

HEATHKIT[®] MANUAL

for the

**DELUXE QRP
CW TRANSCEIVER
Model HW-9**

595-3059



HEATH COMPANY • BENTON HARBOR, MICHIGAN

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YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component, will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

Heathkit® Manual

for the

DELUXE QRP CW TRANSCEIVER Model HW-9

595-3059

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The Heathkit Model HW-9 Deluxe QRP CW Transceiver is a compact 80-through 10-meter HF transceiver designed with the avid low-power CW operator in mind. It covers the lower 250 kHz of the 80, 40, 20, and 15-meter amateur bands. When you install the Model HWA-9 Accessory Band Pack, the Transceiver also covers the 30, 17, and 12-meter WARC bands and the lower 250 kHz of the 10-meter band. Broadband circuits eliminate the need to tune circuits within a band. Just turn the Band switch and select the desired frequency.

The design of the wide-band front-end stages eliminates the need for the customary RF amplifier in the receiver section. This results in a receiver that can properly handle incoming signals with a wide dynamic range. Also, only one frequency conversion is used in the main signal path of the receiver section. This is done to reduce spurious responses (birdies) and to maintain high image rejection.

Power for this Transceiver can be furnished by a power supply, such as the Heathkit Model PSA-9 Power Supply, or directly from any regulated 12.6 VDC source that can supply at least 1 ampere.

To align this Transceiver, you should have a VTVM (vacuum-tube voltmeter) or VOM (volt-ohmmeter), a frequency counter capable of measuring frequencies accurately up to at least 10 MHz, and a 50-ohm resistive dummy load.

The following features are also included in your Transceiver:

- Solid-state transmit/receive switching that permits full break-in operation.
- Continuously variable RF power output.
- Receiver incremental tuning (RIT).
- An audio-active filter with selectable wide or narrow selectivity.
- A front panel meter that indicates signal strength in receive and relative power in transmit.

This Transceiver is a handy addition to any ham shack for avid QRP operators, newcomers, or old timers alike.

UNPACKING

**DO NOT UNPACK ANY PART OF YOUR KIT
UNTIL A STEP DIRECTS YOU TO DO SO.**

Locate the "Pack Index Sheet" that is packed inside the main shipping carton for your Transceiver. Note that the shipping carton is divided into three smaller sections. These sections make up Packs 1 and 2 and the Final Pack, and may be made up of several bags, envelopes, small boxes, and loose parts. Do not unpack any of these parts until a step specifically directs you to do so.

When you check parts against a "Parts List," return any part or group of parts packaged in a bag or other container, with a part number on it, to its container after you identify it. Leave these parts there until you actually use them in a step. This will help prevent you from mixing up the parts, and help you identify the parts when you need them.

Some parts, however, are in a bag or envelope that is not marked with an actual part number, but with a packaging number that begins with the number "173-." These numbers are used for packaging purposes only and do not appear in the Manual "Parts Lists." Open each bag or envelope that is marked with only a "173-" packaging number to identify the parts it contains.

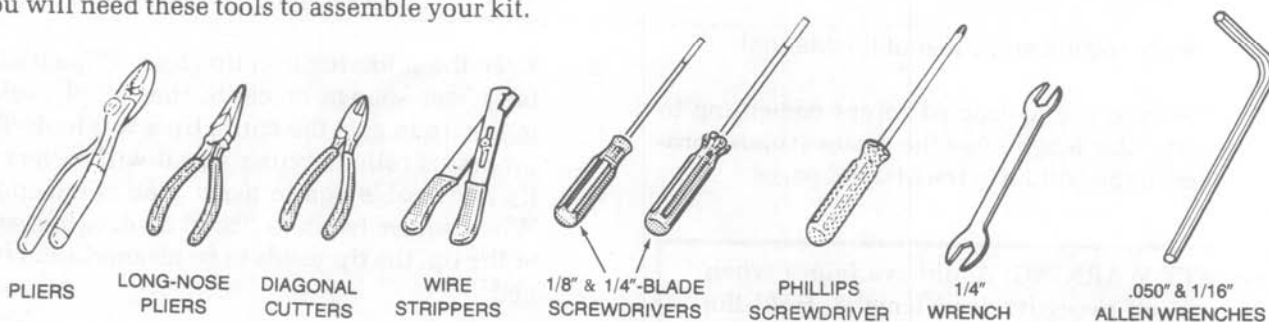
NOTE: Never use a "173-" packaging number if you must order a replacement part. Use only the part numbers listed in the Manual Parts List for this purpose.

Save all of the packaging material until you account for all of the parts.

ASSEMBLY NOTES

TOOLS

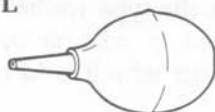
You will need these tools to assemble your kit.



OTHER HELPFUL TOOLS



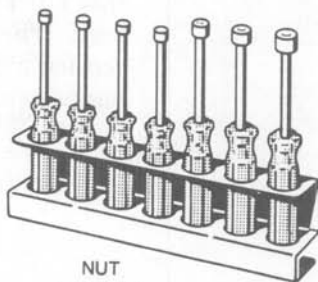
NUT STARTER
(May Be Supplied
With Kit)



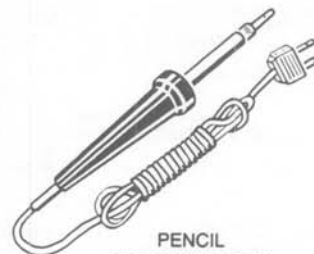
DESOLDERING
BULB*



DESOLDERING
BRAID*



NUT
DRIVERS



PENCIL
SOLDERING IRON
(22 to 25 WATTS)

*To Remove Solder From Circuit Connections.

