

Heathkit[®] Manual

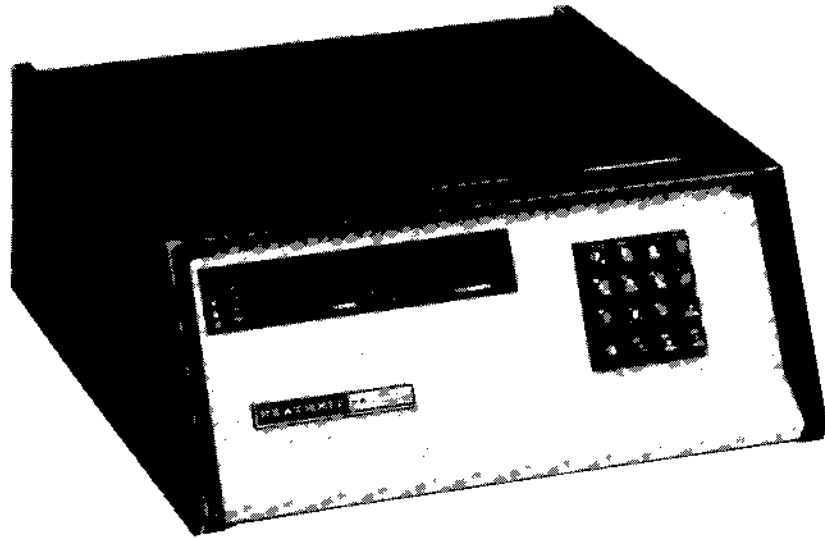
for the

DIGITAL COMPUTER

Model H8

ASSEMBLY

595-2013-02



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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UNPACKING

Your Digital Computer shipping carton contains a box marked "CPU Circuit Board" and a smaller box marked "Pack #2." After you remove these two boxes, the remaining parts in the shipping carton form the Main Pack, which are items too large to fit into the other parts packs and those items which you will use in the chassis assembly section.

- () Set aside the boxes marked "CPU Circuit Board" and "Pack #2" until one of these packs is called for in an assembly section. DO NOT disturb either of these packs yet.

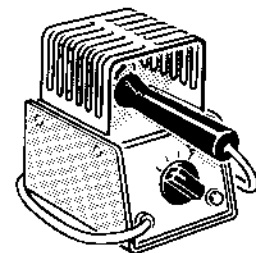
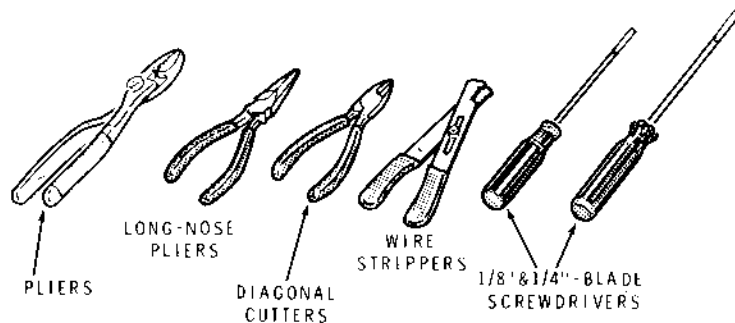
Each assembly section of this Manual contains its own "Parts List" and "Step-by-Step Assembly" instructions. At the beginning of each Parts List, you will be instructed which parts pack to locate and unpack. You may also be directed to locate certain required parts from the Main Pack.

To avoid intermixing parts, do not remove or open any of the parts packs until you are directed to do so at the beginning of one of the "Parts Lists." Return any part that is packed in an individual envelope, with the part number on it, back in its envelope after you identify it until that part is called for in a step. Some envelopes have one transparent side so you can identify the parts inside without opening the envelope.

ASSEMBLY NOTES

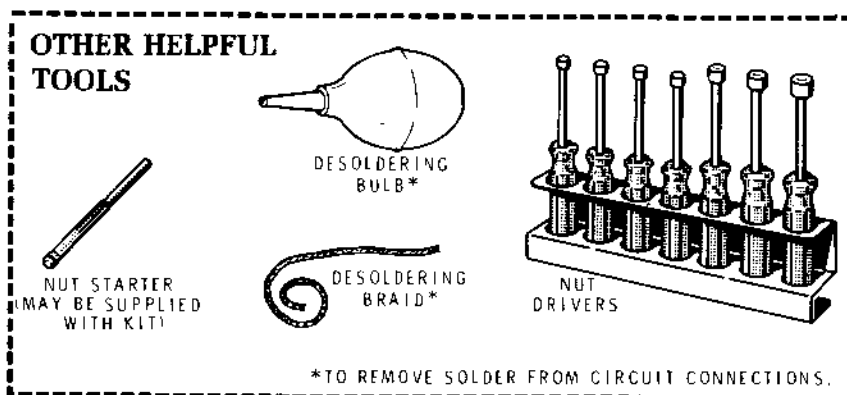
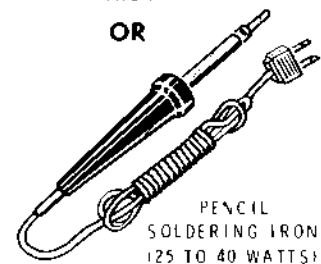
TOOLS

You will need these tools to assemble your kit.



HEATHKIT
SOLDERING
IRON

OR



ASSEMBLY

1. Follow the instructions carefully and read the entire step before you perform the operation.
2. 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.
3. 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.
4. Position all parts as shown in the Pictorials.
5. 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 excess lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

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

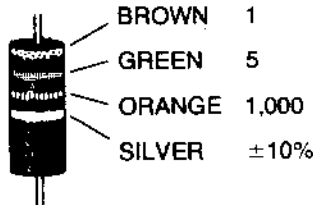
It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A 25 to 40-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.
2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

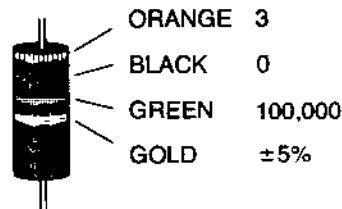
PARTS

Resistors will be called out by their resistance value in Ω (ohms), $k\Omega$ (kilohms), or $M\Omega$ (megohms). Certain types of resistors will have the value printed on the body, while others will be identified by a color code. The colors of the bands and the value will be given in the steps, therefore the following color code is given for information only.

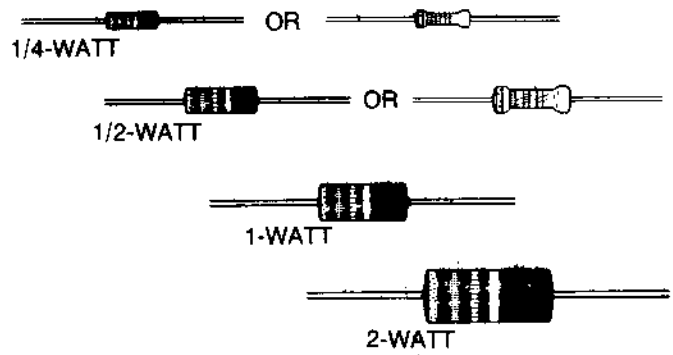
EXAMPLES:



$15 \times 1,000 = 15,000 \Omega$ (15,000 OHMS),
or "15 $k\Omega$ "



$30 \times 100,000 = 3,000,000 \Omega$ (or 3 $M\Omega$)
3 $M\Omega = 3$ MEGOHMS



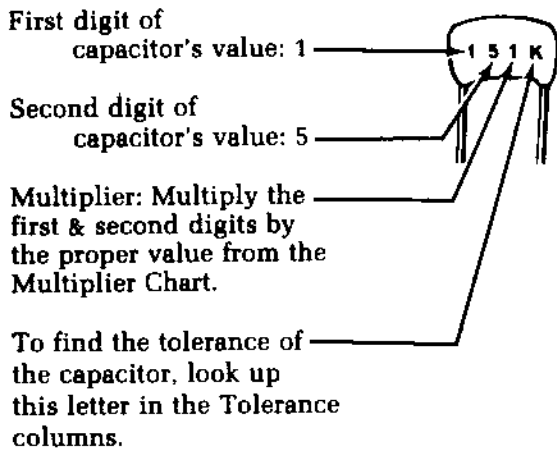
COLOR	1st DIGIT	2nd DIGIT	MULTIPLY BY
BLACK	0	0	1
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
VIOLET	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	1,000,000,000
GOLD			.1
SILVER			.01

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 or μF).



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

*DuPont Registered Trademark



CHASSIS ASSEMBLY

PARTS LIST

- () Locate and remove all of the parts from the main pack (parts left in the shipping carton). Be sure you have removed the items from the carton as directed in the "Unpacking" section.
- () Unpack these parts and check each part against the following list. The key numbers correspond to the numbers on the "Chassis Parts Pictorial" (Illustration Booklet, Page 1). Set aside any re-

maining parts not called for in this Parts List. They will be called for later.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If one is not available, see "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

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

ELECTRONIC COMPONENTS

NOTE: The following resistors have a tolerance of 10% unless otherwise noted. 10% is indicated by a fourth color band of silver.

A1	1-20	1	10 k Ω , 1/2-watt (brown-black-orange) resistor	R2
A2	1-42-2	1	150 Ω , 2-watt (brown-green-brown) resistor	R1
A3	21-71	1	.001 μ F (1000 pF) ceramic capacitor	C1
A4	25-842	1	77,000 μ F electrolytic capacitor	C2
A5	25-843	2	2200 μ F electrolytic capacitor	C3, C4
A6	57-27	4	1N2071 diode	D3, D4, D5, D6
A7	100-1708	1	Diode assembly	D1/D2
A8	54-940	1	Power transformer	T1
A9	60-54	1	120/240 slide switch	SW2
A10	60-808	1	NOR/LOW slide switch	SW3
A11	60-619	1	Rocker switch	SW1
A12	401-163	1	Speaker	SP1
A13	421-23	1	1-ampere, slow-blow fuse	F1

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

HARDWARE

Hardware packets are marked to show the size of the hardware they contain (HDW #4, or, HDW #2, & #6, etc.). You may have to open more than one packet — in this pack — to locate all of the hardware of any one (#6, for example) size.

#6 Hardware

B1	250-56	41	6-32 \times 1/4" screw
B2	250-305	6	6-32 \times 1/4" hex stud
B3	250-89	10	6-32 \times 3/8" screw
B4	251-8	2	6-32 spade bolt
B5	252-3	6	6-32 nut
B6	252-22	4	6-32 Speed Nut*
B7	252-80	2	6-32 cap nut
B8	252-195	20	6-32 self-retaining nut
B9	253-60	2	#6 flat washer
B10	254-1	21	#6 lockwasher
B11	255-79	3	6-32 shoulder spacer
B12	259-1	2	#6 solder lug

*Registered Trademark, Tinnerman Co.



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

Hardware (cont'd.)

#8 Hardware

C1	250-98	6	8-32 x 1/2" screw
C2	252-4	6	8-32 nut
C3	252-706	4	8-32 lock nut
C4	253-45	4	#8 flat washer
C5	254-2	6	#8 lockwasher

Other Hardware

D1	250-1256	2	10-32 x 1/4" screw
D2	254-3	2	#10 lockwasher
D3	259-26	4	#10 solder lug
D4	252-708	2	5/32" nut
D5	259-22	1	Spade lug
D6	253-8	1	Brass flat washer

SHEET METAL PARTS

E1	200-1296-1	1	Chassis
E2	203-1891-1	1	Top cover
E3	203-1892-1	1	Front panel
E4	204-2265	2	Circuit board mounting bracket
E5	204-2267-1	1	Cable clamp
E6	204-2292	1	Tie bracket
E7	206-1249	1	AC shield
E8	206-1250	1	Capacitor shield
E9	207-98	1	Capacitor mounting strap
E10	207-622	1	Circuit board support clamp

WIRE

344-7	1'6"	Large black wire
344-33	2'	Medium black wire
344-111	6'3"	Orange wire
344-118	1'3"	Large red wire
344-120	2'6"	Small black wire
344-121	4'	White wire
346-35	8"	Stepping
347-55	7'6"	8-wire cable
89-54	1	Line cord

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

PRINTED MATERIAL

F1	390-1357	1	Model label
	390-1415	1	Instruction card
F2	390-926	1	Warning label
F3	391-34	1	Blue and white label
F4	391-611	1	Nameplate
F5	390-1371	1	Keyboard label set
	597-260	1	Parts Order Form
	597-1656	1	Heath User's Group (HUG) Application
	597-1659	1	HUG return envelope
		1	Assembly Manual (See Page 1 for part number.)
		1	Operation Manual (See Page 1 for part number.)
		1	Software Manual (See Page 1 for part number.)

MISCELLANEOUS

G1	354-7	2	Large cable tie
G2	73-3	1	Rubber grommet
G3	261-20	4	Rubber foot
G4	352-31	1	Thermal compound*
G5	423-11	1	Fuseholder
G6	434-148	1	AC socket
G7	432-946	20	25-pin plug
G8	75-736	1	Strain relief
G9	432-120	2	PCB connector
G10	73-39	18"	Foam tape
G11	490-5	1	Nut starter
G12	490-111	1	IC lifter
G13	490-185	1	Package of Soder Wick**
	203-1879	1	Set of side panels containing:
G14	203-1877	1	Right side panel
G15	203-1878	1	Left side panel
G16	446-683	1	Window
G17	354-5	1	Small cable tie
	85-1936-1	1	Mother circuit board
	701-29	1	3-ring binder
	703-16	1	Set of 5 tabs (for binder)
	880-63	1	System software cassette tape (Assembler, Editor, Basic, Debug)

Solder

*Dow Corning thermal heat sink compound contains Zinc Oxides, SiO₂, and slight traces of CO₂.

**Registered Trademark, Solder Removal Company



STEP-BY-STEP ASSEMBLY

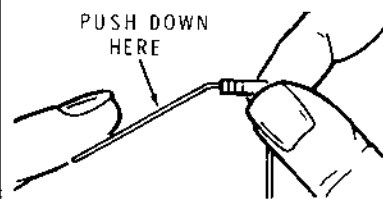
MOTHER CIRCUIT BOARD
ASSEMBLY

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.

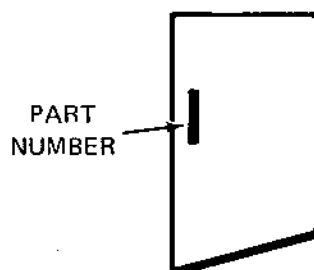
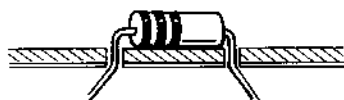
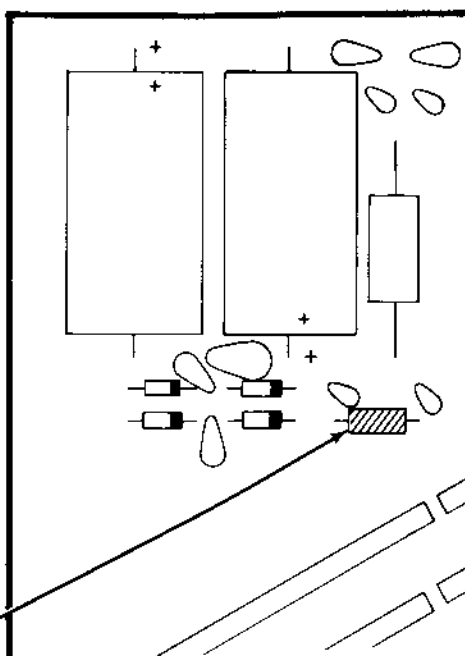
- (✓) Position the mother circuit board as shown in the identification drawing with the printed side (not the foil side) up.

- (✓) R2: Hold a 10 k Ω (brown-black-orange) resistor by the body as shown and bend the leads straight down.



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

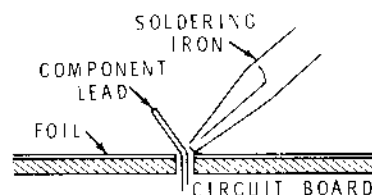
- (✓) Press the resistor against the circuit board. Then bend the leads outward slightly to hold the resistor in place.

IDENTIFICATION
DRAWING

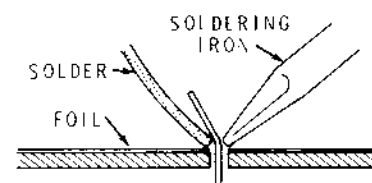
CONTINUE

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

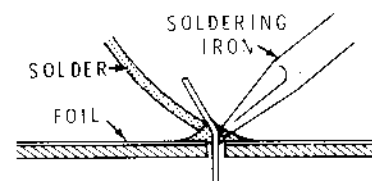
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat both for two or three seconds.



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.

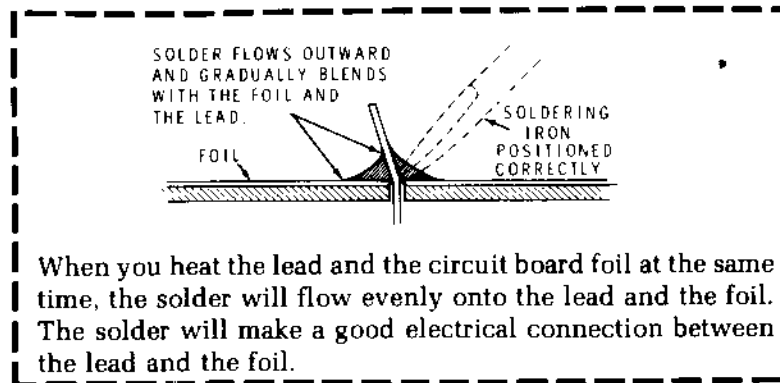


- (✓) Cut off the excess lead lengths close to the connection. WARNING: Clip the leads so the ends will not fly toward your eyes.

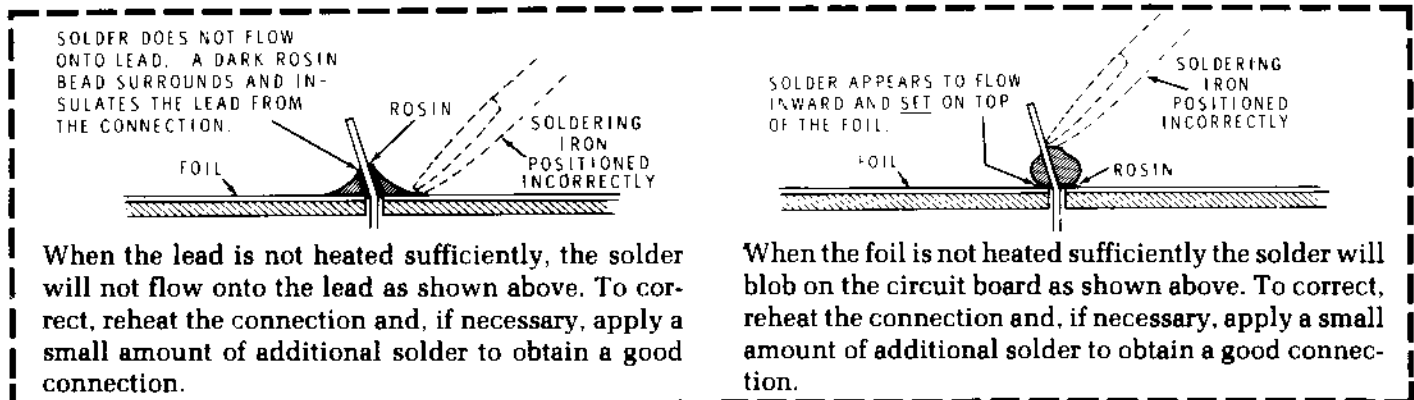
- (✓) Check the connection. Compare it to the illustrations on Page 10. After you have checked the solder connections, proceed with the assembly on Page 11. Use the same soldering procedure for each connection.

PICTORIAL 1-1

A GOOD SOLDER CONNECTION



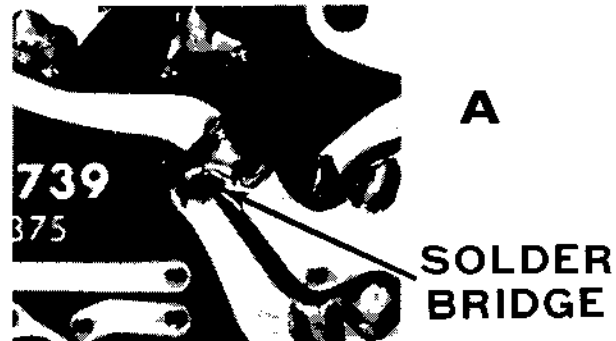
POOR SOLDER CONNECTIONS



SOLDER BRIDGES

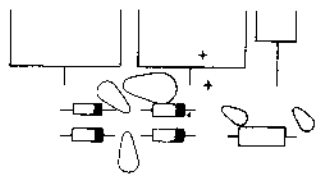
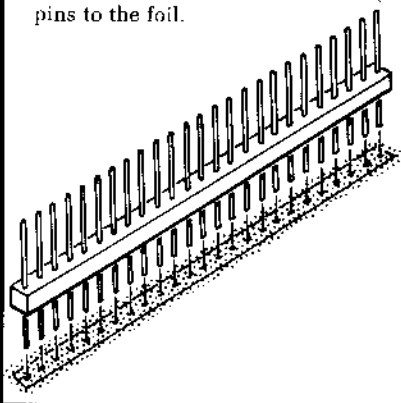
A solder bridge between two adjacent foils is shown in photograph A. Photograph B shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils 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 each circuit board has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.



START →

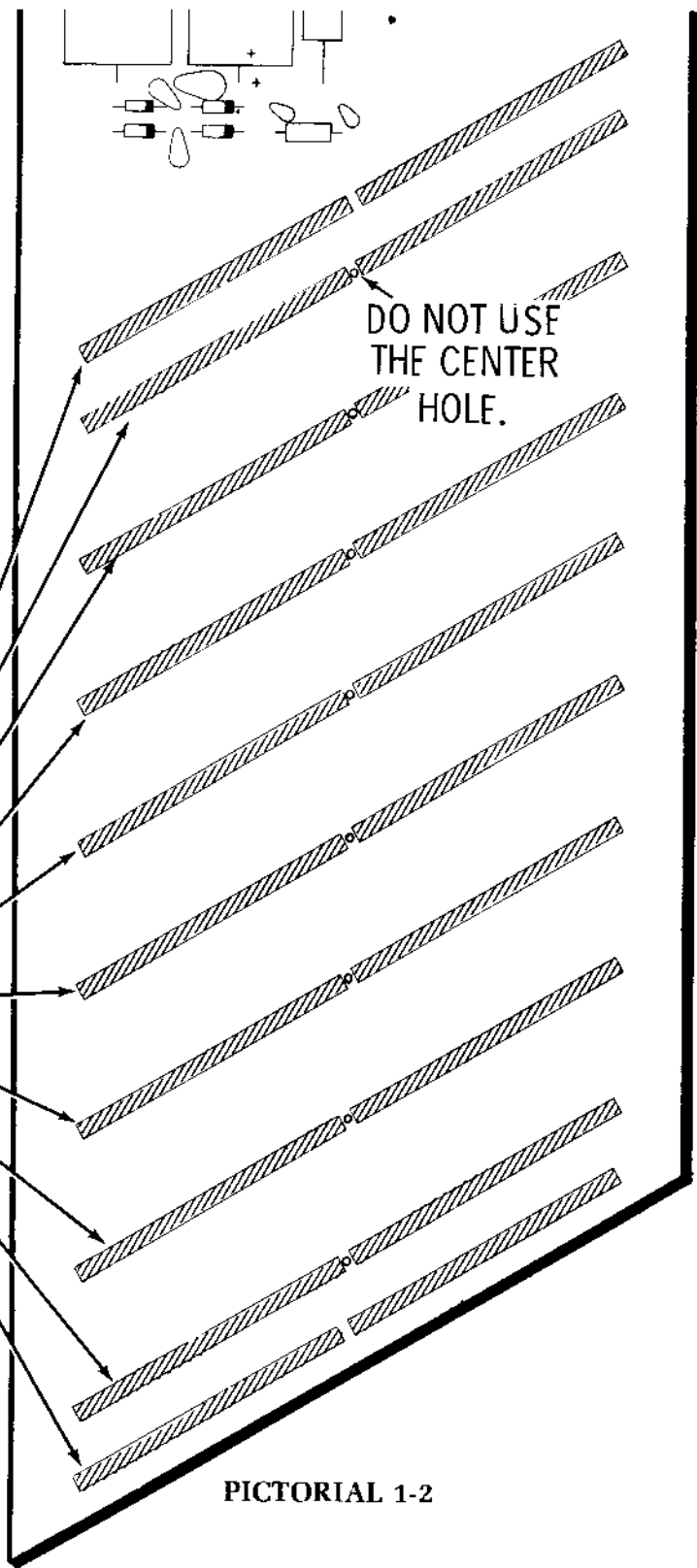
NOTE: When you install a 25-pin plug in the following steps, first insert the short pins into the circuit board holes. Then push the plug down tight against the circuit board. Turn the circuit board over and solder one pin on each end of the plug to the foil. Check the plug to make sure it is still tight against the circuit board. Then solder the remaining pins to the foil.



Install **two** 25-pin plugs at each of the following locations:

- P10.
- P9.
- P8.
- P7.
- P6.
- P5.
- P4.
- P3.
- P2.
- P1.

