SESMA

MODEL SB-104 Single Sideband Transceiver

HEATHKIT®

OPERATION MANUAL

HEATH COMPANY . BENTON HARBOR, MICHIGAN

HEATHKIT®

I-595-1770-01

PROBLEMS

- 2|6 604.3 CW
  2|6 606.4 LSB
  2|6 603.6 USB ON ANY BAND ⇒ Board D not oscillating for desired band
  coil not adjusted properly

- unstable frequency on any band ⇒ VFO level

- " " on all bands ⇒ " " (lower ~~bit~~ digit)

29999.9 → 20000.0

not connected to counter but to the band switch

Operation

of the

HEATHKIT

SINGLE SIDEBAND TRANSCEIVER

MODEL SB-104-I 00503

239 - B
235 - A
236 - D
239 - ALC
239 - E
239 - F
239 - G
242 - C
242 - DRIVER
244 - PA

Frequency counter 286

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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TEST AND ADJUSTMENTS

The only circuit boards which should be connected or installed at this time are: the display circuit board on the back of the front panel, the VFO/Filter circuit board under the chassis, and the circuit boards in the VFO and the Converter assemblies. The remaining circuit boards will be installed as part of the "Test and Adjustment" section.

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. If you have a difficulty, DO NOT proceed until it has been corrected as, in some cases, damage could result.

A push-to-talk switch, as found on most 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), you should refer to Figure 2-6 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 front panel locations and to Figure 1-2 for rear panel connections (fold-out from Page 237).

Refer to Figure 1-3 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 1-3A.

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

PUSHBUTTON OPERATION

The pushbuttons on switches S2 and S3 operate in the following ways:

1. Push in to latch. Release by pushing again and quickly removing your finger. Example: the ON switch.
2. Push in to latch. Release by depressing 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.

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 the electric outlet.

( ) Depress the ON button until it latches. The two pilot lamps should light and the meter should read half way between 12 and 15 in 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 or Q2 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.

( ) Refer to Figure 1-4 (fold-out from Page 237) and prepare a 24" shielded cable. Lay this cable aside. It will be used later.

TRANSMIT AUDIO/REGULATOR

( ) Plug in circuit board B (#85-1580). Make sure it enters the two side guides properly and is pushed all the way down.

( ) Depress the ON button. The pilot lamps should light and the display should read FFFF.F with the BAND switch at 3.5.

POSSIBLE CAUSE CHART

1. Display does not light.
   - A. No voltage at switch S3, section C, pin 6.
   - B. Voltage at "A" on display board too low or missing.
   - C. Refer to the "Display Troubleshooting Chart" (Page 288).

( ) On the bottom of the chassis, connect the common lead of your voltmeter to the chassis and measure 5 volts DC at terminal A21 and 11 volts DC at B1.

POSSIBLE CAUSE CHART

1. 5 or 11 volts incorrect.
   - A. Chassis wiring.
   - B. IC202 or IC203.
   - C. Q1 or Q2.

( ) Turn the BAND switch and observe the first digit, which should be blank (not lighted) or read 1 or 2, depending upon the position of the BAND switch:

BAND SWITCH	FIRST DIGIT
3.5	Blank
7.0	Blank
14.0	1
21.0	2
WWV	1
28.0	2
28.5	2
29.0	2
29.5	2

POSSIBLE CAUSE CHART

1. The first digit is incorrect.
   - A. IC156.
   - B. BAND switch wired incorrectly.
   - C. BAND switch turned 180°.

( ) Depress the 100 Hz button. The digit (letter) on the right end of the display should disappear.

0 ¼ ½ ¾ 1 (INCHES) 2 3 4 5 6 7
1/8 3/8 5/8 7/8
0 .5 1 (CM) 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

POSSIBLE CAUSE CHART

1. The last digit does not disappear.
   A. Switch defective.
   B. Switch wired incorrectly.

( ) Connect your microphone to the MIC socket (see Figure 2-5 on Page 250 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 replay 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.

P. 298 C209 +11V = 0

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 at BE. P. 1. 192

( ) 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.

( ) The microphone can be removed, if desired.

COUNTER

( ) On card A, use your ohmmeter to check the resistance from the center conductor of J101 to the ground foil. If the meter shows less than infinite (∞) resistance, you must find the cause and correct it before you proceed.

( ) Plug in circuit board A (#85-1417).

( ) Insert the phono plug (on the shielded lead coming from chassis cutout AA) through the rounded slot in the lateral shield into phono socket J101 on the circuit board.

NOTE: In the following steps, the BAND switch is still at 3.5.

( ) Depress the ON button. The display should read 6600.0.

( ) Depress the USB button. The display should read 6603.6.

( ) Depress the LSB button. The display should read 6606.4.

( ) Depress the CW button. The display should read 6604.3.

POSSIBLE CAUSE CHART		
1.	Incorrect counter readout.	
	A.	Time base not running.
	B.	Chassis wiring.
	C.	Diodes D101 through D110.
	D.	IC102, IC104, IC106, IC108, or IC110.
	E.	+5 VDC is low.

( ) Release the ON button.

PRELIMINARY VFO OUTPUT ADJUSTMENT

( ) Refer to Figure 1-3 (fold-out from Page 237) and engage the VFO Level Adjust control through hole FY in the side of the VFO assembly. Turn this control fully counterclockwise.

HFO COIL ADJUSTMENT

( ) Plug the extender board (#85-1465) into compartment D.

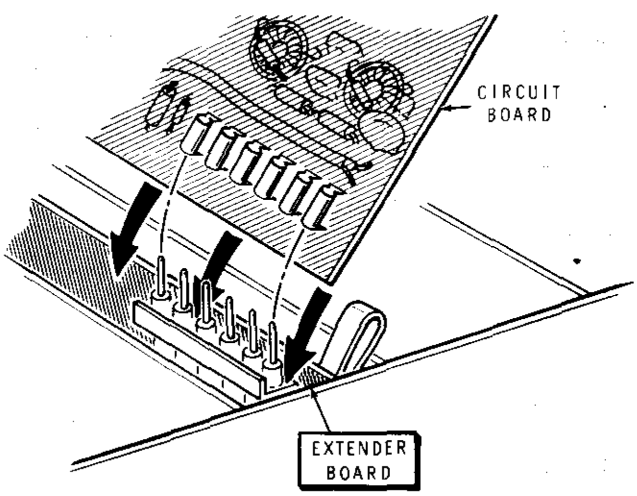


Figure 1-5

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

( ) Plug circuit board D (#85-1418) 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: The high frequency oscillator coils will be adjusted in the following steps. Refer to Figure 1-6 for the method of inserting the alignment tool in 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.

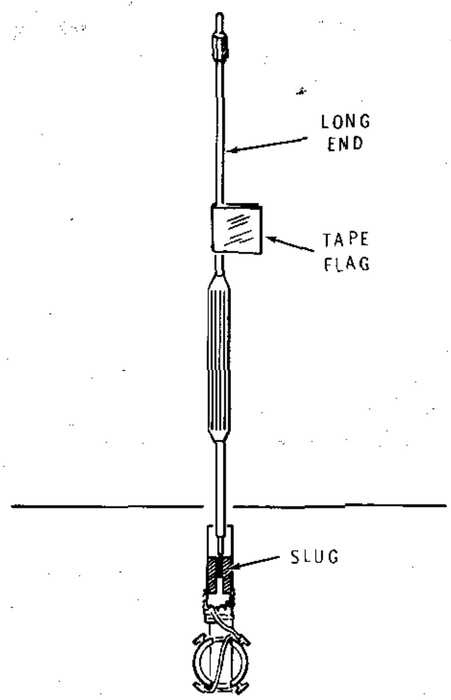


Figure 1-6

( ) Set your voltmeter on 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 it counterclockwise to 0 volts. Then rotate the slug clockwise for the peak voltage, which will be typically 0.2 VDC to 0.5 VDC.

NOTE: The frequency display may be random during the following adjustments.

BAND SWITCH	OSCILLATING POINTS	SENSITIVITY TURNS (BOTTOM POINT)	COIL NUMBER		ROTATE SLUG FOR PEAK VOLTAGE. THEN ROTATE SLUG AS DESCRIBED.	≈ VOLTS	≈ FREQUENCY	FINAL ≈ VOLTS	FINAL ≈ FREQ
3.5	2	1'2	L401		1/2 turn CW*	.126	12397'706	.118	12399.704
7.0	1	4'5	L402		1 turn CCW**	.162		.156	15900'84
14.0	2	1'3	L403	1/2	1 turn CW	.227	22895.41	.194	22895'84
WWV	2	1'5	L404		1/2 turn CW	.217	23895'36	.201	23895'70
21.0	2	1'6	L405	3/4	1 turn CW	.232	29894'68	.195	29895.67
28.0	2	4'5	L406		1 turn CW	.128	36895'25	.126	36895'67
28.5	2	5	L407		1 turn CW	.144	37396'77	.100	37396'78
29.0	2	2'7	L408		1 turn CW				
29.5	2	0'9	L409	1/2	1 turn CW				

*clockwise
**counterclockwise

ORDER CHANGED

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 the HFO/premix 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 compartment D.

VFO OUTPUT ADJUSTMENT

( ) Depress the ON button.

( ) Turn the BAND switch to WWV.

( ) Refer to Figure 1-3 (fold-out from Page 237) and engage the VFO adjustment control through hole FY in the side of the VFO assembly. Turn the control clockwise until the display becomes unstable. Then turn the control back until the display is stable.

(✓) Turn the BAND switch to 29.5 and check for display stability (+ or – one count). If the display is unstable, turn the control counterclockwise until the display is stable at both the 29.5 and WWV positions of the band switch.

VFO FREQUENCY, SHIFT AND LEVEL ADJUSTMENT

NOTES:

1. In the following step, if the alignment tool will not engage the coil slug, loosen the four VFO mounting screws on the bottom of the chassis and move the VFO forward. After the adjustment is completed, reposition the VFO and tighten the mounting screws.
2. The object of this adjustment is to center the 500 kHz of the 3.5 band within the total VFO tuning range.

( ) Turn the BAND switch to 3.5.

( ) Depress the ON button.

( ) Turn the MAIN TUNING knob until the display will go no lower. If the display is then unstable (except the right digit), repeat the VFO Output adjustment.

( ) Remove the MAIN TUNING knob.

( ) Insert the coil alignment tool into hole ET in the panel and into the corresponding hole in the VFO enclosure. Fit the tool into the coil slug. Adjust the slug until the display reads approximately 3475.0. You may be able to see this display at two positions of the coil slug. When you have the correct position, the display will read lower with counterclockwise rotation of the alignment tool.

( ) Reinstall the MAIN TUNING knob.

( ) Turn the MAIN TUNING knob until the frequency displayed is approximately 3800. Then temporarily remove the large knob.

( ) Depress the USB button and write down the frequency displayed.

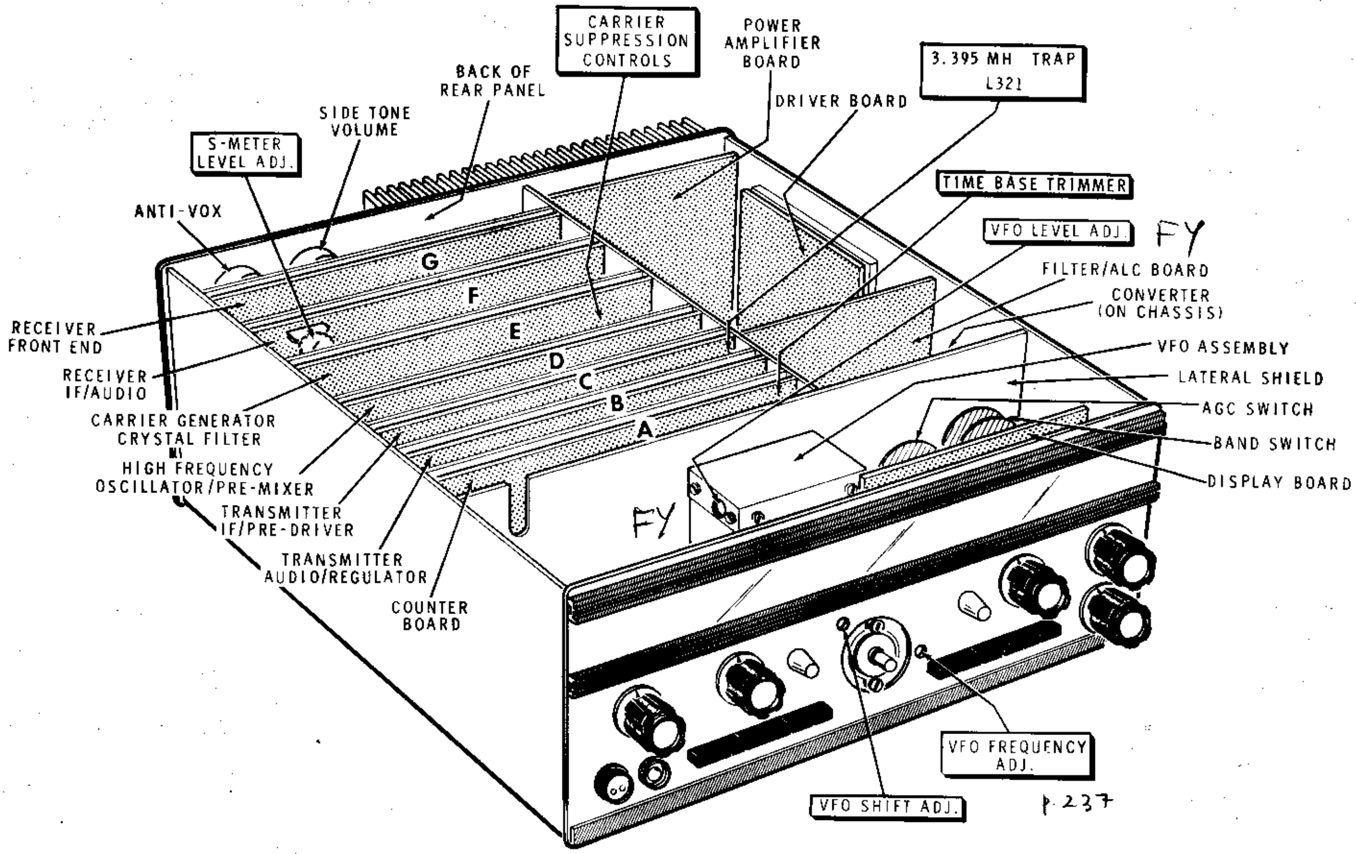


Figure 1-3

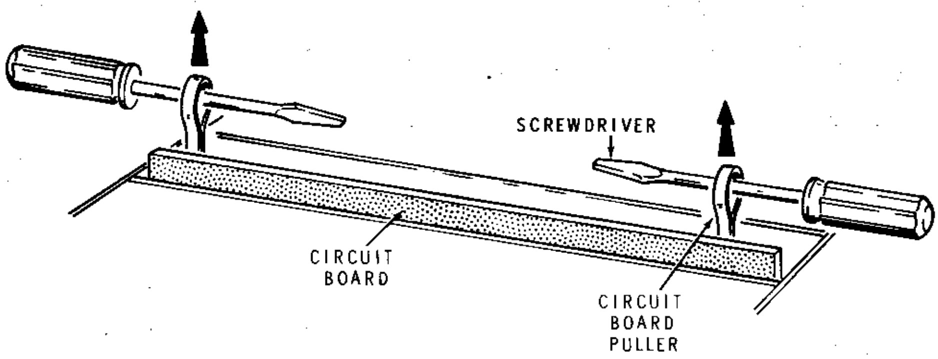


Figure 1-3A

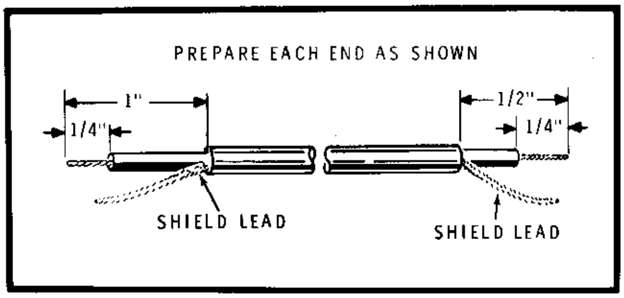


Figure 1-4

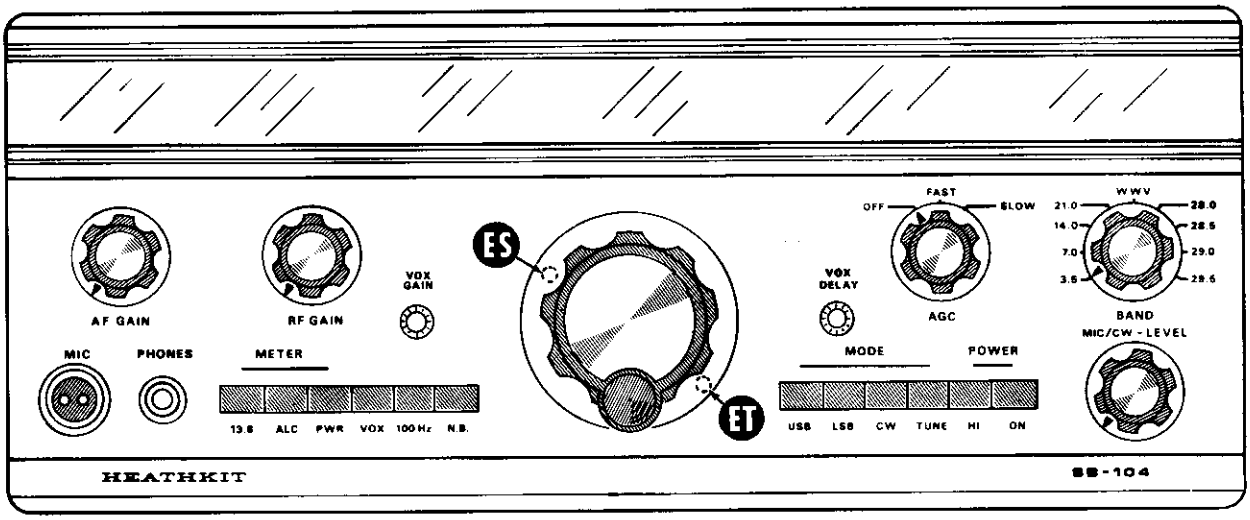


Figure 1-1

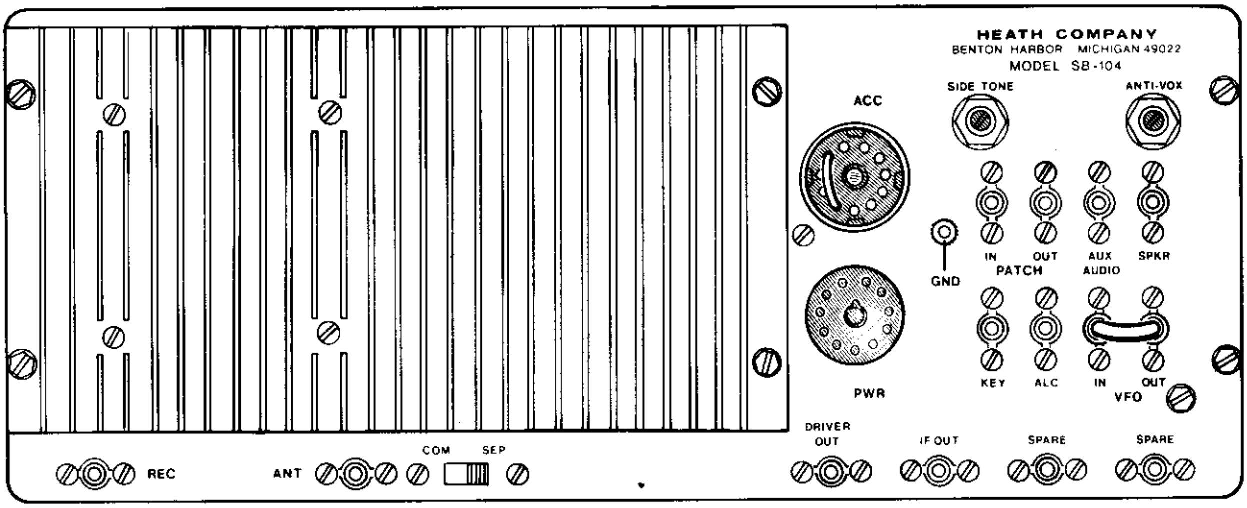


Figure 1-2

(/) Insert a small screwdriver into hole ES in the panel, and into the corresponding hole in the VFO enclosure, so the screwdriver engages the notch in the shaft of C1211, the 15-60 pF trimmer on the oscillator board. If the blade on your screwdriver is too large for the panel hole, you may be able to engage the trimmer through the large knob hole.

(/) Depress the LSB button.

(/) Adjust C1211 carefully until the LSB frequency display is the same as the USB frequency you wrote down, and the same frequency is displayed when either the LSB or USB is depressed. Remove any metal screwdriver before taking the frequency reading.

POSSIBLE CAUSE CHART

1. The same frequency is not displayed in both LSB and USB.
   A. FUNCTION switch wiring.
   B. Connector SO1201.
   C. Diode D1201.

(/) To prevent light from shining through, place small pieces of black tape over holes ES and ET (the two VFO adjustment holes) on the back of the panel.

(/) Replace the knob and tighten both setscrews.

(/) Check the stability of the VFO frequency display. If necessary, adjust the VFO level for a stable display at BAND switch positions WWV and 29.5.

(/) Check the stability of the frequency display at all positions of the BAND switch. If the display is unstable on any band, perform the second step under "VFO Output Adjustment" on Page 237. Do not turn the control beyond the point where the display becomes stable.

(/) Release the ON button.

RECEIVER ALIGNMENT

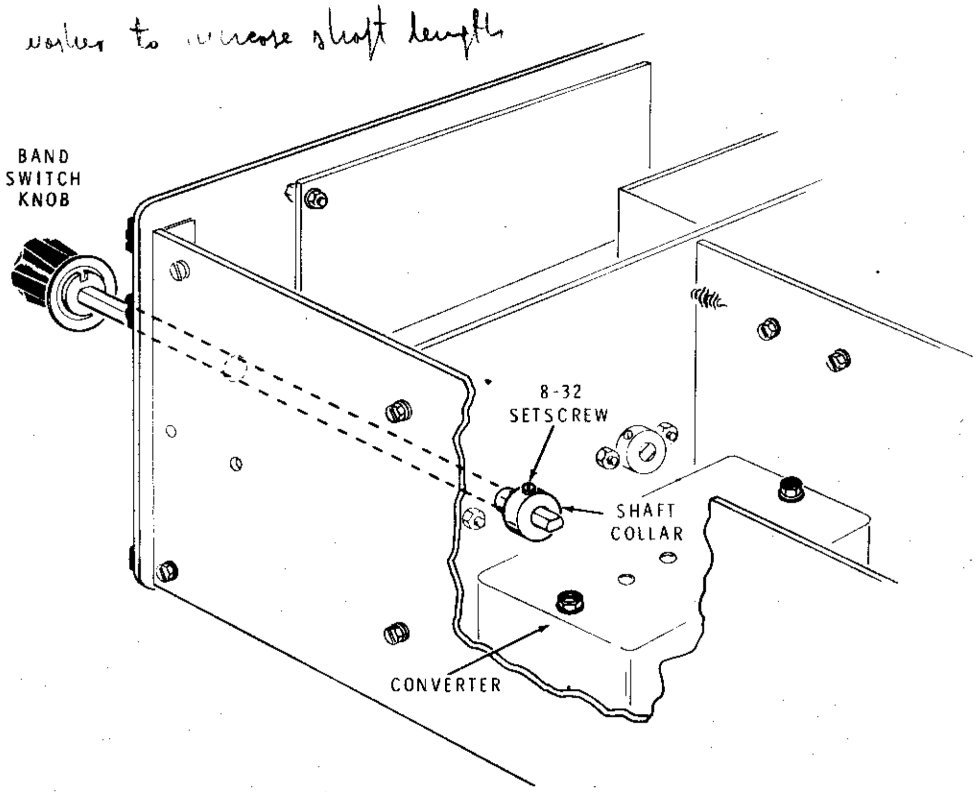
Refer to Pictorial 12-37 (fold-out from Page 239) for the following steps.

(/) Turn the BAND switch to 3.5.

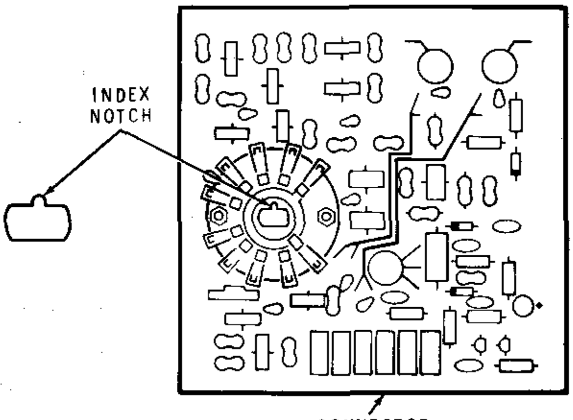
( ) Loosen the setscrew in the band switch shaft collar.

(/) Refer to Detail 12-37A and pull the BAND switch knob and shaft forward until the end of the shaft is over the converter assembly.

(/) extra washer to increase shaft length



Detail 12-37A



Detail 12-37B

( ) Refer to Detail 12-37B and position BOTH switch rotors on the ALC/filter circuit board (#85-1425-1) 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 board into connector K, just back of the converter assembly. 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 a flatted side of the shaft.

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

( ) Plug circuit board E (#85-1463) into its compartment.

( ) Plug circuit board F (#85-1462) into its compartment.

( ) Plug circuit board G (#85-1459) into its compartment.

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

( ) Depress the ON button.

( ) **Turn the RF GAIN knob fully clockwise.**

( ) Turn the AF GAIN knob clockwise until you hear noise from the 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 troubleshooting guide.

( ) Release the ON button.

8.65 MHZ BANDPASS FILTER ALIGNMENT

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

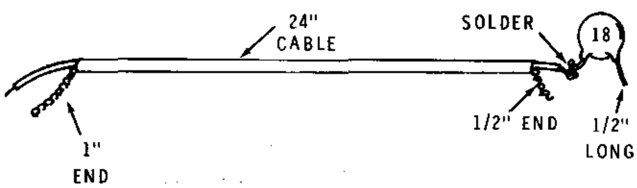
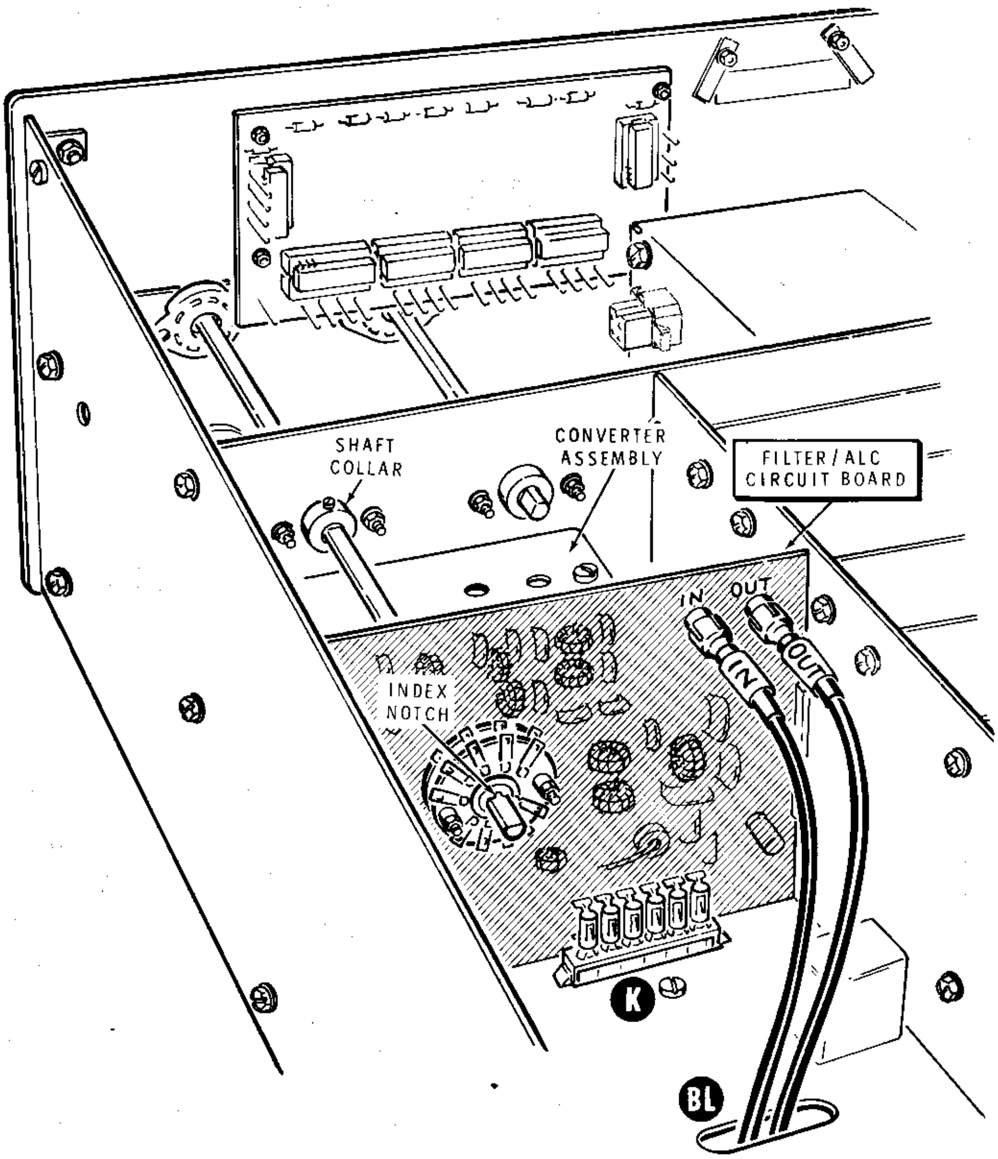


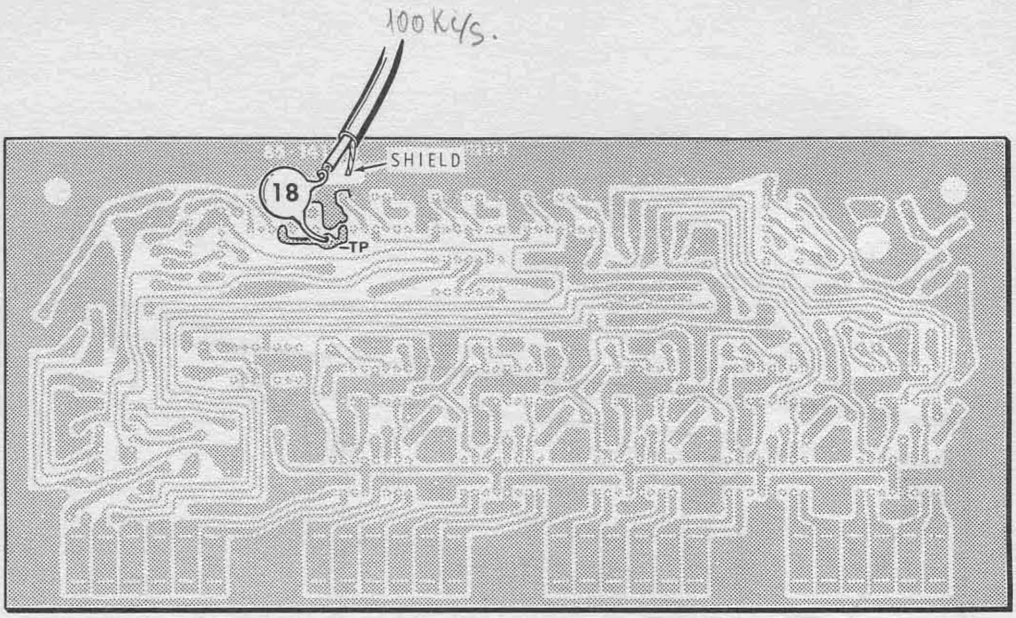
Figure 1-7

( ) Refer to Figure 1-7 and solder one lead of the 18 pF disc capacitor to the center conductor at the 1/2" end of the 24" shielded cable prepared earlier.

( ) Remove the phono plug from socket J101 on circuit board A. Then remove the circuit board from your Transceiver.

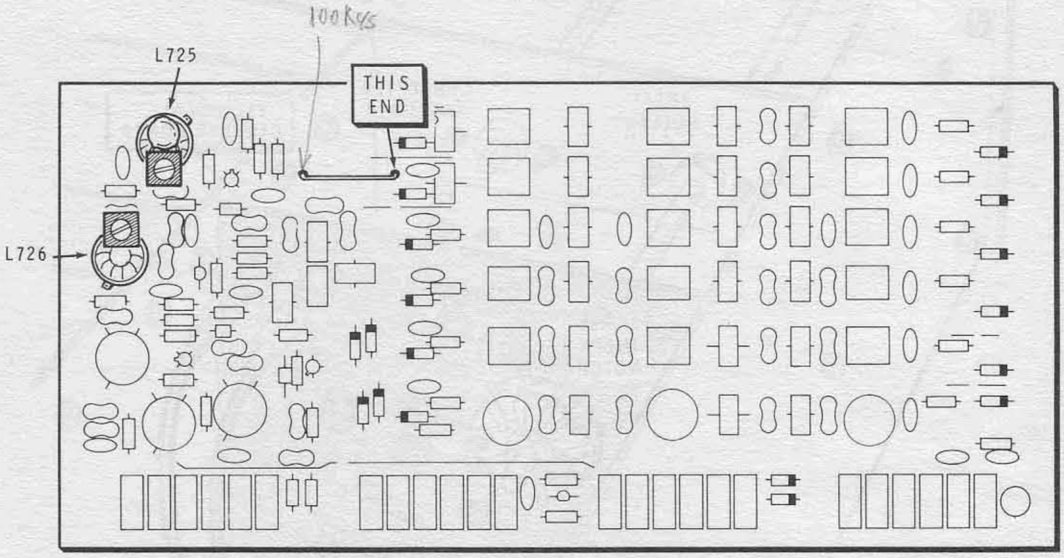


PICTORIAL 12-37



A
COUNTER

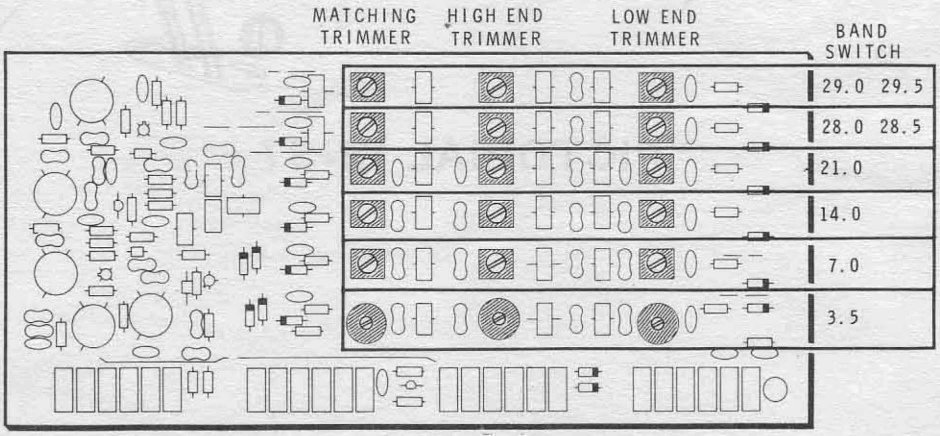
Figure 1-8A



G
Rx FRONT END

Figure 1-8B

BOARD G



G
Rx FRONT END

Figure 1-9

(✓) Refer to Figure 1-8A (fold-out from this page) and solder the free lead of the 18 pF capacitor to the foil designated TP on circuit board A. Solder the cable shield wires to the ground foil in the area shown.

(X) Carefully plug board A back into its compartment. Look between the foil side of the circuit board and the shield to make sure the "hot" lead of the capacitor does not touch the shield.

(X) Replace the phono plug in J101.

(X) Remove circuit board G from the Transceiver.

(X) Refer to Figure 1-8B 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.

(X) Position the end of the center conductor of the shielded cable coming from circuit board A alongside the end of the jumper and solder the two together. Use a minimum amount of solder. Bend the shield wires out of the way.

( ) Install the extender board in position G.

To adjust 1st band pass filter

( ) Install circuit board G in the extender board.

( ) Set the front panel controls as follows:

Band Switch	3.5	
RF Gain	Fully clockwise	(AGC cntrl)
ALC button	Depressed	
USB button	Depressed	
AGC	Fast	

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.

100 Kc/s harmonics

( ) Tune the Transceiver to 3800 kHz. Then select the strongest signal within 5 kHz of this frequency.

When you perform any of the alignment steps in the remainder of this Manual, keep the S-meter below a full scale indication by adjustment of the S-Meter Level Adjust control on circuit board F (see Figure 1-3, fold-out from Page 237). DO NOT use the RF GAIN control for this purpose.

( ) Set the S-METER LEVEL ADJUST control, (see Figure 1-3, fold-out from Page 237) for an S-meter reading of S9+50.

( ) Tune the Transceiver to 3500 kHz and select the strongest signal within one-half of a tuning knob revolution.

HFO/PREMIX

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

( ) Write down the S-meter reading.

( ) Push circuit board D back down onto its connectors.

100 Kc/s harmonics

( ) Tune the Transceiver to 4000 kHz and select the strongest signal within one-half of a tuning knob revolution.

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

( ) 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. The readings will probably never coincide exactly. Two or three repetitions of the adjustment should be adequate.

( ) Remove the shielded cable from the jumper on circuit board G.

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

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 G.

( ) Remove circuit board G from the extender board and the extender board from position G.

( ) Reinstall circuit board G in position G.

( ) Reinstall circuit board D.

NOTE: The shielded cable connected to circuit board A will be used in the following bandpass filter alignment steps.

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 of the 80, 40, 20, and 15 meter bands. Two filters are used for the 10 meter band, one for the 28.0 and 28.5 band switch positions, and one for the 29.0 and 29.5 positions. The alignment of a filter calls for a coarse adjustment to a center ferquency, 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 counter (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 across the SPKR terminals (to provide a load).

Figure 1-9 (fold-out from Page 240) identifies the trimmer capacitors to be adjusted for each band switch position.

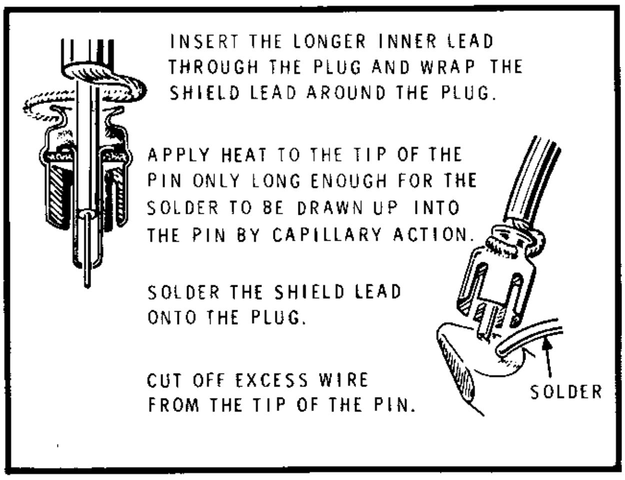


Figure 1-10

( ) Refer to Figure 1-10 and install a phono plug on the free end of the 24" shielded cable connected to circuit board A.

( ) Insert the phono plug in the ANT jack on the rear panel (below the heat sink).

( ) Check that the rear panel antenna switch is in the COM position.

( ) Set the front panel controls as follows:

RF Gain	Fully clockwise
ALC	Depressed
AGC	Fast
Band	29.0
Level	Fully counterclockwise
USB	Depressed
ON	Depressed

Buttons not mentioned should be released.

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

( ) Tune the Transceiver to the strongest signal in the vicinity of 29 400 kHz. NOTE: The counter provides many signals across the band, but the strongest signals will be heard at (or near) the 100 kHz points.

( ) Refer to Figure 1-9 and adjust the three trimmers for the 29.0 band to secure the greatest deflection of the S-meter needle. Repeat the adjustment two or three times until no greater deflection can be seen.

( ) Tune to the strongest 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 meter 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 secure the most uniform response.

( ) Turn the BAND switch to 28.0 and tune the Transceiver for the strongest signal near 28 400 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 for the strongest signal near 28 000 kHz.

( ) Adjust the Low End trimmer for maximum S-meter deflection and note the meter reading.

( ) Turn the BAND switch to 28.5 and tune the Transceiver to the strongest signal near 29 000 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 29 000 kHz frequency has the lower meter reading, adjust the Low End trimmer to increase the reading. If the 28 000 kHz frequency had the lower reading, turn the BAND switch to 28.0, tune to 28 000 kHz, and adjust the High End trimmer to increase the meter reading.

( ) Repeat the adjustments two or three times for the most uniform response across the band.

( ) Follow the same procedure and adjust the bandpass filters for the 21.0, 14.0, 7.0, and 3.5 bands. The trimmers for each band are shown in Figure 1-9. Refer to Figure 1-11 for the three frequencies to use for the adjustments of each filter.

RANGE	BAND	FREQUENCIES		
		MID-BAND (ADJ. 3 TRIMMERS)	LOW END	HIGH END
29-30	29.0 29.5	29400	29 000	29 700
28-29	28.0 28.5	28 400	28 000	29 000
21-21.5	21.0	21 100	21 000	21 400
14-15.5	14.0	14 200	14 000	14 400
7-7.5	7.0	7 100	7 000	7 300
3.5-4	3.5	3 800	3 500	4 000

Figure 1-11

( ) Tune the Transceiver to 3800 kHz. Then select the strongest signal within 5 kHz of this frequency.

( ) Set the S-METER LEVEL ADJUST control (see Figure 1-3, fold-out from Page 237) for an S-meter reading of S9+50.

( ) Remove the phono plug from the ANT socket on the rear panel and unsolder and remove the shielded cable and the 18 pF capacitor from the foil side of circuit board A.

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

COUNTER CLOCK SETTING

NOTE: The counter clock output will be calibrated against the signal of station WWV, Colorado, on 15,000 kHz or station CHU, Canada, on 7,335 kHz. One of the stations may be more easily received than the other in your location.

( ) Connect an antenna (suitable for the frequency of the calibration station selected) to the COM antenna socket. Be sure the rear panel switch is still at COM.

( ) Turn the BAND switch to WWV or 7.0, as appropriate.

( ) Depress the ON button.

( ) Tune to zero beat station WWV in the vicinity of 15,000 kHz or station CHU at 7335.0 kHz.

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

( ) Adjust the time base trimmer capacitor on the upper right-hand corner of circuit board A (next to the crystal) until the display reads 15,000.0 or 7335.0.

POSSIBLE CAUSE CHART

1. Display cannot be adjusted to agree with WWV or CHU frequencies.
   - A. Y101 not within tolerance.
   - B. C114 defective.

( ) Release the ON button.

LOW POWER TRANSMITTER CHECK

(\) Check coil L321 on circuit board C (#85-1420-3) to be sure the coil slug is still flush with the bottom of the coil form (see Pictorial 5-12 on Page 89).

(\) 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 (fold-out from Page 243) and mount the driver circuit board (#85-1421) 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 leads coming from chassis cutout BL into the corresponding sockets on the driver circuit board.

(\) Connect a 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 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 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 all bands 3.5 through 21.0 have been checked.

POSSIBLE CAUSE CHART

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

( ) Depress the ALC button and repeat the preceding step. The meter should show an ALC indication as the MIC/CW-LEVEL control is advanced.

( ) Release the ON button.

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 inserting the alignment tool. Be sure the meter drops to 0 when the LEVEL control is fully counterclockwise.

( ) Depress the ALC and ON buttons.

Refer to Figure 1-12 (fold-out from this page) for the following steps.

( ) Turn the BAND switch to 28.0.

( ) Tune the Transceiver to 28.100.

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.

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

( ) 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.

( ) Depress the TUNE button.

( ) Adjust coils L309 and L320 for a peak indication on the meter. Repeat the adjustment until no higher reading can be obtained.

( ) Repeat the foregoing series of steps two or three times until you are sure the maximum reading has been obtained.

( ) Release the TUNE and ON buttons.

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 the transmitter IF circuit board in the "Maintenance" section.
2. Response across one or more bands is not uniform.
   A. Refer to the Transmitter IF circuit board in the "Maintenance" section.
3. Display erratic on one or more bands.
   A. Readjust the VFO level as required.

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.

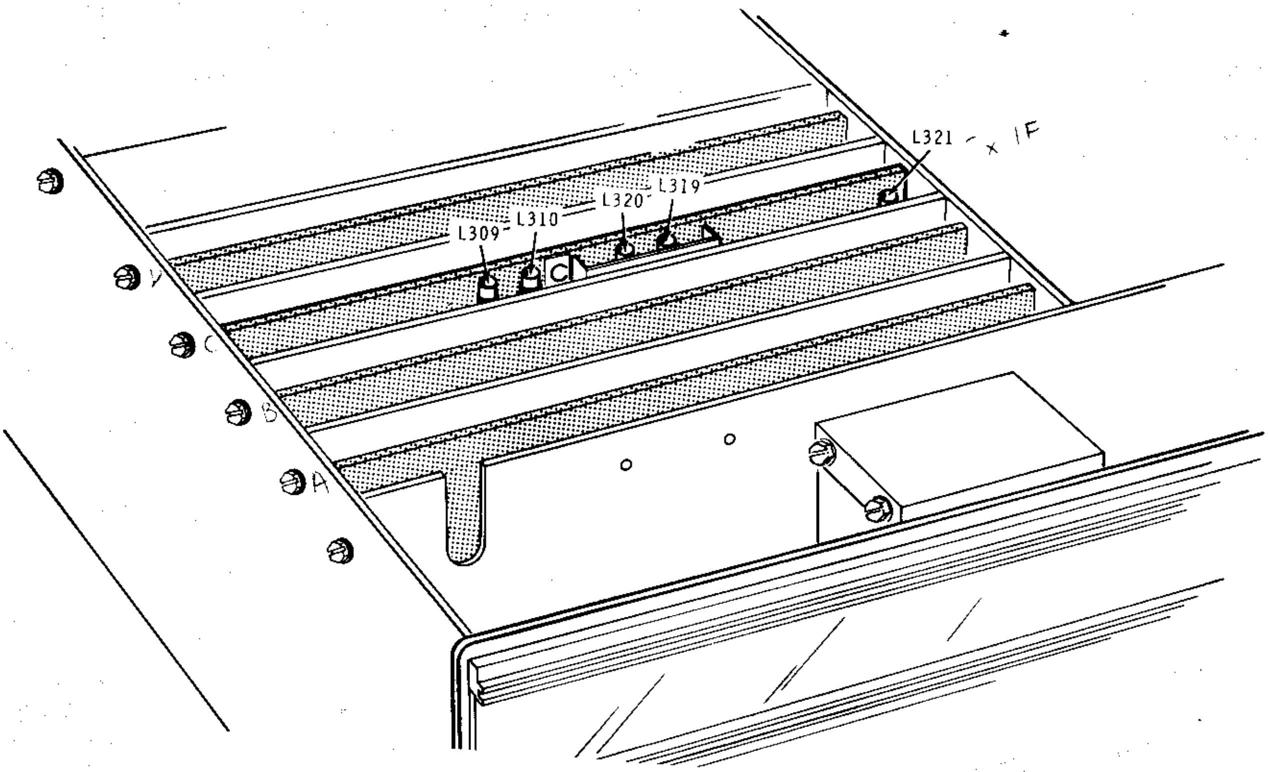
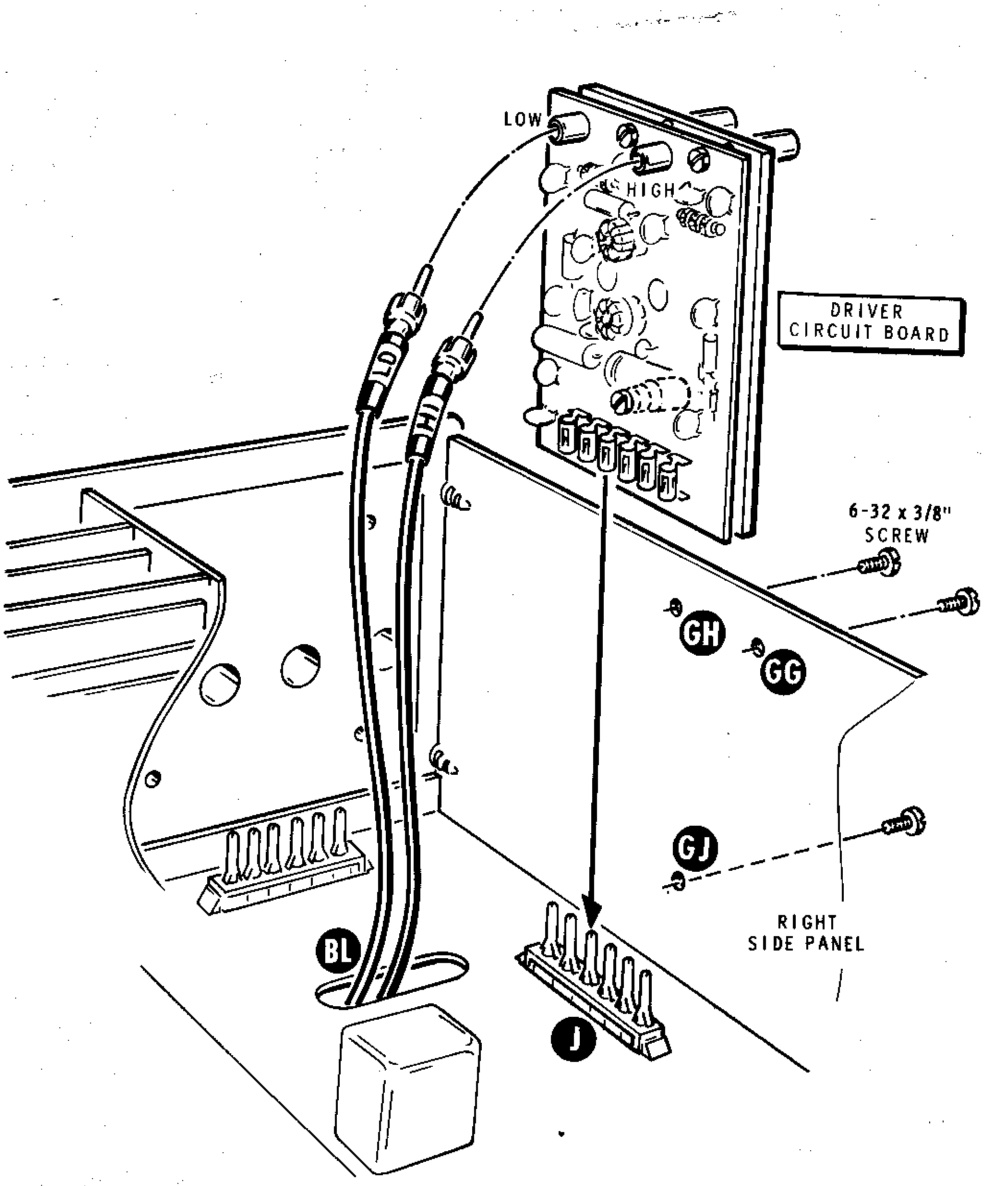
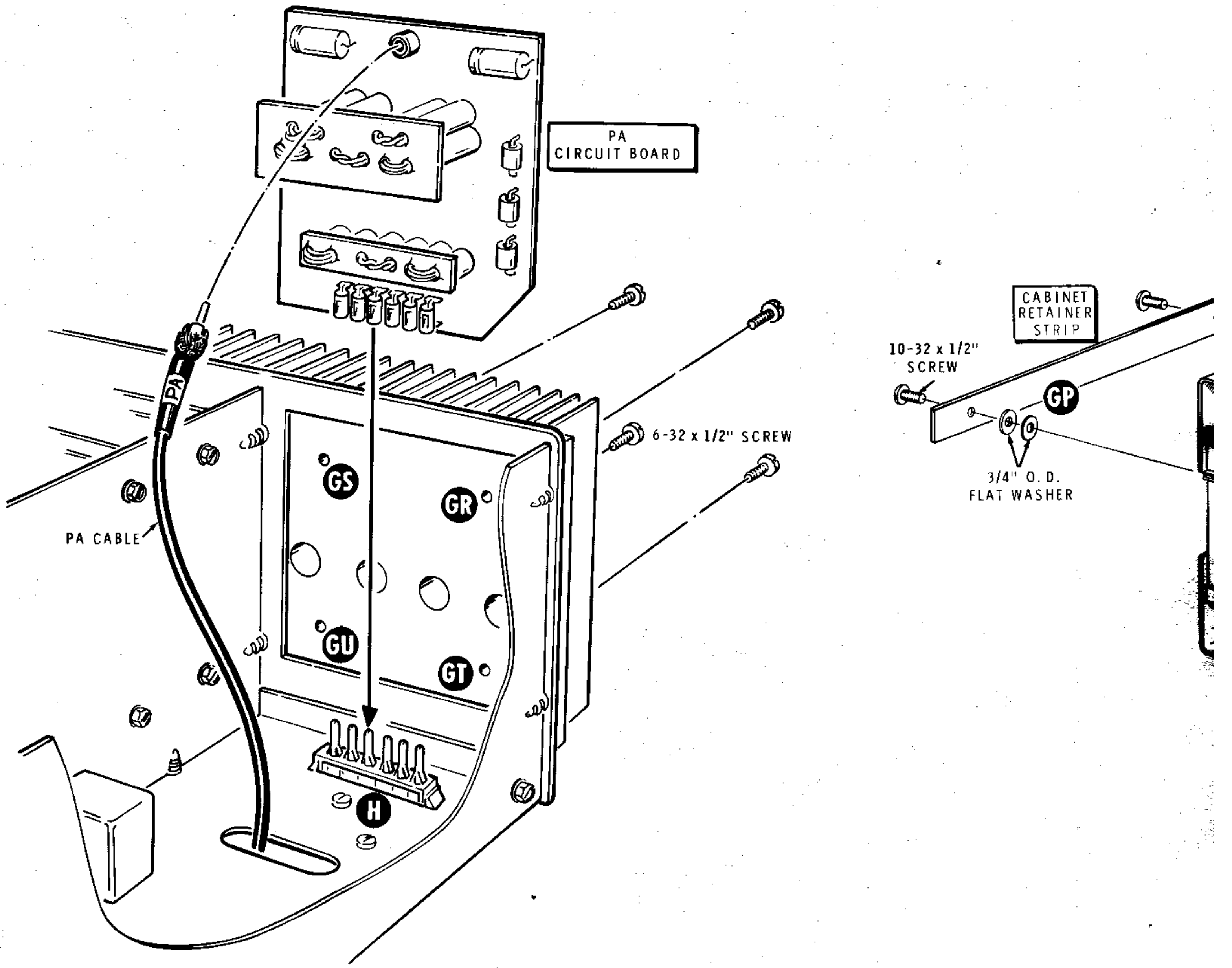


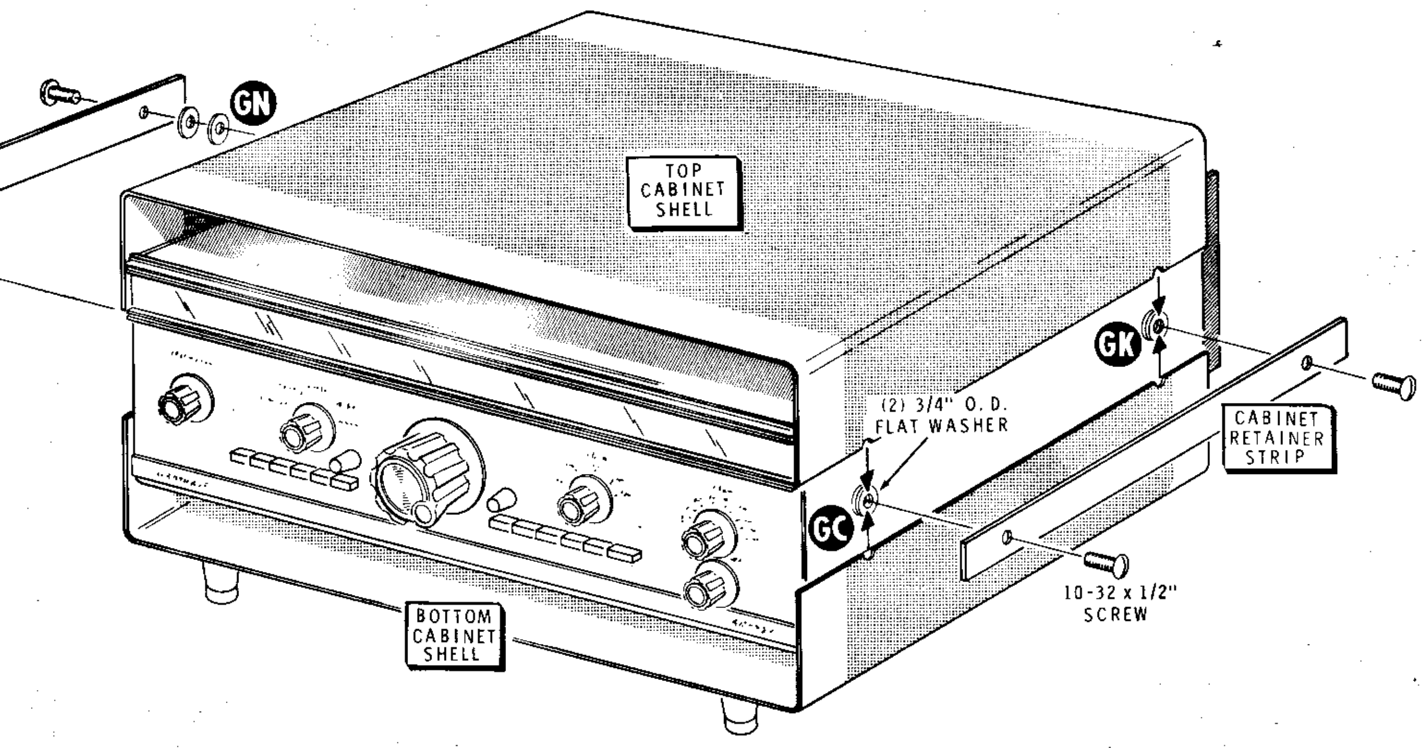
Figure 1-12



PICTORIAL 12-38



PICTORIAL 12-39



PICTORIAL 12-41

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

( ) Turn the LEVEL control fully counterclockwise.

