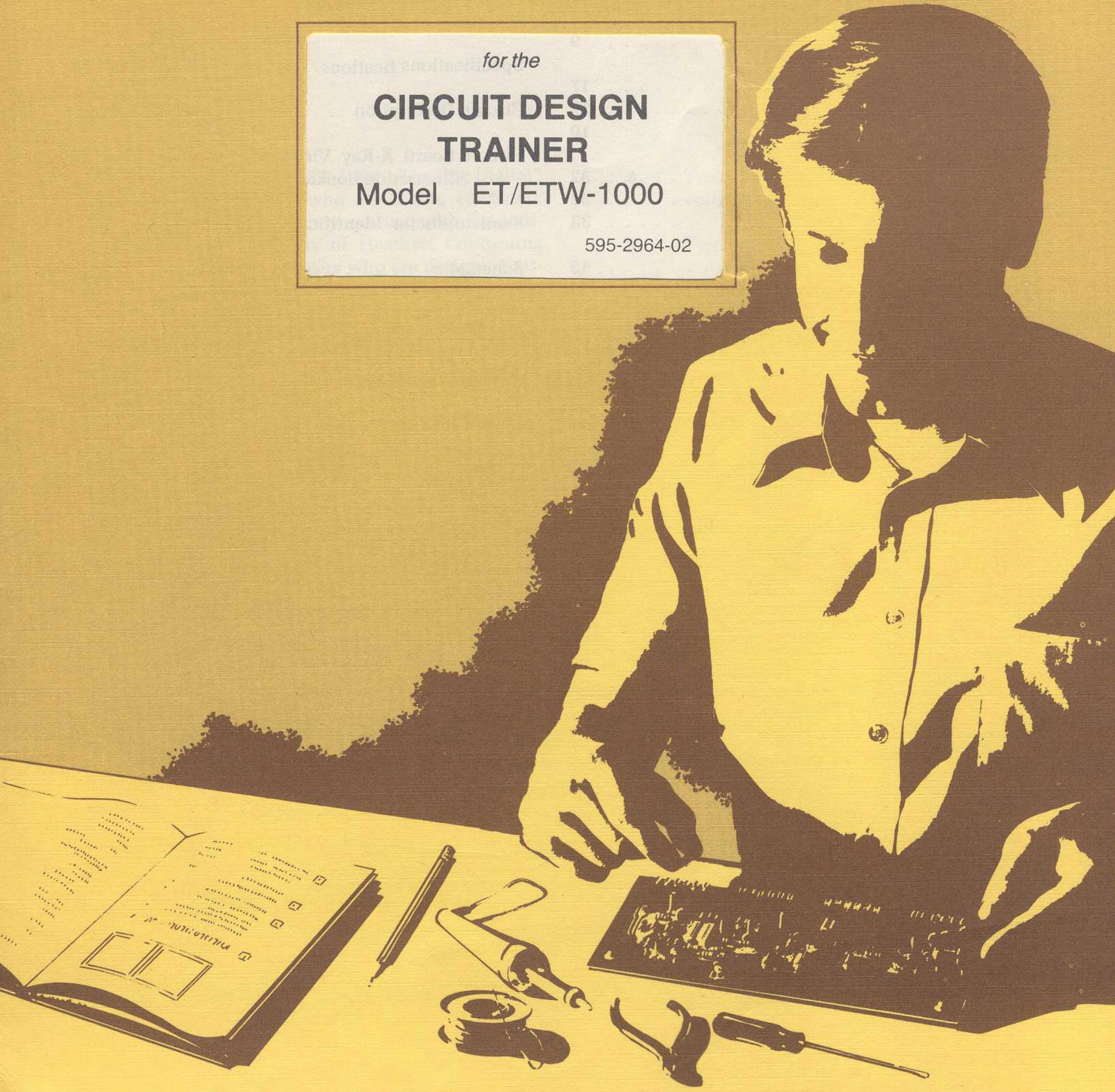
HEATHKIT®
MANUAL

for the

CIRCUIT DESIGN TRAINER

Model ET/ETW-1000

595-2964-02



HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

R/C, Audio, and Electronic Organs	(616) 982-3310
Amateur Radio	(616) 982-3296
Test Equipment, Weather Instruments and Home Clocks	(616) 982-3315
Television	(616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive, Appliances and General Products	(616) 982-3496
Computers — Hardware	(616) 982-3309
Computers — Software:	
Operating Systems, Languages, Utilities	(616) 982-3860
Application Programs	(616) 982-3884
Heath Craft Wood Works	(616) 982-3423

YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

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

Heath's Responsibility

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

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

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

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

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

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

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

Owner's Responsibility

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

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

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

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

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

Heathkit® Manual

for the

CIRCUIT DESIGN TRAINER

Model ET/ETW-1000

595-2964-02

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

TABLE OF CONTENTS

INTRODUCTION

The Heathkit Model ET-1000 "Analog/Digital" Trainer is for students who are taking electronic courses, a learning tool they can use with the individual learning programs of Heathkit Continuing Education, and for engineers who are designing circuits. With the double breadboard, you can quickly build and test circuits that you have designed or want to experiment with. This Trainer has the following built-in features:

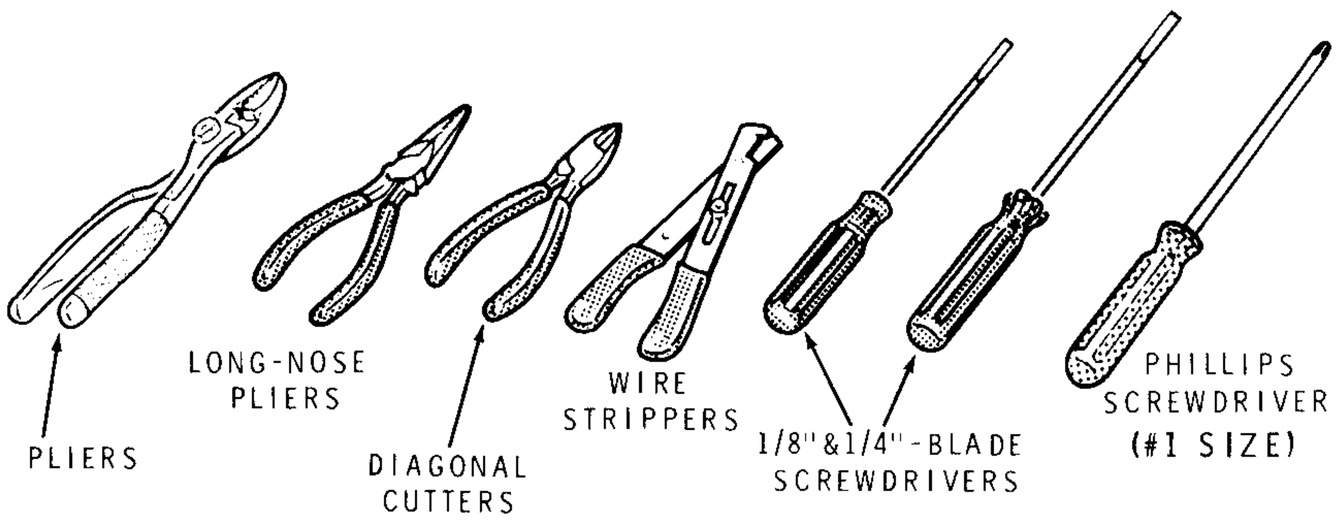
- Logic probe that will detect and indicate HI and LOW logic levels.
- Variable and regulated positive and negative 1.2 to 20 volt DC power supplies.
- A 1 Hz to 100 kHz signal generator with sine, square, and triangle waveform outputs.
- Two 60 Hz sine wave signal sources (15 volts and 30 volts).
- Two "no bounce" logic switches.
- Eight LED logic indicators.
- Connector blocks with "solderless" connections between parts and wires.
- An optional removable breadboard.

Most of the components are mounted on the circuit boards. This makes the kit easy to assemble. The compact size and light weight allow you to move or place the Trainer almost anywhere.

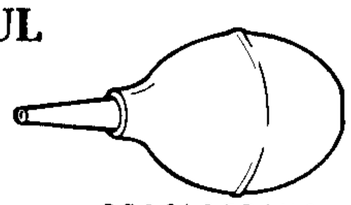
ASSEMBLY NOTES

TOOLS

You will need these tools to assemble your kit.

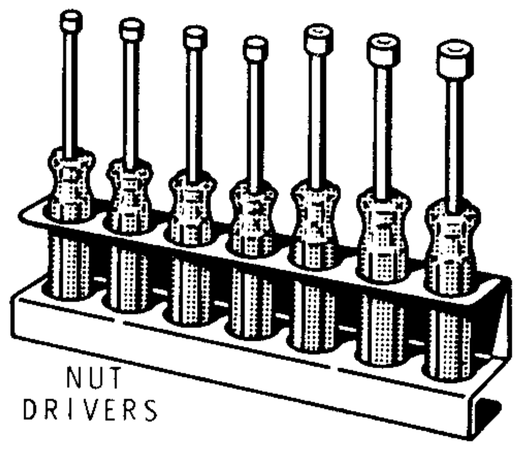


OTHER HELPFUL TOOLS

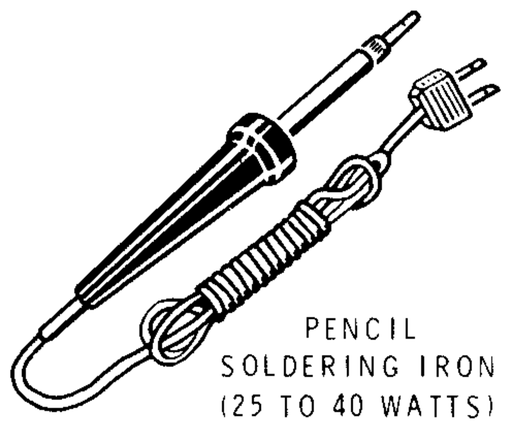

DESOLDERING BULB*


NUT STARTER (MAY BE SUPPLIED WITH KIT)


DESOLDERING BRAID*


NUT DRIVERS

*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS.


PENCIL SOLDERING IRON (25 TO 40 WATTS)

ASSEMBLY

1. Follow the instructions carefully. Read the entire step before you perform each 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 excessive lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

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

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

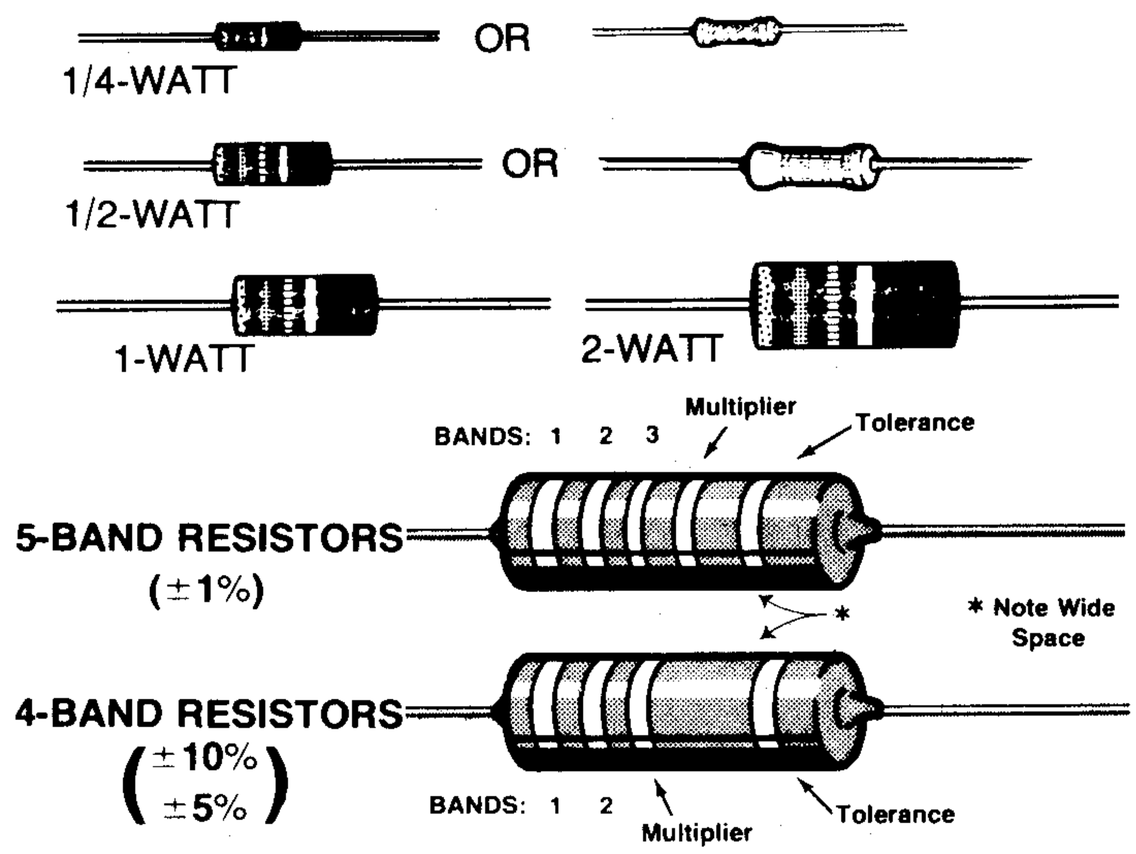
1. Use the right type of soldering iron. A 25 to 40-watt pencil soldering iron with a 1/8″ or 3/16″ chisel or pyramid tip works best.

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.

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

PARTS

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



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

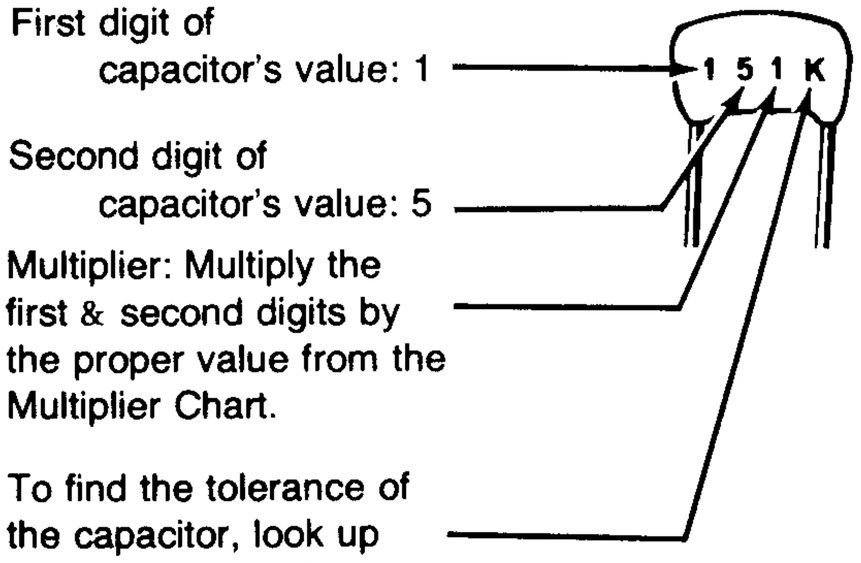
Band 2 2nd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

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

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

Resistance Tolerance	
Color	Tolerance
Silver	±10%
Gold	± 5%
Brown	± 1%

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 × 10 = 150 pF
759 = 75 ×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:	10 pF OR LESS	LETTER	OVER 10 pF
0	1	±0.1 pF	B	
1	10	±0.25 pF	C	
2	100	±0.5 pF	D	
3	1000	±1.0 pF	F	±1%
4	10,000	±2.0 pF	G	±2%
5	100,000		H	±3%
			J	±5%
8	0.01		K	±10%
9	0.1		M	±20%

*DuPont Registered Trademark

POWER SUPPLY CIRCUIT BOARD

PARTS LIST

Refer to the "Pack Index Sheet," and locate Pack #1. Remove Pack #1 and check each part against the following list and Power Supply Circuit Board Parts Pictorial (Illustration Booklet, Page 1). Any part that is packed in an individual envelope with the part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not discard any packing materials until all parts are accounted for.

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

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

RESISTORS

NOTES:

1. All 5% resistors have four color bands (last band gold). This last band (gold) will not be called out.
2. All color banded 1% resistors have five color bands (last band brown). This brown band is set apart from the other bands. The last band (brown) will not be called out.
3. The resistors may be packaged in more than one envelope.

Refer directly to the enclosed "Taped Components Chart." Follow the instructions at the top of that chart to check your resistors and diodes.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
1%, 1/4-Watt				
A1	6-3752-12	1	37.5 kΩ (org-viol-grn-red)	R209
A1	6-1003-12	1	100 kΩ (brn-blk-blk-org)	R205
A1	6-1503-12	2	150 kΩ (brn-grn-blk-org)	R204, R208
A1	6-9003-12	1	900 kΩ (wht-blk-blk-org)	R207
A1	6-2004-12	1	2 MΩ (red-blk-blk-yel)	R206
5%, 1/4-Watt				
A1	6-121-12	2	120 Ω (brn-red-brn)	R202, R203
A1	6-221-12	2	220 Ω (red-red-brn)	R211, R212
A1	6-561-12	1	560 Ω (grn-blu-brn)	R201

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
CAPACITORS				
B1	21-762	4	.1 μF (104) ceramic	C205, C208, C212, C215
B2	27-145	2	.22 μF Mylar	C202, C203
B3	25-866	2	22 μF electrolytic	C213, C216
B4	25-885	2	100 μF electrolytic	C206, C209
B4	25-893	2	1000 μF electrolytic	C211, C214
B3	25-878	2	2200 μF electrolytic	C204, C207
B3	25-903	1	6800 μF electrolytic	C201
DIODES				
C1	57-65	8	1N4002	D205-D209, D211, D212, D213
C1	57-609	4	1N5393	D201-D204
INTEGRATED CIRCUITS				

NOTE: Integrated circuits are marked for identification in one of the following four ways:

1. Part number.
2. Type number. (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.

D1	442-616	1	LM2901	U206
D2	442-674	1	UA7812	U202
D2	442-675	1	UA7912	U203
D2	442-708	1	LM317	U204
D2	442-709	1	LM337	U205
D3	442-30	1	UA309	U201

PLUGS — SOCKETS — HEAT SINKS

E1	432-943	1	2-pin plug
E2	432-829	1	3-pin plug
E3	432-827	2	4-pin plug
E4	434-298	1	14-pin IC socket
E5	434-189	1	3-lug IC socket
E6	215-658	1	Heat sink (black)
E7	215-65	4	Heat sink (gold)

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 the hardware of any one size (#6, for example).

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
#4 Hardware				
F1	250-1411	4	4-40 × 1/4″ pan head screw	
F2	250-1409	8	#4 × 3/8″ self-tapping screw	
F3	252-2	4	4-40 nut	
F4	254-9	4	#4 lockwasher	
#6 Hardware				
G1	250-1280	1	6-32 × 3/8″ pan head screw	
G2	250-1425	2	6-32 × 1/2″ pan head screw	
G3	250-304	1	6-32 stud	
G4	255-129	1	6-32 spacer	
GENERAL				
H1	352-31	1	Thermal compound	
	490-185	1	De-solder wick	

WIRE-SLEEVING-MISCELLANEOUS

Wire (solid)

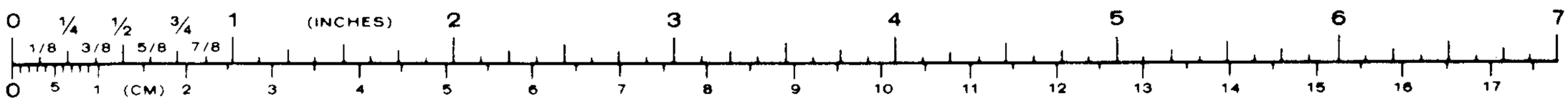
344-50	4′	Black wire
344-51	4′	Brown wire
344-52	4′	Red wire
344-53	4′	Orange wire
344-54	4′	Yellow wire
344-55	4′	Green wire
344-56	4′	Blue wire
344-57	4′	Violet wire
344-59	4′	White wire

Wire (stranded) — Sleeving

344-2	2′3″	Large black wire
344-15	1′	Small black wire
344-16	2′	Red wire
344-80	1′	Orange wire
344-82	1′	White wire
344-155	2′3″	Green wire
346-20	6″	Heath-shrinkable sleeving
346-1	6″	Sleeving

Miscellaneous

85-2871-01	1	Power supply circuit board
390-2405	1	Nameplate
	1	Taped Components Chart
390-2406	1	Caution label
	1	Blue and white label
	1	Parts Order Form
390-1872	1	FCC Compliance label
		Solder
		Assembly Manual (See title page for Part Number.)



STEP-BY-STEP ASSEMBLY

START

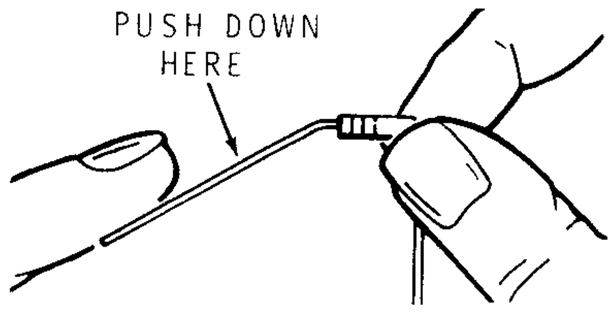
( ) Position the power supply circuit board so the part number is toward the top as shown. The board will be in this position for all of the Pictorials unless specified otherwise.

In the following steps, you will be given detailed instruction 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.

NOTES:

1. When you install a component that has its value printed on it, position the value marking up, so it can be easily read. Diodes should be mounted with their type or part number up, if possible.
2. Refer to the "**Taped Components Chart**" before you begin.

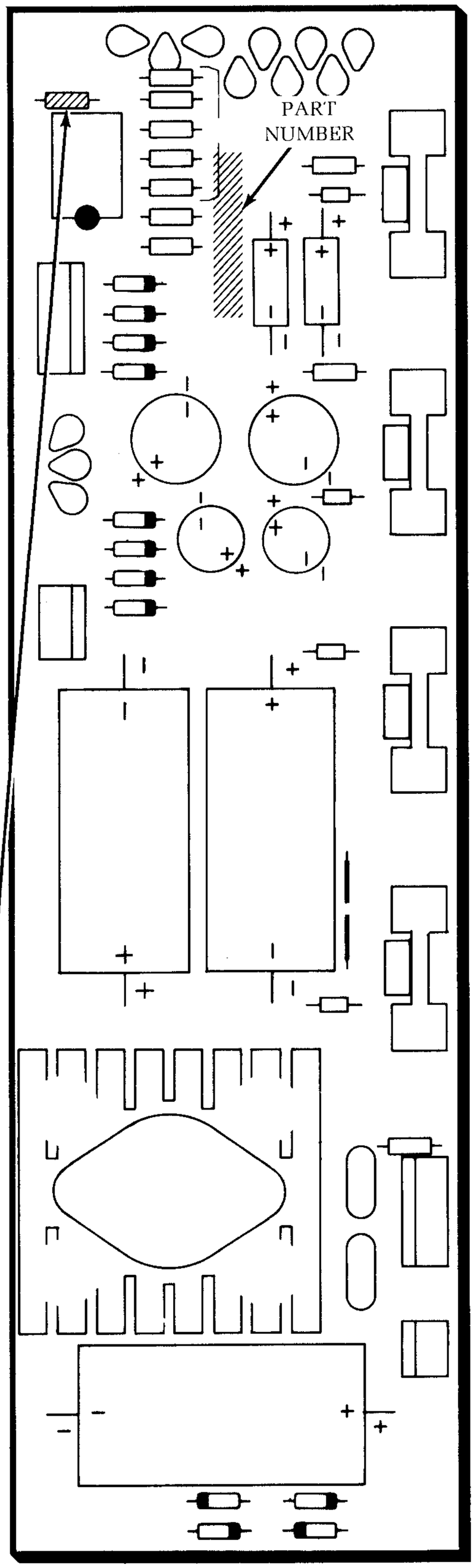
( ) Hold a 900 kΩ, 1% (wht-blk-blk-org) resistor by the body and bend the leads straight down to fit the hole spacing on the circuit board.



( ) R207: 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.

( ) Turn the circuit board over so the foil side is up.

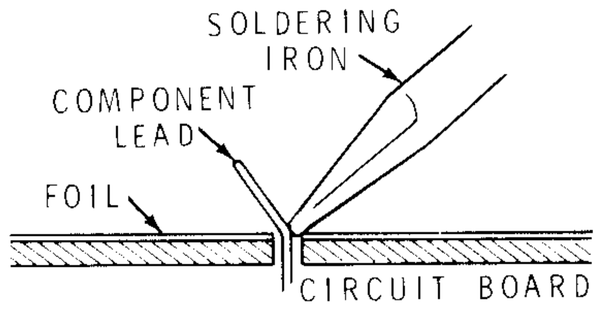


PICTORIAL 1-1

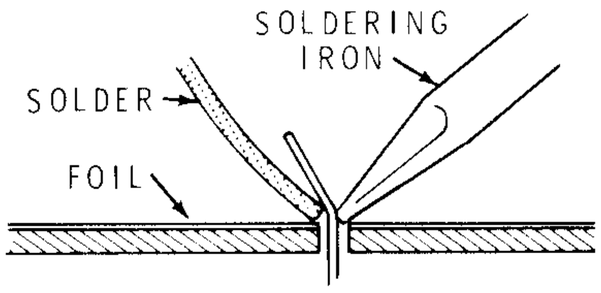
CONTINUE

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

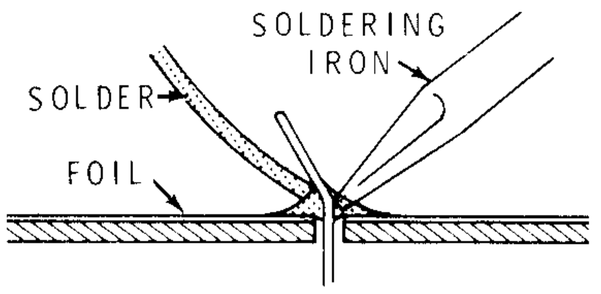
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



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



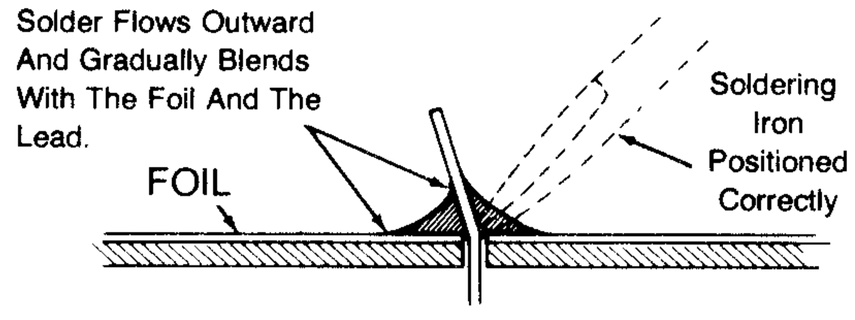
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



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

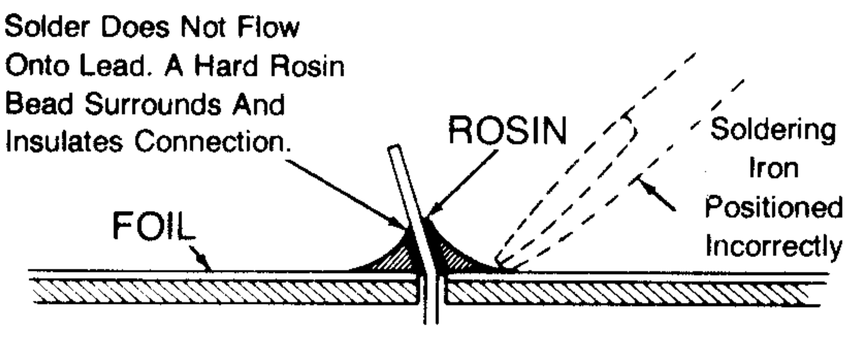
( ) Check each connection. Compare it to the illustrations on Page 10. After you have checked the solder connections, proceed with the assembly on Page 11. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION

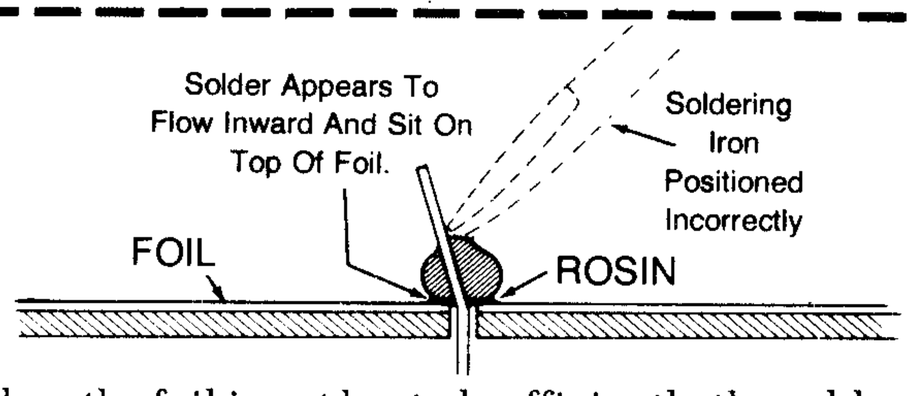


When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS



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

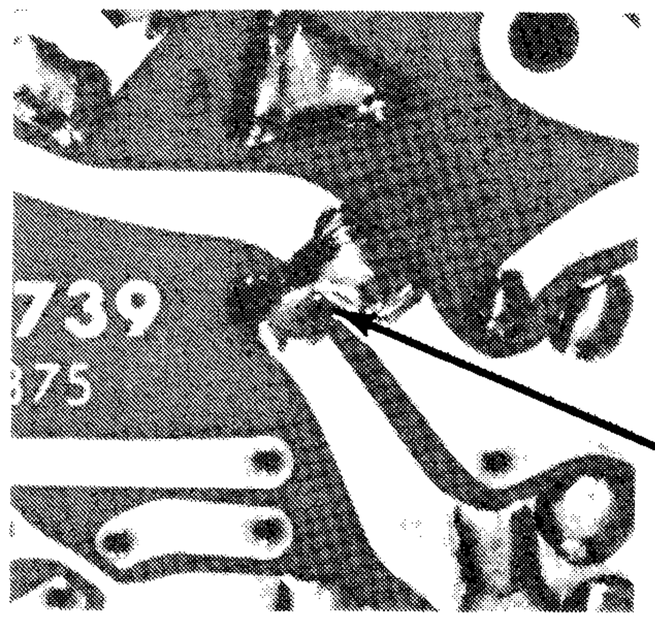


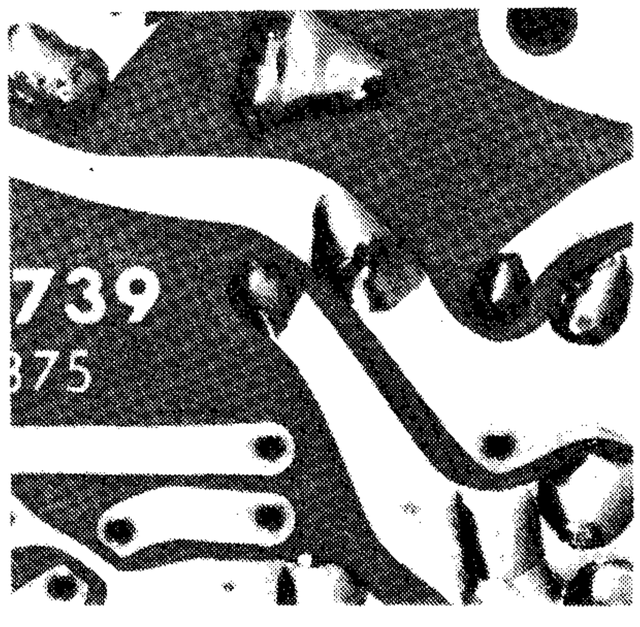
When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

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

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





START

NOTE: Make sure you installed the first part in Pictorial 1-1.

All resistors are 5% unless specified otherwise.

( ) R206: 2 MΩ, 1% (red-blk-blk-yel).

( ) R204: 150 kΩ, 1% (brn-grn-blk-org).

( ) R205: 100 kΩ, 1% (brn-blk-blk-org).

( ) R208: 150 kΩ, 1% (brn-grn-blk-org).

( ) R209: 37.5 kΩ, 1% (org-viol-grn-red).

( ) R212: 220 Ω (red-red-brn).

( ) R211: 220 Ω (red-red-brn).

( ) R202: 120 Ω (brn-red-brn).

( ) C212: .1 μF (104) glass ceramic.

( ) R203: 120 Ω (brn-red-brn).

( ) C215: .1 μF (104) glass ceramic.

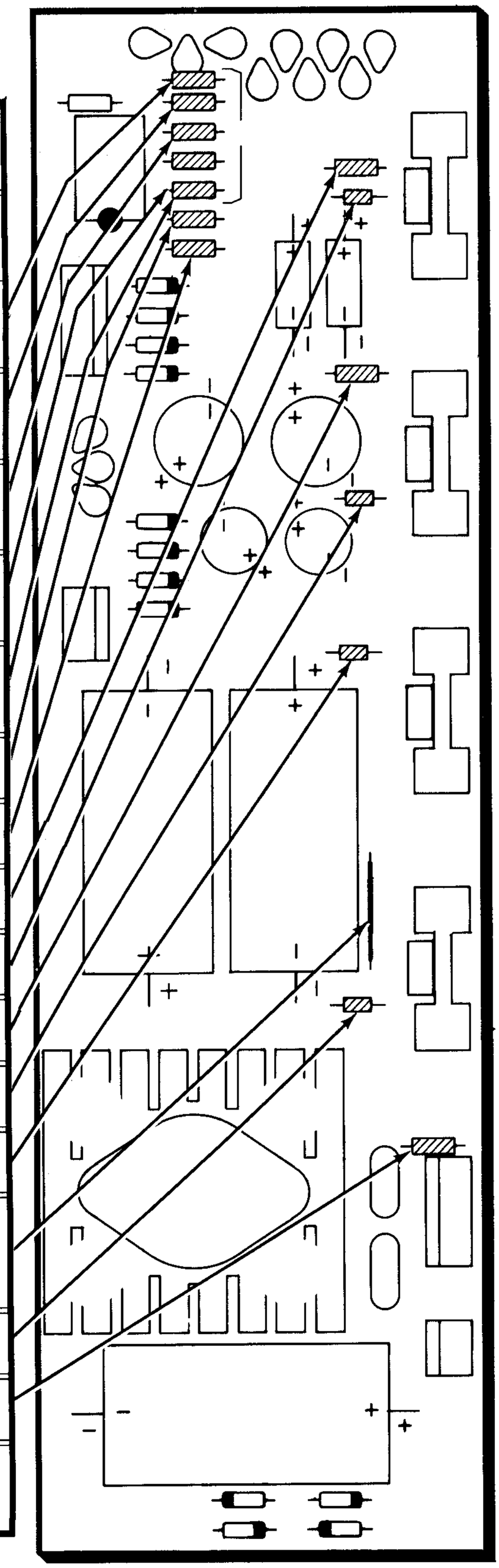
( ) C205: .1 μF (104) glass ceramic.

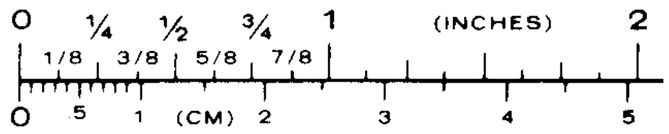
( ) Remove 1/4″ of insulation from each end of a 1-1/4″ black solid wire and install it.

( ) C208: .1 μF (104) glass ceramic.

( ) R201: 560 Ω (grn-blu-brn).

( ) Solder all leads to the foil and cut off the excess length.

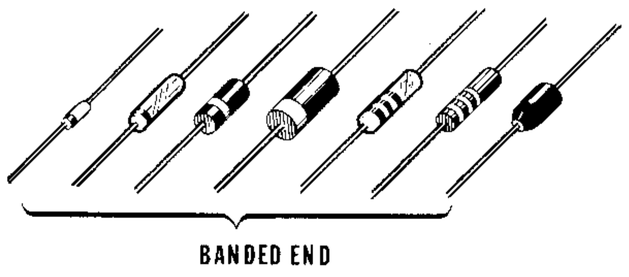




PICTORIAL 1-2

START

NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD.



Install eight 1N4002 (#57-65) diodes at the following locations.

( ) D209.

( ) D211.

( ) D212.

( ) D213.

( ) D205.

( ) D206.

( ) D207.

( ) D208.

( ) Install four 1N5393 (#57-609) diodes at the following locations.

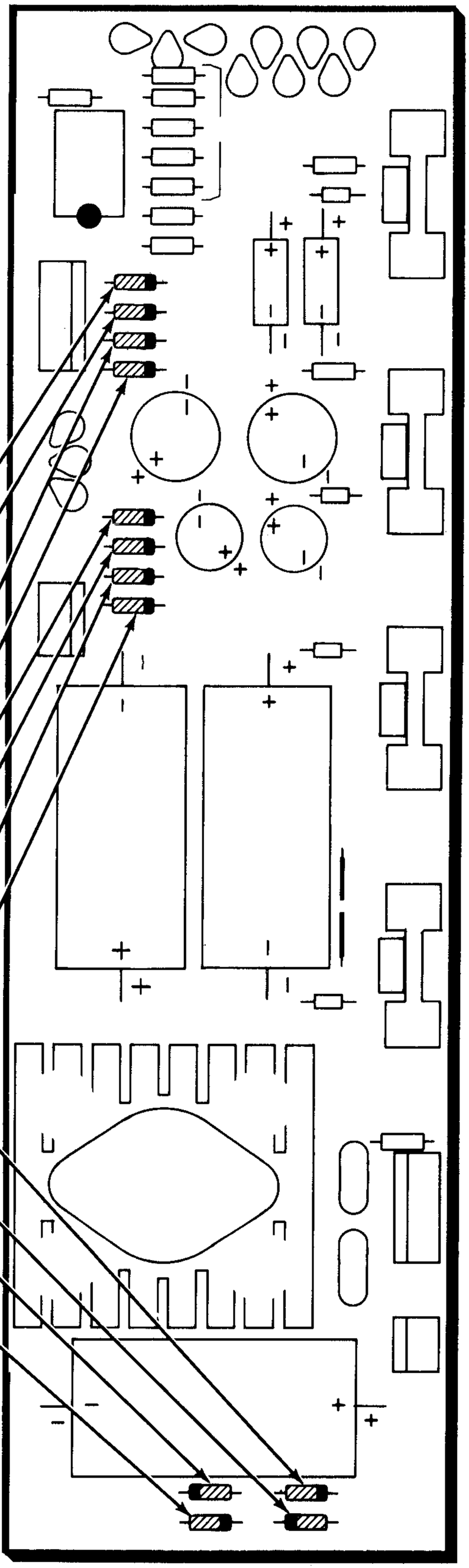
( ) D204.

( ) D201.

( ) D203.

( ) D202.

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



PICTORIAL 1-3

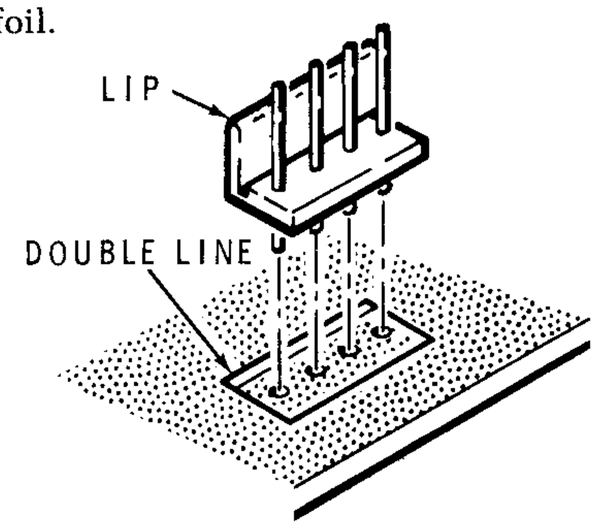
START

NOTE: When you install the following IC socket and IC, refer to Detail 1-4A (Illustration Booklet, Page 2).

( ) 14-pin IC socket at U206.

( ) U206: LM2901 IC (#442-616).

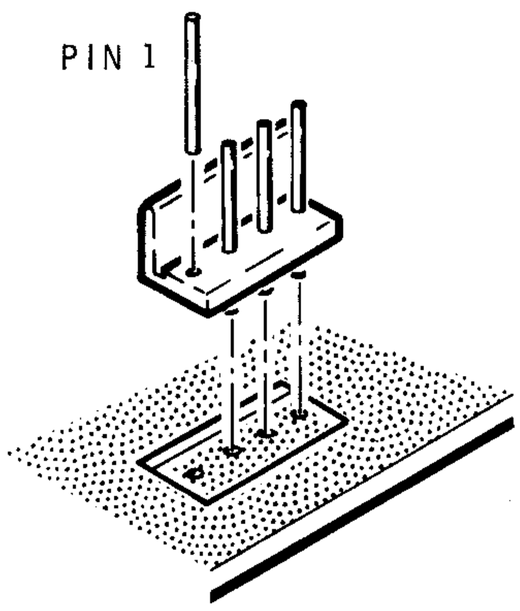
NOTE: When you install each of the following plugs, position the lip of the plug over the double line on the circuit board. Then insert the pins into the board and solder them to the foil.



