# HEATHKIT® MANUAL

*for the*

## 60 MHz TRIPLE TRACE OSCILLOSCOPE

Model IO-4360A

ASSEMBLY 595-3239

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*

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| R/C, Audio, and Electronic Organs | (616) 982-3310 |
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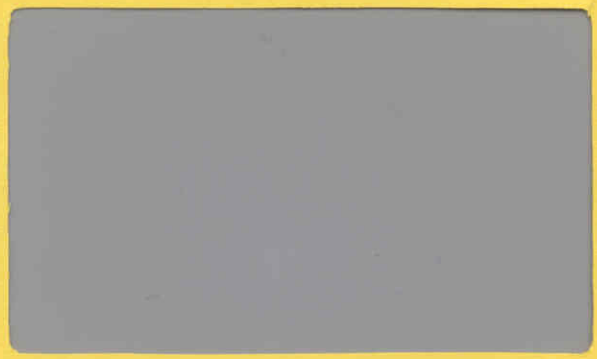

## YOUR HEATHKIT 90-DAY LIMITED WARRANTY

### Consumer Protection Plan for Heathkit Consumer Products

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

### Heath's Responsibility

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

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

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

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

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

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

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

### Owner's Responsibility

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

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

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

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

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

# Heathkit® Manual

*for the*

## 60 MHz TRIPLE TRACE OSCILLOSCOPE

Model IO-4360A

ASSEMBLY 595-3239

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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# TABLE OF CONTENTS

INTRODUCTION . . . . . 1-3

UNPACKING INSTRUCTIONS . . . . . 1-5

ASSEMBLY NOTES . . . . . 1-6

CONTROL CIRCUIT BOARD . . . . . 2-1
Parts List . . . . . 2-1
Step-by-Step Assembly . . . . . 2-3

HIGH VOLTAGE CIRCUIT BOARD . . . . . 3-1
Parts List . . . . . 3-1
Step-by-Step Assembly . . . . . 3-3

VERTICAL DEFLECTION CIRCUIT BOARD . 4-1
Parts List . . . . . 4-1
Step-by-Step Assembly . . . . . 4-4

LOW VOLTAGE CIRCUIT BOARD . . . . . 5-1
Parts List . . . . . 5-1
Step-by-Step Assembly . . . . . 5-4

VERTICAL PREAMP CIRCUIT BOARD . . . . 6-1
Parts List . . . . . 6-1
Step-by-Step Assembly . . . . . 6-5

HORIZONTAL CIRCUIT BOARD . . . . . 7-1
Parts List . . . . . 7-1
Step-by-Step Assembly . . . . . 7-6

CHASSIS . . . . . 8-1
Parts List . . . . . 8-1
Step-by-Step Assembly . . . . . 8-4
Rear Panel Assembly . . . . . 8-4
Rear Panel Wiring . . . . . 8-8
Frame and Bezel Assembly . . . . . 8-12
Low Voltage Assembly . . . . . 8-14
Control Circuit Board . . . . . 8-19
Initial Voltage Tests . . . . . 8-25
High Voltage Assembly . . . . . 8-26
Vertical Deflection Circuit Board . . . . . 8-30
Interconnect Wiring . . . . . 8-32
Vertical Preamp Assembly . . . . . 8-33
Horizontal Circuit Board . . . . . 8-36
CRT Assembly and Installation . . . . . 8-38
Test Cable Preparation . . . . . 8-44

FINAL ASSEMBLY . . . . . 8-46

WARRANTY . . . . . Inside front cover

CUSTOMER SERVICE . . . . . Inside rear cover

# INTRODUCTION

Your 60 MHz Triple Trace Oscilloscope, Model IO-4360A, is a laboratory-grade test instrument that is ideal for the wide range of measurements typically found in electronics, development laboratories, and scientific research. Some of its outstanding features are:

- Triple trace.
- Delayed sweep.
- Wide 60 MHz bandwidth.
- Fast 7 nS vertical rise time.
- High brightness mesh CRT with internal graticule.
- 2 mV/cm sensitivity.
- Inverting input switch.
- Algebraic add function.
- Vertical delay lines.
- Sync separator for stable display of TV signals.
- Single sweep function.
- Full X-Y operation with Z-axis control.
- External, viewable, triggered input.

The attenuator networks of channels Y1 and Y2 have 12 calibrated ranges, from 2 millivolts/centimeter to 10 volts/centimeter. The channel 2 input can be inverted by a pushbutton switch. This complements the ADD function, which displays the resultant waveform after both input signals have been algebraically added together.

The internal vertical delay lines insure that the horizontal sweep starts before the beginning of the vertical signal. Thus, the complete vertical waveform will be displayed. Since the amplifier rise time is as rapid as 7 nanoseconds, very fast rise -time signals can be faithfully reproduced.

The calibrated time base ranges, from .1 second/centimeter to 100 nanoseconds/centimeter, are readily switched in a 1, 2, 5-step sequence. Any sweep speed can be expanded 10 times when the ×10 switch is pulled out. Delayed sweep (a more sophisticated way of expanding the sweep) is also available. It allows you to first select the exact portion of the waveform that you want to expand, and then it expands the waveform by the predetermined factor.

The Trigger Select switch and Level control allow the time base to be precisely triggered at any point along the positive or negative slope of the trigger signal. You can select various trigger signals. Other Trigger Mode switches control the trigger input bandpass to allow triggering on only fast or only slow signals. Also, Auto and Norm switches are provided that can automatically display a baseline on the screen when there is no trigger signal.

A calibrated 1-volt peak-to-peak square wave signal is provided through a front panel terminal post for probe calibration. Also, rear panel switches match the power transformer to standard line voltages from 108 to 260 volts AC.

While the solid-state circuitry provides excellent sensitivity, stability, and versatility, the rugged construction and dependable operation of this Oscilloscope make it an indispensable tool for the critical hobbiest, service technician, or professional.

NOTE: To properly test and calibrate your Oscilloscope, you will need the following instruments:

- A vacuum-tube volt-ohmmeter or a high-input impedance VOM.
- An oscilloscope calibrator, such as the Heathkit Precision Oscilloscope Calibrator, Model IG-4244, or its equivalent.

  **OR**

- An accurate source of time and voltage square waves.

# UNPACKING INSTRUCTIONS

DO NOT UNPACK YOUR KIT UNTIL YOU ARE INSTRUCTED TO DO SO.

Your kit is packed in two shipping cartons. Inside the larger carton is a box marked "Pks 1-6." All the remaining parts in the carton are the "Final Pack."

Do not remove any parts from the box marked "Pks 1-6" Packs until they are specifically called for in a Parts List. You will be instructed to open each pack as it is needed.

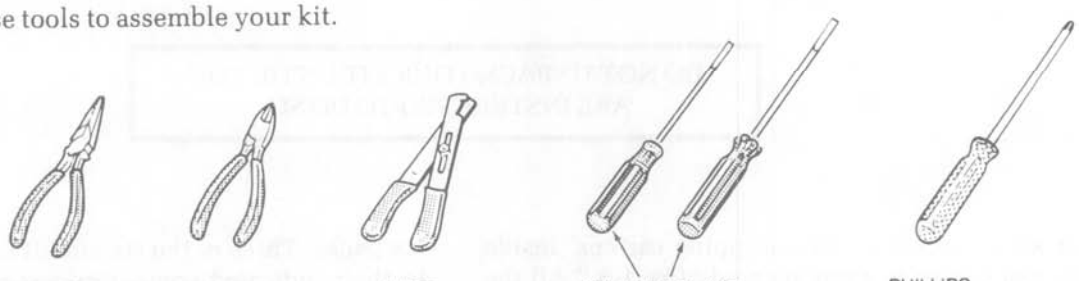
Inside the box marked "PKS 1-6" is a "Pack Index Sheet" that shows how the box is divided into its six packs. Three of the six circuit boards are packed in their indicated compartments; you will find the remaining three circuit boards in the Final Pack, on the cabinet components.

Any part that is packed in an individual envelope should be placed back in the envelope after you identify it until it is called for in a step. Do not discard any packing material until you have accounted for all the parts.

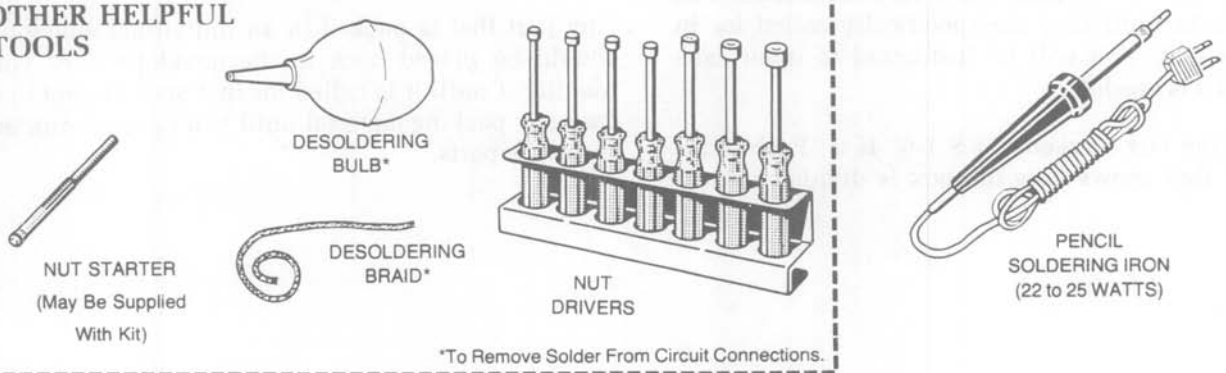
# ASSEMBLY NOTES

## TOOLS

You will need these tools to assemble your kit.




### OTHER HELPFUL TOOLS




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

## SOLDERING

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

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

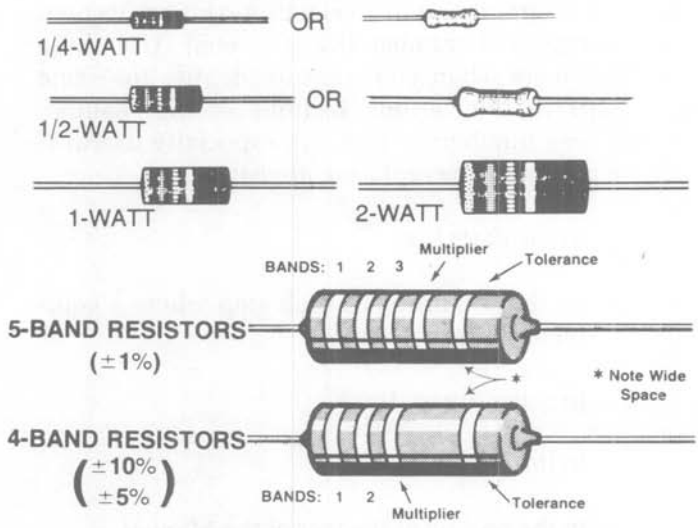
1. Use the right type of soldering iron. A 22 to 25-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.

2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

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

## PARTS

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




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

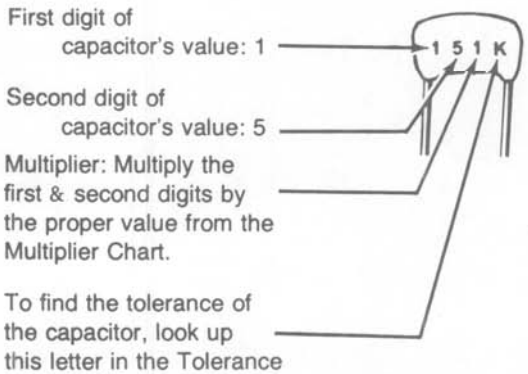
| Band 2 2nd Digit | |
|---|---|
| Color | Digit |
| Black | 0 |
| Brown | 1 |
| Red | 2 |
| Orange | 3 |
| Yellow | 4 |
| Green | 5 |
| Blue | 6 |
| Violet | 7 |
| Gray | 8 |
| White | 9 |

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

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

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

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




EXAMPLES:

151K = 15 × 10 = 150 pF
759 = 75 ×0.1 = 7.5 pF

NOTE: The letter "R" may be used at times to signify a decimal point: as in: 2R2 = 2.2 (pF or μF).

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

Heathkit®

# CONTROL CIRCUIT BOARD

## PARTS LIST

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

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."

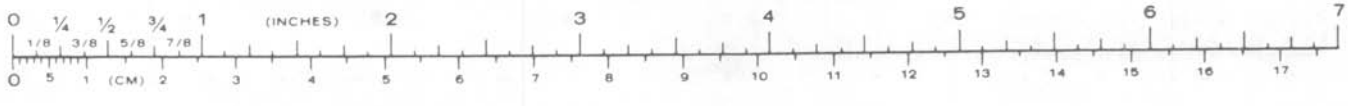
### GENERAL

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| A1 | 6-271-12 | 1 | 270 Ω, 5%, 1/4-watt (red-viol-brn) | R362 |
| A2 | 412-637 | 1 | Red LED | D361 |
| A3 | 10-1137 | 1 | 2000 Ω (2K) control | R363 |
| A3 | 10-1142 | 1 | 100 kΩ control | R361 |
| | 85-2896-1 | 1 | Control circuit board | |
| A4 | 432-958 | 1 | 10-hole socket | |
| A5 | 432-866 | 11 | Small spring connector (one extra) | |
| A6 | 432-121 | 2 | PCB pin | |
| A7 | 438-55 | 1 | Polarizing plug | |
| A8 | 432-893 | 1 | Terminal post | |
| | 490-185 | 1 | Desoldering braid | |
| A9 | 490-5 | 1 | Nut starter | |
| | | | Solder | |

### PARTS FROM FINAL PACK

#### Stranded Wire

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION |
|---|---|---|---|
| | 344-32 | 6″ | Large green |
| | 344-90 | 1′ | Black |
| | 344-91 | 1′ | Small brown |
| | 344-92 | 1′ | Small red |
| | 344-93 | 1′ | Small orange |
| | 344-95 | 9″ | Small green |
| | 344-96 | 1′ | Blue |
| | 344-114 | 1′ | White-brown |
| | 344-115 | 19″ | White-red |
| | 344-140 | 8″ | White-yellow |
| | 344-159 | 8½″ | WHITE-GREEN |



| KEY No. | HEATH Part No. | QTY. | DESCRIPTION |
|---|---|---|---|

## PARTS FROM FINAL PACK (cont'd.)

### Solid Wire

| | | |
|---|---|---|
| 340-8 | 4'9" | Small bare |
| 340-9 | 4" | Large bare |
| 344-21 | 1'9" | Large red |
| 344-34 | 5' | Large brown |
| 344-35 | 1'9" | Large orange |
| 344-53 | 2'6" | Small orange |
| 344-186 | 2'6" | Violet |
| 344-187 | 2' | White |
| 344-188 | 2'6" | Gray |

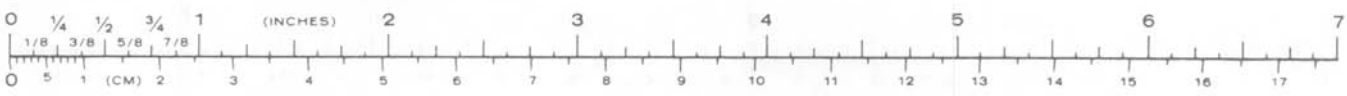
### Cable-Sleeving

| | | |
|---|---|---|
| 343-12 | 7' | RG-174/U (braid) shielded cable |
| 343-15 | 1'6" | AMW style 1435 (foil) shielded cable |
| 347-55 | 1'9" | 8-wire flat cable |
| 347-66 | 2'8" | 25-wire flat cable |
| 345-1 | 6" | Flat braid |
| 346-1 | 2'2" | Small sleeving |
| 346-5 | 1'3" | Large sleeving |
| 346-26 | 7" | Clear sleeving (not in bundle) |
| 346-35 | 1'6" | Small heat-shrinkable sleeving |

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION |
|---|---|---|---|

## LABELS-PRINTED MATERIALS (Inside Assembly Manual Cover)

| | | |
|---|---|---|
| 390-147 | 1 | "Danger" label |
| 390-186 | 1 | Label set |
| 390-1255 | 1 | Fuse label |
| 390-2681 | 1 | "Heath" label |
| | 1 | Blue and white label |
| 391-81 | 2 | Round knob insert |
| 597-260 | 1 | Parts Order Form |
| | 1 | Assembly Manual (see title page for part number.) |
| | 1 | Operation Manual (see title page for part number.) |



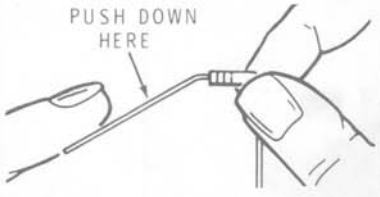
# STEP-BY-STEP ASSEMBLY

## 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. IMPORTANT: Be sure to read each step completely **before** you perform the operation.

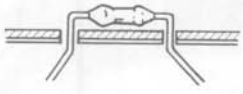
( ) Position the circuit board as shown with the printed side (not the foil side) up.

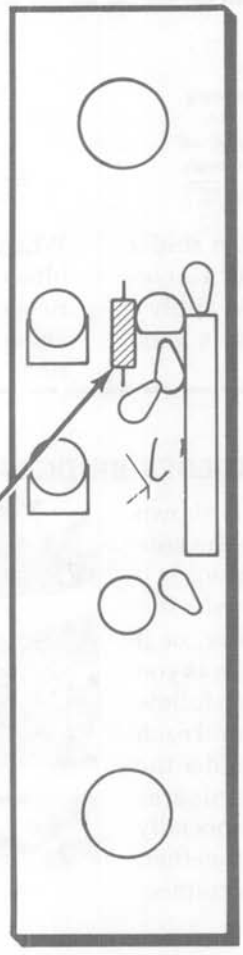
( ) Hold the 270 Ω (red-viol-brn) resistor and bend the leads straight down to fit the hole spacing on the circuit board.




( ) R362: 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.



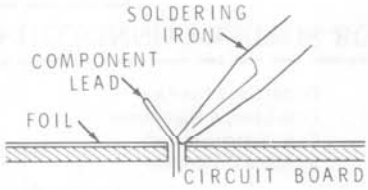


PICTORIAL 1-1

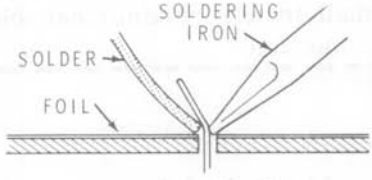
## CONTINUE

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

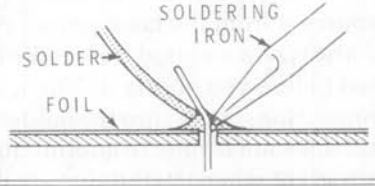
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.




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



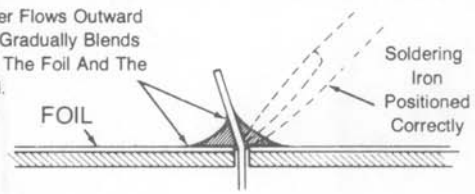

3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.




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

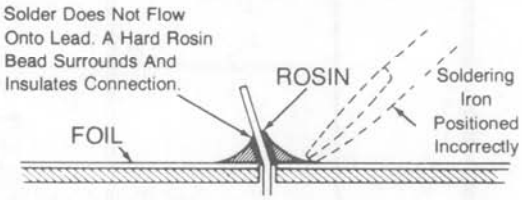
( ) Check the connection. Compare it to the illustrations on the next page. After you have checked the solder connections, proceed with the assembly on Page 2-5. Use the same soldering procedure for each connection.

## A GOOD SOLDER CONNECTION

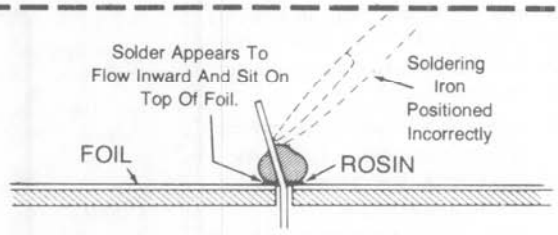



When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

## POOR SOLDER CONNECTIONS



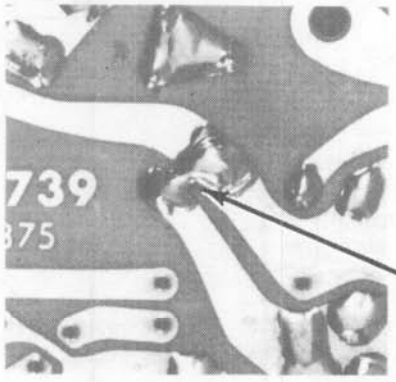

When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.




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

## SOLDER BRIDGES

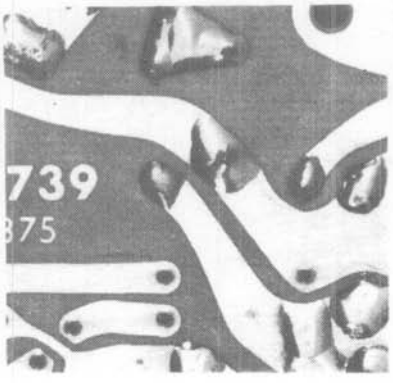
A solder bridge between two adjacent foils is shown in photograph **A**. Photograph **B** shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other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




**A**

SOLDER BRIDGE

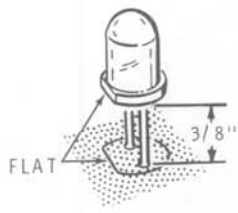
**B**




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

**START**

( ) D361: When you install the LED, position the flat on the LED over the outline of the flat on the circuit board. Insert the leads into the board, solder them to the foil, and cut off the excess lead lengths.

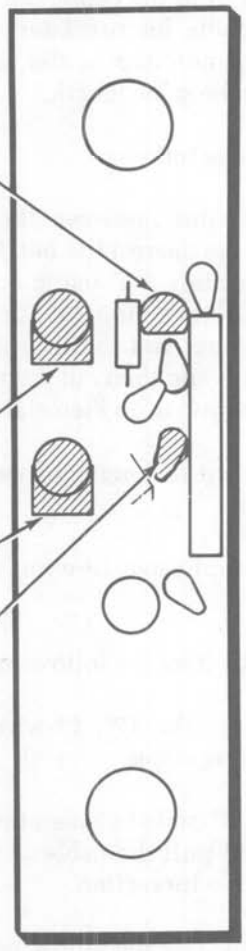



NOTE: When you install the following controls, insert the leads through the circuit board and solder them to the foil. Then cut off the excess lead lengths.

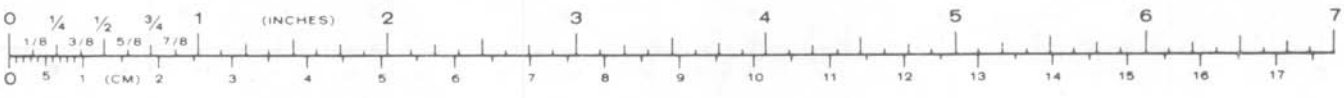
( ) R361: 100 kΩ.

( ) R363: 2000 Ω (2 kΩ).

( ) Insert the terminal post at J361, solder it to the foil, and cut off the excess length.



**PICTORIAL 1-2**



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

NOTE: Do **not** discard any wires or cables until you have completed your Oscilloscope kit.

Refer to Part A of Pictorial 1-3 for the next three steps.

( ) 1. Position the 25-wire flat cable so the outside black and yellow leads are as shown.

( ) 2. Cut a 17″ length from the cable. Set the remaining piece aside for use later. NOTE: Always cut perpendicular to the cable so the leads will be the same length.

( ) 3. Prepare the cable as follows:

a. Separate the wires (between the violet and blue that are nearest the outside yellow) approximately 1/4″ using a pair of cutters. To do this, first let the sharp edges of the cutter seat in the groove between the wires and then cut them apart. See the inset drawing on Pictorial 1-3.

b. Separate the entire length of cable by pulling it apart.

c. Set aside the indicated (8-wire) section for use later.

Refer to Part B of Pictorial 1-3 for the following steps.

( ) Cut a 9″ section from the 17″, 17-wire cable for use in the following steps.

( ) Separate the end of 9″ cable between the black and white wires and pull the cable apart. Set aside the indicated 7-wire section.

Refer to Part C of Pictorial 1-3 for the following steps.

( ) As in a previous step, cut between each of the 10 wires in the remaining cable; then pull the wire apart for 3/4″ at each end of the cable.

( ) Remove 1/8″ of insulation from the ends of each wire. Tightly twist each bare wire end and apply a small amount of solder to hold the fine strands together.

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

Refer to Detail 1-4A for the next twelve steps.

( ) 1. Install a small spring connector on each wire at one end of the cable. See inset drawing #1.

In the following steps, you will insert the connectors into the 10-hole socket. Be sure to position the socket with the slotted side up and the connectors with the small tabs up when you install them. See inset drawing #2.

( ) 2. Black in hole 1.

( ) 3. Brown in hole 2.

( ) 4. Red in hole 3.

( ) 5. Orange in hole 4.

( ) 6. Yellow in hole 5.

( ) 7. Green in hole 6.

( ) 8. Blue in hole 7.

( ) 9. Violet in hole 8.

( ) 10. Gray in hole 9.

( ) 11. White in hole 10.

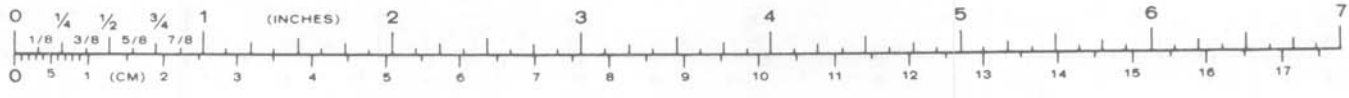
( ) 12. Push the small polarizing plug (#438-55) into hole 9 of the socket.

Connect the other end of the 10-wire cable to the control circuit board in the following steps. Solder each wire to the foil as it is installed and cut off the excess wire length.

( ) Black in hole 1.

( ) Brown in hole 2.

( ) Red in hole 3.



( ) Orange in hole 4.

( ) Yellow in hole 5.

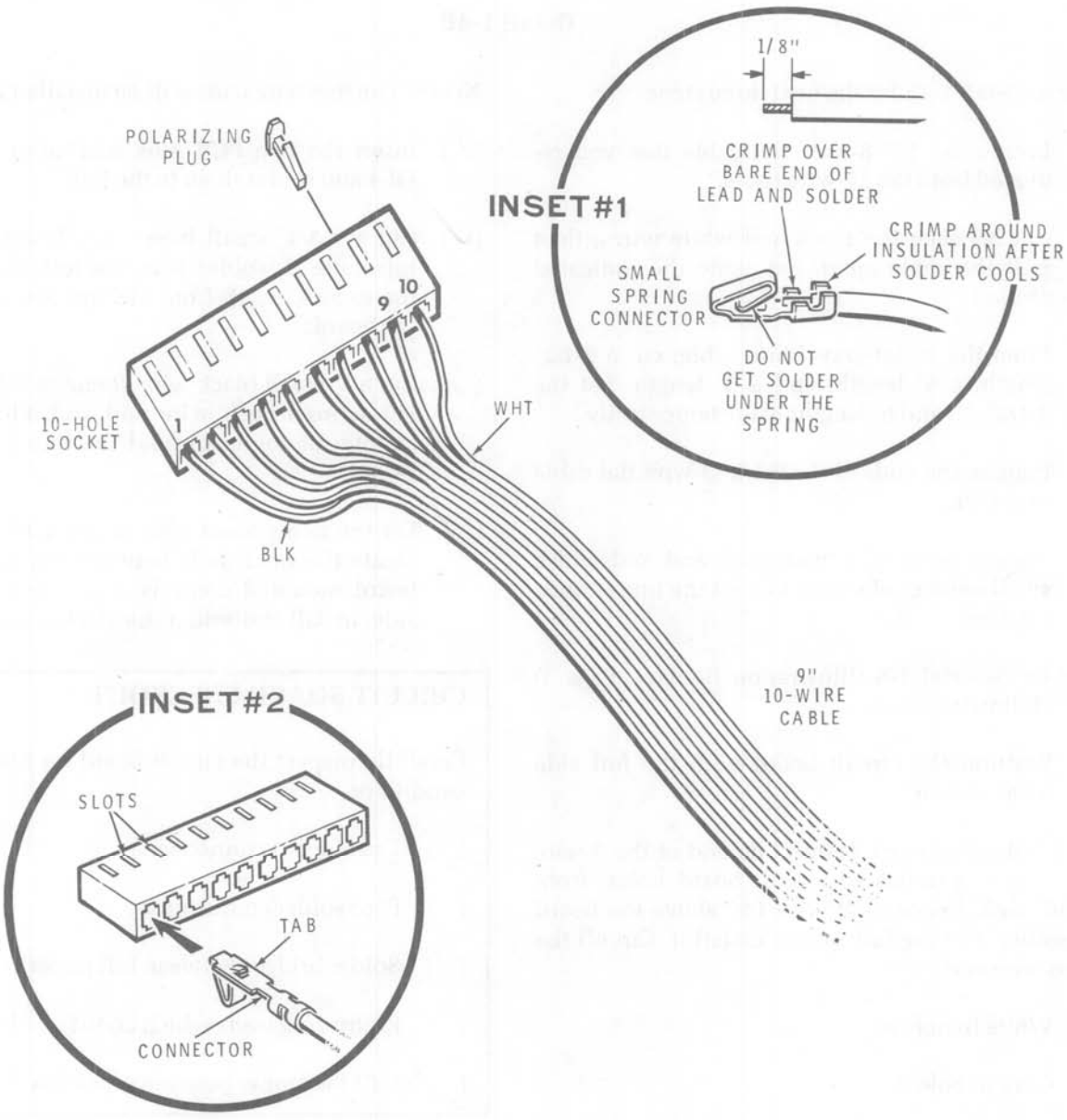
( ) Green in hole 6.

( ) Blue in hole 7.

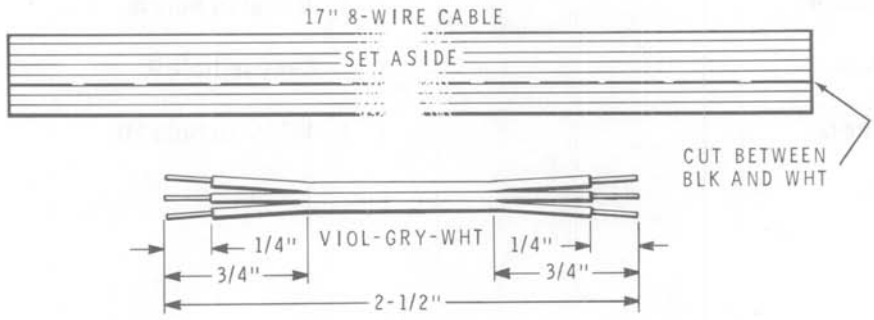
( ) Violet in hole 8.

( ) Gray in hole 9.

( ) White in hole 10.




**Detail 1-4A**




**Detail 1-4B**

Refer to Detail 1-4B for the next three steps.

( ) Locate the 17" 8-wire flat cable that you removed from the 25-wire cable.

( ) Cut between the black and white wires; then pull the cable apart. Set aside the indicated section.

( ) From the violet-gray-white cable, cut a 2-1/2" length, a 5" length, and a 6" length. Set the 3-1/2", 5", and 6" lengths aside temporarily.

( ) Prepare the ends of the 2-1/2" 3-wire flat cable as shown.

( ) Tightly twist each bare wire end and add a small amount of solder to hold the fine strands together.

Refer to Pictorial 1-5 (Illustration Booklet, Page 3) for the following steps.

( ) Position the circuit board with the foil side up as shown.

In the following steps, install one end of the 3-wire cable into the indicated circuit board holes, from the **foil** side. Space each wire 1/8" above the board and solder it to the foil as you install it. Cut off the excess wire end.

( ) White in hole A.

( ) Gray in hole B.

( ) Violet in hole C.

NOTE: The free wire ends will be installed later.

( ) Insert the two PCB pins into holes J363 and J364 and solder them to the foil.

( ) Cut a 1-3/4" small bare wire. Insert one end into hole D, solder it to the foil, and cut off the excess length from the component side of the board.

( ) Cut a 2" small black wire. Remove 1/4" of insulation from each wire end and add a small amount of solder to hold the fine strands together.

( ) On the component side of the circuit board, locate the small hole between the two circuit board mounted controls. Then, from the foil side, install and solder the black wire.

**CIRCUIT BOARD CHECKOUT**

Carefully inspect the circuit board for the following conditions.

( ) Unsoldered connections.

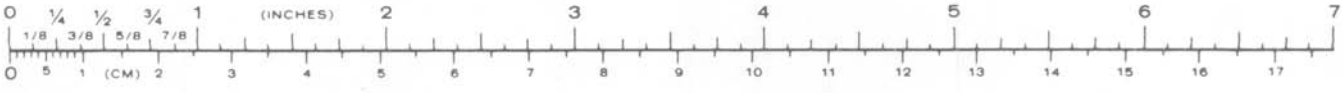
( ) Poor solder connections.

( ) Solder bridges between foil patterns.

( ) Protruding leads which could touch together.

( ) LED for proper position of the flat.

Set the control circuit board aside until it is called for later.



Heathkit®

# HIGH-VOLTAGE CIRCUIT BOARD

## PARTS LIST

Open Pack #2 and check each part against the following list. Do not remove components that are suppplied on a tape from the tape until you use them in a step. Return any part that is packed in an individual envelope, with the part number on it, back to the envelope after you identify it until that part is called for in a step. Do not throw away any packing material until all of the parts are accounted for.

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

**TAPED COMPONENTS**

Refer directly to the "Taped Component Chart (Pack #2)." Follow the instructions at the top of that chart to check the following components.

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| **RESISTORS** | | | |
| NOTE: The following resistors are rated at 1/4-watt and have a tolerance of 5% unless otherwise stated. A 5% tolerance is indicated by a fourth color band of gold. | | | |
| 6-229-12 | 2 | 2.2 Ω (red-red-gld) | R215, R216 |
| 6-330 | 1 | 33 Ω, 1/2-watt (org-org-blk) | R203 |
| 6-122 | 1 | 1200 Ω, 1/2-watt (brn-red-red) | R205 |
| 6-332-12 | 2 | 3300 Ω (org-org-red) | R207, R208 |
| **RESISTORS (Cont'd.)** | | | |
| 6-472-12 | 1 | 4700 Ω (yel-viol-red) | R206 |
| 6-562 | 1 | 5600 Ω, 1/2-watt (grn-blu-red) | R201 |
| 6-103-12 | 1 | 10 kΩ (brn-blk-org) | R217 |
| 6-124-12 | 1 | 120 kΩ (brn-red-yel) | R202 |
| 6-474-12 | 1 | 470 kΩ (yel-viol-yel) | R204 |
| **CAPACITOR** | | | |
| 21-762 | 1 | .1 μF (104) glass | C203 |

**NON-TAPED PARTS**

The following parts are not taped on strips. The key numbers correspond to the numbers on the "High-Voltage Circuit Board Parts Pictorial" (Illustration Booklet, Page 4).

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **RESISTORS, 1-WATT** | | | | |
| A1 | 6-104-1 | 1 | 100 kΩ (brn-blk-yel) | R211 |
| A1 | 6-684-1 | 1 | 680 kΩ (blue-gry-yel) | R212 |
| A1 | 6-105-1 | 2 | 1 MΩ (brn-blk-grn) | R213, R214 |
| **CAPACITORS** | | | | |
| **Ceramic** | | | | |
| B1 | 21-79 | 1 | .001 µF | C205 |
| B1 | 21-116 | 1 | .005 µF | C206 |
| B1 | 21-38 | 2 | .02 µF | C209, C211 |
| **Electrolytic** | | | | |
| B2 | 25-147 | 1 | 10 uF | C202 |
| B3 | 25-832 | 1 | 100 µF | C207 |
| **Other Capacitors** | | | | |
| B4 | 27-27 | 1 | .022 µF Mylar | C204 |
| B4 | 27-47 | 1 | .1 µF Mylar | C208 |
| B5 | 27-188 | 1 | .1 µF (0.1K) 250 V polystyrene | C201 |
| **TRANSISTOR-INTEGRATED CIRCUIT (IC)** | | | | |

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

1. Part number.
2. Type number (For integrated circuits, this refers only to the number and letters shown in **bold** print in the Parts List. Disregard any other numbers or letters in the IC.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

| | | | | |
|---|---|---|---|---|
| C1 | 417-834 | 1 | MPSU10 transistor | Q203 |
| C2 | 442-22 | 1 | **741** IC | U201 |

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **SOCKETS-BOOT** | | | | |
| D1 | 432-865 | 2 | Small 3-hole socket | |
| D2 | 432-1022 | 1 | Large 8-hole socket | |
| D3 | 432-1066 | 1 | Boot | |
| D4 | 434-230 | 1 | 8-pin IC socket | |
| **CLIP-CONNECTORS** | | | | |
| E1 | 432-753 | 8 | Large spring connector (1 extra) | |
| E2 | 432-866 | 6 | Small spring connector | |
| E3 | 432-1065 | 1 | Anode clip | |
| **HARDWARE** | | | | |
| F1 | 250-1414 | 4 | 4-40 × 1/4" screw | |
| F2 | 250-1428 | 2 | 6-32 × 1/4" screw | |
| F3 | 250-1307 | 2 | #6 × 1/4" sheet metal screw | |
| F4 | 252-85 | 2 | 6-32 spring nut | |
| F5 | 254-9 | 4 | #4 lockwasher | |
| F6 | 255-151 | 4 | 13/16" spacer | |
| **MISCELLANEOUS** | | | | |
| G1 | 10-1132 | 1 | 10 kΩ control | R209 |
| G2 | 51-193 | 1 | High-voltage transformer | T201 |
| | 85-2699-1 | 1 | High-voltage circuit board | |
| G3 | 57-610 | 1 | FM-50 diode | D201 |
| G4 | 205-1910 | 1 | Top shield | |
| G5 | 206-1449 | 1 | Transformer shield | |
| G6 | 206-1450 | 1 | Bottom shield | |
| | | 1 | Tape Chart | |

# STEP-BY-STEP ASSEMBLY

## START

( ) Position the high-voltage circuit board as shown.

NOTE: All resistors are 1/4-watt unless specified otherwise.

( ) R203: 33 Ω, 1/2-watt (org-org-blk).

( ) R202: 120 kΩ (brn-red-yel).

( ) R216: 2.2 Ω (red-red-gld).

( ) R201: 5600 Ω, 1/2-watt (grn-blu-red).

( ) R206: 4700 Ω (yel-viol-red).

( ) R205: 1200 Ω, 1/2-watt (brn-red-red).

( ) R217: 10 kΩ (brn-blk-org).

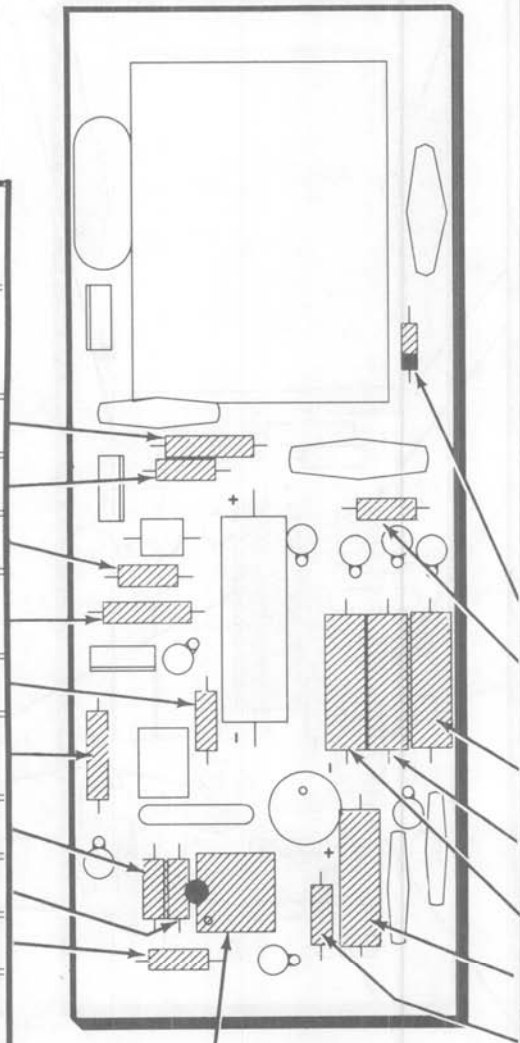
( ) R208: 3300 Ω (org-org-red).

( ) R207: 3300 Ω (org-org-red).

Refer to Figure 1 (Illustration Booklet, Page 1) when you install the following IC socket.

( ) 8-pin IC socket.

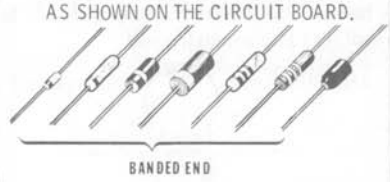
( ) Solder the leads to the foil and cut off the excess lead lengths.



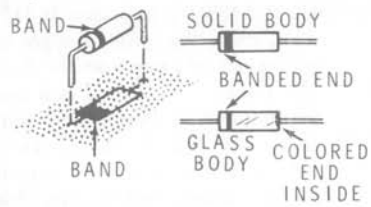
**PICTORIAL 2-1**

## CONTINUE

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




NOTE: When you install the following diodes, be sure to position the banded end as shown on the circuit board. When a diode is installed backward, the circuit WILL NOT WORK properly.




( ) D201: FM50 diode (#57-610).

( ) R204: 470 kΩ (yel-viol-yel).

( ) R211: 100 kΩ, 1-watt (brn-blk-yel).

( ) R212: 680 kΩ, 1-watt (blu-gry-yel).

( ) R213: 1 MΩ, 1-watt (brn-blk-grn).

( ) R214: 1 MΩ, 1-watt (brn-blk-grn).

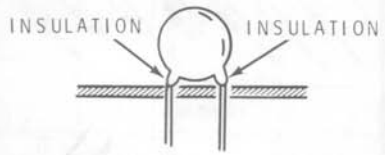
( ) R215: 2.2 Ω (red-red-gold).

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

## START

( ) C204: .022 µF Mylar.

NOTE: When you install ceramic capacitors, do not push the insulated portions of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil.




( ) C203: .1 µF (104) glass ceramic.

( ) C201: .1 µF (0.1K) polystyrene.

( ) Q203: MPSU10 transistor (#417-834). Place the beveled edges of the transistor **away from** the double line on the circuit board and insert the leads. Position the transistor 1/4" above the board. Then solder the leads to the foil and cut off the excess lead lengths. See Detail 2-2A.

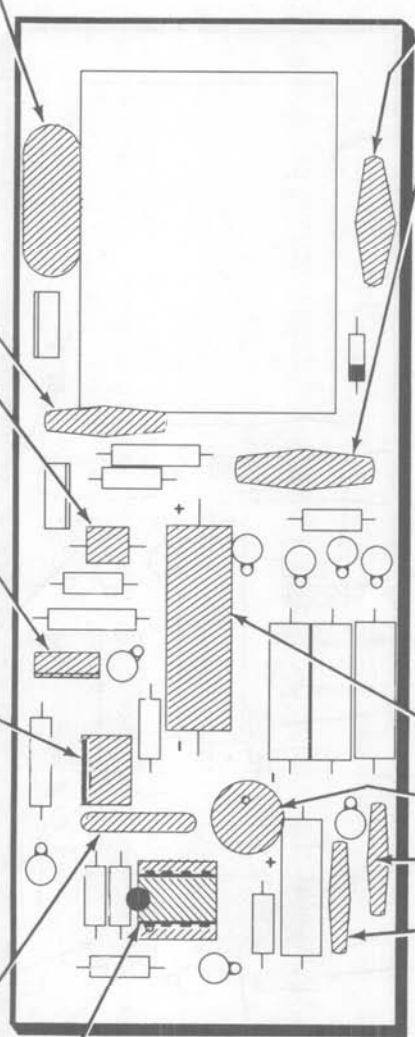
( ) R209: 10 kΩ control. Solder the leads to the foil and cut off the excess lengths. NOTE: Position the rotating front of the control toward the heavy line. Turn this control fully counterclockwise.

( ) C208: .1 µF Mylar.

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

Refer to Figure 1 (Illustration Booklet, Page 1) when you install the following IC.

( ) U201: **741** IC (#442-22).



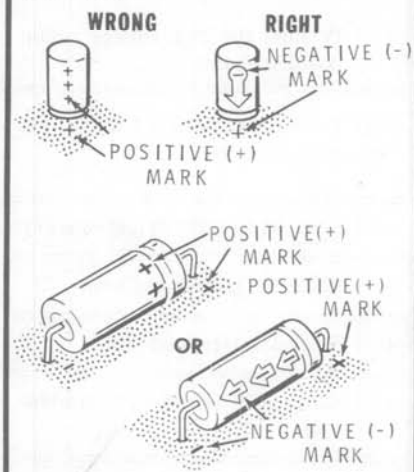
**PICTORIAL 2-2**

## CONTINUE

( ) C205: .001 µF ceramic.

( ) C206: .005 µF ceramic.

NOTE: Before you install an electrolytic capacitor, note the position of the identified (+ or –) lead. Be sure you connect the positive (+) lead to the positive (+) marked point on the circuit board.



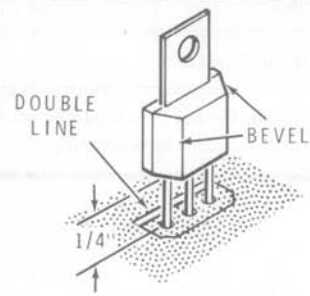

( ) C202: 10 µF electrolytic.

( ) C207: 100 µF electrolytic.

( ) C209: .02 µF ceramic.

( ) C211: .02 µF ceramic.

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




**Detail 2-2A**

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

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

( ) Locate the 5″ and the 6″ violet-gray-white 3-wire flat cables that you set aside earlier.

( ) As in a previous step, prepare both ends of the 5″ and 6″ viol-gry-wht cables. Remove 1/8″ of insulation from each wire end.

Refer to Part B of Detail 2-3A for the next four steps.

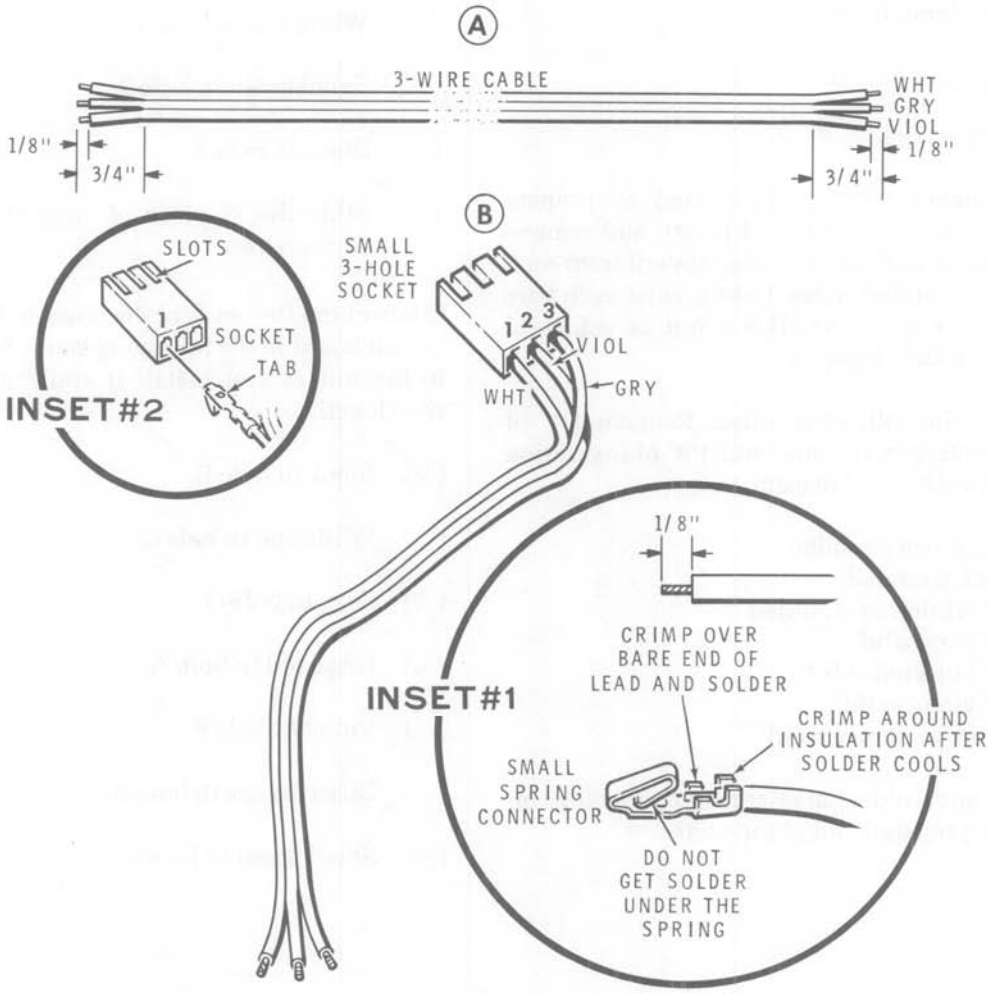
( ) Install a small spring connector on each wire at one end of each cable. See inset #1.

In the following steps, you will install the connectors into the small 3-hole sockets. Be sure to position the sockets with the slotted side up and the connectors with the small tab up when you insert them. See inset #2.

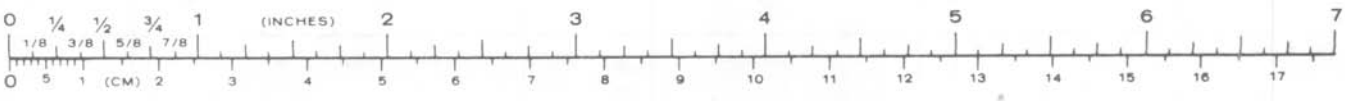
( ) White in hole 1.

( ) Violet in hole 2.

( ) Gray in hole 3.




**Detail 2-3A**



Refer to Pictorial 2-3 for the following steps.

Connect the free ends of the cables to the high voltage circuit board in the following steps. Solder each wire to the foil as you install it and cut off the excess wire length.

6″ CABLE AT Q202:

( ) Violet in hole C.

( ) Gray in hole B.

( ) White in hole E.

5″ CABLE AT Q201:

( ) Violet in hole C.

( ) Gray in hole B.

( ) White in hole E.

NOTE: Whenever you are instructed to prepare wires, cut them to the indicated length and remove 1/4″ of insulation (unless otherwise stated) from each wire end. On stranded wires, tightly twist each bare wire end, and apply a small amount of solder to hold the fine strands together.

( ) Prepare the following wires. Remove 1/4″ of insulation from one end and **1/8″ of insulation** from the other end of each wire.

9″ small green stranded
10″ black stranded
10-3/4″ white-red stranded
11-1/2″ gray solid
11-1/2″ large red solid
11-1/2″ violet solid
10-1/2″ large orange solid

( ) Crimp and solder large spring connectors on the 1/8″ prepared end of each wire.

Refer to Detail 2-3B for the following steps.

In the following steps, you will install the connectors into the large 8-hole socket. Be sure to position the socket with the slotted side up and the connectors with the small tab up when you insert them. See the inset drawing.

( ) Gray in hole 1.

( ) Violet in hole 2.

( ) Large orange in hole 3.

( ) Large red in hole 4.

( ) **No wire** in hole 5.

( ) White-red in hole 6.

( ) Small green in hole 7.

( ) Black in hole 8.

( ) Slide the 7″ piece of clear sleeving over the seven wires.

Connect the free ends of the wires to the high voltage circuit board in the following steps. Solder each wire to the foil as you install it and cut off the excess wire length.

( ) Black in hole E.

( ) White-red in hole C.

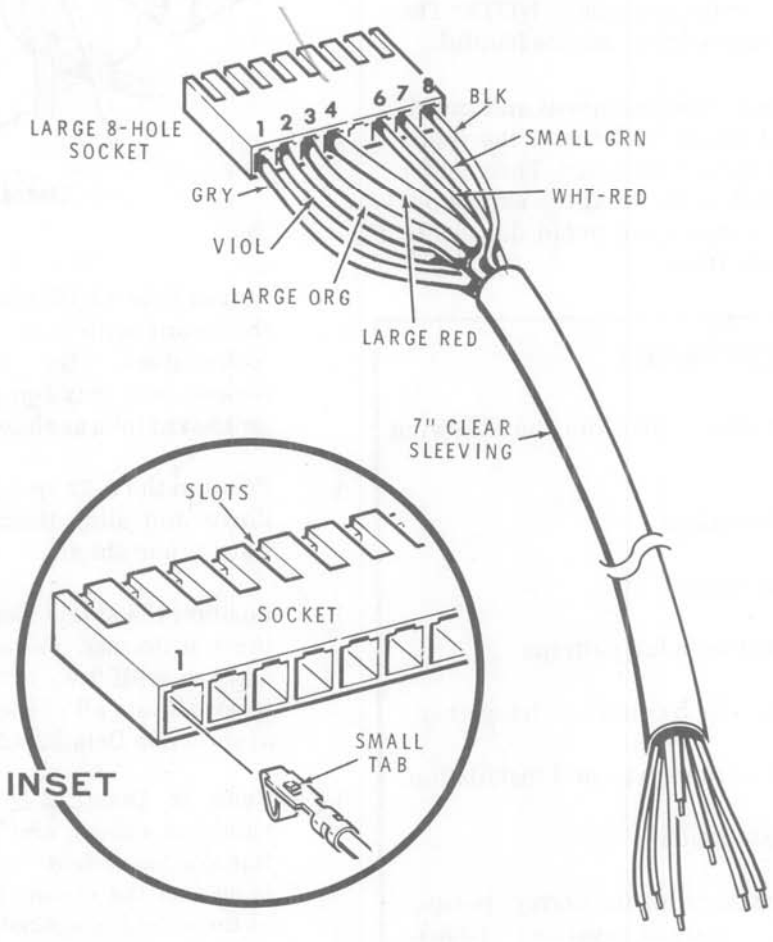
( ) Gray in hole G.

( ) Large red in hole A.

( ) Violet in hole F.

( ) Large orange in hole B.

( ) Small green in hole D.


LARGE 8-HOLE SOCKET
1 2 3 4 6 7 8
BLK
SMALL GRN
WHT-RED
GRY
VIOL
LARGE ORG
LARGE RED
7" CLEAR SLEEVING
SLOTS
SOCKET
1
SMALL TAB
INSET

**Detail 2-3B**

Refer to Pictorial 2-4 (Illustration Booklet, Page 5) for the following step.

( ) Position the boot as shown and slide it over the lead coming from the high voltage transformer.

( ) Insert the end of the lead 1/8" into the hole in the clip and solder it.

( ) After the connection cools, push the boot over the clip until it seats into place. NOTE: The blade of a small screwdriver may be helpful.

( ) Position the transformer as shown and install it on the circuit board. Make sure the transformer is seated against the board. Then solder the pins to the foil, and cut off the excess pin ends. NOTE: Be careful and avoid damage to the adjacent diode, D201.

## CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

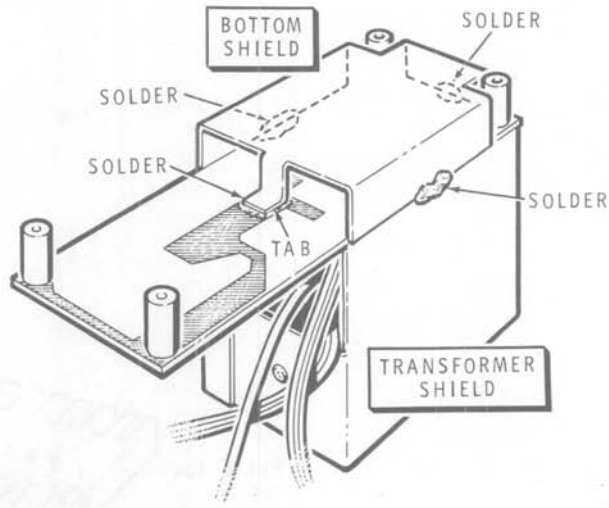
( ) Protruding leads which could touch together.

( ) Transistor for the proper type and installation.

( ) IC for proper installation.

( ) Electrolytic capacitors for the correct position of the positive (+) mark or negative (−) mark.

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




**Detail 2-4A**

( ) Mount four 13/16" spacers on the foil side of the board with 4-40 × 1/4" screws and #4 lockwashers. Be sure to install the lockwashers between the spacers and the circuit board foils as shown.

( ) Position the 6-32 spring nuts with the lip side down and slide them over the tabs on the transformer shield.

( ) Position the shield as shown and slide it over the transformer. Fasten it to the transformer bracket with two 6-32 × 1/4" sheet metal screws.Route all of the wires out of the shield as shown in Detail 2-4A.

( ) Refer to Detail 2-4A, position the bottom shield as shown, and slide its edges over the transformer shield. Make sure the shield tab is against the circuit board foil and the back of the shield is against the transformer shield. Solder the tab to the foil. Make sure the bottom shield is equally spaced from the circuit board. Then solder the back and two sides to the transformer shield.

( ) Mount the top shield on the transformer shield with two #6 × 1/4" sheet metal screws.

Set the high-voltage assembly aside until it is called for in a step.

# VERTICAL DEFLECTION CIRCUIT BOARD

## PARTS LIST

Open Pack #3 and check each part against the following list. Do not remove components that are supplied on a tape from the tape until you use them in a step. Return any part that is packed in an individual envelope, with the part number on it, back to the envelope after you identify it until that part is called for in a step. Do not throw away any packing material until all of the parts are accounted for.

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

**TAPED COMPONENTS**

Refer directly to the "Taped Component Chart (Pack #3)." Follow the instructions at the top of that chart to check the following components.

### RESISTORS

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

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| 6-229-12 | 2 | 2.2 Ω (red-red-gld) | R352, R353 |
| 6-220-12 | 4 | 22 Ω (red-red-blk) | R312, R313, R321, R326 |
| 6-330-12 | 2 | 33 Ω (org-org-blk) | R345, R346 |
| 6-3329-12 | 1 | 33.2 Ω, 1% (org-org-red-gld) | R333 |
| 6-390-12 | 2 | 39 Ω (org-wht-blk) | R347, R348 |
| 6-5119-12 | 2 | 51.1 Ω, 1% (grn-brn-brn-gld) | R327, R328 |
| 6-5629-12 | 2 | 56.2 Ω, 1% (grn-blu-red-gld) | R318, R329 |

### RESISTORS (Cont'd.)

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| 6-7159-12 | 2 | 71.5 Ω, 1% (viol-brn-grn-gld) | R303, R304 |
| 6-8069-12 | 2 | 80.6 Ω, 1% (gry-blk-blu-gld) | R315, R316 |
| 6-9319-12 | 4 | 93.1 Ω, 1% (wht-org-brn-gld) | R301, R302, R323, R324 |
| 6-1000-12 | 2 | 100 Ω, 1% (brn-blk-blk-blk) | R325, R339 |
| 6-1100-12 | 1 | 110 Ω, 1% (brn-brn-blk-blk) | R305 |
| 6-1870-12 | 2 | 187 Ω, 1% (brn-gry-viol-blk) | R319, R322 |
| 6-2150-12 | 1 | 215 Ω, 1% (red-brn-grn-blk) | R317 |
| 6-2550-12 | 2 | 255 Ω, 1% (red-grn-grn-blk) | R337, R338 |
| 6-4320-12 | 2 | 432 Ω, 1% (yel-org-red-blk) | R311, R314 |
| 6-9090-12 | 1 | 909 Ω, 1% (wht-blk-wht-blk) | R334 |
| 6-1691-12 | 1 | 1690 Ω, 1% (brn-blu-wht-brn) | R307 |
| 6-6981-12 | 1 | 6980 Ω, 1% (blu-wht-gry-brn) | R306 |

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| **CAPACITORS** | | | |
| 21-769 | 4 | .01 µF (103) glass ceramic | C304, C321, C325, C328 |

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| **CHOKES** | | | |
| 45-605 | 4 | .10 µH (slvr-gld-brn-blk-slvr) | L301, L302, L303, L304 |

**NON-TAPED PARTS**

The following parts are not taped on strips. The key numbers correspond to the numbers on the "Vertical Deflection Parts Pictorial" (Illustration Booklet, Page 6.)

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **RESISTORS** | | | | |
| A1 | 6-1370-1 | 2 | 137 Ω, 1-watt, 1% (brn-org-viol-blk) | R331, R332 |
| A2 | 3-58-5 | 1 | 150 Ω, 5-watt, 5% | R343 |
| A3 | 5-9-7 | 2 | 475 Ω, 7-watt, 1% | R341, R342 |
| **CAPACITORS** | | | | |
| **Ceramic** | | | | |
| B1 | 21-157 | 3 | 5 pF | C301, C302, C315 |
| B1 | 21-181 | 1 | 7.7 pF | C309 |
| B1 | 21-115 | 1 | 9 pF | C319 |
| B1 | 21-3 | 2 | 10 pF | C303, C312 |
| B1 | 21-710 | 2 | 47 pF | C311, C318 |
| B2 | 21-750 | 1 | 56 pF (560) | C316 |
| B1 | 21-75 | 1 | 100 pF (100k) | C308 |
| B2 | 21-715 | 1 | 150 pF (151) | C317 |
| B1 | 21-722 | 2 | 330 pF | C313, C314 |
| B1 | 21-171 | 2 | 680 pF | C305, C306 |
| B2 | 21-745 | 1 | 1500 pF (152) | C307 |
| B2 | 21-765 | 2 | .0033 µF (332) | C326, C327 |
| B1 | 21-43 | 1 | .001 µF | C322 |
| **Electrolytic** | | | | |
| B3 | 25-885 | 2 | 100 µF | C323, C324 |

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **TRANSISTORS** | | | | |

NOTE: Transistors may be marked for identification in any one of the following four ways:

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

| | | | | |
|---|---|---|---|---|
| C1 | 417-917 | 4 | MPSH81 | Q301, Q302, Q303, Q304 |
| C2 | 417-205 | 2 | 2N3866 | Q307, Q308 |
| C2 | 417-982 | 2 | MRF531 | Q313, Q314 |
| C2 | 417-893 | 2 | 2N5109 | Q305, Q306 |
| C2 | 417-976 | 2 | MRF525 | Q312, Q309 |
| **CONTROLS** | | | | |
| D1 | 10-1139 | 2 | 100 Ω | R335, R336 |
| D1 | 10-1102 | 1 | 500 Ω | R351 |
| D1 | 10-1103 | 2 | 2000 Ω (2K) | R308, R309 |
| **PLUGS-PINS** | | | | |
| E1 | 432-121 | 2 | PCB pin | |
| E2 | 432-969 | 1 | 5-pin straight plug | |
| E3 | 432-984 | 1 | 10-pin right-angle plug | |

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| KEY No. | HEATH Part No. | QTY. | DESCRIPTION |
|---|---|---|---|
| **HARDWARE** | | | |
| F1 | 250-1414 | 4 | 4-40 × 1/4" screw |
| F2 | 252-2 | 2 | 4-40 nut |
| F3 | 253-198 | 2 | Nylon shoulder washer |
| F4 | 254-9 | 2 | #4 lockwasher |

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **MISCELLANEOUS** | | | | |
| G1 | 40-1928 | 2 | 21 µH coil | L305, L306 |
| G2 | 45-619 | 2 | .68 µH choke (slvr-gld-blu-gry-slvr) | L307, L308 |
| G2 | 45-620 | 2 | 1.5 µH choke (slvr-brn-gld-grn-slvr) | L313, L314 |
| G3 | 75-827 | 2 | Beryllium flat washer | |
| | 85-2703-1 | 1 | Vertical deflection circuit board | |
| G4 | 204-2640 | 1 | Bracket | |
| G5 | 215-679 | 2 | Heat sink | |
| | | 1 | Tape Chart | |

4 10uH SIL/GLD/BRN/BLK/SIL
L301 – L304

# STEP-BY-STEP ASSEMBLY

**START**

( ) Position the vertical deflection circuit board as shown.

NOTE: To read the color bands on chokes, always start with the wide band and read to the right. All resistors are 1/4-watt unless specified otherwise.

( ) L304: .10 µH choke (slvr-gld-brn-blk-slvr) (#45-605).

( ) L302: .10 µH choke (slvr-gld-brn-blk-slvr) (#45-605).

( ) R305: 110 Ω, 1% (brn-brn-blk-blk).

( ) R306: 6980 Ω, 1% (blu-wht-gry-brn).

( ) R307: 1690 Ω, 1% (brn-blu-wht-brn).

( ) R312: 22 Ω, (red-red-blk).

( ) R314: 432 Ω, 1% (yel-org-red-blk).

( ) C304: .01 µF (103) glass ceramic.

( ) R325: 100 Ω, 1% (brn-blk-blk-blk).

( ) R327: 51.1 Ω, 1% (grn-brn-brn-gld).

( ) R328: 51.1 Ω, 1% (grn-brn-brn-gld).

( ) R329: 56.2 Ω, 1% (grn-blu-red-gld).

( ) R333: 33.2, 1% (org-org-red-gld).

( ) R348: 39 Ω (org-wht-blk).

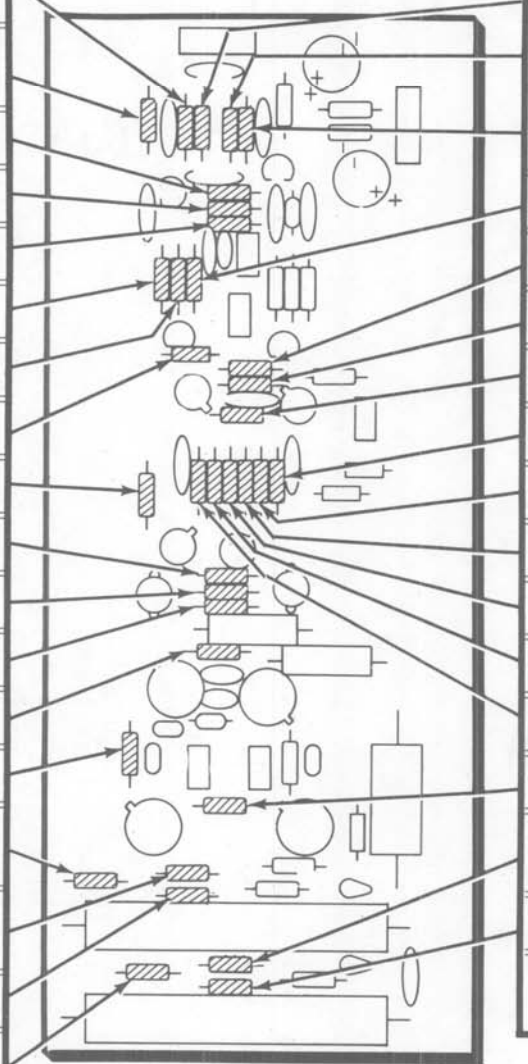
( ) L314: 1.5 µH choke (slvr-brn-gld-grn-slvr) (#45-620).

( ) L308: .68 µH choke (slvr-gld-blu-gry-slvr) (#405-619).

( ) R338: 255 Ω, 1% (red-grn-grn-blk).

( ) L313: 1.5 µH (slvr-brn-gld-grn-slvr) (#45-620).

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



PICTORIAL 3-1

**CONTINUE**

( ) R302: 93.1 Ω, 1% (wht-org-brn-gld).

( ) R301: 93.1 Ω, 1% (wht-org-brn-gld).

( ) L303: .10 µH choke (slvr-gld-brn-blk-slvr) (#45-605).

( ) R304: 71.5 Ω, 1% (viol-brn-grn-gld).

( ) R315: 80.6 Ω, 1% (gry-blk-blu-gld).

( ) R316: 80.6 Ω, 1% (gry-blk-blu-gld).

( ) R318: 56.2 Ω, 1% (grn-blu-red-gld).

( ) R323: 93.1 Ω, 1% (wht-org-brn-gld).

( ) R321: 22 Ω (red-red-blk).

( ) R319: 187 Ω, 1% (brn-gry-viol-blk).

( ) R322: 187 Ω, 1% (brn-gry-viol-blk).

( ) R326: 22 Ω (red-red-blk).

( ) R324: 93.1 Ω, 1% (wht-org-brn-gld).

( ) R334: 909 Ω, 1% (wht-blk-wht-blk).

( ) L307: .68 µH choke (slvr-gld-blu-gry-slvr) (#45-619).

( ) R337: 255 Ω, 1% (red-grn-grn-blk).

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

**START**

( ) L301: .10 µH choke (slvr-gld-brn-blk-slvr) (#45-605).

(✓) R353: 2.2 Ω (red-red-gld).

( ) R352: 2.2 Ω (red-red-gld).

( ) R303: 71.5 Ω, 1% (viol-brn-grn-gld).

(✓) R313: 22 Ω (red-red-blk).

( ) R311: 432 Ω, 1% (yel-org-red-blk).

( ) R317: 215 Ω, 1% (red-brn-grn-blk).

( ) C328: .01 µF (103) glass ceramic.

( ) C325: .01 µF (103) glass ceramic.

( ) R347: 39 Ω (org-wht-blk).

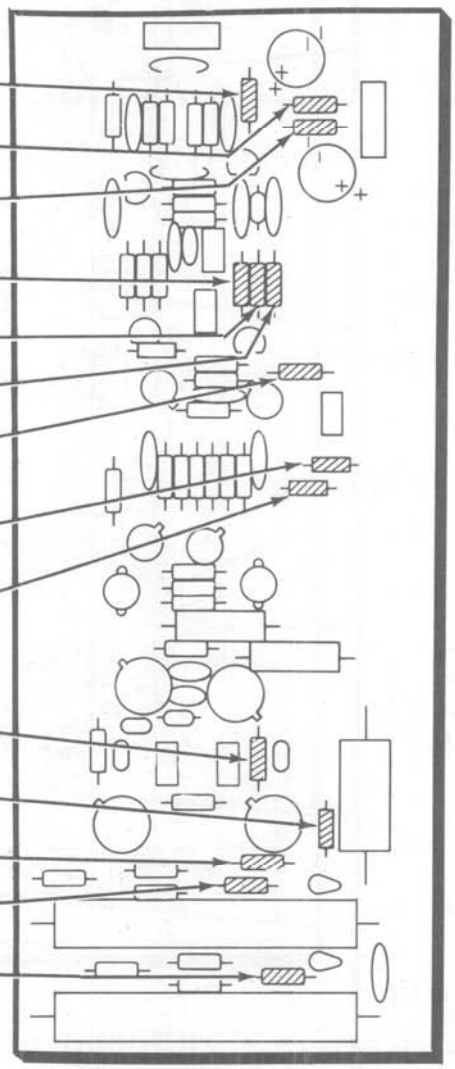
( ) C321: .01 µF (103) glass ceramic).

(✓) R339: 100 Ω, 1% (brn-blk-blk-blk).

(✓) R346: 33 Ω (org-org-blk).

(✓) R345: 33 Ω (org-org-blk).

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



**PICTORIAL 3-2**

**START**

( ) C303: 10 pF ceramic.

( ) C301: 5 pF ceramic.

( ) C302: 5 pF ceramic.

( ) C312: 10 pF ceramic.

( ) C306: 680 pF ceramic.

( ) C311: 47 pF ceramic.

( ) C309: 7.7 pF ceramic. Use pliers to spread these leads slightly, if necessary.

( ) C315: 5 pF ceramic.

( ) C314: 330 pF ceramic.

( ) C318: 47 pF ceramic.

( ) C319: 9 pF ceramic.

( ) C317: 150 pF (151) ceramic.

( ) C316: 56 pF (560) ceramic.

( ) C327: 3300 pF (332) ceramic.

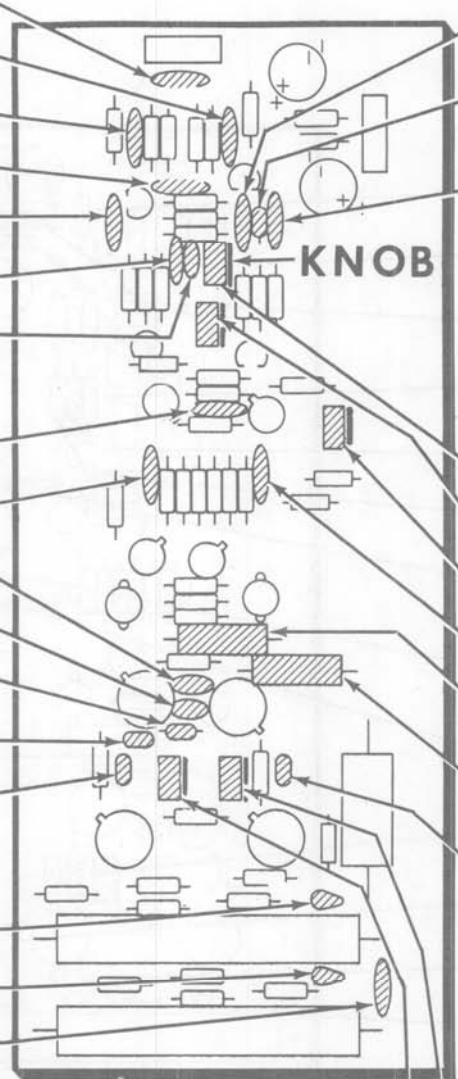
NOTE: As you install each of the following PCB pins, solder it to the foil.

