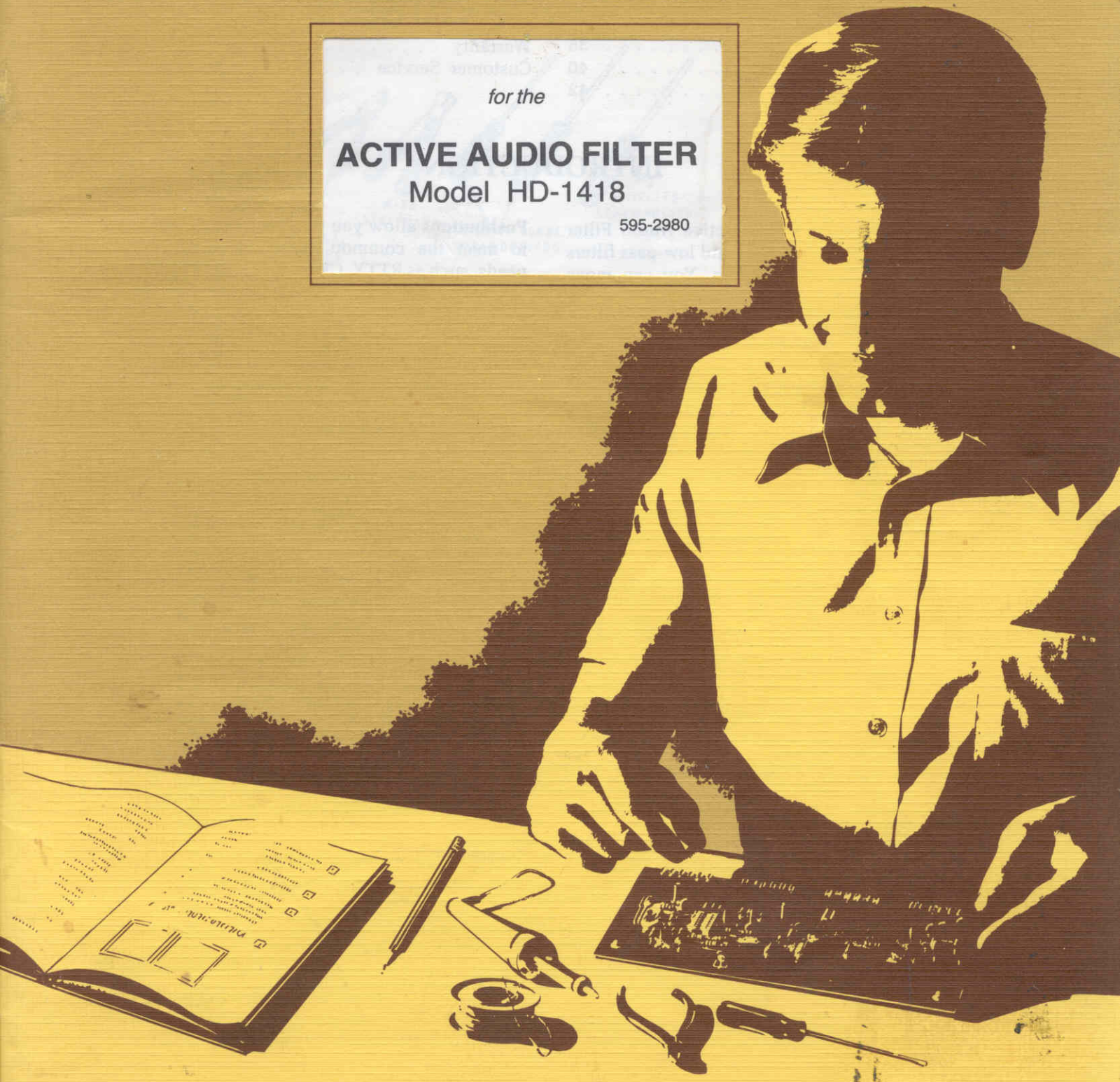
HEATHKIT®
MANUAL

for the

ACTIVE AUDIO FILTER
Model HD-1418

595-2980



HEATH COMPANY • BENTON HARBOR, MICHIGAN

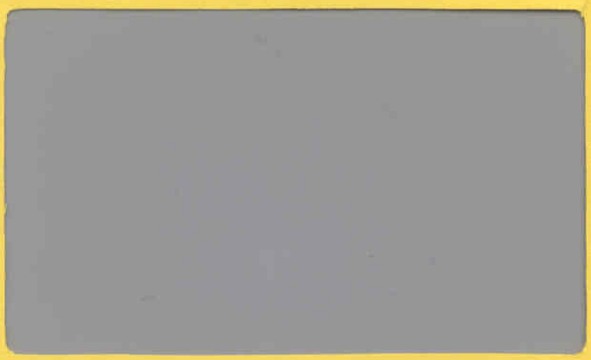
HEATH COMPANY PHONE DIRECTORY

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

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

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

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



YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

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

Heath's Responsibility

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

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

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

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

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

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

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

Owner's Responsibility

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

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

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

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

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

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ACTIVE AUDIO FILTER

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HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

TABLE OF CONTENTS

INTRODUCTION

The Heathkit Model HD-1418 Active Audio Filter has five-pole (section) high-pass and low-pass filters plus a two-pole notch/peak filter. You can move these filters through a 300 to 2500 Hz audio frequency band to help you select or reject certain frequency components of signals you tune in with your shortwave communication equipment. This Filter can help eliminate unwanted signals, such as sideband interference from the partial overlapping of SSB signals or heterodyning, as long as the unwanted signal has a slightly different frequency than the desired signal.

Pushbuttons allow you to easily configure the Filter to meet the common shortwave communication needs, such as RTTY, CW, and SSB applications.

This Manual provides you with assembly and operation instructions, plus a circuit description, troubleshooting chart, and other post-construction information.

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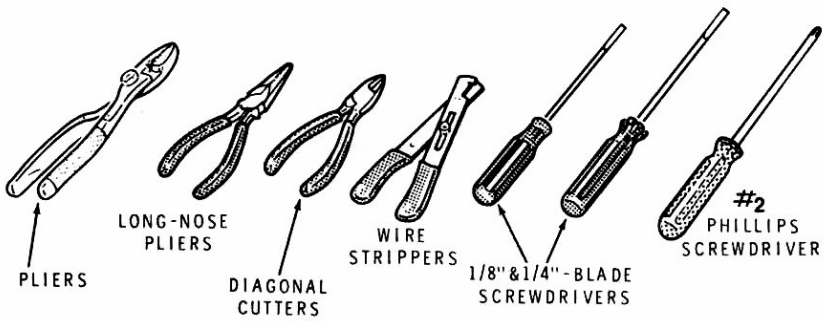
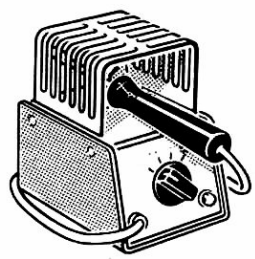
ASSEMBLY NOTES

TOOLS

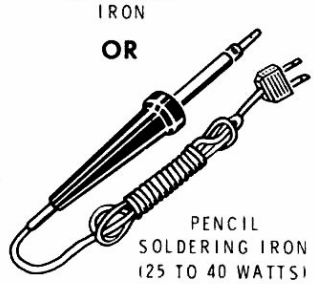
You will need these tools to assemble your kit.