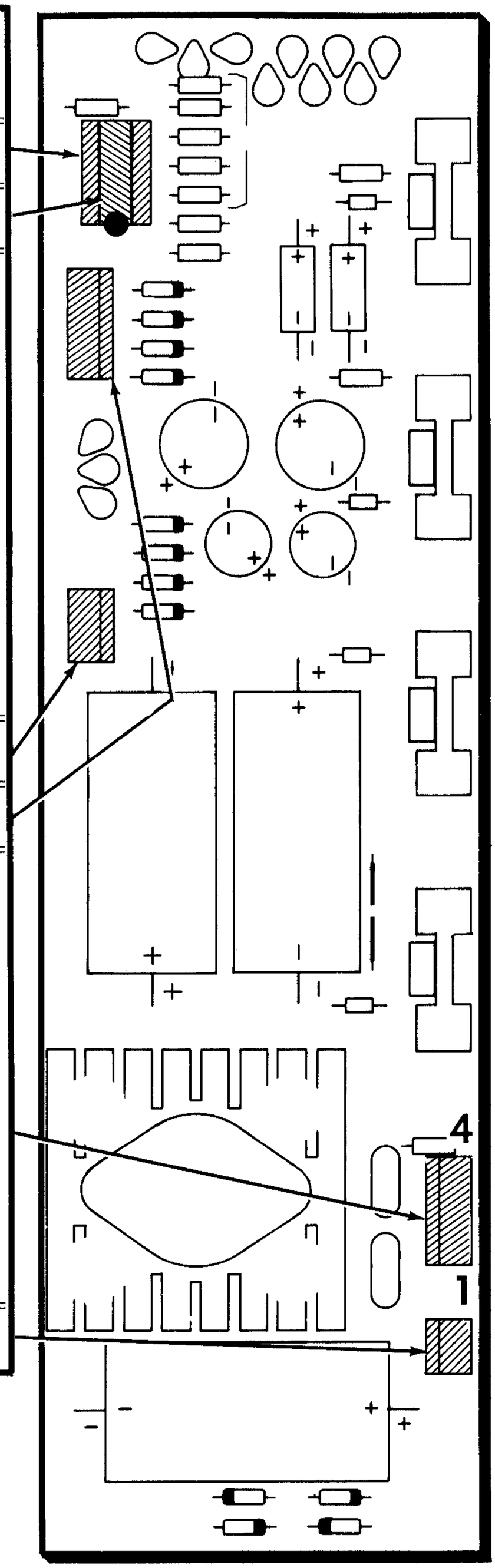
( ) 3-pin plug at P203.

( ) 4-pin plug at P204.

( ) 4-pin plug at P202. First pull pin 1 from the plug.



( ) 2-pin plug at P201.



PICTORIAL 1-4

START

Install the following electrolytic capacitors as shown in Detail 1-5A.

( ) C213: 22 µF electrolytic.

( ) C216: 22 µF electrolytic.

( ) C214: 1000 µF electrolytic.

( ) C211: 1000 µF electrolytic.

( ) C206: 100 µF electrolytic.

( ) C209: 100 µF electrolytic.

( ) C207: 2200 µF electrolytic.

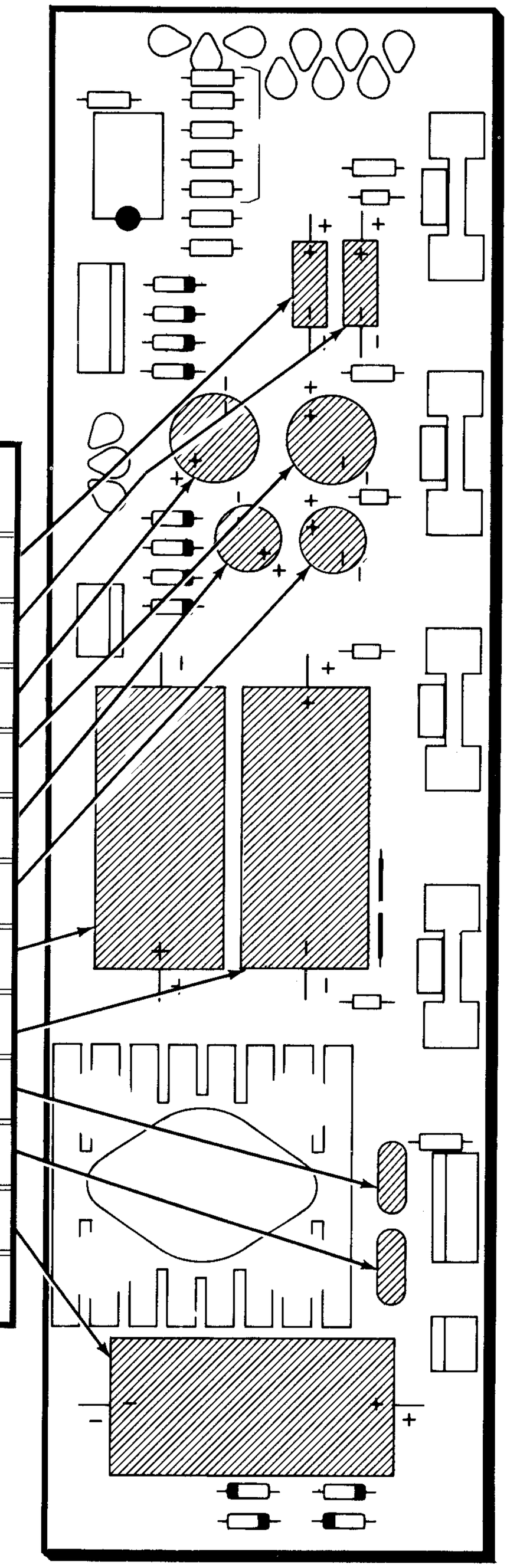
( ) C204: 2200 µF electrolytic.

( ) C203: .22 µF Mylar.

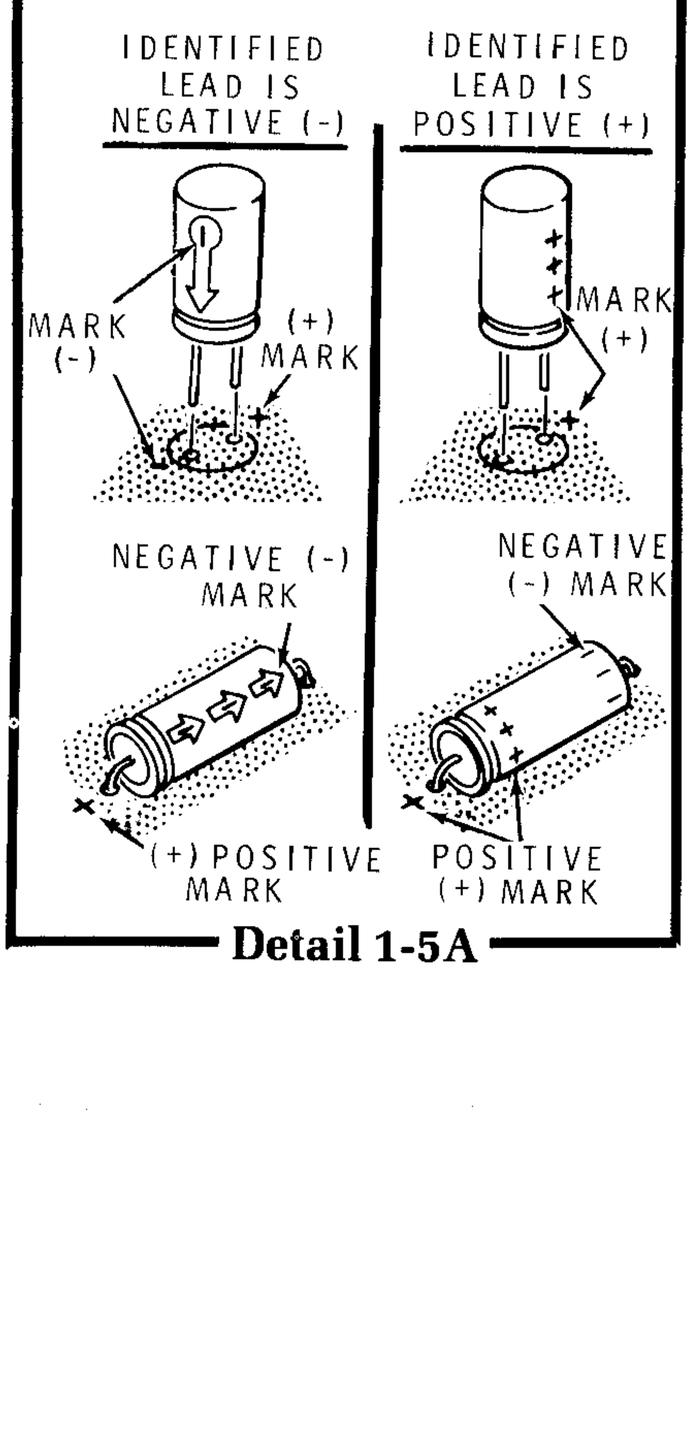
( ) C202: .22 µF Mylar.

( ) C201: 6800 µF electrolytic.

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



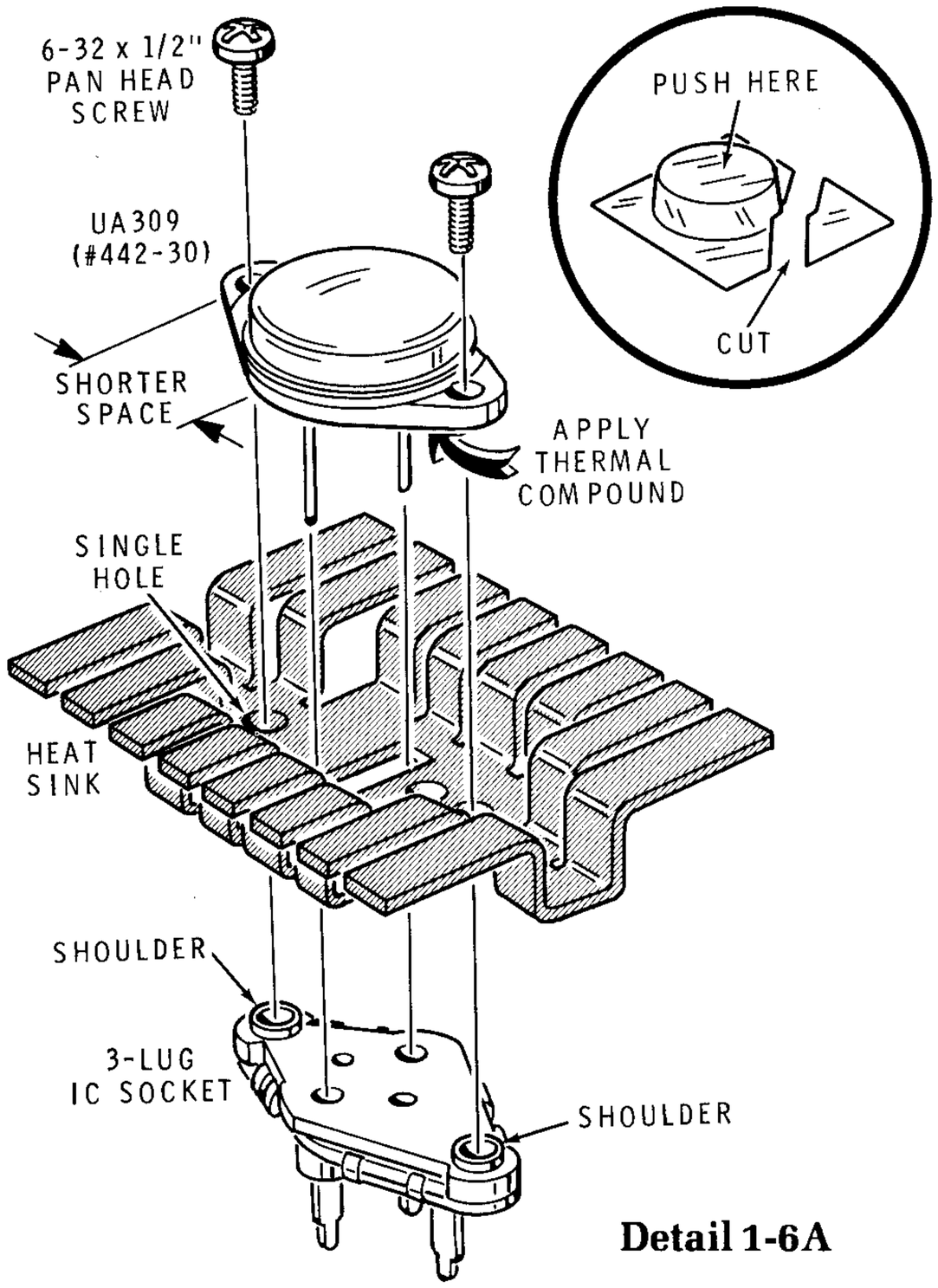
NOTE: Before you install an electrolytic capacitor, look at it and identify the leads. One lead will have a positive (+) mark or a negative (−) mark near it. Be sure to install the positive lead in the positive-marked hole, or the negative lead in the negative-marked hole.



Detail 1-5A

PICTORIAL 1-5

Heathkit®



Detail 1-6A

Refer to Detail 1-6A for the following steps.

NOTE: The thermal compound you will use in the following step is not caustic. However, make sure you do not get it in your eyes, ears, nose, mouth, or on your clothing. Wash your hands after you use the compound. Keep this and all chemicals out of the reach of children.

( ) Refer to the inset drawing and open the container of thermal compound.

( ) **Apply a layer of compound on the lead side of the UA309 (#442-30) IC and set it down temporarily. Save the container of compound.**

( ) Position the heat sink so the prong side is facing up and the end with the single hole is as shown.

( ) Note the shorter space from the leads of the IC and the hole in the case. Now place the IC on the heat sink so the shorter space is toward the single hole in the heat sink.

( ) While holding the IC in place with your finger, position the 3-lug IC socket so the three lugs are as shown. Then insert the IC leads into the socket.

( ) Fasten the assembly with two 6-32 × 1/2″ pan head screws. NOTE: The shoulder on the socket will not seat into the heat sink holes.

Refer to Pictorial 1-6 (Illustration Booklet, Page 3) for the following steps.

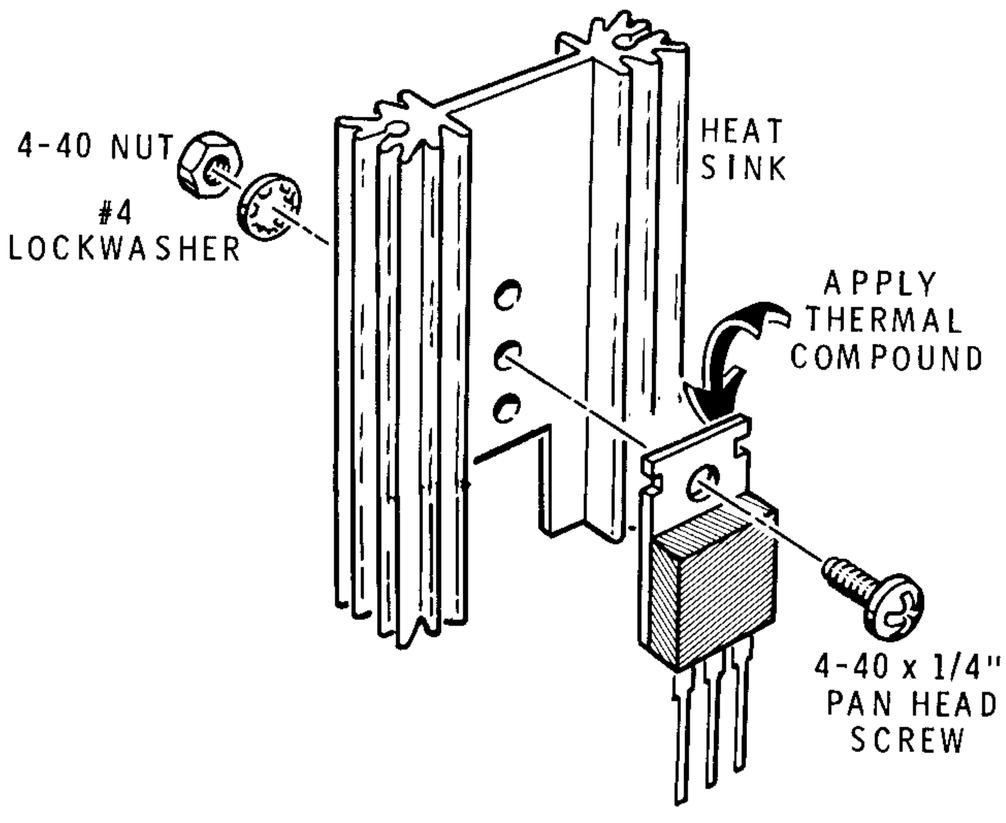
( ) Position the circuit board as shown.

( ) Insert the leads of the IC socket into the circuit board at U201. Make sure the leads are seated in the holes, and then solder them to the foil.

( ) Mount the 6-32 spacer on the circuit board in the hole next to plug P203 with the 6-32 stud.

( ) Install a 6-32 × 3/8″ pan head screw on the spacer. Tighten the screw finger tight only.

( ) Refer to Detail 1-6B and mount the remaining four IC's on the remaining heat sinks. First apply a layer of thermal compound on the metal side of the IC's. Then mount each one in the middle hole in the heat sink. Use 4-40 × 1/4″ pan head screws, #4 lockwashers, and 4-40 nuts as shown. Make sure the IC is parallel with the bottom of the heat sink. Then tighten the hardware. NOTE: You may discard the remaining thermal compound.



Detail 1-6B

Install the assemblies on the circuit board in the following steps. Insert the IC leads into the board and fasten the heat sinks with #4 × 3/8" self-tapping screws. Then solder the leads to the foil, cut off the excess lead lengths.

( ) LM317 (#442-708) IC at U204.

( ) LM337 (#442-709) IC at U205.

( ) UA7812 (#442-674) IC at U202.

( ) UA7912 (#442-675) IC at U203.

CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

( ) Electrolytic capacitors for the correct position of the identified lead.

( ) Protruding leads which could touch together.

( ) IC for the proper installation.

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

Set the circuit board aside temporarily.

MAIN CIRCUIT BOARD

PARTS LIST

Refer to the "Pack Index Sheet," and locate Pack #2. Remove Pack #2 and check each part against the following list and the Main Circuit Board Parts Pictorial (Illustration Booklet, Page 4). Any part that is packed in an individual envelope with the part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not discard any packing materials until all parts are accounted for.

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

RESISTORS

NOTES:

1. All 5% resistors have four color bands (last band gold). This last band (gold) will not be called out.

2. All color banded 1% resistors have five color bands (last band brown). This brown band is set apart from the other bands. The last band (brown) will not be called out.

3. The resistors may be packaged in more than one envelope.

1%, 1/4-Watt

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	6-9091-12	1	9090 Ω (wht-blk-wht-brn)	R109
A1	6-1202-12	1	12 kΩ (brn-red-blk-red)	R113

5%, 1/4-Watt

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	6-181-12	8	180 Ω (brn-gry-brn)	R126, R127, R128, R129, R131, R132, R133, R134
A1	6-221-12	1	220 Ω (red-red-brn)	R102
A1	6-102-12	5	1000 Ω (brn-blk-red)	R114, R135, R136, R137, R138
A1	6-222-12	8	2200 Ω (red-red-red)	R117, R118, R119, R121, R122, R123, R124, R125
A1	6-472-12	1	4700 Ω (yel-viol-red)	R104
A1	6-512-12	2	5100 Ω (grn-brn-red)	R106, R108
A1	6-562-12	1	5600 Ω (grn-blu-red)	R103
A1	6-103-12	8	10 kΩ (brn-blk-org)	R105, R115, R116, R144, R145, R146, R147, R148
A1	6-223-12	1	22 kΩ (red-red-org)	R107
A1	6-104-12	1	100 kΩ (brn-blk-yel)	R101

Other Resistors

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A2	9-124	2	4700 Ω resistor pack	RP101, RP102

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

CAPACITORS

Ceramic

B1	21-3	1	10 pF	C113
B1	21-722	1	330 pF	C114
B1	21-191	1	510 pF	C118
B1	21-143	3	.05 µF	C102, C105, C119
B2	21-762	2	.1 µF (104) ceramic	C121, C122

Mylar

C1	27-104	1	.0047 µF (472 k)	C115
C2	27-129	1	.047 µF	C116
C3	27-86	1	.47 µF	C117
C4	27-175	1	1.0 µF	C107

Electrolytic

D1	25-900	2	1.0 µF	C104, C112
D1	25-820	1	10 µF, NP (non-polarized)	C108
D1	25-880	1	10 µF, 35V	C103
D1	25-952	1	100 µF	C101

Other

E1	29-20	1	.001 µF (1000 pF) polystyrene	C106
E1	29-67	1	.01 µF (10000 pF) polycarbon	C111
E2	29-42	1	.1 µF polystyrene	C109

LED's

F1	412-640	1	Red	D111
F1	412-652	9	Green	D101-D109

INTEGRATED CIRCUIT (IC's)

NOTE: Integrated circuits are marked for identification in one of the following four ways:

1. Part number.
2. Type number. (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.

G1	442-710	1	XR2206	U101
G1	443-728	2	74LS00	U103, U106
G1	443-919	2	74LS126	U104, U105
G1	443-942	1	74LS123	U102

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

CONNECTORS — SOCKETS

H1	432-874	34	4-wire connector block
H2	432-973	2	8-wire connector block
H3	432-875	2	Breadboarding socket (with connectors and vinyl strip)
H4	75-825	1	Insulator
H5	434-298	1	14-pin IC socket
H5	434-299	2	16-pin IC socket

SWITCHES — CONTROLS

J1	60-86	2	3-lug switch	SW105, SW106
J2	60-78	1	6-lug switch	SW101
J3	60-656	1	DIP switch	SW104
J4	63-1398	2	Rotary switch	SW102, SW103
J5	10-393	1	5 MΩ control	R112
J6	10-1054	1	1000 Ω (1 kΩ) control	R139
J6	10-1195	2	2000 Ω (2 kΩ) control	R141, R142
J6	10-1055	1	100 kΩ control	R143
J6	10-1194	1	100 kΩ control	R111

MISCELLANEOUS

K1	204-182	1	L-bracket
K2	75-750	1	Tape
K3	260-700	10	Grommet
K4	260-701	10	Retainer ring
K5	455-50	7	Knob insert
K6	462-399	7	Knob

HARDWARE

#4 Hardware

L1	250-1467	4	#4 self-tapping stud
L2	250-1411	6	4-40 × 1/4" pan head screw
L3	250-163	2	#4 × 5/16" self-tapping screw

#6 Hardware

M1	250-1325	4	6-32 × 1/4" pan head screw
M2	255-185	4	6-32 spacer
M3	254-1	4	#6 lockwasher

Other Hardware

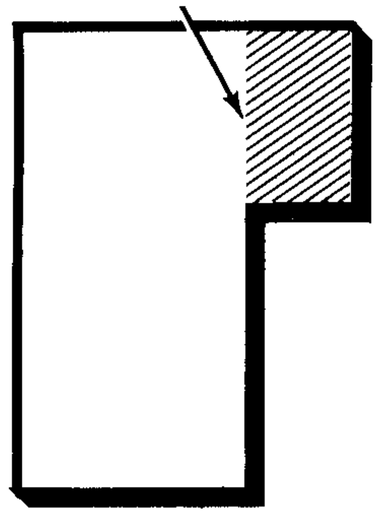
N1	252-7	8	Control nut
N2	253-10	7	Flat washer
N3	254-5	7	Lockwasher
N4	260-703	4	Speed clip

PART FROM FINAL PACK

	85-2872-1	1	Main circuit board

STEP-BY-STEP ASSEMBLY

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



IDENTIFICATION DRAWING

START

NOTE: Due to its large size, only a part of the circuit board is shown. The shaded area in the identification drawing at the top of each Page indicates the area you are assembling.

( ) Position the main circuit board as shown and with the printed side up.

( ) R113: 12 kΩ, 1% (brn-red-blk-red).

( ) R115: 10 kΩ (brn-blk-org).

NOTE: When you are instructed to prepare a solid wire, cut it to the specified length and remove 1/4″ of insulation from each end.

( ) 1″ black solid wire.

( ) 1″ black solid wire.

( ) 1″ black solid wire.

( ) 7/8″ black solid wire.

( ) R109: 9090 Ω, 1% (wht-blk-wht-brn).

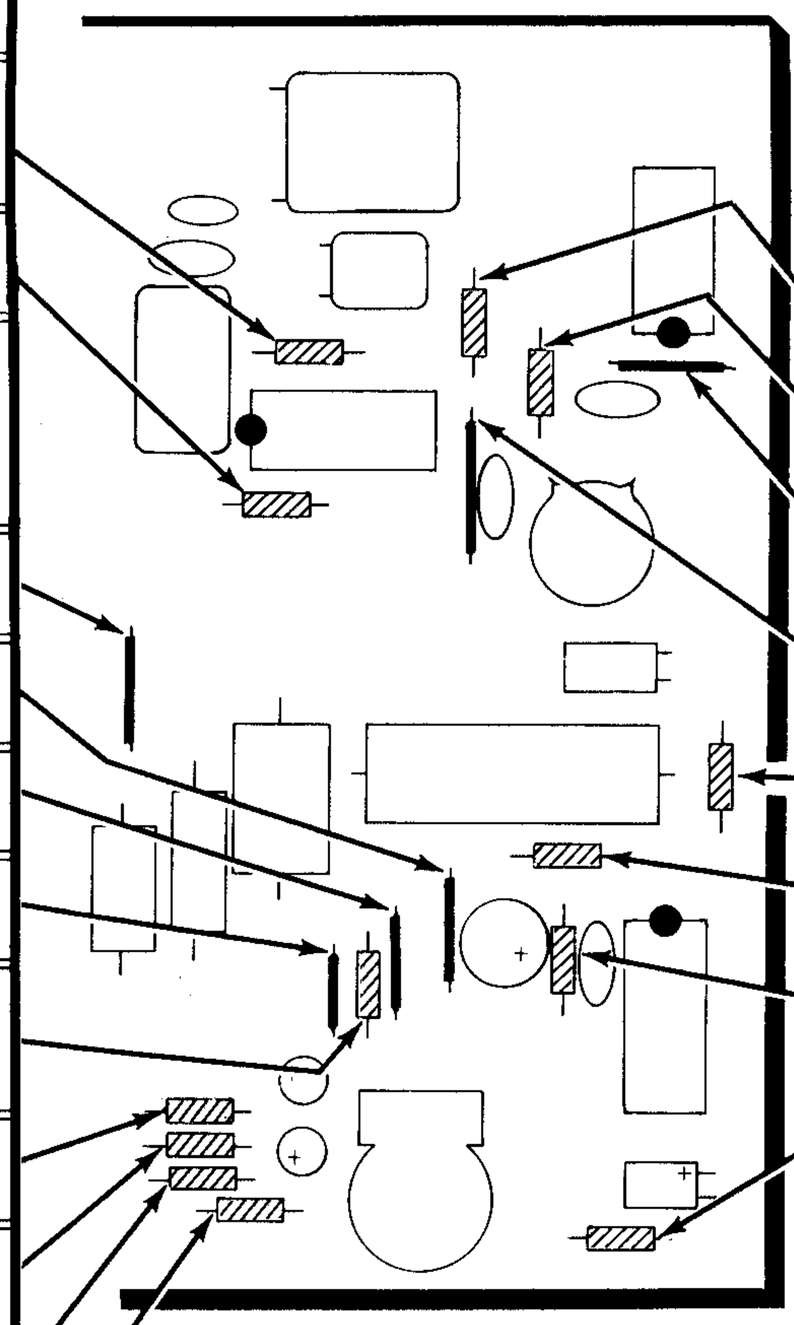
( ) R106: 5100 Ω (grn-brn-red).

( ) R107: 22 kΩ (red-red-org).

( ) R116: 10 kΩ (brn-blk-org).

( ) R108: 5100 Ω (grn-brn-red).

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



CONTINUE

( ) R116: 10 kΩ (brn-blk-org).

( ) R114: 1000 Ω (brn-blk-red).

( ) 1″ black solid wire.

( ) 1-1/8″ black solid wire.

( ) R104: 4700 Ω (yel-viol-red).

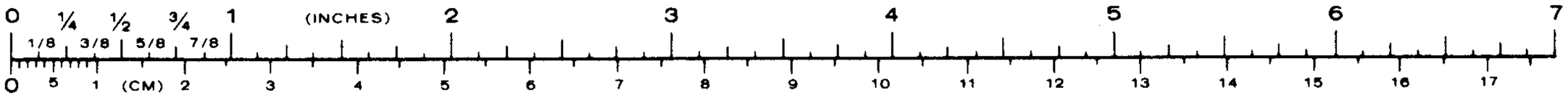
( ) R101: 100 kΩ (brn-blk-yel).

( ) R103: 5600 Ω (grn-blu-red).

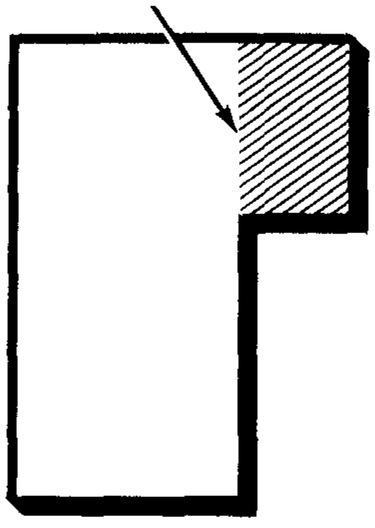
( ) R102: 220 Ω (red-red-brn).

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

PICTORIAL 2-1



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



IDENTIFICATION DRAWING

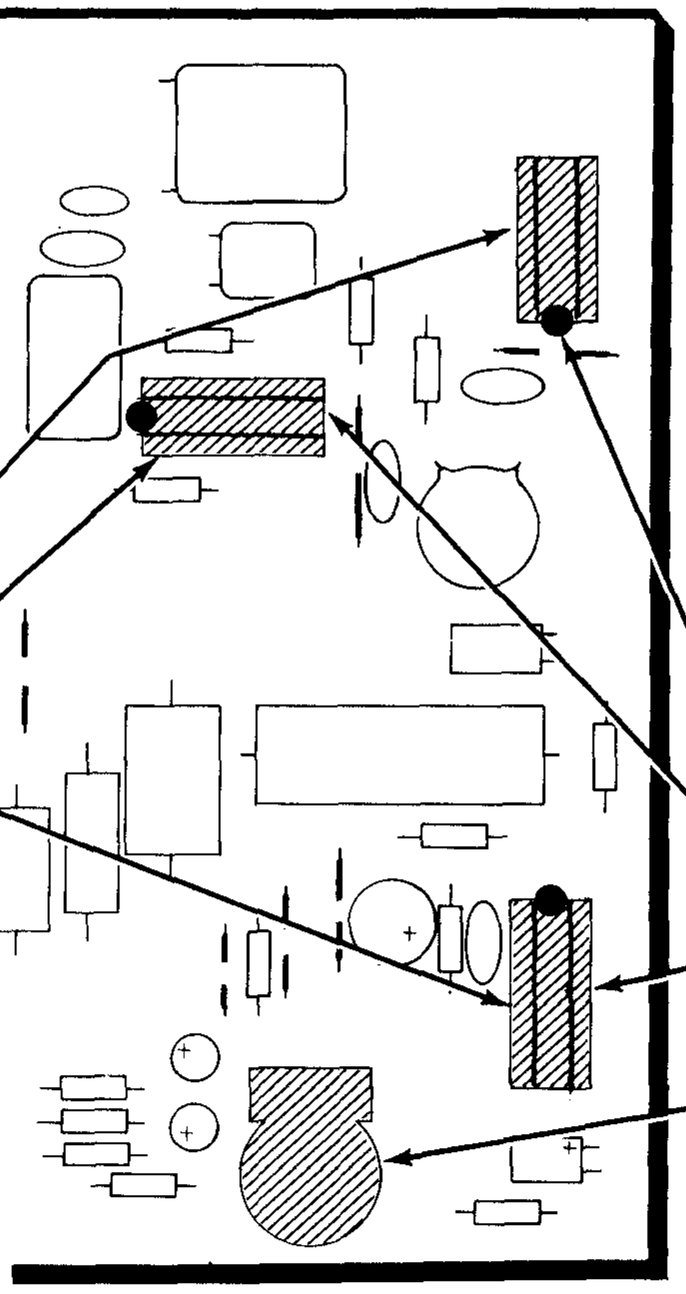
START

Refer to Detail 1-4A (Illustration Booklet, Page 2) when you install the following IC sockets and IC's.

( ) 14-pin IC socket.

( ) 16-pin IC socket.

( ) 16-pin IC socket.



CONTINUE

( ) U103: 74LS00 (#443-728).

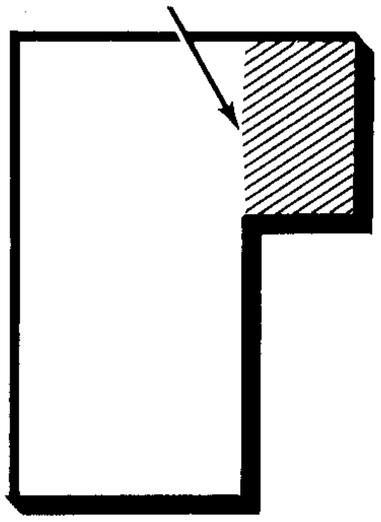
( ) U102: 74LS123 (#443-942).

( ) U101: XR2206 (#442-710).

( ) R112: 5 MΩ (#10-393) control. Solder the lugs and tabs to the foil.

PICTORIAL 2-2

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



IDENTIFICATION DRAWING

START

NOTE: When you install each of the next two capacitors, insert the leads, lay the capacitor flat against the board in the outline, and solder the leads to the foil.

( ) C117: .47 µF Mylar.

( ) C116: .047 µF Mylar.

( ) C113: 10 pF ceramic.

( ) C114: 330 pF ceramic.

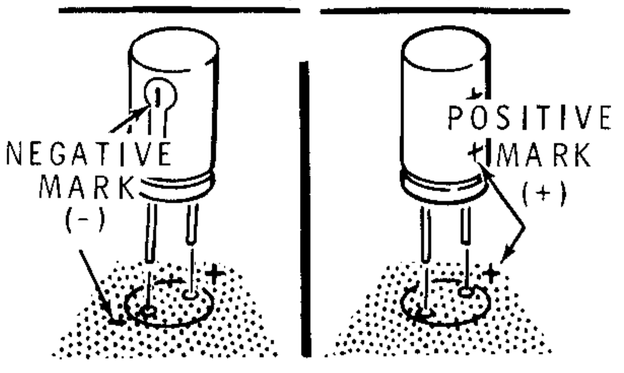
( ) C115: .0047 µF (472 k) Mylar. NOTE: You may have to reform the leads to insert them into the holes.

( ) C109: .1 µF polystyrene.

( ) C111: .01 µF (10000 pF) polycarbon.

( ) C106: .001 µF (1000 pF) polystyrene.

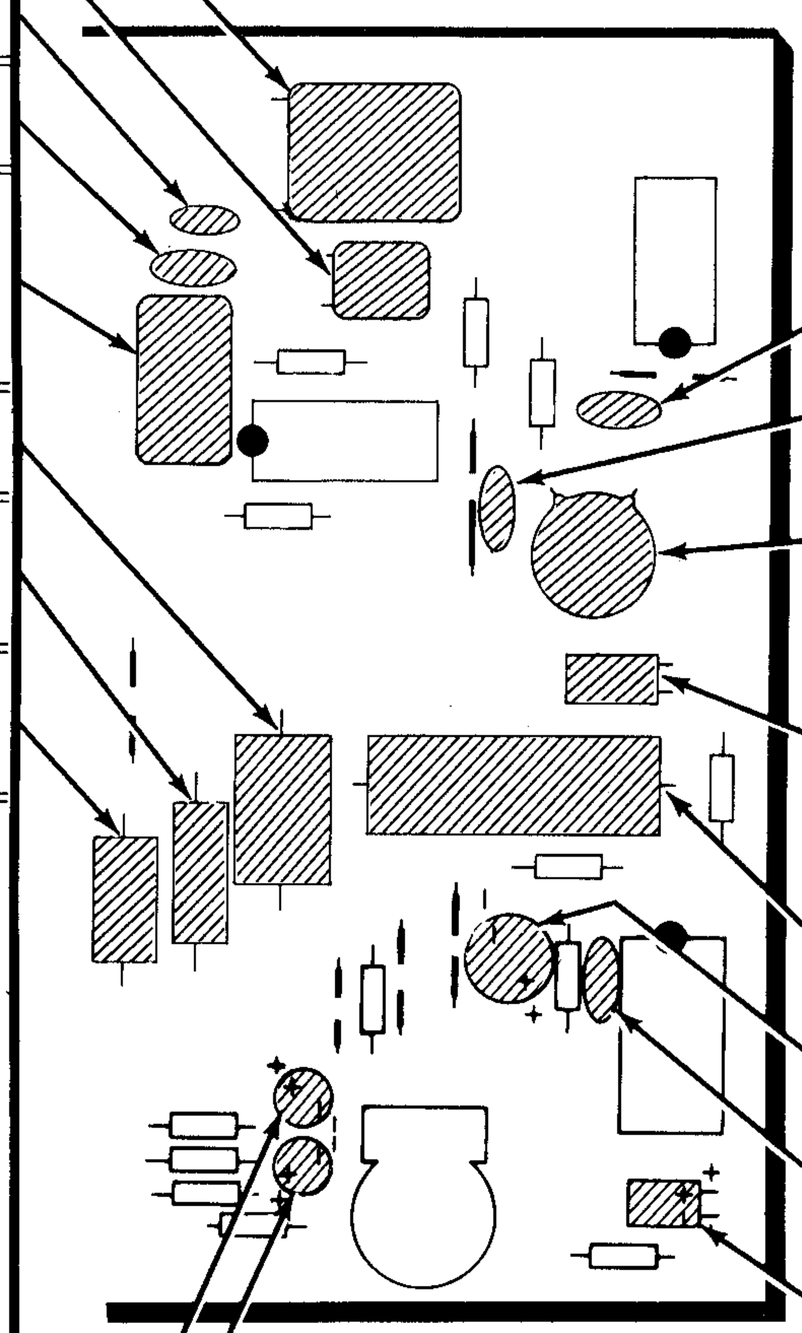
NOTE: Before you install an electrolytic capacitor, look at it and identify the leads. One lead will have a positive (+) mark or a negative (−) mark near it. Be sure to install the positive lead in the positive-marked hole, or the negative lead in the negative-marked hole.



( ) C104: 1.0 µF electrolytic.

( ) C103: 10 µF, 35 V electrolytic. NOTE: Do not confuse this capacitor with the 10 µF NP (non-polarized).

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



PICTORIAL 2-3

CONTINUE

( ) C102: .05 µF ceramic.

( ) C119: .05 µF ceramic.

( ) C118: 510 pF ceramic. Lay this capacitor against the board.

( ) C108: 10 µF, NP (non-polarized) electrolytic. Lay this capacitor against the board. NOTE: This capacitor can be installed either way.

( ) C107: 1.0 µF Mylar.

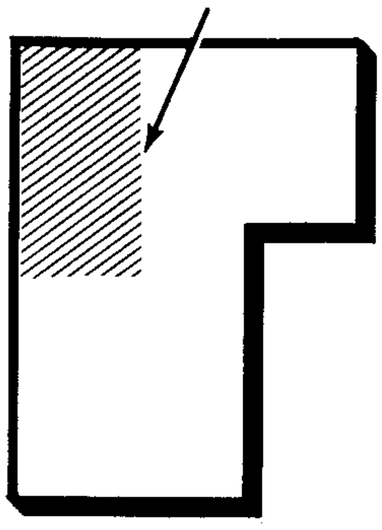
( ) C101: 100 µF electrolytic.

( ) C105: .05 µF ceramic.

( ) C112: 1.0 µF electrolytic. Lay this capacitor against the board.

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

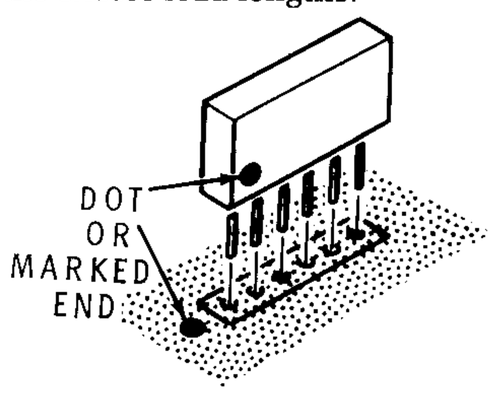
The steps performed in this Pictorial are in this area of the circuit board.



IDENTIFICATION DRAWING

START

NOTE: When you install each of the following resistor packs, match the dot or marked end with the number one (1) location on the board. Then solder the leads to the foil and cut off the excess lead lengths.



( ) R148: 10 kΩ (brn-blk-org).

( ) RP102: 4700 Ω resistor pack.

( ) RP101: 4700 Ω resistor pack.

( ) R135: 1000 Ω (brn-blk-red).

( ) R136: 1000 Ω (brn-blk-red).

( ) R138: 1000 Ω (brn-blk-red).

( ) R137: 1000 Ω (brn-blk-red).

( ) R118: 2200 Ω (red-red-red).