( ) PCB pin.

( ) PCB pin.

( ) C322: .001 µF ceramic.

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




**PICTORIAL 3-3**

**CONTINUE**

( ) C308: 100 pF (100k) ceramic.

( ) C307: 1500 pF (152) ceramic. Use pliers to bend the leads inward slightly, if necessary.

( ) C305: 680 pF ceramic.

NOTE: When you install the five controls in this Pictorial, position the knobs of all controls toward the right edge of the board as shown in the Pictorial. Push each control down tight against the board, solder the leads to the foil, and cut off the excess lead lengths.

( ) R309: 2000 Ω (2k) control.

( ) R308: 2000 Ω (2k) control.

( ) R351: 500 Ω control.

( ) C313: 330 pF ceramic.

( ) R332: 137 Ω, 1%, 1-watt (brn-org-viol-blk).

( ) R331: 137 Ω, 1%, 1-watt (brn-org-viol-blk).

( ) C326: 3300 pF (332) ceramic.

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

NOTE: After you vertically-mount the next two controls, **before you solder the leads,** bend the controls upward to an approximate 45° angle. Then solder the leads as you hold the controls at the desired angle.

( ) R335: 100 Ω control.

( ) R336: 100 Ω control.

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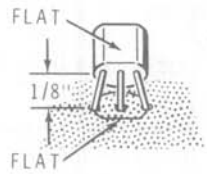
## START

NOTE: When you install each of the following transistors, position the flat on the transistor over the outline of the flat on the circuit board. Then insert the leads into the circuit board holes and solder them to the foil. Cut off any excess lead lengths.



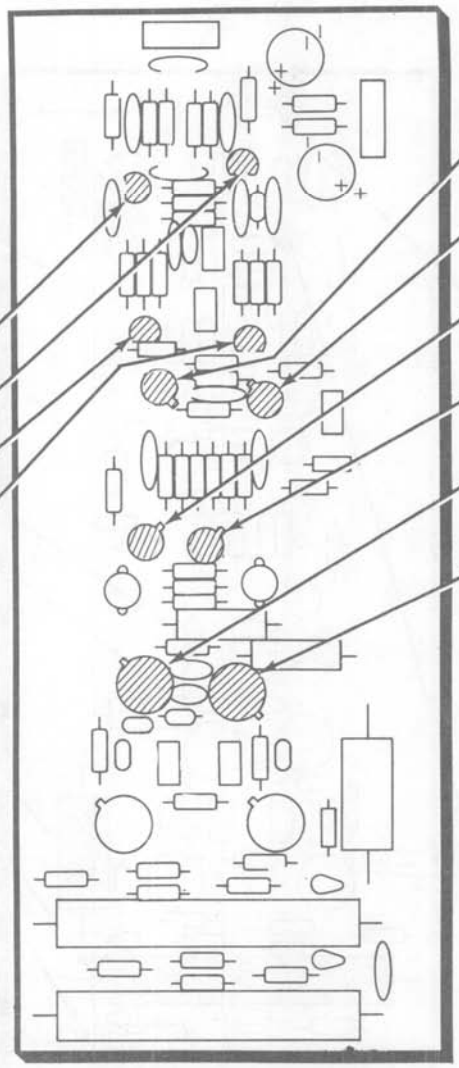

Locate four MPSH81 transistors (#417-917) and install them in the following steps.

( ) Q302: .....

( ) Q301: .....

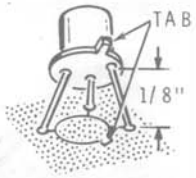
( ) Q304: .....

( ) Q303: .....



## CONTINUE

NOTE: When you install each of the following transistors, position the tab over the outline of the tab on the circuit board. Then insert the leads into the circuit board holes and solder them to the foil. Cut off the excess lead lengths.




( ) Q306: 2N5109 transistor (#417-893).

( ) Q305: 2N5109 transistor (#417-893).

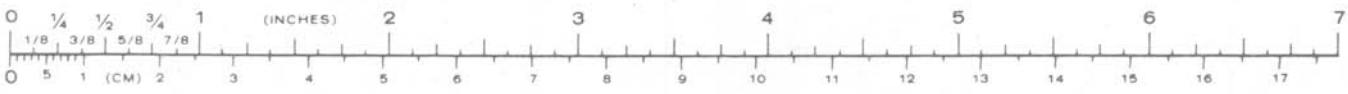
( ) Q308: 2N3866 transistor (#417-205).

( ) Q307: 2N3866 transistor (#417-205).

( ) Q312: MRF525 transistor (#417-976).

( ) Q309: MRF525 transistor (#417-976).

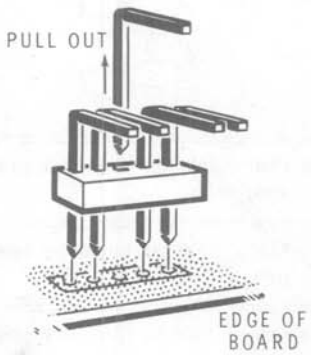
**PICTORIAL 3-4**



**START**

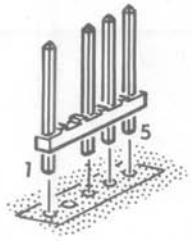
( ) Locate the 10-pin right-angle plug. Cut this plug exactly in the center to make two 5-pin plugs. Save one of these plugs for use with Pack 4.

( ) Pull out and discard the center pin of a 5-pin right-angle plug as shown.

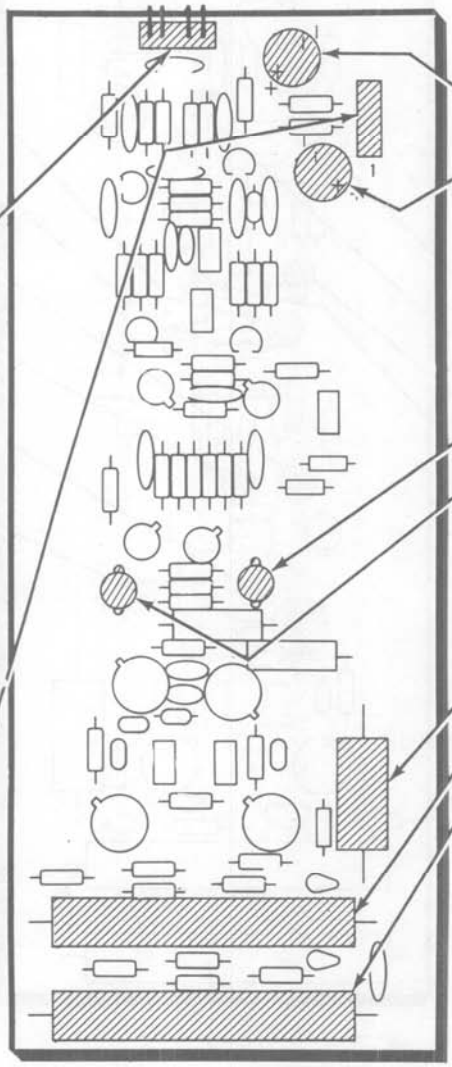



( ) P301: Position the plug so the pins point toward the edge of the board as shown. Install the plug and cut off the excess pins.

( ) Locate the 5-pin straight plug. Pull out and discard the second pin from either end as shown.

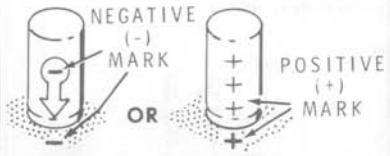



( ) P302: Install the plug. Position the end that has the pin removed nearest the #1 location on the board. Solder the pins to the foil and cut off the excess pins.



**CONTINUE**

NOTE: When you install the electrolytic capacitors, always match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board OR match the negative (–) mark on the capacitor with the negative (–) mark on the circuit board.




( ) C324: 100 µF electrolytic.

( ) C323: 100 µF electrolytic.

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

NOTE: As you install each of the next two coils, solder the leads to the foil and cut off the excess lead lengths.

( ) L305: 21 µH coil (#40-1928).

( ) L306: 21 µH coil (#40-1928).

NOTE: When you install each of the next three resistors, position it 1/4" above the board. Solder the leads to the foil and cut off the excess lead lengths.

( ) R343: 150 Ω, 10%, 5-watt.

( ) R342: 475 Ω, 1%, 7-watt.

( ) R341: 475 Ω, 1%, 7-watt.

**PICTORIAL 3-5**

## CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

( ) Protruding leads which could touch together.

( ) Transistors for the proper installation.

( ) Electrolytic capacitors for the correct position of the positive (+) mark.

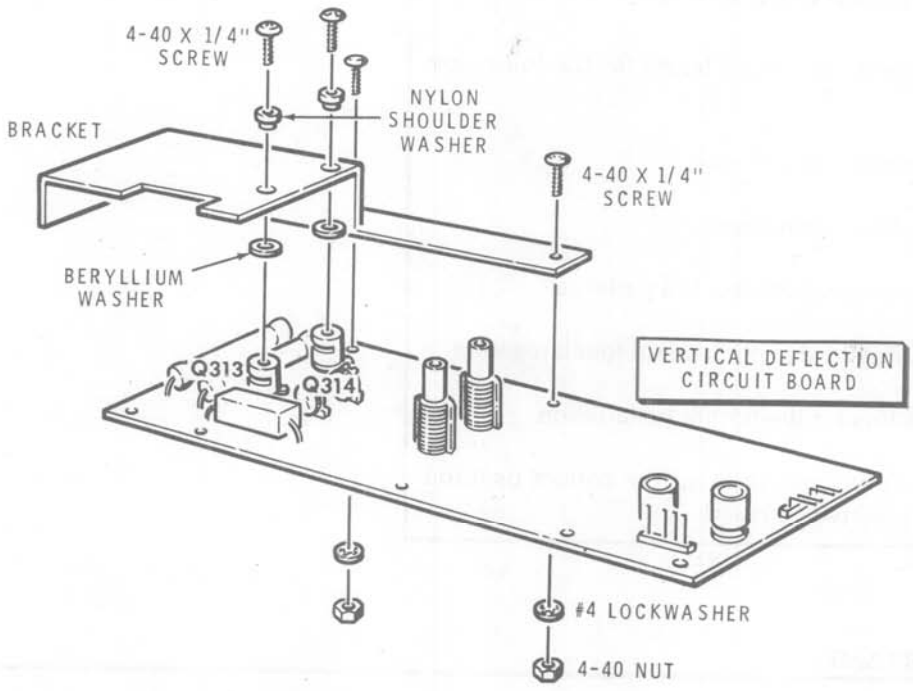
**VERY IMPORTANT:**

### BERYLLIUM OXIDE (BeO) WASHERS

The ceramic washers you will use in the following steps are made of high-fired beryllium oxide (BeO). We chose this particular material because of its superior thermal conductivity and high electrical resistivity — it is by far the best substance we know of to efficiently transmit the heat of the transistors to the heat sink where it is dissipated into the air. While the normal installation and use of these ceramic washers is totally safe and will not expose you to any danger, nevertheless, we should caution you that beryllium oxide in its vapor and dust forms is a deadly poison and should never be swallowed, breathed, or brought into contact with the skin or eyes. Under no circumstances should the beryllium oxide ceramic washers be drilled, chipped, crushed, sawed, ground, filed, or subjected to any other dust producing operation. The washers should never be heated to over 1,000°C (the unit has been designed so that the washers will not be subjected to temperature in excess of 100°C).

Should these washers become cracked, chipped, or even pulverized or should dust be produced in any other way, remove the small pieces (and dust) with a wet paper towel. Then discard the towel in a sealed plastic bag. Beryllium oxide dust or particles should never be swept or vacuumed.

Wash your hands thoroughly after any contact with the beryllium oxide washers.




**PICTORIAL 3-6**

Refer to Pictorial 3-6 for the following steps.

( ) Refer to Detail 3-6A and push two MRF531 transistors (#417-205) into heat sinks in the manner shown.

**Detail 3-6A**

( ) Loosely mount the top of each transistor heat sink to the bracket with a beryllium washer, a nylon shoulder washer, and a 4-40 × 1/4" screw.

( ) Carefully aligning each transistor's leads with its corresponding holes in the circuit board, secure the bracket to the side of the vertical deflection circuit board with 4-40 × 1/4" hardware as shown.

( ) Snug the two transistor heat sink mounting screws, making sure the nylon shoulder washers are centered in their holes.

( ) Turn the circuit board over and solder all six transistor leads to the foils. Cut off the excess lead lengths.

( ) Tighten the heat sink screws.

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

Heathkit®

# LOW-VOLTAGE CIRCUIT BOARD

## PARTS LIST

Open Pack #4 and check each part against the following list. Do not remove components that are supplied on a tape from the tape until you use them in a step. Return any part that is packed in an individual envelope, with the part number on it, back to the envelope after you identify it until that part is called for in a step. Do not throw away any packing material until all of the parts are accounted for.

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

**TAPED COMPONENTS**

Refer directly to the "Taped Component Chart (Pack #4)." Follow the instructions at the top of that chart to check the following components.

### RESISTORS

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

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| 6-229-12 | 3 | 2.2 Ω (red-red-gld) | R174, R175, R176 |
| 6-279-12 | 1 | 2.7 Ω (red-viol-gld) | R115 |
| 6-390-12 | 1 | 39 Ω (org-wht-blk) | R108 |
| 6-470-12 | 1 | 47 Ω (yel-viol-blk) | R147 |
| 6-101-12 | 2 | 100 Ω (brn-blk-brn) | R139, R153 |
| 6-2000-12 | 1 | 200 Ω, 1% (red-blk-blk-blk) | R126 |
| 6-2370-12 | 1 | 237 Ω, 1% (red-org-viol-blk) | R132 |
| 6-471-12 | 2 | 470 Ω (yel-viol-brn) | R113, R159 |

### RESISTORS (Cont'd.)

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| 6-511-12 | 1 | 510 Ω (grn-brn-brn) | R172 |
| 6-7150-12 | 2 | 715 Ω, 1% (viol-brn-grn-blk) | R112, R133 |
| 6-821-12 | 1 | 820 Ω (gry-red-brn) | R162 |
| 6-102-12 | 4 | 1000 Ω, 5% (brn-blk-red) | R103, R128, R134, R136, R154 |
| 6-1001-12 | 2 | 1000 Ω, 1% (brn-blk-blk-brn) | R129, R131 |
| 6-1431-12 | 1 | 1430 Ω, 1% (brn-yel-org-brn) | R107 |
| 6-222-12 | 1 | 2200 Ω (red-red-red) | R165 |
| 6-2211-12 | 1 | 2210 Ω, 1% (red-red-brn-brn) | R125 |
| 6-272-12 | 4 | 2700 Ω (red-viol-red) | R141, R142, R148, R157 |
| 6-332-12 | 2 | 3300 Ω (org-org-red) | R135, R137 |
| 6-392-12 | 1 | 3900 Ω (org-wht-red) | R145 |
| 6-472-12 | 2 | 4700 Ω (yel-viol-red) | R143, R155 |
| 6-4751-12 | 1 | 4750 Ω, 1% (yel-viol-grn-brn) | R117 |

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| **RESISTORS (Cont'd)** | | | |
| 6-562-12 | 1 | 5600 Ω (grn-blu-red) | R144 |
| 6-752-12 | 1 | 7500 Ω (viol-grn-red) | R152 |
| 6-103-12 | 2 | 10 kΩ (brn-blk-org) | R156, R161 |
| 6-123-12 | 1 | 12 kΩ (brn-red-org) | R163 |
| 6-1432-12 | 2 | 14.3 kΩ, 1% (brn-yel-org-red) | R109, R111 |
| 6-183-12 | 1 | 18 kΩ (brn-gry-org) | R114 |
| 6-273-12 | 2 | 27 kΩ (red-viol-org) | R103, R146 |
| 6-333-12 | 1 | 33 kΩ (org-org-org) | R121 |
| 6-473-12 | 1 | 47 kΩ (yel-viol-org) | R151 |
| 6-683-12 | 2 | 68 kΩ (blu-gry-org) | R119, R168 |
| 6-753-12 | 3 | 75 kΩ (viol-grn-org) | R122, R123, R124 |
| 6-8062-12 | 3 | 80.6 kΩ, 1% (gry-blk-blu-red) | R106, R116, R118 |
| 6-104-12 | 2 | 100 kΩ (brn-blk-yel) | R149, R158 |
| 6-474-12 | 1 | 470 kΩ (yel-viol-yel) | R169 |
| 6-105-12 | 2 | 1 MΩ (brn-blk-grn) | R127, R171 |

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| **DIODES** | | | |
| 56-16 | 1 | 1N5231B | D106 |
| 56-24 | 7 | 1N458 | D122-D128 |
| 56-26 | 2 | 1N191 (brn-wht-brn) | D117, D121 |
| 56-85 | 1 | 5V zener | D107 |
| 57-27 | 15 | 1N2071 | D101-D105 D108-D116, D118, D119 |

**NON-TAPED PARTS**

The following parts are not taped on strips. The key numbers correspond to the numbers on the "Low-Voltage Circuit Board Parts Pictorial" (Illustration Booklet, Page 7.)

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **RESISTORS, 10%, 5-WATT, WIRE-WOUND** | | | | |
| A1 | 3-35-5 | 1 | 39 Ω | R105 |
| A1 | 3-16-5 | 1 | 175 Ω | R104 |
| **RESISTORS, 5%, 1/4-WATT (added)** | | | | |
| | 6-122-12 | 1 | 1200 Ω (brn-red-red) | R165 |
| | 6-152-12 | 1 | 1500 Ω (brn-grn-red) | R162 |
| | 6-752-12 | 1 | 7500 Ω (viol-grn-red) | R167 |
| | 6-823-12 | 1 | 82 kΩ (gry-red-org) | R177 |
| | 6-154-12 | 1 | 150 kΩ (brn-grn-yel) | R101 |
| **CAPACITORS** | | | | |
| **Ceramic** | | | | |
| B1 | 21-33 | 1 | 3.3 pF | C151 |
| B1 | 21-120 | 2 | 500 pF | C152, C153 |
| B1 | 21-26 | 1 | .003 µF | C149 |

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **CAPACITORS (Cont'd.)** | | | | |
| B1 | 21-16 | 13 | .01 µF | C101-C105, C118, C119, C121, C122, C129, C131, C132, C133 |
| B1 | 21-765 | 1 | .0033 µF (332) | C147 |
| **Electrolytic** | | | | |
| B2 | 25-299 | 2 | 1.5 µF | C106, C148 |
| B3 | 25-880 | 11 | 10 µF vertical | C123, C126, C127, C128, C134-C139, C142 |
| B4 | 25-147 | 1 | 10 µF horizontal | C113 |
| B4 | 25-16 | 1 | 20 µF | C107 |
| B4 | 25-852 | 3 | 100 µF | C108, C109, C112 |
| B5 | 25-269 | 2 | 2000 µF | C124, C125 |
| B5 | 25-895 | 2 | 2200 µF | C157, C158 |
| **DIODE** | | | | |
| | 56-48 | 1 | BZT110A | D129 |

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **Other Capacitors** | | | | |
| B6 | 27-191 | 1 | .01 μF Mylar | C145 |
| B6 | 27-193 | 1 | .047 μF Mylar | C111 |
| B7 | 27-188 | 8 | .1 μF (.1K) polystyrene | C114, C115, C116, C117, C141, C143, C146, C156 |
| B8 | 20-105 | 1 | 180 pF mica | C154 |
| B9 | 28-5 | 1 | .22 pF phenolic (red-red-gry-slvr) | C144 |
| B10 | 23-115 | 1 | .1 μF paper | C155 |
| **TRANSISTORS-INTEGRATED CIRCUITS (IC's)** | | | | |
| D1 | 417-260 | 1 | 2N4258A transistor | Q108 |
| D1 | 417-295 | 3 | MPSL51 transistor | Q101, Q109, Q112 |
| D1 | 417-811 | 6 | MPSL01 transistor | Q102, Q103, Q104, Q106, Q111, Q113 |
| D1 | 417-875 | 1 | 2N3904 transistor | Q107 |
| D2 | 442-22 | 1 | **741** IC | U102 |
| D3 | 417-856 | 1 | MJE5979 transistor | Q105 |
| D3 | 442-603 | 1 | **78M05** IC | U104 |
| D3 | 442-708 | 1 | LM**317** | U101 |
| D3 | 442-709 | 2 | LM**337** | U103, U105 |

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

1. Part number.
2. Type number (On integrated circuits, this refers only to the numbers and letters shown in **bold** print in the Parts List. Disregard any other numbers or letters on the IC.
3. Part number and type number.
4. Part number with a type number other than the one listed.

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **SOCKETS-PLUGS-PINS** | | | | |
| E1 | 432-121 | 1 | PCB pin | |
| E2 | 432-825 | 1 | Large 6-pin plug | |
| E3 | 432-827 | 1 | Large 4-pin plug | |
| E4 | 432-829 | 2 | Large 3-pin plug | |
| E5 | 432-865 | 1 | Small 3-hole socket | |
| E6 | 432-866 | 32 | Small spring connector (1 extra) | |
| E7 | 432-876 | 1 | 8-pin plug | |
| E8 | 432-958 | 1 | Small 10-hole socket | |
| E9 | 432-970 | 1 | Small 5-hole socket | |
| E10 | 432-984 | 1 | Small 10-pin right-angle plug | |
| E11 | 432-1010 | 1 | Small 15-hole socket | |
| E12 | 432-1130 | 1 | Small 6-pin plug | |
| E13 | 434-230 | 1 | 8-pin IC socket | |
| E14 | 438-55 | 3 | Polarizing plug | |
| **HARDWARE** | | | | |
| F1 | 250-1415 | 7 | 4-40 × 3/8" screw | |
| F2 | 250-1428 | 1 | 6-32 × 1/4" screw | |
| F3 | 252-2 | 7 | 4-40 nut | |
| F4 | 253-198 | 5 | Nylon shoulder washer | |
| F5 | 254-9 | 7 | #4 lockwasher | |
| F6 | 254-1 | 1 | #6 lockwasher | |
| **MISCELLANEOUS** | | | | |
| G1 | 10-1141 | 1 | 1000 Ω (1K) control | R166 |
| G1 | 10-1138 | 2 | 10 kΩ control | R138, R164 |
| G1 | 10-1142 | 1 | 100 k control | R102 |
| G2 | 75-139 | 5 | Transistor insulator | |
| G3 | 204-2607 | 1 | Heat sink | |
| G4 | 255-63 | 1 | 2" spacer | |
| G5 | 352-13 | 2 1 | Silicone grease | |
| G6 | 354-6 | 5 | Cable tie | |
| | | 1 | Tape Chart (2-Page) | |
| **PART FROM FINAL PACK** | | | | |
| | 85-2882-1 | 1 | Low-voltage power supply circuit board (under cabinet components) | |

# STEP-BY-STEP ASSEMBLY

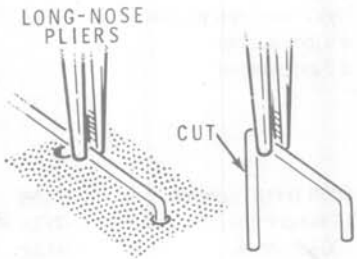
**START**

( ) Position the circuit board as shown.

In the following steps, you will install a bare wire at each of the 45 jumper o——J——o locations. Use the small bare wire and install each of the jumpers as follows:

1. Make a 90° bend approximately 1/4" from one end of the wire.

2. Insert the 90° bend into one hole at the jumper location and dress the wire toward the other hole. Grasp the wire with a pair of long-nose pliers at this second hole. Remove the wire (still holding it with the pliers). Make another 90° bend and cut the wire.




3. Install the wire and bend the ends outward to hold it in place.

4. After you have installed the bare wires, turn the circuit board over and solder the wires to the foil. Then cut off the excess wire lengths.

Install a bare wire at each of the 45 numbered locations. Install them in the numbered sequence and check off the steps in the right-hand column.

( ) Check and make sure none of the bare jumper wires touch other jumpers.

**CONTINUE**

1. ( )
2. ( )
3. ( )
4. ( )
5. ( )
6. ( )
7. ( )
8. ( )
9. ( )
10. ( )
11. ( )
12. ( )
13. ( )
14. ( )
15. ( )
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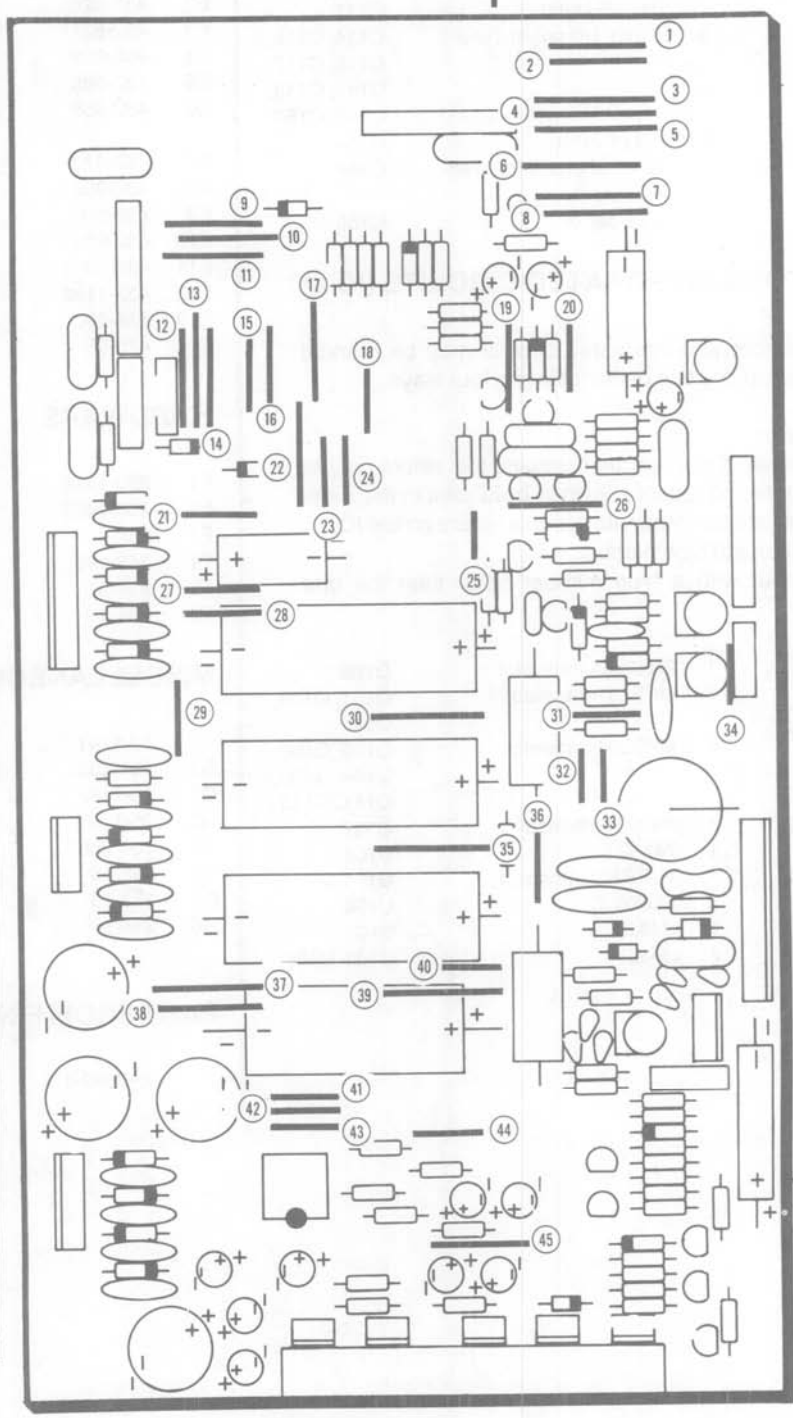
40. ( )
41. ( )
42. ( )
43. ( )
44. ( )
45. ( )



**PICTORIAL 4-1**

## START

NOTE: In some of the following Pictorials, you will be working with either the left half of the board or the right half. In this Pictorial, you will be working with the left half.

NOTES:

1. Install diodes as stated in Detail 4-2A.
2. All resistors are 1/4-watt, 5%, unless otherwise noted.

( ) R124: 75 kΩ (viol-grn-org).

( ) R123: 75 kΩ (viol-grn-org).

( ) D101: 1N2071 diode (#57-27).

( ) D105: 1N2071 diode (#57-27).

( ) D104: 1N2071 diode (#57-27).

( ) D103: 1N2071 diode (#57-27).

( ) D102: 1N2071 diode (#57-27).

( ) R122: 75 kΩ (viol-grn-org).

( ) D109: 1N2071 diode (#57-27).

( ) D108: 1N2071 diode (#57-27).

( ) D112: 1N2071 diode (#57-27).

( ) D111: 1N2071 diode (#57-27).

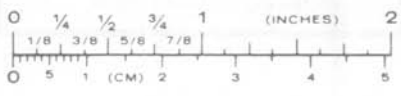
( ) D113: 1N2071 diode (#57-27).

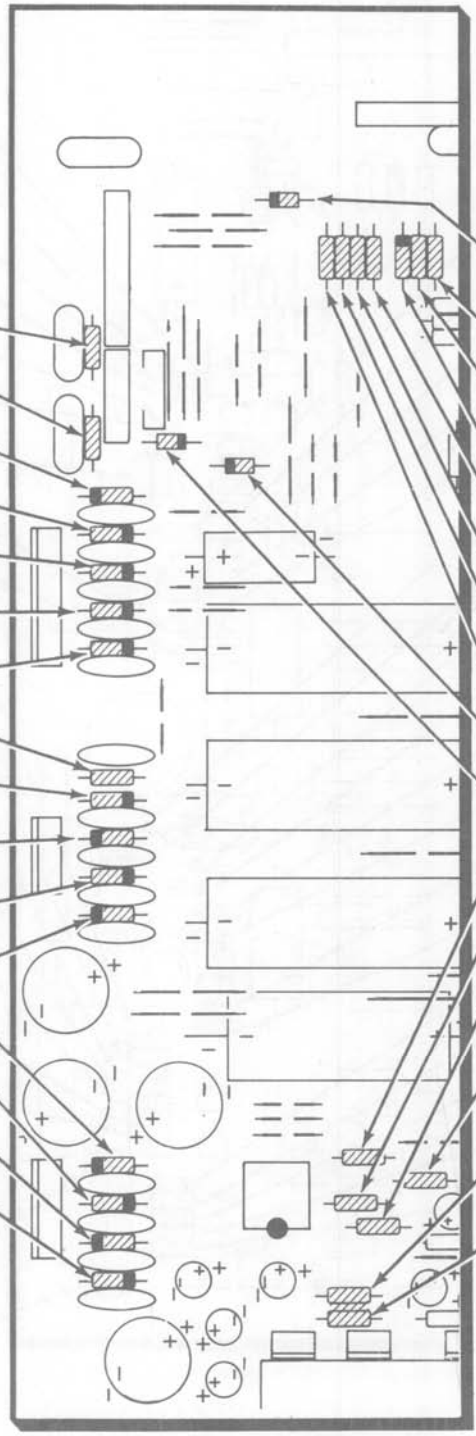
( ) D114: 1N2071 diode (#57-27).

( ) D115: 1N2071 diode (#57-27).

( ) D116: 1N2071 diode (#57-27).

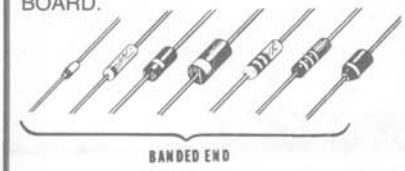
( ) Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 4-2

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




Detail 4-2A

## CONTINUE

( ) D121: 1N191 diode (brn-wht-brn, #56-26).

( ) R142: 2700 Ω (red-viol-red).

( ) R143: 4700 Ω (yel-viol-red).

( ) D122: 1N458 diode (#56-24).

( ) R135: 3300 Ω (org-org-red).

( ) R137: 3300 Ω (org-org-red).

( ) R134: 1000 Ω (brn-blk-red).

( ) R136: 1000 Ω (brn-blk-red).

( ) D119: 1N2071 diode (#57-27).

( ) D118: 1N2071 diode (#57-27).

( ) R127: 1 MΩ (brn-blk-grn).

( ) R128: 1000 Ω (brn-blk-red).

( ) R129: 1000 Ω, 1% (brn-blk-blk-brn).

( ) R131: 1000 Ω, 1% (brn-blk-blk-brn).

( ) R132: 237 Ω, 1% (red-org-viol-blk).

( ) R133: 715 Ω, 1% (viol-brn-grn-blk).

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

## START

NOTE: In this Pictorial you will be working with the right half of the board. When you install the diodes, be sure to position the banded ends as shown.

* ( ) R167: 7500 Ω (viol-grn-red).

( ) R168: 68 kΩ (blu-gry-org).

( ) R163: 12 kΩ (brn-red-org).

( ) D125: 1N458 diode (#56-24).

* ( ) R165: 1200 Ω (brn-red-red).

( ) R171: 1MΩ (brn-blk-grn).

* ( ) D129: BZT110A diode (#56-48).

NOTE: Mount this diode on the foil side of the board, making absolutely certain to use the correct foil pads, and to position the banded end as shown on the top of the board.

( ) D127: 1N458 diode (#56-24).

( ) D128: 1N458 diode (#56-24).

( ) R169: 470 kΩ (yel-viol-yel).

( ) R172: 510 Ω (grn-brn-brn).

( ) R103: 27 kΩ (red-viol-org).

( ) R121: 33 kΩ (org-org-org).

( ) D106: 1N5231B diode (#56-16).

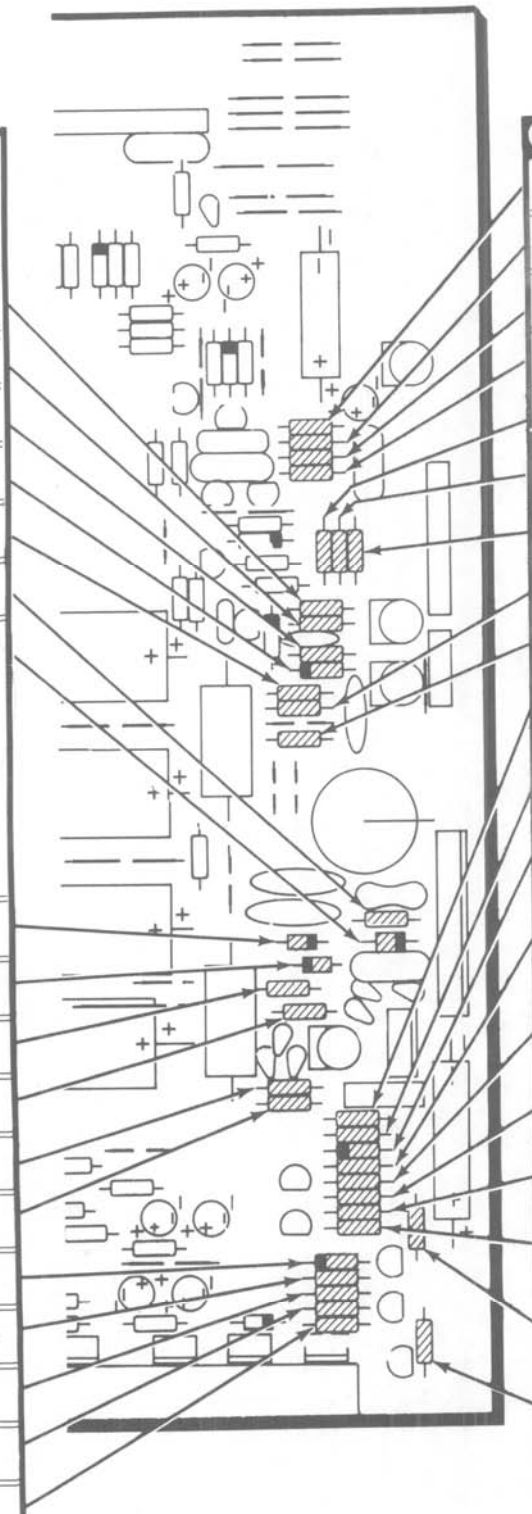
( ) R107: 1430, 1% (brn-yel-org-brn).

( ) R108: 39 Ω (org-wht-blk).

( ) R114: 18 kΩ (brn-gry-org).

( ) R113: 470 Ω (yel-viol-brn).

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



PICTORIAL 4-3

## CONTINUE

( ) R148: 2700 Ω (red-viol-red).

( ) R149: 100 kΩ (brn-blk-yel).

( ) R152: 7500 Ω (viol-grn-red).

( ) R154: 1000 Ω (brn-blk-red).

( ) R176 2.2 Ω (red-red-gld).

( ) R153: 100 Ω (brn-blk-brn).

( ) R147: 47 Ω (yel-viol-blk).

( ) R156: 10 kΩ (brn-blk-org).

( ) R155: 4700 Ω (yel-viol-red).

( ) R119: 68 kΩ (blu-gry-org).

( ) R117: 4750 Ω, 1% (yel-viol-grn-brn).

( ) D107: 5V zener diode (#56-85).

( ) R112: 715 Ω, 1% (viol-brn-grn-blk).

( ) R111: 14.3 kΩ, 1% (brn-yel-org-red).

( ) R118: 80.6 kΩ, 1% (gry-blk-blu-red).

( ) R116: 80.6 kΩ, 1% (gry-blk-blu-red).

( ) R109: 14.3 kΩ, 1% (brn-yel-org-red).

( ) R106: 80.6 kΩ, 1% (gry-blk-blu-red).

( ) R115: 2.7 Ω (red-viol-gld).

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

* These components are loose — not on the Taped Component Chart.

**START**

NOTE: In this Pictorial you will be working with the right half of the board. When you install the diodes, be sure to position the banded ends as shown.

( ) R141: 2700 Ω (red-viol-red).

( ) R139: 100 Ω (brn-blk-brn).

( ) R144: 5600 Ω (grn-blu-red).

( ) R174: 2.2 Ω (red-red-gld).

( ) R175: 2.2 Ω (red-red-gld).

( ) C144: .22 pF (red-red-gry-slvr).

( ) R151: 47 kΩ (yel-viol-org).

( ) R161: 10 kΩ (brn-blk-org).

( ) R162: 820 Ω (gry-red-brn). 1500 BRN-GRN-RED

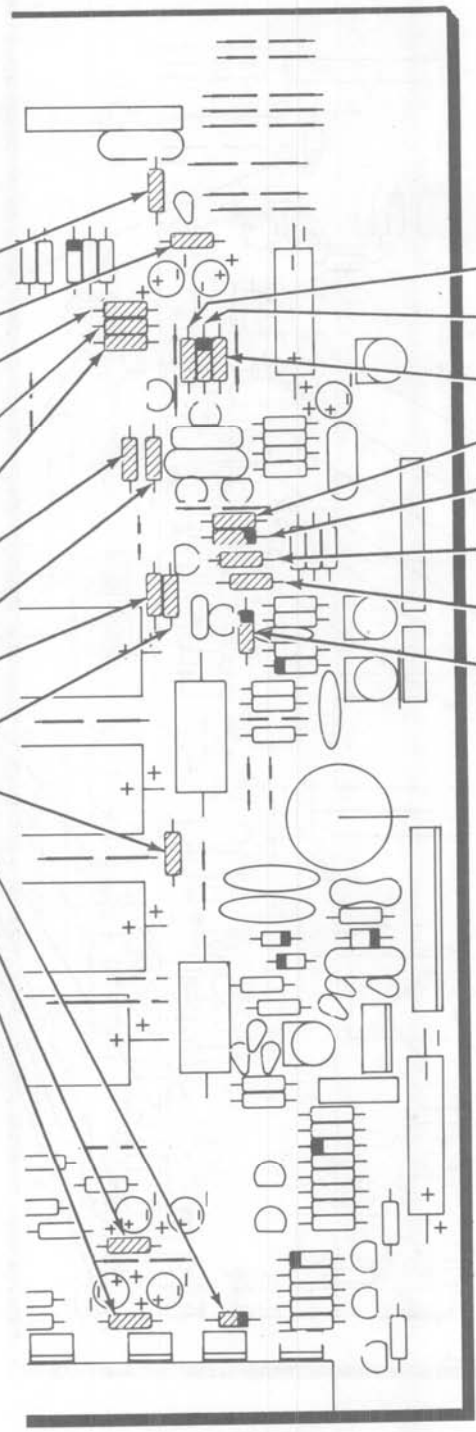
( ) R101: 27 Ω (red-viol-org). 150 BRN GRN Yell

( ) D117: 1N191 diode (brn-wht-brn, #56-26).

( ) R126: 200 Ω, 1% (red-blk-blk-blk).

( ) R125: 2210, 1% (red-red-brn-brn).

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



**CONTINUE**

( ) R145: 3900 Ω (org-wht-red).

( ) D123: 1N458 diode (#56-24).

( ) R146: 27 kΩ (red-viol-org).

( ) R157: 2700 Ω (red-viol-red).

( ) D124: 1N458 diode (#56-24).

( ) R159: 470 Ω (yel-viol-brn).

( ) R158: 100 kΩ (brn-blk-yel).

( ) D126: 1N458 diode (#56-24).

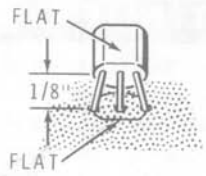
( ) Solder the leads to the foil and cut off the excess lead lengths.

**PICTORIAL 4-4**

* Note - These parts are loose - not on the Taped Componet chart.

**START**

NOTE: When you install each of the following transistors, position the flat on the transistor over the outline of the flat on the circuit board. Then insert the leads into the circuit board holes and solder them to the foil. Cut off any excess lead lengths.




( ) Q107: 2N3904 (#417-875).

( ) Q108: 2N4258A (#417-260).

( ) Q111: MPSL01 (#417-811).

( ) Q109: MPSL51 (#417-295).

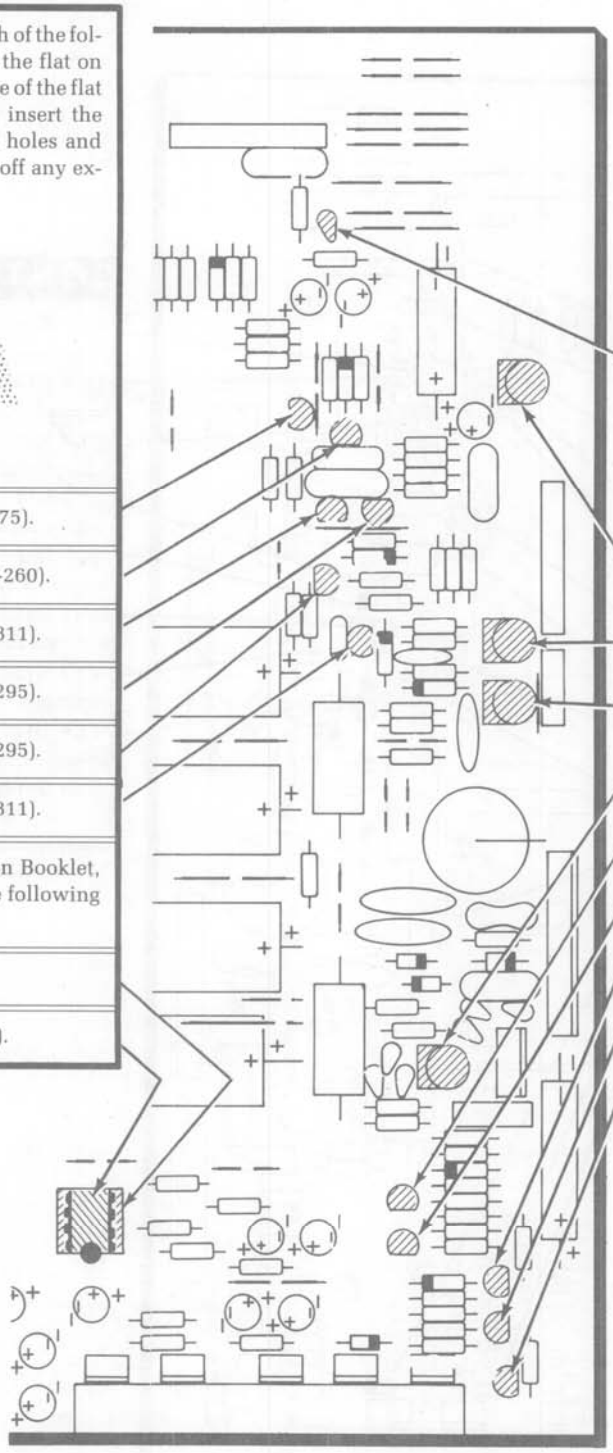
( ) Q112: MPSL51 (#417-295).

( ) Q113: MPSL01 (#417-811).

Refer to Figure 1 (Illustration Booklet, Page 1) when you install the following IC socket and IC.

( ) 8-pin IC socket.

( ) U102: **741** IC (#442-22).



**CONTINUE**

( ) Install the PCB pin at G and solder it to the foil.

NOTE: As you install each of the following components, solder the leads to the foil and cut off the excess lead lengths.

( ) R138: 10 kΩ control.

( ) R164: 10 kΩ control.

( ) R166: 1000 Ω (1K) control.

( ) R102: 100 kΩ control.

( ) Q104: MPSL01 (#417-811).

( ) Q103: MPSL01 (#417-811).

( ) Q101: MPSL51 (#417-295).

( ) Q102: MPSL01 (#417-811).

( ) Q106: MPSL01 (#417-811).

**PICTORIAL 4-5**

**START**

NOTE: In this Pictorial you will be working with the left side of the board.

( ) C117: .1 µF (.1 k) polystyrene.

( ) C116: .1 µF (.1 k) polystyrene.

( ) C115: .1 µF (.1 k) polystyrene.

( ) C101: .01 µF ceramic.

( ) C105: .01 µF ceramic.

( ) C104: .01 µF ceramic.

( ) C103: .01 µF ceramic.

( ) C102: .01 µF ceramic.

( ) C114: .1 µF (.1 k) polystyrene.

( ) C119: .01 µF ceramic.

( ) C118: .01 µF ceramic.

( ) C122: .01 µF ceramic.

( ) C121: .01 µF ceramic.

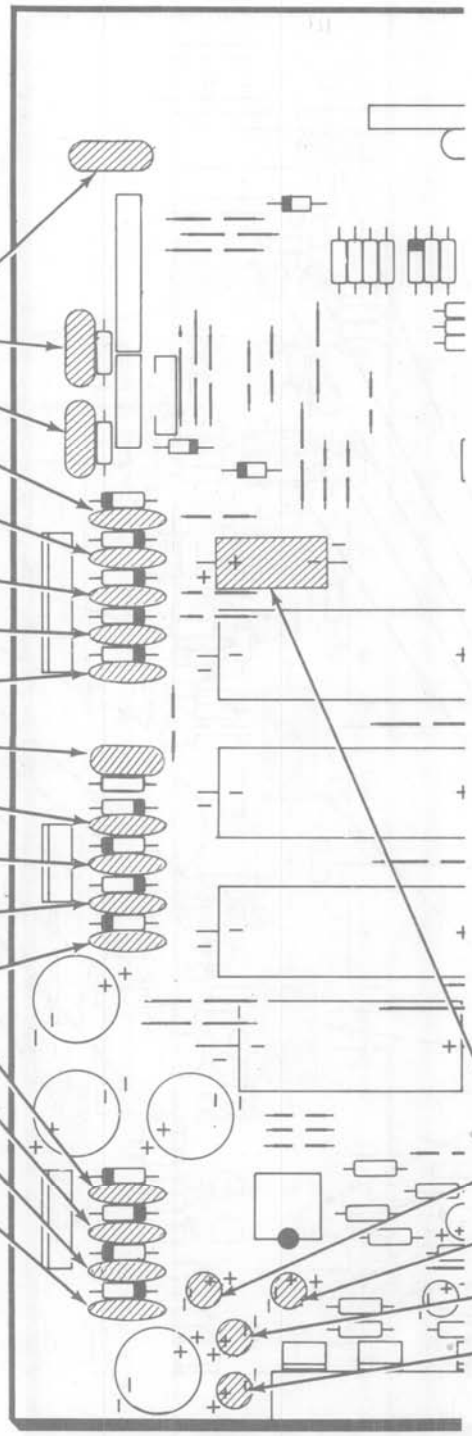
( ) C129: .01 µF ceramic.

( ) C131: .01 µF ceramic.

( ) C132: .01 µF ceramic.

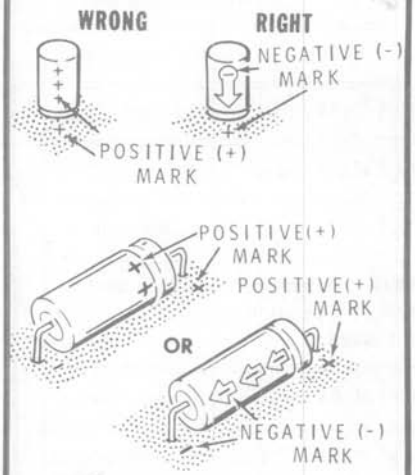
( ) C133: .01 µF ceramic.

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



**CONTINUE**

NOTE: Before you install an electrolytic capacitor, note the position of the identified (+ or –) lead. Be sure you connect the positive (+) lead to the positive (+) marked point on the circuit board.




( ) C106: 1.5 µF electrolytic.

( ) C136: 10 µF vertical electrolytic.

( ) C137: 10 µF vertical electrolytic.

( ) C134: 10 µF vertical electrolytic.

( ) C135: 10 µF vertical electrolytic.

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

**PICTORIAL 4-6**

**START**

NOTE: In this Pictorial you will be working with the right side of the board.

( ) C141: .1 µF (.1 k) polystyrene.

( ) C138: 10 µF vertical electrolytic.

( ) C139: 10 µF vertical electrolytic.

( ) C145: .01 µF Mylar.

( ) C146: .1 µF (.1 k) polystyrene.

NOTE: When you install the next two resistors, position them 1/4" away from the board.

( ) R105: 39 Ω, 5-watt, wire-wound.

( ) R104: 175 Ω, 5-watt, wire-wound.

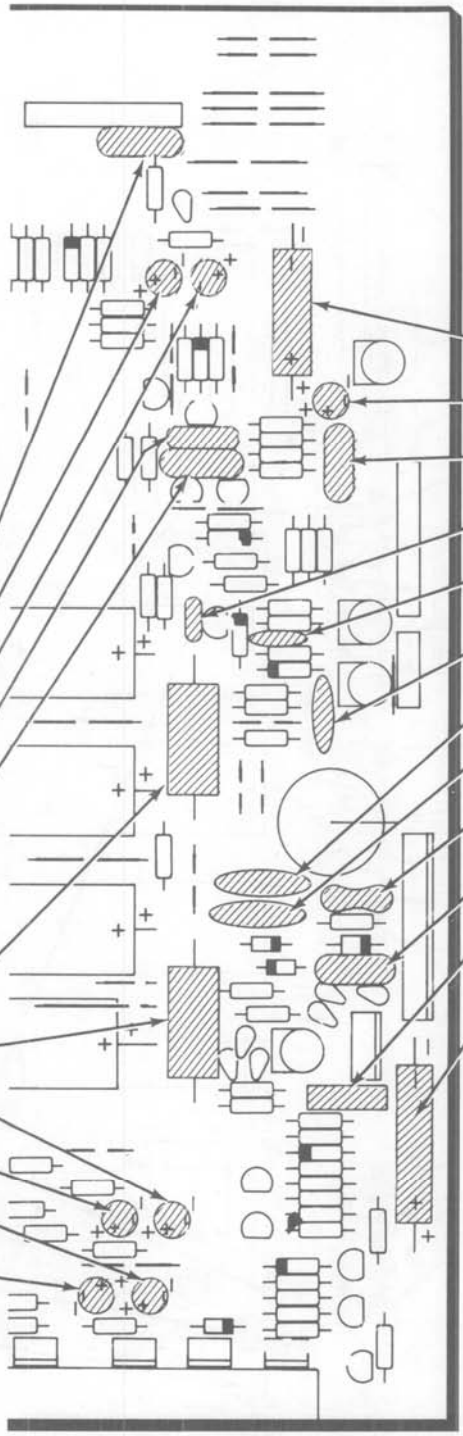
( ) C128: 10 µF vertical electrolytic.

( ) C126: 10 µF vertical electrolytic.

( ) C127: 10 µF vertical electrolytic.

( ) C123: 10 µF vertical electrolytic.

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



**CONTINUE**

( ) C148: 1.5 µF electrolytic.

( ) C142: 10 µF vertical electrolytic.

( ) C143: .1 µF (.1 k) polystyrene.

( ) C147: 3300 (332) ceramic.

( ) C151: 3.3 pF ceramic.

( ) C149: .003 µF ceramic.

( ) C153: 500 pF ceramic.

( ) C152: 500 pF ceramic.

( ) C154: 180 pF mica.

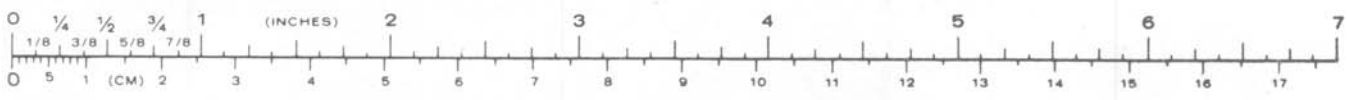
( ) C156: .1 µF (.1 k) polystyrene.

( ) C111: .047 (.047 k) Mylar.

( ) C113: 10 µF horizontal electrolytic.

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

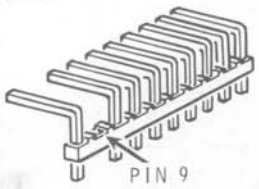
**PICTORIAL 4-7**



**Heathkit®**

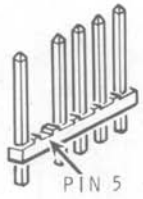
**START**

( ) Locate the small 10-pin right angle plug. Pull out and discard pin 9.




( ) P101: Position the plug as shown and install it. Solder the pins to the foil.

( ) Locate the small 6-pin plug. Pull out and discard pin 5.




( ) P111: Position the plug as shown and install it. Then solder the pins to the foil.

NOTE: When you install the remaining plugs, position the tab side over the double line on the board. Then solder the pins to the foil.

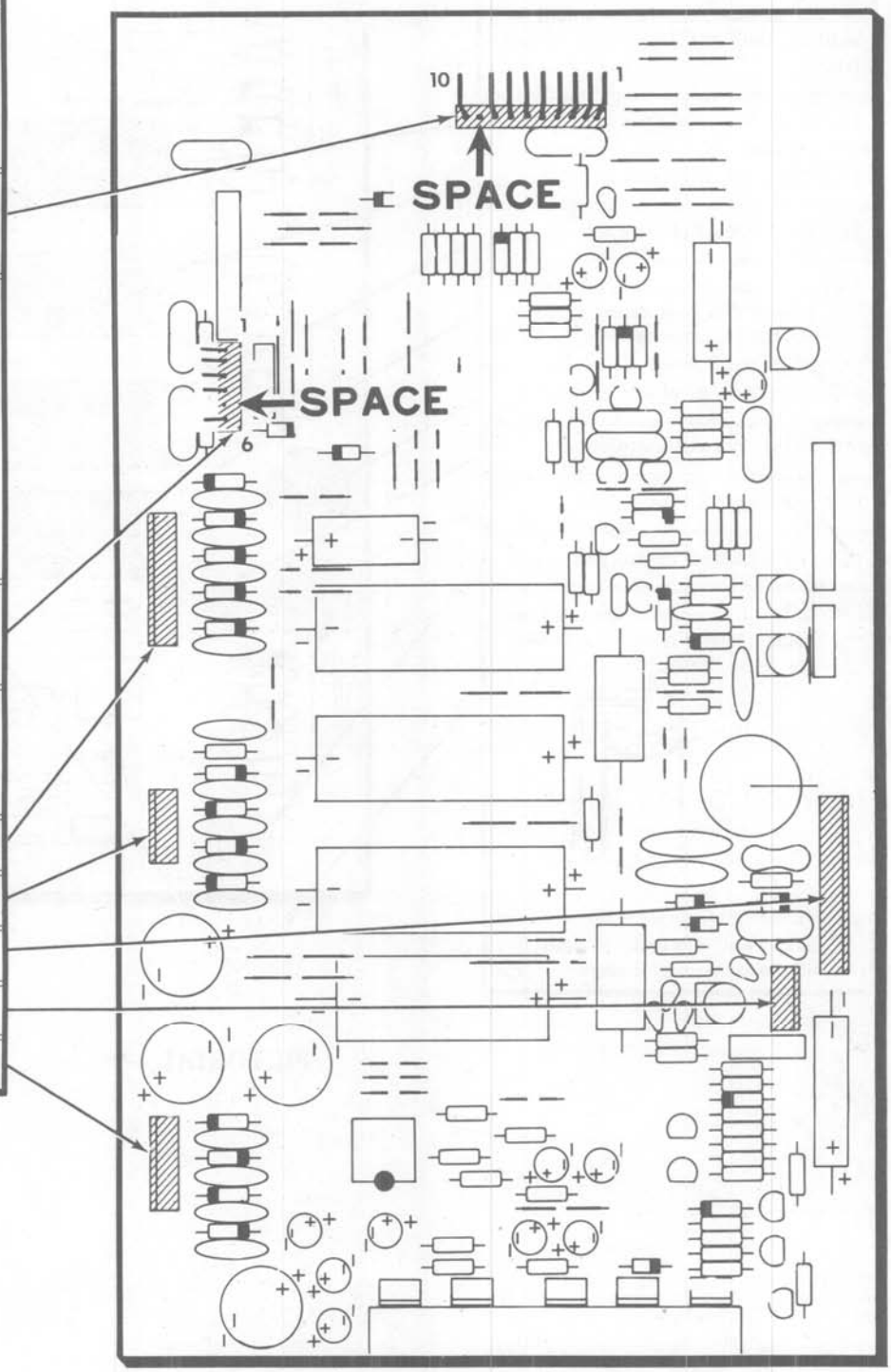
( ) P102: Large 6-pin plug.

( ) P103: Large 3-pin plug.

( ) P105: 8-pin plug.

( ) P106: Large 3-pin plug.

( ) P104: Large 4-pin plug.




**PICTORIAL 4-8**

**START**

NOTE: In this Pictorial you will be working with the lower half of the board.

( ) C109: 100 µF electrolytic.

( ) C108: 100 µF electrolytic.

( ) C112: 100 µF electrolytic.

( ) C107: 20 µF electrolytic. NOTE: Mount this component as far to the right as possible.

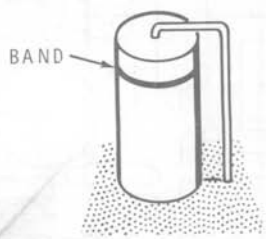
( ) C125: 2000 µF electrolytic.

( ) C124: 2000 µF electrolytic.

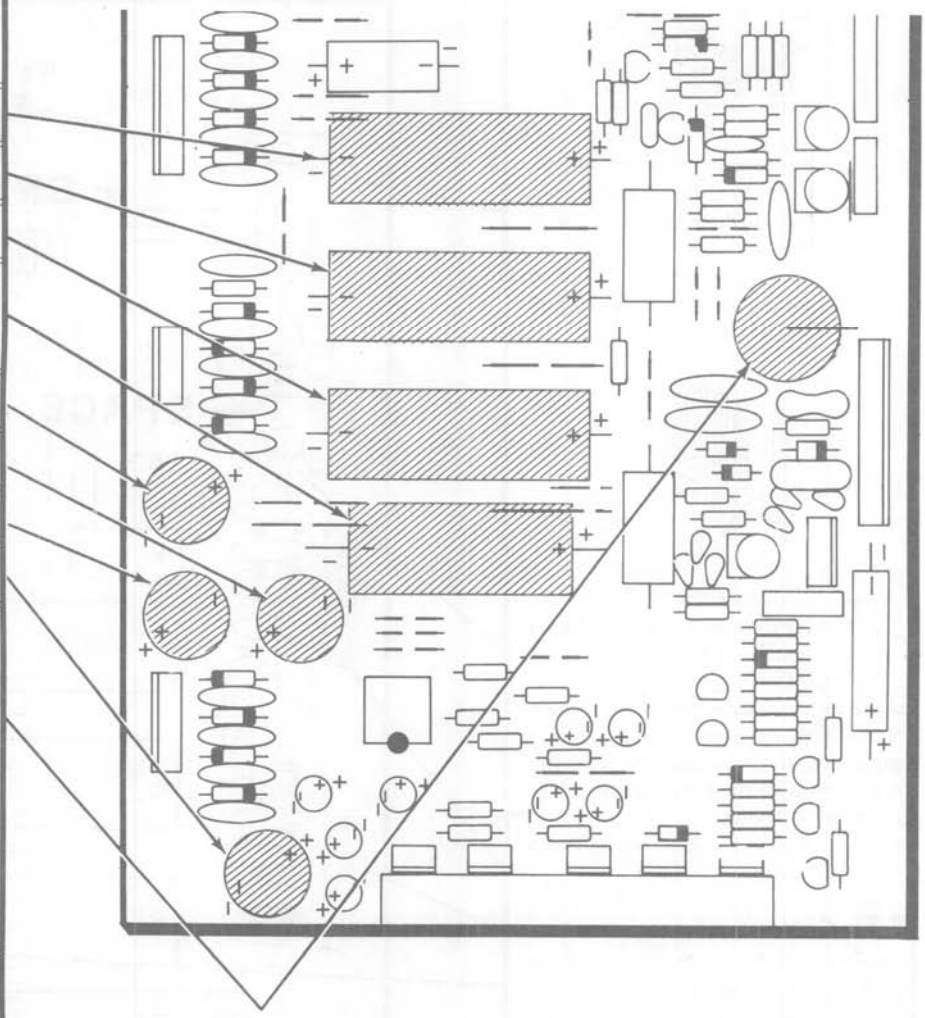
( ) C158: 2200 µF electrolytic.

( ) C157: 2200 µF electrolytic.

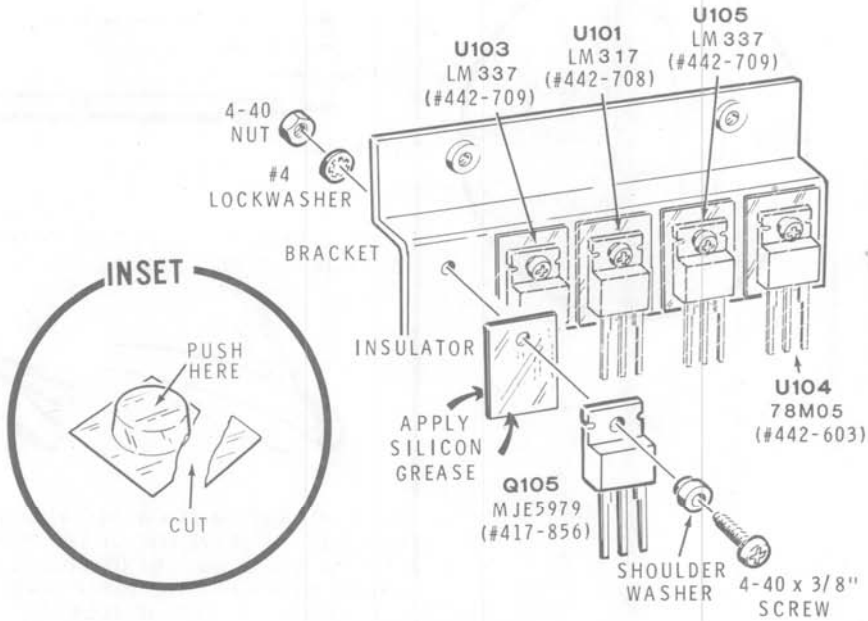
( ) C155: .1 µF paper. Install this capacitor vertically with the banded end up as shown.




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



**PICTORIAL 4-9**




**Detail 4-10A**

Refer to Pictorial 4-10 (Illustration Booklet, Page 8) for the following steps.

WARNING: The silicone grease you will use in the following step(s) helps transfer heat from the transistor to the heat sink. The grease is not caustic, but make sure you do not get it into your eyes, ears, nose, mouth, or on your clothing. Always wash your hands after you use the grease. Keep this and all chemicals out of the reach of children.

Refer to Detail 4-10A for the next seven steps.

( ✓ ) 1. Position the heat sink as shown in the Detail.

( ) 2. Refer to the inset drawing and open the container of silicone grease. Apply a layer of grease to both sides of a transistor insulator. Place the insulator on the heat sink at Q105.

( ✓ ) 3. Q105: Mount the MJE5979 transistor (#417-856) on the heat sink with a 4-40 × 3/8" screw, shoulder washer, #4 lockwasher, and 4-40 nut. Be sure the shoulder of the washer seats in the hole in the transistor. Do not tighten the hardware securely at this time.

Mount the following IC's on the heat sink, using the same method as you did with the transistor.

( ✓ ) 4. U103: LM**337** (#442-709).

( ✓ ) 5. U101: LM**317** (#442-708).

( ✓ ) 6. U105: LM**337** (#442-709).

( ✓ ) 7. U104: **78M05** (#442-603).

( ) Position the circuit board as shown in Pictorial 4-10 and mount the heat sink as follows.

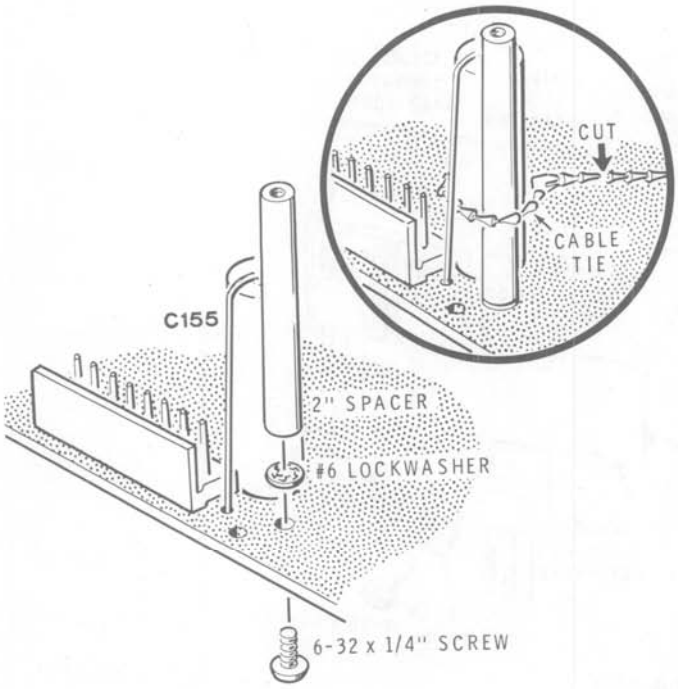
1. Line up the transistor and IC leads with their proper holes in the board and insert them.

2. Fasten the heat sink with 4-40 × 3/8" screws, #4 lockwashers, and 4-40 nuts.

3. Solder the transistor and IC leads to the foil and cut off the excess lengths.

4. Tighten the transistor and IC hardware.

NOTE: Save the remaining silicone grease for use later.




**Detail 4-10B**

( ) Refer to Detail 4-10B and mount the 2″ spacer on the board near capacitor C155. Use a 6-32 × 1/4″ screw and a #6 lockwasher. Then install a cable tie around the spacer and capacitor as shown in the inset drawing.

( ) Secure the four indicated capacitors (C107, C108, C109, C112) to the circuit board with cable ties as shown in Pictorial 4-10.

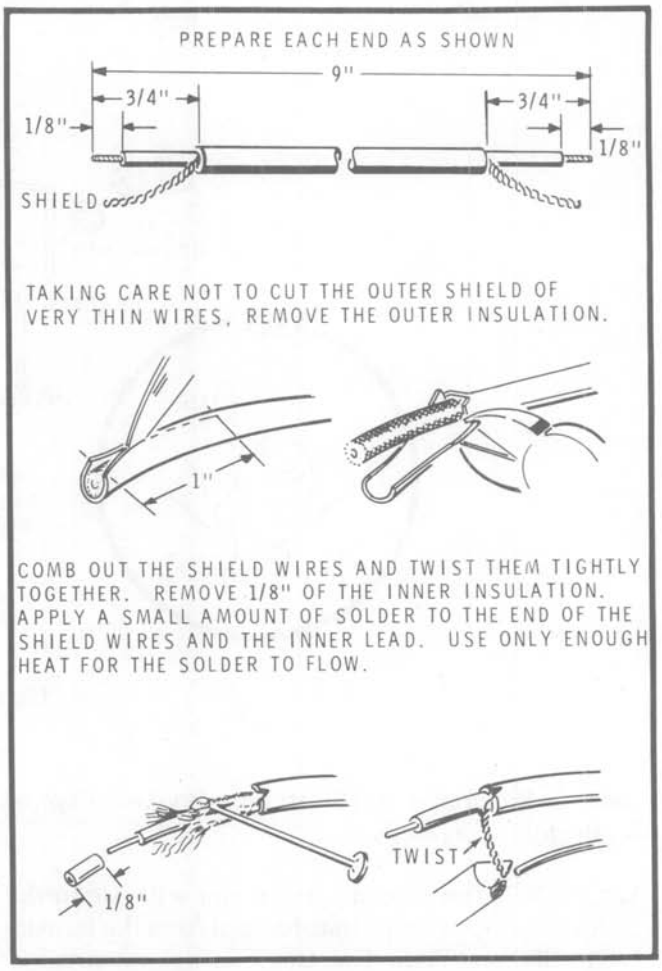
( ) Prepare the following wires:

6″ white
6″ large orange
6″ large red
6″ white-yellow (save the remainder)
6″ white-brown
6″ white-red

Connect one end of each wire to the circuit board in the following steps. Solder the wires to the foil and cut off the excess wire ends.

( ) White wire in hole A.

( ) Large orange wire in hole B.




**Detail 4-10C**

( ) Large red wire in hole C.

( ) White-yellow wire in hole D.

( ) White-brown wire in hole E.

( ) White-red wire in hole F.

( ) Refer to Detail 4-10C and prepare both ends of a 9″ RG-174/U (braid) shielded cable as shown. Set this cable aside temporarily.

NOTE: After you prepare the next three cables, set them aside temporarily.

Refer to Detail 4-10D (Illustration Booklet, Page 9) for the following steps.

Refer to Part A of Detail 4-10D for the next two steps.

( ) Locate the 17", 5-wire flat cable.

( ) Cut off a 7" length and prepare both ends as shown. Cut the brown wire from one end as shown.

Refer to Part B of Detail 4-10D for the next four steps.

( ) Locate the 8", 17-wire flat cable.

( ) Cut the cable to make a 3-1/2" and a 4-1/2" length.

( ) Separate the end of the 3-1/2" cable between the white and black wires and pull the cables apart. Set aside the indicated section.

( ) Prepare both ends of the 10-wire cable and cut off the black and orange wires from one end.

Refer to Part C of Detail 4-10D for the next two steps.

( ) Separate the end of the 4-1/2" cable between the green and yellow wires. Pull the blue and green wires from the cable and discard them.

( ) Prepare both ends of the 15-wire cable.

Refer to Part D of Detail 4-10D for the following steps.

( ) Crimp and solder small spring connectors on the end of the 7", 5-wire cable that has the brown lead cut off. See inset #1.

( ) Crimp and solder small spring connectors on the end of the 3-1/2" 10-wire cable that has the black and orange wires cut off.

( ) Crimp and solder small spring connectors on one end (either end) of the 4-1/2" 15-wire cable.

( ) Crimp and solder small spring connectors on **both** ends of the 9" shielded cable.

In the following steps, you will insert the connectors of each cable into sockets. Be sure to position the sockets with the slotted side up and the connectors with the small latching tab up when you insert them. See inset #2.

5-WIRE CABLE:

( ) Locate the small 5-hole socket.

( ) Yellow wire in hole 1.

( ) Orange wire in hole 2.

( ) Red wire in hole 3.

NOTE: Hole 4 is unused.

( ) Black wire in hole 5.

( ) Insert a polarizing plug in hole 4 of the socket.

10-WIRE CABLE:

( ) Locate the small 10-hole socket.

NOTE: Do not install a wire in hole 1.

( ) Brown wire in hole 2.

( ) Red wire in hole 3.

( ) **No wire** in hole 4.

( ) Yellow wire in hole 5.

( ) Green wire in hole 6.

( ) Blue wire in hole 7.

( ) Violet wire in hole 8.

( ) Gray wire in hole 9.

( ) White wire in hole 10.

In the next two steps, you will insert the connectors at either end of the 9" shielded cable in the remaining holes of the small 10-hole socket.

( ) Inner lead in hole 1.

( ) Shield lead in hole 4.

( ) Insert a polarizing plug in hole 9 of the 10-hole socket.

Insert the other end of the shielded cable into a small 3-hole socket as follows:

( ) Shield lead in hole 1.

( ) Inner lead in hole 2.

( ) Hole 3 is unused.

15-WIRE CABLE:

( ) Locate the small 15-hole socket.

Install the connectors on the 15-wire cable in the following steps. Be sure to perform these steps just as you did in the previous steps.

( ) Black wire in hole 1.

( ) Brown wire in hole 2.

( ) Red wire in hole 3.

( ) Orange wire in hole 4.

( ) Yellow wire in hole 5.

( ) Green wire in hole 6.

