

HEATHKIT[®] MANUAL

for the

SSB/CW RECEIVER
Model HR-1680

595-1830-08



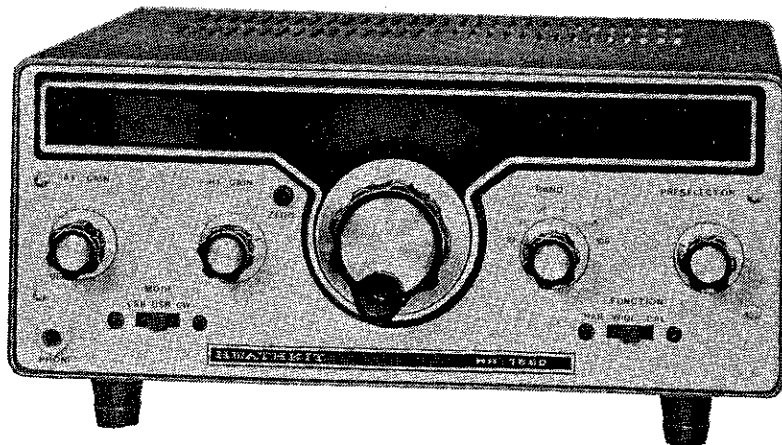
HEATH COMPANY • BENTON HARBOR, MICHIGAN

Heathkit® Manual

for the

SSB/CW RECEIVER Model HR-1680

595-1830-08



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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TABLE OF CONTENTS

UNPACKING	3	OPERATION	81
PARTS LISTS	4	Typical Operating Characteristics	82
VFO Circuit Board	5	IN CASE OF DIFFICULTY	
HFO/XTAL Calibrator Circuit Board	6	Visual Checks	83
Front End Circuit Board	8	Precautions for Troubleshooting	84
AUD/REG Circuit Board	9	Checking Transistors and Diodes	84
Chassis	12	Troubleshooting Charts	85
ASSEMBLY NOTES	14	SPECIFICATIONS	88
CIRCUIT BOARD ASSEMBLY	16	CIRCUIT DESCRIPTION	
VFO Circuit Board	17	Front End Circuit Board	90
HFO/XTAL Calibrator Circuit Board	22	AUD/REG Circuit Board	91
Front End Circuit Board	27	VFO Circuit Board	92
AUD/REG Circuit Board	33	HFO/XTAL Calibrator Circuit Board	93
CHASSIS ASSEMBLY	42	Other Circuits	93
INITIAL TESTS		CIRCUIT BOARD X-RAY VIEWS	94
Resistance Checks	66	IDENTIFICATION CHARTS	
Voltage Checks	69	Diodes	98
Sound Check	70	Transistors	99
ALIGNMENT	71	Integrated Circuits	100
CABINET ASSEMBLY	78	SCHEMATIC	Fold-in
INSTALLATION	79	WARRANTY	Inside front cover
		CUSTOMER SERVICE	Inside rear cover

UNPACKING

The Receiver shipping carton contains individual packs marked Pack #1, Pack #2, Pack #3, and Pack #4 (2 bags). After you remove all of these packs, the remaining packs and loose parts in the shipping carton form Parts Pack #5, which contains items too large to fit into the other parts packs, parts used for several circuit boards, and those items which you will use in the chassis assembly section.

This Manual contains a separate Parts List for each assembly section. At the beginning of each Parts List, you will be instructed which parts pack to open. You will also be directed to remove certain required parts from Pack #5.

To avoid intermixing parts, do not remove or open any of the parts packs until you are directed to do so at the beginning of one of the Parts Lists.

PARTS LISTS

The following pages contain several Parts Lists, one for each major section of this kit (Front End Circuit Board, Chassis, etc.). Check the parts and assemble this kit in the following manner:

1. Open the pack as directed in the step at the beginning of the Parts List.
2. Check the parts against the list.
3. Proceed to the assembly section, as directed at the end of the list.
4. After you complete the assembly section, return, as directed, to the next Parts List.
5. Repeat the process for each Parts List and assembly section.

Remove the Parts Pictorial from the "Illustration Booklet" and place it in a convenient location where you can refer to it during the assembly of this kit. Many parts in the Parts List are keyed to the Parts Pictorial for identification. Other parts not shown on the Parts Pictorial have the part numbers stamped on them.

After you identify any part that is packed in an individual envelope with the part number on it, place the part back in its envelope until that part is called for in a step. Some envelopes have a transparent side so you can identify the parts inside without opening the envelope. Do not throw away any packing materials until all the parts are accounted for.

Each circuit part in this kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

- In the Parts List,
- At the beginning of each step where a component is installed,
- In some illustrations,
- In the Schematic,
- In the sections at the rear of the Manual.

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 this Manual. For price information, refer to the separate "Heath Parts Price List."

VFO CIRCUIT BOARD

Remove the pack marked #1 and check each part against the following list.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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RESISTORS, 1/2-watt

NOTES:

- Resistors may be packed in more than one envelope. Open all of the resistor envelopes in this pack before you check them against the following list.
- The following resistors have a tolerance of 5% unless otherwise noted. 5% is indicated by a gold fourth band.

A2	6-470	2	47 Ω (yellow-violet-black)	R302, R314
A2	6-101	2	100 Ω (brown-black-brown)	R311, R316
A2	6-121	1	120 Ω (brown-red-brown)	R303
A2	6-621	1	620 Ω (blue-red-brown)	R304
A2	6-681	1	680 Ω (blue-gray-brown)	R315
A2	6-392	2	3900 Ω (orange-white-red)	R309, R313
A2	6-472	1	4700 Ω (yellow-violet-red)	R308
A2	6-223	2	22 k Ω (red-red-orange)	R305, R312
A2	6-224	1	220 k Ω (red-red-yellow)	R307
A2	6-105	1	1 M Ω (brown-black-green)	R301

CAPACITORS

Disc

B2	21-168	2	4.7 pF	C307, C308
B2	21-3	1	10 pF	C305
B2	21-190	2	50 pF	C301, C303
B2	21-56	1	470 pF	C311
B2	21-191	3	510 pF	C302, C304, C306
B2	21-176	3	.01 μ F	C309, C312, C313

Mica

B1	20-108	1	200 pF	C317
B1	20-112	1	310 pF	C318
B1	20-139	1	330 pF	C314
B1	20-116	1	400 pF	C316
B1	20-107	1	680 pF	C315

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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INDUCTORS

C1	40-1684	3	3.75 μ H toroid	L302, L303, L304
C1	40-1800	1	1.3 μ H toroid	L305
C2	40-1859	1	Variable inductor	L301
C3	45-82	1	350 μ H choke	RFC301

DIODES

D1	56-89	1	GD510	D302
D1	56-19	1	VR-9.1	ZD301
D1	56-24	1	1N458	D301

TRANSISTORS

NOTE: Transistors may be marked for identification in any of the following four ways:

- Part number.
- Type number.
- Part number and type number.
- Part number with a type number other than the one listed.

E1	417-169	2	MPF105	Q301, Q302
E3	417-801	1	MPSA20	Q304
E1	417-234	1	2N3638A	Q303

MISCELLANEOUS

R1	10-311	1	5 k Ω control	R306
H1	432-121	4	PCB pin	
H2	432-123	6	Circuit board connector	
R2	215-63	1	Heat sink	
R3	206-502	1	Coil shield	
Solder				



KEY HEATH QTY. DESCRIPTION
No. Part No. _____
CIRCUIT
Comp. No.

PARTS FROM PACK #5 (parts in the shipping carton)

NOTE: Remove the wire bundle. Cut off lengths when you are directed to do so by the assembly steps in the various sections of this Manual.

Wire bundle consists of:

340-1	7-1/2'	Large bare wire
340-2	3'	Small bare wire
343-15	1'	Shielded cable
344-52	4-1/2'	Red wire
344-58	8'	Gray wire
346-1	1-1/2'	Sleeving

KEY HEATH QTY. DESCRIPTION
No. Part No. _____
CIRCUIT
Comp. No.

Parts From Pack #5 (parts in the shipping carton) cont'd.

85-1731-2	1	VFO circuit board
390-1045	1	Terminal identification label
391-34	1	Blue and white label
597-260	1	Parts Order Form
	1	Assembly Manual (See front cover for part number.)
	1	Illustration Booklet

Proceed to "Assembly Notes" on Page 14.

HFO/XTAL CALIBRATOR CIRCUIT BOARD

Remove the pack marked #2 and check each part against the following list.

KEY HEATH QTY. DESCRIPTION
No. Part No. _____
CIRCUIT
Comp. No.

RESISTORS, 1/2-Watt

NOTES:

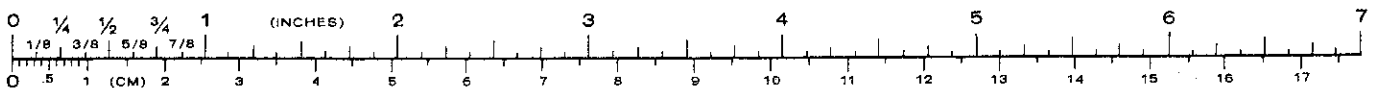
- Resistors may be packed in more than one envelope. Open all of the resistor envelopes in this pack before you check them against the following list.
- The following resistors have a tolerance of 5% unless otherwise noted. 5% is indicated by a gold fourth band.

A2	6-470	1	47 Ω (yellow-violet-black)	R421
A2	6-151	1	150 Ω (brown-green-brown)	R418
A2	6-221	2	220 Ω (red-red-brown)	R414, R427
A2	6-271	1	270 Ω (red-violet-brown)	R417

KEY HEATH QTY. DESCRIPTION
No. Part No. _____
CIRCUIT
Comp. No.

Resistors (cont'd.)

A2	6-102	8	1000 Ω (brown-black-red)	R402, R404, R406, R408, R411, R413, R424, R426
A2	6-222	1	2200 Ω (red-red-red)	R419
A2	6-562	1	5600 Ω (green-blue-red)	R422
A2	6-153	6	15 kΩ (brown-green-orange)	R401, R403, R405, R407, R409, R412
A2	6-223	1	22 kΩ (red-red-orange)	R416
A2	6-473	2	47 kΩ (yellow-violet-orange)	R415, R425
A2	6-224	1	220 kΩ (red-red-yellow)	R423



KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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CAPACITORS
Disc

B2	21-33	1	3.3 pF	C419
B2	21-157	2	5 pF	C403, C409
B2	21-181	2	7.7 pF	C402, C406
B2	21-3	2	10 pF	C404, C424
B2	21-7	1	33 pF	C427
B2	21-22	2	220 pF	C413, C416
B2	21-176	7	.01 μ F	C401, C405, C407, C411, C414, C417, C422
B2	21-95	3	.1 μ F	C421, C423, C426

Mica

B1	20-77	1	24 pF	C408
B1	20-101	1	47 pF	C412
B1	20-102	2	100 pF	C415, C418

INDUCTORS

C4	40-687	5	0.5 μ H coil (green dot)	L401, L402, L403, L404, L405
C4	40-1047	1	1.42 μ H coil (gray dot)	L406
C5	45-73	1	2.2 μ H choke	L407

DIODES-TRANSISTORS

D1	56-26	1	1N191 (brown-white-brown)	D415
D1	56-24	12	1N458	D401, D402, D403, D404, D405, D406, D408, D409, D411, D412, D413, D414
D1	56-16	1	1N751	ZD401

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Diodes-Transistors (cont'd.)

NOTE: Transistors may be marked for identification in any of the following four ways:

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one listed.

E3	417-801	2	MPSA20	Q403, Q404
E3	417-293	2	2N5770	Q401, Q402

CRYSTALS

G2	404-43	1	100 kHz	Y407
G1	404-207	1	12.395 MHz	Y406
G1	404-208	1	15.895 MHz	Y405
G1	404-209	1	22.895 MHz	Y404
G1	404-210	1	29.895 MHz	Y403
G1	404-211	1	36.895 MHz	Y402
G1	404-212	1	37.395 MHz	Y401

MISCELLANEOUS

R4	31-52	1	8-60 pF trimmer	C425
H1	432-121	1	PCB pin	
H3	432-124	12	Circuit board connector	
R5	475-10	1	Ferrite bead	
N2	250-56	2	6-32 x 1/4" screw	
N15	254-1	2	#6 lockwasher	
N18	255-142	2	6-32 x 5/8" spacer	

PART FROM PACK #5

85-1954-1	1	HFO/XTAL calibrator circuit board
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Proceed to "HFO/XTAL Calibrator Circuit Board" assembly on Page 22.

FRONT END CIRCUIT BOARD

Remove the pack marked #3 and check each part against the following list.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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RESISTORS, 1/2-Watt

NOTES:

- Resistors may be packed in more than one envelope. Open all of the resistor envelopes in this pack before you check them against the following list.
- The following resistors have a tolerance of 5% unless otherwise noted. 5% is indicated by a gold fourth band.

A2	6-470	9	47 Ω (yellow-violet-black)	R102, R103, R104, R105, R114, R116, R117, R118, R119
A2	6-101	4	100 Ω (brown-black-brown)	R123, R16, R129, R133
A2	6-221	2	220 Ω (red-red-brown)	R125, R131
A2	6-271	1	270 Ω (red-violet-brown)	R108
A2	6-821	1	820 Ω (gray-red-brown)	R109
A2	6-102	2	1000 Ω (brown-black-red)	R101, R106
A2	6-272	2	2700 Ω (red-violet-red)	R113, R115
A2	6-332	1	3300 Ω (orange-orange-red)	R128
A2	6-472	1	470 Ω (yellow-violet-red)	R112
A2	6-103	2	10 k Ω (brown-black-orange)	R111, R134
A2	6-223	2	22 k Ω (red-red-orange)	R121, R127
A2	6-473	1	47 k Ω (yellow-violet-orange)	R122
A2	6-104	3	100 k Ω (brown-black-yellow)	R107, R124, R132

CAPACITORS

Mica

B1	20-52	2	7.5 pF	C141, C144
B1	20-160	1	33 pF	C156
B1	20-101	1	47 pF	C103
B1	20-147	2	75 pF	C112, C124
B1	20-176	2	94 pF	C109, C121
B1	20-124	1	115 pF	C145
B1	20-104	2	130 pF	C138, C142
B1	20-126	2	255 pF	C105, C106

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Mica (cont'd.)

B1	20-113	1	470 pF	C154
B1	20-122	1	1000 pF	C153
B1	20-127	1	1300 pF	C107

Disc

B2	21-78	1	5 pF	C116
B2	21-3	3	10 pF	C133, C135, C143
B2	21-7	2	33 pF	C134, C149
B2	21-13	1	500 pF	C108
B2	21-176	17	.01 μ F	C104, C111, C113, C114, C115, C117, C118, C122, C125, C127, C129, C132, C136, C137, C147, C151, C152

Other

B3	31-68	6	1-8 pF trimmer	C119, C123, C126, C128, C131, C155
B13	31-85	2	5-25 pF trimmer	C139, C146
B4	25-117	1	100 μ F electrolytic	C148

INDUCTORS

C1	40-1862	2	.25 μ H (blue dot)	L102, L105
C1	40-1866	1	.76 μ H (orange dot)	L115
C6	40-1789	1	1.0 μ H toroid	L109
C1	40-1869	3	1.31 μ H (green dot)	L103, L104, L114
C1	40-1870	1	1.59 μ H (red dot)	L113
C6	40-1788	1	1.8 μ H toroid	L108
C7	40-1805	3	2.25 μ H toroid	L116, L117, L118
C1	40-1874	1	3.8 μ H (blue dot)	L112
C6	40-1787	1	4.7 μ H toroid	L107
C1	40-1732	2	10.1 μ H toroid	L111, L119

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Inductors (cont'd.)				
C6	40-1786	1	13 μ H toroid	L106
C8	40-487	1	300 μ H peaking coil (orange-black-brown)	RFC102
C3	45-82	1	350 μ H RF choke	RFC101
C9	40-1888	1	3.395 MHz trap	TC101

DIODES-TRANSISTORS

D1	56-24	17	1N458 diode	D101, D102, D103, D104, D105, D106, D107, D108, D109, D111, D112, D113, D114, D115, D116, D117, D118
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NOTE: Transistors may be marked for identification in any of the following four ways:

1. Part number.
2. Type number.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Diodes-Transistors (cont'd.)				
3. Part number and type number.				
4. Part number with a type number other than the one listed.				
E2	417-863	3	MFE131 transistor	Q101, Q102, Q103
E1	417-201	1	X29A829 transistor	Q104

MISCELLANEOUS

H1	432-121	1	PCB pin
H3	432-124	18	Circuit board connector
R5	475-10	5	Ferrite bead
N2	250-56	2	6-32 \times 1/4" screw
N15	254-1	2	#6 lockwasher
N18	255-142	2	6-32 \times 5/8" spacer

PART FROM PACK #5

85-2072-1	1	Front end circuit board
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Proceed to "Front End Circuit Board" assembly on Page 27.

AUD/REG CIRCUIT BOARD

Remove the packs (2) marked #4 and check each part against the following list.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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RESISTORS

NOTES:

1. Resistors may be packed in more than one envelope. Open all of the resistor envelopes in this pack before you check them against the following list.
2. The following resistors have a tolerance of 5% unless otherwise noted. 5% is indicated by a gold fourth band.

1/4-Watt

A1	6-470-12	3	47 Ω (yellow-violet-black)	R237, R248, R249
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KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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1/4-Watt (Cont'd.)

A1	6-101-12	7	100 Ω (brown-black-brown)	R203, R205, R221, R222, R229, R245, R253
A1	6-2370-12	1	237 Ω , 1% (red-orange-violet-black)	R201
A1	6-391-12	2	390 Ω (orange-white-brown)	R256, R257
A1	6-271-12	3	270 Ω (red-violet-brown)	R244, R247, R263
A1	6-331-12	1	330 Ω (orange-orange-brown)	R234
A1	6-681-12	1	680 Ω (blue-gray-brown)	R233
A1	6-821-12	2	820 Ω (gray-red-brown)	R224, R238
A1	6-102-12	4	1000 Ω (brown-black-red)	R239, R241, R242, R243
A1	6-122-12	1	1200 Ω (brown-red-red)	R232



KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
1/4-Watt (cont'd.)				
A1	6-152-12	2	1500 Ω (brown-green-red)	R261, R262
A1	6-222-12	1	2200 Ω (red-red-red)	R254
A1	6-2371-12	1	237 Ω , 1% (red-orange-violet-brown)	R202
A1	6-272-12	1	2700 Ω (red-violet-red)	R223
A1	6-332-12	1	3300 Ω (orange-orange-red)	R204
A1	6-392-12	1	3900 Ω (orange-white-red)	R259
A1	6-472-12	3	4700 Ω (yellow-violet-red)	R235, R236, R255
A1	6-682-12	1	6800 Ω (blue-gray-red)	R258
A1	6-103-12	2	10 k Ω (brown-black-orange)	R228, R231
A1	6-333-12	2	33 k Ω (orange-orange-orange)	R211, R212
A1	6-473-12	4	47 k Ω (yellow-violet-orange)	R251, R252, R264, R265
A1	6-683-12	2	68 k Ω (blue-gray-orange)	R216, R218
A1	6-104-12	5	100 k Ω (brown-black-yellow)	R214, R215, R217, R219, R226
A1	6-684-12	3	680 k Ω (blue-gray-yellow)	R207, R213, R225
A1	6-105-12	1	1 M Ω (brown-black-green)	R227
A1	6-155-12	2	1.5 M Ω (brown-green-green)	R208, R209

CAPACITORS

Mica

B1	20-100	2	30 pF	C249, C252
B1	20-102	2	100 pF	C251, C253
B1	20-149	1	150 pF	C235
B1	20-178	1	160 pF	C237

Disc

B2	21-3	3	10 pF	C231, C243, C244
B2	21-9	1	100 pF	C248
B2	21-140	1	.001 μ F	C233
B2	21-25	1	.0013 μ F (1300 pF)	C204

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Disc (cont'd.)				
B2	21-176	14	.01 μ F	C208, C225, C227, C229, C230, C232, C234, C236, C238, C239, C241, C242, C245, C246
B2	21-95	1	.1 μ F	C228
Electrolytic				
B5	25-256	1	.47 μ F (tantalum)	C206
B5	25-123	1	2 μ F	C224
B4	25-924	3	2.2 μ F	C215, C216, C223
B4	25-233	1	22 μ F	C217
B4	25-915	1	47 μ F	C207
B4	25-117	3	100 μ F	C209, C219, C226
B4	25-160	1	250 μ F	C205
B4	25-148	1	1000 μ F	C202
Other				
B7	28-4	2	1.5 pF phenolic (brown-green-white-silver)	C254, C256
B8	29-5	4	1000 pF polystyrene	C211, C212, C213, C214
B9	27-47	3	.1 μ F Mylar*	C201, C218, C221

INDUCTORS

C10	40-821	1	2.83 MHz coil	TC201
C1	40-1877	1	13.2 μ H toroid (yellow and white dots)	L202
C7	40-1881	1	13.9 μ H toroid (yellow dot)	L201

DIODES-TRANSISTORS-INTEGRATED CIRCUITS (IC's)

D1	56-26	3	1N191 diode (brown-white-brown)	D205, D206, D207
D1	56-50	1	DO-7 zener diode	ZD201

*DuPont Registered Trademark

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Diodes-Transistors-Integrated Circuits (IC's)				
(cont'd.)				

NOTE: Transistors and integrated circuits may be marked for identification in any of the following four ways:

1. Part number.
2. Part number. (On integrated circuits, this refers only to the numbers; the letters may be different or missing.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

E1	417-241	1	EL131	Q204
E1	417-169	2	MPP105 transistor	Q208, Q209
E3	417-801	3	MPSA20 transistor	Q203, Q206, Q207
E1	417-201	1	X29A829 transistor	Q202
E2	417-863	1	MFE131 transistor	Q205
F1	442-708	1	LM317T IC	IC201
F2	442-602	1	LM324N IC	IC203
F2	442-610	1	TBA820L IC	IC202
F3	442-96	1	MC1496G IC	IC203

CRYSTALS

G1	404-205	1	3393.6 kHz	Y205
G1	404-206	1	3396.4 kHz	Y206

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Crystals (cont'd.)				
	404-331	1	Filter set consists of:	
G1		2	3393.8 kHz (3.3938 MHz)	Y201, Y204
G1		2	3395.05 kHz (3.39505 MHz)	Y202, Y203

MISCELLANEOUS

R6	215-604	2	Heat sink	
R7	260-56	2	Fuse clip	
K3	421-29	1	3/4-ampere, slow-blow fuse	F201
H3	432-124	18	Circuit board connector	
H4	434-267	1	14-pin (staggered pin) IC socket	
H5	434-298	1	14-pin (in-line) IC socket	
R5	475-10	2	Ferrite bead	
M1	250-273	2	4-40 x 3/8" screw	
M2	252-15	2	4-40 nut	
M3	254-9	2	#4 lockwasher	
N1	253-2	1	#6 fiber shoulder washer	
N2	250-56	2	6-32 x 1/4" screw	
N15	254-1	2	#6 lockwasher	
N18	255-142	2	6-32 x 5/8" spacer	
	490-5	1	Plastic nut starter	

PART FROM PACK #5

	85-2654-1	1	AUD/REG circuit board	
--	-----------	---	-----------------------	--

Proceed to "AUD/REG Circuit Board" assembly on Page 33.

CHASSIS

Unpack the remaining parts. Then check each part against the following list.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.	KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
RESISTORS, 1/2-Watt					HARDWARE				
NOTE: The following resistors have a 5% tolerance (gold fourth band).					NOTE: Hardware packets are marked to show the size of the hardware they contain (HDW #4, HDW #6, etc.). You may have to open more than one packet in this pack to locate all of the hardware of any one (#6, for example) size.				
A2	6-470	1	47 Ω (yellow-violet-black)	R2	#3 Hardware				
A2	6-821	1	820 Ω (gray-red-brown)	R8	L1	250-49	2	3-48 x 1/4" screw	
A2	6-473	1	47 k Ω (yellow-violet-orange)	R6	L2	252-1	2	3-48 nut	
A2	6-103	1	10 k Ω (brown-black-orange)	R3	L3	254-7	2	#3 lockwasher	
A2	6-684	1	680 k Ω (blue-gray-yellow)	R5	#4 Hardware				
CAPACITORS					M4	250-285	7	4-40 x 1/4" screw	
B10	26-153	1	VFO capacitor	C3	M5	250-375	3	4-40 x 5/16" flat head screw	
B11	26-151	1	Preselector capacitor	C1	M6	250-248	7	4-40 x 1/2" self-tapping screw	
B9	27-47	2	.1 μ F Mylar	C4, C5	M7	250-312	2	4-40 x 3/4" screw	
B12	25-208	1	1500 μ F electrolytic	C2	M8	252-15	5	4-40 nut	
DIODES					M9	254-9	7	#4 lockwasher	
D1	56-89	1	GD510	D5	#6 Hardware				
D1	57-65	4	1N4002	D1, D2, D3, D4	N2	250-56	7	6-32 x 1/4" screw	
CONTROLS-SWITCHES					N3	250-1157	3	6-32 hex spacer	
J1	10-27	1	3000 (3 k) Ω control	R1	N4	250-381	4	6-32 x 3/8" black screw	
J2	10-1184	1	15 k Ω control	R7	N5	250-89	38	6-32 x 3/8" screw	
J3	19-721	1	100 k Ω control with switch	R4/SW1	N6	250-218	4	6-32 x 3/8" phillips head screw	
J4	60-22	2	Slide switch	SW2, SW3	N7	250-155	8	#6 x 3/8" black sheet metal screw	
J5	63-1254	1	Wafer switch	SW4A/SW4B	N8	250-1187	1	6-32 x 1-1/4" black flat head screw	
OTHER ELECTRONIC PARTS					N9	250-162	8	6-32 x 1/2" screw	
	54-915	1	Power transformer	T1	N10	250-406	1	6-32 x 5/8" flat head screw	
K1	407-716	1	Meter	M1	N11	250-40	2	6-32 x 1-1/2" screw	
K2	412-58	2	#1813 lamp	PL1, PL2	N12	252-3	55	6-32 nut	
K3	421-31	1	3/16-ampere fuse	F1					

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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#6 Hardware (cont'd.)

N13	253-60	8	#6 flat washer	
N14	253-89	1	#6 "D" washer	
N15	254-1	68	#6 lockwasher	
N16	254-6	1	#6 external tooth lockwasher	
N17	259-1	12	#6 solder lug	

#8 Hardware

P1	250-43	6	8-32 x 1/4" setscrew	
P2	250-18	2	8-32 x 3/8" screw	
P3	252-4	2	8-32 nut	
P4	254-2	2	#8 lockwasher	

Other Hardware

Q1	252-7	4	Control nut	
Q2	252-146	2	Window retainer	
Q3	252-10	2	Push-on nut	
Q4	253-10	4	Control flat washer	
Q5	253-59	3	Spring washer	
Q6	254-4	2	Control lockwasher	
Q7	255-2	2	3/16" spacer	
Q8	255-49	4	5/16" spacer	
Q9	255-77	3	7/16" spacer	
Q10	259-10	2	Control solder lug	

SHEET METAL PARTS

S1	90-1200-1	1	Cabinet top	
S2	90-1201-1	1	Cabinet bottom	
S3	200-1256	1	Chassis	
S4	203-1750-1	1	Front panel	
S5	203-1751-1	1	Rear panel	
S6	204-2003	2	Meter bracket	
S7	204-2155	1	VFO bracket	
S8	204-2154	1	Capacitor mounting bracket	
S9	204-2156	1	Pressure plate	
S10	205-756	1	Drive mounting bracket	
S11	205-761	1	Dial drive plate	
S12	205-1648	1	Spacer plate	
S13	206-1206	1	VFO shield	
S14	206-1235	2	Circuit board shield	

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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CONNECTORS

H6	432-72	2	Male terminal	
H7	432-73	20	Female terminal	
H8	432-120	7	PCB connector (one extra)	
H9	432-180	12	Chassis connector	
H10	432-196	1	Male terminal housing	
H11	432-808	3	Extender terminal housing	
H12	432-907	1	Female terminal housing	
H13	434-42	5	Phono socket	
H14	436-4	1	Phone jack	
H15	438-4	3	Phono plug	

MISCELLANEOUS

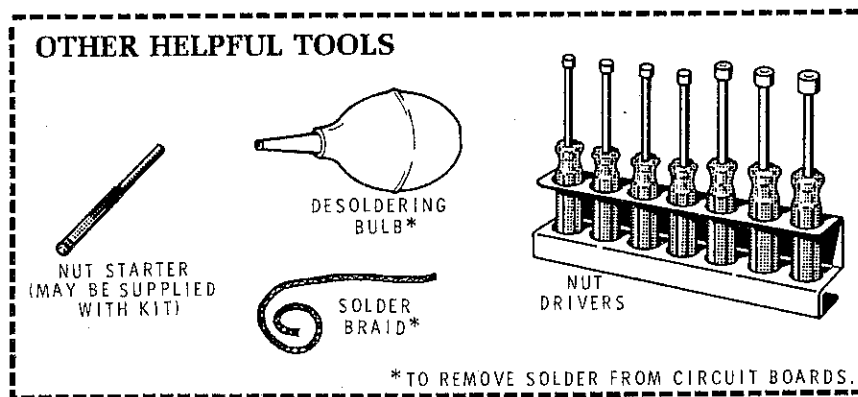
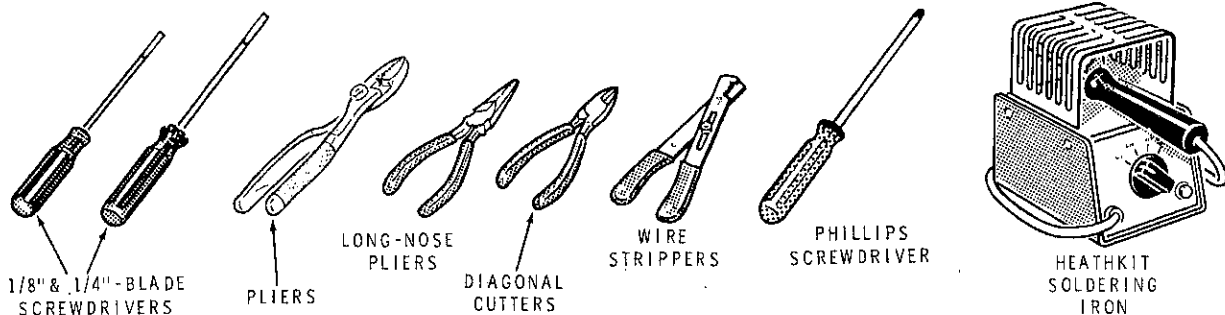
R8	75-71	1	Strain relief	
R9	75-61	8	Cabinet nut	
	89-23	1	Line cord	
R10	100-1041	2	Vernier drive	
	134-949	1	Wire harness	
R11	206-86	2	Lamp shield	
R12	207-22	1	Cable clamp	
R13	255-59	2	Tapered spacers	
R14	261-9	4	Round foot	
R15	266-200	1	Clutch plate	
R16	261-41	1	Square foot	
R17	391-622	1	Nameplate	
R18	422-1	1	Fuse block	
R19	431-26	1	1-lug terminal strip	
R20	431-81	2	6-lug terminal strip	
R21	434-44	2	Lamp socket	
R22	446-663	1	Dial window	
R23	462-288	1	Pushbutton	
R24	462-906	1	Large knob	
R25	462-933	4	Small knob	
R26	463-67	1	Dial pointer	
R27	464-73	1	Tuning dial	
R28	490-1	1	Alignment tool	
R29	205-778	1	1" steel blade	

Proceed to "Chassis Assembly" on Page 42.

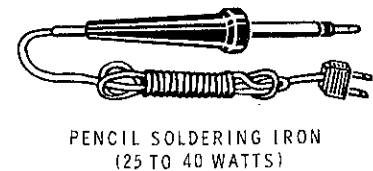
ASSEMBLY NOTES

TOOLS

You will need these tools to assemble your kit.



OR



ASSEMBLY

- Follow the instructions carefully, and read the entire step before you perform the operation.
 - Position all parts as shown in the Pictorials.
 - The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.
 - A separate "Illustration Booklet" contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. When the Manual says to refer to a certain Pictorial or Detail and that illustration is not on the same page, or on the page across from it, refer to the "Illustration Booklet."
- Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.
- Solder a part or a group of parts only when you are instructed to do so.

6. Resistors will be called out by their resistance value in Ω (ohms), $k\Omega$ (kilohms), or $M\Omega$ (megohms), and color code. Use 1/2-watt resistors unless directed otherwise.
7. Capacitors will be called out by their capacitance value (in pF or μF) and type (disc, Mylar, or electrolytic).
8. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

NOTE: Always use rosin core, radio-type solder (60:40 or 50:50 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

SAFETY WARNING: Avoid eye injury when you cut off excess lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

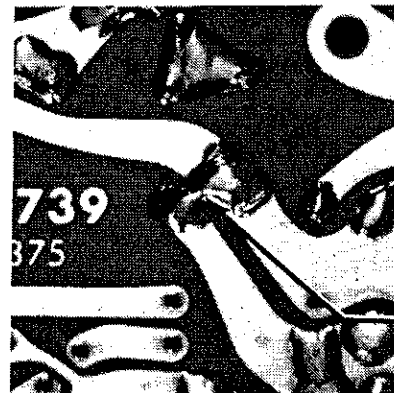
Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A good quality, 25 to 40-watt, pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.
2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.
3. Due to the small foil area around the circuit board holes and the small areas between foils, you must use the utmost care to prevent solder bridges between adjacent foil areas.

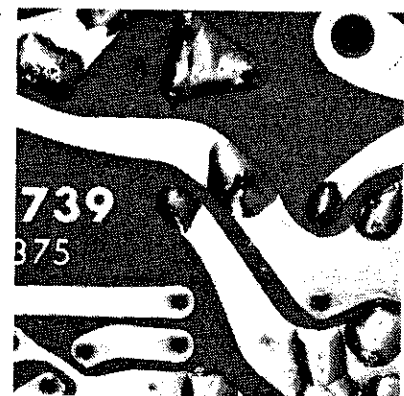
A solder bridge between two adjacent foils is shown in photograph A below. Photograph B shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: Always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area, and does not bridge to another foil. This is especially important when the foils are small and close together. **NOTE:** It is alright for solder to bridge two connections on the same foil.

Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. **NOTE:** The foil side of each circuit board has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.



A

**SOLDER
BRIDGE**



B

CIRCUIT BOARD ASSEMBLY

NOTES:

1. Unless you are otherwise instructed, install all parts on the top side of each circuit board (the side with component outlines), and solder the leads to the other side.
2. Take your time when you assemble each circuit board--accuracy is far more important than speed. Position each component over its outline on the circuit board and solder each connection carefully. Improper soldering causes more difficulties than anything else. Be careful not to cover unused holes with solder or to form a solder "bridge" between two foils. Refer to the "Assembly Notes" section of this Manual for information about removing a solder "bridge."
3. Solder a part, or group of parts, only when you are instructed to do so. Follow the instructions carefully and read the entire assembly step before you perform each operation.
4. Detail drawings of part installations that will be used on more than one circuit board are on a page in the "Illustration Booklet." Remove the page called "Circuit Board Details" from the "Illustration Booklet." Then place the page in a convenient location where you can refer to it during the assembly of the circuit boards.

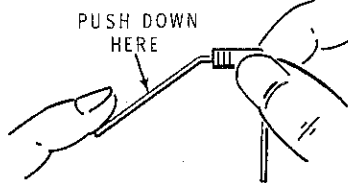
VFO CIRCUIT BOARD

START

- () Position the VFO circuit board as shown with the printed side (not the foil side) up. Then complete the steps in the following Pictorials.

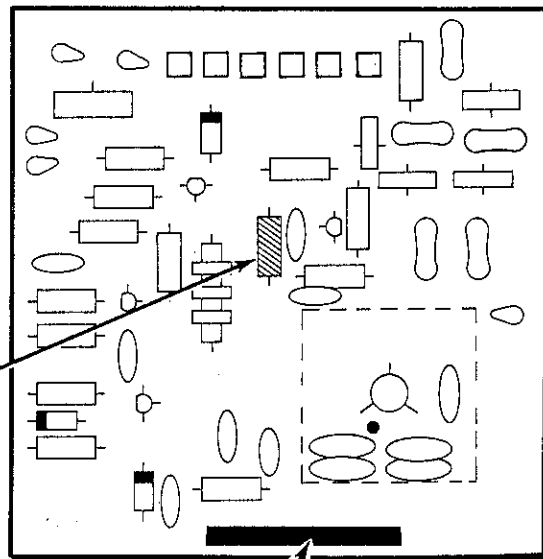
NOTE: In the following steps you will be given detailed instructions on how to install and solder the first part on a circuit board. Read and perform each step carefully. Then use the same procedure whenever you install parts on a circuit board.

- () R313: Hold a 3900 Ω (orange-white-red) resistor by the body as shown and bend the leads straight down.



- () Push the leads through the holes at the proper location on the circuit board. The end with color bands may be positioned either way.

- () Press the resistor against the circuit board. Then bend the leads outward slightly to hold the resistor in place.



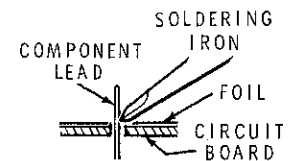
PART NUMBER

PICTORIAL 1-1

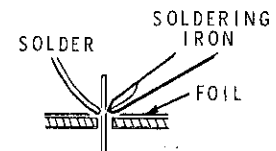
CONTINUE

- () Solder the resistor leads to the circuit board as follows:

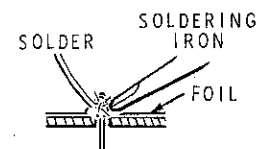
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat both for 2 or 3 seconds.



2. Then apply solder to the other side of the connection. IMPORTANT: Let the heated lead and the circuit board foil melt the solder.