ASSEMBLY

- Follow the instructions carefully. Read the entire step before you perform each operation.
- 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.
- Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.
- Position all parts as shown in the Pictorials.
- Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic 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 section at the rear of the Manual.
7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excessive 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:

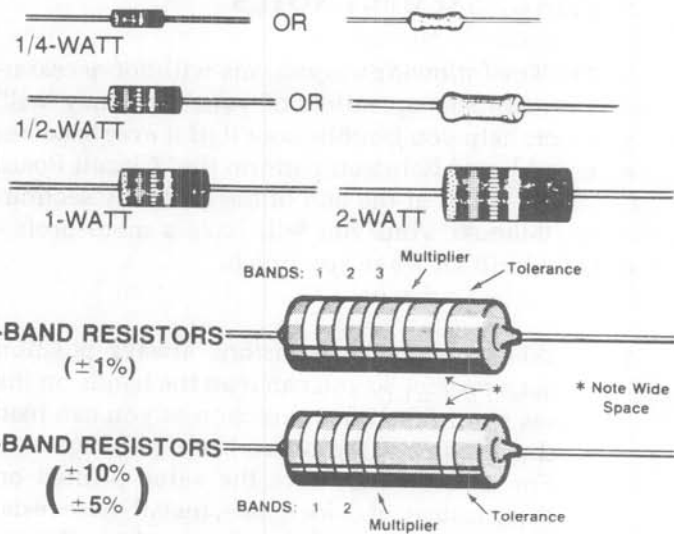
1. Use the right type of soldering iron. A 22 to 25-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.
2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, 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.

NOTE: Always use rosin core, radio-type solder (60:40 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.

Heathkit®

PARTS

Resistors are identified in Parts Lists and steps by their resistance value in Ω (ohms), $k\Omega$ (kilohms), or $M\Omega$ (megohms). They are usually identified by a color code and four or five color bands, where each color represents a number. These colors (except for the last band, which indicates a resistor's "tolerance") will be given in the steps in their proper order. Therefore, the following color code is given for information only. NOTE: Occasionally, a "precision" or "power" resistor may have the value stamped on it.



Band 1 1st Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Band 2 2nd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Band 3 (if used) 3rd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Multiplier	
Color	Multiplier
Black	1
Brown	10
Red	100
Orange	1,000
Yellow	10,000
Green	100,000
Blue	1,000,000
Silver	0.01
Gold	0.1

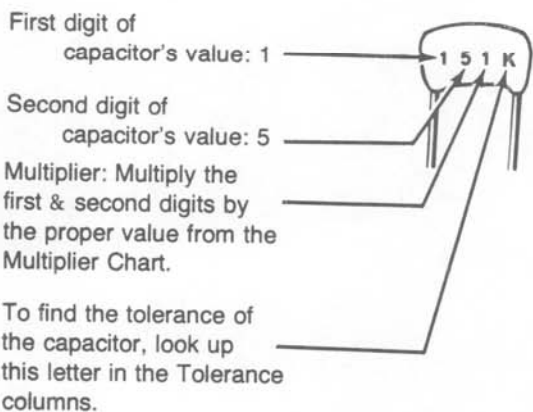
Resistance Tolerance	
Color	Tolerance
Silver	± 10%
Gold	± 5%
Red	± 2%
Brown	± 1%
Green	± 5%
Blue	± 25%
Violet	± .1%
Gray	± 05%

Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar*, electrolytic, etc. Some capacitors may have their value printed in the following manner:

EXAMPLES:

$151K = 15 \times 10 = 150 pF$
 $759 = 75 \times 0.1 = 7.5 pF$

NOTE: The letter "R" may be used at times to signify a decimal point: as in: $2R2 = 2.2 (pF \text{ or } \mu F)$.



MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY:	10 pF OR LESS	LETTER	OVER 10 pF
0	1	±0.1 pF	B	
1	10	±0.25 pF	C	
2	100	±0.5 pF	D	
3	1000	±1.0 pF	F	±1%
4	10,000	±2.0 pF	G	±2%
5	100,000		H	±3%
			J	±5%
8	0.01		K	±10%
9	0.1		M	±20%

*DuPont Registered Trademark.

SPECIAL ASSEMBLY NOTES

NOTE: The following suggestions will not necessarily improve the operation of your kit. They will, however, help you troubleshoot it (if it ever becomes necessary), and help you perform the "Circuit Board Checkout" steps at the end of the assembly sections of this Manual. And you will have a more professionally-built kit when you finish.

1. When you install resistors, always position each resistor so you can read the bands on the resistor in the same direction as you can read the printing on the circuit board (see Figure 1). For resistors that have the value printed on them instead of color bands, install these resistors so the values are facing away from the circuit board and read in the same direction as the printing on the circuit board.

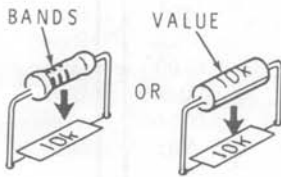


Figure 1

2. When you install ceramic, Mylar, or mica capacitors, always position each capacitor so you can read the value on the capacitor in the same direction as you can read the printing on the circuit board (see Figure 2).

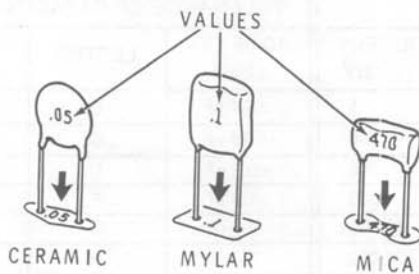


Figure 2

3. When you install electrolytic or other tubular capacitors, always position each capacitor so the value is facing away from the circuit board (see Figure 3). Be sure to observe the correct polarity when you install electrolytic capacitors (as you will be directed in the steps). Other, non-polarized, capacitors should be installed so you can read the values in the same direction as the printing on the circuit board.

