

MODEL GR-88 VHF-FM Monitor Receiver

HEATHKIT®

ASSEMBLY MANUAL

VHF-FM Monitor Receiver

Model GR-88

HEATH COMPANY

BENTON HARBOR, MICHIGAN



PRICE \$2.00



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I-595-1080-05

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Sincerely,

HEATH COMPANY
Benton Harbor, Michigan 49022

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Assembly and Operation of the



VHF-FM MONITOR RECEIVER

MODEL GR-88

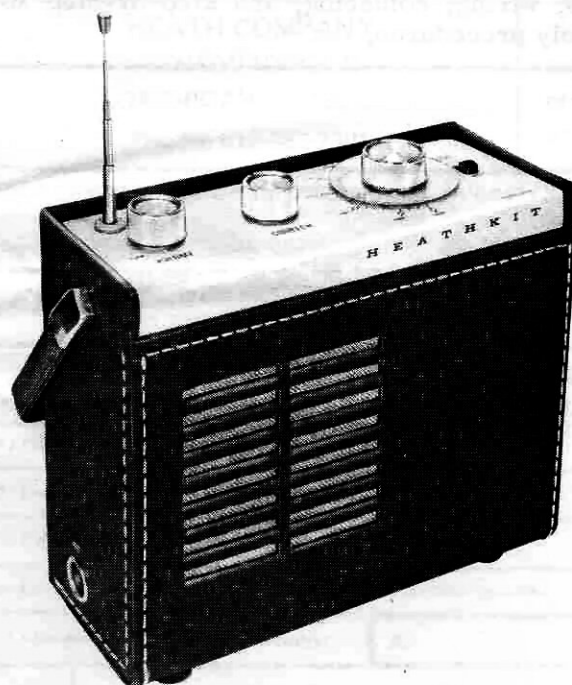


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HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

INTRODUCTION

The Heathkit Model GR-88 VHF-FM Monitor Receiver is completely transistorized, battery powered, and designed to operate in the 152-174 MHz frequency range. This frequency range covers police, fire, private telephone, marine, weather, utilities, industrial and similar communications services.

The GR-88 Receiver is tunable, or it can be operated as a crystal controlled receiver (crystal not included) for monitoring a specific frequency. A noise operated squelch circuit completely cuts off the audio stages during stand-by, thus conserving battery power and permitting continuous monitoring over long periods of time.

The built-in telescoping antenna provides excellent reception in most areas, however an antenna jack is also provided for use with an external antenna. The GR-88 Receiver may be operated portable on the self-contained battery power supply, or it can be operated on 120/240 volts AC by using the Heathkit Model GRA-88-1 accessory power supply.

Reliable solid-state circuitry, housed in a lime oak leatherette case, makes the GR-88 VHF-FM Monitor Receiver attractive to look at, fun to assemble, and easy to use.

Refer to the "Kit Builders Guide" for additional information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

PARTS LIST

The numbers in parentheses are keyed to the numbers in the Parts Pictorial (fold-out from Page 5).

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual.

PART No.	PARTS Per Kit	DESCRIPTION
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PART No.	PARTS Per Kit	DESCRIPTION
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RESISTORS

(1) 1-140	2	1.5 Ω (brown-green-gold)
1-129	1	4.7 Ω (yellow-violet-gold)
1-103	1	33 Ω (orange-orange-black)
1-3	1	100 Ω (brown-black-brown)
1-66	1	150 Ω (brown-green-brown)
1-45	3	220 Ω (red-red-brown)
1-42	4	270 Ω (red-violet-brown)
1-4	3	330 Ω (orange-orange-brown)
1-6	1	470 Ω (yellow-violet-brown)
1-119	1	560 Ω (green-blue-brown)
1-9	4	1000 Ω (brown-black-red)
1-11	1	1500 Ω (brown-green-red)
1-10	1	1200 Ω (brown-red-red)
1-44	2	2200 Ω (red-red-red)
1-14	3	3300 Ω (orange-orange-red)
1-46	1	3900 Ω (orange-white-red)
1-16	3	4700 Ω (yellow-violet-red)
1-19	3	6800 Ω (blue-gray-red)
1-73	1	8200 Ω (gray-red-red)
1-20	5	10 k Ω (brown-black-orange)
1-21	3	15 k Ω (brown-green-orange)
1-22	3	22 k Ω (red-red-orange)
1-67	1	39 k Ω (orange-white-orange)
1-25	5	47 k Ω (yellow-violet-orange)

CAPACITORS

Mica

(2) 20-160	1	33 pF
20-103	1	150 pF
20-115	1	300 pF
20-107	1	680 pF

Disc

(3) 21-33	1	3.3 pF
21-6	1	27 pF
21-75	3	100 pF
21-17	3	270 pF
21-140	1	.001 μ F
21-27	2	.005 μ F
21-16	13	.01 μ F
21-82	1	.02 μ F
21-48	2	.05 μ F

Electrolytic

(4) 25-115	1	10 μ F
25-160	1	250 μ F
25-148	1	1000 μ F
(5) 25-195	1	2.2 μ F tantalum
(6) 25-212	1	22 μ F tantalum

Others

(7) 27-47	5	.1 μ F Mylar*
27-85	2	.22 μ F Mylar
(8) 31-57	1	Trimmer

CONTROLS-SWITCH

(9) 10-281	1	10 k Ω control
19-135	1	10 k Ω control with switch
(10) 60-2	1	Slide switch

COILS-TRANSFORMERS

(11) 40-923	1	Filter coil
40-924	1	.62 μ H oscillator coil
52-120	3	1F transformer
(12) 40-925	1	Detector coil
(13) 45-74	1	.47 μ H choke
45-75	1	.68 μ H choke
(14) 53-13	1	Ratio detector

DIODES-TRANSISTORS

(15) 56-26	2	1N191 crystal diode (brown-white-brown)
(16) 56-56	2	1N4149 silicon diode

PART No.	PARTS Per Kit	DESCRIPTION
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Diodes-Transistors (cont'd.)

NOTE: When identifying each transistor, look for the part number or type number printed on the transistor case.

(17) 417-118	4	2N3393 transistor
417-201	1	X29A829 transistor
(18) 417-154	5	2N2369 or X10G1829 transistor
(19) 417-293	1	2N5770 transistor
117-6	1	Packaged transistor set
Consisting of:		
(20) 417-121	1	2N2430 transistor
417-122	1	2N2431 transistor

HARDWARE

(21) 250-202	3	3-48 x 7/8" screw
(22) 250-4	4	4-40 x 3/8" screw
(23) 250-56	7	6-32 x 1/4" screw
(24) 250-229	3	6-32 x 1/4" phillips head screw
(25) 250-89	1	6-32 x 3/8" screw
(26) 250-170	23	#6 x 1/4" sheet metal screw
(27) 250-444	2	6-32 x 1/2" handle mounting screw
(28) 252-1	6	3-48 nut
(29) 252-15	2	4-40 nut
(30) 252-89	2	4-40 push-on nut
(31) 252-3	9	6-32 nut
(32) 252-68	2	8-32 push-on nut
(33) 252-39	1	1/4" nut
(34) 252-7	4	Control nut
(35) 254-7	6	#3 lockwasher
(36) 254-9	2	#5 lockwasher
(37) 254-1	6	#6 lockwasher
(38) 254-5	2	Control lockwasher
(39) 253-10	2	Control flat washer
253-49	1	Clear nylon washer

PART No.	PARTS Per Kit	DESCRIPTION
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Hardware (cont'd.)

253-50	1	Black nylon shoulder washer
(40) 255-50	3	Spacer
(41) 255-45	1	Tapped fiber spacer
(42) 258-30	2	Battery spring
(43) 259-1	1	#6 solder lug
(44) 259-2	2	#8 solder lug
(45) 259-12	1	1/4" solder lug
(46) 259-24	1	Wire clamp

CABLE-WIRE-SLEEVING

343-15	1	Shielded cable
344-50	1	Black wire
344-52	1	Red wire
344-53	1	Orange wire
344-55	1	Green wire
344-59	1	White wire
346-19	1	Sleeving
345-1	1	Flat braid

TERMINAL STRIP-SOCKETS-PLUG

(47) 431-49	1	11-lug terminal strip
(48) 434-42	1	Phono socket
(49) 434-70	1	Crystal socket
(50) 438-4	1	Phono plug

METAL PARTS

(51) 200-547	1	Chassis
(52) 204-434	1	Antenna bracket
(53) 204-955	2	Tuner bracket
(54) 204-956	2	Handle bracket
(55) 204-957	1	Support bracket
(56) 204-959	1	Battery support bracket
(57) 205-688-1	1	Dial plate

PART No.	PARTS Per Kit	DESCRIPTION
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GENERAL

(58) 100-863	1	Vernier drive assembly
110-51	1	Tuner assembly
142-128	1	Antenna
211-43	1	Handle
(59) 214-30	1	Battery housing
(60) 214-31	2	Battery end cap
401-109	1	Speaker

MISCELLANEOUS

(61) 73-43	1	Plastic grommet
85-1444-1	1	Circuit board
93-11	1	Leatherette case

PART No.	PARTS Per Kit	DESCRIPTION
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Miscellaneous (cont'd.)

(62) 455-31	1	Antenna insert
462-230	1	Large knob
462-238	2	Small knob
(63) 464-57	1	Tuning dial
(64) 469-13	1	Battery contact
490-1	1	Alignment tool
490-5	1	Nut starter
597-260	1	Parts Order Form
390-158	1	Battery label
391-34	1	Identification label
597-308	1	Kit Builders Guide
	1	Manual (see front cover for part number)
		Solder

STEP-BY-STEP ASSEMBLY

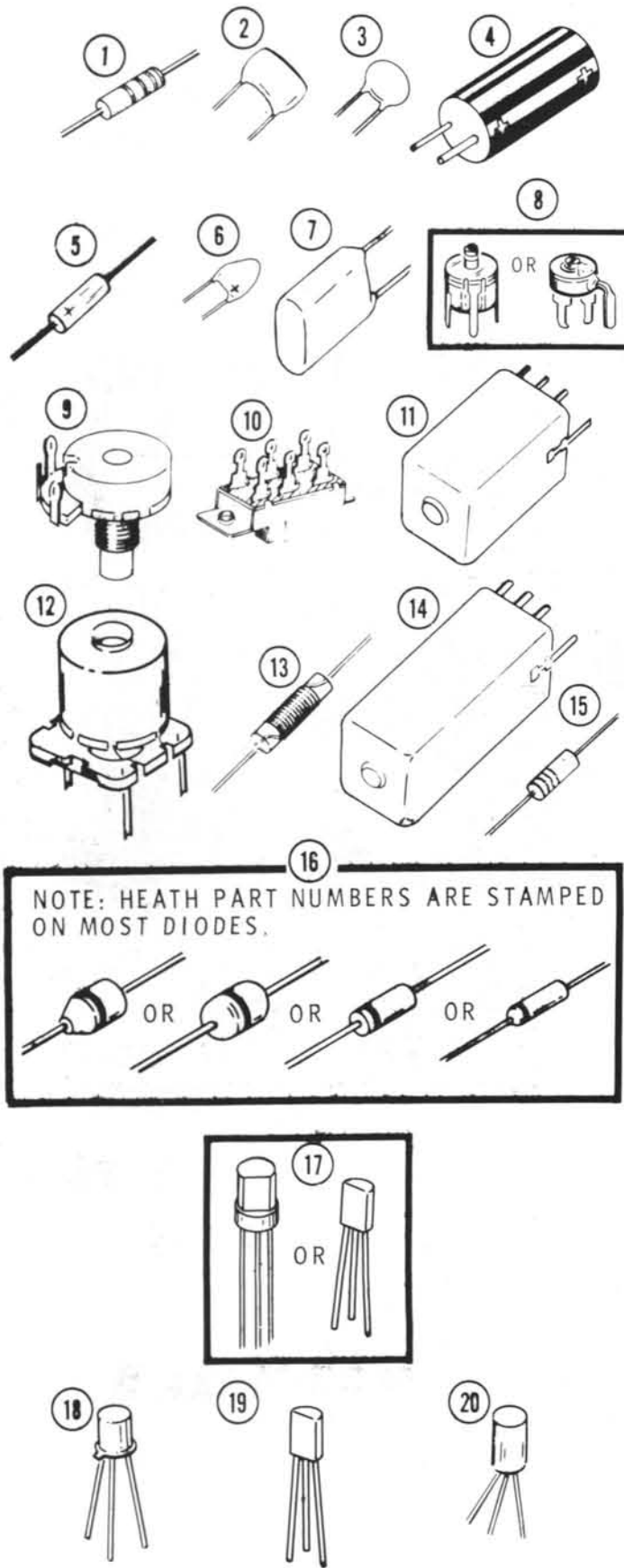
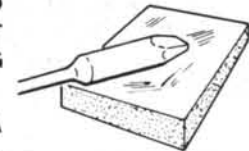
Before you start the circuit board assembly, be sure to read the Circuit Board Parts Mounting and Soldering sections (Pages 11, 12, and 13) of the Kit Builders Guide.

Resistors will be called out by the resistance value (in Ω or $k\Omega$) and color code. Capacitors will be called out by the capacitance value (in pF or μF) and type (mica, disc, electrolytic, Mylar or tantalum).

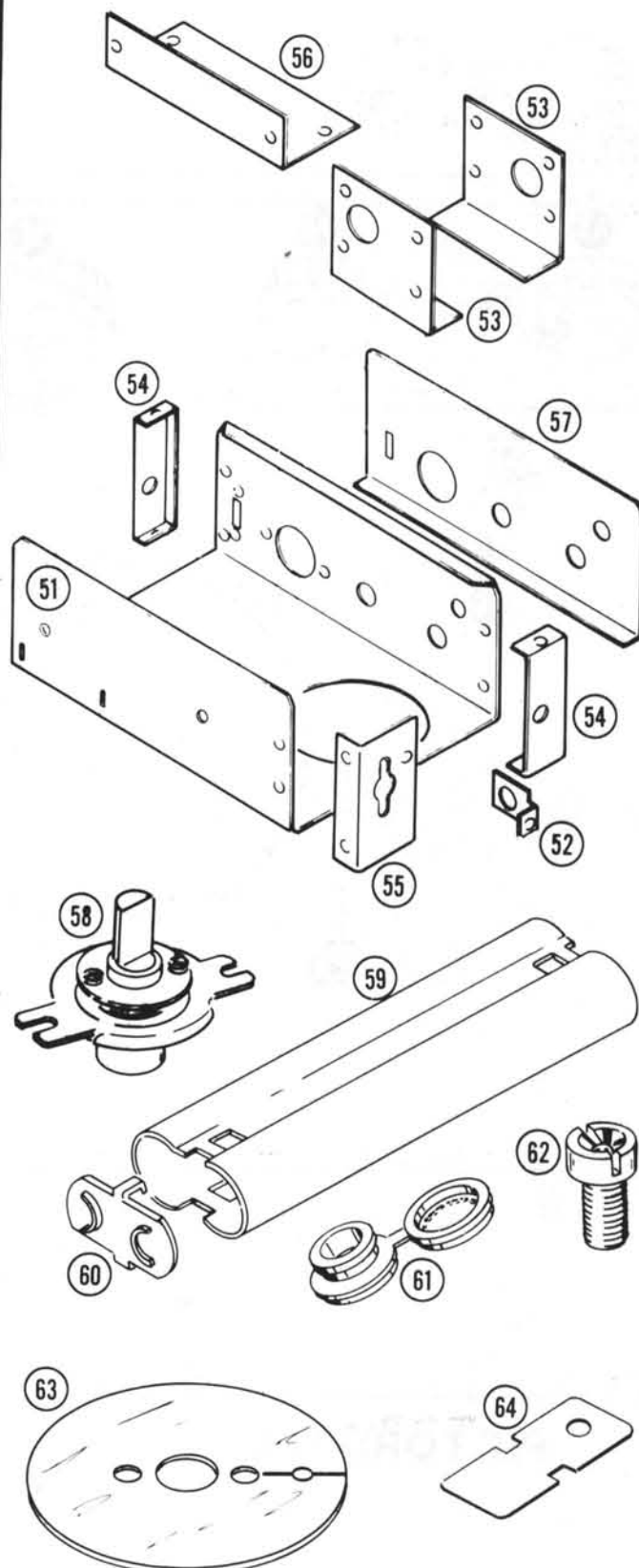
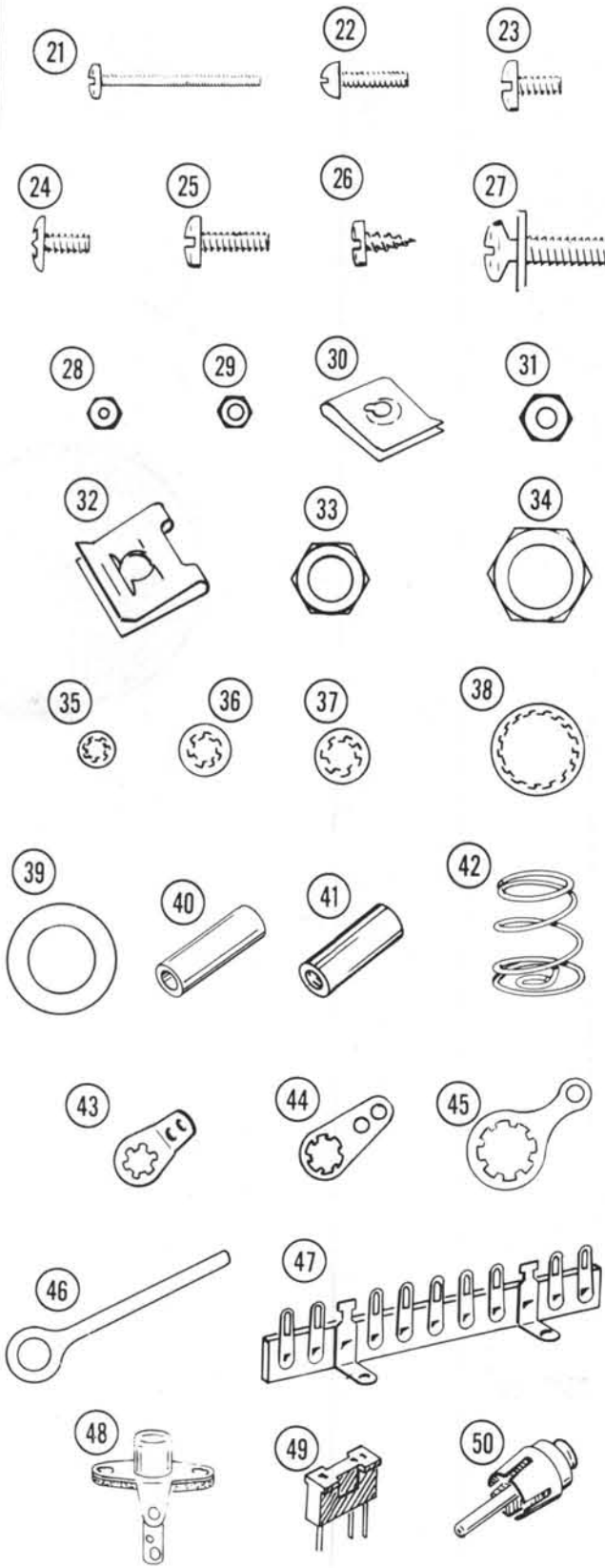
Perform the steps on Pictorials 1 through 7.

FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN...