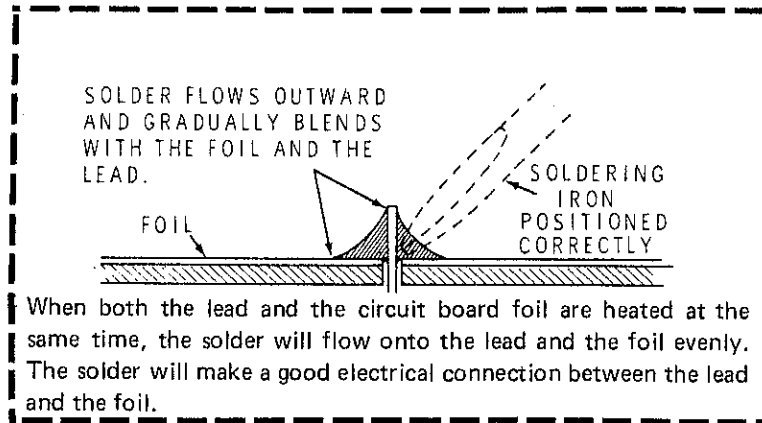
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



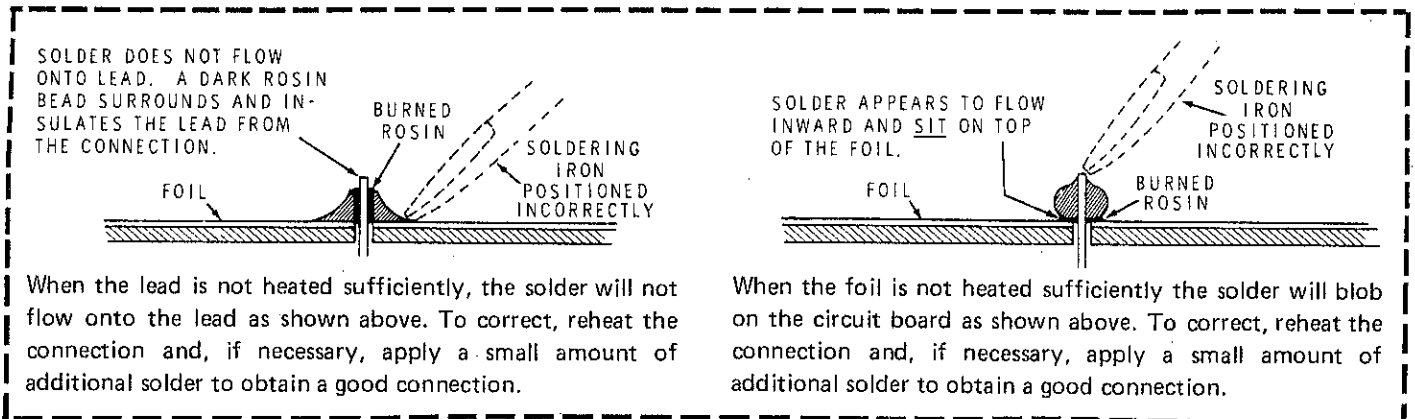
- () Cut off the excess lead length close to the connection. CAUTION: Hold the lead with one hand to prevent the lead from hitting you in the eye.

- () Check the connection. Compare it to the illustrations on the next page. After you have checked the solder connections, proceed with the assembly on Page 19. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION

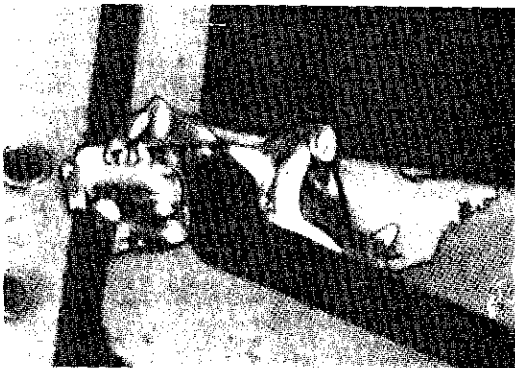


POOR SOLDER CONNECTIONS



SOLDER CONNECTIONS TO WATCH OUT FOR

The following photographs show examples of the types of bad solder connections that are the most common cause of trouble. If you locate any of these bad solder connections in your kit, correct them as instructed.

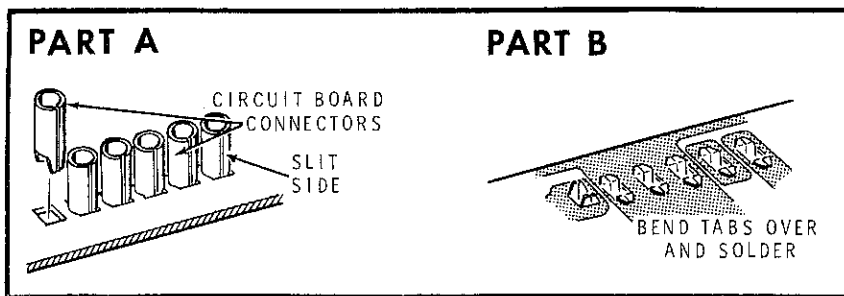


Here, hot solder has been dropped onto the foil and the solder connected or bridged (or crossed) three foils. To correct, hold the circuit board above the soldering iron and reheat the solder. As the solder melts, it will flow down the iron. PROTECT YOUR EYES.



Here, solder has flowed along a lead and bridged to another foil. To correct, hold the circuit board above the soldering iron and reheat the solder. As the solder melts, it will flow down the iron. Then cut off the excess lead lengths. PROTECT YOUR EYES.

NOTE: Solder that bridges two connections on the SAME FOIL is alright and should not be corrected.



Detail 1-2A

START ▾

() Refer to Part A of Detail 1-2A and install six circuit board connectors with the slit side positioned as shown.

() Turn the circuit board over and bend the tabs over against the foil as shown in Part B of Detail 1-2A. Make sure the connectors are straight; then solder the tabs to the foil. Do not allow the solder to get close to the circuit board mounting hole.

NOTE: Details A through M are in the "Illustration Booklet."

() D302: GD510 diode (#56-89). Refer to Detail A.

() R305: 22 kΩ (red-red-orange).

() R304: 620 Ω (blue-red-brown).

() R311: 100 Ω (brown-black-brown).

() R308: 4700 Ω (yellow-violet-red).

() R309: 3900 Ω (orange-white-red).

() R307: 220 kΩ (red-red-yellow).

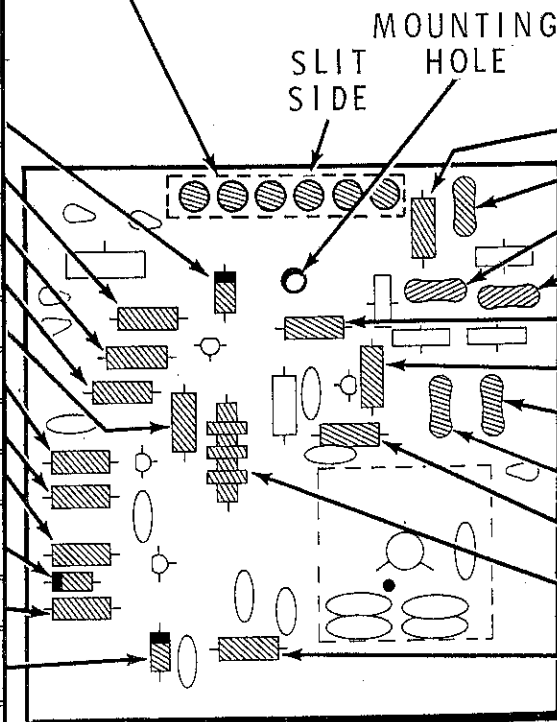
() R303: 120 Ω (brown-red-brown).

() D301: 1N458 diode (#56-24). Refer to Detail A.

() R301: 1 MΩ (brown-black-green).

() ZD301: VR-9.1 diode (#56-19). Refer to Detail A.

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



CONTINUE ▾

() R316: 100 Ω (brown-black-brown).

() C317: 200 pF mica.

() C318: 310 pF mica.

() C316: 400 pF mica.

() R312: 22 kΩ (red-red-orange).

() R315: 680 Ω (blue-gray-brown).

() C315: 680 pF mica.

() C314: 330 pF mica.

() R314: 47 Ω (yellow-violet-black).

() RFC301: 350 μH choke (#45-82). Refer to Detail B.

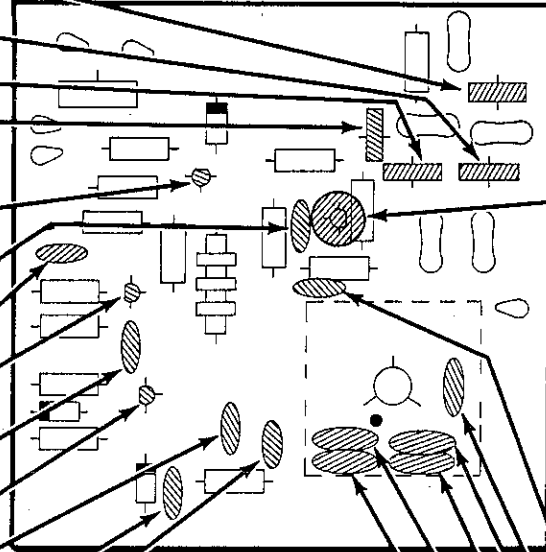
() R302: 47 Ω (yellow-violet-black).

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

PICTORIAL 1-2

START ↘

- () L304: 3.75 μ H toroid (#40-1684). Refer to Detail C.
- () L303: 3.75 μ H toroid (#40-1684).
- () L302: 3.75 μ H toroid (#40-1684).
- () L305: 1.3 μ H toroid (#40-1800).
- () Q304: MPSA20 transistor (#417-801). Refer to Detail D.
- () C311: 470 pF disc. Refer to Detail E.
- () C312: .01 μ F disc.
- () Q302: MPF105 transistor (#417-169). Refer to Detail D.
- () C308: 4.7 pF disc.
- () Q301: MPF105 transistor (#417-169). Refer to Detail D.
- () C307: 4.7 pF disc.
- () C309: .01 μ F disc.
- () C305: 10 pF disc.
- () Solder the leads to the foil and cut off the excess lead lengths.

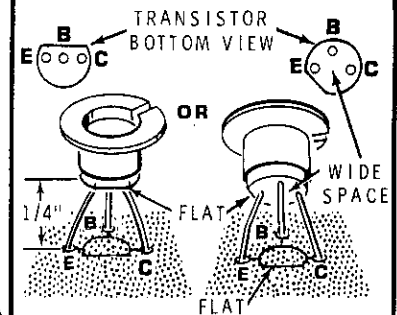


CONTINUE ↘

- () Push a heat sink onto a 2N3638A transistor (#417-234). The bottom of the heat sink must not project below the transistor body or its leads might be shorted.



- () Q303. Prepared transistor and heat sink. Identify the leads from one of the drawings below. Then insert the leads into the indicated circuit board holes as shown. Solder the leads to the foil and cut off the excess lead lengths.



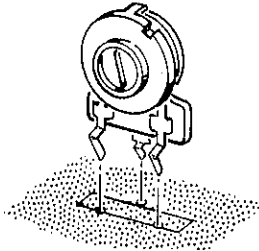
- () C313: .01 μ F disc.
- () C302: 510 pF disc.
- () C304: 510 pF disc.
- () C306: 510 pF disc.
- () C301: 50 pF disc.
- () C303: 50 pF disc.
- () Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-3

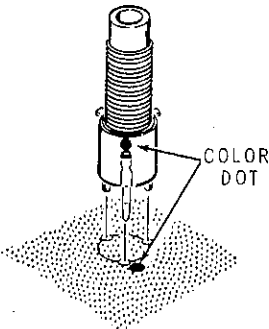
START

() Refer to Detail F and install PCB pins at A, B, C, and D.

() R306: 5000 (5 k) Ω control (#10-311). Push the control down firmly against the circuit board. Then solder the lugs to the foil.

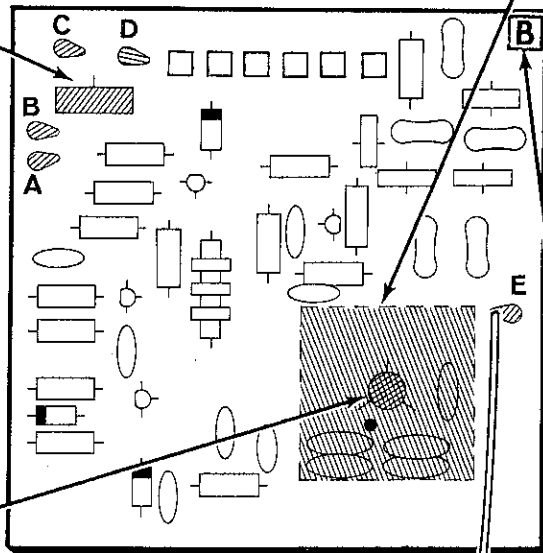


() L301: Variable inductor (#40-1859). Position the color dot on the coil toward the dot near the coil outline on the circuit board. Then solder the lugs to the foil.



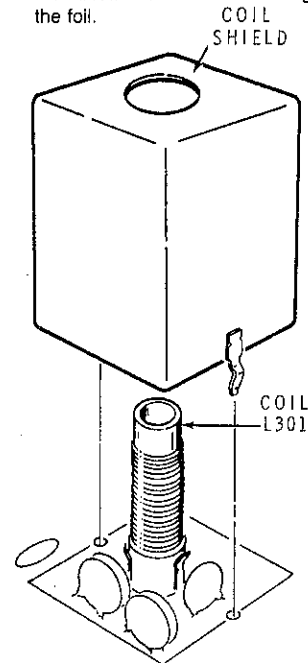
NOTE: When you perform the next step, do not allow the wire to extend more than 1/8" from the foil side of the circuit board.

() Cut a 4" length of large bare wire. Then install the 4" wire at hole E and solder the wire to the foil.



CONTINUE

() Install a coil shield over coil L301 on the circuit board. Solder the lugs to the foil.



() Cut a large letter "B" from the terminal identification label (#390-1045) and remove the adhesive backing. Press the letter onto the circuit board at the location shown.

CIRCUIT BOARD CHECKOUT

Carefully inspect the foil side of the circuit board for the following most commonly made errors:

- () Unsoldered connections.
- () "Cold" solder connections.
- () Solder bridges between foil patterns.
- () Protruding leads which could touch together.

Refer to the illustrations where the parts were installed as you make the following visual checks.

- () Transistors for proper type and installation.
- () Diodes for the correct position of the banded end.

This completes the assembly of the circuit board. Set it aside until it is called for in a step. Proceed to the "HFO/XTAL Calibrator Circuit Board" Parts List on Page 6.

FINISH

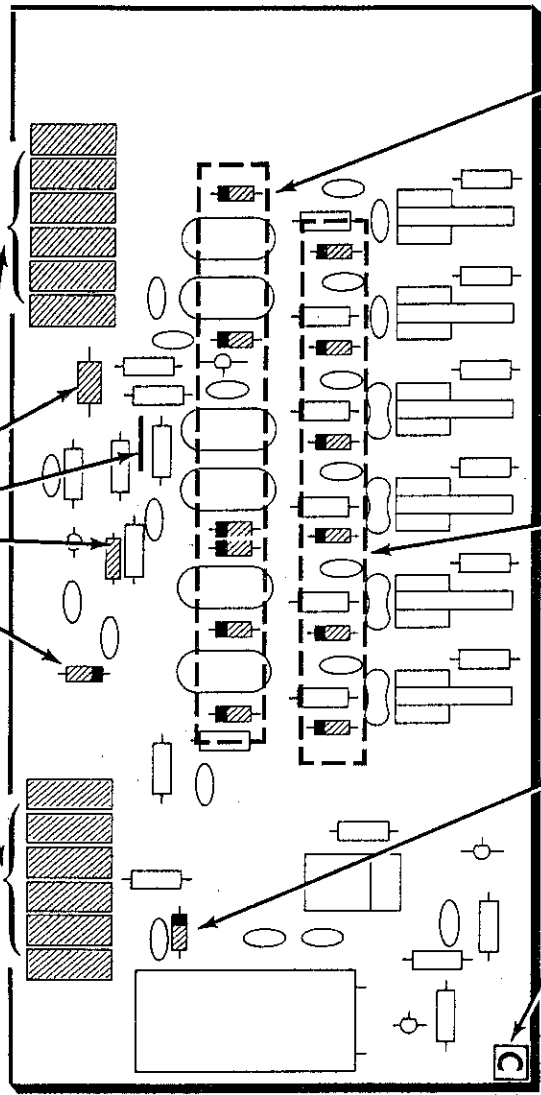
PICTORIAL 1-4



HFO/XTAL CALIBRATOR CIRCUIT BOARD

START ▾

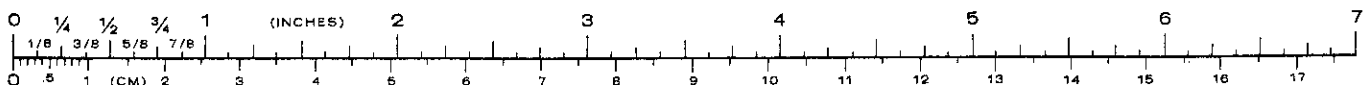
- () Position the HFO/XTAL Calibrator circuit board as shown. Then complete the steps in the following Pictorials.
- () Six circuit board connectors. Refer to Detail G.
- () Ferrite bead. Refer to Detail H.
- () 3/4" small bare wire.
- () L407: 2.2 μ H choke (#45-73).
- () D415: 1N191 diode (#56-26, brown-white-brown). Refer to Detail A.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () Six circuit board connectors. Refer to Detail G.



CONTINUE ▾

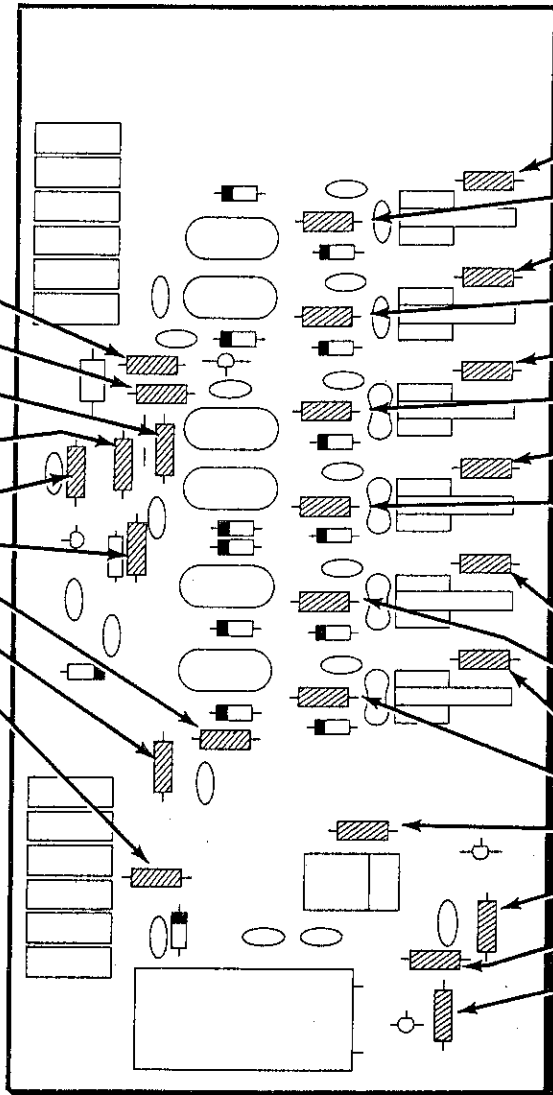
- Refer to Detail A and install six 1N458 diodes (#56-24) at:
- () D408.
 - () D409.
 - () D411.
 - () D412.
 - () D413.
 - () D414.
- () Solder the leads to the foil and cut off the excess lead lengths.
- Refer to Detail A and install six 1N458 diodes (#56-24) at:
- () D401.
 - () D402.
 - () D403.
 - () D404.
 - () D405.
 - () D406.
- () ZD401: 1N751 diode (#56-16). Refer to Detail A.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () Cut a letter "C" from the terminal identification label sheet and remove the adhesive backing. Press this letter onto the circuit board at the location shown.

PICTORIAL 2-1



START ↘

- () R414: 220 Ω (red-red-brown).
- () R416: 22 kΩ (red-red-orange).
- () R415: 47 kΩ (yellow-violet-orange).
- () R421: 47 Ω (yellow-violet-black).
- () R417: 270 Ω (red-violet-brown).
- () R418: 150 Ω (brown-green-brown).
- () R422: 5600 Ω (green-blue-red).
- () R419: 2200 Ω (red-red-red).
- () R427: 220 Ω (red-red-brown).
- () Solder the leads to the foil and cut off the excess lead lengths.



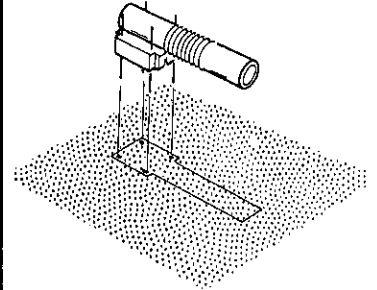
CONTINUE ↘

- () R402: 1000 Ω (brown-black-red).
- () R401: 15 kΩ (brown-green-orange).
- () R404: 1000 Ω (brown-black-red).
- () R403: 15 kΩ (brown-green-orange).
- () R406: 1000 Ω (brown-black-red).
- () R405: 15 kΩ (brown-green-orange).
- () R408: 1000 Ω (brown-black-red).
- () R407: 15 kΩ (brown-green-orange).
- () Solder the leads to the foil and cut off the excess lead lengths.
- () R411: 1000 Ω (brown-black-red).
- () R409: 15 kΩ (brown-green-orange).
- () R413: 1000 Ω (brown-black-red).
- () R412: 15 kΩ (brown-green-orange).
- () R426: 1000 Ω (brown-black-red).
- () R425: 47 kΩ (yellow-violet-orange).
- () R424: 1000 Ω (brown-black-red).
- () R423: 220 kΩ (red-red-yellow).
- () Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 2-2

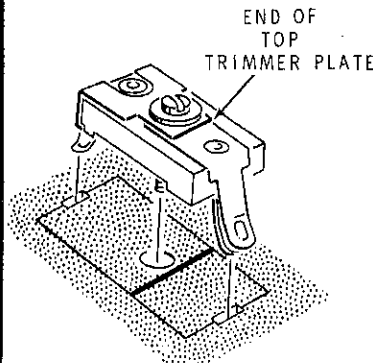
CONTINUE ↘

When you install a coil on the board, position it over its outline, making sure all four coil pins are inserted through the board holes. Then solder each pin.

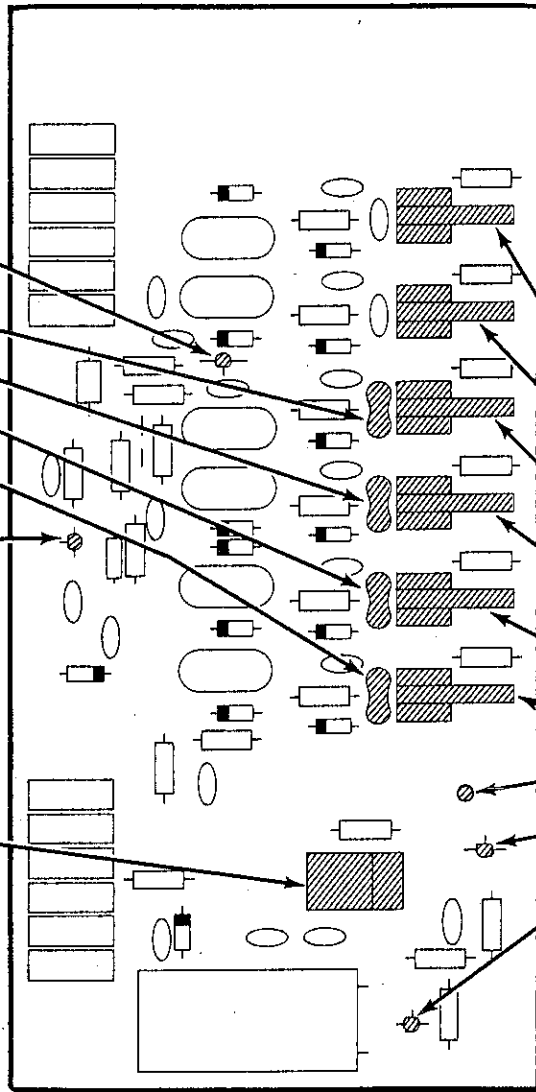


START ↘

- () Q401: 2N5770 transistor (#417-293). Refer to Detail D.
- () C408: 24 pF mica.
- () C412: 47 pF mica.
- () C415: 100 pF mica.
- () C418: 100 pF mica.
- () Q402: 2N5770 transistor (#417-293). Refer to Detail D.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () C425: Install the 8-60 pF trimmer capacitor as follows:
 1. Refer to the illustration below and identify the end of the top trimmer plate.
 2. Insert the trimmer lugs into the circuit board so the end of the top plate is toward the right as shown.
 3. Push the trimmer down against the circuit board. Then bend the lugs over flat against the other side of the circuit board.
 4. Solder the lugs to the foil.



- () Use a small screwdriver to turn the screw in trimmer capacitor C425 down snug. DO NOT FORCE. Then turn the screw one turn counterclockwise.

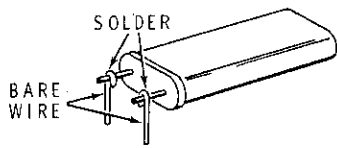


- () L401: 0.5 μH coil (#40-687, green dot).
- () L402: 0.5 μH coil (#40-687, green dot).
- () L403: 0.5 μH coil (#40-687, green dot).
- () L404: 0.5 μH coil (#40-687, green dot).
- () L405: 0.5 μH coil (#40-687, green dot).
- () L406: 1.42 μH coil (#40-1047, gray dot).
- () PCB pin at TP. Refer to Detail F.
- () Q403: MPSA20 transistor (#417-801). Refer to Detail D.
- () Q404: MPSA20 transistor (#417-801). Refer to Detail D.

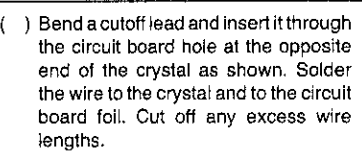
PICTORIAL 2-3

START ▾

- () C404: 10 pF disc. Refer to Detail E.
- () C403: 5 pF disc.
- () C409: 5 pF disc.
- () C422: .01 μ F disc.
- () C413: 220 pF disc.
- () C419: 3.3 pF disc.
- () C416: 220 pF disc.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () Bend and solder a cutoff lead to each pin of the 100 kHz crystal (#404-43).

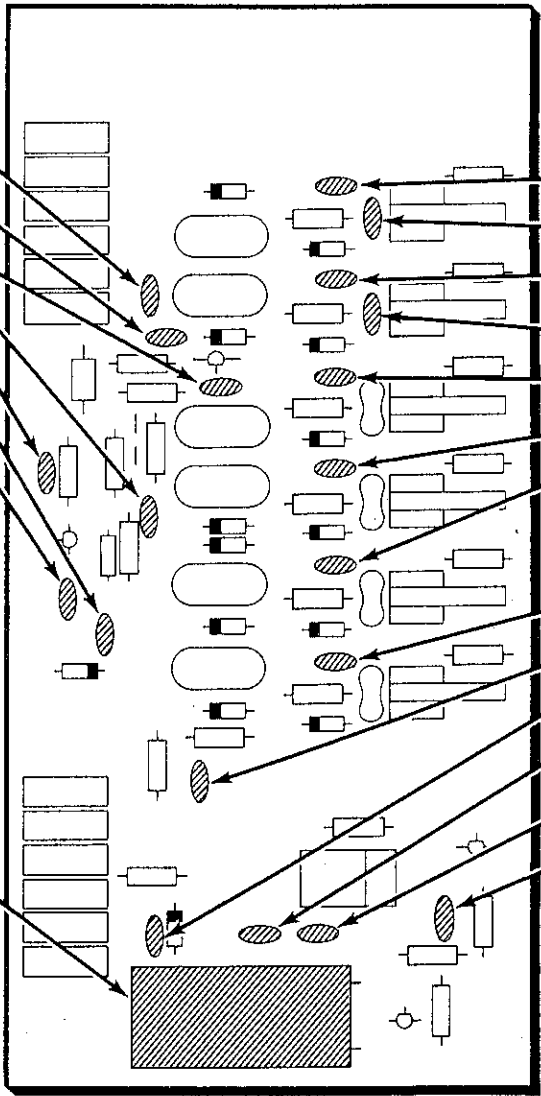


- () Y407: Install the crystal on the circuit board by inserting the bare wire leads through their circuit board holes. Solder the leads to the foil and cut off any excess wire lengths.



CONTINUE ▾

- () C401: .01 μ F disc.
- () C402: 7.7 pF disc.
- () C405: .01 μ F disc.
- () C406: 7.7 pF disc.
- () C407: .01 μ F disc.
- () C411: .01 μ F disc.
- () C414: .01 μ F disc.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () C417: .01 μ F disc.
- () C421: .1 μ F disc.
- () C423: .1 μ F disc.
- () C427: 33 pF disc.
- () C424: 10 pF disc.
- () C426: .1 μ F disc.
- () Solder the leads to the foil and cut off the excess lead lengths.

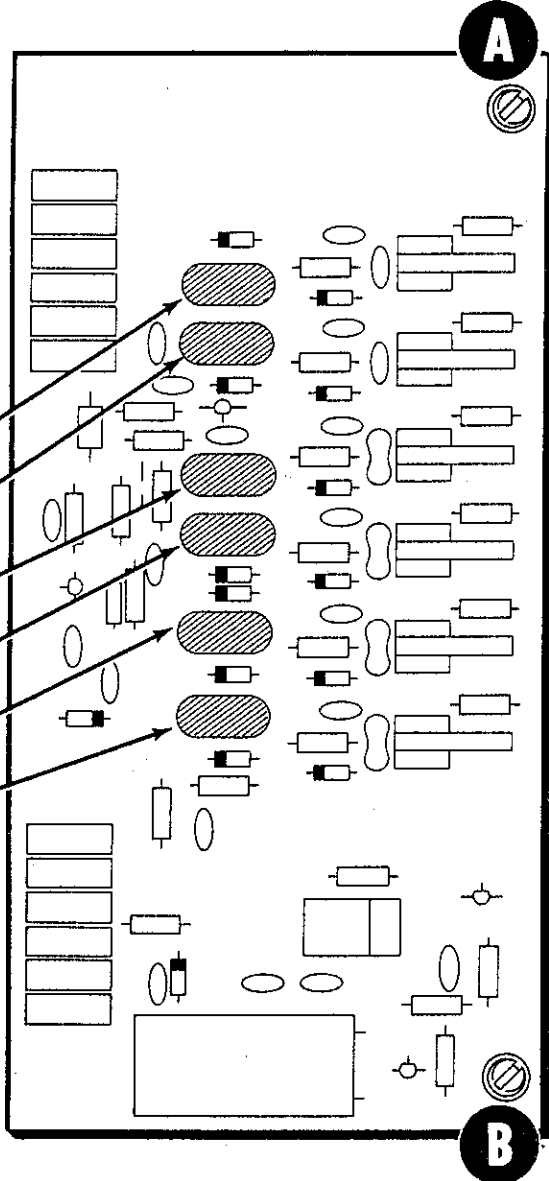


PICTORIAL 2-4

START →

NOTE: When you perform the following steps, each crystal may be installed either way in the circuit board. Be sure you install each crystal in its correct location. Solder each crystal as you install it. Use a minimum amount of heat and solder.

- () Y401: 37.395 MHz crystal (#404-212).
- () Y402: 36.895 MHz crystal (#404-211).
- () Y403: 29.895 MHz crystal (#404-210).
- () Y404: 22.895 MHz crystal (#404-209).
- () Y405: 15.895 MHz crystal (#404-208).
- () Y406: 12.395 MHz crystal (#404-207).



CONTINUE →

- () Refer to Detail J and mount a 6-32 x 5/8" spacer at A with a 6-32 x 1/4" screw and a #6 lockwasher.
- () In a similar manner, mount a 6-32 x 5/8" spacer at B.

CIRCUIT BOARD CHECKOUT

Carefully inspect the foil side of the circuit board for the following most commonly made errors.

- () Unsoldered connections.
- () "Cold" solder connections.
- () Solder bridges between foil patterns.
- () Protruding leads which could touch together.

Refer to the illustrations where the parts were installed as you make the following visual checks.

- () Transistors for proper **type** and **installation**.
- () Diodes for the correct position of the banded end.

This completes the assembly of the circuit board. Set it aside until it is called for in a step. Proceed to the "Front End Circuit Board" Parts List on Page 8.

PICTORIAL 2-5

FRONT END CIRCUIT BOARD

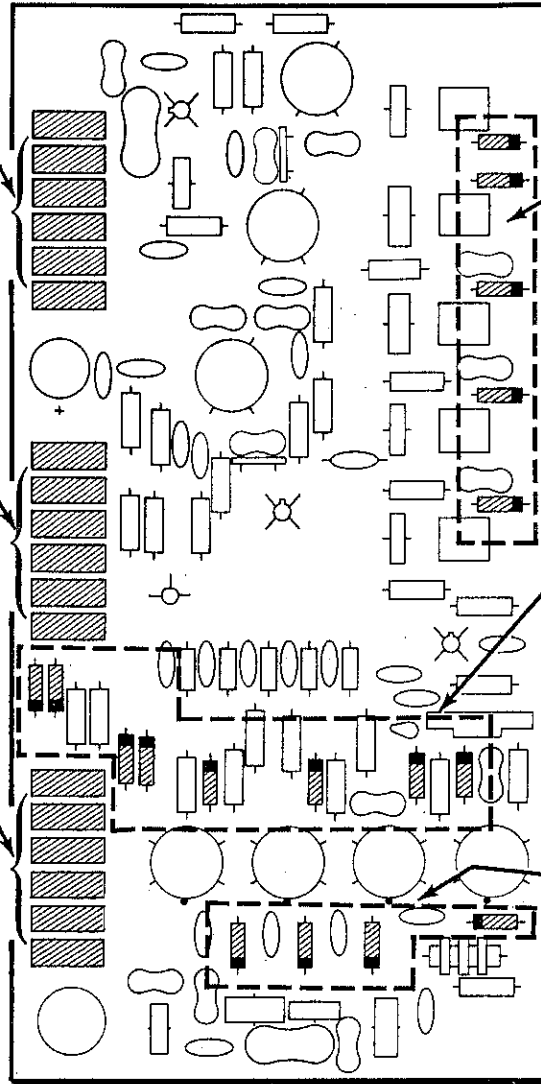
START

() Position the front end circuit board as shown. Then perform the steps in the following Pictorials.

() Six circuit board connectors. Refer to Detail G.

() Six circuit board connectors. Refer to Detail G.

() Six circuit board connectors. Refer to Detail G.



CONTINUE

Refer to Detail A and install five 1N458 diodes (#56-24) at:

- () D118.
- () D117.
- () D116.
- () D115.
- () D114.

Refer to Detail A and install eight 1N458 diodes (#56-24) at:

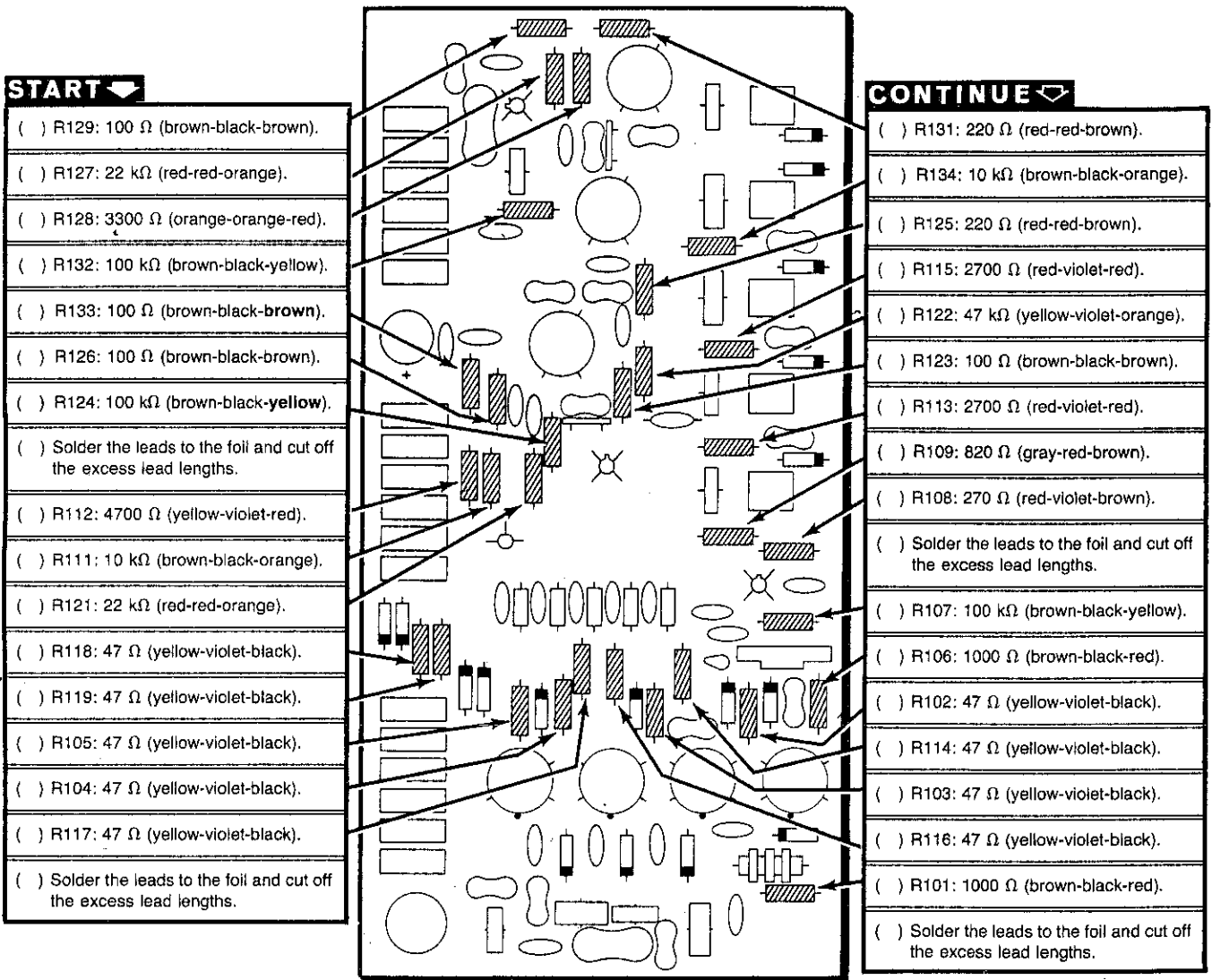
- () D113.
- () D112.
- () D111.
- () D109.
- () D108.
- () D106.
- () D104.
- () D102.

Refer to Detail A and install four 1N458 diodes (#56-24) at:

- () D107.
- () D105.
- () D103.
- () D101.

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

PICTORIAL 3-1



PICTORIAL 3-2

START →

NOTE: The following toroid coils can be installed only one way in the circuit board. Solder the lugs of each coil to the foil as you install it.

() L118: 2.2 μ H toroid coil (#40-1805).

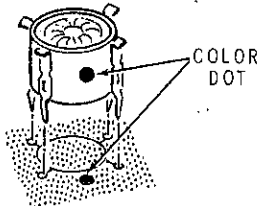
() L117: 2.2 μ H toroid coil (#40-1805).

() L116: 2.2 μ H toroid coil (#40-1805).

() Refer to Detail H and install ferrite beads in the five locations shown.