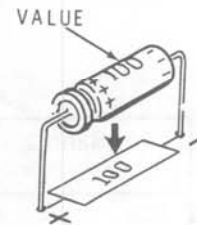


Figure 3

4. Install diodes so the type numbers or part numbers are facing away from the circuit board. Be sure to match the band on one end of each diode with the band mark on the circuit board.

OSCILLATOR CIRCUIT BOARD

3-510 21-191
 - 1-50 21-190
 - 1-33 - 21-7
 3-4.7 21-168
 - 1-18 21-60

PARTS LIST

Remove the parts from Pack #1. Then check each part against the following list. Do not remove components that are supplied on a tape from the tape until you use them in a step. Return any part that is packed in an individual envelope, with the part number on it, back to the envelope after you identify it until that part is called for in a step. Do not throw away any packing material until all of the parts are accounted for.

To order a replacement part, always include the PART NUMBER. 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 prices, refer to the separate "Heath Parts Price List."

TAPED COMPONENTS

NOTE: These parts are taped on a strip which was checked before shipment. Since these parts are taped in the order of assembly, you may not wish to check them against the following list.

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
----------------	------	-------------	-------------------

RESISTORS

NOTE: The following resistors are rated at 1/4-watt and have a tolerance of 5%. A 5% tolerance is indicated by a fourth color band of gold.

6-470-12	3	47 Ω (yel-viol-blk)	R128, R129, R142
6-101-12	5	100 Ω (brn-blk-brn)	R104, R138, R147, R153, R174
6-221-12	3	220 Ω (red-red-brn)	R123, R124, R143

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
----------------	------	-------------	-------------------

Resistors (Cont'd)

6-271-12	5	270 Ω (red-viol-brn)	R155, R159, R161, R164, R165
6-331-12	2	330 Ω (org-org-brn)	R135, R148
6-471-12	1	470 Ω (yel-viol-brn)	R156
6-681-12	2	680 Ω (blu-gry-brn)	R145, R151
6-152-12	2	1500 Ω (brn-grn-red)	R158, R163
6-222-12	5	2200 Ω (red-red-red)	R107, R109, R113, R117, R166
6-332-12	2	3300 Ω (org-org-red)	R157, R162

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
-------------------	------	-------------	----------------------

Resistors (Cont'd)

6-392-12	2	3900 Ω (org-wht-red)	R137, R139
6-682-12	2	6800 Ω (blu-gry-red)	R168, R169
6-822-12	1	8200 Ω (gry-red-red)	R105
6-103-12	3	10 k Ω (brn-blk-org)	R118, R132, R133
6-123-12	3	12 k Ω (brn-red-org)	R108, R110, R114
6-223-12	5	22 k Ω (red-red-org)	R102, R103, R141, R171, R172
6-333-12	1	33 k Ω (org-org-org)	R127
6-473-12	1	47 k Ω (yel-viol-org)	R154
6-104-12	3	100 k Ω (brn-blk-yel)	R126, R144, R152
6-224-12	1	220 k Ω (red-red-yel)	R136
6-334-12	1	330 k Ω (org-org-yel)	R134
6-155-12	1	1.5 M Ω (brn-grn-grn)	R146

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
-------------------	------	-------------	----------------------

CAPACITORS

21-761	32	.01 μ F (103) glass ceramic	C102, C107, C112, C121, C129, C139, C141, C143, C145, C151, C153, C157, C162, C174, C176, C178, C181, C189, C191, C192, C193, C195, C197, C203, C209, C212, C214, C216, C217, C218, C219, C226 C177
21-762	1	.1 μ F (104) glass ceramic	

DIODES

56-24	1	1N458	D119
56-26	2	1N191 (brn-wht-brn)	D138, D139
56-56	2	1N4149	D141, D142
56-646	17	BA-244 (red-yel-yel)	D101, D102, D103, D104, D107, D108, D112, D113, D121, D122, D123, D124, D127, D128, D132, D133, D143 D118
57-65	1	1N4002	

NON-TAPED PARTS

The following parts are not taped on strips. The key numbers correspond to the numbers on the "Oscillator Circuit Board Parts Pictorial" (Illustration Booklet, Page 1).

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

Mica

A1	20-97	2	50 pF	C207, C208
A1	20-110	1	75 pF	C205
A1	20-119	2	90 pF	C127, C128
A1	20-102	1	100 pF	C206
A1	20-124	1	115 pF	C149
A1	20-178	2	160 pF	C118, C119
A1	20-105	1	180 pF	C111
A1	20-108	1	200 pF	C109
A1	20-115	2	300 pF	C105, C106

Ceramic

A2	21-33	1	3.3 pF	C126
A2	21-168	4	4.7 pF	C117, C179, C188, C194
A2	21-78	3	5 pF	C167, C171, C173
A2	21-169	2	6 pF	C108, C169
A2	21-115	1	9 pF	C104
A2	21-3	4	10 pF	C168, C172, C202, C211
A2	21-60	1	18 pF	C186
A2	21-84	1	24 pF	C161
A2	21-7	3	33 pF	C101, C184, C213
A2	21-147	2	47 pF	C156, C175
A2	21-190	1	50 pF	C182
A2	21-54	1	75 pF	C225
A2	21-75	1	100 pF (100K)	C152
A2	21-22	1	220 pF	C221
A2	21-17	1	270 pF	C222
A2	21-722	1	330 pF	C201
A2	21-56	1	470 pF	C196
A2	21-13	1	500 pF	C198
A2	21-191	3	510 pF	C183, C185, C187
A2	21-171	2	680 pF	C199, C223
A2	21-140	2	.001 μ F (1000 pF)	C103, C215

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

B1	40-1785	4	.14 μ H coil (violet)	L107, L108, L112, L113
B2	40-2076	6	.3 μ H coil	L101, L102, L124, L125, L127, L129
B2	40-2075	3	.44 μ H coil	L103, L104, L137
B2	40-2070	1	3 μ H coil	L135
B3	40-2111	1	5.5 μ H coil	L118
B4	45-73	1	2.2 μ H choke (red-red-gold)	L133
B5	45-625	2	4.7 μ H choke (yel-viol-gold)	L122, L123
B5	45-621	4	100 μ H choke (brn-blk-brn)	L119, L121, L134, L136

TRANSISTORS

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.