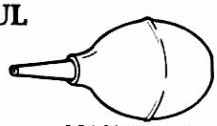
SOLDERING IRON

OR



PENCIL SOLDERING IRON (25 TO 40 WATTS)

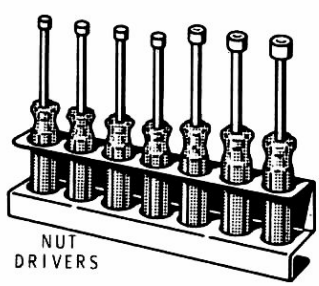
OTHER HELPFUL TOOLS



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. Read the entire step before you perform each operation.

2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

3. Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.

4. Position all parts as shown in the Pictorials.

5. Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

   — In the Parts List,

   — At the beginning of each step where a component is installed,

   — In some illustrations,

   — In the Schematic,

   — In the section at the rear of the Manual.

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

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

SOLDERING

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

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

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

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

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

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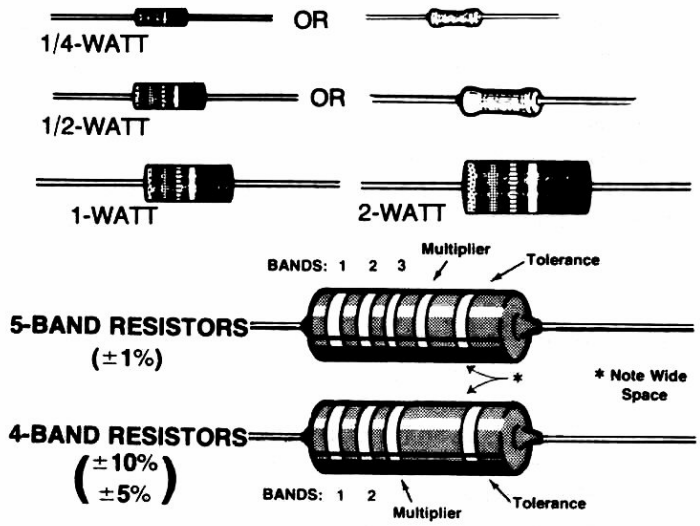
PARTS

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



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

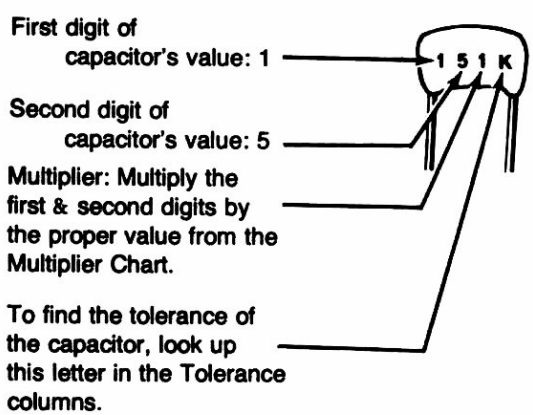
Band 2 2nd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

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

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

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

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



EXAMPLES:

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

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

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

*DuPont Registered Trademark

SPECIAL ASSEMBLY NOTES

NOTE: The following suggestions will not necessarily improve the operation of your kit. They will, however, help you troubleshoot it (if it ever becomes necessary), and help you perform the "Circuit Board Checkout" steps at the end of the assembly sections of this Manual. And you will have a more professionally-built kit when you finish.

1. When you install resistors, always position each resistor so you can read the bands on the resistor in the same direction as you can read the printing on the circuit board (see Figure 1). For resistors that have the value printed on them instead of color bands, install these resistors so the values are facing away from the circuit board and read in the same direction as the printing on the circuit board.

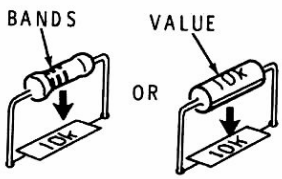


Figure 1

2. When you install ceramic, Mylar, or mica capacitors, always position each capacitor so you can read the value on the capacitor in the same direction as you can read the printing on the circuit board (see Figure 2).

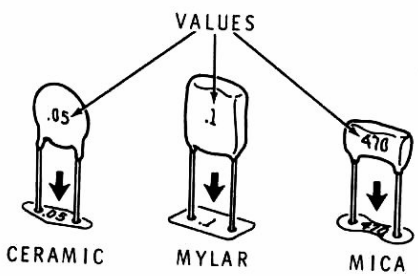


Figure 2

3. When you install electrolytic or other tubular capacitors, always position each capacitor so the value is facing away from the circuit board (see Figure 3). Be sure to observe the correct polarity when you install electrolytic capacitors (as you will be directed in the steps). Other, non-polarized, capacitors should be installed so you can read the values in the same direction as the printing on the circuit board.

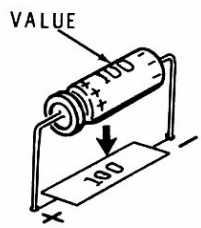


Figure 3

4. Install diodes so the type numbers or part numbers are facing away from the circuit board. Be sure to match the band on one end of each diode with the band mark on the circuit board.

PARTS LIST

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

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

TAPED COMPONENTS

Refer directly to the enclosed "Taped Component Chart." Follow the instructions at the top of that chart to check the following components.

RESISTORS

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

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
6-279-12	1	2.7 Ω (red-viol-gold)	R74
6-100-12	1	10 Ω (brn-blk-blk)	R81
6-470-12	1	47 Ω (yel-viol-blk)	R97
6-680-12	1	68 Ω (blu-gry-blk)	R2
6-471-12	1	470 Ω (yel-viol-brn)	R96
6-621-12	1	620 Ω (blu-red-brn)	R11
6-681-12	1	680 Ω (blu-gry-brn)	R1
6-821-12	1	820 Ω (gry-red-brn)	R12
6-102-12	1	1000 Ω (brn-blk-red)	R75
6-152-12	2	1500 Ω (brn-grn-red)	R4, R82
6-222-12	2	2200 Ω (red-red-red)	R71, R77
6-332-12	5	3300 Ω (org-org-red)	R9, R17, R19, R103, R106
6-392-12	3	3900 Ω (org-wht-red)	R94, R99, R102
6-562-12	2	5600 Ω (grn-blu-red)	R3, R8
6-6651-12	1	6650 Ω, 1% (blu-blu-grn-brn)	R24

Resistors (Cont'd)

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
6-103-12*	31	10 kΩ (brn-blk-org)	R6, R13, R14, R15, R16, R23, R25, R28, R29, R31, R33, R36, R37, R39, R41, R48, R49, R51, R53, R55, R58, R59, R62, R78, R79, R87, R88, R93, R98, R101, R105
6-1912-12	1	19.1 kΩ, 1% (brn-wht-brn-red)	R26
6-273-12	3	27 kΩ (red-viol-org)	R68, R69, R72
6-3482-12	5	34.8 kΩ, 1% (org-yel-gry-red)	R46, R47, R54, R56, R64
6-3652-12	2	36.5 kΩ, 1% (org-blu-grn-red)	R32, R52
6-393-12	1	39 kΩ (org-wht-org)	R67

* These resistors are packed in a separate envelope with the part number on it.

