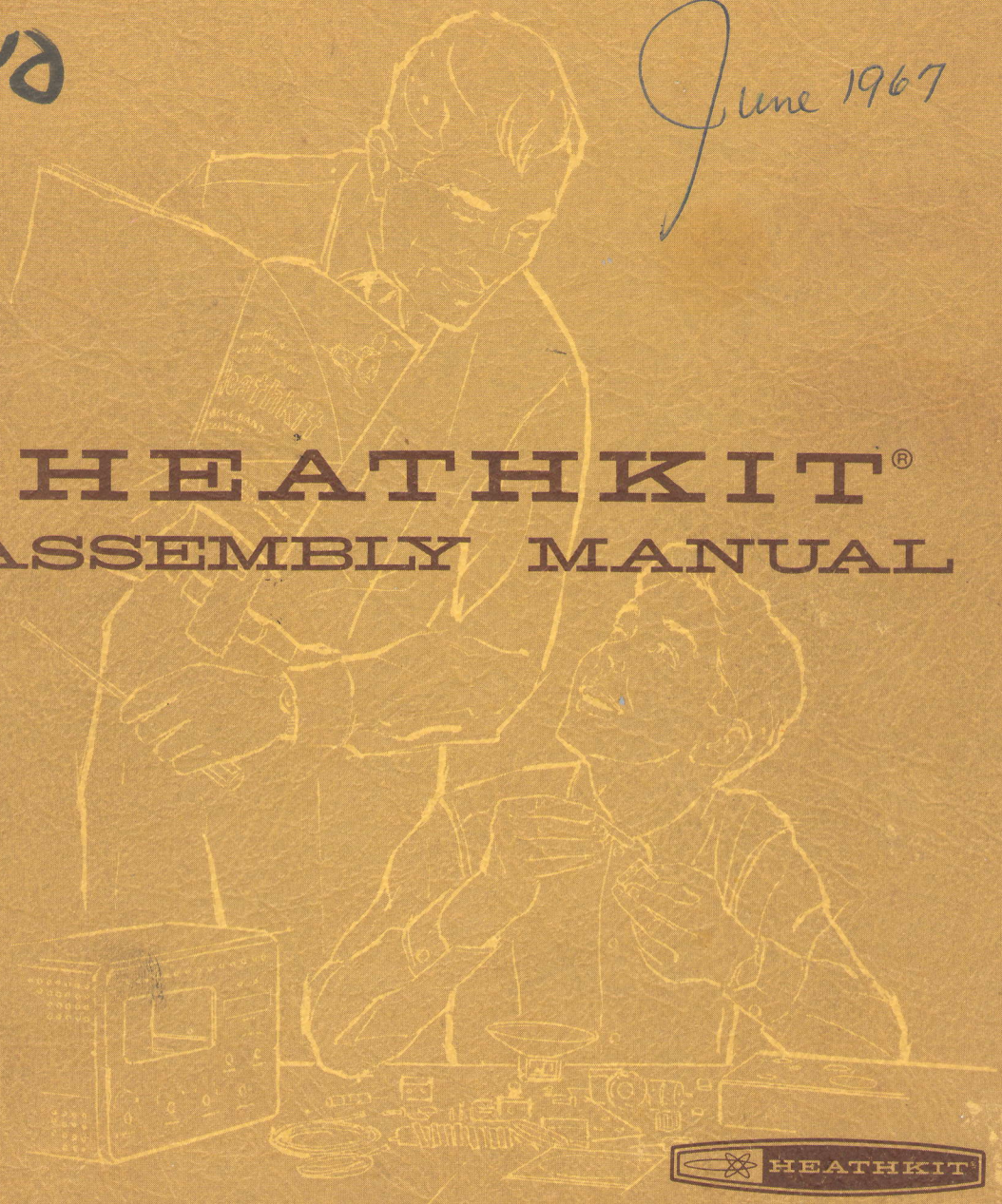
PRICE $1.00

June 1967



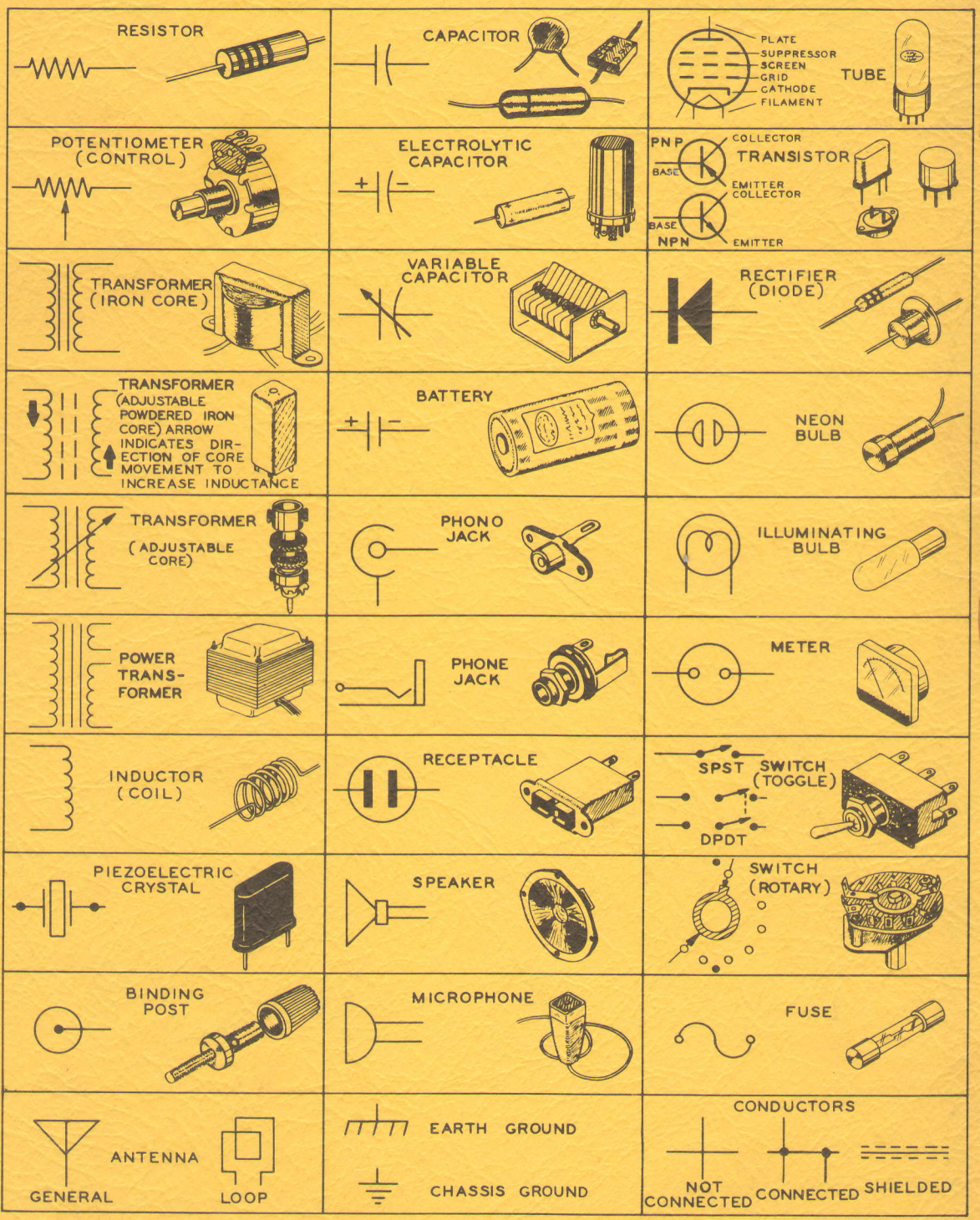
HEATHKIT®
ASSEMBLY MANUAL

FM PORTABLE RADIO

MODEL GR-61

TYPICAL COMPONENT TYPES

This chart is a guide to commonly used types of electronic components. The symbols and related illustrations should prove helpful in identifying most parts and reading the schematic diagrams.

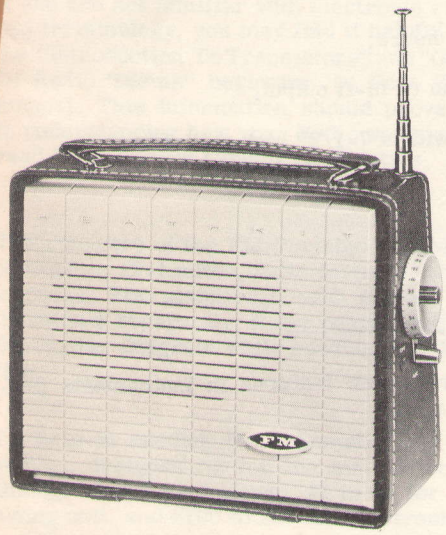


(1966)

Assembly and Operation of the HEATHKIT

FM PORTABLE RADIO

MODEL GR-61



HEATH COMPANY
BENTON HARBOR,
MICHIGAN

TABLE OF CONTENTS

12/30/66

SPECIFICATIONS

Tuning Range	88 to 108 megacycles.
Intermediate Frequency (IF)	10.7 megacycles.
Sensitivity	3 uv for 20 db quieting (average), 5 uv for 20 db quieting (maximum). (Measurements taken in aligned condition.)
Controls	Volume, Tone, and AFC.
Transistors	3 - 2N1747 4 - 2N1274 1 - 2N2495 1 - 2N2671 1 - 2N2654 } in FM tuning unit
Antenna	Collapsible whip with provisions for external 300 Ω antenna.
Speaker	4" x 6" oval, permanent magnet type.
Batteries	Six 1-1/2 volt size C cells.
Normal Battery Life	300-500 hours.
Accessory Jack	Earphone or hi-fi output.
Size	9-1/2" wide x 7-1/2" high x 4" deep.
Net Weight	3 lbs.

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

INTRODUCTION

Your new FM Portable Radio features a dependable 10-transistor circuit, housed in an attractive imitation-leather case. The front of the case is made of durable high-impact plastic.

Exceptionally high quality is designed into this Radio, as evidenced by the preassembled and prealigned FM tuning unit, and the prealigned IF and ratio detector transformers. Three IF-limiter stages, plus a ratio detector combination with AFC, provide stable FM reception. The push-pull audio power amplifier circuit delivers more than adequate power for the 4" x 6" speaker to give large-room sound coverage.

The preassembled and prealigned FM tuning unit contributes to ease of assembly and insures consistently good FM performance. A heavy-duty circuit board is used to further simplify assembly of the kit.

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

CIRCUIT DESCRIPTION

If you are not familiar with electronic circuitry and terminology, you may find it helpful to read the "Introduction To Transistors" and "Glossary Of Radio Terms" beginning on Page 27 of the manual. This information should prove helpful in understanding how your Radio works when you read the following Circuit Description.

The circuitry of the FM Portable Radio consists of the RF, IF-limiter, ratio detector, and audio sections. For simplicity, each section will be discussed separately. Refer occasionally to the Schematic Diagram while reading this description.

To help in reading the Schematic, the letter-number designations for the circuit parts are number coded as follows: #1 to 99 for the FM tuning unit, and #100 to 200 for the circuit board and chassis. For example, resistor R3 is in the FM tuning unit, and resistor R103 is on the circuit board.

RF SECTION

The RF section contains the RF amplifier, oscillator, and mixer stages, all in a preassembled and prealigned tuning unit.

FM signals from the antenna are applied to transformer T1, which matches the antenna to the first section of the tuning capacitor, C1A. This portion of the tuning capacitor tunes the emitter circuit of RF amplifier Q1 to the desired FM station frequency. C1B, the second section of the tuning capacitor, tunes the collector circuit of Q1 to the same station frequency.

Q2 is operated as a feedback tuned-collector oscillator at 10.7 megacycles above the frequency of the desired FM station. The amplified FM station frequency from Q1, and the oscillator frequency from Q2 are mixed in Q3 to provide a difference frequency of 10.7 megacycles. This difference frequency is coupled through transformer T2, out of the preassembled tuning unit, to the first IF amplifier, Q4.

IF-LIMITER SECTION

The 10.7 megacycle signal from the FM tuning unit is applied to Q4, the first IF amplifier. From Q4, the IF signal passes through transformer T3, which passes only the difference frequency of 10.7 megacycles, to Q5, the second IF amplifier. After additional amplification in Q5, the signal is applied through T4, the second IF transformer, to limiter stage Q6, which limits on all but the weakest signals.

Stages Q4 and Q5 act as IF amplifiers for weak signals, and as limiters for strong signals. Limiter stages are used to remove any AM (amplitude modulation) of the IF signal, and to limit the signal to the proper level for the ratio detector. The IF signal from limiter Q6 is next applied to ratio detector transformer, T5.

RATIO DETECTOR

Ideally, the IF signal applied to the ratio detector should be of constant amplitude, but contain variations in frequency which correspond to the audio signal being transmitted by the FM station. The amount of frequency deviation from the center frequency of 10.7 megacycles determines the amplitude of the resulting audio signal. The number of times per second that the IF signal deviates from 10.7 megacycles determines the resulting audio frequency. The combination of diodes D3, D4, and transformer T5 detect frequency variations in the IF signal, and change these variations into an audio signal.

Most of the resistors and capacitors used in the ratio detector are encapsulated in a P.E.C. (packaged electronic circuit). The use of this P.E.C. eliminates any variations in performance that could result from different wiring techniques. The circuit of the P.E.C. includes a de-emphasis network to compensate for high frequency pre-emphasis that was added to the transmitted audio signal; it thus provides a flat audio frequency response. This network also attenuates frequencies above the audio range.

The audio output signal of the ratio detector is applied both to Q7, the emitter follower and, as an AFC voltage, to Q2 of the FM tuning unit. Any shift of the IF from the 10.7 megacycle center frequency appears as a DC voltage which is applied to diode D1; this is commonly called AFC voltage. The DC voltage shift on D1 in turn changes the oscillator capacity, thereby effectively retuning it and causing it to track the particular station that is being received.

AUDIO SECTION

The audio signal from the ratio detector is applied to Q7, the emitter follower, which acts as a matching network between the ratio detector and the Volume control. After the Volume control, the audio signal is amplified by driver amplifier Q8 and then to the Tone control and to driver transformer T6. Transformer T6 couples the audio signal to Q9 and Q10, the push-pull audio amplifier stages. From Q9 and Q10 the signal, is coupled to the speaker and earphone jack through T7, the audio output transformer. When an earphone is plugged in, the built-in speaker is automatically disconnected from the circuit and the audio signal goes instead to the earphone.

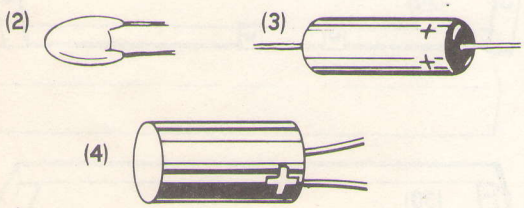
Operating power is supplied by six 1-1/2 volts size C flashlight batteries.

PARTS LIST

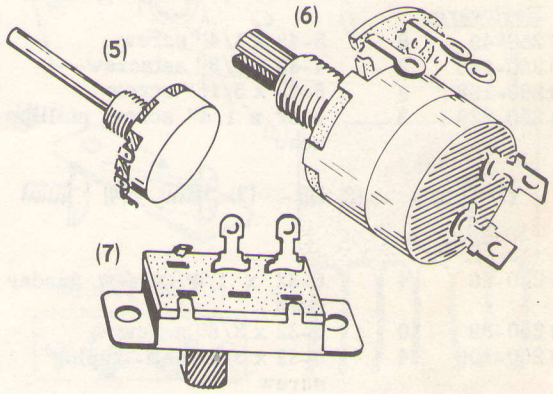
The numbers in parentheses in the Parts List are keyed to the numbers in the Parts drawings to aid in parts identification.

