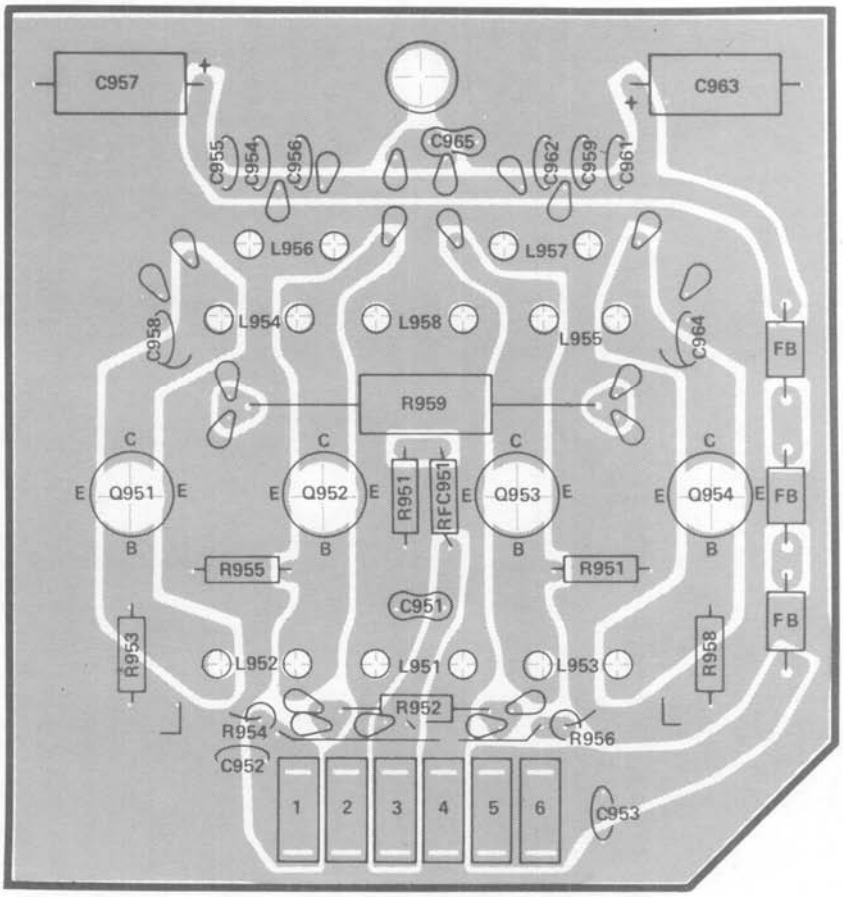
VOLTAGES (±20%)

NOTES:

1. POWER SUPPLY AND 4Ω SPEAKER CONNECTED
2. ANTENNA NOT CONNECTED
3. BAND SWITCH IN 3.5 POSITION
4. RF GAIN MAXIMUM CLOCKWISE
5. AF GAIN MAXIMUM COUNTERCLOCKWISE
6. DC VOLTAGES MEASURED WITH 20 kΩ/VOLT INPUT VOM TO CHASSIS

( ) DC VOLTAGE WITH MODE SWITCH IN USB, LSB, OR CW POSITION

X-RAY VIEW



P.A. TRANSISTOR CHECK

NOTE: The P.A. circuit board must be mounted to the heat sink on the rear panel of the Transceiver.

Use the following check to determine whether the P.A. transistors are defective:

1. Connect an antenna or dummy load to the ANT jack on the rear panel.
2. Set your voltmeter on its lowest scale (1.5V or higher) and connect its common lead to the chassis.
3. Depress the SSB, ON and HI buttons. The TUNE button must be released.
4. Key the Transceiver by using the PTT microphone switch.
5. Connect the input probe of your voltmeter first to the foil of L952 and then to the foil of L953. At each foil you should obtain the following "normal" reading on the TX line. If you obtain a "bad" reading, see paragraph 8 following.

	NORMAL	BAD
TX (HI PWR)	0.65V	1.2V
RX	0V	1.2V

6. Release the HI button and the PTT switch.
7. Repeat the checks in paragraph 5. You should obtain the readings on the RX line above.
8. If you obtain a "bad" reading in either the TX or RX checks, all four final transistors should be replaced. These are sold by Heath only as a matched set of four transistors. Refer to "Power Amplifier Warranty" on Page 57 for the special one-year warranty.