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Resistors (Cont'd)			
6-4422-12	6	44.2 kΩ, 1% (yel-yel-red-red)	R21, R22, R42, R45, R63, R65
6-5362-12	2	53.6 kΩ, 1% (grn-org-blu-red)	R38, R57
6-563-12	1	56 kΩ (grn-blu-org)	R104
6-5622-12	4	56.2 kΩ, 1% (grn-blu-red-red)	R34, R35, R43, R66
6-823-12	2	82 kΩ (gry-red-org)	R85, R86
6-104-12	2	100 kΩ (brn-blk-yel)	R7, R27
6-2613-12	2	261 kΩ, 1% (red-blu-brn-org)	R44, R61
6-274-12	2	270 kΩ (red-viol-yel)	R83, R84
6-394-12	1	390 kΩ (org-wht-yel)	R18
6-105-12	1	1 MΩ (brn-blk-grn)	R95
CAPACITORS			
21-784	6	.001 µF (102) glass ceramic	C8, C45, C47, C48, C51, C53

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Capacitors (Cont'd)			
21-761	6	.01 µF (103) glass ceramic	C1, C2, C3, C4, C34, C35
21-762	7	.1 µF (104) glass ceramic	C5, C9, C33, C37, C39, C61, C62
DIODES			
57-65	4	1N4002	D1, D2, D3, D4
56-56	2	1N4149	D6, D7
56-608	1	1N4739A	D5

NON-TAPED PARTS

The following parts are not taped on strips. The key numbers correspond to the numbers on the "Parts Pictorial" (Illustration Booklet, Page 1).

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
CAPACITORS				
Ceramic				
A1	21-738	1	68 pF	C56
A2	21-75	1	100 pF (100K)	C31
A2	21-184	1	750 pF	C36
Mylar				
A3	27-129	1	.047 µF	C58
A3	27-85	1	.22 µF	C32
Polystyrene				
A4	29-5	14	1000 pF	C13, C16, C17, C18, C19, C21, C22, C23, C25, C26, C27, C28, C29, C55
A4	29-7	1	1500 pF	C15

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Electrolytic				
A5	25-900	5	1 µF	C11, C24, C46, C49, C52
A5	25-880	6	10 µF	C12, C14, C38, C43, C54, C57
A5	25-883	3	47 µF	C42, C44, C59
A5	25-891	1	470 µF	C41
A5	25-951	2	1000 µF	C6, C7
CONTROLS				
B1	10-1196	2	10 kΩ	R91, R92
B1	10-1197	1	20 kΩ	R73
B2	12-185	1	Dual 10 kΩ control	R76/R89
SWITCHES				
C1	64-919	1	Pushbutton	S1
C2	64-920	1	4-section pushbutton	S2/3/4/5

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

TRANSISTORS–INTEGRATED CIRCUITS (IC's)

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

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

D1	417-801	1	MPSA20 transistor	Q1
D2	442-21	14	MC1458 IC	U2, U3, U4, U5, U6, U7, U8, U9, U10, U11, U12, U15, U16, U17
D2	442-75	1	LM311P IC	U1
D2	442-616	1	LM2901N IC	U18
D2	442-748	1	ULN2280B IC	U13
D2	442-744	3	CD4066BCN IC	U20, U21, U22
D2	443-604	1	CD4007AE or MC14007UB IC	U14
D2	443-701	1	MC14049CP or CD4049CN IC	U19

HARDWARE

NOTE: Hardware packets are marked to show the size of the hardware they contain (HDW #4, or HDW #6 & #8, etc.). You may have to open more than one packet to locate all of the hardware of any one size (#6, for example).

#4 Hardware

E1	250-366	8	4-40 × 3/16" screw
E2	250-1184	2	#4 × 1/4" self-tapping screw
E3	254-9	4	#4 lockwasher
E4	255-798	4	4-40 × 1/4" hex spacer

#6 Hardware

F1	250-33	4	6-32 × 1/8" setsecrew
F2	250-1307	4	#6 × 1/4" sheet metal screw
F3	250-1280	6	6-32 × 3/8" screw
F4	252-3	6	6-32 nut
F5	254-1	6	#6 lockwasher

Other Hardware

G1	252-194	1	Decorative control nut
G2	253-15	3	Fiber control flat washer
G3	253-731	2	Shoulder washer
G4	259-34	4	Control solder lug
G5	811-1	4	Metric control nut

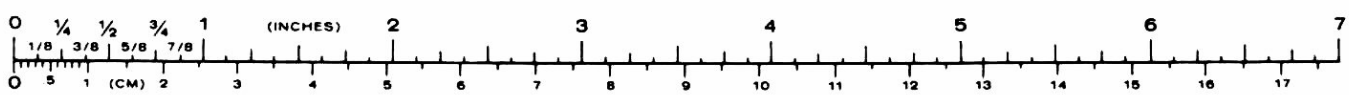
CONNECTORS–SOCKETS

H1	432-866	4	Spring connector	
H2	432-1030	2	2-pin socket shell	
H3	434-42	3	Phono socket	J3, J4, J5
H4	434-230	15	8-pin IC socket	
H4	434-298	5	14-pin IC socket	
H4	434-299	1	16-pin IC socket	
H5	436-45	1	Power jack	J2
H6	436-57	1	Phone jack	J1
H7	438-54	1	Power plug	

MISCELLANEOUS

J1	3-22-2	1	1.2Ω, 2-watt, 10% (brn-red-gold-silv) resistor	R5
J2	75-743	2	Insulator paper	
	85-2834-1	1	Circuit board	
J3	90-1299-1	1	Cabinet top	
J4	200-1431-1	1	Chassis	
J5	261-29	4	Foot	
	340-8	1'	Bare wire	
	344-125	2'	Black wire	
	344-128	2'	Orange wire	
	344-170	4'	Violet wire	
J6	412-633	2	Light-emitting diode (LED)	D8, D9
J7	455-44	4	Bearing	
J8	462-1138	5	Pushbutton knob	
J9	462-1157	4	Round knob	
J10	475-17	4	Ferrite core	
J11		1	Blue and white label*	
	597-260	1	Parts Order Form*	
			Assembly Manual (See Page 1 for the part number.)	
			Solder	

*These items may be packed inside the Manual.



STEP-BY-STEP ASSEMBLY

CIRCUIT BOARD ASSEMBLY

Refer to Pictorial 1-1 (Illustration Booklet, Page 2) as you read the following notes and steps.

NOTES:

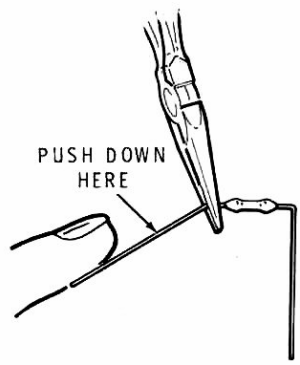
1. Many circuit board drawings, such as the one shown in Pictorial 1-1, are divided into two or more sections. These sections show you which area of the circuit board you are working in for a specific series of steps.
2. Each series of steps has you installing parts in a top-to-bottom, left-to-right sequence. Occasionally, you may be directed to install a particular component in an area out of sequence. These components are each identified in the step and on the Pictorial with a special callout.
3. Check off each step as you perform it. You may also wish to place a check mark near each component on the Pictorial as you install it.
4. In general, solder instructions are given only at the end of a series of similar steps. You may solder more often, if you desire.

NOTE: Refer to the "Taped Components Chart" before you begin.

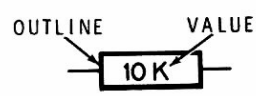
In the following steps, you will be given detailed instructions on how to install and solder the first part on the circuit board. Read and perform each step carefully. Then use the same procedure whenever you install parts on a circuit board.

( ) Note that the circuit board has foil on both sides, but only one side has the component outlines shown on it. This side of the circuit board is referred to as the "component side." Position the circuit board as shown in the Pictorial with the component side up. Always install components on the component side of the circuit board, and solder the leads to the foil on the other side unless a step specifically directs you otherwise.

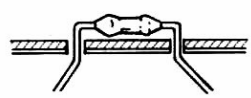
( ) R29: Hold a 10 kΩ (brn-blk-org) resistor as shown and bend the leads straight down with long-nose pliers to fit the hole spacing on the circuit board.