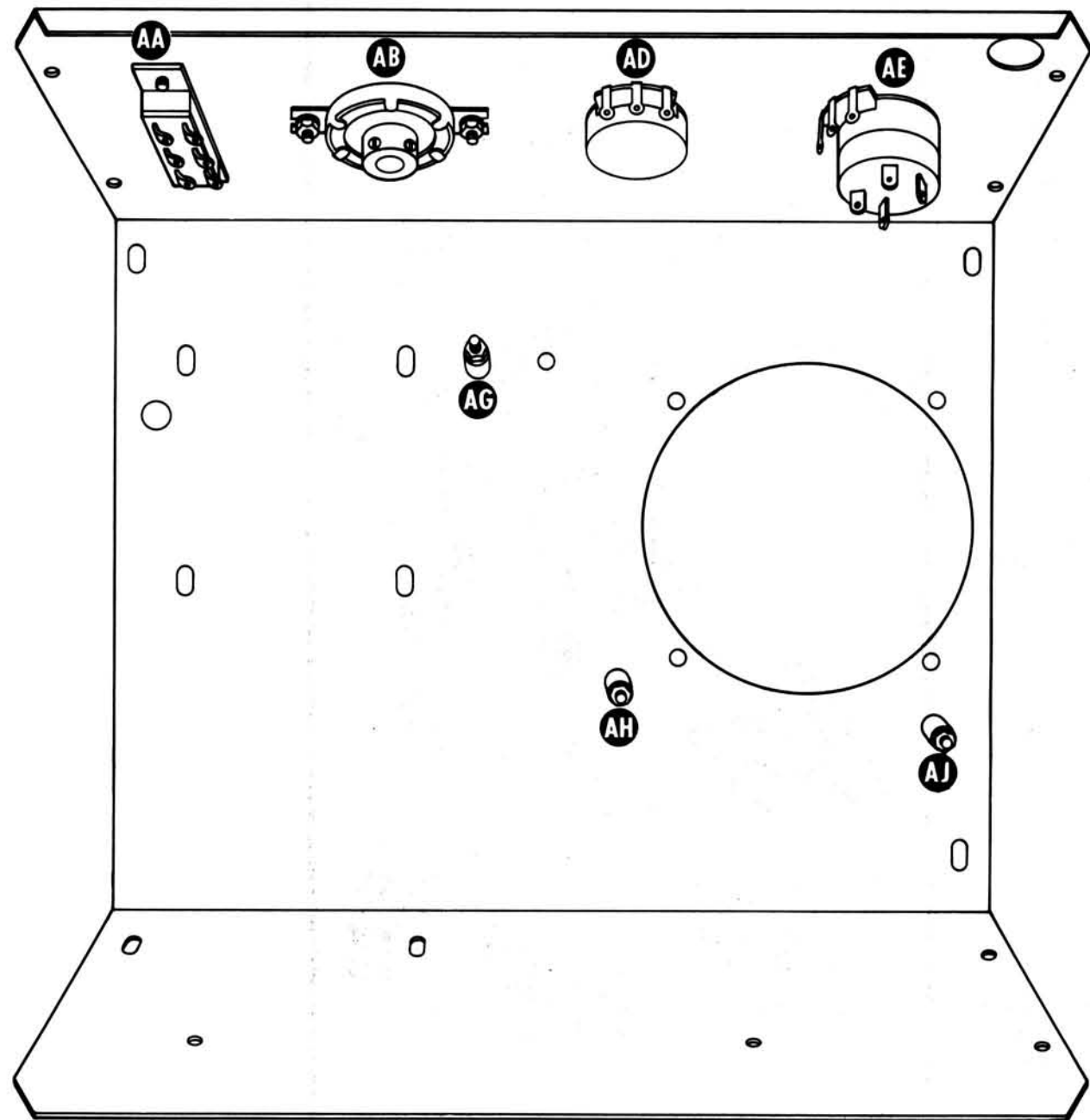
WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.



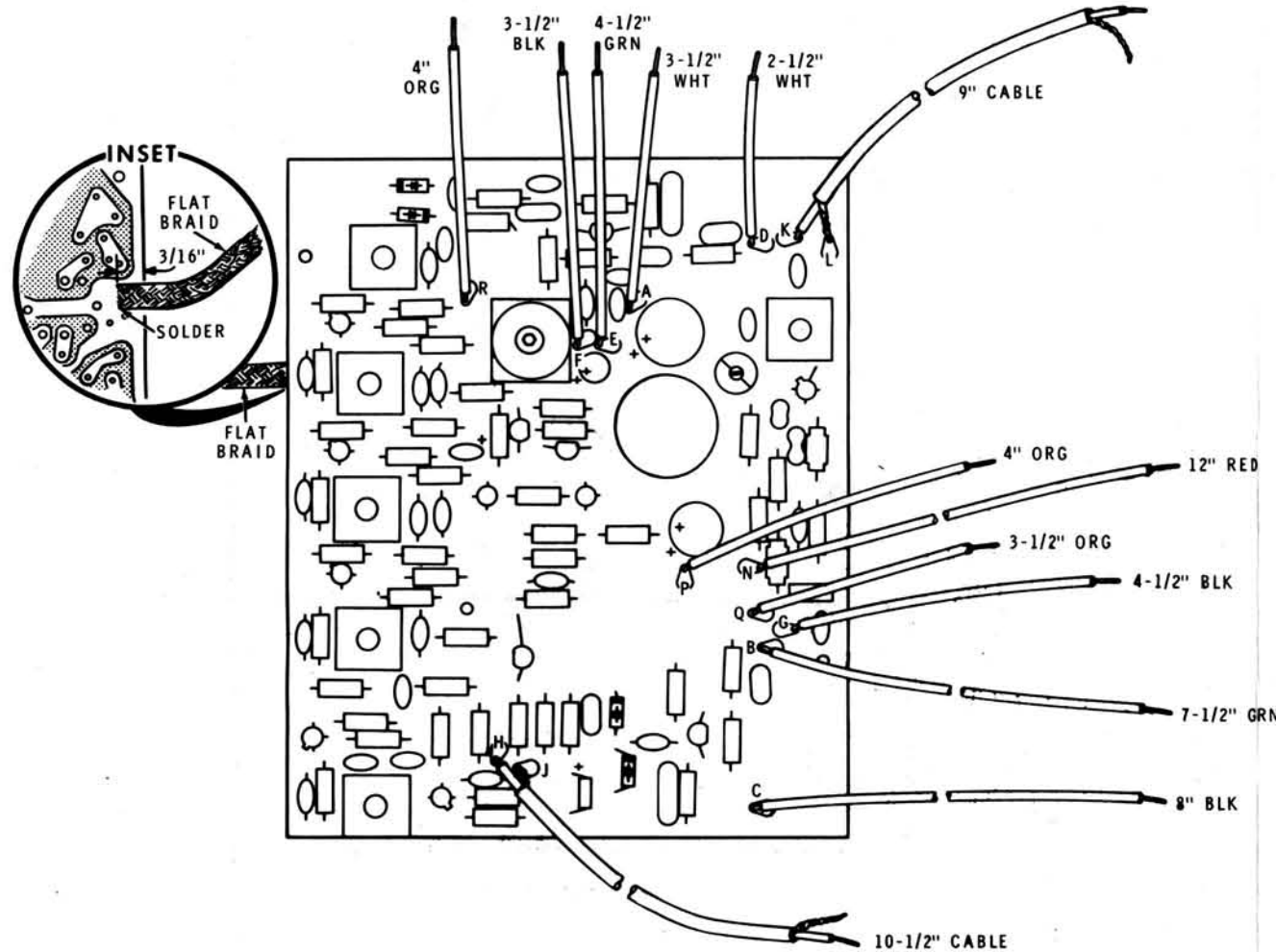
PARTS PICTORIAL



CIRCUIT BOARD ASSEMBLY



PICTORIAL 9



PICTORIAL 8

IDENTIFICATION DRAWING

PART NUMBER

START

Position the circuit board with the part number as shown in the identification drawing. Then complete each step on the Pictorial.

NOTE: Only one-half of the circuit board is shown in Pictorial 1. The identification drawing at the top of the Pictorial shows the area of the circuit board to be assembled.

(✓) 1000 Ω (brown-black-red).	(✓) Crystal diode #56-26 (brown-white-brown).
(✓) 1500 Ω (brown-green-red).	(✓) Crystal diode #56-26 (brown-white-brown).
(✓) 4700 Ω (yellow-violet-red).	(✓) 6800 Ω (blue-gray-red).
(✓) 150 Ω (brown-green-brown).	(✓) 6800 Ω (blue-gray-red).
(✓) 270 Ω (red-violet-brown).	(✓) 39 k Ω (orange-white-orange).
(✓) 220 Ω (red-red-brown).	(✓) 10 k Ω (brown-black-orange).
(✓) 15 k Ω (brown-green-orange).	(✓) 1000 Ω (brown-black-red).
(✓) 270 Ω (red-violet-brown).	(✓) 22 k Ω (red-red-orange).
(✓) Solder the leads to the foil and cut off the excess lead lengths.	(✓) Solder the connections to the foil and cut off the excess lead lengths.
(✓) 220 Ω (red-red-brown).	(✓) 270 Ω (red-violet-brown).
(✓) 330 Ω (orange-orange-brown).	(✓) 10 k Ω (brown-black-orange).
(✓) 330 Ω (orange-orange-brown).	(✓) 22 k Ω (red-red-orange).
(✓) 15 k Ω (brown-green-orange).	(✓) 4.7 Ω (yellow-violet-gold).
(✓) 47 k Ω (yellow-violet-orange).	(✓) 270 Ω (red-violet-brown).
(✓) 330 Ω (orange-orange-brown).	(✓) 47 k Ω (yellow-violet-orange).
(✓) 1000 Ω (brown-black-red).	(✓) 22 k Ω (red-red-orange).
(✓) 470 Ω (yellow-violet-brown).	(✓) 15 k Ω (brown-green-orange).
(✓) Solder the leads to the foil and cut off the excess lead lengths.	(✓) Solder the leads to the foil and cut off the excess lead lengths.

CONTINUE

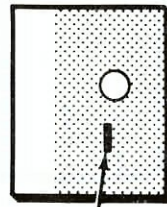
NOTE: When you install each of the following crystal diodes, be sure to position the banded end as shown.

BANDED END

PROCEED TO PICTORIAL 2.

PICTORIAL 1

IDENTIFICATION DRAWING



PART NUMBER

CONTINUE

START

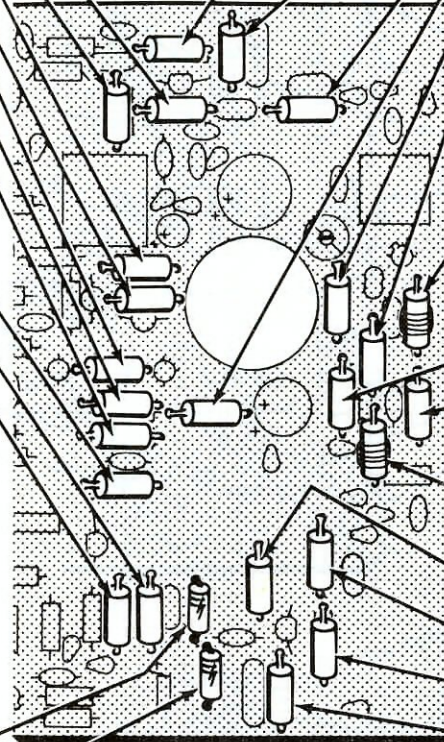
- () 3300 Ω (orange-orange-red).
- () 47 k Ω (yellow-violet-orange).
- () 47 k Ω (yellow-violet-orange).
- () 1200 Ω (brown-red-red).
- () 33 Ω (orange-orange-black).
- () 1.5 Ω (brown-green-gold).
- () 1000 Ω (brown-black-red).
- () Solder the leads to the foil and cut off the excess lead lengths.
- () 10 k Ω (brown-black-orange).
- () 2200 Ω (red-red-red).
- () 8200 Ω (gray-red-red).

NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. THE CATHODE END OF THE DIODE IS MARKED WITH A BAND OR BANDS. ALWAYS POSITION THIS END AS SHOWN IN THE PICTORIAL.

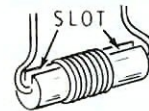


BAND OR BANDS

- () Silicon diode #56-56.
- () Silicon diode #56-56.
- () Solder the leads to the foil and cut off the excess lead lengths.



- () 6800 Ω (blue-gray-red).
- () 220 Ω (red-red-brown).
- () 3300 Ω (orange-orange-red).
- () 1.5 Ω (brown-green-gold).
- () 100 Ω (brown-black-brown).
- () 3900 Ω (orange-white-red).
- () .47 μ H choke (#45-74).



- () Solder the leads to the foil and cut off the excess lead lengths.
- () 4700 Ω (yellow-violet-red).
- () 560 Ω (green-blue-brown).
- () .68 μ H choke (#45-75). Install this choke in the same manner as the .47 μ H choke previously installed.
- () 3300 Ω (orange-orange-red).
- () 47 k Ω (yellow-violet-orange).
- () 10 k Ω (brown-black-orange).
- () 2200 Ω (red-red-red).
- () Solder the leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 3.

PICTORIAL 2

IDENTIFICATION DRAWING

START



NOTE: Because of the characteristics of very high radio frequencies, all component leads should be kept as short as possible. Clean the insulation from each disc capacitor lead as shown before you install the capacitor on the circuit board.



REMOVE INSULATION
FROM LEADS

(U) 270 pF disc.

() .01 μ F disc.

() .01 μ F disc.

() .01 μ F disc.

() .01 μ F disc.

() .01 μ F disc.

() .01 μ F disc.

() .01 μ F disc.

() 100 pF disc.

() .01 μ F disc.

() Solder the leads to the foil and cut off the excess lead lengths.

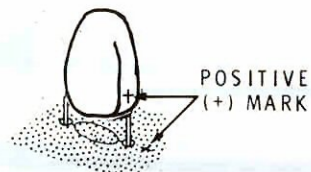


PART NUMBER

CONTINUE



- () 270 pF disc.
- () .1 μ F Mylar.
- () 270 pF disc.
- () .01 μ F disc.
- () 22 μ F tantalum electrolytic. Be sure to position the positive (+) marked lead in the positive (+) marked hole in the circuit board.
- () .01 μ F disc.
- () .01 μ F disc.
- () 100 pF disc.
- () .01 μ F disc.
- () Solder the leads to the foil and cut off the excess lead lengths.



POSITIVE
(+) MARK

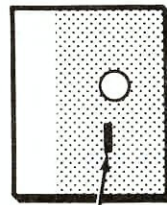
PROCEED TO PICTORIAL 4.

PICTORIAL 3

START



IDENTIFICATION DRAWING



PART NUMBER

NOTE: Clean the insulation from the disc capacitor leads before you install the capacitor on the circuit board.

() .22 μ F Mylar.

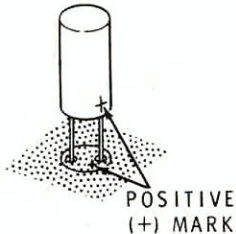
() .1 μ F Mylar.

() .005 μ F disc.

() .05 μ F disc.

() .005 μ F disc.

NOTE: When you install the following electrolytic capacitors, be sure to position the positive (+) lead of the capacitor in the positive (+) marked hole in the circuit board.



POSITIVE
(+) MARK

() 10 μ F electrolytic.

() 1000 μ F electrolytic.

() 250 μ F electrolytic.

() Solder the leads to the foil and cut off the excess lead lengths.

() .01 μ F disc.

() .05 μ F disc.

() .1 μ F Mylar.

() .22 μ F Mylar.

() 2.2 μ F tantalum electrolytic. Be sure to position the positive (+) end (red end) of the capacitor toward the positive (+) marked hole on the circuit board.

RED END



() Solder the leads to the foil and cut off the excess lead lengths.

CONTINUE



() .1 μ F Mylar.

() 3.3 μ F disc.

() .001 μ F disc.

() Install the trimmer.



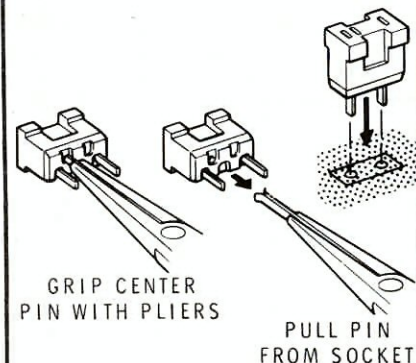
#31-57

() 300 pF mica.

() 33 pF mica.

() .02 μ F disc.

() Crystal socket. First use a pair of pliers to remove the center pin from the socket as shown. Then insert the pins of the socket through the circuit board and solder them to the foil.



() 27 pF disc.

() .1 μ F Mylar.

() Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 4

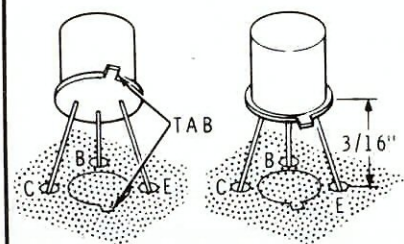
PROCEED TO PICTORIAL 5.

IDENTIFICATION DRAWING

START



NOTE: When you install the following transistors, first line up the locating tab on the transistor with the outline of the tab on the circuit board. Then insert the transistor leads into their correct holes, which are indicated by C, B, and E. Position the transistor $3/16''$ away from the circuit board. Solder each lead to the foil and cut off the excess lead lengths.



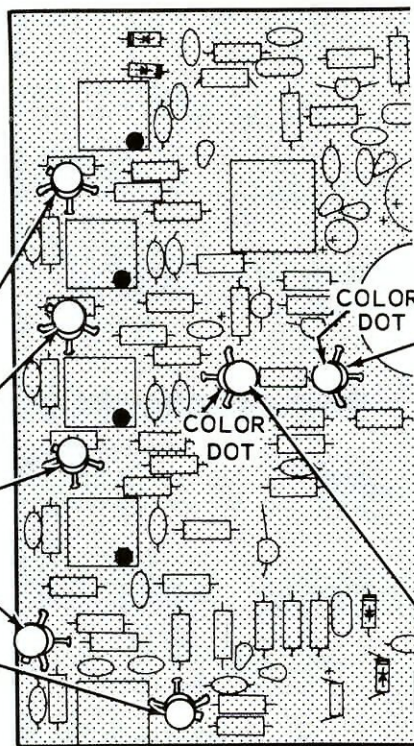
() 2N2369 transistor (#417-154) at Q5.

() 2N2369 transistor (#417-154) at Q4.

() 2N2369 transistor (#417-154) at Q3.

() 2N2369 transistor (#417-154) at Q2.

() 2N2369 transistor (#417-154) at Q1.

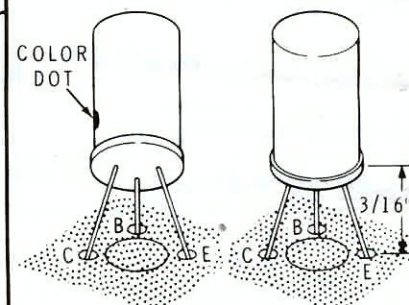


PART NUMBER

CONTINUE



() 2N2430 transistor at Q11. Note that the collector (C) lead is marked by a color dot. Insert the transistor leads into their correct holes which are indicated by C, B, and E. Position the transistor $3/16''$ away from the circuit board. Solder each lead to the foil and cut off the excess lead lengths.



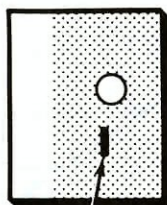
() In the same manner, install the 2N2431 transistor at Q12.

PROCEED TO PICTORIAL 6.

PICTORIAL 5

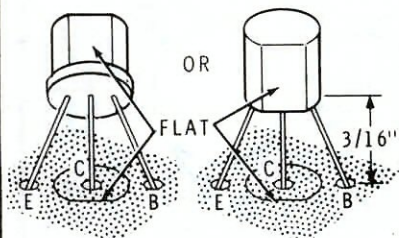
IDENTIFICATION DRAWING

START



PART NUMBER

NOTE: When you install the following transistors, first line up the flat of the transistor with the flat of the outline on the circuit board. Then insert the transistor leads into their correct holes and position the transistor $3/16''$ away from the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

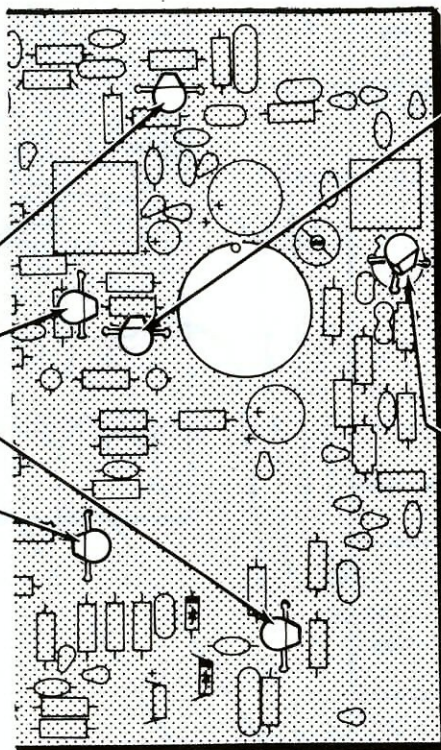


() 2N3393 transistor (#417-118) at Q6.

() 2N3393 transistor (#417-118) at Q9.

() 2N3393 transistor (#417-118) at Q7.

() 2N3393 transistor (#417-118) at Q8.

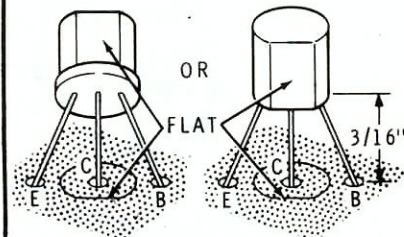


PICTORIAL 6

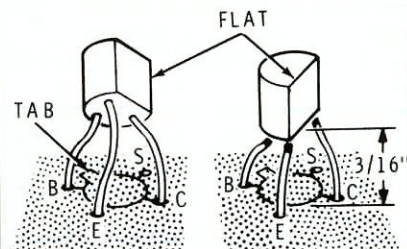
CONTINUE



() In the same manner, install the X29A829 transistor (#417-201) at Q10.



