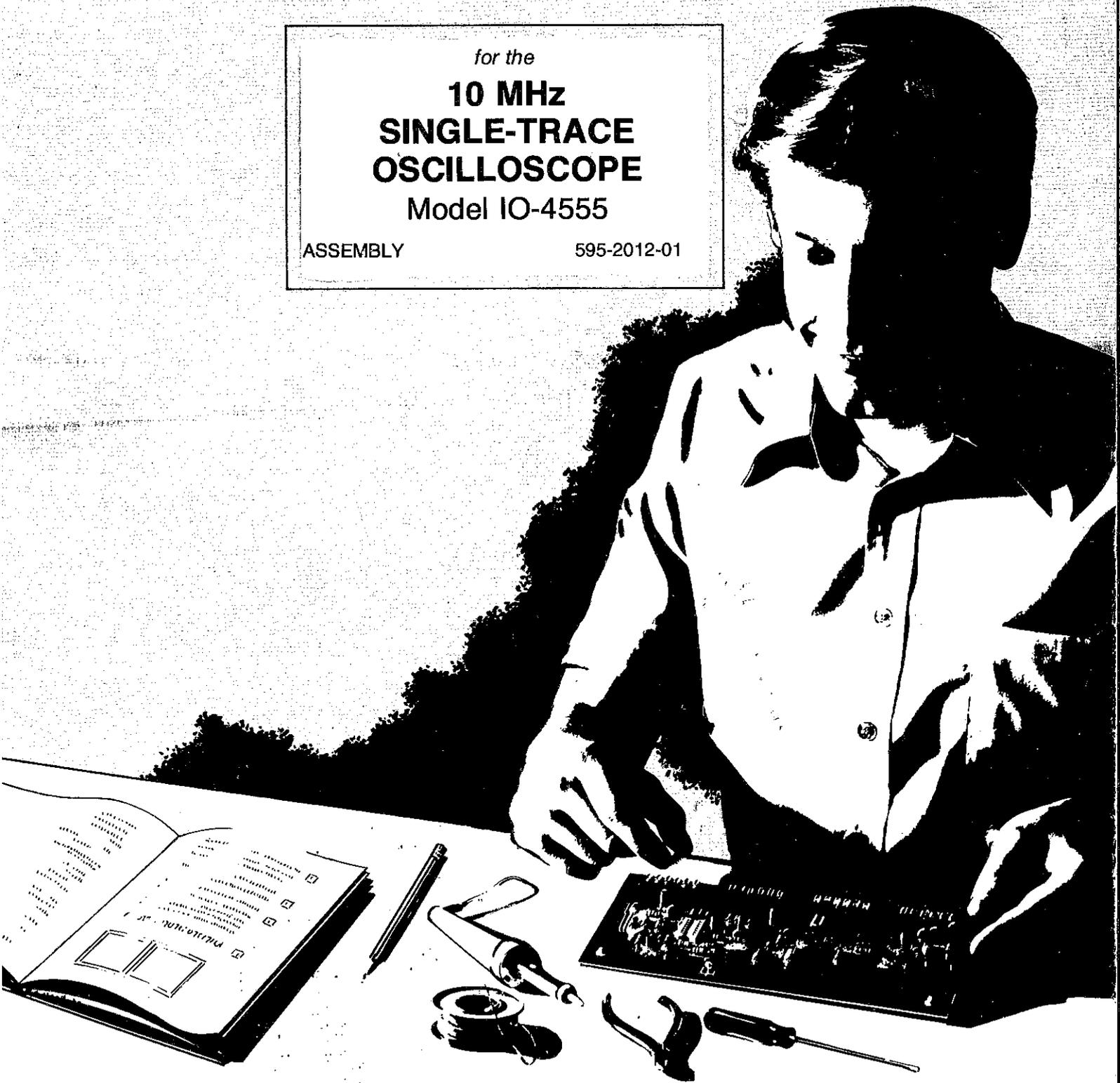


HEATHKIT[®] MANUAL

for the
**10 MHz
SINGLE-TRACE
OSCILLOSCOPE**
Model IO-4555

ASSEMBLY

595-2012-01



HEATH COMPANY • BENTON HARBOR, MICHIGAN

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INTRODUCTION

This Oscilloscope is a portable, triggered-sweep, single-trace, DC-to-10 MHz, laboratory-grade instrument. Outstanding features such as the fast vertical rise time, good trace brightness, and the high input sensitivity make the Oscilloscope ideal for the wide range of measurements typically encountered in electronics, development laboratories, and scientific research. In addition, the rugged construction and dependable operation make it a versatile tool for either the hobbyist or the service technician.

The vertical input and X input channels, when used in X-Y operation, provide a maximum signal sensitivity of 10 millivolts/centimeter. The attenuator networks can be switched through 11 calibrated ranges to set the deflection factor from 10 millivolts/centimeter to 20 volts volts/centimeter.

Calibrated time-base ranges from 0.2 seconds/centimeter to 0.2 microsecond/centimeter are readily switched in a 1-, 2-, 5-step sequence. A control on the Time Base switch provides variable sweep speeds between switch positions. Any sweep speed can be expanded 5 times when the X5 control is pulled out, giving a maximum sweep speed of 40 nanoseconds/centimeter.

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.

Various trigger signals can be selected. These include a sample of Channel Y input signals, an externally applied trigger signal, or a sample of the line voltage. The Trigger Mode switch controls the trigger input bandpass. A special TV position cuts off unwanted high frequency signals. This is especially useful when you want to trigger on TV vertical frame signals.

A calibrated 1-volt peak-to-peak square wave signal is provided through a front panel connector, allowing easy probe compensation, vertical amplifier calibration, and comparison.

Front panel display controls include Intensity, Focus, and Vertical and Horizontal position. An additional control, accessible through the rear panel, adjusts Astigmatism. Internal switches are used to match the regulated power supply to conventional line voltages from 105 volts to 260 volts AC.

Thus, this Oscilloscope combines the most desirable features required for precise measurement and display, while its solid-state circuitry provides excellent sensitivity, stability, and versatility.

UNPACKING INSTRUCTIONS

**DO NOT UNPACK YOUR OSCILLOSCOPE PARTS
UNTIL YOU ARE INSTRUCTED TO DO SO.**

The Oscilloscope packaging consists of the main carton which contains a small carton marked Packs #1 - #4, and a number of containers and loose parts, some of which are wrapped. These parts will be considered the Final Pack even though they may not be marked as such. Packs #1 through #4 are used to assemble the four circuit boards, while the Final Pack is used to assemble the chassis. When you unpack Packs #1 through #4, you will also remove a number of parts from the Final Pack. Each assembly section has a Parts List that relates to a pack. **NEVER UNPACK MORE THAN ONE PACK AT A TIME.**

The carton marked Packs #1 - #4 contains the parts for the circuit boards and a "Pack Index Sheet." This sheet identifies the location of each pack in the carton. Do not unpack the entire carton at one time. Refer to the "Pack Index Sheet" when the Manual instructs you to locate a certain pack.

When you check parts, return any part, or group of parts, that is packaged in a bag or envelope with a part number to its container after you identify it, and leave it there until you actually use it in a step. This will prevent intermixing of parts and aid in part identification. Some parts, however, have been placed in a bag or envelope that is not marked with the actual part number but is instead marked with a packaging number that begins with the number "171-" or "172-". These numbers are used for packaging purposes only and do not appear in the Manual Parts Lists. Open each bag or envelope that is marked with only a "171-" or "172-" packaging number to identify the parts it contains.

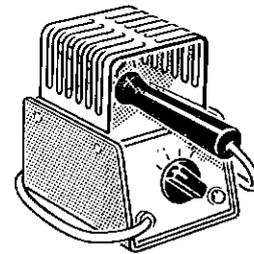
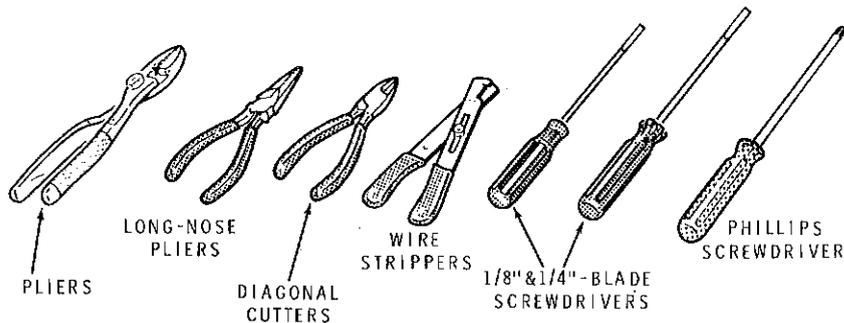
NOTE: Never use a "171-" or "172-" packaging number if you must order a replacement part. Use only the part numbers listed in the Manual Parts Lists for this purpose.

Remove the labels, Parts Order Form, CRT window, and graticule from the Manual and lay them aside. These parts will be used in the Chassis Assembly.

ASSEMBLY NOTES

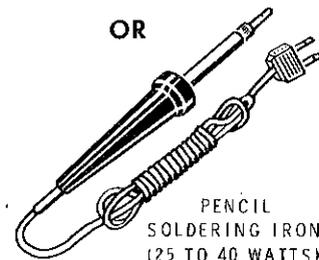
TOOLS

You will need these tools to assemble your kit.



HEATHKIT
SOLDERING
IRON

OR

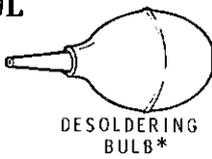


PENCIL
SOLDERING IRON
(25 TO 40 WATTS)

OTHER HELPFUL TOOLS



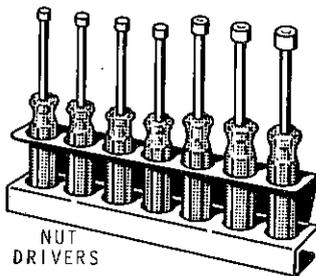
NUT STARTER
(MAY BE SUPPLIED
WITH KIT)



DESOLDERING
BULB*



DESOLDERING
BRAID*



NUT
DRIVERS

*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS.

ASSEMBLY

1. Follow the instructions carefully and read the entire step before you perform the operation.
2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.
3. Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.
4. Position all parts as shown in the Pictorials.
5. Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:
- In the Parts List,
 - At the beginning of each step where a component is installed,
 - In some illustrations,
 - In the Schematic,
 - In the section at the rear of the Manual.
7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excess lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

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

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

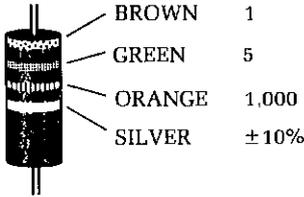
1. Use the right type of soldering iron. A 25-40-watt pencil soldering iron with a 1/8" 3/16" chisel or pyramid tip works best.
2. Keep the soldering iron tip clean. Wipe it off on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and 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 re-tinned.



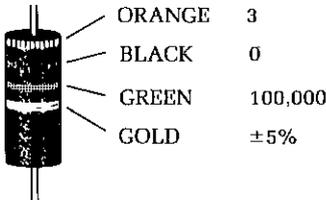
PARTS

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

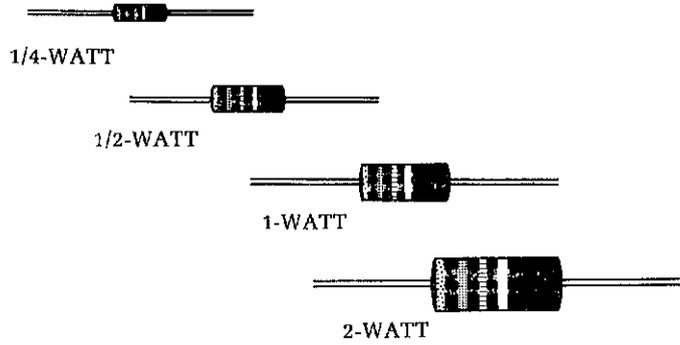
EXAMPLES:



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



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



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

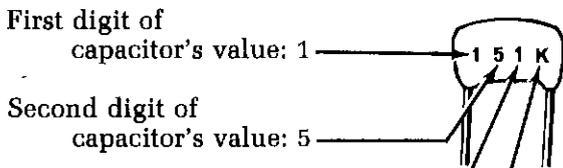
Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar*, electrolytic, etc. Some capacitors may have their value printed in the following manner:

EXAMPLES:

$151K = 15 \times 10 = 150 pF$

$759 = 75 \times 0.1 = 7.5 pF$

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



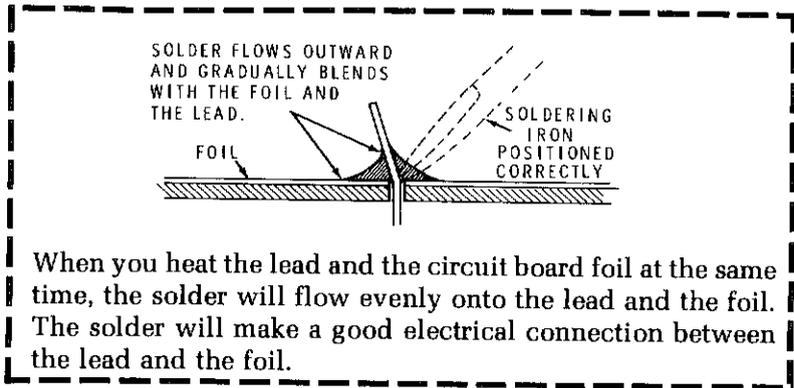
Multiplier: Multiply the first & second digits by the proper value from the Multiplier Chart.

To find the tolerance of the capacitor, look up this letter in the Tolerance columns.

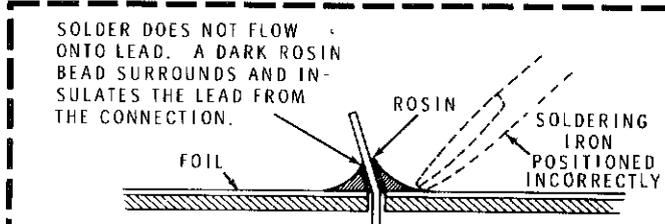
MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY:	10pF OR LESS	LETTER	OVER 10pF
0	1	$\pm 0.1 pF$	B	
1	10	$\pm 0.25 pF$	C	
2	100	$\pm 0.5 pF$	D	
3	1000	$\pm 1.0 pF$	F	$\pm 1\%$
4	10,000	$\pm 2.0 pF$	G	$\pm 2\%$
5	100,000		H	$\pm 3\%$
			J	$\pm 5\%$
8	0.01		K	$\pm 10\%$
9	0.1		M	$\pm 20\%$

*DuPont Registered Trademark

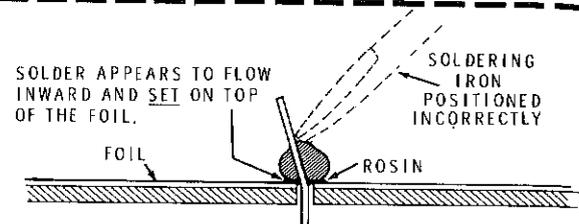
A GOOD SOLDER CONNECTION



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.

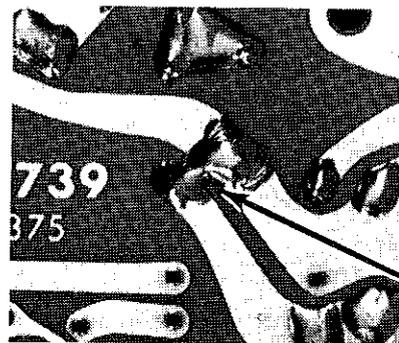


When the foil is not heated sufficiently the solder blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

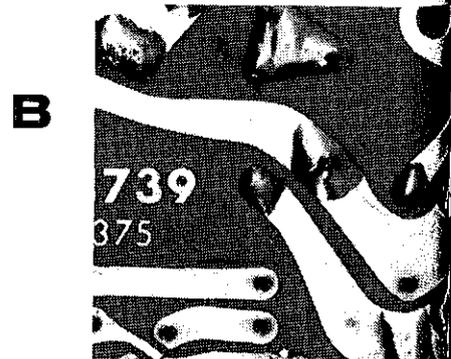
A solder bridge between two adjacent foils is shown in photograph A. Photograph B shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils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

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



A

SOLDER BRIDGE



B

LOW VOLTAGE CIRCUIT BOARD

PARTS LIST

Refer to the "Pack Index Sheet" and locate pack #1. Then remove the parts from this pack and check each one against the following list. The key numbers correspond to the numbers on the Low Voltage Circuit Board Parts Pictorial (on Page 1 in the Illustration Booklet). Any part that is packaged in an individual envelope with a part number on it should be placed back in its envelope after you identify it until the part is called for in a step.

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

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

NOTE: The following resistors have a tolerance of 5% unless they are listed otherwise. 5% is indicated by a fourth color band of gold, while 10% is indicated by a silver band.

1/4-Watt

A1	1-1-12	2	100 Ω , 10% (brown-black-brown)	R304, R305
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1/2-Watt

A2	1-123	2	100 Ω (brown-black-brown)	R312, R314
A2	1-133	1	15 k Ω (brown-green-orange)	R308
A2	1-124	1	27 k Ω (red-violet-orange)	R311

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

Resistors (cont'd.)

2-Watt

A3	3-2-2	2	.33 Ω (orange-orange-silver)	R306, R307
A3	3-6-2	1	.51 Ω (green-brown-silver)	R315
A3	3-3-2	1	2.7 Ω (red-violet-gold)	R313
A3	1-20-2	2	100 Ω , 10% (brown-black-brown)	R302, R303

5-Watt

A4	3-28-5	1	90 Ω , 10%, wire-wound	R301
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CONTROL

B1	10-386	1	10 k Ω	R309
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KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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CAPACITORS**Mylar***

C1	27-47	2	.1 μ F	C305, C306
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Electrolytic

C2	25-123	2	2 μ F	C303, C304
C3	25-111	1	1000 μ F, tubular	C4
C4	25-148	4	1000 μ F, 15V or 16V	C309, C311, C312, C313
C4	25-164	4	1000 μ F, 25V	C301, C302 C307, C308

DIODES — TRANSISTORS — INTEGRATED CIRCUIT

D1	56-816	2	1N5232 zener diode	ZD313 ZD314
D1	57-27	12	1N2071 diode	D301-D312

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

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

D2	417-118	1	2N3393 transistor	Q304
D2	417-201	1	X29A829 transistor	Q306
D3	417-234	1	2N3638A transistor	Q305
D4	417-818	1	MJE181 transistor	Q302
D4	417-819	1	MJE171 transistor	Q301
D5	417-224	1	MPSU05 transistor	Q303
D6	442-65	1	SG4501N integrated circuit	IC301

HARDWARE

E1	250-213	2	4-40 x 5/16" screw
E2	252-2	2	4-40 nut
E3	254-9	2	#4 lockwasher

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

MISCELLANEOUS

F1	215-94	2	Heat sink
F2	434-298	1	14-pin socket
F3	490-5	1	Nut starter
F4	490-111	1	IC puller

PARTS FROM FINAL PACK

85-1540-1	1	Low voltage circuit board
	1	Assembly Manual**
	1	Operation Manual**
597-260	1	Parts Order Form

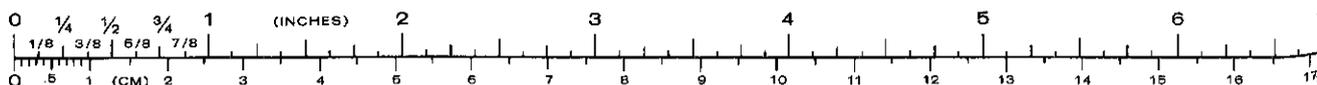
Solder

Wire

340-8	62"	Bare wire
344-2	21"	Larger black
344-50	12"	Smaller black
344-34	30"	Larger brown
344-126	35"	Smaller brown
344-21	27"	Larger red
344-52	3"	Smaller red
344-35	18"	Larger orange
344-128	24"	Smaller orange
344-36	18"	Larger yellow
344-54	3-1/2"	Smaller yellow
344-112	12"	Green
344-29	19"	Blue
344-59	5"	White
344-70	19"	White-black
344-71	7-1/2"	White-brown
344-72	20"	White-red
344-73	21"	White-orange
344-74	33"	White-yellow
344-76	18"	White-blue
344-78	17"	White-gray
347-2	12"	Twin lead
346-4	4"	Fiber sleeving
346-7	3"	Large sleeving
346-21	8"	Teflon* sleeving

*DuPont Registered Trademark

**See front cover for part numbers

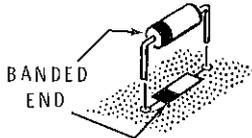


STEP-BY-STEP ASSEMBLY

START

() Position the circuit board as shown.

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



(✓) ZD313: 1N5232 zener diode (#56-616).

(✓) ZD314: 1N5232 zener diode (#56-616)

(✓) D309: 1N2071 diode (#57-27).

(✓) D311: 1N2071 diode (#57-27).

() D312: 1N2071 diode (#57-27).

(✓) D310: 1N2071 diode (#57-27).

(✓) D306: 1N2071 diode (#57-27).

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

(✓) D308: 1N2071 diode (#57-27).

(✓) D307: 1N2071 diode (#57-27).

(✓) D305: 1N2071 diode (#57-27).

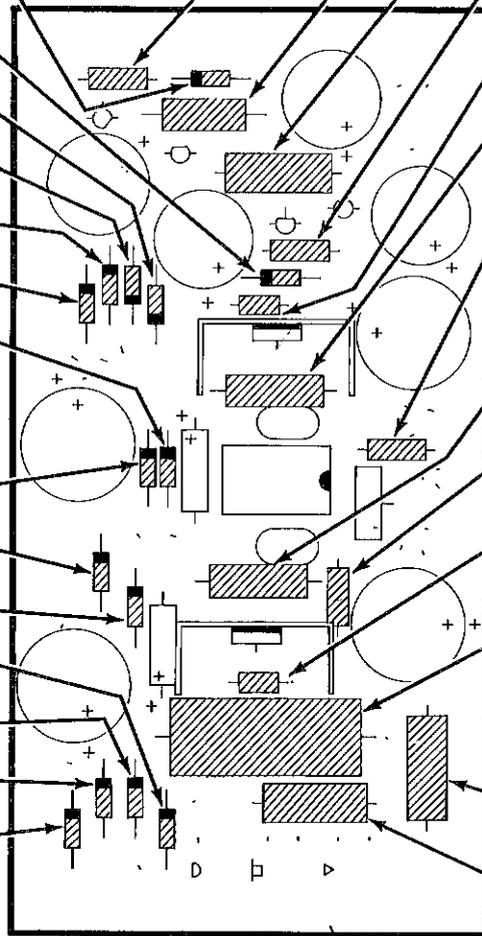
(✓) D301: 1N2071 diode (#57-27).

(✓) D302: 1N2071 diode (#57-27).

(✓) D304: 1N2071 diode (#57-27).

() D303: 1N2071 diode (#57-27).

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



PICTORIAL 1-1

CONTINUE

(✓) R314: 100 Ω , 1/2-watt (brown-black-brown).

(✓) R315: .51 Ω , 2-watt (green-brown-silver). The circuit board may be marked "1W."

(✓) R313: 2.7 Ω , 2-watt (red-violet-gold).

(✓) R312: 100 Ω , 1/2-watt (brown-black-brown).

(✓) R304: 100 Ω , 1/4-watt (brown-black-brown).

(✓) R306: .33 Ω , 2-watt (orange-orange-silver).

(✓) R308: 15 k Ω , 1/2-watt (brown-green-orange).

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

(✓) R307: .33 Ω , 2-watt (orange-orange-silver).

(✓) R311: 27 k Ω , 1/2-watt (red-violet-orange).

(✓) R305: 100 Ω , 1/4-watt (brown-black-brown).

(✓) R301: 90 Ω , 10%, 5-watt wire-wound. Mount the resistor 1/16" above the circuit board.

NOTE: Position the next two resistors 1/4" away from the circuit board.

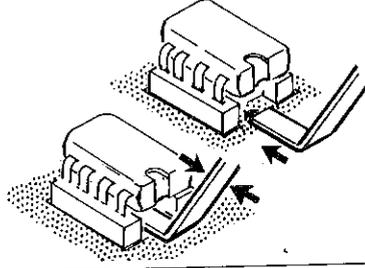
(✓) R303: 100 Ω , 2-watt (brown-black-brown).

(✓) R302: 100 Ω , 2-watt (brown-black-brown).

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

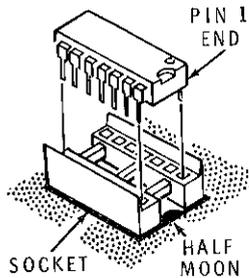
START →

NOTE: An IC puller has been included with this kit in case you have to remove an IC from its socket. To use the puller, insert its foot beneath the IC; then gently rock the tool back and forth to lift the IC.

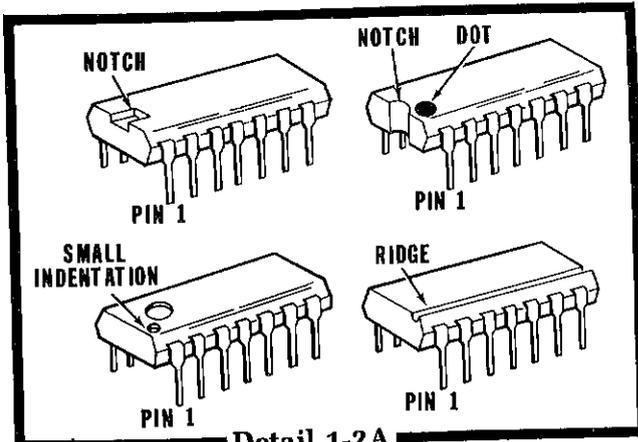


(✓) 14-pin socket at IC301. Be sure the pins are straight before you install the socket. Solder the pins to the foil.

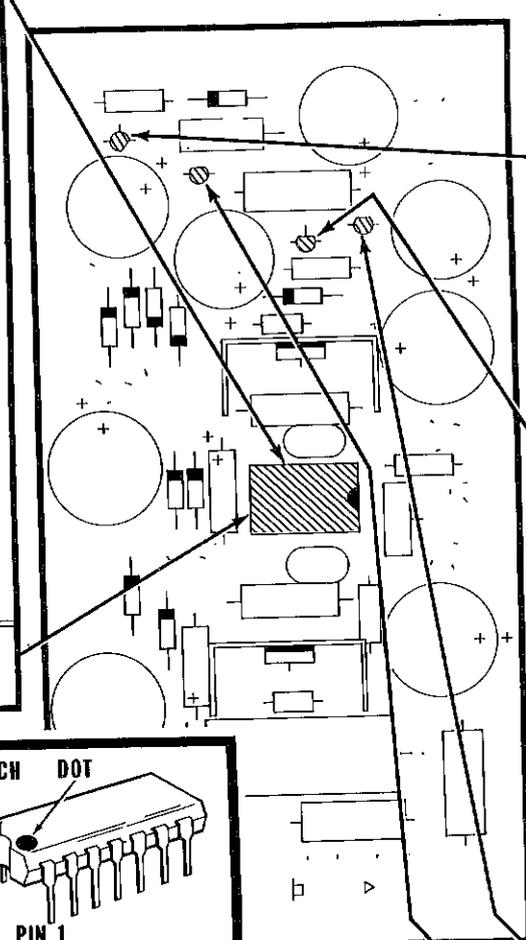
NOTE: To install an integrated circuit, first refer to Detail 1-2A and identify the pin 1 end. Then position the pin 1 end toward the half-moon mark on the circuit board and carefully install the integrated circuit. Make sure all the pins are in their respective holes.



(✓) IC301: SG4501N integrated circuit (#442-65).



Detail 1-2A



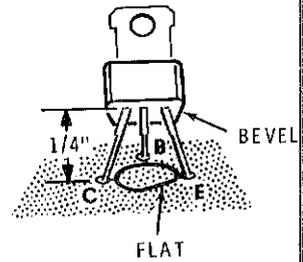
PICTORIAL 1-2

CONTINUE →

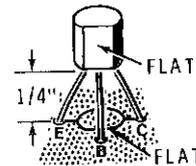
In the following steps, install each transistor as follows:

1. Refer to the illustrations and identify the shape of the transistor you received. Then identify the C, B, and E leads.
2. Insert the transistor leads into the corresponding E, C, and B holes in the circuit board.
3. Position the transistor 1/4" above the circuit board.
4. Turn the circuit board over and solder the leads to the foil, and cut off the excess lead lengths.

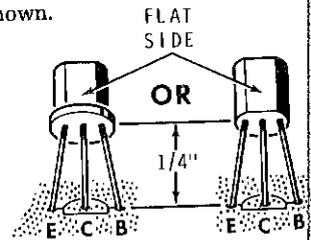
(✓) Q303: MPSU05 transistor (#417-224).



() Q305: 2N3638A transistor (#417-234).



Install the next two transistors shown.



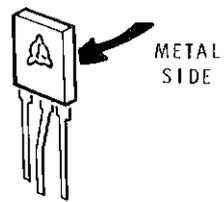
() Q306: X29A829 transistor (#417-201).

() Q304: 2N3393 transistor (#417-118).

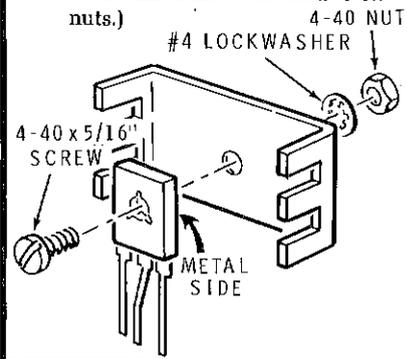
START ↘

(✓) Prepare a transistor heat sink combination as follows:

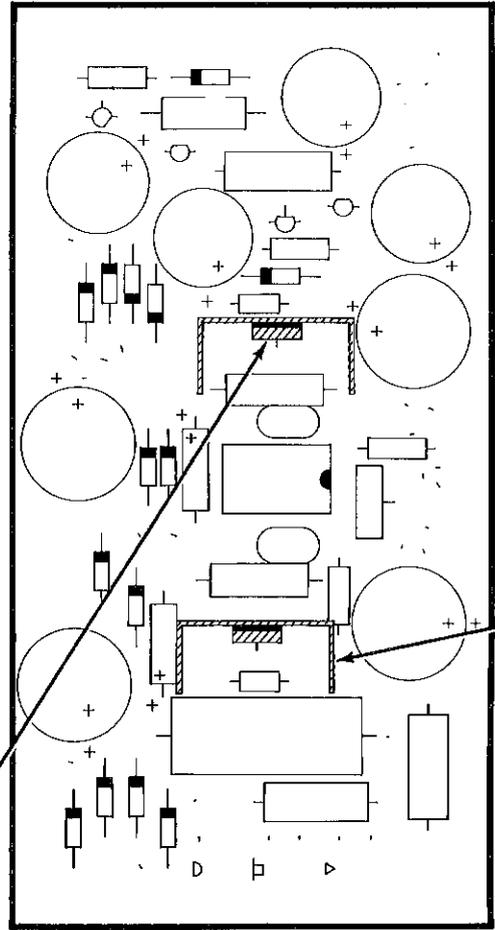
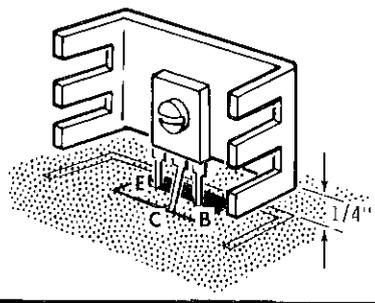
1. Bend the center (c) lead of an MJE171 transistor (#417-819) away from the metal side of the transistor as shown.



2. Mount a heat sink to the transistor with a 4-40 x 5/16" screw, a #4 lockwasher, and a 4-40 nut. (Use the plastic nut starter to hold and start 4-40 and 6-32 nuts.)



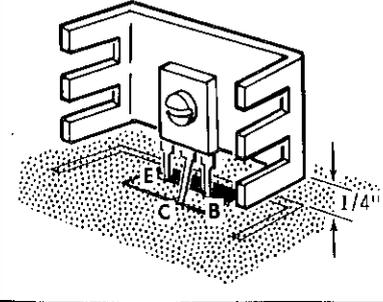
- (✓) Q301: MJE171 transistor heat sink combination (#417-819). Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE ↘

- (✓) As before, prepare another transistor heat sink combination. Use the MJE181 transistor (#417-818).

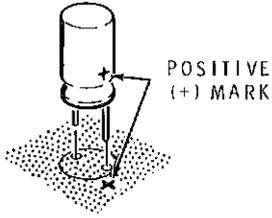
- (✓) Q302: MJE181 transistor heat sink combination (#417-818). Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 1-3

START

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

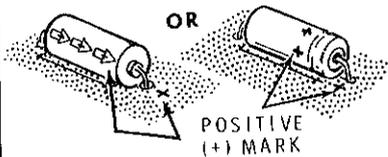


(✓) C311: 1000 μ F, 15V or 16V electrolytic.

(✓) C309: 1000 μ F, 15V or 16V electrolytic.

(✓) C302: 1000 μ F, 25V electrolytic.

NOTE: When you install an electrolytic capacitor, always match the positive (+) marked end of the capacitor with the positive (+) mark on the circuit board.

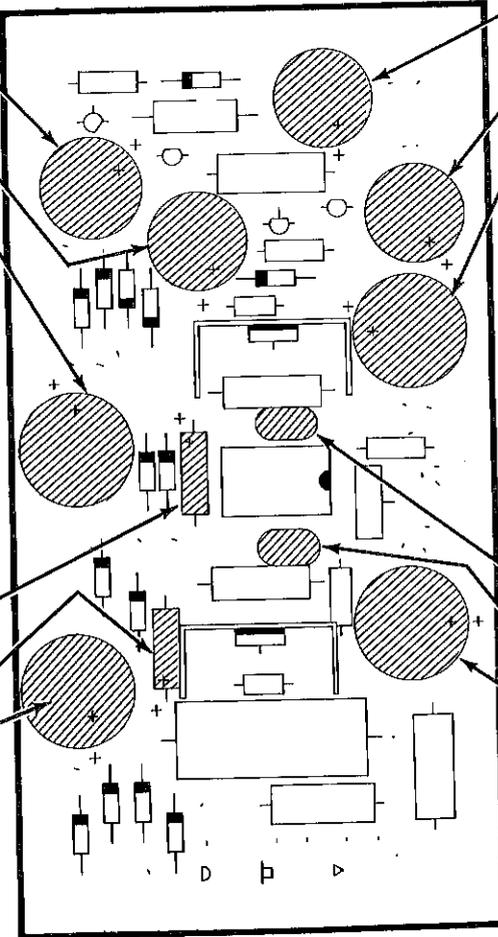


(✓) C303: 2 μ F electrolytic.

(✓) C304: 2 μ F electrolytic.

(✓) C301: 1000 μ F, 25V electrolytic.

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



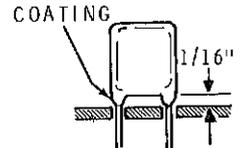
CONTINUE

(✓) C313: 1000 μ F, 15V or 16V electrolytic.

(✓) C312: 1000 μ F, 15V or 16V electrolytic.

(✓) C307: 1000 μ F, 25V electrolytic.

NOTE: A coating on Mylar capacitor leads can extend through the circuit board and make soldering difficult. Therefore, always space Mylar capacitors 1/16" off the circuit board.



(✓) C305: .1 μ F Mylar.

(✓) C306: .1 μ F Mylar.

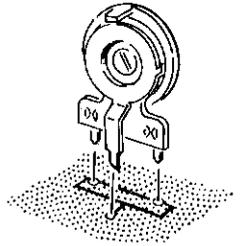
(✓) C308: 1000 μ F, 25V electrolytic.

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

PICTORIAL 1-4

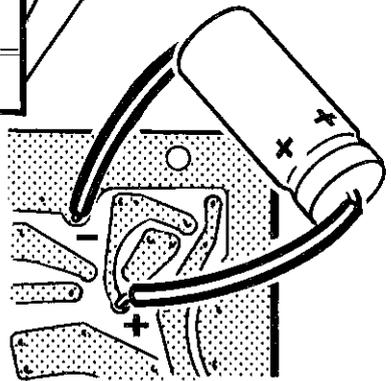
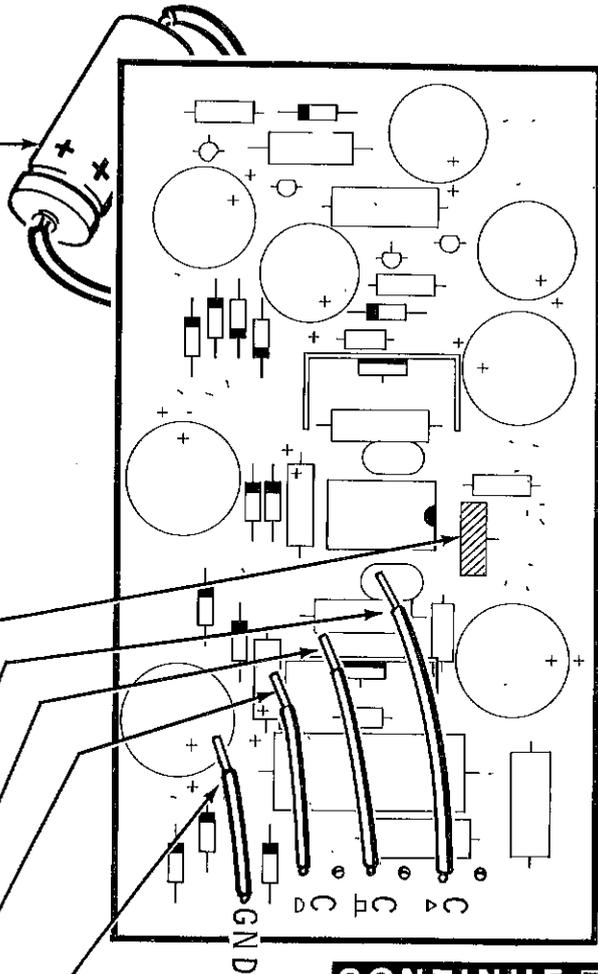
START ▾

- (✓) Cut both leads of a 1000 μ F tubular electrolytic capacitor to 1-1/2".
- (✓) Cut two 1-1/4" lengths of fiber sleeving.
- (✓) Slide a length of sleeving over each lead of a 1000 μ F electrolytic capacitor.
- (✓) C4: 1000 μ F electrolytic. Connect the capacitor to the foil side of the circuit board and solder the leads to the foil as shown in Detail 1-5A.
- (✓) R309: 10 k Ω control (#10-386). Solder the lugs to the foil.



NOTE: When a wire is called for, cut the wire to the specified length and remove 1/4" of insulation from each end. If the wire is stranded, twist the fine wire strands and apply a small amount of solder to the bare ends to hold the strands together. Solder each wire to the foil as it is installed. The loose wire ends will be connected later.

- (✓) 2-1/2" white-red wire at C D.
- (✓) 2-1/4" smaller red wire at C B.
- (✓) 2-3/4" white-blue wire at C D.
- (✓) 3" larger black wire at GND.



Detail 1-5A

CONTINUE ▾

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 and integrated circuit for proper installation.
- () Capacitors for the correct position of the positive end.
- () Diodes for the correct position of the banded end.

FINISH

Set the circuit board aside temporarily. The remaining circuit board holes will be used later.



HIGH VOLTAGE CIRCUIT BOARD

PARTS LIST

Refer to the "Pack Index Sheet" and locate pack #2. Then remove the parts from this pack and check each one against the following list. The key numbers correspond to the numbers on the High Voltage Circuit Board Parts Pictorial (on Page 1 in the Illustration Booklet). Any part that is packaged in an individual envelope with a part number on it should be placed back in its envelope after you identify it until the part is called for in a step.

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

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

NOTE: The following resistors have a tolerance of 10% unless they are listed otherwise. 10% is indicated by a fourth color band of silver, while 5% is indicated by a gold band. The resistors may be packed in more than one envelope. Open all the resistor envelopes in this pack before you check the resistors against the Parts List.