C1	417-234	1	2N3638A	Q106
C1	417-293	4	2N5770	Q101, Q108, Q109, Q111
C2	417-863	1	MFE131	Q107
C1	417-169	3	MPF105	Q102, Q105, Q112
C1	417-801	5	MPSA20	Q103, Q104, Q113, Q114, Q115

CRYSTALS

D1	404-639	1	8.8314 MHz	Y109
D1	404-664	1	18.330 MHz	Y101
D1	404-665	1	21.830 MHz	Y102
D1	404-667	1	28.830 MHz	Y104
D1	404-669	1	35.830 MHz	Y106

20-117
20-714
185 pF

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

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

CONNECTORS

E1	432-121	3	PCB pin	
E2	432-134	5	Wire socket	
E3	432-969	1	5-pin plug	

WIRE—CABLE

340-1	3"	Large bare wire
340-8	18"	Small bare wire
343-12	10' 6"	Shielded cable
344-2	5"	Black stranded wire
344-59	2'	White solid wire
344-3	18"	Large red stranded wire
344-163	6"	Small black solid wire
344-170	7'	Violet solid wire
347-55	4'	8-wire cable

MISCELLANEOUS

F1	10-918	1	500 Ω control	R173
F1	10-941	1	100 k Ω control	R131
	85-2801-1	1	Oscillator circuit board	
F2	206-1463	1	Oscillator shield	
F3	475-10	10	Ferrite bead	
F4		1	Blue and white label*	
	597-260	1	Parts Order Form*	
		1	Taped Component Chart	
		1	Assembly Manual (see Page 1 for the part number)	

Solder

* These items may be packed inside the Manual.



STEP-BY-STEP ASSEMBLY

Refer to Pictorial 1-1 (Illustration Booklet, Page 2) as you read the following notes and steps.

NOTES:

1. Many circuit board drawings, such as the one shown in Pictorial 1-1, are divided into two or more sections. These sections show you which area of the circuit board you are working in for a specific series of steps.
2. Refer to the "Taped Components Chart." Note that it is divided into numbered sections that match the sections on the circuit board.
3. Each series of steps has you installing parts in a top-to-bottom, left-to-right sequence. Occasionally, you may be directed to install a component in an area out of sequence. These components are each identified in the step and on the Pictorial with a special callout.
4. Check off each step as you perform it. You may also wish to place a check mark near each component on the Pictorial as you install it.
5. In general, solder instructions are given only at the end of a series of similar steps. You may solder more often, if you desire.

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

- () Note that the circuit board has foil on one side and component outlines on the other. The side with the component outlines is referred to as the "component side."

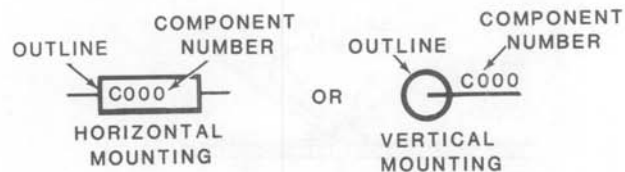
Position the circuit board as shown in the Pictorial with the component side up. Always install components on the component side of the circuit board,

and solder the leads to the foil on the other side unless a step specifically directs you otherwise.

- () C176: Hold a .01 μ F (103) glass ceramic capacitor as shown and bend the leads straight down to fit the hole spacing on the circuit board.



- () Start the leads into the holes at the capacitor's location at the top of Section 1 of the circuit board. This type of capacitor can be positioned either way. NOTE: Glass ceramic capacitors are identified on the circuit board by the following outlines:

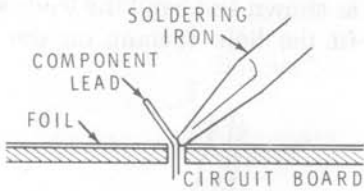


- () Press the capacitor against the circuit board. Then bend the leads outward slightly to hold it in place.

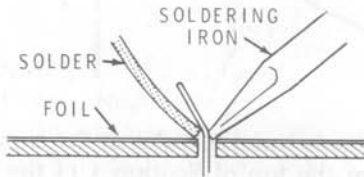


() Solder the capacitor leads to the circuit board as follows:

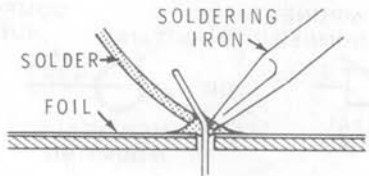
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



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 lengths close to the connection. **WARNING:** Clip the leads so the ends will not fly toward your eyes.

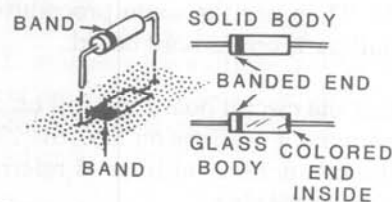
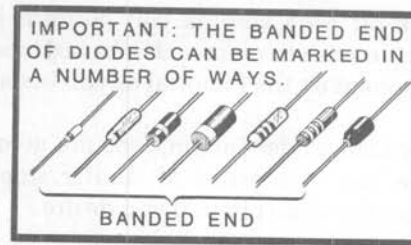
() Check each connection. Compare it to the illustrations on Page 15. After you have checked the solder connections, proceed with the assembly on this page. Use the same soldering procedure for each connection.