Visually check each plug for solder bridges.



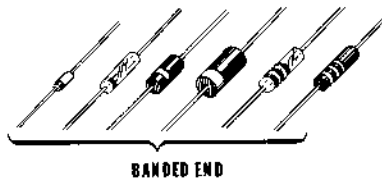
PICTORIAL 1-2

START ↘

NOTE: Make sure you have installed the resistor in Pictorial 1-1.

(✓) R1: 150 Ω, 2-watt (brown-green-brown). Form the resistor leads as necessary to fit the circuit board holes.

NOTE: When you install a diode, position its banded end as shown in the Pictorial. A circuit will not operate properly if the diode is installed backward.



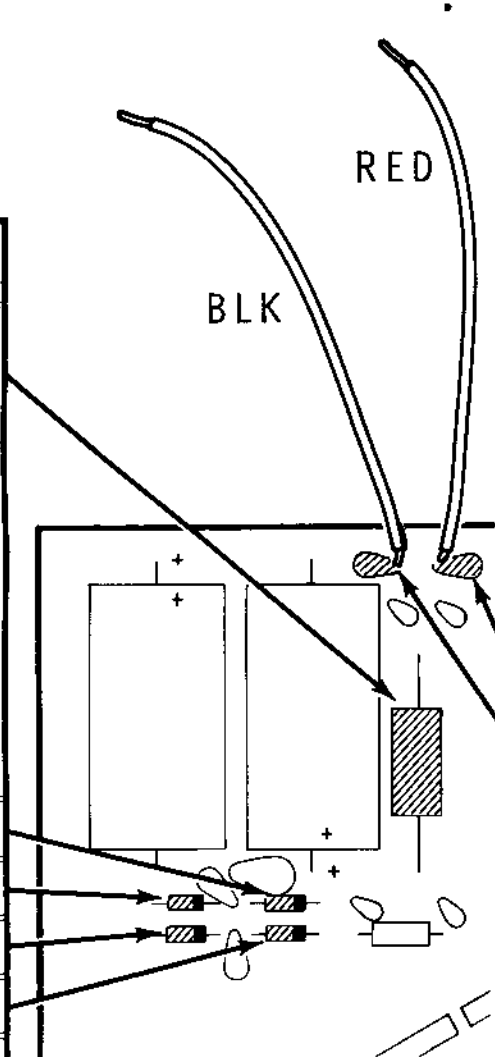
() D3: 1N2071 diode (#57-27).

(✓) D6: 1N2071 diode (#57-27).

(✓) D5: 1N2071 diode (#57-27).

(✓) D4: 1N2071 diode (#57-27).

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



PICTORIAL 1-3

CONTINUE ↘

NOTE: As you wire this kit, you will be instructed to prepare lengths of wire ahead of time, as in the following step. To prepare a wire, cut it to the indicated length and remove 1/4" of insulation from each end. Then melt a small amount of solder on the bare wire ends to hold the small strands of wire together.

() Prepare the following wires:

11" large red

11" large black

Install the prepared wires in the following steps. Solder each wire to the foil as you install it and cut off the excess wire end. The other end of the wire will be connected later.

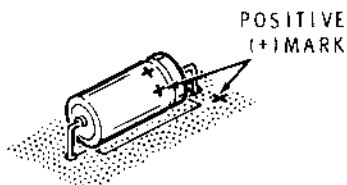
(✓) 11" red.

() 11" black.



START

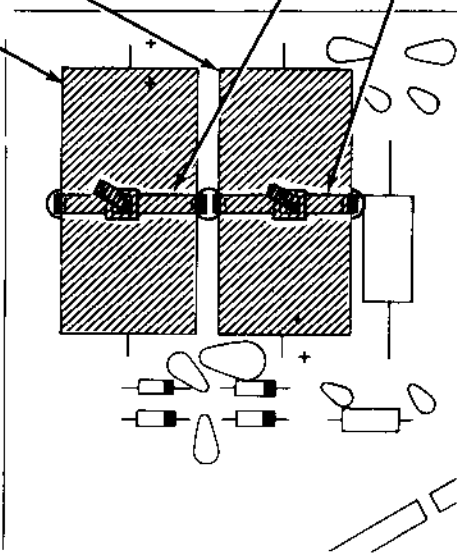
NOTE: When you install an electrolytic capacitor, always position the plus (+) marked end of the capacitor toward the plus mark on the circuit board.



(✓) C3: 2200 μ F electrolytic capacitor.

(✓) C4: 2200 μ F electrolytic capacitor.

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

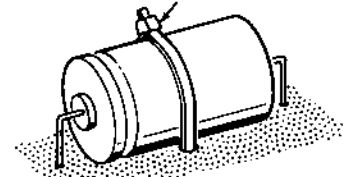


PICTORIAL 1-4

CONTINUE

() Thread a large cable tie through the holes in the circuit board and around capacitor C4. Make sure the rough side of the cable tie is toward the capacitors. Then pull the cable tie tight and cut off the excess length.

CABLE TIE



() In the same manner, install a large cable tie around capacitor C3.

(✓) Use an ohmmeter to check for unwanted shorts between each adjacent pin at any of the 50-pin plugs (two 25-pin plugs). NOTE: Pins 0 and 1, and pins 48 and 49 are connected together; these should show up as shorts.

CIRCUIT BOARD CHECKOUT

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

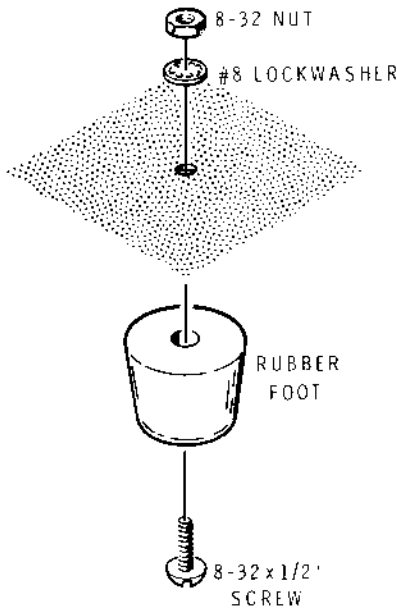
- () Unsoldered connections.
- (✓) Poor solder connections.
- (✓) Solder bridges between foil patterns.
- (✓) Protruding leads which could touch together or the chassis when the circuit board is installed later.

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

- (✓) Electrolytic capacitors for the correct position of the positive (+) mark.
- (✓) Diodes for the correct orientation.

Set the circuit board aside until it is called for in a step.

FINISH



Detail 2-1A

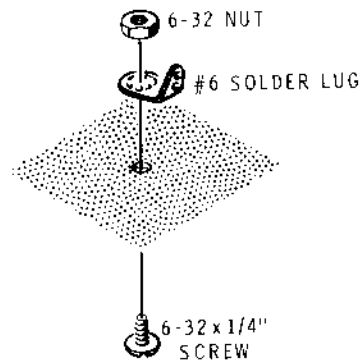
CHASSIS

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

- (✓) Position the chassis as shown in the Pictorial.

NOTE: When a step calls for hardware, only the screw size is given. For instance, if "6-32 x 3/8" hardware" is called for, it means you should use a 6-32 x 3/8" screw, one or more lockwashers, and a 6-32 nut at each mounting hole. The detail referred to in the step shows the proper number and placement of lockwashers.

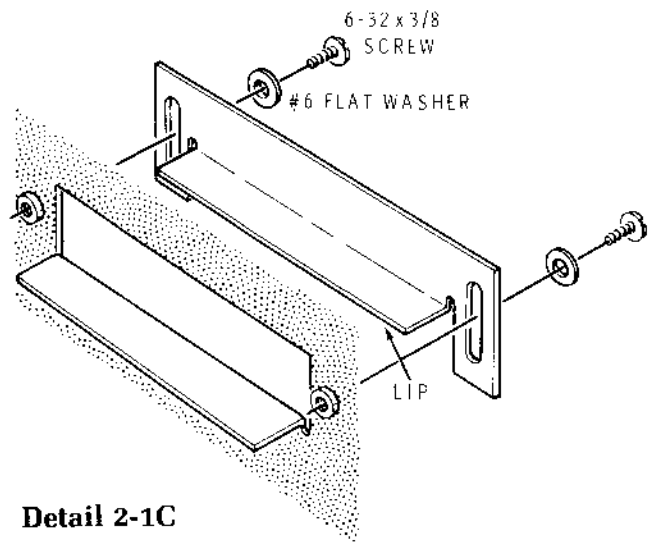
- (✓) Refer to Detail 2-1A and mount a rubber foot on the bottom of the chassis at AA. Use 8-32 x 1/2" hardware.
- (✓) Similarly, mount rubber feet on the bottom of the chassis at AB, AC, and AD. Use 8-32 x 1/2" hardware.
- (✓) Scrape or sand any excess paint from around holes AE and AF on the inside of the chassis.



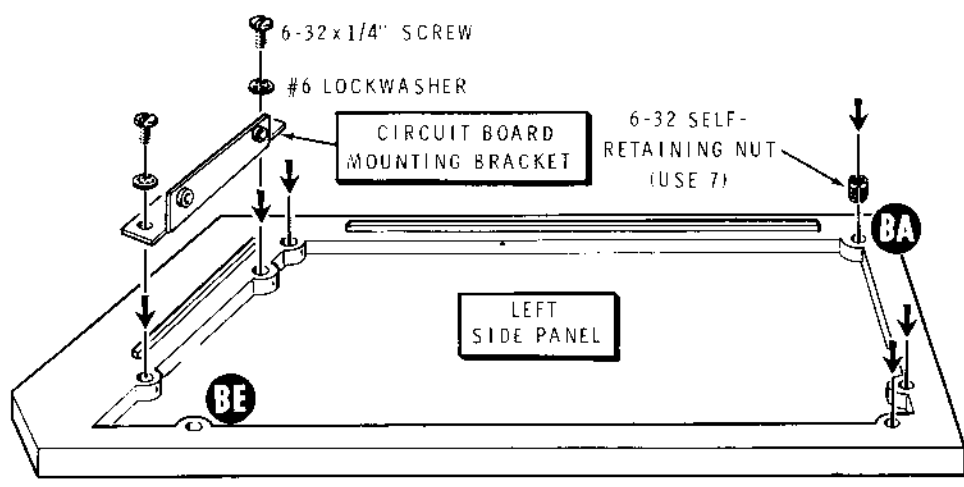
Detail 2-1B

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

- (✓) Refer to Detail 2-1B and mount a #6 solder lug at AE. Use 6-32 x 1/4" hardware and be sure to position the solder lug as shown in the Pictorial.
- (✓) Similarly, mount a #6 solder lug at AF with 6-32 x 1/4" hardware.
- (✓) Refer to Detail 2-1C and mount the cable clamp on the rear of the chassis at AG. Use two 6-32 x 3/8" screws and two #6 flat washers. Be sure to position the lip on the clamp as shown. Slide the clamp down as far as possible before you tighten the screws.



Detail 2-1C



Detail 2-1D

(✓) Locate the left side panel and position it on your work surface as shown in Detail 2-1D. Place the panel on a soft cloth to prevent it from being scratched when you perform the following steps.

() Refer again to Detail 2-1D and install a 6-32 self-retaining nut at BA as follows:

1. Start the split (slotted) end of the nut into the hole in the panel.
2. Use the handle of a nut starter (or screwdriver) to push the nut all the way into the panel.
3. Turn a 6-32 x 1/4" screw all the way into the nut. Then remove the screw and set it aside. This seats the nut in the panel and makes it easier to reinstall the screw later.

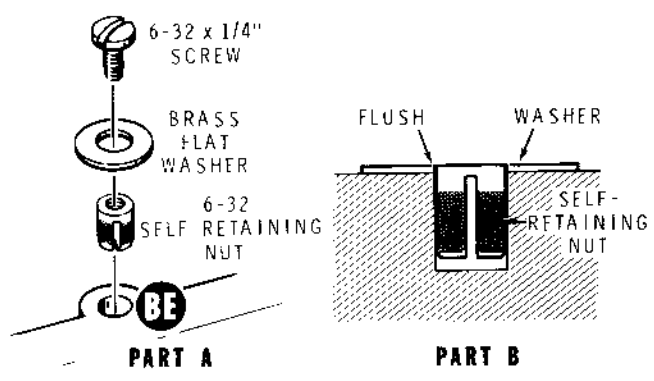
(✓) Similarly, install 6-32 self-retaining nuts in five of the remaining holes in the side panel (marked with arrows). Do not install a nut at BE at this time.

(✓) Refer again to Detail 2-1D and mount a circuit board mounting bracket to the left side panel. Use two 6-32 x 1/4" screws and two #6 lockwashers. Be sure to position the bracket as shown.

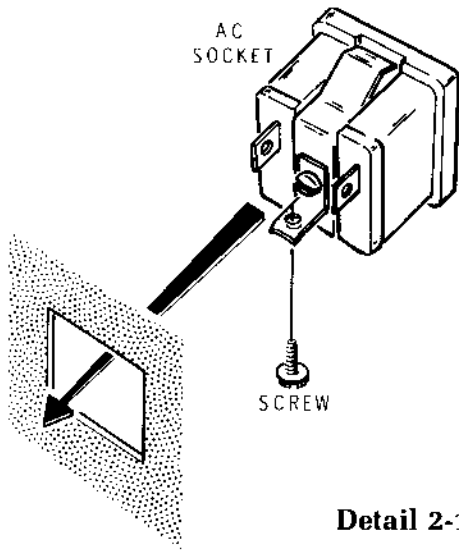
(✓) Refer to Detail 2-1E and install a 6-32 self-retaining nut at BE as follows:

1. Start the split (slotted) end of the nut into the hole in the panel.
2. Place the brass flat washer over the end of the self-retaining nut.
3. Use the handle of a nut starter (or screwdriver) to push the nut into the panel until the top of the nut is flush with the flat washer.
4. Turn a 6-32 x 1/4" screw all the way into the nut. Then remove the screw and flat washer and set them aside.

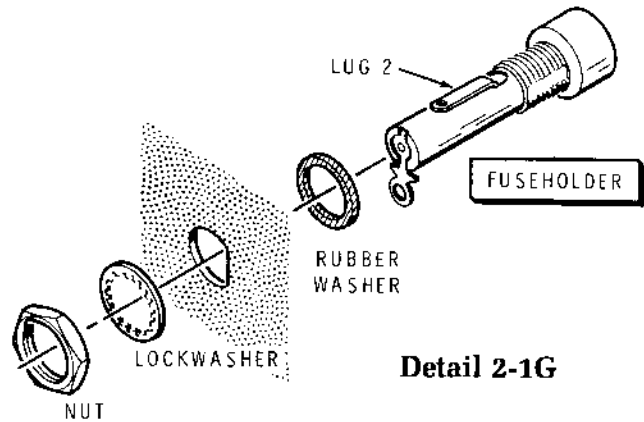
(✓) Mount the left side panel to the chassis at BB, BC, BD, and BE as shown in the Pictorial. Use four 6-32 x 1/4" screws and four #6 lockwashers.



Detail 2-1E



Detail 2-1F



Detail 2-1G

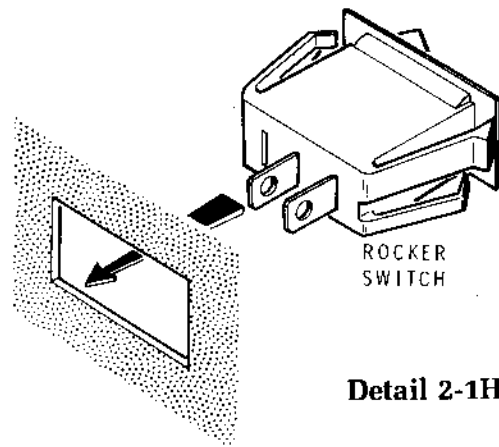
(✓) S1: Refer to Detail 2-1F and remove (and discard) the screw from an AC socket. Then install the socket at S1 in the rear of the chassis. Be sure to position the socket as shown in the Pictorial. Push the socket into the chassis hole until it locks in place.

(✓) F1: Remove the fuseholder cap by twisting it counterclockwise with a screwdriver. Then install a 1-ampere, slow-blow fuse and replace the cap. Do not overtighten the cap.

(✓) SW1: Refer to Detail 2-1H and install the rocker switch at SW1 in the chassis. Be sure to install the switch so the lugs are **away** from the left side panel. Push the switch into the chassis hole until it locks in place.

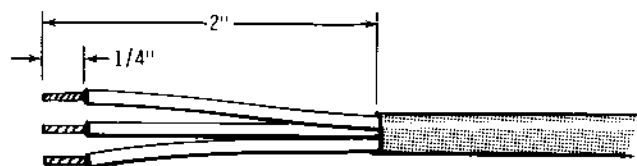
(✓) Refer to Detail 2-1G and mount the fuseholder at F1. Use the hardware supplied with the fuseholder. Position the fuseholder as shown in the Pictorial and do not overtighten the nut.

(✓) Carefully bend lug 2 of the fuseholder away from the fuseholder body as shown in the Pictorial.



Detail 2-1H





Detail 2-2A

Refer to Pictorial 2-2 (Illustration Booklet, Page 4) for the following steps.

(✓) Refer to Detail 2-2A and prepare the line cord as follows:

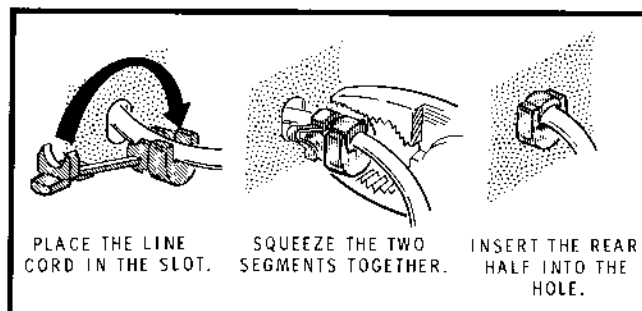
1. Remove the outer insulation of the line cord for 2".
2. Twist together the fine wire strands at the end of each lead. Then melt a small amount of solder to the end of each lead to hold the strands together.

NOTES:

1. When you are directed to "make a mechanically secure connection," as in the following steps, refer to the inset drawing on the Pictorial.
2. In the following steps, (NS) means not to solder because other wires will be added later. "S-" with a number following it, such as (S-3), means to solder the connection. The number following the "S-" tells you how many wires are at the connection.

(✓) Route the end of the line cord through hole AJ in the chassis. Then connect the green line cord lead to solder lug AE (S-1). Make a mechanically secure connection.

(✓) Connect the black line cord lead to AC socket S1 lug 1 (NS). Make a mechanically secure connection.



Detail 2-2B

(✓) Connect the white line cord lead to AC socket S1 lug 2 (NS). Make a mechanically secure connection.

(✓) Install the strain relief on the line cord at AJ as shown in Detail 2-2B.

(✓) C1: Cut both leads of a .001 μ F (1000 pF) ceramic capacitor to 1/2". Then connect the capacitor between AC socket S1 lugs 1 (NS) and 2 (NS). Make mechanically secure connections.

NOTE: When wiring this kit, you will be directed to prepare the wires ahead of time, as in the following step. To prepare a wire, cut it to the indicated length and remove 1/4" of insulation from each end. Then melt a small amount of solder on the bare wire ends to hold the fine wire strands together, if not already done. The wires are listed in the order in which you will use them.

() Prepare the following medium black wires:

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

NOTE: Make mechanically secure connections when you connect the prepared wires in the next three steps.

(✓) Connect the 2-1/2" wire from solder lug AF (S-1) to AC socket S1 lug 3 (S-1).

(✓) Connect the 1-3/4" wire from AC socket S1 lug 1 (S-3) to fuseholder F1 lug 1 (S-1).

(✓) Connect the 1-1/2" wire from fuseholder F1 lug 2 (S-1) to switch SW1 lug 1 (S-1).

Refer to Pictorial 2-3 for the following steps.

(✓) SW2: Locate the 120/240 slide switch (#60-54) and position it as shown in the Pictorial. (Note the position of the bare jumper wire connected between lugs 5 and 6 on the switch.)

() Prepare the following medium black wires:

One 5"

One 4"

Two 1-1/2"

NOTE: Make mechanically secure connections when you connect the wires to the switches in the following steps.

(✓) Connect one end of the 5" black wire to switch SW2 lug 1 (NS). The other end will be connected later.

(✓) Connect one end of the 4" black wire to switch SW2 lug 2 (NS). The other end will be connected later.

(✓) Connect one end of a 1-1/2" wire to switch SW2 lug 3 (S-1). The other end will be connected later.

(✓) Connect one end of the other 1-1/2" wire to switch SW2 lug 4 (S-1). The other end will be connected later.

(✓) Locate the power transformer. Then slide a rubber grommet over the black, black-red, black-green, black-yellow, black-white, and black-gray transformer leads.

(✓) Connect the black transformer lead to switch SW2 lug 1 (S-2).

(✓) Connect the black-red transformer lead to switch SW2 lug 2 (S-2).

() SW3: Locate the NOR/LOW slide switch (#60-608) and position it near slide switch SW2 as shown. Refer to the printing on the front of the switch and the inset drawing on the Pictorial to properly orient the switch.

(✓) Connect the black-white transformer lead to switch SW3 lug 5 (S-1).

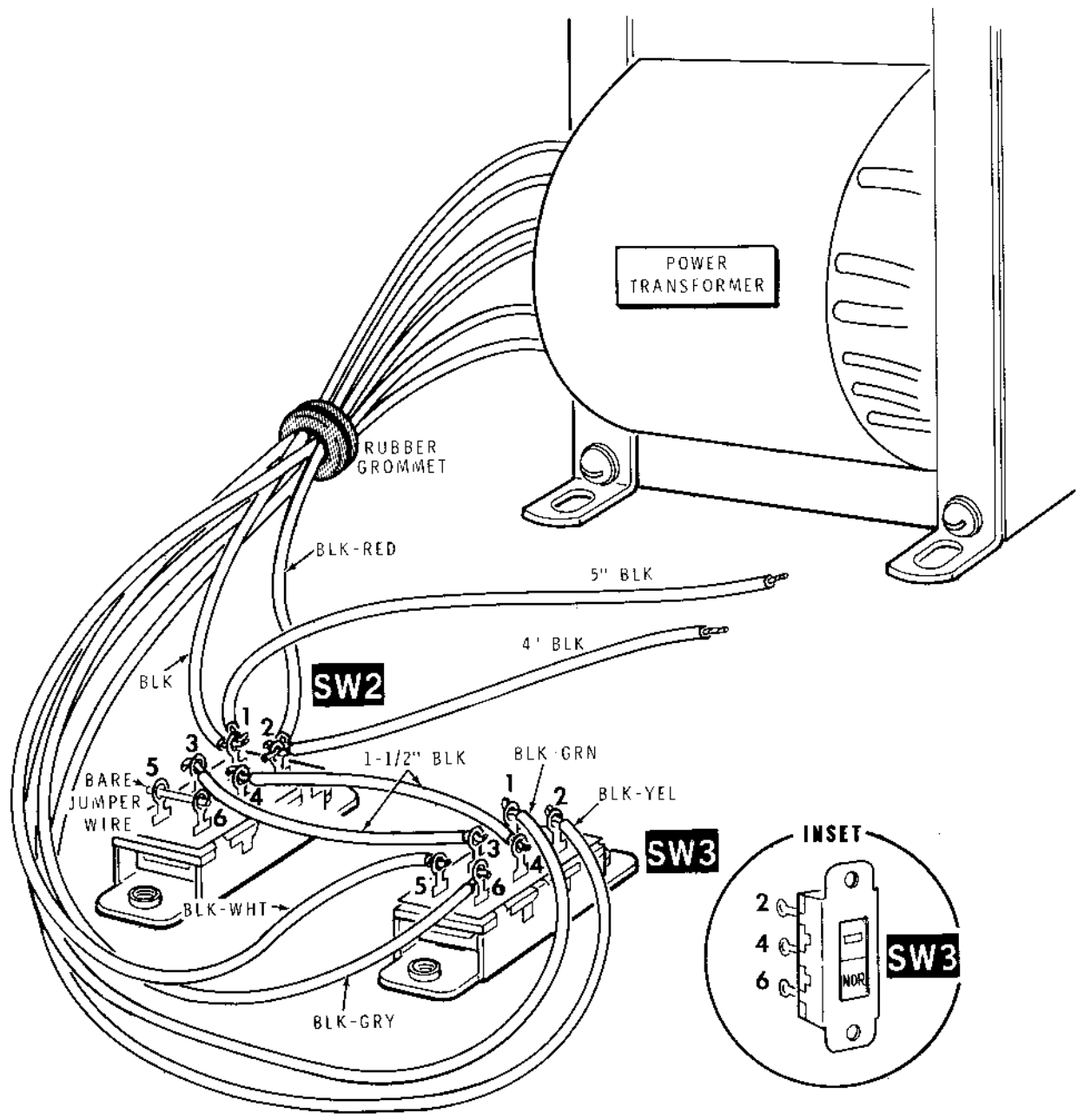
(✓) Connect the black-gray transformer lead to switch SW3 lug 6 (S-1).

(✓) Connect the free end of the black wire coming from switch SW2 lug 3 to switch SW3 lug 3 (S-1).