( ) Blue wire in hole 7.

( ) Violet wire in hole 8.

( ) Gray wire in hole 9.

( ) White wire in hole 10.

( ) Black wire in hole 11.

( ) Brown wire in hole 12.

( ) Red wire in hole 13.

( ) Orange wire in hole 14.

( ) Yellow wire in hole 15.

( ) Insert a polarizing plug in hole 6 of the socket.

Refer to Pictorial 4-10 (Illustration Booklet, Page 8) for the following steps.

Connect the other end of these prepared cables to the low voltage power supply circuit board in the following steps. Solder each lead to the foil and cut off the excess lead lengths.

5-WIRE CABLE AT P110:

( ) Position the circuit board as shown.

( ) Black wire in hole 1.

( ) Brown wire in hole 2.

( ) Red wire in hole 3.

( ) Orange wire in hole 4.

( ) Yellow wire in hole 5.

10-WIRE CABLE AT P109:

( ) Black wire in hole 1.

( ) Brown wire in hole 2.

( ) Red wire in hole 3.

( ) Orange wire in hole 4.

( ) Yellow wire in hole 5.

( ) Green wire in hole 6.

( ) Blue wire in hole 7.

( ) Violet wire in hole 8.

( ) Gray wire in hole 9.

( ) White wire in hole 10.

15-WIRE CABLE:

(At P107)

( ) Black wire in hole 1.

( ) Brown wire in hole 2.

( ) Red wire in hole 3.

( ) Orange wire in hole 4.

( ) Yellow wire in hole 5.

( ) Green wire in hole 6.

( ) Blue wire in hole 7.

( ) Violet wire in hole 8.

( ) Gray wire in hole 9.

( ) White wire in hole 10.

(At P108)

( ) Black wire in hole 1.

( ) Brown wire in hole 2.

( ) Red wire in hole 3.

( ) Orange wire in hole 4.

( ) Yellow wire in hole 5.

Refer to Detail 4-10E for the following steps.

( ) Cut the leads of an 82 kΩ (gry-red-org) resistor to 1/2". Form a small hook in each lead as shown.

( ) Prepare both ends of a white-green wire. Form a small hook in one wire end.

( ) Crimp together the hook in the wire-end and one end of the resistor (S-1).

( ) Cut a 1-1/2" piece of small heat-shrinkable sleeving. Slide this over the resistor and wire assembly so the hook on the other resistor end is just exposed.

( ) With a match, or other source of heat, shrink the sleeving over the resistor.

**CIRCUIT BOARD CHECKOUT**

Carefully inspect the circuit board for the following conditions.

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

( ) Protruding leads which could touch together.

( ) Transistors for the proper type and installation.

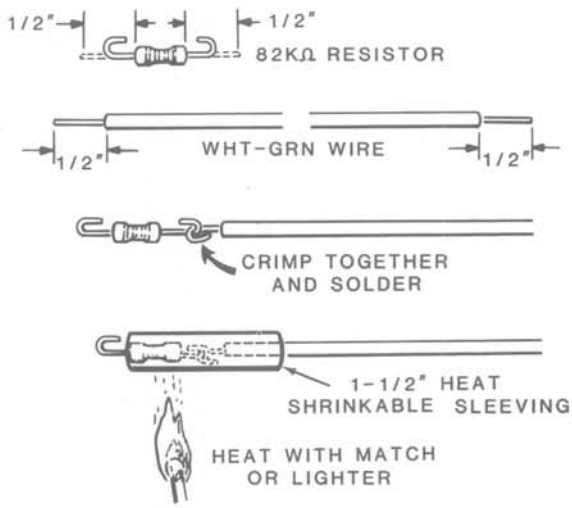
( ) Electrolytic capacitors for the correct position of the positive (+) mark or minus (−) mark.

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

( ) IC's for the proper type and installation.

NOTE: There are some unused holes on the circuit board.

( ) R177: Refer to Pictorial 4-10 and connect the hook on the 82 kΩ resistor to the top lead of capacitor C155 as shown (S-1). The free end of the white-green wire will be connected later.




**Detail 4-10E**

Heathkit®

# VERTICAL PREAMP CIRCUIT BOARD

## PARTS LIST

Open Pack #5 and check each part against the following list. Do not remove components that are supplied on a tape from the tape until you use them in a step. Return any part that is packed in an individual envelope, with the part number on it, back to the envelope after you identify it until that part is called for in a step. Do not throw away any packing material until all of the parts are accounted for.

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

**TAPED COMPONENTS**

Refer directly to the "Taped Component Chart (Pack #5)." Follow the instructions at the top of that chart to check the following components.

### RESISTORS

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

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| 6-229-12 | 17 | 2.2 Ω (red-red-gld) | R404, R481, R484, R504, R581, R584, R611, R672, R673, R675, R676, R677, R678, R679, R681, R683, R684 |
| 6-519-12 | 4 | 5.1 Ω (grn-brn-gld) | R401, R501, R405, R505 |
| 6-2009-12 | 2 | 20 Ω, 1% (red-blk-blk-gld) | R413, R513 |
| 6-220-12 | 1 | 22 Ω (red-red-blk) | R410 |
| 6-270-12 | 3 | 27 Ω (red-viol-blk) | R409, R509, R510 |
| 6-330-12 | 2 | 33 Ω (org-org-blk) | R426, R526 |
| 6-390-12 | 8 | 39 Ω (org-wht-blk) | R403, R406, R487, R482, R503, R506, R582, R587 |
| 6-4759-12 | 8 | 47.5 Ω, 1% (yel-viol-grn-gld) | R464, R465, R475, R564, R565, R575, R664, R665 |
| 6-510-12 | 2 | 51 Ω (grn-brn-blk) | R437, R537 |
| 6-5119-12 | 7 | 51.1 Ω, 1% (grn-brn-brn-gld) | R471, R472, R571, R572, R649, R651, R662 |

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| **RESISTORS (Cont'd.)** | | | |
| 6-680-12 | 4 | 68 Ω (blu-gry-blk) | R427, R493, R527, R593 |
| 6-8069-12 | 2 | 80.6 Ω, 1% (gry-blk-blu-gld) | R467, R567 |
| 6-8669-12 | 2 | 86.6 Ω, 1% (gry-blu-blu-gld) | R605, R606 |
| 6-101-12 | 4 | 100 Ω, 5% (brn-blk-brn) | R495, R555, R595, R695 |
| 6-1000-12 | 4 | 100 Ω, 1% (brn-blk-blk-blk) | R435, R447, R535, R547 |
| 6-121-12 | 3 | 120 Ω (brn-red-brn) | R491, R591, R607 |
| 6-2000-12 | 4 | 200 Ω, 1% (red-blk-blk-blk) | R485, R486, R585, R586 |
| 6-241-12 | 4 | 240 Ω (red-yel-brn) | R449, R451, R549, R551 |
| 6-3010-12 | 5 | 301 Ω, 1% (org-blk-brn-blk) | R458, R558, R559, R561, R658 |
| 6-3160-12 | 2 | 316 Ω, 1% (org-brn-blu-blk) | R603, R604 |
| 6-331-12 | 6 | 330 Ω, 5% (org-org-brn) | R612, R613, R614, R615, R622, R623 |
| 6-3320-12 | 4 | 332 Ω, 1% (org-org-red-blk) | R459, R461, R659, R661 |
| 6-361-12 | 6 | 360 Ω (org-blu-brn) | R468, R469, R568, R569, R668, R669 |
| 6-391-12 | 4 | 390 Ω (org-wht-brn) | R476, R478, R576, R578 |
| 6-4320-12 | 4 | 432 Ω, 1% (yel-org-red-blk) | R479, R483, R579, R583 |
| 6-471-12 | 2 | 470 Ω (yel-viol-brn) | R425, R525 |
| 6-5360-12 | 4 | 536 Ω, 1% (grn-org-blu-blk) | R462, R562, R601, R602 |
| 6-561-12 | 2 | 560 Ω (grn-blu-brn) | R492, R592 |
| 6-7500-12 | 4 | 750 Ω, 1% (viol-grn-blk-blk) | R473, R474, R573, R574 |
| 6-7680-12 | 2 | 768 Ω, 1% (viol-blu-gry-blk) | R438, R538 |
| 6-8250-12 | 3 | 825 Ω, 1% (gry-red-grn-blk) | R466, R566, R666 |
| 6-8450-12 | 2 | 845 Ω, 1% (gry-yel-grn-blk) | R693, R694 |
| 6-102-12 | 5 | 1000 Ω (brn-blk-red) | R496, R498, R596, R598, R608 |
| 6-1301-12 | 2 | 1300 Ω, 1% (brn-org-blk-brn) | R424, R524 |
| 6-2001-12 | 10 | 2000 Ω, 1% (red-blk-blk-brn) | R431, R443, R444, R445, R446, R531, R543, R544, R545, R546 |
| 6-222-12 | 2 | 2200 Ω (red-red-red) | R428, R528 |
| 6-272-12 | 4 | 2700 Ω (red-viol-red) | R452, R454, R552, R554 |
| 6-332-12 | 3 | 3300 Ω (org-org-red) | R457, R557, R657 |
| 6-362-12 | 6 | 3600 Ω (org-blu-red) | R625, R626, R627, R628, R629, R631 |
| 6-3831-12 | 2 | 3830 Ω, 1% (org-gry-org-brn) | R448, R548 |
| 6-392-12 | 6 | 3900 Ω (org-wht-red) | R616, R617, R618, R619, R621, R624 |
| 6-472-12 | 8 | 4700 Ω (yel-viol-red) | R456, R556, R635, R632, R633, R634, R636, R656 |
| 6-752-12 | 3 | 7500 Ω (viol-grn-red) | R429, R529, R696 |
| 6-912-12 | 1 | 9100 Ω (wht-brn-red) | R609 |
| 6-103-12 | 2 | 10 kΩ, 5% (brn-blk-org) | R494, R594 |
| 6-1002-12 | 2 | 10 kΩ, 1% (brn-blk-blk-red) | R499, R599 |
| 6-153-12 | 2 | 15 kΩ (brn-grn-org) | R442, R542 |
| 6-104-12 | 2 | 100 kΩ (brn-blk-yel) | R432, R532 |
| 6-4123-12 | 2 | 412 kΩ, 1% (yel-brn-red-org) | R433, R533 |
| 6-4533-12 | 2 | 453 kΩ, 1% (yel-grn-org-org) | R423, R523 |
| 6-5003-12 | 6 | 500 kΩ, 1% (grn-blk-blk-org) | R416, R417, R418, R516, R517, R518 |
| 6-105-12 | 2 | 1 MΩ, 5% (brn-blk-grn) | R402, R502 |
| 6-1004-12 | 2 | 1 MΩ, 1% (brn-blk-blk-yel) | R415, R515 |
| **DIODES** | | | |
| 56-31 | 2 | PS18775 | D402, D502 |
| 56-56 | 2 | 1N4149 | D403, D503 |
| 56-67 | 2 | 1N4740A | D404, D504 |
| **CAPACITORS** | | | |
| 21-763 | 2 | 330 pF (331) glass | C434, C534 |
| 21-769 | 19 | .01 µF (103) glass | C414, C415, C416, C424, C436, C514, C515, C516, C524, C525, C536, C603, C604, C605, C606, C607, C608, C609, C624 |
| 21-762 | 2 | .1 µF (104) glass | C431, C531 |

**NON-TAPED PARTS**

The following parts are not taped on strips. The key numbers correspond to the numbers on the "Vertical Preamp Circuit Board Parts Pictorial" (Illustration Booklet, Page 10).

## RESISTORS

### Precision

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| A1 | 2-774-12 | 2 | 10.1 kΩ, 1/4% (brn-blk-brn-red) | R412, R512 |
| A1 | 2-773-12 | 2 | 111 kΩ, 1/4% (brn-brn-brn-org) | R408, R508 |
| A1 | 2-771-12 | 2 | 900 kΩ, 1/4% (wht-blk-blk-org) | R407, R507 |
| A1 | 2-772-12 | 2 | 990 kΩ, 1/4% (wht-wht-blk-org) | R411, R511 |

### Other Resistors

| | | | | |
|---|---|---|---|---|
| A2 | 1-139 | 4 | 100 MΩ, 1/2-watt, 5% (brn-blk-viol) | R421, R434, R521, R534 |
| A3 | 9-127 | 2 | 400 Ω resistor pack | R488, R588 |

## CAPACITORS

### Ceramic

| | | | | |
|---|---|---|---|---|
| B1 | 21-764 | 2 | 4.3 pF | C412, C512 |
| B1 | 21-157 | 2 | 5 pF | C435, C535 |
| B1 | 21-3 | 6 | 10 pF | C423, C523, C533, C601, C602, C631 |
| B1 | 21-111 | 2 | 15 pF (15 K) | C405, C505 |
| B1 | 21-155 | 2 | 33 pF | C422, C522 |
| B1 | 21-167 | 4 | 39 pF | C427, C432, C527, C532 |
| B1 | 21-738 | 2 | 68 pF (680) (small rectangular) | C417 C517 |
| B1 | 21-75 | 2 | 100 pF (100k) (JK100) | C418, C518 |
| B1 | 21-766 | 2 | 330 pF (331) | C408, C508 |
| B1 | 21-171 | 4 | 680 pF (round) | C419, C421, C519, C521 |
| B1 | 21-43 | 6 | .001 µF | C411, C428, C429, C511, C528, C529 |
| B1 | 21-31 | 2 | .02 µF | C401, C501 |

### Electrolytic

| | | | | |
|---|---|---|---|---|
| B2 | 25-880 | 13 | 10 µF | C612, C613, C615, C616, C617, C618, C619, C621, C623, C625, C627, C628, C629 |
| B2 | 25-915 | 2 | 47 µF | C413, C513 |
| B2 | 25-885 | 4 | 100 µF | C611, C614, C622, C626 |

### Trimmer Capacitors

| | | | | |
|---|---|---|---|---|
| B3 | 31-83 | 6 | 2-6 pF (red dot) | C402, C404, C407, C502, C504, C507 |
| B3 | 31-71 | 4 | 3.2-18 pF (blue dot) | C406, C426, C506, C526 |
| B3 | 31-85 | 2 | 5-25 pF (brown dot) | R403, R503 |

## TRANSISTORS-INTEGRATED CIRCUITS (IC's)

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

1. Part number.
2. Type number (On integrated circuits, this refers only to the numbers and letters shown in **bold** print in the Parts List. Disregard any other numbers or letters on the IC.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

| | | | | |
|---|---|---|---|---|
| C1 | 417-154 | 2 | 2N2369 transistor | Q601, Q602 |
| C2 | 417-293 | 4 | 2N5770 transistor | Q402, Q502, Q606, Q607 |
| C2 | 417-801 | 1 | MPSA20 transistor | Q603 |
| C2 | 417-828 | 2 | E304 transistor (selected) | Q401, Q501 |
| C2 | 417-854 | 2 | SF50077 diode | D401, D501 |
| C2 | 417-874 | 2 | 2N3906 transistor | Q404, Q504 |

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **TRANSISTORS-IC's (Cont'd)** | | | | |
| C2 | 417-887 | 8 | MPSH10 transistor | Q403, Q406, Q407, Q503, Q506, Q507, Q508, Q509 |
| C2 | 417-917 | 8 | MPSH81 transistor | Q412, Q413, Q414, Q415, Q512, Q513, Q514, Q515 |
| C2 | 417-931 | 2 | PN4858 transistor | Q416, Q516 |
| C3 | 417-975 | 2 | CA3127 transistor module | Q405, Q505 |
| C3 | 417-978 | 3 | CA3102 transistor module | Q411, Q511, Q611 |
| C3 | 442-759 | 2 | LF**411**N IC | U401, U501 |
| C3 | 443-22 | 1 | SN**74121** IC | U605 |
| C3 | 443-728 | 1 | SN**74LS00** IC | U601 |
| C3 | 443-780 | 1 | SN**74LS08** IC | U604 |
| C3 | 443-829 | 2 | SN**74LS76** IC | U602, U603 |
| **CONTROLS-SWITCHES** | | | | |
| D1 | 10-1173 | 3 | 50 Ω control | R439, R539, R589 |
| D1 | 10-1139 | 1 | 100 Ω control | R663 |
| D1 | 10-1140 | 2 | 500 Ω control | R477, R577 |
| D1 | 10-1137 1138 | 2 | 2000 Ω (2K) control | R463, R563 |
| D1 | 10-1132 | 2 | 10 kΩ control | R497, R597 |
| D1 | 10-1142 | 6 | 100 kΩ control | R414, R422, R441, R514, R522, R541 |
| D2 | 10-1186 | 2 | 2000 Ω (2K) control | R453, R553 |
| D3 | 61-51 | 2 | Toggle switch w/hardware | SW401, SW501 |
| D4 | 64-896 | 1 | Pushbutton switch assembly | SW601 |
| D5 | 63-1388 | 2 | Rotary switch assembly | SW402/R436 SW502/R536 |
| **SOCKETS-PLUGS-CONNECTORS** | | | | |
| E1 | 432-758 | 2 | BNC connector w/hardware | |
| E2 | 432-817 | 2 | 4-hole plug with ears | |
| E3 | 432-855 | 8 | Female connector pins (1 extra) | |
| E4 | 432-866 | 8 | Small spring connector (2 extra) | |
| E5 | 432-903 | 1 | 10-pin plug | |
| E6 | 432-1304 | 1 | Small 7-hole socket | |
| E7 | 434-230 | 2 | 8-pin IC socket | |
| E7 | 434-298 | 6 | 14-pin IC socket | |
| E7 | 434-299 | 4 | 16-pin IC socket | |
| E8 | 438-55 | 1 | Polarizing plug | |

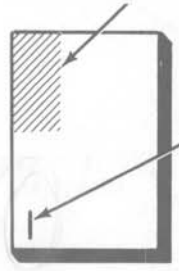
| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **HARDWARE** | | | | |
| F1 | 250-1347 | 2 | 4-40 × 1/8" allen setscrew | |
| F1 | 250-1282 | 4 | 6-32 × 1/8" allen setscrew | |
| F2 | 252-39 | 2 | 1/4" nut | |
| F3 | 252-7 | 2 | Control nut | |
| F4 | 254-14 | 2 | 1/4" lockwasher | |
| F5 | 259-12 | 2 | 1/4" solder lug | |
| F6 | 259-27 | 2 | BNC solder lug | |
| F7 | 259-10 | 2 | Control solder lug | |
| **KNOBS** | | | | |
| G1 | 462-1108 | 2 | Knob (red inlay) | |
| G2 | 462-1106 | 2 | Knob (gray inlay) | |
| G3 | 462-1110 | 2 | Plain knob | |
| **MISCELLANEOUS** | | | | |
| H1 | 45-73 | 7 | 2.2 μH choke (red-red-gld-slvr) | L601-L607 |
| | 74-4 | 2 | Roll of black tape | |
| H2 | 203-2119 | 1 | Front panel | |
| H3 | 206-1435 | 1 | Shield | |
| H4 | 475-16 | 6 | Ferrite bead | |
| H5 | 490-14 | 1 | .062" allen wrench | |
| H6 | 490-23 | 1 | .049" allen wrench | |
| H7 | 490-111 | 1 | IC lifter | |
| H8 | 490-168 | 1 | 1/4"-5/16" wrench | |
| | | 1 | Tape Chart (2-Page) | |
| **PART FROM FINAL PACK** | | | | |
| | 85-2900-1 | 1 | Vertical preamp circuit board | |

10K HORIZONTAL CONTROL

Vertical Control

# STEP-BY-STEP ASSEMBLY

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




**START**

NOTE: Because of its large size, only a part of the circuit board is shown. The shaded area in the identification drawing at the top of the page indicates the area you are assembling. Refer to this drawing first on each Pictorial before you begin the assembly.

NOTE: All resistors are 5% unless specified otherwise.

( ) C609: .01 µF (103) glass ceramic.

( ) L603: 2.2 µH choke (red-red-gld-slvr, #45-73).

( ) L602: 2.2 µH choke (red-red-gld-slvr, #45-73).

( ) R673: 2.2 Ω (red-red-gld).

( ) R657: 3300 Ω (org-org-red).

( ) C624: .01 µF (103) glass ceramic.

( ) R585: 200 Ω, 1% (red-blk-blk-blk).

( ) R586: 200 Ω, 1% (red-blk-blk-blk).

( ) R587: 39 Ω (org-wht-blk).

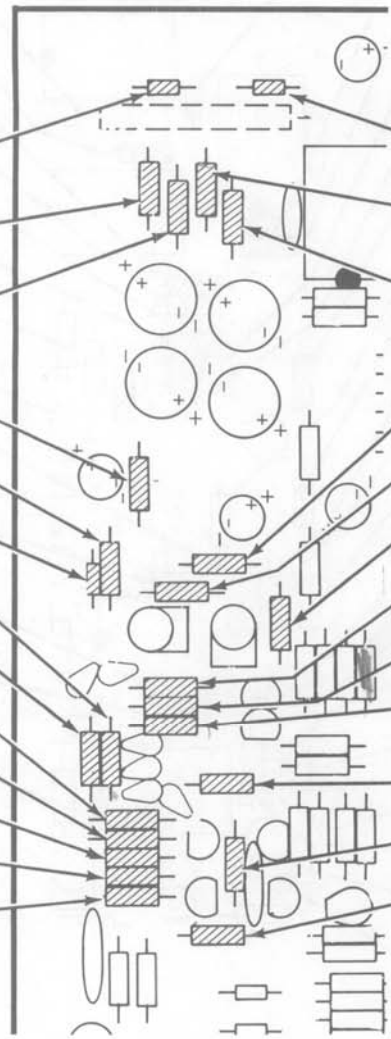
( ) R583: 432 Ω, 1% (yel-org-red-blk).

( ) R584: 2.2 Ω (red-red-gld).

( ) R581: 2.2 Ω (red-red-gld).

( ) R579: 432, 1% (yel-org-red-blk).

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



**CONTINUE**

( ) C608: .01 µF (103) glass ceramic.

( ) L604: 2.2 µH choke (red-red-gld-slvr, #45-73).

( ) L601: 2.2 µH choke (red-red-gld-slvr, #45-73).

( ) R675: 2.2 Ω (red-red-gld).

( ) R656: 4700 Ω (yel-viol-red).

( ) R661: 332 Ω, 1% (org-org-red-blk).

( ) R651: 51.1 Ω, 1% (grn-brn-brn-gld).

( ) R695: 100 Ω (brn-blk-brn).

( ) R649: 51.1 Ω, 1% (grn-brn-brn-gld).

( ) R578: 390 Ω (org-wht-brn).

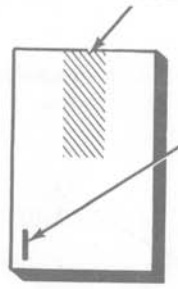
( ) R582: 39 Ω (org-wht-blk).

( ) R576: 390 Ω (org-wht-brn).

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

**PICTORIAL 5-1**

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




IDENTIFICATION DRAWING

**START**

( ) C606: .01 µF (103) glass ceramic.

( ) R696: 7500 Ω (viol-grn-red).

( ) L605: 2.2 µH choke (red-red-gld-slvr, #45-73).

( ) R629: 3600 Ω (org-blu-red).

( ) R626: 3600 Ω (org-blu-red).

( ) L606: 2.2 µH choke (red-red-gld-slvr, #45-73).

( ) R666: 825 Ω, 1% (gry-red-grn-blk).

( ) R658: 301 Ω, 1% (org-blk-brn-blk).

( ) R669: 360 Ω (org-blu-brn).

( ) R659: 332 Ω, 1% (org-org-red-blk).

( ) R662: 51.1 Ω, 1% (grn-brn-brn-gld).

( ) R572: 51.1 Ω, 1% (grn-brn-brn-gld).

( ) R566: 825 Ω, 1% (gry-red-grn-blk).

( ) R574: 750 Ω, 1% (viol-grn-blk-blk).

( ) R575: 47.5 Ω, 1% (yel-viol-grn-gld).

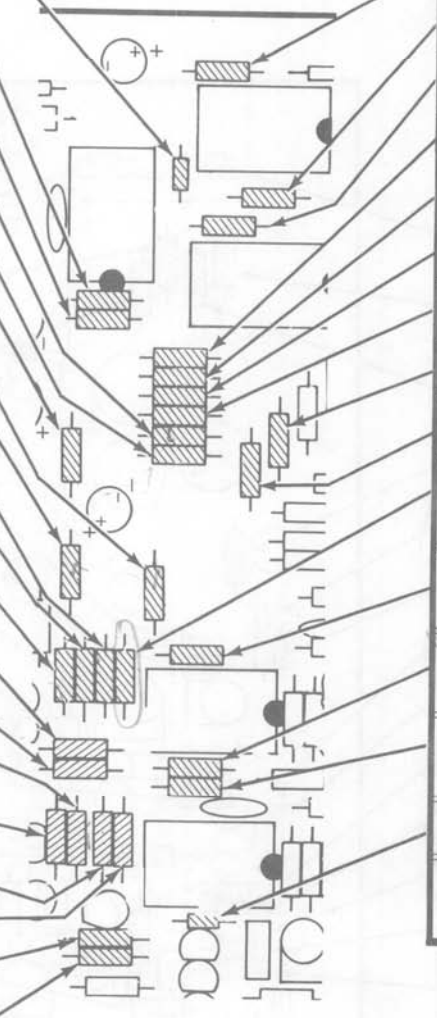
( ) R569: 360 Ω (org-blu-brn).

( ) R564: 47.5 Ω, 1% (yel-viol-grn-gld).

( ) R571: 51.1 Ω, 1% (grn-brn-brn-gld).

( ) R573: 750 Ω, 1% (viol-grn-blk-blk).

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



**CONTINUE**

( ) R636: 4700 Ω (yel-viol-red).

( ) R633: 4700 Ω (yel-viol-red).

( ) R635: 4700 Ω (yel-viol-red).

( ) R625: 3600 Ω (org-blu-red).

( ) R628: 3600 Ω (org-blu-red).

( ) R627: 3600 Ω (org-blu-red).

( ) R631: 3600 Ω (org-blu-red).

( ) R621: 3900 Ω (org-wht-red).

( ) R624: 3900 Ω (org-wht-red).

( ) R664: 47.5 Ω, 1% (yel-viol-grn-gld). NOTE: The circuit board may be screened "R661."

( ) R665: 47.5 Ω, 1% (yel-viol-grn-gld).

( ) R565: 47.5 Ω, 1% (yel-viol-grn-gld).

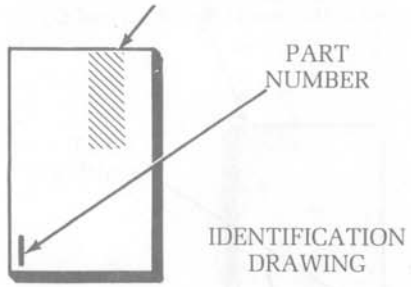
( ) R567: 80.6 Ω, 1% (gry-blk-blu-gld).

( ) C534: 330 pF (331) glass ceramic.

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

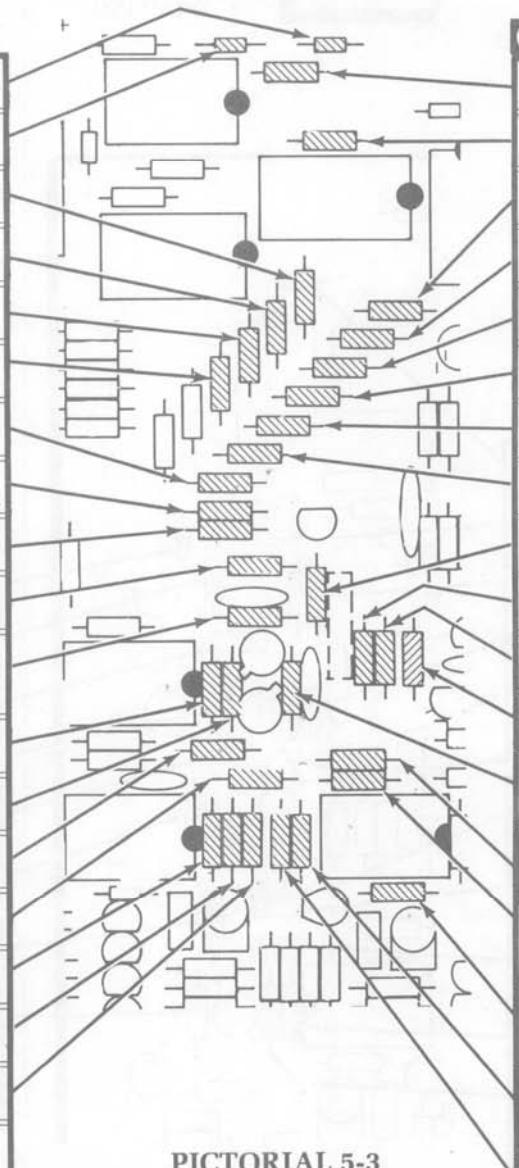
**PICTORIAL 5-2**

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




**START**

- ( ) C605: .01 µF (103) glass ceramic.
- ( ) C607: .01 µF (103) glass ceramic.
- ( ) R617: 3900 Ω (org-wht-red).
- ( ) R616: 3900 Ω (org-wht-red).
- ( ) R619: 3900 Ω (org-wht-red).
- ( ) R618: 3900 Ω (org-wht-red).
- ( ) R623: 330 Ω (org-org-brn).
- ( ) R609: 9100 Ω (wht-brn-red).
- ( ) R611: 2.2 Ω (red-red-gld).
- ( ) R694: 845 Ω, 1% (gry-yel-grn-blk).
- ( ) R606: 86.6 Ω, 1% (gry-blu-blu-gld).
- ( ) R668: 360 Ω (org-blu-brn).
- ( ) R603: 316 Ω, 1% (org-brn-blu-blk).
- ( ) R604: 316 Ω, 1% (org-brn-blu-blk).
- ( ) R466: 825 Ω, 1% (gry-red-grn-blk).
- ( ) R568: 360 Ω (org-blu-brn).
- ( ) R601: 536 Ω, 1% (grn-org-blu-blk).
- ( ) R602: 536 Ω, 1% (grn-org-blu-blk).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

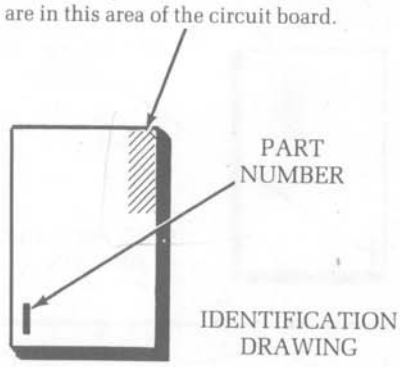


**PICTORIAL 5-3**

**CONTINUE**

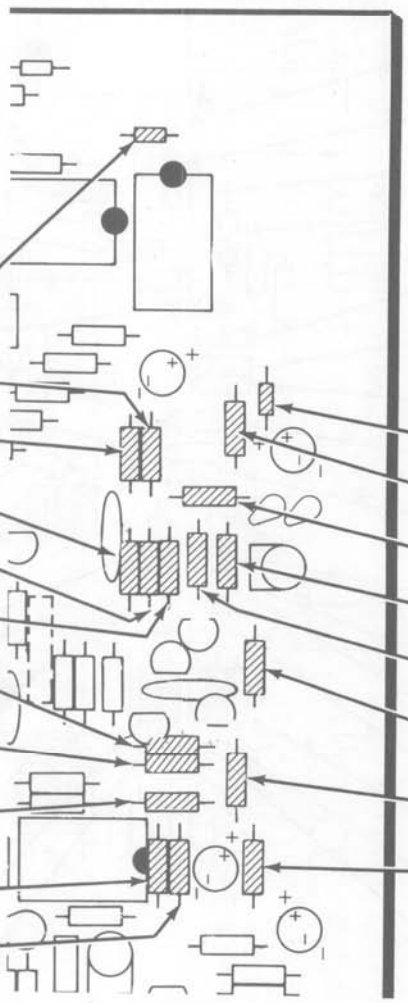
- ( ) R634: 4700 Ω (yel-viol-red).
- ( ) R632: 4700 Ω (yel-viol-red).
- ( ) R672: 2.2 Ω (red-red-gld).
- ( ) R613: 330 Ω (org-org-brn).
- ( ) R612: 330 Ω (org-org-brn).
- ( ) R615: 330 Ω (org-org-brn).
- ( ) R614: 330 Ω (org-org-brn).
- ( ) R622: 330 Ω (org-org-brn).
- ( ) R693: 845 Ω, 1% (gry-yel-grn-blk).
- ( ) R608: 1000 Ω (brn-blk-red).
- ( ) R607: 120 Ω (brn-red-brn).
- ( ) R476: 390 Ω (org-wht-brn).
- ( ) R605: 86.6 Ω, 1% (gry-blu-blu-gld).
- ( ) R467: 80.6 Ω, 1% (gry-blk-blu-gld).
- ( ) R465: 47.5 Ω, 1% (yel-viol-grn-gld).
- ( ) R471: 51.1 Ω, 1% (grn-brn-brn-gld).
- ( ) R464: 47.5 Ω, 1% (yel-viol-grn-gld).
- ( ) R469: 360 Ω (org-blu-brn).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

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




**START**

- ( ) C603: .01 µF (103) glass ceramic.
- ( ) R486: 200 Ω, 1% (red-blk-blk-blk).
- ( ) R485: 200 Ω, 1% (red-blk-blk-blk).
- ( ) R479: 432 Ω, 1% (yel-org-red-blk).
- ( ) R481: 2.2 Ω (red-red-gld).
- ( ) R484: 2.2 Ω (red-red-gld).
- ( ) R475: 47.5 Ω, 1% (yel-viol-grn-gld).
- ( ) R473: 750 Ω, 1% (viol-grn-blk-blk).
- ( ) R472: 51.1 Ω, 1% (grn-brn-brn-gld).
- ( ) R468: 360 Ω (org-blu-brn).
- ( ) C434: 330 pF (331) glass ceramic.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

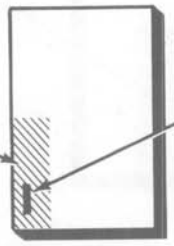


**CONTINUE**

- ( ) C604: .01 µF (103) glass ceramic.
- ( ) L607: 2.2 µH (red-red-gld-slvr, #45-73).
- ( ) R487: 39 Ω (org-wht-blk).
- ( ) R482: 39 Ω (org-wht-blk).
- ( ) R483: 432 Ω, 1% (yel-org-red-blk).
- ( ) R478: 390 Ω (org-wht-brn).
- ( ) R474: 750 Ω, 1% (viol-grn-blk-blk).
- ( ) R681: 2.2 Ω (red-red-gld).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

**PICTORIAL 5-4**

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

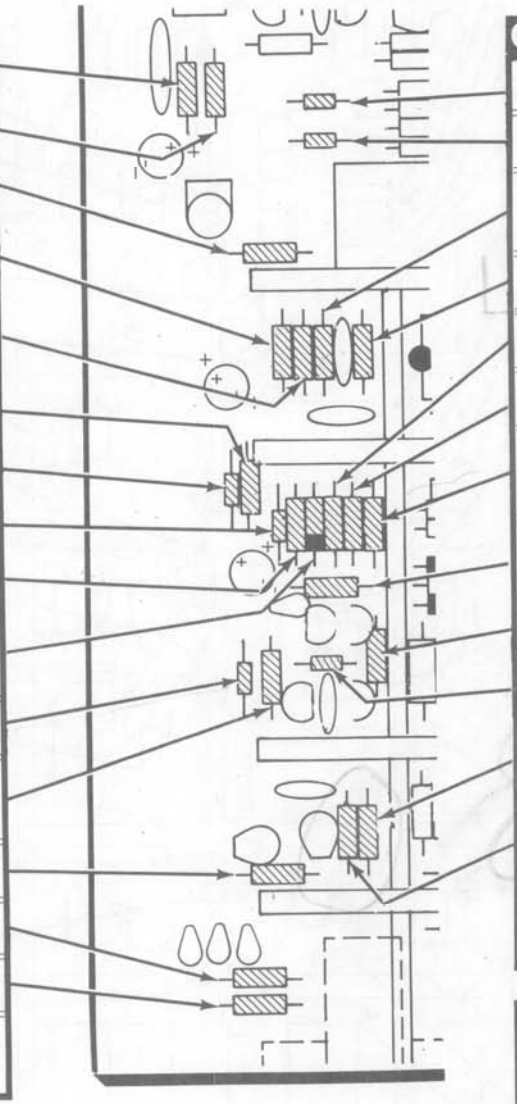


PART NUMBER

IDENTIFICATION DRAWING

**START**

- ( ) R684: 2.2 Ω (red-red-gld).
- ( ) R676: 2.2 Ω (red-red-gld).
- ( ) R542: 15 kΩ (brn-grn-org).
- ( ) R546: 2000 Ω, 1% (red-blk-blk-brn).
- ( ) R548: 3830 Ω, 1% (org-gry-org-brn).
- ( ) R532: 100 kΩ (brn-blk-yel).
- ( ) C516: .01 µF (103) glass ceramic.
- ( ) C515: .01 µF (103) glass ceramic.
- ( ) R527: 68 Ω (blu-gry-blk).
- ( ) D503: 1N4149 diode (#56-56). See Detail 1-5A.
- ( ) C531: .1 µF (104) glass ceramic.
- ( ) R524: 1300 Ω, 1% (brn-org-blk-brn).
- ( ) R506: 39 Ω (org-wht-blk).
- ( ) R556: 4700 Ω (yel-viol-red).
- ( ) R557: 3300 Ω (org-org-red).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

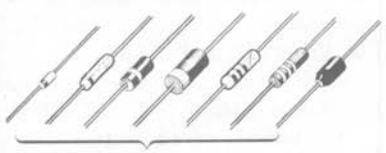


**CONTINUE**

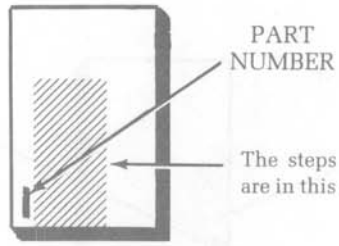
- ( ) C525: .01 µF (103) glass ceramic.
- ( ) C524: .01 µF (103) glass ceramic.
- ( ) R545: 2000 Ω, 1% (red-blk-blk-brn).
- ( ) R547: 100 Ω, 1% (brn-blk-blk-blk).
- ( ) R528: 2200 Ω (red-red-red).
- ( ) R535: 100 Ω, 1% (brn-blk-blk-blk).
- ( ) R531: 2000 Ω, 1% (red-blk-blk-brn).
- ( ) R533: 412 kΩ, 1% (yel-brn-red-org).
- ( ) R526: 33 Ω (org-org-blk).
- ( ) C514: .01 µF (103) glass ceramic.
- ( ) R508: 111 kΩ, 1/4% (brn-brn-brn-org).
- ( ) R507: 900 kΩ, 1/4% (wht-blk-blk-org).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

**PICTORIAL 5-5**

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



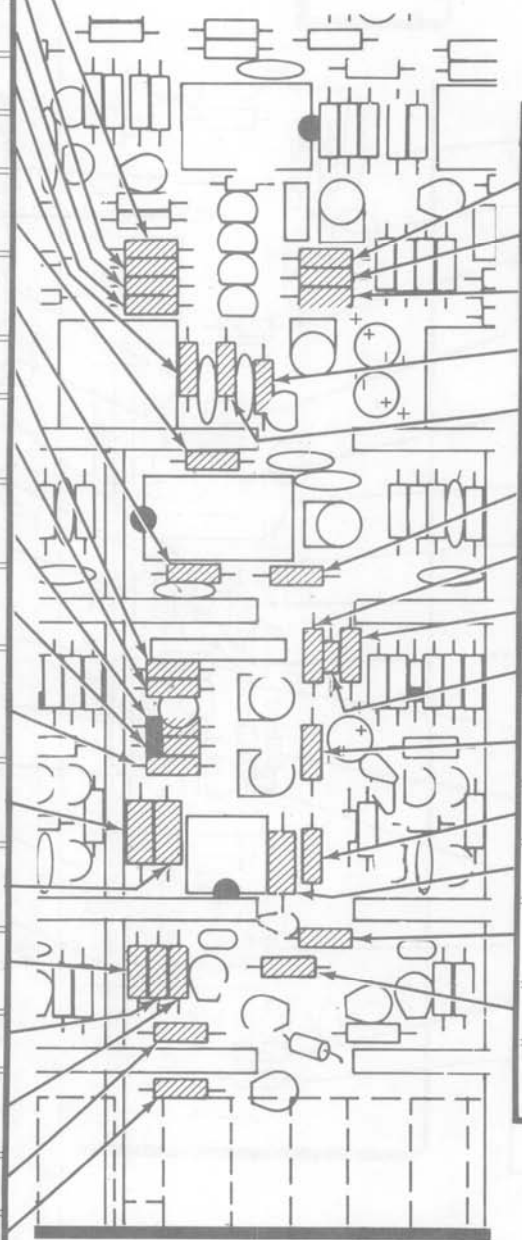

**Detail 1-5A**




IDENTIFICATION DRAWING

**START**

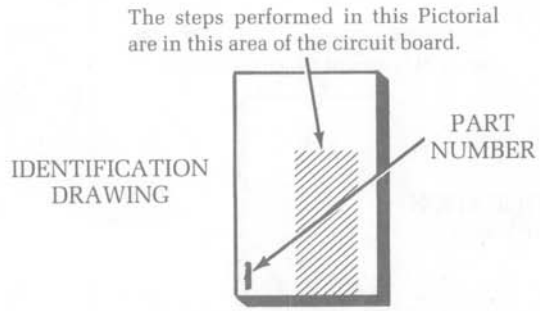
- ( ) R555: 100 Ω (brn-blk-brn).
- ( ) R554: 2700 Ω (red-viol-red).
- ( ) R595: 100 Ω (brn-blk-brn).
- ( ) R552: 2700 Ω (red-viol-red).
- ( ) R549: 240 Ω (red-yel-brn).
- ( ) R544: 2000 Ω, 1% (red-blk-blk-brn).
- ( ) R543: 2000 Ω, 1% (red-blk-blk-brn).
- ( ) R529: 7500 Ω (viol-grn-red).
- ( ) R523: 453 kΩ, 1% (yel-grn-org-org).
- ( ) D504: 1N4740A diode (#56-67). Note the banded end.
- ( ) D502: PS118775 diode (#56-31). Note the banded end.
- ( ) C536: .01 µF (103) glass ceramic. NOTE: The circuit board may be screened "C531."
- ( ) R534: 100 MΩ, 1/2-watt (brn-blk-viol).
- ( ) R521: 100 MΩ, 1/2-watt (brn-blk-viol).
- ( ) R512: 10.1 kΩ, 1/4% (brn-blk-brn-red).
- ( ) R592: 560 Ω (grn-blu-brn).
- ( ) R511: 990 kΩ, 1/4% (wht-wht-blk-org).
- ( ) R591: 120 Ω (brn-red-brn).
- ( ) R509: 27 Ω (red-viol-blk).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.



**CONTINUE**

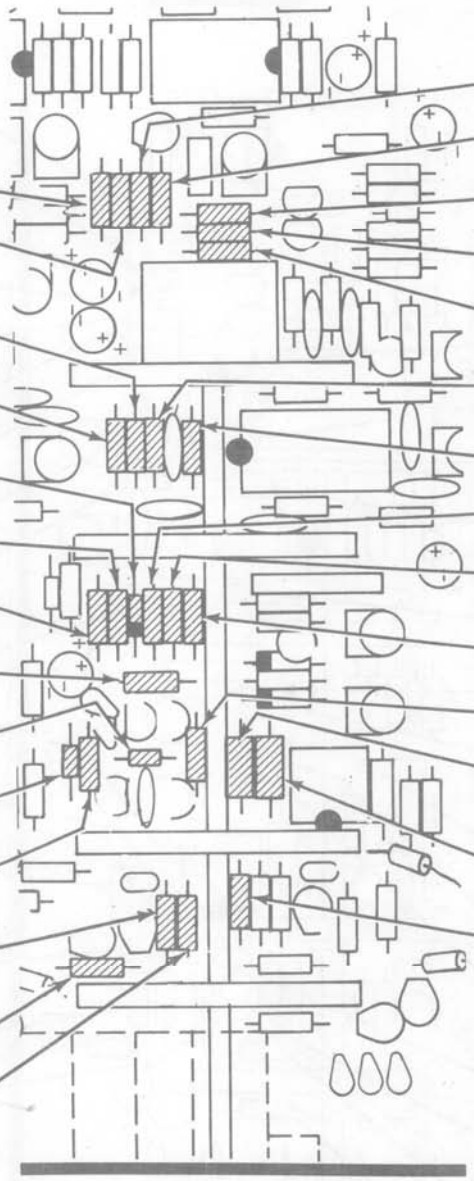
- ( ) R561: 301 Ω, 1% (org-blk-brn-blk).
- ( ) R562: 536 Ω, 1% (grn-org-blu-blk).
- ( ) R559: 301 Ω, 1% (org-blk-brn-blk).
- ( ) R537: 51 Ω (grn-brn-blk).
- ( ) R551: 240 Ω (red-yel-brn).
- ( ) R538: 768 Ω, 1% (viol-blu-gry-blk).
- ( ) R599: 10 kΩ, 1% (brn-blk-blk-red).
- ( ) R432: 100 kΩ, (brn-blk-yel).
- ( ) C416: .01 µF (103) glass ceramic.
- ( ) R518: 500 kΩ, 1% (grn-blk-blk-org).
- ( ) R525: 470 Ω (yel-viol-brn).
- ( ) R515: 1 MΩ, 1% (brn-blk-blk-yel).
- ( ) R517: 500 kΩ, 1% (grn-blk-blk-org).
- ( ) R513: 20 Ω, 1% (red-blk-blk-gld).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

**PICTORIAL 5-6**




**START**

- ( ) R558: 301 Ω, 1% (org-blk-brn-blk).
- ( ) R679: 2.2 Ω (red-red-gld).
- ( ) R448: 3830 Ω, 1% (org-gry-org-brn).
- ( ) R446: 2000 Ω, 1% (red-blk-blk-brn).
- ( ) D403: 1N4149 diode (#56-56). Note the banded end.
- ( ) R427: 68 Ω (blu-gry-blk).
- ( ) C415: .01 μF (103) glass ceramic.
- ( ) R433: 412 kΩ, 1% (yel-brn-red-org).
- ( ) C414: .01 μF (103) glass ceramic.
- ( ) C431: .1 μF (104) glass ceramic.
- ( ) R424: 1300 Ω, 1% (brn-org-blk-brn).
- ( ) R407: 900 kΩ, 1/4% (wht-blk-blk-org).
- ( ) R406: 39 Ω (org-wht-blk).
- ( ) R408: 111 kΩ, 1/4% (brn-brn-brn-org).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

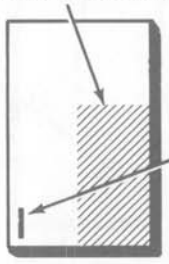


**CONTINUE**

- ( ) R683: 2.2 Ω (red-red-gld).
- ( ) R458: 301 Ω, 1% (org-blk-brn-blk).
- ( ) R459: 332 Ω, 1% (org-org-red-blk).
- ( ) R461: 332 Ω, 1% (org-org-red-blk).
- ( ) R462: 536 Ω, 1% (grn-org-blu-blk).
- ( ) R445: 2000 Ω, 1% (red-blk-blk-brn).
- ( ) R447: 100 Ω, 1% (brn-blk-blk-blk).
- ( ) R428: 2200 Ω (red-red-red).
- ( ) R435: 100 Ω, 1% (brn-blk-blk-blk).
- ( ) R431: 2000 Ω, 1% (red-blk-blk-brn)
- ( ) R426: 33 Ω (org-org-blk).
- ( ) R434: 100 MΩ, 1/2-watt (brn-blk-viol).
- ( ) R421: 100 MΩ, 1/2-watt (brn-blk-viol).
- ( ) R412: 10.1 kΩ, 1/4% (brn-blk-brn-red).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

**PICTORIAL 5-7**

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



IDENTIFICATION DRAWING

PART NUMBER

**START**

( ) R449: 240 Ω (red-yel-brn).

( ) R451: 240 Ω (red-yel-brn).

( ) R437: 51 Ω (grn-brn-blk).

( ) R444: 2000 Ω, 1% (red-blk-blk-brn).

( ) R443: 2000 Ω, 1% (red-blk-blk-brn).

( ) R429: 7500 Ω (viol-grn-red).

( ) R423: 453 kΩ, 1% (yel-grn-org-org).

( ) D404: 1N4740A diode (#56-67). Note the banded end.

( ) D402: PS18775 diode (#56-31).

( ) C436: .01 μF (103) glass ceramic. NOTE: The circuit board may be screened "C431."

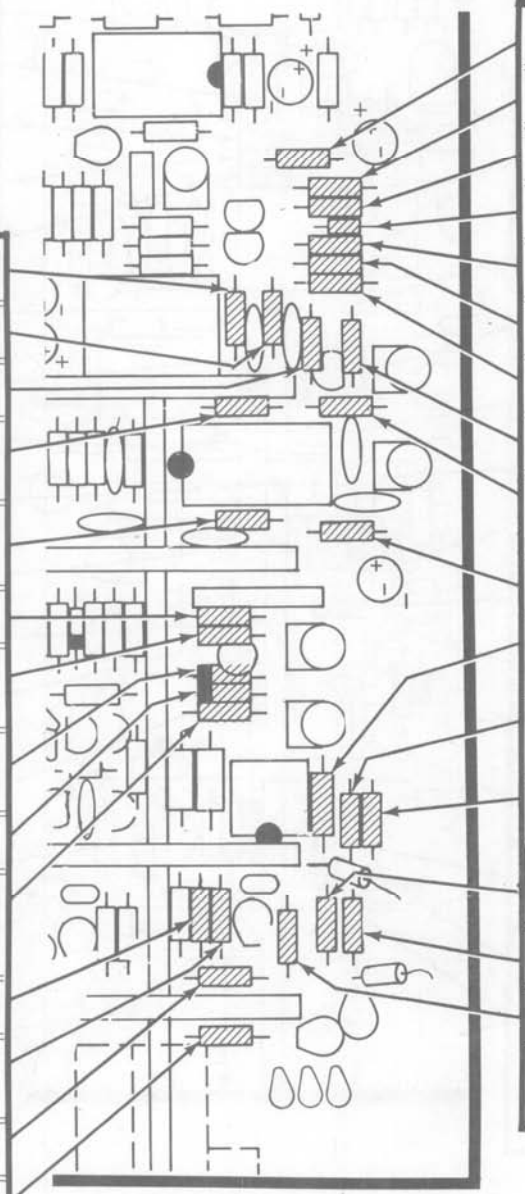
( ) R492: 560 (grn-blu-brn).

( ) R411: 990 kΩ, 1/4% (wht-wht-blk-org).

( ) R491: 120 Ω (brn-red-brn).

( ) R409: 27 Ω (red-viol-blk).

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



**CONTINUE**

( ) R677: 2.2 Ω (red-red-gld).

( ) R456: 4700 Ω (yel-viol-red).

( ) R457: 3300 Ω (org-org-red).

( ) C424: .01 μF (103) glass ceramic.

( ) R495: 100 Ω (brn-blk-brn).

( ) R454: 2700 Ω (red-viol-red).

( ) R452: 2700 Ω (red-viol-red).

( ) R442: 15 kΩ (brn-grn-org).

( ) R438: 768 Ω, 1% (viol-blu-gry-blk).

( ) R678: 2.2 Ω (red-red-gld).

( ) R415: 1 MΩ, 1% (brn-blk-blk-yel).

( ) R418: 500 kΩ, 1% (grn-blk-blk-org).

( ) R425: 470 Ω (yel-viol-brn).

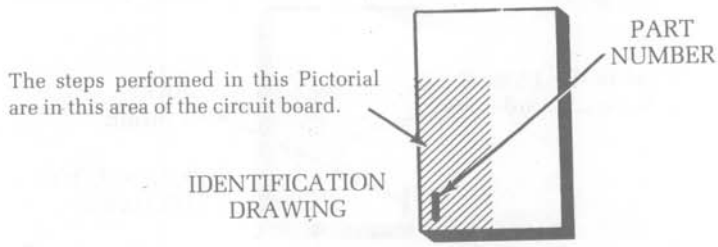
( ) R417: 500 kΩ, 1% (grn-blk-blk-org).

( ) R499: 10 kΩ, 1% (brn-blk-blk-red).

( ) R413: 20 Ω, 1% (red-blk-blk-gld).

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

**PICTORIAL 5-8**




**START**

NOTE: When you install each of the following controls and trimmers, match the outline of the part with the outline on the board. Insert the leads, solder them to the foil, and cut off the excess lead lengths.

( ) R577: 500 Ω control.

( ) R663: 100 Ω control.

( ) C526: 3.2 - 18 pF trimmer (blue dot).

( ) R563: 2000 Ω (2K) control. 10K HORIZONTAL

( ) R541: 100 kΩ control.

( ) R539: 50 Ω control.

( ) R514: 100 kΩ control.

( ) R522: 100 kΩ control.

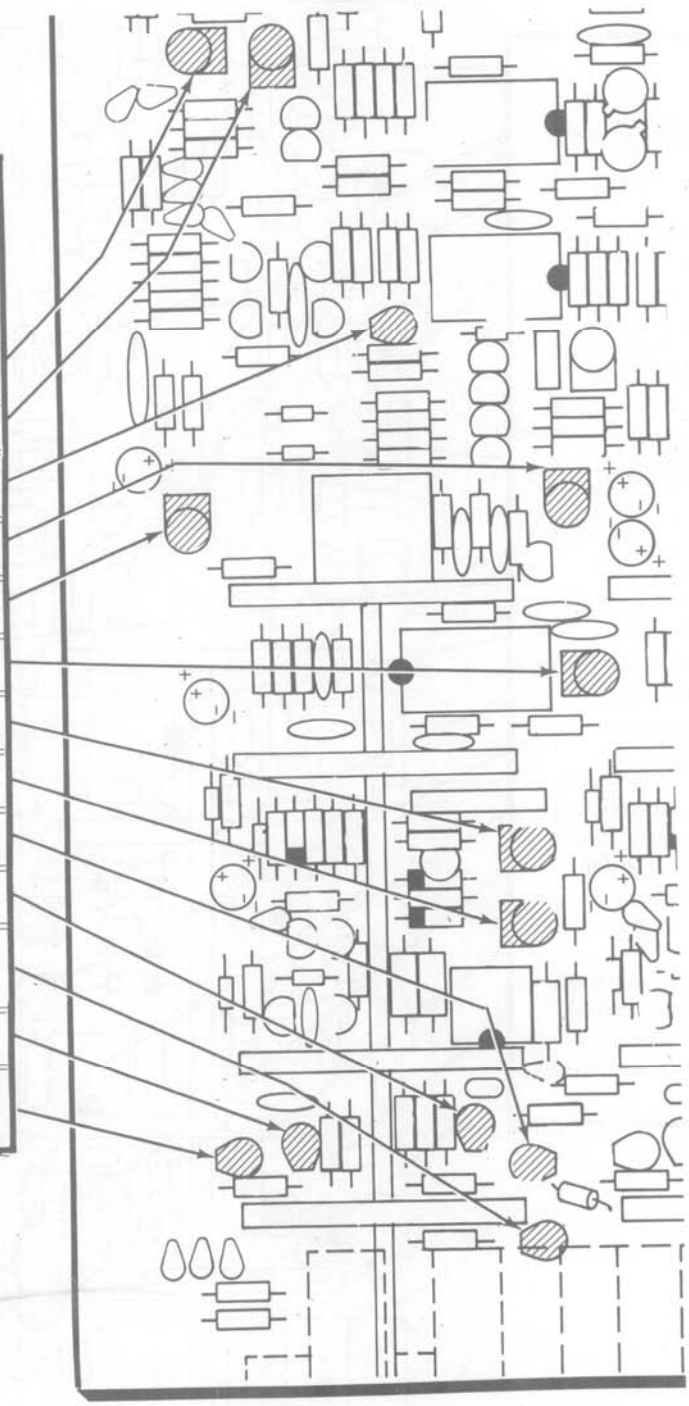
( ) C502: 2 - 6 pF trimmer (red dot).

( ) C507: 2 - 6 pF trimmer (red dot).

( ) C506: 3.2 - 18 pF trimmer (blue dot).

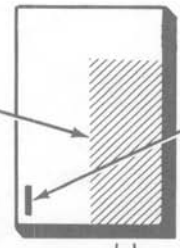
( ) C504: 2 - 6 pF trimmer (red dot).

( ) C503: 5-25 pF trimmer. (brown dot).



**PICTORIAL 5-9**

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




**START**

( ) R477: 500 Ω control.

( ) R463: 2000 Ω (2K) control. 10K HORIZONTAL

( ) C426: 3.2 - 18 pF trimmer (blue dot).

( ) R589: 50 Ω control.

NOTE: Mount the next two controls vertically. Position the rotating front of the control toward the heavy line drawn on the Pictorial.

( ) R597: 10 kΩ control. VERTICAL

( ) R497: 10 kΩ control. VERTICAL

( ) R441: 100 kΩ control.

( ) R439: 50 Ω control.

( ) R414: 100 kΩ control.

( ) R422: 100 kΩ control.

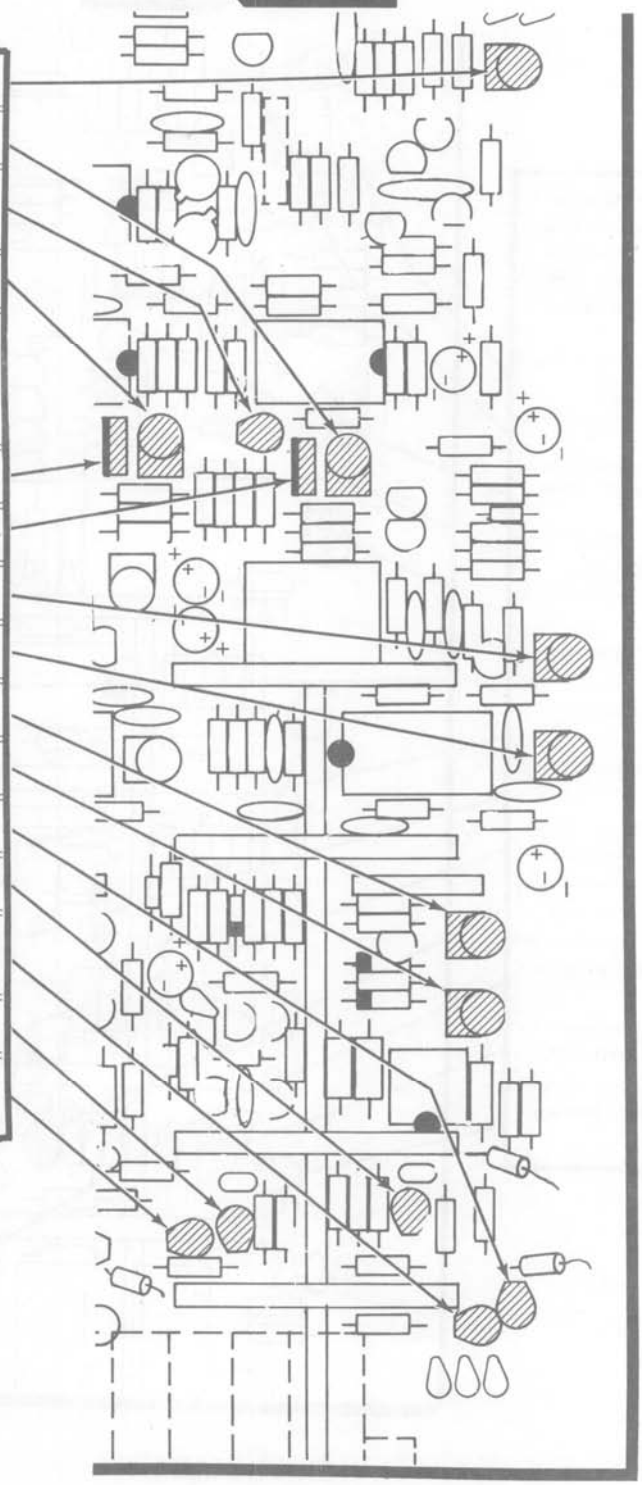
( ) C402: 2 - 6 pF trimmer (red dot).

( ) C407: 2 - 6 pF trimmer (red dot).

( ) C406: 3.2 - 18 pF trimmer (blue dot).

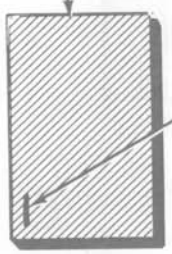
( ) C404: 2 - 6 pF trimmer (red dot).

( ) C403: 5-25 pF trimmer (brown dot).



**PICTORIAL 5-10**

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




IDENTIFICATION
DRAWING

**START**

Refer to Figure 1 (Illustration Booklet, Page 1) when you install the following IC sockets.

( ) Two 14-pin IC sockets.

( ) Two 16-pin IC sockets.

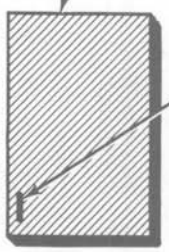
( ) Four 14-pin IC sockets.

( ) Two 16-pin IC sockets.

( ) Two 8-pin IC sockets.

**PICTORIAL 5-11**

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




**START**

Refer to Figure 1 (Illustration Booklet, Page 1) when you install the following IC's and transistor modules.

( ) U604: SN**74LS08** IC (#443-780).

( ) U605: SN**74121** IC (#443-22).

( ) U603: SN**74LS76** IC (#443-829).

( ) U602: SN**74LS76** IC (#443-829).

( ) U601: SN**74LS00** IC (#443-728).

( ) Q611: CA3102 transistor module (#417-978).

( ) Q511: CA3102 transistor module (#417-978).

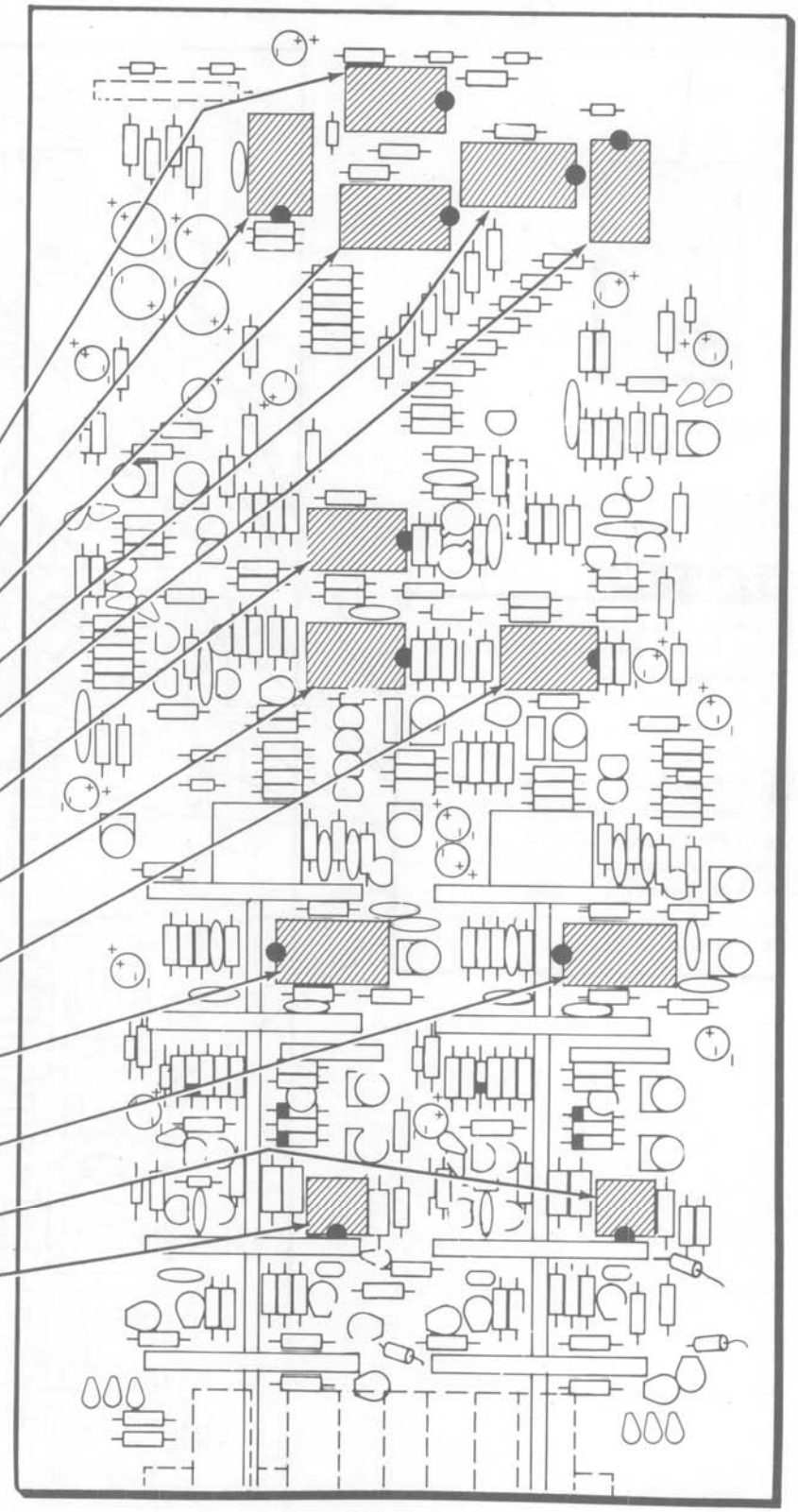
( ) Q411: CA3102 transistor module (#417-978).

( ) Q505: CA3127 transistor module (#417-975).

( ) Q405: CA3127 transistor module (#417-975).

( ) U401: LF**411**N IC (#442-759).

( ) U501: LF**411**N IC (#442-759).

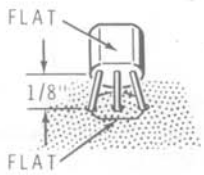


**PICTORIAL 5-12**

**Heathkit®**

## START

NOTE: When you install each of the following transistors and diodes, position the flat on the part over the outline of the flat on the circuit board. Then insert the leads into the circuit board holes and solder them to the foil. Cut off any excess lead lengths.




( ) Q607: 2N5770 transistor (#417-293).

( ) Q606: 2N5770 transistor (#417-293).

( ) Q515: MPSH81 transistor (#417-917).

( ) Q513: MPSH81 transistor (#417-917).

( ) Q514: MPSH81 transistor (#417-917).

( ) Q512: MPSH81 transistor (#417-917).

( ) Q516: PN4858 transistor (#417-931).

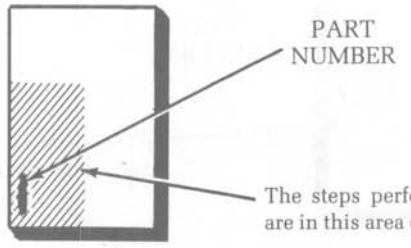
( ) Q504: 2N3906 transistor (#417-874).

( ) Q502: 2N5770 transistor (#417-293).

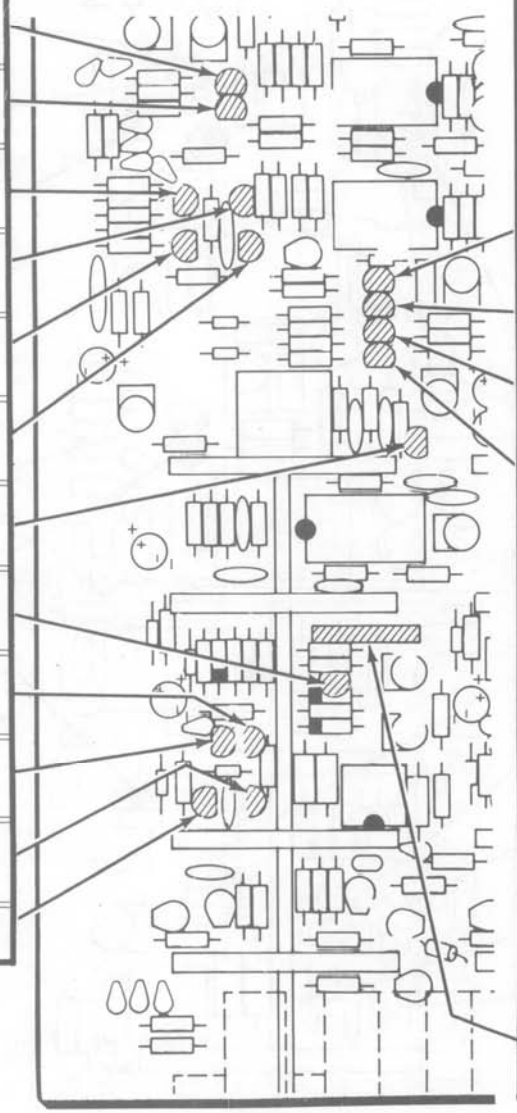
( ) Q503: MPSH10 transistor (#417-887).

( ) Q501: E304 (selected) transistor (#417-828).

( ) D501: SF50077 diode (#417-854).

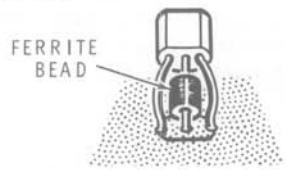



IDENTIFICATION DRAWING



## CONTINUE

NOTE: When you install each of the next four transistors, slide a ferrite bead on the center lead as shown. Push the transistor all the way down to the top of the ferrite bead.



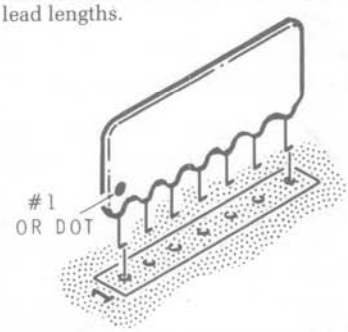

( ) Q509: MPSH10 transistor (#417-887) and ferrite bead.

( ) Q508: MPSH10 transistor (#417-887) and ferrite bead.

( ) Q507: MPSH10 transistor (#417-887) and ferrite bead.

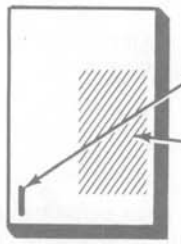
( ) Q506: MPSH10 transistor (#417-887) and ferrite bead.

NOTE: When you install the following resistor pack, match up #1 or the dot on the part with the #1 location on the board. Then insert the leads, solder them to the foil, and cut off the excess lead lengths.




( ) R588: 400 Ω resistor pack (#9-127).

**PICTORIAL 5-13**




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

IDENTIFICATION DRAWING

## START

NOTE: When you install the next two transistors, position the tabs over the outline of the tabs on the circuit board. Then insert the leads into the circuit board holes and solder them to the foil. Cut off the excess lead lengths.

( ) Q601: 2N2369 transistor (#417-154).

( ) Q602: 2N2369 transistor (#417-154).

NOTE: In the following steps, match the flat on the transistor with the outline of the flat on the board.

( ) Q416: PN4858 transistor (#417-931).

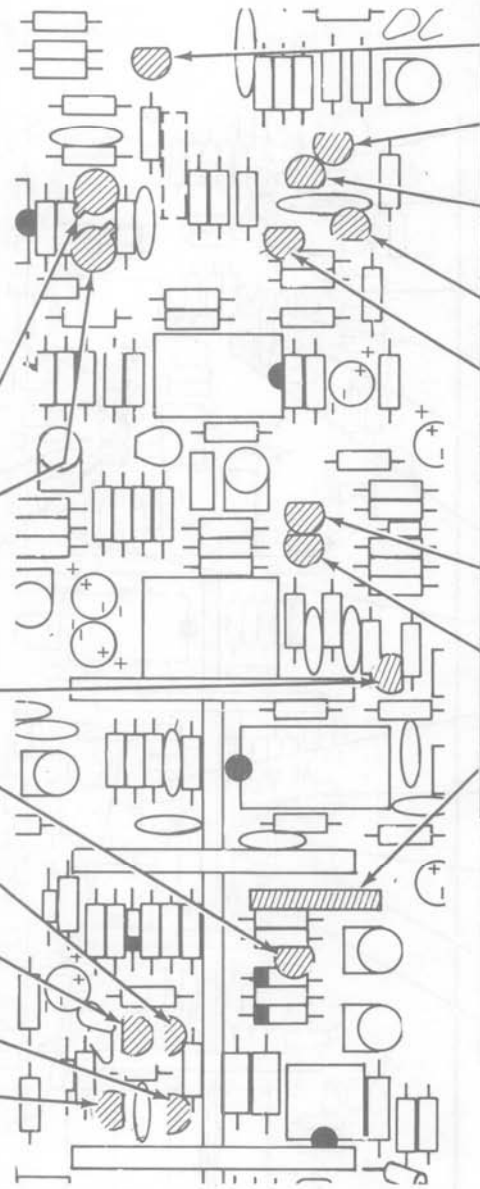
( ) Q404: 2N3906 transistor (#417-874).

( ) Q402: 2N5770 transistor (#417-293).

( ) Q403: MPSH10 transistor (#417-887).

( ) Q401: E304 (selected) transistor (#417-828).

( ) D401: SF50077 diode (#417-854).



## CONTINUE

( ) Q603: MPSA20 transistor (#417-801).