() 2N5770 transistor (#417-293) at Q13. Position this transistor with its flat side facing away from the tab printed on the circuit board. Insert the B, C, and E lead into their correct holes and position the transistor $3/16''$ above the circuit board. Then solder the leads to the foil and cut off the excess lead length.

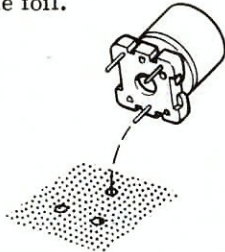


PROCEED TO PICTORIAL 7.

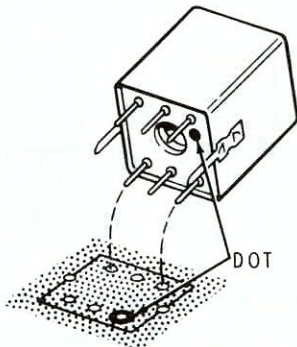
START



- () Filter coil #40-925 at L2. Insert the coil pins through the circuit board and solder them to the foil.



NOTE: When you install the following transformer, position the color dot on the transformer over the dot on the circuit board. Then insert the transformer pins through the circuit board. Solder the pins and the mounting lugs to the foil. Do not solder where there is no foil.



- () Ratio detector #53-13 at T4.

- () IF transformer #52-120 at T3.

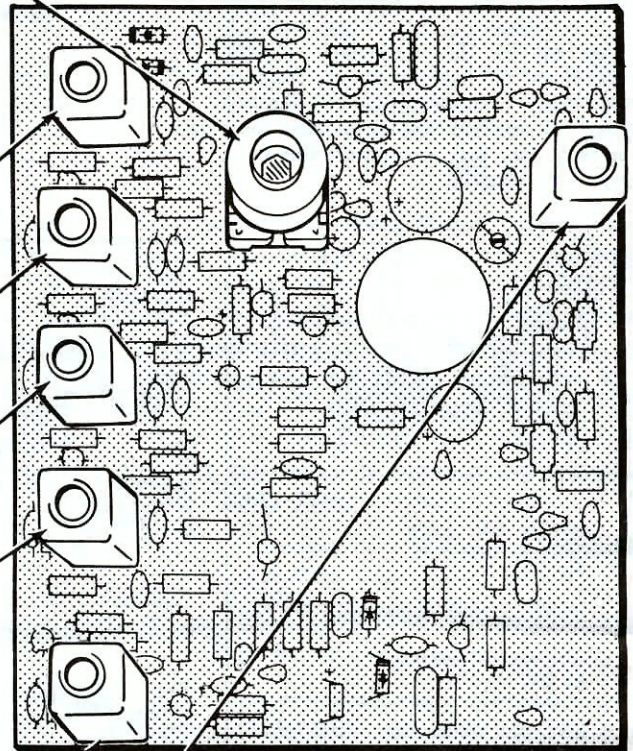
- () IF transformer #52-120 at T2.

- () IF transformer #52-120 at T1.

NOTE: Make sure the metal portion of the IF transformer does not touch the lead on capacitor C1 (.01 μ F disc). If necessary, move the lead of the capacitor.

- () IF filter #40-923 at L1. Insert the pins through the circuit board and solder them to the foil. Do not solder where there is no foil.

- () Oscillator coil #40-924 at L3. Insert the pins through the circuit board and solder them to the foil. Then cut off the excess pin length.



NOTE: Two resistors and three capacitors should be left over at the completion of the circuit board Pictorials. These components are as follows: one 4700 Ω (yellow-violet-red), and one 10 k Ω (brown-black-orange) resistor; one 150 pF mica, one 680 pF mica, and one 100 pF disc capacitor.

FINISH

PICTORIAL 7

Refer to Pictorial 8 (fold-out from Page 6) for the following steps.

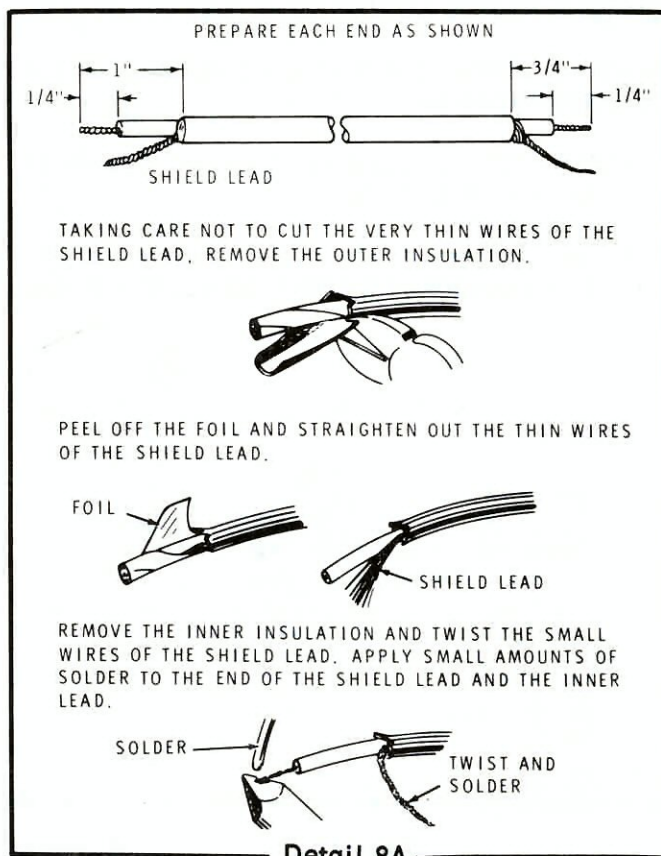
NOTE: When wiring this kit, you may find it easier to prepare the lengths of hookup wire ahead of time, as in the following step. To prepare a wire, cut it to the indicated length and remove 1/4" of insulation from each end. The wires are listed in the order in which they will be used.

- () Prepare the following lengths of hookup wire:

Orange 4"	Orange 4"
White 3-1/2"	Orange 3-1/2"
White 2-1/2"	Black 4-1/2"
Green 4-1/2"	Green 7-1/2"
Black 3-1/2"	Black 8"
Red 12"	

Connect one end of each wire to the circuit board as follows; the other end of each wire will be connected later:

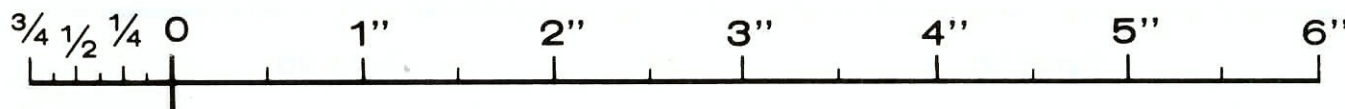
- (✓) 4" orange wire to hole R (S-1).
- () 3-1/2" white wire to hole A (S-1).
- () 2-1/2" white wire to hole D (S-1).
- (✓) 4-1/2" green wire to hole E (S-1).
- (✓) 3-1/2" black wire to hole F (S-1).
- (✓) 12" red wire to hole N (S-1).
- (✓) 4" orange wire to hole P (S-1).
- () 3-1/2" orange wire to hole Q (S-1).
- (✓) 4-1/2" black wire to hole G (S-1).
- (✓) 7-1/2" green wire to hole B (S-1).
- () 8" black wire to hole C (S-1).
- () Refer to Detail 8A and prepare a 10-1/2" shielded cable and a 9" shielded cable as shown.
- () At the short end of the 10-1/2" shielded cable connect the inner lead to hole H (S-1) and the shield lead to hole J (S-1) on the circuit board.



- (✓) At the short end of the 9" shielded cable, connect the inner lead to hole K (S-1) and the shielded lead to hole L (S-1) on the circuit board.
- (✓) Solder a 2-1/2" length of flat braid to the indicated foil on the foil side of the circuit board as shown in the inset drawing on Pictorial 8.

The other ends of the shielded cables will be connected later.

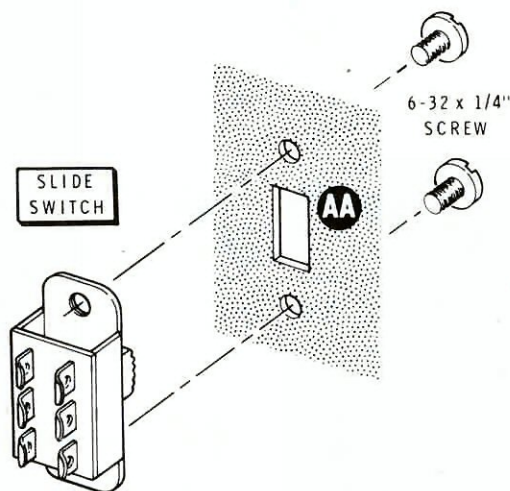
- () Carefully inspect the foil side of the circuit board for any solder bridges between foils. Solder any connections that may have been missed. Disregard the unused, unmarked holes in the circuit board. Then set the circuit board aside temporarily.



CHASSIS PARTS MOUNTING

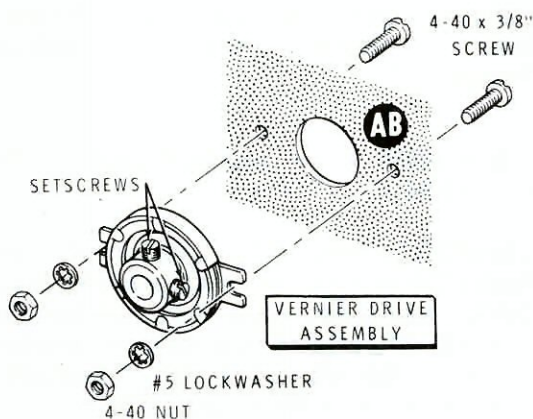
Refer to Pictorial 9 (fold-out from Page 6) for the following steps.

- () Bend all six lugs of the slide switch as shown in Detail 9A.
- () Again refer to the Detail and mount the slide switch at AA with 6-32 x 1/4" screws.

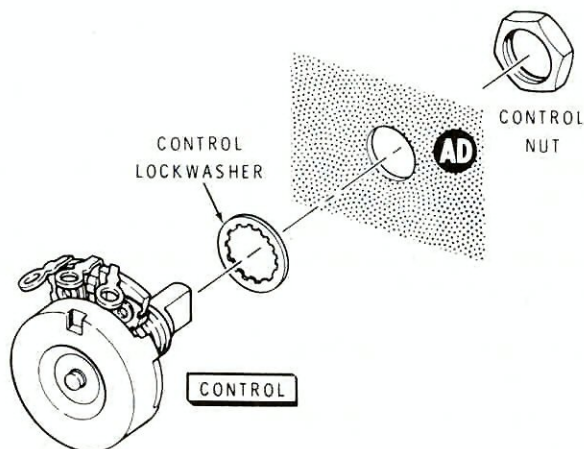


Detail 9A

- () Refer to Detail 9B and mount the vernier drive assembly at AB with 4-40 x 3/8" screws, #5 lockwashers, and 4-40 nuts. Tighten the hardware only finger tight at this time. Unscrew the setscrews so they extend 1/8" from the vernier drive assembly.

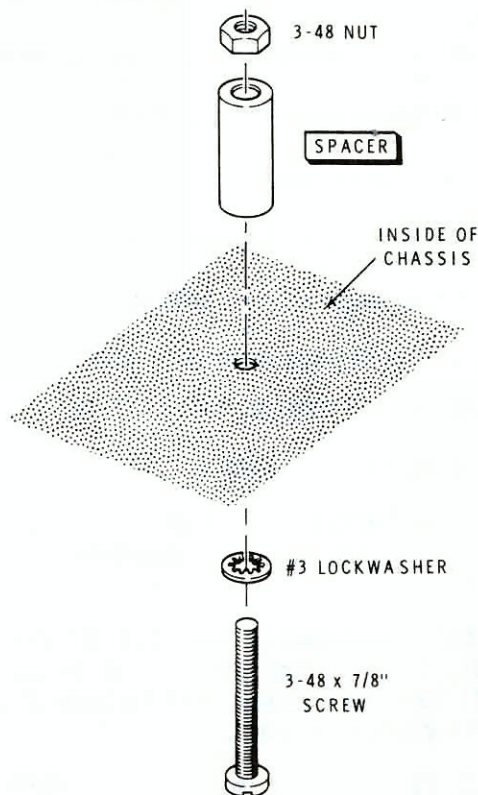


Detail 9B



Detail 9C

- () Mount the 10 kΩ control (#10-281) at AD as shown in Detail 9C. Use a control lockwasher, and a control nut. Position the control as shown.
- () Mount the 10 kΩ control with switch (#19-135) at AE with a control lockwasher, and a control nut. Position the control as shown.
- () Refer to Detail 9D and mount the spacers at AG, AH, and AJ, with 3-48 x 7/8" screws, #3 lockwashers, and 3-48 nuts.



Detail 9D

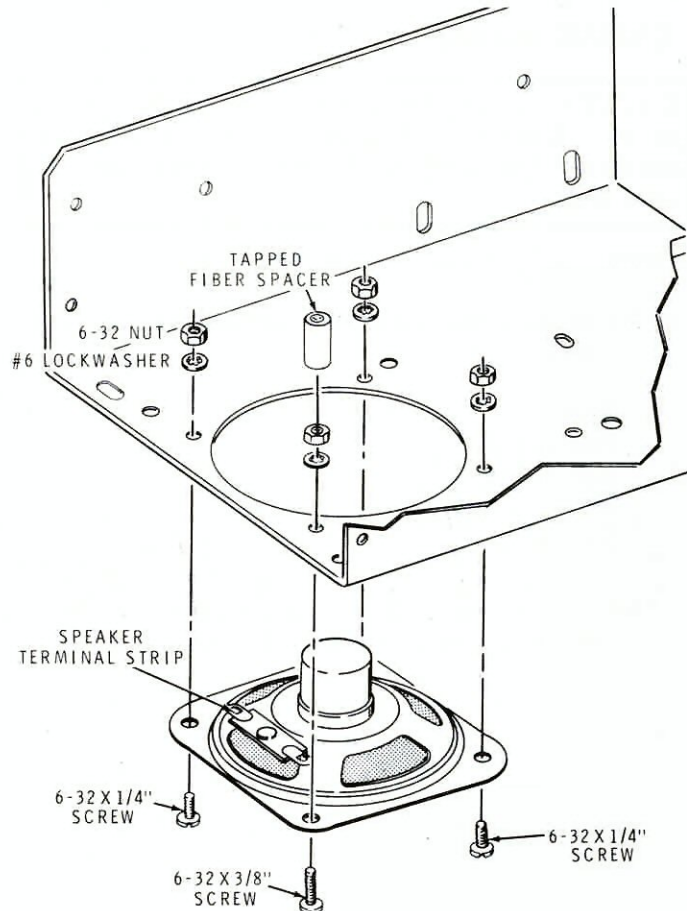
Refer to Pictorial 10 for the following steps.

CAUTION: When handling the speaker, be very careful not to damage its paper cone. After the speaker is mounted, it is a good idea to protect the speaker throughout the remainder of the assembly by taping a piece of cardboard over the front of the speaker. A 3-1/2" square piece of cardboard can be cut from the shipping carton for this purpose.

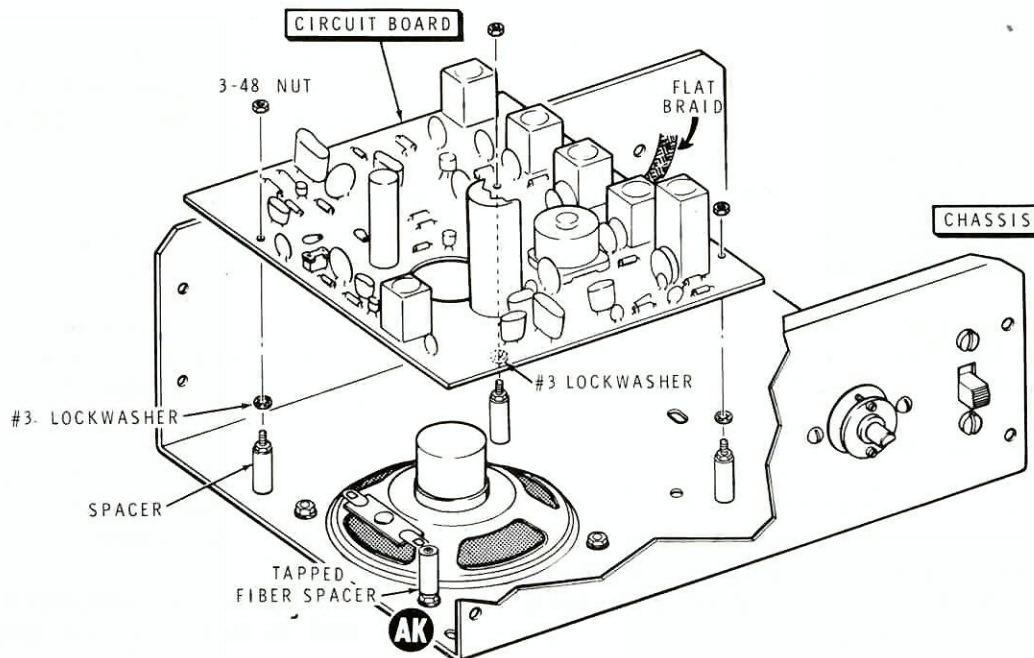
- () Mount the speaker on the front of the chassis as shown in Detail 10A. Use a 6-32 x 3/8" screw, a #6 lockwasher, and a 6-32 nut at AK. Use 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts in the remaining holes. Be sure to position the speaker terminal lugs as shown in the Pictorial.

NOTE: The tapped fiber spacer will be used in the following step. One end of the spacer is tapped for a 3-48 screw, and the other end is tapped for a 6-32 screw. Be sure to use the 6-32 tapped end.

- () Refer to the Pictorial and screw the 6-32 end of the tapped fiber spacer onto the end of the 6-32 x 3/8" screw at AK.
- () Mount the circuit board on the spacers with #3 lockwashers, and 3-48 nuts. Be sure to place the lockwashers on the foil side of the circuit board. Bend the flat braid up as shown.



Detail 10A



PICTORIAL 10

CHASSIS WIRING

CAUTION: Lead placement is extremely critical in this Receiver. Follow the Pictorials very carefully for lead placement to obtain proper operation.

Refer to Pictorial 11 for the following steps.

- () Prepare the following lengths of hookup wire:

Red 10"
Red 3-1/2"
Red 4-1/2"
White 1-1/2"
Red 8"

- () Connect the 10" red wire from lug 4 of switch AA (NS), to lug 7 of control AE (NS).

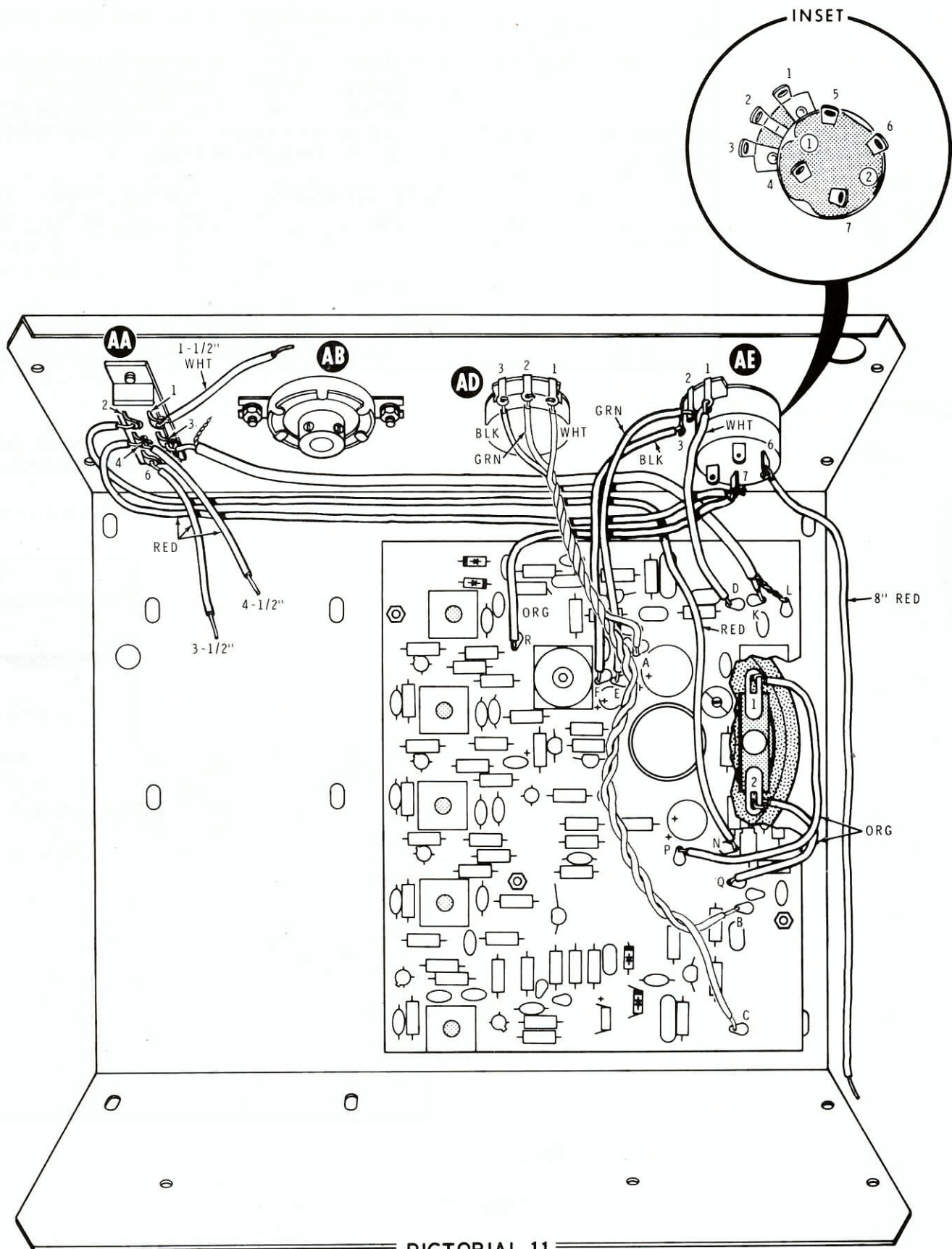
Only one end of the precut wires will be connected in the following steps. The other end will be connected later.