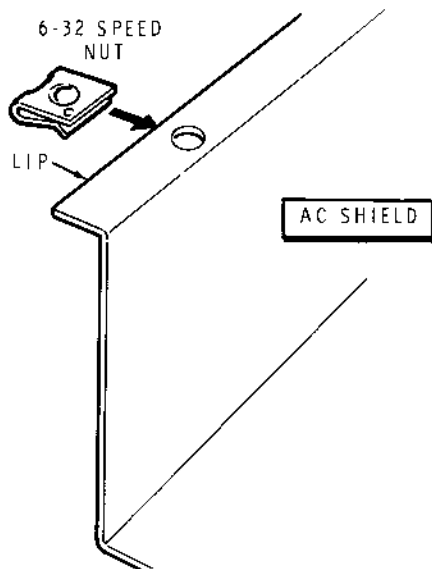
(✓) Connect the free end of the black wire coming from switch SW2 lug 4 to switch SW3 lug 4 (S-1).

(✓) Connect the black-green transformer lead to switch SW3 lug 1 (S-1).

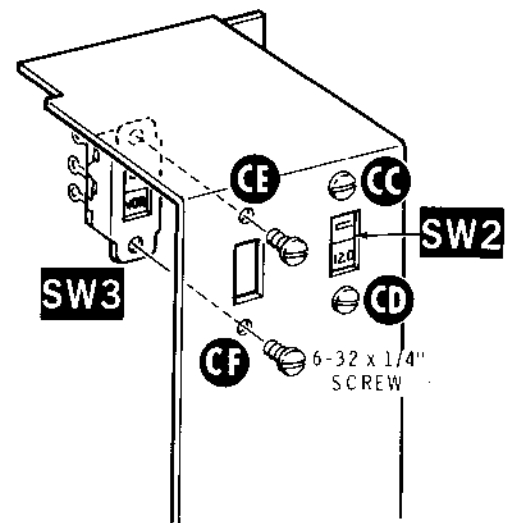
(✓) Connect the black-yellow transformer lead to switch SW3 lug 2 (S-1).



PICTORIAL 2-3



Detail 2-4A

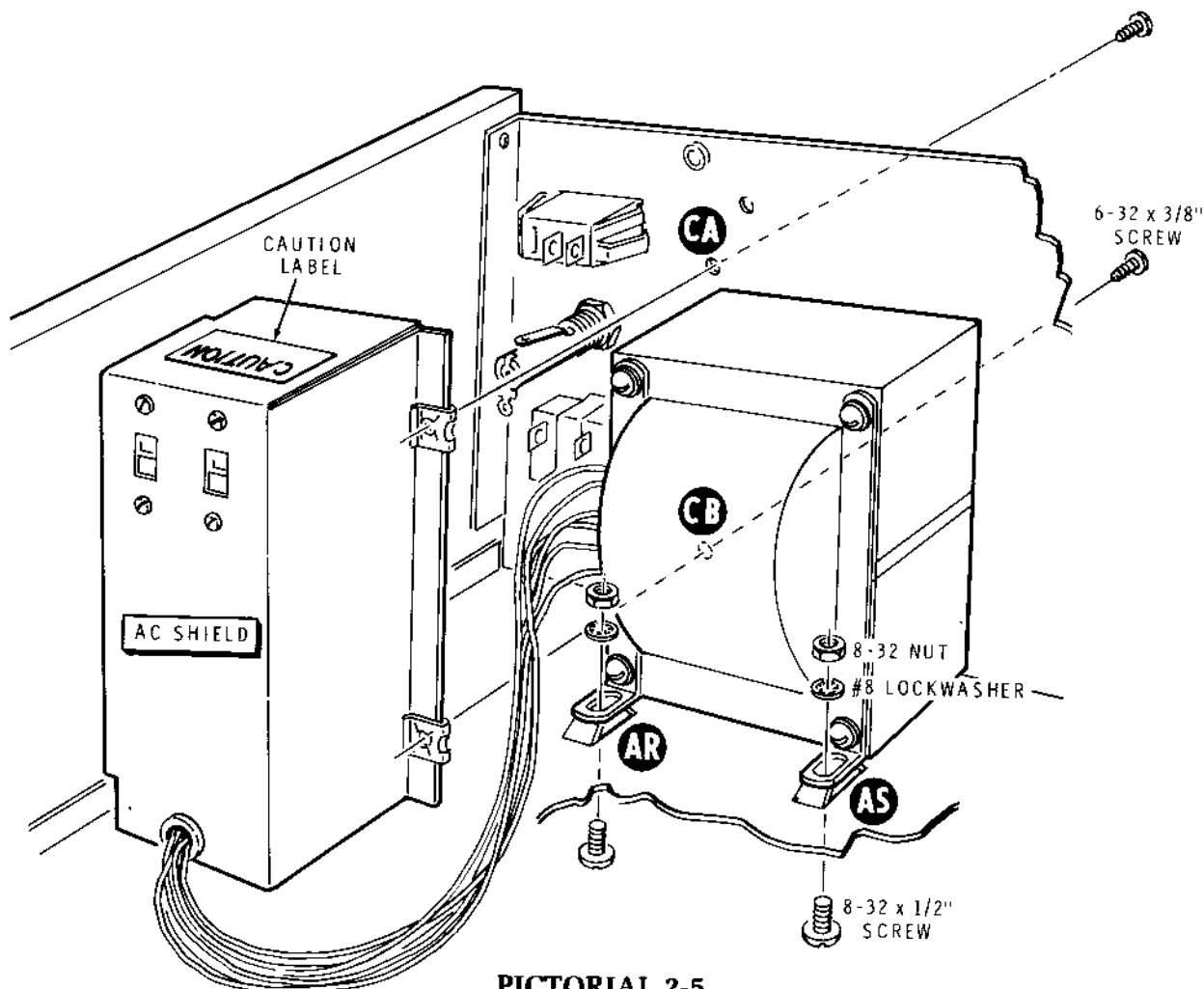


Detail 2-4B

Refer to Pictorial 2-4 (Illustration Booklet, Page 4) for the following steps.

- (✓) Place the power transformer inside the chassis and position the slide switches near the left rear corner of the chassis.
- (✓) Locate two 6-32 Speed Nuts. Note that each Speed Nut is flat on one side. Refer to Detail 2-4A and push the Speed Nuts onto the lip of the AC shield with the flat side as shown at CA and CB on the Pictorial.
- (✓) Refer to Detail 2-4B and mount the 120/240 slide switch (SW2) onto the AC shield at CC and CD. Use two 6-32 × 1/4" screws.

- (✓) Similarly, mount the NOR/LOW slide switch (SW3) onto the AC shield at CE and CF. Use two 6-32 × 1/4" screws.
- (✓) Place the rubber grommet, on the transformer wires, into the slot on the bottom edge of the AC shield.
- (✓) Connect the free end of the black wire coming from switch SW2 lug 1 to AC socket S1 lug 2 (S-3). Make a mechanically secure connection.
- (✓) Connect the free end of the black wire coming from switch SW2 lug 2 to switch SW1 lug 2 (S-1). Make a mechanically secure connection.



PICTORIAL 2-5

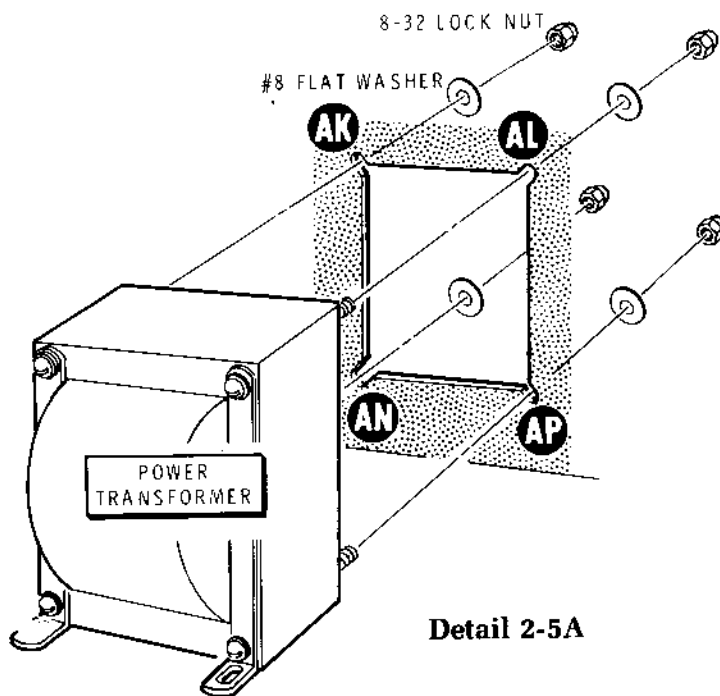
Refer to Pictorial 2-5 for the following steps.

- (✓) Mount the AC shield to the rear of the chassis at CA and CB with two 6-32 × 3/8" screws. Be careful that you do not pinch any wires between the AC shield and the chassis.
- (✓) Carefully peel away the backing paper from the caution label. Then press the label on top of the AC shield as shown in the Pictorial.

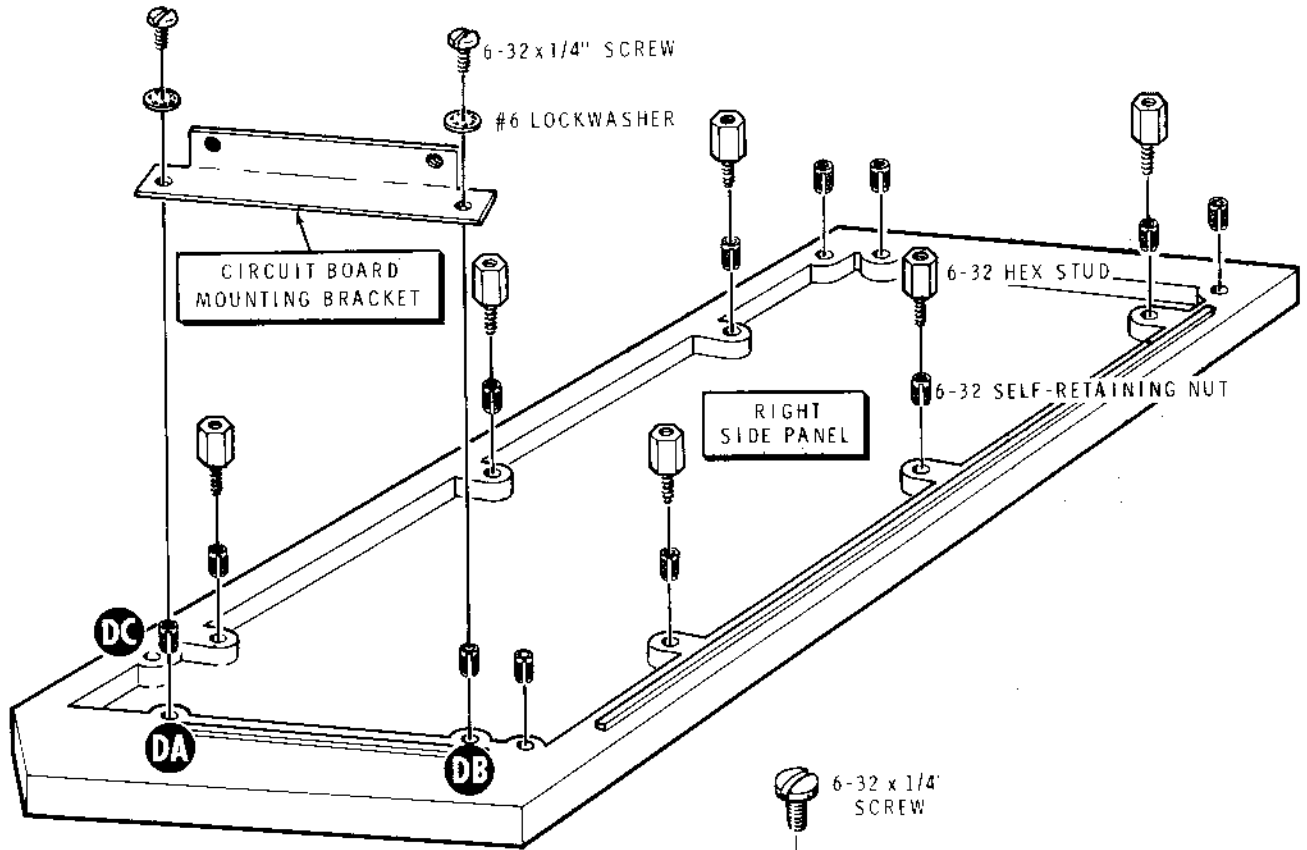
NOTE: When you perform the next step, **do not** use the brass washer.

- (✓) Refer to Detail 2-5A and mount the power transformer to the chassis. Use four #8 flat washers, and four 8-32 lock nuts on the rear of the chassis at AK, AL, AN, and AP. Use 8-32 × 1/2" hardware at AR and AS as shown in the Pictorial.

- (✓) Push the slack in the black power transformer leads through the rubber grommet and into the AC shield.



Detail 2-5A



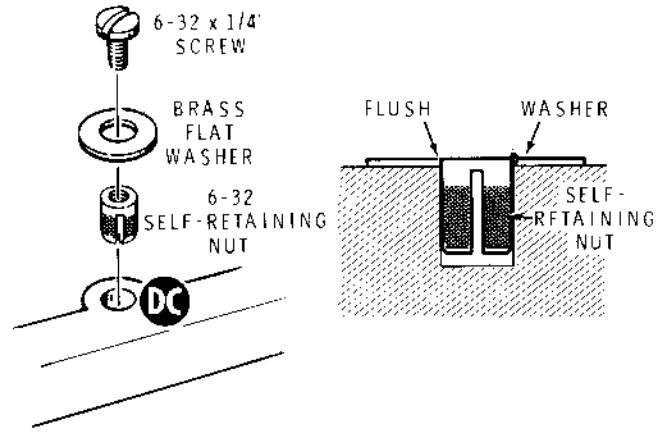
PICTORIAL 2-6

Refer to Pictorial 2-6 for the following steps.

(✓) Locate the right side panel and position it on your work surface as shown. Place the panel on a soft cloth to prevent it from being scratched when you perform the following steps.

(✓) Refer to Detail 2-6A and install a 6-32 self-retaining nut at DC as follows:

1. Start the split (slotted) end of the nut into the hole in the panel.
2. Place the brass flat washer over the end of the self-retaining nut.
3. Use the handle of a nut starter (or screwdriver) to push the nut into the panel until the top of the nut is flush with the flat washer.
4. Turn a 6-32 x 1/4" screw all the way into the nut. Then remove the screw and flat washer and set them aside.

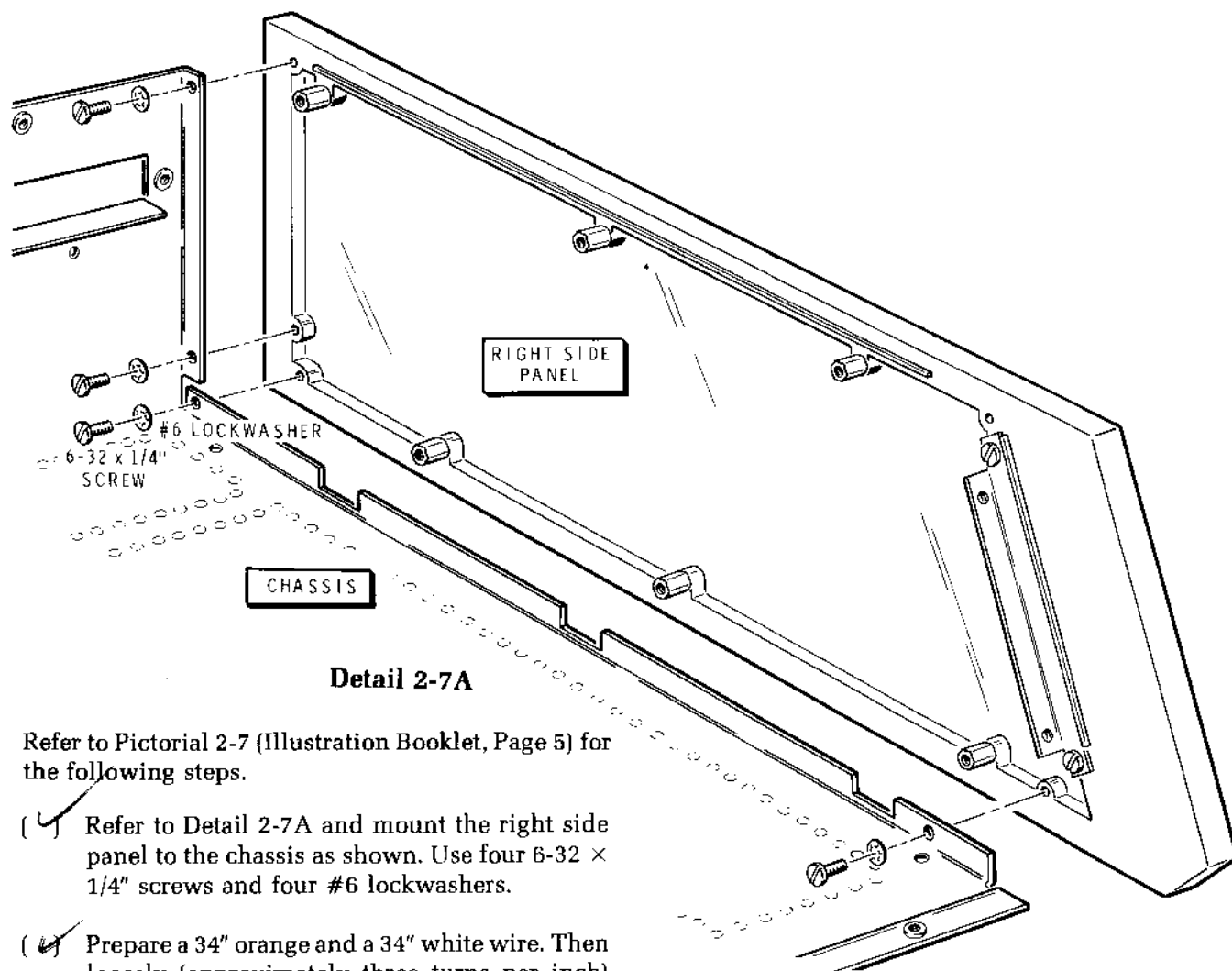


Detail 2-6A

(✓) Install 6-32 self-retaining nuts at the twelve remaining holes in the panel. Use the same procedure as you did when you prepared the left side panel.

(✓) Mount a circuit board mounting bracket to the right side panel at DA and DB. Use two 6-32 x 1/4" screws and two #6 lockwashers. Be sure to position the bracket as shown.

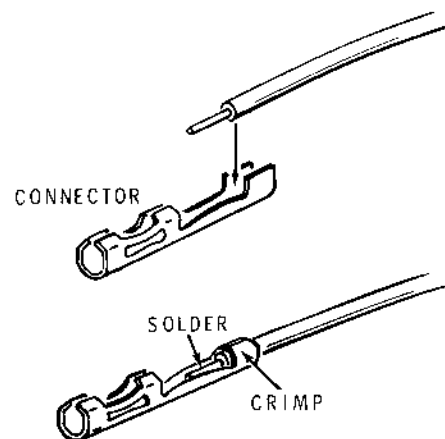
(✓) Install 6-32 x 1/4" hex studs in the self-retaining nuts at the six locations shown.



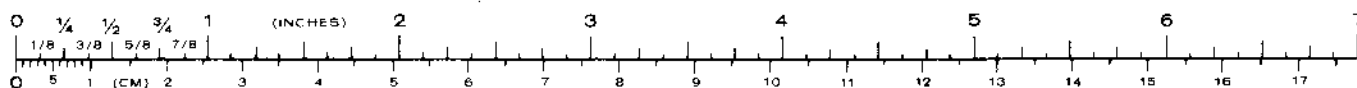
Detail 2-7A

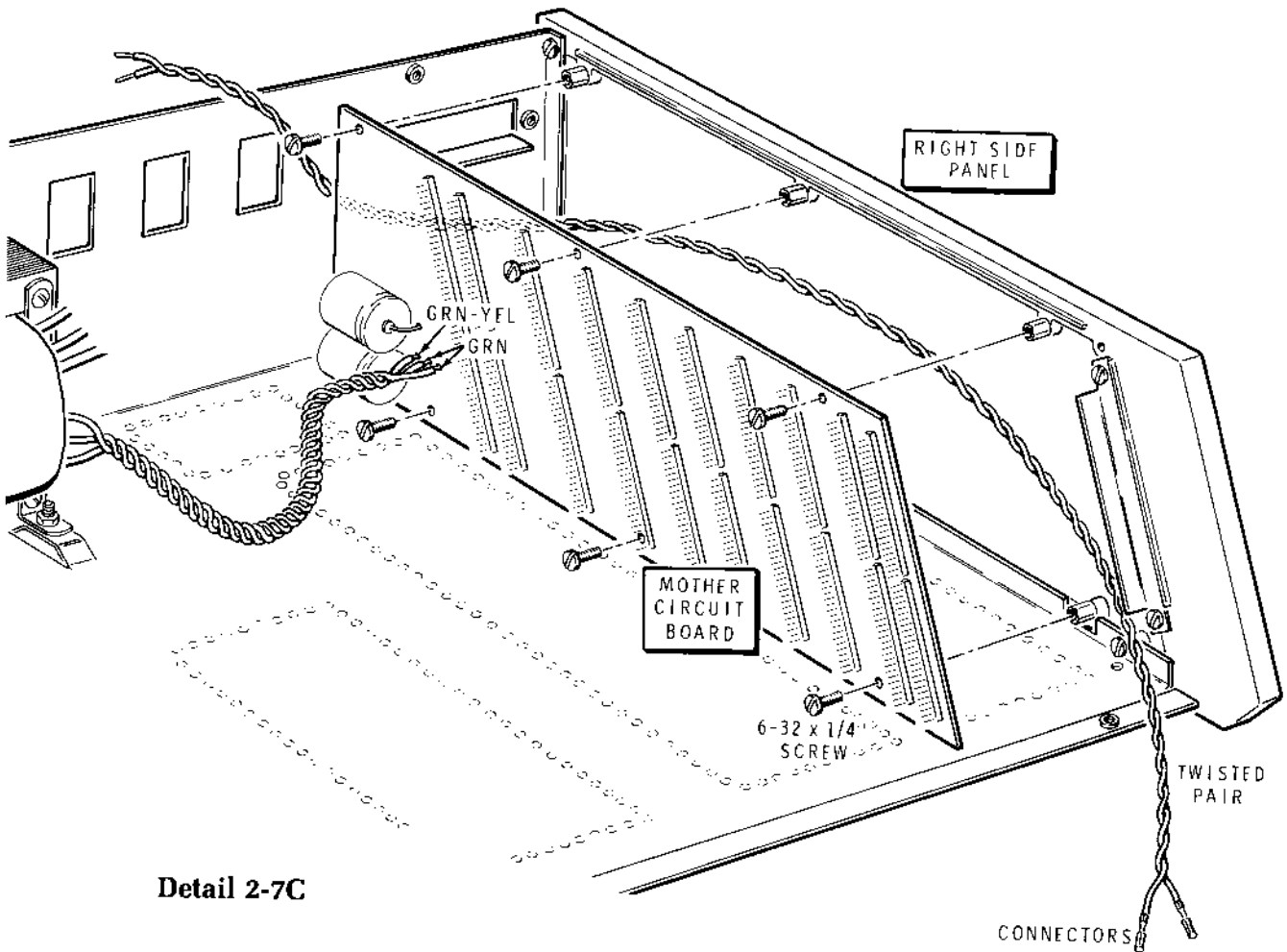
Refer to Pictorial 2-7 (Illustration Booklet, Page 5) for the following steps.

- (✓) Refer to Detail 2-7A and mount the right side panel to the chassis as shown. Use four 6-32 × 1/4" screws and four #6 lockwashers.
- (✓) Prepare a 34" orange and a 34" white wire. Then loosely (approximately three turns per inch) twist the two wires together.
- (✓) Refer to Detail 2-7B and install a PCB connector (#432-120) on each wire at one end of the twisted pair. Set this twisted pair aside temporarily.
- (✓) Locate the mother circuit board and position it inside the chassis.
- (✓) Twist together the two green and the green-yellow transformer wires. Then connect the green-yellow lead to circuit board hole GRN/YEL (S-1).
- (✓) Connect either green transformer lead to either circuit board hole labeled GRN (S-1).
- (✓) Connect the other green transformer lead to the other circuit board hole labeled GRN (S-1).