SPECIFICATIONS

GENERAL

Active Devices	All solid-state.
Frequency Coverage	3.5 MHz through 29.0 MHz (through 29.7 MHz with HWA-104-1 Accessory) amateur bands. WWV (receive only) on 15 MHz.
Frequency Stability	Less than 100 Hz/hr drift after 30-minute warmup; less than 100 Hz drift for ±10% change in primary voltage.
Modes of Operation	Selectable upper or lower sideband (suppressed carrier) and CW.
Dial Accuracy	Within 2.5 kHz after calibration at nearest 100 kHz marker. Built-in calibrator provides 100 kHz and 25 kHz markers.
Tuning Rate	Approximately 15 kHz per turn.
Tuning Backlash	50 Hz or less.
Audio Frequency Response	350 to 2450 Hz ±75 Hz (6 dB bandwidth).
Phone Patch Impedance	4 ohms output to speaker; high impedance output to transmitter.
Power Requirements	13.8 VDC nominal (maximum 16 VDC) at: Receive: 1.5 amps. Transmit, low power: 2.5 amps. Transmit, high power: 20 amps.

TRANSMITTER

RF Power Output	High Power (50 Ω nonreactive load). SSB: 100 watts PEP ±1 dB. CW: 100 watts ±1 dB. Low Power SSB: 1 watt PEP (minimum). CW: 1 watt (minimum).
Output Impedance	50 ohms, less than 2:1 SWR.
Carrier Suppression	55 dB down from 100 watt single-tone output at 1000 Hz reference.
Unwanted Sideband Suppression	55 dB down from 100 watt single-tone output at 1000 Hz reference.
Harmonic Radiation	45 dB below 100 watt output.
Spurious Radiation	-50 dB within ±3 MHz of carrier, except, on the 3.5 MHz band, -40 dB at 3.395 MHz. -60 dB greater than ±3 MHz from carrier.
Third Order Distortion	30 dB down from two-tone output, reference at 100 watts PEP.
Transmit/Receive Operation	SSB: PTT or Vox. CW: Keyed-tone Vox or manual. NOTE: In the low power mode, all transmit-receive switching is solid state.
CW Sidetone	Internally switched to speaker or headphones in CW mode. Approximately 700 Hz tone.
Microphone Input	High impedance with a rating of -45 to -55 dB; approximately 25 kΩ to match Heath desk-type microphone.

RECEIVER

Sensitivity	Less than 1 microvolt for 10 dB signal-plus-noise to noise ratio for SSB operation.
Selectivity	2.1 kHz minimum at 6 dB down, 7 kHz maximum at 60 dB down.
CW Selectivity (with accessory CW filter)	400 Hz at 6 dB down, 2 kHz at 60 dB down.
Overall Gain	Less than 1 microvolt for 0.5 watt audio output.
Audio Output	2.5 watts into 4 ohms, 1.25 watts into 8 ohms, at less than 10% THD.
	Low impedance headphone (4-8 ohm).
AGC	Less than 1 millisecond attack time; switch selectable 100 μsec and 100 mS release, and OFF.
Intermodulation Distortion	-60 dB.
Image Rejection	-60 dB.
IF Rejection	-60 dB.
Internally Generated Spurious Signals	Below 2 microvolt equivalent antenna input, except at 3.65, 3.74, 14.24, and 21.2 MHz.
Cabinet Dimensions (Less knobs, feet, sockets, rails)	5-3/4" high x 14-15/32" wide x 13-7/8" deep. (14.6 cm. x 36.75 cm. x 35.24 cm.)
Net Weight	20 lbs. (7 kg.)

THEORY OF OPERATION

While reading this section, refer to Figure 5-1, the Functions and Chassis Interconnections diagram.

RECEIVER

Refer to the "Receiver Block Diagram" in the "Illustration Booklet."

The incoming signals pass through the filter/ALC circuit board and through the 8.65 MHz band reject filter, to the receiver front end board if the same antenna is used for receiving and transmitting. If the separate receiving antenna connection is used, the incoming signals are applied directly to the receiver front end circuit board through the band reject filter. Diode D4 isolates the receiver in the low power transmit mode.

