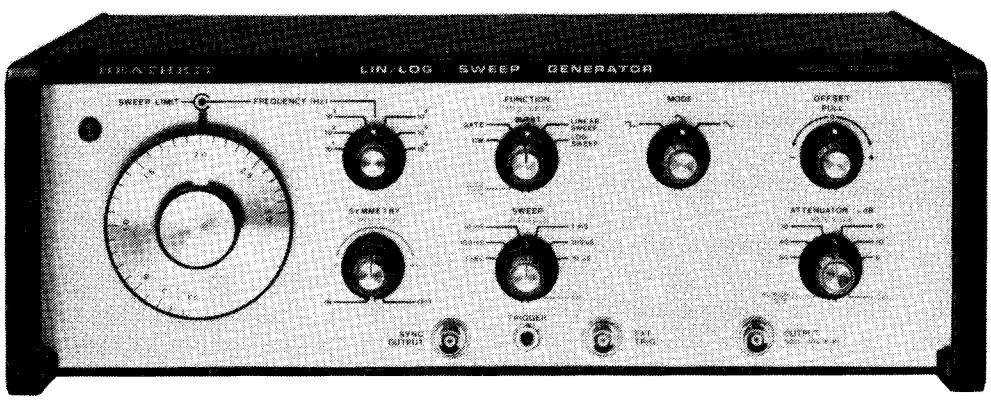
Heathkit® Manual

for the

LIN/LOG SWEEP GENERATOR

Model IG-1275

595-1758-01



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

TABLE OF CONTENTS

UNPACKING INSTRUCTIONS

DO NOT UNPACK YOUR LIN/LOG SWEEP GENERATOR PARTS UNTIL YOU ARE INSTRUCTED TO DO SO.

The Generator packaging consists of a main carton which contains three packages, marked PACK #1, PACK #2, and PACK #3, and a number of loose parts which are wrapped or bagged. These loose parts will be considered the Final Pack even though they may not be marked as such. Do not unpack the entire carton at one time. When the Manual instructs you to locate a certain pack, remove that pack and any additional parts specified from the Final Pack (usually a circuit board).

When you check the parts against the Parts List, return any part or group of parts, packaged in a bag or envelope with a part number, to its container after you identify the part. This will prevent intermixing of parts and aid in part identification. Do not throw away any packing material until you have accounted for all the parts.

Each circuit part in this kit has its own component number (R2, C4, etc.). Use these numbers when you want to positively 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:

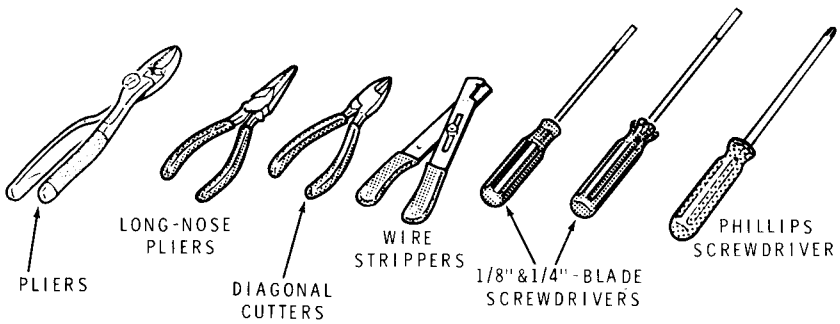
- In the Parts Lists,
- At the beginning of each step where a component is installed,
- In some illustrations,
- In the Schematic,
- In the sections at the rear of the Manual.

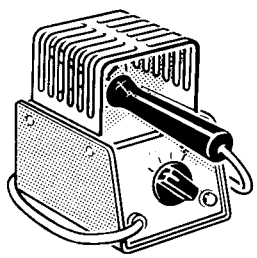
NOTE: The parts have "key numbers." These correspond to parts drawings in the "Illustration Booklet." Each parts list will have its own set of parts illustrations.

ASSEMBLY NOTES

TOOLS

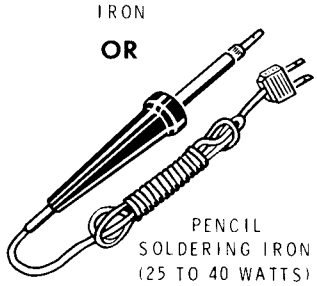
You will need these tools to assemble your kit.





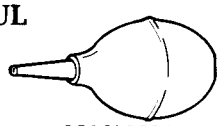
HEATHKIT SOLDERING IRON

OR



PENCIL SOLDERING IRON (25 TO 40 WATTS)

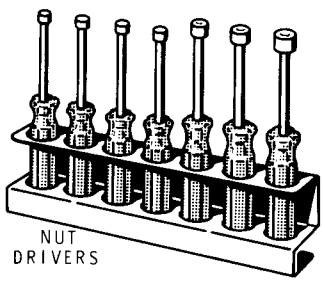
OTHER HELPFUL TOOLS



DESOLDERING BULB*

NUT STARTER (MAY BE SUPPLIED WITH KIT)

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. Resistors will be called out by their resistance value in Ω (ohms), kΩ (kilohms), or MΩ (megohms), and color code. Use 1/2-watt resistors unless directed otherwise.

7. Capacitors will be called out by their capacitance value (in pF or μF) and type (ceramic, Mylar, or electrolytic).

8. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

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

SOLDERING

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

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

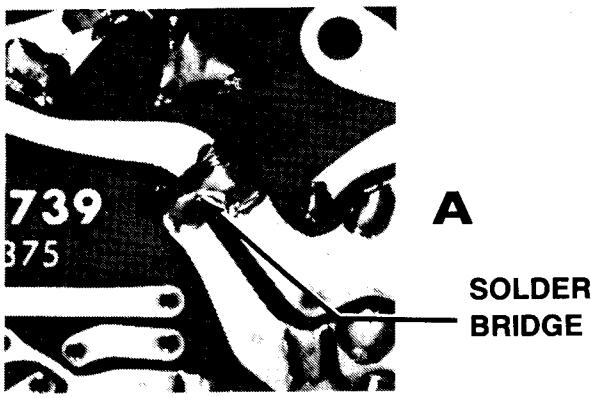
1. Use the right type of soldering iron. A good quality, 25 to 40-watt, pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.

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

3. Due to the small foil area around the circuit board holes and the small areas between foils, you must use the utmost care to prevent solder bridges between adjacent foil areas.

A solder bridge between two adjacent foils is shown in photograph A below. 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.



OUTPUT CIRCUIT BOARD

PARTS LIST

Unpack the parts package labeled #1. Check each part against the following list and the Parts Pictorial (on Page 1 in the Illustration Booklet). Any part that is packed in an individual envelope with the part number on it should be placed back into the envelope after you identify it until it is called for in a step. Do not throw away any packing material until all parts are accounted for.

RESISTORS

1/4-Watt Resistors

NOTES:

1. Resistors are 5% tolerance (fourth band of gold) unless otherwise noted. A fourth color band of silver indicates 10% tolerance.

2. The resistors may be packed in more than one envelope. Open all the resistor envelopes in this pack before you check them against the Parts List.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	1-125-12	2	22 Ω (red-red-black)	R266, R267
A1	1-57-12	3	33 Ω (orange-orange-black)	R254, R255, R256
A1	1-58-12	2	47 Ω (yellow-violet-black)	R219, R242
A1	1-115-12	1	51 Ω (green-brown-black)	R202
A1	1-102-12	1	68 Ω (blue-gray-black)	R214
A1	1-70-12	4	1200 Ω (brown-red-red)	R206, R209, R227, R241

Resistors (cont'd.)

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	1-99-12	1	1800 Ω (brown-gray-red)	R263
A1	1-106-12	1	3600 Ω (orange-blue-red)	R248
A1	1-75-12	1	3900 Ω (orange-white-red)	R272
A1	1-91-12	2	22 kΩ (red-red-orange)	R218, R243
A1	1-31-12	2	68 kΩ, 10% (blue-gray-orange)	R257, R259
A1	1-47-12	2	150 kΩ, 10% (brown-green-yellow)	R211, R262

Precision Resistors

NOTE: Precision resistors are 1/8-watt, 1% tolerance unless otherwise noted. Precision resistors may be marked with a manufacturer's number in addition to resistance value and tolerance.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A2	2-53-11	2	15.8 Ω	R222, R235
A2	2-54-11	2	21 Ω	R223, R236
A2	2-55-11	2	22.6 Ω	R221, R234
A2	2-56-11	2	30.1 Ω	R224, R237
A2	2-603-1	2	51.01 Ω, 1-watt	R281, R285
A2	2-57-11	2	51.1 Ω	R225, R238
A2	2-602-1	2	61.11 Ω, 1-watt	R283, R284

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

Resistors (cont'd.)

A2	2-601-11	1	71.15 Ω, 1-watt	R277
A2	2-58-11	1	71.5 Ω	R228
A2	2-329	2	96.25 Ω, 1/2-watt	R276, R278
A2	2-66-11	1	150 Ω	R201
A2	2-59-11	1	237 Ω	R229
A2	2-328	1	247.5 Ω, 1/2-watt	R282
A2	2-35-11	1	254 Ω	R265
A2	2-60-11	1	453 Ω	R231
A2	2-21-11	1	511 Ω	R273
A2	2-61-11	1	681 Ω	R232
A2	2-62-11	3	1500 Ω (1.5k)	R217, R233, R246
A2	2-12-11	4	2000 Ω (2k)	R205, R247, R253, R261
A2	2-46-12	2	2500 Ω (2.5k), 1/4-watt	R208, R279
A2	2-611-12	2	3010 Ω (3.01k), 1/4-watt	R204, R207
A2	2-52-11	1	3200 Ω (3.2k)	R258
A2	2-49-11	1	6110 Ω (6.11k)	R251
A2	2-613-12	1	9000 Ω (9k), 1/4-watt	R249
A2	2-41-11	2	13 kΩ	R215, R244

Other Resistors

A3	1-135	2	6.8 Ω, 1/2-watt, 5% (blue-gray-gold-gold)	R269, R271
A4	1-41-2	3	47 Ω, 2-watt, 5% (yellow-violet-black)	R268, R274, R275

CAPACITORS

NOTE: Capacitors can be marked in many different ways. EXAMPLE: 22, 22k, 22M, 22 μF. However, the Parts List and installation instructions will always use μF (or pF for very small value capacitors).

B1	20-104	1	130 pF mica	C212
B1	20-108	1	200 pF mica	C211
B2	21-33	1	3.3 pF ceramic	C208
B2	21-176	8	0.01 μF ceramic	C201—C206, C210, C213
B3	27-47	3	0.1 μF Mylar*	C214, C215, C216
B4	31-71	1	3.2-18 pF trimmer (blue dot)	C207
B4	31-83	1	2-6 pF trimmer (red dot)	C209

*Registered Trademark, DuPont Corp.

DIODES — TRANSISTORS

NOTE: Diodes and 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.

C1	56-16	1	1N751 zener diode (5.1-volt)	D201
C1	56-31	1	PS18775 zener diode (6.8-volt)	D215
C1	56-56	4	1N4149 diode	D207, D214, D216, D217
C1	56-86	10	FD777 diode	D202—D206, D208, D209, D211, D212, D213
C2	417-224	1	MPSU05 transistor	Q214
C2	417-225	1	MPSU55 transistor	Q215
C3	417-269	1	SGC5282 transistor	Q216
C4	417-879	2	2N3251 transistor	Q212, Q213
C5	417-874	1	2N3906 transistor	Q207
C5	417-875	1	2N3904 transistor	Q206
C6	417-235	2	2N4121 transistor	Q204, Q208
C6	417-801	5	MPSA20 transistor	Q201, Q202, Q203, Q205, Q209
C7	417-877	1	CA3018A transistor array	Q211

CONTROLS — SWITCHES — INDUCTOR

D1	10-917	2	200 Ω control	R226, R239
D1	10-295	2	750 Ω control	R216, R245
D1	10-936	1	1000 kΩ (1k) control	R203
D1	10-1070	1	2500 Ω (2.5 k) control	R252
D1	10-385	2	50 kΩ control	R212, R264
D2	19-724	1	1000 Ω (1k) control/switch	R213/SW202
D3	63-1274	1	Rotary switch	SW201
D4	40-582	1	62 μH inductor (blue-red-black)	L201

HARDWARE

E1	250-52	2	4-40 × 1/4" screw
E2	252-2	2	4-40 nut
E3	252-39	1	Small control nut
E4	253-2	2	Fiber shoulder washer
E5	254-14	1	Small control lockwasher

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

WIRE

340-8		60"	Bare wire
344-33		54"	Stranded black wire (thick insulation)
344-50		36"	Solid black wire
344-51		36"	Brown wire
344-52		12"	Red wire
355-53		18"	Orange wire
344-54		48"	Yellow wire
344-55		24"	Green wire
344-56		18"	Blue wire
344-57		30"	Violet wire
344-58		18"	Gray wire
344-59		24"	White wire
344-71		12"	White-brown wire
344-72		18"	White-red wire
344-74		6"	White-yellow wire
344-75		18"	White-green wire
344-76		18"	White-blue wire

MISCELLANEOUS

F1	75-159		3	Transistor spacer
F2	75-204		2	Transistor insulator (between two pieces of cardboard)

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

Miscellaneous (cont'd.)

F3	215-31		1	TO-5 style heat sink
F4	215-63		2	Small heat sink
F5	215-610		1	Flat heat sink
F6	352-13		1	Silicone grease
F7	490-5		1	Nut starter
				Solder

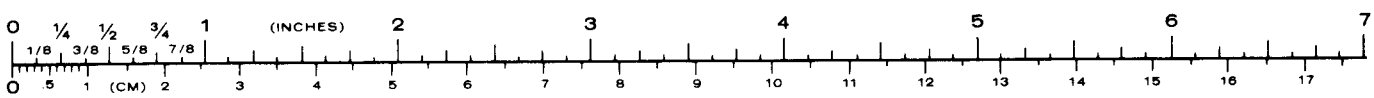
PARTS FROM FINAL PACK

	85-1563-3		1	Output circuit board
L1	390-1255		1	Fuse label
L2	391-34		1	Blue and white label

NOTE: Be sure you refer to the numbers on the blue and white label in any communications you may have about this kit with Heath Company. You may want to write the model and series numbers in the illustrated sample for future convenience.

597-260		1	Parts Order Form
		1	Assembly Manual (See Page 1 for part number.)

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



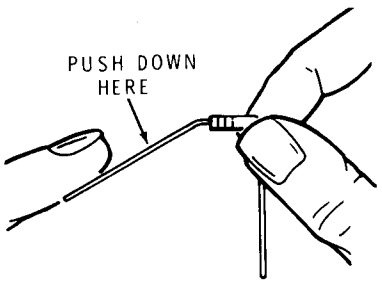
STEP-BY-STEP ASSEMBLY

START

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

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

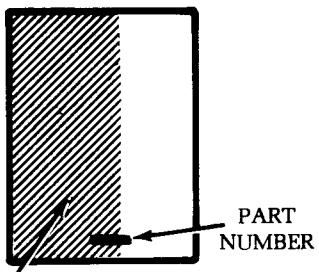
( ) Hold a 3600 Ω (orange-blue-red) resistor by the body as shown and bend the leads straight down. NOTE: The lead spacing for some resistors may be wider than the resistor body.



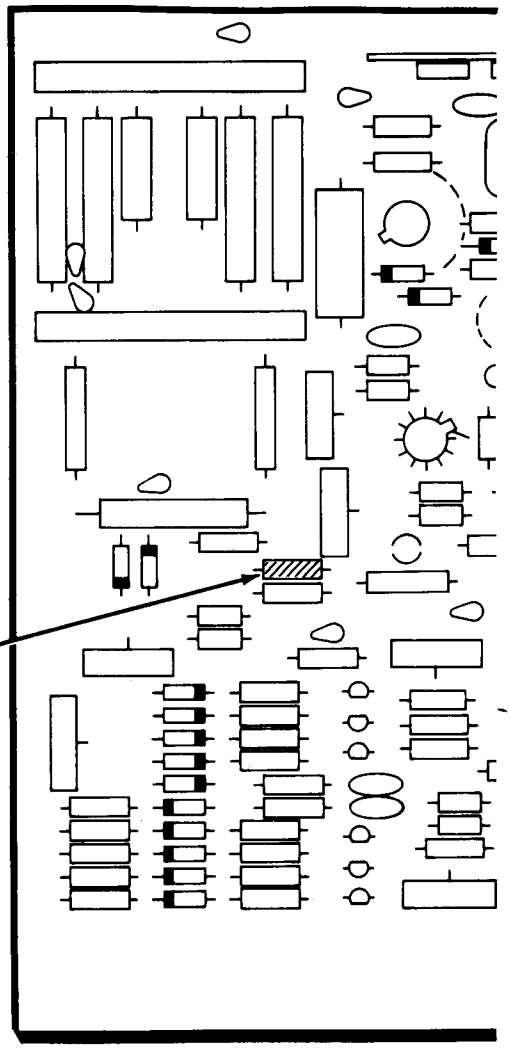
(✓) R248: Push the leads through the holes at the proper location on the circuit board. The end with color bands may be positioned either way.

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

IDENTIFICATION DRAWING



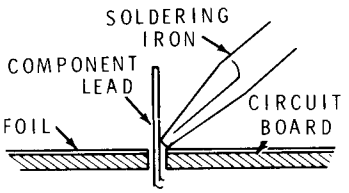
The part installed in this Pictorial is in this area of the circuit board.



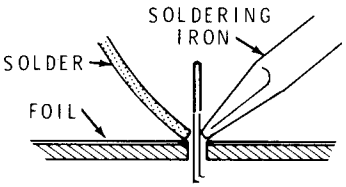
CONTINUE

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

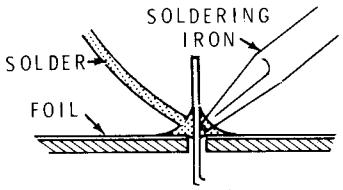
1. Place the soldering iron tip against both the lead and the circuit board foil. Heat **both** for 2 or 3 seconds.



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



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

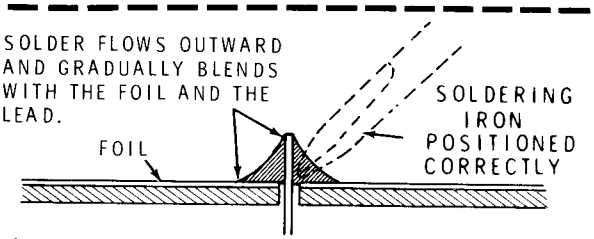


(✓) Hold the lead with one hand while you cut off the excess lead length close to the connection. This will keep you from being hit in the eye by the flying lead.

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

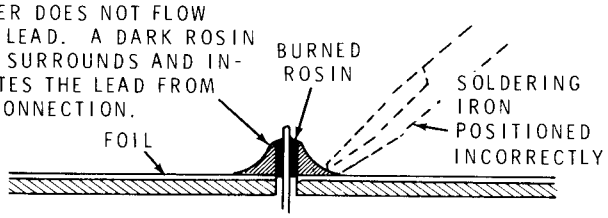
PICTORIAL 1-1

A GOOD SOLDER CONNECTION

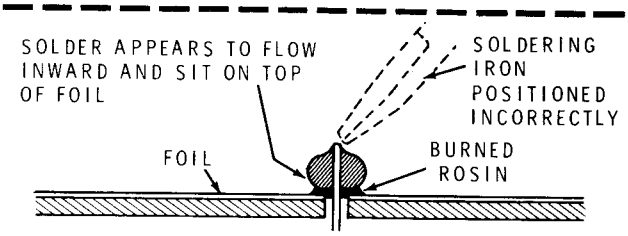


When both the lead and the circuit board foil are heated at the same time, the solder will flow onto the lead and the foil evenly. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS



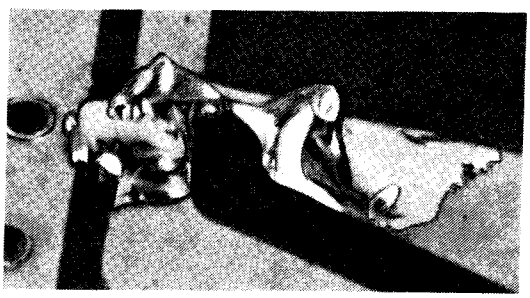
When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.



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

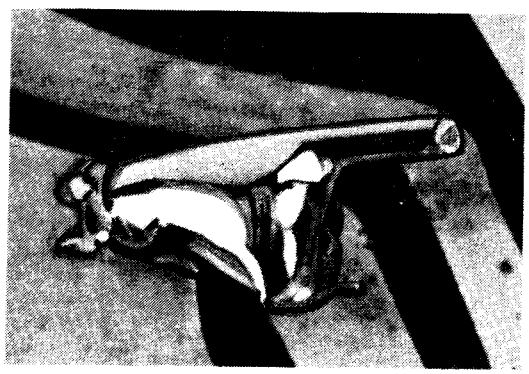
SOLDER CONNECTIONS TO WATCH OUT FOR

The following photographs show examples of the types of bad solder connections that are the most common cause of trouble. If you locate any of these bad solder connections in your kit, correct them as instructed.



Here, hot solder has been dropped onto the foil and the solder connected or bridged (or crossed) three foils. To correct, hold the circuit board above the soldering iron and reheat the solder. As the solder melts, it will flow down the iron.

NOTE: Solder that bridges two connections on the SAME FOIL is alright and should not be corrected.



Here, solder has flowed along a lead and bridged to another foil. To correct, hold the circuit board above the soldering iron and reheat the solder. As the solder melts, it will flow down the iron. Then cut off the excess lead lengths. PROTECT YOUR EYES.

HEATHKIT®

START

NOTE: Bend the leads of precision resistors so the leads fit into the holes at the end of each resistor outline and the value is visible.

- ( ) R279: 2500 Ω (2.5 k), precision.
- ( ) R282: 247.5 Ω, 1/2-watt precision.
- ( ) R284: 61.11 Ω, 1-watt precision.
- ( ) R285: 51.01 Ω, 1-watt precision.
- ( ) R276: 96.25 Ω, 1/2-watt precision.
- ( ) R278: 96.25 Ω, 1/2-watt precision.
- ( ) R277: 71.15 Ω, 1-watt precision.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

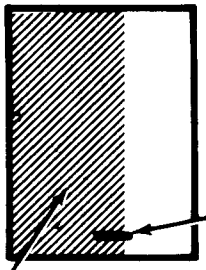
NOTE: Refer to Figure A (on Page 5 of the Illustration Booklet) to install the following diodes.

- ( ) D214: 1N4149 diode (#56-56).
- ( ) D207: 1N4149 diode (#56-56).

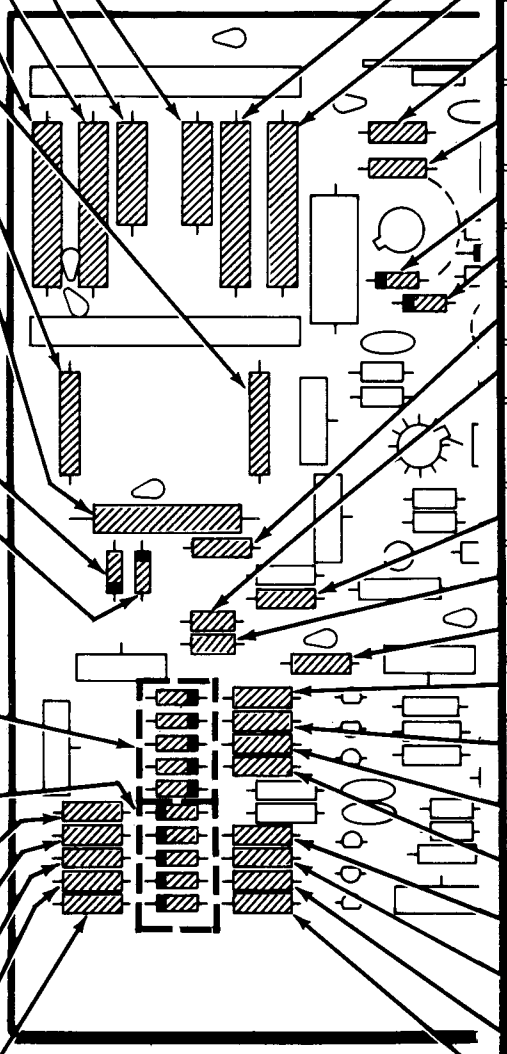
NOTE: In the next two steps install ten FD777 diodes (#56-86) in two groups of 5 diodes each.

- ( ) D208, D209, D211, D212 and D213: Five FD777 diodes.
- ( ) D202 through D206: Five FD777 diodes.
- ( ) R228: 71.5 Ω precision.
- ( ) R229: 237 Ω precision.
- ( ) R231: 453 Ω precision.
- ( ) R232: 681 Ω precision.
- ( ) R233: 1500 Ω (1.5 k) precision.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

IDENTIFICATION DRAWING



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



PICTORIAL 1-2

CONTINUE

- ( ) R281: 51.01 Ω, 1-watt precision.
- ( ) R283: 61.11 Ω, 1-watt precision.
- ( ) R271: 6.8 Ω, 1/2-watt (blue-gray-gold-gold).
- ( ) R269: 6.8 Ω, 1/2-watt (blue-gray-gold-gold).
- ( ) D217: 1N4149 diode (#56-56).
- ( ) D216: 1N4149 diode (#56-56).
- ( ) R214: 68 Ω (blue-gray-black).
- ( ) R227: 1200 Ω (brown-red-red).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) R247: 2000 Ω (2 k) precision.
- ( ) R241: 1200 Ω (brown-red-red).
- ( ) R244: 13 kΩ precision.
- ( ) R238: 51.1 Ω precision.
- ( ) R237: 30.1 Ω precision.
- ( ) R236: 21 Ω precision.
- ( ) R235: 15.8 Ω precision.
- ( ) R222: 15.8 Ω precision.
- ( ) R223: 21 Ω precision.
- ( ) R224: 30.1 Ω precision.
- ( ) R225: 51.1 Ω precision.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

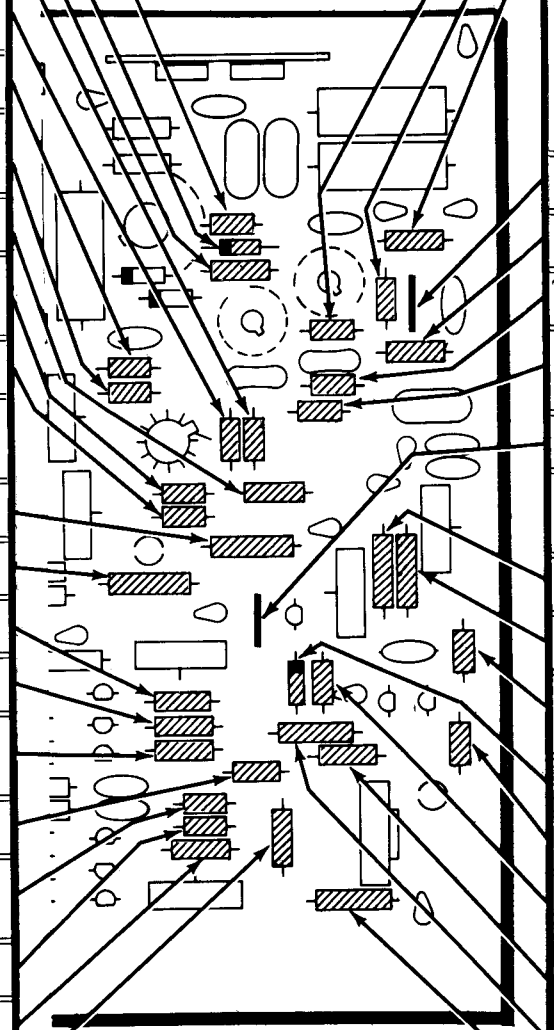
The steps performed in this Pictorial are in this area of the circuit board.

IDENTIFICATION DRAWING

PART NUMBER

START

- ( ) R272: 3900 Ω (orange-white-red).
- ( ) D215: PS18775 diode (#56-31). See Figure A on Page 5 of the Illustration Booklet.
- ( ) R273: 511 Ω precision.
- ( ) R257: 68 kΩ (blue-gray-orange).
- ( ) R255: 33 Ω (orange-orange-black).
- ( ) R263: 1800 Ω (brown-gray-red).
- ( ) R262: 150 kΩ (brown-green-yellow).
- ( ) R258: 3200 Ω (3.2 k) precision.
- ( ) R254: 33 Ω (orange-orange-black).
- ( ) R259: 68 kΩ (blue-gray-orange).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) R249: 9000 Ω (9 k) precision.
- ( ) R251: 6110 Ω (6.11 k) precision.
- ( ) R246: 1500 Ω (1.5 k) precision.
- ( ) R243: 22 kΩ (red-red-orange).
- ( ) R242: 47 Ω (yellow-violet-black).
- ( ) R206: 1200 Ω (brown-red-red).
- ( ) R219: 47 Ω (yellow-violet-black).
- ( ) R218: 22 kΩ (red-red-orange).
- ( ) R217: 1500 Ω (1.5 k) precision.
- ( ) R215: 13 kΩ precision.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 1-3

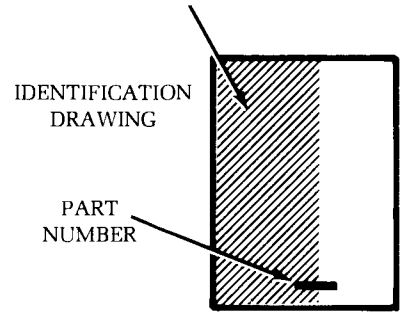
CONTINUE

- ( ) R261: 2000 Ω (2 k) precision.
- ( ) R266: 22 Ω (red-red-black).
- ( ) R253: 2000 Ω (2 k) precision.

NOTE: To prepare a jumper wire, as in the following step, cut a piece of bare wire to the length indicated. Then form the wire to fit over the jumper outline on the circuit board and into the holes at the ends of the outline.

- ( ) 1" bare jumper wire.
- ( ) R265: 254 Ω precision.
- ( ) R267: 22 Ω (red-red-black).
- ( ) R256: 33 Ω (orange-orange-black).
- ( ) 1" bare jumper wire.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) R207: 3010 Ω (3.01 k) precision.
- ( ) R204: 3010 Ω (3.01 k) precision.
- ( ) R211: 150 kΩ (brown-green-yellow).
- ( ) D201: 1N751 diode (#56-16).
- ( ) R209: 1200 Ω (brown-red-red).
- ( ) R202: 51 Ω (green-brown-black).
- ( ) R205: 2000 Ω (2 k) precision.
- ( ) R208: 2500 Ω (2.5 k) precision.
- ( ) R201: 150 Ω precision.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

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



START

NOTE: As you mount each component in this Pictorial, solder its leads to the foil and cut off the excess lead lengths, if any.

( ) R275: 47 Ω, 2-watt (yellow-violet-black).

NOTE: When you are referred to a Figure, as in the next step and all subsequent circuit board steps, use the Figures on Pages 4 and 5 of the Illustration Booklet.

( ) C210: Refer to Figure B and install a 0.01 μF ceramic capacitor.

( ) R264: 50 kΩ control. See Figure C.

( ) R252: 2500 Ω (2.5k) control. NOTE: The circuit board may be marked 2000.

( ) C205: 0.01 μF ceramic.

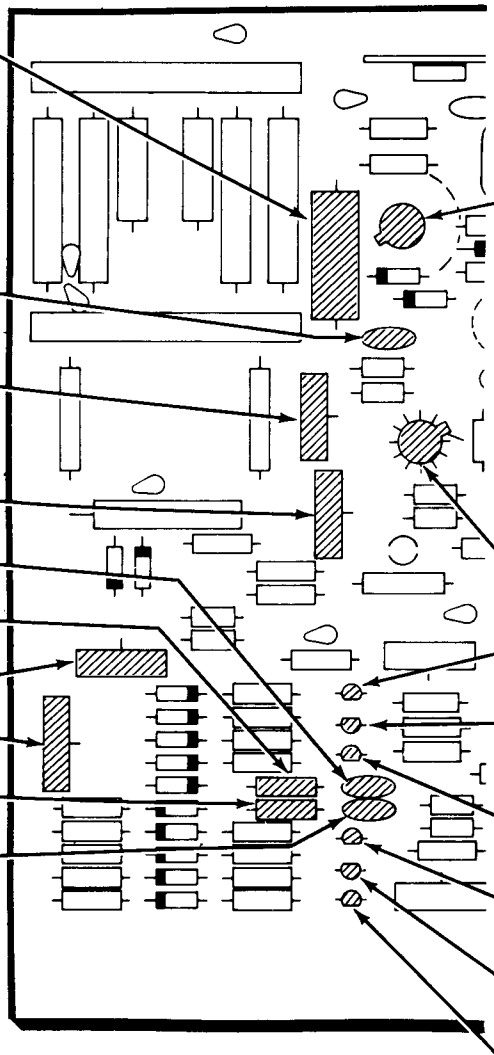
( ) R234: 22.6 Ω precision.

( ) R239: 200 Ω control.

( ) R226: 200 Ω control.

( ) R221: 22.6 Ω precision.

( ) C206: 0.01 μF ceramic.



CONTINUE

( ) Refer to Figure D and mount a TO-5 style heat sink and a transistor spacer onto an SGC5282 (#417-269) transistor.

( ) Q216: SGC5282 transistor (#417-269), transistor spacer, and TO-5 style heat sink. See Figure E-1.

( ) Refer to Figure E-2 and bend the leads of a CA3018A transistor array (#417-877) as shown. As you mount the transistor in the following step, be sure all of its leads are installed through the board before you solder them to the foil.

( ) Q211: CA3018A transistor array (#417-877).

( ) Q209: MPSA20 transistor (#417-801). See Figure E-3.

( ) Q208: 2N4121 transistor (#417-235). See Figure E-3.

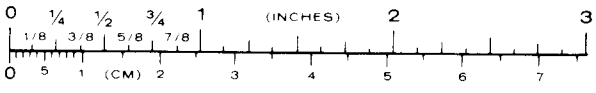
( ) Q207: 2N3906 transistor (#417-874). See Figure E-4.

( ) Q206: 2N3904 transistor (#417-875). See Figure E-4.

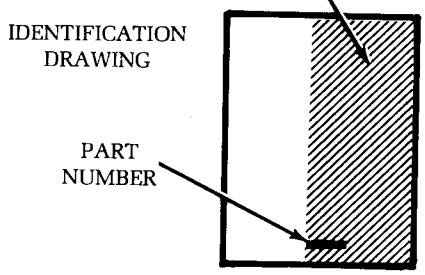
( ) Q205: MPSA20 transistor (# 417-801). See Figure E-3.

( ) Q204: 2N4121 transistor (#417-235). See Figure E-3.

PICTORIAL 1-4



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



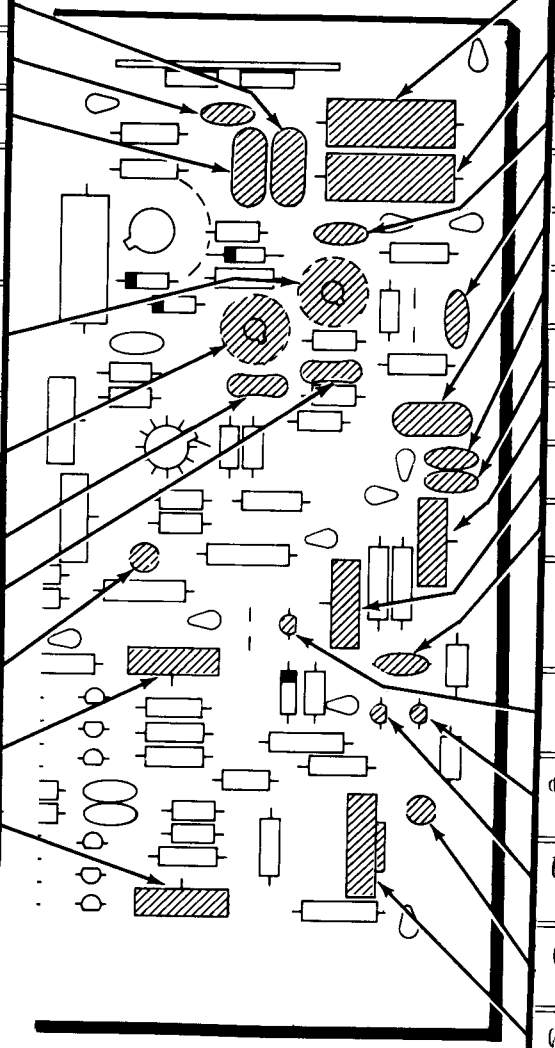
START

NOTE: In this Pictorial, solder the leads of each component to the foil as you mount it. Cut off the excess lead lengths.

- ( ) C214: 0.1 μF Mylar.
- ( ) C213: 0.01 μF ceramic.
- ( ) C215: 0.1 μF Mylar.

NOTE: Refer to Figure E-5 to prepare two transistors, heat sinks, and spacers in the next two steps. Then refer to Figure E-6 to mount them.

- ( ) Q212: 2N3251 transistor (#417-879), heat sink, and spacer.
- ( ) Q213: 2N3251 transistor (#417-879), heat sink, and spacer.
- ( ) C211: 200 pF mica.
- ( ) C212: 130 pF mica.
- ( ) C209: 2-6 pF trimmer (#31-83, red dot). See Figure F.
- ( ) R245: 750 Ω control. Refer to Figure C.
- ( ) R216: 750 Ω control.



CONTINUE

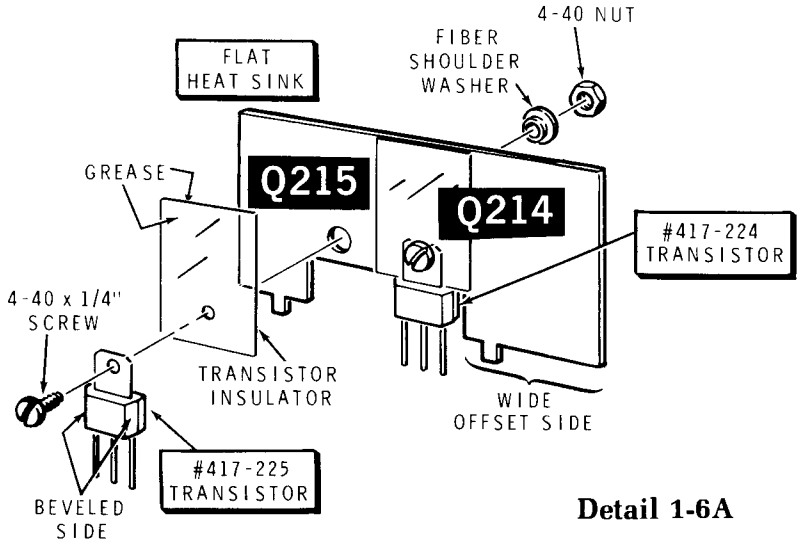
NOTE: In the next two steps, position each resistor body approximately 1/8" above the circuit board.