PART No.	PARTS Per Kit	DESCRIPTION
Resistors (1/2 Watt)		
(1) 1-129	2	4.7 Ω (yellow-violet-gold)
1-41	1	10 Ω (brown-black-black)
1-2	1	68 Ω (blue-gray-black)
1-45	3	220 Ω (red-red-brown)
1-8	1	820 Ω (gray-red-brown)
1-9	3	1 KΩ (brown-black-red)
1-10	1	1.2 KΩ (brown-red-red)
1-13	3	2.7 KΩ (red-violet-red)
1-14	1	3.3 KΩ (orange-orange-red)
1-16	2	4.7 KΩ (yellow-violet-red)
1-19	3	6.8 KΩ (blue-gray-red)
1-20	2	10 KΩ (brown-black-orange)
1-109	1	12 KΩ (brown-red-orange)
1-21	1	15 KΩ (brown-green-orange)
1-69	1	18 KΩ (brown-gray-orange)
1-22	1	22 KΩ (red-red-orange)
1-60	1	68 KΩ (blue-gray-orange)
1-26	1	100 KΩ (brown-black-yellow)
1-35	1	1 megohm (brown-black-green)

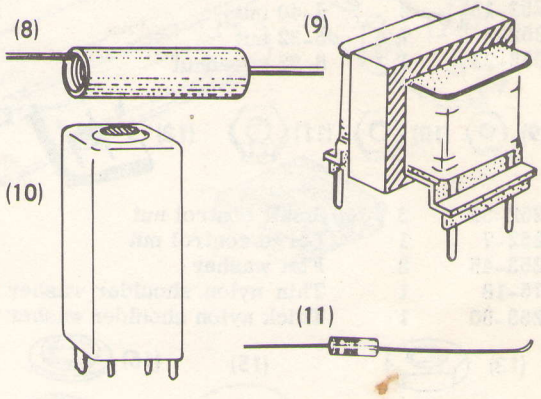
Capacitors		
(2) 21-17	1	270 μμf disc ceramic
21-46	1	.005 μfd disc ceramic
21-94	9	.05 μfd disc ceramic
(3) 25-54	1	10 μfd 15 V tubular electrolytic
(4) 25-115	4	10 μfd 15 V electrolytic
25-116	1	50 μfd 15 V electrolytic
25-117	2	100 μfd 15 V electrolytic
25-111	1	1000 μfd 15 V tubular electrolytic



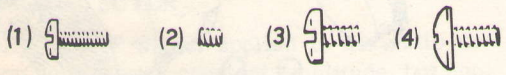
PART No.	PARTS Per Kit	DESCRIPTION
Controls-Switch		
(5) 10-138	1	100 KΩ linear control
(6) 19-81	1	10 KΩ control with SPST switch
(7) 60-18	1	SPST switch



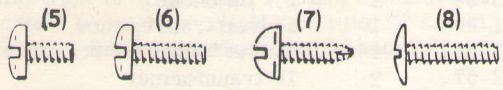
Choke-Transformers-Diode		
(8) 45-35	2	1.7 μh choke
(9) 51-97	1	Driver transformer
51-98	1	Output transformer
(10) 52-57	2	IF transformer
53-6	1	Ratio detector transformer
(11) 56-26	1	Crystal diode



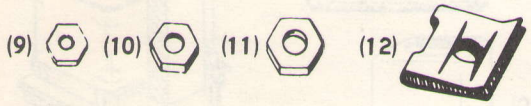
PART No.	PARTS Per Kit	DESCRIPTION
Transistors		
417-70	1	2N2671 transistor (in FM tuning unit)
417-71	1	2N2654 transistor (in FM tuning unit)
417-72	1	2N2495 transistor (in FM tuning unit)
417-57	3	2N1747 transistor
117-2	1	Transistor package containing four part no.417-21, type 2N1274 transistors
Hardware		
(1) 250-49	8	3-48 x 1/4" screw
(2) 250-156	2	4-40 x 1/8" setscrew
(3) 250-138	8	6-32 x 3/16" screw
(4) 250-229	3	6-32 x 1/4" screw, phillips head



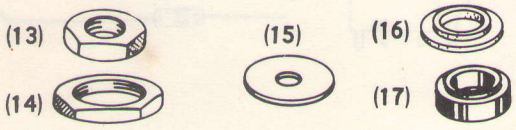
(5) 250-56	4	6-32 x 1/4" screw, binder head
(6) 250-89	10	6-32 x 3/8" screw
(7) 250-106	4	6-32 x 3/8" self-tapping screw
(8) 250-10	2	6-32 x 1/2" screw



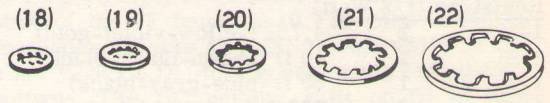
(9) 252-1	8	3-48 nut
(10) 252-15	2	4-40 nut
(11) 252-3	7	6-32 nut
(12) 252-22	4	6-32 speednut



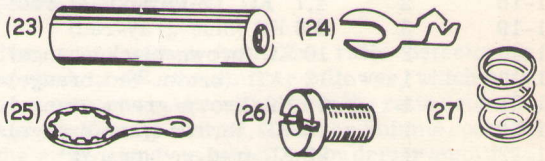
(13) 252-39	3	Small control nut
(14) 252-7	1	Large control nut
(15) 253-45	2	Flat washer
(16) 75-18	1	Thin nylon shoulder washer
(17) 253-50	1	Thick nylon shoulder washer



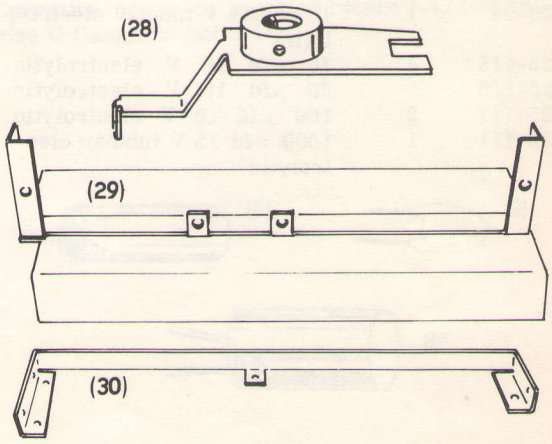
PART No.	PARTS Per Kit	DESCRIPTION
Hardware (cont'd.		
(18) 254-7	8	#3 lockwasher
(19) 254-9	2	#4 lockwasher
(20) 254-1	7	#6 lockwasher
(21) 254-14	2	Small control lockwasher
(22) 254-4	1	Large control lockwasher



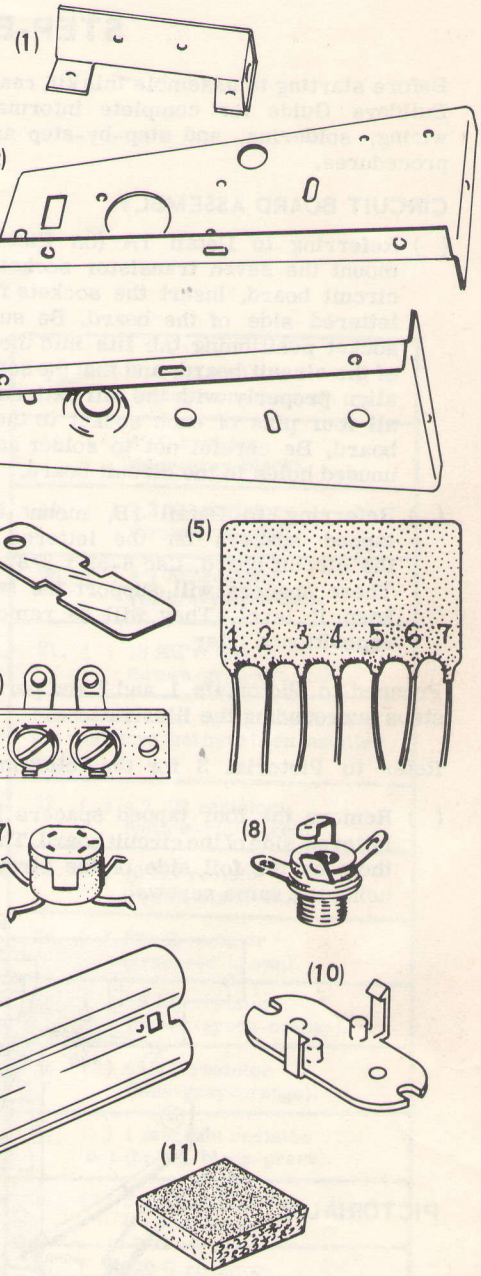
(23) 255-11	4	Tapped spacer
(24) 259-11	2	Spade lug
(25) 259-12	1	Large solder lug
(26) 455-31	1	Antenna bushing
(27) 258-30	2	Battery spring



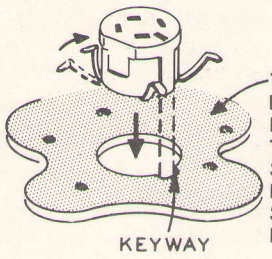
Cable-Wire-Sleeving		
343-7	1	Length shielded cable
344-50	1	Length black hookup wire
344-16	1	Length stranded red wire
344-15	1	Length stranded black wire
346-1	1	Length sleeving
Metal Parts		
(28) 100-M416	1	Switch lever
(29) 100-M417	1	Bottom circuit board bracket
(30) 204-M517	1	Top circuit board bracket



	PART No.	PARTS Per Kit	DESCRIPTION
	Metal Parts (cont'd.)		
(1)	204-M519	1	Antenna bracket
(2)	205-M391	1	Right end plate
(3)	205-M392	1	Left end plate
(4)	469-M13	1	Battery contactor
	Miscellaneous		
(5)	84-25	1	P.E.C. (packaged electronic circuit)
	85-51F831	1	Circuit board
	92-9	1	Cabinet front
	93-8	1	Leather case
	110-14	1	FM tuning unit
	391-23	1	Nameplate
	401-19	1	Speaker
(6)	431-6	1	2-screw terminal strip
(7)	434-110	7	Transistor socket
(8)	436-16	1	Earphone jack
	462-87	1	Small tuning knob
	462-181	1	Large tuning knob
	462-89	1	Volume knob
	462-175	2	Tapered knob
	490-1	1	Alignment tool
	490-23	1	Allen wrench
	1142-42	1	Collapsible antenna
	390-158	1	Battery label
(9)	214-30	1	Battery holder
(10)	214-31	2	Battery holder end
(11)	73-47	3	Sponge rubber pad
	331-6		Solder
	595-593	1	Manual



Detail 1A



TOP SIDE
NOTE: SOCKETS MUST BE INSERTED FROM THE TOP (LETTERED) SIDE OF THE CIRCUIT BOARD. THIS IS THE SIDE OPPOSITE THE METALIC FOIL.

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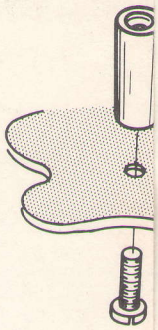
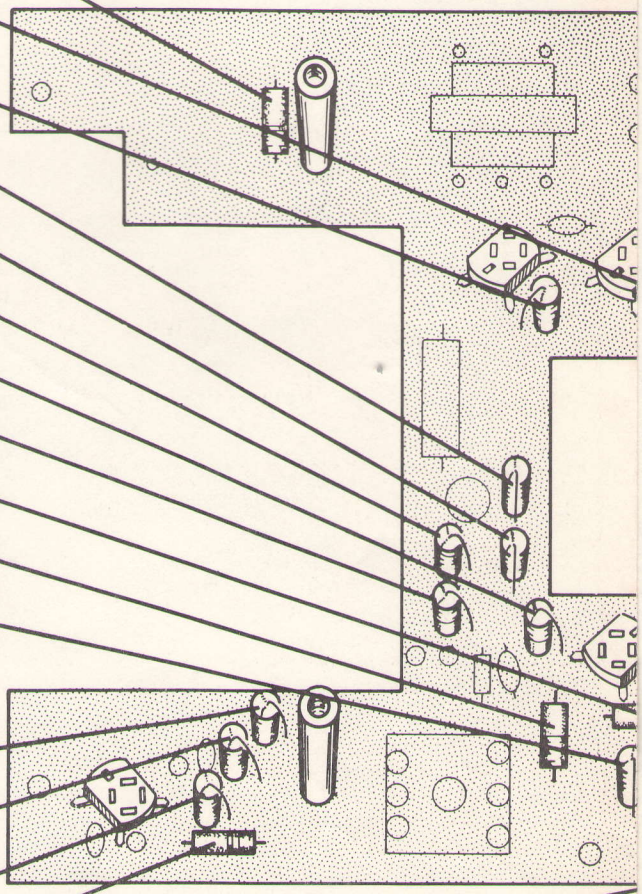


1. ( ) 10 Ω resistor (brown-black-black).
2. ( ) 4.7 Ω resistor (yellow-violet-gold). Refer to Detail 1C.
3. ( ) 4.7 Ω resistor (yellow-violet-gold).
4. ( ) 22 KΩ resistor (red-red-orange).
5. ( ) 12 KΩ resistor (brown-red-orange).
6. ( ) 100 KΩ resistor (brown-black-yellow).
7. ( ) 1 KΩ resistor (brown-black-red).
8. ( ) 10 KΩ resistor (brown-black-orange).
9. ( ) 220 Ω resistor (red-red-brown).
10. ( ) 2.7 KΩ resistor (red-violet-red).
11. ( ) 6.8 KΩ resistor (blue-gray-red).

Now solder and cut off the leads of the resistors that have been installed so far. Be careful not to cover unused holes when soldering.

12. ( ) 1 KΩ resistor. (brown-black-red).
13. ( ) 2.7 KΩ resistor (red-violet-red).
14. ( ) 6.8 KΩ resistor (blue-gray-red).
15. ( ) 220 Ω resistor (red-red-brown).
16. ( ) 1 KΩ resistor (brown-black-red).



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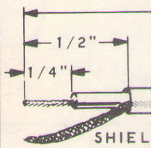

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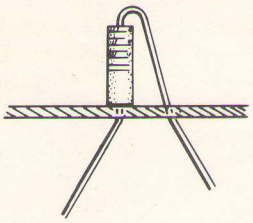

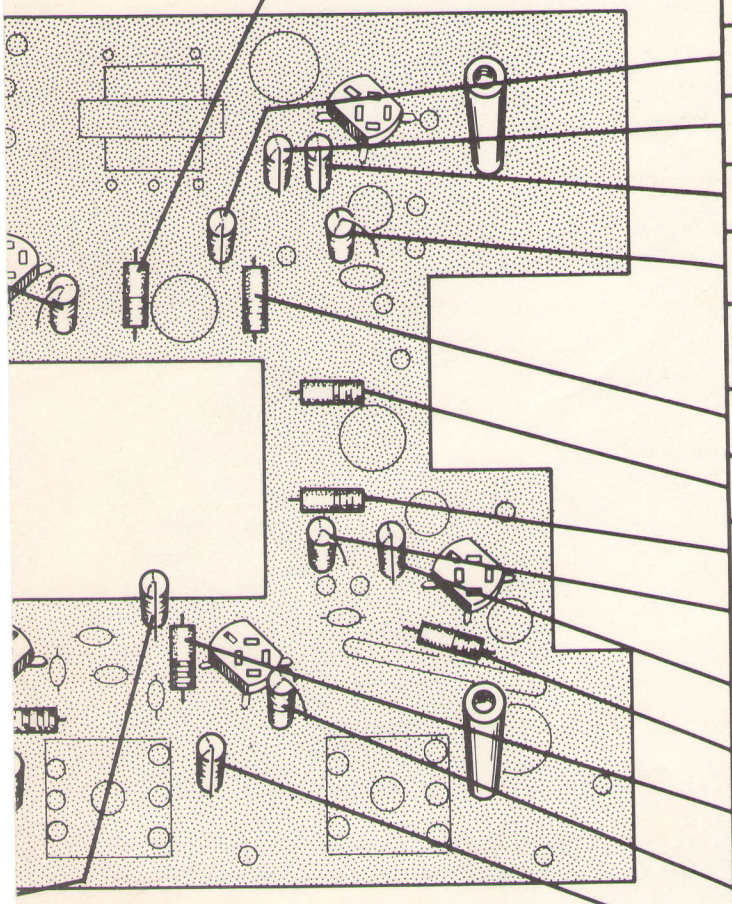

PICTORIAL 1

17. ( ) 3.3 KΩ resistor (orange-orange-red).