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

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

( ) Tune to approximately 7000 kHz.

( ) Close the key. The meter should read between 1/2 and 1 as the LEVEL control is advanced.

( ) 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 the transmitter audio/regulator circuit board in the "Maintenance" section.

P.A. (Power Amplifier) CIRCUIT BOARD

CAUTION:

The thermal compound in the following steps can be injurious to both your eyes and your clothes. It should be handled with utmost care.

KEEP THE COMPOUND AWAY FROM YOUR EYES. Wash your hands immediately after using the compound. Should you get any in your eyes, wash them out with water at once and get to a doctor as soon as possible.

KEEP THE COMPOUND OFF YOUR CLOTHES. If you get the compound on your clothes it may leave a permanent white stain.

Refer to Pictorial 12-39 (fold-out from this page) for the following steps.

( ) Refer to Detail 12-39A and position the P.A. circuit board (#85-1422) 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. Then push the P.A. assembly back against the heat sink. 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.

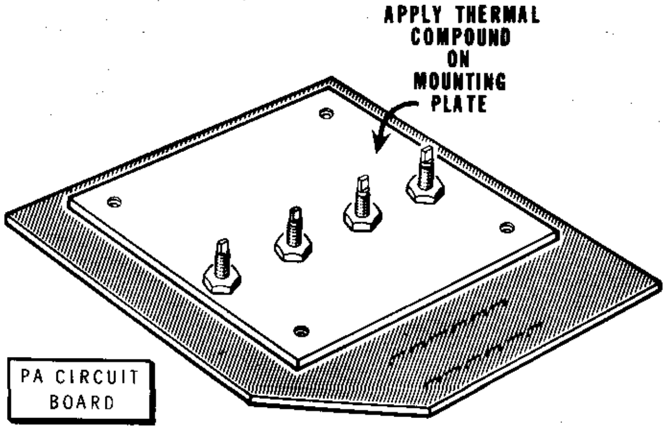
CAUTION: Check to make sure that all five cables in the P.A. compartment are properly connected. If you make an error at this point, you may have to replace the four power transistors.

( ) Set front panel controls as follows. The position of other controls is immaterial:

LEVEL:	Fully counterclockwise
BAND:	7.0
VOX DELAY:	Fully counterclockwise

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

( ) Connect the cable from the power supply.



Detail 12-39A

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). This must be carefully observed in the following steps. Complete duty cycle information is shown in the Operations section of this Manual on Page 261.

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

( ) Depress the TUNE button..

( ) Advance the LEVEL control. The meter should read approximately 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, being 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 269.
   - 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/Filter 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 the 50 Ω dummy load to the ANT socket.

( ) Connect the microphone.

( ) 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 making the following adjustment. Prolonged keying of the Transceiver while attempting to achieve an optimum setting creates 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, fold-out from Page 237). 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.

3.395 TRAP ADJUSTMENT

( ) Remove circuit board D.

( ) Preset these controls:

BAND:	3.5
LEVEL:	Fully counterclockwise

( ) Depress buttons PWR, HI, and ON.

( ) Depress the TUNE button.

( ) Turn the MIC/CW LEVEL fully [redacted]clockwise.

( ) Carefully observe whether the meter needle moves up-scale.

( ) If there is any meter indication, adjust coil L321 on the right side of circuit board C (Figure 1-12) for a null (least indication). Adjust it in a counterclockwise direction.

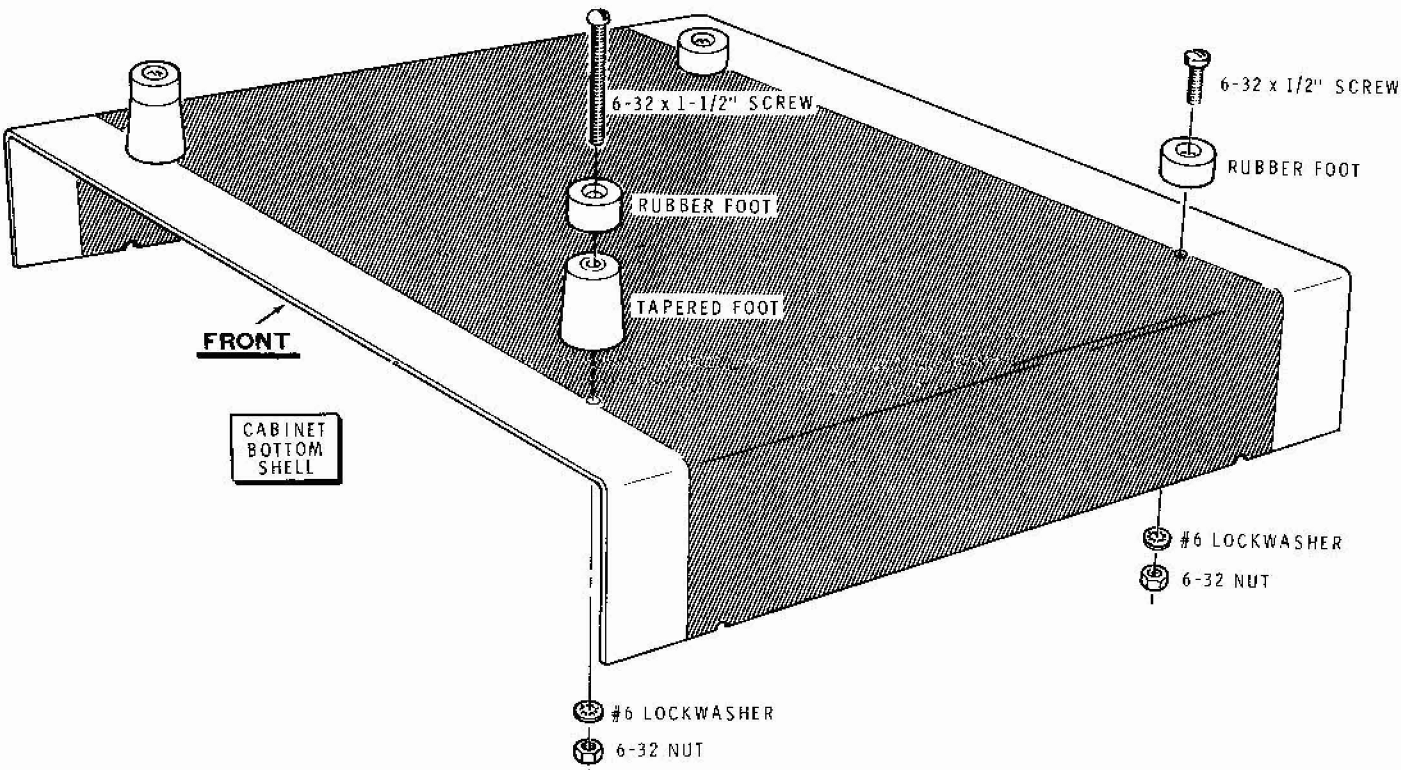
( ) Depress the LSB button and key the Transceiver. If there is no meter indication, the adjustment is complete. If there is a meter indication, switch back and forth between USB and LSB and adjust L321 for the best possible null at both positions.

( ) Release the ON button.

( ) Reinstall circuit board D.

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

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. If you wish your Transceiver to have an upward tilt of the panel, use both the tapered spacers and the rubber feet at the two front corners of the bottom shell.

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 for the next four steps.

( ) Attach a cabinet retainer strip to each side panel. Use a 10-32 x 1/2" screw and two 3/4" OD 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 3/4" 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. Turn the board pullers down.

( ) Tighten the four 10-32 screws.

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

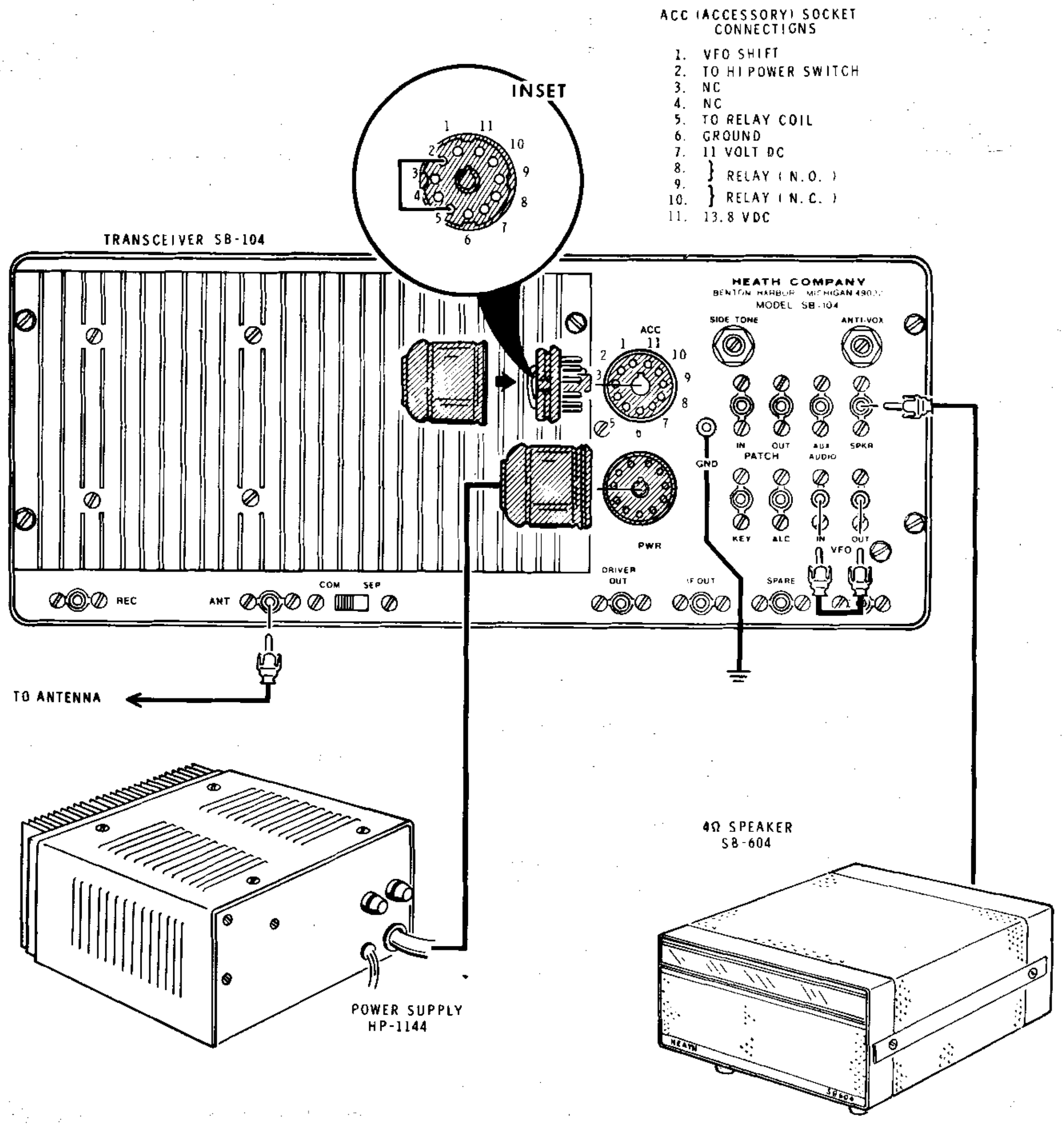

ACC (ACCESSORY) SOCKET CONNECTIONS
1. VFO SHIFT
2. TO HI POWER SWITCH
3. NC
4. NC
5. TO RELAY COIL
6. GROUND
7. 11 VOLT DC
8. 9. } RELAY (N.O.)
10. } RELAY (N.C.)
11. 13.8 VDC
INSET
TRANSCEIVER SB-104
HEATH COMPANY
MODEL SB-104
SIDE TONE
ANTI-VOX
ACC
GND
PATCH
IN
OUT
AUX AUDIO
SPKR
KEY
ALC
VFO
PWR
DRIVER OUT
IF OUT
SPARE
REC
ANT
COM
SEP
TO ANTENNA
4Ω SPEAKER
SB-604
POWER SUPPLY
HP-1144

Figure 2-1

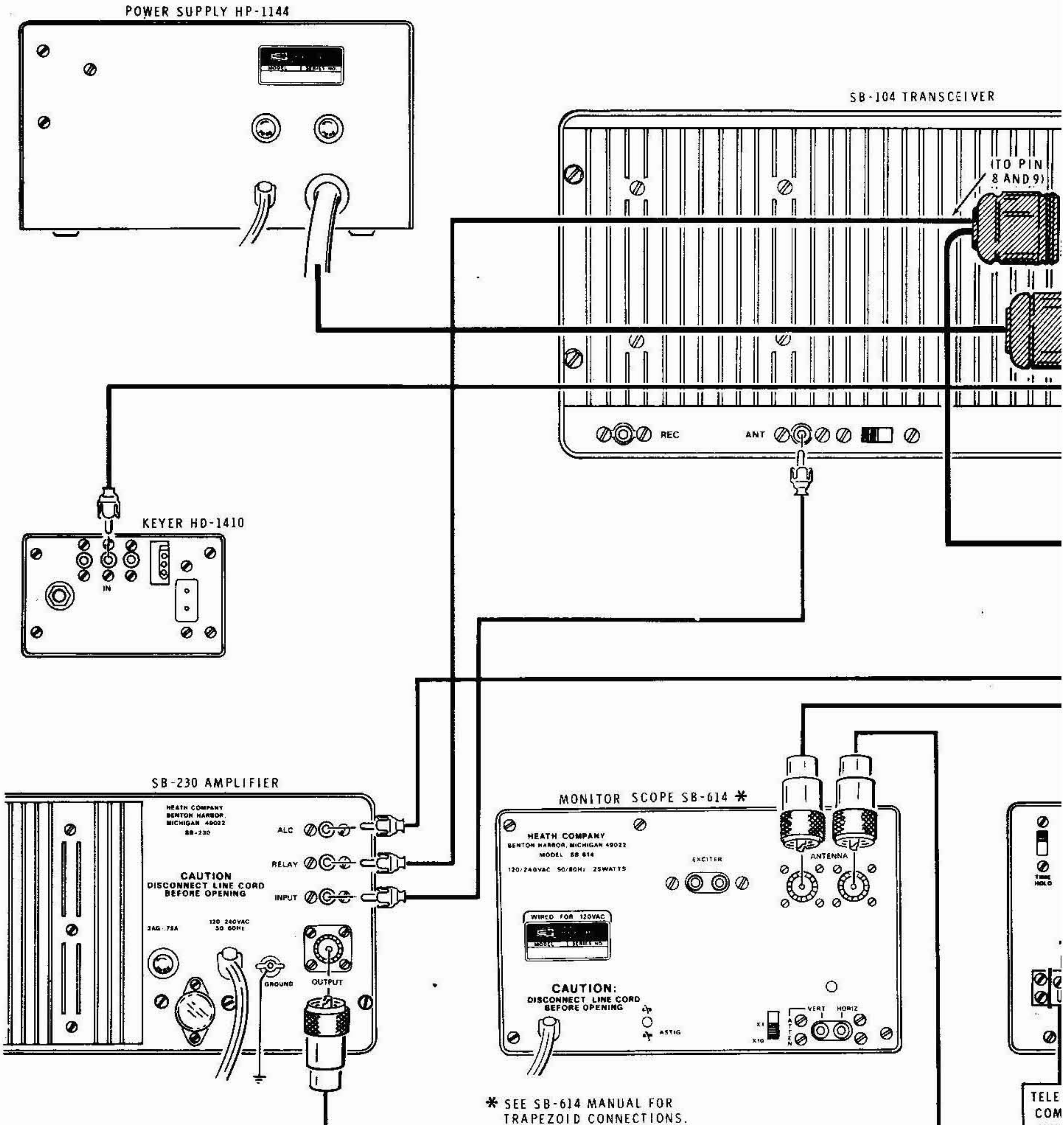
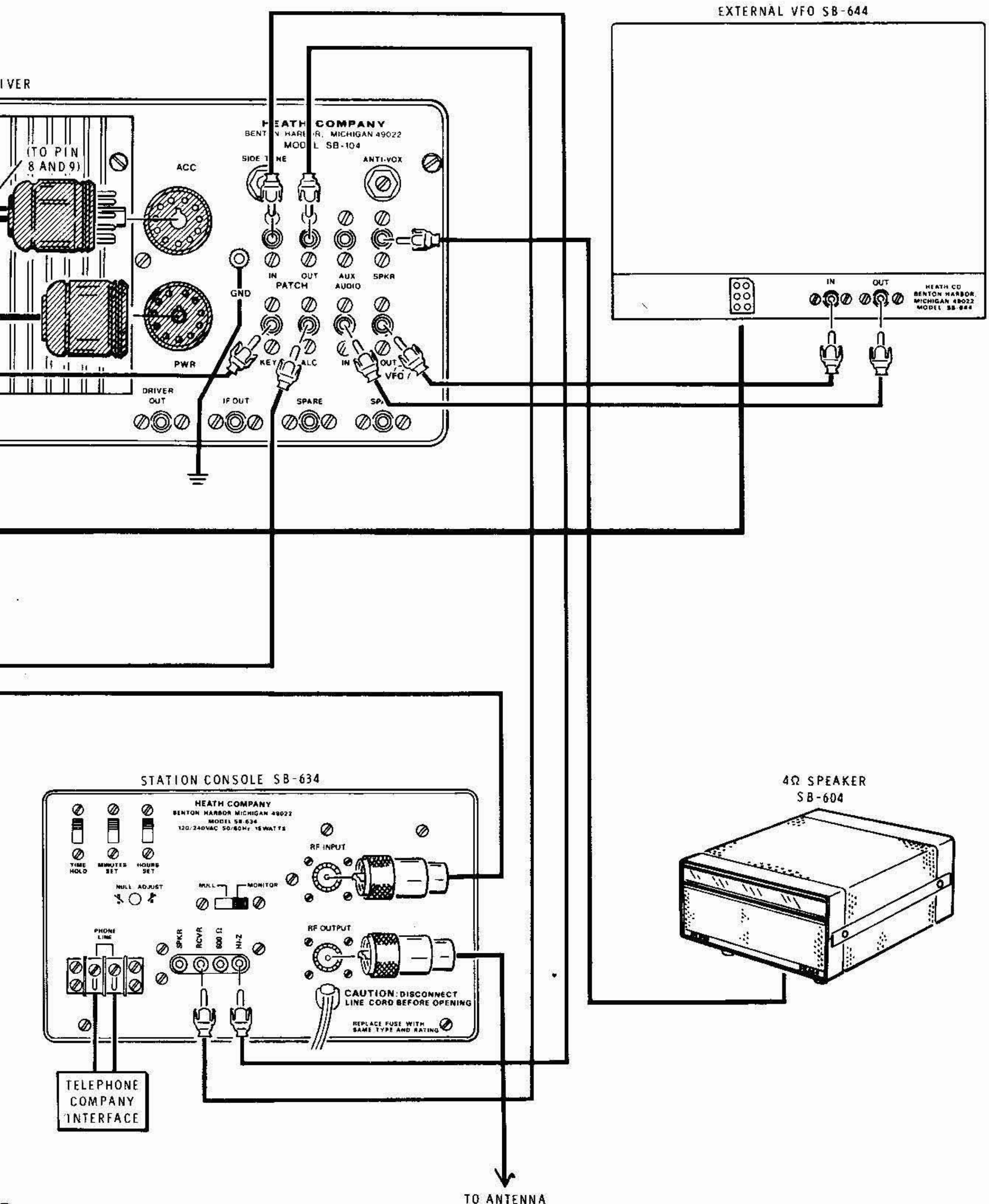

POWER SUPPLY HP-1144
SB-104 TRANSCEIVER
(TO PIN 8 AND 9)
REC
ANT
KEYER HD-1410
IN
SB-230 AMPLIFIER
HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022
SB-230
ALC
RELAY
INPUT
CAUTION
DISCONNECT LINE CORD
BEFORE OPENING
3AG-.75A
120 240VAC
50 60Hz
GROUND
OUTPUT
MONITOR SCOPE SB-614 *
HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022
MODEL SB 614
120/240VAC 50/60Hz 25WATTS
EXCITER
ANTENNA
WIRED FOR 120VAC
CAUTION:
DISCONNECT LINE CORD
BEFORE OPENING
ASTIG
VERT
HORIZ
X1
X10
ATTEN
* SEE SB-614 MANUAL FOR
TRAPEZOID CONNECTIONS.
TELE
COM
INTE

Figure 2-2


EXTERNAL VFO SB-644
IVER
HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022
MODEL SB-104
(TO PIN 8 AND 9)
ACC
SIDE TONE
ANTI-VOX
IN
OUT
PATCH
AUX AUDIO
SPKR
GND
PWR
KEY
ALC
IN
OUT
VFO
DRIVER OUT
IF OUT
SPARE
IN
OUT
HEATH CO
BENTON HARBOR,
MICHIGAN 49022
MODEL SB-644
STATION CONSOLE SB-634
HEATH COMPANY
BENTON HARBOR MICHIGAN 49022
MODEL SB-634
120/240VAC 50/60Hz 15WATTS
TIME HOLD
MINUTES SET
HOURS SET
NULL ADJUST
NULL
MONITOR
RF INPUT
RF OUTPUT
PHONE LINE
SPKR
RCVR
600 Ω
HI-Z
CAUTION: DISCONNECT LINE CORD BEFORE OPENING
REPLACE FUSE WITH SAME TYPE AND RATING
TELEPHONE COMPANY INTERFACE
4Ω SPEAKER
SB-604
TO ANTENNA

2

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

Figure 2-1 shows basic fixed station connections. Figure 2-2 (fold-out from Page 248) shows connections for various accessories that may be used with the Transceiver. Figure 2-3 (fold-out from Page 251) 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.

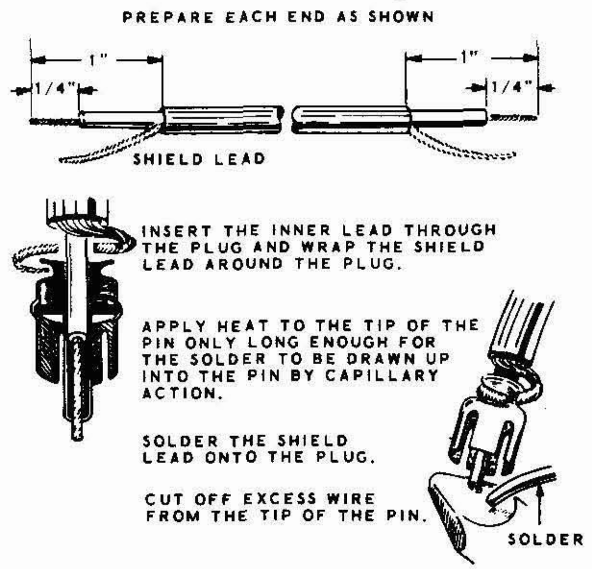


Figure 2-4

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 found. 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.

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.

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

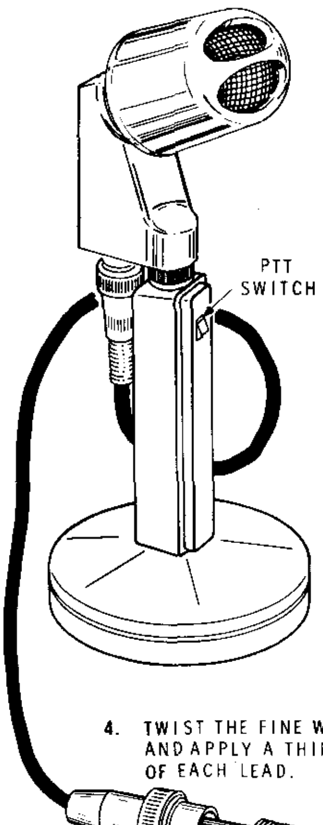
Figure 2-3 shows the installation of the Transceiver with a Heath amplifier.

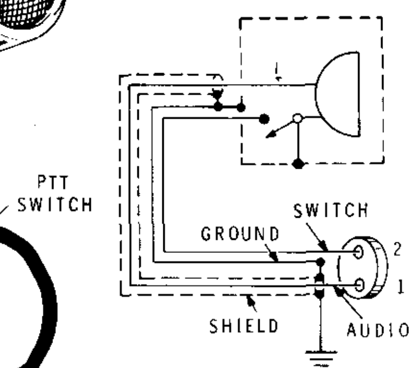
ALC Connections

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.

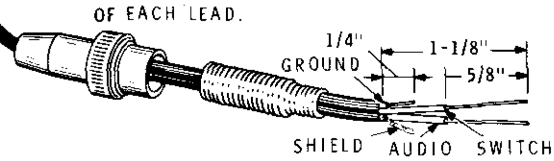
Antenna Relay Connections

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.

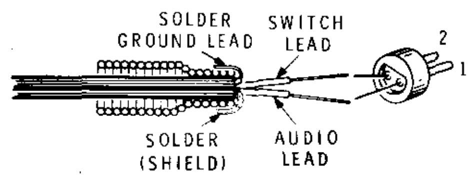




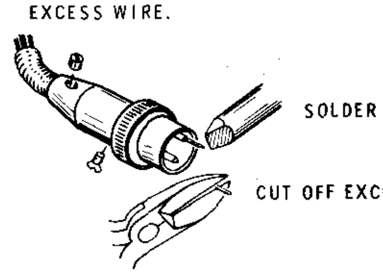
1. REMOVE 1-1/8" OF OUTER INSULATION.
2. REMOVE ALL BUT 1/4" OF THE BRAIDED SHIELD.
3. UNBRAID THE 1/4" OF SHIELD AND TWIST THE FINE SHIELD WIRES TO FORM A STRANDED LEAD.
4. TWIST THE FINE WIRES OF EACH LEAD TOGETHER AND APPLY A THIN FILM OF SOLDER TO THE END OF EACH LEAD.



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

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.

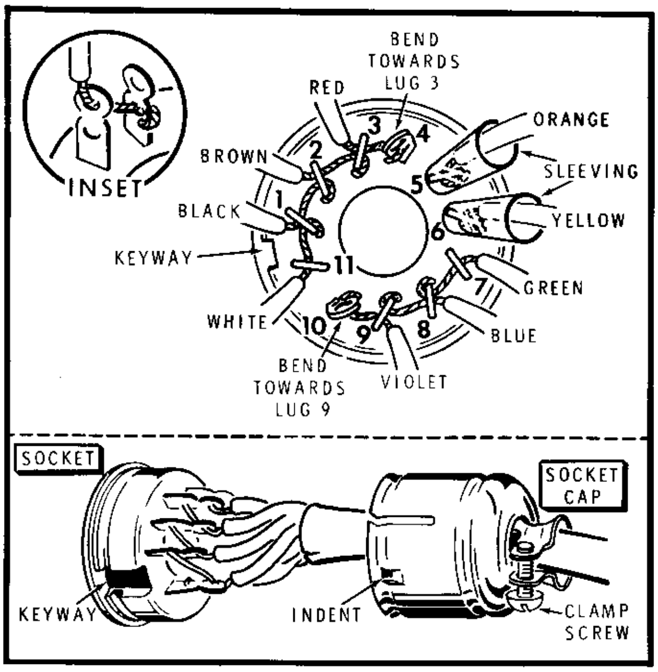
( ) Perform the numbered steps in Figure 2-5.

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.



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

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 "Operations" section.

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. See the "Power Supply" discussion in the "Operation" section of this Manual.

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 possiblity of transistor damage if the wires should ever be disconnected.

If the frequency display should fail to light when the Transceiver is turned on, turn it off quickly and check for proper polarity of the power cable.

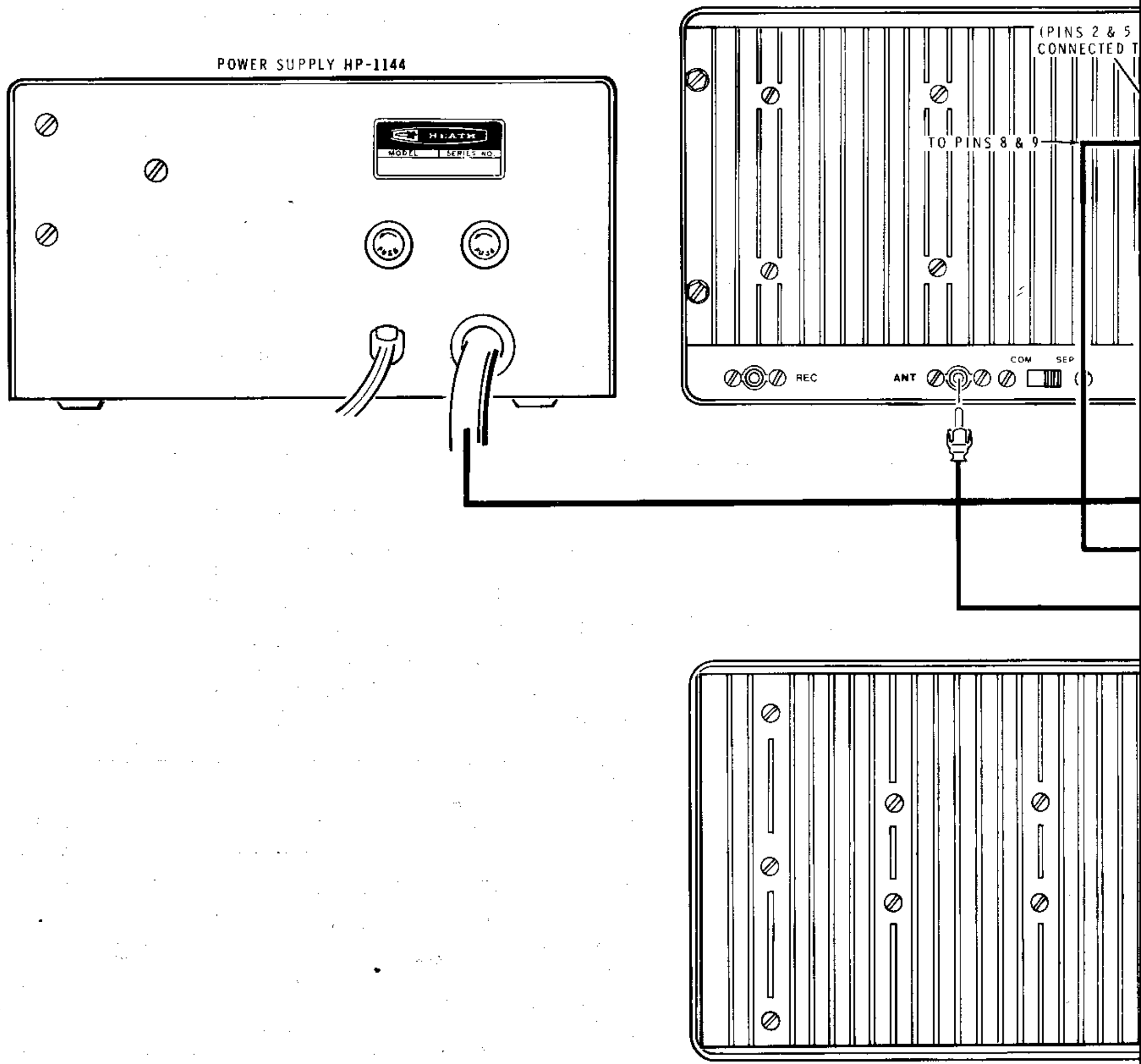
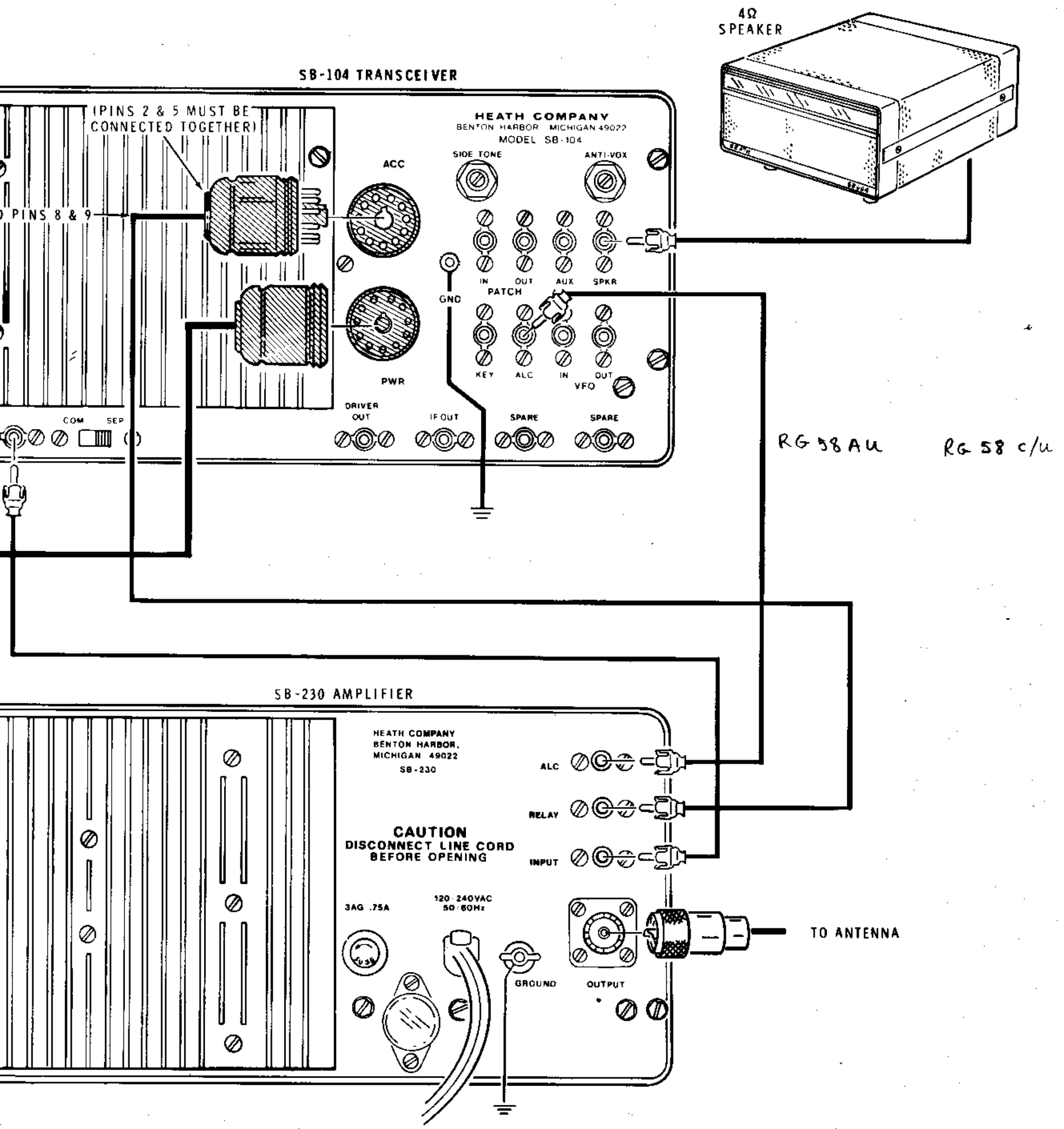
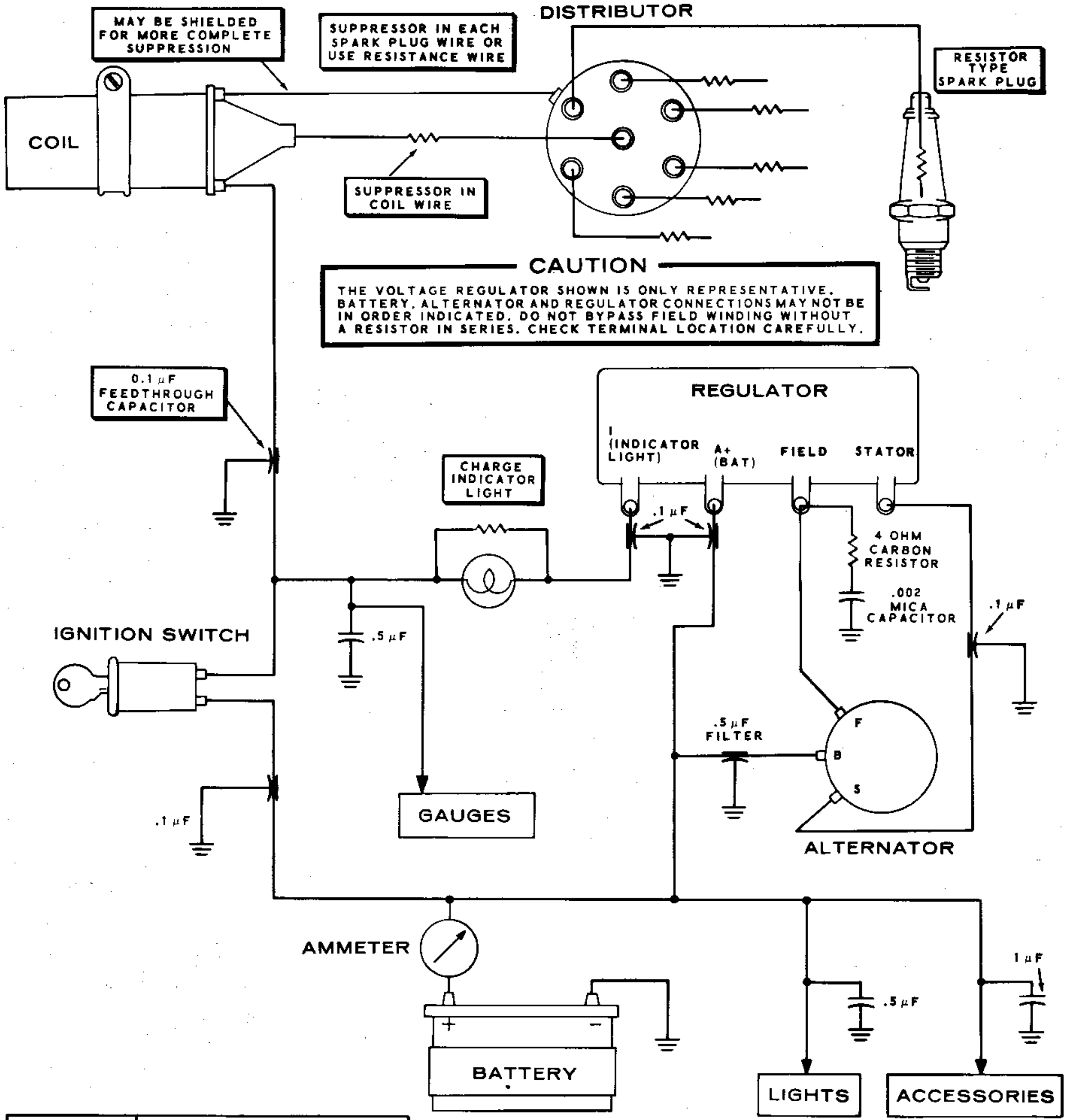

POWER SUPPLY HP-1144
HEATH
MODEL
SERIES NO.
(PINS 2 & 5
CONNECTED T
TO PINS 8 & 9
REC
ANT
COM
SEP

Figure 2-3



4Ω
SPEAKER
SB-104 TRANSCEIVER
(PINS 2 & 5 MUST BE CONNECTED TOGETHER)
PINS 8 & 9
HEATH COMPANY
BENTON HARBOR MICHIGAN 49022
MODEL SB-104
SIDE TONE
ANTI-VOX
ACC
IN
OUT
AUX
SPKR
PATCH
GND
KEY
ALC
IN
OUT
VFO
PWR
COM
SEP
DRIVER OUT
IF OUT
SPARE
SPARE
RG 58 AU
RG 58 c/u
SB-230 AMPLIFIER
HEATH COMPANY
BENTON HARBOR,
MICHIGAN 49022
SB-230
ALC
RELAY
INPUT
CAUTION
DISCONNECT LINE CORD
BEFORE OPENING
3AG .75A
120-240VAC
50/60Hz
GROUND
OUTPUT
TO ANTENNA

re 2-3



VALUE OF SUPPRESSOR	MANUFACTURER AND REPRESENTATIVE TYPE	
10K OHM	ERIE TYPE	L7VR-10ME
5K OHM	ERIE TYPE	L7VR-5ME
.5 μF FEEDTHROUGH	SPRAGUE	48P18 (40 AMP), BRACKET MOUNT
.1 μF FEEDTHROUGH	SPRAGUE	80P3 (20 AMP), BULKHEAD MOUNT
	SPRAGUE	48P9 (20 AMP), BRACKET MOUNT
.5 μF	MALLORY	AG-451
1 μF	MALLORY	AG-452

NOTE: ALL GROUND CONNECTIONS SHOULD BE MADE TO THE COMPONENT BEING BYPASSED, PREFERABLY BY MOUNTING THE SUPPRESSOR DIRECTLY ON THE COMPONENT.

Figure 2-9

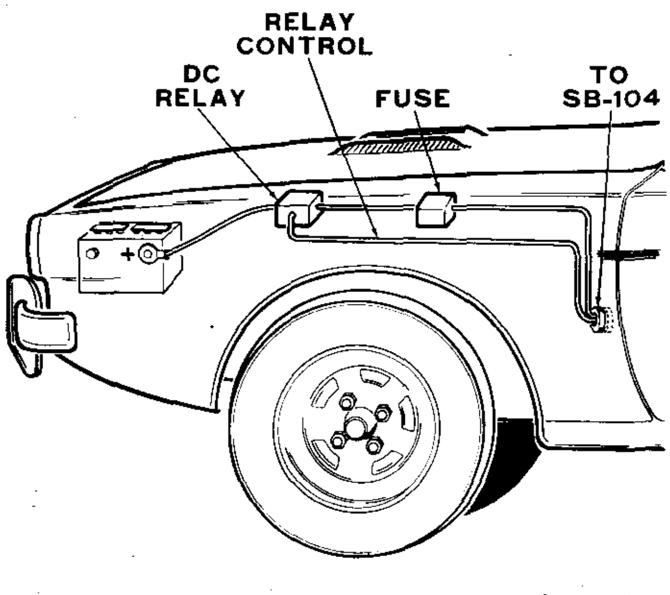


Figure 2-7

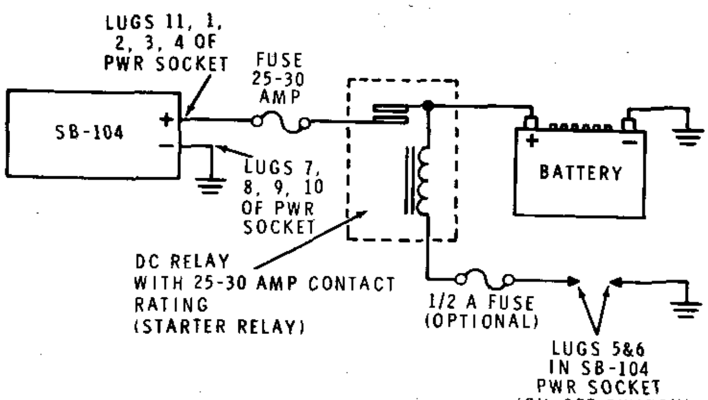


Figure 2-8

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 80 m.

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.

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 40 m.

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

14 MHz 20 m.

No network needed. Bandwidth is approximately 100 kHz.

21 MHz 15 m.

No network needed. Bandwidth is about 150 kHz.

28 MHz 10 m.

The antenna for this band is normally cut of 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 inch 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 "Operations" 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 advise 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 (fold-out from Page 252) 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 <u>in neutral</u>. 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 Troubleshooting Chart and Figure 2-9 (fold-out from Page 252), 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.

TYPE OF NOISE	POSSIBLE CAUSE	RECOMMENDED REMEDY
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.

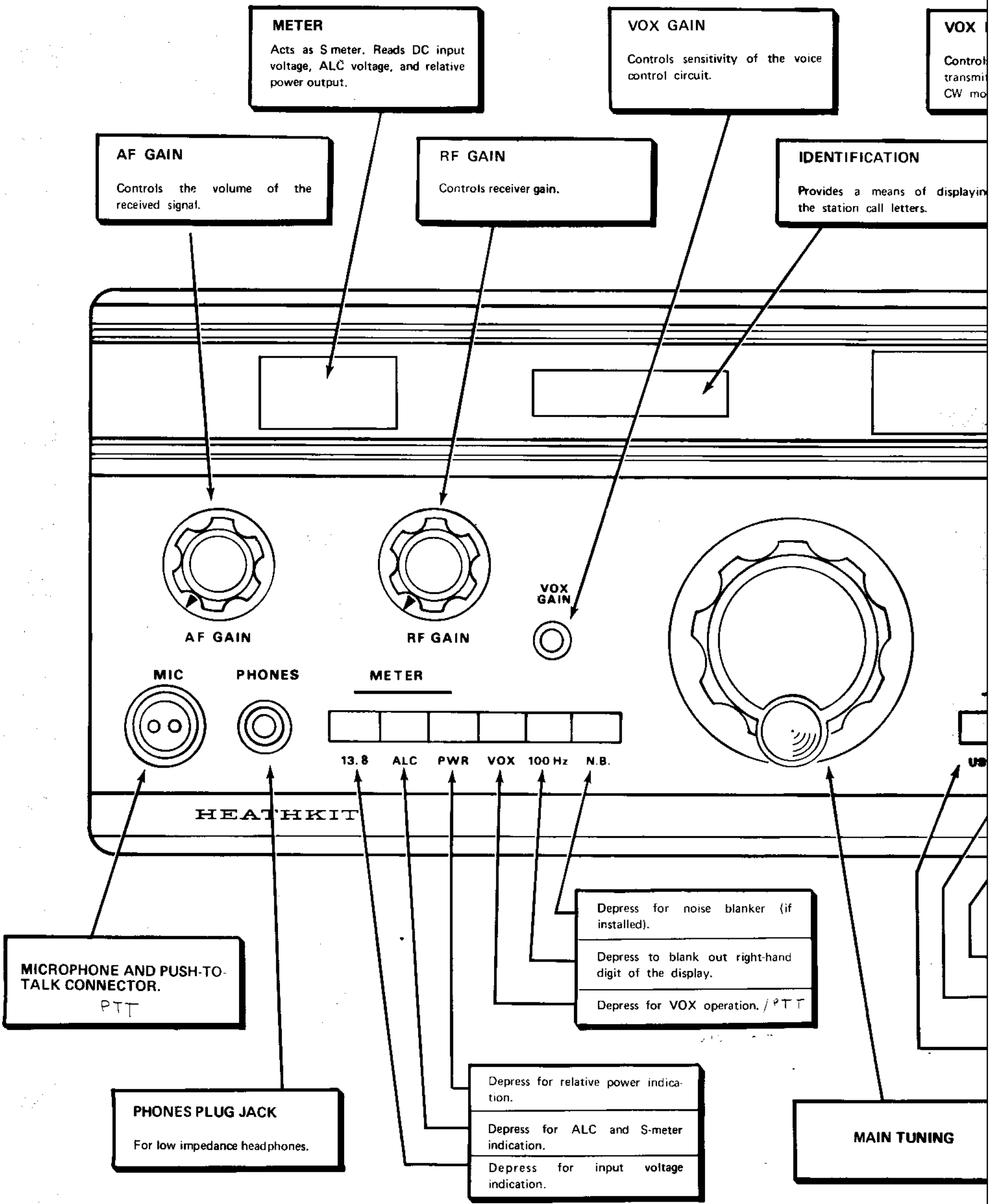
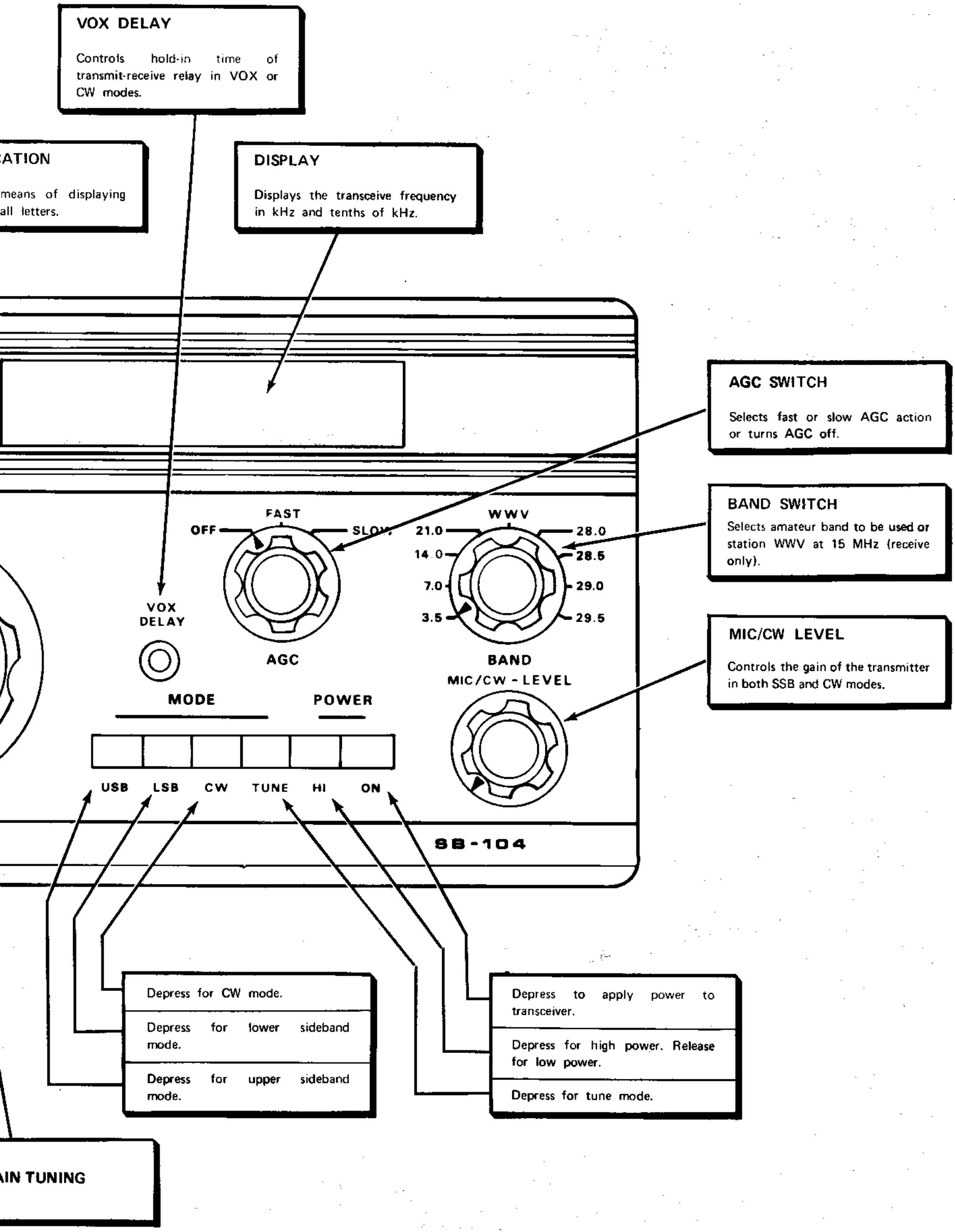

METER
Acts as S meter. Reads DC input voltage, ALC voltage, and relative power output.
VOX GAIN
Controls sensitivity of the voice control circuit.
VOX
Control
transmi
CW mo
AF GAIN
Controls the volume of the received signal.
RF GAIN
Controls receiver gain.
IDENTIFICATION
Provides a means of displayin
the station call letters.
AF GAIN
RF GAIN
VOX GAIN
MIC
PHONES
METER
13.8
ALC
PWR
VOX
100 Hz
N.B.
HEATHKIT
Depress for noise blanker (if installed).
Depress to blank out right-hand digit of the display.
Depress for VOX operation. / PTT
MICROPHONE AND PUSH-TO-TALK CONNECTOR.
PTT
Depress for relative power indication.
Depress for ALC and S-meter indication.
Depress for input voltage indication.
PHONES PLUG JACK
For low impedance headphones.
MAIN TUNING

Figure 3-


VOX DELAY
Controls hold-in time of transmit-receive relay in VOX or CW modes.
ATION
means of displaying
all letters.
DISPLAY
Displays the transceive frequency in kHz and tenths of kHz.
AGC SWITCH
Selects fast or slow AGC action or turns AGC off.
BAND SWITCH
Selects amateur band to be used or station WWV at 15 MHz (receive only).
MIC/CW LEVEL
Controls the gain of the transmitter in both SSB and CW modes.
FAST
OFF
SLOW
AGC
VOX
DELAY
WWV
21.0
14.0
7.0
3.5
28.0
28.5
29.0
29.5
BAND
MIC/CW - LEVEL
MODE
POWER
USB
LSB
CW
TUNE
HI
ON
SB-104
Depress for CW mode.
Depress for lower sideband mode.
Depress for upper sideband mode.
Depress to apply power to transceiver.
Depress for high power. Release for low power.
Depress for tune mode.
AIN TUNING

igure 3-1

OPERATION

NOTE: YOU MUST HAVE AN AMATEUR RADIO OPERATOR 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 the initial settings have been made, 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 which 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 these operating instructions are read, comprehended, and observed. 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 (fold-out from Page 256) for a front panel view of the Transceiver and a concise explanation of control functions.