- () Connect one end of the 3-1/2" red wire to lug 6 of switch AA (S-1).
- () Connect one end of the 4-1/2" red wire to lug 4 of switch AA (S-2).
- () Connect one end of the 1-1/2" white wire to lug 1 of switch AA (S-1).
- () Connect one end of the 8" red wire to lug 6 of control AE (S-1).
- () Route the shielded cable from holes K and L on the circuit board as shown and connect the inner lead to lug 3 of switch AA (S-1). The shield lead will be connected later.
- () Route the red wire from hole N on the circuit board as shown and connect the free end to lug 2 of switch AA (S-1).
- () Connect the free end of the orange wire coming from hole R on the circuit board to lug 7 of control AE (S-2).
- () Connect the free end of the black wire coming from hole F on the circuit board to lug 3 of control AE (S-1).

- () Connect the free end of the green wire coming from hole E on the circuit board to lug 2 of control AE (S-1).
- () Connect the free end of the white wire coming from hole D on the circuit board to lug 1 of control AE (S-1).
- () Locate the black wire coming from hole C and the green wire coming from hole B in the circuit board. Twist these wires together with approximately 1-1/2 turns per inch.
- () Locate the white wire coming from hole A in the circuit board. Twist the white wire approximately 1-1/2 turns around the twisted black and green wires.
- () Connect the free end of the black wire coming from hole C on the circuit board to lug 3 of control AD (S-1).
- () Connect the free end of the green wire coming from hole B on the circuit board to lug 2 of control AD (S-1). Position this wire as shown.
- () Connect the free end of the white wire coming from hole A on the circuit board to lug 1 of control AD (S-1).
- () Position the twisted black, green, and white wires exactly as shown in the Pictorial, and press them close to the circuit board.
- () Connect the free end of the orange wire coming from hole P on the circuit board to lug 1 on the speaker (S-1).
- () Connect the free end of the orange wire coming from hole Q on the circuit board to lug 2 on the speaker (S-1).
- () Bend the speaker lugs down slightly so they are between the circuit board connections and the speaker frame.

The remaining unconnected wires on the circuit board and chassis will be connected later.





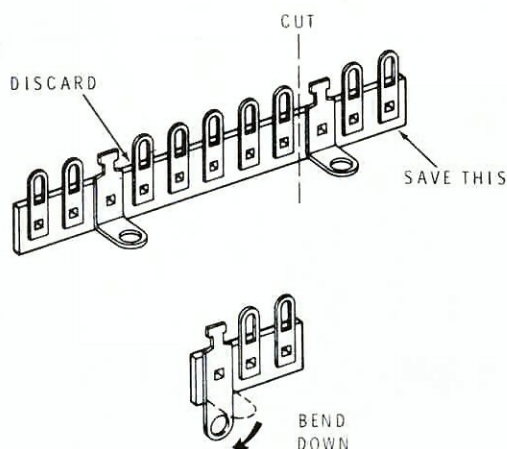
PICTORIAL 11

TUNER INSTALLATION

Refer to Pictorial 12 (fold-out from Page 19) for the following steps.

- () Locate the 11-lug terminal strip and cut off the indicated 3-lug section as shown in Detail 12A. Discard the 8-lug section.

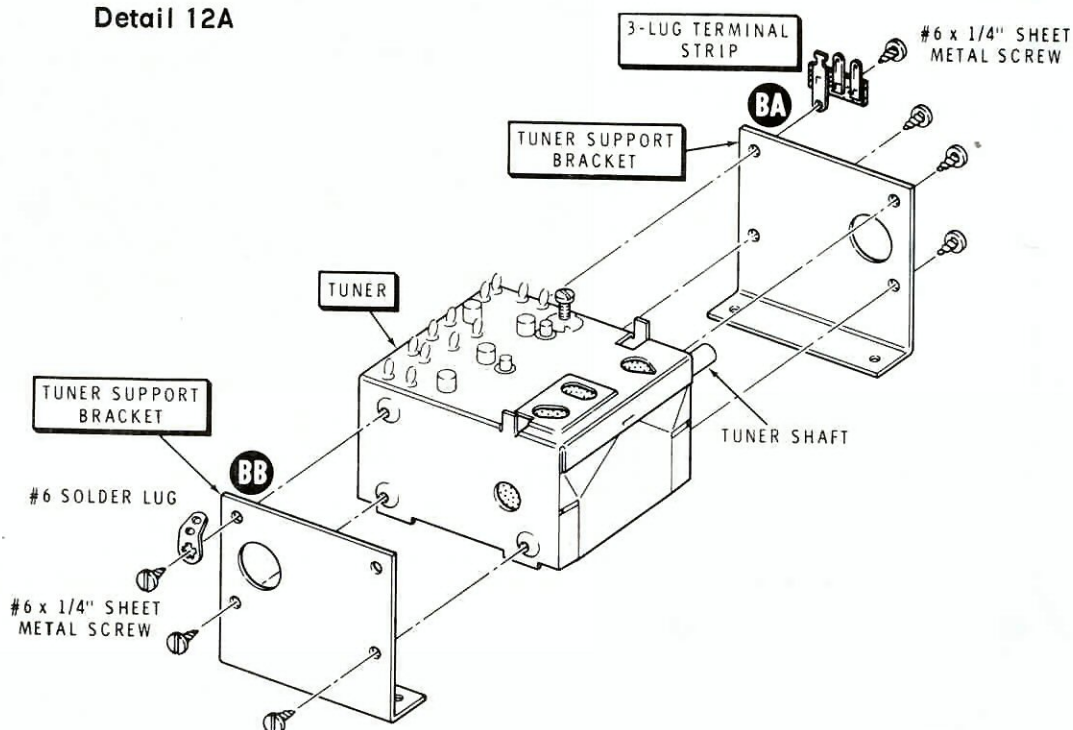
NOTE: Use care when bending the terminal strip mounting foot in the next step as it can be broken off.



Detail 12A

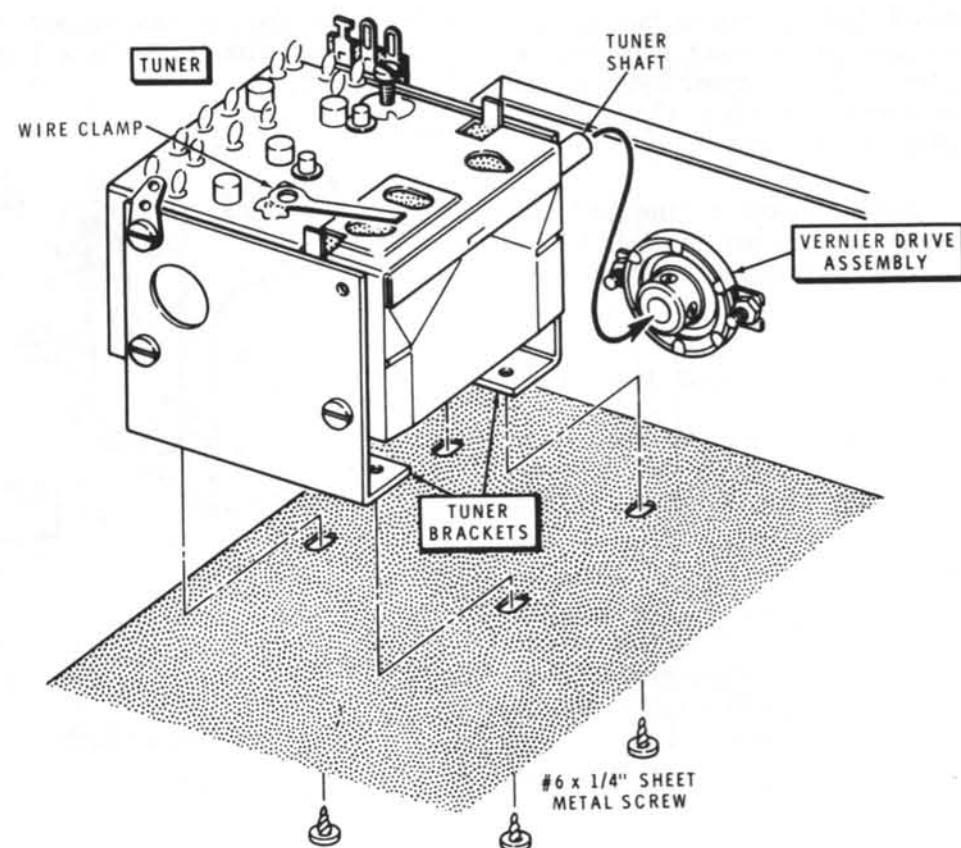
Refer to Detail 12B for the next three steps.

- () Mount a tuner support bracket to the shaft end of the tuner with a #6 x 1/4" sheet metal screw and the cut off 3-lug terminal strip at BA. Use #6 x 1/4" sheet metal screws in the remaining three holes.
- () Mount a tuner support bracket to the back of the tuner with a #6 x 1/4" sheet metal screw and a #6 solder lug at BB. Use #6 x 1/4" sheet metal screws in the remaining two holes.
- () Refer to Detail 12C and position the wire clamp on the tuner exactly in the position shown. Then solder it to the tuner. Cut the wire clamp to a length of 5/8".
- () Looking at the tuner from the shaft end, turn the tuner shaft fully counterclockwise.
- () Set the tuner into the chassis. Do not mount the tuner at this time.
- () Solder the short red wire coming from lug 6 of switch AA to lug 6 on the tuner.

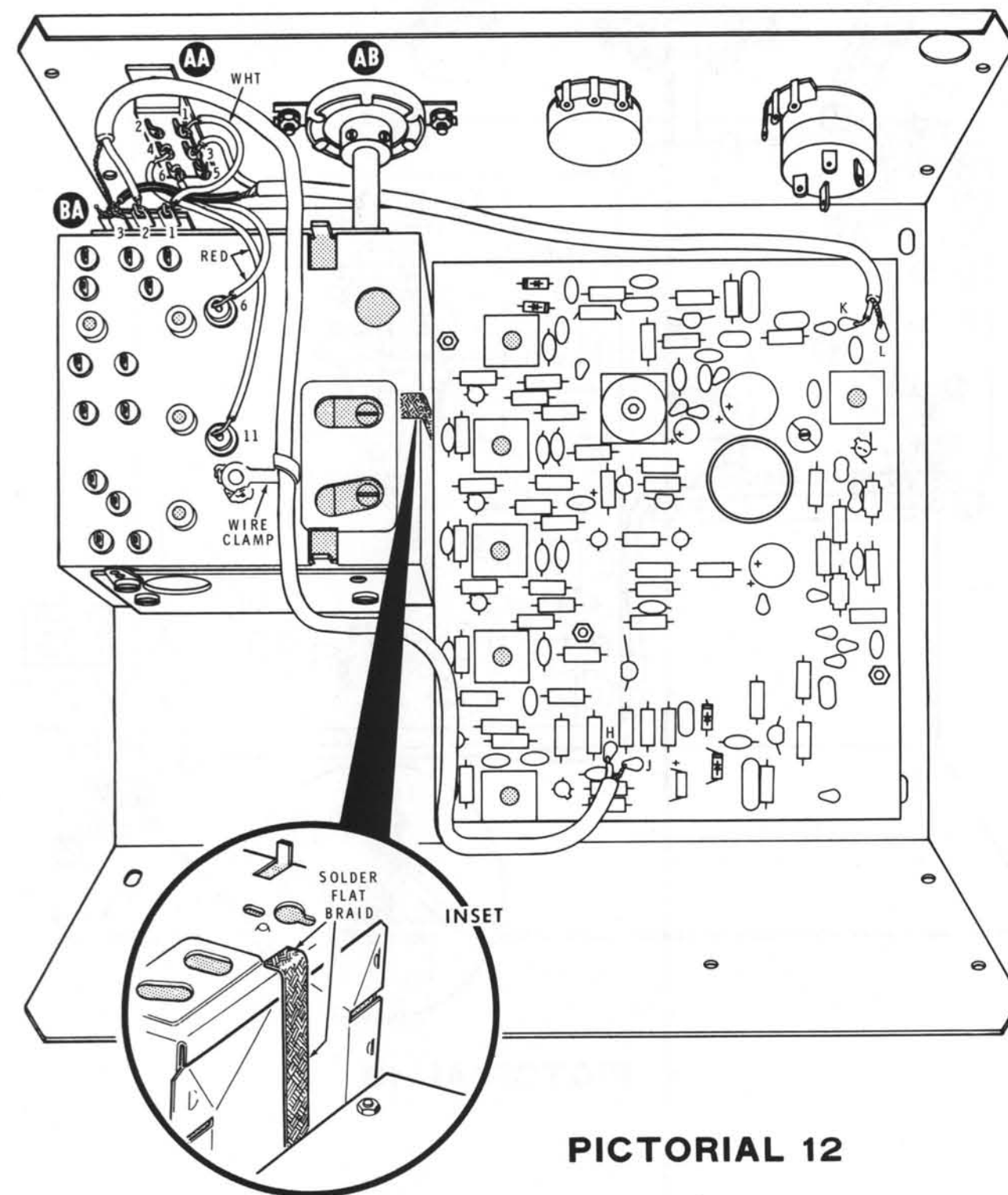


Detail 12B

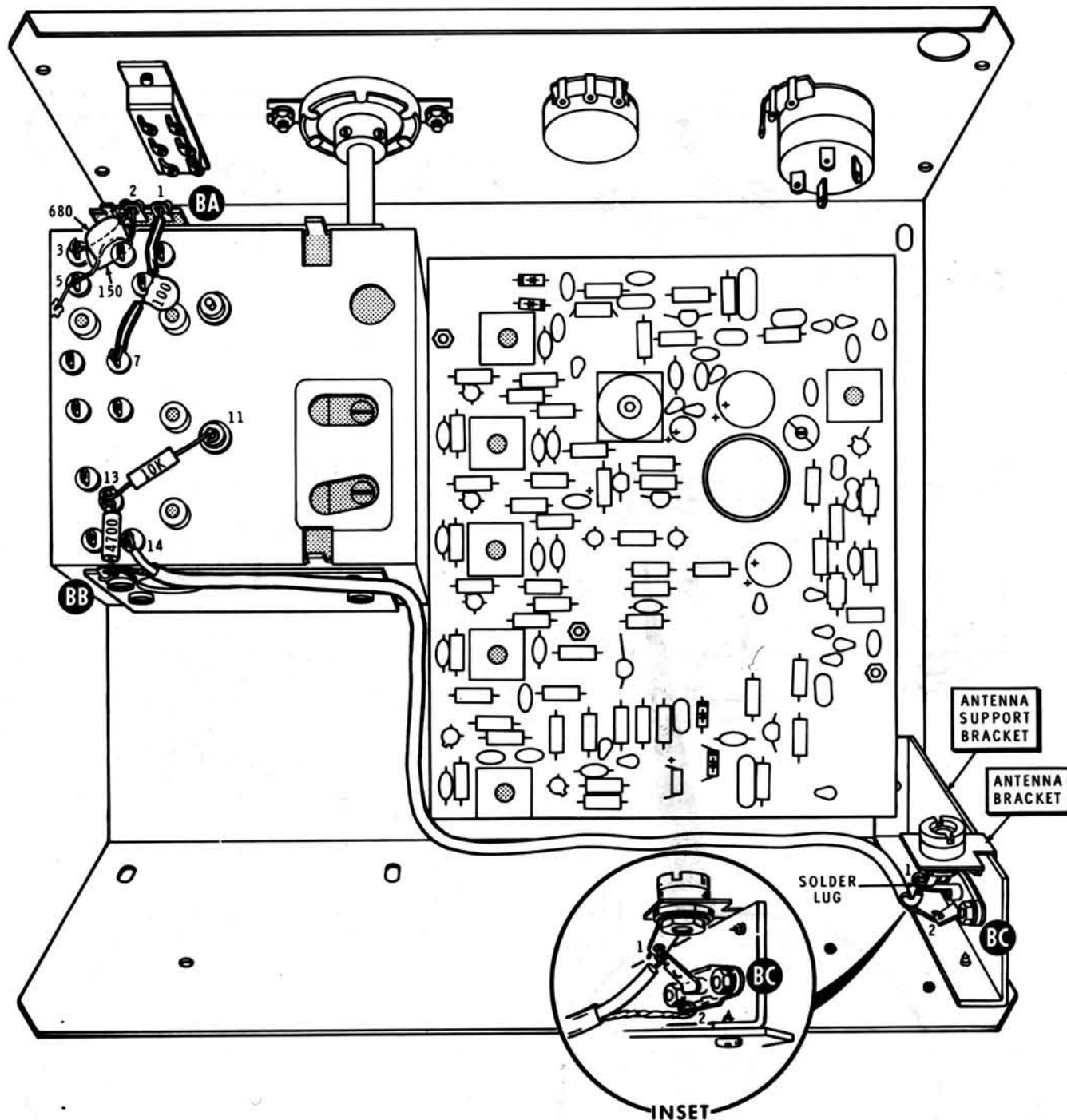
- (✓) Solder the red wire coming from lug 4 of switch AA to lug 11 on the tuner.
- (✓) Connect the white wire coming from lug 1 of switch AA to lug 1 of terminal strip BA (NS).
- (✓) Place a 1/2" length of sleeving over the shield lead of the cable connected to lug 3 of switch AA. Then connect this shield lead to lug 3 of terminal strip BA (NS).
- (✓) Connect the inner lead of the shielded cable from holes H and J on the circuit board to lug 2 (NS) and the shield lead to lug 3 (S-2) of terminal strip BA. Be careful that the shield lead does not touch any other connections.
- (✓) Position the shielded cable connected in the previous step exactly as shown in the Pictorial. Then bend the wire clamp over the cable.
- (✓) Insert the end of the tuner shaft into the vernier drive assembly. Then mount the tuner brackets to the chassis as shown in Detail 12C. Use four #6 x 1/4" sheet metal screws. Slide the tuner as far forward as possible before tightening the sheet metal screws. Do not tighten the vernier drive setscrews until instructed to do so.
- (✓) Now tighten the vernier drive mounting screws.
- (✓) Refer to the inset drawing on Pictorial 12 and solder the flat braid (coming from the circuit board) to the top and side of the tuner as shown (S-2).



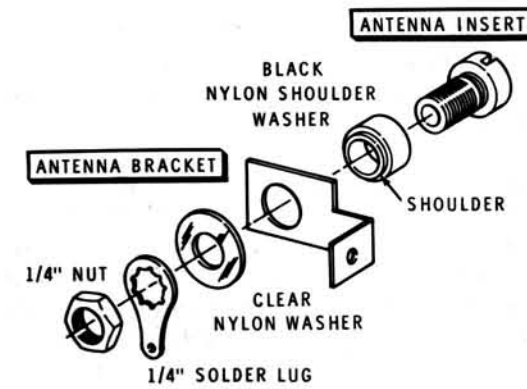
Detail 12C



PICTORIAL 12



PICTORIAL 13



Detail 13A

Refer to Pictorial 13 for the following steps.