( ) Q415: MPSH81 transistor (#417-917).

( ) Q414: MPSH81 transistor (#417-917).

( ) Q413: MPSH81 transistor (#417-917).

( ) Q412: MPSH81 transistor (#417-917).

NOTE: When you install each of the next two transistors, slide a ferrite bead on the center lead.

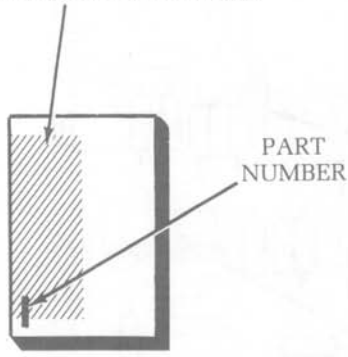
( ) Q407: MPSH10 transistor (#417-887) and ferrite bead.

( ) Q406: MPSH10 transistor (#417-887) and ferrite bead.

( ) R488: 400 Ω resistor pack (#9-127). Be sure to match the #1 end or dot with #1 on the board.

**PICTORIAL 5-14**

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



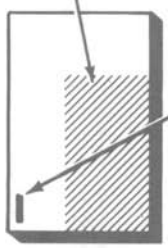

IDENTIFICATION
DRAWING

**START**

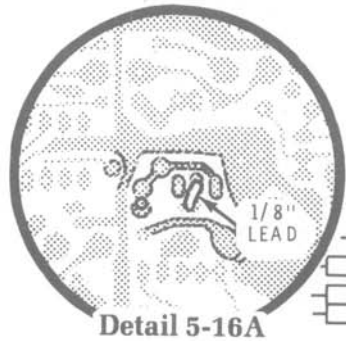
- ( ) C631: 10 pF ceramic.
- ( ) C533: 10 pF ceramic.
- ( ) C532: 39 pF ceramic.
- ( ) C527: 39 pF ceramic.
- ( ) C519: 680 pF ceramic (round).
- ( ) C521: 680 pF ceramic (round).
- ( ) C523: 10 pF ceramic.
- ( ) C522: 33 pF ceramic.
- ( ) C535: 5 pF ceramic.
- ( ) C512: 4.3 pF ceramic.
- ( ) C508: 330 pF (331) ceramic.
- ( ) C505: 15 pF ceramic.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

**PICTORIAL 5-15**

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




IDENTIFICATION DRAWING




**Detail 5-16A**

**START**

( ) C432: 39 pF ceramic.

( ) C601: 10 pF ceramic.

( ) C602: 10 pF ceramic.

( ) C427: 39 pF ceramic.

( ) C421: 680 pF ceramic (round).

( ) C419: 680 pF ceramic (round).

( ) C518: 100 pF (100 k) ceramic.

( ) C517: 68 (680) pF ceramic (small rectangular).

( ) C423: 10 pF ceramic.

( ) C422: 33 pF ceramic. Position the circuit board foil-side up. Then refer to Detail 5-16A and cut the right-hand capacitor lead to 1/8". Bend this lead over against the indicated foil and solder the connections. IMPORTANT: Be sure this lead only touches the center foil pad as shown.

( ) C435: 5 pF ceramic.

( ) C417: 68 pF (680) ceramic (small rectangular).

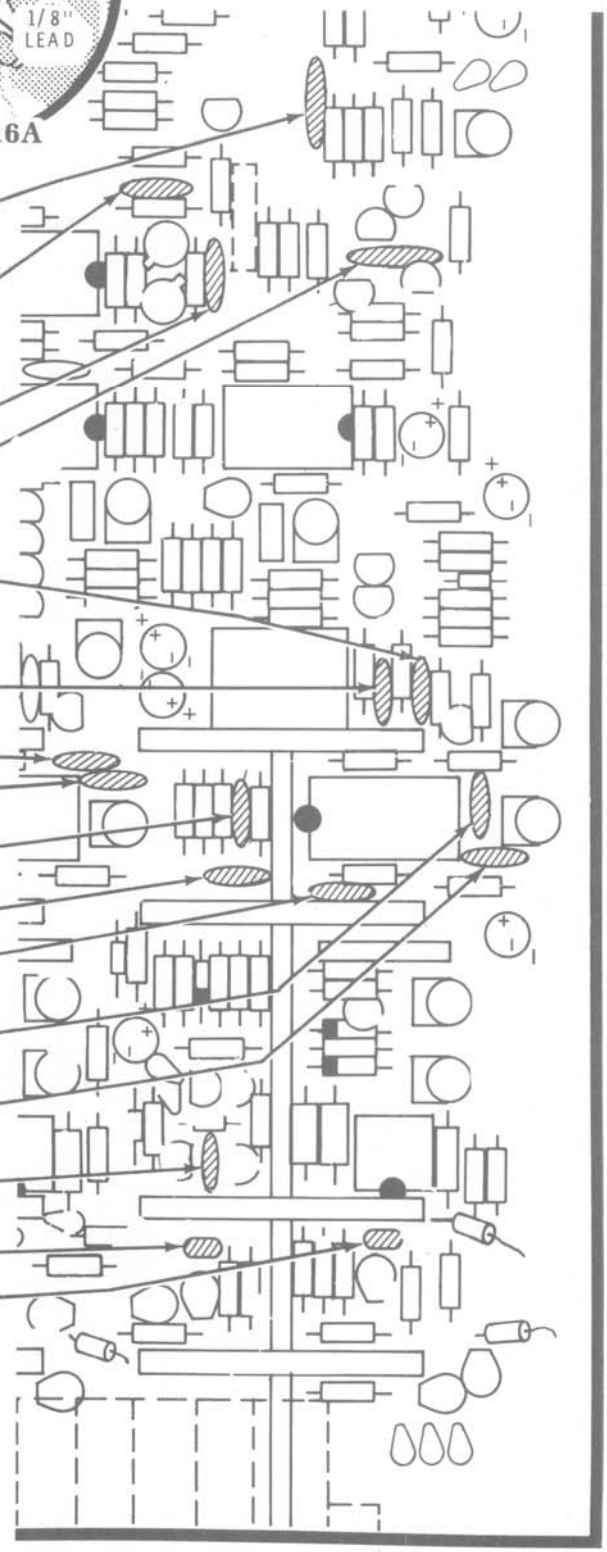
( ) C418: 100 pF (100 k) ceramic.

( ) C412: 4.3 pF ceramic.

( ) C405: 15 pF ceramic.

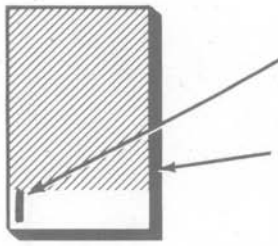
( ) C408: 330 pF (331) ceramic.

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



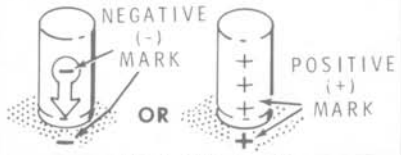
**PICTORIAL 5-16**

Heathkit®




IDENTIFICATION DRAWING

NOTE: When you install electrolytic capacitors, always match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board OR match the negative (–) mark on the capacitor with the negative (–) mark on the circuit board.




**Detail 5-17A**

**START**

Install the following electrolytic capacitors as shown in Detail 5-17A.

( ) C627: 10 µF.

( ) C611: 100 µF.

( ) C622: 100 µF.

( ) C614: 100 µF.

( ) C626: 100 µF.

( ) C613: 10 µF.

( ) C615: 10 µF.

( ) C628: 10 µF.

( ) C612: 10 µF.

( ) C629: 10 µF.

( ) C621: 10 µF.

( ) C617: 10 µF.

( ) C616: 10 µF.

( ) C619: 10 µF.

( ) C623: 10 µF.

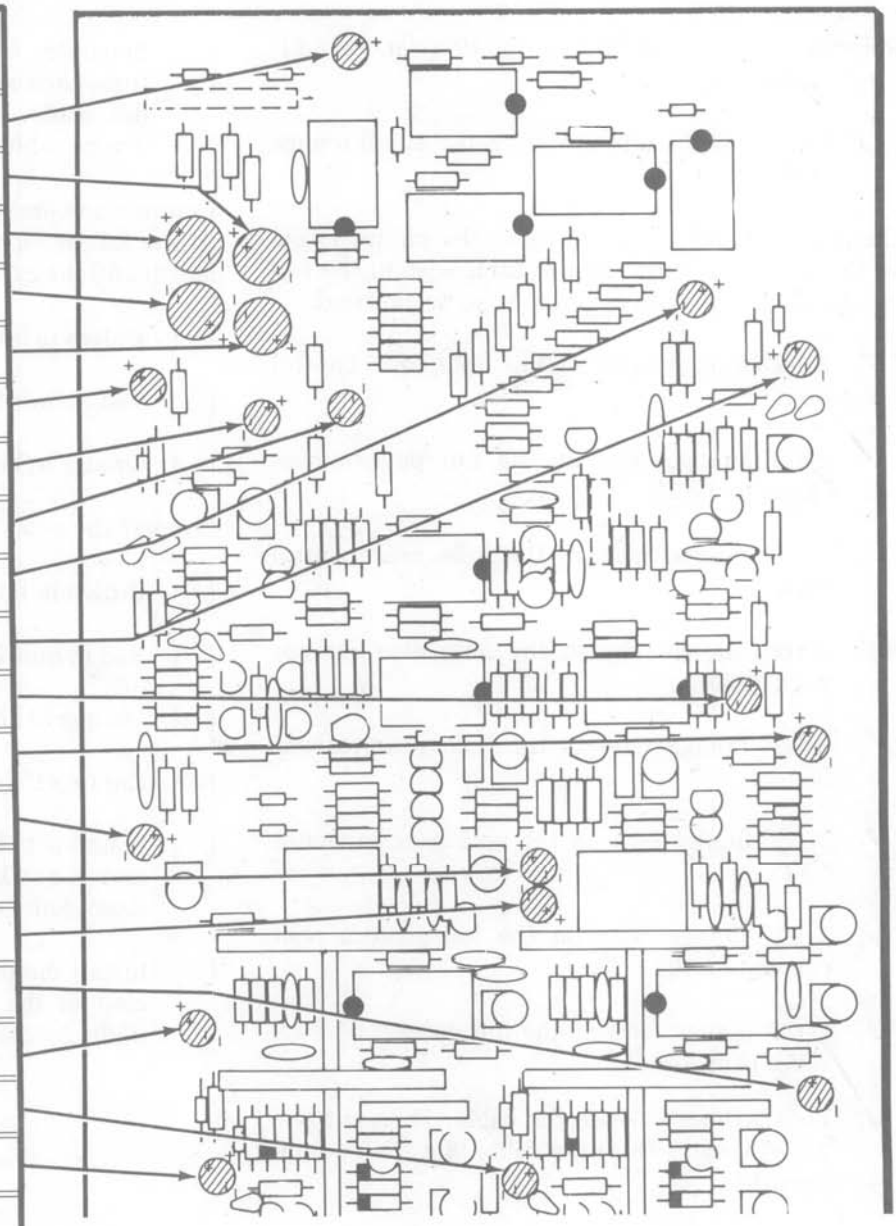
( ) C618: 10 µF.

( ) C625: 10 µF.

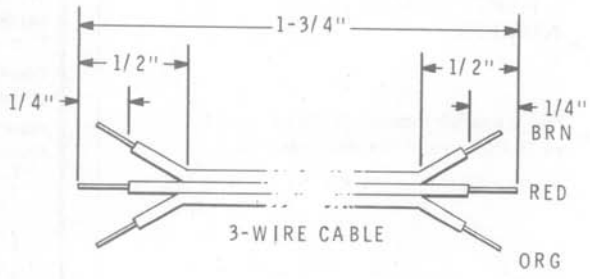
( ) C413: 47 µF.

( ) C513: 47 µF.

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



**PICTORIAL 5-17**




**Detail 5-18A**

Refer to Pictorial 5-18 (Illustration Booklet, Page 11) for the following steps.

( ) Prepare both ends of eight 2-1/2″ small orange **solid** wires.

Connect one end of each wire to the circuit board in the following steps. Solder each wire to the foil as you connect it; then cut off the excess bare end.

( ) 2-1/2″ orange wire in the hole near control R541.

( ) 2-1/2″ orange wire on the foil pattern near capacitor C625.

( ) 2-1/2″ orange wire in the hole near control R563.

( ) 2-1/2″ orange wire in the hole near resistor pack R588.

( ) 2-1/2″ orange wire in the hole near resistor R416.

( ) 2-1/2″ orange wire in the hole near capacitor C505.

( ) 2-1/2″ orange wire on the foil pattern near capacitor C405.

( ) 2-1/2″ orange wire on the foil pattern near resistor pack R488.

( ) Locate the 9″, 7-wire flat cable. Then cut two 1-3/4″ lengths from the cable. Set the remainder aside.

( ) Separate a brown-red-orange combination from each short 7-wire cable. Set the remainder aside. Then prepare the ends of each 3-wire cable as shown in Detail 5-18A.

Connect one end of either cable to the circuit board in the following steps. Solder the wires to the foil and cut off the excess wire lengths.

( ) Brown in hole N.

( ) Red in hole O.

( ) Orange in hole P.

Connect the other 3-wire cable as follows:

( ) Brown in hole C.

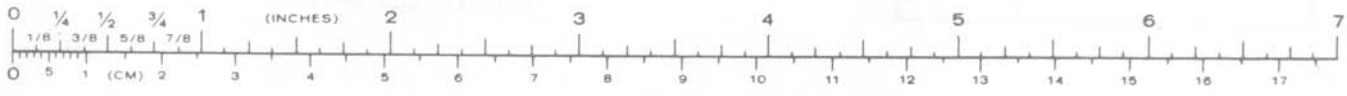
( ) Red in hole D.

( ) Orange in hole E.

( ) Cut two 1″ small bare wires.

( ) Install a 1″ bare wire in the hole near the left end of 111 kΩ, 1/4% (brn-brn-brn-red) resistor R408. Solder the wire to the foil.

( ) Install the other 1″ bare wire in the hole adjacent to the center of 111 kΩ, 1/4% resistor R508. Solder the wire to the foil.



Refer to Detail 5-18B for the following steps.

( ) Locate two .001 µF ceramic capacitors, two 68 Ω (blu-gry-blk) resistors, and the small heat-shrinkable sleeving.

( ) Prepare two resistor-capacitor combinations as shown in the Detail.

Refer to Pictorial 5-18 for the following steps.

NOTE: As you install each of the following parts, solder the leads to the foil and cut off the excess lead lengths.

( ) R593/C511: Install the 3/8" end of one resistor capacitor combination in hole AA on the circuit board. Position the combination about 1/8" from the board.

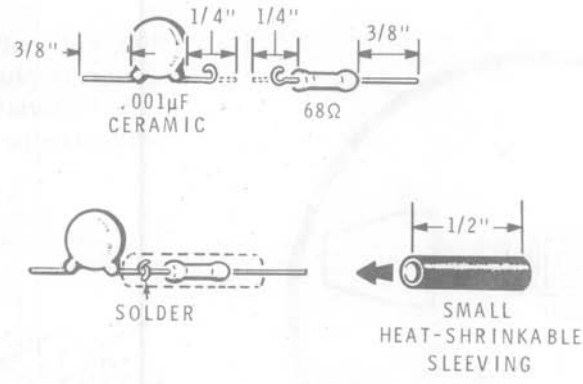
( ) R493/C411: Similarly install the other resistor-capacitor combination in hole A.

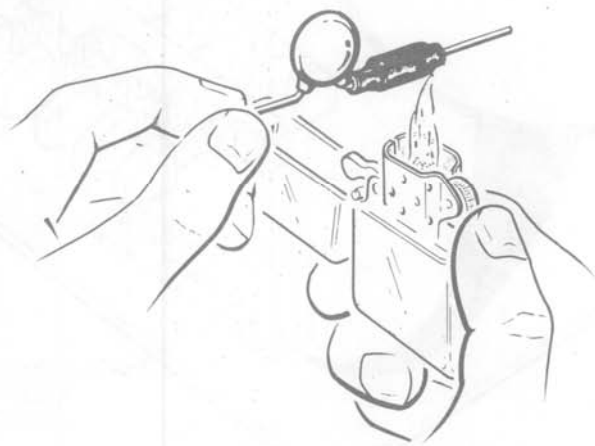
( ) R404: Install a 2.2 Ω (red-red-gld) resistor at R404. Use 5/8" of small sleeving (not the heat-shrinkable) on each lead. To keep the sleeving from coming off the free end of the resistor, make a 90° bend at the end of the lead.

( ) R504: Similarly prepare and install another 2.2 Ω (red-red-gld) resistor at R504.

( ) R416: Cut one end of a 500 kΩ, 1% (grn-blk-blk-org) resistor to 3/8". Install this end of the resistor at R416. Position the resistor about 1/8" from the board.

( ) R516: Similarly prepare and install a 500 kΩ, 1% (grn-blk-blk-org) resistor in hole I.



**Detail 5-18B**

Refer to Pictorial 5-19 (Illustration Booklet, Page 12) for the following steps.

( ) Position the circuit board with the component side down as shown.

( ) SW601: Install the pushbutton switch assembly on the circuit board as follows. Refer to Detail 5-19A.

1. Carefully insert all the switch pins into their mounting holes.

2. Push the assembly onto the circuit board. Make sure the crimped portion of each pin is fully seated against the circuit board.

3. Check the switch assembly to make sure it is parallel with the board as shown in the inset drawing.

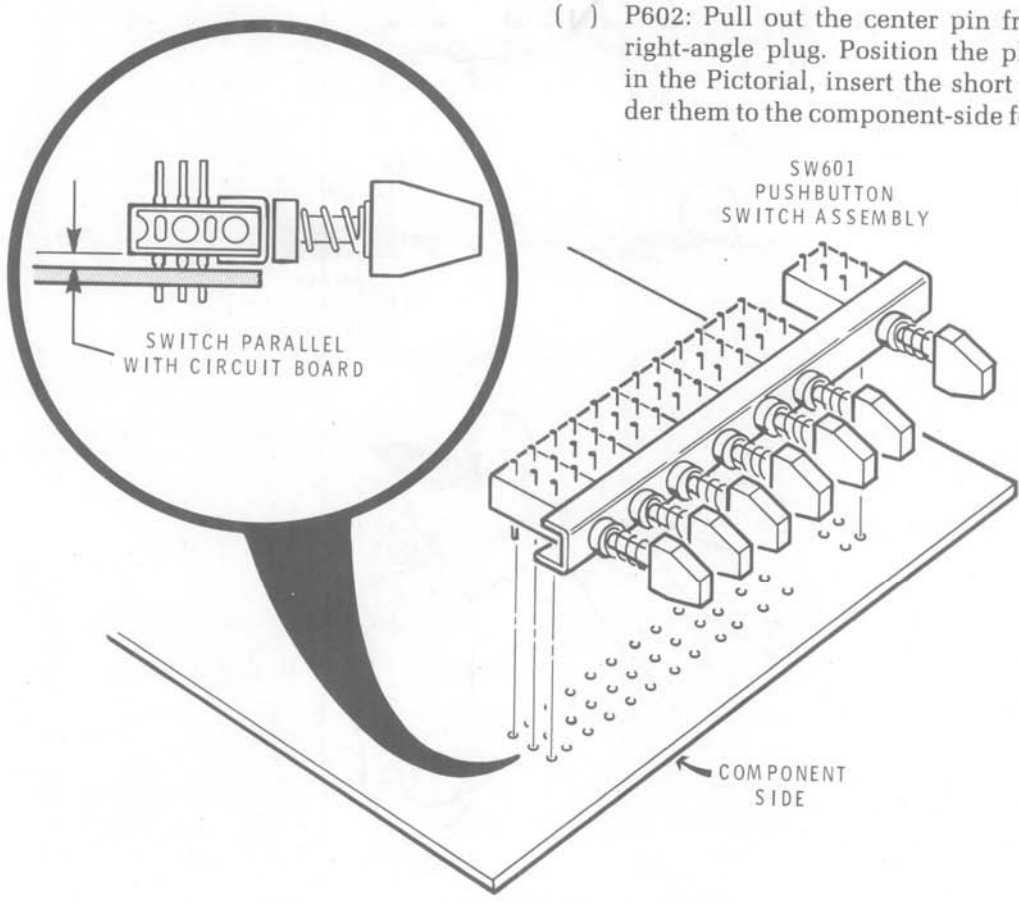
4. Turn the board over and, on the component side, solder one pin on each end and at the middle of the switch assembly.

5. Turn the board over and check the switch to make sure the assembly is still parallel. Again turn the board over and solder the remaining pins to the component-side foils. IMPORTANT: Some of these foil pads are small and feed through to the top of the board. Be sure each of these pads is well soldered and that the solder "wicks" downward along the sides of the switch pins.

( ) P601: Pull pin 9 from a 10-pin plug; then install the plug as shown. Insert the short pins into the board and solder them to the component-side foil.

( ) Locate the 5-pin right-angle plug saved from a previous pack.

( ) P602: Pull out the center pin from the 5-pin right-angle plug. Position the plug as shown in the Pictorial, insert the short pins and solder them to the component-side foil.




**Detail 5-19A**

( ) Refer to Detail 5-19B and prepare both ends of **four** 16" RG-174/U (Braid) shielded cables as shown. Do **not** apply solder to the shields at one end of each cable.

( ) Install small spring connectors on the **inner** leads at the end of all four of the prepared cables (with unsoldered shields) as shown in inset drawing #1 on Pictorial 5-19.

( ) Tightly twist the unsoldered shield leads of **two** shielded cables together and crimp and solder a small spring connector on the ends of these leads. See inset drawing #1.

( ) Prepare the other two cables in exactly the same manner.

In the following steps, you will insert the connectors of each cable assembly into a 7-hole socket. Be sure to position the sockets with the slotted side up and the connectors with the small tabs up when you insert them.

NOTE: Use strips of numbers from the label set to mark the ends of cables in the following steps.

Either cable assembly:

( ) Shield lead pair in hole 1.

( ) Inner lead of either cable in hole 2.

( ) Place label strip #1 around the other end of the cable whose inner lead is in hole 2.

NOTE: Hole 3 is not used.

( ) Inner lead of the other cable in hole 4.

( ) Mark the end of the cable to hole 4 with label strip **"2."**

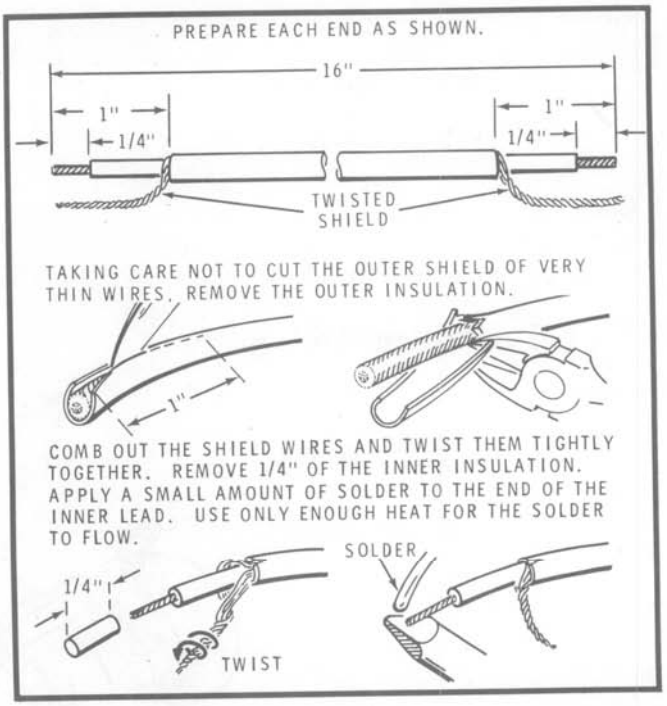
Other cable assembly:

Insert the connectors into the 7-hole socket in the following steps.

( ) Shield lead pair in hole 5.

( ) Inner lead of either cable in hole 6.

( ) Mark the end of this cable with label strip **"3."**




**Detail 5-19B**

( ) Inner lead of the other cable in hole 7.

( ) Mark the end of this cable with label strip **"4."**

( ) Cut a 6" piece of black tape. Refer to inset drawing #2 and wrap the length of tape from the 7-hole socket rearward onto the cables until all exposed shield leads are covered.

( ) Cut two 2" pieces from the roll of black tape.

( ) Wrap a 2" length of black tape around the four shielded cables in two places as shown in the Pictorial.

( ) Push a polarizing pin into hole 3 of the 7-hole socket.

Install the free ends of the cables through the holes in the underside of the circuit board in the following steps. Use 3/4" of small sleeving on the shield lead of each cable. Solder the leads to the underside foils and cut off the excess lead lengths.

Cable "3":

( ) Inner lead in hole Q.

( ) Shield lead in hole R.

Cable "1":

( ) Inner lead in hole U.

( ) Shield lead in hole V.

Cable "2":

( ) Inner lead in hole S.

( ) Shield lead in hole T.

Cable "4":

( ) Inner lead in hole F.

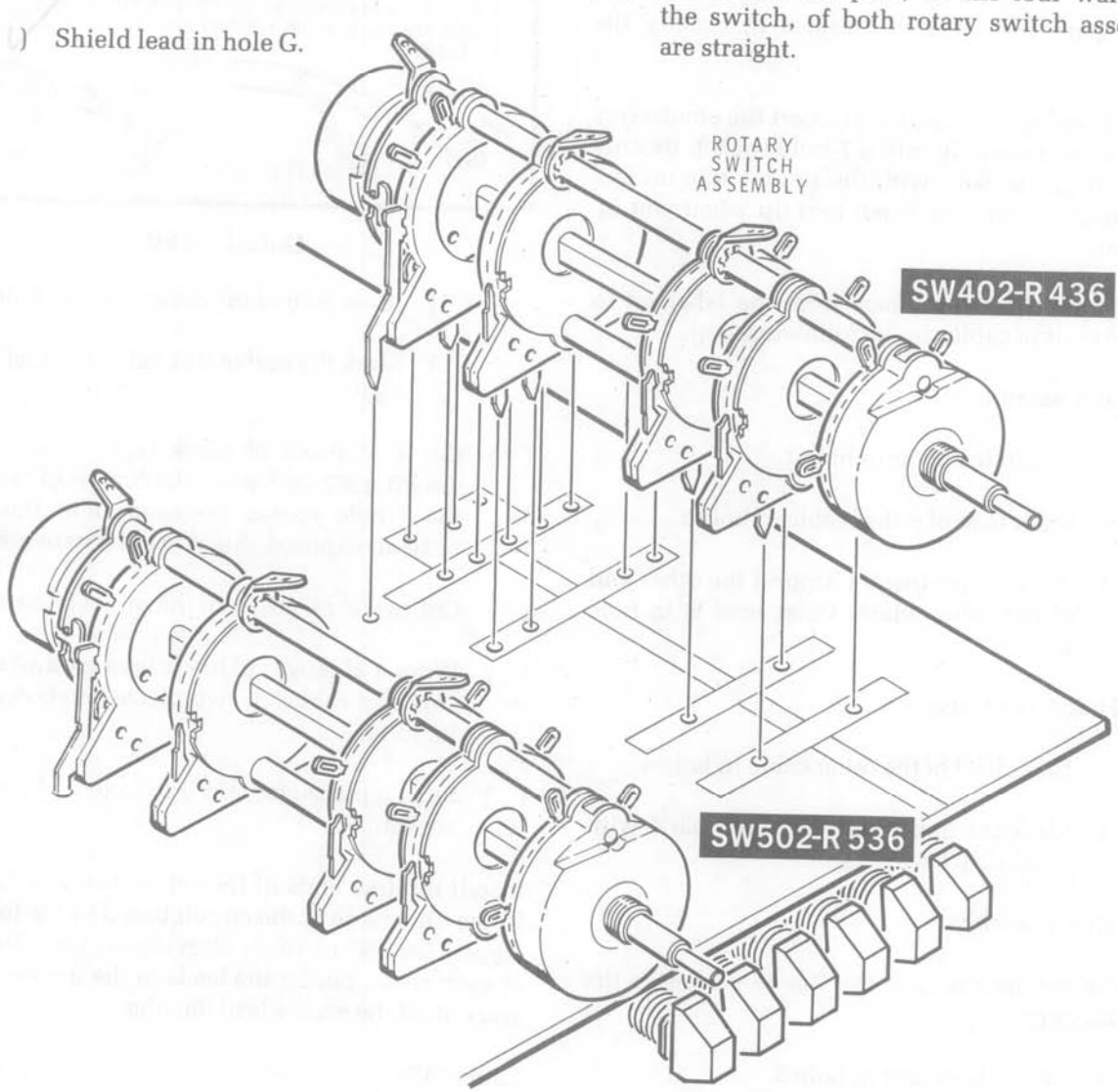
( ) Shield lead in hole G.

Refer to Pictorial 5-20 (Illustration Booklet, Page 13) for the following steps.

Refer to Detail 5-20A for the following steps.

( ) Position the circuit board as shown. Then position the eight wires, four resistors, and two resistor-capacitor combinations, that still have to be connected, straight up so you can mount the two rotary switch assemblies in the following steps. NOTE: Be sure to position the bare wires to the side, toward the solder lugs on the switch wafers.

( ) Make sure the pins, on the four wafers and the switch, of both rotary switch assemblies are straight.




**Detail 5-20A**

NOTE: In the following steps, rotate solder lug G upward to clear the adjacent trimmer capacitor.

( ) SW402-R436/SW502-R536: Install each of the rotary switch assemblies (#63-1388) as follows:

1. Carefully insert all of the wafer pins into their mounting holes.

2. Push the assembly onto the board. Make sure that all four wafers are completely seated down against the board. NOTE: Slightly reposition adjacent components, if necessary.

3. On each switch, tack-solder one rear-corner pin to its foil and one front-corner pin diagonally opposite the soldered rear pin.

( ) Temporarily refer to Pictorial 5-27 on Page 6-34 and position the front panel (without mounted components) over the pushbutton switches and onto the shafts of the two control-switch assemblies. Secure the control switch shafts with two control nuts.

( ) Carefully check all the pushbutton switches for adequate clearance and freedom of operation. With pliers, turn the control and switch shafts to be sure they operate correctly.

( ) Making sure **all** the wafers of both control-switch assemblies are all the way down onto the surface of the board, solder all the remaining pins to the circuit board foils.

( ) Remove the front panel and control nuts from the assemblies and set them aside temporarily.

In the following steps, you will be wiring rotary switch SW402.

NOTE: In the following steps, (NS) means not to solder because other wires 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.

( ) Cut both leads of a 22 Ω (red-red-blk) resistor to 1/2".

( ) R410: Connect the prepared 22 Ω resistor leads from wafer B lug 8 (NS) to wafer C lug 8 (S-1). Form the resistor upward as shown.

( ) Prepare a 1-3/4" small orange **solid** wire.

( ) Connect a 1-3/4" small orange solid wire from wafer A lug 6 (NS) to solder lug A (NS).

( ) Cut the leads of two .001 μF ceramic capacitors to 1/2".

( ) C429: Connect one of the capacitors between wafer A lugs 6 (NS) and 8 (NS). Use 1/4" of sleeving on each lead.

( ) C428: Connect the other capacitor between wafer A lugs 6 (S-3) and 4 (NS).

Connect the free end of the following components and wires coming from the board to switch SW402.

( ) Refer to inset drawing #2 on Pictorial 5-20 and locate the short bare wire just below solder lug G (on the back of switch wafer B). Pass the end of the wire through solder lug G (S-1). Cut off the excess wire end.

( ) Resistor R404 (2.2 Ω) to wafer B lug 8 (S-2).

( ) Resistor R416 (500 kΩ) to wafer C lug 9 (S-1).

( ) Connect the free end of resistor-capacitor combination R493/C411 to switch SW402 wafer C lug 4 (S-1).

( ) Either orange wire adjacent to wafer C to solder lug A (NS).

( ) Other orange wire adjacent to wafer C to solder lug A (S-3).

( ) Orange wire near R488 to solder lug B (S-1).

( ) Orange wire adjacent to wafer E to solder lug C (S-1).

( ) Cut a 3/4" small bare wire.

( ) Install a 3/4" wire between SW402 wafer E lugs 5 (S-1) and 6 (S-1). Cut off any excess wire ends.

In the following steps, you will be wiring switch SW502.

( ) Cut the leads of a 27 Ω (red-viol-blk) resistor to 1/2".

( ) R510: Connect the prepared 27 Ω resistor leads from wafer B lug 8 (NS) to wafer C lug 8 (S-1). Form the resistor upward as shown.

( ) Prepare a 1-3/4" small orange solid wire.

( ) Connect a 1-3/4" small orange wire from wafer A lug 6 (NS) to solder lug D (NS).

( ) Cut the leads of two .001 μF ceramic capacitors to 1/2".

( ) C529: Connect one of the capacitors between wafer A lugs 6 (NS) and 8 (NS). Use 1/4" of sleeving on each lead.

( ) C528: Connect the other capacitor between wafer A lugs 6 (S-3) and 4 (NS) of wafer A.

Connect the free end of the following components and wires coming from the board to switch SW502.

( ) Refer to inset drawing #1 on Pictorial 5-20 and locate the short bare wire just below solder lug D (on the back of switch wafer B). Pass the end of the wire through solder lug H (S-1). Cut off the excess wire end.

( ) Resistor R504 (2.2 Ω) to wafer B lug 8 (S-2).

( ) Orange wire adjacent to wafer C to solder lug D (S-2).

( ) Either wire adjacent to wafer D to solder lug E (NS).

( ) Other orange wire adjacent to wafer D to solder lug E (S-2).

( ) Orange wire adjacent to wafer E to solder lug F (S-1).

( ) Connect the free end of 500 kΩ resistor R516 to switch SW502 wafer C lug 9 (S-1).

( ) Connect the free end of resistor capacitor combination R593/C511 to switch SW502 wafer C lug 4 (S-1).

( ) Cut a 3/4" small bare wire.

( ) Install a 3/4" small bare wire between SW502 wafer E lugs 5 (S-1) and 6 (S-1). Cut off the excess wire ends.

Refer to Pictorial 5-21 (Illustration Booklet, Page 14) for the following steps.

( ) Locate the 8-wire flat cable and cut it to 21". Remove and discard the gray wire. Separate the wires at each end as shown and prepare the ends of the wires.

( ) Crimp and solder female connectors on end A of the cable as shown in inset drawing #1.

Refer to inset drawing #2 and connect the following resistors to end B of the cable. Cut both leads of each resistor to 3/8". Form a hook in one resistor lead and the end of the cable wire and solder the connection. Then slide a 1/2" length of small heat shrinkable sleeving over the connection and part of the resistor. Heat the sleeving until it shrinks around the parts.

( ) R494: 10 kΩ resistor on the brown wire.

( ) R496: 1000 Ω resistor on the orange wire.

( ) R498: 1000 Ω resistor on the yellow wire.

( ) R596: 1000 Ω resistor on the green wire.

( ) R598: 1000 Ω resistor on the blue wire.

( ) R594: 10 kΩ resistor on the violet wire.

Refer to Pictorial 5-22 (Illustration Booklet, Page 15) for the following steps.

In the following steps, you will insert the connectors into two 4-hole plugs (with ears). Position the plugs with the grooved side up as shown. Insert the connectors until they snap into place. Tug on each wire to make sure the connectors are latched in the socket. NOTE: Disregard **any** numbers embossed on plugs and sockets.

PLUG P501:

( ) Green wire in hole 1.

( ) Blue wire in hole 2.

( ) Violet wire in hole 3.

PLUG P401:

( ) Brown wire in hole 1.

( ) Red wire in hole 2.

( ) Orange wire in hole 3.

( ) Yellow wire in hole 4.

Connect the other end of the cable resistors to switches SW402 and SW502 in the following steps.

( ) Yellow wire to SW402 wafer A lug 4 (S-2).

( ) Orange wire to SW402 wafer A lug 8 (S-2).

( ) Blue wire to SW502 wafer A lug 4 (S-2).

( ) Green wire to SW502 wafer A lug 8 (S-2).

Connect the remaining wires to the circuit board in the following steps. Solder the wires to the foil and cut off the excess wire lengths.

( ) Brown wire to hole L.

( ) Red wire to hole K near C605.

( ) Violet to hole H.

( ) Cut the ears from plugs P401 and P501.

**CIRCUIT BOARD CHECKOUT**

Carefully inspect the circuit board for the following conditions.

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

( ) Protruding leads which could touch together.

( ) Transistors for the proper type and installation.

( ) Electrolytic capacitors for the correct position of the positive (+) or negative (−) marks.

( ) Diodes for the correct position of the banded end.

( ) IC's for the proper type and installation.

Set the circuit board aside temporarily.

Refer to Pictorial 5-23 for the following steps.

The following parts will be mounted on the front panel.

( ) Carefully bend the end of both 1/4" solder lugs and both BNC solder lugs up at a 30° angle as shown in the inset drawing. **Do not make a sharp bend.**

( ) Open the envelope containing one of the toggle switches and hardware. Only one flat nut and the tapered nut will be used; you may discard the remaining hardware.

( ) Turn the flat nut all the way onto the switch bushing, but do not tighten it.

( ) SW401: Position the switch so the lugs are as shown and mount it at SW401 with a 1/4" solder lug and the tapered nut. Turn the tapered nut on the bushing, with your fingers, as far as it will go. Make sure the switch and solder lug are positioned as shown. Then tighten the flat nut against the inside of the panel with the wrench supplied.

( ) SW501: Similarly mount the other toggle switch at SW501.

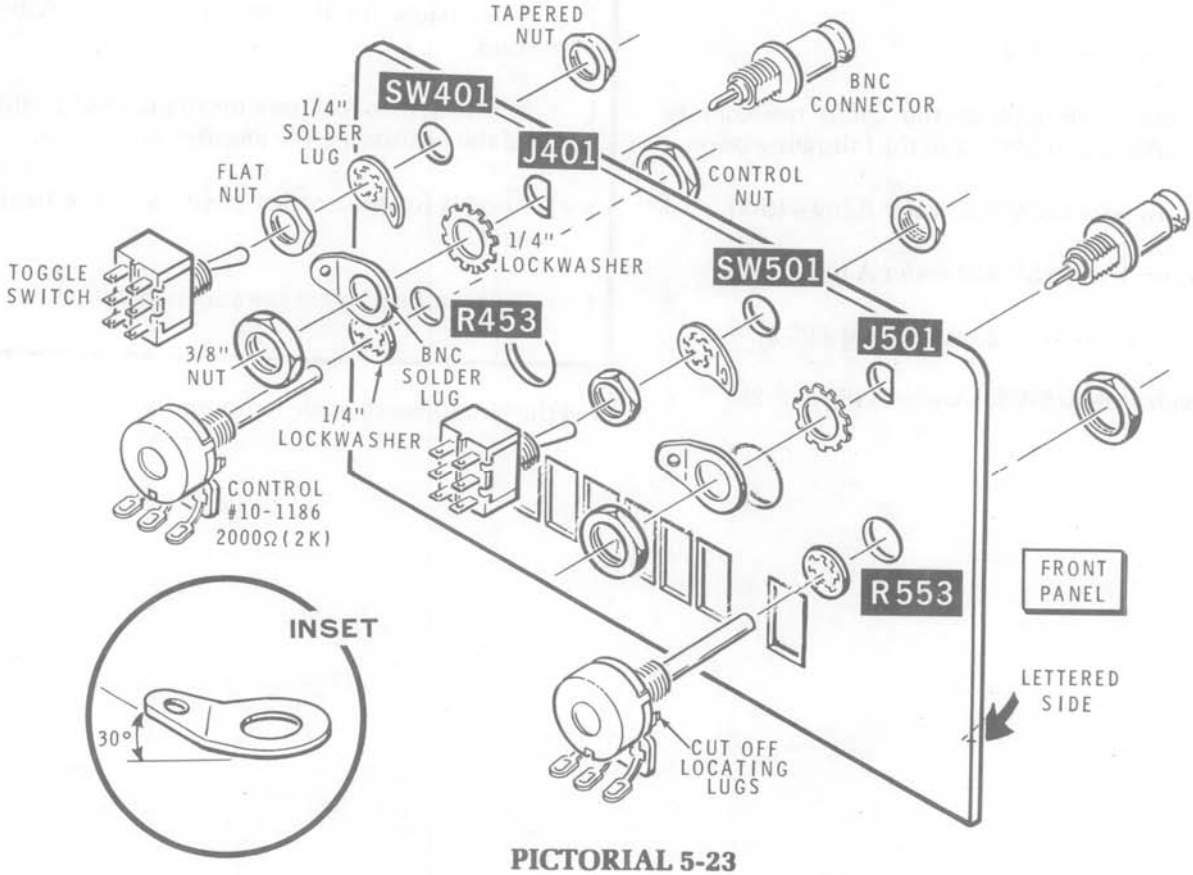
( ) J401: Using the hardware supplied with the BNC connector, mount a BNC connector and a BNC solder lug on the front panel at J401. Position the solder lug as shown.

( ) J501: In the same manner, mount the other BNC connector at J501.

NOTE: In all of the following steps, if a control or switch has a locating tab, bend the tab flat or cut it from the component.

( ) R453: Mount a 2000 Ω (2K, #10-1186) control at R453 with a 1/4" lockwasher and 1/4" nut. Be sure to position the control lugs as shown.

( ) R553: Similarly mount the other 2000 Ω (2K, #10-1186) control at R553.




**PICTORIAL 5-23**

Refer to Pictorial 5-24 for the following steps.

( ) R402: Connect a 1 MΩ (brn-blk-grn) resistor between SW401 lugs 2 (NS) and 6 (NS). Use 3/8" of small sleeving on the lead to lug 2.

( ) R403: Connect one lead of a 39 Ω (org-wht-blk) resistor to SW401 lug 2 (S-2). Use 1/2" of small sleeving on the lead to lug 2. Position the resistor straight up as shown.

( ) Cut the length of large bare wire into two 2" pieces. Form each wire, using the full size template in the inset drawing on Pictorial 5-24.

( ) Insert the shorter end of one wire through the solder lugs at J401 (NS) and SW401 (NS). Connect the other end to SW401 lug 4 (S-1).

( ) Cut two 2-3/4" pieces of flat braid.

( ) Connect one end of a 2-3/4" braid to the bare wire between the two solder lugs (S-3).

( ) R401: Connect a 5.1 Ω (grn-brn-gld) resistor from J401 (S-1) to SW401 lug 1 (NS). Use 5/8" of small sleeving on each lead.

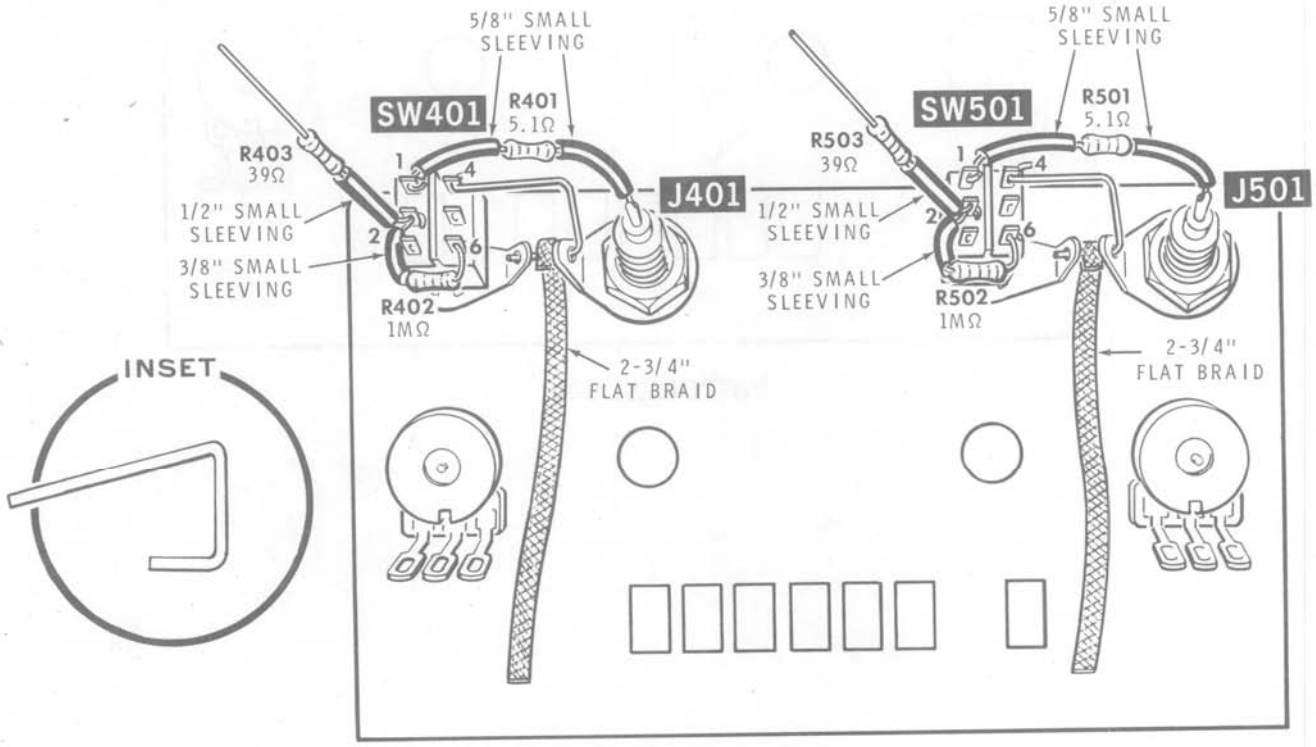
( ) R502: Connect a 1 MΩ (brn-blk-grn) resistor between SW501 lugs 2 (NS) and 6 (NS). Use 3/8" of small sleeving on the lead to lug 2.

( ) R503: Connect one lead of a 39 Ω (org-wht-blk) resistor to SW501 lug 2 (S-2). Use 1/2" of small sleeving on the lead to lug 2. Position the resistor straight up as shown.

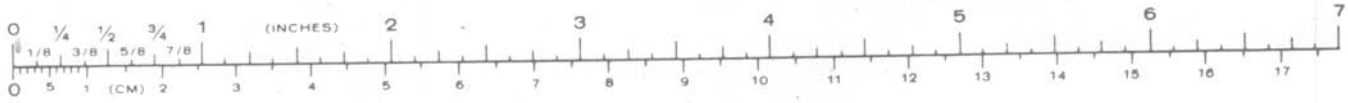
( ) Insert the shorter end of the other bare wire, that you formed earlier, through the solder lugs at J501 (NS) and SW501 (NS). Connect the other end to SW501 lug 4 (S-1).

( ) Connect one end of a 2-3/4" braid to the bare wire between the two solder lugs (S-3).

( ) R501: Connect a 5.1 Ω (grn-brn-gld) resistor from J501 (S-1) to SW501 lug 1 (NS). Use ~~5/8"~~ 3/8" of small sleeving on each lead.




**PICTORIAL 5-24**



Refer to Pictorial 5-25 for the following steps.

( ) R405: Cut both leads of a 5.1 Ω (grn-brn-gld) resistor to 1/2". Connect the resistor between SW401 lugs 3 (S-1) and 5 (S-1).

( ) Cut two 1/2" pieces of small sleeving.

( ) C401: Cut the leads of a .02 μF ceramic capacitor to 1/4" and 3/4".

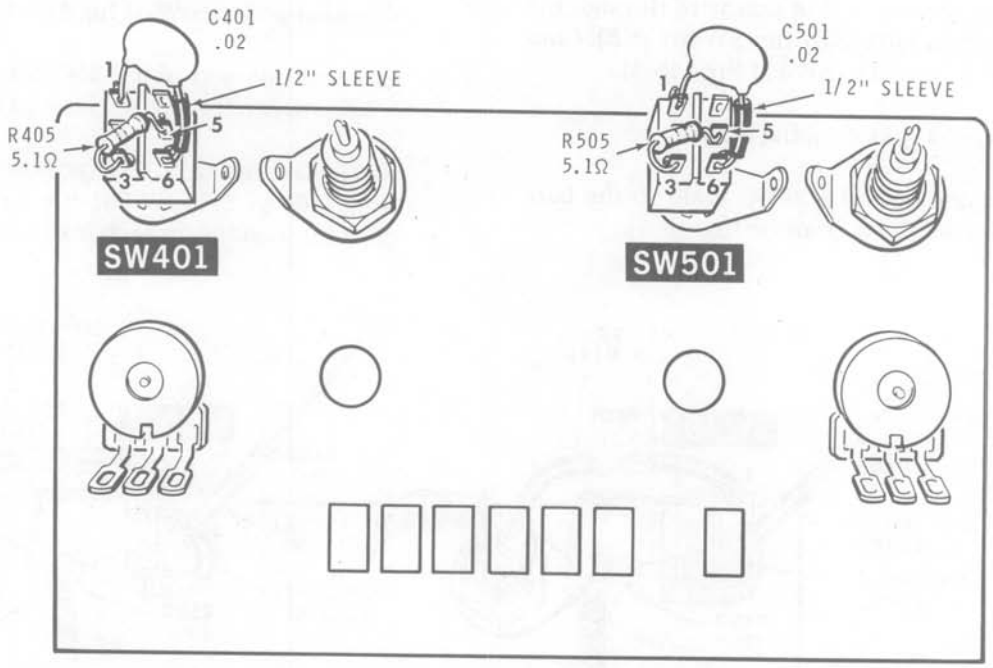
( ) Place a 1/2" piece of sleeving on the 3/4" capacitor lead; then connect the capacitor between SW401 lugs 1 (S-2) and 6 (S-2).

( ) R505: Cut both leads of a 5.1 Ω (grn-brn-gld) resistor to 1/2". Connect the resistor between SW501 lugs 3 (S-1) and 5 (S-1).

( ) C501: Cut the leads of a .02 μF ceramic capacitor to 1/4" and 3/4".

( ) Place a 1/2" sleeve on the 3/4" capacitor lead; then connect the capacitor between SW501 lugs 1 (S-2) and 6 (S-2).

Set the front panel aside temporarily.



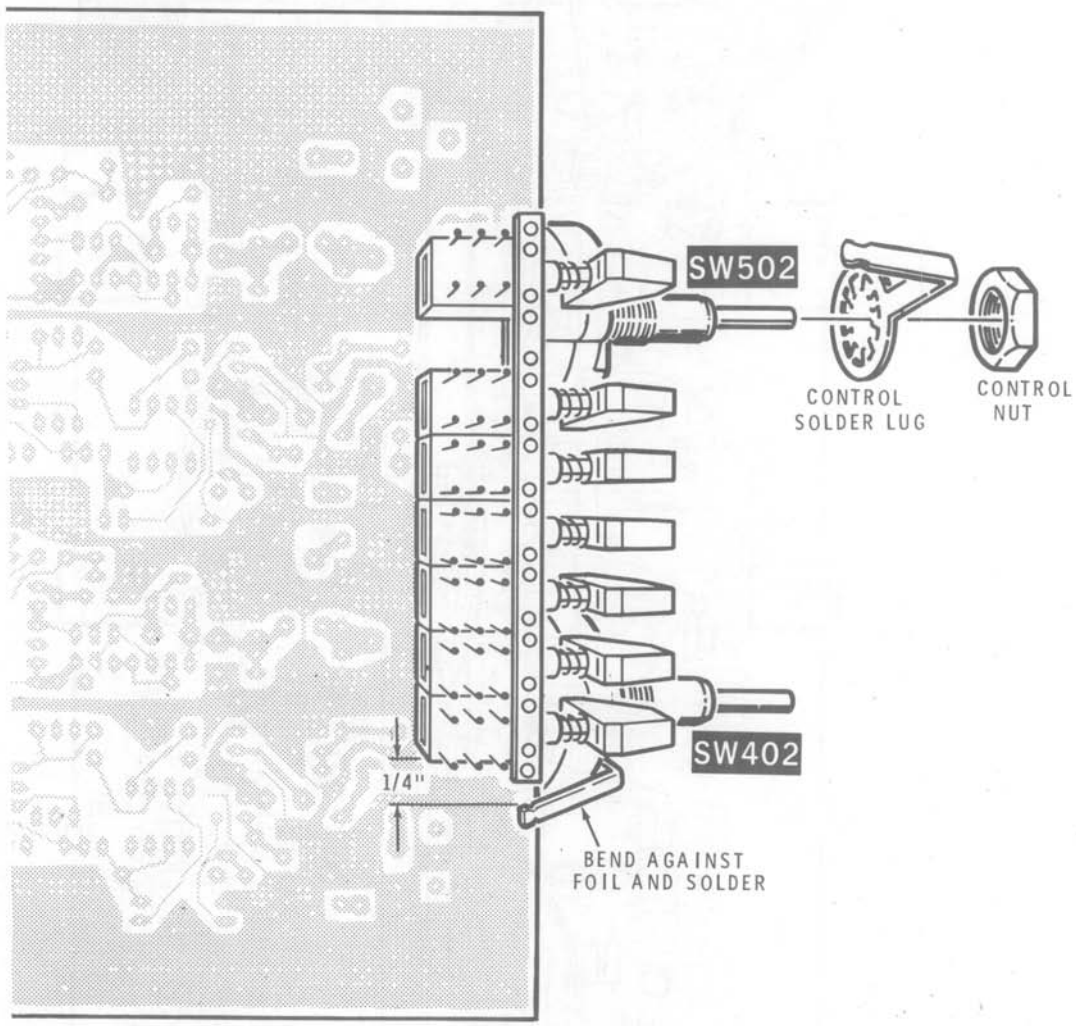

**PICTORIAL 5-25**

Refer to Pictorial 5-26 for the following steps.

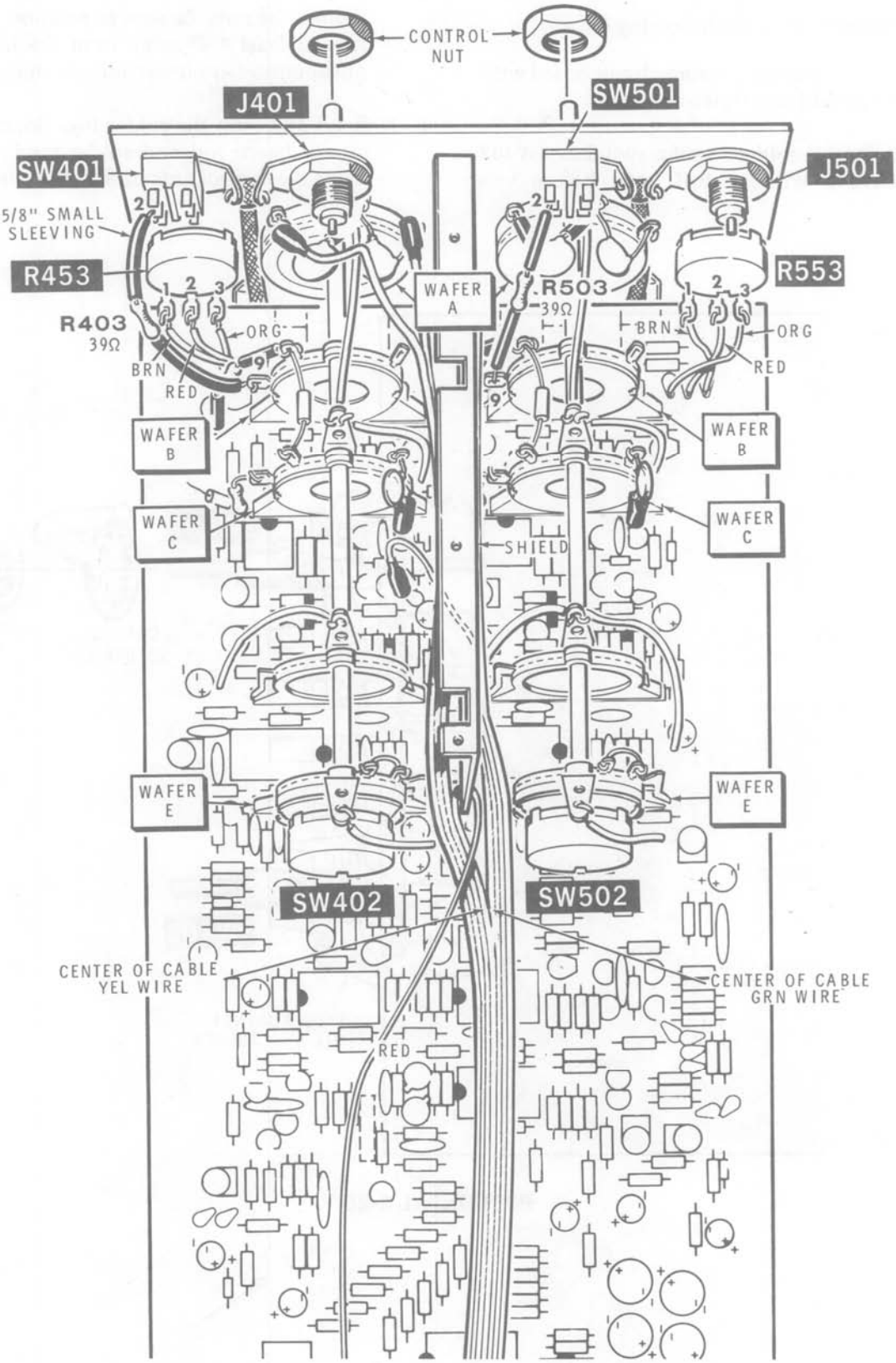
( ) Position the vertical preamp circuit board with the component side down as shown.

( ) Install control solder lugs on switches SW402 and SW502 with control nuts. Before you tighten the nuts, be sure to position the solder lugs at least 1/4" away from the base of the pushbutton switch assembly as shown.

( ) Bend and form the solder lugs down onto the circuit board foil and solder them. Then remove the control nuts from both switches.




**PICTORIAL 5-26**




**PICTORIAL 5-27**

Refer to Pictorial 5-27 for the following steps.

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

( ) Place the front panel on the two rotary switch shafts. Make sure the two flat braids are routed under the circuit board. Secure the panel with the two control nuts. Be sure not to get the braid between the solder lug and the panel.

( ) Connect the free end of the 39 Ω resistor coming from SW401 to SW402 wafer B lug 9 (S-1). Use 5/8" of small sleeving on the lead.

( ) Connect the free end of the 39 Ω resistor coming from SW501 to SW502 wafer B lug 9 (S-1). Use 5/8" of small sleeving on the lead.

Connect the 3-wire flat cables to controls R453 and R553 in the following steps.

CONTROL R453:

( ) Brown wire to lug 1 (S-1).

( ) Red wire to lug 2 (S-1).

( ) Orange wire to lug 3 (S-1).

CONTROL R553:

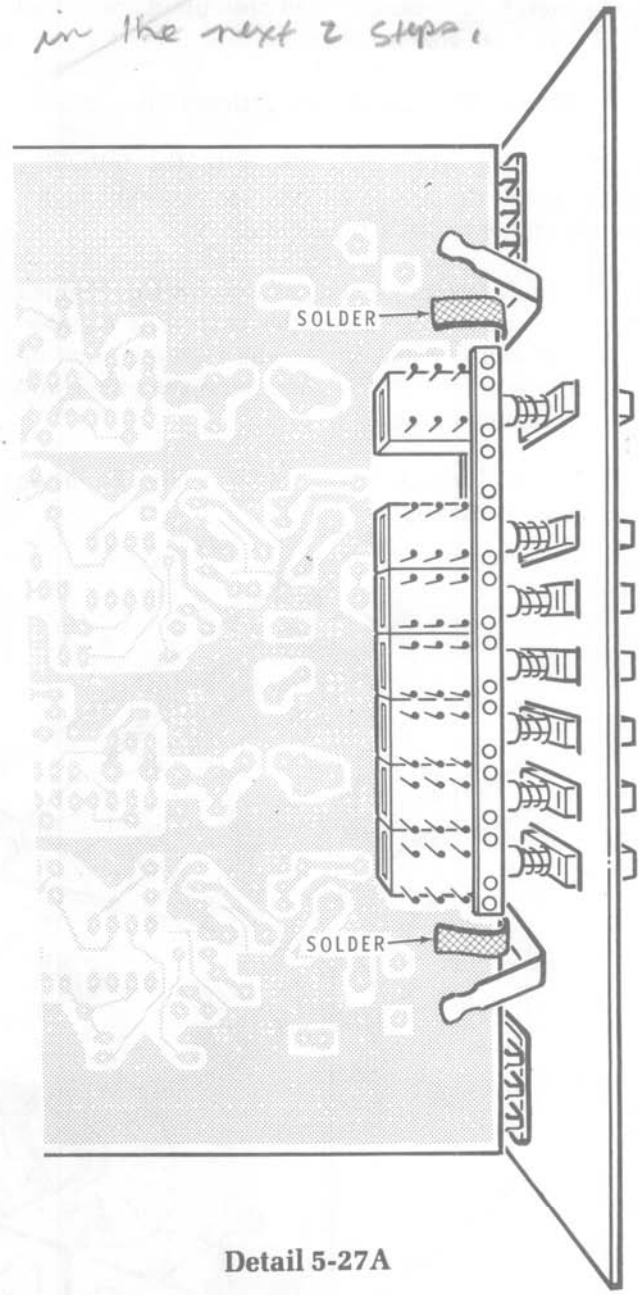
( ) Brown wire to lug 1 (S-1).

( ) Red wire to lug 2 (S-1).

( ) Orange wire to lug 3 (S-1).

( ) Position the shield (#206-1435) with the flange toward the left. Note the two tabs on the shield. Then locate the two holes on the circuit board, between rotary switches SW402 and SW502, that are this distance apart. Insert the tabs into these holes. As you do this, position the bottom edge of the shield down between the flat cable yellow and green wires as shown. Turn the board over and solder the tabs to the foil.

( ) Refer to Detail 5-27A and solder the two flat braids to the foil next to the two control solder lugs.




**Detail 5-27A**

Refer to Pictorial 5-28 for the following steps.

( ) Start 6-32 setscrews into both plain knobs and into both gray inlay knobs.

( ) Start 4-40 setscrews into both red inlay knobs.

NOTE: When you install knobs in the following steps, space the knobs so they do not rub on the panel or other knobs behind them.

( ) Install a plain knob on switch SW402. Tighten the setscrew and turn the knob fully counterclockwise. Then loosen the setscrew, line up the pointer with number 10 on the panel, and retighten the setscrew.

( ) Similarly install the other plain knob on switch SW502.

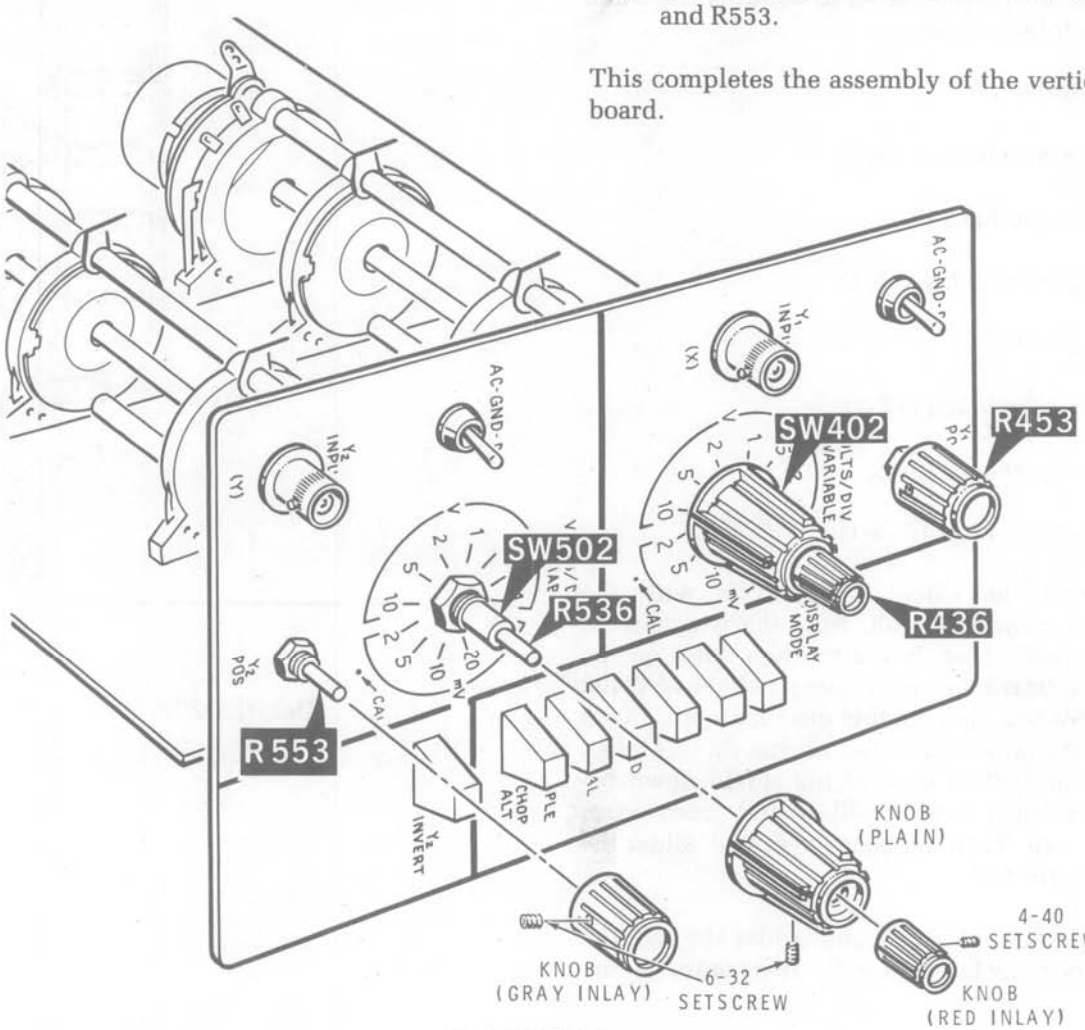
( ) Install a red inlay knob on control R436. Tighten the setscrew and turn the control fully clockwise. Then loosen the setscrew, line up the pointer with the CAL dot on the panel, and retighten the setscrew.

( ) Similarly install the other red inlay knob on control R536.

NOTE: When you install the next two knobs, the pointer should be at the (upright) 12 o'clock position when the control is at the center of its rotation. To do this, set the control to its approximate 12 o'clock position. Install the knob with the pointer at the 12 o'clock position and tighten the setscrew. Rotate the knob fully clockwise and then counterclockwise while noting the location of the pointer. Relocate the pointer as necessary.

( ) Install the gray inlay knobs on controls R453 and R553.

This completes the assembly of the vertical preamp board.




**PICTORIAL 5-28**

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# HORIZONTAL CIRCUIT BOARD

## PARTS LIST

Open Pack #6 and check each part against the following list. Do not remove components that are supplied on a tape from the tape until you use them in a step. Return any part that is packed in an individual envelope, with the part number on it, back to the envelope after you identify it until that part is called for in a step. Do not throw away any packing material until all of the parts are accounted for.

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

**TAPED COMPONENTS**

Refer directly to the "Taped Component Chart (Pack #6)." Follow the instructions at the top of that chart to check the following components.

### RESISTORS

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

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| 6-229-12 | 9 | 2.2 Ω (red-red-gld) | R836, R889, R984, R985, R986, R987, R988, R989, R991 |
| 6-1009-12 | 2 | 10 Ω, 1% (brn-blk-blk-gld) | R912, R992 |
| 6-3019-12 | 2 | 30.1 Ω, 1% (org-blk-brn-gld) | R731, R732 |
| 6-4759-12 | 4 | 47.5 Ω, 1% (yel-viol-grn-gld) | R727, R797, R954, R955 |

### RESISTORS (Cont'd.)

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| 6-510-12 | 2 | 51 Ω (grn-brn-blk) | R751, R839 |
| 6-6199-12 | 1 | 61.9 Ω, 1% (blu-brn-wht-gld) | R733 |
| 6-680-12 | 1 | 68 Ω (blu-gry-blk) | R713 |
| 6-6819-12 | 1 | 68.1 Ω, 1% (blu-gry-brn-gld) | R708 |
| 6-9099-12 | 3 | 90.9 Ω, 1% (wht-blk-wht-gld) | R712, R914, R915 |
| 6-1000-12 | 3 | 100 Ω, 1% (brn-blk-blk-blk) | R735, R927, R928 |
| 6-121-12 | 1 | 120 Ω (brn-red-brn) | R793 |
| 6-151-12 | 1 | 150 Ω (brn-grn-brn) | R756 |
| 6-2000-12 | 6 | 200 Ω, 1% (red-blk-blk-blk) | R704, R737, R738, R763, R828, R831 |
| 6-2150-12 | 2 | 215 Ω, 1% (red-brn-grn-blk) | R895, R902 |
| 6-221-12 | 2 | 220 Ω (red-red-brn) | R824, R825 |

## RESISTORS (Cont'd)

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| 6-2370-12 | 1 | 237 Ω, 1% (red-org-viol-blk) | R743 |
| 6-271-12 | 3 | 270 Ω (red-viol-brn) | R786, R796, R865 |
| 6-3010-12 | 4 | 301 Ω, 1% (org-blk-brn-blk) | R714, R716, R742, R744 |
| 6-391-12 | 4 | 390 Ω (org-wht-brn) | R814, R817, R860, R979 |
| 6-4260-12 | 1 | 426Ω, 1% (yel-red-blu-blk) | R935 |
| 6-4990-12 | 5 | 499Ω, 1% (yel-wht-wht-blk) | R707, R833, R896, R901, R956 |
| 6-5230-12 | 2 | 523 Ω, 1% (grn-red-org-blk) | R916, R921 |
| 6-561-12 | 2 | 560 Ω (grn-blu-brn) | R952, R999 |
| 6-6040-12 | 2 | 604 Ω, 1% (blu-blk-yel-blk) | R709, R711 |
| 6-681-12 | 5 | 680 Ω (blu-gry-brn) | R746, R749, R761, R852, R883 |
| 6-821-12 | 4 | 820 Ω (gry-red-brn) | R717, R719, R938, R939 |
| 6-8250-12 | 1 | 825 Ω, 1% (gry-red-grn-blk) | R739 |
| 6-9090-12 | 1 | 909 Ω, 1% (wht-blk-wht-blk) | R741 |
| 6-1001-12 | 8 | 1000 Ω, 1% (brn-blk-blk-brn) | R904, R905 R906, R922, R925, R926, R929, R931 |
| 6-1211-12 | 2 | 1210 Ω, 1% (brn-red-brn-brn) | R798, R869 |
| 6-1331-12 | 2 | 1330 Ω, 1% (brn-org-org-brn) | R936, R941 |
| 6-1471-12 | 1 | 1470 Ω, 1% (brn-yel-viol-brn) | R918 |
| 6-152-12 | 4 | 1500 Ω (brn-grn-red) | R754, R777, R778, R792 |
| 6-1691-12 | 1 | 1690 Ω, 1% (brn-blu-wht-brn) | R919 |
| 6-1821-12 | 2 | 1820 Ω, 1% (brn-gry-red-brn) | R924, R934 |
| 6-1911-12 | 1 | 1910 Ω, 1% (brn-wht-brn-brn) | R832 |
| 6-202-12 | 2 | 2000 Ω (red-blk-red) | R783, R791 |
| 6-222-12 | 3 | 2200 Ω (red-red-red) | R857, R964, R982 |
| 6-2261-12 | 1 | 2260 Ω, 1% (red-red-blu-brn) | R829 |
| 6-2431-12 | 2 | 2430 Ω, 1% (red-yel-org-brn) | R897, R899 |
| 6-332-12 | 1 | 3300 Ω (org-org-red) | R974 |
| 6-3901-12 | 1 | 3900 Ω, 1% (org-wht-blk-brn) | R734 |
| 6-432-12 | 1 | 4300 Ω (yel-org-red) | R819 |
| 6-472-12 | 4 | 4700 Ω (yel-viol-red) | R762, R771, R802, R881 |
| 6-562-12 | 6 | 5600 Ω (grn-blu-red) | R827, R862, R879, R894, R898, R975 |

## RESISTORS (Cont'd.)

| HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|
| 6-622-12 | 2 | 6200 Ω (blu-red-red) | R963, R965 |
| 6-682-12 | 4 | 6800 Ω (blu-gry-red) | R846, R856, R858, R859 |
| 6-103-12 | 8 | 10 kΩ, 5% (brn-blk-org) | R757, R758, R799, R866, R962, R969, R973, R983 |
| 6-1072-12 | 2 | 10.7 kΩ, 1% (brn-blk-viol-red) | R946, R947 |
| 6-123-12 | 1 | 12 kΩ (brn-red-org) | R848 |
| 6-153-12 | 2 | 15 kΩ (brn-grn-org) | R968, R972 |
| 6-223-12 | 1 | 22 kΩ (red-red-org) | R845 |
| 6-243 | 2 | 24 kΩ, 1/2-watt (red-yel-org) | R878, R997 |
| 6-333-12 | 2 | 33 kΩ (org-org-org) | R723, R967 |
| 6-393-12 | 1 | 39 kΩ (org-wht-org) | R822 |
| 6-4122-12 | 2 | 41.2 kΩ, 1% (yel-brn-red-red) | R943, R944 |
| 6-473-12 | 1 | 47 kΩ (yel-viol-org) | R855 |
| 6-104-12 | 3 | 100 kΩ, 5% (brn-blk-yel) | R703, R722, R958 |
| 6-1003-12 | 1 | 100 kΩ, 1% (brn-blk-blk-org) | R702 |
| 6-9003-12 | 1 | 900 kΩ, 1% (wht-blk-blk-org) | R701 |
| 6-105-12 | 3 | 1M Ω (brn-blk-grn) | R721, R794, R966 |

## CAPACITORS

| | | | |
|---|---|---|---|
| 21-769 | 20 | .01 μF (103) glass | C705, C706, C708, C709, C712, C717, C721, C734, C745, C746, C747, C749, C762, C763, C765, C773, C784, C785, C788, C796, |
| 21-762 | 5 | .1 μF (104) glass | C719, C733, C766, C769, C787 |

## DIODES

| | | | |
|---|---|---|---|
| 56-71 | 4 | 1N825A | D708, D709, D723, D724 |
| 56-85 | 1 | 5V zener | D719 |
| 56-602 | 6 | Selected germanium | D713, D714, D715, D716, D717, D745 |
| 56-613 | 2 | 1N5230B | D712, D725 |
| 56-616 | 1 | 1N5232B | D728 |

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**NON-TAPED PARTS**

Most of the following parts are not taped on strips. The key numbers correspond to the number on the "Horizontal Circuit Board Parts Pictorial" (Illustration Booklet, Page 16).