1/2-Watt

A1	1-145	2	47 Ω, 5% (yellow-violet-black)	R415, R416
A1	1-175	1	120 Ω, 5% (brown-red-brown)	R401
A1	1-9	1	1000 Ω (brown-black-red)	R408
A1	1-80	1	1200 Ω, 5% (brown-red-red)	R414
A1	1-20	3	10 kΩ (brown-black-orange)	R402, R407, R418
A1	1-22	2	22 kΩ (red-red-orange)	R417, R421
A1	1-67	1	39 kΩ (orange-white-orange)	R422

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Resistors (cont'd.) 1/2 Watt

A1	1-47	2	56 kΩ (green-blue-orange)	R404, R405
A1	1-102	1	82 kΩ (gray-red-orange)	R427
A1	1-59	1	220 kΩ (red-red-yellow)	R423
A1	1-189	1	270 kΩ (red-violet-yellow)	R424
A1	1-34	3	680 kΩ (blue-gray-yellow)	R411, R412, R413

1-Watt

A2	1-33-1 ✓	2	680 kΩ (blue-gray-yellow)	R425, R426
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2-Watt

A3	1-1-2 ✓	2	2700 Ω (red-violet-red)	R403, R404
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KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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CONTROLS

B1	10-390	✓1	20 kΩ	R419
B1	10-941	✓1	100 kΩ	R409
B1	10-946	✓1	500 kΩ	R430

CAPACITORS**Ceramic**

C1	21-60	✓2	18 pF	C404, C405
C1	21-139	✓1	150 pF	C415
C1	21-90	✓2	.001 μF	C403, C406
C1	21-36	✓1	.002 μF	C407
C1	21-141	✓1	.0033 μF (3300)	C414
C1	21-116	✓2	.005 μF	C410, C411
C1	21-16	✓1	.01 μF	C416

Paper

C2	23-62	✓2	.1 μF	C408, C409
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Tantalum

C3	25-220	✓2	10 μF (10M)	C412, C413
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Electrolytic

C4	25-267	✓2	100 μF	C401, C402
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KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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DIODES — TRANSISTORS — INTEGRATED CIRCUIT

D1	✓56-56	1	1N4149 diode	D406
D1	56-68	1	ZVR-68 zener diode	ZD403
D1	✓57-27	1	1N2071 diode	D402
D1	✓57-56	2	SCM-30 diode	D404, D405

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

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

D2	✓417-805	2	2N4889 transistor	Q402, Q403
D3	✓417-834	✓3	MPSU10 transistor	Q404, Q405, Q406
D4	✓442-22	1	N5741V integrated circuit	IC401

MISCELLANEOUS

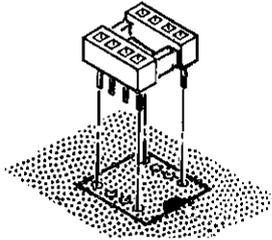
E1	434-230	1	8-pin socket
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PART FROM FINAL PACK

85-1962-2	1	High voltage circuit board
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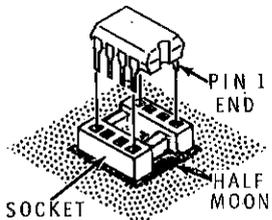
START

NOTE: To install an 8-pin socket, be sure the socket pins are straight. Then insert the socket pins and solder them to the foil.

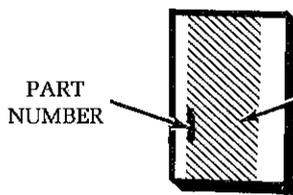


(✓) 8-pin socket at IC401.

NOTE: To install an integrated circuit, first refer to Detail 2-3A (at the bottom of the next column) and identify the pin 1 end. Then position the pin 1 end toward the half-moon mark on the circuit board and carefully install the integrated circuit. Make sure all the pins are in their respective holes.



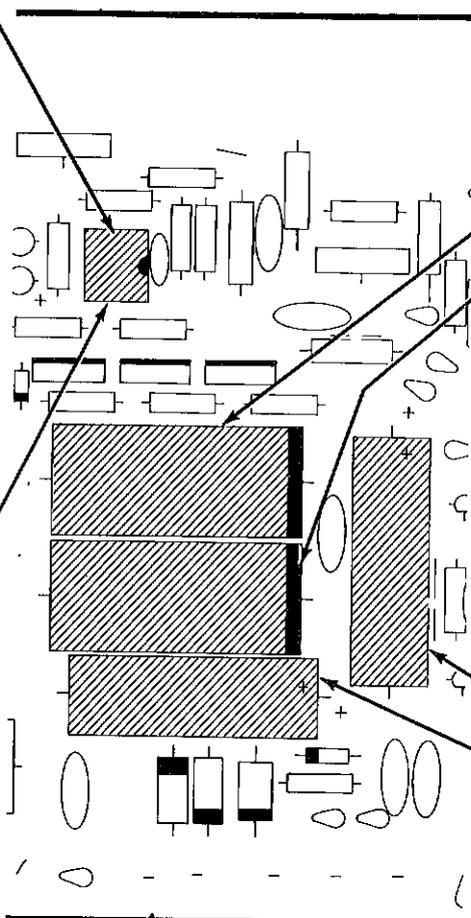
(✓) IC401: N5741V integrated circuit (#442-22).



PART NUMBER

IDENTIFICATION DRAWING

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



CONTINUE

NOTE: When you install .1 μ F paper capacitors, always match the banded end of the capacitor with the band outline on the circuit board.



(✓) C409: .1 μ F paper.

(✓) C408: .1 μ F paper.

NOTE: When you install an electrolytic capacitor, always match the positive (+) marked end of the capacitor with the positive (+) mark on the circuit board.

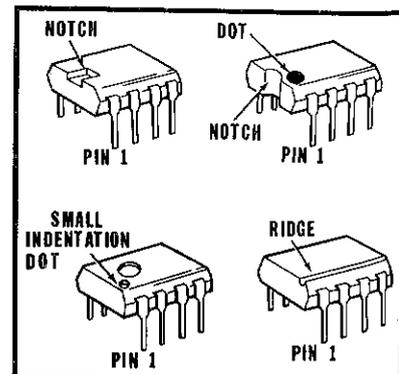


(✓) C402: 100 μ F electrolytic.

(✓) C401: 100 μ F electrolytic.

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

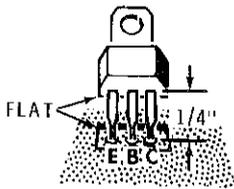
PICTORIAL 2-3



Detail 2-3A

START ▾

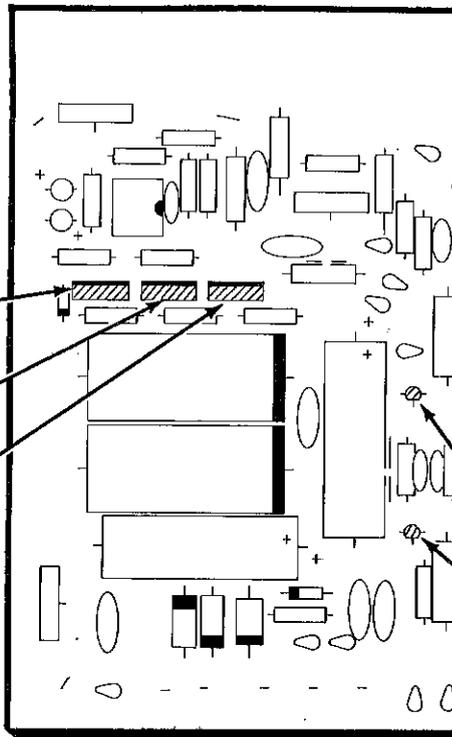
NOTE: Install the next three transistors as shown. Line up the indicated flat of the transistor with the flat on the circuit board. Solder the leads to the foil and cut off the excess lead lengths.



(✓) Q406: MPSU10 transistor (#417-834).

(✓) Q405: MPSU10 transistor (#417-834).

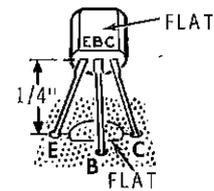
(✓) Q404: MPSU10 transistor (#417-834).



CONTINUE ▾

In the following steps, install each transistor as follows:

1. Refer to the illustration below and identify the E, B, and C leads.
2. Insert the leads into the corresponding E, B, and C holes in the circuit board.
3. Position the transistor 1/4" above the circuit board.
4. Turn the circuit board over, solder the leads to the foil, and cut off the excess lead lengths.



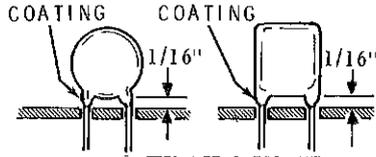
(✓) Q403: 2N4889 transistor (#417-805).

(✓) Q402: 2N4889 transistor (#417-805).

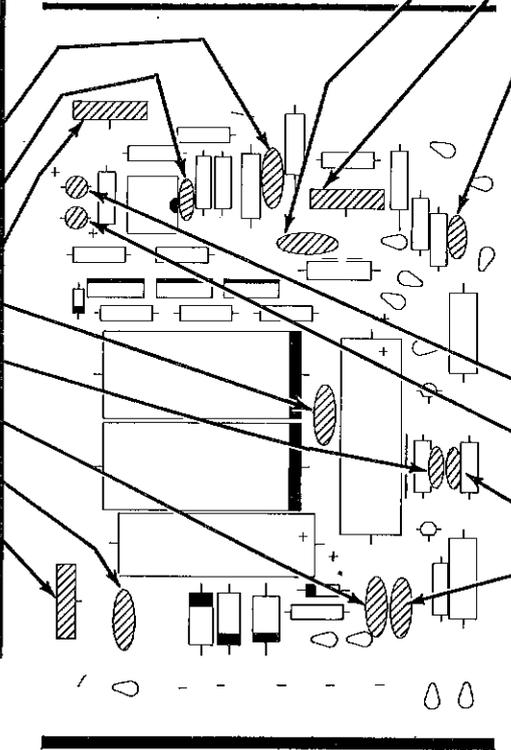
PICTORIAL 2-4

START

NOTE: A coating on ceramic and Mylar capacitor leads can extend through the circuit board and make soldering difficult. Therefore, always space ceramic and Mylar capacitors 1/16" off the circuit board.



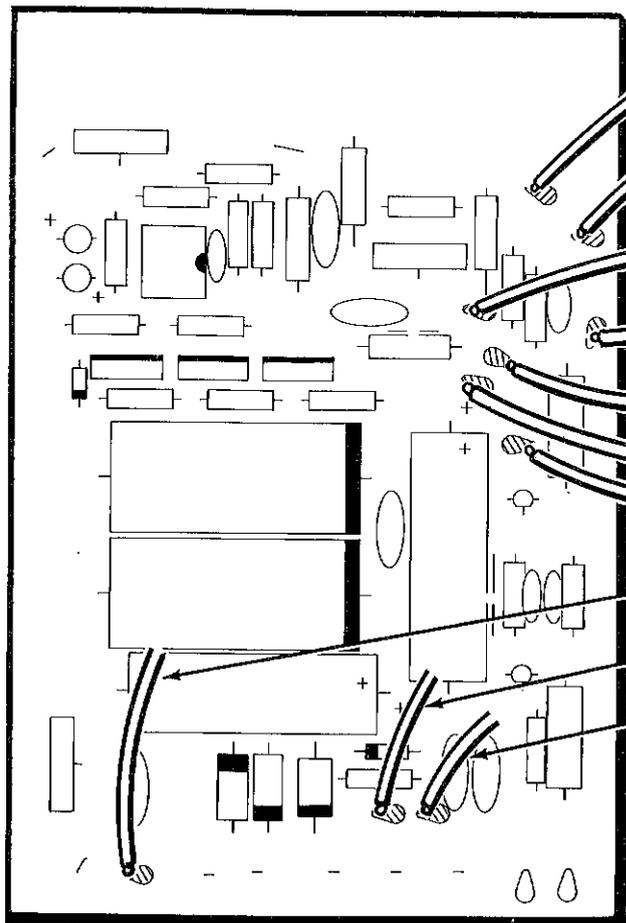
- C415: 150 pF ceramic.
- C414: .0033 μ F ceramic.
- R419: 20 k Ω control (#10-390).
- C411: .005 μ F ceramic.
- C405: 18 pF ceramic.
- C406: .001 μ F ceramic.
- C416: .01 μ F ceramic.
- R430: 500 k Ω control (#10-946).
- Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

- C410: .005 μ F ceramic.
 - R409: 100 k Ω control (#10-941). Solder the leads to the foil.
 - C407: .002 μ F ceramic.
- NOTE: When you install a tantalum capacitor, always insert the positive (+) or dot marked lead of the capacitor, in the positive (+) marked hole on the circuit board.
- POSITIVE (+) MARK COLOR DOT
-
- C413: 10 μ F tantalum.
 - C412: 10 μ F tantalum.
 - C404: 18 pF ceramic.
 - C403: .001 μ F ceramic.
 - Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 2-5



PICTORIAL 2-6

START ▼

In the following steps, when you prepare a wire, twist the bare wire strands together and apply a small amount of solder to hold them together. Solder each wire as you install it and cut off the excess wire length.

- (✓) 10" larger yellow wire at K. ✓
- (✓) 10" larger orange wire at G. ✓
- (✓) 5-1/2" larger red wire at B. ✓
- (✓) 2-1/2" larger red wire at A. ✓
- (✓) 2-1/2" larger orange wire at C. ✓
- (✓) 5-1/2" larger yellow wire at D. ✓
- (✓) 2-1/2" larger yellow wire at E. ✓
- (✓) 12" green wire at M. ✓
- (✓) 13" larger brown wire at L. ✓
- (✓) 13" larger brown wire at J. ✓

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 and IC for proper type and installation.
- (✓) Capacitors for the correct position of the banded end.
- (✓) Diodes for the correct position of the banded end.

FINISH

Set the circuit board aside temporarily. The remaining holes will be used later.



VERTICAL CIRCUIT BOARD

PARTS LIST

Refer to the "Pack Index Sheet" and locate pack #3. Then remove the parts from this pack and check each one against the following list. The key numbers correspond to the numbers on the Vertical Circuit Board Parts Pictorial (on Page 2 in the Illustration Booklet). Any part that is packaged in an individual envelope with a part number on it should be placed back in its envelope after you identify it until the part is called for in a step.

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

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
RESISTORS				
1/8-Watt, 1%				
A1	2-32-11	1	200 Ω	R157-2
A1	2-15-11	6	1000 Ω (1k)	R102-1, R102-2, R122-1, R122-2, R125-1, R125-2
A1	2-12-11	1	2000 Ω (2k)	R156-2
A1	2-40-11	2	10.1 k Ω	R104-1, R104-2
A1	2-41-11	1	13 k Ω	R155-2
A1	2-42-11	2	111 k Ω	R106-1, R106-2
A1	2-43-11	2	900 k Ω	R105-1, R105-2
A1	2-44-11	2	990 k Ω	R103-1, R103-2
A1	2-45-11	2	999 k Ω	R101-1, R101-2

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp.
Resistors (cont'd.)				
1/4-Watt, 1%				
A1	2-725-12	2	523 Ω	R132-1, R132-2
A1	2-610-12	4	900 Ω	R121-1, R121-2, R126-1, R126-2
A1	2-61-12	2	2050 Ω (2.05k)	R131-1, R131-2
A1	2-96-12	2	1 M Ω	R107-1, R107-2
1/4-Watt				
NOTE: The following resistors have a tolerance of 5% unless they are listed otherwise. 5% is indicated by a fourth color band of gold, while 10% is indicated by a silver band.				
B1	1-57-12	2	33 Ω (orange-orange-black)	R112-1, R112-2
B1	1-102-12	2	68 Ω (blue-gray-black)	R127-1, R127-2

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Resistors (cont'd.)				
1/2-Watt				
✓C1	1-41	18	10 Ω, 10% (brown-black-black-silver)	R117-1, R117-2, R118-1, R118-2, R133-1, R133-2, R134-1, R134-2, R142-1, R142-2, R143-1, R143-2, R154-1, R154-2, R158-2, R162-2, R163-1, R163-2
C1	1-103	4	33 Ω, 10% (orange-orange-black)	R108-1, R108-2, R169, R171
C1	1-145	6	47 Ω (yellow-violet-black)	R115-1, R115-2, R116-1, R116-2, R159-2, R161-2
C1	1-53	2	68 Ω (blue-gray-black)	R160, R170
C1	1-123	6	100 Ω (brown-black-brown)	R136-1, R136-2, R141-1, R141-2, R175, R177
C1	1-112	4	180 Ω (brown-gray-brown)	R146-1, R146-2, R147-1, R147-2
C1	1-151	2	330 Ω (orange-orange-brown)	R123-1, R123-2
C1	1-5	2	360 Ω (orange-blue-brown)	R129-1, R129-2
C1	1-157	2	470 Ω (yellow-violet-brown)	R165, R167
C1	1-95	2	560 Ω (green-blue-brown)	R111-1, R111-2
C1	1-131	1	620 Ω (blue-red-brown)	R166
C1	1-52	2	680 Ω (blue-gray-brown)	R119-1, R119-2
C1	1-79	2	820 Ω (gray-red-brown)	R137-2, R139-2
C1	1-172	2	1000 Ω (brown-black-red)	R135-1, R135-2

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Resistors (cont'd.)				
1/2-Watt				
C1	1-80	2	1200 Ω (brown-red-red)	R151-1, R151-2
C1	1-81	2	1500 Ω (brown-green-red)	R144-1, R144-2
C1	1-144	6	1800 Ω (brown-gray-red)	R137-1, R139-1, R145-1, R145-2, R148-1, R148-2
C1	1-90	2	2000 Ω (red-black-red)	R153-1, R153-2
C1	1-51	1	6800 Ω (blue-gray-red)	R172
C1	1-76	2	33 kΩ (orange-orange-orange)	R152-1, R152-2
C1	1-104	2	100 kΩ (brown-black-yellow)	R109-1, R109-2
C1	1-101	2	1 MΩ (brown-black-green)	R113-1, R113-2
1-Watt				
✓D1	1-27-1	1	33 kΩ, 10% (orange-orange-orange)	R173
2-Watt				
✓D2	1-46-2	1	180 Ω, 5% (brown-gray-brown)	R168
7-Watt				
D3	3-36-7	2	1200 Ω wire-wound	R174, R176
CONTROLS — SWITCHES				
F1	10-914	2	100 Ω control	R124-1, R124-2
✓F1	10-918	3	500 Ω control	R164-2, R149-1, R149-2
✓F2	10-1099	1	2000 Ω (2k) control	R138-2
F3	63-1231	2	11-position rotary switch with control	SW101-1/ R128-1, SW101-2/ R128-2
CAPACITORS				
Mica				
✓G1	20-119	1	90 pF	C119-2
✓G1	20-103	1	150 pF	C119-1

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Capacitors (cont'd.)**Ceramic**

✓ G2	21-157	2	5 pF	C121-1, C121-2
✓ G2	21-155	2	33 pF	C146-1, C146-2
✓ G2	21-86	1	75 pF	C126
✓ G2	21-17	1	270 pF	C125-2
✓ G2	21-171	2	680 pF	C106-1, C106-2
✓ G2	21-46	2	5000 pF (.005)	C103-1, C103-2
✓ G2	21-16	7	.01 μ F	C112-1, C112-2, C113-1, C113-2, C117-1, C117-2, C128
J G3	21-65	2	25 pF (violet-red-green-black-green)	C122-1, C122-2
J G3	21-66	2	50 pF (violet-green-black-black-green)	C109-1, C109-2

Tantalum

J G4	25-220	10	10 μ F	C114-1, C114-2, C115-1, C115-2, C116-1, C116-2, C123-1, C123-2, C124-1, C124-2
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Mylar

✓ G5	27-47	1	.1 μ F	C127
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Trimmer

✓ G6	31-83	2	2-6 pF (red dot)	C111-1, C111-2
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KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp.
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Capacitors (cont'd.)

✓ G6	31-71	12	3.2-18 pF (blue dot)	C101-1, C101-2, C102-1, C102-2, C104-1, C104-2, C105-1, C105-2, C107-1, C107-2, C108-1, C108-2
✓ G7	31-65	2	15-60 pF	C118-1, C118-2

DIODES

✓ H1	56-50	2	DO-7 zener	ZD105-1, ZD105-2
✓ H1	56-56	6	1N4149	D103-1, D103-2, D104-1, D104-2, D106-1, D106-2

TRANSISTORS

NOTE: Transistors are marked for identification in 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.

J1	417-100	2	2N3053	Q111, Q112
J2	417-201	2	X29A829	Q104-1, Q104-2
J3	417-292	4	2N5771	Q105-1, Q105-2, Q106-1, Q106-2

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

J3	417-293	8	2N5770	Q109-2, Q110-2, Q115-1, Q115-2, Q116-1, Q116-2, Q117-1, Q117-2 D101-1, D101-2, D102-1, D102-2
J4	417-854	4	SF50077	Q103-1, Q103-2, Q107-1, Q107-2, Q108-1, Q108-2, Q118-1, Q118-2, Q119-2 Q101-1, Q101-2, Q102-1, Q102-2
J4	417-801	9	MPSA20	Q113, Q114
J5	417-828	4	E304	
J6	417-834	2	MPSU10	

HARDWARE

K1	250-52	2	4-40 × 1/4" screw
K2	250-186	4	#4 × 3/8" self-tapping screw
K3	252-2	2	4-40 nut
K4	252-39	1	1/4" nut
K5	254-9	2	#4 lockwasher
K6	253-170	1	1/4" flat washer

MISCELLANEOUS

✓ L1	45-39	2	4.65 μH coil	L101, L102
✓ L2	204-2140	1	Control mounting bracket	
✓ L3	206-1183	1	Vertical input shield	
✓ L4	215-45	2	Small heat sink	
✓ L5	215-65	2	Large heat sink	
✓ L6	432-134	13	Socket pin (one extra pin supplied)	
✓ L7	475-16	2	Ferrite bead	

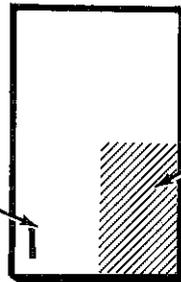
PART FROM FINAL PACK

85-1989-1	1	Vertical circuit board
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STEP-BY-STEP ASSEMBLY

NOTE: The leads of some components that are installed on this circuit board are soldered to the foil that extends around the outside edges of the board. It is important not to get a large lump of solder on this foil because it could interfere with the mounting of the board later. Therefore, do not bend the lead toward the edge of the board, let it protrude straight up. Then use just enough solder to make a good connection.

IDENTIFICATION
DRAWING



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

START

- () Position the circuit board as shown in the identification drawing.
- NOTE: When you install the 1% resistors, position them so the value is visible.
- (✓) R123-1: 330 Ω (orange-orange-brown).
- (✓) R125-1: 1000 Ω (1k), 1%.
- (✓) R133-1: 10 Ω (brown-black-black-silver).
- (✓) R122-1: 1000 Ω (1k), 1%.
- (✓) R117-1: 10 Ω (brown-black-black-silver).
- (✓) R113-1: 1 MΩ (brown-black-green).
- (✓) R116-1: 47 Ω (yellow-violet-black).
- (✓) R115-1: 47 Ω (yellow-violet-black).
- (✓) R112-1: 33 Ω 1/4-watt (orange-orange-black).
- (✓) R109-1: 100 kΩ (brown-black-yellow).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.
- (✓) R106-1: 111 kΩ, 1%.
- (✓) R105-1: 900 kΩ, 1%.
- (✓) R104-1: 10.1 kΩ, 1%.
- (✓) R103-1: 990 kΩ, 1%.
- () Solder all leads to the foil and cut off the excess lead lengths.

CONTINUE

- (✓) R134-1: 10 Ω (brown-black-black-silver).
- (✓) R132-1: 523 Ω, 1%.
- (✓) R131-1: 2.05 kΩ (2050), 1%.
- (✓) R126-1: 900 Ω, 1%.
- (✓) R121-1: 900 Ω, 1%.
- (✓) R119-1: 680 Ω (blue-gray-brown).
- (✓) R127-1: 68 Ω, 1/4-watt (blue-gray-black).
- (✓) R118-1: 10 Ω (brown-black-black-silver).
- (✓) R129-1: 360 Ω (orange-blue-brown).
- (✓) R111-1: 560 Ω (green-blue-brown).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.
- (✓) R108-1: 33 Ω 1/2-watt (orange-orange-black).
- (✓) R107-1: 1 MΩ, 1%.
- (✓) R102-1: 1000 Ω (1k), 1%.
- (✓) R101-1: 999 kΩ, 1%.
- (✓) Solder the leads to the foil and cut off the excess lead lengths.

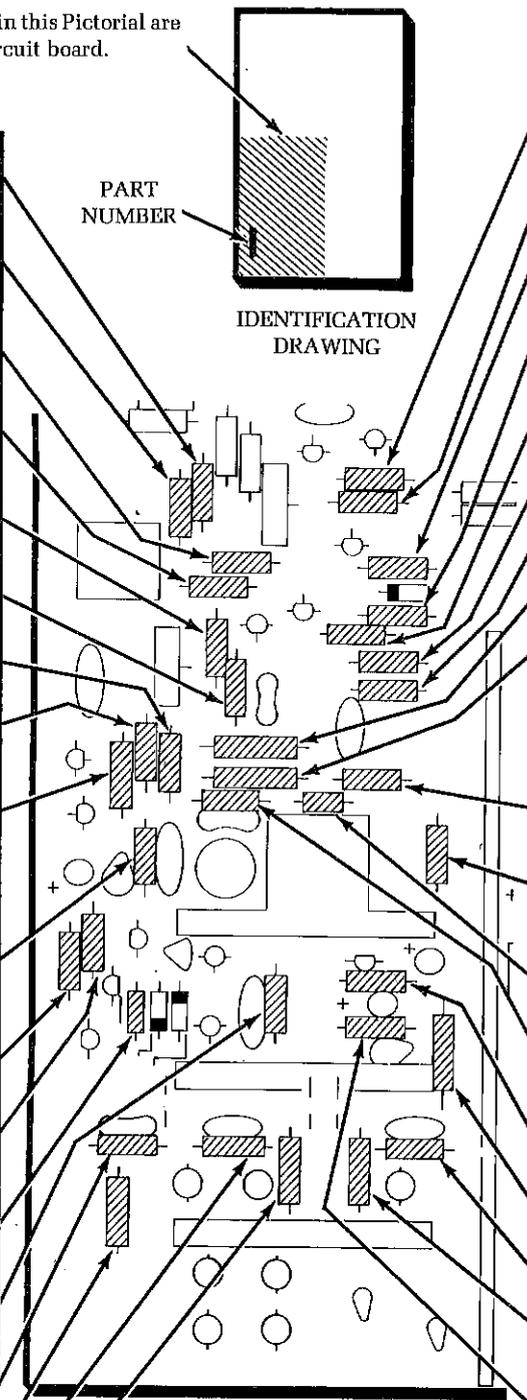
PICTORIAL 3-1

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

CONTINUE ↘

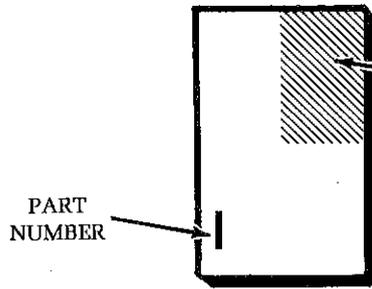
START ↘

- (✓) R139-2: 820 Ω (gray-red-brown).
- (✓) R137-2: 820 Ω (gray-red-brown).
- (✓) R141-2: 100 Ω (brown-black-brown).
- (✓) R136-2: 100 Ω (brown-black-brown).
- (✓) R123-2: 330 Ω (orange-orange-brown).
- (✓) R125-2: 1000 Ω (1k), 1%.
- (✓) R133-2: 10 Ω (brown-black-black-silver).
- (✓) R122-2: 1000 Ω (1k), 1%.
- (✓) R117-2: 10 Ω (brown-black-black-silver).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.
- (✓) R113-2: 1 MΩ (brown-black-green).
- (✓) R115-2: 47 Ω (yellow-violet-black).
- (✓) R116-2: 47 Ω (yellow-violet-black).
- (✓) R112-2: 33 Ω, 1/4-watt (orange-orange-black).
- (✓) R109-2: 100 kΩ (brown-black-yellow).
- (✓) R106-2: 111 kΩ, 1%.
- (✓) R105-2: 900 kΩ, 1%.
- (✓) R104-2: 10.1 kΩ, 1%.
- (✓) R103-2: 990 kΩ, 1%.
- (✓) Solder all leads to the foil and cut off the excess lead lengths.



PICTORIAL 3-2

- (✓) R159-2: 47 Ω (yellow-violet-black).
- (✓) R161-2: 47 Ω (yellow-violet-black).
- (✓) R155-2: 13 kΩ, 1%.
- (✓) R135-2: 1000 Ω (brown-black-red).
- (✓) R134-2: 10 Ω (brown-black-black-silver).
- (✓) R132-2: 523 Ω, 1%.
- (✓) R131-2: 2.05 kΩ (2050), 1%.
- (✓) R126-2: 900 Ω, 1%.
- (✓) R121-2: 900 Ω, 1%.
- (✓) Solder the leads to the foil and cut off the excess lead lengths.
- (✓) R119-2: 680 Ω (blue-gray-brown).
- (✓) R118-2: 10 Ω (brown-black-black-silver).
- (✓) R127-2: 68 Ω, 1/4-watt (blue-gray-black).
- (✓) R129-2: 360 Ω (orange-blue-brown).
- (✓) R111-2: 560 Ω (green-blue-brown).
- (✓) R107-2: 1 MΩ, 1%.
- (✓) R102-2: 1000 Ω (1k), 1%.
- (✓) R101-2: 999 kΩ, 1%.
- (✓) R108-2: 33 Ω 1/2-watt (orange-orange-black).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.

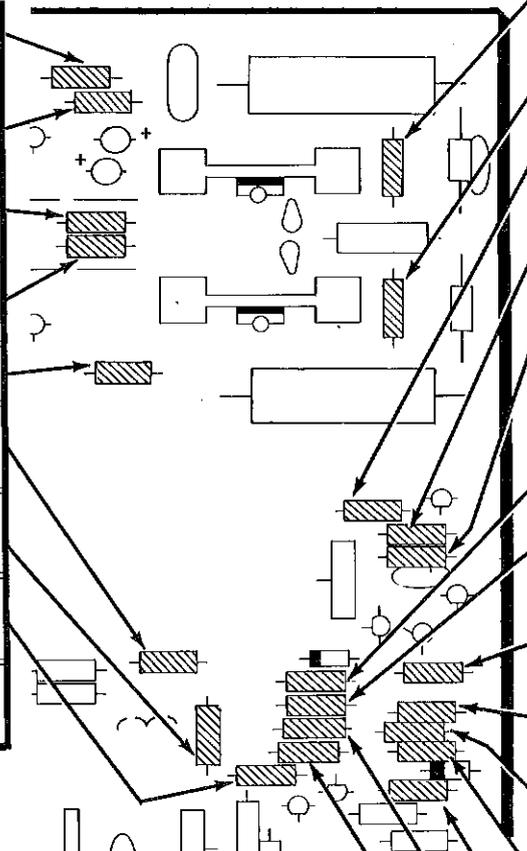


The steps performed in this Pictorial are in this area of the circuit board.

IDENTIFICATION DRAWING

START →

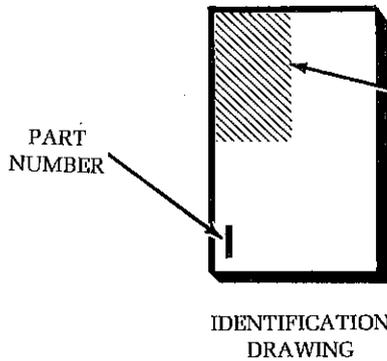
- (✓) R163-1: 10 Ω (brown-black-black-silver).
- (✓) R154-1: 10 Ω (brown-black-black-silver).
- (✓) R169: 33 Ω 1/2-watt (orange-orange-black).
- (✓) R171: 33 Ω 1/2-watt (orange-orange-black).
- (✓) R172: 6800 Ω (blue-gray-red).
- (✓) R139-1: 1800 Ω (brown-gray-red).
- (✓) R137-1: 1800 Ω (brown-gray-red).
- (✓) R136-1: 100 Ω (brown-black-brown).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.



CONTINUE ↘

- (✓) R175: 100 Ω (brown-black-brown).
- (✓) R177: 100 Ω (brown-black-brown).
- (✓) R151-1: 1200 Ω (brown-red-red).
- (✓) R147-1: 180 Ω (brown-gray-brown).
- (✓) R146-1: 180 Ω (brown-gray-brown).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.
- (✓) R153-1: 2000 Ω (red-black-red).
- (✓) R143-1: 10 Ω (brown-black-black-silver).
- (✓) R152-1: 33 kΩ (orange-orange-orange).
- (✓) R145-1: 1800 Ω (brown-gray-red).
- (✓) R148-1: 1800 Ω (brown-gray-red).
- (✓) R144-1: 1500 Ω (brown-green-red).
- (✓) R135-1: 1000 Ω (brown-black-red).
- (✓) R142-1: 10 Ω (brown-black-black-silver).
- (✓) R141-1: 100 Ω (brown-black-brown).
- () Solder all leads to the foil and cut off the excess lead lengths.

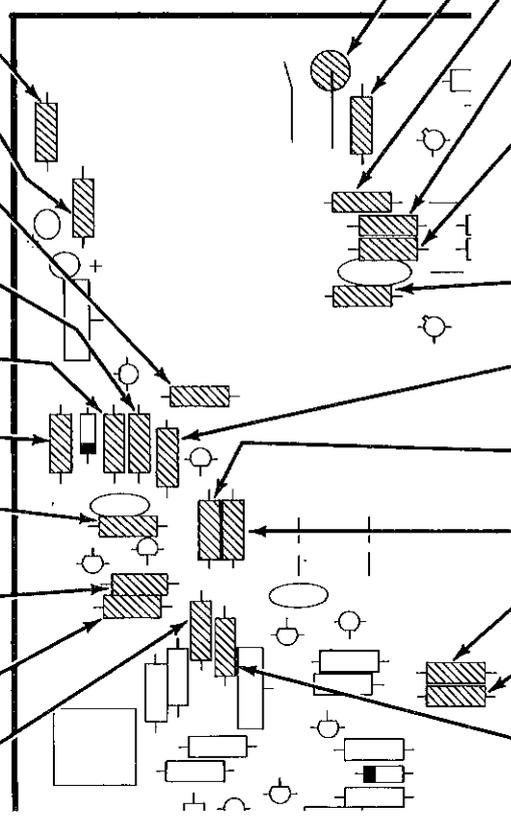
PICTORIAL 3-3



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

START →

- (✓) R163-2: 10 Ω (brown-black-black-silver).
- (✓) R154-2: 10 Ω (brown-black-black-silver).
- (✓) R152-2: 33 kΩ (orange-orange-orange).
- (✓) R146-2: 180 Ω (brown-gray-brown).
- (✓) R147-2: 180 Ω (brown-gray-brown).
- (✓) R153-2: 2000 Ω (red-black-red).
- (✓) R148-2: 1800 Ω (brown-gray-red).
- (✓) R142-2: 10 Ω (brown-black-black-silver).
- (✓) R143-2: 10 Ω (brown-black-black-silver).
- (✓) R162-2: 10 Ω (brown-black-black-silver).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 3-4

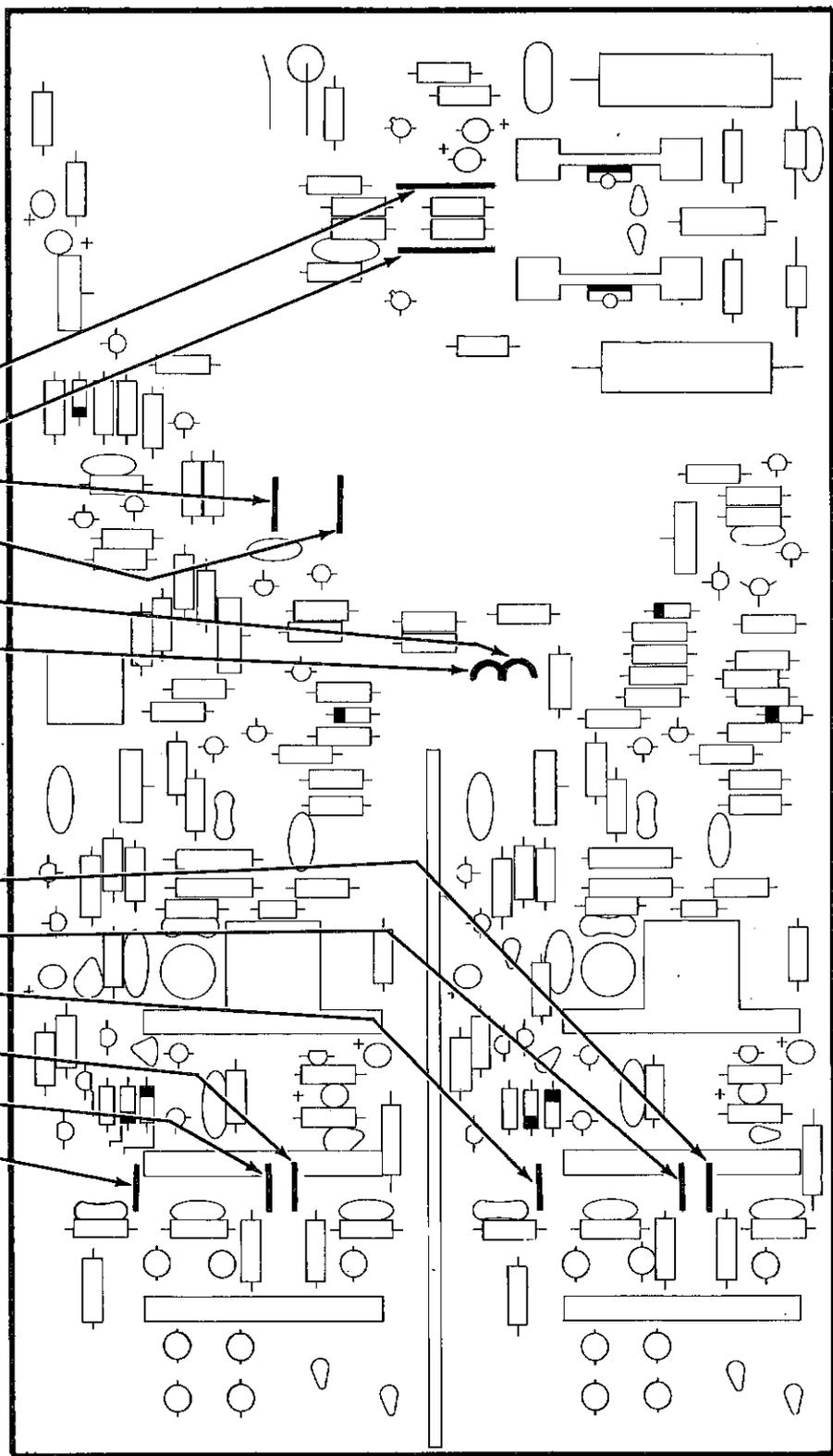
CONTINUE ↘

- () R168: 180 Ω, 2-watt (brown-gray-brown). Mount this resistor vertically as shown.
- 
- (✓) R166: 620 Ω (blue-red-brown).
 - (✓) R160: 68 Ω (blue-gray-black).
 - (✓) R165: 470 Ω (yellow-violet-brown).
 - (✓) R167: 470 Ω (yellow-violet-brown).
 - (✓) Solder all leads to the foil and cut off the excess lead lengths.
 - (✓) R170: 68 Ω 1/2-watt (blue-gray-black).
 - (✓) R151-2: 1200 Ω (brown-red-red).
 - (✓) R145-2: 1800 Ω (brown-gray-red).
 - (✓) R144-2: 1500 Ω (brown-green-red).
 - (✓) R157-2: 200 Ω, 1%.
 - (✓) R156-2: 2000 Ω (2k), 1%.
 - (✓) R158-2: 10 Ω (brown-black-black-silver).
 - (✓) Solder all leads to the foil and cut off the excess lead lengths.