Figure 3-2 (fold-out from Page 263) shows rear panel controls and connections. Figure 1-3 (fold-out from Page 237) 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.

DISPLAY

Displays the frequency to which the Transceiver is tuned, plus or minus 100 Hz. Depress the "100 Hz" button if you want to blank out the right-hand digit, which displays the 100 Hz points. If the accessory VFO is being used for split frequency operation, the display will follow both the receiving and transmitting frequencies.

AF GAIN

Increases the volume of the received signal with clockwise rotation.

RF GAIN

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. * SEE NB.

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.

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.

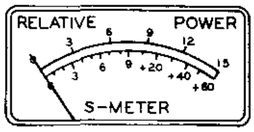


Figure 3-3

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 6 on the upper scale.

see pages 243 & 245

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.

100 Hz

When this button is depressed, the right-hand digit of the frequency display is turned off.

NB To compensate for any slight distortion in crowded areas on the band, turn the transceiver RF gain control CCW until the distortion is gone.

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

Controls S-meter sensitivity. Instructions for setting this control will be found in the "Test and Adjustment" section under "Preselector Filter Coil Alignment" (Page 242).

CARRIER SUPPRESSION CONTROLS

These controls on circuit board E balance out the carrier. See "Test and Adjustment" section under "Carrier Suppression" (Page 245).

TIME BASE CONTROL pg. 242

Tune in station WWV until the announcer's voice sounds natural. Release the 100 Hz button. Adjust the time base trimmer capacitor on circuit board A until the display is 15 000.0.

VFO SHIFT

A trimmer capacitor in the VFO to be adjusted so the display 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 should 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):

LEVEL – Mic/CW	CCW
RF GAIN	CW
AF GAIN	CCW
BAND	Any
VOX GAIN	CCW
VOX DELAY	CCW
AGC	Slow
METER	13.8
VOX	Released
100 Hz	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 259).

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	
			TX	RX
SSB	2 units	1 unit	1 hour	30 min
CW	1 unit	1 unit	15 minutes	15 min
TUNE	1 unit	5 units	30 seconds	150 sec.

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 Tranceiver as in "Initial Actions" (Page 259).
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 259).
2. Depress the ALC, 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 operations:

   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 LEVEL control until the panel meter kicks up to approximately 3 (upper scale) on voice peaks. CAUTION: Do not advance the 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. If high power is desired, 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 259).

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 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. If desired, depress the HI button.

8. 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 this SSB and CW modes.

TROUBLESHOOTING

CONTENTS

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 below. Even if you are reasonably sure that you know the area your trouble is in, we suggest that you read through "Localizing the Trouble" because of the additional information that is given there.

Because it is tied in very closely with this part of the Manual, you will often be referred to the "Maintenance" section (see Page 275) in the following pages. The "Maintenance" section has complete information on each circuit board, including a "Troubleshooting Chart," an "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 (fold-out from Page 323) and to the "Chassis Photographs" (Page 321).

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 that 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 281, which also contains the special Power Amplifier circuit board warranty.

REPLACEMENT PARTS

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

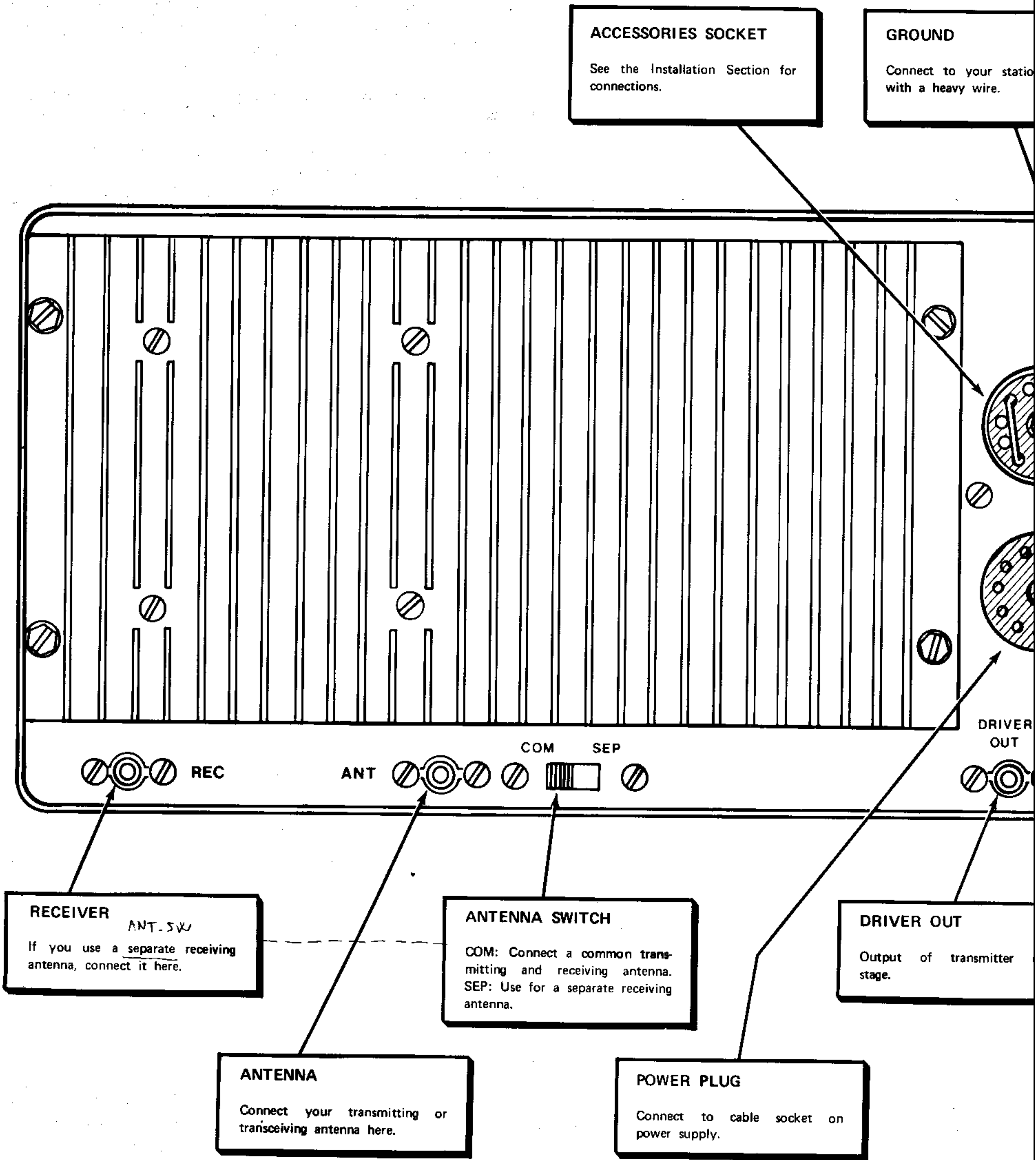
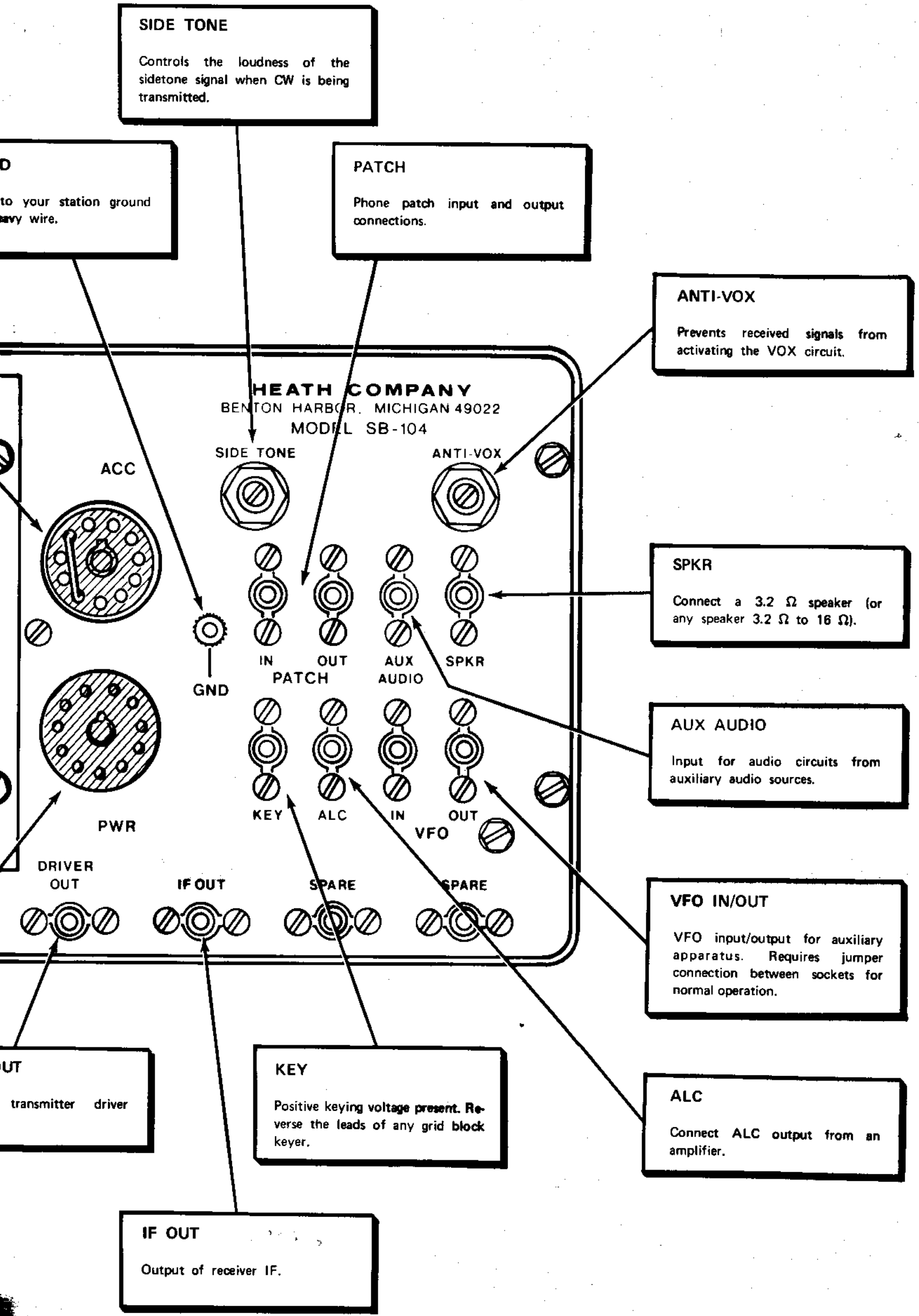
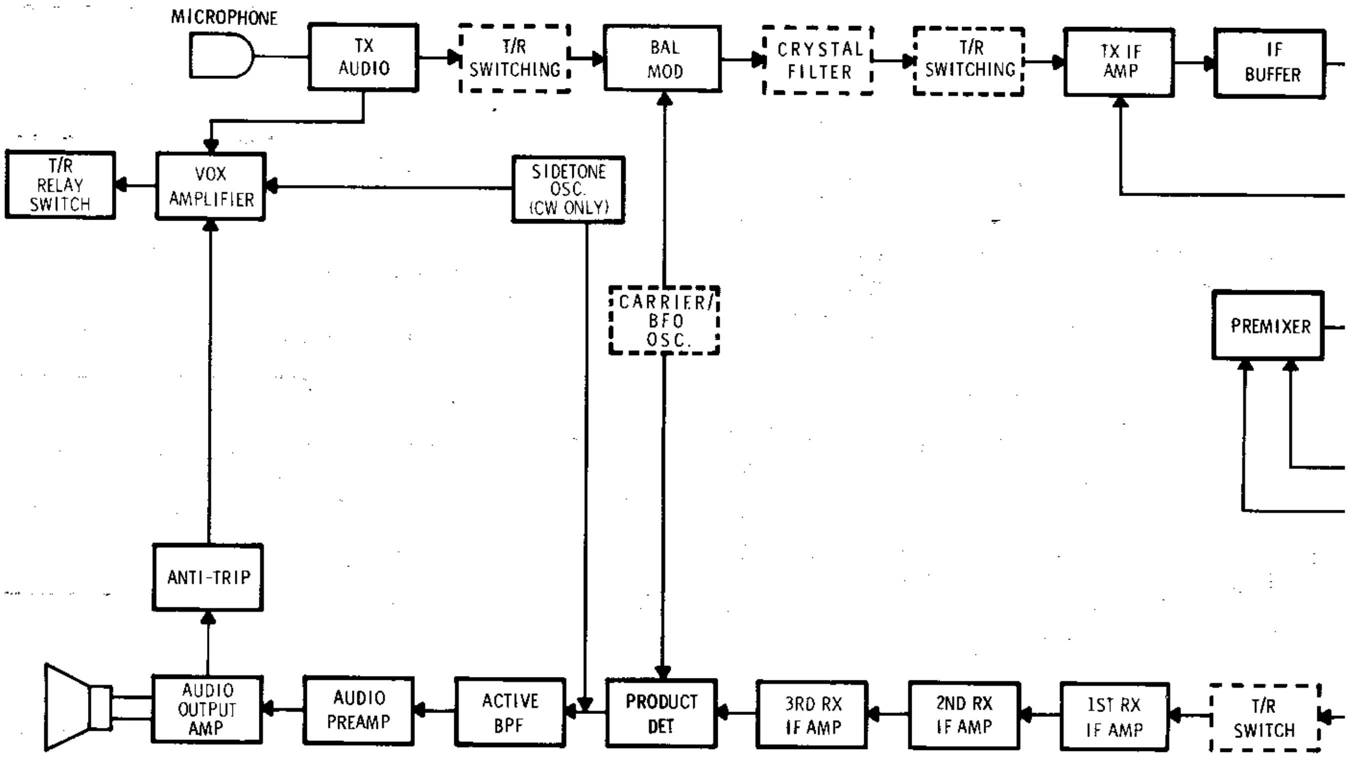

ACCESSORIES SOCKET
See the Installation Section for connections.
GROUND
Connect to your statio
with a heavy wire.
REC
ANT
COM
SEP
DRIVER OUT
RECEIVER
ANT-SW
If you use a separate receiving antenna, connect it here.
ANTENNA SWITCH
COM: Connect a common transmitting and receiving antenna.
SEP: Use for a separate receiving antenna.
DRIVER OUT
Output of transmitter
stage.
ANTENNA
Connect your transmitting or transceiving antenna here.
POWER PLUG
Connect to cable socket on power supply.

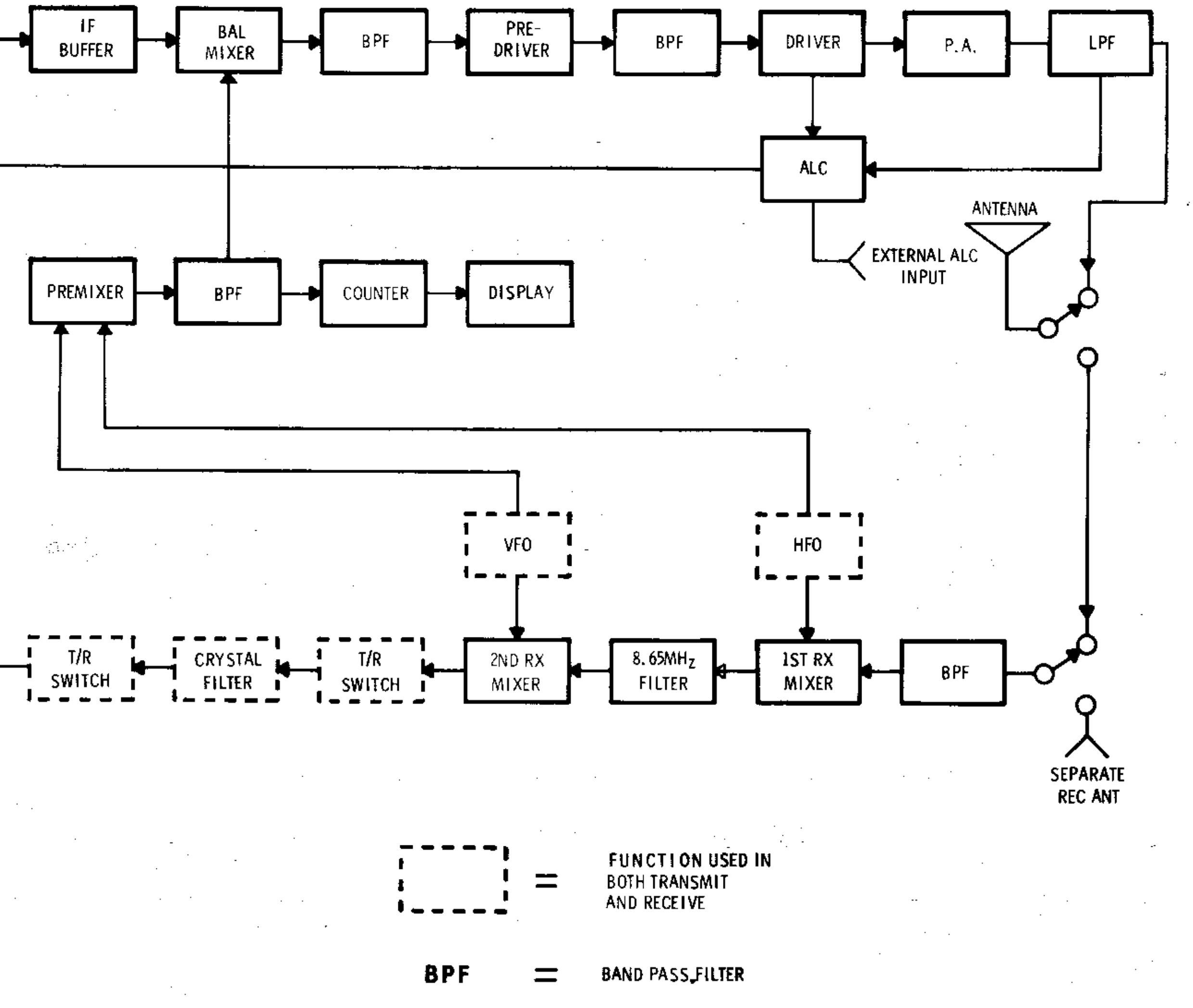
Figure 3-2


SIDE TONE
Controls the loudness of the sidetone signal when CW is being transmitted.
D
to your station ground
avy wire.
PATCH
Phone patch input and output connections.
ANTI-VOX
Prevents received signals from activating the VOX circuit.
HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022
MODEL SB-104
SIDE TONE
ANTI-VOX
ACC
GND
IN
OUT
PATCH
AUX AUDIO
SPKR
KEY
ALC
IN
OUT
VFO
PWR
DRIVER OUT
IF OUT
SPARE
SPARE
SPKR
Connect a 3.2 Ω speaker (or any speaker 3.2 Ω to 16 Ω).
AUX AUDIO
Input for audio circuits from auxiliary audio sources.
VFO IN/OUT
VFO input/output for auxiliary apparatus. Requires jumper connection between sockets for normal operation.
UT
transmitter driver
KEY
Positive keying voltage present. Reverse the leads of any grid block keyer.
ALC
Connect ALC output from an amplifier.
IF OUT
Output of receiver IF.

e 3-2



FUNCTIONAL BLOCK DIAG


IF BUFFER
BAL MIXER
BPF
PRE-DRIVER
BPF
DRIVER
P.A.
LPF
ALC
ANTENNA
EXTERNAL ALC INPUT
PREMIXER
BPF
COUNTER
DISPLAY
VFO
HFO
T/R SWITCH
CRYSTAL FILTER
T/R SWITCH
2ND RX MIXER
8.65MHz FILTER
1ST RX MIXER
BPF
SEPARATE REC ANT
= FUNCTION USED IN BOTH TRANSMIT AND RECEIVE
BPF = BAND PASS FILTER

CK DIAGRAM

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 233.

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 (fold-out from Page 264) and the "Theory of Operation" (Page 319) carefully. Then use deductive reasoning to pinpoint your trouble to a specific area. (If neither the transmitter or 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," fold-out from Page 300.
- If you know your trouble is in the transmitter, or in the receiver, or in the readout circuits, refer to one of the following sections:

"Receiver Troubleshooting Guide" . . . . Page 266
"Transmitter Troubleshooting Guide" . . . Page 268
"Display Troubleshooting Guide" . . . . Page 270

- 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 273.

After you localize the trouble to one area:

- Refer to the correct part of the "Maintenance" section (Page 275) 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 272) before you make any measurements. Also refer to "Checking Transistors and Diodes."

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 VFO 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.

To check the VFO 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.

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 VFO 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 DC 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 Output Adjustment" on Page 237.

TEST POINT		OHMS RESISTANCE*	DC VOLTS	RF 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" (fold-out from Page 267), 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," "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:

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 272.)
3. Check any questionable diodes and transistors. See Page 274.
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 for front end 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 310. 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 P. 307

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.

(X) 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 on the fold-out from Page 306.

(X) Connect a 1" jumper wire between the free end of R645 and pin 20 of board E. (+11V)

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

(X) 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 310. Check T502, D506-D509, IC502 and associated 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 310. 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 Gen/Xtal Filter Circuit Board," Page 306. 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 ANT. SW SEP

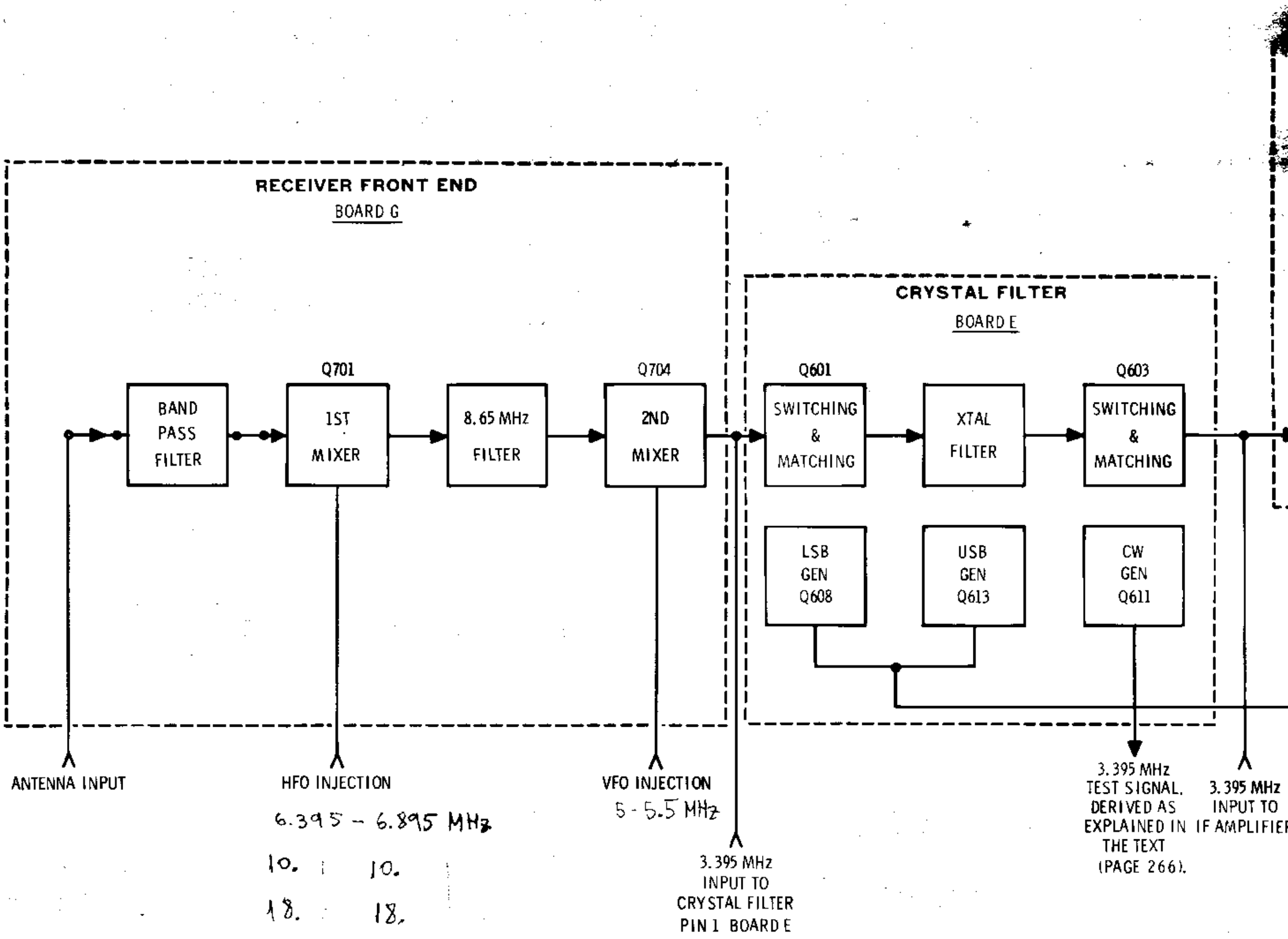
( ) Insert the phono plug on the end of the 24" test lead into the REC phono socket on the rear panel. Connect the other end of the cable as in Figure 1-8 on Page 241. 100KC/S.

( ) You should hear a tone at each 100 kHz point (3.500 MHz, 3.600 MHz, 3.700 MHz etc.) of the VFO dial.

( ) If you do not hear a tone, refer to "Receiver Front End Circuit Board," Page 308. Check Q701, Q702, Q703, Q704 and the associated circuitry, the bandpass filters, and the injection of VFO and HFO signals.

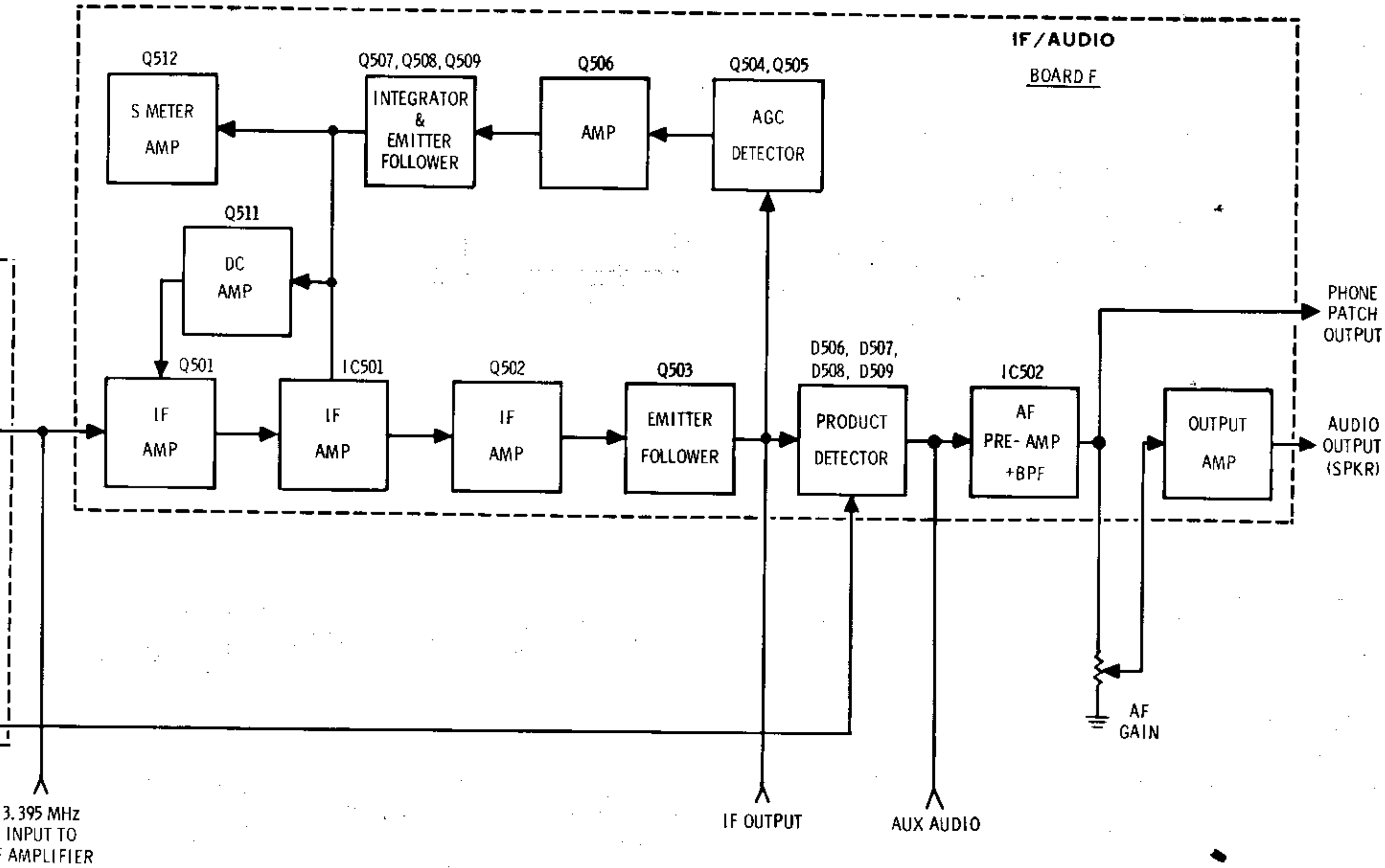
( ) Disconnect the 18 pF capacitor from the counter board.

0 ¼ ½ ¾ 1 (INCHES) 2 3 4 5 6 7
0 .5 1 (CM) 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

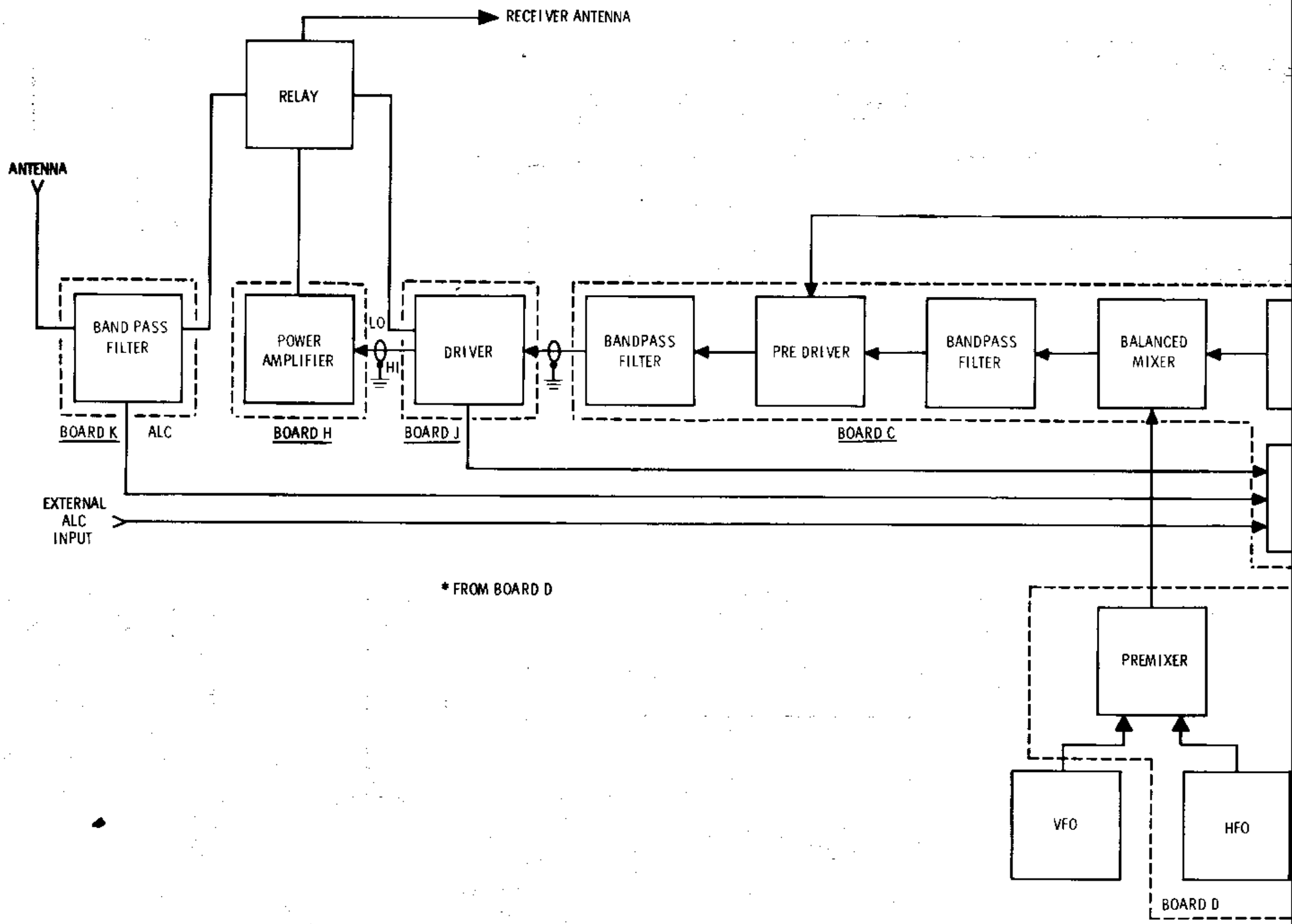


10.	10.
18.	18.
17.	17.
24.	24.
31.	31.
31.	32.
32.	32.
32.	33.

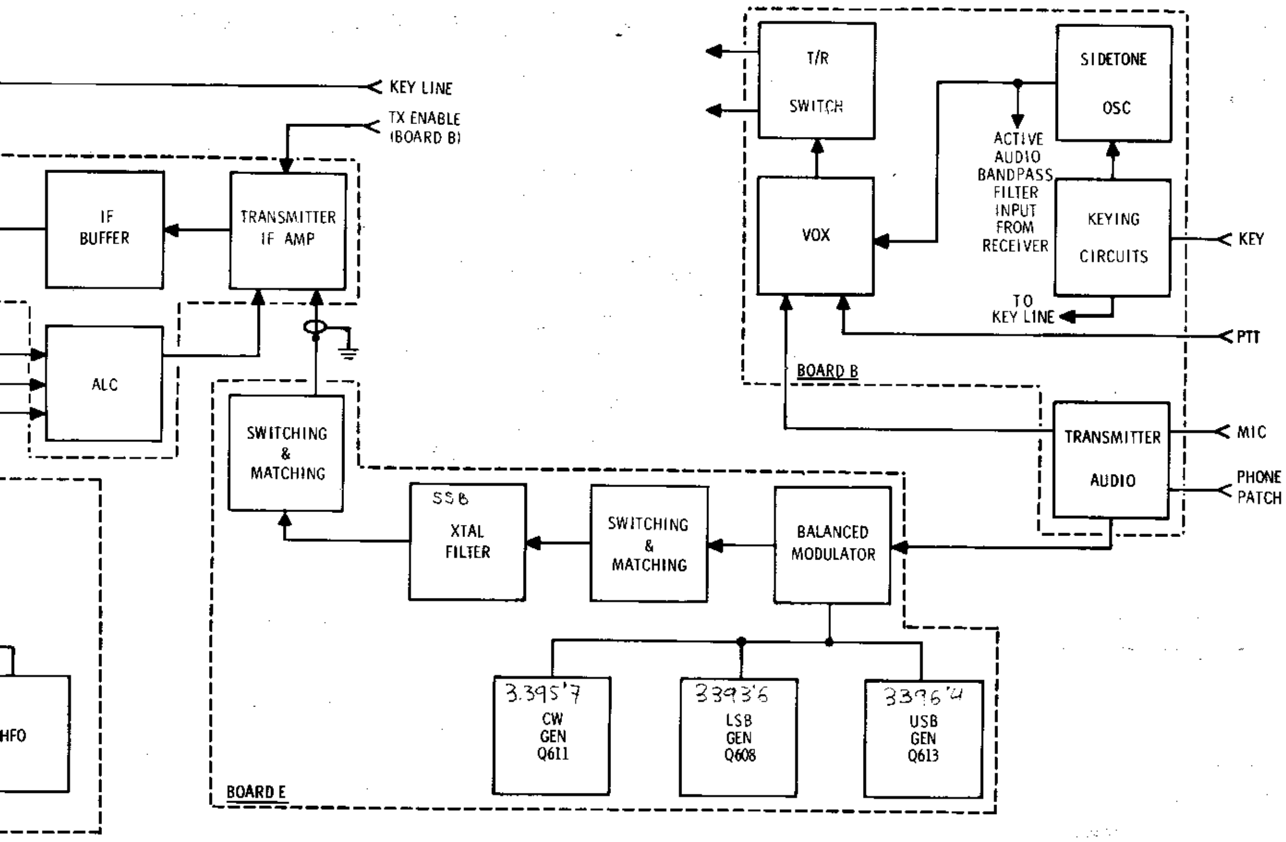
RECEIVER BLOCK DIA


IF/AUDIO
BOARD F
Q512
S METER AMP
Q507, Q508, Q509
INTEGRATOR & EMITTER FOLLOWER
Q506
AMP
Q504, Q505
AGC DETECTOR
Q511
DC AMP
Q501
IF AMP
IC501
IF AMP
Q502
IF AMP
Q503
EMITTER FOLLOWER
D506, D507, D508, D509
PRODUCT DETECTOR
IC502
AF PRE-AMP +BPF
OUTPUT AMP
PHONE PATCH OUTPUT
AUDIO OUTPUT (SPKR)
AF GAIN
3.395 MHz INPUT TO
AMPLIFIER
IF OUTPUT
AUX AUDIO

DIAGRAM


RECEIVER ANTENNA
RELAY
ANTENNA
BAND PASS FILTER
POWER AMPLIFIER
LO
HI
DRIVER
BANDPASS FILTER
PRE DRIVER
BANDPASS FILTER
BALANCED MIXER
BOARD K
ALC
BOARD H
BOARD J
BOARD C
EXTERNAL ALC INPUT
* FROM BOARD D
PREMIXER
VFO
HFO
BOARD D

TRANSMITT



TTER BLOCK DIAGRAM

TRANSMITTER TROUBLESHOOTING GUIDE

Refer to the "Transmitter Block Diagram" (fold-out from Page 268), 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/Crystal 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:

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 272).
3. Check any questionable diodes and transistors. See Page 274.
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.

TEST CIRCUIT PREPARATION

When a transmitter circuit board is functioning properly, an RF signal will be present at the output and input. Parts are furnished for a simple RF detector which can be used with a high input impedance voltmeter for signal tracing in some low level RF circuits. See Figure 4-1 and the accompanying steps on the fold-out from Page 269.

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.

LT 30 VAC OR 30 VRF

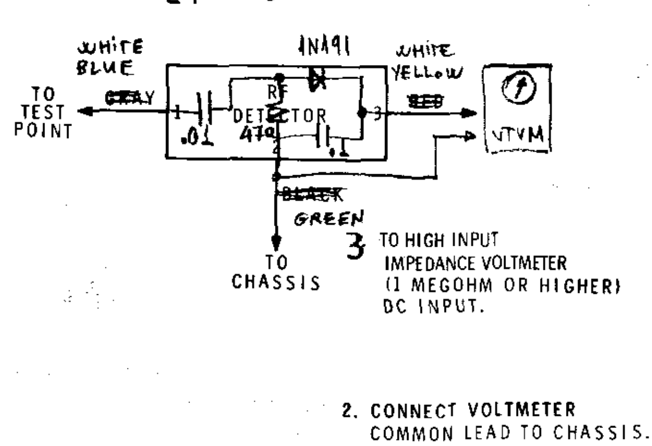


Figure 4-2

To use the RF detector, connect it as shown in Figure 4-2. 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/CRYSTAL 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 4-2 and connect the RF detector wires as follows:

( ) Red wire to the high input impedance voltmeter.

( ) ORANGE ~~Black~~ wire to the chassis of the Transceiver.

( ) Gray wire to pin 6 of board E.

( ) If there is no indication on your voltmeter, proceed to "Carrier Gen/Xtal Filter Circuit Board," Page 306. 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 or board E.

TRANSMITTER IF

( ) Connect the gray 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 298. 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 gray wire from pin 24 of board C.

DRIVER

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

( ) Connect the gray 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 300. 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 gray wire from diode D904.

P.A.

Use the following check to see if the P.A. transistors are defective. Figure 4-3 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.

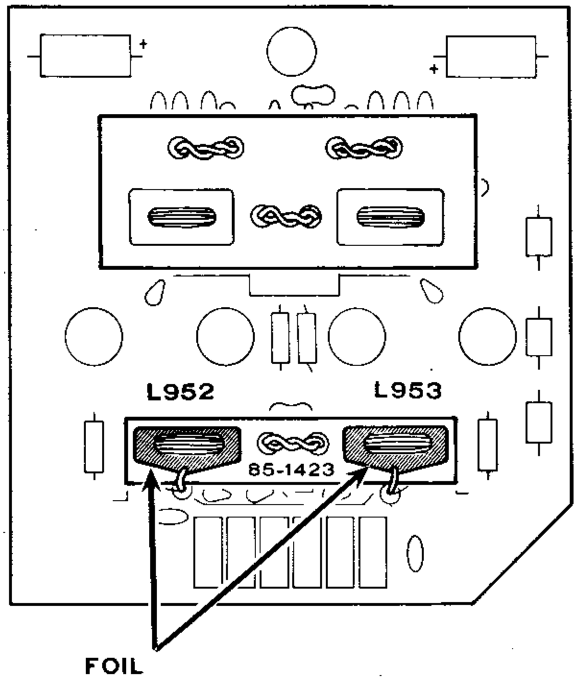


Figure 4-3

( ) Push the HI PWR button in.

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

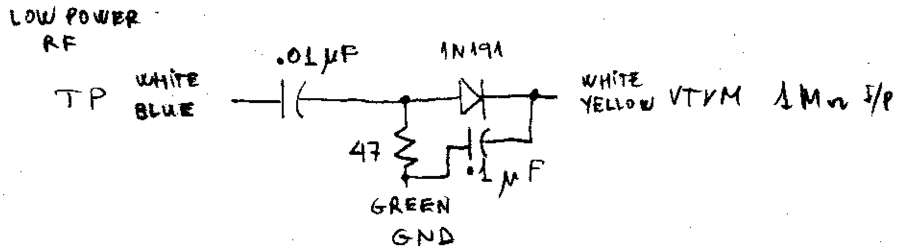
( ) Connect the input lead of your voltmeter first to one foil and then to the other. At each foil, you should obtain the following "normal" reading. If you obtain a "bad" reading at either foil, all four final transistors should be replaced (these are only sold by Heath as a matched set of four transistors).

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

Refer to "P.A.Circuit Board," Page 312, for additional troubleshooting information about this section of the Transceiver.

Refer to "Power Amplifier Warranty" on Page 281 for the special one-year warranty on this circuit board.

0 ¼ ½ ¾ 1 (INCHES) 2 3 4 5 6 7
1/8 3/8 5/8 7/8
0 .5 1 (CM) 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17



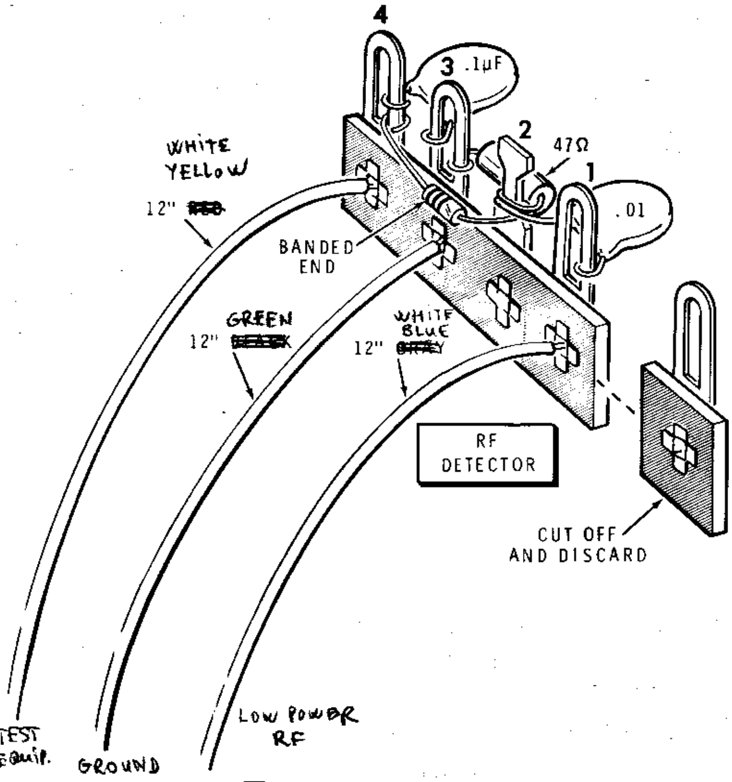


Figure 4-1

RF DETECTOR

Refer to Figure 4-1 for the following steps.

(X) Cut off and discard the indicated lug from the terminal strip you laid aside earlier.

(X) Connect a .1 µF disc capacitor between lug 3 (NS) and lug 4 (NS).

(X) Connect a 47 Ω (yellow-violet-black) resistor between lug 2 (NS) and lug 3 (S-2).

(X) solder detector p 268

26

(X) Connect the lead at the banded end of a 1N191 diode (#56-56) to lug 4 (S-2). Connect the other lead to lug 2 (NS).

(X) Connect a .01 µF disc capacitor between lug 1 (S-1) and lug 2 (S-3).

(X) Connect a 12" ~~red~~ WHITE YELLOW wire to the lower hole of lug 4 (S-1).

(X) Connect a 12" ~~black~~ GREEN wire to the lower hole of lug 3 (S-1).

(X) Connect a 12" ~~gray~~ WHITE BLUE wire to the lower hole of lug 1 (S-1).

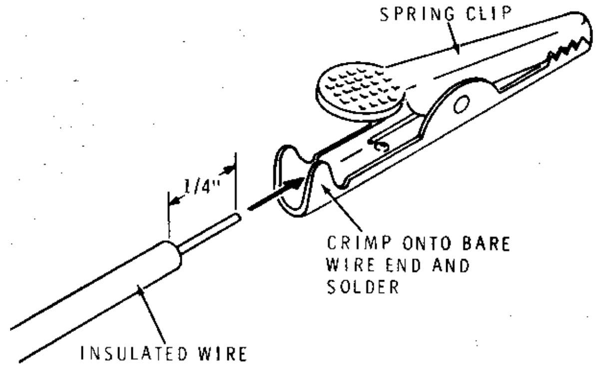
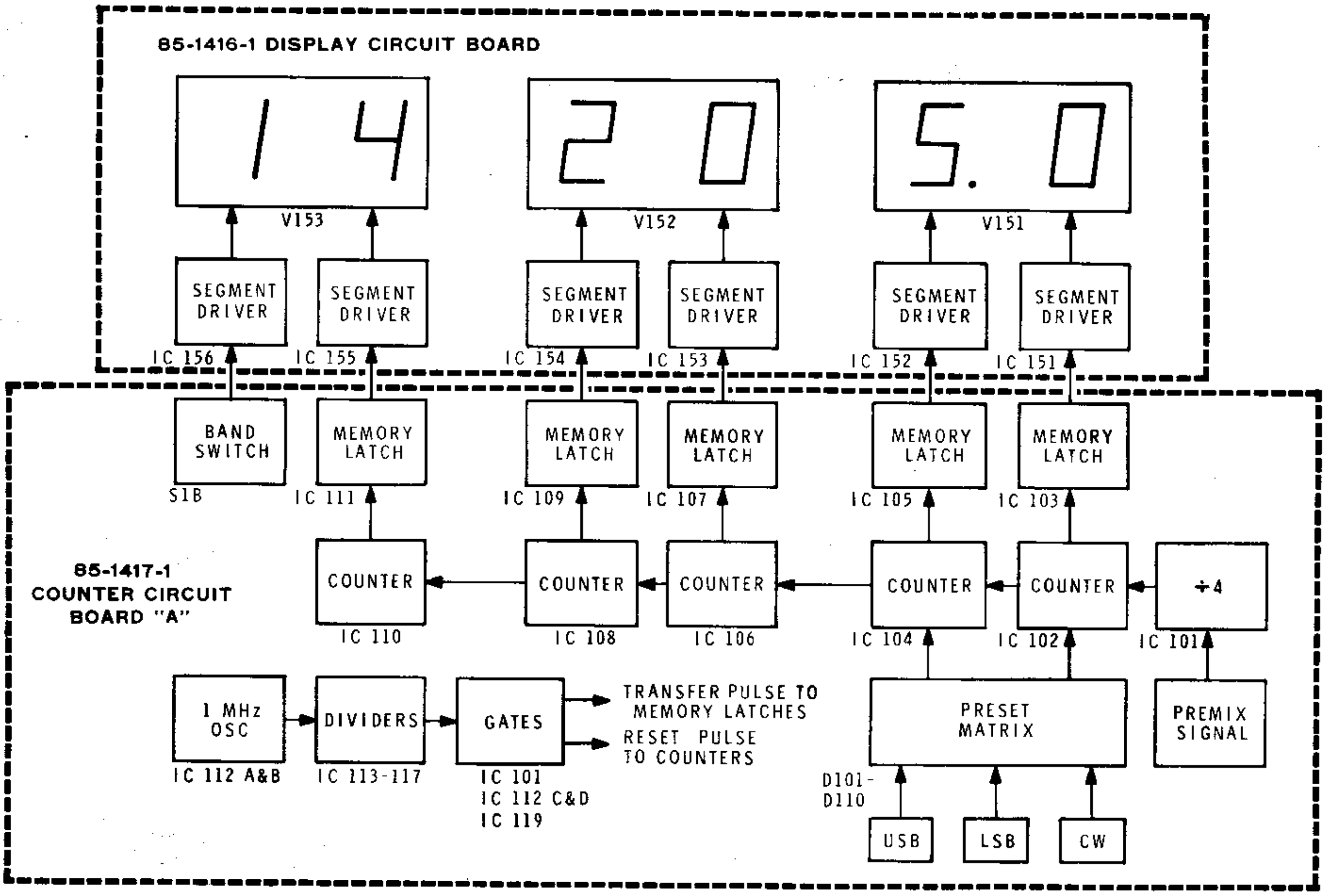


Figure 4-1A

(X) Refer to Figure 4-1A and connect three spring clips to the free ends of the three wires.