Now start at the top of Section 1 and install the following components. The sequence of the steps matches the locations of the components on the circuit board. **NOTE:** Make sure you installed capacitor C176 in an earlier step.

In order to make the assembly easier, you may wish to precut all of the parts from a section and, as you do, prebend the leads and lay the parts on your work surface in the order of assembly. Then you can hold the circuit board while you install the parts in sequence without interruption.

NOTES:

1. In some of the following steps you will install diodes. Whenever you install a diode, always match the banded end of the diode with the band mark on the circuit board. A diode will not work properly if it is installed backwards.
2. The banded end will always be positioned toward the colored tape on the "Taped Components Chart."



CAUTION: ALWAYS POSITION THE BANDED END OF A DIODE AS SHOWN ON THE CIRCUIT BOARD.

A GOOD SOLDER CONNECTION

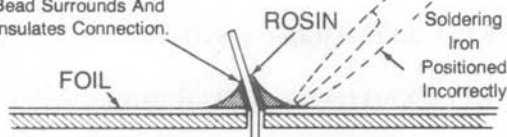
Solder Flows Outward
And Gradually Blends
With The Foil And The
Lead.



When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

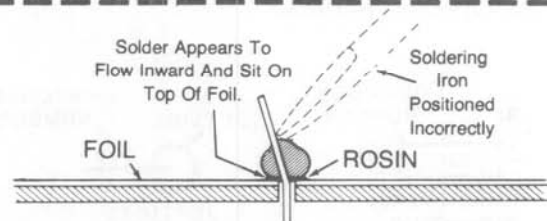
POOR SOLDER CONNECTIONS

Solder Does Not Flow
Onto Lead. A Hard Rosin
Bead Surrounds And
Insulates Connection.



When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

Solder Appears To
Flow Inward And Sit On
Top Of Foil.

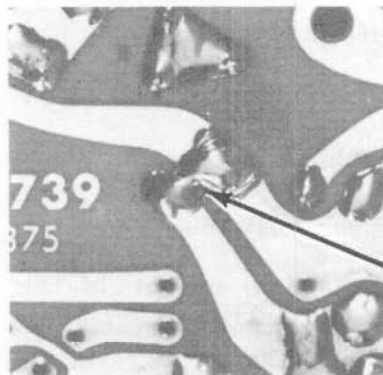


When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

A solder bridge between two adjacent foils is shown in photograph A. 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.

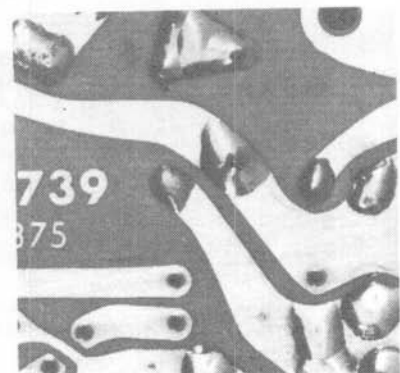
Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will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



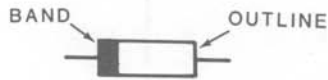
A

SOLDER
BRIDGE

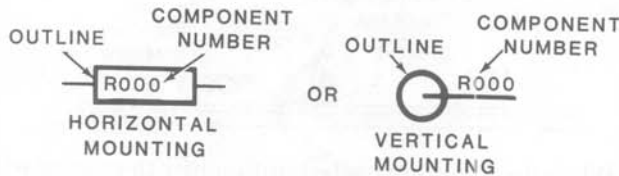
B



- () D139: 1N191 diode (brn-wht-brn, #56-26).
NOTE: Diodes are identified on the circuit board by the following outline:



- () D138: 1N191 diode (brn-wht-brn, #56-26).
() C177: .1 μ F (104) glass ceramic capacitor.
() R103: 22 k Ω (red-red-org) resistor. NOTE: Resistors are identified on the circuit board by the following outlines:



- () C102: .01 μ F (103) glass ceramic capacitor.
() R102: 22 k Ω (red-red-org) resistor.
() R104: 100 Ω (brn-blk-brn) resistor.
() R141: 22 k Ω (red-red-org) resistor.
() C178: .01 μ F (103) glass ceramic capacitor.
() R137: 3900 Ω (org-wht-red) resistor.
() R136: 220 k Ω (red-red-yel) resistor.
() R135: 330 Ω (org-org-brn) resistor. NOTE: Mount this resistor vertically above its outline as shown below:



- () D119: 1N458 diode (#56-24).

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

Install components in Section 2 of the circuit board as follows:

- () R105: 8200 Ω (gry-red-red) resistor.
() R139: 3900 Ω (org-wht-red) resistor.
() R142: 47 Ω (yel-viol-blk) resistor.
() R138: 100 Ω (brn-blk-brn) resistor.
() C189: .01 μ F (103) glass ceramic capacitor.
() R129: 47 Ω (yel-viol-blk) resistor.
() R134: 330 k Ω (org-org-yel) resistor.
() R128: 47 Ω (yel-viol-blk) resistor.
() Solder the leads to the foil and cut off the excess lead lengths.

Install components in Section 3 of the circuit board as follows:

NOTE: Be sure to position the banded end of the diode toward the band mark on the circuit board. If your BA-244 diodes are marked with a color code (red-yel-yel), position the red band toward the band mark on the circuit board.

- () D101: BA-244 (red-yel-yel, #56-646) diode.
() D103: BA-244 (red-yel-yel, #56-646) diode.

NOTE: Occasionally, you will be directed to skip certain components. These components will be installed later if you have the Model HWA-9 Accessory Band Pack.

