

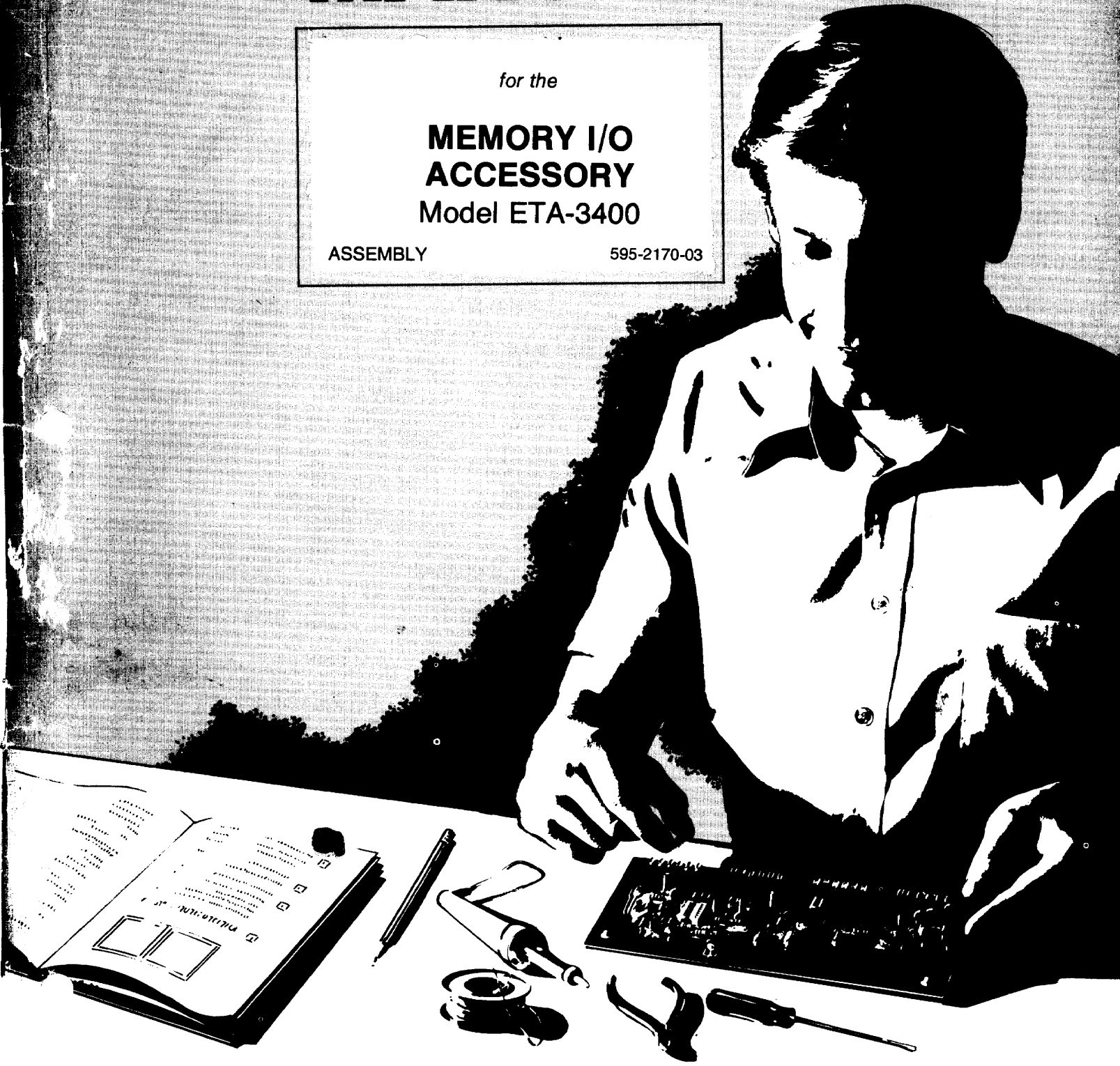
# HEATHKIT<sup>®</sup> MANUAL

*for the*

**MEMORY I/O  
ACCESSORY**  
Model ETA-3400

ASSEMBLY

595-2170-03



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  
Computer Hardware ..... (616) 982-3309  
Computer Software ..... (616) 982-3860  
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<sup>®</sup> Manual

*for the*

## **MEMORY I/O ACCESSORY** Model ETA-3400

ASSEMBLY

595-2170-03

**HEATH COMPANY**  
BENTON HARBOR, MICHIGAN 49022

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## INTRODUCTION

The ETA-3400 Memory I/O Accessory expands the capability of the ET-3400 Microprocessor Trainer by adding Tiny BASIC and a terminal monitor (both in ROM), expansion RAM, and audio cassette program storage. The standard Accessory comes with 1,024 bytes of user RAM memory, which can be expanded to a total of 4,096 bytes.

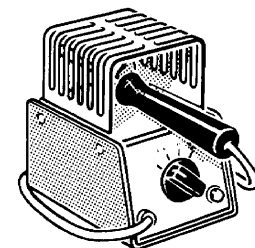
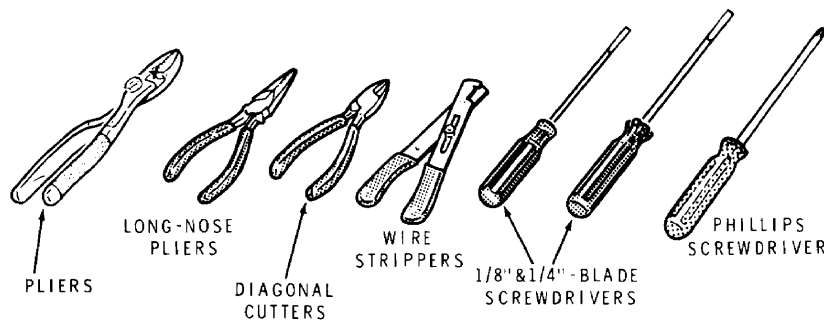
A serial I/O port provides communication to a standard terminal such as the Heath H9 Video Terminal or

H36 hard copy terminal. Baud rates are selectable from 110 through 9600. Both EIA RS-232 and 20 mA current loop interfaces are provided. Machine language object code may be easily stored using a cassette recorder such as the Heath ECP-3801, with or without a terminal. The audio cassette storage feature plus additional user memory both enhance the ET-3400 Trainer, and do not require a terminal. With a terminal, you can also store BASIC programs on cassette tapes.

## ASSEMBLY NOTES

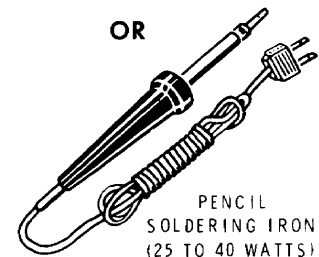
### TOOLS

You will need these tools to assemble your kit.

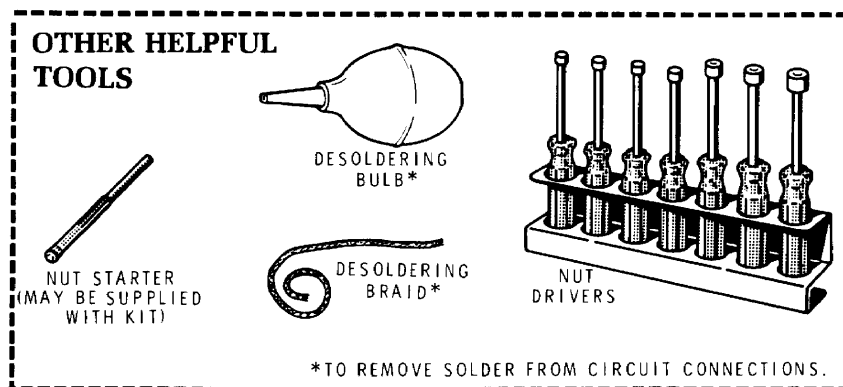


HEATHKIT  
SOLDERING  
IRON

OR



PENCIL  
SOLDERING IRON  
(25 TO 40 WATTS)



**OTHER HELPFUL TOOLS**

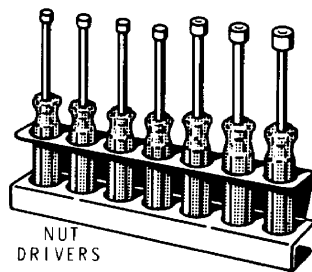
NUT STARTER  
(MAY BE SUPPLIED  
WITH KIT)



DESOLDERING  
BULB\*



DESOLDERING  
BRAID\*



NUT  
DRIVERS

\*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS.

### 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 excess lead lengths. Hold the leads so they cannot fly toward your eyes.**

## SOLDERING

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

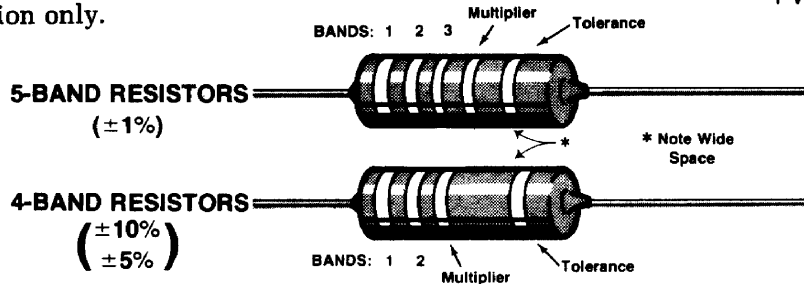
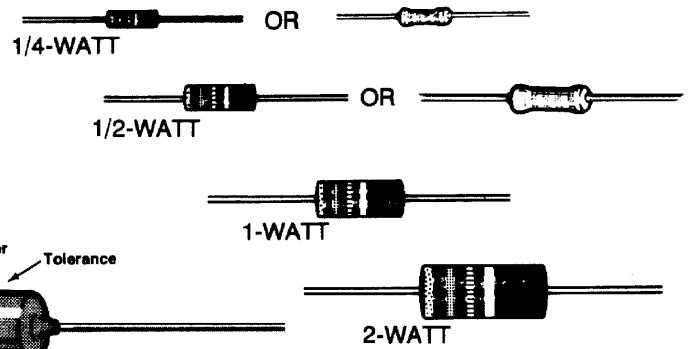
It is easy to make a good solder connection if you follow a few simple rules:

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

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



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

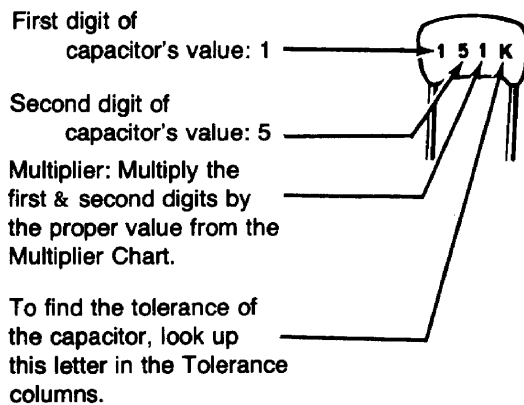
Resistance Tolerance	
Color	Tolerance
Silver	±10%
Gold	±5%
Brown	±1%

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

**EXAMPLES:**

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

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



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

\*DuPont Registered Trademark





# PARTS LIST

Check each part against the following list. 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.

The key numbers correspond to the numbers on the "Parts Pictorial" on Page 1 in the separate "Illustration Booklet."

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

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
<b>RESISTORS</b>				
NOTES:				
1. All resistors are 1/4-watt, 5% tolerance unless otherwise noted. A fourth color band of silver indicates a 10% tolerance; a fourth band of gold indicates 5% tolerance.				
2. The resistors may be packed in more than one envelope. Open all the resistor envelopes in this pack before you check them against the Parts List.				
A1	6-470-12	1	47 Ω (yellow-violet-black)	R122
A1	6-101-12	1	100 Ω (brown-black-brown)	R101
A1	6-151-12	1	150 Ω (brown-green-brown)	R113
A1	6-471-12	2	470 Ω (yellow-violet-brown)	R121, R129
A1	6-102-12	9	1000 Ω (brown-black-red)	R105, R108, R109, R111, R114, R115, R123, R130, R131
A1	6-222-12	15	2200 Ω (red-red-red)	R118, R119, R124, R126, R132, R134 through R143
A1	6-332-12	1	3300 Ω (orange-orange-red)	R106
A1	6-472-12	5	4700 Ω (yellow-violet-red)	R116, R120, R125, R127, R128
A1	6-103-12	4	10 kΩ (brown-black-orange)	R102, R104, R110, R117
A1	6-104-12	3	100 kΩ (brown-black-yellow)	R103, R107, R112

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
<b>CAPACITORS</b>				
<b>Electrolytic Capacitors</b>				
B1	25-221	1	2.2 μF tantalum	C102
B1	25-276	2	4.7 μF tantalum	C108, C110
B2	25-924	6	2.2 μF electrolytic	C105, C106, C111, C112, C114, C115
B3	25-241	2	1200 μF	C107, C109
B3	25-272	1	6000 μF	C113
<b>Other Capacitors</b>				
B4	21-71	2	.001 μF ceramic	C2, C3
B4	21-182	1	.047 μF (473) ceramic	C101
B5	21-46	1	.005 μF ceramic	C103
B5	21-95	4	.1 μF ceramic	C104, C116, C117, C118
B6	27-127	1	.047 μF Mylar	C1
<b>DIODES</b>				
C1	56-56	3	1N4149 diode	D107, D108, D109
C1	57-42	2	3A1 diode	D105, D106
C1	57-65	4	1N4002 diode	D101, D102, D103, D104



KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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**TRANSISTORS — INTEGRATED CIRCUITS (IC's)**

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

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

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

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

**CAUTION:** The integrated circuits packed in conductive foam can be damaged by static voltage. Since these parts are quite expensive, do not remove them from their packages until you are instructed to do so.

D1	417-874	1	2N3906 transistor	Q101
D1	417-875	4	2N3904 transistor	Q102 through Q105
D2	442-54	1	μA7805 IC	U110
D2	442-633	1	78M12CKC IC	U102
D2	442-664	1	79M12CKC IC	U101
D3	442-616	1	LM3302N, LM2901N, or μA775 IC	U109
D3	443-18	1	7404N IC	U104
D3	443-46	1	7402N IC	U107
D3	444-28	1	74S188N IC	U108
D3	443-764	2	2114 IC	U117, U118
D3	443-843	1	MC6820 IC	U103
D4	444-24	1	"TINY BASIC" ROM IC	U106
D4	444-51	1	"Terminal Monitor" ROM IC	U105

**CONNECTORS — SOCKETS**

E1	432-865	1	3-hole socket	
E2	432-866	3	Spring connector	
E3	432-1062	1	40-pin connector	S101
E4	434-253	1	40-pin IC socket	
E5	434-298	3	14-pin IC socket	
E6	434-299	1	16-pin IC socket	
E7	434-307	2	24-pin IC socket	

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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**CONNECTORS — SOCKETS (cont'd)**

E8	434-310	8	18-pin IC socket	
E9	432-1028	1	25-hole socket	S102
E10	432-1031	25	Female connector pin	
E11	432-1032	1	25-hole connector shell	
E12	432-1033	25	Male connector pin	
E13	434-107	2	Phono socket	
E14	434-148	1	AC power socket	
E15	438-4	2	Phono plug	
E16	438-26	2	Red phone plug	

**HARDWARE**

NOTE: The hardware may be in more than one packet. Open all the hardware packets according to their size before you check the hardware.

Hardware is shown actual size. To identify a piece of hardware, place it over the illustration.

F1	250-13	2	6-32 × 1" screw
F2	250-89	8	6-32 × 3/8" screw
F2	250-381	9	6-32 × 3/8" black screw
F3	250-273	2	4-40 × 3/8" screw
F4	250-1325	16	6-32 × 1/4" black screw
F5	250-1305	1	#6 × 5/8" self-tapping screw
F6	252-2	2	4-40 nut
F7	252-3	4	6-32 nut
F8	252-22	3	Speed Nut*
F9	254-1	2	#6 lockwasher
F10	254-9	2	#4 lockwasher
F11	255-71	2	Long threaded spacer
F12	255-142	8	Short threaded spacer
F13	259-1	2	#6 solder lug
F14	423-11	1	Fuseholder

**CIRCUIT BOARD — CABINET — SHIELD**

	85-2146-1	1	Circuit board
	90-1275-1	1	Cabinet top
	90-1276-1	1	Cabinet bottom
G1	206-1288	1	Shield

**WIRE — LINE CORD**

	89-54	1	Line cord
	340-8	6"	Bare wire
	344-35	8"	Orange wire
	344-59	8"	White wire
	347-55	20"	8-wire flat cable
	344-33	12"	Large black wire
	344-50	8"	Small black wire
	343-11	48"	Shielded wire
	134-1034	1	40-conductor flat cable

\*Registered Trademark, Tinnerman Company



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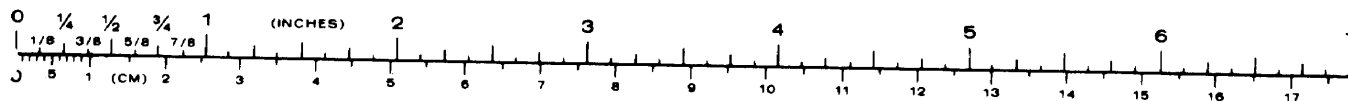
KEY HEATH No. Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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**MISCELLANEOUS**

H1	45-615	1	Toroid coil	L1
H2	54-920	1	Power transformer	T1
H3	60-619	1	Rocker switch	SW1
H4	73-3	1	Rubber grommet	
H5	73-92	1	Foam gasket	
H6	75-90	1	Paper insulator	
H7	75-754	1	Strain relief	
	206-1415	1	5" × 12" foil shield	
H8	261-34	4	Foot	
H9	346-67	2"	Shrinkable tubing	
H10	352-13	1	Silicone grease	
H11	354-5	3	Short cable tie	
H12	354-7	2	Long cable tie	
H13	421-42	1	3/8-ampere slow-blow fuse	F1
H14	431-1	1	2-lug terminal strip	
H15	431-83	1	5-lug terminal strip	
	490-185	1	Desoldering braid	

**PRINTED MATERIAL**

J1	391-34	1	"Heathkit" label
	597-260	1	Parts Order Form
		1	Assembly Manual (See Page 1 for part number).
		1	Software Reference Manual (See Page 1 for part number).



# STEP-BY-STEP ASSEMBLY

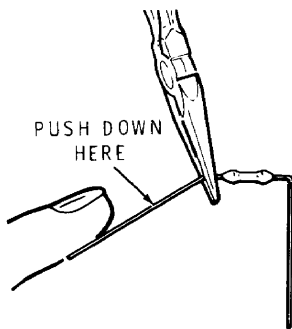
## CIRCUIT BOARD ASSEMBLY

### START

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

( ) Position the circuit board as shown with the printed side (not the foil side) up.

( ) R119: Hold a 2200Ω (red-red-red) resistor as shown and bend the leads straight down with long-nose pliers to fit the hole spacing on the circuit board.

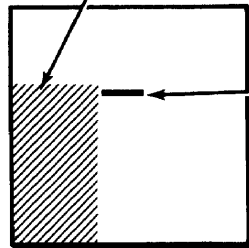


( ) Push the leads through the holes at the indicated location on the circuit board. The end with color bands may be positioned either way.

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

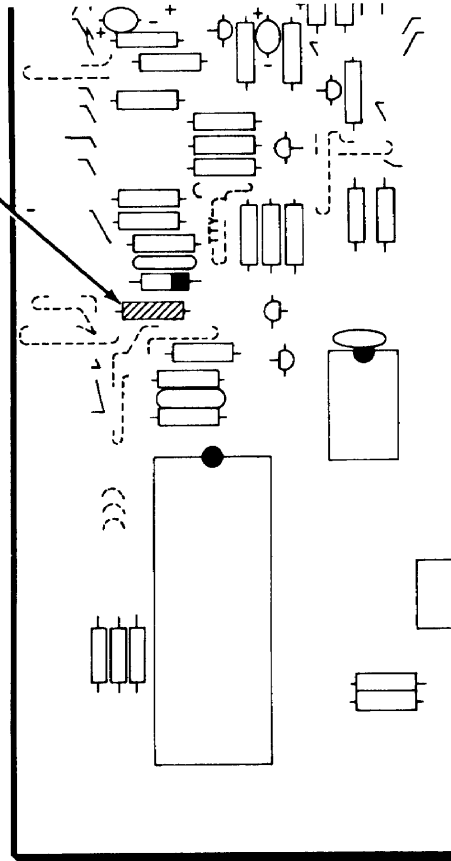


The steps performed in this Pictorial are in this area of the circuit board.



PART NUMBER

IDENTIFICATION DRAWING

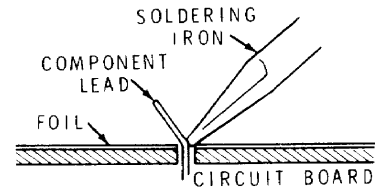


PICTORIAL 1-1

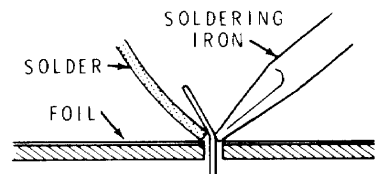
### CONTINUE

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

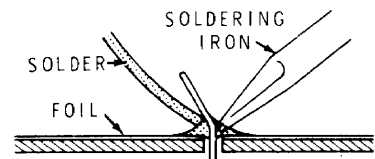
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat both for two or three seconds.



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



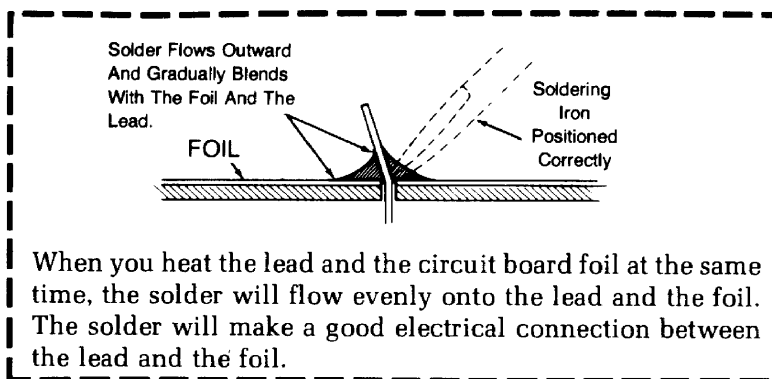
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



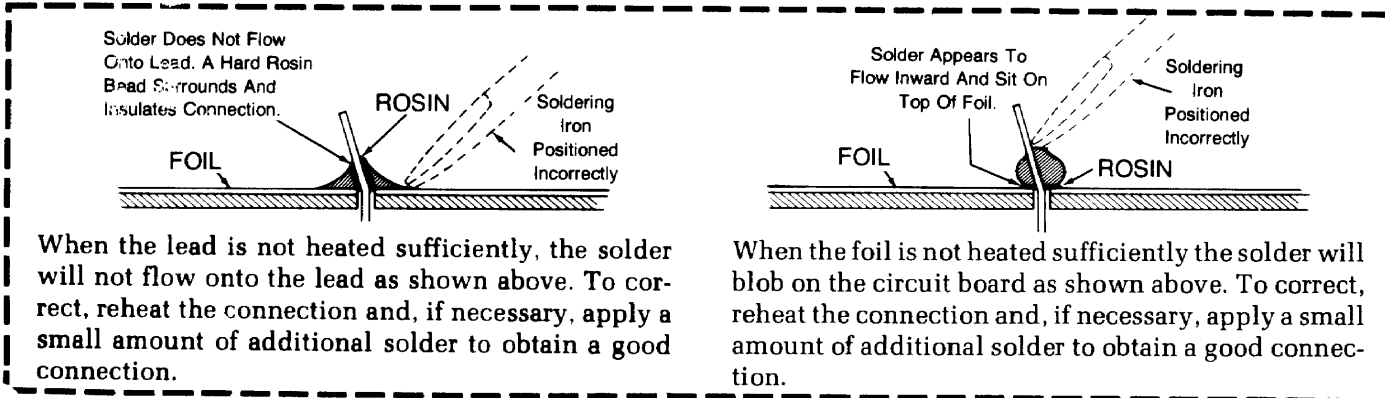
( ) Hold the lead with one hand while you cut off the excess lead length close to the connection. This will keep you from being hit in the eye by the flying lead.

( ) Check each connection. Compare it to the illustrations on Page 11. After you have checked the solder connections, proceed with the assembly on Page 12. Use the same soldering procedure for each connection.

## A GOOD SOLDER CONNECTION



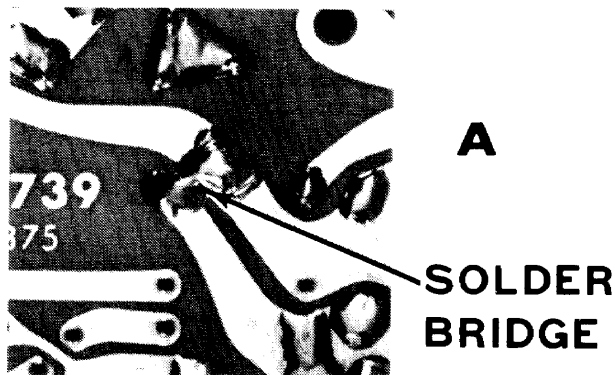
## POOR SOLDER CONNECTIONS



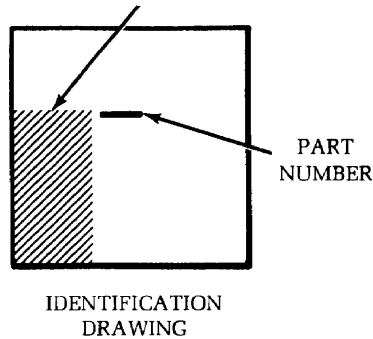
## SOLDER BRIDGES

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

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

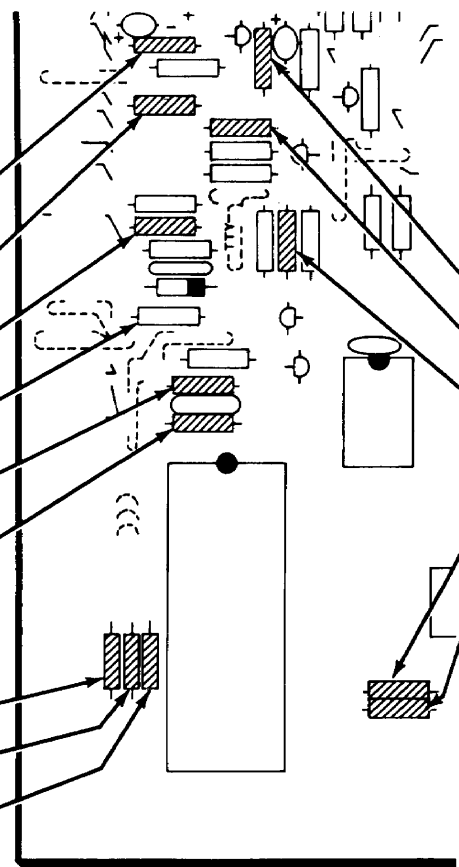


The steps performed in this Pictorial are in this area of the circuit board.