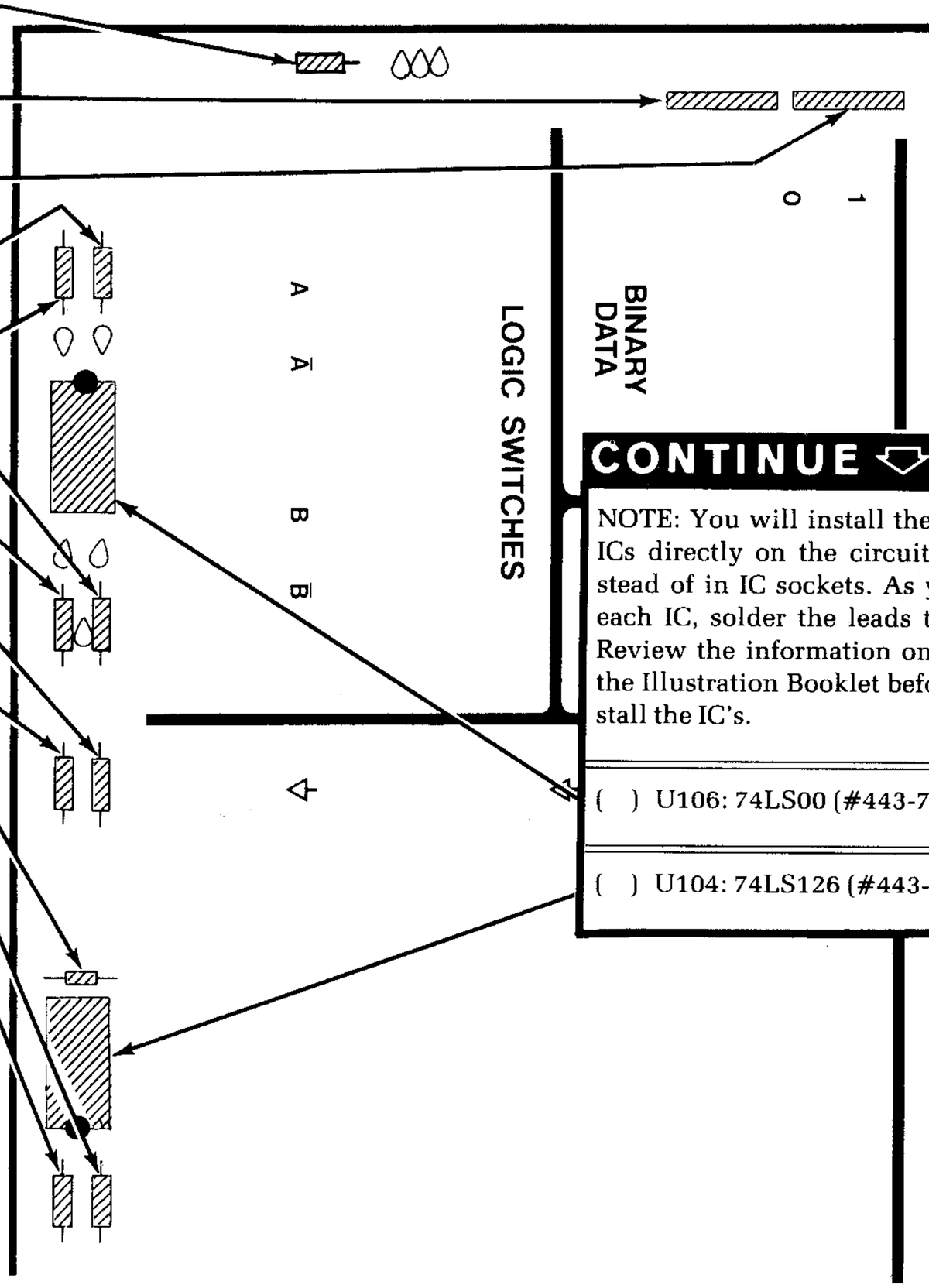
( ) R117: 2200 Ω (red-red-red).

( ) C121: .1 µF (104) glass ceramic.

( ) R121: 2200 Ω (red-red-red).

( ) R119: 2200 Ω (red-red-red).

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



CONTINUE

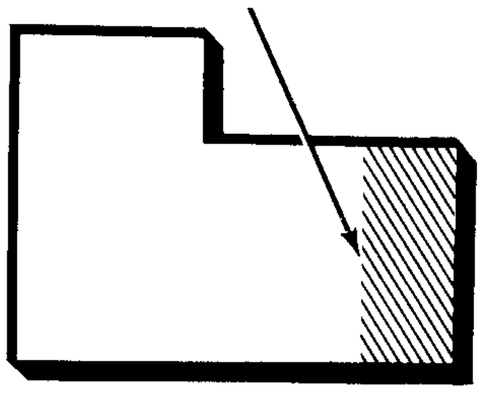
NOTE: You will install the following ICs directly on the circuit board instead of in IC sockets. As you install each IC, solder the leads to the foil. Review the information on Page 2 of the Illustration Booklet before you install the IC's.

( ) U106: 74LS00 (#443-728).

( ) U104: 74LS126 (#443-919).

PICTORIAL 2-4

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



IDENTIFICATION DRAWING

START

( ) Reposition the circuit board as shown in the Identification Drawing.

( ) R134: 180 Ω (brn-gry-brn).

( ) R133: 180 Ω (brn-gry-brn).

( ) R126: 180 Ω (brn-gry-brn).

( ) R127: 180 Ω (brn-gry-brn).

( ) R129: 180 Ω (brn-gry-brn).

( ) R128: 180 Ω (brn-gry-brn).

( ) R131: 180 Ω (brn-gry-brn).

( ) R132: 180 Ω (brn-gry-brn).

( ) R125: 2200 Ω (red-red-red).

( ) R124: 2200 Ω (red-red-red).

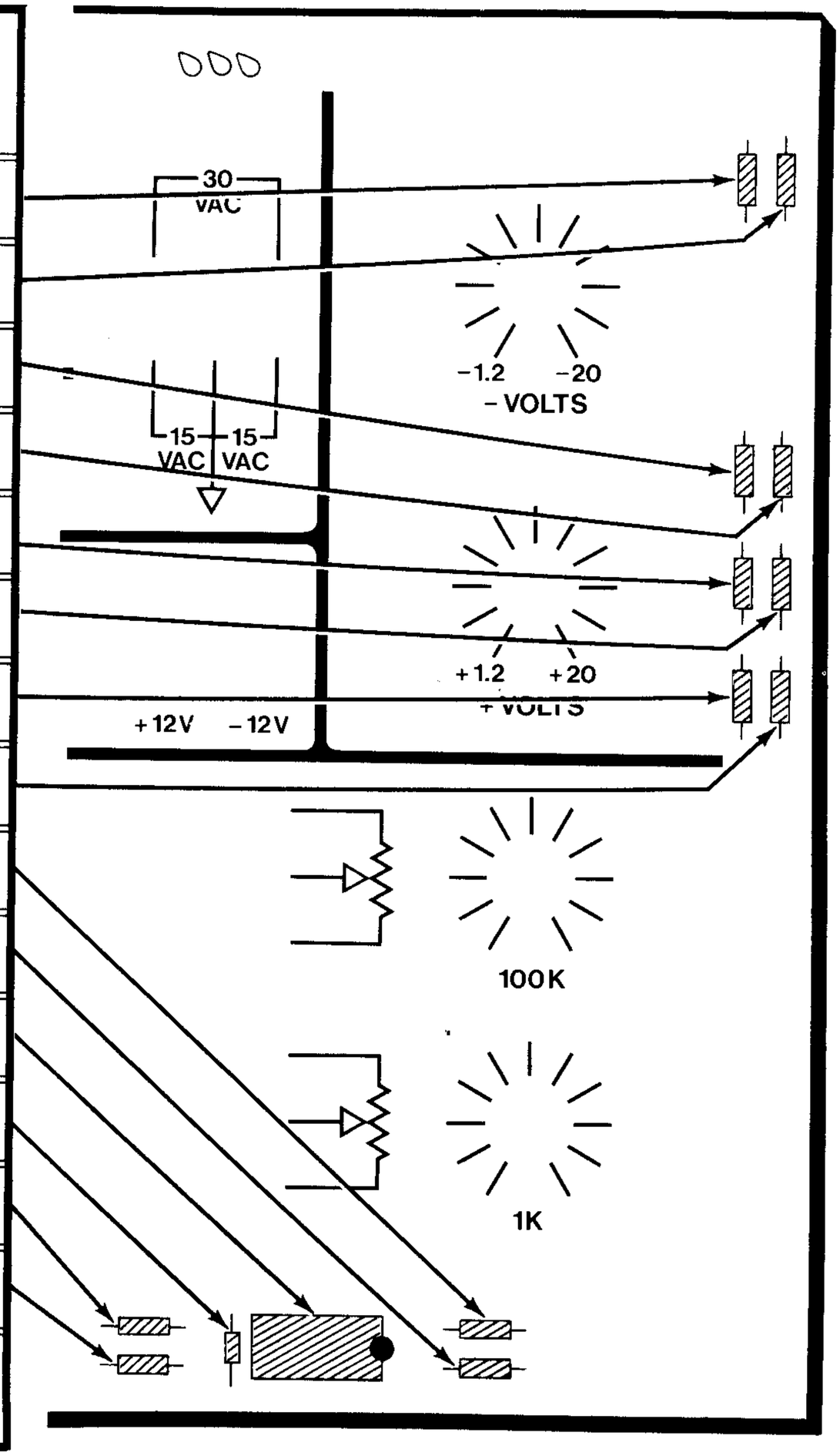
( ) U105: 74LS126 (#443-919) IC.

( ) C122: .1 µF (104) glass ceramic.

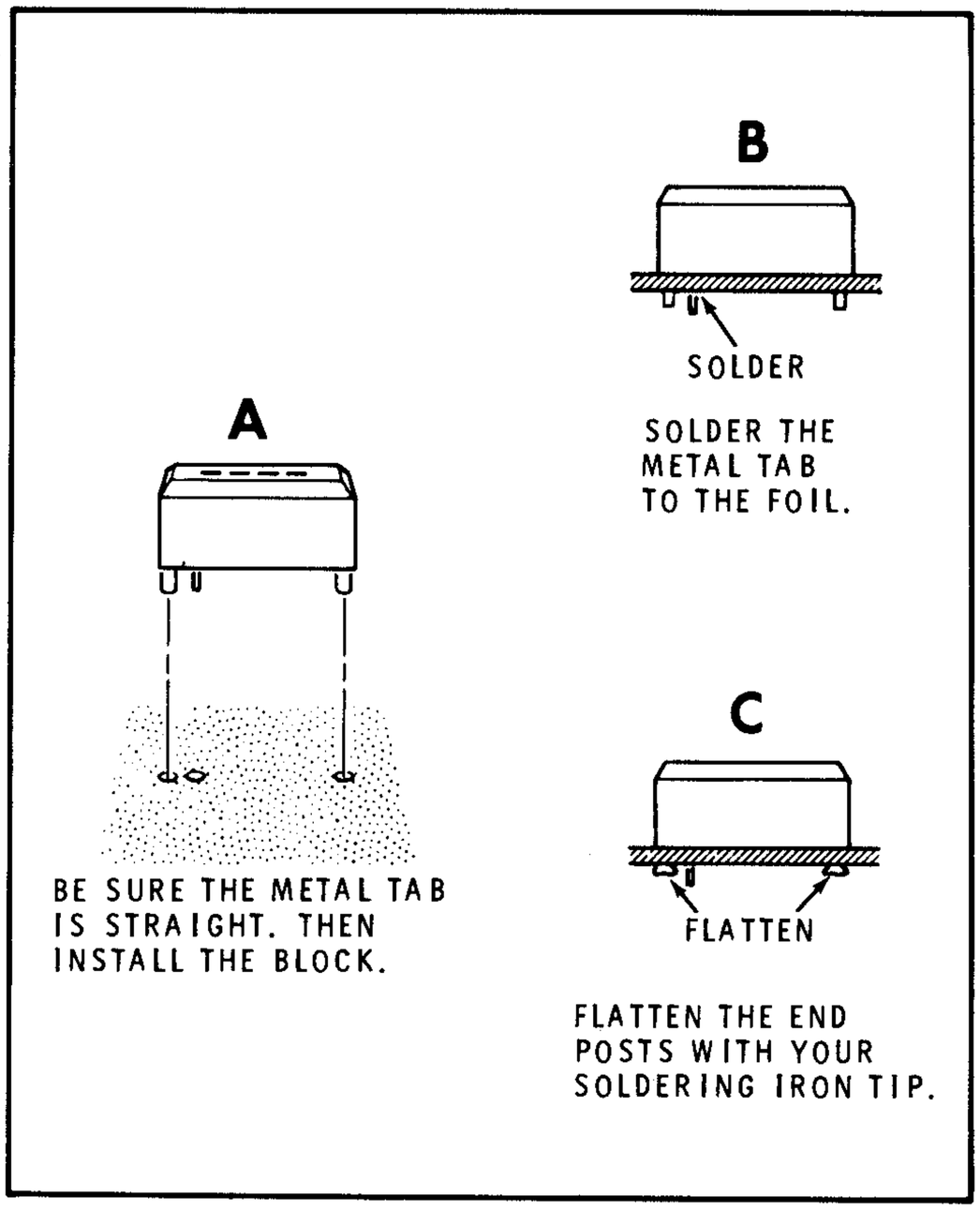
( ) R123: 2200 Ω (red-red-red).

( ) R122: 2200 Ω (red-red-red).

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



PICTORIAL 2-5



Detail 2-6A

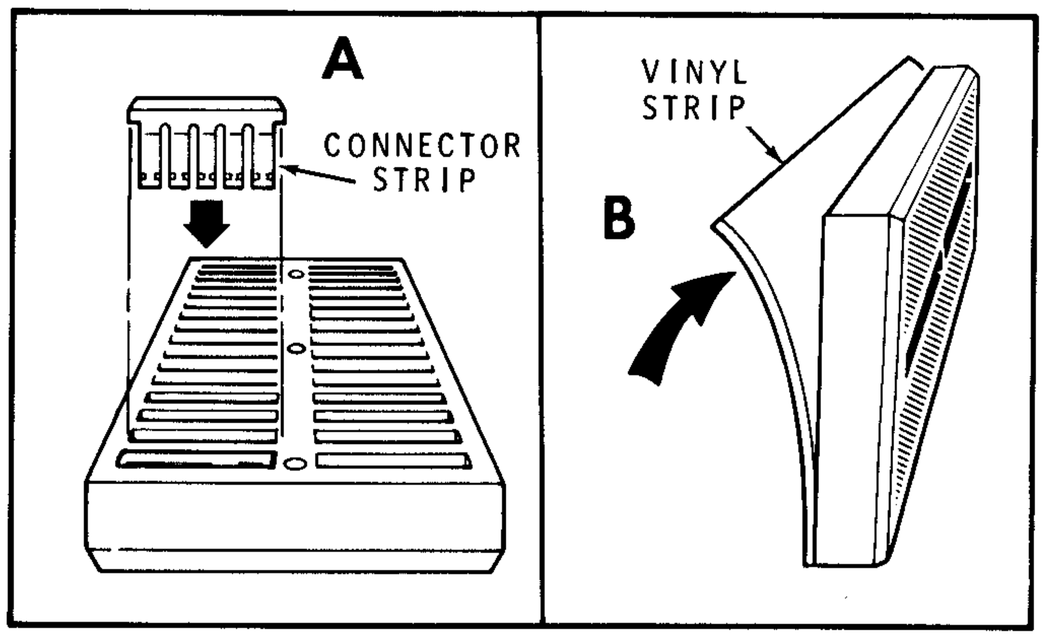
Refer to Pictorial 2-6 (Illustration Booklet, Page 5) for the following steps.

( ) Refer to Detail 2-6A and install 4-wire connector blocks at the thirty-four locations. These areas are called out on the Pictorial. NOTE: Make sure the block is pressed against the board when you solder the tab and flatten the posts.

( ) Similarly install the two 8-wire connector blocks. 432-973

( ) Refer to Part A of Detail 2-6B and install the connector strips supplied with the two breadboarding sockets, into the sockets. You may have some connector strips left over.

( ) Refer to Part B of Detail 2-6B and remove the paper backing from the vinyl strips supplied with the breadboarding sockets. Then line up the long edges of the vinyl strips and sockets as shown, and press the sticky side of the vinyl strips against the sockets.



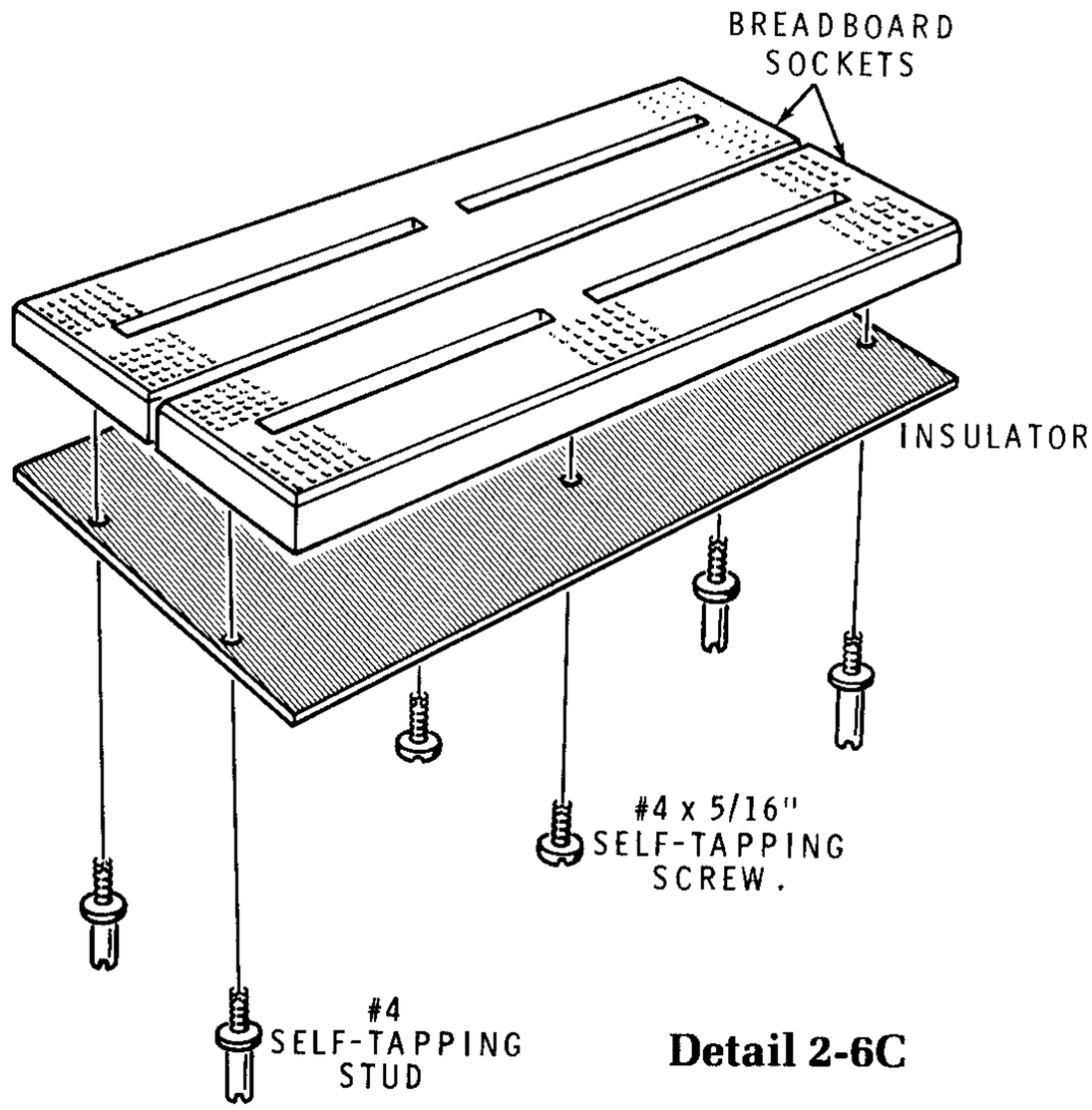
Detail 2-6B

( ) Refer to Detail 2-6C and mount the insulator to both breadboarding sockets with two #4 × 5/16″ self-tapping screws and four #4 self-tapping studs. NOTE: You will have to poke a hole through the vinyl at these six locations first.

( ) Refer to Detail 2-6D and insert the four speed clips into the four holes in the main board where the breadboarding sockets were mounted.

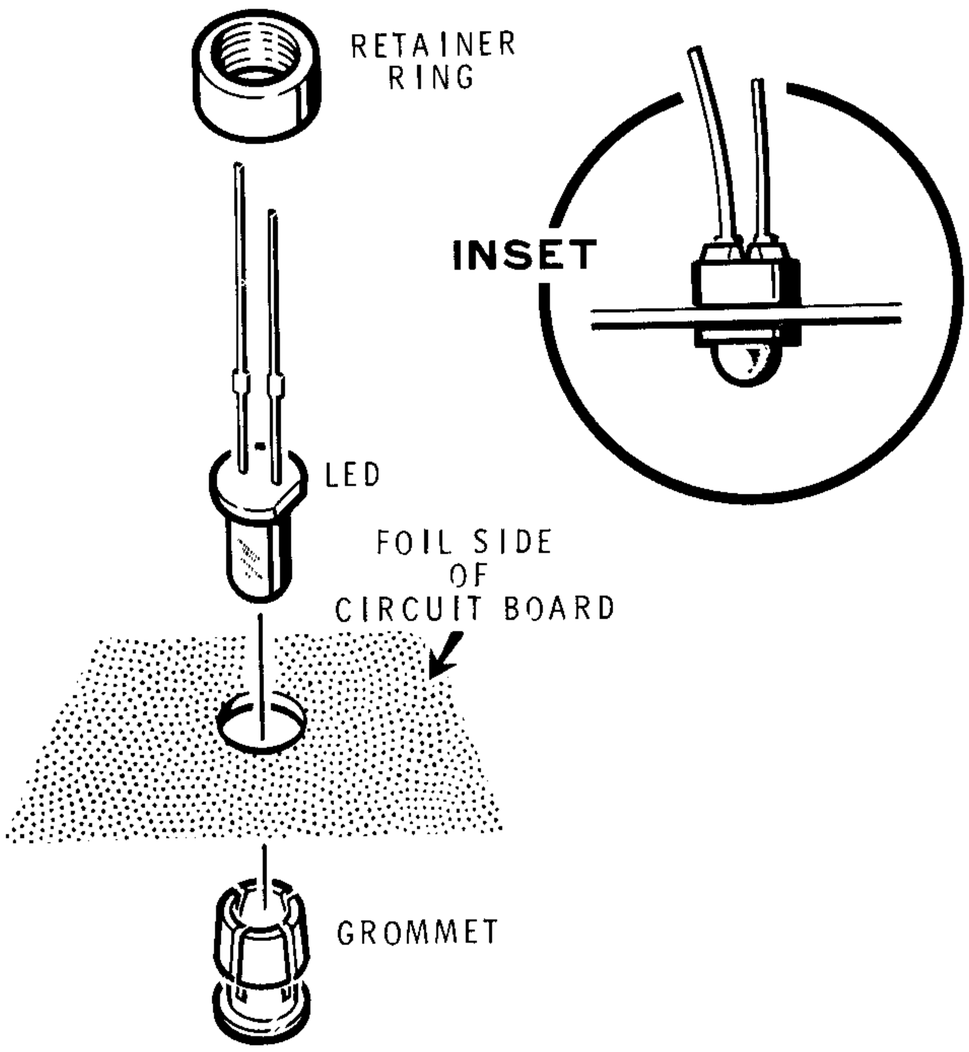
( ) Install the breadboarding assembly by inserting studs into the speed clips.

( ) SW104: Position the DIP switch so the digits 0 through 7 are right-side up. Install the switch on the left side of the board below "LOGIC INDICATORS." Insert the pins and solder them to the foil.



Detail 2-6C

Detail 2-6D



Detail 2-7A

Refer to Pictorial 2-7 (Illustration Booklet, Page 6) for the following steps.

( ) L0 (D108): Refer to Detail 2-7A and install a green LED as follows:

1. Push the grommet into the hole, from the top side of the circuit board, as far as it will go.

2. Using a small screwdriver push the LED all the way down into the grommet from the foil side until it snaps in place. Position the shorter lead as shown in Pictorial 2-7.

3. Place the retainer ring over the LED and press the ring over the grommet as far as it will go. You will have to hold the grommet from the other side as you do this.

In a similar manner, install green LED's at:

( ) L1 (D107).

( ) L2 (D106).

( ) L3 (D105).

( ) L4 (D104).

( ) L5 (D103).

( ) L6 (D102).

( ) L7 (D101).

( ) Low (D109).

( ) Install a red LED at HI (D111).

NOTES:

1. When you solder a lead or wire to the foil in the following steps, lay the lead end flat on the foil and solder it to the foil. If the lead tries to spring up off the foil, hold it down with the blade of a screwdriver until the solder cools.

2. After you solder the leads of the LED's onto the foil patterns, cut off the excess length so they can not touch another foil. Leave some slack in the leads as you bend it over the retainer ring.

3. In the following steps, (NS) means not to solder because other wires will be added later. "S-" with a number, such as (S-3), means to solder the connection. The number following the "S" tells how many wires are at the connection.

Solder the leads of the LED's to the foil in the following steps.

L0:

( ) Shorter lead to foil 1 (S-1).

( ) Other lead to foil 2 (S-1).

L1:

( ) Shorter lead to foil 3 (S-1).

( ) Other lead to foil 4 (S-1).

L2:

( ) Shorter lead to foil 5 (S-1).

( ) Other lead to foil 6 (S-1).

L3:

( ) Shorter lead to foil 7 (S-1).

( ) Other lead to foil 8 (S-1).

L4:

( ) Shorter lead to foil 9 (S-1).

( ) Other lead to foil 10 (S-1).

L5:

( ) Shorter lead to foil 11 (S-1).

( ) Other lead to foil 12 (S-1).

L6:

( ) Shorter lead to foil 13 (S-1).

( ) Other lead to foil 14 (S-1).

L7:

( ) Shorter lead to foil 15 (S-1).

( ) Other lead to foil 16 (S-1).

NOTE: The numbers for the next two LED's may not actually appear on the board.

Low:

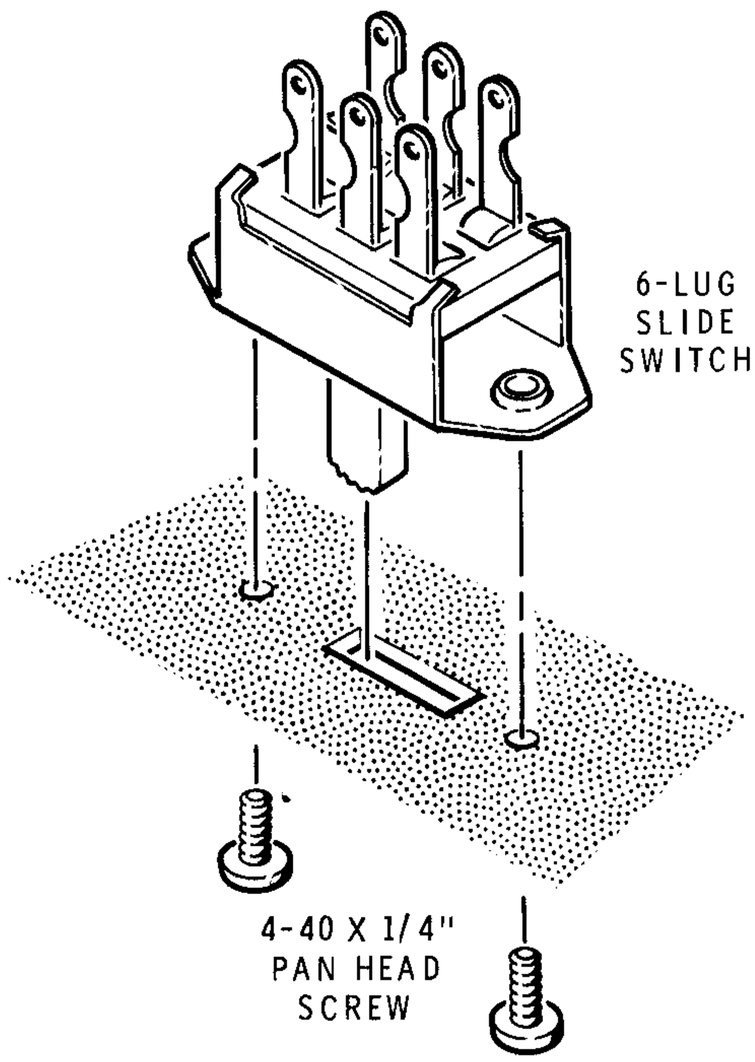
( ) Shorter lead to foil 21 (S-1).

( ) Other lead to foil 22 (S-1).

HI:

( ) Shorter lead to foil 23 (S-1).

( ) Other lead to foil 24 (S-1).



Detail 2-7B

( ) Refer to Detail 2-7B and mount the 6-lug slide switch at SW101. Use 4-40 × 1/4" pan head screws.

( ) Similarly mount the 3-lug slide switches at SW105 and SW106. Be sure to position each switch so the spring loaded button is toward the left, as shown in inset drawing #2.

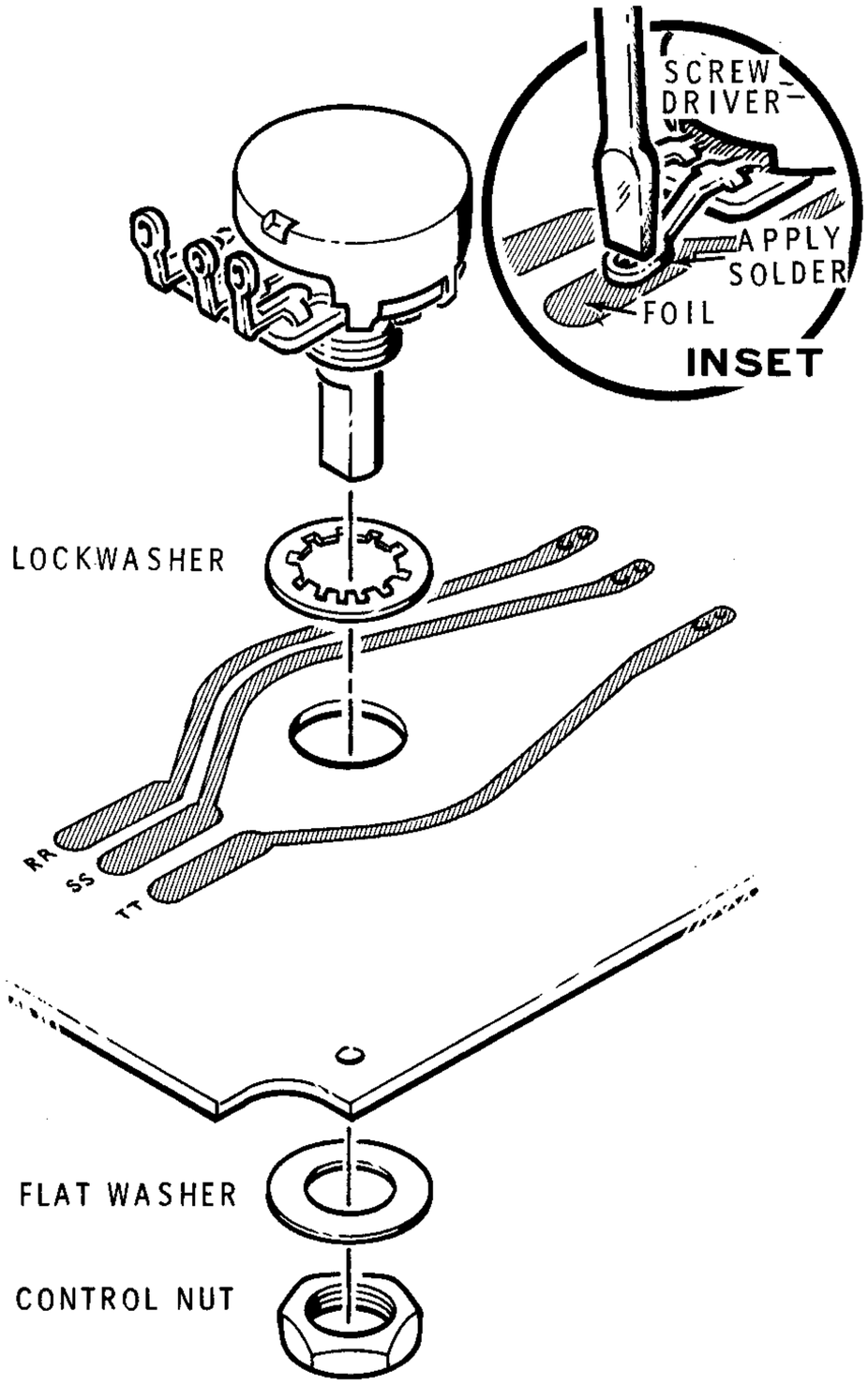
Mount the controls on the circuit board in the following steps. Use a lockwasher, flatwasher, and control nut as shown in Detail 2-7C for each control. Before you tighten the nut, make sure the lugs are centered over their respective foil patterns as shown on the Pictorial. After you tighten the nut, bend the lugs down against the foil and then push them firmly with a screwdriver so they stay against the foil. See the inset drawing on Detail 2-7C. Then solder the lugs to the foil.

( ) R139: 1000 Ω (1 kΩ) control (#10-1054).

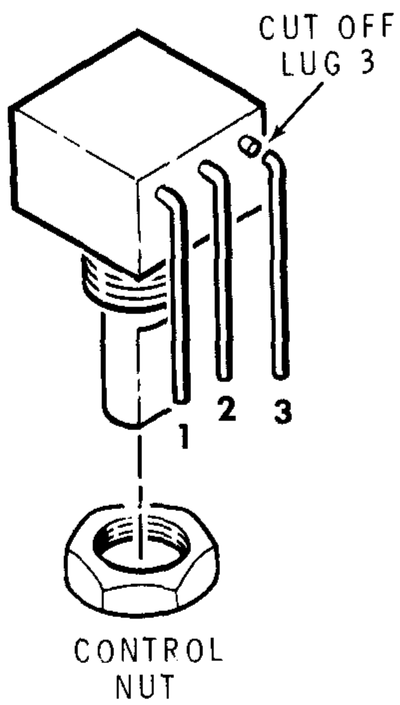
( ) R143: 100 kΩ control (#10-1055). NOTE: Make sure you do not use the other 100 kΩ control (#10-1194).

( ) R141: 2000 Ω (2 kΩ) control (#10-1195). NOTE: Do not bend lug 1 down, it will not be used.

( ) R142: 2000 Ω (2 kΩ) control (#10-1195). NOTE: Do not bend lug 1 down, it will not be used.



Detail 2-7C



Detail 2-7D

NOTE: The next control you will mount could be supplied as shown in Detail 2-7D or as the type you have previously mounted. If you have received the type shown in the Detail, cut off lug 3. Also install a control nut on the bushing and tighten it.

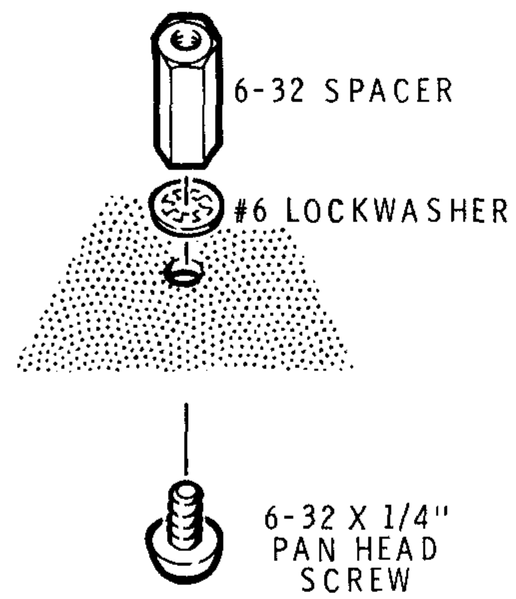
( ) R111: 100 kΩ control (#10-1194). If you have received a regular control, do not bend down lug 3, it will not be used. Then install it as you did the previous controls.

NOTE: Do not loosen or remove the nut that is already on the bushing of each of the next two switches.

( ) SW102: Mount a rotary switch (#63-1398). Use a lockwasher, flat washer, and control nut. Before you tighten the nut, position the switch so lug 4 is at the 12 o'clock position. Do not overtighten the nut.

( ) SW103: Similarly mount the other rotary switch.

( ) Refer to Detail 2-7E and mount 6-32 spacers at A, B, C, and D with 6-32 × 1/4" pan head screws and #6 lockwashers.



Detail 2-7E

NOTE: You will be instructed to prepare wires ahead of time as in the following steps. To prepare a wire, cut it to the indicated length and remove 1/4" of insulation from the ends. The wires are listed in the order in which they will be used.

( ) Prepare the following lengths of solid wire:

1-5/8" white
1-5/8" green
2" blue
2" yellow
2" violet

Connect the wires from switch SW101 to the circuit board in the following steps. NOTE: When you insert the wires into the board, leave approximately 1/8" between the end of the insulation and the board. This will make it easier to solder the wire to the foil.

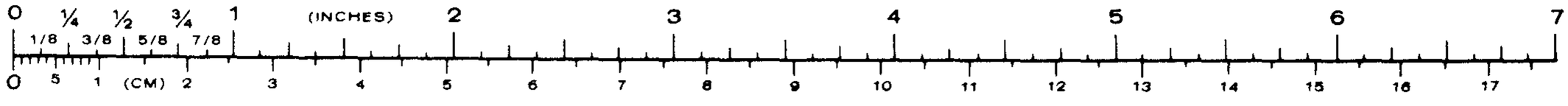
( ) White wire from lug 3 (S-1) to hole M (S-1).

( ) Green wire from lug 2 (S-1) to hole P (S-1).

( ) Blue wire from lug 6 (S-1) to hole O (S-1).

( ) Yellow wire from lug 5 (S-1) to hole Q (S-1).

( ) Violet wire from lug 4 (S-1) to hole N (S-1).



( ) Prepare the following lengths of solid wire:

2-1/2″ yellow
2″ green
2″ blue
1-3/4″ violet
2-3/4″ white
2-1/4″ orange

Connect the wires from switch SW102 to the circuit board in the following steps:

( ) Yellow wire from lug 1 (S-1) to hole I (S-1).

( ) Green wire from lug 2 (S-1) to hole J (S-1).

( ) Blue wire from lug 3 (S-1) to hole K (S-1).

( ) Violet wire from lug 4 (S-1) to hole L (S-1).

( ) White wire from lug 5 (S-1) to hole G (S-1).

( ) Orange wire from lug A (S-1) to hole H (S-1).

( ) Prepare the following lengths of solid wire:

2″ yellow
1-3/4″ green
1-5/8″ blue
1-3/4″ violet
1-3/4″ white
2″ orange

Connect the wires from switch SW103 to the circuit board in the following steps:

( ) Yellow wire from lug 1 (S-1) to hole B (S-1).

( ) Green wire from lug 2 (S-1) to hole C (S-1).

( ) Blue wire from lug 3 (S-1) to hole D (S-1).

( ) Violet wire from lug 4 (S-1) to hole E (S-1).

( ) White wire from lug 5 (S-1) to hole F (S-1).

( ) Orange wire from lug A (S-1) to hole A (S-1).

( ) Prepare the following lengths of solid wire:

1-1/2″ yellow
1-1/2″ black
1-1/4″ blue
1-1/4″ green
1-1/2″ white
1-3/4″ black

NOTE: When you connect the following wires to the switches, wrap the wire around the lug. The hole in the lugs will be used for resistors later.

Connect the wires from switch SW106 to the circuit board in the following steps:

( ) Yellow wire from lug 1 (NS) to hole X (S-1).

( ) Black wire from lug 2 (NS) to hole Y (S-1).

( ) Blue wire from lug 3 (NS) to hole W (S-1).

Connect the wires from switch SW105 to the circuit board in the following steps:

( ) Green wire from lug 1 (NS) to hole U (S-1).

( ) White wire from lug 3 (NS) to hole V (S-1).

( ) Black wire from lug 2 (S-1) of switch SW105 to lug 2 (S-2) of switch SW106.

( ) Turn the circuit board over and cut off the excess wire lengths protruding from the component side of the board.

NOTE: When you install the following resistors, use a 3/8″ length of sleeving on each lead.

( ) Cut the leads of four 10 kΩ (brn-blk-org) resistors to 1/2″.

Connect two resistors from switch SW105 to the circuit board in the following steps.

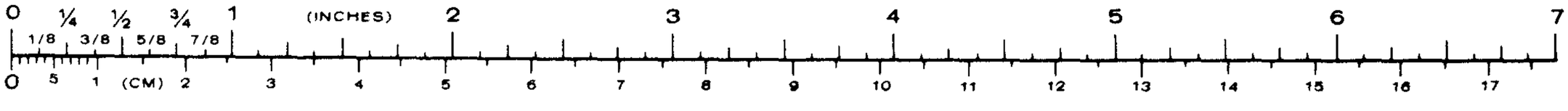
( ) R144: 10 kΩ resistor from lug 3 (S-2) to the foil pattern (S-1).

( ) R145: 10 kΩ resistor from lug 1 (S-2) to the foil pattern (S-1).

Connect two resistors from switch SW106 to the circuit board in the following steps.

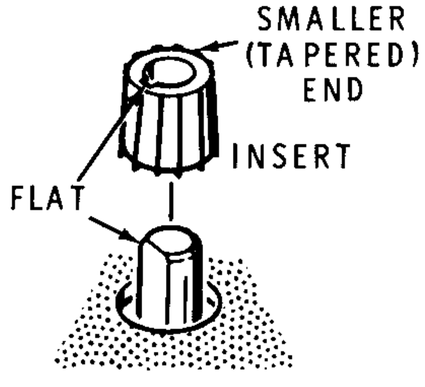
( ) R146: 10 kΩ resistor from lug 3 (S-2) to the foil pattern (S-1).