- () Skip D105.
() D107: BA-244 (red-yel-yel, #56-646) diode.
() Skip D109.
() D112: BA-244 (red-yel-yel, #56-646) diode.
() Skip D114 and D116.
() C181: .01 μ F (103) glass ceramic capacitor.

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- () R127: 33 k Ω (org-org-org) resistor.
- () C197: .01 μ F (103) glass ceramic capacitor.
- () R126: 100 k Ω (brn-blk-yel) resistor.
- () Solder the leads to the foil and cut off the excess lead lengths.

Install components in Section 4 of the circuit board as follows:

- () C107: .01 μ F (103) glass ceramic capacitor.
- () C112: .01 μ F (103) glass ceramic capacitor.
NOTE: Mount this capacitor vertically above its outline (similar to the way you mounted the vertical resistors earlier).
- () Skip C116.
- () C121: .01 μ F (103) glass ceramic capacitor.
- () Skip C125.
- () C129: .01 μ F (103) glass ceramic capacitor.
- () Skip C134 and C138.
- () R145: 680 Ω (blu-gry-brn) resistor.
- () R143: 220 Ω (red-red-brn) resistor.
- () R132: 10 k Ω (brn-blk-org) resistor.
- () C191: .01 μ F (103) glass ceramic capacitor.
- () R133: 10 k Ω (brn-blk-org) resistor.
- () C192: .01 μ F (103) glass ceramic capacitor.
- () C193: .01 μ F (103) glass ceramic capacitor.
- () C195: .01 μ F (103) glass ceramic capacitor.
- () D118: 1N4002 (#57-65) diode.
- () Solder the leads to the foil and cut off the excess lead lengths.

Install components in Section 5 of the circuit board as follows:

- () D102: BA-244 (red-yel-yel, #56-646) diode.
- () C139: .01 μ F (103) glass ceramic capacitor.
- () D104: BA-244 (red-yel-yel, #56-646) diode.
- () C141: .01 μ F (103) glass ceramic capacitor.
- () Skip D106 and C142.
- () C143: .01 μ F (103) glass ceramic capacitor.
- () D108: BA-244 (red-yel-yel, #56-646) diode.
- () Skip C144 and D111.
- () C145: .01 μ F (103) glass ceramic capacitor.
- () D113: BA-244 (red-yel-yel, #56-646) diode.
- () Skip C146, D115, C147, and D117.
- () R148: 330 Ω (org-org-brn) resistor.
- () C203: .01 μ F (103) glass ceramic capacitor.
- () R146: 1.5 M Ω (brn-grn-grn) resistor.
- () R147: 100 Ω (brn-blk-brn) resistor.
- () Solder the leads to the foil and cut off the excess lead lengths.

Install components in Section 6 of the circuit board as follows:

- () R107: 2200 Ω (red-red-red) resistor.
- () D121: BA-244 (red-yel-yel, #56-646) diode.
- () R109: 2200 Ω (red-red-red) resistor.
- () D123: BA-244 (red-yel-yel, #56-646) diode.
- () Skip R111 and D125.
- () R113: 2200 Ω (red-red-red) resistor.

- () D127: BA-244 (red-yel-yel, #56-646) diode.
- () Skip R115 and D129.
- () R117: 2200 Ω (red-red-red) resistor.
- () D132: BA-244 (red-yel-yel, #56-646) diode.
- () Skip R119, D134, R121, and D136.
- () R144: 100 k Ω (brn-blk-yel) resistor.
- () C174: .01 μ F (103) glass ceramic capacitor.
- () C219: .01 μ F (103) glass ceramic capacitor.
- () D143: BA-244 (red-yel-yel, #56-646) diode.
- () R164: 270 Ω (red-viol-brn) resistor.
- () C216: .01 μ F (103) glass ceramic capacitor.
NOTE: Mount this capacitor vertically.
- () Solder the leads to the foil and cut off the excess lead lengths.

Install components in Section 7 of the circuit board as follows:

- () C151: .01 μ F (103) glass ceramic capacitor.
- () Skip C155, C159, and C164.
- () R171: 22 k Ω (red-red-org) resistor.
- () R174: 100 Ω (brn-blk-brn) resistor.
- () R166: 2200 Ω (red-red-red) resistor. NOTE: Mount this resistor vertically.
- () R162: 3300 Ω (org-org-red) resistor.
- () C217: .01 μ F (103) glass ceramic capacitor.
- () R163: 1500 Ω (brn-grn-red) resistor.
- () R165: 270 Ω (red-viol-brn) resistor.
- () C214: .01 μ F (103) glass ceramic capacitor.
- () Solder the leads to the foil and cut off the excess lead lengths.

Install components in Section 8 of the circuit board as follows:

- () C153: .01 μ F (103) glass ceramic capacitor.
- () C157: .01 μ F (103) glass ceramic capacitor.
- () C162: .01 μ F (103) glass ceramic capacitor.
- () Skip C166.
- () R172: 22 k Ω (red-red-org) resistor.
- () C218: .01 μ F (103) glass ceramic capacitor.
- () C226: .01 μ F (103) glass ceramic capacitor.
- () R159: 270 Ω (red-viol-brn) resistor.
- () R157: 3300 Ω (org-org-red) resistor.
- () R158: 1500 Ω (brn-grn-red) resistor.
- () R161: 270 Ω (red-viol-brn) resistor.
- () R156: 470 Ω (yel-viol-brn) resistor. NOTE: Mount this resistor vertically.
- () Solder the leads to the foil and cut off the excess lead lengths.