Detail 2-7B

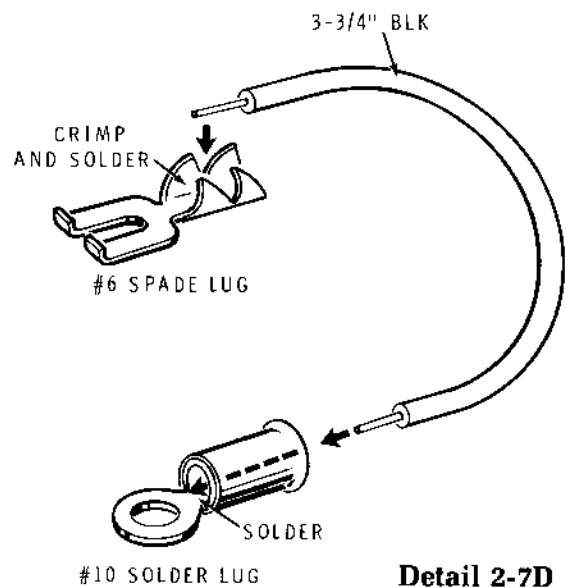




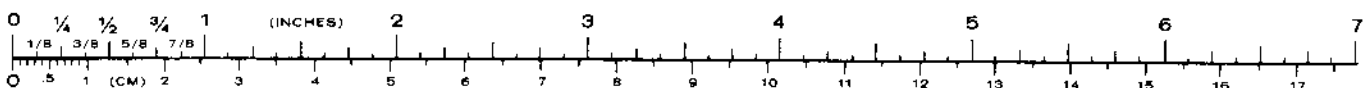
Detail 2-7C

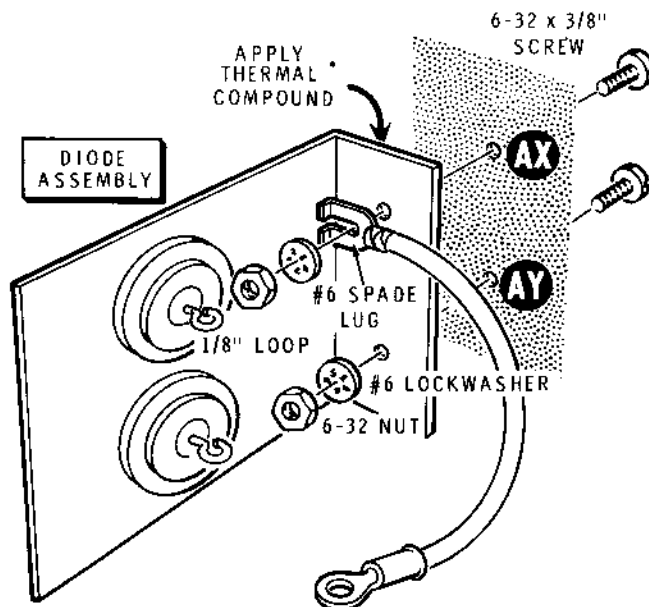
NOTE: When you perform the next step, be sure to position the twisted pair of wires (prepared earlier) between the circuit board and the side panel as shown. Also be sure the connectors on one end of the twisted pair are toward the front of the chassis.

- (✓) Refer to Detail 2-7C and mount the mother circuit board to the right side panel. Use six 6-32 x 1/4" screws.
- (✓) Position the green and green-yellow transformer wires along the rear edge of the chassis as shown in the Pictorial.
- (✓) Prepare a 3-3/4" large black wire.
- (✓) Refer to Detail 2-7D and install a #10 solder lug on one end and a #6 spade lug on the other end of the prepared wire.



Detail 2-7D





Detail 2-7E

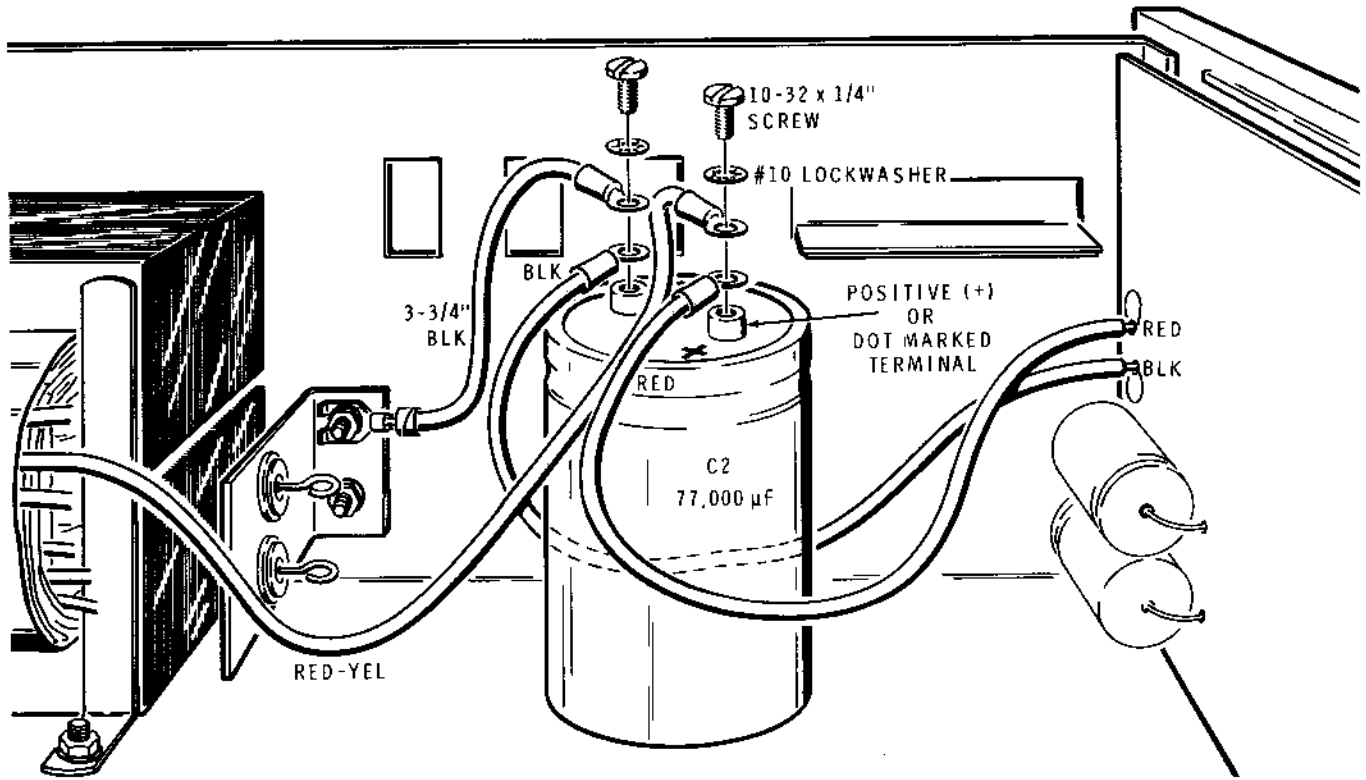
- (✓) Locate the diode assembly and cut each diode lead to 7/8", if this has not already been done. Then refer to Detail 2-7E and form a 1/8" loop in each lead.

WARNING: You will be using Dow Corning 340 thermal heat sink compound in the next step and in several other steps in this Manual. Although the compound is not caustic, it may cause temporary discomfort if it gets into your eyes. If this happens, rinse your eyes with warm water. If the compound gets into your clothing, the clothing may require professional cleaning. The compound contains Zinc Oxides, SiO₂, and slight traces of CO₂.

- (✓) Refer to the inset drawing on the Pictorial and cut open the thermal compound container. Then spread a thin layer of the compound onto the mounting flange of the diode assembly.

NOTE: Save the remaining compound for use later.

- (✓) D1/D2: Refer again to Detail 2-7E and mount the diode assembly and the #6 spade lug, on the end of the 3-3/4" wire prepared earlier, to the rear of the chassis at AX and AY. Use 6-32 x 3/8" hardware.
- (✓) Connect either red transformer lead to the loop in the lead of diode D2 (S-1).
- (✓) Connect the other red transformer lead to the loop in the lead of diode D1 (S-1).
- (✓) Install #10 solder lugs on the end of the red-yellow transformer lead and on the ends of the red and black wires coming from the mother circuit board. Refer back to Detail 2-7D if necessary.



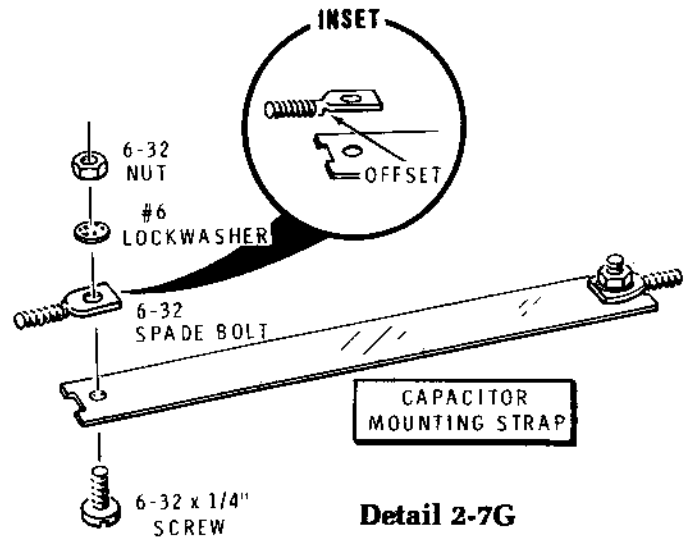
Detail 2-7F

NOTE: If your 77,000 μF electrolytic capacitor has two screws supplied with it, use them to connect the wires in the following steps. If your capacitor does not have two screws supplied with it, use the hardware called out in the step to connect the wires.

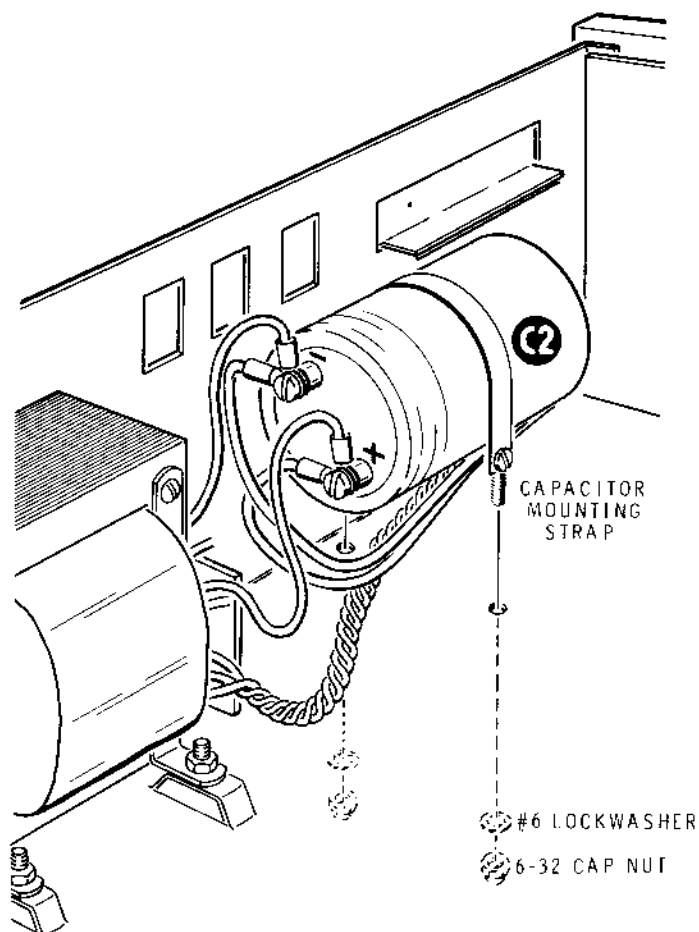
(✓) C2: Locate the 77,000 μF electrolytic capacitor. Then refer to Detail 2-7F and connect the solder lug on the free end of the red wire coming from the mother circuit board and the solder lug on the end of the red-yellow transformer lead to the positive (+) or dot marked terminal of the capacitor. Use a 10-32 × 1/4" screw and a #10 lockwasher. Position the solder lugs as shown in the Pictorial.

(✓) Connect the free end of the black wire coming from the mother circuit board and the solder lug on the free end of the black wire coming from the diode assembly to the other capacitor terminal. Use a 10-32 × 1/4" screw and a #10 lockwasher. Position the solder lugs as shown in the Pictorial.

(✓) Refer to Detail 2-7G and mount a 6-32 spade bolt on each end of the capacitor mounting strap. Use 6-32 × 1/4" hardware. Be sure to position the offset in the spade bolts as shown in the inset drawing and mount both spade bolts on the **same side** of the strap.



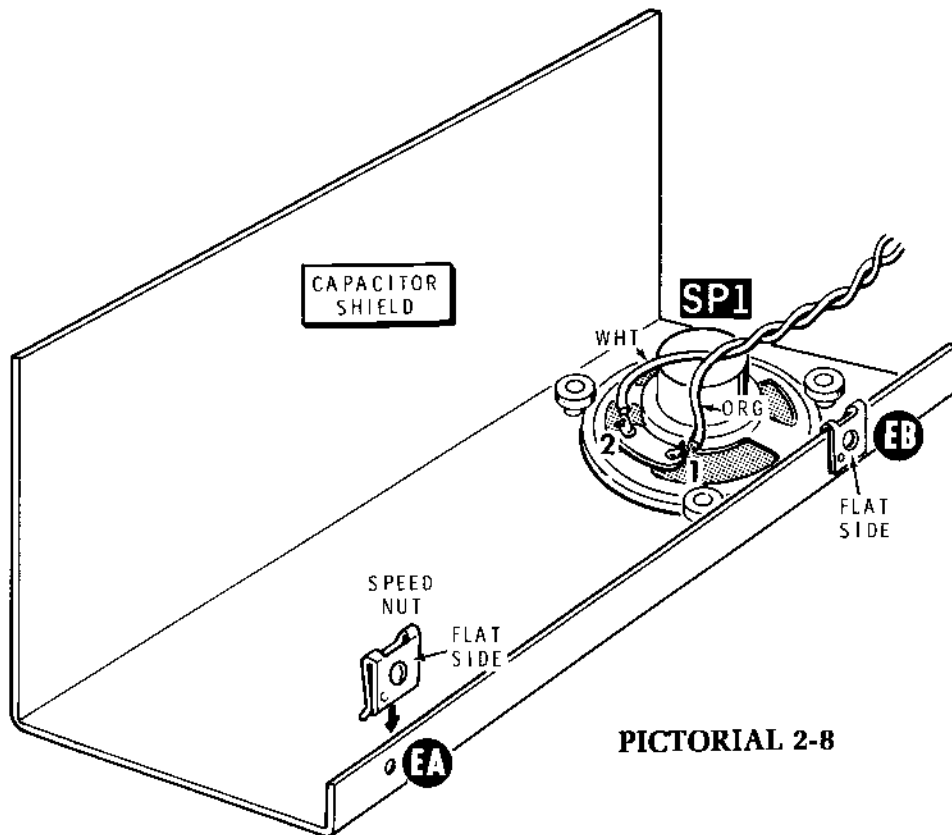
Detail 2-7G



Detail 2-7H

NOTE: When you perform the next step, be sure to position the twisted transformer wires and the red and black wires coming from the mother circuit board on the inside of the capacitor mounting strap. Do not, however, allow any wires to become pinched between the capacitor and the chassis or the strap and the chassis.

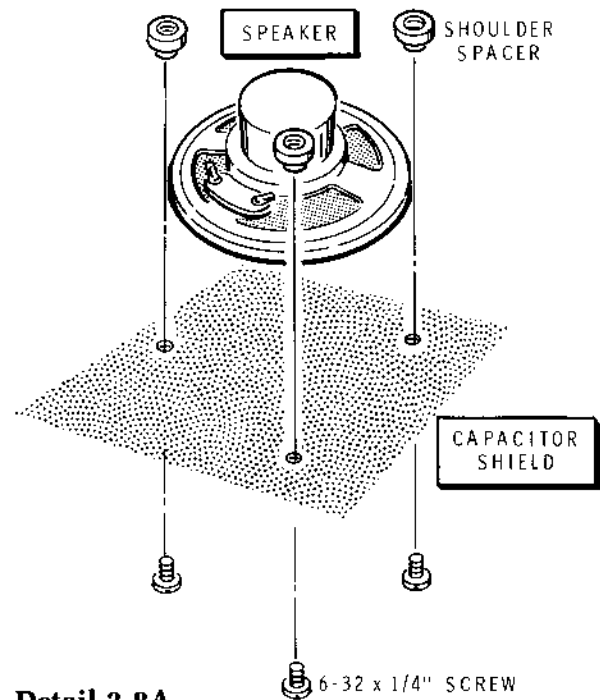
- (✓) Refer to Detail 2-7H and loosely mount capacitor C2 to the chassis with the capacitor mounting strap as shown. Use two #6 lockwashers and two 6-32 cap nuts.
- (✓) Position capacitor C2 so the strap is around the middle of the capacitor body and so the capacitor terminals are oriented as shown. Then tighten the cap nuts on the bottom of the chassis. **DO NOT** overtighten the cap nuts.



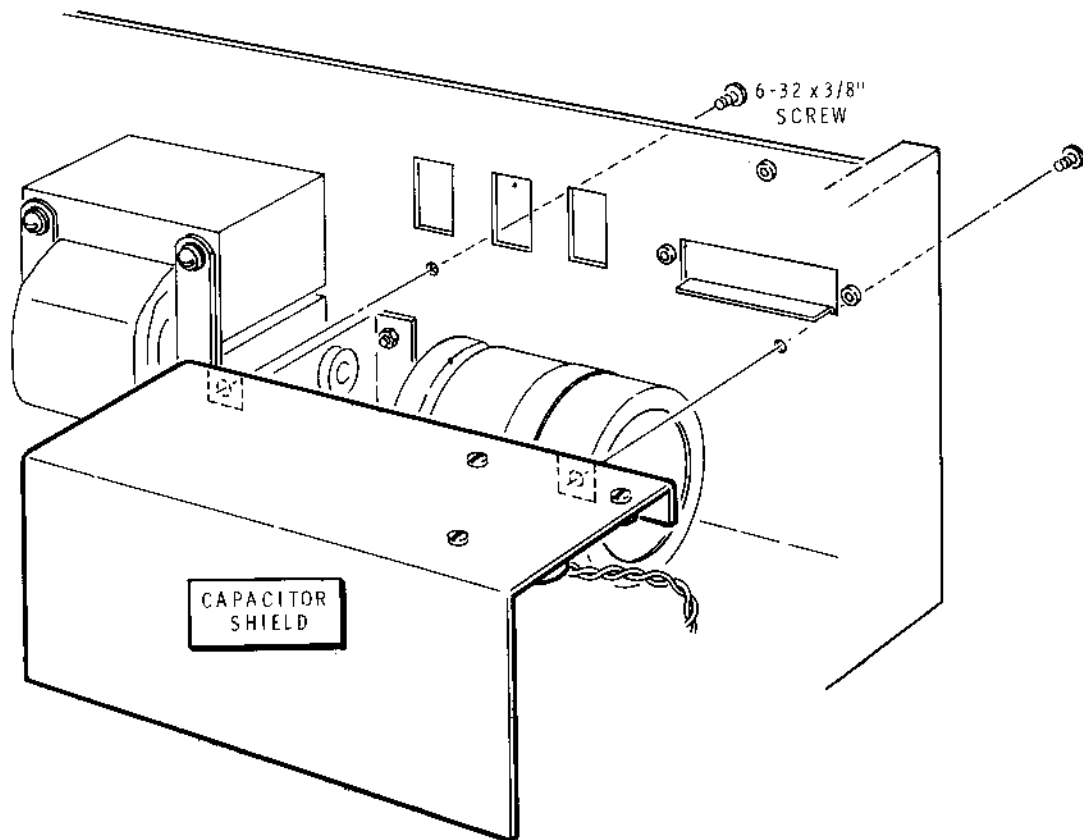
PICTORIAL 2-8

Refer to Pictorial 2-8 for the following steps.

- (✓) Locate two 6-32 Speed Nuts. Note that each Speed Nut is flat on one side. Push the Speed Nuts onto the lip of the capacitor shield with the flat side as shown at EA and EB.
- (✓) SP1: Refer to Detail 2-8A and mount the speaker to the capacitor shield with three shoulder spacers and three 6-32 × 1/4" screws. Be sure to position the lugs on the speaker as shown in the Pictorial.
- (✓) Locate the end of the twisted pair coming from behind the mother circuit board. Then connect the end of the orange wire to speaker SP1 lug 1 (S-1). Connect the end of the white wire to lug 2 (S-1).



Detail 2-8A



PICTORIAL 2-9

Refer to Pictorial 2-9 and mount the capacitor shield to the rear of the chassis. Use two 6-32 \times 3/8" screws. NOTE: If the shield does not fit tightly against the bottom of the chassis, remove the shield and reform it as necessary until it does. Position the excess twisted pair inside the capacitor shield.

Check the wires near the diode assembly. If necessary, reposition these wires so they do not touch the diode assembly. The assembly becomes quite hot during operation and could burn the insulation on any wires that come into contact with it.



POWER SUPPLY TESTS

PRIMARY WIRING TESTS

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

- Be sure the line cord is not plugged in.
- Push the POWER switch (rear panel) to OFF.
- Place the 120/240 switch (on the AC shield) in the 120 position.
- Place the NOR/LOW switch in the NOR position.

If you do not have an ohmmeter, remove the AC shield and carefully check the line cord, fuseholder, Power switch, 120/240 switch, NOR/LOW switch, and the transformer wiring against that shown in Pictorials 2-2, 2-3, and 2-4. Make sure there are no fine strands of wire or solder blobs touching adjacent terminals or the chassis. Then proceed to "Secondary Wiring Tests."

If you have an ohmmeter, perform the following resistance measurements. NOTE: You will be instructed to connect one of the ohmmeter leads to ground. This can be the metal capacitor shield.

- Place the ohmmeter switch in the R × 10 position.

METER CONNECTIONS			
RED LEAD	BLACK LEAD	METER READING	POSSIBLE CAUSE OF TROUBLE
<input type="checkbox"/> 1. Either flat prong of the line cord.	Ground	INFINITE with the POWER switch On or Off.	A. Wiring on switches SW1, SW2, or SW3. B. AC socket wiring. C. T1.
<input type="checkbox"/> 2. Other flat prong of the line cord.	Ground	INFINITE with the POWER switch On or Off.	A. Wiring on switches SW1, SW2, or SW3. B. AC socket wiring. C. T1.
<input type="checkbox"/> 3. Round prong of the line cord.	Ground	0 Ω with the POWER switch On or Off.	A. Green lead of the line cord not properly connected at solder lug AE. See Pictorial 2-1.
<input type="checkbox"/> 4. Either flat prong of the line cord.	Other flat prong.	1 MΩ or higher (POWER switch OFF).	A. Wiring on switches SW1, SW2, or SW3. B. AC socket wiring. C. T1. D. C1.
<input type="checkbox"/> 5. Either flat prong of the line cord.	Other flat prong.	Approximately 5 Ω or less with the 120/240 switch in either position (POWER switch On).	A. Wiring on switches SW1, SW2, or SW3. B. AC socket wiring. C. T1. D. Fuse or wiring on fuseholder.

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



SECONDARY WIRING TESTS

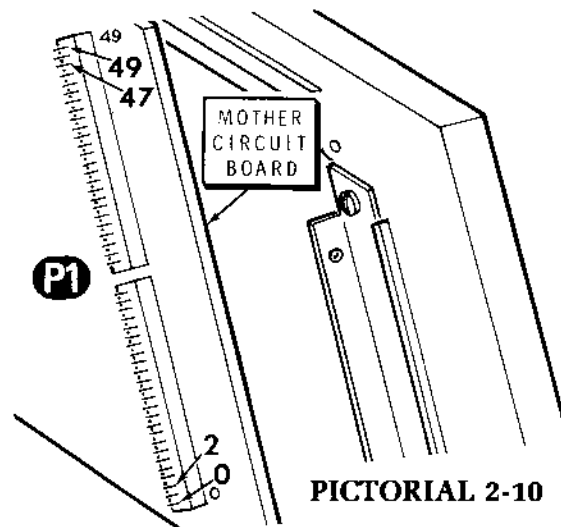
If you have an ohmmeter available, make the following resistance checks before you proceed to "Voltage Checks." If you do not obtain the proper results, refer to the "Possible Cause" chart which follows and correct the problem before you continue.

Refer to Pictorial 2-10 for the following steps.

NOTES:

- When you connect the leads of your meter to the plug pins on the mother circuit board, in the following steps, be sure the leads touch **only** the indicated pin.
- The internal wiring of most ohmmeters is such that the positive terminal of the meter battery is connected to the positive test lead and the negative battery terminal is connected to the negative (common) test lead. In some ohmmeters, this wiring is reversed and will give erroneous readings in the following measurements. Interchange the ohmmeter leads if the measurements do not check out properly the first time.

- Connect the common or ground lead of your meter to plug P1 pin 0.
- Be sure your ohmmeter is in the $R \times 10$ position.
- Touch the other meter lead to plug P1 pin 49. The meter needle should drop to a low indication and then rise slowly (charging of capacitor C2) and stop at approximately 150Ω .



PROBLEM	POSSIBLE CAUSE
1. Low reading.	A. Diode assembly D1/D2. B. Capacitor C2. C. Solder bridge on mother circuit board.
2. High reading.	A. Resistor R1. B. Unsoldered connection on mother circuit board.

- () Touch the meter probe to plug P1 pin 2. The meter should indicate approximately 70Ω .

PROBLEM	POSSIBLE CAUSE
1. Low reading.	A. Diode D5 or D6. B. Capacitor C4. C. Solder bridge on mother circuit board.
2. High reading.	A. Transformer T1. B. Diode D5 or D6. C. Unsoldered connection on mother circuit board.

- () Touch the meter probe to plug P1 pin 47. The meter should indicate a high resistance reading.

PROBLEM	POSSIBLE CAUSE
1. Low reading.	A. Diode D3 or D4. B. Capacitor C3. C. Solder bridge on mother circuit board.