The incoming signal next passes through the appropriate bandpass filter on the receiver front end circuit board, and is then mixed with the signals from the VFO and the HFO to form the 3395 kHz IF signal. One section of the RF Gain control acts as a shunt to vary the level.

The IF signal is connected to the carrier generator/crystal filter circuit board which contains a selective crystal filter for SSB, and generates the USB, LSB, and CW BFO signals. Solid-state switching is used for mode selection and also to select the proper filter if the optional CW crystal filter is installed.

The 3395 kHz IF signal is fed to the receiver IF/audio circuit board where it is amplified, detected, and the audio signal again amplified. The second half of the RF Gain control varies the IF gain. AGC voltage is detected and amplified on this circuit board. The circuit provides fast, slow, or off AGC action. The S-meter driver operates in conjunction with the AGC voltage. Audio inputs, outputs and controls are connected to this circuit board.

TRANSMITTER

Refer to the "Transmitter Block Diagram" in the Illustration Booklet.

The transmitter audio/regulator circuit board accepts the microphone, key, and phone patch inputs, which it processes and controls. It regulates the 11 volt DC voltage used throughout the Transceiver. The functions located on this circuit board are the audio preamplifiers, the VOX and PTT circuits, the keying circuits, the CW sidetone generator, the relay driver, the SSB/CW control, and the aforementioned voltage regulator.

The carrier generator/crystal filter circuit board contains the balanced modulator, which mixes the transmitter audio and the appropriate carrier (BFO). The carrier is then balanced out, leaving a double sideband signal, one sideband of which is removed by the crystal filter.

The 3395 kHz IF signal is amplified on the transmitter IF circuit board. The IF signal and the premix signal are combined in the balanced mixer, and are then passed through a bandpass filter, after which they are again amplified. Keying is accomplished at this point by turning these amplifiers on and off. The amplifiers are followed by a second group of bandpass filters, which are followed by the driver circuit board.

The HFO signals for the various bands are generated by crystal oscillators on the HFO/premix circuit board. These signals are mixed with the VFO output to form a premix signal, which is then filtered by a group of bandpass filters.

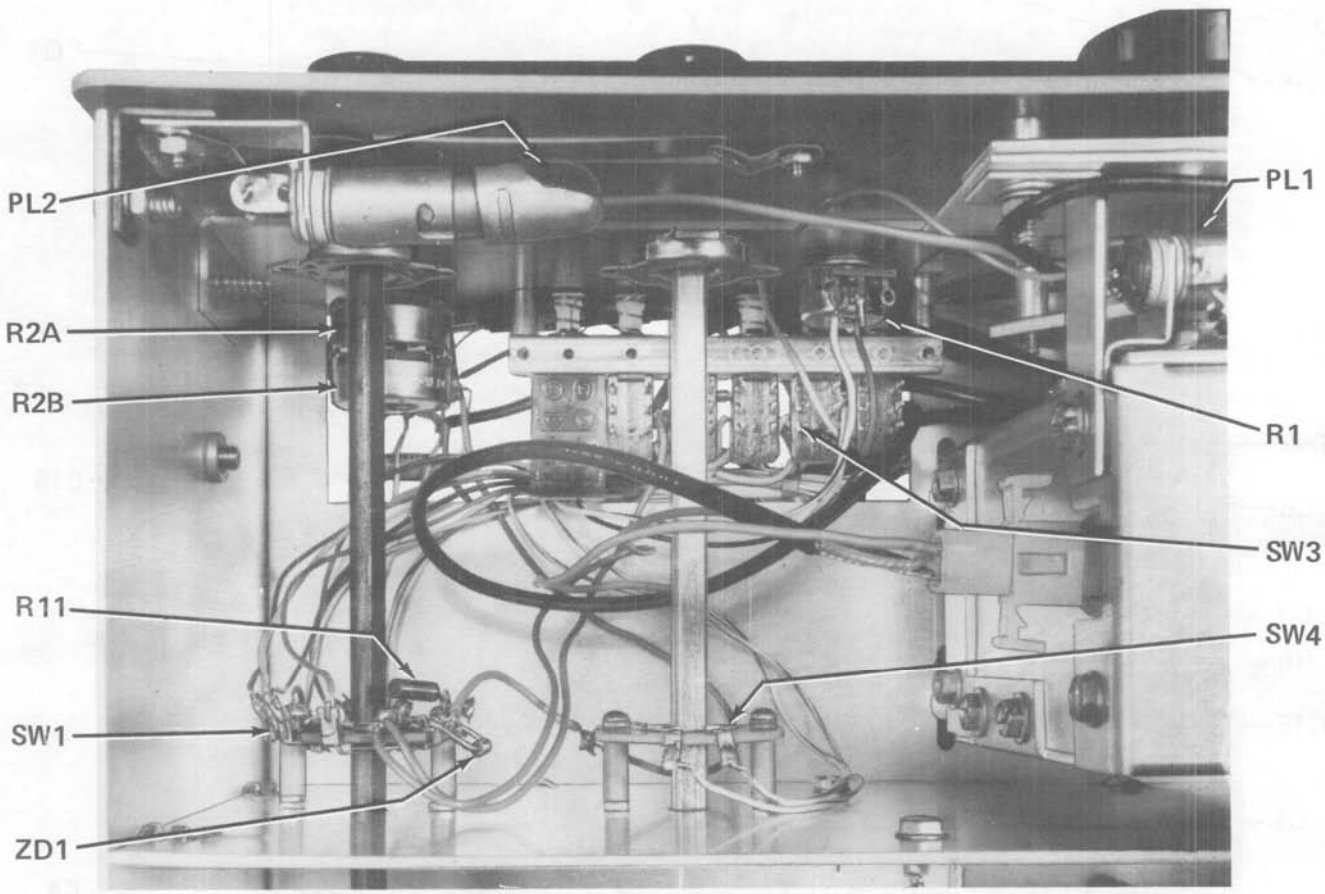
The VFO operates over a range of 500 kHz. Its output is fed to the HFO/premix board, where it is processed as a component of the premix signal. The VFO output level is increased on the 28.0 – 29.5 MHz bands by the VFO Filter switch.