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

NOTE: When you install the following toroid coils, be sure to position the color dot on the coil as shown by the dot on the circuit board. Solder the lugs of each coil as you install it.



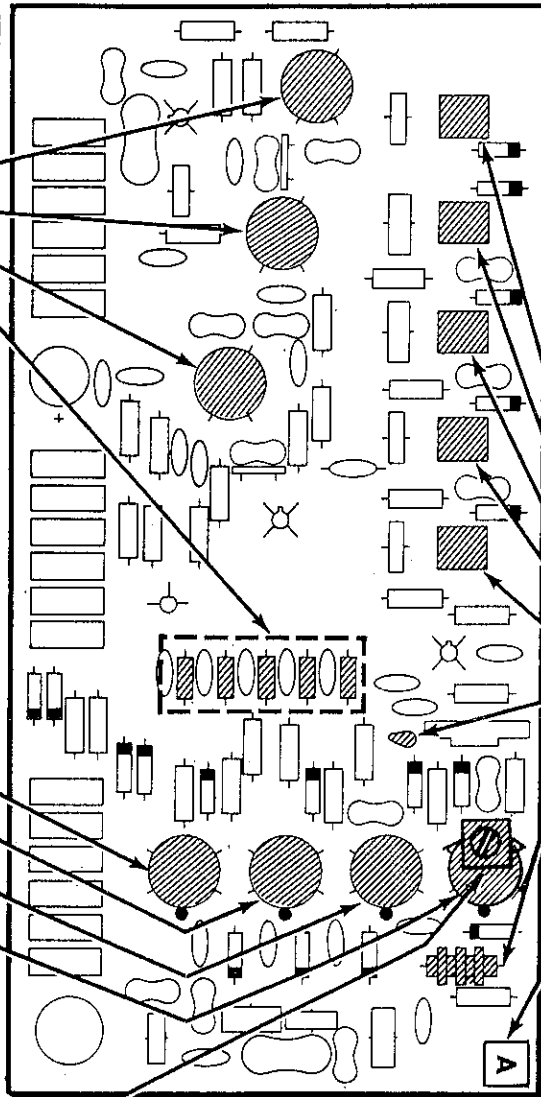
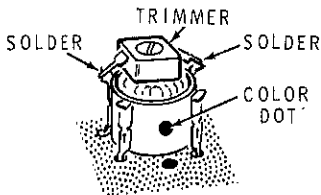
() L109: 1.0 μ H toroid coil (#40-1789).

() L108: 1.8 μ H toroid coil (#40-1788).

() L107: 4.7 μ H toroid coil (#40-1787).

() L106: 13 μ H toroid coil (#40-1786).

() C155: Install a 1-8 pF trimmer on the coil at L106. Bend the trimmer lugs so they touch the two indicated coil lugs. (These are the lugs on the side of the coil away from the color dot.) Then solder the trimmer lugs to the coil lugs.



CONTINUE →

Install five 1-8 pF trimmer capacitors at the following locations. These trimmer capacitors may be installed either way in the circuit board. Solder the lugs to the foil as you install each capacitor.

() C131.

() C128.

() C126.

() C123.

() C119.

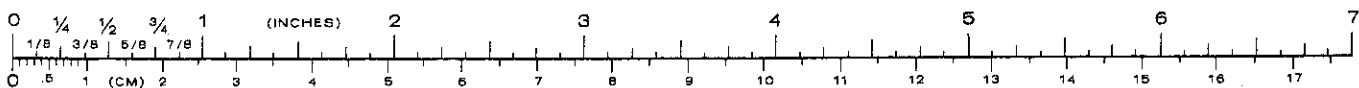
() PCB pin at A. Refer to Detail F.

() RFC101: 350 μ H RF choke (#45-82). Refer to Detail B.

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

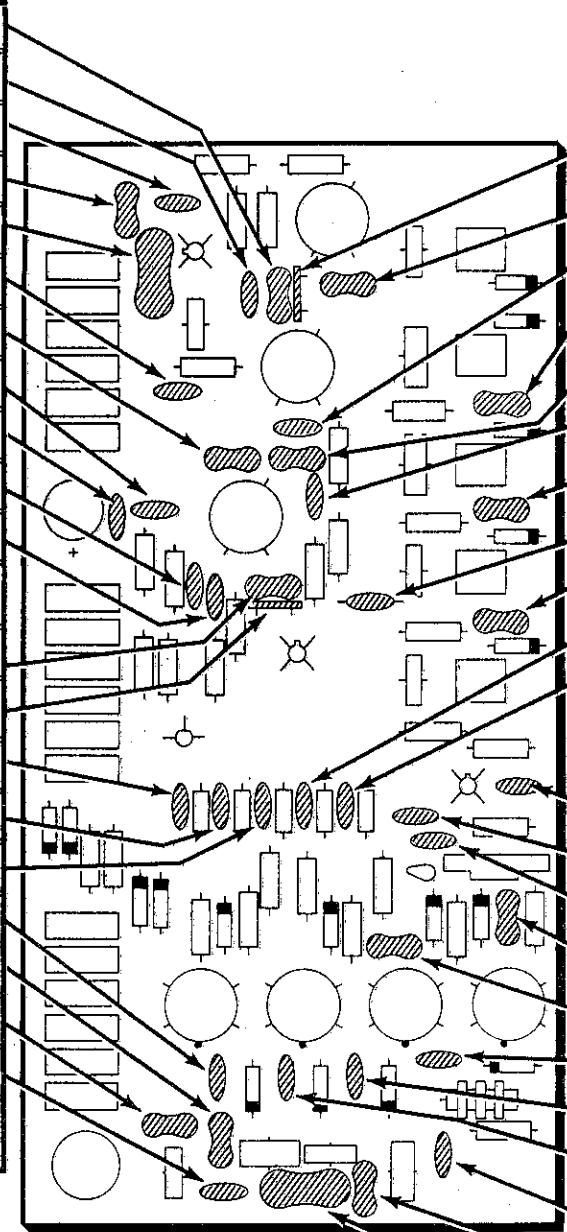
() Cut a large letter "A" from the terminal identification label and remove the adhesive backing. Press the letter onto the circuit board at the location shown.

PICTORIAL 3-3



START

- () C144: 7.5 pF mica.
- () C147: .01 μ F disc. Refer to Detail E.
- () C151: .01 μ F disc.
- () C154: 470 pF mica.
- () C153: 1000 pF mica.
- () C149: 33 pF disc.
- () C141: 7.5 pF mica.
- () C152: .01 μ F disc.
- () C134: 33 pF disc.
- () C136: .01 μ F disc.
- () C135: 10 pF disc.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () C138: 130 pF mica.
- () C139: 5-25 pF trimmer. Refer to Detail M.
- () C132: .01 μ F disc.
- () C129: .01 μ F disc.
- () C127: .01 μ F disc.
- () C115: .01 μ F disc.
- () C105: 255 pF mica.
- () C103: 47 pF mica.
- () C104: .01 μ F disc.
- () Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

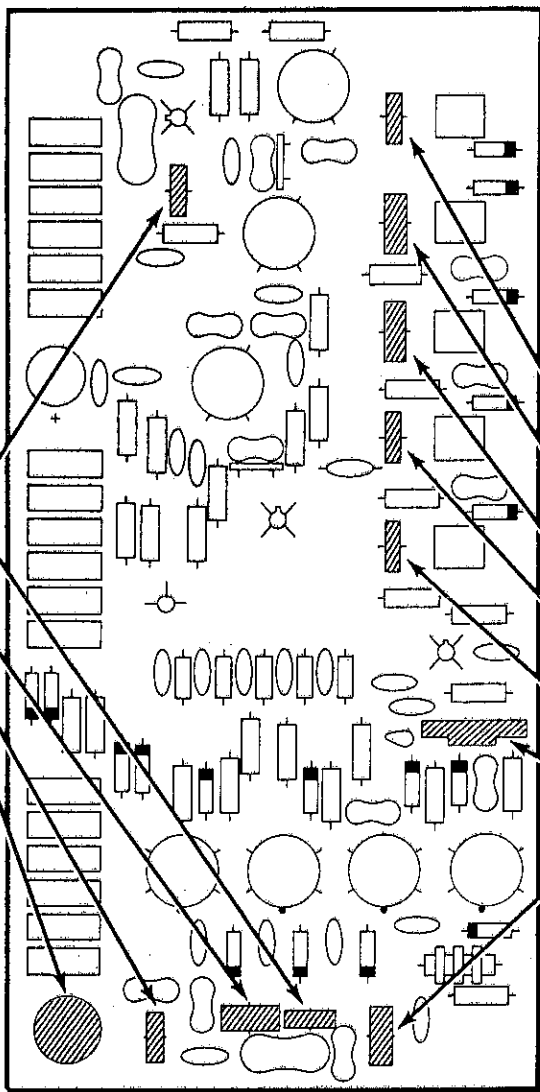
- () C146: 5-25 pF trimmer. Refer to Detail M.
- () C145: 115 pF mica.
- () C143: 10 pF disc.
- () C156: 33 pF mica.
- () C142: 130 pF mica.
- () C137: .01 μ F disc.
- () C124: 75 pF mica.
- () C133: 10 pF disc.
- () C121: 94 pF mica
- () C125: .01 μ F disc.
- () C122: .01 μ F disc.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () C118: .01 μ F disc.
- () C117: .01 μ F disc.
- () C116: 5 pF disc.
- () C109: 94 pF mica.
- () C112: 75 pF mica.
- () C111: .01 μ F disc.
- () C113: .01 μ F disc.
- () C114: .01 μ F disc.
- () C108: 500 pF disc.
- () C106: 255 pF mica.
- () C107: 1300 pF mica.
- () Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 3-4

START ↩

NOTE: Refer to Detail C when you install the following toroid coils.

- () L119: 10.1 μ H toroid coil (#40-1732).
- () L105: .25 μ H toroid coil (#40-1862, blue dot).
- () L103: 1.31 μ H toroid coil (#40-1869, green dot).
- () L102: .25 μ H toroid coil (#40-1862, blue dot).
- () TC101: 3.395 MHz trap (#40-1888). Solder the lugs to the foil.



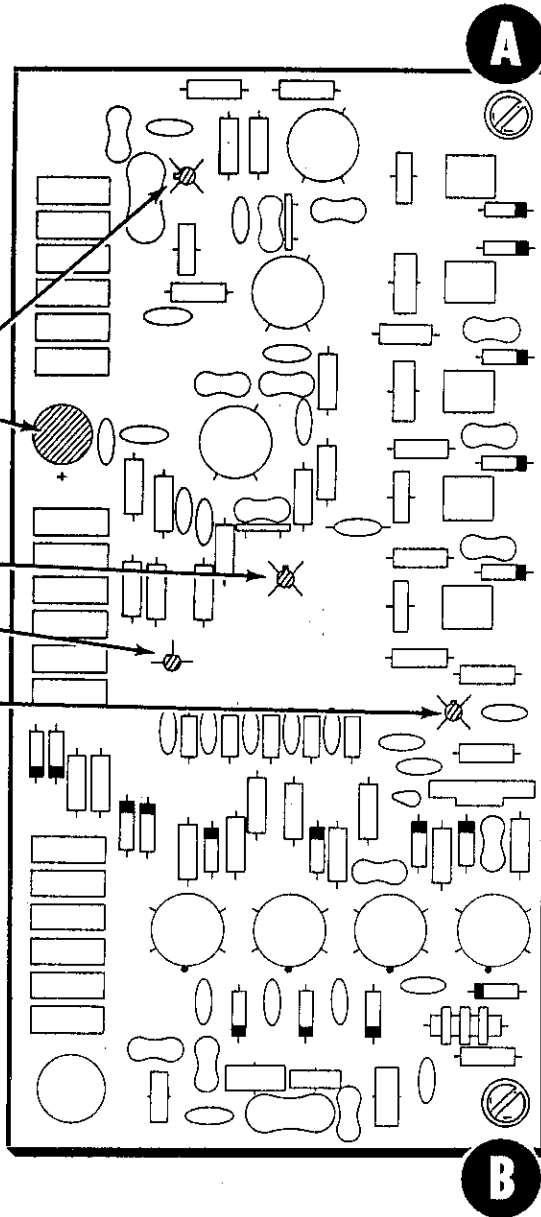
CONTINUE ↪

- () L115: .76 μ H toroid coil (#40-1866, orange dot).
- () L114: 1.31 μ H toroid coil (#40-1869, green dot).
- () L113: 1.59 μ H toroid coil (#40-1870, red dot).
- () L112: 3.8 μ H toroid coil (#40-1874, blue dot).
- () L111: 10.1 μ H toroid coil (#40-1732).
- () RFC102: 300 μ H peaking coil (#40-487, orange-black-brown). Solder the leads to the foil and cut off any excess lead lengths.
- () L104: 1.31 μ H toroid coil (#40-1869, green dot).

PICTORIAL 3-5

START ▾

- () Q103: MFE131 transistor (#417-863). Refer to Detail K.
- () C148: 100 μ F electrolytic. Refer to Detail L.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () Q102: MFE131 transistor (#417-863). Refer to Detail K.
- () Q104: X29A829 transistor (#417-201). Refer to Detail D.
- () Q101: MFE131 transistor (#417-863). Refer to Detail K.



CONTINUE ▾

- () Refer to Detail J and mount a 6-32 x 5/8" spacer at A with a 6-32 x 1/4" screw and a #6 lockwasher.
- () In a similar manner, mount a 6-32 x 5/8" spacer at B.

CIRCUIT BOARD CHECKOUT

Carefully inspect the foil side of the circuit board for the following most commonly made errors.

- () Unsoldered connections.
- () "Cold" solder connections.
- () Solder bridges between foil patterns.
- () Protruding leads which could touch together.

Refer to the illustrations where the parts were installed as you make the following visual checks.

- () Transistors for proper type and installation.
- () Electrolytic capacitor for the correct position of the positive (+) mark.
- () Diodes for the correct position of the banded end.

This completes the assembly of the circuit board. Set it aside until it is called for in a step. Proceed to the "Aud/Reg Circuit Board" Parts List on Page 9.

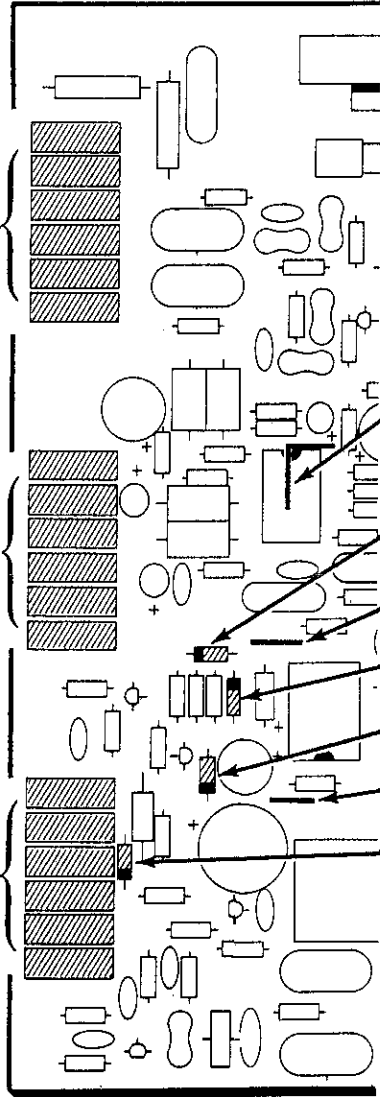
FINISH

PICTORIAL 3-6

AUD/REG CIRCUIT BOARD

START ▶

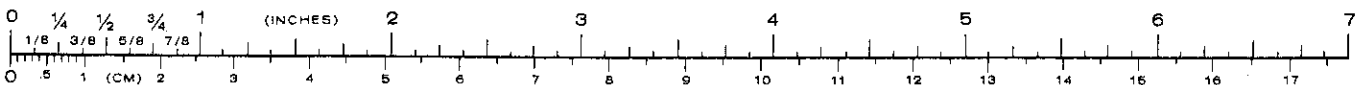
- () Position the AUD/REG circuit board as shown. Then perform the steps in the following Pictorials.
- () Six circuit board connectors. Refer to Detail G.
- () Six circuit board connectors. Refer to Detail G.
- () Six circuit board connectors. Refer to Detail G.



CONTINUE ◀

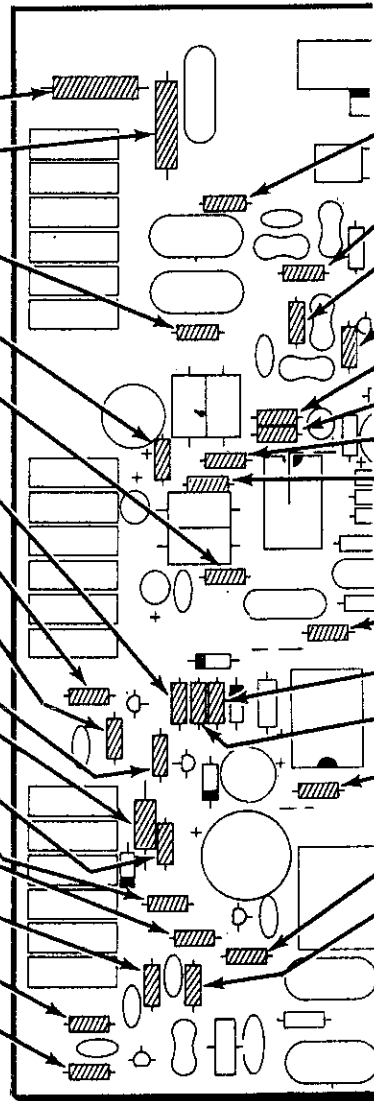
- () Cut a 1-1/4" length of small bare wire. Use this wire in the next step.
- () Form the 1-1/4" small bare wire exactly over the outline of the wire on the circuit board. Push the wire down tightly against the circuit board. Then solder the wire ends to the foil and cut off the excess wire ends.
- () D206: 1N191 diode (#56-26, brown-white-brown). Refer to Detail A.
- () Cut a 3/4" length of small bare wire. Then install the wire at J.
- () D205: 1N191 diode (#56-26, brown-white-brown).
- () ZD201: DO-7 diode (#56-50).
- () Cut a 3/4" length of small bare wire. Then install the wire at J.
- () D207: 1N191 diode (#56-26, brown-white-brown).
- () Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 4-1



START

- () R202: 237 Ω, 1% (red-orange-violet-black).
- () R201: 2370 Ω, 1% (red-orange-violet-brown).
- () R261: 1500 Ω (brown-green-red).
- () R207: 680 kΩ (blue-gray-yellow).
- () R212: 33 kΩ (orange-orange-orange).
- () R226: 100 kΩ (brown-black-yellow).
- () R235: 4700 Ω (yellow-violet-red).
- () R234: 330 Ω (orange-orange-brown).
- () Solder the leads to the foil and cut off the excess lead lengths.
- () R224: 820 Ω (gray-red-brown).
- () Ferrite bead. Refer to Detail H.
- () R233: 680 Ω (blue-gray-brown).
- () R236: 4700 Ω (yellow-violet-red).
- () R253: 100 Ω (brown-black-brown).
- () R258: 6800 Ω (blue-gray-red).
- () R259: 3900 Ω (orange-white-red).
- () R263: 270 Ω (red-violet-brown).
- () Solder the leads to the foil and cut off the excess lead lengths.

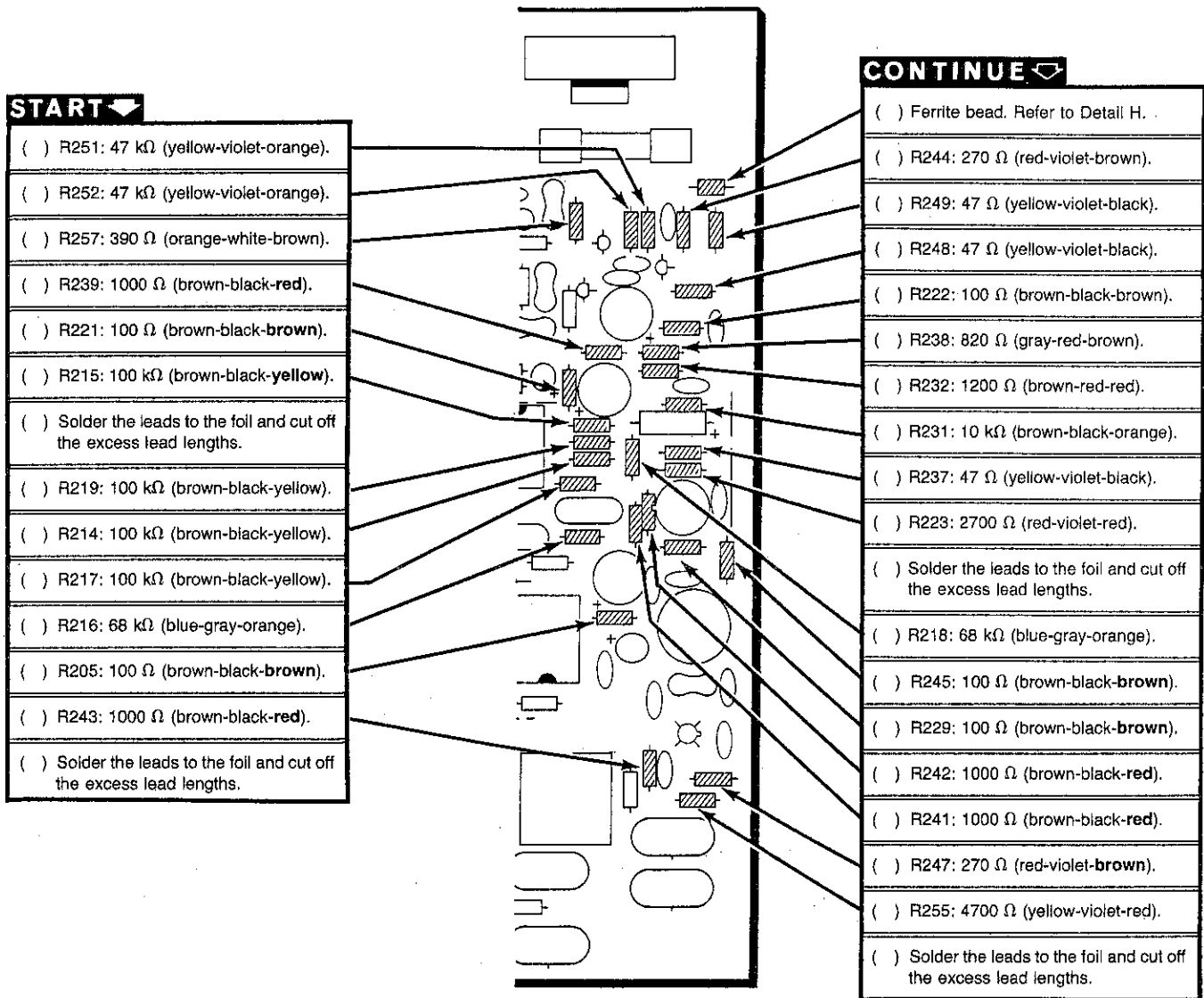


CONTINUE

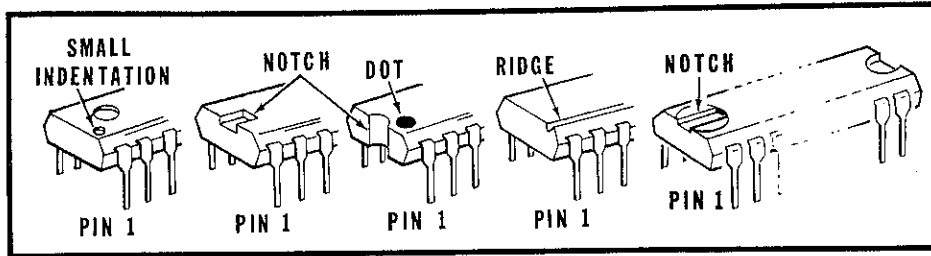
- () R262: 1500 Ω (brown-green-red).
- () R264: 47 kΩ (yellow-violet-orange).
- () R265: 47 kΩ (yellow-violet-orange).
- () R256: 390 Ω (orange-white-brown).
- () R211: 33 kΩ (orange-orange-orange).
- () R213: 680 kΩ (blue-gray-yellow).
- () R208: 1.5 MΩ (brown-green-green).
- () R209: 1.5 MΩ (brown-green-green).
- () Solder the leads to the foil and cut off the excess lead lengths.
- () R204: 3300 Ω (orange-orange-red).
- () R227: 1 MΩ (brown-black-green).
- () R225: 680 kΩ (blue-gray-yellow).
- () R203: 100 Ω (brown-black-brown).
- () R228: 10 kΩ (brown-black-orange).
- () R254: 2200 Ω (red-red-red).
- () Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 4-2

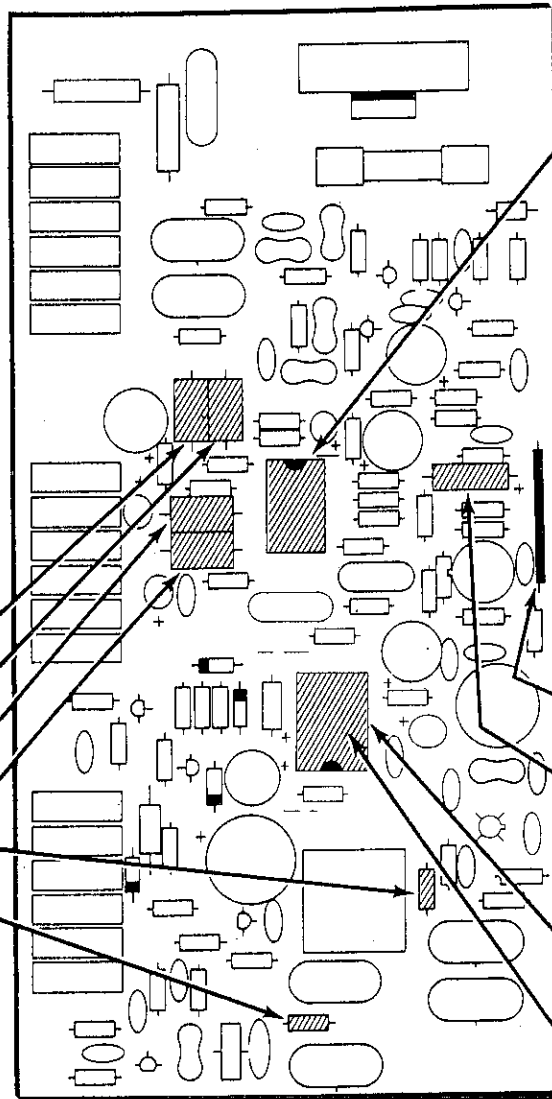




PICTORIAL 4-3



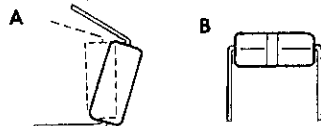
Detail 4-4A



START →

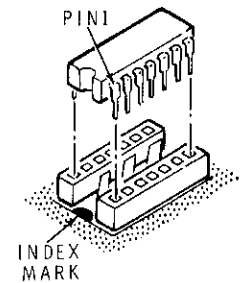
- () C211: 1000 pF polystyrene.
- () C212: 1000 pF polystyrene.
- () C214: 1000 pF polystyrene.
- () C213: 1000 pF polystyrene.
- () C256: 1.5 pF (brown-green-white-silver) phenolic.
- () C254: 1.5 pF (brown-green-white-silver) phenolic.
- () Solder the leads to the foil and cut off the excess lead lengths.

Before you install an IC, be sure the pins are straight. Lay it down on one of its rows of pins, as below at A, and roll it over until the pins are at right angles or are bent in slightly as shown at B. Repeat this process for the other row of pins.



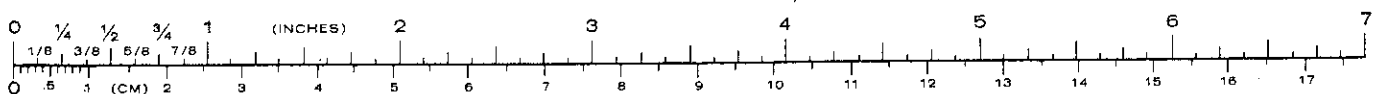
CONTINUE →

- () 14-pin (in-line) IC socket (#434-298). This socket can be installed either way in the circuit board. Solder the pins to the foil.
- () IC203: LM324N IC (#442-602). Refer to Detail 4-4A to identify the pin 1 end of the IC. Then position the pin 1 end of the IC over the index mark on the circuit board and carefully insert the pins into the socket.



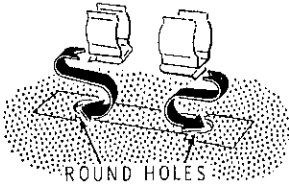
- () Cut a 1-5/8" length of gray wire. Remove 1/4" of insulation from each end. Then install the wire at J.
- () C224: 2 μF electrolytic. Refer to Detail L.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () 14-pin (staggered pin) IC socket (#434-267). This socket can only be installed one way in the circuit board. Solder the pins to the foil.
- () IC202: TBA820L IC (#442-610). Refer to Detail 4-4A to identify the pin 1 end of the IC. Then position the pin 1 end of the IC over the index mark on the circuit board and carefully insert the pins into the socket.

PICTORIAL 4-4

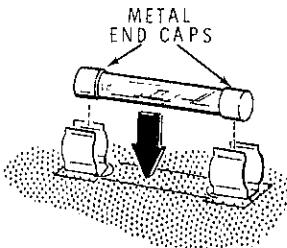


START

- () Slide a fuse clip into each hole in the circuit board at F201 as shown. Do not solder the clips yet.

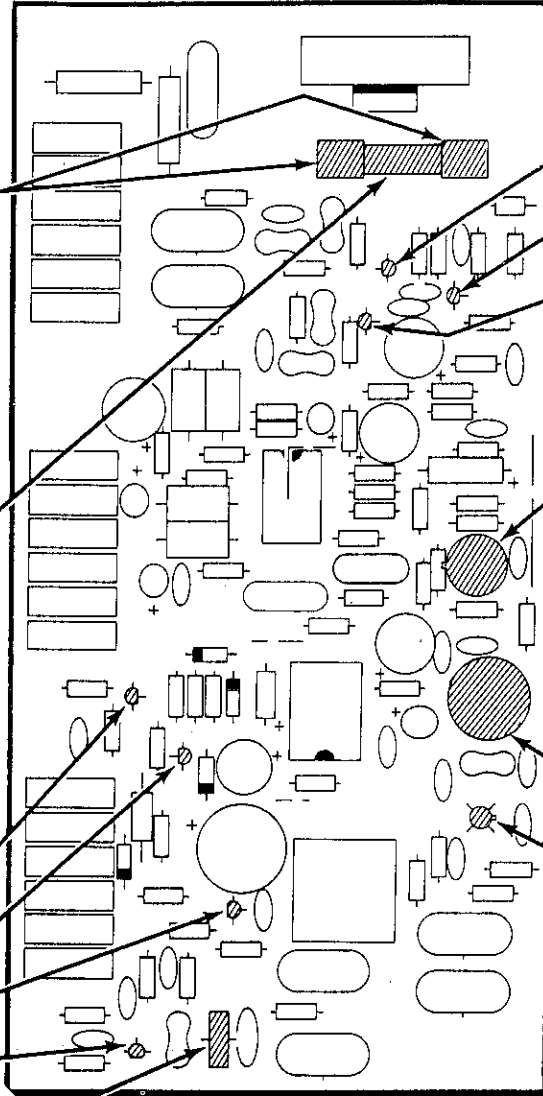


- () F201: Force the ends of the 3/4 ampere fuse into the two clips. Make sure the metal end caps on the fuse are centered in the clips as shown. Then solder the clips to the foil.



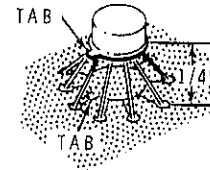
NOTE: Refer to Detail D for the following steps.

- () Q204: EL131 transistor (#417-241).
- () Q203: MPSA20 transistor (#417-801).
- () Q202: X29A829 transistor (#417-201).
- () Q207: MPSA20 transistor (#417-801).
- () L202: 13.2 μ H toroid coil (#40-1877, yellow and white dots). Refer to Detail C.


CONTINUE

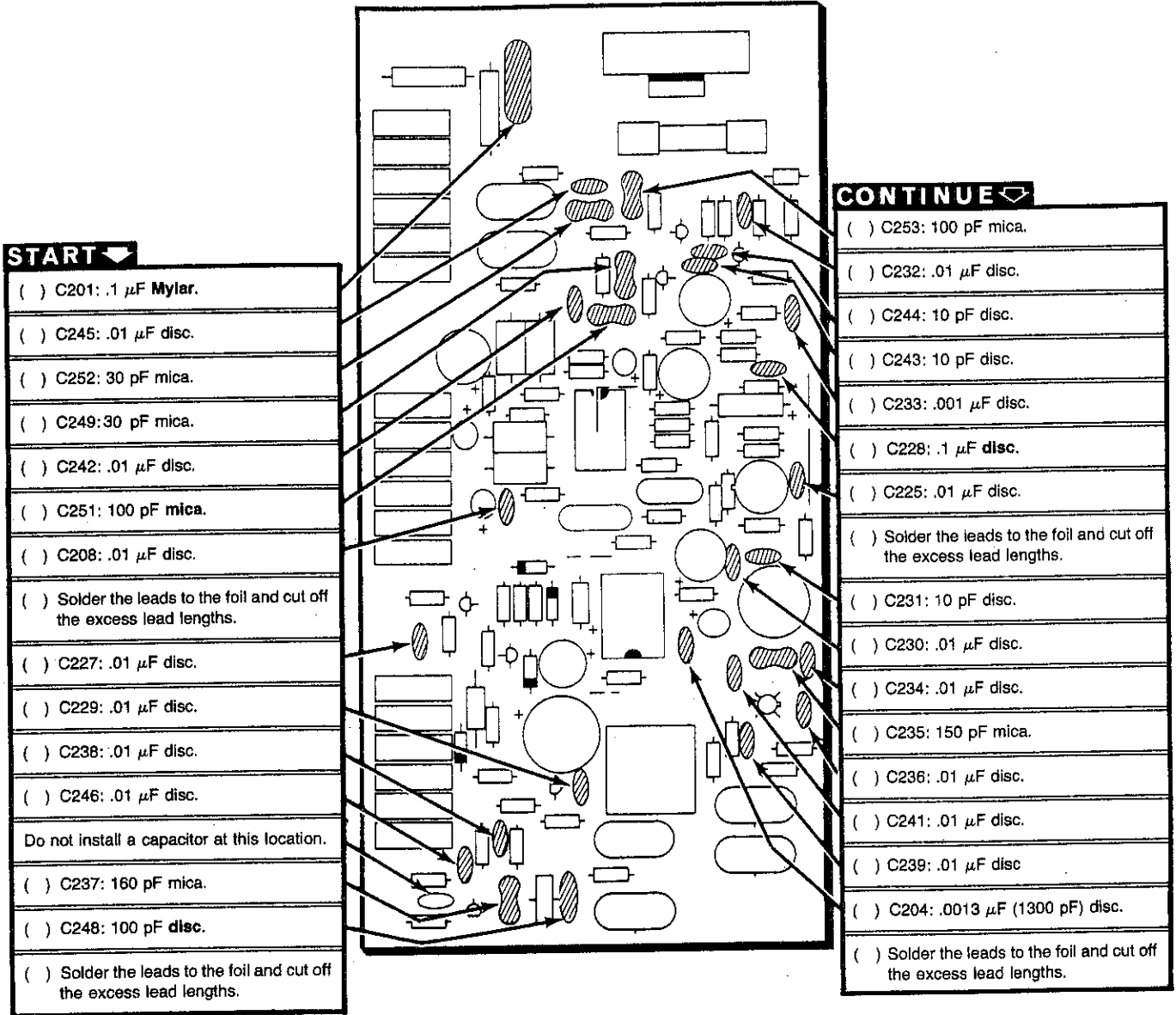
NOTE: Refer to Detail D for the next three steps.

- () Q209: MPF105 transistor (#417-169).
- () Q206: MPSA20 transistor (#417-801).
- () Q208: MPF105 transistor (#417-169).
- () IC204: MC1496G integrated circuit (#442-96). Line up the tab on the IC with the outline of the tab on the circuit board. Then insert the IC leads in their respective circuit board holes. Solder the leads to the foil and cut off the excess lead lengths.



- () L201: 13.9 μ H toroid coil (#40-1881, yellow dot). This coil can be installed in the circuit board only one way. Solder the lugs to the foil.
- () Q205: MFE131 transistor (#417-863). Refer to Detail K.

PICTORIAL 4-5



START ▾

- () C201: .1 μ F Mylar.
- () C245: .01 μ F disc.
- () C252: 30 pF mica.
- () C249: 30 pF mica.
- () C242: .01 μ F disc.
- () C251: 100 pF mica.
- () C208: .01 μ F disc.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () C227: .01 μ F disc.
- () C229: .01 μ F disc.
- () C238: .01 μ F disc.
- () C246: .01 μ F disc.
- Do not install a capacitor at this location.
- () C237: 160 pF mica.
- () C248: 100 pF disc.
- () Solder the leads to the foil and cut off the excess lead lengths.

CONTINUE ▾

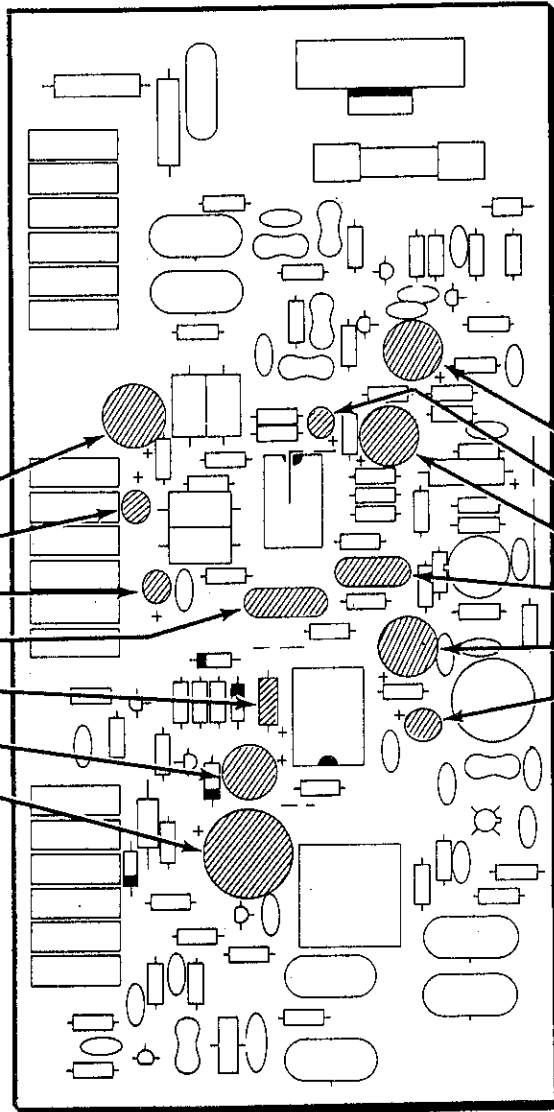
- () C253: 100 pF mica.
- () C232: .01 μ F disc.
- () C244: 10 pF disc.
- () C243: 10 pF disc.
- () C233: .001 μ F disc.
- () C228: .1 μ F disc.
- () C225: .01 μ F disc.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () C231: 10 pF disc.
- () C230: .01 μ F disc.
- () C234: .01 μ F disc.
- () C235: 150 pF mica.
- () C236: .01 μ F disc.
- () C241: .01 μ F disc.
- () C239: .01 μ F disc.
- () C204: .0013 μ F (1300 pF) disc.
- () Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 4-6

START

NOTE: Refer to Detail L when you install electrolytic and tantalum capacitors.