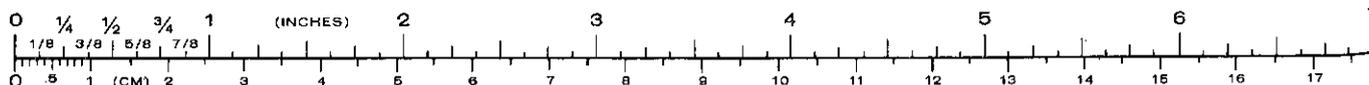
NOTE: The remaining resistors will be installed later.

START →

- (✓) 1-1/4" bare wire.
- (✓) 1-1/4" bare wire.
- (✓) 1" bare wire.
- (✓) 1" bare wire.
- () 3/4" bare wire.
- (✓) 3/4" bare wire.
- (✓) Solder all wires to the foil and cut off the excess lengths.
- NOTE:** When you install the following wires, make sure they are placed flat against the circuit board.
- (✓) 7/8" bare wire.
- (✓) Solder the wires to the foil and cut off the excess lengths.

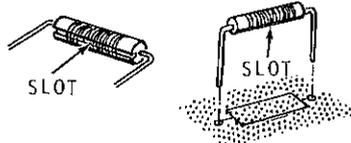


PICTORIAL 3-5



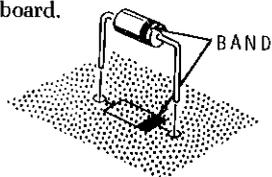
START →

(✓) L101: 4.65 μ H coil (45-39). Bend the leads toward the slots.



(✓) L102: 4.65 μ H coil (45-39). Bend the leads toward the slots.

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



(✓) D106-2: 1N4149 diode (#56-56).

(✓) D106-1: 1N4149 diode (#56-56).

(✓) ZD105-1: DO-7 zener diode (#56-50).

(✓) ZD105-2: DO-7 zener diode (#56-50).

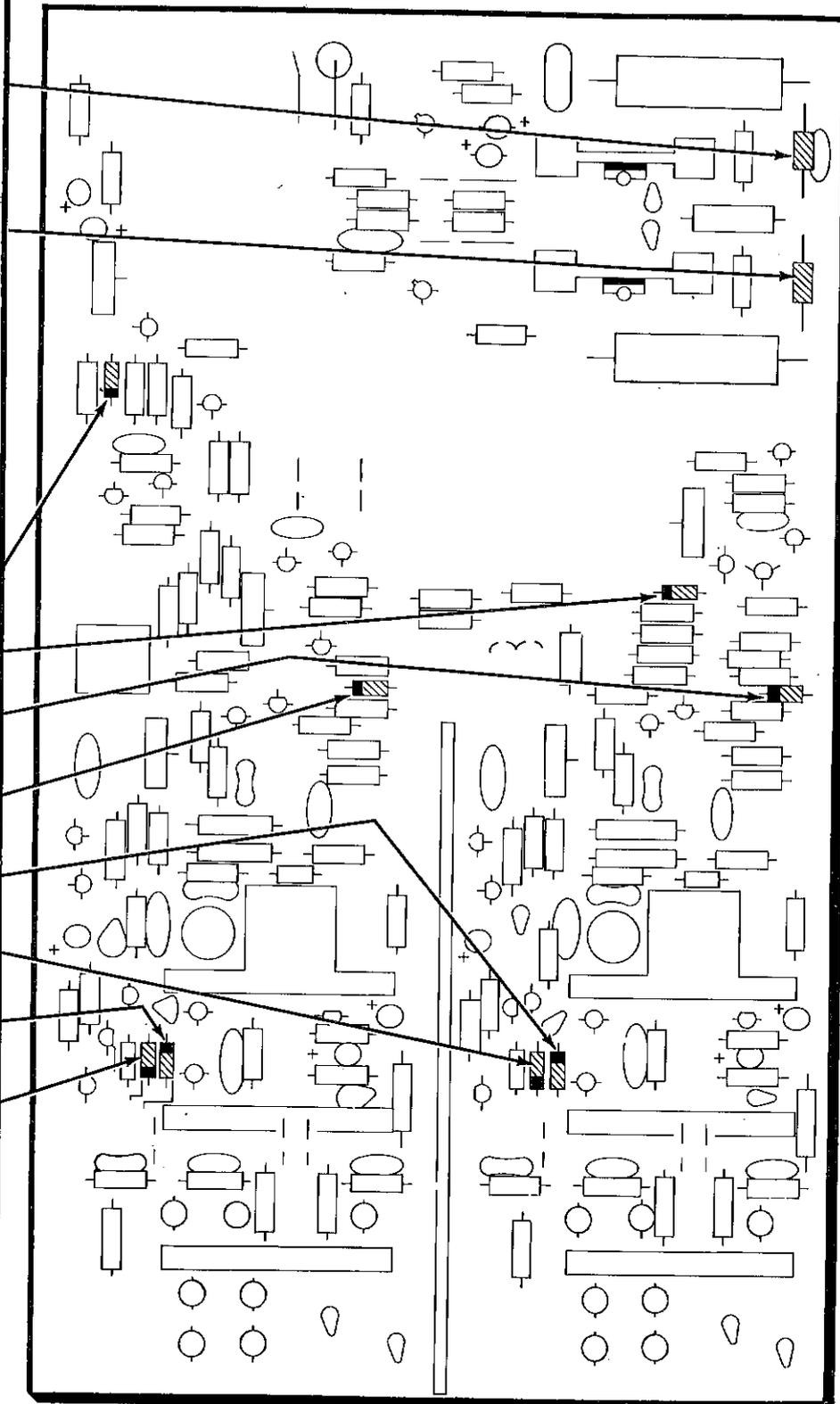
(✓) D103-1: 1N4149 diode (#56-56).

(✓) D104-1: 1N4149 diode (#56-56).

(✓) D103-2: 1N4149 diode (#56-56).

(✓) D104-2: 1N4149 diode (#56-56).

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

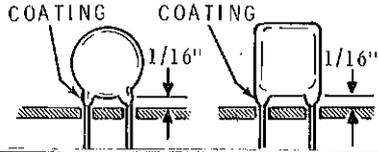


PICTORIAL 3-6

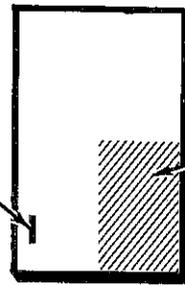
START →

(✓) C119-1: 150 pF mica.

NOTE: A coating on ceramic and Mylar capacitor leads can extend through the circuit board and make soldering difficult. Therefore, always space ceramic and Mylar capacitors 1/16" off the circuit board.



PART NUMBER



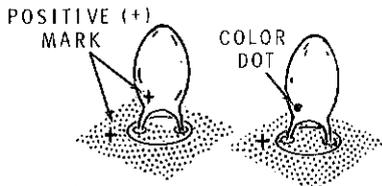
IDENTIFICATION DRAWING

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

(✓) C117-1: .01 μF ceramic.

(✓) C113-1: .01 μF ceramic.

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



(✓) C116-1: 10 μF tantalum.

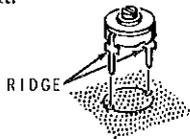
(✓) C112-1: .01 μF ceramic.

(✓) C106-1: 680 pF ceramic.

(✓) C109-1: 50 pF ceramic (violet-green-black-black-green).

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

NOTE: Solder each of the following trimmer capacitors to the foil as you install it.



(✓) C107-1: 3.2-18 pF trimmer (blue dot).

(✓) C108-1: 3.2-18 pF trimmer (blue dot).

(✓) C105-1: 3.2-18 pF trimmer (blue dot).

CONTINUE →

(✓) C122-1: 25 pF ceramic (violet-red-green-black-green).

(✓) C121-1: 5 pF ceramic.

(✓) C118-1: 15-60 pF trimmer.

(✓) C114-1: 10 μF tantalum.

(✓) C115-1: 10 μF tantalum.

(✓) C104-1: 3.2-18 pF trimmer (blue dot).

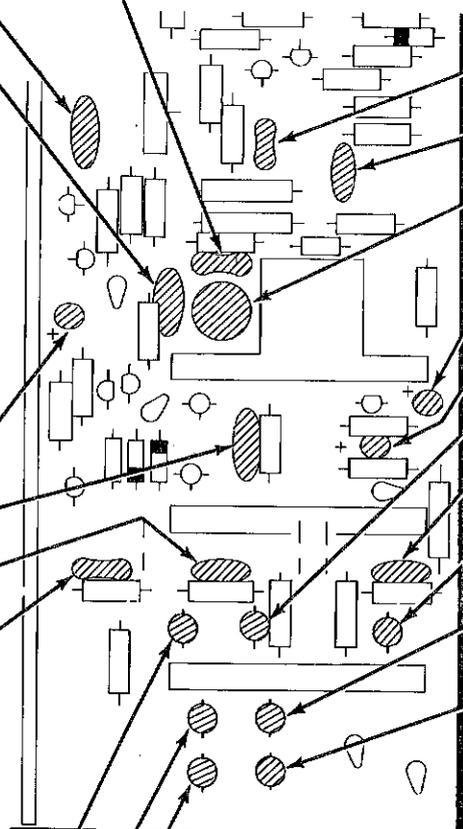
(✓) C103-1: .005 μF ceramic.

(✓) C101-1: 3.2-18 pF trimmer (blue dot).

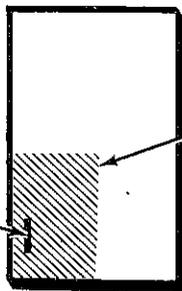
(✓) C102-1: 3.2-18 pF trimmer (blue dot).

(✓) C111-1: 2-6 pF trimmer (red dot).

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



PICTORIAL 3-7



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

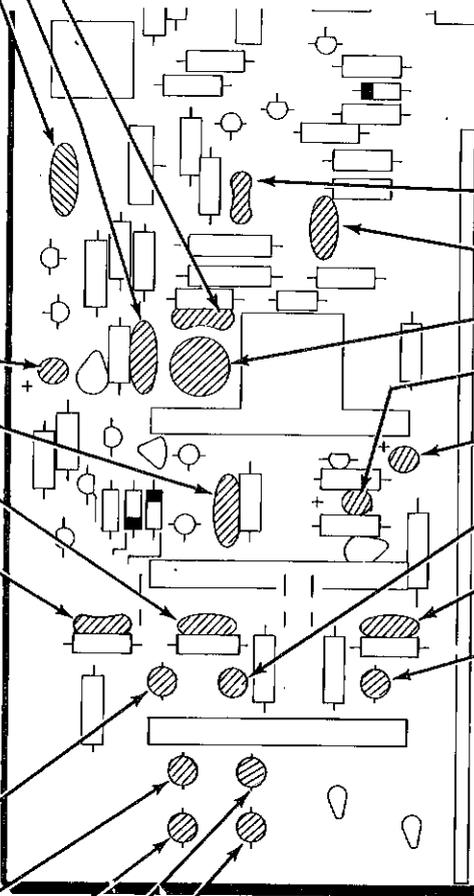
PART NUMBER

IDENTIFICATION DRAWING

START →

- (✓) C119-2: 90 pF mica.
 - (✓) C113-2: .01 μ F ceramic.
 - (✓) C117-2: .01 μ F ceramic.
- NOTE: When you install a tantalum capacitor, always insert the positive (+) or dot marked lead of the capacitor in the positive (+) marked hole on the circuit board.
- PLUS (+)
MARK OR DOT

PLUS (+)
MARK
- (✓) C116-2: 10 μ F tantalum.
 - (✓) C112-2: .01 μ F ceramic.
 - (✓) C106-2: 680 pF ceramic.
 - (✓) C109-2: 50 pF ceramic (violet-green-black-black-green).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.
- NOTE: Solder each of the following trimmer capacitors to the foil as you install it.
- (✓) C107-2: 3.2-18 pF trimmer (blue dot).
 - (✓) C108-2: 3.2-18 pF trimmer (blue dot).
 - (✓) C105-2: 3.2-18 pF trimmer (blue dot).
 - (✓) C102-2: 3.2-18 pF trimmer (blue dot).
 - (✓) C111-2: 2-6 pF trimmer (red dot).

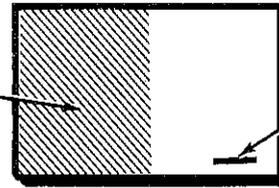


CONTINUE →

- (✓) C122-2: 25 pF ceramic (violet-red-green-black-green).
 - (✓) C121-2: 5 pF ceramic.
 - (✓) C118-2: 15-60 pF trimmer.
 - (✓) C115-2: 10 μ F tantalum.
 - (✓) C114-2: 10 μ F tantalum.
 - (✓) C104-2: 3.2-18 pF trimmer (blue dot).
 - (✓) C103-2: .005 μ F ceramic.
 - (✓) C101-2: 3.2-18 pF trimmer (blue dot).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 3-8

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



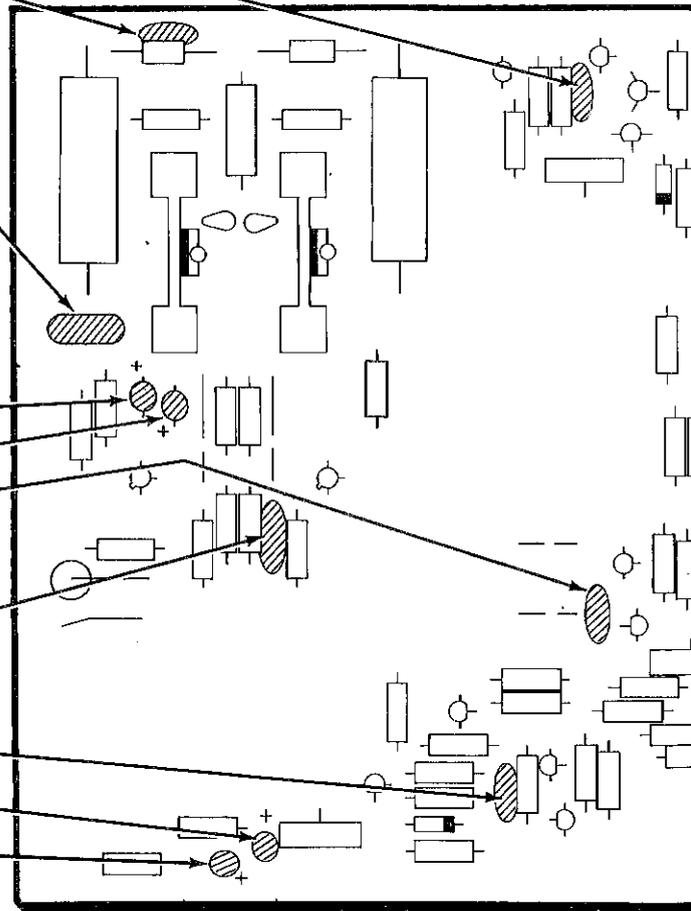
IDENTIFICATION DRAWING

START ▼

- (✓) Reposition the circuit board as shown in the identification drawing.
- (✓) C146-1: 33 pF ceramic.
- (✓) C128: .01 μ F ceramic.
- (✓) C127: .1 μ F Mylar.

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

- (✓) C124-1: 10 μ F tantalum.
- (✓) C123-1: 10 μ F tantalum.
- (✓) C125-2: 270 pF ceramic.
- (✓) Solder the leads to the foil and cut off the excess lead lengths.
- (✓) C126: 75 pF ceramic.
- (✓) C146-2: 33 pF ceramic.
- (✓) C123-2: 10 μ F tantalum.
- (✓) C124-2: 10 μ F tantalum.
- (✓) Solder the leads to the foil and cut off the excess lead lengths.



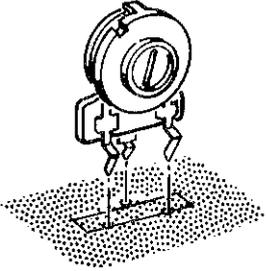
PICTORIAL 3-9



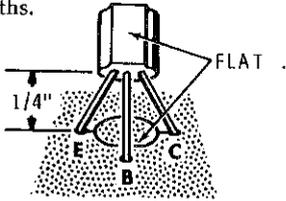
START →

(✓) Reposition the circuit board as shown in the identification drawing.

(✓) R124-1: 100 Ω control (#10-314). Solder the lugs to the foil.



NOTE: Install the next transistors as shown. Line up the flat on the transistor with the flat on the circuit board. Solder each transistor as it is installed and cut off the excess lead lengths.

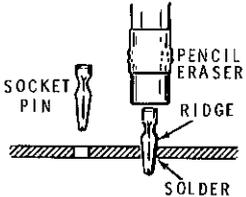


(✓) Q106-1: 2N5771 transistor (#417-292).

(✓) Q105-1: 2N5771 transistor (#417-292).

(✓) Q103-1: MPSA20 transistor (#417-801).

NOTE: To install a socket pin, insert it until the ridge is against the board. Use a pencil eraser to press the pin into the hole. Make sure the pin is straight; then solder the pin to the foil.



(✓) Install three socket pins at Q102-1.

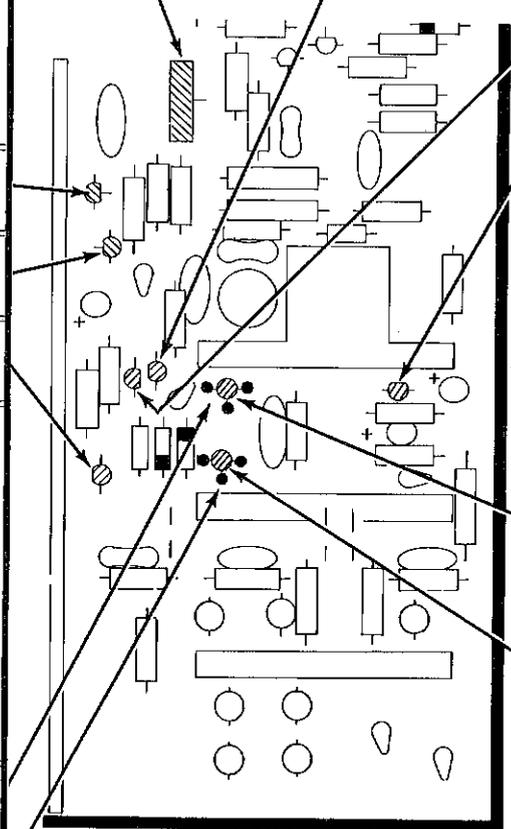
(✓) Install three socket pins at Q101-1.

IDENTIFICATION DRAWING



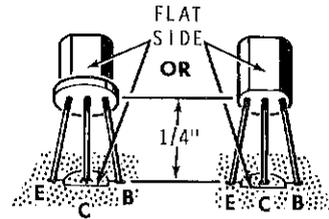
PART NUMBER

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

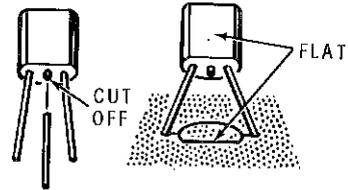


CONTINUE →

(✓) Q104-1: X29A829 transistor (#417-201).



NOTE: In the next two steps, carefully cut off the center lead of the diode as shown. Line up the flat on the diode with the flat on the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

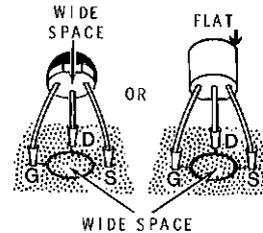


(✓) D101-1: SF50077 diode (#417-854).

(✓) D102-1: SF50077 diode (#417-854).

(✓) Locate two E304 transistors (#417-828). Cut their leads 1/2" from the body. NOTE: When you install them in the next two steps, do not solder the leads.

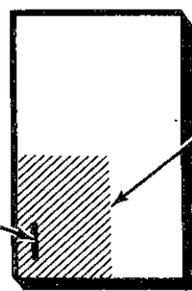
(✓) Q102-1: E304 transistor (#417-828).



(✓) Q101-1: E304 transistor (#417-828).

PICTORIAL 3-10

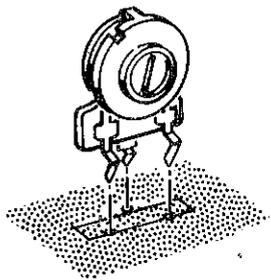
IDENTIFICATION DRAWING



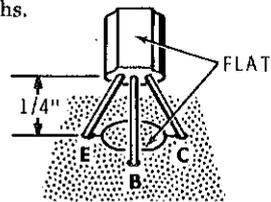
The steps performed in this Pictorial are in this area of the circuit board.

START

(✓) R124-2: 100 Ω control (#10-314). Solder the lugs to the foil.



NOTE: Install the following transistors as shown. Line up the flat on the transistor with the flat on the circuit board. Solder each transistor as it is installed and cut off the excess lead lengths.

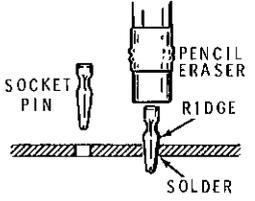


(✓) Q106-2: 2N5771 transistor (#417-292).

(✓) Q105-2: 2N5771 transistor (#417-292).

(✓) Q103-2: MPSA20 transistor (#417-801).

NOTE: To install a socket pin, insert it until the ridge is against the board. Use a pencil eraser to press the pin into the hole. Make sure the pin is straight; then solder the pin to the foil.

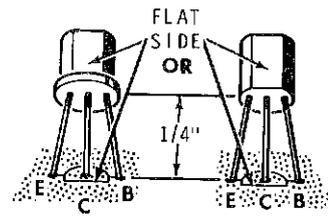


(✓) Install three socket pins at Q102-2.

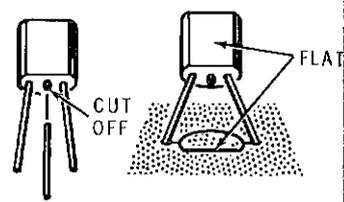
(✓) Install three socket pins at Q101-2.

CONTINUE

(✓) Q104-2: X29A829 transistor (#417-201).



NOTE: In the next two steps, carefully cut off the center lead of the diode as shown. Line up the flat on the diode with the flat on the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

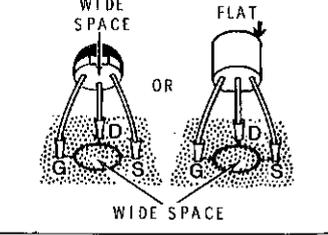


(✓) D101-2: SF50077 diode (#417-854).

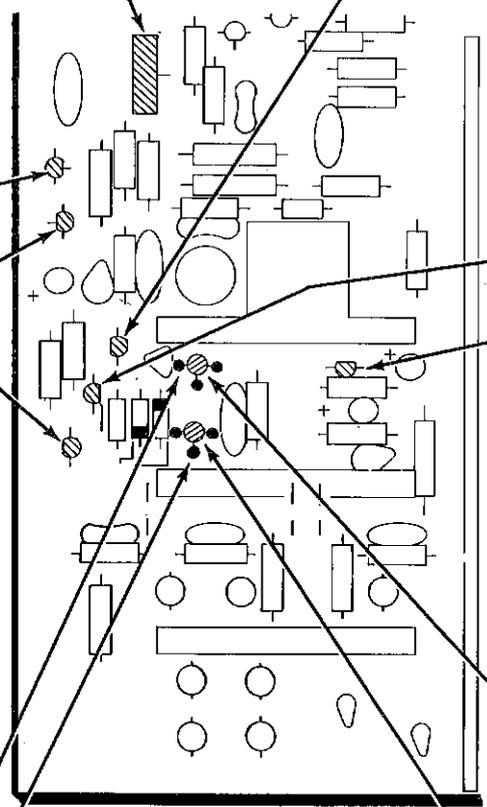
(✓) D102-2: SF50077 diode (#417-854).

(✓) Locate two E304 transistors (#417-828). Cut their leads 1/2" from the body. NOTE: When you install them in the next two steps, do not solder the leads.

(✓) Q102-2: E304 transistor (#417-828).



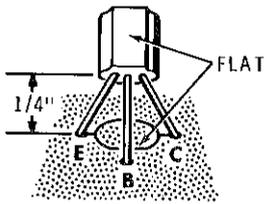
(✓) Q101-2: E304 transistor (#417-828).



PICTORIAL 3-11

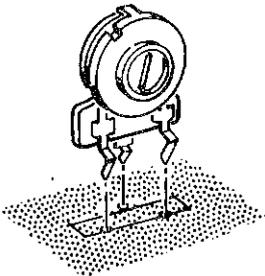
START →

NOTE: Install the following transistors as shown.



(✓) Q118-2: MPSA20 transistor (#417-801).

NOTE: As you install a control, solder the leads to the foil.



(✓) R149-2: 500 Ω control (#10-918).

(✓) Q117-2: 2N5770 transistor (#417-293).

(✓) Q115-2: 2N5770 transistor (#417-293).

(✓) Q116-2: 2N5770 transistor (#417-293).

(✓) Q110-2: 2N5770 transistor (#417-293).

(✓) Q109-2: 2N5770 transistor (#417-293).

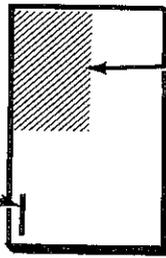
(✓) R164-2: 500 Ω control (#10-918).

(✓) Q119-2: MPSA20 transistor (#417-801).

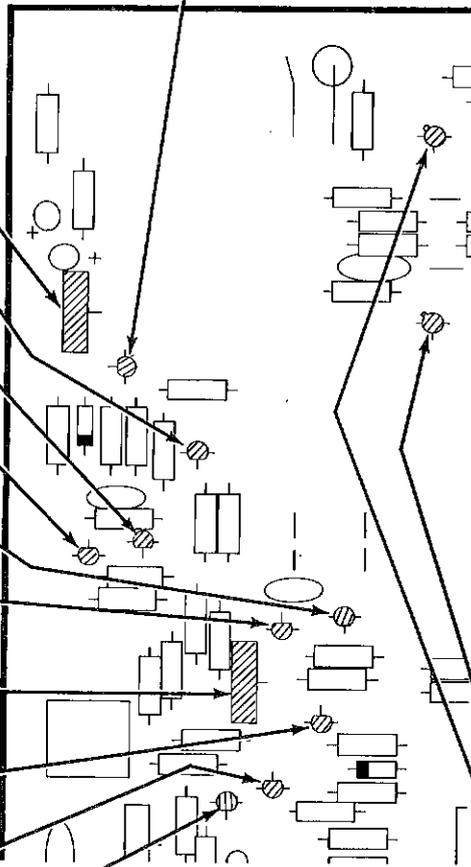
(✓) Q108-2: MPSA20 transistor (#417-801).

(✓) Q107-2: MPSA20 transistor (#417-801).

IDENTIFICATION DRAWING

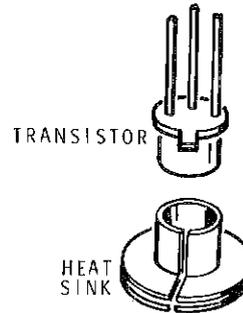


The steps performed in this Pictorial are in this area of the circuit board.



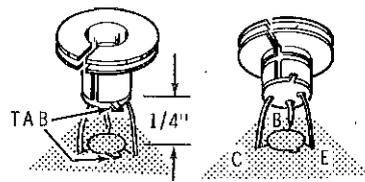
CONTINUE →

() Install a small heat sink onto a 2N3053 transistor (#417-100). Place the heat sink on your work area as shown, and press the transistor into it.



(✓) In the same manner, press the other 2N3053 transistor into the other small heat sink.

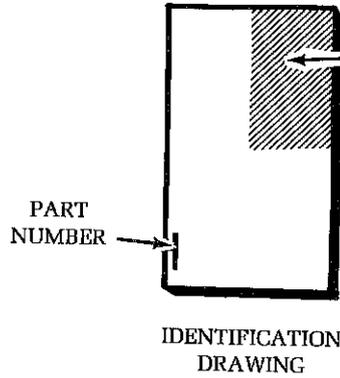
NOTE: Install each of the following transistors in the manner shown. First line up the locating tab on the transistor with the outline of the locating tab on the circuit board. Then insert the transistor leads into their correct holes which are indicated by C, B, and E. Solder each lead to the foil and cut off the excess lead length.



(✓) Q112: 2N3053 transistor (#417-100).

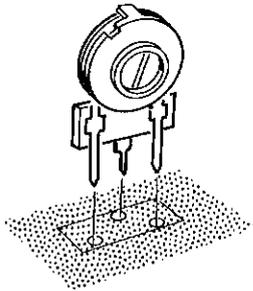
(✓) Q111: 2N3053 transistor (#417-100).

PICTORIAL 3-12

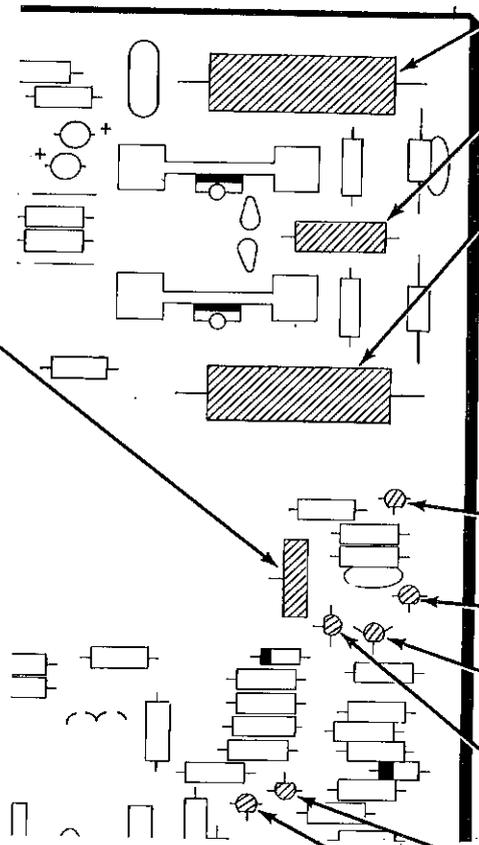


START →

NOTE: As you install the following control, solder the leads to the foil.



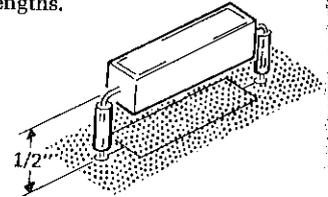
(✓) R149-1: 500 Ω control (#10-918).



PICTORIAL 3-13

CONTINUE ↘

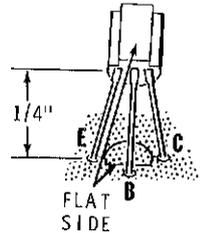
NOTE: Cut and use the lengths of teflon sleeving on the leads of the following resistors when it is called for. Solder the leads to the foil at each resistor. Then cut off the excess lead lengths.



(✓) R174: 1200 Ω, 7-watt. Use 1/2" lengths of sleeving.

(✓) R173: 33 kΩ, 1-watt (orange-orange-orange).

(✓) R176: 1200 Ω, 7-watt. Use 1/2" lengths of sleeving.



(✓) Q117-1: 2N5770 transistor (#417-293).

(✓) Q115-1: 2N5770 transistor (#417-293).

(✓) Q116-1: 2N5770 transistor (#417-293).

(✓) Q118-1: MPSA20 transistor (#417-801).

(✓) Q108-1: MPSA20 transistor (#417-801).

(✓) Q107-1: MPSA20 transistor (#417-801).

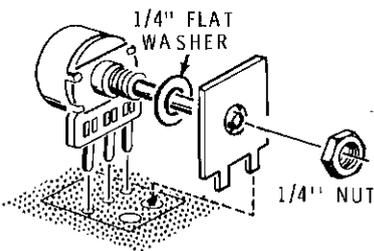


START →

(✓) Reposition the circuit board as shown in the identification drawing.

(✓) R138-2:

1. Mount a 2000 Ω (2k) control (#10-1099) to a control mounting bracket as shown. Use a 1/4" flat washer and nut. Be sure the bracket lugs are parallel with the control lugs.
2. Install the assembly and solder the lugs to the foil. Be sure the control shaft is parallel with the circuit board.

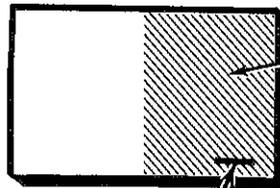


NOTE: In the next two steps you will install switches. Be sure the bare circuit board wires at these switch locations are down flat on the circuit board and do not keep the switches from being mounted all the way down onto the circuit board.

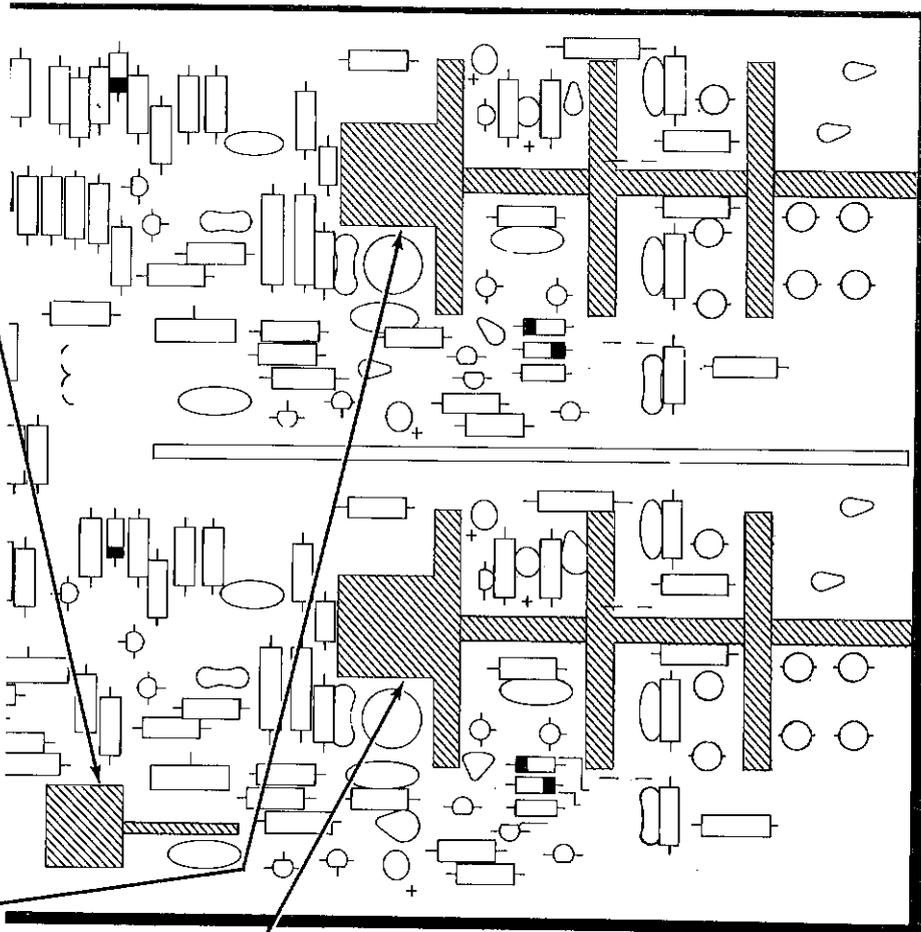
(✓) SW101-1/R128-1: 11-position rotary switch. Make sure the lugs on each wafer are straight. Install the lugs, one wafer at a time, into the circuit board. Be sure the switch is down onto the circuit board as far as it will go. Then solder one lug of each switch wafer to the foil. Check the switch to be sure it is properly seated. Then solder the remaining lugs.

(✓) SW101-2/R128-2: In the same manner, install the other 11-position rotary switch.

IDENTIFICATION DRAWING

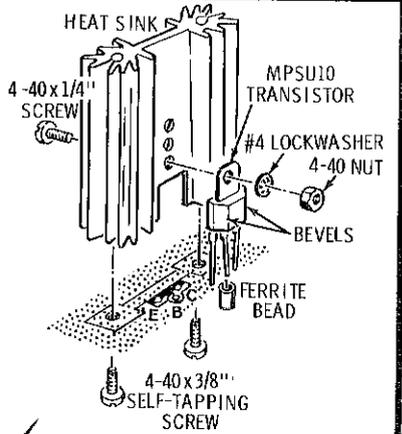


PART NUMBER



PICTORIAL 3-14

START →

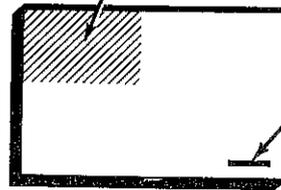


✓ Q114: Assemble and mount a transistor heat sink assembly as follows:

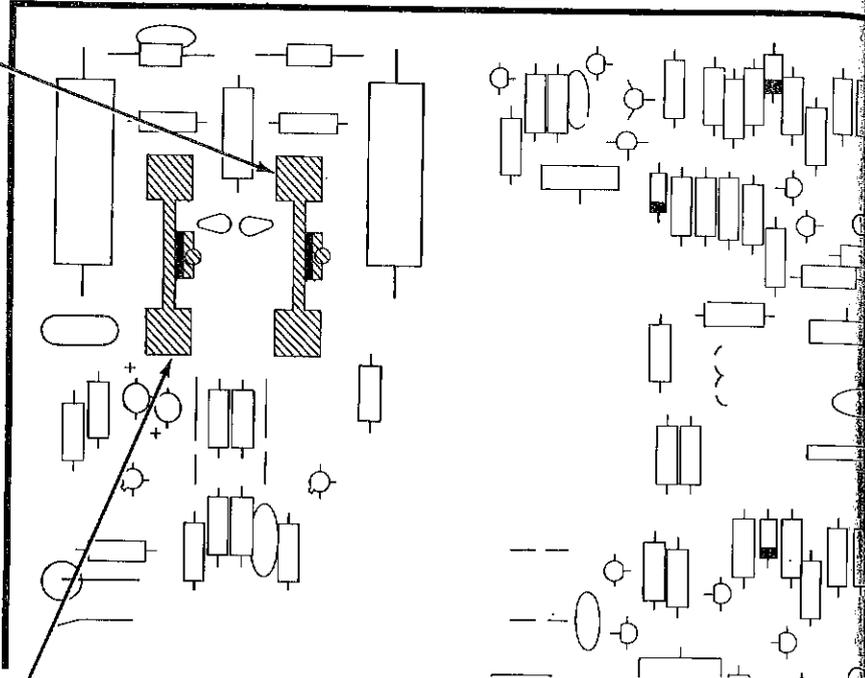
1. Loosely mount an MPSU10 transistor (#417-834) on a large heat sink with a 4-40 x 1/4" screw, a #4 lockwasher, and a 4-40 nut as shown. Be sure the bevels of the transistor are positioned as shown.
2. Slide a ferrite bead over the center transistor lead.
3. Mount the transistor heat sink assembly onto the circuit board at Q114 with two 4-40 x 3/8" self-tapping screws.
4. Solder the transistor leads to the foil and cut off the excess lead lengths.
5. Tighten the transistor heat sink screw.

✓ Q113: In the same manner, assemble and mount another transistor heat sink assembly.

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



IDENTIFICATION DRAWING



PICTORIAL 3-15

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 proper type and installation.
- ✓ Capacitors for the correct position of the positive lead.
- ✓ Diodes for the correct position of the banded end.