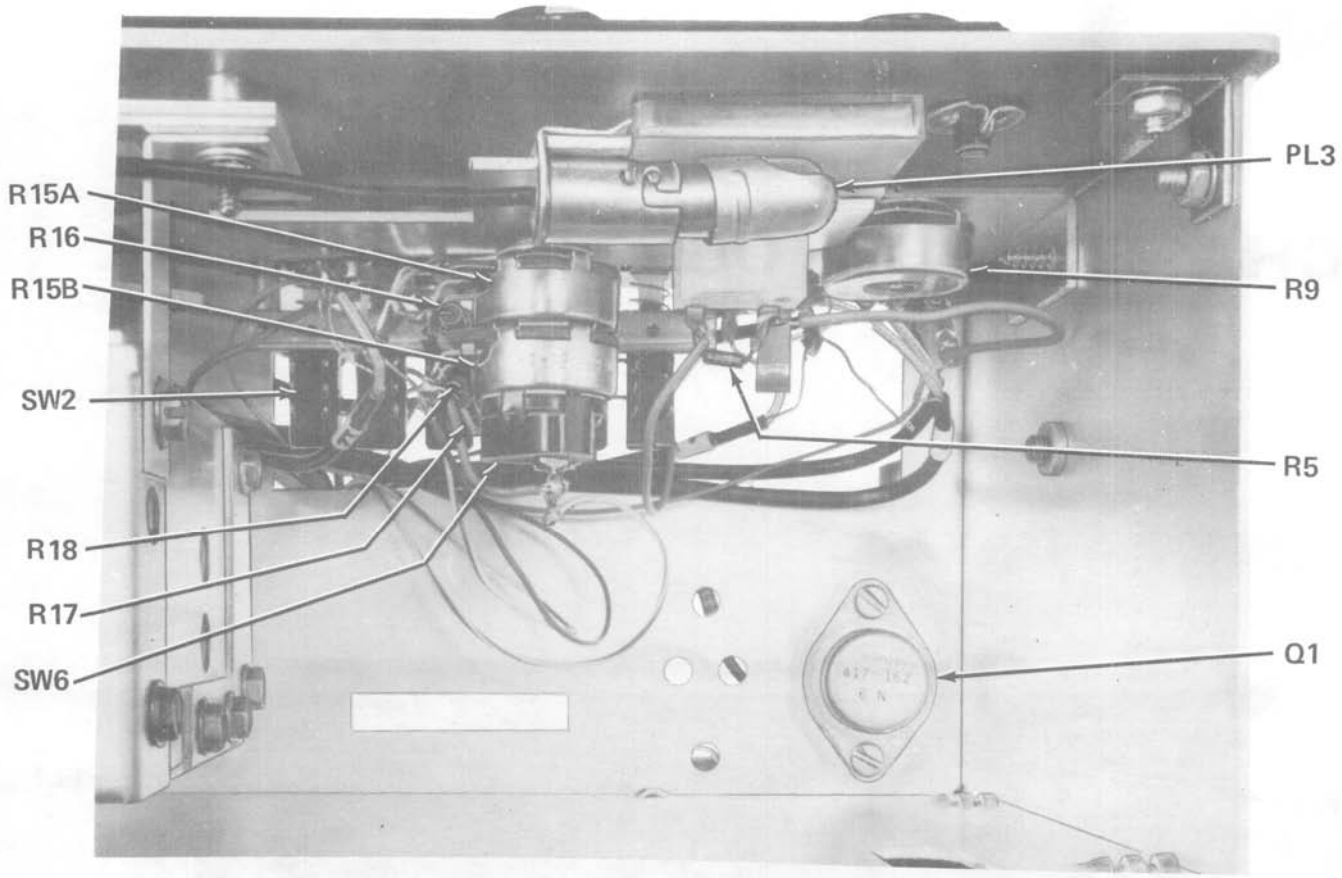
The driver circuit amplifies the signal to the level required to drive the power amplifier. However, the driver output can also be switched to bypass the power amplifier and furnish a QRP signal direct to the filter/ALC board and the antenna. Part of the output is rectified and used for ALC voltage in the low power mode.

