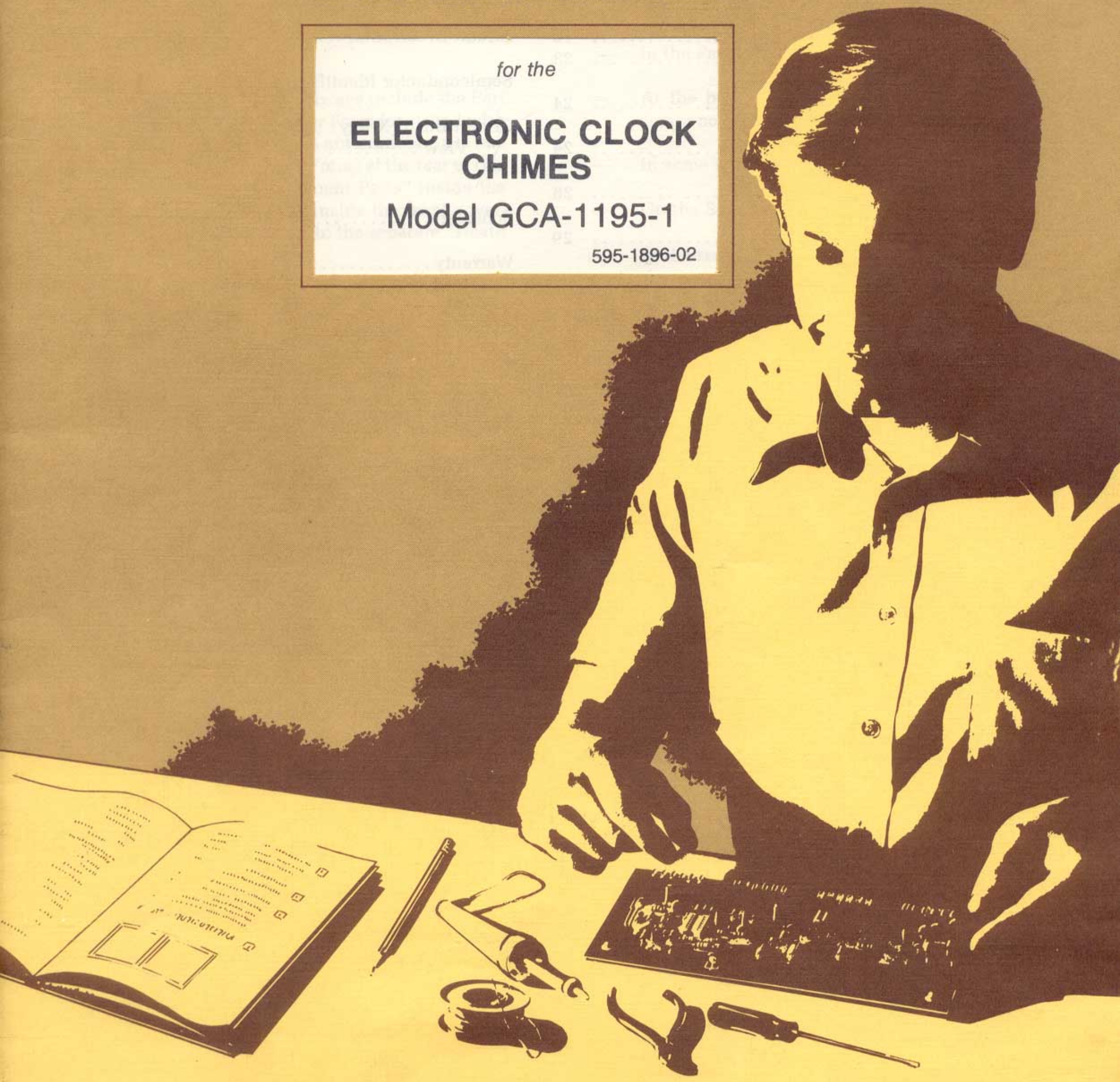
HEATHKIT® MANUAL

for the

ELECTRONIC CLOCK CHIMES

Model GCA-1195-1

595-1896-02



HEATH COMPANY • BENTON HARBOR, MICHIGAN

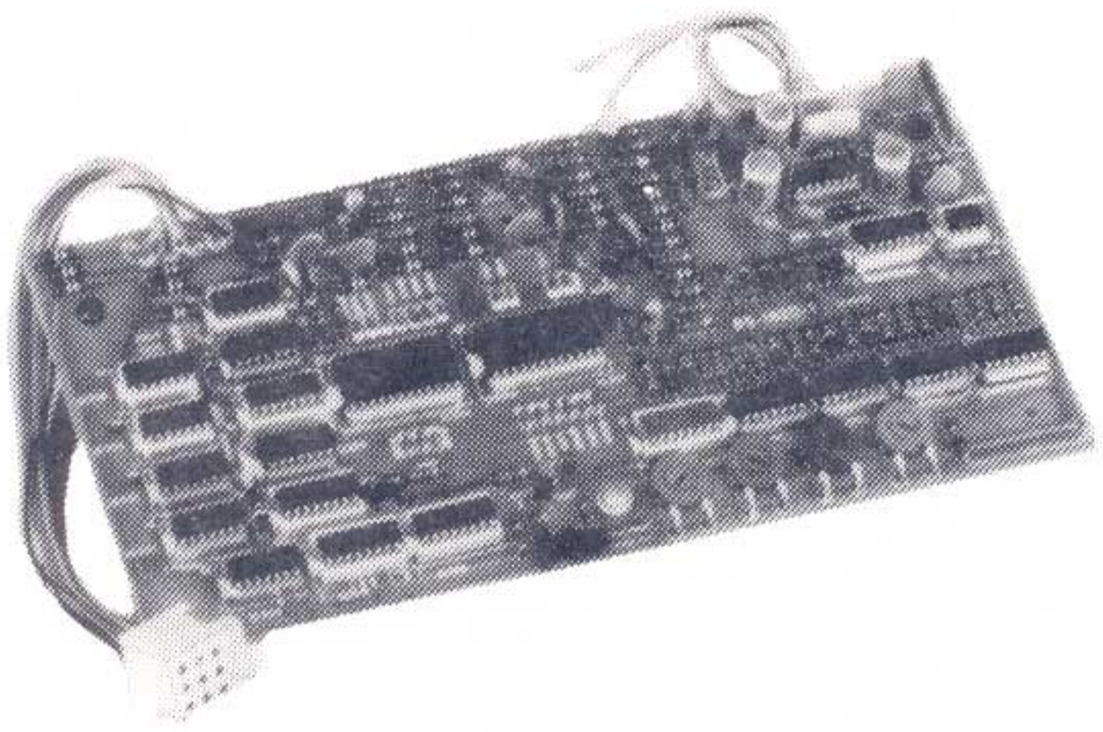
Heathkit® Manual

for the

ELECTRONIC CLOCK CHIMES

Model GCA-1195-1

595-1896-02



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

TABLE OF CONTENTS

PARTS LIST

Check each part against the following list. Any part that is packed in an individual envelope with a part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not throw away any packing material until all parts are accounted for.

To order a replacement part, always include the Part Number and use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, use one of the "Expedited Parts Order Forms at the rear of this Manual, or refer to "Replacement Parts" inside the rear cover. Your Warranty is inside the front cover. For pricing information, refer to the separate "Heath Parts Price List."

Each circuit part in this kit has its own component number (R2, C4, etc.). The purpose of these numbers is to help you easily identify the same part in each section of the Manual. These numbers will appear:

— In the Parts List,

— At the beginning of each step where a component is installed,

— In some illustrations,

— On the Schematic,

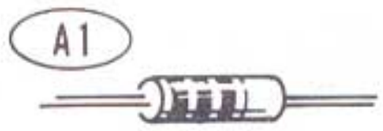
— In the sections at the rear of the Manual.

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

RESISTORS

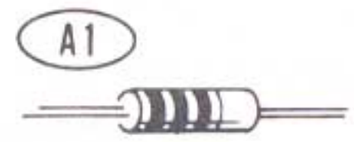
NOTE: The following resistors have a 10% tolerance (silver fourth band) unless otherwise stated. The resistors may be packed in more than one envelope. Open all the resistor envelopes in this pack before you check the resistors against the Parts List.

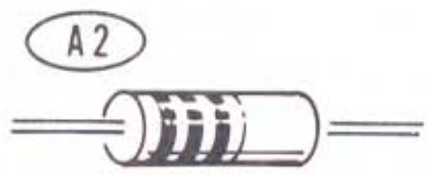
1/2-Watt

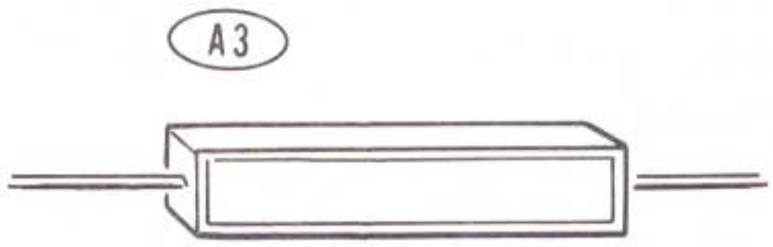


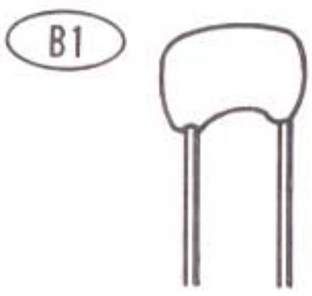
~~A1~~	1-3	5	100 Ω (brown-black-brown)	R366, R373, R386, R379, R393
	1-6	2	470 Ω (yellow-violet-brown)	R394,R404
	1-9	1	1000 Ω (brown-black-red)	R401
	1-13	5	2700 Ω (red-violet-red)	R328, R335, R342, R348, R355
	1-14	2	3300 Ω (orange-orange-red)	R323, R325
	1-20	9	10 kΩ (brown-black-orange)	R303, R317, R318, R321, R322, R395, R396, R397, R398

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Resistors 1/2-Watt (cont'd.)				
LA1	1-25	15	47 kΩ (yellow-violet-orange)	R361, R363, R364,R367, R369, R371, R374, R376, R377, R381, R383, R384, R387, R389, R391
	1-26	19	100 kΩ (brown-black-yellow)	R304, R305, R306, R307, R308, R309, R310, R311, R314, R326, R327, R333, R334, R339, R341, R346, R347, R353 R354
	1-27	10	150 kΩ (brown-green-yellow)	R329, R336, R343, R349, R356, R362, R368, R375, R382, R388
	1-29	2	220 kΩ (red-red-yellow)	R315, R316
	1-35	16	1 MΩ (brown-black-green)	R331, R332, R337, R338, R344, R345, R351, R352, R357, R358, R365, R372, R378, R385, R392, R402
	1-71	1	4.7 MΩ (yellow-violet-green)	R403
Other Resistors				
~~A2~~	1-54-1	1	270 Ω, 1-watt, (red-violet-brown)	R302
~~A3~~	3-28-10	1	12 Ω, 10-watt, wire-wound	R301
~~LA4~~	10-383	4	10 kΩ control	R319, R324, R359, R399
CAPACITORS				
Mica				
~~B1~~	20-102	1	100 pF	C306
Disc				
~~B2~~	21-75	1	100 pF	C300
~~B2~~	21-140	1	1000 pF (.001)	C305









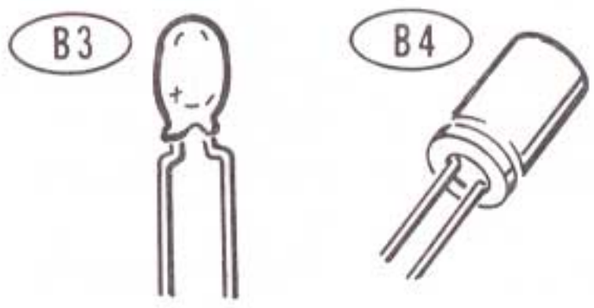
KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Disc (cont'd.)				
~~B2~~	21-171	1	680 pF	C326
	21-176	4	.01 μF	C301, C302, C303, C304
	21-199	~~8~~ 7	.1 μF	C307, C309, C312, C314, C316, C319, C322, C323
Tantalum				
~~B3~~	25-220	7	10 μF (10 m)	C308, C311, C313, C315, C317, C318, C321
Electrolytic				
~~B4~~	25-804	3	100 μF	C324, C325, C328
Mylar*				
~~B5~~	27-60	1	.22 μF	C327
DIODES-TRANSISTORS-INTEGRATED CIRCUITS				
~~C1~~	56-56	24	1N4149 diode	D302, D303, D304, D305, D306, D307, D308, D309, D311, D312, D313, D314, D315, D316, D317, D318, D319, D321, D322, D323, D324, D325, D326, D327
	56-90	1	1N4742A zener diode	ZD301

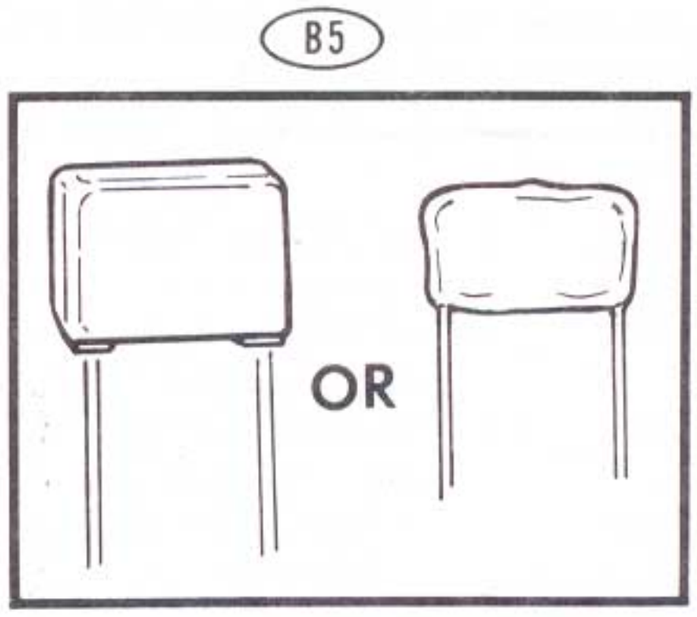
NOTE: Transistors and integrated circuits are marked for identification in one of the following four ways:

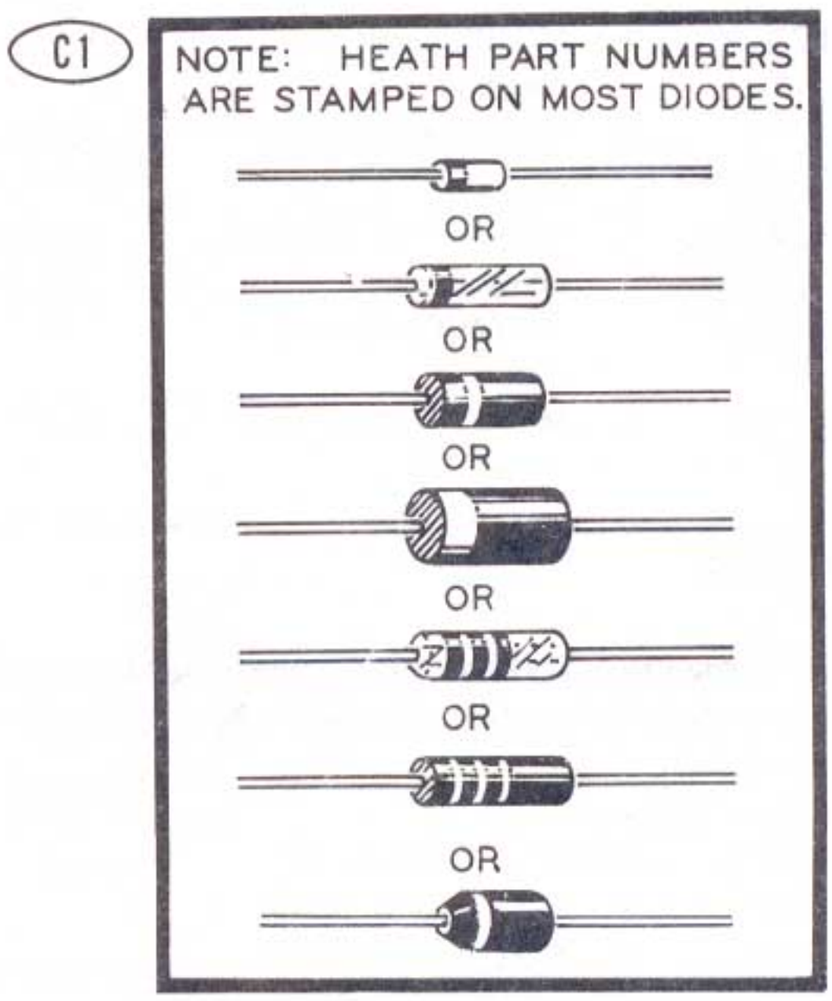
1. Part number.
2. Type number. (On integrated circuits this refers only to the numbers; the letters may be different or missing.)
3. Part number and type number.
4. Part number with a type number other than the one shown.

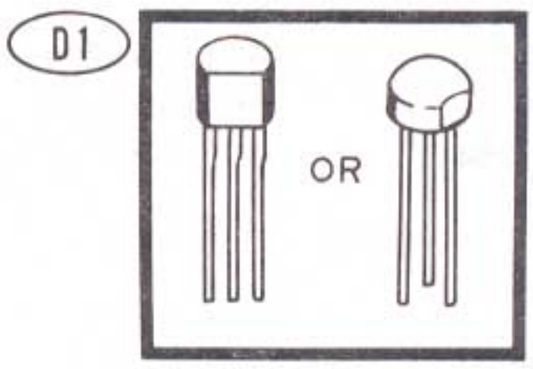
~~D1~~	417-235	~~4~~ 5	2N4121 transistor	Q302, Q303, Q304, Q305, Q306

*DuPont Registered Trademark









KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

Diodes-Transistors-Integrated Circuits (cont'd.)

~~LD1~~	417-881	1	MPS-A13 transistor	Q307
~~LD2~~	417-818	1	MJE181 transistor	Q301
~~LD3~~	442-22	1	N5741V integrated circuit	IC323
	442-610	1	TBA820 integrated circuit	IC324

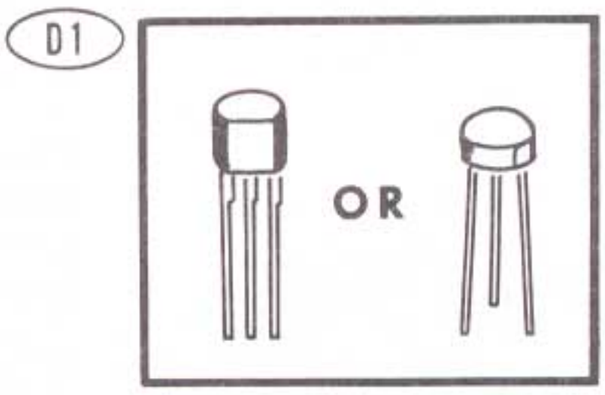
CAUTION: The following integrated circuits can be damaged by static electricity. Do not remove them from their boxes until you are instructed to do so in a step.