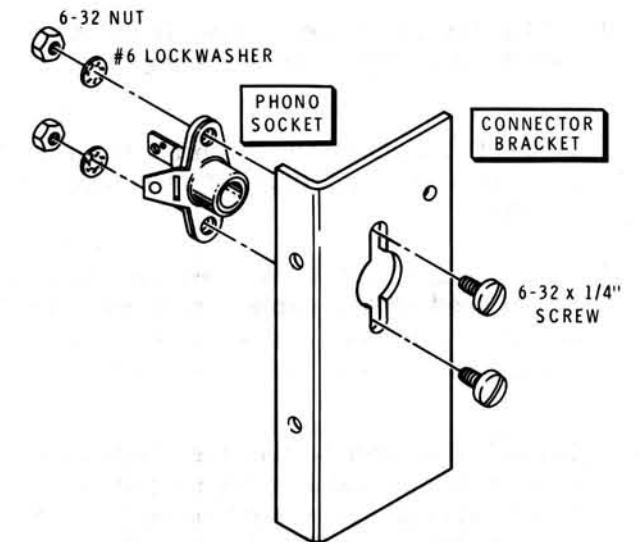
NOTE: When you install the black nylon shoulder washer in the next step, be sure to position the shoulder of the washer in the hole of the bracket.

- (✓) Refer to Detail 13A and mount the antenna insert to the antenna bracket with a black nylon shoulder washer, a clear nylon washer, a 1/4" solder lug, and a 1/4" nut. Position the solder lug as shown.
- (✓) Mount the phono socket to the antenna support bracket as shown in Detail 13B with 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts.

Refer to Detail 13C for the next two steps.

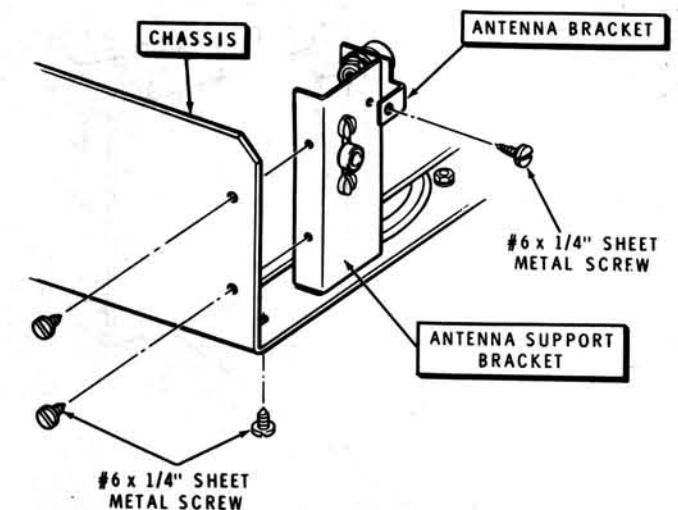
NOTE: In the next step it may be necessary to reposition the solder lug on the antenna insert to make contact with the phono socket lug.

- (✓) Mount the antenna bracket on the antenna support bracket with a #6 x 1/4" sheet metal screw. Bend lug 1 of the phono socket so that it touches the solder lug as shown in the inset drawing in Pictorial 13.



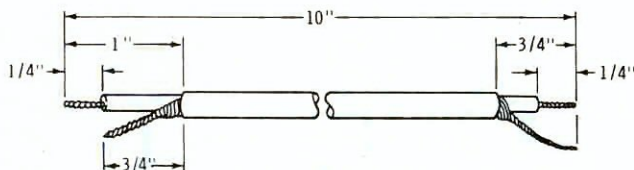
Detail 13B

- (✓) Mount the antenna support bracket to the chassis with three #6 x 1/4" sheet metal screws.



Detail 13C

CUT THE CABLE ACCORDING TO THE DIMENSIONS BELOW.
PREPARE EACH END AS SHOWN.



Detail 13D

- () Refer to Detail 13D and prepare a 10' length of shielded cable as shown.
- () Connect the longer inner lead of the shielded cable to lug 1 of phono socket BC (S-2). Be sure the antenna solder lug is also soldered to lug 1 of BC.
- () Connect the shield lead at this end of the shielded cable to lug 2 of phono socket BC (S-1).
- () At the free end of this cable, connect the inner lead to lug 14 on the tuner (S-1) and the shield lead to solder lug BB (NS).

NOTE: Only the components that will be connected to the tuner in the following steps are shown on the tuner.

- () Solder one lead of a 10 k Ω (brown-black-orange) resistor to lug 11 on the tuner. Connect the other lead to lug 13 on the tuner (NS).
- () Connect a 4700 Ω (yellow-violet-red) resistor from lug 13 on the tuner (S-2) to solder lug BB (S-2).

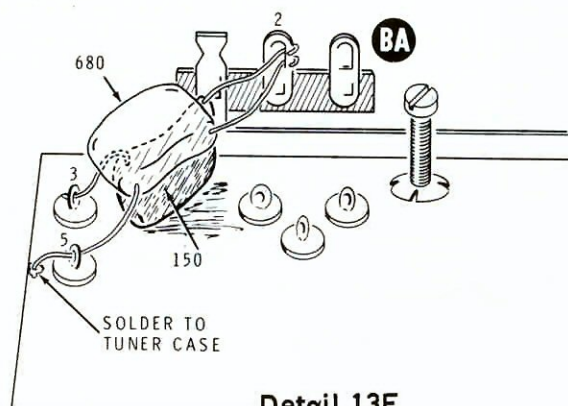
- () Place 1/2" lengths of sleeving over each lead of a 100 pF disc capacitor; then connect the capacitor from lug 1 of terminal strip BA (S-2) to lug 7 on the tuner (S-1).

CAUTION: 150 pF and 680 pF mica capacitors will be installed in the following steps. The positions of the two capacitors are very critical and the steps should be followed exactly.

- () Cut both leads of a 150 pF mica capacitor to a length of 3/8".
- () Refer to Detail 13E and connect the 150 pF mica capacitor from lug 2 of terminal strip BA (NS) to lug 3 on the tuner (S-1). Position the capacitor exactly as shown and press it down against the tuner.
- () Cut both leads of a 680 pF mica capacitor to a length of 1/2".

NOTE: Where a lead passes through one connection and then goes to another point, as in the next step, it will count as two leads in the solder instruction (S-2), one entering and one leaving the connection.

- () Refer to Detail 13E and connect one lead of a 680 pF mica capacitor to lug 2 of terminal strip BA (S-3). Pass the other lead through lug 5 on the tuner (S-2) and solder the end of this lead directly to the tuner case. Position the capacitor exactly as shown and press it against the 150 pF mica capacitor previously installed.

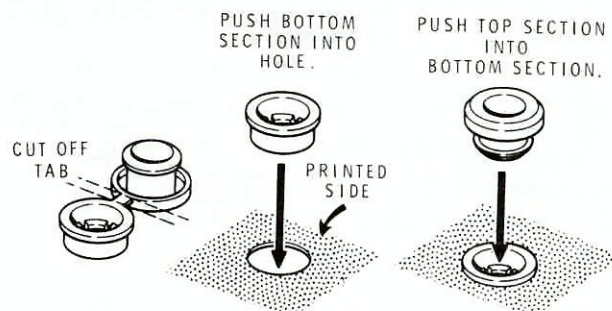


Detail 13E

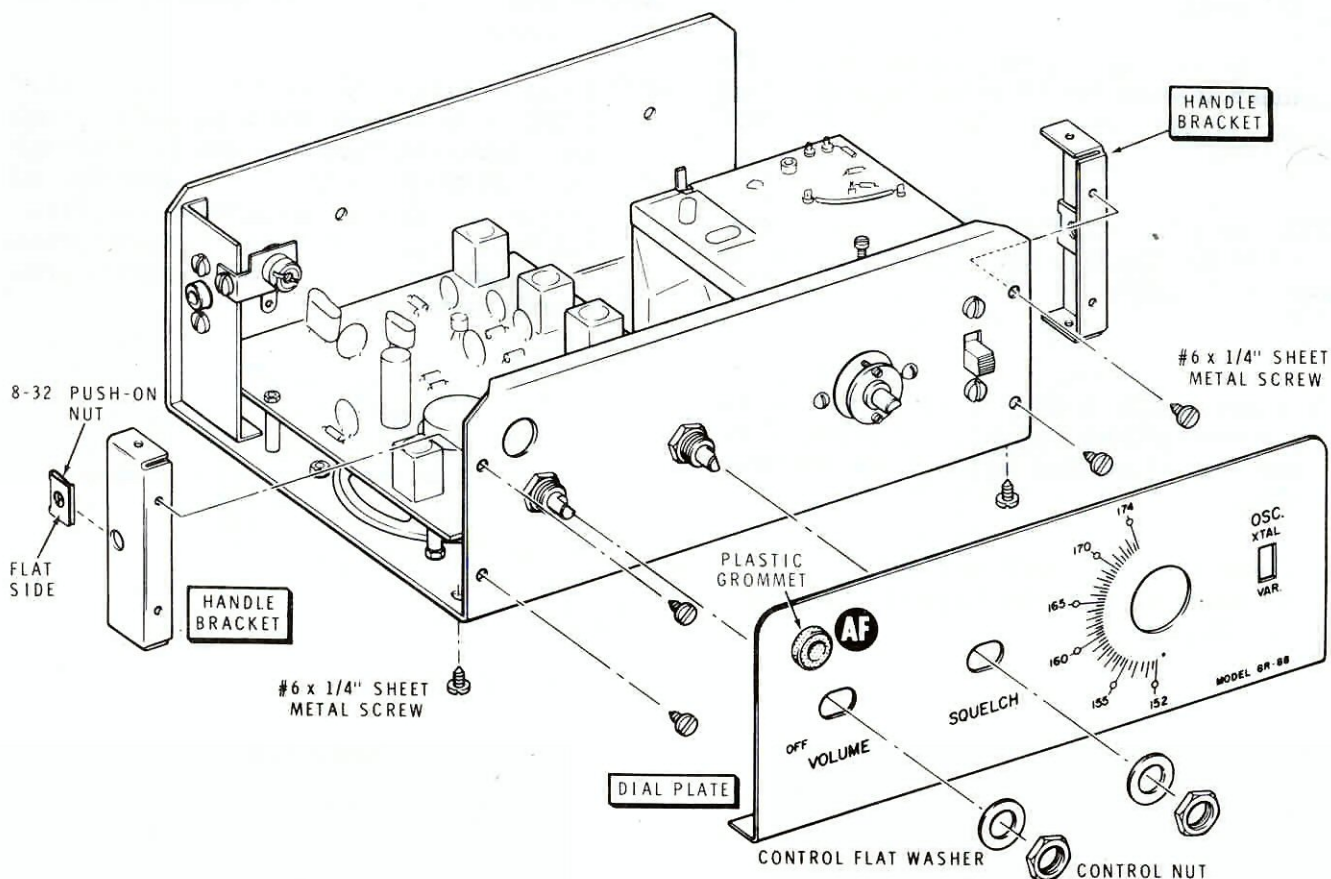
DIAL PLATE AND HANDLE BRACKET ASSEMBLY

Refer to Pictorial 14 for the following steps.

- () Mount one handle bracket on the left side of the chassis as shown. Use three #6 x 1/4" sheet metal screws.
- () In the same manner, mount the remaining handle bracket on the right side of the chassis with three #6 x 1/4" sheet metal screws. Do not pinch any wires between the bracket and chassis.
- () Install 8-32 push-on nuts on the handle brackets as shown with the flat side out.
- () Locate the plastic grommet and carefully cut off the tab as shown in Detail 14A.
- () Locate the dial plate.
- () Install a plastic grommet in the dial plate at AF as shown in Detail 14A.
- () Set the dial plate over the control shafts and secure it to the Volume and Squelch controls with two control flat washers and two control nuts. Be sure the dial plate is positioned so the slide switch will move freely in both directions.



Detail 14A



PICTORIAL 14

Refer to Pictorial 15 for the following steps.

- () Turn the vernier shaft counterclockwise until the vernier setscrews are positioned as shown in inset drawing #1.
- () Remove the two brass screws from the vernier drive assembly and lay them aside temporarily.

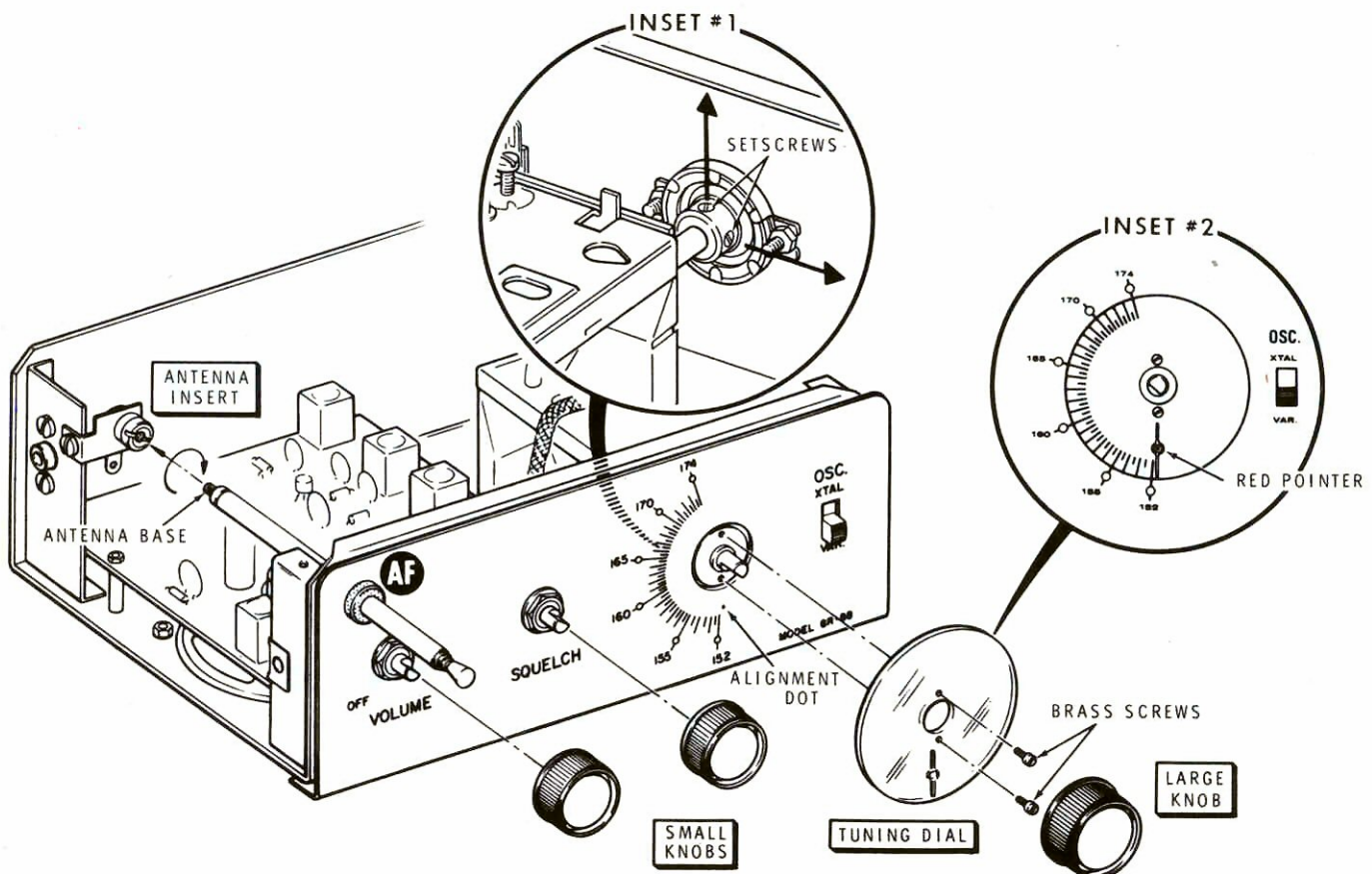
NOTE: The raised outer edge of the tuning dial should be next to the dial plate.

- () Place the tuning dial over the vernier shaft with the indicator at the low (152 MHz) end of the dial. Secure the tuning dial to the vernier drive assembly with the two brass screws.
- () Push the large knob onto the vernier shaft. Be sure it does not bind against the tuning dial.

NOTE: Even though the vernier drive assembly setscrews are loose, the tuner shaft may turn

with the vernier shaft in a clockwise direction. Therefore, in the next step, turn the vernier shaft only in a counterclockwise direction.

- () Turn the vernier shaft in a counterclockwise direction until the round opening in the red pointer is directly over the small alignment dot on the dial plate as shown in inset drawing #2.
- () Without moving the shaft, tighten the one vernier drive assembly setscrew that is accessible; then turn the vernier shaft clockwise only enough to tighten the second setscrew.
- () Push the two small knobs onto the Squelch and Volume control shafts.
- () Make sure the Volume control is turned fully counterclockwise to its OFF position.
- () Pass the antenna through grommet AF and screw the base of the antenna into the antenna insert.



PICTORIAL 15

PRELIMINARY RESISTANCE TEST

Refer to Pictorial 16 for the following steps.

NOTE: If a high input impedance ohmmeter is available, perform the following resistance test.

- () Adjust the ohmmeter to read on the Rx 100 range.
- () Connect the ohmmeter common lead to the chassis.
- () Touch the ohms lead to lug 7 of control AE. The ohmmeter should indicate 400 ohms or greater. If you obtain a reading of less than 400 ohms, refer to the "In Case of Difficulty" section of the Manual. If you obtain a correct reading, refer to the "Battery Holder Assembly" section.

BATTERY HOLDER ASSEMBLY

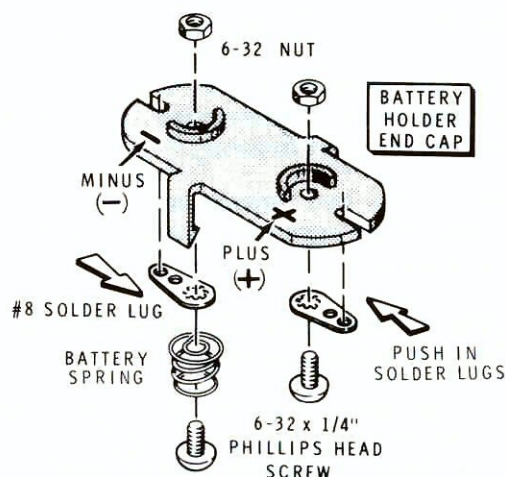
Refer to Detail 16A for the next two steps.

NOTE: When performing the next two steps, push the #8 solder lugs in as far as possible, as shown. Otherwise the solder lugs will not fit into the battery holder in a later step.

- () Locate one of the battery holder end caps. At the positive (+) end of the cap, install a 6-32 x 1/4" phillips head screw, a #8 solder lug, and a 6-32 nut.
- () At the negative (-) end of the battery holder end cap, mount a battery spring with a 6-32 x 1/4" phillips head screw, a #8 solder lug and a 6-32 nut.

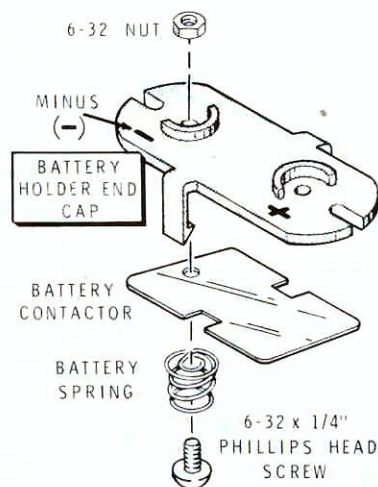
Refer to Pictorial 16 for the following steps.

- () Connect the red wire from lug 6 of control AE to the solder lug at the positive (+) end of the battery holder end cap (S-1).