**START** ↙

- NOTE: Make sure you installed the 2200 Ω resistor on Page 10.
- ( ) R129: 470 Ω (yellow-violet-brown).
  - ( ) R121: 470 Ω (yellow-violet-brown).
  - ( ) R114: 1000 Ω (brown-black-red).
  - ( ) This resistor should have been installed in Pictorial 1-1.
  - ( ) R111: 1000 Ω (brown-black-red).
  - ( ) R112: 100 kΩ (brown-black-yellow).
- Install three 2200 Ω (red-red-red) resistors.
- ( ) R143. ....
  - ( ) R142. ....
  - ( ) R141. ....
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

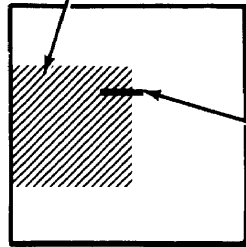


**CONTINUE** ↘

- Install five 2200 Ω (red-red-red) resistors.
- ( ) R124.
  - ( ) R126.
  - ( ) R118.
  - ( ) R136.
  - ( ) R132.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

**PICTORIAL 1-2**

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



PART NUMBER

IDENTIFICATION DRAWING

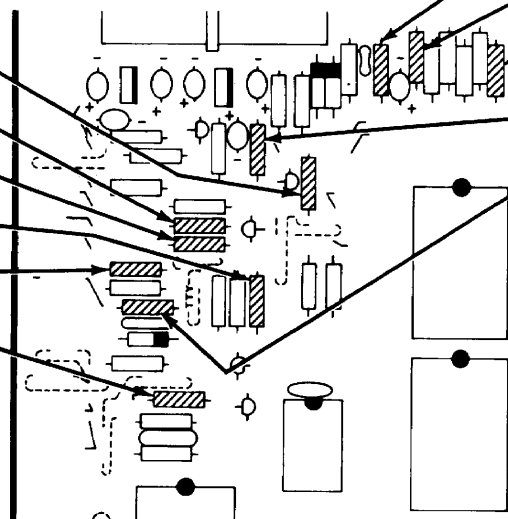
**START** ↘

Install five 4700 Ω (yellow-violet-red) resistors at the following locations.

- ( ) R125. ....
- ( ) R127. ....
- ( ) R128. ....
- ( ) R120. ....
- ( ) R116. ....

---

- ( ) R110: 10 kΩ (brown-black-orange).



**CONTINUE** ↘

Install five 1000 Ω (brown-black-red) resistors at the following locations.

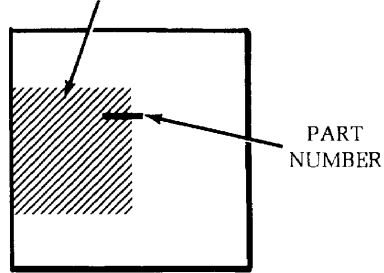
- ( ) R109.
- ( ) R105.
- ( ) R108.
- ( ) R123.
- ( ) R115.

---

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

PICTORIAL 1-3

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



IDENTIFICATION DRAWING

**START** →

- ( ) R101: 100 Ω (brown-black-brown).

---

- ( ) R113: 150 Ω (brown-green-brown).

---

- ( ) R122: 47 Ω (yellow-violet-black).

---

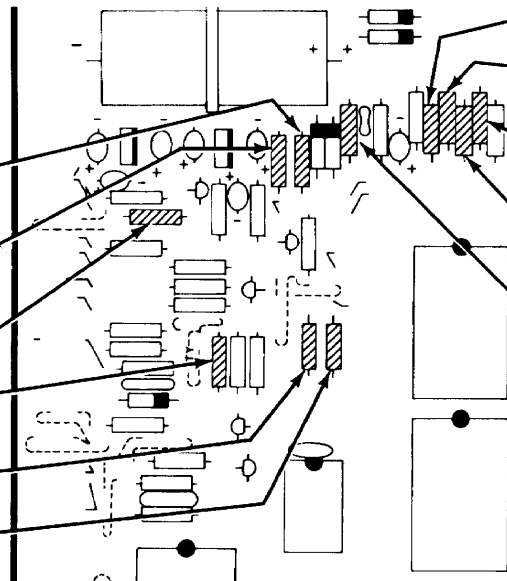
- ( ) R117: 10 kΩ (brown-black-orange).

---

- ( ) R130: 1000 Ω (brown-black-red).

---

- ( ) R131: 1000 Ω (brown-black-red).



**CONTINUE** ⇐

- ( ) R103: 100 kΩ (brown-black-yellow).

---

- ( ) R104: 10 kΩ (brown-black-orange).

---

- ( ) R107: 100 kΩ (brown-black-yellow).

---

- ( ) R106: 3300 Ω (orange-orange-red).

---

- ( ) R102: 10 kΩ (brown-black-orange).

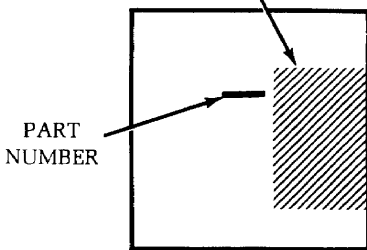
---

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

PICTORIAL 1-4



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



IDENTIFICATION DRAWING

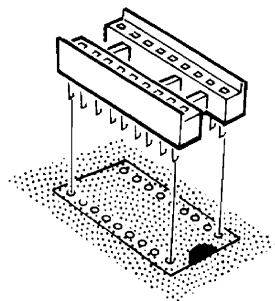
Install six 2200  $\Omega$  (red-red-red) resistors at the following locations.

- ( ) R138. ....
- ( ) R137. ....
- ( ) R140. ....
- ( ) R139. ....
- ( ) R134. ....
- ( ) R135. ....

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

NOTE: When you install an IC socket, use the following procedure.

1. Be sure all the pins are straight.
2. Insert the pins into the holes.
3. Turn the circuit board over and be sure the correct number of pins extend from the board. If not, one or more pins may be bent under the socket. Remove the socket, straighten the pins, and reinstall the socket.
4. Solder the pins to the foil as you install each socket.

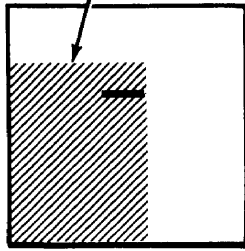


Install 18-pin IC sockets at the eight following locations:

- ( ) U112.
- ( ) U111.
- ( ) U114.
- ( ) U113.
- ( ) U116.
- ( ) U115.
- ( ) U118.
- ( ) U117.

PICTORIAL 1-5

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



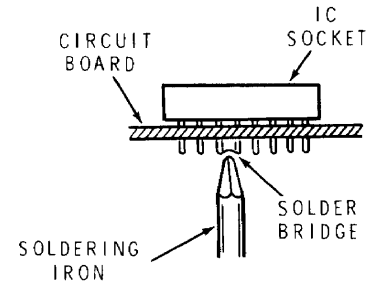
IDENTIFICATION DRAWING

PART NUMBER

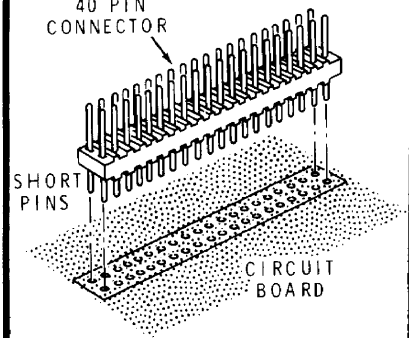
**CONTINUE** ↘

- ( ) 14-pin IC socket at U107.
- ( ) 16-pin IC socket at U108.

Carefully check each socket for solder bridges between pins. If a solder bridge has occurred, hold the circuit board foil-side-down as shown, and hold the soldering iron tip between the two points that are bridged. The solder will flow down the soldering iron tip.

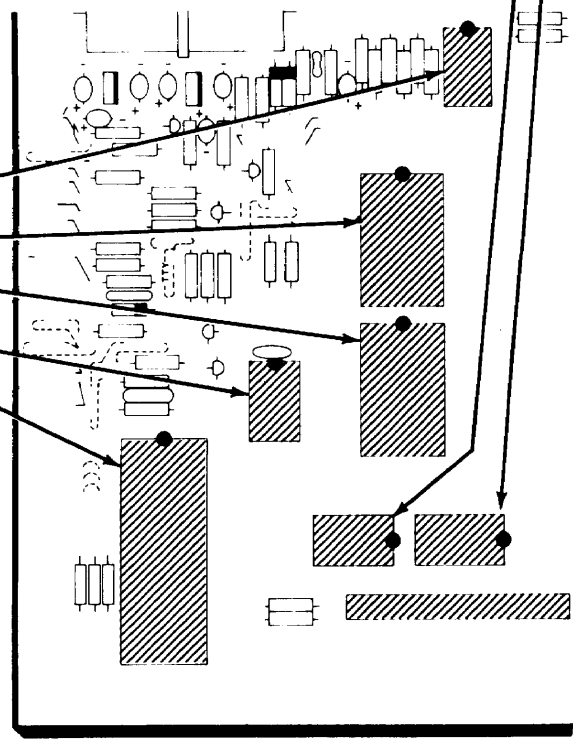


- ( ) S101: Install the 40-pin connector as shown below. Guide the short pins of the connector through the holes on the circuit board and solder the pins to the foil.



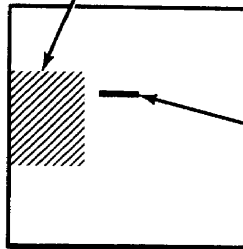
**START** ↘

- ( ) 14-pin IC socket at U109.
- ( ) 24-pin IC socket at U105.
- ( ) 24-pin IC socket at U106.
- ( ) 14-pin IC socket at U104.
- ( ) 40-pin IC socket at U103.



PICTORIAL 1-6

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

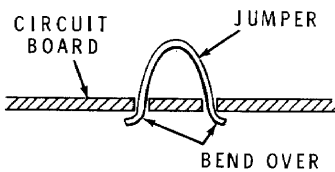


IDENTIFICATION DRAWING

**START** ↘

( ) Cut eight 3/4" bare wires; then bend each one into a loop. These will be used for jumper wires in the following steps.

NOTE: When you install each jumper wire, push the loop as far as possible into the circuit board holes. Bend the free ends of each wire slightly, and pull the loop upward. Then solder the wires to the foil.



**EIA or 20 mA CURRENT LOOP (TTY)**

In the following steps, you will select the type of signals (EIA or 20 mA current loop) for use with your terminal. Refer to the "Operation" section (Page 49) of this Manual and determine which type of signal you want to use and perform only that section as described below. If you use the H36 DEC Writer or another 20 mA current loop terminal, perform the step under 20 mA "Current Loop." If you intend to use the Heath H9 Video Terminal or another RS-232 terminal, perform the step under "EIA RS-232."

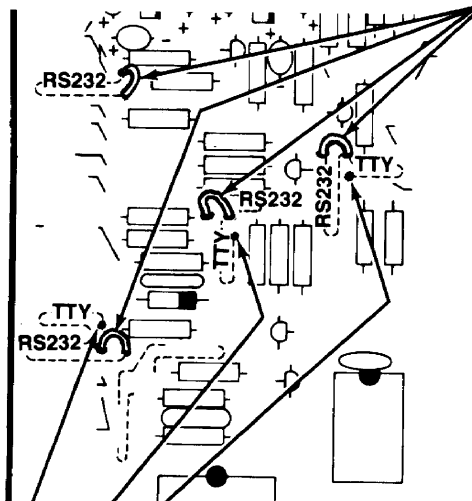
**20 mA CURRENT LOOP**

( ) Install three jumper wires at the circuit board holes marked TTY.

**CONTINUE** ↙

**EIA RS-232**

( ) Install four jumper wires at the circuit board holes marked RS-232.



PICTORIAL 1-7

**START** →

**500 mV or 50 mV**

The following jumper wire selects the proper audio output level to your tape recorder.

- ( ) Connect one end of a jumper wire to the hole shown in the Pictorial.
- ( ) If you use the AUX or LINE inputs on your tape recorder, connect the free end of the jumper wire to the 500 mV circuit board hole. If you use the MIC input on your tape recorder, connect the free end of the jumper wire to the 50 mV circuit board hole.

**Terminal Baud Rate**

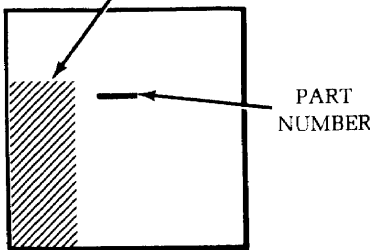
In the following step, you will install jumper wires to match the baud rate of your terminal. Some common speeds are:

- Teletype — 110.
- H36 DEC Writer (High speed mechanical) — 300.
- Heath H9 Video Terminal — 600.

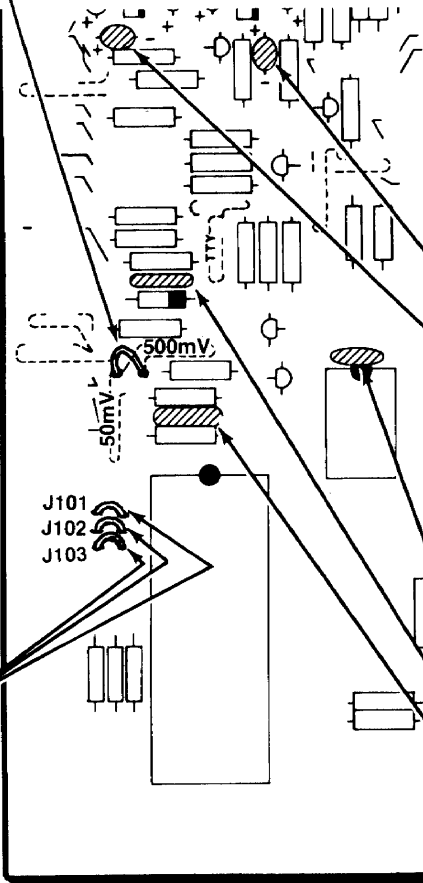
( ) Refer to the following table and locate the baud rate that is required for your terminal; then install only the jumper wire(s) listed.

BAUD RATE	JUMPER(S) INSTALLED
110	No jumpers
300	J101 J102 J103
600	J102
1200	J101 J102
2400	J103
4800	J101 J103
9600	J102 J103

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

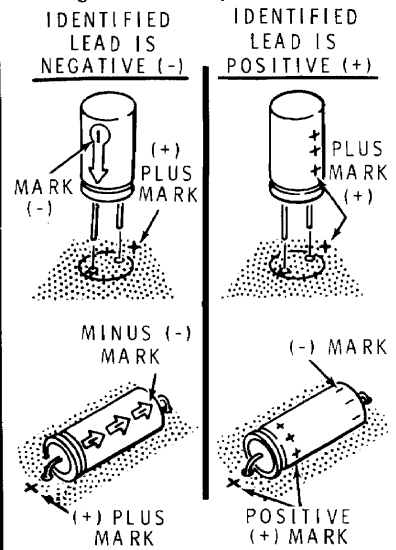


IDENTIFICATION DRAWING



**CONTINUE** →

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



- ( ) C111: 2.2  $\mu$ F electrolytic.
- ( ) C106: 2.2  $\mu$ F electrolytic.

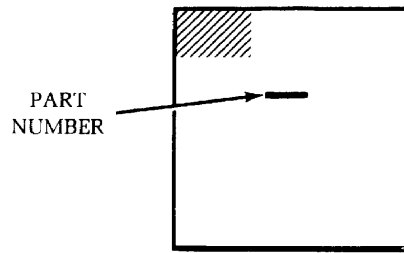
NOTE: Before you install ceramic capacitors, use long-nose pliers to remove the excess insulation from the capacitor leads.



- ( ) C116: .1  $\mu$ F ceramic.
- ( ) C104: .1  $\mu$ F ceramic.
- ( ) C103: .005  $\mu$ F ceramic.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-8

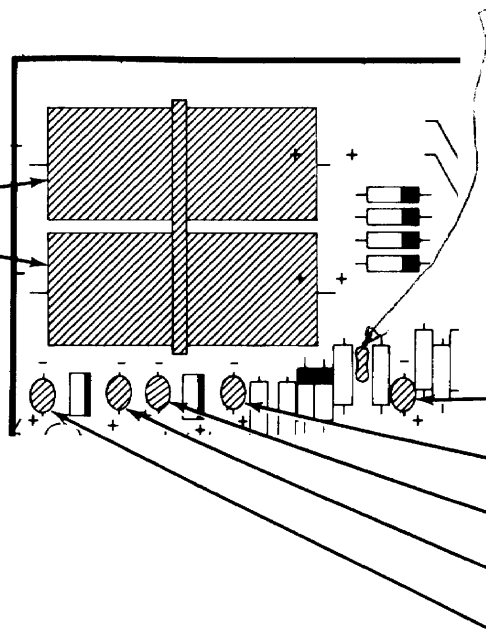
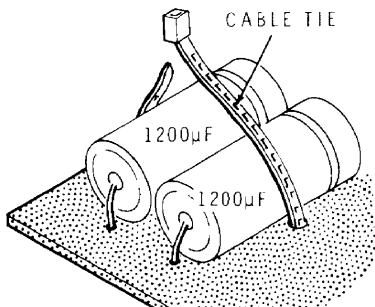
The steps performed in this Pictorial are in this area of the circuit board.



IDENTIFICATION DRAWING

**CONTINUE** ↘

- ( ) C109: 1200  $\mu$ F electrolytic.
- ( ) C107: 1200  $\mu$ F electrolytic.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) Route a long cable tie through the holes in the circuit board, as shown below, and around the two 1200  $\mu$ F capacitors. Make sure the head of the cable tie is positioned as shown. Then pass the free end of the tie through the head, pull the tie tight, and cut off the excess tie end.

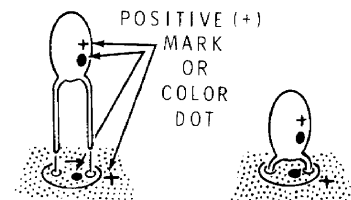


PICTORIAL 1-9

**CONTINUE** ↘

- ( ) C101: .047  $\mu$ F (473) ceramic.

NOTE: When you install tantalum capacitors, be sure to position the plus (+) or color dot marked lead in the plus marked hole in the circuit board.

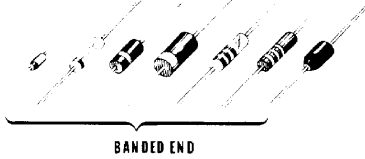


- ( ) C102: 2.2  $\mu$ F tantalum.
- ( ) C108: 4.7  $\mu$ F tantalum.
- ( ) C105: 2.2  $\mu$ F electrolytic.
- ( ) C112: 2.2  $\mu$ F electrolytic.
- ( ) C110: 4.7  $\mu$ F tantalum.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

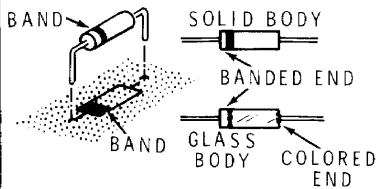
**START** →

In the next two steps, you will install diodes. Be sure you install each diode as follows:

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



**CAUTION: ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD.**



If your diode has a solid body, the band is clearly defined. If your diode has a glass body, do not mistake the colored end inside the diode for the banded end. Look for a band painted on the outside of the glass.

( ) D105: 3A1 diode (#57-42).

( ) D106: 3A1 diode (#57-42).

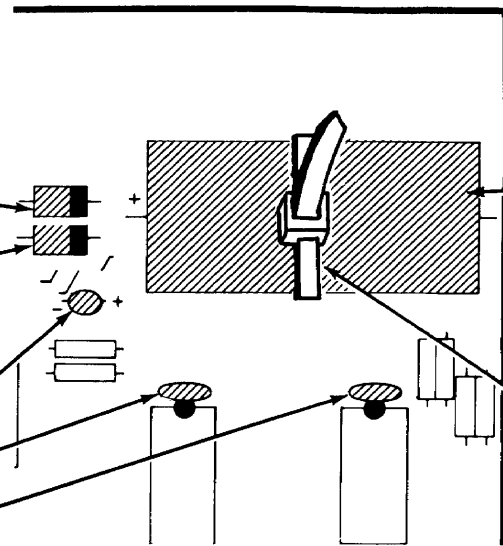
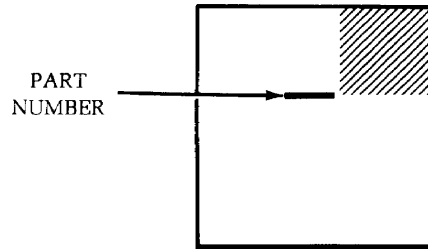
( ) Solder the leads to the foil and cut off the excess lead lengths.

( ) C115: 2.2  $\mu$ F electrolytic.

( ) C117: .1  $\mu$ F ceramic.

( ) C118: .1  $\mu$ F ceramic.

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



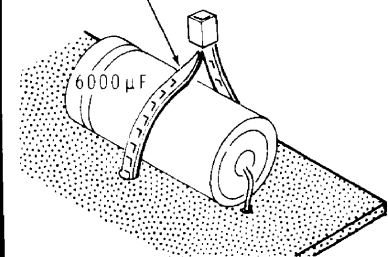
**CONTINUE** →

( ) C113: 6000  $\mu$ F electrolytic.

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

( ) Route a long cable tie through the holes in the circuit board as shown, and around the 6000  $\mu$ F capacitor. Make sure the head of the cable tie is positioned as shown. Then pass the free end through the head, pull the tie tight and cut off the excess tie end.

CABLE TIE

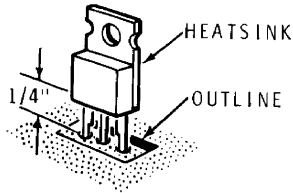


PICTORIAL 1-10

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

**START** →

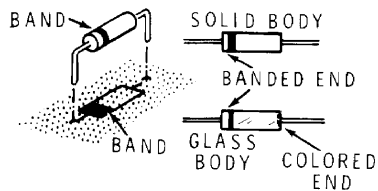
NOTE: When you install each of the following IC's, position the metal heat sink of the IC over the outline of the heat sink on the circuit board. Insert the IC leads into the circuit board holes. Position the bottom of the IC 1/4" above the circuit board. Then solder the leads to the foil and cut off the excess lead lengths.



- ( ) U102: 78M12CKC integrated circuit.
- ( ) U101: 79M12CKC integrated circuit.

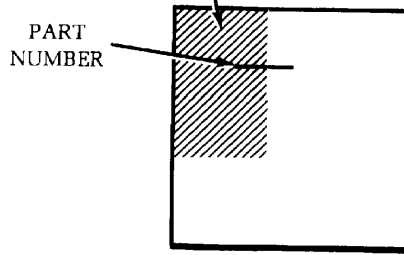
NOTE: When you install the diodes in the next seven steps, be sure to position the banded ends as shown.

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

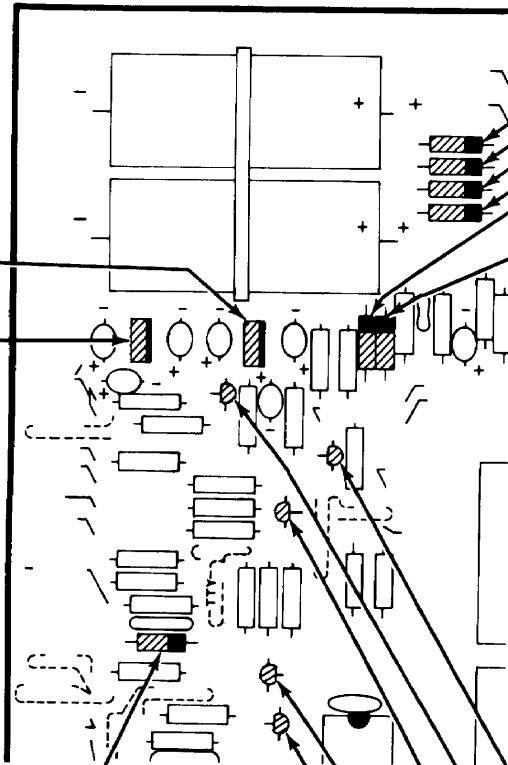


If your diode has a solid body, the band is clearly defined. If your diode has a glass body, do not mistake the colored end inside the diode for the banded end. Look for a band painted on the outside of the glass.

- ( ) D109: 1N4149 diode (#56-56).



IDENTIFICATION DRAWING

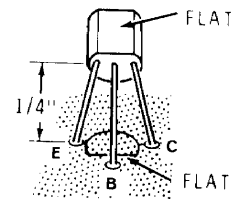


PICTORIAL 1-11

**CONTINUE** →

- ( ) D101: 1N4002 diode (#57-65).
- ( ) D102: 1N4002 diode (#57-65).
- ( ) D103: 1N4002 diode (#57-65).
- ( ) D104: 1N4002 diode (#57-65).
- ( ) D107: 1N4149 diode (#56-56).
- ( ) D108: 1N4149 diode (#56-56).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

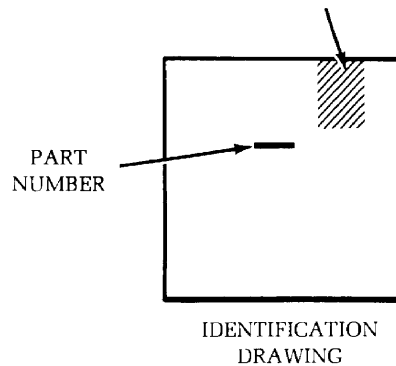
NOTE: When you install each of the following transistors, position the flat of the transistor over the outline of the flat on the circuit board. Then insert the transistor leads into their correct E, B, and C holes. Solder the leads to the foil and cut off the excess lead lengths.



- ( ) Q102: 2N3904 (#417-875) transistor.
- ( ) Q101: 2N3906 (#417-874) transistor.
- ( ) Q103: 2N3904 (#417-875) transistor.
- ( ) Q104: 2N3904 (#417-875) transistor.
- ( ) Q105: 2N3904 (#417-875) transistor.

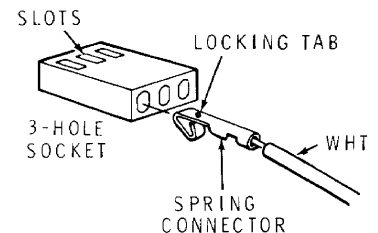
**CONTINUE** ↘

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

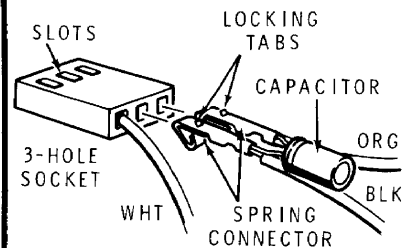


( ) Install the spring connector (on the white wire you prepared earlier) into the 3-hole socket as follows:

1. Position the 3-hole socket so its slots are up as shown.
2. Position the spring connector on the white wire so its locking tab is up as shown.
3. Push the spring connector into socket hole 1 until the pin locks in place.



( ) Position the spring connectors on the 2-wire/capacitor combination so their locking tabs are up as shown. Push the spring connector on the black wire into socket hole 2 and the connector on the orange wire into hole 3. If necessary, push the leads of the capacitor together; then push the spring connectors into the holes until the pins lock in place.



Connect the three wires coming from the 3-hole connector shell to the circuit board as follows:

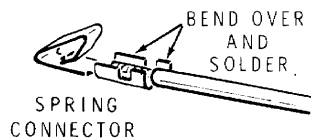
- ( ) White wire to hole WHT.
- ( ) Black wire to hole BLK.
- ( ) Orange wire to hole ORG.
- ( ) Solder the wires to the circuit board foil and cut off the excess wire lengths.

**START** ↘

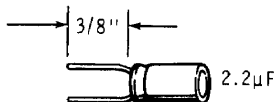
( ) Locate the 8" orange wire, the 8" white solid wire, and the 8" small black wire.

( ) Remove 1/8" of insulation from one end and 1/4" of insulation from the other end of each wire.

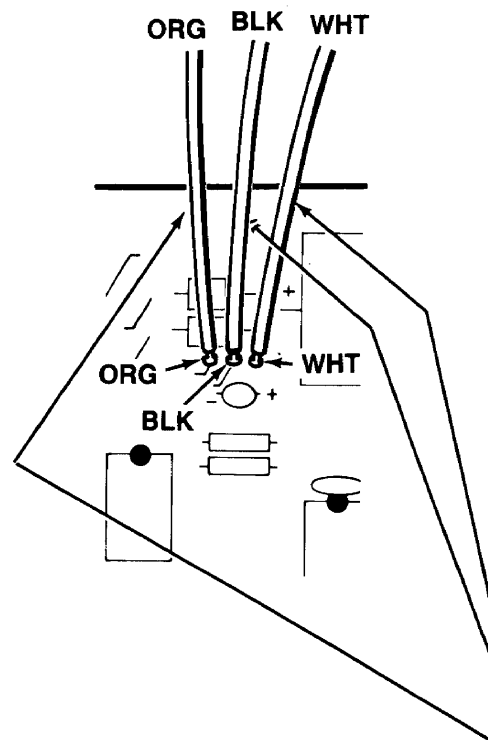
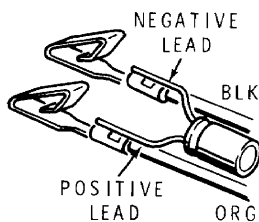
( ) Install and solder a spring connector on the 1/8" prepared end of each wire.