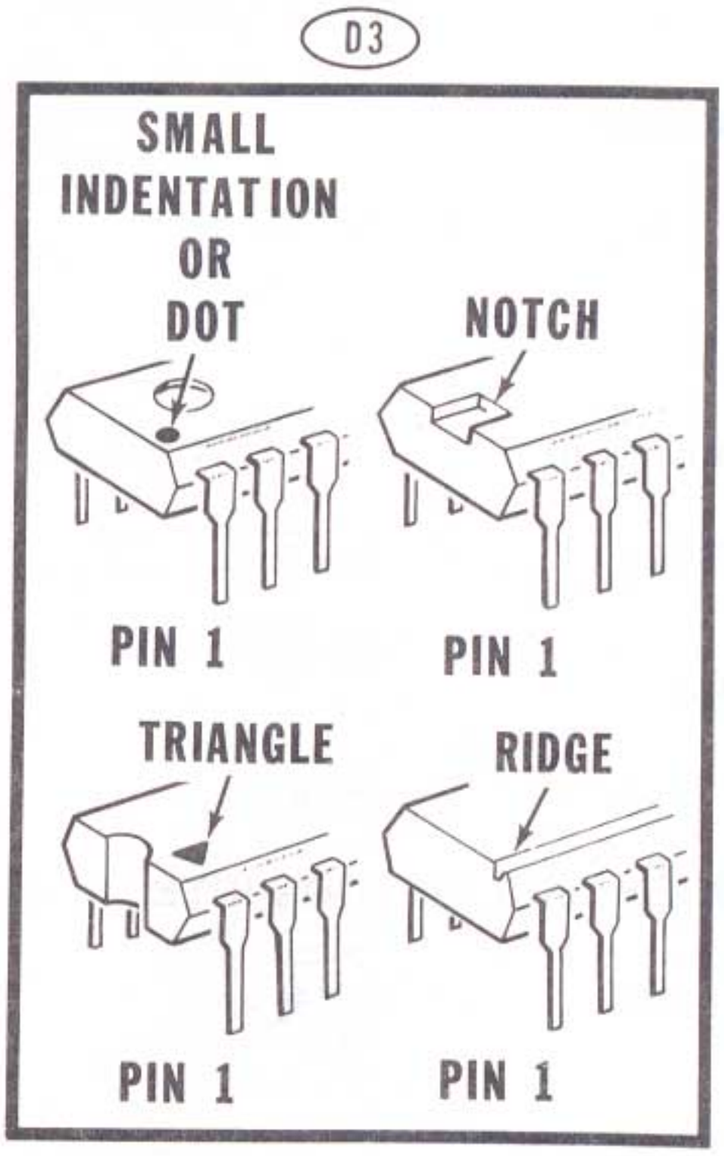
443-701	2	MC14049 or CD4049 integrated circuit	IC311, IC322
443-703	2	MC14001 or CD4001 integrated circuit	IC305, IC315
443-704	1	MC14002 or CD4002 integrated circuit	IC302
443-607	7	MC14013, CD4013, or F34013 integrated circuit	IC303, IC304, IC309, IC314, IC318, IC319, IC321
443-706	1	MC14071 integrated circuit	IC301
443-707	2	MC14515 integrated circuit	IC306, IC307
443-708	3	MC14516 or CD4516 integrated circuit	IC308, IC312, IC313
443-709	1	MM74C93 integrated circuit	IC317
443-710	1	MK50240 integrated circuit	IC316

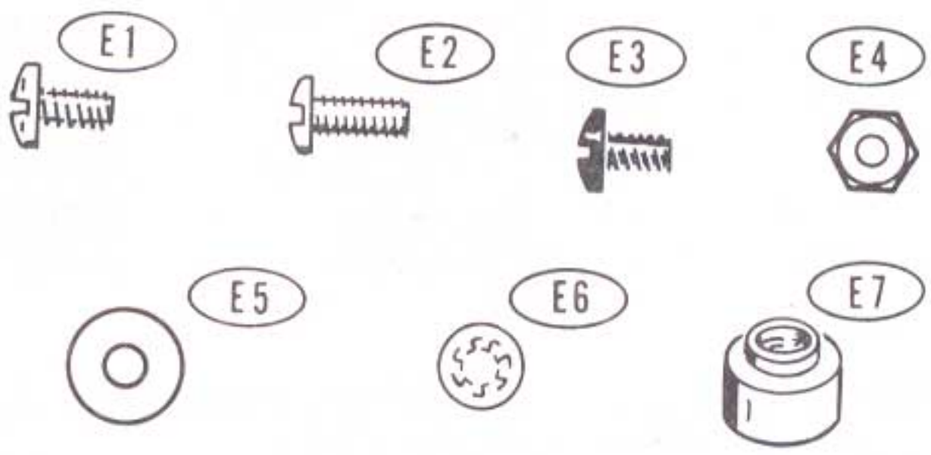
HARDWARE

NOTE: The hardware may be packed in more than one packet. Open all the hardware packets before you check the hardware against the Parts List.

E1	250-56	9	6-32 ×1/4" screw
E2	250-587	1	6-32 × 5/16" screw
E3	250-1174	6	6-32 × 3/16" black screw
E4	252-3	4	6-32 nut
E5	253-60	1	#6 flat washer
E6	254-1	10	#6 lockwasher
E7	255-163	6	6-32 × 3/8" spacer



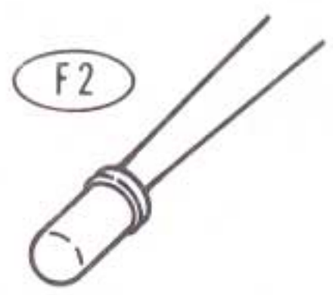


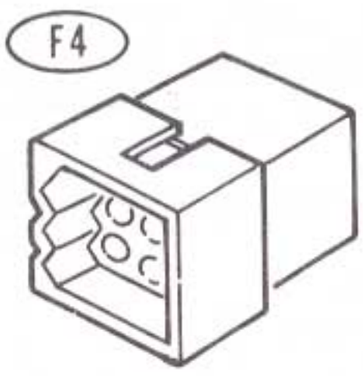


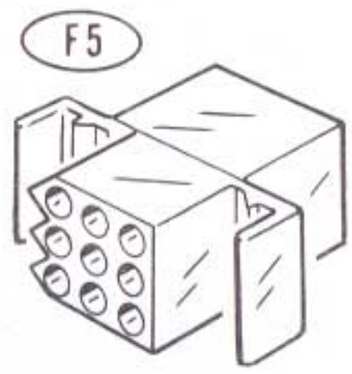
KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

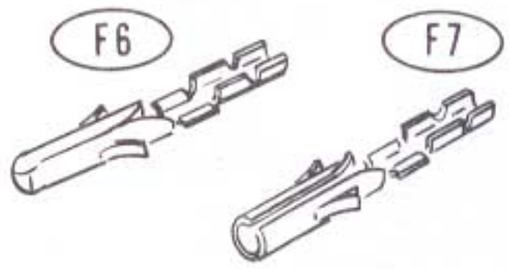
MISCELLANEOUS

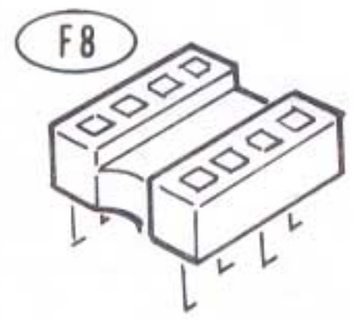
	85-1820-1	1	Circuit board
F1	207-5	1	Cable clamp
	344-90	48″	Black wire
	347-55	12″	Flat cable
	401-145	1	Speaker SP1
F2	412-616	1	LED D328
F3	432-66	2	Speaker connector
F4	432-70	1	9-hole connector socket
F5	432-71	1	9-hole connector plug
F6	432-72	9	Male connector pin
F7	432-73	9	Female connector pin
F8	434-266	1	8-pin IC socket
F9	434-267	13	14-pin IC socket
	434-268	6	16-pin IC socket
F10	434-306	4	12-pin socket strip
F11	490-111	1	IC puller
	490-185	1	Solder-Wick*
	391-34	1	Blue and white label
	597-260	1	Parts Order Form
		1	Assembly Manual (See Page 1 for part number.)
			Solder

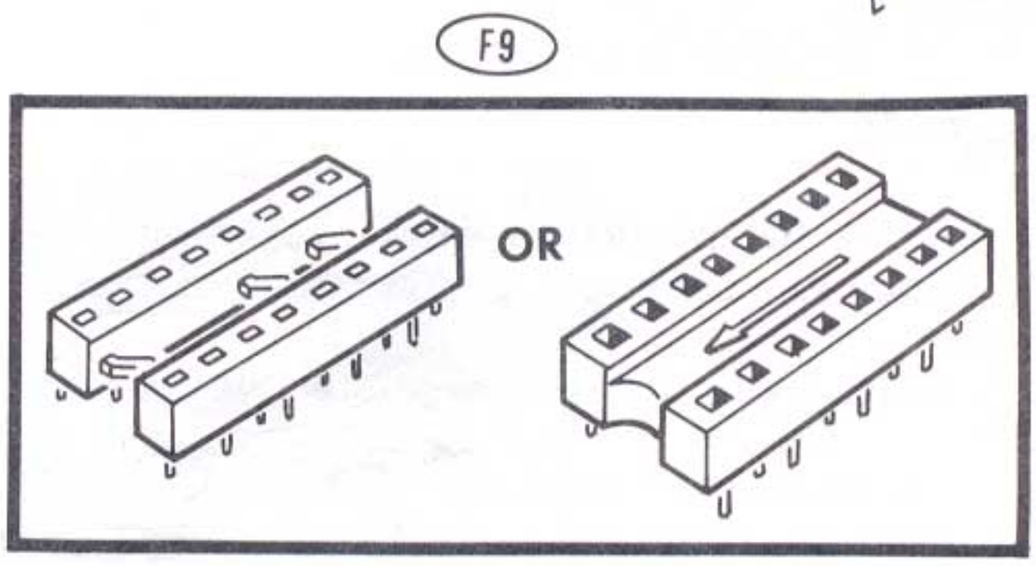


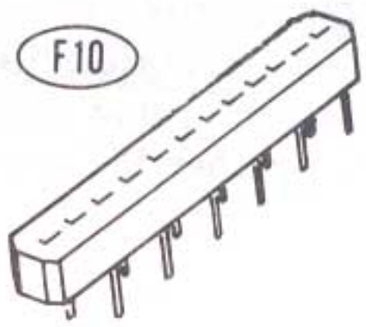


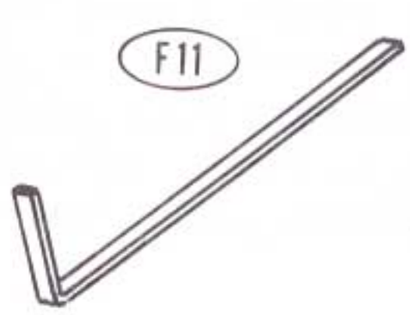




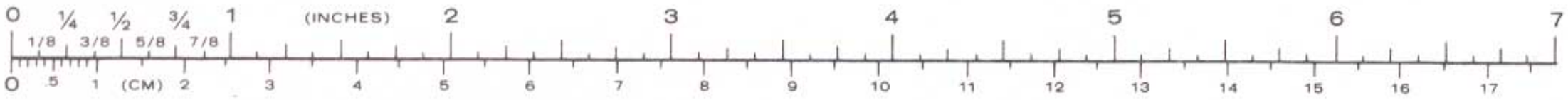








*Registered Trademark, Solder Removal Co.

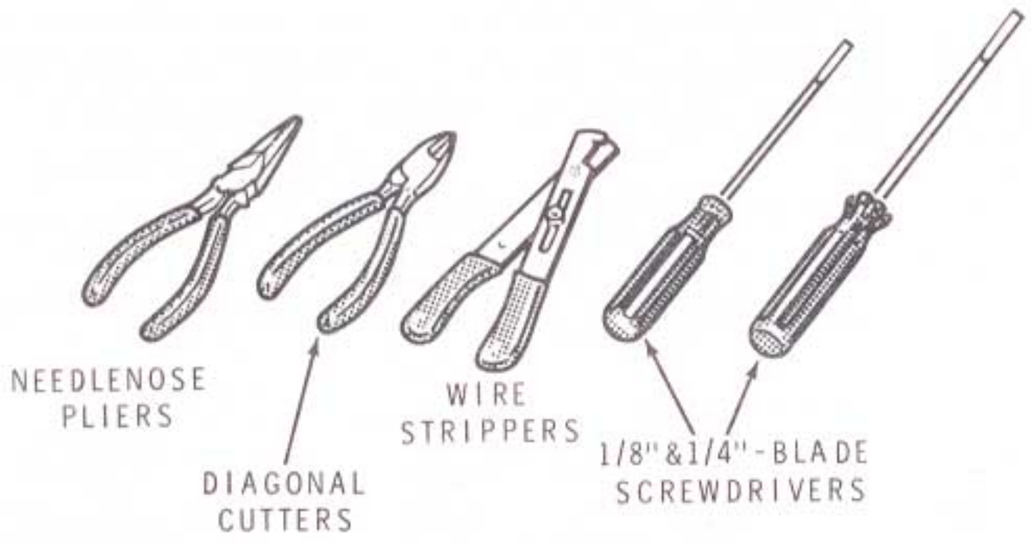


STEP-BY-STEP ASSEMBLY

ASSEMBLY NOTES

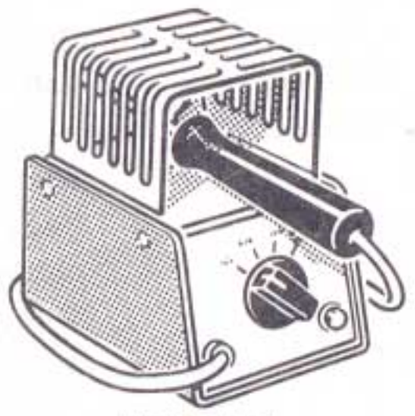
Tools

You will need these tools to assemble your kit.

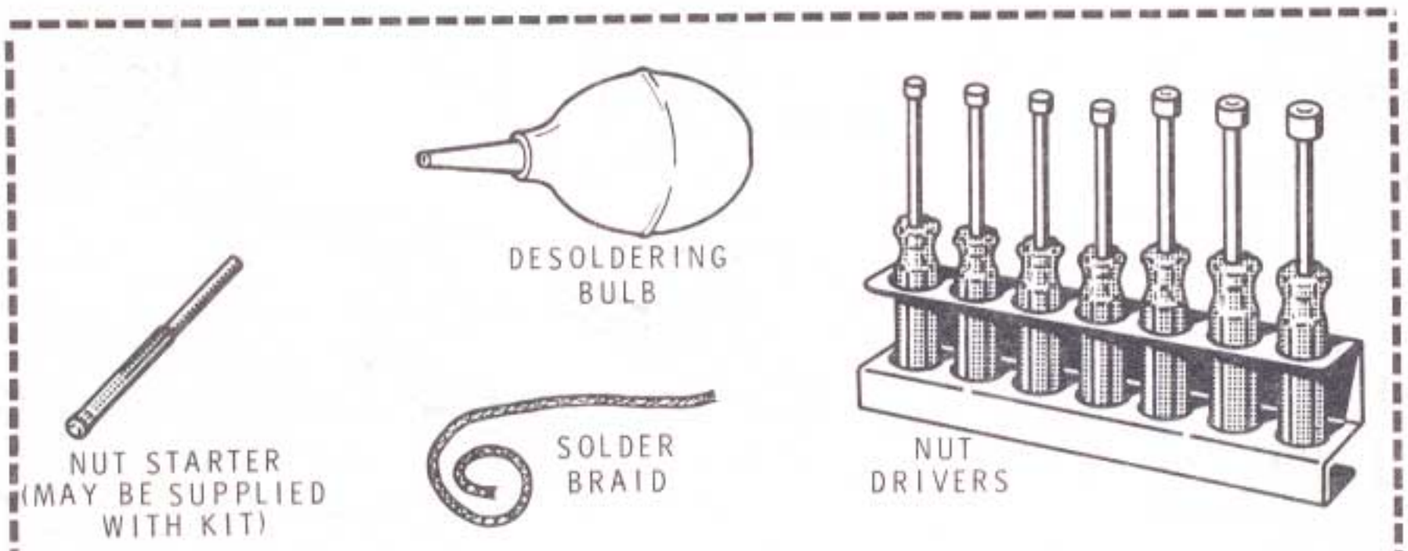


PENCIL SOLDERING IRON (25 TO 40 WATTS)

OR



HEATHKIT SOLDERING IRON



Assembly

1. Follow the instructions carefully, and read the entire step before you perform the operation.

2. Position all parts as shown in the Pictorials.

3. 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.

4. 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, refer to the "Illustration Booklet" if that illustration is not on the same page or the page across from it.

   Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.

5. 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), kΩ (kilohms), or MΩ (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 (ceramic, tantalum, electrolytic, etc.).

8. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

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 a right type of soldering iron. A 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 Part A of the photograph below. Part 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.

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

B

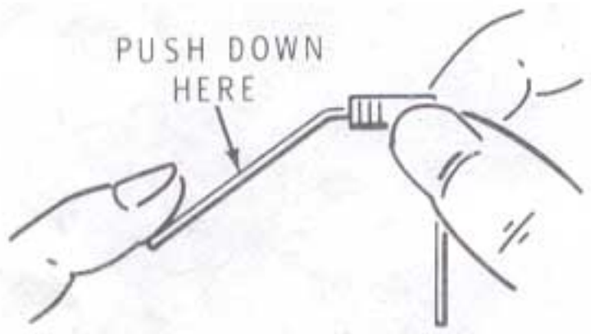
CIRCUIT BOARD

START

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.

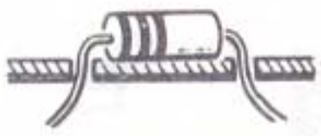
☐ Position the circuit board as shown with the printed side up.

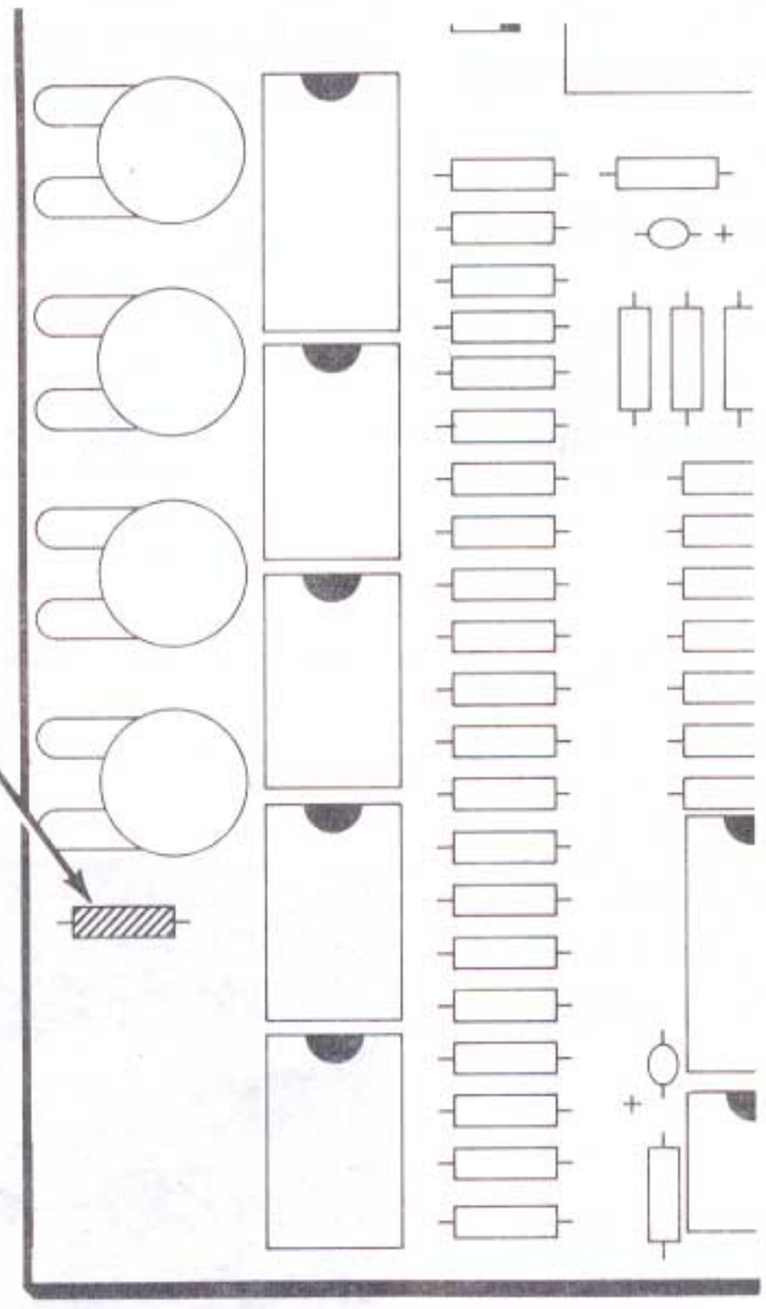
☐ R321: Hold a 10 kΩ (brown-black-orange) resistor by the body as shown and bend the leads straight down.



☐ 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.