START

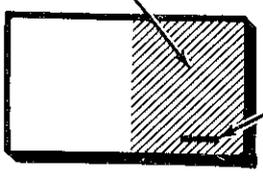
NOTES:

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

2. When you install a wire in the circuit board, solder it to the foil.

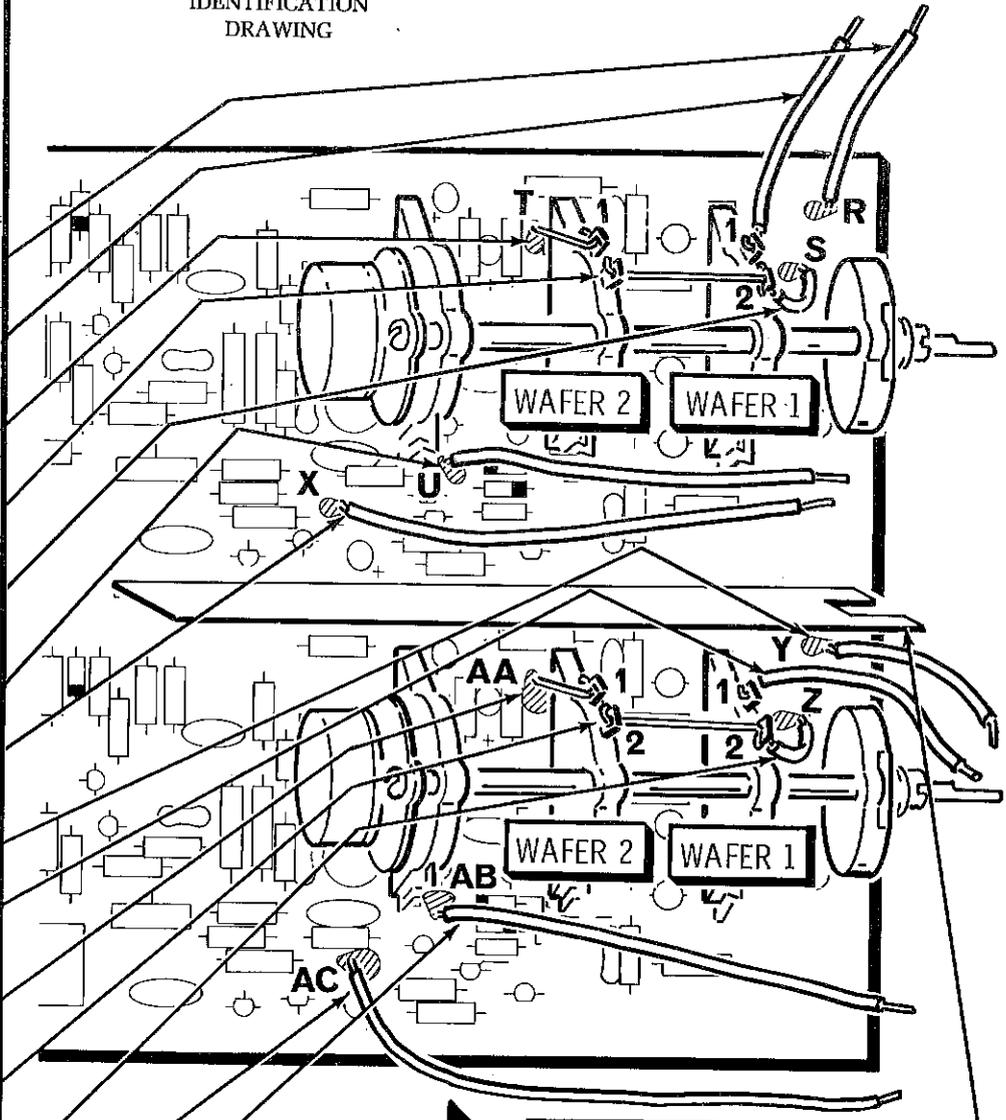
- (✓) 2-1/2" smaller black wire at hole R.
- (✓) 1-3/4" smaller orange wire at wafer 1 lug 1 (S-1).
- (✓) 1-1/4" bare wire from hole T to wafer 2 lug 1 (S-1).
- (✓) 1-1/2" bare wire from wafer 1 lug 2 (NS) to wafer 2 lug 2 (S-1).
- (✓) 1-3/4" white wire from hole S to wafer 1 lug 2 (S-2).
- (✓) 3-1/2" white-black wire at hole U.
- (✓) 4-1/2" white-gray wire at hole X.
- (✓) 2-1/2" smaller black wire at hole Y.
- (✓) 1-3/4" smaller orange wire at wafer 1 lug 1 (S-1).
- (✓) 1-1/4" bare wire from hole AA to wafer 2 lug 1 (S-1).
- (✓) 1-1/2" bare wire from wafer 1 lug 2 (NS) to wafer 2 lug 2 (S-1).
- (✓) 1-3/4" white wire from hole Z to wafer 1 lug 2 (S-2).
- (✓) 4-1/4" white-gray wire at hole AC.
- (✓) 3-1/2" white-black wire at hole AB.

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



PART NUMBER

IDENTIFICATION DRAWING



CONTINUE

() Vertical input shield. Position the notched end as shown and solder the tabs to the foil. Keep the shield perpendicular to the circuit board.

NOTE: There are a number of holes in this circuit board that are not used.

Set the circuit board aside temporarily.

PICTORIAL 3-16



HORIZONTAL CIRCUIT BOARD

PARTS LIST

Refer to the "Pack Index Sheet" and locate pack #4. Then remove the parts from this pack and check each one against the following list. The key numbers correspond to the numbers on the Horizontal Circuit Board Parts Pictorial (on Page 3 in the Illustration Booklet). Any part that is packaged in an individual envelope with a part number on it should be placed back in its envelope after you identify it until the part is called for in a step.

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

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

RESISTORS

1/2-Watt, 1%

A1	2-83	1	200 Ω	R238
A1	2-58	1	1000 Ω (1k)	R237
A1	2-232	1	1800 Ω (1.8k)	R236
A1	2-38	1	20 k Ω	R246
A1	2-201	1	30 k Ω	R245
A1	2-99	1	50 k Ω	R244
A1	2-11	1	100 k Ω	R243
A1	2-204	1	300 k Ω	R242
A1	2-76	1	500 k Ω	R241
A1	2-14	1	1 M Ω	R239

1/4-Watt

NOTE: The following resistors have a tolerance of 5% unless they are listed otherwise. 5% is indicated by a fourth color band of gold, while 10% is indicated by a silver band.

B1	1-103-12	2	150 Ω (brown-green-brown)	R203, R205
B1	1-84-12	1	100 k Ω (brown-black-yellow)	R202
B1	1-87-12	1	1 M Ω (brown-black-green)	R204

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

1/2-Watt

C1	1-143	1	2.7 Ω (red-violet-gold)	R271
C1	1-173	3	10 Ω (brown-black-black)	R212, R285
C1	1-171	1	22 Ω (red-red-black)	R207
C1	1-62	1	51 Ω (green-brown-black)	R208
C1	1-123	2	100 Ω (brown-black-brown)	R249, R274, R281, R283
C1	1-112	5	180 Ω (brown-gray-brown)	R274, R281, R283
C1	1-137	1	200 Ω (red-black-brown)	R257
C1	1-147	5	220 Ω (red-red-brown)	R232, R256, R276
C1	1-170	2	270 Ω (red-violet-brown)	R214, R276
C1	1-151	2	330 Ω (orange-orange-brown)	R247, R276
C1	1-94	1	390 Ω (orange-white-brown)	R229

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

1-63	1	510 Ω (green-brown-brown)	R270
1-52	2	680 Ω (blue-gray-brown)	R267, R273
1-172	7	1000 Ω (brown-black-red)	R206, R216, R218, R231, R234, R259, R262 R278
1-97	1	1100 Ω (brown-brown-red)	R235
1-80	1	1200 Ω (brown-red-red)	R266, R277
1-81	2	1500 Ω (brown-green-red)	R219, R251, R254 R221
1-138	3	3900 Ω (orange-white-red)	R209, R211
1-43	1	4700 Ω (yellow-violet-red)	R279, R280
1-51	2	6800 Ω (blue-gray-red)	R228
1-114	2	8200 Ω (gray-red-red)	R217
1-67	1	39 kΩ, 10% (orange-white-orange)	R201
1-115	1	47 kΩ (yellow-violet-orange)	
1-101	1	1 MΩ (brown-black-green)	

1/2 Watt

1-8-1	1	68 kΩ, 10%, (blue-gray-orange)	R252
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1/4 Watt

3-21-7	2	4700 Ω (4.7k), wire-wound	R286, R287
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CONTROLS — SWITCHES

10-314	1	100 Ω control	R272
10-918	1	500 Ω control	R268
10-936	2	1000 Ω (1k) control	R248, R258
10-904	1	5000 Ω (5k) control	R255
19-717	1	10 kΩ control with switch	R253/SW205
63-1306	1	21-position rotary switch	SW203
63-1307	1	4-position rotary switch with control	SW201/R213/ SW204
63-1234	1	3-position rotary switch	SW202/R263A/ R263B

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

G1	20-102	1	100 pF	C201
G1	20-103	1	150 pF	C228
G1	20-121	1	290 pF	C224

Ceramic

G2	21-85	1	56 pF	C223
G2	21-172	1	100 pF	C222
G2	21-21	2	200 pF	C211, C233
G2	21-163	1	.001 μF	C221
G2	21-16	3	.01 μF	C202, C203, C207
G2	21-82	1	.02 μF	C219
G2	21-95	1	.1 μF	C218
G2	21-99	2	.2 μF	C235, C236

Electrolytic

G3	25-125	1	5 μF	C227
G4	25-165	1	6 μF nonpolarized	C206
G5	25-54	2	10 μF	C212, C234
G6	25-117	2	100 μF	C204, C205

Tantalum

G7	25-195	1	2.2 μF, 15V	C217
G8	25-221	2	2.2 μF, 20V	C225, C226
G8	25-212	1	22 μF	C216

Polystyrene

G9	29-40	1	.02 μF	C231
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Mylar

G10	27-47	2	.1 μF	C208, C209
G11	27-168	1	2 μF	C232

Trimmer

G12	31-36	1	8-50 pF	C229
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DIODES — TRANSISTORS — INTEGRATED CIRCUITS

H1	56-31	2	PS18775	ZD214, ZD217
H1	56-16	4	1N751 zener diode (violet-green-brown)	ZD203, ZD204, ZD210, ZD211

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

H1	56-56	6	1N4149 diode	D205, D206, D207, D208, D215, D216
H1	56-59	1	1N750A zener diode	ZD209

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

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

✓ H2	417-154	2	2N2369 transistor	Q203, Q206
✓ H2	417-237	2	SE6020 transistor	Q212, Q213
✓ H3	417-118	2	2N3393 transistor	ZD201, ZD202
✓ H4	417-235	3	2N4121 transistor	Q210, Q211, Q216
✓ H5	417-293	1	2N5770 transistor	Q209
✓ H6	417-828	4	E304 transistor	Q201, Q202, Q204, Q205
✓ H7	417-834	2	MPSU10 transistor	Q214, Q215
✓ H8	442-50	1	U760 integrated circuit	IC201
✓ H8	443-1	3	SN7400N integrated circuit	IC202, IC204, IC208
✓ H8	443-16	1	SN7476N integrated circuit	IC203

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

✓ H8	443-23	2	SN74122N integrated circuit	IC205,
✓ H8	443-44	1	SN7413N integrated circuit	IC207
✓ H8	443-45	1	SN7408N integrated circuit	IC209

HARDWARE

J1	250-52	2	4-40 x 1/4" screw
J2	250-186	4	#4 x 3/8" self-tapping screw
J3	252-2	4	4-40 nut
J4	254-9	2	#4 lockwasher
J5	250-170	2	#6 x 1/4" self-tapping screw
J6	252-7	1	Control nut

MISCELLANEOUS

K1	45-73	2	2.2 μ H coil (red-red-gold)	L201, L
K2	204-2078	1	Control mounting bracket	
K3	215-95	2	Heat sink	
K4	434-298	8	14-pin socket	
K4	434-299	1	16-pin socket	
K5	475-16	2	Ferrite bead	

PART FROM FINAL PACK

85-1990-1	1	Horizontal circuit board
-----------	---	--------------------------

STEP-BY-STEP ASSEMBLY

NOTE: The leads of some components that are installed on this circuit board are soldered to the foil that extends around the outside edges of the board. It is important not to get a large lump of solder on this foil because it could interfere with the mounting of the board later. Therefore, do not bend the lead toward the edge of the board, let it protrude straight up. Then use just enough solder to make a good connection.

IDENTIFICATION
DRAWING

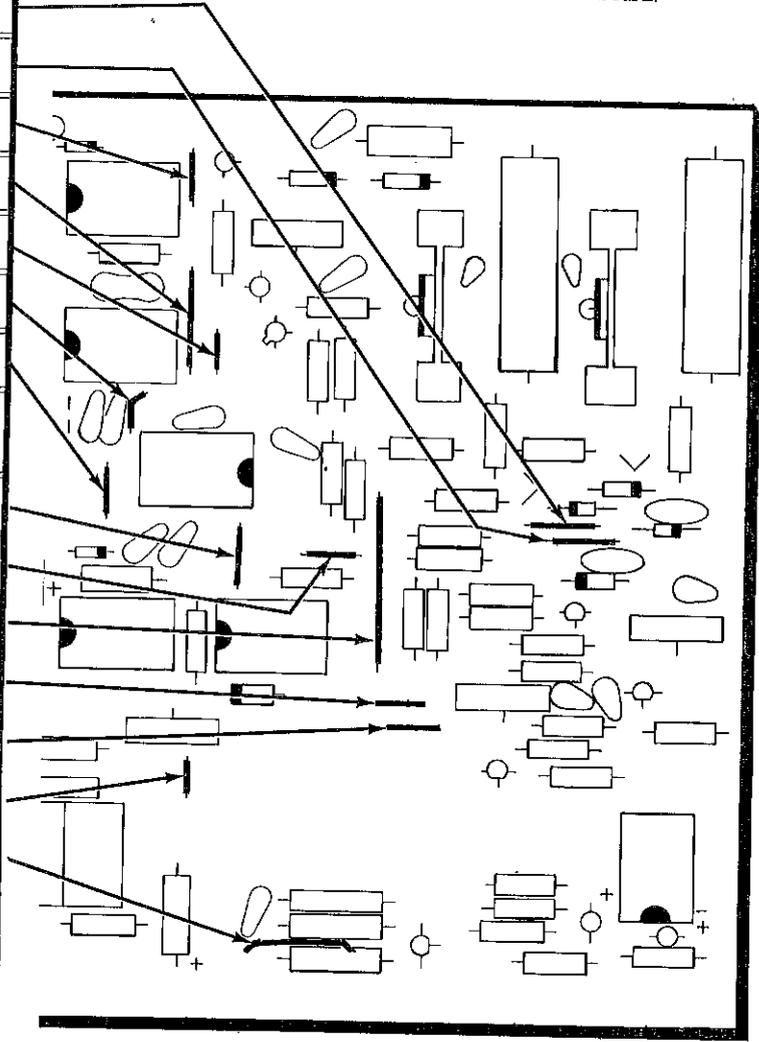
PART
NUMBER



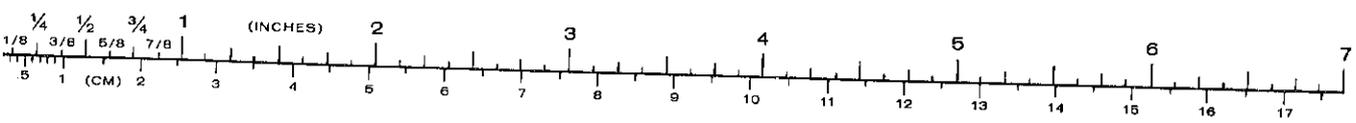
The steps performed in this Pictorial are in this area of the circuit board.

START →

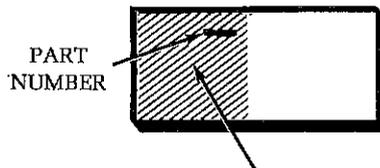
- () Position the circuit board as shown in the identification drawing.
- (✓) 1" bare wire.
- (✓) 1" bare wire.
- (✓) 7/8" bare wire.
- (✓) 1-1/4" bare wire.
- (✓) 7/8" bare wire.
- (✓) 7/8" bare wire.
- (✓) 7/8" bare wire.
- (✓) Solder the wires to the foil and cut off the excess lengths.
- (✓) 7/8" bare wire.
- (✓) 7/8" bare wire.
- (✓) 1-3/4" bare wire.
- (✓) 3/4" bare wire.
- (✓) 3/4" bare wire.
- (✓) 3/4" bare wire.
- (✓) 1-1/8" bare wire.
- (✓) Solder the wires to the foil and cut off the excess lengths.



PICTORIAL 4-1

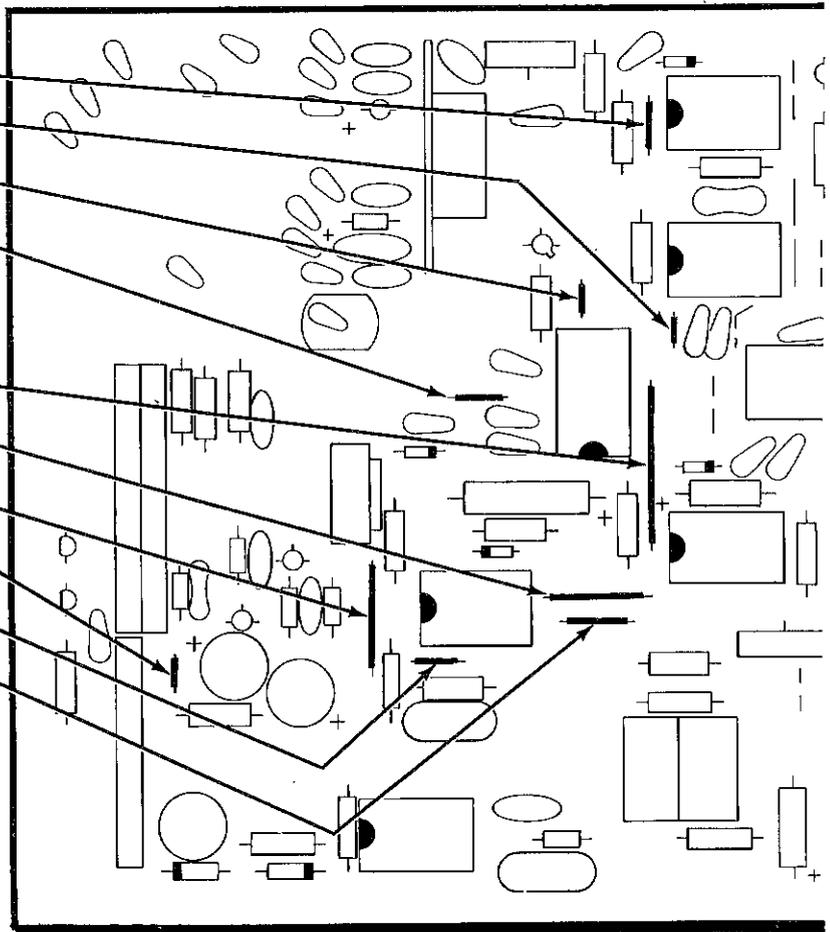


IDENTIFICATION
DRAWING



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

- START** →
- (✓) 7/8" bare wire.
 - (✓) 3/4" bare wire.
 - (✓) 3/4" bare wire.
 - (✓) 7/8" bare wire.
 - () Solder all wires to the foil and cut off the excess lengths.
 - (✓) 1-5/8" bare wire.
 - (✓) 1-1/4" bare wire.
 - (✓) 1-1/4" bare wire.
 - (✓) 3/4" bare wire.
 - (✓) 7/8" bare wire.
 - (✓) 1" bare wire.
 - (✓) Solder all wires to the foil and cut off the excess lengths.

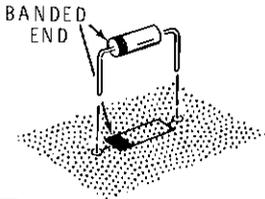


PICTORIAL 4-2

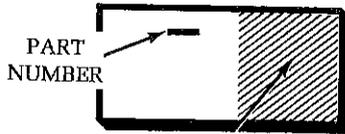


START →

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



IDENTIFICATION DRAWING



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

(✓) ZD210: 1N751 zener diode (#56-16).

(✓) ZD211: 1N751 zener diode (#56-16).

(✓) R285: 10 Ω (brown-black-black).

(✓) R283: 180 Ω (brown-gray-brown).

(✓) R281: 180 Ω (brown-gray-brown).

(✓) R261: 220 Ω (red-red-brown).

(✓) R279: 8200 Ω (gray-red-red).

(✓) R280: 8200 Ω (gray-red-red).

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

(✓) R278: 1100 Ω (brown-brown-red).

(✓) R276: 220 Ω (red-red-brown).

(✓) R267: 680 Ω (blue-gray-brown).

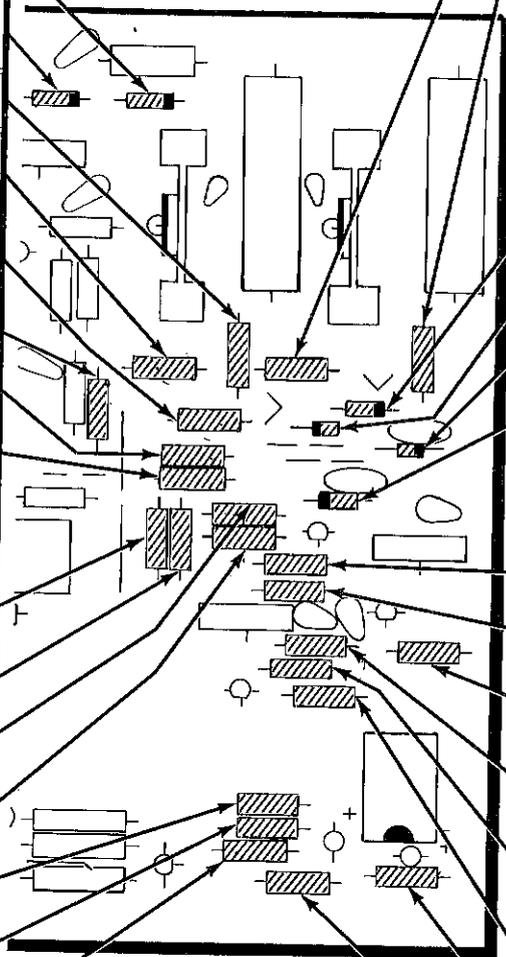
(✓) R274: 180 Ω (brown-gray-brown).

(✓) R235: 1200 Ω (brown-red-red).

(✓) R234: 1000 Ω (brown-black-red).

(✓) R233: 220 Ω (red-red-brown).

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



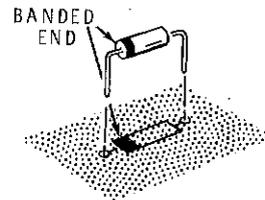
PICTORIAL 4-3

CONTINUE →

(✓) R282: 180 Ω (brown-gray-brown).

(✓) R284: 10 Ω (brown-black-black).

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



(✓) ZD217: PS18775 zener diode (#56-31).

(✓) D216: 1N4149 diode (#56-56).

(✓) D215: 1N4149 diode (#56-56).

(✓) ZD214: PS18775 zener diode (#56-31).

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

(✓) R271: 2.7 Ω (red-violet-gold).

(✓) R273: 680 Ω (blue-gray-brown).

(✓) R270: 510 Ω (green-brown-brown).

(✓) R275: 180 Ω (brown-gray-brown).

(✓) R269: 100 Ω (brown-black-brown).

(✓) R277: 1500 Ω (brown-green-red).

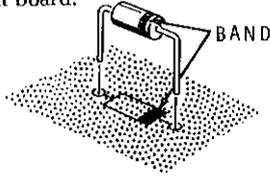
(✓) R232: 220 Ω (red-red-brown).

(✓) R231: 1000 Ω (brown-black-red).

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

START

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

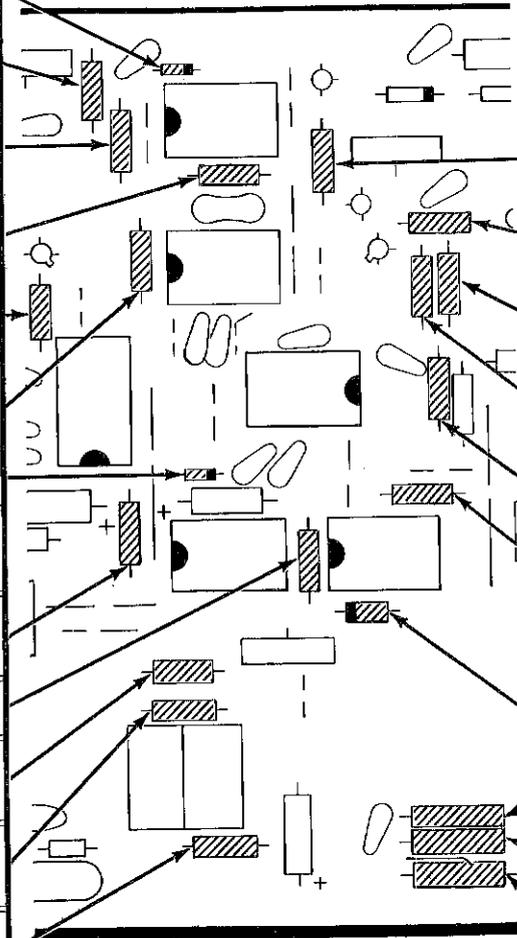


IDENTIFICATION
DRAWING



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

- (✓) D208: 1N4149 diode (#56-56).
- (✓) R221: 4700 Ω (yellow-violet-red).
- (✓) R228: 39 kΩ (orange-white-orange).
- (✓) R229: 390 Ω (orange-white-brown).
- (✓) R219: 3900 Ω (orange-white-red).
- (✓) R218: 1000 Ω (brown-black-red).
- (✓) D207: 1N4149 diode (#56-56).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.
- (✓) R217: 47 kΩ (yellow-violet-orange).
- (✓) R256: 220 Ω (red-red-brown).
- (✓) R262: 1000 Ω (brown-black-red).
- (✓) R264: 330 Ω (orange-orange-brown).
- (✓) R266: 1500 Ω (brown-green-red).
- () Solder the leads to the foil and cut off the excess lead lengths.

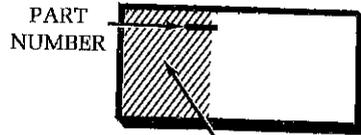


CONTINUE

- (✓) R247: 330 Ω (orange-orange-brown).
- (✓) R249: 100 Ω (brown-black-brown).
- (✓) R251: 3900 Ω (orange-white-red).
- (✓) R254: 3900 Ω (orange-white-red).
- (✓) R259: 1000 Ω (brown-black-red).
- (✓) R257: 200 Ω (red-black-brown).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.
- (✓) ZD209: 1N750A zener diode (#56-59).
- (✓) R236: 1800 Ω (1.8k), 1%.
- (✓) R237: 1000 Ω (1k), 1%.
- (✓) R238: 200 Ω, 1%.
- (✓) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 4-4

IDENTIFICATION
DRAWING

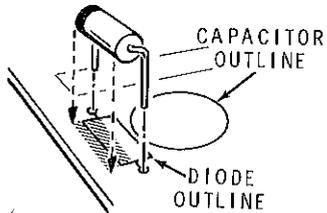


The steps performed in this Pictorial are in this area of the circuit board.

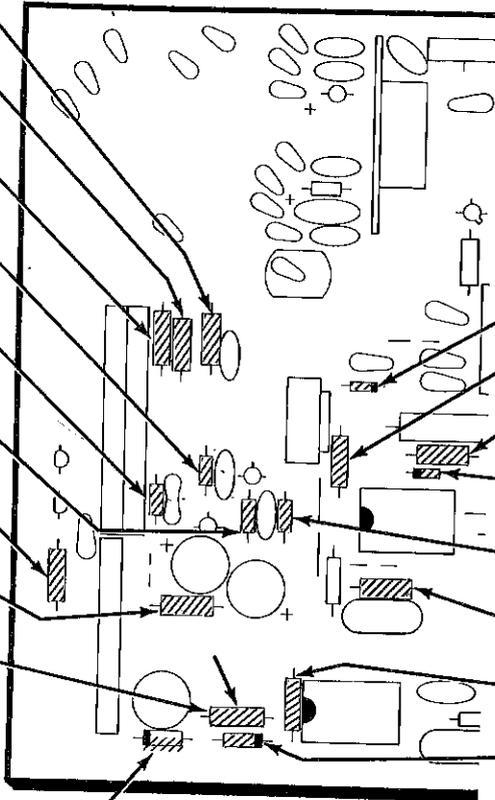
START →

- (✓) R214: 270 Ω (red-violet-brown).
- (✓) R216: 1000 Ω (brown-black-red).
- (✓) R206: 1000 Ω (brown-black-red).
- (✓) R203: 150 Ω, 1/4-watt (brown-green-brown).
- (✓) R202: 100 kΩ, 1/4-watt (brown-black-yellow).
- (✓) R204: 1MΩ, 1/4-watt (brown-black-green).
- (✓) R201: 1 MΩ (brown-black-green).
- (✓) R207: 22 Ω (red-red-black).
- (✓) R208: 51 Ω (green-brown-black).

(✓) ZD203: 1N751 zener diode (#56-16). Bend the leads slightly so the diode is positioned away from the capacitor outline as shown. The diode should not sit inside its outline.



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



PICTORIAL 4-5

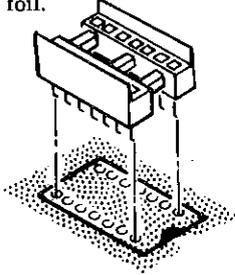
CONTINUE ↘

- (✓) D206: 1N4149 diode (#56-56).
- (✓) R212: 10 Ω (brown-black-black).
- (✓) R215: 270 Ω (red-violet-brown).
- (✓) D205: 1N4149 diode (#56-56).
- (✓) R205: 150 Ω, 1/4-watt (brown-green-brown).
- (✓) R211: 6800 Ω (blue-gray-red).
- (✓) R209: 6800 Ω (blue-gray-red).
- (✓) ZD204: 1N751 zener diode (#56-16).
- () Solder the leads to the foil and cut off the excess lead lengths.

START →

() Reposition the circuit board as shown.

NOTE: To install an IC socket, be sure the socket pins are straight. Then insert the socket pins and solder them to the foil.



() 14-pin socket at IC201.

() 14-pin socket at IC202.

() 16-pin socket at IC203.

() 14-pin socket at IC206.

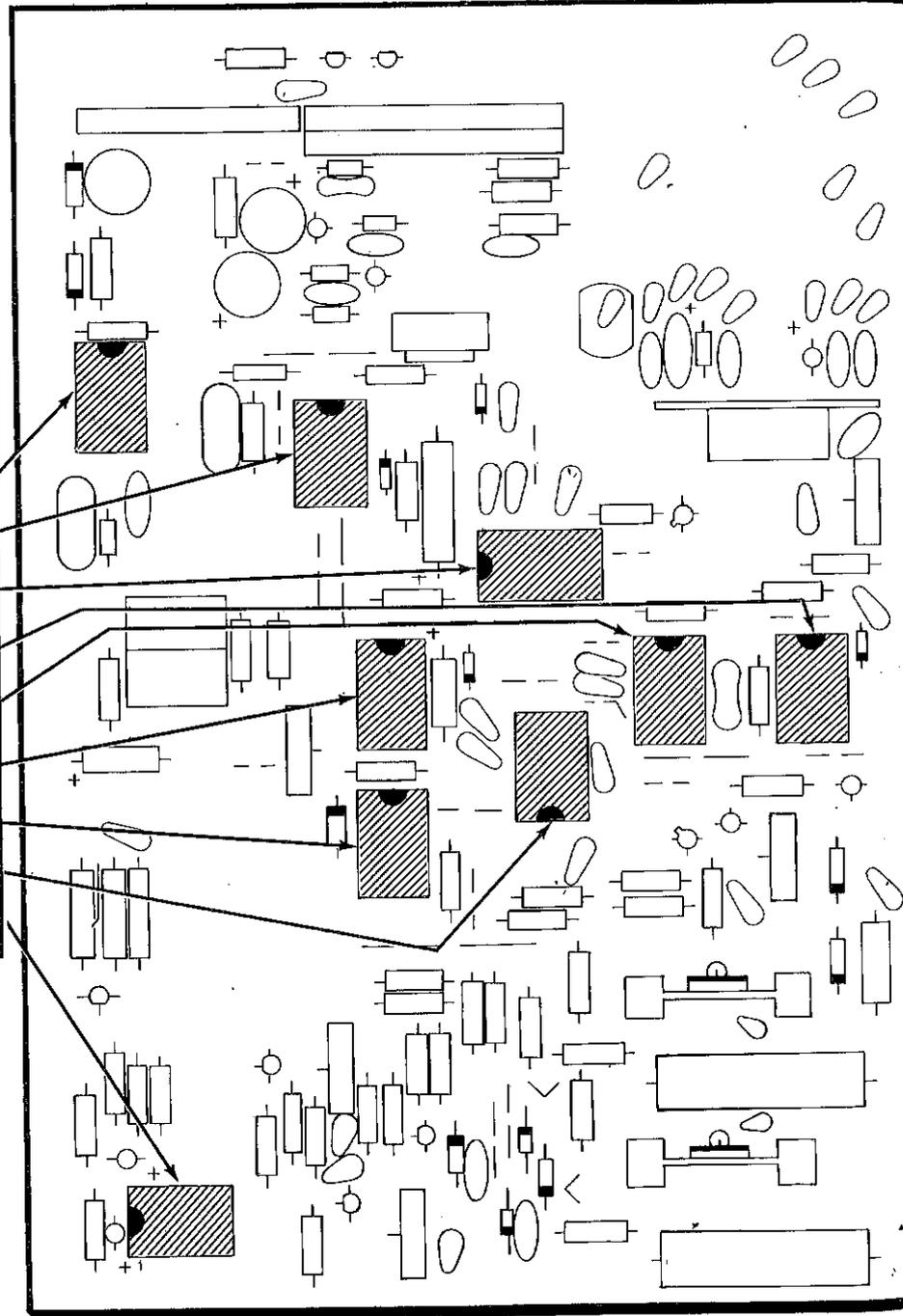
() 14-pin socket at IC204.

() 14-pin socket at IC205.

() 14-pin socket at IC207.

() 14-pin socket at IC209.

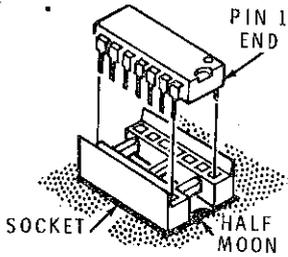
() 14-pin socket at IC208.



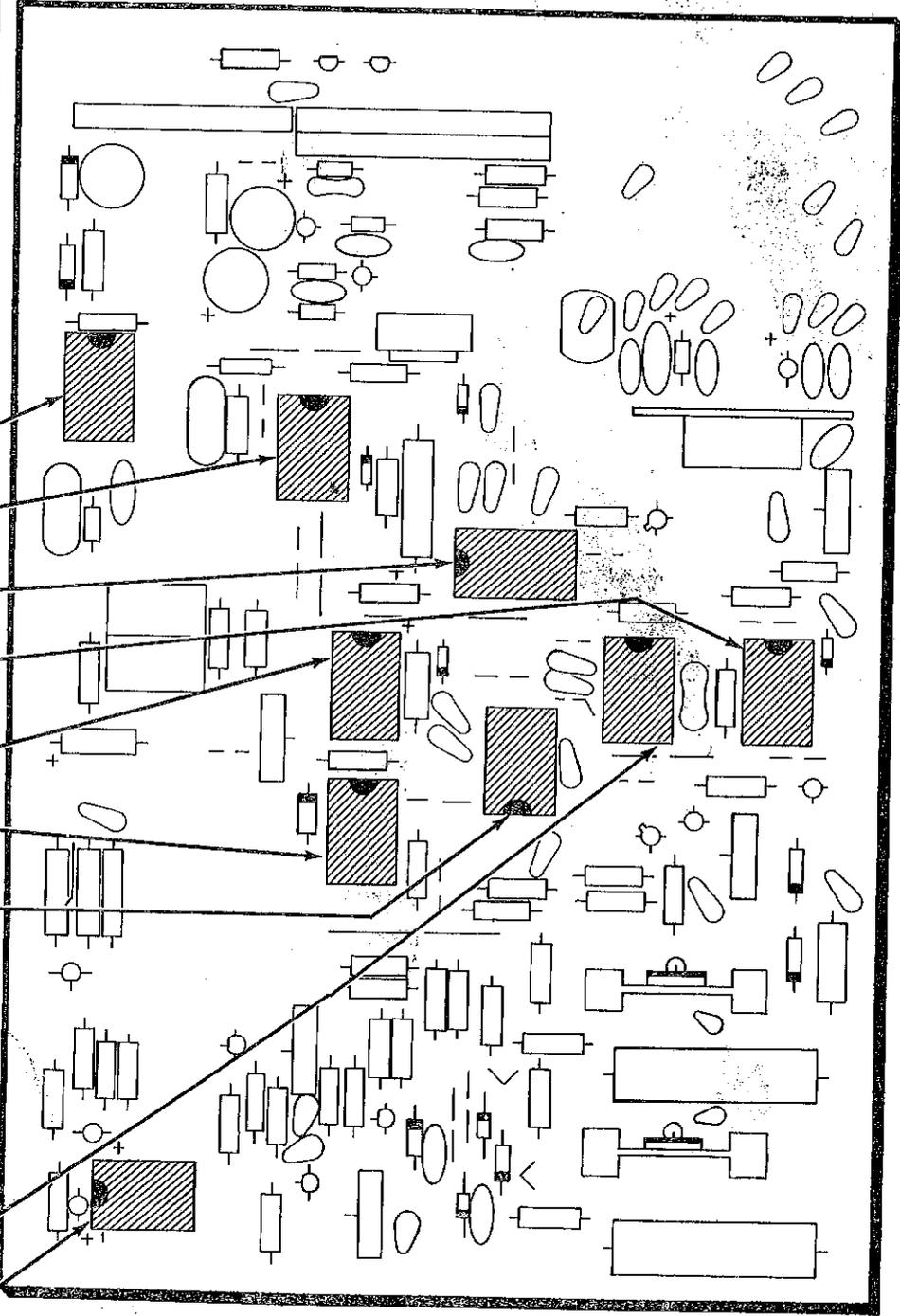
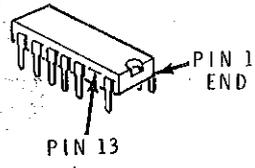
PICTORIAL 4-6

START →

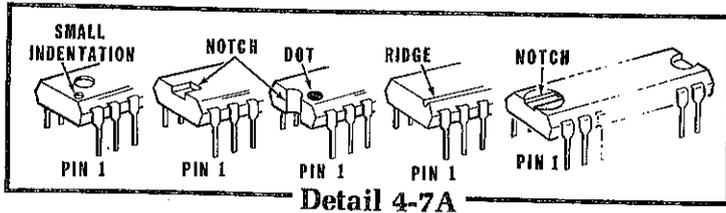
NOTE: To install an integrated circuit, refer to Detail 4-7A and identify the pin 1 end of the integrated circuit. Then position the pin 1 end toward the index mark on the circuit board and carefully install the integrated circuit. Make sure all the pins are in their respective holes.



- (✓) IC201: U760 integrated circuit (#442-50).
- (✓) IC202: SN7400N integrated circuit (#443-1).
- (✓) IC203: SN7476N integrated circuit (#443-16).
- (✓) IC206: SN74122N integrated circuit (#443-23).
- (✓) IC205: SN74122N integrated circuit (#443-23).
- (✓) IC207: SN7413N integrated circuit (#443-44).
- (✓) IC209: SN7408N integrated circuit (#443-45). After identifying the pin 1 end of this IC, break off pin 13 at the base of the IC with a pair of long-nose pliers.
- (✓) IC204: SN7400N integrated circuit (#443-1).
- (✓) IC208: SN7400N integrated circuit (#443-1).



PICTORIAL 4-7

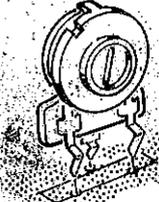


Detail 4-7A

START

() Reposition the circuit board as shown in the identification drawing.

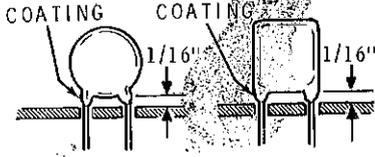
NOTE: As you install each of the following controls, solder the leads to the foil.



(✓) R248: 1000 Ω control (#10-936). (The circuit board may be marked 500.)

(✓) C224: 290 pF mica.

NOTE: A coating on ceramic and Mylar capacitor leads can extend through the circuit board and make soldering difficult. Therefore, always space ceramic and Mylar capacitors 1/16" off the circuit board.



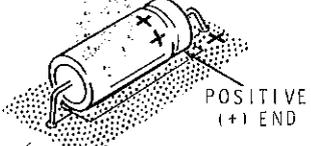
(✓) C236: .2 μF ceramic.

(✓) C235: .2 μF ceramic.

(✓) R272: 100 Ω control (#10-314).

(✓) R268: 500 Ω control (#10-918).

NOTE: When you install an electrolytic capacitor, always match the positive (+) marked end of the capacitor with the positive (+) mark on the circuit board.