( ) Cut both leads of a 2.2 μF electrolytic capacitor to 3/8".



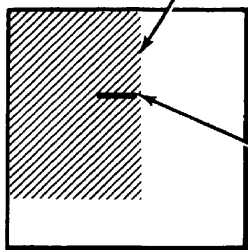
( ) Place the orange and black wires side by side as shown below and solder the 2.2 μF capacitor leads to the connector tabs. Make sure you solder the positive (+) lead of the capacitor to the connector on the orange wire.



PICTORIAL 1-12



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



PART NUMBER

IDENTIFICATION DRAWING

**START** →

( ) Cut a 9" length of 8-wire flat cable.

( ) Use diagonal cutters or a knife to start separating the red and brown wires from the cable; then separate and discard the red and brown wires.

( ) Refer to Detail 1-13A (Illustration Booklet, Page 2) and prepare the ends of the remaining 6-wire cable.

Connect the 1/4" ends of the prepared 6-wire cable to the circuit board in the following steps.

( ) Gray wire to hole +TTY.

( ) Violet wire to hole RS-232 GND.

( ) Blue wire to hole +TTY.

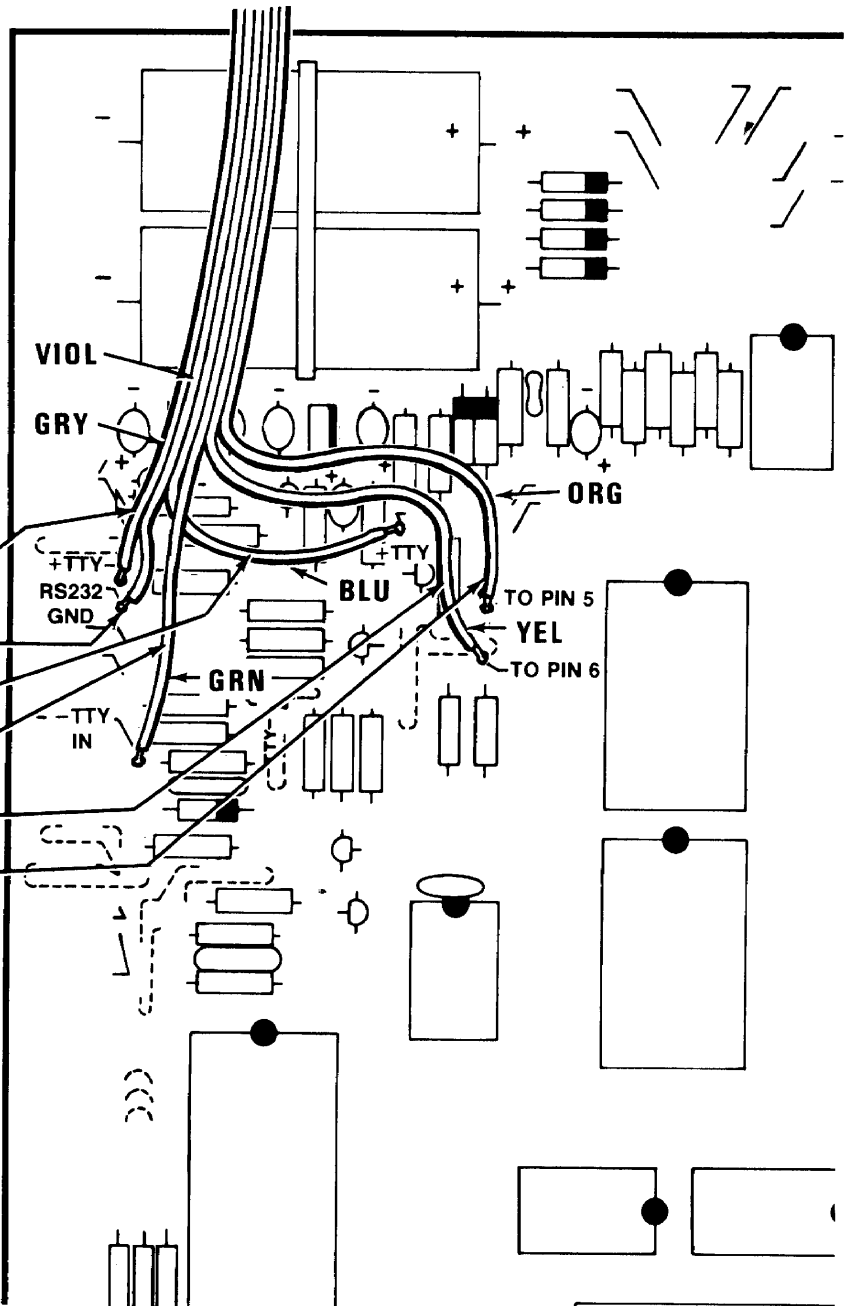
( ) Green wire to hole -TTY IN.

( ) Yellow wire to hole TO PIN 6.

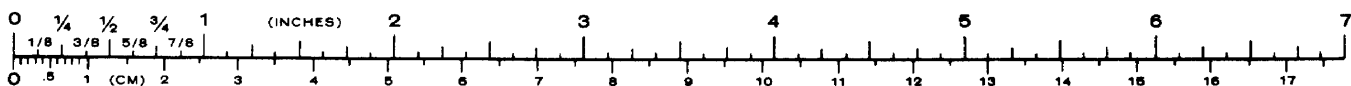
( ) Orange wire to hole TO PIN 5.

( ) Solder the wires to the circuit board foil and cut off the excess wire lengths.

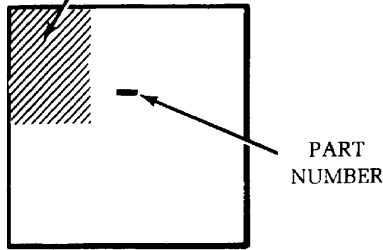
NOTE: The other end of this cable will be connected later.



PICTORIAL 1-13



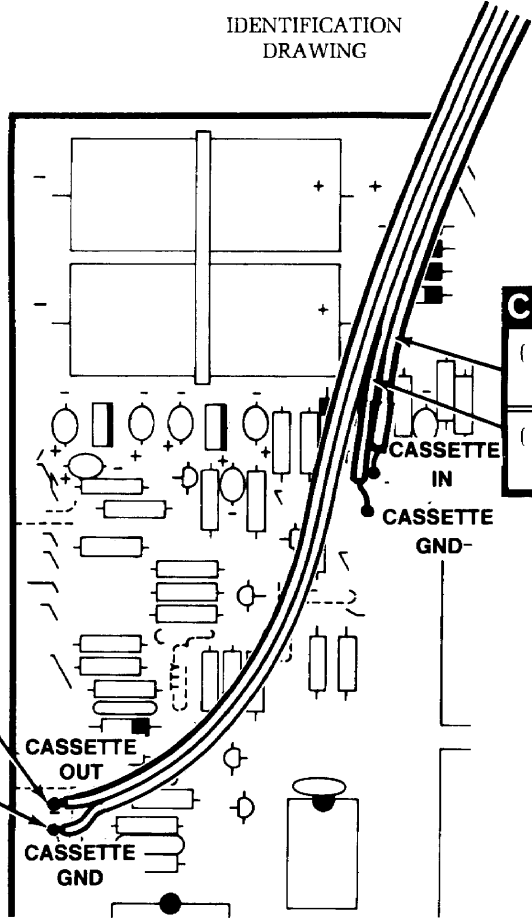
The steps performed in this Pictorial are in this area of the circuit board.



IDENTIFICATION DRAWING

**START** ↘

- ( ) Cut an 11" length of 8-wire flat cable.
  - ( ) Separate the brown through yellow 4-wire cable from the green through gray 4-wire cable. Set the green through gray cable aside.
  - ( ) Refer to Detail 1-14A (Illustration Booklet, Page 2) and prepare the ends of the brown through yellow cable.
- Connect the 1/4" ends of the prepared 4-wire cable to the circuit board in the following steps. Solder each wire as you connect it.
- ( ) Brown wire to hole CASSETTE OUT.
  - ( ) Red wire to hole CASSETTE GND.

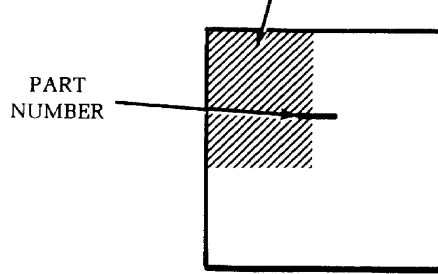


**CONTINUE** ↘

- ( ) Yellow wire to hole CASSETTE IN.
- ( ) Orange wire to hole CASSETTE GND.

PICTORIAL 1-14

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



IDENTIFICATION DRAWING

**START**

( ) Cut a 9' length of the green through gray 4-wire cable.

( ) Refer to Detail 1-15A (Illustration Booklet, Page 2) and prepare the ends of the green through gray cable.

Connect the 1/4" ends of the prepared 4-wire cable to the circuit board in the following steps.

( ) Gray wire to hole -TTY/RS-232 OUT.

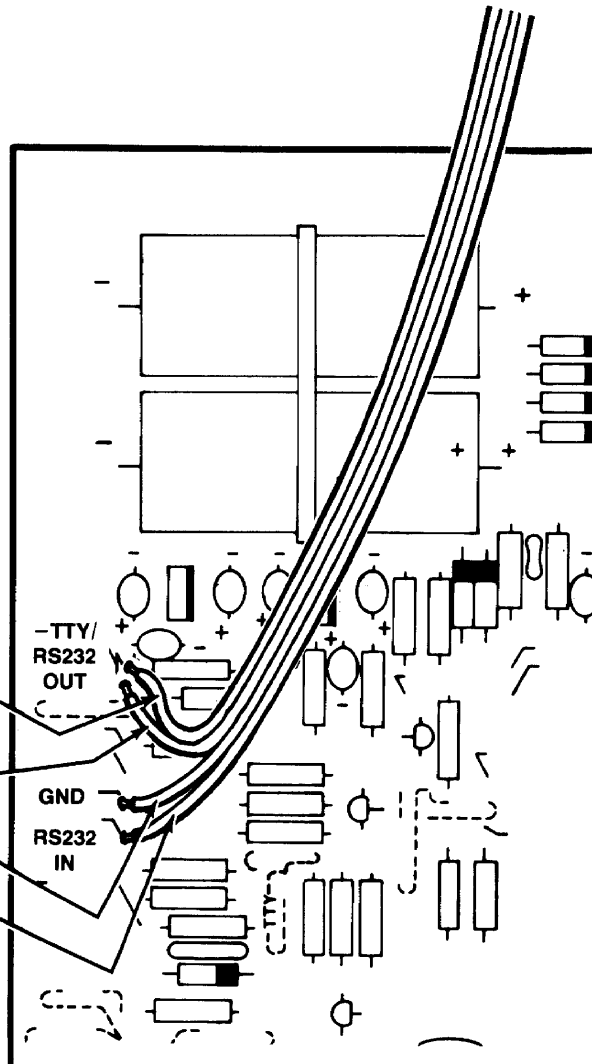
( ) Violet wire to hole -TTY/RS-232 OUT.

( ) Blue wire to hole GND.

( ) Green wire to hole RS-232 IN.

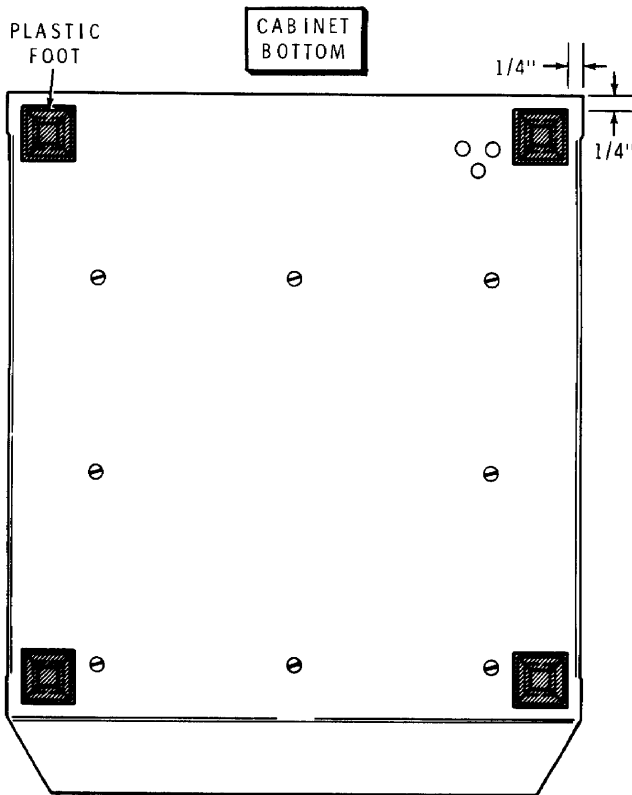
( ) Solder the wires to the circuit board foil and cut off the excess wire lengths.

Set the circuit board aside and proceed to "Cabinet Assembly and Wiring."



PICTORIAL 1-15

## CABINET ASSEMBLY AND WIRING



**PICTORIAL 2-1**

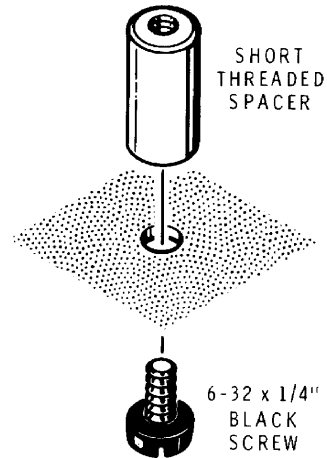
Refer to Pictorial 2-1 for the following steps.

- ( ) Turn the cabinet bottom upside down.
- ( ) Remove the paper backing from the four feet and press them in place on the cabinet bottom 1/4" from the four corners as shown.

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

- ( ) Position the cabinet bottom on your work area as shown.

**NOTE:** When the following steps call for hardware, use black screws **only** where specified.

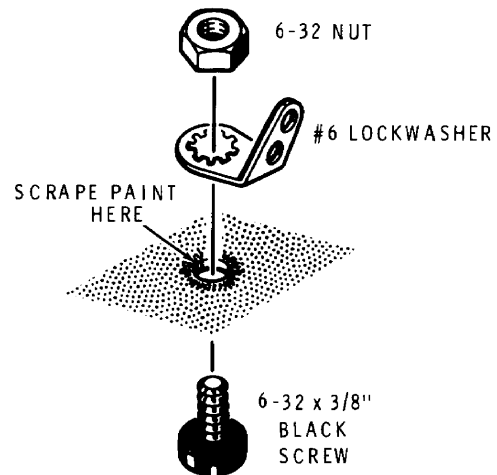


**Detail 2-2A**

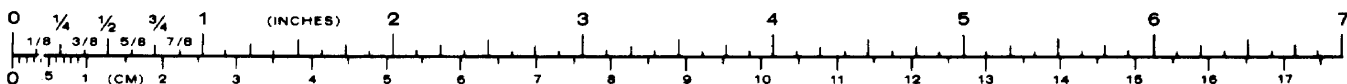
- ( ) Refer to Detail 2-2A and loosely mount a short threaded spacer at A using a 6-32 × 1/4" black screw.
- ( ) In the same manner, loosely mount seven short threaded spacers at B, C, D, E, F, G, and H.

Refer to Detail 2-2B for the next three steps.

- ( ) Scrape the paint from around holes J and K on the inside of the cabinet bottom.
- ( ) Mount a #6 solder lug at J using a 6-32 × 3/8" screw and a 6-32 nut. Be sure to position the solder lug as shown in the Pictorial.
- ( ) In the same manner, mount a #6 solder lug at K.



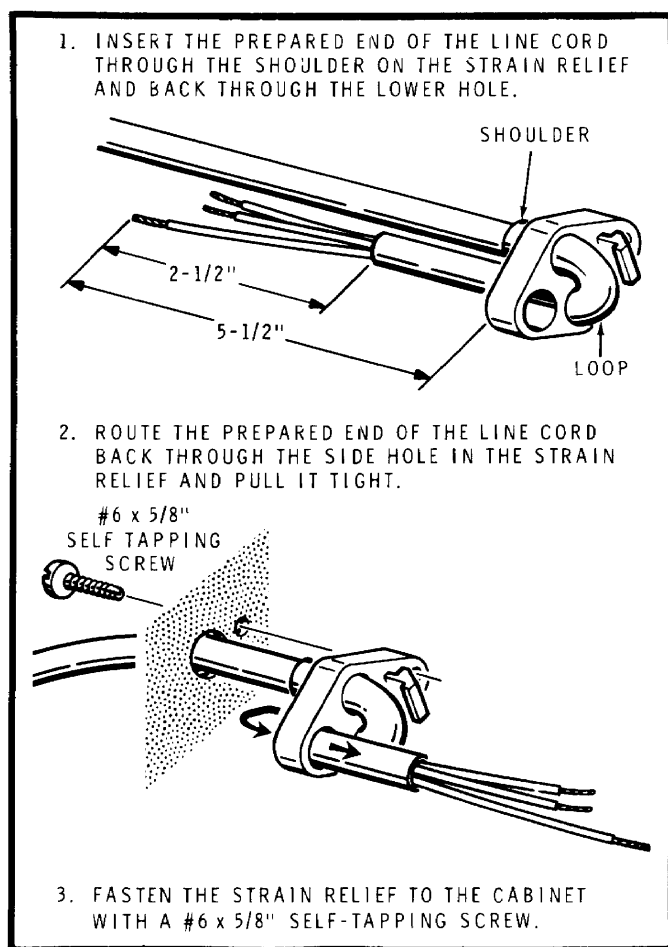
**Detail 2-2B**





NOTE: To prepare a wire, as in the following step, cut it to the indicated length and remove 1/4" of insulation from each end. If not already done, tightly twist each wire end and apply a small amount of solder to hold the fine strands together.

- ( ) If it has not already been done, cut back 2-1/2" of the outer insulation on the three-wire end of the line cord. Cut an additional 1" from the ends of the black and the green line cord wires. Prepare the wire ends.
- ( ) Pass the 3" end of the line cord through hole L; then refer to Detail 2-2C and attach the strain relief and line cord to the cabinet bottom.



**Detail 2-2C**

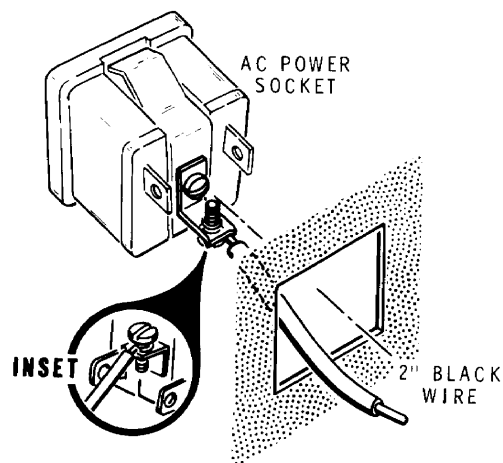
Refer to Pictorial 2-3 (Illustration Booklet, Page 3) for the following steps.

- ( ) Prepare a 2" large black wire.

- ( ) Remove an additional 1/4" of insulation (1/2" total) from one end of the 2" black wire.

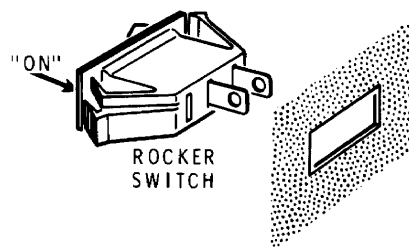
Refer to Detail 2-3A for the next two steps.

- ( ) Connect the 1/2" end of the 2" black wire to screw terminal 3 of the AC power socket M as shown in the inset drawing. Tighten the screw securely.
- ( ) Guide the 2" black wire and AC power socket into hole M. Be sure the screw terminal is facing down as shown; then push the socket until it snaps into place.



**Detail 2-3A**

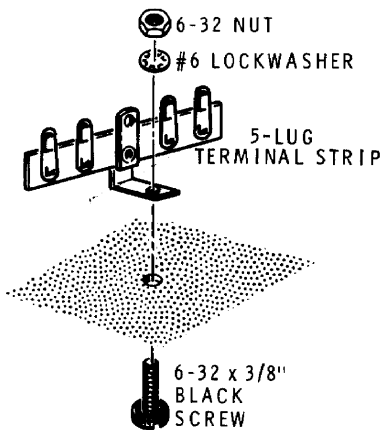
- ( ) SW1: Refer to Detail 2-3B and position the rocker switch so the ON lettering appears as shown. Guide the switch into hole SW1; then push the switch until it snaps into place.



**Detail 2-3B**

## NOTES:

1. In the following steps, (NS) means not to solder a connection because other wires or leads will be connected 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. After you solder a wire to lead, cut off any excess lengths.
  2. Make "mechanically secure" connections as shown in the inset drawing on Pictorial 2-3.
- ( ) Connect the end of the black wire coming from AC socket M terminal 3 to solder lug J (S-1). Be sure to make a mechanically secure connection.
- ( ) Connect the end of the green line cord lead to solder lug K. Make a mechanically secure connection (S-1).
- ( ) Refer to Detail 2-3C and mount a 5-lug terminal strip at TS1 using a 6-32  $\times$  3/8" screw, a 6-32 nut, and a #6 lockwasher. Be sure to position the terminal strip as shown in the Pictorial.



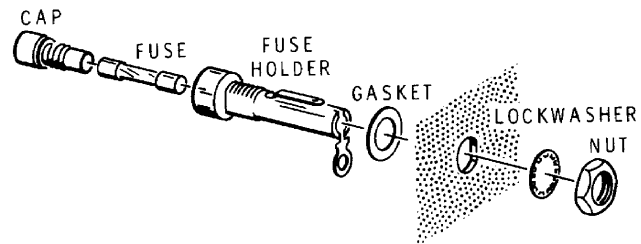
Detail 2-3C

Refer to Detail 2-3D for the following two steps.

- ( ) Mount the fuseholder at F1 using the hardware supplied in the fuseholder package. Be sure the end lug on the fuseholder is facing the bottom of the cabinet as shown.

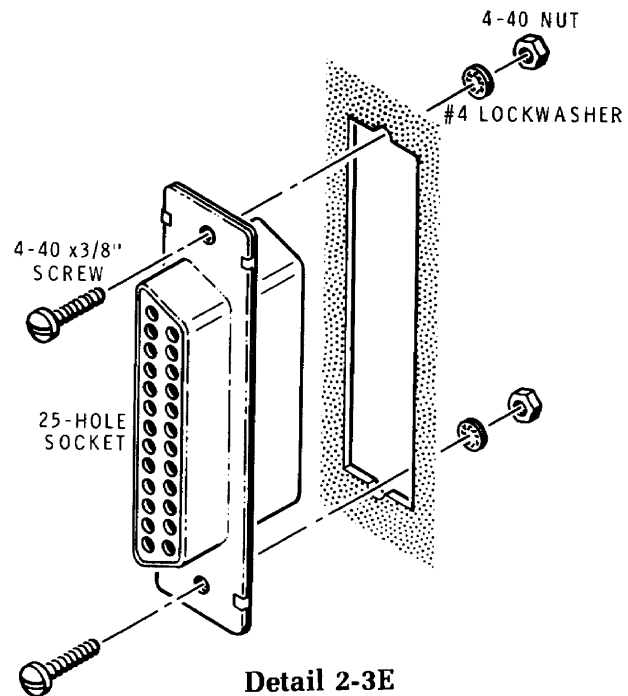
NOTE: A 3/8"-ampere slow-blow fuse was supplied with this kit for 120 VAC line voltage. If the line voltage in your area is 240 VAC, you must obtain a 3/16- ampere, 250 VAC slow-blow fuse.

- ( ) F1: Remove the fuseholder cap, and install the proper fuse in the fuseholder. Then replace the cap.

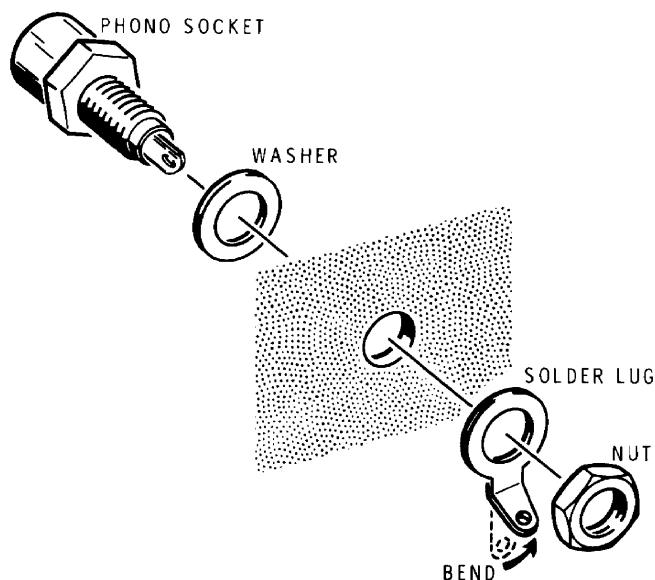


Detail 2-3D

- ( ) S102: Refer to Detail 2-3E and mount the 25-hole socket S102 using two 4-40  $\times$  3/8" screws, two #4 lockwashers, and two 4-40 nuts. Make sure the socket is positioned as shown.



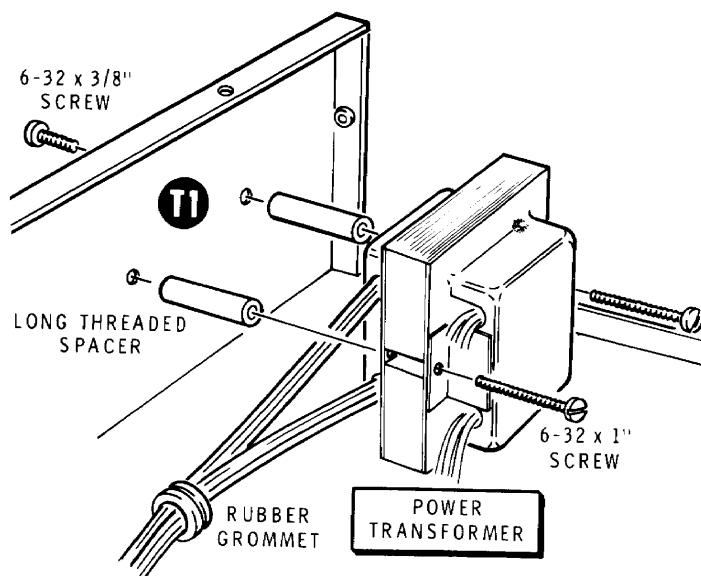
Detail 2-3E



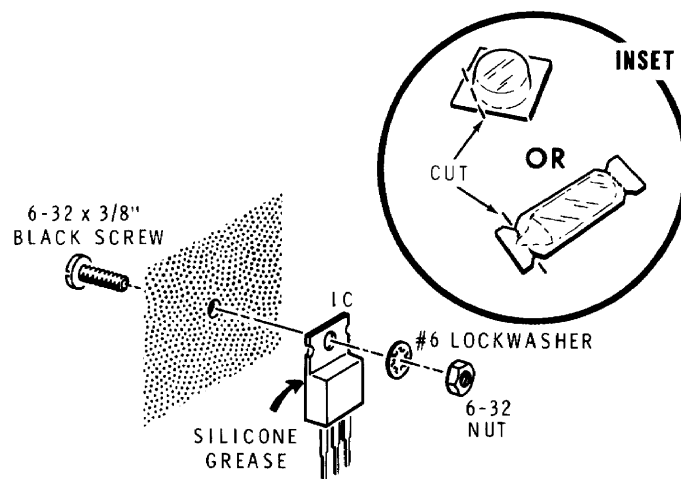
Detail 2-3F

Refer to Detail 2-3F for the following two steps.