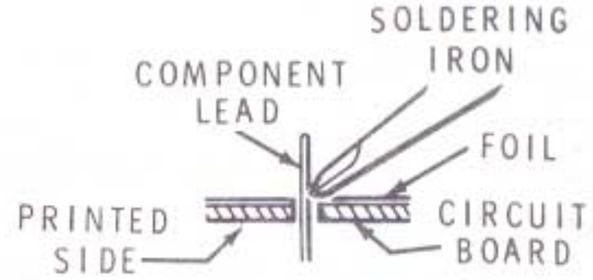


PICTORIAL 1-1

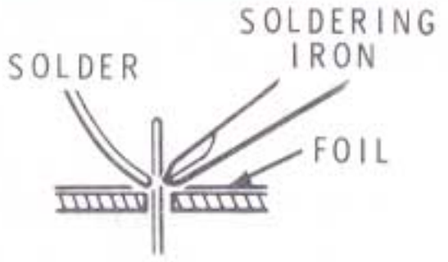
CONTINUE

☐ Solder the resistor leads to the circuit board as follows:

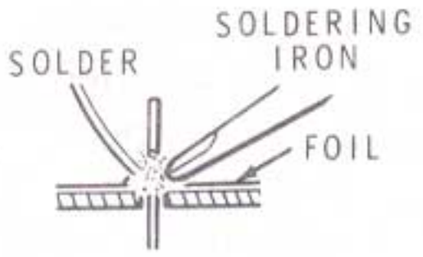
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for 2 or 3 seconds.



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



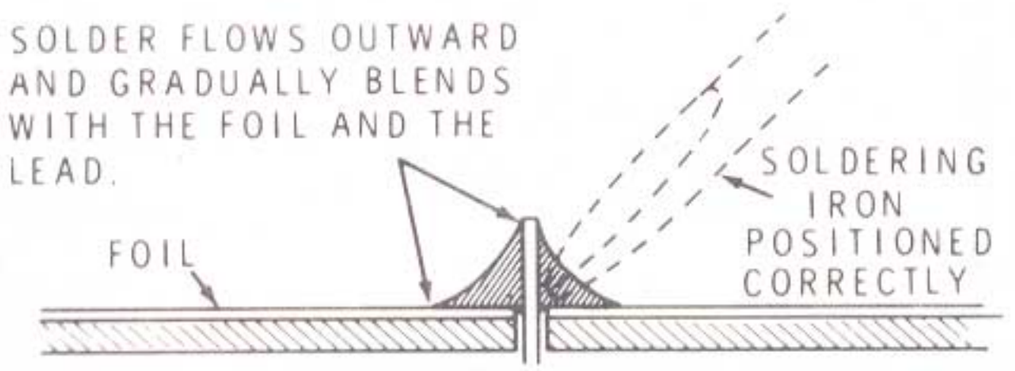
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



☐ Hold the lead with one hand while you cut off the excess lead length close to the connection. This will keep you from being hit in the eye by the flying lead.

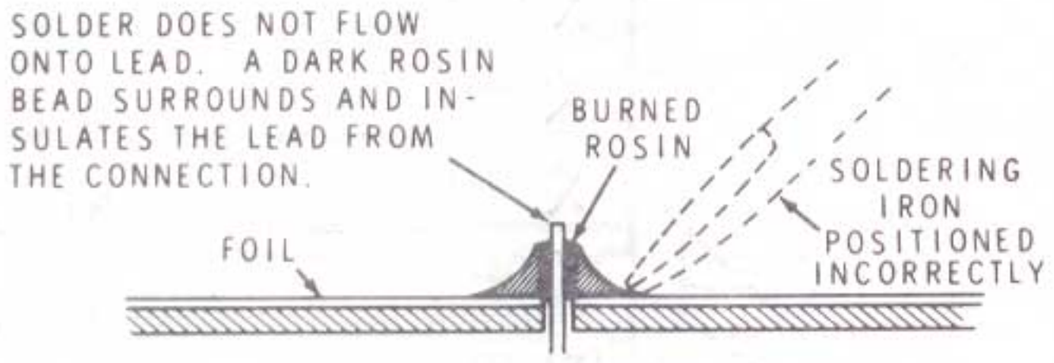
☐ Check the connection. Compare it to the illustrations on the next page. After you have checked the solder connections, proceed with the assembly on Page 12. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION

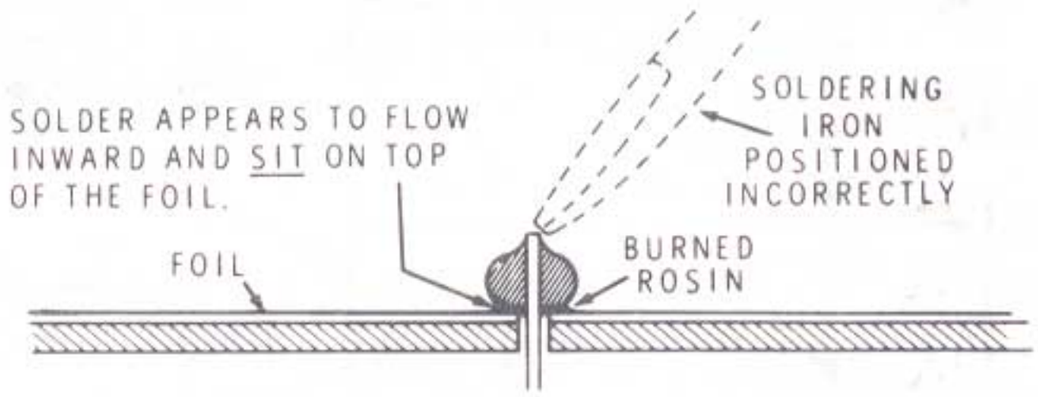


When both the lead and the circuit board foil are heated at the same time, the solder will flow onto the lead and the foil evenly. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS



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.



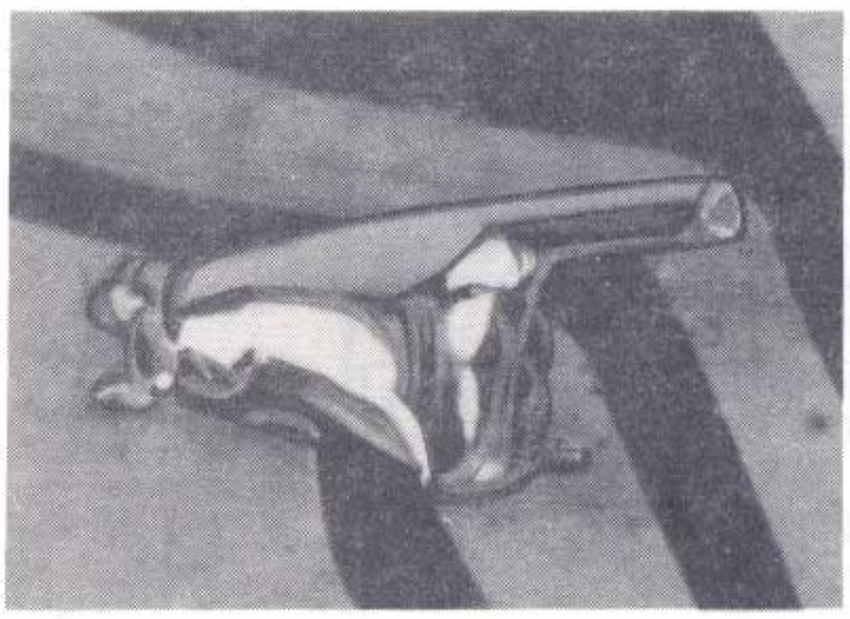
When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER 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.

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

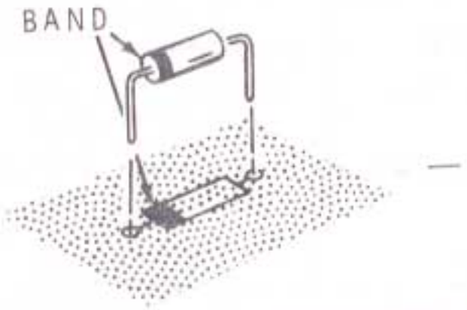


Here, solder has flowed along a lead and bridged to another foil. To correct, hold the circuit board above the soldering iron and reheat the solder. As the solder melts, it will flow down the iron. Then cut off the excess lead lengths. PROTECT YOUR EYES.

START

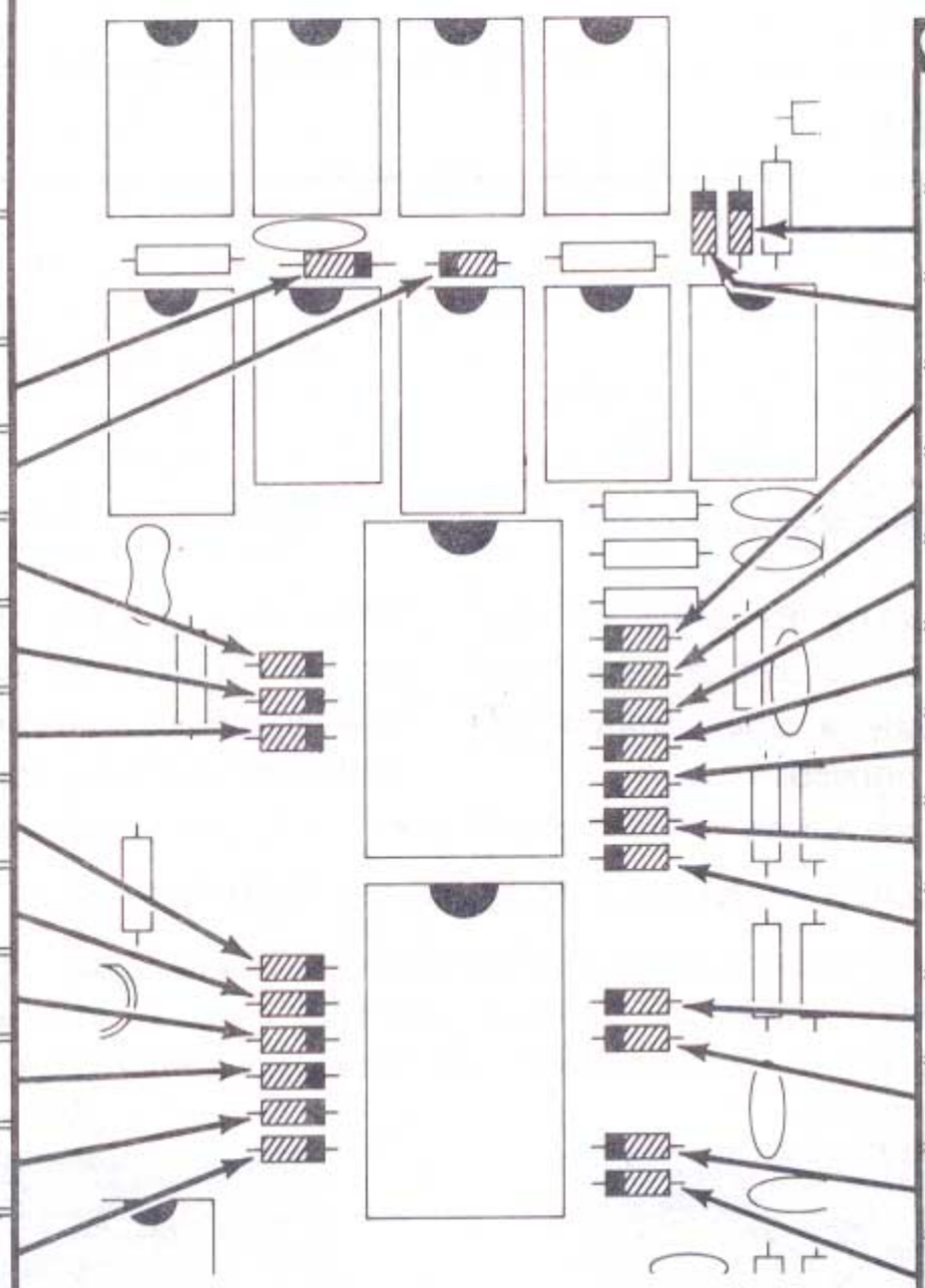
Position the circuit board with the lettered side up as shown. Then perform the following steps.

NOTE: When you install a diode, always match the band on the diode with the band mark on the circuit board. A DIODE WILL NOT WORK IF IT IS INSTALLED BACKWARDS. See Detail 1-2A.



Install eleven 1N4149 diodes (#56-56) at:

- (X) D303 .....
- (X) D302 .....
- (X) D324 .....
- (X) D317 .....
- (X) D312 .....
- (X) D326 .....
- (X) D315 .....
- (X) D321 .....
- (X) D309 .....
- (X) D323 .....
- (X) D308 .....
- (X) Solder the leads to the foil and cut off the excess lead lengths.



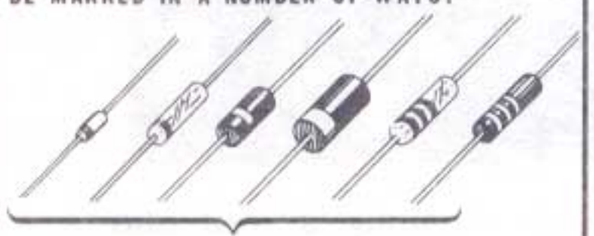
CONTINUE

Install thirteen 1N4149 diodes (#56-56) at:

- (X) D304.
- (X) D305.
- (X) D313.
- (X) D325.
- (X) D318.
- (X) D307.
- (X) D319.
- (X) D314.
- (X) D306.
- (X) D327.
- (X) D316.
- (X) D311.
- (X) D322.
- (X) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-2

IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.



Detail 1-2A

START

Install eight 100 kΩ (brown-black-yellow) resistors at:

(X) R309 .....

(X) R306 .....

(X) R305 .....

(X) R307 .....

(X) R308 .....

(X) R311 .....

(X) R304 .....

(X) R314 .....

(X) R322: 10 kΩ (brown-black-orange).

Install two 220 kΩ (red-red-yellow) resistors at:

(X) R315 .....

(X) R316 .....

(X) R303: 10 kΩ (brown-black-orange).

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

Install two 3300 Ω (orange-orange-red) resistors at:

(X) R323 .....

(X) R325 .....

(X) R403: 4.7 MΩ (yellow-violet-green).

(X) R402: 1 MΩ (brown-black-green).

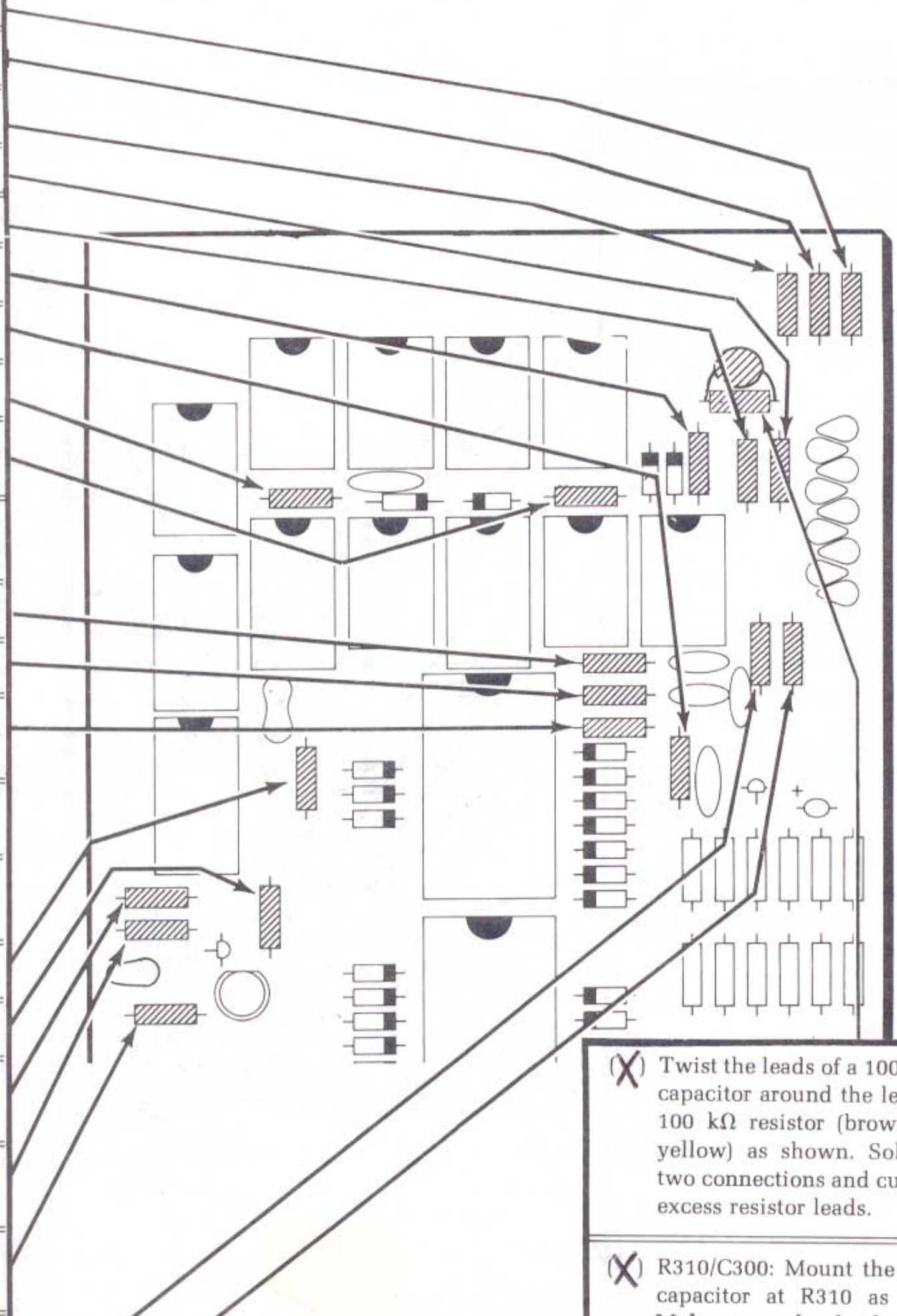
(X) R404: 470 Ω (yellow-violet-brown).

Install two 10 kΩ (brown-black-orange) resistors at:

(X) R318 .....

(X) R317 .....

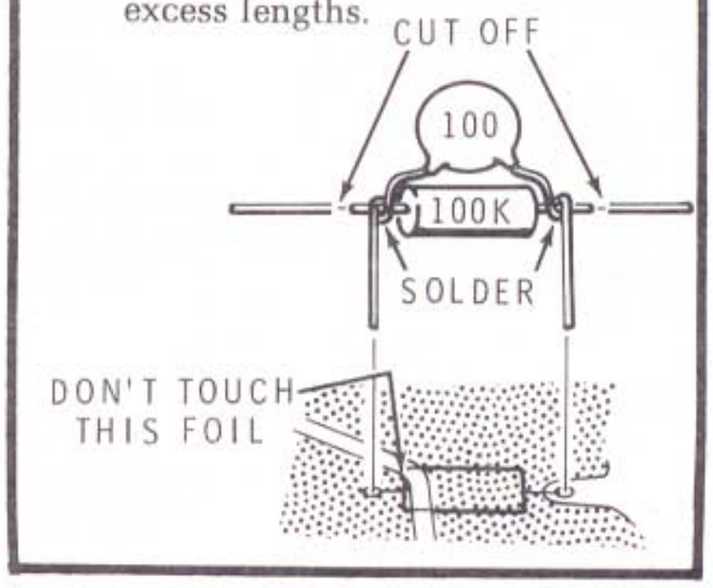
(X) Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 1-3

(X) Twist the leads of a 100 pF disc capacitor around the leads of a 100 kΩ resistor (brown-black-yellow) as shown. Solder the two connections and cut off the excess resistor leads.

(X) R310/C300: Mount the resistor capacitor at R310 as shown. **Make sure the leads do not touch the top circuit board foil.** Solder the leads and cut off the excess lengths.