( ) Start the leads into the holes at the resistor's location at the top of Section 1 of the circuit board. The end with color bands may be positioned either way. NOTE: Resistors are identified by the following outline:

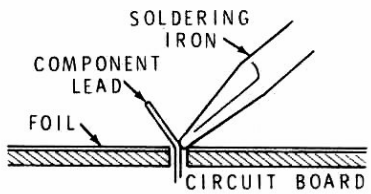


( ) Press the resistor against the circuit board. Then bend the leads outward slightly to hold it in place.

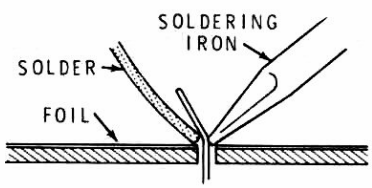


( ) Solder the resistor leads to the circuit board as follows:

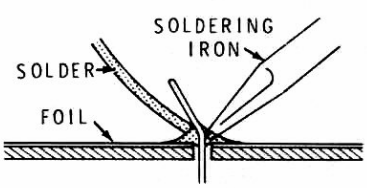
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



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



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



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

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

Start at the top of Section 1 and install the following resistors. The sequence of the steps matches the locations of the resistors on the circuit board. NOTE: Make sure you installed resistor R29 in an earlier step.

( ) R32: 36.5 kΩ, 1% (org-blu-grn-red).

( ) R31: 10 kΩ (brn-blk-org).

( ) R28: 10 kΩ (brn-blk-org).

( ) R33: 10 kΩ (brn-blk-org).

( ) R27: 100 kΩ (brn-blk-yel).

( ) R26: 19.1 kΩ, 1% (brn-wht-brn-red).

( ) R25: 10 kΩ (brn-blk-org).

( ) R8: 5600 Ω (grn-blu-red).

( ) R9: 3300 Ω (org-org-red).

( ) R6: 10 kΩ (brn-blk-org).

( ) R7: 100 kΩ (brn-blk-yel).

( ) R1: 680 Ω (blu-gry-brn).

( ) R2: 68 Ω (blu-gry-blk).

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

Install resistors in Section 2 of the circuit board as follows:

( ) R35: 56.2 kΩ, 1% (grn-blu-red-red).

( ) R34: 56.2 kΩ, 1% (grn-blu-red-red).

( ) R15: 10 kΩ (brn-blk-org).

( ) R13: 10 kΩ (brn-blk-org).

( ) R14: 10 kΩ (brn-blk-org).

( ) R16: 10 kΩ (brn-blk-org).

( ) R12: 820 Ω (gry-red-brn).

( ) R19: 3300 Ω (org-org-red).

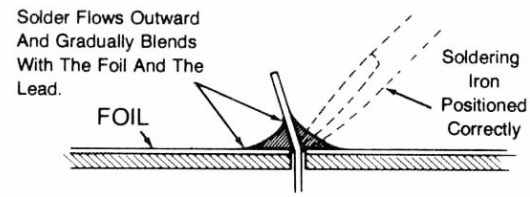
( ) R11: 620 Ω (blu-red-brn).

( ) R3: 5600 Ω (grn-blu-red).

( ) R4: 1500 Ω (brn-grn-red).

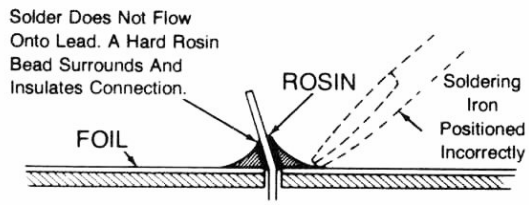
( ) Solder the leads to the foil and cut off the excess lead lengths.

A GOOD SOLDER CONNECTION

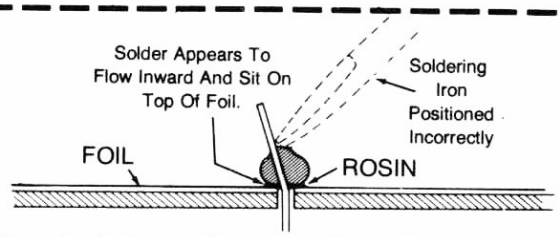


When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS



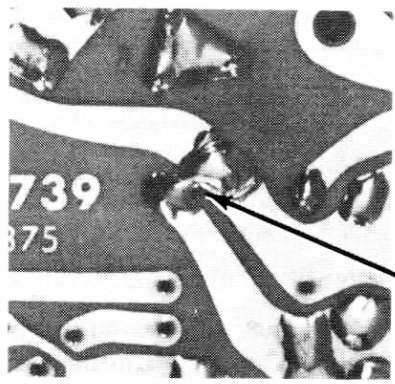
When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

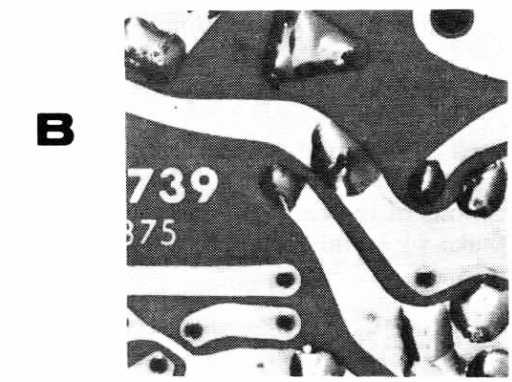


When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

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





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

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Install resistors in Section 3 of the circuit board as follows:

( ) R44: 261 kΩ, 1% (red-blu-brn-org).

( ) R39: 10 kΩ (brn-blk-org).

( ) R37: 10 kΩ (brn-blk-org).

( ) R38: 53.6 kΩ, 1% (grn-org-blu-red).

( ) R36: 10 kΩ (brn-blk-org).

( ) R41: 10 kΩ (brn-blk-org).

( ) R43: 56.2 kΩ, 1% (grn-blu-red-red).

( ) R42: 44.2 kΩ, 1% (yel-yel-red-red).

( ) R21: 44.2 kΩ, 1% (yel-yel-red-red).

( ) R22: 44.2 kΩ, 1% (yel-yel-red-red).

( ) R88: 10 kΩ (brn-blk-org).

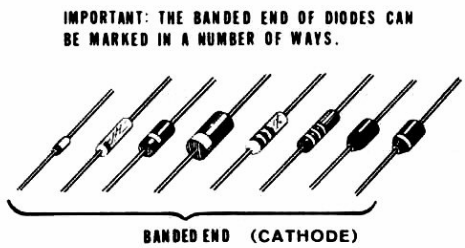
( ) R77: 2200 Ω (red-red-red).

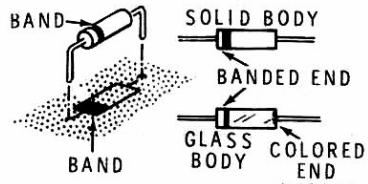
( ) R18: 390 kΩ (org-wht-yel).

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

Install diodes and resistors in Section 4 of the circuit board as follows:

NOTE: In some of the following steps, you will install diodes. Whenever you install a diode, always match the banded end of the diode with the band mark on the circuit board. A diode will not work properly if it is installed backwards.





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

( ) D2: 1N4002 diode (#57-65). NOTE: Diodes are identified on the circuit board by the following outline:

(✓) D1: 1N4002 diode (#57-65).

(✓) R48: 10 kΩ (brn-blk-org).

(✓) R45: 44.2 kΩ, 1% (yel-yel-red-red).

(✓) R46: 34.8 kΩ, 1% (org-yel-gry-red).

( ) R47: 34.8 kΩ, 1% (org-yel-gry-red).

( ) R79: 10 kΩ (brn-blk-org).

( ) R24: 6650 Ω, 1% (blu-blu-grn-brn).

( ) R23: 10 kΩ (brn-blk-org).