## RESISTORS

### 1/4-Watt Resistors

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| A1 | 6-101-12 | 23 | 100 Ω, 5% (brn-blk-brn) (packed separately on tape strips; do not use with Tape Chart.) | R724, R747, R813, R886, R903, R908, R909, R911, R907, R923, R933, R937, R942, R945, R948, R951, R953, R957, R961, R971, R981, R993, R995 |
| A1 | 6-511-12 | 32 | 510 Ω (grn-brn-brn) (packed separately on tape strips; do not use with Tape Chart.) | R706, R726, R745, R748, R752, R753, R755, R764, R765, R766, R767, R768, R769, R772, R773, R774, R775, R776, R779, R781, R782, R785, R787, R788, R789, R818, R835, R837, R841, R863, R882, R976 |
| A1 | 6-102-12 | 23 | 1000 Ω, 5% (brn-blk-red) (packed separately on tape strips; do not use with Tape Chart.) | R729, R750, R759, R784, R811, R815, R816, R823, R826, R834, R842, R843, R844, R847, R854, R861, R887, R891, R892, R893, R959, R978, R984 |

### 1/4% Precision Resistors

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| A2 | 2-770-12 | 2 | 25 kΩ (red-grn-blk-red) | R809, R877 |
| A2 | 2-769-12 | 2 | 50 kΩ (grn-blk-blk-red) | R808, R876 |
| A2 | 2-768-12 | 2 | 125 kΩ (brn-red-grn-org) | R807, R875 |
| A2 | 2-767-12 | 2 | 250 kΩ (red-grn-blk-org) | R806, R874 |
| A2 | 2-766-12 | 2 | 500 kΩ (grn-blk-blk-org) | R805, R873 |
| A2 | 2-765-12 | 2 | 1.25 MΩ (brn-red-grn-yel) | R804, R872 |
| A2 | 2-764-12 | 2 | 2.5 MΩ red-grn-blk-yel) | R803, R871 |

## CAPACITORS

### Ceramic

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| B1 | 21-701 | 1 | 3.3 pF | C707 |
| B1 | 21-111 | 1 | 15 pF (15k) | C759 |
| B1 | 21-6 | 1 | 27 pF | C716 |
| B1 | 21-121 | 3 | 56 pF | C704, C715, C713 |
| B1 | 21-744 | 1 | 82 pF (820) | C761 |
| B1 | 21-75 | 4 | 100 pF (100 k) (JK100) | C727, C737, C758, C789 |
| B1 | 21-162 | 1 | 180 pF | C752 |
| B1 | 21-22 | 1 | 220 pF | C702 |
| B1 | 21-17 | 4 | 270 pF | C722, C728, C736, C753 |
| B1 | 21-36 | 3 | .002 μF (2000 pF) | C741, C742, C748 |
| B1 | 21-43 | 3 | .001 μF | C703, C711, C735 |
| B2 | 21-175 | 2 | .001 μF (102k) | C743, C744 |

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **CAPACITORS (Cont'd.)** | | | | |
| **Electrolytic** | | | | |
| B3 | 25-900 | 1 | 1 µF | C732 |
| B3 | 25-924 | 1 | 2.2 µF | C729 |
| B3 | 25-879 | 2 | 4.7 µF | C738, C739 |
| B3 | 25-820 | 2 | 10 µF, 10V (nonpolarized) | C714, C786 |
| B3 | 25-880 | 14 | 10 µF, 35V | C731, C768, C774, C775, C776, C777, C778, C779, C781, C782, C783, C792, C793, C794 |
| B3 | 25-929 | 1 | 39 µF | C718 |
| B4 | 25-299 | 2 | 1.5 µF | C791, C795 |
| B5 | 25-883 | 1 | 47 µF | C751 |
| **Other Capacitors** | | | | |
| B6 | 20-101 | 2 | 47 pF mica | C725, C756 |
| B7 | 28-5 | 2 | .22 pF phenolic (red-red-slvr) | C772, C764 |
| B8 | 29-43 | 2 | .01 µF (10000) (103) polystyrene | C724, C755 |
| B9 | 27-188 | 2 | .1 µF (.1K) polyester | C767, C771 |
| B10 | 27-175 | 2 | 1 µF Mylar | C754, C723 |
| B11 | 31-85 | 3 | 5-25 pF trimmer (brn) | C701, C726, C757 |
| **DIODES** | | | | |
| C1 | 56-56 | 24 | 1N4149 (packed separately on tape strips; do not use with Tape Chart.) | D701-D706, D711, D718, D721, D722, D726, D727, D729, D731-D735, D739, D741-D744, D746 |
| C2 | 412-637 | 2 | NSL5076A LED | D707, D747 |
| C3 | 56-670 | 2 | MBD101 | D737, D738 |
| **TRANSISTORS** | | | | |

NOTE: Transistors may be marked for identification in any one of the following four ways:

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

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| D1 | 417-154 | 6 | 2N2369 | Q715, Q717, Q719, Q727, Q728, Q733 |
| **TRANSISTORS (Cont'd.)** | | | | |
| D2 | 417-235 | 7 | 2N4121 | Q716, Q718, Q722, Q732, Q734, Q736, Q758 |
| D2 | 417-260 | 7 | 2N4258A | Q702, Q711, Q712, Q713, Q714, Q724, Q726 |
| D2 | 417-291 | 1 | 2N5458 | Q729 |
| D2 | 417-293 | 9 | 2N5770 | Q706, Q707, Q708, Q709, Q723, Q747, Q748, Q749, Q751 |
| D2 | 417-874 | 1 | 2N3906 | Q725 |
| D2 | 417-875 | 4 | 2N3904 | Q759, Q761, Q762, Q763 |
| D2 | 417-887 | 10 | MPSH10 | Q703, Q704, Q735, Q737, Q738, Q739, Q741, Q742, Q743, Q744 |
| D2 | 417-917 | 2 | MPSH81 | Q745, Q746 |
| D3 | 417-947 | 4 | MDS-21 | Q752, Q753, Q755, Q756 |
| D3 | 417-948 | 2 | MDS-60 | Q754, Q757 |
| D4 | 417-902 | 4 | NPD5566 transistor module | Q701, Q705, Q721, Q731 |
| **INTEGRATED CIRCUITS (IC's)** | | | | |

NOTE: Integrated circuits may be marked for identification in any one of the following four ways:

1. Part number.
2. Type number (This refers only to the numbers and letters in **bold** print in the Parts List. Disregard any other numbers or letters on the IC.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

| | | | | |
|---|---|---|---|---|
| E1 | 442-742 | 1 | LF**347** | U716 |
| E1 | 443-1 | 4 | SN**7400** | U707, U711, U712, U714 |
| E1 | 443-16 | 1 | SN**7476** | U709 |
| E1 | 443-44 | 1 | SN**7413** | U706 |
| E1 | 443-45 | 1 | SN**7408** | U713 |
| E1 | 443-625 | 1 | SN**74132** | U715 |
| E1 | 443-636 | 1 | MC**10116** | U701 |
| E1 | 443-679 | 1 | MC**10131** | U703 |
| E1 | 443-683 | 1 | MC**10102** | U702 |
| E1 | 443-765 | 2 | MC**10105** | U704, U705 |
| E1 | 443-942 | 1 | **74LS123** | U708 |

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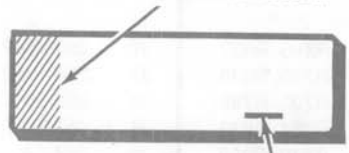
| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **CONTROLS** | | | | |
| F1 | 10-1139 | 2 | 100 Ω | R868, R932 |
| F1 | 10-1155 | 2 | 200 Ω | R725, R838 |
| F1 | 10-1140 | 4 | 500 Ω | R705, R795, R864, R913 |
| F1 | 10-1141 | 2 | 1000 Ω (1K) | R849, R888 |
| F1 | 10-1137 | 4 | 2000 Ω (2K) | R736, R812, R853, R867 |
| F1 | 10-1138 | 1 | 10 kΩ | R907 |
| F2 | 10-1187 | 1 | 1000 Ω (1K) | R851 |
| F3 | 10-1186 | 1 | 2000 Ω (2K) | R718 |
| F4 | 10-1202 | 1 | 10 kΩ | R801 |
| F5 | 19-749 | 1 | 10 kΩ control w/switch | R821, SW705 |
| F6 | 19-757 | 1 | 1000 Ω dual control w/switch | R884, R885, SW706 |
| **SWITCHES** | | | | |
| G1 | 63-1391 | 1 | 1-wafer rotary switch | SW704 |
| G2 | 63-1389 | 1 | 2-wafer rotary switch | SW701 |
| G3 | 63-1390 | 1 | Rotary switch assembly w/control | SW702, R728 |
| G4 | 64-897 | 1 | Pushbutton switch assembly | SW703 |
| **PIN-CONNECTOR-SOCKETS-PLUGS** | | | | |
| H1 | 432-121 | 2 | PCB pin | |
| H2 | 432-758 | 1 | BNC connector w/hardware | |
| H3 | 432-1039 | 1 | 15-pin plug | |
| H4 | 432-1041 | 1 | 2-hole jumper socket | |
| H5 | 432-1044 | 3 | 7-pin right-angle plug | |
| H6 | 432-1129 | 1 | 4-pin plug | |
| H7 | 434-230 | 4 | 8-pin IC socket | |
| H7 | 434-298 | 8 | 14-pin IC socket | |
| H7 | 434-299 | 7 | 16-pin IC socket | |

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| **HARDWARE** | | | | |
| J1 | 250-1347 | 4 | 4-40 × 3/32" setscrew | |
| J2 | 250-1282 | 10 | 6-32 × 1/8" setscrew | |
| J3 | 252-39 | 3 | 1/4" nut | |
| J4 | 252-7 | 4 | Control nut | |
| J5 | 254-14 | 3 | 1/4" lockwasher | |
| J6 | 254-4 | 2 | Control lockwasher | |
| J7 | 259-10 | 3 | Control solder lug | |
| **KNOBS** | | | | |
| K1 | 462-1106 | 1 | Knob 23/32" dia. | |
| K2 | 462-1108 | 2 | Knob (red inlay) | |
| K3 | 462-1110 | 3 | Knob (gray inlay), 7/16" dia. | |
| K4 | 462-1139 | 1 | Knob (clear) | |
| K5 | 462-1140 | 1 | Knob 29/32" dia. | |
| K6 | 462-1141 | 1 | Knob 19/32" dia. | |
| K7 | 462-1142 | 1 | Knob (gray inlay), 9/16" dia. | |
| **MISCELLANEOUS** | | | | |
| L1 | 45-73 | 2 | 2.2 μH choke (red-red-gld-slvr) | L701, L702 |
| L2 | 203-2120 | 1 | Front panel | |
| L3 | 206-1434 | 1 | Shield | |
| L4 | 255-89 | 1 | 1-1/2" spacer | |
| L5 | 258-718 | 1 | Spring | |
| L6 | 453-303 | 1 | Shaft | |
| L7 | 456-51 | 1 | Shaft coupler | |
| L8 | 475-16 | 2 | Ferrite bead | |
| | | 1 | Tape Chart (2-Page) | |
| **PART FROM THE FINAL PACK** | | | | |
| | 85-2880-1 | 1 | Horizontal circuit board | |

# STEP-BY-STEP ASSEMBLY

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



IDENTIFICATION DRAWING

PART NUMBER

## START

NOTE: Because of its large size, only a part of the circuit board is shown. The shaded area in the identification drawing at the top of the Page indicates the area you are assembling. Refer to this drawing on each Pictorial before you begin the assembly. Note that you may be required to reposition the circuit board in some Pictorials.

**All resistors are 5% unless specified otherwise.**

( ) R792: 1500 Ω (brn-grn-red).

( ) R789: 510 Ω (grn-brn-brn).

( ) R713: 68 Ω (blu-gry-blk).

( ) R708: 68.1 Ω, 1% (blu-gry-brn-gld).

( ) C712: .01 µF (103) glass ceramic.

( ) R707: 499 Ω, 1% (yel-wht-wht-blk).

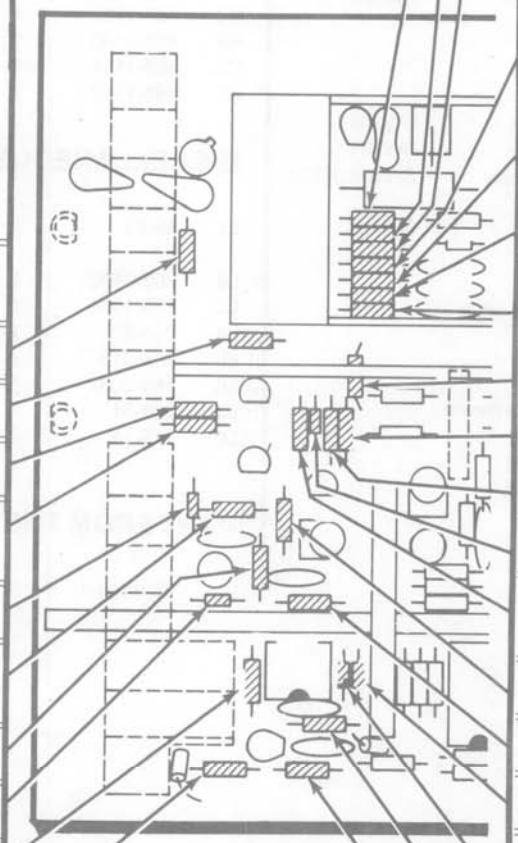
( ) R723: 33 kΩ (org-org-org).

( ) C785: .01 µF (103) glass ceramic.

( ) R777: 1500 Ω (brn-grn-red).

( ) R701: 900 kΩ, 1% (wht-blk-blk-org).

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



PICTORIAL 6-1

## CONTINUE

( ) R807: 125 kΩ, 1/4% (brn-red-grn-org).

( ) R806: 250 kΩ, 1/4% (red-grn-blk-org).

( ) R805: 500 kΩ, 1/4% (grn-blk-blk-org).

( ) R809: 25 kΩ, 1/4% (red-grn-blk-red).

( ) R808: 50 kΩ, 1/4% (grn-blk-blk-red).

( ) R804: 1.25 M, 1/4% (brn-red-grn-yel).

( ) R803: 2.5 M, 1/4% (red-grn-blk-yel).

( ) R887: 1000 Ω (brn-blk-red).

( ) R711: 604 Ω, 1% (blu-blk-yel-blk).

( ) R709: 604 Ω, 1% (blu-blk-yel-blk).

( ) C708: .01 µF (103) glass ceramic.

( ) R712: 90.9 Ω, 1% (wht-blk-wht-gld).

( ) R706: 510 Ω (grn-brn-brn).

( ) R704: 200 Ω,1% (red-blk-blk-blk).

( ) C709: .01 µF (103) glass ceramic.

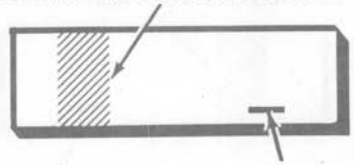
( ) D701: 1N4149 diode (#56-56). Note the position of the banded end.

( ) R703: 100 kΩ (brn-blk-yel).

( ) R702: 100 kΩ, 1% (brn-blk-blk-org).

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

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



IDENTIFICATION DRAWING

PART NUMBER

**START**

( ) C733: .1 µF (104) glass ceramic.

( ) C734: .01 µF (103) glass ceramic.

( ) R716: 301 Ω, 1% (org-blk-brn-blk).

( ) R714: 301 Ω, 1% (org-blk-brn-blk).

( ) R721: 1 MΩ (brn-blk-grn).

( ) R722: 100 kΩ (brn-blk-yel).

( ) R964: 2200 Ω (red-red-red).

( ) R963: 6200 Ω (blu-red-red).

( ) R959: 1000 Ω (brn-blk-red).

( ) R962: 10 kΩ (brn-blk-org).

( ) R983: 10 kΩ (brn-blk-org).

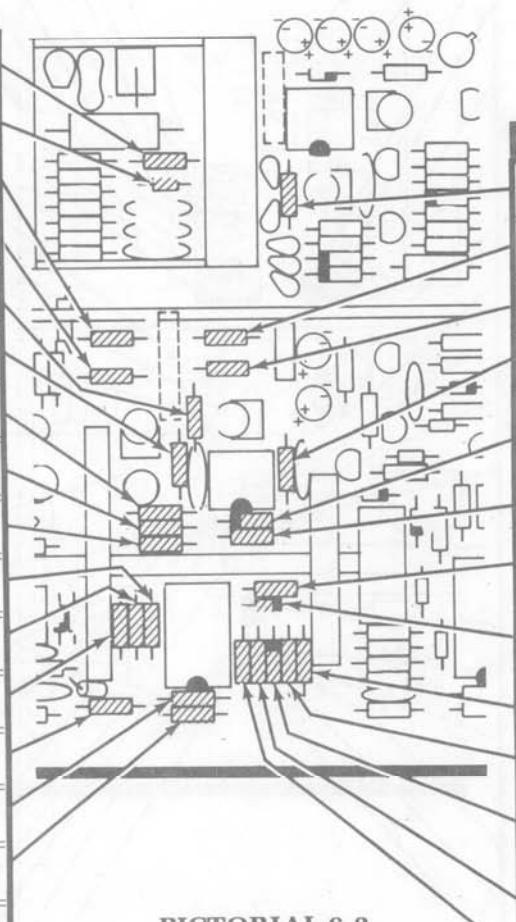
( ) R958: 100 kΩ (brn-blk-yel).

( ) C784: .01 µF (103) glass ceramic.

( ) R961: 100 Ω (brn-blk-brn).

( ) R984: 1000 Ω (brn-blk-red).

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



**PICTORIAL 6-2**

**CONTINUE**

( ) R799: 10 kΩ (brn-blk-org).

( ) R719: 820 Ω (gry-red-brn).

( ) R717: 820 Ω (gry-red-brn).

( ) R724: 100 Ω (brn-blk-brn).

( ) D702: 1N4149 diode (#56-56). Note the banded end.

( ) R965: 6200 Ω (blu-red-red).

( ) C787: .1 µF (104) glass ceramic.

( ) D744: 1N4149 diode (#56-56). Note the banded end.

( ) R967: 33 kΩ (org-org-org).

( ) R982: 2200 Ω (red-red-red).

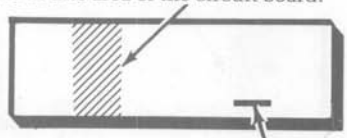
( ) D745: Diode (#56-602). Note the banded end.

( ) R981: 100 Ω (brn-blk-brn).

( ) R966: 1 MΩ (brn-blk-grn).

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

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

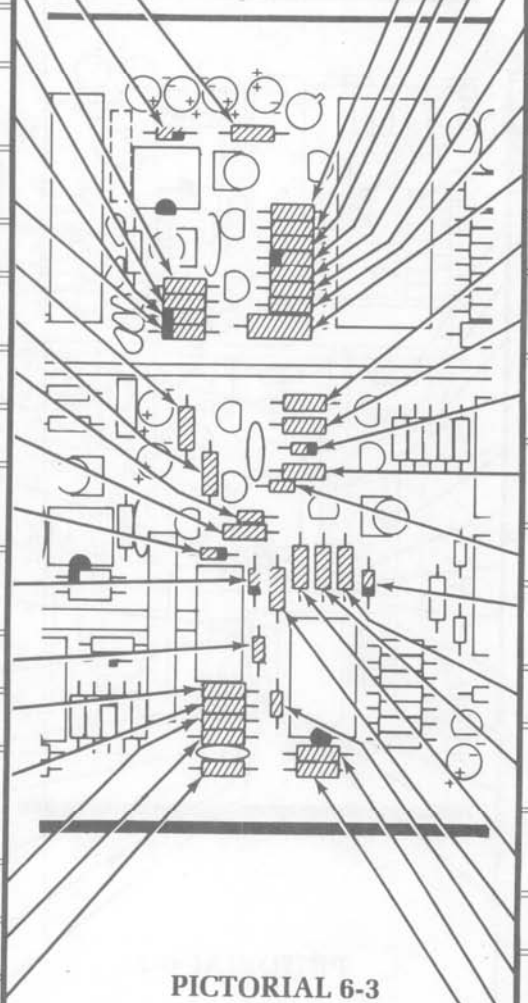


IDENTIFICATION DRAWING

PART NUMBER

**START**

- ( ) R796: 270 Ω (red-viol-brn).
- ( ) D711: 1N4149 diode (#56-56). Note the banded end.
- ( ) R971: 100 Ω (brn-blk-brn).
- ( ) R802: 4700 Ω (yel-viol-red).
- ( ) D709: 1N825A diode (#56-71). Note the banded end.
- ( ) D708: 1N825A diode (#56-71). Note the banded end.
- ( ) R738: 200 Ω, 1% (red-blk-blk-blk).
- ( ) R727: 47.5 Ω, 1% (yel-viol-grn-gld).
- ( ) C773: .01 µF (103) glass ceramic.
- ( ) R726: 510 Ω (grn-brn-brn).
- ( ) D703: 1N4149 diode (#56-56). Note the banded end.
- ( ) D704: 1N4149 diode (#56-56). Note the banded end.
- ( ) C788: .01 µF (103) glass ceramic.
- ( ) R754: 1500 Ω (brn-grn-red).
- ( ) R750: 1000 Ω (brn-blk-red). NOTE: The circuit board may be screened "R959."
- ( ) R972: 15 kΩ (brn-grn-org).
- ( ) R968: 15 kΩ (brn-grn-org).
- ( ) R969: 10 kΩ (brn-blk-org).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

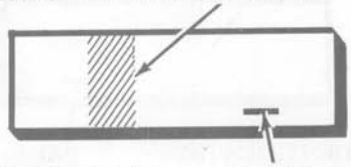


**PICTORIAL 6-3**

**CONTINUE**

- ( ) R862: 5600 Ω (grn-blu-red).
- ( ) R814: 390 Ω (org-wht-brn).
- ( ) R813: 100 Ω (brn-blk-brn).
- ( ) D712: 1N5230B diode (#56-613). Note the banded end.
- ( ) R797: 47.5 Ω, 1% (yel-viol-grn-gld).
- ( ) R798: 1210 Ω, 1% (brn-red-brn-brn).
- ( ) R749: 680 Ω (blu-gry-brn).
- ( ) R997: 24 kΩ, 1/2-watt (red-yel-org).
- ( ) R737: 200 Ω, 1% (red-blk-blk-blk).
- ( ) R731: 30.1 Ω, 1% (org-blk-brn-gld).
- ( ) D706: 1N4149 diode (#56-56). Note the banded end.
- ( ) R732: 30.1 Ω, 1% (org-blk-brn-gld).
- ( ) C717: .01 µF (103) glass ceramic.
- ( ) D705: 1N4149 diode (#56-56). Note the banded end.
- ( ) R735: 100 Ω, 1% (brn-blk-blk-blk).
- ( ) R733: 61.9 Ω, 1% (blu-brn-wht-gld).
- ( ) R734: 3900 Ω, 1% (org-wht-blk-brn).
- ( ) R729: 1000 Ω, (brn-blk-red).
- ( ) C796: .01 µF (103) glass ceramic.
- ( ) R988: 2.2 Ω (red-red-gld).
- ( ) R991: 2.2 Ω (red-red-gld).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

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



IDENTIFICATION DRAWING

PART NUMBER

**START**

( ) R743: 237 Ω, 1% (red-org-viol-blk).

( ) R744: 301 Ω, 1% (org-blk-brn-blk).

( ) R742: 301 Ω, 1% (org-blk-brn-blk).

( ) R741: 909 Ω, 1% (wht-blk-wht-blk).

( ) R739: 825 Ω, 1% (gry-red-grn-blk).

( ) R775: 510 Ω (grn-brn-brn).

( ) R774: 510 Ω (grn-brn-brn).

( ) R755: 510 Ω (grn-brn-brn).

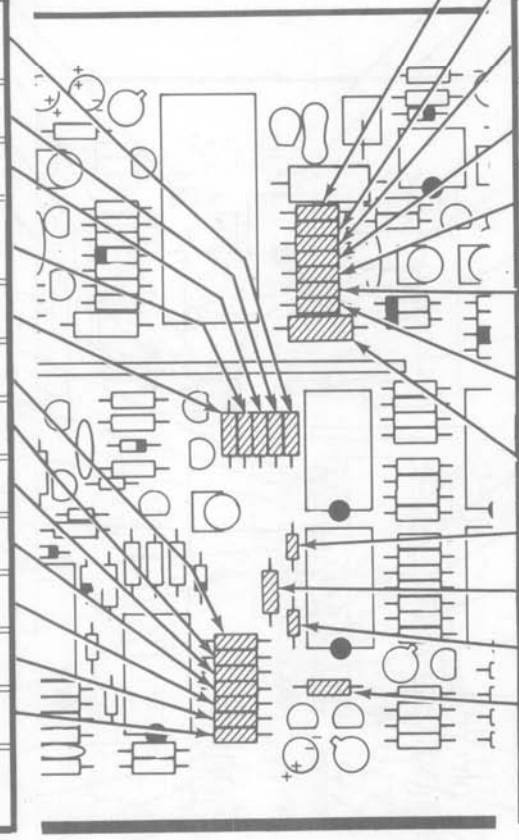
( ) R976: 510 Ω (grn-brn-brn).

( ) R772: 510 Ω (grn-brn-brn).

( ) R757: 10 kΩ (brn-blk-org).

( ) R756: 150 Ω (brn-grn-brn).

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



**CONTINUE**

( ) R875: 125 kΩ, 1/4% (brn-red-grn-org).

( ) R874: 250 kΩ, 1/4% (red-grn-blk-org).

( ) R873: 500 kΩ, 1/4% (grn-blk-blk-org).

( ) R877: 25 kΩ, 1/4% (red-grn-blk-red).

( ) R876: 50 kΩ, 1/4% (grn-blk-blk-red).

( ) R872: 1.25 MΩ, 1/4% (brn-red-grn-yel).

( ) R871: 2.5 MΩ, 1/4% (red-grn-blk-yel).

( ) R878: 24 kΩ, 1/2-watt (red-yel-org).

( ) C705: .01 µF (103) glass ceramic.

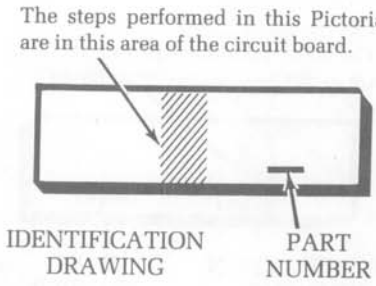
( ) R773: 510 Ω (grn-brn-brn).

( ) C746: .01 µF (103) glass ceramic.

( ) R758: 10 kΩ (brn-blk-org).

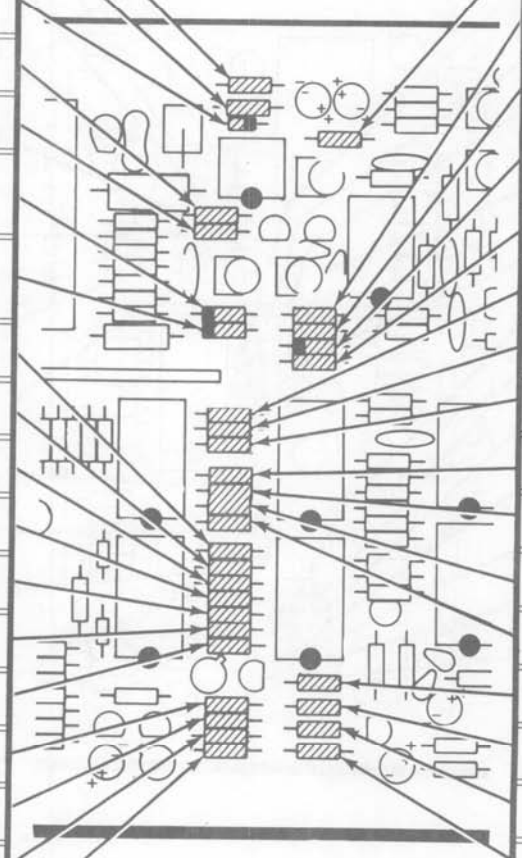
( ) Solder the leads to the foil and cut off the excess lead lengths.

**PICTORIAL 6-4**




**START**

- ( ) R889: 2.2 Ω (red-red-gld).
- ( ) R986: 2.2 Ω (red-red-gld).
- ( ) D726: 1N4149 diode (#56-56). Note the banded end.
- ( ) R866: 10 kΩ (brn-blk-org).
- ( ) R995: 100 Ω (brn-blk-brn).
- ( ) D724: 1N825A diode (#56-71). Note the banded end.
- ( ) D723: 1N825A diode (#56-71). Note the banded end.
- ( ) C721: .01 µF (103) glass ceramic.
- ( ) R778: 1500 Ω (brn-grn-red).
- ( ) R776: 510 Ω (grn-brn-brn).
- ( ) R768: 510 Ω (grn-brn-brn).
- ( ) R781: 510 Ω (grn-brn-brn).
- ( ) R765: 510 Ω (grn-brn-brn).
- ( ) R782: 510 Ω (grn-brn-brn).
- ( ) R783: 2000 Ω (red-blk-red).
- ( ) R784: 1000 Ω (brn-blk-red).
- ( ) C719: .1 µF (104) glass ceramic.
- ( ) R761: 680 Ω (blu-gry-brn).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

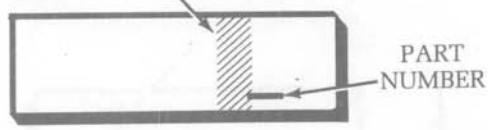


**PICTORIAL 6-5**

**CONTINUE**

- ( ) R865: 270 Ω (red-viol-brn).
- ( ) R869: 1210 Ω, 1% (brn-red-brn-brn).
- ( ) R863: 510 Ω (grn-brn-brn).
- ( ) D725: 1N5230B diode (#56-613). Note the banded end.
- ( ) R746: 680 Ω (blu-gry-brn).
- ( ) C706: .01 µF (103) glass ceramic.
- ( ) R745: 510 Ω (grn-brn-brn).
- ( ) R748: 510 Ω (grn-brn-brn).
- ( ) R747: 100 Ω (brn-blk-brn).
- ( ) R752: 510 Ω (grn-brn-brn).
- ( ) R751: 51 Ω (grn-brn-blk).
- ( ) R753: 510 Ω (grn-brn-brn).
- ( ) R764: 510 Ω (grn-brn-brn).
- ( ) R767: 510 Ω (grn-brn-brn).
- ( ) R759: 1000 Ω (brn-blk-red).
- ( ) R762: 4700 Ω (yel-viol-red).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

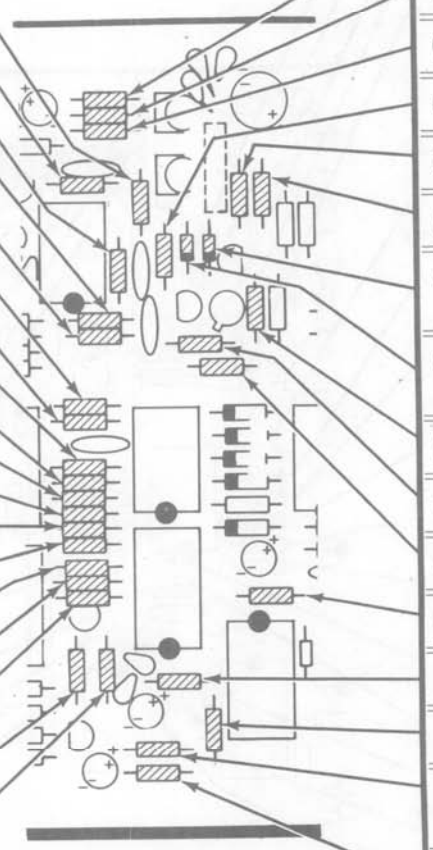
The steps performed in this Pictorial are in this area of the circuit board.




IDENTIFICATION DRAWING

**START**

- ( ) R858: 6800 Ω (blu-gry-red).
- ( ) R861: 1000 Ω (brn-blk-red).
- ( ) R859: 6800 Ω (blu-gry-red).
- ( ) C765: .01 µF (103) glass ceramic.
- ( ) R860: 390 Ω (org-wht-brn).
- ( ) R793: 120 Ω (brn-red-brn).
- ( ) R794: 1 MΩ (brn-blk-grn).
- ( ) R786: 270 Ω (red-viol-brn).
- ( ) R785: 510 Ω (grn-brn-brn).
- ( ) R771: 4700 Ω (yel-viol-red).
- ( ) R787: 510 Ω (grn-brn-brn).
- ( ) R788: 510 Ω (grn-brn-brn).
- ( ) R779: 510 Ω (grn-brn-brn).
- ( ) R791: 2000 Ω (red-blk-red).
- ( ) R769: 510 Ω (grn-brn-brn).
- ( ) R766: 510 Ω (grn-brn-brn).
- ( ) R763: 200 Ω, 1% (red-blk-blk-blk).
- ( ) R979: 390 Ω (org-wht-brn). NOTE: The circuit board may be screened "R893."
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

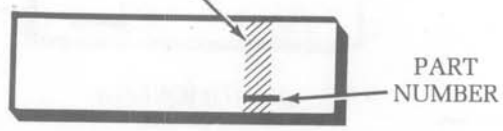


**PICTORIAL 6-6**

**CONTINUE**

- ( ) R848: 12 kΩ (brn-red-org).
- ( ) R852: 680 Ω (blu-gry-brn).
- ( ) R846: 6800 Ω (blu-gry-red).
- ( ) R857: 2200 Ω (red-red-red).
- ( ) R854: 1000 Ω (brn-blk-red).
- ( ) R847: 1000 Ω (brn-blk-red).
- ( ) D721: 1N4149 diode (#56-56). Note the banded end.
- ( ) D722: 1N4149 diode (#56-56). Note the banded end.
- ( ) R845: 22 kΩ (red-red-org).
- ( ) R855: 47 kΩ (yel-viol-org).
- ( ) R856: 6800 Ω (blu-gry-red).
- ( ) R817: 390 Ω (org-wht-brn).
- ( ) R822: 39 kΩ (org-wht-org).
- ( ) R842: 1000 Ω (brn-blk-red).
- ( ) L701: 2.2 µH (red-red-gld-slvr) (#45-73).
- ( ) L702: 2.2 µH (red-red-gld-slvr) (#45-73).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

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




IDENTIFICATION DRAWING

**START**

( ) R984: 2.2 Ω (red-red-gld).

( ) R987: 2.2 Ω (red-red-gld).

( ) R836: 2.2 Ω (red-red-gld).

( ) R844: 1000 Ω (brn-blk-red).

( ) R985: 2.2 Ω (red-red-gld).

NOTE: When you install the diodes as directed on this Pictorial, be sure to observe the position of their banded ends.

( ) D713: Selected germanium diode (#56-602).

( ) D714: Selected germanium diode (#56-602).

( ) D715: Selected germanium diode (#56-602).

( ) D716: Selected germanium diode (#56-602).

( ) R816: 1000 Ω (brn-blk-red).

( ) D717: Selected germanium diode (#56-602).

( ) R818: 510 Ω (grn-brn-brn).

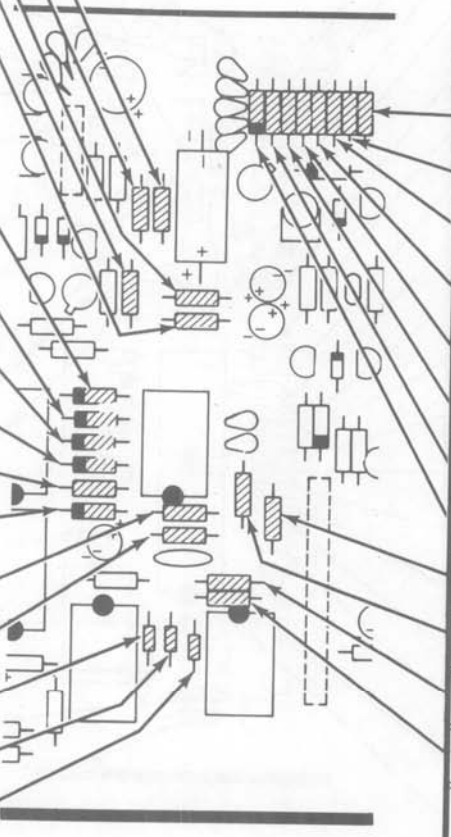
( ) R819: 4300 Ω (yel-org-red).

( ) C745: .01 µF (103) glass ceramic.

( ) C747: .01 µF (103) glass ceramic.

( ) C749: .01 µF (103) glass ceramic.

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



**CONTINUE**

( ) R903: 100 Ω (brn-blk-brn).

( ) R909: 100 Ω (brn-blk-brn).

( ) R975: 5600 Ω (grn-blu-red).

( ) R881: 4700 Ω (yel-viol-red).

( ) R886: 100 Ω (brn-blk-brn).

( ) R883: 680 Ω (blu-gry-brn).

( ) R882: 510 Ω (grn-brn-brn).

( ) D727: 1N4149 diode (#56-56).

( ) R839: 51 Ω (grn-brn-blk).

( ) R815: 1000 Ω (brn-blk-red).

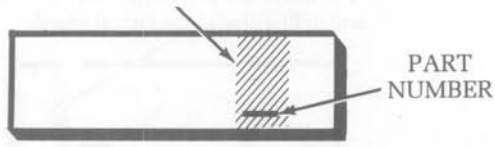
( ) R811: 1000 Ω (brn-blk-red).

( ) R843: 1000 Ω (brn-blk-red).

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

**PICTORIAL 6-7**

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




IDENTIFICATION DRAWING

**START**

NOTE: When you install diodes as directed on this Pictorial, be sure to observe the position of their banded ends.

( ) D732: 1N4149 diode (#56-56).

( ) D728: 1N5232B diode (#56-616).

( ) D734: 1N4149 diode (#56-56).

( ) R905: 1000 Ω, 1% (brn-blk-blk-brn).

( ) R914: 90.9 Ω, 1% (wht-blk-wht-gld).

( ) R915: 90.9 Ω, 1% (wht-blk-wht-gld).

( ) R912: 10 Ω, 1% (brn-blk-blk-gld).

( ) D733: 1N4149 diode (#56-56).

( ) D735: 1N4149 diode (#56-56).

( ) R902: 215 Ω, 1% (red-brn-grn-blk).

( ) D731: 1N4149 diode (#56-56).

( ) R901: 499 Ω, 1% (yel-wht-wht-blk).

( ) R899: 2430 Ω, 1% (red-yel-org-brn).

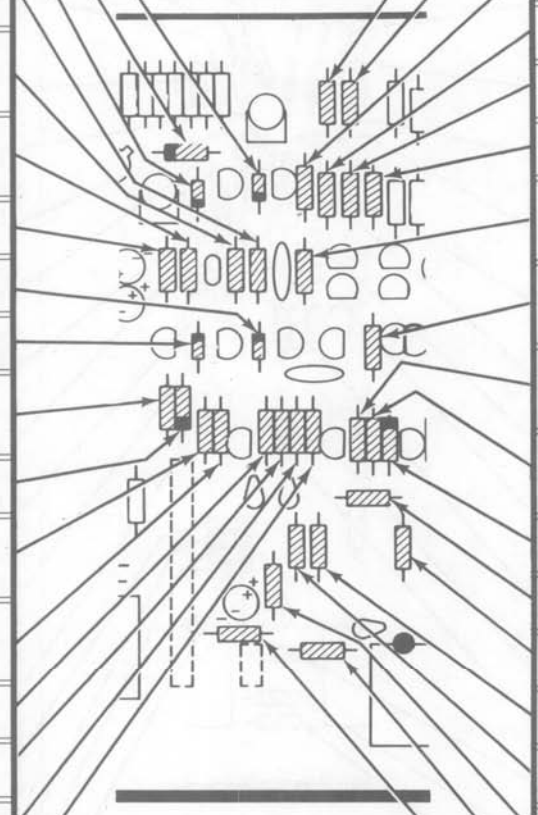
( ) R898: 5600 Ω (grn-blu-red).

( ) R911: 100 Ω (brn-blk-brn).

( ) R908: 100 Ω (brn-blk-brn).

( ) R894: 5600 Ω (grn-blu-red).

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



**PICTORIAL 6-8**

**CONTINUE**

( ) R919: 1690 Ω, 1% (brn-blu-wht-brn).

( ) R918: 1470 Ω, 1% (brn-yel-viol-brn).

( ) R906: 1000 Ω, 1% (brn-blk-blk-brn).

( ) R917: 100 Ω (brn-blk-brn).

( ) R921: 523 Ω, 1% (grn-red-org-blk).

( ) R923: 100 Ω (brn-blk-brn).

( ) R904: 1000 Ω, 1% (brn-blk-blk-brn).

( ) R895: 215 Ω, 1% (red-brn-grn-blk).

( ) R897: 2430 Ω, 1% (red-yel-org-brn).

( ) R896: 499 Ω, 1% (yel-wht-wht-blk).

( ) D729: 1N4149 diode (#56-56).

( ) R879: 5600 Ω (grn-blu-red).

( ) R978: 1000 Ω (brn-blk-red).

( ) R893: 1000 Ω (brn-blk-red).

( ) R892: 1000 Ω (brn-blk-red).

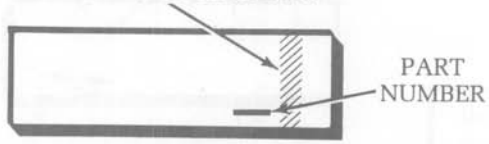
( ) R989: 2.2 Ω (red-red-gld).

( ) R891: 1000 Ω (brn-blk-red).

( ) R834: 1000 Ω (brn-blk-red).

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

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

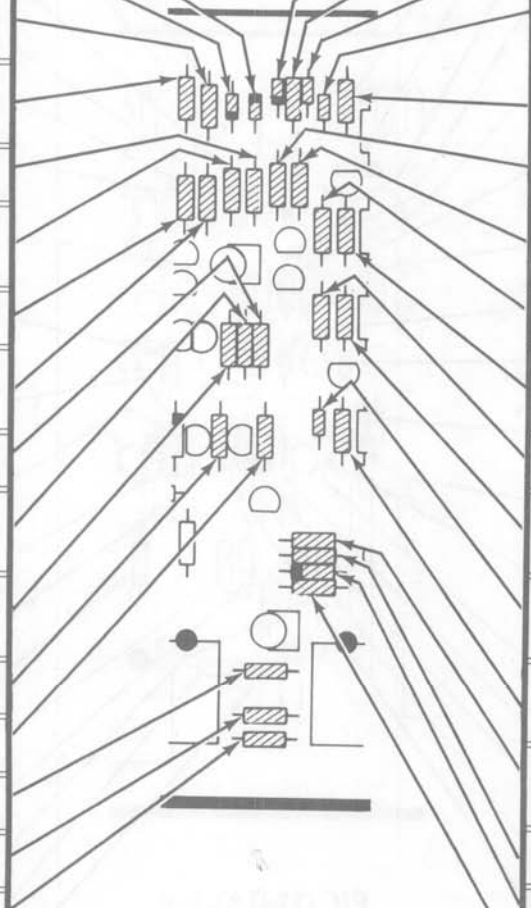



IDENTIFICATION DRAWING

**START**

NOTE: When you install diodes as directed on this Pictorial, be sure to observe the position of their banded ends.

- ( ) D741: 1N4149 diode (#56-56).
- ( ) D746: 1N4149 diode (#56-56).
- ( ) R922: 1000 Ω, 1% (brn-blk-blk-brn).
- ( ) R924: 1820 Ω, 1% (brn-gry-red-brn).
- ( ) R927: 100 Ω, 1% (brn-blk-blk-blk).
- ( ) R926: 1000 Ω, 1% (brn-blk-blk-brn).
- ( ) R916: 523 Ω, 1% (grn-red-org-blk).
- ( ) R925: 1000 Ω, 1% (brn-blk-blk-brn).
- ( ) R928: 100 Ω, 1% (brn-blk-blk-blk).
- ( ) R931: 1000 Ω, 1% (brn-blk-blk-brn).
- ( ) R929: 1000 Ω, 1% (brn-blk-blk-brn).
- ( ) R974: 3300 Ω (org-org-red).
- ( ) R973: 10 kΩ (brn-blk-org).
- ( ) C744: .001 µF (102 k) ceramic.
- ( ) C743: .001 µF (102 k) ceramic.
- ( ) R841: 510 Ω (grn-brn-brn).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

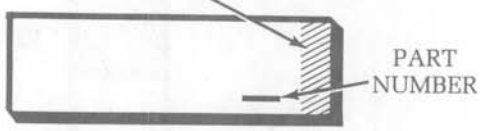


**PICTORIAL 6-9**

**CONTINUE**

- ( ) D739: 1N4149 diode (#56-56).
- ( ) R935: 426 Ω, 1% (yel-red-blu-blk).
- ( ) C763: .01 µF (103) glass ceramic.
- ( ) C764: .22 pF (red-red-gld-slvr) phenolic.
- ( ) R943: 41.2 kΩ, 1% (yel-brn-red-red).
- ( ) R933: 100 Ω (brn-blk-brn).
- ( ) R934: 1820 Ω, 1% (brn-gry-red-brn).
- ( ) R937: 100 Ω (brn-blk-brn).
- ( ) R936: 1330 Ω, 1% (brn-org-org-brn).
- ( ) R942: 100 Ω (brn-blk-brn).
- ( ) R941: 1330 Ω, 1% (brn-org-org-brn).
- ( ) C722: .22 pF (red-red-gld-slvr) phenolic.
- ( ) R944: 41.2 kΩ, 1% (yel-brn-red-red).
- ( ) R829: 2260 Ω, 1% (red-red-blu-brn).
- ( ) R828: 200 Ω, 1% (red-blk-blk-blk).
- ( ) D718: 1N4149 diode (#56-56).
- ( ) R831: 200 Ω, 1% (red-blk-blk-blk).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

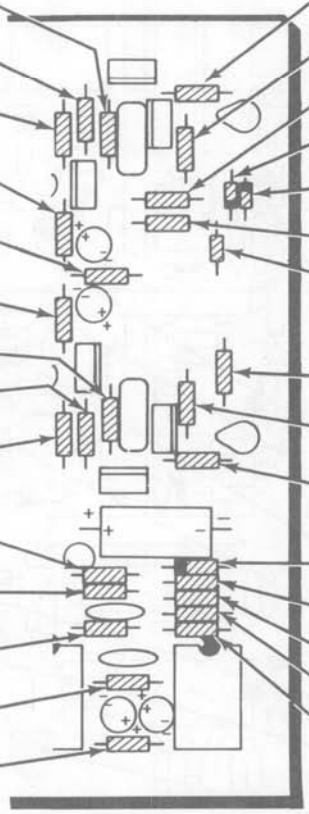
The steps performed in this Pictorial are in this area of the circuit board.




IDENTIFICATION DRAWING

**START**

- ( ) R948: 100 Ω (brn-blk-brn).
- ( ) C766: .1 µF (104) glass ceramic.
- ( ) R938: 820 Ω (gry-red-brn).
- ( ) R954: 47.5 Ω, 1% (yel-viol-grn-gld).
- ( ) R956: 499 Ω, 1% (yel-wht-wht-blk).
- ( ) R955: 47.5 Ω, 1% (yel-viol-grn-gld).
- ( ) R951: 100 Ω (brn-blk-brn).
- ( ) C769: .1 µF (104) glass ceramic.
- ( ) R939: 820 Ω (gry-red-brn).
- ( ) R827: 5600 Ω (grn-blu-red).
- ( ) R832: 1910 Ω, 1% (brn-wht-brn-brn).
- ( ) R837: 510 Ω (grn-brn-brn).
- ( ) R835: 510 Ω (grn-brn-brn).
- ( ) R825: 220 Ω (red-red-brn).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

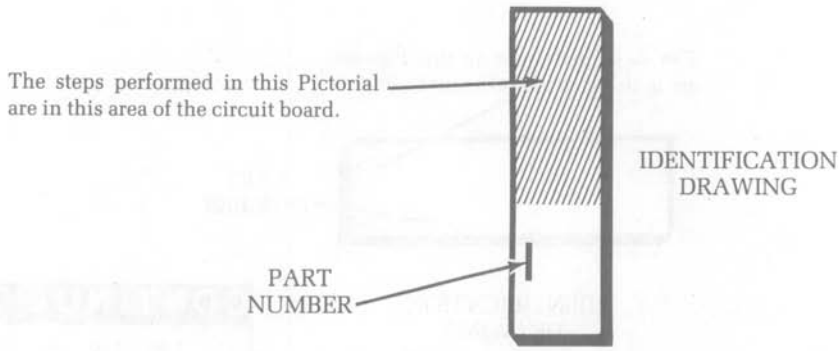


**PICTORIAL 6-10**

**CONTINUE**

- ( ) R953: 100 Ω (brn-blk-brn).
- ( ) R999: 560 Ω (grn-blu-brn).
- ( ) R945: 100 Ω (brn-blk-brn).
- ( ) D742: 1N4149 diode, (#56-56). Note the banded end.
- ( ) D743: 1N4149 diode (#56-56). Note the banded end.
- ( ) R946: 10.7 kΩ, 1% (brn-blk-viol-red).
- ( ) C762: .01 µF (103) glass ceramic.
- ( ) R947; 10.7 kΩ, 1% (brn-blk-viol-red).
- ( ) R952: 560 Ω (grn-blu-brn).
- ( ) R957: 100 Ω (brn-blk-brn).
- ( ) D719: 5 V zener diode (#56-85). Note the banded end.
- ( ) R833: 499 Ω, 1% (yel-wht-wht-blk).
- ( ) R826: 1000 Ω (brn-blk-red).
- ( ) R823: 1000 Ω (brn-blk-red).
- ( ) R824: 220 Ω (red-red-brn).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

NOTE: You should have 2 resistors left at this time: One 10 Ω, 1% (brn-blk-blk-gld) and one 100 Ω 5% (brn-blk-brn). Save these resistors for use later.




**START**

Position the circuit board as shown in the Identification Drawing.

NOTE: When you install the following controls and trimmers, match the outline of the part with the outline on the board. Insert the leads, solder them to the foil, and cut off the excess lead lengths.

( ) C701: 5-25 pF trimmer (brn).

( ) R705: 500 Ω control.

( ) C726: 5-25 pF trimmer (brn).

( ) R888: 1000 Ω (1K) control.

( ) R725: 200 Ω control.

( ) R812: 2000 Ω (2K) control.

( ) R795: 500 Ω control.

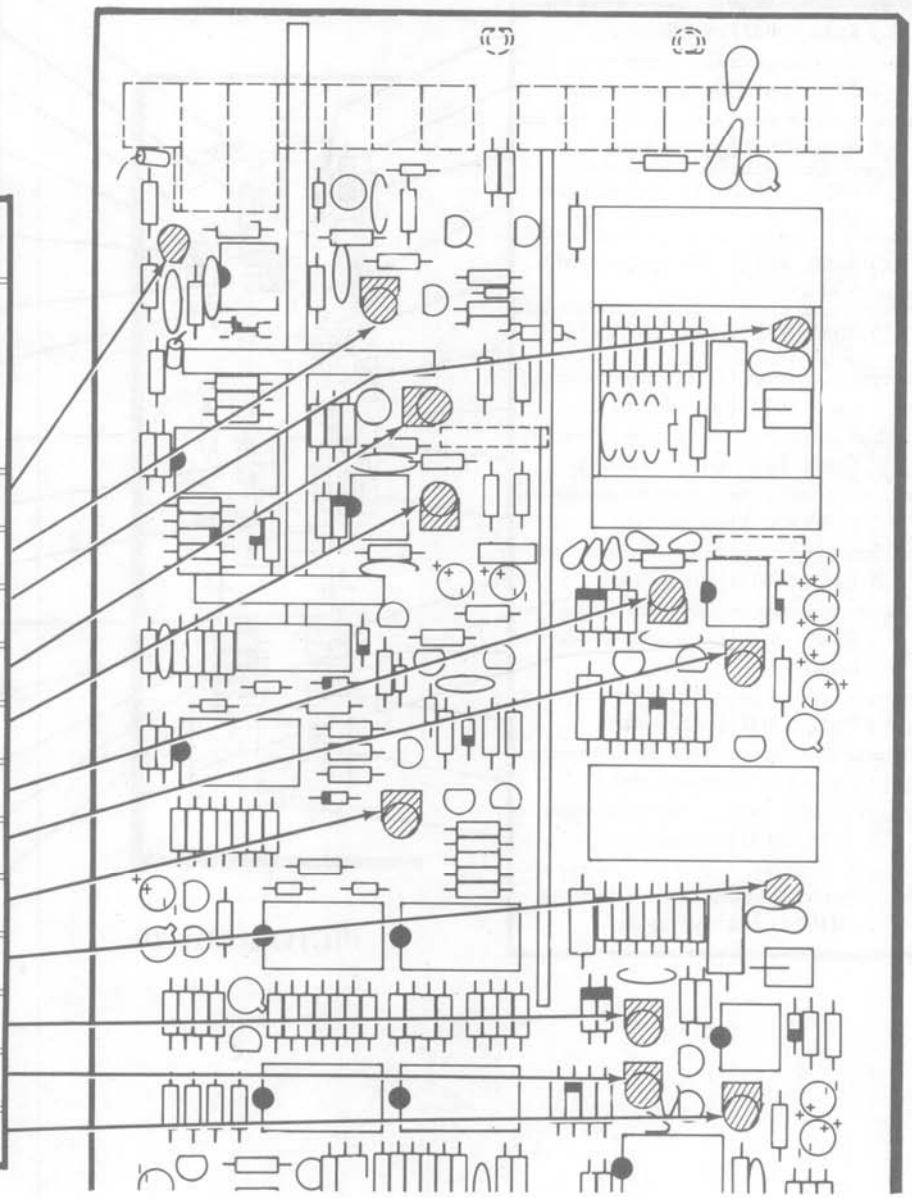
( ) R736: 2000 Ω (2K) control.

( ) C757: 5-25 pF trimmer (brn).

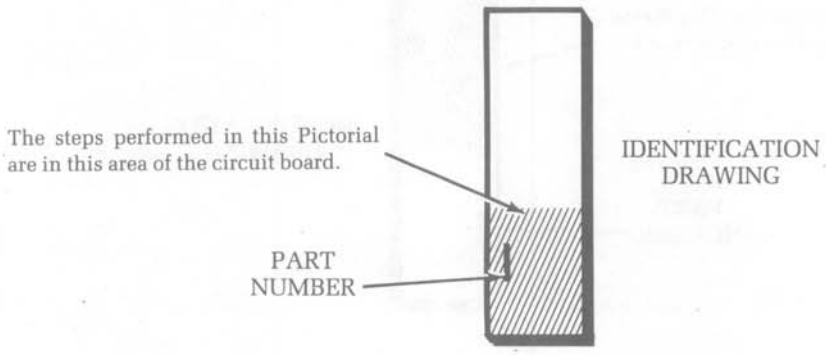
( ) R867: 2000 Ω (2K) control.

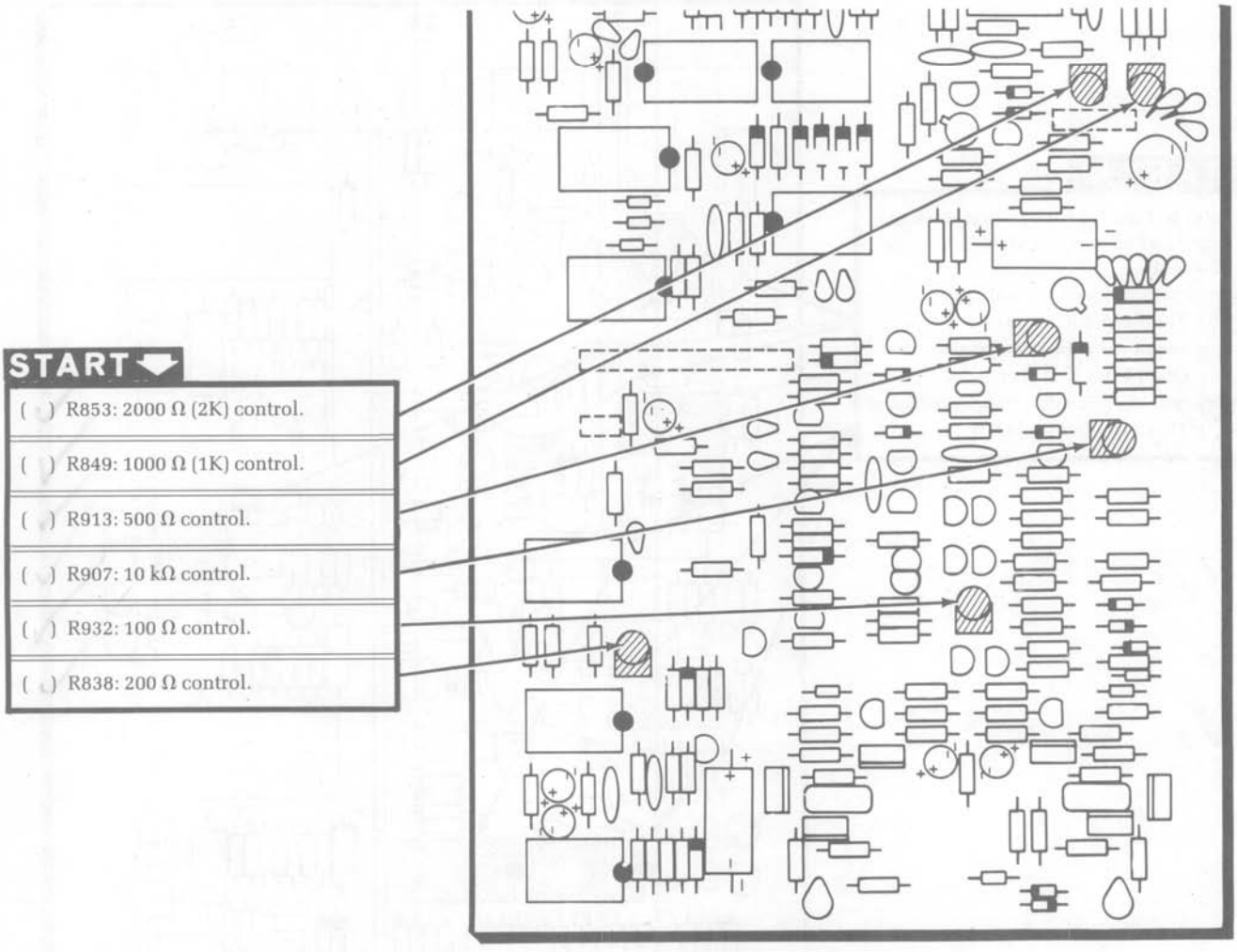
( ) R868: 100 Ω control.

( ) E864: 500 Ω control.

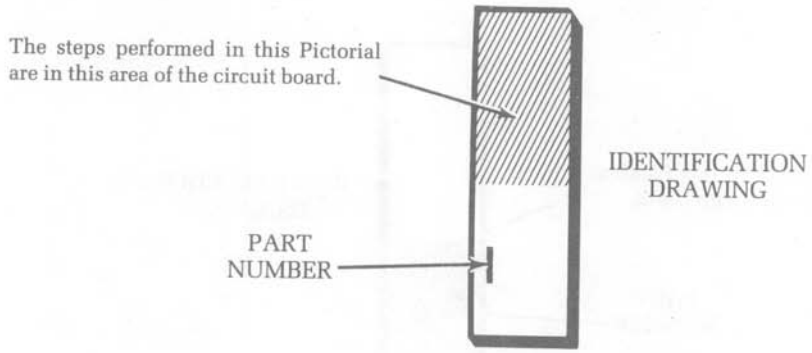


**PICTORIAL 6-11**




**PICTORIAL 6-12**



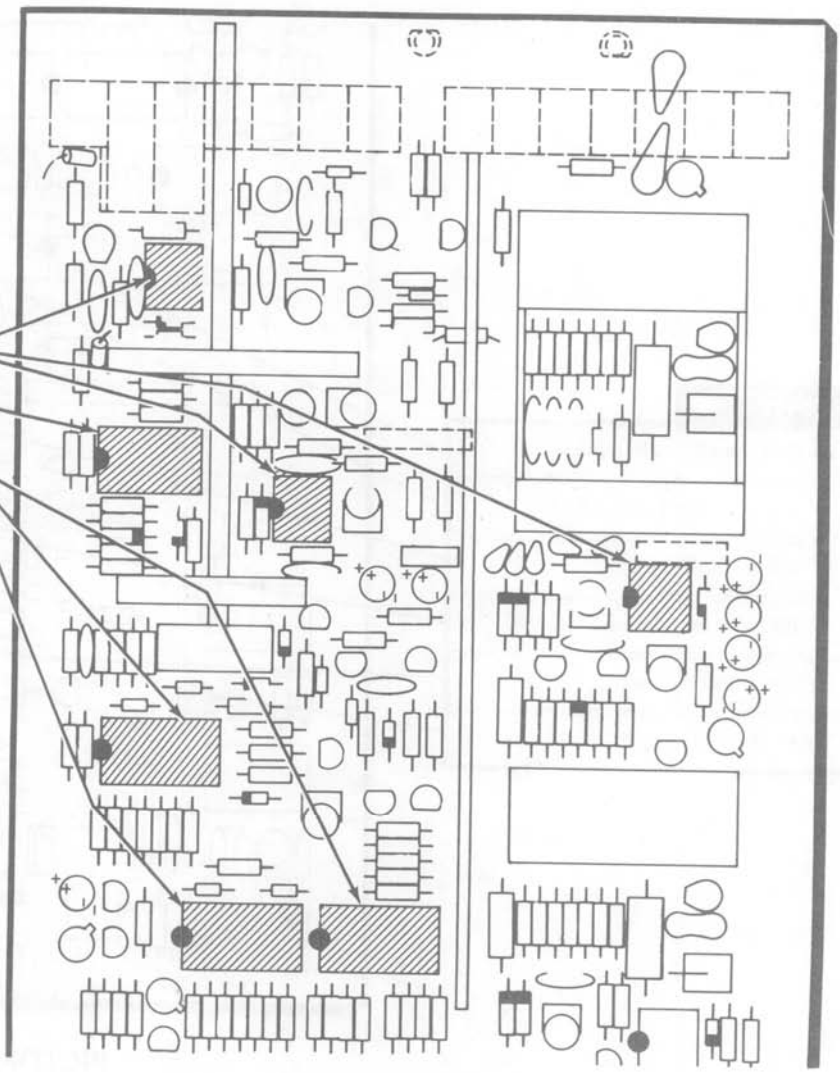

**START**

Refer to Figure 1 (Illustration Booklet, Page 1) when you install the following IC sockets.

( ) Three 8-pin IC sockets.

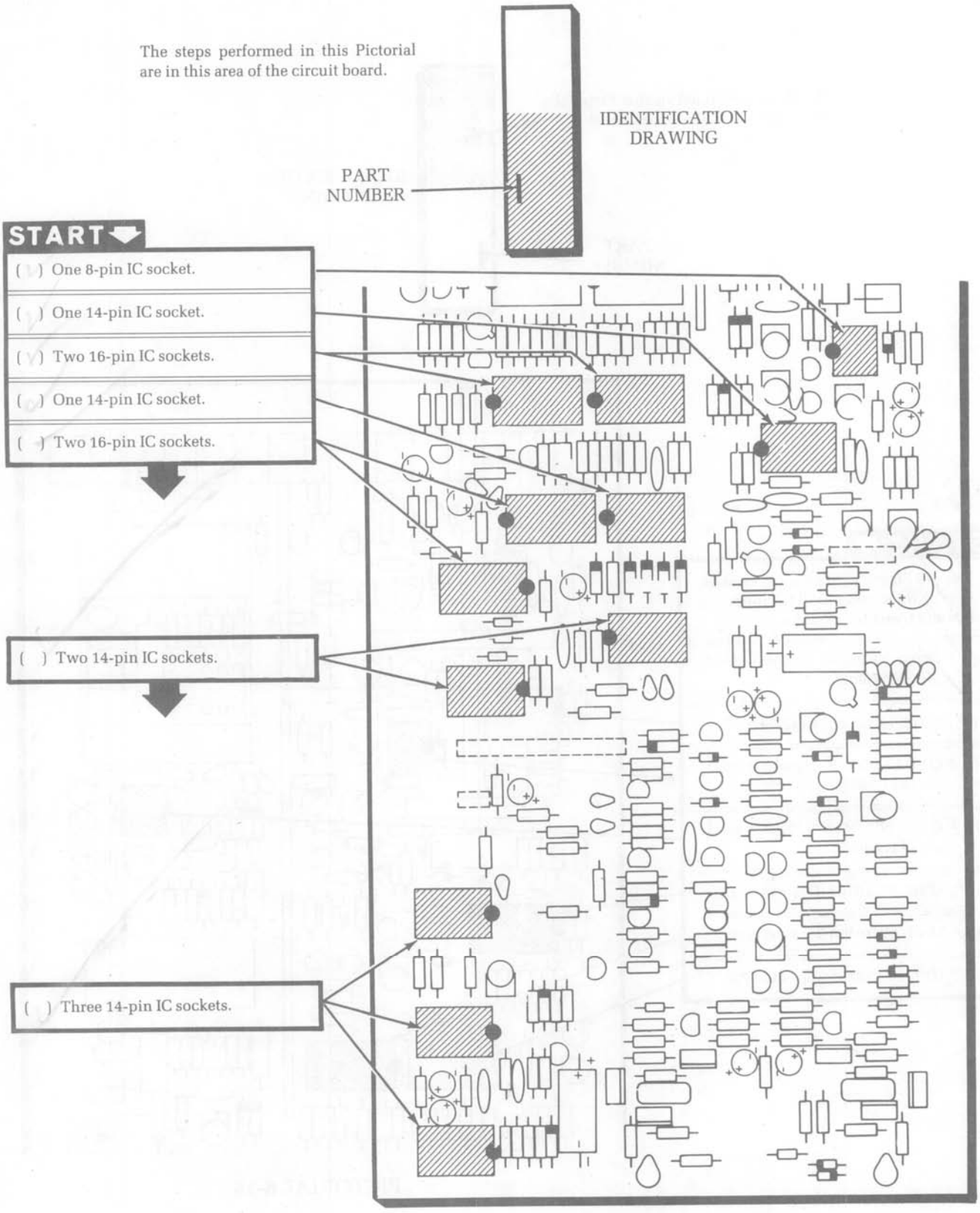
( ) One 14-pin IC socket.

( ) Three 16-pin IC sockets.

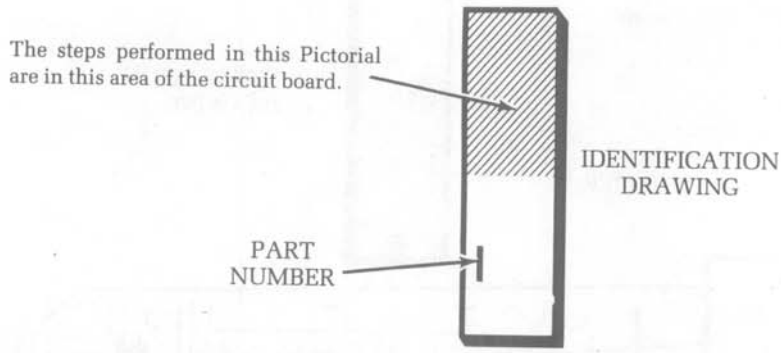


**PICTORIAL 6-13**

Heathkit®




**PICTORIAL 6-14**




**START**

Refer to Figure 1 (Illustration Booklet, Page 1) when you install the following IC's and transistor modules.

( ) Q701: NPD5566 transistor module (#417-902).

( ) U716: LF**347** IC (#442-742).

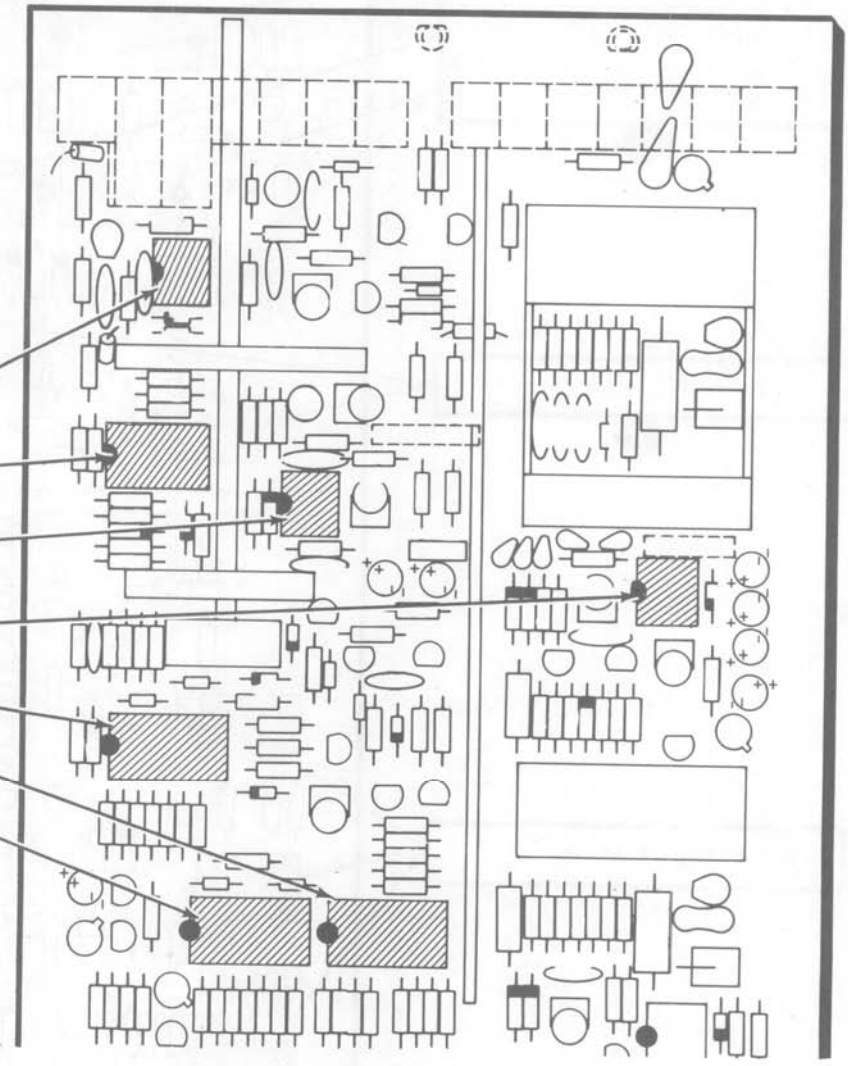
( ) Q705: NPD5566 transistor module (#417-902).

( ) Q721: NPD5566 transistor module (#417-902).

( ) U702: MC**10102** IC (#443-683).

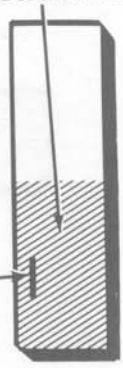
( ) U701: MC**10116** IC (#443-636).

( ) U703: MC**10131** IC (#443-679).



**PICTORIAL 6-15**

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




**START**

( ) Q731: NPD5566 transistor module (#417-902).

( ) U705: MC**10105** IC (#443-765).

( ) U704: MC**10105** IC (#443-765).

( ) U715: SN**74132** IC (#443-625).

( ) U706: SN**7413** IC (#443-44).

( ) U708: SN**74LS123** IC (#443-942).

( ) U709: SN**7476** IC (#443-16).