- ( ) Mount a phono socket at P using the hardware supplied with the socket. Make sure the solder lug is positioned as shown in the Pictorial, then bend it up slightly as shown in the Detail.
- ( ) Mount a phono socket at R using the hardware supplied with the socket. Make sure the solder lug is positioned as shown in the Pictorial, then bend it up slightly as shown in the the Detail.



Detail 2-3H



Detail 2-3G

Refer to Detail 2-3G for the following two steps.

- ( ) Refer to the inset drawing and open the silicone grease pod. Apply a liberal amount of grease to the bare metal side of the  $\mu$ A7805 integrated circuit (#442-54).
- ( ) U110: Mount the integrated circuit at U110 using a 6-32  $\times$  3/8" screw, a #6 lockwasher, and a 6-32 nut. Face the bare metal side of the IC against the mounting surface. Be sure to position the IC as shown in the Pictorial.

Refer to Detail 2-3H for the following three steps.

- ( ) 1. Mount two long threaded spacers at T1 using two 6-32  $\times$  3/8" black screws.
- ( ) 2. Pass the following transformer leads through a rubber grommet as shown: black-green, black-red, black-yellow, and black.
- ( ) 3. T1: Mount the power transformer on the long threaded spacers at T1 using two 6-32  $\times$  1" screws. Be sure the transformer leads are positioned as shown.

Refer to Pictorial 2-4 (Illustration Booklet, Page 3) for the following steps.

- ( ) Prepare three 2-1/2" large black wires.

NOTE: In the following steps, be sure to make mechanically secure connections.

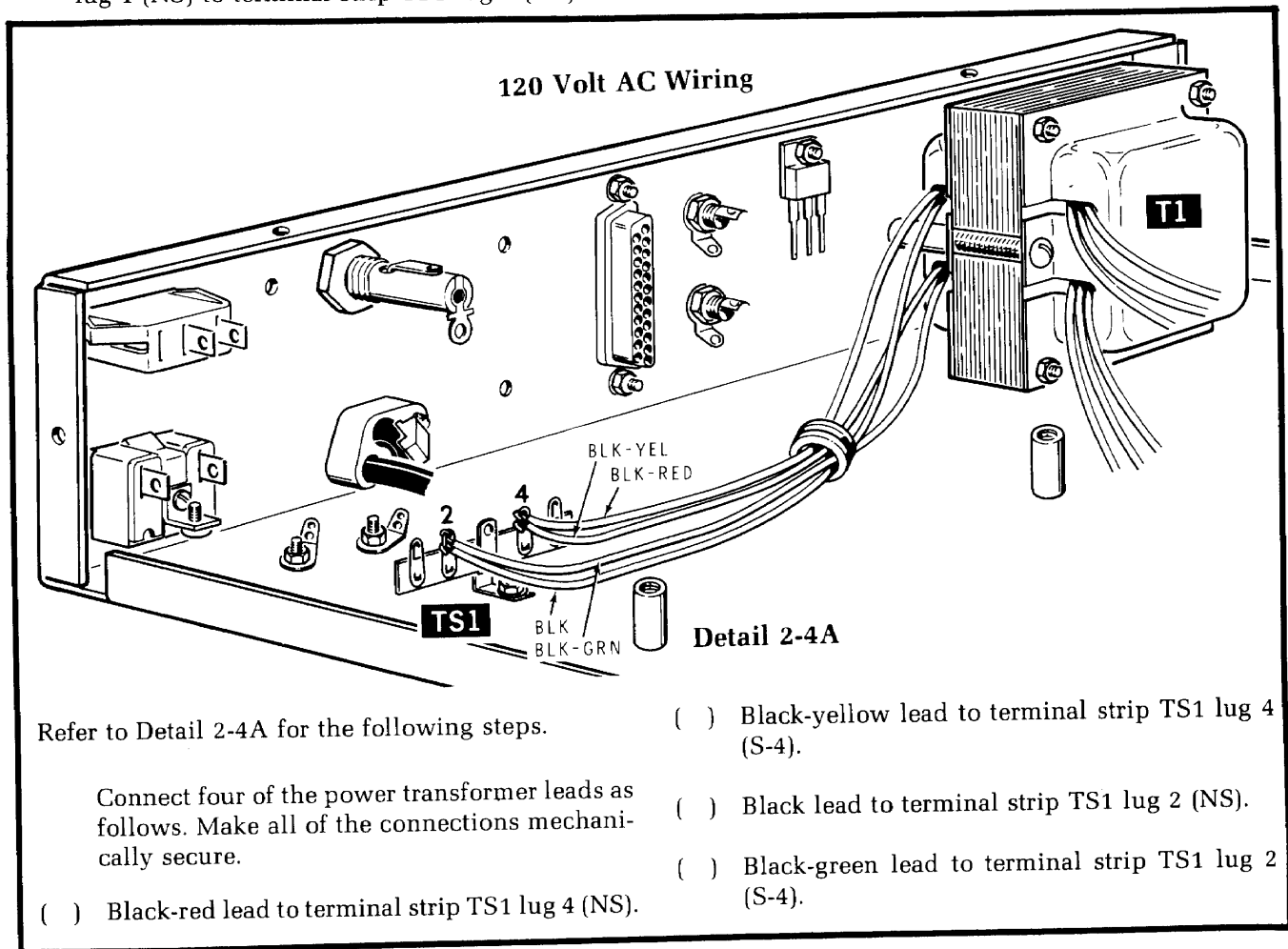
- ( ) Connect a 2-1/2" black wire from switch SW1 lug 2 (S-1) to fuseholder F1 lug 2 (S-1).

- ( ) Connect a 2-1/2" black wire from AC power socket M lug 2 (S-1) to the **eyelet** in terminal strip TS1 lug 2 (S-1).
- ( ) Connect a 2-1/2" black wire from socket M lug 1 to the **eyelet** in terminal strip TS1 lug 4 (S-1).
- ( ) Connect the black line cord wire to fuseholder F1 lug 1 (S-1).
- ( ) Connect the white line cord wire to terminal strip TS1 lug 1 (NS).
- ( ) Cut the leads of two .001  $\mu$ F ceramic capacitors (#21-71) to 1/2". Use these two capacitors in the next two steps.
- ( ) C3: Connect a .001  $\mu$ F ceramic capacitor between terminal strip TS1 lugs 2 (NS) and 3 (NS).
- ( ) C2: Connect a .001  $\mu$ F ceramic capacitor between terminal strip TS1 lugs 3 (S-2) and 4 (NS).
- ( ) C1: Cut the leads of a .047 Mylar capacitor to 1/2". Connect the capacitor from switch SW1 lug 1 (NS) to terminal strip TS1 lug 1 (NS).

- ( ) Cut the four leads of the toroid coil to 1-1/2".
- ( ) L1: Connect the toroid coil leads as follows:
  1. One black lead to switch SW1 lug 1 (S-2).
  2. The other black lead to terminal strip TS1 lug 4 (NS).
  3. One white lead to terminal strip TS1 lug 1 (S-3).
  4. The other white lead to terminal strip TS1 lug 2 (NS).

### ALTERNATE LINE VOLTAGE WIRING

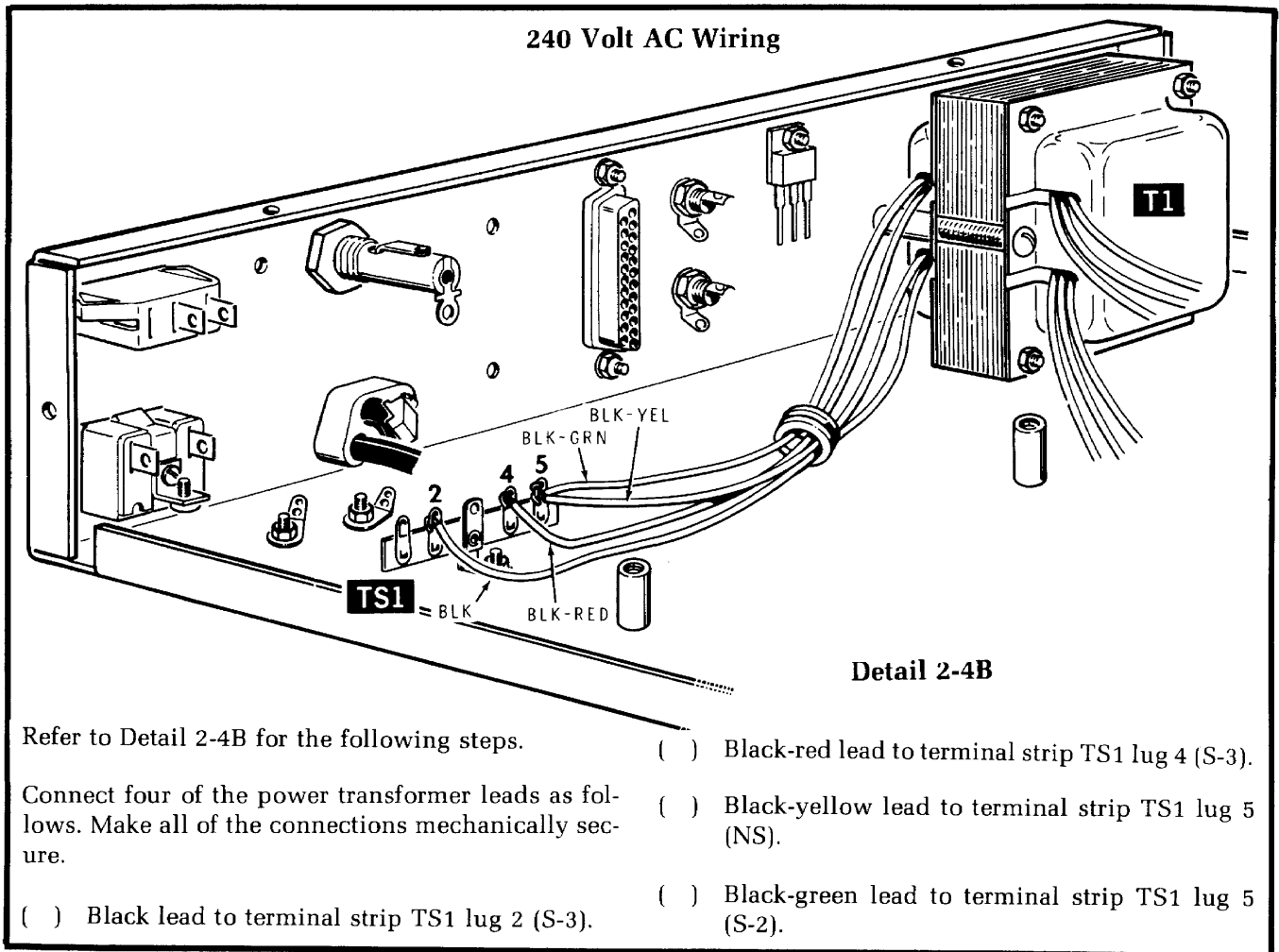
Two sets of line voltage wiring instructions follow, one for 120 VAC line voltage and the other for 240 VAC line voltage. In the United States 120 VAC is most often used, while in other countries 240 VAC is more common. USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.





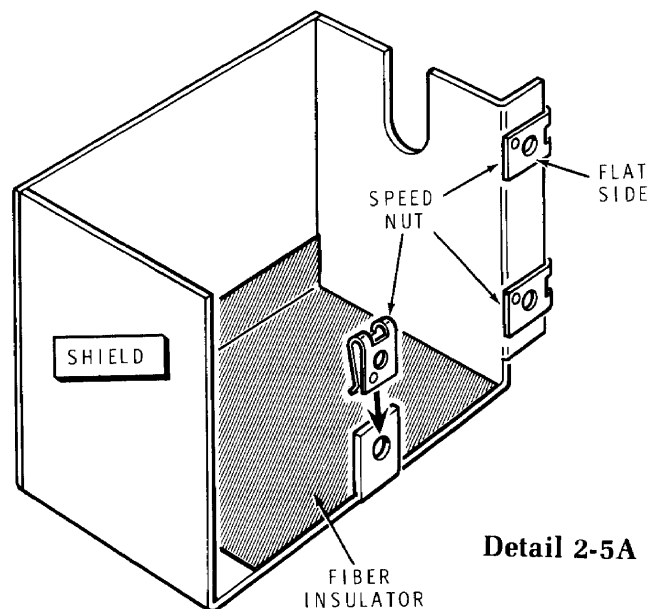


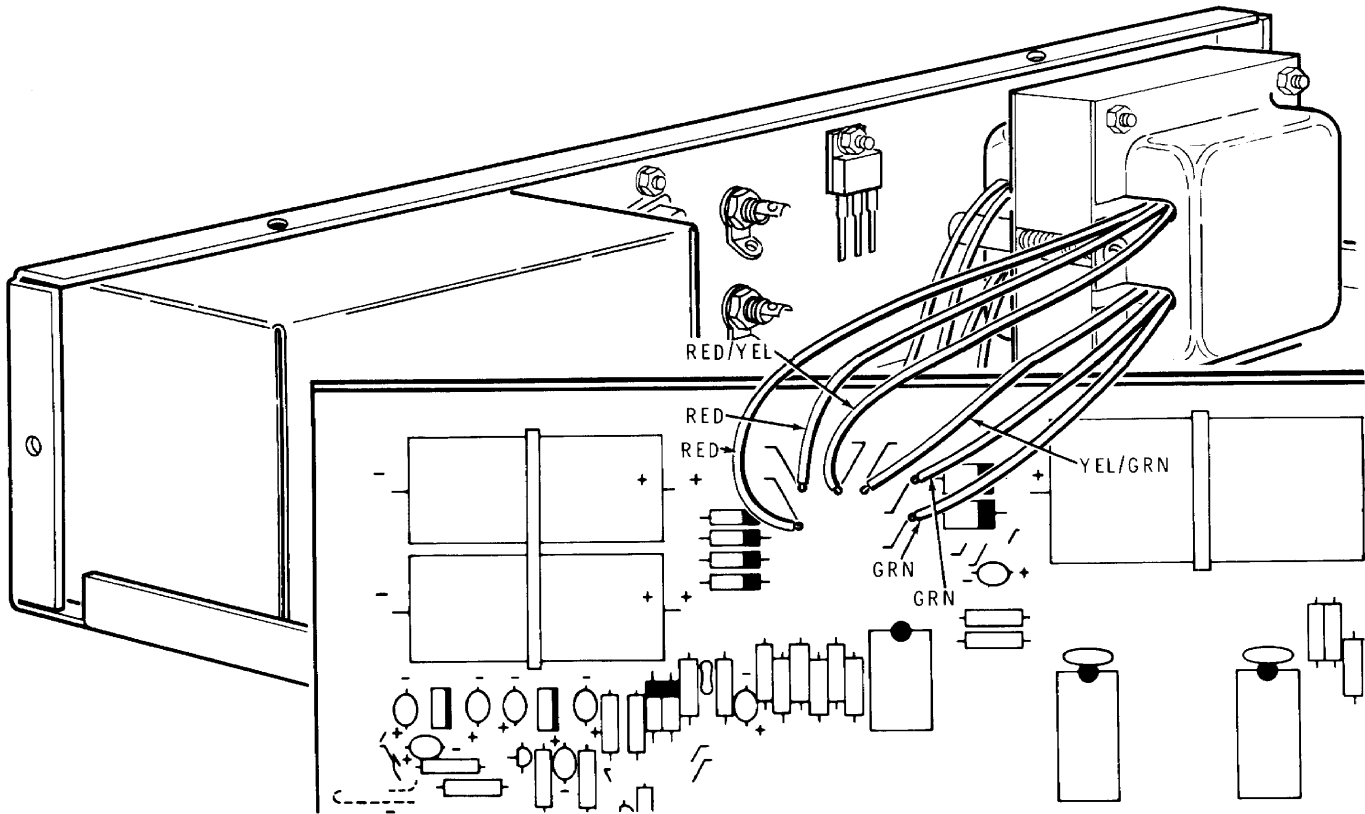
## 240 Volt AC Wiring



Refer to Pictorial 2-5 (Illustration Booklet, Page 3) for the following steps.

- ( ) Locate three Speed Nuts. Note that each Speed Nut is flat on one side. Push the Speed Nuts onto the shield with the flat sides as shown in Detail 2-5A.
- ( ) Before you remove the backing paper from the paper insulator, place it inside the shield as shown in Detail 2-5A and shape it to fit. Then remove the backing paper and stick the insulator down into place.
- ( ) Position the transformer leads and rubber grommet as shown in the Pictorial. Place the rubber grommet in the shield slot; then mount the shield to the cabinet using three 6-32 × 3/8" screws.





PICTORIAL 2-6

Refer to Pictorial 2-6 for the following steps.

**NOTE:** As you connect each of the remaining power transformer leads to the circuit board in the following steps, solder the lead to the foil and cut off the excess lead length.

- ( ) Position the circuit board, component side up, near the power transformer as shown in the Pictorial.

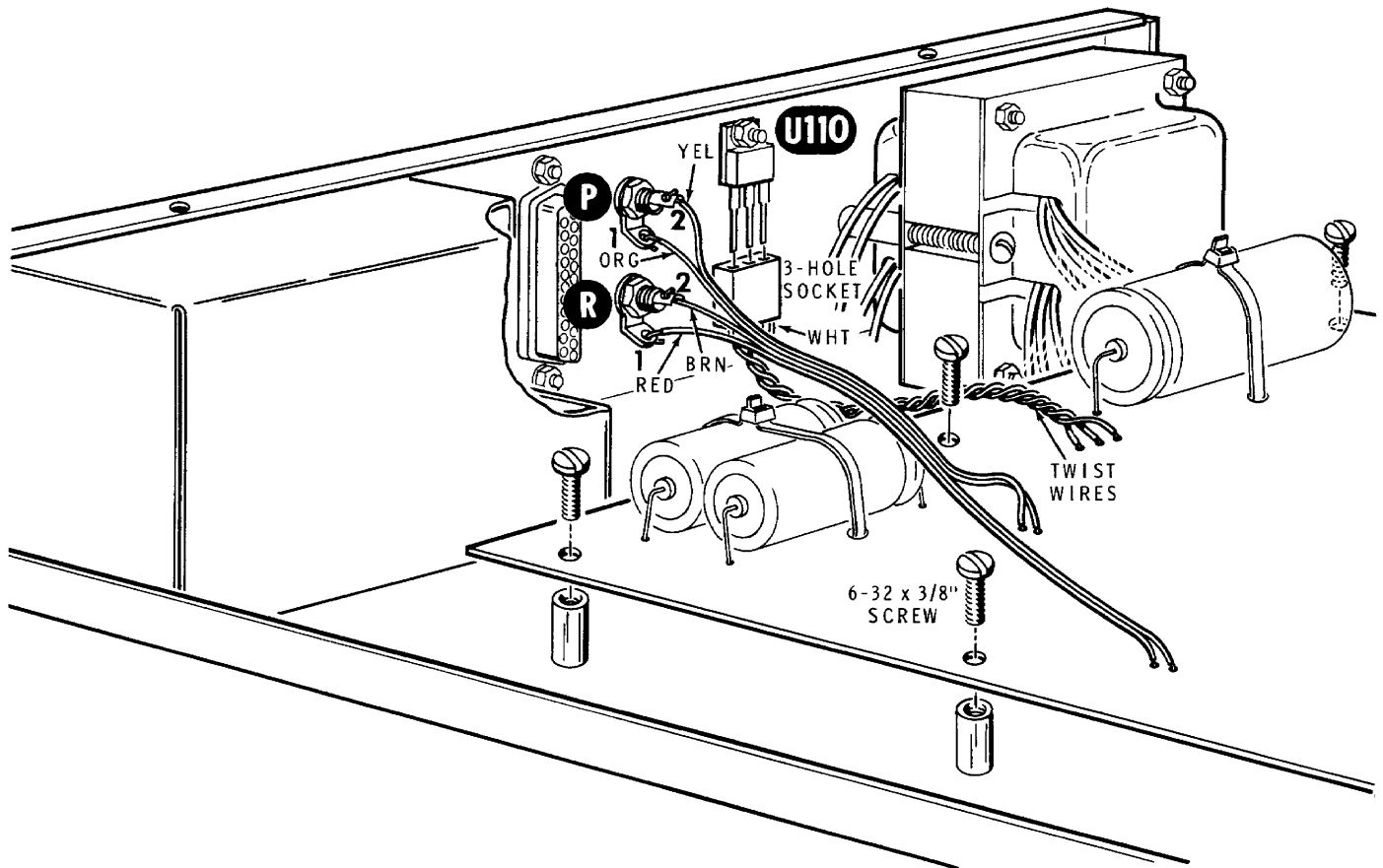
Connect six power transformer leads to the circuit board as follows:

- ( ) Yellow-green lead to the hole marked YEL/GRN.
- ( ) Red-yellow lead to the hole marked RED/YEL.
- ( ) Either red lead to either hole marked RED.
- ( ) Other red lead to remaining hole marked RED.
- ( ) Either green lead to either hole marked GRN.

- ( ) Other green lead to remaining hole marked GRN.

Carefully inspect the circuit board for the following conditions.

- ( ) Unsoldered connections.
- ( ) Poor solder connections.
- ( ) Solder bridges between foils.
- ( ) Protruding leads which could touch together.
- ( ) Transistors for the proper type and installation.
- ( ) Electrolytic and tantalum capacitors for the correct position of the plug (+) or color dot marked lead.
- ( ) Diodes for the correct position of the banded end.



PICTORIAL 2-7

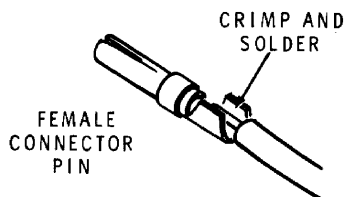
Refer to Pictorial 2-7 for the following steps.

- ( ) Position the circuit board mounting holes over the eight short threaded spacers on the cabinet bottom; then mount the circuit board to the spacers with 6-32  $\times$  3/8" screws.
- ( ) Now tighten the screws underneath the chassis that hold the spacers in place.
- ( ) Twist together the orange, black, and white wires of the 3-hole socket as shown; then push the connector onto the integrated circuit leads

at U110. Be sure the white wire on the 3-hole socket is closest to the power transformer.

Connect the free ends of the brown through yellow 4-wire cable coming from the circuit board as follows.

- ( ) Red wire to phono socket R lug 1 (S-1).
- ( ) Brown wire to phono socket R lug 2 (S-1).
- ( ) Orange wire to phono socket P lug 1 (S-1).
- ( ) Yellow wire to phono socket P lug 2 (S-1).

**Detail 2-8A**

Refer to Pictorial 2-8 (Illustration Booklet, Page 4) for the following steps.

- ( ) Refer to Detail 2-8A and solder a female connector pin (#432-1031) to each wire on the 4-wire and 6-wire cables.

**IMPORTANT:** In the following steps, you will install connector pins in the 25-hole socket. Make sure you install all pins in the correct holes. Once the pins are in place, they are very difficult to remove. Holes 1, 13, 14, and 25 are numbered on the back of the socket.

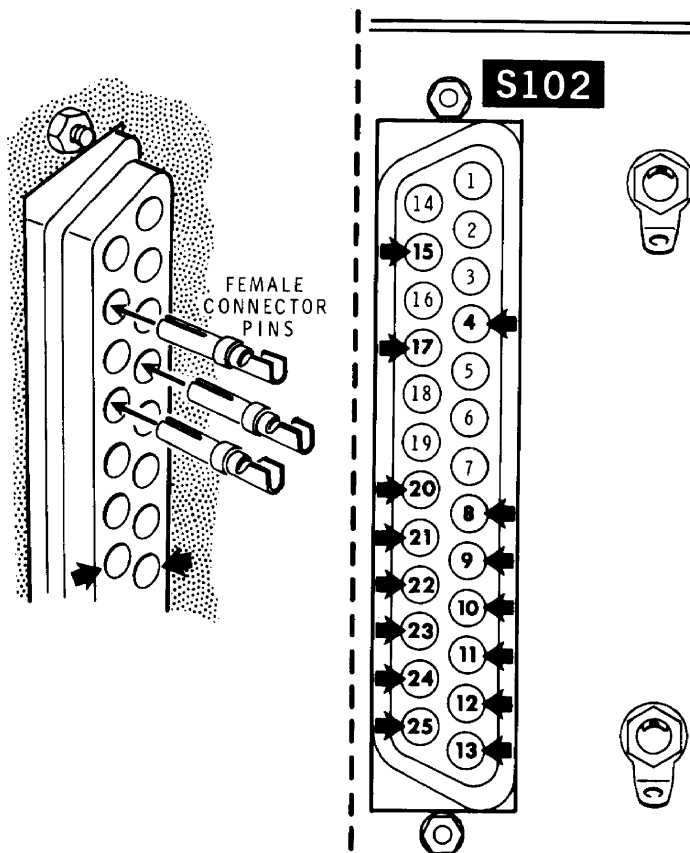
- ( ) Refer to Detail 2-8B and install the leftover female connector pins in S102 holes 4, 8 through 13, 15, 17, and 20 through 25. Push the pins in until they lock into place. **NOTE:** No wires will be connected to these pins; they will be used to help hold the plug and socket together.

Refer to Detail 2-8C for the following ten steps.

**NOTE:** Refer to the inset drawing of Detail 2-8B for the hole numbers of the connector. Each time you install a connector pin, gently pull on the wire to make sure the pin is locked in place.

Install the connector pins on the gray through orange 6-wire cable in socket S102 as follows:

- ( ) 1. Violet wire in hole 7.
- ( ) 2. Green wire in hole 19.
- ( ) 3. Yellow wire in hole 6.

**Detail 2-8B**



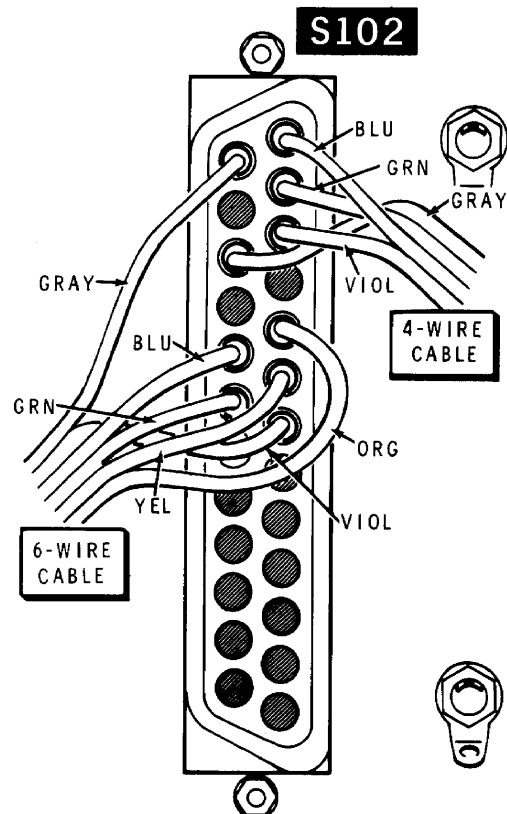
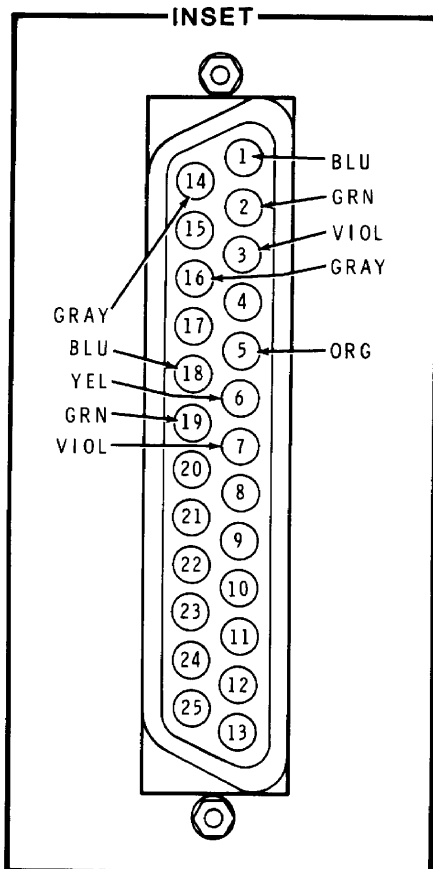
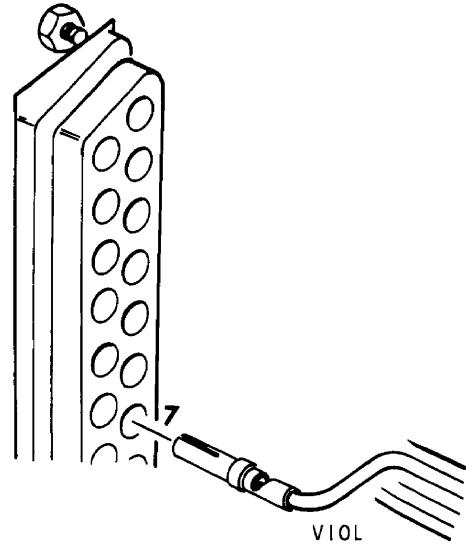
- ( ) 4. Blue wire in hole 18.
- ( ) 5. Orange wire in hole 5. NOTE: The gray wire will be installed later.