- ( ) R268: 47 Ω, 2-watt (yellow-violet-black).
- ( ) R274: 47 Ω, 2-watt (yellow-violet-black).
- ( ) C201: 0.01 μF ceramic.
- ( ) C202: 0.01 μF ceramic.
- ( ) C216: 0.1 μF Mylar.
- ( ) C204: 0.01 μF ceramic.
- ( ) C203: 0.01 μF ceramic.
- ( ) R212: 50 kΩ control.
- ( ) R203: 1000 Ω (1 k) control.
- ( ) C208: 3.3 pF ceramic.

NOTE: Refer to Figure E-3 as you install transistors in the next three steps.

- ( ) Q201: MPSA20 transistor (#417-801).
- ( ) Q203: MPSA20 transistor (#417-801).
- ( ) Q202: MPSA20 transistor (#417-801).
- ( ) C207: 3.2-18 pF trimmer (#31-71, blue dot).
- ( ) L201: 62 μH inductor.
- ( ) Check the circuit board foil to make sure all the component leads have been soldered.

PICTORIAL 1-5



Detail 1-6A

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

( ) Refer to Detail 1-6A and mount two transistors on the flat heat sink as follows:

A. Cut open the small pod of silicone grease. Coat both sides of a transistor insulator with a thin layer of grease.

B. Position the insulator onto the flat heat sink at Q215 as shown in the Detail. Center the insulator hole over the proper hole in the heat sink. NOTE: The heat sink holes are offset to one side. Position the heat sink properly.

C. Push a 4-40 × 1/4" screw through the hole in the top tab of the MPSU55 (#417-225) transistor. NOTE: Be sure the beveled sides of the transistor are positioned outward as shown.

D. Push the threaded end of the screw through the mounting hole at Q215 in the heat sink.

NOTE: Use the plastic nut starter supplied with the kit to hold and start 4-40 and 6-32 nuts, as in the following steps.

E. Place the fiber shoulder washer on the screw threads and center the shoulder of the washer into the heat sink hole. Then, place a 4-40 nut onto the screw and tighten the nut finger tight. NOTE: The insulator may be a little long. Do not cut the insulator; allow it to bend under the heat sink.

F. Repeat the process to mount an MPSU05 transistor (#417-224) onto the heat sink at Q214.

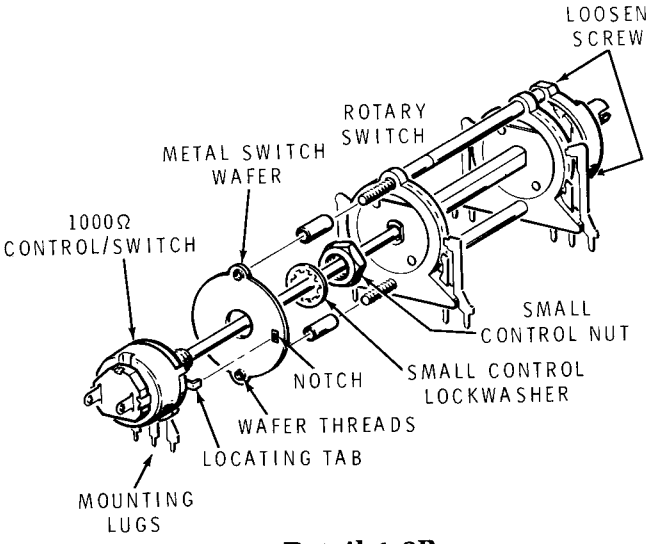
NOTE: Save the remaining silicone grease for later use.

( ) Position the leads of transistors Q214 and Q215 into their holes in the circuit board as shown in the Pictoirial. Then position the heat sink mounting tabs into their circuit board holes.

( ) Turn the circuit board foil-side-up and solder the heat sink mounting tabs to the foil. Make sure the heat sink is vertical to the circuit board.

( ) Tighten the hardware on transistors Q214 and Q215. Do not let the transistors twist as you tighten the hardware. Then solder the six transistor leads to the foil and cut off the excess lead lengths.

( ) Using an ohmmeter, measure the resistance between the flat heat sink (common lead) and the mounting tab (input lead) of transistors Q214 and Q215. The resistance will vary between ohmmeters, but should be greater than 1000 ohms. This test is used to check for a short circuit to the heat sink.



Detail 1-6B

NOTE: As you mount the control onto the metal switch wafer in the following steps, you will be instructed to remove the wafer from the switch assembly. To do this, loosen (but do not remove) the two switch screws until the metal wafer can be lifted from the assembly. Be especially careful that the switch wafers and spacers remain on the long wafer assembly screws.

( ) Refer to Detail 1-6B and mount a 1000 Ω control with switch (#19-724) onto the rotary switch (#63-1274) as follows:

A. Loosen the rotary switch screws just enough that you can remove the rear metal wafer from the assembly. Carefully set the rotary switch aside temporarily.

B. Place the metal wafer over the shaft on the 1000 Ω control and secure the wafer with a small control lockwasher and a small control nut. Be sure to fit the control locating tab into the wafer notch. Keep the wafer threads positioned on the control side of the wafer.

C. Carefully push the long control shaft through the hollow center shaft of the rotary switch assembly.

D. Position the three control mounting lugs in the same direction as the rotary switch mounting lugs. Then tighten the rotary switch screws into the threaded holes in the metal wafer. Do not overtighten the screws and break the plastic switch wafer.

( ) R213/SW201/SW202: Position the rotary switch assembly onto the circuit board as shown in the Pictorial. Be sure all the switch lugs are as far down onto the top of the circuit board as possible. Solder the thirteen lugs to the foil.

CIRCUIT BOARD CHECKOUT

Carefully inspect the output circuit board for the following conditions.

( ) Unsoldered connections. Disregard the unused holes.

( ) Poor solder connections.

( ) Solder bridges between foil patterns. See Page 10.

( ) Protruding leads which could touch together.

( ) Transistors for the proper type and installation.

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

Set the circuit board aside temporarily.

GENERATOR CIRCUIT BOARD

PARTS LIST

Unpack the parts package labeled #2. Check each part against the following list and the Parts Pictorial (on Page 2 in the Illustration Booklet). Any part that is packed in an individual envelope with the part number on it should be placed back into the envelope after you identify it until it is called for in a step. Do not throw away any packing material until all parts are accounted for.

RESISTORS

1/4-Watt Resistors

NOTES:

1. Resistors are 5% tolerance (fourth color band of gold) unless otherwise noted. A fourth color band of silver indicates 10% tolerance.

2. The resistors may be packed in more than one envelope. Open all the resistor envelopes in this pack before you check them against the Parts List.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	1-55-12	1	10 Ω (brown-black-black)	R154
A1	1-125-12	2	22 Ω (red-red-black)	R188, R192
A1	1-115-12	4	51 Ω (green-brown-black)	R161, R184, R193, R199
A1	1-102-12	2	68 Ω (blue-gray-black)	R151, R186
A1	1-60-12	9	100 Ω (brown-black-brown)	R137, R138 R139, R141, R145, R146, R148, R149, R163
A1	1-105-12	3	200 Ω (red-black-brown)	R159, R182, R183

Resistors (cont'd.)

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	1-121-12	2	300 Ω (orange-black-brown)	R179, R185
A1	1-64-12	1	390 Ω (orange-white-brown-	R152
A1	1-65-12	2	470 Ω (yellow-violet-brown)	R173, R176
A1	1-118-12	1	620 Ω (blue-red-brown)	R164
A1	1-67-12	1	680 Ω (blue-gray-brown)	R165
A1	1-69-12	1	1000 Ω (brown-black-red)	R181
A1	1-70-12	2	1200 Ω (brown-red-red)	R158, R162
A1	1-99-12	2	1800 Ω (brown-gray-red)	R175, R178
A1	1-72-12	4	2200 Ω (red-red-red)	R129, R134, R174, R177
A1	1-74-12	2	3300 Ω (orange-orange-red)	R155, R157
A1	1-76-12	1	4700 Ω (yellow-violet-red)	R156

1/2-Watt Resistors

A2	1-123	2	100 Ω (brown-black-brown)	R101, R102
A2	1-128	1	62 kΩ (blue-red-orange)	R106
A2	1-99	1	240 kΩ (red-yellow-yellow)	R105
A2	1-74	2	18 MΩ, 10% (brown-gray-blue)	R144, R147

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

Resistors (cont'd.)

NOTE: All precision resistors are 1% tolerance unless otherwise noted.

1/8-Watt Precision Resistors

A3	2-3-11	2	211.7 Ω	R167, R169
A3	2-15-11	1	1000 Ω (1k)	R117
A3	2-12-11	2	2000 Ω (2k)	R120, R172
A3	2-39-11	3	3900 Ω (3.9k)	R187, R189, R198
A3	2-17-11	1	5760 Ω (5.76k)	R109
A3	2-18-11	1	10 kΩ	R122
A3	2-40-11	2	10.1 kΩ	R196, R197
A3	2-63-11	2	26.1 kΩ	R118, R195

1/4-Watt Precision Resistors

A3	2-98-12	2	1350 Ω (1.35k)	R131, R135
A3	2-58-12	1	1370 Ω (1.37k)	R191
A3	2-729-12	2	1690 Ω (1.69k), 0.1%	R126, R136
A3	2-658-12	3	2210 Ω (2.21k)	R111, R127, R132
A3	2-611-12	2	3010 Ω (3.01k)	R123, R168
A3	2-604-12	1	3300 Ω (3.3k)	R166
A3	2-677-12	1	4000 Ω (4k)	R171
A3	2-88-12	1	5000 Ω (5k)	R116
A3	2-676-12	1	8000 Ω (8k)	R114
A3	2-730-12	4	15 kΩ, 0.1%	R124, R125, R128, R133
A3	2-666-12	1	18.75 kΩ	R113
A3	2-96-12	2	1 MΩ	R121, R142

Other Resistor

A4	3-7-2	2	1 Ω, wire-wound, 2-watt, 10% (brown-black-gold-silver)	R103, R104

CAPACITORS

Mica

B1	20-130	2	12 pF	C136, C142
B1	20-118	1	15 pF	C132

Capacitors (cont'd.)

B1	20-100	4	30 pF	C125, C126, C127, C131
B1	20-174	1	42 pF	C148
B1	20-141	1	82 pF	C137
B1	20-102	2	100 pF	C139, C141

Ceramic

B2	21-33	1	3.3 pF	C134
B2	21-176	13	0.01 μF	C114—C119, C121, C122, C123, C128, C129, C133, C135

Mylar

B3	27-47	2	0.1 μF	C105, C106
B4	27-173	1	Matched set of 5 capacitors consisting of:	
		1	*960 pF*	*C147*
		1	*0.01 μF*	*C146*
		1	*0.1 μF*	*C145*
		1	*1 μF*	*C144*
		1	*10 μF*	*C143*

Other Capacitors

B5	25-197	2	1 μF tantalum	C102, C103
B6	25-220	2	10 μF tantalum	C107, C108
B7	31-71	2	3.2-18 pF trimmer (blue dot)	C138, C149
B8	25-804	2	100 μF electrolytic	C112, C113
B8	25-819	1	500 μF electrolytic	C111
B8	25-828	2	2000 μF electrolytic	C101, C104
B8	25-812	1	3000 μF electrolytic	C109

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

DIODES — TRANSISTORS — INTEGRATED CIRCUITS

C1	56-56	11	1N4149 diode	D109, D112, D114, D116, D118, D119, D121—125
C1	56-636	4	HP5082-2811 diode	D111, D113, D115, D117
C1	57-27	8	1N2071 diode	D101—D108

NOTE: Transistors and integrated circuits are marked for identification in one of the four following 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 with a type number other than the one listed.
3. Part number and type number.

C2	417-874	2	2N3906 transistor	Q109, Q112
C2	417-875	4	2N3904 transistor	Q106, Q107, Q108, Q111
C3	417-283	1	SM07275 transistor	Q102
C3	417-284	1	SM62186 transistor	Q101
C3	417-828	2	MCHE-304 transistor	Q103, Q104
C4	417-876	1	CA3046 transistor array	Q105
C4	442-65	1	4501 integrated circuit	IC101
C4	442-73	1	75107 integrated circuit	IC108
C5	442-22	1	741 integrated circuit	IC109
C5	442-39	4	301 integrated circuit	IC104—IC107
C6	442-617	1	78MGT2C integrated circuit	IC102
C6	442-618	1	79MGT2C integrated circuit	IC103

CONTROLS — SWITCH — FERRITE BEADS

D1	10-918	1	500 Ω control	R153
D1	10-1070	1	2500 Ω (2.5k) control	R115
D1	10-904	1	5000 Ω (5k) control	R194
D1	10-385	3	50 kΩ control	R108, R119, R143
D1	10-941	1	100 kΩ control	R107
D2	10-1071	1	5000 Ω (5k) control	R112
D3	63-1269	1	Rotary switch	SW101
D4	475-15	6	1/8" ferrite bead	FB101—FB106
D5	475-10	2	1/4" ferrite bead	FB107, FB108

HARDWARE

E1	250-1172	4	2-56 × 1/4" screw
E2	252-51	4	2-56 nut
E3	254-26	4	#2 lockwasher

MISCELLANEOUS

	73-92	1	Foam tape
F1	260-16	6	Alligator clip
F2	354-7	1	Cable tie
F3	432-134	6	Socket pin
F4	434-230	5	8-pin IC socket
F5	434-298	3	14-pin IC socket
F6	432-865	2	Connector housing
F7	432-866	7	Connector
F8	490-11	1	IC puller

PART FROM FINAL PACK

	85-1943-1	1	Generator circuit board

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

STEP-BY-STEP ASSEMBLY

START

Position the generator circuit board as shown in the identification drawing. Then proceed with the following steps.

( ) Cut a 1/2" × 1" piece of cardboard from your shipping carton.

NOTE: Install each of the six resistors in this Pictorial in the following manner:

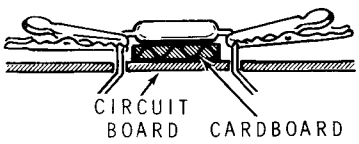
A. Bend the resistor leads to fit into the circuit board holes.

B. Mount the resistor into the circuit board with the strip of cardboard under the body of the resistor as shown in Detail 2-1A.

C. Bend the resistor leads on the foil side of the board to hold the resistor in place.

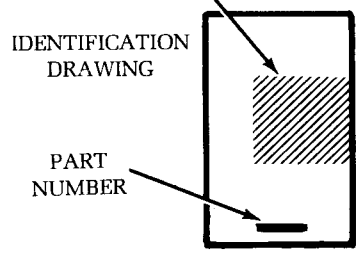
D. On the top of the circuit board, fasten an alligator clip to each of the resistor leads (to heat sink the resistor).

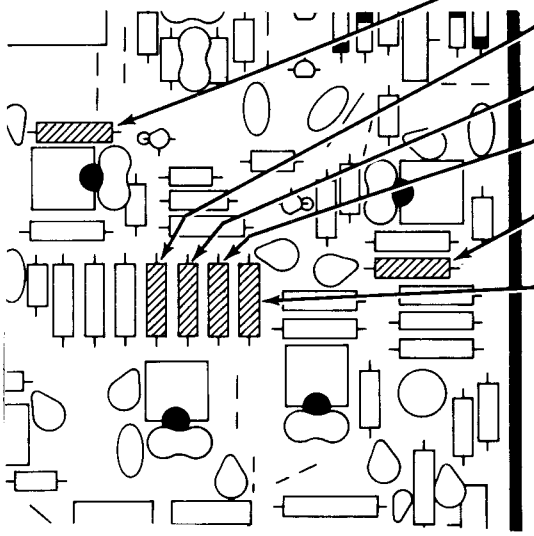
E. Solder the leads to the foil and cut off the excess lead lengths. Then remove the cardboard strip and the alligator clips from the resistor.



Detail 2-1A

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





PICTORIAL 2-1

CONTINUE

NOTE: Be sure to use the correct procedure as you install each of the following six resistors. Failure to do so may cause the component to be damaged by heat from the soldering process.

( ) R126: 1690 Ω (1.69 k) precision resistor.

( ) R128: 15 kΩ precision resistor.

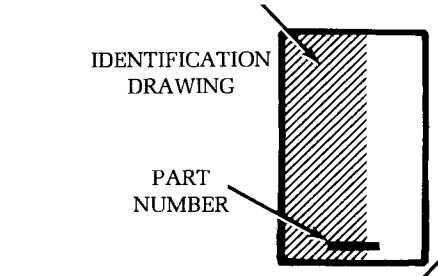
( ) R133: 15 kΩ precision resistor.

( ) R125: 15 kΩ precision resistor.

( ) R136: 1690 Ω (1.69 k) precision resistor.

( ) R124: 15 kΩ precision resistor.

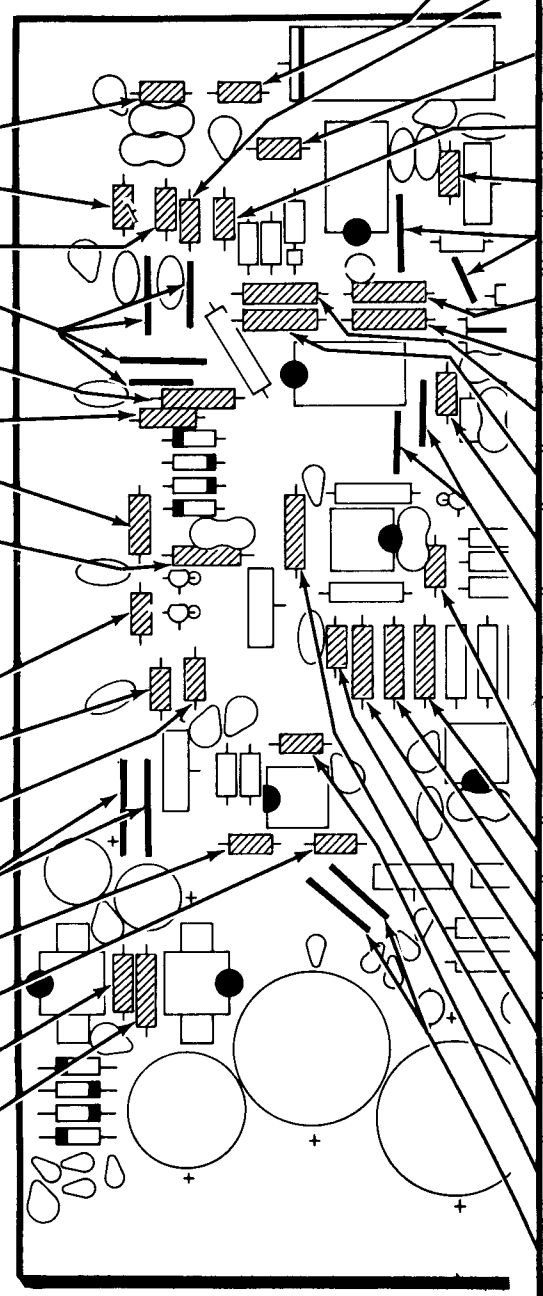
The steps performed in this Pictorial are in this area of the circuit board.



START

Position the generator circuit board as shown in the identification drawing. Then proceed with the following steps.

- Cut 10 1" lengths of bare wire and two 1-1/4" lengths. These wires will be used as jumpers on this Pictorial.
- R164: 620 Ω (blue-red-brown).
- R159: 200 Ω (red-black-brown).
- R165: 680 Ω (blue-gray-brown).
- Four 1" bare jumper wires.
- R168: 3010 Ω (3.01 k) precision.
- R189: 3900 Ω (3.9 k) precision.
- R187: 3900 Ω (3.9 k) precision.
- R191: 1370 Ω (1.37 k) precision.
- Solder the leads to the foil and cut off the excess lead lengths.
- R188: 22 Ω (red-red-black).
- R192: 22 Ω (red-red-black).
- R193: 51 Ω (green-brown-black).
- Two 1-1/4" bare jumper wires.
- R195: 26.1 kΩ precision.
- R198: 3900 Ω (3.9 k) precision.
- R109: 5760 Ω (5.76 k) precision.
- R111: 2210 Ω (2.21 k) precision.
- Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

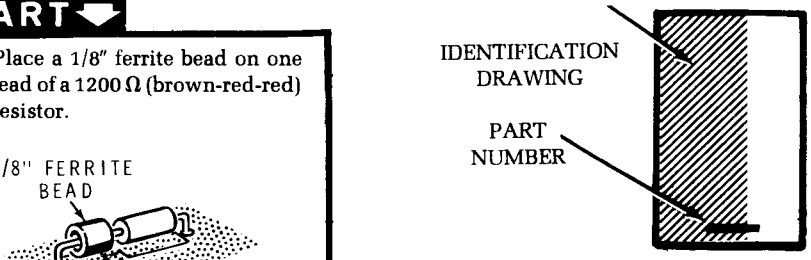
- R163: 100 Ω, 1/4-watt (brown-black-brown). NOTE: The circuit board may be marked 51.
- R156: 4700 Ω (yellow-violet-red).
- R161: 51 Ω (green-brown-black).
- R162: 1200 Ω (brown-red-red).
- R154: 10 Ω (brown-black-black).
- Two 1" bare jumper wires.
- R171: 4000 Ω (4 k) precision.
- R166: 3300 Ω (3.3 k) precision.
- R172: 2000 Ω (2 k) precision.
- R167: 211.7 Ω precision.
- R173: 470 Ω (yellow-violet-brown).
- Two 1" bare jumper wires.
- Solder the leads to the foil and cut off the excess lead lengths.
- R137: 100 Ω, 1/4-watt (brown-black-brown).
- R127: 2210 Ω (2.21 k) precision.
- R131: 1350 Ω (1.35 k) precision.
- R135: 1350 Ω (1.35 k) precision.
- R138: 100 Ω, 1/4-watt (brown-black-brown).
- R142: 1 MΩ precision.
- R199: 51 Ω (green-brown-black).
- Two 1" bare jumper wires.
- Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 2-2

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

IDENTIFICATION DRAWING

PART NUMBER



START

( ) Place a 1/8" ferrite bead on one lead of a 1200 Ω (brown-red-red) resistor.

1/8" FERRITE BEAD

( ) R158/FB104: 1200 Ω resistor and ferrite bead.

( ) R157: 3300 Ω (orange-orange-red).

( ) R155: 3300 Ω (orange-orange-red).

( ) R169: 211.7 Ω precision.

NOTE: Refer to Figure A as you install the following diodes.

( ) D123: 1N4149 diode (#56-56).

( ) D122: 1N4149 diode (#56-56).

( ) D124: 1N4149 diode (#56-56).

( ) D125: 1N4149 diode (#56-56).

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

( ) R129: 2200 Ω (red-red-red).

( ) R196: 10.1 k precision.

( ) R197: 10.1 k precision.

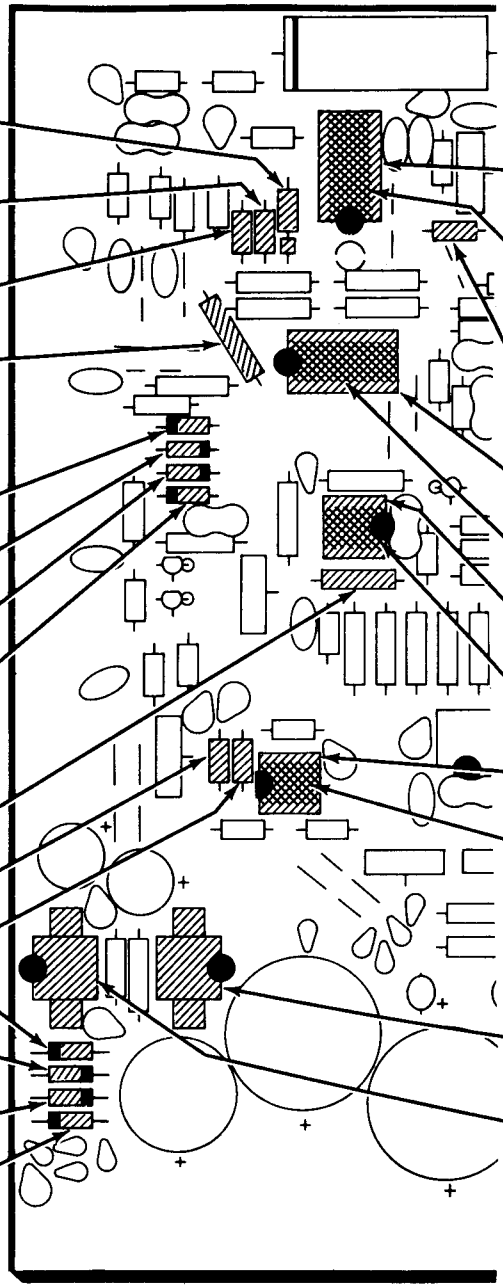
( ) D105: 1N2071 diode (#57-27).

( ) D106: 1N2071 diode (#57-27).

( ) D107: 1N2071 diode (#57-27).

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

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



CONTINUE

( ) 14-pin socket at Q105. See Figure G.

( ) Q105: 14-pin transistor array CA3046 (#417-876). See Figure H.

( ) R152: 390 Ω (orange-white-brown). Solder the leads to the foil and cut off the excess lead lengths.

( ) 14-pin socket at IC108.

( ) IC108: 75107 integrated circuit (#442-73). See Figure H.

( ) 8-pin socket at IC106.

( ) IC106: 301 integrated circuit (#442-39).

( ) 8-pin socket at IC109.

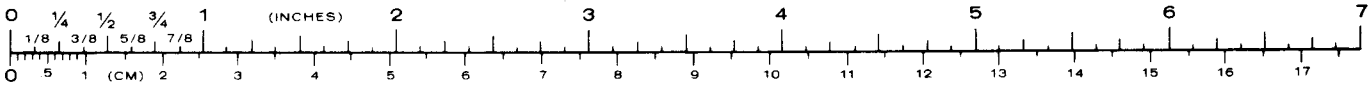
( ) IC109: 741 integrated circuit (#442-22).

NOTE: Refer to Figure J as you perform the next two steps.

( ) IC103: 79MGT2C integrated circuit (#442-618).

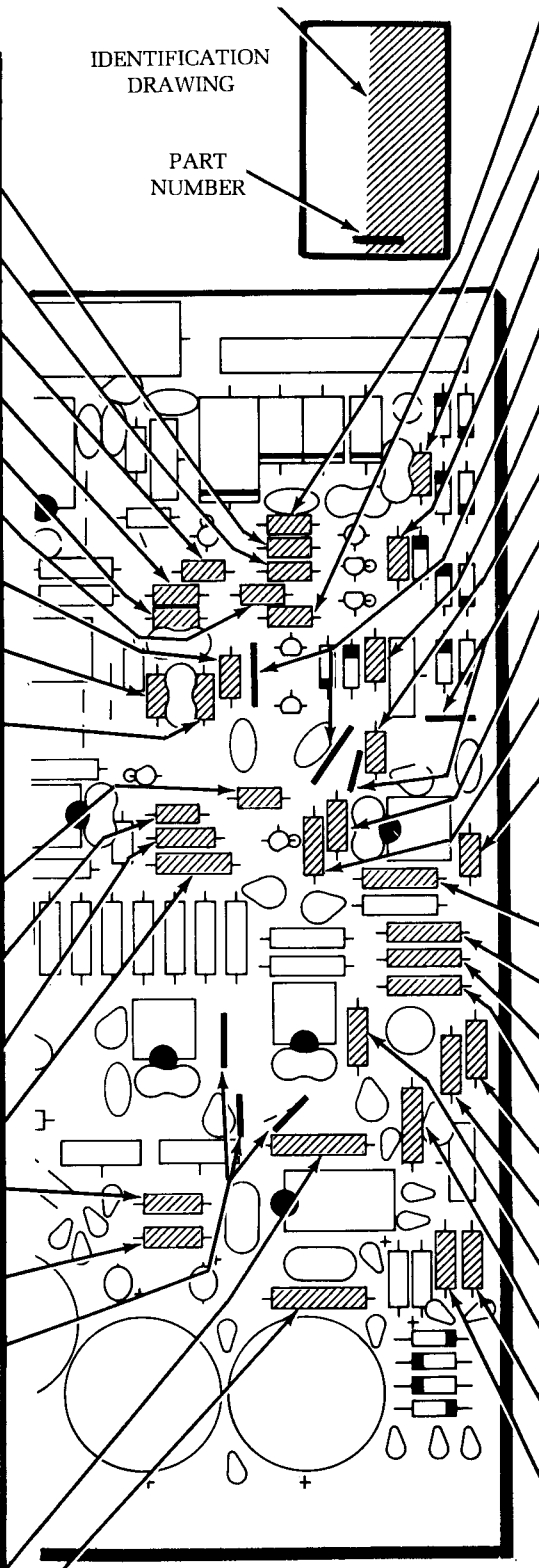
( ) IC102: 78MGT2C integrated circuit (#442-617).

PICTORIAL 2-3



HEATHKIT®

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



START

- ( ) Prepare seven 1" bare jumper wires for use in this Pictorial.
- ( ) R149: 100 Ω, 1/4-watt (brown-black-brown).
- ( ) R182: 200 Ω (red-black-brown).
- ( ) R179: 300 Ω (orange-black-brown).
- ( ) R178: 1800 Ω (brown-gray-red).
- ( ) R177: 2200 Ω (red-red-red).
- ( ) R183: 200 Ω (red-black-brown).
- ( ) R175: 1800 Ω (brown-gray-red).
- ( ) R176: 470 Ω (yellow-violet-brown).
- ( ) R174: 2200 Ω (red-red-red).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) R141: 100 Ω, 1/4-watt (brown-black-brown).
- ( ) R145: 100 Ω, 1/4-watt (brown-black-brown).
- ( ) R144: 18 MΩ, 1/2-watt (brown-gray-blue).
- ( ) R132: 2210 Ω (2.21 k) precision.
- ( ) R106: 62 kΩ, 1/2-watt (blue-red-orange).
- ( ) R105: 240 kΩ, 1/2-watt (red-yellow-yellow).
- ( ) Three 1" bare jumper wires.

NOTE: Position the next two 2-watt resistors approximately 1/4" above the circuit board when you install them.

- ( ) R104: 1Ω, wire-wound, 2-watt (brown-black-gold-silver).
- ( ) R103: 1Ω, wire-wound, 2-watt (brown-black-gold-silver).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

CONTINUE

- ( ) R151: 68 Ω (blue-gray-black).
- ( ) R181: 1000 Ω (brown-black-red).
- ( ) R148: 100 Ω, 1/4-watt (brown-black-brown).
- ( ) R184: 51 Ω (green-brown-black).
- ( ) Two 1" bare jumper wires.
- ( ) R185: 300 Ω (orange-black-brown).
- ( ) R186: 68 Ω (blue-gray-black).
- ( ) Two 1" bare jumper wires.
- ( ) R146: 100 Ω, 1/4-watt (brown-black-brown).
- ( ) R147: 18 MΩ, 1/2-watt (brown-gray-blue).
- ( ) R139: 100 Ω, 1/4-watt (brown-black-brown).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) R134: 2200 Ω (red-red-red).
- ( ) R116: 5000 Ω (5 k) precision.
- ( ) R113: 18.75 kΩ precision.
- ( ) R118: 26.1 kΩ precision.
- ( ) R120: 2000 Ω (2 k) precision.
- ( ) R117: 1000 Ω (1 k) precision.
- ( ) R114: 8000 Ω (8 k) precision.
- ( ) R121: 1 MΩ precision.
- ( ) R101: 100 Ω, 1/2-watt (brown-black-brown).
- ( ) R102: 100 Ω, 1/2-watt (brown-black-brown).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 2-4

START

( ) R153: 500 Ω control. See Figure C.

( ) Refer to Figure T and install socket pins at holes G, D, and S of transistor Q104.

( ) Q104/FB103: NCHE-304 transistor (#417-828) and 1/8" ferrite bead. See Figure E-7. Press each lead into its respective socket pin. DO NOT solder the leads to the pins.

( ) Install socket pins at holes G, D, and S of transistor Q103.

( ) Q103: NCHE-304 transistor (#417-828) with **NO** ferrite bead. Press each lead into its respective socket pin. DO NOT solder the leads to the pins.

NOTE: Refer to Figure E-8 for the following four steps.

( ) Q108/FB105: 2N3904 transistor (#417-875) and 1/8" ferrite bead.

( ) Q109/FB106: 2N3906 transistor (#417-874) and 1/8" ferrite bead.

( ) Q107: 2N3904 transistor (#417-875) with **NO** ferrite bead.

( ) Q106: 2N3904 transistor (#417-875) with **NO** ferrite bead.

NOTE: Refer to Figure E-9 for the next two steps.

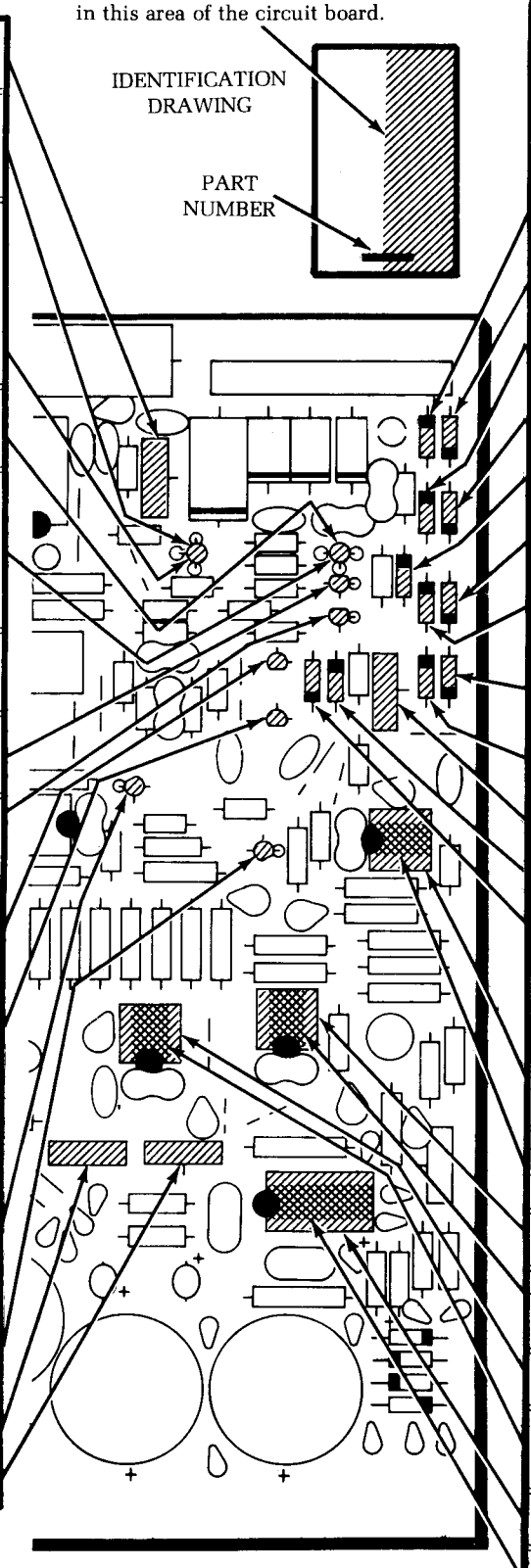
( ) Q101/FB102: SM62186 transistor (#417-284) and 1/8" ferrite bead.

( ) Q102/FB101: SM07275 transistor (#417-283) and 1/8" ferrite bead.

( ) R108: 50 kΩ control

( ) R107: 100 kΩ control.

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



PICTORIAL 2-5

CONTINUE

NOTE: Refer to Figure A as you install diodes in the following steps.

CAUTION: You will install two different types of diodes in the next nine steps. Do not interchange the diodes; they are physically similar.

( ) D115: HP5082-2811 diode (#56-636).

( ) D116: 1N4149 diode (#56-56).

( ) D114: 1N4149 diode (#56-56).

( ) D117: HP5082-2811 diode (#56-636).

( ) D118: 1N4149 diode (#56-56).

( ) D112: 1N4149 diode (#56-56).

( ) D111: HP5082-2811 diode (#56-636).

( ) D113: HP5082-2811 diode (#56-636).

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

( ) R115: 2500 Ω control.

( ) D119: 1N4149 diode (#56-56).

( ) D121: 1N4149 diode (#56-56).

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

( ) 8-pin socket at IC107. See Figure G.

( ) IC107: 301 integrated circuit (# 442-39). See Figure H.

( ) 8-pin socket at IC104.

( ) IC104: 301 integrated circuit (#442-39).

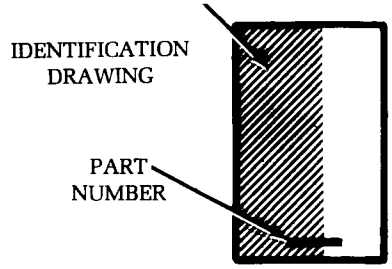
( ) 8-pin socket at IC105.

( ) IC105: 301 integrated circuit (#442-39).

( ) 14-pin socket at IC101.

( ) IC101: 4501 integrated circuit (#442-65).

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



START

( ) C137: 82 pF mica.

( ) C136: 12 pF mica.

( ) C114: 0.01 μF ceramic. See Figure B.

( ) C115: 0.01 μF ceramic.

( ) C116: 0.01 μF ceramic.

( ) C142: 12 pF mica.

( ) C117: 0.01 μF ceramic.

( ) C118: 0.01 μF ceramic.

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

NOTE: Refer to Figure E-8 to mount transistors and ferrite beads in the next two steps.

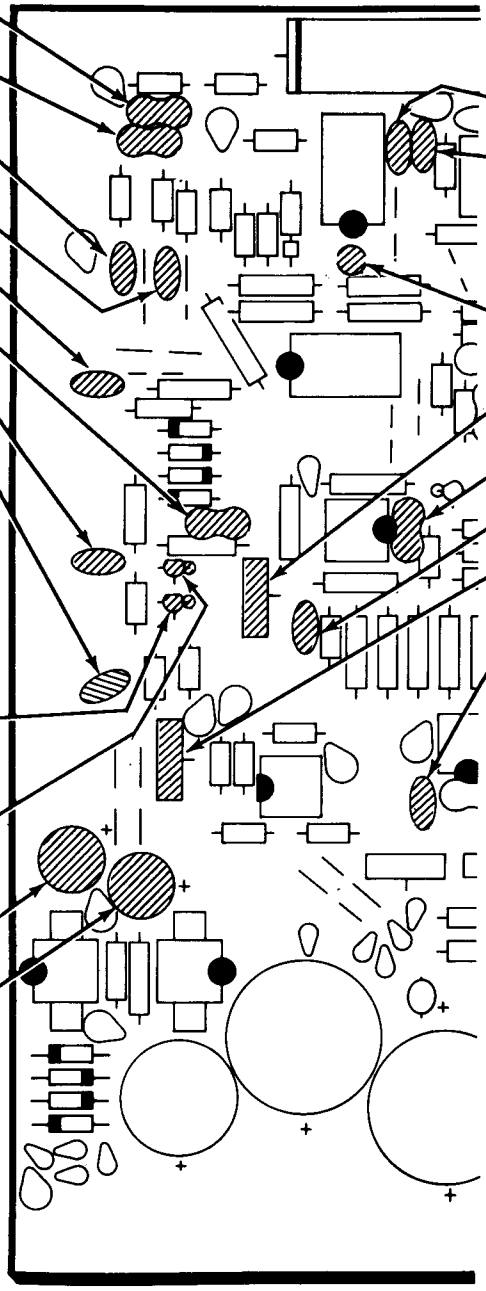
( ) Q112/FB108: 2N3906 transistor (#417-874) with 1/4" ferrite bead.