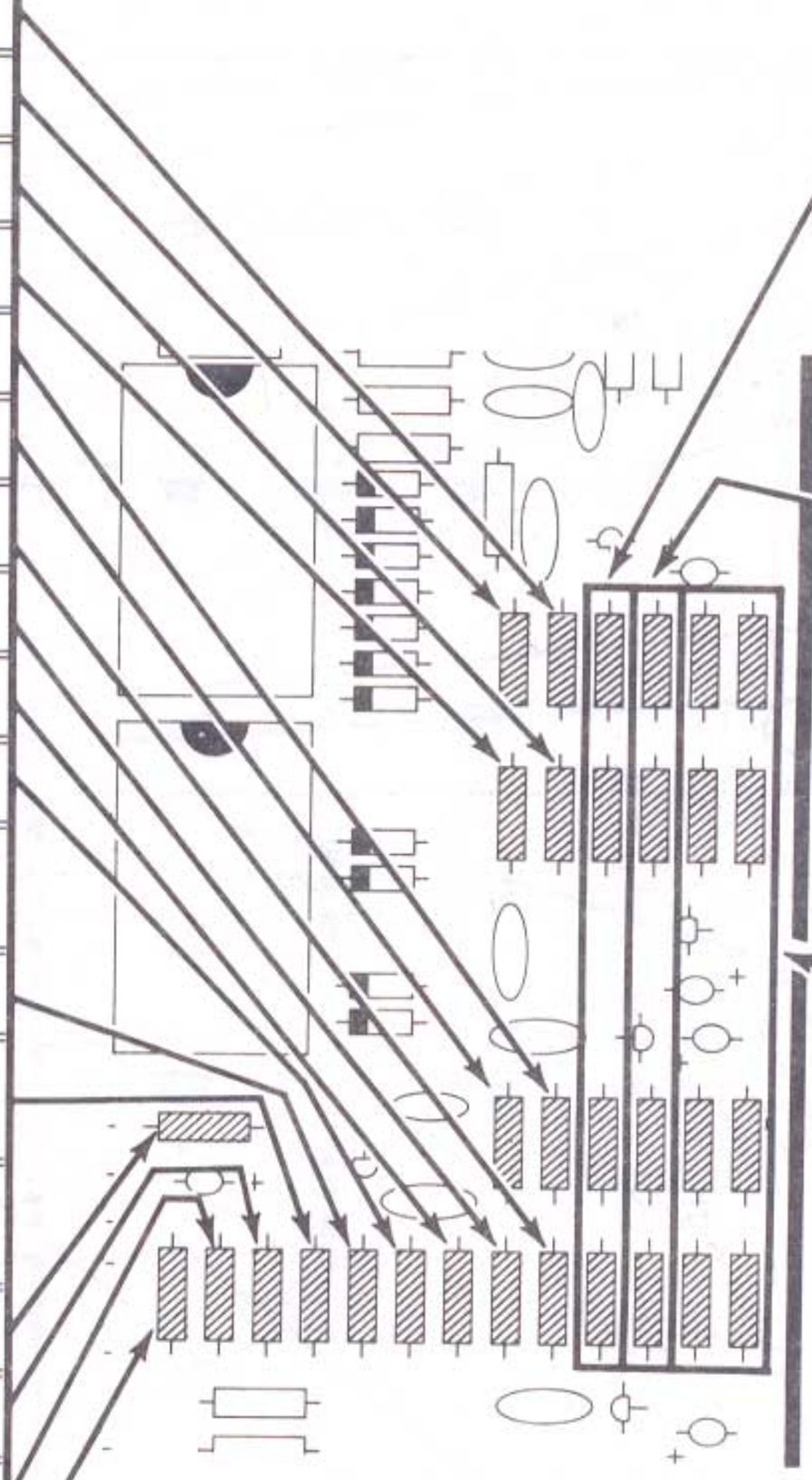
START

Install ten 100 kΩ (brown-black-yellow) resistors at:

- (X) R327 .....
- (X) R326 .....
- (X) R334 .....
- (X) R333 .....
- (X) R341 .....
- (X) R339 .....
- (X) R347 .....
- (X) R346 .....
- (X) R353 .....
- (X) R354 .....
- (X) Solder the leads to the foil and cut off the excess lead lengths.
- (X) R355: 2700 Ω (red-violet-red).
- (X) R356: 150 kΩ (brown-green-yellow).

Install four 1 MΩ (brown-black-green) resistors at:

- (X) R365 .....
- (X) R392 .....
- (X) R358 .....
- (X) R357 .....
- (X) Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

Install four 2700 Ω (red-violet-red) resistors at:

- (X) R328.
- (X) R335.
- (X) R342.
- (X) R348.

Install four 150 kΩ (brown-green-yellow) resistors at:

- (X) R329.
- (X) R336.
- (X) R343.
- (X) R349.
- (X) Solder the leads to the foil and cut off the excess lead lengths.

Install eight 1 MΩ (brown-black-green) resistors at:

- (X) R331.
- (X) R332.
- (X) R337.
- (X) R338.
- (X) R344.
- (X) R345.
- (X) R351.
- (X) R352.
- (X) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-4

START

- ( ) R361: 47 kΩ (yellow-violet-orange).
- ( ) R366: 100 Ω (brown-black-brown).
- ( ) R362: 150 kΩ (brown-green-yellow).

Install four 47 kΩ (yellow-violet-orange) resistors at:

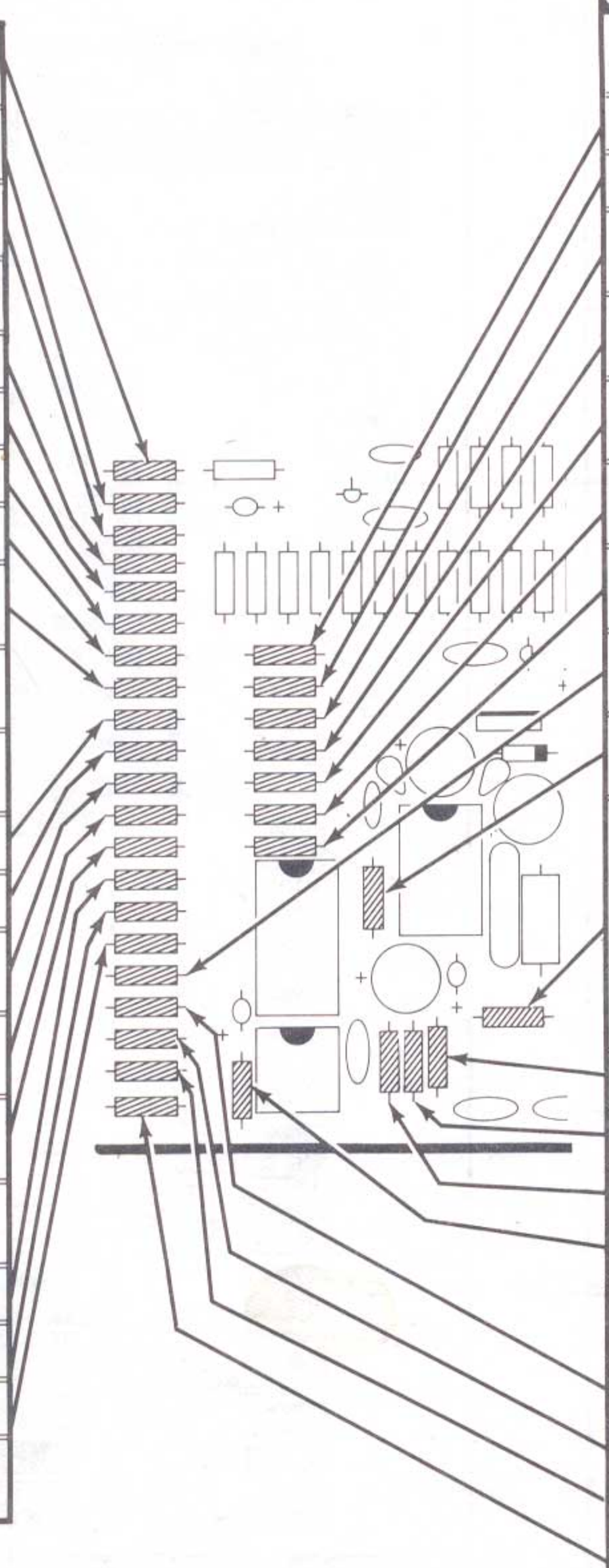
- ( ) R371 .....
- ( ) R364 .....
- ( ) R377 .....
- ( ) R387 .....
- ( ) R388: 150 kΩ (brown-green-yellow).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

Install two 47 kΩ (yellow-violet-orange) resistors at:

- ( ) R363.
- ( ) R381.
- ( ) R382: 150 kΩ (brown-green-yellow).
- ( ) R376: 47 kΩ (yellow-violet-orange).
- ( ) R368: 150 kΩ (brown-green-yellow).

Install three 47 kΩ (yellow-violet-orange) resistors at:

- ( ) R391 .....
- ( ) R384 .....
- ( ) R367 .....
- ( ) Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

Install two 100 Ω (brown-black-brown) resistors at:

- ( ) R393.
- ( ) R379.
- ( ) R378: 1 MΩ (brown-black-green).
- ( ) R386: 100 Ω (brown-black-brown).
- ( ) R385: 1 MΩ (brown-black-green).
- ( ) R373: 100 Ω (brown-black-brown).
- ( ) R372: 1 MΩ (brown-black-green).
- ( ) R375: 150 kΩ (brown-green-yellow).
- ( ) R401: 1000 Ω (brown-black-red).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) R394: 470 Ω (yellow-violet-brown).

Install four 10 kΩ (brown-black-orange) resistors at:

- ( ) R398.
- ( ) R395.
- ( ) R396.
- ( ) R397.

Install four 47 kΩ (yellow-violet-orange) resistors at:

- ( ) R374.
- ( ) R369.
- ( ) R389.
- ( ) R383.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

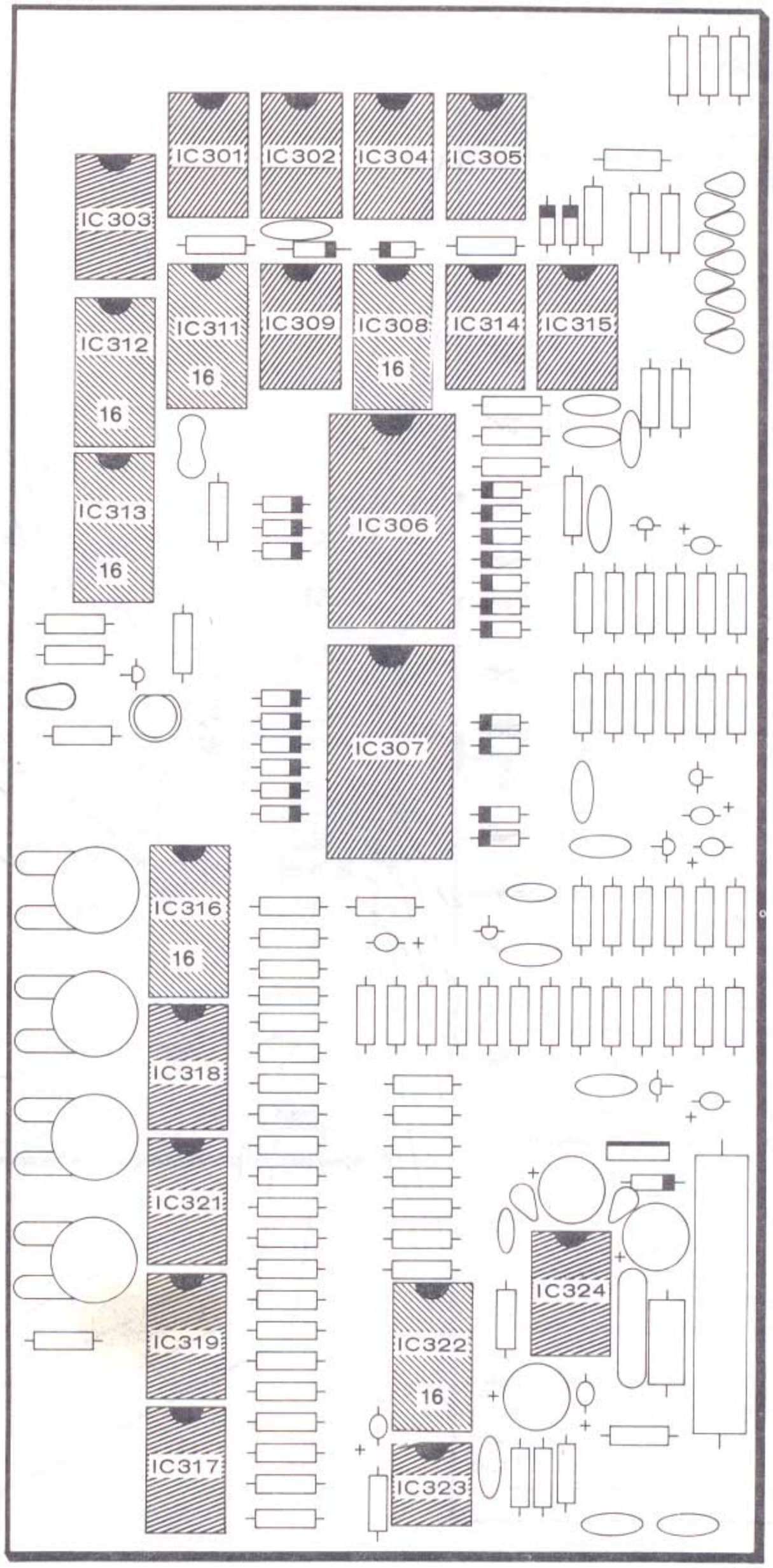
PICTORIAL 1-5

START

NOTE: The IC sockets and strips supplied with your kit can be correctly installed in only one manner. Be sure the socket pins are straight before you mount the sockets in the following steps. Solder the pins to the foil as you install each socket.

Be sure all of the socket pins are through the circuit board before you begin to solder the pins to the foil.

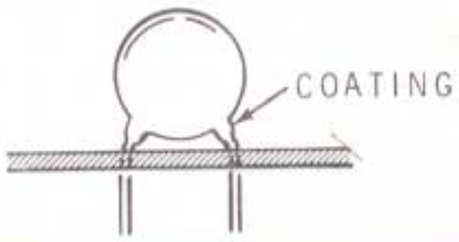
- [X] 16-pin socket at IC 308.
- [X] 16-pin socket at IC 311.
- [X] 16-pin socket at IC 312.
- [X] 16-pin socket at IC 313.
- [X] 16-pin socket at IC 316.
- [X] 16-pin socket at IC 322.
- [X] 14-pin socket at IC 305.
- [X] 14-pin socket at IC 304.
- [X] 14-pin socket at IC 302.
- [X] 14-pin socket at IC 301.
- [X] 14-pin socket at IC 315.
- [X] 14-pin socket at IC 314.
- [X] 14-pin socket at IC 309.
- [X] 14-pin socket at IC 303.
- [X] 14-pin socket at IC 318.
- [X] 14-pin socket at IC 321.
- [X] 14-pin socket at IC 319.
- [X] 14-pin socket at IC 317.
- [X] 14-pin socket at IC 324.
- [X] Two 12-pin socket strips at IC 306.
- [X] Two 12-pin socket strips at IC 307.
- [X] 8-pin socket at IC 323.



PICTORIAL 1-6

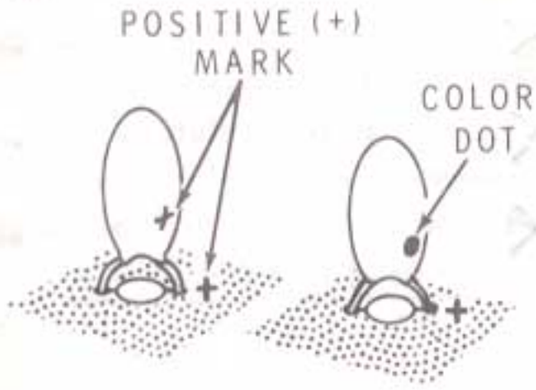
START

NOTE: When you install ceramic capacitors, space the capacitor about 1/8" above the circuit board. This will prevent the coating on the leads from protruding through the circuit board and making soldering difficult.

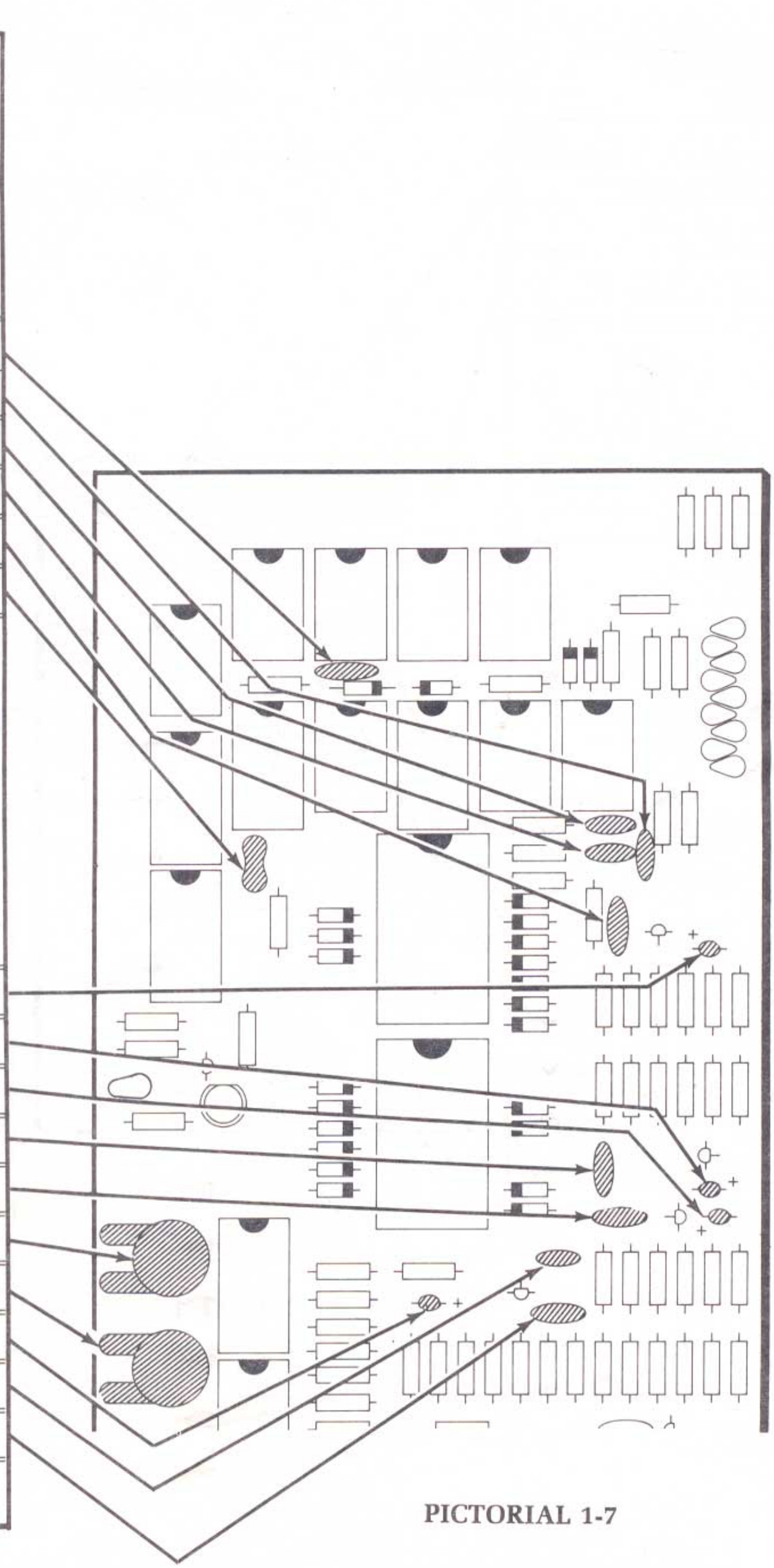


- [X] C302: .01 μF ceramic.
- [X] C301: .01 μF ceramic.
- [X] C303: .01 μF ceramic.
- [X] C304: .01 μF ceramic.
- [X] C307: .1 μF ceramic.
- [X] C306: 100 pF mica.

NOTE: When you install a tantalum capacitor, always position the positive (+) or dot marked lead of the capacitor in the positive (+) marked hole.



- [X] C308: 10 μF tantalum.
- [X] C311: 10 μF tantalum.
- [X] C313: 10 μF tantalum.
- [X] C309: .1 μF ceramic.
- [X] C312: .1 μF ceramic.
- [X] R324: 10 kΩ control (#10-383).
- [X] R319: 10 kΩ control (#10-383).
- [X] C317: 10 μF tantalum.
- [X] C305: 1000 pF (.001) disc.
- [X] C316: .1 μF ceramic.
- [X] Solder the leads to the foil and cut off the excess lead lengths.