( ) R147: 10 kΩ resistor from lug 1 (S-2) to the foil pattern (S-1).



Refer to Pictorial 2-8 (Illustration Booklet, Page 7) for the following steps.

( ) **Position the circuit board with the component side facing up as shown.**

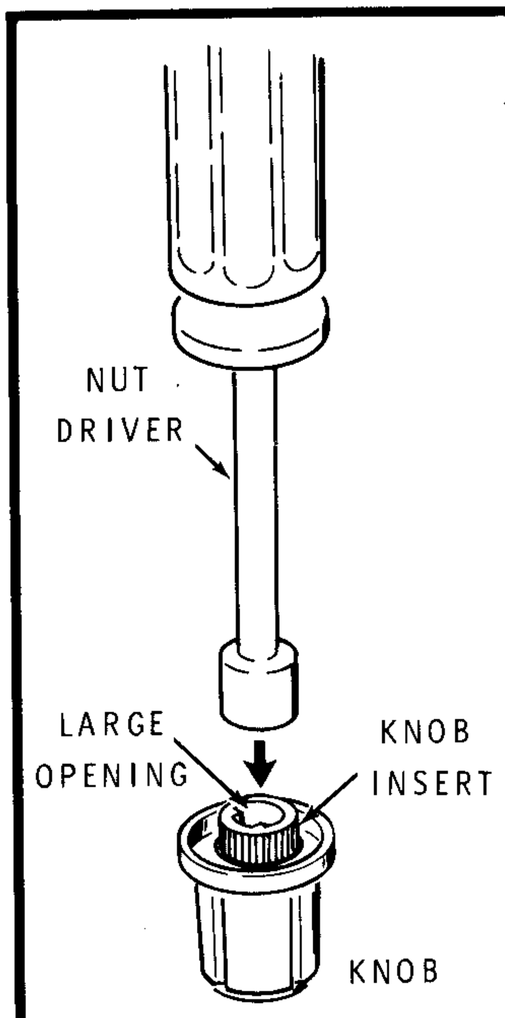


Detail 2-8A

NOTE: Refer to Detail 2-8A and note that the knob insert is tapered. When you place one of these inserts on a control shaft, make sure the smaller (tapered) end faces out or the knob will not slide onto the insert. If you are not sure which end is the smaller, roll the insert across a flat surface; the insert will gradually turn toward the smaller end.

( ) Install an insert on each of the control shafts and the switch shafts. Then turn all of the shafts fully counterclockwise.

( ) Refer to Detail 2-8B and follow the instructions to install the knobs on the inserts.



1 LINE UP THE POINTER AS SHOWN IN PICTORIAL 2-8 (ILLUSTRATION BOOKLET PAGE 7). MAKE SURE THE SWITCH SHAFT IS STILL FULLY COUNTERCLOCKWISE.

2 PUSH THE KNOB PART WAY ONTO THE INSERT.

3 CAREFULLY REMOVE BOTH THE INSERT AND THE KNOB. DO NOT ALLOW THE KNOB TO COME OFF THE INSERT.

4 PLACE THE KNOB ON A TABLE OR OTHER FIRM SURFACE. PLACE A SOFT CLOTH UNDER THE KNOB TO PREVENT IT FROM BEING MARRED. THEN USE A NUT DRIVER OR LARGE SCREWDRIVER AND DRIVE THE INSERT INTO THE KNOB. UNTIL IT IS FLUSH WITH THE INSIDE OF THE KNOB AS SHOWN.

5 REPLACE THE KNOB ON THE CONTROL FROM WHICH IT WAS REMOVED.

Detail 2-8B

CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

( ) Protruding leads which could touch together.

( ) ICs for the proper installation.

( ) LEDs for the proper installation.

( ) Electrolytic capacitors for the proper position of the marked lead.

Set the circuit board aside temporarily.

CHASSIS

PARTS LIST

Check all of the remaining parts against the following list and the Chassis Parts Pictorial (Illustration Booklet, Page 8). Any part that is packed in an individual envelope with the part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not discard any packing materials until all parts are accounted for.

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

RESISTOR — CAPACITOR — CHOKE — LED

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	6-9002-12	1	90 kΩ, 1%, 1/4-watt (wht-blk-blk-red)	Cal. R.
A2	21-71	2	.001 µF ceramic capacitor	C217, C218
A3	27-127	1	.047 µF Mylar capacitor	C216
A4	45-615	1	RF choke	L201
A5	412-640	1	Red LED	D210

SOCKETS — CONNECTORS

B1	432-1030	1	Small 2-hole socket
B2	432-974	1	Large 2-hole socket
B3	432-803	1	3-hole socket
B4	432-954	2	4-hole socket
B5	432-866	2	Small connector
B6	432-753	12	Large Connector

GENERAL

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C1	61-43	1	Power switch	SW201
C2	423-11	1	Fuseholder	
C3	431-86	1	6-lug terminal strip	
C4	261-28	4	Plastic feet	
C5	75-754	1	Strain relief	
C6	260-701	1	Retainer ring	
C7	260-700	1	LED grommet	
C8	73-43	1	Cable grommet	
C9	354-5	6	Cable tie	
C10	438-48	1	Nylon plug	
C11	421-23	1	1-ampere slow-blow fuse	F201

HARDWARE

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

Heathkit®

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
#4 Hardware				
D1	250-4111	10	4-40 × 1/4″ pan head screw	
D2	252-731	10	4-40 brass insert	
#6 Hardware				
E1	250-1325	4	6-32 × 1/4″ pan head screw	
E2	250-1280	6	6-32 × 3/8″ pan head screw	
E3	250-1420	8	6-32 × 3/8″ flat head screw	
E4	250-1322	1	#6 × 5/8″ self-tapping screw	
E5	252-3	2	6-32 nut	
E6	252-725	12	6-32 brass insert	
E7	254-1	2	#6 lockwasher	
E8	259-1	1	#6 solder lug	
#8 Hardware				
F1	250-1437	4	8-32 × 1/2″ pan head screw	
F2	252-4	4	8-32 nut	
F3	254-2	4	#8 lockwasher	
MISCELLANEOUS				
	92-786	1	Cabinet top	
	92-787	1	Cabinet bottom	
	54-1010	1	Power transformer	T201
G1	200-1458-1	1	Chassis	
	89-54	1	Line cord	

STEP-BY-STEP ASSEMBLY

Refer to Pictorial 3-1 (Illustration Booklet, Page 9) for the following steps.

NOTE: You will be instructed to prepare wires ahead of time, as in the following steps. To prepare a wire, cut it to the indicated length and remove 1/4″ of insulation from the ends. When you are using stranded wire, twist the fine strands together and apply a small amount of solder on the ends. The wires are listed in the order in which they will be used.

( ) Prepare the following lengths of wire:

4-3/4″ white stranded
4-3/4″ yellow solid
4-3/4″ green solid
4-3/4″ orange stranded
4-3/4″ small black stranded
14″ violet solid
14″ white solid
14″ blue solid
7″ white stranded
7″ orange stranded
5″ small black stranded

( ) Position the power supply circuit board as shown.

Connect the wires to the power supply circuit board in the following steps. After you solder the wires to the foil cut off the excess wire lengths from the foil side of the board.

( ) 4-3/4″ white stranded wire to hole M (S-1).

( ) 4-3/4″ yellow solid wire to hole L (S-1).

( ) 4-3/4″ green solid wire to hole K (S-1).

( ) 4-3/4″ orange stranded wire to hole H (S-1).

( ) 4-3/4″ small black stranded wire to hole G (either hole).

( ) Twist together the 14″ violet, 14″ white, and 14″ blue solid wires.

( ) Violet wire to hole F (S-1).

( ) White wire to hole E (S-1).

( ) Blue wire to hole D (S-1).

( ) Twist together the 7″ white and 7″ orange stranded wires.

( ) White wire to hole B (S-1).

( ) Orange wire to hole A (S-1).

( ) 5″ small black stranded wire to hole C (S-1).

( ) Refer to Detail 3-1A and position the main and power supply circuit boards as shown. Then mount the power supply board on spacers A, B, C, and D with 6-32 × 1/4″ pan head screws.

Refer again to Pictorial 3-1 for the following steps.

NOTE: When you solder a wire to the foil in the following steps, lay the bare end flat on the foil and solder it to the foil. If the wire tries to spring up off the foil, hold it down with the blade of a screwdriver until the solder cools.

Connect the wires coming from the power supply board to the main board in the following steps:

( ) White wire from M to foil EE (S-1).

( ) Yellow wire from L to foil FF (S-1).

( ) Green wire from K to foil GG (S-1).

( ) Black wire from G to foil HH (S-1).

( ) Orange wire from H to foil JJ (S-1).

( ) Violet wire from F to hole 18 (S-1).

( ) White wire from E to hole 19 (S-1).

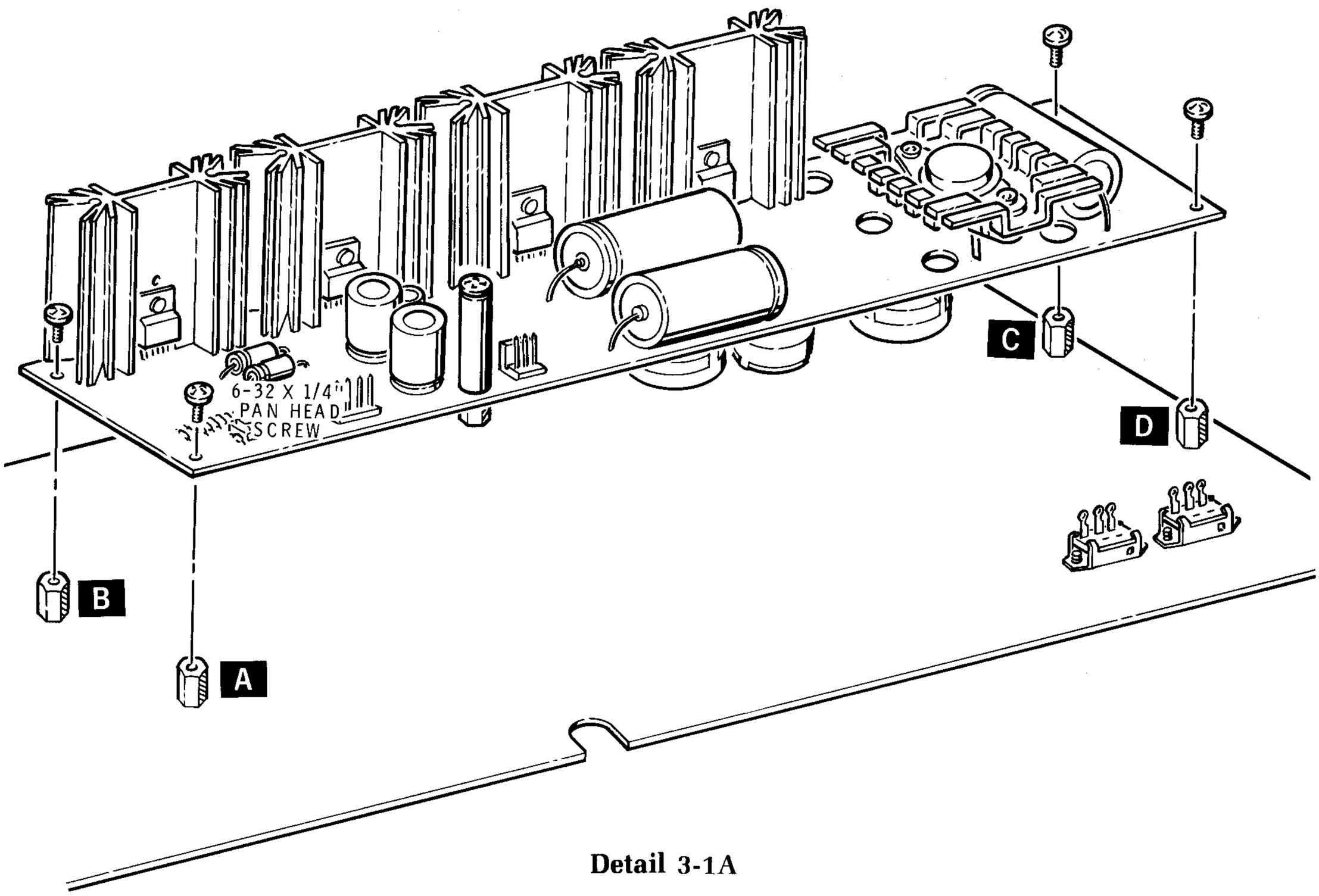
( ) Blue wire from D to hole 17 (S-1).

( ) Orange wire from A to foil LL (S-1).

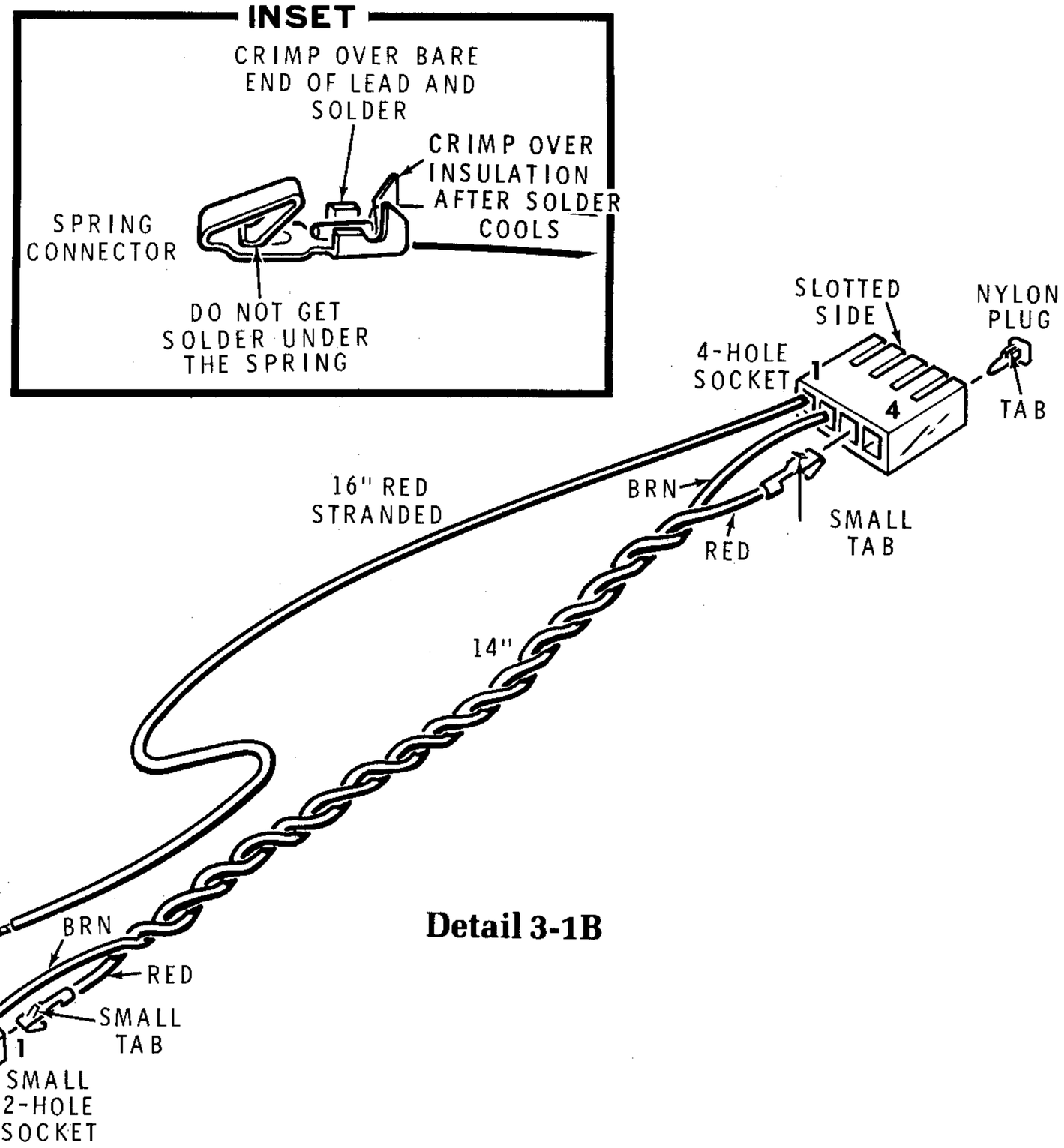
( ) White wire from B to foil KK (S-1).

( ) Black wire from C to foil NN (S-1).

( ) Cut off the excess lead lengths that protrude from the component side of the board.



Detail 3-1A



Detail 3-1B

Refer to Detail 3-1B for the following steps.

( ) Twist together a 14″ brown and a 14″ red solid wire. Remove 1/8″ of insulation from both wires at one end, and 3/16″ from the wires at the other end.

( ) Refer to the inset drawing and install large connectors on the 3/16″ stripped ends of these wires, and small connectors on the 1/8″ stripped ends, as shown in the inset drawing.

( ) Remove 3/16″ of insulation from both ends of a 16″ red stranded wire. Install a large connector on one end only.

In the following steps, you will insert the connectors that are on these wires into a 4-hole and small 2-hole socket. Be sure to position the sockets with the slotted side up and the connectors with the small tab up when you insert them. Make sure the tab snaps into place.

4-Hole Socket

( ) 16″ red stranded wire in hole 1.

( ) Large connector on brown wire in hole 2.

( ) Large connector on red wire in hole 3.

( ) Position the nylon plug with the small tab as shown. Insert the nylon plug in hole 4.

Small 2-hole Socket

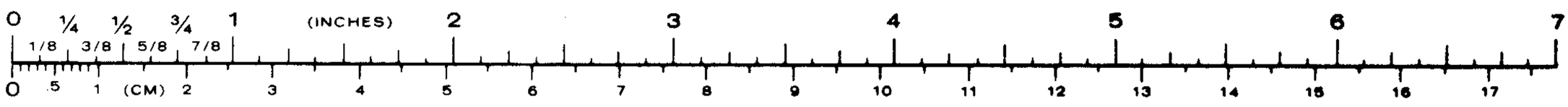
( ) Red wire in hole 1.

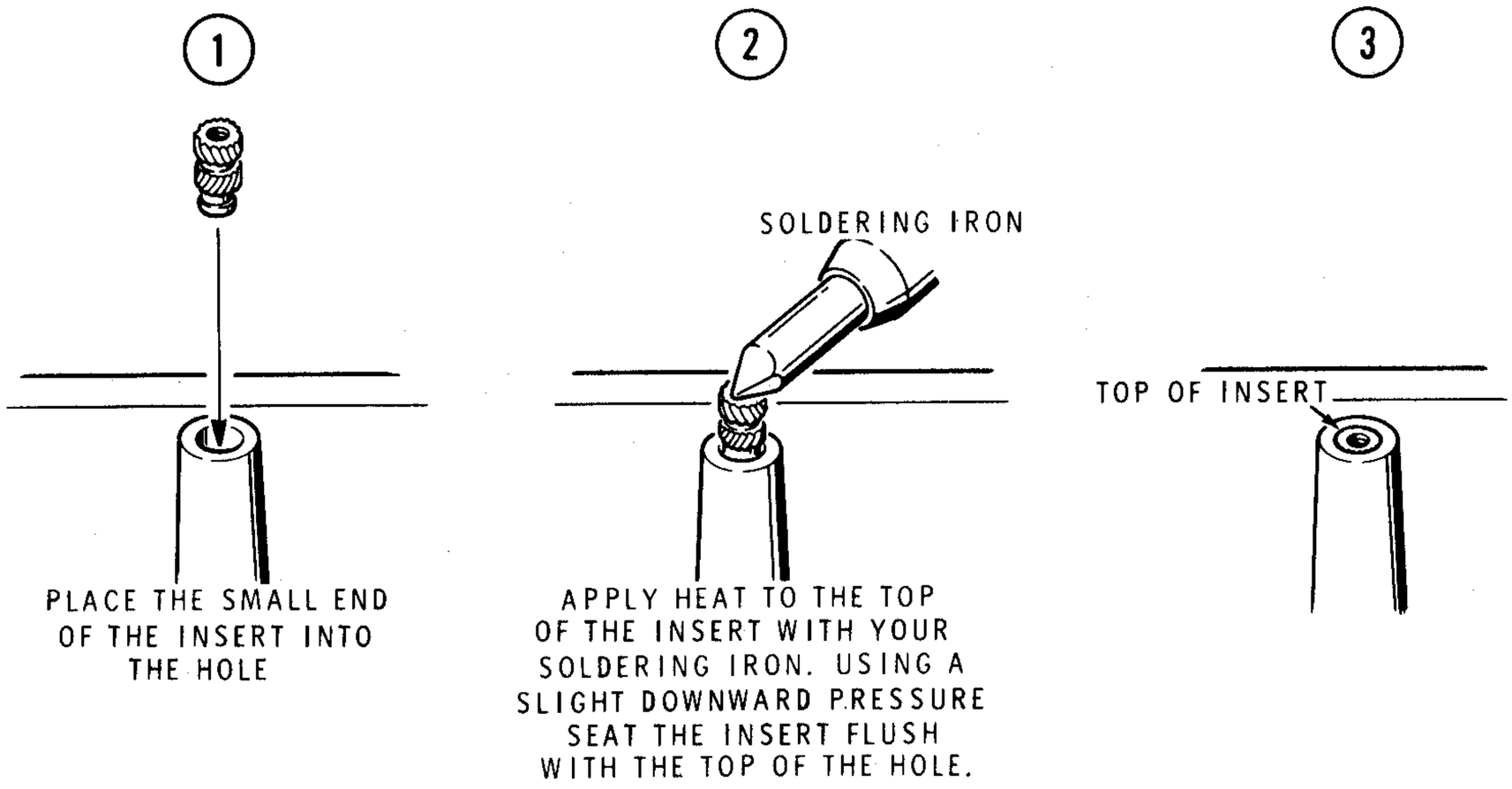
( ) Brown wire in hole 2.

Refer again to Pictorial 3-1 for the following steps.

( ) Position the 4-hole socket as shown and install it on plug P202. Then route the red stranded wire as shown and solder it to the foil at MM.

Set the assembly aside temporarily.





Detail 3-2A

Refer to Pictorial 3-2 (Illustration Booklet, Page 10) for the following steps.

( ) Position the cabinet bottom and top as shown. NOTE: There may be a film on the cabinet, if there is wipe it thoroughly with a clean cloth.

NOTE: Before you install brass inserts make sure your soldering iron is clear of solder or solder may flow down into an insert. Then refer to Detail 3-2A and use your soldering iron to install the inserts in the following steps. The white arrows on the Pictorial indicate where to install the smaller 4-40 inserts, and the dark arrows indicate where to install the larger 6-32 inserts.

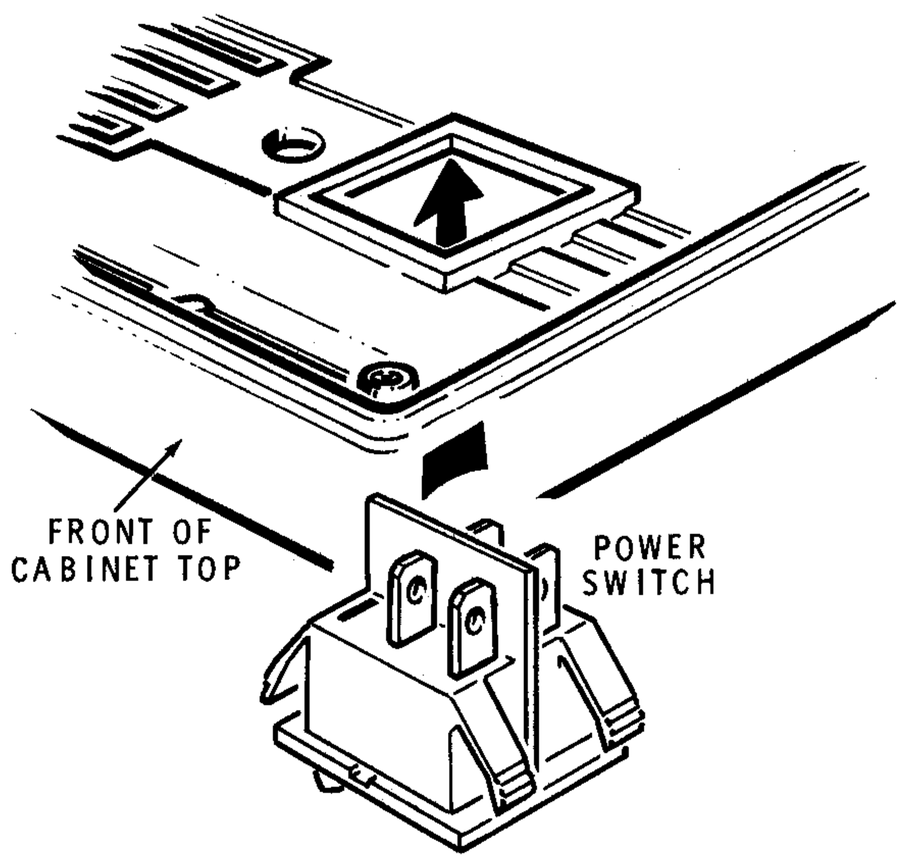
( ) Install the ten 4-40 brass inserts at the white arrow locations in the cabinet top.

( ) Install the twelve 6-32 brass inserts at the black arrow locations in the cabinet top and bottom.

( ) Turn the cabinet bottom over. Then peel the backing from the four plastic feet and install then at the recesses at each corner.

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

( ) Refer to Detail 3-3A and position the power switch so the lugs are as shown. Then push it into the cabinet top from the top side of the cabinet at SW101. Make sure the four tabs lock in place. Use a screwdriver and pry them out slightly.



Detail 3-3A

( ) Refer to Detail 3-3B and place the cabinet top so the top side is up. Then peel the POWER, OFF, ON portion from the nameplate label and place it in the rectangular recessed area at the right side of the cabinet top.

( ) D210: Refer to Detail 3-3C and install the red LED in the cabinet top at D210 as follows:

1. Push the LED grommet into the hole from the outside of the cabinet top as far as it will go.

2. Push the LED all the way into the grommet.

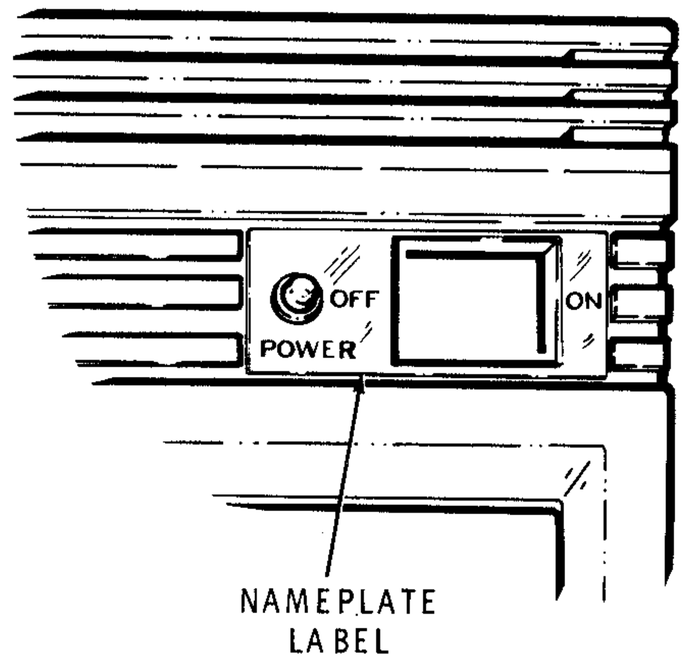
3. Place the retainer ring over the LED and press the ring over the grommet as far as it will go. You will have to hold the grommet from the other side as you do this.

( ) Refer to Pictorial 3-3 and position the main circuit board assembly as shown. Then place it inside the cabinet top.

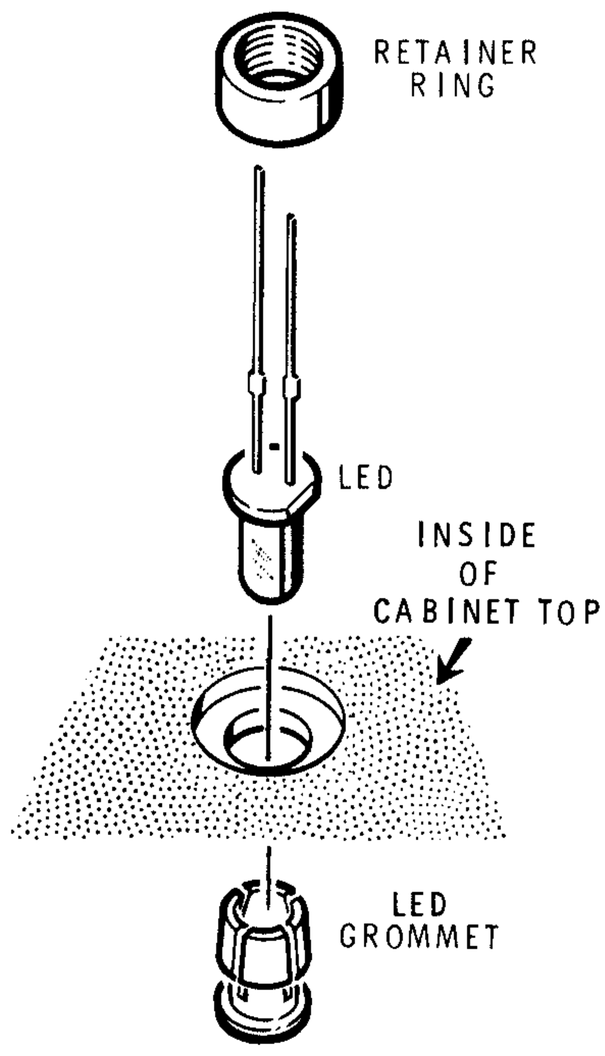
( ) Line up the ten holes in the board with the brass inserts in the cabinet and fasten it with ten 4-40 × 1/4″ pan head screws.

( ) Install the socket, on the end of the brown and red twisted wires coming from P202, on the leads of the LED at D210. The brown wire should match up with the shorter LED lead. After you install the socket, bend the LED leads over the socket as shown in the inset drawing.

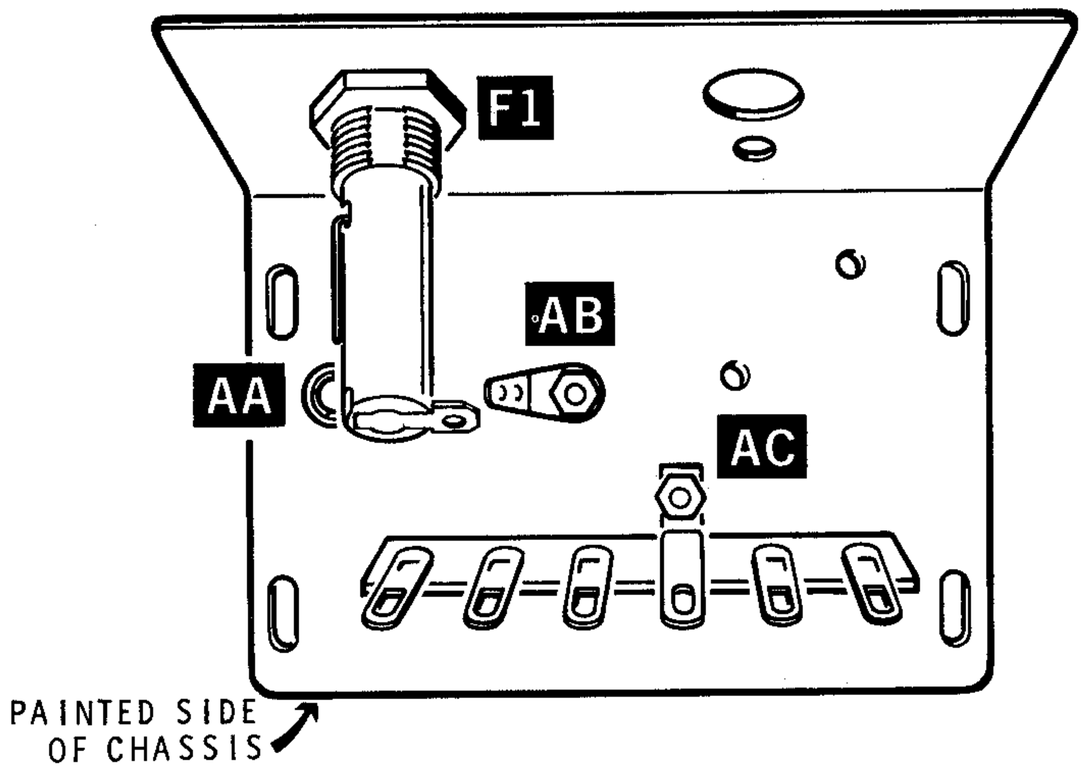
Set this assembly aside temporarily.



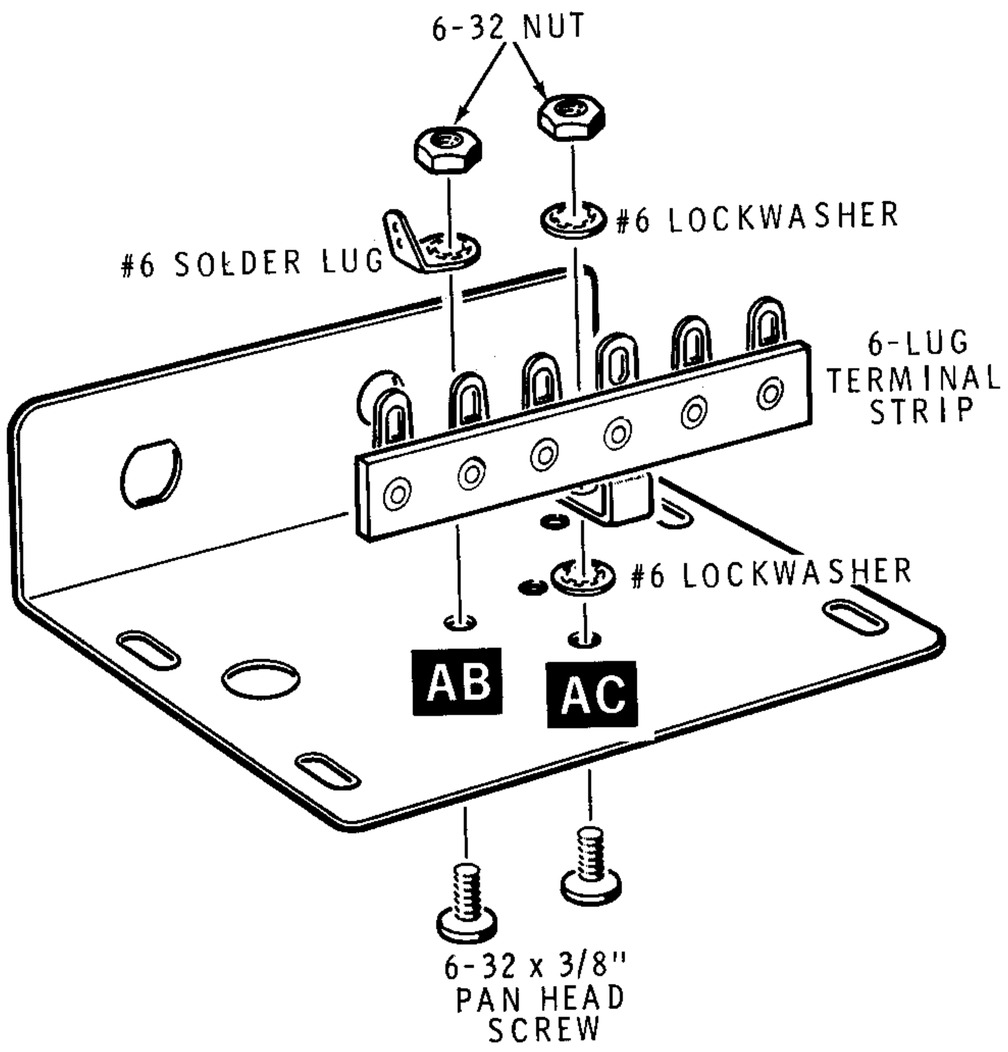
Detail 3-3B



Detail 3-3C



PICTORIAL 3-4



Detail 3-4A

Refer to Pictorial 3-4 for the following steps.

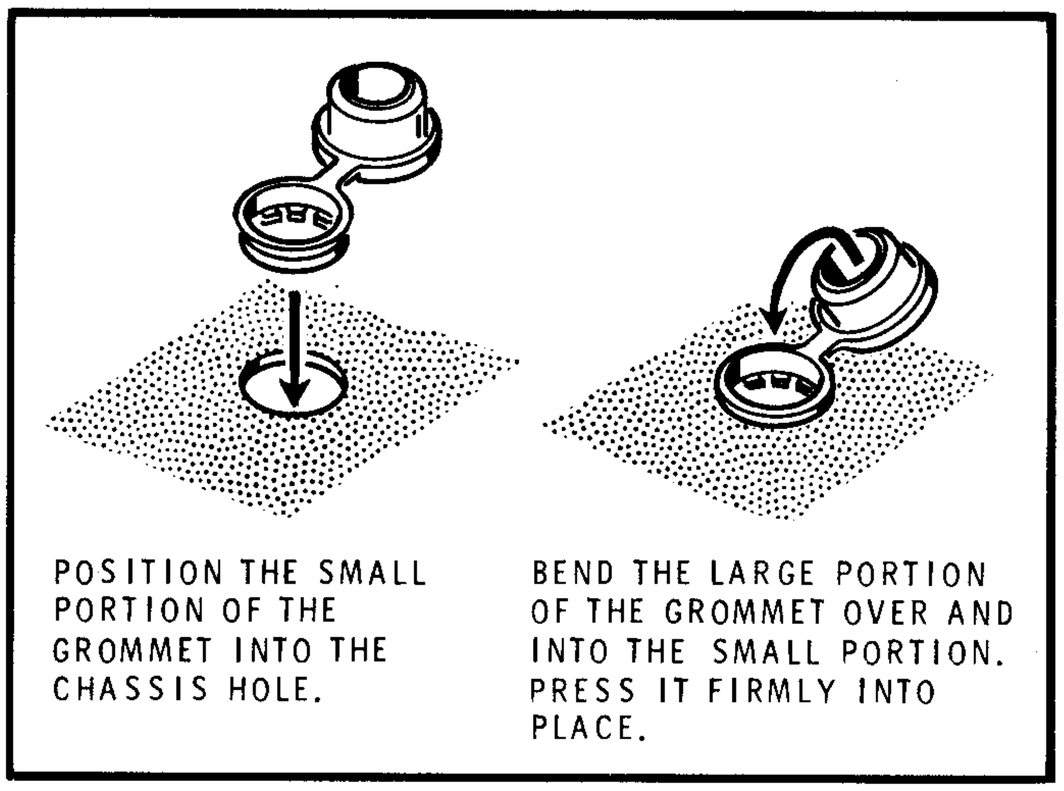
( ) Position the chassis as shown. NOTE: Check holes AB and AC. If there is paint around these holes, scrape it off.

( ) Refer to Detail 3-4A and mount a #6 solder lug at AB with a 6-32 × 3/8″ pan head screw and a 6-32 nut. Position the solder lug as shown.

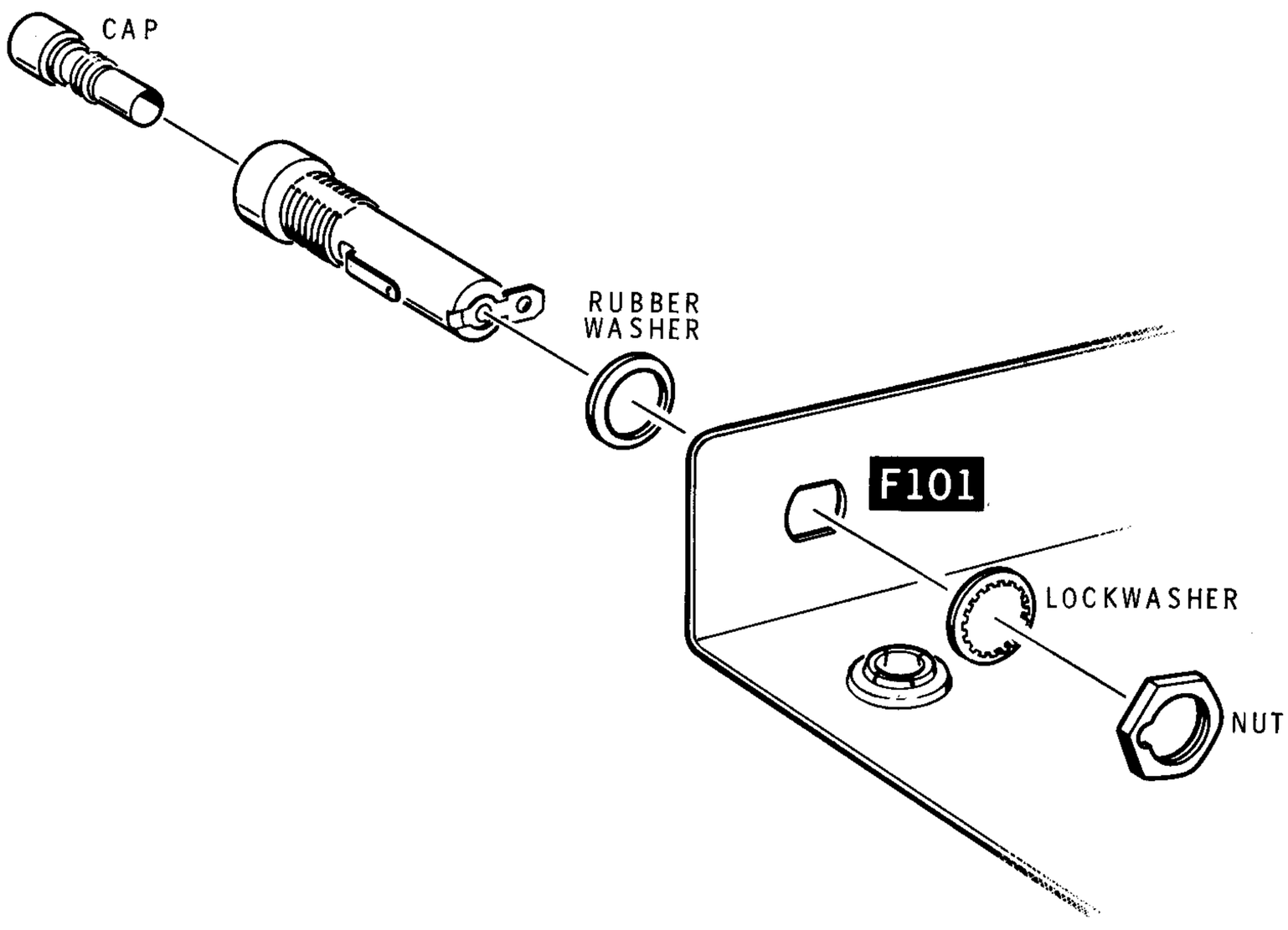
( ) Refer to Detail 3-4A, position the 6-lug terminal strip as shown, and mount it at AC. Use a 6-32 × 3/8″ pan head screw, two #6 lockwashers, and a 6-32 nut.