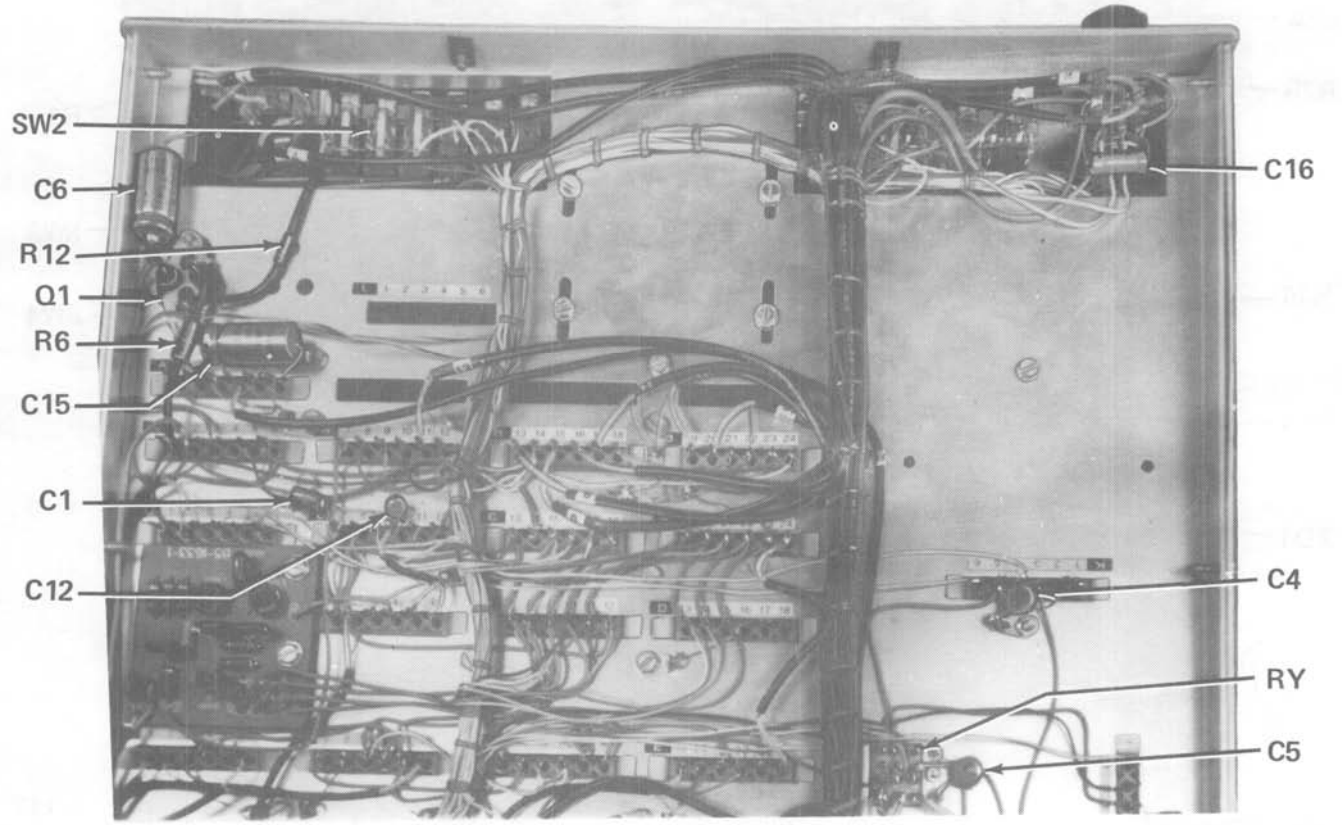
The power amplifier consists essentially of two push-pull amplifiers operated in parallel. Their bias voltage is furnished by a diode mounted in the heat sink, so the bias voltage tracks with the heat sink temperature to prevent thermal runaway. The circuit is broad-banded and no tuning of the power amplifier output circuit is required.