18. ( ) 68 Ω resistor (blue-gray-black).

19. ( ) 1.2 KΩ resistor (brown-red-red).

20. ( ) 4.7 KΩ resistor (yellow-violet-red).

21. ( ) 18 KΩ resistor (brown-gray-orange).

Now solder and cut off the leads of the resistors that have been installed so far.

22. ( ) 4.7 KΩ resistor (yellow-violet-red).

23. ( ) 10 KΩ resistor (brown-black-orange).

24. ( ) 820 Ω resistor (gray-red-brown).

25. ( ) 15 KΩ resistor (brown-green-orange).

26. ( ) 68 KΩ resistor (blue-gray-orange).

27. ( ) 1 megohm resistor (brown-black-green).

28. ( ) 2.7 KΩ resistor (red-violet-red).

29. ( ) 220 Ω resistor (red-red-brown).

30. ( ) 6.8 KΩ resistor (blue-gray-red).

Now solder and cut off the leads of the remaining resistors.

PROCEED TO PICTORIAL 2

Before starting
Builders Guide
wiring, solderi
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PICTORIAL 3

STEP-BY-STEP ASSEMBLY

Before starting to assemble this kit, read the Kit Builders Guide for complete information on wiring, soldering, and step-by-step assembly procedures.

CIRCUIT BOARD ASSEMBLY

( ) Referring to Detail 1A (on Pictorial 1), mount the seven transistor sockets on the circuit board. Insert the sockets from the lettered side of the board. Be sure each socket positioning tab fits into the keyway of the circuit board, and that the socket pins align properly with the foil pattern. Solder all four pins of each socket to the circuit board. Be careful not to solder any of the unused holes in the circuit board.

( ) Referring to Detail 1B, mount the four tapped spacers on the lettered side of the circuit board. Use 6-32 x 3/8" screws. These spacers will support the board and keep it level. They will be removed and repositioned later.

Proceed to Pictorials 1 and 2 and perform the steps surrounding the illustrations.

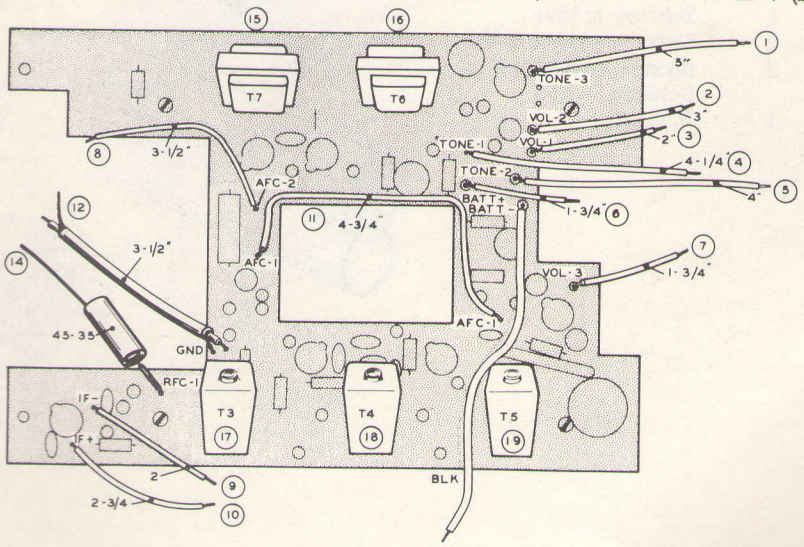
Refer to Pictorial 3 for the following steps.

( ) Remove the four tapped spacers from the lettered side of the circuit board. Then mount them on the foil side of the circuit board using the same screws.

NOTE: When using hookup wire in the following steps, cut the required length of wire and strip 1/4" of insulation from each end.

Connect one end of the following wires to the circuit board. The correct length is given at the beginning of each step. The free ends of these wires will be connected later.

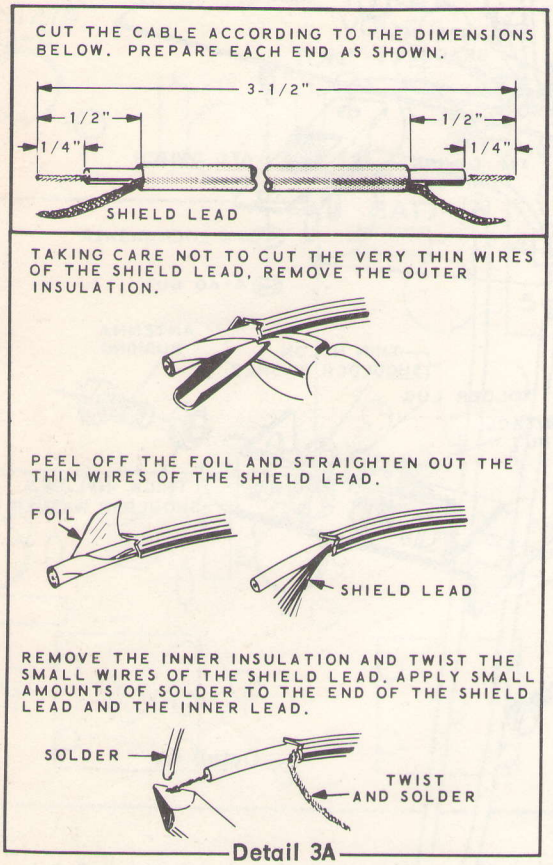
	LENGTH	FROM
1.	( ) 5"	TONE-3 (S-1)
2.	( ) 3"	VOL-2 (S-1)
3.	( ) 2"	VOL-1 (S-1)
4.	( ) 4-1/4"	TONE-1 (S-1)
5.	( ) 4"	TONE-2 (S-1)
6.	( ) 1-3/4"	BATT + (S-1)
7.	( ) 1-3/4"	VOL-3 (S-1)
8.	( ) 3-1/2"	AFC-2 (S-1)
9.	( ) 2"	IF - (S-1)
10.	( ) 2-3/4"	IF + (S-1)



PICTORIAL 3

11. ( ) Connect a 4-3/4" wire between points AFC-1 (S-1) to AFC-1 (S-1) on the circuit board. Position as shown.

( ) Referring to Detail 3A, prepare a 3-1/2" length of shielded cable as shown.



Detail 3A

12. ( ) At one end of the cable, connect the inner wire to AGC (S-1) and the shield to GND (S-1) of the circuit board. Leave the other end free. Be careful not to overheat the cable conductors since this may cause the inner insulation to melt, resulting in a short circuit. Grip the leads with pliers between the solder connection and the insulation.

13. ( ) Remove 1/4" of insulation from each end of a 9" length of stranded black wire. Twist the separate strands together tightly at each end of the wire. Then apply a small amount of solder to each end to hold the strands together.

( ) Connect one end of this 9" black wire to BATT- on the circuit board (S-1). The other end will be connected later.

14. ( ) RFC-1. Cut one lead length of a RF choke (#45-35) to 1", place 3/4" of sleeving over this lead and connect it to RFC-1 on the circuit board (S-1). Leave the other end free.

( ) Clip off all excess leads at the soldered joints on the foil side of the circuit board.

NOTE: When mounting transformers in the following steps, carefully align the pins of each transformer with the holes of the circuit board. The spacing of the transformer pins and the holes of the circuit board are such that when aligned properly they will mount easily, without forcing.

15. ( ) T7. Install the output transformer (#51-98) at T7. Solder all 5 pins.

16. ( ) T6. Install the driver transformer (#51-97) at T6. Solder all 5 pins.

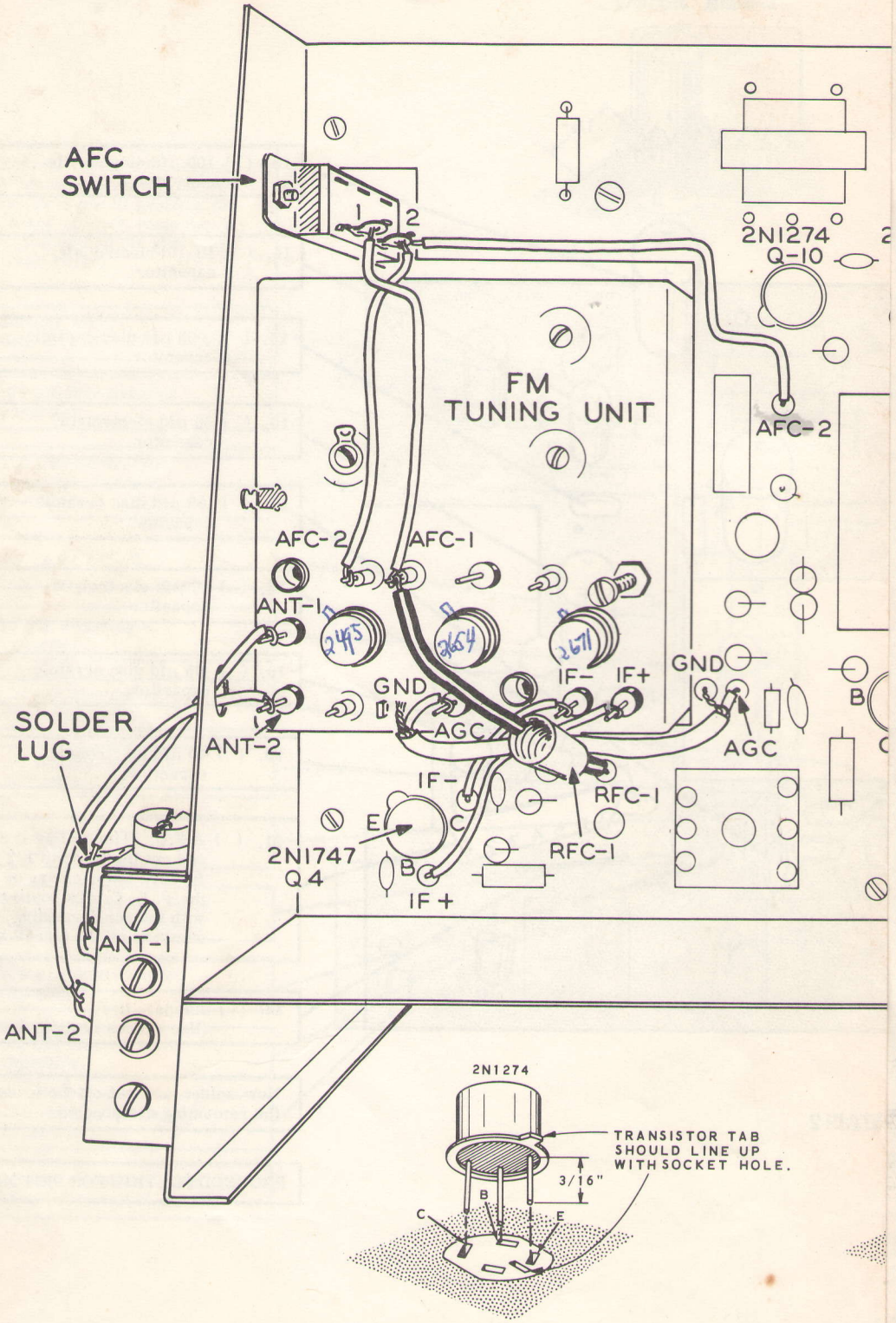
17. ( ) T3. Install one of the IF transformers (#52-57) at T3. Solder all 8 pins.

18. ( ) T4. Install the remaining IF transformer (#52-57) at T4. Solder all 8 pins.

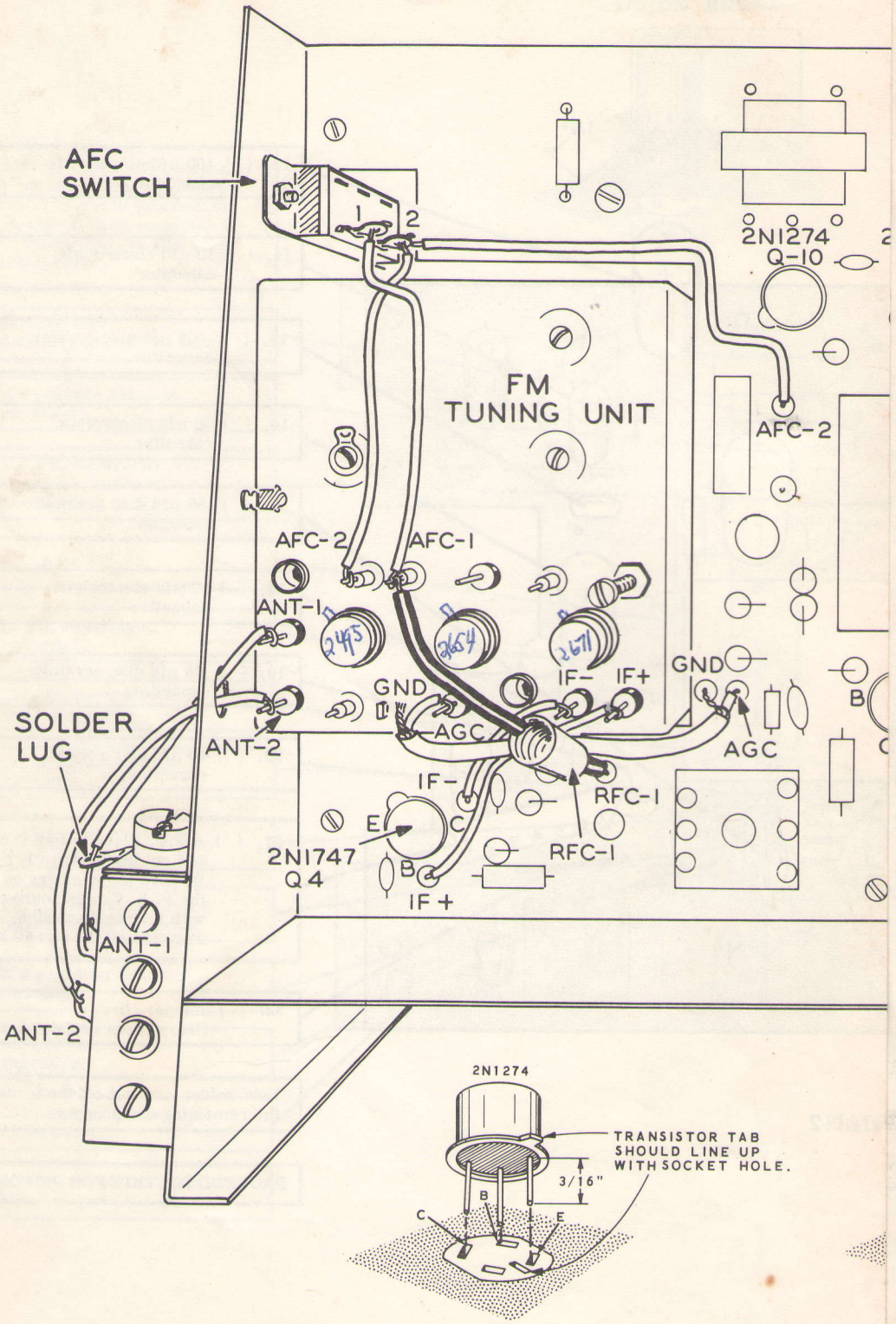
19. ( ) T5. Install the ratio detector transformer (#53-6) at T5. Solder all 7 pins.

( ) Check to see that all the connections made on the circuit board have been soldered.