( ) Refer to Detail 3-4B and install the cable grommet at AA from the painted side of the chassis as shown.

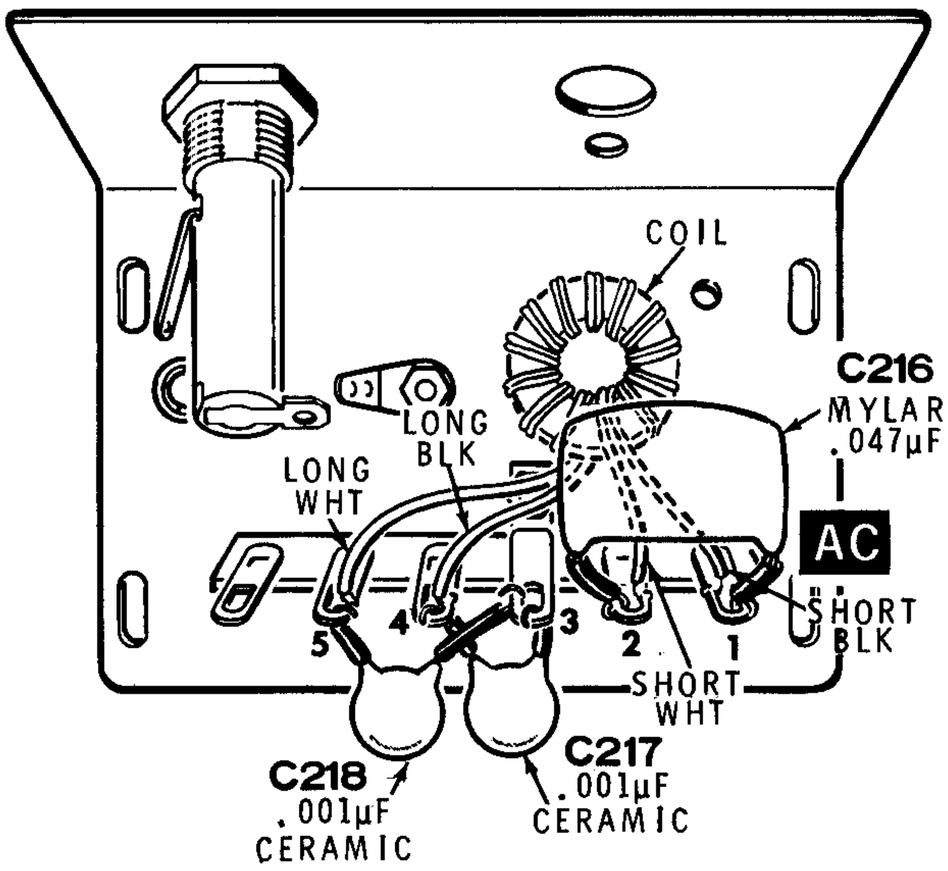
( ) Refer to Detail 3-4C and mount the fuseholder at F101 with the hardware supplied with the fuseholder. Position the fuseholder so the lugs are as shown. NOTE: The fuse will be installed later.

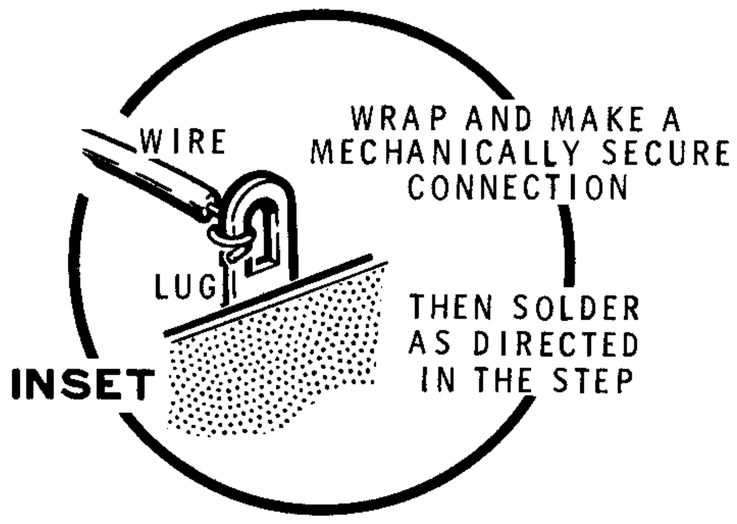


Detail 3-4B



Detail 3-4C





PICTORIAL 3-5

( ) Refer to Detail 3-5A and shorten the leads of the RF choke as shown. Then remove 1/4″ of insulation from the ends.

Refer to Pictorial 3-5 for the following steps.

Connect the leads of the choke, and the capacitors, to terminal strip AC in the following steps. NOTE: Make a mechanically secure connection as shown in the inset drawing. Also, use a 3/8″ length of sleeving on each capacitor lead and keep the leads as short as possible.

( ) Shorter black lead to lug 1 (NS).

( ) Shorter white lead to lug 2 (NS).

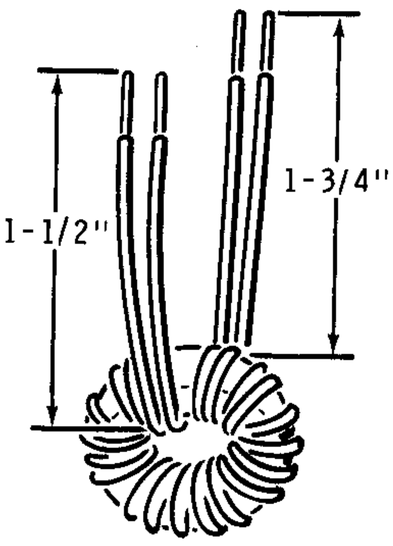
( ) Long black lead to lug 4 (NS).

( ) Long white lead to lug 5 (NS).

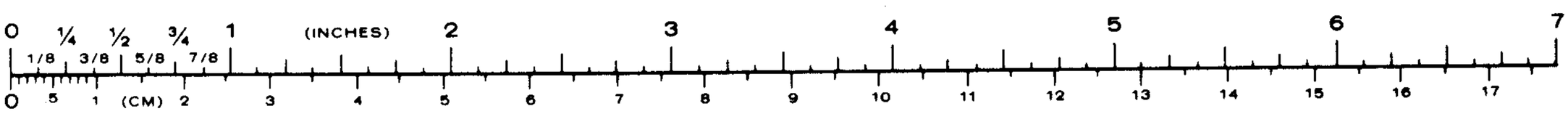
( ) C216: Connect a .047 µF Mylar capacitor between lugs 1 (NS) and 2 (NS).

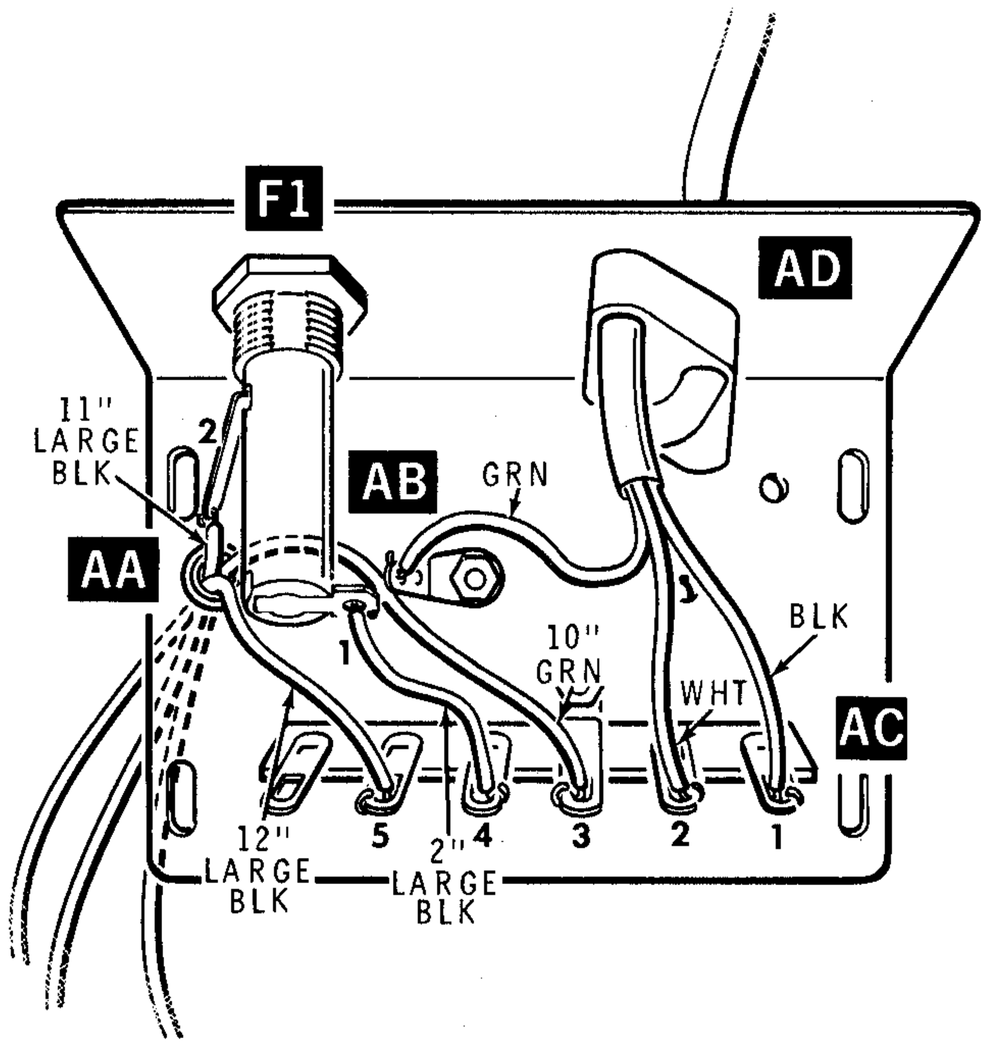
( ) C217: Connect a .001 µF ceramic capacitor between lugs 3 (NS) and 4 (NS).

( ) C218: Connect a .001 µF ceramic capacitor between lugs 3 (NS) and 5 (NS).



Detail 3-5A





PICTORIAL 3-6

Refer to Pictorial 3-6 for the following steps.

( ) Prepare the following lengths of stranded wire:

2″ large black stranded
11″ large black stranded
12″ large black stranded
10″ green stranded

NOTE: In the following steps, be sure to make mechanically secure connections. Wrap the lead ends securely around the lugs.

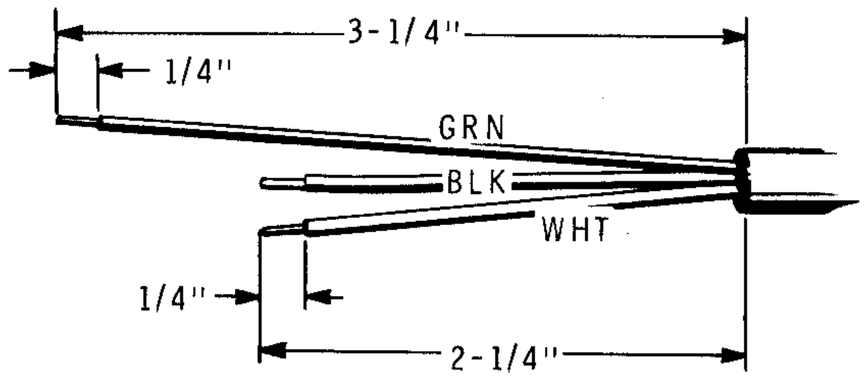
( ) Connect the 2″ wire from lug 1 of fuseholder F1 (S-1) to lug 4 of terminal strip AC (S-3).

( ) Route the 11″ wire through grommet AA and connect the end to lug 2 of fuseholder F1 (S-1).

( ) Route the 12″ wire through grommet AA and connect the end to lug 5 of terminal strip AC (S-3).

( ) Route the 10″ green wire under the fuseholder and through grommet AA. Connect the end to lug 3 of terminal strip AC (S-3).

( ) Refer to Detail 3-6A and prepare the end of the line cord.



Detail 3-6A

( ) Refer to Part A of Detail 3-6B and route the line cord through hole AD in the chassis and through the line cord strain relief.

( ) Refer to Part B of Detail 3-6B and route the line cord through the remaining hole in the strain relief. Then fasten the strain relief to the chassis with a #6 × 5/8″ self-tapping screw.

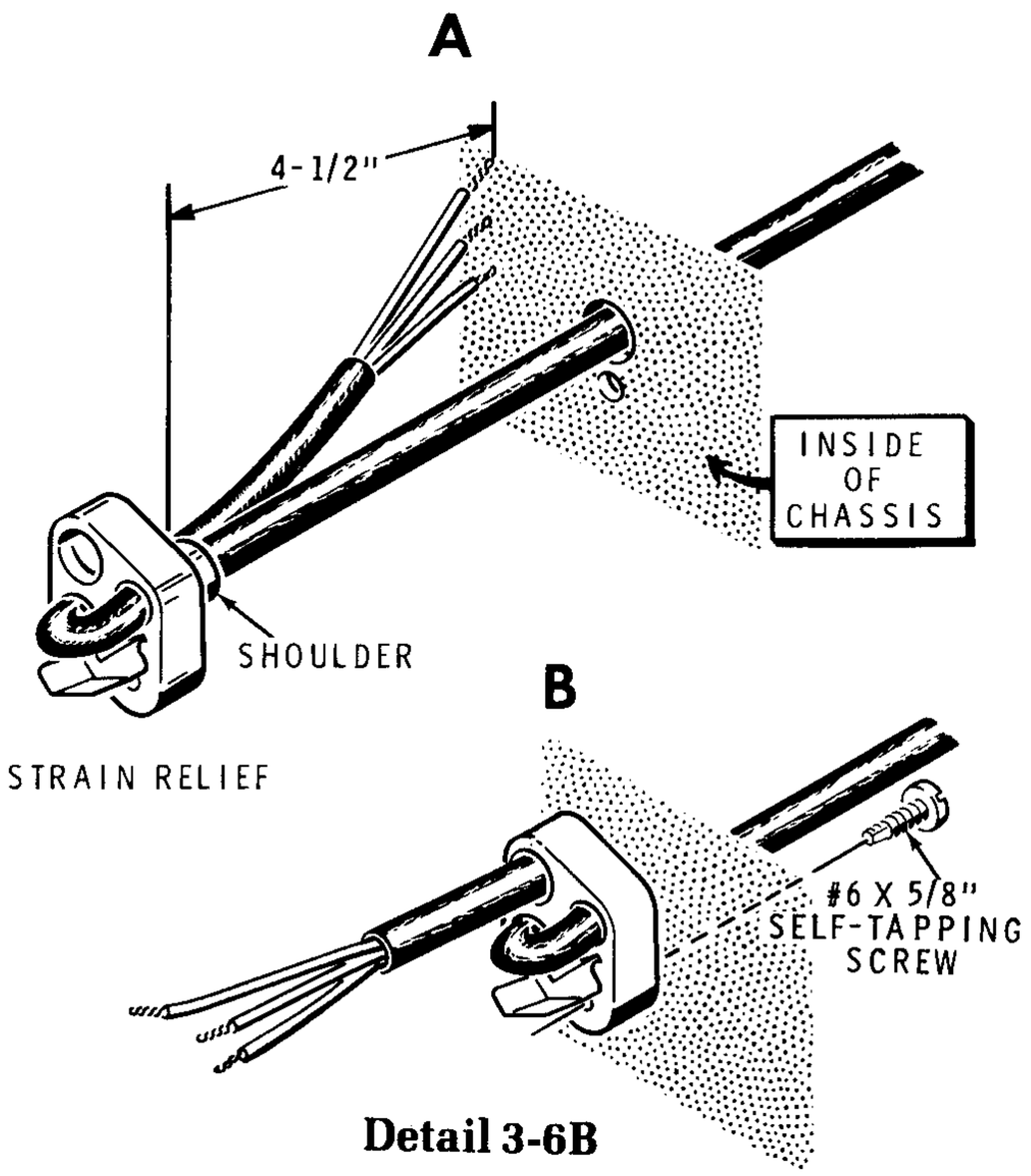
Connect the line cord leads in the following steps. Be sure to make a mechanically secure connection.

( ) Black lead to lug 1 of AC (S-3).

( ) White lead to lug 2 of AC (S-3).

( ) Green lead to AB (S-1).

( ) Push the .047 Mylar capacitor down toward the choke. This completes the chassis wiring. Set it aside temporarily.



Detail 3-6B

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

( ) Position the power transformer as shown.

( ) Prepare both ends of a 14″ green stranded wire.

( ) Connect one end of the green wire to the solder lug on the transformer (NS).

( ) Twist together the following groups of transformer leads:

Two red, the red-yellow, and the green wire from the solder lug. When you twist this group of wires, pull them up straight and then twist them together.

Two green and the green-yellow.

Two yellow.

( ) Install large spring connectors on the ends of each twisted group. See inset drawing #1.

Insert the connectors that are on these cables into sockets as you are directed in the following steps. Be sure to position the sockets with the slotted side up and the connectors with the small tab up when you insert them. See inset drawing #2.

3-Hole Socket (two green, green-yellow group):

( ) Green-yellow in hole 1.

( ) Either green in hole 2.

( ) Other green in hole 3.

4-Hole Socket (Two red, red-yellow, green group):

( ) Either red in hole 1.

( ) Red-yellow in hole 2.

( ) Green in hole 3.

( ) Other red in hole 4.

2-Hole Socket (Yellow group):

( ) Either yellow in hole 1.

( ) Other yellow in hole 2.

( ) Twist together the following groups of transformer leads.

Two blue and the blue-yellow.

The black and the black-green.

The black-yellow and the black-red.

( ) Mount the transformer on the cabinet bottom at the location shown in Pictorial 3-7 (Illustration Booklet, Page 12). Use 8-32 × 5/8″ pan head screws, #8 lockwashers, and 8-32 nuts.

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

( ) Position the cabinet bottom and top as shown.

( ) Route the line cord, coming from the chassis, through the rectangular opening at the back of the cabinet bottom and set the chassis in place.

Connect the leads coming from the transformer in the following steps:

( ) Either blue wire to hole R (S-1).

( ) Blue-yellow wire to hole S (S-1).

( ) Other blue wire to hole T (S-1).

NOTE: When you install the sockets in the following steps, position the slotted side of each socket as indicated on the pictorial.

( ) Install the socket with the yellow leads on plug P201.

( ) Install the socket with the green and green-yellow leads on plug P203.

( ) Install the socket with the red, green, and red-yellow leads on plug P204.

( ) Cut four 1″ lengths of heat-shrinkable sleeving.

( ) Place a 1″ length of sleeving over each of the black wires coming from the chassis. Set the other sleeving aside, it will be used later.

( ) Connect either black wire to lug 4 of switch SW101 (S-1).

( ) Connect the other black wire to lug 2 of switch SW101 (S-1).

( ) Connect the green wire coming from the chassis to the solder lug on transformer T1 (S-2).

ALTERNATE LINE VOLTAGE WIRING

Two sets of line voltage wiring instructions are given below, one for 120 VAC and the other for 240 VAC. In the United States 120 VAC is most common. USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.

120 VAC Wiring

( ) Place a 1" length of sleeving over each of the remaining two groups of transformer leads.

( ) Connect the black and black-green leads to lug 3 of switch SW101 (S-2).

( ) Connect the black-yellow and black-red leads to lug 1 of switch SW101 (S-2).

( ) Make sure the sleeving is over the four switch lugs. Then install a cable tie around the wires above the sleeving and draw the tie up tightly. See the inset drawing.

( ) Remove the fuseholder cap and install the 1-ampere fuse. Then reinstall the cap.

Proceed to "Cabinet Bottom" on Page 44.

240 VAC Wiring

NOTE: The plug on the power cord for this kit is for standard 120 VAC outlets in most of North America. For 240 VAC operation in other countries, cut off and replace this plug with a permanent plug that matches your 240 VAC receptacle.

( ) Unwind the remaining two groups of transformer leads.

( ) Cut off 6" from the black-yellow and black-green leads and discard them. Prepare the ends of the transformer leads.

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

( ) Position the chassis as shown.

( ) Route the two transformer leads through the grommet from the top of the chassis.

( ) Connect both leads to lug 6 of terminal strip AC (S-2).

( ) Place a 1" length of sleeving over the two remaining transformer leads.

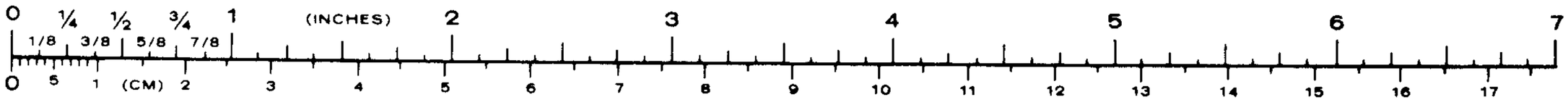
( ) Connect the black-red lead to lug 3 of switch SW101 (S-1).

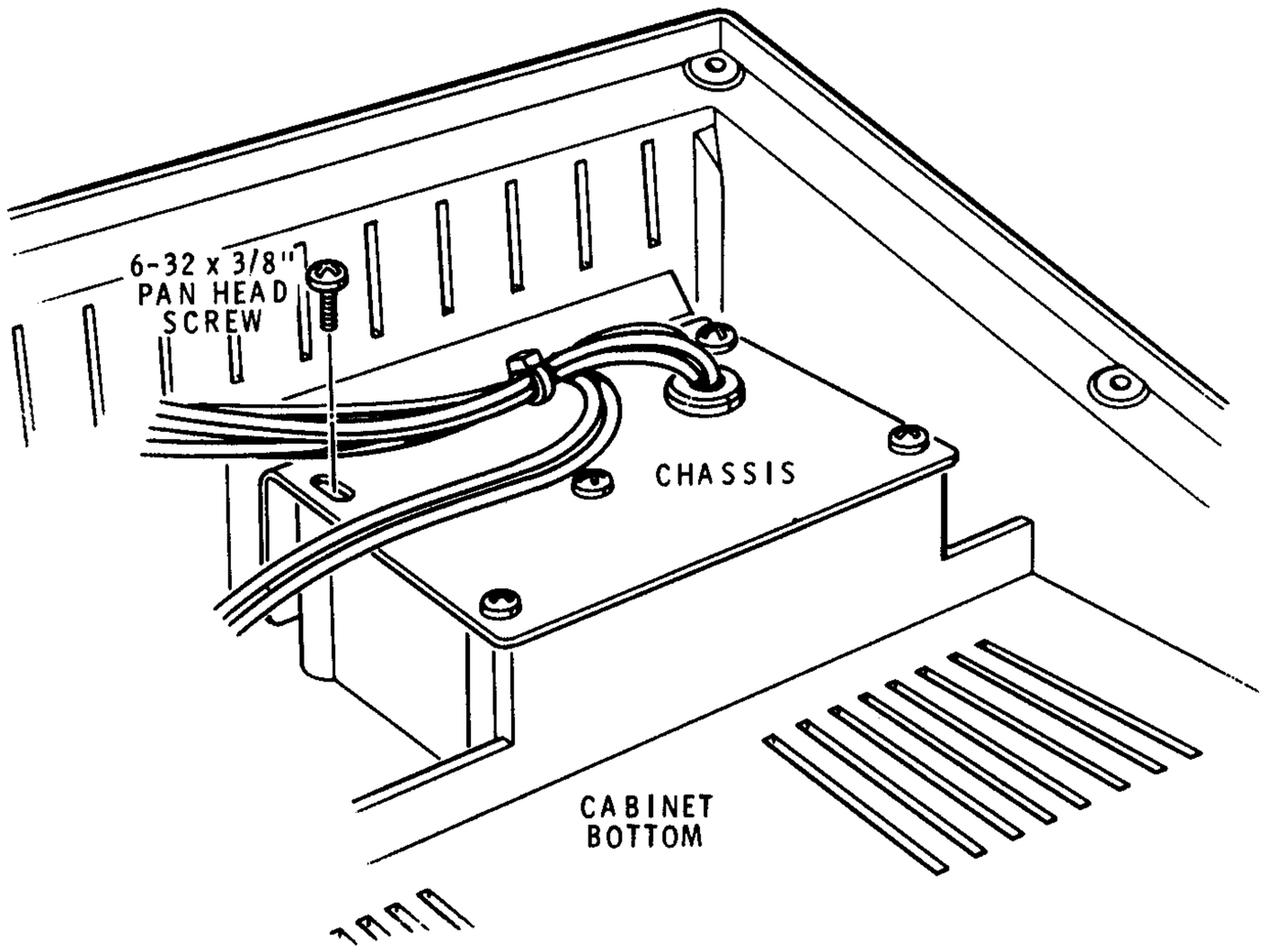
( ) Connect the black lead to lug 1 of switch SW101 (S-1).

( ) Make sure the sleeving is over the two switch lugs. Then install a cable tie around the wires above the sleeving and draw the tie up tightly. See the inset drawing.

( ) Remove the fuseholder cap and install a 1/2-ampere fuse. Then reinstall the fuse.

Proceed to "Cabinet Bottom" on Page 44.





Detail 3-8B

CABINET BOTTOM

( ) Refer to Detail 3-8B and place the chassis into position in the cabinet bottom. Fasten it with four 6-32 × 3/8″ pan head screws.

( ) Bunch the wires at the five locations shown in Pictorial 3-8 and install cable ties around them. Pull the tie so it is just snug around the wires so it can still be moved if necessary.

PRIMARY WIRING TESTS

A wiring error in the primary wiring circuit (line cord, ON-OFF 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 power cord is not plugged in.

( ) Press the POWER switch to OFF.

( ) If you do not have an ohmmeter, carefully check the line cord, fuse, POWER switch, and transformer wiring with that shown in the Pictorials. Make sure there are no fine strands of wire or solder blobs touching adjacent terminals or the chassis. Then proceed to the "Operation Checks," on Page 47.

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 ground can be in any one of the ground pins (▽) on the front panel.

( ) Place the ohmmeter switch in the "X10 ohms" position.

METER CONNECTIONS		METER READING	POSSIBLE CAUSE OF TROUBLE
RED LEAD	**BLACK LEAD**		
1. Either flat prong of the line cord plug.	Ground	INFINITE with the POWER switch ON or OFF.	A. Choke L201 wired incorrectly. B. Switch SW101 wired incorrectly. C. Capacitors C216, C217, C218.
2. Other flat prong of the line cord plug.	Ground	INFINITE with the POWER switch ON or OFF.	
3. Round prong of the line cord plug.	Ground	0 Ω with the POWER switch ON or OFF.	
4. Either flat prong.	Other flat prong.	1M or higher with the POWER switch OFF.	
( ) Turn the POWER switch ON			
5. Either flat prong.	Other flat prong.	0 to 10 ohms	

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

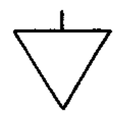
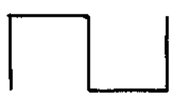
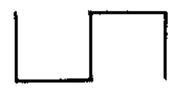
OPERATION CHECKS

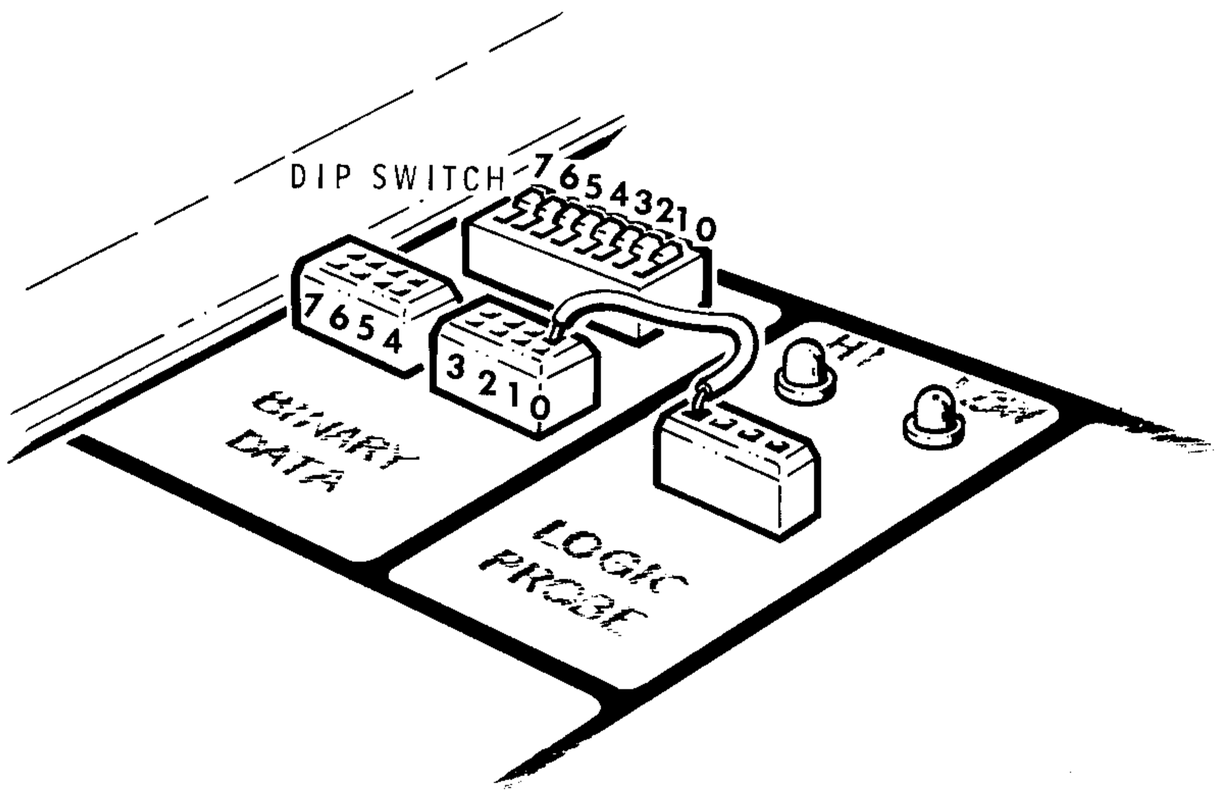
The purpose of this section of the Manual is to make sure your kit operates properly.

Set the controls listed below as follows:

( ) Plug the line cord into an AC outlet.
( ) POWER switch — ON.
( ) PULSE(sec) — 2 m.
( ) FREQ. — Fully counterclockwise.
( ) FREQ. MULTIPLIER — 1.
( ) BINARY DATA — All eight switches in the 1 position. NOTE: The 1 and 0 positions are screened on the circuit board next to the switch.
( ) Locate a 12" solid wire (any color) and remove 3/8" of insulation from each end.

To make the checks in the following chart, insert one end of the wire into the connector block indicated in column A, and the other end in the connector block indicated in column B. You should obtain the results shown in the READING column.

A	B	READING
LOGIC PROBE		LOW LED should light.
LOGIC PROBE	+5 V	HI LED should light.
LOGIC PROBE	LOGIC SWITCH A	LOW LED should light. Push the A LOGIC switch. The HI LED should light.
LOGIC PROBE	LOGIC SWITCH $\overline{A}$	HI LED should light. Push the A LOGIC switch. The LOW LED should light.
LOGIC PROBE	LOGIC SWITCH B	LOW LED should light. Push the B LOGIC switch. The HI LED should light.
LOGIC PROBE	LOGIC SWITCH $\overline{B}$	HI LED should light. Push the B LOGIC switch. The LOW LED should light.
LOGIC PROBE	PULSE (sec)	LOW LED should light and HI LED should blink on and off.
LOGIC PROBE		HI and LOW LED's alternately blinking.
LOGIC PROBE		HI and LOW LED's alternately blinking.
+5 V	L0	L0 LED should light. Repeat the same procedure with L1 through L7.



PICTORIAL 3-9

Refer to Pictorial 3-9 for the following steps.

( ) Insert one end of the wire into the LOGIC PROBE connector block.

In the following checks, you will insert the other end of the wire into either row of horizontal holes in the BINARY DATA connector blocks. Note that numbered holes 0 through 7 on the blocks in the Pictorial correspond to the numbers on the individual switches of the dip switch. All switches should now be in the UP position.

( ) Insert the other end of the wire into hole 0 of the connector block.

( ) Push switch 0 DOWN. The LOW LED should light. Leave the switch in this position.

( ) Repeat this procedure with each of the other switches. EXAMPLE: Move the wire to position 1 on the connector block and push switch 1 DOWN. For each position of the switch and wire, the LOW LED should light.

All switches should now be in the DOWN position.

( ) Move the wire back to the 0 position on the connector block. Then repeat the above procedure by moving the wire from 1 through 7 and correspondingly moving each switch in the UP position. The HI LED should come on each time you do this.

Refer to Pictorial 3-10 (Illustration Booklet, Page 14) for the following steps.

If a voltmeter is available, check the following voltages. If one is not available, proceed to the "Operation" section.

Connect the meter leads as shown in the Pictorial when you are taking these readings. Set the meter to the next highest range than the maximum voltage reading you are taking. You will also have to insert a short bare wire (1/2") into the connector first so you can connect the meter leads to it.

( ) Take both 15 VAC readings.

( ) Take the 30 VAC reading.

( ) Take the −1.2 to −20 VDC reading. Adjust the control from fully counterclockwise to fully clockwise.

( ) Take the +1.2 to +20 VDC reading. Adjust the control from fully counterclockwise to fully clockwise.

( ) Take the +12 VDC reading.

( ) Take the −12 VDC reading.

( ) Turn the Power switch OFF and unplug the unit.

OPERATION

Pictorial 3-11 (Illustration Booklet, Page 15) describes the function of each control and connector block.

CALIBRATION

If an ohmmeter is available, perform the following steps. If you do not have an ohmmeter, proceed to "Final Assembly."

This adjustment calibrates the Trainer's Function Generator to be within ±10% of the correct frequency. If this adjustment is not done, the frequency may be off as much as 30%.

Refer to Pictorial 3-12 for the following steps.

( ) Turn the FREQ control (on the screened side of the main circuit board) fully counterclockwise.

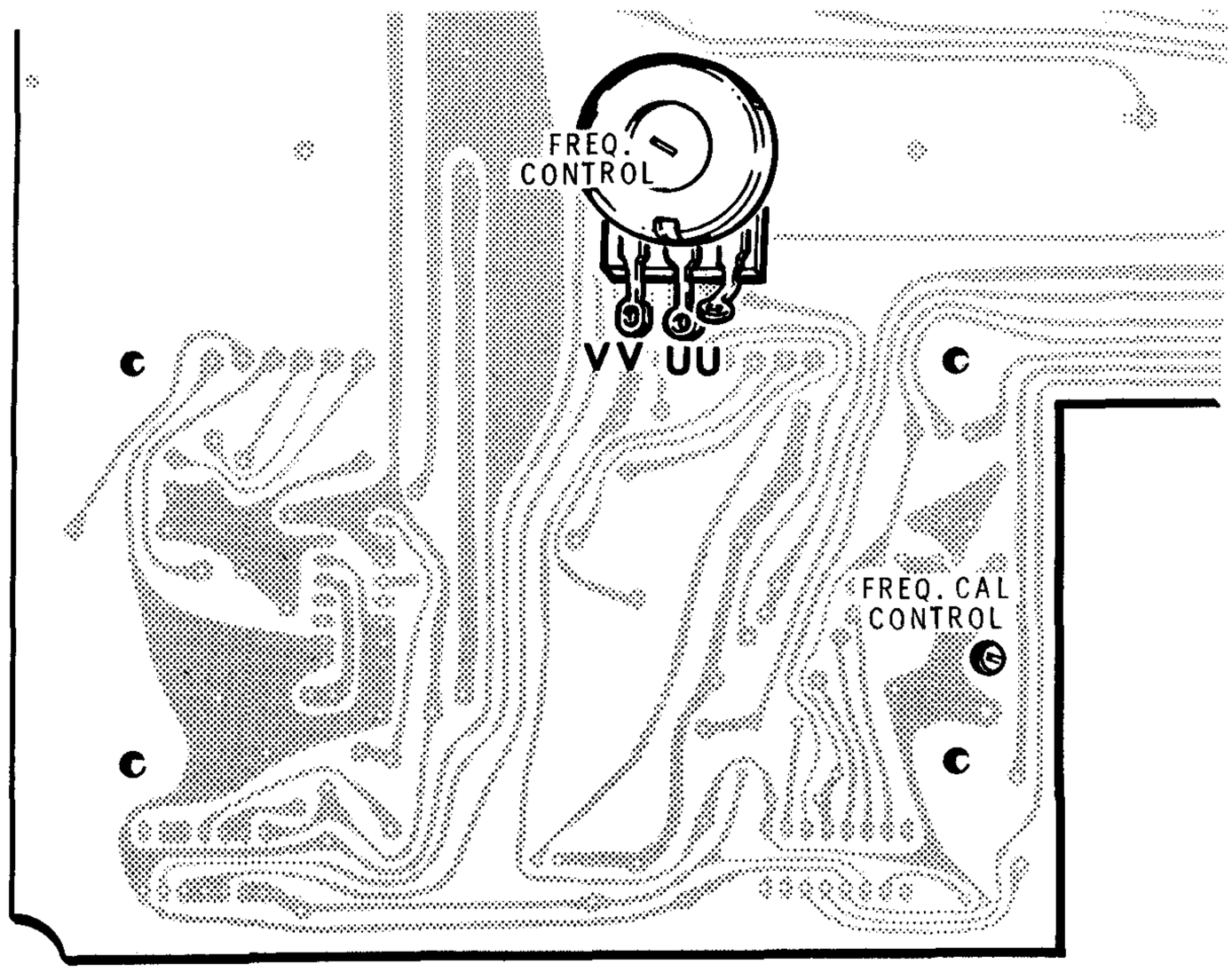
( ) Locate the 90 kΩ (wht-blk-blk-red) calibration resistor. Measure the resistance and note the reading on the meter.

( ) Connect one meter lead to point UU and the other to VV on the main circuit board.

( ) Adjust the FREQ CAL control, from the foil side of the board, with a small screwdriver, for the same reading you recorded on the meter. NOTE: If you can not get the correct reading, reverse the meter leads.

( ) Disconnect the meter leads.

( ) This completes the adjustment. Proceed to "Final Assembly."



PICTORIAL 3-12

FINAL ASSEMBLY

Refer to Pictorial 4-1 (Illustration Booklet, Page 16) for the following steps.

( ) Before you place the cabinet top on the cabinet bottom, note the screw on the end of the spacer mounted on the power supply. When the cabinet top is placed on the bottom, and seated properly, this screw should touch the cabinet bottom. To check this, push down in the proximity of the breadboarding sockets with your thumb to see if there is any spongy feeling. Adjust the screw and repeat this procedure until it feels solid.

( ) Carefully place the cabinet top on the bottom. Look inside and position the leads as necessary to keep them from getting pinched. Fasten the top and bottom together with eight 6-32 × 1/2" flat head screws.

( ) Peel the backing from the Caution label and place the label on the back of the cabinet bottom near the fuse.

( ) Peel the backing from the blue and white label and place this label next to the Caution label. Be sure to refer to the numbers on this label in any communications you have with the Heath Company about this kit.

( ) Peel the backing from the nameplate label and install this label on the cabinet top in the rectangular recessed area.

( ) Peel the backing from the FCC compliance label and install the label next to the blue and white label.

Refer to Pictorial 4-2 for the following steps.

( ) Pull one half of the tape from the other half.