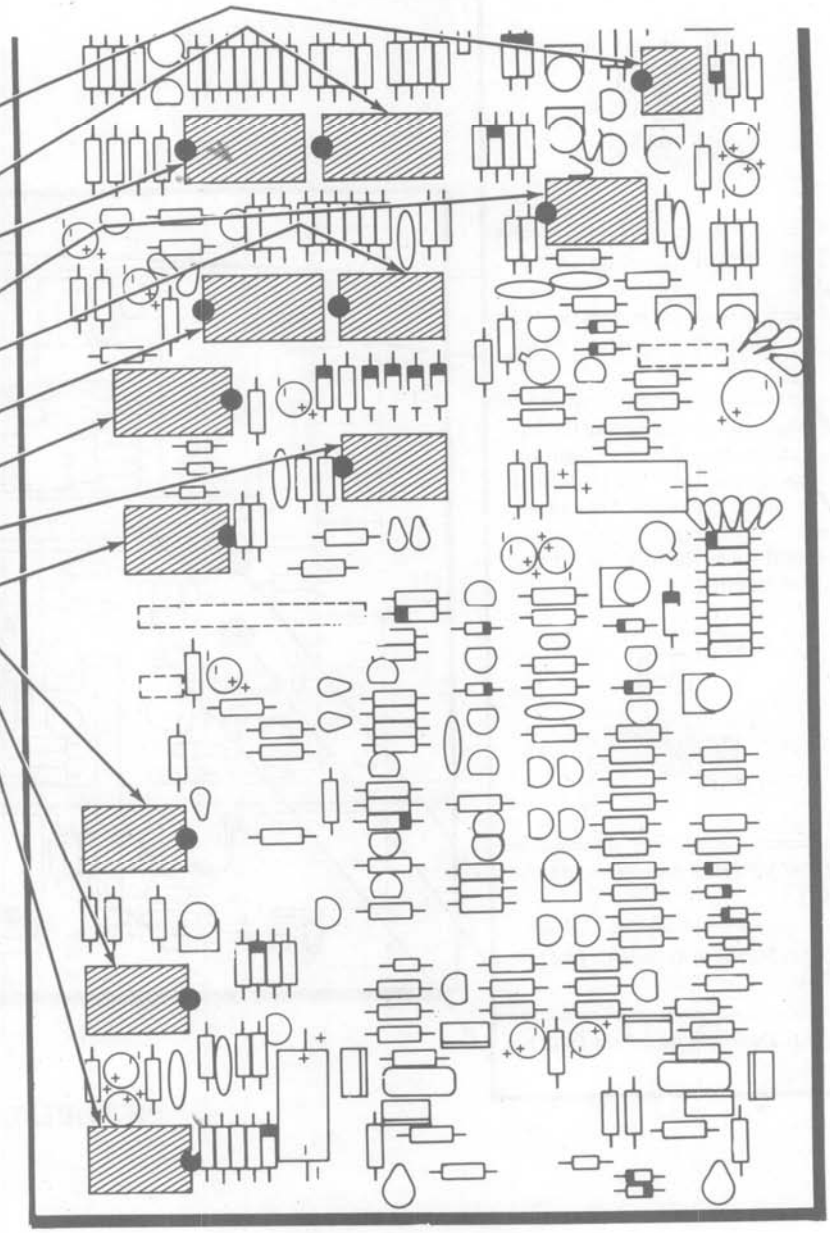
( ) U707: SN**7400** IC (#443-1).

( ) U711: SN**7400** IC (#443-1).

( ) U713: SN**7408** IC (#443-45).

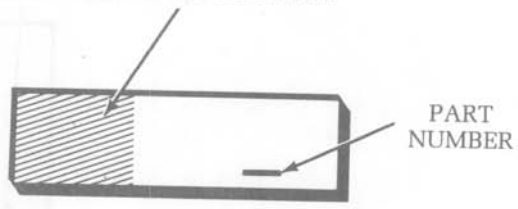
( ) U712: SN**7400** IC (#443-1).

( ) U714: SN**7400** IC (#443-1).



**PICTORIAL 6-16**

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




IDENTIFICATION
DRAWING

**START**

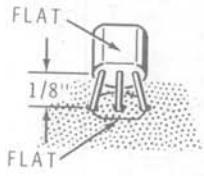
Position the circuit board as shown in the Identification Drawing

NOTE: When you install the next two transistors, position the tab over the outline of the tab on the circuit board. Then insert the leads into the circuit board holes and solder them to the foil. Cut off the excess lead lengths.

( ) Q728: 2N2369 transistor (#417-154).

( ) Q719: 2N2369 transistor (#417-154).

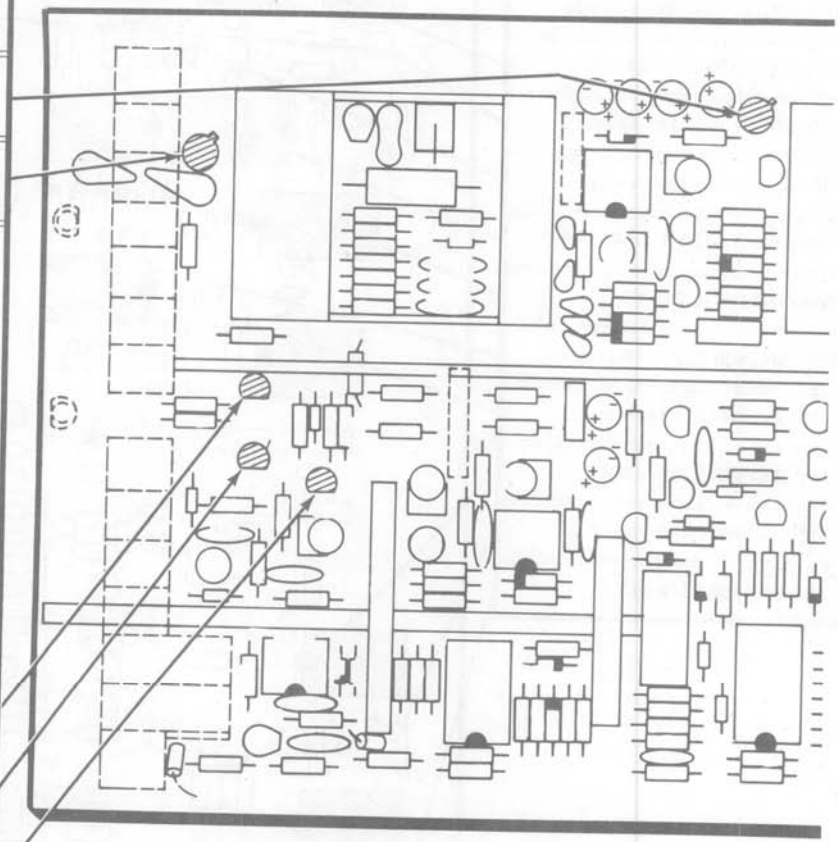
NOTE: When you install each of the following transistors and diodes, position the flat on the part over the outline of the flat on the circuit board. Then insert the leads into the circuit board holes and solder them to the foil. Cut off any excess lead lengths.




( ) Q704: MPSH10 transistor (#417-887).

( ) Q703: MPSH10 transistor (#417-887).

( ) Q702: 2N4258A transistor (#417-260).



**PICTORIAL 6-17**

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

IDENTIFICATION DRAWING

START

( ) Q729: 2N5458 transistor (#417-291).

( ) Q722: 2N4121 transistor (#417-235).

NOTE: As you install the next transistor, slide a ferrite bead onto the indicated lead as shown. Push the transistor all the way down to the top of the bead.

( ) Q761: 2N3904 transistor (#417-875).

( ) Q711: 2N4258A transistor (#417-260).

( ) Q712: 2N4258A transistor (#417-260).

( ) Q707: 2N5770 transistor (#417-293).

( ) Q708: 2N5770 transistor (#417-293).

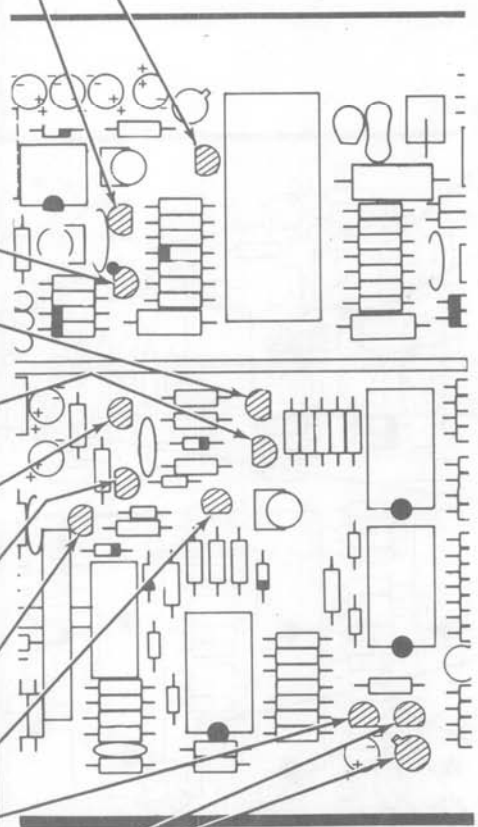
( ) Q706: 2N5770 transistor (#417-293).

( ) Q709: 2N5770 transistor (#417-293).

( ) Q713: 2N4258A transistor (#417-260).

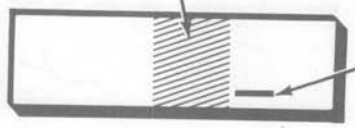
( ) Q714: 2N4258A transistor (#417-260).

( ) Q715: 2N2369 transistor (#417-154). Note the installation instructions at the top of the preceding page.



**PICTORIAL 6-18**

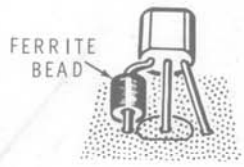
The steps performed in this Pictorial are in this area of the circuit board.




IDENTIFICATION DRAWING

**START**

NOTE: As you install the next transistor, slide a ferrite bead onto the indicated lead as shown. Push the transistor all the way down to the top of the bead.




( ) Q762: 2N3904 transistor (#417-875).

( ) Q732: 2N4121 transistor (#417-235).

( ) Q725: 2N3906 transistor (#417-874).

( ) Q726: 2N4258A transistor (#417-260).

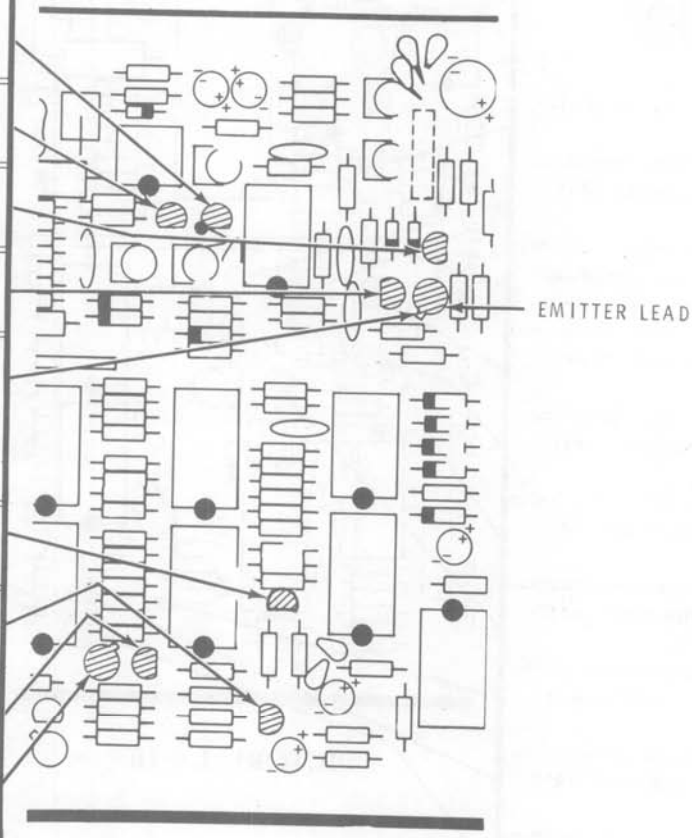
( ) Q727: 2N2369 transistor (#417-154). NOTE: Check the indicated lead of this transistor; it must **not** touch the adjacent resistor. Reposition the body of the resistor slightly, if necessary.

( ) Q763: 2N3904 transistor (#417-875).

( ) Q716: 2N4121 transistor (#417-235).

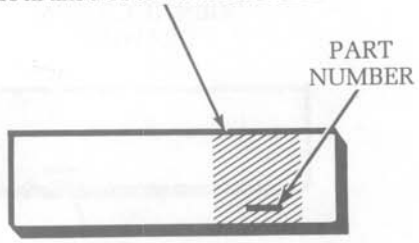
( ) Q718: 2N4121 transistor (#417-235).

( ) Q717: 2N2369 transistor (#417-154).




**PICTORIAL 6-19**

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




IDENTIFICATION DRAWING

**START**

( ) Q733: 2N2369 transistor (#417-154).

( ) Q741: MPSH10 transistor (#417-887).

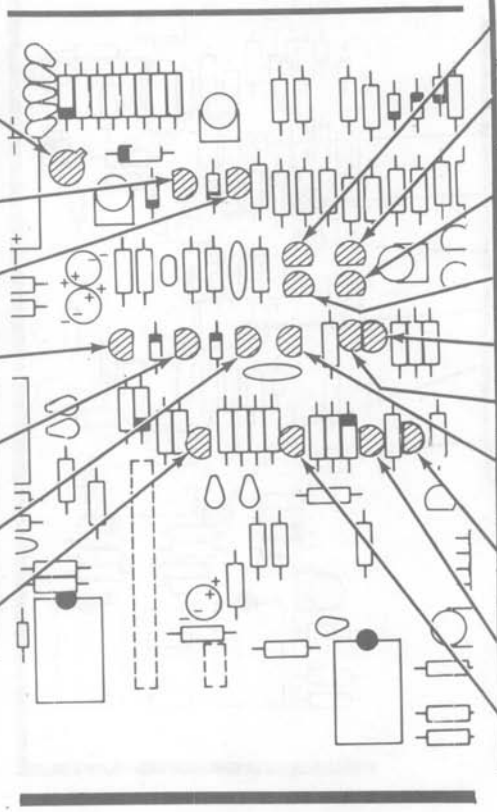
( ) Q738: MPSH10 transistor (#417-887).

( ) Q737: MPSH10 transistor (#417-887).

( ) Q742: MPSH10 transistor (#417-887).

( ) Q739: MPSH10 transistor (#417-887).

( ) Q736: 2N4121 transistor (#417-235).



**CONTINUE**

( ) Q743: MPSH10 transistor (#417-887).

( ) Q745: MPSH81 transistor (#417-917).

( ) Q746: MPSH81 transistor (#417-917).

( ) Q744: MPSH10 transistor (#417-887).

( ) D738: MBD101 diode (#56-670).

( ) D737: MBD101 diode (#56-670).

( ) Q735: MPSH10 transistor (#417-887).

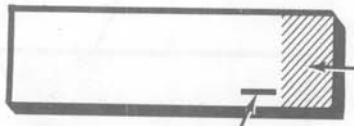
( ) Q758: 2N4121 transistor (#417-235).

( ) Q759: 2N3904 transistor (#417-875).

( ) Q734: 2N4121 transistor (#417-235).

**PICTORIAL 6-20**

IDENTIFICATION DRAWING



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

PART NUMBER

**START**

Install five 2N5770 transistors (#417-293) in the following steps.

( ) Q749:

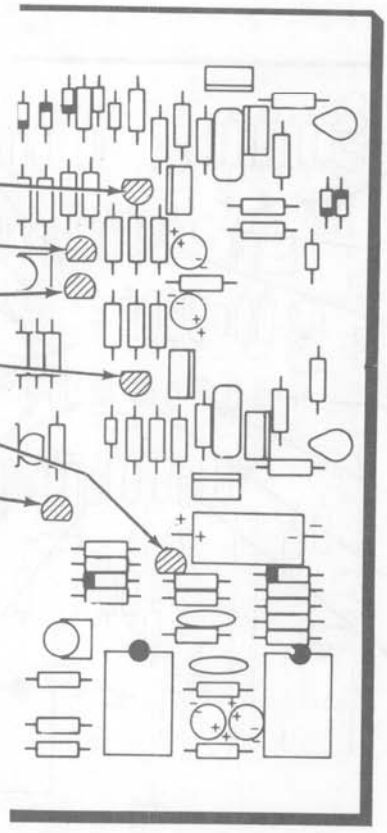
( ) Q747:

( ) Q748:

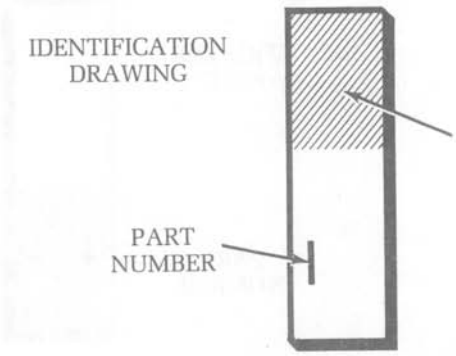
( ) Q751:

( ) Q723:

( ) Q724: 2N4258A transistor (#417-260).



**PICTORIAL 6-21**




**START**

Position the circuit board as shown in the Identification Drawing.

( ) C713: 56 pF ceramic.

( ) C704: 56 pF ceramic.

( ) C703: .001 µF ceramic.

( ) C702: 220 pF ceramic.

( ) C725: 47 pF mica.

( ) C711: .001 µF ceramic.

( ) C735: .001 µF ceramic.

( ) C736: 270 pF ceramic.

( ) C737: 100 pF (100 k) ceramic.

( ) C715: 56 pF ceramic.

( ) C789: 100 pF (100 k) ceramic.

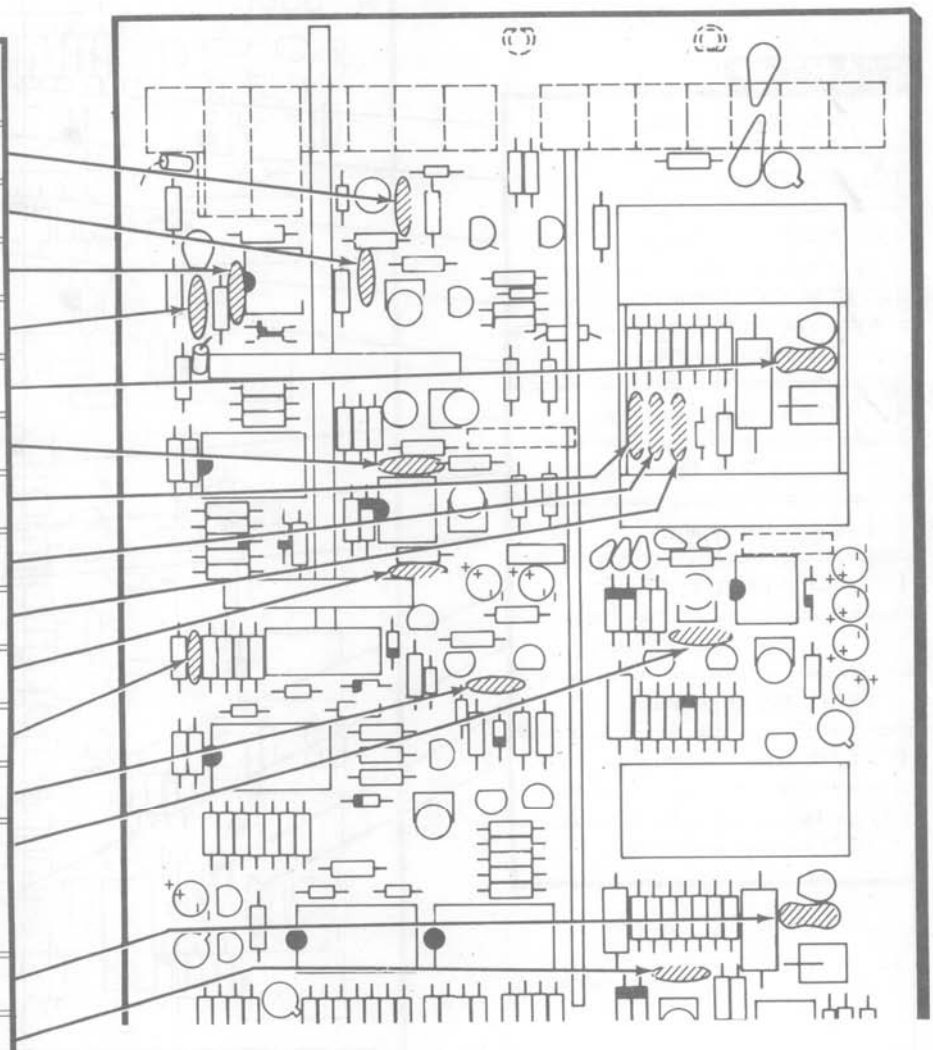
( ) C716: 27 pF ceramic.

( ) C727: 100 pF (100 k) ceramic. NOTE: The callout for this capacitor may be partially concealed by the adjacent control.

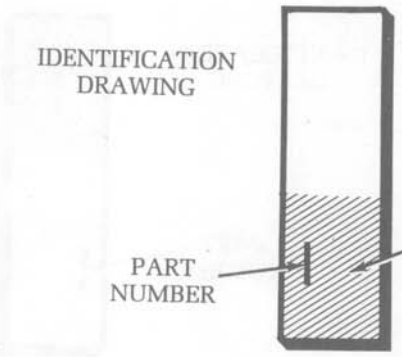
( ) C756: 47 pF mica.

( ) C758: 100 pF (100 k) ceramic.

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

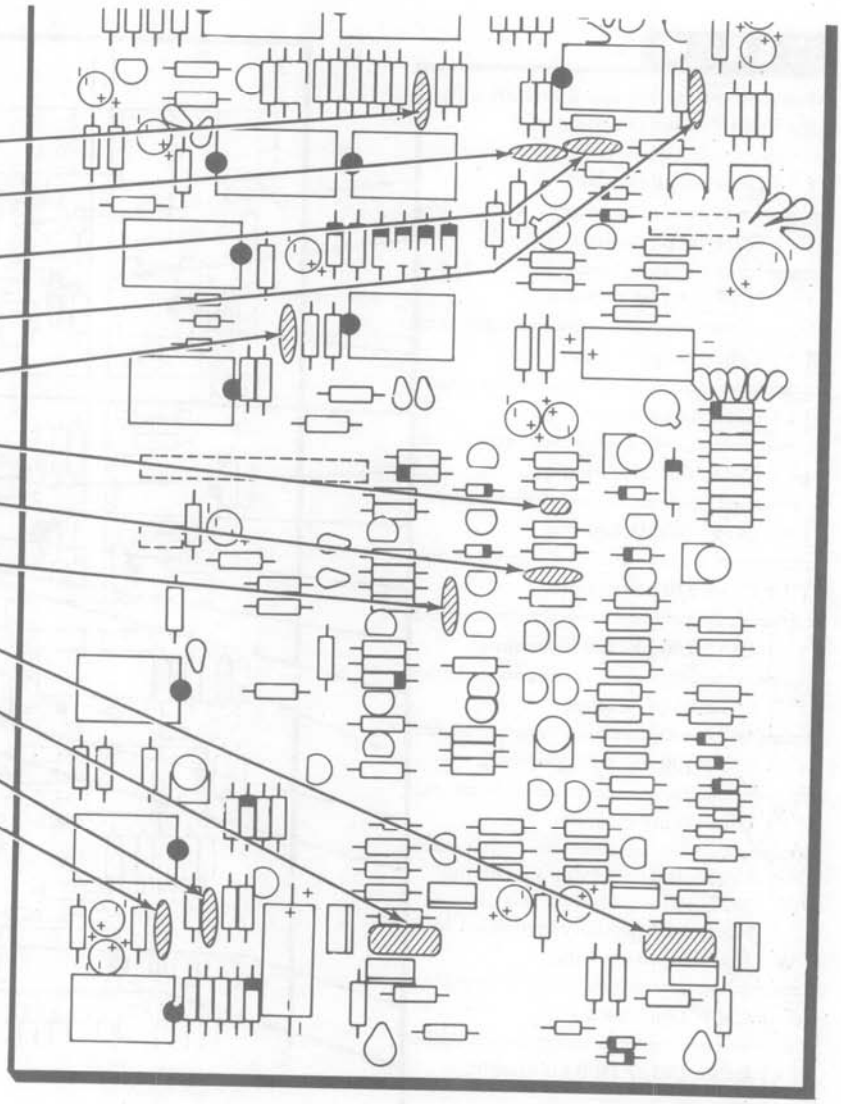


**PICTORIAL 6-22**




**START**

- ( ) C722: 270 pF ceramic.
- ( ) C753: 270 pF ceramic.
- ( ) C752: 180 pF ceramic.
- ( ) C748: .002 µF ceramic.
- ( ) C728: 270 pF ceramic.
- ( ) C761: 82 pF (820) ceramic.
- ( ) C759: 15 pF (15 k) ceramic.
- ( ) C707: 3.3 pF ceramic.
- ( ) C767: .1 µF (.1 k) polyester.
- ( ) C771: .1 µF (.1 k) polyester.
- ( ) C741: .002 µF ceramic.
- ( ) C742: .002 µF ceramic.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.



**PICTORIAL 6-23**

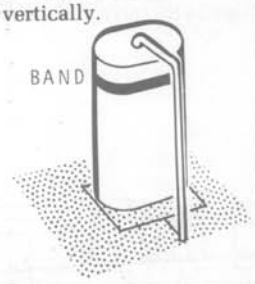
Heathkit®

START

( ) C714: 10 µF, 10V nonpolarized electrolytic. This capacitor can be installed either way.

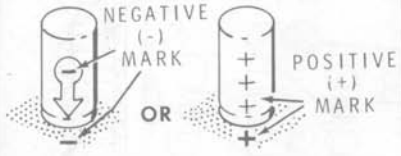
( ) C724: .01 µF (10000 pF)(103) polystyrene.

( ) C723: 1 µF Mylar. Mount this capacitor vertically.




( ) C786: 10 µF, 10V nonpolarized electrolytic. This capacitor can be installed either way.

NOTE: When you install electrolytic capacitors, always match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board OR match the minus (–) mark on the capacitor with the minus (–) mark on the circuit board.




( ) C783: 10 µF, 35V electrolytic.

( ) C794: 10 µF, 35V electrolytic.

( ) C731: 10 µF, 35V electrolytic.

( ) C732: 1 µF, **50V** electrolytic.

( ) C776: 10 µF, 35V electrolytic.

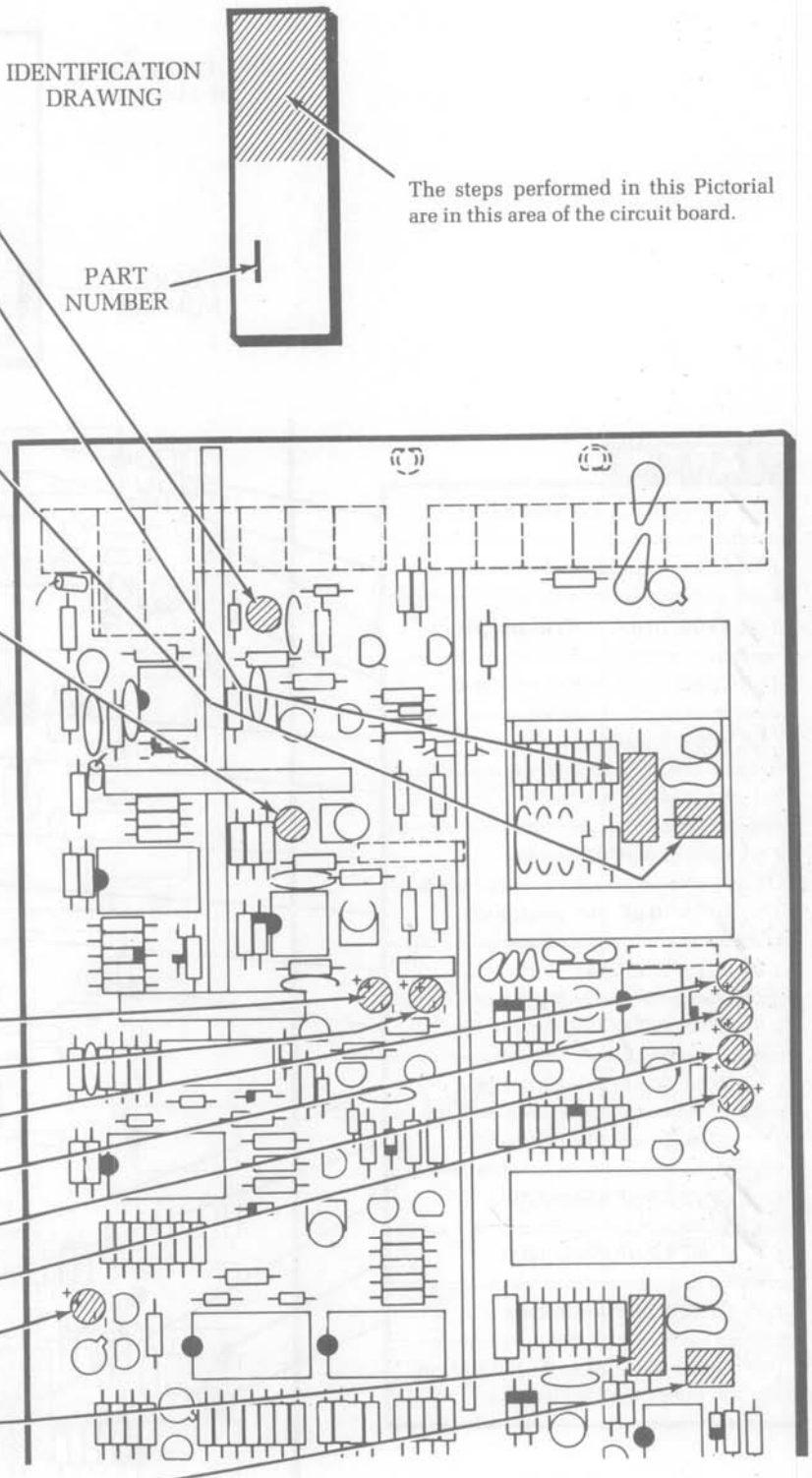
( ) C779: 10 µF, 35V electrolytic.

( ) C718: 39 µF electrolytic.

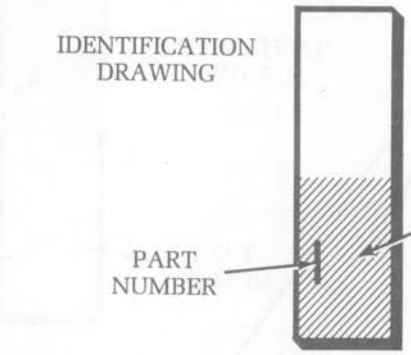
( ) C755: .01 µF (10,000 pF) polystyrene. (103)

( ) C754: .1 µF Mylar. Mount this capacitor vertically.

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

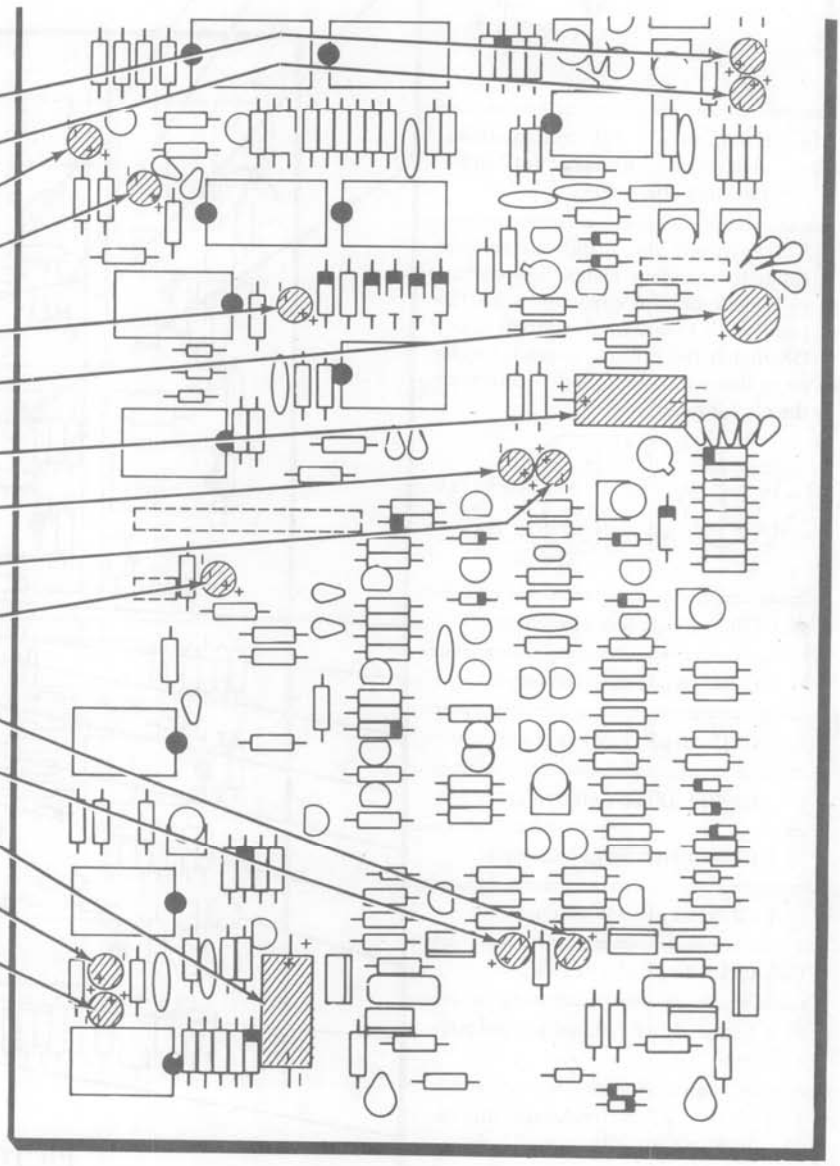



**PICTORIAL 6-24**



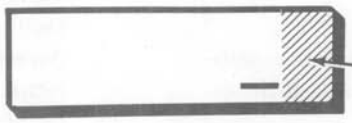

START

- ( ) C777: 10 µF, 35V electrolytic.
- ( ) C781: 10 µF, 35V electrolytic.
- ( ) C792: 10 µF, 35V electrolytic.
- ( ) C782: 10 µF, 35V electrolytic.
- ( ) C729: 2.2 µF electrolytic.
- ( ) C751: 47 µF electrolytic.
- ( ) C795: 1.5 µF electrolytic.
- ( ) C778: 10 µF, 35V electrolytic.
- ( ) C775: 10 µF, 35V electrolytic.
- ( ) C793: 10 µF, 35V electrolytic.
- ( ) C768: 10 µF, 35V electrolytic.
- ( ) C774: 10 µF, 35V electrolytic.
- ( ) C791: 1.5 µF electrolytic.
- ( ) C739: 4.7 µF electrolytic.
- ( ) C738: 4.7 µF electrolytic.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.



**PICTORIAL 6-25**

IDENTIFICATION
DRAWING

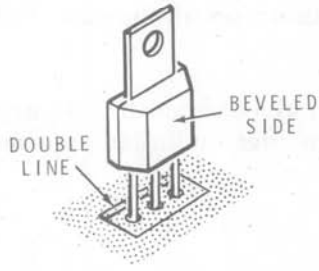


The steps performed in this Pictorial are in this area of the circuit board.

PART
NUMBER

**START**

NOTE: When you install the following transistors, place the beveled side of the transistors AWAY from the double line of the outline on the board. Insert the leads as far as they will go into the holes. Solder the leads to the foil and cut off the excess lengths.




( ) Q752: MDS-21 (#417-947).

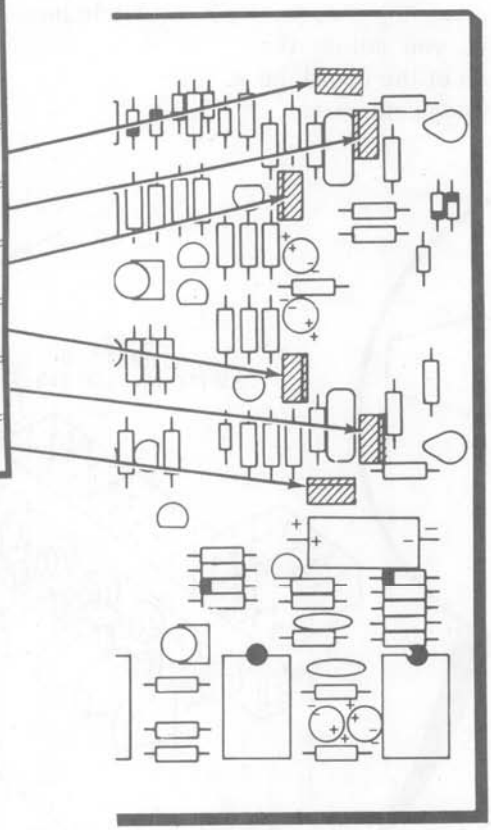
( ) Q754: MDS-60 (#417-948).

( ) Q755: MDS-21 (#417-947).

( ) Q756: MDS-21 (#417-947).

( ) Q757: MDS-60 (#417-948).

( ) Q753: MDS-21 (#417-947).



**PICTORIAL 6-26**

Refer to Pictorial 6-27 (Illustration Booklet, Page 18) for the following steps.

( ) Position the circuit board with the component side down as shown.

( ) SW703: Install the pushbutton switch assembly (#64-897) on the circuit board as follows. Refer to Detail 6-27A.

1. Make sure all of the switch pins are straight.

2. Carefully insert all the switch pins into their mounting holes.

3. Push the assembly onto the circuit board. Make sure the crimped portion of each pin is fully seated against the circuit board.

4. Check the switch assembly to make sure it is parallel with the board as shown in the inset drawing.

NOTE: In the following steps, as you solder the switch pins on the component side of the board, be careful not to heat and damage any adjacent parts.

5. Turn the board over and, on the component side, solder one pin on each end and at the middle of the switch assembly.

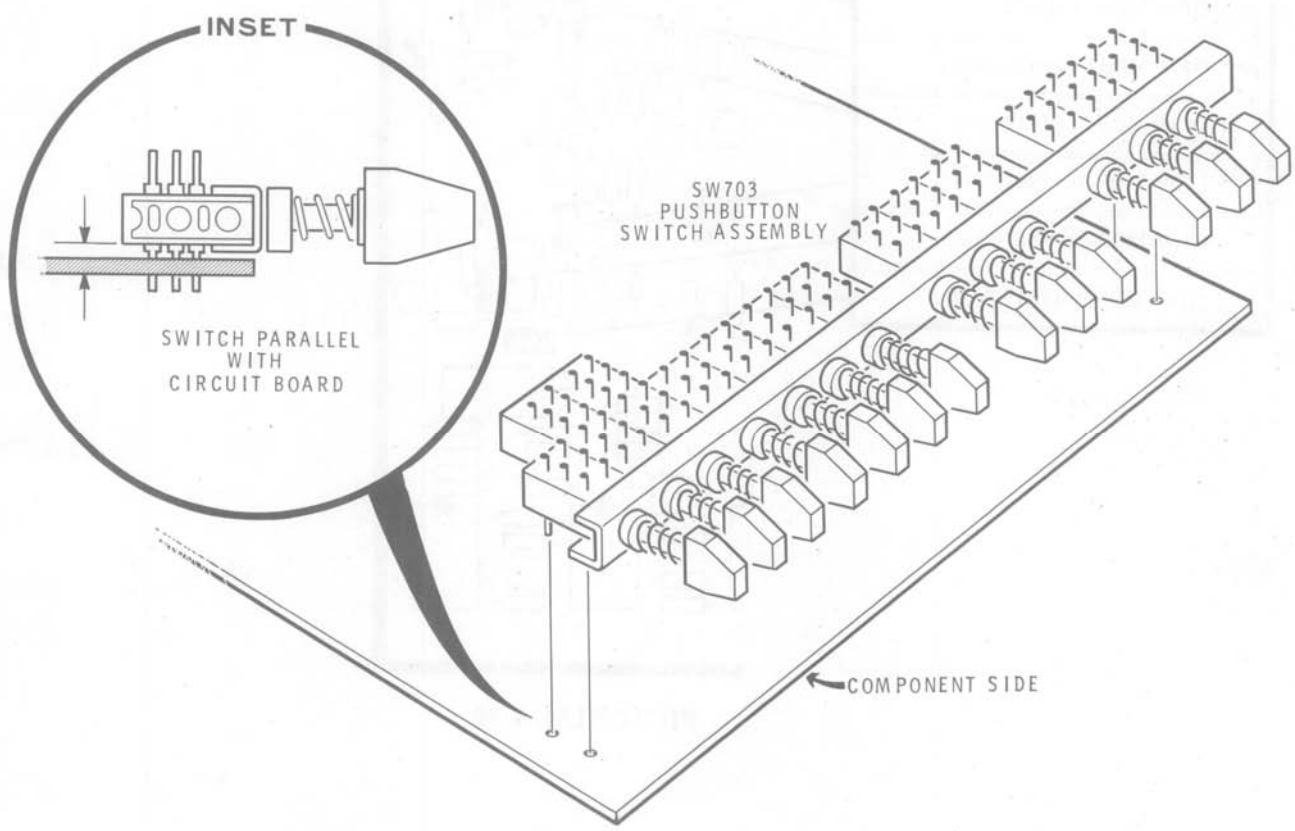
6. Turn the board over again and check the switch to make sure the assembly is still parallel. Turn the board over and solder the remaining pins to the component-side foils. Be sure the solder "wicks" onto each switch pin at the small foil pads.

( ) Turn the circuit board component-side down.

( ) Insert the short end of a PCB pin into hole AA on the foil side of the board. Solder the pin to the foil.

( ) In the same manner, install the other PCB pin in hole BB.

( ) Refer to the Pictorial and cut all of the exposed top pins from the indicated pushbutton switches.




**Detail 6-27A**

When you install the following plugs on the back of the board, insert the short pins into the board and solder them to the **component-side** foil.

( ) Pull pin 3 from a 7-pin right-angle plug.

( ) P701: Install the prepared 6-pin right-angle plug.

( ) Cut off one end pin from **two** 7-pin right-angle plugs as shown in the inset drawing.

( ) P703: Install one of the 6-pin right-angle plugs.

( ) P704: Install the remaining 6-pin right-angle plug. NOTE: Check the component-side screen to make sure this plug is in the correct holes.

( ) Cut pin 6 from right-angle plugs P703 and P704.

( ) P702: Pull pin 6 from a 15-pin plug. Install the 15-pin plug at P702 as shown.

( ) P705: Cut off one end pin from the 4-pin plug. Then install the plug.

( ) Push a 2-hole jumper socket onto P704 pins 1 and 2 as shown.

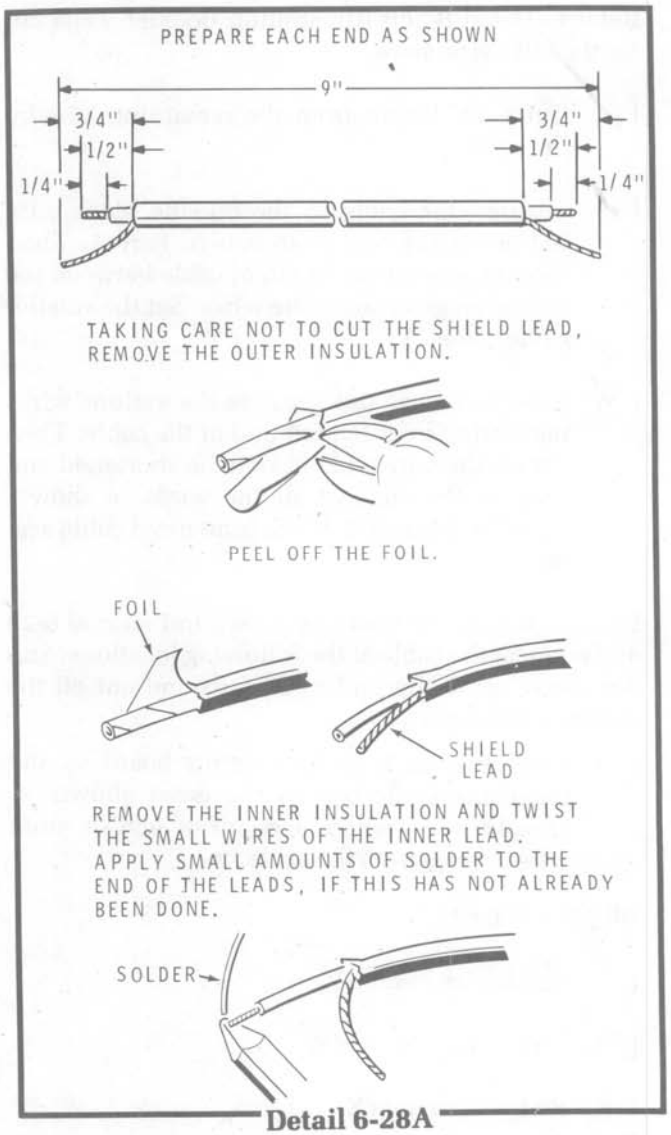
( ) D707: Cut two 1/2" lengths of small sleeving and place them on the leads of a NSL5076A LED (#412-637). Mount the LED vertically with the flat side **toward the rear** of the board at D707. Solder the leads to the component-side foil and cut off the excess lead lengths. Sharply bend the LED so its leads are parallel to the surface of the board as shown.

( ) D747: Similarly install the other NSL5076A LED (#412-637). However, mount the LED with the flat **toward the front edge** of the board.

Refer to Pictorial 6-28 (Illustration Booklet, Page 19) for the following steps.

( ) Refer to Detail 6-28A and prepare both ends of two 9" AMW style 1435 shielded cable.

Connect the cables to the component side of the circuit board in the following steps. Use 1/2" of small sleeving on the shield leads. Solder the leads to the underside foils and cut off the excess lead lengths.




**Detail 6-28A**

NOTE: At EE and FF, solder the leads to the component side foils as necessary.

EITHER CABLE:

( ) Inner lead at one end of the cable in hole EE. Shield lead in hole FF.

( ) Inner lead at the other end of the cable in hole CC. Shield lead in hole DD.

OTHER CABLE:

( ) Inner lead at one end of the cable in hole R. Shield lead in hole S.

( ) Inner lead at the other end of the cable in hole T. Shield lead in hole U.

Refer to Detail 6-28B (Illustration Booklet, Page 20) for the following steps.

( ) Cut a 14″ length from the remaining 25-wire flat cable.

( ) Position the cable so the outside black wire is toward the top as shown in Part A. Then separate the entire length of cable between the indicated green and blue wires. Set the smaller cable aside.

( ) Refer to Part B and separate the various wires measuring from the **left** end of the cable. Then cut off the wires that have to be shortened and prepare the ends of all the wires as shown. Save the leftover 8″ black-brown-red cable segment.

Position the circuit board as shown in Pictorial 6-28 and connect the cable at the following locations. Solder the wires to the underside foils and cut off the excess wire lengths.

( ) Place the cable on the circuit board so the breakouts come out in the areas shown. A "breakout" is where a group of one or more wires comes from the cable.

BREAKOUT #1:

( ) Black wire in hole V.

( ) Brown wire in hole W.

( ) Red wire in hole X.

BREAKOUT #2:

( ) Orange wire in hole K.

( ) Yellow wire in hole L.

( ) Green wire in hole M.

BREAKOUT #3:

( ) Blue wire in hole O.

( ) Violet wire in hole Q.

( ) Gray wire in hole P.

( ) White wire in hole N.

( ) Black wire in hole Z.

BREAKOUT #4:

( ) Brown wire in hole Y.

BREAKOUT #5:

( ) Red wire in hole G.

( ) Orange wire in hole F.

BREAKOUT #6:

( ) Yellow wire in hole I.

( ) Green wire in hole H.

Refer to Pictorial 6-29 (Illustration Booklet, Page 21) for the following steps.

( ) Position the circuit board as shown.

You will install the rotary switches next; to install them use the following procedure:

1. Make sure all of the wafer pins are straight.

2. Carefully insert all of the wafer pins into their mounting holes.

3. Make sure all of the wafers are completely seated against the board.

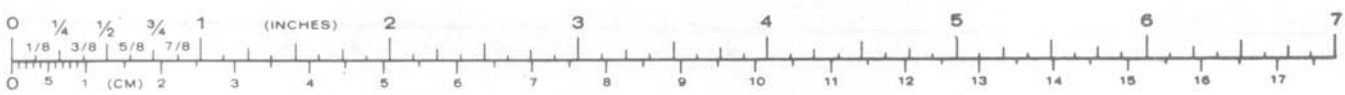
4. Turn the board over and tack-solder one rear-corner pin to the foil, and one front-corner pin, diagonal to the soldered rear pin.

( ) SW702/R728: Install the rotary switch assembly.

Refer to Detail 6-29A for the following steps.

( ) Cut two 1-5/8″ pieces of black tape. Place a piece of tape on the lower front of switches SW701 and SW704 as shown. Press half the tape width on the vertical part of the switch; then form the other half onto the bottom surface.

( ) SW704: Install the single wafer rotary switch. Then turn the switch shaft fully counterclockwise as you view the switch from the shaft end. Tack-solder one rear-corner pin to the foil and one front-corner pin, diagonal to the soldered rear pin.



( ) SW701: In the same manner, install the dual wafer rotary switch.

( ) Push the switch shaft all the way through SW701 outer shaft and into the outer shaft of SW704.

( ) Install the threaded spacer on the dual wafer rotary switch. Turn the spacer to 3/16″ from the switch body.

( ) Refer to Detail 6-31A on Page 7-37 and temporarily mount the front panel (without other components installed) onto the switch assemblies as shown. Secure the shafts with two control nuts. Be sure the two LEDs are positioned into their front panel holes.

( ) Slightly readjust the threaded spacer so the front panel is exactly parallel to the front edge of the board.

( ) Check to be sure all switches and controls operate freely. If they do not, unsolder the switch pins and readjust the switch position until the switches operate freely. Then turn the circuit board over and solder all the switch pins to the foil.

( ) Remove the control nuts and front panel from the switches and set them aside temporarily. Remove the switch shaft from the switches.

( ) Locate the shaft coupler and start two 4-40 setscrews into the side holes in the coupler.

( ) Place the coupler onto SW704 outer switch shaft so that one of the setscrews is visible from the top.

( ) Locate the conical spring. Install the spring between the coupler and switch SW701. Position the larger portion of the spring on the switch shaft and toward SW701. Then compress the spring between the coupler and the switch.

( ) Insert the switch shaft through the shaft of switch SW701, from the front panel, through the spring, the coupler, and switch SW704. Leave 1/8″ of the shaft protruding from the back of switch SW704. Then tighten both setscrews.

## CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

( ) Protruding leads which could touch together.

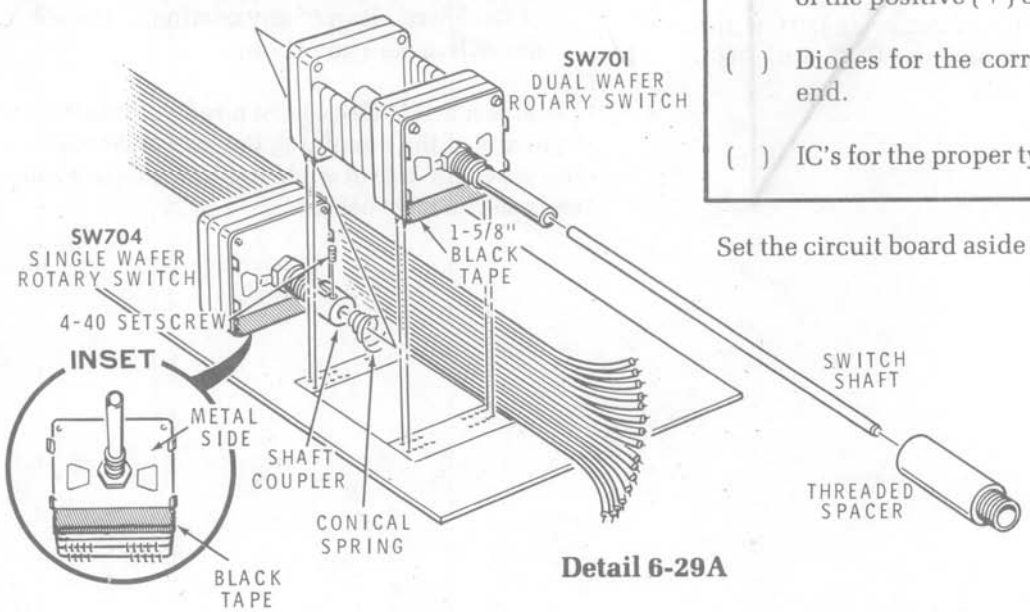
( ) Transistors for the proper type and installation.

( ) Electrolytic capacitors for the correct position of the positive (+) or negative (−) marks.

( ) Diodes for the correct position of the banded end.

( ) IC's for the proper type and installation.

Set the circuit board aside temporarily.




**Detail 6-29A**

Refer to Pictorial 6-30 (Illustration Booklet, Page 21) for the following steps.

The following parts will be mounted on the front panel.

NOTE: When you mount the following controls, make sure you position the lugs as shown in the Pictorial.

( ) R718: Mount the 2000 Ω (2 K) control (#10-1186) with a 1/4" lockwasher and 1/4" nut.

( ) R821/SW705: Mount the 10 kΩ control with switch (#19-749) with a 1/4" lockwasher and 1/4" nut.

( ) R801: Mount a 10 kΩ control (#10-1202) with a 1/4" lockwasher and 1/4" nut.

( ) R884/R885/SW706: Mount a 1000 Ω (1 K) dual control with switch (#19-757). Use a 3/8" control lockwasher and control 3/8" nut.

( ) R851: Mount a 1000 Ω (1 K) control (#10-1187) with a control solder lug and 3/8" control nut. Position the solder lug at approximately the 1 o'clock position and bend it as shown in the inset drawing.

( ) Locate another control solder lug and straighten it. Cut off 3/8" from the end. Then bend it at a 90° angle as shown at J701 where it will be used in the next step.

( ) J701: Mount the BNC connector at J701 with the control solder lug and the BNC nut. Discard the BNC lockwasher.

Refer to Pictorial 6-31 (Illustration Booklet, Page 22) for the following steps.

Refer to Detail 6-31A for the next seven steps.

( ) 1. Position the horizontal circuit board as shown.

( ) 2. Locate a control solder lug and straighten it. Cut off 3/8" from the end. Then bend it at a 90° angle as shown.

( ) 3. Place the control solder lug on the threaded spacer of switch SW701.

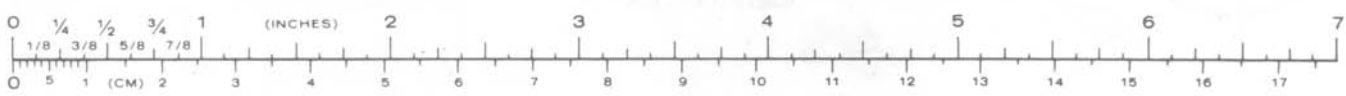
( ) 4. Place a 3/8" control lockwasher on the shaft of switch SW702/R728.

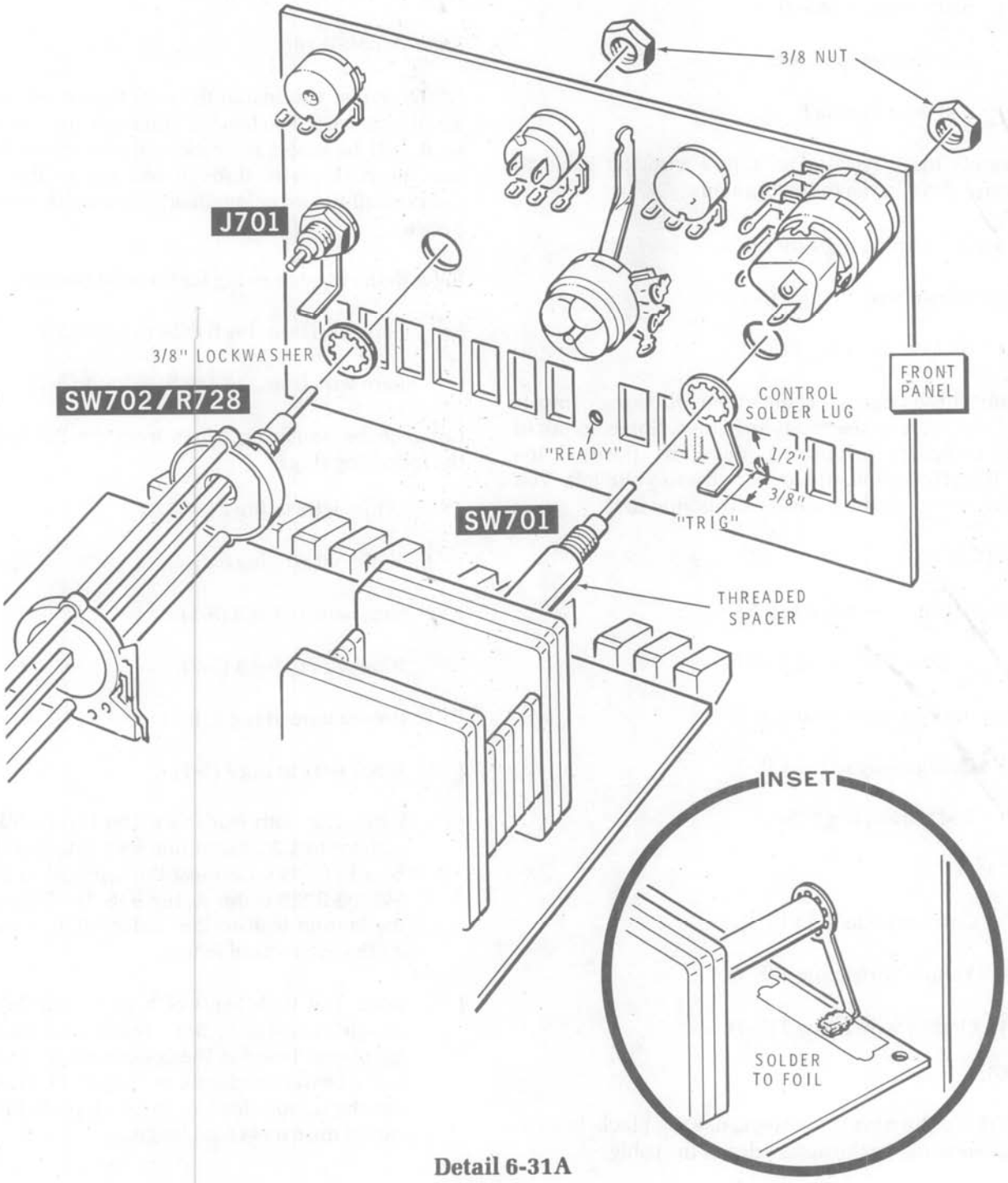
( ) 5. Place the front panel over the switch shafts and secure it with two 3/8" control nuts. Before you tighten the nut on SW701, make sure the control solder lug is positioned as shown. Also insert LED's D707 and D747 in panel holes TRIG and READY.

( ) 6. Recheck and make sure the front panel and the edge of the board are parallel. Readjust the threaded spacer if necessary.

( ) 7. Refer to the inset drawing, and solder this control solder lug and the one at J701 to the foil. Make sure the end of the solder lugs do not protrude over the edge of the foil pad and touch any other foil or connections. NOTE: If necessary, scrape this area of the board clean of any coating so the solder will make a good bond.

( ) Remove a 5-1/4" black-brown-red combination from any of the remaining flat cables. Separate the wires for 1/2" at each end and prepare the ends as you have before.




3/8 NUT
J701
3/8" LOCKWASHER
SW702/R728
FRONT PANEL
CONTROL SOLDER LUG
"READY"
1/2"
3/8"
"TRIG"
SW701
THREADED SPACER
INSET
SOLDER TO FOIL

**Detail 6-31A**

Connect one end of the cable to the circuit board at location R718 in the following steps. Solder the wires to the underside foil and cut off the excess wire lengths.

( ) Black wire to hole D.

( ) Brown wire to hole C.

( ) Red wire to hole B.

Connect the other end of this 3-wire flat cable to control R718 in the following steps.

( ) Red wire to lug 1 (S-1).

( ) Brown wire to lug 2 (S-1).

( ) Black wire to lug 3 (S-1).

Connect the large flat cable to the following controls and switches in the following steps. Some colors in this cable are duplicated; therefore, position the cable with the **outside green wire to your left.** You will connect the four wires on this side first.

R821/SW705:

( ) Green wire to lug 1 (S-1).

( ) Yellow wire to lug 2 (S-1).

Lug 3 has no connection to it.

( ) Orange wire to lug 4 (S-1).

( ) Red wire to lug 5 (S-1).

R851:

( ) Green wire to lug 1 (S-1).

( ) Yellow wire to lug 2 (S-1).

( ) Orange wire to lug 3 (S-1).

R801:

NOTE: In the next three steps, use the black, brown, and red wires on the **outer edge** of the cable.

( ) Black wire to lug 1 (S-1).

( ) Brown wire to lug 2 (S-1).

( ) Red wire to lug 3 (S-1).

R884/R885/SW706:

NOTE: When you install the next two wires, use the small bare wire. The lengths you need are very short, so it will be easier to work with the entire length and insert the wire through one lug to the other, then cut off the extra length after you solder the connection.

Refer to the inset drawing for the next two steps.

( ) Bare wire from lug 6 (NS) to lug 3 (S-1).

( ) Bare wire from lug 4 (NS) to lug 1 (S-1).

Connect the remaining wires from the flat cable in the following steps.

( ) White wire to lug 2 (S-1).

( ) Violet wire to lug 6 (S-2).

( ) Gray wire to lug 5 (S-1).

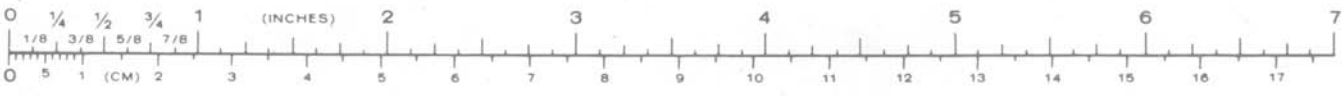
( ) Blue wire to lug 4 (S-2).

( ) Brown wire to lug 8 (S-1).

( ) Black wire to lug 7 (S-1).

( ) R993: Cut both leads of a 100 Ω (brn-blk-brn) resistor to 1/2". Insert one lead into the circuit board at R993. Connect the top lead to switch SW702/R728 wafer A, lug 9 (S-1). Then solder the bottom lead to the underside foil and cut off the excess lead length.

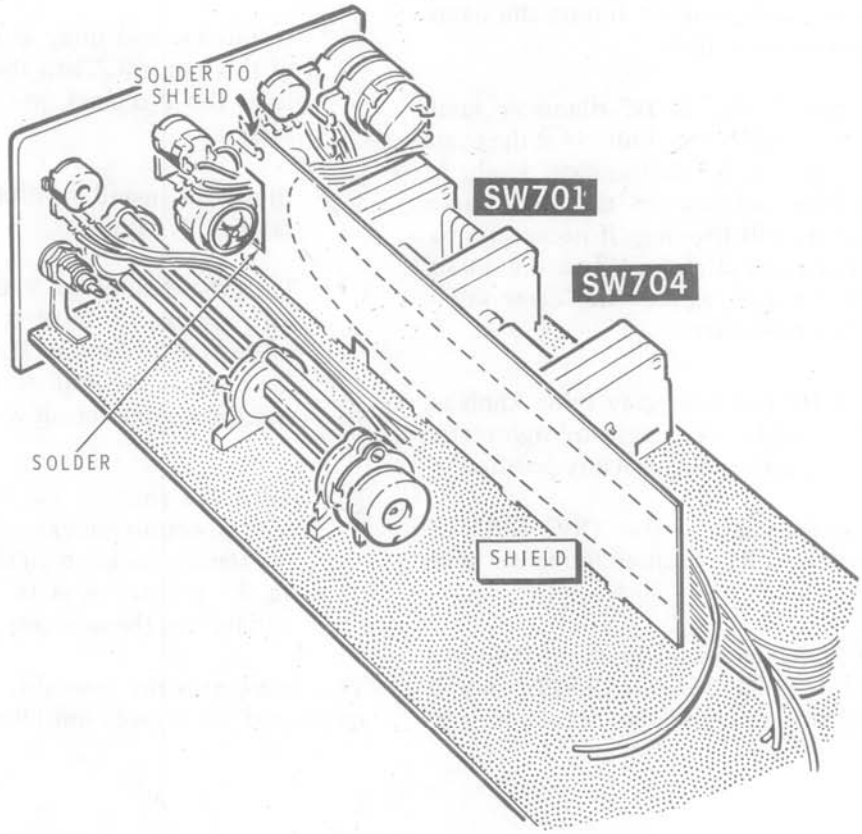
( ) R992: Cut both leads of a 10 Ω, 1% (brn-blk-blk-gld) resistor to 5/8". Insert one lead into the circuit board at R992. Connect the top lead to the center conductor of J701 (S-1). Then solder the bottom lead to the underside foil and cut off the excess lead length.



Refer to Pictorial 6-32 for the following steps.

( ) Position the shield so the cutout is toward the front as shown. Then insert the five tabs into the circuit board holes near switches SW701 and SW704. Be sure to route the large flat cable and two shielded cables on the right side of the shield. The control solder lug should be on the left side of the shield. Turn the board over and solder the four tabs to the foil. Then solder the control solder lug to the shield, and the first shield tab to the component side of the board.

This completes the circuit board assembly. The knobs will be installed next.




**PICTORIAL 6-32**

## KNOB INSTALLATION

Refer to Pictorial 6-33 for the following steps.

( ) Start 4-40 setscrews into both red inlay knobs.

( ) Start 6-32 setscrews into all of the remaining knobs. The clear knob and the 29/32" diameter knob will take two setscrews each.

NOTE: In the following steps, space the knobs just far enough from the panels so they do not rub.

( ) Install the clear knob on the outer shaft of the A and B TIME/CM switch. Tighten one setscrew and turn the knob fully counterclockwise. Then loosen the setscrew, line up the pointer with number 100 on the panel and tighten both setscrews.

( ) Similarly, mount the 29/32" diameter knob over the clear knob so its pointer is at the same position as the pointer on the clear knob. At this point, the notches on the two knobs should align and fit together. If necessary, rotate the outer knob slightly. When the 29/32" knob is all the way against the clear knob, tighten its two setscrews.

( ) Install the 9/16" diameter gray inlay knob on the DELAY TIME POS control, and tighten the setscrew. The pointer can be at any position.

( ) Turn the inner shaft of the TRIG SELECT/LEVEL switch fully counterclockwise with your fingers.

( ) Install the 23/32" diameter knob on the outer shaft of the TRIG SELECT/LEVEL switch. Tighten the setscrew and turn the knob fully counterclockwise. Then loosen the setscrew, line up the pointer with positive (+) mark in the LINE position, and tighten the setscrew.

( ) Install a red inlay knob on the inner shaft of the TRIG SELECT/LEVEL switch. Turn the knob so the pointer is at the 7 o'clock position, and tighten the setscrew.

( ) Turn the inner and outer shafts of the HORIZ POS control fully counterclockwise with your fingers.

( ) Install the 19/32" knob on the outer shaft of this control. Turn the knob so the pointer is at the 7 o'clock position, and tighten the setscrew.

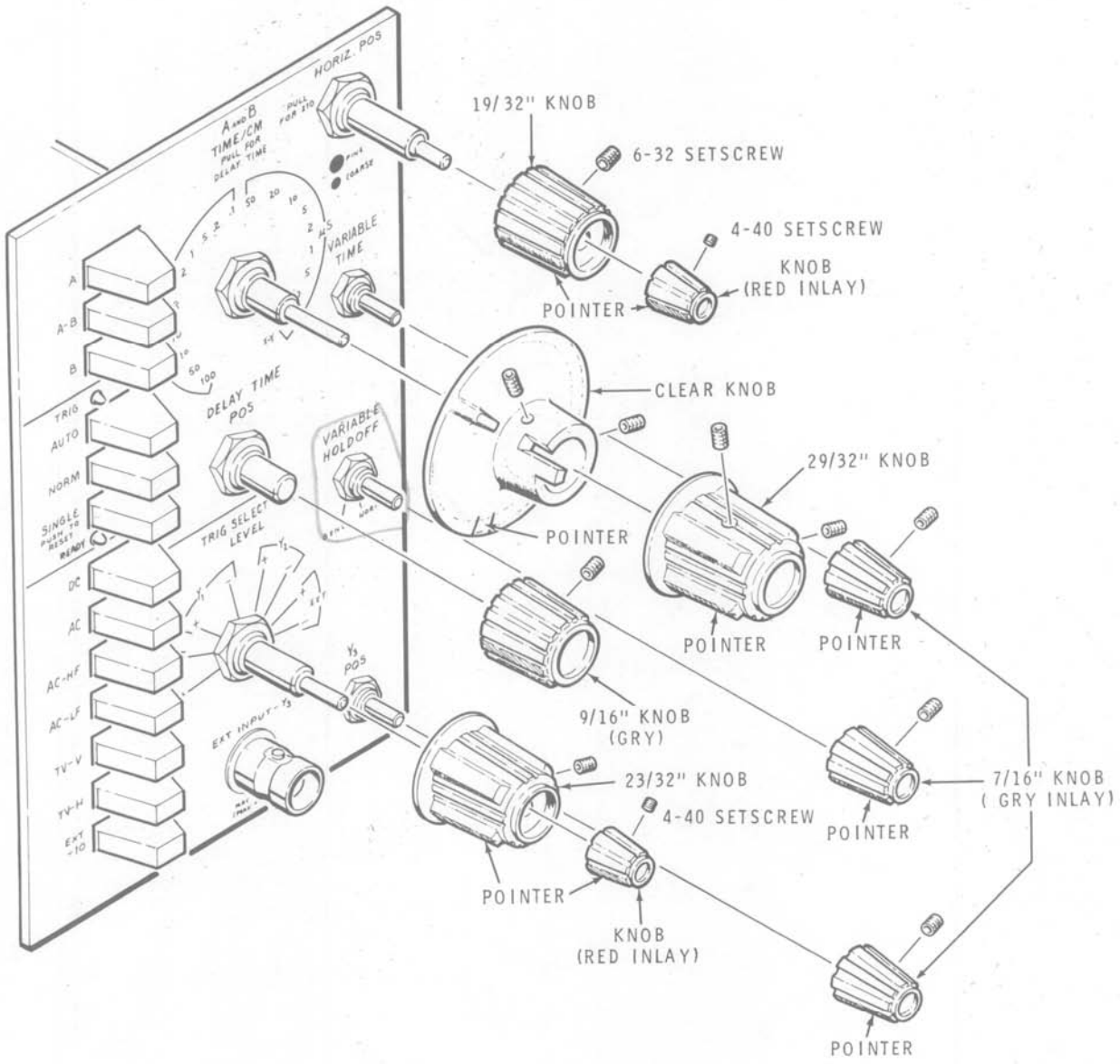
( ) Install the red inlay knob on the inner shaft of this control. Turn the knob so the pointer is at the 7 o'clock position, and tighten the setscrew.

( ) Similarly install another gray inlay knob on control $Y_3$ POS.

( ) Turn the shaft of the VARIABLE TIME control fully clockwise until it clicks. Install a gray inlay 7/16" diameter knob on the shaft, turn the knob so the pointer is at the CAL position, and tighten the setscrew.

( ) Turn the shaft of the VARIABLE HOLDOFF control counterclockwise until it clicks. Install the remaining knob on the shaft, turn the knob so the pointer is at the B ENDS A position, and tighten the setscrew.

This completes the assembly of the horizontal circuit board. Set it aside until it is called for.




**PICTORIAL 6-33**

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# CHASSIS

## PARTS LIST

Unpack the remainder of the kit. Then check each part against the following list. The key numbers correspond to the numbers on the "Chassis Parts Pictorial" (Illustration Booklet, Pages 23 through 25).