- () C217: 22 μ F electrolytic.
- () C215: 2.2 μ F tantalum.
- () C223: 2.2 μ F tantalum.
- () C221: .1 μ F Mylar.
- () C206: .47 μ F tantalum.
- () C205: 250 μ F electrolytic.
- () C202: 1000 μ F electrolytic.
- () Solder the leads to the foil and cut off the excess lead lengths.


CONTINUE

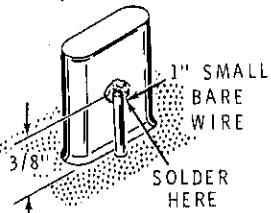
- () C226: 100 μ F electrolytic.
- () C216: 2.2 μ F tantalum.
- () C219: 100 μ F electrolytic.
- () C218: .1 μ F Mylar.
- () C209: 100 μ F electrolytic.
- () C207: 47 μ F tantalum.
- () Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 4-7

START

NOTE: Use the following procedure when you are directed to install a crystal in this circuit board.

1. Install the crystal in the location shown and solder the lugs to the foil.
2. Cut a 1" small bare wire (unless directed otherwise in the step).
3. Solder the 1" small bare wire to the side of the crystal near the area shown and to the circuit board foil. Do not solder near the base of the crystal. Cut off the excess wire ends.



() Y206: 3396.4 kHz crystal (#404-206) and 1" small bare wire.

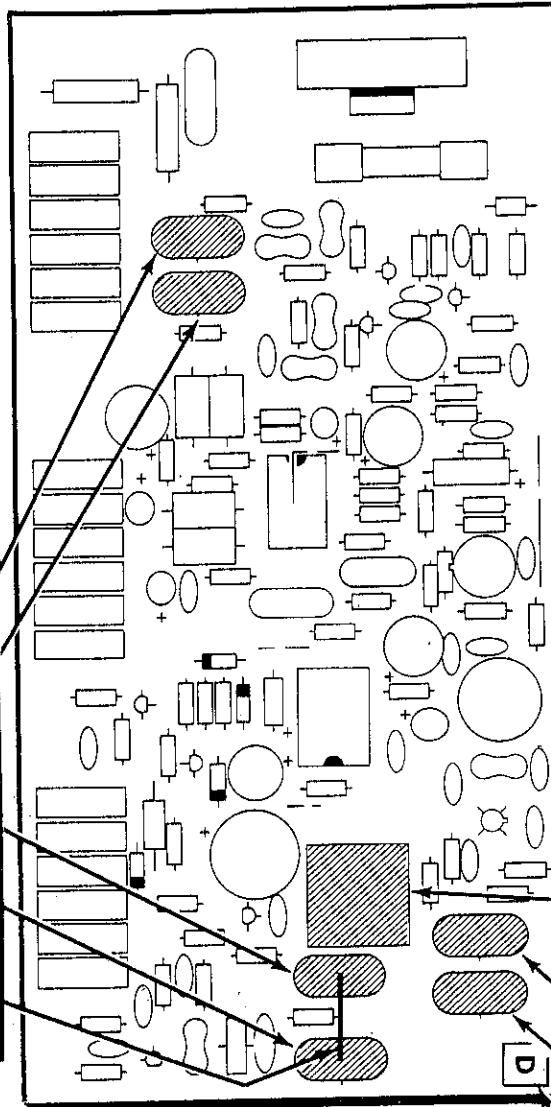
() Y205: 3393.6 kHz crystal (#404-205) and 1" small bare wire.

NOTE: The following crystals are from the filter set (#404-331).

() Y204: 3393.8 kHz (3.3938 MHz) crystal. Do not solder a 1" small bare wire to the side of this crystal.

() Y203: 3395.05 kHz (3.39505 MHz) crystal and 1" small bare wire.

() Solder a 1" small bare wire to the top of the crystals at Y204 and Y203 as shown. Cut off any excess bare wire ends.



CONTINUE

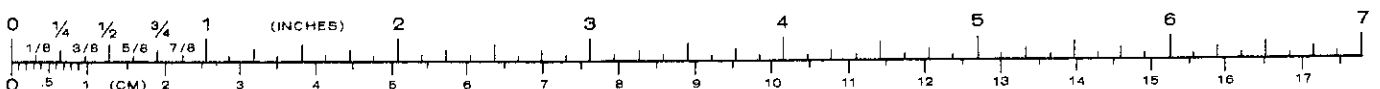
() TC201: 2.83 MHz coil (#40-821). This coil can be installed only one way in the circuit board. Solder all five lugs to the foil.

() Y202: 3395.05 kHz (3.39505 MHz) crystal and 1" small bare wire.

() Y201: 3393.8 kHz (3.3938 MHz) crystal and 1" small bare wire.

() Cut a letter "D" from the terminal identification sheet and remove the adhesive backing. Press the letter onto the circuit board at the location shown.

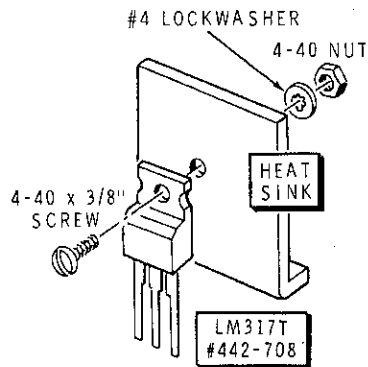
PICTORIAL 4-8



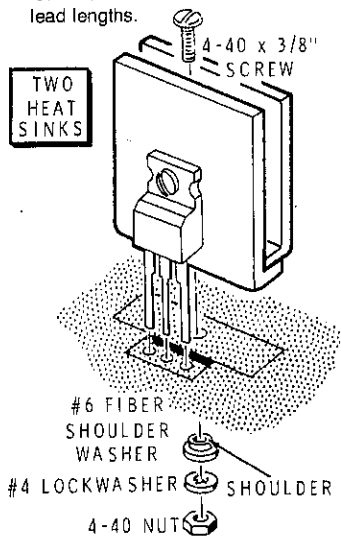
START ▾

NOTE: Use the plastic nut starter supplied with this kit to hold and start 6-32 and 4-40 nuts on screws.

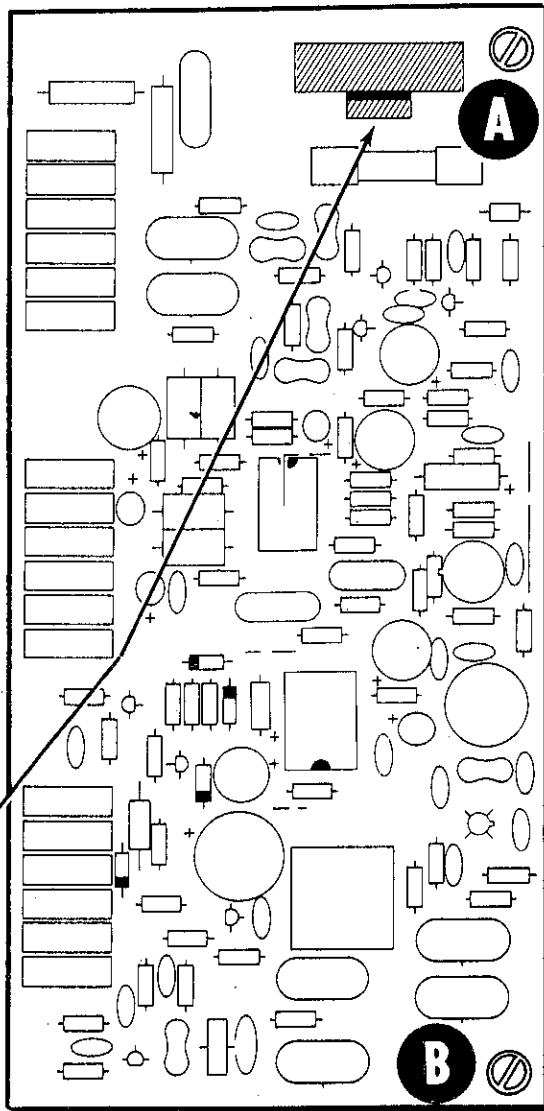
- () Mount an LM317T IC (#442-708) to one of the two heat sinks as shown. Use a 4-40 x 3/8" screw, a #4 lockwasher, and a 4-40 nut. Tighten the hardware only finger tight.



- () IC201: Mount the two heat sinks to the circuit board as shown with a 4-40 x 3/8" screw, a #6 fiber shoulder washer, #4 lockwasher, and a 4-40 nut. Be sure the shoulder on the washer is seated in the circuit board hole and the heat sink is within the outline before you tighten the hardware. Then solder the transistor leads to the foil and cut off the excess lead lengths.



- () Tighten the hardware that is holding the IC to the heat sink.



CONTINUE ▾

- () Refer to Detail J and mount a 6-32 x 5/8" spacer at A with a 6-32 x 1/4" screw and a #6 lockwasher.
- () In a similar manner, mount a 6-32 x 5/8" spacer at B.

CIRCUIT BOARD CHECKOUT

Carefully inspect the foil side of the circuit board for the following most commonly made errors.

- () Unsoldered connections.
- () "Cold" solder connections.
- () Solder bridges between foil patterns.
- () Protruding leads which could touch together.

Refer to the illustrations where the parts were installed as you make the following visual checks.

- () Transistors for proper **type** and **installation**.
- () Integrated circuits for the proper **type** and **installation**.
- () Electrolytic capacitors for the correct position of the positive (+) mark.
- () Diodes for the correct position of the banded end.

This completes the assembly of the circuit board. Set it aside until it is called for in a step. Proceed to the "Chassis" Parts List on Page 12.

FINISH

PICTORIAL 4-9

CHASSIS ASSEMBLY

NOTES:

1. Always tighten the hardware when you install it unless you are instructed to leave it loose.
2. When a step calls for hardware, only the screw size will be given. For example, if "6-32 x 3/8" hardware" is called for, it means you should use a 6-32 x 3/8" screw, one or more #6 lockwashers, and a 6-32 nut at each mounting hole. The Detail referred to in the step will show you the proper number of lockwashers to use.

REAR PANEL PARTS MOUNTING

Refer to Pictorial 5-1 for the following steps.

- () Place a soft cloth on your work surface to prevent the rear panel from becoming scratched.

- () Position the rear panel as shown with the lettered side down.

NOTE: Use the plastic nut starter to hold and start 6-32 and 4-40 nuts on screws.

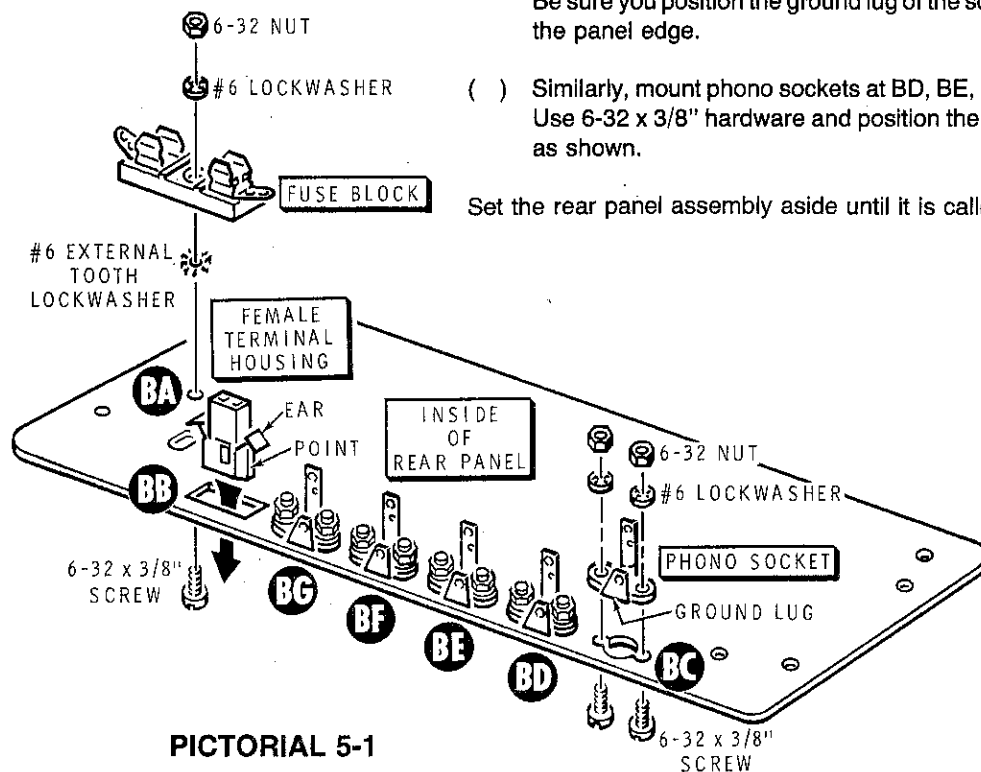
- () Mount the fuse block at BA on the rear panel with 6-32 x 3/8" hardware. Be sure to use the #6 external tooth lockwasher between the fuse block and the rear panel. Position the fuse block parallel to the edges of the rear panel before you tighten the hardware.

- () Install the female terminal housing in hole BB. Be sure to position the side of the housing with the point as shown. Bend the ears of the housing back while you push the housing into place.

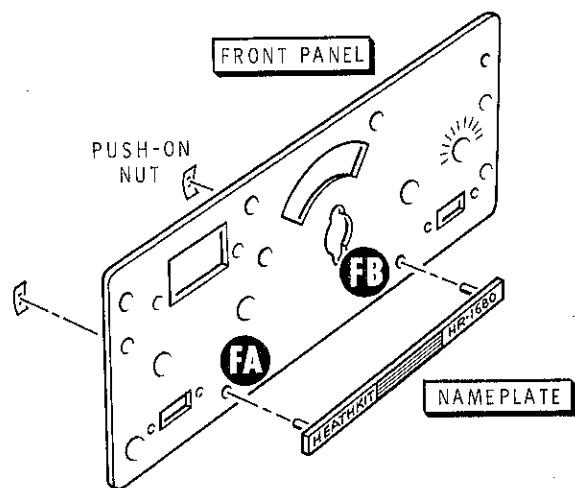
- () Mount a phono socket at BC with 6-32 x 3/8" hardware. Be sure you position the ground lug of the socket toward the panel edge.

- () Similarly, mount phono sockets at BD, BE, BF, and BG. Use 6-32 x 3/8" hardware and position the ground lugs as shown.

Set the rear panel assembly aside until it is called for later.



PICTORIAL 5-1

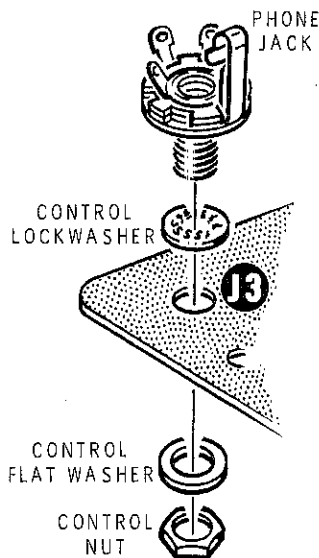


Detail 5-2A

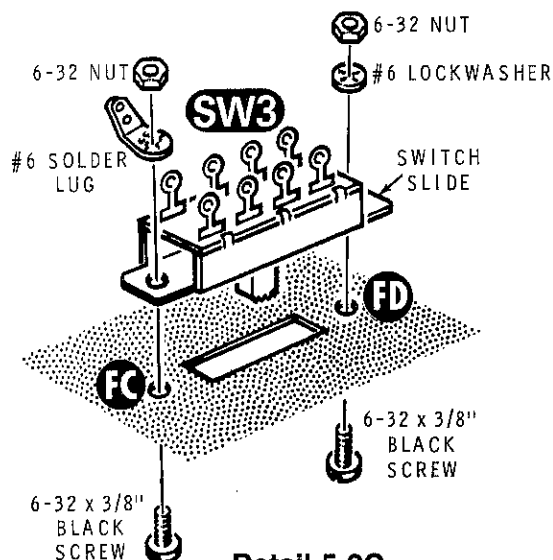
FRONT PANEL PARTS MOUNTING

Refer to Pictorial 5-2 (in the "Illustration Booklet") for the following steps.

- () Place a soft cloth on your work surface so the front panel will not become scratched.
- () Refer to Detail 5-2A and insert the studs on the nameplate into holes FA and FB in the front panel. Then lay the front panel flat on your work surface and secure the nameplate with two push-on nuts.
- () J3: Refer to Detail 5-2B and mount a phone jack at J3. Use a control lockwasher, a control flat washer, and a control nut. Be sure to position the jack as shown in the Pictorial.

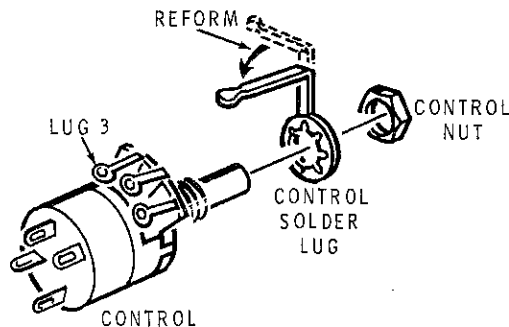


Detail 5-2B

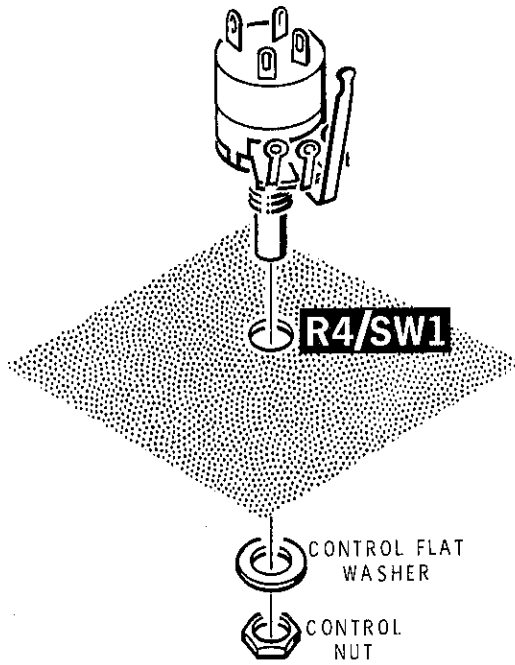


Detail 5-2C

- () SW3: Refer to Detail 5-2C and mount a slide switch at SW3. Use a 6-32 x 3/8" black screw, a #6 solder lug, and a 6-32 nut at FC and a 6-32 x 3/8" black screw, a #6 lockwasher, and a 6-32 nut at FD. Be sure to position the solder lug as shown in the Pictorial.
- () SW2: In a similar manner, mount a slide switch at SW2. Use a 6-32 x 3/8" black screw, a #6 solder lug, and a 6-32 nut at FE and a 6-32 x 3/8" black screw, a #6 lockwasher, and a 6-32 nut at FF. Position the solder lug as shown in the Pictorial.
- () Refer to Detail 5-2D and place a control solder lug and a control nut on the 100 kΩ control with switch (#19-721). Form the solder lug so it touches lug 3 of the control. Solder the two lugs together. Then remove the nut. You will use this control in the next step.

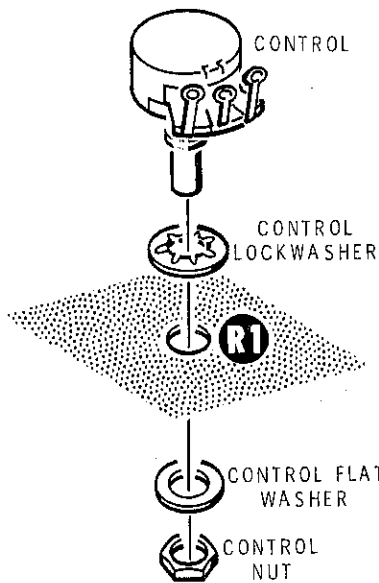


Detail 5-2D

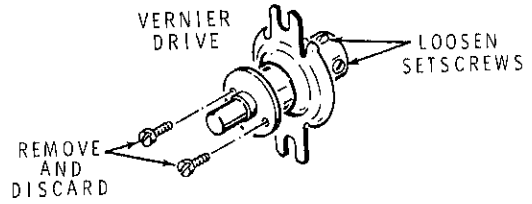


Detail 5-2E

- () R4/SW1: Refer to Detail 5-2E and mount the prepared control at R4/SW1 on the front panel. Use a control flat washer and a control nut. Position the control as shown in the Pictorial.
- () R1: Refer to Detail 5-2F and mount the 3000 (3 k) Ω control (#10-27) at R1. Use a control lockwasher, a control flat washer, and a control nut. Position the control as shown in the Pictorial.

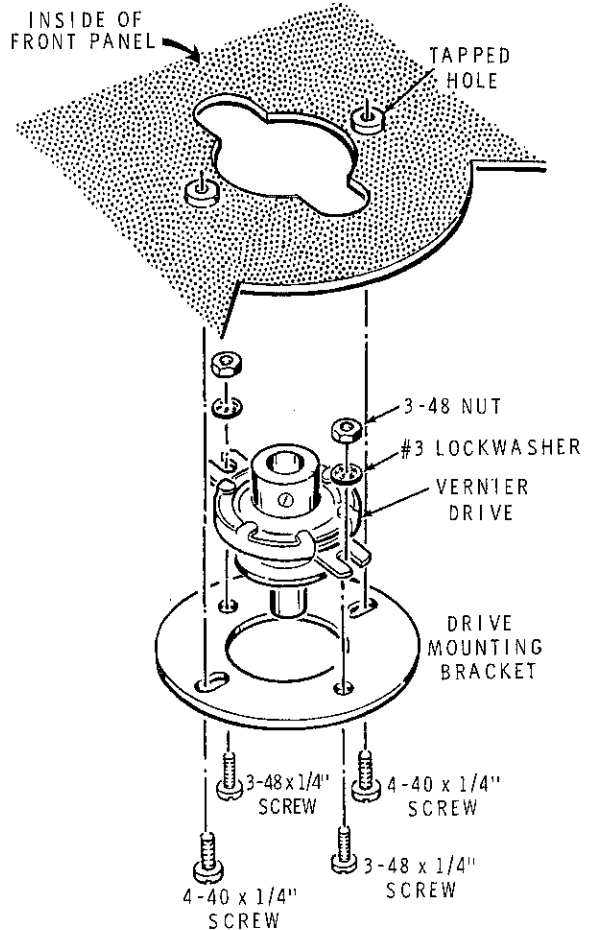


Detail 5-2F

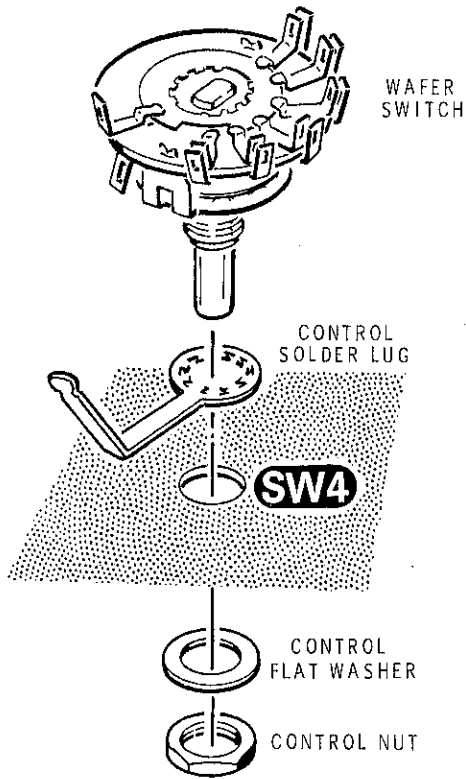


Detail 5-2G

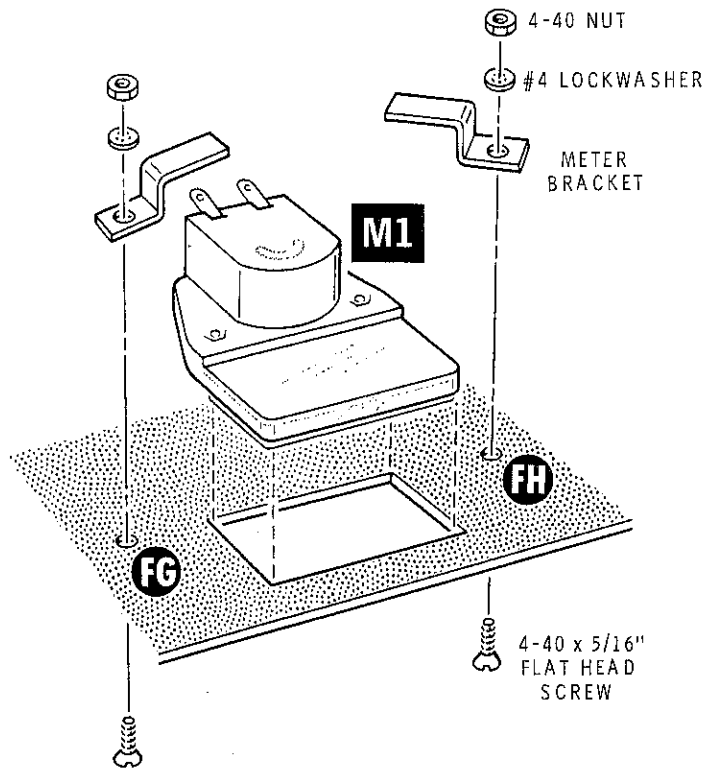
- () Refer to Detail 5-2G and remove and discard the two brass screws in the collar of a vernier drive. Then loosen the two setscrews in the bushing just enough to allow a 1/4" shaft to be inserted into the bushing.
- () Refer to Detail 5-2H and mount the vernier drive onto the drive mounting bracket. Use 3-48 x 1/4" hardware.
- () Again refer to Detail 5-2H and mount the drive mounting bracket onto the front panel. Use 4-40 x 1/4" screws in the two tapped holes. Tighten these screws fingertight only.



Detail 5-2H

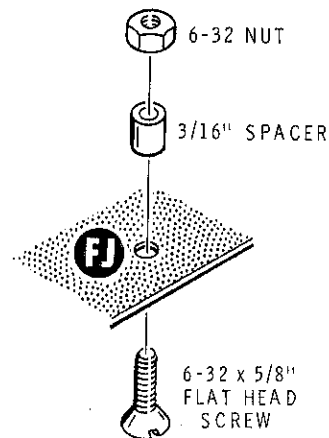


Detail 5-2J

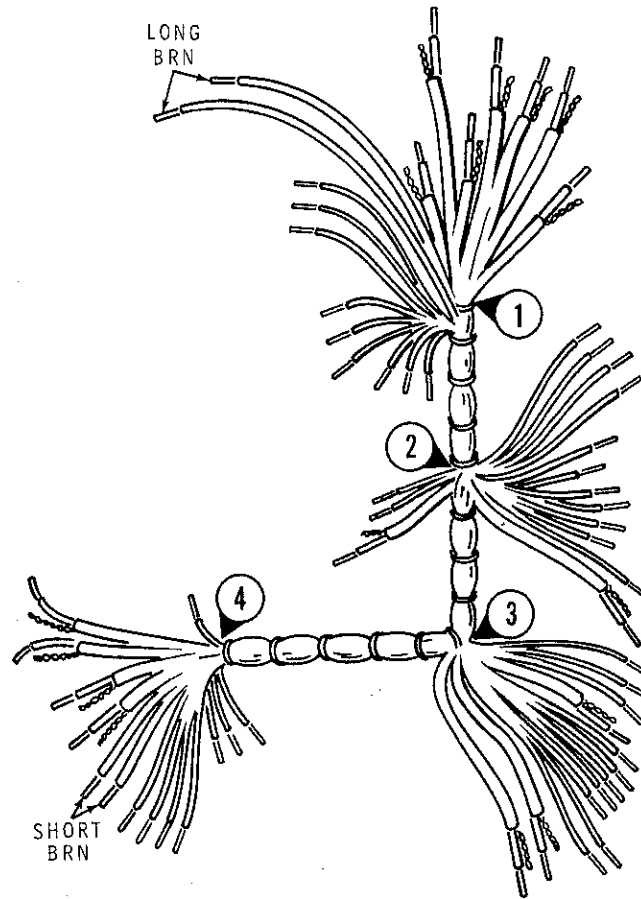


Detail 5-2K

- () SW4: Refer to Detail 5-2J and mount the wafer switch at SW4 on the front panel. Use a control solder lug, a control flat washer, and a control nut. Position the switch and solder lug as shown in the Pictorial.
- () M1: Refer to Detail 5-2K and mount the meter to the front panel. Use a 4-40 x 5/16" flat head screw, a meter bracket, a #4 lockwasher, and 4-40 nut at FG and FH. Position the meter brackets as shown in the Pictorial. **Bend the brackets as necessary so they hold the meter firmly in place.**
- () Inspect the meter terminals carefully. If you find a small wire connecting the two terminals, remove and discard this wire.
- () Refer to Detail 5-2L and mount a 3/16" spacer on the front panel at FJ with a 6-32 x 5/8" flat head screw and a 6-32 nut.
- () Similarly, mount another 3/16" spacer on the front panel at FK with a 6-32 x 1-1/4" black flat head screw and a 6-32 nut.



Detail 5-2L



Detail 5-3A

FRONT PANEL WIRING

Refer to Pictorial 5-3 (in the "Illustration Booklet") for the following steps.

NOTE: When you wire this kit, you will be instructed to prepare wires 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 you will use them.

() Prepare the following wires:

- | | |
|------------|------------|
| 2-1/4" red | 6" gray |
| 1-1/2" red | 3-1/2" red |
| 4" red | 1-1/2" red |

NOTES:

1. In the following steps, (NS) means not to solder because other wires will be added later. "S-" with a number, such as (S-3), means to solder the connection. The number following the "S" tells how many wires are at the connection.
2. When a wire passes through a connection and then goes to another point, as in the next step, the solder instructions will call for two wires (S-2), one entering and one leaving the connection. Be especially careful when

you solder these connections that you apply enough solder and heat to properly solder these "through wires."

Connect the prepared wires as follows:

- () Remove an additional 3/4" (total 1") of insulation from one end of the 2-1/4" red wire. Then connect this end of the wire through SW3 lug 1 (S-2) to solder lug FC (S-1). Connect the other end of the wire to SW3 lug 3 (S-1).
- () 1-1/2" red from SW3 lug 6 (NS) to lug 8 (NS).
- () 4" red from SW3 lug 8 (S-2) to control R1 lug 3 (NS).
- () 6" gray to the solder lug at R4 lug 3 (NS). Route this wire as shown. The free end will be connected later.
- () 3-1/2" red to control R1 lug 3 (S-2). Route this wire as shown. The free end will be connected later.
- () 1-1/2" red from SW2 lug 2 (NS) to lug 4 (S-1).
- () Cut a 1-1/4" length of small bare wire. Then connect the wire from SW4 lug 8 (S-1) to the control solder lug (S-1).

WIRE HARNESS

NOTES:

1. The locations where one or more wires leave the wiring harness are called "breakouts," abbreviated "BO." Each BO has a number, as shown in Detail 5-3A.
2. Harness wires and cables are identified by length and color. Wires may be a solid color, or they may be white with a colored stripe (such as white-red). Cables may also be marked with a color band near the ends.
3. Identify as BO#4 the end of the wire harness which has two **short** brown wires. The other end of the harness is BO#1.

- () Refer to Detail 5-3A and form a right angle bend in the harness at BO#3.

Position the harness near the front panel as shown in the Pictorial. Then connect some of the wires at BO#4 as follows:

NOTE: When you connect shielded cables, always use a 1/2" length of sleeving on the shield lead unless otherwise directed. Refer to inset drawing #1 on the Pictorial for identification of the shield lead.

- () Brown shielded cable — inner lead to J3 lug 2 (S-1).
— shield lead to J3 lug 1 (NS).
- () Black shielded cable — inner lead to J3 lug 3 (S-1).
— shield lead to J3 lug 1 (S-2).
- () White-green wire to SW3 lug 5 (S-1).
- () Red wire to SW3 lug 6 (S-2).
- () White-orange wire to SW3 lug 7 (S-1).
- () **Either** black wire to SW1 lug 1 (S-1).
- () Other black wire to SW1 lug 2 (S-1).

NOTE: When you are directed to "make a mechanically secure connection," as in the next two steps, refer to inset drawing #2 on the Pictorial.

- () **Either** brown wire to SW1 lug 3 (S-1). Make a mechanically secure connection.

- () Other brown wire to SW1 lug 4 (S-1). Make a mechanically secure connection.
- () Green shielded cable — inner lead to R4 lug 2 (S-1).
— shield lead to the solder lug at R4 lug 3 (NS).
- () Yellow shielded cable — inner lead to R4 lug 1 (S-1).
— shield lead to the solder lug at R4 lug 3 (S-3).
- () Orange wire to R1 lug 2 (NS).

The white-black and the white-red wires will be connected later.

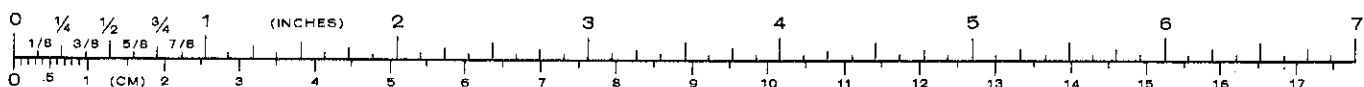
Connect the wires at BO#3 as follows:

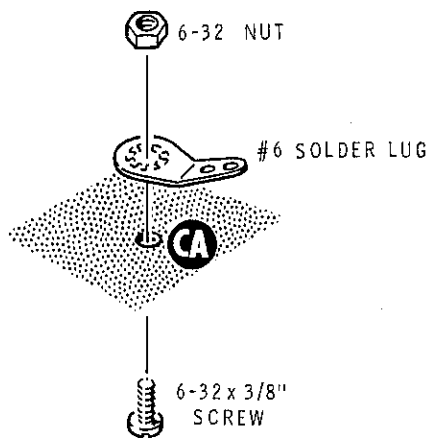
- () Red shielded cable — inner lead to SW2 lug 1 (S-1).
— shield lead to solder lug FE (NS).
- () Yellow shielded cable — inner lead to SW2 lug 2 (S-2).
— shield lead to solder lug FE (NS).
- () Orange shielded cable — inner lead to SW2 lug 3 (S-1).
— shield lead to solder lug FE (S-3).
- () White-red wire to SW2 lug 7 (S-1).
- () Carefully identify the **shortest** of the three red wires at this breakout. Then connect this wire to SW2 lug 8 (S-1).

NOTE: When you connect the following wires to switch SW4, be sure to connect each wire to **both** lugs at each location. The solder instructions will indicate two lugs (S-2).

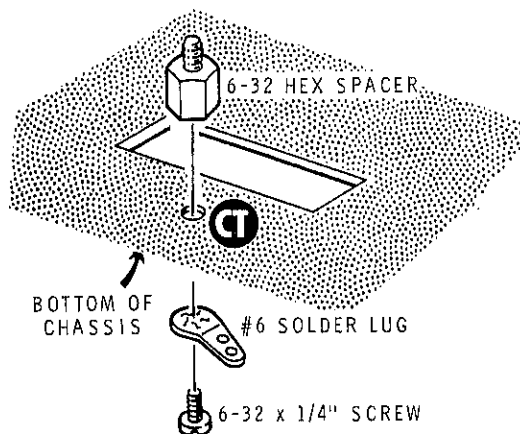
- () White-brown wire to SW4 lug 1 (S-2).
- () Brown wire to SW4 lug 2 (S-2).
- () Green wire to SW4 lug 3 (S-2).
- () White-blue wire to SW4 lug 4 (S-2).
- () Yellow wire to SW4 lug 5 (S-2).
- () Gray wire to SW4 lug 6 (S-2).
- () Both remaining red wires to SW4 lug 7 (S-2). NOTE: There is only one lug at this location.

Set the front panel assembly aside until it is called for in a step.





Detail 5-4A

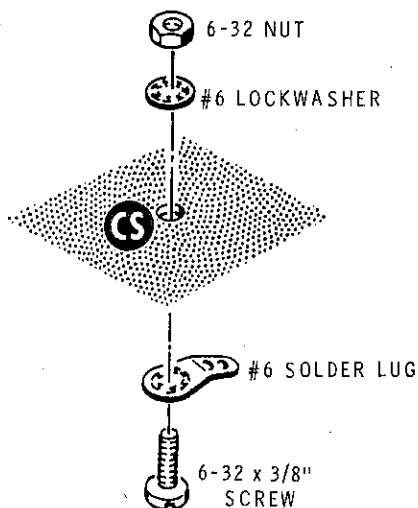


Detail 5-4C

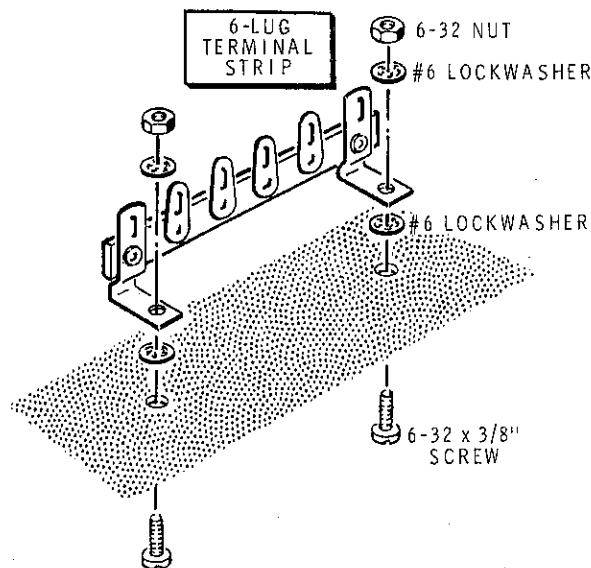
TOP CHASSIS

Refer to Pictorial 5-4 (in the "Illustration Booklet") for the following steps.