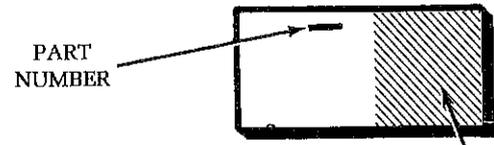


(✓) C212: 10 μF electrolytic.

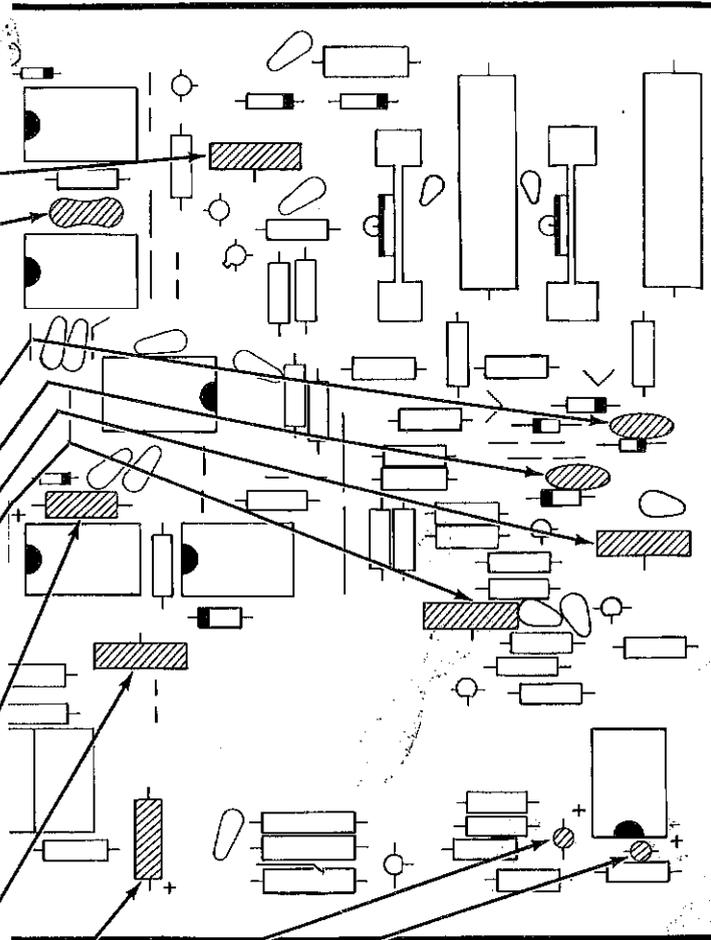
(✓) R255: 5000 Ω (5k) control (#10-904).

(✓) C234: 10 μF electrolytic.

IDENTIFICATION DRAWING

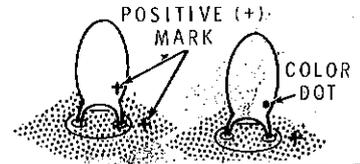


The steps performed in this Pictorial are in this area of the circuit board.



CONTINUE

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



(✓) C225: 2.2 μF, 20V tantalum.

(✓) C226: 2.2 μF, 20V tantalum.

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

PICTORIAL 4-8

START →

IDENTIFICATION
DRAWING



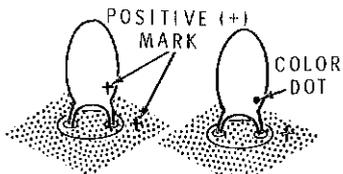
The steps performed in this Pictorial are in this area of the circuit board.

LARGE SWITCH
GOES HERE LATER

CONTINUE →

- (✓) C223: 56 pF ceramic.
- (✓) C222: 100 pF ceramic. Position the capacitor to the left so it will not interfere with the large switch that you will install later.

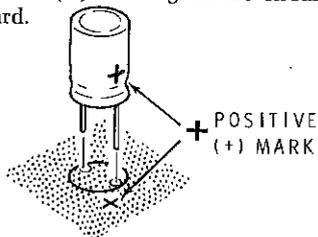
NOTE: When you install a tantalum capacitor, always insert the positive (+) or dot marked lead of the capacitor in the positive (+) marked hole on the circuit board.



- (✓) C216: 22 μF tantalum.
- (✓) C221: 1000 pF (.001) ceramic.
- (✓) C217: 2.2 μF, 15V tantalum. Position the positive (+) marked (or red-colored) end as indicated on the circuit board screen.

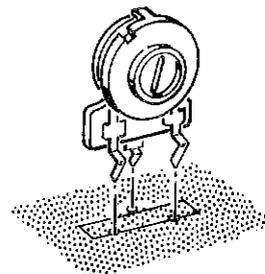
- (✓) C219: .02 μF ceramic.
- (✓) C218: .1 μF ceramic.
- (✓) C211: 200 pF ceramic.
- (✓) C202: .01 μF ceramic.
- (✓) C201: 100 pF mica.

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



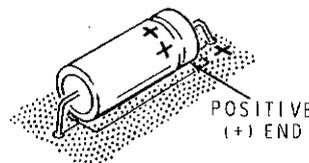
- (✓) C204: 100 μF electrolytic.
- (✓) C205: 100 μF electrolytic.
- (✓) Solder the leads to the foil and cut off the excess lead lengths.

- (✓) C233: 200 pF ceramic.
- NOTE: As you install the following control, solder the leads to the foil.



- (✓) R258: 1000 Ω (1k) control (#10-936).
- (✓) C203: .01 μF ceramic.

NOTE: When you install an electrolytic capacitor, always match the positive (+) marked end of the capacitor with the positive (+) mark on the circuit board.

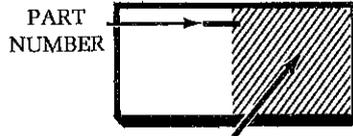


- (✓) C227: 5 μF electrolytic.
- (✓) L201: 2.2 μH coil (#45-73, red-red-gray).
- (✓) C208: .1 μF Mylar.
- (✓) C207: .01 μF ceramic.
- (✓) L202: 2.2 μH coil (#45-73, red-red-gray).
- (✓) C209: .1 μF Mylar.

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

PICTORIAL 4-9

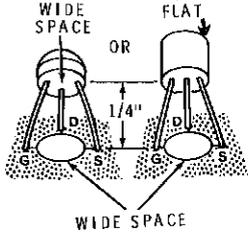
IDENTIFICATION
DRAWING



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

START →

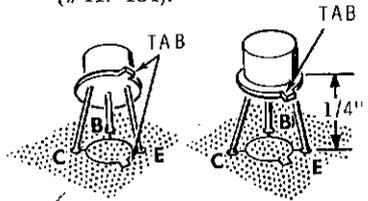
In the following steps, line up the transistor with its outline on the circuit board and insert the leads into their correct holes. Solder the leads to the foil and cut off the excess lead lengths.



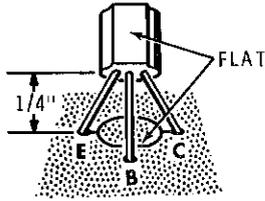
(✓) Q204: E304 transistor (#417-828).

(✓) Q205: E304 transistor (#417-828).

(✓) Q206: 2N2369 transistor (#417-154).

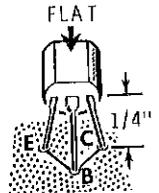


(✓) Q209: 2N5770 transistor (#417-293).



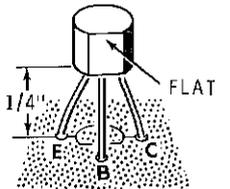
CONTINUE →

(✓) Q212: S6020 transistor (#417-237).



(✓) Q213: SE6020 transistor (#417-237).

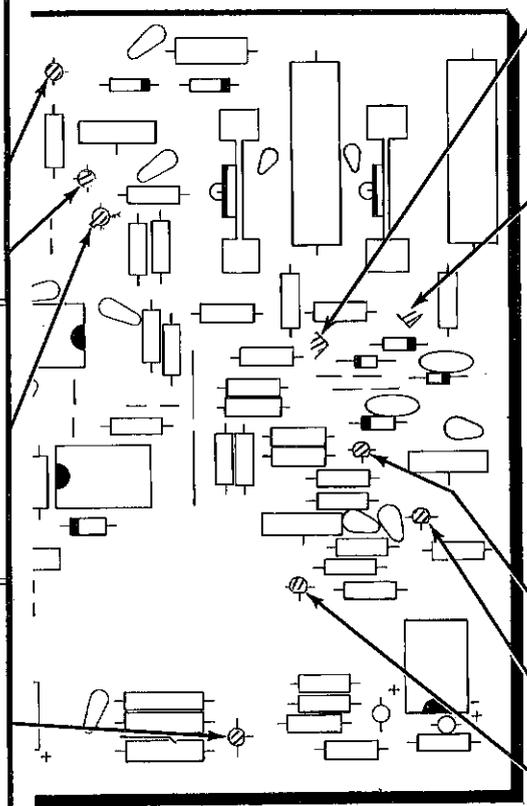
NOTE: Install the next three transistors as shown.



(✓) Q210: 2N4121 transistor (#417-235).

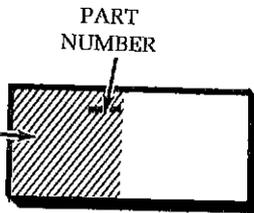
(✓) Q211: 2N4121 transistor (#417-235).

(✓) Q216: 2N4121 transistor (#417-235).



PICTORIAL 4-10

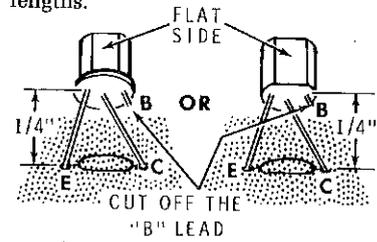
The steps performed in this Pictorial are in this area of the circuit board.



IDENTIFICATION DRAWING

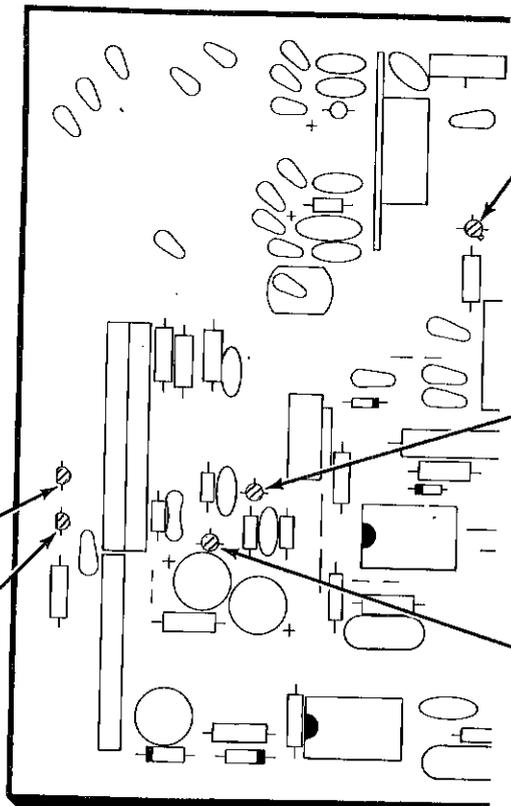
START →

NOTE: Install the following transistors as shown. Solder each lead to the foil and cut off the excess lead lengths.



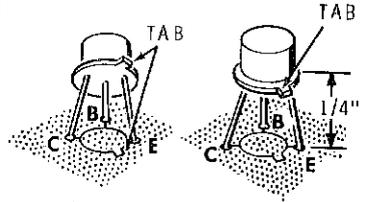
(✓) ZD202: 2N3393 transistor (#417-118).

(✓) ZD201: 2N3393 transistor (#417-118).

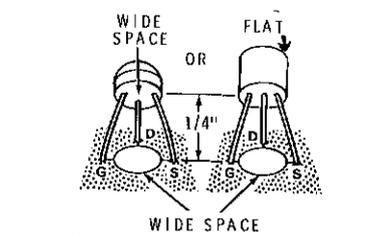


CONTINUE ↘

(✓) Q203: 2N2369 transistor (#417-154).



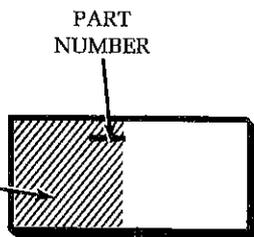
(✓) Q202: E304 transistor (#417-828).



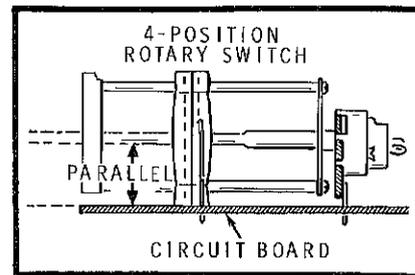
(✓) Q201: E304 transistor (#417-828).

PICTORIAL 4-11

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



IDENTIFICATION DRAWING



Detail 4-12A

START →

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

() SW201/R213/SW204:
4-position rotary switch with 100 Ω control (#63-1307). Make sure the pins on each wafer are straight. Install the pins, one wafer at a time, into the circuit board. Make sure the switch is parallel to the circuit board. (See Detail 4-12A.) Solder the pins to the foil.

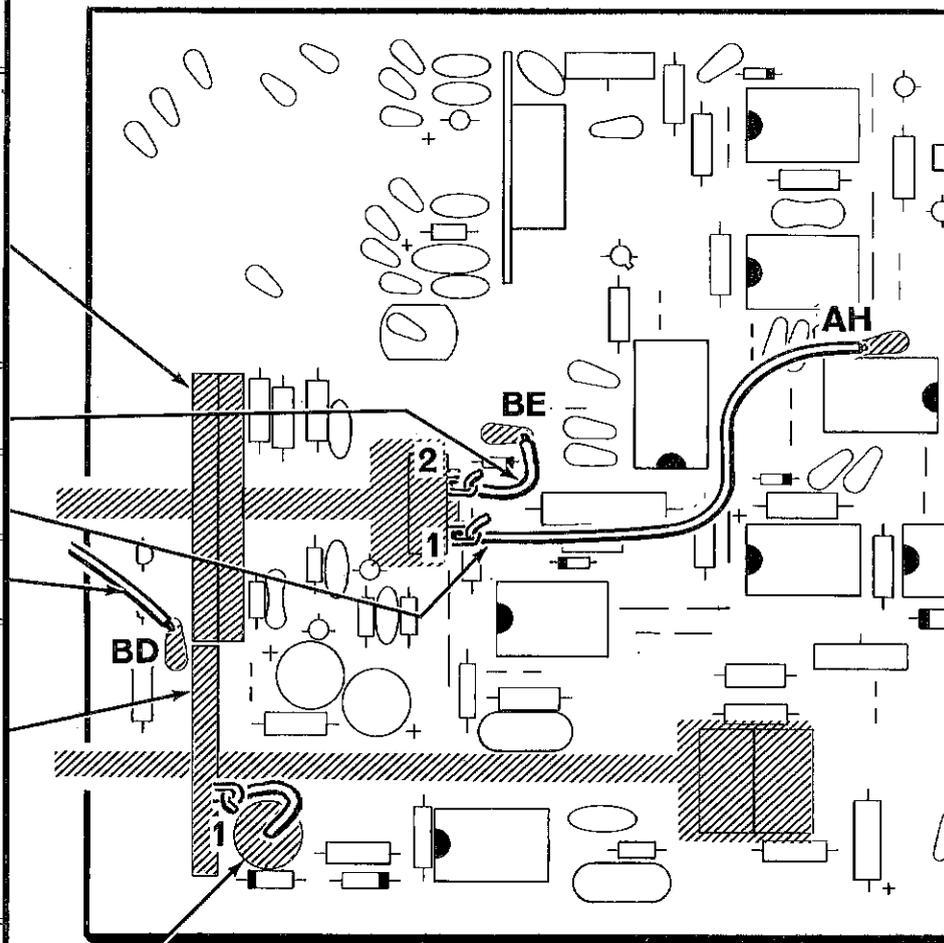
() 1-1/2" white-black wire from SW204 lug 2 (S-1) to hole BE.

(✓) 3-1/4" white-brown wire from SW204 lug 1 (S-1) to hole AH.

(✓) 2-1/4" white-black wire at hole BD.

(✓) SW202/R263A/R263B:
3-position rotary switch (#63-1234) with dual 1000 Ω controls. Make sure the pins on the wafer are straight. Install the pins, one wafer at a time, into the circuit board. Make sure the switch is parallel to the circuit board. Solder the pins to the foil.

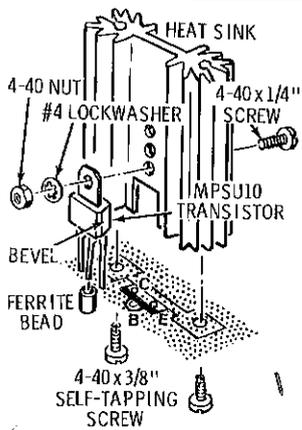
(✓) C206: 6 μF nonpolarized electrolytic. Position this capacitor with either lead to the circuit board. Connect the other lead to SW202 lug 1 (S-1).



PICTORIAL 4-12



START →

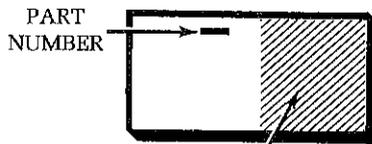


(✓) Q214: Assemble and mount a transistor heat sink assembly as follows. (NOTE: THIS ASSEMBLY IS DIFFERENT FROM THOSE ON THE VERTICAL CIRCUIT BOARD.)

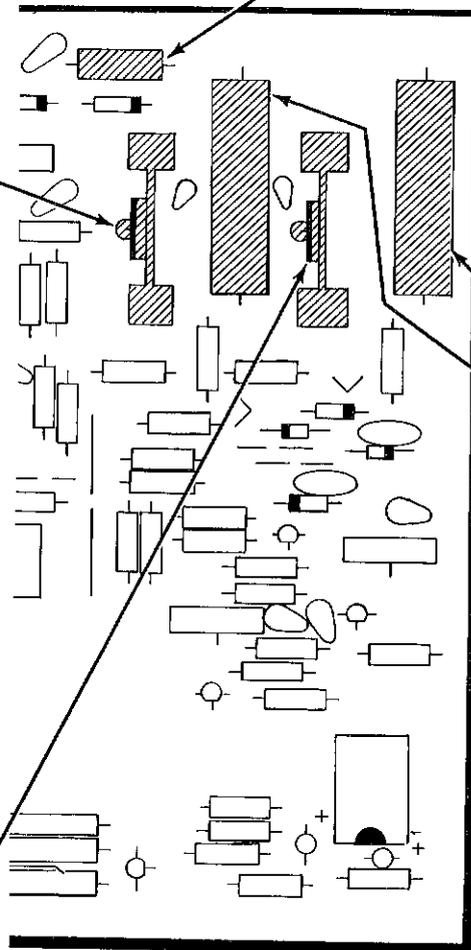
1. Loosely mount an MPSU10 transistor (#417-B34) on a large heat sink with a 4-40 x 1/4" screw, a #4 lockwasher, and a 4-40 nut as shown. Be sure the bevels are positioned as shown.
2. Slide a ferrite bead over the center transistor lead.
3. Mount the transistor heat sink assembly onto the circuit board at Q214 with two 4-40 x 3/8" self-tapping screws.
4. Solder the transistor leads to the foil and cut off the excess lead lengths.
5. Tighten the screw.

(✓) Q215: In the same manner, mount another transistor heat sink assembly.

IDENTIFICATION DRAWING



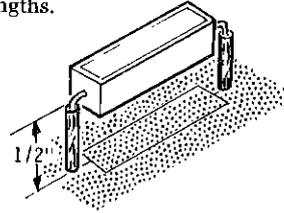
The steps performed in this Pictorial are in this area of the circuit board.



CONTINUE →

(✓) R252: 68 kΩ, 1-watt (blue-gray-orange). Solder the leads to the foil and cut off the excess lead lengths.

NOTE: Cut and use the lengths of teflon sleeving called for on the leads of the following resistors. Solder the leads to the foil as you install each resistor. Then cut off the excess lead lengths.

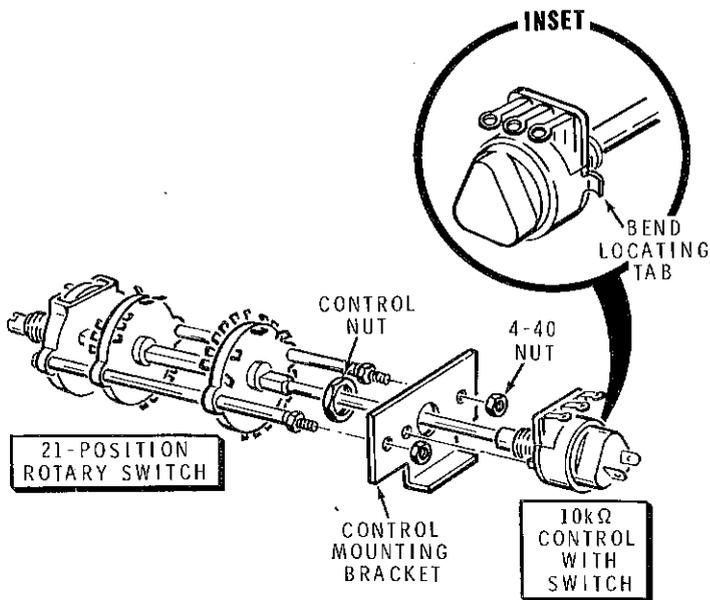


(✓) R286: 4700 Ω, 7-watt. Use 1/2" lengths of sleeving.

(✓) R287: 4700 Ω, 7-watt. Use 1/2" lengths of sleeving.

(✓) Set the circuit board aside temporarily.

PICTORIAL 4-13



PICTORIAL 4-14

TIME/CM SWITCH

Refer to Pictorial 4-14 for the following steps.

NOTE: If your control has two locating tabs, bend the indicated tab out (refer to the inset drawing on Pictorial 4-14). If your control has only one locating tab, do not bend it.

- (✓) R253/SW205: Mount a 10 kΩ control with switch (#19-717) to the control mounting bracket as shown. Use a control nut. The one tab on the control should fit in the small hole in the bracket.
- (✓) SW203: Mount the 21-position rotary switch to the control mounting bracket with two 4-40 nuts. Be sure to position the rotary switch so the lugs are as shown in Pictorial 4-15.

Refer to Pictorial 4-15 ("Illustration Booklet", Page 4) for the following steps.

- () Position the switch assembly as shown.

NOTE: To prepare the lengths of wire in the following steps, cut the wire to the specified length. Then remove 1/4" of insulation from each end, twist the fine wires together and apply a small amount of solder. Position all wires as shown in the Pictorial.

- () Prepare the following wires:

QUANTITY	WIRE
1	1-1/2" smaller brown
1	1-1/4" smaller brown
2	1-3/4" smaller brown
1	2" smaller brown
1	2-3/4" smaller orange

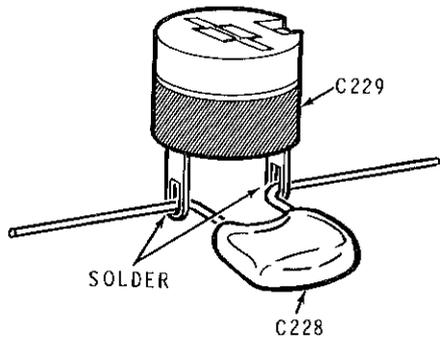
CAUTION: When you solder a wire to a switch lug use only enough solder to make a good connection on the lug. Do not permit solder to run down onto the rivets on the wafer.

- () Connect a 1-1/2" smaller brown wire to wafer lugs 8 (NS) and 11 (S-1).
- (✓) Remove an additional 1/4" of insulation from one end of the 1-1/4" smaller brown wire.
- (✓) Connect the 1/4" bare end of this wire to wafer lug 3 (NS). Connect the bare 1/2" end through wafer 1 lug 5 (NS) to lug 7 (NS).
- (✓) Connect a 1-3/4" smaller brown wire between wafer 2 lugs 6 (NS) and 29 (NS).
- (✓) Connect a 2" smaller brown wire between wafer 2 lugs 6 (S-2) and 19 (S-1).
- (✓) Connect a 1-3/4" smaller brown wire between wafer 2 lugs 4 (NS) and 23 (NS).
- (✓) Carefully twist lugs 7, 8, 10, and 11 (of wafer 2) 90° as shown in the inset drawing.

NOTE: Where a wire end passes through a lug and then goes elsewhere, as in the following step, it will be treated as two wires in the soldering instructions (S-2), one entering and one leaving the lug.

- (✓) Connect a 1" bare wire from wafer 2 lug 7 (S-1) through lug 8 (S-2), through lug 10 (S-2), to lug 11 (NS).
- (✓) Refer to Detail 4-15A and prepare a 150 pF mica capacitor (C228) and an 8-50 pF trimmer capacitor (C229) assembly as shown. (Do not cut off any excess mica capacitor lead lengths)



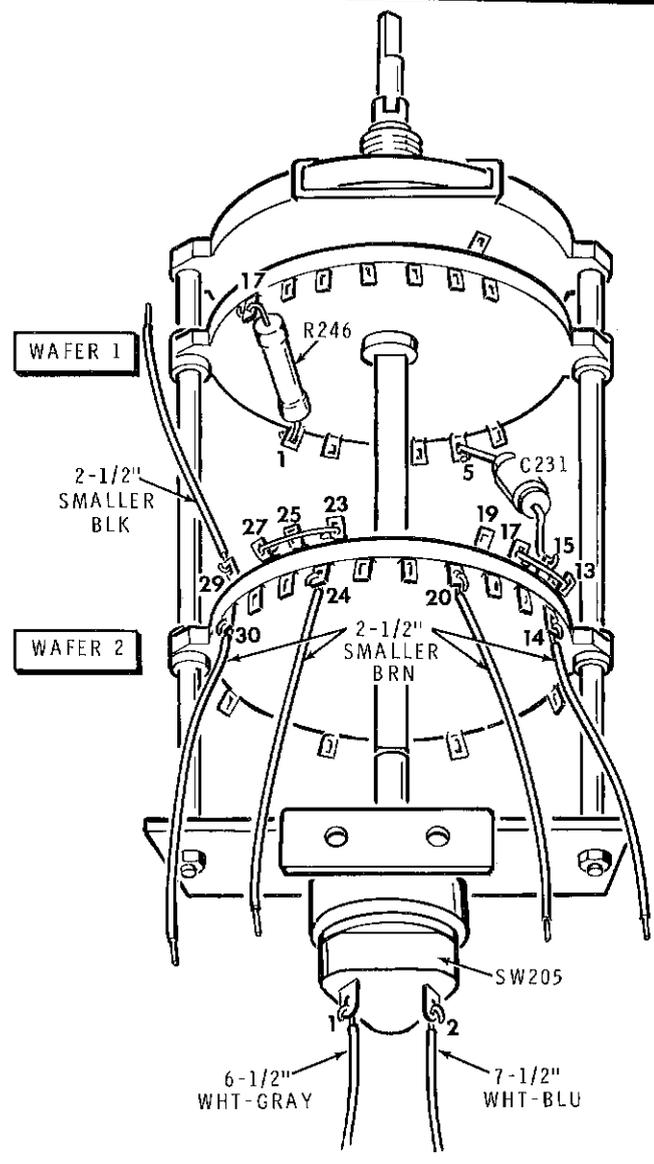


Detail 4-15A

- ✓ C228, C229: Connect the capacitor assembly from wafer 1 lug 3 (S-2) to wafer 2 lug 4 (S-2). Be sure to cut off any excess lead lengths.
- ✓ Connect a 2-3/4" smaller orange wire from wafer 1 lug 4 (S-1) to R253 lug 2 (S-1).

Refer to Pictorial 4-16 for the following steps.

- ✓ Position the switch assembly as shown.
- ✓ R246: Connect a 20 kΩ, 1% resistor between wafer 1, lugs 17 (NS) and 1 (NS). Position the resistor 1/4" away from the wafer.
- ✓ Connect a 1" bare wire from wafer 2, lug 13 (S-1), **past** lug 15, to lug 17 (S-1). Position lug 15 so that it touches the bare wire (NS).
- ✓ Connect a 1" bare wire from wafer 2, lug 23 (S-2), **past** lug 25, to lug 27 (S-1). Solder the bare wire to lug 25.

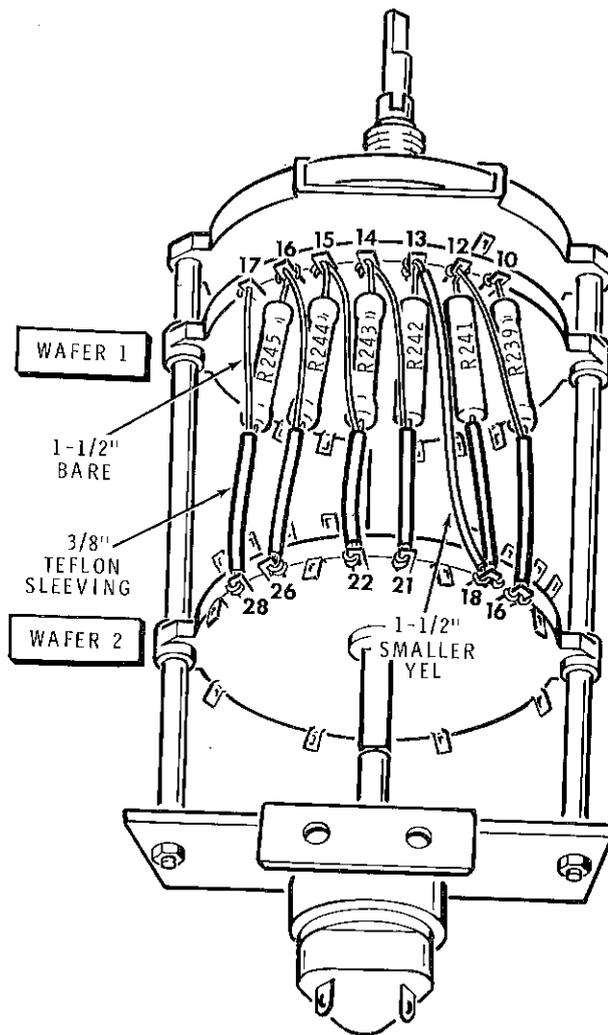


PICTORIAL 4-16

QUANTITY	WIRE
4	2-1/2" smaller brown
1	2-1/2" smaller black
1	7-1/2" white-blue
1	6-1/2" white-gray

NOTE: Connect only one end of the following wires. The free ends will be connected later.

- ✓ 2-1/2" smaller brown wire to wafer 2 lug 30 (S-1).
- ✓ 2-1/2" smaller black wire to wafer 2 lug 29 (S-2).
- ✓ 2-1/2" smaller brown wire to wafer 2 lug 24 (S-1).
- ✓ 2-1/2" smaller brown wire to wafer 2 lug 20 (S-1).
- ✓ 2-1/2" smaller brown wire to wafer 2 lug 14 (S-1).
- ✓ 7-1/2" white-blue wire to switch SW205 lug 2 (S-1).
- ✓ 6-1/2" white-gray wire to switch SW205 lug 1 (S-1).



PICTORIAL 4-17

Refer to Pictorial 4-17 for the following steps.

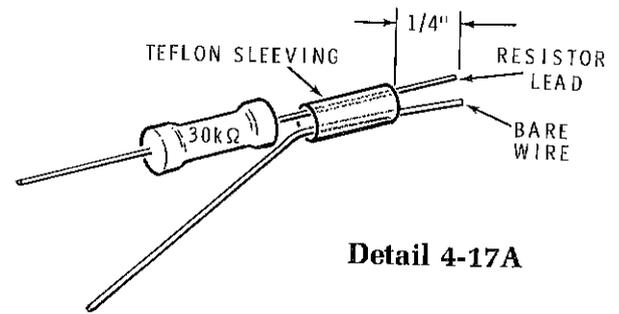
- (✓) Cut five 1-1/2" lengths of bare wire.
- (✓) Cut six 3/8" lengths of teflon sleeving.

Refer to Detail 4-17A for the next two steps.

- (✓) 1. Place a length of teflon sleeving over one lead of a 30 k Ω , 1% resistor. Position the sleeving up against the resistor body.
- (✓) 2. Insert a bare wire through the same teflon sleeving until it extends 1/4" beyond the sleeving. Then cut the resistor lead even with the end of the bare wire.

NOTE: In the following steps you may bend the switch lugs up to make lead installation easier.

- (✓) R245: Connect the bare wire and resistor lead to wafer 2 lug 28 (S-2).



Detail 4-17A

- (✓) Connect the other end of the bare wire to wafer 1 lug 17 (S-2).
- (✓) Connect the other end of the 30 k Ω , 1% resistor to wafer 1 lug 16 (NS).

Prepare the following resistors and bare wires in the same manner.

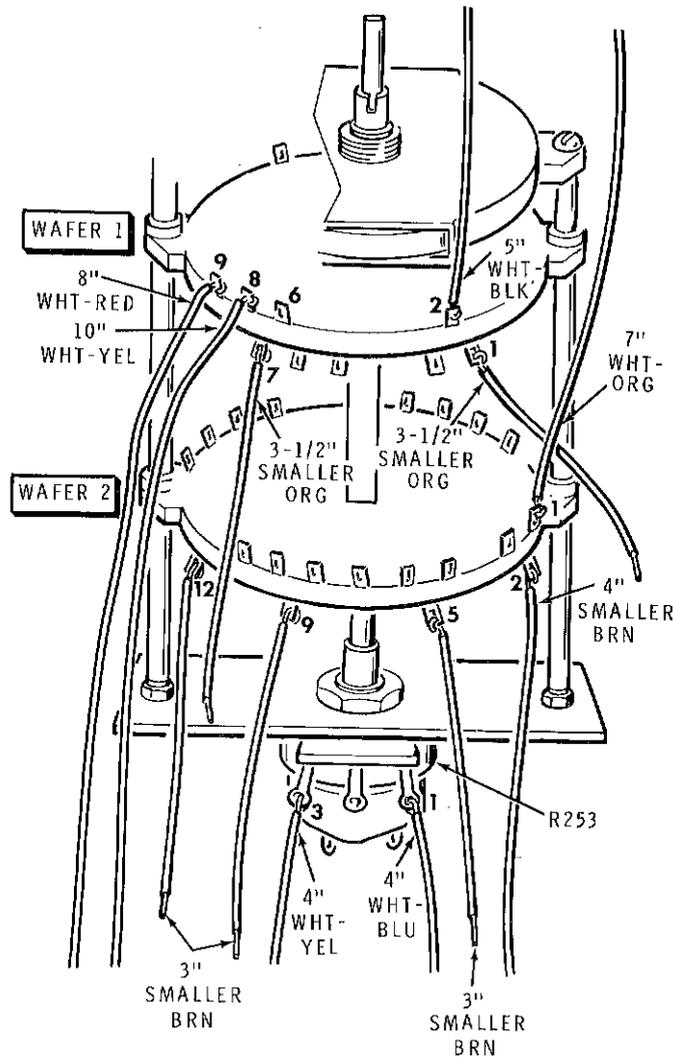
- (✓) Place a length of sleeving over one lead of a 50 k Ω , 1% resistor and a length of bare wire.
- (✓) R244: Connect the bare wire and resistor lead to wafer 2 lug 26 (S-2).
- (✓) Connect the other end of the bare wire to wafer 1 lug 16 (S-2).
- (✓) Connect the other lead of the 50 k Ω , 1% resistor to wafer 1 lug 15 (NS).
- (✓) Place a length of sleeving over one lead of a 100 k Ω , 1% resistor and a length of bare wire.
- (✓) R243: Connect the bare wire and resistor lead to wafer 2 lug 22 (S-2).
- (✓) Connect the other end of the bare wire to wafer 1 lug 15 (S-2).
- (✓) Connect the other lead of the 100 k Ω , 1% resistor to wafer 1 lug 14 (NS).
- (✓) Place a length of sleeving over one lead of a 300 k Ω , 1% resistor and a length of bare wire.
- (✓) R242: Connect the bare wire and resistor lead to wafer 2 lug 21 (S-2).
- (✓) Connect the other end of the bare wire to wafer 1 lug 14 (S-2).
- (✓) Connect the other lead of the 300 k Ω , 1% resistor to wafer 1 lug 13 (NS).
- (✓) Connect a 1-1/2" smaller yellow wire from wafer 1 lug 13 (S-2) to wafer 2 lug 18 (NS).

- (✓) Place a length of sleeving over one lead of a 500 kΩ, 1% resistor.
- (✓) R241: Connect this lead of the resistor to wafer 2 lug 18 (S-2).
- (✓) Connect the other lead of the 500 kΩ, 1% resistor to wafer 1 lug 12 (NS).
- (✓) Place a length of sleeving over one lead of 1 MΩ, 1% resistor and a length of bare wire.
- (✓) R239: Connect the bare wire and resistor lead to wafer 2 lug 16 (S-2).
- (✓) Connect the other end of the bare wire to wafer 1 lug 12 (S-2).
- (✓) Connect the other lead of the 1 MΩ, 1% resistor to wafer 1 lug 10 (S-1).

Refer to Pictorial 4-18 for the following steps.

- (✓) Prepare the following wires:

QUANTITY	WIRE
1	8" white-red
1	10" white-yellow
2	3-1/2" smaller orange
1	5" white-black
3	3" smaller brown
1	4" smaller brown
1	7" white-orange
1	4" white-yellow
1	4" white-blue

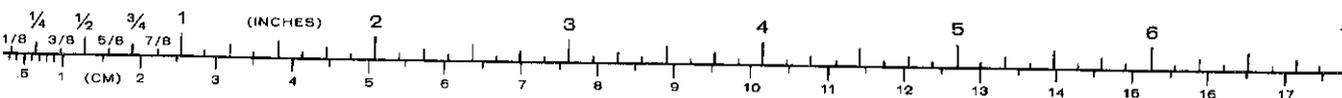


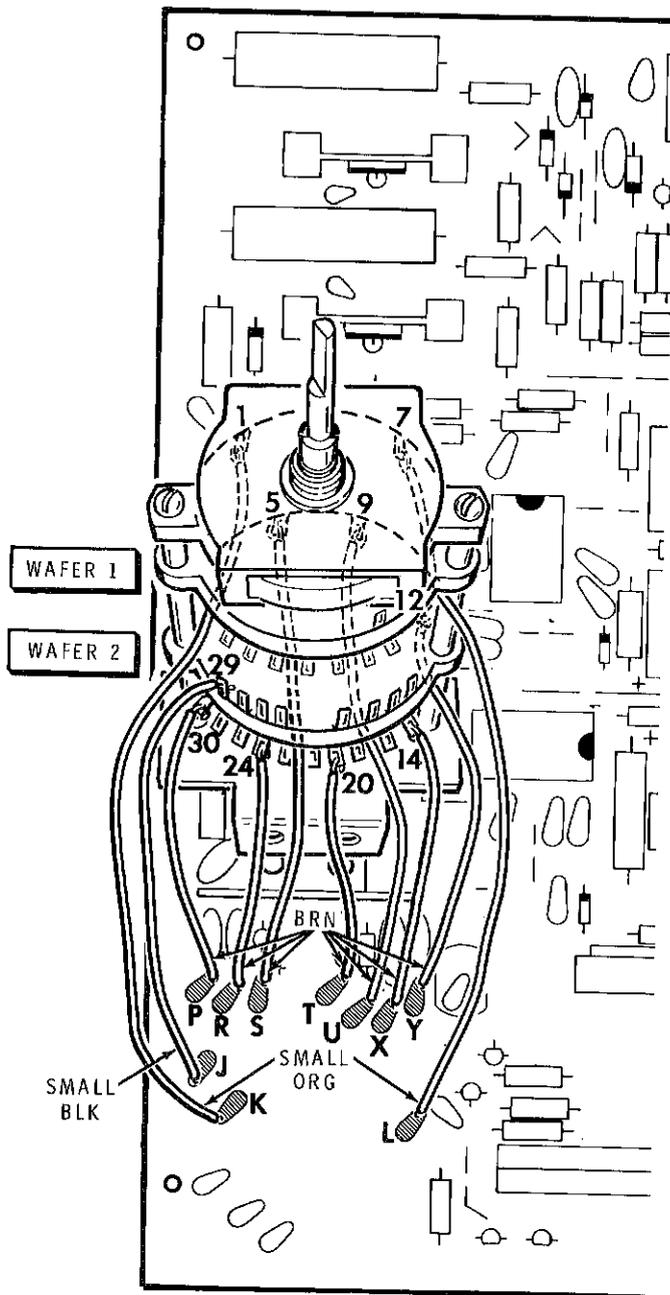
PICTORIAL 4-18

- (✓) Position the switch assembly as shown.