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

### ELECTRONIC COMPONENTS

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| A1 | 6-104-12 | 1 | 100 kΩ, 1/4-watt (brn-blk-yel) resistor | R1 |
| A2 | 2-17 | 1 | 10 MΩ, 1/2-watt, 1% resistor | Test |
| A3 | 21-72 | 2 | .005 μF (5000 pF) ceramic capacitor | C1, C2 |
| A4 | 41-9 | 1 | Delay line | L2 |
| A5 | 54-1028 | 1 | Power transformer | T1 |
| A6 | 411-870 | 1 | D14651P31 CRT | V1 |

NOTE: Transistors may be marked for identification in any one of the following four ways:

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

| | | | | |
|---|---|---|---|---|
| A7 | 417-195 | 2 | MJE340 transistor | Q201, Q202 |
| A8 | 421-23 | 1 | 1-ampere slow-blow fuse | F1 |
| A9 | 422-1 | 1 | Fuseholder | |
| 56-45 | | 1 | 1N4747A Diode | D1 |

### CONTROLS-SWITCHES

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION | CIRCUIT Comp. No. |
|---|---|---|---|---|
| B1 | 10-1188 | 1 | 7.5 MΩ control | R365 |
| B2 | 19-751 | 1 | 1000 Ω (1K) control w/switch | R364/SW1 |
| B3 | 60-54 | 1 | 120/240 slide switch | SW2 |
| B4 | 60-608 | 1 | NOR/LOW slide switch | SW3 |

### HARDWARE

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

#### #4 Hardware

| | | | |
|---|---|---|---|
| C1 | 250-1410 | 4 | 4-40 × 1/4" flat head screw |
| C2 | 250-1414 | 43 | 4-40 × 1/4" screw |
| C3 | 250-1450 | 3 | 4-40 × 5/16" flat head screw |
| C4 | 250-1415 | 2 | 4-40 × 3/8" screw |
| C5 | 252-2 | 2 | 4-40 nut |
| C6 | 254-9 | 2 | #4 lockwasher |

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION |
|---|---|---|---|

## #6 Hardware

| | | | |
|---|---|---|---|
| D1 | 250-1282 | 2 | 6-32 × 1/8" allen setscrew |
| D2 | 250-70 | 4 | 6-32 × 3/16" flat head screw |
| D3 | 250-1174 | 2 | 6-32 × 3/16" screw |
| D4 | 250-1325 | 31 | 6-32 × 1/4" black screw |
| D5 | 250-1422 | 12 | 6-32 × 1/4" flat head screw |
| D6 | 250-1419 | 1 | 6-32 × 1/4" black flat head screw |
| D7 | 250-1280 | 1 | 6-32 × 3/8" screw |
| D8 | 250-1430 | 4 | 6-32 × 1/2" screw |
| D9 | 250-1322 | 1 | #6 × 5/8" self-tapping screw |
| D10 | 250-406 | 6 | 6-32 × 5/8" flat head screw |
| D11 | 250-1427 | 1 | 6-32 × 1" screw |
| D12 | 252-3 | 19 | 6-32 nut |
| D13 | 254-1 | 20 | #6 lockwasher |
| D14 | 259-1 | 3 | #6 solder lug |
| D15 | 259-29 | 2 | #6 long lug |

## Other Hardware

| | | | |
|---|---|---|---|
| E1 | 250-329 | 2 | 8-32 × 5/8" screw |
| E2 | 250-1278 | 4 | #10 × 7/8" self-tapping screw |
| E3 | 252-4 | 4 | 8-32 nut |
| E4 | 252-7 | 2 | Control nut |
| E5 | 253-9 | 4 | #8 flat washer (3/8" dia.) |
| E6 | 253-45 | 2 | #8 flat washer (1/2" dia.) |
| E7 | 254-2 | 6 | #8 lockwasher |
| E8 | 254-14 | 1 | 1/4" lockwasher |
| E9 | 259-27 | 1 | BNC solder lug |

## SPACERS

| | | | |
|---|---|---|---|
| F1 | 255-74 | 2 | 1/16" thick spacer |
| F2 | 255-49 | 6 | 5/16" spacer |
| F3 | 255-809 | 1 | 1/2" spacer |
| F4 | 255-746 | 4 | 6-32 × 5/8" hex spacer |

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION |
|---|---|---|---|

## METAL PARTS

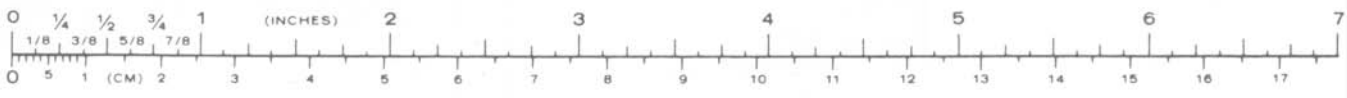
| | | | |
|---|---|---|---|
| G1 | 90-1287-1 | 1 | Cabinet top |
| G2 | 90-1284-1 | 1 | Cabinet bottom |
| G3 | 203-2118-1 | 1 | Rear panel |
| G4 | 203-2121 | 1 | Control panel |
| G5 | 210-132-1 | 1 | Front bezel |

NOTE: The following four parts appear to be nearly identical; they are not. Clearly mark each piece at this time to save some possible confusion later.

| | | | |
|---|---|---|---|
| G6 | 204-2833 | 1 | Upper left strut |
| G7 | 204-2834 | 1 | Lower left strut |
| G8 | 204-2835 | 1 | Upper right strut |
| G9 | 204-2836 | 1 | Lower right strut |
| G10 | 204-2764 | 1 | CRT rear bracket |
| G11 | 204-2609 | 1 | CRT left pivot bracket |
| G12 | 204-2646 | 1 | CRT right pivot bracket |
| G13 | 205-1886 | 2 | Circuit board mounting bracket |
| G14 | 205-1887 | 3 | Compartment cover |
| G15 | 205-1908-1 | 1 | Cabinet cover plate |
| G16 | 205-1909 | 1 | Cabinet sub cover |
| G17 | 205-1911-1 | 1 | Preamplifier cover |
| G18 | 206-1417 | 1 | High-voltage enclosure |
| G19 | 206-1428 | 1 | CRT shield |
| G20 | 206-1451 | 1 | Preamplifier top cover |
| G21 | 206-1452 | 1 | Preamplifier bottom cover |
| G22 | 211-92 | 1 | Handle |
| G23 | 266-807 | 2 | Handle detent |

## PLASTIC AND RUBBER PARTS

| | | | |
|---|---|---|---|
| H1 | 73-34 | 2 | Alligator clip insulator |
| H2 | 73-59 | 1 | Grommet |
| H3 | 73-188 | 1 | CRT cushion strip |
| H4 | 75-139 | 2 | Transistor insulator |
| H5 | 75-785 | 2 | Switch cover |
| H6 | 75-754 | 1 | Line cord strain relief |
| H7 | 75-837 | 1 | Side rail insulator |
| H8 | 211-67 | 1 | Handle top grip |
| H9 | 211-68 | 1 | Handle bottom grip |
| H10 | 261-9 | 4 | Foot |
| | 305-67 | 4 | Cord retainer set, consisting of: |
| *H11* | *261-51* | *1* | *Cord retainer* |
| *H12* | *261-52* | *1* | *Cord retainer base* |
| H13 | 414-41 | 1 | Blue filter |



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| KEY No. | HEATH Part No. | QTY. | DESCRIPTION |
|---|---|---|---|

## CONNECTORS

| | | | |
|---|---|---|---|
| J1 | 432-120 | 7 | Female terminal |
| J2 | 432-148 | 2 | 3-hole white socket |
| J3 | 432-149 | 2 | 3-hole plug w/ears |
| J4 | 432-753 | 15 | Large spring connector (1 extra) |
| J5 | 432-758 | 1 | BNC connector with hardware |
| J6 | 432-803 | 2 | Large 3-hole socket |
| J7 | 432-817 | 1 | 4-hole square plug |
| J8 | 432-821 | 1 | Large 6-hole socket |
| J9 | 432-854 | 4 | Male connector pin |
| J10 | 432-855 | 7 | Female connector pin |
| J11 | 432-866 | 8 | Small spring connector |
| J12 | 432-954 | 1 | 4-hole socket |

| KEY No. | HEATH Part No. | QTY. | DESCRIPTION |
|---|---|---|---|

## CONNECTORS (Cont'd.)

| | | | |
|---|---|---|---|
| J13 | 432-970 | 2 | Small 5-hole socket |
| J14 | 438-55 | 2 | Polarizing plug |
| J15 | 436-38 | 1 | Banana jack |

## MISCELLANEOUS

| | | | |
|---|---|---|---|
| | 89-54 | 1 | Line cord |
| | 134-237 | 1 | BNC cable assembly |
| K1 | 258-192 | 2 | Coil spring |
| K2 | 260-16 | 2 | Alligator clip |
| K3 | 350-12 | 1 | Glue |
| K4 | 434-375 | 1 | CRT socket |
| K5 | 462-908 | 2 | Detent cover |
| K6 | 462-1107 | 2 | Control knob |
| K7 | 490-71 | 1 | Alignment tool |

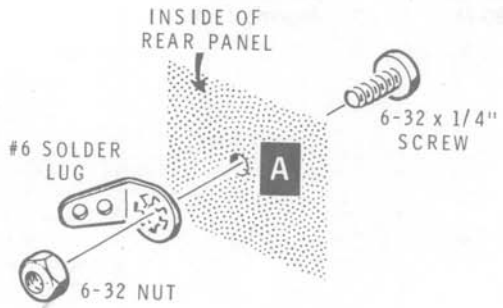
# STEP-BY-STEP ASSEMBLY

## REAR PANEL ASSEMBLY

Refer to Pictorial 7-1 (Illustration Booklet, Page 26) for the following steps.

( ) Position the rear panel on your work area as shown.

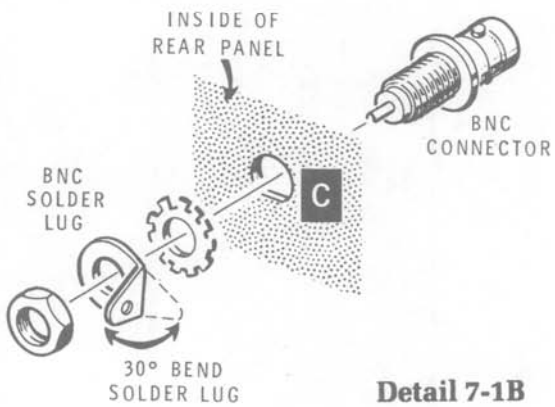
( ) Refer to Detail 7-1A and mount a #6 solder lug on the rear panel at A as shown. Use a 6-32 × 1/4" screw and a 6-32 nut. Position the solder lug as shown in the Pictorial.




**Detail 7-1A**

( ) In the same manner, install another #6 solder lug on the rear panel at B.

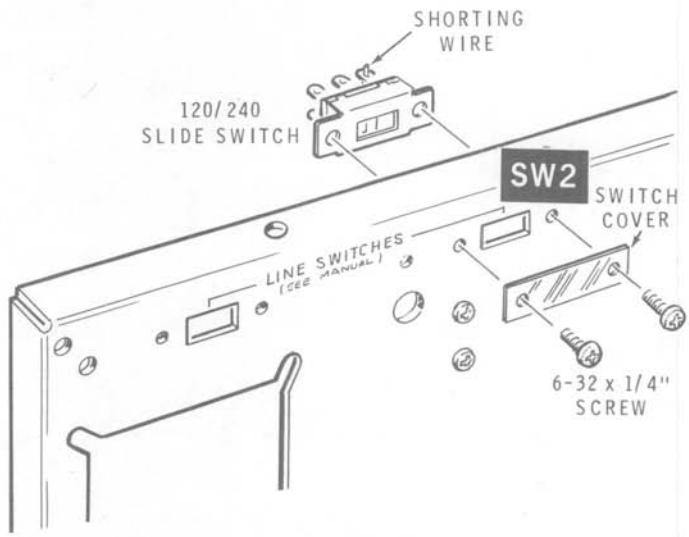
( ) Refer to Detail 7-1B and mount a BNC connector on the rear panel at C in the manner shown. Use the hardware supplied with the connector and a BNC solder lug. Bend the end of the solder lug upward approximately 30 degrees as shown. Position the solder lug as shown in the Pictorial.




**Detail 7-1B**

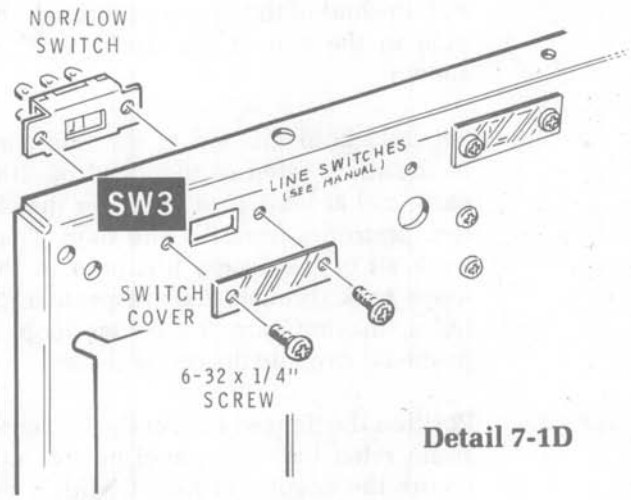
( ) Locate the 120/240 slide switch. If necessary, use the tip of a screwdriver and set the switch slide to expose the numbering for the voltage in your area. If you are going to use 120-volts AC, set the switch slide to expose the "120" as shown in the inset drawing on the Pictorial.

( ) SW2: Refer to Detail 7-1C and mount the 120/240 slide switch and a switch cover on the rear panel at SW2 with two 6-32 × 1/4" screws. Be sure to mount the switch so the shorting wire is positioned as shown in the Pictorial. NOTE: Push out the cover holes to clear them if necessary.

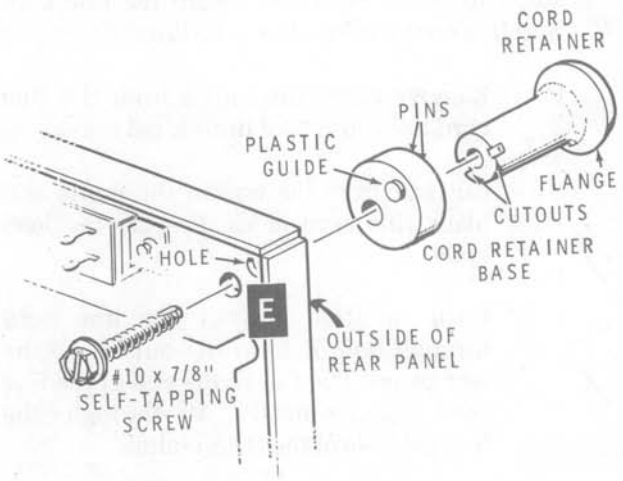



**Detail 7-1C**

( ) If the line voltage in your area is normally less than 115-volts AC (or less than 230-volts AC for 240-volt service), set the NOR/LOW slide switch to "LOW". If your voltage is higher than 115 VAC (or 230 VAC) set the switch so the lettering "NOR" (normal) is exposed.




**Detail 7-1D**




**Detail 7-1E**

( ) SW3: Refer to Detail 7-1D and, in the same manner as with switch SW2, mount the NOR/LOW switch and a switch cover on the rear panel at SW3. Position the "NOR" on the switch to the side nearer the center of the panel.

( ) Refer to Detail 7-1E and mount a cord retainer on the outside of the rear panel at E as follows:

1. Hold the cord retainer base against the outside of the rear panel so the plastic guide is in the hole as shown in the Detail.

2. Align the pins on the cord retainer base with the cutouts in the cord retainer. Then hold the cord retainer and base together. Be sure the flange on the end of the cord retainer is toward the corner of the panel.

3. Use a #10 × 7/8" self-tapping screw to secure the cord retainer to the rear panel.

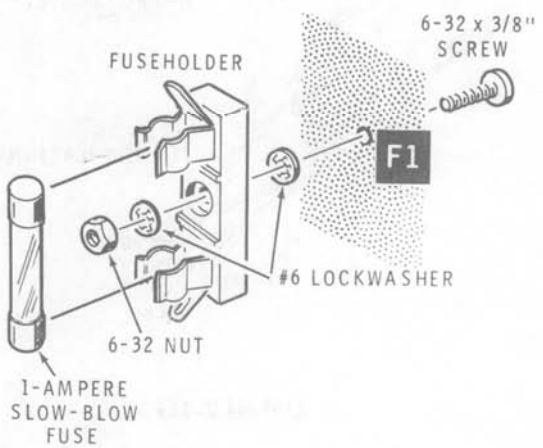
( ) In the same manner, mount cord retainers on the outside of the rear panel at F, G, and H.

NOTE: When hardware is called for in a step, only the screw size will be given. For instance, if 6-32 × 3/8" hardware is called for, use a 6-32 × 3/8" screw, one or more #6 lockwashers, and a 6-32 nut. The Pictorial or Detail will show the number of lockwashers to use.

( ) Refer to Detail 7-1F and mount the fuseholder onto the rear panel at F1 using 6-32 × 3/8" hardware. Position the fuseholder as shown in the Pictorial.

( ) F1: Push a 1-ampere, slow-blow fuse into the fuseholder clips. IMPORTANT: If your line voltage is nominally 240 VAC, use a 3AG 1/2-ampere, slow-blow fuse (not supplied).

( ) On the fuse label write "1-ampere, slow-blow" in the space provided ("1/2-ampere, slow blow," if 240 VAC). Remove the paper backing from the label and press the label in place on the inside of the rear panel at the location shown.




**Detail 7-1F**

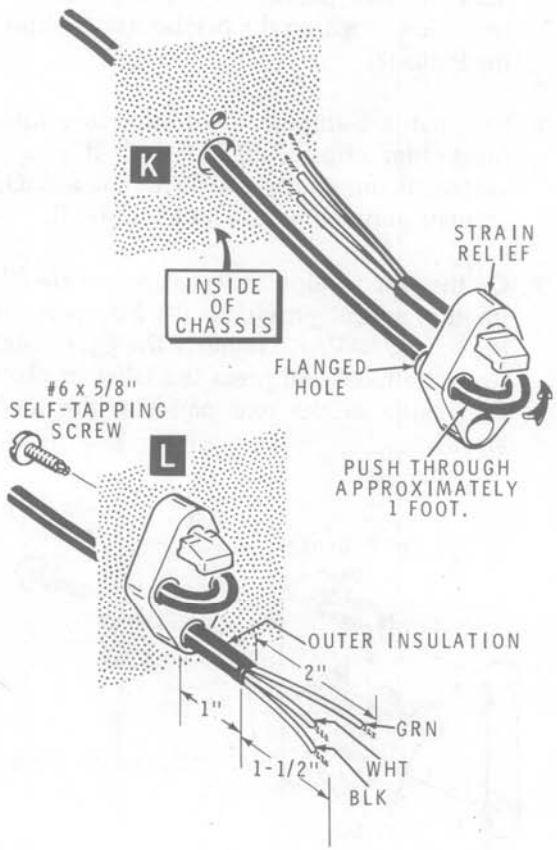
( ) Refer to Detail 7-1G and install the line cord and line cord strain relief as follows:

1. Remove outer insulation from the line cord to expose 2″ of individual wires.

2. Cut 1/2″ from the end of the white and black line cord leads. Prepare the lead ends.

3. Push the free end of the line cord through hole K from the outside of the rear panel. Then push the end of the line cord approximately 1′ through the flanged hole of the strain relief.

4. Loop the line cord over and through the other hole in the center of the strain relief.




**Detail 7-1G**

5. Pull the end of the line cord through the hole in the end of the strain relief as shown.

6. Securely hold the end of the line cord in the strain relief so that 3″ of the line cord, and at least 1″ of the outer insulation protrudes from the end hole. Then work all of the excess line cord in the loops back through their respective (2) holes, making sure the center loop is pushed down into the center recess.

7. Position the flanged hole of the line cord strain relief into rear panel hole K and secure the adapter at hole L with a #6 × 5/8″ self-tapping screw.

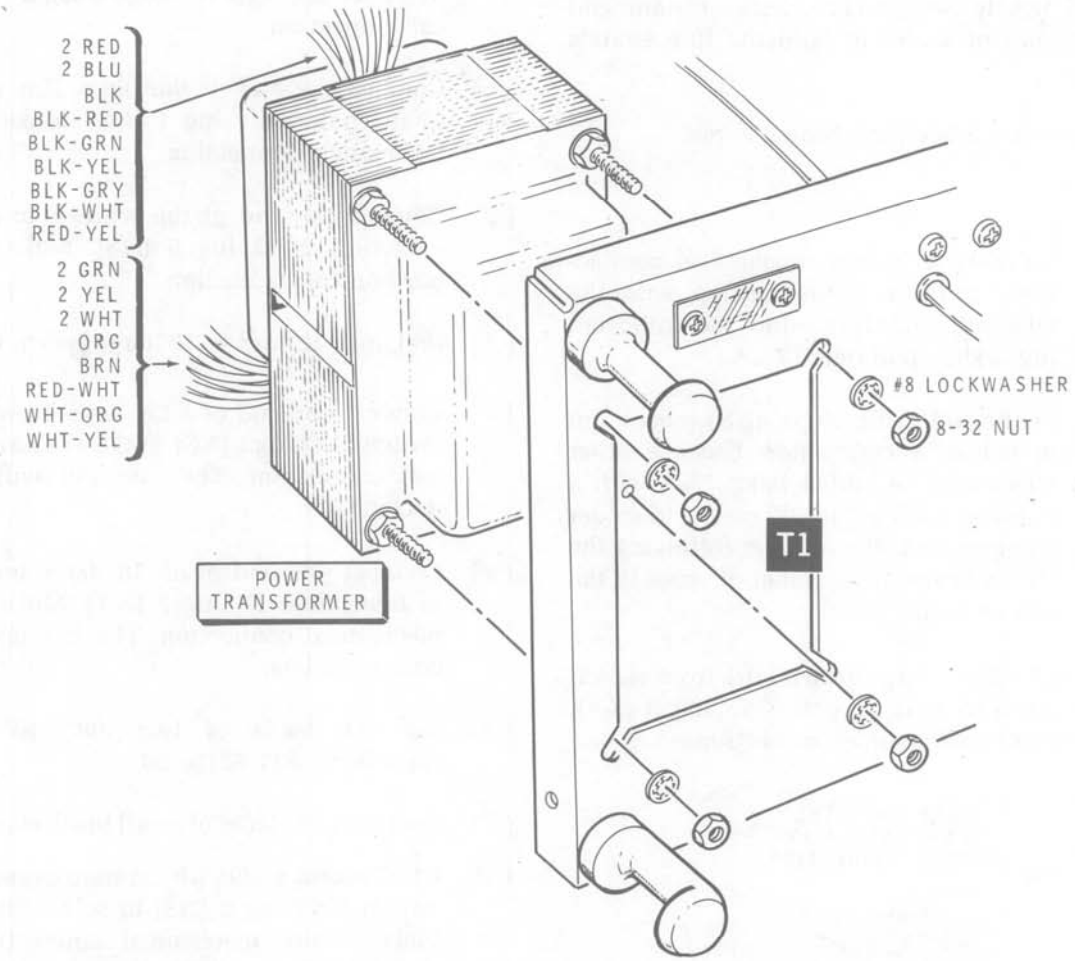
IMPORTANT:

The plug on the power cord for this kit is for standard 120 VAC outlets. For 240 VAC operation in the U.S.A., cut off and replace this plug with a permanent plug that matches your 240 VAC receptacle in a manner such that your power connection conforms with section 210-21 (b) of the National Electric code, which reads, in part:

> "Receptacle connected to circuits having different voltage, frequencies, or types of current (AC or DC) on the same premises shall be of such design that attachment plugs used on such circuits are not interchangeable."

When you install the new plug, make sure it is connected according to your local electrical code. Keep in mind that the green line cord wire is connected to the Oscilloscope chassis.

( ) T1: Refer to Detail 7-1H and secure the power transformer to the rear panel at T1 with four #8 lockwashers and four 8-32 nuts as shown. Be sure to position the transformer leads as shown in the Pictorial.




**Detail 7-1H**

## REAR PANEL WIRING

Refer to Pictorial 7-2 (Illustration Booklet, Page 27) for the following steps.

( ) Position the rear panel as shown.

NOTE: To prepare a wire, as in the following step, cut the wire to the length indicated; then remove 1/4" of insulation from each wire end. If the wire is stranded, tightly twist the bare wire ends and add a small amount of solder to hold the fine strands together.

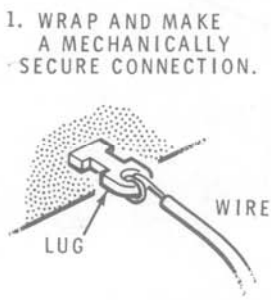
( ) Prepare two 3-3/4" large brown wires.

NOTES:

1. To make a "secure mechanical connection," as in the following step, wrap the wire end tightly around the indicated lug as shown in Detail 7-2A.

2. In the following steps, (NS) means not to solder a connection because other wires will be added later. "S-" with a number, such as "(S-2)" means to solder a connection; the number following the "S" indicates the number of wires in the connection.

( ) Connect a 3-3/4" large brown wire from switch SW2 lug 5 (S-1) to switch SW3 lug 5 (S-1). Make secure mechanical connections.




**Detail 7-2A**

( ) Connect a 3-3/4" large brown wire from switch SW2 lug 2 (S-1) to switch SW3 lug 2 (S-1). Make secure mechanical connections.

( ) Tightly twist the ends of the line cord and add a small amount of solder to each end to hold the fine strands together. Cut each bare wire end to 1/4".

( ) Connect the end of the green line cord lead to solder lug A (S-1). Make a secure mechanical connection.

( ) Connect the end of the black line cord lead to fuseholder F1 lug 1 (NS). Make a secure mechanical connection.

( ) Connect the end of the white line cord lead to switch SW2 lug 6 (NS). Make a secure mechanical connection.

( ) Prepare a 22" and an 18" large brown wire.

( ) Connect one end of a 22" large brown wire to switch SW2 lug 1 (NS). Make a secure mechanical connection. The free end will be connected later.

( ) Connect one end of an 18" large brown wire to fuseholder F1 lug 2 (S-1). Make a secure mechanical connection. The free end will be connected later.

( ) Cut the leads of two .005 μF ceramic capacitors (#21-72) to 3/4".

( ) Cut two 1/2" pieces of small black sleeving.

( ) C1: Connect a .005 μF ceramic capacitor from switch SW2 lug 6 (NS) to solder lug B (NS). Make secure mechanical connections. Use 1/2"of sleeving on the indicated lead.

( ) C2: Connect a .005 μF ceramic capacitor from solder lug B (S-2) to fuseholder F1 lug 1 (S-2). Make secure mechanical connections. Use 1/2" of sleeving on the indicated lead.

( ) Carefully check to make sure that none of the four capacitor leads are touching any other lugs or connections. Move a lead slightly if necessary.

Refer to Pictorial 7-3 (Illustration Booklet, Page 28) for the following steps.

Connect the free ends of the transformer leads in the following steps. As you connect each wire, make a secure mechanical connection.

( ) Black-green lead to switch SW3 lug 6 (S-1).

( ) Black-yellow lead to switch SW3 lug 1 (S-1).

( ) White-black lead to switch SW3 lug 4 (S-1).

( ) Gray-black lead to switch SW3 lug 3 (S-1).

( ) Black-red lead to SW2 lug 1 (S-2).

( ) Black lead to SW2 lug 6 (S-3).

( ) Position all of the connected transformer leads inside the rear panel flange as shown in the Pictorial.

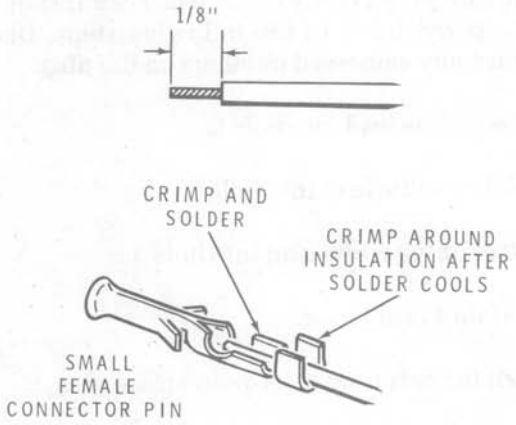
( ) Route the large brown wire coming from SW2 lug 1 between the line cord strain relief and the inner side of the power transformer as shown. Then twist this wire with the brown wire coming from fuseholder F1 lug 2, approximately one turn per inch, for their entire lengths.

( ) Cut the longer twisted brown wire to the same length as the other brown wire. Remove 1/4" of insulation from the end of the cut wire; then cut the bare ends of both wires to 1/8".

( ) Refer to Detail 7-3A and crimp and solder a female connector pin onto the ends of each of the twisted brown wires in the manner shown.

( ) Refer to the Pictorial and push the connector on the end of either brown wire into hole 1 of a 3-hole plug (with ears) as shown. Tug on the wire to make sure the pin is firmly latched in the plug.

( ) In the same manner, push the connector pin on the other brown wire into plug hole 3.




**Detail 7-3A**

( ) Cut the two ears from the 3-hole plug. The plug will be connected later.

( ) In the same manner, prepare the two green transformer leads. Then crimp and solder female connector pins onto the ends of both leads.

( ) As in a previous step, install the green-wire connectors into holes 1 and 3 of a 3-hole plug (with ears). Twist the green leads together along their lengths; the plug will be connected later. NOTE: These connectors may fit tightly; reform the connectors slightly with pliers if necessary.

( ) Cut the ears from the plug.

( ) Cut the bare wire ends of all of the remaining transformer leads to 1/8".

( ) Along their insulated lengths, twist together the two white and the red-white transformer leads.

( ) Crimp and solder a female connector pin onto the end of each of these leads. NOTE: Cut the longer tab ends from each connector; then crimp the four tabs down onto the **bare** wire ends (not around the insulation).

( ) Refer to Pictorial 7-3 and position a 4-hole square plug exactly as shown. Then install the prepared leads in the following steps. **Disregard any embossed numbers on the plug.**

( ) Red-white lead into hole 2.

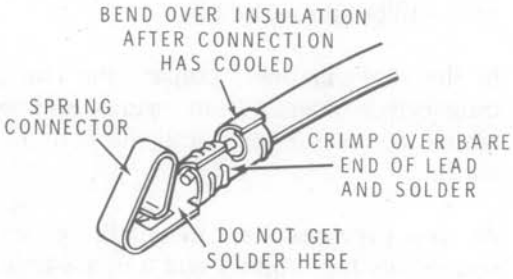
( ) Either white lead into hole 1.

( ) Remaining white lead into hole 3.

NOTE: Hole 4 is not used.

( ) Cut the ears from the 4-hole square plug.

( ) Along their insulated lengths, twist together the brown, orange and white-orange transformer leads. Then crimp and solder a large spring connector onto the end of each of the three leads as shown in Detail 7-3B.




**Detail 7-3B**

( ) Push the spring connector on the end of the brown lead into hole 1 of a 4-hole socket. Make sure the latching tab on the connector is upward as shown in the Pictorial. Tug on the lead to make sure the connector is latched in the socket.

( ) In the same manner, install the connector on the end of the white-orange lead into socket hole 2.

( ) In the same manner, install the connector on the end of the orange lead into socket hole 3.

( ) Along their insulated lengths, twist together the two yellow and the white-yellow transformer leads. As in the previous steps, crimp and solder a large spring connector onto the end of each of these three leads.

Push the yellow and white-yellow leads into a 3-hole socket as follows:

( ) Either yellow into hole 1.

( ) White-yellow into hole 2.

( ) Remaining yellow into hole 3.

( ) Twist together the two red, the two blue, and the red-yellow transformer leads.

( ) As in a previous step, crimp and solder large spring connectors onto the ends of the five leads.

Push the connectors on the ends of the five leads into a large 6-hole socket as follows:

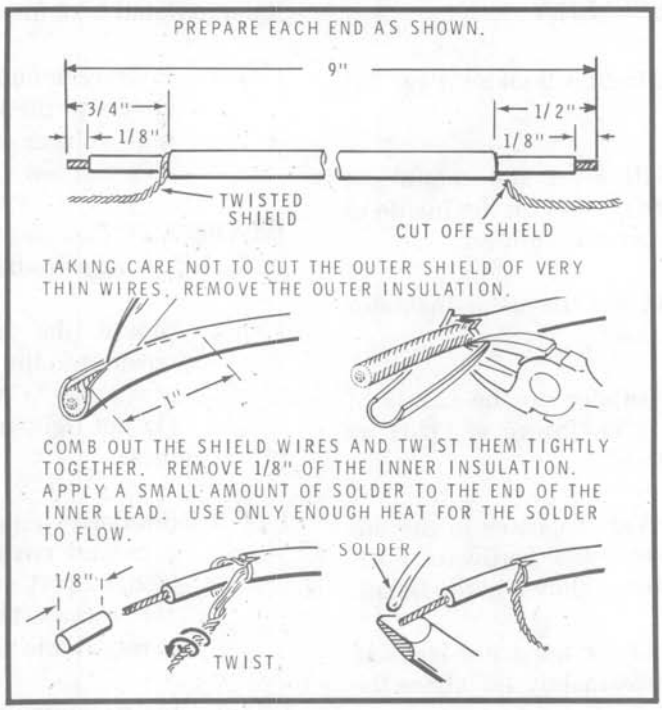
( ) Push the connector on one of the blue leads into socket hole 2. Tug on the lead to make sure the connector is latched.

( ) Install the other blue lead into socket hole 3.

( ) Either red lead into socket hole 4.

( ) The other red lead into socket hole 5.

( ) The red-yellow lead into hole 6.




**Detail 7-3C**

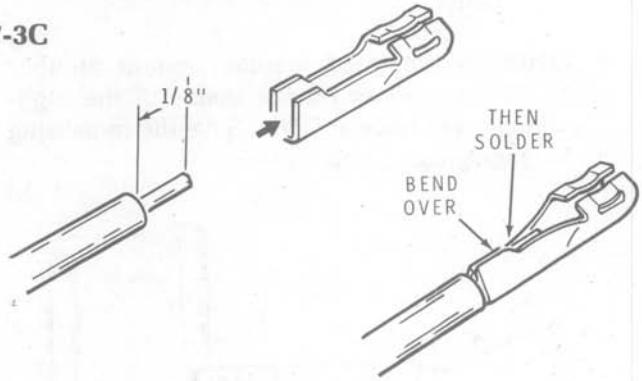
( ) Refer to Detail 7-3C and cut and prepare 9" RG-174/u (braid) shielded cable in the manner shown.

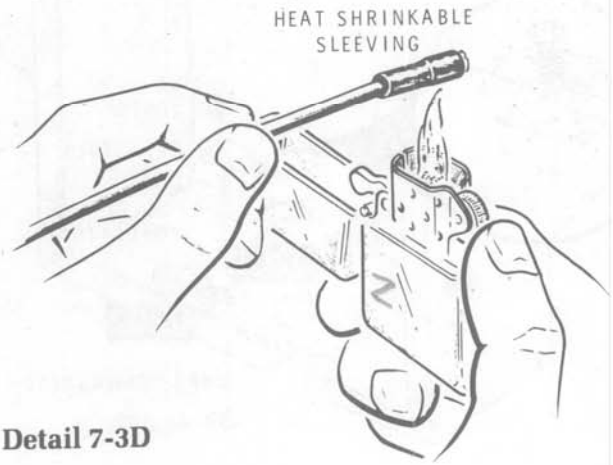
( ) Refer to Detail 7-3D and, on the end of the cable without a shield lead, crimp and solder a female terminal onto the end of the inner lead in the manner shown.

( ) Cut a 3/4" piece of small heat-shrinkable sleeving. Push the sleeving all the way up onto the terminal. Then heat the sleeving evenly, using a match or some similar source of heat until the sleeving is snug around the connector.

( ) On the other end of the shielded cable, connect the inner lead to the center conductor of BNC connector C (S-1). Connect the shield lead to the BNC solder lug (S-1).

This completes the rear panel wiring. Carefully check all the connections to make sure they are well soldered.




**Detail 7-3D**

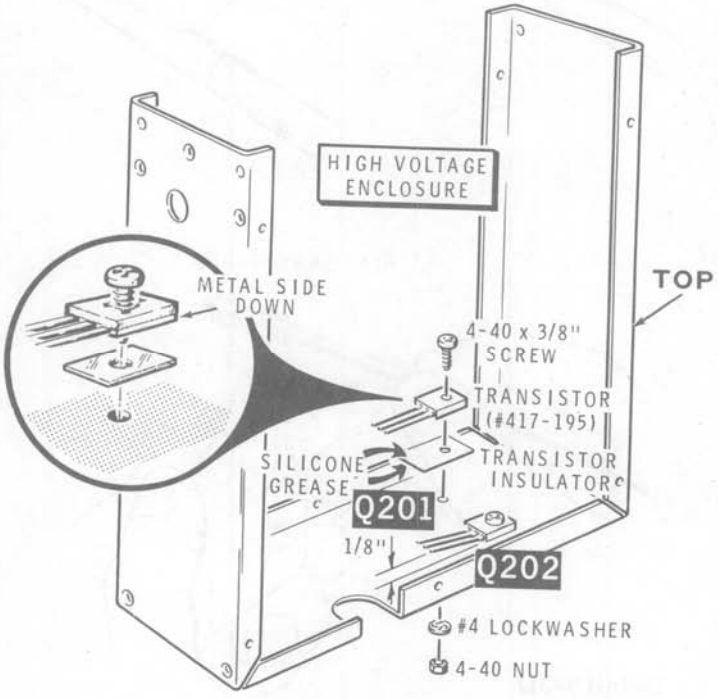
## FRAME AND BEZEL ASSEMBLY

Refer to Pictorial 8-1 (Illustration Booklet, Page 29) for the following steps.

( ) Q201: Refer to Detail 8-1A and mount an MJE340 transistor (#417-195) on the inside of the high-voltage enclosure as follows:

1. Coat both sides of a transistor insulator with silicone grease.
2. Position the insulator on the inside of the high-voltage enclosure at Q201 as shown in the Detail.
3. Secure an MJE340 transistor to the enclosure with 4-40 × 3/8″ hardware. Position the transistor as shown in the Detail.
4. Raise the ends of the transistor leads so the tips are approximately 1/8″ above the panel.

( ) Q202: In the same manner, mount another MJE340 transistor on the inside of the high-voltage enclosure at Q202. Save the remaining silicone grease for use later.




**Detail 8-1A**

Refer to Detail 8-1B for the next three steps.

( ) 1. Loosely mount one of the compartment covers to the top center of the back of the high-voltage enclosure at AA with a 4-40 × 1/4″ screw.

IMPORTANT: Be sure to correctly identify each strut in the following steps before you proceed.

( ) 2. Mount the high-voltage enclosure and cover onto the upper left strut (#204-2610) at AB and AC with two 4-40 × 1/4″ screws. Do not tighten the screws securely at this time.

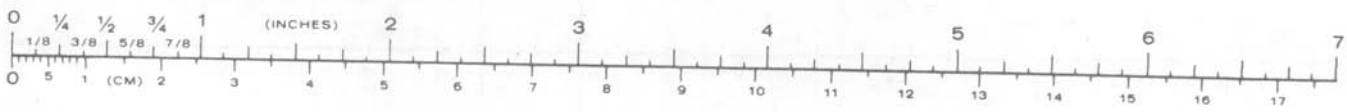
( ) 3. Similarly, mount the high-voltage enclosure and cover onto the lower left strut (#204-2611) at AD and AE with 4-40 × 1/4″ screws. Do not tighten the screws securely at this time.

( ) 1. Install a circuit board mounting bracket on the rear end of the lower left strut at BE, BF, and BG with three 5/16″ spacers and three sets of 6-32 × 5/8″ flat head hardware. NOTE: The bracket is symmetrical and may be mounted with either end toward the rear. See inset drawing #1.

( ) 2. Similarly, install another circuit board mounting bracket on the rear end of the lower right strut (#204-2613) at BH, BJ, and BK with three 5/16″ spacers, two #6 long lugs, and 6-32 × 5/8″ flat head hardware. Mount the #6 long lugs under the lockwashers at BH, and BJ as shown in Detail inset drawing #2.

( ) 3. Sharply bend solder lugs BH and BJ straight up toward the top of the unit. Then cut each solder lug to a length of 1″ as shown.

( ) Position the strut and enclosure assembly into the rear panel as shown in Pictorial 8-1.



CAUTION: In the following steps, you will install the struts and their attached components on the rear panel. To avoid bending or breaking any parts, handle the assembly carefully until you have secured all parts and tightened the hardware. Reposition the assembly as necessary by grasping the rear panel.

( ) Secure the upper and lower left struts to the rear panel flanges at J and K with two 6-32 × 1/4" flat head screws. Do not tighten the screws securely at this time.

( ) Secure the high-voltage enclosure to the top flange of the rear panel at L and N with 6-32 × 1/4" flat head hardware.

( ) In the same manner, secure the bottom of the high-voltage enclosure to the rear panel flange at P and R using 6-32 × 1/4" flat head hardware.

( ) Securely tighten all of the enclosure and strut mounting hardware.

( ) Secure the upper right strut (#204-2612) onto the top rear panel flange at S with a 6-32 × 1/4" flat head screw. NOTE: Reposition the wires as necessary.

( ) Similarly, secure the lower right strut to the bottom rear panel flange at T with a 6-32 × 1/4" flat head screw.

( ) Position the bezel onto the free ends of the four struts as shown. Then secure the bezel to the struts as follows:

1. At BA and BB on the lower bezel flange, secure the bezel to the two lower struts with 6-32 × 1/4" flat head hardware as shown in the Pictorial.

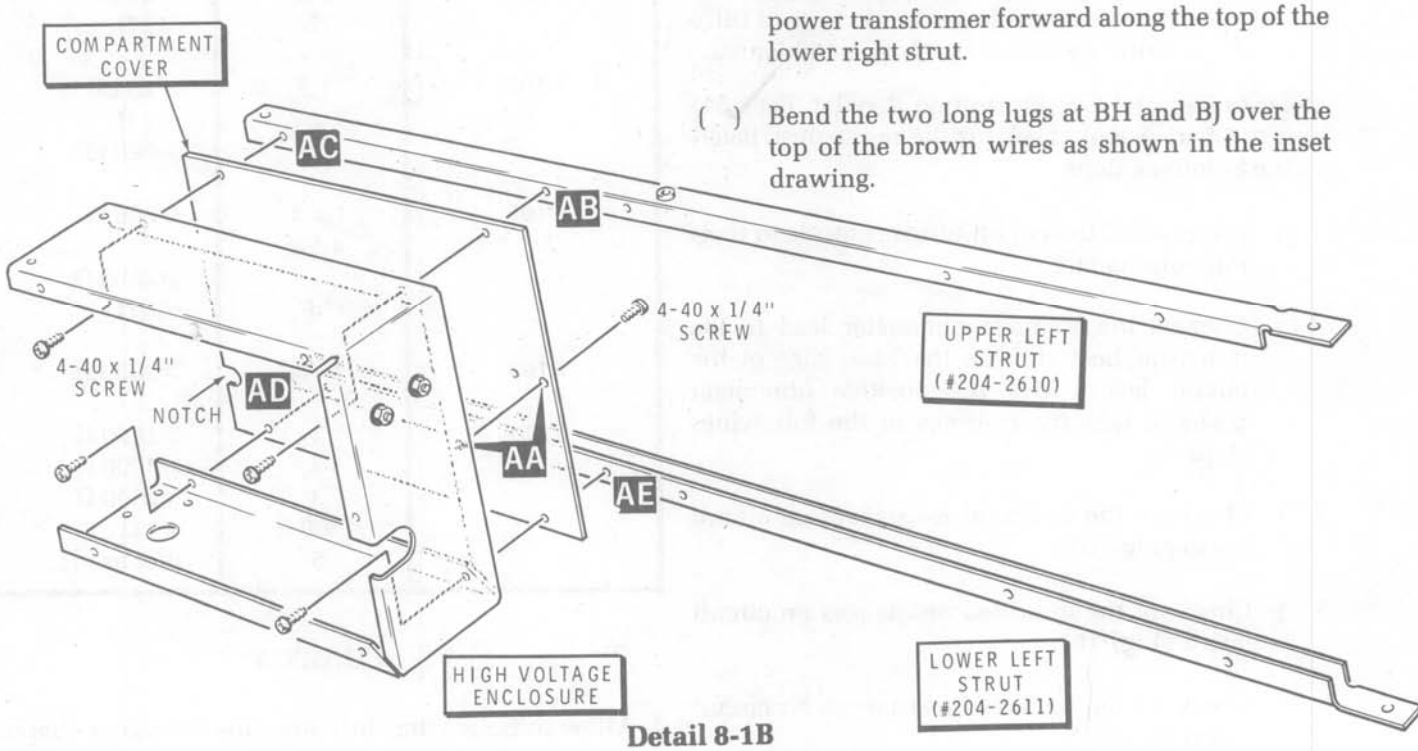
2. At BC, on the upper bezel flange, secure the bezel and the upper left strut with a 6-32 × 1/4" flat head screw and the CRT left pivot bracket (#204-2609). Position the bracket as shown in the Pictorial.

3. Similarly, secure the bezel and the upper right strut at BD with a 6-32 × 1/4" screw and the CRT right pivot bracket (#204-2646). Position the bracket as shown in the Pictorial.

Refer to Detail 8-1C (Illustration Booklet, Page 30) for the next two steps.

( ) Locate the two twisted brown wires with the 3-hole plug coming from the rear panel. Route the twisted wires from the lower corner of the power transformer forward along the top of the lower right strut.

( ) Bend the two long lugs at BH and BJ over the top of the brown wires as shown in the inset drawing.




**Detail 8-1B**

## LOW VOLTAGE ASSEMBLY

### Resistance Checks

NOTES:

1. In all of the of the following sections, when you are directed to make resistance measurements, set your ohmmeter to the most suitable range to include the indicated value. For Infinity and Zero readings, use the same meter range you would use for the measurement of 1000 ohms.

2. All resistances indicated in the charts were measured from a circuit board (foil) ground connection. Therefore, you should always connect the common lead of your meter to a convenient ground point on a ground lead or a ground foil. Measure with the positive meter probe to the points indicated in the charts.

3. If all of your resistance readings are significantly different, reverse the leads and try again.

4. If you fail to obtain any desired resistance reading, do NOT proceed until you have found and corrected any problem. If necessary, refer to the "In Case of Difficulty" section in the Operation Manual.

Refer to Pictorial 8-2 (Illustration Booklet, Page 31) and to Chart A and check for the resistances listed in the following steps.

( ) Preset all of the circuit board controls to their rotational centers.

( ) Connect the common ohmmeter lead to the transistor heat sink on the back edge of the circuit board. Use the positive ohmmeter probe to take the readings in the followings steps.

( ) Check for the indicated resistances on circuit board plug P101.

( ) Check for the indicated resistances on circuit board plug P102.

( ) Check for the indicated resistances on circuit board plug P103.

( ) Check for the indicated resistances on circuit board plug P104.

( ) Check for the indicated resistances on circuit board plug P105.

( ) Check for the indicated resistances on circuit board plug P106.

( ) Check for the indicated resistances on circuit board plug P111.

| PLUG OR SOCKET NO. | PIN NO. | RESISTANCE |
|---|---|---|
| P101 | 1 | <2Ω |
| | 2 | >6000 Ω |
| | 3 | >1800 Ω* |
| | 4 | >8000 Ω |
| | 5 | >200 kΩ |
| | 6 | >3000 Ω |
| | 7 | >2000 Ω |
| | 8 | >200 kΩ |
| | 9 | (not used) |
| | 10 | <2 Ω |
| P102 | 1 | <2 Ω |
| | 2-5 | >50 kΩ* |
| | 6 | <2 Ω |
| P103 | 1,3 | >20 kΩ* |
| | 2 | <2 Ω |
| P104 | 1,3 | >20 kΩ* |
| | 2 | <2 Ω |
| | 4 | >200 kΩ |
| P105 | 1,2,3, 4,5,6 | >200 kΩ |
| | 7 | >2000 Ω |
| | 8 | <2 Ω |
| P106 | 1,2,3 | >200 kΩ |
| P111 | 1 | >1800 Ω |
| | 2 | >3000 Ω |
| | 3 | >2000 Ω |
| | 4,6 | <2 Ω |
| | 5 | (not used) |

**CHART A**

* Allow sufficient time for capacitors to become charged.

NOTE: Check the individual wires coming from the circuit board for the resistances indicated in the following steps.

( ) White wire coming from A: Infinity.

( ) Orange wire coming from B: Over 100 kΩ.

( ) Red wire coming from C: Over 100 kΩ.

( ) White-yellow wire coming from D: Over 50 kΩ.

( ) White-brown wire coming from E: Over 20 kΩ.

( ) White-red wire coming from F: Over 100 kΩ.

NOTES:

1. In the following steps, refer to the call-outs on the top of the circuit board to locate the wires running to the plugs where you will measure the resistances.

2. Refer to Chart B to check for the resistances indicated in the following steps.

3. To measure resistances on connector housings, as in the following steps, wrap a piece of small wire around the tip of your ohmmeter probe, then measure the indicated connector pin with the tip of the wire.

( ) Measure the connectors on 15-pin socket S702 for the indicated resistances.

( ) Measure the connectors on 10-pin socket S601 for the indicated resistances.

( ) Measure the connectors on 5-pin socket S302 for the indicated resistances.

| PLUG OR SOCKET NO. | PIN NO. | RESISTANCE |
|---|---|---|
| S702 | 1,2 | >200 kΩ |
| | 3 | >2000 Ω |
| | 4 | >2000 Ω |
| | 5 | >200 kΩ |
| | 6 | (not used) |
| | 7 | >200 kΩ |
| | 8 | >8000 Ω |
| | 9 | >200 kΩ |
| | 10 | <2 Ω |
| | 11 | >400 Ω |
| | 12 | >2000 Ω |
| | 13 | >3000 Ω |
| | 14 | >200 Ω |
| | 15 | >200 kΩ |
| S601 | 1 | >200 kΩ |
| | 2 | >400 Ω |
| | 3,4 | >200 kΩ |
| | 5 | >1800 Ω |
| | 6 | >2000 Ω |
| | 7 | >3000 Ω |
| | 8 | >200 kΩ |
| | 9 | (not used) |
| | 10 | <2 Ω |
| S302 | 1 | >8000 Ω |
| | 2 | (not used) |
| | 3 | >3000 Ω |
| | 4 | >2000 Ω |
| | 5 | <2 Ω |

**CHART B**

( ) White-green wire coming from the top of Cap. C155: Approx. 82KΩ.

Refer to Chart C and check for the indicated resistances on the heat sink-mounted integrated circuits and transistor as follows:

( ) Check IC U104 for the indicated lead resistances.

( ) Check IC U105 for the indicated lead resistances.

( ) Check IC U101 for the indicated lead resistances.

( ) Check IC U103 for the indicated lead resistances.

( ) Check transistor Q105 for the indicated lead resistances.

| COMPONENT | LEAD | RESISTANCE |
|---|---|---|
| U104 | In | >10 kΩ* |
| | Com | Zero<2 Ω |
| | Out | >1800 Ω |
| U105 | Adj | >400 Ω |
| | In | >5000 Ω* |
| | Out | >400 Ω |
| U101 | Adj | >2000 Ω |
| | Out | >2000 Ω |
| | In | >10 kΩ* |
| U103 | Adj | >20 kΩ |
| | In | >6000 Ω* |
| | Out | >3000 Ω |
| Q105 | B | >9000 Ω |
| | C | >20 kΩ* |
| | E | >8000 Ω |

**CHART C**

*** Allow time for capacitors to charge.**

## CRT Socket

Refer to Pictorial 8-3 (Illustration Booklet, Page 32) for the following steps.

( ) Position the CRT socket as shown.

( ) Connect the large red wire coming from the low voltage circuit board to CRT socket lug 3 (S-1).

( ) Cut the leads of a 100 kΩ (brn-blk-yel) resistor to 1/2".

( ) R1: Connect the resistor leads between CRT socket lugs 2 (NS) and 4 (NS) as shown.

( ) Cut the leads of a 1N4747A diode (#56-45) to 1".

( ) Connect the lead on the **banded end** of the diode to CRT socket lug 14 (NS) and the other lead to lug 12 (NS).

( ) Connect the large orange wire from the low voltage circuit board to socket lug 4 (S-2).

( ) Connect the large white wire coming from the low voltage circuit board to socket lug 5 (S-1).

( ) Connect the small white-brown wire to lug 6 (S-1).

( ) Connect the small white-red wire to lug 9 (S-1).

( ) Connect the small white-green wire to lug 12 (S-2).

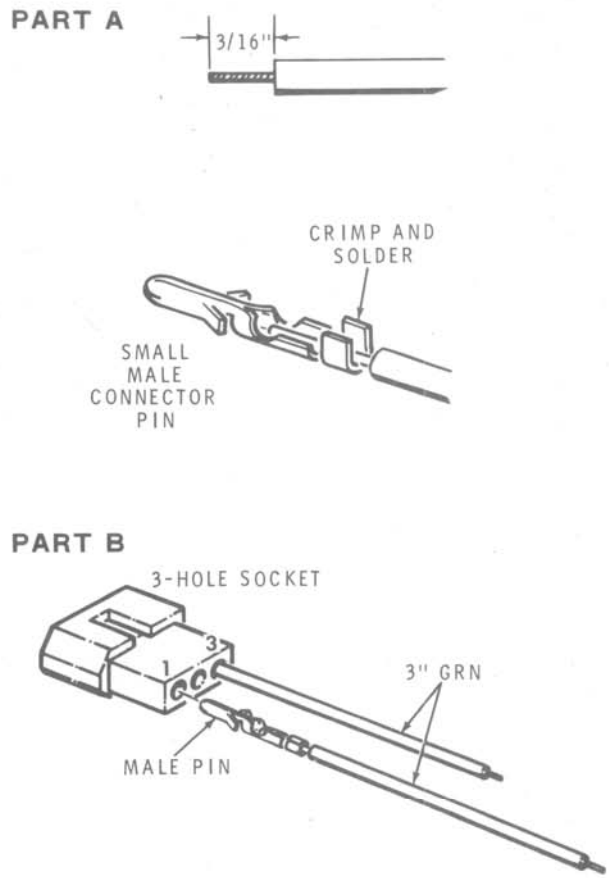
( ) Connect the small white-yellow wire to lug 14 (S-2).

( ) Cut and prepare two 3" large green wires. Remove 3/16" of insulation from each wire end.

( ) Refer to Part A of Detail 8-3A and crimp and solder a male connector pin onto one end of each green wire as shown.

( ) Refer to Part B of Detail 8-3A and push the pins on the green wires into holes 1 and 3 of a 3-hole white socket. Tug on each of the wires to make sure the pins are latched in the socket holes.

( ) Connect one of these green wires to CRT socket lug 2 (S-2) and the other green wire to lug 1 (S-1). NOTE: The socket will be connected later.




**Detail 8-3A**

( ) Cut and prepare the following small stranded wires. Remove 1/8" of insulation from one end of each wire.

| | |
|---|---|
| 6" orange | 5" blue |
| 6" red | 4-1/2" brown |

( ) As in a previous step, crimp and solder a female terminal onto one end of each of the four small wires.

( ) Cut four 3/4" pieces of small heat-shrinkable sleeving.

( ) Slide a piece of heat-shrinkable sleeving all the way down over each small wire and onto the female terminal. Then, using a match or other suitable heat source, shrink the sleeving onto each terminal as shown in Detail 8-3B.

**Detail 8-3B**

( ) Connect the free end of the small orange wire to CRT socket lug 7 (S-1).

( ) Connect the free end of the small red wire to CRT socket lug 6 (S-1).

( ) Connect the free end of the small blue wire to CRT socket lug 9 (S-1).

( ) Connect the free end of the small brown wire to CRT socket lug 11 (S-1).

( ) Cut a 2" piece of black tape. Then gather together the six wires coming from the low-voltage circuit board to the CRT socket and tightly wrap the piece of tape around the wires approximately midway between the board and the socket as shown in Pictorial 8-3.

**Circuit Board Installation.**

Refer to Pictorial 8-4 (Illustration Booklet, Page 33) for the following steps.

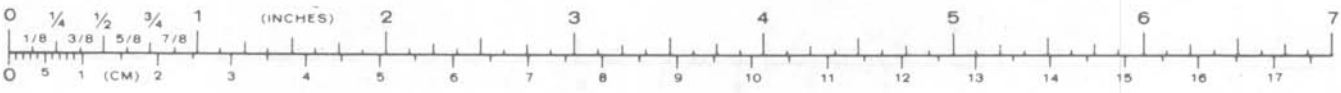
NOTE: In the following step, the low-voltage circuit board will help to align the upper and lower struts, and to position each of them at ninety degrees to the front and rear panels. Slightly loosen the strut-mounting hardware temporarily if necessary to achieve this. You may want to check the angle of the struts against the front and rear panels with a small carpenters square to make sure these components are truly squared.

( ) Taking care to keep all wires and leads below the circuit board, position the low-voltage circuit board into the bottom of the frame assembly. Loosely secure the circuit board to the two circuit board mounting brackets with six 4-40 × 1/4" screws as shown.

( ) Secure the low-voltage circuit board heat sink to the rear panel with two 6-32 × 1/4" screws as shown.

( ) Recheck the struts to make sure they are squared with the front and rear panels, adjust them slightly if necessary, and tighten the strut hardware. Then tighten the six circuit board mounting screws.

( ) Recheck all brackets, panel, and circuit board mounting hardware installed to this point to make sure it is all secured tightly.



## CONTROL CIRCUIT BOARD

Refer to Pictorial 9-1 (Illustration Booklet, Page 34) for the following steps.

( ) Push a banana jack through hole CA in the bottom center of the bezel.

( ) While holding the banana jack in place, on the inside of the bezel, position the circuit board over the banana jack as shown. Carefully position the red LED and the terminal post through their respective holes in the front panel. Place a 1/4″ lockwasher and a 1/2″ spacer onto the end of the banana jack, then loosely mount the jack with a #6 solder lug and a 6-32 × 1/4″ screw.

( ) Position the control panel onto the lower front of the bezel as shown. Hold the panel in place as you perform the next two steps.

( ) R365: Push the shaft of a 7.5 MΩ control (#10-1188) through the control circuit board, through the bezel, and out the front panel FOCUS hole. Loosely mount the control shaft to the control panel with a control nut. Cut the locating tab from the front of this control.

( ) SW1/R364: Similarly, mount the 1000 Ω control with switch (#19-751) through the control circuit board, bezel, and control panel at the hole labeled INTENSITY. Loosely mount the control shaft with a control nut. Cut the locating tab from the front of this control, if necessary.

( ) Make sure the terminal post and the red LED are centered in their respective control panel holes; then making sure each control is positioned as shown in the Pictorial, tighten the control nuts on the front panel.

( ) Position the banana jack solder lug as shown and tighten its mounting screw.

Refer to Pictorial 9-2 (Illustration Booklet, Page 34) for the following steps.

( ) Locate the 2″ black wire on the foil side of the circuit board. Connect the free end of this wire to the banana jack solder lug (NS).

( ) Pass the free end of the bare wire coming from the control circuit board foil upward through the solder lug and over onto the bare metal case of control R365. Solder the wire to the solder lug (S-3). The end of this wire will be connected later.

Connect the short violet, gray, and white wires coming from the rear of the control circuit board to the lugs of control R364 as follows:

( ) Violet wire to lug 1 (S-1).

( ) Gray wire to lug 2 (S-1).

( ) White wire to lug 3 (S-1).

( ) Cut and prepare two 3″ large brown wires.

( ) Crimp and solder a male connector pin onto one end of each wire. Cut the tab ends from the connectors; then crimp the connectors around the bare wire ends.

( ) Push the connector pin on one brown wire into hole 1 of a 3-hole white socket. Tug on the wire to make sure the pin is securely latched.

( ) In the same manner, push the connector on the other brown wire into socket hole 3.

( ) Cut two 3/4″ pieces of small heat-shrinkable sleeving. Push one piece of sleeving up onto each brown wire.

( ) Connect the end of either brown wire to switch 1 lug 4 (S-1). Make a secure mechanical connection.

( ) Connect the end of the other brown wire to SW1 lug 5 (S-1). Make a secure mechanical connection.

( ) After the connections have cooled, slide the sleeving down both brown wires, all the way until the switch lug connections are entirely covered. Then, using a match or other suitable heat source, heat the sleeving and shrink it onto the switch connections.

( ) Cut and prepare a 16" large white, large gray, and large violet wire.

( ) Cut three 3/4" pieces of small heat-shrinkable sleeving. Slide one piece of this sleeving up onto one end of each of the three prepared wires.

Connect one end (with sleeving) of each of the three prepared wires to the lugs of control R365 in the following steps.

( ) Large violet to lug 1 (S-1).

( ) Large white to lug 2 (S-1).

( ) Large gray to lug 3 (S-1).

( ) After the soldered connections have cooled, slide the heat-shrinkable sleeving down onto the three control lugs as far as possible. Then, using a match or other suitable heat source, shrink the sleeving onto the control lugs.

( ) Slide a 15" piece of large black sleeving all the way down onto the large violet, gray, and white wires.

( ) Cut the bare ends of the three heavy wires to 3/16".

( ) Crimp and solder a large spring connector onto the end of each of the three heavy wires. NOTE: Do NOT crimp the connector over the insulation.

( ) Push the connector on the end of the large white wire into hole 1 of a large 3-hole socket. Tug on the wire to make sure its connector is latched in the socket.

( ) In the same manner, push the gray wire connector into socket hole 2, and the violet wire connector into hole 3.

Refer to Pictorial 9-3 for the following steps.

( ) Turn the INTENSITY and the FOCUS controls fully counterclockwise; the INTENSITY control should click to indicate it is off.

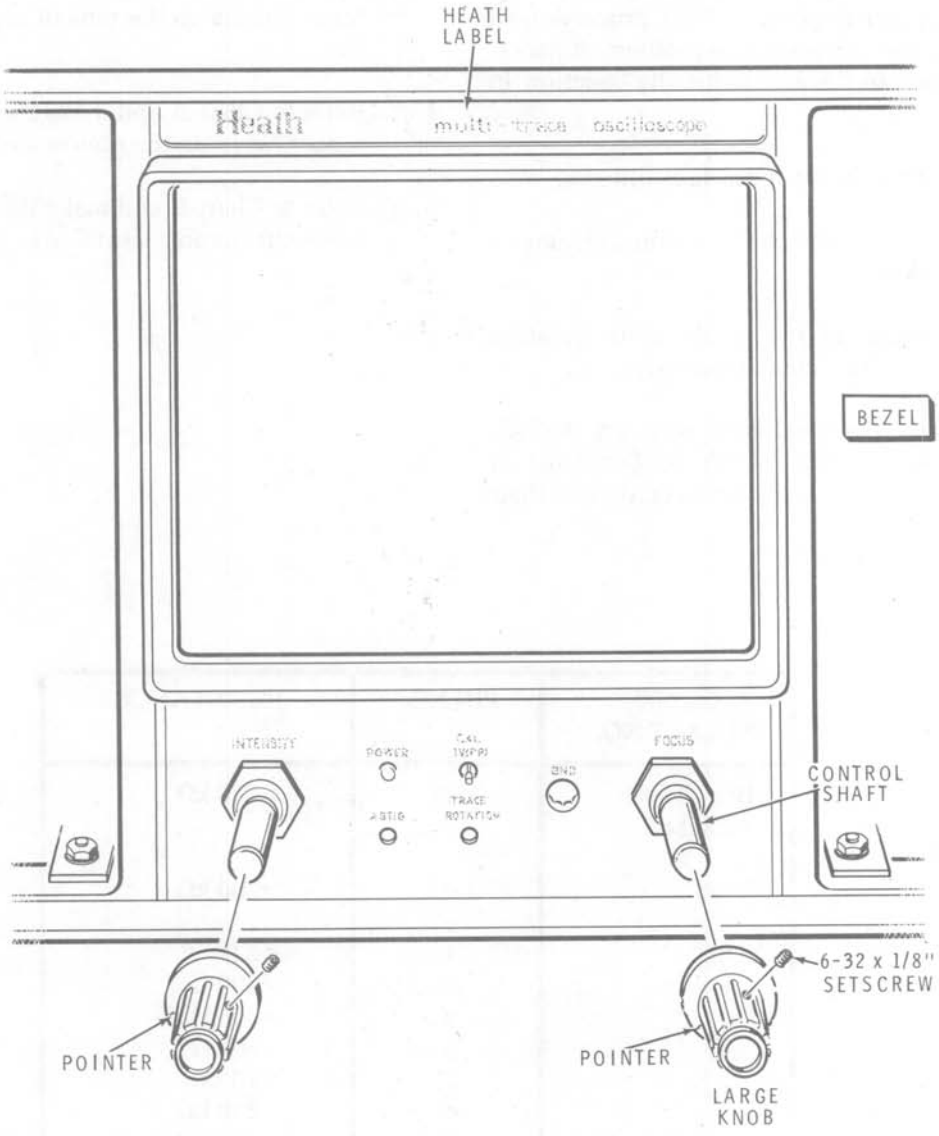
( ) Using an allen wrench, start a 6-32 × 1/8" allen setscrew into each of the control knobs.

NOTE: In the next two steps, space the knobs slightly away from the panel surface so they do not rub.

( ) Position a knob onto the FOCUS control shaft. Position its pointer at the 7 o'clock position and tighten the setscrew.

( ) Similarly, install the other knob on the INTENSITY control shaft, making sure the pointer is over the "Off" index mark.

( ) Remove the paper backing from the "Heath" label and press the label in place in the narrow slot at the top of the bezel as shown in the Pictorial.




**PICTORIAL 9-3**

### Resistance Checks

Refer to Pictorial 9-4 for the following steps.

NOTE: In the following steps, if you fail to obtain the desired resistance reading, do NOT proceed until you have found and corrected any problem. If necessary, refer to the "In Case of Difficulty" section in the Operation Manual.

( ) Preset the front panel controls as follows:

INTENSITY control fully counterclockwise until it clicks off.

FOCUS control to the center of its rotation (pointer at the 12 o'clock position).

Using a small screwdriver, turn the ASTIGMATISM and TRACE ROTATION controls on the control circuit board to the centers of their rotations.

( ) Connect the common ohmmeter lead to the solder lug on the rear of the banana plug spacer.

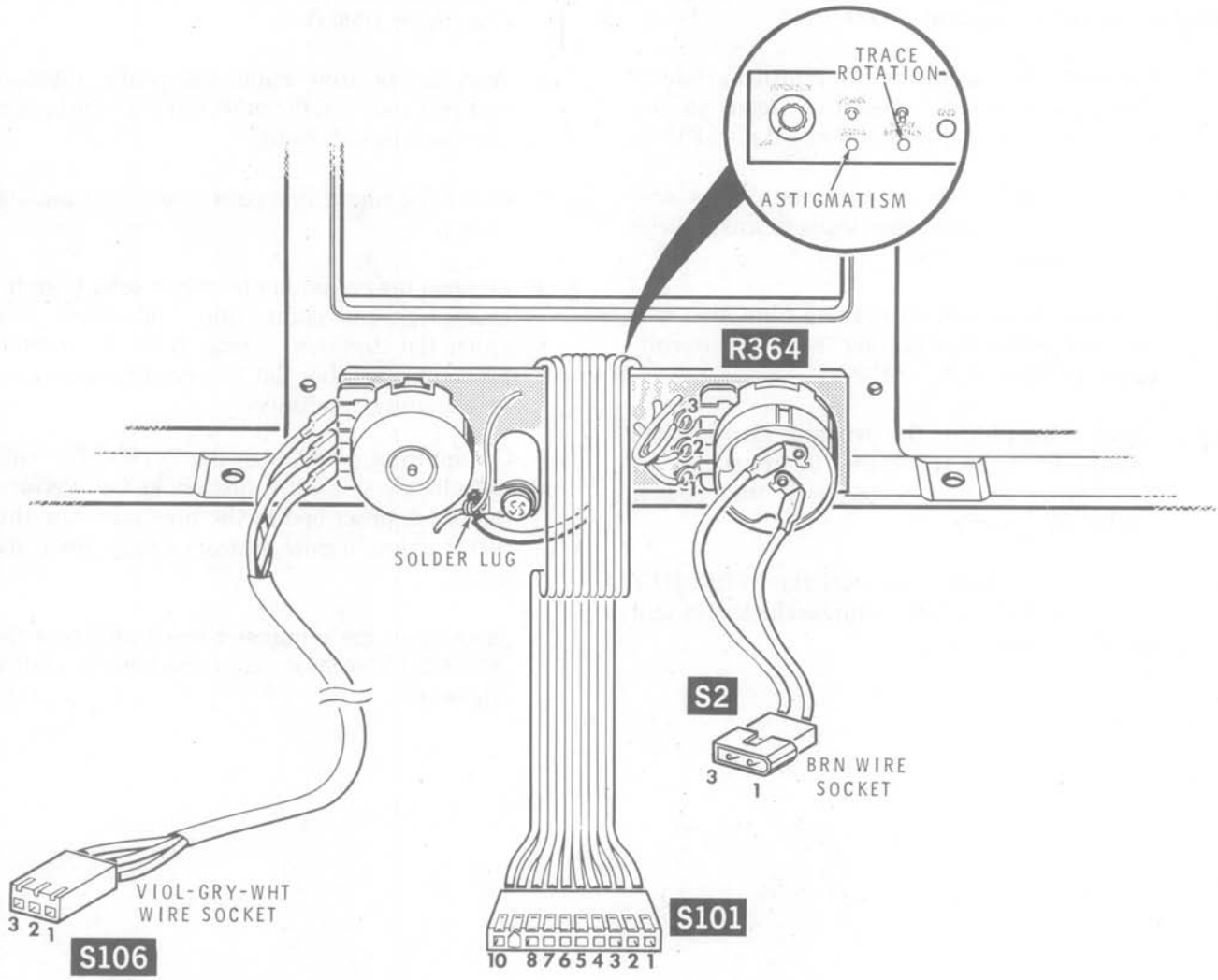
( ) Refer to Chart A and make the indicated resistance checks on the pins of brown-wire socket S2.

( ) Refer to Chart A and make the indicated resistance checks on the pins of socket S106.

( ) Refer to Chart A and make the indicated resistance checks on socket S101.

| PLUG OR SOCKET NO. | PIN NO. | RESISTANCE |
|---|---|---|
| Brn wire socket S2 | 1,3 | >200 kΩ |
| S106 | 1,2,3 | >200 kΩ |
| S101 | 1 | <2 Ω |
| | 2 | >900 Ω |
| | 3 | >900 Ω |
| | 4 | >90 kΩ |
| | 5 | >40 kΩ |
| | 6 | >200 kΩ |
| | 7 | >200 kΩ |
| | 8 | >200 kΩ |
| | 9 | (not used) |
| | 10 | <2 Ω |

**CHART A**




**PICTORIAL 9-4**

Refer to Pictorial 9-5 (Illustration Booklet, Page 35) for the following steps.

In the following steps, when you are instructed to connect a socket to a circuit board plug, be sure to position the socket as shown in the Pictorial. Be sure to observe the correct pin spacing, matching pin for pin between each plug and socket.

( ) Connect the socket on the brown, white-orange, and orange transformer leads to low voltage power supply circuit board plug P104.

( ) Connect the socket on the two yellow and white-yellow transformer leads to low voltage circuit board plug P103.

( ) Connect the socket on the two blue, two red, and red-yellow transformer leads to low voltage circuit board plug P102.

( ) Connect the plug on the two large brown wires coming from the rear panel to the socket on the brown wires coming from front panel switch SW1.

( ) On the front panel, make sure the INTENSITY control is turned fully counterclockwise and that it is clicked Off.

Refer to Pictorial 9-6 (Illustration Booklet, Page 36) for the following steps.

( ) Connect your ohmmeter negative lead to any convenient bare metal chassis ground.

( ) Set your ohmmeter for the appropriate range to measure 1000 Ω.

( ) With the positive ohmmeter probe, measure first one and then the other flat line cord prong for a reading of infinity.

( ) Check the round line cord prong for a reading of zero.

( ) Remove the common ohmmeter lead from the chassis ground connection, and attach it to either flat line cord prong. With the positive probe on the other flat line cord prong, check for a reading of infinity.

( ) On the front panel, turn the INTENSITY control clockwise until it just clicks On. Perform the check described in the previous step; this reading should now indicate a very low resistance.

( ) Disconnect the ohmmeter leads and turn the INTENSITY control counterclockwise until it clicks Off.

## INITIAL VOLTAGE TESTS

CAUTION: In the following steps, when power is applied to your unit, take all precautions to keep your hands away from the "High Voltage Areas" shown in Pictorial 9-6; THE VOLTAGES IN THESE AREAS ARE POTENITALLY LETHAL. Keep one hand in your pocket as you make any checks with the meter probe in your other hand.

IMPORTANT: Check to make sure the CRT socket and its wires are positioned where they cannot become shorted to the chassis or other components.

( ) Plug the line cord into an AC outlet.

( ) Connect the common voltmeter lead to a convenient bare metal point on the oscilloscope frame.

NOTES:

1. Set your voltmeter to the proper DC-voltage range to obtain meaningful readings in the following steps. Be sure to switch your voltmeter leads or voltmeter polarity switch to check for negative (−) voltages.

2. Be sure to touch only the indicated socket pin; to do otherwise might short a connection and damage a regulator or an IC. You may wish to turn the Oscilloscope power on and off between each voltage check, using an alligator-clip and a short bare wire to connect to the designated pin.

( ) On the front panel, turn the INTENSITY control until it just clicks on; the front panel red LED ("On") will **not** turn on at this time.

( ) Refer to Chart A and check for the indicated voltages on 15-wire flat cable socket S702 coming from circuit board wire connections designated P107 and P108.

| SOCKET NO. | PIN NO. | DC VOLTAGE |
|---|---|---|
| S702 | 8 | +85-95 V |
| | 9 | +150-200 V |
| | 11 | −4.7-5.3 V |
| | 12 | +4.7-5.3 V |
| | 13 | −14.5-15.5 V |
| | 14 | +14.5-15.5 V |

**CHART A**

( ) Turn off the Oscilloscope power and remove the line cord from the AC outlet.

NOTE: Do **not** proceed until the power has been turned off for at least **five minutes.**

## HIGH VOLTAGE ASSEMBLY

### Resistance Checks

Refer to Pictorial 10-1 for the following steps.

NOTE: When you make the following resistance checks, if you do not obtain the correct results, do NOT proceed until you have found and corrected the problem. If you are not able to locate the problem, refer to the "In Case of Difficulty" section in the Operation Manual.

Check the leads of the enclosure-mounted transistors, Q201 and Q202, for the resistances indicated in the following steps. NOTE: As these two components are identical, only one reading will be stated. Be sure to check both devices.

( ) Connect the common lead of your ohmmeter to any bare-metal area on the high-voltage enclosure.