( ) Q111/FB107: 2N3904 transistor (#417-875) with 1/4" ferrite bead.

( ) C112: 100 μF electrolytic. See Figure K.

( ) C113: 100 μF electrolytic.

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



CONTINUE

( ) C134: 3.3 pF ceramic.

( ) C119: 0.01 μF ceramic.

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

( ) C138: 3.2-18 pF (blue dot) trimmer (#31-71). See Figure F.

( ) R143: 50 kΩ control.

( ) C127: 30 pF mica.

( ) C128: 0.01 μF ceramic.

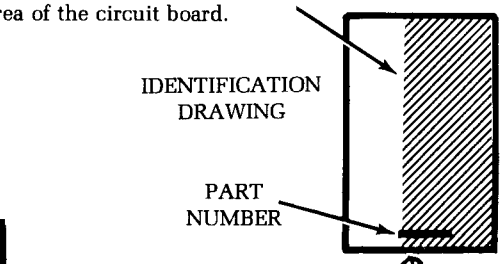
( ) R194: 5000 Ω (5 k) control.

( ) C121: 0.01 μF ceramic.

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

PICTORIAL 2-6

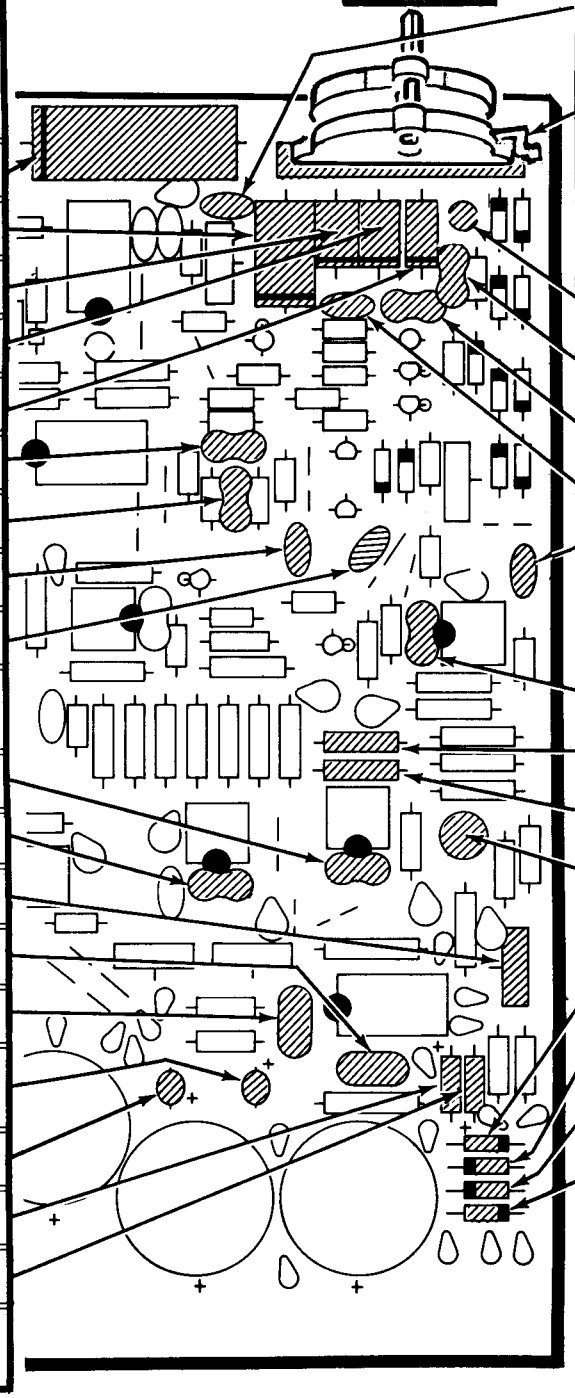
The steps performed in this Pictorial are in this area of the circuit board.



START

NOTE: Locate the matched set of Mylar capacitors (#27-173). Install these capacitors in the next five steps. Be sure to position the banded ends as shown.

- ( ) C143: 10 µF Mylar.
- ( ) C144: 1 µF Mylar.
- ( ) C145: 0.1 µF Mylar.
- ( ) C146: 0.01 µF Mylar.
- ( ) C147: 960 pF Mylar.
- ( ) C141: 100 pF mica.
- ( ) C139: 100 pF mica.
- ( ) C122: 0.01 µF ceramic.
- ( ) C123: 0.01 µF ceramic.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) C125: 30 pF mica.
- ( ) C126: 30 pF mica.
- ( ) R119: 50 kΩ control.
- ( ) C105: 0.1 µF Mylar.
- ( ) C106: 0.1 µF Mylar.
- ( ) C107: 10 µF tantalum. See Figure L.
- ( ) C108: 10 µF tantalum.
- ( ) C102: 1 µF tantalum.
- ( ) C103: 1 µF tantalum.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.



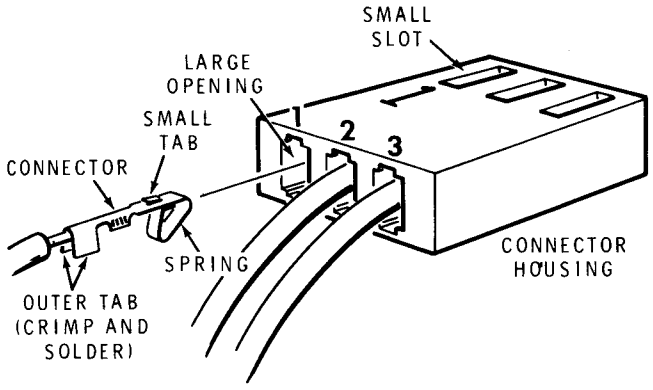
CONTINUE

- ( ) C135: 0.01 µF ceramic.
- ( ) SW101: Position the rotary switch as shown. Push its lugs firmly into the circuit board. Then solder all seven switch lugs to the foil. Make sure the switch body remains vertical to the board.
- ( ) C149: 3.2-18 pF (blue dot) trimmer (#32-71). See Figure F.
- ( ) C148: 42 pF mica.
- ( ) C132: 15 pF mica.
- ( ) C133: 0.01 µF ceramic.
- ( ) C129: 0.01 µF ceramic.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) C131: 30 pF mica.
- ( ) R122: 10 kΩ precision resistor.
- ( ) R123: 3010 Ω (3.01 k) precision.
- ( ) R112: 5000 Ω (5 k) control. See Figure P.

Refer to Figure A as you mount the following four diodes.

- ( ) D104: 1N2071 diode (#57-27).
- ( ) D103: 1N2071 diode (#57-27).
- ( ) D102: 1N2071 diode (#57-27).
- ( ) D101: 1N2071 diode (#57-27).
- ( ) Solder the lead to the foil and cut off the excess lead lengths.

PICTORIAL 2-7



Detail 2-8A

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

NOTE: When you prepare the following hookup wires, remove 1/4" of insulation from one end and 1/8" of insulation from the other end of each wire.

( ) Prepare the following wires:

4-3/4" red	3" yellow
4" blue	4"green
4-1/4" white	3-1/2" brown

( ) Refer to Detail 2-8A and install a connector (#432-866) on the 1/8" end of the 4-3/4" red wire as follows:

a. Carefully crimp the outer tabs of the connector over the short bare wire end.

b. Melt a small amount of solder to the wire end and the crimped end of the connector. NOTE: Be careful to avoid getting solder onto the other parts of the connector.

( ) In the same manner, crimp and solder a connector on the 1/8" prepared end of the other wires:

4" blue	4" green
4-1/4" white	3-1/2" brown
3" yellow	

NOTE: One connector is supplied as a spare.

Again refer to Detail 2-8A for the following steps.

( ) Position a connector housing on your work area with the small slots up and the larger openings toward you as shown in the Detail. Note that the openings in the connector are numbered in the illustration from left to right, 1, 2, and 3.

( ) Position the connector, on the end of the blue wire, so the spring side is down. Note the small tab on the upper, flat part of the connector. This small tab is designed to fit into the small slot on the top of the connector housing. As you push the wire connector into the connector housing, be sure to keep this small tab up.

( ) Push the connector on the end of the blue wire into slot 1 in the connector housing. Then gently pull on the wire to make sure the connector tab has engaged the housing slot.

( ) In the same manner, push the connector on the white wire into slot 2 in the housing, and the red wire connector into slot 3.

Set the connector assembly aside temporarily.

( ) In the same manner, install the remaining three prepared wires with connectors into the other connector housing as follows:

Yellow wire connector into slot 1.

Green wire connector into slot 2.

Brown wire connector into slot 3.

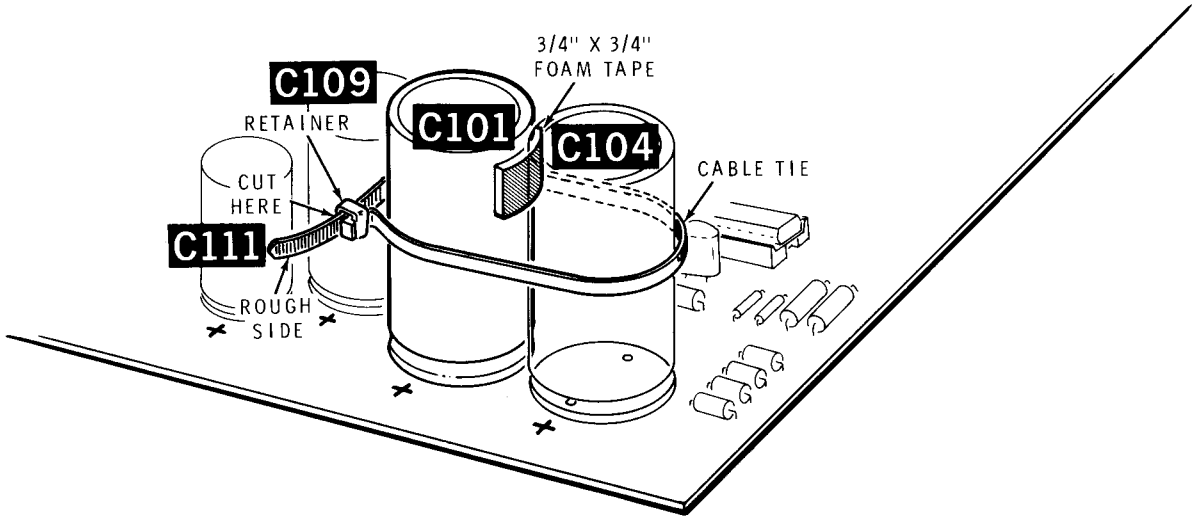
Again refer to Pictorial 2-8 for the following steps.

( ) On the connector housing with yellow, green, and brown wires, install the free wire ends into the indicated generator circuit board holes. Solder each wire to the circuit board foil as it is installed.

Yellow wire to hole I.

Brown wire to hole J.

Green wire to hole K.



Detail 2-8B

( ) In the same manner, connect the other connector assembly wires to the generator circuit board holes. Solder each wire as it is installed.

Blue wire to hole F.

Red wire to hole G.

White wire to hole H.

( ) Cut off any excess wire lengths on the foil side of the circuit board.

Refer to Figure K (on Page 4 in the Illustration Booklet) to mount electrolytic capacitors in the following three steps. Detail 2-8A shows the location of the four electrolytic capacitors you will install in the following steps.

( ) C111: Mount a 500 μF electrolytic capacitor (#25-819) at C111 on the generator circuit board. Solder its leads to the foil and cut off the excess lead lengths.

( ) C109: In the same manner, mount and solder a 3000 μF electrolytic capacitor (#25-812) at C109.

( ) C101: In the same manner, mount and solder a 2000 μF electrolytic capacitor (#25-828) at C101.

( ) Refer to Detail 2-8B and cut a 3/4" length of foam tape. Remove the paper backing from one side of the tape. Press the tape in place on the top side of capacitor C101 as shown in the Detail. Then remove the paper backing from the other side of the tape. Save the remaining foam tape for use later. NOTE: Be sure the tape is facing the outline of capacitor C104 on the circuit board.

( ) C104: Mount the remaining 2000 μF electrolytic capacitor on the circuit board at C104. Be sure the capacitor is pressed down onto the top of the board. Solder the leads to the foil and cut off the excess lead lengths.

( ) Refer to Detail 2-8B and start the tip of the cable tie through the retainer on the other end as shown. Pass the loop of the cable tie over 2000 μF capacitors C101 and C104 as shown in the Detail. Position the tie around the middle of the capacitors. Pull the cable tie tight; then cut off the excess tie length. Note that the rough side of the cable tie is positioned next to the capacitors.

CIRCUIT BOARD CHECKOUT

Carefully inspect the generator circuit board for the following conditions.

( ) Unsoldered connections. Disregard any unused holes.

( ) Poor solder connections.

( ) Solder bridges between foil patterns. See Page 10.

( ) Protruding leads which could touch together.

( ) Transistors for the proper type and installation.

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

( ) Mylar capacitors for the correct position of the banded end.

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

( ) Integrated circuits for the correct position of pin 1.

Set the circuit board aside temporarily. Save the six alligator clips for later use.

SWEEP CIRCUIT BOARD

PARTS LIST

Unpack the parts package labeled #3. Check each part against the following list and the Parts Pictorial (on Page 3 in the Illustration Booklet). Any part that is packed in an individual envelope with the part number on it should be placed back into the envelope after you identify it until it is called for in a step. Do not throw away any packing material until all parts are accounted for.

RESISTORS

NOTES:

1. Resistors are 5% tolerance (fourth color band of gold) unless otherwise noted. A fourth color band of silver indicates 10% tolerance. Precision resistors are not color coded.

2. The resistors may be packed in more than one envelope. Open all the resistor envelopes in this pack before you check them against the Parts List.

1/4-Watt Resistors

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	1-55-12	3	10 Ω (brown-black-black)	R304, R363, R365
A1	1-125-12	1	22 Ω (red-red-black)	R305
A1	1-113-12	1	62 Ω (blue-red-black)	R357

Resistors (cont'd.)

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	1-102-12	1	68 Ω (blue-gray-black)	R321
A1	1-60-12	3	100 Ω (brown-black-brown)	R315, R319, R367
A1	1-63-12	3	270 Ω (red-violet-brown)	R318, R320, R358
A1	1-92-12	2	330 Ω (orange-orange-brown)	R354, R356
A1	1-66-12	1	560 Ω (green-blue-brown)	R364
A1	1-69-12	4	1000 Ω (brown-black-red)	R336, R355, R362, R369
A1	1-99-12	1	1800 Ω (brown-gray-red)	R317
A1	1-72-12	2	2200 Ω (red-red-red)	R308, R366
A1	1-75-12	2	3900 Ω (orange-white-red)	R316, R368
A1	1-76-12	1	4700 Ω (yellow-violet-red)	R334
A1	1-80-12	1	10 kΩ (brown-black-orange)	R332
A1	1-82-12	2	33 kΩ (orange-orange-orange)	R327, R329
A1	1-12-12	1	82 kΩ, 10% (gray-red-orange)	R335

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

Resistors (cont'd.)

1/8-Watt Precision Resistors

NOTE: All precision resistors are 1% tolerance unless otherwise noted.

A2	2-36-11	1	720 Ω	R346
A2	2-15-11	2	1000 Ω (1k)	R302, R326
A2	2-38-11	1	1800 Ω (1.8k)	R359
A2	2-12-11	3	2000 Ω (2k)	R323, R341, R353
A2	2-67-11	1	3630 Ω (3.63k)	R339
A2	2-50-11	1	5370 Ω (5.37k)	R337
A2	2-17-11	1	5760 Ω (5.76k)	R312
A2	2-18-11	3	10 kΩ	R306, R307, R351
A2	2-20-11	3	14.3 kΩ	R325, R342, R344
A2	2-25-11	1	18 kΩ, 0.1%	R338
A2	2-10-11	1	49.9 kΩ	R345

1/4-Watt Resistors

A2	2-46-12	2	2500 Ω (2.5k)	R309, R311
A2	2-97-12	1	7150 Ω (7.15k)	R324
A2	2-34-12	1	15 kΩ	R348
A2	2-68-12	1	20 kΩ	R313
A2	2-94-12	1	200 kΩ	R314

Other Resistor

A3	1-105	1	10 kΩ, 1/2-watt, (brown-black-orange)	R331

CAPACITORS

Mica

B1	20-118	1	15 pF	C311
B1	20-147	1	75 pF	C312
B1	20-108	1	200 pF	C318
B1	20-122	1	0.001 μF (1000 pF)	C313
B2	20-55	1	500 pF (silver mica)	C307

Mylar

B3	27-74	1	0.01 μF	C314
B3	27-172	1	0.05 μF	C308
B3	27-77	1	0.1 μF	C315
B4	27-171	1	5 μF	C309

Other Capacitors

B5	21-176	6	0.01 μF ceramic	C301—C306
B6	25-197	1	1 μF tantalum	C316
B7	25-220	1	10 μF tantalum	C317

DIODES — TRANSISTORS — INTEGRATED CIRCUITS

C1	56-56	6	1N4149 diode	D301—D304, D306, D307
C1	56-87	1	FH1100 diode	D305
C2	417-874	1	2N3906 transistor	Q305
C2	417-875	4	2N3904 transistor	Q302, Q306, Q307, Q308
C3	417-284	1	SM62186 transistor	Q301
C3	417-828	2	NCHE-304 transistor	Q303, Q304
C4	442-73	1	75107 integrated circuit	IC303
C4	443-1	2	7400 integrated circuit	IC308, IC309
C4	443-6	1	7474 integrated circuit	IC305
C4	443-23	1	74122 integrated circuit	IC304
C5	442-22	3	741 integrated circuit	IC301, IC302, IC306
C6	442-619	1	8049 integrated circuit	IC307

CONTROLS — SWITCHES — FERRITE BEADS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
D1	10-918	2	500 Ω control	R322, R361
D1	10-318	2	2000 Ω (2k)	R343, R349
D1	10-1070	1	2500 Ω (2.5k) control	R301
D1	10-311	1	5000 Ω (5k) control	R352
D2	10-990	1	1000 Ω (1k) control	R347
D3	63-1271	1	Short rotary switch with 1000 Ω (1k) control	SW302/R303
D4	63-1308	1	Long rotary switch with 5000 Ω (5k) control and snap switch	SW301/ SW303/R328
D5	475-15	2	Ferrite bead	FB301, FB302

MISCELLANEOUS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
	134-962	1	Wire harness	
E1	432-120	1	Wire connector	
E2	432-121	2	Terminal pin	
E3	432-134	6	Socket pin	
E4	434-230	3	8-pin IC socket	
E5	434-298	5	14-pin IC socket	
E6	434-299	1	16-pin IC socket	

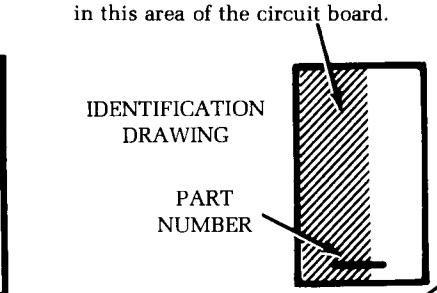
PART FROM FINAL PACK

	85-1993-1	1	Printed circuit board

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

STEP-BY-STEP ASSEMBLY

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



START

Position the sweep circuit board as shown in the identification drawing. Then proceed with the following steps.

( ) Cut 12 1" bare wires and three 1-1/2" bare wires for use as jumpers.

( ) R313: 20 kΩ precision.

( ) R314: 200 kΩ precision.

( ) R306: 10 kΩ precision.

( ) R307: 10 kΩ precision.

( ) 1" bare jumper wire.

( ) R315: 100 Ω (brown-black-brown).

( ) R316: 3900 Ω (orange-white-red).

( ) 1-1/2" bare jumper wire.

( ) R317: 1800 Ω (brown-gray-red).

( ) 1" bare jumper wire.

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

( ) 1-1/2" bare jumper wire.

( ) Three 1" bare jumper wires.

( ) R342: 14.3 kΩ precision.

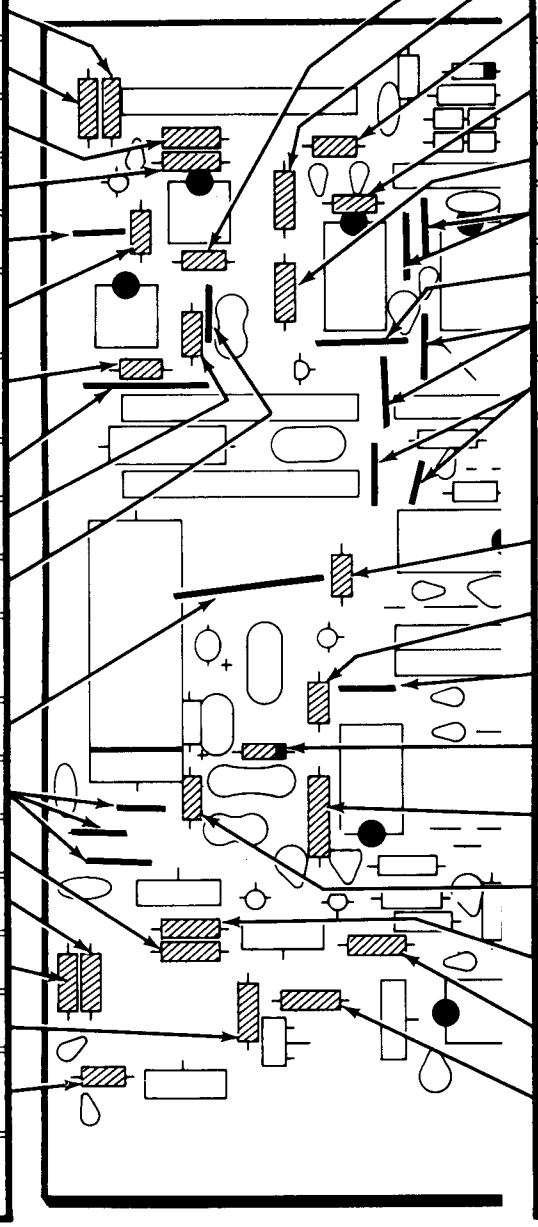
( ) R305: 22 Ω (red-red-black).

( ) R304: 10 Ω (brown-black-black).

( ) R345: 49.9 kΩ precision.

( ) R302: 1000 Ω (brown-black-red).

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



CONTINUE

( ) R308: 2200 Ω (red-red-red).

( ) R311: 2500 Ω (2.5 k) precision.

( ) R312: 5760 Ω (5.76 k) precision.

( ) R336: 1000 Ω (brown-black-red).

( ) R309: 2500 Ω (2.5 k) precision.

( ) Two 1" bare jumper wires.

( ) 1-1/2" bare jumper wire.

( ) Two 1" bare jumper wires.

( ) Two 1" bare jumper wires.

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

( ) R319: 100 Ω (brown-black-brown).

( ) R320: 270 Ω (red-violet-brown).

( ) 1" bare jumper wire.

( ) D301: 1N4149 diode (#56-56). See Figure A.

( ) R321: 68 Ω (blue-gray-black).

( ) R327: 33 kΩ (orange-orange-orange).

( ) R344: 14.3 kΩ precision.

( ) R367: 100 Ω (brown-black-brown).

( ) R346: 720 Ω precision.

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

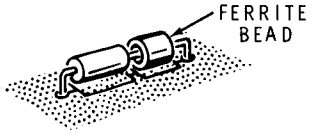
PICTORIAL 3-1

START

( ) R366: 2200 Ω (red-red-red).

( ) R364: 560 Ω (green-blue-brown).

( ) R365/FB302: Place a ferrite bead on one lead of a 10 Ω (brown-black-black) resistor. Mount the resistor and bead as shown.



( ) R363/FB301: In the same manner, prepare and install another 10 Ω (brown-black-black) resistor and ferrite bead.

( ) Cut five 1" and eight 1-1/2" bare wires.

( ) Two 1" bare jumper wires.

( ) R354: 330 Ω (orange-orange-brown).

( ) R318: 270 Ω (red-violet-brown).

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

( ) R331: 10 kΩ, 1/2-watt (brown-black-orange).

( ) R335: 82 kΩ (gray-red-orange).

( ) Two 1" bare jumper wires.

( ) Two 1-1/2" bare jumper wires.

( ) R326: 1000 Ω (1 k) precision.

( ) R325: 14.3 kΩ precision.

( ) Four 1-1/2" bare jumper wires.

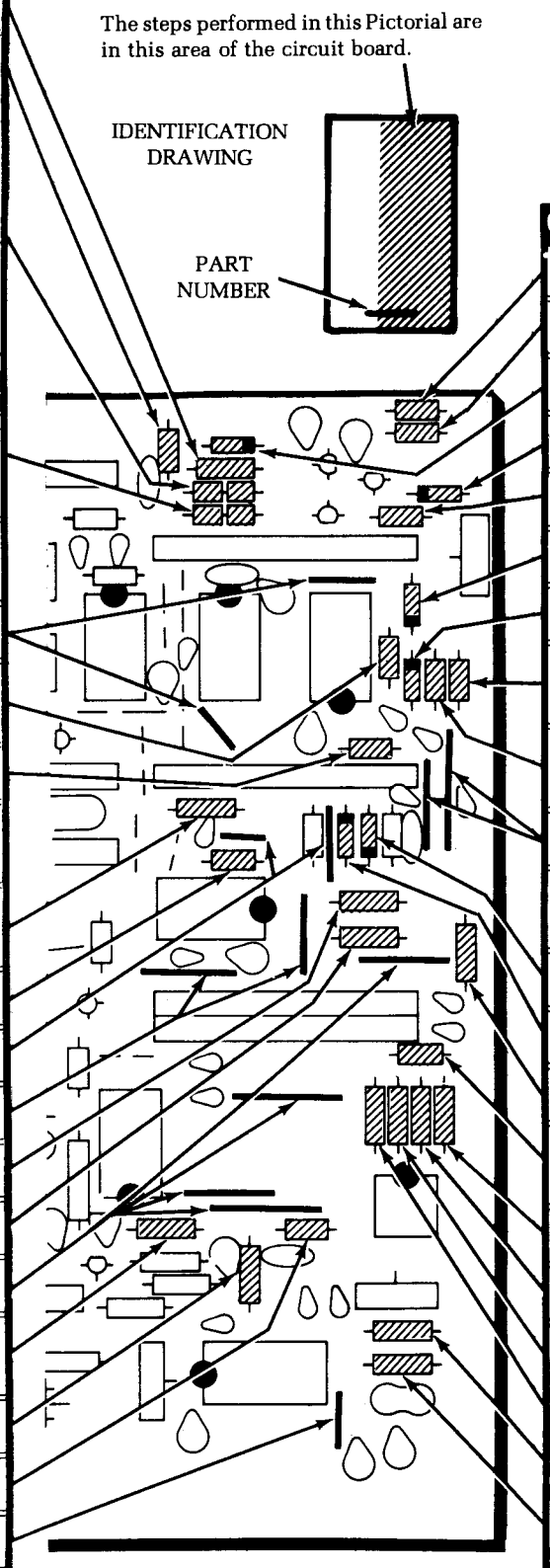
( ) R368: 3900 Ω (orange-white-red).

( ) R323: 2000 Ω (2 k) precision.

( ) R341: 2000 Ω (2 k) precision.

( ) One 1" bare jumper wire.

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



PICTORIAL 3-2

CONTINUE

( ) R362: 1000 Ω (1 k) precision.

( ) R358: 270 Ω (red-violet-brown).

( ) D307: 1N4149 diode (#56-56).

( ) D306: 1N4149 diode (#56-56).

( ) R357: 62 Ω (blue-red-black).

( ) D304: 1N4149 diode (#56-56).

( ) D305: FH1100 diode (#56-87).

( ) R356: 330 Ω (orange-orange-brown).

( ) R355: 1000 Ω (brown-black-red).

( ) Two 1-1/2" bare jumper wires.

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

( ) D303: 1N4149 diode (#56-56).

( ) D302: 1N4149 diode (#56-56).

( ) R359: 1800 Ω (1.8 k) precision.

( ) R332: 10 kΩ (brown-black-orange).

( ) R353: 2000 Ω precision.

( ) R339: 3630 Ω (3.63 k) precision.

( ) R338: 18 kΩ precision.

( ) R337: 5370 Ω (5.37 k) precision.

( ) R351: 10 kΩ precision.

( ) R348: 15 kΩ precision.

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

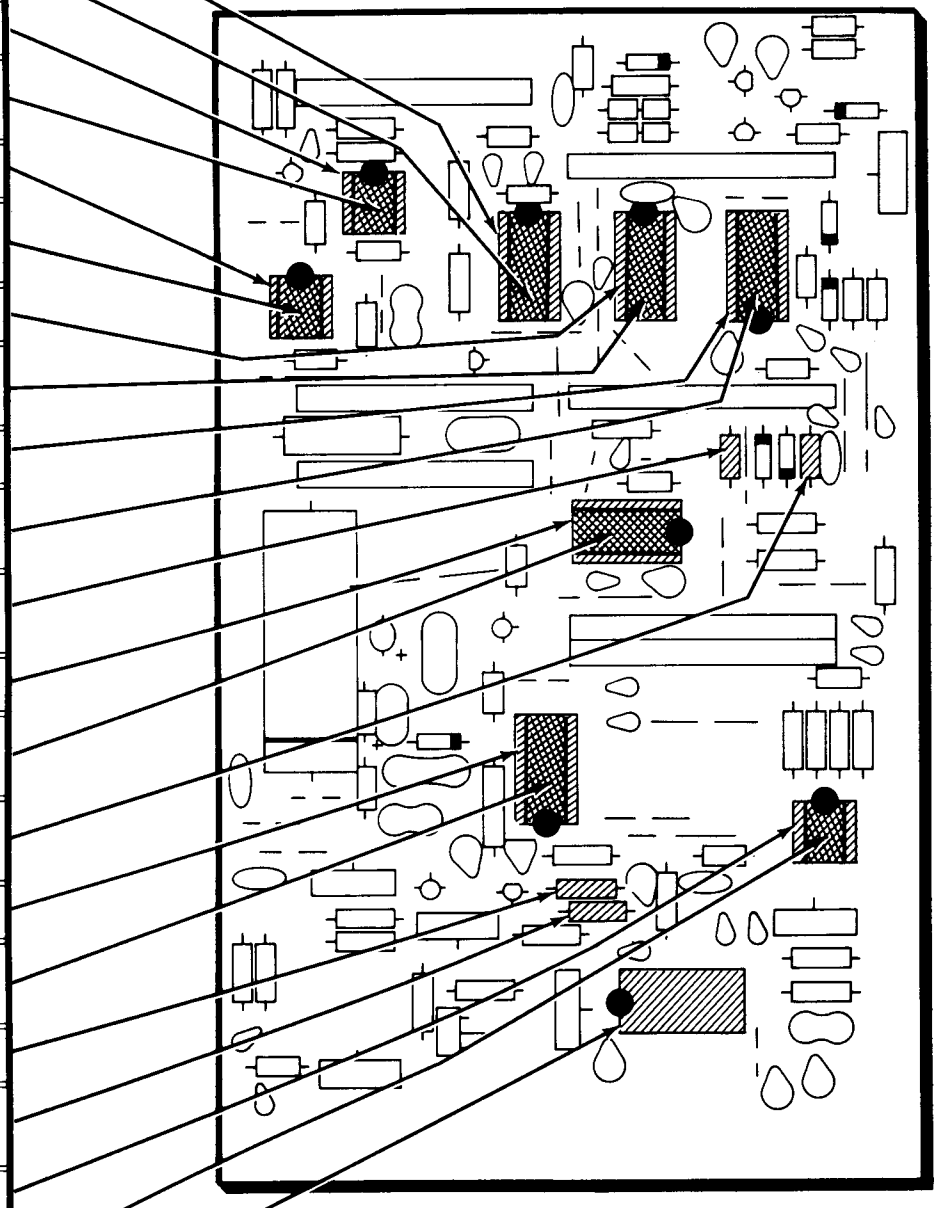
HEATHKIT®

START

- ( ) 14-pin socket at IC309.
- ( ) IC309: 7400 integrated circuit (#443-1).
- ( ) 8-pin socket at IC301.
- ( ) IC301: 741 integrated circuit (#442-22).
- ( ) 8-pin socket at IC302.
- ( ) IC302: 741 integrated circuit (#442-22).
- ( ) 14-pin socket at IC305.
- ( ) IC305: 7474 integrated circuit (#443-6).
- ( ) 14-pin socket at IC308.
- ( ) IC308: 7400 integrated circuit (#443-1).
- ( ) R334: 4700 Ω (yellow-violet-red).
- ( ) 14-pin socket at IC303.
- ( ) IC303: 75107 integrated circuit (#442-73).
- ( ) R329: 33 kΩ (orange-orange-orange).
- ( ) 14-pin socket at IC304.
- ( ) IC304: 74122 integrated circuit (#443-23).
- ( ) R324: 7150 Ω (7.15 k) precision.
- ( ) R369: 1000 Ω (brown-black-red).
- ( ) 8-pin socket at IC306.
- ( ) IC306: 741 integrated circuit (#442-22).
- ( ) 16-pin socket at IC307.

NOTE: The integrated circuit at IC307 will be installed in a later step.

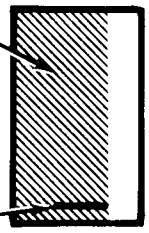
- ( ) Solder all resistor leads to the foil and cut off the excess lead lengths.



PICTORIAL 3-3

IDENTIFICATION DRAWING

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



PART NUMBER

START

( ) C301: 0.01 μF ceramic.

( ) Q301: SM62186 transistor (#417-284). See Figure E-9.

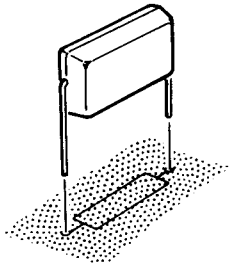
( ) C311: 15 pF mica.

( ) Q302: 2N3904 transistor (#417-875). See Figure E-8.

( ) C308: 0.05 μF Mylar.

( ) C307: 500 pF silver mica.

NOTE: Form the leads to mount this capacitor on edge as shown.



( ) C309: 5 μF Mylar. Install the capacitor on its narrow edge and position the banded end as shown.

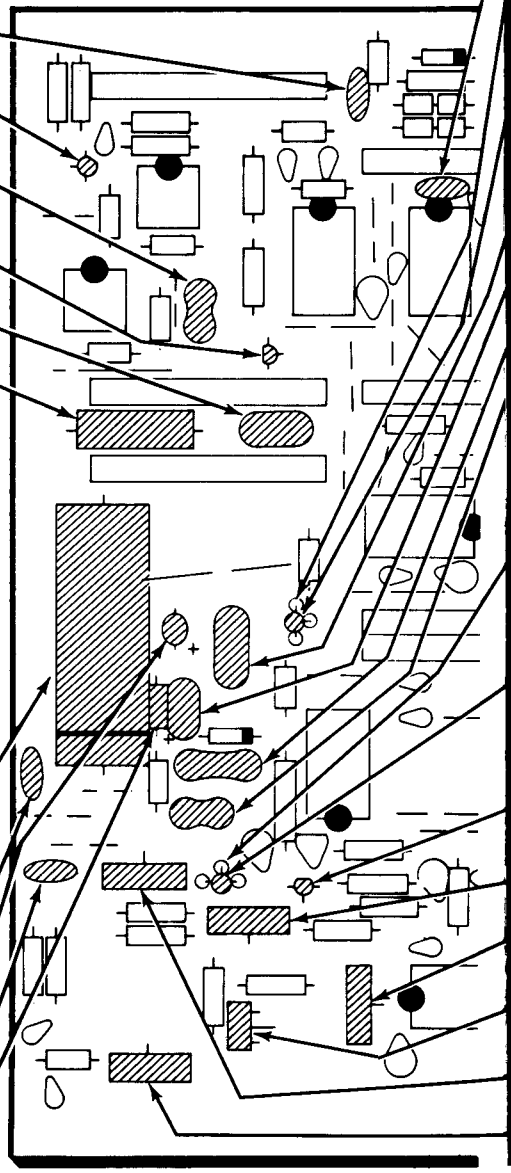
( ) C302: 0.01 μF ceramic.

( ) C317: 10 μF tantalum. See Figure L.

( ) C303: 0.01 μF ceramic.

( ) C316: 1 μF tantalum.

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



CONTINUE

( ) C305: 0.01 μF ceramic.

( ) Refer to Figure T and install socket pins at holes G, D, and S of transistor Q303.

( ) Q303: NCHE-304 transistor (#417-828). See Figure E-7. Press each lead into its respective socket pin. DO NOT solder the leads to the pins.

( ) C315: 0.1 μF Mylar.

( ) C314: 0.01 μF Mylar.

( ) C313: 1000 pF mica.

( ) C312: 75 pF mica.

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

( ) Install socket pins at holes G, D, and S of transistor Q304.

( ) Q304: NCHE-304 transistor (#417-828). See Figure E-7. Press each lead into its respective socket pin. DO NOT solder the leads to the pins.

( ) Q308: 2N3904 transistor (#417-875). See Figure E-8.

( ) R343: 2000 Ω (2 k) control.

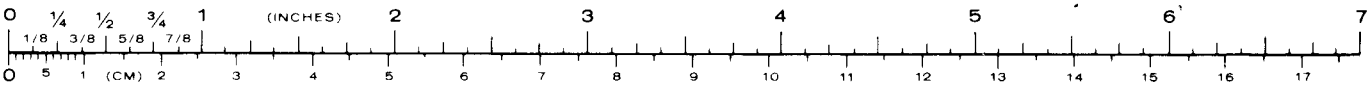
( ) R349: 2000 Ω (2 k) control.

( ) R347: 1000 Ω (1 k) control. See Figure R.

( ) R322: 500 Ω control.

( ) R301: 2500 Ω (2.5 k) control.

PICTORIAL 3-4



HEATHKIT®

START

NOTES:

1. As you install each wire or component in this Pictorial, solder the leads to the foil and cut off the excess lead lengths.

2. To prepare hookup wires, as in the following step, cut each wire to the length indicated, and then remove 1/4" of insulation from the wire ends.

( ) Prepare the following wires:

5" org	7-1/4" wht-grn
5" wht	6" blk solid
4-3/4" viol	5" wht-yel.

( ) 5" orange wire to B.

( ) 5" white wire to J.

( ) 4-3/4" violet wire to AB.

( ) 7-1/4" white-green wire to AC.

NOTE: Refer to Figure E-8 for the next three steps.

( ) Q307: 2N3904 transistor (#417-875).

( ) Q305: 2N3906 transistor (#417-874).

( ) Q306: 2N3904 transistor (# 417-875).

( ) 6" black wire at AF.

( ) 5" white-yellow wire at Z.