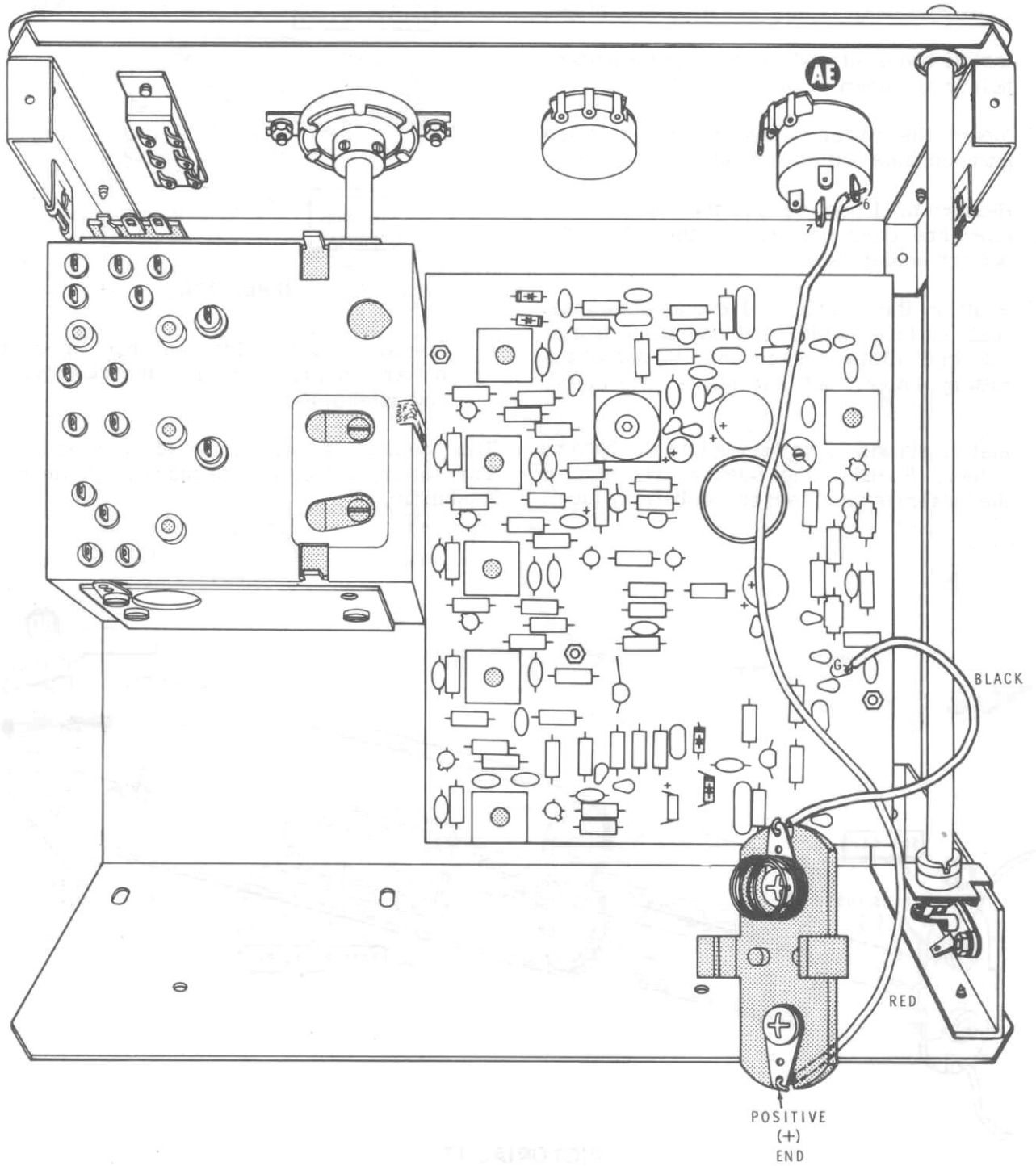


Detail 16A

- () Connect the black wire from hole G on the circuit board to the solder lug at the negative (-) end of the battery holder end cap (S-1).
- () At the negative (-) end of the remaining battery holder end cap, mount the battery contact and battery spring as shown in Detail 16B. Use a 6-32 x 1/4" phillips head screw and a 6-32 nut.



Detail 16B



PICTORIAL 16

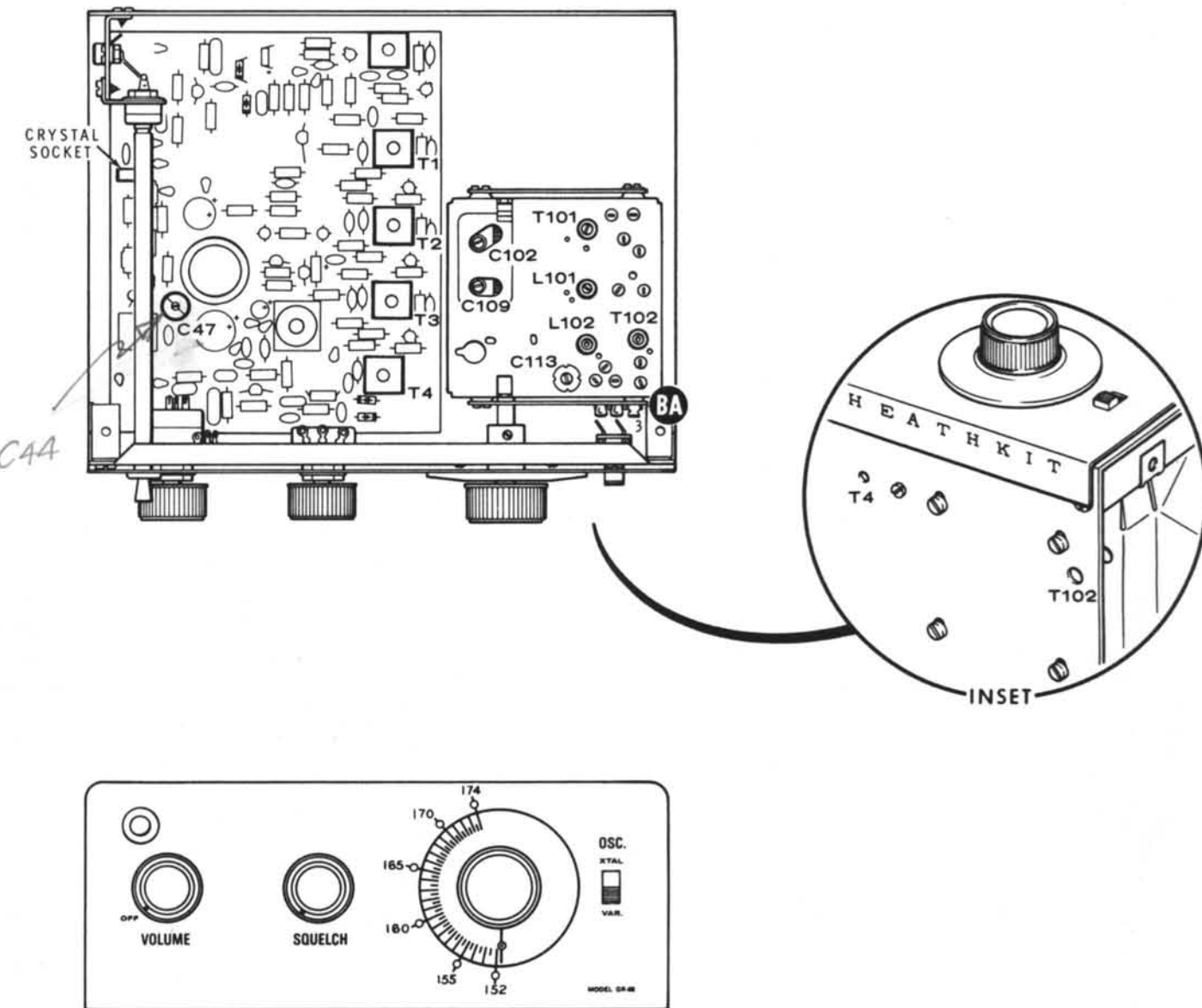
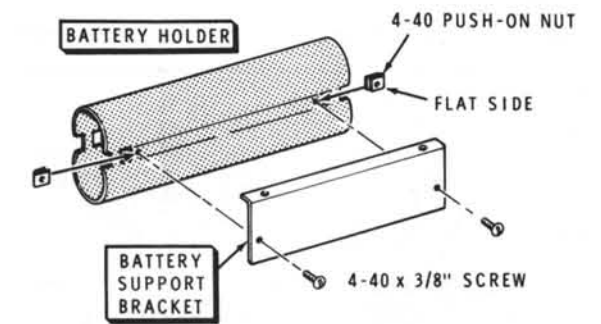


FIGURE 1

Refer to Pictorial 17 for the following steps.

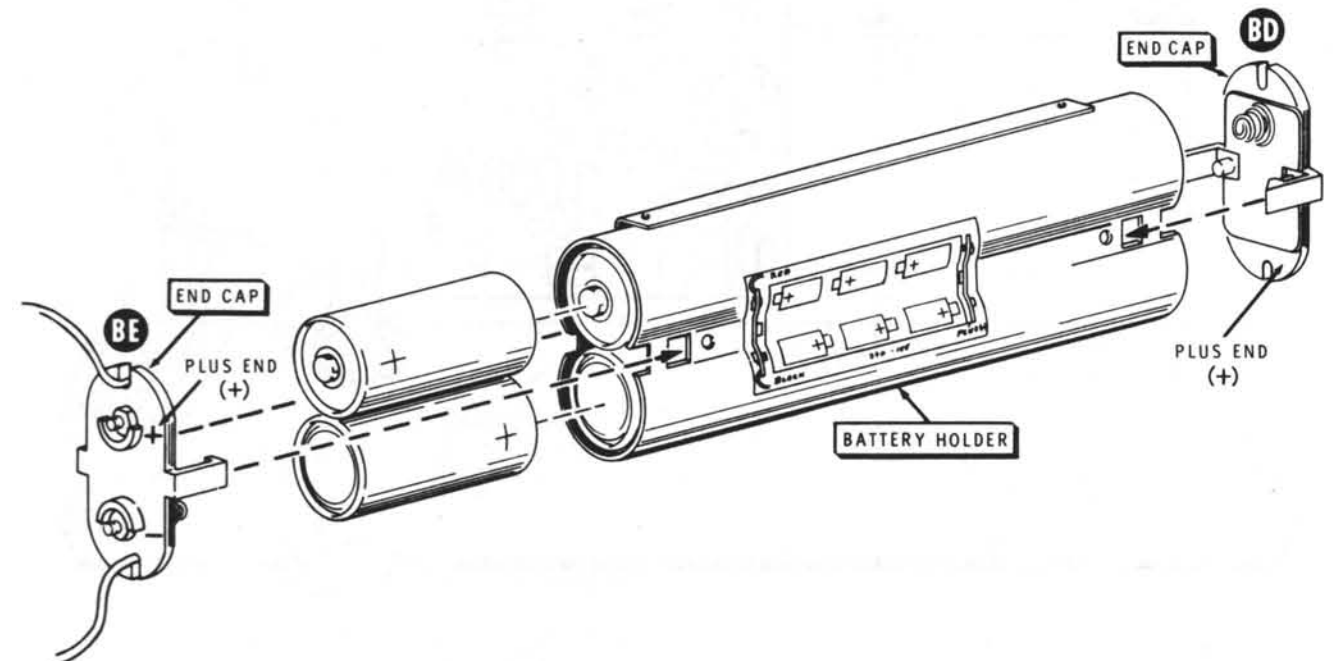
- (✓) Install two 4-40 push-on nuts on the battery holder as shown in Detail 17A.
- (✓) Mount the battery support bracket to the push-on nuts with two 4-40 x 3/8" screws.
- (✓) Remove the backing paper from the battery label and stick the label on the side of the battery holder as shown.
- (✓) Position the positive (+) end as shown and push battery holder end cap BD (the cap with the battery contact) onto the end of the battery holder until it snaps into place.
- () Install six size C batteries into the battery holder. Position the positive (+) ends of the batteries as shown on the battery label.



Detail 17A

- (✓) Install battery holder end cap BE on the battery holder; position the positive (+) end as shown.

This completes the wiring of your Receiver. The battery holder will be mounted in the Final Assembly.



PICTORIAL 17

FM ALIGNMENT

In the following steps, you will be directed to adjust the ratio detector transformer, the IF transformers, and transformer T102 in the tuner. Do not make an adjustment unless you are directed to do so or misalignment will result.

Since the IF transformers and tuner have been prealigned, only slight adjustments will be necessary to give you maximum performance from your Receiver. Perform an adjustment only when instructed to do so.

NOTE: If you encounter any difficulty during the following adjustments, turn the Receiver OFF and refer to the In Case of Difficulty section of the Manual (Page 33). Then, after the trouble is located and repaired, return to this section and complete the following steps.

Refer to Figure 1 (fold-out from Page 26) for the following steps.

Set the controls as follows:

- () OSC. switch: Variable position.
- () SQUELCH control: Fully counterclockwise.
- () VOLUME control: Fully counterclockwise in OFF position.
- () Telescoping antenna: Fully collapsed.
- () Turn the VOLUME control clockwise until you hear a hissing noise.

NOTE: In the following steps, be careful that you do not turn the slugs of the transformers and coils too far, or instrument alignment may be required. To prevent this from happening, put a flag (piece of tape) on the long end of the alignment tool as shown in Figure 1A. The flag will indicate how far the slug has been turned.

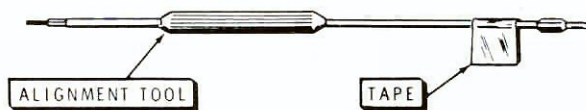


Figure 1A

NOTE: The bottom slug in transformer T4 and T102 must be adjusted through an access hole in the chassis under transformer T4 and T102.

- () Adjust the top and bottom slugs of transformer T102 for loudest noise. No more than 1/2 turn should be needed on each slug.
- () All IF transformers have been carefully set at the factory and should be very close to optimum setting. However, transformers T1, T2, and T3 can be adjusted with the alignment tool for loudest noise. Again no more than 1/2 turn is needed.
- () Carefully adjust the bottom slug in ratio detector transformer T4 for loudest noise in the speaker. No more than 1/2 turn is needed to obtain maximum noise.
- () Extend the telescoping internal antenna to its full length. Carefully tune in a station. A telephone station between 152 to 154 MHz would be the best since they transmit for longer periods of time.
- () Adjust the top slug in ratio detector transformer T4 for maximum audio signal. Again this adjustment should not require more than 1/2 turn in either direction.

NOTE: Perform steps #1 and #2 only if a crystal is inserted in the crystal socket. A crystal is not included with this kit. For information on crystals, refer to Crystal Considerations on Page 31.

- () 1. If a crystal is installed, place the OSC. switch in the XTAL position. Turn the tuning dial to the frequency for which the crystal was selected.
- () 2. Adjust trimmer C44 for the loudest hissing noise in the speaker, or if a signal is being transmitted, adjust C44 for maximum audio signal.
- () When no audio signal is present, turn the SQUELCH control clockwise just until the background hiss disappears. When an audio signal appears, it will be heard.

This completes alignment; proceed to Final Assembly.

FINAL ASSEMBLY

- (1) Refer to Pictorial 18 and mount the battery support bracket to the chassis with two #6 x 1/4" sheet metal screws.

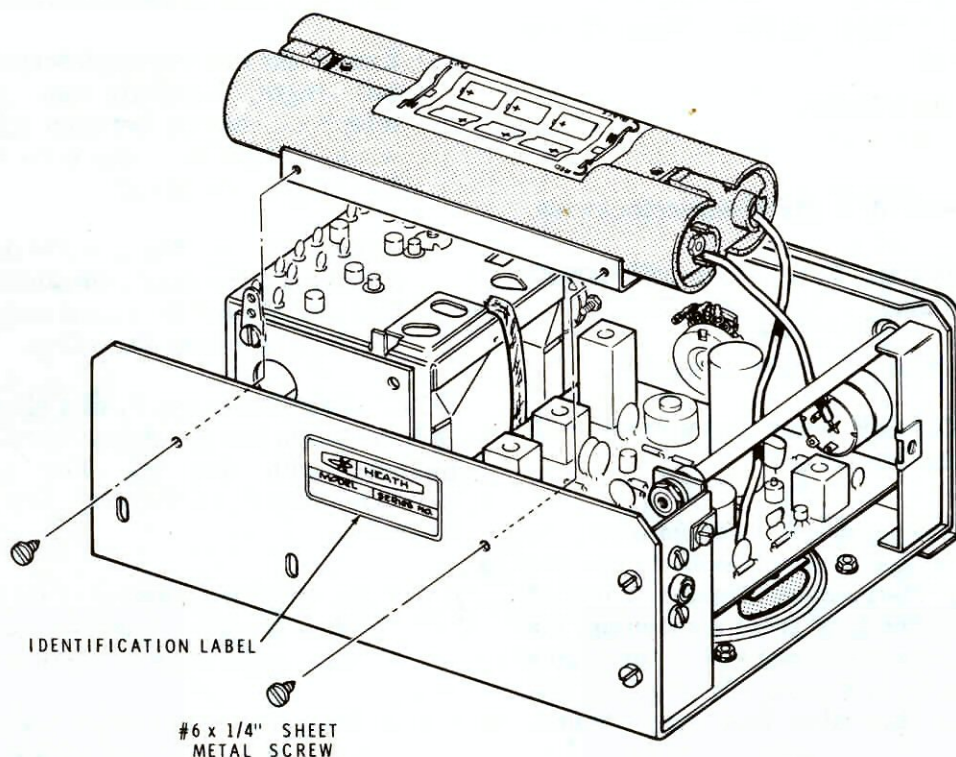
NOTE: The blue and white label shows the Model Number and Production Series Number of your kit. Refer to these numbers in any communications with the Heath Company; this assures you that you will receive the most complete up-to-date information in return.

- (1) Carefully peel away the backing paper from the blue and white identification label. Press the label into place on the bottom of the chassis as shown.

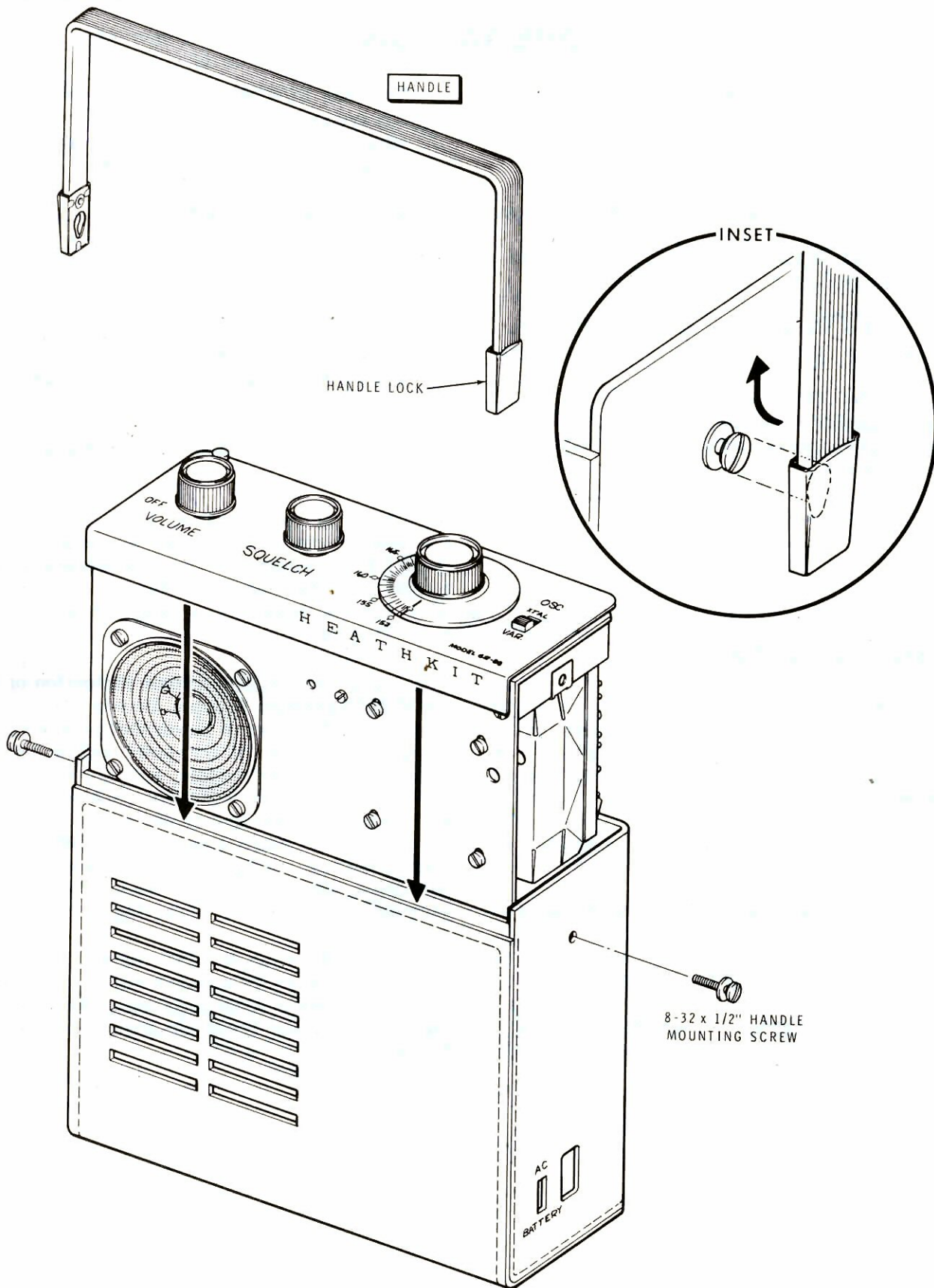
Refer to Pictorial 19 for the following steps.

- () Slide the Receiver down into the leatherette case and secure it with two 8-32 x 1/2" handle mounting screws.
- () Refer to the inset drawing on Pictorial 19 and insert the head of the handle mounting screw into the handle lock. Then press the end of the handle lock toward the handle mounting screw until the screw head snaps into place in the handle lock.

This completes the assembly of your VHF-FM Monitor Receiver.