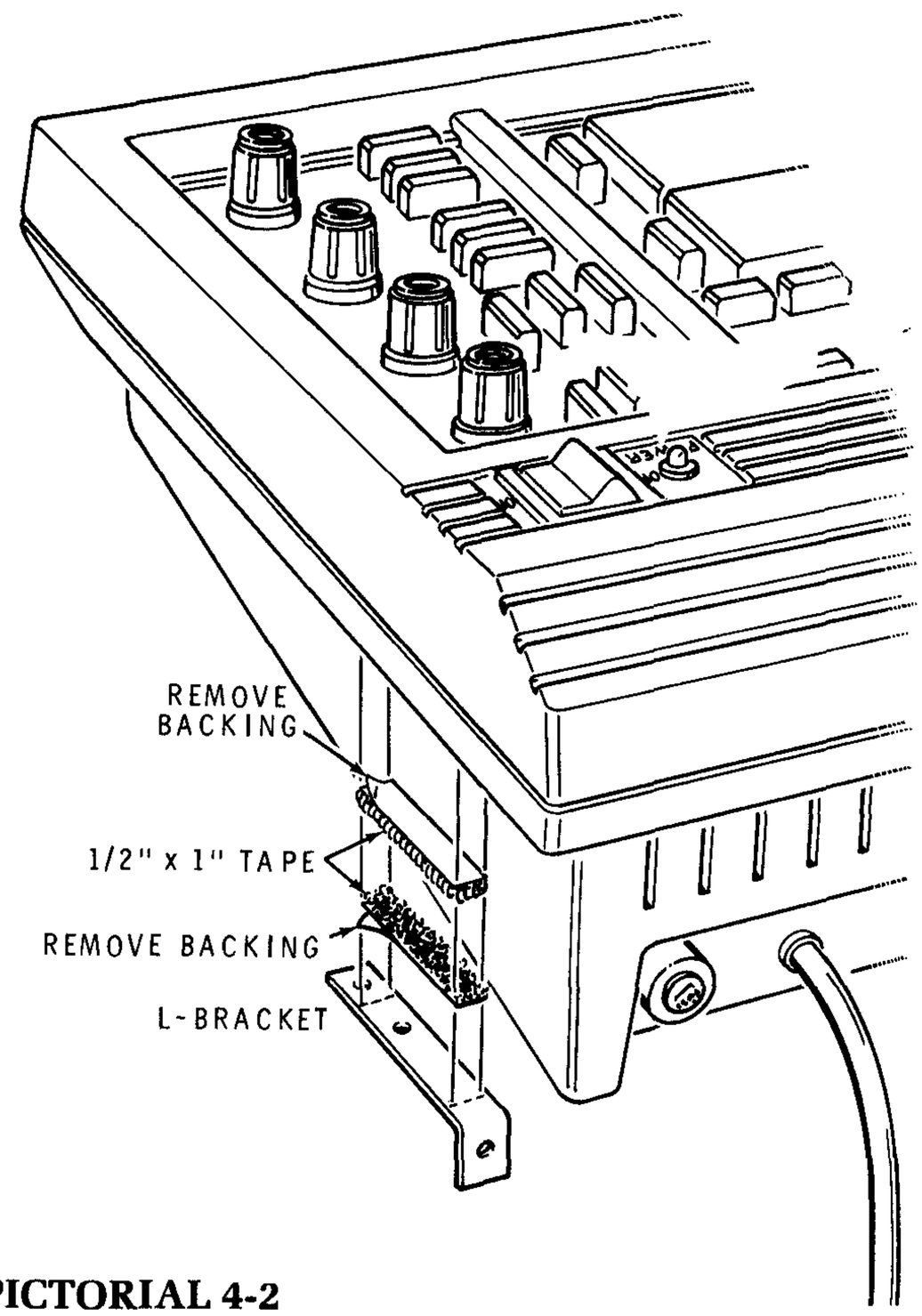
( ) Cut off a 1/2″ × 1″ piece from each half.

( ) Remove the backing from either of the halves and press it on the long side of the L-bracket, approximately in the middle.

( ) Remove the backing from the other half and press it under the right side of the cabinet at the location shown.

( ) NOTE: The L-bracket is used for prying the breadboarding assembly from the speed clips when you want to remove it. Store the L-bracket under the cabinet by pressing the pieces of tape together.

This completes the Step-By-Step Assembly.



PICTORIAL 4-2

IN CASE OF DIFFICULTY

Use the "Visual Tests" first to find a difficulty that shows up right after your kit is assembled. You can also use the "Troubleshooting Charts" right after your kit is assembled, or at some future time in case your Circuit Design Trainer should ever malfunction.

If you still can not locate the trouble after you complete the "Visual Tests," and a voltmeter is available, check voltage readings against those shown on the "Schematic Diagram" (Illustration Booklet, Page 19). Read the "Precautions" on this Page before you make any measurements. NOTE: All voltage readings were taken with a high input impedance voltmeter.

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

NOTE: Refer to the "Circuit Board X-Ray View" (Illustration Booklet, Pages 17 and 18) for the physical location of parts on the circuit boards.

VISUAL TESTS

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

2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered as described in the "Soldering" section on Page 5 of the Manual.

3. Check to be sure that all transistors are in their proper locations. Make sure each lead is connected to the proper point.

4. Check to be sure that each of the IC pins are properly installed in their connectors, and not bent or under the IC. Also be sure the IC's are installed in their correct positions.

5. Check the values of the parts. Be sure in each step that the proper part has been wired into the circuit, as shown in the Pictorial diagrams. It would be easy, for example, to install a 680 Ω (blue-gray-brown) resistor where a 6800 Ω (blue-gray-red) resistor should have been installed.

6. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

7. A review of the "Circuit Description" may also help you determine where the trouble is.

PRECAUTIONS

1. Be cautious when you test IC circuits. Although they have almost unlimited life when used properly, they are vulnerable to damage from excessive voltage.

2. Be sure you do not short any terminals to ground when making voltage measurements. If the probe should slip, for example, and short out a bias or supply point, it is very likely to damage one or more ICs or diodes.

TROUBLESHOOTING CHARTS

The following chart lists problems and possible causes of some troubles you might encounter. If a particular part is mentioned (D201, for example) as a possible cause, check that part and other components connected to it to see that they are installed and/or wired correctly. Also check for solder bridge and poor connections in the surrounding area. It is also possible, on rare occasions, for a part to be faulty and require replacement.

PROBLEM	POSSIBLE CAUSE
Power LED does not light.	1. Fuse F101. 2. Socket reversed on Power LED. 3. IC U201. 4. Diodes D201, D202, D203, D204.
Pulse circuit does not function properly.	1. ICs U102, U103, U101.
Incorrect reading from pulse generator.	1. Switch SW103 wired incorrectly. 2. IC U101, U103.
Incorrect reading from pulse generator.	1. Switch SW102 wired incorrectly.
Logic indicators stay on or not functioning.	1. ICs U104, U105.
Binary Data switch SW104 does not function properly.	1. Resistor packs RP101, RP102 installed backwards.
Logic Probe does not function properly.	1. IC U206.
Logic Switches do not function properly.	1. IC U106. 2. Switches SW105, SW106 wired incorrectly.
No +5 V or −5 V supply.	1. IC201. 2. Diodes D201, D202, D203, D204.
No +12 V supply. −12 V is functioning.	1. IC U202.
No −12 V supply. +12 V is functioning.	1. IC U203.
+1.2 V to +20 V power supply does not function, but the −1.2 V to −20 V does.	1. U204.
−1.2 V to −20 V power supply does not function, but the +1.2 V to +20 V does.	1. U205.
No −1.2 V to −20 V or +1.2 to 20 V supply.	1. Diodes D209, D211, D212, D213.

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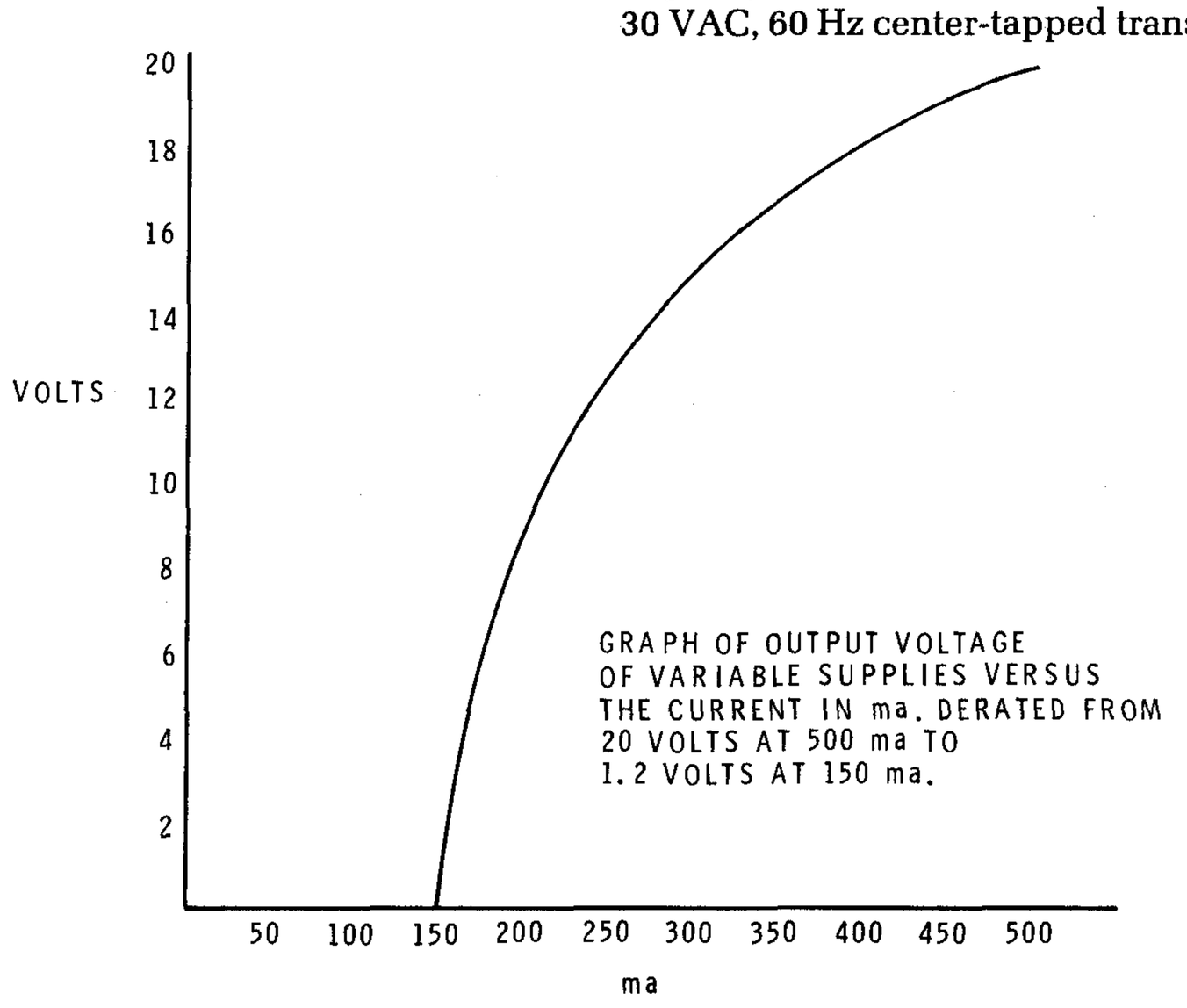
SPECIFICATIONS

LOAD REGULATION

+5 volts DC	Better than ±2%.
+12 volts DC	Better than ±1%.
−12 volts DC	Better than ±1%.
Variable ±20 volt DC supplies	Better than ±2%. ($V_{out} \geq 5V$; I_{out} = 10 mA to I_{max}. See chart below.)
Output voltage	Greater than 3 volts peak to peak.

POWER SUPPLIES

Output Voltages (short circuit protected)	+5 volts DC at 1-ampere, regulated. +12 volts at 500 mA, regulated. −12 volts at 500 mA, regulated. +1.2 to +20 volts, variable regulated (see graph below). −1.2 to +20 volts, variable regulated (see graph on Page 58). 30 VAC, 60 Hz center-tapped transformer.



FUNCTION GENERATOR

Sine, Square, and Triangle Waveform Outputs (short circuit protected) Frequency Multiplier	1 to 100 kHz range.
Switch Selectable Frequency Ranges	1 to 10 Hz. 10 to 100 Hz. 100 Hz to 1 kHz. 1 to 10 kHz. 10 to 100 kHz.
Switch Selectable Pulse Widths	2 m sec. 200 μ sec. 20 μ sec. 2 μ sec. 200 n sec.

LOGIC SWITCHES

Type	Momentary contact, spring loaded.
Circuit	Two flip-flop latches for contact bounce buffering.
Output States	Complimentary, +5 volts and +0.2 volts.

BINARY DATA

Input Switch	Eight miniature switches in a dual-in-line package. (For experiments.)
Potentiometers	1000 Ω and 100 kΩ.
Logic Indicators	Eight green LED's with separate input terminals. (For experiments.)
Logic Probe Threshold	1 volt.

GENERAL

Power Requirements	105 - 130 volts or 210 - 260 volts rms, 50/60 Hz 95 watts maximum.
Dimensions	15-3/4" w × 10-3/4" d × 4-3/4" h (40.0 × 27.0 × 12.0 cm.)
Net Weight	8.4 lbs. (3.8 kg.)

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (Illustration Booklet, Page 19) while you read this "Circuit Description."

LOGIC SWITCHES

Switch A-$\overline{A}$ controls a latching flip-flop made up of sections A and B of U106. When switch SW105 is in the $\overline{A}$ position, pin 1 is low. This produces a high at pins 3 and 4. Pin 5 is also high through R145. This makes a low at pin 6. When SW105 is in the A position, a low is at pin 5. This forces pins 6 and 2 high. With highs at pins 1 and 2, pins 3 and 4 go low and the outputs A and $\overline{A}$ have changed state.

Switch B-$\overline{B}$ operates the same as switch A-$\overline{A}$.

BINARY DATA SECTION

The eight-section data switch has one side of all switches connected to ground. The other side of each section has a 4700 ohm pull-up resistor to the 5 V power supply. The connectors below the switch provide convenient connection for two wires to each switch section. With a switch in the lower (closed) position, the associated terminal will provide a logic 0 level (ground). In the up (open) position the level will be logic 1. The switch sections are numbered 0 through 7 from right to left.

LOGIC INDICATORS

The eight connectors numbered 0 through 7 are inputs to the noninverting buffers U104 and U105. A 2200 ohm pull-down resistor is connected from each input terminal to ground to hold the input at logic 0 when no connection is made to the terminals. Each buffer output is connected through an LED and a 180 ohm current-limiting resistor to ground. When the inputs to the buffer are logic 0, the outputs are also 0 and the LED is off. When the input rises to logic 1, the output also rises to logic 1 and lights the LED.

FUNCTION GENERATOR

The three functions of the generator (sine, square, and triangle) are produced by U101; the square wave is present at pin 11. It is fed to U103 where it is buffered and inverted. Pin 2 of U101 has the sine and triangle waveforms present. These waveforms are selected by switch SW101.

The frequency of U101 is determined by capacitors C106, C107, C108, C109, C111, and resistors R110, R111, and R112. The pulse width output of U102 is determined by resistor R113 and capacitor C113, C114, C115, C116, and C117.

PULSE GENERATOR

The signal from pin 11 of U101 is inverted by U103 and fed to multivibrator U102. The pulse width is determined by the selection of capacitors U113 through C117.

NOTE: The frequency generator must be set to a period greater than the pulse generator (P = 1/F).

LOGIC PROBE

IC U206 is a quad single-supply comparator designed for level detection and low-level sensing applications. However, for the logic probe application, only two of the comparators (1 and 2) are actually used.

With the logic probe not being used, a voltage dividing network consisting of R206 and R207 establishes a bias of approximately 1.5 volts on pins 5 and 6 of comparators 1 and 2 respectively. Likewise, a voltage divider consisting of R208 and R209 biases pin 4 of comparator 1 at approximately 1 volt, while voltage divider R204 and R205 biases pin 7 of comparator 2 at approximately 2 volts.

Comparator 1 is connected as a noninverting device. Thus, in the quiescent state (no input on the logic probe), there is a high output at pin 2 of comparator 1. Recall that when the signal applied to a comparator's noninverting input (pin 5) is more positive than the signal applied to the inverting input (pin 4), the output is high. With a high output from comparator 1, the green LED can not conduct.

Comparator 2 is connected as an inverting device. Again, with no input from the logic probe, there is a high output at pin 1 of comparator 2. This is because the signal applied to the noninverting input (pin 7) is more positive than the signal applied to the inverting input (pin 6). Thus, with a high output from comparator 2, the red LED will not conduct.

However, when the logic probe is connected to a high logic level (in excess of 2 volts), the inverting input (pin 6) of comparator 2 becomes more positive than noninverting input (pin 7). Because this is an inverting device, a low will be felt at the output. This low at the output will allow the red LED to conduct, showing there is a high logic level present. At the same time, the high logic level is also applied to the noninverting input of comparator 1. This causes pin 5 to become more positive than in the quiescent stage. Thus, the output of comparator 1 will remain high and the green LED will not conduct.

If the logic probe is connected to a low logic level (less than .8 volt), the noninverting input at pin 5 of comparator 1 will become less positive than the inverting input at pin 4. This causes a low to be felt at the output, which in turn causes the green LED to conduct, indicating a low logic level is present. Also, the low logic level on the probe will cause the inverting input at pin 6 of comparator 2 to become less positive than the noninverting input at pin 7. Hence, the output of comparator 2 will be positive and the red LED will not conduct.

POWER SUPPLIES

The voltage from the secondary winding of tranformer T201 is rectified by diodes D201, D202, D203, and D204. The voltage is filtered by capacitor C201 and regulated by IC U201 to produce the +5 volt DC supply.

The voltage from one of the center-tapped secondary windings of T201 (green leads) is rectified by diodes D205 and D206, filtered by C204, and regulated by U202. This produces the +12 volt supply. The voltage from the same winding is rectified by diodes D207 and D208, filtered by capacitor C207, and regulated by IC U203 to provide the −12 volt supply.

The voltage from the center-tapped winding (red leads) is rectified by diode D209 and D211, filtered by capacitor C211, and regulated by IC U204. Resistor R141 is used to vary the voltage from +1.2 to +20 volts. The voltage from the same winding is rectified by diode D212 and D213 and filtered by capacitor C214. Resistor R142 is used to vary the voltage from −1.2 to −20 volts.

CIRCUIT BOARD X-RAY VIEWS

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

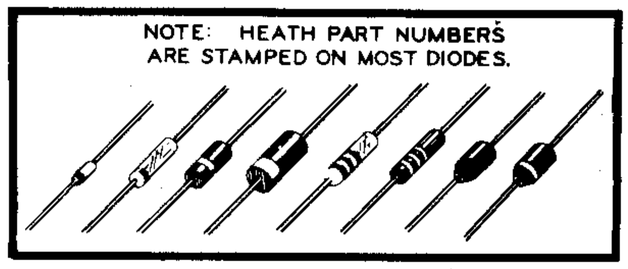
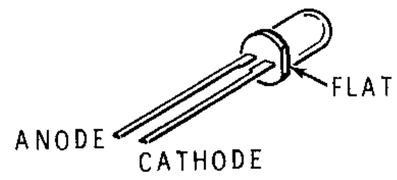
A. Find the circuit component number (R5, C3, etc.) on the "X-Ray View," Page 17 and 18 in the Illustration Booklet.

B. Locate this same number in the "Circuit Component Number" column of the "Parts List" in the front of this Manual.

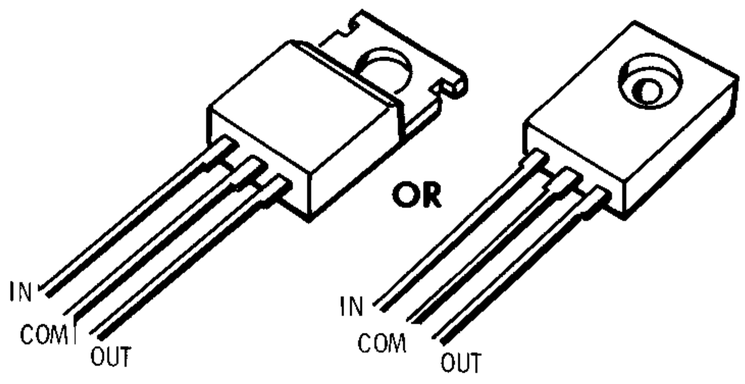
C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.

SEMICONDUCTOR IDENTIFICATION CHARTS

DIODES

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
57-65	1N4002	D205 - D209, D211, D212, D213	
57-609	1N5393	D201 - D204	
412-640	LST5053	D110	
412-652	LT4233	D101 - D109	

INTEGRATED CIRCUITS

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
442-674	UA7812	U202	

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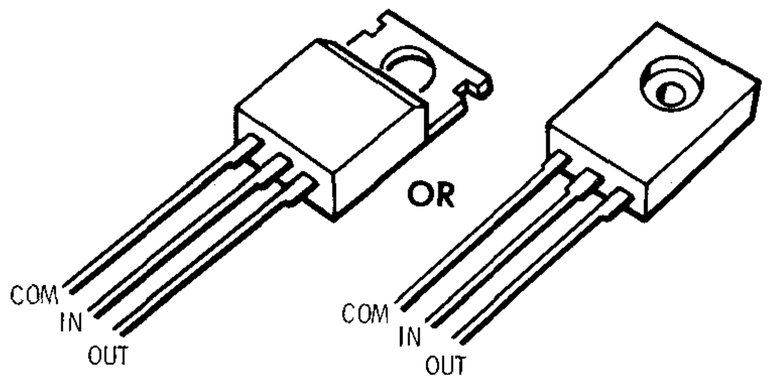
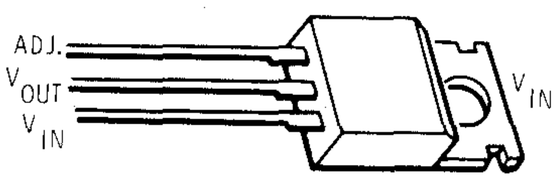
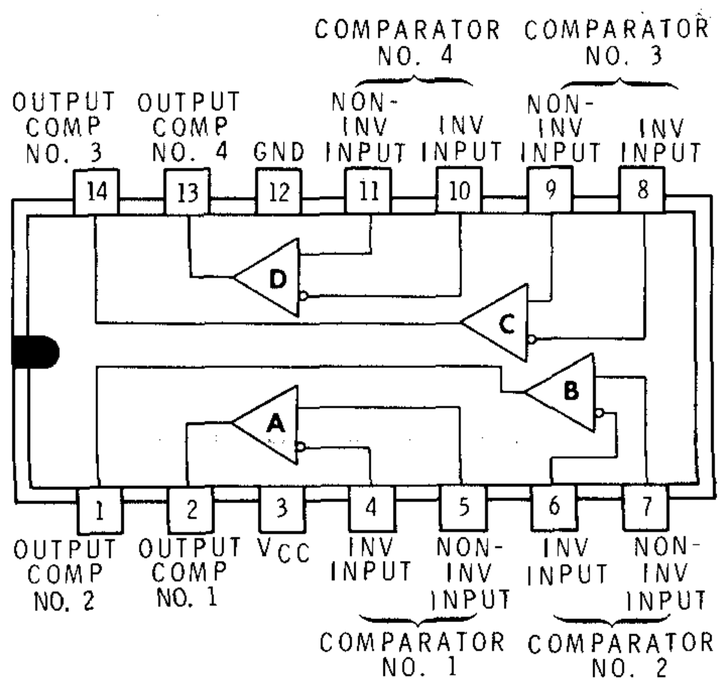
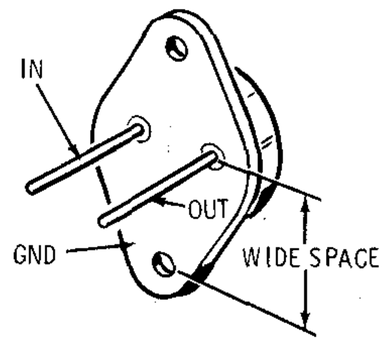
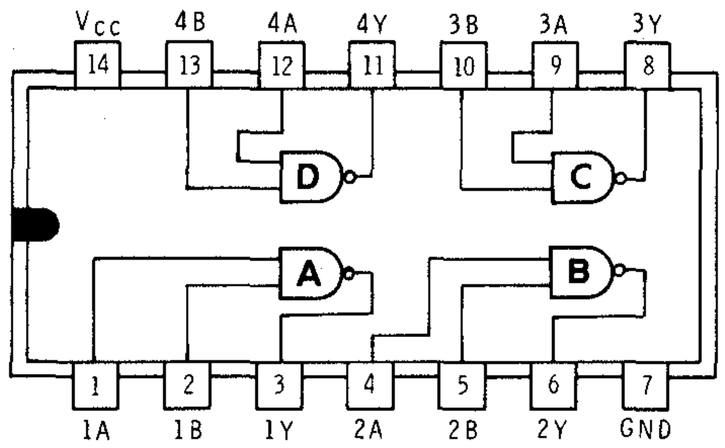
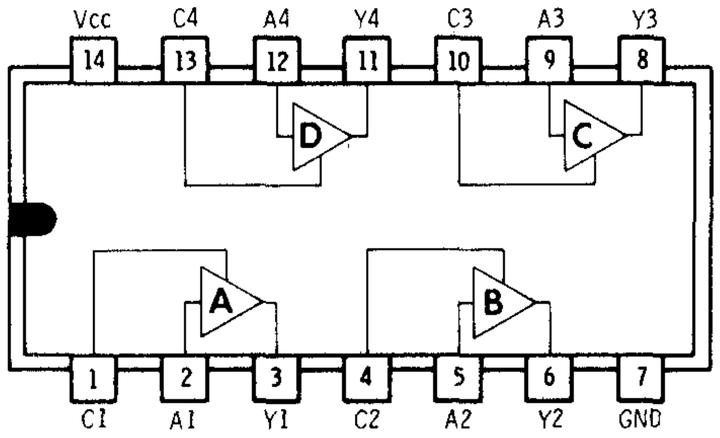
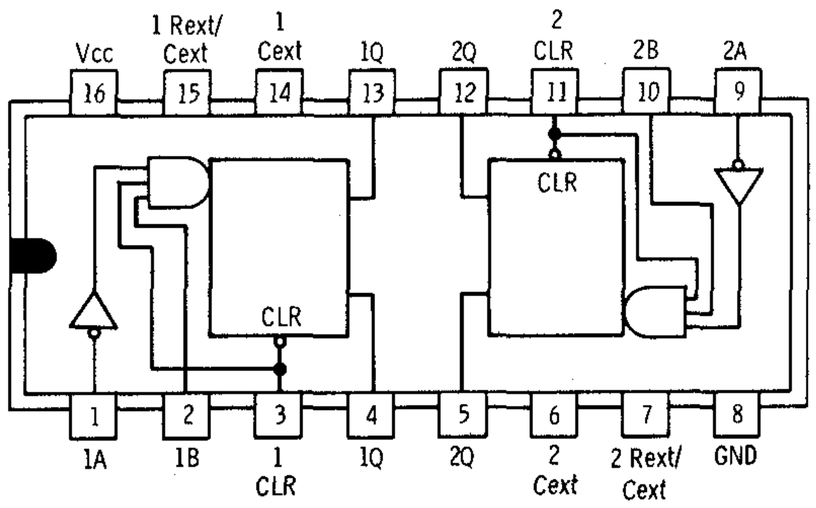
HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
442-675	UA7912	U203	
442-708	LM317	U204	
442-709	LM337	U205	
442-616	LM2901	U206	
442-30	UA309	U201	

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
443-728	74LS00	U103, U106	
443-919	74LS126	U104, U105	 FUNCTION TABLE INPUTS: A, C — OUTPUT: Y H H H L H L X L Hi-Z Y = A Hi - Z = HIGH IMPEDANCE
443-942	74LS123	U102	

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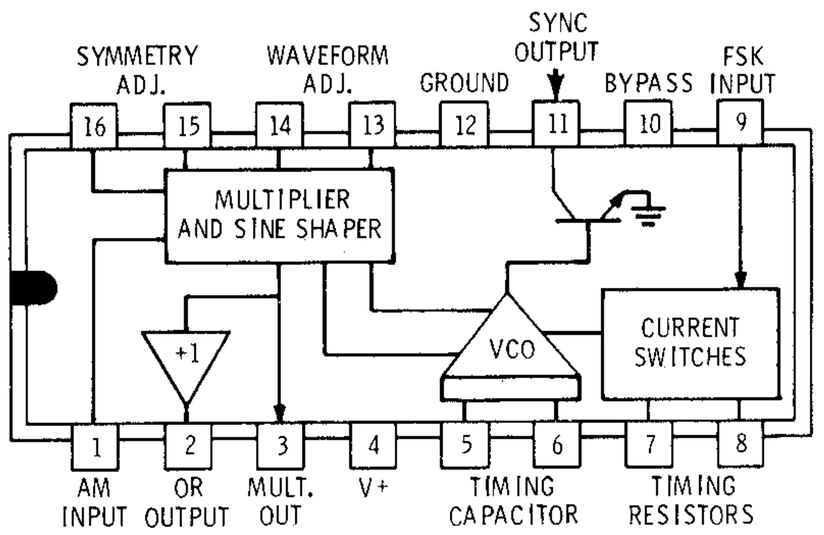
HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
442-710	XR2206	U101	

CUSTOMER SERVICE

REPLACEMENT PARTS

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

ORDERING FROM THE FACTORY

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

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

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

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

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

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

TECHNICAL CONSULTATION

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

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

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

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

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

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

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

REPAIR SERVICE

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

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

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

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

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

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

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH
ZENITH

HEATH COMPANY • BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

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HEATH ZENITH

THE TECHNICAL EXCHANGE

ET-1000 ANALOG/DIGITAL CIRCUIT DESIGN TRAINER

ASSEMBLY MANUAL CORRECTIONS

TEB ET-1000-1

Make the following changes to assembly manual #595-2964:

Page 18--Left column, under "Capacitors":

From:	B1	21-705	1	10 pF	C113
To:	B1	21-3	1	10 pF	C113

Illustration Booklet, page 19:

Locate resistor R148 in the lower left corner of the illustration. Delete this resistor and write: "This resistor is connected to the blue wire on the foil side of the board."

On the left side of the schematic, add the following note under the 240 VAC wiring diagram: "When wiring the unit for 240 VAC, remove capacitor C216."

(MI4247gp) - October 25, 1983a

GROMMET AND RETAINER RING PART NUMBER CHANGE

TEB ET-1000-2

Add the following part number changes to your #595-2964 manual.

Page 18 - Right column, under "Miscellaneous" and
Page 32 - Right column, under "General."

Change: LED Grommet part number from #260-89 to #260-700

Retainer Ring part number from #260-90 to #260-701

(MI4298fk) - December 19, 1983a

HEATH ZENITH

THE TECHNICAL EXCHANGE

ET-1000 ANALOG/DIGITAL CIRCUIT DESIGN TRAINER

BUFFERS U104 AND U105 FAIL

TEB ET-1000-3

On the main circuit board, users of the trainer sometimes connect 20 VDC into the logic indicator sockets, L0 thru L7. This causes the noninverting buffers at U104 and U105 to fail. To prevent this failure, a 470 ohm resistor and a 5 volt zener diode are added to each buffer input.

Two 1000 ohm resistors are also installed in the outputs of buffer/inverter U103A and B.

Install the following changes on each unit received for service.

Parts Needed

Qty	Description	Heath P.N.
8	470 ohm resistor	6-471-12
2	1000 ohm resistor	6-102-12
8	1N4733A 5 V zener diode	56-619

Installation

-- Refer to the main board foil-side view on the back of this bulletin and cut the foils at each of the ten resistor locations shown.

— Scrape away one-half inch of solder resist on each side of the foil cut and tin the foil.

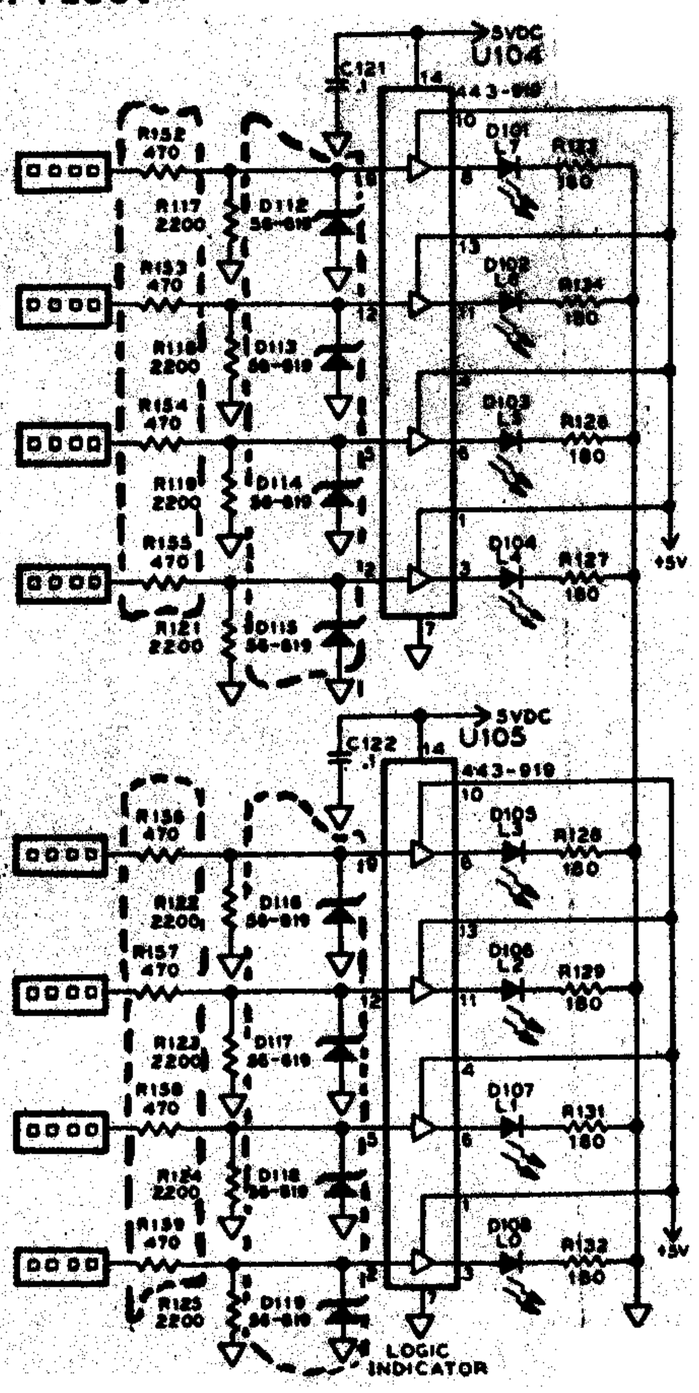
In the next two steps, as each resistor is installed across the foil cut, lay the resistor across the foil cut and flat against the board along the foil run. Then solder the resistor leads to the foil.

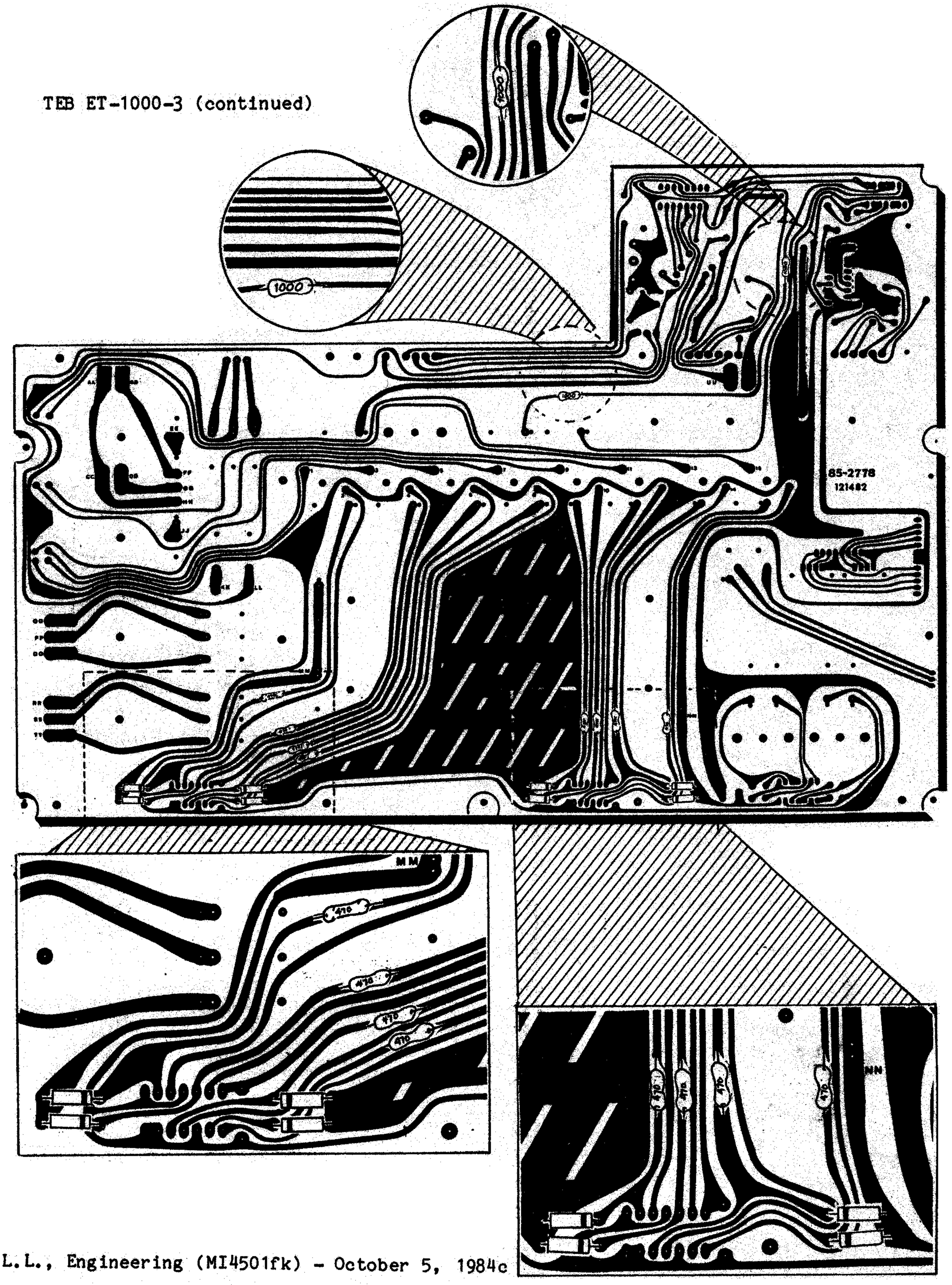
— Refer to the main board foil-side view and solder the eight 470 ohm resistors (#6-471-12) on the eight cut foils near U104 and U105.

-- Solder the two 1000 ohm resistors (#6-102-12) across the cut foils in the outputs of U103A and B.

-- As shown in the main board foil-side view, solder a zener diode (#56-619) at the eight locations shown. Observe the direction of the banded end of each diode.

This completes the modification of the main board.