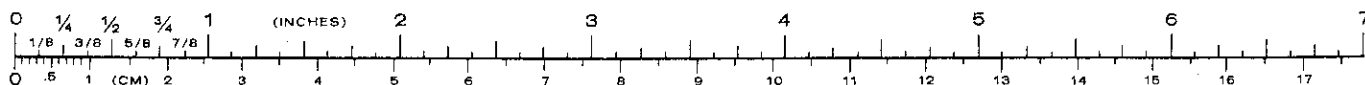
- () Position the chassis on your work surface as shown.
- () Refer to Detail 5-4A and mount a #6 solder lug at CA with 6-32 x 3/8" hardware. Position the solder lug as shown in the Pictorial.
- () Refer to Detail 5-4B and mount a #6 solder lug on the bottom of the chassis at CS with 6-32 x 3/8" hardware. Position the lug as shown in the Pictorial.
- () Refer to Detail 5-4C and mount a #6 solder lug on the bottom of the chassis at CT with a 6-32 hex spacer and a 6-32 x 1/4" screw. Position the solder lug as shown on the Pictorial.
- () Refer to Detail 5-4D and mount a 6-lug terminal strip at CB with 6-32 x 3/8" hardware.
- () In a similar manner, mount another 6-lug terminal strip at CC with 6-32 x 3/8" hardware.

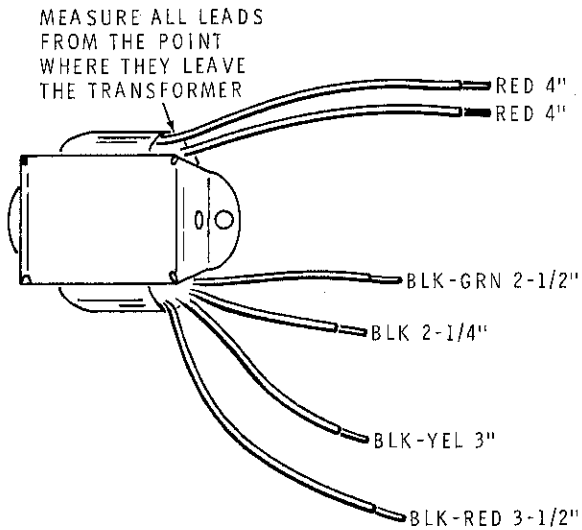


Detail 5-4B



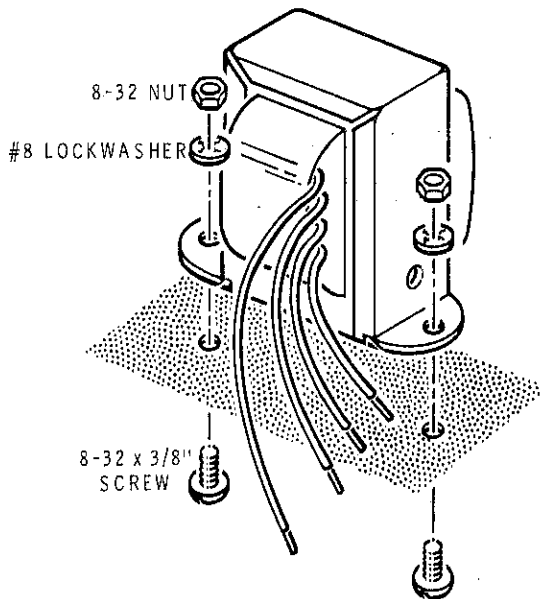
Detail 5-4D





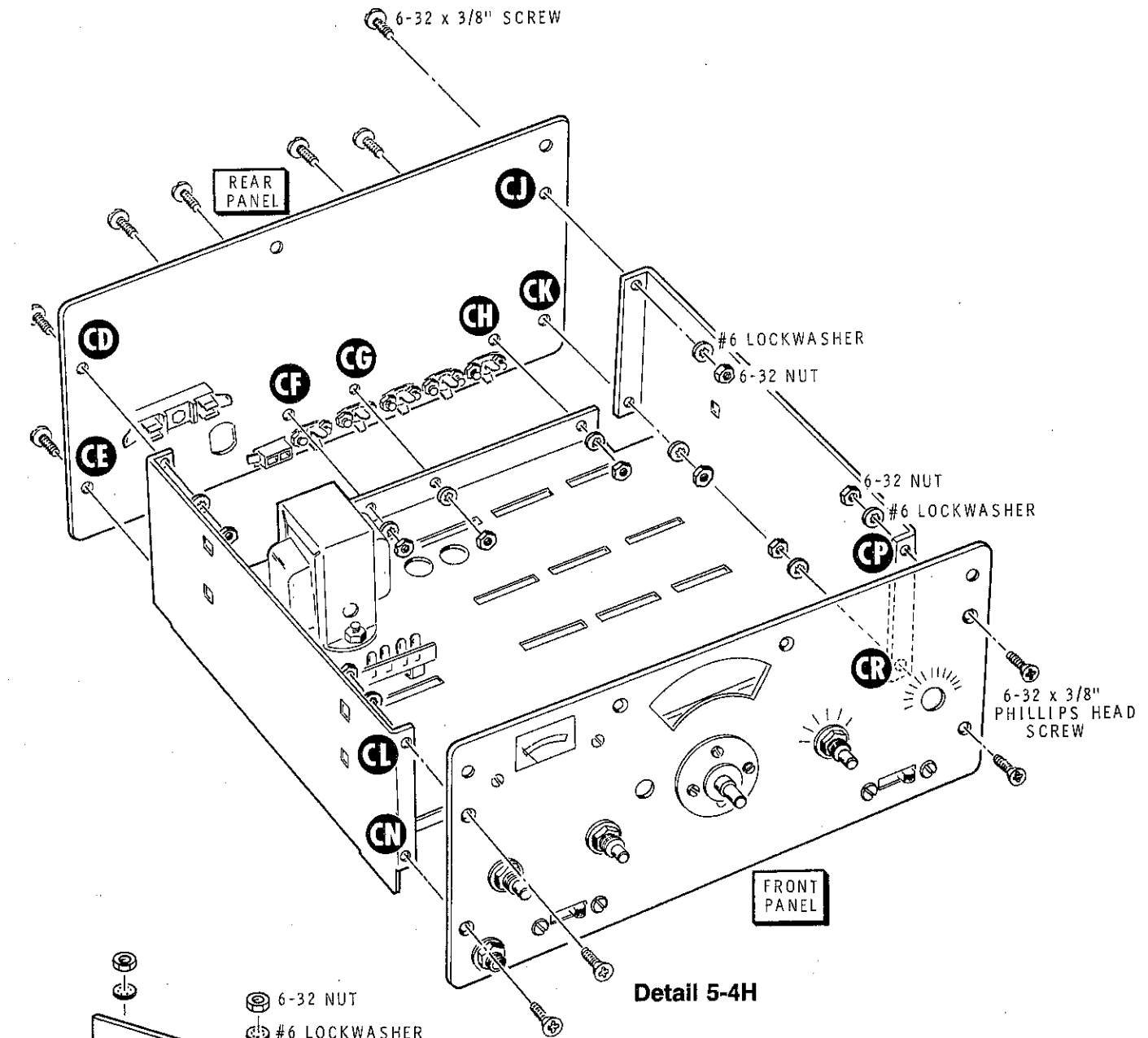
Detail 5-4E

- () Connect the black-green transformer lead to terminal strip CB lug 4 (NS). Make a mechanically secure connection.
- () Connect the black-yellow transformer lead to terminal strip CB lug 3 (NS). Make a mechanically secure connection.
- () Connect the black-red transformer lead to terminal strip CB lug 2 (NS). Make a mechanically secure connection.
- () Prepare a 14" red wire. Then connect one end of the 14" red wire to terminal strip CC lug 5 (NS). Route the wire along the side and under the rear of the chassis as shown. The free end will be connected later.
- () Connect the **upper** red transformer lead to terminal strip CC lug 4 (NS).
- () Connect the other red transformer lead to terminal strip CC lug 3 (NS).
- () Refer to Detail 5-4E and cut the leads of the power transformer to the lengths shown. Then remove 1/4" of insulation from the end of each lead. Melt a small amount of solder on the end of each lead, if not already done.
- () T1: Refer to Detail 5-4F and mount the power transformer at T1 with 8-32 x 3/8" hardware. Be sure to position the transformer as shown in the Pictorial.
- () Connect the black transformer lead to terminal strip CB lug 5 (NS). Make a mechanically secure connection.

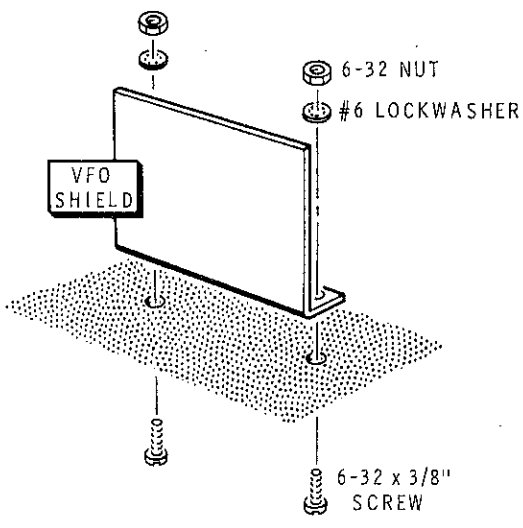


Detail 5-4F

- () D1: Connect the lead at the banded end of a 1N4002 diode (#57-65) to terminal strip CC lug 5 (NS). Connect the other diode lead to lug 4 (NS).
- () D2: Connect the lead at the banded end of a 1N4002 diode (#57-65) to terminal strip CC lug 4 (S-3). Connect the other diode lead to lug 2 (NS).
- () D3: Connect the lead at the banded end of a 1N4002 diode (#57-65) to terminal strip CC lug 3 (NS). Connect the other diode lead to lug 2 (NS).
- () D4: Connect the lead at the banded end of a 1N4002 diode (#57-65) to terminal strip CC lug 5 (NS). Connect the other diode lead to lug 3 (S-3).
- () C2: Connect the lead at the positive (+) marked end of a 1500 μ F electrolytic capacitor to terminal strip CC lug 5 (S-4). Connect the other capacitor lead through lug 1 (S-2) to lug 2 (S-3).
- () Carefully check the leads of the four diodes now mounted on terminal strip CC. Make sure none of the leads touch each other unless they go to the same terminal strip lug.

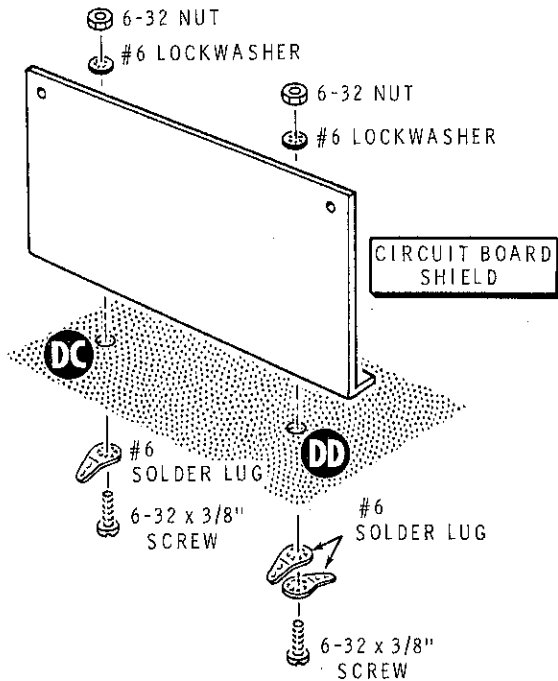


Detail 5-4H

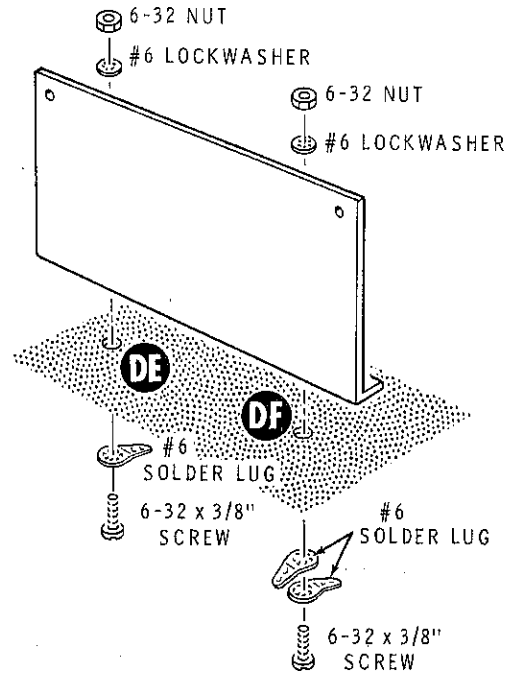


Detail 5-4G

- () Refer to Detail 5-4G and mount the VFO shield to the chassis at DA and DB with 6-32 x 3/8" hardware.
- () Refer to Detail 5-4H and mount the rear panel assembly to the chassis at CD, CE, CF, CG, CH, CJ, and CK. Use 6-32 x 3/8" hardware at each location. Be careful not to pinch the red wire coming from terminal strip CC between the chassis and the rear panel.



Detail 5-4J

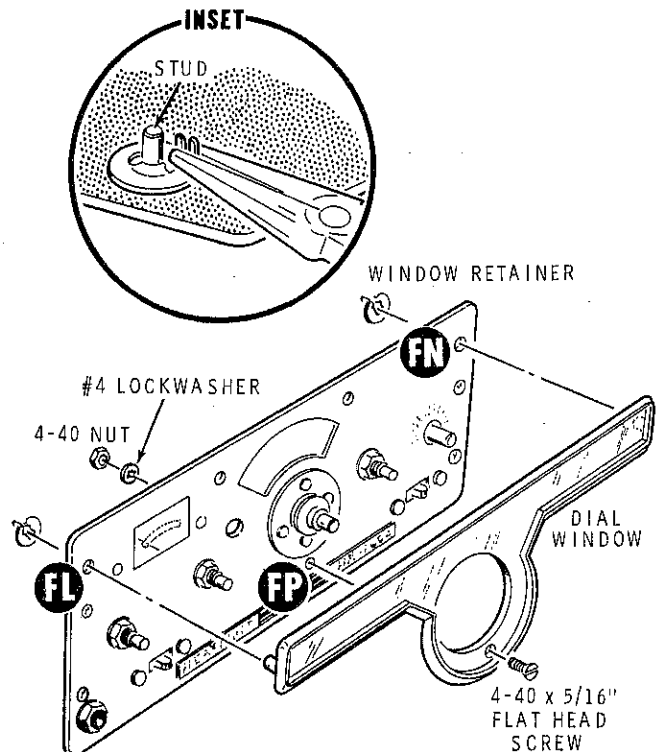


Detail 5-4K

- () Refer to Detail 5-4J and mount a circuit board shield to the chassis at DC and DD with 6-32 x 3/8" hardware. Use a #6 solder lug at DC and two #6 solder lugs at DD. Position the solder lugs as shown in the Pictorial.
- () Refer to Detail 5-4K and mount a circuit board shield to the chassis at DE and DF with 6-32 x 3/8" hardware. Use a #6 solder lug at DE and two #6 solder lugs at DF. Position the solder lugs as shown in the Pictorial.
- () Refer again to Detail 5-4H and mount the front panel assembly to the chassis at CL, CN, CP, and CR. Use 6-32 x 3/8" phillips head hardware at each location. Be sure the wire harness is under the chassis and the white-black harness wire is on top of the chassis as shown in the Pictorial.

() Wipe off the dial window with water and detergent to remove all fingerprints. DO NOT SOAK. After the window is dry, do not touch the red part of the window.

() Refer to Detail 5-4L and mount the dial window onto the front panel. First insert the studs on the window into holes FL and FN. Then refer to the inset drawing and secure the window at FL and FN with two window retainers. Secure the window at FP with 4-40 x 5/16" flat head hardware. **Do not overtighten the hardware at FP.**



Detail 5-4L

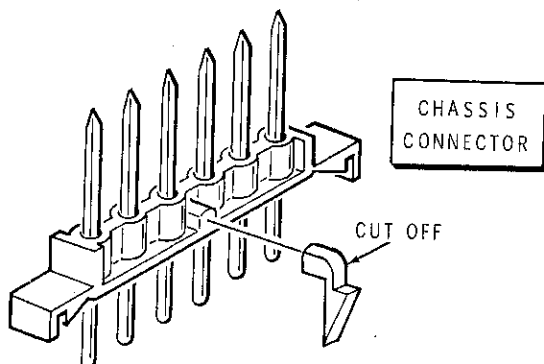
BOTTOM CHASSIS

Refer to Pictorial 5-5 (in the "Illustration Booklet") for the following steps.

- () Position the chassis with the bottom side up as shown in the Pictorial.
- () Refer to Detail 5-5A and cut the arrow-shaped lug from 12 chassis connectors. Set three of the chassis connectors aside for use during "Alignment."
- () Refer to Detail 5-5B (in the "Illustration Booklet") and install 9 of the chassis connectors in the 9 rectangular openings in the chassis. Install each connector with the rounded terminals down. Bend the tabs of the connectors up and place the slotted tab against one end of the opening until it snaps into place (use a screwdriver blade, if necessary).

NOTE: The terminal identification labels, which you will install in the following steps, will positively identify each of the plug-in terminals. It is very important that you affix each label at the correct connector and that you align each number with its pin as shown in the inset drawing on the Pictorial. To install a label, remove the number strips from the paper backing, align the numbers with the terminals, and press the label carefully into position. Refer to the Pictorial for the position of each label. A pair of tweezers may help you position the labels.

- () Remove the four rows of D labels. Discard row D19-24. Then affix the other three rows as shown in the Pictorial.
- () Remove the four rows of C labels. Discard row C13-18 and C19-24. Then affix the other two rows.
- () Remove the four rows of A labels. Discard row A19-24. Then affix the other three rows.



Detail 5-5A

- () Remove the four rows of B labels. Discard rows B7-12, B13-18, and B19-24. Then affix row B1-6.

NOTE: When you solder a wire to a terminal of a chassis connector, wrap the end of the wire tightly around the terminal as close to the connector body (or previously installed wire) as possible. When you are directed to solder a terminal, place the tip of your soldering iron against the terminal and the wire and heat the parts thoroughly. Then touch the end of the solder to the joint and melt a small amount of solder on the parts. Make sure each wire is soldered.

- () Cut the following lengths of small bare wire:

1-1/2"	1-1/4"
1"	1-1/2"
1-3/4"	1-1/4"
1-1/4"	1-1/2"
1"	

Connect the prepared small bare wires as follows:

- () 1-1/2" from D2 (NS) to solder lug DF (NS).
- () 1" from D10 (NS) to solder lug CS (S-1).
- () 1-3/4" from D13 (S-1) to solder lug DE (NS).
- () 1-1/4" from C2 (S-1) to solder lug DG (S-1).
- () 1" from C5 (NS) to solder lug DD (S-1).
- () 1-1/4" from A2 (NS) to solder lug DH (S-1).
- () 1-1/2" from A15 (S-1), around A14 (NS), to solder lug DC (NS).
- () 1-1/4" from A17 (NS) to solder lug DC (S-2).
- () 1-1/2" from B4 (S-1), against B3 (S-2), around B2 (NS), to solder lug CT (S-1).
- () Prepare the following wires:

One 6" gray	Two 5-3/4" gray
One 6" red	One 7-1/2" gray
One 2-1/2" gray	One 3-1/2" red
One 2-3/4" gray	One 7" red
Three 6-1/2" gray	

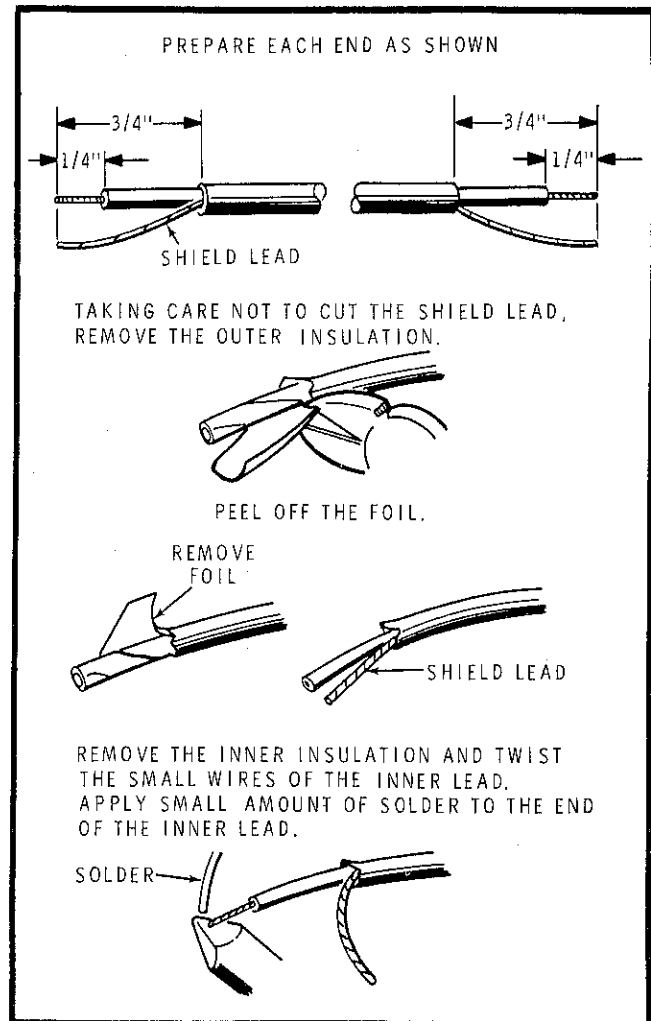
Connect the prepared wires as follows:

- () 6" gray from D3 (NS) to BF lug 1 (S-1).
- () 6" red from D4 (NS) to D16 (NS).

- () Connect the free end of the red wire coming from terminal strip CC lug 5 to D18 (S-1).
- () 2-1/2" gray from C1 (S-1) to A1 (NS).
- () 2-3/4" gray from C4 (S-1) to A3 (NS).
- () 6-1/2" gray from A4 (NS) to C8 (S-1).
- () 6-1/2" gray from A5 (NS) to C9 (S-1).
- () 6-1/2" gray from A6 (NS) to C10 (S-1).
- () 5-3/4" gray from A7 (NS) to C11 (S-1).
- () 5-3/4" gray from A8 (NS) to C12 (S-1).
- () 7-1/2" gray from A11 (NS) to B5 (S-1).
- () 3-1/2" red from A12 (NS) to C7 (NS).
- () 7" red from A12 (NS) to B6 (S-1).
- () Refer to Detail 5-5C and prepare a 6-1/2" and a 4" shielded cable.

Connect the prepared shielded cables to the chassis connector terminals as follows. The connections of the center conductors are designated first in each step, followed by the shield wires. Be sure to use 1/2" of sleeving on each shield lead.

- () 6-1/2" shielded cable from C6 (S-1) to A13 (S-1), with the shield wires to C5 (S-2) and A14 (S-3).
- () 4" shielded cable from A16 (S-1) to B1 (S-1), with the shield wires to A17 (NS) and B2 (S-3).
- () R3: Connect a 10 k Ω (brown-black-orange) resistor from BD lug 1 (S-1) to D9 (NS). Use 1/4" of sleeving on each lead.
- () R2: Slide a 3/8" length of sleeving on one lead of a 47 Ω (yellow-violet-black) resistor. Then connect this lead of the resistor to D6 (NS). Connect the other resistor lead to solder lug DF (NS).



Detail 5-5C

- () C5: Connect a .1 μ F Mylar capacitor from D4 (S-2) to solder lug DF (NS). Use 1/4" of sleeving on each lead.
- () C4: Connect a .1 μ F Mylar capacitor from D16 (NS) to solder lug DE (S-2). Use 1/4" of sleeving on each lead.



Refer to Pictorial 5-6 (in the "Illustration Booklet") for the following steps.

- () Position the harness against the bottom of the chassis as shown.
- () Place the plastic cable clamp around the harness in the approximate location shown.

Connect the wires coming from BO#2 of the harness as follows:

- () White-red wire to C3 (S-1).
- () Carefully identify the two longest red wires at this breakout. Then connect these two wires to C7 (S-3).
- () Gray wire to A3 (S-2).
- () Yellow wire to A4 (S-2).
- () White-blue wire to A5 (S-2).
- () Green wire to A6 (S-2).
- () Brown wire to A7 (S-2).
- () White-brown wire to A8 (S-2).
- () White-yellow wire to A9 (S-1).
- () Orange wire to A10 (S-1).
- () White-violet wire to A11 (S-2).
- () Remaining red wire to A12 (S-3).
- () Blue shielded cable — inner lead to A1 (S-2).
— shield lead to A2 (S-2).
- () Violet shielded cable — inner lead to A18 (S-1).
— shield lead to A17 (S-3).

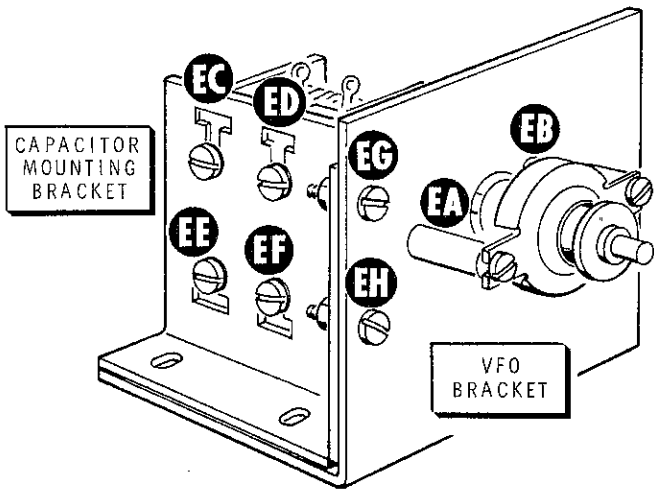
Connect the wires coming from BO#1 as follows:

- () White-violet wire to D3 (S-2).
- () White-yellow wire to D5 (S-1).
- () White-black wire to D7 (S-1).

- () White-red wire to D8 (S-1).
- () White-green wire to D14 (S-1).
- () White-orange wire to D15 (S-1).
- () Red wire to D16 (S-3).
- () **Short** black wire to D17 (S-1).
- () Route the two brown wires down through chassis cutout AA. They will be connected later.
- () Brown shielded cable — inner lead to BC lug 1 (S-1).
— shield lead to BC lug 2 (S-1).
- () Blue shielded cable — inner lead to BG lug 1 (S-1).
— shield lead to BG lug 2 (NS).
- () Violet shielded cable — inner lead to D1 (S-1).
— shield lead to D2 (S-2).
- () Black shielded cable — inner lead to D6 (S-2).
— shield lead to solder lug DF (S-4).
- () Green shielded cable — inner lead to D9 (S-2).
— shield lead to D10 (NS).
- () Red shielded cable — inner lead to D11 (S-1).
— shield lead to D10 (NS).
- () Orange shielded cable — inner lead to D12 (S-1).
— shield lead to D10 (S-4).
- () Refer to the inset drawing and install a male terminal on the free end of the long black wire coming from BO#1 of the harness. Then, when the solder connection is cool, push the terminal into BB hole 2 until it locks in place.
- () Prepare a 2" gray wire.
- () Install a male terminal on one end of the wire. Then, when the solder connection is cool, push the terminal into BB hole 1 until it locks in place. Connect the free end of the wire to BG lug 2 (S-2).
- () Inspect each terminal of each chassis connector. Make sure all wires are soldered at each terminal.

Set the chassis aside temporarily.



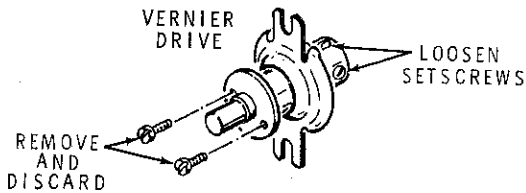


PICTORIAL 5-7

VFO ASSEMBLY

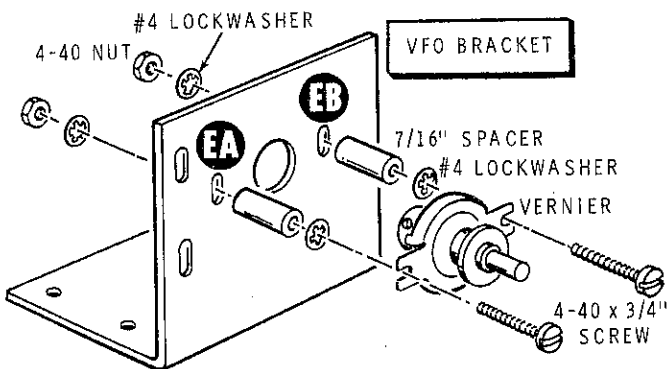
Refer to Pictorial 5-7 for the following steps.

- () Refer to Detail 5-7A and remove and discard the two brass screws in the collar of the remaining vernier drive. Then loosen the two setscrews in the bushing just enough to allow a 1/4" shaft to be inserted into the bushing.

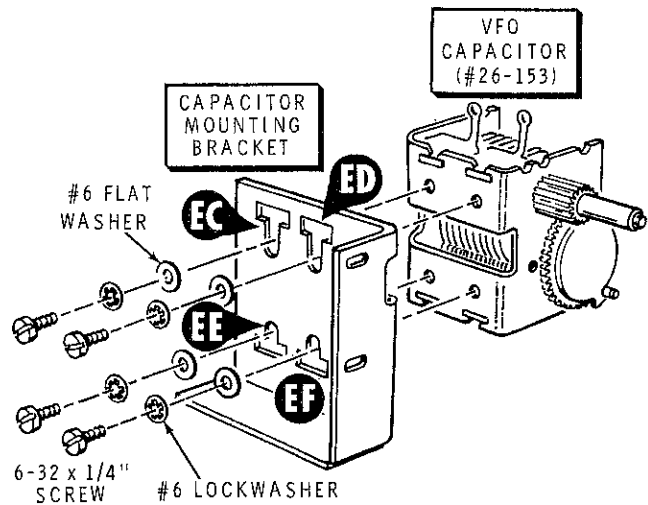


Detail 5-7A

- () Refer to Detail 5-7B and loosely mount the vernier to the VFO bracket at EA and EB with 7/16" spacers and 4-40 x 3/4" hardware.

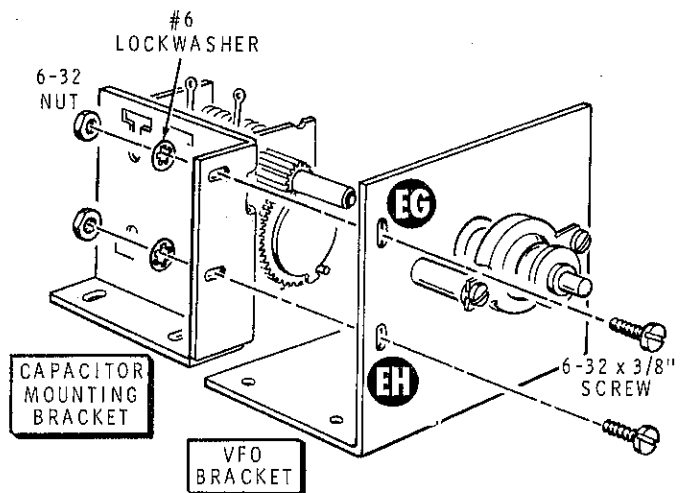


Detail 5-7B

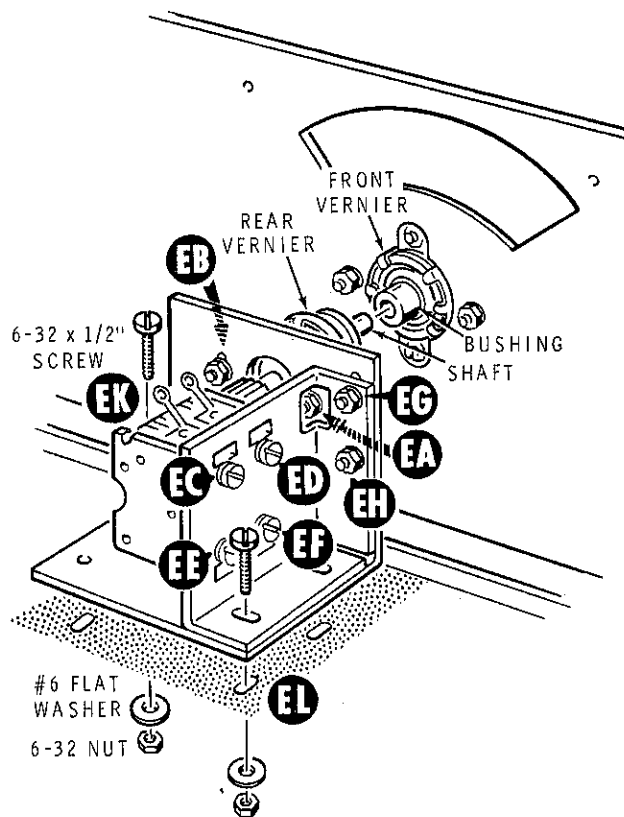


Detail 5-7C

- () Locate the VFO capacitor (#26-153). Then turn the shaft fully clockwise until the capacitor plates are fully meshed (closed).
- () C3: Refer to Detail 5-7C and loosely mount the VFO capacitor to the capacitor mounting bracket at EC, ED, EE, and EF with 6-32 x 1/4" screws, #6 lockwashers, and #6 flat washers.
- () Refer to Detail 5-7D and loosely mount the VFO bracket to the capacitor mounting bracket at EG and EH with 6-32 x 3/8" hardware. Be sure the capacitor shaft enters the bushing in the vernier drive.



Detail 5-7D



PICTORIAL 5-8

Refer to Pictorial 5-8 for the following steps.

- () Position the chassis on your work surface.

NOTE: Perform the next six steps carefully. The VFO assembly must be properly aligned for smooth operation.

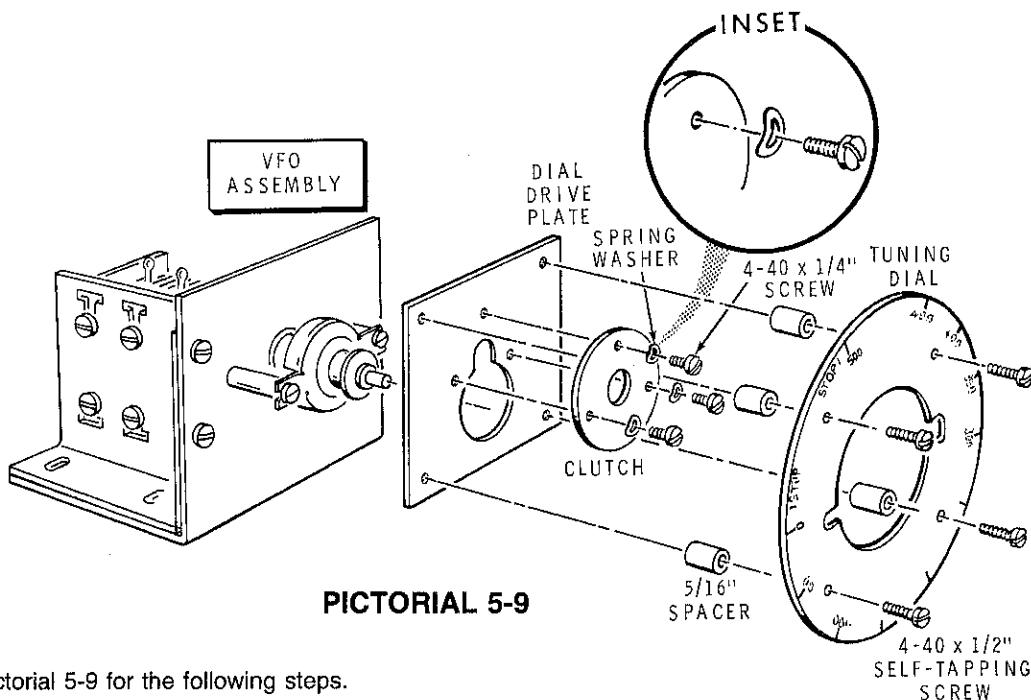
- () Loosely mount the VFO assembly to the chassis at EK and EL with 6-32 x 1/2" screws, #6 flat washers, and 6-32 nuts. Be sure the shaft of the rear vernier goes into the bushing on the front vernier.
- () Push the VFO toward the front panel as much as possible. Then tighten the hardware at EC, ED, EE, and EF.

- () Use a pair of long-nose pliers or an open-end wrench and tighten the hardware at EG and EH.

- () Remove the hardware at EK and EL and remove the VFO assembly from the chassis.

- () Be sure the hardware at EC, ED, EE, EF, EG, and EH is tight. Then tighten the hardware at EA and EB.

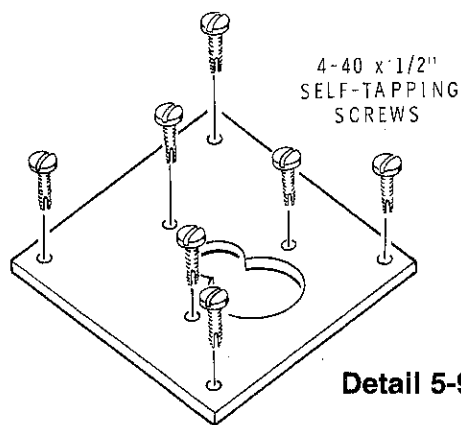
- () Tighten the setscrews in the bushing on the rear vernier.



PICTORIAL 5-9

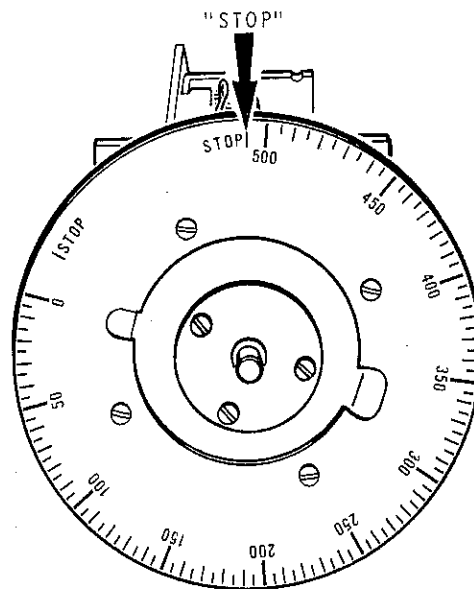
Refer to Pictorial 5-9 for the following steps.

- () Refer to Detail 5-9A and turn a 4-40 x 1/2" self-tapping screw into each of the seven holes in the dial drive plate. Turn the screws in until about one-third of the length extends from the back side of the plate.
- () Remove the backing paper from the tuning dial, then mount the tuning dial onto the dial drive plate. Use four 4-40 x 1/2" self-tapping screws (set aside earlier) and four 5/16" spacers.
- () Turn the shaft of the vernier to its full clockwise position. Then slip the tuning dial in a clockwise direction until the STOP at the "500" end of the scale is at the 12 o'clock position as shown in Detail 5-9B.