PICTORIAL 18



PICTORIAL 19

OPERATION

VARIABLE OSCILLATOR

1. Extend the telescoping antenna to its full length.
 2. Place the OSC. switch in the VAR. position.
 3. Turn the SQUELCH control fully counter-clockwise to turn off the squelch.
 4. Turn the Receiver on and adjust the VOLUME to a comfortable listening level.
 5. Turn the TUNING DIAL to a station. When no signal is received, adjust the SQUELCH control clockwise until the background hiss disappears.
 6. Turn the Receiver OFF.
5. Turn the TUNING DIAL to the crystal selected frequency. When no signal is received adjust the SQUELCH control clockwise until the background hiss disappears.
 6. Turn the Receiver OFF.

GENERAL

If an external antenna is used, make sure the telescoping antenna is pushed all the way in. Connect the external antenna to the ANTENNA jack located at the lower left corner of the Receiver. For further information on external antennas refer to Base Station Antennas on Page 32.

Reception in automobiles, trains, airplanes, and boats is possible in most locations, although it may be necessary to place the Receiver near a window for best results. Otherwise, the metal of a vehicle may act as a shield against the radio signals.

You will probably notice some distortion of the sound at maximum volume. This is normal and represents the reserve power that provides good reception even when battery power is low. Excessive distortion, low volume, and poor sensitivity are signs of weak batteries. Always remove worn-out batteries immediately. Old batteries may swell and make removal difficult, or may leak chemical compounds that would cause corrosion. Do not store the radio for extended periods of time without removing the batteries.

The leatherette case should withstand all normal handling and may be cleaned with a damp cloth and a mild soap when necessary. Do not use solvents, cleaning fluids or abrasives to clean the case.

CRYSTAL OSCILLATOR

A crystal of the proper frequency must be installed in the crystal socket on the circuit board for crystal oscillator operation. For further information on crystals, refer to Crystal Considerations.

1. Extend the telescoping antenna to its full length.
2. Place the OSC. switch in the XTAL position.
3. Turn the SQUELCH control fully counter-clockwise to turn off the squelch.
4. Turn the Receiver on and adjust the VOLUME to a comfortable listening level.

CRYSTAL CONSIDERATIONS

The Receiver can be crystal controlled if you want to monitor a single station. Crystal controlled operation provides drift-free reception over a long period of time. Because the desired operating frequency is not known, crystals are

not supplied with the kit. However, crystals of the proper frequency can be purchased locally. The following formula will help you to determine the crystal frequency.

$$\text{DESIRED CRYSTAL FREQUENCY (MHz)} = \frac{\text{DESIRED RECEIVED FREQUENCY} - 10.7 \text{ MHz}}{3}$$

EXAMPLE: Desired received frequency = 162.550 MHz

$$\begin{array}{r} 162.550 \text{ MHz} \\ -10.700 \text{ MHz} \\ \hline 151.850 \text{ MHz} \end{array}$$

$$\begin{array}{r} 50.6166 \text{ MHz} \\ 3 \overline{)151.850} \\ \underline{15} \\ 018 \\ \underline{18} \\ 05 \\ \underline{3} \\ 20 \\ \underline{18} \\ 20 \end{array}$$

Crystal frequency = 50.6166 MHz

Include the following specifications when ordering crystals:

Frequency: MHz.

Holder type: HC-18U.

Load Capacitance: 32 pF.

Mode: Parallel resonance on the third mechanical overtone mode of oscillation.

Frequency tolerance: .0025% at 25 degrees C.

Maximum Drive level: 1.2 mW.

Effective resistance: 25 ohms.

NOTE: Cut the wire leads of the HC-18U holder to 1/4" length measured from the bottom of the case.

NOTE: 162,550 MHz is used as an example to figure the crystal frequency. This frequency is used by the U.S. weather bureau for marine forecasts in major coastal cities, including Chicago and Kansas City, for tornado information.

*Crystal purchase of 12/8/75 from
QAL Crystal Labs
14106 Willow Pl.
Westminster, CA
(714) 893-8333
\$5.30*

BASE STATION ANTENNAS

Three basic types of antennas used for the reception of VHF-FM signals are shown below. Use the following information to help select a type of antenna most suitable for your application.



Figure 2

1. **Vertical Ground Plane Antenna** - The vertical ground plane antenna is an omnidirectional type antenna that provides optimum performance for reception of vertically polarized signals. Virtually all stations transmitting in the VHF spectrum (frequencies covered by your receiver) use vertically polarized antennas making the ground plane antenna adequate for receiving signals from medium to long range distances.
2. **Coaxial Antenna** - The coaxial antenna is similar in operation to the ground plane antenna. In most applications this type of antenna performs as well as the ground plane antenna. The coaxial antenna is ideal for installations where a vertical ground plane is not feasible. This antenna, as with the ground plane, is good for receiving signals from the medium to long range distances.

3. **Vertical Beam Antenna** - The vertical beam antenna is a highly efficient directional antenna generally intended for long range reception of signals. An average five-element vertical beam provides an equivalent increase in signal strength of 7 times.

A phono plug has been provided for connecting an external antenna to the receiver. Refer to Figure 3 to connect the phono plug to the antenna cable.

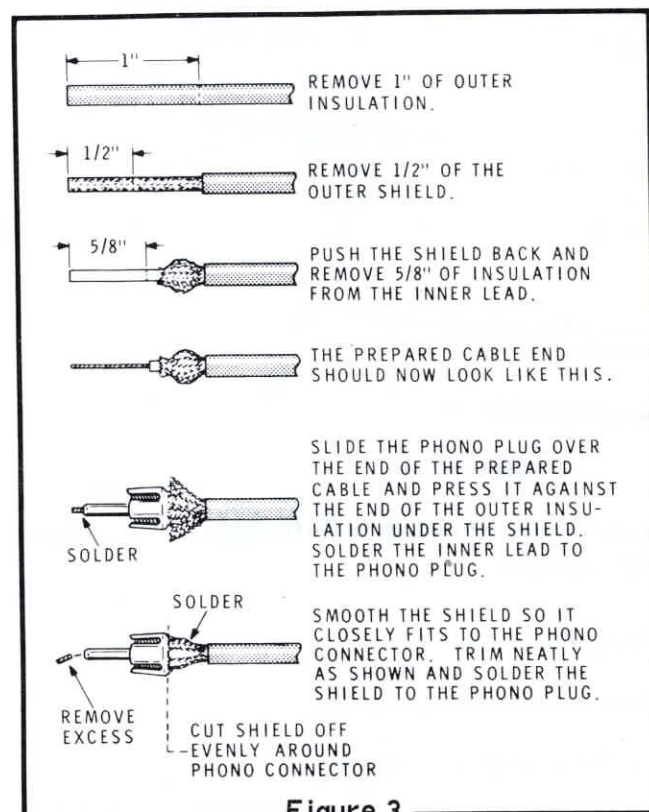


Figure 3

IN CASE OF DIFFICULTY

If your Receiver does not operate properly after assembly, use the following information to help locate and correct the difficulty. The Troubleshooting Chart will also help to locate the problem.

NOTE: In checking for proper location of the components, refer to the Circuit Board X-Ray View on Page 42.

1. Recheck the wiring. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something you have consistently overlooked.
2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure they are soldered as described in the Soldering section of the Kit Builders Guide.
3. Check the value of the parts. Be sure that the proper part has been wired into the circuit for each step as shown in the Pictorial diagrams and as called out in the wiring instructions.
4. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.
5. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those shown on the Schematic Diagram (fold-out from Page 49) and the Voltage Chart on Page 43. NOTE: All voltage readings were taken with an 11 megohm input voltmeter. Voltages may vary as much as $\pm 20\%$.
6. A review of the Circuit Description may also help you find the trouble if you have a knowledge of electronics.

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

Troubleshooting Chart

DIFFICULTY	POSSIBLE CAUSE
Receiver dead.	1. Dead batteries. 2. Batteries installed incorrectly. 3. Battery holder wired incorrectly. 4. Transistors installed incorrectly. 5. Defective OFF-ON switch. 6. XTAL-VAR switch lugs shorted to chassis.
Audio section inoperative.	1. Open speaker voice coil. 2. Transistors Q9, Q10, Q11, or Q12 shorted. 3. Capacitors C37 or C34 open. 4. Transistor Q8 shorted. 5. Control R35 shorted. 6. Resistor R29 open.
Audio distortion.	1. Batteries weak. 2. Diodes D1 and D2 installed backwards or open. 3. Improper alignment of T4. 4. Defective speaker.
IF amplifier stages oscillates.	1. .01 bypass capacitor open. 2. Improper grounding of IF board to chassis. Be sure to use lockwashers where indicated. Tighten mounting hardware. 3. Wiring not positioned as shown in Pictorials.
Sensitivity poor.	1. Defective tuner. 2. Transistors Q1, Q2, Q3, Q4, or Q5 shorted or open. 3. Defective IF transformer. 4. Shorted coax from tuner. 5. Bypass capacitors C1, C4, C7, C11, C14 or C17 open. 6. IF transformer installed backward. 7. Dial plate incorrectly positioned so that XTAL-VAR switch does not make contact.
Squelch inoperative	1. Diodes D3 and D4 shorted. 2. Transistors Q6, Q7, and Q8 shorted. 3. Capacitors C25, C28, or C33 open. 4. Control R37 open.
Crystal oscillator will not function.	1. Crystal defective. 2. OSC. switch inoperative. 3. Chokes L4 and L5 interchanged. 4. Transistor Q13 shorted. 5. Shorted coax cable going to tuner.

INSTRUMENT ALIGNMENT

This alignment procedure requires the use of electronic test equipment and is only provided in case this Receiver should ever need to be completely aligned at some future time due to parts replacements. The following procedure should only be performed by those who have instrument alignment experience. Refer to Figure 1 (fold-out from Page 26).

Equipment Needed:

- A 10.7 MHz RF generator with 1000 Hz, 30% modulation.
- A high input impedance VTVM set to its lowest AC range.
- An RF generator capable of 152 to 174 MHz coverage with 1000 Hz, 30% AM modulation.

() Set the Receiver controls as follows:

VOLUME - ON.

SQUELCH - Fully counterclockwise.

TUNING DIAL - Low end of dial (152).

OSC. switch - VAR.

ANTENNA - Fully collapsed.

Refer to Figure 1 (fold-out from Page 26) for the following coil, transformer, and TP (test point) locations. Complete the adjustments given in the Alignment Charts.

IF ALIGNMENT CHART

RF GENERATOR		VTVM	ADJUST	
Connect To	Frequency and Output	Connect To	Transformer	For VTVM Reading
Lug 2 of terminal strip BA.	10.7 MHz with 1000 Hz, 30% modulation. Set generator for 1/4 scale deflection on the VTVM. Reduce the generator level to maintain a 1/4 scale VTVM deflection during alignment. NOTE: The minimum generator RF level is 250 μ V.	Speaker terminals.	Slug of T1.	Maximum reading.
			Slug of T2.	
			Slug of T3.	
			Bottom slug of T4. Repeat each step until no further improvement is obtained.	
			Top slug of T4.	Minimum reading (sharp null).

FRONT END ALIGNMENT CHART

FRONT END ALIGNMENT CHART

STEP	RF GENERATOR		CONNECT VTVM TO	TUNER TUNED TO	ADJUST FOR MAXIMUM VTVM READING
	Connect To	Frequency and Output			
1.	Antenna terminals.	153 MHz 1000 Hz, 30% modulation generator.	Speaker terminals	To maximum reading near 153 MHz.	Top and bottom slugs of T102.
2.		NOTE: keep generator output at less than 1/4 scale deflection on VTVM.			T101
3.				172 MHz	L102
4.					C102 and C109
					C113
5.	Repeat steps 2 and 4 until dial tracks.				
6.	Repeat steps 1 and 3 until no further improvement can be obtained.				

SPECIFICATIONS

Tuning Range.	152 to 174 MHz.
Antenna Input.	50 to 75 ohms.
Sensitivity.	2.0 microvolts or less for 20 dB quieting.
IF Frequency.	10.7 MHz.
IF Selectivity.	±40 kHz at 6 dB down.
Image Rejection.	40 dB or greater.
IF Rejection.	80 dB or greater.
Audio Output.	250 milliwatts at less than 10% distortion.
Speaker.	3" Round, 24 ohm, Permanent magnet.
Transistor Complement.	Tuner - 2 - 2SC784 1 - SE-5006
	IF and Audio - 5 - 2N2369 4 - 2N3393 1 - X29A829 1 - 2N2430 1 - 2N2431 1 - 2N5770
Diode Complement.	2 - 1N191 2 - 1N4646
Batteries.	Six 1-1/2 volt size C cells (not included).
Dimensions.	9" wide x 7-1/2" high x 3-1/2" deep.
Net Weight.	3 lbs. without batteries.

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

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (fold-out from Page 49) while reading this circuit description.

RF signals are received by the antenna and coupled to the tuning unit. Here the desired RF signal is selected and mixed with the local oscillator to produce a 10.7 MHz IF (intermediate frequency) signal. This signal is coupled to the IF stages where it is amplified and separated from the other unwanted signals.

The 10.7 MHz IF signal is then coupled to the ratio detector where it is changed to an audio signal. The audio signal from the detector is amplified and split into two paths. One path takes the audio signal through the audio amplifier to be further amplified before it is coupled to the speaker. The second path takes the audio signal to the squelch circuit to turn the squelch circuit off and allow the output stages of the amplifier to conduct. In the following paragraphs, each circuit will be described individually.

FM TUNING UNIT

The FM RF signals from the antenna are coupled from the primary to the secondary winding of transformer T101. The signal is selected by the tuning circuit consisting of tuning capacitor C101A, C102, C103 and the secondary of transformer T101. The selected RF signal is then coupled through capacitor C104 to RF amplifier Q101 where it is amplified and coupled through capacitor C115 to mixer transistor Q102. A tuned circuit consisting of capacitor C101B, C109, C111 and coil L101 is tuned to the RF signal and provides proper impedance matching between transistors Q101 and Q102.

The local oscillator, composed of transistor Q103, capacitors C101C, C112, C113, and coil L102 produces a signal that is 10.7 MHz below the selected RF signal. This signal is coupled through capacitor C114 to mixer transistor Q102. Here it is mixed with the selected RF signal to produce the 10.7 MHz IF (intermediate frequency) signal. The IF signal is then coupled through transformer T102, and capacitors C131 and C132 to the first IF amplifier.

IF AMPLIFIERS

The IF signal from the tuner is coupled to the first IF amplifier Q1 where it is amplified and coupled through capacitor C2 to IF filter L1. Here the overall bandwidth of the 10.7 MHz signal is reduced by the permanently tuned, high "Q" inductor circuit of L1. The IF signal is then coupled through capacitor C3 to transistor Q2 where it is amplified and coupled through load resistor R8 to IF transformer T1.

Since the IF transformers are tuned to the 10.7 MHz IF signal, all other signals are rejected, but the 10.7 MHz signal is allowed to pass. The IF signal is then coupled to transistor Q3. Here it is amplified and coupled through load resistor R14 and IF transformer T2 to transistor Q4 where it is amplified again. From Q4 the IF signal is coupled through load resistor R19 and IF transformer T3 to limiter transistor Q5.

The amplitude of the 10.7 MHz IF signal is limited by transistor Q5, thus eliminating amplitude modulation from the FM signal. With a very strong signal, all four IF amplifiers act as limiters. With weak signals, only transistor Q5 limits.

RATIO DETECTOR

From transistor Q5 the IF signal is coupled through resistor R25 and ratio detector transformer T4 to the ratio detector circuit. Refer to Figure 4. The secondary of T4 is center tapped by L4 making it appear to the detector circuit as two coils (represented as L2 and L3). Coil L4 is common to L2 and L3. Consider a separate voltage to be induced into each of the coils L2, L3 and L4 by the primary windings. The voltage induced into L4 is in series with both L2 and L3 and will remain relatively constant in amplitude as long as the voltage across the primary does not change. (Remember the voltage across the primary will stay relatively constant due to the limiting action of transistor Q5.)

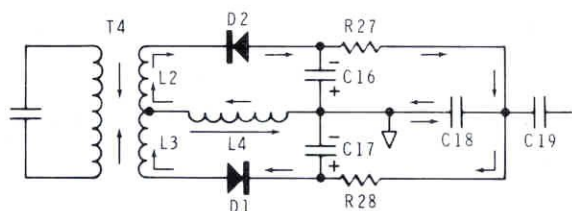


Figure 4

Notice that each diode has its own separate loop through which current flows (indicated by the arrows). Current flowing in diode D2 is controlled by the voltage induced in L2 and L4 which charges capacitor C16. The current flowing in diode D1 is controlled by the voltage induced in coils L3 and L4 which charges capacitor C17.

When the IF signal deviates from 10.7 MHz due to modulation by the audio signal, the current in one diode loop increases while the current in the other loop decreases. These changes are caused by a change in phase relationship in the signal current across coils L2, L4 and L3, L4. The audio output signal is coupled through diode load resistors R27 and R28 and capacitor C19 to transistor Q6. Capacitor C18 functions as a filter by passing high frequency audio to ground. At 10.7 MHz the diode currents are equal, thus they cancel each other out and no voltage appears across resistor R32. The amplitude of this output voltage is determined by how far the IF signal deviates from 10.7 MHz and the frequency of the output voltage is determined by how often the IF signal deviates from 10.7 MHz.

AUDIO CIRCUITS

The audio signal from the ratio detector circuit is amplified by transistor Q6 and divided into two paths. One of these paths couples the signal through the volume control and capacitor C34 to predriver transistor Q9. Here the signal is amplified and coupled directly to driver transistor Q10 where it is amplified again. Driver transistor Q10 and output transistors Q11 and Q12 form a complementary-symmetry output circuit. In this circuit, a positive-going signal applied to the base of Q11 causes the transistor to conduct, charging capacitor C37 through the speaker voice coil. When the audio signal goes negative, Q11 is cut off. This negative-going signal causes Q12 to conduct, discharging capacitor C37 back through the speaker voice

coil. This charging and discharging of capacitor C37 produces an audio signal in the speaker. Audio feedback from output transistors Q11 and Q12 is applied to the emitter of transistor Q9 through capacitor C36 and resistor R51.

SQUELCH CIRCUIT

Under no signal condition, a signal voltage in the form of noise (white noise) is coupled through the second path from transistor Q6 to a notch filter. This notch filter consists of capacitors C24 and C26 and coil L2.

Here a section of the noise voltage is selected and coupled through capacitor C25, Squelch control R37 and capacitor C28 to amplifier transistor Q7. The noise voltage is amplified and then rectified by diodes D3 and D4 and filtered by capacitors C32 and C33, and resistors R43, R44, and R45. This produces a DC voltage which is coupled to switching transistor Q8. The emitter of Q8 is directly connected to the emitter of transistor Q9. When there is no audio signal, the Squelch control is advanced enough to allow sufficient noise voltage level to drive transistor Q8 into saturation. This applies a positive voltage to the emitter of transistor Q9 and cuts it off, which in turn cuts off transistors Q10, Q11 and Q12. When an audio signal is received, the noise voltage going into the squelch circuit is reduced causing the audio stages to turn on. As the Squelch control is advanced, a stronger audio signal is required to turn the audio stages on.

CRYSTAL OSCILLATOR CIRCUIT

The oscillator circuit is a common emitter, third overtone crystal oscillator. This circuit uses the anti-resonant frequency of the quartz crystal in a negative feedback loop to sustain oscillations at the desired operating frequency.

The tuned circuit at the output, consisting of coil L3 and capacitor C44, is tuned to three times the crystal frequency. This selects the third harmonic and rejects unwanted harmonics.

POWER SUPPLY

Power for the GR-88 is supplied by six 1.5 volt size C batteries. The off-on switch is connected between the positive terminal of the batteries and the circuit board ground.

AC POWER SUPPLY

The following instructions are for the installation of the Heathkit AC Power Supply Model GRA-88-1 into your GR-88 Receiver. The installation is very easy and takes only a few minutes.

- () Remove the handle and handle mounting screws and remove the Receiver from its case.

Refer to Pictorial 20 for the following steps.