( ) R361: 500 Ω control.

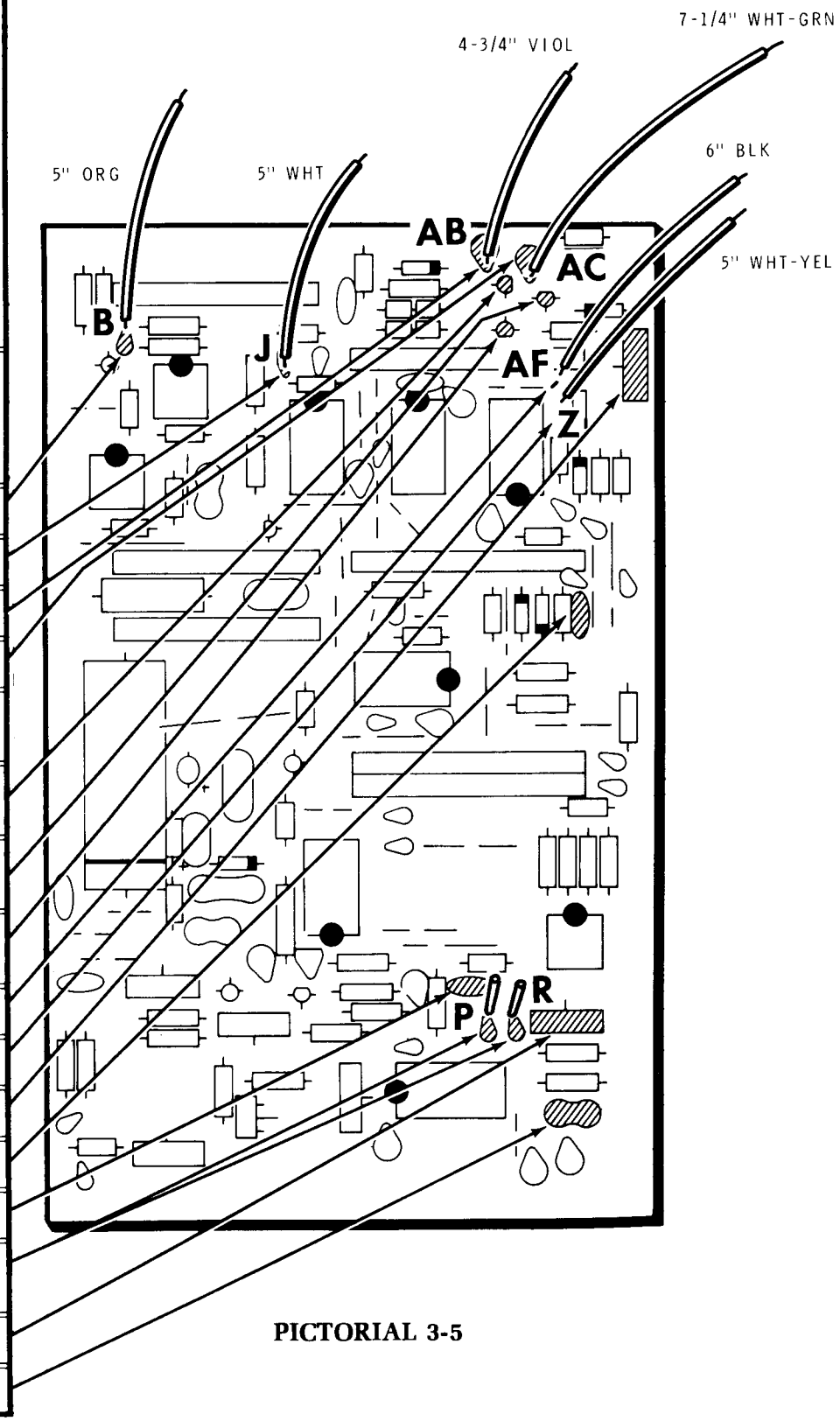
( ) C304: 0.01 μF ceramic.

( ) C306: 0.01 μF ceramic.

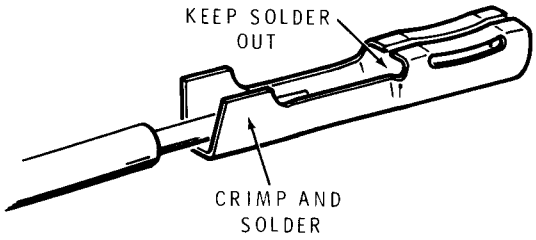
( ) Two terminal pins at P and R. See Figure S.

( ) R352: 5000 Ω (5 k) control.

( ) C318: 200 pF mica.



PICTORIAL 3-5



Detail 3-6A

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

( ) Position all the wires previously installed on the sweep circuit board straight up from the surface of the board. This is to prevent any of the wires from being caught under the switches to be mounted in the following steps.

( ) Locate the short rotary switch (#63-1271).

( ) SW302: Position this switch on the top of the sweep circuit board at SW302 as shown in the Pictorial. Firmly push each of the switch wafers down onto the surface of the board so the wafer lugs are all the way through the board. Then solder the lugs to the foil.

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

( ) Connect the free end of the orange wire coming from circuit board hole B to control R303 lug 2 (S-1).

( ) Prepare the following wires:

4-1/2" gray
5-1/4" yellow
2-1/2" yellow
2-3/4" blue
2" violet
2-1/2" white

( ) Connect one end of the 4-1/2" gray wire to control R303 lug 1 (S-1). Connect the other end of the wire to circuit board hole C (S-1).

( ) Similarly, connect the 5-1/4" yellow wire from R303 lug 3 (S-1) to circuit board hole A (S-1).

( ) Connect one end of the 2-1/2" yellow wire to circuit board hole D (S-1). The free end will be connected later.

( ) Connect one end of the 2-3/4" blue wire to circuit board hole F (S-1). The free end will be connected later.

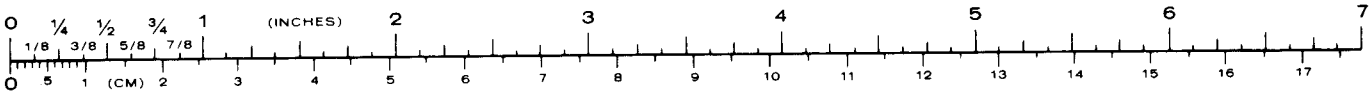
( ) Connect one end of the 2" violet wire to circuit board hole AR (S-1). Connect the other end of this wire to circuit board hole AS (S-1). Position the wire up away from the circuit board.

( ) Refer to Detail 3-6A and crimp a wire connector (#432-120) onto one end of the 2-1/2" white wire. Then solder the connection. Be careful you do not permit any solder to run into the open end of the connector.

( ) Connect the other end of this prepared wire to circuit board hole S (S-1).

( ) Push the connector on the end of the white wire onto terminal pin R as shown in the Pictorial.

( ) On the foil side of the circuit board be sure you have cut all the excess wire lengths from the wire connections made in the previous steps.



NOTE: In the following step, you will identify the wires in the small wire harness. Each group of wires comes from a "breakout" in the harness. These breakouts are designated numerically as BO#1, BO#2, etc. Be sure the wire harness is correctly positioned as shown in the Pictorial before you connect any of its wires.

( ) Refer to Detail 3-6B and form the small wire harness (#134-962) as shown.

NOTE: As you connect the harness wires in the following steps, solder each wire to the circuit board foil and cut off the excess wire lengths.

( ) Position the wire harness over the top of the circuit board as shown in the Pictorial.

Connect two of the wires coming from harness BO#1 as follows:

( ) White wire to hole U.

( ) Red wire to hole AG.

Connect two of the wires coming from harness BO#2 in the following steps.

( ) White-black wire to hole G.

( ) Brown wire to hole N.

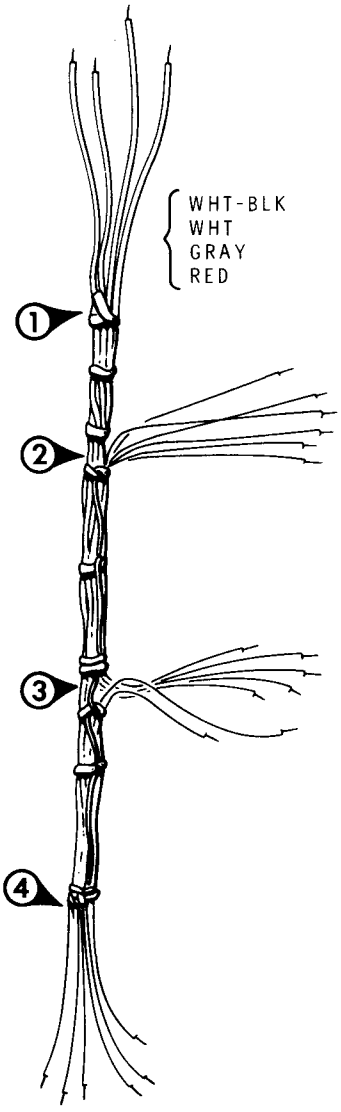
Connect three of the wires coming from harness BO#3 in the following steps.

( ) White wire to hole X.

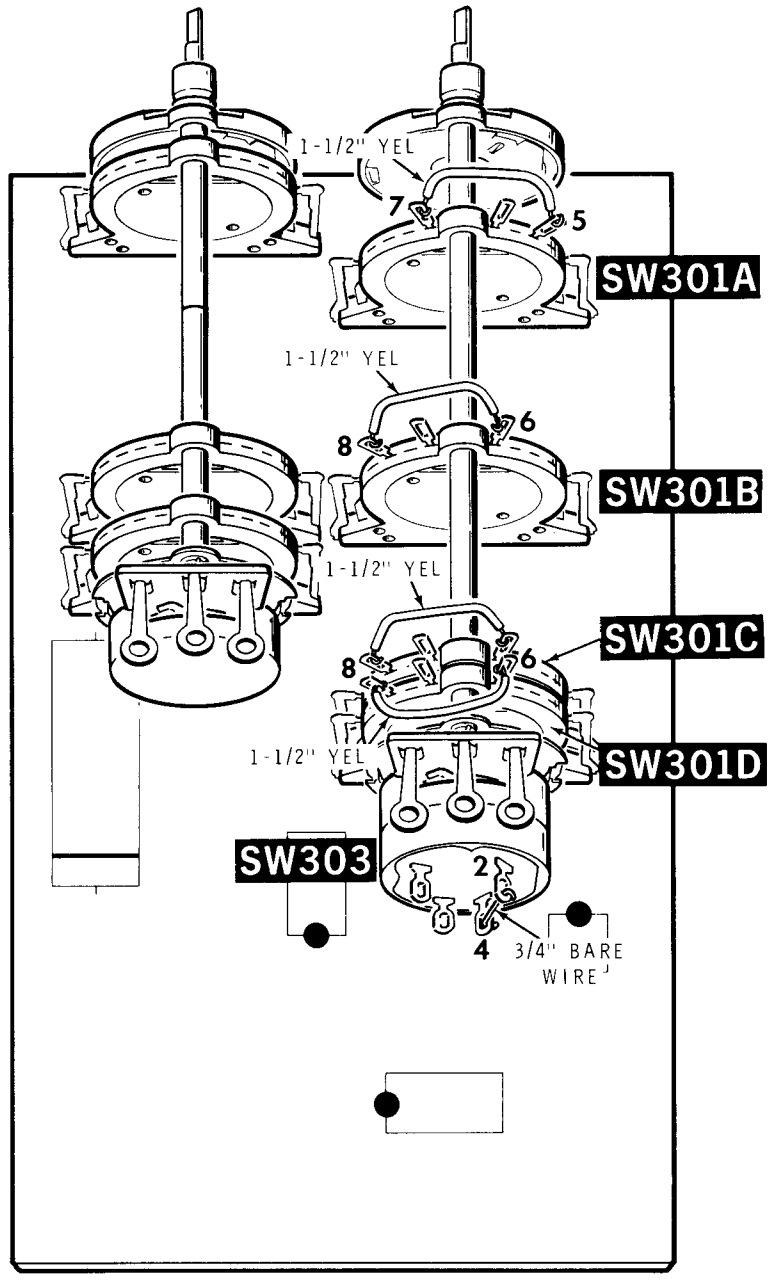
( ) Longer red wire to hole AH.

( ) Yellow wire to hole AE.

NOTE: The remaining harness wires will be connected later.



Detail 3-6B



PICTORIAL 3-7

Refer to Pictorial 3-7 for the following steps.

( ) At the right front of the circuit board, position the violet, black, white-green, and white-yellow wires toward the right edge of the board.

( ) At the center of the circuit board, position all the remaining wires and the wire harness toward the left edge of the board.

( ) SW301/SW303/R328: Push the long rotary switch (#63-1308) firmly down onto the circut board so the lugs on all four switch wafers are all the way through the board. Solder the wafer lugs to the circuit board foil.

( ) Carefully examine the circuit board area around the switch. Make sure none of the bare jumper wires touch the metal parts of the switch.

NOTE: The long rotary switch, installed in the previous step, is the Function switch and will be referred to as SW301. This switch has four plastic wafers with external lugs. The wafers are designated from front to rear as wafer A, wafer B, wafer C, and wafer D. On the top of each switch wafer, looking at the switch from the shaft end, each lug position is numbered clockwise from 5 through 8, whether there is a lug at a numbered location or not. This applies only to the exposed lugs with loops in them. Specific switch wafers and lugs will be called out as follows: "SW301A lug 5, SW301C lug 8, etc."

( ) Prepare four 1-1/2" yellow wires and cut one 3/4" bare wire for use in the following steps.

( ) Connect a 1-1/2" yellow wire between SW301A lugs 5 (S-1) and 7 (S-1).

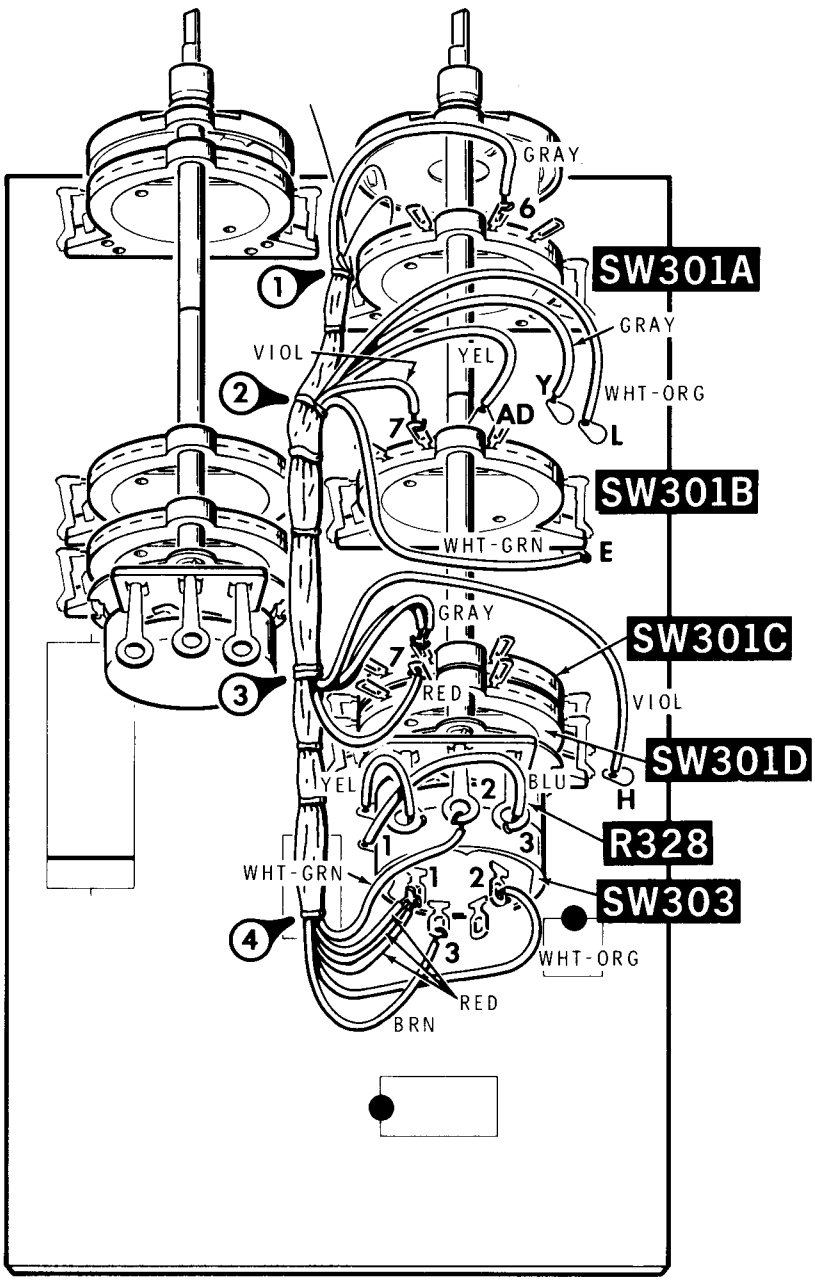
( ) Connect a 1-1/2" yellow wire between SW301B lugs 6 (S-1) and 8 (S-1).

( ) Connect a 1-1/2" yellow wire between SW301C lugs 6 (S-1) and 8 (S-1).

( ) Connect a 1-1/2" yellow wire between SW301D lugs 6 (S-1) and 8 (S-1).

NOTE: Recheck the connections made in the last two steps and be sure none of the wire ends or solder connections between the two switch wafers, SW301C and SW301D, are touching.

( ) Connect a 3/4" bare wire between SW303 (on the rear of the Function switch assembly) lugs 2 (NS) and 4 (S-1).



PICTORIAL 3-8

Refer to Pictorial 3-8 for the following steps.

( ) Connect the gray wire coming from wire harness BO#1 to switch SW301A lug 6 (S-1).

( ) Connect the violet wire coming from wire harness BO#2 to switch SW301B lug 7 (S-1).

( ) Connect the **two** gray wires coming from wire harness BO#3 to switch SW301C lug 7 (S-2).

( ) Connect the red wire coming from wire harness BO#3 to switch SW301D lug 7 (S-1).

( ) Connect the blue wire from circuit board hole F to control R328 lug 3 (S-1).

( ) Connect the yellow wire from circuit board hole D to control R328 lug 1 (S-1).

Connect the harness wires coming from BO#4 to the lugs of control R328 and switch SW303 (both on the rear of the Function switch assembly) in the following steps.

( ) White-green wire to control R328 lug 2 (S-1).

( ) Brown wire to switch SW303 lug 3 (S-1).

( ) Connect but **do not** solder all three red wires to switch SW303 lug 1.

( ) White-orange wire to SW303 lug 2 (S-2).

( ) Position the wire harness midway between the two rotary switch assemblies as shown in the Pictorial.

Connect the harness wires coming from BO#2 to the circuit board holes in the next four steps. Solder each wire as it is installed and cut off the excess wire lengths.

( ) Yellow wire to hole AD (S-1).

( ) Gray wire to hole Y (S-1).

( ) White-orange wire to hole L (S-1).

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

( ) Connect the violet wire coming from harness BO#3 to hole H (S-1) in the circuit board.

NOTE: This completes the assembly of the sweep circuit board. There are several wires coming from the board and the wire harness that will be connected later. Also, there are several unused holes in the circuit board which will have wires connected to them later. Set integrated circuit #442-619 (8049) aside. It will be installed during initial calibration.

CIRCUIT BOARD CHECKOUT

Carefully check the sweep circuit board for the following conditions.

( ) Unsoldered connections. (Three red wires on control R328 lug 1 are not soldered at this time.)

( ) Poor solder connections.

( ) Solder bridges between foil patterns. See Page 10.

( ) Protruding leads on switch wafer lugs that touch, or solder connections that are bridged.

( ) Protruding leads on the circuit board foil which could touch together.

( ) Transistors for the proper type and installation.

( ) Electrolytic capacitors for the correct position of the positive (+) end or side.

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

( ) Integrated circuits for correct position of pin 1. (IC307 is not installed in its socket at this time.)

Set the circuit board aside temporarily.

CHASSIS

PARTS LIST

Check all the remaining parts in the Final Pack against the following Parts List and the Parts Pictorial (on Page 6 in the Illustration Booklet).

RESISTORS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	1-81-12	1	27 kΩ, 1/4-watt, 5% (red-violet-orange)	R404
A2	2-56-12	1	1000 Ω (1k), 1/4-watt, 1% precision	R2
A2	2-267	1	16 kΩ, 1/2-watt, 1% precision	R403
A2	2-268	1	24 kΩ, 1/2-watt, 1% precision	R402
A2	2-269	1	48 kΩ, 1/2-watt, 1% precision	R401

CAPACITORS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
B1	21-71	1	0.001 μF (1000 pF), 1.4 kV ceramic	C1
B2	27-68	1	0.0033 μF (3300 pF) Mylar	C401
B2	27-42	1	0.0068 μF (6800 pF) Mylar	C402
B2	27-106	1	0.01 μF Mylar	C403

CONTROL — SWITCHES

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C1	12-165	1	Dual 5000 Ω (5k) control	R5/R6
C2	19-723	1	50 kΩ control with switch	R1/SW3
C3	63-1272	1	Rotary switch	SW1
C4	63-1270	1	Rotary switch with dual 33 kΩ control	SW2/R3/R4
C5	60-54	1	"120-240" slide switch	SW4
C6	60-608	1	"Low-Nor" slide switch	SW5
C7	64-31	1	Pushbutton switch	SW6

HARDWARE

#4 Hardware

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
D1	250-156	1	4-40 × 1/8" setscrew
D2	250-213	9	4-40 × 5/16" screw
D7	252-2	8	4-40 nut
D18	254-9	9	#4 lockwasher
D24	255-151	1	4-40 × 13/16" tapped spacer

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

Hardware (cont'd.)

#6 Hardware

D3	250-276	25	6-32 × 3/8" back flat head screw	
D4	250-381	19	6-32 × 3/8" black screw	
D5	250-11	4	6-32 × 1/2" flat head screw	
D8	252-3	9	6-32 nut	
D9	252-84	20	Push-on nut	
D13	253-2	2	#6 fiber shoulder washer	
D19	254-1	11	#6 lockwasher	
D23	255-129	1	6-32 × 1-1/2" threaded spacer	
D25	259-1	1	#6 solder lug	

Other Hardware

D6	250-1186	2	8-32 × 3/8" black screw	
D10	252-4	2	8-32 nut	
D11	252-7	8	Control nut	
D12	252-73	1	Spring nut	
D14	253-170	1	Small flat washer	
D15	253-10	7	Control flat washer	
D16	253-196	14	Large plastic shoulder washer	
D17	253-194	1	Large spring washer	
D20	254-2	2	#8 lockwasher	
D21	254-5	8	Control lockwasher	
D22	254-14	1	Small control lockwasher	
D26	259-27	7	Large solder lug	

METAL PARTS

E1	203-1496-3	2	Side panel	
E2	203-1771-1	1	Rear panel	
E3	205-1605	1	Front subpanel	
E4	205-1599-1	2	Top/bottom panel	
E5	204-2179	1	Transistor bracket	
E6	204-2180	1	Switch bracket	
E7	204-2197	1	Circuit board mounting bracket	
E8	204-2217	1	Reduction drive bracket	
E9	205-1670	1	Control mounting plate	
E10	211-75	2	Handle	
E11	216-71	1	Top rail	
E12	216-72	1	Bottom rail	
E13	454-25	4	Cam nut	

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

GROMMET — INSULATORS — SLEEVING

F1	73-3	1	Rubber grommet	
F2	73-34	2	Rubber insulator	
F3	75-152	2	Transistor insulator (between two pieces of cardboard)	
F4	75-736	1	Line cord strain relief	
	346-1	1-1/2"	Black fiber sleeving	
	346-26	7"	Clear sleeving	
	346-35	1-3/4"	Black plastic sleeving	

TERMINAL STRIPS — CONNECTOR — FUSEHOLDER

G1	431-41	1	2-lug terminal strip	
G2	431-77	1	5-lug terminal strip	
G3	431-82	1	Terminal collar	
G4	432-758	7	BNC connector with hardware	
G5	422-1	1	Fuseholder	

KNOBS — KNOB INSERTS — BUSHINGS

H1	455-11	1	Brass bushing	
H2	455-71	4	Large knob bushing	
H3	455-613	4	Concentric knob bushing	
H4	455-619	3	Short D-hole knob bushing	
H5	462-951	4	Black knob	
H6	462-363	4	Red knob	
H7	462-366	1	1-1/4" flat knob	
H8	462-1001	3	Combination knob	
H9	462-975	1	3" silver dial	
H10	462-976	1	3" black dial	

MISCELLANEOUS

J1	54-923	1	Power transformer	T1
	89-54	1	Line cord	
	134-963	1	Wire harness	
J2	412-72	1	Lamp	PL1
J3	417-289	1	2N6109 transistor	Q1
J3	417-296	1	TA7311 transistor	Q2
J4	421-42	1	3/8-ampere slow-blow fuse	F1

Miscellaneous (cont'd.)

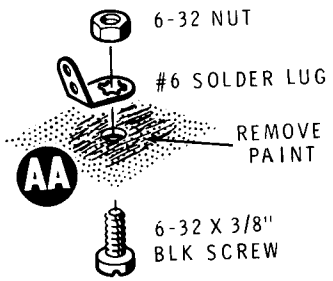
KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
K1	100-863	1	Reduction drive assembly	
K2	100-1689	1	Sweep arm assembly	
K3	134-237	1	BNC cable assembly	
K4	261-34	4	Plastic foot	
K5	263-8	3	Felt pad	
K6	413-10	1	Red lens	
K7	490-23	1	Allen wrench	

PRINTED MATERIAL

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
L3	390-1385	1	Front trim panel	
L4	390-1260	1	Trim label	

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

STEP-BY-STEP ASSEMBLY



Detail 4-1A

REAR PANEL ASSEMBLY

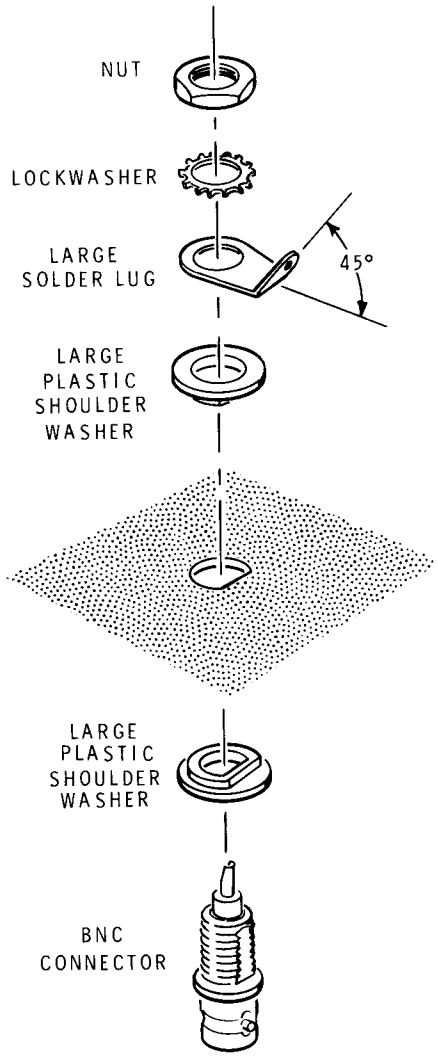
Refer to Pictorial 4-1 (on Page 8 in the Illustration Booklet) for the following steps.

( ) Position the rear panel as shown.

( ) Refer to Detail 4-1A and scrape any paint from around hole AA on the inside of the panel. Then mount a #6 solder lug to the inside of the rear panel with a 6-32 × 3/8" black screw and a 6-32 nut at location AA. Position the solder lug as shown in the Pictorial.

( ) Refer to Detail 4-1B and mount a BNC connector to the rear panel at location AB. Use the hardware supplied with the connector, two large plastic shoulder washers, and a large solder lug. Make sure the shoulder of each plastic washer fits into the rear panel opening and the solder lug is positioned as shown in the Pictorial, before you tighten the nut. Then tighten the nut. Bend the small end of the solder lug out away from the rear panel to an angle of approximately 45 degrees.

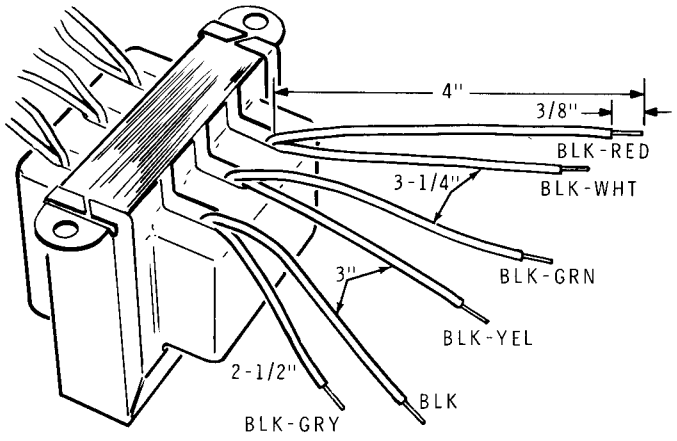
( ) In a like manner, mount a BNC connector at location AC.



Detail 4-1B

( ) In a like manner, mount a BNC connector at location AD.

( ) In a like manner, mount a BNC connector at location AE.



Detail 4-1C

( ) Refer to Detail 4-1C and cut the transformer wires to the indicated lengths. Measure the wires from where they come out of the transformer. Then remove 3/8" of insulation from the end of each of these wires. Note that the two red and the red-yellow wires, the two green and the green-yellow wires are not cut.

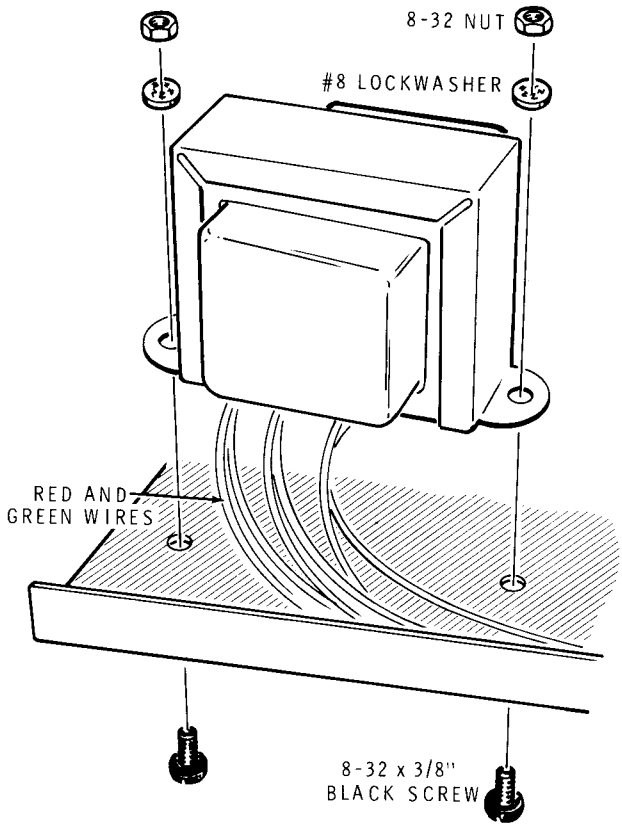
( ) T1: Refer to Detail 4-1D and mount the transformer to the rear panel with two 8-32 × 3/8" black screws, two #8 lockwashers, and two 8-32 nuts. Position the six uncut red and green wires toward the top of the rear panel.

( ) Twist the two green and the green-yellow transformer wires together.

( ) Twist the two red and the red-yellow transformer wires together.

( ) Locate the 7" length of clear sleeving and cut off 4-1/2". Then slide the 4-1/2" sleeve over the two sets of twisted wires. Position the wires and sleeve under the top edge of the rear panel. One end of the sleeve should be even with the side of the transformer. Save the remaining sleeving.

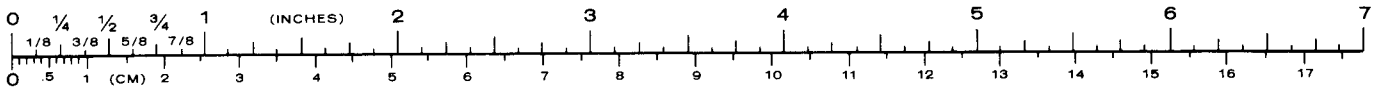
Temporarily set the rear panel aside and prepare the switch bracket in the following steps.



Detail 4-1D

( ) Refer to Detail 4-1E (on Page 8 in the Illustration Booklet) and mount the fuseholder to the switch bracket at location F1 with a 6-32 × 3/8" black screw, two #6 lockwashers, and a 6-32 nut. Position the fuseholder parallel to the edge of the bracket.

( ) Refer to Detail 4-1E and mount the 2-lug terminal strip to the switch bracket at location BA with 6-32 × 3/8" black screw, two #6 lockwashers, and a 6-32 nut. Make sure the terminal strip is positioned over the edge of the bracket.



( ) SW5: Locate the "120-240" slide switch. Then refer to Detail 4-1E and mount the switch to the switch bracket at location SW5 with two 6-32 × 3/8" black screws. Position the switch so the jumper wire is toward the fuseholder.

( ) SW6: Locate the "Low-Nor" slide switch. Then refer to Detail 4-1E and mount the switch to the switch bracket at location SW6 with two 6-32 × 3/8" black screws. Position the switch so the letters NOR, on the slide, are toward the fuseholder.

( ) Locate the fuse label and write "3/8 A, 3AG, S.B." on the label in the space provided.

( ) Remove the backing paper from the fuse label and press the label onto the switch bracket as shown.

Again, refer to Pictorial 4-1 and wire the switch plate as follows:

NOTE: When you are instructed to prepare a wire, cut the wire to the indicated length, and remove 1/4" of insulation from each end of the wire (unless instructed otherwise). The wires are always prepared in the order they will be used.

( ) Prepare the following black **stranded** wires. Remove 3/8" of insulation from each end of the wires.

2"	1-1/2"
2"	6-1/2"
2-1/4"	9-3/4"

NOTE: As you connect **each** wire to the switch bracket, make a mechanically secure connection before you solder the wire to the lug. Refer to the inset drawing in Pictorial 4-1.

Connect the six black stranded wires as follows:

( ) 2" wire from switch SW6 lug 2 (S-1) to switch SW5 lug 2 (S-1).

( ) 2" wire from switch SW6 lug 5 (S-1) to switch SW5 lug 5 (S-1).

( ) 2-1/4" wire from switch SW5 lug 6 (S-1) to terminal strip BA lug 1 (NS).

( ) 1-1/2" wire from switch SW5 lug 3 (S-1) to terminal strip BA lug 2 (NS).

( ) 6-1/2" wire to terminal strip BA lug 2 (NS). The free end will be connected in a later step.

( ) 9-3/4" wire to fuseholder F1 lug 2 (S-1). The free end will be connected in a later step.

( ) Route the 9-3/4" wire over near terminal strip BA lug 2. Align the 9-3/4" and 6-1/2" wire ends. Then twist the wires together along their entire length.

Position the switch bracket near the rear panel, under the transformer, and connect the transformer wires as follows:

( ) Black-yellow wire to switch SW6 lug 1 (S-1).

( ) Black-gray (not black-white) wire to switch SW6 lug 3 (S-1).

( ) Black-green wire to switch SW6 lug 4 (S-1).

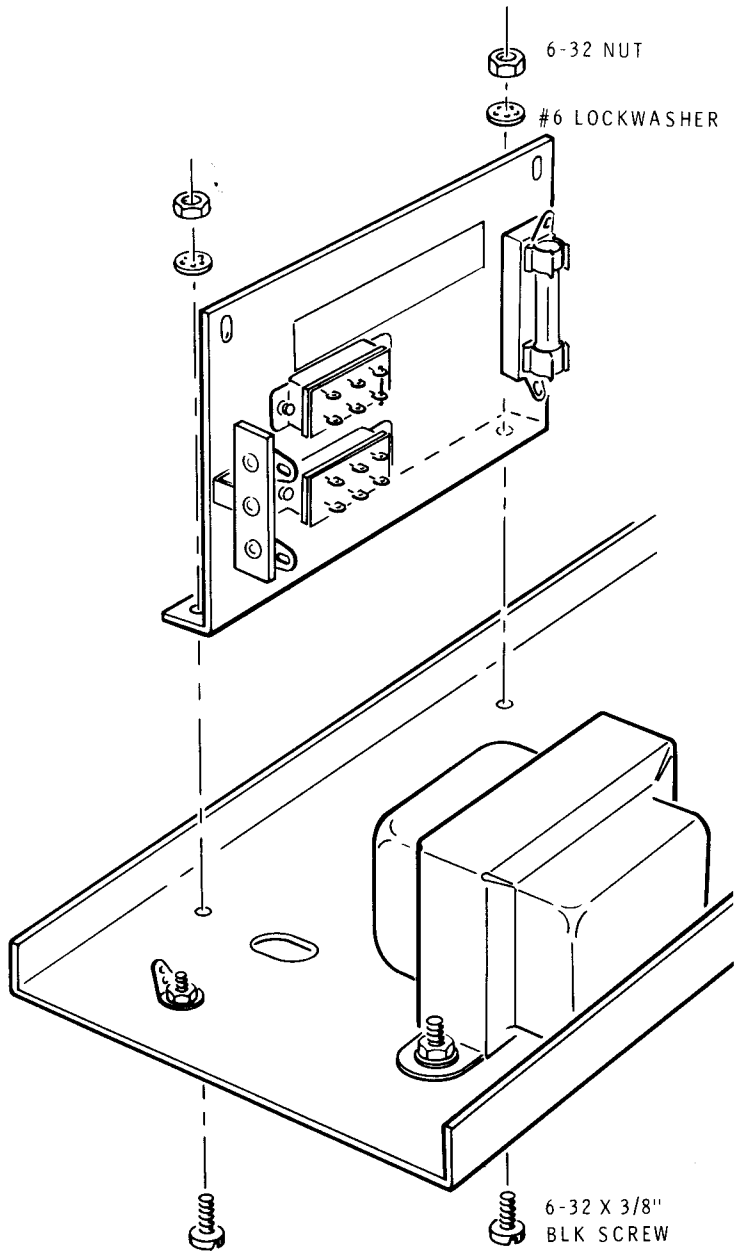
( ) Black-white wire to switch SW6 lug 6 (S-1).

( ) Black wire to terminal strip BA lug 1 (NS).

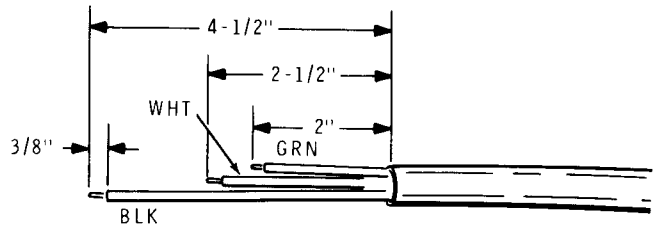
( ) Black-red wire to terminal strip BA lug 2 (NS).

( ) Cut two 3/4" lengths of black fiber sleeving. Then place a sleeve over each lead of a 0.001 μF (1000 pF), 1.4kV ceramic capacitor.