Install the connector pins on the gray through green 4-wire cable as follows:

- ( ) 6. Gray wire in hole 16. Make sure this is the gray wire on the 4-wire cable.
- ( ) 7. Violet wire in hole 3.
- ( ) 8. Green wire in hole 2.
- ( ) 9. Blue wire in hole 1.
- ( ) 10. Install the connector pin on the remaining gray wire (from the 6-wire cable) in hole 14.
- ( ) Position the cables and transformer leads as shown in the Pictorial.

- ( ) Refer to the inset drawing of the Pictorial and install three short cable ties on the cables at the locations shown.

This completes the "Step-by-Step Assembly" of your Memory I/O Accessory. Check it over carefully at this time to be sure there are no wire clippings or solder splashes lodged in the wiring, and that there are no loose wires or unsoldered connections. Then proceed to "Initial Tests". Save the foil shield for use with your ET/ETW-3400A Microprocessor Trainer Modification Kit.



Detail 2-8C

## INITIAL TESTS

**NOTE:** You will need a volt-ohmmeter to perform the following tests. If such a meter is not available, proceed to "ET-3400 Modifications".

### RESISTANCE MEASUREMENTS

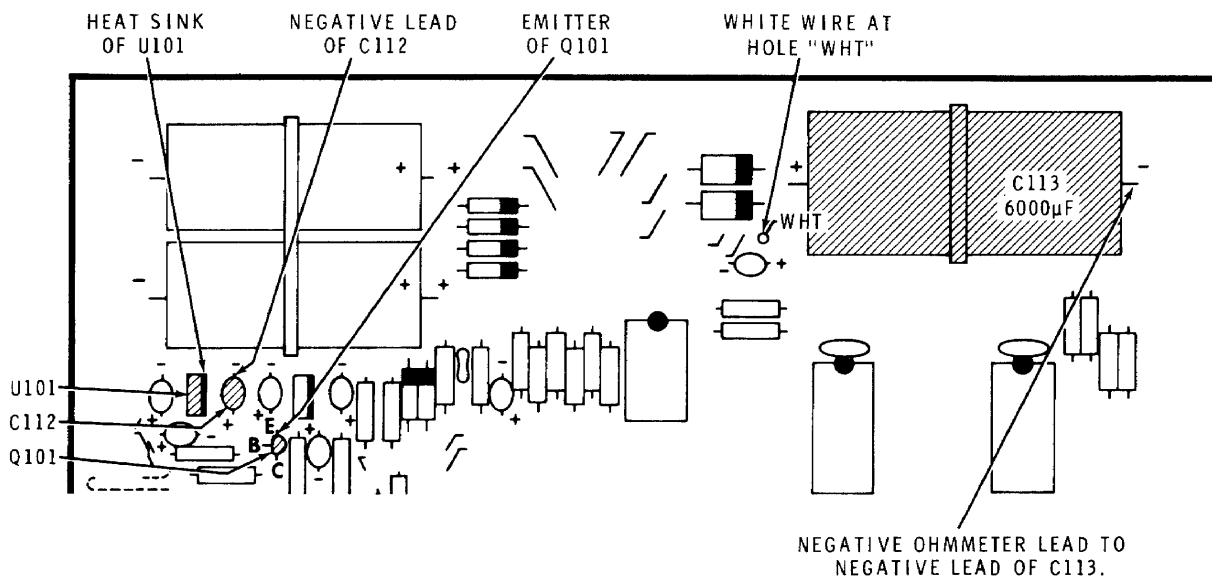
- ( ) Use an ohmmeter to measure the resistance between each flat plug prong and the round prong on the line cord. In both measurements, you should obtain an infinite indication. Be sure the test probe is not touching the chassis or any connection.

If you do not obtain infinite indications, recheck all wiring and make sure no fine wire strands at any connection are touching another connection.

Use an ohmmeter to make the following resistance measurements before you apply power to your Memory I/O Accessory. This will insure that the power supplies will not be damaged due to a wiring error or some incorrectly installed or faulty part. If you do not get the proper indication under "Approximate Meter Reading," check the wiring and installation of the parts listed in the "Possible Cause" column for that step. You may also refer to the "In Case of Difficulty" section of the Manual (Page 52). Be sure you obtain the correct resistance reading before proceeding.

Refer to Pictorial 3-1 for the following steps.

- ( ) Place the AC POWER switch in the OFF position.



PICTORIAL 3-1



- ( ) Connect the negative ohmmeter lead to the negative lead of the 6000  $\mu\text{F}$  capacitor (C113). Then touch the positive meter lead to the points indicated in the following chart.

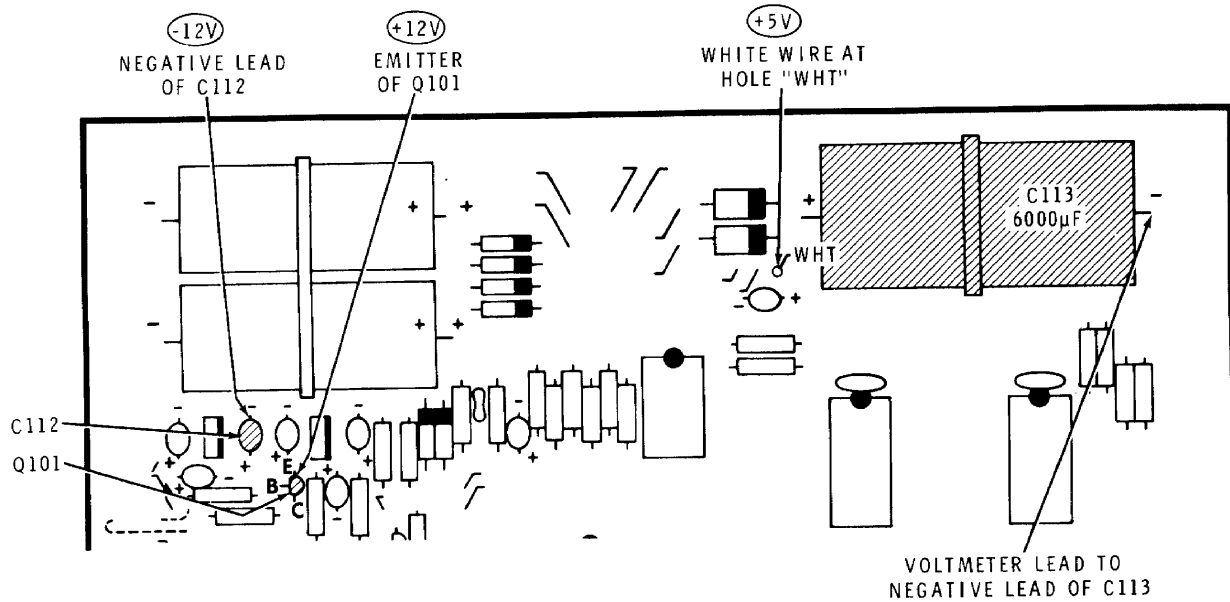
**NOTES:**

1. Not all ohmmeters are polarized the same. Therefore, if you do not get the correct meter reading the first time, connect the positive meter

lead to C113 and touch the negative meter lead to the point indicated in the chart. If this produces the correct indication, cross out the word "positive" in the heading of the first column and write in "negative."

2. The ohmmeter that was used to make the following measurements was powered by a 1.5-volt battery and set on the R $\times$ 100 range.

POSITIVE METER LEAD TO:	APPROXIMATE METER READING	POSSIBLE CAUSE
( ) White wire at hole WHT.	420 - 600 $\Omega$	<ol style="list-style-type: none"> <li>1. Solder bridge on circuit board.</li> <li>2. Capacitor C115, C116, C117, or C118.</li> <li>3. Wiring error on 3-hole socket at U110.</li> <li>4. Integrated circuit U110.</li> </ol>
( ) Heat sink of U101.	550 - 630 $\Omega$	<ol style="list-style-type: none"> <li>1. Solder bridge on circuit board.</li> <li>2. Diode D101, D102, D103, or D104.</li> <li>3. Integrated circuit U101.</li> </ol>
( ) Negative lead of C112 (2.2 $\mu\text{F}$ )	550 - 1200 $\Omega$	<ol style="list-style-type: none"> <li>1. Solder bridge on circuit board.</li> <li>2. Capacitor C106 or C112.</li> <li>3. Integrated circuit U101.</li> </ol>
( ) Emitter of Q101.	4000 - 8000 $\Omega$	<ol style="list-style-type: none"> <li>1. Solder bridge on circuit board.</li> <li>2. Capacitor C105 or C111.</li> <li>3. Integrated circuit U102.</li> <li>4. Transistor Q101 or Q102.</li> </ol>



PICTORIAL 3-2

**VOLTAGE MEASUREMENTS**

NOTE: If at any time during the following steps you fail to obtain the desired reading, immediately unplug the line cord from the AC outlet and refer to the "Possible Cause" chart which follows each step. You may also refer to the "In Case of Difficulty" section of the Manual (Page 48). Be sure you obtain the correct voltage reading before you proceed.

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

Refer to Pictorial 3-2 for the following steps.

- ( ) Set the voltmeter to measure +5 volts DC.
- ( ) Connect the negative lead of your voltmeter to the negative lead of capacitor C113.
- ( ) Hold the probe (positive lead) of your voltmeter to the white wire at +5 V and push the AC POWER switch to ON. The voltmeter should indicate approximately +5 volts (4.75 to 5.25 volts).

PROBLEM	POSSIBLE CAUSE
Meter does not indicate +5 volts.	<ol style="list-style-type: none"> <li>1. Solder bridge on circuit board.</li> <li>2. Wiring error on circuit board at diodes D105, D106.</li> <li>3. Wiring error on 3-hole socket at U110.</li> <li>4. Diodes D105, D106.</li> <li>5. Integrated Circuit U110.</li> </ol>





- ( ) Remove the voltmeter probe from the circuit board and reset the voltmeter to measure +12 volts DC.
- ( ) Hold the probe of your voltmeter to the emitter of Q101. The voltmeter should indicate approximately +12 volts (10.8 to 13.2 volts).

PROBLEM	POSSIBLE CAUSE
Meter does not indicate +12 volts.	<ol style="list-style-type: none"> <li>1. Solder bridge on circuit board.</li> <li>2. Wiring error on circuit board at diodes D101 through D104.</li> <li>3. Wiring error on circuit board at U102.</li> <li>4. Diodes D101 through D104.</li> <li>5. Integrated circuit U102.</li> <li>6. Capacitor C107.</li> </ol>

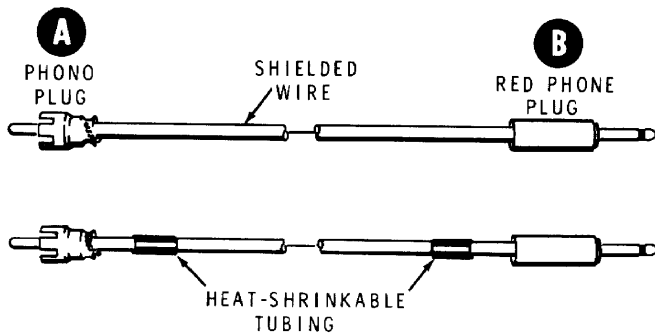
- ( ) Remove the voltmeter probe from the circuit, and disconnect the negative voltmeter lead from capacitor C113.
- ( ) Connect the probe (positive lead) of your voltmeter to the negative lead of capacitor C113.
- ( ) Hold the negative lead of your voltmeter to the negative lead of capacitor C112 at -12 volts. The voltmeter should indicate approximately 12 volts (10.8 to 13.2 volts).

PROBLEM	POSSIBLE CAUSE
Meter does not indicate -12 volts.	<ol style="list-style-type: none"> <li>1. Solder bridge on circuit board.</li> <li>2. Wiring error on circuit board at diodes D101 through D104.</li> <li>3. Wiring error on circuit board at U101.</li> <li>4. Diodes D101 through D104.</li> <li>5. Integrated circuit U101.</li> <li>6. Capacitor C109.</li> </ol>

- ( ) Push the AC POWER switch to the OFF position, disconnect the voltmeter leads, and unplug the line cord.

This completes the "Initial Tests" of your Memory I/O Accessory. Set the Memory I/O Accessory aside and proceed to the ET-3400 Trainer Modification Kit. Then return to "Final Assembly and Operational Tests" in this Manual.

## FINAL ASSEMBLY AND OPERATIONAL TESTS

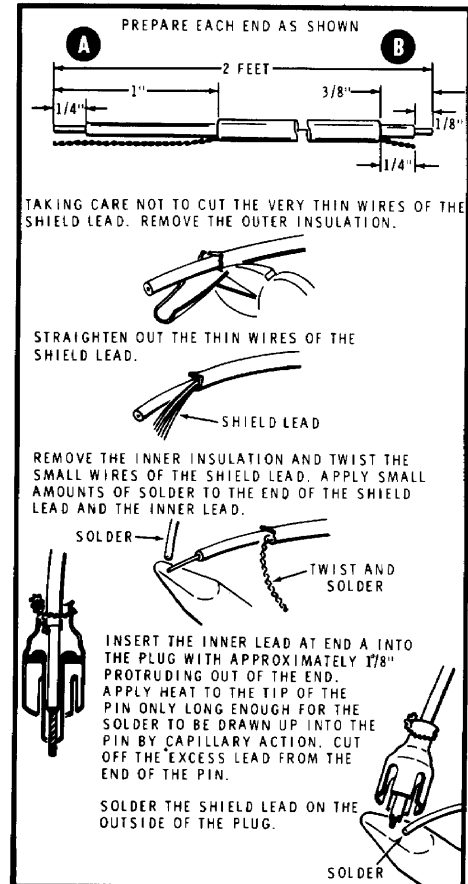


**PICTORIAL 5-1**

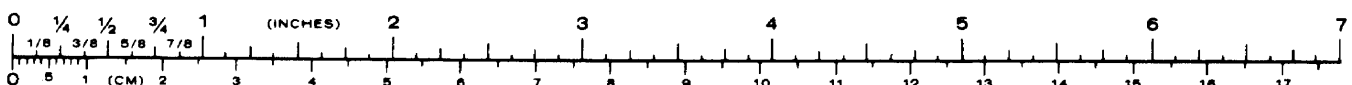
Refer to Pictorial 5-1 for the following steps.

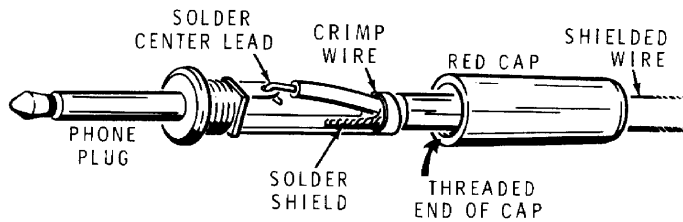
**NOTE:** In the following steps, you will be instructed to assemble two shielded wire cables. After you complete the first cable, repeat the steps for the second cable where double check spaces are provided. Some steps have only one check space. Perform these steps only once as instructed.

- ( ) ( ) Refer to Detail 5-1A and prepare a shielded wire and phono plug as shown.
- ( ) Cut two 1" pieces of heat-shrinkable tubing and slide them over end B on one shielded wire.
- ( ) ( ) Remove the red cap on one of the phone plugs and slide it over the shielded wire at end B with the threaded end as shown.



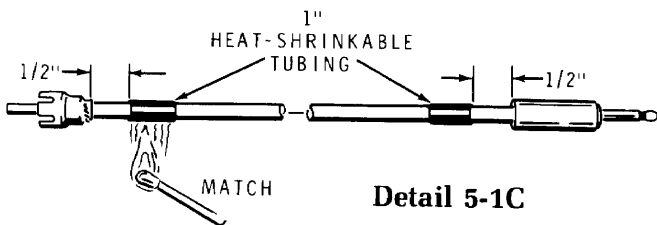
**Detail 5-1A**





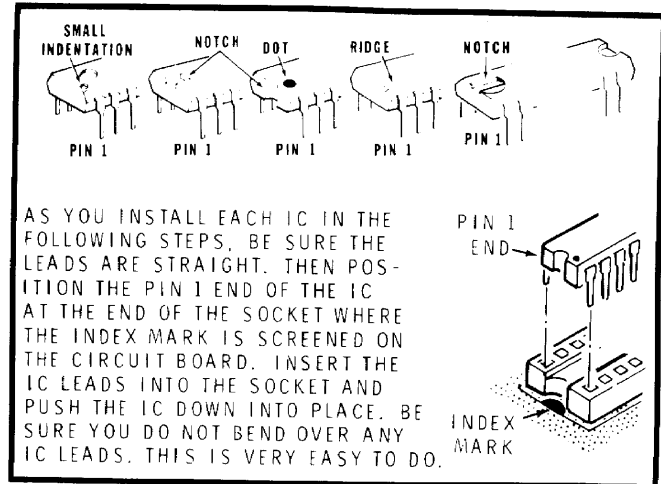
Detail 5-1B

- ( ) ( ) Refer to Detail 5-1B and solder the center lead of the shielded wire to the indicated lug of the phone plug. Solder the shield to the indicated location on the phone plug. After the connection cools, replace the red cap on the phone plug.



Detail 5-1C

- ( ) Refer to Detail 5-1C and position the previously installed 1" pieces of heat-shrinkable tubing approximately 1/2" from each plug on the shielded wire. Shrink the tubing in place with a lighter or a match.
- ( ) If an ohmmeter is available, make continuity checks of your cables.
- ( ) Temporarily set the two cables aside.



Detail 5-2A

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

NOTE: In the following steps, when you install an integrated circuit, refer to Detail 5-2A, remove the IC from its packing material (if necessary), and install the IC as shown.

- ( ) Connect one end of the 40-conductor cable to the Memory I/O Accessory.

NOTE: In the following steps, you will install the IC's and make tests to insure that your Memory I/O Accessory is working properly. Make sure you install all of the IC's in the exact sequence listed. If you do not get the indicated response at any time, refer to the "In Case of Difficulty" section in the "Operation Manual."



Refer to Pictorial 5-2 and install the IC's as follows:

- ( ) U104: 7404N (#443-18).
- ( ) U107: 7402N (#443-46).
- ( ) U108: 74S188N (#444-28).

NOTE: Some of the integrated circuits that you will install in the following steps are MOS devices that can be damaged by static electricity. Install each of these integrated circuits (identified as "MOS" in the step) without interruption as follows:

1. Remove the IC mounted in conductive foam from its envelope.
2. Hold the IC in one hand and pull the conductive foam pad from the pins. (Save this foam in case you ever remove the IC.)
3. Touch the circuit board while you hold the IC.
4. Carefully insert the IC in its socket before you release the the circuit board with your other hand. The IC is now protected by the circuit board socket and foil.

- ( ) U117: (MOS) 2114, 6614P, or S4045 (#443-764).
- ( ) U118: (MOS) 2114, 6614P, or S4045 (#443-764).
- ( ) Temporarily, place the Accessory cabinet top on the cabinet bottom, but do not install any screws. Then set the Microprocessor Trainer on top of the Accessory.
- ( ) Connect the other end of the 40-conductor cable to the Microprocessor Trainer. Make sure the cable is not twisted.
- ( ) Connect the phono plug with the heat-shrinkable tubing to the TAPE INPUT phono jack.
- ( ) Connect the remaining phono plug to the TAPE OUTPUT phono jack.

- ( ) Plug the Trainer line cord into the ETA-3400 Accessory AC socket. Then plug the Accessory line cord into a wall outlet.
- ( ) Set the POWER switch on both units to ON.
- ( ) Press the RESET button on the TRAINER. The display should indicate "CPU UP." This shows that the system has successfully communicated with the new RAM (U117 and U118).
- ( ) Unplug the line cord of the ETA-3400 Accessory from the wall outlet.
- ( ) U105, (MOS) terminal monitor ROM (#444-51).
- ( ) Plug in the Accessory line cord.
- ( ) Press the RESET button on the Trainer. Again, the display should be "CPU UP."

NOTE: In the following chart, you will examine the data at each address listed. These are the terminal monitor ROM locations. For each one, press the RESET button, then the EXAM button and the address number. The Trainer should display the address number in the first four digits, and the information under "Data" in the last two digits. The last column in the chart is supplementary information that tells you which address bits are being tested.

Address	Data	Address Bit(s) Tested
( ) 1400	0F	ALL
( ) 1401	CE	A1
( ) 1402	10	A2
( ) 1404	6F	A3
( ) 1408	86	A4
( ) 1410	C6	A5
( ) 1420	26	A6
( ) 1440	33	A7
( ) 1480	4C	A8
( ) 1500	27	A9
( ) 1600	26	A10
( ) 1800	4A	A11



- ( ) Unplug the Accessory line cord.
- ( ) U106: (MOS) "Tiny Basic" ROM (#444-24).
- ( ) Plug in the Accessory line cord.
- ( ) Press the Trainer RESET button; the display should read "CPU UP."
- ( ) Using the same procedure as before, examine the following Tiny Basic ROM locations.

Address	Data	Address Bit(s) Tested
1C00	7E	All
1C01	1D	A1
1C02	00	A2
1C04	1D	A3
1C08	E1	A4
1C10	15	A5
1C20	EE	A6
1C40	CE	A7
1C80	BD	A8
1D00	CE	A9
1E00	04	A10

- ( ) Unplug the Accessory line cord.
- ( ) U109: LM3302N, LM2901N, or  $\mu$ A775 (#442-616).
- ( ) U103: (MOS) MC6820 (#443-843).
- ( ) If your cassette recorder has a high level line input (AUX or LINE), make sure the jumper on the Accessory circuit board is connected to "500 mV." If your recorder has only a microphone input, make sure the jumper is at "50 mV." These jumpers establish the output record levels.
- ( ) If you are using a TTY or other 20 mA current loop terminal, make sure the circuit board jumpers are installed at "TTY." If you are using

the Heath H9 Video Terminal or other RS-232 terminal, make sure the jumpers are installed at "RS-232."

- ( ) Refer to the following table and make sure the jumpers on the accessory circuit board correspond to the baud rate you are using. NOTE: TTY will require 110 baud. 600 baud is recommended for the Heath H9 Video Terminal.

Baud Rate	Jumper(s) Required
110	No jumpers
300	J101, J102, J103
600	J102
1200	J101, J102
2400	J103
4800	J101, J103
9600	J102, J103

- ( ) Refer to "Operation" on Page 45 and connect your terminal to the "D" connector on the rear panel of the Accessory.
- ( ) Plug in the Accessory line cord.
- ( ) On the Trainer press the RESET button, then press the DO button, then "1AF6." The terminal should print "this is a terminal test," followed by a carriage return and line feed. This test will continue until the RESET button is pressed.
- ( ) Press the RESET button.
- ( ) Execute a memory test program, using the "DO" function to execute the diagnostic which begins at 1A34. An increment type diagnostic proceeds with the LWA (last work address) display in the leftmost four LED's and the current test pattern displayed in the right most two LED's. A pattern failure ceases the test and displays the failed address/pattern on the LED's.



The following test will determine if the cassette load and save feature works correctly.

- ( ) Attach the audio interface cables between the Accessory and your audio cassette recorder. Set the playback level and tone controls to center range.
- ( ) Using the "Auto" function on the Trainer, enter the following list of data into memory, starting at 0000.

Address	Data	Address	Data	Address	Data
0000	BD	0010	CE	0020	∅F
0001	FC	0011	2F	0021	26
0002	BC	0012	∅∅	0022	EA
0003	B6	0013	∅9	0023	2∅
0004	2∅	0014	26	0024	DA
0005	07	0015	FD		
0006	D6	0016	16		
0007	F1	0017	5D		
0008	CB	0018	26		
0009	1∅	0019	EC		
000A	D7	001A	86		
000B	F1	001B	∅1		
000C	48	001C	DE		
000D	BD	001D	F∅		
000E	FE	001E	8C		
000F	3A	001F	C1		

- ( ) Cassette save program: Press "DO," and "1A8F". The Trainer will display "- - -Fr," indicating a request for the starting save address.
- ( ) Enter 0000. The display will indicate "- - -La," which is a request for the save ending address.
- ( ) Place the recorder in the record mode and wait for the tape leader to pass the recorder head. Now enter 0024, and data will be transferred to the cassette tape.
- ( ) When the recording is complete, the Trainer will display "CPU UP." At that point, stop the recorder and rewind the tape.
- ( ) Unplug the Accessory line cord, then plug it back in. This will prevent the memory from retaining what was recorded.
- ( ) Cassette load program: Press "DO," and 1ABC". Put the recorder in the playback mode. As data is loaded into memory, the decimal point on the left display digit of the Trainer will flash. If the

load is successful, the Trainer will display "CPU UP". If a data error is encountered, the Trainer will display "Error". Repeat the cassette load program if you get an error.

- ( ) Push "DO" and 0000. The segments of each LED will sequence on and off beginning with the left LED. This will continue until you press RESET.

NOTE: If you have purchased the optional Memory Chip Set ETA-3400-1, refer to the instructions supplied with the set and install those IC's at this time. Then return to this Manual.

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

- ( ) Position the 40-conductor cable flat against the top surface of the cabinet bottom.
- ( ) Secure the cabinet top to the cabinet bottom with eight 6-32 × 1/4" screws.
- ( ) Locate the blue and white label and remove the protective paper backing. Then press the label onto the rear panel of your Memory I/O Accessory as shown. Refer to the numbers on this label in any correspondence you may have with the Heath Company concerning this kit.

Refer to Pictorial 5-4 (Illustration Booklet, Page 6) for the following steps.

NOTE: Disregard the following steps if you have not installed adhesive foam gaskets on the ET-3400 Trainer.

- ( ) Disconnect the 40-conductor cable connector from the ET-3400 Trainer.
- ( ) Turn the Trainer cabinet upside down and remove the protective paper backing from the four foam gaskets.
- ( ) Carefully position the Trainer as shown in the Pictorial. Be sure not to cover the top screws of the Memory I/O Accessory; then press the Trainer onto the cabinet top of the Memory I/O Accessory.
- ( ) Reconnect the 40-conductor cable connector to the Trainer.

This completes the "Final Assembly and Operational Tests." Proceed to "Operation."