( ) R87: 10 kΩ (brn-blk-org).

( ) R85: 82 kΩ (gry-red-org).

( ) R84: 270 kΩ (red-viol-yel).

( ) R86: 82 kΩ (gry-red-org).

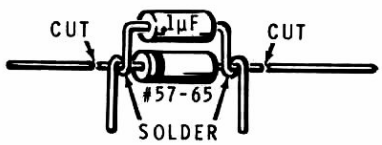
( ) Solder the leads to the foil and cut off the excess lead lengths.

Install diodes, capacitors, and resistors in Section 5 of the circuit board as follows:

( ) Use the following procedure to prepare two diode-capacitor combinations:

1. Form the leads of a 1N4002 diode (#57-65) as shown. Then wrap the leads of a .1 µF (104) glass ceramic capacitor around the leads of the diode.

2. Solder the leads together as shown. Then cut off the diode leads as close as possible to the solder connection.



( ) D3/C61: Diode-capacitor combination at D3.

( ) D4/C62: Diode-capacitor combination at D4.

( ) R53: 10 kΩ (brn-blk-org).

( ) R51: 10 kΩ (brn-blk-org).

( ) R49: 10 kΩ (brn-blk-org).

( ) R52: 36.5 kΩ, 1% (org-blu-grn-red).

( ) R56: 34.8 kΩ, 1% (org-yel-gry-red).

( ) R78: 10 kΩ (brn-blk-org).

( ) R93: 10 kΩ (brn-blk-org).

( ) R81: 10 Ω (brn-blk-blk).

( ) D6: 1N4149 diode (#56-56).

( ) R82: 1500 Ω (brn-grn-red).

( ) R83: 270 kΩ (red-viol-yel).

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

Install resistors in Section 6 of the circuit board as follows:

( ) R55: 10 kΩ (brn-blk-org).

( ) R54: 34.8 kΩ, 1% (org-yel-gry-red).

( ) R59: 10 kΩ (brn-blk-org).

( ) R63: 44.2 kΩ, 1% (yel-yel-red-red).

( ) R103: 3300 Ω (org-org-red).

( ) R106: 3300 Ω (org-org-red).

( ) R104: 56 kΩ (grn-blu-org).

( ) R105: 10 kΩ (brn-blk-org).

( ) R94: 3900 Ω (org-wht-red).

( ) R99: 3900 Ω (org-wht-red).

( ) D7: 1N4149 diode (#56-56).

( ) R98: 10 kΩ (brn-blk-org).

( ) R17: 3300 Ω (org-org-red).

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

Install resistors and a diode in Section 7 of the circuit board as follows:

( ) R61: 261 kΩ, 1% (red-blu-brn-org).

( ) R57: 53.6 kΩ, 1% (grn-org-blu-red).

( ) R58: 10 kΩ (brn-blk-org).

( ) R64: 34.8 kΩ, 1% (org-yel-gry-red).

( ) D5: 1N4739A diode (#56-608).

( ) R96: 470 Ω (yel-viol-brn).

( ) R102: 3900 Ω (org-wht-red).

( ) R97: 47 Ω (yel-viol-blk).

( ) R101: 10 kΩ (brn-blk-org).

( ) R75: 1000 Ω (brn-blk-red).

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

Install resistors in Section 8 of the circuit board as follows:

( ) R65: 44.2 kΩ, 1% (yel-yel-red-red).

( ) R62: 10 kΩ (brn-blk-org).

( ) R66: 56.2 kΩ, 1% (grn-blu-red-red).

( ) R67: 39 kΩ (org-wht-org).

( ) R68: 27 kΩ (red-viol-org).

( ) R69: 27 kΩ (red-viol-org).

( ) R71: 2200 Ω (red-red-red).

( ) R72: 27 kΩ (red-viol-org).

( ) R95: 1 MΩ (brn-blk-grn).

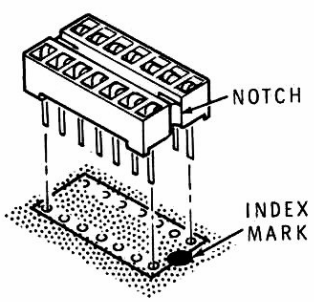
( ) R47: 2.7 Ω (red-viol-gold).

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

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

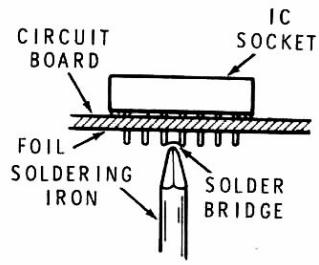
NOTES:

1. In the following steps, you will install IC sockets. To install an IC socket, make sure the pins are straight. Then start the pins into the circuit board holes. The index mark on the circuit board must still be visible after you install the socket. Solder the pins to the foil as you install each socket.

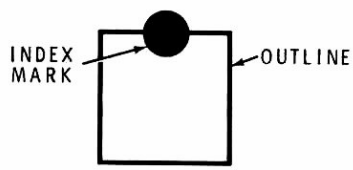


2. It is very easy to form a solder bridge between foils when you install an IC socket. After you install each socket, carefully inspect the foil for solder bridges and remove any that you find as described below. If you suspect that you have a solder bridge, but are not positive, you can check your foil pattern against the one shown on Illustration Booklet, Page 12.

To remove a solder bridge, hold the circuit board component-side-up as shown and hold your soldering iron tip between the two points that are bridged. The solder will flow down the soldering iron tip.



Install IC sockets in Section 1 of the circuit board at the following locations. NOTE: IC sockets are identified on the circuit board by the following outline:



( ) Five 8-pin IC sockets at U5, U6, U7, U4, and U8.

( ) Two 14-pin IC sockets at U21 and U20.

Install IC sockets in Section 2 of the circuit board as follows:

( ) Five 8-pin IC sockets at U2, U3, U1, U16, and U15.

Install IC sockets in Section 3 of the circuit board as follows:

( ) Four 8-pin IC sockets at U9, U10, U11, and U12.

( ) Two 14-pin IC sockets at U22 and U14.

Install IC sockets in Section 4 of the circuit board as follows:

( ) 16-pin IC socket at U19.

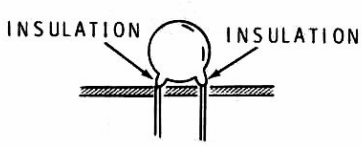
( ) 14-pin IC socket at U18.

( ) 8-pin IC socket at U17.

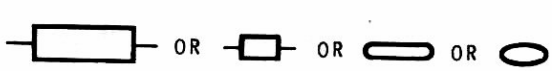
NOTE: Do not install an IC socket at U13. An integrated circuit will be soldered directly to the circuit board at this location later.

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

NOTE: In some of the following steps, you will install disc-type ceramic capacitors. When you install these ceramic capacitors, do not push the insulated portion of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil.



Install ceramic and polystyrene capacitors in Section 1 of the circuit board as follows. NOTE: These capacitors are identified on the circuit board by the following outlines:



( ) C1: .01 µF (103) glass ceramic.

( ) C2: .01 µF (103) glass ceramic.

( ) C18: 1000 pF polystyrene.

( ) C19: 1000 pF polystyrene.

( ) C17: 1000 pF polystyrene.

( ) C16: 1000 pF polystyrene.

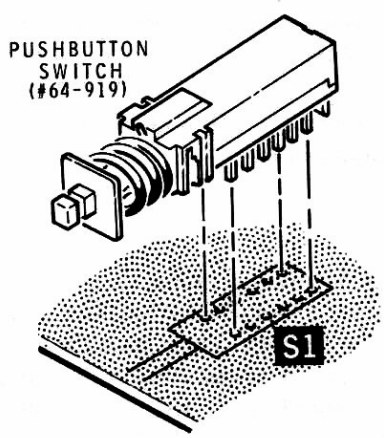
( ) C8: .001 µF (102) glass ceramic.