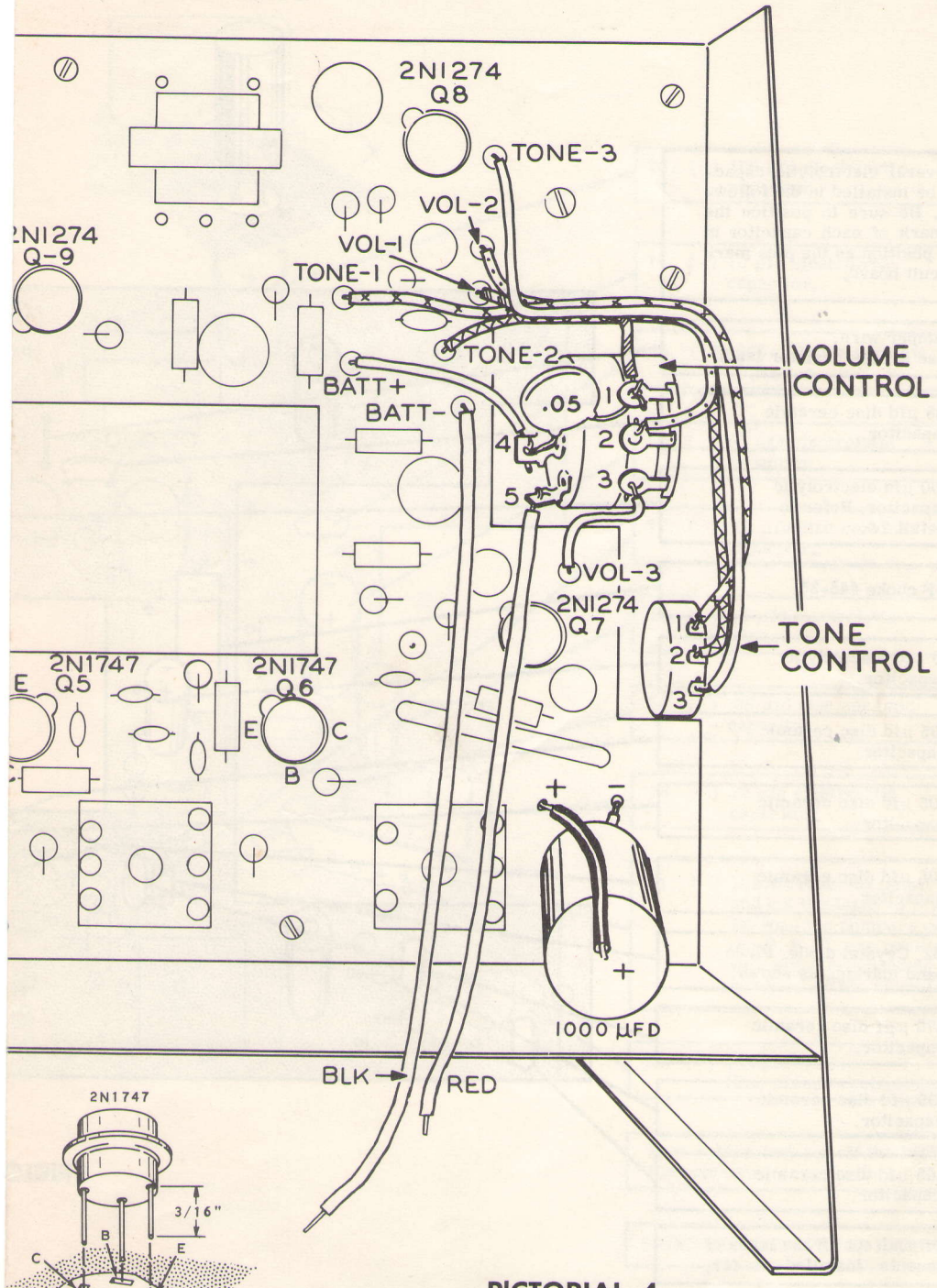
Set the board aside temporarily.


AFC SWITCH
1
2
2N1274
Q-10
FM
TUNING UNIT
AFC-2
AFC-2
AFC-1
ANT-1
GND
IF-
IF+
GND
SOLDER LUG
ANT-2
AGC
AGC
IF-
RFC-1
E
C
2N1747
Q 4
B
RFC-1
IF +
ANT-1
ANT-2
2N1274
TRANSISTOR TAB SHOULD LINE UP WITH SOCKET HOLE.
3/16"
B
C
E

Detail 4E


AFC
SWITCH
1
2
2N1274
Q-10
FM
TUNING UNIT
AFC-2
AFC-2
AFC-1
ANT-1
GND
IF-
IF+
GND
SOLDER
LUG
ANT-2
AGC
AGC
IF-
RFC-1
E
C
2N1747
Q 4
B
RFC-1
IF +
ANT-1
ANT-2
2N1274
TRANSISTOR TAB
SHOULD LINE UP
WITH SOCKET HOLE.
3/16"
B
C
E

Detail 4E



Detail 4F

PICTORIAL 4

6-32 SPEEDN

FLAT SIDE

6-32 NUT

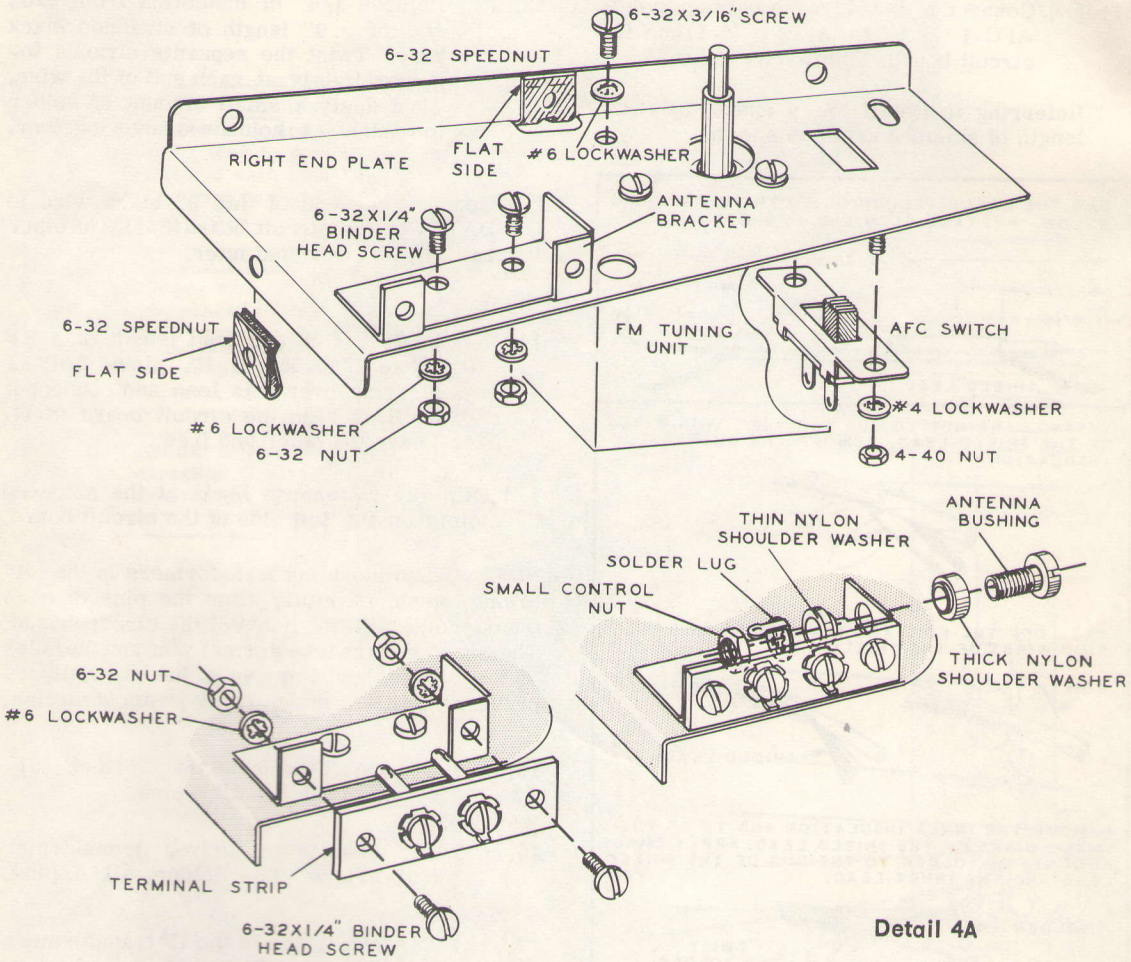
#6 LOCKWASHER

TERMINA

RIGHT END PLA

Refer to Detail

( ) Mount two 6-
plate. Be sur
is positioned



Detail 4A

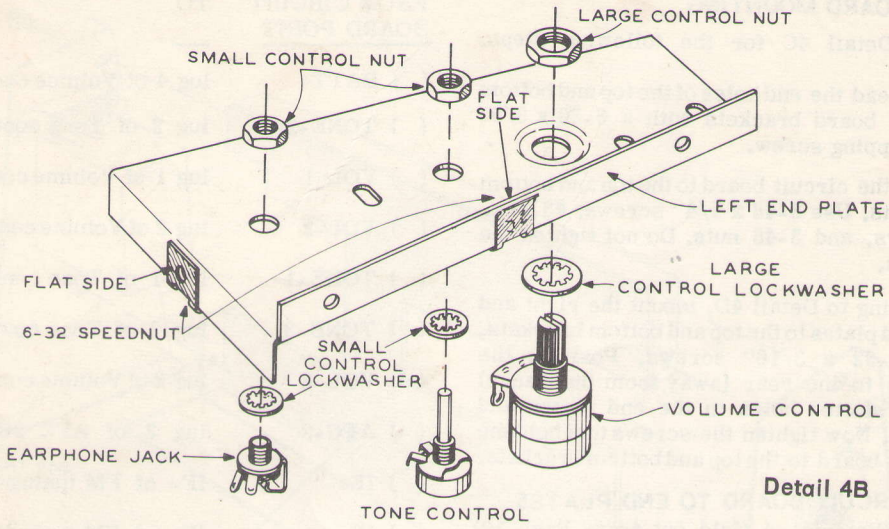
RIGHT END PLATE PARTS MOUNTING

Refer to Detail 4A for the following steps.

( ) Mount two 6-32 speednuts on the right end plate. Be sure the flat side of each speednut is positioned as shown.

( ) Mount the antenna bracket to the end plate. Use 6-32 x 1/4" binder head screws, #6 lockwashers, and 6-32 nuts.

( ) Mount the 2-screw terminal strip to the antenna bracket. Position it as shown. Use 6-32 x 1/4" binder head screws, #6 lockwashers, and 6-32 nuts.



Detail 4B

( ) Mount the antenna bushing to the antenna bracket. Use the thick nylon shoulder washer, thin nylon shoulder washer, solder lug, and small control nut. Position and bend the solder lug as shown. Tighten securely with a large screwdriver.

( ) Mount the AFC switch with #4 lockwashers and 4-40 nuts. Be sure the switch lugs are positioned as shown. See Pictorial 4.

( ) Mount the preassembled FM tuning unit with #6 lockwashers and 6-32 x 3/16" screws.

Set the right end plate aside temporarily.

LEFT END PLATE PARTS MOUNTING

Refer to Detail 4B for the following parts.

( ) Mount two 6-32 speednuts on the left end plate. Be sure the flat side of each speednut is positioned as shown.

( ) Mount the Volume control (#19-81) with a large control lockwasher and large control nut. Position the lugs as shown.

( ) Mount the Tone control (#10-138) with a small control lockwasher and small control nut. Position the lugs as shown.

( ) Mount the earphone jack with a small control lockwasher and small control nut. Position the lugs as shown.

Set the left end plate aside temporarily.

CIRCUIT BOARD MOUNTING

Refer to Detail 4C for the following steps.

( ) Prethread the end holes of the top and bottom circuit board brackets with a 6-32 x 3/8" self-tapping screw.

( ) Mount the circuit board to the top and bottom brackets. Use 3-48 x 1/4" screws, #3 lockwashers, and 3-48 nuts. Do not tighten the screws.

( ) Referring to Detail 4D, mount the right and left end plates to the top and bottom brackets. Use 6-32 x 3/16" screws. Position the screws to the rear (away from the flange) of the slotted holes in the end plates and tighten. Now tighten the screws that hold the circuit board to the top and bottom brackets.

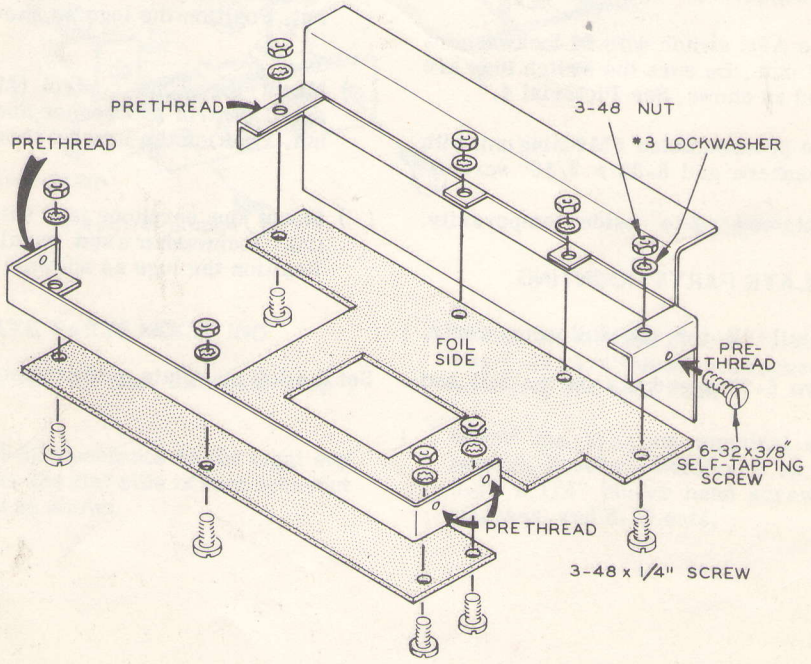
WIRING CIRCUIT BOARD TO END PLATES

Refer to Pictorial 4 (fold-out from Page 10) for the following steps.