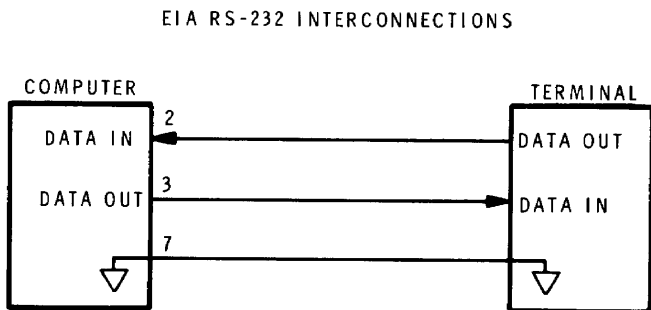
## OPERATION

### SERIAL I/O PORT

The signals that the serial I/O port uses to communicate with the terminal may be one of two types; EIA RS-232C compatible, or 20 mA active current loop. The type you select must match that used by your terminal. The RS-232 levels are normally used by CRT terminals and other high speed devices. The 20 mA loop is used with teletypes or whenever very long lines are used between units.

### RS-232 Levels

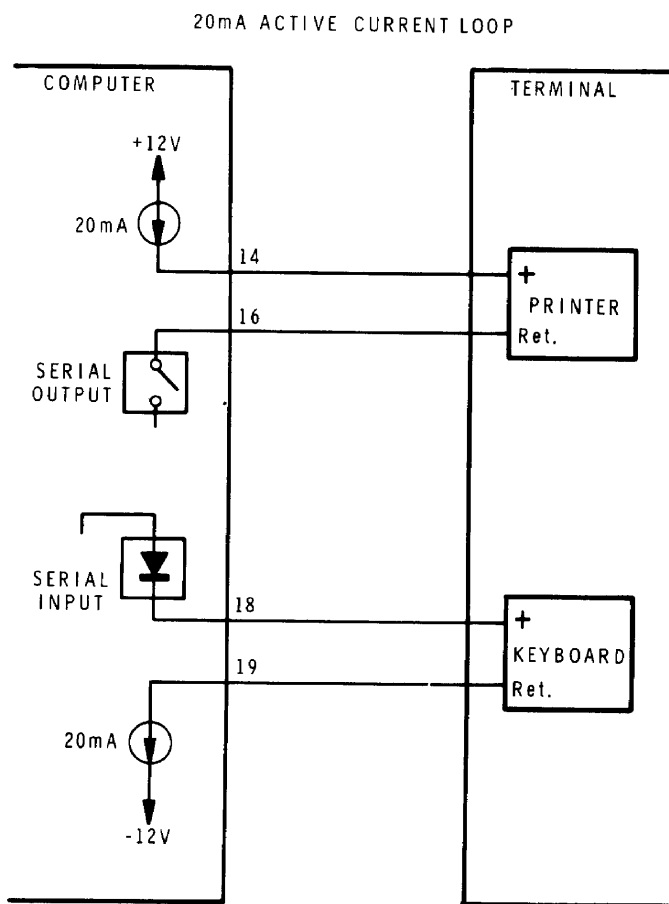
To use the RS-232 levels, you should have installed the four EIA jumpers and none of the TTY jumpers. (See page 17 of the "Step-by-Step Assembly.") A cable coming from the rear of the Computer connects to your terminal as shown below in Pictorial 5-5.



PICTORIAL 5-5

### 20 mA Active Current Loop

The 20 mA active current loop is used when the serial I/O interface is to supply the current for the loop. This is normally the mode used with a teletypewriter or other passive device. To use this mode, you should have installed circuit board jumpers at the three TTY locations and none at the EIA locations. A cable coming from the rear panel of your Computer connects as shown in Pictorial 5-6.



PICTORIAL 5-6

Proceed to the "Software Reference Manual".

## CIRCUIT DESCRIPTION

As you read this section, refer to the Block Diagram (Page 47), and the schematic (fold-in). The circuit description applies to the ETA-3400 microcomputer accessory.

### POWER SUPPLY

Switch SW1 applies power to the primary windings of power transformer T1. The secondary windings of T1 reduce the AC voltage to provide two separate AC supplies. Fuse F1 protects the unit against excessive current.

The AC voltage from one of the center-tapped secondary windings (green leads) is rectified by diodes D105 and D106 and filtered by capacitor C113. This filtered voltage is regulated by integrated circuit U110 and capacitors C114 and C115 to produce a stable +5-volt DC source.

The other center-tapped secondary winding (red leads) is rectified by diodes D101 and D102 and filtered by capacitor C107. This filtered voltage is regulated by integrated circuit U101 and capacitors C108 and C111 to produce a stable +12-volt DC source. Diodes D103 and D104 also rectify the voltage of the transformer secondary (red leads) to produce a negative voltage that is filtered by C109. This negative voltage is then regulated by U102 and capacitors C110 and C112 to produce a stable -12-volt DC source.

### ADDRESS DECODER

Integrated circuit U108 is a 32×8-bit ROM that is programmed to provide the seven outputs that select the various memory expansion functions (Tiny Basic, terminal monitor, and memory). An eighth output (D8, pin 9), "group decode," goes high when any of the expansion functions are addressed. This group decode signal is ANDed with R/W in U107B to produce a signal ( $\overline{RE}$ ) that indicates that a memory read is

requested from the memory expansion area. When this occurs, the data bus buffer in the ET-3400 must be pointed toward the CPU. The  $\overline{RE}$  signal performs this function.

### MEMORY FUNCTIONS

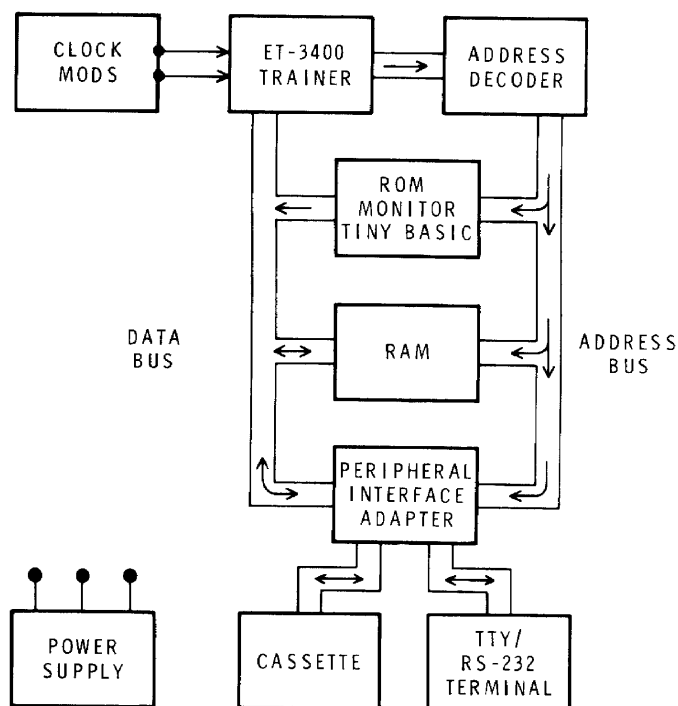
The individual decoder lines from U108 select either of the two ROM's or one of the 1K RAM's. When one of the ROM's is selected, its particular  $\overline{CS}$  line goes low, the address location appears on address bus lines A0 through A15, and data is put on the bus (D0 through D7) and routed to the CPU.

The 4K expansion RAM is made up of eight 1K×4-bit memory IC's. These 1K×4-bit memories are grouped in pairs to form the four 1K×8-bit memory blocks. A RAM read cycle is the same as the ROM read cycle explained above. When a RAM write cycle occurs, the appropriate  $\overline{CS}$  line goes low, the proper address appears on the address bus, the data is presented on the data bus by the CPU, and the R/W line is pulsed low to latch the data into the RAM location.

### DATA I/O

Integrated circuit U103, a PIA (peripheral interface adapter), is used for I/O functions and baud rate selection. This device has two (port A and port B) 8-bit bidirectional data buses and four control lines. Each of the data lines can be programmed to act as an input or output. Bit 0 of port A (pin 2) is the serial output for a terminal. Bit 7 of port A is the serial input from a terminal. Bits 1, 2, and 3 are jumpers that let you select the desired baud rate. Software routines read the state of these bits and structure the serial I/O (bits 0 - 7) of port A accordingly. Port B of the PIA is the cassette I/O. Bit 0 is a FSK (frequency shift keying) output that is an FSK representation of the cassette dump data. The frequencies are "Kansas City Standards" (1200/2400 Hz). Bit 7 is the input for the cassette load data.





BLOCK DIAGRAM

### CASSETTE INPUT

Resistor R101 presents a load to the recorder output. R102, D107, and D108 limit the amplitude of the cassette output to approximately  $\pm 0.6$  volts. R109, R105, and C102 bias the input to comparator U109 to 2.5 volts. Resistors R106 and R107 form a positive feedback that provides 150 mV hysteresis to reduce noise susceptibility. The square wave output of U109 is coupled to port B, bit 7 (pin 17) of the PIA (U103).

### CASSETTE OUTPUT

Square wave FSK cassette data generated by software is output from port B, bit 0 (pin 10) of the PIA. This output is filtered by the low pass filter made up of R112 and C103. Resistors R110 and R111 form a voltage divider that allows the data to be output to the recorder at a microphone input level (50 mV) or at a higher level input (500 mV) to an auxiliary input.

### TERMINAL INPUT

The terminal input circuit can be configured for an RS232 or a 20 mA current loop signal. The 20 mA current loop is active and it is not isolated.

When the circuit is configured for the 20 mA current loop, resistors R113 and R114 provide an active 20 mA current source. When the 20 mA input line switches, transistor Q104 produces an inverted signal. This signal is again inverted by Q105 before it is applied to port A, bit 7 of U103.

When the circuit is configured for an RS232 input, transistor Q104 inverts the RS232 voltage swings and generated TTL levels that are acceptable to the PIA input.

### TERMINAL OUTPUT

The terminal output circuit can also be configured for an RS232 or a 20 mA current loop output. The current loop is active and it is not isolated.

When the circuit is configured for the 20 mA current loop, software generated serial data is outputted from port A, bit 0 of the PIA. This serial data is inverted by Q102 and coupled to output driver Q101. Output current is limited to 20 mA by R129 and R121.

When the circuit is wired for RS232 operation, the software generated serial data is inverted by Q103 and again by Q102. It is then coupled to output drive Q101. Resistor R129 is the pull-down load resistor.

## IN CASE OF DIFFICULTY

**WARNING: Dangerous AC voltage is present inside the cabinet (where the fuse is located) when the line cord is plugged in. See Pictorial 6-2.**

This section of the Manual is divided into three parts: "Visual Checks," "Troubleshooting Chart," and "Detailed Troubleshooting." Use the "Visual Checks" first to find a difficulty that shows up right after your kit is assembled. You can also use the other two sections right after your kit is assembled, or at some future time — if your Accessory ever stops working.

If the trouble is still not located after you complete the "Visual Checks," check voltage readings against those shown in the "Schematic." NOTE: All voltage readings were taken with a high impedance voltmeter (10 M $\Omega$  or greater).

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

### 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 consistently overlook.

2. About 90 percent 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.

**CAUTION:** Before you solder or reheat any connections, remove the following integrated circuits. Refer back to "Final Assembly and Operational Tests" for replacement and proper handling of these IC's.

U103 (#443-843)

U105 (#444-51)

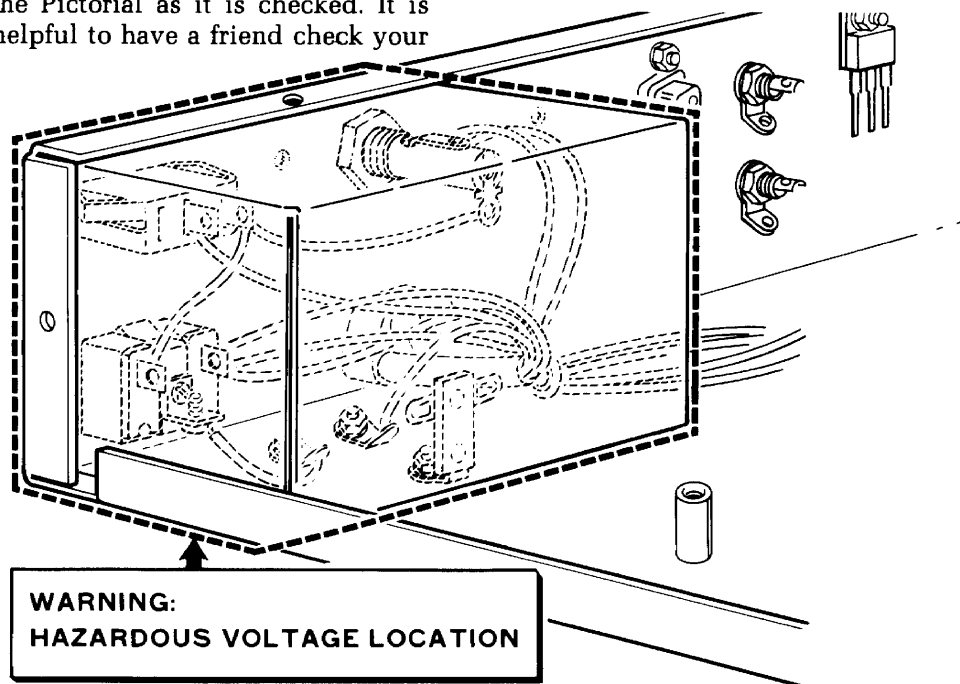
U106 (#444-24)

U108 (#444-28)

U117 (#443-764)

U118 (#443-764)

3. Check to be sure that all the integrated circuits are in their proper location and that each IC pin is properly installed in its connector, and not bent or under the IC.



PICTORIAL 6-2



4. 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 470  $\Omega$  (yellow-violet-brown) resistor where a 4700  $\Omega$  (yellow-violet-red) resistor should have been installed.
  5. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.
2. Be sure you do not short any terminals to ground when making voltage measurements. If the probe slips, for example, and shorts out a bias or supply point, it is very likely to damage one or more IC or diodes.
  3. Do not remove an IC while the line cord is plugged in.

### Substitution

Corresponding display components can be interchanged; U111 through U118 can be interchanged, for example. If a random-access memory location consistently shows incorrect data you can interchange the memory IC with one of the others. If the problem moves to the new location the memory IC is probably bad. If the problem remains at the same location check the associated circuitry for a solder bridge or broken foil. If you cannot see anything physically wrong then you can suspect the memory decoder chip, U108.

### Precautions

1. Be cautious when you test IC's. Although they have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage or current than some other components.

## Troubleshooting Chart

### NOTES:

1. The following chart lists parts to check. These parts indicate areas of the circuits where problems could exist. Check the circuitry and look for an assembly error or **solder bridge**. Parts are rugged and reliable. Consider a part to be bad last.
2. If you make a repair, make sure you eliminate the cause as well as the effect of the trouble. If, for example, you find a damaged part, be sure you find out what damaged the part. If the cause is not eliminated, the replacement part may also become damaged when you put the unit back into operation.
3. In several areas of the circuit boards, the foil patterns are quite narrow. When you unsolder a part to check or replace it, avoid excessive heat while you remove the part. A suction-type desoldering tool makes part removal easier.

## TROUBLESHOOTING CHART

DIFFICULTY	POSSIBLE CAUSE
Failure to get CPU UP.	<ol style="list-style-type: none"> <li>1. ET-3400 Trainer not functioning. Disconnect ETA-3400 Accessory. Reinstall IC14 and IC15 (443-721) and test Trainer operation.</li> <li>2. Check connector cable.</li> <li>3. Accessory not functioning.</li> </ol>
No +5V, 12V and -12 supplies.	<ol style="list-style-type: none"> <li>1. Fuse F1.</li> <li>2. Transformer T1 primary.</li> <li>3. Line cord wiring.</li> </ol>
No +5V supply.	<ol style="list-style-type: none"> <li>1. Short circuit on 5V line.</li> <li>2. Transformer T1 secondary (green and green-yellow leads).</li> <li>3. Rectifier diodes (57-42).</li> <li>4. Regulator U110.</li> </ol>
No $\pm 12$ V supply.	<ol style="list-style-type: none"> <li>1. Short circuit on <math>\pm 12</math> V line.</li> <li>2. Transformer T1 secondary (red and red-yellow leads).</li> <li>3. Bridge rectifier. (D101, D102, D103, D104).</li> <li>4. Regulators U101 and U102.</li> </ol>
Memory Test Failure.	<ol style="list-style-type: none"> <li>1. U111, U112, U113, U114, U115, U116, U117, U118 RAM.</li> </ol>
Failure to get TINY BASIC or Monitor. (: or MON>)	<ol style="list-style-type: none"> <li>1. Wrong baud rate.</li> <li>2. Fantom II Monitor ROM (U105).</li> <li>3. TINY BASIC ROM (U106).</li> <li>4. Address Decoder (U107 and U108).</li> <li>5. Peripheral interface adapters (U103).</li> <li>6. TTY/RS232 I/O circuitry.</li> <li>7. Video terminal incorrectly wired or not operating.</li> </ol>
Cassette I/O.	<ol style="list-style-type: none"> <li>1. Check cassette operation. (Wiring, playback level, tape).</li> <li>2. U109, D107, D108.</li> <li>3. Cassette I/O circuitry.</li> <li>4. Address Decoder (U107 and U108).</li> <li>5. Peripheral interface adapter (U103).</li> <li>6. TINY BASIC and/or Fantom II ROM.</li> </ol>



## SPECIFICATIONS

Clock .....	1MHz crystal controlled.
Terminal MONITOR in ROM .....	2k × 8 NMOS.
TINY BASIC in ROM .....	2k × 8 NMOS.
Serial I/O .....	110, 300, 600, 1200, 4800, 9600 baud. RS232 and 20 mA active current loop.
Audio Cassette Storage .....	300 to 2400 baud (programmable).
RAM .....	1 k × 8 RAM expandable to 4 k in 1 k increments with optional Chip Set (ETA-3400-1).
ET-3400 Interface .....	Buffered data address and control buses connected by 40-pin ribbon cable.
Local Power Supply .....	+12 volts and -12 volts @ 50 mA. +5 volts @ 1 ampere.
Power Requirements .....	105-130 volts, 50-60 Hz, 11 watts. 210-260 volts, 50-60 Hz, 11 watts.
Weight .....	6 lbs (3.36 kg).
Dimensions .....	11-1/4" wide × 13" deep × 3-1/2" high. 28.58 cm × 33.02 cm × 8.89 cm.



## SEMICONDUCTOR IDENTIFICATION CHARTS

This section is divided into three parts: Component Number Index, Part Number Index, and ROM and PLA Programs. The first section provides a cross-reference between semiconductor component numbers and their respective Part Numbers. The component numbers are listed in numerical order. The sec-

ond section provides a lead configuration detail (basing diagram) for each semiconductor Part Number. The Part Numbers in the second section are also listed in numerical order. The third section provides a program for the specially "programmed" integrated circuit decoder.

### Component Number Index

This index shows the Part number of each semiconductor in the Terminal.

#### DIODES

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER
D101-D104	57-65
D105-D106	57-42
D107-D109	56-56

#### TRANSISTORS

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER
Q101	417-874
Q102-Q105	417-875

#### INTEGRATED CIRCUITS

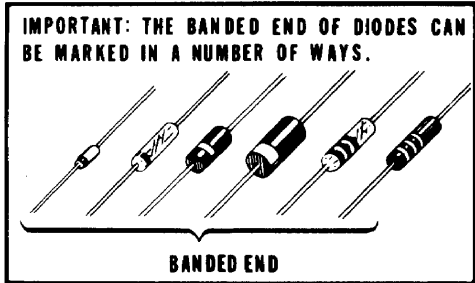
CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER
U101	442-664
U102	442-663
U103	443-843
U104	443-18
U105	444-51
U106	444-24
U107	443-46
U108	444-28
U109	442-616
U110	442-54
U117-U118	443-764



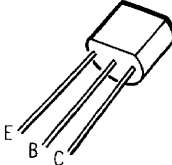
## Part Number Index

This index shows a lead configuration detail (basing diagram) of each semiconductor Part Number.

### DIODES

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
D105, D106	57-42	3A1	<p>IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.</p> 
D101, D102, D103 D104	57-65	1N4002	
D107, D108, D109	56-56	1N4149	

### TRANSISTORS

HEATH PART NUMBER	MAY BE REPLACED WITH	TRANSISTOR BASING DIAGRAM
417-874 417-875	2N3906 2N3904	

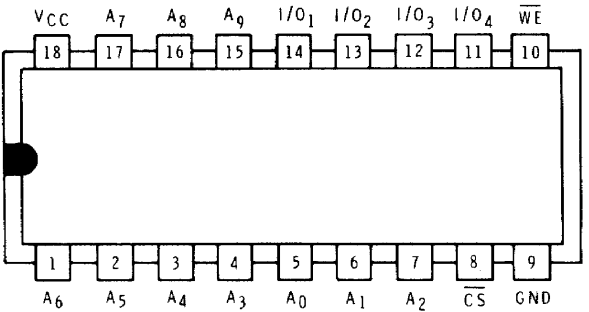
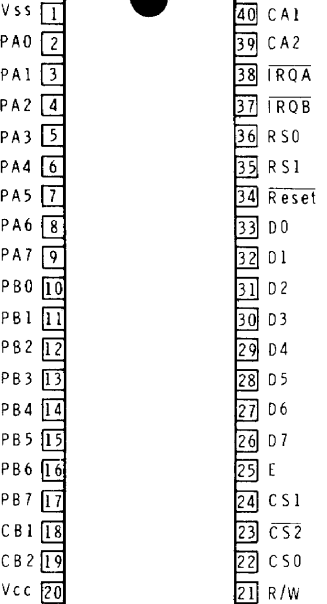
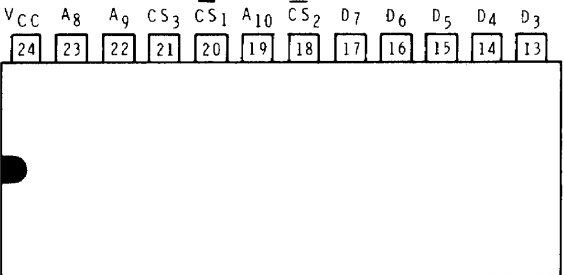
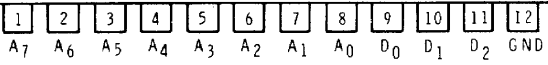
INTEGRATED CIRCUITS

HEATH NUMBER	MAY BE REPLACED WITH	DESCRIPTION	IDENTIFICATION
442-54	$\mu$ A7805	5-VOLT REGULATOR U110	
442-616	LM3302N LM2901N $\mu$ A775	VOLTAGE COMPARATOR U109	
442-663	$\mu$ A78M12	12-VOLT REGULATOR U102	<p>TO-220 PACKAGE PACKAGE OUTLINE GH PACKAGE CODE U</p>
442-664	$\mu$ A79M12	-12-VOLT REGULATOR U101	
443-18	7404N	HEX INVERTER U104	
443-46	7402	QUAD 2-INPUT POSITIVE NOR GATE U107	





Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	IDENTIFICATION
443-764	NMOS2114	1 k × 8 STATIC RAM U117, U118	
443-843	MC6820	PERIPHERAL INTERFACE ADAPTER U103	
444-24	NMOS2316E	TINY BASIC ROM U106	
444-51	NMOS2316E	MONITOR ROM U105	 <p data-bbox="966 1711 1258 1837"> <b>PIN NAMES</b>  A<sub>0</sub>-A<sub>10</sub> ADDRESS INPUTS  D<sub>7</sub>-D<sub>0</sub> DATA OUTPUTS  CS<sub>1</sub>-CS<sub>3</sub> CHIP SELECT INPUTS </p>

Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	IDENTIFICATION
444-28	TTL 32*8 ROM	ADDRESS DECODER ROM	



**FOR PARTS REQUESTS ONLY**

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

**DO NOT WRITE IN THIS SPACE**

**INSTRUCTIONS**

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

NAME \_\_\_\_\_  
 ADDRESS \_\_\_\_\_  
 CITY \_\_\_\_\_  
 STATE \_\_\_\_\_ ZIP \_\_\_\_\_

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

Model # \_\_\_\_\_ Invoice # \_\_\_\_\_  
 Date Purchased \_\_\_\_\_ Location Purchased \_\_\_\_\_

LIST HEATH PART NUMBER	QTY.	PRICE EACH	TOTAL PRICE

TOTAL FOR PARTS	
HANDLING AND SHIPPING	
MICHIGAN RESIDENTS ADD 4% TAX	
<b>TOTAL AMOUNT OF ORDER</b>	

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

Phone (Replacement parts only): 616 982-3571

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

**FOR PARTS REQUESTS ONLY**

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

**DO NOT WRITE IN THIS SPACE**

**INSTRUCTIONS**

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Total enclosed \$ \_\_\_\_\_
- If you prefer COD shipment, check the COD box and mail this form. COD

NAME \_\_\_\_\_  
 ADDRESS \_\_\_\_\_  
 CITY \_\_\_\_\_  
 STATE \_\_\_\_\_ ZIP \_\_\_\_\_

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

Model # \_\_\_\_\_ Invoice # \_\_\_\_\_  
 Date Purchased \_\_\_\_\_ Location Purchased \_\_\_\_\_

LIST HEATH PART NUMBER	QTY.	PRICE EACH	TOTAL PRICE

TOTAL FOR PARTS	
HANDLING AND SHIPPING	
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THIS FORM IS FOR U.S. CUSTOMERS ONLY  
 OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

CUT ALONG DOTTED LINE

# 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

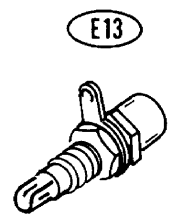
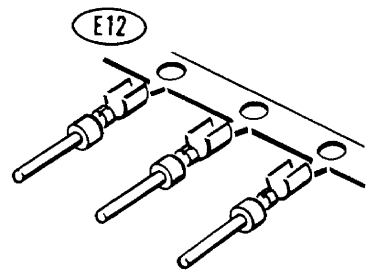
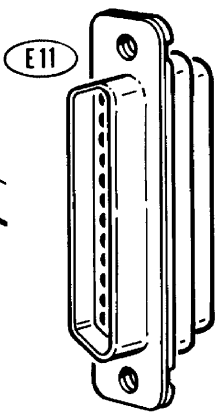
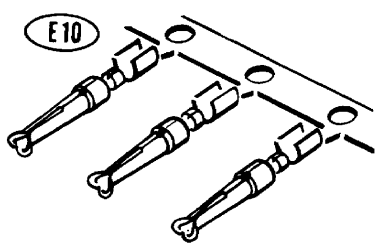
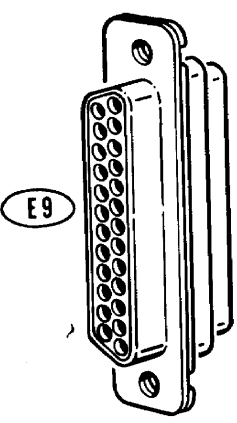
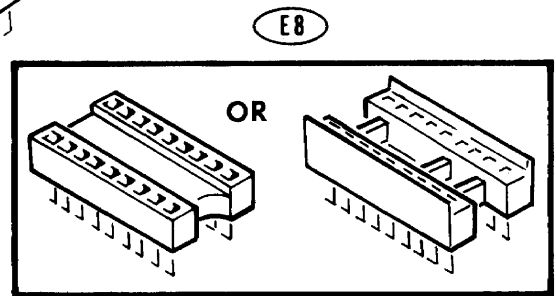
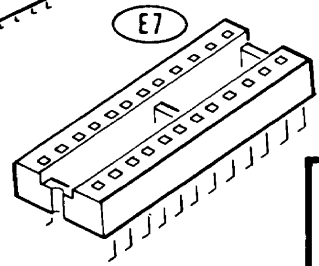
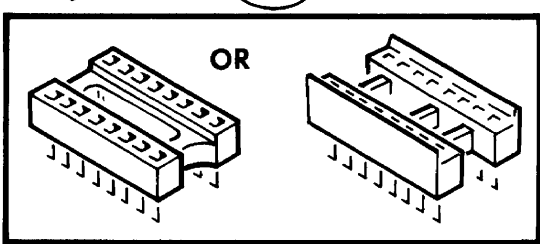
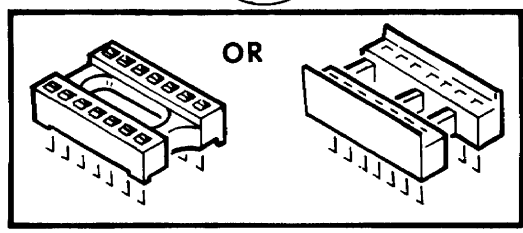
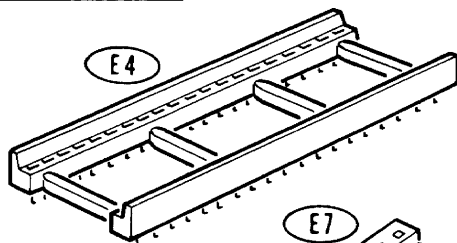
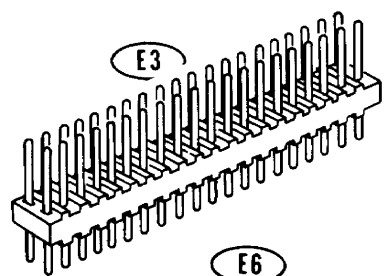
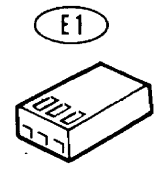
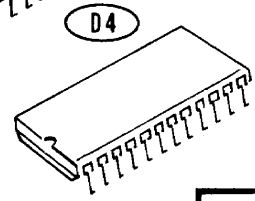
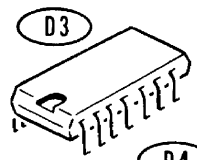
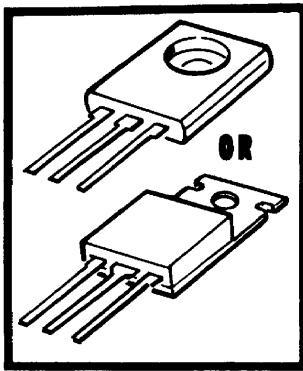
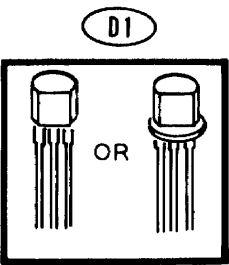
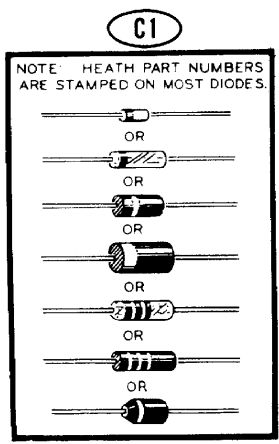
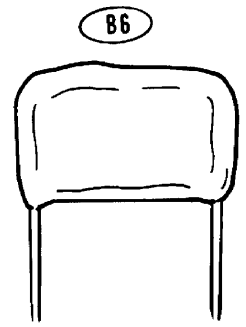
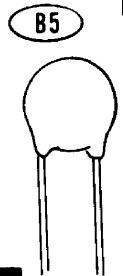
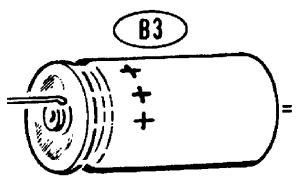
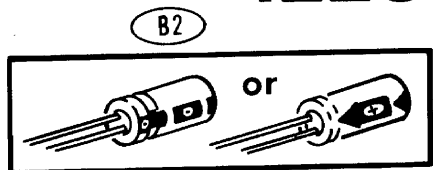
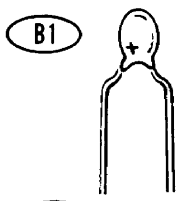
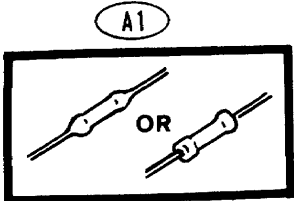


**HEATH COMPANY • BENTON HARBOR, MICHIGAN**  
**THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM**

LITHO IN U.S.A.