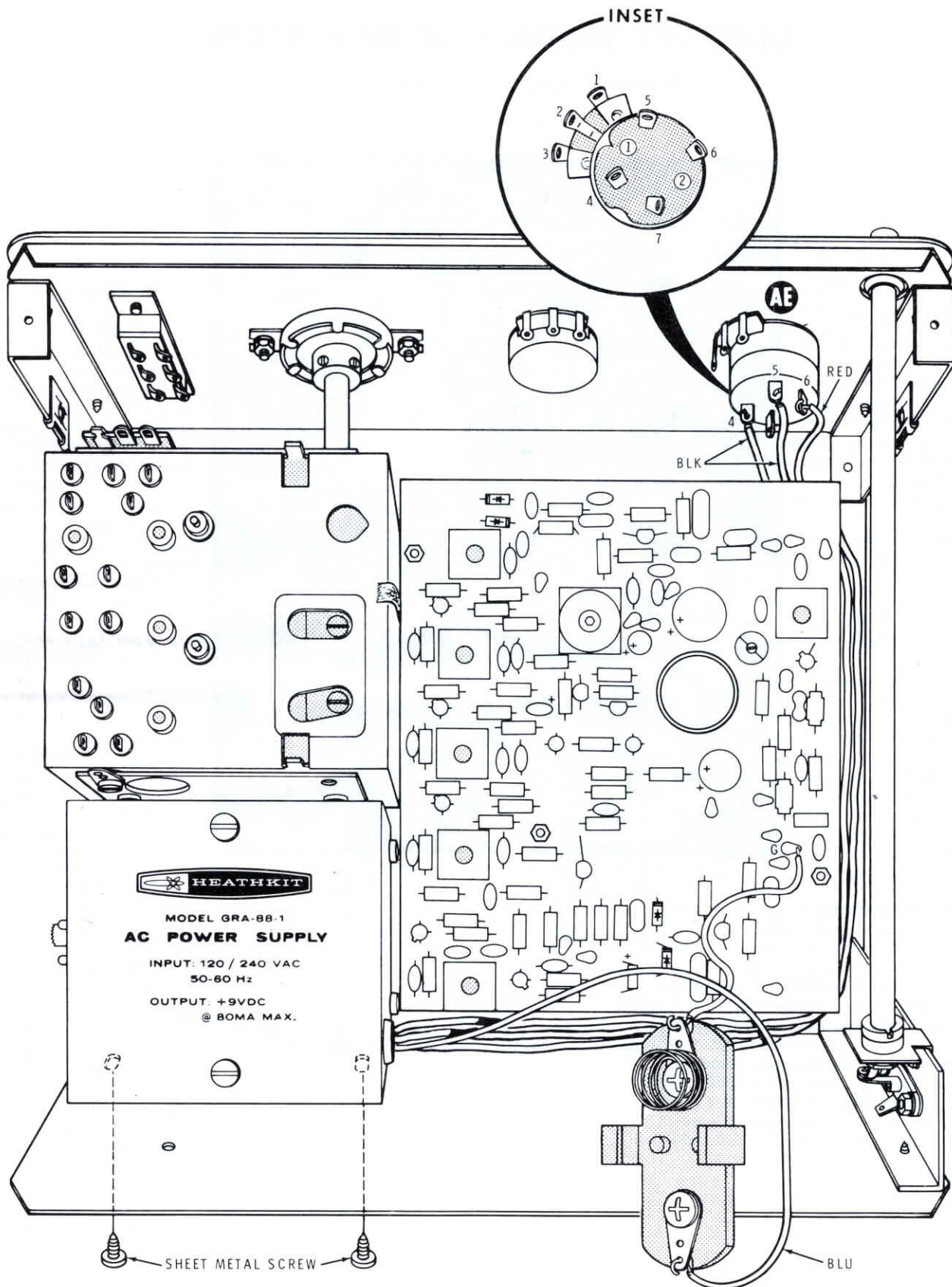
- () Remove the screws that secure the battery holder bracket to the chassis.
- () Remove the battery holder end cap that has the wires connected to it. Set the battery holder and batteries aside temporarily. Do not remove the batteries from the battery holder.
- () Unsolder and remove the red wire that is connected between the positive (+) lug of the battery holder end cap and lug 6 of control AE.
- () Install the AC Power Supply into the chassis with two #6 x 1/4" sheet metal screws that come with the Power Supply. Position the red and two black wires of the Power Supply under the circuit board as shown.

Connect the wires from the Power Supply to the Receiver as follows:

NOTE: Refer to the inset drawing on Pictorial 20 for the proper lug numbering on control AE.

- () Red wire to lug 6 of control AE (S-1).
- () Either black wire to lug 4 of control AE (S-1).
- () The remaining black wire to lug 5 of control AE (S-1).
- () Blue wire to the positive (+) lug of the battery holder end cap (S-1).
- () Replace the battery holder end cap on the battery holder. Be sure to replace the end cap as shown on the battery label.
- () Install the battery holder back in the chassis with two #6 x 1/4" sheet metal screws.
- () Remove the two knock-outs located in the lower left-hand side of the leatherette case. This is done by removing the tape from the inside of the case and pushing the knock-outs inward.
- () Install the Receiver in the case and replace the handle and the handle mounting screws.

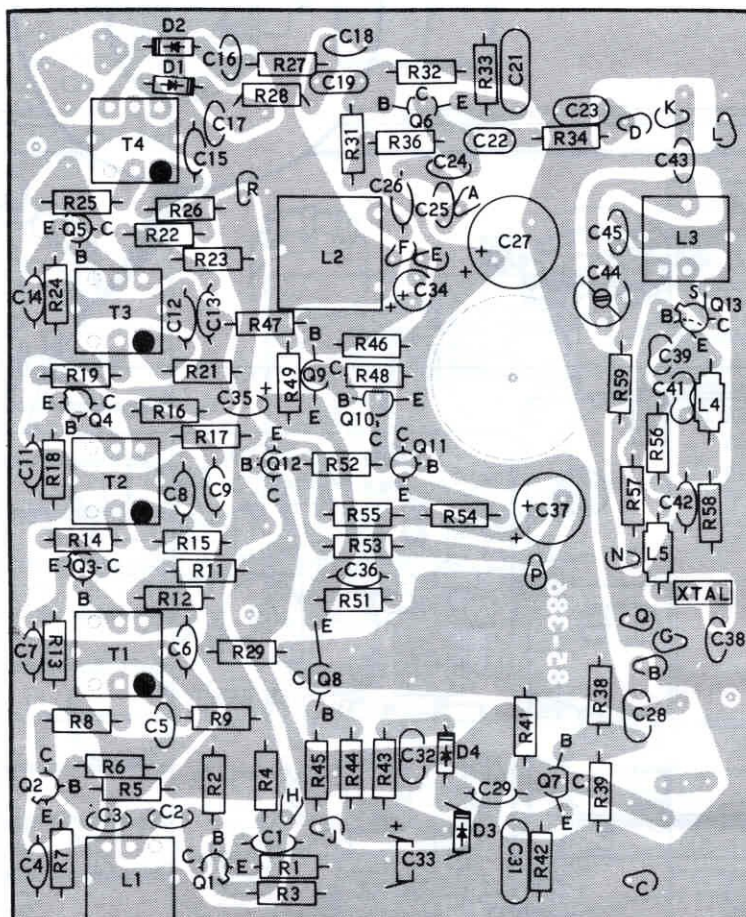
This completes the installation of the AC Power Supply. Return to the Power Supply Manual for Operating Instructions.



PICTORIAL 20

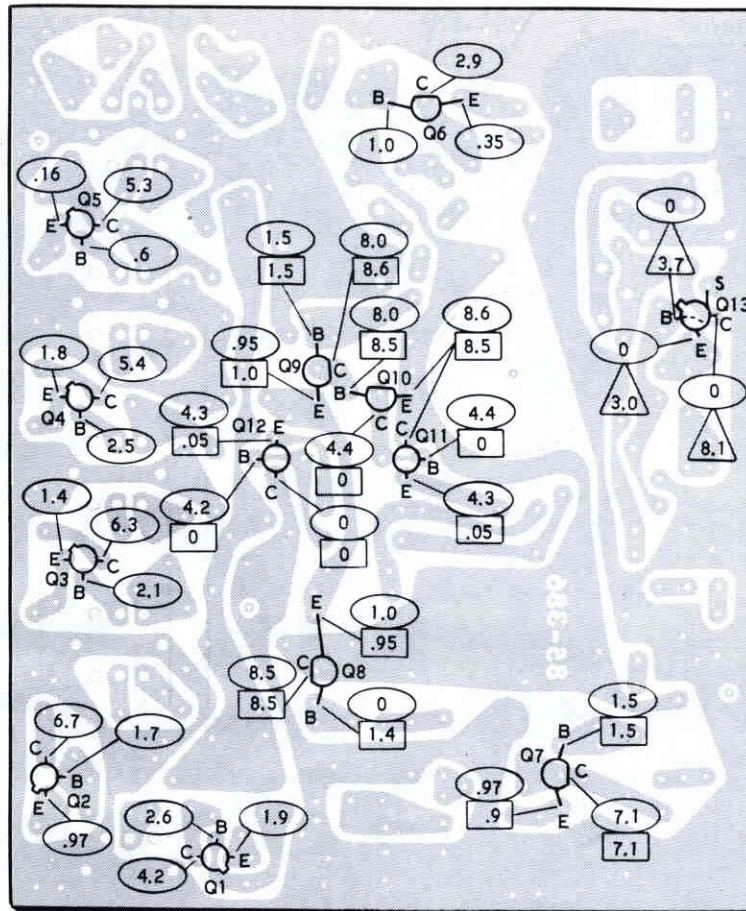
CIRCUIT BOARD X-RAY VIEW

(Viewed From Component Side)



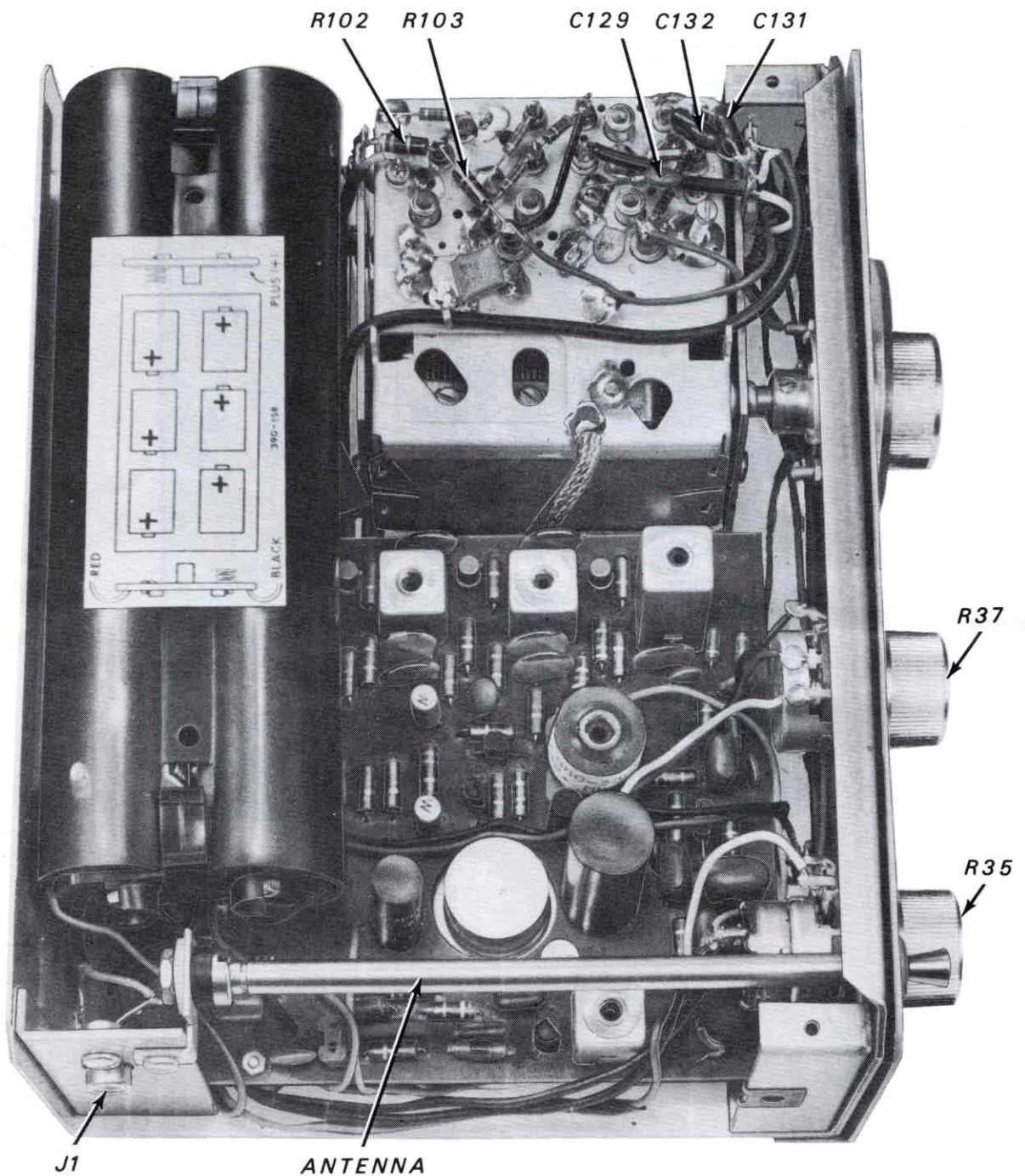
VOLTAGE CHART

(Viewed From Component Side)



612-88

CHASSIS PHOTOGRAPH



REPLACEMENT PARTS PRICE LIST

To order parts, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to Replacement Parts in the "Kit Builders Guide."

PART No.	PRICE Each	DESCRIPTION
-------------	---------------	-------------

RESISTORS

1-140	.10	1.5 Ω
1-129	.10	4.7 Ω
1-103	.10	33 Ω
1-3	.10	100 Ω
1-66	.10	150 Ω
1-45	.10	220 Ω
1-42	.10	270 Ω
1-4	.10	330 Ω
1-6	.10	470 Ω
1-119	.10	560 Ω
1-9	.10	1000 Ω
1-11	.10	1500 Ω
1-10	.10	1200 Ω
1-44	.10	2200 Ω
1-14	.10	3300 Ω
1-46	.10	3900 Ω
1-16	.10	4700 Ω
1-19	.10	6800 Ω
1-73	.10	8200 Ω
1-20	.10	10 k Ω
1-21	.10	15 k Ω
1-22	.10	22 k Ω
1-67	.10	39 k Ω
1-25	.10	47 k Ω

CAPACITORS

Mica

20-160	.15	33 pF
20-103	.15	150 pF
20-115	.25	300 pF
20-107	.40	680 pF

Disc

21-33	.10	3.3 pF
21-6	.10	27 pF
21-75	.10	100 pF
21-17	.10	270 pF
21-140	.10	.001 μ F
21-27	.10	.005 μ F
21-16	.10	.01 μ F
21-82	.10	.02 μ F
21-48	.15	.05 μ F

PART No.	PRICE Each	DESCRIPTION
-------------	---------------	-------------

Electrolytic

25-115	.40	10 μ F
25-160	.60	250 μ F
25-148	.95	1000 μ F
25-195	.60	2.2 μ F tantalum
25-212	.70	22 μ F tantalum

Others

27-47	.20	.1 μ F Mylar
27-48	.25	.22 μ F Mylar
31-57	.70	Trimmer

CONTROLS-SWITCH

10-281	.55	10 k Ω control
19-135	1.15	10 k Ω control with switch
60-2	.30	Slide switch

COILS-TRANSFORMERS

40-923	1.75	Filter coil
40-924	.45	.62 μ H oscillator coil
52-120	.85	IF transformer
40-925	1.05	Detector coil
45-74	.20	.47 μ H choke
45-75	.30	.68 μ H choke
53-13	1.65	Ratio detector

DIODES-TRANSISTORS

56-26	.25	1N191 crystal diode
56-56	.20	IN4149 silicon diode
417-118	.40	2N3393 transistor
417-201	.50	X29A829 transistor
417-154	1.65	2N2369 or X10G1829 transistor
417-293	.45	2N5770 transistor
117-6	2.05	Packaged transistor set
Consisting of:		
417-121		2N2430 transistor
417-122		2N2431 transistor

PART No.	PRICE Each	DESCRIPTION
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HARDWARE

250-202	.05	3-48 x 7/8" screw
250-4	.05	4-40 x 3/8" screw
250-56	.05	6-32 x 1/4" screw
250-229	.05	6-32 x 1/4" phillips head screw
250-89	.05	6-32 x 3/8" screw
250-170	.05	#6 x 1/4" sheet metal screw
250-444	.10	8-32 x 1/2" handle mounting screw
252-1	.05	3-48 nut
252-15	.05	4-40 nut
252-89	.05	4-40 push-on nut
252-3	.05	6-32 nut
252-68	.10	8-32 push-on nut
252-39	.05	1/4" nut
252-7	.05	Control nut
254-7	.05	#3 lockwasher
254-9	.05	#5 lockwasher
254-1	.05	#6 lockwasher
254-5	.05	Control lockwasher
253-10	.05	Control flat washer
253-49	.05	Clear nylon washer
253-50	.05	Black nylon shoulder washer
255-50	.05	Spacer
255-45	.20	Tapped fiber spacer
258-30	.05	Battery spring
259-1	.05	#6 solder lug
259-2	.05	#8 solder lug
259-12	.05	1/4" solder lug
259-24	.05	Wire clamp

CABLE-WIRE-SLEEVING

343-7	.05/ft	Shielded cable
344-50	.05/ft	Black wire
344-52	.05/ft	Red wire
344-53	.05/ft	Orange wire
344-55	.05/ft	Green wire
344-59	.05/ft	White wire
346-19	.05/ft	Sleeving
345-1	.10/ft	Flat braid

TERMINAL STRIP-SOCKETS-PLUG

431-49	.15	11-lug terminal strip
434-42	.10	Phono socket
434-70	.15	Crystal socket
438-4	.10	Phono plug

PART No.	PRICE Each	DESCRIPTION
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METAL PARTS

200-547	1.20	Chassis
204-434	.15	Antenna bracket
204-955	.20	Tuner bracket
204-956	.10	Handle bracket
204-957	.15	Support bracket
204-959	.20	Battery support bracket
205-688-1	.65	Dial plate

GENERAL

100-863	1.30	Vernier drive assembly
110-51	11.50	Tuner assembly*
142-128	1.20	Antenna
211-43	1.50	Handle
214-30	.90	Battery housing
214-31	.35	Battery end cap
401-109	2.00	Speaker

MISCELLANEOUS

73-43	.10	Plastic grommet
85-1444-1	1.40	Circuit board
93-11	5.00	Leatherette case
455-31	.25	Antenna insert
462-230	.55	Large knob
462-238	.50	Small knob
464-57	.35	Tuning dial
469-13	.10	Battery contact
490-1	.10	Alignment tool
490-5	.10	Nut starter
390-158	.10	Battery label
	2.00	Manual (See front cover for part number.)
331-6	.15	Solder

The above prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering from a Heathkit Electronic Center to cover local sales tax, postage and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties and rates of exchange.

* Tuners are available at half-price plus postage on an exchange basis; the defective unit returnable after replacement is received. Tuner returned must be in repairable condition.

EXPEDITED PARTS ORDER FORM (FOR REPAIR PARTS ONLY)				PLEASE DO NOT WRITE IN THIS SPACE		
(1) Give Part Numbers as they are in parts list.				KIT MODEL _____ DATE OF PURCHASE _____ SERIES NUMBER _____		
(2) Include remittance or permission for C.O.D. shipment.		☐ CASH	☐ C.O.D.			
(3) Use separate sheet of paper for all correspondence.						
(4) Prices may change to reflect current manufacturing costs.						
(5) Current HEATH account number		AA				
QTY.	PART NUMBER	DESCRIPTION	PRICE	TOTAL PRICE	MARK PROPER SPACE FOR WARRANTY PARTS ONLY	
					3 DAMAGED	2 DEFECTIVE
HEATH COMPANY BENTON HARBOR MICHIGAN 49022 PHONE 616-983-7381			NAME _____ ADDRESS _____ CITY _____ STATE _____ ZIP _____			

THIS FORM IS FOR U.S. CUSTOMERS ONLY. OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR.

- CUT ALONG DOTTED LINE -

EXPEDITED PARTS ORDER FORM (FOR REPAIR PARTS ONLY)				PLEASE DO NOT WRITE IN THIS SPACE		
(1) Give Part Numbers as they are in parts list.				KIT MODEL _____ DATE OF PURCHASE _____ SERIES NUMBER _____		
(2) Include remittance or permission for C.O.D. shipment.		☐ CASH	☐ C.O.D.			
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HEATH COMPANY BENTON HARBOR MICHIGAN 49022 PHONE 616-983-7381			NAME _____ ADDRESS _____ CITY _____ STATE _____ ZIP _____			

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CUSTOMER SERVICE

REPLACEMENT PARTS

If you need a replacement part, please fill in the Parts Order Form that is furnished and mail it to the Heath Company. Or, if you write a letter, include the:

- Part number and description as shown in the Parts List.
- Model number and Series number from the blue and white label.
- Date of purchase.
- Nature of the defect.

Please do not return parts to the factory unless they are requested. Parts that are damaged through carelessness or misuse by the kit builder will not be replaced without cost, and will not be considered in warranty.

Parts are also available at the Heathkit Electronic Centers listed in your catalog. Be sure to provide the Heath part number. Bring in the original part when you request a warranty replacement from a Heathkit Electronic Center.

NOTE: Replacement parts are maintained specifically to repair Heathkit products. Parts sales for other reasons will be declined.

TECHNICAL CONSULTATION

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

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

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

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

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

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

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

REPAIR SERVICE

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

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

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

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

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

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

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH

Schlumberger

HEATH COMPANY • BENTON HARBOR, MICHIGAN
THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.