( ) C9: .1 µF (104) glass ceramic.

( ) C4: .01 µF (103) glass ceramic.

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

( ) S1: Install a pushbutton switch (#64-919) in the circuit board at S1. Start the pins of the switch into the circuit board holes as shown. Push the switch down tight against the circuit board and solder two pins (at opposite corners) to the foil. Make sure the switch is still down tight against the circuit board. Then solder the remaining pins to the foil.



Install ceramic and polystyrene capacitors in Section 2 of the circuit board as follows:

( ) C3: .01 µF (103) glass ceramic.

( ) C5: .1 µF (104) glass ceramic.

( ) C21: 1000 pF polystyrene.

( ) C13: 1000 pF polystyrene.

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

Install ceramic and polystyrene capacitors in Section 3 of the circuit board as follows:

( ) C22: 1000 pF polystyrene.

( ) C23: 1000 pF polystyrene.

( ) C51: .001 µF (102) glass ceramic.

( ) C15: 1500 pF polystyrene.

( ) C47: .001 µF (102) glass ceramic.

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

Install ceramic and polystyrene capacitors in Section 4 of the circuit board as follows:

( ) C25: 1000 pF polystyrene.

( ) C55: 1000 pF polystyrene.

( ) C53: .001 µF (102) glass ceramic.

( ) C45: .001 µF (102) glass ceramic.

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

Install ceramic and polystyrene capacitors in Section 5 of the circuit board as follows:

( ) C26: 1000 pF polystyrene.

( ) C56: 68 pF ceramic.

( ) C48: .001 µF (102) glass ceramic.

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

Install components in Section 6 of the circuit board as follows:

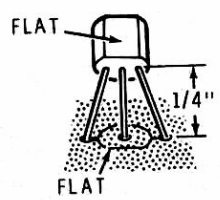
( ) C27: 1000 pF polystyrene capacitor.

( ) C28: 1000 pF polystyrene capacitor.

( ) C29: 1000 pF polystyrene capacitor.

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

( ) Q1: Install an MPSA20 transistor (#417-801) in the circuit board at Q1. Position the transistor so the flat side is over the outline of the flat on the circuit board. Then start the leads into their corresponding holes in the circuit board. Position the transistor 1/4" above the circuit board. Then solder the leads to the foil and cut off any excess lead lengths.



( ) C31: 100 pF (100K) ceramic capacitor.

( ) R5: 1.2 Ω, 2-watt, 10% (brn-red-gold-silv) resistor.

( ) C33: .1 µF (104) glass ceramic capacitor.

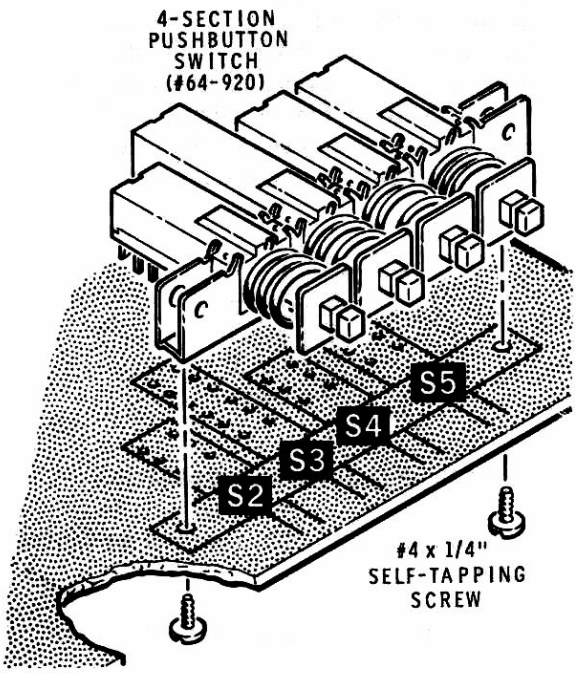
( ) C37: .1 µF (104) glass ceramic capacitor.

( ) C34: .01 µF (103) glass ceramic capacitor.

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

Install components in Section 7 of the circuit board as follows:

( ) S2/S3/S4/S5: Install a 4-section pushbutton switch assembly (#64-920) in the circuit board at S2/S3/S4/S5. Start the pins of the switch assembly into the circuit board holes as shown. Push the switch down tight against the circuit board and use two #4 × 1/4" self-tapping screws to secure the switch to the circuit board. Then solder all of the switch pins to the foil.



( ) C39: .1 μF (104) glass ceramic capacitor.

( ) C36: 750 pF ceramic capacitor.

( ) C35: .01 μF (103) glass ceramic capacitor.

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

Refer to Pictorial 1-4 (Illustration Booklet, Page 5) for the following steps.

Many of the IC's used in this kit are CMOS (complementary metal-oxide semiconductor) devices. These are rugged and reliable components when they are installed, but they can be damaged by static electricity during installation. The other IC's are of a type that is not susceptable to static electricity. Nevertheless, you should treat these IC's as if they were CMOS types, since it will avoid all possible confusion between IC's and provide protection in all cases. Use the procedure shown in Detail 1-4A whenever you are directed to install IC's.

( ) Position the circuit board as shown in the Pictorial.

Install integrated circuits in the sockets on the circuit board as follows:

( ) U1: Install an LM311P IC (#442-75) at U1.

( ) U14: Install a CD4007AE or MC14007UB IC (#443-604) at U14.

( ) U19: Install an MC14049CP or CD4049CN IC (#443-701) at U19.

( ) U18: Install an LM2901N IC (#442-616) at U18.

( ) U20, U21, U22: Install CD4066BCN IC's (#442-744) at U20, U21, and U22.

( ) U2-U12, U15-U17: Install MC1458P IC's (#442-21) at U2, U3, U4, U5, U6, U7, U8, U9, U10, U11, U12, U15, U16, and U17.

NOTE: The following integrated circuit does not have a socket.

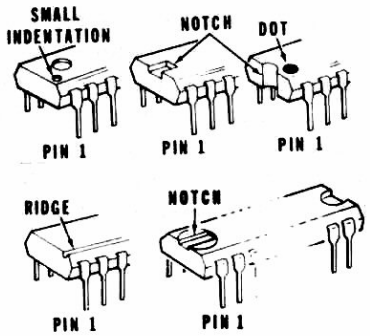
( ) U13: Install a ULN2280B IC (#442-748) in the circuit board at U13 and solder the pins to the foil.

Once you remove a protected IC from its protective foam packing, DO NOT lay the IC down or let go of it until it is installed in its socket. When you bend the leads of a protected IC, hold the IC in one hand and place your other hand on your work surface before you touch the IC to your work surface. This will equalize the static electricity between the work surface and the IC.

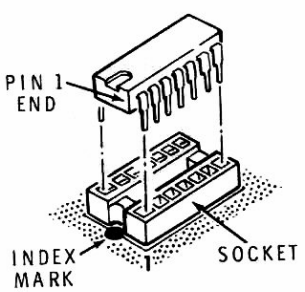
The pins on the IC's may be bent out at an angle, so they do not line up with the holes in the IC socket. DO NOT try to install an IC without first bending the pins as described below. To do so may damage the IC pins or the socket, causing intermittent contact.

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

Compare the IC to the drawing shown below. Then determine which end of the IC is the pin 1 end.