( ) C1: Connect a 0.001 μF (1000 pF), 1.4kV ceramic capacitor to terminal strip BA: one lead to lug 1 (NS) and the other lead to lug 2 (S-4). The fiber sleeving should be tight against the capacitor body and next to the terminal lugs. Make sure each lead on lug 2 is soldered.



Detail 4-1F



Detail 4-1G

( ) Refer to Detail 4-1F and mount the switch bracket to the rear panel with two 6-32 × 3/8" black screws, two #6 lockwashers, and two 6-32 nuts.

CAUTION: Electrical regulations in some areas require a special line cord and/or plug for 240-volt operation. If the cord and plug supplied are not approved for your area, obtain an approved cord and plug locally and proceed with the following steps, making changes as necessary.

( ) Refer to Detail 4-1G and prepare the line cord. Remove the indicated amount of outer insulation, cut the wires to length, and remove 3/8" of insulation from each wire end. Twist the fine wire strands together on each wire. Then melt a small amount of solder on each wire end to hold the wire strands together.

( ) Pass the prepared end of the line cord through hole AF in the rear panel.

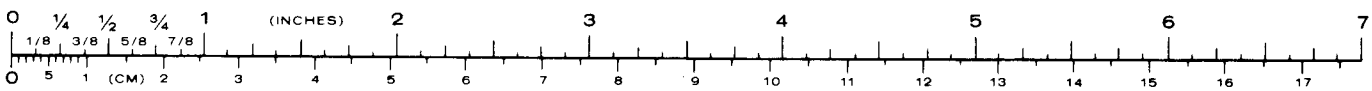
Connect the line cord wires as follows. Make a mechanically secure connection before you solder each wire.

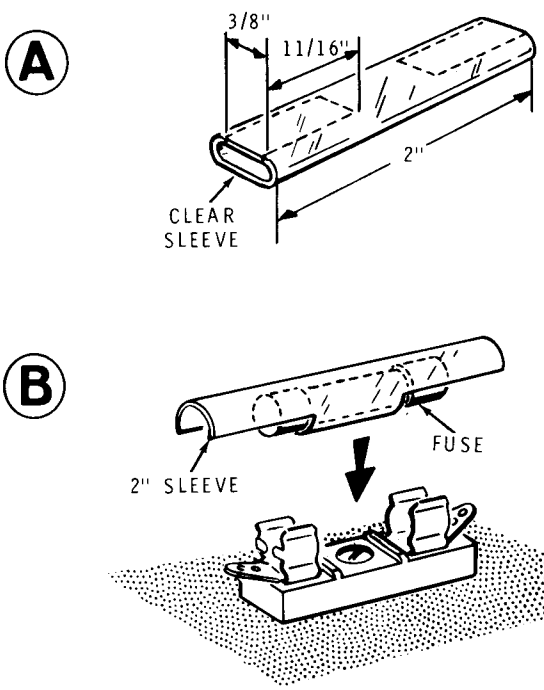
( ) Green wire to solder lug AA (S-1).

( ) White wire to terminal strip BA lug 1 (S-4). Make sure each lead is soldered on this lug.

( ) Black wire to fuseholder F1 lug 1 (S-1).

( ) Position the body of capacitor C1 down near the switch bracket.

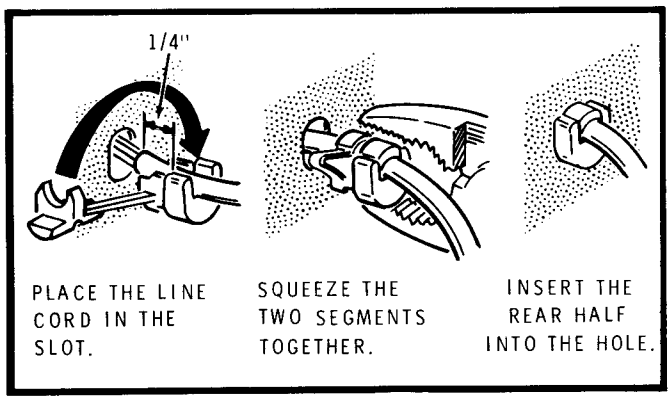




Detail 4-1H

( ) Refer to Detail 4-1H and prepare a fuse cover from the large clear sleeve. Cut a 2" length of sleeve (save the remaining sleeve for later use). Then refer to part A of the Detail and cut a section out of each end of the sleeve as shown. Part B shows how the sleeve should appear. NOTE: You will find it easier to measure and cut the sleeve if you flatten it a small amount.

( ) F1: Locate the 3/8-ampere slow-blow fuse and slip it into the sleeve. Then press the fuse into the fuseholder as shown in Detail 4-1H part B. The center portion of the sleeve should fit between the fuse clips, and the outer portion should cover the fuse clips.



Detail 4-1J

( ) Turn the rear panel around. Then refer to Detail 4-1J and install the line cord strain relief. Note that the end of the line cord outer insulation is approximately 1/4" from the strain relief.

( ) Reposition the rear panel as shown in the Pictorial.

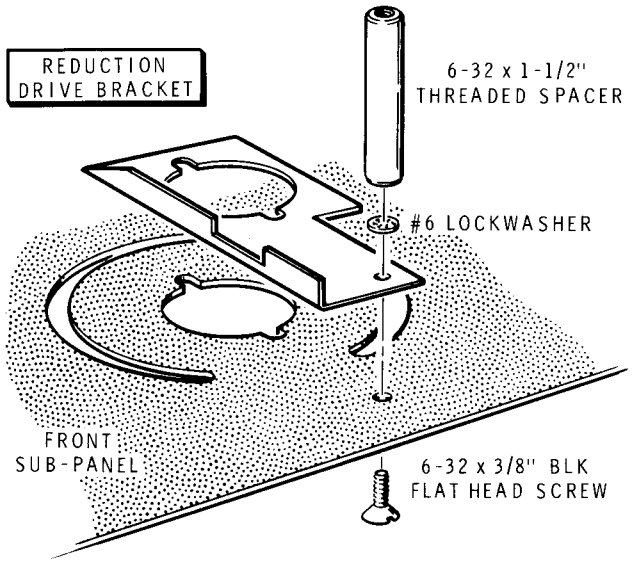
( ) Prepare the following black **solid** wires:

1"
1-3/4"

( ) Connect one end of the 1" black wire to solder lug AB (S-1) and the other end to solder lug AC (NS).

( ) Connect one end of the 1-3/4" black wire to solder lug AD (NS) and the other end to solder lug AE (S-1).

Temporarily set the rear panel assembly aside.



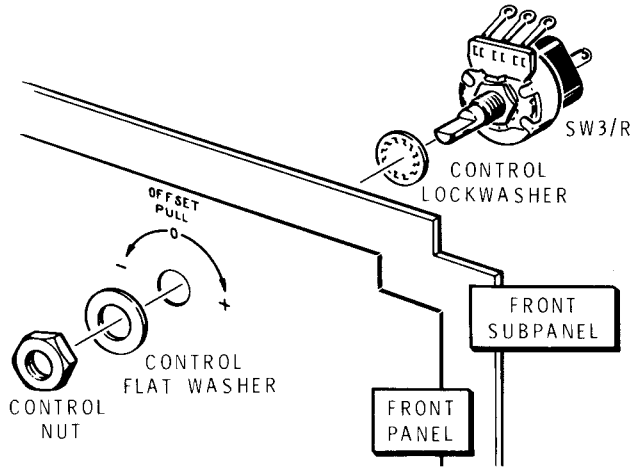
Detail 4-2A

FRONT PANEL ASSEMBLY

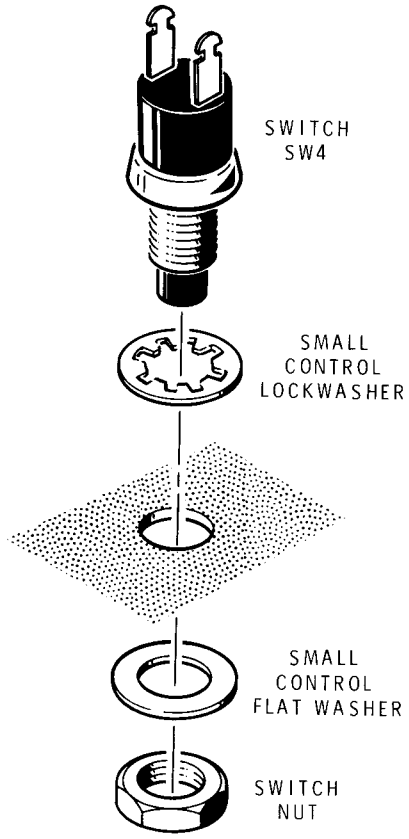
Refer to Pictorial 4-2 (on Page 9 in the Illustration Booklet) for the following steps.

( ) Refer to Detail 4-2A and mount a 6-32 × 1-1/2" threaded spacer and the reduction drive bracket to the front subpanel at location CA with a 6-32 × 3/8" black flat head screw and #6 lockwasher. Make sure this screw is **tight** and the bracket is aligned with the front panel cutout.

( ) SW3/R2: Align the front trim panel with the front subpanel. Then refer to Detail 4-2B and mount a switch/control (#19-723) at location SW3/R2 with a control lockwasher, control flat washer, and control nut. Position the switch/control as shown in the Pictorial.



Detail 4-2B

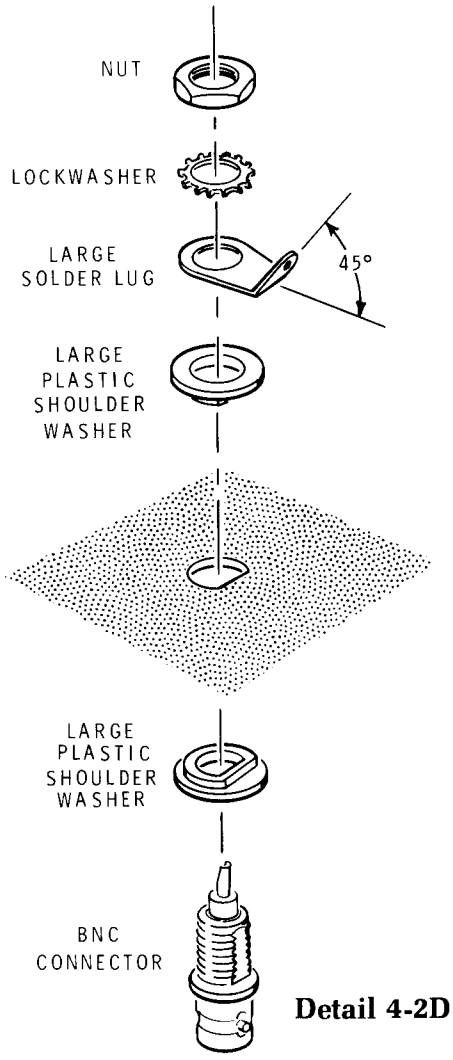


Detail 4-2C

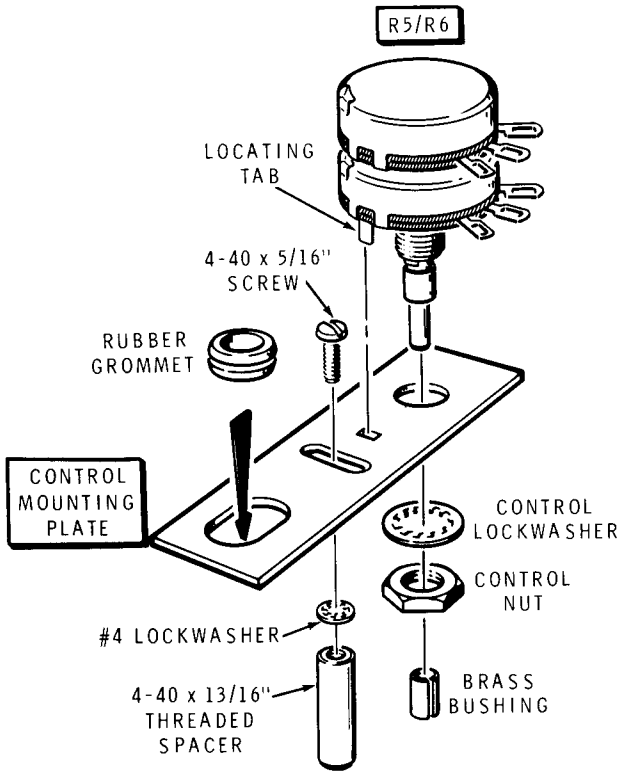
( ) SW2/R3/R4: In a like manner, mount a switch/dual control (#63-1270) at location SW2/R3/R4 with a control lockwasher, control flat washer, and a control nut. Position the switch/dual control as shown.

( ) SW1: In a like manner, mount a switch (#63-1272) at location SW1 with a control lockwasher, control flat washer, and a control nut. Position the switch as shown, with the small locating bump near the top of the front panel.

( ) SW4: Refer to Detail 4-2C and mount a pushbutton switch (#64-31) at location SW4 with a small control lockwasher, small flat washer, and the nut supplied with the switch. Position the switch as shown. Do not overtighten and strip the soft metal threads.



Detail 4-2D



Detail 4-2E

( ) Refer to Detail 4-2D and mount a BNC connector at location CC. Use the hardware supplied with the connector, two large plastic shoulder washers, and a large solder lug. Make sure the shoulder of each plastic washer fits into the panel opening and the solder lug is positioned as shown in the Pictorial before you tighten the nut. Then tighten the nut. Bend the small end of the solder lug out away from the panel to an angle of approximately 45 degrees.

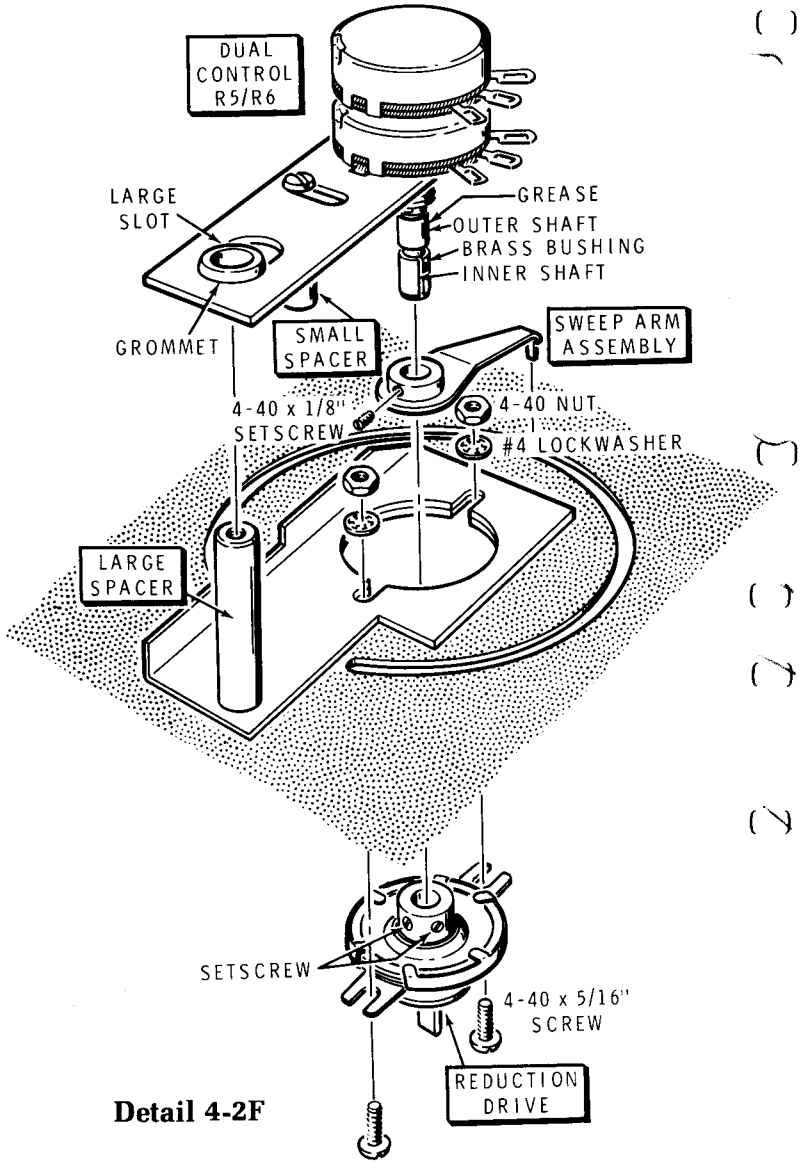
( ) In a like manner, mount a BNC connector at location CD.

( ) In a like manner, mount a BNC connector at location CE.

( ) Refer to Detail 4-2E and insert a rubber grommet into the large slot in the control mounting plate.

( ) Refer to Detail 4-2E and position the mounting plate so it matches the illustration. Then mount a 4-40 × 13/16" threaded spacer with a 4-40 × 5/16" screw and #4 lockwasher. Position the spacer in the center of the slot. You will realign the spacer in a later step.

( ) R5/R6: Refer to Detail 4-2E and mount the dual control (#12-165) to the control mounting plate with a control lockwasher and control nut. Be sure to fit the control locating tab into the slot provided in the plate. Then press the brass bushing onto the inner shaft of the dual control until the bushing is even with the end of the shaft.



Detail 4-2F

( ) Refer to Detail 4-2F and mount the reduction drive to the front panel at location CB with two 4-40 × 5/16″ screws, two #4 lockwashers, and two 4-40 nuts. NOTE: If there is any tape on the drive, remove it before installation.

( ) Loosen the two setscrews in the reduction drive.

( ) Turn the outer shaft of dual control R5/R6 fully clockwise and the inner shaft fully counterclockwise. Then apply a very thin layer of silicone grease on the outer shaft.

( ) With the allen wrench supplied in this kit, start the 4-40 × 1/8″ setscrew into the sweep arm assembly. Be careful; do not strip the threads.

( ) Refer to Detail 4-2F and slide the sweep arm assembly onto the outer shaft of dual control R5/R6. Then slide the inner shaft of the dual control into the reduction drive, and press the grommet in the large slot of the control mounting plate over the large threaded spacer. Press the control shaft into the reduction drive as far as it will go, but allow approximately 1/32″ clearance between the small threaded spacer and reduction drive mounting hardware. Then tighten the two reduction drive setscrews so they are snug. Do not tighten the setscrew on the sweep arm assembly.

( ) Remove the paper backing from a felt pad. Then refer to Detail 4-2G and press the pad onto the front panel at one of the three positions indicated by a felt pad index mark.

( ) In a like manner, affix two more felt pads to the front panel.

( ) Remove the two reduction-drive dial mounting screws. Then temporarily mount the 3″ silver dial to the reduction-drive mounting flange with the two screws you just removed.

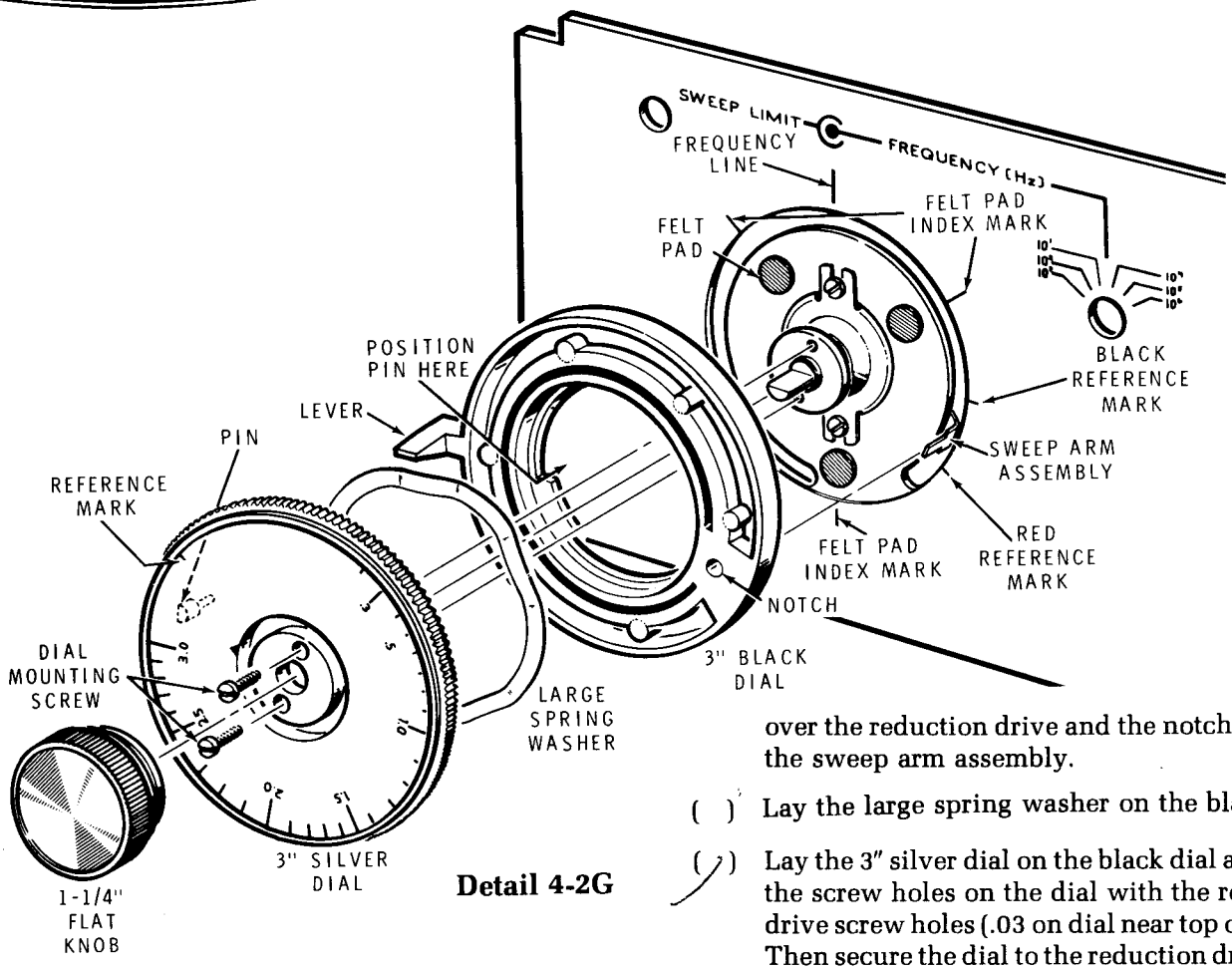
( ) Gently turn the dial counterclockwise to ensure that the control is fully counterclockwise. Then loosen the two reduction drive setscrews and turn the dial counterclockwise until the reference mark on the dial is aligned with the FREQUENCY line on the front panel. Tighten the reduction drive setscrews. NOTE: The setscrews should be accessible from the bottom left corner of the front panel. If they are not positioned properly, remove the 3″ silver dial, turn the dial 180 degrees, and remount the dial. Then turn the dial counterclockwise and align the reference mark before you tighten the reduction drive setscrews.

( ) Turn the dial fully clockwise.

( ) Remove the 3″ silver dial. Put the screws in a safe place; they are small and easy to lose.

( ) Use a pair of long-nose pliers to make sure the outer shaft of the dual control is still fully clockwise.

( ) Watch the outer shaft of the dual control, and rotate the sweep arm assembly to the black reference mark on the front panel. (If the shaft moves, reposition it fully clockwise with a pair of long-nose pliers.) Then tighten the sweep arm setscrew so that it just makes contact with the outer shaft.



Detail 4-2G

( ) Rotate the sweep arm assembly clockwise until the **bottom edge** of the sweep arm is aligned with the red reference mark. Then tighten the sweep arm setscrew.

( ) Rotate the sweep arm assembly counterclockwise until the **bottom edge** of the sweep arm is aligned with the black reference mark. Then loosen the setscrew without changing the position of the outer shaft of the dual control. NOTE: If the shaft moves, you must repeat the previous two steps and realign the sweep arm assembly.

NOTE: In the following steps, you will install the 3" silver dial, large spring washer, and 3" black dial. When you install these parts, the sweep arm assembly will fit into a notch on the back of the 3" black dial. You must use extreme care when you align the sweep arm and notch, and not allow the outer shaft of the dual control to turn. If the shaft turns, the Generator will not calibrate properly, and you will have to repeat this tedious alignment procedure.

( ) Refer to Detail 4-2G and carefully position the 3" black dial on the front panel so it is centered over the reduction drive and the notch fits over the sweep arm assembly.

( ) Lay the large spring washer on the black dial.

( ) Lay the 3" silver dial on the black dial and align the screw holes on the dial with the reduction drive screw holes (.03 on dial near top of panel). Then secure the dial to the reduction drive with the two small screws you saved.

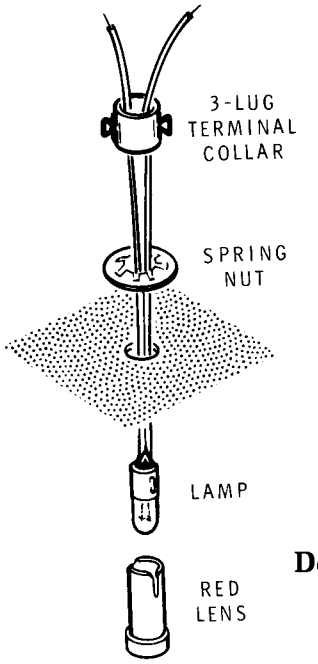
( ) Hold the sweep arm assembly so it does not bind on the control shaft and turn the black dial fully clockwise. (The pin on the back of the silver dial limits the rotation of the black dial.)

( ) Position the sweep arm assembly so it does not contact the reduction drive mounting bracket. Then tighten the setscrew in the sweep arm assembly.

( ) Turn the black dial counterclockwise until the lever on the dial is centered over the frequency line. Then loosen the screw on the small threaded spacer and position the spacer against the sweep arm assembly. Tighten the screw. Recheck the lever to make sure it is still centered.

NOTE: The two frequency controls are now aligned. If you ever remove the dials, the alignment will not be affected. Any apparent binding between knobs will diminish with use.

( ) Press the 1-1/4" flat knob onto the center shaft of the reduction drive.



Detail 4-2H

( ) Refer to Detail 4-2H and press a red lens into hole PL1 from the front of the panel. Then press a spring nut over the split end of the lens, and push it up against the panel. This will hold the lens tightly in position.

( ) Cut off each lead of the lamp 1-1/2" from the body of the lamp, remove 1/4" of insulation from each lead, twist the fine wire strands of each lead together, and melt a small amount of solder on each lead.

( ) Align the two ridges on the lamp body with the two slits in the red lens and press the lamp into the lens.

( ) Pass the lamp leads through the center of the terminal collar. Then press the collar onto the lens. NOTE: The collar may not go completely on to the lens because of its tight fit. Push it on as far as possible.

( ) Connect either lamp lead to terminal collar PL1 lug 1 (NS) and the other lamp lead to lug 2 (NS).

( ) Prepare the following wires:

1-1/2" black solid	1-3/4" white-brown
2" black solid	2" white
2" black solid	2-1/4" white-green
2" yellow	2-1/2" yellow
1-3/4" white	

Connect the prepared wires to the front panel assembly in the following steps.

( ) 1-1/2" black wire from solder lug CD (S-1) to pushbutton switch SW4 lug 2 (NS).

( ) 2" black wire to pushbutton switch SW4 lug 2 (S-2). The other end of the wire will be connected in a later step.

( ) 2" black wire to solder lug CE (S-1). The other end of the wire will be connected in a later step.

( ) 2" yellow wire to BNC connector CE (S-1). The other end of the wire will be connected in a later step.

NOTE: Where a wire passes through a connection and then goes to another point, as in the next step, it will count as two wires in the solder instruction (S-2), one entering and one leaving the connection.

( ) Remove an additional 1/4" of insulation from one end of the 1-3/4" white wire. Then pass the long bare end through control R4 lug 1 (S-2) to lug 2 (S-1). Connect the free end of the wire to switch SW2 lug 1 (S-1).

( ) 1-3/4" white-brown wire from switch SW2 lug 2 (NS) to control R4 lug 3 (S-1).

( ) Remove an additional 1/4" of insulation from one end of the 2" white wire. Then pass the long bare end through control R3 lug 3 (S-2) to lug 2 (S-1). Connect the free end of the wire to switch SW2 lug 4 (S-1).

( ) 2-1/4" white-green wire from switch SW2 lug 5 (NS) to control R3 lug 1 (S-1).

( ) 2-1/2" yellow wire to switch **SW1**: from lug 3 (S-1) to lug 10 (NS). Position the wire out away from the switch.

( ) R1: Connect a 1000 Ω (1k), 1/4-watt, 1% precision resistor from control R2 lug 2 (S-1) to switch SW3 lug 1 (NS).

Set the front panel assembly aside temporarily.

Refer to Pictorial 4-3 (on Page 9 in the Illustration Booklet) for the following steps.

( ) Position the rear panel assembly as shown and loosely mount the circuit board mounting bracket to the rear panel with two 6-32 × 3/8" black screws, two #6 lockwashers, and two 6-32 nuts.

( ) Loosely mount the sweep circuit board to the bracket with two 4-40 × 5/16" screws, two #4 lockwashers, and two 4-40 nuts. Be sure to position the circuit board on the right side of the bracket.

( ) Refer to Detail 4-3A and install ten 6-32 push-on nuts onto each handle. Note that you must squeeze each nut slightly so it will fit more securely onto the handle. Position the flat side of the nut to the **outside** of the handle.

NOTE: Place a soft cloth or rug on your work surface to protect the handles from scratches.

( ) **Loosely** mount either handle to the left end of the rear panel with two 6-32 × 3/8" black screws.

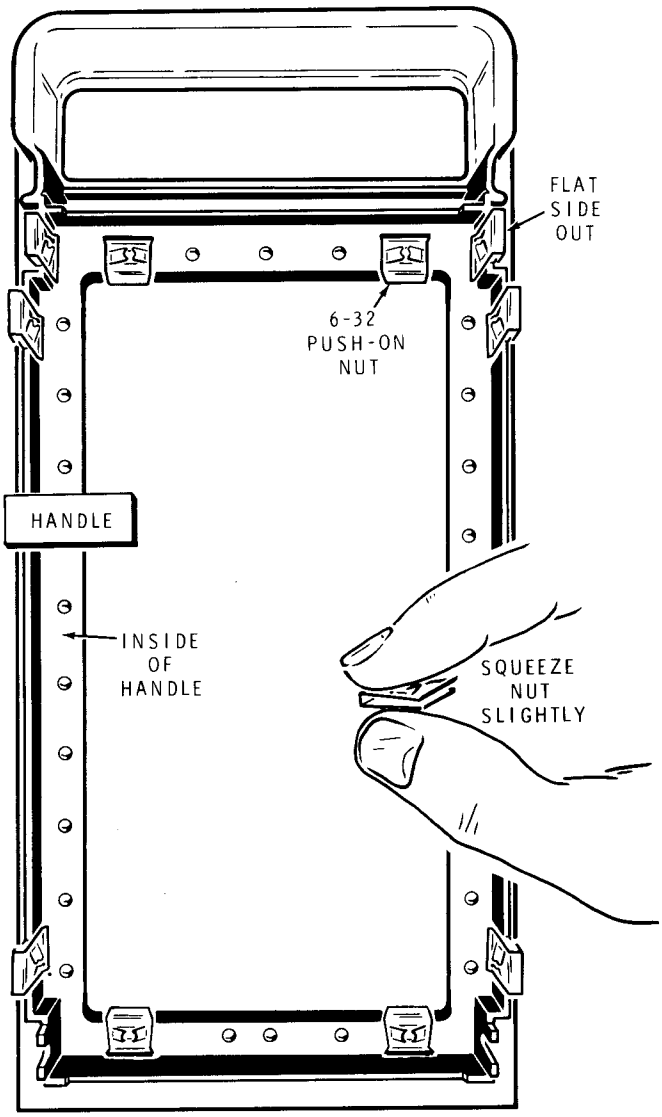
( ) **Loosely** mount the other handle to the right end of the rear panel with two 6-32 × 3/8" black screws.

( ) Place a control lockwasher over the shaft of each switch on the sweep circuit board.

( ) Mount the front panel assembly to the sweep circuit board switches with two control flat washers and two control nuts. Do not pinch any wires between the board and front panel.

( ) Swing each handle in so the front panel fits into the groove in each handle. Then tighten the four screws that secure the handles to the rear panel.

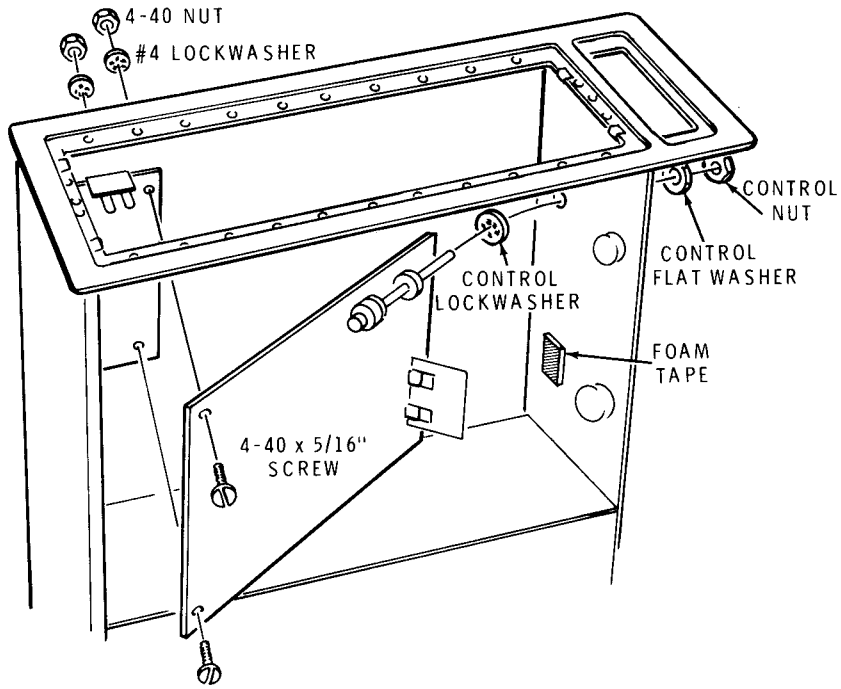
( ) Tighten the #6 hardware that secures the circuit board mounting bracket to the rear panel.



Detail 4-3A

( ) Tighten the #4 hardware that secures the circuit board to the bracket.

CAUTION: The two handles are secured only to the rear panel at this time. Whenever you reposition or lift the chassis assembly, always hold both handles. If you lift the chassis with one handle, you may damage the rear panel, mounting screws, or handle.



Detail 4-4A

CHASSIS WIRING

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

( ) Position the chassis on its left handle as shown.

( ) Cut a 1" length of foam tape and remove the paper backing from one side. Press the foam tape onto the front panel next to BNC connector CD and 5/8" from the bottom edge of the front panel. (See the inset drawing.) Then remove the paper backing from the other side of the foam tape.

( ) Refer to Detail 4-4A and place a control lockwasher over the switch shaft on the output circuit board. Then install the output circuit board in the chassis, from the top. Make sure the circuit board is parallel to the bottom edge of the front panel. Then secure the circuit board switch to the front panel with a control flat washer and a control nut.

( ) Loosen the #6 hardware that secures the switch bracket to the rear panel.

( ) Loosely secure the output circuit board to the switch bracket with two 4-40 × 5/16" screws, two #4 lockwashers, and two 4-40 nuts.

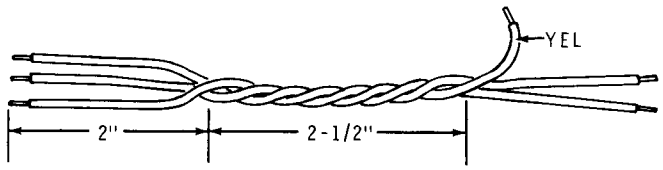
( ) Tighten the #6 hardware that secures the switch bracket to the rear panel.

( ) Tighten the #4 hardware that secures the output circuit board to the switch bracket.

( ) Cut two 7/8" lengths of black plastic sleeving.

( ) Place a sleeve over the end of each of the long black wires coming from the switch bracket. NOTE: Slide the sleeves away from the wire ends at least 1". (The sleeving is heat shrinkable.)

( ) Connect either long black wire to switch SW203 lug 1 (S-1) and the other lead to lug 2(S-1). NOTE: Make a mechanically secure connection with each wire before you solder the connection. After the connections have cooled, push the sleeving up each wire and over the connections.



Detail 4-4B

( ) Position the twisted black wires down next to the edge of the circuit board.

( ) Prepare the following wires:

6-1/4" white-red
6-1/4" white-blue
6" yellow

( ) Refer to Detail 4-4B and hold the three wires so their ends are even at one end of the bundle. Then beginning 2" from the even end of the bundle, twist the wires together for a distance of 2-1/2".

Connect the even end wires to the output circuit board in the following steps:

( ) 6-1/4" white-red wire to hole D (S-1).

( ) 6-1/4" white-blue wire to hole E (S-1).

( ) 6" yellow wire to hole F (S-1).

( ) Cut off the excess wire lengths from the foil side of the circuit board.

Connect the free ends of the 3-wire bundle to switch/control SW3/R2 in the following steps.

( ) Yellow wire to switch SW3 lug 1 (S-2).

( ) White-red wire to control R2 lug 1 (S-1).

( ) White-blue wire to control R2 lug 3 (S-1).

( ) Prepare the following wires:

3-1/4" black solid
4-1/2" red
5-3/4" blue
7-1/4" orange

Connect the four prepared wires from the output circuit board to the front panel switches as follows:

( ) 3-1/4" black wire from hole G (S-1) to switch SW3 lug 2 (S-1).

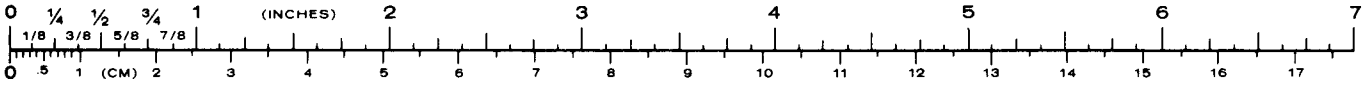
( ) 4-1/2" red wire from hole A (S-1) under switch SW203, to switch SW1 lug 5 (S-1).

( ) 5-3/4" blue wire from hole C (S-1) to switch SW1 lug 4 (S-1).

( ) 7-1/4" orange wire from hole B (S-1) to switch SW1 lug 11 (S-1).

( ) Position the blue and orange wires away from the output circuit board.

( ) Cut off the excess wire lengths from the foil side of the circuit board.



( ) Refer to Detail 4-4C and unfold wire harness #134-963 as shown. Note the wire breakout locations in the illustration. They serve as wire locators in the assembly steps.

( ) Fold the wire harness containing breakouts #1 and #2 under the remaining harness, at breakout #3.

( ) Position the harness in the chassis so the fold point rests in the cutout in the circuit board mounting plate and breakouts #1 and #2 are under the sweep circuit board.

Connect the wires from breakout #4 to the sweep circuit board as follows:

( ) White-yellow wire to hole K (S-1).