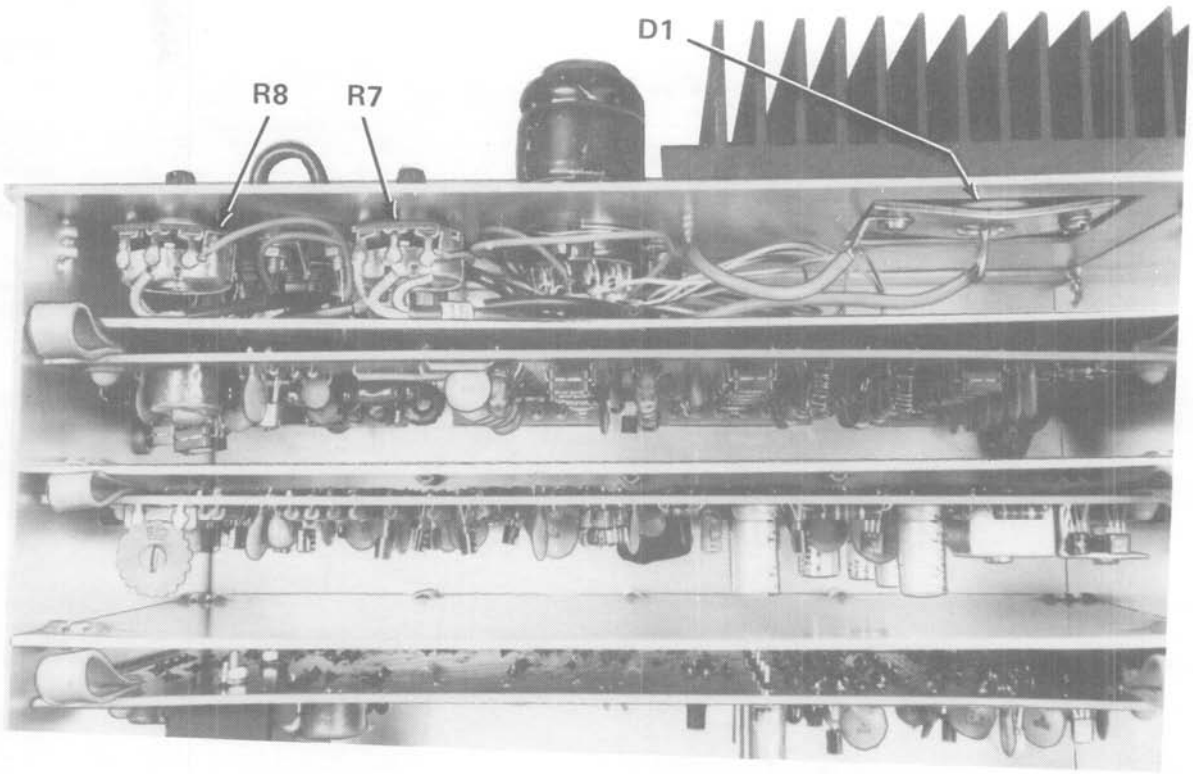
The filter/ALC circuit board contains low-pass filters to attenuate harmonics which must be suppressed to prevent interference to other services. Solid-state switching is used to change the ALC time constant for SSB and CW. Part of the power output is rectified and connected to the panel meter for the Relative Power indication.