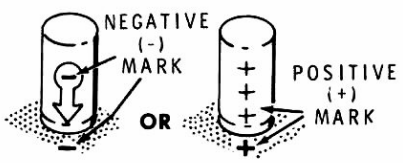
Position the pin 1 end of the IC over the index mark on the circuit board. Then start the IC pins into the socket. Make sure that all of the pins are started into the socket. Then push the IC firmly into the socket. NOTE: An IC pin can become bent under the IC and it will appear as though it is correctly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



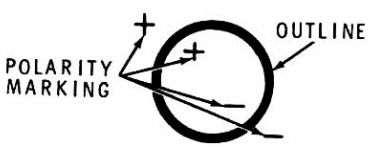
Detail 1-4A

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

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



Install electrolytic capacitors in Section 1 of the circuit board as follows. NOTE: Electrolytic capacitors are identified on the circuit board by the following outline:

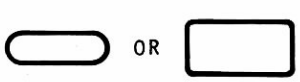


( ) C11: 1 µF electrolytic.

( ) C14: 10 µF electrolytic.

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

Install electrolytic and Mylar capacitors in Section 2 of the circuit board as follows. NOTE: Mylar capacitors are identified on the circuit board by the following outline:



( ) C43: 10 µF electrolytic.

( ) C24: 1 µF electroltyic.

( ) C58: .047 F Mylar (may be installed either way in the circuit board).

( ) C42: 47 µF electrolytic.

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

Install electrolytic capacitors in Section 3 of the circuit board as follows:

( ) C57: 10 µF.

( ) C54: 10 µF.

( ) C46: 1 µF.

( ) C49: 1 µF.

( ) C52: 1 µF.

( ) C12: 10 µF.

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

Install electrolytic and Mylar capacitors in Section 4 of the circuit board as follows:

( ) C59: 47 µF electrolytic.

( ) C44: 47 µF electrolytic.

( ) C6: 1000 µF electrolytic.

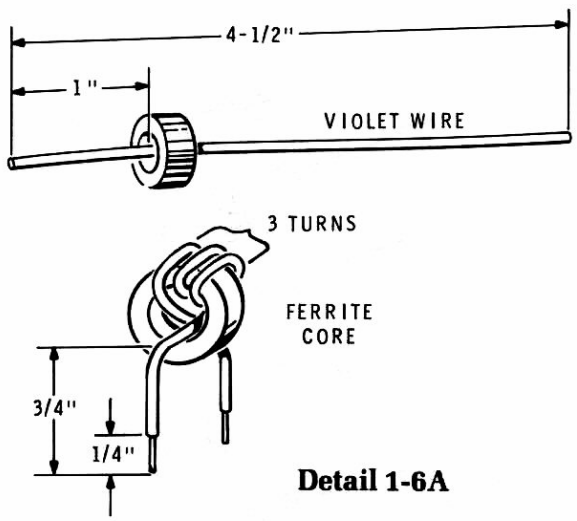
( ) C7: 1000 µF electrolytic.

( ) C32: .22 µF Mylar (may be installed either way in the circuit board).

( ) C38: 10 µF electrolytic.

( ) C41: 470 µF electrolytic.

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



Detail 1-6A

Refer to Pictorial 1-6 (Illustration Booklet, Page 7) for the following steps.

( ) Refer to Detail 1-6A and use the following procedure to wind a 3-turn coil:

1. Cut a 4-1/2" violet wire. Do not remove any insulation from the ends of the wire yet.

2. Push one end of the prepared wire through a ferrite core until it extends 1" from the core. Then wind three turns of wire around the core. Be sure to pull each turn tight against the core. Also be sure each turn of the wire does not cross another turn.

3. Cut off the excess ends of the wire so they extend 3/4" away from the point where they exit the core. Then remove 1/4" of insulation from each wire end.

( ) L4: Insert one end of the prepared coil into circuit board hole A, solder it to the foil, and cut off any excess wire end. The other wire end will be connected later.

NOTE: When a step directs you to prepare a stranded wire, (1) cut the indicated color wire to the length specified and (2) remove 1/4" of insulation from each end. Then (3) tightly twist together the strands at each end of the wire and (4) melt a small amount of solder on these ends to hold the strands together.

( ) Prepare the following stranded wires:

three 2" black
two 2" orange

Connect and solder one end of the prepared wires to the circuit board as follows. The other ends of these wires will be connected later.

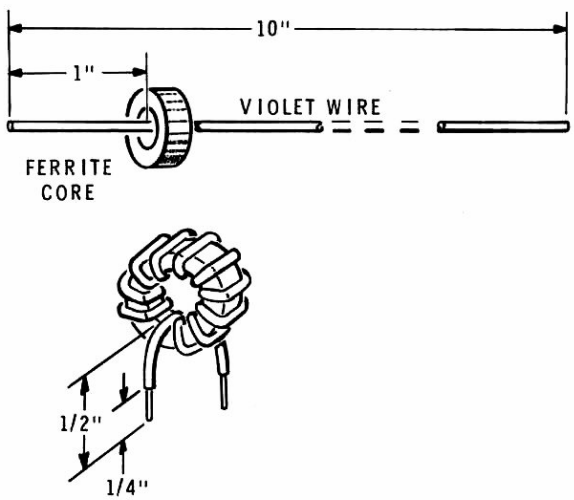
( ) 2" black to hole B.

( ) 2" orange to hole C.

( ) 2" black to hole D.

( ) 2" orange to hole E.

( ) 2" black to hole F.

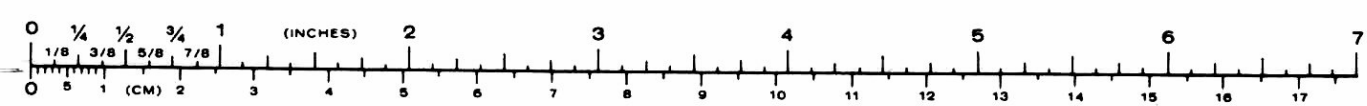


Detail 1-6B

( ) Refer to Detail 1-6B and use the following procedure to prepare three 10-turn coils:

1. Cut a 10" violet wire. Do not remove any insulation from the ends of the wire yet.

2. Push one end of the prepared wire through the ferrite core until it extends 1" from the core. Then wind 10 turns of wire around the core. Be sure to pull each turn tight against the core. Also be sure each turn of the wire does not cross another turn.



( ) Cut the excess wire ends of one of the 10-turn coils so they extend 1/2" from the point where they exit the core. Then remove 1/4" of insulation from each wire end. Use this coil in the next step.

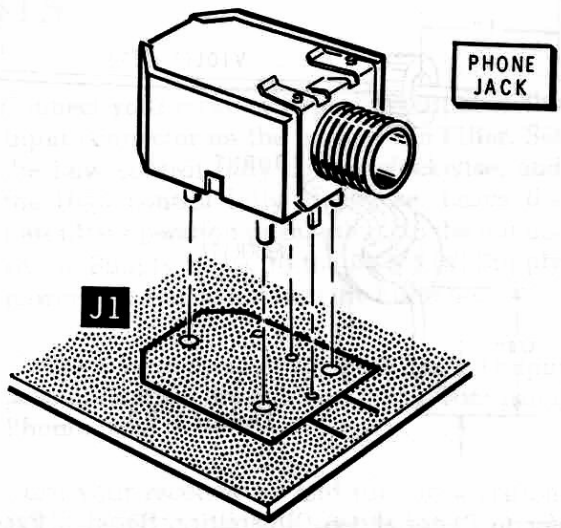
( ) L3: Start the bare leads of a prepared 10-turn coil into the circuit board holes at L3. Then solder the leads to the foil and cut off any excess wire ends.