1000
85-2778
121482
MM
470
NN

HEATH ZENITH

THE TECHNICAL EXCHANGE

ET-1000 ANALOG/DIGITAL
CIRCUIT DESIGN TRAINER

REGULATOR U204 FAILURE

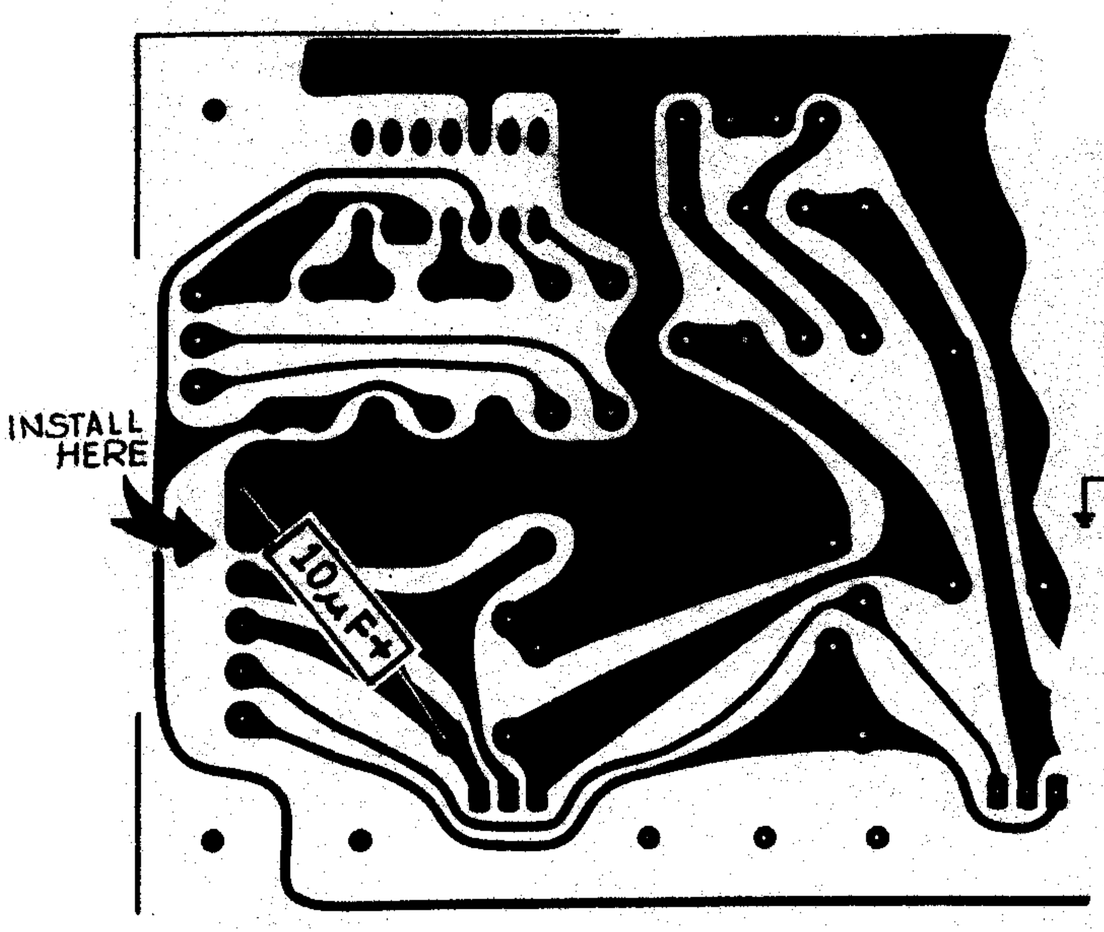
TEB ET-1000-4

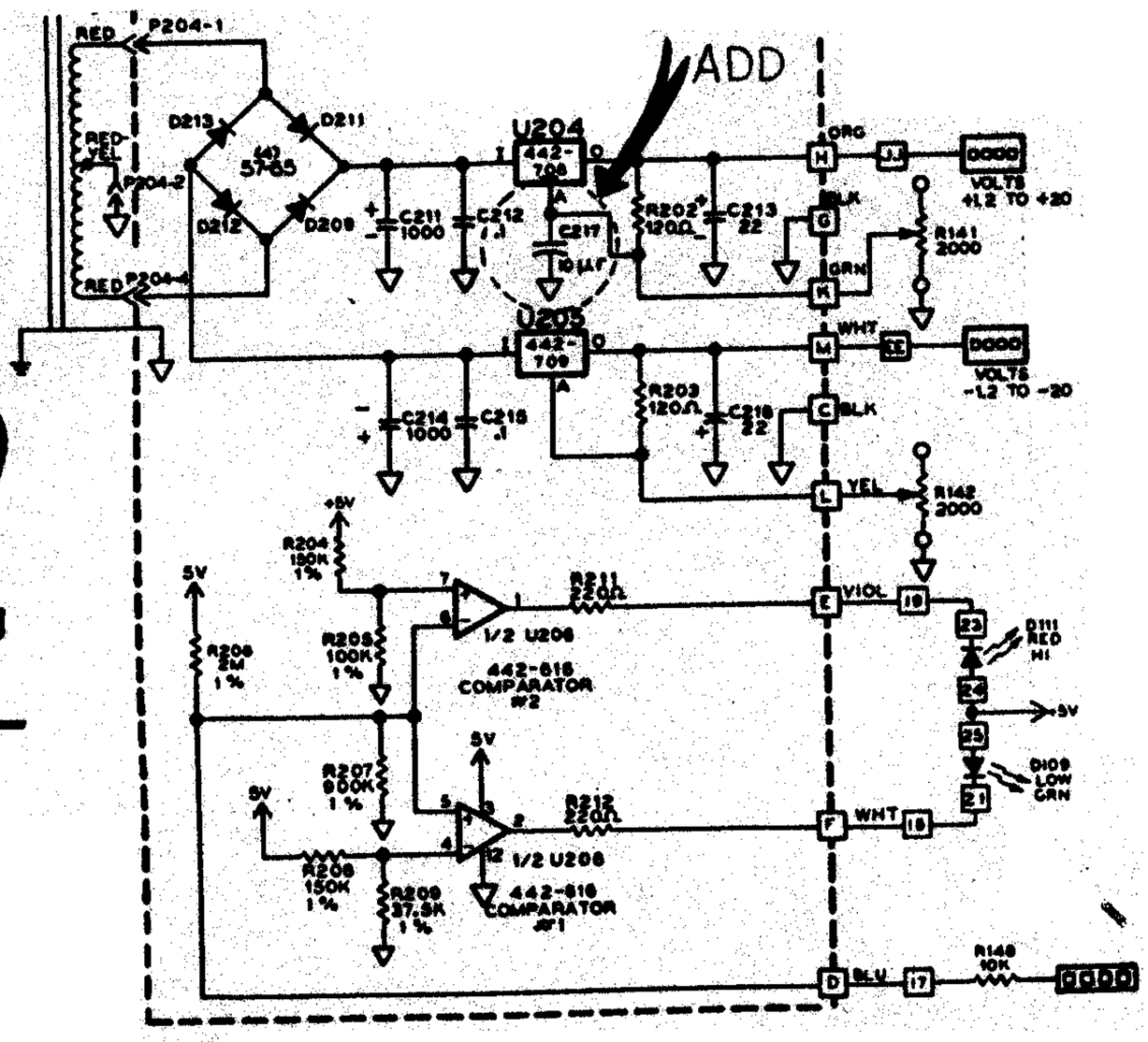
On the power supply board, adjustable voltage regulator U204 fails because of self oscillation. To prevent this oscillation, make the following change.

On the foil side of the power supply board,

Add: 10 uF electrolytic capacitor (#25-864) from the A input of U204 to ground.

Install this capacitor as shown in the foil-side view below. Add this change on your shop schematic as shown in the partial schematic.





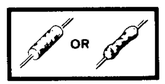
L.L., Engineering (MI4501fk) - October 5, 1984c

ILLUSTRATION BOOKLET

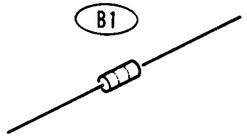
POWER SUPPLY CIRCUIT BOARD

PARTS PICTORIAL

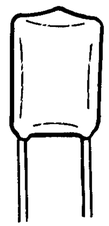
A1



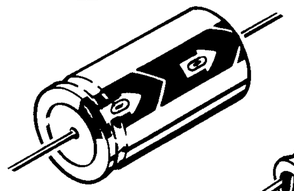
B1



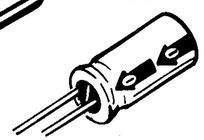
B2



B3

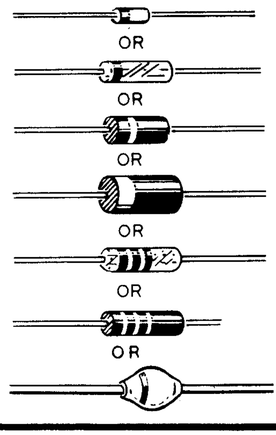


B4



C1

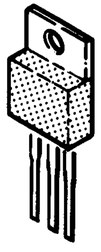
NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES.



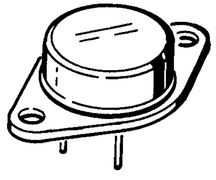
D1

ALWAYS IDENTIFY AN I.C. BY THE PART NUMBER OR TYPE NUMBER
NOTE: THE STYLE MAY BE SLIGHTLY DIFFERENT THAN SHOWN.

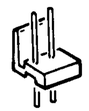
D2



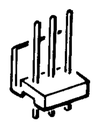
D3



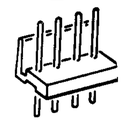
E1



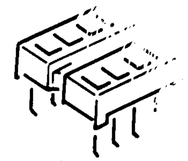
E2



E3

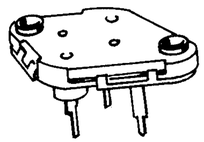


E4

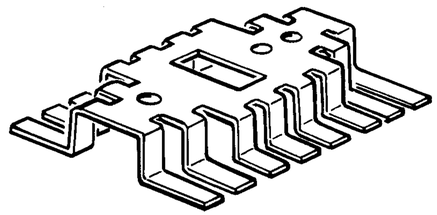


ALWAYS IDENTIFY AN I.C. SOCKET BY COUNTING ITS PINS.
NOTE: THE STYLE MAY BE SLIGHTLY DIFFERENT THAN SHOWN.

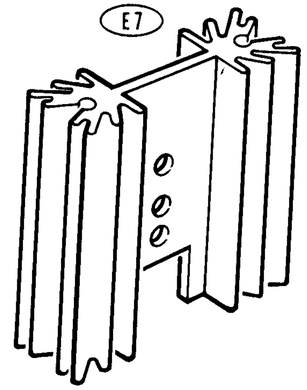
E5



E6



E7



F1

F2

F3

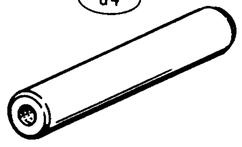
F4

G1

G2

G3

G4

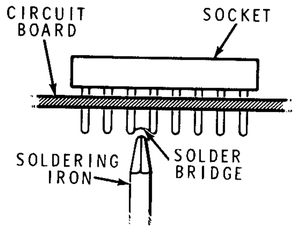


H1

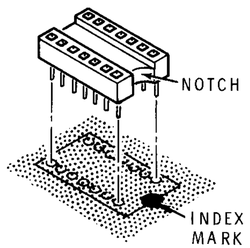
Model ET-1000

IC SOCKET INSTALLATION

As you install the following IC sockets, be very careful that you do not bridge solder between socket pins. (Solder bridged between two pins that are on the same foil is alright.) If a solder bridge should occur, hold the circuit board foil-side-down as shown. Then hold your soldering iron tip between the two points where solder is bridged. The solder will flow down the iron. Also, you can use desoldering braid.



To install IC sockets, be sure the socket pins are straight and insert the socket pins into the holes. The index mark on the circuit board must still be visible after it is installed. Solder the pins to the foil as you install each socket and cut off any excess pin lengths.



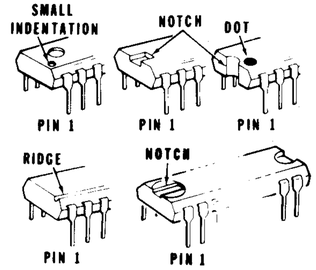
IC INSTALLTION

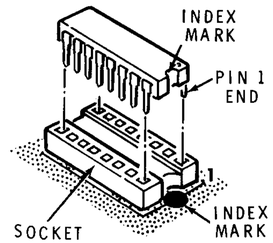
CAUTION: Integrated Circuits (IC's) are complex electronic devices that perform many complicated functions in the circuit. However, these devices can be damaged during installation. Read all of the following information before you install any IC's.

The pins on the IC's are bent out at an angle so they do not line up with the holes in the IC socket. DO NOT try to install the IC without first bending the pins. To do so may damage the IC pins or the socket, causing intermittent contact.

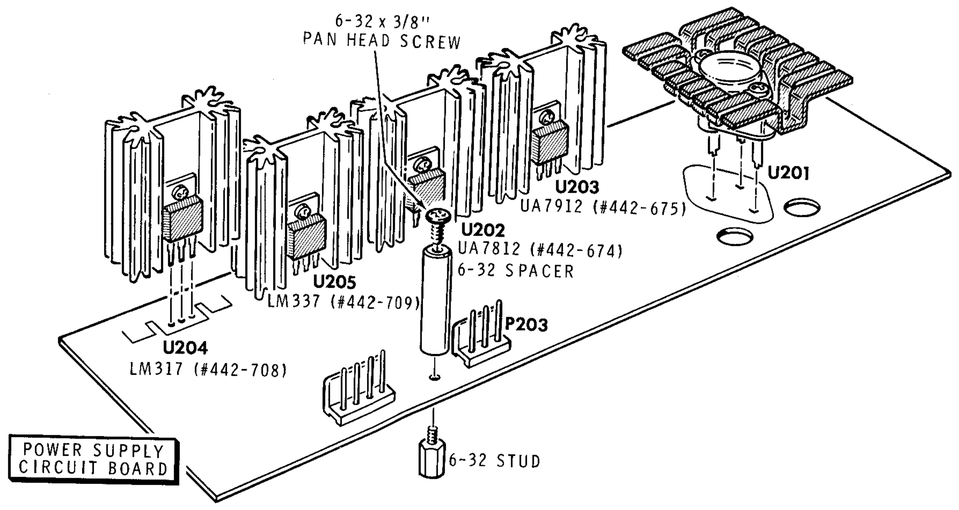
Before you install an IC, lay it down on its side as shown and very carefully roll it toward the pins to bend the lower pins into line. Then turn the IC over and bend the pins on the other side in the same manner.

Make sure that the pin 1 end of the IC is positioned over the index mark on the circuit board. Also make sure that all of the pins are started into the socket. Then press the IC firmly into the socket. NOTE: An IC pin can become bent under the IC and it will appear as through it is correctly installed in the socket.





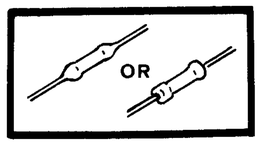
Detail 1-4A



PICTORIAL 1-6

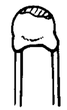
MAIN CIRCUIT BOARD
PARTS PICTORIAL

A1

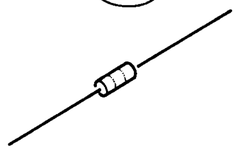


A2

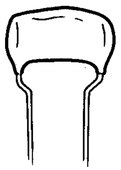
B1



B2

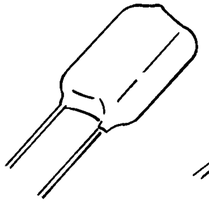


C1

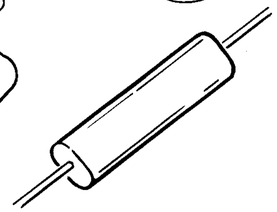


C2

C3



C4

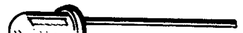


D1

E1

E2

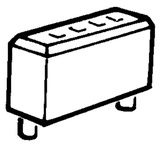
F1



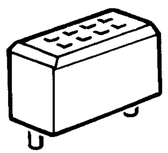
G1

ALWAYS IDENTIFY AN I.C. BY THE PART NUMBER OR TYPE NUMBER
NOTE: THE STYLE MAY BE SLIGHTLY DIFFERENT THAN SHOWN.

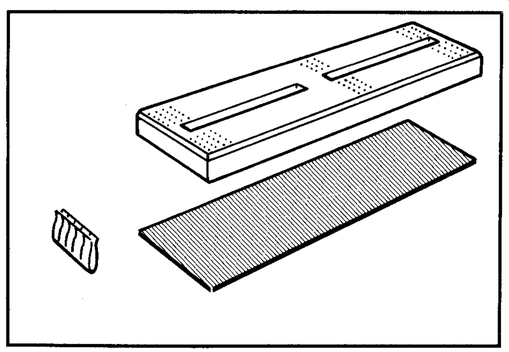
H1



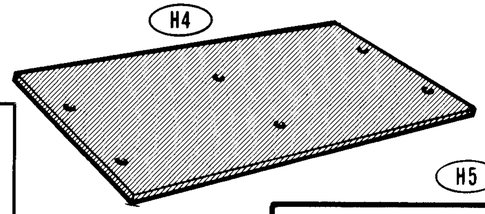
H2



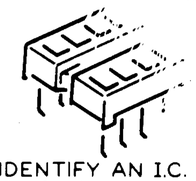
H3



H4

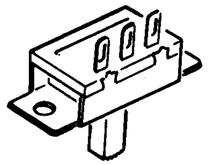


H5

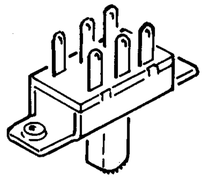


ALWAYS IDENTIFY AN I.C. SOCKET BY COUNTING ITS PINS.
NOTE: THE STYLE MAY BE SLIGHTLY DIFFERENT THAN SHOWN.

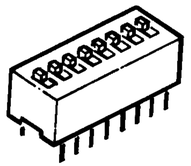
J1



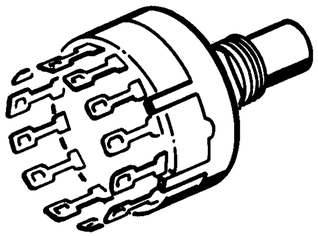
J2



J3

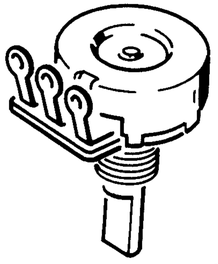


J4

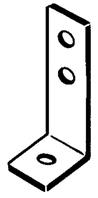


J5

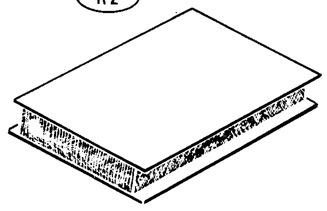
J6



K1



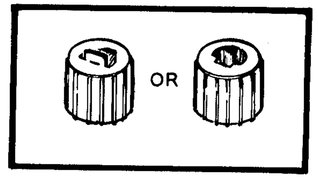
K2



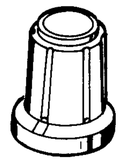
K3

K4

K5



K6



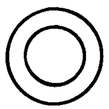
L1

L2

L3

N1

N2

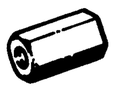


N3

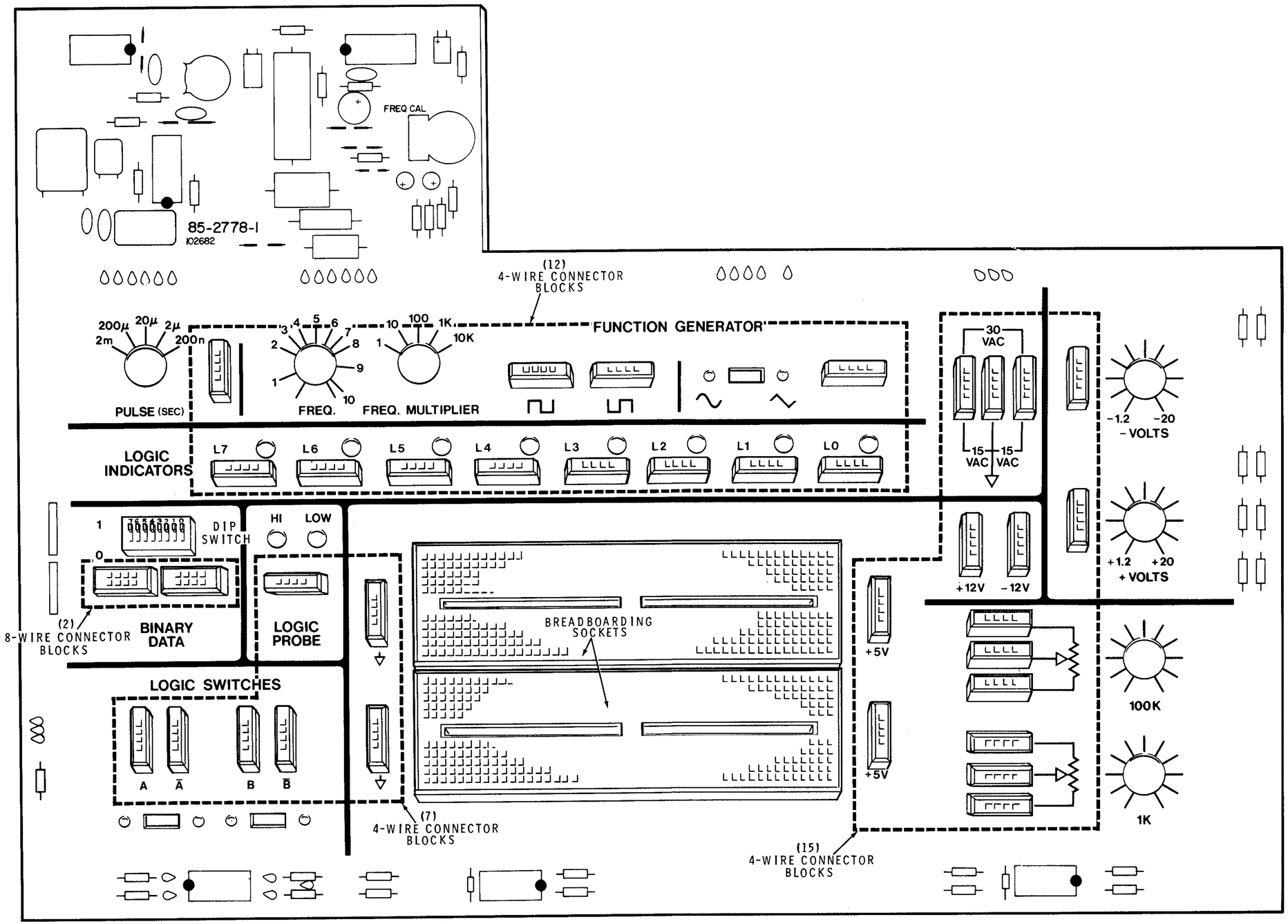
N4

M1

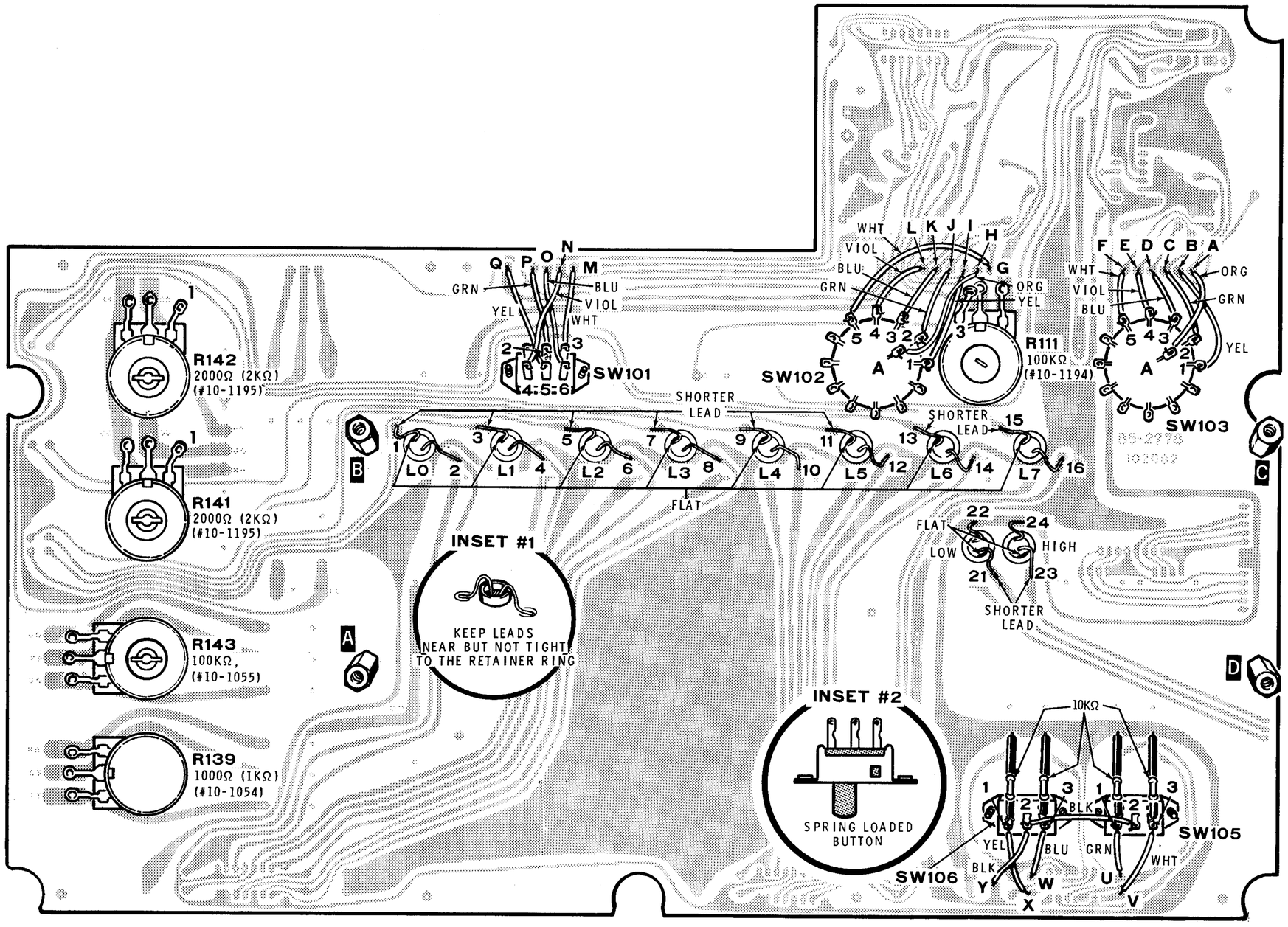
M2



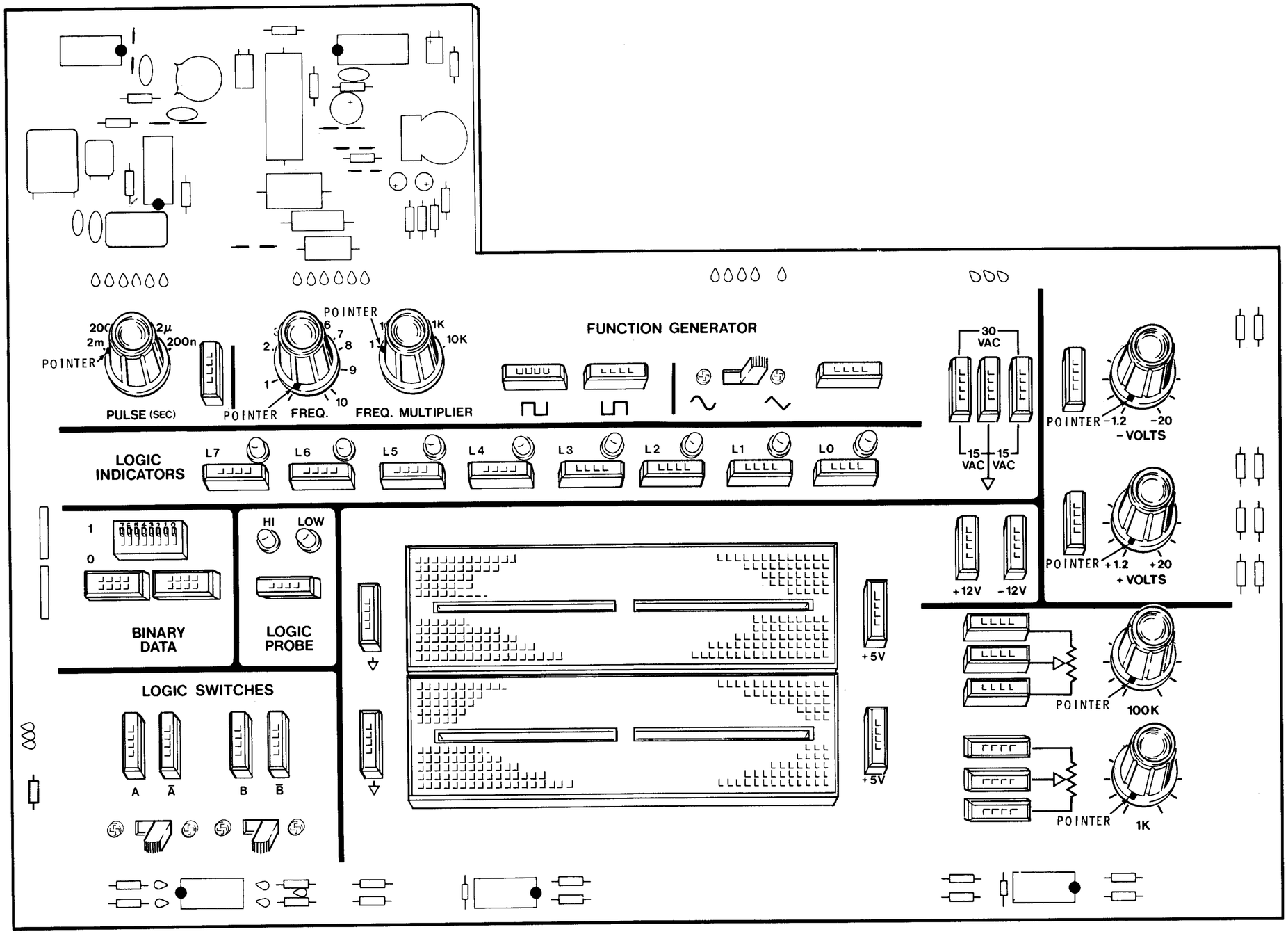
M3



PICTORIAL 2-6



PICTORIAL 2-7

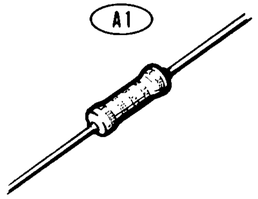


PICTORIAL 2-8

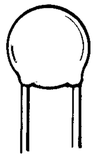
CHASSIS

PARTS PICTORIAL

A1



A2



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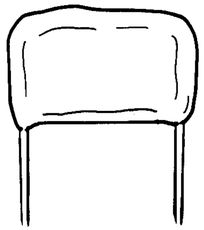
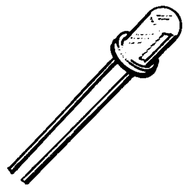


A4

A5



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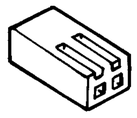
B2



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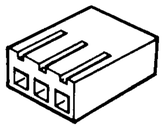

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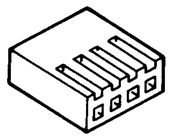
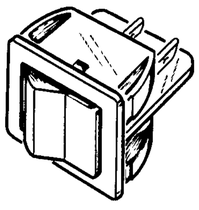


B5

B6

C1



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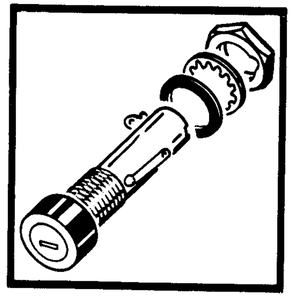

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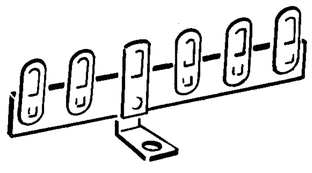

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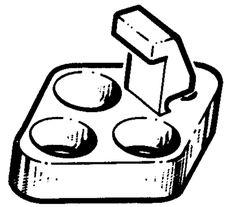
C5

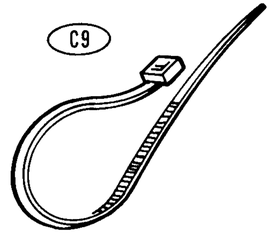


C6

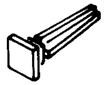
C7

C8

C9



C10



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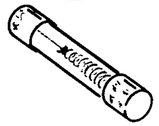


D1

D2

E1

E2

E3

E4

E5

E6

E7

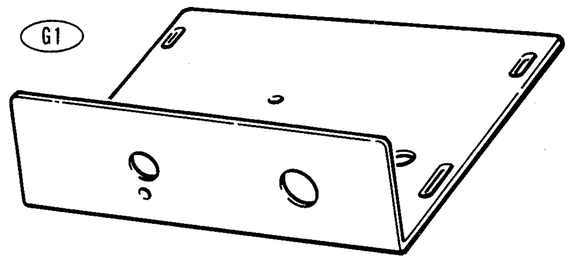
E8

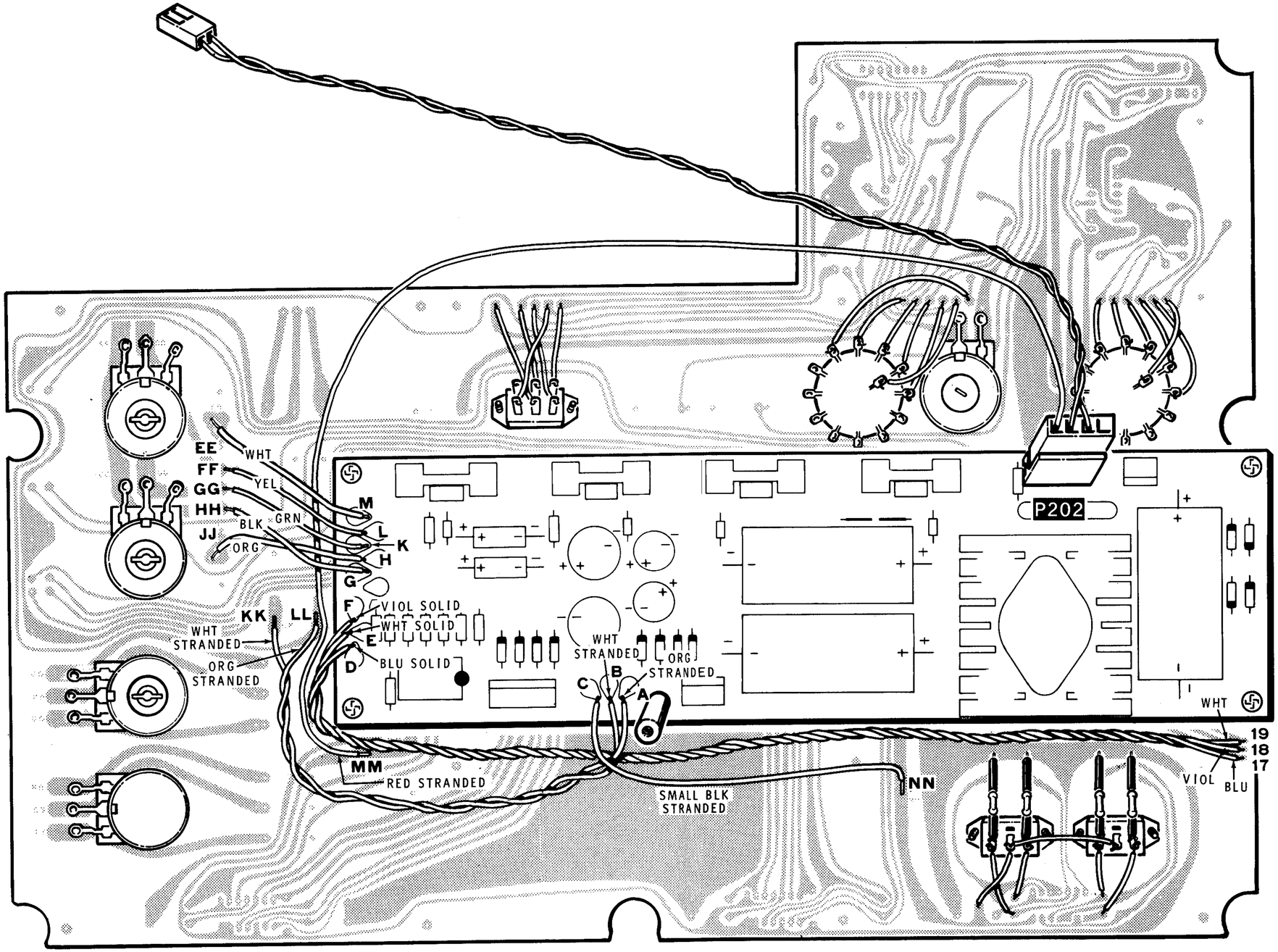
F1

F2

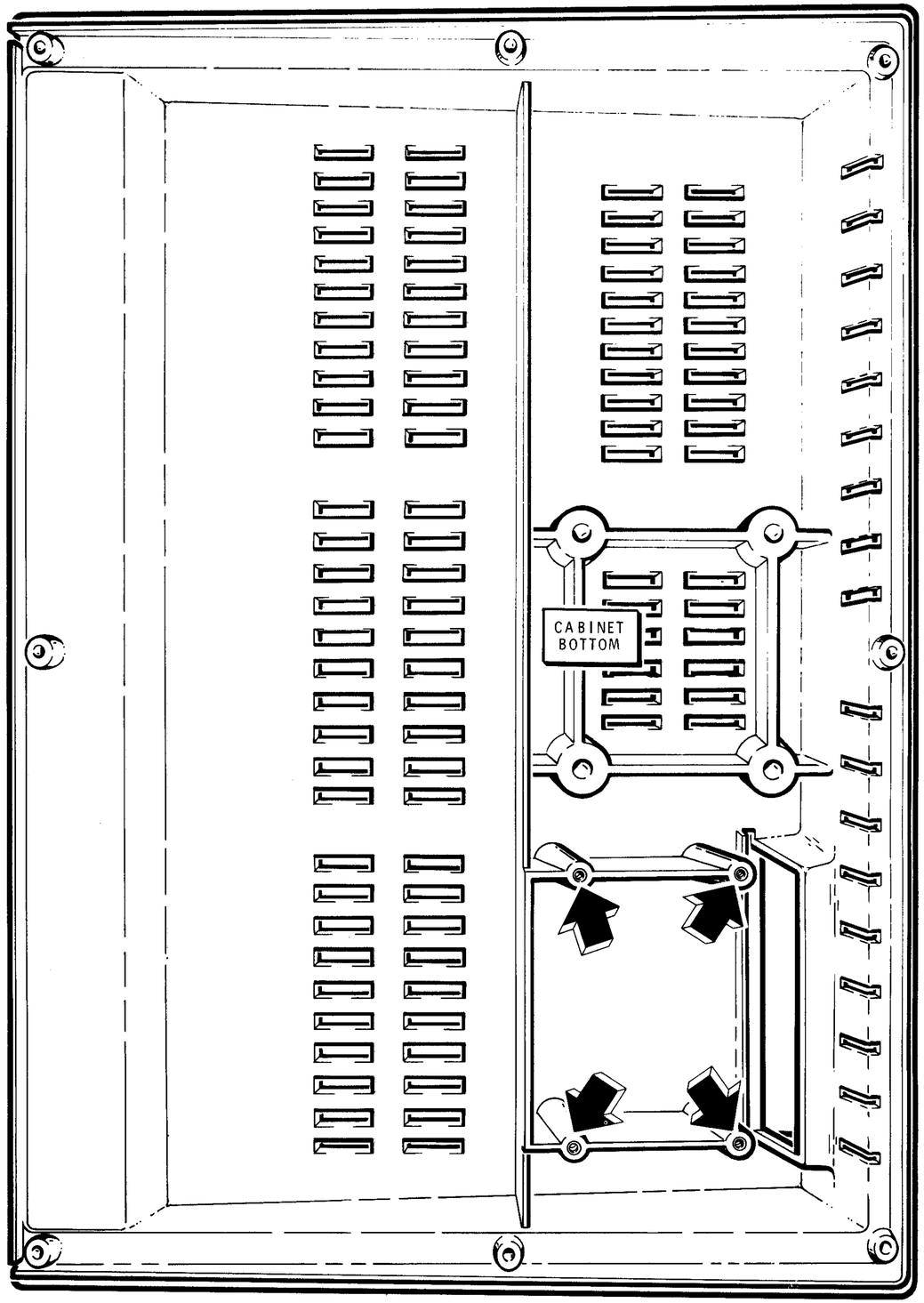
F3

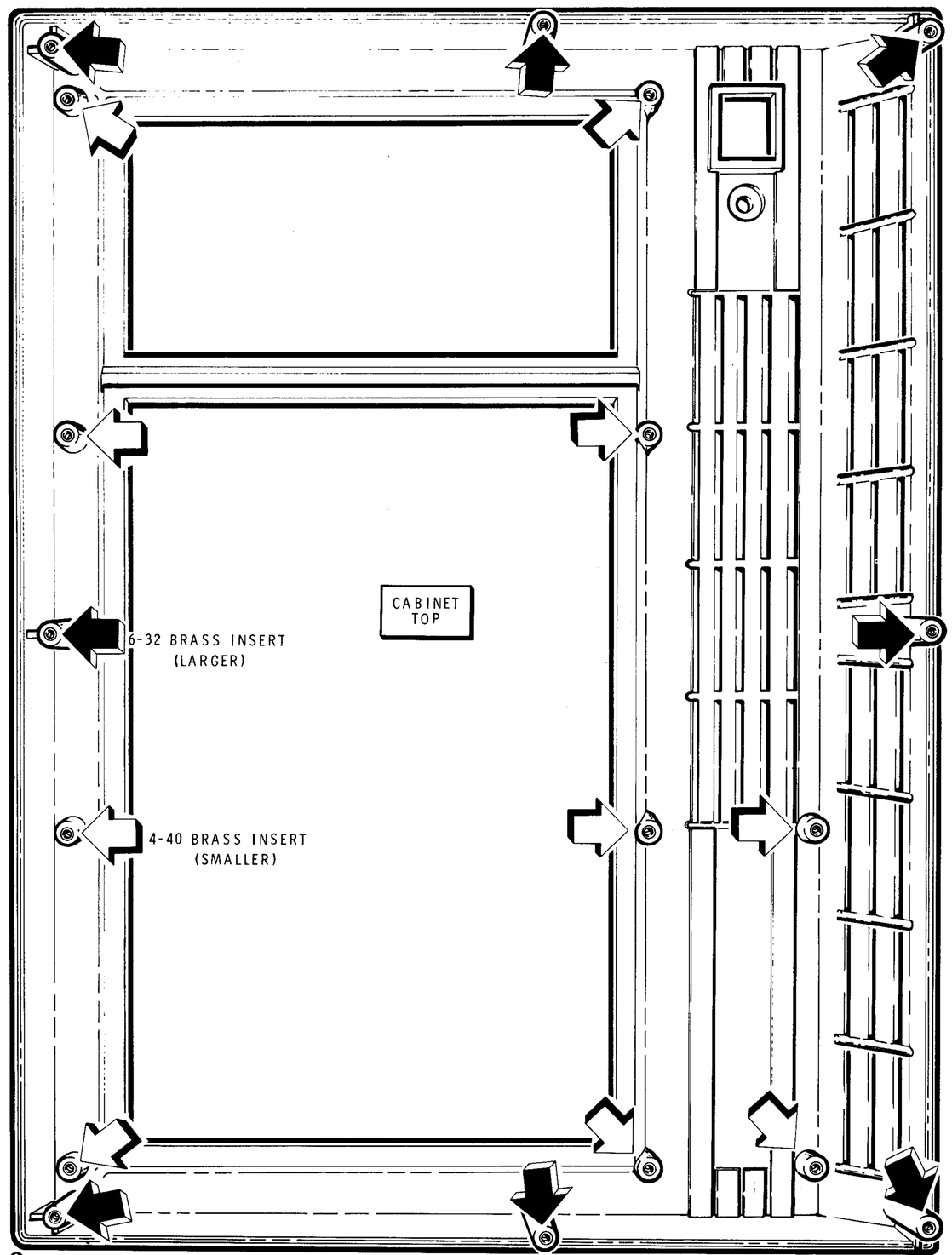
G1





PICTORIAL 3-1





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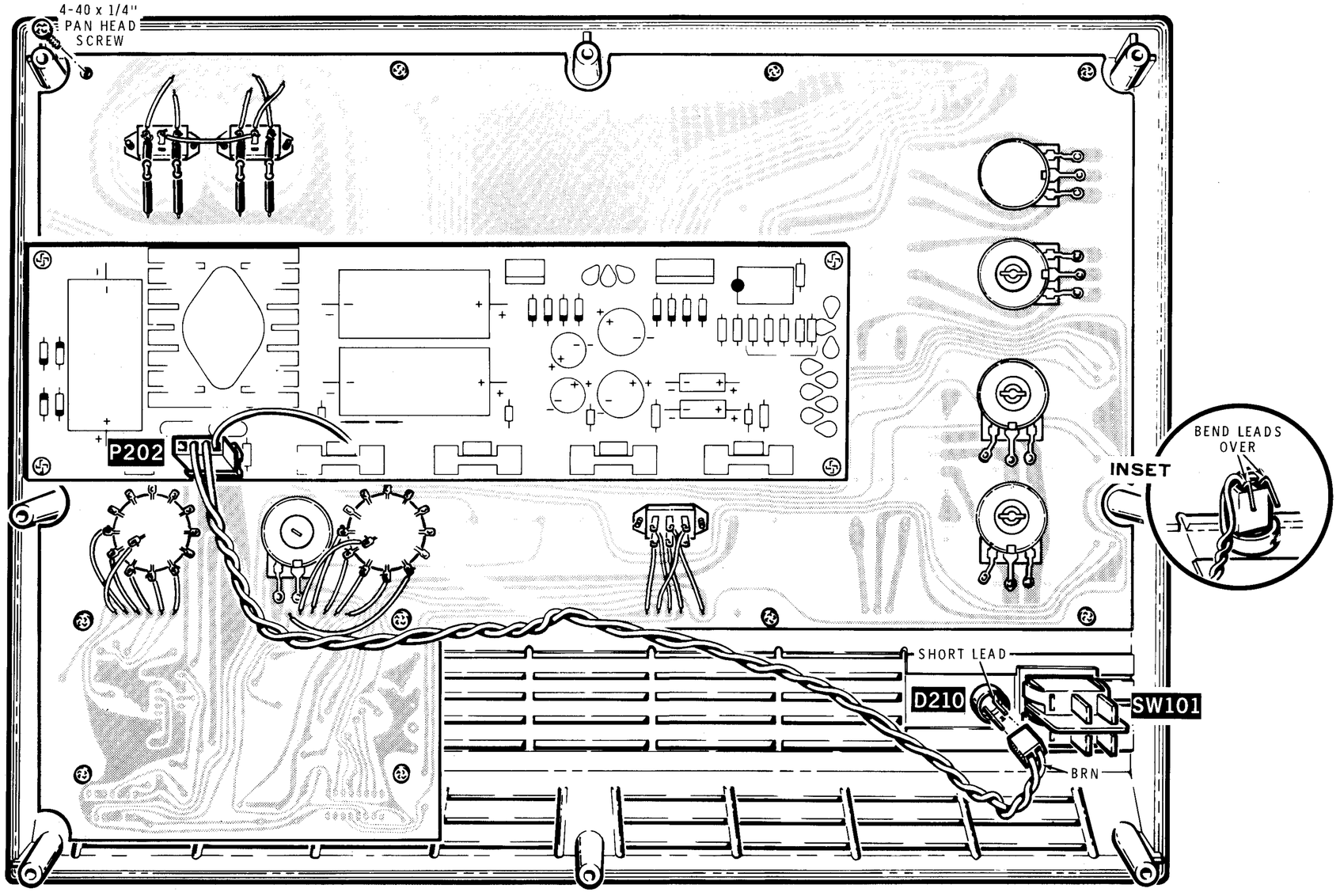