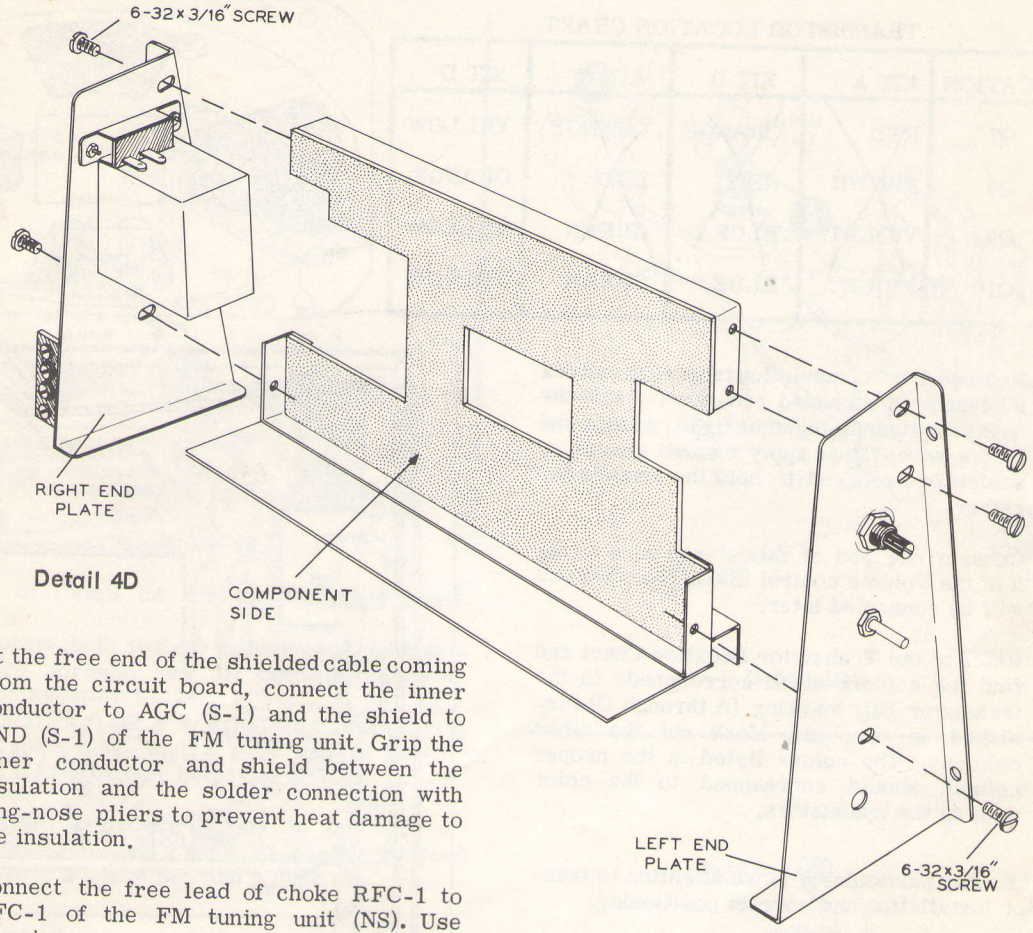
Connect the free ends of the wires coming from the circuit board to end plate terminals as directed in the following steps:

FROM CIRCUIT BOARD POINT	TO
( ) BATT+	lug 4 of Volume control (NS).
( ) TONE-2	lug 2 of Tone control (S-1).
( ) VOL-1	lug 1 of Volume control (NS).
( ) VOL-2	lug 2 of Volume control (S-1).
( ) TONE-1	lug 1 of Tone control (S-1).
( ) TONE-3	lug 3 of Tone control (S-1).
( ) VOL-3	lug 3 of Volume control (S-1).
( ) AFC-2	lug 2 of AFC switch (NS).
( ) IF-	IF- of FM tuning unit (S-1).
( ) IF+	IF+ of FM tuning unit (S-1).

( ) Connect a .05 µfd disc ceramic capacitor from lug 4 (S-2) to lug 1 (S-2) of the Volume control.



Detail 4C



Detail 4D

( ) At the free end of the shielded cable coming from the circuit board, connect the inner conductor to AGC (S-1) and the shield to GND (S-1) of the FM tuning unit. Grip the inner conductor and shield between the insulation and the solder connection with long-nose pliers to prevent heat damage to the insulation.

( ) Connect the free lead of choke RFC-1 to AFC-1 of the FM tuning unit (NS). Use sleeving.

( ) Connect a 3" wire from AFC-2 on the FM tuning unit (S-1) to lug 2 of the AFC switch (S-2).

( ) Connect a 3-1/4" wire from AFC-1 of the FM tuning unit (S-2) to lug 1 of the AFC switch (S-1).

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

( ) Connect one end of a 2-3/4" wire to ANT-1 of the FM tuning unit (S-1). Strip 1/2" of insulation from the other end of this wire and pass the wire through the solder lug at the antenna bushing (S-2) to ANT-1 of the 2-screw terminal strip (S-1).

( ) Connect a 3-1/4" wire from ANT-2 of the 2-screw terminal strip (S-1) to ANT-2 of the FM tuning unit (S-1).

( ) Place a 2" length of sleeving on the plus (+) lead of the 1000 μfd tubular electrolytic capacitor (#25-111). Bend this lead down against the side of the capacitor as shown.

( ) Mount the capacitor to the circuit board by placing the lead from the negative end into the (-) hole of the circuit board. Place the plus (+) lead into the (+) hole of the circuit board. Solder both leads to the circuit board and clip off the excess wire.

TRANSISTOR LOCATION CHART

LOCATION	KIT A	KIT B	KIT C	KIT D
Q7	RED	ORANGE	ORANGE	YELLOW
Q8	BROWN	RED	RED	ORANGE
Q9	VIOLET	BLUE	GREEN	YELLOW
Q10	VIOLET	BLUE	GREEN	YELLOW

( ) Remove 1/4" of insulation from each end of a 9" length of stranded red wire. Twist the separate strands together tightly at each end of the wire. Then apply a small amount of solder to each end to hold the strands together.

( ) Connect one end of this 9" red wire to lug 5 of the Volume control (S-1). The other end will be connected later.

( ) Refer to the Transistor Location Chart and find the column which corresponds to the transistor bag marking (A through D) furnished in your kit. Mark out the other columns. The colors listed in the proper column should correspond to the color dots on the transistors.

NOTE: Pay particularly close attention to transistor installation and correct positioning.

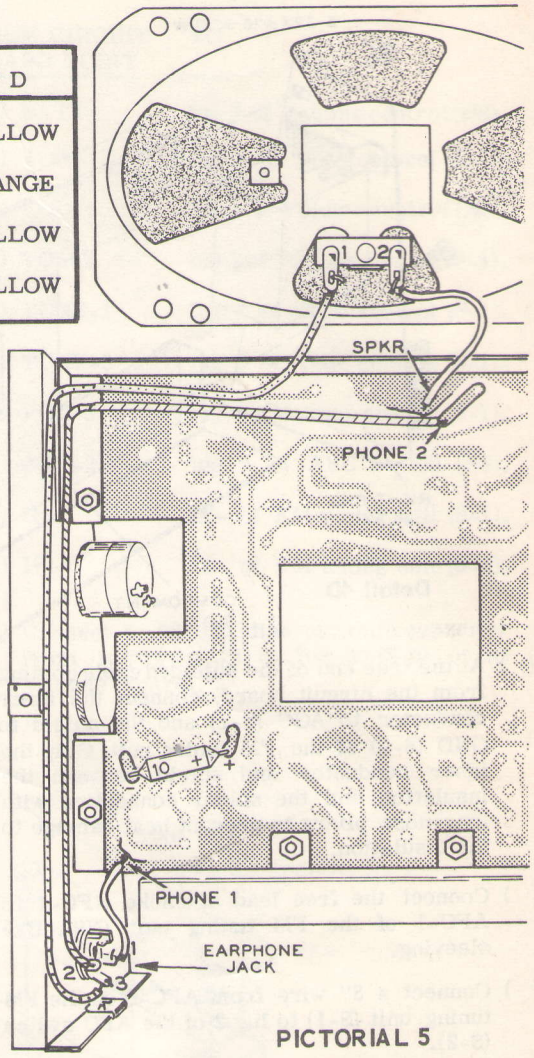
( ) Referring to Detail 4E, cut the leads of the four 2N1274 transistors to 3/16" and install them in the proper sockets, according to the Transistor Location Chart.

( ) Referring to Detail 4F, cut the leads of the three 2N1747 transistors to 3/16" and install them in sockets Q4, Q5, and Q6.

FINAL WIRING

Refer to Pictorial 5 for the following steps.

( ) Cut both leads of the 10 μfd tubular electrolytic capacitor to 1/2". Connect the plus (+) lead to the (+) marked hole and the other lead to the (-) marked hole on the foil side of the circuit board. Solder both connections. Cut off the positive lead on the other side of the board.



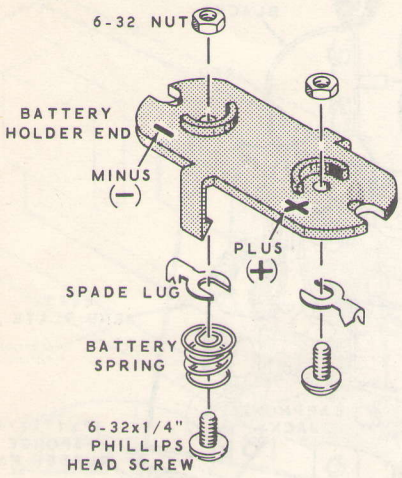
PICTORIAL 5

( ) Connect a 2-1/2" wire from PHONE-1 of the circuit board (S-1) to lug 1 of the earphone jack (S-1).

( ) Connect a 10-1/2" wire from PHONE-2 of the circuit board (S-1) to lug 2 of the earphone jack (S-1).

( ) Locate the speaker and connect a 9" wire from lug 3 of the earphone jack (S-1) to lug 1 of the speaker (S-1).

( ) Connect a 7" wire from SPKR on the circuit board (S-1) to lug 2 of the speaker (S-1).



Detail 6A

Refer to Detail 6A for the following steps.

( ) Locate both battery holder ends, both battery springs, and the battery contactor.

( ) Install a 6-32 x 1/4" phillips head screw, a spade lug, and a 6-32 nut at plus (+) on either battery holder end.

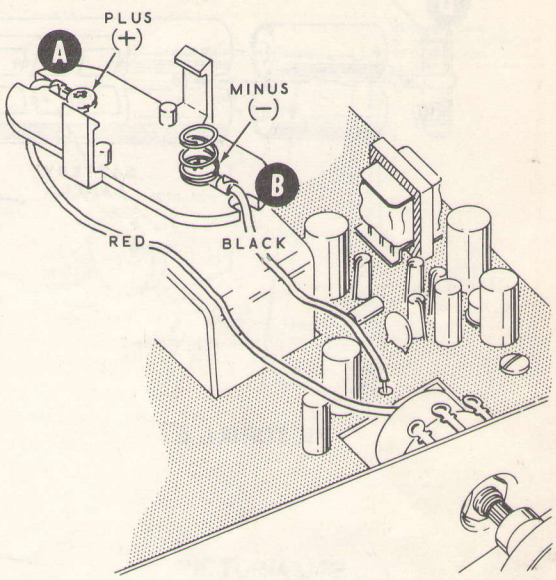
( ) Mount a battery spring in the hole at minus (-). Use a 6-32 x 1/4" phillips head screw, a spade lug, and a 6-32 nut.

Refer to Detail 6B for the following steps.

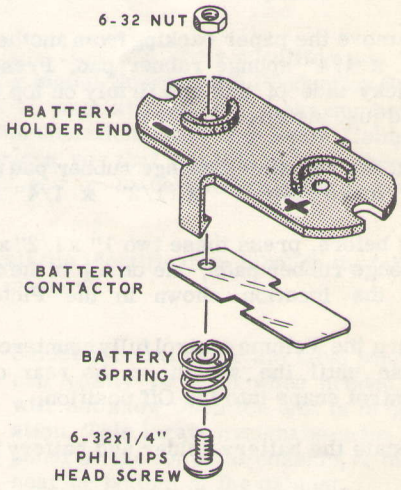
( ) Position the red wire, coming from the Volume control, through slot A to the plus (+) spade lug (S-1). Clip off the excess wire close to the spade lug.

( ) Position the black wire, coming from the circuit board, through slot B to the minus (-) spade lug (S-1). Clip off the excess wire close to the spade lug.

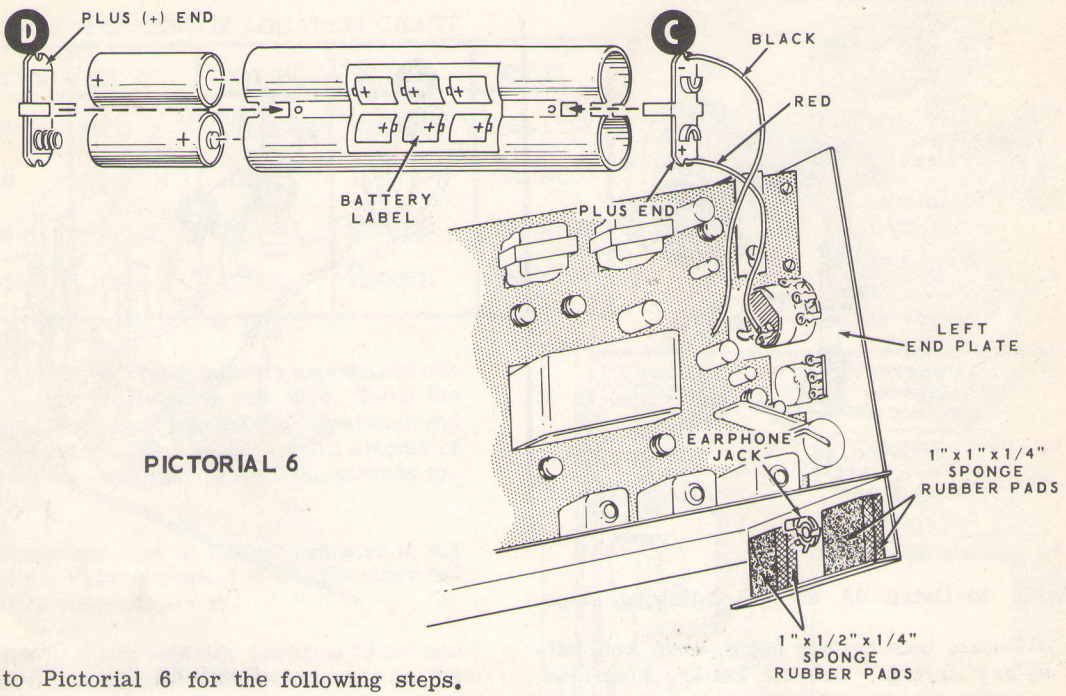
( ) Referring to Detail 6C, mount the battery contactor and spring on the remaining battery holder end. Use a 6-32 x 1/4" phillips head screw, and a 6-32 nut in the hole at minus (-).



Detail 6B



Detail 6C



PICTORIAL 6

Refer to Pictorial 6 for the following steps.

( ) Remove the paper backing from one of the 1" x 1" x 1/4" sponge rubber pads. Press the sticky side of the pad firmly against the left end plate at the location shown in Pictorial 6.

( ) Remove the paper backing from another 1" x 1" x 1/4" sponge rubber pad. Press the sticky side of this pad firmly on top of the pad just installed.

( ) Cut the remaining sponge rubber pad in two, to make two 1" x 1/2" x 1/4" pads.

( ) As before, press these two 1" x 1/2" x 1/4" sponge rubber pads, one on top of the other, at the location shown in the Pictorial.

( ) Turn the Volume control fully counterclockwise until the switch on the rear of the control snaps into the Off position.

( ) Locate the battery holder and battery label.

( ) Remove the paper backing from the battery label. Stick the label on the side of the battery holder as shown.

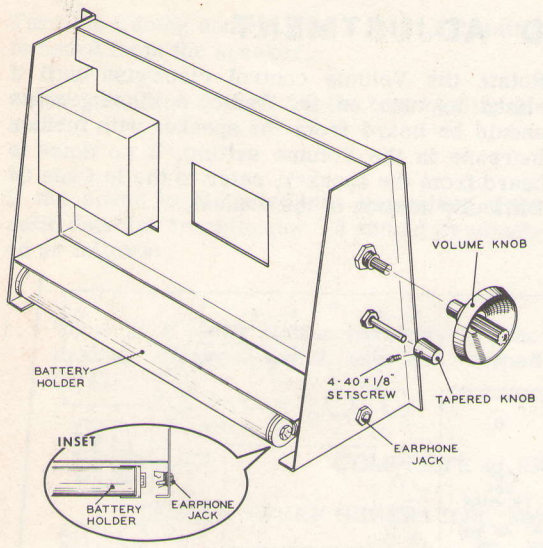
( ) Install the six batteries in the battery holder. Position the positive (+) ends of the batteries as shown on the battery label.

( ) Push battery end D (the one with battery contactor) onto either end of the battery holder until it snaps into place. Position the plus (+) end as shown.

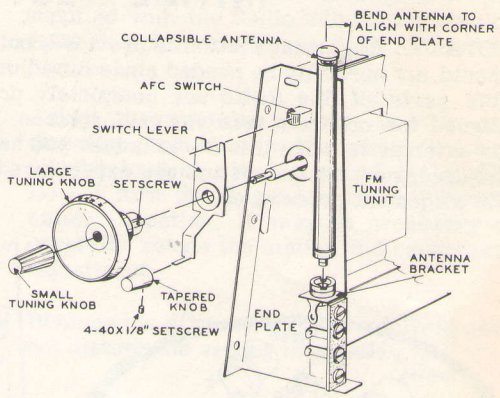
( ) Install battery end C on the battery holder; position the plus (+) end as shown.