(X) Lay the RF detector aside. It will be used later.



DISPLAY BLOCK DIAGRAM

DISPLAY TROUBLESHOOTING GUIDE

As you go through the tests in the following pages, refer to the schematic diagrams of the Counter and Display circuit boards in the Maintenance section of this Manual, and to the Display Block Diagram (fold-out from Page 270), which shows how signals flow through the counting and display circuits.

When you get the correct result, proceed to the next test. If you do not get the correct result, turn to "Display Circuit Board" and "Counter Circuit Board" in the "Maintenance" section, which will give you some specific areas to check. When you turn to the "Maintenance" section:

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 points shown. Also see "Voltage and Continuity Checks," Page 272.
3. Check any questionable diodes and transistors. See Page 274.
4. Be sure each circuit is correctly wired and that the correct parts are installed.
5. Read the "Circuit Description" and study the Schematic diagram to better understand and analyze your problem.

Trouble in the counting and display circuits will usually be evidenced by a total or partial blanking of the display, an incorrect display, or an unevenly lighted display.

1. If any segment of a number is brighter than the other segments, it is probably caused by a faulty segment driver or by a short circuit on the circuit board (such as a solder bridge).

( ) Interchange the suspected segment driver IC with one of the others. If both the overbright segment and the interchanged IC move to a new display digit, the IC must be at fault and should be replaced.

( ) If the overbright segment remains at the same location after the driver IC's are interchanged, carefully inspect the circuit board for a solder bridge, leads unintentionally touching each other, and similar conditions.

2. If the entire display is blanked out:

( ) Check for +180 VDC at pin A on the display circuit board. If the voltage is low, disconnect the wire at pin A and check the voltage again. If the voltage at the end of the connecting wire is then satisfactory, but low when connected, look for a short circuit on the display board.

( ) If the +180 VDC is either absent or low, check for +5VDC at the converter input (the terminal under the AGC switch shaft bushing).

( ) If the +5 VDC is not present at the converter input terminal, use voltage or continuity checks to trace the circuit back to Q1, the voltage source, to find the discontinuity.

( ) If the +5 VDC is present, look for the difficulty on the converter circuit board. Check for a faulty transistor or an open diode.

3. If all or part of a digit is not lighted, or the incorrect number is displayed, voltage checks or IC substitution can be used.

( ) If the entire display has only three or four segments lighted, check for +5 VDC at pin B on the display circuit board. If the voltage is not present, use voltage or continuity checks back to Q1, the +5 VDC source.

( ) If there is no premix signal input to be counted, the display will show one of the preset frequencies (6606.4 kHz, 6603.6 kHz, or 6604.3 kHz).

( ) Refer to the schematic diagrams and check the input voltages and the ground connections at each IC in the counter, memory and driver IC's, and at the display tubes. If any of these voltages are incorrect, use a voltmeter to trace the circuit back to Q1, the voltage source. If the supply voltages are satisfactory, check the IC's by one of the following methods.

A. To check IC's by substitution, interchange the segment driver IC with another driver IC. If the fault moves with the IC, it should be replaced. If the fault remains at the same digit, interchange the memory latch and observe the result. If the fault still remains at the same digit, interchange the counter IC.

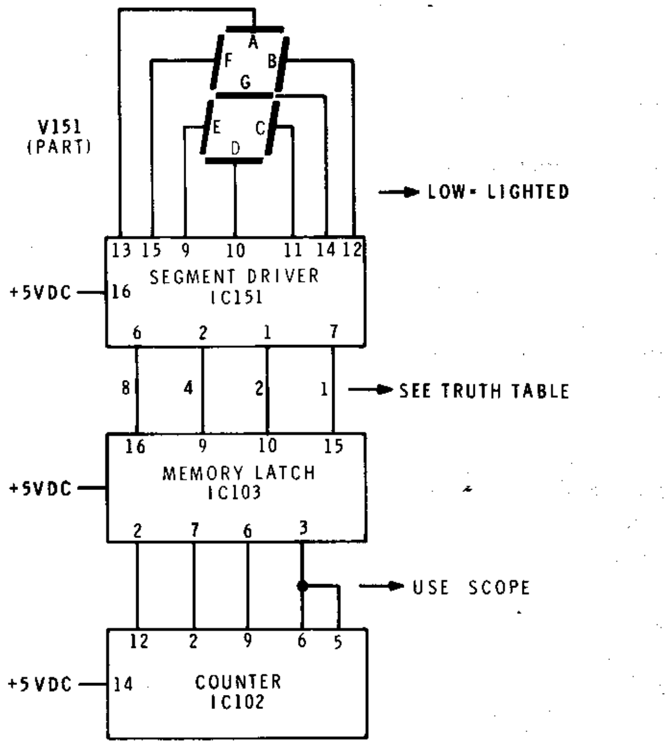
B. To use voltage checks on a display string, refer to Figure 4-4 which illustrates the right-hand (sixth) digit of the display.

( ) Check voltages at the segment driver output pins. The voltages at pins connected to lighted segments should be lower than at pins connected to unlighted segments.

( ) If you know that a 3 should be displayed but segment G (for example) is not lighted, check the voltage at pin 14 of the segment driver. If this voltage is similar in value to the voltages at pins 13, 12, 11 and 10 (all of whose tube segments are lighted), the tube is obviously at faoult. If the voltage at pin 14 is higher than the other four pins, then the segment driver may be faulty. However, before making this decision, make the following test.

( ) Check voltages at the memory latch output pins. The decimal value of the decoded BCD output voltage should be equivalent to the displayed number. Refer to the memory latch truth table in Figure 4-4 to determine the decimal value from the high and low voltages at the four memory latch outputs. For example, if pins 10 and 15 are high and pins 16 and 9 are low, the value column shows a 3, and the number displayed should be a 3. If so, the segment driver and the display tube are operating satisfactorily.

NOTE: The counter outputs cannot be checked with a voltmeter as their outputs change rapidly with the count. Use either an oscilloscope or the substitution method described to check the counter outputs.



VALUE	MEMORY LATCH PINS 16	9	10	15
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H

L = LESS THAN 0.8VDC
H = MORE THAN 1.5VDC

MEMORY LATCH TRUTH TABLE

Figure 4-4

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 274).

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 Page 275 and on Figure 5-1 (fold-out from Page 323).

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 Transceiver OFF and use your ohmmeter (on its RX1 scale) to check the continuity of the path to the voltage source. Use the "X-Ray View" (see "Maintenance," Page 275 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 264.

BOARD	FUNCTION	DO TEST UNDER (see index Page 275)	PAGE
B	Transmitter audio amps., Vox ampl., keying, relay driver, regulator	"Transmit Audio Regulator."	235
A	Frequency display, memories, counters	"Counter"	236
D	HF oscillators, Transmitter bandpass filters, VFO shift	"HFO Premix Coil Adjustments" "VFO Shift Adjustment"	237 239
K	ALC, filter		
E	LSB, USB, and CW generators, balanced modulator, SSB and CW filters	"Receiver Alignment"	239
F	Receiver IF, AF, AGC		
G	Receiver front end, bandpass filters.		
C	Transmitter IF amps., ALC, bandpass filters	"Low Power Transmitter"	243
J	Driver		
H	Power Amplifier	"P.A. Circuit Board"	244

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 "Pinout Diagrams" on Page 276.

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 VFO/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.

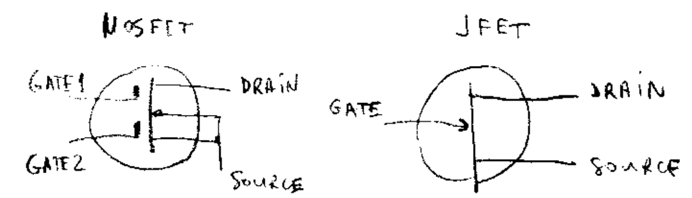
Method 2

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 SECTION

INDEX

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 pin-out diagrams and 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:

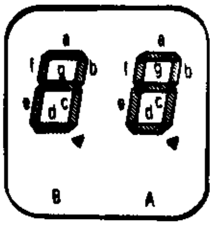
A. Find the circuit component number (R5, Q2, etc.) on the proper "X-Ray View" or the Schematic.

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

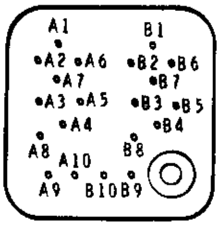
C. Adjacent to the circuit component number, you will find the Part Number and Description, which must be supplied when you order a replacement part.

Pin-out Diagrams

Display Tubes and Integrated Circuits



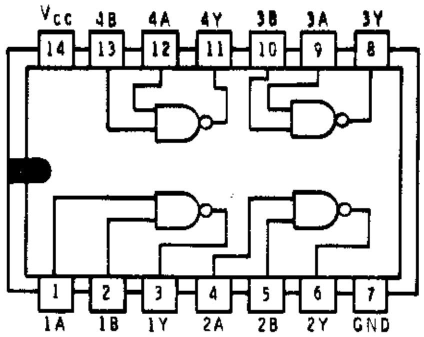
VIEWED
FROM FRONT



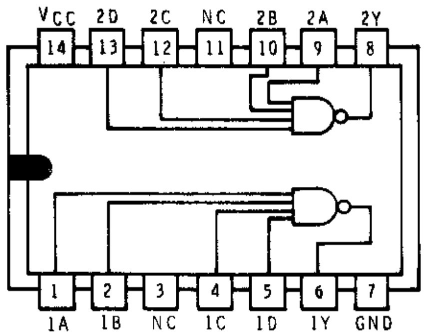
VIEWED
FROM BACK

SEGMENT	PIN NUMBER
a	1
b	2
c	3
d	4
e	5
f	6
g	7
DECIMAL	8 (NOT USED)
ANODE	9
	10 (NOT USED)

V151, V152, V153,
PART NO. 411-286,
SP-352



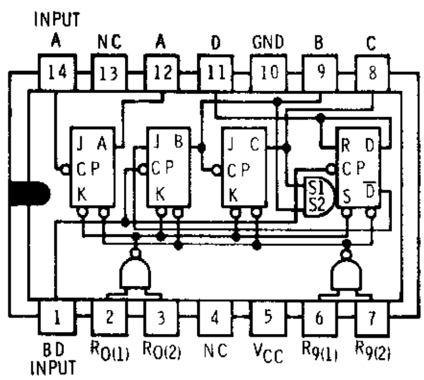
IC112
PART NO. 443-1
SN7400N



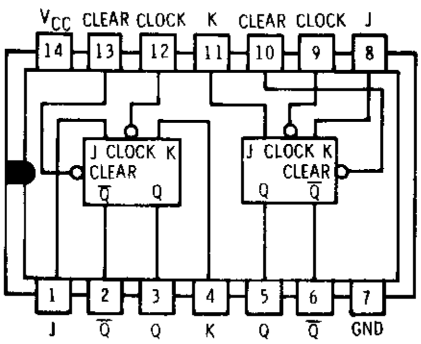
IC119
PART NO. 443-2
SN7420N

TRUTH TABLE
BCD COUNT SEQUENCE

COUNT	OUTPUT D	OUTPUT C	OUTPUT B	OUTPUT A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1



IC113, IC114, IC115, IC116
PART NO. 443-7
SN7490N

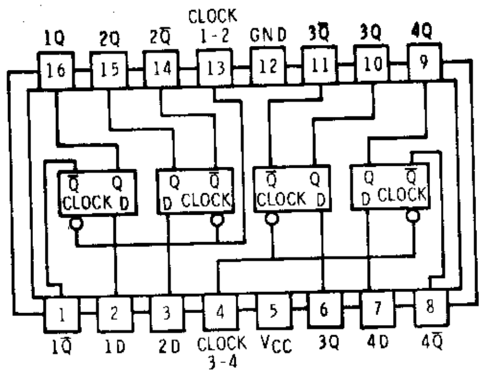


TRUTH TABLE
(Each Flip-Flop)

t_n J	t_n K	t_{n+1} Q
0	0	Q_n
0	1	0
1	0	1
1	1	$\overline{Q_n}$

NOTE: t_n = BIT TIME BEFORE CLOCK PULSE
t_n+1 = BIT TIME AFTER CLOCK PULSE

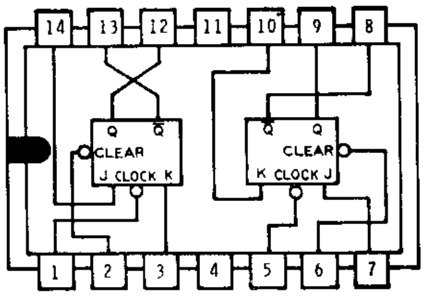
IC117, IC118
PART NO. 443-5
SN7473N



TRUTH TABLE (EACH LATCH)	
t_n	t_n+1
D	Q
1	1
0	0

IC103, IC105, IC107,
IC109, IC111
PART NO. 443-13
SN7475N

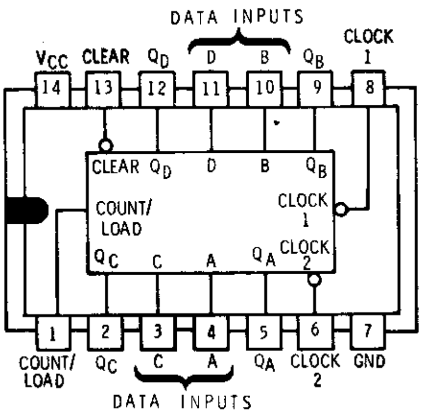
NOTE: t_n = BIT TIME BEFORE CLOCK NEGATIVE-GOING TRANSITION.
t_n+1 = BIT TIME AFTER CLOCK NEGATIVE-GOING TRANSITION.



TRUTH TABLE		
t_n	t_n+1	
J	K	Q
0	0	Q_n
0	1	0
1	0	1
1	1	$\bar{Q}_n$

IC101
PART NO. 443-70
SN74H103CU

NOTE: t_n = BIT TIME BEFORE CLOCK PULSE
t_n+1 = BIT TIME AFTER CLOCK PULSE



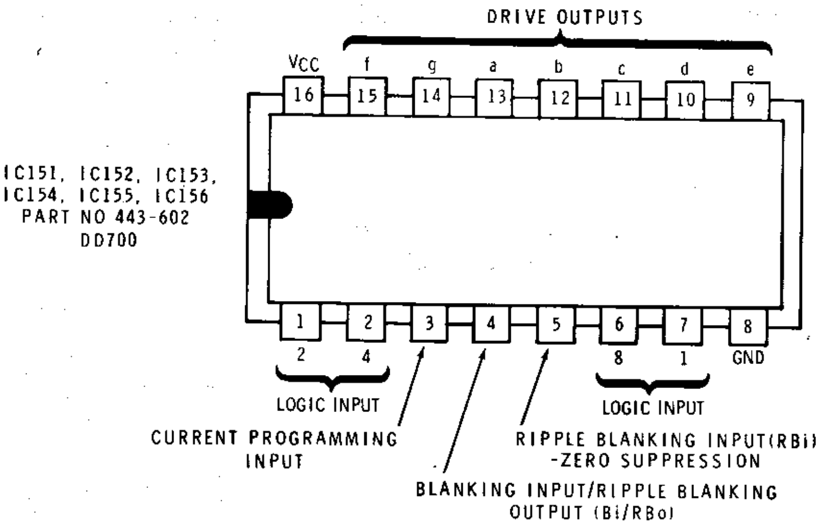
TRUTH TABLE
(BCD) (SEE NOTE)

COUNT	OUTPUT			
	Q_D	Q_C	Q_B	Q_A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H

NOTE: OUTPUT Q_A CONNECTED TO CLOCK-2 INPUT.

ASYNCHRONOUS INPUT: LOW INPUT TO CLEAR SETS Q_A, Q_B, Q_C AND Q_D LOW.

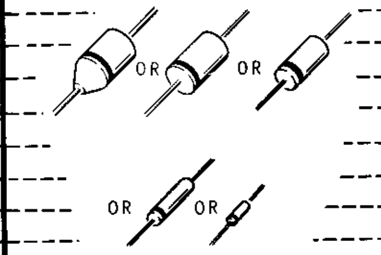
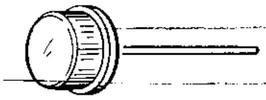
IC102, IC104, IC106,
IC108, IC110
PART NO. 443-628
74196

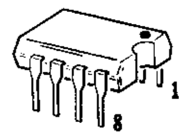
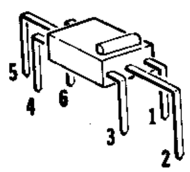
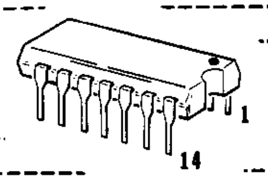
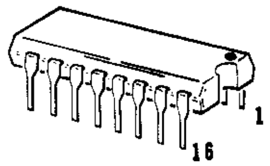


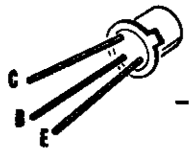
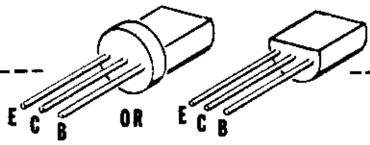
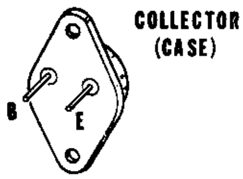
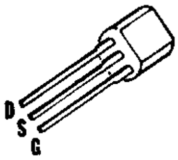
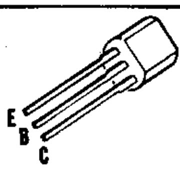
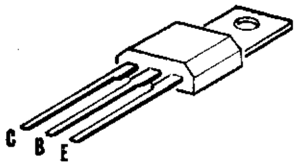
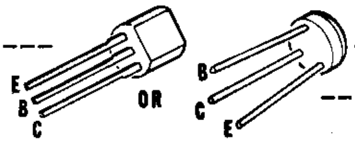
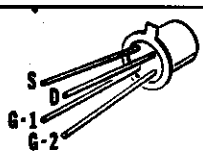
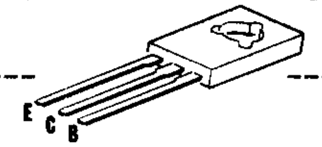
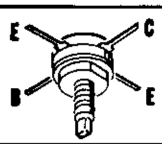
TRUTH TABLE														
	BCD INPUT						SEGMENT DRIVE OUTPUT							
DECIMAL OR FUNCTION	RBI	8	4	2	1	BI/RBO	a	b	c	d	e	f	g	DISPLAY
0	1	0	0	0	0	1	0	0	0	0	0	0	1	0
1	X	0	0	0	1	1	1	0	0	1	1	1	1	1
2	X	0	0	1	0	1	0	0	1	0	0	1	0	2
3	X	0	0	1	1	1	0	0	0	0	1	1	0	3
4	X	0	1	0	0	1	1	0	0	1	1	0	0	4
5	X	0	1	0	1	1	0	1	0	0	1	0	0	5
6	X	0	1	1	0	1	0	1	0	0	0	0	0	6
7	X	0	1	1	1	1	0	0	0	1	1	1	1	7
8	X	1	0	0	0	1	0	0	0	0	0	0	0	8
9	X	1	0	0	1	1	0	0	0	0	1	0	0	9
10	X	1	0	1	0	1	0	0	0	1	0	0	0	A
11	X	1	0	1	1	1	1	1	0	0	0	0	0	b
12	X	1	1	0	0	1	0	1	1	0	0	0	1	C
13	X	1	1	0	1	1	1	0	0	0	0	1	0	d
14	X	1	1	1	0	1	0	1	1	0	0	0	0	E
15	X	1	1	1	1	1	0	1	1	1	0	0	0	F
BI	X	X	X	X	X	0	1	1	1	1	1	1	1	
RBI	0	0	0	0	0	0	1	1	1	1	1	1	1	

NOTE: LOGIC "I" ON ALL INPUTS AND RBo IS DEFINED AS THE HIGH TTL/DTL STATE. LOGIC "0" ON OUTPUTS a-g IS DEFINED AS THE LOW OR CURRENT SINKING STATE (DISPLAY ON STATE). X IS DEFINED AS "DON'T CARE" CONDITION

Identification Charts

HEATH PART NO.	TYPE	VIEW	TOTAL	1	2	3	4	5	6	7	8	9	10	11	12	
			Pg CONN	11 VFO	55 A	[illegible] D	31 B	73 C	91 J	101 K	109 E	123 G	137 F	151 H	165 CHASSIS	
DIODES																
56-6	1N710, 6.8V	NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES.	1										1			1.50
56-16	1N751, 5.1V		2				2									1.50
56-19	VR-9.1		2				1								1	1.50
56-20	1N295		4					1		3						.40
56-24	1N458		45			12		10	1		9	12			1	.90
56-26	1N191		5	1		1			2		1				1	.40
56-56	1N4149		68	2	10	24	5	8	4			6	9			.30
56-59	1N750A, 4.7V		2					1					1			1.00
56-87	FH1100		16			4		4			4		4			.90
57-27	1N2071		4		4											.75
57-64	DRS-110		12					10	2							[illegible].05
57-65	1N4002		7				2	3	2							.30
56-63	VR-10A 1%			1												1.45
57-34	1N3491		1												1	1.15
56-89	GD510										1					? Price?

HEATH PART NO.	TYPE	VIEW	TOTAL	1	2	3	4	5	6	7	8	9	10	11	12	
INTEGRATED CIRCUITS																
442-18	MC1350P		2					1					1			2.50
442-48	MFC6030 Discontinued		2				2									4.15
442-71	LM3900		2				1						1			3.30
443-1	SN7400N		1		1											.70
443-2	SN7420N		1		1											.70
443-5	SN7473N		2		2											1.45
443-7	SN7490N		4		4											2.95
443-70	SN74H103CU		1		1											2.20
443-628	74196		5		5											5.70
443-13	2N7475N		5		5											2.95
443-602	DD700		6		6											4.80
411-286	SP-352	Display tube	3		3											6.15

HEATH PART NO.	TYPE	VIEW	TOTAL	1	2	3	4	5	6	7	8	9	10	11	12	
TRANSISTORS																
417-89	PT3141C		1					1								? N/U
417-154	2N2369		5		1	2		1				1				1.65
417-205	2N3866		2			1		1								3.20
417-118	2N3393		2	2												.40
417-201	X29A829		7				4				3					.50
417-162	MHT9210		2												2	2.40
417-169	MPF105		2	2												1.50
417-172	MPS6521		4			4										.70
417-801	MPSA20		29				6	2	1	2	9		9			.25
417-224	MPSU05		2		2											1.40
417-233	2N3643		1										1			.55
417-234	2N3638A		2	1									1			.60
417-235	2N4121		5									2	3			.60
417-240	40673		3									2	1			2.40
417-263	SJE607		1										1			1.50
417-264	SJE608		1										1			1.65
417-830	PT6619		2						2							18.75
417-831-1	PT5767 * (SET OF 4 417-831)		1											1		50.00 4 TRS.

*HAS WIDE LEADS

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 for that circuit board.

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 the Model SB-104 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	Counter	5.00
B	Transmitter Audio/Regulator	5.00
C	Transmitter IF	10.00
D	HFO/Premix	5.00
E	Carrier Generator/Crystal 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	Filter/ALC	5.00
	Display	5.00

*Plus parts charge when out of warranty.

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.

After one year, a matched set of the four transistors used on the power amplifier circuit board may be purchased from the Heath Company for $50.00. Because of the necessity for balancing the transistor characteristics, 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® TRANSCEIVER MODEL SB-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 PIN-OUT DIAGRAMS AND 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 ON FOLD-OUT FROM PAGE 323.
7. SYMBOLS:

= A PLUG-IN CONNECTION.

= CIRCUIT BOARD GROUND.

= CHASSIS GROUND.

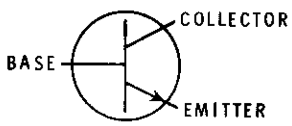
= IDENTIFIED CIRCUIT BOARD HOLES.

= CIRCUIT BOARD EDGE CONNECTOR.

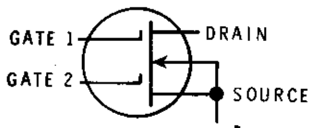
FB

= FERRITE BEAD.

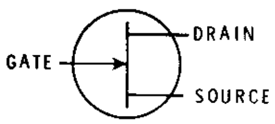
= PHONO SOCKET.



BIPOLAR TRANSISTOR



MOSFET



J FET

VFO and Buffer Circuit Boards

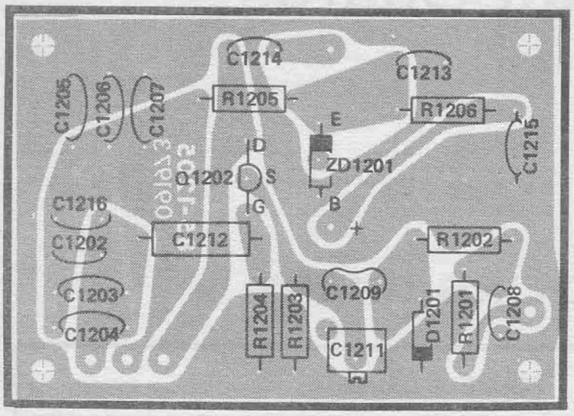
TROUBLESHOOTING CHART

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. 4. Resolder bare wires from tuning capacitor C1201 to circuit board solder lugs.
Less than .4 to .5 VDC VFO output.	1. Refer to "VFO/Buffer Troubleshooting Guide."

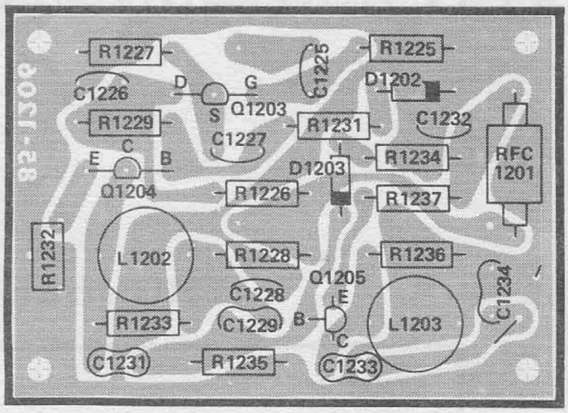
NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the Parts List starting on Page 11 of this Manual.

X-RAY VIEWS

VFO BOARD



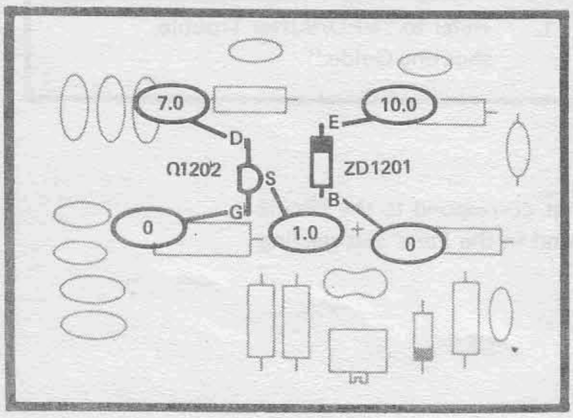
BUFFER BOARD

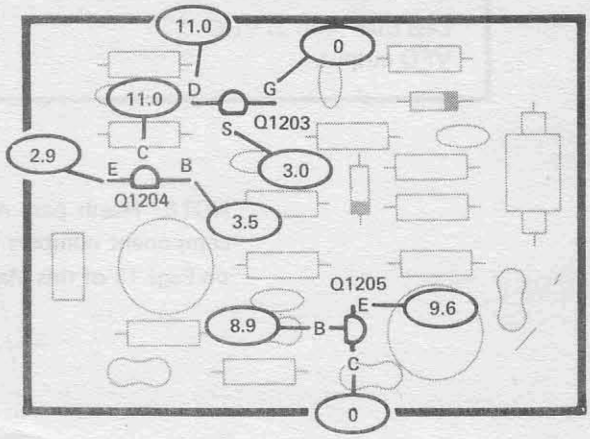


(Shown from component side)

VOLTAGE CHARTS

(Shown from component side)





DC VOLTAGES

TRANSMITTER VOLTAGES (±20%)

NOTFS:

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

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.

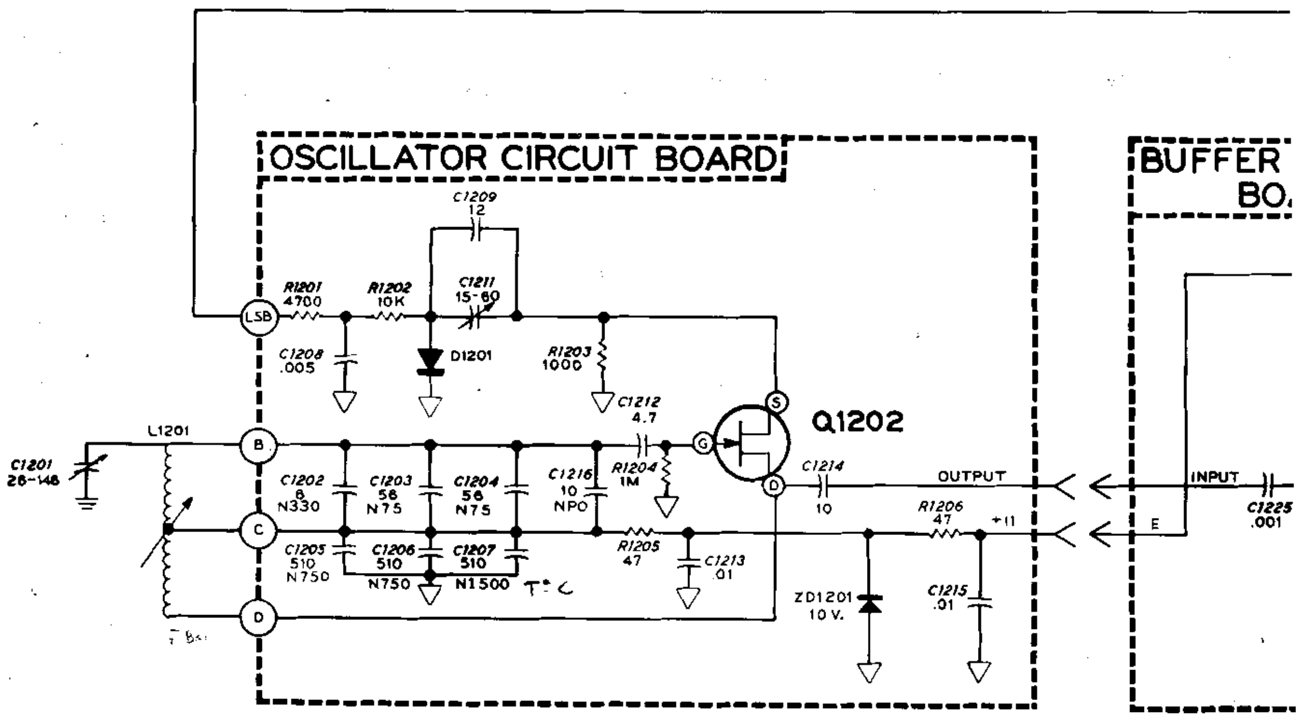
Diode D1201 acts as a switch to add or remove C1209 and C1211 from the circuit. These capacitors shift the VFO frequency so the output carrier frequency remains the same when you switch sidebands. D1201 is switched by the polarity of the voltage applied to its anode by the LSB pushbutton switch. ZD1201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

SCHEMAT

Refer to Page 282 for Schemat

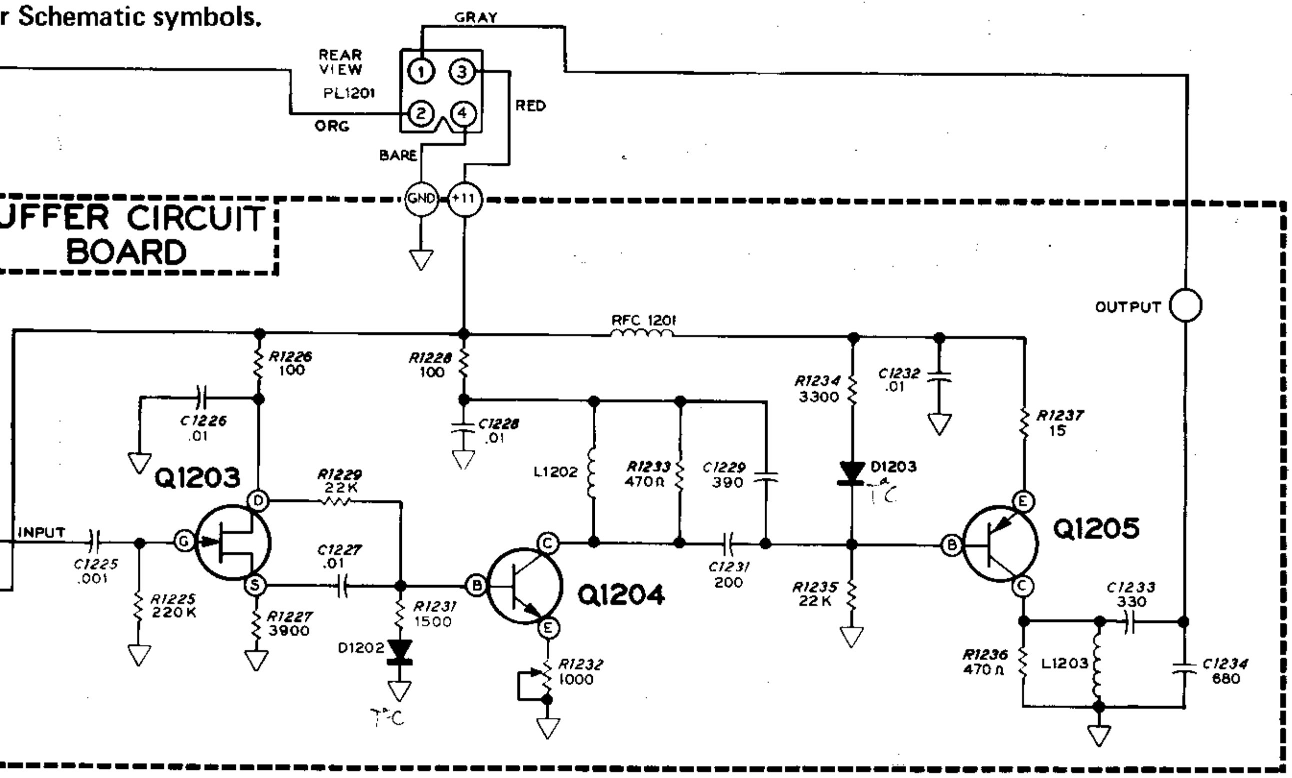


C1201
Spare
section

ADJ
L1201
C1211
R1232

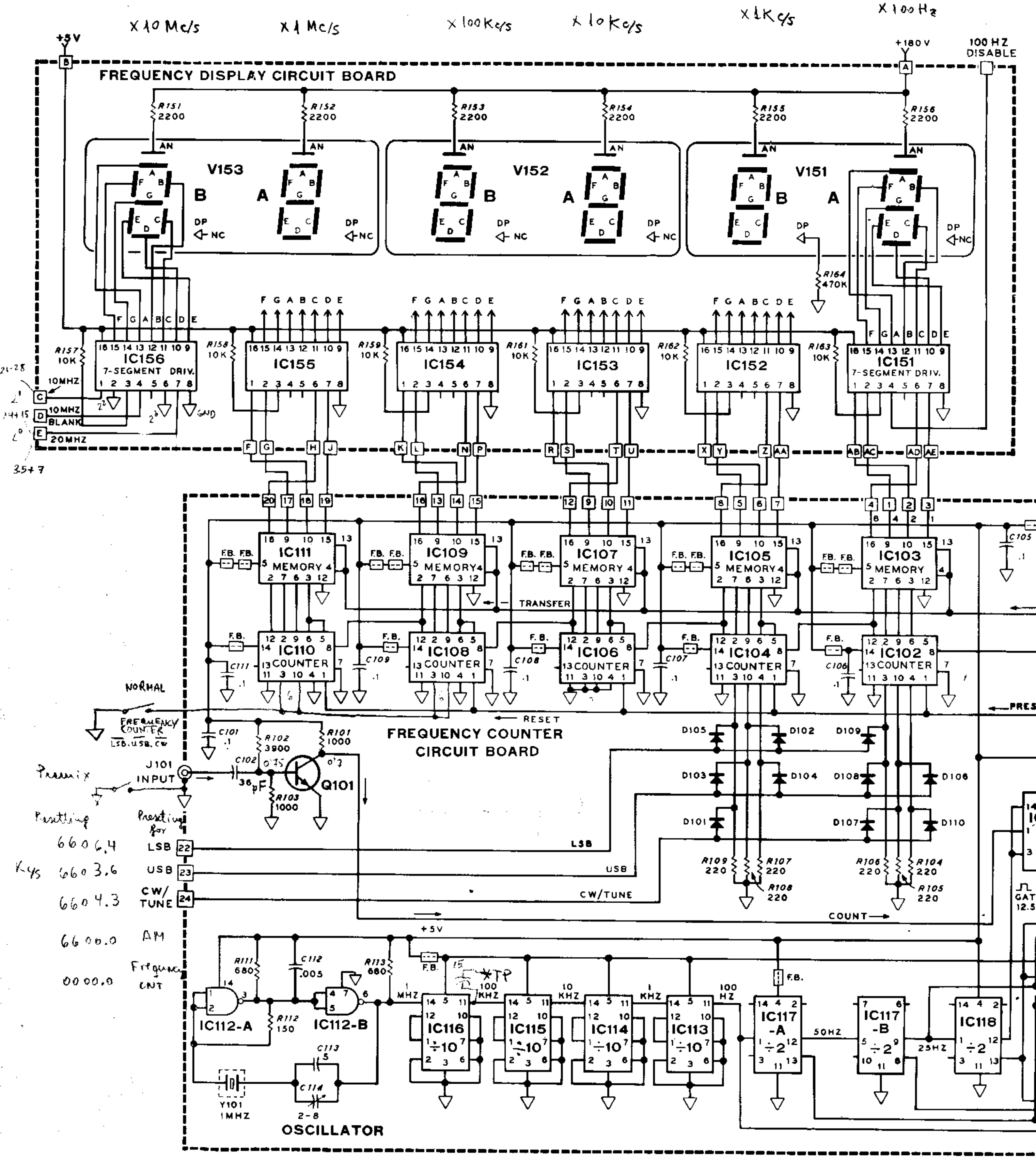
EMATIC

r Schematic symbols.

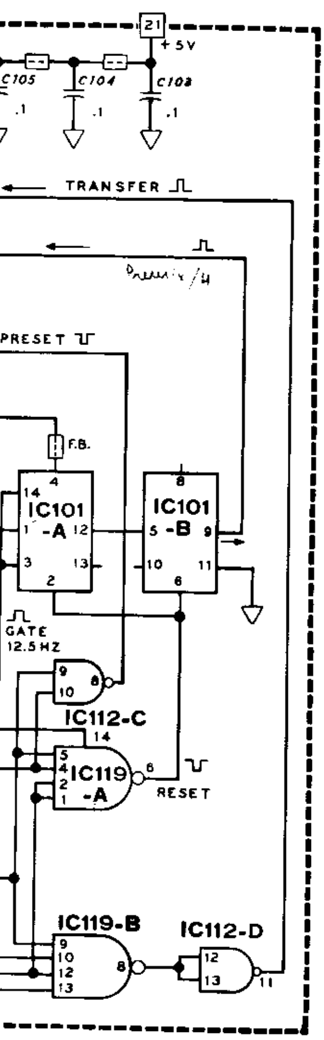


DIODES	QUAN-TITY	TYPE	HEATH PART NO.
D1201	1	1N191	56-26
D1202, D1203	2	1N4149	56-56
ZD1201, 10V.	1	VR-10A	56-67
TRANSISTORS			
Q1202, Q1203	2	MPF105	417-169
Q1204	1	2N3393	417-118
Q1205	1	2N3638A	417-234

? 10V



X 10 Mc/s
X 1 Mc/s
x 100 Kc/s
x 10 Kc/s
x 1 Kc/s
x 100 Hz
+5V
+180V
100 HZ DISABLE
FREQUENCY DISPLAY CIRCUIT BOARD
R151 2200
R152 2200
R153 2200
R154 2200
R155 2200
R156 2200
V153
V152
V151
R164 470K
R157 10K
R158 10K
R159 10K
R161 10K
R162 10K
R163 10K
IC156 7-SEGMENT DRIV.
IC155
IC154
IC153
IC152
IC151 7-SEGMENT DRIV.
10MHZ
10MHZ BLANK
20MHZ
IC111 MEMORY
IC109 MEMORY
IC107 MEMORY
IC105 MEMORY
IC103 MEMORY
TRANSFER
IC110 COUNTER
IC108 COUNTER
IC106 COUNTER
IC104 COUNTER
IC102 COUNTER
RESET
PRESET
NORMAL
FREQUENCY COUNTER
LSB, USB, CW
FREQUENCY COUNTER CIRCUIT BOARD
J101 INPUT
Q101
R101 1000
R102 3900
R103 1000
C101 .1
C102 36 pF
Premix
Resetting
Presetting for
6606.4
6603.6
6604.3
6600.0
0000.0
Kc/s
LSB
USB
CW/ TUNE
AM
Frequency CNT
LSB
USB
CW/TUNE
COUNT
R109 220
R108 220
R107 220
R106 220
R105 220
R104 220
D101
D102
D103
D104
D105
D106
D107
D108
D109
D110
GATE 12.5
+5V
R111 680
C112 .005
R113 680
R112 150
IC112-A
IC112-B
1 MHZ
100 KHZ
10 KHZ
1 KHZ
100 HZ
TP
IC116 ÷10
IC115 ÷10
IC114 ÷10
IC113 ÷10
IC117-A ÷2
IC117-B ÷2
IC118 ÷2
50HZ
25HZ
C113 5
C114 2-8
Y101 1MHZ
OSCILLATOR



A

DISPLAY AND COUNTER SCHEMATICS

Refer to Page 282 for Schematic symbols.

ADJ
C114

DIODES	QUANTITY	TYPE	HEATH PART NO.
D101-D110	10	1N4149	56-56
TRANSISTORS			
Q101	1	2N2369	417-154
INTEGRATED CIRCUITS			
IC101	1	SN74H103	443-70
IC102, IC104, IC106, IC108, IC110	5	74196	443-628
IC103, IC105, IC107, IC109, IC111	5	SN7475N	443-13
IC112	1	SN7400N	443-1
IC113-IC116	4	SN7490N	443-7
IC117, IC118	2	SN7473N	443-5
IC119	1	SN7420N	443-2
IC151-IC156	6	DD700	443-602

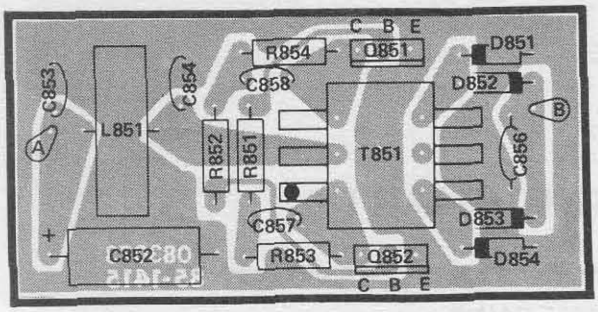
Converter Circuit Board

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
Output voltage low.	1. Q851, Q852, T851. 2. 5 volt input low.
No output voltage.	1. No input voltage. 2. Q851, Q852, T851. 3. D851 – D854. 4. C851 – C857. 5. Solder bridge on board.

DIODES	QUAN-TITY	TYPE	HEATH PART NO.
D851-D854	4	1N2071	57-27
TRANSISTORS			
Q851, Q852	2	MPSU05	417-224

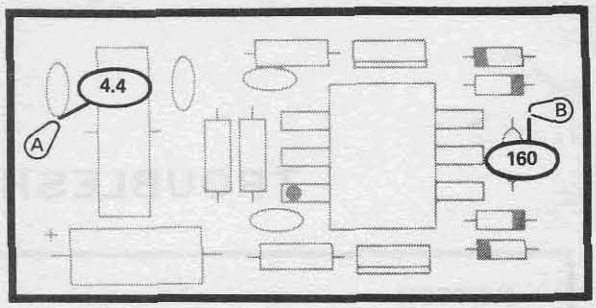
X-RAY VIEW



(Shown from component side)

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the Parts List starting on Page 31 of this Manual.

VOLTAGE CHART
(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

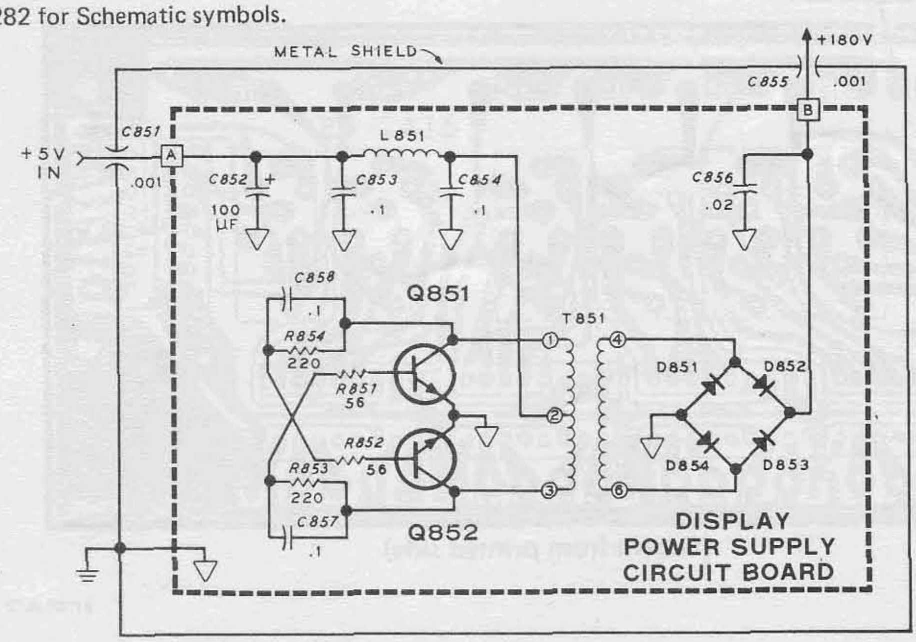
◯ DC VOLTAGE IN RECEIVE OR TRANSMIT MODES

CIRCUIT DESCRIPTION

The converter consists of an oscillator, formed by Q851 and Q852, T851, and associated feedback components. This circuit oscillates at approximately 25 kHz, and the high voltage on the secondary of T851 is rectified by D851 through D854 to produce the required 180 VDC. L851 and the associated capacitors filter the 25 kHz switching noise off of the input line. The converter is enclosed in a shield box to prevent the harmonics of 25 kHz from interfering with the operation of the remainder of the Transceiver.

SCHEMATIC

Refer to Page 282 for Schematic symbols.



ADJ
NONE

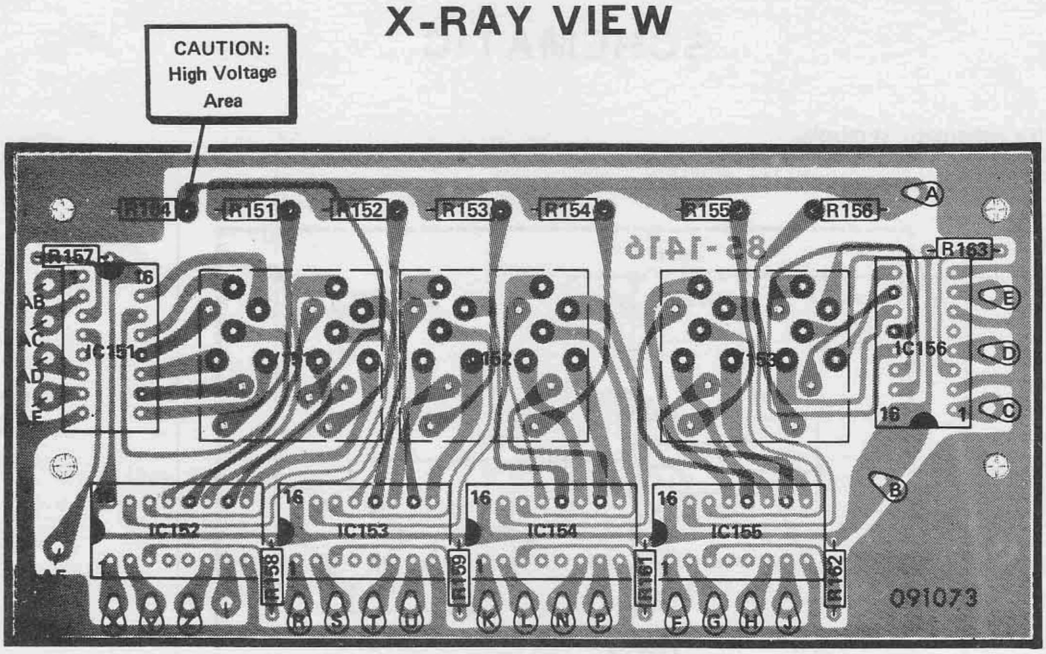
A

Display Circuit Board

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
In one digit, one segment brighter than others.	The associated segment driver IC.
One segment will not light.	1. Defective display tube. 2. Associated segment driver IC. 3. Tube pin mounting sockets.
Display will not light.	1. 5V or 180V missing. 2. Segment driver. 3. Display tube.
Display incorrect.	1. Signal from counter board. 2. Wiring error between counter and display boards.

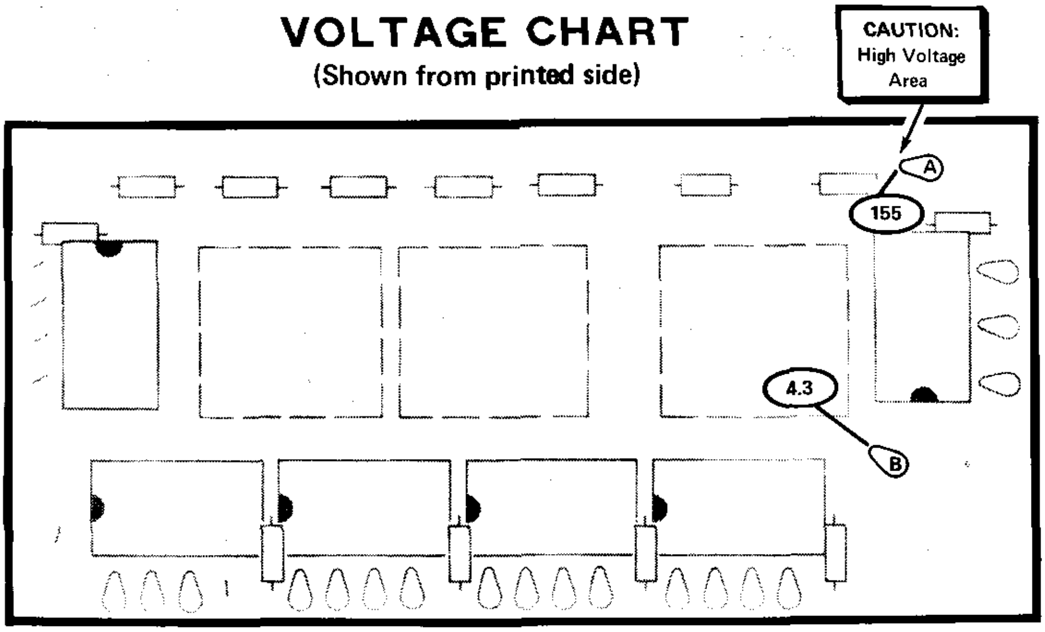
X-RAY VIEW



(Shown from printed side)

VOLTAGE CHART

(Shown from printed 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

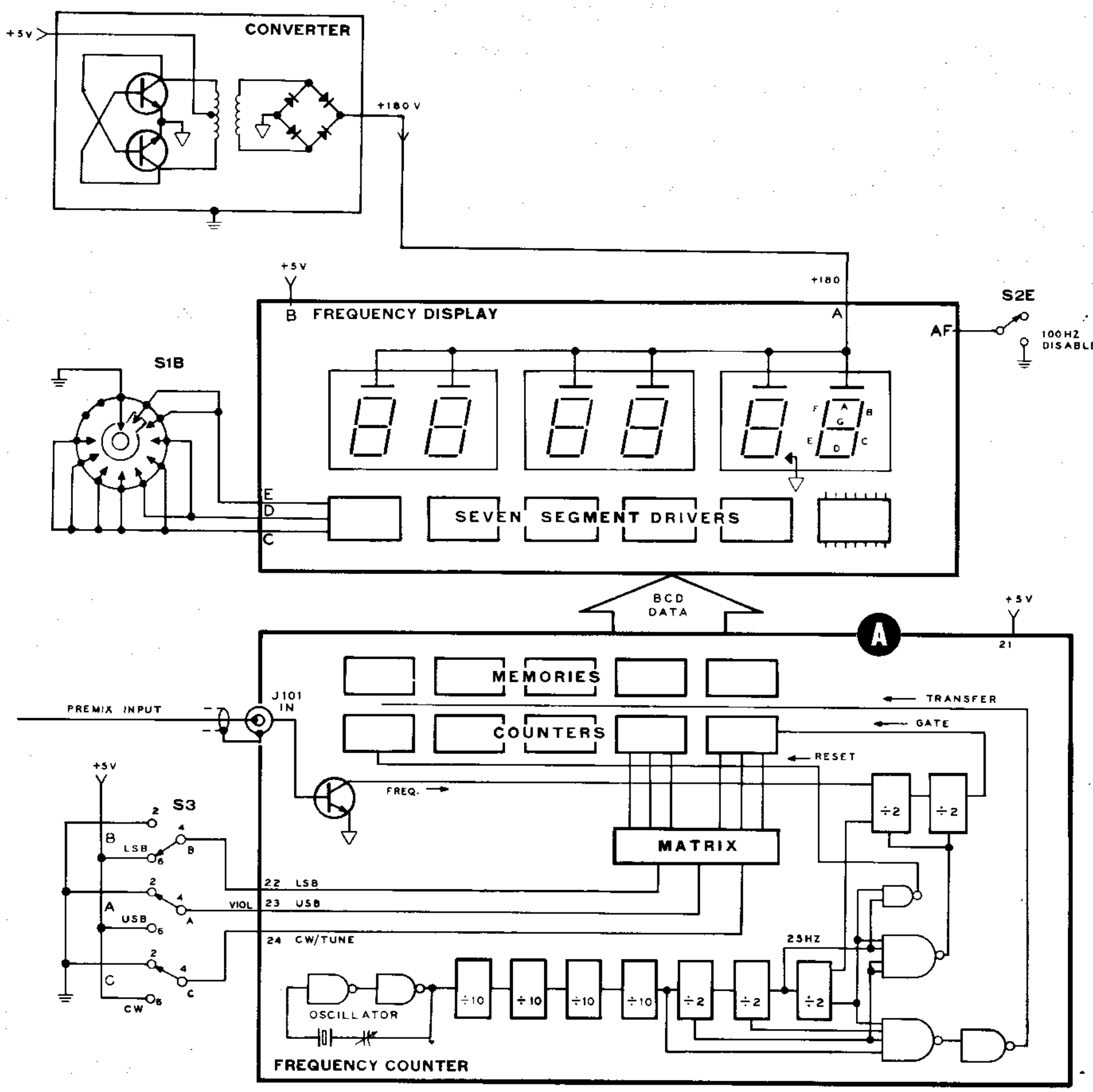
NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the Parts List starting on Page 31 of this Manual.