NOTE: Connect the following wires to the switch. The free ends will be connected later.

- (✓) 8" white-red wire to wafer 1 lug 9 (S-1).
- (✓) 10" white-yellow wire to wafer 1 lug 8 (S-2).
- (✓) 3-1/2" smaller orange wire to wafer 1 lug 7 (S-2).
- (✓) 5" white-black wire to wafer 1 lug 2 (S-1).
- (✓) 3-1/2" small orange wire to wafer 1 lug 1 (S-2).
- (✓) 3" smaller brown wire to wafer 2 lug 12 (S-1).
- (✓) 3" smaller brown wire to wafer 2 lug 9 (S-1).
- (✓) 3" smaller brown wire to wafer 2 lug 5 (S-1).
- (✓) 4" smaller brown wire to wafer 2 lug 2 (S-1).
- (✓) 7" white-orange wire to wafer 2 lug 1 (S-1).
- (✓) 4" white-yellow wire to control R253 lug 3 (S-1).
- (✓) 4" white-blue wire to control R253 lug 1 (S-1).
- (✓) Check all the switch lugs to be sure that solder has not bled onto nearby lugs or rivets. All lugs should be soldered except wafer 2, lugs 3 and 11, and wafer 1, lug 6.





PICTORIAL 4-20

- () Refer to Pictorial 4-19 (on Page 4 in the "Illustration Booklet") and check the switch lugs for the proper connections. An indication such as "wht-brn" means that a white-brown wire should be connected to that lug. If a wire color is repeated, it means that there should be two wires of that color on the lug. Where a bare wire goes through a lug and then on to another lug it counts as two wires. Resistors and capacitors are called out by their values only.

Refer to Pictorial 4-20 for the following steps.

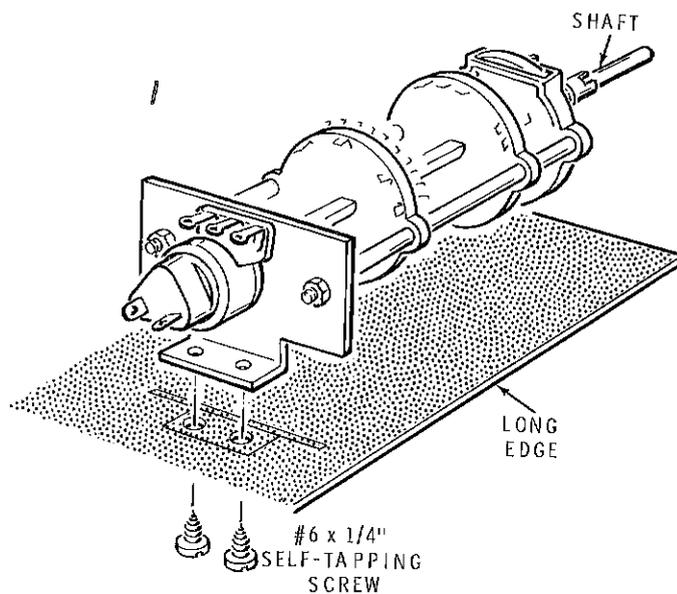
- () Position the switch assembly near the horizontal circuit board as shown.

Connect the wires coming from wafer 2 to the circuit board as follows. Solder each wire to the foil as you install it. (NOTE: The brown wires called for are smaller brown wires.)

- (✓) Brown wire from lug 30 to hole P.
- (✓) Brown wire from lug 24 to hole R.
- (✓) Brown wire from lug 5 to hole S.
- (✓) Brown wire from lug 20 to hole T.
- (✓) Brown wire from lug 9 to hole U.
- (✓) Brown wire from lug 14 to hole X.
- (✓) Brown wire from lug 12 to hole Y.
- (✓) Smaller black wire from lug 29 to hole J.

Connect the wires coming from wafer 1 to the circuit board as follows. Solder each wire to the foil as you install it.

- (✓) Smaller orange wire from lug 1 to hole K.
- (✓) Smaller orange wire from lug 7 to hole L.



Detail 4-21A

Refer to Pictorial 4-21 (on Page 4 in the "Illustration booklet") for the following steps.

Refer to Detail 4-21A and loosely mount the switch assembly to the circuit board at SW203 as shown. Use two #6 × 1/4" self-tapping screws. Do not pinch any wires between the circuit board and switch.

Connect the wires coming from wafer 2 to the circuit board as follows. Solder each wire to the foil as you install it. Position each wire down neatly on the circuit board.

White-orange from lug 1 to hole AK.

Smaller brown from lug 2 to hole AE.

Connect the wires coming from wafer 1 to the circuit board as follows. Solder each wire to the foil as you install it.

White-black from lug 2 to hole BB.

White-yellow from lug 8 to hole BA.

White-red from lug 9 to hole BC.

Connect the wires coming from control R253 to the circuit board as follows. Solder each wire to the foil as you install it.

White-blue from lug 1 to hole AU.

White-yellow from lug 3 to hole AX.

C232: Install one lead of the 2 μ F capacitor in hole Z on the circuit board as shown. Solder the lead to the foil and cut off the excess lead length. NOTE: If your capacitor has a band on one end you may disregard this band.

Connect the other capacitor lead to switch SW203 wafer 2 lug 11 (S-2).

Connect the wires coming from switch SW205 to the circuit board as follows. Solder each wire to the foil as you install it.

White-blue from lug 2 to hole AZ.

White-gray from lug 1 to hole AY.

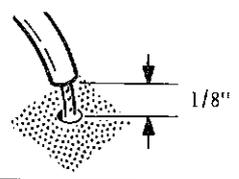
Position all the wires down neatly on the circuit board.

NOTE: There will be several unused holes in the circuit board, Holes AF, AG and AJ will not be used.

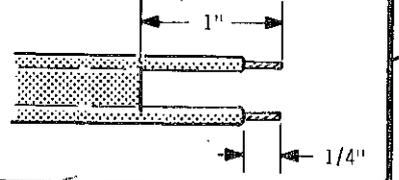
START

() Turn the circuit board over and position it as shown.

In the following steps, install the wires to the foil side of the circuit board as shown. Solder each wire as you connect it. Leave the wire insulation 1/8" from the circuit board so the connection can be soldered.



(✓) 11" twin lead at H and G. Prepare both ends as shown.



(✓) 7" white-red wire at hole C.

(✓) 18" white-yellow wire at hole B.

(✓) 12" white-orange wire at hole A.

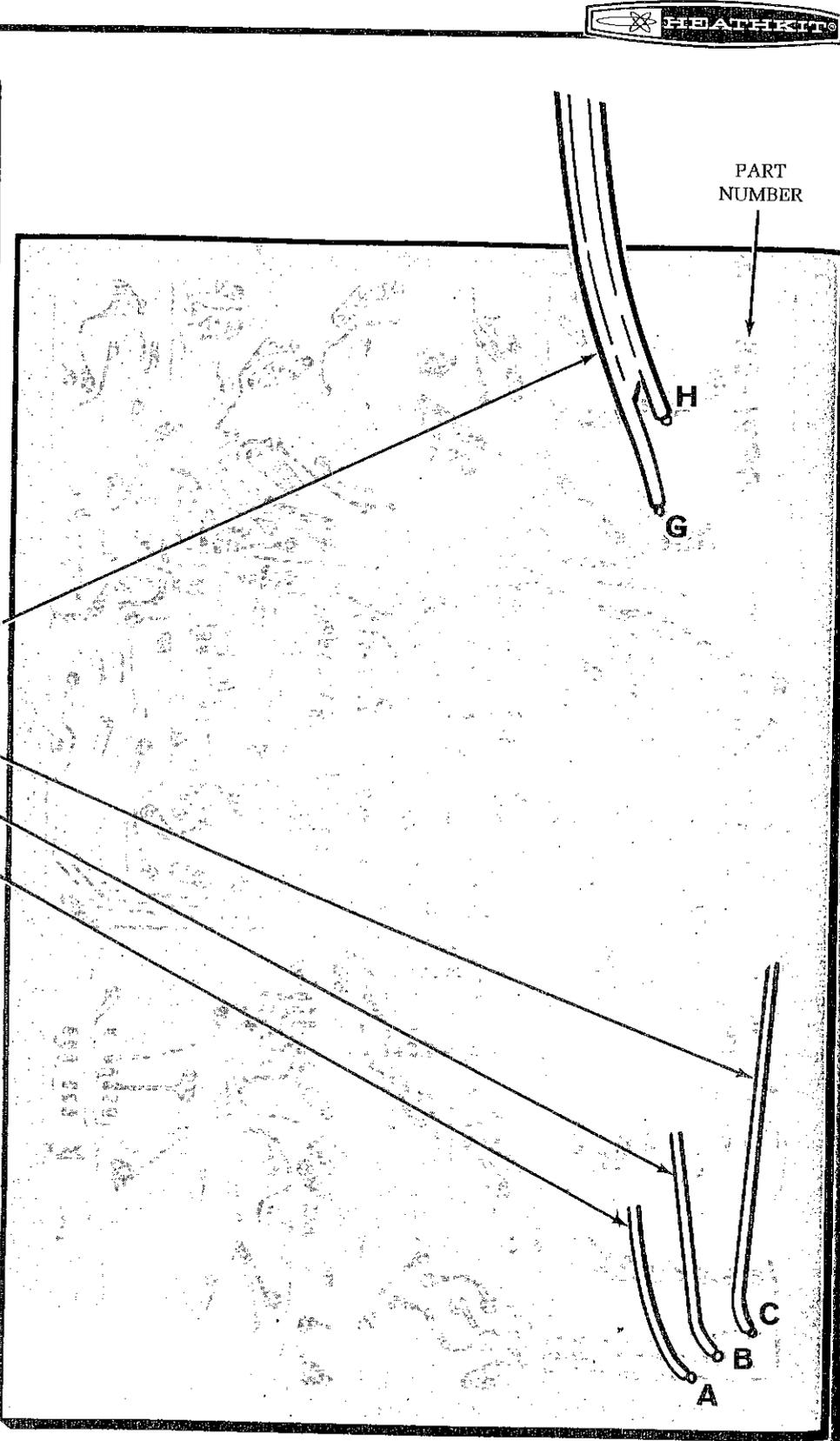
CIRCUIT BOARD CHECKOUT

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 and integrated circuits for proper type and installation.
- (✓) Capacitors for the correct position of the banded end.
- (✓) Diodes for the correct position of the banded end.

FINISH

Set the circuit board aside temporarily.



PICTORIAL 4-21



CHASSIS ASSEMBLY

PARTS LIST

unpack the remaining parts (Final Pack) and check each part against the following list. The key numbers correspond to the numbers on the Chassis Assembly Parts Pictorial (on Page 5 in the Illustration Booklet).

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

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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RESISTORS — CONTROLS — CAPACITORS

1-49	1	22 Ω , 1/2-watt (red-red-black) resistor	R7
1-7-1	1	47 k Ω , 1-watt (yellow-violet-orange) resistor	R4
1-35-1	1	1.5 M Ω , 1-watt (brown-green-green)	R8
2-14	1	1 M Ω , precision resistor	
2-17	1	10 M Ω , precision resistor	
10-1058	2	200 Ω control	R5, R6
19-716	1	10 k Ω control with switch	R2/SW3
10-1043	1	1 M Ω control	R3
27-132	2	.1 μ F Mylar capacitor	C1, C2
25-228	1	100-100-300 electrolytic capacitor	C3

SWITCHES — INSULATORS

0-54	1	120-240 switch	SW4
0-608	1	NOR-LOW switch	SW5
0-610	2	DP3T slide switch	SW1, SW2
3-5	1	Cushion strip	
3-34	3	Alligator clip insulator	
3-45	5	Grommet	
5-103	1	Fish paper	
5-182	1	Line cord strain relief	
5-710	4	Circuit board standoff	

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

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

#1-#2-#3 Hardware

C1	250-1231	4	1-78 x 1/4" flat head screw
C2	250-420	2	#2 x 1/4" self-tapping screw
C3	250-251	4	3-48 x 3/8" flat head screw
C4	252-1	4	3-48 nut
C5	254-7	4	#3 lockwasher

#4 Hardware

C6	250-156	2	4-40 x 1/8" setscrew
C7	250-52	8	4-40 x 1/4" screw
C8	250-1106	3	4-40 x 5/16" black flat head screw
C9	252-15	8	4-40 nut
C10	254-9	8	#4 lockwasher

#6 Hardware

C11	250-70	4	6-32 x 3/16" flat head screw
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KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Hardware (cont'd.)

C12	250-170	7	#6 x 1/4" self-tapping screw	
C13	250-235	12	6-32 x 1/4" screw	
C14	250-416	8	6-32 x 1/4" flat head screw	
C15	250-100	4	6-32 x 5/16" setscrew	
C16	250-89	5	6-32 x 3/8" screw	
C17	250-434	1	6-32 x 3/8" flat head screw	
C18	250-441	4	#6 x 3/8" self-tapping flat head screw	
C19	250-475	12	#6 x 3/8" hex head screw	
C20	250-162	1	6-32 x 1/2" screw	
C21	250-503	4	6-32 x 3/4" flat head screw	
C22	252-3	19	6-32 nut	
C23	254-1	21	#6 lockwasher	
C24	259-1	1	#6 solder lug	
C25	255-188	4	6-32 tapped hex spacer	

#8 Hardware

C26	250-585	4	8-32 x 1/2" screw	
C27	250-97	2	8-32 x 1" screw	
C28	252-4	6	8-32 nut	
C29	254-2	10	#8 lockwasher	
C30	253-45	2	#8 flat washer	

Other Hardware

C31	250-1162	2	10-32 x 5/8" thumbscrew	
C32	252-7	7	Control nut	
C33	253-10	5	Control flat washer	
C34	259-27	2	Large solder lug	
C35	252-193	1	Push-on nut	
C36	255-49	4	5/16" spacer	
C37	255-66	2	1-3/8" threaded spacer	

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

	90-1109-2	1	Top cover	
	90-1110-2	1	Bottom cover	
	100-1676	1	Front subpanel	
	(203-1632)			
	203-1903-1	1	Front panel	
	200-1205	1	Rear subpanel	
	200-1206	1	Left subpanel	
	200-1207	1	Right subpanel	
	203-1631-1	1	Rear panel	
D1	204-2066	1	Right shield bracket	
D2	204-2067	1	Left shield bracket	
D3	204-2139	2	Control bracket	
	205-1414	2	Side rail	
	206-1120	1	CRT shield	
D4	206-1205	1	CRT subshield	
D5	207-606	2	CRT clamp	
	210-97	1	Rear panel ring	
	210-98	1	Front panel ring	
D6	210-76	1	CRT ring	
D7	211-61	1	Handle	
D8	266-807	2	Detent	

KNOBS — BUSHINGS — FEET

E1	462-951	5	Large black control knob	
E2	455-613	5	Concentric knob bushing	
E3	455-71	6	Small knob bushing	
E4	462-363	5	Small red knob	
E4	462-390	1	Small black knob	
E5	462-399	2	Black knob with skirt	
E6	455-50	2	Large knob bushing	
E7	462-908	2	Detent cover	
E8	455-54	2	Large nylon bearing	
E8	455-62	1	Small nylon bearing	
E9	261-1	8	Small rubber foot	
E10	261-9	4	Large rubber foot	

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

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

LABELS — CRT — WINDOW

390-147	1	Danger label
390-1255	1	Fuse replacement label
390-1379	1	Heathkit label
391-34	1	Blue and white label
411-815	1	CRT (cathode ray tube)
414-36	1	Graticule
446-646	1	CRT window
210-74	1	CRT bezel

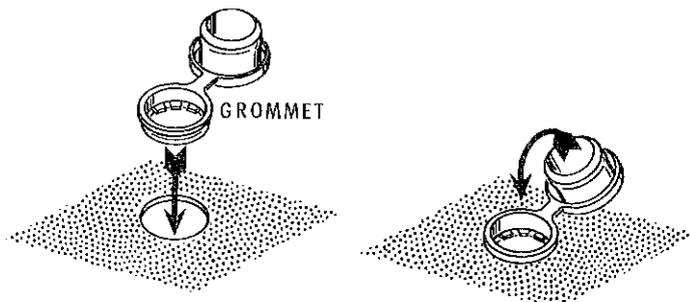
MISCELLANEOUS

54-919	1	Power transformer
89-22	1	Line cord
134-237	1	Test cable
134-940	1	Wire harness
456-36	1	1/8" coupling
456-7	2	1/4" coupling
207-38	1	Plastic clamp
211-67	1	Top handle grip
211-68	1	Bottom handle grip

Miscellaneous (cont'd.)

G5	258-192	2	Coil spring	
G6	260-16	3	Alligator clip	
G7	261-39	4	Cord retainer	
G8	354-6	1	Cable tie	
G9	391-81	2	Decorative insert	
G10	412-17	1	#53 lamp	PL1
G11	421-20	1	1/2-ampere slow-blow fuse	F1
G11	421-23	1	1-ampere slow-blow fuse	F1
G12	422-1	1	Fuse block	
G13	431-14	1	Terminal strip	
G14	432-59	3	BNC connector	
G15	432-893	1	Feed-through connector	
G16	434-41	1	CRT socket	
G17	434-44	1	Lamp socket	
G18	453-271	2	Long control shaft	
G18	453-272	1	Short control shaft	
G19	490-23	1	Allen wrench	
G20	490-71	1	Alignment tool	

STEP-BY-STEP ASSEMBLY

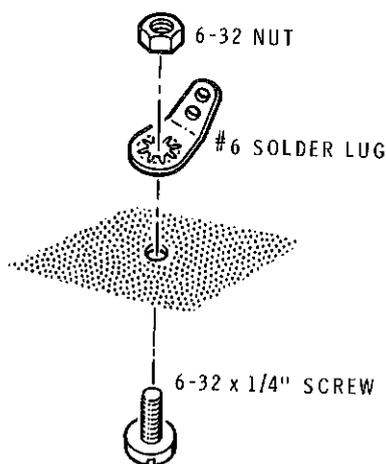


Detail 5-1A

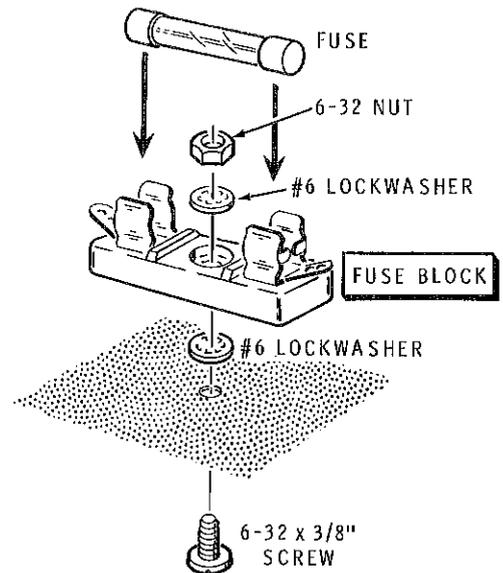
REAR SUBPANEL ASSEMBLY

Refer to Pictorial 5-1 (Page 6 in the "Illustration Booklet") for the following steps.

- (✓) Position the rear subpanel as shown.
- (✓) Refer to Detail 5-1A and install grommets in holes A, B, and C.
- (✓) Refer to Detail 5-1B and install a #6 solder lug at D with a 6-32 x 1/4" screw and a 6-32 nut. Position the solder lug as shown.

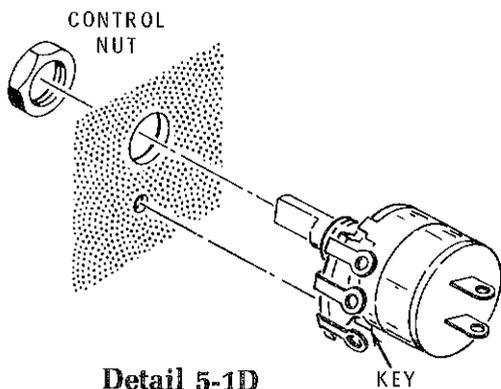


Detail 5-1B



Detail 5-1C

- (✓) Refer to Detail 5-1C and install the fuse block at F1. Use a 6-32 x 3/8" screw, two #6 lockwashers, and a 6-32 nut.
- (✓) F1: If you intend to operate your Oscilloscope from 120 volts, install a 1-ampere slow-blow fuse at F1. However, if you intend to operate your Oscilloscope from 240 volts, install a 1/2-ampere slow-blow fuse.
- (✓) Mark the fuse rating on the fuse replacement label (1-ampere for 120-volt operation, or 1/2-ampere for 240-volt operation). Then remove the paper backing and press the label onto the subpanel near the fuse block as shown in the Pictorial.
- (✓) Push the circuit board standoffs into holes E, F, G, and H. See the inset drawing. Be sure to position the standoffs as shown.



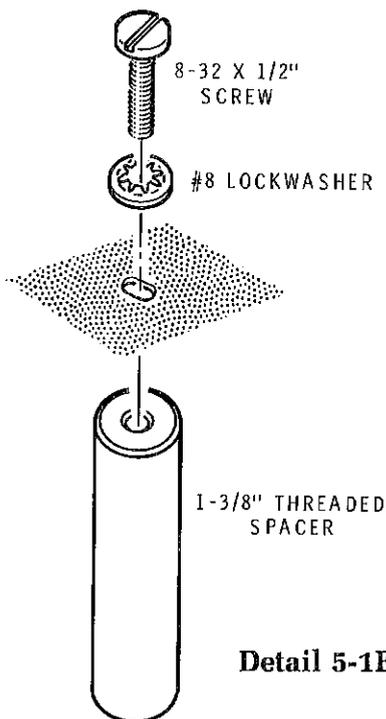
Detail 5-1D

R2/SW3: Refer to Detail 5-1D and install a 10 kΩ control with switch (#19-716) at R2/SW3 with a control nut. Be sure the control key goes into the subchassis hole.

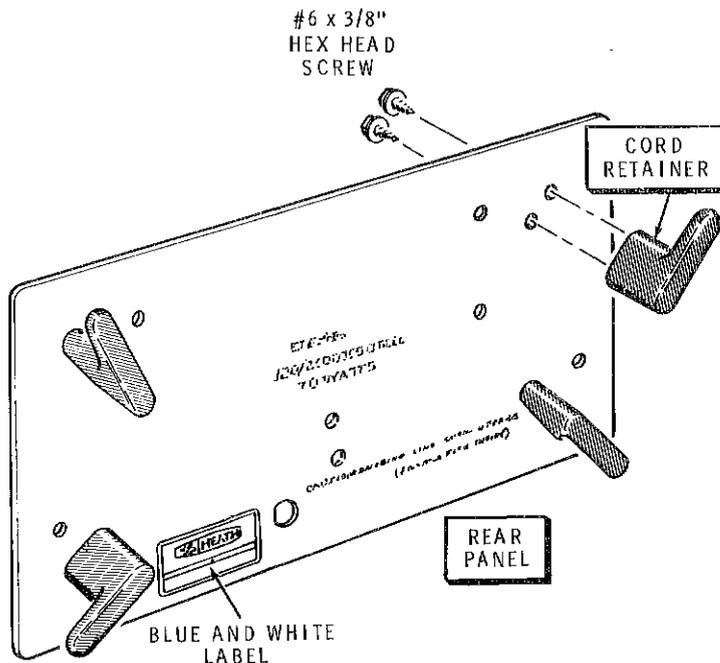
R3: In a similar manner, install a 1 MΩ control (#10-1043) at R3 with a control nut.

NOTE: When you install the following spacers, push them in the direction shown by the large arrows in Pictorial 5-1 before you tighten the screws.

Refer to Detail 5-1E and mount a 1-3/8" threaded spacer at J. Use an 8-32 x 1/2" screw and a #8 lockwasher.



Detail 5-1E



PICTORIAL 5-2

() Similarly, mount another 1-3/8" threaded spacer at K with an 8-32 x 1/2" screw and a #8 lockwasher.

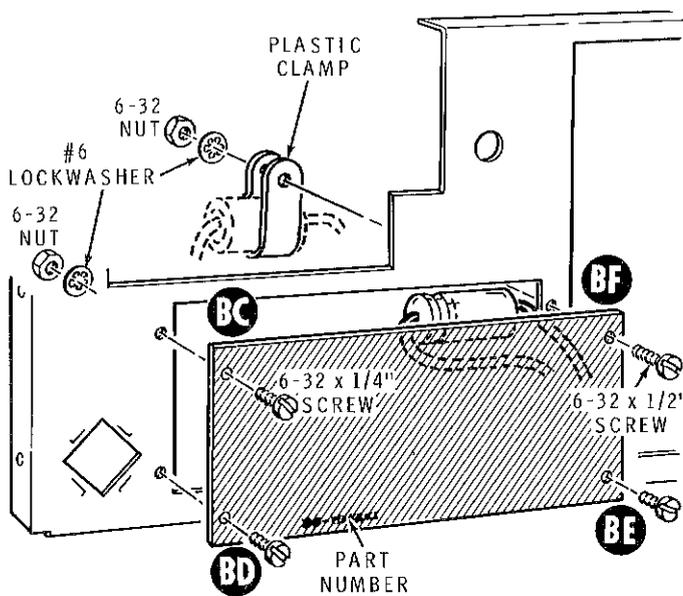
() Set this subpanel aside temporarily.

REAR PANEL ASSEMBLY

Refer to Pictorial 5-2 for the following steps.

(✓) Mount the four cord retainers to the rear panel with #6 x 3/8" hex head screws as shown. Be sure to fit the locating ridges on the retainers into the panel holes before you tighten the screws. DO NOT overtighten the screws.

(✓) Remove the backing paper from the blue and white label and press the label to the rear panel as shown. Refer to the numbers on this label in any communications you have with the Heath Company about this kit.



Detail 5-3A

CHASSIS ASSEMBLY AND WIRING

Refer to Pictorial 5-3 (Page 6 in the "Illustration Booklet") for the following steps.

- (✓) Position the rear panel so that hole AA is as shown.
- (✓) Mount the rear subpanel to the rear panel with three #6 × 1/4" self-tapping screws as shown.
- (✓) Install a grommet in the left subpanel at hole BB.
- (✓) Loosely attach the left subpanel to the rear panel and rear subpanel with four #6 × 3/8" hex head screws. Then tighten the four screws.
- (✓) Install a grommet in the right subpanel at hole BA.
- (✓) Loosely attach the right subpanel to the rear panel and rear subpanel with four #6 × 1/4" self-tapping screws. Then tighten the four screws.

NOTE: When hardware is called for in a step, only the screw size will be given. For instance, if "6-32 × 1/4" hardware" is called for, it means that a 6-32 × 1/4" screw, one or more #6 lockwashers, and a 6-32 nut

should be used for each mounting hole. The Detail referred to in the step will show the proper number of lockwashers to use.

- (✓) Refer to Detail 5-3A and mount the low voltage circuit board (#85-1540) to the right subpanel. Use three sets of 6-32 × 1/4" hardware at corners BC, BD, and BE. Be sure to position the circuit board so the part number is as shown. Do not pinch any wires between the circuit board and the subpanel. Also, be sure the circuit board does not protrude into other cutout areas of the subpanel.
- (✓) At hole BF, secure the indicated capacitor to the subpanel [with the positive (+) end as shown] with a plastic clamp and 6-32 × 1/2" hardware. Be sure neither the capacitor nor its leads protrude into the area where the horizontal circuit board goes.

NOTE: The next two circuit boards must mount flush against the subpanels. When you install these boards, refer to the inset drawing and check along the edge of the rectangular cutout in the subpanel to see if any excess solder or wire ends are keeping the circuit board from fitting properly against the subpanel. Re-heat or trim connections as necessary to make the circuit boards fit properly. (The circuit boards must fit properly so the switch shafts will line up properly with the front panel.)

- (✓) Loosely mount the vertical circuit board 85-1989-1 to the left subpanel with six sets of 4-40 × 1/4" hardware.
- (✓) In a similar manner, loosely mount the horizontal circuit board (#85-1990) to the right subpanel with four sets of 6-32 × 1/4" hardware. Be careful that you do not pinch any wires between the circuit board and the subpanel.
- (✓) Refer to Detail 5-3B ("Illustration Booklet", Page 6) and temporarily mount the front subpanel to the left and right subpanels with four #6 × 3/8" self-tapping flat head screws.
- (✓) Install and tighten five control nuts on the five shafts protruding through the front subpanel. Tighten all the screws that hold both the vertical and horizontal circuit boards and the two screws holding switch SW203. Then remove the five control nuts.

Refer to Pictorial 5-4 (Page 7 in the "Illustration Booklet") for the following steps.

- Prepare two 9" blue wires.
- Connect one blue wire to hole N (S-1).
- Connect the other blue wire to hole P (S-1). The free ends of these wires will be connected later.

In the following steps, connect the wires coming from the foil side of the horizontal circuit board to the foil of the vertical circuit board. Solder each wire as you connect it. Do not shorten any of the wires.

- White-orange to hole J. Route this wire as shown.
- White-yellow to hole K. Route this wire as shown.

The white-red wire and the twin lead will be connected later. Also the two blue wires coming from the vertical circuit board will be connected later.

Refer to Pictorial 5-5 (Page 8 in the "Illustration Booklet") for the following steps.

Refer to Detail 5-5A (in the "Illustration Booklet") and form the wire harness as shown.

Note: In the following steps, the term "BO" (breakout) refers to a place where a group of wires come out of the harness. Each breakout is identified by a number.

Refer to the Pictorial and route BO#16 (breakout #16), BO #15, BO #14, BO#17, and BO#13 through grommet BA.

Route BO's #16, 15, 14, and 17 through grommet BB.

Route BO's #16 and 15 through grommet A.

Route BO#12 through grommet C.

Position the remaining breakouts as shown in the Pictorial.

Refer to Pictorial 5-6 (Page 9 in the "Illustration Booklet") for the following steps.

In the following steps, connect the wires coming from the indicated breakouts. Solder each wire as you connect it to the horizontal circuit board. NOTE: Be very careful that solder does not flow down onto nearby foils and cause a solder bridge.

BO#8

- (✓) Orange to hole ORG +15 V.
- (✓) White-brown to hole AR.
- (✓) Gray to hole GRY-15V.
- (✓) Cut off the white-violet wire; it will not be used.

BO#9

- (✓) Brown to hole BRN-5V.

BO#10

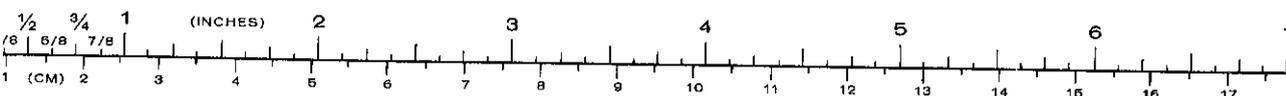
- (✓) Either orange to either hole ORG +15V.
- (✓) Other orange to other hole ORG +15V.
- (✓) Either gray to either hole GRY -15V.
- (✓) Other gray to other hole GRY -15V.
- (✓) White-brown - route this wire through the indicated hole. It will be connected later.

BO#5

- (✓) Either red to either hole RED +170V.
- (✓) Other red to other hole RED +170V.

BO #6

- (✓) Orange to hole ORG +15V.
- (✓) Black to hole BLK/GND.
- (✓) Gray to hole GRY -15V.



BO #7

- (✓) Twist the red and white wires.
- (✓) White to hole AC.
- (✓) Red to hole AD.
- (✓) Yellow to hole YEL +5V.

In the following steps, connect the wires coming from the indicated breakout to the low voltage circuit board. Solder each wire as you connect it.

BO #4

- (✓) Either yellow to either hole +5VDC/YEL.
- (✓) Other yellow to other hole +5VDC/YEL.
- (✓) Brown to hole -5VDC/BRN.

BO #3

- (✓) Three orange wires to three holes +15VDC/ORG.

BO #2

- (✓) Three black wires to three holes GND.
- (✓) Three gray wires to three holes -15VDC/GRY.

BO #1

- (✓) White-red to hole +150V/WHT-RED.
- (✓) Either red to hole +170V/RED.

The other red wire will be connected later.

BO #11

- (✓) Two twisted green wires to two holes PL-1/GRN.

Refer to Pictorial 5-7 (Page 10 in the "Illustration Booklet") for the following steps.

In the following steps, connect the wires coming from BO #17 to the vertical circuit board. Solder each wire as you connect it.

- (✓) Either gray to either -15V/GRY.

- (✓) Other gray to other -15V/GRY.
- (✓) Either orange to either +15V/ORG.
- (✓) Other orange to other +15V/ORG.
- (✓) Cut off the yellow wire; it will not be used.

Connect the wires coming from BO #14 as follows:

- (✓) Black to GND/BLK.
- (✓) White-red to +150/RED-WHT. Make sure this wire does not touch the 7-watt resistor.

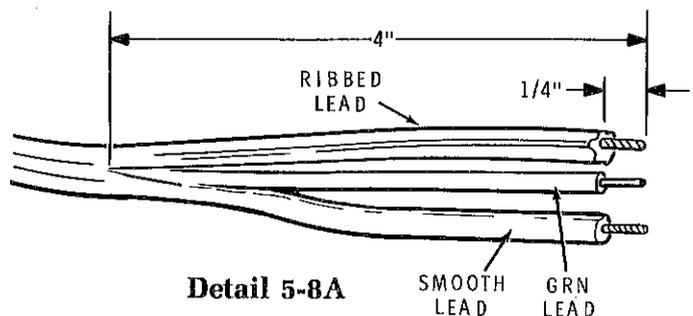
Refer to Pictorial 5-8 (Page 10 in the "Illustration Booklet") for the following steps.

- (✓) Reposition the Oscilloscope as shown.
- (✓) SW4: Temporarily mount the 120-240 switch as shown with one 6-32 x 1/4" screw. Be sure the lugs with the shorting wire are positioned up as shown.
- (✓) Set the switch to 120 or 240, depending on the line voltage that you will operate the Oscilloscope on.
- (✓) SW5: Temporarily mount the NOR-LOW switch as shown with one 6-32 x 1/4" screw. Be sure NOR is showing on the switch and it is positioned as shown in inset drawing #1.

NOTE: One of the line cord leads is marked with a rib as shown in inset drawing #2. Be sure you identify this ribbed lead in the next step.

- (✓) Refer to Detail 5-8A and carefully prepare the line cord leads as shown. Then twist and melt a small amount of solder on the bare wire ends.

- (✓) Pass the prepared end of the line cord through hole AA from the lettered side of the rear panel.

**Detail 5-8A**

In the following steps, wrap the leads around the lugs to make mechanically secure connections as shown in inset drawing #3.

Connect the line cord leads as follows:

- (✓) Green lead to solder lug D (S-1).
- (✓) Smooth lead to fuseholder F1 lug 1 (S-1).
- (✓) Ribbed lead to switch SW4 lug 6 (NS).
- (✓) Refer to Detail 5-8B and secure the line cord in rear panel hole AA with the strain relief. Be sure to route the transformer lead (going to switch SW4) around the transformer, not over it.

- (✓) Cut each lead of a 1.5 MΩ, 1-watt, 10% (brown-green-green) resistor 3/4" from the resistor body.
- (✓) R8: Connect the prepared 1.5 MΩ resistor to control R3, between lugs 1 (NS) and 3 (NS). Position the resistor body away from the control body.
- (✓) Position the high voltage circuit board as shown and route the following wires through grommet B. They will be connected later. (Do not mount the circuit board down onto the plastic standoffs until you are instructed to do so.)
- (✓) Green from hole M.
- (✓) Two brown from holes J and L. Twist these leads together as shown before you route them.
- (✓) Orange from hole G.
- (✓) Yellow from hole K.

Connect and solder the wire harness wires coming from grommet C to the circuit board as follows:

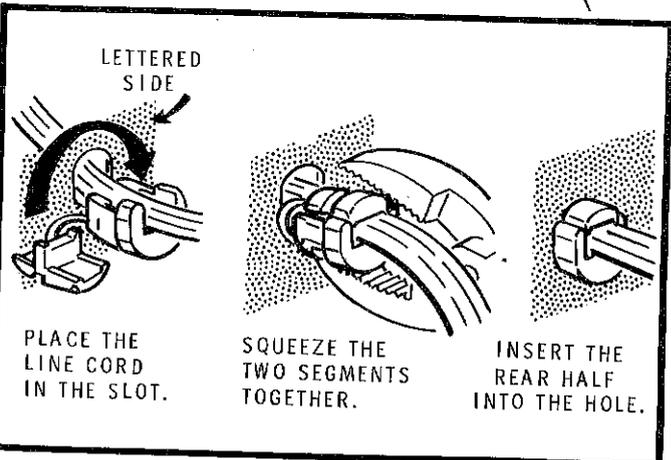
- (✓) Short red to hole F.
- (✓) White to hole H.
- (✓) Long red to hole +170V.

Connect and solder the wires coming from grommet A to the circuit board as follows:

- (✓) Red wire to either indicated unmarked hole.
- () Orange to hole +15V/ORG.
- (✓) Gray to hole -15V/GRY.
- (✓) Black to hole GND.
- (✓) Cut off the white-violet wire; it will not be used.

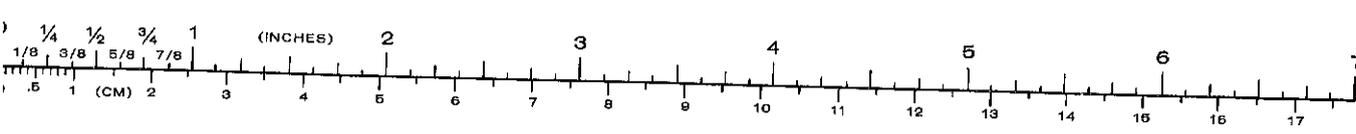
In the following steps, connect and solder the remaining wires coming from the circuit board as follows:

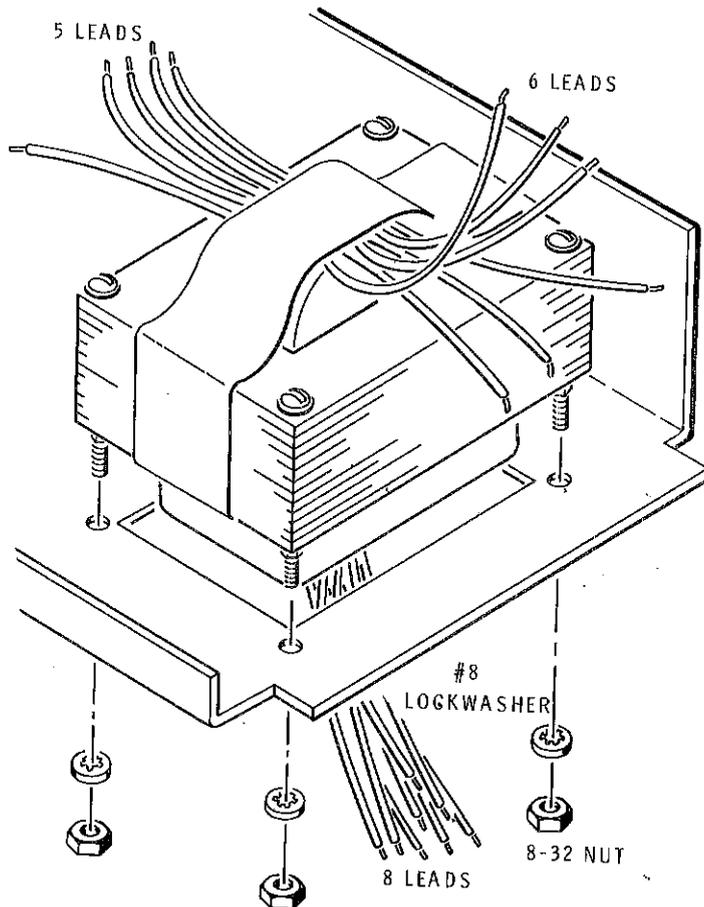
- (✓) Yellow from hole D to control R3 lug 1 (S-2).
- (✓) Red from hole B to control R3 lug 3 (S-2).