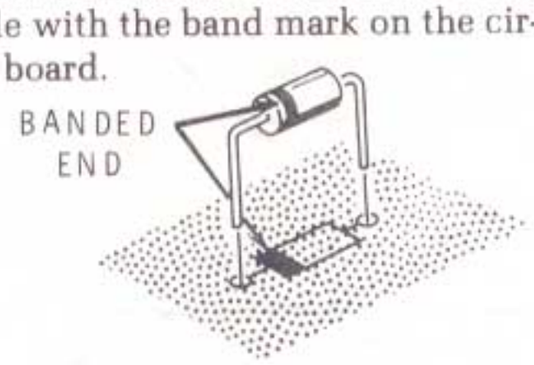
PICTORIAL 1-7

START

(X) R301: 12 Ω, 10-watt, wire-wound. Position this resistor 1/8" off the circuit board.

(X) C315: 10 μF tantalum.

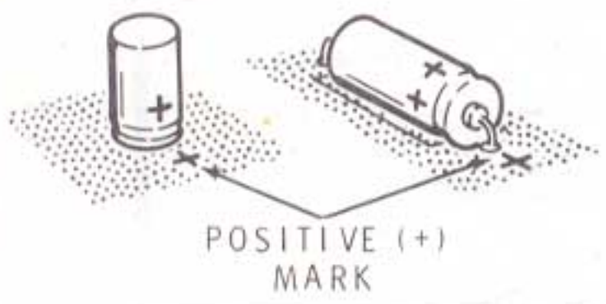
NOTE: When you install a diode, always match the band or bands on the diode with the band mark on the circuit board.



(X) ZD301: 1N4742A zener diode (#56-90).

(X) C314: .1 μF ceramic.

NOTE: When you install the following electrolytic capacitors, be sure you match the positive (+) marking on the capacitor with the positive (+) marking on the circuit board.



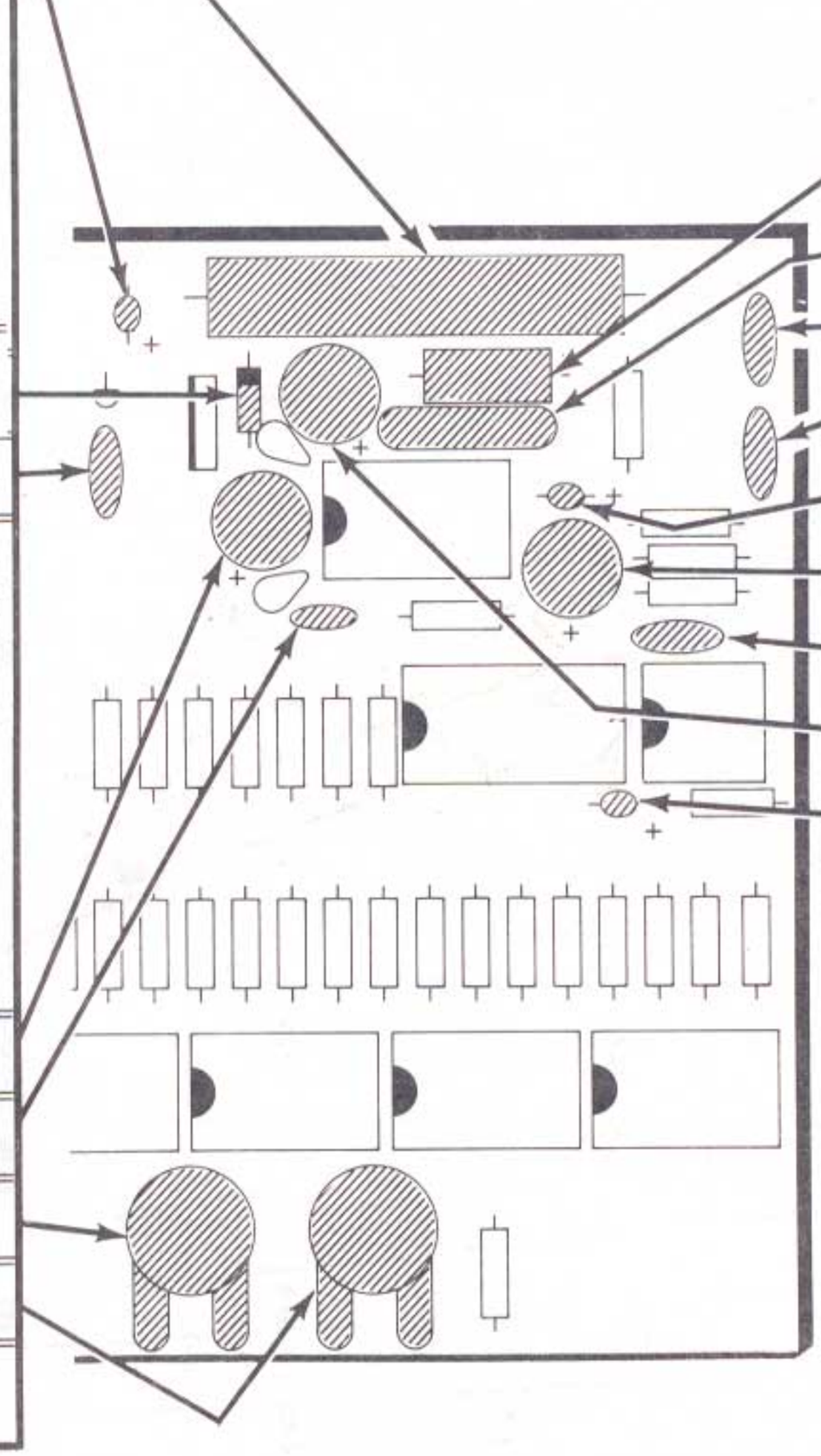
(X) C328: 100 μF electrolytic.

(X) C326: 680 pF ceramic.

(X) R359: 10 kΩ control (#10-383).

(X) R399: 10 kΩ control (#10-383).

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



CONTINUE

(X) R302: 270 Ω, 1-watt (red-violet-brown).

(X) C327: .22 μF Mylar.

(X) C322: .1 μF ceramic.

(X) C323: .1 μF ceramic.

(X) C321: 10 μF tantalum.

(X) C324: 100 μF electrolytic

(X) C319: .1 μF ceramic.

(X) C325: 100 μF electrolytic.

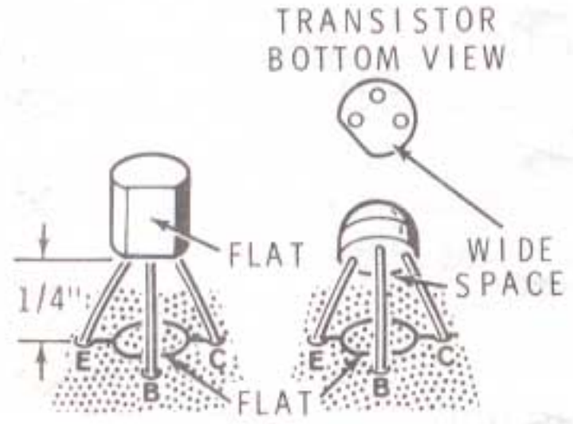
(X) C318: 10 μF tantalum.

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

PICTORIAL 1-8

START

NOTE: When you install each of the following transistors, identify the E, B, and C leads on the transistors. Then insert the E, B, and C leads of the transistor into the corresponding E, B, and C holes in the circuit board. Position the transistor 1/4" above the circuit board. Solder the leads to the foil and cut off the excess lead lengths.



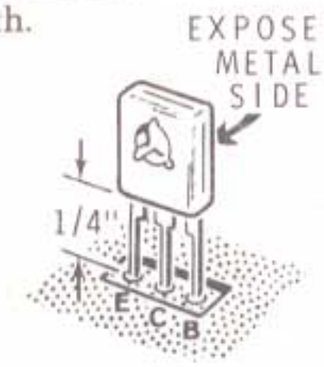
Install five 2N4121 (#417-235) transistors at:

- [ ] Q302 .....
- [ ] Q303 .....
- [ ] Q304 .....
- [ ] Q305 .....
- [ ] Q306 .....

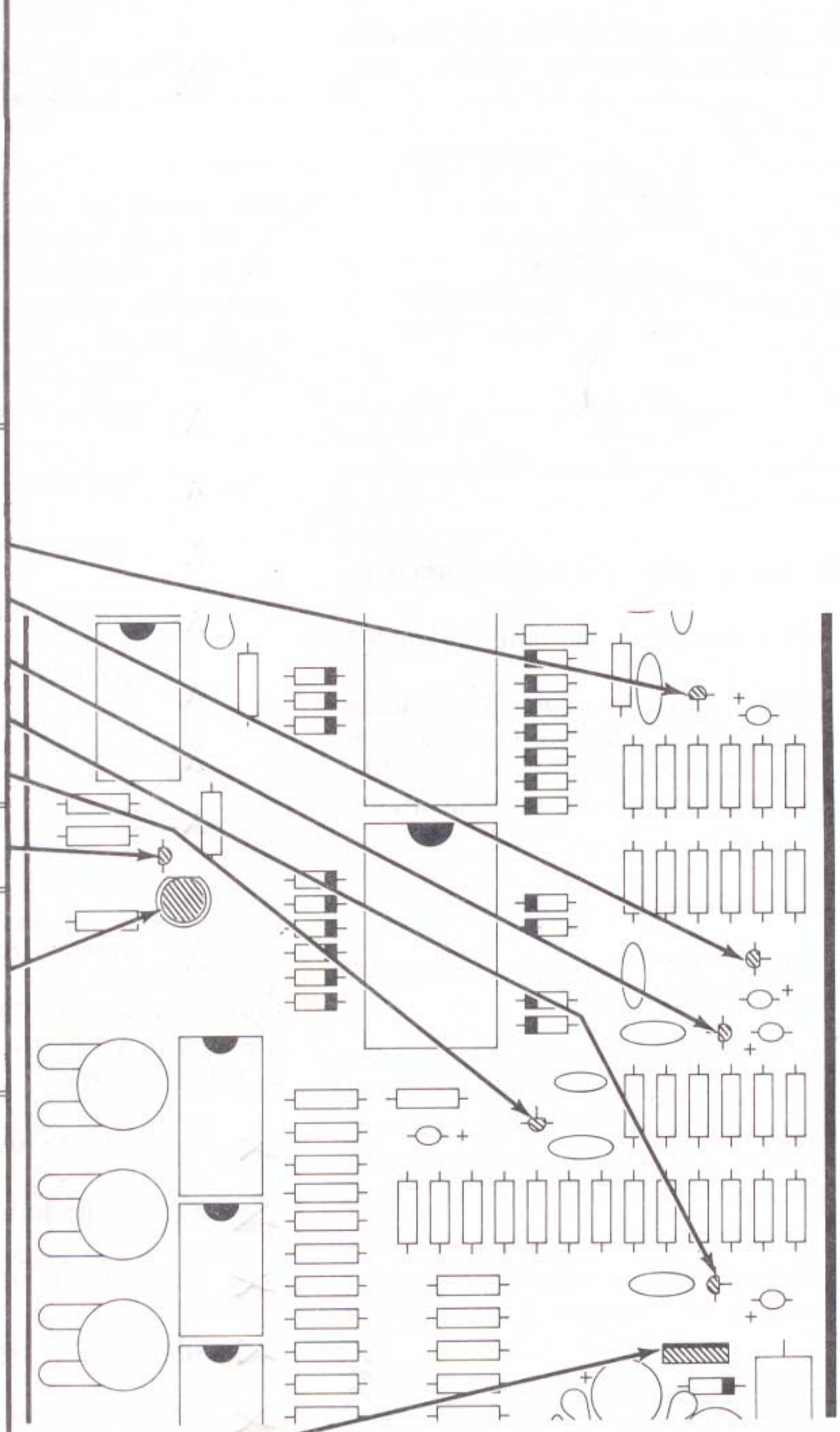
- [ ] Q307: MPS-A13 (#417-881) transistor.

- [ ] D328: LED. Position the flat side on the LED with the outline of the flat on the circuit board. Solder the leads to the foil and cut off the excess lead lengths. Position the LED 1/4" off the circuit board.

NOTE: To install the following transistor, insert the leads into their correct holes, E, C, and B. Solder each lead to the foil and cut off the excess lead length.



- [ ] Q301: MJE181 (#417-818) transistor.

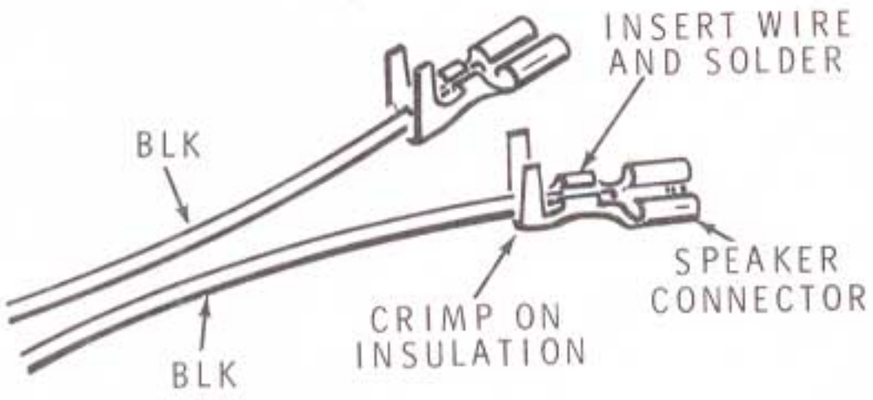


PICTORIAL 1-9

Refer to Pictorial 1-10 for the following steps.

(✂) Cut two 12″ black wires and remove 1/4″ of insulation from each end of each wire. Then twist the fine wire strands and apply just enough solder to the bare wire ends to hold the fine strands together.

(✂) Refer to Detail 1-10A and install a speaker connector onto either end of both 12″ black wires as shown.



Detail 1-10A

Connect and solder the free end of the black wires to the circuit board as follows:

(✂) Either black wire to either hole marked SP.

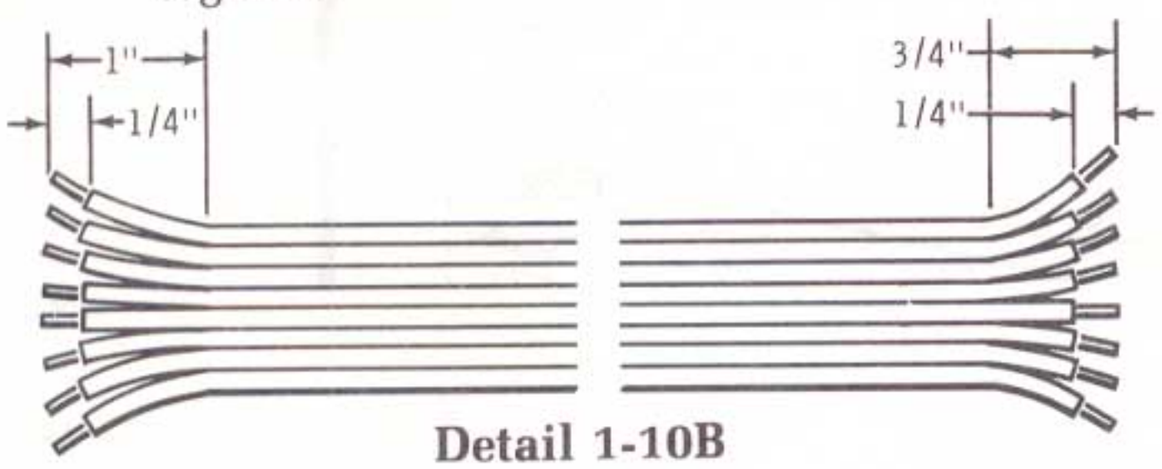
(✂) Other black wire to other hole marked SP.

(X) Cut two 6″ black wires. Remove 1/4″ of insulation from the ends of each wire. Then twist the fine wire strands and apply just enough solder to the bare wire ends to hold the fine strands together.

(X) Cut two 6″ flat cables.

NOTE: Use a sharp knife or scissors to separate the individual wires from the flat cable.

(X) Refer to Detail 1-10B and prepare the ends of the 6″ flat cables as shown. Remove 1/4″ of insulation from the ends of each wire. Then twist the fine wire strands and apply just enough solder to the bare wire ends to hold the fine strands together.



Detail 1-10B

Refer to Detail 1-10C for the next twelve steps.

(X) On one 6″ flat cable (at the end separated for a length of 1″), crimp and solder a female connector pin onto each wire.

(X) Crimp and solder a female connector pin onto one end of a 6″ black wire.

(X) Cut off both locking tabs from a 9-hole connector plug.

Insert the connectors on the flat cable and black wire into the 9-hole connector plug in the following steps. Note that the hole numbers are stamped in the back of the plug. Each time you install a connector, lightly pull on the wire to make sure the connector is securely locked in place.

(X) Brown wire to hole 1.

(X) Red wire to hole 2.

(X) Orange wire to hole 3.

(X) Gray wire to hole 4.

(X) Black wire to hole 5.

(X) Yellow wire to hole 6.

(X) Violet wire to hole 7.

(X) Blue wire to hole 8.

(X) Green wire to hole 9.

Connect and solder the free end of the flat cable and black wire with the connector plug to the circuit board as follows:

(✂) Gray wire to hole CA.

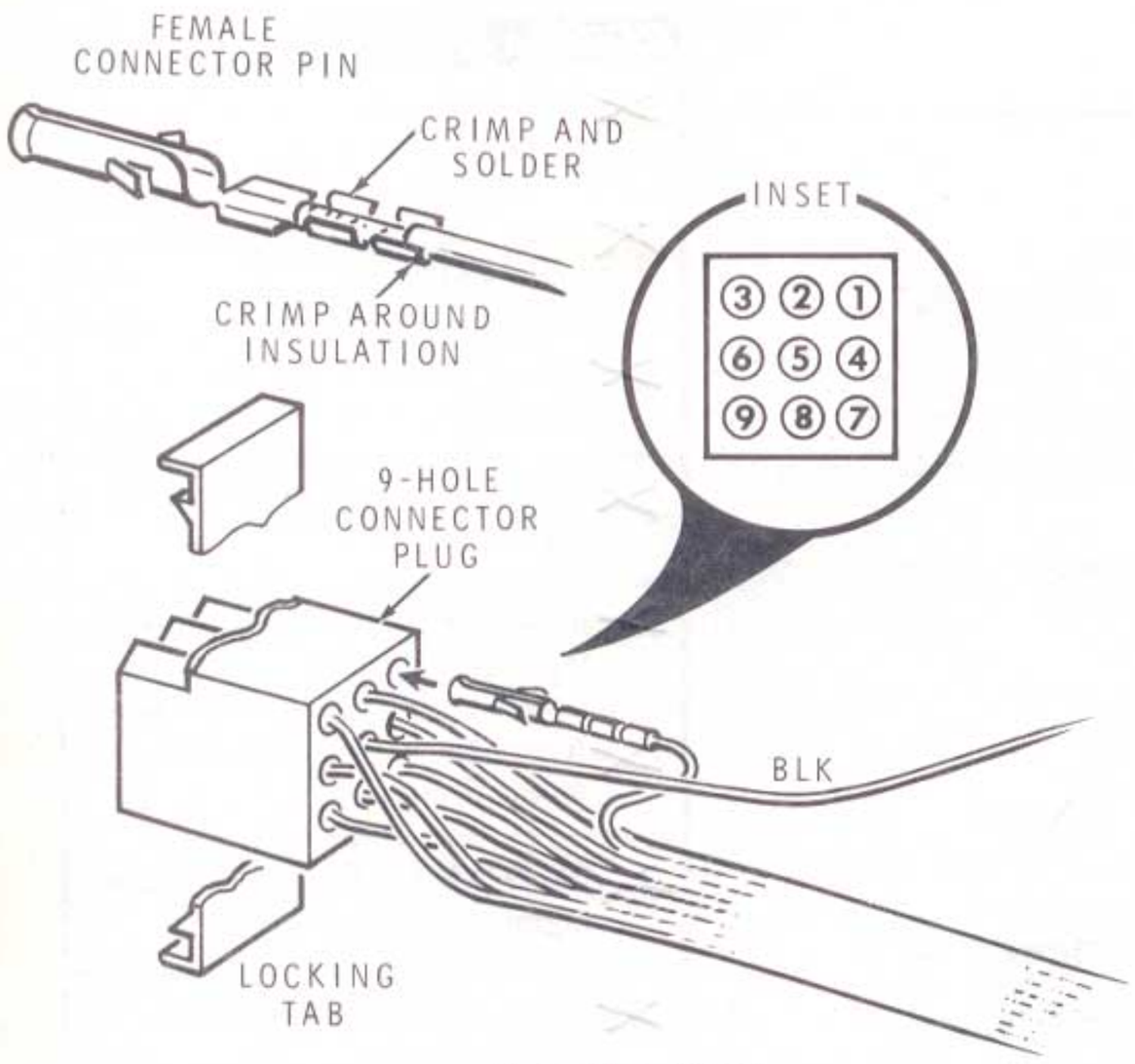
(✂) Violet wire to hole CB.