Refer to the Display Circuit Board Schematic, fold-out from Page 286.

CIRCUIT DESCRIPTION

The display board receives the outputs of five memory latches (IC's 103, 105, 107, 109 and 111) from the counter board (A). The four BCD outputs of each memory latch are processed by a segment driver so the appropriate segments of its display tube are turned on. The first display digit has a segment driver (IC156) which is controlled by the Band switch. This digit is in the megahertz position and is blank, or reads 1 or 2, as appropriate.

The schematic diagram shows segment driver outputs A through G, which drive similarly lettered segments of the display tubes. The driver output voltages for lighted segments are lower than the voltages for unlighted tube segments. Each tube requires an anode voltage of 180 VDC, which is supplied by the converter from its 5 VDC input. This is the only high voltage used in the Transceiver.



1. BAND SWITCH AT 3.5MHZ POSITION.
2. ENCIRCLED LETTERS ON PLUG-IN BOARDS REFER TO UNDER—CHASSIS LABELS.

SIMPLIFIED COUNTER AND DISPLAY SCHEMATIC
(From Figure 5-1)

286

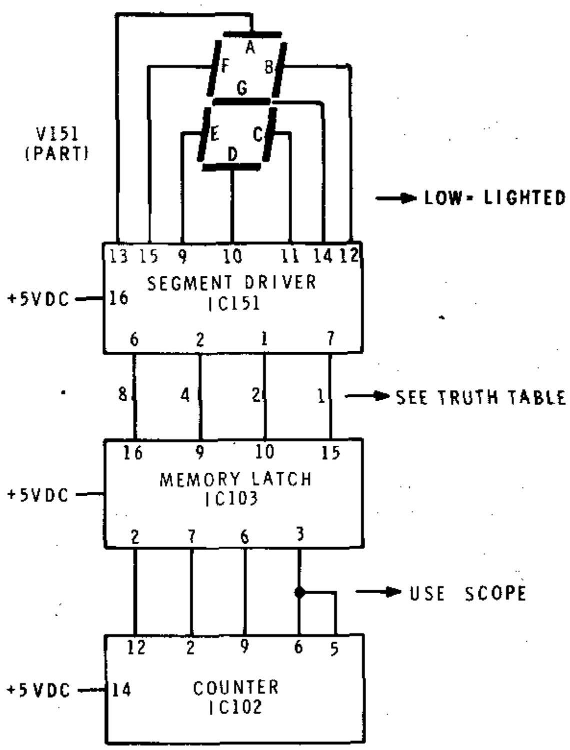
A

Counter Circuit Board

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
Readout of preset frequencies incorrect (6606.4, 6603.6, 6604.3)	1. Time base not running. 2. IC-112 thru IC-119. 3. 5V missing.
One digit incorrect.	1. Associated counter IC. 2. Associated memory IC. 3. Display board connections. 4. Chassis wiring.
Will not count (preset frequency display OK).	1. Premix signal missing or low in voltage. 2. Q101. 3. IC101.

CIRCUIT DESCRIPTION



VALUE	MEMORY LATCH PINS 16	9	10	15
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H

MEMORY LATCH TRUTH TABLE

L = LESS THAN 0.8VDC
H = MORE THAN 1.5VDC

Figure 4-4

The function of this card is to count the premix signal (the difference frequency of the mixed HFO and VFO signals) and to place the count in the proper format for display. Figure 4-4 shows a counter, memory latch, segment driver and display tube chain. The truth table for the memory latch output pins is included.

The premix signal is amplified by Q101 and applied to prescaler IC101, which divides the input signal by four. This division is necessary to reduce ambiguity and flicker in the last (100 Hz) digit of the display, and to insure that the counters will be operating below their maximum frequency limit.

A stable crystal oscillator (IC112A, 112B and Y101) is used as a 1 MHz time base. Six integrated circuits (IC113 through IC118) form a divider string whose 100 Hz, 50 Hz, 25 Hz, and 12.5 Hz outputs are applied to IC's 119A, 119B and 112C to produce the gate, reset and transfer pulses. The gate pulse controls the length of time the counter will accept the input signal for counting. The transfer pulse allows the data in the counter to enter the memory latches, and the reset pulse resets the counters and prescalers.

As the premix signal is above the signal frequency by an amount equal to the BFO frequency, the presettable decade counters are programmed to start counting from a preset number below zero by the amount of the BFO frequency. To calculate this preset number, the BFO frequency is subtracted from 10,000.0 kHz, which is used as an "arbitrary zero." See Figure 4.5. It is convenient to use 10,000.0 kHz as the false zero because the counters use only five digits of the display and the "1" will not be seen.

An example follows for a 3900 kHz LSB signal:

If the counter IC's are preset at 6606.4 kHz and the premix signal frequency of 7293.6 kHz is counted, the total for

A

10000.0 kHz	FALSE ZERO FREQUENCY
3393.6 kHz	LSB BFO FREQUENCY
6606.4	PRESET FREQUENCY

	BFO	PRESET
USB	3396.4 kHz	6603.6 kHz
LSB	3393.6	6606.4
CW	3395.7	6604.3

B

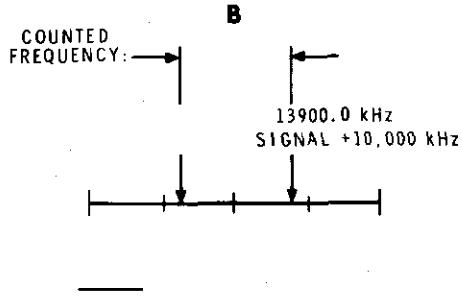
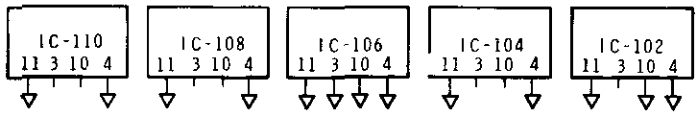


Figure 4-5



LOWER SIDEBAND PRESET.

	IC-110	IC-108	IC-106	IC-104	IC-102
NUMERICAL VALUE	8 4 2 1	8 4 2 1	8 4 2 1	8 4 2 1	8 4 2 1
LOGICAL VALUE *	L H H L	L H H L	L L L L	L H H L	L H L L
PRESET VALUE	6	6	0	6	4

* L=LOW H=HIGH,
LOWS NOT SIGNIFICANT.
TOTAL OF HIGH VALUES
EQUAL PRESET VALUE.

Figure 4-6

display is 13900.0 kHz as shown in Figure 4.5. However, as there is no provision for displaying the figure "1," the display will read 3900.0, which is the correct signal frequency. The following tabulation shows the calculations:

HFO for 3.5 MHz band	12395.0 kHz
VFO	5101.4
Premix	7293.6 kHz
False zero	10000.0 kHz
BFO for LSB	3393.6
Preset	6606.4 kHz
Preset frequency	6606.4 kHz
Counted frequency (Premix)	7293.6
Display (Signal) frequency	*13900.0 kHz

*The signal frequency will be displayed as "3900," as the "1" cannot be seen.

NOTE: The first of the six display digits is controlled by the BAND switch and is blank, 1, or 2 as appropriate. This discussion deals only with digits two through six, controlled by the counter IC's.

BCD (binary-coded decimal) is used to program each counter IC for a preset frequency at pins 11, 3, 10, and 4 (which have decimal values of 8, 4, 2, and 1). If any of these pins is grounded, it is logically low, and if not connected or positive, it is logically high. Only the high pins are significant. The values of the highs, if any, at the pins of each IC are added together to determine the preset number for that IC. Refer to Figure 4-6, the schematic diagram, and the following explanation of how the counter IC's are programmed for the LSB preset frequency of 6606.4 kHz.

IC110: Pins 11 and 4 are grounded and therefore have no value. Pins 3 and 10, with values of 4 and 2 respectively, are not connected and are therefore high, so the figures are significant. 4 + 2 = 6 as the preset value for this IC.

IC108: Same as IC110.

IC106: All pins are grounded and are therefore low, so the preset value is 0.

IC104: Pin 11 is grounded directly and pin 4 is grounded through R107, so there is no value at these pins. When the front panel LSB button is pushed, a positive voltage is connected to pin 22 of counter circuit board A. This voltage is applied to the anodes of D105 and D102, which causes them to conduct and pass the voltage to pins 3 and 10 of the IC. These pins are therefore high and have values of 4 and 2, so the preset value of the IC is 6.

IC102: Pin 11 is grounded directly, and pins 10 and 4 are grounded through R105 and R104, so these pins are low and without value. The positive LSB voltage is applied through D109 to pin 3, which becomes high and has a value of 4. The preset value for this IC is therefore 4.

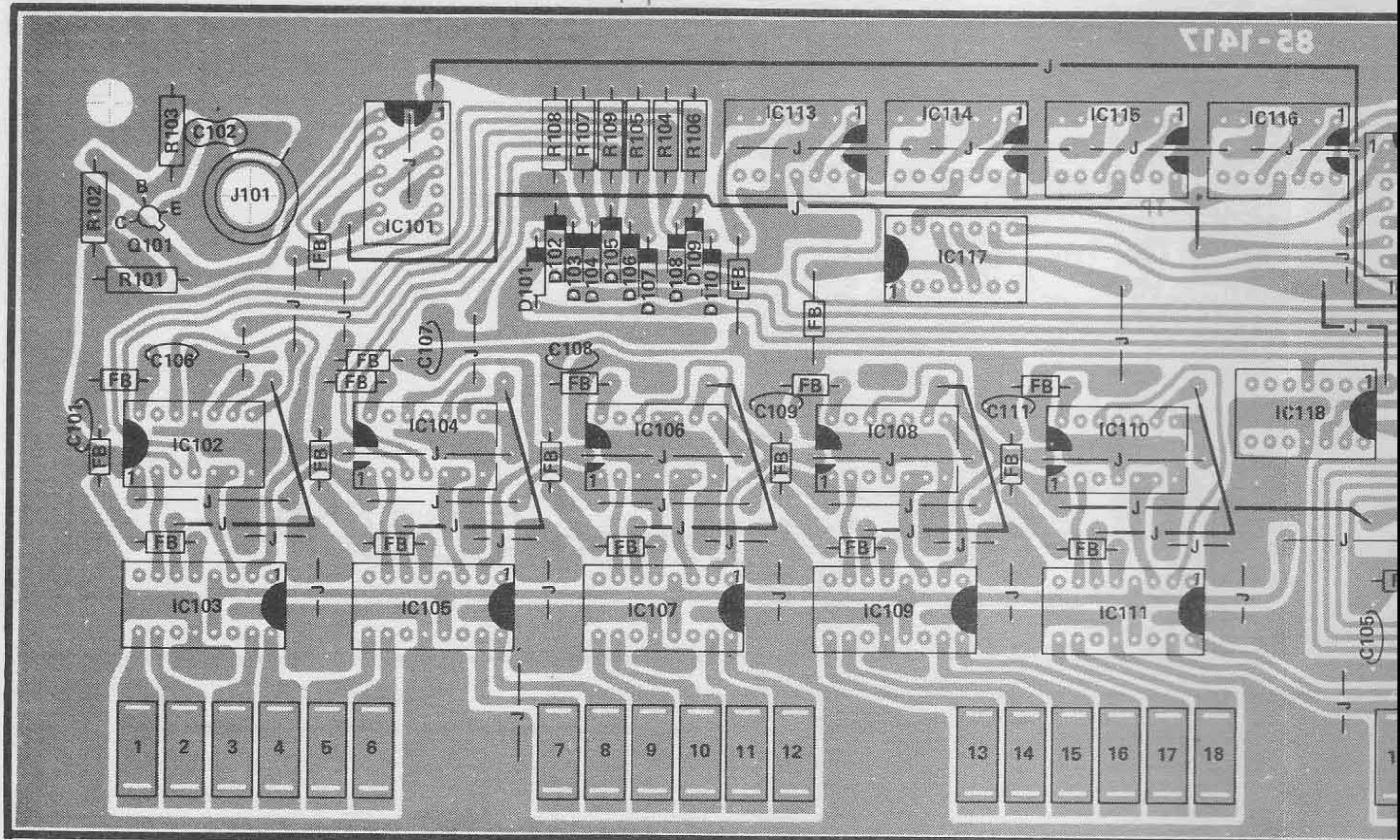
The presets for the second, third and fourth digits of the display are fixed as "660" (IC's 110, 108 and 106). The remaining two digits change as the USB, LSB, and CW buttons apply positive voltages through the diode matrix to the pins of IC104 and IC102. The USB preset frequency will be 6603.6 because the positive voltage from pin 23 of board A will be applied to IC104 pins 10 and 4, total value 3, and IC102 pins 3 and 10, total value 6. The CW preset frequency will be 6604.3 because the positive voltage will be connected from pin 24 of board A to IC104 pin 3, value 4, and to IC102 pins 10 and 4, total value 3.

IC's 103, 105, 107, 109 and 111 are memory latches which store data from the counters during counting periods. This eliminates flashing digits which would otherwise be present during counting periods. During the transfer pulse, the BCD count present at a counter output is transferred to the memory, which retains the count at its output until the next transfer pulse.

The memory outputs are connected to the segment drivers, which are located on the display circuit board. The significant outputs are logically high. Each memory output is coded using BCD in a manner similar to the decimal coding described for presetting the counters.

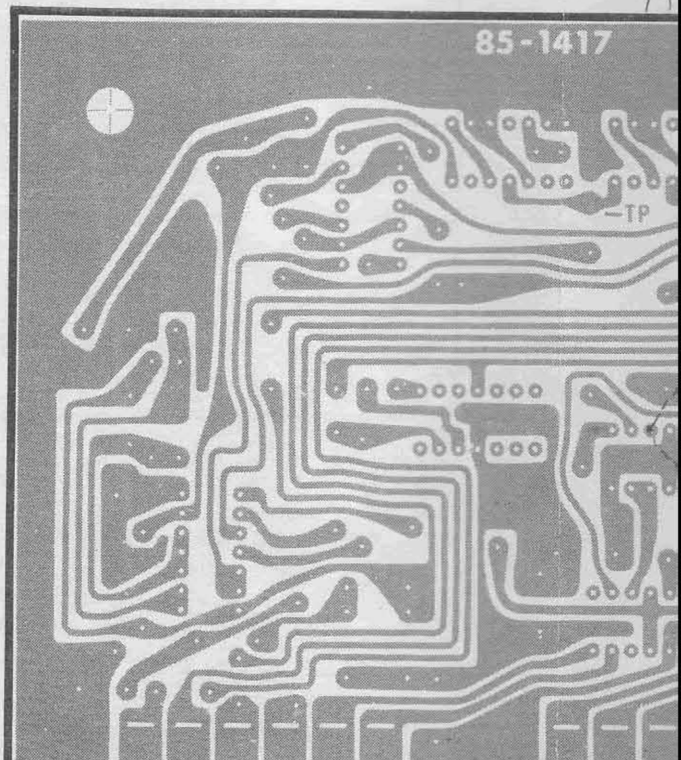
A

X-RAY VIEW



(Shown from component side)

A

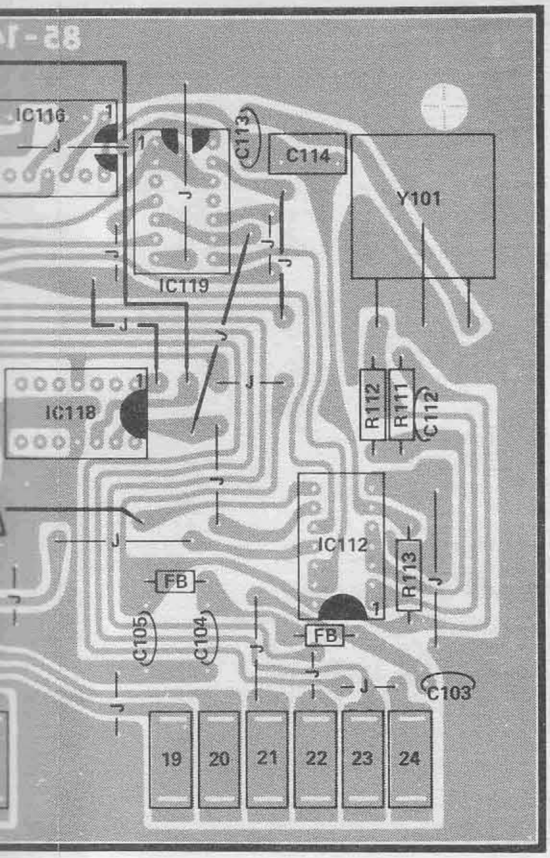


TRANSMITTER VOLTAGES (±20%)

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

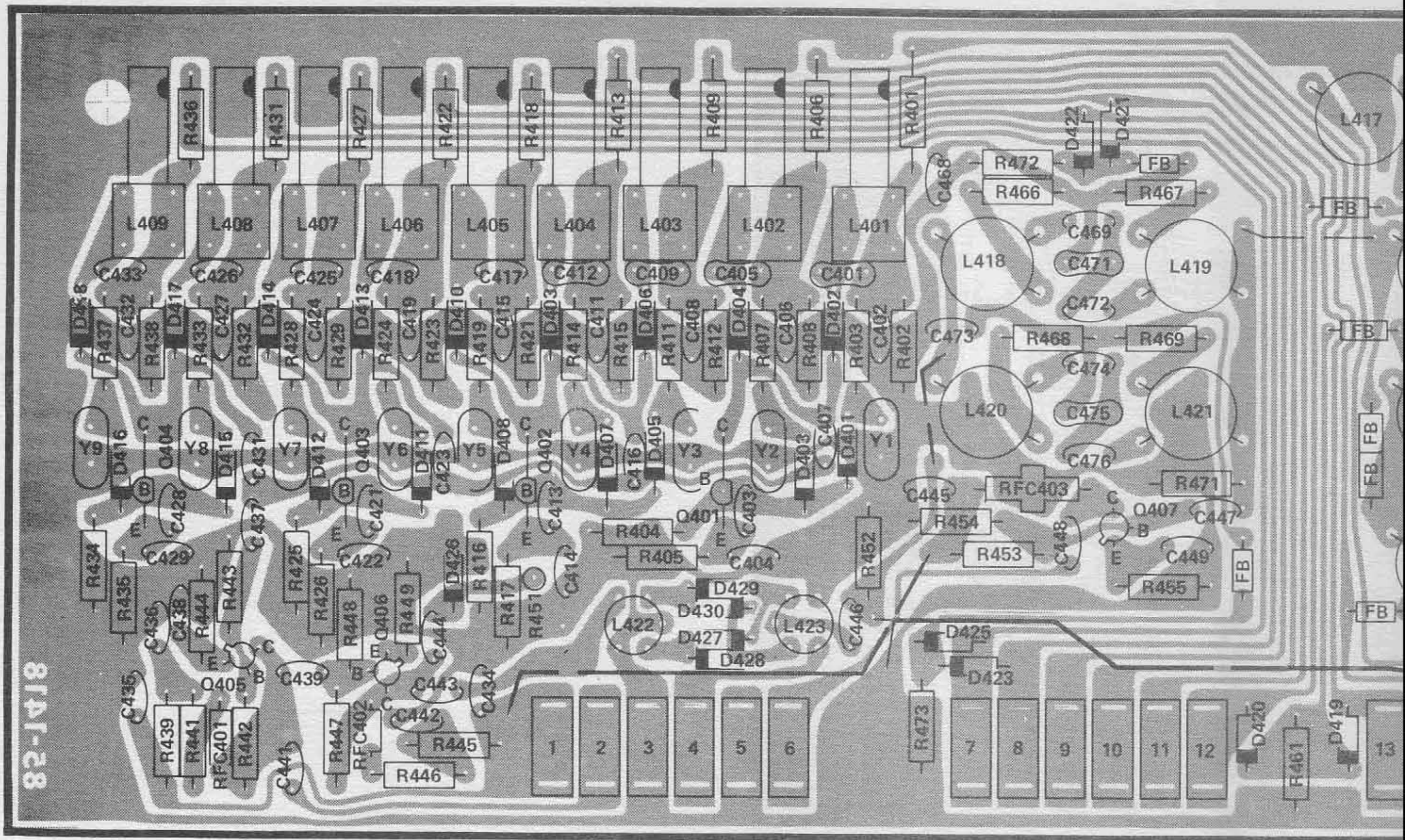
DC VOLTAGE IN RECEIVE OR TRANSMIT MODES



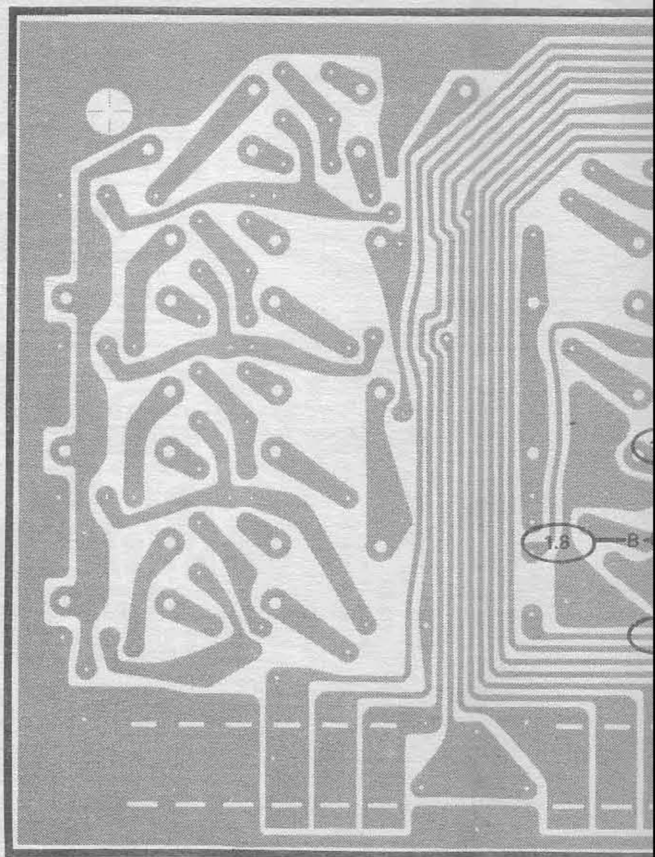
A **VOLTAGE CHART**

(Shown from foil side)

X-RAY VIEW



(Shown from component side)

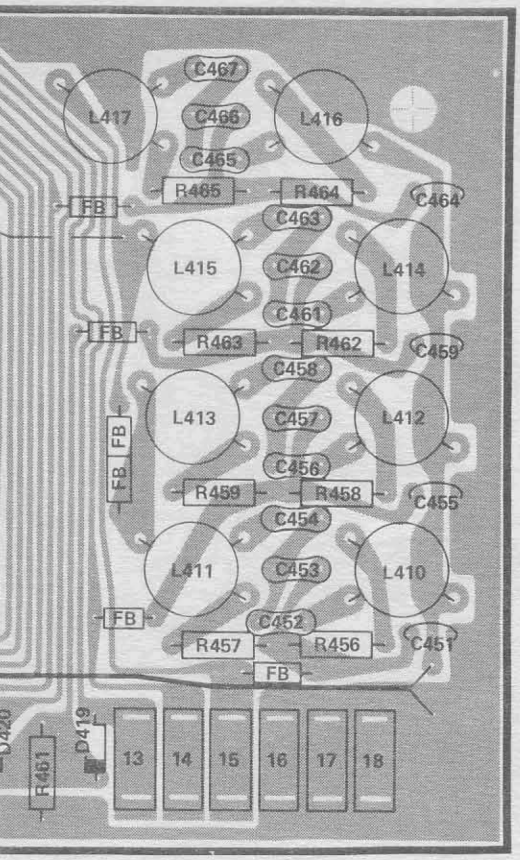


TRANSMITTER VOLTAGES (±20%)

NOTES:

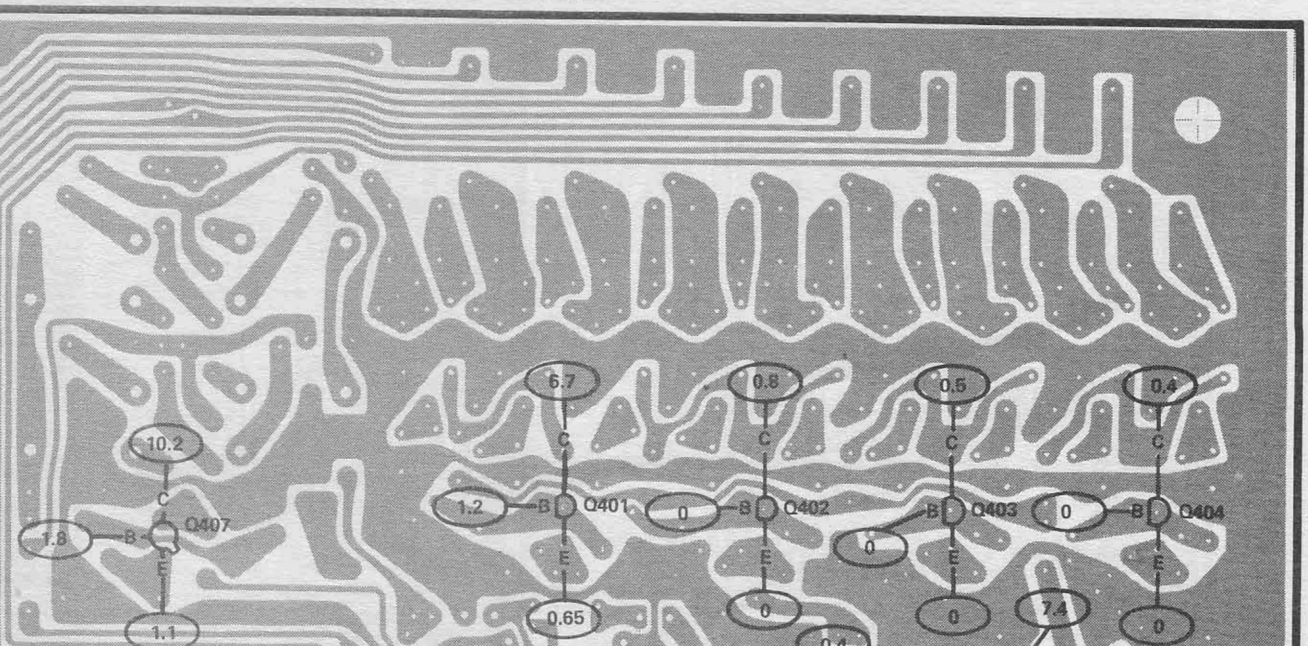
1. BANDSWITCH IN 3.5 POSITION
2. MODE SWITCH IN TUNE POSITION
3. METER SWITCH IN PWR POSITION
4. MIC/CW-LEVEL FULLY COUNTERCLOCKWISE

◯ DC VOLTAGE IN RECEIVE OR TRANSMIT MODES



HFO PREMIX

VOLTAGE CHART



(Shown from foil side)

D

HFO/Premixer Circuit Board

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
HFO will not oscillate or output voltage very low (all bands).	1. Bandswitch 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.

Refer to the "X-Ray View" and "Voltage Chart" (fold-out from this page).

CIRCUIT DESCRIPTION

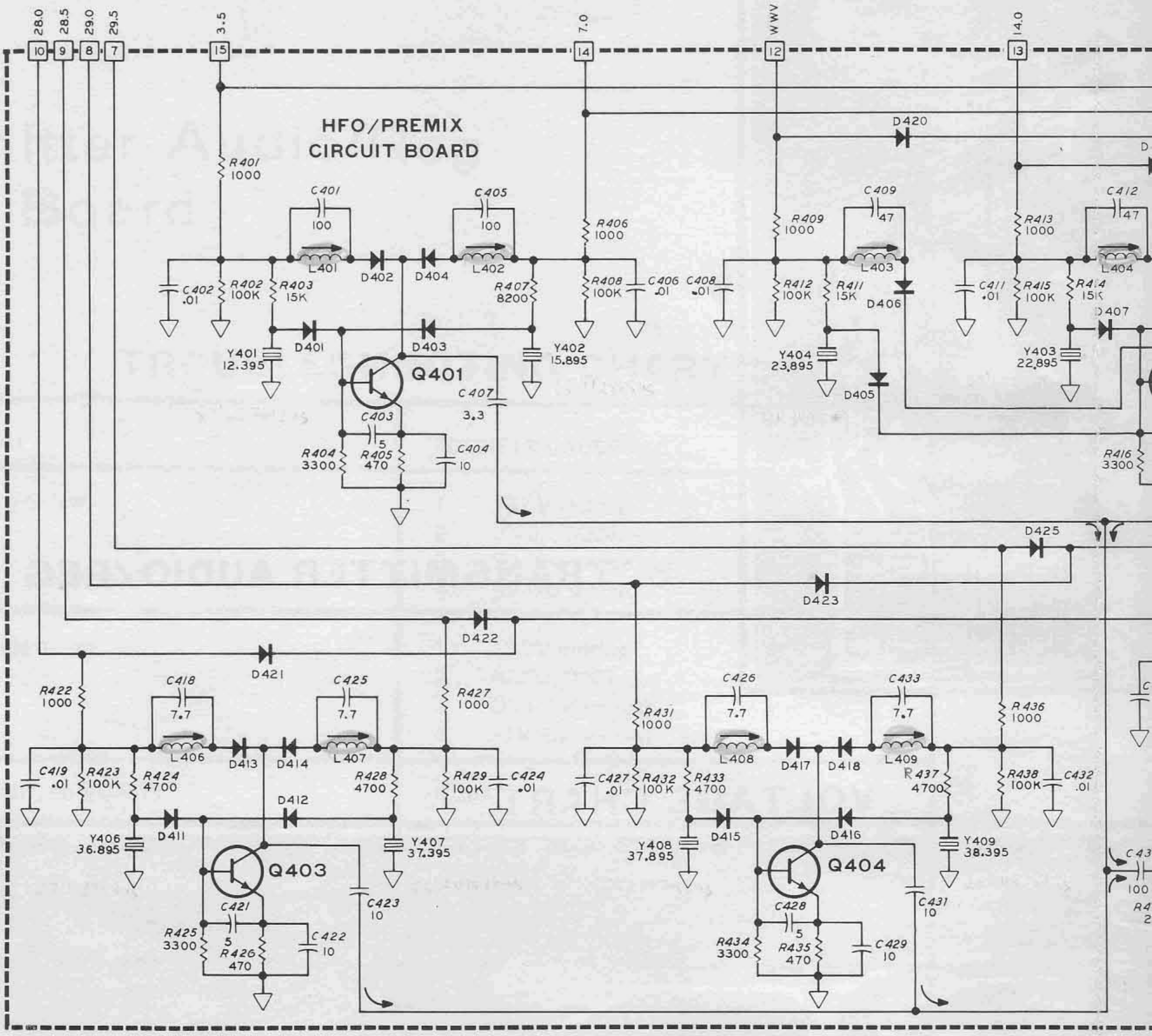
The function of these circuits is to generate crystal-controlled injection signals, and to mix these signals with the VFO signal to obtain the premix signal.

Q401, Q402, Q403, and Q404 are used as oscillators. These oscillators are diode-selected, as are the proper oscillator crystals.

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 D430 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 and counter circuits.

o/c if unused
+9'5 if selected



ADJ
L 401
L 402
L 403
L 404
L 405
L 406
L 407
L 408
L 409

IP

D

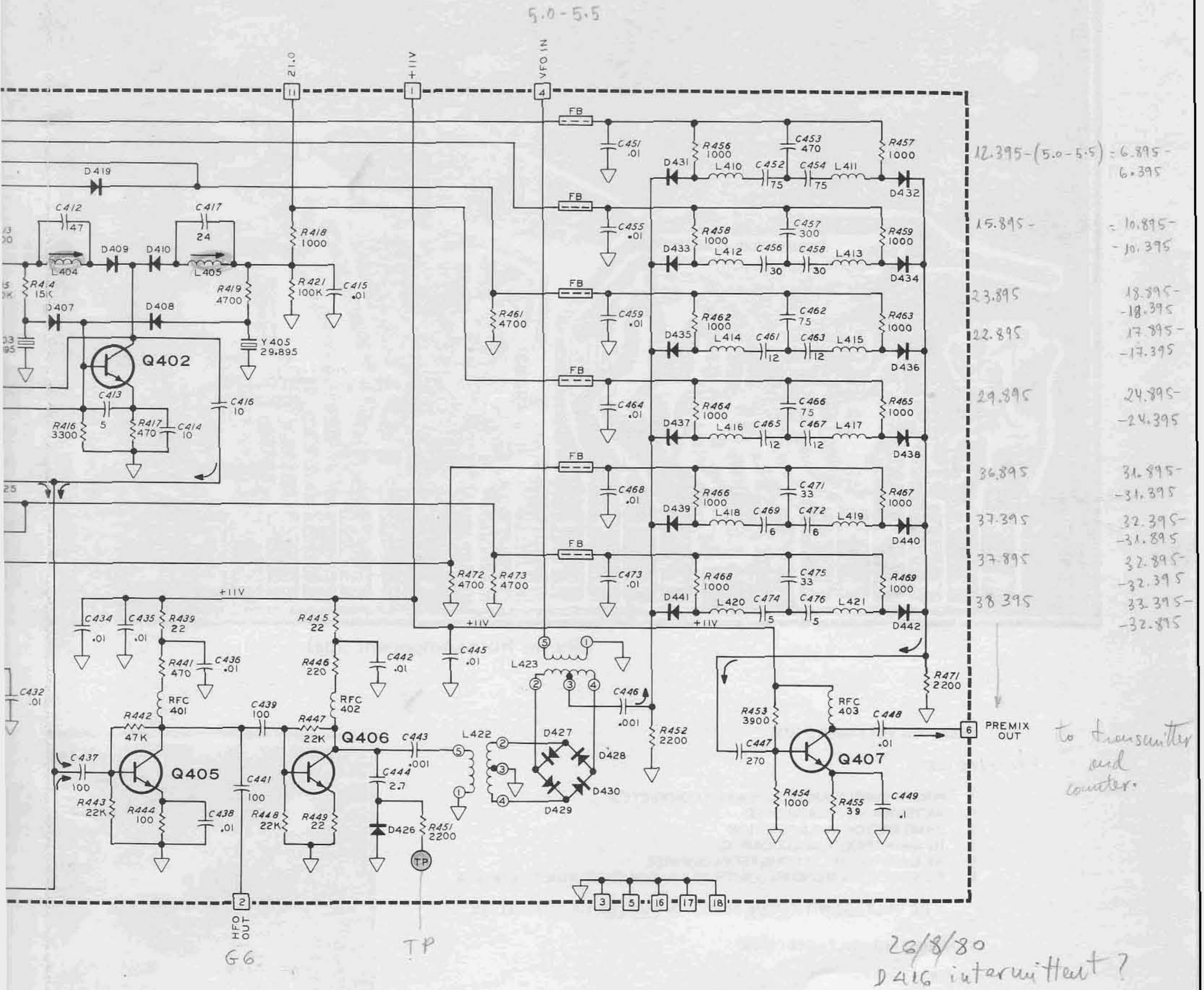
HFO/PREMIXER

CIRCUIT BOARD D

Refer to Page 282 for Schema

3RD Harmonic cristal activity 90% out of the circuit

12787'61 Mc/s



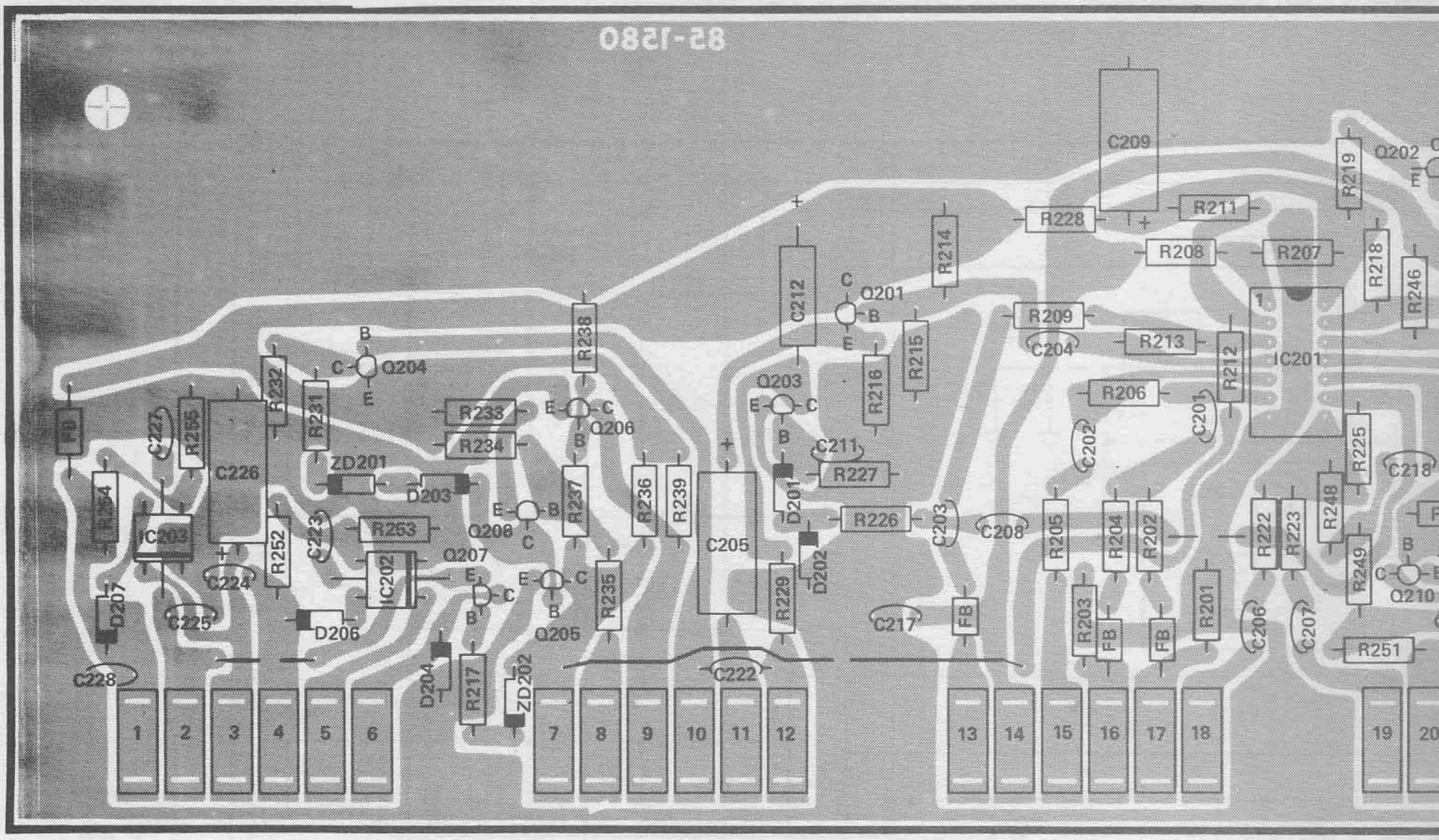
IXER SCHEMATIC

r Schematic symbols.

DIODES	QUANTITY	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
TRANSISTORS			
Q401-Q404	4	MPS6521	417-172
Q405, Q406	2	2N2369	417-154
Q407	1	2N3866	417-205

B

X-RAY VIEW



(Shown from component 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

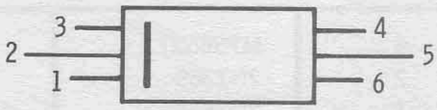
DC VOLTAGE WITH MODE SWITCH IN CW POSITION

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

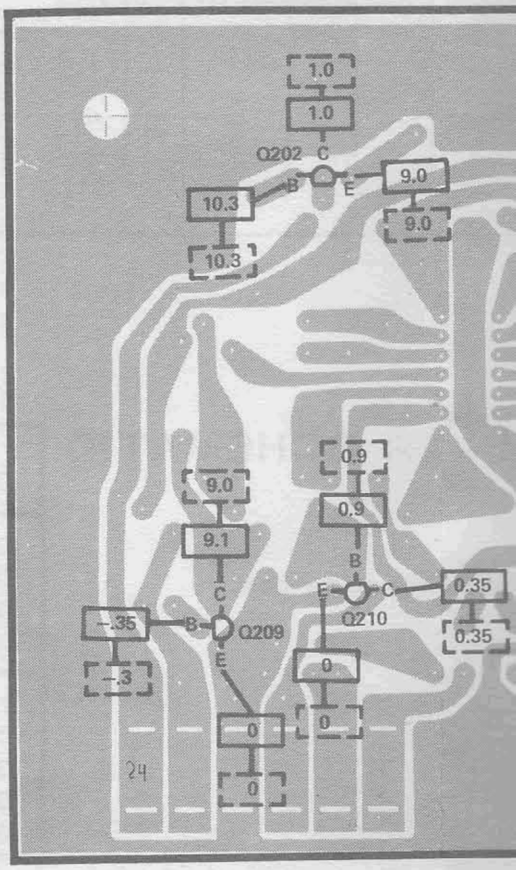
DC VOLTAGE IN RECEIVE OR TRANSMIT MODES

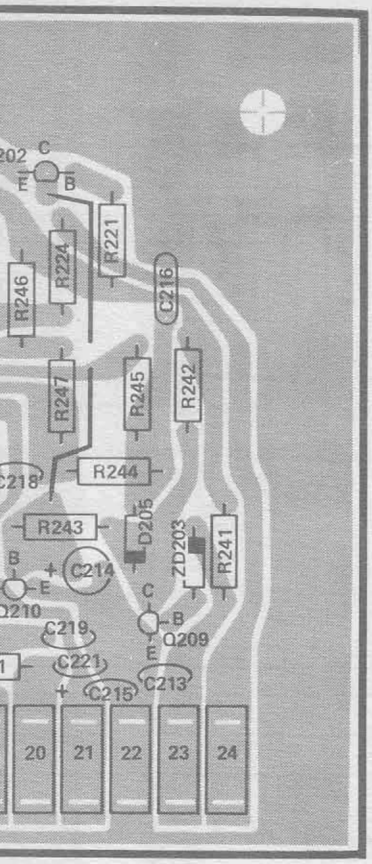
BASE DIAGRAM

TOP VIEW



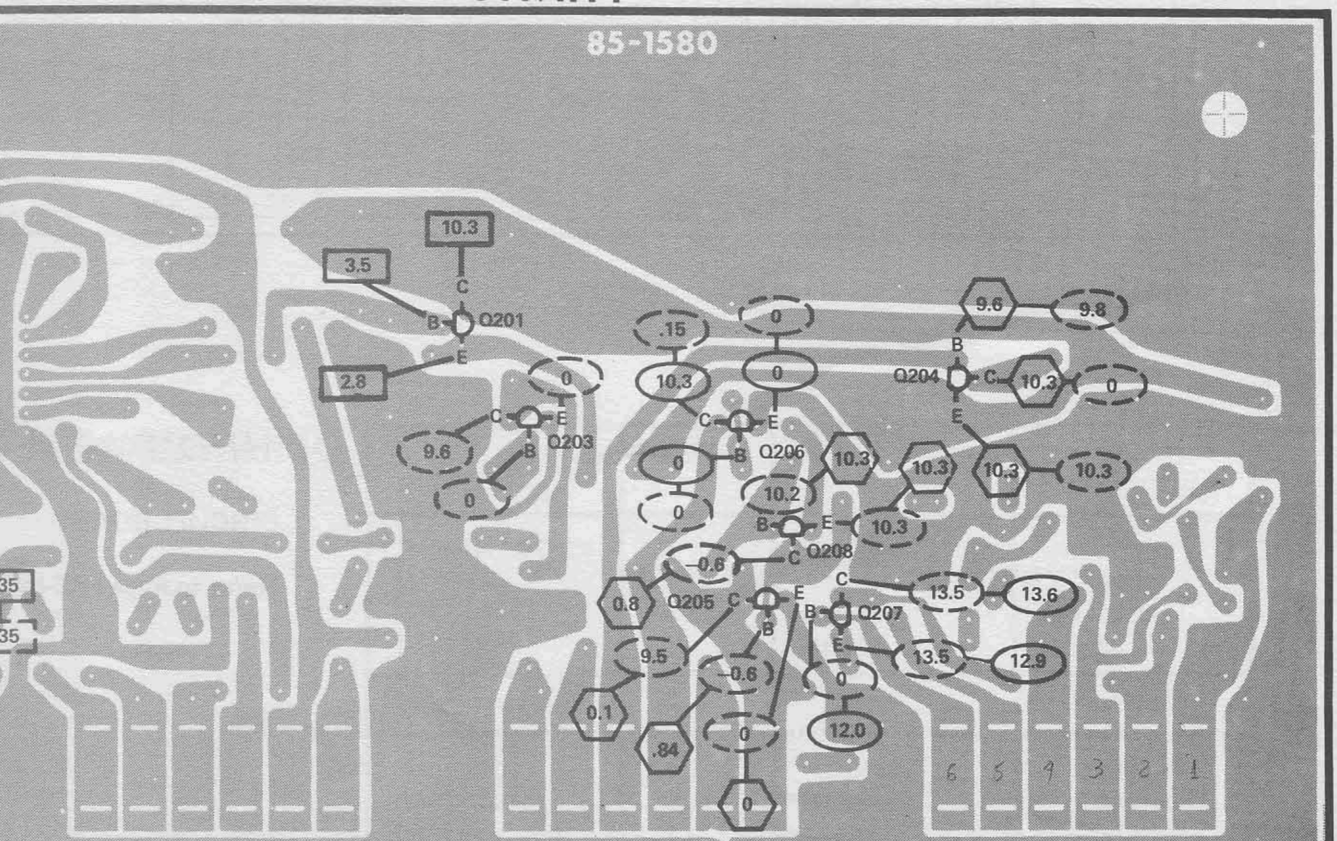
IC202, IC203





B **TRANSMITTER AUDIO/REG**

B **VOLTAGE CHART**



(Shown from foil side)

B

Transmitter Audio/Reg Circuit Board

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
5V missing or low.	1. 13.8V missing. 2. IC202, D206. 3. Q1 (5V source). 4. 5V line shorted.
11V missing or low.	1. 13.8V missing. 2. IC203, D207. 3. Q2 (11V source). 4. 11V line 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 S3E.
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 63 of this Manual.

Refer to the "X-Ray View" and "Voltage Chart" (fold-out from Page 296).

CIRCUIT DESCRIPTION

The function of these circuits is to process the transmitter audio input, provide the transceiver T/R control functions, and regulate the 13.8 volt input voltage to 11 volts and 5 volts for use throughout the Transceiver.

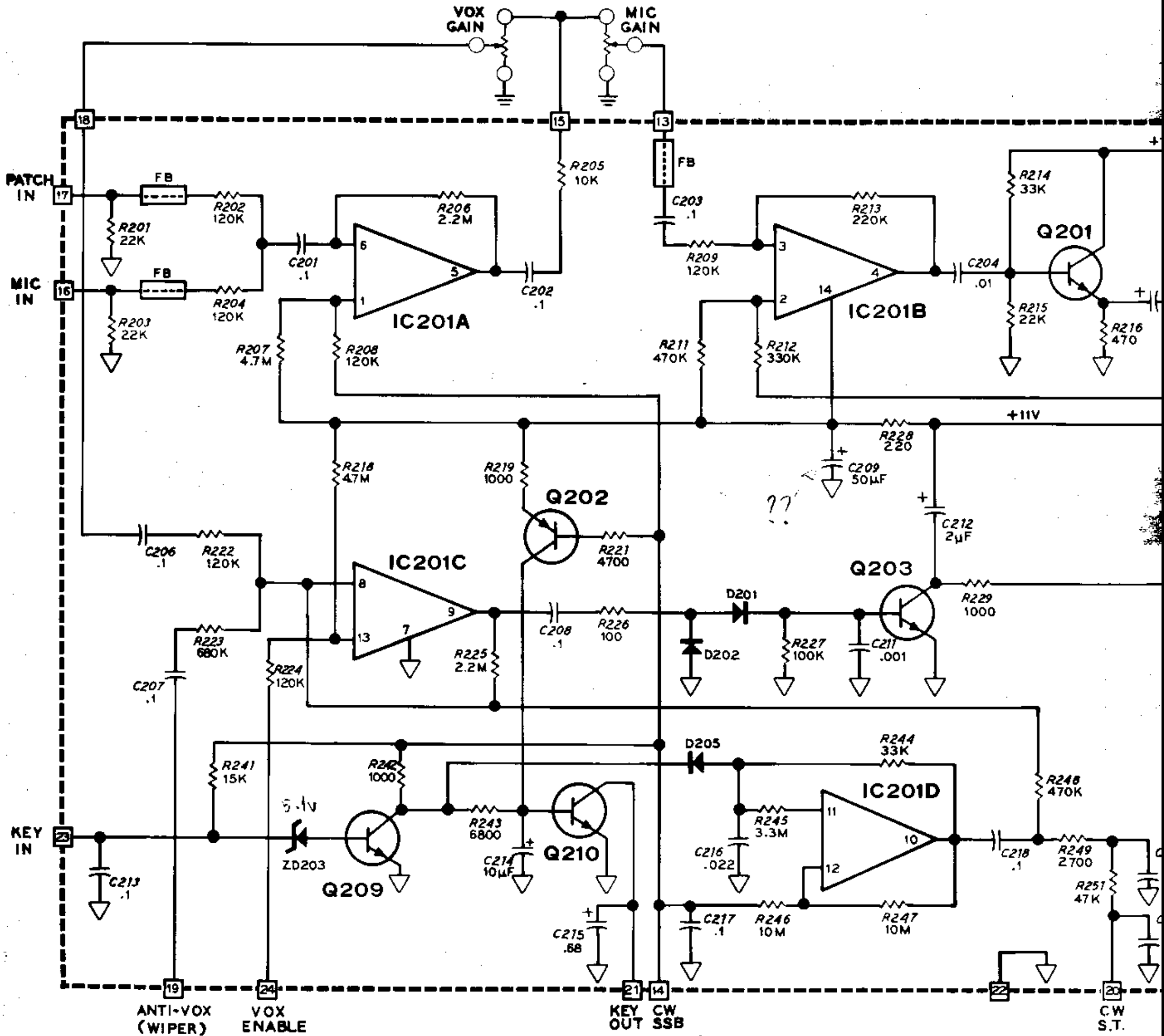
IC201 is a quad-operational amplifier, (there are four op amps in one package). One section is used as a microphone preamplifier. Phone patch inputs are also processed through this stage, which is disabled in the CW and TUNE modes to prevent microphone audio from being transmitted illegally. The microphone preamplifier feeds two 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 sidetone 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.

IC202 is the 5-volt regulator, and IC203 is the 11-volt regulator. External chassis-mounted pass transistors (Q1 and Q2) are used with these regulators to increase the current-handling capacity.