# ILLUSTRATION I

## PARTS PICTOR

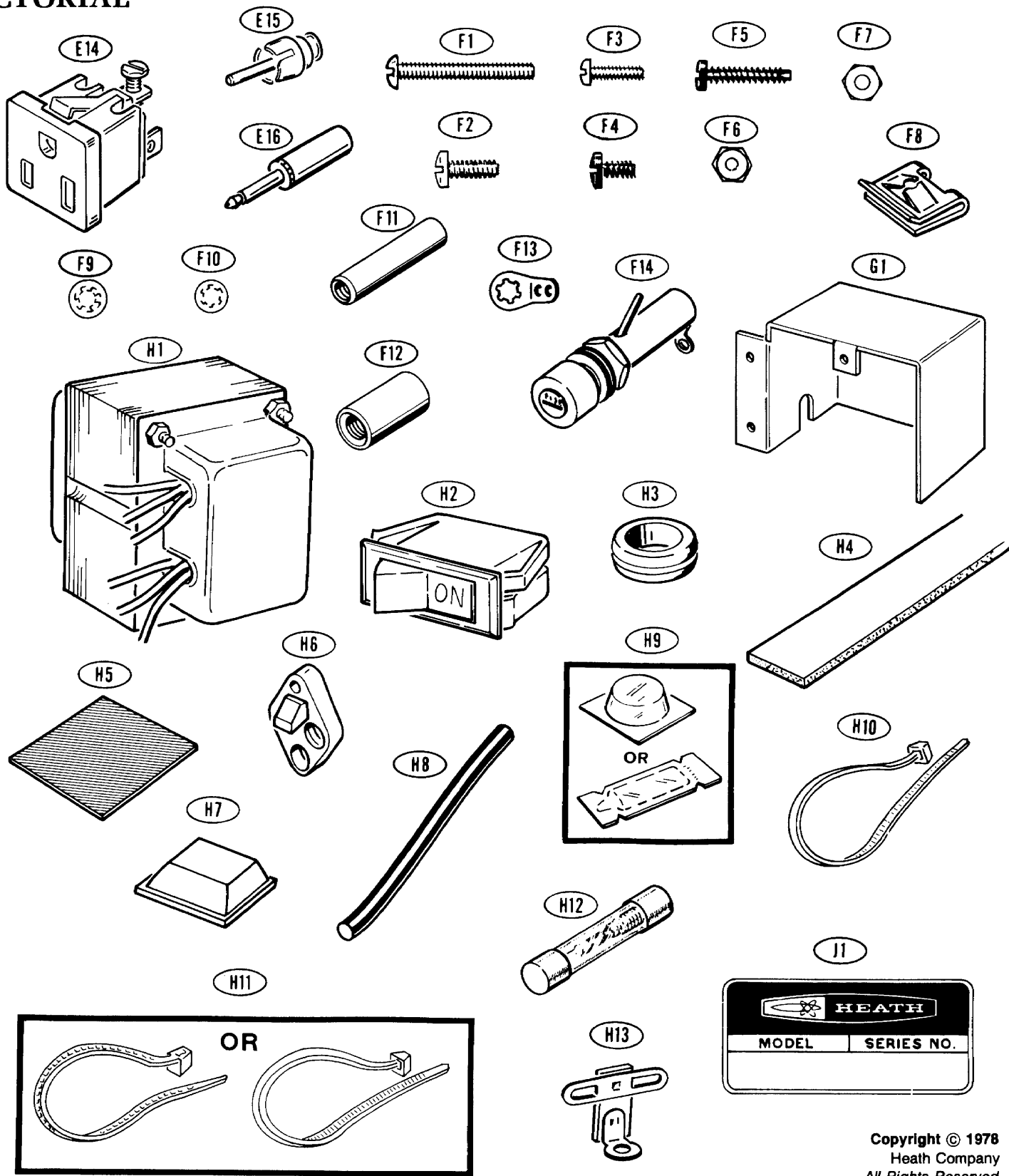
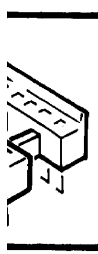
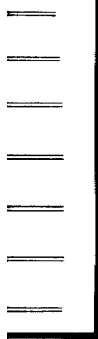


# ATION BOOKLET

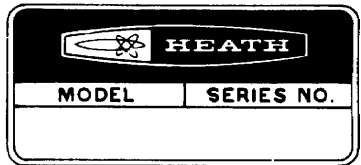
Part of 595-2170-03

## RTS PICTORIAL

NUMBERS  
ST DIODES.



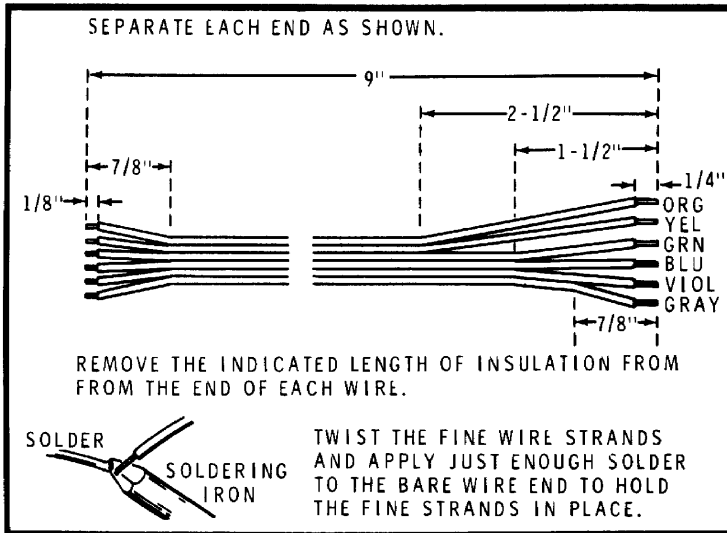
Model ETA-3400



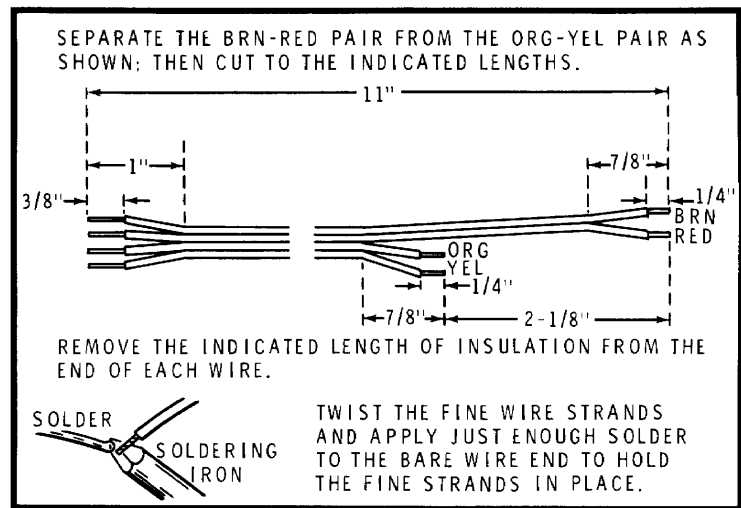
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Printed in the United States of America

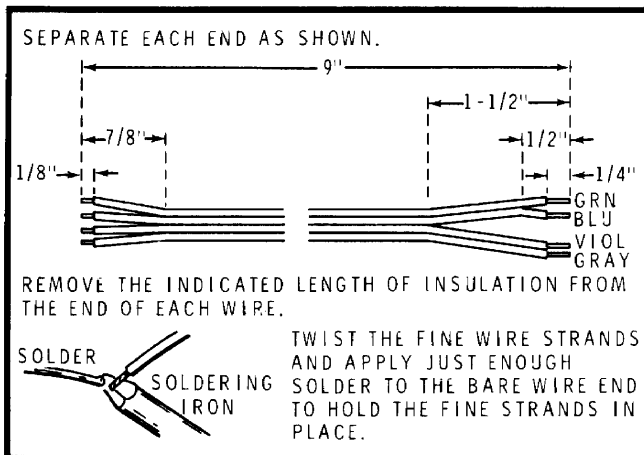




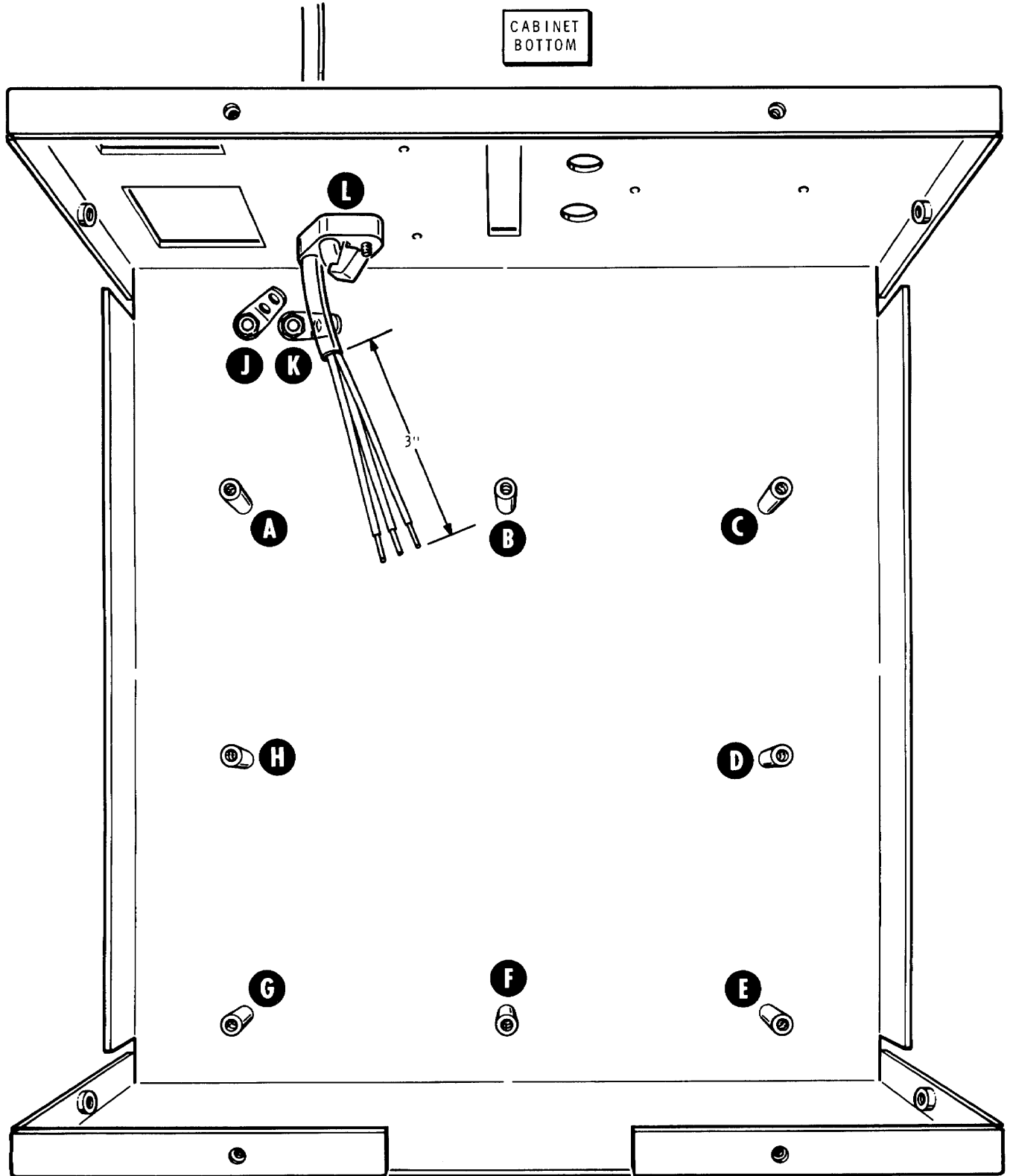
**Detail 1-13A**



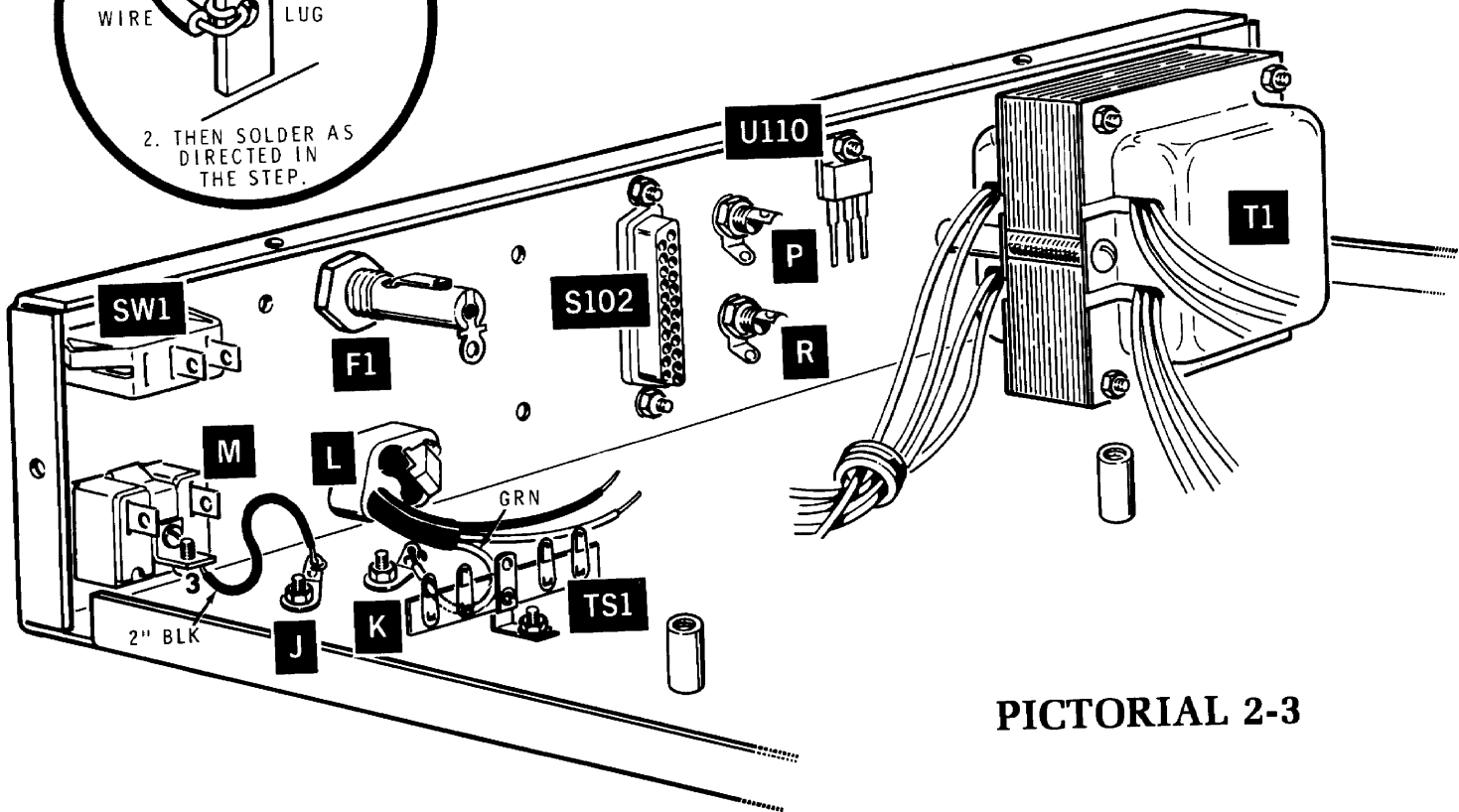
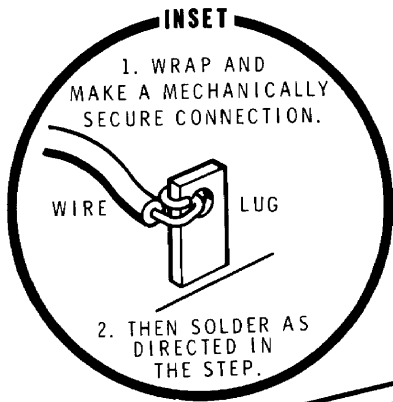
**Detail 1-14A**



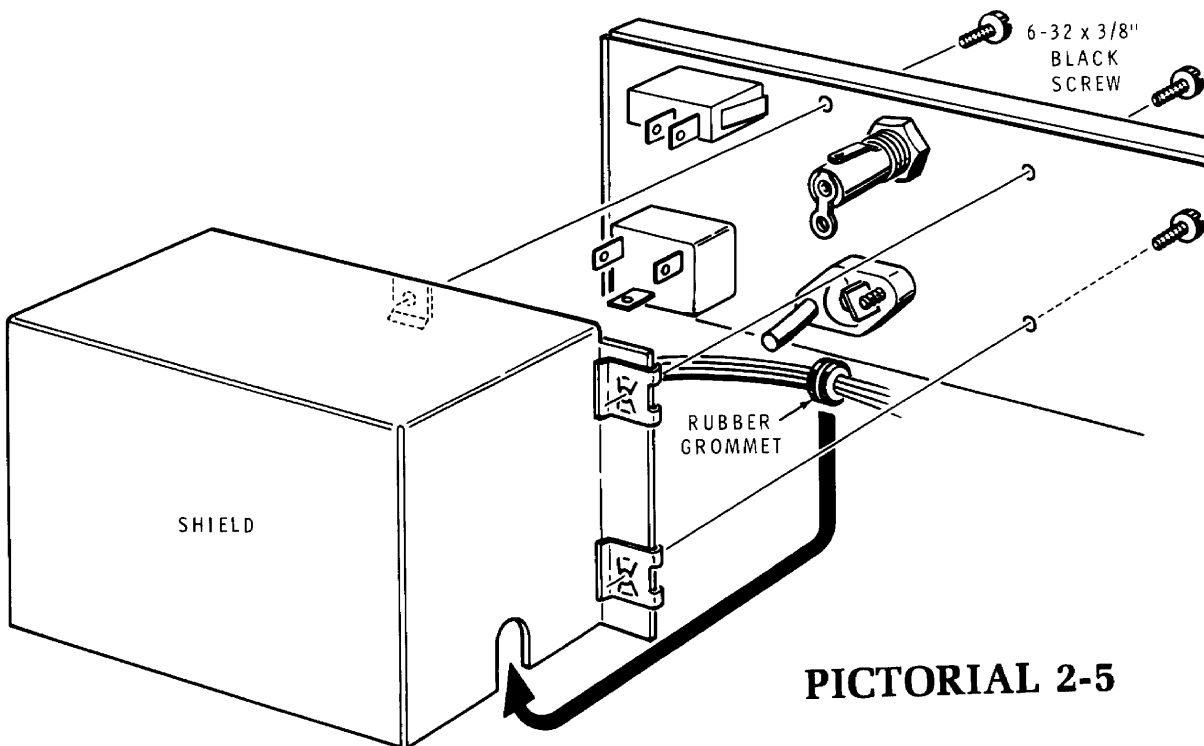
**Detail 1-15A**



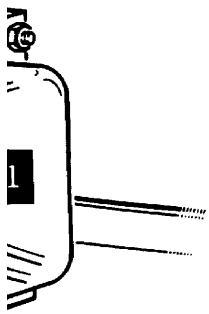
PICTORIAL 2-2



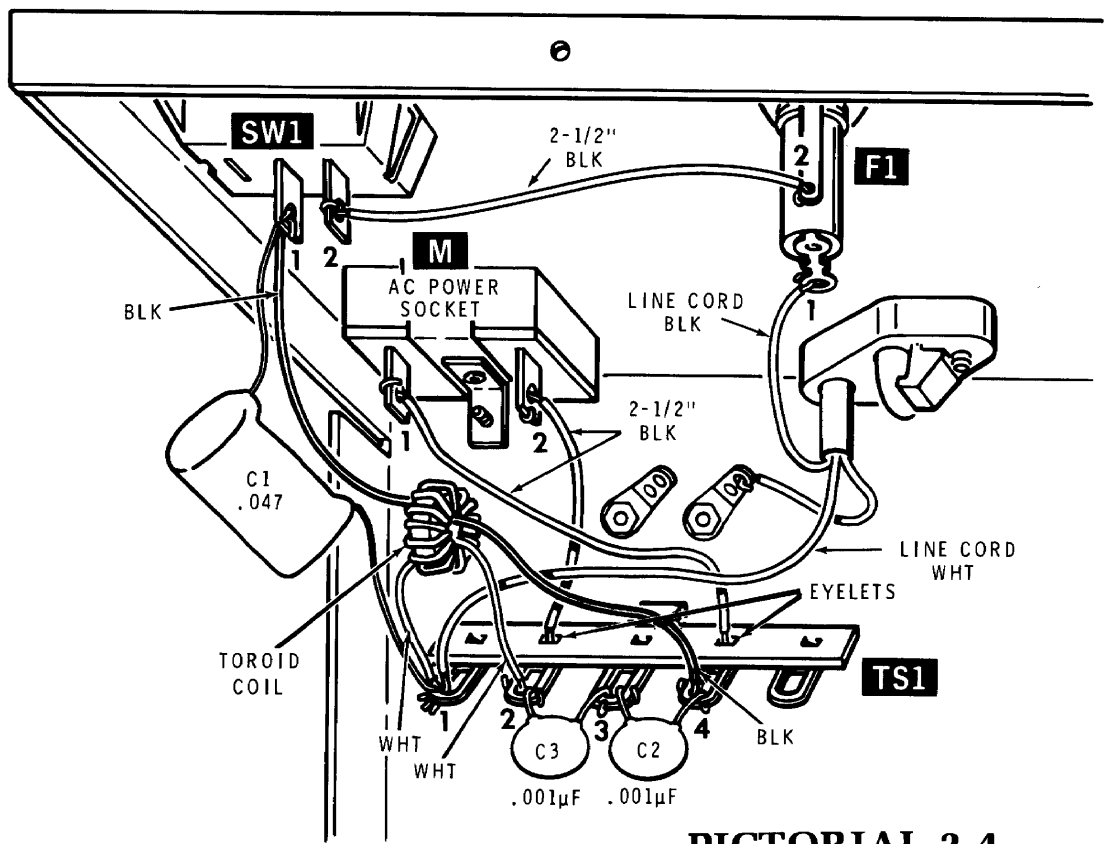
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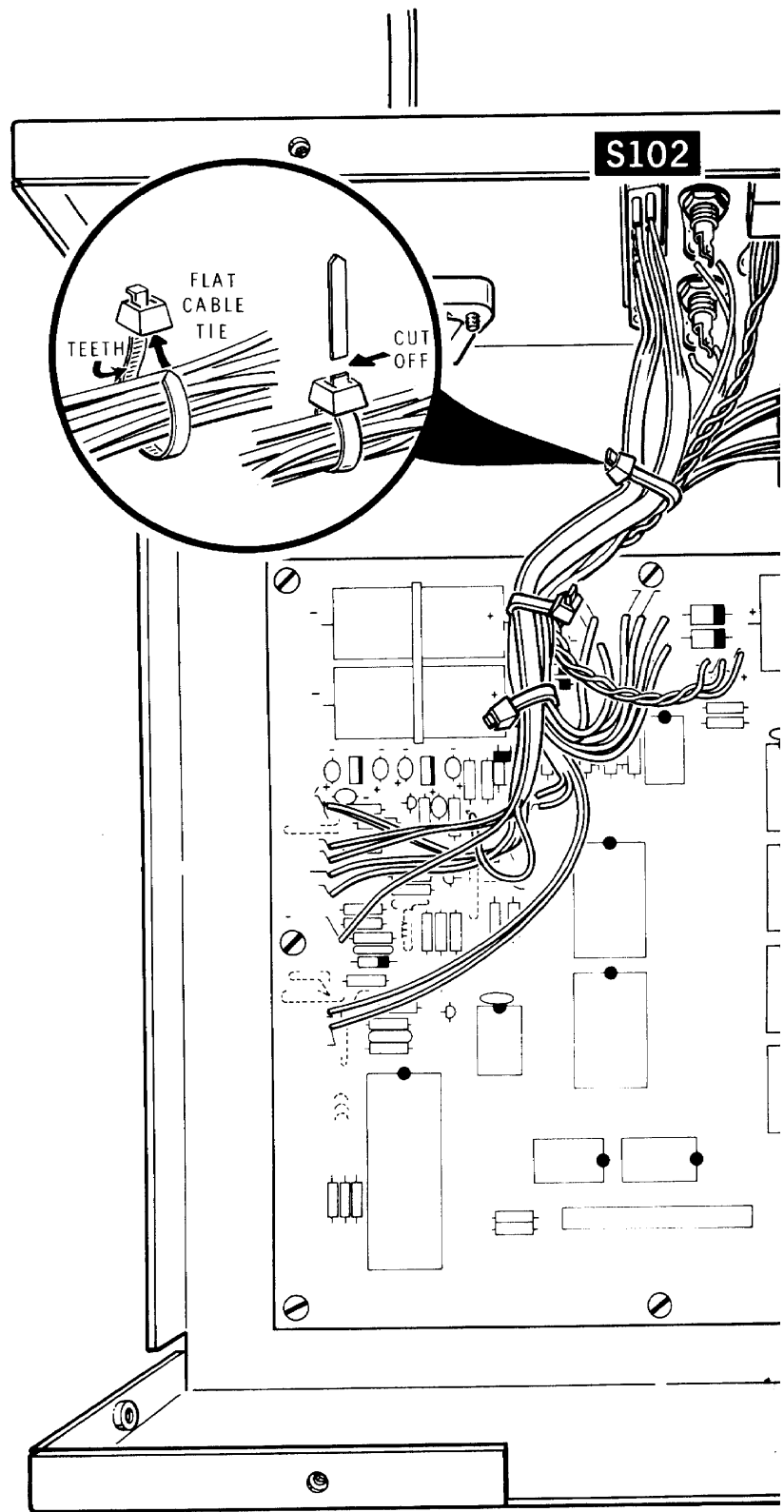
**PICTORIAL 2-5**