- () Disconnect the meter leads from the mother circuit board.



VOLTAGE CHECKS

- () Be sure the POWER switch (rear panel) is in the OFF position.
- () Place the 120/240 switch in the proper position for your line voltage.
- () Place the NOR/LOW switch in the NOR position, if not already done. NOTE: This is the normal setting for this switch. Do not use the low position unless you observe an operating malfunction caused by low line voltage. You will not be able to observe this until your Digital Computer is completely assembled and operating.
- () Set your meter to measure -25 volts DC.

NOTE: Be careful in the following steps that your VTVM leads do not touch anything other than the points indicated in the steps. If your VTVM probe should slip (for instance) and short two pins together, you could damage the power supply in your Computer.

- () Remove two 3/8" pieces of insulation from an orange wire. Use these pieces of insulation in the next two steps.
- () Slide one piece of insulation over plug P1 pin 1.
- () Slide the remaining piece of insulation over plug P1 pin 48.
- () Connect the common or ground lead of your meter to plug P1 pin 0.
- () Plug the line cord into a proper AC outlet.
- () Push the POWER switch to ON.
- () Touch the meter probe to plug P1 pin 2. The meter should indicate between -17 and -24 volts.

PROBLEM	POSSIBLE CAUSE
1. Low reading.	A. Transformer T1 wiring. B. Capacitor C4. C. Switch SW2 or SW3.
2. High reading.	A. Transformer T1 wiring. B. Switch SW2 or SW3.

- () Set your meter to measure +25 volts DC.
- () Connect the meter probe to plug P1 pin 47. The meter should indicate between +17 and +24 volts.

PROBLEM	POSSIBLE CAUSE
1. Low reading.	A. Transformer T1 wiring. B. Capacitor C3. C. Switch SW2 or SW3.
2. High reading.	A. Transformer T1 wiring. B. Switch SW2 or SW3.



- () Set your meter to measure +15 volts DC.
- () Touch the meter probe to plug P1 pin 49. The meter should indicate between +9 and +12 volts.

PROBLEM	POSSIBLE CAUSE
1. Low reading.	A. Transformer T1 wiring. B. Capacitor C2. C. Switch SW2 or SW3.
2. High reading.	A. Transformer T1 wiring. B. Switch SW2 or SW3. C. Resistor R1.

- () Push the POWER switch to OFF.
- () Unplug the line cord.
- () Disconnect the meter leads from the mother circuit board.
- () Remove the pieces of insulation from plug P1 pins 1 and 48.

This completes the "Power Supply Tests." Proceed to "Control Circuit Board."

CONTROL CIRCUIT BOARD

PARTS LIST

- (✓) Locate the box marked Pack #2.
- (✓) Unpack these parts and check each part against the following list. Return any part that is packed in an individual envelope with the part number on it back in the envelope after you identify it until it is called for in a step. Do not discard any packing materials until all parts are accounted for. The key numbers correspond to the num-

bers on the "Control Circuit Board Parts Pictorial" (Illustration Booklet, Page 6).

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Customer Service" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

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

NOTES:

1. Resistors may be packed in more than one envelope. Open all of the resistor envelopes in this pack before you check the resistors against the Parts List.
2. The following resistors are 1/4-watt and have a tolerance of 5% unless otherwise noted. 5% is indicated by a fourth color band of gold.

A1	1-56-12	8	15 Ω (brown-green-black)	R123, R124, R125, R126, R127, R128, R129, R131
A1	1-103-12	1	150 Ω (brown-green-brown)	R154
A1	1-105-12	1	200 Ω (red-black-brown)	R104
A1	1-121-12	2	300 Ω (orange-black-brown)	R155, R166

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

A1	1-66-12	18	560 Ω (green-blue-brown)	R105, R108, R109, R113, R114, R117, R118, R122, R142, R143, R144, R145, R146, R147, R148, R149, R151, R164
A1	1-69-12	28	1000 Ω (brown-black-red)	R101, R102, R106, R107, R111, R112, R115, R116, R119, R121, R132, R133, R134, R135, R136, R137, R138, R139, R141, R152, R156, R157, R158, R159, R161, R162, R163, R165



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

A1	1-81-12	1	27 k Ω (red-violet-orange)	R153
A1	2-674-12	1	40 k Ω , 1% precision	R103

CAPACITORS

B1	20-107	1	680 pF mica	C105
B2	21-95	12	.1 μ F ceramic	C104, C107, C108, C109, C111, C112, C113, C114, C115, C116, C117, C118
B3	27-118	1	.15 μ F Mylar	C101
B4	25-221	2	2.2 μ F tantalum	C102, C106
B5	25-238	1	100 μ F tantalum	C103

DIODES — LEDs — TRANSISTORS — INTEGRATED CIRCUITS (IC's)

C1	56-56	1	1N4149 diode	D101
C2	411-819	9	LED display	LED101, LED102, LED103, LED104, LED105, LED106, LED107, LED108, LED109
C3	412-811	4	LED lamp	LED111, LED112, LED113, LED114

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

1. Part number.
2. Type number. (For integrated circuits this refers only to the numbers, the letters may vary.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

C4	417-235	8	2N4121 transistor	Q111, Q112, Q113, Q114, Q115, Q116, Q117, Q118
C5	417-875	1	2N3904 transistor	Q119
C5	417-881	9	MPSA13 transistor	Q101, Q102, Q103, Q104, Q105, Q106, Q107, Q108, Q109

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Transistors — Integrated Circuits (cont'd.)**IMPORTANT**

If any components are missing from the sealed IC package, return the **unopened** package for replacement. Claims for missing IC's will not be honored.

If you locate damaged or defective IC's, order individual replacements. Be sure to follow the standard instructions on the "Parts Order Form" and on the inside rear cover of the Manual. Save defective or damaged components for return instructions.

C6	442-54	2	7805 IC	IC101, IC120
C7	443-1	1	7400 IC	IC110
C7	443-3	1	7430 IC	IC105
C7	443-6	2	7474 IC	IC102, IC108
C7	443-46	1	7402 IC	IC111
C7	443-54	1	7403 IC	IC112
C8	443-90	1	74123 IC	IC107
C8	443-752	4	74LS175 IC	IC106, IC116, IC117, IC118
C9	443-754	1	74LS240 IC	IC113
C7	443-755	2	74LS04 IC	IC104, IC109
C8	443-756	2	74148 IC	IC114, IC115

CAUTION: The following IC's can be damaged by static electricity. Do not remove these IC's from the conductive foam until you are instructed to do so in a step.

C8	443-713	1	14028 IC	IC119
C8	443-760	1	14040 IC	IC103

HARDWARE

Hardware packets are marked to show the size of the hardware they contain (HDW #4, or, HDW #2 & #6, etc.). You may have to open more than one packet — in this pack — to locate all of the hardware of any one (#6, for example) size.

#4 Hardware

D1	250-52	7	4-40 \times 1/4" screw
D2	252-2	7	4-40 nut
D3	255-195	7	4-40 hex stud
D4	259-9	2	#4 solder lug
D5	259-29	5	Long solder lug

#6 Hardware

D6	250-56	2	6-32 \times 1/4" screw
D7	252-3	2	6-32 nut
D8	254-1	2	#6 lockwasher



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

CONNECTORS — SOCKETS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
E1	432-121	2	PCB pin	
E2	432-866	40	Spring connector (5 extra)	
E3	432-865	2	3-hole connector shell	
E4	432-970	1	5-hole connector shell	
E5	432-948	2	25-hole connector shell	
E6	434-292	18	5-pin socket	
E7	434-298	8	14-pin IC socket	
E8	434-299	9	16-pin IC socket	
E9	434-311	1	20-pin IC socket	

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

MISCELLANEOUS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
F1	64-839	16	Pushbutton switch	SW101, SW102, SW103, SW104, SW105, SW106, SW107, SW108, SW109, SW110, SW111, SW112, SW113, SW114, SW115, SW116
F2	462-1023	16	Pushbutton knob	

PARTS FROM THE MAIN PACK

	85-1935-1	1	Control circuit board	
G1	215-620	1	Heat sink	

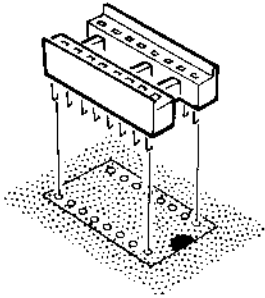


STEP-BY-STEP ASSEMBLY

START

(✓) Position the control circuit board as shown in the Identification Drawing. Then perform all of the steps in the following Pictorials.

NOTE: The IC sockets that you will install in the following steps can be installed either way in the circuit board. Be sure the pins are straight, insert the pins into the holes, and solder the pins to the foil as you install each socket.



(✓) 16-pin IC socket at IC107.

(✓) 14-pin IC socket at IC108.

(✓) 14-pin IC socket at IC109.

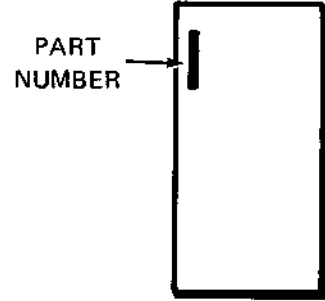
(✓) 14-pin IC socket at IC110.

(✓) 14-pin IC socket at IC111.

(✓) 14-pin IC socket at IC112.

(✓) 20-pin IC socket at IC113.

(✓) 16-pin IC socket at IC114.



IDENTIFICATION DRAWING

CONTINUE

(✓) 14-pin IC socket at IC102.

(✓) 16-pin IC socket at IC103.

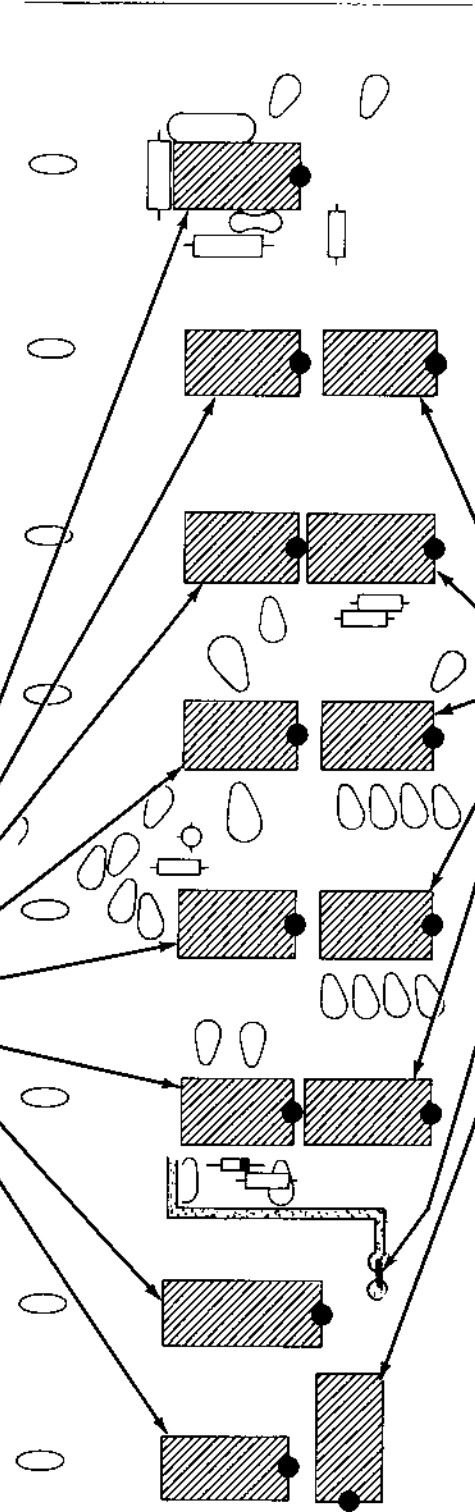
(✓) 14-pin IC socket at IC104.

(✓) 14-pin IC socket at IC105.

(✓) 16-pin IC socket at IC106.

(✓) Remove all of the insulation from a 1" white wire. Then install the wire at the location shown. Solder the wire to the foil and cut off the excess wire ends.

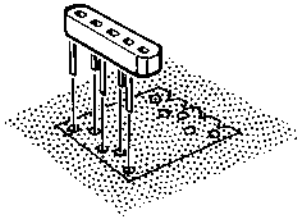
(✓) 16-pin IC socket at IC115.



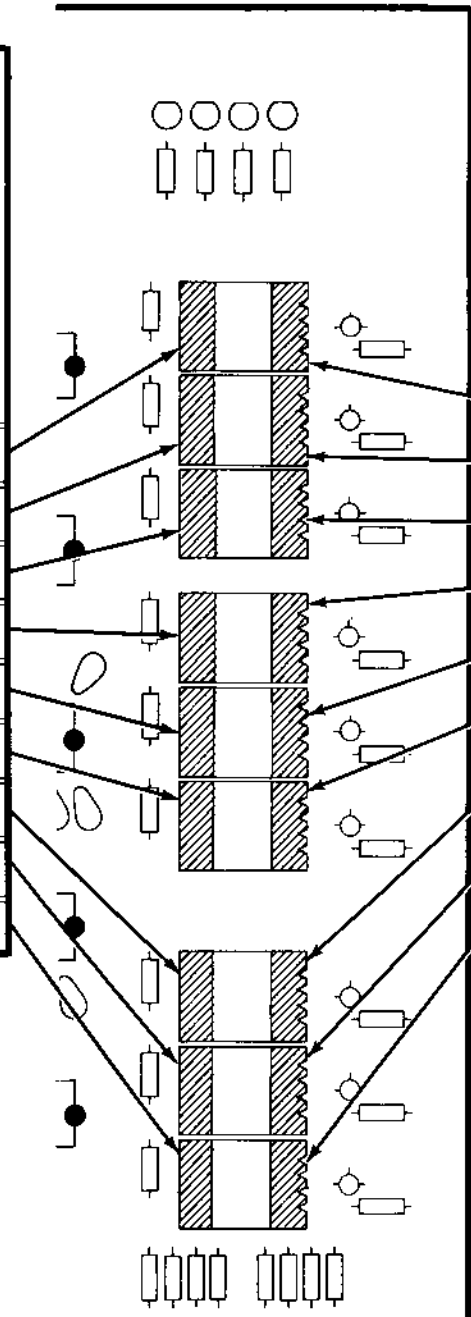
PICTORIAL 3-1

START ↘

NOTE: The 5-pin sockets that you will install in the following steps can only be installed in one way. Solder the pins to the foil as you install each socket.



- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.



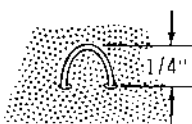
CONTINUE ↘

- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.
- (✓) 5-pin socket.

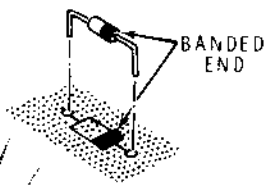
PICTORIAL 3-2

START →

(✓) Remove all of the insulation from a 1" white wire. Then form the wire into a loop and install the wire at the location shown. NOTE: These holes are not labeled on the circuit board. Position the top of the loop 1/4" above the top of the circuit board. Then solder the wire to the foil and cut off any excess wire ends.

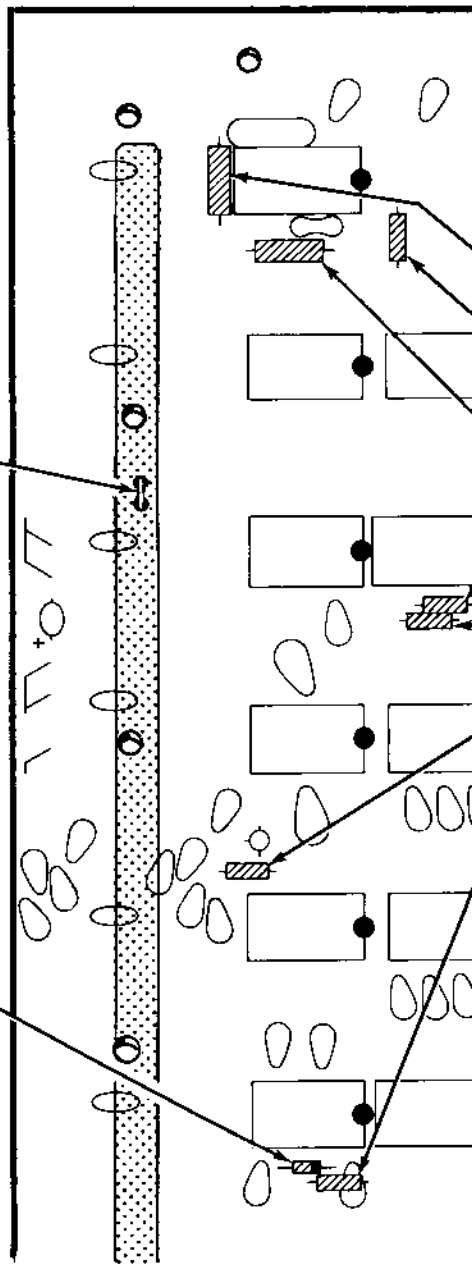


NOTE: When you install a diode, always match the band or bands on the diode with the band mark on the circuit board.



(✓) D101: 1N4149 diode (#56-56).

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



CONTINUE →

(✓) R103: 40 kΩ, 1% precision.

(✓) R152: 1000 Ω (brown-black-red).

(✓) R153: 27 kΩ (red-violet-orange). Form the leads to fit the circuit board holes.

(✓) R102: 1000 Ω (brown-black-red).

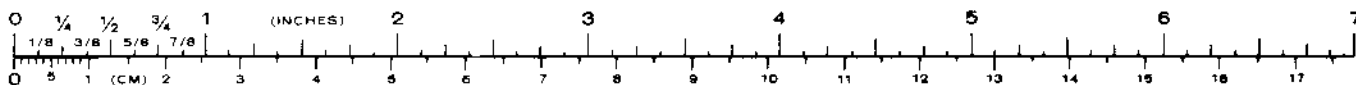
(✓) R101: 1000 Ω (brown-black-red).

(✓) R164: 560 Ω (green-blue-brown).

(✓) R161: 1000 Ω (brown-black-red).

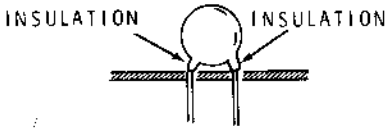
(✓) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 3-3



START →

NOTE: When you install 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.

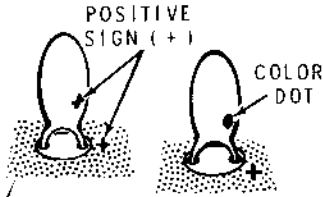


(✓) C109: .1 μ F ceramic.

(✓) C107: .1 μ F ceramic.

(✓) C111: .1 μ F ceramic.

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



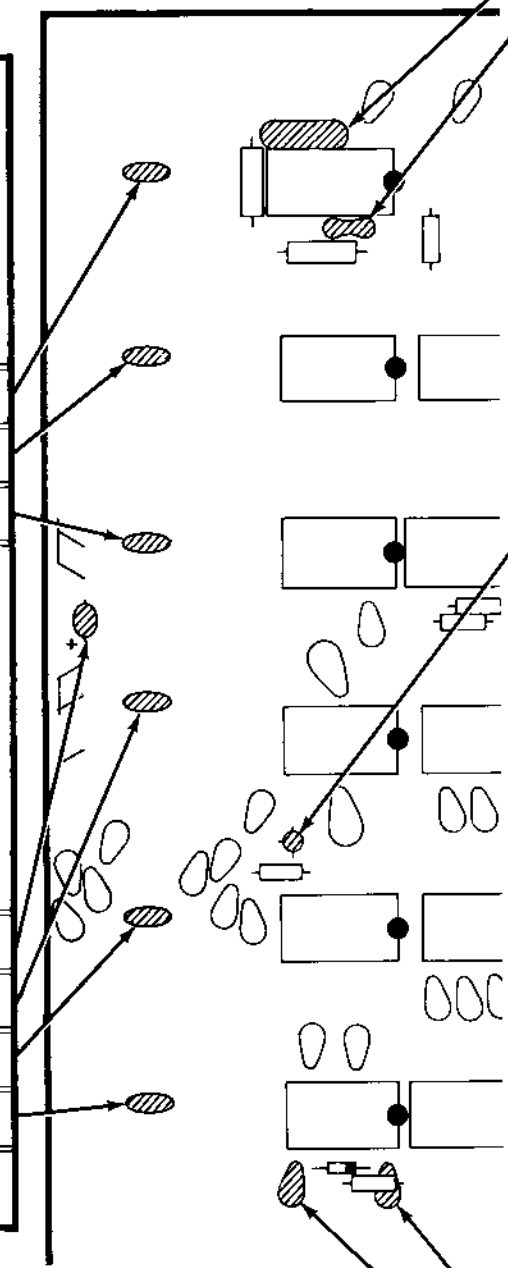
(✓) C106: 2.2 μ F tantalum.

(✓) C112: .1 μ F ceramic.

(✓) C108: .1 μ F ceramic.

(✓) C113: .1 μ F ceramic.

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



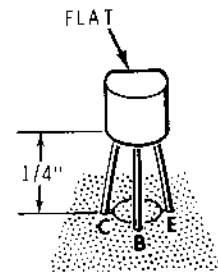
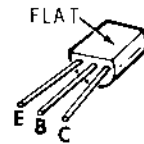
CONTINUE →

(✓) C101: .15 μ F Mylar.

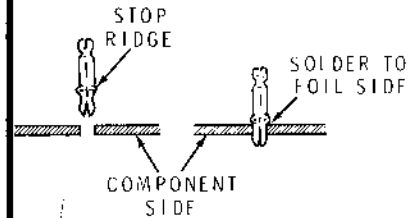
(✓) C105: 680 pF mica.

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

(✓) Q119: 2N3904 transistor (#417-875). First identify the C, B, and E leads. Then insert the leads into their correct C, B, and E holes in the circuit board as shown. Solder the leads to the foil and cut off the excess lead lengths.



NOTE: In the following steps, install PCB pins in the holes from the other (bottom) side of the circuit board as shown. Push the pin down firmly against the circuit board. Then solder the pin to the foil.



(✓) PCB pin at F.

(✓) PCB pin at E.

PICTORIAL 3-4

START ▾

- (✓) R166: 300 Ω (orange-black-brown).

- (✓) R155: 150 Ω (brown-green-brown).

- Install nine 1000 Ω (brown-black-red) resistors at:

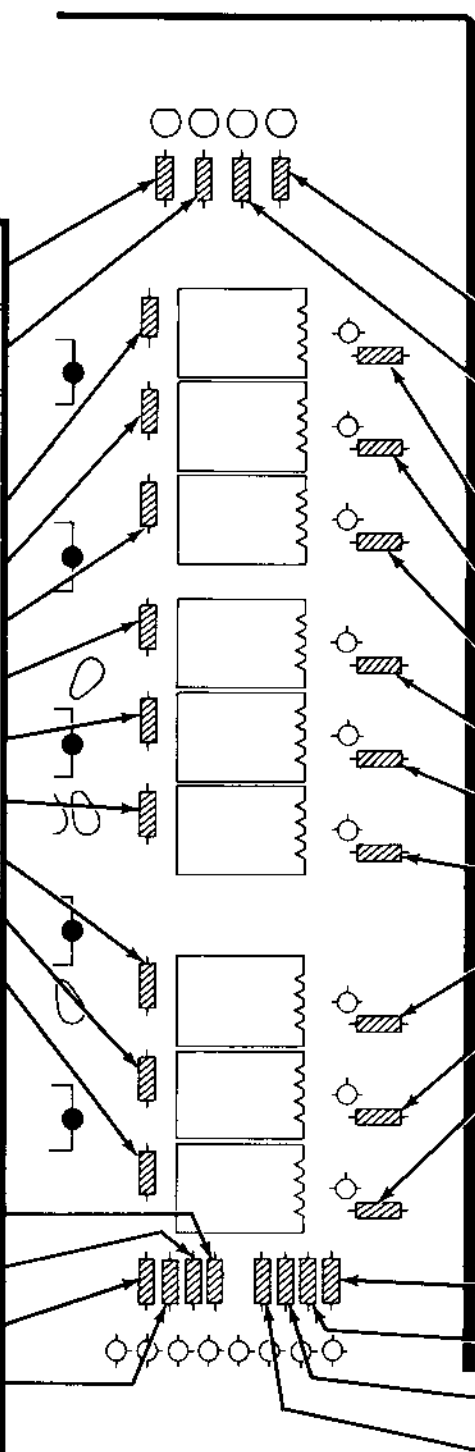
 - (✓) R132.
 - (✓) R133.
 - (✓) R134.
 - (✓) R135.
 - (✓) R136.
 - (✓) R137.
 - (✓) R138.
 - (✓) R139.
 - (✓) R141.

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

- Install four 15 Ω (brown-green-black) resistors at:

 - (✓) R127.
 - (✓) R128.
 - (✓) R131.
 - (✓) R129.

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



CONTINUE ▾

- (✓) R154: 300 Ω (orange-black-brown).

- (✓) R104: 200 Ω (red-black-brown).

- Install nine 560 Ω (green-blue-brown) resistors at:

 - (✓) R142.
 - (✓) R143.
 - (✓) R144.
 - (✓) R145.
 - (✓) R146.
 - (✓) R147.
 - (✓) R148.
 - (✓) R149.
 - (✓) R151.