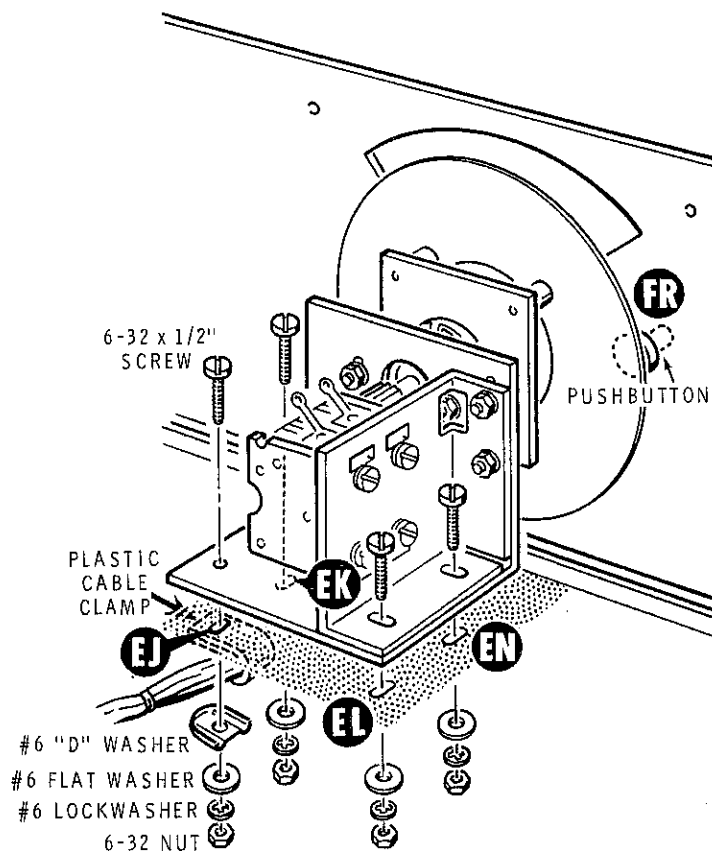


Detail 5-9A

- () Remove and save four of the seven screws in the dial drive plate. The other three screws may be discarded.
- () Place the larger portion of the opening in the dial drive plate over the collar of the vernier and slide the plate down behind the collar.
- () Place the clutch onto the vernier and secure it to the dial drive plate with three 4-40 x 1/4" screws and three spring washers. Tighten these screws until the end of each screw is flush with the back side of the dial drive plate. Then turn each screw one turn counterclockwise.



Detail 5-9B



PICTORIAL 5-10

Refer to Pictorial 5-10 for the following steps.

- () Insert the pushbutton into hole FR in the front panel.

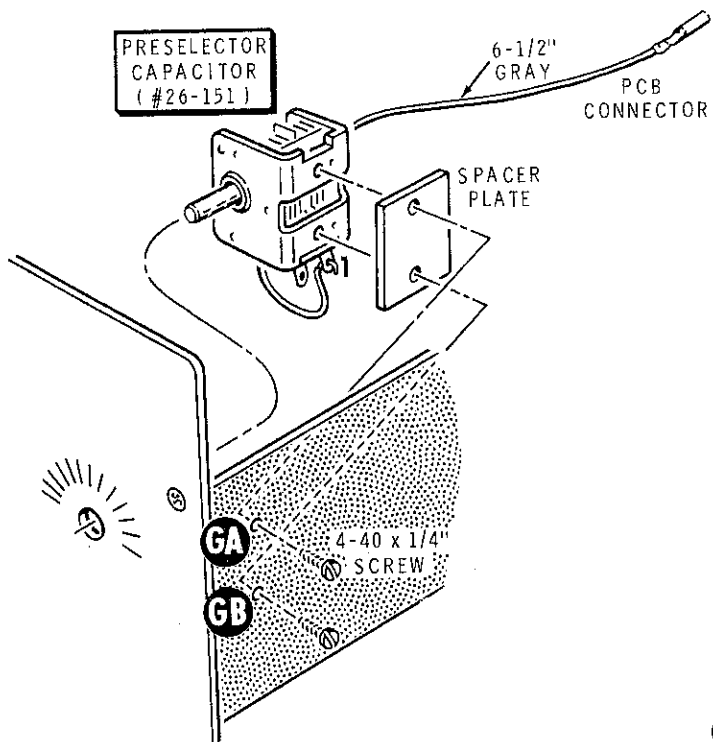
NOTE: Before you tighten the hardware in the following step, be sure to push the VFO assembly toward the front panel as much as possible.

- () Mount the VFO assembly to the chassis. Be sure the shaft of the rear vernier goes into the bushing on the front vernier. Use 6-32 x 1/2" hardware and a #6 flat washer at EK, EL, and EN. Secure the VFO assembly and the plastic cable clamp (on the harness) at EJ with 6-32 x 1/2" hardware, a #6 "D" washer, and a #6 flat washer.
- () Tighten the two screws that hold the drive mounting bracket to the front panel. NOTE: These screws are on the round plate in the center of the front panel.
- () Tighten the two setscrews in the bushing of the front vernier. NOTE: Turn the shaft of the vernier drive as necessary so you can gain access to the setscrews.
- () Reposition the harness wires as necessary so they cannot rub against the tuning dial.

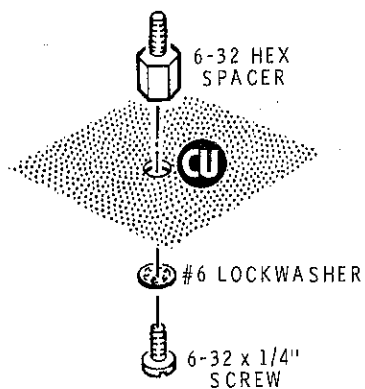
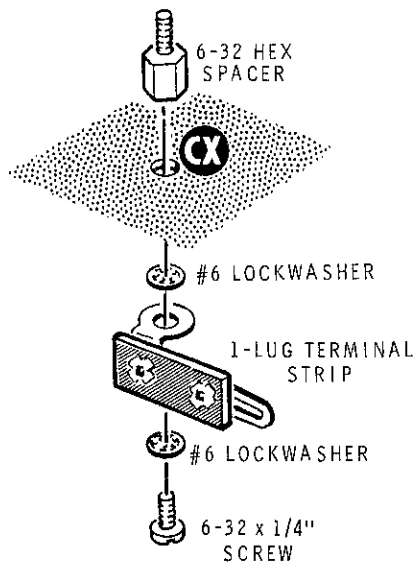
FINAL ASSEMBLY

Refer to Pictorial 5-11 (in the "Illustration Booklet") for the following steps.

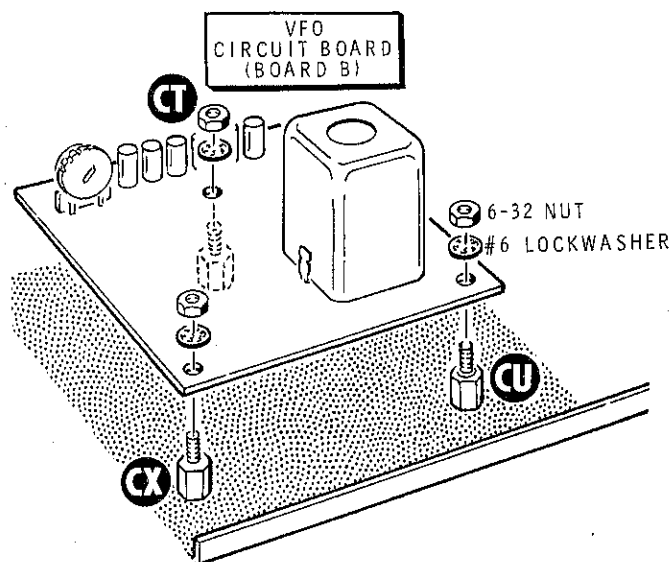
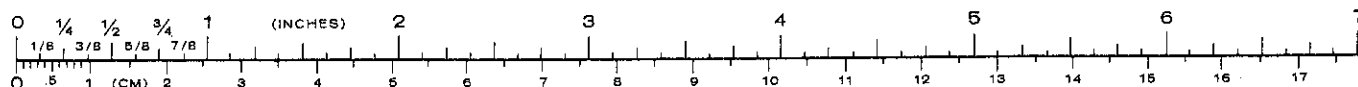
- () Refer to inset drawing #1 and push a cabinet nut into each of the four square holes in the left and right sides of the chassis. Use long-nose pliers to squeeze the tabs together.
- () Prepare a 6-1/2" gray wire.
- () Refer to inset drawing #2 and install a PCB connector (#432-120) on one end of the 6-1/2" wire.
- () Locate the preselector capacitor (#26-151). Then turn the shaft fully counterclockwise until the capacitor plates are fully meshed (closed).
- () Refer to Detail 5-11A and connect one end of the 6-1/2" gray wire to preselector capacitor (#26-151) lug 1 (S-1).


Detail 5-11A

- () C1: Refer to Detail 5-11A and mount the preselector capacitor and a spacer plate to the chassis at GA and GB with 4-40 × 1/4" screws.
- () Refer to Detail 5-11B and mount a 6-32 hex spacer at CU with a 6-32 × 1/4" screw and a #6 lockwasher.


Detail 5-11B

Detail 5-11C

- () Refer to Detail 5-11C and mount a 6-32 hex spacer and a 1-lug terminal strip at CX. Use a 6-32 × 1/4" screw and two #6 lockwashers. Position the terminal strip as shown in the Pictorial.
- () Refer to Detail 5-11D and install the VFO circuit board (board B). Push the circuit board onto the chassis connector. Then secure the board at CT, CU, and CX with #6 lockwashers and 6-32 nuts.

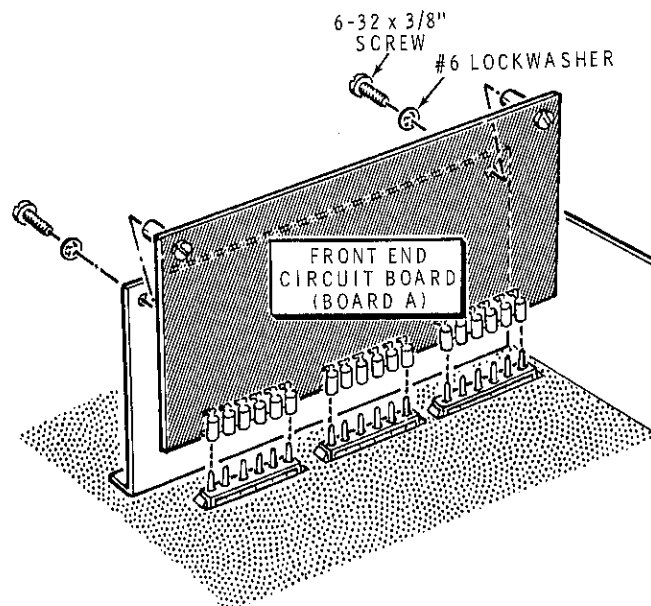

Detail 5-11D


- () Form the large bare wire coming from hole E on the VFO circuit board as shown. Then connect the end of the wire to C3 lug 1 (S-1). Be sure this wire does not touch the capacitor mounting bracket. Bend the lug up as necessary.
- () Prepare the following wires:
 - 6" gray
 - 6" red
- () Refer to inset drawing #2 and install a PCB connector on one end of each wire.
- () Connect the free end of the gray wire to M1 lug 1 (NS).
- () Connect the free end of the red wire to M1 lug 2 (NS).
- () D5: Connect the lead at the banded end of GD510 diode (#56-89) to M1 lug 1 (NS). Connect the other diode lead to lug 2 (NS).
- () R7: Connect one lead of a 15 k Ω control to M1 lug 1 (S-3) and the other lead to lug 2 (S-3).
- () Twist together (approximately 3 turns per inch) the red and gray wires coming from the meter. Leave about 1-1/2" of wire untwisted at the free end.
- () Refer to inset drawing #2 and install a PCB connector on the end of the white-black wiring coming from BO#4 of the harness.
- () Twist the white-black harness wire around the red and gray twisted pair.
- () Refer to inset drawing #3 and prepare the 15 k Ω control as shown. Bend the center lead over and solder it to the outer lead. Cut off the excess lead length from the center lead.

NOTE: To connect a wire with a PCB connector on it to a circuit board, push the connector onto the indicated circuit board pin.

Connect the wires at the free end of the twisted wires to the VFO circuit board as follows:

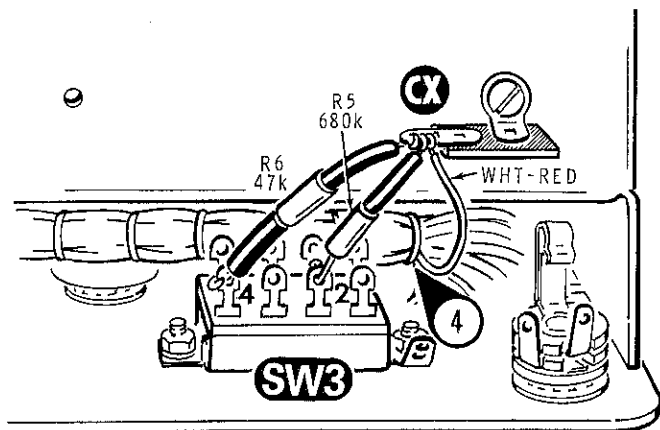
- () White-black wire to pin A.
- () Red wire to pin B.
- () Gray wire to pin C.



Detail 5-11E

- () Refer to Detail 5-11E and mount the front end circuit board (board A) to the front circuit board shield. Use two 6-32 \times 3/8" screws and two #6 lockwashers.
- () Push the connector on the end of the wire coming from lug 1 of C1 onto PCB pin A on the front end circuit board. Position this wire exactly as shown on the Pictorial.
- () Mount the HFO circuit board (board C) to the center circuit board shield. Use two 6-32 \times 3/8" screws and two #6 lockwashers.
- () Mount the AUD/REG circuit board (board D) to the rear panel. Use two 6-32 \times 3/8" screws and two #6 lockwashers.





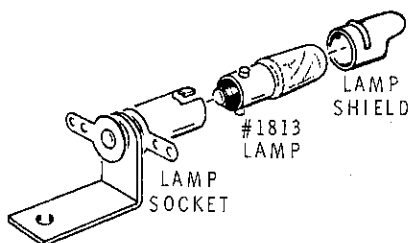
PICTORIAL 5-12

Refer to Pictorial 5-12 for the following steps.

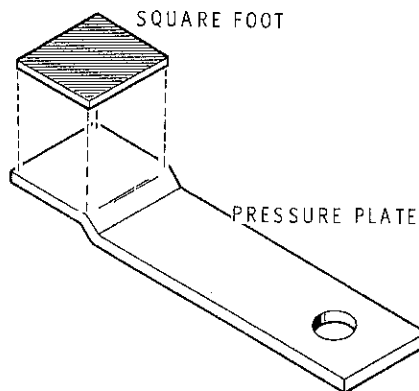
- () Turn the chassis bottom-side-up.
- () Connect the free end of the white-red wire coming from harness BO#4 to terminal strip CX (NS).
- () R6: Cut one lead of a 47 kΩ resistor (yellow-violet-orange) to 3/4". Slide a 5/8" length on this lead. Connect this lead to SW3 lug 4 (S-1). Slide a 5/8" length of sleeving on the other resistor lead. Then connect the lead to terminal strip CX (NS).
- () R5: Cut one lead of a 680 kΩ Resistor (blue-gray-yellow) to 1/2". Connect the 1/2" lead to SW3 lug 2 (S-1). Slide a 5/8" length of sleeving on the other resistor lead. Then connect the lead to terminal strip CX (S-3).

Refer to Pictorial 5-13 (in the "Illustration Booklet") for the following steps.

- () Refer to Detail 5-13A and install a #1813 lamp in each lamp socket. Then place a lamp shield on each lamp.



Detail 5-13A

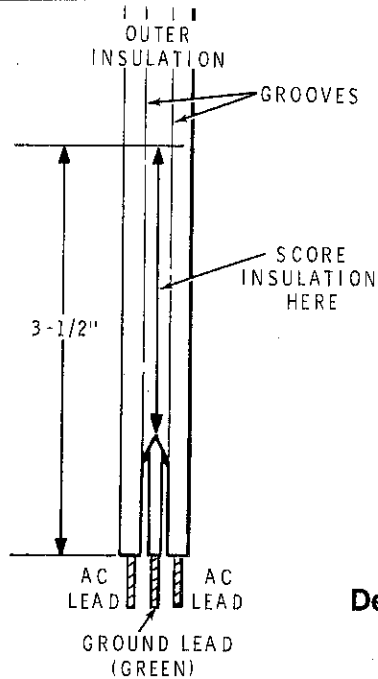


Detail 5-13B

- () Carefully peel the backing paper from the square foot. Then refer to Detail 5-13B and press the foot onto the pressure plate. Be sure to press the foot on the proper side of the pressure plate as shown.

NOTE: When you perform the next step, be sure the tuning dial is between the front panel and the dial pointer as shown. Also, be sure to position the hairline on the dial pointer **toward** the front panel.

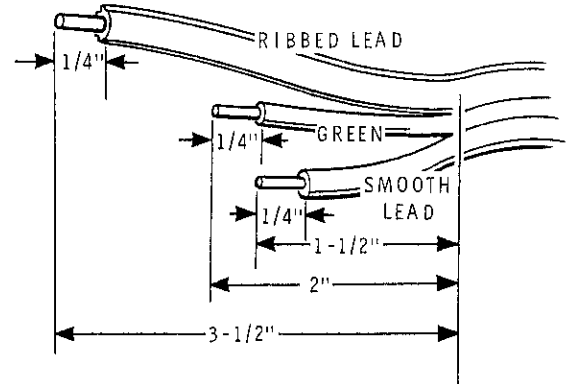
- () Mount the dial pointer onto the screw at FJ on the front panel with a 6-32 nut and #6 lockwasher. Tighten the nut only finger tight.
- () Mount the dial pointer, the pressure plate, a 7/16" spacer, and the two lamp sockets onto the screw at FK on the front panel. Use a #6 lockwasher, a #6 solder lug, and a 6-32 nut. Tighten the nut only finger tight.
- () Turn the main tuning shaft a few times to make sure the four spacers on the dial drive plate do not rub against the dial pointer. Reposition the dial pointer as necessary. Then tighten the hardware. NOTE: The dial pointer should be as low as possible without rubbing on the spacers. Also, be sure the hairline on the dial pointer is straight up and down and all parts are positioned as shown on the Pictorial.
- () Again turn the main tuning shaft a few times and make sure no hardware on the dial drive plate rubs on any hardware on the front panel. Loosen the hardware that holds the VFO assembly to the chassis and the two setscrews in the front bushing and reposition the VFO assembly as necessary. Then tighten the hardware.
- () Check the pressure plate to be sure it does not touch any lugs on the RF Gain control.



Detail 5-14A

Refer to Pictorial 5-14 (in the "Illustration Booklet") for the following steps.

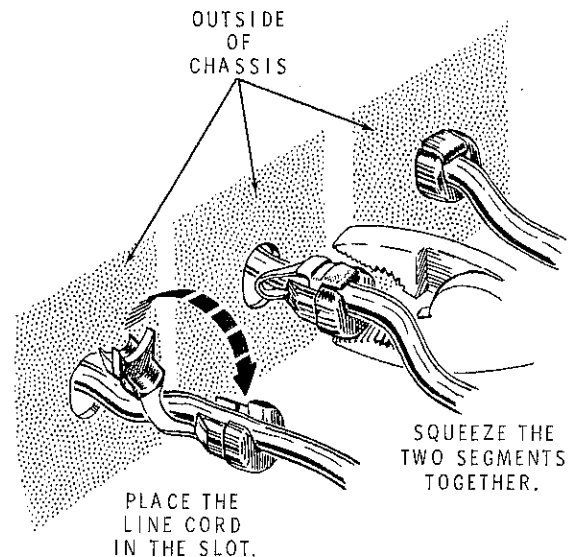
- () Cut a 2-3/4" small bare wire. Then connect the wire from PL1 lug 1 (NS), through solder lug FK (NS), to PL2 lug 2 (S-1). Use a 3/4" sleeving on the bare wire between PL1 lug 1 and solder lug FK. Use 1-1/4" sleeving between PL2 lug 2 and solder lug FK.
- () Connect the free end of the gray wire coming from the solder lug at R4 lug 3 to solder lug FK (S-3).
- () Prepare a 2" red wire. Then connect the wire from PL1 lug 2 (NS) to PL2 lug 1 (S-1).
- () Connect the free end of the red wire coming from R1 lug 3 to PL1 lug 2 (S-2).
- () R8: Refer to the inset drawing and connect an 820 Ω (gray-red-brown) resistor from R1 lug 2 (S-2) to PL1 lug 1 (S-2).
- () Connect the **short** brown harness wire coming from chassis cutout AA to fuse block F1 lug 1 (S-1). Make a mechanically secure connection.
- () Connect the **long** brown harness wire coming from chassis cutout AA to terminal strip CB lug 5 (NS). Make a mechanically secure connection.
- () Refer to Detail 5-14A and split the outer insulation of the line cord (to separate the line cord leads) as follows, so you do not cut into the protective insulation for the AC leads.
 1. Use a knife point to score a 3-1/2" line BETWEEN the two grooves. Do this on both sides of the line cord.



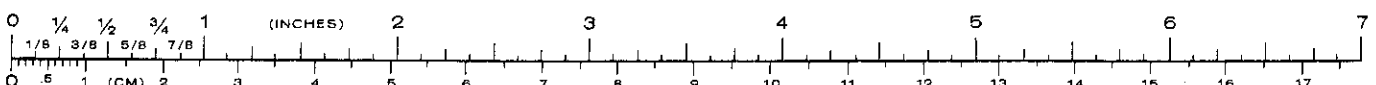
Detail 5-14B

2. Grasp the leads by the insulation and pull the leads apart. The line cord will separate on the scored lines.

- () Refer to Detail 5-14B and prepare the ends of the line cord as shown. Note that there is a smooth lead and a ribbed lead as shown in the inset drawing on the Pictorial. Melt a small amount of solder on the lead ends to hold the fine strands together.
- () Pass the line cord through hole BH in the rear panel.
- () Connect the smooth line cord wire to fuse block F1 lug 2 (S-1). Make a mechanically secure connection.
- () Connect the green line cord wire to solder lug CS (S-1). Make a mechanically secure connection.
- () Connect the ribbed line cord wire to terminal strip CB lug 2 (NS). Make a mechanically secure connection.
- () Install the line cord strain relief at BH as shown in Detail 5-14C. It may be necessary to squeeze the strain relief with pliers when you install it.



Detail 5-14C



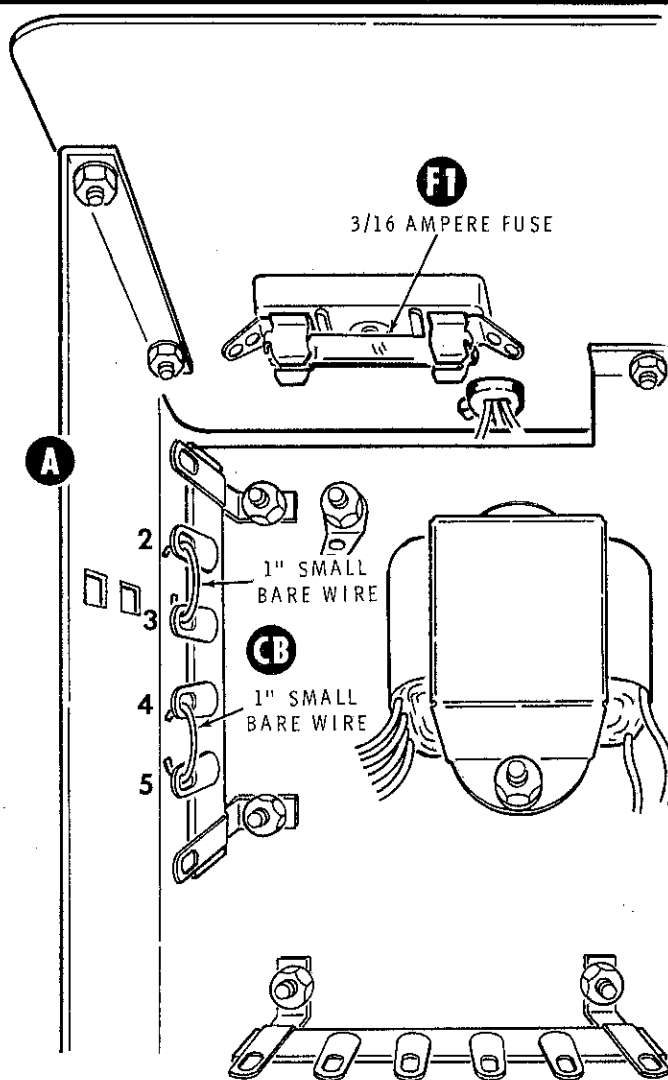
ALTERNATE LINE VOLTAGE WIRING

Two sets of line voltage wiring instructions are given below, one for 120 VAC line voltage and the other for 240 VAC line voltage. In the U.S.A., 120 VAC is most often used, while in many other countries 240 VAC is more common. USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.

120 VAC Wiring

Refer to Detail 5-14D Part A for the following steps.

- () Cut two 1" lengths of small bare wire.
- () Connect a 1" small bare wire between terminal strip CB lugs 2 (S-3) and 3 (S-2). Make mechanically secure connections.
- () Connect a 1" small bare wire between terminal strip CB lugs 4 (S-2) and 5 (S-3). Make mechanically secure connections.
- () F1: Insert a 3/16-ampere fuse into fuse block F1.
- () Carefully peel away the backing paper from the blue and white label. Then refer to Part B of the Detail and press the label onto the lower portion of the label outline on the rear panel as shown.



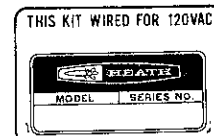
Detail 5-14D

B

CAUTION: FOR CONTINUED PROTECTION AGAINST FIRE HAZARD, REPLACE FUSE ONLY WITH SAME TYPE AND RATING.

120VAC 3/16 AMP SLOW BLOW
 240VAC 1/8 AMP SLOW BLOW
 13.8VDC 3/4 AMP SLOW BLOW
 (FUSES LOCATED INSIDE)

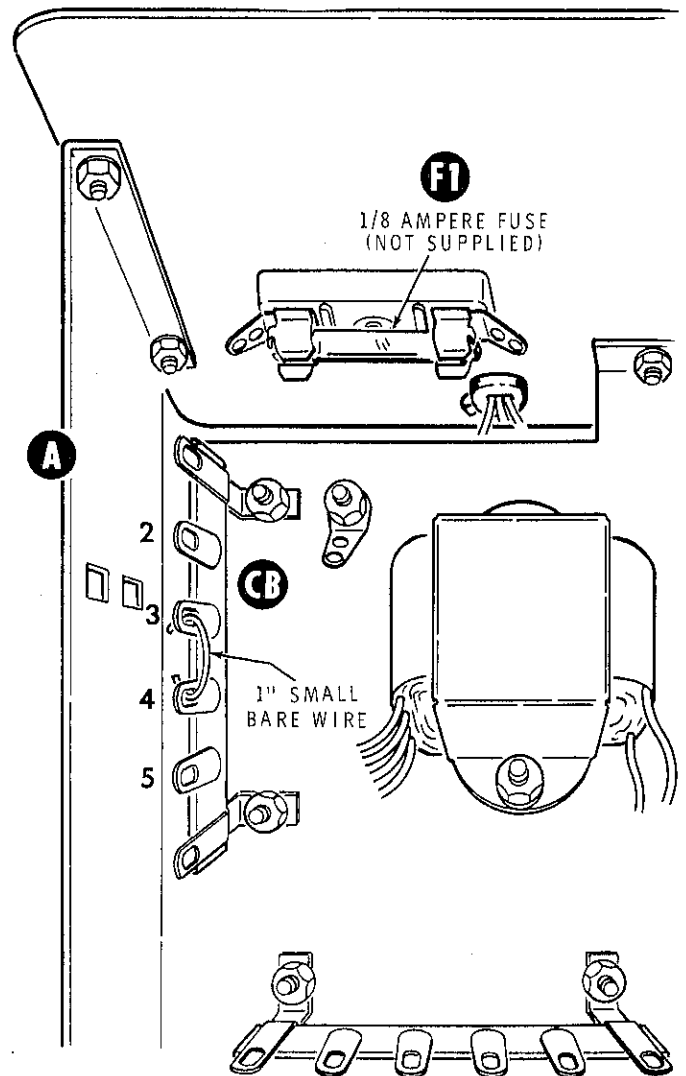
CAUTION:
 TO PREVENT ELECTRICAL SHOCK
 DISCONNECT LINE CORD BEFORE
 REMOVING COVERS.



240 VAC Wiring

Refer to Detail 5-14E Part A for the following steps.

- () Cut a 1" length of small bare wire.
- () Connect a 1" small bare wire between terminal strip CB lugs 3 (S-2) and 4 (S-2). Make mechanically secure connections.
- () Solder the wires at terminal strip CB lug 2 (S-2).
- () Solder the wires at terminal strip CB lug 5 (S-2).
- () F1: Insert a 1/8-ampere slow-blow fuse (not supplied) into fuse block F1.
- () Carefully peel away the backing paper from the blue and white label. Then refer to Part B of the Detail and press the label onto the upper part of the label outline on the rear panel as shown.



Detail 5-14E

B

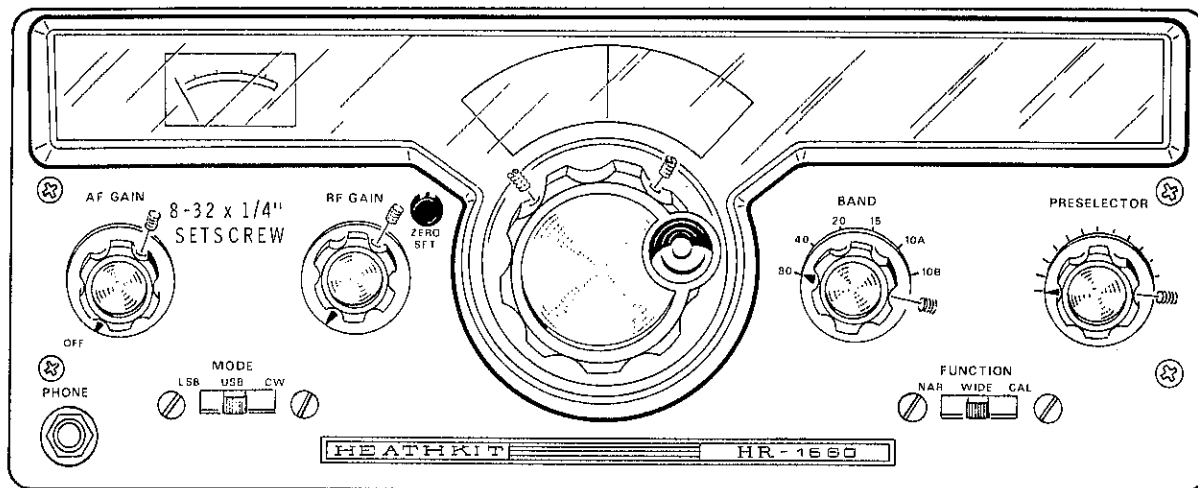
CAUTION:
TO PREVENT ELECTRICAL SHOCK
DISCONNECT LINE CORD BEFORE
REMOVING COVERS.

CAUTION: FOR CONTINUED PROTECTION
AGAINST FIRE HAZARD, REPLACE FUSE
ONLY WITH SAME TYPE AND RATING.

120VAC	3/16 AMP	SLOW BLOW
240VAC	1/8 AMP	SLOW BLOW
13.8VDC	3/4 AMP	SLOW BLOW

(FUSES LOCATED INSIDE)





PICTORIAL 5-15

KNOB INSTALLATION

Refer to Pictorial 5-15 for the following steps.

- () Start an 8-32 x 1/4" setscrew into each of the four small knobs. Start two setscrews into the large knob.
- () Except for the VFO (center) shaft, turn all of the front panel shafts fully counterclockwise.
- () Place the large knob onto the VFO shaft and tighten the setscrews.
- () Place four small knobs onto the shafts at AF Gain, RF Gain, Band, and Preselector. Position the knob index marks as shown in the Pictorial and tighten the setscrews.

This completes the assembly of your SSB/CW Receiver. Before you proceed to "Initial Tests," look it over carefully to be sure:

1. That all hardware is tightened.
2. There are no unsoldered connections.
3. There are no cutoff wire ends or solder splashes lodged in the wiring.
4. There are no protruding wire ends that could short to adjacent lugs.

INITIAL TESTS

The purpose of this section of the Manual is to make sure your Receiver operates properly and will not be damaged as a result of a wiring error. A transistor or other component, for example, could be destroyed instantly by a short circuit that causes excessive current.

RESISTANCE CHECKS

PRIMARY WIRING TESTS

A wiring error in the primary wiring circuit (line cord, On-Off switch, etc.) of your Receiver could cause you to receive a severe electrical shock. These "Primary Wiring Tests" will assure you that no such wiring errors exist.

- () Be sure the line cord is not plugged in.
- () Turn the AF GAIN control to OFF.

If you do not have an ohmmeter, carefully check the line cord, fuse block, switch SW1, and the transformer wiring against

that shown in Pictorials 5-3, 5-4, 5-14, and Detail 5-14D or 5-14E. Make sure there are no fine strands of wire, or solder blobs, touching adjacent terminals or the chassis. Then proceed to "Sound Check" on Page 70.

If you have an ohmmeter, perform the following resistance measurements.

- () Turn on your ohmmeter and allow it to warm up, if necessary.
- () Set your ohmmeter on the R X 10 range.

NOTE: When you are instructed to connect a lead to ground, connect the lead to the chassis.

METER CONNECTIONS		METER READING	POSSIBLE CAUSE OF TROUBLE
RED LEAD	BLACK LEAD		
1. Either flat prong of the line cord plug.	Ground	INFINITE with the AF GAIN control ON or OFF.	A. Switch SW1 wiring. B. Terminal strip CB wiring. C. Fuse block wiring. D. T1.
2. Other flat prong of the line cord plug.	Ground	INFINITE with the AF GAIN control ON or OFF.	A. Switch SW1 wiring. B. Terminal strip CB wiring. C. Fuse block wiring. D. T1.
3. Round prong of the line cord plug.	Ground	0 Ω with the AF GAIN control ON or OFF.	A. Green lead of the line cord not properly connected at solder lug CS. See Pictorial 5-14.
4. Either flat prong.	Other flat prong.	1 M Ω or higher (AF GAIN control OFF).	A. Terminal strip CB wiring. B. SW1 wiring.
5. Either flat prong.	Other flat prong.	Approximately 50-70 Ω for 120 VAC, or approximately 200 Ω for 240 VAC wiring. (AF GAIN control ON).	A. Terminal strip CB wiring. B. SW1 wiring. C. Fuse F1. D. Fuse block wiring. E. T1.

This completes the "Primary Wiring Tests." If all tests were satisfactory, proceed to "Other Resistance Checks." If any of the tests were not correct, you must make the corrections necessary to obtain the correct readings before you continue.

OTHER RESISTANCE CHECKS

- () Turn on your ohmmeter and allow it to warm up, if necessary.
- () Set your ohmmeter on the RX10 range.
- () Position the chassis bottom-side-up as shown in Figure 1-1 (in the "Illustration Booklet").
- () Connect the common ohmmeter test lead to the chassis.

NOTE: The internal wiring of most ohmmeters is such that the positive terminal of the meter battery is connected to the positive test lead and the negative battery terminal is connected to the negative (common) test lead. In some ohmmeters this wiring is reversed and will give erroneous readings in the following measurements. Interchange the ohmmeter leads if the measurements do not check out correctly the first time.

Connect the positive ohmmeter test lead to the chassis connector terminals listed in the following chart and check your resistance readings. If your readings disagree with those given in each step, check the items listed in the "Possible Cause" column.

NOTE: Some of the readings, in the following steps, may take a few seconds to reach the indicated resistance due to the charging of capacitors.

TEST POINT TERMINAL	RESISTANCE IN OHMS	POSSIBLE CAUSE
() D18	INFINITY	1. D1-D4. 2. C2. 3. IC201.
() D17	10-20 (approximate)	1. Wiring error on SW1. 2. Solder bridge on AUD/REG circuit board.
() D16	10-20 (approximate)	1. Wiring error at chassis connectors D16, D4, C7, B6, or A12. 2. Wiring error on SW3 or SW4. 3. Solder bridge on any circuit board.

VOLTAGE CHECKS

Preset the front panel controls and switches as follows:

AF GAIN Off until it clicks.
 RF GAIN Fully clockwise.
 BAND switch 80.
 MODE switch LSB.
 FUNCTION switch Wide.
 PRESELECTOR Midrange.

Connect the Receiver power cord to an AC outlet.

NOTE: The following voltage checks require the use of a high-impedance input (1 megohm or more) voltmeter. Voltage measurements are $\pm 20\%$.

Set your voltmeter to measure at least +20 VDC and connect the common lead to the chassis.

NOTE: If any of the following observations and checks fail, immediately turn the Receiver off and disconnect the line cord. Correct the problem before you proceed. Check the "Possible Causes" that follow each check.

Rotate the AF GAIN control clockwise until it clicks. The dial lamps should light.

POSSIBLE CAUSE CHART
1. Dial lamps do not light. A. Wiring error on PL1 or PL2. B. Wiring error on R1. C. Wiring error on SW3. D. Wiring error on SW2. E. Wiring error on connector A12. F. PL1 and/or PL2.

Connect the positive voltmeter test lead to the chassis connector terminals listed in the following chart and check the voltage readings. If your readings disagree with those given in each step, check the items listed in the "Possible Cause" column.

TEST POINT TERMINAL	VOLTAGE ($\pm 20\%$)	POSSIBLE CAUSE
<input type="checkbox"/> D18	23	1. F1. 2. Wiring error on terminal strip CB. 3. D1-D4. 4. C2.
<input type="checkbox"/> D16	13.5	1. IC201.
<input type="checkbox"/> D4	13.5	1. Wiring error at D16 or D4.
<input type="checkbox"/> C7	13.5	1. Wiring error at D16 or C7.
<input type="checkbox"/> A12	13.5	1. Wiring error at C7 or A12.
<input type="checkbox"/> B6	13.5	1. Wiring error at A12 or B6.

Turn the AF GAIN control to Off.

SOUND CHECK

- () Connect a 4 or 8-ohm speaker to the SPKR (speaker) jack on the rear panel.
- () Connect the Receiver power cord to an AC outlet, if not already done.
- () Rotate the AF GAIN control fully clockwise. You should hear noise from the speaker.
- () Turn the lamp shields on PL1 and PL2 for proper lighting at the meter and tuning dial.