( ) Place the battery holder in the battery compartment as it is shown in Pictorial 7A. Be careful not to damage the earphone jack.

This completes the wiring of your Portable FM Radio. Check all wiring for any possible errors, and make sure that all connections are soldered, except the three holes near transistor socket Q8. These holes are provided for an alternate output to a hi-fi system as explained in the Operation section of the manual.



PICTORIAL 7A



PICTORIAL 7B

FINAL ASSEMBLY

Refer to Pictorial 7A for the following steps.

( ) Make sure the Volume control is still fully counterclockwise and push the Volume knob onto the control shaft.

( ) Start a 4-40 x 1/8" setscrew into a small tapered knob. Mount the knob on the Tone control shaft and tighten the setscrew with the allen wrench.

Refer to Pictorial 7B for the following steps.

( ) Slide the switch lever onto the tuning shaft so the notch will engage the AFC switch.

( ) Turn the FM tuning shaft fully counterclockwise. Position the large Tuning knob on the large Tuning shaft so that the dash (-) mark near "88" is straight up, then tighten the setscrew.

( ) Push the small tuning knob onto the small Tuning shaft.

( ) Start a 4-40 x 1/8" setscrew in the tapered knob. Mount the knob on the switch lever and tighten the setscrew.

( ) Install the collapsible antenna and extend it to its full length. To insure proper fit in the case, move the antenna forward (bending the antenna bracket) until the antenna lines up with the corner of the end plate as shown. The antenna should remain parallel to the side of the end plate.

NOTE: The blue and white identification 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 and up-to-date information in return.

( ) Install the identification label in the following manner:

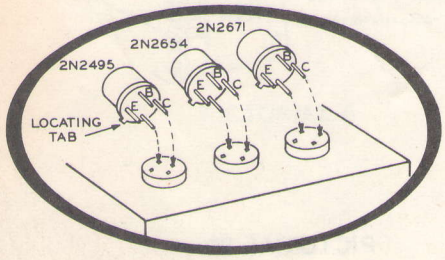
1. Select a location for the label where it can easily be seen when needed, but will not show when the unit is in operation. This location might be on the rear panel or the top of the chassis, or on the rear or bottom of the cabinet.

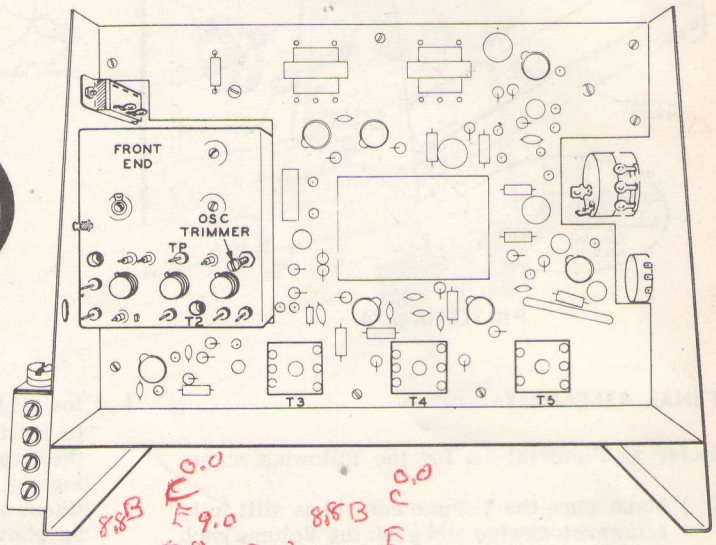
2. Carefully peel away the backing paper. Then press the label into position.

INITIAL TEST AND ADJUSTMENT

NOTE: An Alignment section is provided, but it should not normally be needed since all adjustable parts of this Radio are completely prealigned for optimum receiver performance. Do not attempt to align this Radio unless you have the necessary equipment and are experienced in FM alignment procedures.

Rotate the Volume control clockwise until it clicks to turn on the Radio. A hissing noise should be heard from the speaker with further increase in the Volume setting. If no noise is heard from the speaker, refer to the In Case Of Difficulty section of the manual.





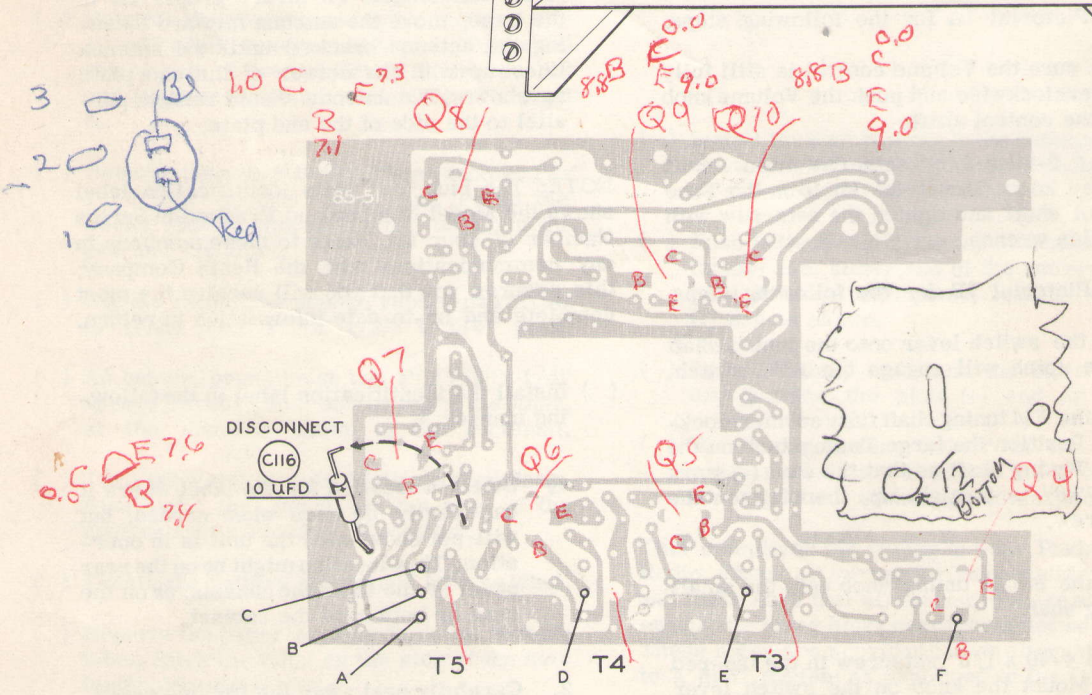


Figure 1

Turn the Tuning control until a local FM station is heard from the speaker.

Adjust the Tone control for the tone quality desired.

If the sound is distorted, the secondary of the ratio detector transformer T5 should be adjusted as follows:

1. Tune in a weak station carefully for the loudest, clearest sound, with AFC turned OFF.
2. Insert the short end of the alignment tool supplied with the Radio into the top slug of ratio detector transformer T5. Refer to Figure 1.
3. Adjust the top slug slowly, first in one direction and then in the other direction for the loudest, clearest sound. CAUTION: Do not turn the slug more than 1/2 turn in either direction. It may be necessary to carefully retune the station and repeat this adjustment.
4. Remove the alignment tool carefully so as to not disturb the setting of the slug.

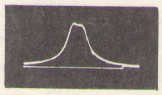
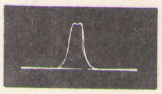
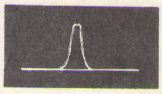
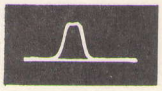
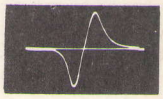
COMPLETE ALIGNMENT PROCEDURE

USING A SWEEP GENERATOR, MARKER GENERATOR, AND OSCILLOSCOPE

Tuning Control - off station position
Volume Control - full counterclockwise (switch on)
AFC Switch - OFF

Make sure the sweep generator output signal is low enough to prevent limiting in the IF stage.

NOTE: Refer to Figure 1 for the location of test and alignment points.

PREPARATION	SWEEP GENERATOR: Connect sweep generator	SWEEP GENERATOR: Sweep generator and marker generator frequency	OSCILLOSCOPE: To be connected	ADJUST: for maximum gain and bandwidth	ADJUST: for approximate response
Disconnect positive (+) lead of C116 from the circuit board.	Through .01 µfd capacitor to point D	10.7 mc	Point C or A	Bottom slug of T5	
	Through .01 µfd capacitor to point E	10.7 mc		Top and bottom slugs of T4	
	Through .01 µfd capacitor to point F	10.7 mc		Top and bottom slugs of T3	
	Through 100 KΩ resistor to TP on front end	10.7 mc	Point C or A	Top and bottom slugs of T2	
	Through 100 KΩ resistor to TP on front end	10.7 mc	Point B	Top slug of T5 for straightest center portion of curve and balanced plus (+) and minus (-) swing.	

CABINET ASSEMBLY

Refer to Detail 8A for the following steps.

( ) Remove the antenna, all the knobs except the one from the switch lever, and remove the switch lever from the Radio.

( ) Mount the speaker on the threaded spacers with 6-32 x 3/8" screws. Position the speaker and its wires as shown.

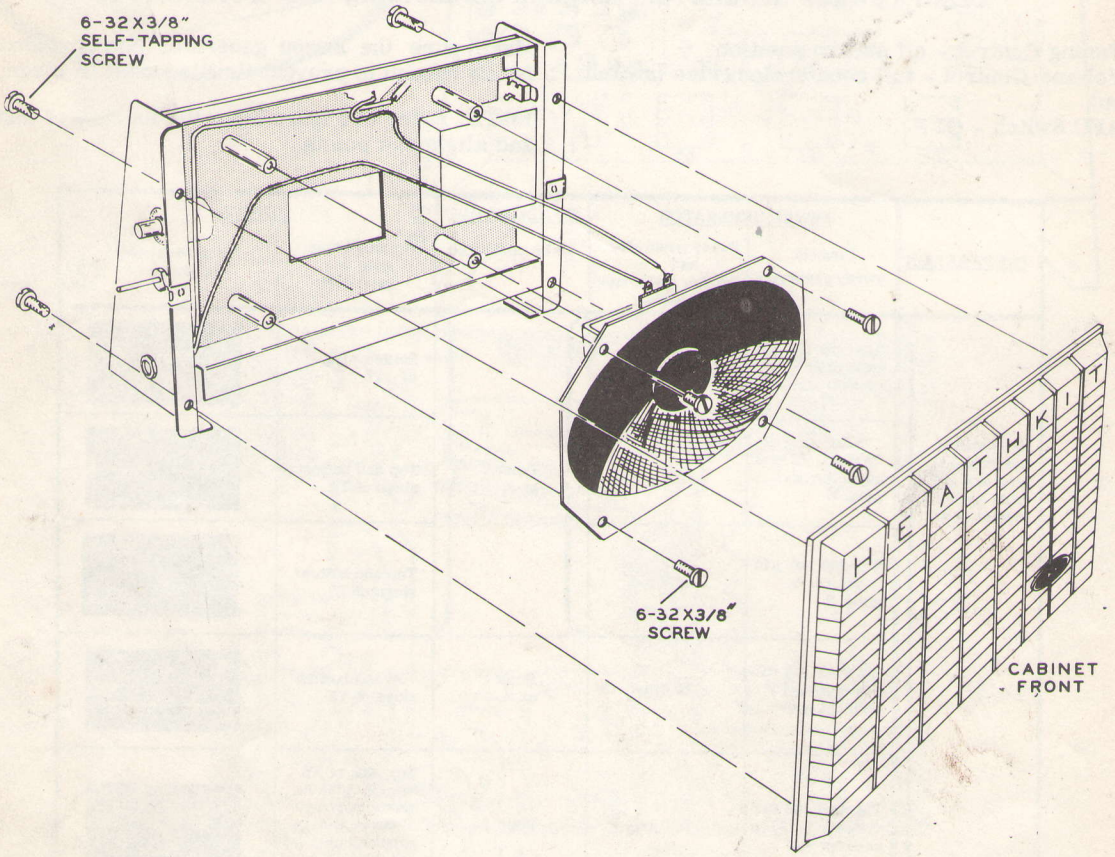
( ) Place a soft cloth under the cabinet front. Mount the end plates to the cabinet front with four 6-32 x 3/8" self-tapping screws.

( ) Loosen the five screws that hold the end plate to the top and bottom circuit board brackets, and push the circuit board down so the speaker is tight against the cabinet front. Tighten the five screws in the end plates.

Refer to Pictorial 8 for the following steps.

( ) Remove the two screws that hold the circuit board to the top threaded spacers.

( ) Carefully position the leather case over the Radio as shown. Be sure all wires are pushed clear of the area covered by the leather case brackets.



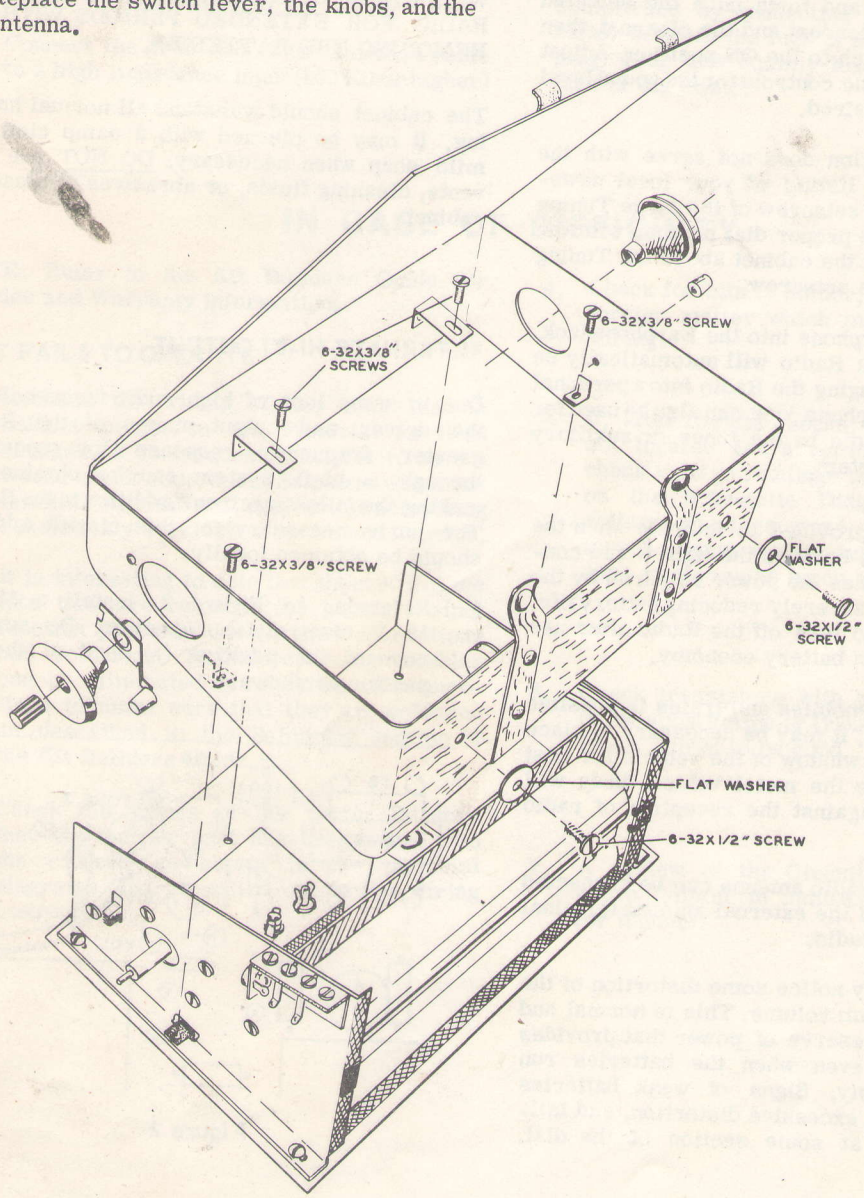
Detail 8A

( ) Install 6-32 x 3/8" screws through the two top brackets, 6-32 x 3/8" screws in the side brackets, and 6-32 x 1/2" screws and flat washers through the bottom holes of the leather case.