( ) Check the transistor emitter (E) lead for a reading of infinity.

( ) Check the transistor collector (C) lead for a reading of infinity.

( ) Check the transistor base (B) lead for a reading of infinity.

Refer to Pictorial 10-2 for the following steps.

( ) Preset the High Volts Adj control to the center of its rotation.

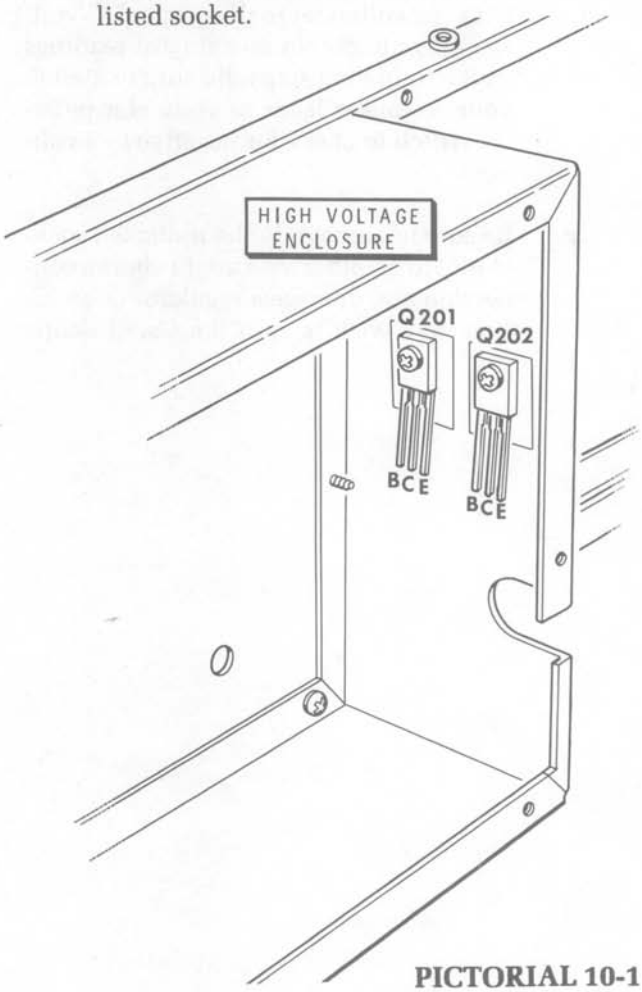
( ) Connect your common ohmmeter lead to the circuit board shield.

( ) Refer to Chart A and check the resistance checks on the 8-hole socket as indicated.

( ) Refer to Chart A and make the resistance check on the high-voltage anode lead as indicated.

NOTE: Although the 3-hole sockets may be connected to Q201 and Q202 interchangeably, their resistances are different.

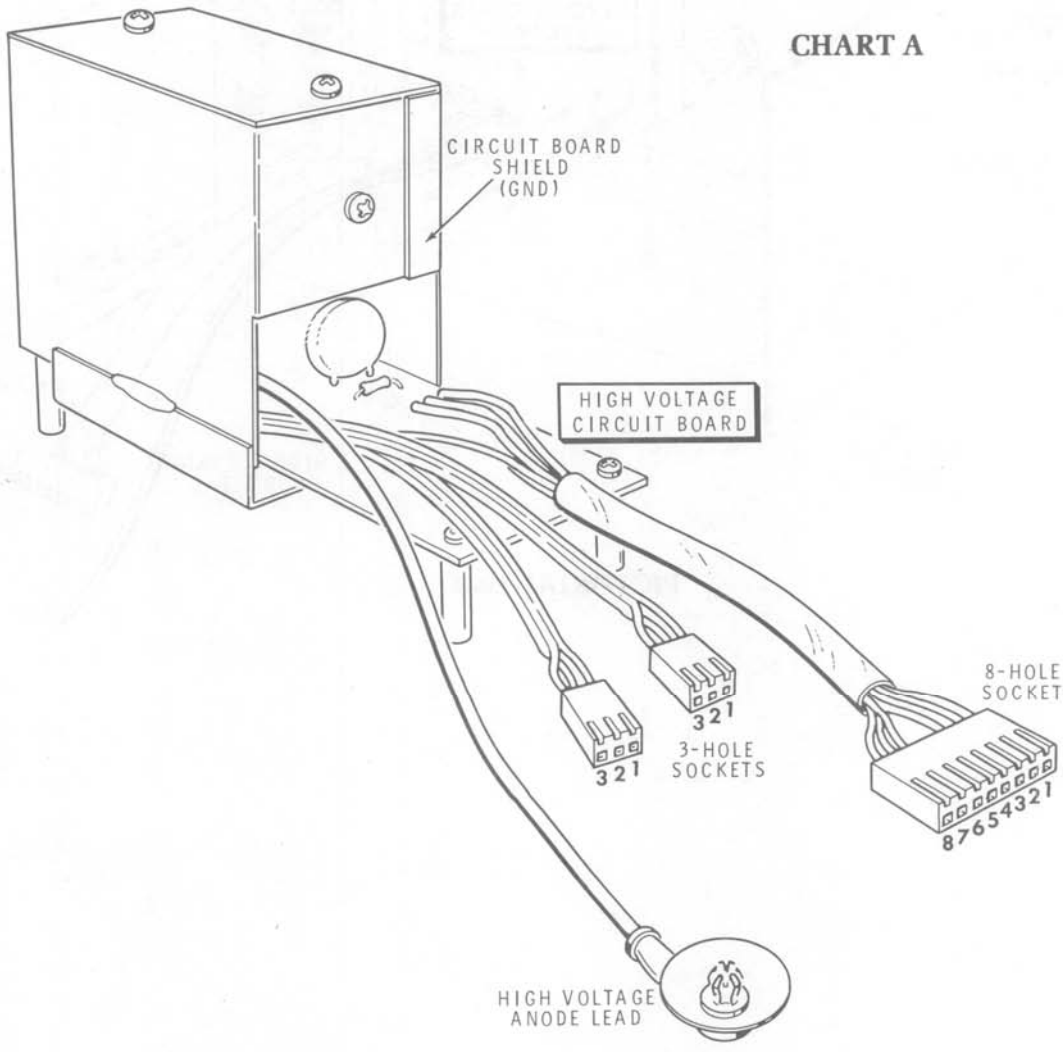
( ) As you refer to Chart A, first check one of the 3-hole sockets and determine which of the two indicated readings applies to that socket; then take the reading and compare it to the other listed socket.



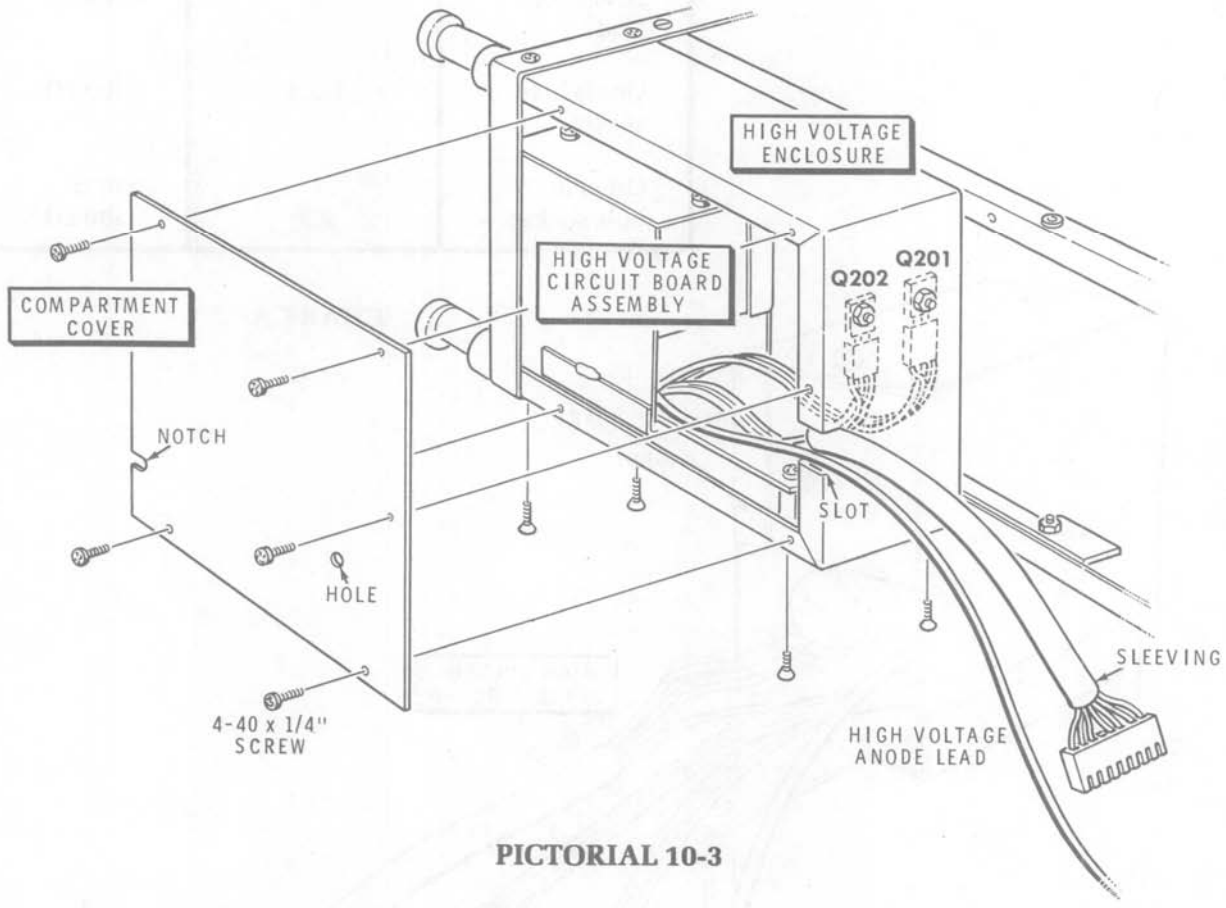

**PICTORIAL 10-1**

| PLUG OR SOCKET NO. | PIN NO. | RESISTANCE |
|---|---|---|
| 8-hole socket | 1-4 | >200 kΩ |
| | 5 | (not used) |
| | 6 | >200 kΩ |
| | 7 | >6000 Ω |
| | 8 | <2 Ω |
| H.V. anode lead | 1 | >200 kΩ |
| One 3-hole socket | 1,2,3 | >200 kΩ |
| Other 3-hole socket | 1 | >30 Ω |
| | 2,3 | >200 kΩ |

**CHART A**




**PICTORIAL 10-2**




**PICTORIAL 10-3**

### Circuit Board Installation

Refer to Pictorial 10-3 for the following steps.

( ) Position the oscilloscope assembly as shown.

( ) Carefully position the high-voltage circuit board assembly into the high-voltage enclosure as shown. Then secure the spacers to the bottom of the enclosure with four 4-40 × 1/4″ flat head screws.

NOTE: In the following steps, when you install connector sockets onto the leads of the transistors, you can connect either of the sockets (and wires) to either of the transistors; they are interchangeable.

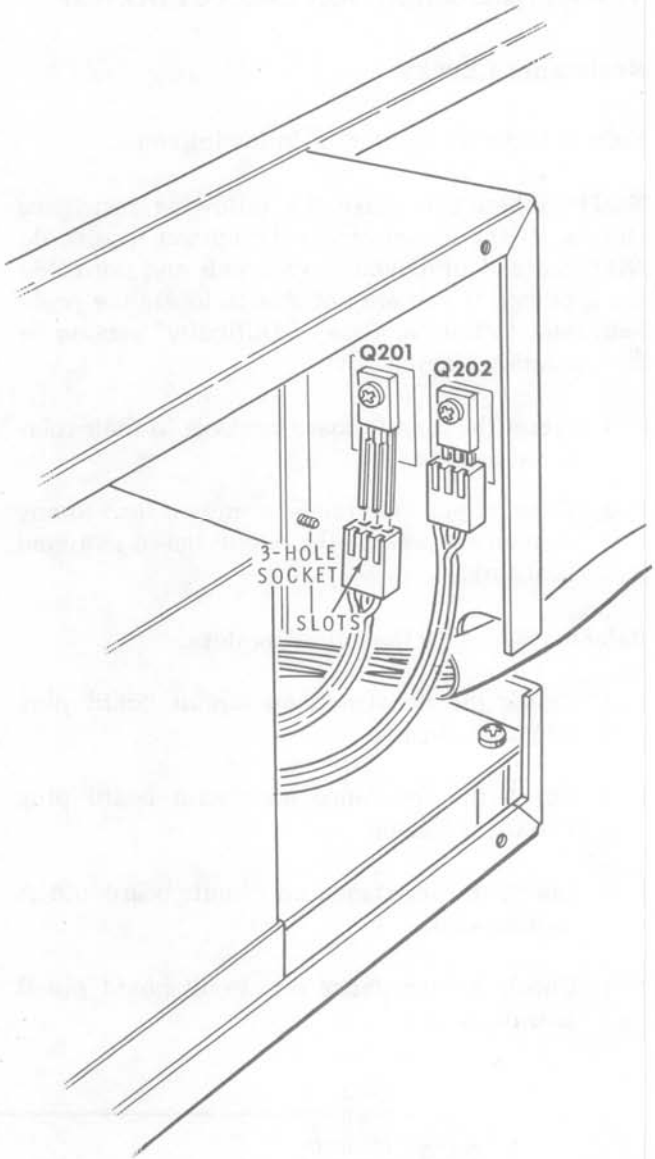
( ) Refer to Detail 10-3A and, on the inside of the enclosure, carefully push one of the small 3-hole sockets on the leads coming from the high-voltage circuit board onto the leads of transistor Q201 in the manner shown.

( ) In the same manner, install the other 3-hole socket onto the leads of transistor Q202.

( ) Carefully check to make sure the two transistor sockets are positioned onto their respective transistor leads with the housing slots as shown. If they are upside down, the transistor will not operate correctly and it may become damaged.

( ) Route the high-voltage anode lead and the sleeving-enclosed wires through the slot in the outer flange of the high-voltage enclosure as shown.

( ) Making sure the hole in the compartment cover and the small notch in one edge are positioned as shown in the Pictorial, slide the rear edge of the cover under the rear panel flange. Then secure the compartment cover on the outside of the high-voltage enclosure with five 4-40 × 1/4″ screws.




**Detail 10-3A**

## VERTICAL DEFLECTION CIRCUIT BOARD

### Resistance Checks

Refer to Pictorial 11-1 for the following steps.

NOTE: When you make the following resistance checks, if you do not obtain the correct results, do NOT proceed until you have found and corrected the problem. If you are not able to locate the problem, refer to the "In Case of Difficulty" section in the Operation Manual.

( ) Preset the circuit board controls to their rotational centers.

( ) Connect your ohmmeter common lead to any convenient area on the circuit board-mounted heat sink.

Refer to Chart A for the following steps.

( ) Check the resistance on circuit board plug P301 as indicated.

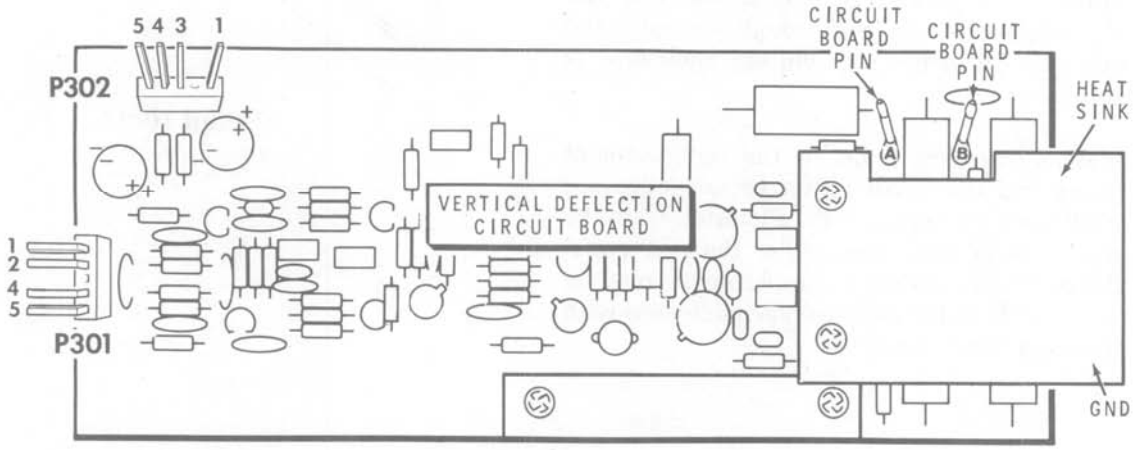
( ) Check the resistance on circuit board plug P302 as indicated.

( ) Check the resistance on circuit board pin A as indicated.

( ) Check the resistance on circuit board pin B as indicated.

| PLUG OR PIN NO. | PIN NO. | RESISTANCE |
|---|---|---|
| P301 | 1 | <2 Ω |
| | 2 | >6000 Ω |
| | 3 | (not used) |
| | 4 | >6000 Ω |
| | 5 | <2 Ω |
| P302 | 1 | >200 kΩ |
| | 2 | (not used) |
| | 3 | >8000 Ω |
| | 4 | >6000 Ω |
| | 5 | <2 Ω |
| Pin A | | >200 kΩ |
| Pin B | | >200 kΩ |

**CHART A**




**PICTORIAL 11-1**

### Circuit Board Installation

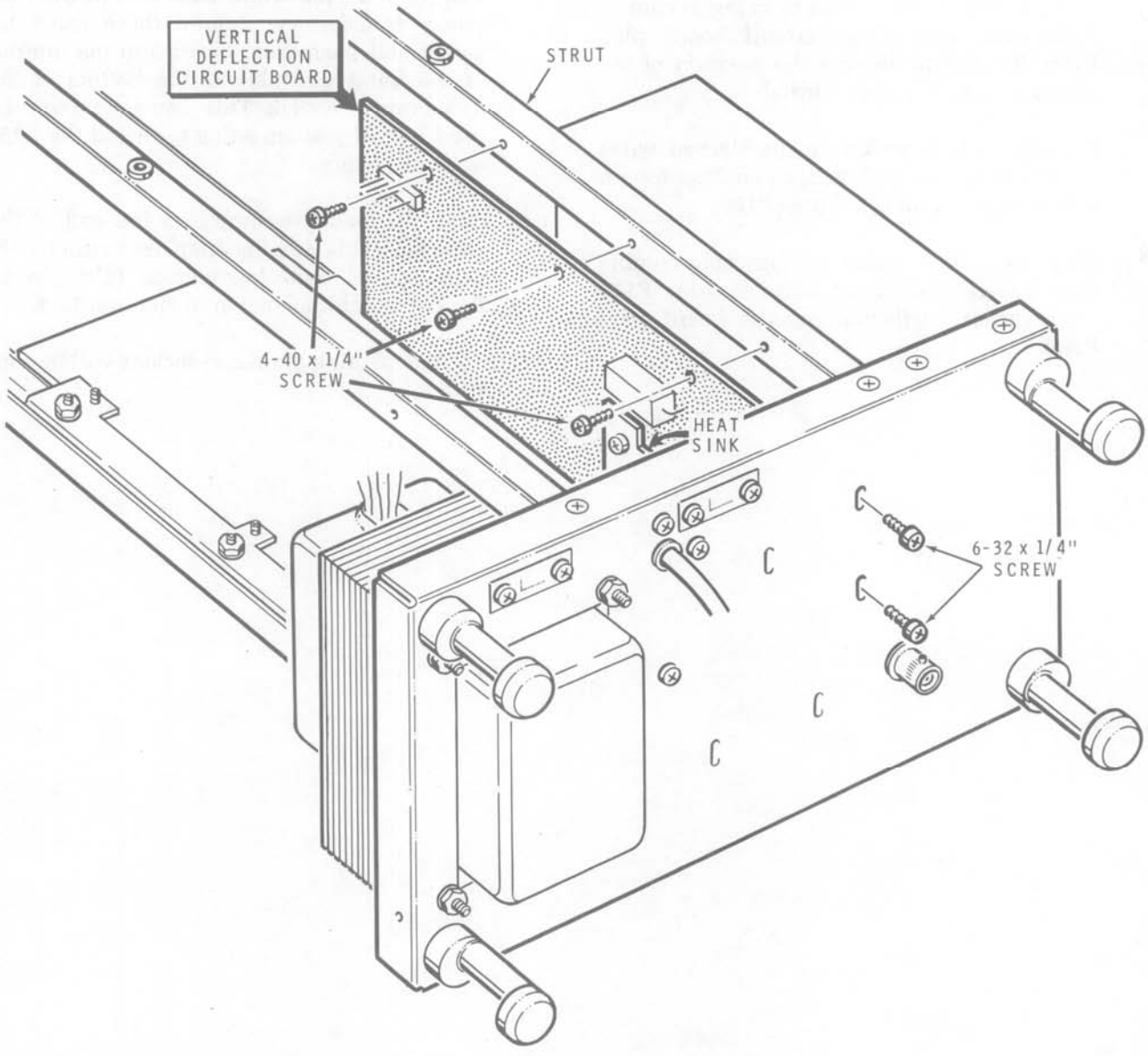
Refer to Pictorial 11-2 for the following steps.

( ) Position the frame assembly as shown.

( ) Position the vertical deflection circuit board on the inside flange of the upper left strut as shown. Then loosely mount the board to the strut with three 4-40 × 1/4" screws. NOTE: The two end holes on the circuit board will not be used.

( ) Secure the vertical deflection circuit board heat sink to the rear panel with two 6-32 × 1/4" screws.

( ) Tighten the three 4-40 × 1/4" circuit board strut mounting screws.




**PICTORIAL 11-2**

## INTERCONNECT WIRING

Refer to Pictorial 12-1 (Illustration Booklet, Page 37) for the following steps.

( ) Push the 10-hole socket on the cable coming from the control circuit board onto low-voltage circuit board plug P101. NOTE: This socket is "keyed" and will fit correctly in only one manner.

( ) Push the 3-hole socket on the end of the sleeved three wires coming from Focus control R365 onto low-voltage circuit board plug P106. Be sure to observe the position of the socket as shown in the Pictorial.

( ) Push the 8-hole socket on the sleeved wires coming from the high-voltage enclosure onto low-voltage circuit board plug P105.

( ) Push the 5-hole socket on the cable coming from low-voltage circuit board location P110 onto vertical deflection circuit board plug P302.

( ) Locate the small blue and small brown wires coming from the CRT socket. Push the female terminal on the end of the blue wire onto deflection circuit board PCB pin A and the brown wire female terminal onto pin B.

( ) On the CRT socket, locate the two large green wires with the 3-hole socket. Push the plug on the green wires coming from the power transformer into this socket.

( ) Locate the 4-hole socket on the end of the two white and the red-white leads coming from the power transformer. Bundle these leads together and push them down into the interior of the frame assembly at the bottom of the transformer. NOTE: This connector will be used later if you are going to install the IOA-4200 Accessory.

( ) Push the female terminal on the end of the shielded cable coming from rear panel BNC connector C onto low-voltage PCB pin G. Route this cable as shown in Pictorial 12-1.

NOTE: The remaining plugs and sockets will be connected later.

## VERTICAL PREAMP ASSEMBLY

### Resistance Checks

Refer to Pictorial 13-1 (Illustration Booklet, Page 38) for the following steps.

( ) Position the vertical preamp circuit board as shown.

NOTES:

1. In the following steps, when you are directed to make resistance measurements, set your ohmmeter to the most suitable range to include the indicated value. For infinity and zero readings, use the meter range you would use to measure 1000 ohms.

2. All resistances in the charts were measured from a circuit board ground (foil) connection. Therefore, you should always connect the common lead of your meter to a convenient point on a ground lead or a ground foil. Measure with the positive meter probe to the points indicated in the charts.

( ) On the vertical preamp front panel, push in the Y1 DISPLAY MODE switch.

Refer to Pictorial 13-1 and to Chart A and check for the resistances listed in the following steps.

( ) Set the circuit board controls to their rotational centers.

( ) Check for the indicated resistances on circuit board plug P601.

( ) Check for the indicated resistances on circuit board plug P602.

( ) Position the 7-pin socket on the end of the four shielded cables as shown in the Pictorial; then check each connector pin in the socket for the indicated resistance.

| PLUG OR SOCKET NO. | PIN NO. | RESISTANCE |
|---|---|---|
| P601 | 1 | >200 kΩ |
| | 2 | >290 Ω |
| | 3 | >200 kΩ |
| | 4 | <2 Ω |
| | 5 | >3000 Ω |
| | 6 | >2000 Ω |
| | 7 | >1000 Ω |
| | 8 | >5000 Ω |
| | 9 | (not used) |
| | 10 | <2 Ω |
| P602 | 1 | <2 Ω |
| | 2 | >2000 Ω |
| | 3 | (not used) |
| | 4 | >2000 Ω |
| | 5 | <2 Ω |
| 7-pin socket | 1,5 | <2 Ω |
| | 2,4 | >200 kΩ |
| | 6,7 | >400 Ω |

**CHART A**

### Circuit Board Installation

Refer to Pictorial 13-2 (Illustration Booklet, Page 39) for the following steps.

( ) Position the frame assembly as shown.

Refer to Detail 13-2A for the next three steps.

( ) Loosely mount a compartment cover and the preamplifier top cover onto the upper left strut at DA and DB with two 4-40 × 1/4″ screws.

( ) Secure the compartment cover and the preamplifier bottom cover onto the lower left strut at DC and DD with two 4-40 × 1/4″ screws.

( ) Tighten all four cover mounting screws.

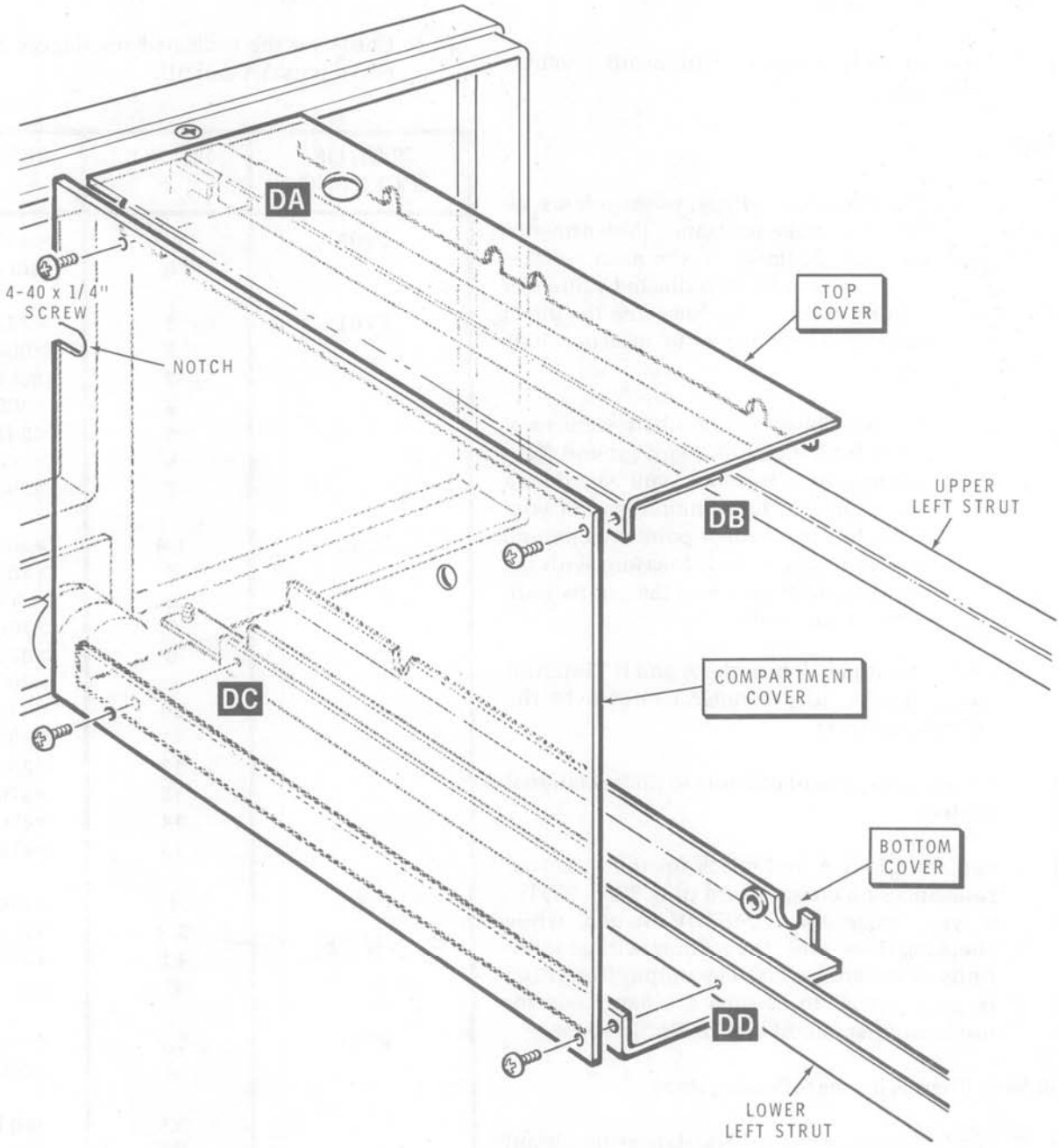
Position all cables and harnesses out of the way as follows, and as shown in the Pictorial.

( ) High voltage anode lead and sleeved wires: Bend sharply over the top of the high-voltage enclosure and into the center area of the frame assembly.

( ) All wires and cables from the low-voltage circuit board: To the rear and to the right side of the frame assembly.

( ) Carefully position the vertical preamplifier assembly into the frame assembly. As you do this, route the 8-wire flat cable over the rear of the circuit board and toward the center of the frame assembly. Position the bundled shielded cables (coming from the foil side of the board) to the interior of the assembly.

( ) After the circuit board assembly is positioned as far as possible into the frame, line up the circuit board mounting holes with the holes in the top left strut. Then secure the circuit board to the upper and lower struts with six 4-40 × 1/4″ screws.


DA
4-40 x 1/4"
SCREW
NOTCH
TOP
COVER
UPPER
LEFT STRUT
DB
COMPARTMENT
COVER
DC
BOTTOM
COVER
DD
LOWER
LEFT STRUT

**Detail 13-2A**

## HORIZONTAL CIRCUIT BOARD

### Resistance Checks

Refer to Pictorial 14-1 (Illustration Booklet, Page 40) for the following steps.

( ) Position the horizontal circuit board assembly as shown.

NOTES:

1. In the following steps, when you are directed to make resistance measurments, set your ohmmeter to the most suitable range to include the indicated value. For infinity and zero readings, use the meter range you would use to measure 1000 ohms.

2. All resistances in the chart were measured from a circuit board ground (foil) connection. Therefore, you should always connect the common lead of your meter to a convenient point on a ground lead or a ground foil. Measure with the positive meter probe to the points indicated in the chart.

( ) On the front panel, turn the A and B TIME/CM switch knobs fully counterclockwise to the 100 mS positions.

( ) Set all circuit board controls to their rotational centers.

( ) Refer to Chart A and check for the indicated resistances on circuit board plug P703. NOTE: If you rotate the TIME/DIV switch while checking these pins, the reading will go to infinity at certain points. The output from P703 is programmed to become a binary code for use in another circuit of your Oscilloscope.

Refer to Chart A for the following steps.

( ) Check for the indicated resistances on circuit board plug P701.

( ) Check for the indicated resistances on circuit board plug P702.

( ) Check for the indicated resistances on circuit board plug P704. **Temporarily remove the jumper (for this test only)** from pins 1 and 2.

( ) Check for the indicated resistances on circuit board plug P705.

( ) Check for the indicated resistances on circuit board pins AA and BB.

| PLUG OR SOCKET NO. | PIN NO. | RESISTANCE |
|---|---|---|
| P703 | 1-5 | <2 Ω |
| | 6 | (not used) |
| P701 | 1 | <2 Ω |
| | 2 | >800 Ω |
| | 3 | (not used) |
| | 4 | >800 Ω |
| | 5 | <2 Ω |
| | 6 | >900 Ω |
| | 7 | >200 kΩ |
| P702 | 1-4 | >200 kΩ |
| | 5 | >1000 Ω |
| | 6 | (not used) |
| | 7 | >1000 Ω |
| | 8 | >30 kΩ |
| | 9 | >200 kΩ |
| | 10 | <2 Ω |
| | 11 | >380 Ω |
| | 12 | >290 Ω |
| | 13 | >470 Ω |
| | 14 | >470 Ω |
| | 15 | >470 Ω |
| P704 | 1 | >400 Ω |
| | 2,3 | >200 kΩ |
| | 4,5 | <2 Ω |
| | 6 | (not used) |
| P705 | 1,3 | <2 Ω |
| | 2 | >200 kΩ |
| | AA | >40 kΩ |
| | BB | >40 kΩ |

**CHART A**

### Circuit Board Installation

Refer to Pictorial 14-2 (Illustration Booklet, Page 41) for the following steps.

( ) Remove the paper backing from the narrow side rail insulator and press the insulator on the upper right strut so that the insulator holes are directly over the mounting holes at DG and DH as shown.

( ) Carefully slide the horizontal circuit board rearward through the right front bezel opening until the front circuit board panel is all the way into the bezel recess.

( ) Secure the horizontal circuit board to the upper and lower right struts with eight 4-40 × 1/4" screws.

Refer to Pictorial 14-3 (Illustration Booklet, Page 42) for the following steps.

( ) Push the 10-hole socket coming from low voltage circuit board plug P109 onto vertical preamp plug P601. Position the "keyed" socket as shown.

( ) Push the 3-hole connector on the shielded cable coming from vertical preamp plug P601 onto horizontal circuit board plug P705. NOTE: The plug may be installed in either direction.

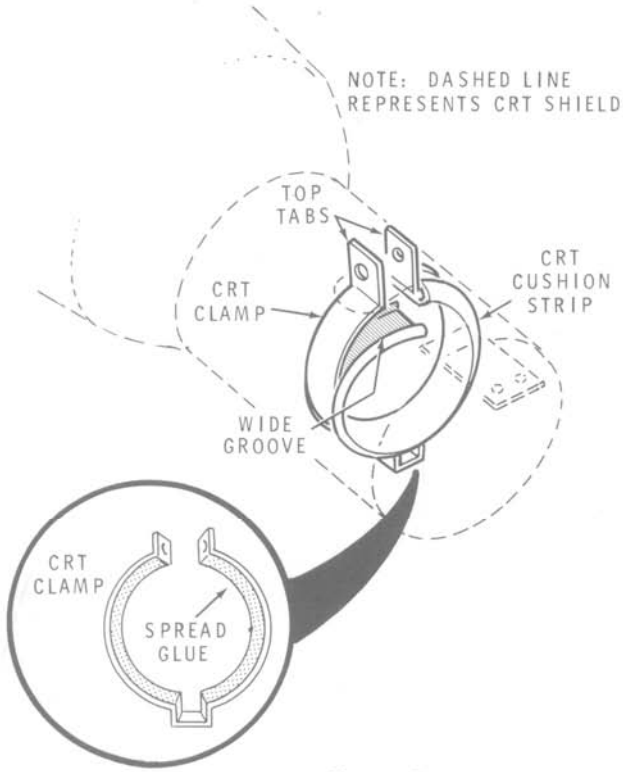
( ) Push the female pin on the end of the small orange wire coming from the CRT socket onto horizontal circuit board pin BB.

( ) Push the female pin on the end of the small red wire coming from the CRT socket onto horizontal circuit board pin AA.

( ) Push the 15-hole socket on the cable coming from low voltage circuit board P107/P108 onto horizontal circuit board plug P702. NOTE: The socket is "keyed" and will fit correctly in only one manner.

( ) Locate the 7-pin socket on the end of the four shielded cables coming from the vertical preamp circuit board. Push this socket onto horizontal circuit board plug P701. NOTE: This plug is "keyed" and will fit correctly in only one manner.

The remaining plugs and sockets will be installed later.




**Detail 15-1A**

## CRT ASSEMBLY AND INSTALLATION

Refer to Pictorial 15-1 (Illustration Booklet, Page 43) for the following steps.

( ) Open the small tube of glue and, using a safety pin or other sharp pointed tool, push a hole through the tube tip.

( ) Cut 1/4″ from one end of the CRT cushion strip.

( ) Refer to Detail 15-1A and spread a layer of glue onto the CRT clamp as shown. Then, working from one of the top tabs in a circular direction toward the other tab, press the CRT cushion strip onto the clamp. Be sure the wide groove in the bottom of the strip is all the way down onto the clamp surface as you work the strip from one tab toward the other. Save the remaining glue.

**Detail 15-1B**

( ) Refer to Detail 15-1B and install a 1/4″ rubber grommet in hole TA in the CRT shield.

Set the CRT shield aside temporarily.

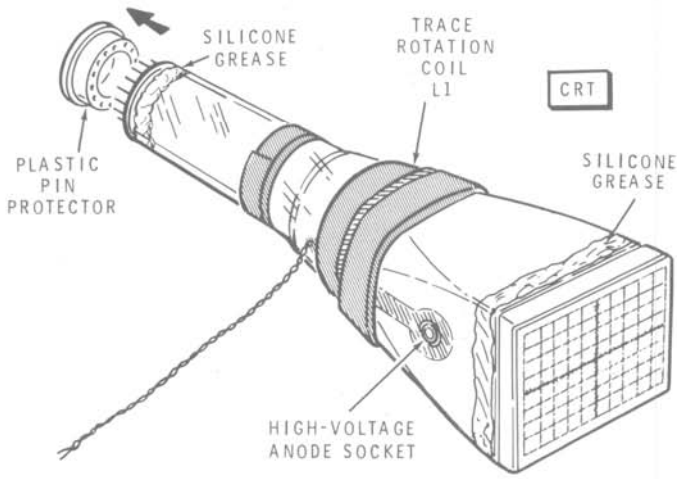
> WARNING: Be careful when you handle the CRT. Do not strike, scratch or subject the CRT to more than moderate pressure at any time. Due to its high vacuum, a fracture of the glass could cause an implosion of considerable violence capable of causing personal injury.

( ) Carefully unpack the CRT.

Refer to Detail 15-1C for the next two steps.

( ) Position the CRT so the high-voltage anode socket is toward you as shown in the Detail.

( ) Remove all of the white tape (front and rear) and the plastic pin protector from the back end of the CRT.



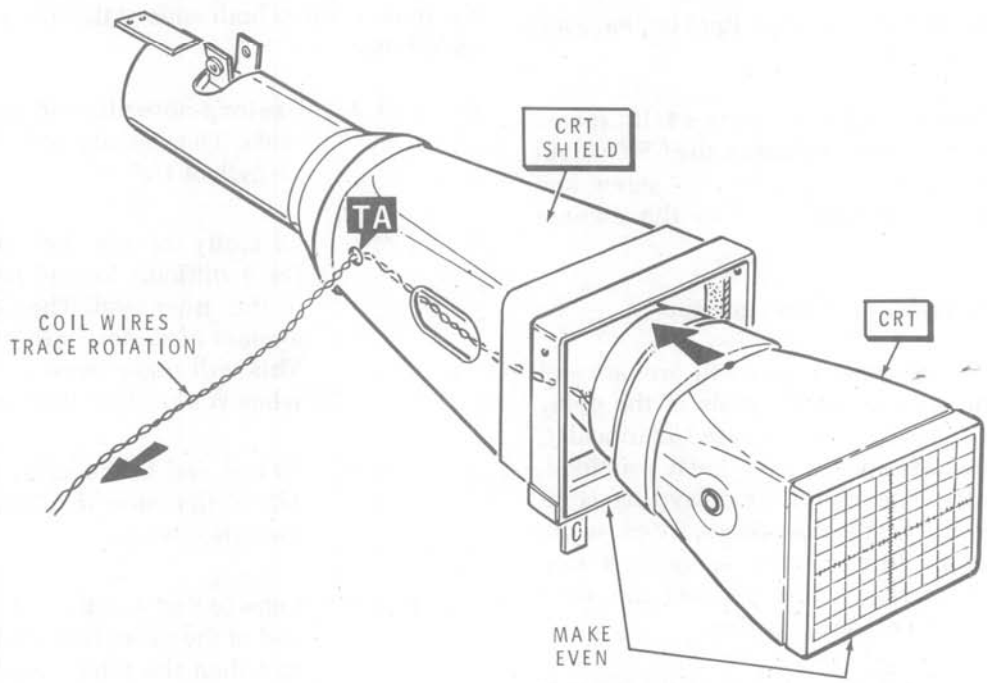

**Detail 15-1C**

( ) Smear a thin layer of silicone grease around the neck of the CRT as shown. ^and the front surfaces.

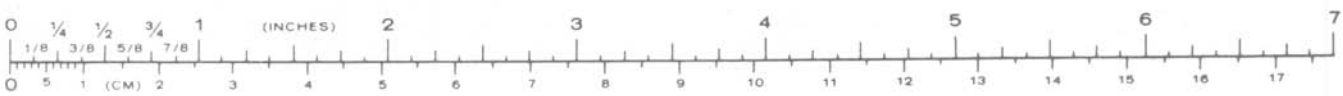
( ) Refer to Detail 15-1D and install the CRT in the CRT shield. Route the wires coming from the trace rotation coil through grommet TA in the shield. The face of the CRT should finally be exactly even with the front edges of the shield.

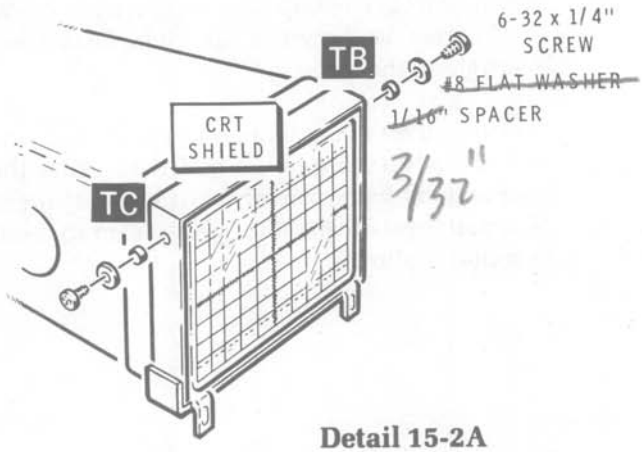
( ) Secure the CRT clamp tabs snugly with a 6-32 × 1" screw as shown in the Pictorial. Do not overtighten the screw.

( ) Crimp and solder a female terminal onto the end of each trace rotation coil wire. After the connections have cooled, shrink a 3/4" piece of small heat-shrinkable sleeving onto each terminal as shown.




**Detail 15-1D**






**Detail 15-2A**

Refer to Pictorial 15-2 (Illustration Booklet, Page 43) for the following steps.

( ) Refer to Detail 15-2A and secure a 1/16" spacer to each of the upper corners of the CRT shield at TB and TC using a 6-32 × 1/4" screw and a #8 flat washer (3/8" dia.) in the manner shown.

Refer to Detail 15-2B for the following steps.

NOTE: In the following steps, you will prepare and install wires and sockets on the ends of the delay line. Since both ends will be prepared identically, two sets of check-off spaces have been provided. Completely prepare one end of the delay line as directed, checking the first set of spaces. Then, when you are directed to do so, return to the first step of double check-off spaces and perform the same steps on the other end of the delay line.

( ) ( ) 1. Refer to Part 1 of Detail 15-2B and prepare the ends of a 3" 4-wire flat cable in the manner shown. Use a black-brown-red-orange 4-wire cable removed from the 25-wire flat cable supplied with the kit. Be sure to tightly twist the wire ends and to add a small amount of solder to each bare end to hold the fine strands together.

( ) ( ) 2. Refer to Part 2 of the Detail and crimp and solder small spring connectors onto the even ends of the wires on the 4-wire cable. Push the connectors into a 5-hole socket as follows:

Black wire into hole 1.
Brown wire into hole 2.
Red wire into hole 4.
Orange wire into hole 5.

( ) ( ) 3. Push a polarizing plug into hole 3 of the 5-hole socket.

IMPORTANT: The delay line, which you will be working with in the following steps, is delicate. Handle it gently and do not bend it sharply.

NOTE: Perform the next two steps only if they have not already been done.

Refer to Part 3 of Detail 15-2B and expose 1/2" of the inner leads at both ends of the delay line (#41-9) as follows:

( ) ( ) 4. Use long-nose pliers to grasp the inner leads. Then gently pull them out for a length of 1/2".

( ) ( ) 5. Carefully scrape 1/4" of insulation (very difficult to see) from the ends of the inner lead. Then melt a small amount of solder on these leads ends. This will make them easier to solder when you connect them later.

( ) ( ) 6. At one end of the delay line, remove 1/2" of the outer insulation to expose the shield wires.

( ) ( ) 7. Refer to Part 4 of the Detail and at one end of the delay line, on first one side and then the other, comb out, pinch together, and tightly twist approximately half of the cable shield braid as shown. Add solder to these twisted shield ends.

( ) ( ) 8. Refer to Part 5 of the Detail and form a small hook in the ends of the four wires on one of the socket assemblies. Also form small hooks on the ends of the two inner leads and the two shield leads on one end of the delay line.

( ) ( ) 9. Cut two 1/2" pieces of small heat-shrinkable sleeving.

( ) ( ) 10. Place a 1/2" piece of sleeving over the end of the brown wire and over the red wire on the socket assembly.

( ) ( ) 11. Connect the socket assembly wires to the delay line as follows:

Brown wire to either inner lead (S-1).
Red wire to the other inner lead (S-1).
Black wire to either shield lead (S-1).
Orange wire to the other shield lead (S-1).

( ) ( ) 12. Slide the sleeving on the red and brown wires down over the solder-connections and shrink the sleeving in place.

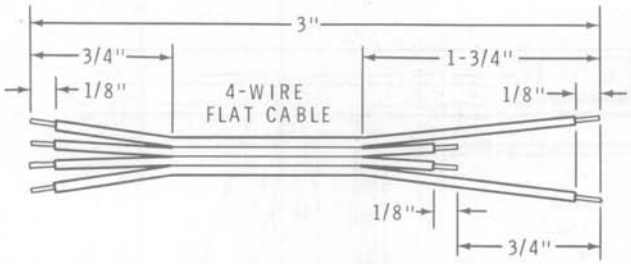
( ) ( ) 13. Refer to Part 6 of the Detail and tightly tape the end of the delay line and the flat 4-wire cable to hold the connections firmly in place.

Return to Step 1 of the delay line instructions and complete all 13 steps on the other end of the delay line before you proceed with the following steps.

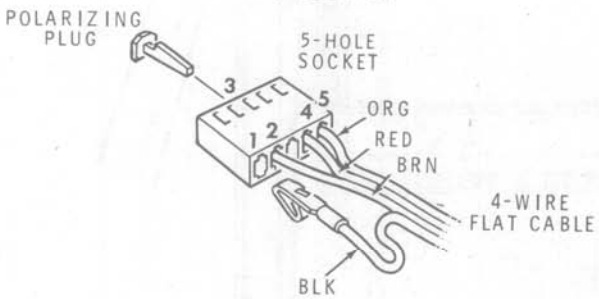
( ) Position one end of the delay line on the top of the CRT shield as shown in the Pictorial. Route the cable rearward toward the CRT clamp and down onto the narrow portion of the shield. Then start wrapping the delay line around the shield, keeping each turn flat against the previous turn and tight against the shield. As you come upward with the third and final turn, route it forward toward the face of the CRT as shown.

( ) Using black electrical tape, tightly secure the delay line to the CRT shield. Be sure to overlap the tape so as to cover the delay line as shown in the Pictorial.

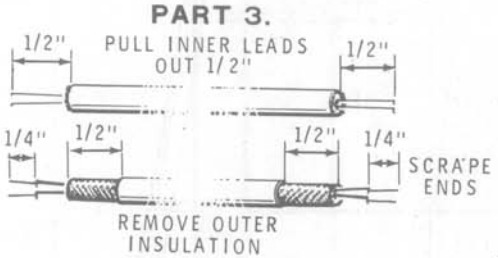
**PART 1.**



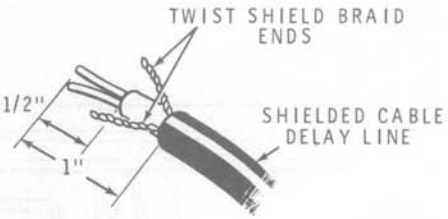

**PART 2.**



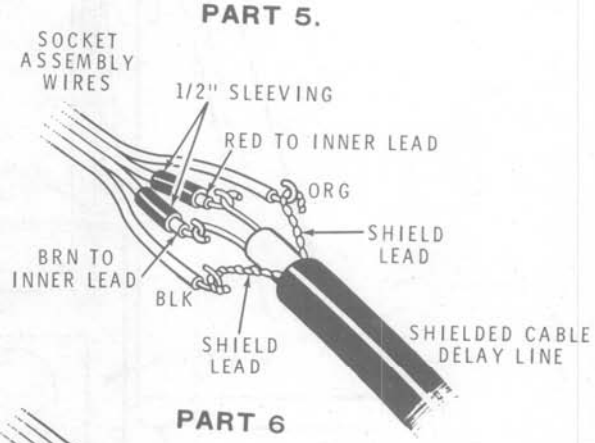

**PART 3.**



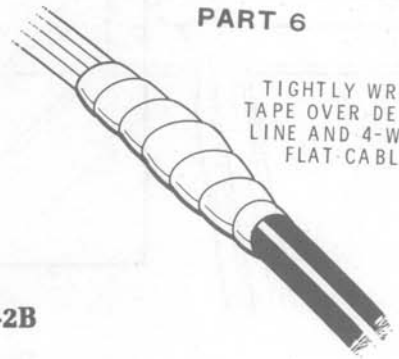

**PART 4.**




**PART 5.**




**PART 6**




**Detail 15-2B**

Refer to Pictorial 15-3 (Illustration Booklet, Page 44) for the following steps.

Refer to Detail 15-3A for the next two steps.

( ) Apply a small amount of glue to the narrow recessed edges of the bezel opening as shown. Use the glue **sparingly** to avoid its squeezing out around the filter in the next step.

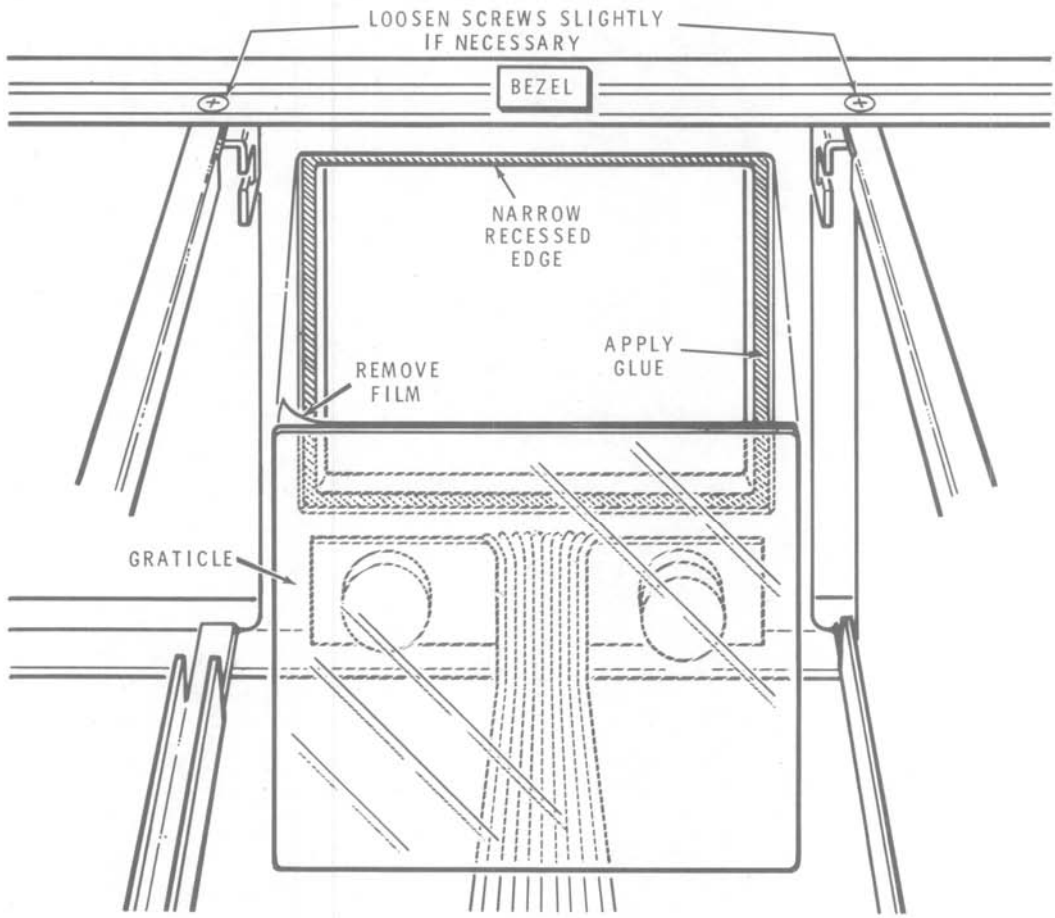
( ) If necessary, remove the thin film from both sides of the graticule and position the blue filter into the bezel as shown. Set the assembly aside for approximately one hour to allow the glue to set.

( ) On the front panel, remove the knob from the FOCUS control. Then loosen the control nut. Temporarily rotate the FOCUS control on the inside of the assembly so the lugs are toward the bottom of the bezel.

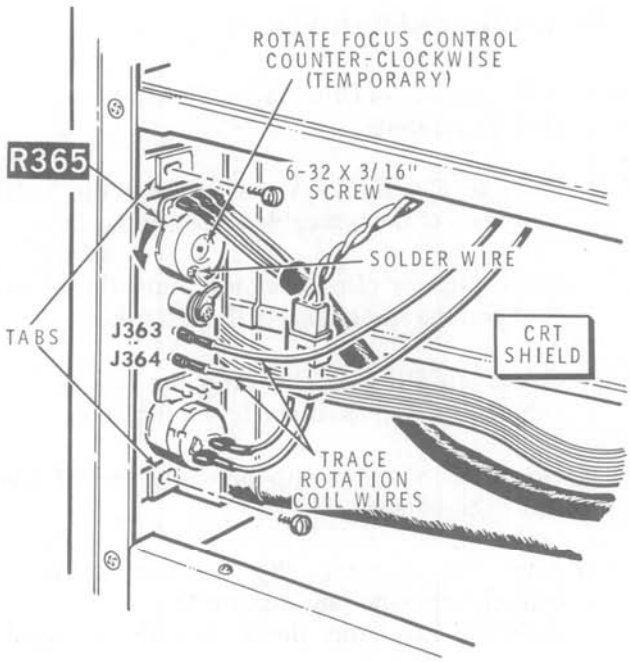
( ) Position the upper corner pivot spacers on the front of the CRT into the slots in the pivot brackets on the top of the bezel as shown. Holding the CRT at approximately 30 degrees up from the horizontal position, work the CRT shield forward into the pivot bracket slots as far as possible. NOTE: Loosen the bracket screws temporarily if necessary. See Detail 15-3A.

( ) Tilt the CRT shield upward as necessary, and push the high-voltage clip on the anode lead coming from the high-voltage enclosure into the high-voltage anode on the left side of the CRT as shown.

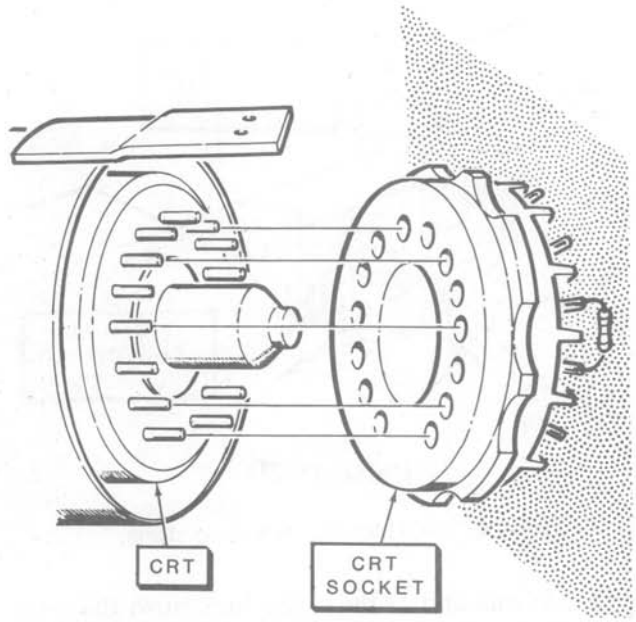
( ) Making sure all the leads, plugs, and sockets (not yet connected) on the inside of the frame assembly are positioned upward and to either side, carefully lower the CRT assembly downward into the frame as shown. Be certain the lower left tab (as shown in the Pictorial) does not come in contact with the FOCUS control lugs.




**Detail 15-3A**




**Detail 15-3B**




**Detail 15-3C**

( ) Refer to Detail 15-3B for the following steps.

NOTE: In the following step, be **sure** to use only the hardware specified to avoid damage to the front panel.

( ) Loosely secure the tabs on the lower front of the CRT shield to the bezel with two 6-32 × **3/16"** screws. NOTE: You may have to press downward slightly on the top front of the CRT shield to align these holes.

( ) Check the graticule lines on the CRT to make sure they are aligned with the front panel opening. If necessary, grasp the CRT shield and twist it slightly to correctly position the graticule lines. Then tighten the two tab mounting screws.

( ) Rotate the FOCUS control back to its original position and tighten the control nut. Reinstall the knob.

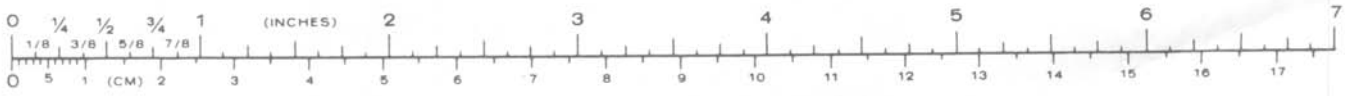
( ) Solder the end of the short bare wire, coming from the banana jack solder lug, to the case of control R365.

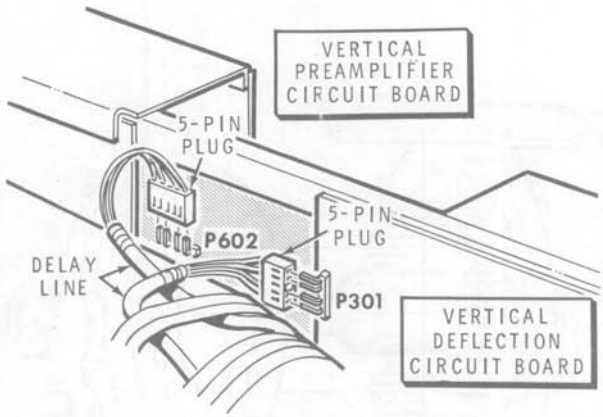
( ) Locate the two small trace rotation coil wires. Push the female terminals on these wires onto control circuit board pins J363 and J364 as shown in Detail 15-3B.

NOTE: In the following step, make sure the CRT wires to the vertical deflection horizontal circuit boards are routed as straight as possible to their connections without crossing or twining with other wires. If necessary, remove a wire from its connecting point, reroute it, and then reconnect it.

( ) Refer to Detail 15-3C and, using the fingers of both hands, position the CRT socket onto the CRT in the manner shown. After the socket has started onto the CRT pins, push the socket as far forward as possible onto the pins.

( ) Refer to the Pictorial and, on the rear panel, loosely secure the CRT rear bracket to hole D. Then secure the bracket to the CRT shield tab. Use three 6-32 × 1/4" screws as shown in the Pictorial. Tighten the screw at hole D.






**Detail 15-3D**

Refer to Detail 15-3D for the next two steps.

( ) On one end of the delay line, push the 5-pin socket down and onto vertical preamplifier plug P602 in the manner shown.

( ) Similarly, connect the other delay line plug onto vertical deflection circuit board plug P301.

( ) Remove the paper backing from the "Danger" label and press the label in place on the top of the high voltage enclosure as shown.

( ) Remove the backing paper from the blue and white label and press the label in place on the Oscilloscope rear panel as shown in the Pictorial. NOTE: Be sure to refer to the Model and Series numbers on the blue and white label in any correspondence you have with the Heath Company about your kit.

( ) You may store connectors P401 and P501 down between the CRT shield and the inner side of the vertical preamp shield.

## TEST CABLE PREPARATION

Refer to Pictorial 15-4 (Illustration Booklet, Page 44) for the following steps.

( ) Refer to Detail 15-4A and prepare the indicated end of the test cable assembly as shown.

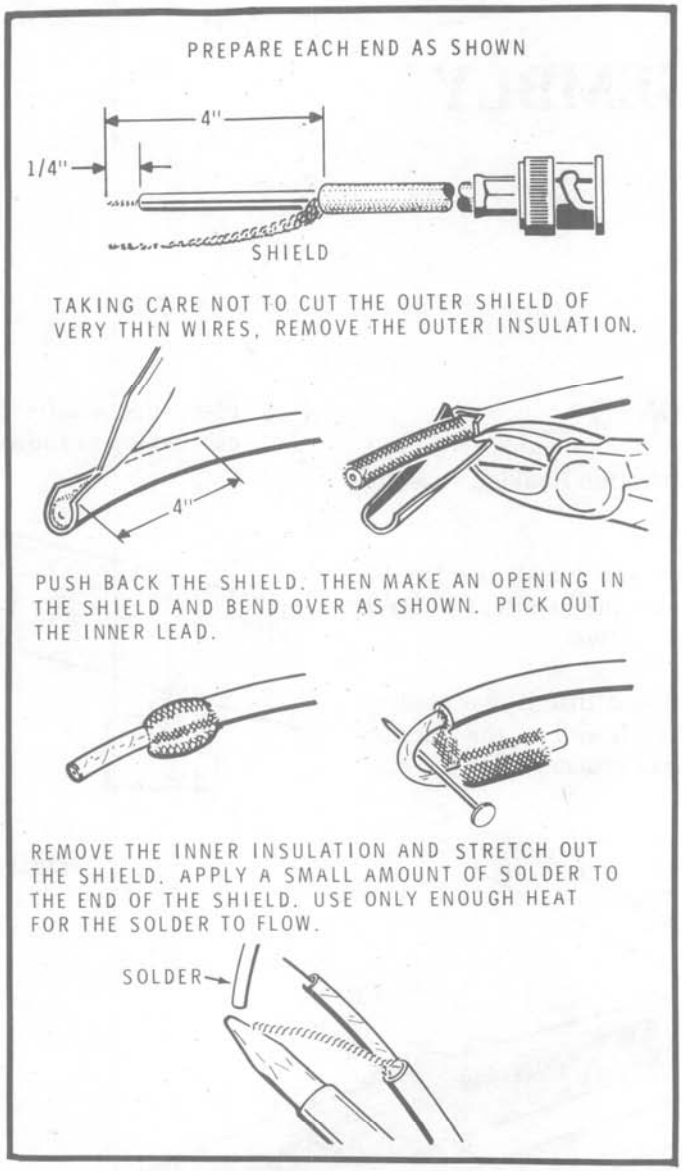
( ) Push alligator clip insulators onto the inner lead and the shield lead of the test cable.

( ) Solder an alligator clip onto the end of the cable inner lead as shown in the Pictorial.

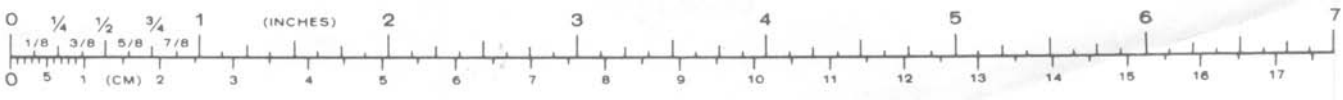
( ) Solder an alligator clip onto the end of the cable shield lead.

( ) After the alligator clip connections have cooled, bend the tabs around the leads. Then slide the insulators down over the alligator clips.

Except for the "Final Assembly," this completes the step-by-step assembly of your Oscilloscope. Refer to your Operation Manual, Section 14, and perform all the necessary adjustments and have determined that your Oscillope is completely operational, return to this Assembly Manual to perform the steps under "Final Assembly."


PREPARE EACH END AS SHOWN
4"
1/4"
SHIELD
TAKING CARE NOT TO CUT THE OUTER SHIELD OF VERY THIN WIRES, REMOVE THE OUTER INSULATION.
4"
PUSH BACK THE SHIELD. THEN MAKE AN OPENING IN THE SHIELD AND BEND OVER AS SHOWN. PICK OUT THE INNER LEAD.
REMOVE THE INNER INSULATION AND STRETCH OUT THE SHIELD. APPLY A SMALL AMOUNT OF SOLDER TO THE END OF THE SHIELD. USE ONLY ENOUGH HEAT FOR THE SOLDER TO FLOW.
SOLDER

**Detail 15-4A**


0 1/4 1/2 3/4 1 (INCHES) 2 3 4 5 6 7
1/8 3/8 5/8 7/8
0 5 1 (CM) 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

# FINAL ASSEMBLY

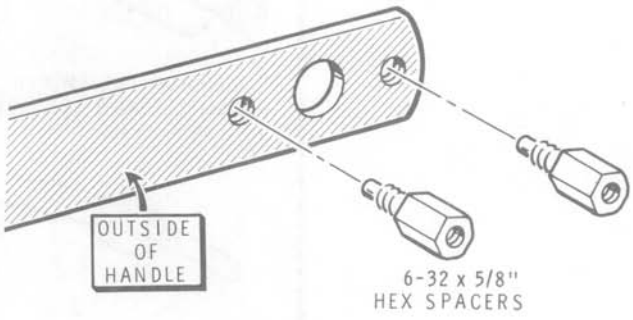
## HANDLE INSTALLATION

Refer to Pictorial 16-1 (Illustration Booklet, Page 45) for the following steps.

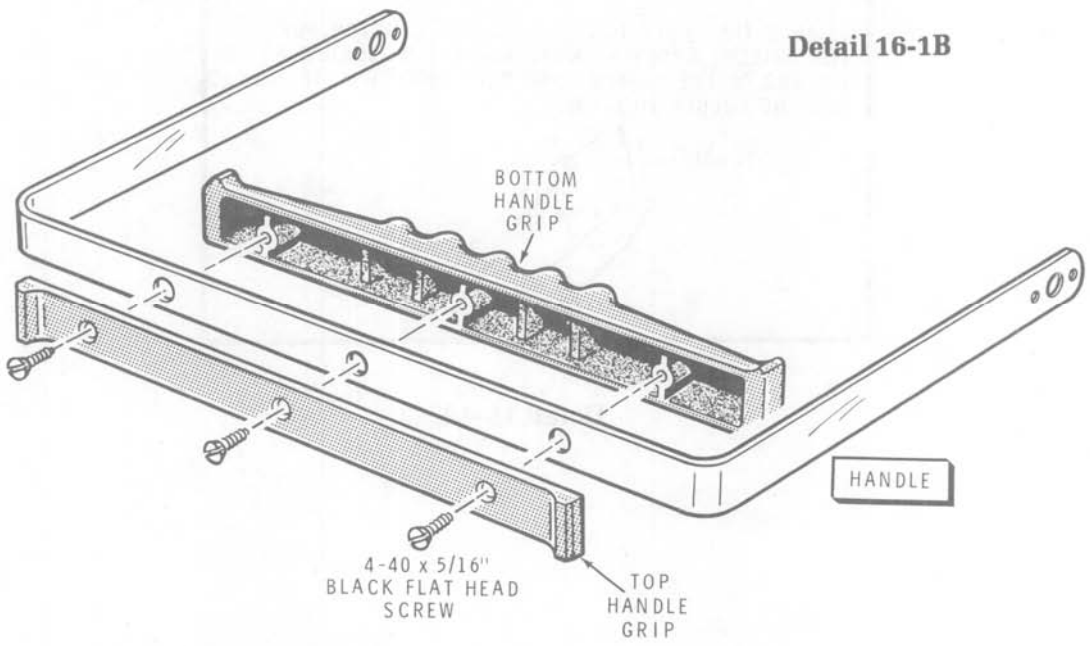
( ) Refer to Detail 16-1A and install the handle top and bottom grips on the handle. Use three 4-40 × 5/16" flat head screws.

( ) Refer to Detail 16-1B and install two 6-32 × 5/8" hex spacers in each end of the handle. Be sure to install these spacers from the outside of the handle.

( ) Place the handle around the outside of the cabinet top as shown in the Pictorial.




**Detail 16-1B**



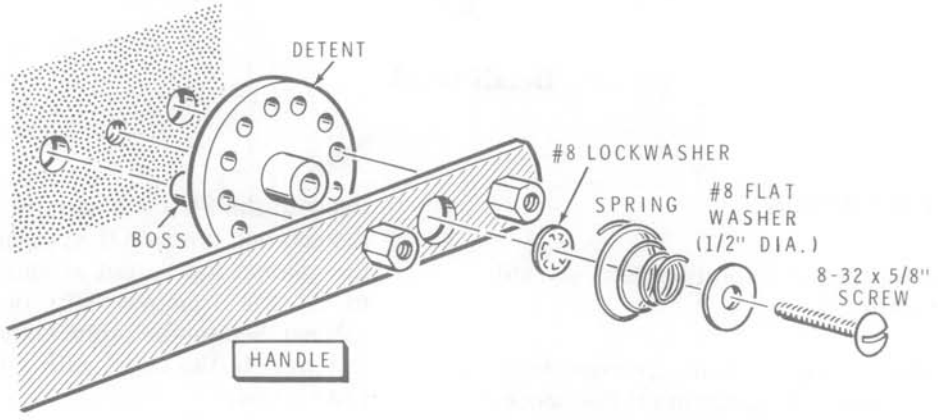

**Detail 16-1A**

( ) Refer to Detail 16-1C and mount the handle and a detent on each side of the cabinet top. Be sure the bosses on the detents are positioned in the holes in the cabinet. Then install a #8 lockwasher, a #8 flat washer (1/2" dia.), an 8-32 × 5/8" screw and a coil spring at each location. Do not overtighten the screw.

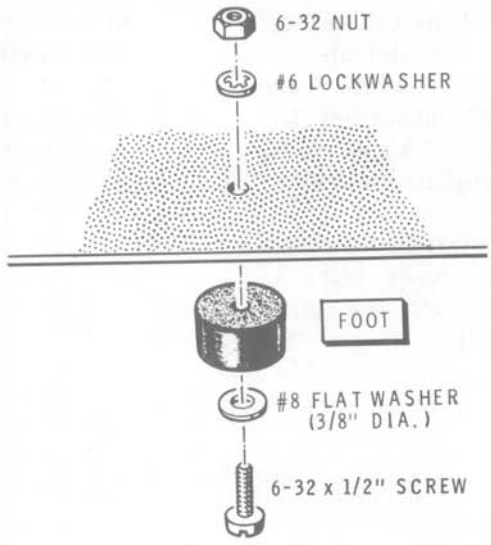
( ) Refer to the Pictorial and mount detent covers on each end of the handle as shown. Use 6-32 × 3/16" flat head screws. Be sure the cutout in the cover fits over the handle.

( ) Carefully inspect the two knob inserts. If either of them has a protective film over the shiny side, carefully peel away this film.

( ) Carefully remove the paper backing from each knob insert. Then press the insert into the center of each detent cover as shown.




**Detail 16-1C**




**Detail 16-2A**

## CABINET INSTALLATION

Refer to Pictorial 16-2 (Illustration Booklet, Page 46) for the following steps.

NOTE: If you have not aligned and calibrated your Oscilloscope yet, you should perform all the necessary steps to complete these operations before you install the Oscilloscope in the cabinet.

( ) Refer to Detail 16-2A and mount four feet on the underside of the cabinet bottom at holes EA, EB, EC, and ED in the manner shown. Use #8 (3/8" dia.) flat washers and 6-32 × 1/2" hardware.

( ) Secure the cabinet bottom to the frame assembly, the front bezel, and the rear panel at EF, EG, EH, EJ, EK, and EL with six 6-32 × 1/4" screws. Be sure to position the perforated portion of the cabinet bottom toward the rear as shown.

( ) Position the cabinet top down onto the frame assembly in such a manner that the sides of the top are on the outside of the cabinet bottom flanges as shown. Secure the cabinet top to the front bezel, the rear panel, and to the frame assembly with nine 6-32 × 1/4" screws.

( ) Refer to the Pictorial and, on the top front of the cabinet, position the cabinet subcover into the cabinet top cutout as shown. Be sure not to let the subcover slip down inside the cabinet. Secure the cabinet cover plate and the subcover to the bezel with a 6-32 × 1/4" flat head screw.

**IMPORTANT:** If you have purchased the Heathkit Model IOA-4200 Time-Voltage Module Accessory for use with this Oscilloscope, we recommend that you use the Oscilloscope for a minimum of 10 operating hours to get thoroughly acquainted with all its functions and applications before you install and use the Time-Voltage Module. It was for this reason that you were not previously instructed to assemble and install your Accsessory kit. If you have this Module, you should assemble it now and prepare to install it after the Oscilloscope has been in operation for the prescribed time. However, you should **not** install the Module if you believe the Oscilloscope to not be operating properly in all respects.

# 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

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