Detail 5-8B

- (✓) Securely wrap the line cord around the cord retainers on the rear panel.
- (✓) Prepare two 7" larger black wires. Twist the bare ends and apply a small amount of solder to hold the wire strands together.
- (✓) Connect one 7" larger black wire from fuseholder F1 lug 2 (S-1) to switch R2/SW3 lug 5 (S-1). Make mechanically secure connections.
- (✓) Connect the other 7" larger black wire from switch R2/SW3 lug 4 (S-1) to switch SW4 lug 3 (NS). Make mechanically secure connections.
- (✓) Prepare a 13" larger red wire.
- (✓) Connect one end of the 13" larger red wire to control R3 lug 2 (S-1). Route the free end through grommet B; it will be connected later.



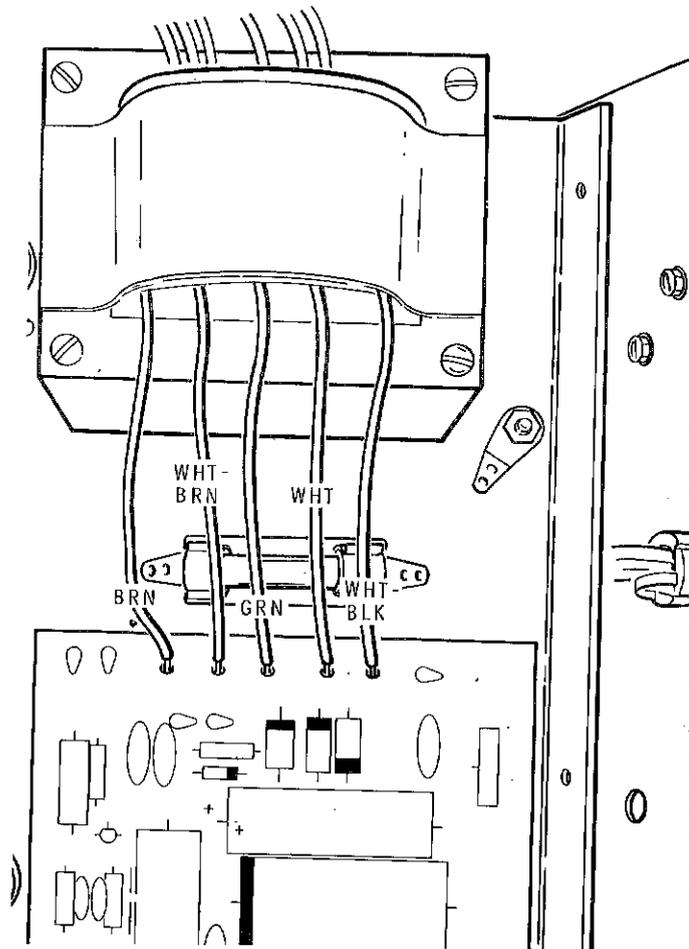


Detail 5-8C

- (✓) Red from hole A to control R2/SW3 lug 3 (S-1).
- (✓) Orange from hole C to control R2/SW3 lug 2 (S-1).
- (✓) Yellow from hole E to control R2/SW3 lug 1 (S-1).
- (✓) T1: Refer to Detail 5-8C and mount the power transformer with four #8 lockwashers and 8-32 nuts. Be sure to position the transformer so the 6 leads and the 5 leads are placed as shown. Do not pinch any wires between the transformer and chassis.

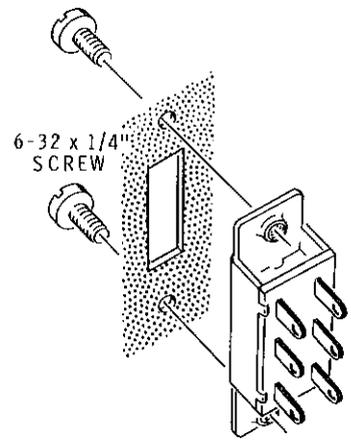
Refer to Detail 5-8D and connect and solder the five indicated transformer leads to the high voltage circuit board as follows:

- (✓) Brown to hole BRN.



Detail 5-8D

- (✓) White-brown to hole WHT/BRN.
- (✓) Green to hole GRN.
- (✓) White to hole WHT.
- (✓) White-black to hole WHT/BLK.
- (✓) Position the circuit board so the four circuit board standoffs line up with the circuit board holes. Then push the circuit board down until the standoffs latch in place. See inset drawing #4 on the Pictorial.



Detail 5-9A

- (✓) Refer to Detail 5-9A, remove the two screws that hold the two switches, position the switches down into their permanent positions, and secure them in place with four 6-32 x 1/4" screws.
- () Install a cable tie around the six transformer leads, pull it tight, and cut off the excess length of cable tie.

Refer to Pictorial 5-10 (Page 11 in the "Illustration Booklet") for the following steps.

- (✓) C3: Refer to Detail 5-10A and mount the 100-100-300 μ F electrolytic capacitor to the right subpanel as shown. Be sure to position the three center lugs as shown. Then twist the four mounting lugs 1/8 turn.
- (✓) R4: Cut both leads of a 47 k Ω (yellow-violet-orange), 1-watt resistor to 1/2". Then connect it between capacitor C3 lugs 3 (NS) and 4 (NS).

Refer to Pictorial 5-9 (Page 11 in the "Illustration Booklet") for the following steps.

- (✓) Prepare two 1-1/2" larger black wires. Twist the bare ends and apply a small amount of solder to hold the wire strands together.

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

- (✓) Connect one 1-1/2" larger black wire between switch SW4 lug 2 (S-1) and switch SW5 lug 2 (S-1).
- (✓) Connect the other 1-1/2" larger black wire between switch SW4 lug 5 (S-1) and switch SW5 lug 5 (S-1).

Connect transformer leads to switch SW4 as follows:

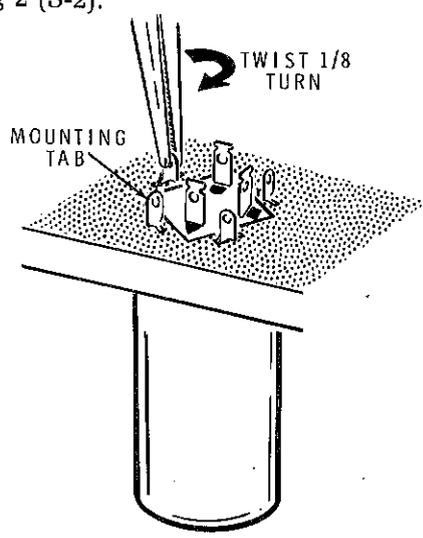
- (✓) Black to lug 6 (S-2). Wrap the bare end around the switch lug if necessary.
- (✓) Black-red to lug 3 (S-2). Wrap the bare end around the switch lug if necessary.

Connect transformer leads to switch SW5 as follows:

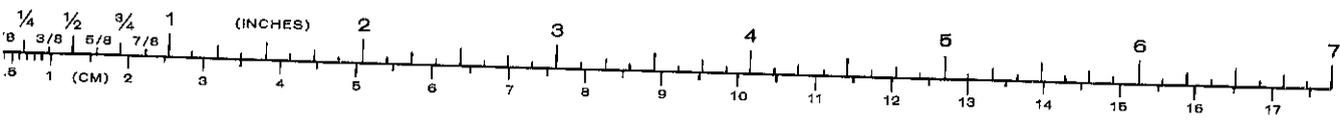
- (✓) Black-yellow to lug 3 (S-1).
- (✓) Black-green to lug 6 (S-1).
- (✓) Black-gray to lug 1 (S-1).
- (✓) Black-white to lug 4 (S-1).

Connect the low voltage circuit board wires to capacitor C3 as follows:

- (✓) Black to lug 4 (S-2).
- (✓) White-blue to lug 1 (S-1).
- (✓) Red to lug 2 (NS).
- (✓) White-red to lug 3 (S-2).
- (✓) Connect the red harness wire to capacitor C3 lug 2 (S-2).



Detail 5-10A



Connect the power transformer leads to the low voltage circuit board as follows:

- (✓) Short red to the indicated hole RED (S-1).
- (✓) Long red to the other hole RED (S-1).
- () White-yellow to the hole WHT/YEL (S-1).
- (✓) Either yellow to either hole YEL (S-1).
- (✓) Other yellow to the other hole YEL (S-1).
- (✓) Either orange to either hole ORG (S-1).
- (✓) Other orange to the other hole ORG (S-1).
- (✓) White-orange to hole WHT/ORG (S-1).

Refer to Pictorial 5-11 (Page 12 in the "Illustration Booklet") for the following steps.

In the following steps connect the wires coming from grommet B to the CRT socket. Be sure to count the socket lugs by starting at the keyway.

Twisted brown wire pair:

- (✓) Either wire to lug 12 (S-1).
- (✓) Other wire to lug 1 (S-1).
- (✓) Orange to lug 2 (S-1).
- (✓) Yellow to lug 3 (S-1).
- (✓) Red to lug 4 (S-1).
- (✓) Green to lug 8 (S-1).

Connect the wires coming from the vertical circuit board to the CRT socket as follows:

- (✓) Blue from hole N to lug 6 (S-1).
- (✓) Blue from hole P to lug 7 (S-1).

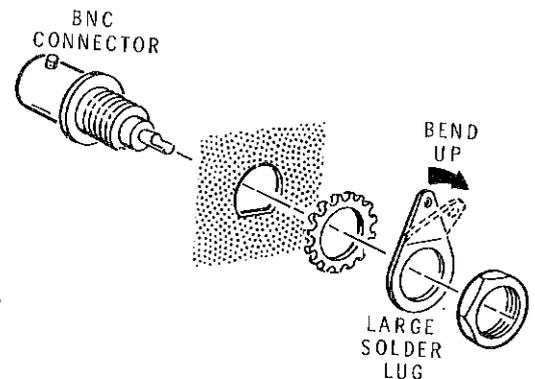
Connect the twin lead coming from the horizontal circuit board to the CRT socket as follows:

- () Lead from hole H to lug 9 (S-1).
- (✓) Lead from hole G to lug 10 (S-1).

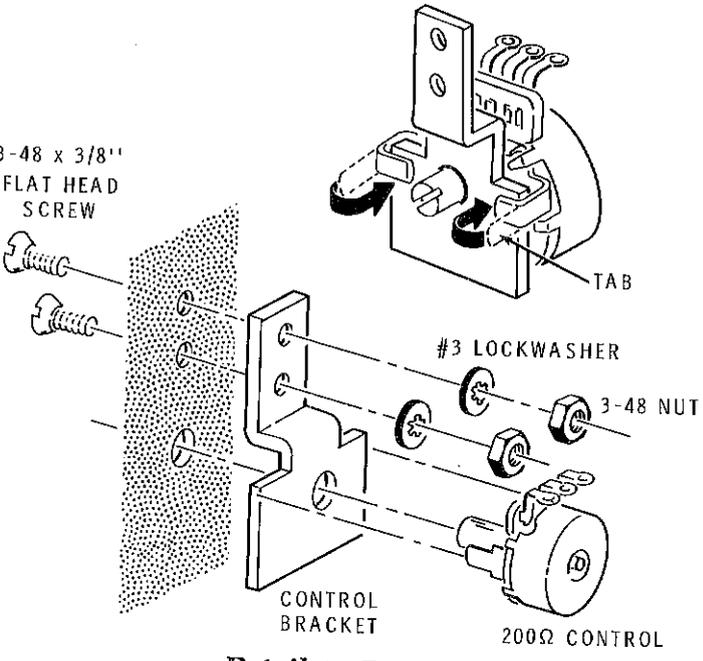
FRONT PANEL ASSEMBLY

Refer to Pictorial 6-1 (Page 12 in the "Illustration Booklet") for the following steps.

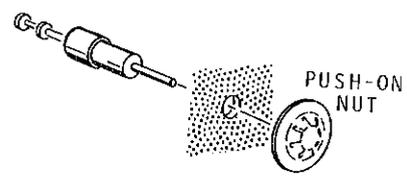
- (✓) Remove the four screws that hold the front subpanel to the left and right subpanels, and position the front subpanel as shown. Set the rest of the chassis aside temporarily.
- (✓) Refer to Detail 6-1A and mount a BNC connector, with its hardware, at X. Use a large solder lug and position it as shown. Then bend the solder lug up as shown.
- (✓) In a similar manner, mount another BNC connector and large solder lug at Y. Bend the solder lug up as shown.
- (✓) Mount a BNC connector at CB. Use only the hardware supplied with the connector.



Detail 6-1A



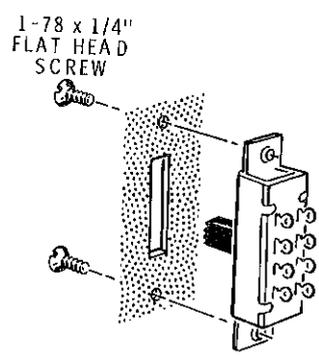
Detail 6-1B



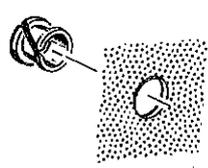
Detail 6-1D

- ✓ Refer to Detail 6-1B and mount a 200 Ω control (#10-1058) on a control bracket. Bend the control tabs over as shown and be sure the control lugs are positioned as shown.
- ✓ In a similar manner, mount another 200 Ω control on a control bracket.
- ✓ R5: Refer again to Detail 6-1B and mount a control bracket at R5. Use two sets of 3-48 x 3/8" flat head hardware. Be sure the control knob lines up behind its hole in the front subpanel.
- ✓ R6: In a similar manner, mount the other control bracket at R6.

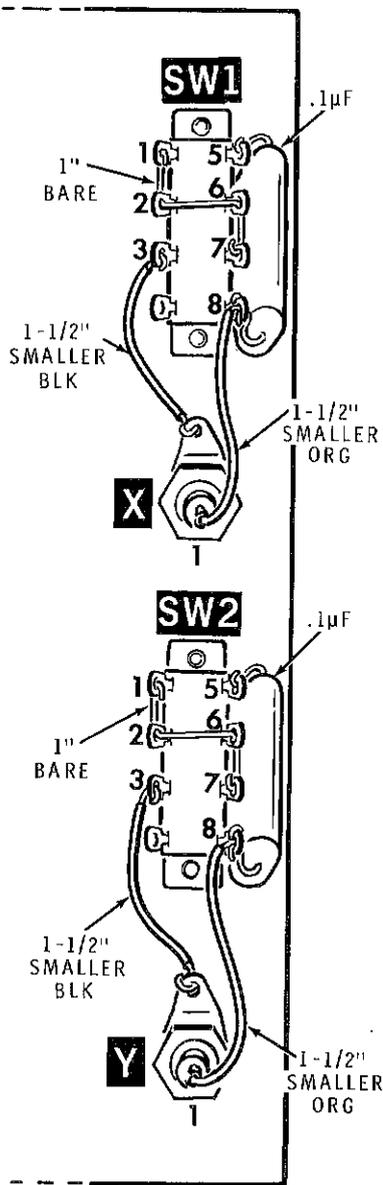
- ✓ SW1: Refer to Detail 6-1C and mount a DP3T switch at SW1. Use two 1-78 x 1/4" flat head screws.
- ✓ SW2: In a similar manner, mount another DP3T switch at SW2.
- ✓ Refer to Detail 6-1D and mount a feed-through connector at CG with a push-on nut. The connector is fragile — be careful not to break it off.
- ✓ Refer to Detail 6-1E and (from the front of the subpanel) install two large nylon bearings in holes CC and CD.
- ✓ In a similar manner, install a small nylon bearing in hole CE.



Detail 6-1C



Detail 6-1E



PICTORIAL 6-2

Refer to Pictorial 6-2 for the following steps.

() Prepare the following wires:

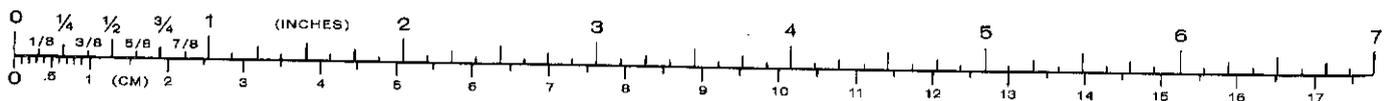
- Two 1" bare
- Two 1-1/2" smaller black
- Two 1-1/2" smaller orange

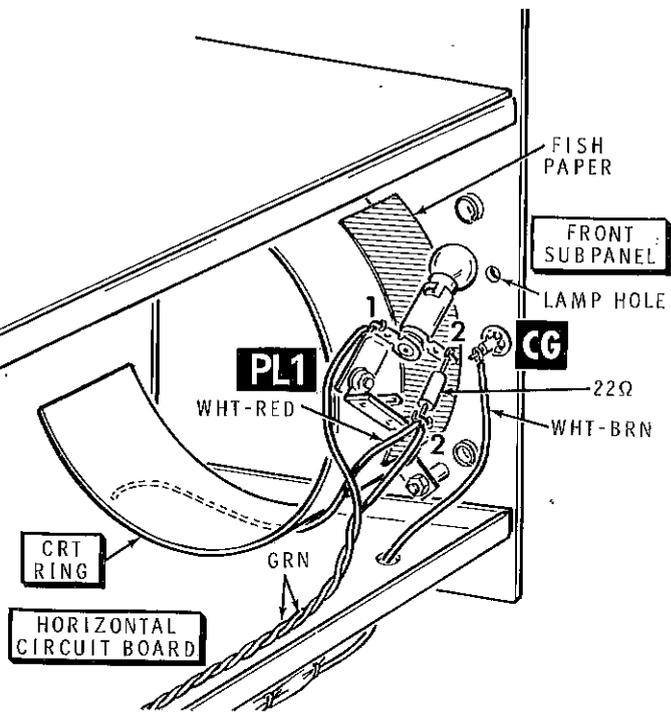
- (✓) Connect a 1" bare wire from switch SW1 lug 1 (S-1), through lug 2 (S-2), through lug 6 (S-2), to lug 7 (S-1).
- () Connect a 1" bare wire from switch SW2 lug 1 (S-1), through lug 2 (S-2), through lug 6 (S-2), to lug 7 (S-1).

NOTE: The two capacitors that will be installed next are nonpolarized and can be installed either way.

- () C1: Connect a .1 μ F capacitor between switch SW1 lugs 5 (S-1) and 8 (NS).
- (✓) C2: Connect a .1 μ F capacitor between switch SW2 lugs 5 (S-1) and 8 (NS).
- () Connect a 1-1/2" smaller black wire from the solder lug of connector X (S-1) to switch SW1 lug 3 (NS).
- () Connect a 1-1/2" smaller orange wire from connector X lug 1 (S-1) to switch SW1 lug 8 (S-2). NOTE: Crimp the end of this wire around the capacitor lead at lug 8.
- (✓) Connect a 1-1/2" smaller black wire from the solder lug of connector Y (S-1) to switch SW2 lug 3 (NS).
- (✓) Connect a 1-1/2" smaller orange wire from connector Y lug 1 (S-1) to switch SW2 lug 8 (S-2). Crimp the end of this wire around the capacitor lead at lug 8.

- (✓) Refer to Pictorial 6-3 (Illustration Booklet, Page 12) and mount the front subpanel to the chassis. Use four #6 \times 3/8" self-tapping flat head screws. Be careful you do not pinch any wires between the metal parts.

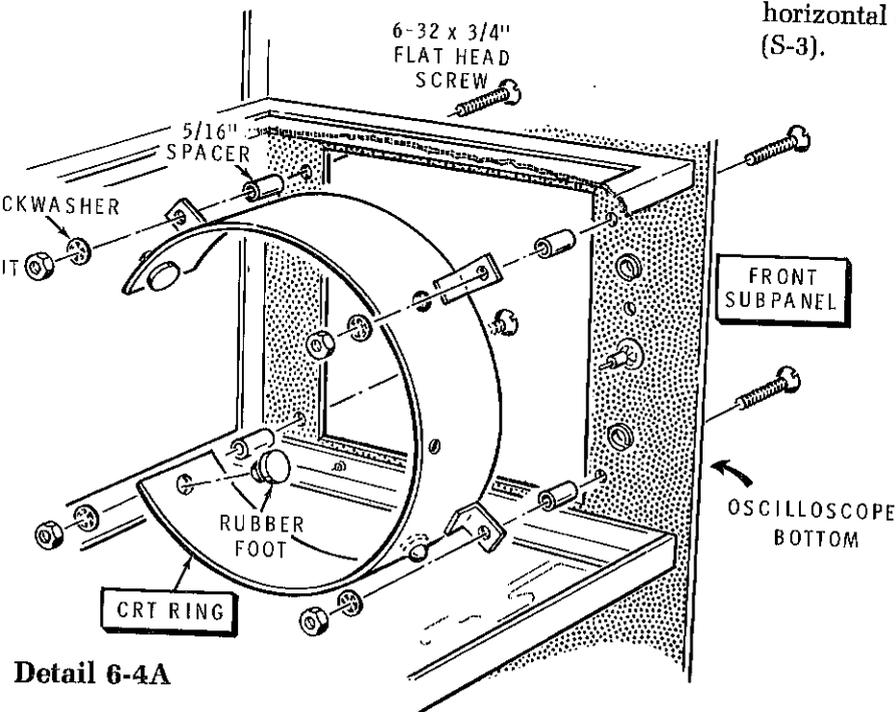




PICTORIAL 6-4

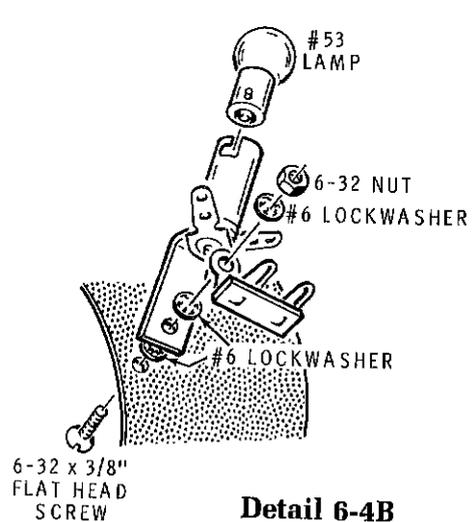
Refer to Pictorial 6-4 for the following steps.

- ✓ Refer to Detail 6-4A and install four rubber feet in the CRT ring.
- ✓ Mount the CRT ring to the front subpanel with four sets of 6-32 x 3/4" flat head hardware and four 5/16" spacers as shown.



Detail 6-4A

- ✓ (1) Refer to the Pictorial. Then cut the piece of fish paper to 3-3/4" x 3/4", remove the protective paper backing, and mount the fish paper onto the CRT ring so the straightest edge of the paper is tight against the front subpanel. (This will keep light from leaking from the pilot lamp to the CRT face.)
- ✓ Refer to Detail 6-4B and install a #53 lamp in the lamp socket.
- ✓ Mount the lamp socket and terminal strip to the CRT ring with 6-32 x 3/8" flat head hardware. Position the socket so the lamp is behind the lamp hole.
- ✓ Connect the white-brown wire coming from the hole in the horizontal circuit board to connector CG (S-1).
- ✓ Cut both leads of the 22 Ω (red-red-black) resistor to 1/2".
- ✓ Connect the resistor between pilot lamp PL1 lug 2 (S-1) and terminal strip lug 2 (NS).
- ✓ Locate the two twisted green wires coming from the wire harness and route them as shown.
- ✓ Connect either of the twisted green wires to pilot lamp PL1 lug 1 (S-1).
- ✓ Connect the other twisted green wire to terminal strip lug 2 (NS).
- ✓ Connect the white-red wire coming from the horizontal circuit board to terminal strip lug 2 (S-3).



Detail 6-4B

Refer to Pictorial 6-5 (Page 13 in the "Illustration Booklet") for the following steps.

Connect the free ends of the remaining vertical circuit board wires as follows:

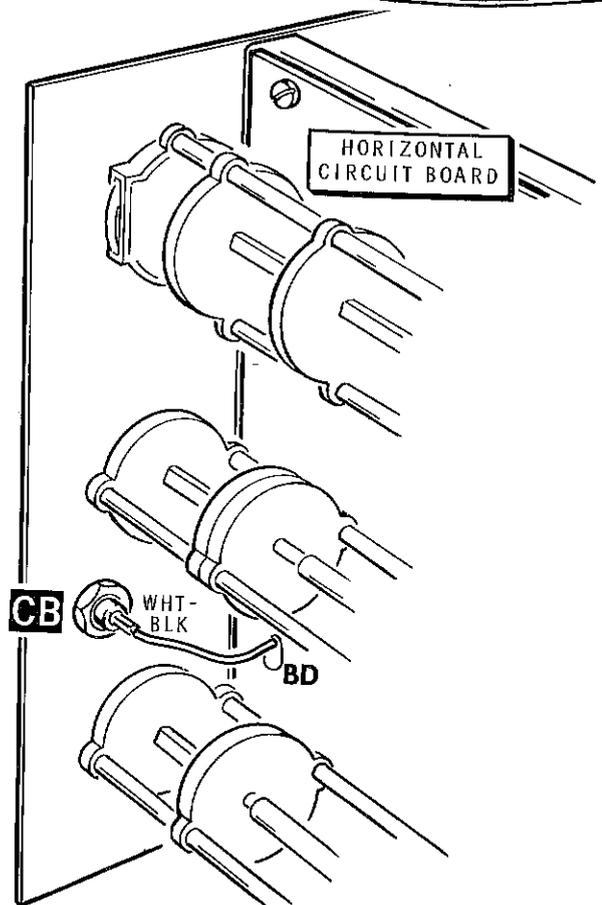
- (✓) Black from hole R to switch SW1 lug 3 (S-2). Wrap the wire end around the lug.
- (✓) Orange from switch SW101-1 to switch SW1 between lugs 1 and 2 (S-1).
- (✓) Remove an additional 1/4" of insulation from the end of the white-gray wire coming from hole X. Then route this wire through control R5 lug 1 (S-2) to lug 2 (S-1).
- (✓) White-black from hole U to control R5 lug 3 (S-1).
- (✓) Black from hole Y to switch SW2 lug 3 (S-2). Wrap the wire end around the lug.
- (✓) Orange from switch SW101-2 to switch SW2 between lugs 1 and 2 (S-1).
- (✓) Refer to the inset drawing and position the two capacitors so they are across the back of the switches. Then check the connections at each lug to make sure that none of the lugs are touching together or touching the metal case of the switch.
- (✓) Remove an additional 1/4" of insulation from the end of the white-gray wire coming from hole AC. Then route this wire through control R6 lug 1 (S-2) to lug 2 (S-1).
- (✓) White-black from hole AB to control R6 lug 3 (S-1).

Refer to Pictorial 6-6 for the following step.

- () Connect the white-black wire coming from hole BD to BNC connector CB (S-1).

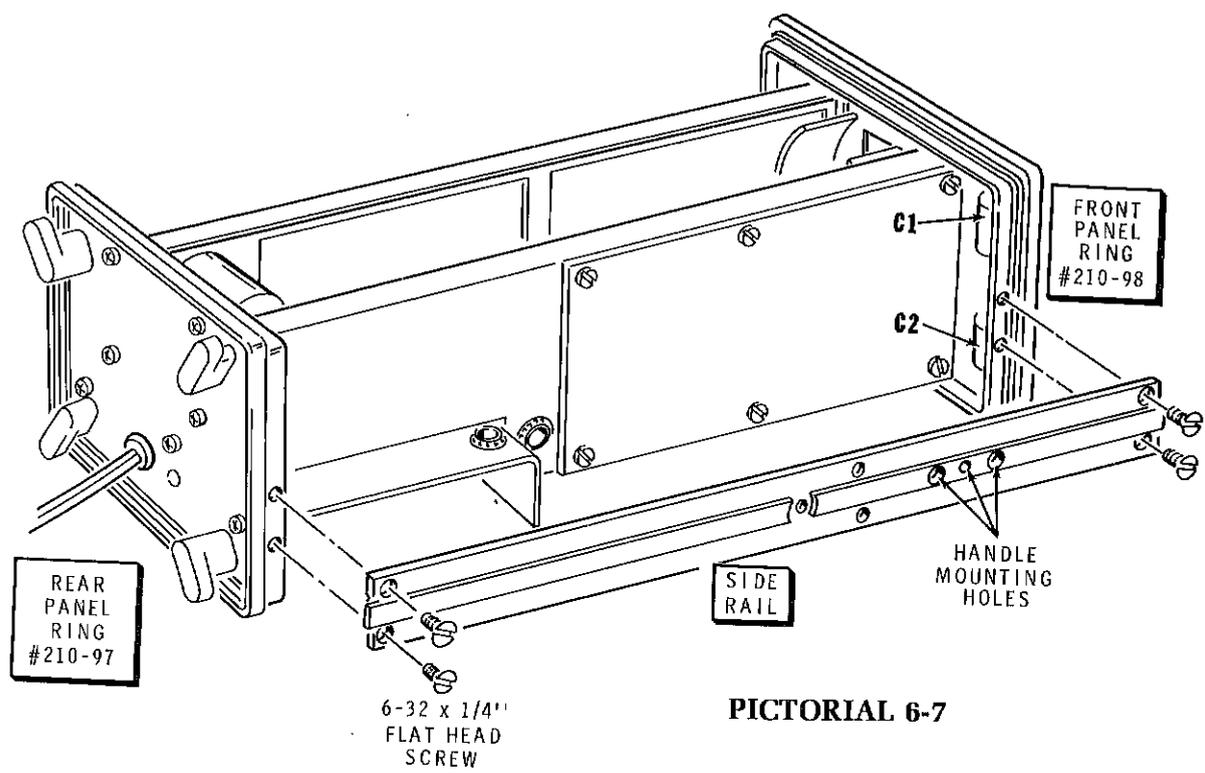
Refer to Pictorial 6-7 for the following steps.

- () Refer to Detail 6-7A and place the front panel over the switch shafts and against the subpanel. Now check connectors X, Y, and CB to make sure they are centered in the front panel holes. If they are not centered, loosen the nuts, slightly, center the connectors, and retighten the nuts. Then secure the front panel with five control flat washers and control nuts on the five switches. Do not overtighten these nuts.

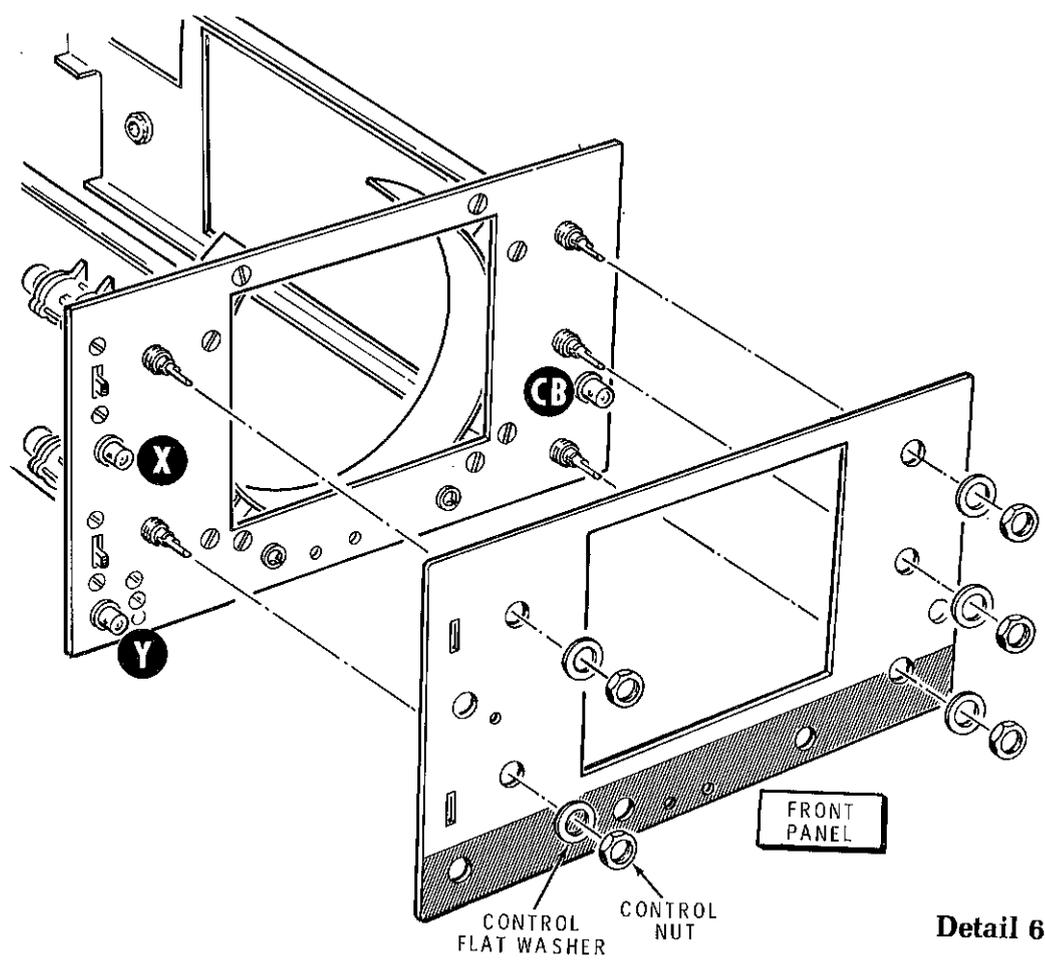


PICTORIAL 6-6

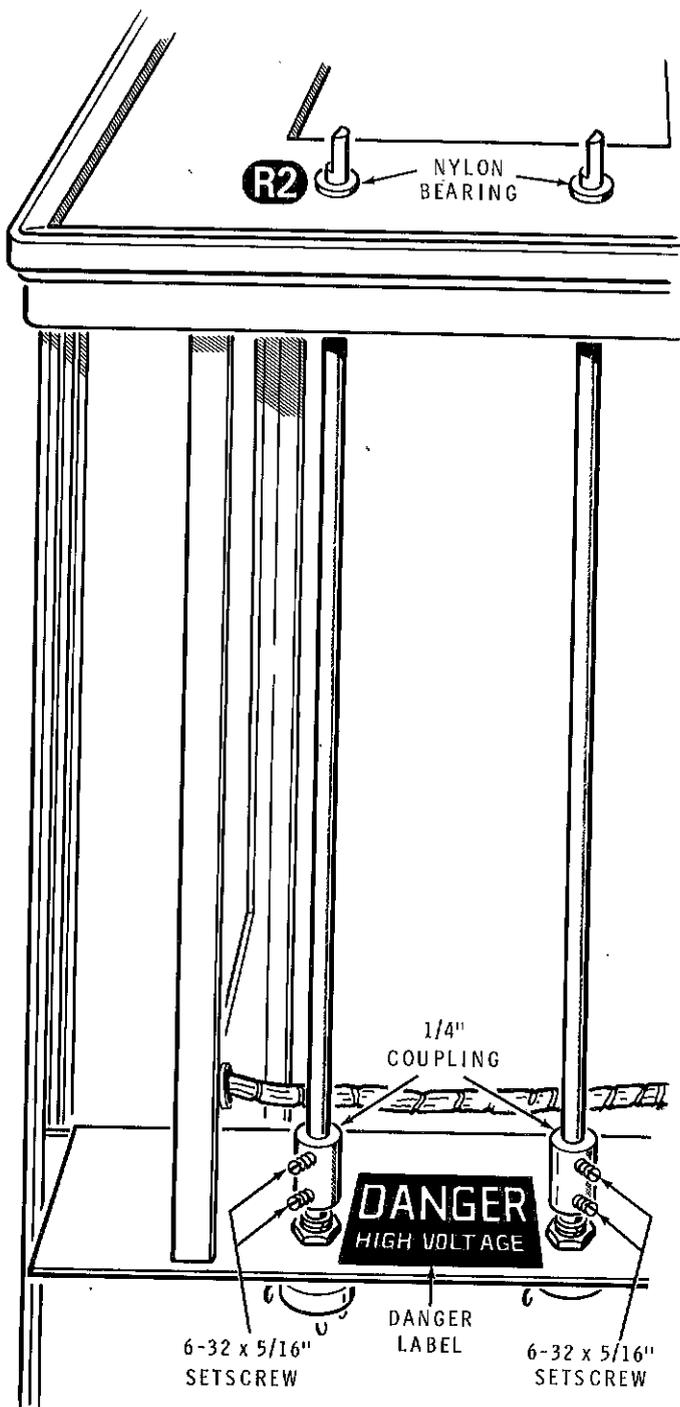
- () Locate the front panel ring (#210-98). The front of the ring has a silver trim around most of it. The area that has no silver trim is the top. Place the ring over the front panel with the top side toward the top of the front panel.
- () Locate the rear panel ring (#210-97). Position the ring so the two holes along the side are closest to the bottom as shown. Then place the ring over the rear panel.
- () Position a side rail so the handle-mounting holes, called out in the Pictorial are toward the front, as shown. Mount the rail to the front panel ring and then to the rear panel ring. If the side rail holes do not line up properly with the rear panel ring holes, it may be necessary to loosen the seven screws at the back of the rear panel. If you do have to loosen them, retighten them after the following step.
- () In a similar manner, mount the other side rail with four 6-32 × 1/4" flat head screws.



PICTORIAL 6-7



Detail 6-7A



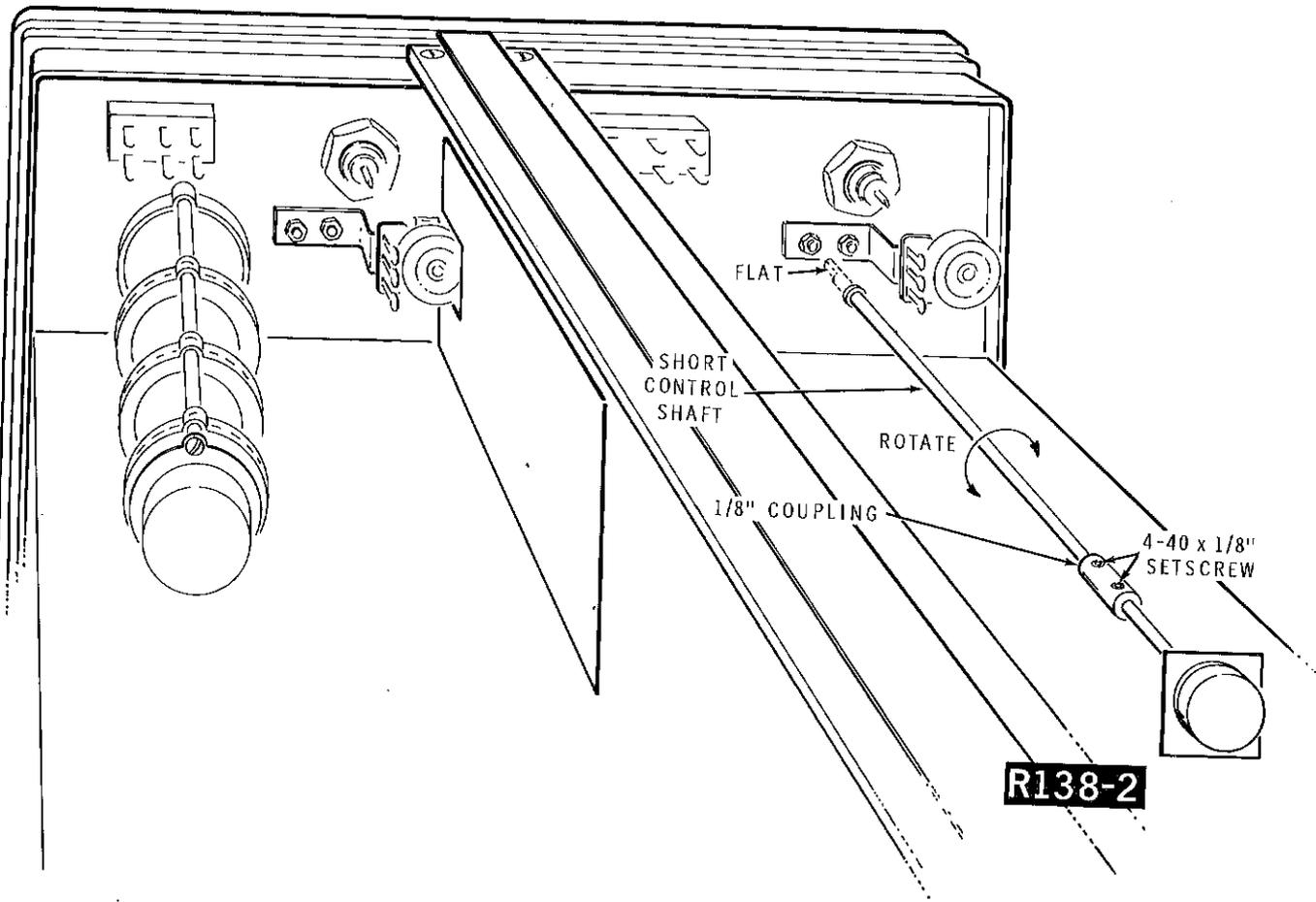
PICTORIAL 6-8

Refer to Pictorial 6-8 for the following steps.