(✂) Blue wire to hole CC.

(✂) Green wire to hole CD.

(✂) Yellow wire to hole CE.

(✂) Orange wire to hole CF.



Detail 1-10C

- [X] Red wire to hole CG.
- [X] Brown wire to hole CH.
- [X] Black wire to hole CJ.
- [X] Cut the excess lead lengths from the foil side of the circuit board.
- [X] Cut a 12″ black wire. Remove 1/4″ of insulation from each end. Then twist the fine wire strands and apply just enough solder to the bare wire ends to hold the fine strands together.
- [X] Connect and solder one end of the 12″ black wire to hole TP on the circuit board. Since this wire will be used as a test lead, the other end will not be connected. Cut the excess lead length from the foil side of the circuit board.
- [X] Mount a cable clamp and a 6-32 × 3/8″ spacer to the circuit board at hole AE as shown. Use a 6-32 × 5/16″ screw, a #6 flat washer, and a #6 lockwasher.
- [X] Mount a 6-32 × 3/8″ spacer to the circuit board at hole AF. Use a 6-32 × 1/4″ screw and a #6 lockwasher.
- [X] In the same manner, mount a 6-32 × 3/8″ spacer to the circuit board at holes AA, AB, AC, and AD.
- [X] Fold the black test lead and slide it into the cable clamp at AE. Be sure the bare wire end is not touching anything.

Temporarily lay the circuit board aside.

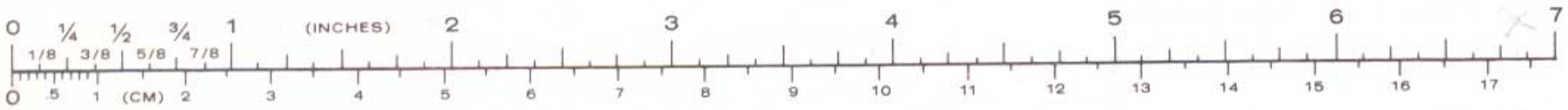
Refer to Detail 1-10D for the next twelve steps.

- [X] On the other 6″ flat cable (at the end separated for a length of 1″), crimp and solder a male connector pin onto each wire.
- [X] Crimp and solder a male connector pin onto one end of a 6″ black wire.

Insert the connectors on the flat cable and black wire into the 9-hole connector socket in the following steps. Note that the hole numbers are stamped in the back of the socket. Each time you install a connector, lightly pull on the wire to make sure the connector is securely locked in place.

- [X] Brown wire to hole 1.
- [X] Red wire to hole 2.
- [X] Orange wire to hole 3.
- [X] Gray wire to hole 4.
- [X] Black wire to hole 5.
- [X] Yellow wire to hole 6.
- [X] Violet wire to hole 7.
- [X] Blue wire to hole 8.
- [X] Green wire to hole 9.
- [X] Plug the 9-hole connector plug into the 9-hole connector socket and make sure the wire colors to the socket match the wire colors to the plug.

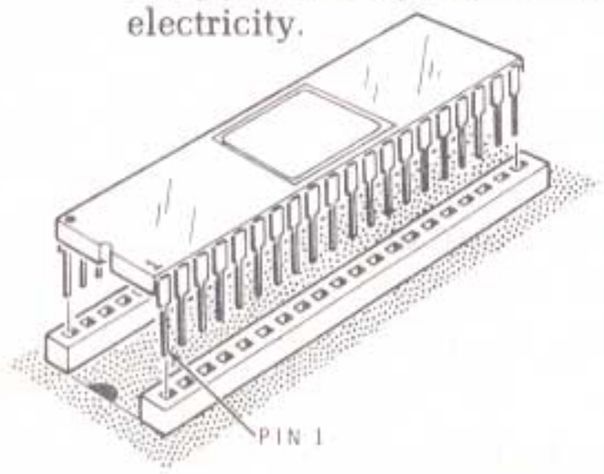
Temporarily lay this cable assembly aside.



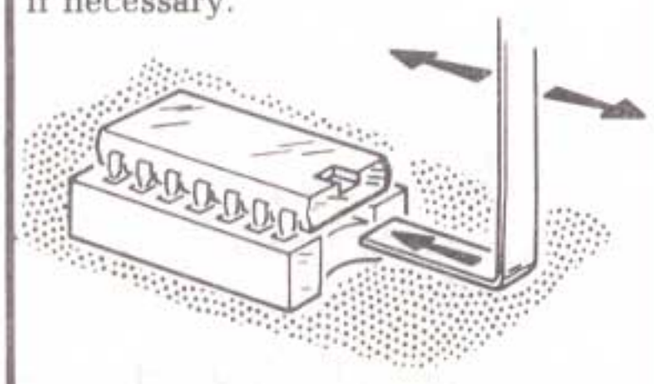
START

NOTE: The integrated circuits that you will install in the next steps are rugged and reliable components. However, normal static electricity discharged from your body, through an integrated circuit pin to an object, can damage the integrated circuits. Read the instructions first. Then carefully perform each step without interruption.

1. Remove the IC from its package, with both hands.
2. Hold the IC in one hand, remove the conductive foam, and straighten any bent pins with the other hand.
3. Continue holding the IC, being careful not to touch it to anything, while you pick up and hold the circuit board in your other hand.
4. Align the pin 1 end of the IC with socket pin 1. See Detail 1-11A. Carefully start the IC pins into the sockets; then push the IC down into the sockets. Once the IC's are inserted into the sockets they are protected against static electricity.

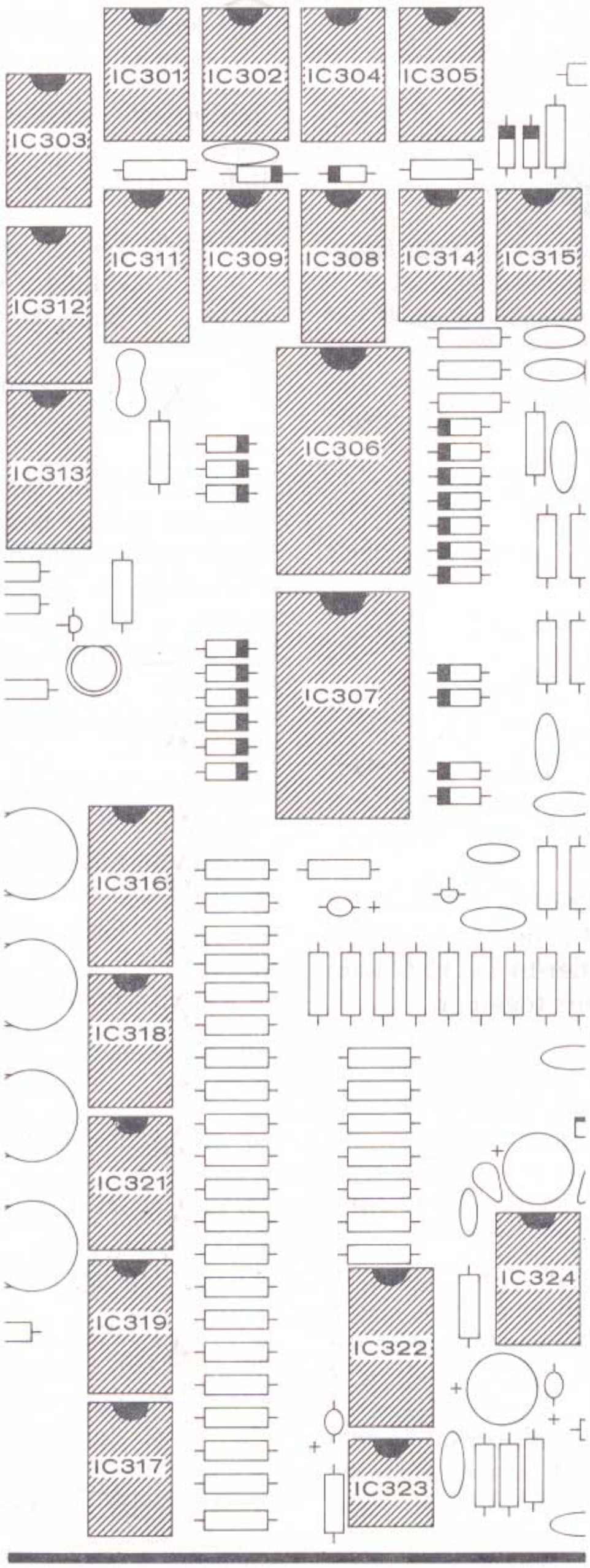


NOTE: An IC puller has been furnished to remove an IC from its socket if necessary.



Push the shorter end of the puller in between the IC and the socket and rock the longer portion back and forth. Be very careful as the IC pins are very easily bent.

- [ ] IC305: MC14001 (#443-703) integrated circuit.
- [ ] IC304: MC14013 (#443-607) integrated circuit.



PICTORIAL 1-11

CONTINUE

- [ ] IC302: MC14002 (#443-704) integrated circuit.
- [ ] IC301: MC14071 (#443-706) integrated circuit.
- [ ] IC315: MC14001 (#443-703) integrated circuit.
- [ ] IC314: MC14013 (#443-607) integrated circuit.
- [ ] IC308: MC14516 (#443-708) integrated circuit.
- [ ] IC309: MC14013 (#443-607) integrated circuit.
- [ ] IC311: MC14049 (#443-701) integrated circuit.
- [ ] IC303: MC14013 (#443-607) integrated circuit.
- [ ] IC312: MC14516 (#443-708) integrated circuit.
- [ ] IC313: MC14516 (#443-708) integrated circuit.
- [ ] IC306: MC14515 (#443-707) integrated circuit.
- [ ] IC307: MC14515 (#443-707) integrated circuit.
- [ ] IC316: MK50240 (#443-710)
- [ ] IC318: MC14013 (#443-607) integrated circuit.
- [ ] IC321: MC14013 (#443-607) integrated circuit.
- [ ] IC319: MC14013 (#443-607) integrated circuit.
- [ ] IC317: MC74C93 (#443-709) integrated circuit.
- [ ] IC322: MC14049 (#443-701) integrated circuit.
- [ ] IC323: N5741V (#442-22) integrated circuit.
- [ ] IC324: TBA820L (#442-610) integrated circuit.

NOTE: The pin 1 end of all of the IC's should be facing the same direction.

CLOCK PREPARATION

Refer to Pictorial 2-1 for the following steps.

(X) If not already done, remove your Electronic Clock from its cabinet.

(X) Remove the Clock's circuit board assembly from the chassis by removing the two screws that mount the assembly to the chassis.

(X) Remove the power circuit board from the display circuit board.

NOTE: In the following steps, solder each wire to the foil as you install it.

Connect the free end of the 9-hole connector socket cable to the power circuit board as follows:

(X) Black wire to hole CJ.

(X) Brown wire to hole CH.

(X) Red wire to hole CG.

(X) Orange wire to hole CF.

(X) Yellow wire to hole CE.

(X) Green wire to hole CD.

(X) Blue wire to hole CC.

(X) Violet wire to hole CB.

(X) Gray wire to hole CA.

(X) Cut off the excess lead lengths from the foil side of the circuit board.

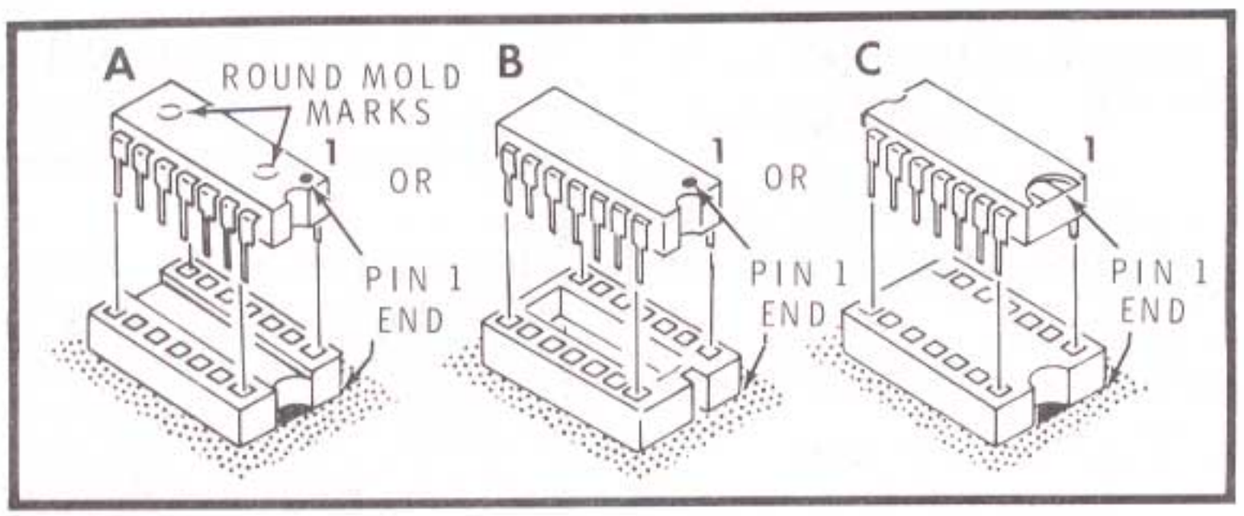
(X) Locate the speaker and bend the tab up as shown.

(X) Mount the speaker to the Clock's chassis as shown. Use four 6-32 × 1/4" screws, four #6 lockwashers, and four 6-32 nuts. Be sure to position the speaker lugs as shown.

(X) Push the power circuit board onto the four standoffs on the display circuit board.

(X) Remount the Clock's circuit board assembly on the chassis.

This completes the "Step-by-Step Assembly." Proceed to the "Alignment."



Detail 1-11A

ALIGNMENT

If you do not get the indicated results as you perform the "Alignment," refer to the "Tests," which follow.

Refer to Figure 1-1 for control locations while you perform the following steps.

NOTE: You may want to listen to the Chimes recording supplied with your Clock to hear what the Chimes should sound like when properly aligned.

- Plug the 9-pin connector plug into the 9-pin connector socket.
- Push the speaker connectors onto the speaker lugs.
- If not already done, adjust the four circuit board controls to their center of rotation.
- Connect the Clock's line cord plug to an appropriate AC outlet.
- Rotate the DECAY control (R359) in both directions. Note that in one direction of rotation, an intermingling of all the synthesized tones occurs, while in the other direction, the intermingling of tones fades into the background.
- Adjust the DECAY control to the point where the intermingling of tones fades into the background.
- FAST advance the clock display several hours. This will set up the Chimes circuitry so it will operate properly.
- Rotate the PITCH control (R324) in both directions. Note that the Pitch can be varied approximately 1-1/2 octaves over the musical scale.
- Adjust the PITCH control to the pitch that is most pleasing to you.
- Adjust the VOLUME control (R399) to the loudness you desire.
- Adjust the TIC-TOC volume control (R319) to the loudness you desire.
- Unplug the line cord.

NOTE: You can readjust the Chimes any time after the "Final Assembly" through holes in the back of the chassis.

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

TESTS

If you do not get the indicated results as you perform each test, refer to the "Possible Cause Chart" which follows. If none of the difficulties listed in the chart is the cause of the malfunction, refer to the appropriate part of the "In Case of Difficulty" section. If you have a difficulty, DO NOT proceed until it has been corrected since, in some cases, the difficulty may cause further damage.

Refer to Figure 1-1 while you perform the following tests.

( ) Position the Chimes circuit board on a non-conductive surface near the Clock and, if not already done, plug the 9-pin connector plug into the 9-pin connector socket.

( ) If not already done, push the speaker connectors onto the speaker lugs.

( ) Turn the four circuit board controls to their center rotation.

( ) Connect the Clock's line cord plug to an appropriate AC outlet.

( ) Remove the test lead from the cable clamp.

In the following steps, you will touch the test lead to certain points on the Chimes circuit board as called out in the steps. As you touch a point, the LED will either light, not light, or flash, as indicated in the step.

VOLTAGE REGULATOR/TEST CIRCUIT

( ) Touch the test lead to the emitter (E) of Q301. The LED should light.

POSSIBLE CAUSE CHART
1. LED does not light. A. 9-pin connectors wired improperly. B. Q301 or Q307. C. ZD301 or D328. D. R301, R302, R402, R403, or R404.

TIME DECODER/PROGRAM ENCODER

( ) Touch the test lead to IC305 pin 11. The LED should flash once per second.

POSSIBLE CAUSE CHART
1. LED does not flash once per second. A. 9-pin connectors wired improperly. B. IC305.

( ) Advance the clock display to 1:58 and pause for approximately one minute. Then advance the display to 2:01 and pause for approximately one minute.

( ) Touch the test lead to IC304 pin 1. The LED should not light.

( ) Continue holding the test lead to IC304 pin 1 and advance the clock display to 2:15. The LED should light and remain lit approximately 8 seconds.

POSSIBLE CAUSE CHART
1. LED does not light. 2. LED remains lit. A. 9-pin connectors wired improperly. B. IC302, or IC304 or IC305.

( ) Touch the test lead to IC303 pin 13. The LED should not light.

( ) Continue to touch the test lead to IC303 pin 13 and advance the clock display to 2:30. The LED should light for approximately 12 seconds.

POSSIBLE CAUSE CHART
1. LED does not light. 2. LED remains lit. A. 9-pin connectors wired improperly. B. IC301 or IC303.

( ) Touch the test lead to IC304 Pin 13. The LED should not light.

( ) Continue to touch the test lead to IC304 pin 13 and advance the clock display to 2:45. The LED should light and remain lit approximately 18 seconds.

POSSIBLE CAUSE CHART
1. LED does not light. 2. LED remains lit. A. 9-pin connectors wired improperly. B. IC302, IC304, or IC305.

( ) Touch the test lead to IC303 pin 1. The LED should not light.

( ) Continue to touch the test lead to IC303 pin 1 and advance the clock display to 3:00. The LED should light for approximately 37 seconds.

POSSIBLE CAUSE CHART
1. LED does not light. A. 9-pin connectors wired improperly. B. IC301 or IC303.
2. LED remains lit. A. 9-pin connectors wired improperly. B. C301. C. R303.

( ) Touch the test lead to the connector on the orange lead at the 9-pin connector plug and FAST advance the clock display from 10:00 through 1:00. The LED should light at 10:00 and remain lit until 1:00.

POSSIBLE CAUSE CHART
1. LED does not light. A. IC302 or IC308.

( ) Advance the clock display to 1:08 and wait approximately one minute. Then touch the test lead to IC302 pin 13. The LED should light.

POSSIBLE CAUSE CHART
1. LED does not light. A. IC311. B. C306. C. R323, R324, or R325.

NOTE FREQUENCY SYNTHESIZER

( ) Touch the test lead to IC311 pin 2. The LED should light.

POSSIBLE CAUSE CHART
1. LED does not light. A. IC316.

( ) Touch the test lead to IC316 pins 4, 6, 8, 9, 10, 11, 13, 14, 15, and 16. The LED should light.

POSSIBLE CAUSE CHART
1. LED does not light. A. IC317.

( ) Touch the test lead to IC317 pins 10, 12 and 13. The LED should light.

POSSIBLE CAUSE CHART
1. LED does not light. A. IC318.

( ) Touch the test lead to IC318 pins 1 and 13. The LED should light.

POSSIBLE CAUSE CHART
1. LED does not light. A. IC309.

( ) Touch the test lead to IC309 pin 1. The LED should light.

POSSIBLE CAUSE CHART
1. LED does not light. A. IC319.

( ) Touch the test lead to IC319 pins 1 and 13. The LED should light.

POSSIBLE CAUSE CHART
1. LED does not light. A. IC321.

( ) Touch the test lead to IC321 pins 1 and 13. The LED should light.

TIC-TOC SYNTHESIZER

( ) Touch the test lead to IC314 pins 1 and 13. The LED should flash slowly.