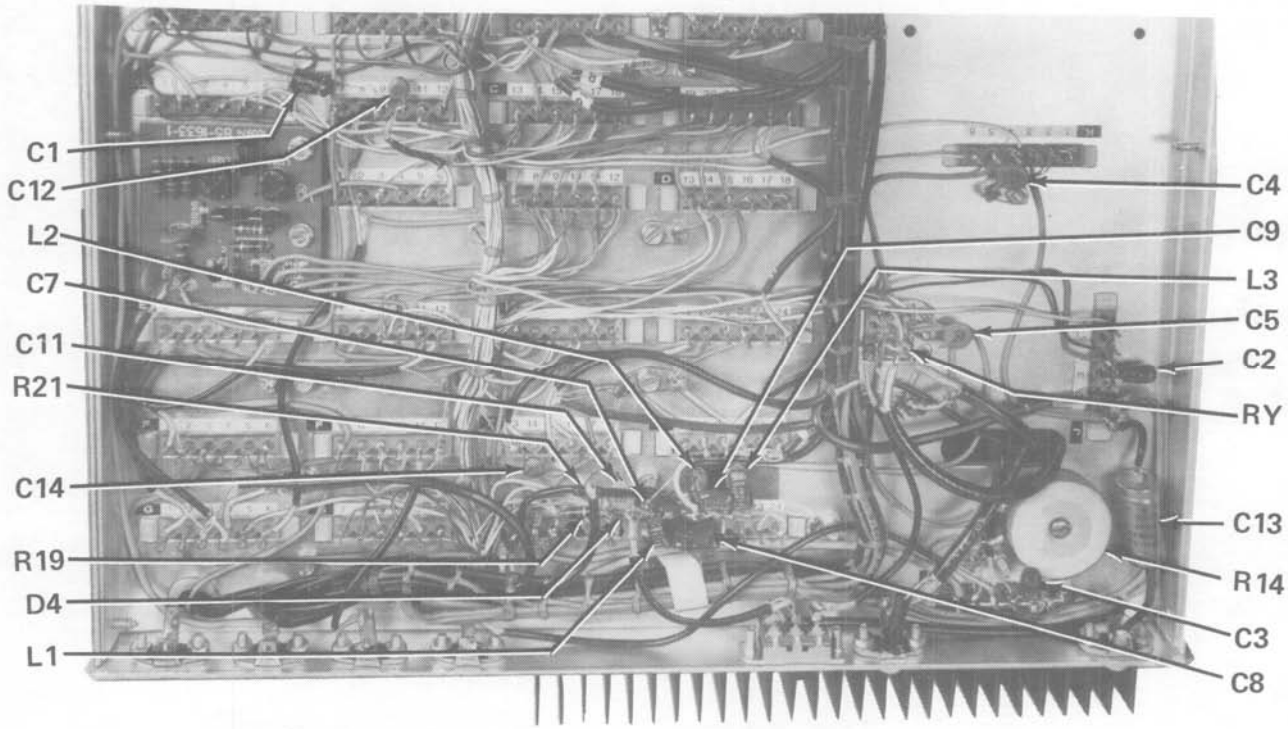
CHASSIS PHOTOGRAPHS




R15A
R16
R15B
SW2
R18
R17
SW6
PL3
R9
R5
Q1


SW2
C6
R12
Q1
R6
C15
C1
C12
C16
C4
RY
C5


D1
R8
R7


C1
C12
L2
C7
C11
R21
C14
R19
D4
L1
C4
C9
L3
C5
C2
RY
C13
R14
C3
C8

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH

ZENITH

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