- (✓) Remove the backing paper from the danger label and apply the label as shown.
- (✓) Start two 6-32 × 5/16" setscrews into each of the 1/4" couplings.
- (✓) Place the couplings about halfway down over the shaft of both subchassis controls. Then tighten the lower setscrew of each coupling against the flat of the control shaft. **DO NOT** overtighten the setscrews!
- (✓) Slide a long control shaft through each of the two indicated nylon bearings, and down into each coupling. **NOTE:** The flatted end of both shafts must extend above the front panel as shown. However, their rotational position is not important.
- (✓) Temporarily tighten the upper setscrew of both couplings.
- (✓) Turn both shafts fully counterclockwise. Shaft R2 should click to OFF.

Refer to Pictorial 6-9 for the following steps.

- (✓) Start two 4-40 × 1/8" setscrews into a 1/8" coupling. Use the allen wrench supplied with your kit.
- (✓) Place the 1/8" coupling about halfway down over the shaft of control R138-2/SW102-2. Then tighten the setscrew against the control shaft. Carefully bend nearby circuit board parts out of the way as necessary.
- (✓) Slide a short control shaft through the indicated small nylon bearing and down into the coupling. **NOTE:** The flatted end of the shaft must extend out of the front panel. However, the rotational position is not important.
- (✓) Temporarily tighten the upper setscrew of the couplings.
- () Rotate the control shaft as far as it will go both ways to be sure there is no interference between the coupling and nearby circuit board parts. Carefully bend parts out of the way as necessary.



PICTORIAL 6-9

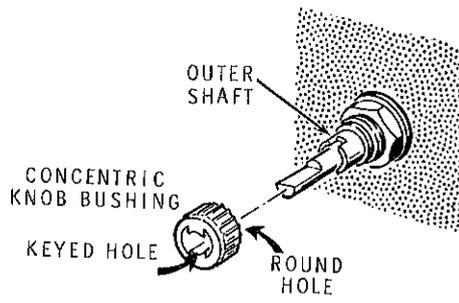
Refer to Pictorial 6-10 (Page 13 in the "Illustration booklet") for the following steps.

The front panel knobs use bushings that must be pressed into the knobs before the knobs are mounted on the control shafts. Perform the following steps carefully since it is very difficult to remove a knob bushing once it is fully inserted. You will line up the pointer on each knob with a specific mark on the front panel. Whenever you remove any knob, be sure to replace it on the control shaft from which you removed it.

NOTE: Examine the concentric shaft knob bushing (455-613) before you perform the following steps. Note that the bushing has a round hole at one end and a "keyed hole" at the other end. In the following steps, be sure you place the bushing on the outer shaft so the round hole is toward the front panel.

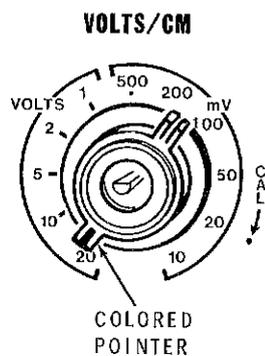
(X) Refer to Detail 6-10A and place a concentric knob bushing (with the round hole toward the front panel) onto the outer shafts of switches SW101-1, SW101-2, SW203, SW201, and SW202.

(✓) Rotate the outer shaft of these switches fully counterclockwise.



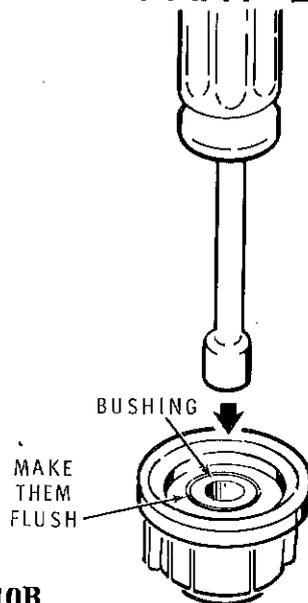
Detail 6-10A

PART A



Detail 6-10B

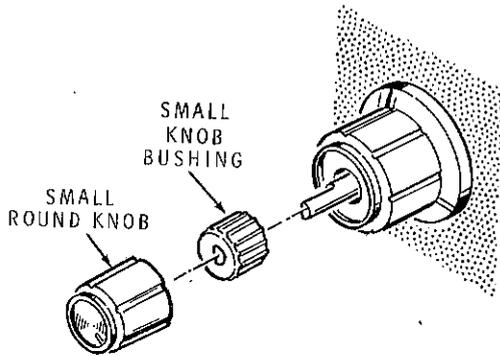
PART B



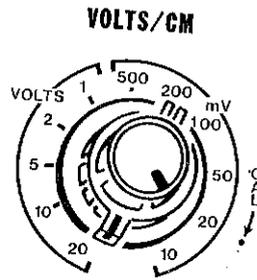
- (✓) Refer to Part A of Detail 6-10B and line up the colored pointer of a large black control knob (#462-951) with the 20 VOLTS mark on the front panel at SW101-1. Then press the knob part way onto the bushing.
- (✓) Now carefully remove **both** the bushing and the knob. Do not allow the knob to come off the bushing.
- (✓) Refer to Part B of Detail 6-10B and place the knob and bushing on a table or other firm surface. Place a soft cloth under the knob to prevent it from being marred. Use a nut driver or other tool and drive the bushing into the knob as shown.
- (✓) Replace the knob onto switch SW101-1. Be sure the pointer is lined up with the 20 VOLTS mark.
- (✓) In a similar manner, install large black control knobs onto the remaining switches with bushings. Be sure the knob pointers point to the most counterclockwise positions as shown in the Pictorial.
- (✓) Refer to Part A of Detail 6-10C and install a small knob bushing onto the inner shaft of control R128-1. NOTE: One end of the bushing has a metal insert. This must be installed toward the shaft.

- (✓) Turn the inner shaft fully clockwise.
 - (✓) Line up the pointer of a small red knob with the CAL "dot" as shown in Part B of Detail 6-10C. Then press the knob part way onto the bushing.
 - (✓) Carefully remove **both** the knob and bushing and drive the bushing into the knob.
 - (✓) Replace the knob on the shaft.
 - (✓) In a similar manner, install a small knob bushing and small red knob on control R128-2. Be sure the inner shaft is fully clockwise and the knob pointer lines up with the CAL "dot"
 - (✓) In a similar manner, install a small knob bushing and small red knob onto the inner shaft of control R253/SW205. Be sure the inner shaft is fully clockwise and the knob pointer lines up with the CAL arrow point.
 - (✓) Turn both knobs and pull the small knob of this control/switch to make sure they operate freely. If the shafts seem to bind, loosen the control nut on the front panel and reposition the switch. If the shafts still bind, loosen the two 4-40 nuts on the control mounting bracket and the two screws that mount the bracket to the circuit board (refer to Pictorial 4-14, Page 60 and Detail 4-20A, Page 64). Reposition the switch and re-tighten all hardware.
 - (✓) Install a small knob bushing and small red knob onto the inner shaft of control R213/SW204. Be sure the inner shaft is fully clockwise and the knob pointer is at the 5 o'clock position.
 - (✓) Similarly install a small knob bushing and small red knob onto the inner shaft of control R263. Be sure the inner shaft is fully clockwise and the knob pointer is at the 5 o'clock position.
- NOTE: As you install each of the next three knobs, first loosen the top setscrew that holds its control shaft. Then pull the shaft out through the front panel several inches and install the knob. (If you don't do this, the control can be damaged.) Then reconnect the shaft. Be sure the knob points to the proper position.
- (✓) Install a small knob bushing and small black knob onto the shaft of control R138-2. Be sure the shaft is fully clockwise and the pointer is at the 5 o'clock position.

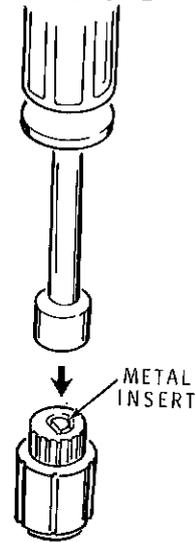
PART A



PART B



PART C

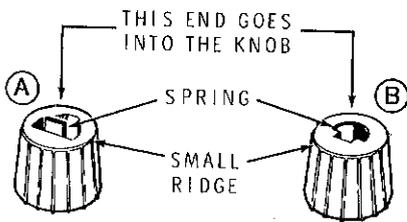


Detail 6-10C

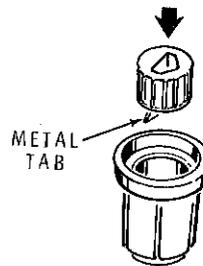
NOTE: Refer to Detail 6-10D and notice that the large shaft knob bushings are tapered. When you place one of these bushings in a knob, be sure the smaller (tapered) end goes in or the bushing will not slide into the knob. If you are not sure which end is smaller, roll the bushing across a flat surface; the bushing will gradually turn toward the smaller end.

- (✓) Install two large shaft knob bushings into two small black knobs with skirts as shown in Detail 6-10E.
- (✓) Install one black knob on control shaft R2. Line up the pointer with the PWR OFF dot.
- (✓) Install the other black knob on control shaft R3. Position the pointer at the 5 o'clock position.

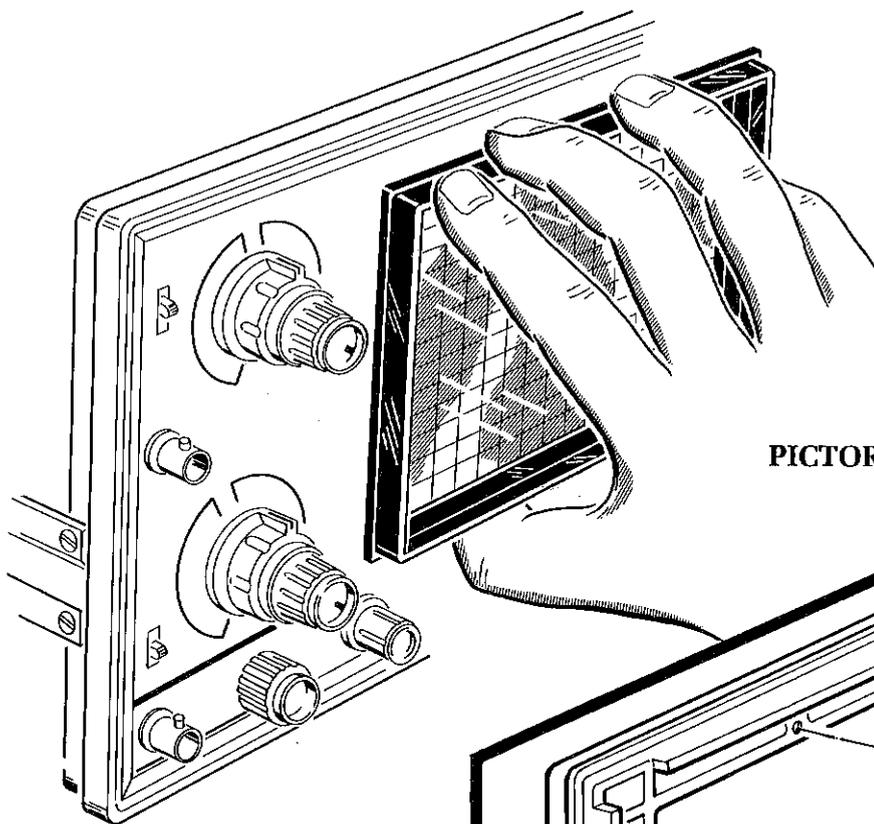
NOTE: The large shaft bushings may look like either A or B below.



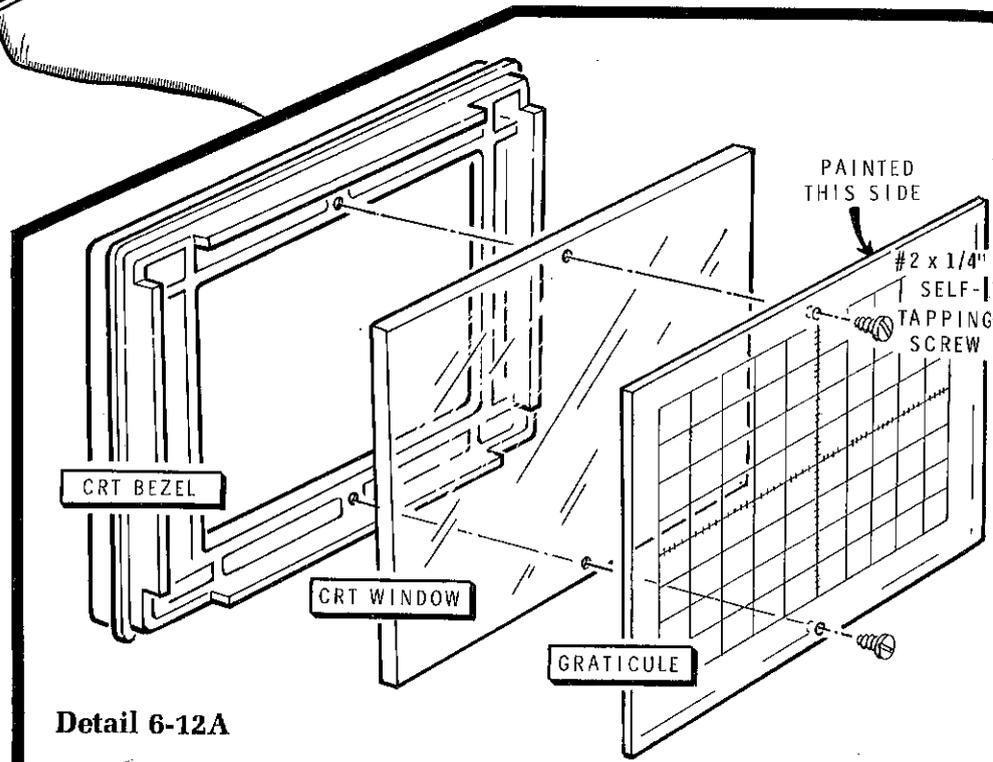
Detail 6-10D



Detail 6-10E



PICTORIAL 6-12



Detail 6-12A

Refer to Pictorial 6-12 for the following steps.

- (✓) Refer to Detail 6-12A and remove the protective covering from both sides of the CRT window and graticule.
- (✓) Carefully wipe off the CRT window and graticule with a soft, lint-free cloth.
- (✓) Insert the CRT window into the rear of the CRT bezel. Then insert the graticule with the painted lines toward the inside (next to the CRT window). Make sure the screw holes line up.

- (✓) Secure the assembly with two #2 × 1/4" self-tapping screws.
- (✓) Position the CRT bezel over the front panel cut-out and press on the bezel until it snaps into the cutout. If the bezel hits the CRT, loosen the CRT clamp screws and move the CRT back.

This completes the wiring of your Heathkit Oscilloscope. Carefully inspect all connections for loose wires or unsoldered connections. Remove any wire clippings or solder splashes.

HIGH VOLTAGE PROBE

During the "Initial Tests" you will adjust the high voltage power supply to -1700 volts. If your high input impedance voltmeter will measure 2500 volts, proceed to the "Initial Tests." However, if your voltmeter will not measure 2500 volts, refer to Pictorial 3-13 (Page 14 in the "Illustration Booklet") and perform the following steps.

-) Prepare the ends of the remaining length of large red wire.
-) Locate the 10 M Ω and the 1 M Ω precision resistors and cut their leads to 1/2".

The following steps are grouped according to the input impedance of voltmeters. Only perform the steps that pertain to your voltmeter.

1 M Ω Voltmeters

-) Connect one end of the prepared large red wire to one end of the 10 M Ω resistor (S-1).
-) Connect the free end of the 10 M Ω resistor to one end of the 1 M Ω resistor (S-1).

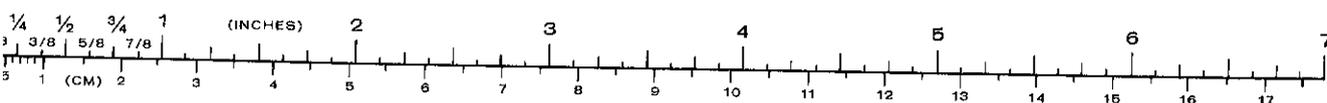
- () Connect the free end of the 1 M Ω resistor to an alligator clip. Crimp the tabs over the resistor lead and solder the connection.
- () Slide the length of large sleeving over the resistor and the connections.
- () Slide the alligator clip insulator over the alligator clip as shown.

Proceed to "Initial Tests."

10 M Ω or 1 M Ω Voltmeters

- () Connect one end of the prepared large red wire to one end of the 10 M Ω resistor (S-1).
- () Connect the free end of the resistor to an alligator clip. Crimp the tabs over the resistor lead and solder the connection.
- () Slide the length of large sleeving over the resistor and its connections.
- () Slide the alligator clip insulator over the alligator clip as shown.

The 1 M Ω resistor will not be used. Proceed to "Initial Tests."



INITIAL TEST

In this section of the Manual you will test the completed Oscilloscope to verify the operation of the power supply circuits. It will direct you through specific tests as well as lead you to the possible cause or to the appropriate troubleshooting chart if a problem does exist.

If a problem exists and you are instructed to check a "component and the associated circuitry," keep the following points in mind as you work in that area — **THEY ARE IMPORTANT:**

1. Most of the kits that are returned for repair do not function properly due to poor soldering. Reheat all doubtful connections. Check carefully for solder bridges between circuit board foils.
2. Make sure all wires are soldered at connections where several wires are connected.
3. Check each transistor to make sure it is the proper type (part number) and that its leads are installed in the proper circuit board holes.
4. Check the value of each part. It is easy, for example, to misread the color code of a 510 Ω (green-brown-brown) resistor in a step that calls for a 150 Ω (brown-green-brown) resistor.
5. Have a friend check your work. Someone who is not familiar with the unit may notice something you have consistently overlooked.
6. Check all component leads connected to the circuit boards. Make sure leads and wires do not extend too far through the circuit boards and make contact with other connections or parts, such as shields or the chassis.

Use a high input impedance volt-ohmmeter to perform the following tests to make sure that a short circuit does not exist in the power supply circuits.

POWER SUPPLY TESTS

NOTE: Do not plug in the Oscilloscope until you are directed to do so in a step.

Refer to Figures 1-1 and 1-2 (Page 15 in the "Illustration Booklet") for the following steps.

- Connect the negative ohmmeter test lead to the chassis.

NOTE: The internal wiring of most ohmmeters is such that the positive terminal of the ohmmeter battery is connected to the positive test lead, and the negative battery terminal is connected to the negative test lead. In some ohmmeters this wiring is reversed and will cause erroneous readings when you make the following measurements. Try reversing the ohmmeter test leads if the measurements do not check out correctly

at first. Be sure your ohmmeter is capable of forward biasing diodes and transistors. Some ohmmeters use a voltage of less than 1.5 volts and cannot forward bias diodes and transistors.

- Connect the positive test lead to the three prongs of the line cord plug. The center prong should produce a reading of zero ohms and the other two should read infinite. (If not, check the line cord wiring.)

Refer to Figure 1-1 for the following test points.

- Check the heat sink on transistor Q301 and make sure it is not touching any nearby resistor leads.

	TEST POINT (TP)	METER RANGE	RESISTANCE	POSSIBLE CAUSE OF INCORRECT READING
(✓)	1	RX10 Ω	100 Ω or higher	C311, C4, C313, Q303, Q304, and associated circuitry.*
(✓)	2			C309, C312, Q305, Q306, and associated circuitry.*
(✓)	3	RX100 Ω	200 Ω or higher	C307, IC301, Q301, and associated circuitry.*
(✓)	4			C308, IC301, Q302, and associated circuitry.*
(✓)	5	RX1 kΩ	10 kΩ or higher	D301, D302, D303, D304, C3, and associated circuitry.
(✓)	6			
(✓)	7			Q215 and associated circuitry.
(✓)	8			
(✓)	9			

if the reading is low, the problem may be on another circuit board. Disconnect wires one by one to isolate the trouble. Example: If the +15 VDC (TP3) reading is low, disconnect orange wires on the circuit board until the reading is correct. Then trace the last wire you disconnected to the proper circuit board and repair the trouble.

Refer to Figures 1-2 (Page 15 in the "Illustration Booklet") and 1-3 for the following test points.

	TEST POINT	METER RANGE	RESISTANCE	POSSIBLE CAUSE OF INCORRECT READING
()	10	RX1 MΩ	2 MΩ or higher	Q404, Q405, Q406, D404, D405, R2, R3 and associated circuitry.
()	11		1 MΩ or higher.	
()	12	RX1 kΩ	10 kΩ or higher.	Q113 and associated circuitry.
()	13			Q114 and associated circuitry.

- () Disconnect the meter and set it aside temporarily.
- () Set all 14 controls on the four circuit boards to their centers of rotation.

Refer to Figure 1-4 (Page 16 in the "Illustration Booklet") and set the front panel controls as follows:

Channel Y controls:

- AC-GND-DC GND
- VOLTS/CM 50mV
- VARIABLE Fully clockwise (CAL)
- POSITION Center of rotation
- DC BAL Center of rotation

Channel X controls:

- AC-GND-DC GND
- VOLTS/CM 50mV
- VARIABLE Fully clockwise (CAL)

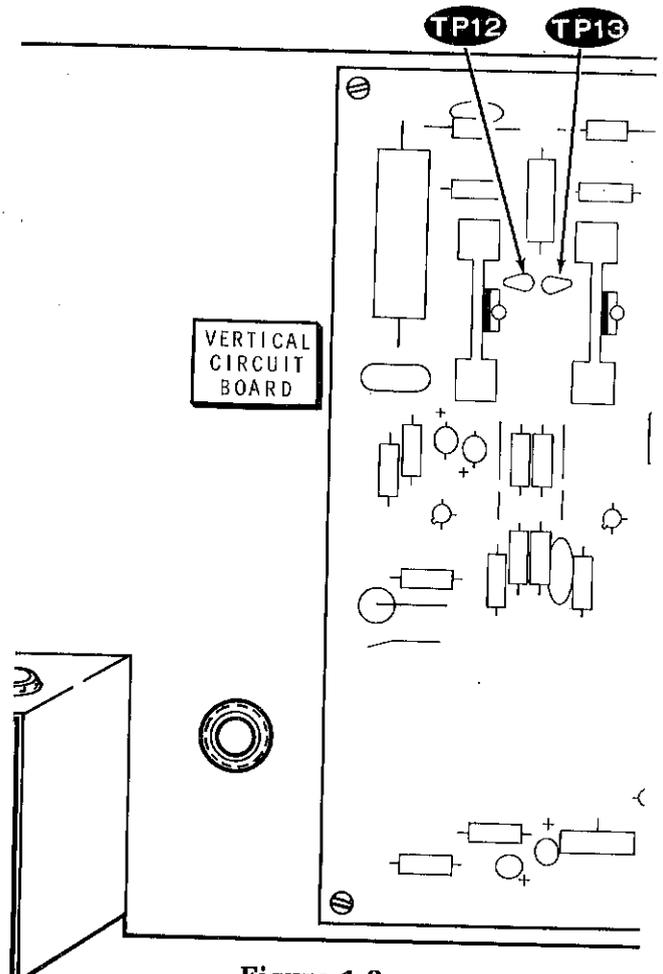


Figure 1-3

- DC BAL Center of rotation
- INTENSITY Fully counterclockwise (OFF)
- FOCUS Center of Rotation
- TIME/CM 1mS
- VARIABLE Fully clockwise (CAL) and pushed in.
- TRIG Y+
- LEVEL Center of rotation and pushed in.
- MODE AC
- HORIZ POS Center of rotation

WARNING: When the line cord is connected to an AC outlet, AC line voltage will be present at several places on the chassis. Also, when the Oscilloscope is turned on, high voltage DC will also be present. Be careful that you do not contact this voltage or an electrical shock will result. See Figure 1-5 (Page 17 in the "Illustration Booklet").

NOTE: If you do not get the proper results in the following tests, immediately unplug the Oscilloscope and proceed to the "In Case of Difficulty" section in your Operation Manual.

- () Connect the common voltmeter lead to the chassis and set your voltmeter to read DC volts.
- () Plug in the Oscilloscope line cord and turn the INTENSITY control clockwise enough to turn the Oscilloscope on.

Refer to Figures 1-1 and 1-2 (Page 15 in the "Illustration Booklet") and make the following voltage tests.

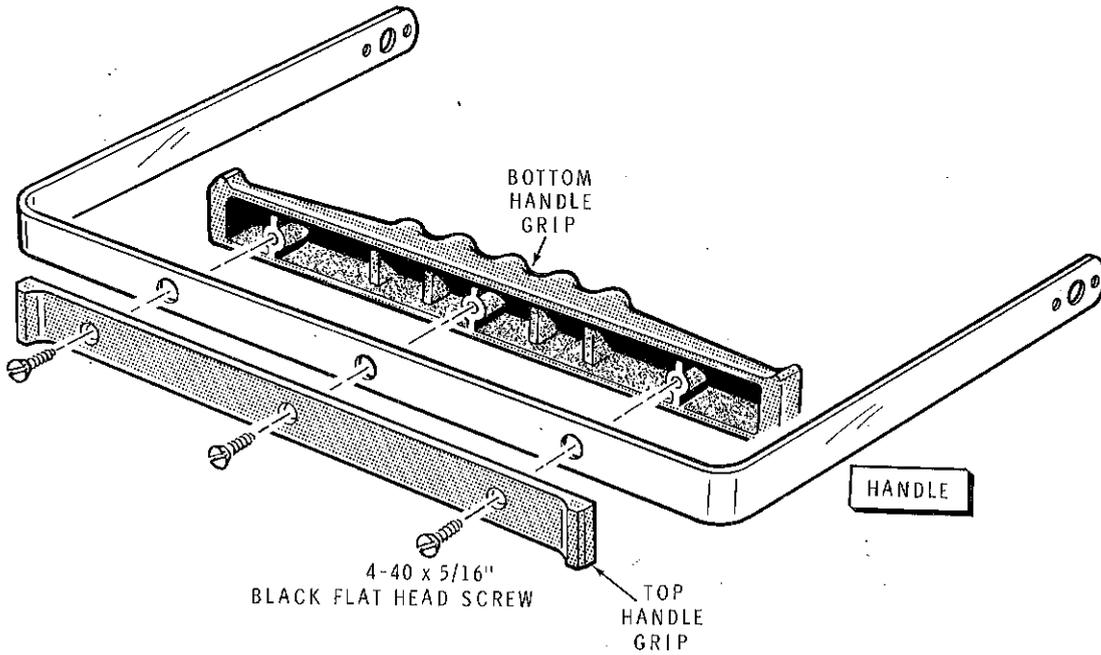
TEST POINT	DC VOLTAGE READING	IF NOT CORRECT, PROCEED TO:
1	4.8 to 5.3 (5.06)	Test #1 (In the "Illustration Booklet" with your Operational Manual.)
2	-4.8 to -5.3 (-5.8)	Test #2
3	14 to 16 (15.04)	Test #3
4	-14 to -17.5* (-15.2)	Test #3
6	150 to 190 (180.6)	Test #4
7	130 to 170 (164)	Test #4

ries with the setting of R309 on the low voltage circuit board.

- Refer to Figure 1-1 and adjust control R309 until test point 4 is -15 volts.
- Turn off the Oscilloscope.
- If you prepared a high voltage probe earlier, connect your voltmeter probe to the bare end of the probe you prepared. If you did not prepare a probe, proceed directly to the next step.
- Adjust your voltmeter to read -2000 volts DC. NOTE: If you are using a high voltage probe you prepared earlier, it will cause your voltmeter to indicate one half of the actual voltage being measured if you use a 10 M Ω or 11 M Ω voltmeter. With a 1 M Ω voltmeter, the reading will be 1/11 the actual voltage.
- Refer to Figure 1-2 and connect the probe to control R2 lug 1.
- Let loose of the probe and control. Then turn on the Oscilloscope. The meter reading should be between -1500 and -2000 volts DC (-750 to -1000 volts if you are using the prepared high voltage probe with 10 M Ω or 11 M Ω ; -135 to -180 volts with a 1 M Ω voltmeter).
- Adjust the HI VOLT ADJ control on the high voltage circuit board to -1700 volts. (Your meter will indicate -850 volts if you are using the prepared high voltage probe with a 10 M Ω or 11 M Ω voltmeter; -155 volts with a 1 M Ω voltmeter).
- Turn off the Oscilloscope and disconnect the meter.
- Turn on the Oscilloscope.
- If a trace is not visible on the CRT after a few minutes of warmup, turn the CHANNEL Y control through its full range and watch for a trace. Then center the trace using the HORIZONTAL control.
- Check to see if the CRT trace is parallel with the horizontal graticule lines. If it is not parallel, perform the following numbered steps.
 1. Note the position of the trace and turn off the power.
 2. Refer to Figure 1-5 (Page 17 in the "Illustration Booklet") and loosen the CRT clamp.
 3. Rotate the CRT to align the trace.
 4. Turn the power on and check the position of the trace.
 5. Repeat steps 1, 3, and 4 as necessary to align the trace to the horizontal graticule lines.
 6. After the correct results have been obtained, turn the power off and tighten the CRT clamp.

This completes the "Initial Tests" section; proceed to "Final Assembly."

FINAL ASSEMBLY

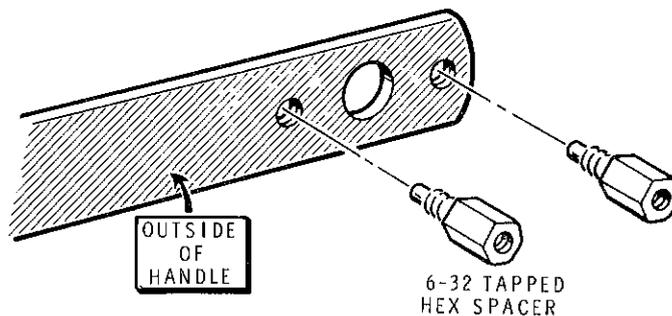


Detail 7-1A

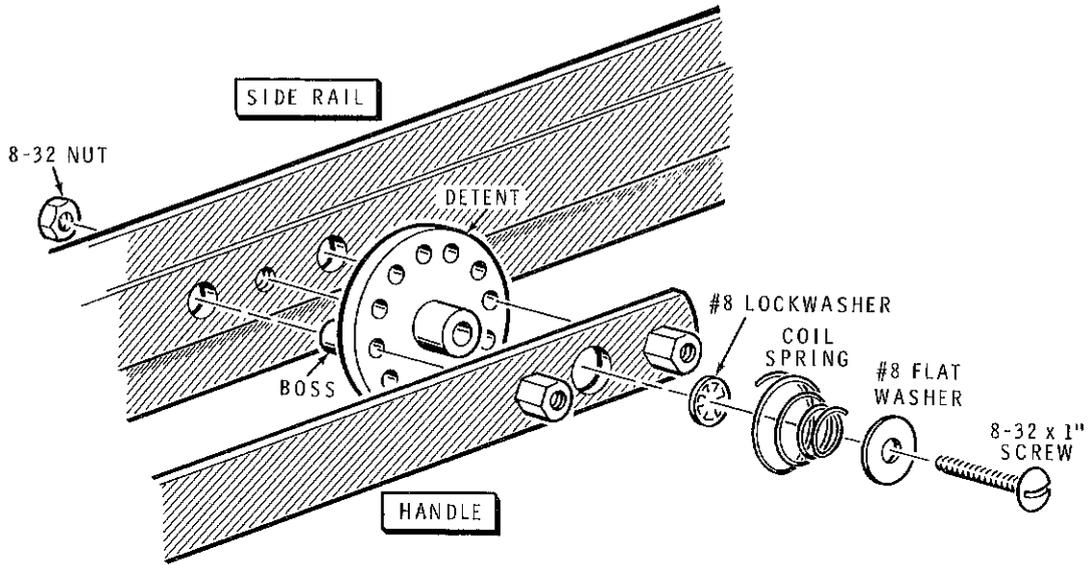
HANDLE INSTALLATION

Refer to Pictorial 7-1 (Page 18 in the "Illustration Packet") for the following steps.

- 1) Refer to Detail 7-1A and install the top and bottom handle grips on the handle. Use three 4-40 x 5/16" black flat head screws.
- 2) Refer to Detail 7-1B and install two 6-32 tapped hex spacers into each end of the handle. Be sure to install these from the outside of the handle.
- 3) Place the handle around the front of the Oscilloscope as shown in the Pictorial.



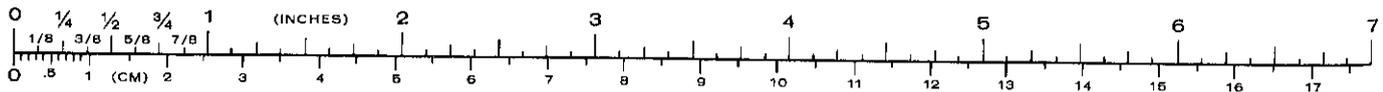
Detail 7-1B

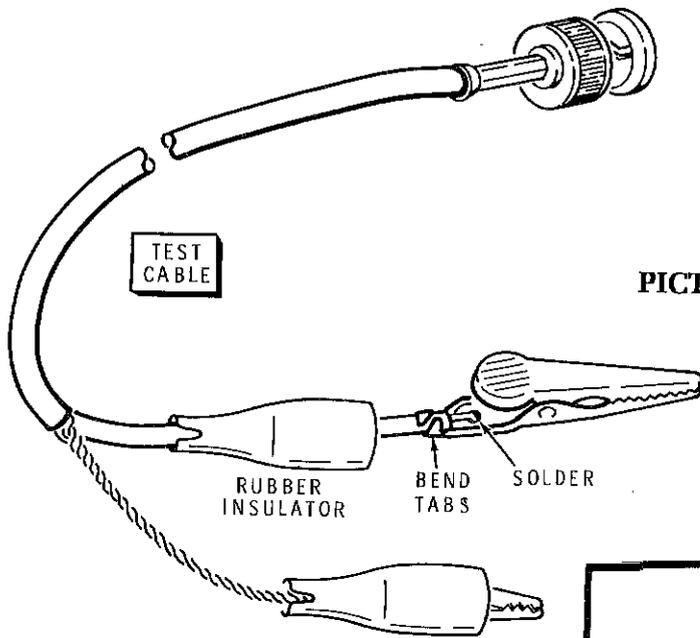


Detail 7-1C

- () Refer to Detail 7-1C and install the handle and a detent at EA and EB. Be sure the bosses on the detents are positioned in the holes in the side rails. Then install an 8-32 × 1" screw, a #8 flat washer, a coil spring, a #8 lockwasher, and an 8-32 nut at each location. Tighten the screws all the way.
- () Refer to Pictorial 7-1 and install detent covers at EA and EB with 6-32 × 3/16" flat head screws. Be sure the cutout in the cover fits over the handle.
- () Carefully peel away the backing paper from the decorative inserts. Then press the inserts into the detent covers at EA and EB. NOTE: If these decorative inserts have a clear protective film over the front side, remove it.
- () Refer to Detail 7-1C and install the handle and a detent at EA and EB. Be sure the bosses on the detents are positioned in the holes in the side rails. Then install an 8-32 × 1" screw, a #8 flat washer, a coil spring, a #8 lockwasher, and an 8-32 nut at each location. Tighten the screws all the way.
- () Install a foot at each of the four mounting holes with 6-32 × 3/8" hardware.
- () Turn a 10-32 × 5/8" thumbscrew two or three turns into hole ED as shown in the Pictorial.
- () Turn the remaining 10-32 × 5/8" thumbscrew into hole EC two or three turns.
- () Position the top and bottom covers on the Oscilloscope as shown. Be sure the ventilation holes in the covers are toward the back of the Oscilloscope and the covers are seated in the grooves in the side rails. Then tighten the two thumbscrews to hold the covers in place.
- () Locate the bottom cover, four large rubber feet, four 6-32 × 3/8" screws, four #6 lockwashers, and four 6-32 nuts. The bottom cover is the cover with four mounting holes in it.
- () Remove the paper backing from the Heathkit label and press the label into place on the front of the Oscilloscope as shown.

Refer to Pictorial 7-2 (Page 18 in the "Illustration Booklet") for the following steps.





PICTORIAL 8-1

TEST CABLE PREPARATION

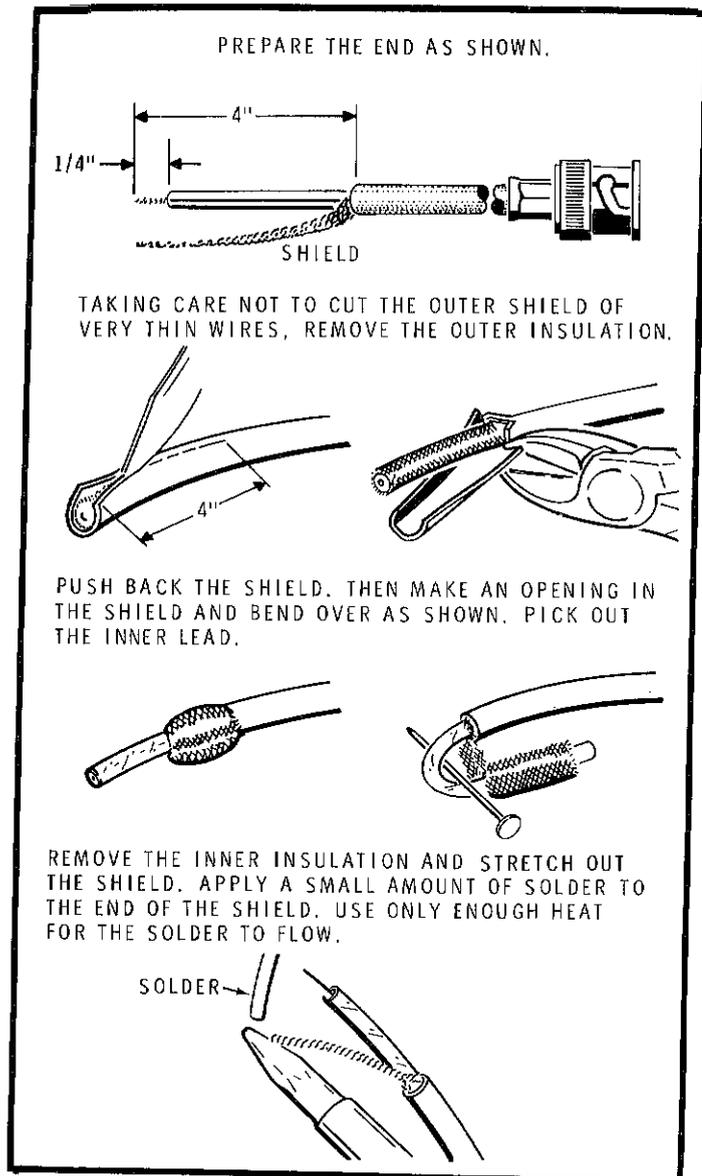
Refer to Pictorial 8-1 for the following steps.

In the following steps you will prepare a test cable.

- 1) Refer to Detail 8-1A and prepare the indicated end of the cable assembly.
- 2) Push rubber insulators onto the inner lead and shield lead of the cable.
- 3) Solder an alligator clip to the end of the inner lead.
- 4) Solder an alligator clip to the end of the shield lead.

After the clips have cooled, bend the tabs around the wire. Then slide the rubber insulators over the alligator clip.

This completes the assembly of your Oscilloscope. Proceed to the Calibration section on Page 22 of the "Operation Manual" and calibrate your Oscilloscope before you attempt to use it as a test instrument.



Detail 8-1A

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