POSSIBLE CAUSE CHART
1. LED does not light. 2. LED lights but does not flash. A. IC314.

( ) Touch the test lead to the banded end of D304 and D305. The LED should light.

POSSIBLE CAUSE CHART
1. LED does not light. 2. LED lights at full intensity. A. IC315 or IC314. B. D304 or D305. C. R322.

( ) Touch the test lead to IC315 pins 10 and 11. The LED should flash dimly at a slow rate.

POSSIBLE CAUSE CHART
1. LED does not light. 2. LED does not flash. 3. LED flashes at full intensity. A. IC315. B. C303 or C304. C. R315 or R316.

CHIMES SYNTHESIZER

NOTE: In some of the following steps, you will be instructed to set the clock display between quarter hours. This means to set the display to any time other than on the hour, 15 minutes after the hour, 30 minutes after the hour, or 45 minutes after the hour.

( ) Advance the clock display to any time between quarter hours and wait approximately one minute. Then touch the test lead to the collector of Q302. The LED should not light.

( ) While you hold the test lead on the collector of Q302, FAST advance the clock display through a one-hour transition (for example, advance the display from 3:08 to 4:08). The LED should light and then slowly go off again.

POSSIBLE CAUSE CHART
1. The LED lights and stays lit. 2. The LED does not light. A. Q302. B. D306, D307, D308, D309, or D311. C. R326, R327, R328, R329, R331, or R332. D. C307 or C308.

( ) Advance the clock display to any time between quarter hours and wait approximately one minute. Then touch the test lead to the collector of Q303. The LED should not light.

( ) While you hold the test lead on the collector of Q303, FAST advance the clock display through a one-hour transition. The LED should light and then slowly go off again.

POSSIBLE CAUSE CHART
1. LED lights and stays lit. 2. LED does not light. A. Q303. B. D312, D313, D314, D315, or D316. C. R333, R334, R335, R336, R337, or R338. D. C309 or C311.

( ) Advance the clock display to any time between quarter hours and wait approximately one minute. Then touch the test lead to the collector of Q304. The LED should not light.

( ) While you hold the test lead on the collector of Q304, FAST advance the clock display through a one-hour transition. The LED should light and then slowly go off again.

POSSIBLE CAUSE CHART
1. LED lights and stays lit. 2. LED does not light. A. Q304. B. D317, D318, D319, D321, D322, or D323. C. R339, R341, R342, R343, R344, or R345. D. C312 or C313.

( ) Advance the clock display to any time between quarter hours and wait approximately one minute. Then touch the test lead to the collector of Q305. The LED should not light.

( ) While you hold the test lead on the collector of Q305, FAST advance the clock display through a one-hour transition. The LED should light and then slowly go off again.

POSSIBLE CAUSE CHART
1. LED lights and stays lit. 2. LED does not light. A. Q305. B. D324, D325, D326, or D327. C. R346, R347, R348, R349, R351, or R352. D. C314 or C315.

( ) Advance the clock display to any time between quarter hours and wait approximately one minute. Then touch the test lead to the collector of Q306. The LED should not light.

( ) While you hold the test lead on the collector of Q306, FAST advance the clock display through a one-hour transition. The LED should light on the hour and then slowly go off again.

POSSIBLE CAUSE CHART
1. LED lights and stays lit. 2. LED does not light. A. Q306. B. R353, R354, R355, R356, R357 or R358. C. C316 or C317.

( ) Unplug the Clock's line cord plug from the AC outlet.

( ) Fold the black test lead and slide it into the cable clamp. Be sure the bare wire end is not touching anything.

This completes the "Tests."

FINAL ASSEMBLY

Refer to Pictorial 3-1 for the following steps.

✂ Carefully remove the protective paper backing from the blue and white label. Then press the label onto the Clock chassis as shown.

✂ Mount the Chimes circuit board to the back of the Clock chassis as shown. Use six 6-32 × 3/16" black screws.

✂ Refer to your Clock Manual and install the Clock in the cabinet.

This completes the "Final Assembly."

OPERATION

The Chimes circuitry depends on the Clock circuitry for its trigger pulses and power. Therefore, anytime AC power to the Clock is interrupted, you must perform one of the following procedures to synchronize the Chimes with the Clock.

Two procedures are given for setting the Clock and Chimes. You can use either procedure.

NOTE: The chimes will be playing while you perform the following steps. This is normal operation. The chimes will stop playing shortly after the time is set.

PROCEDURE #1.

( ) Advance the clock display through a 12:00 to 1:00 transition. This synchronizes the internal hour memory register with the indicated hour of the clock display.

( ) Advance the clock display to the correct time. The next quarter-hour note play may be incorrect. This note play is required to synchronize the Chimes with the clock display. After the first quarter hour, the note play and the striking hour will correspond to the displayed time.

PROCEDURE #2

( ) Advance the clock display through a 12:00 to 1:00 transition. This synchronizes the internal hour memory register with the indicated hour of the clock display.

( ) Advance the clock display to two minutes before the previous quarter hour (for example, if the correct time is 1:52, the previous quarter hour would be 1:45). Allow the chimes to stop playing. Then advance the display to the previous quarter hour. This synchronizes the internal quarter-hour memory register with the indicated quarter hour of the clock display.

( ) Advance the clock display to the correct time. The chimes are now synchronized with the Clock. The note play and the striking hour will correspond to the displayed time.

IN CASE OF DIFFICULTY

This part of the Manual will help you locate and correct any difficulties which might occur. This information is divided into:

Visual Checks
Precautions for Bench Testing
Troubleshooting Chart

NOTES:

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

2. For the physical location of parts on the circuit board, refer to the "Circuit Board X-Ray View" in the "Illustration Booklet."

VISUAL CHECKS

1. About 90% of the kits that are returned for repair do not function properly due to poor soldering. Therefore, you can eliminate many troubles by a careful inspection of connections to make sure they are soldered as described on Page 9 of this Manual. Reheat any doubtful connections and be sure all the wires are soldered at places where several wires are connected. Check carefully for solder bridges between circuit board foils.

2. Make sure all transistors and diodes are in their proper locations, and are installed correctly.

3. Check the value of each part. Be sure the proper part has been wired into the circuit, as shown in the Pictorial diagrams and as specified in the wiring instructions. It would be easy, for example, to install a 10 kΩ (brown-black-orange) resistor in a step that calls for a 100 kΩ (brown-black-yellow) resistor.

4. Recheck the wiring. Trace each lead in 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 you have consistently overlooked.

5. Check all of the wires that are connected to the circuit board to be sure they do not touch the chassis or other lugs. Make sure all wires are properly soldered.

6. A review of the "Circuit Description" may help you determine the problem.

7. If the difficulty still is not cured, read the "Precautions for Bench Testing" section, and the section titled "Troubleshooting Chart."

PRECAUTIONS FOR BENCH TESTING

NOTE: Use a high input impedance voltmeter for voltage measurements.

1. Be cautious when you test transistor circuits. Although transistors 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 circuit any terminals when you make voltage measurements. If the probe should slip, for example, and short out a bias or voltage supply point, it is almost certain to damage one or more transistors or diodes.

3. Do not remove any components while the kit is operating; this could cause considerable damage.

If you make repairs to your Chimes, make sure you eliminate the cause as well as the effect of the trouble. If, for example, you should find a damaged resistor, be sure to find out what caused the resistor to become damaged. If the cause is not eliminated, the replacement resistor may also become damaged when the unit is put back into operation.

Troubleshooting Chart

The following chart lists conditions and possible causes of several specific malfunctions. If a particular part is mentioned (Q6 for example) as a possible cause, check that part to see that it is installed and/or wired correctly. It is also possible, on rare occasions, for a part to be faulty and require replacement.

CONDITION	POSSIBLE CAUSE
Distorted sound.	1. IC324 improperly installed. 2. C324, C325, or C328 improperly installed.
Chimes sound, but no hour enunciation.	1. IC301D, IC312, or IC313 improperly installed. 2. Q306.
Incorrect bongs on hour enunciation.	1. IC311C, IC312, or IC313 improperly installed.
1 or 2 notes sound incorrect or are missing.	1. D306 through D327 improperly installed. 2. IC309B, IC317, IC318, IC319A, IC319B, or IC321 improperly installed.
Tic-toc OK, no chimes.	1. IC301, IC302, IC303, IC304, IC305, IC322, or IC323 improperly installed.
Incorrect timing of chimes or no chimes at irregular intervals.	1. IC301, IC302, IC303, IC304, IC305, or IC311 improperly installed.
Chimes are incorrect tune or sequence.	1. IC301, IC305, IC306, IC307, IC308, IC309, or IC311 improperly installed.

SPECIFICATIONS

Speaker Impedance	8 ohms.
Power Supply	Short circuit protected +11.4-volt series regulator; primary power derived from Electronic Clock.
Frequency Generation	All frequencies are synthesized on an even-tempered scale; adjustable pitch over approximately 1-1/2 octaves.
Electronic Complement	22 integrated circuits, 24 diodes, 7 transistors.
Controls	Pitch frequency, Decay, Volume, Tic-Toc volume.
Dimensions	4-13/16″ × 10″; (10.6 cm × 25.4 cm).
Weight	3 lbs; (1.37 kg).
Maximum Power Requirement of Clock and Chimes	30-watts.

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

THEORY OF OPERATION

The Electronic Clock Chimes, Model GCA-1195-1, synthesizes a natural, mechanical chime sound and reproduces the Westminister chime melody of the famous "Big Ben" clock in London's Victoria Tower. This melody is taken from a composition by Handel, "I Know My Redeemer Liveth."

Synthesization is the production and control of sound, including music. Therefore, any sound can be synthesized by duplicating the pitch, timbre, and loudness contour. The pitch is the dominant frequency of the sound, the timbre is the time-varying frequency spectrum of the sound, and the loudness contour is the amplitude or modulation envelope of the sound. Synthesis of the chime notes uses this principle.

Each note frequency to be used in chime note synthesis is generated by the note synthesizer and related to the other note frequencies by a $12\sqrt{2}$ multiple. This means there is a constant frequency change between each successive note, just like a piano scale. This note frequency relationship establishes what is known as an even-tempered scale. This entire scale can be adjusted approximately 1-1/2 octaves with the Pitch control to transpose the tune into various musical keys. The pitch of these notes is generated to fall within the range of most clock chimes.

For example, a chime note generated has the pitch or dominant frequency of A5 (880.00 Hz). The timbre is accomplished by properly mixing the fundamental or "strike" frequency of A5 with related note frequencies. These note frequencies are: A6 (1760.00 Hz), the second harmonic; E6 (1318.50 Hz), the quint or major fifth; and C5 (523.25 Hz), an octave below the tierce or minor third. The loudness contour or modulation envelope is the percussive shape of fast attack and immediate exponential decay.

All of the five chime notes used to produce the Westminster Chimes melody are synthesized in this manner, four notes for the melody and one note for the striking hour.

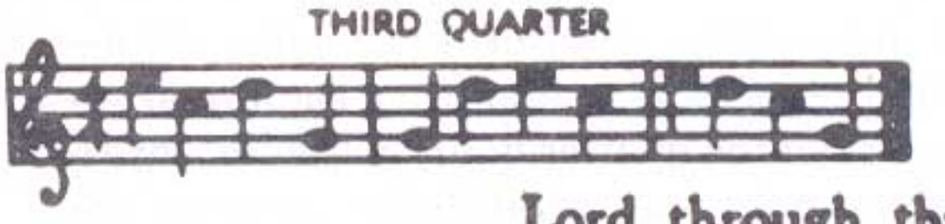
The Westminster Chimes notes produced are shown below in a pitch low enough to fall within the musical staff.

WESTMINSTER CHIMES

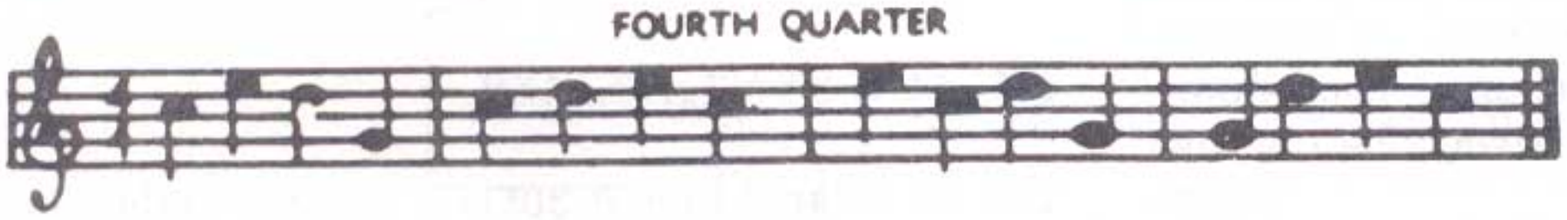
FIRST QUARTER

SECOND QUARTER

THIRD QUARTER



FOURTH QUARTER



Lord through this hour,
Be Thou our guide
So, by Thy power
No foot shall slide

CIRCUIT DESCRIPTION

Refer to the Block Diagram and Schematic Diagram while you read this Circuit Description.

The Electronic Clock Chimes is comprised of eight circuit blocks as shown in the Block Diagram. The Schematic Diagram identifies each block and its associated circuitry.

TEST CIRCUIT

The test circuit is comprised of a transistor switch (Q307) that controls an LED, D328. When a positive voltage is applied to R402, the LED will light. The intensity of the LED is dependent upon the duty cycle of the positive voltage applied to R402. This circuit is used to check the logic levels of the integrated circuits.

VOLTAGE REGULATOR

The voltage regulator regulates the DC voltage from the Electronic Clock's power supply to +11.4 volts. This circuit is comprised of a series-pass regulator, Q301; a zener diode, D301; and two resistors, R301 and R302. Short circuit protection is accomplished by the chosen values of R301 and R302. If the +11.4-volt supply is shorted to ground, Q301 saturates, which keeps the power dissipation within the transistor to a safe limit.

TIME DECODER

The time decoder circuit monitors the displayed time of your Electronic Clock. It identifies each quarter-hour occurrence at the quarter hour, half hour, three-quarter hour, or hour, and controls the program encoder. At 1:00, it presets the hour memory register, IC312, and advances this memory once each hour. Therefore, the striking hour will always be the displayed hour.

Each quarter hour is identified by decoding key segments of the clock display. The even hour can be identified by a positive voltage transition at pins 1 and 2 of IC301A. This positive logic transition, which occurs only on the hour, is speeded up through buffer IC301A and sets the hour flip-flop, IC303A. It also advances the hour memory register, IC312, one count each hour.

Similarly, the half hour is identified by a positive logic transition at pins 5 and 6 of IC301B. This positive logic transition, which occurs only on the half hour, is speeded up through buffer IC301B and sets the half-hour flip-flop, IC303B.

The quarter hour and half hour can be identified by a zero logic transition at pins 2, 3, and 4 of IC302A. This zero logic level occurs only when the minutes displayed are 15 or 45. Zero logic levels on the inputs of IC302A sets only the enabled flip-flop, IC304A or IC304B. IC304A is the quarter-hour flip-flop. It is enabled by flip-flop IC305 A and B only when the hour flip-flop, IC303A, is set. At the same time, IC304B is inhibited. IC304B is the three-quarter hour flip-flop. It is enabled by flip-flop IC305A and B only when the half-hour flip-flop, IC303B, is set. At the same time, IC304A is inhibited.

The output of the appropriate quarter-hour flip-flop is applied to IC302B. IC302B then enables the program encoder for the correct note play.

When the clock's display changes from 12:59 to 1:00, a one-to-zero logic level transition occurs. This transition is differentiated by C301 and R303, inverted by IC311F, and used to preset the hour memory register, IC312, in the program encoder.

The 1 Hz signal from the Electronic Clock is applied to pins 12 and 13 of IC305D. It is buffered by IC305D and used to clock the program encoder and tic-toc synthesizer.

TIC-TOC SYNTHESIZER

The 1Hz signal from IC305D is applied to the tic-toc synthesizer, which is comprised of IC314 and IC315. Also, frequencies one-half chromatic step apart from IC316 are applied to IC315. IC314 and IC315 produce two synchronized pulse bursts one-half chromatic step apart. These two pulse bursts, alternately occurring at a one-second rate, are mixed through R317 and R318 and differentiated by C305 and R319. This signal is then fed to the audio amplifier through R321 to produce the synthesized tic-toc sound.

PROGRAM ENCODER

The program encoder provides rhythm control and sequencing information for the tune and striking hour. Each quarter-hour output of IC302B enables the 5-bit binary counter, IC308 and IC309A, to count the one-second clock pulses. This 5-bit binary count sequences a circulating logic level to enable the chimes synthesizer to key the appropriate circuit for the proper notes to be played. IC308 and IC309A control two 4-to-16 line decoders, IC306 and IC307, which act as a 5-bit to 32-position selector. The positions enabled by IC306 and IC307 control the rhythm and length of play for each tune.

NOTE FREQUENCY SYNTHESIZER

Audio frequencies of the Chimes are generated by an oscillator-controlled octave generator (IC311A, IC311B, and IC316) that produces sixth-octave frequencies. Lower octave frequencies are produced by dividing the outputs of IC316 with frequency dividers IC317, IC318A and IC318B, IC309B, IC319A and IC319B, and IC321A and IC321B.

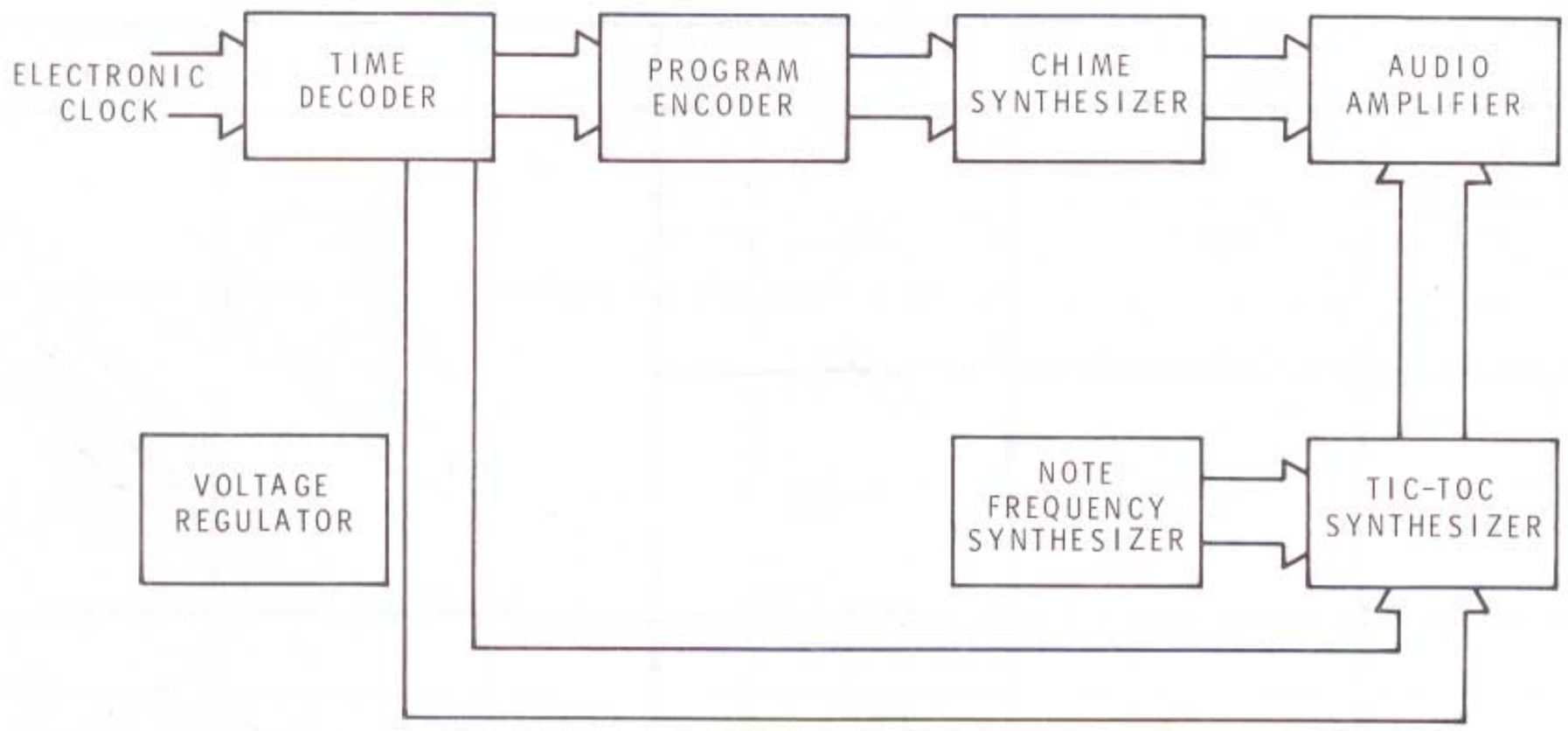
The pitch and timbre of each note is generated with four frequencies; a fundamental frequency, its second harmonic, the quint (or major fifth) above the fundamental frequency, and the tierce (or minor third) below the fundamental frequency. The five chime notes played are derived from mixing the appropriate four audio frequencies in the chimes synthesizer.