Install components in Section 9 of the circuit board as follows:

- () R108: 12 k Ω (brn-red-org) resistor.
- () R110: 12 k Ω (brn-red-org) resistor.
- () Skip R112.
- () R114: 12 k Ω (brn-red-org) resistor.
- () Skip R116.
- () R118: 10 k Ω (brn-blk-org) resistor.
- () Skip R120 and R122.
- () R151: 680 Ω (blu-gry-brn) resistor.
- () R153: 100 Ω (brn-blk-brn) resistor.

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- () R154: 47 k Ω (yel-viol-org) resistor.
- () R155: 270 Ω (red-viol-brn) resistor.
- () C212: .01 μ F (103) glass ceramic capacitor.
- () Solder the leads to the foil and cut off the excess lead lengths.

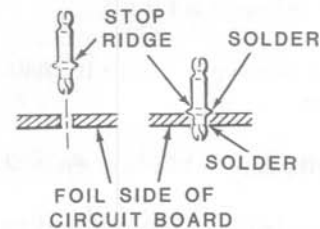
Install components in Section 10 of the circuit board as follows:

- () D122: BA-244 (red-yel-yel, #56-646) diode.
- () D124: BA-244 (red-yel-yel, #56-646) diode.
- () R169: 6800 Ω (blu-gry-red) resistor.
- () Skip D126.
- () R123: 220 Ω (red-red-brn) resistor.
- () D128: BA-244 (red-yel-yel, #56-646) diode.
- () Skip D131.
- () R168: 6800 Ω (blu-gry-red) resistor.
- () D133: BA-244 (red-yel-yel, #56-646) diode.
- () R124: 220 Ω (red-red-brn) resistor.
- () Skip D135 and D137.
- () D141: 1N4149 (#56-56) diode.
- () C209: .01 μ F (103) glass ceramic capacitor.
- () R152: 100 k Ω (brn-blk-yel) resistor. NOTE: Mount this resistor vertically.
- () D142: 1N4149 (#56-56) diode.
- () Solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 1-2 (Illustration Booklet, Page 3) for the following steps.

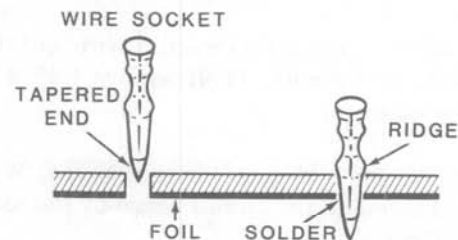
Install parts in Section 1 of the circuit board as follows. NOTE: The following parts are not taped on strips.

NOTE: When a step directs you to install a PCB pin in a circuit board, push the shorter end of the pin as far as possible into the circuit board hole. Then turn the circuit board over and solder the pin to the foil.



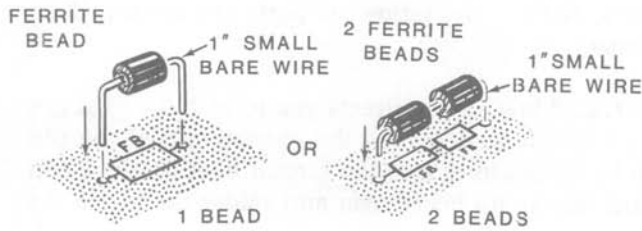
- () PCB pin at RF.
- () PCB pin at METER.

NOTE: When a step directs you to install a wire socket in a circuit board, push the tapered end of the socket as far as possible into the circuit board hole. Then turn the circuit board over and solder the socket to the foil. Try not to fill the socket with solder.



- () Wire socket at TP101.

NOTE: When a step directs you to install one or more ferrite beads, use a 1" small bare wire as shown below.



- Two ferrite beads at FB-FB.

NOTE: Use the same procedure to install chokes as you do resistors.

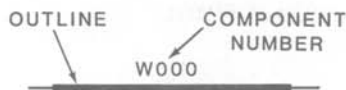
- L121: 100 μ H (brn-blk-brn, #45-621) choke.
- Solder the leads to the foil and cut off the excess lead lengths.

Install the following parts in Section 2 of the circuit board.

- L122: 4.7 μ H (yel-viol-gold, #45-625) choke. NOTE: Mount this choke vertically.
- L123: 4.7 μ H (yel-viol-gold, #45-625) choke. NOTE: Mount this choke vertically.
- L119: 100 μ H (brn-blk-brn, #45-621) choke.

NOTE: When a step calls for solid wire, cut the wire to the indicated length. Then remove 1/4" of insulation from each end.

- W105: 7/8" violet solid wire. NOTE: Wires are indicated on the circuit board by the following outline:



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

Install parts in Section 3 of the circuit board as follows:

- Ferrite bead at FB.
- Wire socket at TP102.
- Two ferrite beads at FB-FB.
- PCB pin at E.
- Wire socket at GND.
- Solder the leads to the foil and cut off the excess lead lengths.
- Install four ferrite beads in Section 4 of the circuit board at the indicated locations. NOTE: Be sure to skip the four locations indicated on the Pictorial.
- Solder the leads to the foil and cut off the excess lead lengths.

Install parts in Section 5 of the circuit board as follows:

- W101: 1" small bare wire.
- W104: 1" small bare wire.
- L133: 2.2 μ H (red-red-gold, #45-73) choke.
- Solder the leads to the foil and cut off the excess lead lengths.

Install parts in Section 6 of the circuit board as follows:

- Wire socket at TP103.
- Ferrite bead at FB.
- Solder the leads to the foil and cut off the excess lead lengths.

Install parts in Section 7 of the circuit board as follows:

- W102: 1-1/4" violet solid wire.