( ) Replace the switch lever, the knobs, and the antenna.

( ) Remove the adhesive backing from the nameplate and press it firmly into the oval of the cabinet front.

This completes assembly of your Portable FM Radio.



PICTORIAL 8

OPERATION

Operation of the FM Radio is simple and conventional. Turn on the Radio, move the AFC switch to the OFF position and select the desired station with the large Tuning knob. Rotate the small Tuning knob back and forth until the selected station sounds the loudest and the clearest, then move the AFC switch to the ON position. Adjust the Volume and Tone controls for the sound level and tone quality desired.

If the dial indication does not agree with the station frequency listing of your local newspaper, loosen the setscrew of the large Tuning knob and align the proper dial number with the locating button on the cabinet above the Tuning knob. Retighten the setscrew.

By plugging an earphone into the Earphone jack, the speaker of the Radio will automatically be disconnected, changing the Radio into a personal portable. The Earphone jack can also be used for connecting the Radio to the tuner or auxiliary input of a hi-fi system.

No pilot light is provided to indicate when the Radio is turned on because the light would consume about 10 times the power required by the Radio itself, thus severely reducing battery life. Make it a habit to turn off the Radio after use to obtain maximum battery economy.

Reception in automobiles and trains is possible in most locations. It may be necessary to place the Radio near a window of the vehicle for best reception because the metal vehicle body will act as a shield against the reception of radio signals.

The automobile radio antenna can be connected to either screw of the external antenna terminal strip of the FM Radio.

You will probably notice some distortion of the sound at maximum volume. This is normal and represents the reserve of power that provides good reception even when the batteries run down considerably. Signs of weak batteries are low volume, excessive distortion, and failure to operate at some section of the dial.

ALWAYS REMOVE EXHAUSTED BATTERIES IMMEDIATELY. THE OLD BATTERIES MAY SWELL AND MAKE REMOVAL DIFFICULT, OR MAY LEAK CHEMICAL COMPOUNDS THAT WILL CAUSE CORROSION. DO NOT STORE THE RADIO FOR EXTENDED PERIODS WITHOUT REMOVING THE BATTERIES.

The cabinet should withstand all normal handling. It may be cleaned with a damp cloth and mild soap when necessary. DO NOT use solvents, cleaning fluids, or abrasives to clean the cabinet.

ALTERNATE HI-FI OUTPUT

Due to some loss of high audio frequencies in the driver and output stages of the Radio, greater frequency response for operation through a hi-fi system can be obtained by making the following circuit addition to the Radio. The parts necessary for this circuit addition should be obtained locally.

( ) Referring to Figure 2, install a 10 μfd 10 V electrolytic capacitor. Be sure to connect the positive (+) lead of the capacitor as shown.

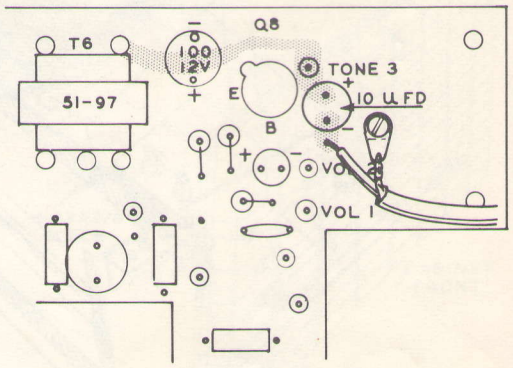


Figure 2

( ) Add a #6 solder lug under the cabinet mounting screw.

( ) Prepare the desired length of shielded cable and solder the inner conductor in the indicated hole of the circuit board. Solder the shield to the solder lug.

( ) Connect the free end of the shielded cable to a high impedance input (100 KΩ or higher) of your hi-fi system.

NOTE: It will be necessary to make up a "dummy load" to protect the output transformer, and to disconnect the speaker of the Radio when it is connected to a hi-fi system. This can be accomplished by connecting a 4 Ω 1/2 watt resistor between the lugs of a miniature earphone plug. Plug this dummy load into the Earphone jack of the Radio.

IN CASE OF DIFFICULTY

NOTE: Refer to the Kit Builders Guide for Service and Warranty information.

UNIT FAILS TO OPERATE

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

2. It is interesting to note that about 90% of the kits that are returned 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 that they are soldered as described in the Soldering section of the Kit Builders Guide.

3. Check the values of the parts. Be sure that the proper part has been wired into the circuit, 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. NOTE: All voltage readings were taken with an 11 megohm input vacuum tube voltmeter. Voltages may vary as much as 10%.

6. Check transistors with a transistor tester or by substitution of transistors of the same types, known to be good.

7. A review of the Circuit Description will prove helpful in indicating where to look for trouble.

TROUBLESHOOTING CHART

CONDITIONS	POSSIBLE CAUSE
Radio completely dead.	1. Faulty batteries. 2. Off-On switch inoperative. 3. Transistors installed wrong. 4. Faulty transistors Q7, Q8, Q9, Q10. 5. Open winding in T3, T4, T5.
Hiss in speaker, but no stations received.	1. Faulty transistor Q1, Q2, Q3. 2. Improper alignment. 3. Open winding in T3, T4, T5. 4. Faulty diode D2. 5. Open capacitors C119, C120.
Radio "motorboats" (pulsating sound output).	1. Open capacitors C125, C126.
Output distorted.	1. Batteries weak. 2. Faulty transformer T5. 3. Improper alignment. 4. Volume turned up too high. 5. Electrolytic capacitor polarity reversed. 6. Faulty transistor Q9 or Q10.

If after making the above checks, the Radio does not perform properly, the simple point-to-point test described below can be used to locate the stage not functioning.

With the speaker removed from the chassis, turn the Radio on and turn the Volume control to the full clockwise position.

Touch the collector lead of transistor Q8 on the component side of the circuit board with the metal blade of a screwdriver. You must touch the blade of the screwdriver with your finger. (There is no shock hazard in the Radio because of the low battery voltage.)

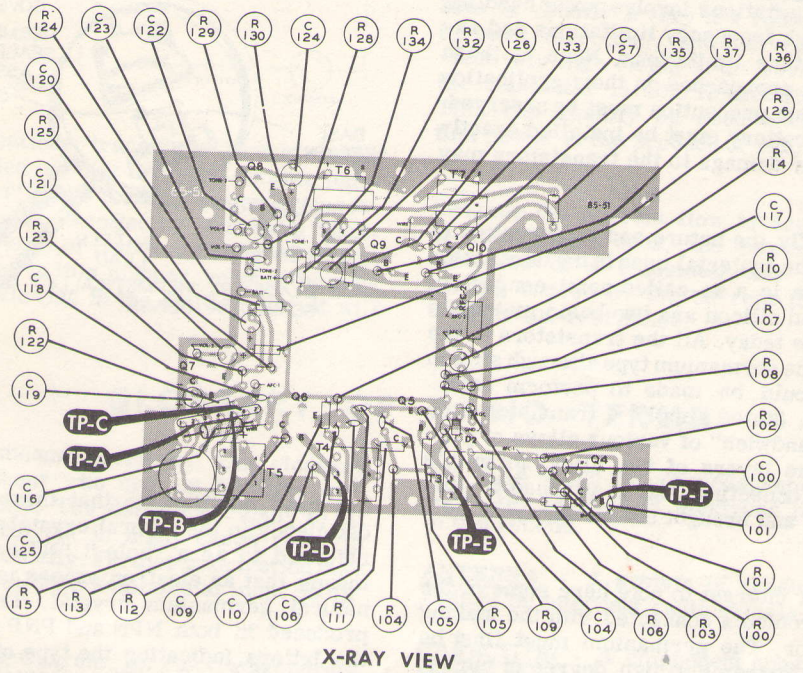
A weak click should be heard. If not, it would indicate that transistor Q9 or Q10 or a component in one or both of these stages is faulty.

If everything checks out to this point, you can then check the base of Q7, collector of Q6, Q5, Q4, and the antenna connection.

With a click at the collector but not at the base of any one transistor (except Q7, at the base), more than likely the transistor is faulty. However, if a click is present at the base of one transistor but not present at the collector (emitter of Q7) of the next one, as you move forward in the circuit toward the antenna, you should suspect that a component between the two transistors is faulty. The gain in stages Q9 and Q10 being so small makes it almost impossible to hear any click when touching either their base or collector leads.

After locating the stage that does not function properly, carefully check all components to see that they are in the proper location, check solder connections, and replace transistors if necessary.

This X-Ray view of the circuit board is provided to aid in troubleshooting.



X-RAY VIEW
(RESISTORS)
(CAPACITORS)

INTRODUCTION TO TRANSISTORS

Transistors have been one of the most important developments in the field of electronics. Although they have been available commercially for only a few years, they have already found application in every branch of the art. They can assume the duties of vacuum tubes in many applications, and they are employed in such a capacity in this Radio.

Transistors possess many advantages over tubes. Probably the one most apparent is their extremely small size, making possible the miniaturization of equipment in which they are used. Other advantages also make the use of transistors desirable as will be explained in the following paragraph.

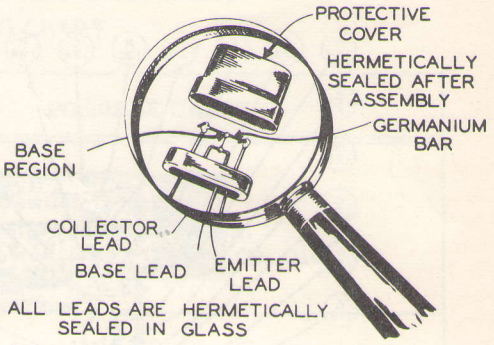
Because of their small size, transistors possess very little mass or inertia. As a result they are not subject to the shock, vibration and microphonic faults of tubes. Transistors do not contain a heater or filament, require no warmup and consume no power which contributes nothing to useful audio output. Because no heat is generated within the cabinet, longer life can be expected from other components subject to deterioration from heat. Transistors operate on very low potential or voltage, measured in volts rather than tens or hundreds of volts as with tubes. This makes battery operation very feasible and eliminates completely the shock hazard found in most tube equipment. Transistors have an extremely long life expectancy. The average life of transistors has not yet been definitely established simply due to lack of time to arrive at representative figures. Transistors have been in continuous operation for years without failure. Most failures are caused by improper use rather than by deficiencies in the basic design.

As with any good thing, there are also limitations to the capabilities of transistors. Primarily, these limitations involve power handling capabilities, high frequency limitations and extreme temperature limitations. None of these limitations are approached in their application in this Radio. One precaution must be observed, however. The battery must be installed exactly as instructed or damage to the transistors may result.

Consider briefly the nature and construction of transistors. The material used in the fabrication of a transistor is a so-called semi-conductor. Germanium and silicon are two basic materials in common use today. All the transistors in the Radio are of the germanium type although silicon transistors could be made to perform satisfactorily also. Stated simply, a transistor consists of a "sandwich" of various alloys of germanium. Three layers of the alloys form this sandwich. A connecting lead is attached to each of the layers and brought out for external connections.

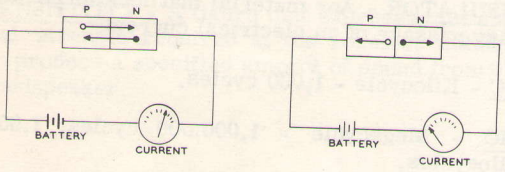
It might be of interest to note here some of the production problems connected with the making of a transistor. The germanium must first be refined to an extremely high degree of purity. The rigid requirements would compare to allowing no more than one kernel of corn in several carloads of wheat. The pure germanium is then "doped" with precisely controlled amounts of other elements to obtain the proper alloy necessary for transistor action. More will be said about the doping process later. The center layer or "meat" of the sandwich may be only 1/1000 inch thick. This layer must be precisely located, and a wire attached. The entire process must be performed under "operating-room" clean conditions. Any contamination of the transistor may be cause for failure. The assembly is then hermetically sealed in a protective case, often with an inert compound to assist in conducting heat away from the assembly. The drawing shows a typical transistor assembly.

As mentioned before, the germanium must be doped to obtain the characteristics needed for transistor action. Different materials are used to produce a "P" or an "N" type germanium. "P" type germanium means that the pure metal



has been modified so that there is an electron deficiency in the natural crystal structure, often referred to as a "hole." "N" type germanium means that an electron excess is created in the natural germanium crystal. Transistors are produced in both NPN and PNP configurations, the letters indicating the type of germanium in each of the layers. The schematic representation for the transistor identifies the type as shown in the two diagrams.

The middle layer of the sandwich is called the base. One outside layer is called the emitter and the other one the collector. The junctions formed between the emitter and base and between the collector and base have a characteristic similar to that of a diode rectifier, in that the junction will conduct current much more readily in one direction than the other. When voltage is applied across a junction, with a positive voltage applied to the "P" type region and negative voltage to the "N" type region, a current consisting of two components will flow. Electrons will flow from the "N" region across the junction to the "P" region and holes will flow or migrate from the "P" region across the junction to the "N" region. If the polarity of the applied voltage is reversed, the electrons and holes move away from the junction and for practical purposes, no current will flow. The drawings illustrate this effect.



In most applications, transistors have operating voltages applied so that the base-emitter junction is "biased" in the forward or conducting direction and the base-collector junction is "biased" in the reverse or non-conducting direction. When connected in this manner, most of the current carriers flowing in the emitter circuit will diffuse across the base region and appear as a current in the collector circuit. Since the emitter bias is usually a very low voltage (being in the forward direction), and the collector bias is relatively high (being in the reverse direction), the transistor is able to produce a power gain. This can readily be seen when you consider that power is the product of voltage and current.

Because the current flow is across a junction of very small area, the power handling capabilities of a transistor are limited due to heating caused by the current flowing through the junction resistance.

GLOSSARY OF RADIO TERMS

While by no means complete, this glossary should assist those who are not familiar with radio terminology. The definitions apply to all radios in general but in many cases refer to this Radio specifically. Further information may be obtained from texts available at most public libraries.

AC - Alternating Current. An electrical current that reverses its direction of flow at regular intervals. House current makes 120 reversals every second. Two reversals are necessary to complete one cycle, hence 60 cycles. Much higher frequencies appear in radio circuitry, up to many millions of cycles per second.

AF - Audio Frequency. Those frequencies that fall within the range of the human ear, approximately 20 to 20,000 cycles per second. Remember that the ear can only hear mechanical vibrations in the air, not electrical currents.

AGC - Automatic Gain Control. Circuitry employed in a receiver to adjust the gain in opposite proportion to the strength of the received signal. Used to reduce the effects of fading signals, or "blasting" when tuning from a weak to a strong signal.

AMPLIFIER - A circuit designed to increase the strength or amplitude of weak signals. Ideally the output signal is an exact magnified reproduction of the input signal.

AMPERE - The unit of measurement of current flow. The number of electrons passing a point in one second.

ANTENNA - A system of conductors used to radiate or intercept radio signals.

CAPACITOR - A component consisting of conducting plates separated by an insulating material. Various materials and construction are used in the capacitors in the radio. Deposited silver plates on ceramic for the disc capacitors, aluminum foil plates separated by a chemical oxide for the electrolytic capacitors and sheet aluminum separated by air for the variable tuning capacitor. Capacitors are used to pass AC while blocking DC and also to tune or "resonate" electrical circuits to a desired frequency.

COIL - A component consisting of wire or some other conductor wound in turns on a suitable form. The number of turns and the size, shape, and material used for the form are determined by the application. Coils are often used with capacitors to form "tuned" circuits.

CONDUCTOR - Any material that permits easy passage of an electrical current.

CONVERTER or MIXER - Circuitry designed to combine the signal from the radio station with an oscillator signal to produce a new signal at a different frequency. See heterodyne.