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

- Install four 15 Ω (brown-green-black) resistors at:

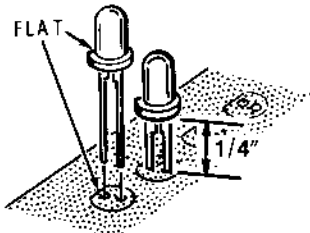
 - (○) R123.
 - (○) R124.
 - (○) R125.
 - (○) R126.

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

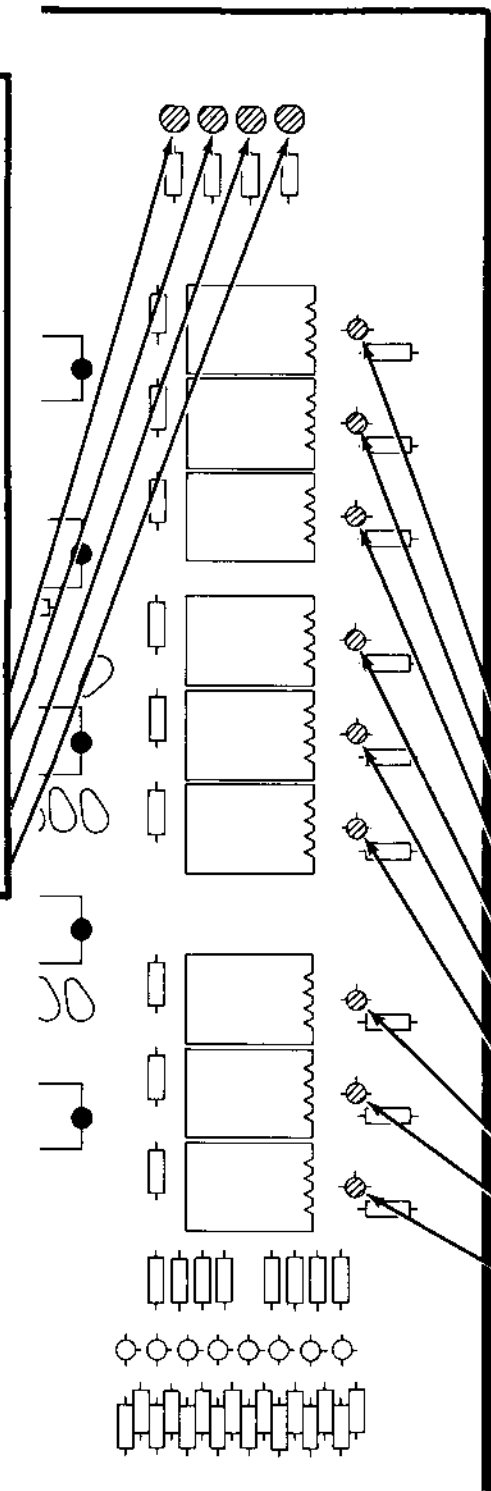
PICTORIAL 3-5

START

Install four LED lamps (#412-611) at the following locations. Be sure to position the flat on the LED as shown by the outline of the flat on the circuit board. An LED lamp will not work properly if it is installed backwards. Position the LED 1/4" away from the circuit board. Then solder the leads to the foil and cut off the excess lead lengths.

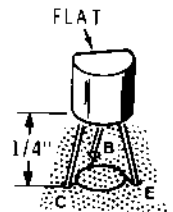
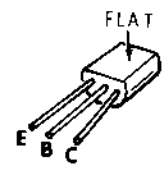


- (1) LED111.
- (2) LED112.
- (3) LED113.
- (4) LED114.



CONTINUE

NOTE: Use the following procedure when you perform the next step. First identify the C, B, and E leads. Then insert the leads into their correct C, B, and E holes in the circuit board as shown. Solder the leads to the foil and cut off the excess lead lengths.

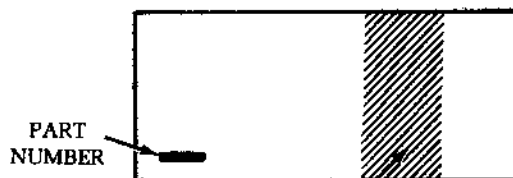


Install nine MPSA13 transistors (#417-881) at the following locations:

- Q101.
- Q102.
- Q103.
- Q104.
- Q105.
- Q106.
- Q107. FM
- Q108.
- Q109.

PICTORIAL 3-6

IDENTIFICATION
DRAWING



The steps performed in this Pictorial are in this area of the circuit board.

START ↘

NOTE: Reposition the circuit board as shown in the identification drawing at the top of this page. The drawing also indicates the area of the circuit board that you will be working in.

Install eight 560 Ω (green-blue-brown) resistors at:

- (0) R105.
- (ψ) R108.
- (0) R109.
- (0) R113.
- (A) R114.
- (2) R117.
- (!) R118.
- (.) R122.

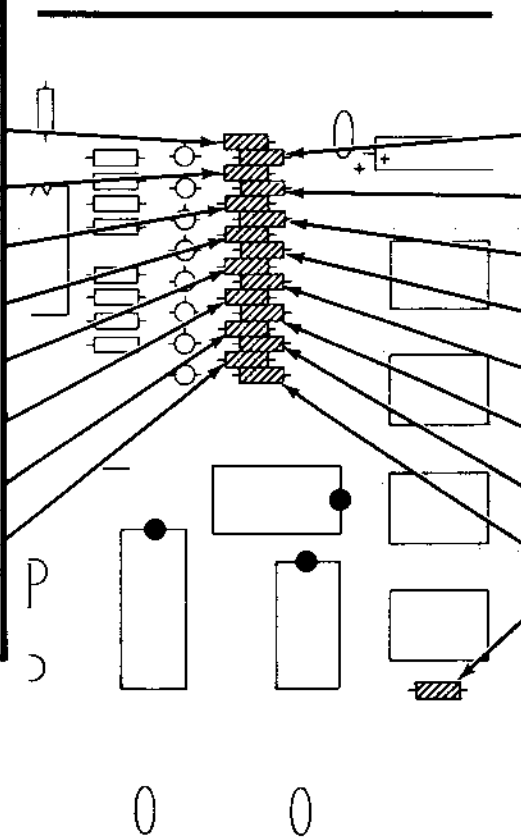
Solder the leads to the foil and cut off the excess lead lengths.

CONTINUE ↘

Install nine 1000 Ω (brown-black-red) resistors at:

- (-) R106.
- (-) R107.
- (-) R111.
- (.) R112.
- (.) R115.
- (.) R116.
- (-) R119.
- (-) R121.
- (-) R165.

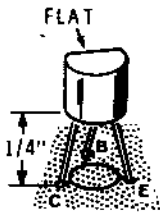
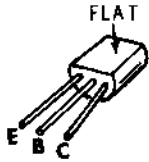
(?) Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 3-7

START

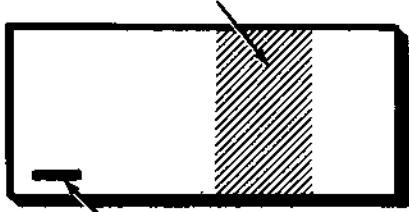
NOTE: Use the following procedure when you perform the next step. First identify the C, B, and E leads. Then insert the leads into their correct C, B, and E holes in the circuit board as shown. Solder the leads to the foil and cut off the excess lead lengths.



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

- Q111.
- Q112.
- Q113.
- Q114.
- Q115.
- Q116.
- Q117.
- Q118.

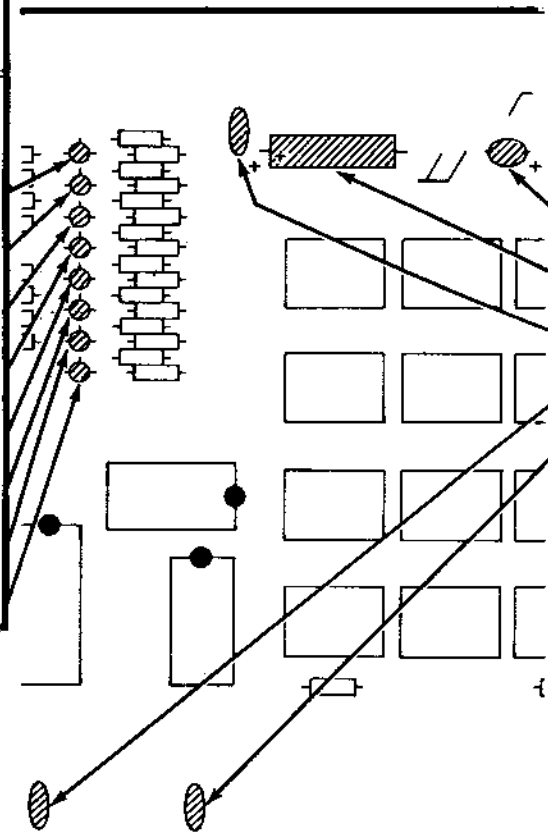
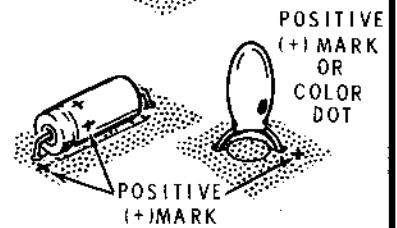
The steps performed in this Pictorial are in this area of the circuit board.



IDENTIFICATION DRAWING

CONTINUE

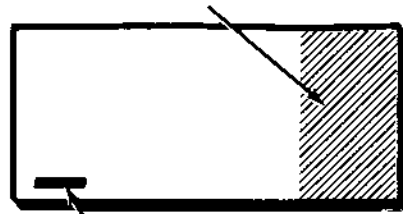
NOTE: When you install electrolytic and tantalum capacitors, be sure to match the positive (+) mark or color dot on the capacitor with the positive (+) mark on the circuit board as shown.



- C102: 2.2 μ F tantalum.
- C103: 100 μ F tantalum.
- C104: .1 μ F ceramic.
- C115: .1 μ F ceramic.
- C114: .1 μ F ceramic.
- Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 3-8

The steps performed in this Pictorial are in this area of the circuit board.



PART NUMBER

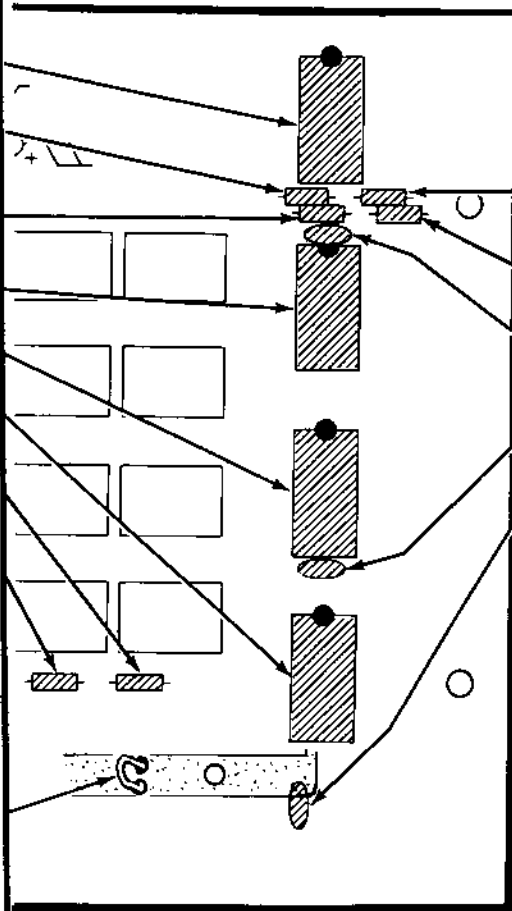
IDENTIFICATION DRAWING

START ↘

NOTE: Solder the pins of each IC socket to the foil as you install it.

- () 16-pin IC socket at IC119.
- (✓) R158: 1000 Ω (brown-black-red).
- (✓) R159: 1000 Ω (brown-black-red).
- (✓) 16-pin IC socket at IC118.
- (✓) 16-pin IC socket at IC117.
- (✓) 16-pin IC socket at IC116.
- (✓) R162: 1000 Ω (brown-black-red).
- (✓) R163: 1000 Ω (brown-black-red).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.

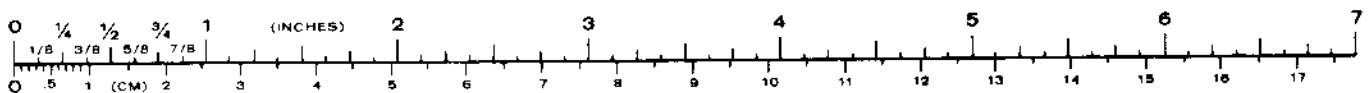
(✓) Remove all the insulation from a 1" white wire. Then form the wire into a loop and install the wire at the location shown. NOTE: These holes are not labeled on the circuit board. Position the top of the loop 1/4" above the top of the circuit board. Then solder the wire to the foil and cut off any excess wire end.



CONTINUE ↘

- (✓) R156: 1000 Ω (brown-black-red).
- (✓) R157: 1000 Ω (brown-black-red).
- (✓) C118: .1 μF ceramic.
- (✓) C117: .1 μF ceramic.
- (✓) C116: .1 μF ceramic.
- (✓) Solder the leads to the foil and cut off the excess lead lengths.

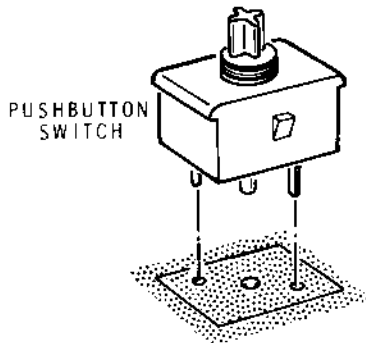
PICTORIAL 3-9



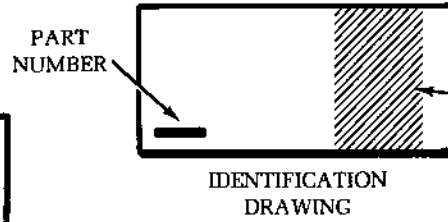
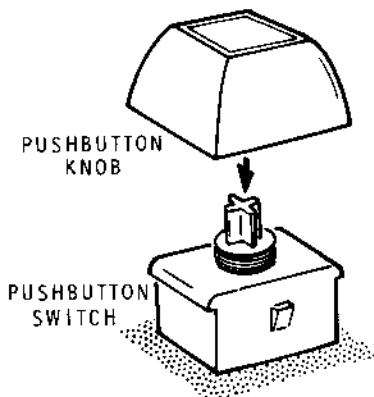
START →

(✓) SW101 through SW116: Install sixteen pushbutton switches as follows:

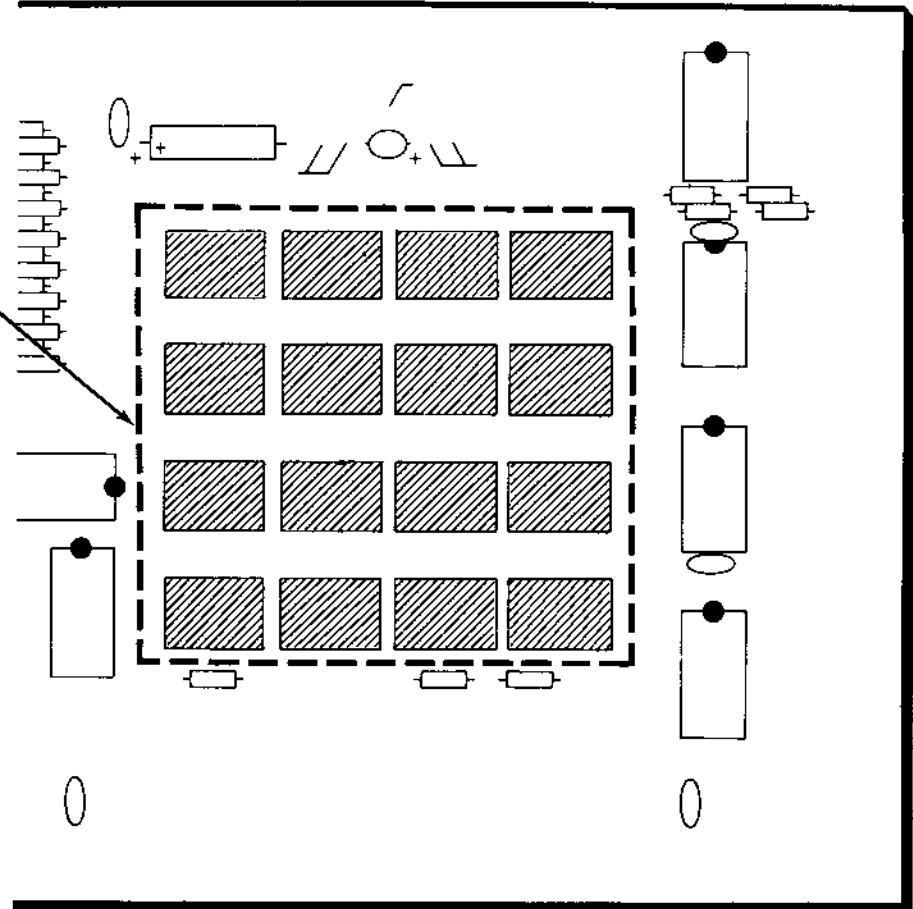
1. Push each switch down firmly against the top of the circuit board. The switch may be installed in the circuit board either way.
2. Solder the two lugs of the switch to the foil.
3. Check the switch to make sure it is still flat against the circuit board. If necessary, reheat the lugs and reposition the switch.



(✓) Install a pushbutton knob onto each of the sixteen pushbutton switches.



The steps performed in this Pictorial are in this area of the circuit board.



PICTORIAL 3-10



The steps performed in this Pictorial are in this area of the circuit board.

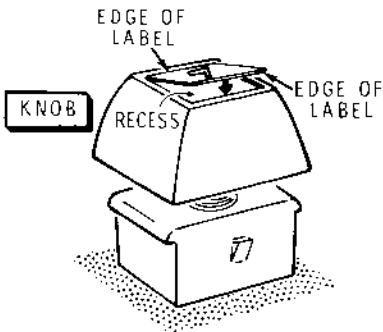
IDENTIFICATION DRAWING

START

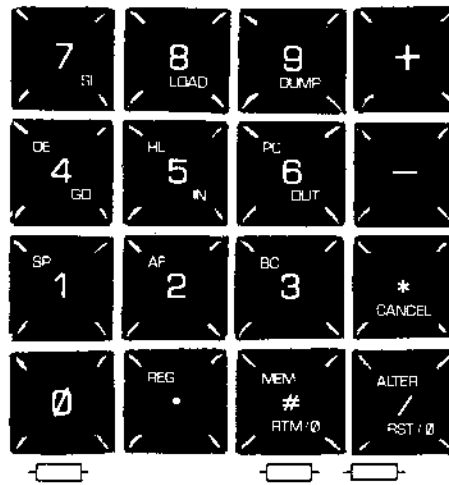
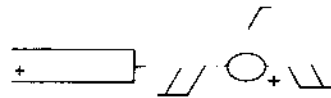
NOTE: If you install a label on the wrong knob in the next step, pull the knob straight off of the switch and reinstall the knob at the correct location.

(✓) Locate the keyboard label set and install each label as follows:

1. Remove a label from its protective backing.
2. Position one edge of the label against the edge of the recess of the corresponding knob.
3. Lower the opposite edge of the label into the recess of the knob. Then press the label into place.



NOTE: Save the remaining label material for use later.



CONTINUE

CIRCUIT BOARD CHECKOUT

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

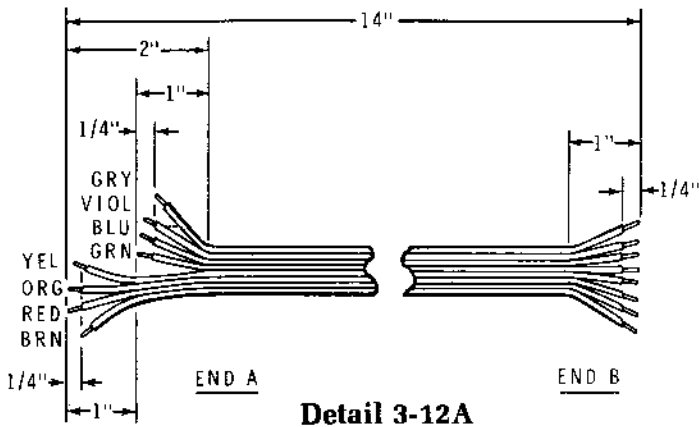
- (✓) Unsoldered connections.
- (✓) Poor solder connections.
- (✓) Solder bridges between foil patterns.
- (✓) Protruding leads which could touch together.

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

- (✓) Transistors for proper type and installation.
- (✓) Tantalum capacitors for the correct position of the positive (+) mark.
- (✓) Diode for the correct position of the banded end.

() Set the IC's and the LED read-outs aside. They will be installed during checkout.

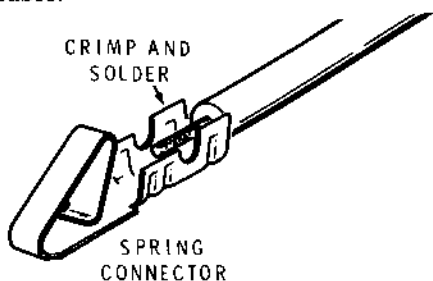
PICTORIAL 3-11



Detail 3-12A

Refer to Pictorial 3-12 (Illustration Booklet, Page 7) for the following steps.

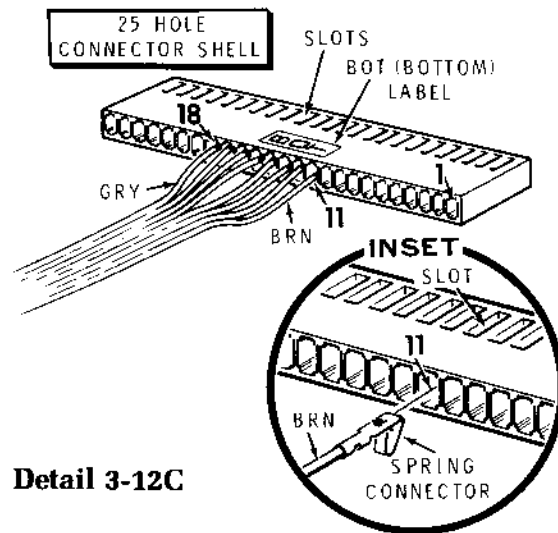
- () Refer to Detail 3-12A and prepare a 14" length of 8-wire cable as shown.
- () Refer to Detail 3-12B and install a spring connector (#432-866) on each wire at end B of the cable.



Detail 3-12B

NOTES:

1. The numbers assigned to the 25-hole connectors are only for use during assembly. These hole numbers will not agree with the numbers shown on the Schematic or on the mating connectors on the mother circuit board.
 2. When you perform the following steps, be sure to position the connector shell and spring connectors as shown before you insert the connectors into the shell. Push in on the wire until the connector snaps into place. Disregard any numbers stamped in the shell.
- (✓) Refer to Detail 3-12C and insert the spring connector on the brown wire into hole 11 of a 25-hole connector shell.



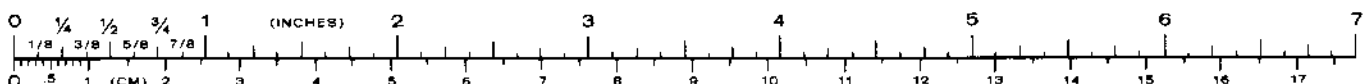
Detail 3-12C

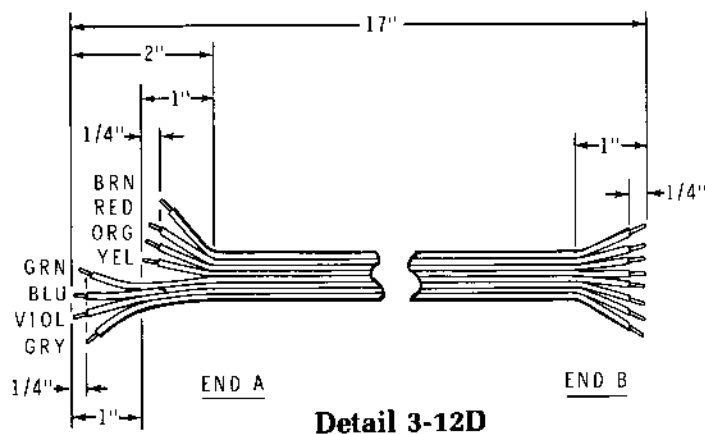
Insert the remainder of the spring connectors into the holes of the connector shell as follows:

- (✓) Red wire into hole 12.
- () Orange wire into hole 13.
- () Yellow wire into hole 14.
- () Green wire into hole 15.
- () Blue wire into hole 16.
- () Violet wire into hole 17.
- () Gray wire into hole 18.
- (✓) Locate the keyboard label set. Then cut and remove the BOT (bottom) label from its protective backing. Then press the label onto the 25-hole connector shell as shown in Detail 3-12C.
- (✓) Position the control circuit board as shown in the Pictorial with the component side down.

Connect end A of the 8-wire cable to the control circuit board as follows. Leave 1/8" of bare wire exposed for soldering and solder the wires to the foil as you install them.

- (✓) Yellow wire to hole $\overline{D3}$.
- () Orange wire to hole $\overline{D2}$.