( ) White-black wire to hole T (S-1).

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

( ) White-blue wire to hole AL (S-1).

( ) White-red wire to hole AK (S-1).

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

( ) Red wire to switch SW303 lug 1 (S-4).

( ) Cut off the excess wire lengths from the foil side of the circuit board.

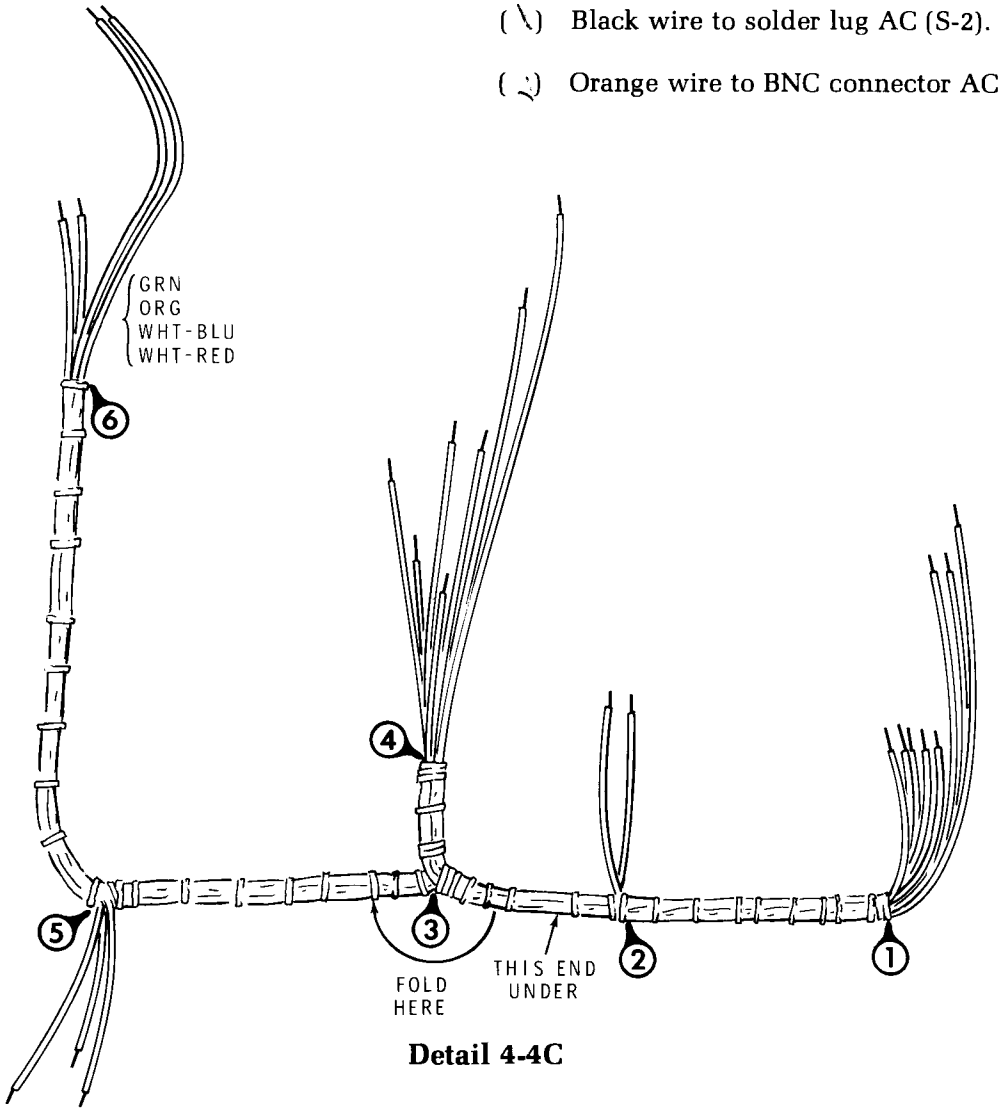
( ) Position the wires near the circuit board.

Connect the wires from breakout #5 to the rear panel as follows. NOTE: You may find these wires easier to install from the bottom of the chassis.

( ) White-yellow wire to BNC connector AB (S-1).

( ) Black wire to solder lug AC (S-2).

( ) Orange wire to BNC connector AC (S-1).



Detail 4-4C

Connect the wires from breakout #6 to the output circuit board in the following steps.

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

( ) White-red wire to hole P (S-1).

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

( ) Green wire to hole T (S-1).

( ) Cut off the excess wire lengths from the foil side of the circuit board.

Route the free ends of the sweep circuit board wires as follows:

( ) White and white-black wires down between the two circuit boards.

( ) Violet and white-yellow wires over the edge of the circuit board (through the notch in the board) and positioned next to the foil side.

( ) Black and white-green wires along the top edge of the front panel, toward the left handle.

Refer to Pictorial 4-5 (on Page 11 in the Illustration Booklet) for the following steps.

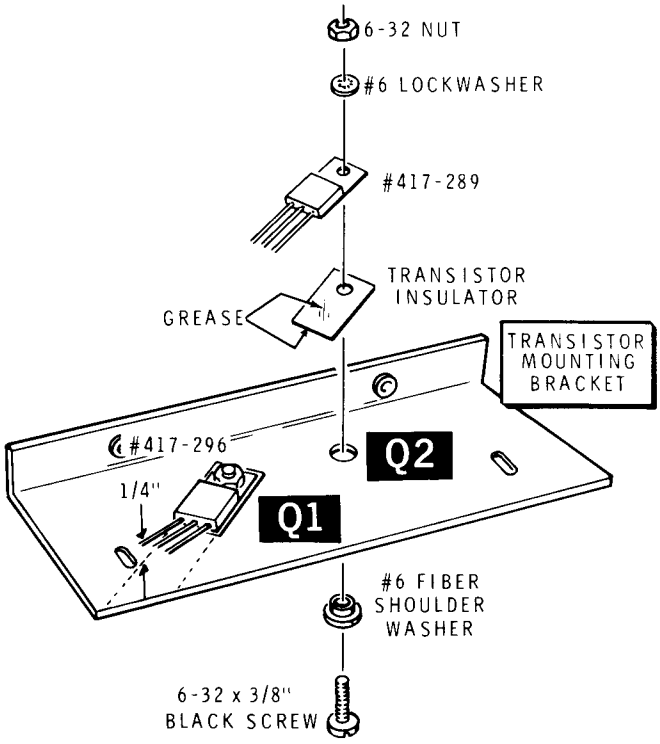
( ) Position the chassis on its right handle, with the chassis bottom toward you as shown.

( ) Q1: Refer to Detail 4-5A and position the transistor bracket as shown. Then mount a TA7311 transistor (#417-296) to the bracket as follows:

1. Apply a thin layer of silicone grease to each side of a transistor insulator and position the insulator on the bracket as shown. Note that the insulator is aligned with the oblong hole in the bracket.

2. Position the TA7311 transistor (#417-296) on the insulator as shown.

3. Secure the transistor to the bracket with a 6-32 × 3/8" black screw, #6 lockwasher, #6 fiber shoulder washer, and 6-32 nut. Make sure the shoulder of the fiber washer is in the bracket hole before you tighten the screw.



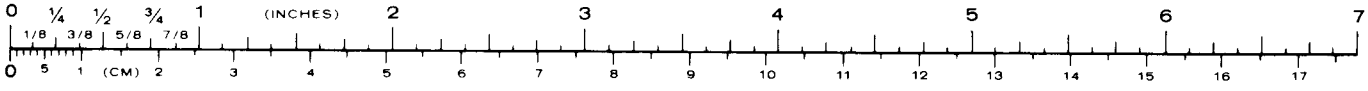
Detail 4-5A

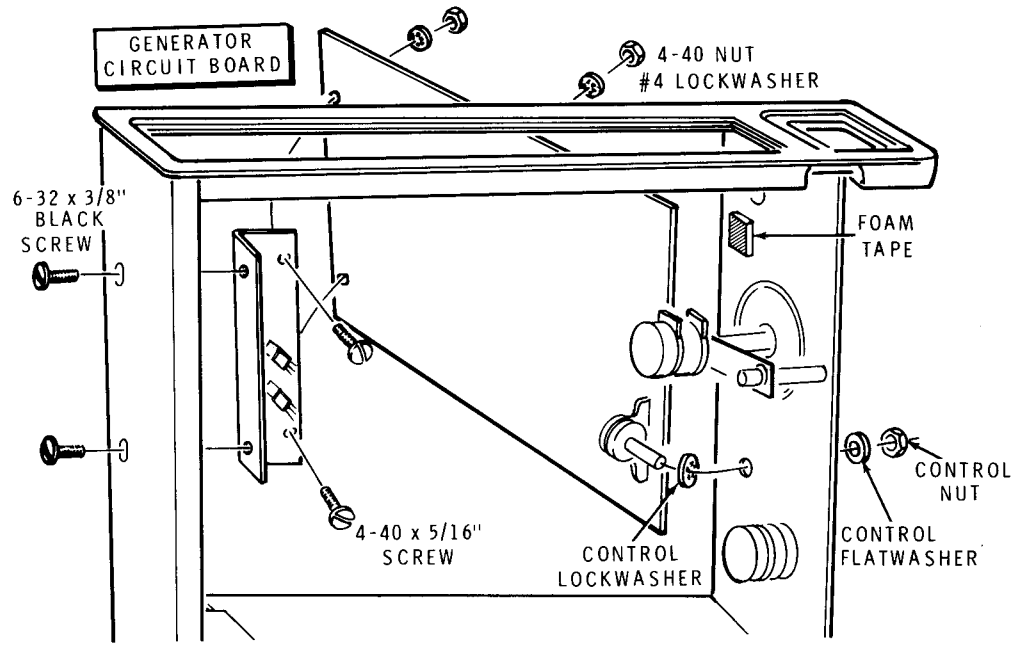
( ) Q2: In a like manner, mount a 2N6109 transistor (#417-289) to the transistor bracket at Q2. Position the insulator and transistor parallel to transistor Q1.

( ) Bend the three leads of transistors Q1 and Q2 up approximately 1/4" above the bracket.

( ) Using an ohmmeter, measure the resistance between the bracket and the mounting tab of transistors Q1 and Q2. The resistance should be infinite. This test is used to check for a short circuit to the bracket.

( ) Cut a 1" length of foam tape and remove the paper backing from one side. Press the tape onto the front panel next to lamp PL1 and 1/4" in from the top edge of the panel. Then remove the paper backing from the other side of the foam tape.





Detail 4-5B

Refer to Detail 4-5B for the following five steps.

( ) 1. Place a control lockwasher over the switch shaft on the generator circuit board. Then install the generator circuit board in the chassis. Make sure the board is parallel to the top edge of the front panel. Then secure the circuit switch to the front panel with a control flat washer and a control nut. NOTE: Do not let the board swing on the switch lugs. Excessive flexing may damage the lugs.

( ) 2. Loosely secure the transistor bracket to the rear panel with two 6-32 × 3/8" black screws. Position the bracket on the component side of the circuit board.

( ) 3. Loosely secure the circuit board to the bracket with two 4-40 × 5/16" screws, two #4 lockwashers, and two 4-40 nuts.

( ) 4. Tighten the two screws that secure the transistor bracket to the rear panel.

( ) 5. Tighten the #4 hardware that secures the circuit board to the bracket.

( ) Route the two red and the red-yellow transformer wires around the transistor bracket (near the sweep circuit board). Then route the two green and the green-yellow transformer wires around the other side of the bracket.

Connect the transformer wires to the generator circuit board as follows:

( ) Red-yellow wire to hole B (S-1).

( ) Either red wire to hole C (S-1).

( ) Other red wire to hole A (S-1).

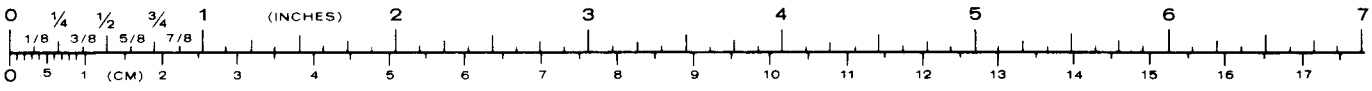
( ) Green-yellow wire to hole X (S-1).

( ) Either green wire to hole U (S-1).

( ) Other green wire to hole Z (S-1).

( ) Push the 3-connector housing with the brown-green-yellow wires onto the leads of transistor Q1 up to the body of the transistor. The brown wire is nearest the bracket screw.

( ) Push the 3-connector housing with the red-white-blue wires onto the leads of transistor Q2 up to the transistor body. The red wire is nearest transistor Q1.



( ) Prepare the following wires:

11-1/2" yellow
16" brown
9" violet
9" violet

Connect the four prepared wires to the generator circuit board as follows:

( ) 11-1/2" yellow wire to hole AS (S-1). Route the wire under the circuit board as shown. The free end will be connected in a later step.

( ) 16" brown wire to hole AZ (S-1). Route the wire under the circuit board as shown. The free end will be connected in a later step.

( ) Twist the two 9" violet wires together. Then connect either wire from one end to hole Y (S-1) and the other wire from the same end to hole AB (S-1).

( ) Connect the other end of the violet twisted wire pair to terminal collar PL1: either wire to lug 1 (S-2) and the other wire to lug 2 (S-2). Position the wire pair along the edge of the circuit board as shown.

( ) Connect the white-yellow wire from the sweep circuit board to hole AY (S-1) on the generator circuit board.

( ) Connect the violet wire from the sweep circuit board to hole AR (S-1) on the generator circuit board.

( ) Cut off the excess wire ends from the foil side of the circuit board.

( ) Prepare the following wires:

7-1/4" brown
6-1/2" brown
6-1/2" white-brown
6-3/4" white-green
7" green

Connect the prepared wires from the generator circuit board to switch SW2 on the front panel. Pass each of the wires through the remaining 1/2" length of clear sleeving. Position the sleeve as shown in the Pictorial.

( ) 7-1/4" brown wire from hole BB (S-1) to lug 3 (NS).

( ) 6-1/2" brown wire from hole AK (S-1) to lug 3 (S-2).

( ) 6-1/2" white-brown wire from hole AL (S-1) to lug 2 (S-2).

( ) 6-3/4" white-green wire from hole AP (S-1) to lug 5 (S-2).

( ) 7" green wire from hole AN (S-1) to lug 6 (S-1).

( ) Prepare a 6" white wire and a 6" black wire. Then twist the wires together.

( ) Connect the two wires at either end of the twisted wire pair to the generator circuit board: white wire to hole AU (S-1) and black wire to hole AX (S-1).

( ) Connect the free end of the twisted wire pair to the front panel; white to BNC connector CC (S-1) and black wire to solder lug CC (S-1). Position the wire pair out away from the front panel and circuit board. NOTE: Do not pass this wire pair through the 1/2" sleeve.

( ) Connect the black wire from switch SW4 to hole K (S-1) on the **output** circuit board. Insert the wire from the foil side of the board. Keep the wire insulation away from the foil to insure a good solder connection.

( ) Connect the white wire from the sweep circuit board to switch SW4 lug 1 (S-1).

( ) Connect the white-black wire from the sweep circuit board to BNC connector CD (S-1).

( ) Connect the yellow wire from BNC connector CE to hole H (S-1) on the output circuit board. Keep the wire insulation away from the foil to insure a good solder connection.

( ) Lay the bare end of the black wire from solder lug CE on the ground foil as shown. Then solder the wire to the foil.

( ) Remove the backing paper from the blue and white identification label and press the label onto the rear panel as shown.

NOTE: The blue and white label shows the model number and production series number of your kit. Refer to these numbers in any communications with the Heath Company; this assures you that you will receive the most complete and up-to-date information in return.

Refer to Pictorial 4-6 (on Page 12 in the Illustration Booklet) for the following steps.

Connect the wires from breakout #2 of the wire harness to the generator circuit board as follows:

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

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

Connect the wires from breakout #1 of the wire harness to the generator circuit board as follows:

( ) Either white-red wire to hole L (S-1).

( ) Other white-red wire to hole N (S-1).

( ) Either white-blue wire to hole T (S-1).

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

( ) Black wire to hole P (S-1).

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

( ) Red wire to hole AC (S-1).

NOTE: When you are instructed to pass a wire through a 1/2" clear sleeve, use the sleeve you installed on the previous page.

( ) Pass the white-black wire through the 1/2" clear sleeve and connect it to control R6 lug 3 (S-1). Pull any excess wire back through the sleeve and position it along the wire harness.

( ) Prepare a 24" black stranded wire and connect one end to hole R (S-1) on the generator circuit board. Then route the wire along the wire harness up through the 4-1/2" clear sleeve. NOTE: You may find this step easier to perform if you route the wire through the sleeve first. The free end of the wire will be connected in a later step.

( ) Prepare the following wires:

5-1/2" black solid
5-1/2" white-blue
6-1/2" green

Connect the prepared wires from the generator circuit board to the rear panel as follows:

( ) 5-1/2" black wire from hole BE (S-1) to solder lug AD (S-2).

( ) 5-1/2" white-blue wire from hole AJ (S-1) to BNC connector AE (S-1).

( ) 6-1/2" green wire from hole BC (S-1) to BNC connector AD (S-1).

( ) Prepare the following wires:

7-1/2" gray
7-1/2" white-red
7" yellow

Connect the prepared wires from the generator circuit board, through the 1/2" clear sleeve, to dual control R5/R6 on the front panel.

( ) 7-1/2" gray wire from hole AG (S-1) to control R6 lug 2 (S-1). Do not pass this wire around the black and white twisted wire pair.

( ) 7-1/2" white-red wire from hole AE (S-1) to control R5 lug 1 (S-1).

( ) 7" yellow wire from hole AF (S-1) to control R5 lug 2 (S-1).

( ) Prepare a 1-1/4" black solid wire and connect it from control R5 lug 3 (S-1) to control R6 lug 1 (NS).

( ) Prepare a 2-1/4" black solid wire and connect it from control R6 lug 1 (S-2) to hole AH (S-1) on the generator circuit board.

( ) Cut off the excess wire lengths from the foil side of the generator circuit board.

Refer to Pictorial 4-7 (on Page 13 in the Illustration Booklet) for the following steps.

( ) Position the chassis as shown.

Route the next four wires you connect next to the front panel.

( ) Connect the yellow wire from the generator circuit board to switch SW1 lug 10 (S-2). Press the wire against the sticky foam tape on the front panel.

( ) Connect the brown wire from the generator circuit board to switch SW1 lug 1 (S-1). Press the wire against the sticky foam tape on the front panel.

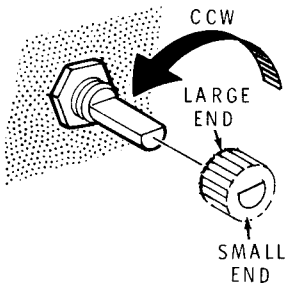
( ) Connect the white-green wire from the sweep circuit board to hole AT (S-1) on the generator circuit board.

( ) Connect the black wire from the sweep circuit board to hole BD (S-1) on the generator circuit board.

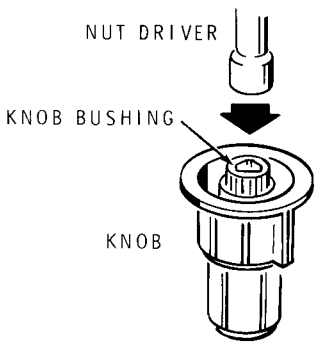
( ) Route the long black stranded wire from the generator circuit board (through the 4-1/2" sleeve) across the transformer, down the rear panel and along the edge of the output circuit board to hole L (S-1).

( ) Prepare a 2-1/2" black stranded wire and connect one end to hole N on the output circuit board. Solder the other end of the wire to the control side of the metal plate on switch/control assembly SW201/SW202/R203/SW203.

( ) Carefully examine the three circuit boards for wire clips lodged in the foil or in the components, and for solder splashes or bridges that may have formed as you soldered the wires in the previous steps. NOTE: Hole AP on the sweep circuit board does not have a wire connected to it. You may use this hole during calibration.



Detail 4-8A



Detail 4-8B

CHASSIS ASSEMBLY

Refer to Pictorial 4-8 (on Page 14 in the Illustration Booklet) for the following steps.

( ) Mount the top rail to the handles with two 6-32 × 1/2" flat head screws at FA and FD. Make sure the front panel is seated in the rail groove.

( ) Loosely mount two cam nuts to the top rail with two 6-32 × 3/8" black flat head screws at FB and FC.

( ) Rotate each cam nut clockwise until it is pressed tightly against the front panel. Then tighten each screw.

( ) Turn the chassis over and mount the bottom rail to the handles with two 6-32 × 1/2" flat head screws at FE and FH. Make sure the front panel is seated in the rail groove.

( ) In the same manner as before, install and tighten two cam nuts in the bottom rail at FF and FG with two 6-32 × 3/8" black flat head screws.

( ) Turn the chassis over.

( ) Remove the backing paper from the trim label. Then carefully align and press the label into the top rail.

NOTE: Examine the knob bushings before you perform the following steps. Notice that one end of each bushing has a larger hole and contains a metal insert. Always start the large hole end of the bushing onto the switch (control) shaft.

( ) Refer to Detail 4-8A and identify the large hole end of the short D-hole bushing. Then push this end of the bushing onto the Offset switch shaft.

( ) Turn the shaft fully counterclockwise and note the bushing position. Then turn the shaft fully clockwise and note the position. Turn the shaft to the center of its rotation.

( ) Align the white index mark on a combination knob with the "0" symbol on the front panel and push the knob onto the bushing.

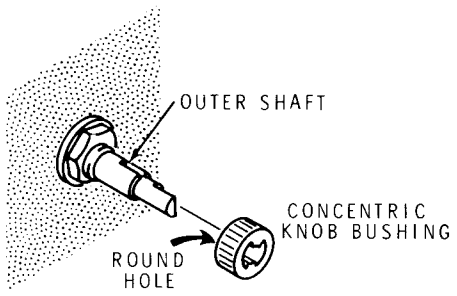
( ) Carefully pull the knob and bushing off together.

( ) Refer to Detail 4-8B and drive the bushing into the knob until the end of the bushing is flush with the inner flat surface of the knob. Use a nut driver or a similar object to drive the bushing into the knob.

( ) Reinstall the knob on the shaft.

( ) In a like manner, install a short D-hole bushing and combination knob on the Mode switch shaft. Turn the shaft fully counterclockwise and align the knob index mark with the square-wave symbol.

( ) In a like manner, install a short D-hole bushing and combination knob on the Frequency switch shaft. Turn the shaft fully counterclockwise and align the knob index mark with the "10¹" symbol.



Detail 4-8C

( ) Refer to Detail 4-8C and press a concentric knob bushing onto the outer shaft of the Attenuator switch. Note that the end of the bushing that is completely round is positioned toward the front panel.

( ) Turn the shaft fully counterclockwise.

( ) Align the white index mark on a black knob with the "50" symbol on the front panel and push the knob onto the bushing.

( ) Carefully pull the knob and bushing off together. Then drive the bushing into the knob as far as it will go.

( ) Reinstall the knob. Make sure the white index mark is pointed toward the "50" symbol.

( ) In a like manner, install a concentric knob bushing and black knob on the outer shaft of the Function switch. Turn the shaft fully counterclockwise and align the knob index mark with the "CW" symbol.

( ) In a like manner, install a concentric knob bushing and black knob on the outer shaft of the Sweep switch. Turn the shaft fully counterclockwise and align the knob index mark with "1 SEC."

( ) In a like manner, install a concentric knob bushing and black knob on the outer shaft of the Symmetry switch. Turn the shaft fully counterclockwise and align the knob index mark with "OUT."

( ) Press a large knob bushing onto the inner shaft, large end first, of the Attenuator switch.

( ) Turn the shaft fully counterclockwise into the detent position.

( ) Align the index mark of a red knob with "POWER OFF" on the front panel and press the knob onto the bushing.

( ) Carefully pull the knob and bushing off together. Then drive the bushing into the knob as far as it will go.

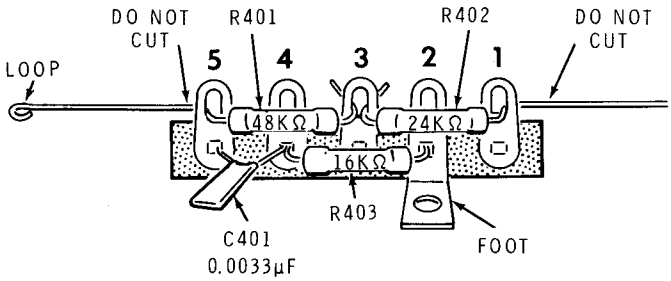
( ) Reinstall the knob.

( ) In a like manner, install a large knob bushing and red knob on the inner shaft of the Function switch. Turn the shaft fully counterclockwise into the detent position and align the knob index mark with "AUTO TRIG."

( ) In a like manner, install a large knob bushing and red knob on the inner shaft of the Sweep switch. Turn the shaft fully **clockwise** and align the knob index mark with "CAL."

( ) In a like manner, install a large knob bushing and red knob on the inner shaft of the Symmetry switch. Before you install the knob, turn the bushing fully counterclockwise and fully clockwise and note the bushing position for each rotation. Then turn the bushing to the center of its rotation and align the knob index mark vertical to the top of the front panel.

This completes assembly of the Generator except for installation of the top, bottom, and side panels. Temporarily set the Generator aside and assemble the notch filter, jumper wire, and test resistor needed for calibration, and the test cable used for general operation.



PICTORIAL 5-1

NOTCH FILTER ASSEMBLY

Refer to Pictorial 5-1 for the following steps.

( ) Locate the 5-lug terminal strip and position it as shown with the foot toward you.

( ) C401: Connect a 0.0033 μF Mylar capacitor between the eyelet of lug 5 (S-1) and the eyelet of lug 4 (NS).

( ) R403: Connect a 16 kΩ precision resistor between the eyelet of lug 4 (NS) and the eyelet of lug 2 (S-1).

( ) R401: Connect a 48 kΩ precision resistor between lugs 5 (S-1) and 3 (NS). Then bend a loop in the end of the indicated lead. Do not cut this lead off.

( ) R402: Connect a 24 kΩ precision resistor between lugs 3 (NS) and 1 (S-1). Do not cut off the lead coming from lug 1.

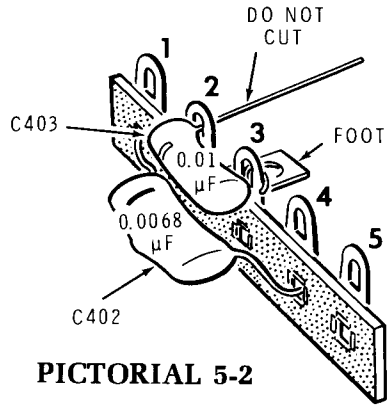
Refer to Pictorial 5-2 for the following steps.

( ) Position the terminal strip so the foot is facing away from you.

( ) C402: Connect a 0.0068 μF Mylar capacitor between the eyelet of lug 1 (S-1) and the eyelet of lug 4 (S-3). Disregard any polarity marks on the capacitor.

( ) C403: Connect a 0.01 μF Mylar capacitor between lugs 2 (S-1) and 3 (S-3). Do not cut off the lead coming from lug 2. Disregard any polarity marks on the capacitor.

Temporarily set the notch filter aside.



PICTORIAL 5-2

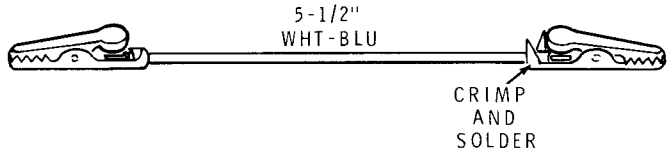
JUMPER WIRE

Refer to Pictorial 5-3 for the following steps.

( ) Prepare a 5-1/2" white-blue wire.

( ) Crimp and solder an alligator clip to each end of the wire.

Temporarily set the jumper wire aside.



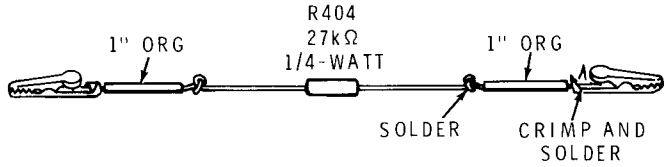
PICTORIAL 5-3

TEST RESISTOR

Refer to Pictorial 5-4 for the following steps.

( ) R404: Bend a small hook on the end of each lead of a 27 kΩ 1/4-watt, 5% (red-violet-orange) resistor.

( ) Prepare two 1" orange wires.



PICTORIAL 5-4

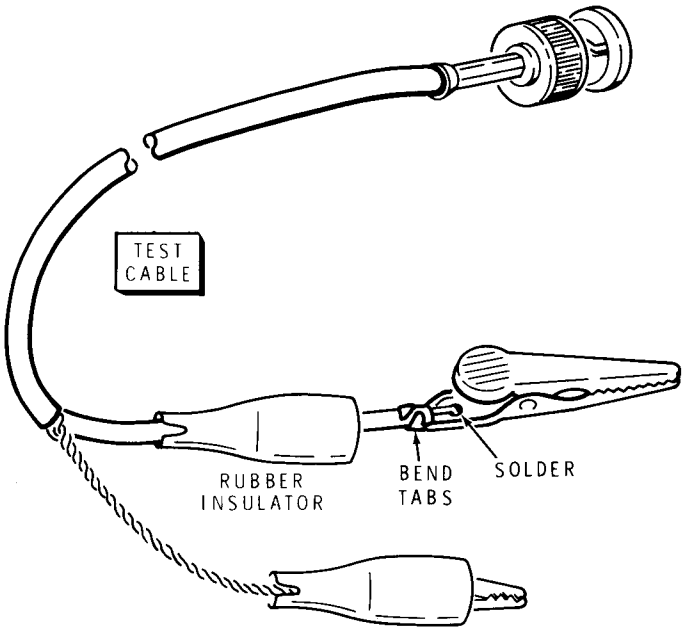
( ) Bend a small hook on one end of an orange wire. Then hook the wire to either resistor lead and solder the connection.

( ) In a like manner, hook and solder the second orange wire to the other resistor lead.

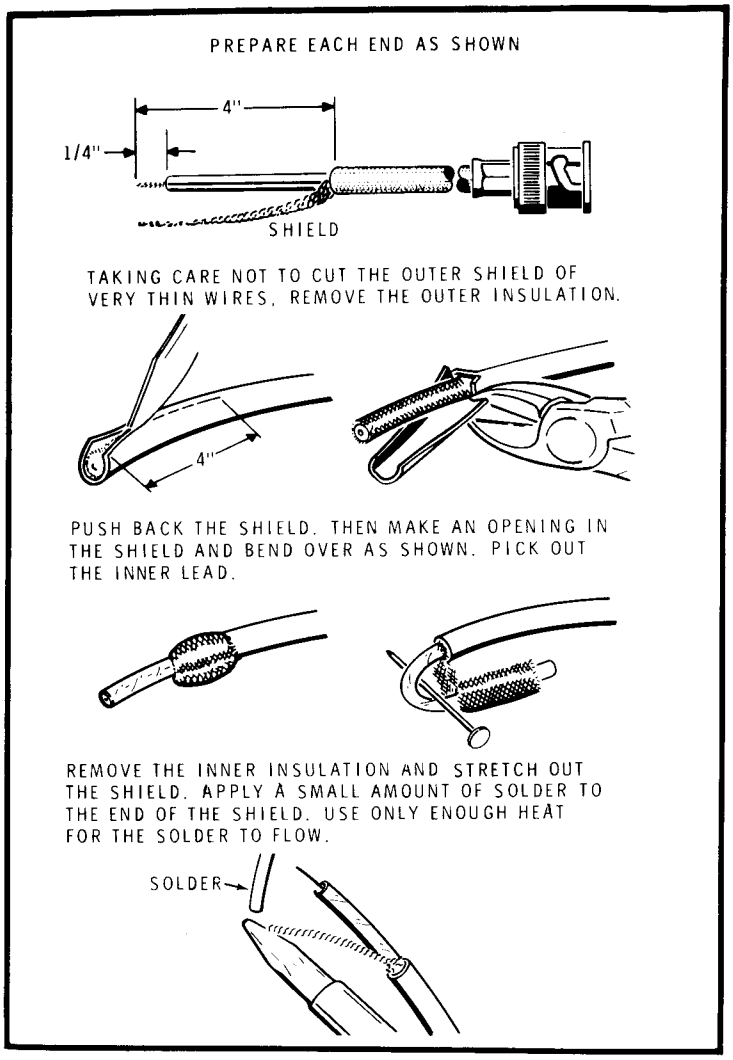
( ) Crimp and solder an alligator clip to the end of either orange wire.

( ) Crimp and solder an alligator clip to the end of the other orange wire.

Temporarily set the test resistor aside.



PICTORIAL 5-5



Detail 5-5A

TEST CABLE

Refer to Pictorial 5-5 for the following steps.

( ) Refer to Detail 5-5A and prepare the indicated end of the cable assembly.

( ) Push a rubber insulator onto the inner lead and one onto the shield lead of the cable.

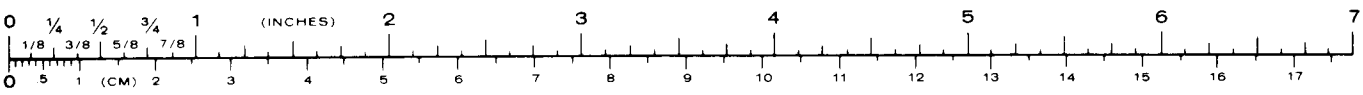
( ) Solder an alligator clip to the end of the inner lead.

( ) 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 cilips.

( ) Temporarily set the test cable aside.

This completes "Step-by-Step Assembly." Proceed to "Initial Tests and Adjustments."



INITIAL TESTS AND CALIBRATION

The purpose of this section is to make sure your Generator operates properly. It also provides the Generator calibration procedure. To perform the various tests and adjustments, the following instruments are required:

- An ohmmeter.
- An AC voltmeter (to monitor line voltage).
- A DC voltmeter with a minimum of 1 MΩ input impedance.
- A DC, triggered oscilloscope with calibrated time base and vertical input.

The following instruments are useful, but not necessary for calibration:

- A 3 MHz frequency counter.
- A high frequency AC voltmeter.
- A harmonic distortion analyzer.

Refer to the "Operation" section on Page 82 and familiarize yourself with the Generator before you begin the tests.

NOTE: If at any time you do not obtain the results indicated, refer to the "In Case of Difficulty" section on Page 86.

Some of the steps and paragraphs, to help you locate any problems, contain a reference to one of the "In Case of Difficulty" "Test Charts." Be sure to read the "In Case of Difficulty" section before you use the "Test Charts."

PRIMARY WIRING TESTS

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

Perform the following resistance measurements. Connect the meter leads, and position the POWER switch and LINE switches as instructed in the chart. NOTE: Use the metal plate on the end of the ATTENUATION switch for ground.

METER CONNECTIONS		METER READING X10 RANGE	POSSIBLE CAUSE OF TROUBLE
RED LEAD	BLACK LEAD		
1. Either flat prong of the line cord plug.	Ground.	INFINITE with the POWER switch ON or OFF.	A. Switch wiring. B. Transformer. C. Line cord.
2. Other flat prong of the line cord plug.	Ground.	INFINITE with the POWER switch ON or OFF.	A. Switch wiring. B. Transformer. C. Line cord.
3. Round prong of the line cord plug.	Ground.	0 Ω with the POWER switch ON or OFF.	A. Green lead of the line cord not properly connected at lug AG.
4. Either flat prong of the line cord plug.	Other flat prong of the line cord plug.	1 MΩ or higher with the POWER switch OFF.	A. Transformer. B. Switch wiring. C. Line cord.
5. Either flat prong of the line cord plug.	Other flat prong of the line cord plug.	POWER switch ON. 120/240 switch 120 NOR/LOW switch NOR — 20 Ω 120/240 switch 120 NOR/LOW switch LOW — 22 Ω 120/240 switch 240 NOR/LOW switch NOR — 75 Ω 120/240 switch 240 NOR/LOW switch LOW — 80 Ω NOTE: All readings are ±20%.	A. Transformer. B. Switch wiring. C. Line cord. D. Fuse.

CALIBRATION

If you are initially calibrating this instrument, preset all of the internal controls to the center of their rotation. If you are recalibrating the instrument, do not preset the internal controls.

( ) If necessary, remove the top, bottom, and side panels.

( ) Refer to Figure 1 (on Page 15 in the Illustration Booklet) and preset the front panel controls as follows:

FREQUENCY control — 3.0.

SWEEP LIMIT control — Fully counterclockwise rotation (align with 3.0).

FREQUENCY switch — 10^4.

FUNCTION switch — CW.

TRIG LEVEL control — AUTO TRIG (detent).

MODE switch — Square wave.

OFFSET control — Pushed in and centered on "0".

SYMMETRY switch — OUT.

% POSITIVE control — Center of rotation.

SWEEP switch — 100 mS.

SWEEP VARIABLE control — Fully clockwise to CAL (detent).

ATTENUATOR switch — 0 dB.

ATTENUATOR VARIABLE control — POWER OFF (detent).

Refer to Figure 2 (on Page 15 in the Illustration Booklet) for the following steps.

( ) Set the 120/240 switch (on the switch mounting plate) to the value that matches your nominal line voltage.

( ) Measure your line (AC) voltage. If it is nominally between 110 and 135 volts, set the NOR/LOW switch (on the switch mounting plate) to NOR. If your voltage is nominally below 110 volts, set the switch to LOW.

WARNING: High AC voltage is present on the chassis at several locations when the line cord plug is connected to AC power. Refer to Figure 2 (in the Illustration Booklet).

NOTE: During calibration, you will be using three different circuit board figures. Pay close attention to the figure references in this section.

( ) Connect the line cord plug to an AC power receptacle.

Refer to Figure 3 (on Page 15 in the Illustration Booklet) for the following steps.

( ) Connect the DC voltmeter between TP6 (test point 6) and ground. NOTE: Use the black wire on the front panel Frequency/Sweep controls for ground.

NOTE: Refer to Test Chart #2 in the Illustration Booklet if you have difficulty in the following steps.

( ) Turn the Generator on (rotate the ATTENUATOR VARIABLE control fully clockwise to CAL.) The PWR lamp should illuminate and the DC voltmeter should indicate approximately −15 ±2 volts.

( ) Allow approximately 30 minutes for the Generator components to warm up and stabilize.

( ) Adjust VOLT ADJ control R108 for −15 ±0.5 volts. Record this voltage reading 15.01 / 14.97.

( ) Now connect the DC voltmeter to TP5 and adjust BAL control R107 for a positive voltage equal in value to the voltage in the previous step.

( ) Remeasure the −15 volt and +15 volt supplies (TP6 and TP5). Although the negative supply can vary ±0.5 volts, the positive supply **must** be identical in value to the negative supply.

NOTE: Refer to Test Chart #1 in the Illustration Booklet if you have difficulty in the following steps.

( ) Measure the voltage at TP7; it should be +5 ±0.25 volts.

( ) Measure the voltage at TP8; it should be −5 ±0.25 volts.

( ) Turn the Generator off.