- " tune

ADJ
VOX GAIN
MIC <<
VOX DELAY

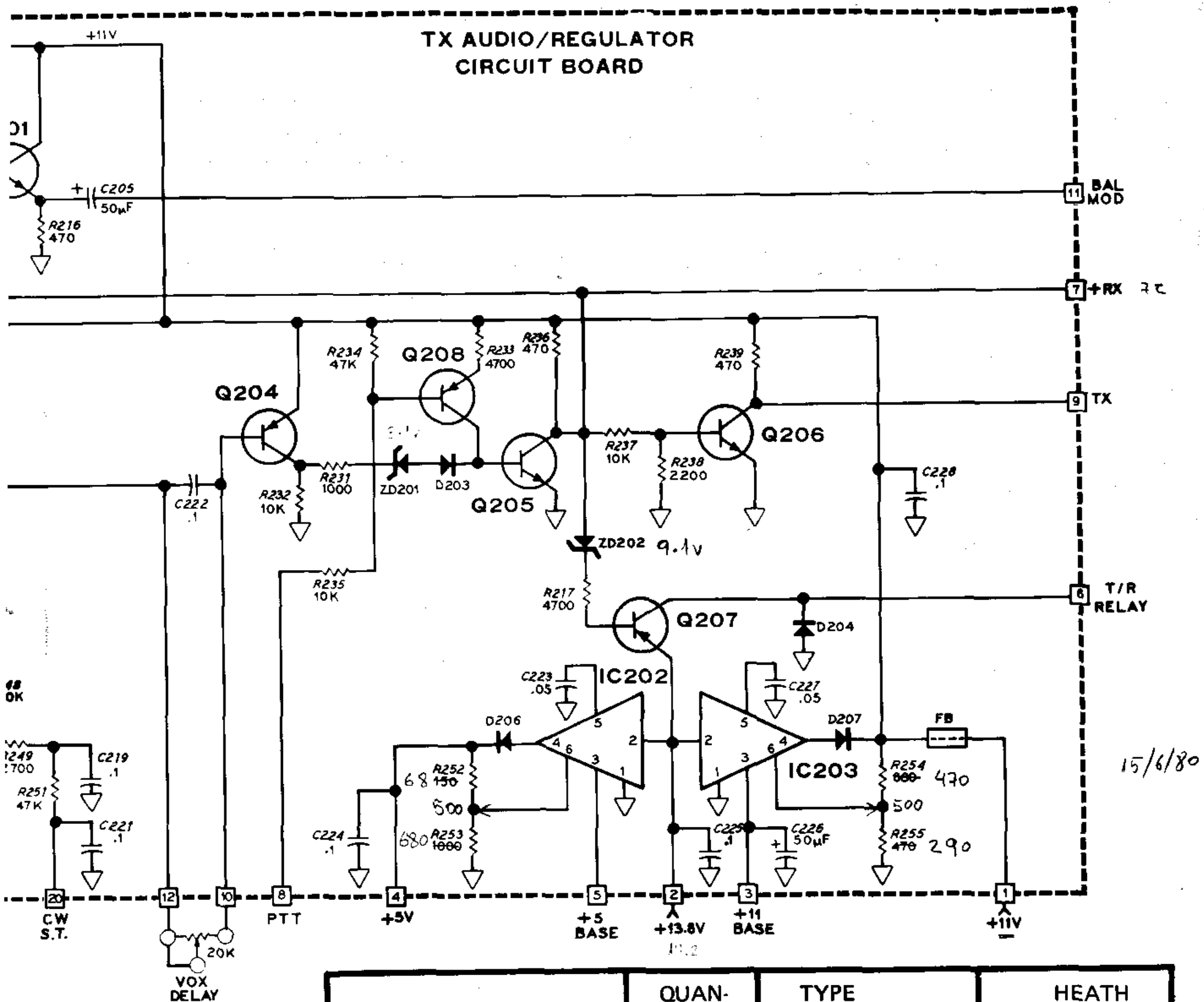
B **TRANSMITTER AUDIO/REG SCH**

CIRCUIT BOARD B

Refer to Page 282 for Schematic symbols.

100 630

150 420



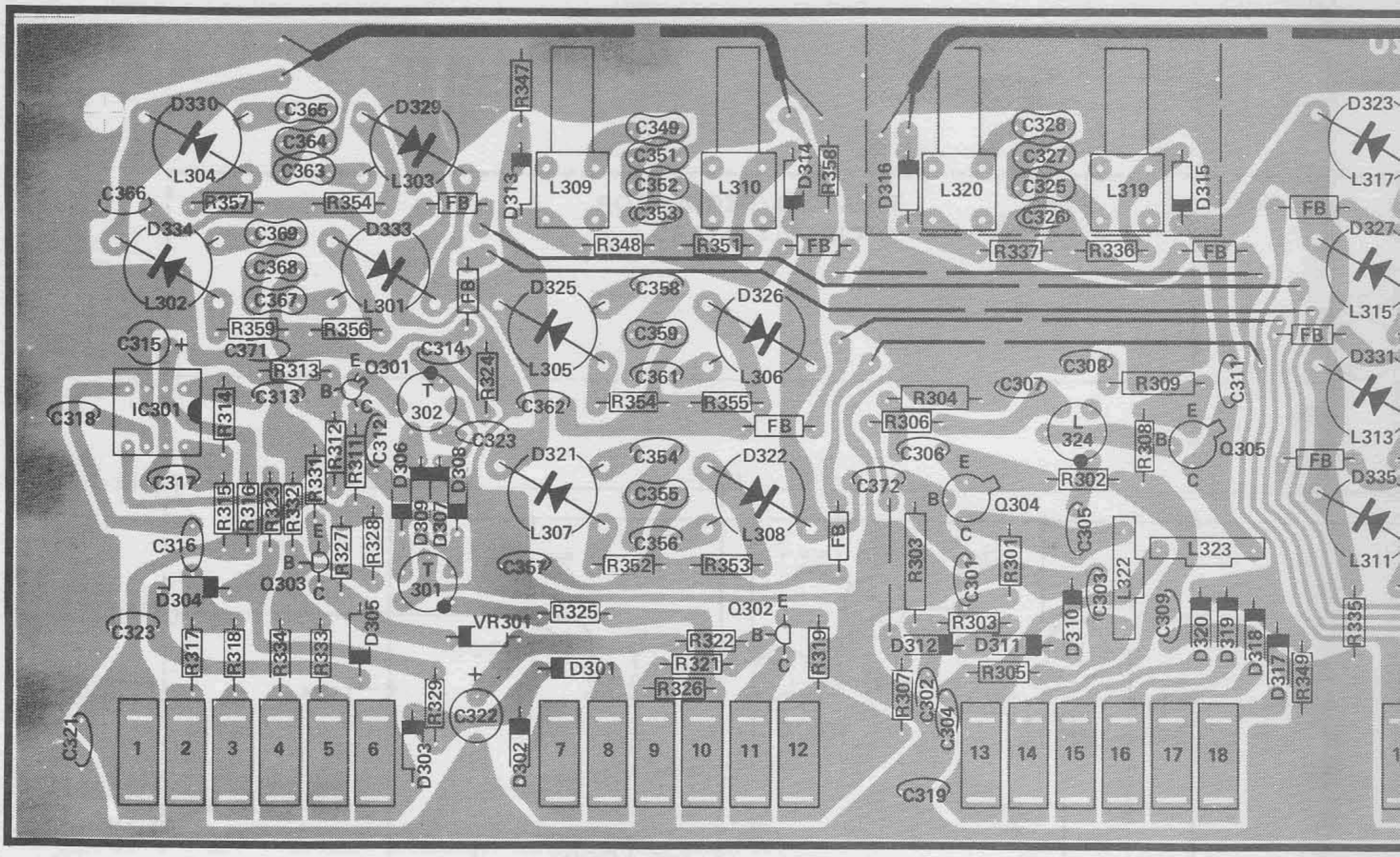
SCHEMATIC

DIODES	QUAN-TITY	TYPE	HEATH PART NO.
D201-D205 D206, D207	5 2	1N4149 1N4002	56-56 57-65
TRANSISTORS			
Q201, Q203, Q205, Q206, Q209, Q210 Q202, Q204, Q207, Q208	6 4	MPSA20 X29A829	417-801 417-201
INTEGRATED CIRCUITS			
IC201 IC202, IC203	1 2	LM3900 MFC6030	442-71 442-48

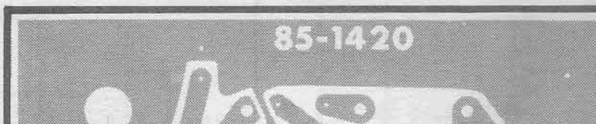
ZD201, ZD203 2 1N751

ZD202 1 VR9.1 9.1V 56-19

X-RAY VIEW



(Shown from component 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

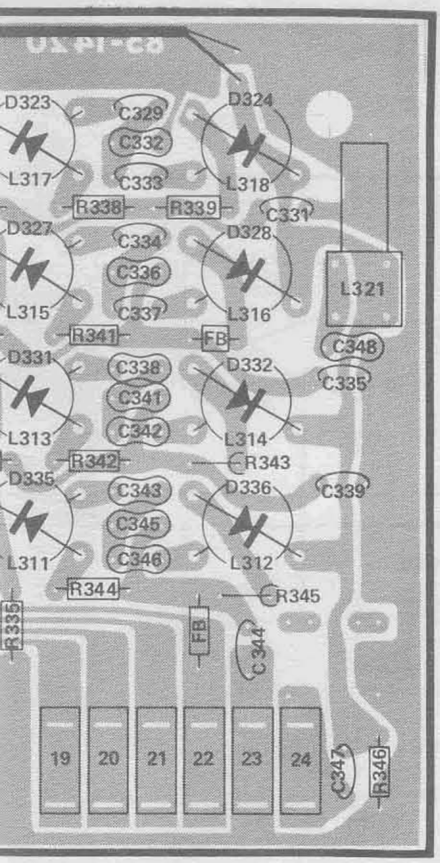
TRANSMITTER VOLTAGES (±20%)

NOTES:

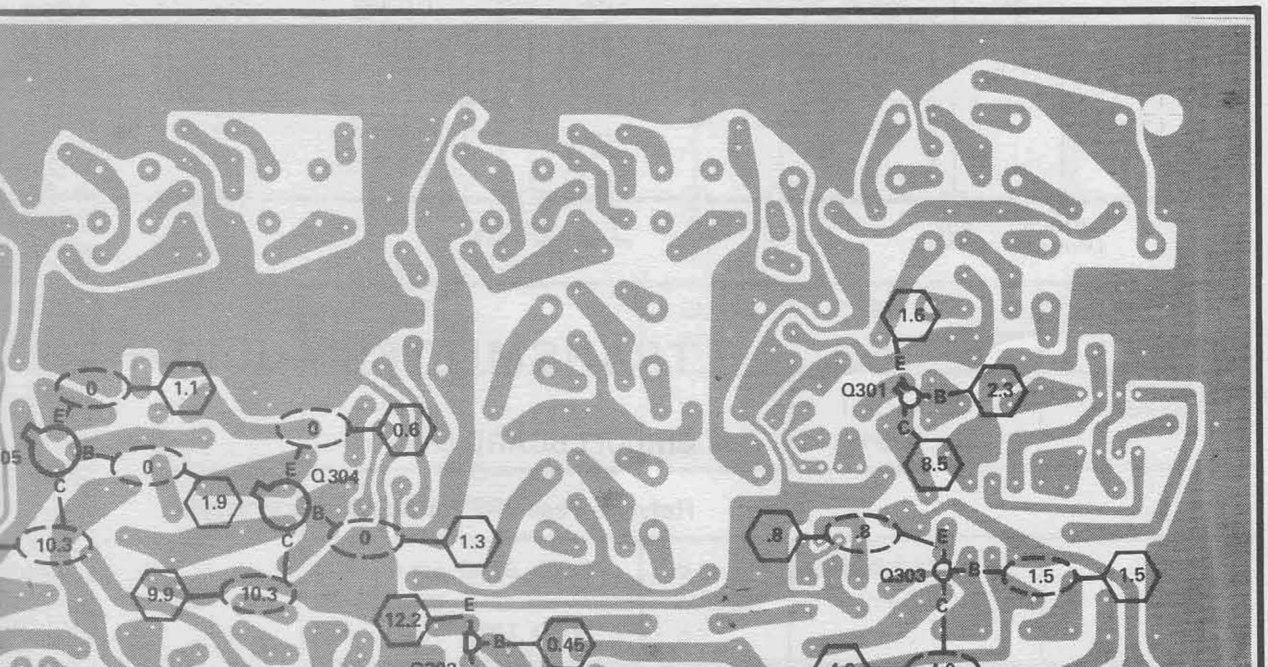
1. BANDSWITCH IN 3.5 POSITION
2. MODE SWITCH IN TUNE POSITION
3. METER SWITCH IN PWR POSITION
4. MIC/CW-LEVEL FULLY COUNTERCLOCKWISE

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

TRANSMITTER IF



VOLTAGE CHART



(Shown from foil side)

C

Transmitter IF Circuit Board

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 card 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 (card 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 73 of this Manual.

Refer to the "X-Ray View" and "Voltage Chart" (fold-out from this page).

CIRCUIT DESCRIPTION

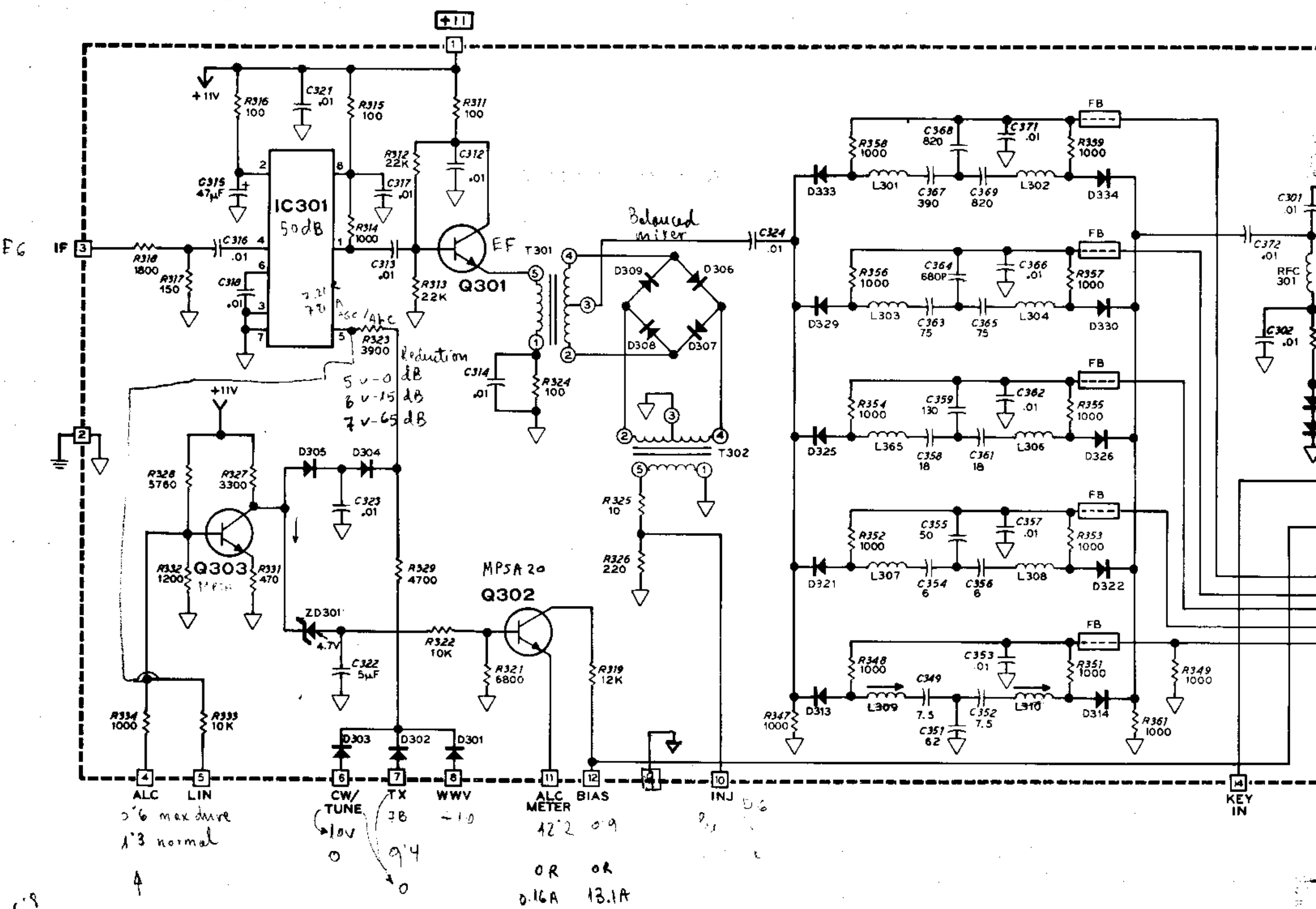
The function of this circuit is to amplify the 3.395 MHz IF signal, mix it with the premix injection to the desired output frequency, and amplify this signal to the level required by the driver (circuit board J).

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 circuit by switching the emitter DC return on and off. The output of the predriver is filtered by diode-selected bandpass filters.

L321 and the 470 pF capacitor at the output form a 3.395 MHz trap, used to reduce the amplitude of a spurious output at that frequency on 80 meters.



C

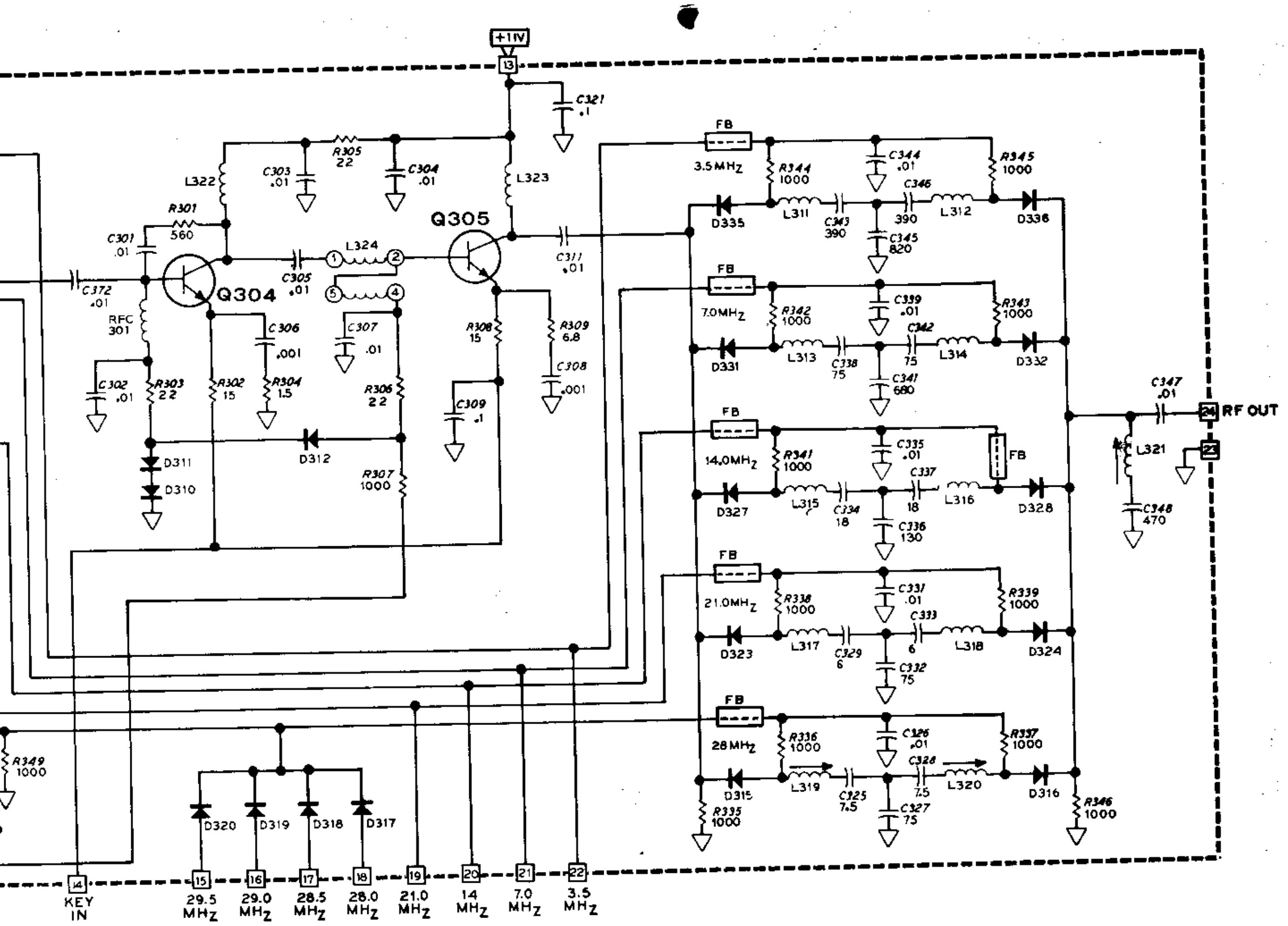
TRANSMITTER IF SCHEMATIC

CIRCUIT BOARD C

Refer to Page 282 for Schematic symbols.

ADJ

L309
L310
L319
L320 — 28 - 30 Mc/s band pass filter
L321 — 3'395 trap



MATIC

ls.

DIODES	QUANTITY	TYPE	HEATH PART NO.
D301-D305, D317-D320	9	1N4149	56-56
D306-D309	4	FH1100	56-87
D310-D312	3	1N4002	57-65
D313, D314, D321, D322, D325, D326 D329, D330, D333, D334	10	1N458	56-24
D315, D316, D323, D324, D327, D328, D331, D332, D335, D336	10	DRS-110	57-64
ZD301, 4.7V	1	1N750A (4.7V)	56-59
TRANSISTORS			
Q301	1	2N2369	417-154
Q302, Q303	2	MPSA20	417-801
Q304, Q305	2	2N3866	417-205
INTEGRATED CIRCUIT			
IC301	1	MC1350P	442-18

CHASSIS CONNECTOR WI

This chart specifies the wire identification (color, marking c under side of the chassis. It does not specify the source of agree with the chart but a wiring error is still suspected, chec the assembly Pictorials.

TERMINALS

ROW	1	2	3	4	5	6	7	8	9	10	11	12	13
COUNTER A	WHT-ORG	WHT-RED	BLK	WHT-YEL	WHT-ORG	WHT-RED	BRN	WHT-YEL	WHT-ORG	WHT-RED	YEL	WHT-YEL	WHT-ORG
TX-AUDRE B	RESISTOR 2 RED	2 ORG	GRAY	RESISTOR 2 ORG	GRAY	2 GRAY GRN	GRAY	BLU	YEL	BLK	#13	WHT-BLK	#8
TX-IF C	2 RED	2 GND	COAX	WHT-ORG	WHT-YEL	WHT-GRN	2 GRAY .1 μF	WHT- VIOL-VIOL GRAY	3 GND	2 COAX	2 VIOL	GRAY	3 RED 4 RED*
HFO-PRE D	2 RED	COAX	2 GND	GRAY	2 GND	COAX	2 GRAY WHT- GRN-BRN	WHT- BRN-BRN 2 GRAY	WHT-BRN 2 GRAY	BRN 2 GRAY	GRN GRAY	WHT- VIOL-VIOL GRAY	WHT-BLU GRAY
CARRIER E	COAX	2 GND	GRAY	GRAY	GRAY	COAX	GRAY	GND	WHT-ORG 2 GRAY	GRAY	3 GRAY	COAX	GRAY
RX-IF F	COAX	2 GND * 1 R 560Ω	2 RED	NC	VIOL	GND	GRAY	YEL	WHT- GRAY-GRAY	WHT- RED-RED	COAX	2 GND	2 GND
RX-FE G	COAX * 1 L 2.2μH	RED	4 GND	#3 COAX	WHT-RED	COAX	GRN	BRN	WHT-BRN	WHT- BRN-BRN	WHT- GRN-BRN	GND	GRAY RESISTOR RED
PA H	ORG GRAY	2 GND	2 COAX	GND	2 RED	2 RED							
DRIVER J	4 ORG	#5	GND -47 μF	GRAY +47 μF	BLK	WHT-BLK							
ALC/OP K	GND	GND	ORG	WHT	GRAY .1 μF	WHT-GRN							
N.B L*	COAX	GND GRAY	RED	GND 2 GRAY	COAX	RED							

*NOISE BLANKER

EXAMPLE:

	7	8	9
R	2 WHT	BLU WHT- RED-RED	#2

R7 = 2 white wires.
R8 = 1 blue wire, and 1 white-red-red wire.
R9 = 1 coax marked "2".
R10 = 1 coax marked "3", and 1 unmarked coax.
R11 = 2 ground connections, negative terminal of a polarized capacitor.
R12 = 1 gray wire and 1 orange wire.

SIS CONNECTOR WIRING CHART

ication (color, marking or type) of the wiring to the connectors on the
ot specify the source of each wire. Consequently, if all the connections
or is still suspected, check the connections at both ends of each wire on

	13	14	15	16	17	18	19	20	21	22	23	24
-YEL	WHT-ORG	WHT-RED	GRN	WHT-YEL	WHT-ORG	WHT-RED	BLU	WHT-YEL	2 ORG	WHT-VIOL-VIOL	VIOL	WHT-VIOL
-BLK	#8	WHT 2 WHT-ORG	#9	#11	#14	#12	#15	#16	GRAY	2 GND	2 BRN	WHT
Y	3 RED 4 RED*	GRAY	GRAY WHT-GRN-BRN	WHT-BRN-BRN GRAY	WHT-BRN GRAY	BRN GRAY	GRN GRAY	BLU GRAY	YEL GRAY	2 GRAY	2 GND	#5
-VIOL Y	WHT-BLU GRAY	YEL GRAY	2 GRAY	GND	GND	GND						
K	GRAY	GRAY	WHT-YEL	WHT-VIOL-VIOL WHT-GRN	2 GRAY	GRAY	COAX	RED	GRAY	2 GND	GRAY	#13
D	2 GND	COAX	#6 #17	#7	3 RED	2 GND	ORG	GND	#2 #4	GND	3 GND	GND
	GRAY RESISTOR RED	2 RED	YEL GRAY RESISTOR	GND	WHT-VIOL-VIOL	WHT-BLU	GND	YEL	GRAY	GRAY	2 GND	GRAY

EXAMPLE:

9	10	11	12
#2	#3 COAX	2 GND .47 μF	GRAY ORG

red wire.

unmarked coax.
ve terminal of a

t.

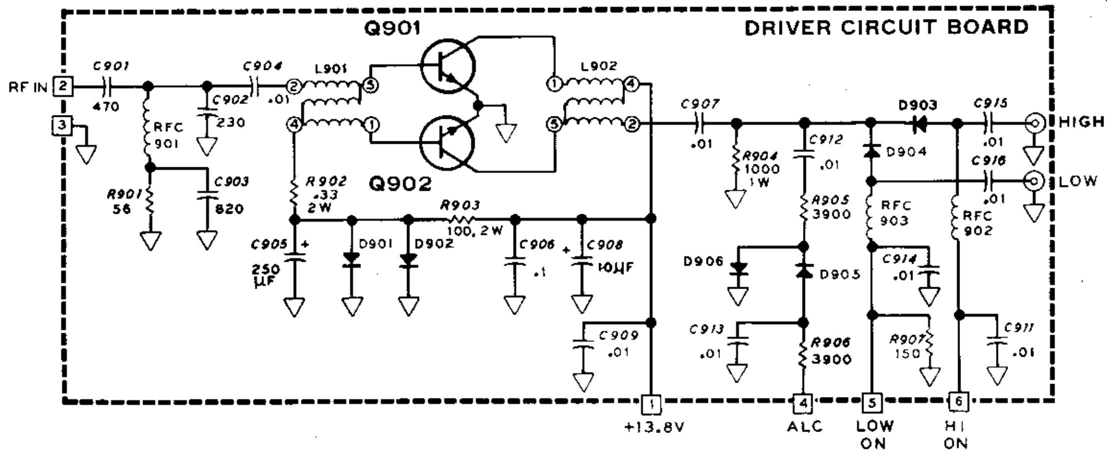
J

Driver Circuit Board

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/predriver (board C). 2. D905, D906. 3. Poor load impedance.

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the Parts List starting on Page 91 of this Manual.

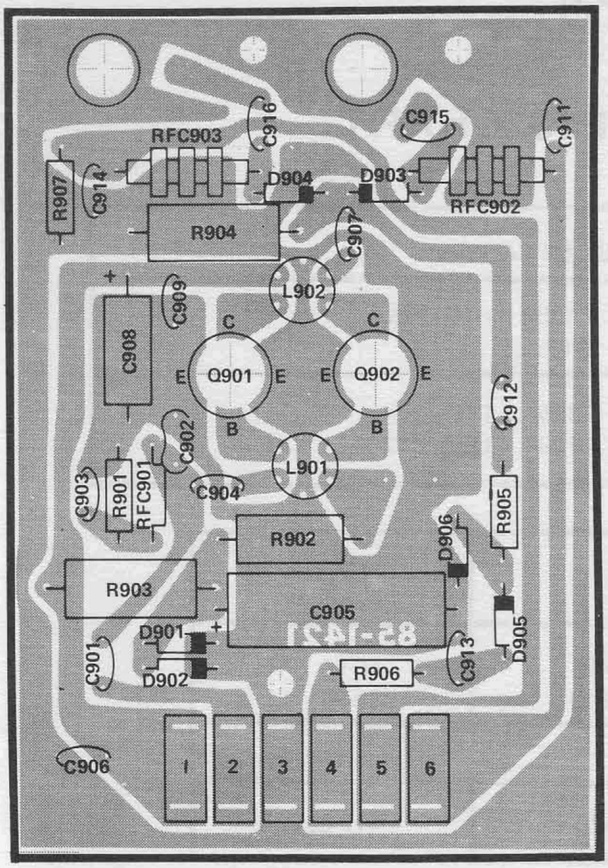


ADJ
NONE

SCHEMATIC
CIRCUIT BOARD J

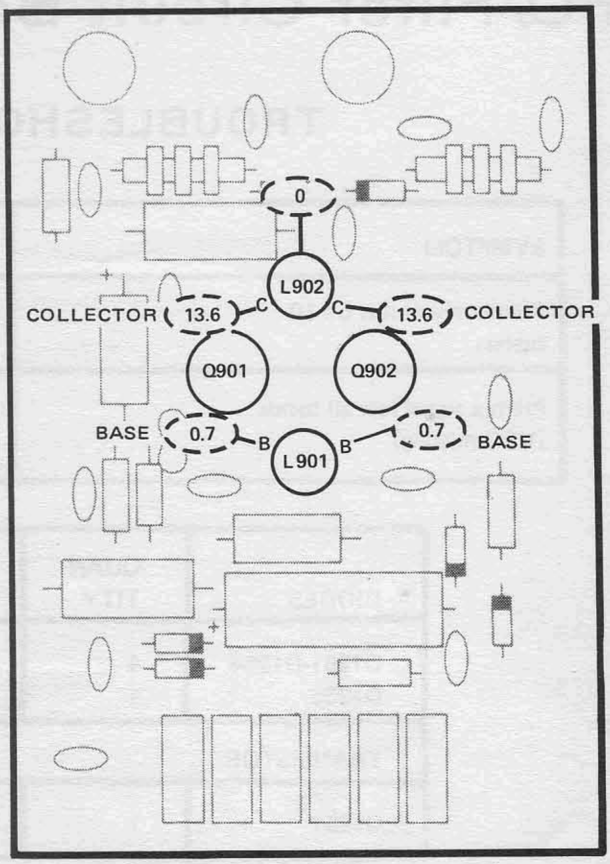
DIODES	QUAN-TITY	TYPE	HEATH PART NO.
D901, D902	2	1N4002	57-65
D903, D904	2	DRS-110	57-64
D905, D906	2	1N191	56-26
TRANSISTORS			
Q901, Q902	2	PT6619	417-830

X-RAY VIEW



(Shown from component side)

VOLTAGE CHART



(Shown from component 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

The function of this circuit is to amplify the predriver 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 controlled by the relay switching line in conjunction 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.

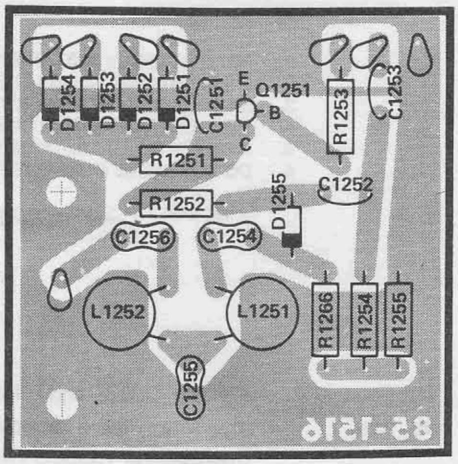
VFO/Filter Circuit Board

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.

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

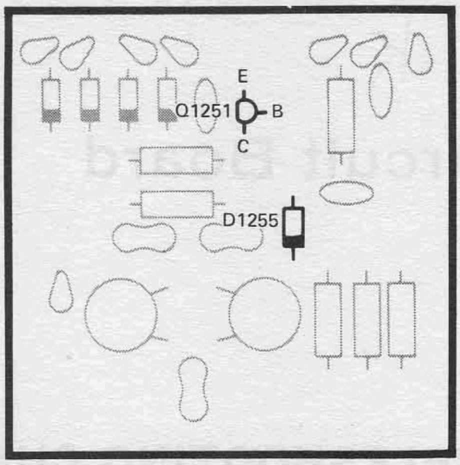
X-RAY VIEW



(Shown from component side)

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the Parts List starting on Page 91 of this Manual.

VOLTAGE CHART



(Shown from component side)

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.

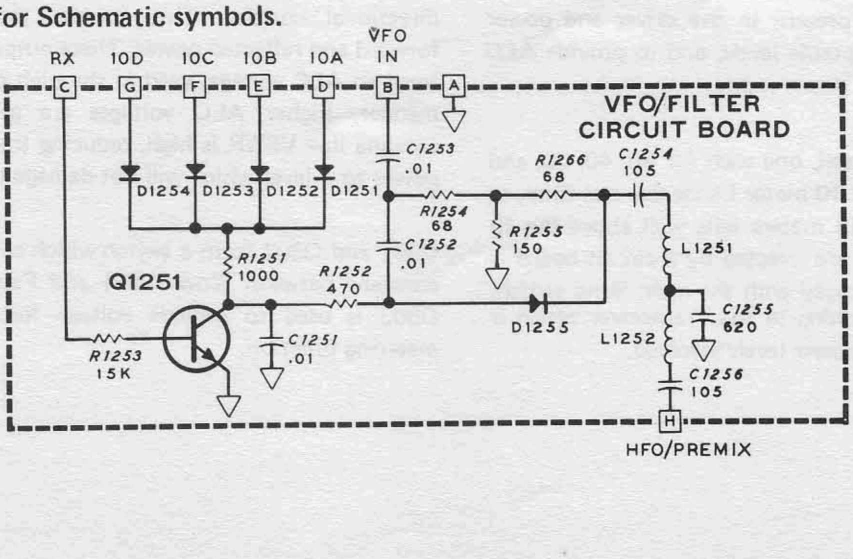
When the Band switch is turned to any of the four bands in the 28.0 through 29.5 MHz range, a positive voltage is applied to one of diodes D1251 through D1254, which causes it to conduct. Consequently, the positive voltage forward biases D1255, which conducts and permits the incoming VFO signal to pass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

SCHEMATIC

Refer to Page 282 for Schematic symbols.



ADJ
NONE

K

ALC/Output Circuit Board

Automatic Level Control

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.

CIRCUIT DESCRIPTION

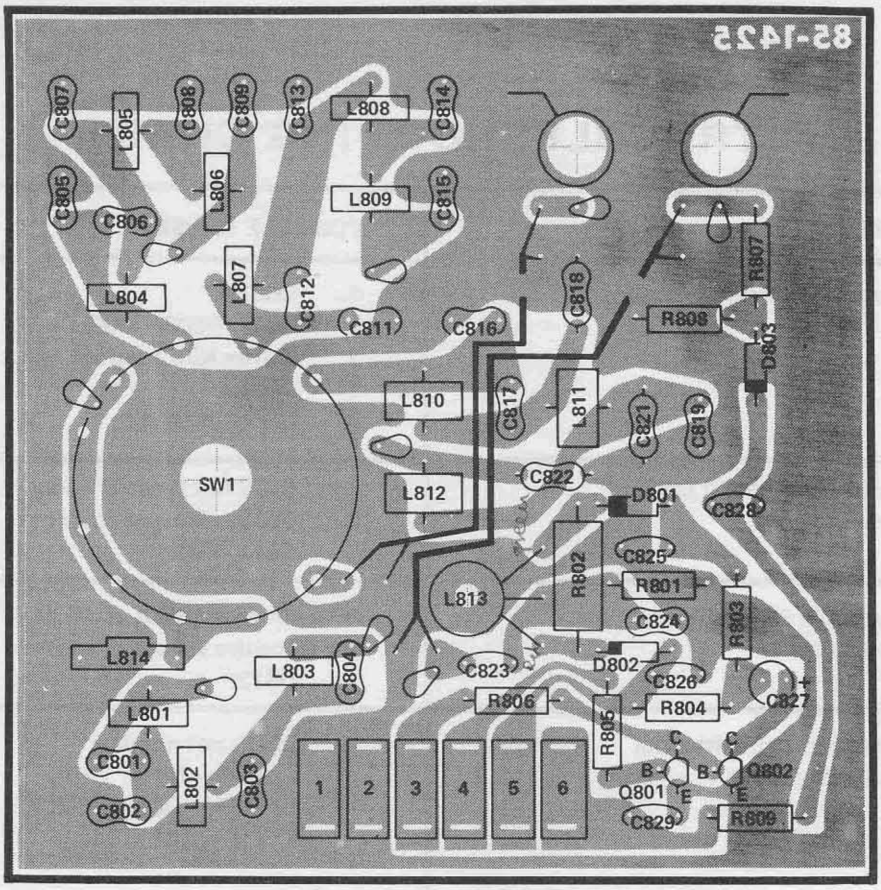
The function of the low pass filter/ALC circuit is to attenuate the harmonics present in the driver and power amplifier outputs to acceptable levels, and to provide ALC control voltage in the high power mode.

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.

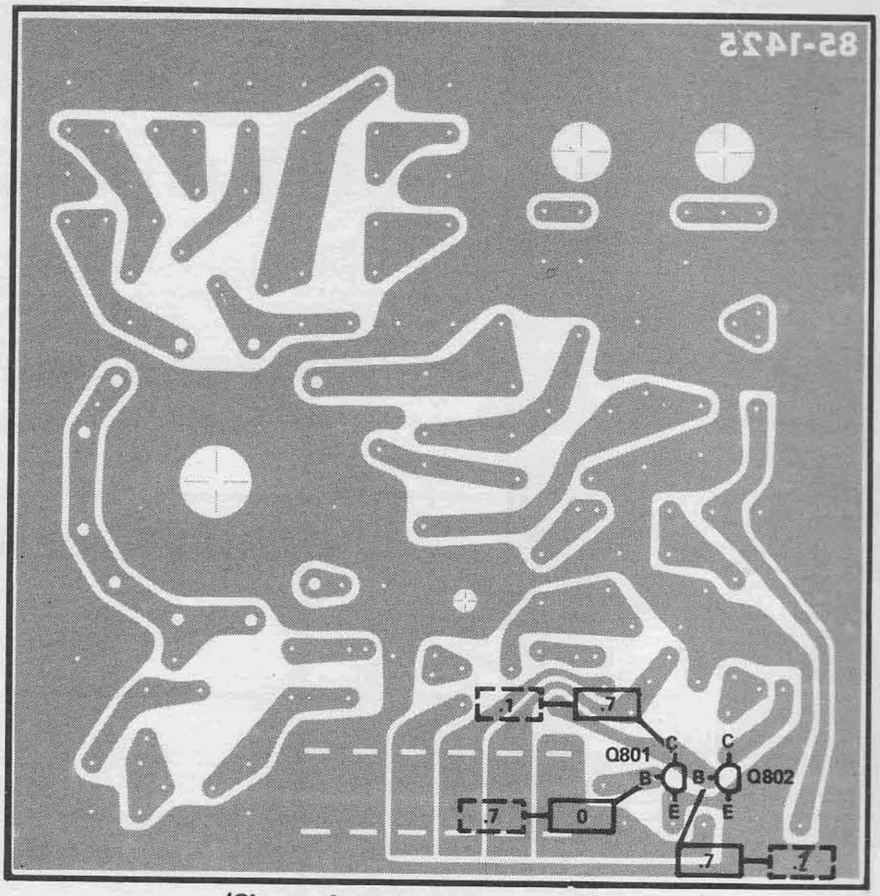
X-RAY VIEW



(Shown from component side)

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

VOLTAGE CHART



(Shown from component side)

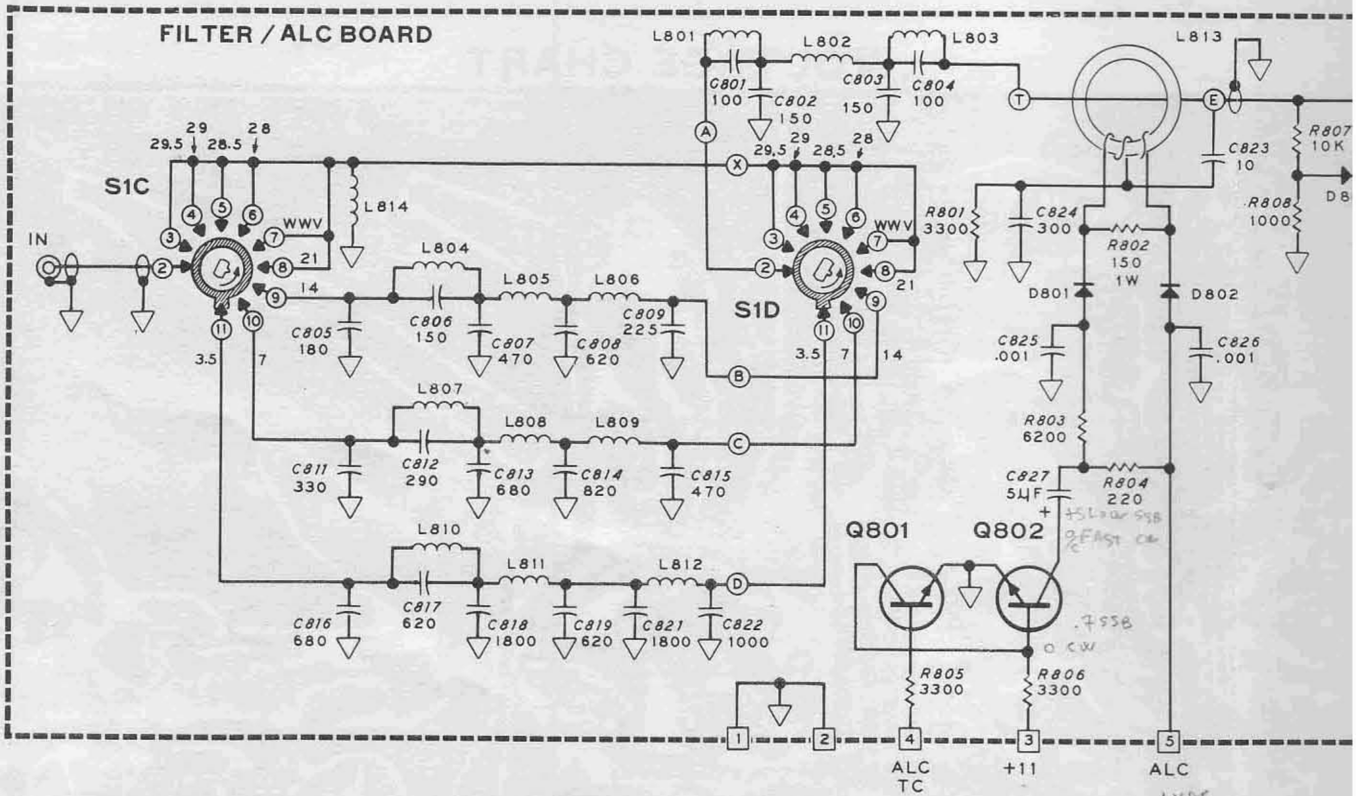
TRANSMITTER VO

NOTES:

1. BANDSWITCH
2. MODE SWITCH
3. METER SWITCH
4. MIC/CW-LEVEL

DC VOLTAG

DC VOLTAG



+5Low SSB
2 FAST CW

.7 SSB
0 CW

1 VDC
min power
min ALC

FILTER/ALC SCHEMATIC

CIRCUIT BOARD K

CW 10 VDC
SSB 0 VDC

Refer to Page 282 for Schematic symbols.

ANSMITTER VOLTAGES (±20%)

OTES:

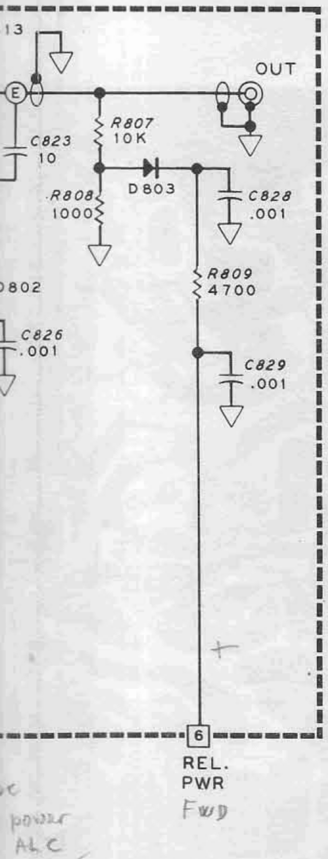
BANDSWITCH IN 3.5 POSITION
MODE SWITCH IN TUNE POSITION
METER SWITCH IN PWR POSITION
MIC/CW-LEVEL FULLY COUNTERCLOCKWISE

DC VOLTAGE WITH MODE SWITCH IN USB OR LSB POSITION

DC VOLTAGE WITH MODE SWITCH IN CW POSITION

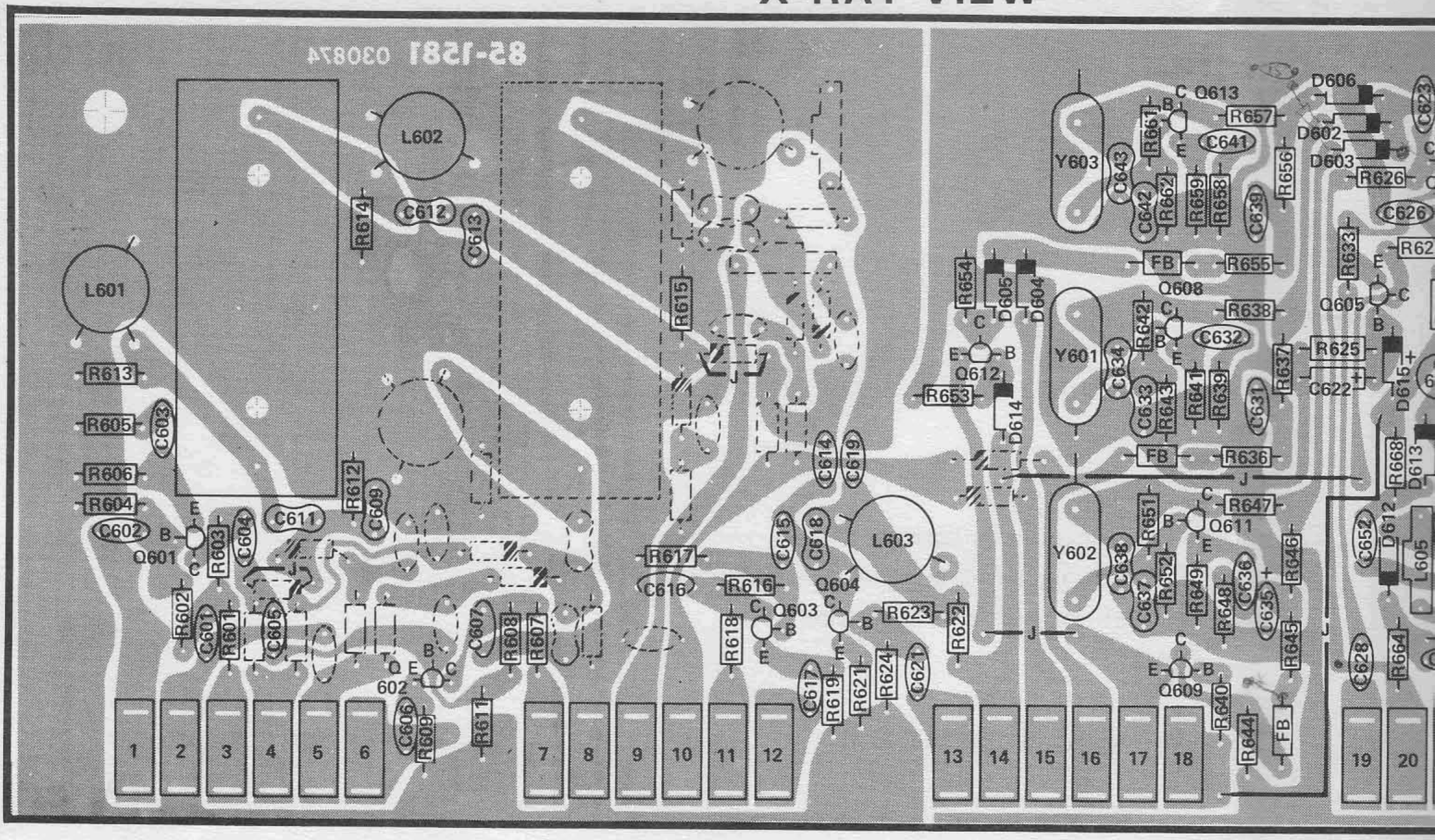
ADJ

NONE



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

X-RAY VIEW



(Shown from component 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%)

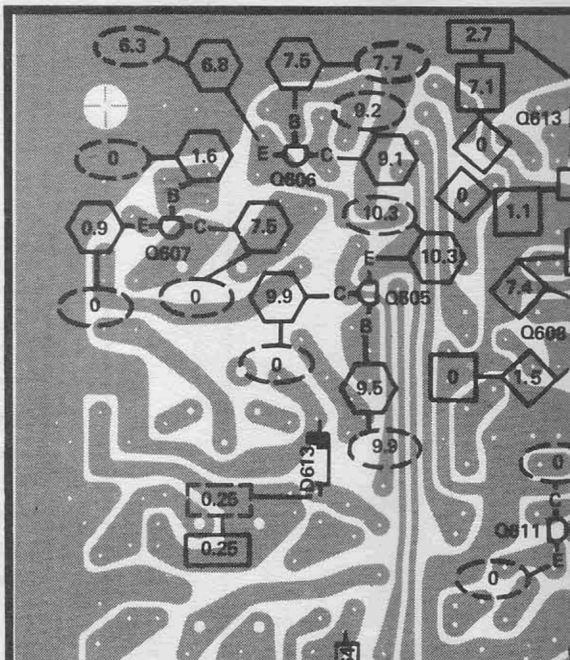
NOTES:

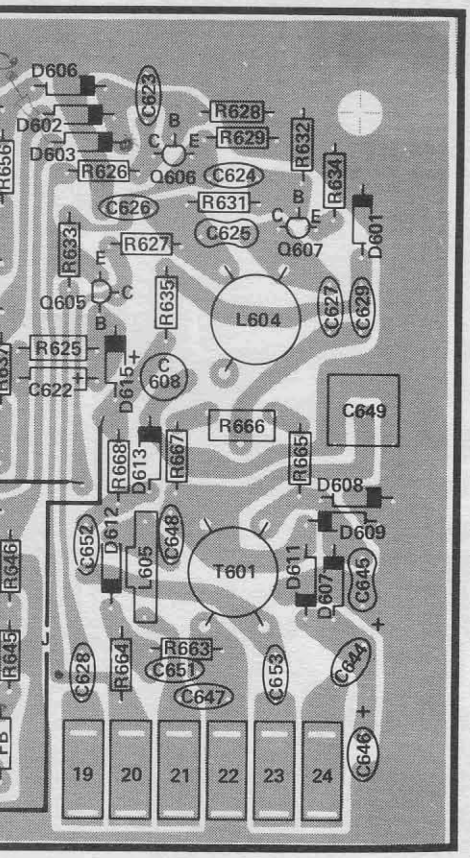
1. BANDSWITCH IN 3.5 POSITION
2. MODE SWITCH IN TUNE POSITION
3. METER SWITCH IN PWR POSITION
4. MIC/CW-LEVEL FULLY COUNTERCLOCKWISE

DC VOLTAGE WITH MODE SWITCH IN USB OR LSB POSITION

DC VOLTAGE WITH MODE SWITCH IN CW POSITION

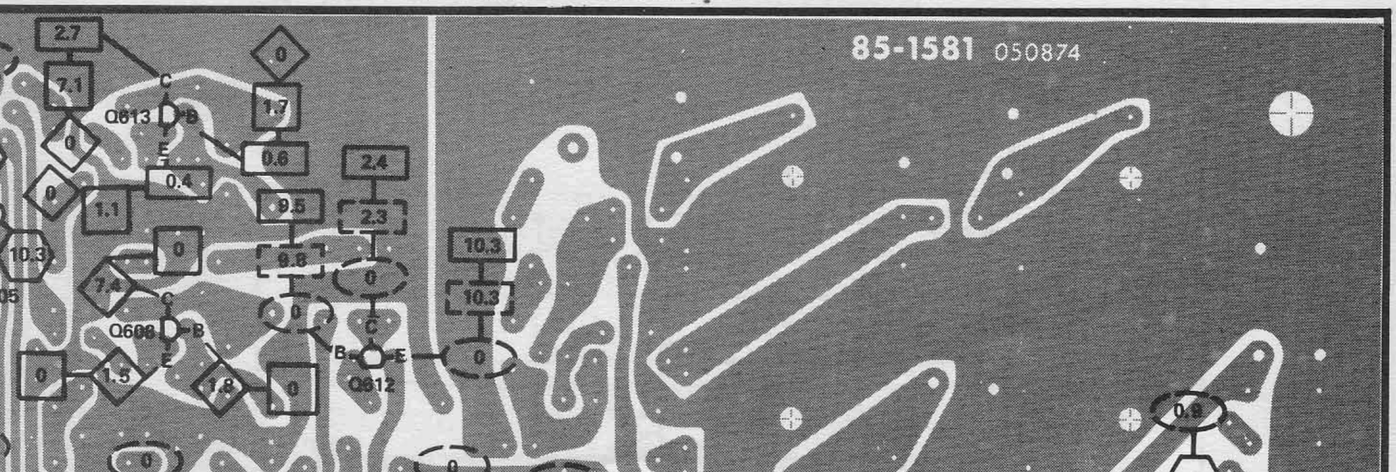
DC VOLTAGE WITH MODE SWITCH IN USB, LSB, OR CW POSITION





CARRIER GEN/XTAL FILTER

VOLTAGE CHART



(Shown from foil side)

E

Carrier Gen/Xtal Filter Circuit Board

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. Q604, Q608.
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.
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.

Refer to the "X-Ray View" and "Voltage Chart" (fold-out from Page 306).