POSSIBLE CAUSE CHART

1. No sound from speaker.
 - A. Speaker connections.
 - B. Wiring error on R4.
 - C. Wiring error on J3 or J4.
 - D. J3 defective.
 - E. Wiring error at connector D6.
 - F. IC202 or IC203.
 - G. Q208 or Y205 (LSB only).
 - H. Q209 or Y206 (USB only).

- () Turn the AF GAIN control to Off.

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



ALIGNMENT

You can completely align your Receiver without any external equipment. You may be able to improve the sensitivity by using a VTVM and an RF generator, but they are not necessary.

If you do not obtain the proper results during alignment, proceed to the "In Case of Difficulty" section on Page 83.

ALIGNMENT PREPARATION

Refer to Figure 2-1 for the following steps.

- () Prepare a 12" gray wire.
- () Solder a PCB connector on each end of the 12" wire.

Set this jumper wire aside. It will be used during "HFO Coil Alignment."

- () Refer to Figure 2-2 and use a pair of pliers to push the 1" steel blade into the smaller end of the nut starter until 1/8" remains exposed. Use this tool when you are instructed to adjust trimmer capacitors.

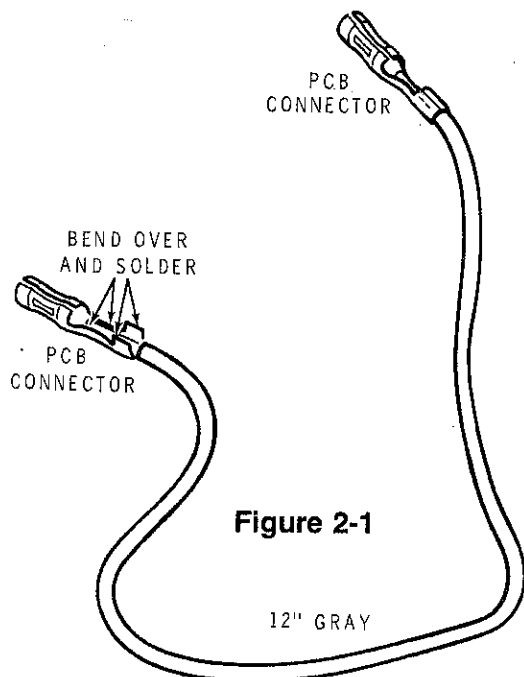


Figure 2-1

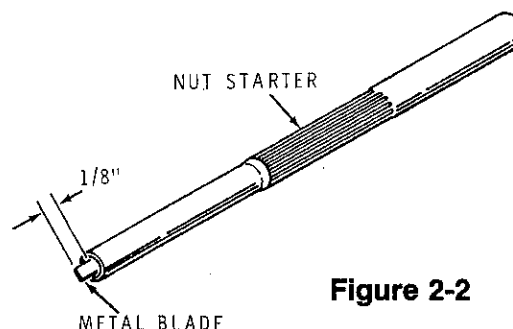


Figure 2-2

Refer to Figure 2-3 (in the "Illustration Booklet") for the following steps.

NOTE: The Figure shows only one extender assembly. You will actually be assembling three of these assemblies when you perform the following steps.

- () Unfold and straighten the large bare wire as much as possible.
- () Cut eighteen 4-1/2" lengths of large bare wire.
- () Solder a female connector on one end of each of the 18 large bare wires.
- () Cut the ears from the three extender terminal housings and the three remaining chassis connectors.

NOTE: Perform the next four steps three times, once for each extender assembly.

- () () () Push one of the female terminals on the end of a large bare wire into each of the six holes in an extender terminal housing. Push each terminal until it locks in place.
- () () () Cut the free ends of the six bare wires, if necessary, until their ends are even.
- () () () Solder the free ends of the bare wires to the six terminals on a chassis connector.
- () () () Check the extender assembly. All connections should be soldered. Also, make sure the bare wires do not touch each other.
- () Set the three extender assemblies aside, they will be used during "Calibrator Adjustment."

- () Set the front panel controls and switches as follows:
 AF GAIN Off.
 RF GAIN Fully clockwise.
 MODE LSB.
 FUNCTION WIDE.
 BAND 80.
 PRESELECTOR 12 o'clock position.

Refer to Figure 2-4 (in the "Illustration Booklet") for the following steps.

- () Set control R306, on the VFO circuit board, to the center of its rotation.
- () Set the tab on control R7 on the rear of the S-meter to the 3 o'clock position as shown on Figure 2-4.
- () Connect a speaker to the SPKR jack on the rear panel, if not already done.

HFO COIL ADJUSTMENT

NOTE: You will adjust the heterodyne frequency oscillator (HFO) coils in the following steps. Refer to Figure 2-5 for the

methods of inserting the alignment tool into the coil and making a "flag" out of tape for the alignment tool so you can count the turns of the tool. Rotate the tool until the voltage peaks on the meter scale. Then rotate the tool as shown in the HFO alignment chart.

- () Remove the gray wire from PCB pin C, on the VFO circuit board, and connect it to PCB pin D.
- () Remove the white-black wire from PCB pin A. Leave this wire unhooked.
- () Connect one end of the 12" jumper wire, that you prepared earlier, to PCB pin A. Connect the other end of the jumper wire to T.P. on the HFO/XTAL calibrator circuit board.

- () Connect the line cord to an AC outlet.
- () Turn the Receiver on with the AF GAIN control.

NOTE: Refer to the HFO/XTAL Calibrator Circuit Board Troubleshooting Chart on Page 86 if you experience any problems during the following adjustments.

- () Adjust each HFO coil as described in the following chart. Before you adjust each coil for the peak meter indication, turn the slug counterclockwise two full turns. Then rotate the slug **clockwise** for maximum meter indication.

NOTE: Rotate control R7, on the rear of the meter, as necessary to keep the S-meter needle on scale.

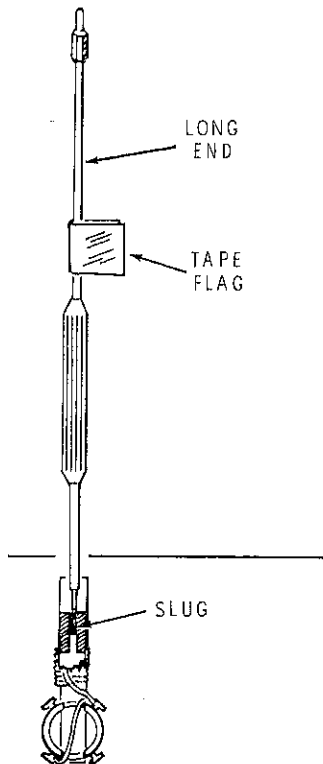


Figure 2-5

BAND SWITCH	COIL NUMBER	ROTATE SLUG FOR PEAK INDICATION. THEN ROTATE SLUG AS DESCRIBED.
80	L406	1/2 turn CW*
40	L405	1/4 turn CW
20	L404	1/4 turn CW
15	L403	1/4 turn CW
10A	L402	1/4 turn CW
10B	L401	1/4 turn CW

*clockwise

- () Turn the Receiver off.
- () Disconnect the line cord from the AC outlet.
- () Disconnect the jumper wire from PCB pin A on the VFO circuit board and T.P. on the HFO/XTAL calibrator circuit board.
- () Reconnect the white-black wire to PCB pin A.
- () Remove the gray wire from PCB pin D and reconnect it to PCB pin C.

VFO ALIGNMENT

NOTE: Refer to the VFO Circuit Board Troubleshooting Chart on Page 86 if you experience any problems during the following adjustments.

- () Set the front panel controls and switches as follows:
 - AF GAIN Off.
 - RF GAIN Fully clockwise.
 - MODE LSB.
 - FUNCTION WIDE.
 - BAND 15.
 - PRESELECTOR 12 o'clock position.
- () Refer to the inset drawing on Figure 2-4 and turn the screw in each VFO trimmer down snug. DO NOT FORCE. Then loosen each screw 1/3 turn.
- () Connect the line cord to an AC outlet.
- () Turn the MAIN TUNING knob clockwise until the dial stops rotating.
- () Manually turn the square dial drive plate, located between the VFO assembly and the front panel, clockwise until the STOP mark near 500 aligns with the pointer.
- () Turn the main tuning knob counterclockwise until the dial reads 200.
- () Turn the Receiver on.
- () Rotate R306, on the VFO circuit board, until the S-meter indicates zero (0).
- () Turn the AF GAIN control knob clockwise until you hear noise from the speaker.
- () Insert the alignment tool into the slug in coil L301 on the VFO circuit board.

NOTE: When you adjust the coil in the following step, you should be able to find the tone within 2 turns either way from its present setting.

- () Turn the alignment tool very slowly until you hear a tone.
- () Turn the BAND switch to 80.
- () Turn the MAIN TUNING knob counterclockwise until the dial reads 0.
- () Peak the PRESELECTOR on noise.

- () Slide the FUNCTION switch to CAL (calibrator).

NOTE: When you perform the following adjustments, always use the strongest calibrator signal, if you find more than one.

- () If necessary, turn the MAIN TUNING knob one or two dial divisions to either side of zero until you hear the calibrator signal. Note whether the signal occurred higher or lower in frequency than the zero mark on the dial.
- () Return the dial to 0.

NOTES:

1. Several of the alignment steps call for adjusting your Receiver to obtain a zero-beat. To do this, slowly make the required adjustment in one direction and listen for a decrease in pitch and volume of the tone. If the pitch and volume seem to increase, make the adjustment in the opposite direction. The tone will go lower and lower in frequency and either disappear or become only an intermittent growl. This is zero-beat.
2. Perform **one** of the next two steps. If one trimmer does not provide enough range, adjust both trimmers in the same direction. Refer to the inset drawing for the location on the access holes on the bottom of the chassis.
 - () If the calibrate signal was **lower** in frequency, carefully adjust either VFO trimmer (through the access hole in the chassis bottom) **counterclockwise** until you hear the calibrator signal. Adjust the trimmer for zero beat.
 - () If the calibrate signal was **higher** in frequency, carefully adjust either VFO trimmer (through the access hole in the chassis bottom) **clockwise** until you hear the calibrator signal. Adjust the trimmer for zero beat.
- () Turn the MAIN TUNING knob until the dial reads 500.
- () Repeat the PRESELECTOR.
- () Adjust coil L301 slightly for zero beat.
- () Return the dial to 0.
- () Adjust either VFO trimmer for zero beat.
- () Repeat the preceding five steps as many times as necessary until zero beat occurs at 0 and 500 on the dial. Be sure the **last** adjustment you make is to a VFO trimmer. NOTE: You may have to repeat these adjustments several times.
- () Turn the Receiver off.
- () Disconnect the line cord from the AC outlet.

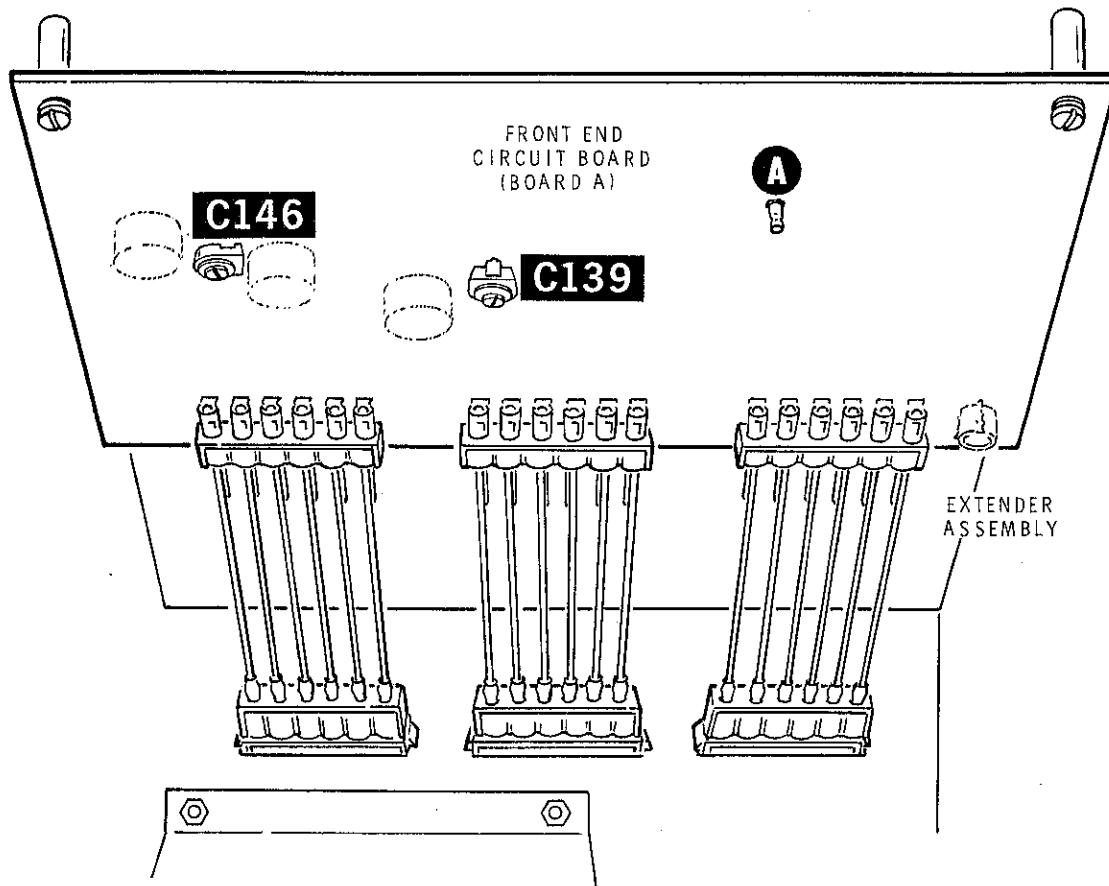


Figure 2-6

FRONT END ALIGNMENT

NOTE: Refer to the Front End Circuit Board Troubleshooting Chart on Page 86 if you experience any problems during the following adjustments.

IF Bandpass Adjustment

NOTE: You may notice some improvement in overall gain if you use an RF generator and an AC voltmeter (in place of the calibrator signal and S meter) in the following steps.

Refer to Figure 2-6 for the following steps.

- () Unplug the gray wire from PCB pin A on the front end circuit board.
- () Remove the two screws that hold the front end circuit board (board A) in place. Then remove the circuit board.
- () Push an extender assembly onto the three chassis connectors where the front end circuit board was plugged in. Then push the circuit board onto the extender assembly.

- () Set the front panel controls and switches as follows:
- AF GAINOff.
- RF GAINFully clockwise.
- MODECW.
- FUNCTIONCAL.
- BAND15.
- TUNING DIAL300.

- () Connect the line cord to an AC outlet.
- () Turn the Receiver on.
- () Turn the MAIN TUNING knob one or two dial divisions each way and locate the strongest nearby calibrator signal, if there is more than one.
- () Adjust trimmer capacitors C139 and C146 for maximum S-meter indication. These trimmers may have only a little effect.
- () Adjust control R7 on the rear of the S meter for mid-scale indication. If you cannot obtain a mid-scale indication, set the control for a maximum indication.
- () Tune to the calibrator signal near 500 and adjust C139 for maximum meter indication.
- () Tune to the calibrator signal near 0 and adjust C146 for maximum meter indication.
- () Repeat the previous two adjustments several times for maximum meter indication at each end of the band.
- () Turn the Receiver off.
- () Disconnect the line cord from the AC outlet.
- () Remove the front end circuit board from the Receiver.
- () Unplug the extender assemblies from the circuit board. Then replace the circuit board in its compartment. Secure the circuit board with two 6-32 × 3/8" screws and two #6 lockwashers.
- () Refer to Pictorial 5-11 (in the "Illustration Booklet") and push the connector on the end of the gray wire coming from lug 1 of C1 onto PCB pin A on the front end circuit board. Position this wire exactly as shown in the Pictorial.

RF Amplifier Adjustments

- () Set the front panel controls and switches as follows:
- AF GAIN Off.
- RF GAIN Fully clockwise.
- MODE CW.
- FUNCTION CAL.
- BAND 80.

- () Connect the line cord to an AC outlet.
- () Turn the Receiver on and adjust the AF GAIN control to a comfortable listening level.

NOTE: When you align the front end circuit board, use the following procedure:

1. Turn the BAND switch to the position indicated in the following Alignment Chart.
2. Tune the Receiver to the calibrator signal near 200 on the dial.
3. Adjust the PRESELECTOR for maximum S-meter indication. Use the RF GAIN control to keep the S-meter indicator near mid-scale.
4. Adjust the indicated trimmer on the front end circuit board for maximum S-meter indication. Some of these trimmers may have only a little effect.
5. Repeat 3 and 4 until no further improvement is noticed.

Refer to Figure 2-4 (in the "Illustration Booklet") for the location of the trimmers in the following steps.

BAND SWITCH	APPROXIMATE PRESELECTOR POSITION	ADJUST TRIMMER
() 80	12 o'clock	C119 and C155
() 40	1 o'clock	C123
() 20	10 o'clock	C126
() 15	2 o'clock	C128
() 10B	2 o'clock	C131

- () Turn the Receiver off.

S METER ADJUSTMENT

- () Set the front panel controls and switches as follows:
 - AF GAIN Off.
 - RF GAIN Fully Clockwise.
 - MODE CW.
 - FUNCTION CAL.
 - BAND 80.
 - TUNING DIAL 300.
- () Turn the Receiver on.
- () Turn the MAIN TUNING knob and the PRESELECTOR for maximum indication of the S meter.
- () Adjust control R7 (on the rear of the S meter) for an indication of about 40 on the S meter. NOTE: If you are unable to get a meter reading of "40," adjust control R7 for the highest obtainable reading.
- () Turn the Receiver off.
- () Disconnect the line cord from the AC outlet.

CALIBRATOR ADJUSTMENT

NOTE: The calibrator should now be reasonably close to the correct setting. If you desire to have the calibrator set more accurately, perform one of the following adjustments. They are listed in order of preference.

Refer to Figure 2-7 for the following steps.

NOTE: Refer to the HFO/XTAL Calibrator Circuit Board Troubleshooting Chart on Page 86 if you experience any problems with the following adjustment.

- () Remove the two screws that hold the HFO/XTAL calibrator circuit board in place. Then remove the circuit board.
- () Push an extender assembly onto the two chassis connectors where the HFO/XTAL circuit board was plugged in. Then push the circuit board onto the extender assembly.

Method #1

- () Connect an accurate frequency counter through a 500 pF capacitor to the collector of transistor Q404 on the HFO/XTAL calibrator circuit board.

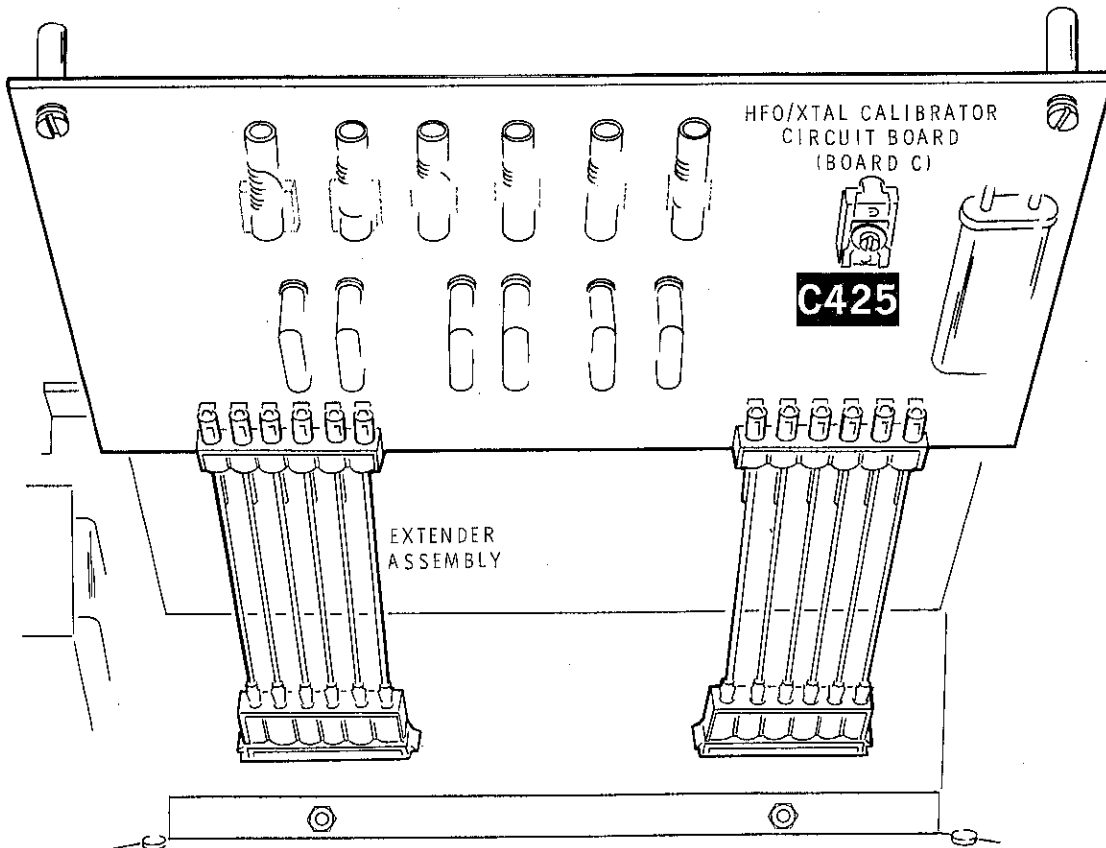


Figure 2-7

- () Connect the line cord to an AC outlet.
- () Turn the Receiver on.
- () Adjust trimmer capacitor C425 until the frequency counter indicates 100 kHz.
- () Turn the Receiver off and disconnect the frequency counter.
- () Disconnect the line cord from the AC outlet.
- () Remove the HFO/XTAL calibrator circuit board from the Receiver.
- () Unplug the extender assemblies from the circuit board. Then replace the HFO/XTAL calibrator board in its compartment. Secure the circuit board with two 6-32 x 3/8" screws and two #6 lockwashers.

This completes the "Alignment." Proceed to "Cabinet Assembly."

Method #2

- () Connect an antenna (suitable for the 40-meter band) to the ANT jack on the rear panel.
- () Turn the BAND switch to 40.
- () Connect the line cord to an AC outlet.
- () Turn the Receiver on and tune to station CHU, Canada, on 7335 kHz. Note whether the station is higher or lower than 7335 kHz on your dial.
- () Turn the main tuning knob until the dial reads 7335 kHz. Then hold the ZERO SET button in and tune to zero beat CHU.
- () Turn the main tuning knob until the dial reads 7300 kHz.
- () Adjust trimmer capacitor C425 for zero beat.
- () Turn the Receiver off.
- () Disconnect the line cord from the AC outlet.

- () Remove the HFO/XTAL calibrator circuit board from the Receiver.
- () Unplug the extender assemblies from the circuit board. Then replace the HFO/XTAL calibrator board in its compartment. Secure the circuit board with two 6-32 x 3/8" screws and two #6 lockwashers.

This completes the "Alignment." Proceed to "Cabinet Assembly."

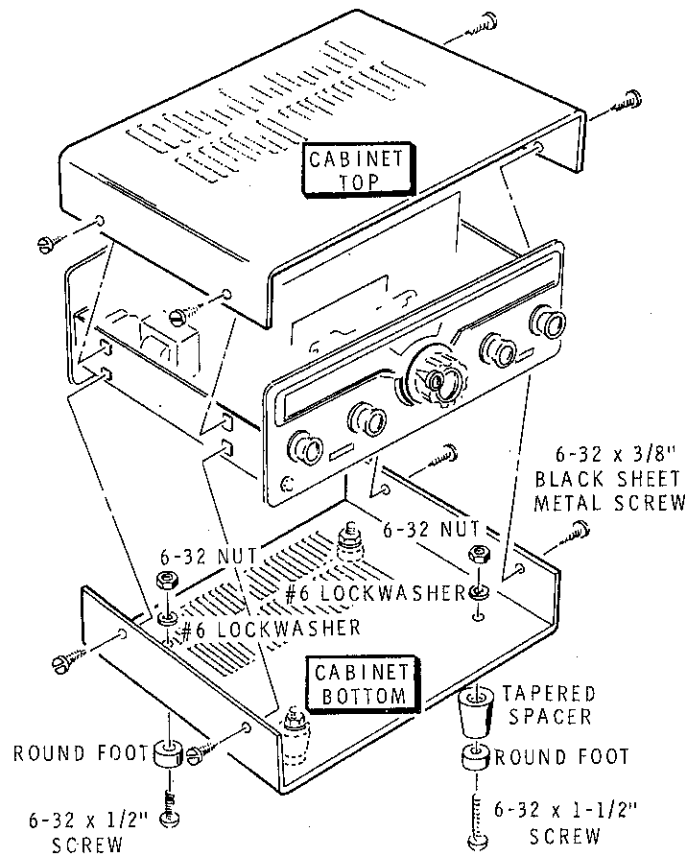
Method #3

NOTE: This method requires the use of a separate SWL receiver that can receive station WWV, Colorado, on 15,000 kHz or 10,000 kHz.

- () Tune your SWL receiver to zero beat WWV on either 15,000 kHz or 10,000 kHz.
- () Connect the antenna input on your SWL receiver to the ANT socket on the rear panel of your HR-1680.
- () Connect the line cord to an AC outlet.
- () Turn your HR-1680 on and place the FUNCTION switch in the CAL position.
- () Adjust trimmer capacitor C425 for zero beat with WWV in your SWL receiver.
- () Turn both receivers off and disconnect the wire that connects the antenna inputs together.
- () Disconnect the line cord from the AC outlet.
- () Remove the HFO/XTAL calibrator circuit board from the Receiver.
- () Unplug the extender assemblies from the circuit board. Then replace the HFO/XTAL calibrator board in its compartment. Secure the circuit board with two 6-32 x 3/8" screws and two #6 lockwashers.

This completes the "Alignment." Proceed to "Cabinet Assembly."

CABINET ASSEMBLY



PICTORIAL 6-1

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

Refer to Pictorial 6-1 for the following steps.

NOTE: Perform only one of the following two steps.

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

NOTE: When you perform the next step, be sure you mount the tapered spacers and the round feet in the holes **away** from the ventilation slots in the cabinet bottom.

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

- () Place the chassis into the cabinet bottom and secure it with two 6-32 x 3/8" black sheet metal screws on each side. Position the ventilating slots **away** from the front panel.

- () Similarly, place the cabinet top onto the chassis and secure it with two 6-32 x 3/8" black sheet metal screws in each side.

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

INSTALLATION

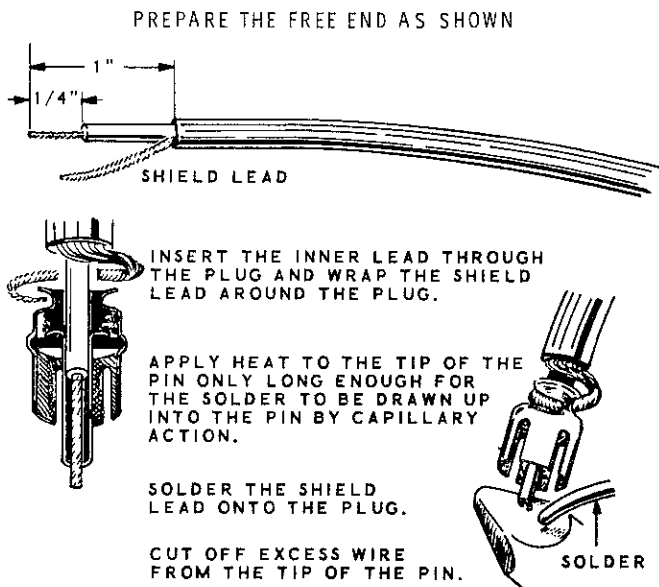


Figure 3-1

This section of the Manual gives you examples of how to connect the Receiver for use by itself or for use with a transmitter for station operation.

BASIC CONNECTIONS

To connect the Receiver for use by itself, simply connect a 4 or 8-ohm speaker to the SPKR jack and a suitable antenna to the ANT jack on the rear panel. Figure 3-1 shows how to install phono connectors (supplied) on the ends of your speaker and antenna cables.

STATION CONNECTIONS

Figure 3-2 shows an example of connections for use with a transmitter. The sidetone input signal from the transmitter, if used, must be at least 10 millivolts rms or greater and should be between 300 and 3300 Hz. The mute input should switch between open (for receive) and ground (for transmit). Refer to the ARRL Handbook for typical relay hookups.

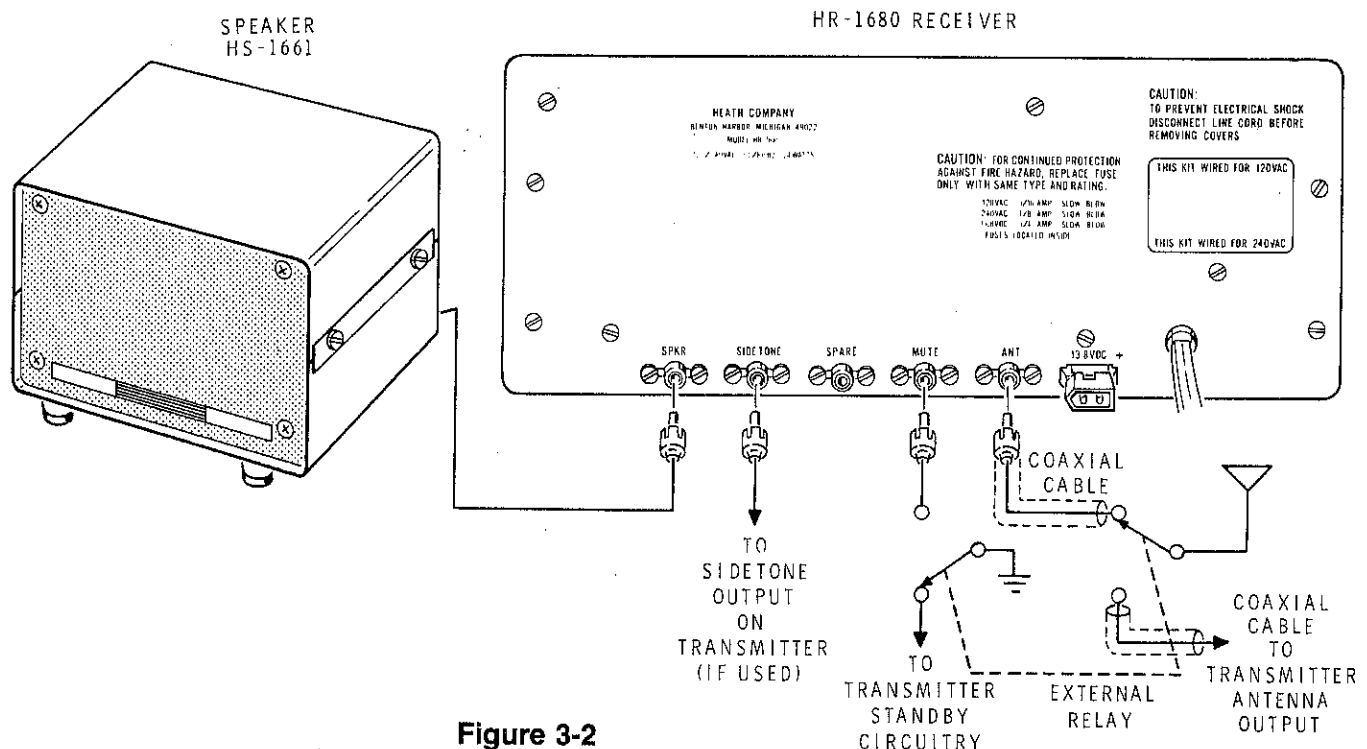


Figure 3-2

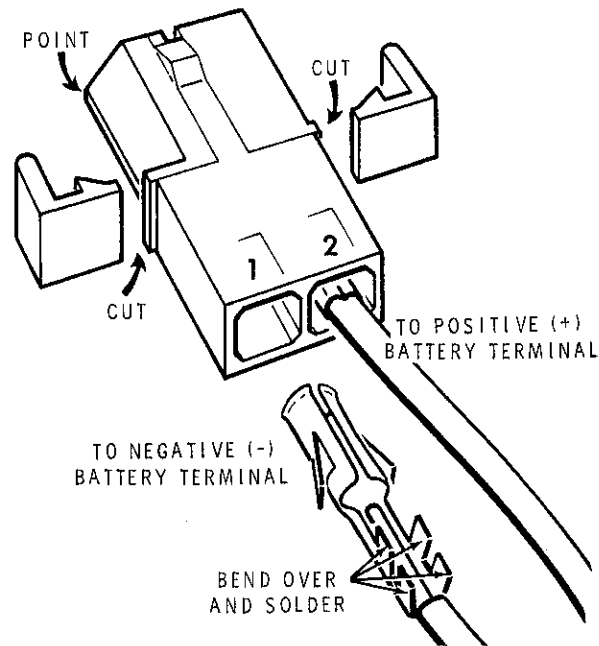


Figure 3-3

BATTERY CONNECTION

If you wish to operate your Receiver from a battery, refer to Figure 3-3 and perform the following steps.

NOTE: The battery must be capable of supplying 13.8 volts at 3/4 amperes.

- () Cut the ears from the male terminal housing.
- () Temporarily disconnect the supply wires from your battery.
- () Solder a female terminal onto the ends of each wire coming from your battery.
- () Position the male terminal housing with the point toward your left as shown. Then push the terminal on your negative (-) battery wire into hole 1 of the housing until it locks in place.

- () Similarly, push the terminal on your positive (+) battery wire into hole 2 of the housing until it locks.

- () Push the male terminal housing into the female housing on the rear panel of the Receiver.

NOTES:

1. When you use the Receiver on AC, disconnect the battery to prevent the battery from being discharged.
2. Use a hash filter in the supply wires when you use this Receiver in a mobile installation. Refer to the ARRL Handbook for noise reduction techniques.

This completes the "Installation." Proceed to the "Operation" section.

OPERATION

Refer to Figure 4-1 (in the "Illustration Booklet") for the location of the front panel controls and switches referred to in the following paragraphs.

TUNING DIAL

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

BAND switch	40 (7 MHz)
Dial reading	35 kHz
Frequency	7.035 MHz

ZERO SET

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

AF GAIN

Turns the power on and increases the volume of the received signal with clockwise rotation.

RF GAIN

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

BAND

Selects the desired amateur band in meters. The Band switch markings on the front panel correspond to the following fre-

quencies in MHz when the tuning dial is set to zero (0):

80	3.5
40	7
20	14
15	21
10A	28
10B	28.5

PRESELECTOR

Tunes the RF amplifier stages. Readjust this control for maximum signal on each BAND as the main tuning is changed.

PHONE

Connect low impedance headphones (or high sensitivity, high impedance headphones) through a phone plug. When you insert a plug in this jack, the loudspeaker is automatically disconnected.

NOTE: If you use low impedance headphones, you may notice a hum at low volume levels. Add a 100 Ω resistor (not supplied) in series with your headphones to reduce this hum.

MODE

Place this switch in the appropriate position for lower sideband, upper sideband, or CW reception. This switch also selects a slow AGC time constant in the sideband positions and a fast AGC time constant in the CW position.

FUNCTION

Place this switch in the desired bandpass position (either narrow or wide). Place the switch in the calibrate position to turn on the 100 kHz crystal calibrator for dial calibration.

TYPICAL OPERATING CHARACTERISTICS

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

1. The S meter may show two peak indications on strong signals. This is due to the audio-derived AGC circuit. One peak is considerably lower than the desired peak. Tune for the greatest peak on the meter.
2. The Receiver may have a different pitch (tone) at high volume levels when the Function switch is in the narrow position. This is due to the narrower bandpass and is normal.
3. When you are calibrating the Receiver dial, there may be several weak calibrator signals. Always use the strongest calibrator signal.
4. If you cannot peak the Preselector on both ends of the 80-meter band, adjust trimmer C155 on the front end circuit board until you are able to.
5. You may notice a hum when you use low impedance headphones. Connect a 100 Ω resistor (not supplied) in series with your headphones to reduce this hum.
6. The heat sink on transistor Q201, on the AUD/REG circuit board, becomes quite hot to the touch. Use caution when you have your hands near this area.

IN CASE OF DIFFICULTY

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

NOTE: Refer to the "Circuit Board X-Ray Views" on Page 94 for the physical location of parts on the circuit boards.

VISUAL CHECKS

1. Recheck the wiring. Trace each lead with a colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something that you have consistently overlooked.
2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered as described in the "Soldering" section of the "Assembly Notes" on Page 14. Be sure there are no solder "bridges" between circuit board foils.
3. Check to be sure all transistors and diodes are in their proper locations. Make sure each lead is connected to the proper point. Make sure each diode band is positioned above the band printed on the circuit board.
4. Check electrolytic capacitors to be sure their positive (+) mark is at the correct position.
5. Check to be sure each IC is properly installed in its socket, and the pins are not bent out or under the IC. Also be sure the IC's are installed in their correct positions.
6. Check the values of the parts. Be sure in each step that you wired the correct part into the circuit, as shown in the Pictorial. It would be easy, for example, to install a 68 k Ω (blue-gray-orange) resistor where a 6800 Ω (blue-gray-red) resistor should be installed.
7. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.
8. A review of the "Circuit Description" may also help you determine where the trouble is.

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

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

PRECAUTIONS FOR TROUBLESHOOTING

1. Use caution when you test IC and transistor circuits. Although they have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage or current than other circuit components.
2. Be sure you do not short any terminals to ground when you make voltage measurements. If the probe should slip, for example, and short across terminals or voltage sources, it is very likely to cause damage to one or more IC's, transistors, or diodes.

CHECKING TRANSISTORS AND DIODES

SILICON BIPOLAR TRANSISTORS

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

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

1. Remove the transistor from the circuit.
2. Set the ohmmeter to the R X 100 range.
3. Connect one of the ohmmeter test leads to the base (B) of the transistor. Touch the other meter lead to the emitter (E) and then to the collector (C). Both readings should be the same, but may be either high or low. If one reading is high and the other low, the transistor should be replaced. (Use the Identification Chart on Page 98 to identify the transistor leads).
4. Interchange the test leads and repeat step 3.

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

MOSFETS

Insulated gate type MOSFETs are used at Q101, Q102, and Q103 on the front end circuit board and at Q205 on the AUD/REG circuit board. Usually, any defect in these devices is an internal short circuit between the source and one of the gates. You can check them in the circuit with a high impedance voltmeter (10 megohms or higher). An abnormally low source voltage may indicate an internal short circuit.