CHIMES SYNTHESIZER

Each of the five composite note signals produced by the note frequency synthesizer is applied to IC322A, IC322B, IC322C, and IC322D or IC322E. Keying circuits, Q302 through Q306 respectively, produce a voltage-controlled envelope that is also applied to voltage-controlled amplifier IC322A, IC322B, IC322C, and IC322D, or IC322E. IC322 modulates the signals from the note frequency synthesizer with the voltage-controlled envelope and applies this signal to IC323. IC323 and its circuitry provide the final voicing that is necessary to produce the mechanical chimes effect.

AUDIO AMPLIFIER

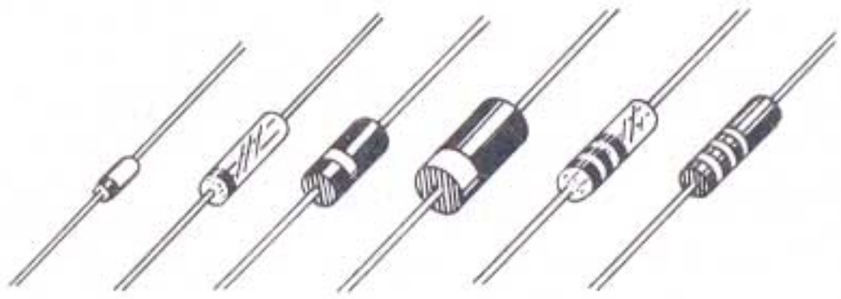
IC324 is an audio amplifier module that provides the final amplification of the Electronic Clock Chimes.



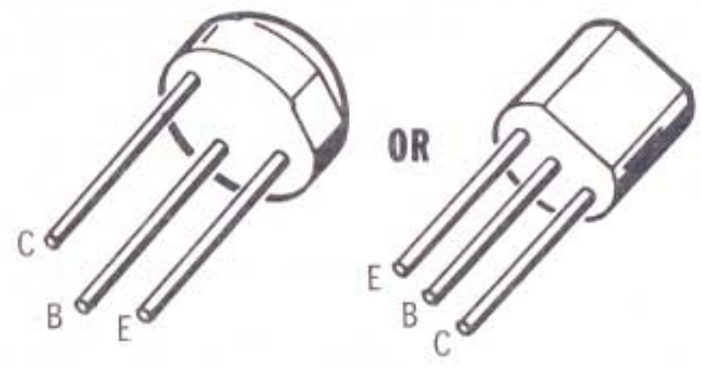
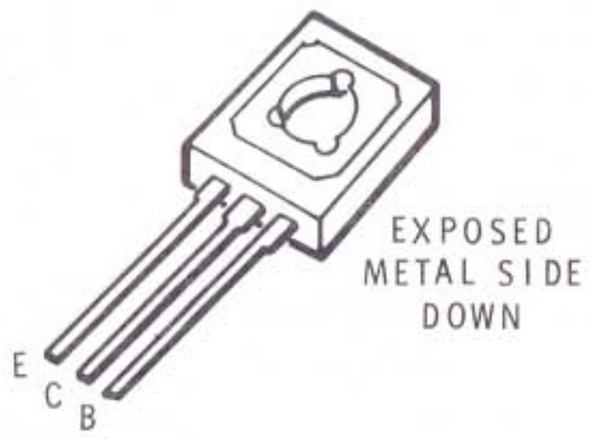
BLOCK DIAGRAM

SEMICONDUCTOR IDENTIFICATION CHARTS

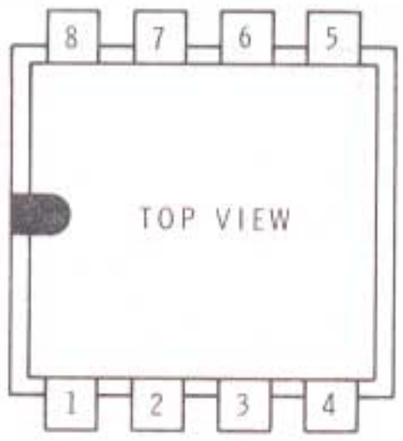
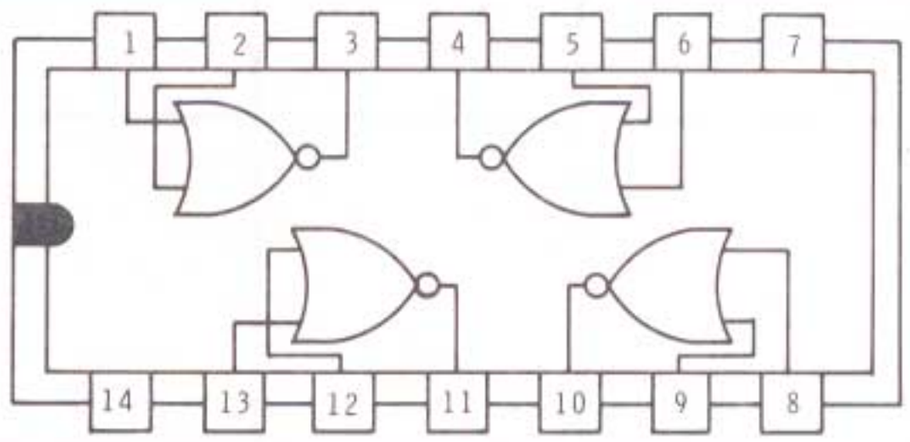
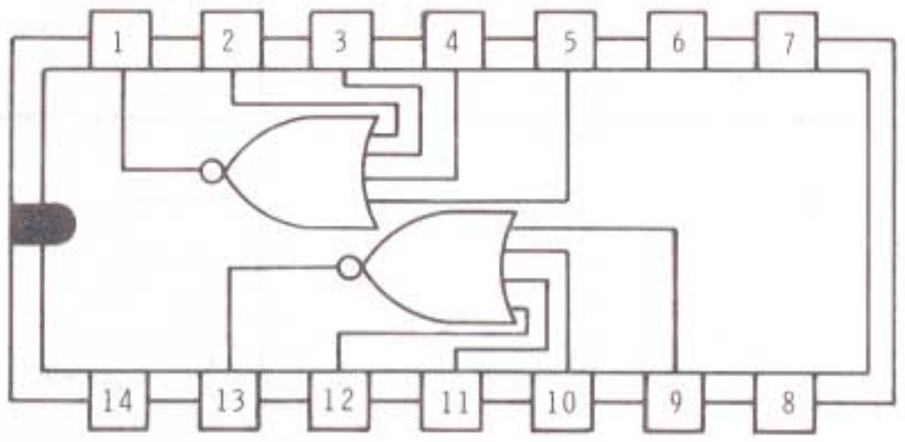
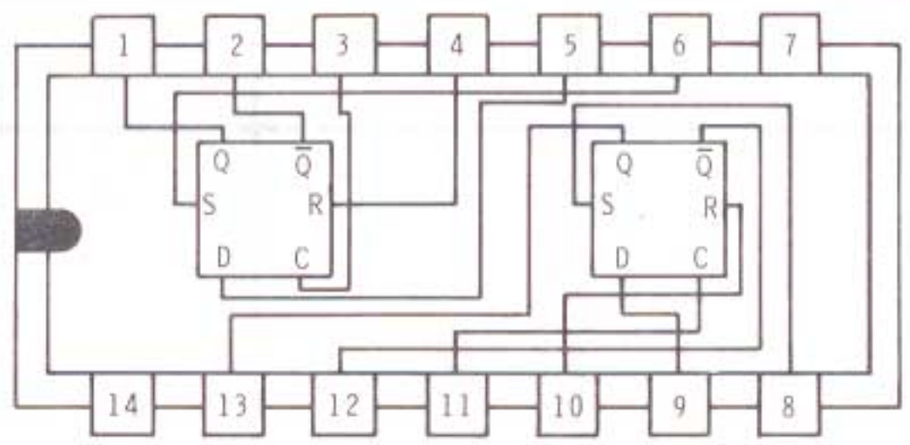
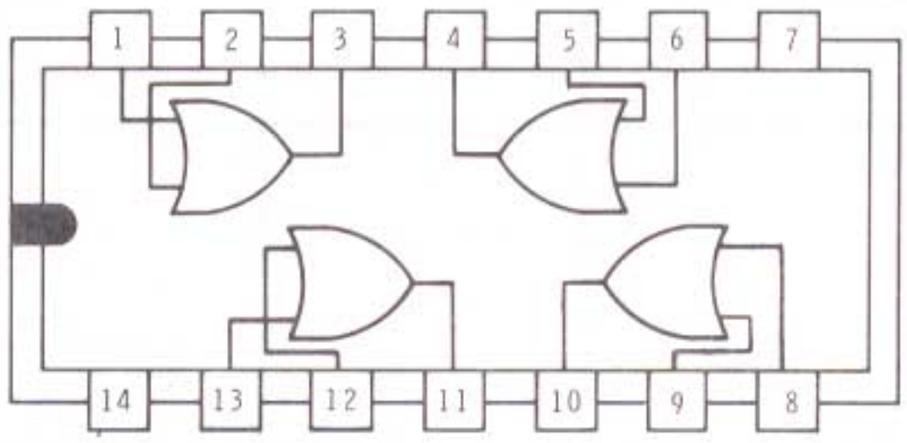
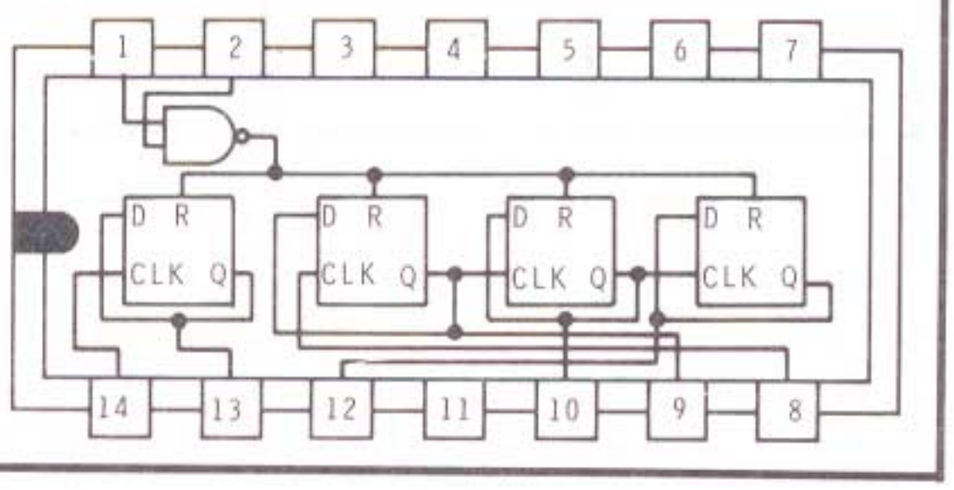
DIODES

SCHEMATIC REFERENCE NUMBER	HEATH PART NUMBER	MANUFACTURER'S NUMBER	IDENTIFICATION DRAWING
ZD301	56-90	IN4742A	**NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES.**
D302, D303, D304, D305, D306, D307, D308, D309, D311, D312, D313, D314, D315, D316, D317, D318, D319, D321, D322, D323, D324, D325, D326, D327	56-56	IN4149	

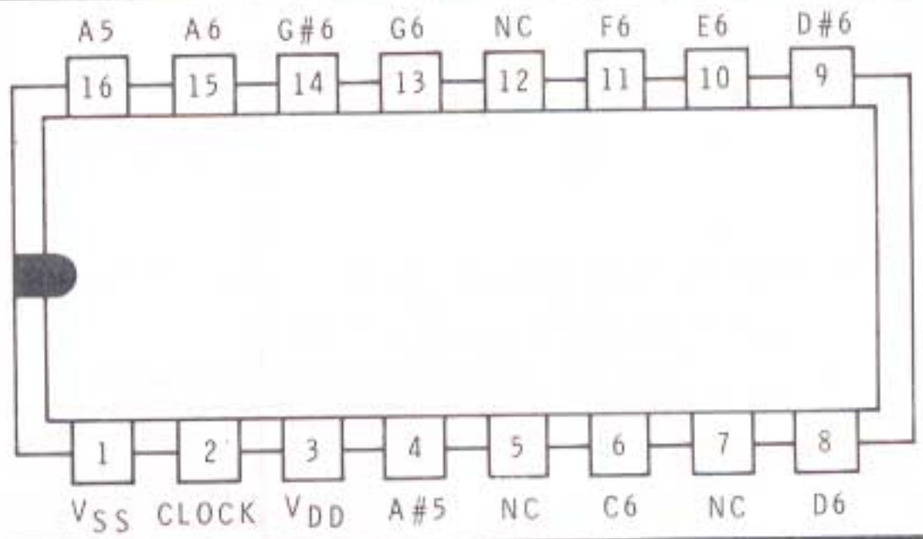
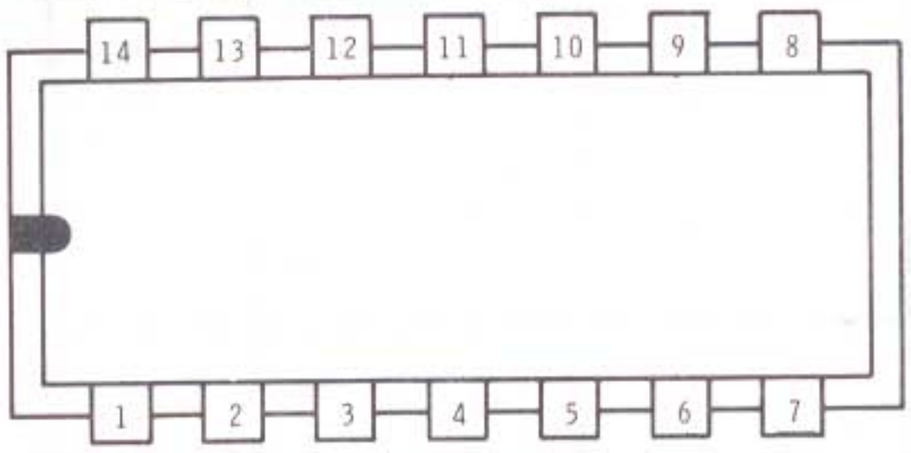
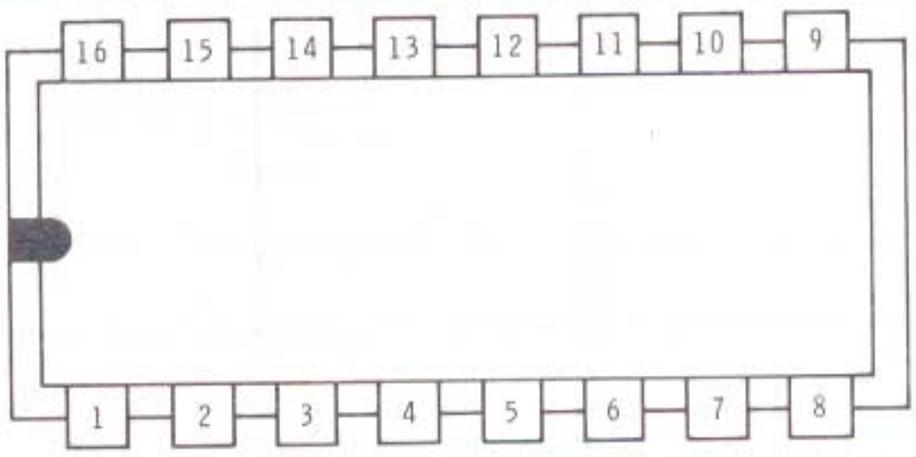
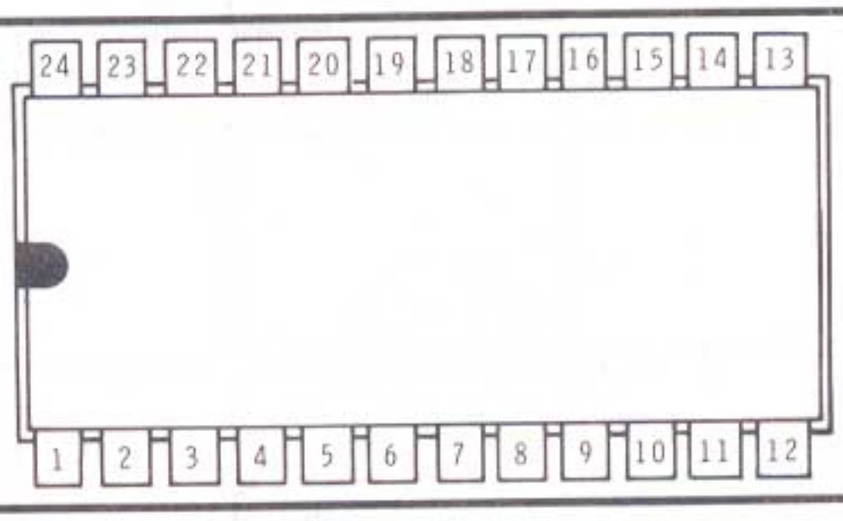
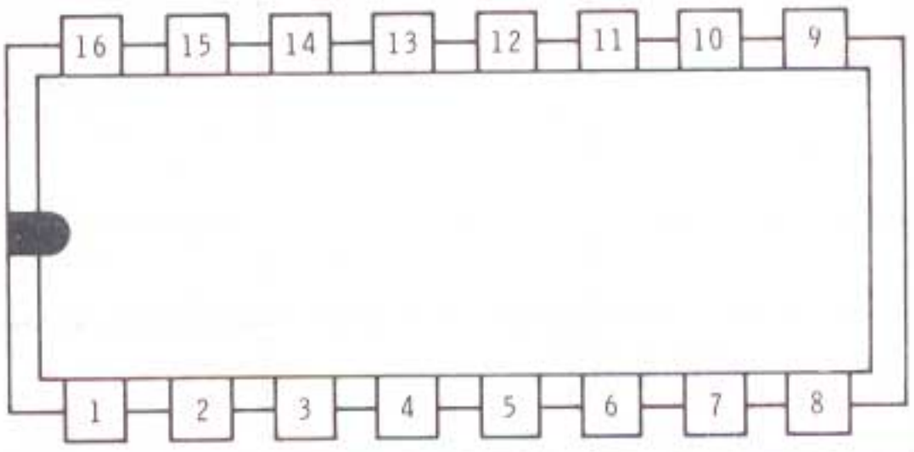
TRANSISTOR LEAD IDENTIFICATION

SCHEMATIC REFERENCE NUMBER	HEATH PART NUMBER	MANUFACTURER'S NUMBER	LEAD IDENTIFICATION
Q302, Q303, Q304, Q305, Q306	417-235	2N4121	
Q307	417-881	MPS-A13	
Q301	417-818	MJE181	

INTEGRATED CIRCUITS

SCHEMATIC REFERENCE NUMBER	HEATH PART NUMBER	MANUFACTURER'S NUMBER	PIN IDENTIFICATION
IC323	442-22	N5741V	
IC305, IC315	443-703	MC14001 CD4001	
IC302	443-704	MC14002 CD4002	
IC303, IC304, IC309, IC314, IC318, IC319, IC321	443-607	MC14013 CD4013 F34013	
IC301	443-706	MC14071	
IC317	443-709	MM74C93	

Integrated Circuits (cont'd.)

SCHEMATIC REFERENCE NUMBER	HEATH PART NUMBER	MANUFACTURER'S NUMBER	PIN IDENTIFICATION
IC316	443-710	MK50240	
IC324	442-610	TBA820	
IC311, IC322	443-701	MC14049, CD4049	
IC306, IC307	443-707	MC14515	
IC308, IC312, IC313	443-708	MC14516, CD4516	

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