CIRCUIT DESCRIPTION

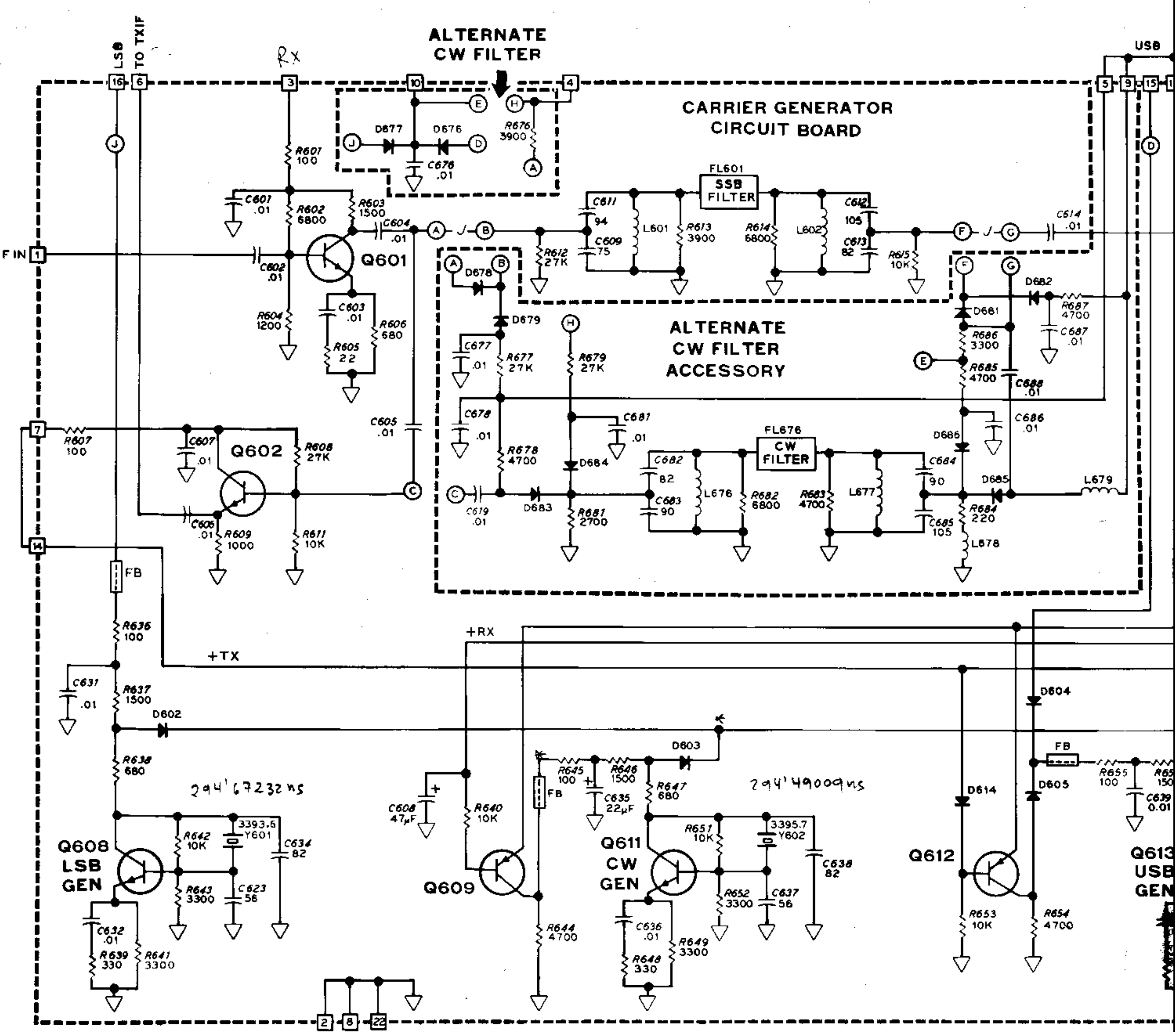
These circuits provide highly selective filtering of the 3.395 MHz IF, and generate the BFO signals in both receive and transmit modes. Solid-state switching is employed to provide bilateral filtering and to select between the single sideband filter and the optional, narrow-bandwidth CW filter.

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 transmit IF board.

The second set of switches selects either the SSB filter or the CW filter. In 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 transmit IF which is fed to the crystal filter.



CARRIER GEN/XTAL FILTER S

E

CIRCUIT BOARD E

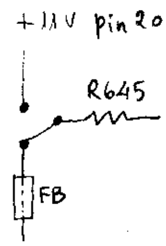
Refer to Page 282 for Schematic symbols.

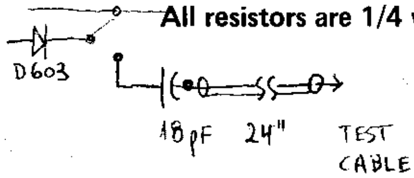
All resistors are 1/4 watt.

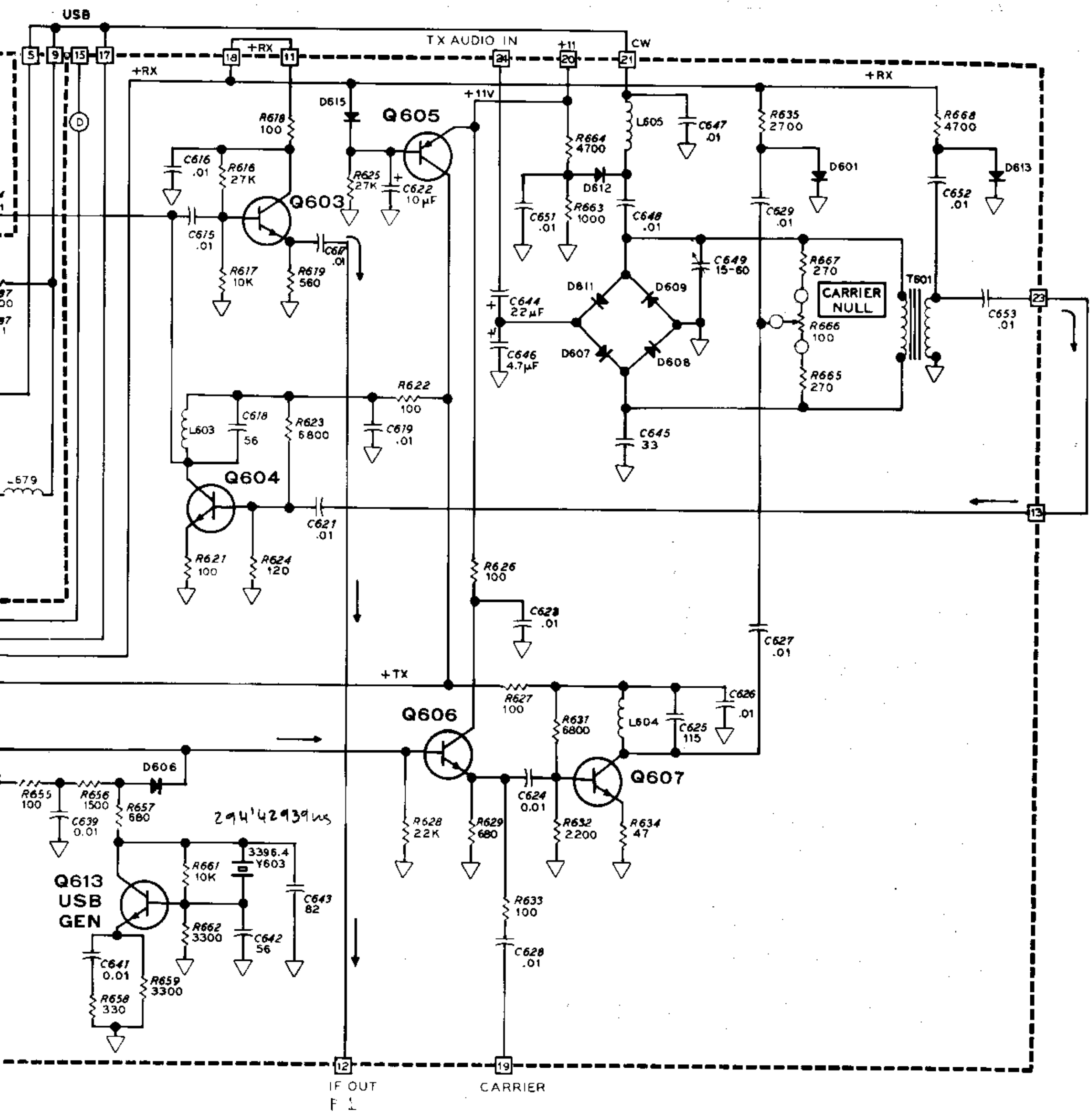
ADJ

R666 carrier null

9.245



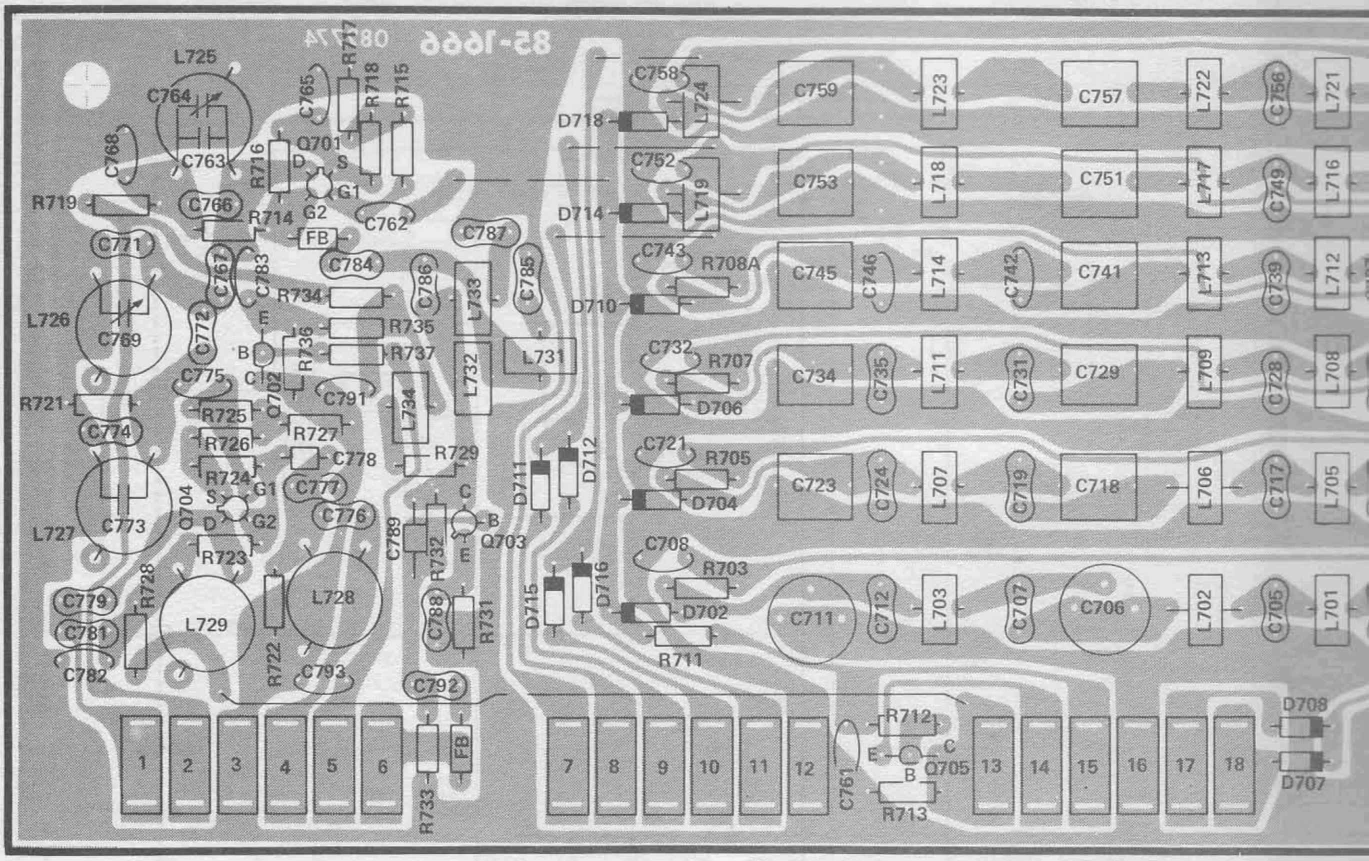




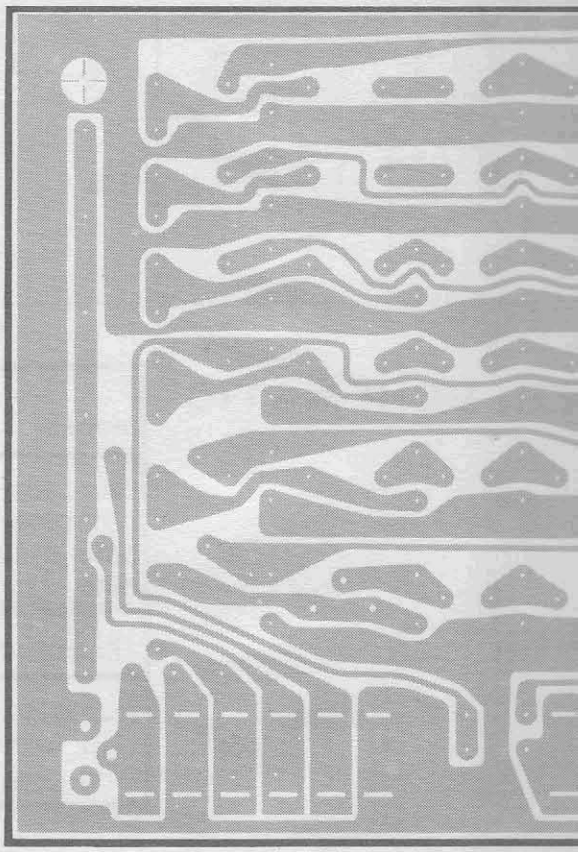
ER SCHEMATIC

DIODES	QUANTITY	TYPE	HEATH PART NO.
D601-D606, D612, D613	8	1N458	56-24
D607-D609, D611	4	FH1100	56-87
D614	1	GD510	56-89
D615	1	1N191	56-26
TRANSISTORS			
Q601-Q604, Q606-Q608, Q611, Q613	9	MPSA20	417-801
Q605, Q609, Q612	3	X29A829	417-201

X-RAY VIEW



(Shown from component side)



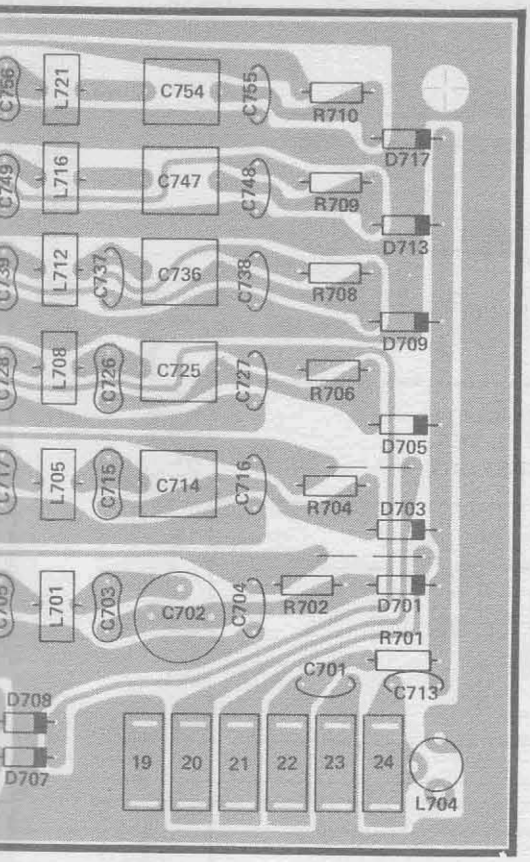
RECEIVER VOLTAGES (±20%)

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

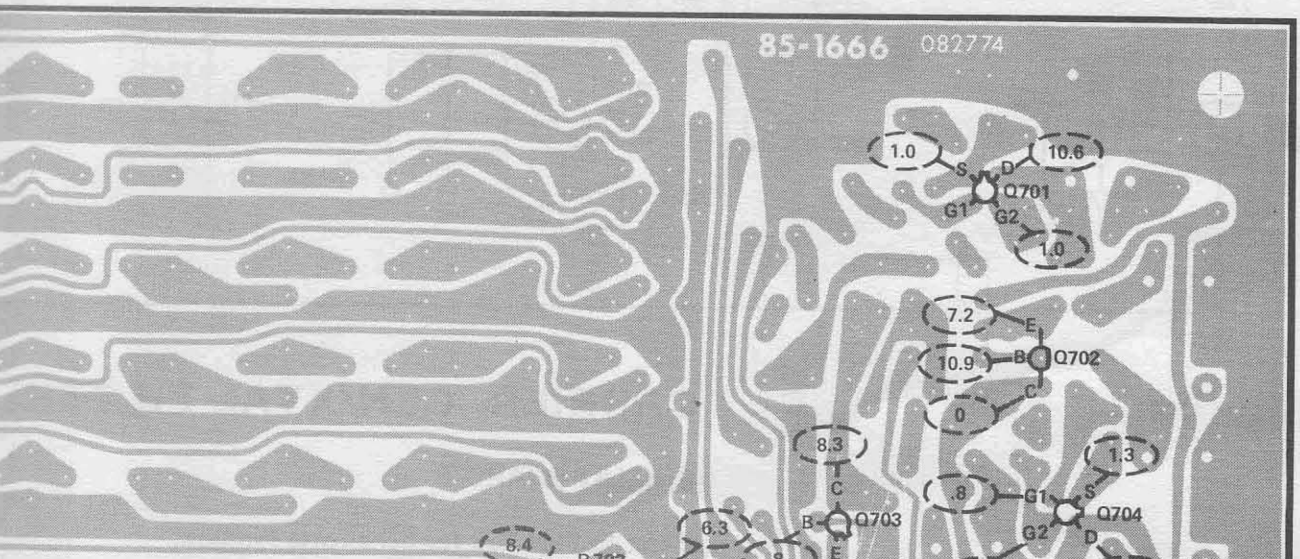
( ) DC VOLTAGE WITH MODE SWITCH IN USB, LSB, OR CW POSITION

Voltage at Q702 taken with RF Gain fully clockwise.



RECEIVER FRONT END

VOLTAGE CHART



(Shown from foil side)

G

Receiver Front End Circuit Board

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
Preselector filter or filters cannot be aligned properly.	1. Alignment cable soldered to wrong foil on counter board. 2. Filter coils interchanged between filters. 3. Switching diodes installed backwards, defective, or not properly biased. D701 – D718.
No HFO injection at G2 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 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.

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

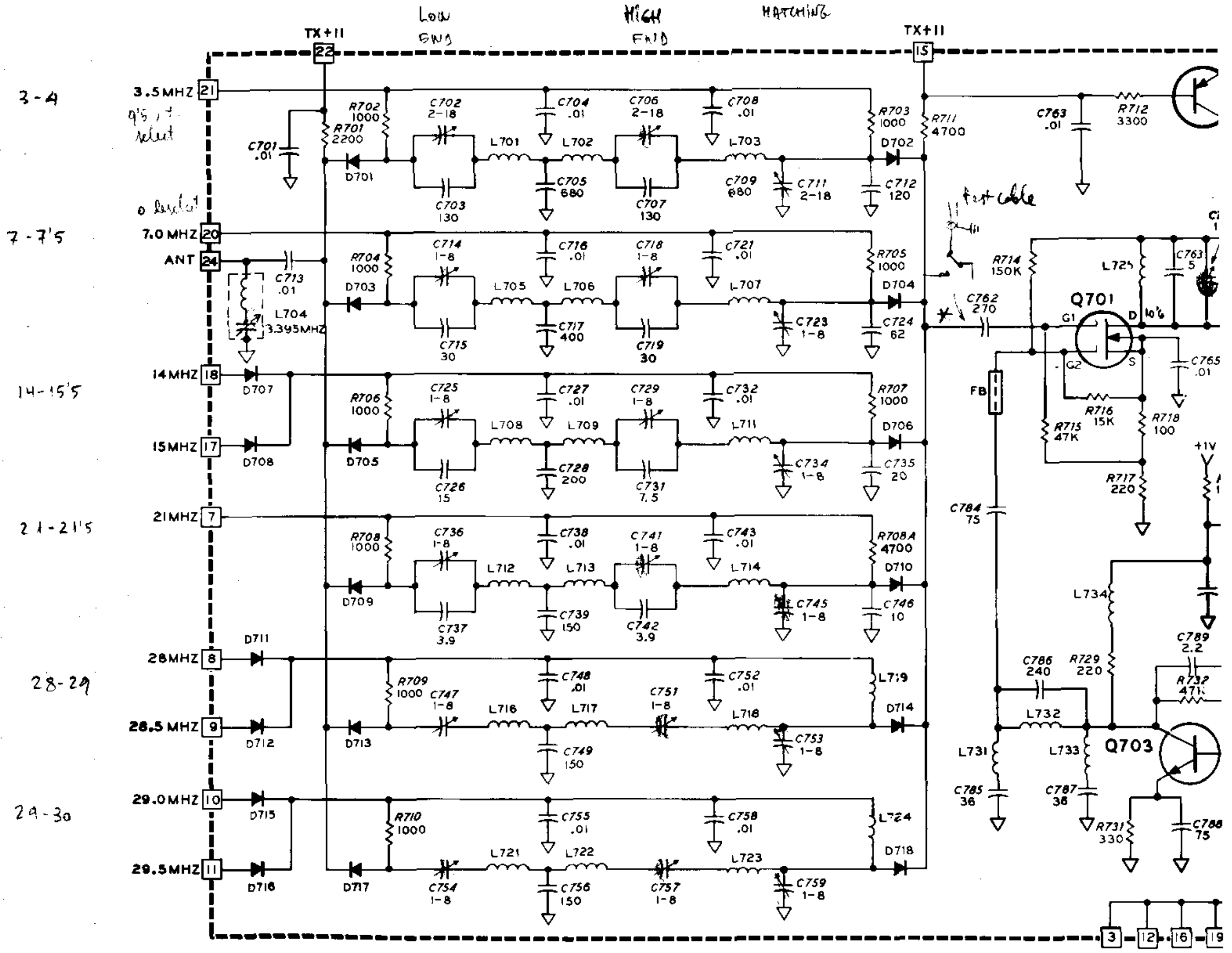
Refer to the "X-Ray View" and "Voltage Chart" (fold-out from Page 308).

CIRCUIT DESCRIPTION

The receiver front end establishes receiver selectivity 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, D714, D717, and D718 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.



ADJ

3'5-4 C702-C706-C711 Band pass filter G
7-7'5 C714-C718-C723
14-15'5 C725-C729-C734
21-21'5 C736-C741-C745
28-29 C747-C751-C753
29-30 C754-C757-C759
8'395-8895 C764 } pag. 240
8'395-8895 C769

L704 3.395

RECEIVER FRONT END SCHEMA

CIRCUIT BOARD G

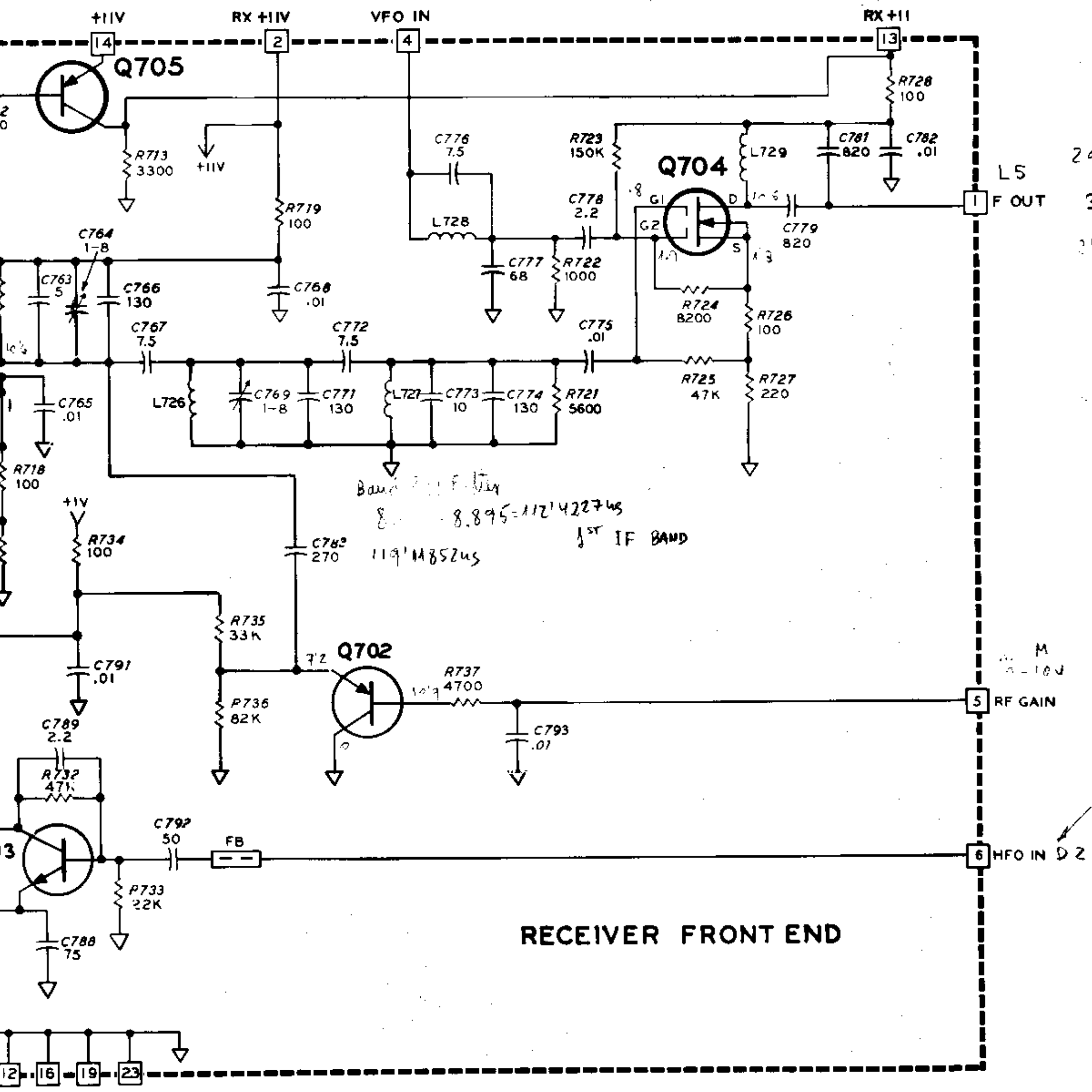
Refer to Page 282 for the Schematic symbols.

DIODI
D701- D707,
TRAN
Q701, Q702, Q703

5'250 = 190' 47617us

200hs 181'81818us

5.0 - 5.5



294'55081us

3.395

2ND IF

Band Pass Filter

8.895 = 112'4227us

1ST IF BAND

119'1852us

XTAL IN VARIABLE IN 1ST conversion

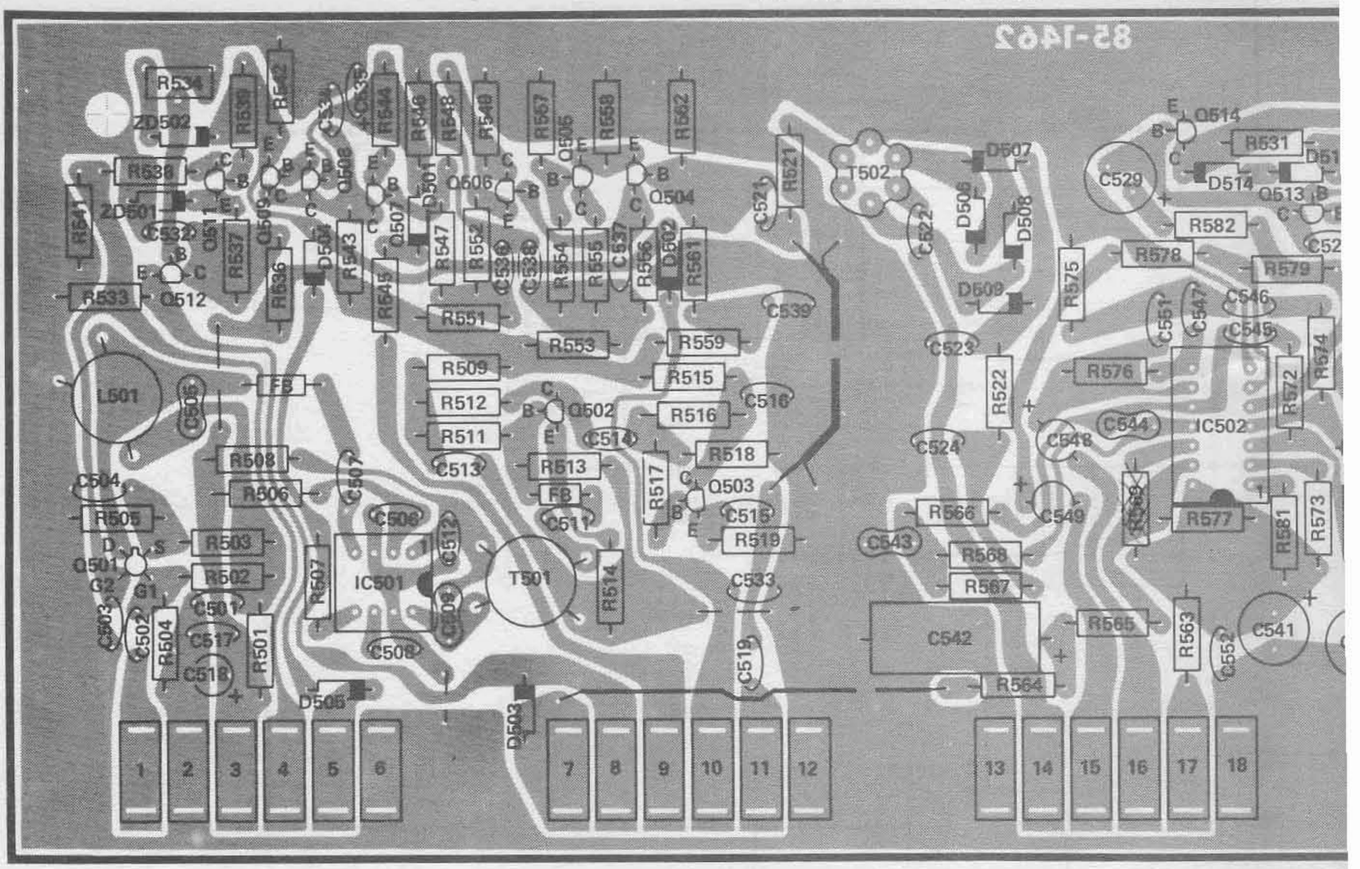
12.395 - (3.5 - 4.0) = 8.895 - 8.395
15.895 - (7.0 - 7'5) =
23.895 - (15.0 - 15'5)
22.895 - (14.0 - 14'5)
29.895 - (21.0 - 21'5)
36.895 - (28.0 - 28'5)
37.395 - (28.5 - 29'0)
37.895 - (29.0 - 29'5)
38.395 - (29.5 - 30'0)

EMATIC

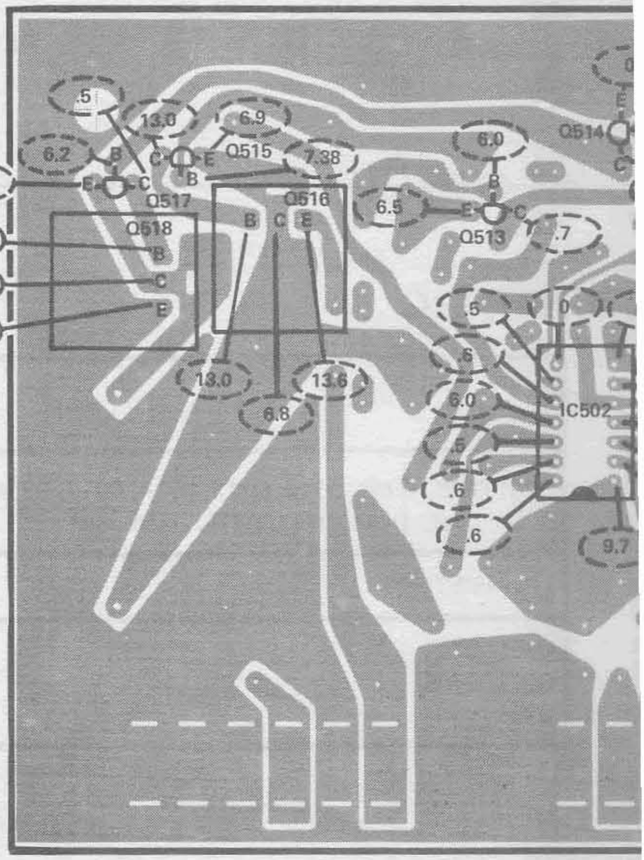
DIODES	QUANTITY	TYPE	HEATH PART NO.
D701-D706, D709, D710, D713, D714, D717, D718 D707, D708, D711, D712, D715, D716	12 6	1N458 1N4149	56-24 56-56
TRANSISTORS			
Q701, Q704 Q702, Q705 Q703	2 2 1	40673 2N4121 2N2369	417-240 417-235 417-154

X-RAY VIEW

JAN 25 75
R569 Deleted



(Shown from component side)

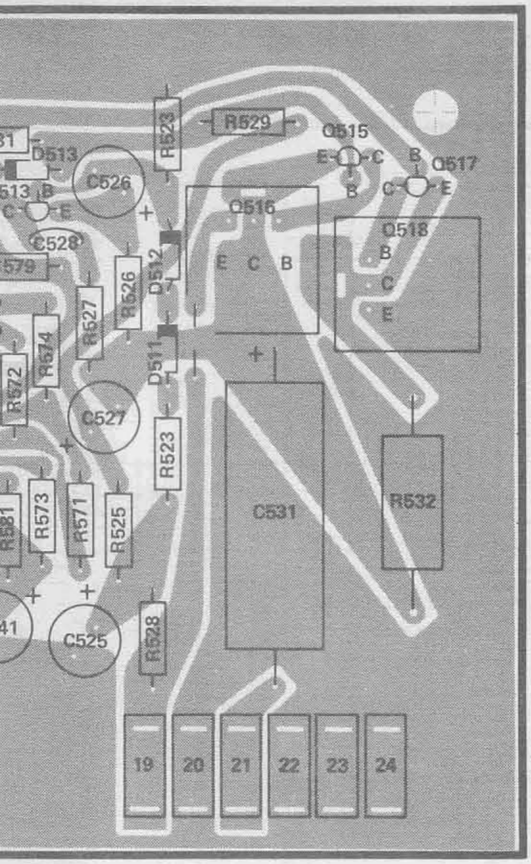


RECEIVER VOLTAGES (±20%)

NOTES:

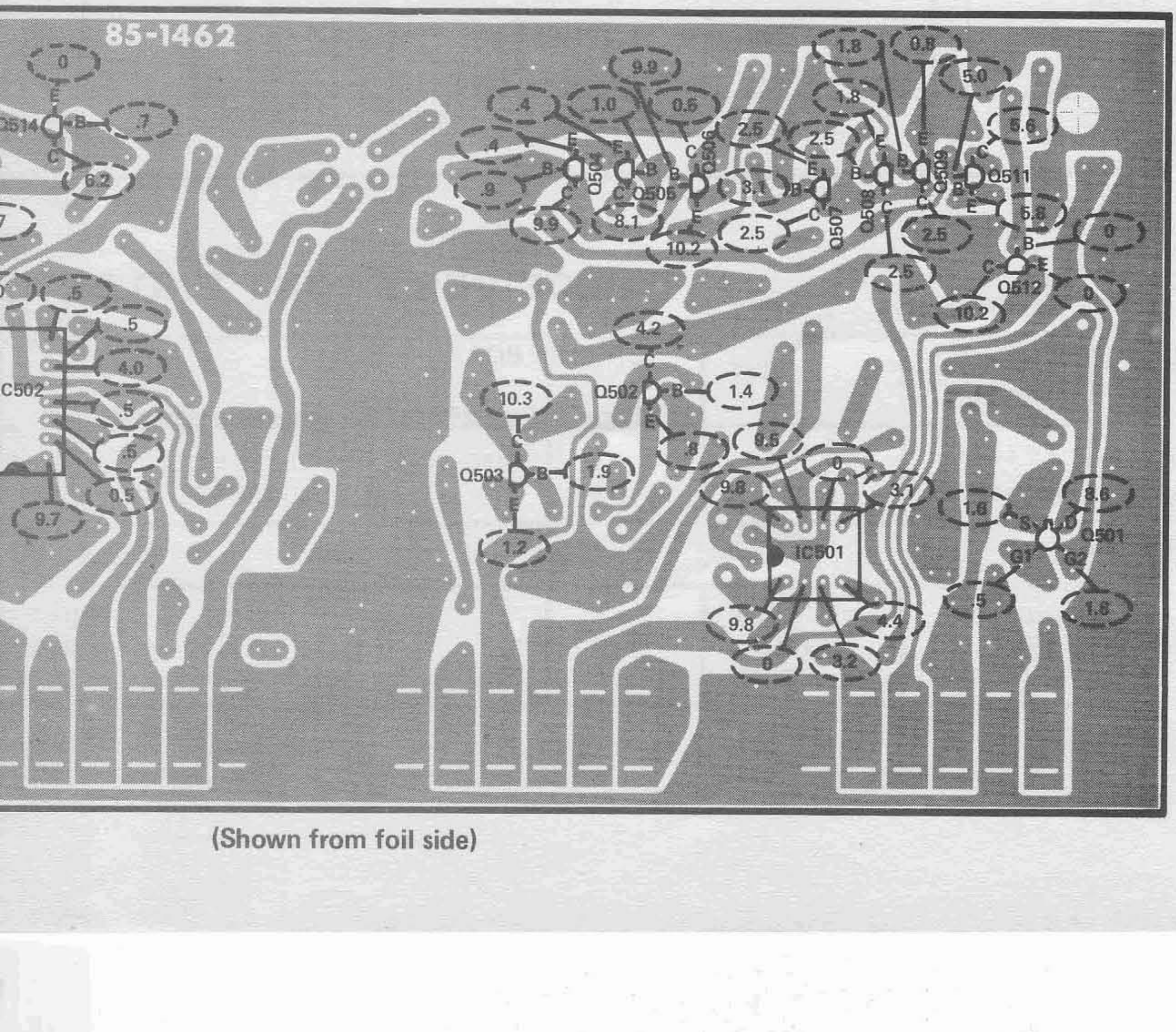
1. POWER SUPPLY AND 4Ω SPEAKER CONNECTED
2. ANTENNA NOT CONNECTED
3. BAND SWITCH IN 3.5 POSITION
4. RF GAIN MAXIMUM CLOCKWISE
5. AF GAIN MAXIMUM COUNTERCLOCKWISE
6. DC VOLTAGES MEASURED WITH 20 KILOHM INPUT VOM TO CHASSIS

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



RECEIVER IF/AUDIO

VOLTAGE CHART



(Shown from foil side)

F

Receiver IF/Audio Circuit Board

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.

Refer to the "X-Ray View" and "Voltage Chart" (fold-out from this page).

CIRCUIT DESCRIPTION

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

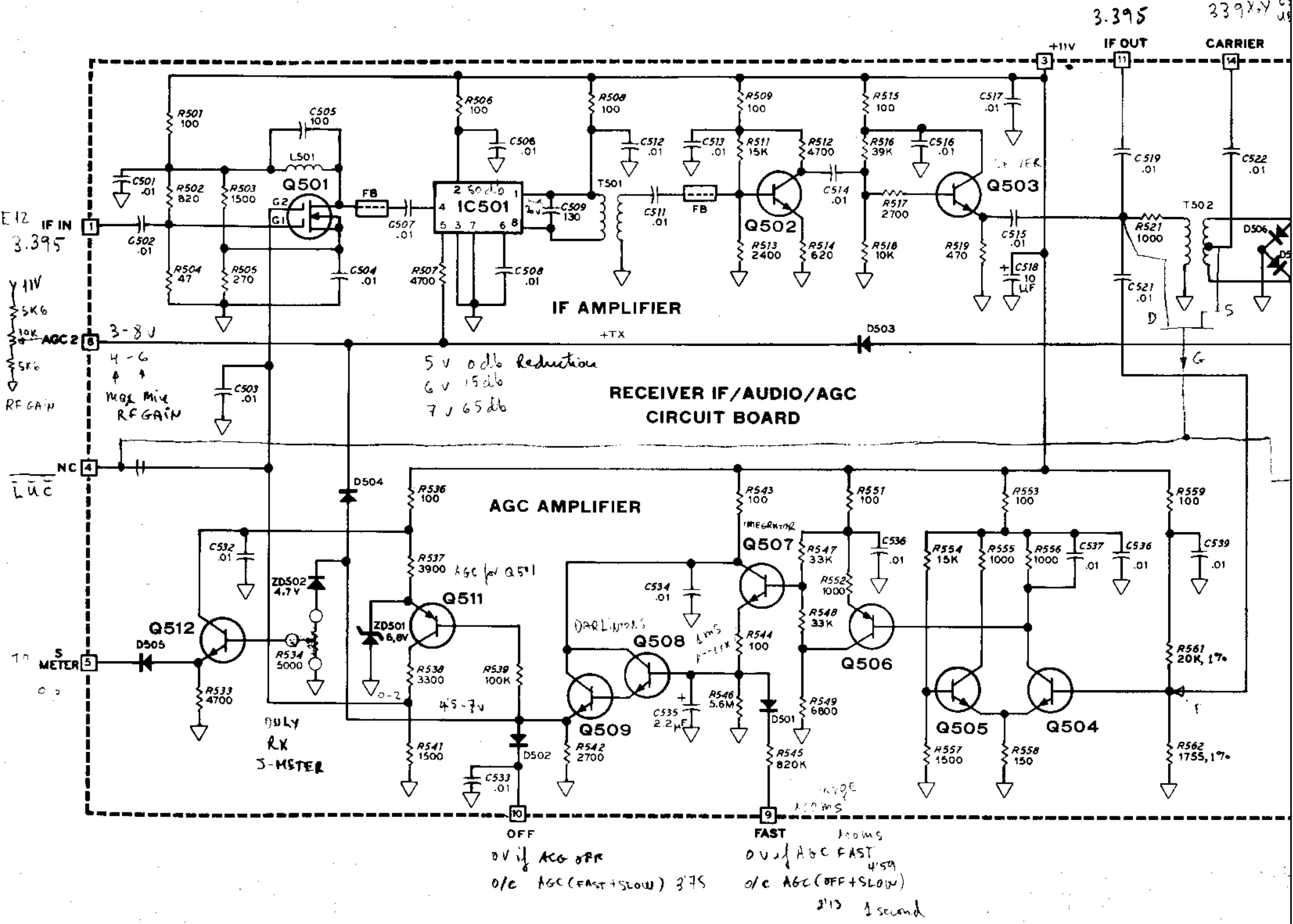
In the receive mode, a 3.395 MHz signal from board E (the crystal filter board) is fed to gate 1 of the dual gate MOSFET, Q501. The signal is amplified and passes to IC501 and Q502 where additional amplification is obtained. Emitter follower Q503 provides the power gain required to drive the product 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 drive. 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 complimentary 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 established by a feedback circuit consisting of Q513, C526, R526, R527, and C528.



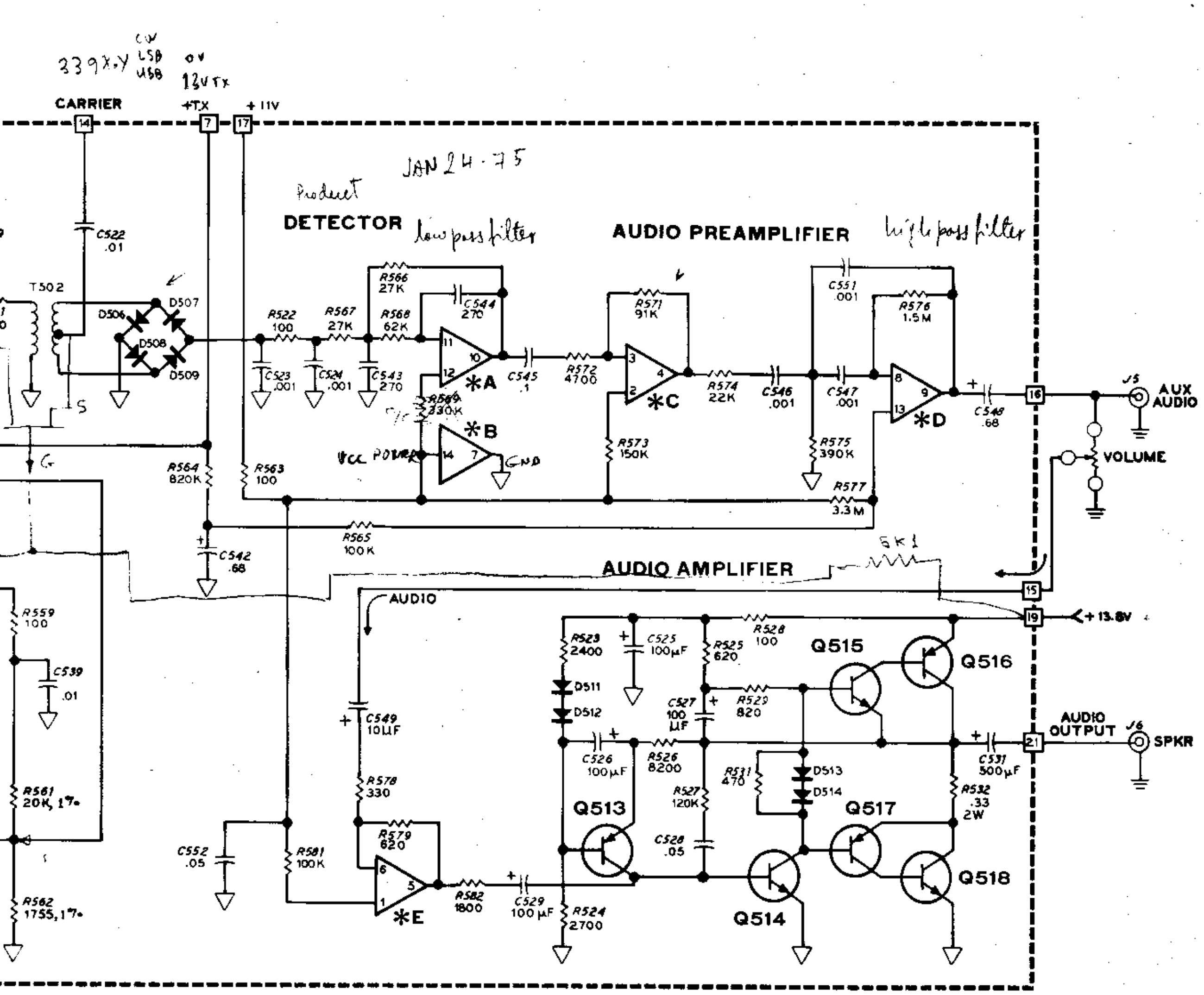
F

RECEIVER IF/AUDIO SCHEM

CIRCUIT BOARD F

Refer to Page 282 for Schematic symbols.

ADJ	FNC
R534	S-METER LEVEL ADJUST



* IC502

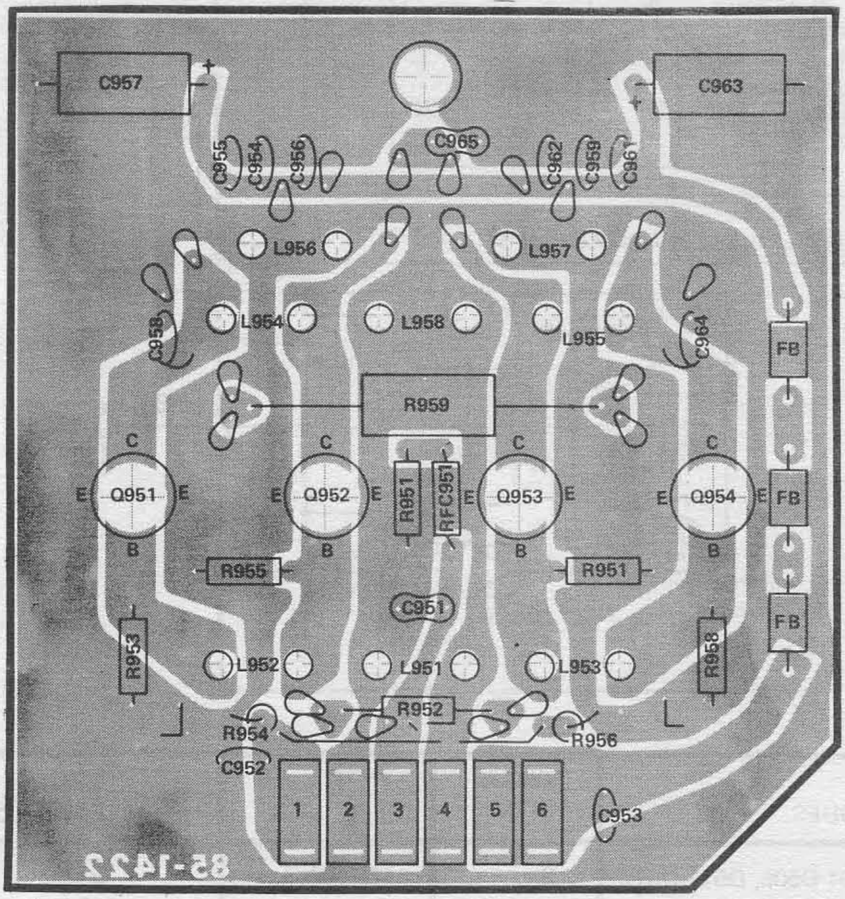
SCHEMATIC

ols.

DIODES	QUANTITY	TYPE	HEATH PART NO.
D501-D505, D511-D514	9	1N4149	56-56
D506-D509	4	FH1100	56-87
ZD501, 6.8V	1	1N710	56-6
ZD502, 4.7V	1	1N750A	56-59
TRANSISTORS			
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
INTEGRATED CIRCUITS			
IC501	1	MC1350P	442-18
IC502	1	LM3900	442-71

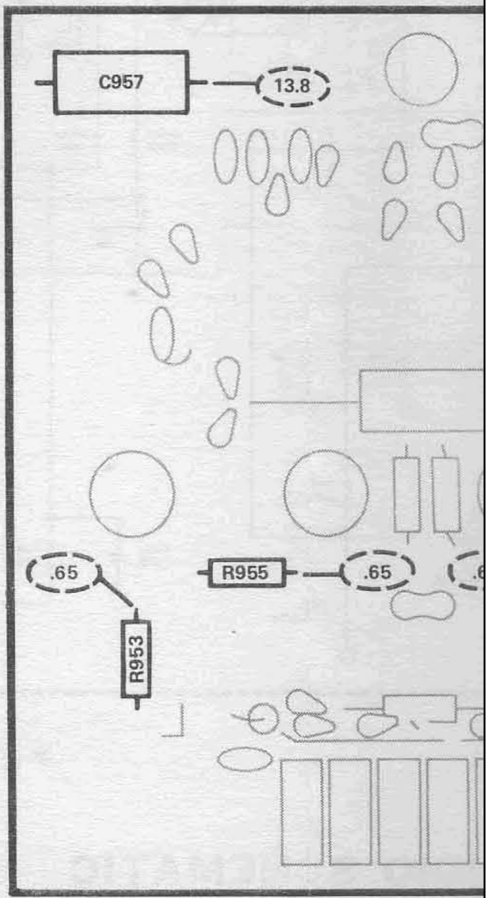
P. A. (POWER AMPLIFIER)

X-RAY VIEW



(Shown from component side)

VOLTAGE C



(Shown from comp

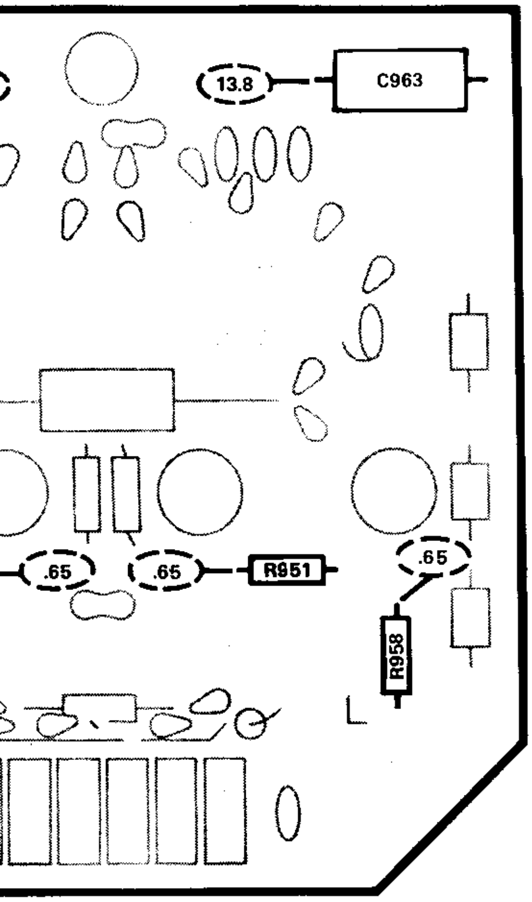
RECEIVER VOLTAGES (±20%)

NOTES:

1. POWER SUPPLY AND 4Ω SPEAKER CO
2. ANTENNA NOT CONNECTED
3. BAND SWITCH IN 3.5 POSITION
4. RF GAIN MAXIMUM CLOCKWISE
5. AF GAIN MAXIMUM COUNTERCLOCK
6. DC VOLTAGES MEASURED WITH 20 K

( ) DC VOLTAGE WITH MODE SWITCH

TAGE CHART



vn from component side)

20%)

4Ω SPEAKER CONNECTED
NECTED
POSITION
CLOCKWISE
COUNTERCLOCKWISE
SURED WITH 20 KILOHM INPUT VOM TO CHASSIS

H MODE SWITCH IN USB, LSB, OR CW POSITION

P.A. TRANSISTOR CHECK

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	OV	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 281 for the special one-year warranty.