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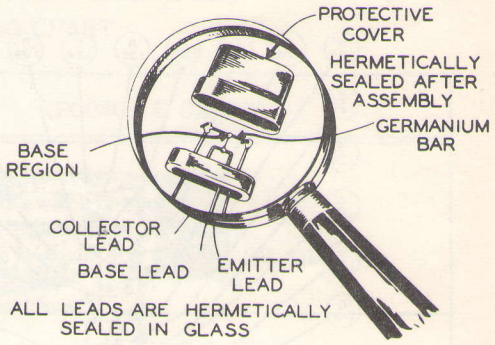

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CURRENT - Generally the movement of electrons through a conductor. In vacuum tubes electron flow occurs in the vacuum. Movement of "holes" can constitute current flow in transistors.

DC - Direct Current. An electrical current that flows in one direction only.

RATIO DETECTOR - A circuit used to extract the intelligence or desired information from a FM radio signal. In the Radio this intelligence consists of the speech or music transmitted by the radio station.

DIODE - A two element or two terminal device capable of passing an electrical current in one direction only. Used in the ratio detector circuit in the Radio.

FREQUENCY - Repetition rate of an alternating current or of the vibration of the loudspeaker cone. Measured in cycles per second.

GROUND - An electrical connection to the earth. Also the reference point for signals and operating voltages in electronic equipment, usually the chassis.

HETERODYNE - The result of combining signals of different frequencies in order to obtain a signal of new frequency. Either the sum or the difference frequency of the two is generally the desired resulting frequency. Also known as "beat."

IF - Intermediate Frequency. The heterodyne or beat frequency produced by the mixer. Most of the amplification and selectivity of the radio signals is accomplished at this frequency. An IF of 10.7 mc is employed by this Radio.

INDUCTANCE - The property of a coil to oppose any change in the magnitude of an electrical current flowing in it.

INSULATOR - Any material that does not permit easy passage of an electrical current.

KC - Kilocycle - 1,000 cycles.

MC - Megacycle - 1,000,000 cycles, 1,000 kilocycles.

MEGOHM - 1,000,000 ohms.

MICROFARAD - A unit of capacity. Refers to the electrical "size" of a capacitor, one millionth of a farad.

OHM (Ω) - The unit of electrical resistance.

OSCILLATOR - Circuitry designed to generate AC at some desired frequency when operated from a DC source. Usually some circuit element or elements are adjustable so that a desired frequency may be obtained.

RF - Radio Frequency. Those frequencies employed for transmission of radio signals, from 10 kilocycles to 100,000 megacycles.

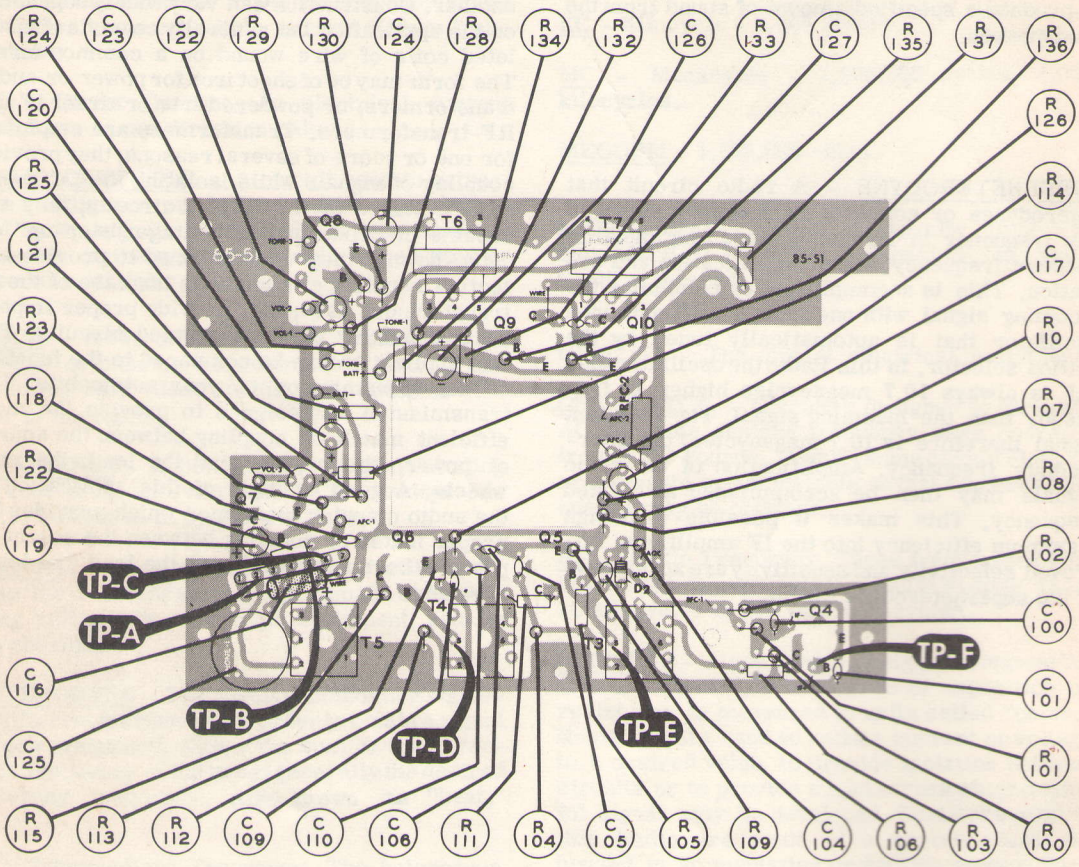
RESISTOR - A component designed to oppose the flow of current. The degree of opposition or resistance is measured in units called "ohms." Resistors are used to reduce current or voltage to a desired value, to provide isolation between circuits or to provide a load across which a useful signal may be developed. Resistors used in this Radio are made of a carbon compound housed in an insulating protective sleeve. Wire leads sealed in each end provide electrical connection to the resistance material.

SELECTIVITY - The ability of a receiver to separate radio stations operating on adjacent channels. In the FM broadcast band these channels are assigned at 200 kilocycle intervals, that is 89 mc, 89.2 mc, 89.4 mc, etc.

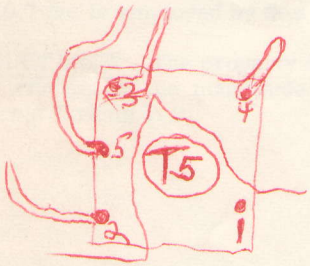
SENSITIVITY - A figure that expresses the signal strength required at the receiver antenna to produce a specified amount of sound from the loudspeaker.

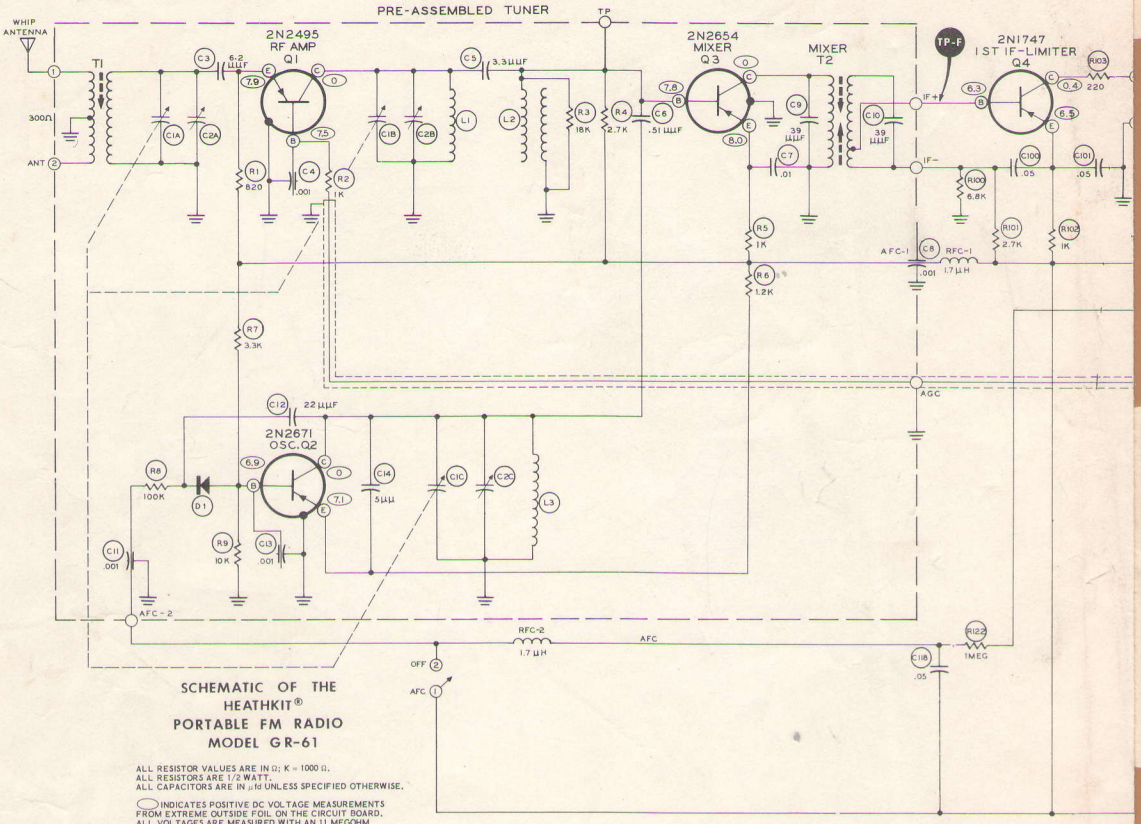
SUPERHETERODYNE - A radio circuit that heterodynes or converts an incoming signal of any frequency in its tuning range to a signal of constant frequency before amplification and detection. This is accomplished by combining the incoming signal with one from a self-contained oscillator that is automatically tuned by the station selector. In this Radio the oscillator signal is always 10.7 megacycles higher in frequency than the incoming signal. The resultant signal therefore is 10.7 megacycles, the intermediate frequency. Amplification of the radio signals may then be accomplished at a fixed frequency. This makes it possible to design maximum efficiency into the IF amplifiers. Improved selectivity and sensitivity are advantages of the superheterodyne circuit.

TRANSFORMER - A component designed to couple AC signals or energy from one circuit to another. Construction can vary widely depending on the application but generally consists of insulated coils of wire wound on a common form. The form may be of sheet iron for power or audio transformers, or powdered iron or air for IF and RF transformers. Transformers are employed for one or more of several reasons; they provide coupling of signals while isolating the DC operating voltages of the coupled circuits; they are capable of producing AC voltage "step-up" or "step-down;" they may be tuned to provide selective coupling of signals as the case of the IF transformers used, they provide proper impedance matching between coupled circuits. The last application can be compared to the function of the transmission of your automobile. The transmission is designed to provide the most efficient match or coupling between the source of power, the engine, and the load, the rear wheels. A good example of this application is the audio output transformer which provides the proper match or coupling between the source of power (the transistors) and the load (the loudspeaker).



X-RAY VIEW
(RESISTORS)
(CAPACITORS)



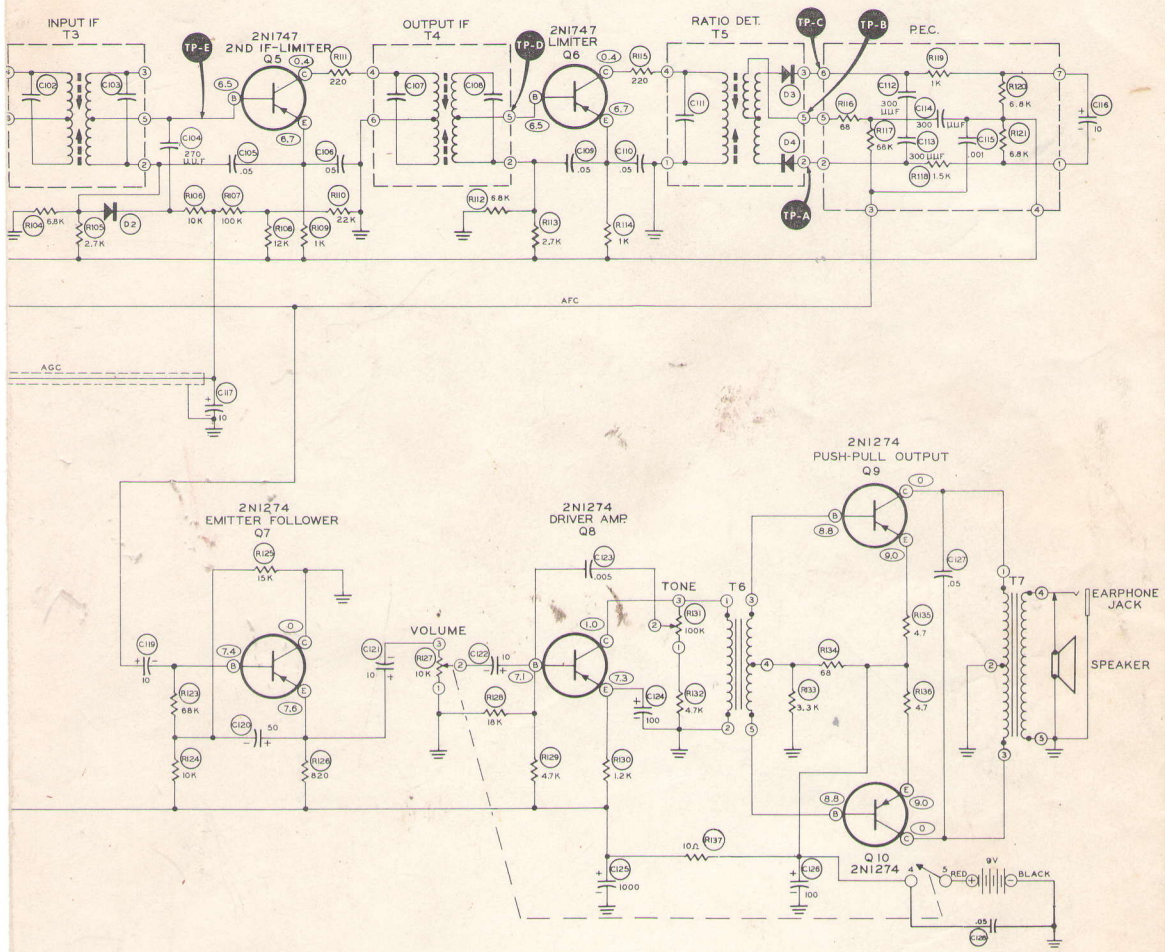


SCHEMATIC OF THE HEATHKIT® PORTABLE FM RADIO MODEL GR-61

ALL RESISTOR VALUES ARE IN Ω; K = 1000 Ω.
ALL RESISTORS ARE 1/2 WATT.
ALL CAPACITORS ARE IN µfd UNLESS SPECIFIED OTHERWISE.

( ) INDICATES POSITIVE DC VOLTAGE MEASUREMENTS FROM EXTREME OUTSIDE FOIL ON THE CIRCUIT BOARD. ALL VOLTAGES ARE MEASURED WITH AN 11 MEGOHM IMPEDANCE VTVM, WITH NO SIGNAL.

R AND C NUMBERS
1 TO 99 FM FRONT END PARTS.
100 TO 200 CIRCUIT BOARD AND CHASSIS PARTS.


INPUT IF
T3
2N1747
2ND IF-LIMITER
Q5
OUTPUT IF
T4
2N1747
LIMITER
Q6
RATIO DET.
T5
P.E.C.
TP-E
TP-D
TP-C
TP-B
TP-A
AFC
AGC
2N1274
EMITTER FOLLOWER
Q7
2N1274
DRIVER AMP.
Q8
2N1274
PUSH-PULL OUTPUT
Q9
Q10
2N1274
VOLUME
TONE
T6
T7
EARPHONE
JACK
SPEAKER
9V
RED
BLACK

HEATH COMPANY

BENTON HARBOR, MICHIGAN

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