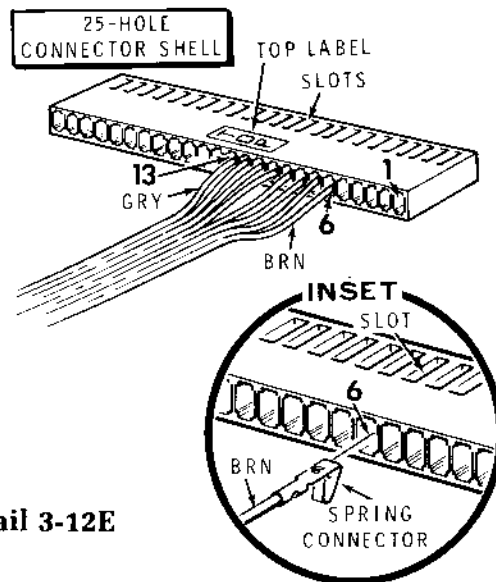


Detail 3-12D

- (✓) Red wire to hole $\overline{D1}$.
- (✓) Brown wire to hole $\overline{D8}$.
- (✓) Green wire to hole $\overline{D4}$.
- (✓) Blue wire to hole $\overline{D5}$.
- (✓) Violet wire to hole $\overline{D6}$.
- (✓) Gray wire to hole $\overline{D7}$.
- (✓) Refer to Detail 3-12D and prepare a 17" length of 8-wire cable as shown.
- (✓) Install a spring connector (#432-866) on each wire at end B of the cable. Refer back to Detail 3-12B if necessary.
- (✓) Refer to Detail 3-12E and insert the spring connector on the brown wire into hole 6 of the remaining 25-hole connector shell. Disregard any numbers stamped in the shell.

Insert the remainder of the spring connectors into the holes of the connector shell as follows:

- (✓) Red wire into hole 7.
- (✓) Orange wire into hole 8.
- (✓) Yellow wire into hole 9.
- (✓) Green wire into hole 10.
- (✓) Blue wire into hole 11.
- (✓) Violet wire into hole 12.
- (✓) Gray wire into hole 13.



Detail 3-12E

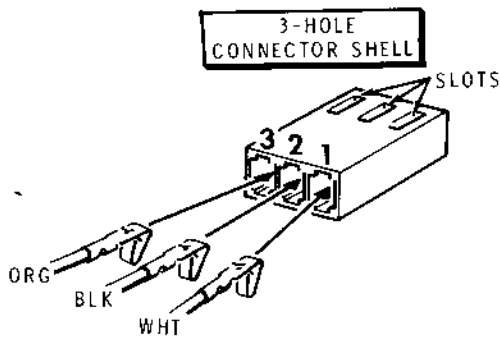
- (✓) Locate the keyboard label set. Then cut and remove the TOP label from its protective backing. Then press the label onto the connector shell as shown in Detail 3-12E.

Connect end A of the 8-wire cable to the control circuit board as follows. Solder the wires to the foil as you install them.

- (✓) Gray wire to hole $\overline{A7}$.
- (✓) Violet wire to hole $\overline{A6}$.
- (✓) Blue wire to hole $\overline{A5}$.
- (✓) Green wire to hole $\overline{A4}$.
- (✓) Brown wire to hole $\overline{A8}$.
- (✓) Red wire to hole $\overline{A1}$.
- (✓) Orange wire to hole $\overline{A2}$.
- (✓) Yellow wire to hole $\overline{A3}$.
- (✓) Prepare the following wires:

Two 4" small black
Two 4" orange
One 3-3/4" white
One 4-1/4" white

- () Install a spring connector (#432-866) on one end of each of the prepared wires.



Detail 3-12F

- (✓) Refer to Detail 3-12F and insert the spring connector on the end of either orange wire into hole 3 of a 3-hole connector shell. Disregard any numbers stamped in the shell.
- (✓) Insert the spring connector on either black wire into hole 2 of the 3-hole connector shell.
- (✓) Insert the spring connector on the end of the 3-3/4" white wire into hole 1 of the connector shell.

NOTE: When you connect the wires coming from the 3-hole connector shell to the circuit board in the following steps, be sure to connect the wires to the correct holes as indicated in the Pictorial.

Connect the wires coming from the 3-hole connector shell to the circuit board at IC120 as follows. Solder the wires to the foil as you connect them.

- (✓) Black wire to either hole GND.
- (✓) Orange wire to either hole +8V.
- (✓) White wire to hole +5V.
- (✓) Insert the spring connector on the end of the remaining orange wire into hole 3 of the remaining 3-hole connector shell. Refer back to Detail 3-12F, if necessary.
- (✓) Insert the spring connector on the end of the remaining black wire into hole 2 of the connector shell.
- (✓) Insert the spring connector on the end of the remaining white wire into hole 1 of the connector shell.

Connect the wires coming from the 3-hole connector shell to the circuit board at IC101 as follows. Solder the wires to the foil as you connect them. Be sure to use the correct hole at each location.

- (✓) Black wire to either hole GND.
- (✓) White wire to hole +5V.
- (✓) Orange wire to either hole +8V.

Refer to Pictorial 3-13 (Illustration Booklet, Page 8) for the following steps.

- (✓) Refer to Detail 3-13A and prepare an 18" length of 8-wire cable as shown. At end B of the cable, do not remove any insulation from the ends of the four **short** wires. These four wires will not be connected to anything at this end of the cable.
- (✓) Install spring connectors (#432-866) on the brown, orange, green, and violet wires at **end B** of the cable.

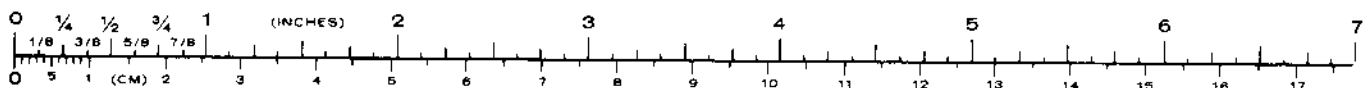
Refer to Detail 3-13B and insert the spring connectors on the prepared cable into the 25-hole connector shells as follows:

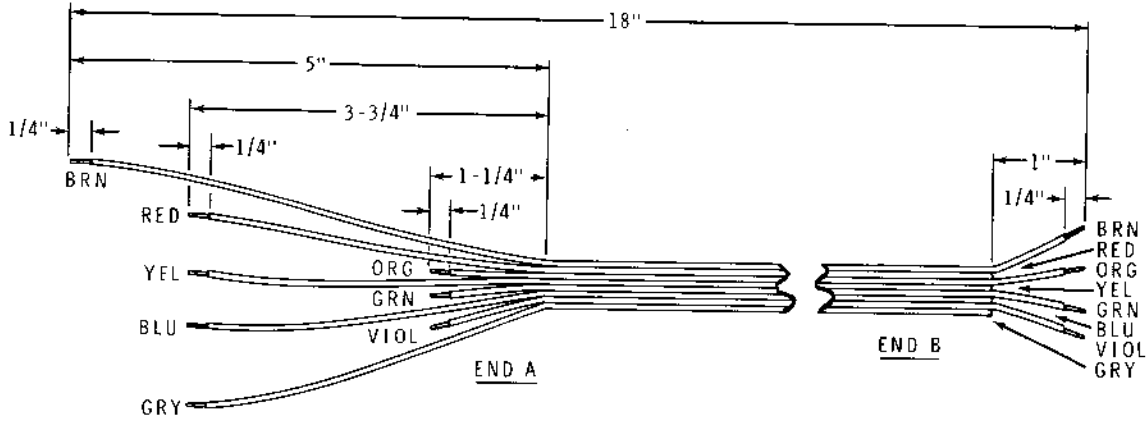
- (✓) Brown wire into hole 20 of the **BOT** (bottom) shell.
- (✓) Orange wire into hole 22 of the BOT shell.
- (✓) Green wire into hole 23 of the BOT shell.
- (✓) Violet wire into hole 2 of the **TOP** shell.

Connect the other end of the 8-wire cable to the control circuit board as follows. Solder the wires to the foil as you connect them.

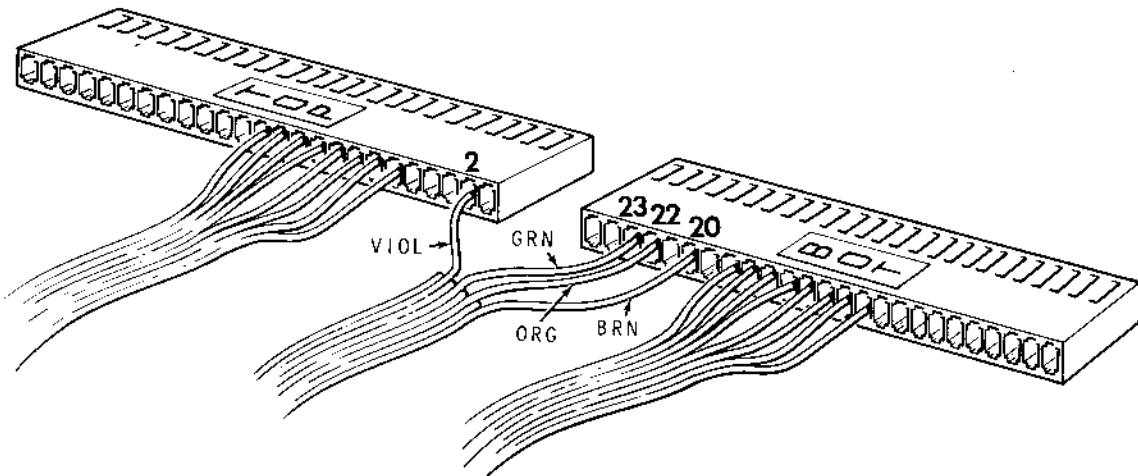
- (✓) Violet wire to hole IOR.
- (✓) Orange wire to hole IOW.
- (✓) Green wire to hole Ø2.
- (✓) Brown wire to hole M1.

NOTE: The red, yellow, blue, and gray cable wires will be connected later.

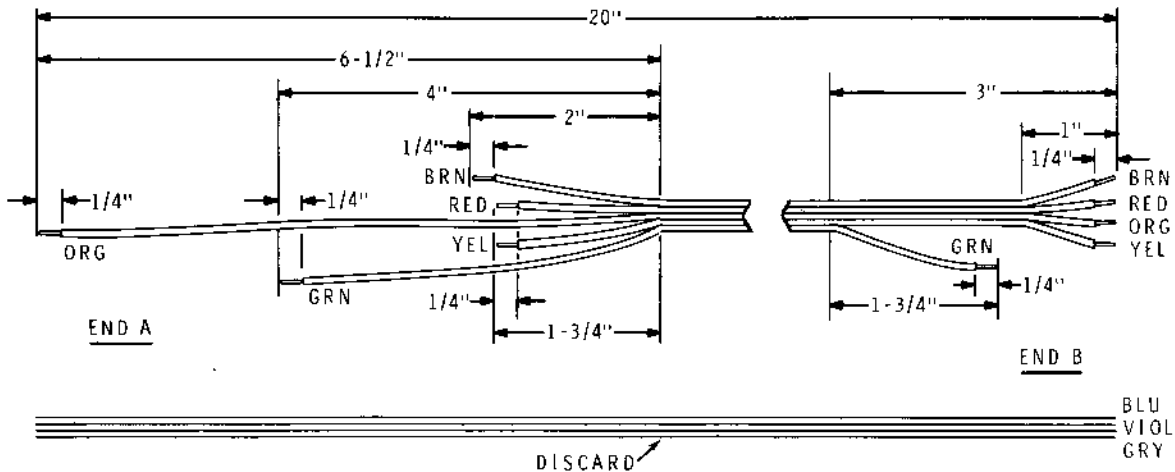




Detail 3-13A



Detail 3-13B



Detail 3-13C

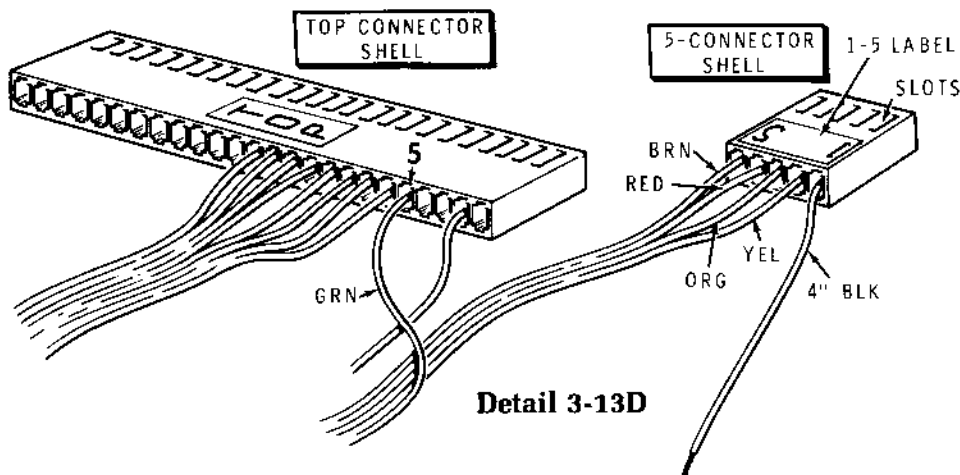
- (✓) Refer to Detail 3-13C and separate a 20" length of 8-wire cable into a 5-wire cable and a 3-wire cable as shown. Discard the 3-wire cable; it will not be used.
- (✓) Prepare the 5-wire cable as shown in Detail 3-13C.
- (✓) Install a spring connector (#432-866) on each wire at **end B** of the cable.
- () Locate the 5-hole connector shell.

NOTE: Disregard any numbers stamped into the 5-hole connector shell when you perform the following steps.

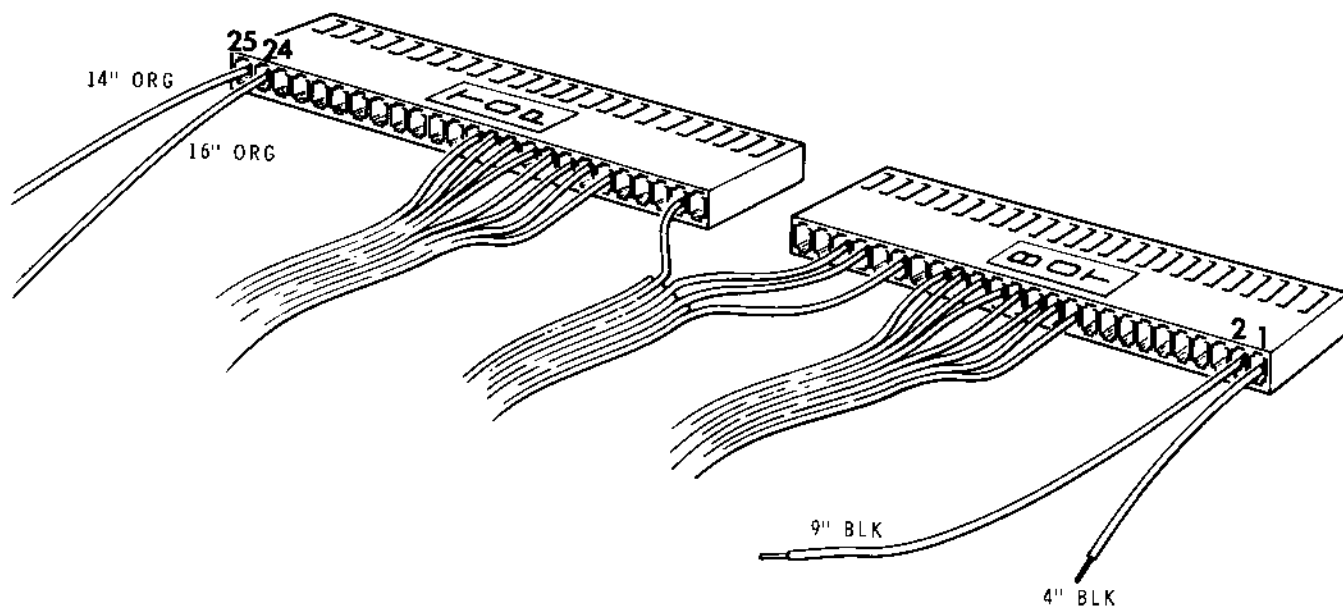
- (✓) Locate the keyboard label set and cut out the "1-5" label. Remove the label from its protective backing and press the label onto the 5-hole connector shell as shown in Detail 3-13D.
- (✓) Refer to Detail 3-13D and insert the spring connector on the brown wire into hole 5 of the 5-hole connector shell.

Insert the spring connectors on the remainder of the wires into the connector shells as follows:

- (✓) Red wire into hole 4 of the 5-hole connector shell.
- (✓) Orange wire into hole 3 of the 5-hole connector shell.
- (✓) Yellow wire into hole 2 of the 5-hole connector shell.
- (✓) Green wire into hole 5 of the **TOP** connector shell.
- (✓) Prepare a 4" length of small black wire.
- (✓) Install a spring connector (#432-866) on **one** end of the prepared wire.
- (✓) Insert the spring connector on the end of the black wire into hole 1 of the 5-hole connector shell.



Detail 3-13D



Detail 3-13E

Connect end A of the 5-wire cable to the control circuit board as follows. Solder the wires to the foil as you connect them.

- (✓) Yellow wire to hole D.
- () Red wire to hole C.
- () Brown wire to hole A.
- (✓) Green wire to hole R.
- (✓) Orange wire to hole B.

(✓) Prepare the following wires:

4" black 16" orange
9" black 14" orange

(✓) Install spring connectors (#432-866) on **one end** of each of the prepared wires.

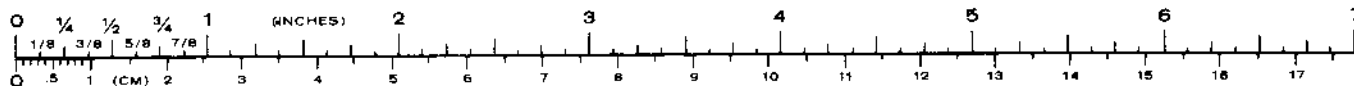
Refer to Detail 3-13E and insert the spring connectors on the ends of the prepared wires into the 25-hole connector shell as follows:

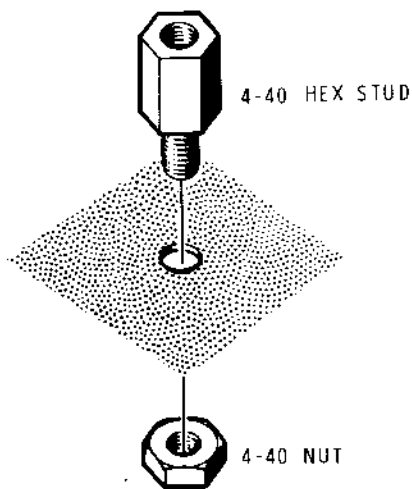
- (✓) 4" black into hole 1 of the BOT shell.
- (✓) 9" black into hole 2 of the BOT shell.
- (✓) 16" orange into hole 24 of the TOP shell.
- (✓) 14" orange into hole 25 of the TOP shell.

Connect the other end of the wires to the control circuit board as follows. Solder the wires to the foil as you connect them.

- (✓) 9" black wire from hole 2 of the BOT shell to hole GND at IC101.
- (✓) 14" orange wire from hole 25 of the TOP shell to hole +8V at IC101.
- (✓) 16" orange wire from hole 24 of the TOP shell to hole +8V at IC120.

NOTE: The 4" black wire from hole 1 of the BOT shell will be connected later.





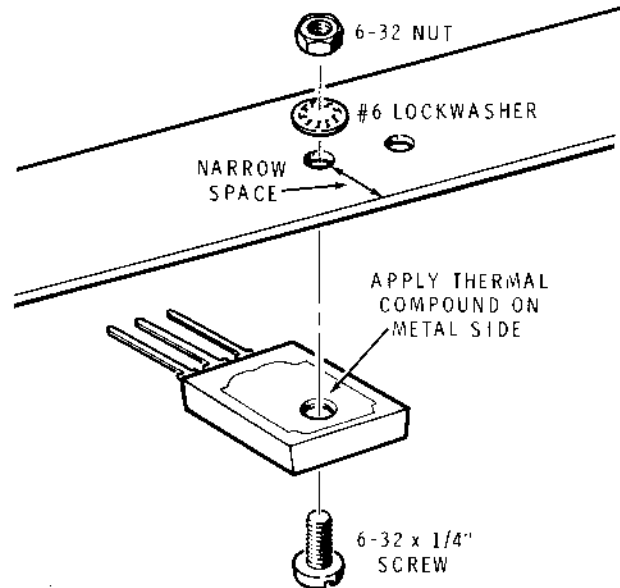
Detail 3-14A

Refer to Pictorial 3-14 (Illustration Booklet, Page 9) for the following steps.

- (✓) Refer to Detail 3-14A and mount a 4-40 hex stud on the control circuit board at GA. Use a 4-40 nut. Do not overtighten the nut.
- (✓) Similarly, mount 4-40 hex studs on the control circuit board at GB, GC, GD, GE, GF, and GG.

WARNING: You will be using Dow Corning 340 thermal heat sink compound in the next step and in several other steps in this Manual. Although the compound is not caustic, it may cause temporary discomfort if it gets into your eyes. If this happens, rinse your eyes with warm water. If the compound gets into your clothing, the clothing may require professional cleaning. The compound contains Zinc Oxides, SiO₂, and slight traces of CO₂.

- (✓) Spread a thin layer of thermal compound on the metal side of two 7805 integrated circuits (#442-54).
- (✓) IC120: Refer to Detail 3-14B and mount a 7805 integrated circuit onto the heat sink at GH. Use 6-32 × 1/4" hardware. Be sure to mount the integrated circuit with the metal side toward the heat sink. Also be sure to use the correct hole on the heat sink and position the integrated circuit as shown in the Pictorial.



Detail 3-14B

- (✓) IC101: In the same manner, mount the other 7805 integrated circuit onto the heat sink at GJ. Use 6-32 × 1/4" hardware and position the integrated circuit as shown in the Pictorial.
- (✓) Position the wires and cables coming from the control circuit board away from the bottom edge of the circuit board.

NOTE: When you mount the heat sink to the circuit board in the following steps, be careful you do not pinch any wires between the heat sink and the mounting studs.

- (✓) Mount the heat sink to the hex stud at GA on the control circuit board with a #4 solder lug, a long solder lug, and a 4-40 × 1/4" screw. Position the solder lugs as shown in the Pictorial.
- (✓) Mount the heat sink to the hex studs at GB, GC, GD, and GE with long solder lugs and 4-40 × 1/4" screws. Position the solder lugs as shown.
- (✓) Mount the heat sink to the hex stud at GF with a 4-40 × 1/4" screw only.
- (✓) Mount the heat sink to the hex stud at GG with a #4 solder lug and a 4-40 × 1/4" screw. Position the solder lug as shown.
- (✓) Cut five 1-1/2" lengths of sleeving. Then slide a length of sleeving on each of the five long solder lugs.



Refer to Pictorial 3-15 (Illustration Booklet, Page 10) for the following steps.

- (✓) Connect the short black wire coming from the BOT connector shell to the solder lug at GA (NS).
- (✓) Connect the four wires (red, yellow, blue, and gray) coming from one of the 8-wire cables to the indicated solder lug at GG (S-4).
- (✓) Position all of the wires coming from the control circuit board along the edge of the heat sink.

Then wrap the long solder lugs on the heat sink around the wires to hold them neatly in place.

- (✓) Install a small cable tie around all of the wires near the BOT connector housing as shown in the inset drawing on the Pictorial.
- (✓) Plug the two 3-hole connector shells onto the integrated circuits at IC101 and IC120. Be sure to position the shells with the white wire as shown.
- (✓) Connect the free end of the short black wire coming from the 5-hole connector shell to the solder lug at GA (S-2).

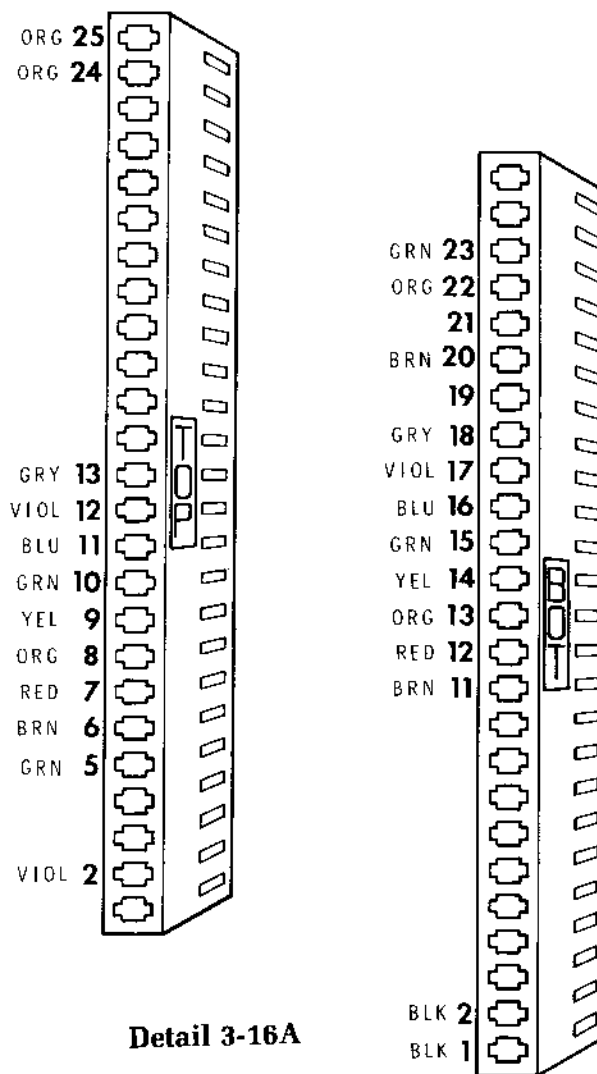
CIRCUIT BOARD INSTALLATION

Refer to Pictorial 3-16 (Illustration Booklet, Page 11) for the following steps.