-3



PICTORIAL 2-4



**PICTORIAL 2**

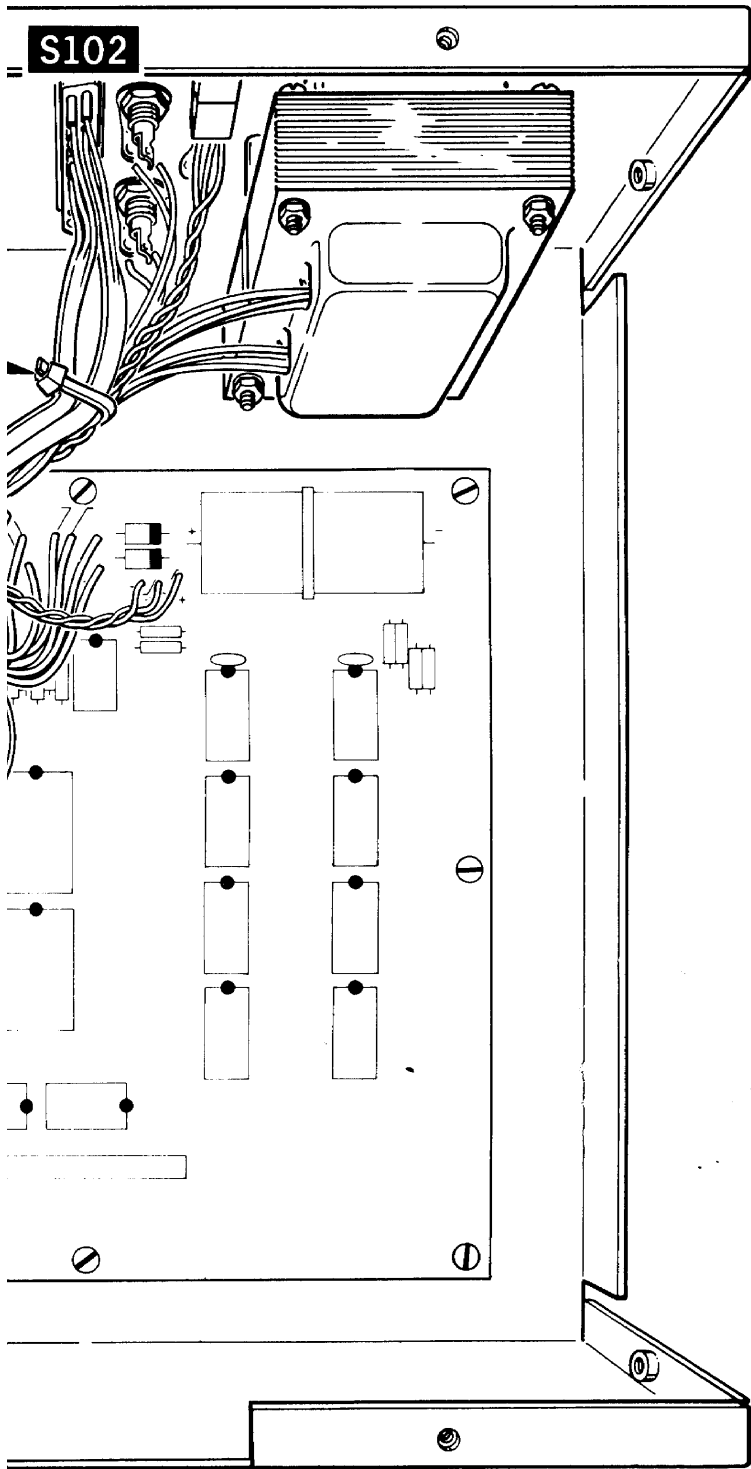
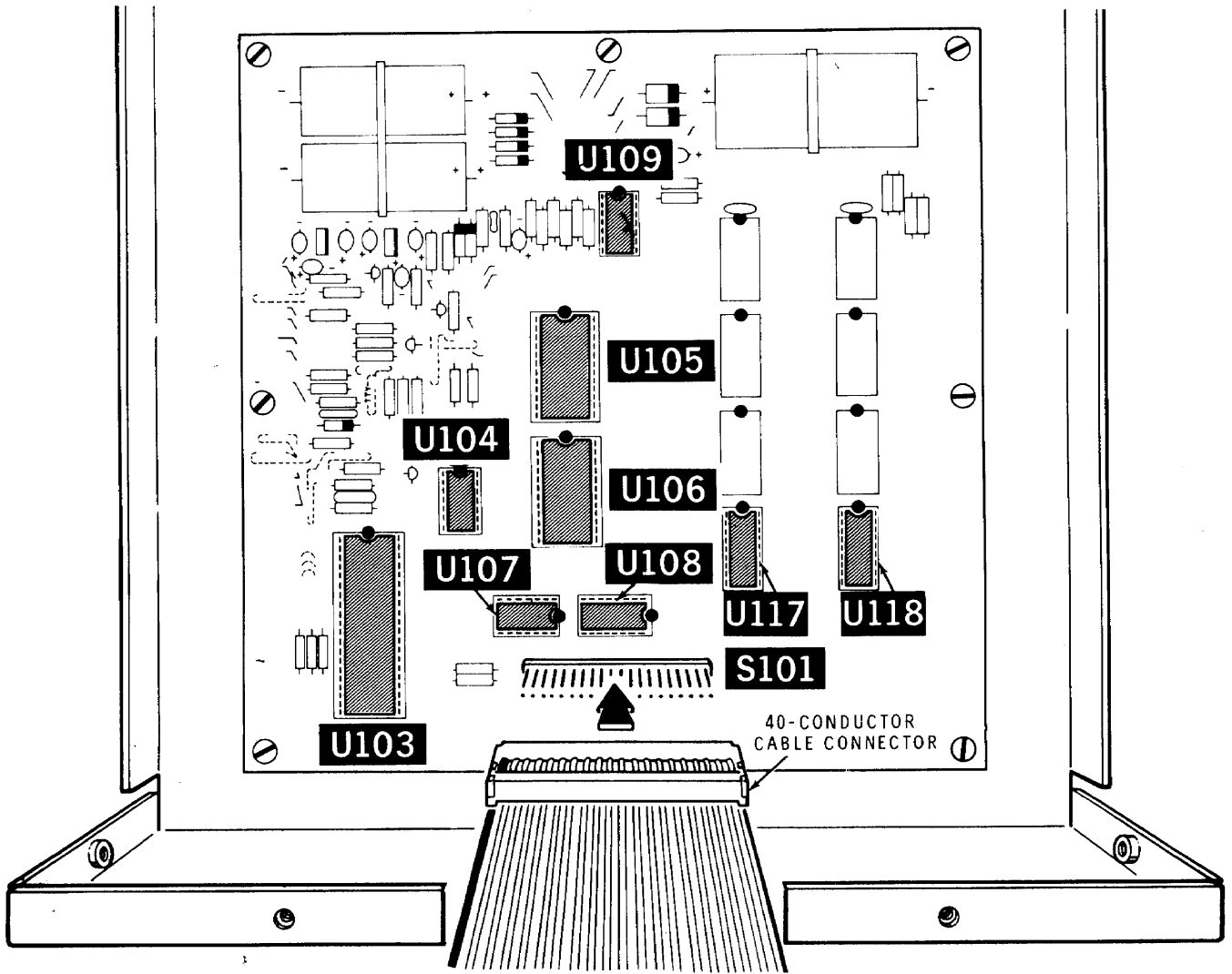
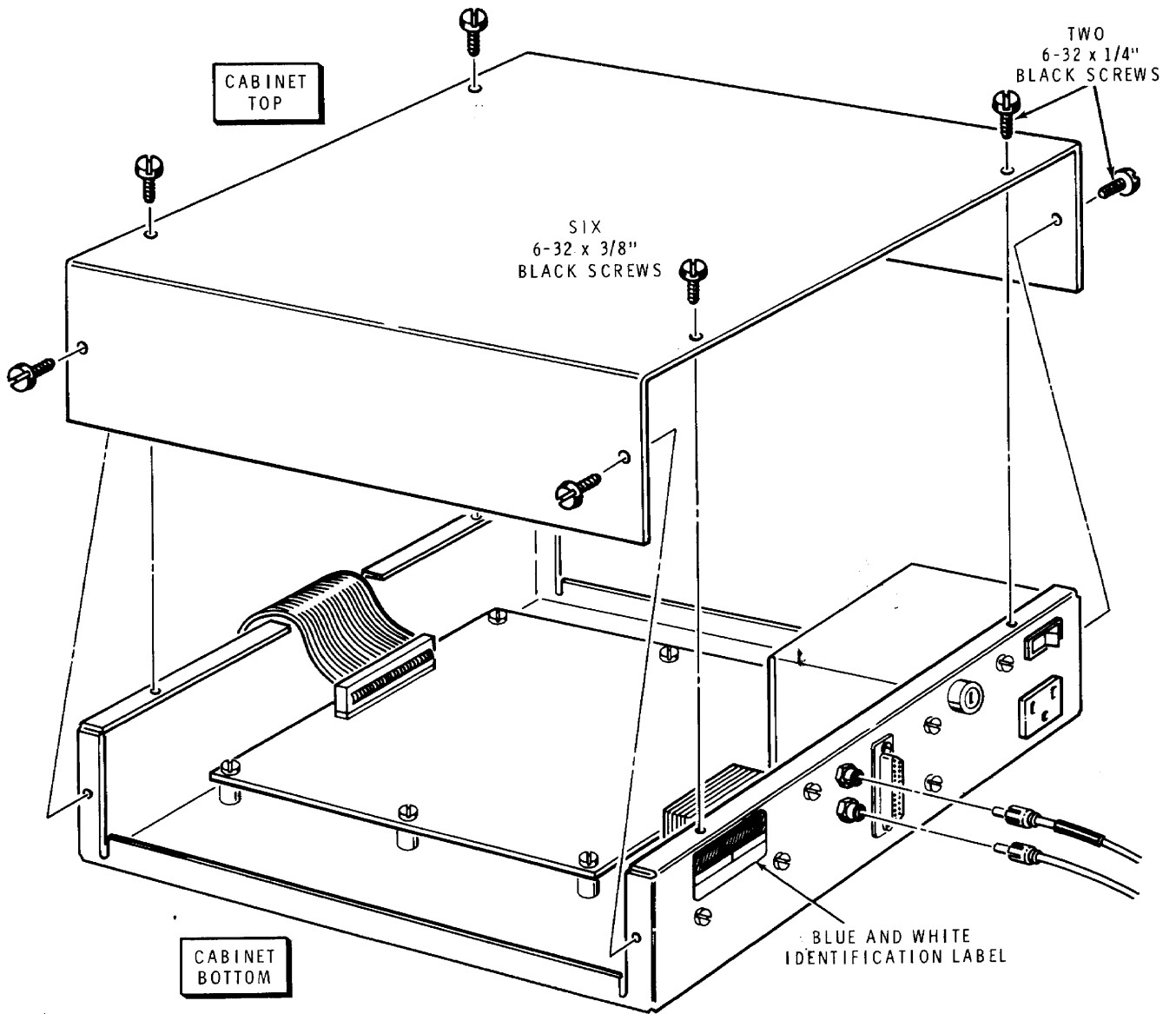


FIGURE 2-8

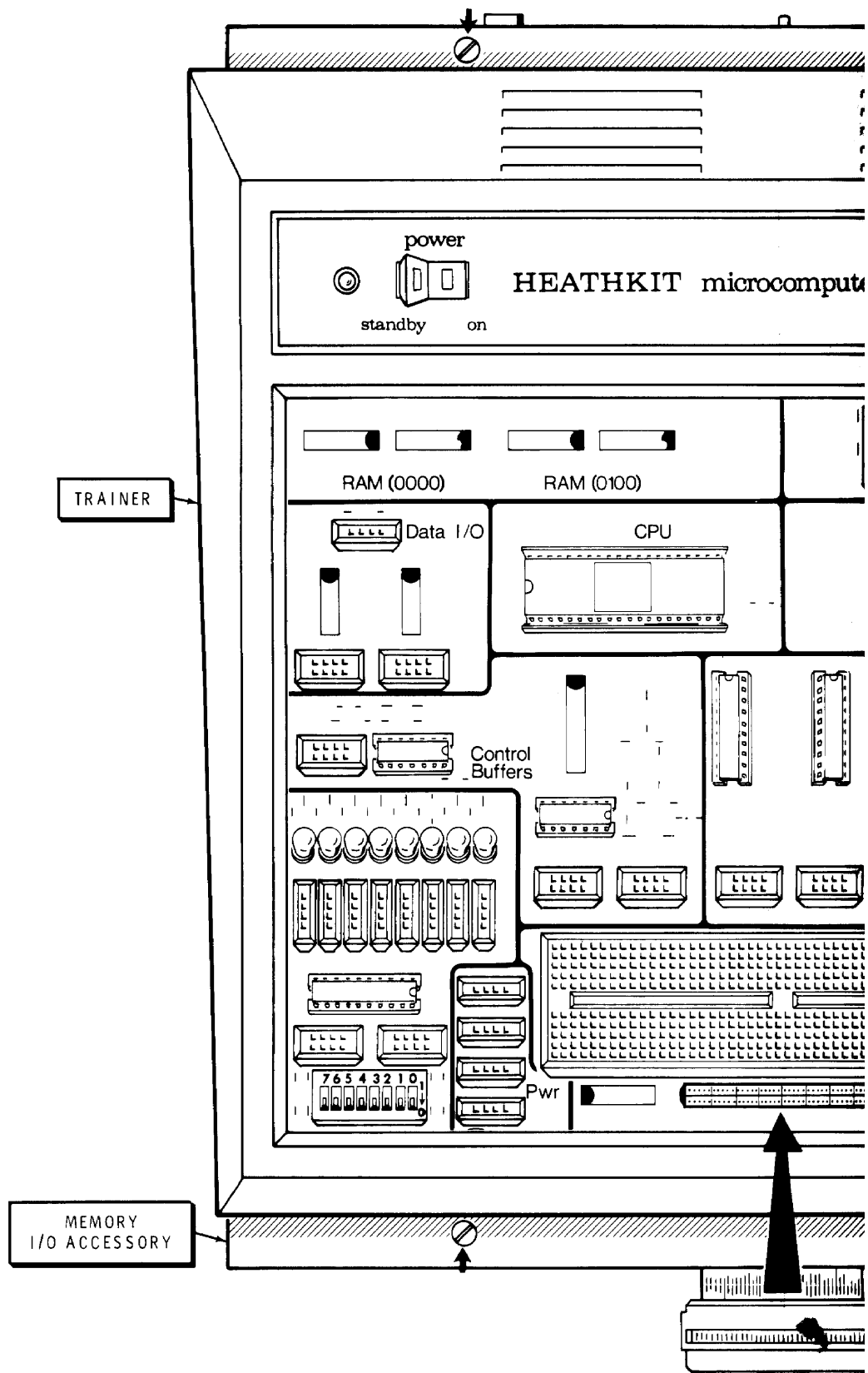


PICTORIAL 5-2



PICTORIAL 5-3





PICTORIAL 5

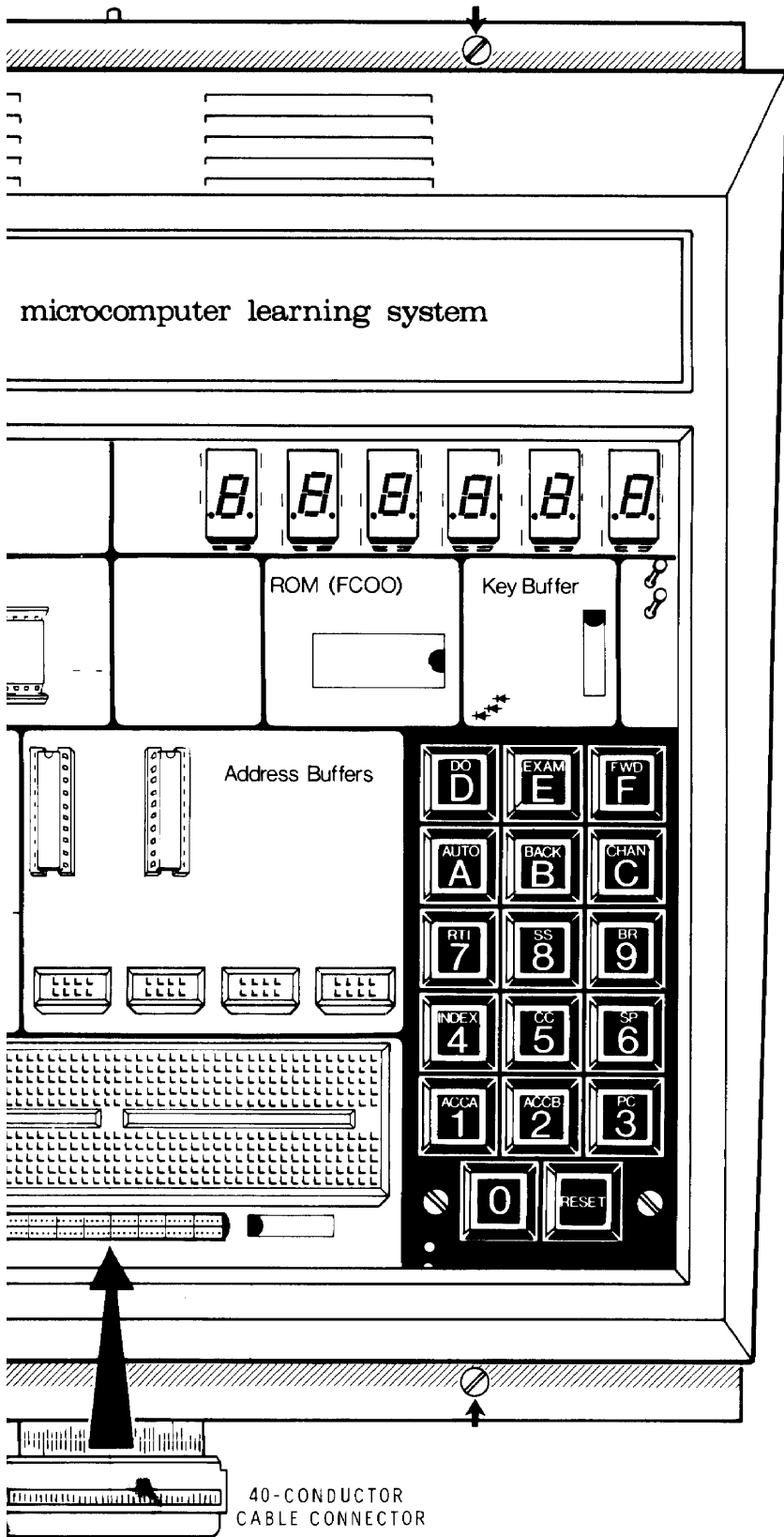
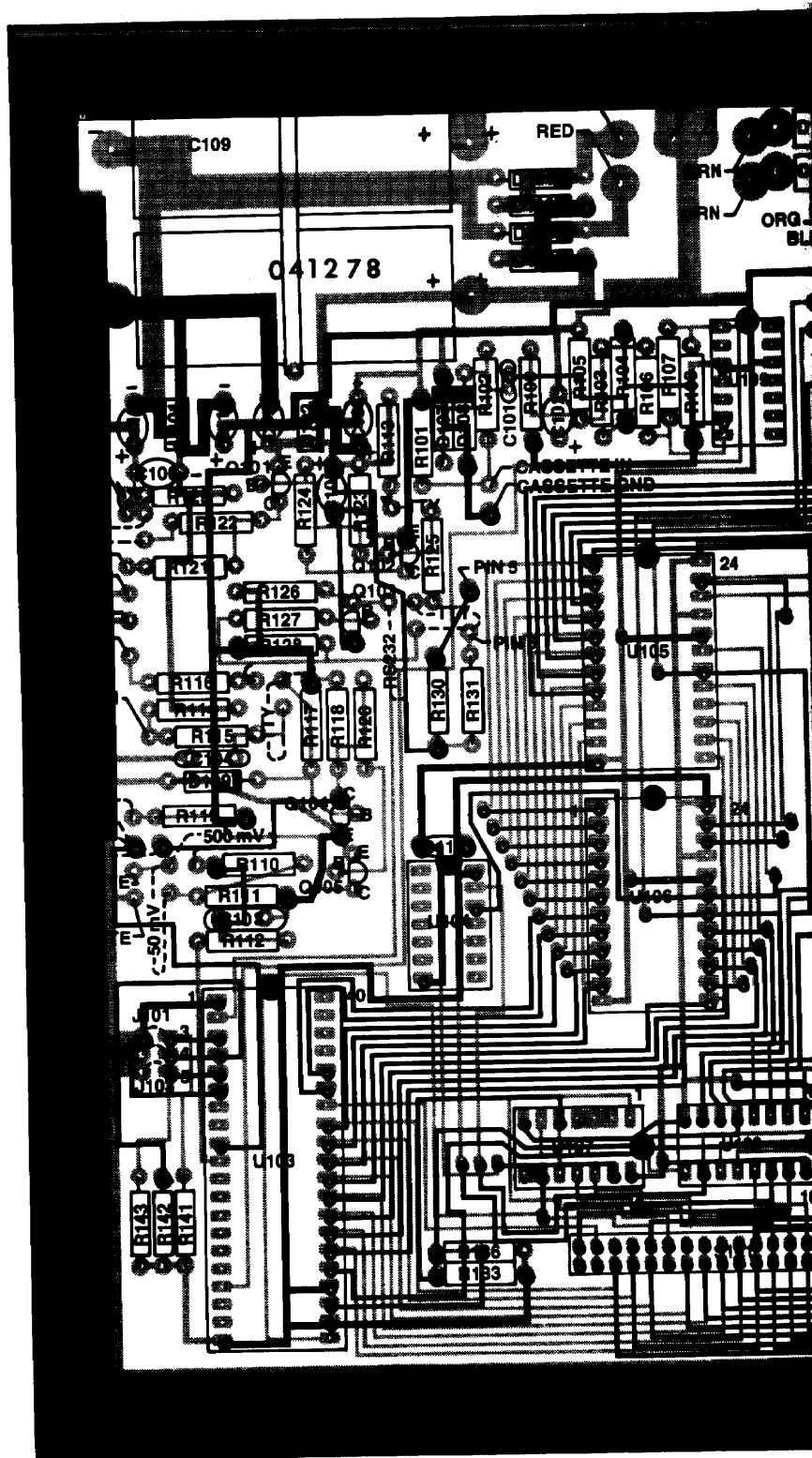
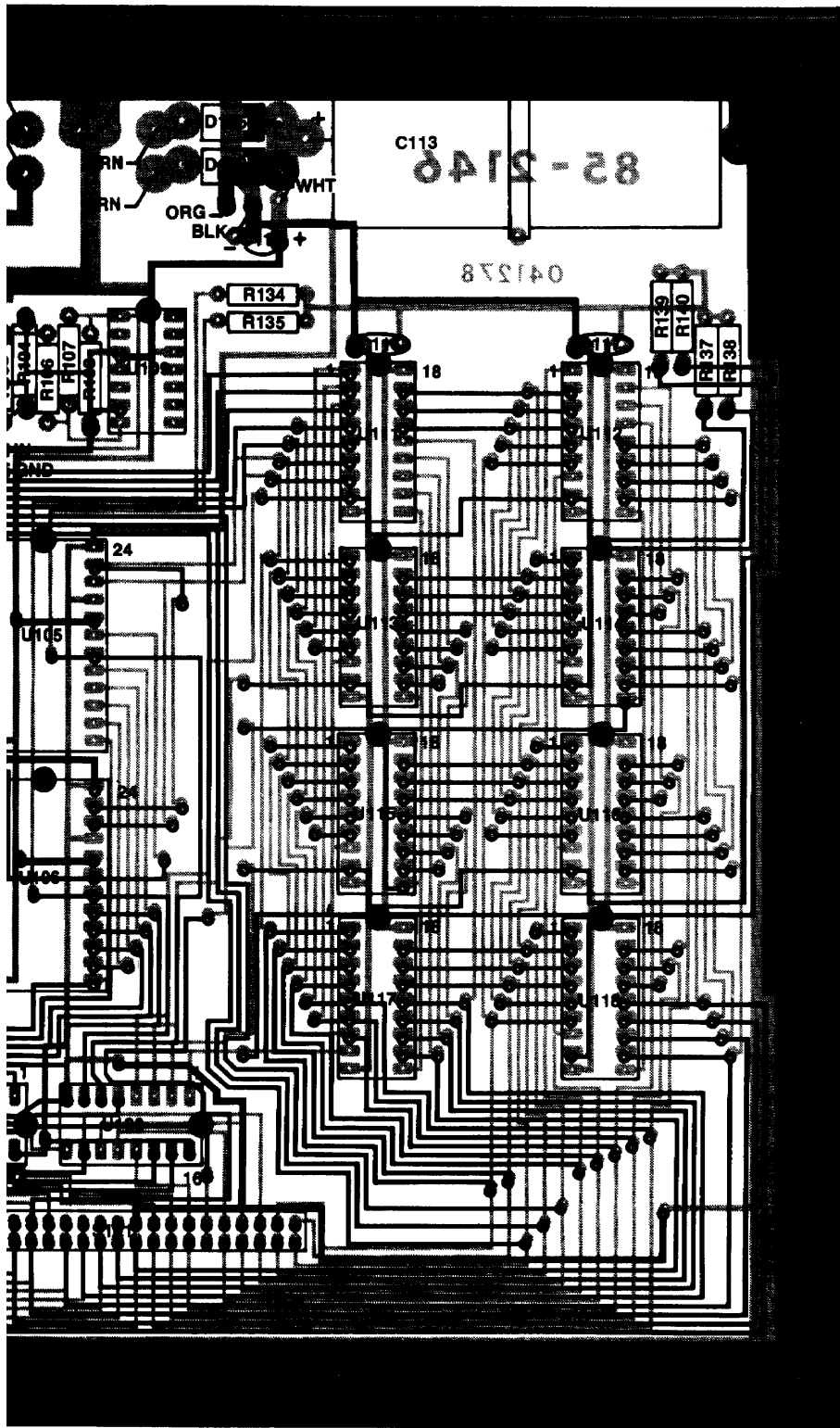


FIGURE 5-4



CIRCUIT BOARD X-F



BOARD X-RAY VIEW