( ) Connect TP1 to ground with a jumper wire. (TP1 is the end lug on the Frequency switch.)

( ) Turn the Generator on. NOTE: When you turn the Generator on; always turn the ATTENUATOR VARIABLE control fully clockwise to CAL.

( ) Connect the DC voltmeter to TP2.

NOTE: Refer to Test Chart #3 in the Illustration Booklet if you have difficulty in the following steps.

( ) Adjust OFFSET control R153 through 0 volts, and then back to 0 volts. NOTE: If you cannot adjust through 0 volts, interchange field-effect transistors Q103 and Q104. Be sure to leave the ferrite bead at location Q104.

( ) Remove the ground from TP1.

( ) Connect your oscilloscope (and frequency counter, if available) to the SYNC OUTPUT connector.

( ) Adjust HIGH FREQ control R112 for 30 kHz ±500 Hz.

( ) Turn the front panel FREQUENCY control fully clockwise.

( ) Adjust LOW FREQ control R119 for 17 Hz ±5 Hz. NOTE: If you cannot adjust the frequency within tolerance, complete the following numbered steps.

1. Turn the Generator off.
2. Refer to the inset drawing in Figure 3 (in the Illustration Booklet) and locate the split foil pad labeled R117.
3. Solder the two halves of foil pad R117 on the generator circuit board together.
4. Turn the Generator on and adjust for 17 Hz ±5 Hz. NOTE: If the frequency adjusts within tolerance, disregard the remaining numbered steps.
5. Turn the Generator off and remove the solder across foil pad R117.
6. Solder the two halves of foil pad R120 together.
7. Turn the Generator on and adjust for 17 Hz ±5 Hz. NOTE: If the frequency adjusts within tolerance, disregard the remaining numbered steps.
8. Turn the Generator off and solder the two halves of foil pad R117 together.
9. Turn the Generator on and adjust for 17 Hz ±5 Hz.

( ) Turn the front panel FREQUENCY control to 3.0 and adjust HIGH FREQ control R112 for 30 kHz ±500 Hz.

( ) Turn the front panel FREQUENCY control fully clockwise and adjust LOW FREQ control R119 for 17 Hz ±5 Hz.

( ) Repeat the two previous steps until the high and low frequencies are within tolerance.

( ) Turn the front panel FREQUENCY control clockwise until you obtain a 30 Hz output (±5 Hz).

NOTE: The SYMMETRY adjustment will effect the FREQUENCY adjustment.

( ) Adjust SYMMETRY control R143 (on the generator circuit board) for a symmetrical square wave. If this cannot be done, it may be necessary to exchange IC105 with IC104, IC106 or IC107.

Refer to Figure 2 (in the Illustration Booklet) for the following steps.

If you have difficulty in the following steps refer to Test Chart #5 in the Illustration Booklet.

WARNING: High AC voltage is present around the output circuit board. Be careful when you perform the following adjustments.

( ) Turn the front panel VARIABLE ATTENUATOR control fully counterclockwise but do not turn the power off.

( ) Connect TP2 to ground with a jumper wire.

( ) Connect the DC voltmeter to the front panel OUTPUT connector and adjust OUTPUT OFFSET control R264 for 0 volts.

( ) Disconnect the voltmeter, and remove the jumper wire from TP2 and ground.

( ) Turn the front panel VARIABLE ATTENUATOR control to CAL.

( ) Turn the front panel FREQUENCY control to 3.0.

( ) Connect the oscilloscope to the front panel OUTPUT connector. NOTE: Use a high impedance oscilloscope probe and clip the ground lead to the connector shell. If you do not use an oscilloscope probe, you must use 50-ohm coaxial cable with an accurate 50-ohm cable terminator.

( ) Note the amplitude of the square wave.

( ) Turn the MODE switch to the triangle wave symbol and note the waveform amplitude.

( ) Set the MODE switch to the waveform with the least amplitude.

( ) Adjust OUTPUT GAIN control R252 for the correct signal amplitude:

20 volts peak-to-peak with high impedance oscilloscope probe.

10 volts peak-to-peak with 50-ohm termination.

( ) Turn the MODE switch to the square waveform symbol.

( ) Turn the FREQUENCY switch to 10^6 and adjust 3 MHZ ADJ trimmer C209 for an optimum square-wave display. You may have to use time base expansion on your oscilloscope for a usable display. NOTE: Depending on the frequency response of your oscilloscope, the display may look like a fat sine wave rather than a true square wave.

Refer to Figure 3 (in the Illustration Booklet) for the following steps. If you have difficulty in the following steps, refer to Test Chart #3 in the Illustration Booklet.

( ) If a frequency counter is available, connect it to the front panel SYNC OUTPUT connector. NOTE: The oscilloscope should remain connected to the OUTPUT connector.

( ) Turn the MODE switch to the triangle wave symbol.

( ) Turn the FREQUENCY switch to 10^5 and observe the signal amplitude.

NOTE: In the next step, again make sure you have proper cable termination. If necessary, connect only the oscilloscope when you adjust C138, and only the frequency counter when you adjust C149.

( ) Turn the FREQUENCY switch to 10^6 and adjust FLAT trimmer C138 for a signal amplitude identical to the amplitude in the previous step, and 3 MHz ADJ trimmer C149 for 3 MHz ±90 kHz. NOTE: These two trimmers will interact with each other.

( ) Repeat the two previous steps until the amplitudes are identical, and the 10^6 output is 3 MHz.

( ) Turn the FREQUENCY switch to 10^6.

( ) Turn the front panel FREQUENCY control fully clockwise.

( ) Adjust ANALOG FREQ control R194 for 0 volts DC at the ANALOG OUTPUT connector on the rear panel.

Refer to Figure 2 (in the Illustration Booklet) for the following steps.

If you have difficulty in the following steps, refer to Test Chart #5 in the Illustration Booklet.

WARNING: High AC voltage is present around the output circuit board. Be careful when you perform the following adjustments.

( ) Connect TP1 to ground with a jumper wire. (Use the resistor lead next to TP1.)

( ) Turn the FREQUENCY switch to 10^3.

( ) Turn the MODE switch to the sine-wave symbol.

( ) Connect the DC voltmeter to the front panel OUTPUT connector and adjust SINE OFFSET control R212 for 0 volts.

( ) Disconnect the voltmeter and remove the jumper wire from TP1 and ground.

NOTE: A harmonic distortion analyzer is the preferred instrument to be used in the next step. If you do not have one, a notch filter is adequate.

( ) Refer to Figure 4 (on Page 14 in the Illustration Booklet) and connect the analyzer or the notch filter to the front panel OUTPUT connector and your oscilloscope as shown. An AC voltmeter can be substituted for the oscilloscope. NOTE: If you have difficulty adjusting the sine wave, refer to Test Chart #4.

( ) Turn the front panel FREQUENCY control to 1.0 (1000 Hz). Then carefully turn this control for minimum signal on the oscilloscope.

( ) Alternately adjust NEG PEAK control R216, POS PEAK control R245, NEG BREAK control R226, and POS BREAK control R239 for minimum signal on the oscilloscope.

( ) Adjust the front panel FREQUENCY control for minimum signal on the oscilloscope. NOTE: Disregard this step if you are using a harmonic distortion analyzer.

( ) Repeat the two previous steps until the signal is reduced as far as possible.

( ) Disconnect the notch filter (or analyzer).

( ) Connect the oscilloscope to the front panel OUTPUT connector.

( ) Turn the MODE switch to the triangle-wave symbol and note the signal amplitude.

( ) Turn the MODE switch to the square wave symbol and note the signal amplitude.

( ) After comparing amplitudes, select the waveform with least amplitude, with the MODE switch.

Refer to Figure 2 (on Page 12 in the Illustration Booklet) for the following steps.

( ) Adjust OUTPUT GAIN control R252 for the correct signal amplitude:

20 volts, peak-to-peak with a high impedance oscilloscope probe.

10 volts peak-to-peak with 50-ohm termination.

( ) Turn the MODE switch to the sine-wave symbol and adjust the SINE GAIN control R203 for a signal amplitude equal to the amplitude of the signal in the previous step.

( ) Turn the FREQUENCY switch to 10^5.

( ) Turn the front panel FREQUENCY control to 3.0 and note the signal amplitude.

( ) Turn the FREQUENCY switch to 10^6 and adjust SINE FLAT trimmer C207 for a signal amplitude equal to the amplitude noted in the previous step.

Refer to Figure 5 (on Page 15 in the Illustration Booklet) for the following steps.

If you have difficulty in the following steps, refer to Test Chart #6 in the Illustration Booklet.

( ) Connect a jumper wire between TP1 and TP2 (across capacitor C309).

( ) Connect the DC voltmeter to the SWEEP OUT connector on the rear panel and adjust OFFSET control R322 through 0 volts and then back to 0 volts. NOTE: If you cannot adjust through 0 volts, perform the following numbered steps.

1. Turn the Generator off.
2. Unsolder the violet jumper wire from hole AR, and resolder it to hole AP.
3. Turn the Generator on and perform the adjustment. NOTE: If you were able to adjust through 0 volts, disregard the remaining numbered steps.

4. Turn the Generator off and interchange field-effect transistors Q303 and Q304.

5. Turn the Generator on and perform the adjustment. NOTE: If you were able to adjust through 0 volts, disregard the remaining steps.

6. Turn the Generator off, unsolder the violet jumper wire from hole AP and resolder it to hole AR.

7. Turn the Generator on and perform the adjustment.

( ) Remove the jumper wire between TP1 and TP2.

( ) Turn the SWEEP switch to 100 μS.

( ) Turn the FUNCTION switch to LINEAR SWEEP.

( ) Connect the oscilloscope to the rear panel SWEEP GATE OUTPUT connector and adjust FREQ control R301 for a 100 μS pulse width (the positive portion of the waveform).

( ) Rotate the front panel SWEEP VARIABLE control fully counterclockwise. You should obtain a pulse width **at least** 10 mS wide. If you do not, perform the following numbered steps.

1. Turn the Generator off.

2. Refer to the inset drawing in Figure 5 and locate the split foil pad labeled R304.

3. Solder the two halves of foil pad R304 on the sweep circuit board together.

4. Turn the Generator on. If the pulse width is at least 10 mS, disregard the remaining numbered steps.

5. Turn the Generator off and remove the solder across foil pad R304.

6. Solder the two halves of foil pad R305 together.

7. Turn the Generator on. If the pulse width is at least 10 mS, disregard the remaining numbered steps.

8. Turn the Generator off and solder the two halves of foil pad R304 together.

9. Turn the Generator on. The pulse width is now a minimum of 10 mS wide.

( ) Connect the oscilloscope to the SWEEP OUTPUT connector on the rear panel.

( ) Turn the front panel SWEEP VARIABLE control fully clockwise to CAL.

( ) Turn the SWEEP switch to 100 mS.

( ) Connect the test resistor between TP1 and TP2 (across capacitor C309).

NOTE: A ramp signal is displayed on the oscilloscope. As the front panel SWEEP VARIABLE control is turned counterclockwise, the ramp sweep rate will decrease until the ramp stops completely. As the control is turned further, the DC voltage level of the signal will decrease.

( ) Turn the front panel SWEEP VARIABLE control counterclockwise until the ramp signal stops sweeping. Then carefully adjust the control for a maximum DC level. This level is approximately 4.5 volts.

( ) Turn the front panel FREQUENCY control fully clockwise.

( ) Turn the front panel SWEEP LIMIT control clockwise so that its lever is centered at 3.0 on the FREQUENCY control.

( ) Turn the FREQUENCY switch to 10^4.

( ) Connect the oscilloscope (and frequency counter if available) to the SYNC OUTPUT connector.

( ) Refer to Figure 3 (in the Illustration Booklet) and adjust SWEEP GAIN control R115 for 30 kHz ±500 Hz.

( ) Remove the test resistor from between TP1 and TP2. Then connect the jumper wire between TP1 and TP2.

( ) Allow the sweep circuit a minimum of five minutes to stabilize. The SYNC OUTPUT frequency will decrease to a low rate (below 100 Hz).

( ) Refer to Figure 5 (in the Illustration Booklet) and turn OFFSET control R322 clockwise a small amount. The signal displayed on the oscilloscope will increase in frequency. Turn the control counterclockwise and watch the oscilloscope. The frequency will slowly decrease until it stabilizes at approximately 7 Hz. Note that there is no change in frequency as you turn the control further counterclockwise. Slowly turn the control clockwise until the frequency **just** begins to increase. NOTE: The frequency may slowly drift back to 7 Hz. This is normal.

( ) Remove the jumper wire from between TP1 and TP2.

( ) Turn the FUNCTION switch to LOG SWEEP.

NOTE: Perform the next three steps if you are calibrating the Generator for the first time. Otherwise, disregard the next three steps.

( ) IC307: Turn the generator off and locate the 8049 integrated circuit (#442-619) that you saved in the sweep circuit board assembly steps. Then refer to Figure H in the "Illustration Booklet" and identify pin 1 on the integrated circuit. Insert the integrated circuit into socket IC307. Turn the Generator on and allow five minutes for it to stabilize.

( ) Refer to Figure 5 (in the Illustration Booklet) and connect the DC voltmeter to TP3. Adjust LOG ZERO control R349 through 0 volts and then back to 0 volts.

( ) Turn the Generator off, pull the white jumper wire connector from connector pin R and push it onto connector pin P. Then turn the Generator on.

( ) Connect the oscilloscope to the rear panel SWEEP OUTPUT connector.

( ) Connect the test resistor between TP1 and TP2.

( ) Turn the front panel SWEEP VARIABLE control clockwise until you observe a ramp signal on the oscilloscope. Then turn the control counterclockwise until the ramp stops (signal level approximately 4.5 volts).

( ) Refer to Figure 5 (in the Illustration Booklet) and connect the DC voltmeter to TP3 and adjust LOG FS control R343 for 10 ±0.1 volts.

( ) Connect the oscilloscope (frequency counter, if available) to the front panel OUTPUT connector and adjust LOG SWEEP control R352 for 30 kHz ±500 Hz.

( ) Connect the DC voltmeter to the rear panel SWEEP OUTPUT connector and adjust the front panel SWEEP VARIABLE control for 1.5 ±0.01 volts.

( ) Adjust LOG CAL control R347 for 300 Hz ±5 Hz at the front panel OUTPUT connector.

( ) Remove the test resistor from between TP1 and TP2, and connect the jumper wire between TP1 and TP2.

( ) Adjust LOG ZERO control R349 for 17 Hz ±5 Hz.

( ) Remove the jumper wire from between TP1 and TP2.

( ) Turn the front panel SWEEP VARIABLE control fully clockwise to CAL.

( ) Turn the front panel FREQUENCY control to 3.0.

( ) Turn the front panel SWEEP LIMIT control fully counterclockwise.

( ) Turn the FUNCTION switch to BURST.

( ) Adjust the oscilloscope reference ground line to the center graticule line (oscilloscope DC coupled).

( ) Turn the front panel TRIG LEVEL control to the center of its rotation.

( ) Turn the SWEEP switch to 100 μS.

( ) Turn the front panel SWEEP VARIABLE control to the center of its rotation.

( ) Turn the MODE switch to the triangle-wave symbol.

( ) Connect the oscilloscope to the front panel OUTPUT connector.

( ) Adjust the front panel TRIG LEVEL control for a waveform that contains two cycles and a base line.

( ) Adjust BASE LINE control R361 to position the signal base line on the center graticule line of the oscilloscope.

( ) Turn the front panel TRIG LEVEL control to AUTO TRIG.

( ) Turn the front panel SWEEP VARIABLE control to CAL.

( ) Disconnect all of the test equipment.

This completed the "Calibration." If you are performing "Initial Tests and Calibration" for the first time, proceed with "Generator Tests" and verify the operation of the remaining circuits that require no calibration. If you were recalibrating the Generator, turn it off, disconnect the line cord plug, and reinstall the top, bottom, and side panels.

GENERATOR TESTS

These tests are to verify that the remaining Generator circuits that were not examined during calibration function properly. Do not change the Generator switch and control settings from the previous page unless you are instructed to do so.

( ) Turn the FUNCTION switch to CW.

( ) Connect the oscilloscope to the front panel OUTPUT connector. You should observe a 30 kHz, 20-volt peak-to-peak (minimum) triangle waveform (high impedance oscilloscope probe).

( ) Connect the oscilloscope to the front panel SYNC OUTPUT connector. You should observe a 30 kHz square wave at 1.5 volts peak-to-peak, minimum.

( ) Connect the DC voltmeter to the rear panel ANALOG OUTPUT connector. You should measure approximately +6 volts. Turn the front panel FREQUENCY control clockwise. As the indicated frequency decreases, the voltage decreases.

( ) Turn the front panel FREQUENCY control to 3.0.

( ) Connect the oscilloscope to the front panel OUTPUT connector. Be sure to properly terminate the cable or use a high impedance oscilloscope probe.

( ) Turn the MODE switch to the square-wave symbol.

( ) Adjust the ATTENUATOR switch and control for a 5-volt peak-to-peak signal.

( ) Pull the OFFSET PULL switch/control to its out position. Then, as you observe the oscilloscope, turn the control fully clockwise and fully counterclockwise. The waveform should deflect completely above and below reference ground (DC coupled oscilloscope input).

( ) Push the OFFSET PULL switch/control in. The waveform should return to a position centered over reference ground.

( ) Turn the SYMMETRY switch to IN. The frequency should divide by approximately 10.

( ) Turn the % POSITIVE control fully clockwise and fully counterclockwise. The symmetry of the waveform should change from a 95% pulse width to a 5% pulse width.

( ) Turn the SYMMETRY switch to OUT. The frequency should increase by approximately 10 and the waveform should be symmetrical.

( ) Turn the FUNCTION switch to GATE. The square-wave signal should still be visible.

( ) Slowly turn the front panel TRIG LEVEL control clockwise until the signal disappears.

( ) Press the TRIGGER pushbutton switch. The signal will reappear as long as the button is pressed. Release the pushbutton.

( ) Connect the test cable to the front panel EXT TRIG connector.

( ) Return to Figure 3 (in the Illustration Booklet) and locate TP7 (+5-volt supply). Then touch the inner lead of the cable to TP7. The signal should appear as long as you touch TP7. Disconnect the test cable from TP7 and the EXT TRIG connector.

( ) Turn the TRIG LEVEL control to the AUTO TRIG position. The signal will reappear.

( ) Turn the front panel FREQUENCY control fully clockwise. The signal frequency will change to less than 30 Hz.

( ) Connect the test cable to the rear panel VCG INPUT connector.

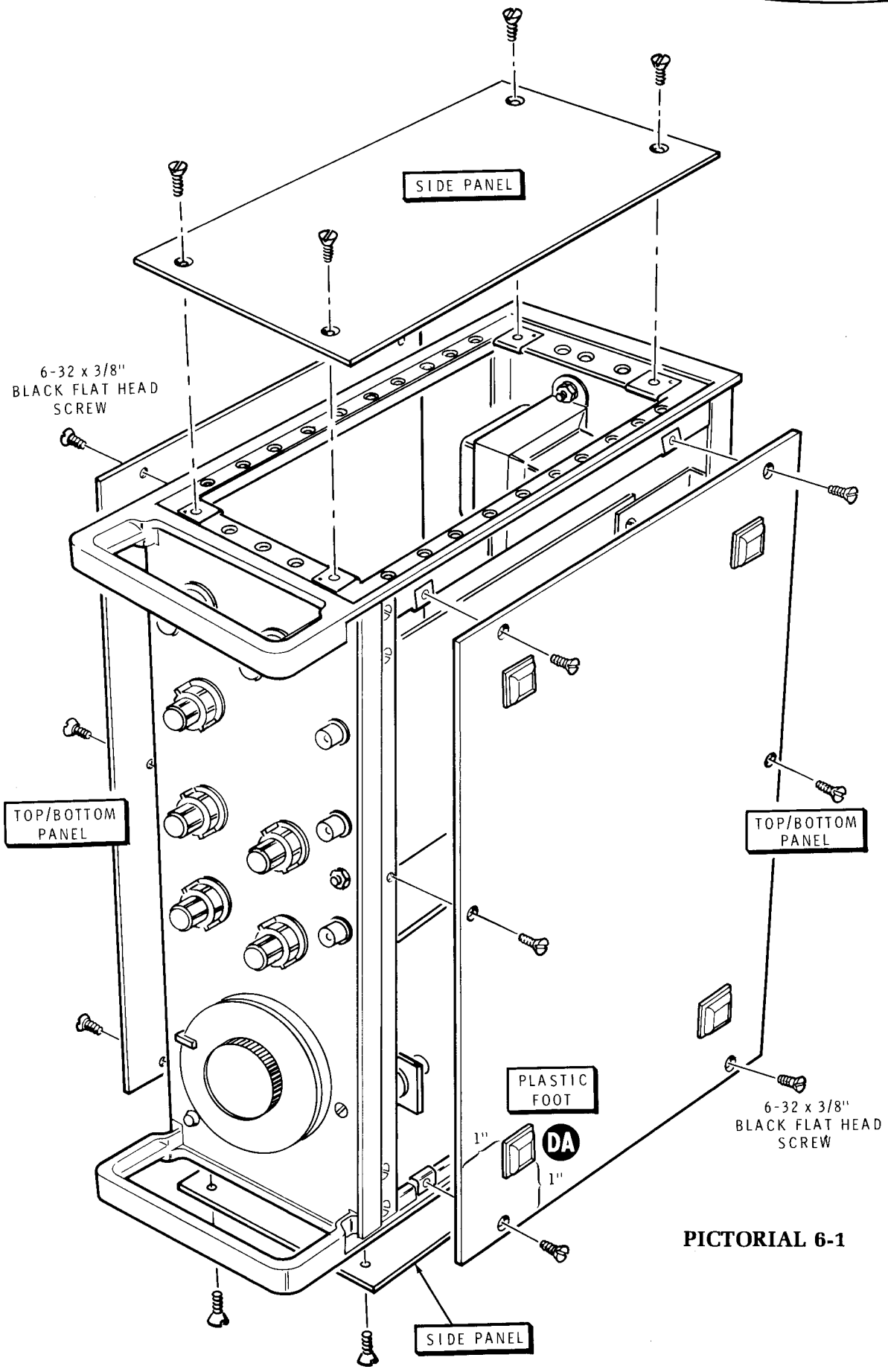
( ) Refer to Figure 3 and locate TP7 (+5-volt supply). Then touch the inner lead of the cable to TP7. The signal frequency should increase to approximately 30 kHz and remain at that frequency as long as you touch TP7. Disconnect the test cable from TP7 and the VCG INPUT connector.

( ) Disconnect the test equipment.

( ) Turn the Generator off.

( ) Disconnect the Generator line cord plug.

This completes the "Initial Tests and Calibration." Save the notch filter, test resistor, and jumper wire for any future recalibration. Proceed to "Final Assembly."



PICTORIAL 6-1

FINAL ASSEMBLY

Refer to Pictorial 6-1 for the following steps.

( ) Position the Generator as shown.

( ) Mount a top/bottom panel to the bottom of the Generator with six 6-32 × 3/8" black flat head screws. NOTE: The two center holes on the panel are offset.

( ) Remove the paper backing from a plastic foot and apply the foot to the bottom panel at DA as shown.

( ) In a similar manner, mount the remaining three plastic feet at the remaining three corners.

( ) Mount a side panel to the left handle with four 6-32 × 3/8" black flat head screws.

( ) Mount a side panel to the right handle with four 6-32 × 3/8" black flat head screws.

( ) Mount a top/bottom panel to the top of the Generator with six 6-32 × 3/8" black flat head screws.

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

OPERATION

This section of the Manual explains the function of each control, switch, and connector, and their interrelationship. Refer to Figure 1 (in the Illustration Booklet) for an illustration of the front panel.

FRONT PANEL

1. Power lamp — Illuminates when the Generator is turned on.

2. **FREQUENCY** control — Sets the main generator frequency for continuous wave, gate, and burst modes of operation. Determines the sweep-start frequency in the linear sweep and log sweep modes of operation. Provides three decades of adjustment.

3. **FREQUENCY** vernier — Provides a 6:1 drive reduction for precise main generator frequency setting.

4. **SWEEP LIMIT** control — Sets the sweep-stop frequency in the linear sweep and log sweep modes of operation. The sweep-stop frequency is determined by the position of the lever (on the dial) in relation to the engraved numbers on the FREQUENCY dial. This control is disabled in the continuous wave, gate, and burst modes.

5. **FREQUENCY** switch — Selects the main generator frequency multiplier.

6. **FUNCTION** switch — Selects the various Generator operational functions:

   CW (continuous wave) — Couples the continuous wave signal from the main generator to the OUTPUT connector.

   GATE — With the TRIG LEVEL control in the AUTO TRIG position, the continuous wave signal is coupled from the main generator to the OUTPUT connector. With the TRIG LEVEL control turned clockwise, the main generator output is enabled by an external trigger signal applied to the EXT TRIG connector. When the trigger signal is removed, the main generator will complete its final cycle before it turns off. If you desire a single pulse output, the external trigger pulse must be of shorter duration than one cycle from the main generator. The TRIG pushbutton can also be used to enable the main generator output. The output of the SWEEP GATE OUTPUT connector is high while the main generator is enabled.

BURST — The composite burst signal is generated by the main and secondary generators. The SWEEP switch and SWEEP VARIABLE control adjust the frequency of the secondary generator and thus, the burst cycle rate. The FREQUENCY switch and the FREQUENCY control adjust the main generator frequency, and through it, the period of each cycle in the burst. Note that the secondary generator must be set to a period greater than the main generator period (p = 1/f). The Generator operates in the Auto Trigger mode regardless of TRIG LEVEL control position. This allows the use of the TRIG LEVEL control to select the number of cycles per burst. The output of the SWEEP GATE OUTPUT connector is high only for the duration of the burst.

LINEAR SWEEP — The SWEEP switch and SWEEP VARIABLE control adjust the frequency of the secondary generator and, in turn, the period of each sweep cycle. The frequency being swept is determined by the main generator. The FREQUENCY switch and FREQUENCY control set the sweep-start frequency, while the SWEEP LIMIT control sets the frequency to which the main generator sweeps. Due to the extremely rapid sweep rate, the 10 μS sweep is not intended for use in the Sweep mode.

The sweep circuit will continue to "free-run" with the TRIG LEVEL control in AUTO TRIG. If the control is turned clockwise, the sweep must be enabled by an external trigger. This can be applied to the EXT TRIG connector, or produced by pressing the TRIGGER switch. The sweep must complete its cycle before it can be started again.

The sweep ramp produced by the secondary generator is coupled to the SWEEP OUTPUT connector. The output of the SWEEP GATE OUTPUT connector is high for the duration of the sweep.

LOG SWEEP — The log sweep circuit is similar to the linear sweep circuit, with one exception. The swept frequency increases at a logarithmic rate. However, the ramp signal at the SWEEP OUTPUT connector remains linear.

7. **TRIG LEVEL** control — This control serves two basic functions. When the gate, linear sweep, or log sweep signals are selected, the control sets the voltage level required at the EXT TRIG connector to enable the Generator output. With the control in AUTO TRIG, the signals are "free-running."

   When the burst signal is selected, the Generator output is enabled regardless of control position. The control is used to select the number of cycles in each burst. With the control in AUTO TRIG, only one cycle is generated in each burst.

8. **MODE** switch — Selects the main generator waveform: Sine, triangle, or square.

9. **OFFSET** control — Allows continuously variable DC offset of the signal at the OUTPUT connector [limited to ±10 volts (open circuit) total signal plus offset]. The DC offset functions independently of the VARIABLE output attenuator, but is attenuated proportionally with the ATTENUATOR switch. This control is activated when pulled to its out position.

10. **ATTENUATOR** switch — Attenuates the output signal in 10 dB steps. Any signal offset is attenuated proportionally.

11. **VARIABLE ATTENUATOR** control — Provides continuously variable attenuation of the output signal from 0 to −20 dB (does not affect signal offset).

12. **OUTPUT BNC** connector — Main Generator output. Refer to the "Attenuation Output Chart" on Page 85.

13. **EXT TRIG BNC** connector — Input for external trigger signal. Used to enable the Generator when the FUNCTION switch is in the GATE, LINEAR SWEEP, or LOG SWEEP positions, and the TRIG LEVEL control is turned clockwise.

14. **SWEEP** switch — Selects the period of the secondary (sweep) generator. Used in conjunction with the burst, linear sweep, and log sweep functions. Should not be turned to the 10 μS position for either sweep function. In the burst function, the secondary generator affects the number of cycles in each burst. Therefore, you should adjust the secondary generator before you select the number of cycles-per-burst with the TRIG LEVEL control.

15. **VARIABLE SWEEP** control — Allows continuously variable expansion of the secondary generator period up to a ratio of 100:1. In the burst function, this control will also affect the number of cycles in a burst.

16. **TRIGGER** pushbutton — Functions in a manner similar to the EXT TRIG connector. Enables the Generator when pressed.

17. **SYNC OUTPUT BNC** connector — Supplies a 1.5-volt (minimum) peak-to-peak signal from a 50-ohm source that is synchronized with the main generator.

18. **SYMMETRY** switch — Switches the SYMMETRY control into or out of the main generator circuit. When switched IN, the main generator output is divided by a factor of ten.

19. **SYMMETRY** control — When switched in, allows continuously variable adjustment of the main generator waveform symmetry from 5% positive to 95% positive.

REAR PANEL

SWEEP GATE OUTPUT BNC connector — Supplies a high TTL level signal to indicate the "on-time" of the secondary (sweep) generator. This is present only in the burst, linear sweep, and log sweep modes of operation.

SWEEP OUTPUT BNC connector — Supplies a 0 to 4.5-volt linear ramp from the secondary (sweep) generator. This is present only in the burst, linear sweep, and log sweep modes of operation.

ANALOG OUTPUT BNC connector — Supplies a voltage representative of the composite signal applied to the main generator. This includes the DC voltage from the FREQUENCY control, linear or log sweep ramp from the secondary generator, and any externally applied voltage at the VCG INPUT connector. Maximum frequency (for each switch selected decade) produces approximately +6 volts.

VCG INPUT BNC connector — Allows external control of the main generator. With the FREQUENCY control set fully clockwise (minimum frequency), a 4.86-volt ±5% DC level will produce a full-scale (maximum) frequency shift. This occurs on each switch-selected decade. This can be expressed as follows:

DIAL INDICATION + (0.625 × EXT VOLTAGE) = EFFECTIVE DIAL INDICATION

EXAMPLE: DIAL INDICATION = 1.5
EXT VOLTAGE = +2.4

1.5 + [0.625 (+2.4)] = (NOTE: The effective dial indication cannot exceed 3.0.)

The FREQUENCY control can also be set to maximum (3.0) and a negative voltage applied. For frequency modulation of the main generator frequency, signals up to 10 kHz can be applied. However, you must not exceed the voltage parameters in relation to the Frequency dial indication.

ATTENUATION — OUTPUT CHART

This chart shows comparative generator output voltage divisions with each setting of the attenuation control. Each division is made using zero attenuation output as a reference (variable attenuation set for 10V P-P output). For example: If your generator output with zero attenuation is 10 volts peak-to-peak, this same output will be 1 volt peak-to-peak with 20 dB attenuation. 10V P-P ÷ 10 = 1 volt P-P (second line on chart).

ATTENUATION (dB)	DIVIDE ZERO ATTENUATION OUTPUT BY:	OUT VOLTAGES INTO A 50 Ω LOAD
0 dB	1.0	10V P-P
10 dB	3.16	3.16V P-P
20 dB	10	1V P-P
30 dB	31.6	.316V P-P
40 dB	100	.1V P-P
50 dB	316	.0316V P-P

IN CASE OF DIFFICULTY

INTRODUCTION

This part of the Manual will help you locate and correct any difficulty which might occur in your Generator. This information is divided into two sections. The "General" section contains suggestions in the following areas:

A. Visual checks and inspection.

B. Precautions to observe while bench testing.

C. Sweep Circuit Board Removal.

The second section consists of a set of trouble locating charts, or "Test Charts." See Page 89. Be sure to read the information on Pages 86, 87, and 88 before you use the "Test Charts."

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

GENERAL

VISUAL CHECKS

1. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many difficulties can be eliminated by a careful inspection of connections to make sure they are soldered as described in the "Soldering" section of the "Assembly Notes." Reheat any doubtful connections and be sure all the wires are soldered at places where several wires are connected.

2. Check each circuit board to be sure there are no solder bridges between adjacent connections. Remove any solder bridges that may exist.

3. Be sure the transistors and integrated circuits are in their proper locations (correct part number and type number). Be sure that each transistor lead is positioned properly and has a good solder connection to the foil. Check each integrated circuit for proper positioning and good contact at all pin connections.

4. Check capacitor values carefully. Be sure the proper part is wired into the circuit at each capacitor location. For example, it would be easy to mistake a .001 μF capacitor for a 100 pF capacitor. Always check the polarity of electrolytic and tantalum capacitors to be sure the "+" lead is installed at the correct location.

5. Check each resistor carefully. It would be easy, for example, to install a 1200 Ω (brown-red-red) resistor where a 220 Ω (red-red-brown) resistor is called for. A resistor that is discolored, cracked, or shows any sign of bulging would indicate that it is faulty and should be replaced.

6. Be sure the correct diode is installed at each diode location, and that the banded end is positioned correctly.

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

8. Check all component leads connected to the circuit boards. Make sure the leads do not extend through the circuit boards and make contact with other connections or parts.

BENCH TESTING

WARNING: The full AC line voltage is present on the switch plate beneath the power transformer, and on the power switch (on the output circuit board). Be careful to avoid personal shock when you work on the Generator.

- Be cautious when you test the transistors and integrated circuits. Although they have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage and current than other circuit components.

- Be careful you do not short any terminals to ground when you make voltage measurements. If the probe should slip, for example, and short out a bias or voltage supply point, it may damage one or more components.

- **Do not** remove any components or wires while the Generator is turned on.

- When you make repairs to the Generator, make sure you eliminate the cause as well as the effect of the trouble. If for example, you should find a damaged resistor, be sure you find out what caused the resistor to become damaged. If the cause is not eliminated, the replacement resistor may also become damaged when the Generator is put back into operation.

- Refer to the X-Ray Views and the Schematic to locate the various components.

- Use a high impedance voltmeter to make any voltage measurements.

- A DC oscilloscope with a high impedance probe should be used to monitor signals.

- Always check the power supplies for proper levels before you attempt to troubleshoot the remaining circuits.

- The accuracy of your measurements will depend on the accuracy of your instruments and the setting of the Generator calibration controls.

- An approximate indication should be within ±20%.

- When TTL level voltages are specified, the voltage must fall within a limited span:

  TTL level 1 (input) = greater than 2 volts, but less than 5.5 volts.

  TTL level 1 (output) = greater than 2.4 volts, but less than 5.5 volts.

  TTL level 0 (input) = less than 0.8 volts, or equal to 0 volts.

  TTL level 0 (output) = less than 0.4 volts, or equal to 0 volts.

- When a component or group of components is listed, examine the adjacent foil patterns and associated components for a possible problem.

- 

Follow the "YES" arrow in the charts when you obtain the proper measurement or condition.

- NO Follow the "NO" arrow in the charts when you do not obtain the proper measurement or condition.
- WHEN YOU BEGIN A TEST CHART, PRESET THE FRONT PANEL CONTROLS AND SWITCHES AS FOLLOWS:

  SWEEP LIMIT control — Fully counterclockwise.
  FREQUENCY control — .3.
  FREQUENCY switch — 10^3.
  FUNCTION switch — CW.
  TRIG LEVEL control — AUTO TRIG (detent).
  MODE switch — Sine wave.
  OFFSET control — Center of rotation (pushed in).
  ATTENUATOR switch — 0.
  ATTENUATOR VARIABLE control — CAL.
  SWEEP switch — 100 mS.
  SWEEP VARIABLE control — Center of rotation.
  SYMMETRY switch — OUT.
  SYMMETRY control — Center of rotation.

SWEEP CIRCUIT BOARD REMOVAL

The sweep circuit board, is designed to operate while it is partly removed to provide access to its components.

To remove the circuit board:

1. Disconnect the white-black wire from the EXT TRIG connector.
2. Disconnect the white wire from the TRIGGER pushbutton.
3. Disconnect the white-yellow wire coming from hole Z on the sweep circuit board at generator board hole AY.
4. Disconnect the black wire coming from hole AF on the sweep circuit board at generator circuit board hole BD.
5. Disconnect the white-green wire coming from hole AC on the sweep circuit board at generator circuit board hole AT.
6. Disconnect the violet wire coming from hole AB on the sweep circuit board at generator circuit board hole AR.
7. Remove the four switch knobs and switch hardware.
8. Remove the #4 hardware that secures the sweep circuit board to the mounting plate.
9. Remove the top trim rail.
10. Pull the sweep circuit board straight back and rotate it out the top of the Generator.
11. Reinstall the #4 hardware in the circuit board hole and plate hole near the top of the Generator, and rest the bottom edge of the board on the top of the front panel. The hardware is used to hold the board in position.
12. With a short jumper wire, reconnect the loose black wire to generator circuit board hole BD.

NOTE: The violet, white-green, and white-yellow wires control the operation of the clamp circuit. Unless you have a difficulty in this circuit, it is not necessary to connect the wires. To manually trigger the sweep circuit, momentarily touch the loose white wire to circuit ground.

TEST CHARTS

The following trouble locating charts are in the "Illustration Booklet." These charts systematically isolate a difficulty to a component or group of components. The components identified in the charts use the same component numbers that are used in the Schematic Diagram, "Circuit Board X-Ray Views," and other sections of the Manual.

TEST CHART	TITLE	ILLUSTRATION BOOK
1	±5-Volt Power Supply	Page 17
2	±23 and ±15-Volt Power Supplies	Page 19
3	Generator	Page 22
4	Sine Shaper	Page 24
5	Output Amplifier	Page 26
6	Sweep Generator and Control	Page 27

SPECIFICATIONS

This unit operates to specifications at 25° C, ±5° C ambient after 1/2-hour warmup.

Output	50-ohm source — short circuit protected. 20 volts p-p open circuit. 10 volts p-p into 50-ohm load.
Output Flatness	±0.1 dB to 300 kHz. ±0.2 dB to 3 MHz.
Output Waveforms	Sine — Triangle —Square. Symmetry continuously variable 5% through 95% to 300 kHz.
Frequency	3 Hz through 3 MHz in 6 range steps on primary decade. 0.03 Hz on third decade of X10 range.
Sine Distortion	Less than 1% on the 10^1 frequency range. Less than 0.5% on the 10^2 through 10^4 frequency ranges. Less than 0.75% on the 10^5 frequency range. Harmonics 30 dB down on the 10^6 frequency range.
Triangle Linearity	No deviation greater than 1% to 300 kHz*.
Square-Wave Rise and Fall	Less than 60 nS.
Dial Accuracy	±3% of full scale (10^1 through 10^5). ±4% of full scale at 10^6.
Attenuator	0 to −50 dB in 10 dB steps. Variable control 0 to −20 dB.
DC Offset	Signal plus offset, limited to ±10 volts open circuit or ±5 volts into 50-ohm load.
Time Symmetry	Within 1% of full period through 300 kHz*.