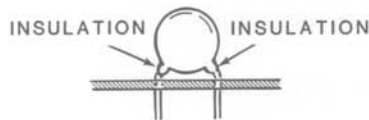
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- () W106: 7/8" violet solid wire.
- () W103: 7/8" violet solid wire.
- () Wire socket at TP104.
- () L134: 100 μ H (brn-blk-brn, #45-621) choke.
- () L136: 100 μ H (brn-blk-brn, #45-621) choke.
- () Solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 1-3 (Illustration Booklet, Page 4) for the following steps.

Install capacitors in Section 1 of the circuit board as follows:

NOTE: In some of the following steps, you will install disc-type ceramic capacitors. When you install these ceramic capacitors, do not push the insulated portion of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil.



- () C101: 33 pF ceramic.
- () C103: .001 μ F (1000 pF) ceramic.
- () C198: 500 pF ceramic.
- () C196: 470 pF ceramic.
- () C194: 4.7 pF ceramic.
- () C188: 4.7 pF ceramic.
- () C186: 18 pF ceramic.
- () Solder the leads to the foil and cut off the excess lead lengths.

Install capacitors in Section 2 of the circuit board as follows:

- () C105: 300 pF mica.
- () C109: 200 pF mica.
- () Skip C114.
- () C118: 160 pF mica.
- () Skip C123.
- () C127: 90 pF mica.
- () Skip C132 and C136.
- () C199: 680 pF ceramic.
- () C201: 330 pF ceramic.
- () C179: 4.7 pF ceramic.
- () C182: 50 pF ceramic.
- () C184: 33 pF ceramic.
- () Solder the leads to the foil and cut off the excess lead lengths.

Install capacitors in Section 3 of the circuit board as follows.

- () C104: 9 pF ceramic.
- () C108: 6 pF ceramic.
- () Skip C113.
- () C117: 4.7 pF ceramic.
- () Skip C122.
- () C126: 3.3 pF ceramic.
- () Skip C131 and C135.
- () C202: 10 pF ceramic.

- C187: 510 pF ceramic.
- C185: 510 pF ceramic.
- C183: 510 pF ceramic.
- Solder the leads to the foil and cut off the excess lead lengths.

Install capacitors in Section 4 of the circuit board as follows.

- C106: 300 pF mica.
- C111: 180 pF mica.
- Skip C115.
- C119: 160 pF mica.
- Skip C124.
- C128: 90 pF mica.
- Skip C133 and C137.
- Solder the leads to the foil and cut off the excess lead lengths.

Install capacitors in Section 5 of the circuit board as follows:

- C149: 115 pF mica.
- Skip C154, C158, and C163.
- C175: 47 pF ceramic.
- Solder the leads to the foil and cut off the excess lead lengths.

Install capacitors in Section 6 of the circuit board as follows:

- C152: 100 pF (100K) **ceramic**.
- C156: 47 pF ceramic.

- C161: 24 pF ceramic.
- Skip C165.
- C223: 680 pF ceramic.
- C221: 220 pF ceramic.
- C222: 270 pF ceramic.
- C225: 75 pF **ceramic**.
- C215: .001 μ F (1000 pF) ceramic.
- C213: 33 pF ceramic.
- Solder the leads to the foil and cut off the excess lead lengths.

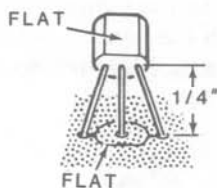
Install capacitors in Section 7 of the circuit board as follows:

- C168: 10 pF ceramic.
- C167: 5 pF ceramic.
- C172: 10 pF ceramic.
- C171: 5 pF ceramic.
- C169: 6 pF ceramic.
- C173: 5 pF ceramic.
- C205: 75 pF **mica**.
- C211: 10 pF ceramic.
- C206: 100 pF **mica**.
- C207: 50 pF **mica**.
- C208: 50 pF **mica**.
- Solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 1-4 (Illustration Booklet, Page 5) for the following steps.

Install parts in Section 1 of the circuit board as follows:

NOTE: When you install each of the following transistors, position it so the flat side is over the outline of the flat on the circuit board. Then start the leads into the corresponding holes in the circuit board. Position the transistor 1/4" above the circuit board. Then solder the leads to the foil and cut off any excess lead lengths.

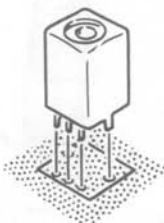


- Q101: 2N5770 transistor (#417-293).
- Q106: 2N3638A transistor (#417-234).
- Q105: MPF105 transistor (#417-169).
- Q102: MPF105 transistor (#417-169).

Install parts in Section 2 of the circuit board as follows:

Solder the leads of each part to the foil as you install it and cut off any excess lead lengths.

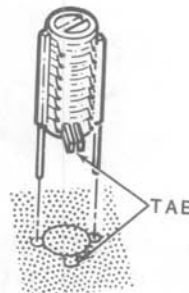
- L101: .3 μ H coil (#40-2076). Match the pins on the coil with their corresponding circuit board holes and push the coil down tight against the circuit board. The coil will only fit one way.



- L103: .44 μ H coil (#40-2075).

- Skip L105.

When you install the next two coils, be sure to match the tab on the coil with the outline of the tab on the circuit board.



- L107: .14 μ F coil (violet, #40-1785).
- Skip L109.
- L112: .14 μ H coil (violet, #40-1785).
- Skip L114 and L116.
- Q103: MPSA20 transistor (#417-801).
- Q104: MPSA20 transistor (#417-801).

Install parts in Section 3 of the circuit board as follows. Solder the leads of each part to the foil as you install it and cut off any excess lead lengths.

- L102: .3 μ H coil (#40-2076).
- L104: .44 μ H coil (#40-2075).
- Skip L106.
- L108: .14 μ H coil (violet, #40-1785). Be sure to match the tab on the coil with the outline of the tab on the circuit board.
- Skip L111.
- L113: .14 μ H coil (violet, #40-1785).
- Skip L115 and L117.