Figure 4-3 (Repeat)

H

Power Amplifier Circuit Board

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
No RF output.	1. Transistors. See "P.A. Transistor Check" on the fold-out. 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.

Refer to the "Voltage Chart" and "X-Ray View" (fold-out from this page).

NOTE: Heath part numbers that correspond to the circuit component numbers will be found in the Parts List starting on Page 151 of this Manual.

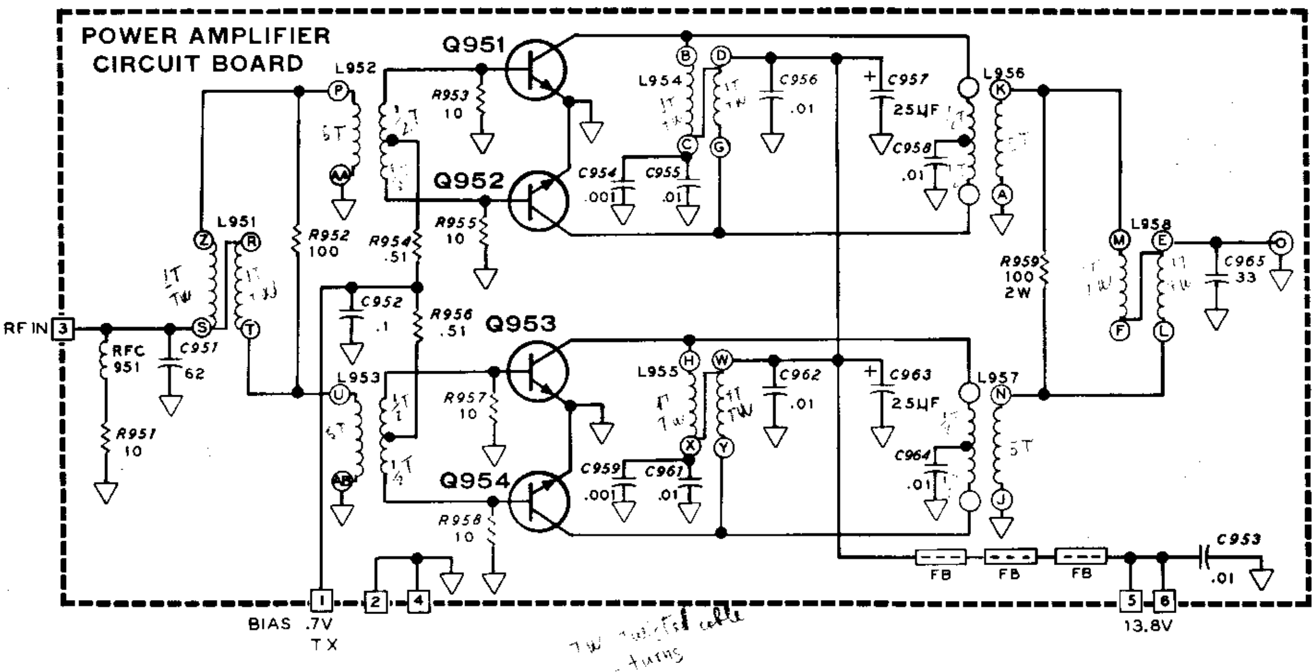
CIRCUIT DESCRIPTION

R952 R959

The function of this circuit is to amplify 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.



50 Ω 3-30 M

ADJ

NONE

POWER AMPLIFIER SCHEMATIC

CIRCUIT BOARD H

Refer to Page 282 for Schematic symbols.

TRANSISTORS	QUANTITY	TYPE	HEATH PART NO.
Q951-Q954	4	2N6456 or S30-12A	417-831

SPECIFICATIONS

GENERAL

Frequency Readout	6-digit electronic display.
Active Devices	All solid-state.
Frequency Coverage	3.5 MHz through 29.7 MHz amateur bands. WWV (receive only) on 15 MHz.
Frequency Stability	Less than 100 Hz/hr drift after 30-min. warmup; less than 100 Hz drift for ±10% change in primary voltage.
Modes of Operation	Selectable upper or lower sideband (suppressed carrier) and CW.
Readout Accuracy	Within ±200 Hz (±1 count).
Audio Frequency Response	350 to 2450 Hz ±75 Hz (6 dB bandwidth).
Tuning Backlash	100 Hz.
Phone Patch Impedance	4 ohm output to speaker; high impedance output to transmitter.
Power Requirements	13.8 VDC nominal (maximum 16 VDC) at: Receive: 2 amps. Transmit, low power: 3 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	50 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 band, -40 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, 5 kHz maximum at 60 dB down. (2:1 nominal shape factor.)
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 headphones (4-8 ohm). 2.5 W 1.25 W

AGC	Less than 1 millisecond attack time; switch selectable 100 millisecond and 1 second 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.)

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

THEORY OF OPERATION

While reading this section, refer to Figure 5-1, the Functions and Chassis Interconnections diagram (fold-out from Page 323).

RECEIVER

Refer to the "Receiver Block Diagram," fold-out from Page 267.

The incoming signals pass through the Filter/ALC circuit board 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.

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," fold-out from Page 268.

The Transmitter Audio/Regulator circuit board accepts the microphone, key, and phone patch inputs, which it processes and controls. It regulates the 5 and 11 volt DC voltages 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 regulators.

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/Predriver 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.

5000 - 5500 KHz

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.

DISPLAY

Refer to the Display Block Diagram on Page 271.

The frequency display is processed on two circuit boards – the counter board and the display board.

On the counter board, a stable crystal oscillator acts as the time base, calibrated against station WWV. A divider string and associated gates provide the gate, transfer, and reset pulses.

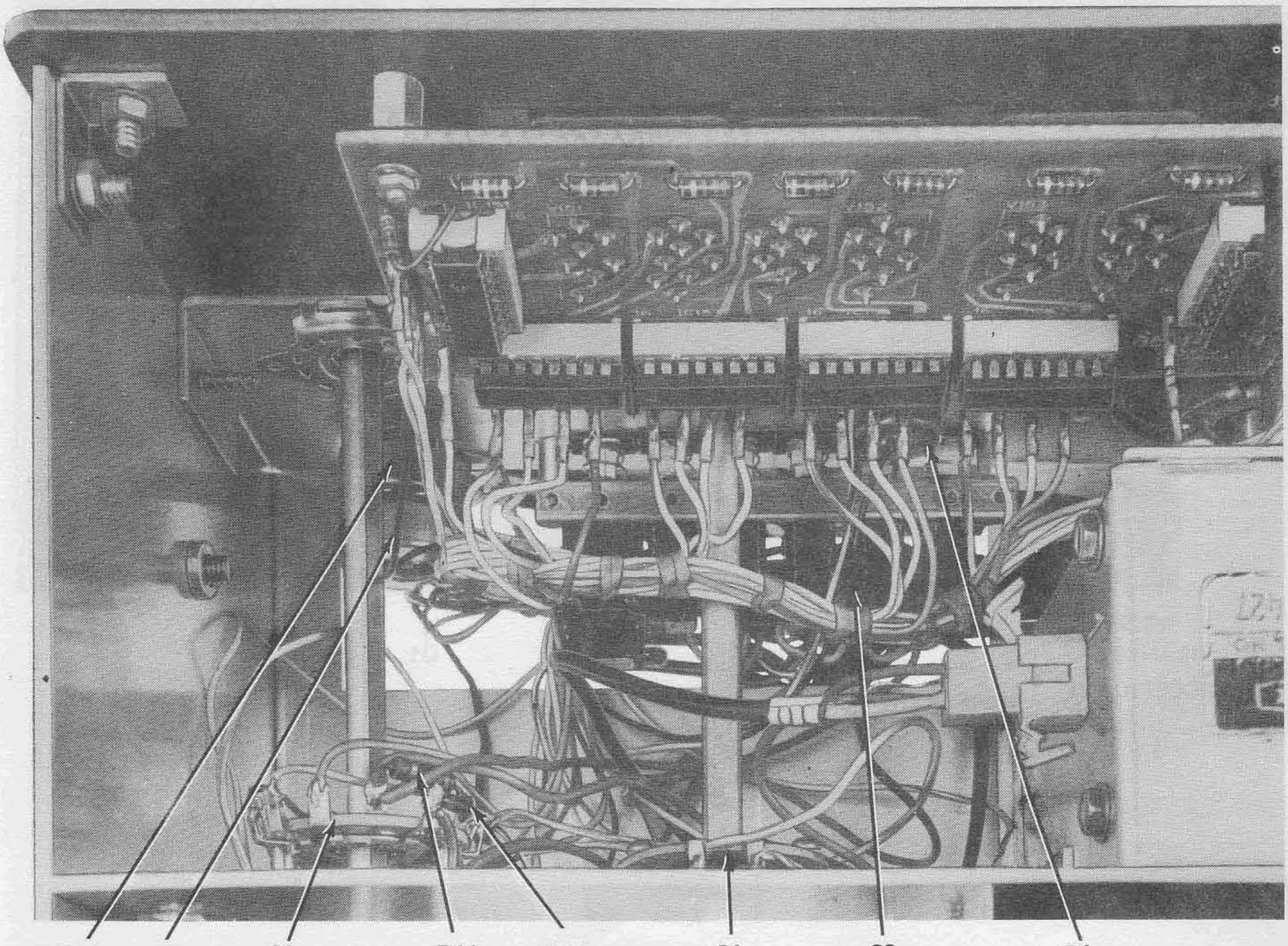
If the BFO frequency is subtracted from the premix frequency, the result is the signal frequency. Therefore, the counter is automatically preset to start counting below an arbitrary 0 by the amount of the BFO frequency. In this way, the entire premix frequency is counted but only the signal frequency is displayed.

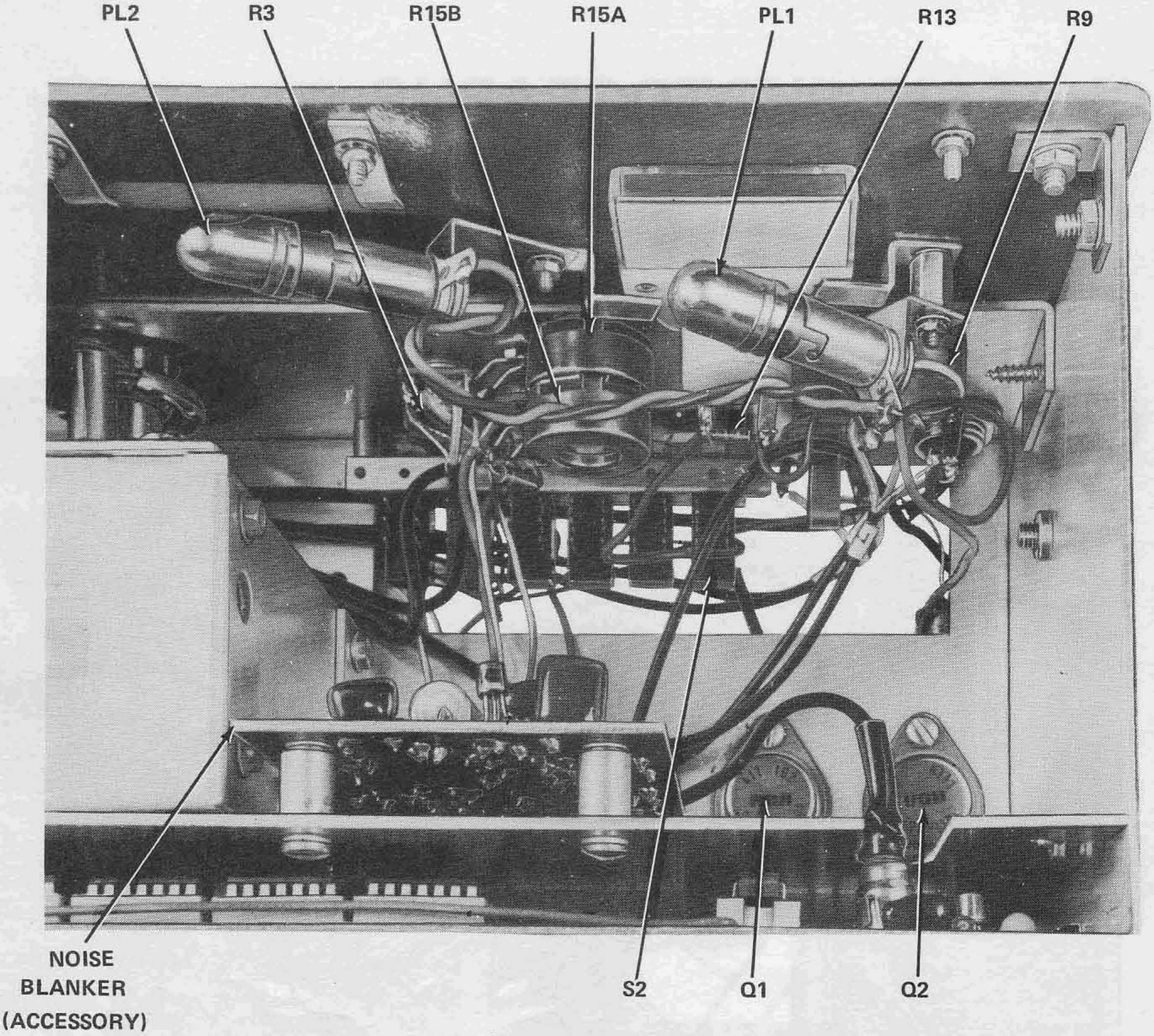
When the transfer pulse occurs, the count is transferred from five counters to memory latches, which retain the count at their outputs for the duration of the counting cycle.

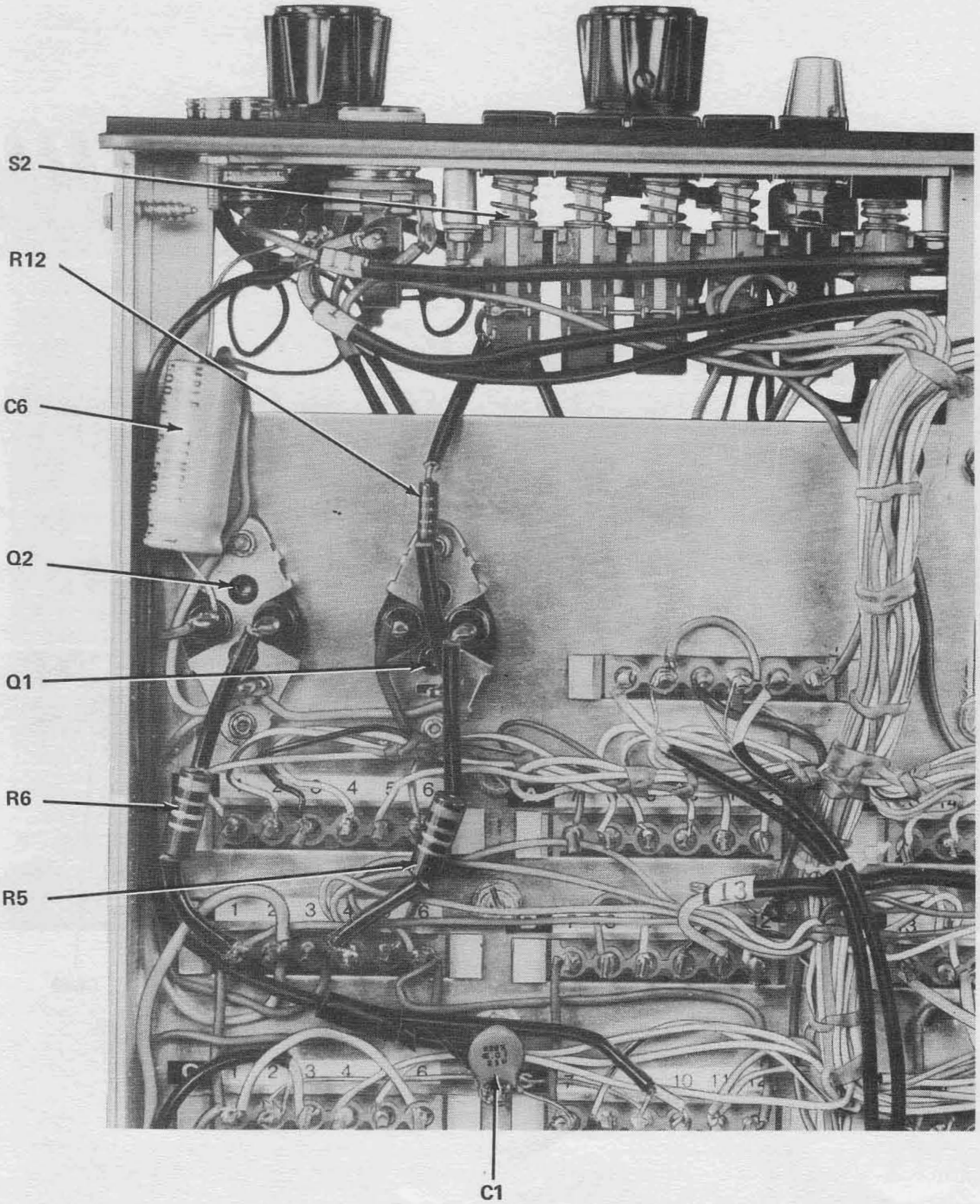
The Display circuit board contains segment drivers, five of which receive and process the count from the memory latches. The drivers turn on the appropriate elements in the display tubes.

The first (left-hand) digit of the display is controlled by the band switch so the digit will be unlighted or show a "1" or a "2" as appropriate for the Band switch position.

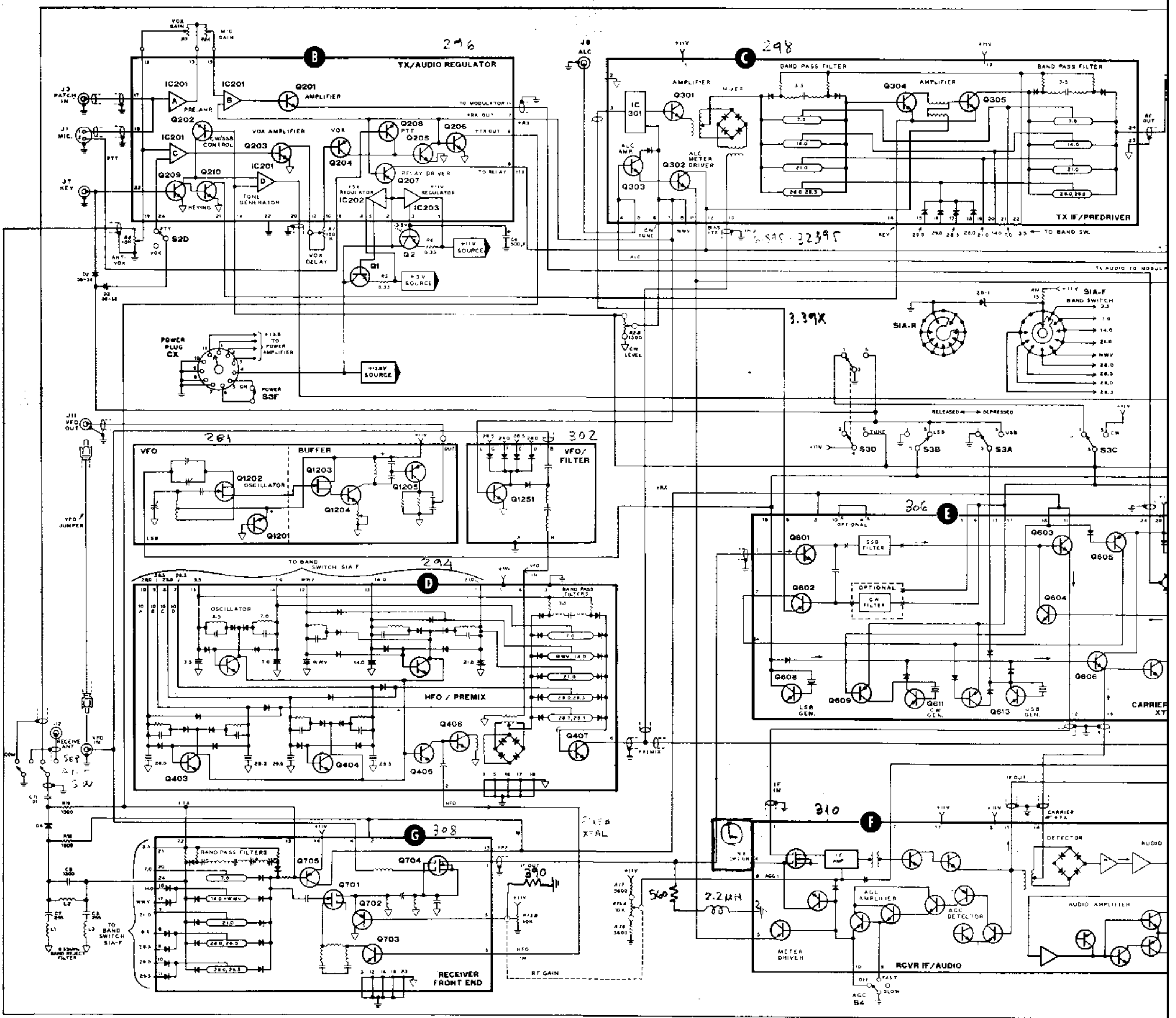
CHASSIS PHOTOGRAPHS



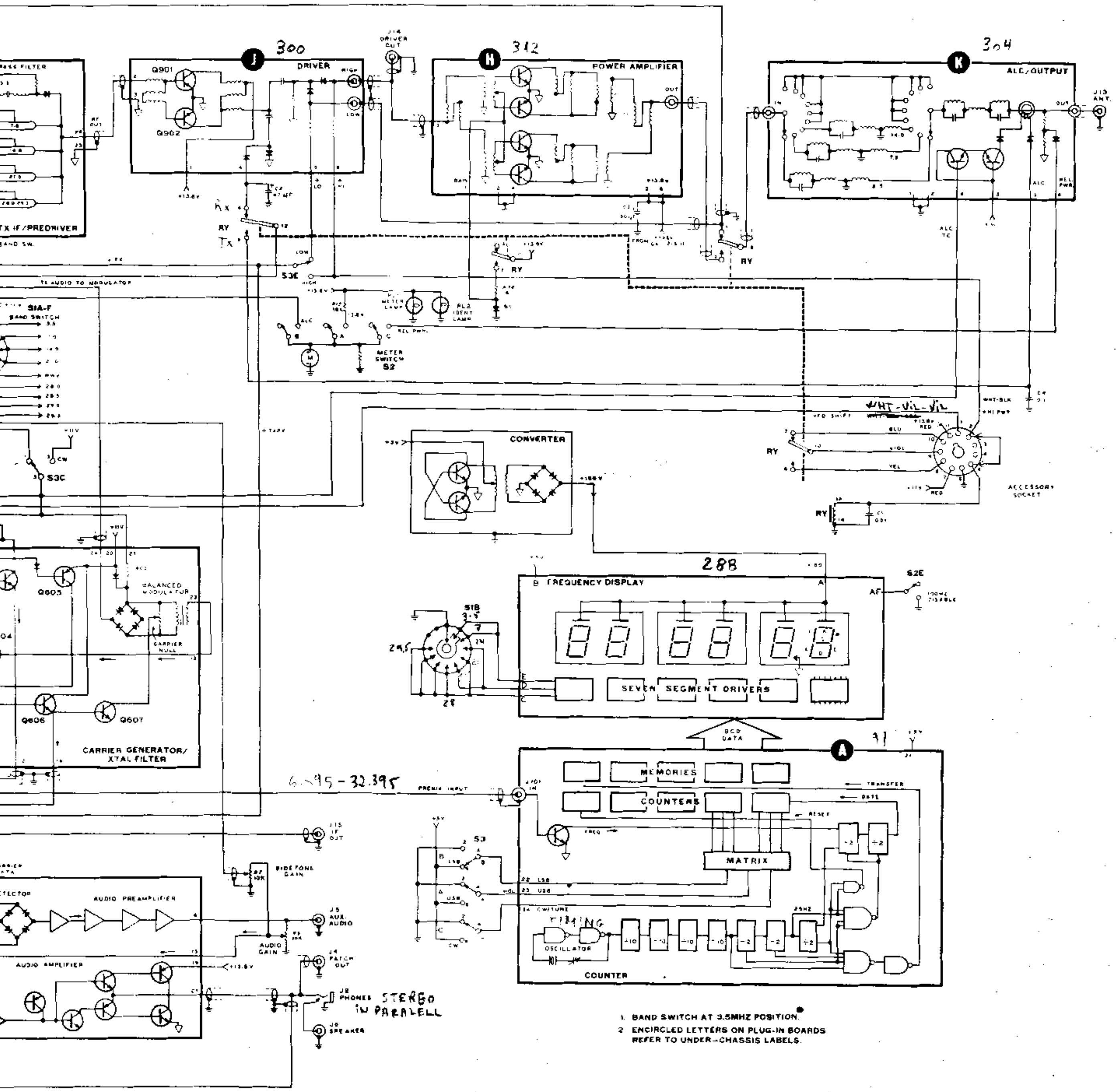

PL2
R3
R15B
R15A
PL1
R13
R9
NOISE
BLANKER
(ACCESSORY)
S2
Q1
Q2


S2
R12
C6
Q2
Q1
R6
R5
C1

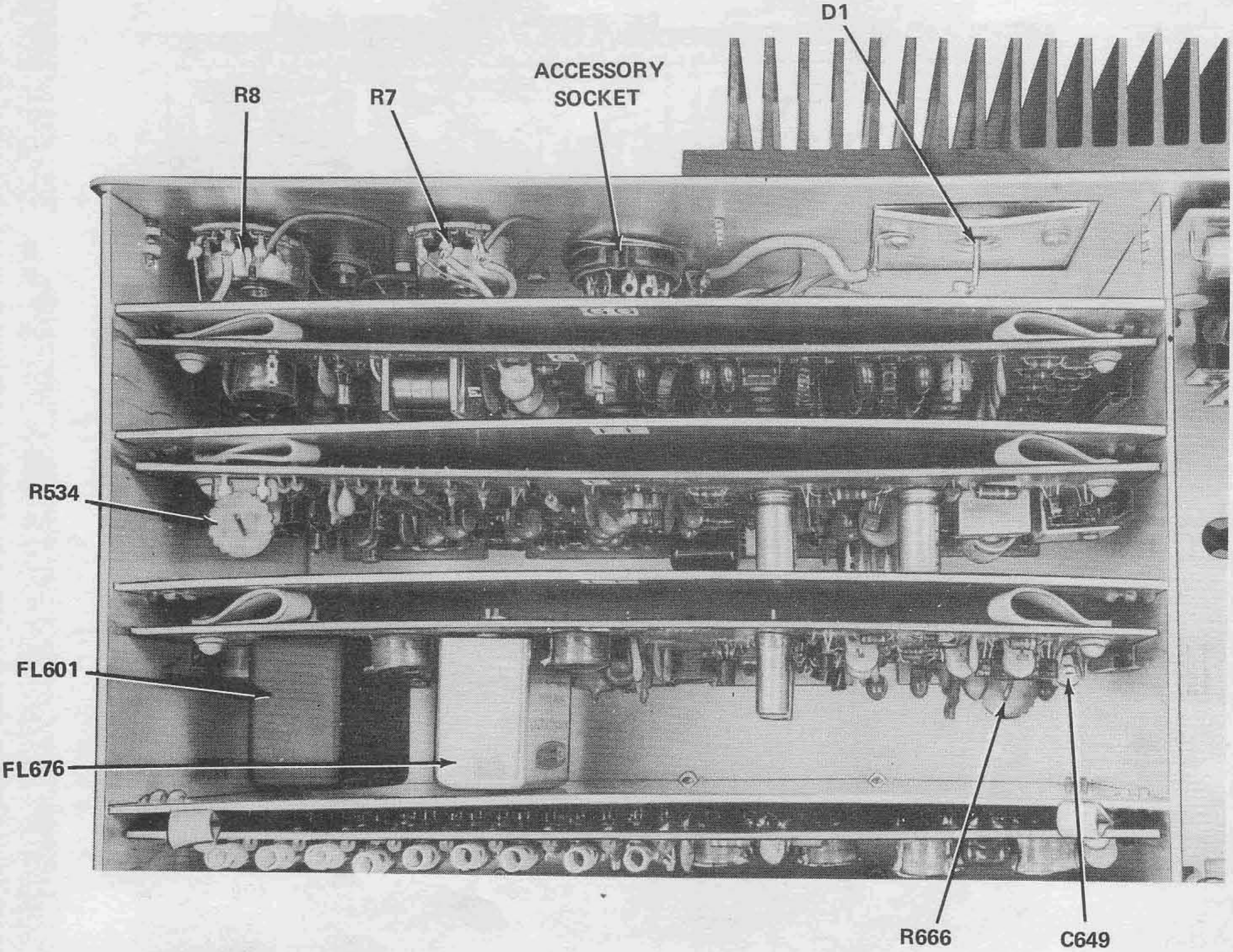
FUNCTIONS AND CHASSIS INT

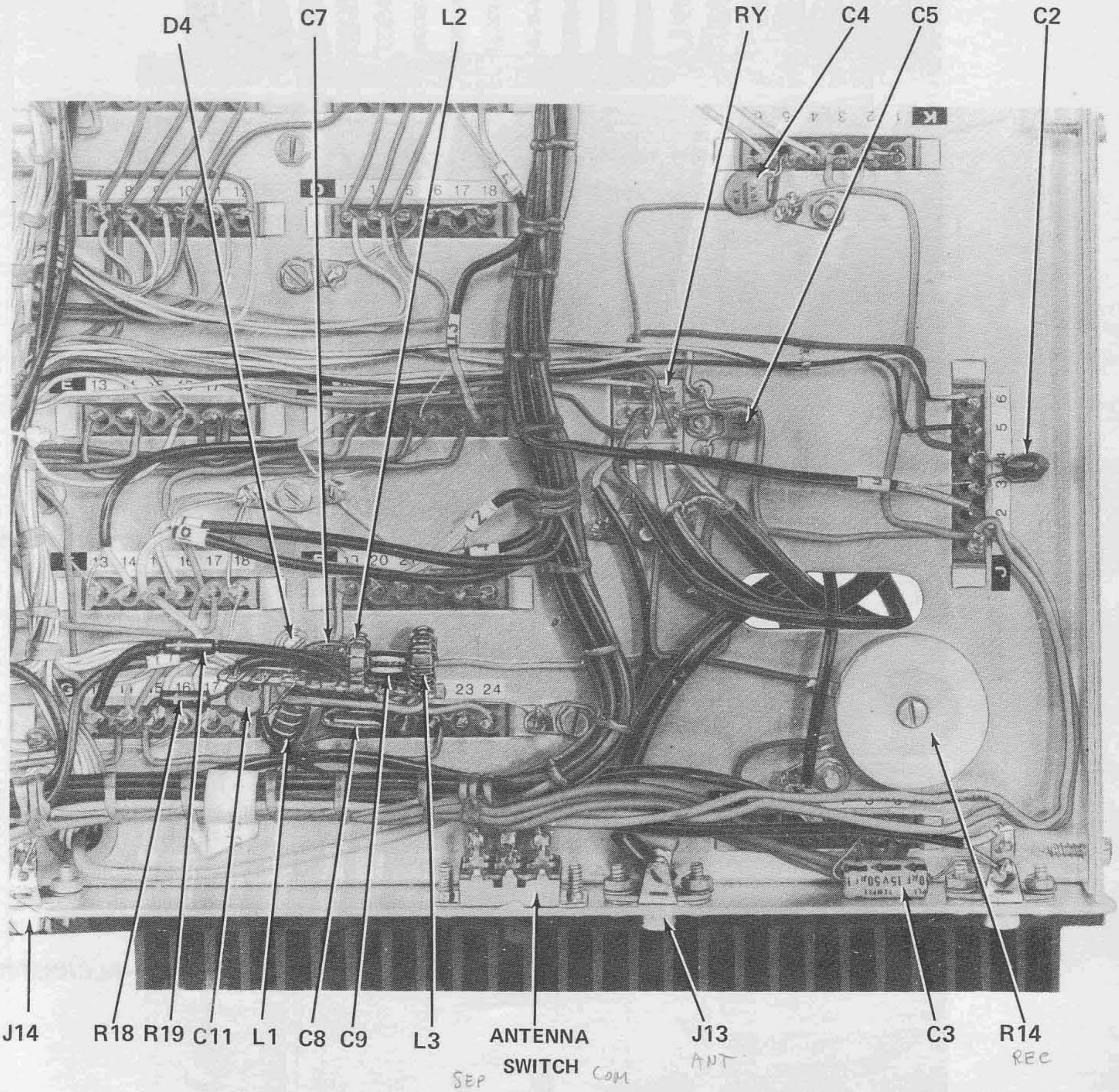


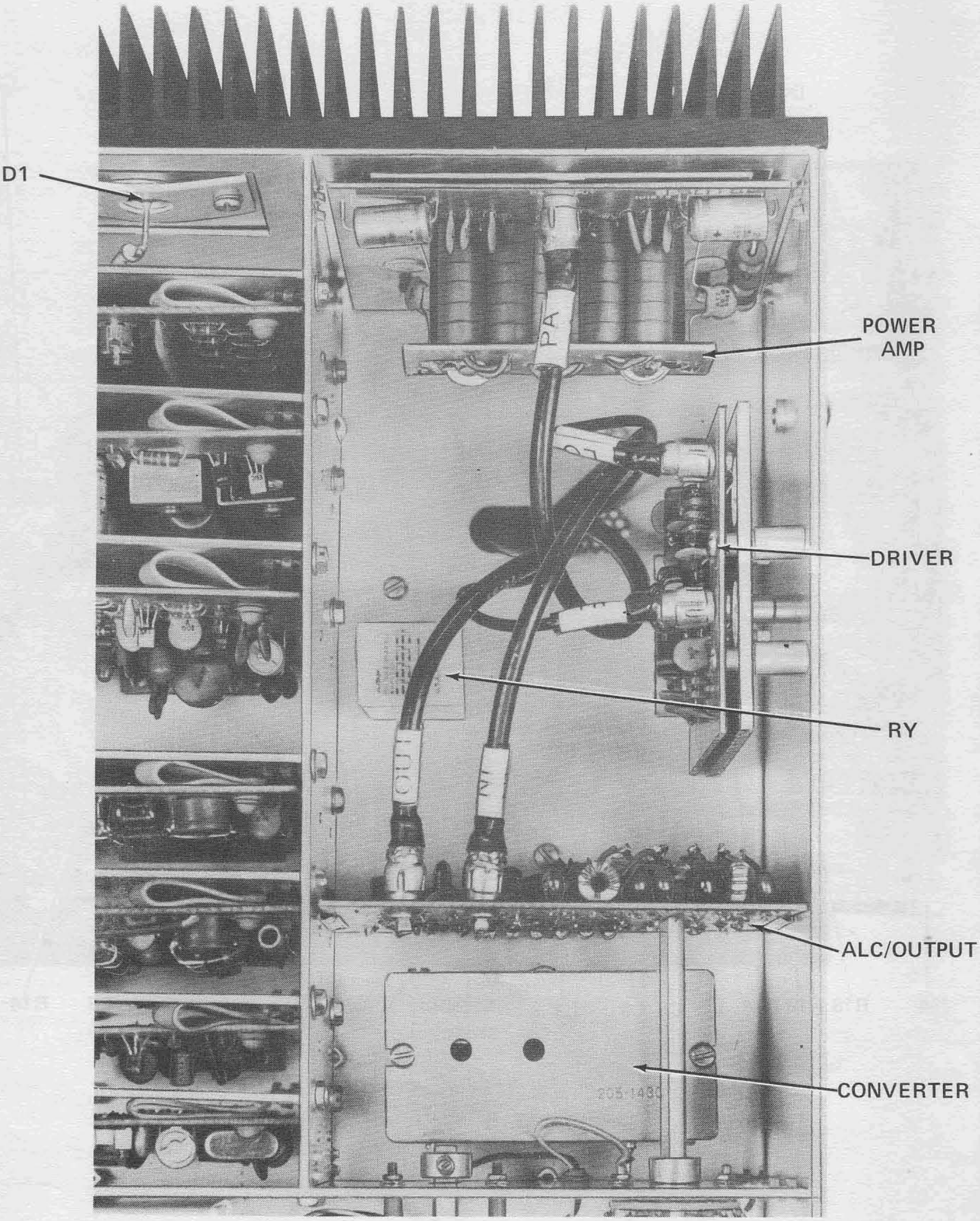
SIS INTERCONNECTIONS



1. BAND SWITCH AT 3.5MHZ POSITION.
2. ENCIRCLED LETTERS ON PLUG-IN BOARDS REFER TO UNDER-CHASSIS LABELS.


D1
ACCESSORY
SOCKET
R8
R7
R534
FL601
FL676
R666
C649


D4
C7
L2
RY
C4
C5
C2
J14
R18
R19
C11
L1
C8
C9
L3
ANTENNA SWITCH
SEP
COM
J13
ANT
C3
R14
REC


D1
POWER AMP
DRIVER
RY
ALC/OUTPUT
CONVERTER
PA
OUT
IN
205-1430

MICROPHONES

ASTATIC MODEL 531

Model 531 "super talk power"

MOBILE MICROPHONE

A TOP PERFORMER AT LOW COST - - GIVES HIGH VALUE. For Amateur or Citizens Band, mobile or stationary communication applications. Has Super Talk Power.

Combines mobile styling and high performance. Response characteristic carefully calculated to give maximum clarity and intelligibility. Complements the average energy curves for voice transmission as published by Fletcher and others. This feature restricts band width of the radiated signal, diminishes interference on adjacent channels and potential higher order harmonics. Inherent design characteristic reduces background noise and feedback. Attractive, rugged and dependable with unusually high output, the Model 531 is fully shielded to minimize hum pickup.

FEATURES *and* SPECIFICATIONS

- OUTPUT: -50 dB below 1 volt/microbar.
- RESPONSE: 150-3500 Hz with a 6 dB rise in the 2000 Hz range.
- IMPEDANCE: at 1000 Hz. approximately 250,000 ohms (EIA rating 100,000 ohms). Element capacitance 650pF ± 20%.
- RECOMMENDED LOAD: Over 1 megohm.
- HIGH IMPEDANCE CERAMIC ELEMENT: Wide temperature tolerance with immunity to humidity.
- POLAR PATTERN: Semi-directional.
- SWITCH: Press-to-talk DPDT spring return switch shorts the microphone element in the "OFF" position and closes the relay circuit in the "ON" position. Designed for long life and trouble free performance, the switch can be easily operated using the microphone in either hand.
- CABLE: Three conductor (one conductor shielded) VINYL jacketed coiled cord that extends to 5 feet. Durable strain relief bushing protects against cable breakage at entry of microphone housing.
- HOUSING: Constructed of high impact molded Cycolac* plastic.
- FULLY SHIELDED
- MOUNTING BRACKET: Design permits mounting on a vertical or horizontal surface.
- SIZE: 3 3/8" high x 2 3/8" wide x 1 5/16" deep.
- WEIGHT: 7 1/4 ounces.

*Tradename of Borg-Warner

(See Reverse Side)

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MANUFACTURERS OF PHONOGRAPH CARTRIDGES
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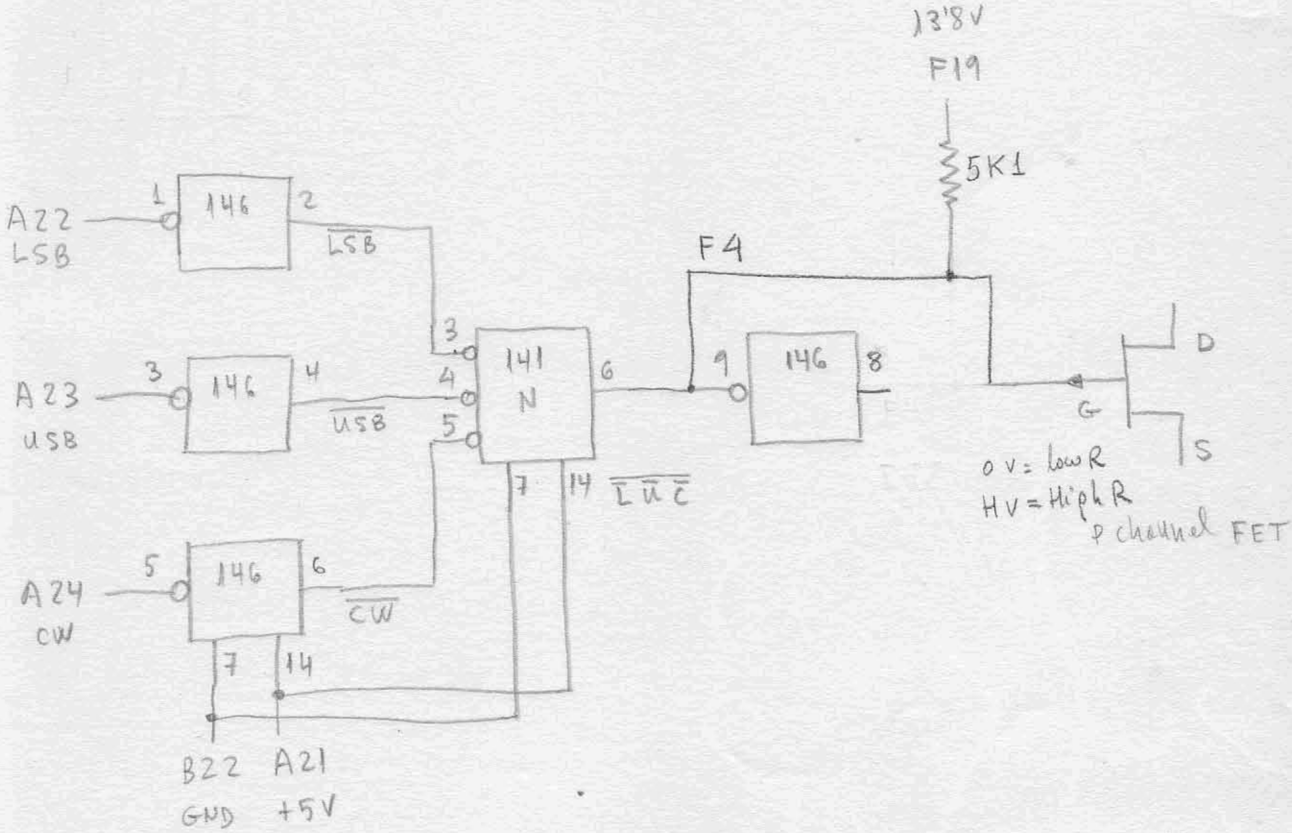
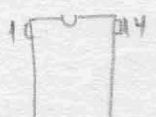
EXPORT SALES: Morhan Exporting Corporation 270-78 Newtown Road, Plainview, New York 11803

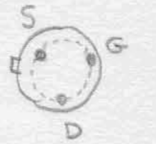
	MAX TX	MIN RX
TUNE	30 seg.	150 seg.
CW	15 min.	15 min.
SSB	1 hora	30 min.

NUNCA CAMBIAR BANDA EN Hi.





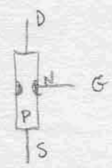
DTL



50218200

P-CHAN

J-FET



$T = \frac{1}{F}$ $\frac{10}{Kc/s} = \mu s$ $\frac{10^6}{Kc/s} = us$

D	12.395 Kc/s	80'677692 us
	15.895	62'912865 us
	23.895	41'849759 us
	22.895	43'677658 us
	29.895	33'450409 us
	36.895	27'103943 us
	37.395	26'741542 us
	38.395	26'045057 us
	5.000	200 us
	5.500	181,81818 us
	5.250	190'47619 us
	8.395	119'11852 us
	8.895	112'4227 us
	3.395	294'55081 us
	8645	115'67379 us
E	3393'6	294'67232 us
	3395'7	294'49009 us
	3396'4	294'42939 us

3'5 - 4 Mc	85'7 - 75 m	20 Kz band
7 - 7'5	42'86 - 40	50 Kz
14 - 14'5	21'43 - 20'69	100 Kz
15 - 15'5	20 - 19'35	
21 - 21'5	14'29 - 13'95	150 Kz
28 - 28'5	10'71 - 10'53	
28'5 - 29	10'71 - 10'34	200 Kz $\frac{1}{4}$ onda
29'0 - 29'5	10'34 - 10'17	
29'5 - 30'0	10'17 - 10	

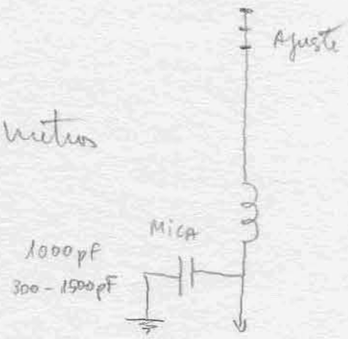
18 Ω

$I = \frac{E}{R}$

$e = V \cdot T = \frac{V}{F}$

$\frac{300.000.\cancel{000}\ m}{3500\cancel{000}}$

80 metros



40 m

Antenas

Frecuencia	λ	λ/2	λ/4
3'5 Mc/s	85'7 m	42'8 m	21'4 m
4	75	37'5	18'7
7	42'8	21'4	10'7
7'5	40	20	10
14	21'4	10'7	5'3
14'5	20'6	10'3	5'1
21	14'3	7'1	3'6
21'5	13'9	6'9	3'5
15	20	10	5
15'5	19'3	9'7	4'8
28	10'7	5'4	2'7
28'5	10'5	5'3	2'6
29	10'3	5'1	2'5
29'5	10'1	5'1	2'5
30	10	5	2'5

TRANSCEIVER

VFO check 10 v Z diode

VFO " female conections on plug in.

VFO pag 29 screw flat head 6-32 x 1/2" 250-11

VFO Sw para el extra del condensador

~~CONVERTER tapa de aluminio pag 57 205-1430~~

DRIVER tighten transistor mount

ALC o/p filter no CRC contacts

PA transistors silicone

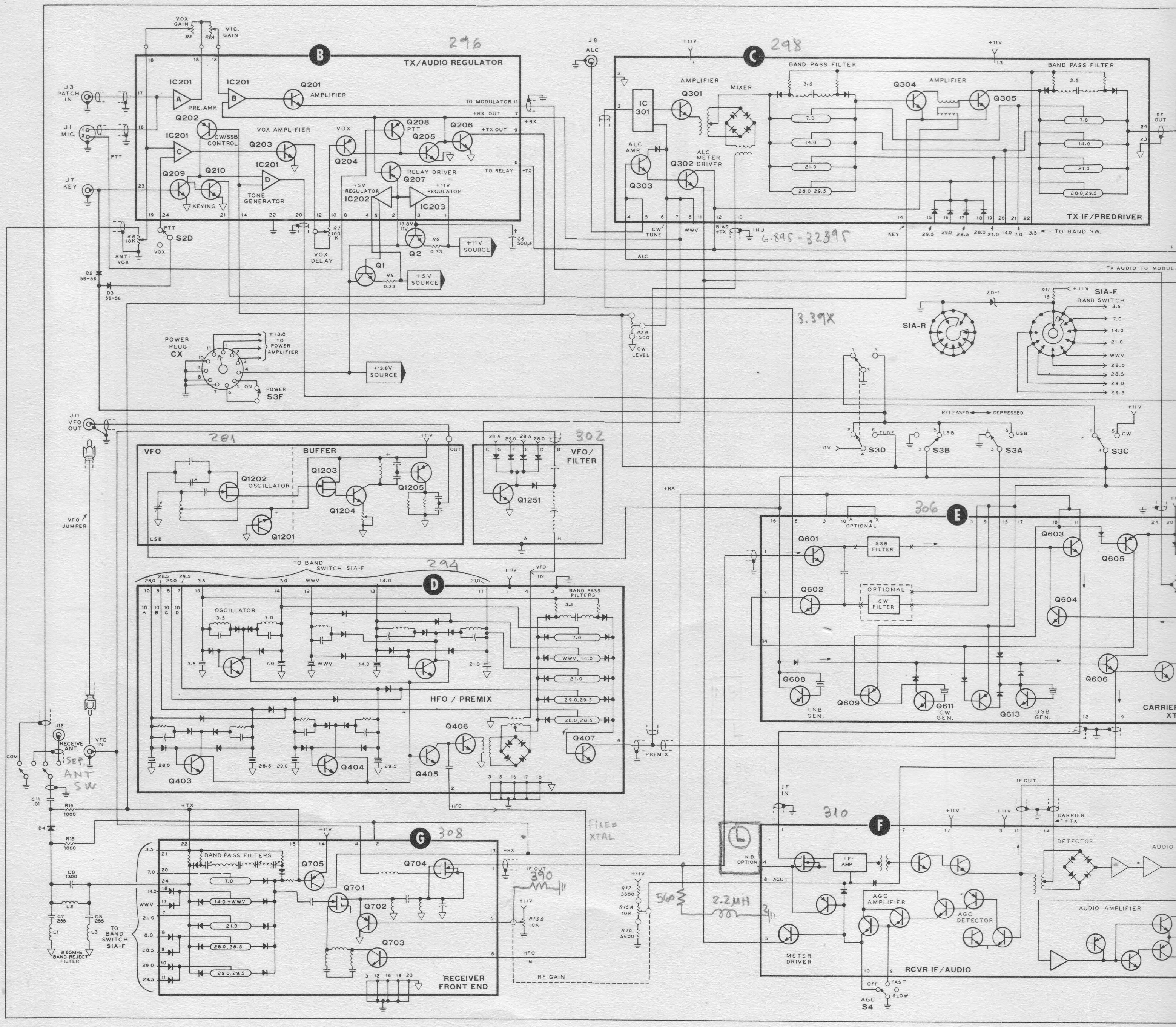
P 231 cambio ondas mavizar y CRC

P 210 1/c on phono sockets ohms

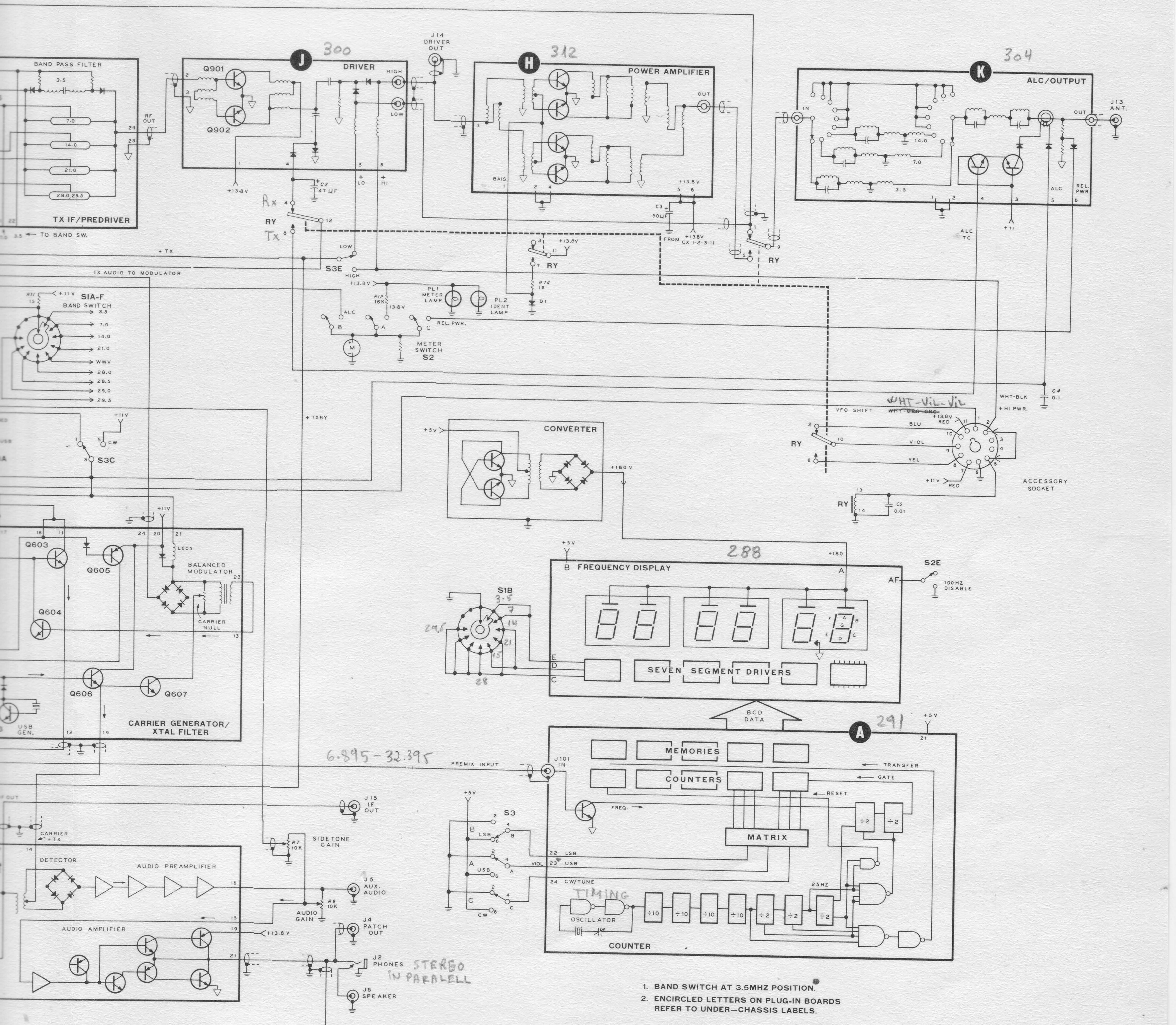
P 228 screws (longer) for heatsink

check Noise Blanker.

FUNCTIONS AND CHASSIS INT



HASSIS INTERCONNECTIONS



1. BAND SWITCH AT 3.5MHZ POSITION.
2. ENCIRCLED LETTERS ON PLUG-IN BOARDS REFER TO UNDER—CHASSIS LABELS.