*Applicable only on top decade of each frequency range.

Sweep Generator	6 ranges, 10 μs through 1s. Each range may be extended by 100 with the variable control.
Sweep Output	Supplies 0 to 4.5-volt linear ramp at sweep generator rate from a 1000-ohm source.
Sweep Gate Output Connector	Supplies high TTL level for duration of sweep or burst.
Analog Output Connector	Supplies 0 to 6 volts DC for 3 decade span. Less than 100-ohm source.
Sync Output Connector	Supplies 1.5-volt (minimum) peak-to-peak signal from a 50-ohm source.
Voltage Control Input Connector (VCO)	0 to ±5 volts signal for a 3-decade span. 8 k ohm input impedance.
External Trigger Input Connector	± (250 mV to 4 volts) with 10 k ohms. Triggers on positive slope.
Operating Temperature	0° to 40° C ambient.*
Power Requirements	100 to 135 volts, 50—60 Hz, 20 watts maximum. Switch selectable for normal or low line. (200 to 270 volts, 50—60 Hz, switch selectable.)
Fuse Requirements	3/8-ampere, slow-blow, 120/240 VAC operation.
Dimensions	15″ wide, 11-7/8″ deep, 5-3/8″ high. (38.1 cm wide, 30.2 cm deep, 13.7 cm high.)
Weight	11.8 lbs. (5.35 kg.)

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

*Operates to specifications at 25° C ±5° C ambient. All specifications after 1/2 hour warmup.

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (fold in) and the Block Diagram (on Page 16 in the Illustration Booklet) as you read the following description.

Components are numbered as follows:

1-99	Parts mounted on the chassis.
101-199	Parts mounted on the generator circuit board.
201-299	Parts mounted on the output circuit board.
301-399	Parts mounted on the sweep circuit board.

The main generator is a voltage-controlled oscillator whose output is a triangle wave. This triangle wave is coupled through the following amplifiers and attenuator to the output, or it is shaped into either a square wave or sine wave and then applied to the output amplifier and attenuator.

The secondary generator and its associated circuitry produce both a linear and antilogarithmic ramp to cause the main generator frequency to sweep linearly or logarithmically. The trigger logic and generator clamp turn the main generator on and off at the proper rate (through diode D118) when the generator is in the Burst or Gate mode.

MAIN GENERATOR

Summing amplifier IC104 algebraically adds the input currents from the frequency dial, VCG input, sweep signal, and low frequency adjust control, and produces a proportional voltage at its output. This voltage controls the negative constant current source (IC107 and Q102), and is inverted by IC105 to control the positive constant current source (IC106 and Q101). The generated constant currents are applied to the diode switch. The diode switch alternately allows the positive and negative current sources to linearly charge the selected integrator capacitor positive and negative as controlled by the level detector. Thus, a triangle wave is produced.

CURRENT SOURCES

IC106 of the positive current source has its positive input connected to a positive reference. The output of IC106 increases until the plus (+) and minus (−) inputs are equal. This turns on Q101 and causes current to flow from the positive source through R126, Q101, R145, and the diode switch (at the proper time) to the integrator capacitor. The current flow produces a voltage at the emitter of Q101 that is equal to the positive reference voltage. Also, the current is proportional to the positive reference but is independent of the collector voltage.

When in a sweep mode, the voltage to the current source is changing. This causes the current to change and a sweep-frequency signal results. The negative current source is similar to the positive source.

Diode Switch

With +5 volts at point A (see the Block Diagram) diode 1 (actually two diodes in series) is reverse biased (turned off). Diode 4 is forward biased and therefore conducts. This makes point D slightly less positive than point A, but still more positive than point C. Therefore, diode 3 is reverse biased. Diode 2 is forward biased so the intergator capacitor charges until the level detector changes state and applies −5 volts at point A. In this case, diode 4 is reverse biased and diode 1 is forward biased. This produces a negative voltage at point B which reverse biases diode 2. Therefore, with a positive voltage at point C and a negative voltage at point D, diode 3 conducts and charges the integrator capacitor negatively.

In the Burst and Gate modes, diode D118 conducts at the signal-zero crossing point and clamps the integrator circuit for the proper length of time. This is covered in greater detail in the section "Generator Clamp."

IC109 provides the analog output and isolates this output from the output of summing amplifier IC104.

Amplifier

The triangle waveform at the integrator capacitor is coupled to the gate of source follower Q103. Transistor Q103 presents a minimum load to the triangle waveform, and Q104 and its associated components make up a constant current source for Q103.

The signal is then coupled to emitter-follower Q105A and its constant current source Q105D, through Q105B to emitter-followers Q105C and Q105E. The signal at the emitter of Q105E is coupled to switch SW1, while the signal at the emitter of Q105C goes to level detector IC108 and through voltage divider R163, R164, and R165 to the generator clamp on the sweep circuit board. (The sweep circuits will be discussed later.)

LEVEL DETECTOR

Level detector IC108 contains two level detectors and two NAND gates wired in a cross-nand latch configuration. This produces complementary outputs from the NAND gates.

The triangle wave from Q105C goes negative until it equals the negative reference voltage at pin 1 of IC108. Then the detector changes state and drives pin 4 high. Pin 4 stays high until the triangle wave at pin 12 becomes as positive as the positive reference voltage at pin 11. Then the detector changes state again.

The outputs of the level detector drive differential amplifier Q106 and Q107. The output is taken from Q107 (clamped by diodes D119 and D121 to provide amplitude symmetry) to switch drivers Q108 and Q109. These transistors drive the diode switch through R184, provide a sync signal to the sweep circuits, and drive the square shaper/amplifier.

SQUARE SHAPER/AMPLIFIER

Diode bridge D122, D123, D124, and D125 shapes the signal. With no input, the diodes are conducting and the input and output of the bridge is zero volts. As the input goes positive, D122 turns off and D123 continues to conduct. The positive potential at the anode of D123 is coupled to the cathode of D125, so D125 turns off. This leaves D124 to remain turned on and drive Q111 and Q112 (the voltage at the base of Q111 and Q112 is determined by voltage divider R187, D124, and R191). Similarly, when the input goes negative, D125 turns on. The signal is then coupled to switch SW1.

OUTPUT AMPLIFIER

Switch SW1 selects the type of waveform to be amplified. Triangle or square waves are applied directly to the output amplifier. However, for a sine wave, the triangle wave is first shaped by the nonlinear load and then amplified by the sine-wave amplifier before it is applied to the output amplifier.

The base of Q211A "sees" the waveform coming from switch SW1; the DC offset voltage from R249, R2, and R1; and the negative feedback from R251 and R252. As the input signal goes positive; Q211A and Q211B conduct more, and Q211C and Q211D conduct less an equal amount. This causes the collector voltage of Q211A and Q211B to drop and the collector voltage of Q211C and Q211D to rise. This differential signal is applied to Q212 and Q213 where a similar action occurs, Q212 conducts more and Q213 conducts less — with the total emitter current remaining virtually constant.

Transistor Q216 is a constant current source. As Q213 conducts less, less current is drawn from Q216, and the voltage at the collectors of Q216 and Q213 becomes less positive. This increases the drive to the base of Q215 and increases its conduction. As the voltage at the collector of Q213 becomes more negative, Q215 will conduct less and Q214 will increase conduction.

Control R252 adjusts the negative DC feedback of the amplifier and, therefore, controls its gain. Capacitor C209 adjusts the AC feedback which controls the amplifier's rise time.

The output attenuator consists of three sections; 10, 20, and 40 dB. They can be connected through switch SW201 for 10, 20, 30, 40, or 50 dB of attenuation. Control R213 provides variable signal attenuation prior to final amplification.

SINE SHAPER

The sine shaper consists of a nonlinear load and a sine-wave amplifier.

Nonlinear Load

As the triangle wave applied to the nonlinear load increases in amplitude (either positively or negatively) more diodes become forward biased and add load resistors (R228—R223) to linear load R201. Then, as the waveform decreases in amplitude, the diodes become reverse biased again. The result is that the triangle wave is shaped into a sine wave that is slightly smaller than the original triangle wave.

Resistors R234, R235, R236, R237, R238, and R239 make up a precision voltage divider; and Q208 and Q209 make up an adjustable constant voltage source for the divider. The highest voltage is at the top (see the Schematic) and the lowest voltage is at the bottom. These voltages reverse bias diodes D208, D209, D211, D212, D213, and D214.

The triangle wave at R201 is connected to R228, R229, R231, R232, and R233. As the waveform goes positive, D213 becomes forward biased first and connects R233 as a load. Similarily R232 through R228 become connected as the waveform increases and then disconnected as the waveform returns to zero.

Transistor Q204 and Q205 make up the negative voltage supply and feed a resistor-diode network that operates on the negative portion of the waveform.

Sine-Wave Amplifier

The sine-wave is taken from the junction of R201 and the nonlinear load, and applied to the sine-wave amplifier.

The sine wave is coupled through the 3 MHz peaking adjustment (L201 and C207) and R205 to differential amplifier Q202 and Q203. The collector of Q202 drives emitter follower Q201, and the emitter signal of Q201 is translated downward 5 volts by zener diode D201. Resistor R202 provides isolation and R203 and R204 provide negative feedback to adjust the amplifier gain.

SWEEP CIRCUITS

Secondary Generator

IC301 supplies a constant voltage (set by R303) through switch SW302A, and R313 or R314, to IC302. This creates constant voltages at the emitter and (through IC302) at the base of Q301. Therefore, the current flowing through Q301 is constant and charges the selected ramp (integrator) capacitor linearly. R301 sets the full period of the secondary generator and R304 and R305 set the minimum frequency.

Source follower Q303 (with its constant current source Q304) presents a minimum load to the ramp signal and drives emitter follower Q308. The signal at the emitter of Q308 is coupled to comparator IC303A which pulses holdoff monostable IC304 when the ramp reaches its maximum level. The holdoff time is determined by the selected capacitor (C312—C317). The pulse from IC304 pin 6, is inverted by IC309A and turns on Q302 which discharges the integration capacitor. Then, after the monostable resets, Q302 turns off and the ramp capacitor is allowed to charge again.

The signal from the emitter of Q308 is also coupled to the Sweep Output connector, and is coupled through SW301B (when in the burst mode) to comparator IC303B. Also, this signal is applied to inverter IC306, and through SW301D (when in the LIN SWEEP mode) to sweep the main generator.

Antilog Converter

The ramp signal is inverted, scaled, and shifted in level by IC306. The output at pin 6 is applied to antilog converter IC307. This again inverts the ramp and changes it from linear to an antilogarithmic ramp to generate a logarithmic sweep. Control R349 adjusts the output to start at zero volts and R343 adjusts the full-scale level. Control R347 calibrates the gain factor.

Generator Clamp

The base of Q307 sees a −5.9 to −8.9-volt triangle wave from the main generator, with −7.45 volts corresponding to zero crossing of the main waveform.

Transistors Q306 and Q307 make up a differential amplifier. As one turns on, the other turns off, and the current through R364 remains constant.

When Q305 is off, −15 volts is at the base of Q306. This turns Q306 off, which in turn turns Q307 on — regardless of the voltage at its base. The collector of Q307 is now more negative than −5 volts and reverse biases clamping diode D118 on the generator circuit board. This allows the main generator to run.

When the switch driver (Q108 and Q109 on the generator circuit board) waveform goes negative, and pin 5 of IC308D is high, pin 6 of IC308D goes low and turns on Q305. The current through Q305 is adjusted by R361 and this sets the voltage at the base of Q306. When the waveform at the base of Q307 goes more negative than the base of Q306, Q307 turns off, its collector goes more positive, and D118 conducts and clamps the integrator capacitor (disabling the main generator).

In the CW mode, switch SW301A sets pin 5 of IC308D low, and no clamping takes place. In the Auto mode of the linear or logarithmic sweep mode, SW303 applies a low to pin 5 of IC308D, using inverter IC308B, and again keeps clamping from taking place.

SWEEP FUNCTIONS

CW Mode

The sweep circuits are not used in this mode of operation. Clamping diode D118 is always reverse biased and ground potential is applied to the sweep input of the main generator through switch SW301D.

Gate Mode

The secondary (ramp) generator is not used in this mode of operation.

When the Ext Trig signal (applied through R331 and SW301B to pin 2 of IC303B) becomes greater than the bias from level control R328 and scaler R329, pin 2 of IC303B goes positive. This causes pin 4 of comparator IC303B to go low which forces the output of IC309B high. (The Trig button can also set this gate high.) This, in turn, forces IC309C low and this low at pin 13 of IC305B sets its Q high and the $\overline{Q}$ low. The high Q output of IC305B (pin 9) is applied through switch SW301A to pin 5 of IC308D. This triggers the generator clamp which releases clamping diode D118.

When the Ext Trig signal at pin 2 of IC303B causes IC303B to change state, pin 4 goes high and IC309D pin 11 goes low the next time the square wave coming from Q108 and Q109 goes high. (It is coupled through R354, D305, and SW301C to pin 2 of IC309C.) The low from pin 11 presets pin 9 (Q) of IC305B high. This high is coupled through switch SW301A to pin 5 of IC308D and causes the generator clamp to clamp the main integrator capacitor as the triangle wave reaches the next negative-going, zero-crossing point.

Burst Mode

The secondary (ramp) generator if free running. When the hold-off period of monostable IC304 ends, pin 6 goes high and clocks pin 8 ($\overline{Q}$) of IC305B low. As before, this sets pin 6 of IC308D high and releases clamping diode D118.

The ramp signal from Q308 is coupled through R332 and SW301B to comparator IC303B. The circuitry clamps diode D118 at zero crossing the same as it does in the Gate mode.

The main generator is now off until the secondary generator ramp triggers comparator IC303A, which triggers monostable IC304 and its "times out" and resets. The end of the hold-off cycle again sets IC305B and turns on the main generator.

Sweep

The sweep function can be set for either linear or logarithmic sweep (by switch SW301D), and these can be operated on Auto (free running) or Trig (externally triggered) by switch SW303.

The automatic sweep is described in the basic sweep generator description. Level detector IC303A triggers hold-off monostable IC304, which causes the sweep capacitor to be discharged. Then, at the end of the hold-off period, the cycle repeats.

In the trigger mode, hold-off monostable IC304 clears latch IC305A as the hold-off cycle begins. This makes the Q output (pin 5) low. This low is coupled through SW303 and inverted to a high by IC308B, and then coupled to pin 5 of IC308D as before. This high clamps diode D118 at the next zero crossing of the signal.

The low Q (pin 5) output from IC305A is also coupled through switch SW301C to pin 10 of IC309A. This makes pin 8 high and holds Q2 turned on, inhibiting the ramp generator.

After the hold-off period ends, the D (pin 2) input of IC305A goes high and an external trigger (when applied through IC303B or the manual Trig button) will cause pin 6 of IC309B to go high and release both the main and secondary generators.

The Sweep Gate output, selected by switch SW301B, is high when the main generator is clamped. In the Gate mode, the gate is high from the time comparator IC303B turns on until it turns off. In the Burst mode, the gate is high for the duration of the burst. In the Auto sweep mode, the gate is low during the hold-off time. And in the Trig sweep mode, the gate is high from the time the sweep starts until it almost stops.

POWER SUPPLIES

Power transformer T1 converts the line voltage to AC voltages of the proper values. The two bridge rectifiers (D101 through D108) rectify these AC voltages into pulsating DC which is filtered by capacitors C101, C104, and C109, and C111. IC102 and IC103 regulate the positive and negative 5-volt supplies, and IC101 controls Q1 and Q2 to regulate the positive and negative 15-volt supplies.

COMPONENT IDENTIFICATION

This section of the Manual contains "Circuit Board X-Ray Views" and "Basing Diagrams." The X-Ray Views show the location of the components. The "Basing Diagrams" illustrate the pin data for all complex devices (transistor arrays and integrated circuits).

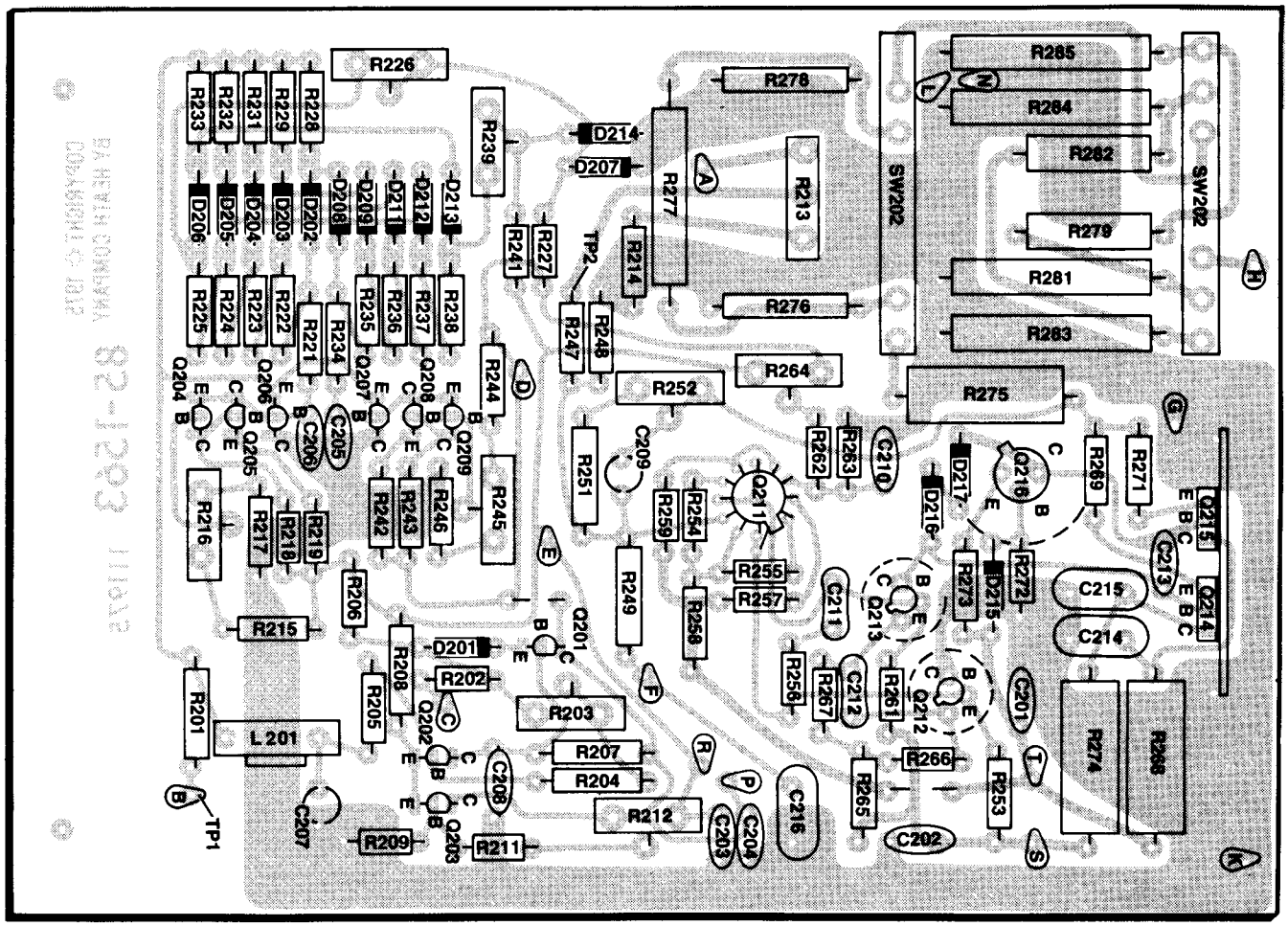
CIRCUIT BOARD X-RAY VIEWS

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

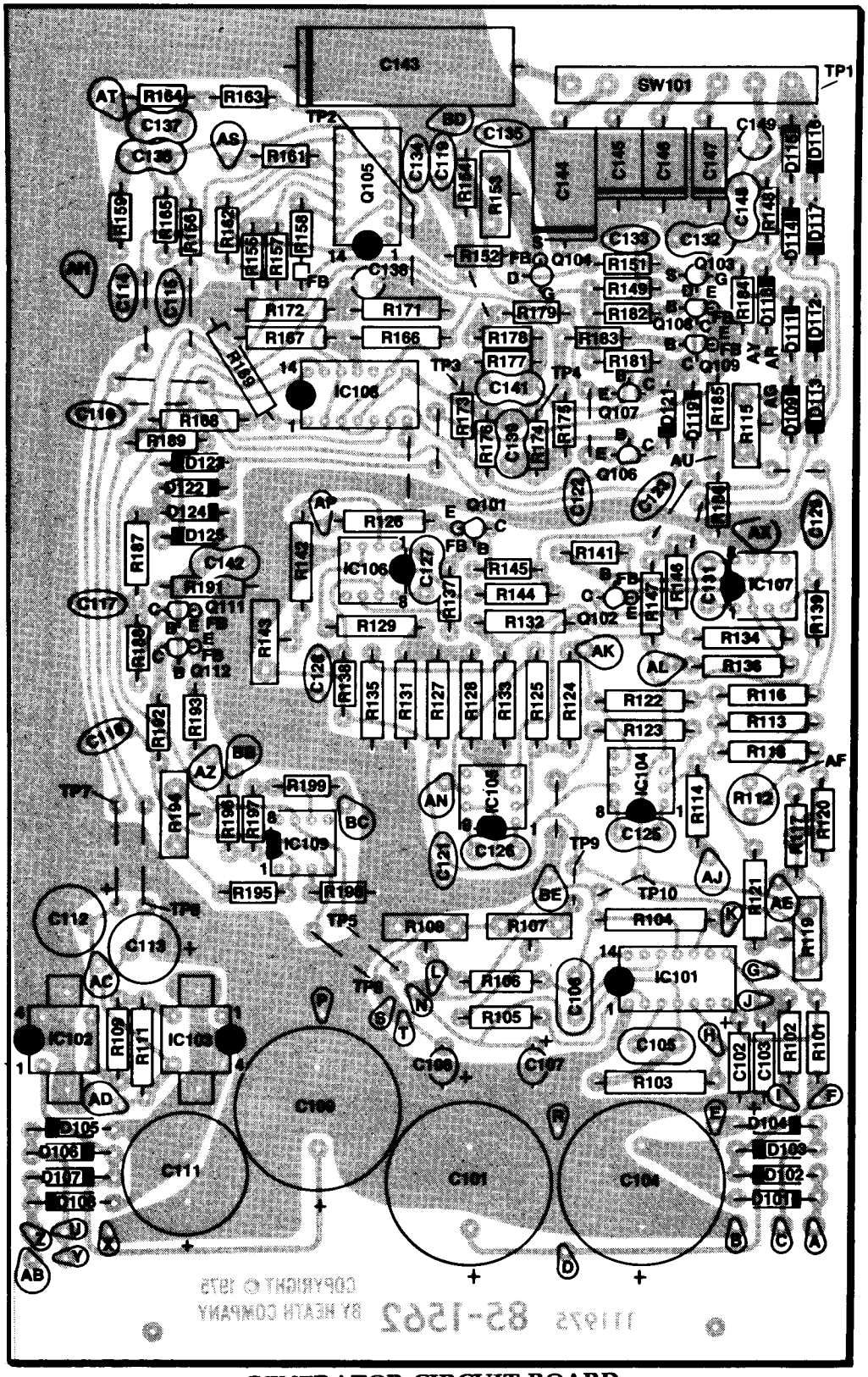
A. Find the circuit component number (R106, C101, etc.) on the X-Ray View.

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

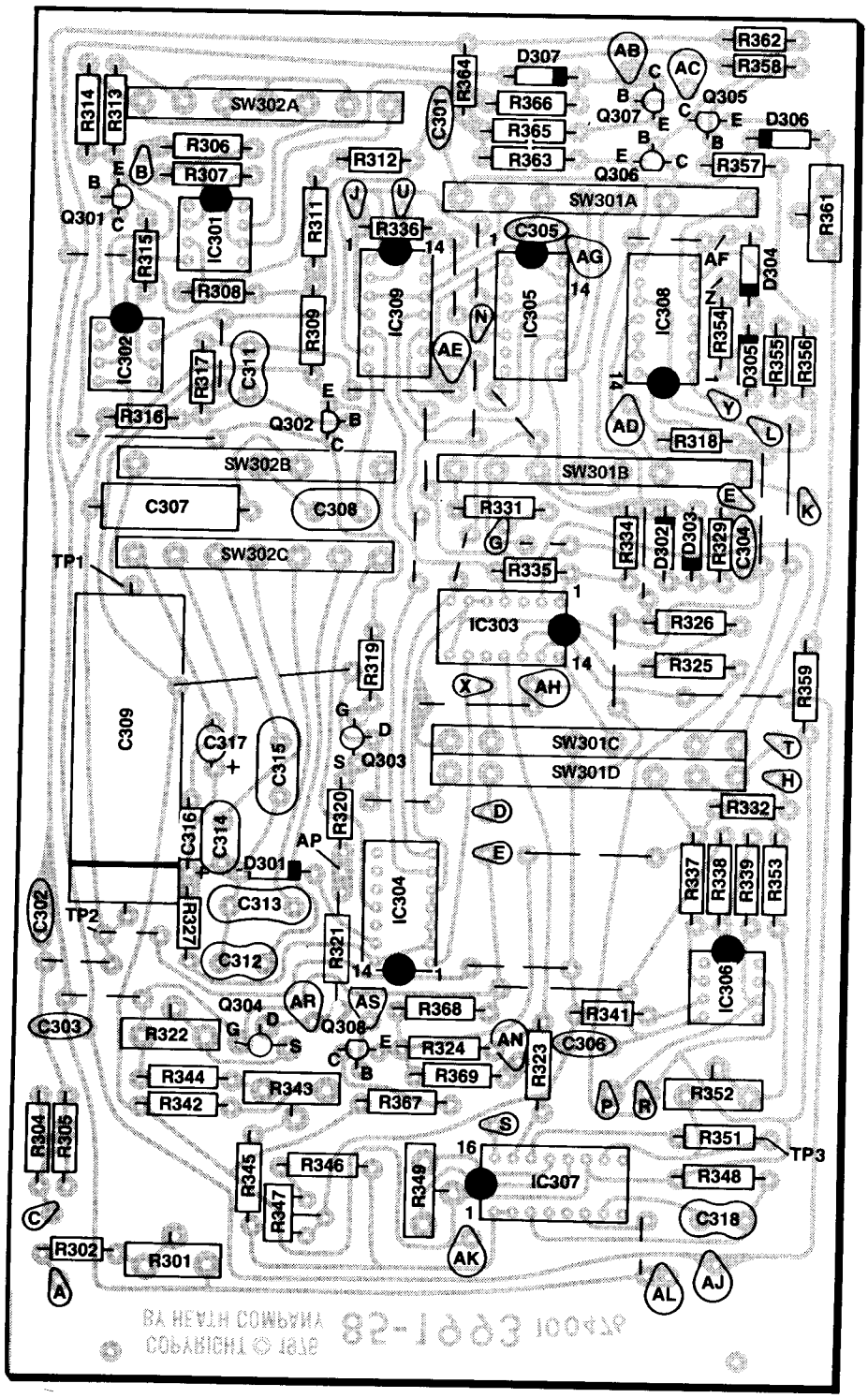
C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



OUTPUT CIRCUIT BOARD
(Shown from the component side.)



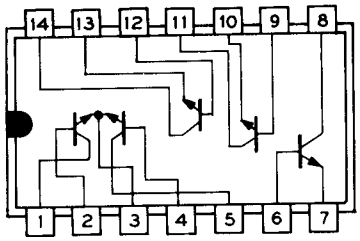
GENERATOR CIRCUIT BOARD
(Shown from the component side.)



SWEEP CIRCUIT BOARD
(Shown from the component side.)

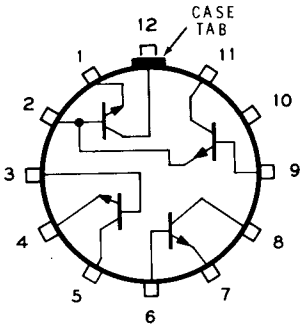
BASING DIAGRAMS
(Shown from the top.)

Q105



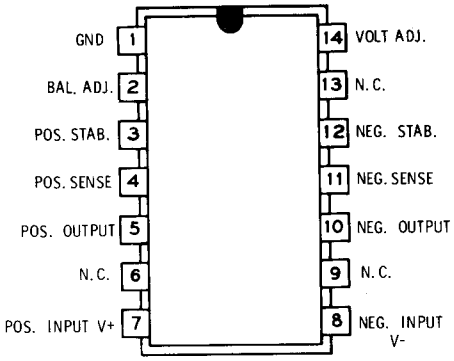
CA3046
TRANSISTOR ARRAY

Q211



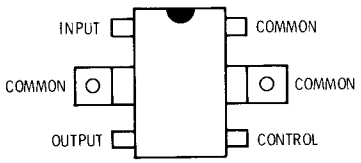
CA3018A
TRANSISTOR ARRAY

IC101



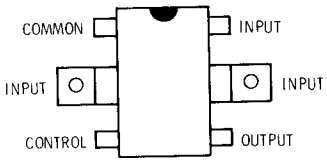
4501 DUAL-TRACKING
VOLTAGE REGULATOR

IC102



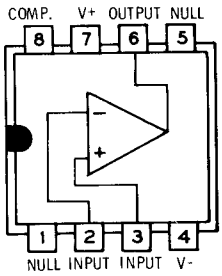
78MGT2C +5 - VOLT
REGULATOR

IC103



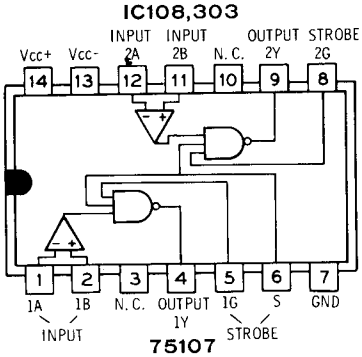
79MGT2C -5 - VOLT
REGULATOR

IC104-107



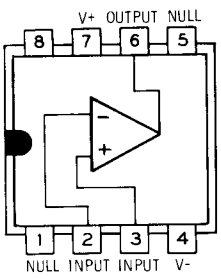
301 HIGH GAIN
OP - AMP

IC108,303



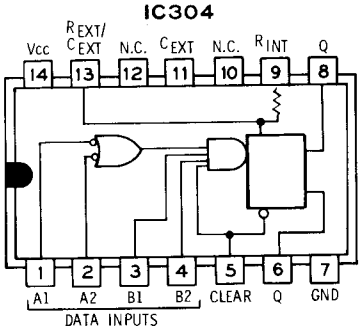
75107
DUAL LINE RECEIVER

IC109,301,302,306



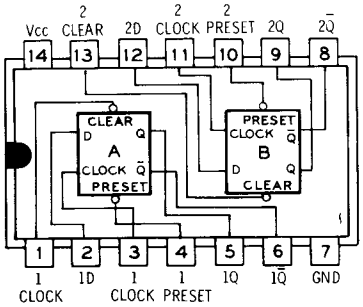
741
HIGH GAIN OP - AMP

IC304



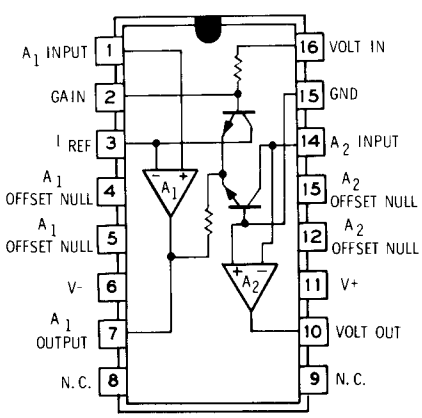
74122 RETRIGGERABLE
MONOSTABLE MULTIVIBRATOR

IC305



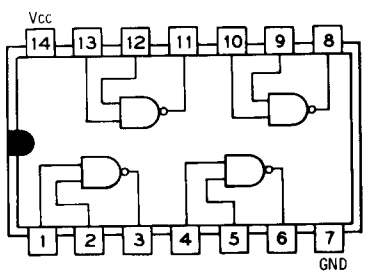
7474
DUAL D - TYPE EDGE - TRIGGERED
FLIP - FLOP

IC307



8049
MONOLITHIC ANTILOG
AMPLIFIER

IC308,309



7400 QUAD 2-INPUT
POSITIVE NAND GATES

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PART NUMBER	PRICE	PART NUMBER	PRICE	PART NUMBER	PRICE	PART NUMBER	PRICE
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1- 31-12	.24	2- 55-11	.42	20- 141	.37	204-2179	.32
1- 41-2	.60	2- 56-11	.42	20- 147	.45	204-2180	.67
1- 47-12	.24	2- 56-12	.48	20- 174	.42	204-2197	.64
1- 55-12	.27	2- 57-11	.42	21- 31	.25	204-2217	2.38
1- 57-12	.27	2- 58-11	.42	21- 33	.30	205-1599- 1	3.37
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1- 60-12	.27	2- 59-11	.42	25- 197	1.05	205-1670	.86
1- 63-12	.27	2- 60-11	.42	25- 220	.75	211- 75	8.12
1- 64-12	.27	2- 61-11	.42	25- 804	.44	215- 31	.86
1- 65-12	.27	2- 62-11	.42	25- 812	1.77	215- 63	.55
1- 66-12	.27	2- 63-11	.42	25- 819	.92	215- 610	1.10
1- 67-12	.27	2- 66-11	.42	25- 828	2.47	216- 71	5.62
1- 69-12	.27	2- 67-11	.42	27- 42	.45	216- 72	5.04
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1- 74	.22	2- 94-12	.42	27- 74	.29	250- 156	.10
1- 74-12	.27	2- 96-12	.42	27- 77	.46	250- 233	.05
1- 75-12	.27	2- 97-12	.48	27- 156	.55	250- 276	.05
1- 76-12	.27	2- 98-12	.42	27- 171	4.47	250- 381	.05
1- 80-12	.27	2- 267	.42	27- 172	.37	250-1172	.05
1- 81-12	.27	2- 268	.42	27- 173	15.28	250-1186	.05
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1- 92-12	.27	2- 329	.42	40- 582	.80	252- 4	.05
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1- 99-12	.27	2- 601-12	.53	56- 16	.55	252- 39	.05
1- 102-12	.27	2- 603- 1	.53	56- 31	1.95	252- 51	.05
1- 105	.22	2- 604-12	.88	56- 56	.55	252- 69	.10
1- 105-12	.27	2- 611-12	.42	56- 86	.94	252- 73	.05
1- 106-12	.27	2- 613-12	.42	56- 87	.90	252- 84	.10
1- 113-12	.27	2- 658-12	.42	59- 636	2.87	255- 155	.15
1- 115-12	.27	2- 666-12	.42	59- 637	.60	255- 2	.05
1- 118-12	.27	2- 676-12	.42	60- 54	1.05	253- 10	.05
1- 121-12	.27	2- 677-12	.42	60- 608	.88	253- 170	.25
1- 123	.22	2- 729-12	.86	63-1269	4.88	253- 194	.55
1- 125-12	.27	2- 730-12	.86	63-1270	9.85	253- 196	.10
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1- 135	.22	10- 295	1.06	63-1272	2.29	254- 5	.05
2- 3-11	.42	10- 311	.75	63-1274	7.87	254- 8	.05
2- 10-11	.42	10- 318	.75	63-1308	18.30	254- 9	.05
2- 12-11	.42	10- 385	.75	64- 31	3.01	254- 14	.05
2- 15-11	.42	10- 904	.75	73- 3	.05	254- 26	.05
2- 17-11	.42	10- 917	.84	73- 34	.15	255- 159	1.00
2- 18-11	.42	10- 918	.75	73- 52	.25	255- 151	.30
2- 20-11	.42	10- 936	.75	75- 152	.15	259- 1	.05
2- 21-11	.42	10- 941	.75	75- 159	.25	259- 27	.10
2- 25-11 1.00		10- 990	2.02	75- 204	.15	260- 16	.20
2- 34-12	.42	10-1070	1.27	75- 736	.15	261- 34	.20
2- 35-11	.42	10-1071	2.10	85-1563- 3	4.76	263- 8	.05
2- 36-11	.42	12- 165	11.89	85-1943- 1	5.46	340- 8	.05@
2- 38-11	.42	19- 723	3.89	85-1995- 1	4.50	344- 33	.05@
2- 39-11	.42	19- 724	8.41	89- 54	2.80	344- 50	.05@
2- 40-11	.42	20- 55	.71	100- 863	******	344- 51	.05@
2- 41-11	.42	20- 100	.37	100-1689	3.50	344- 52	.05@
2- 46-12	.42	20- 102	.37	134- 237	2.46	344- 53	.05@
2- 49-11	.42	20- 104	.40	134- 962	2.96	344- 54	.05@
2- 50-11	.42	20- 108	.43	134- 963	2.99	344- 55	.05@
2- 52-11	.42	20- 118	.42	203-1496- 3	2.99	344- 56	.05@
2- 53-11	.42	20- 122	.66	203-1771- 1	2.46	344- 57	.05@

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PART NUMBER	PRICE	PART NUMBER	PRICE	PART NUMBER	PRICE	PART NUMBER	PRICE
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344- 59	.05@	455- 71	.25				
344- 70	.05@	455- 613	.15				
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344- 76	.05@	462- 975	1.99				
346- 1	.10@	462- 976	.77				
346- 26	.25	462-1001	1.68				
346- 35	.25@	475- 10	.10				
352- 13	.25	475- 15	.10				
354- 7	.15	490- 5	.25				
390-1255	.15	490- 23	.15				
390-1260	.70	490- 111	.15				
390-1385	6.35						
391- 34	.20						
412- 72	1.35						
413- 10	.15						
417- 224	1.18						
417- 225	1.30						
417- 235	.51						
417- 269	.94						
417- 283	.69						
417- 284	.69						
417- 289	1.61						
417- 296	2.25						
417- 801	.40						
417- 828	2.35						
417- 874	.48						
417- 875	.48						
417- 876	1.50						
417- 877	1.99						
417- 879	.94						
421- 42	.65						
422- 1	.65						
431- 41	.15						
431- 77	.15						
431- 82	.15						
432- 120	.05						
432- 121	.02						
432- 134	.03						
432- 758	1.65						
432- 865	.20						
432- 866	.15						
434- 230	.40						
434- 298	.30						
434- 299	.30						
442- 22	2.05						
442- 39	1.43						
442- 65	6.03						
442- 73	3.14						
442- 617	3.04						
442- 618	3.04						
442- 619	33.00						
443- 1	.73						
443- 6	.92						
443- 23	1.15						
454- 25	.48						

ADDITIONAL 3' ROLLS OF SOLDER, #331-6, CAN BE ORDERED FOR 25 CENTS EACH.

The prices shown on this "Heath Parts Price List" apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering (Michigan residents add 4% sales tax) to cover insurance, postage, and handling. Outside the U.S.A., parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties, and rates of exchange.

***** WRITE HEATH COMPANY FOR PRICE INFORMATION.
@ PRICE PER FOOT.