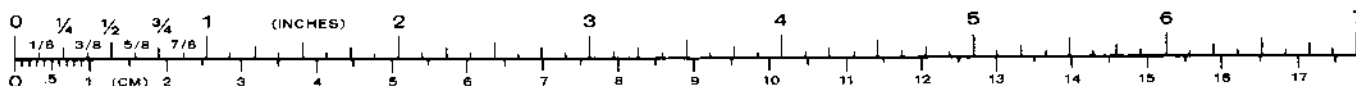
- (✓) Position the control circuit board near the chassis as shown.
- (✓) Locate the twisted pair of wires coming from behind the mother circuit board. Then push the PCB connector on the white wire onto PCB pin E on the back side of the control circuit board.
- (✓) Push the PCB connector on the orange wire onto PCB pin F on the back side of the control circuit board.
- (✓) Push the BOT (bottom) connector shell onto the bottom half of plug P1 on the mother circuit board.
- (✓) Push the TOP connector shell onto the top half of plug P1 on the mother circuit board.

NOTE: The 5-pin connector shell will be connected later.

- (✓) Refer to Detail 3-16A and check the wires in the TOP and BOT connector shells. Be sure each wire is in the correct hole.
- (✓) Mount the control circuit board to the circuit board mounting brackets on the side panels as shown. Use four 6-32 × 1/4" screws. Be careful that you do not pinch any wires between the circuit board and the brackets. Slide the circuit board up away from the bottom of the chassis before you tighten the screws.



Detail 3-16A



CIRCUIT BOARD CHECKS

Refer to Pictorial 3-17 (Illustration Booklet, Page 12) for the following steps.

- () Make sure the POWER switch (rear panel) is in the OFF position.
- () Plug the line cord into the proper AC outlet.

NOTE: If you do not obtain the proper results in the following steps, immediately push the POWER switch to OFF and refer to the "Possible Cause" chart which follows and correct the problem before you continue.

- (✓) Push the POWER switch to ON. The PWR LED (LED111) should light.

PROBLEM	POSSIBLE CAUSE
1. LED111 does not light.	<ul style="list-style-type: none"> A. Solder bridge on mother circuit board. B. Wiring error on control circuit board. C. IC120. D. LED111. E. C106.

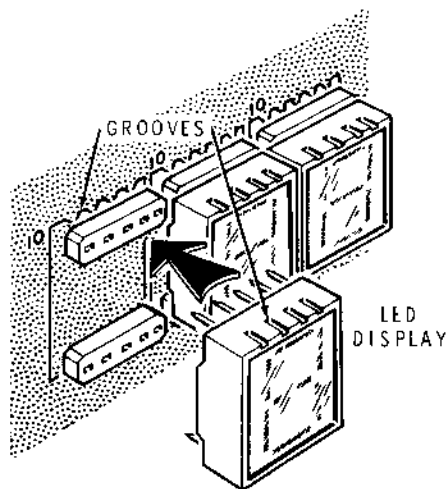
- (✓) Connect the black or common lead of your VTVM to one of the ground test loops on the control circuit board. Do not allow the lead to touch any other part of the circuit board.
- (✓) Set your VTVM to read +5 volts DC.
- (✓) Touch the probe of your VTVM to the indicated foil at TP1. The meter should indicate between +4-3/4 and +5-1/4 volts.

PROBLEM	POSSIBLE CAUSE
1. TP1 does not indicate between 4-3/4 and 5-1/4 volts.	<ul style="list-style-type: none"> A. Solder bridge on control circuit board. B. Wiring error on control circuit board. C. IC101. D. Q101-Q118.

- (✓) Touch your VTVM probe to the indicated foil at TP2. The meter should indicate between +4-3/4 and +5-1/4 volts.

PROBLEM	POSSIBLE CAUSE
1. TP2 does not indicate between 4-3/4 and 5-1/4 volts.	<ul style="list-style-type: none"> A. Solder bridge on control circuit board. B. Wiring error on control circuit board. C. IC120.

- (✓) Push the Power switch to OFF and unplug the line cord.
- (✓) Disconnect the VTVM from the control circuit board.



Detail 3-18A

Refer to Pictorial 3-18 (Illustration Booklet, Page 13) for the following steps.

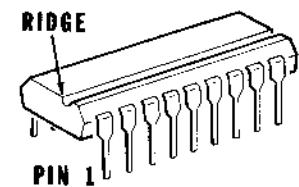
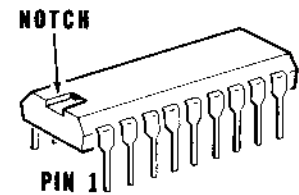
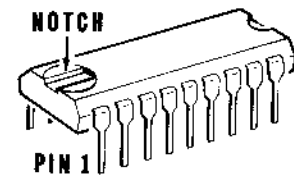
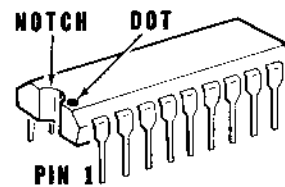
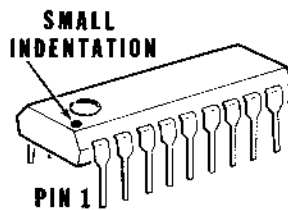
NOTE: Use one hand to give the circuit board some support when you perform the following steps.

- (✓) LED101: Refer to Detail 3-18A and note that one side of the LED display has grooves. Position the grooves **up** and install an LED display in the 5-pin sockets at LED101. Be sure the pins are straight and each pin goes into a socket hole.
- (✓) LED102-LED109: Position the grooves **up** and mount the remaining eight LED displays in the remaining sets of 5-pin sockets.

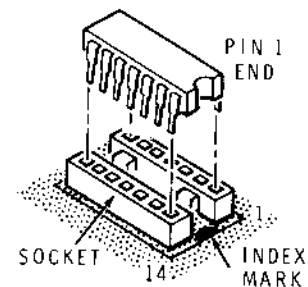
NOTES:

1. If it ever becomes necessary to remove an IC from its socket, use the IC lifter. Refer to the inset drawing on the Pictorial and insert the foot of the lifter beneath the IC; then gently rock the tool back and forth to lift the IC.
2. Refer to Detail 3-18B and, as you install each IC in the following steps, position the pin 1 end of each IC (as shown in Part A of the Detail) toward the index mark on the circuit board (see Part B). Then insert the IC leads into the socket and push the IC down into place.
- (✓) IC107: Install a 74123 IC (#443-90) at IC107.
- (✓) IC102: Install a 7474 IC (#443-6) at IC102.

PART A



PART B



Detail 3-18B

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

- (✓) IC103: Install a 14040 IC (#443-760) at IC103 as follows:
 1. Remove the IC from the conductive foam.
 2. Hold the IC in one hand and straighten any bent pins with the other hand.
 3. Continue holding the IC, being careful not to touch it to anything while you touch the circuit board with your other hand.
 4. Install the IC in its socket.



Install IC's at the following locations:

- IC104: 74LS04 IC (#443-755) at IC104.
- IC105: 7430 IC (#443-3) at IC105.
- IC106: 74LS175 IC (#443-752) at IC106.
- IC108: 7474 IC (#443-6) at IC108.
- IC109: 74LS04 IC (#443-755) at IC109.
- IC110: 7400 IC (#443-1) at IC110.
- IC111: 7402 IC (#443-46) at IC111.
- IC112: 7403 IC (#443-54) at IC112.
- IC113: 74LS240 IC (#443-754) at IC113.
- IC114: 74148 IC (#443-756) at IC114.
- IC115: 74148 IC (#443-756) at IC115.

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

- IC119: Install a 14028 IC (#443-713) at IC119 as follows:
 1. Remove the IC from the conductive foam.
 2. Hold the IC in one hand and straighten any bent pins with the other hand.
 3. Continue holding the IC, being careful not to touch it to anything while you touch the circuit board with your other hand.
 - A. Install the IC in its socket.
- IC118: Install a 74LS175 IC (#443-752) at IC118.
- IC117: Install a 74LS175 IC (#443-752) at IC117.
- IC116: Install a 74LS175 IC (#443-752) at IC116.
- Check each IC just installed for the proper type and installation.
- Plug the line cord into the proper AC outlet.
- Push the POWER switch to ON. The PWR LED (LED111) should light.

PROBLEM	POSSIBLE CAUSE
1. LED111 does not light.	A. IC102-IC119 installed wrong.

- Push the POWER switch to OFF.
- Unplug the line cord.

This completes the "Control Circuit Board" assembly, installation, and initial checkout. Proceed to "CPU Circuit Board."



CPU CIRCUIT BOARD

NOTE: This circuit board was factory assembled and checked. The following Parts List is included for parts replacement purposes.

IMPORTANT: The CPU circuit board assembly has been wired and tested at Heath Company. If it malfunctions during the 90-day period, return the complete circuit board assembly to Heath Company or a Heathkit Electronic Center. It will be promptly repaired and returned. **Individual replacement parts are not supplied under warranty. DO NOT** attempt to service this circuit board assembly yourself during the warranty period; to do so voids the warranty.

Out-of-warranty circuit boards can be serviced by Heath Company (or through a local Heathkit Electronic Center), or you can purchase individual replacement parts to do your own service.

REPLACEMENT PARTS LIST

The Circuit Component numbers in the following list correspond to the numbers on the X-Ray View and Schematic for this circuit board.

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Customer Service" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
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RESISTORS

NOTE: The following resistors are 1/4-watt and have a tolerance of 5% unless otherwise noted.

R201, R202	1-69-12	1000 Ω
R203	1-85-12	220 k Ω
R204-R209	1-69-12	1000 Ω
R110	—	NOT USED
R211-R219	1-69-12	1000 Ω

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
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Resistors (cont'd.)

R220	—	NOT USED
R221-R229	1-69-12	1000 Ω
R230	—	NOT USED
R231	2-46-12	2500 Ω , 1% precision
R232	2-59-12	1780 Ω , 1% precision
R233	2-46-12	2500 Ω , 1% precision
R234	2-61-12	2050 Ω , 1% precision
R235	1-69-12	1000 Ω



CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
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CAPACITORS

C201	20-52	7.5 pF mica
C202-C204	25-221	2.2 μ F tantalum
C205	21-143	.05 μ F ceramic
C206, C207	25-221	2.2 μ F tantalum
C208, C209	21-143	.05 μ F ceramic
C210	—	NOT USED
C211, C212	25-221	2.2 μ F tantalum
C213-C219	21-95	.1 μ F ceramic
C220	—	NOT USED
C221, C222	21-95	.1 μ F ceramic

DIODE — INTEGRATED CIRCUITS (IC's)

D201	56-56	1N4149 diode
IC201	442-54	7805 IC
IC202	442-617	78MGT2C IC
IC203	442-618	79MGT2C IC

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
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Diodes — Integrated Circuits (cont'd.)

IC204	444-13	MK30000 IC
IC205, IC206	443-754	74LS240 IC
IC207	443-3	7430 IC
IC208	443-754	74S240 IC
IC209	443-754	74LS240 IC
IC210	443-754	74S240 IC
IC211	443-754	74LS240 IC
IC212	443-758	8224 IC
IC213	443-762	8080A IC
IC214	443-759	8238 IC
IC215	443-12	7410 IC
IC216	443-730	74LS74 IC
IC217	443-756	74148 IC
IC218	443-754	74LS240 IC

MISCELLANEOUS

Y201	404-590	18.432 MHz crystal
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CIRCUIT BOARD INSTALLATION

Refer to Pictorial 4-1 (Illustration Booklet, Page 14) for the following steps.

- (✓) Locate the box marked "CPU Circuit Board." Then carefully unpack the circuit board. Save the box and packing material so you can use it to return the circuit board for service, if this becomes necessary at a later date.
- (✓) Position the CPU circuit board inside the chassis assembly as shown. Then locate the 5-hole connector shell on the end of the cable coming from the control circuit board. Push the connector shell onto plug P201 on the CPU circuit board. Be sure the end of the shell with the brown wire is positioned as shown.

(✓) Carefully push the two connectors at S201 on the circuit board onto the plugs at P2 on the mother circuit board.

(✓) Secure the CPU circuit board to the bottom of the chassis at FA with a 6-32 × 1/4" screw.

CIRCUIT BOARD CHECK

- () Make sure the POWER switch (rear panel) is in the OFF position.
- () Plug the line cord into the proper AC outlet.

NOTE: If you do not obtain the proper results in the following step, push the POWER switch to OFF and refer to the "Possible Cause" chart which follows:

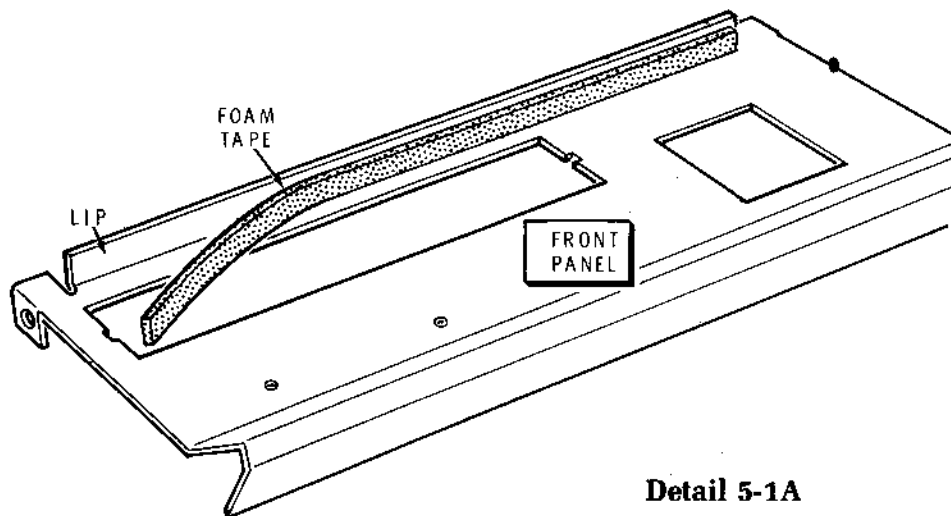
- () Push the POWER switch to ON. The PWR LED (LED111) and the RUN LED (LED112) should light. (The ION LED, LED114, may light after several seconds.)

PROBLEM	POSSIBLE CAUSE
1. LED112 does not light.	<ul style="list-style-type: none"> A. Solder bridge on mother circuit board. B. Wiring error on control circuit board. C. IC107 or IC108. D. LED112.

- () Push the POWER switch to OFF and unplug the line cord.

This completes the CPU circuit board installation and initial checkout. Proceed to "Final Assembly."

FINAL ASSEMBLY



Detail 5-1A

NOTE: You may wish to perform the "Initial Test Routine" and the "Memory Test Routine" in the Operation Manual before you perform the following steps. This will allow you easier access to the control circuit board and CPU circuit board for troubleshooting purposes.

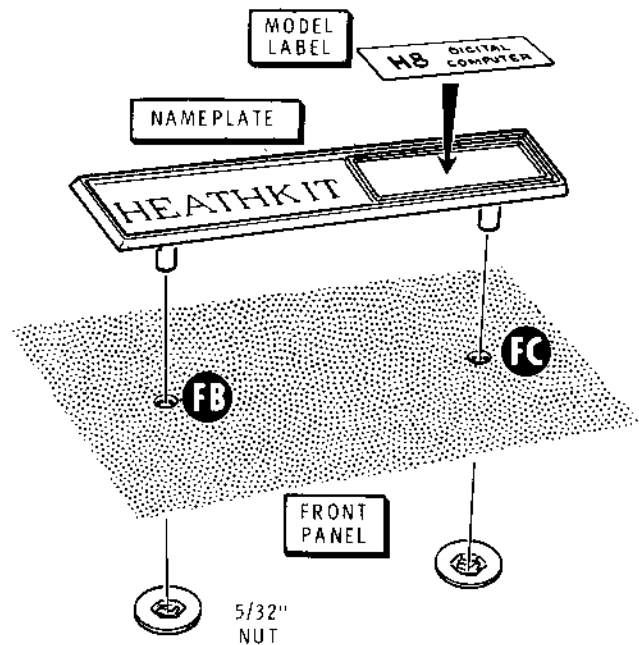
Refer to Pictorial 5-1 (Illustration Booklet, Page 14) for the following steps.

- (M) Locate the front panel and position it as shown in Detail 5-1A.
- (V) Cut a 13-3/4" length of foam tape. Then remove the backing paper and press the tape onto the lip of the front panel as shown in Detail 5-1A.



() Refer to Detail 5-1B and mount the nameplate onto the front panel as follows:

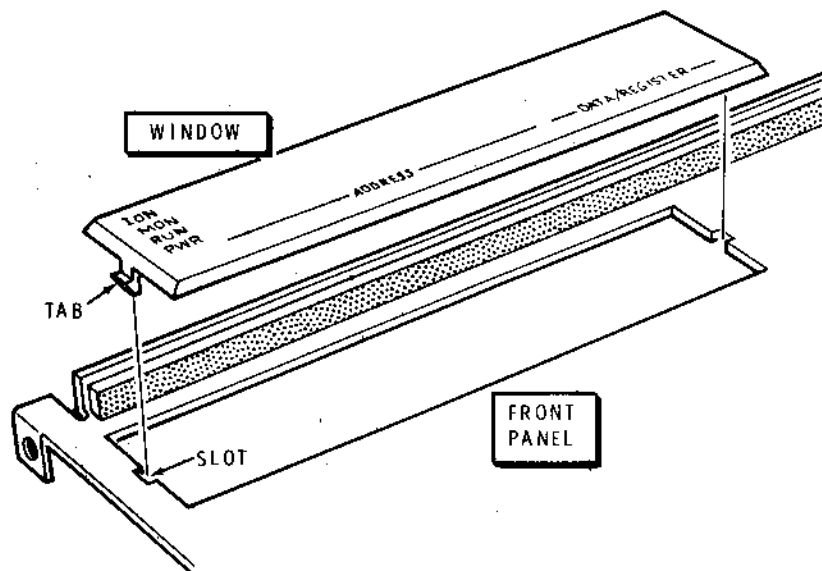
1. From the front of the panel, insert the studs on the nameplate into holes FB and FC.
2. Hold the nameplate in place and turn the front panel over. Then secure the nameplate to the panel with two 5/32" nuts.
3. Carefully peel the backing paper from the model label. Then press the label onto the nameplate in the area shown.



Detail 5-1B

() Refer to Detail 5-1C and mount the window onto the front panel as follows:

1. Wipe off the window with water and detergent to remove all fingerprints. DO NOT SOAK. When the window is dry, hold it only by the edges.
2. From the front of the panel, start one tab on the window into the corresponding slot in the panel. Be sure to position the window with the printing as shown. Then bow the window outward and insert the other tab into its corresponding slot.



Detail 5-1C

() Position the front panel between the chassis side panels as shown in the Pictorial. Be sure the lip on the bottom of the front panel is under the lip on the chassis. Then mount the front panel at BC and BD with two 6-32 \times 1/4" screws and two #6 lockwashers. Do not tighten the screws at this time.

() Secure the front panel to the chassis with two 6-32 \times 3/8" screws and two #6 lockwashers. Tighten these screws only until they are snug. Now tighten the screws at BC and BD.

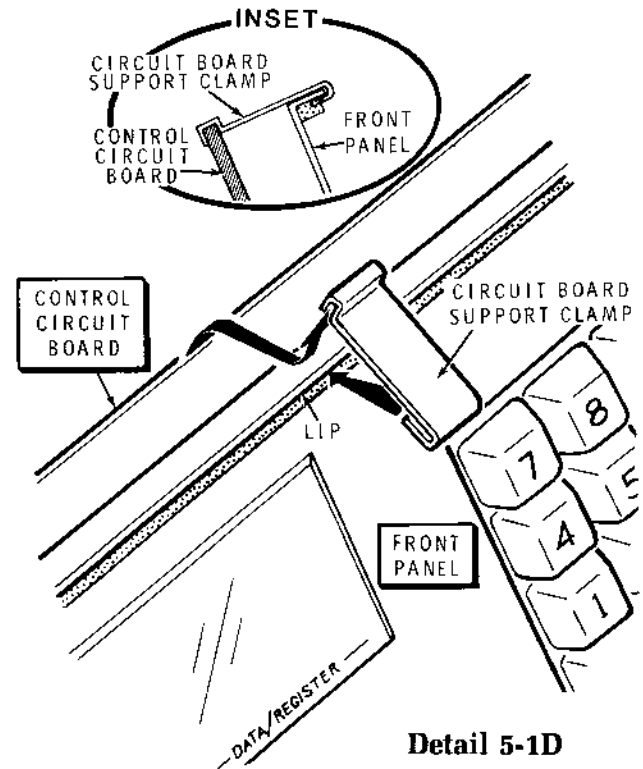
() Refer to Detail 5-1D and install the circuit board support clamp on the front panel as shown. First push the clamp onto the lip of the front panel. Then push the other end of the clamp onto the edge of the control circuit board. Form the clip as necessary so it stays on the edge of the circuit board.

() Refer to Pictorial 5-2 and mount the tie bracket to the rear panel at FD and the CPU circuit board at FE as shown. Use a 6-32 \times 1/4" screw at each location.

Refer to Pictorial 5-3 (Illustration Booklet, Page 14) for the following steps.

() Install the top cover on the chassis assembly as follows:

1. First hook the front of the top cover over the lip on the front panel.
2. Push the rear of the top cover down onto the edge of the rear panel.
3. Secure the top cover at FF and FG with two 6-32 \times 1/4" screws.

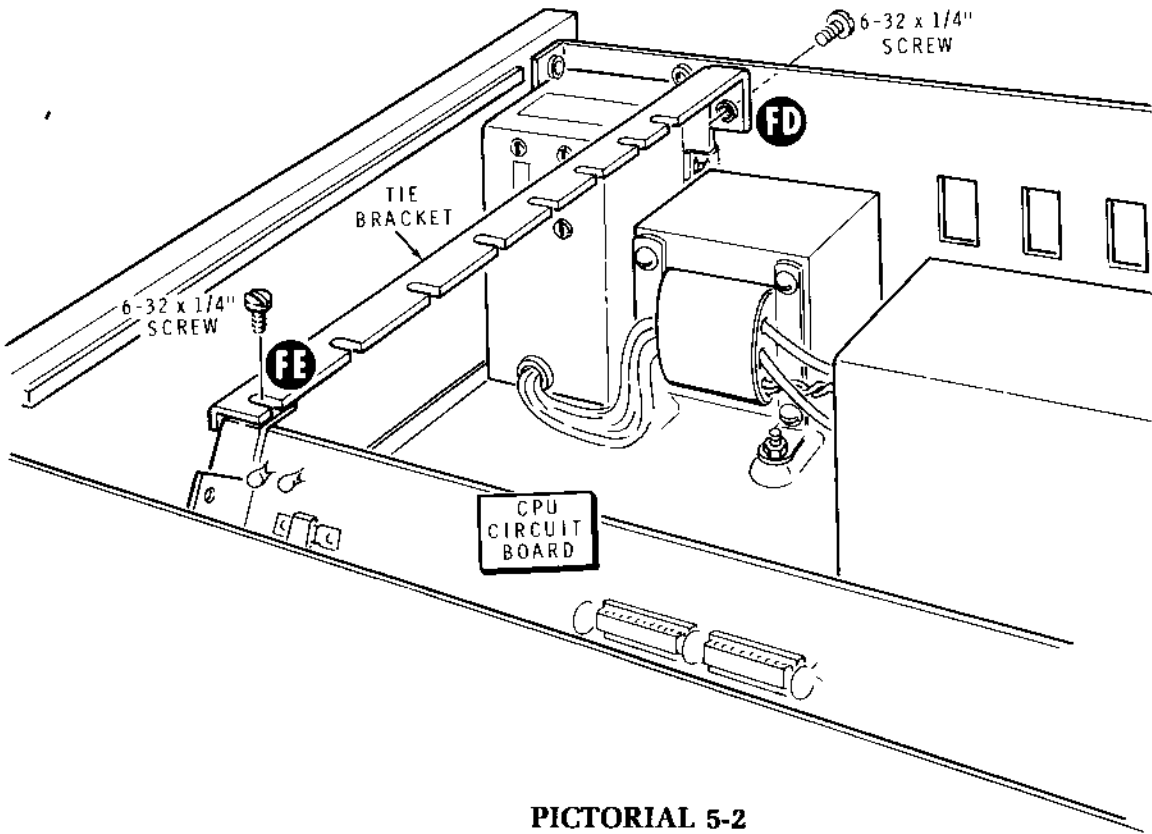


Detail 5-1D

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

() Carefully peel the backing paper from the blue and white label. Then press the label onto the rear of the chassis in the location shown.

This completes the "Final Assembly." Proceed to the Operation Manual.



PICTORIAL 5-2