DIODES

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

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

TROUBLESHOOTING CHARTS

The following charts list the "Problem" and the "Possible Cause" of a large number of malfunctions. If a particular part or parts are mentioned (transistor Q201, for example, or switch SW2) as a possible cause, check these parts to see if they are

wired or installed incorrectly. Also check to see if an improper part was installed at that location. It is also possible, on rare occasions, for a part to be faulty.

GENERAL

PROBLEM	POSSIBLE CAUSE
Dial lamps don't light.	<ol style="list-style-type: none"> 1. Fuses F1 and F201. 2. Switch SW1 defective or wired wrong. 3. Lamps PL1 and PL2 open or shorted. 4. Check wiring of red wires on chassis. 5. See AUD/REG Circuit Board Troubleshooting Chart.
No audio output.	<ol style="list-style-type: none"> 1. Speaker or connections. 2. Wiring error on jack J3, control R4, or switch SW2. 3. Defective shielded cable.
No IF output.	<ol style="list-style-type: none"> 1. Cable wiring error on chassis. 2. See AUD/REG Circuit Board Troubleshooting Chart.
No output from first mixer (Q102).	<ol style="list-style-type: none"> 1. Cable wiring error at terminal C6 or A13, or defective cable. 2. HFO aligned incorrectly. 3. See HFO/XTAL Circuit Board Troubleshooting Chart.
No output from second mixer (Q103).	<ol style="list-style-type: none"> 1. Cable wiring error at terminal B1 or B16, or defective cable. 2. See VFO Circuit Board Troubleshooting Chart.
No RF amplifier output.	<ol style="list-style-type: none"> 1. Wiring error on switch SW4. 2. Wiring error on control R1 or defective control. 3. See Front End Circuit Board Troubleshooting Chart.
AGC does not operate.	<ol style="list-style-type: none"> 1. Wiring error on switch SW3. 2. See AUD/REG Circuit Board Troubleshooting Chart.
BFO does not operate.	<ol style="list-style-type: none"> 1. Wiring error on switch SW3 or at terminals D14 or D15. 2. See AUD/REG Circuit Board Troubleshooting Chart.
Calibrator does not operate.	<ol style="list-style-type: none"> 1. Wiring error on switch SW2 or terminal C3. 2. See HFO/XTAL Calibrator Circuit Board Troubleshooting Chart.
No sidetone from transmitter.	<ol style="list-style-type: none"> 1. Wiring error on socket BD (J5) or terminal D9.
No muting or continuous muting.	<ol style="list-style-type: none"> 1. Wiring error on socket BF (J2) or terminal D3. 2. See VFO Circuit Board, Front End Circuit Board, and AUD/REG Circuit Board Troubleshooting Charts.
No voltage from 23 VDC power supply.	<ol style="list-style-type: none"> 1. Diodes D1 through D4 installed wrong or defective. 2. Capacitor C2 defective. 3. Wiring error on terminal strip CB or CC. 4. Fuse F1 open. 5. Wiring error on switch SW1 or defective switch. 6. AC source.
Will not operate from a 13.5 volt battery.	<ol style="list-style-type: none"> 1. Wiring error on switch SW1 or connector BH (P1). 2. Fuse F201 open.

FRONT END CIRCUIT BOARD

PROBLEM	POSSIBLE CAUSE
Weak or no output from RF amplifier.	<ol style="list-style-type: none"> 1. Diodes D101 through D118 installed wrong or defective. 2. Coils L106 through L109 installed wrong. 3. Front end alignment. 4. Transistor Q101 installed wrong or defective. 5. Wiring error on control R1 or defective control. 6. Transistor Q104 installed wrong or defective. 7. Capacitor C1 open or shorted.
No output from first mixer (Q102).	<ol style="list-style-type: none"> 1. No HFO signal (see HFO/XTAL Calibrator Circuit Board Troubleshooting Chart). 2. Transistor Q102 installed wrong or defective. 3. Wrong part installed at C138, C139, C141 through C147, and L116 through L118.
No output from second mixer (Q103).	<ol style="list-style-type: none"> 1. Wrong part at L119. 2. Capacitor C153 or C154. 3. Transistor Q103 installed wrong or defective. 4. No VFO signal (see VFO Circuit Board Troubleshooting Chart).

VFO CIRCUIT BOARD

PROBLEM	POSSIBLE CAUSE
No VFO output.	<ol style="list-style-type: none"> 1. Transistors Q301 through Q304 installed wrong or defective. 2. Coil L301 installed wrong. 3. Wrong part at C301 through C307. 4. Wire from hole E to VFO capacitor C3 not connected or shorted to mounting bracket.
S meter does not operate.	<ol style="list-style-type: none"> 1. Wrong part at R305 and R306. 2. Wiring error between meter and VFO circuit board. 3. Meter M1 defective. 4. See AUD/REG Circuit Board Troubleshooting Chart. 5. Diode D5 defective. 6. Controls R306 or R7 incorrectly set or defective.

HFO/XTAL CALIBRATOR CIRCUIT BOARD

PROBLEM	POSSIBLE CAUSE
No HFO signal.	<ol style="list-style-type: none"> 1. Diodes D401 through D406, D408, D409, and D411 through D414 installed wrong or defective. 2. Wrong parts installed at capacitor locations C402, C406, C408, C412, C415, or C418. 3. Wrong parts installed at L401 through L406. 4. Wrong parts installed at Y401 through Y406 or defective crystal. 5. Transistors Q401 and Q402 installed wrong or defective. 6. Wiring error on switch SW4.
Calibrator does not operate.	<ol style="list-style-type: none"> 1. Wiring error on switch SW2. 2. Transistors Q403 and Q404 installed wrong or defective. 3. Crystal Y407 defective. 4. Diode ZD401 installed wrong or defective.

AUD/REG CIRCUIT BOARD

PROBLEM	POSSIBLE CAUSE
No audio output.	<ol style="list-style-type: none"> 1. IC202 and IC203 installed wrong or defective. 2. BFO not operating (see next problem).
BFO does not operate.	<ol style="list-style-type: none"> 1. Transistors Q206, Q208, and Q209 installed wrong or defective. 2. Crystal Y205 or Y206 defective. 3. See General Troubleshooting Chart.
Product detector does not operate.	<ol style="list-style-type: none"> 1. IC204 installed wrong or defective. 2. BFO not operating (see above problem). 3. No IF signal (see next problem).
No IF output.	<ol style="list-style-type: none"> 1. Transistors Q205 and Q207 installed wrong or defective. 2. Wrong part at C235, C237, L201, or L202. 3. Wrong parts or defective at Y201 through Y204, C254, and C256. 4. Incorrect AGC voltage (see problem below). 5. Transistor Q202 defective. 6. Coil TC201 defective.
S meter does not operate.	<ol style="list-style-type: none"> 1. Transistor Q204 installed wrong or defective. 2. Diodes D205 and D206 installed wrong or defective. 3. See VFO Circuit Board Troubleshooting Chart.
Incorrect AGC voltage.	<ol style="list-style-type: none"> 1. Transistor Q203 installed wrong or defective. 2. Diode ZD202 defective. 3. Receiver muted (see muting problem in General Troubleshooting Chart). 4. Diode D207 defective. 5. Transistor Q101 (on front end circuit board) or Q205 defective. 6. See S-meter problem above.
Incorrect or no 13.5-volt supply.	<ol style="list-style-type: none"> 1. IC 201 defective. 2. Capacitor C202 defective. 3. Fuse F201 defective. 4. Wrong part at R201 and R202. 5. See General Troubleshooting Chart.

SPECIFICATIONS

Frequency Coverage (Megahertz)	3.5 to 4.0, 7.0 to 7.5, 14.0 to 14.5, 21.0 to 21.5, 28.0 to 28.5, 28.5 to 29.0.
Sensitivity	Less than 0.5 microvolts for 10 dB signal-plus-noise to noise ratio for SSB operation.
IF Selectivity	2.1 kHz minimum at 6 dB down, 7 kHz maximum at 60 dB down.
Overall Audio Response	
Wide	2100 Hz minimum at 6 dB down, 7 kHz maximum at 60 dB down.
Narrow	250 Hz minimum at 6 dB down, 2.5 kHz maximum at 60 dB down (center frequency approximately 750 Hz).
Overall Gain	Less than 1.5 microvolt input for 0.25 watts of audio output.
Audio Output Power8 watts into a 4-ohm load continuous (1.2 watts peak power) at less than 10% THD.
AGC Characteristic	
Blocking Level	3 volts.
Dynamic Range	120 dB or greater.
Time Constant	Attack time less than 1 millisecond. Release time switch selectable at 100 milliseconds (CW) or 1 second (SSB).
Intermodulation Distortion	-60 dB
Image Rejection	50 dB or better.
IF Rejection	60 dB or better.
Internally Generated Spurious Signals	Below 1 microvolt equivalent antenna input except at 3.74, 21.2, 28.6, and 28.9 MHz.
Mode of Operation	Selectable upper or lower sideband and CW.



Frequency Stability	Less than 100 Hz per hour drift after 30 minutes warm up. Less than 100 Hz drift for 10% change in line voltage.
Tuning Rate	Approximately 15 kHz per turn.
Dial Accuracy	Within 2 kHz after calibration at nearest 100 kHz marker.
Muting	Shorted external ground at Mute socket.
Sidetone Input Level	10 millivolts or greater (300 mV maximum).
Dial Backlash	50 Hz or less.
IF Frequencies	
First IF	8.395 to 8.895 MHz.
Second IF	3.395 MHz.
Antenna Input Impedance	50 Ω unbalanced.
Temperature Range	-10°C to 50°C.
Meter Calibration	0 to S-9 +60 dB.
Front Panel Controls	AF Gain control/Power on-off. Preselector. RF Gain. VFO tuning. Band switch. Function switch. Mode switch.
Power Requirements	120 or 240 volts AC (50/60 Hz) 27 watts maximum or 11.5 VDC to 15 VDC at 0.75 amperes maximum.
Overall Dimensions (with knobs and feet installed)	12-3/4" wide \times 6-3/4" high \times 12" deep (32.39 cm \times 17.15 cm \times 30.48 cm).
Net Weight	9-3/4 lbs (4.42 kg).

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

CIRCUIT DESCRIPTION

Refer to the Block Diagram and the Schematic while you read this "Circuit Description." The part numbers on the Schematic are arranged in the following groups to help you locate specific parts on the Schematic, circuit boards, and chassis:

1-99	Parts mounted on the chassis.
100-199	Parts mounted on the front end circuit board.
200-299	Parts mounted on the AUD/REG circuit board.
300-399	Parts mounted on the VFO circuit board.
400-499	Parts mounted on the HFO/XTAL calibrator circuit board.

Incoming signals at the antenna are first amplified by transistor Q101 and then mixed in transistor Q102 with a signal from the HFO/XTAL Calibrator circuit board. The resulting 8.395 to

8.895 MHz first IF signal passes through an 8.5 MHz bandpass filter to transistor Q103. Q103 mixes the first IF signal with the VFO signal which produces a 3.395 MHz second IF signal. The second IF signal passes through a crystal filter to IF amplifier transistor Q205. The amplified IF signal is then changed to audio frequencies by IC204 which is a product detector. The detected audio signal is amplified in IC203C and, depending on the position of the Function switch, is coupled either directly to audio amplifier IC202 or through the active bandpass filter, IC203A and IC203B, to IC202. IC202 amplifies the audio enough to drive a speaker.

The following paragraphs describe the operation of each circuit in more detail.

FRONT END CIRCUIT BOARD

ANTENNA INPUT CIRCUIT

Signals from the antenna first pass through a 3.395 MHz trap, a high frequency trap, and an 8.5 MHz trap before they are coupled to the antenna tuning circuits. The 3.395 MHz trap (TC101) is a series tuned circuit that traps out the 3.395 MHz signal on the antenna input and improves the IF rejection of the Receiver. The high frequency trap (L102 and C103) is a parallel tuned circuit that traps out signals above 30 MHz. The 8.5 MHz trap (L103 through L105 and C105 through C107) is a series and parallel tuned circuit combination which operates in a manner similar to the 3.395 MHz trap.

After the signal passes through the three trap circuits, it is coupled through a tuned circuit to RF amplifier Q101. Each of the four tuned circuits (L106 through L109, C109, C112, and C1) performs two functions. First, the circuit allows only the proper signals to pass through, as determined by the band to which you are tuned, and second, it matches the low impedance antenna circuit to the high impedance input of gate G1 of the RF amplifier. The tuned circuits are selected by the Band switch and switching diodes D101 through D108.

RF AMPLIFIER CIRCUIT

Signals from the antenna input circuit are coupled through C116 to gate G1 of RF amplifier Q101, where they are amplified. Tuned circuits (L111 through L115 and the associated capacitors) provide further signal selectivity. These tuned circuits are selected by the Band switch and switching diodes D114 through D118.

The gain of the RF amplifier is controlled by two methods. AGC voltage, from the AUD/REG circuit board, is applied to gate G2 of Q101 and a voltage from the RF Gain control is applied through R109 to the source (S) of Q101. As the AGC voltage goes down, the RF amplifier gain decreases. As the voltage from the RF Gain control goes up, Q101 becomes cut off. Q104 is used to cut off Q101 during muting when the Receiver is used with a transmitter.

FIRST MIXER CIRCUIT

Signals from the RF amplifier are coupled through C133 to gate G1 of first mixer transistor Q102. At the same time, a signal from the HFO (heterodyne frequency oscillator) circuit board is coupled through C134 to gate G2 of Q102. Q102 mixes these two signals and produces sum and difference frequencies at its drain (D). The bandpass filter (L116 through L118 and the associated capacitors) allows only the 8.395 to 8.895 MHz first IF signal to pass through to the second mixer.

SECOND MIXER CIRCUIT

The first IF signal from the bandpass filter is coupled through C147 to gate G1 of second mixer transistor Q103. At the same time, a signal from the VFO (variable frequency oscillator) circuit board is coupled through C149 to gate G2 of Q103. Q103 mixes these two signals and produces sum and difference frequencies at its drain (D). A tuned circuit (L119, C153, and C154) provides a low impedance for the 3.395 MHz second IF signal which now goes to the AUD/REG circuit board.

AUD/REG CIRCUIT BOARD

CRYSTAL FILTER CIRCUIT

The 3.395 MHz second IF signal, which comes from the front end circuit board, is coupled through C246 to the base (B) of Q207. This transistor matches the impedance of the output of the front end circuit board to the impedance of the crystal filter circuit. The second IF signal from the collector (C) of Q207 is then coupled through C248 to the 2.1 kHz crystal filter (Y201 through Y204, TC201, C254, and C256). Because the crystal filter allows only the 3.395 MHz signal to pass, the sharp selectivity provided by the filter permits excellent rejection of unwanted adjacent signals.

IF AMPLIFIER CIRCUIT

The 3.395 MHz second IF signal, coming from the crystal filter circuit, is coupled through C239 to gate G1 of IF amplifier Q205. Power is supplied to the drain (D) of the transistor through a tuned circuit formed by L201 and C235. AGC voltage is applied to gate G2 of Q205 to limit the gain during strong signal reception.

BFO CIRCUIT

The BFO (beat frequency oscillator) is made up of two crystal controlled oscillators which are selected by the Mode switch. The LSB oscillator (Q208, Y205, and associated components) and the USB/CW oscillator (Q209, Y206, and associated components) are coupled through C243 and C244, respectively, to the base (B) of Q206. Q206 is an emitter follower stage which matches the high impedance output of the crystal oscillators to the low impedance input of the product detector.

PRODUCT DETECTOR

The amplified 3.395 MHz second IF signal is coupled through C231 to the signal input (pin 4) of product detector IC204. A signal from the BFO is coupled through C233 to the carrier input (pin 7) of IC204. IC204 mixes the two input signals and produces sum and difference signals at its output (pin 6). The sum frequency is filtered out by C224 and C225. The difference frequency is an audio signal. R229 sets the gain of the stage.

AUDIO CIRCUIT

The audio signal, coming from the product detector, is coupled through C224 and R218 to the inverting input (pin 13) of operational amplifier IC203C. The amplified audio signal (pin 14) is coupled either through C216 to the function switch or through R213 to the active filter stage. The active filter stage is formed by IC203A and IC203B. These cascaded operational amplifiers are bandpass tuned for a selected bandwidth of audio frequencies. The bandwidth of the active filter circuit is 300 Hz at a center frequency of 750 Hz. This active filter provides sharp selectivity and permits excellent rejection of unwanted adjacent audio signals in the CW mode. The output of the active filter stage is coupled through C215 to the Function switch.

Function switch (SW2) selects either wide bandpass audio signal, coming from IC203C, or the narrow bandpass audio signal, coming from IC203B, and passes it to the AF Gain control (R4). The audio signal, coming from the AF Gain control, and the sidetone input, coming from Sidetone jack J5 (when used), are then fed to the input (pin 7) of the audio power amplifier IC202. The amplified audio signal is then coupled through C205 to the Phone jack (J3) and the SPKR jack (J4). When headphones are connected to the Phone jack, the speaker is automatically disconnected.

S-METER AND AGC CIRCUIT

A sample of the audio signal, coming from the product detector (IC204), is coupled through C218 to operational amplifier IC203D. The amplified audio signal is then coupled through C221 to voltage doubling diodes D205 and D206. D205 and D206 rectify the positive half of the audio signal to produce a pulsating DC voltage.

The DC voltage is affected by a selectable-release time-constant circuit formed by C223 and either R5 or R6 on the Mode switch. The Mode switch selects either R5 or R6 to produce fast and slow AGC action.

The controlled DC voltage causes the source (S) of Q204, a DC voltage detector, to vary in proportion with the amount of voltage on its gate (G). Part of this varying voltage is sent to the S meter to indicate the strength of the received signal. Another part of this varying voltage is DC-coupled through resistor R234 to the base of AGC control transistor Q203. When there is no signal present, Q203 is turned off, allowing zener diode ZD201 to hold the AGC voltage to about 3 volts DC. When a signal is present, the voltage on the source of Q204 goes up, causing Q203 to turn on. The AGC voltage at its collector will drop to .2 volts DC. The AGC voltage controls the gain of IF amplifier Q205 and RF transistor Q101 (on the front end circuit board). This prevents the Receiver from overloading on strong incoming signals.

POWER SUPPLY CIRCUIT

DC voltage from the power supply mounted on the chassis is connected to the input of regulator IC201. IC201 samples and compares the incoming DC voltage with the output voltage and adjusts itself as necessary to maintain a fixed DC voltage level. R201 and R202 control the regulated output voltage.

Fuse F201 is used for protection against short circuits during battery operation.

VFO CIRCUIT BOARD

A field effect transistor (Q301) is used in a Hartley oscillator circuit in the VFO. Part of coil L301, variable capacitor C3 (the main tuning capacitor), and fixed temperature compensating capacitors C301 through C307 are used in the frequency determining circuits. The remaining part of coil L301 is used for feedback to maintain oscillation. Zener diode ZD301 regulates the voltage at the drain of Q301.

The output of oscillator Q301 is coupled through C308 to source-follower transistor Q302, which acts as a buffer and

impedance matching device. Transistor Q303 is a fixed-tuned amplifier which is followed by a low-pass filter (L302 through L305 and C314 through C318) to reduce the harmonic output of the VFO.

Transistor Q304 is used to turn off transistor Q303 during transmission, when the Receiver is used with a transmitter.

Control R306 is used to adjust the S meter to zero during no-signal conditions.

HFO/XTAL CALIBRATOR CIRCUIT BOARD

HFO CIRCUIT

This circuit is formed by a straight-forward crystal controlled oscillator. Switching diodes D401 through D406, D408, D409, and D411 through D414 and Band switch SW4 determine which crystal and its associated tuned circuit is connected to oscillator transistor Q401. The HFO signal produced by Q401 is coupled through C409 to the base of HFO amplifier transistor Q402. The amplified HFO signal is then coupled through C416 to the front end circuit board.

A detector circuit consisting of C419, C421, R419, and D415 provides a DC voltage at TP for use during HFO alignment.

CRYSTAL CALIBRATOR CIRCUIT

Transistors Q403 and Q404 form a 100 kHz astable multivibrator that is controlled by crystal Y407. The output of this multivibrator circuit is a square wave that produces harmonics at every 100 kHz on the dial. Resistor R427 and zener diode ZD401 reduce the 12-volt supply voltage to 5 volts for the multivibrator.

This circuit operates when the Function switch is in the Cal position.

OTHER CIRCUITS

MUTING CIRCUIT

The purpose of this circuit is to shut down the Receiver during transmit (when used with a transmitter) so no interfering or strong signals are present.

When Mute jack J2 is shorted during transmit, transistor Q104, on the front end circuit board, and Q202, on the AUD/REG circuit board, are turned on which turn off RF amplifier transistor Q101 and IF amplifier transistor Q205 respectively.

At the same time, Q304 on the VFO circuit board is turned off, which removes the supply voltage to buffer transistor Q303.

During receive, the opposite occurs allowing the receiver circuits to operate normally.

POWER SUPPLY CIRCUIT

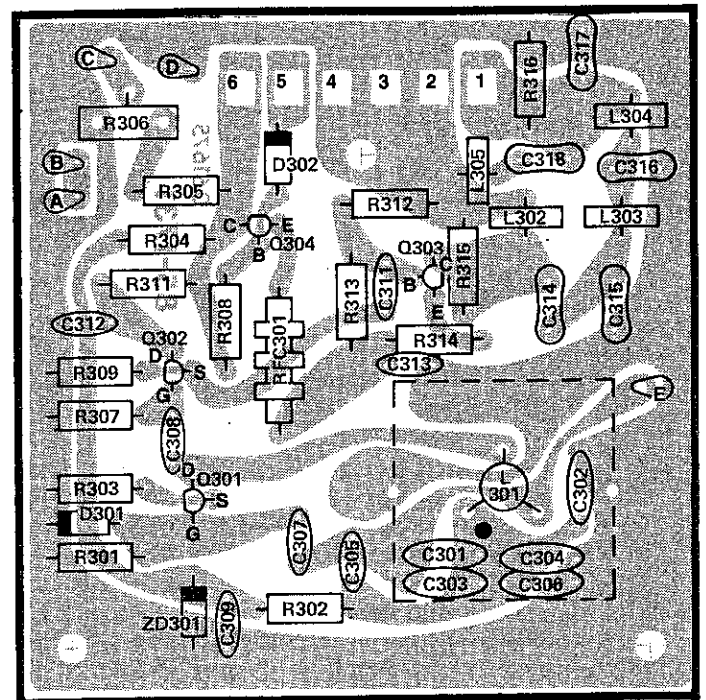
AC power is supplied through fuse F1 and switch SW1A to the primary of transformer T1. T1 has dual primary windings to allow operation from either 120 or 240-volt line voltages.

The voltage at the secondary is rectified by a full-wave bridge circuit formed by diodes D1 through D4. The rectified DC voltage is then filtered by capacitor C2 and is then applied to the regulator circuit on the AUD/REG circuit board.

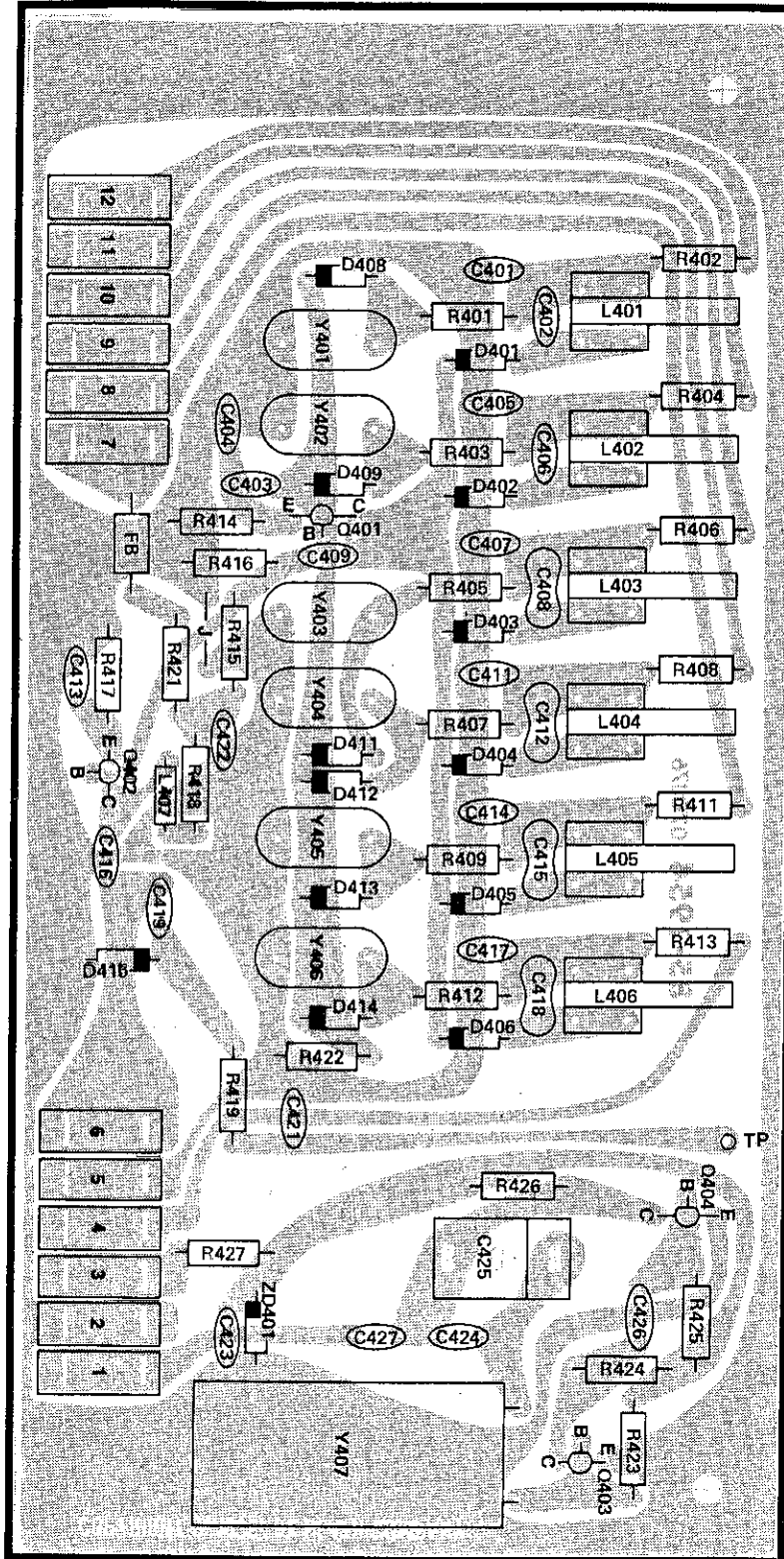
CIRCUIT BOARD X-RAY VIEWS

NOTE: To identify a part shown in one of these views, so you can order a replacement, proceed in either of the following ways:

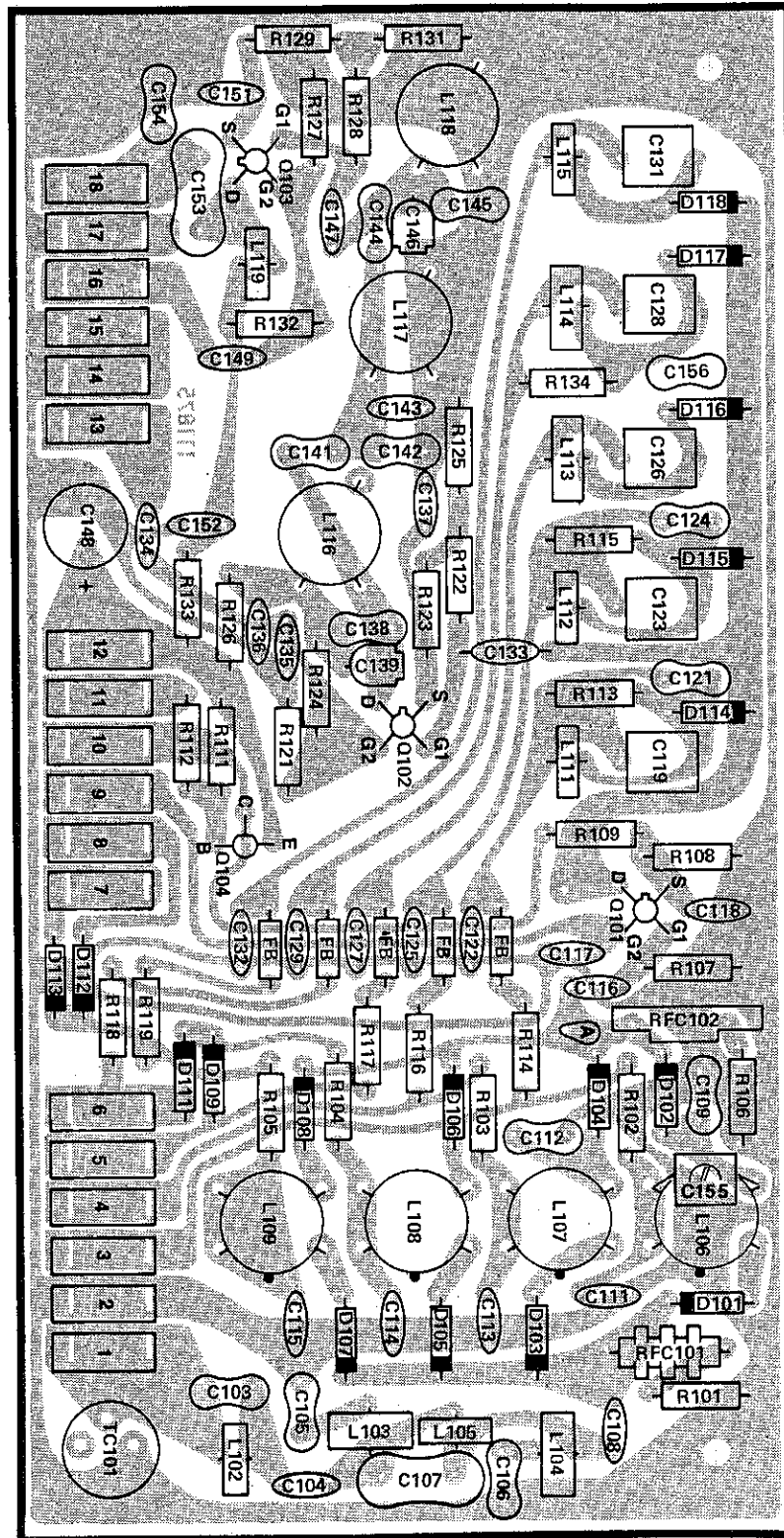
1. A. Refer to the place where the part is installed in the Step-by-Step instructions and note the "description" of the part (for example: 22 k Ω , .05 μ F, or MPF105).
 B. Look up this description in the appropriate parts list.
2. A. Note the identification number of the part (R-number, C-number, etc.).
 B. Locate the same identification number (next to the part) on the Schematic. The "description" of the part will also appear near the part.
 C. Look up this description in the appropriate parts list.



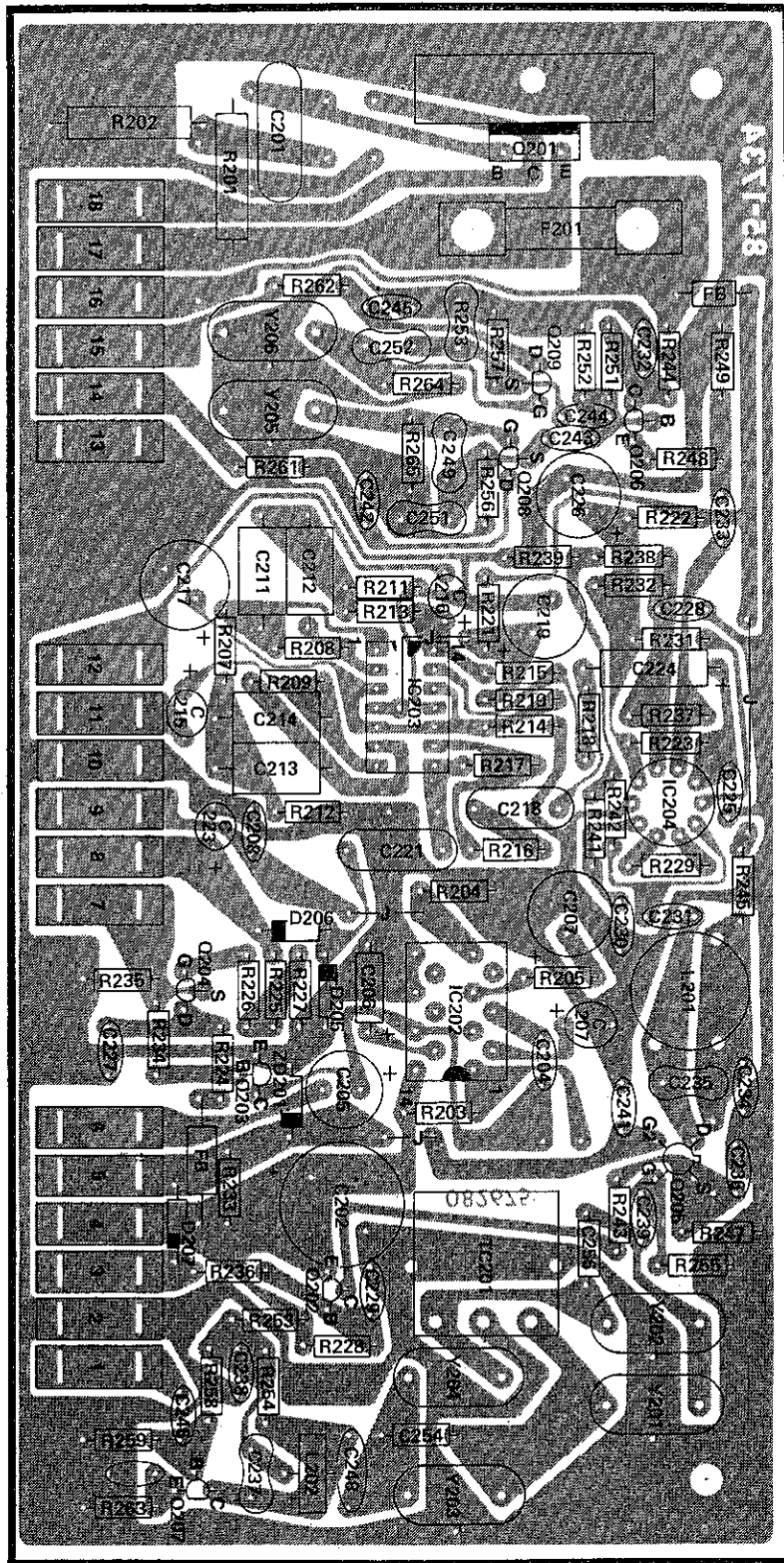
VFO CIRCUIT BOARD
 (Shown from component side)



HFO/XTAL CALIBRATOR CIRCUIT BOARD
(Shown from component side)



FRONT END CIRCUIT BOARD
(Shown from component side)



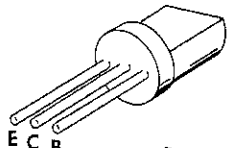
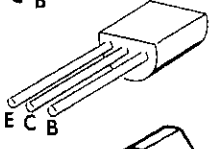
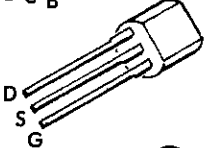
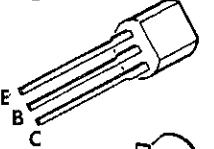
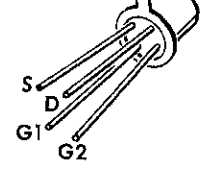
AUD/REG CIRCUIT BOARD
(Shown from component side)

IDENTIFICATION CHARTS

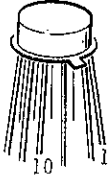
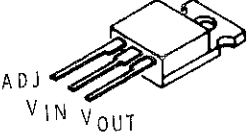
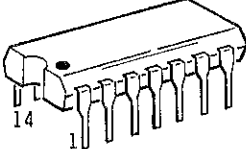
DIODES

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
56-16	1N751	ZD401	<p>NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES</p>
56-19	VR-9.1	ZD301	
56-24	1N458	D101, D102, D103, D104, D105 D106, D107, D108, D109, D111 D112, D113, D114, D115, D116 D118, D401, D402, D403, D404 D405, D406, D408, D409, D411 D412, D413, D414	
56-26	1N191	D205, D206, D207, D415	
56-50	D0-7	ZD201	
56-89	GD510	D5, D302	
57-65	1N4002	D1, D2, D3, D4,	

TRANSISTORS

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	BASING DIAGRAM	
417-293	2N5770	Q401, Q402	D	 <p style="text-align: right;">A</p>
417-169	MPF105	Q208, Q209, Q301, Q302	C	 <p style="text-align: right;">B</p>
417-201	X29A829	Q104, Q202	A OR B	 <p style="text-align: right;">C</p>
417-234	2N3638A	Q303	D	 <p style="text-align: right;">D</p>
417-241	EL131	Q204	C	 <p style="text-align: right;">E</p>
417-801	MPSA20	Q203, Q206, Q207, Q304, Q403	D	
417-863	MFE131	Q101, Q102, Q103, Q205	E	

INTEGRATED CIRCUITS

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
442-96	MC1496G	IC204	
442-708	LM317T	IC201	
442-602	LM324N	IC203	
442-610	TBA820L	IC202	

CUSTOMER SERVICE

REPLACEMENT PARTS

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

ORDERING FROM THE FACTORY

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

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

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

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

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

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

TECHNICAL CONSULTATION

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

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

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

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

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

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

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

REPAIR SERVICE

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

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

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

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

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

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

Heath Company
Service Department
Benton Harbor, Michigan 49022

FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

DO NOT WRITE IN THIS SPACE

INSTRUCTIONS

- Please print all information requested.
- Be sure you list the correct **HEATH** part number exactly as it appears in the parts list.
- If you wish to prepay your order, mail this card and your payment in an envelope. Be sure to include 10% (25¢ minimum, \$3.50 maximum) for insurance, shipping and handling. Michigan residents add 4% tax.
Total enclosed \$_____
- If you prefer COD shipment, check the COD box and mail this form. COD

NAME _____
 ADDRESS _____
 CITY _____
 STATE _____ ZIP _____

The information requested in the next two lines is not required when purchasing nonwarranty replacement parts, but it can help us provide you with better products in the future.

Model # _____ Invoice # _____
 Date _____ Location _____
 Purchased _____ Purchased _____

LIST HEATH PART NUMBER	QTY.	PRICE EACH	TOTAL PRICE

TOTAL FOR PARTS	
HANDLING AND SHIPPING	
MICHIGAN RESIDENTS ADD 4% TAX	
TOTAL AMOUNT OF ORDER	

SEND TO: **HEATH COMPANY**
 BENTON HARBOR
 MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only): 616 982-3571

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

FOR PARTS REQUESTS ONLY

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 MICHIGAN 49022
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Phone (Replacement parts only): 616 982-3571

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