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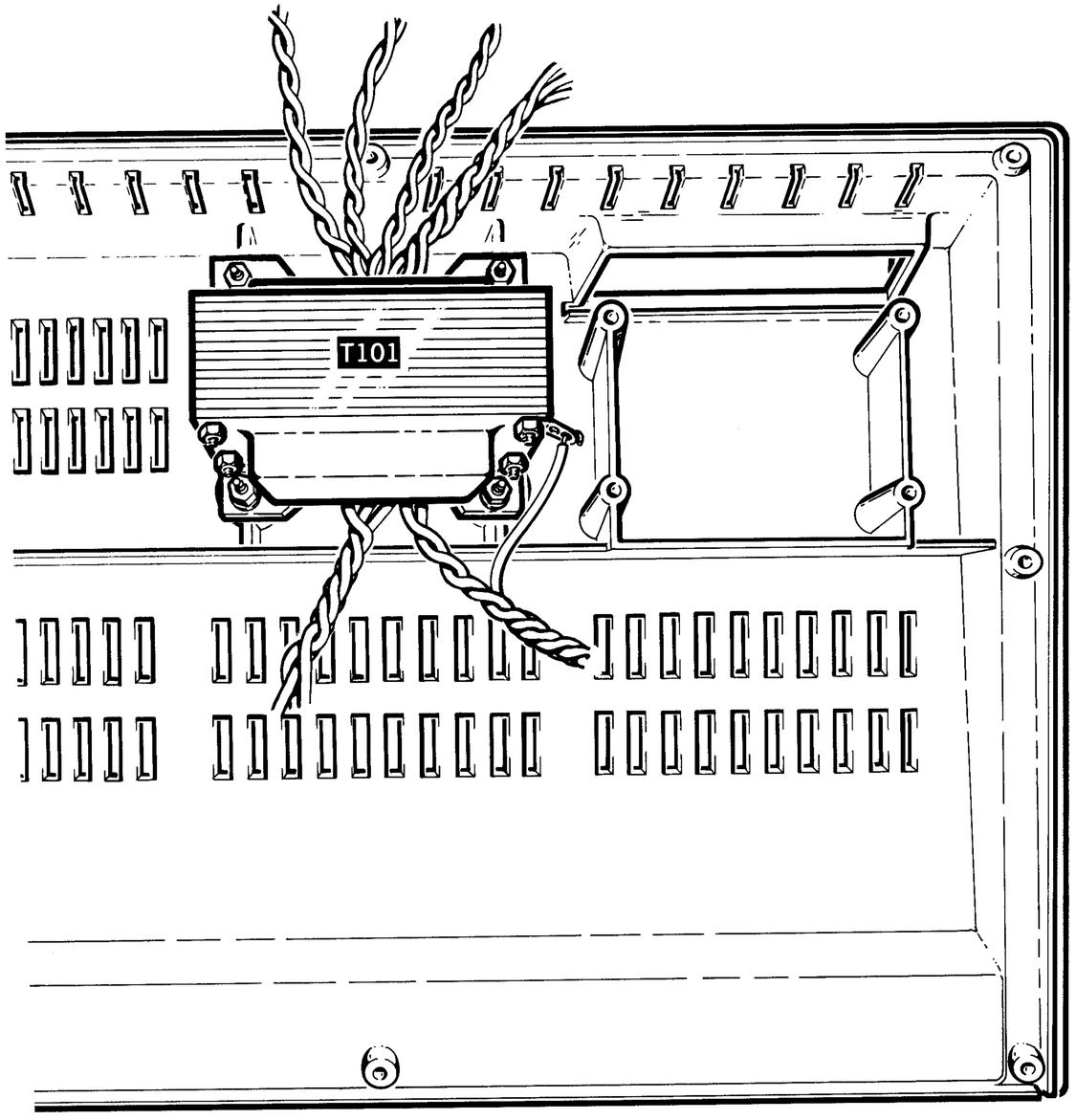

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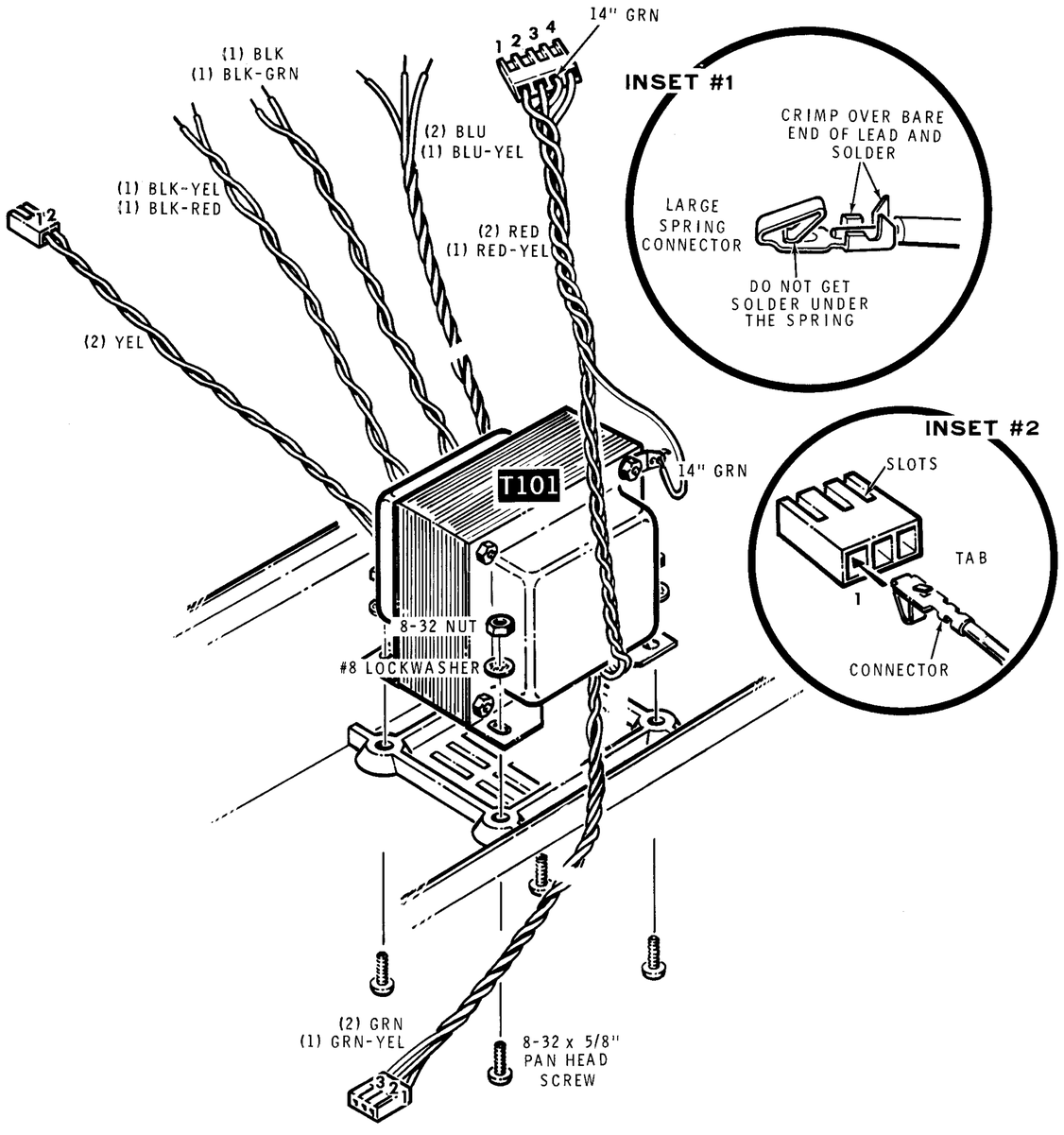
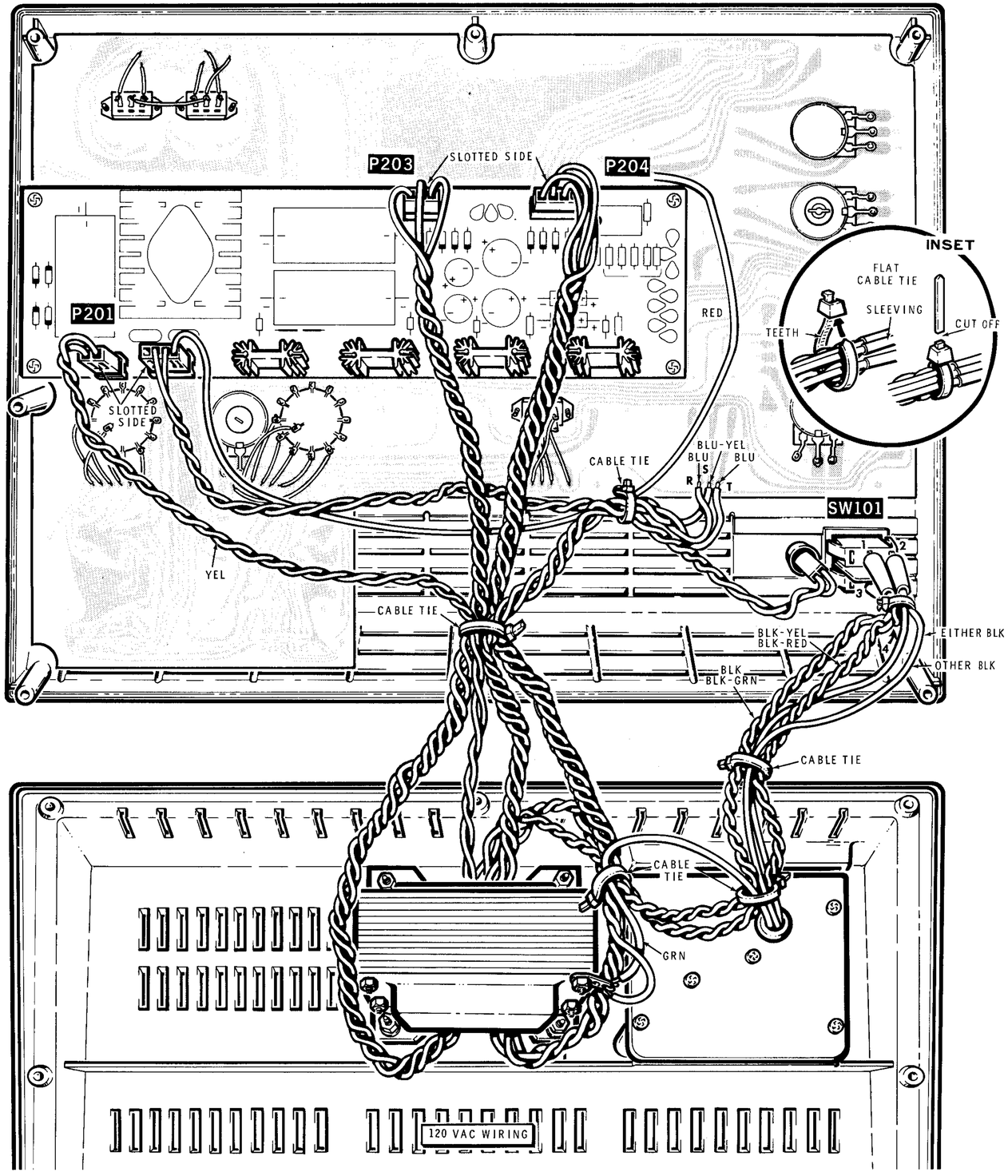
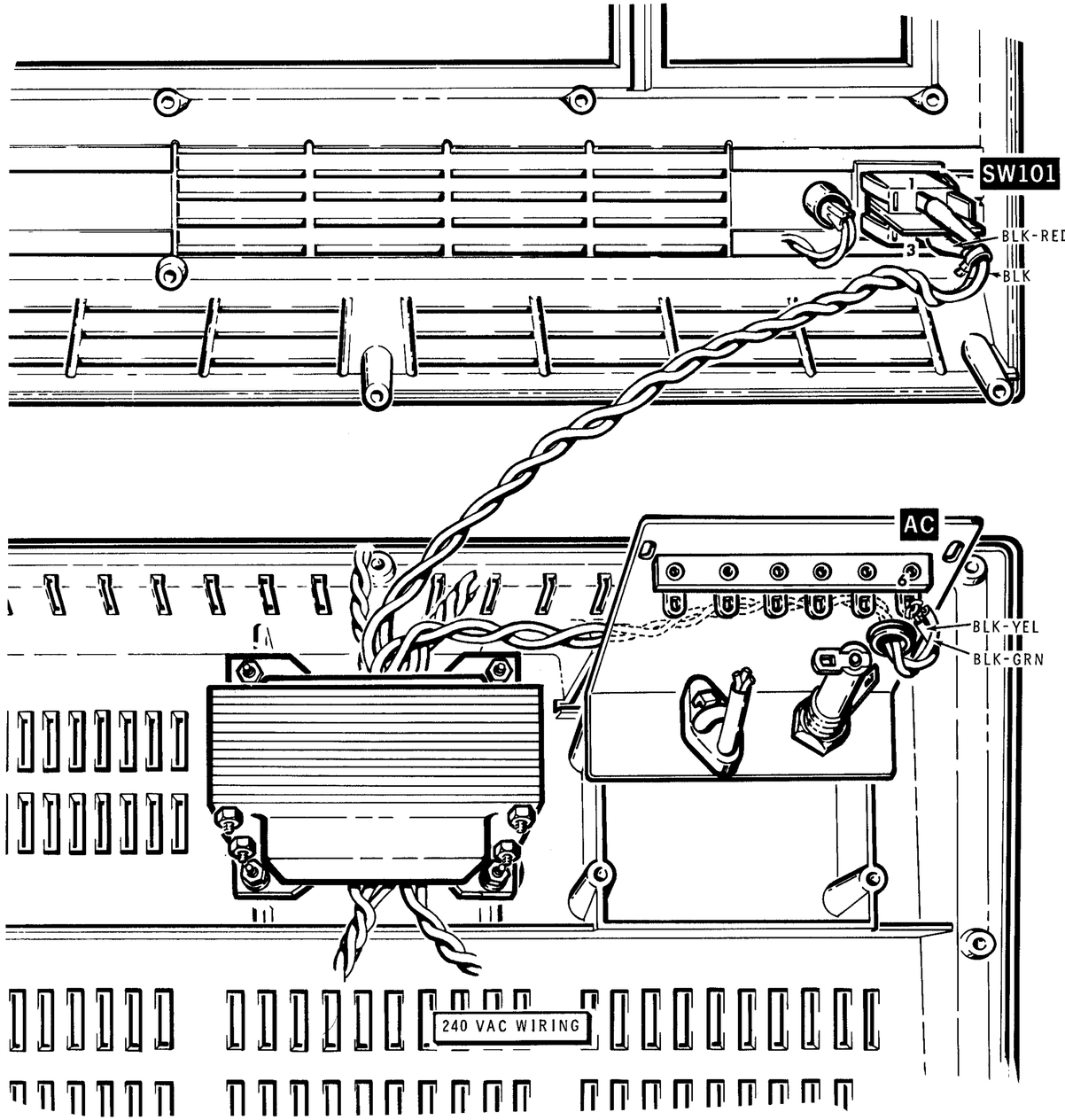


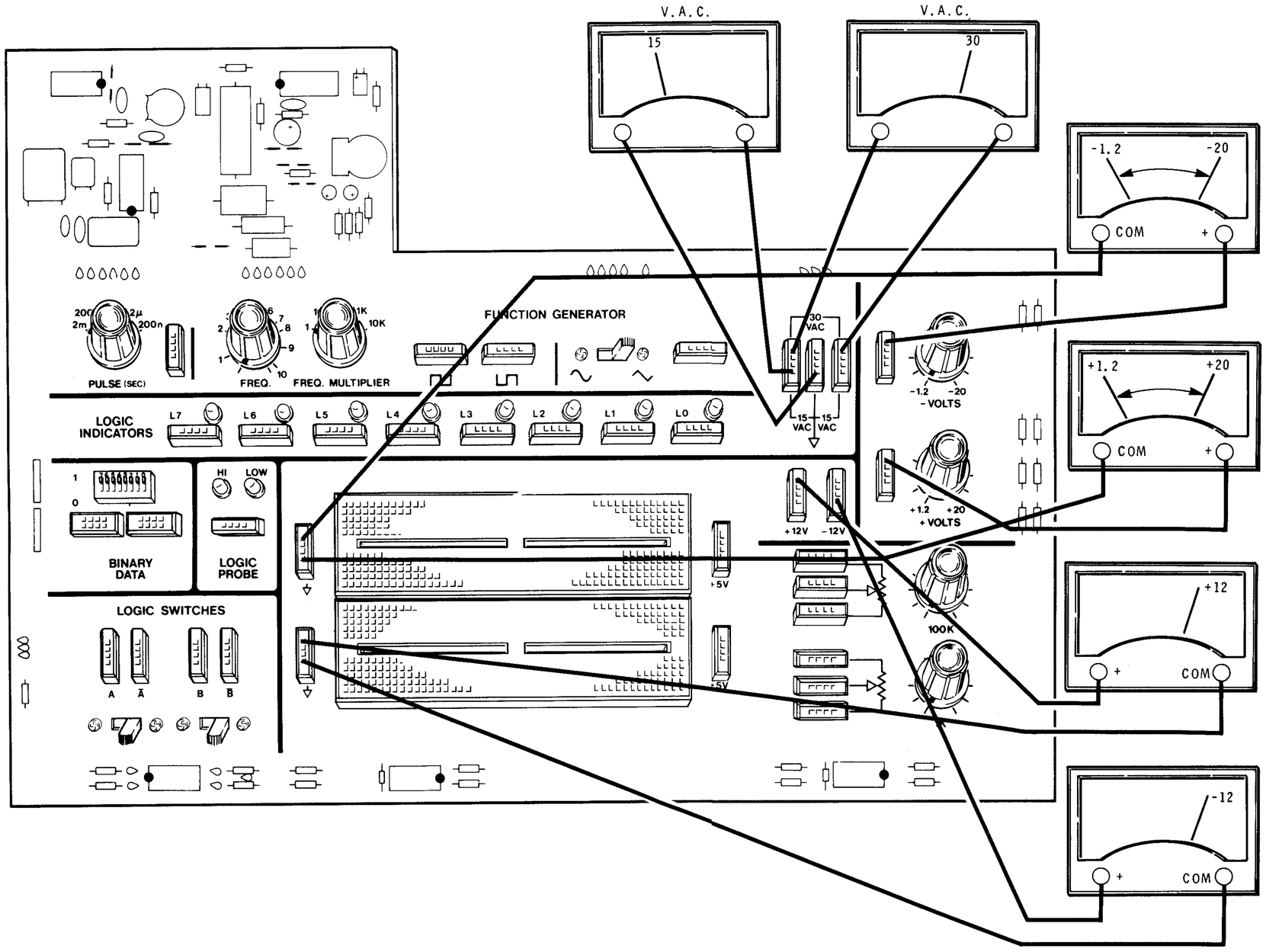
Detail 3-7A



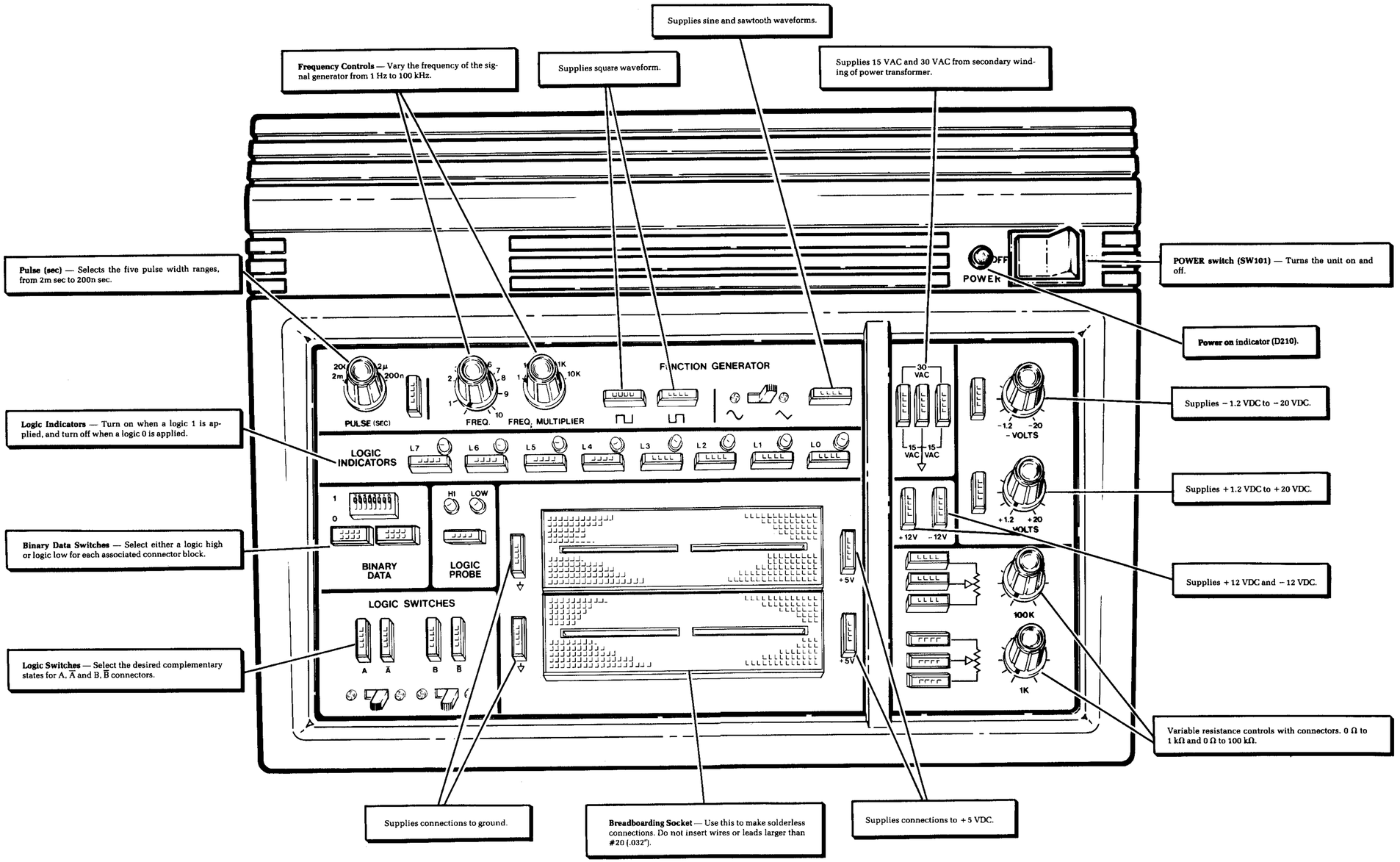
PICTORIAL 3-8



Detail 3-8A



PICTORIAL 3-10



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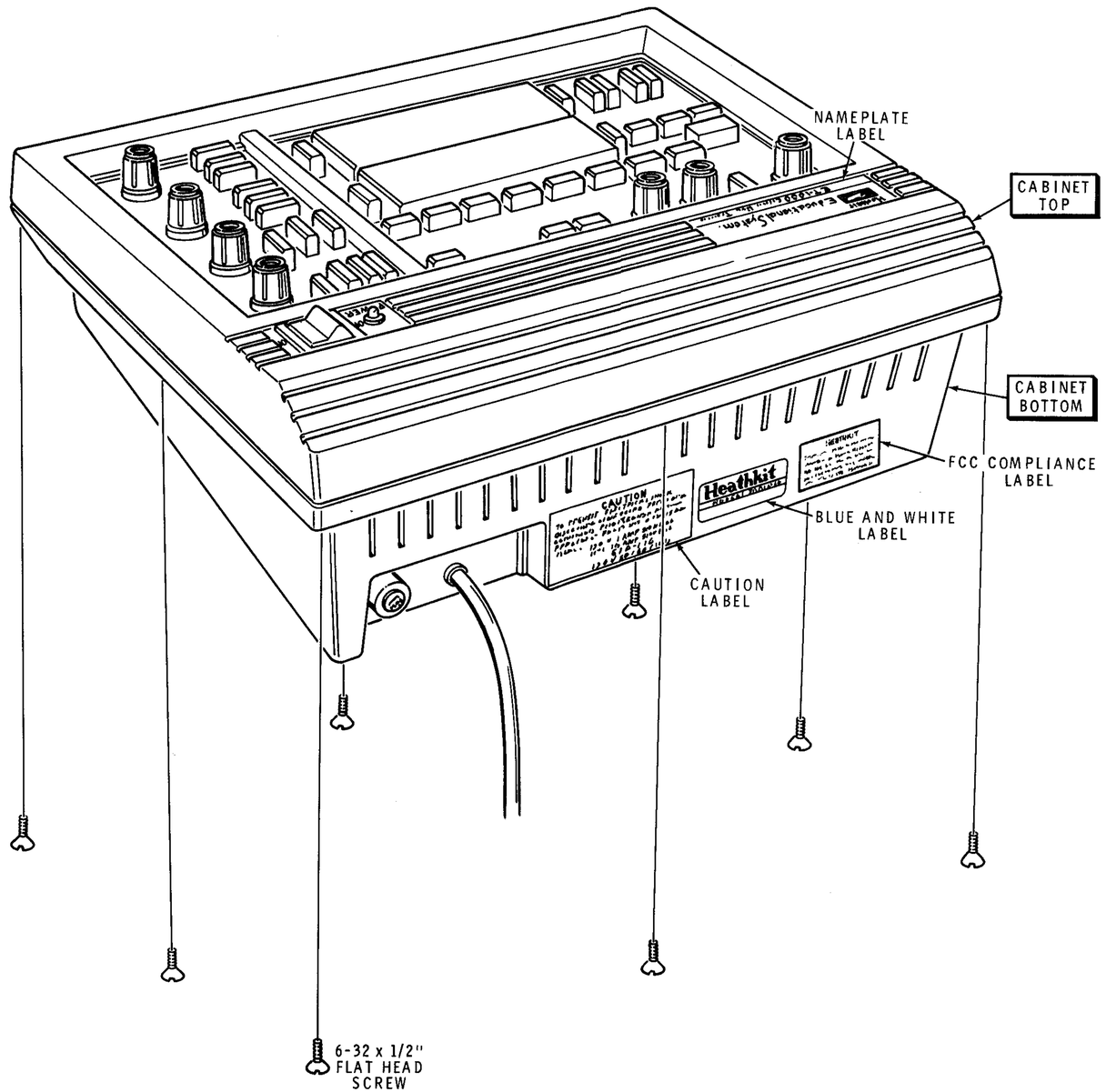
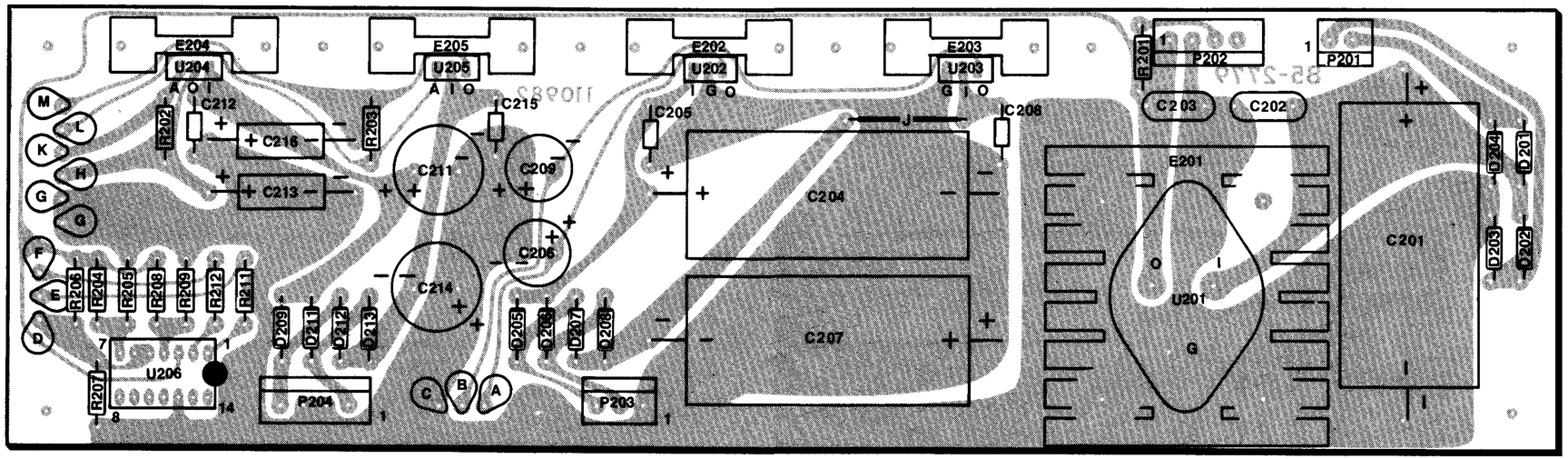
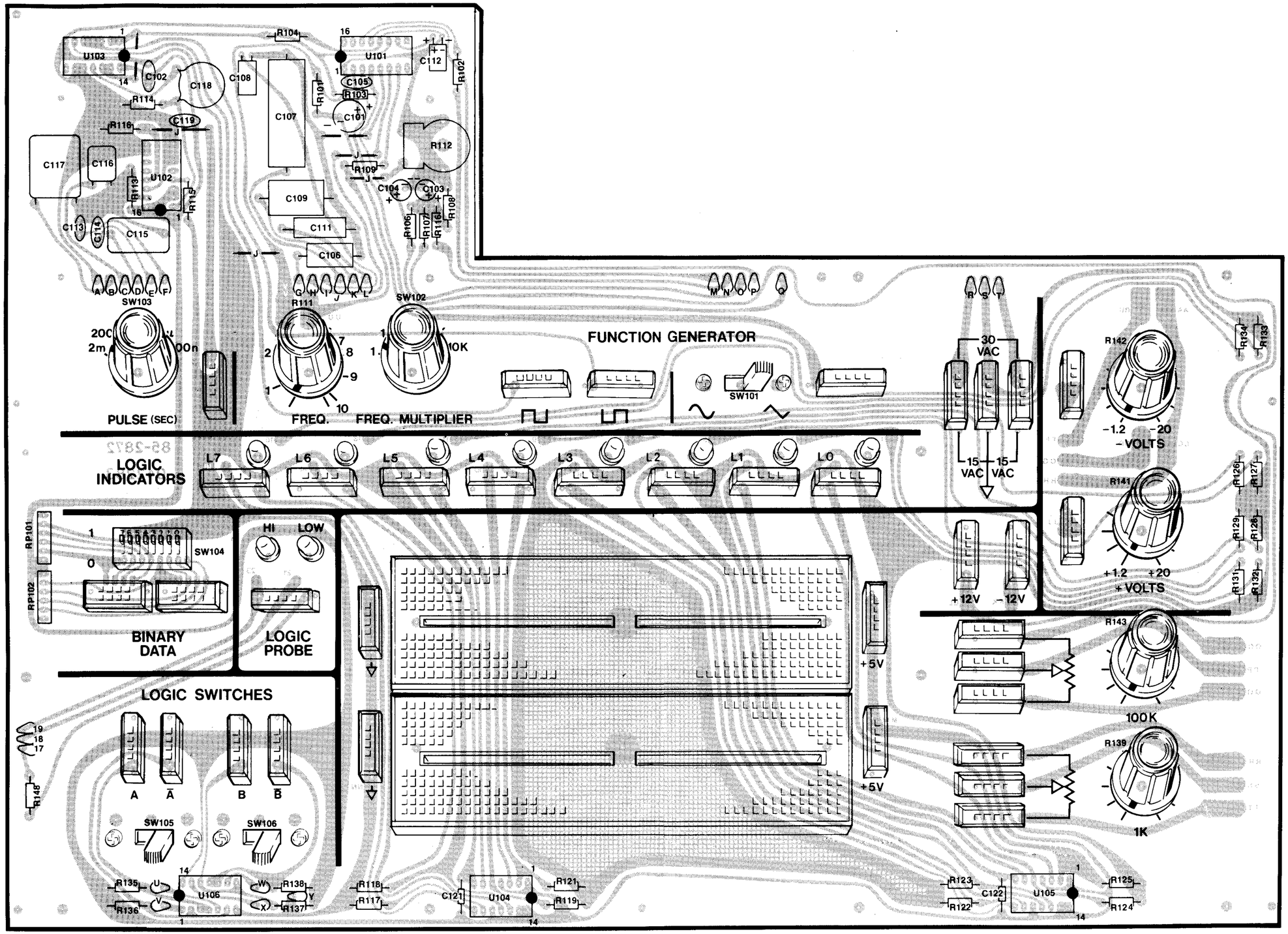


PICTORIAL 4-1



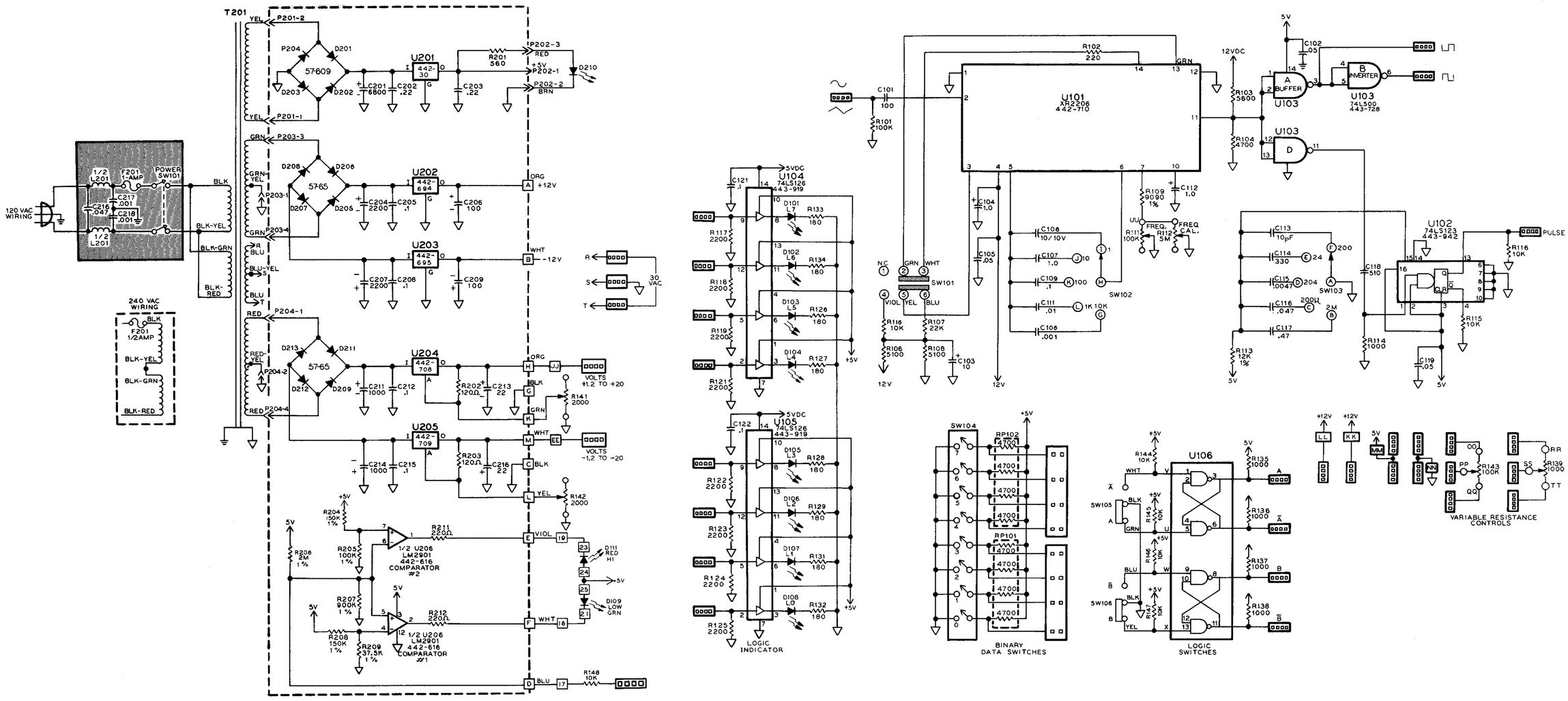
POWER SUPPLY CIRCUIT BOARD

(Shown from the component side.)



MAIN CIRCUIT BOARD

(Shown from the component side.)



SCHEMATIC OF THE HEATHKIT® CIRCUIT DESIGN TRAINER MODEL ET-1000

NOTES:

1. ALL RESISTOR VALUES ARE IN OHMS (k=1,000, M=1,000,000) ALL RESISTORS ARE 1/4-WATT, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN µF (MICROFARADS), UNLESS OTHERWISE SPECIFIED.
3. ⏚ THIS SYMBOL INDICATES CHASSIS GROUND.
4. ▽ THIS SYMBOL INDICATES CIRCUIT BOARD GROUND.
5. → THIS SYMBOL INDICATES DIRECTION.
6. ┼ THIS SYMBOL INDICATES NO CONNECTION.
7. ✚ THIS SYMBOL INDICATES A CONNECTION.
8. REFER TO THE CIRCUIT BOARD X-RAY VIEWS FOR THE PHYSICAL LOCATION OF PARTS.
9. PARTS IN THE SHADED AREA ARE CRITICAL FOR CONTINUED SAFETY. REPLACE THEM ONLY WITH PARTS OF THE SAME RATING OR WITH THE PROPER HEATH PARTS.