( ) Cut the excess wire ends of one of the remaining 10-turn coils so they extend 3/4" from the point where they exit the core. Then remove 1/4" of insulation from each wire end. Use this coil in the next step.

( ) L2: Insert one end of the prepared coil into circuit board hole G, solder it to the foil, and cut off any excess wire end. The other wire end will be connected later.

( ) Cut the excess wire ends of the remaining 10-turn coil so they extend 3/4" from the point where they exit the core. Then remove 1/4" of insulation from each wire end. Use this coil in the next step.

( ) L1: Insert one end of the prepared coil into circuit board hole H, solder it to the foil, and cut off any excess wire end. The other wire end will be connected later.

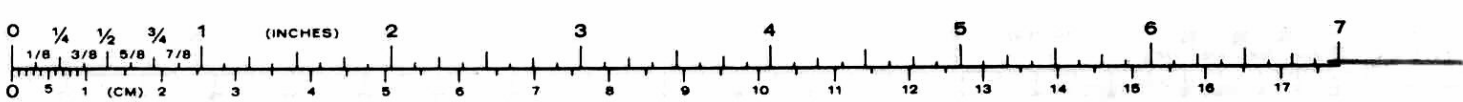


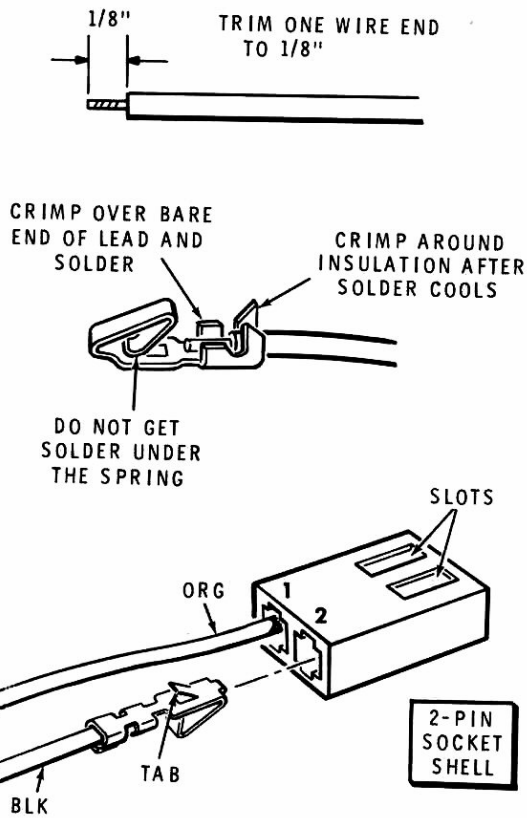
Detail 1-6C

( ) J1: Refer to Detail 1-6C and install the phone jack on the circuit board at J1. Start the pins of the jack into the circuit board holes, push the jack down tight against the circuit board, and solder the pins to the foil.

( ) Prepare the following lengths of stranded wire:

7-3/4" black
7-3/4" orange
2-1/2" black
2-1/2" orange





Detail 1-6D

( ) Refer to Detail 1-6D and solder a spring connector onto **one end** of each of the prepared wires.

( ) Refer again to Detail 1-6D and position a 2-pin socket shell with the slots up as shown. Position the spring connectors on the prepared 7-3/4" wires so the tab is up as shown. Then push the spring connectors into the socket shell until they lock into place as follows:

Orange wire into hole 1
Black wire into hole 2

( ) Refer again to Detail 1-6D and similarly push the spring connectors on the 2-1/2" wires into a 2-pin socket shell as follows:

Orange wire into hole 1
Black wire into hole 2

( ) Connect the free ends of the 7-3/4" wires to the circuit board as follows. Solder each wire to the foil and cut off the excess wire end as you connect it.

Black wire to hole L
Orange wire to hole M

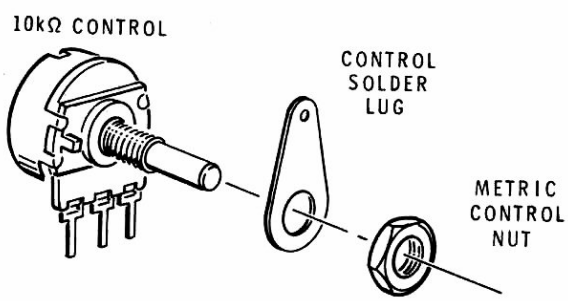
( ) Connect the free ends of the 2-1/2" wires to the circuit board as follows. Solder each wire to the foil and cut off the excess wire end as you connect it.

Black wire to hole N
Orange wire to hole P

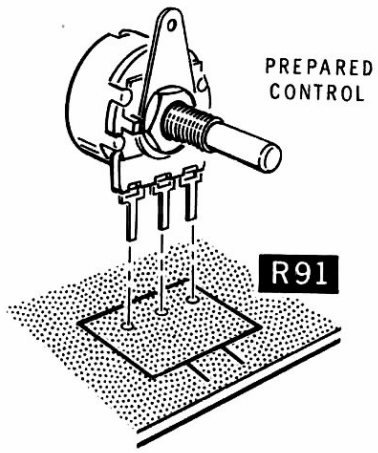
( ) Loosely twist together (approximately one turn per inch) the wires coming from holes L and M and the wires coming from holes N and P as shown in Pictorial 1-6.

( ) Locate a 10 kΩ control (#10-1196), a control solder lug, and a metric control nut. Then refer to Detail 1-6E and use the control nut to mount the solder lug onto the control as shown. Be sure to position the solder lug straight up as shown.

( ) Similarly, mount control solder lugs onto the remaining 10 kΩ control (#10-1196), the 20 kΩ control (#10-1197), and the dual 10 kΩ control (#12-185).



Detail 1-6E



Detail 1-6F

( ) R91: Refer to Detail 1-6F and install a prepared 10 kΩ control (#10-1196) onto the circuit board at R91. Be sure the control is perpendicular to and tight against the circuit board; then solder the lugs to the foil.

( ) R92: Similarly, install the remaining prepared 10 kΩ control (#10-1196) onto the circuit board at R92. Be sure the control is perpendicular to and tight against the circuit board before you solder the lugs to the foil.

( ) R76/R89: Similarly install the prepared dual 10 kΩ control (#12-185) onto the circuit board at R76/R89. Be sure the control is perpendicular to and tight against the circuit board before you solder the lugs to the foil.

( ) R73: Similarly install the prepared 20 kΩ control (#10-1197) onto the circuit board at R73. Be sure the control is perpendicular to and tight against the circuit board before you solder the lugs to the foil.

( ) Cut a 1-3/4" bare wire. Then insert one end of the wire into circuit board hole X and solder it to the foil. The other wire end will be connected later.

( ) Locate the five pushbutton knobs. Then push them onto the shafts of switches S1, S2, S3, S4, and S5. Be sure to push each knob all the way onto the switch shaft.

CIRCUIT BOARD CHECKOUT

Carefully inspect foil side of the circuit board for the following most-commonly-made errors:

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

( ) Protruding leads which could touch together or the chassis when the circiut board is installed later.

Refer to the illustrations where parts where installed as you make the following visual checks:

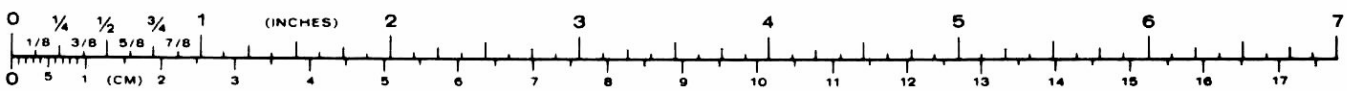
( ) Electrolytic capacitors for the correct position of the positive (+) or negative (−) marked lead.

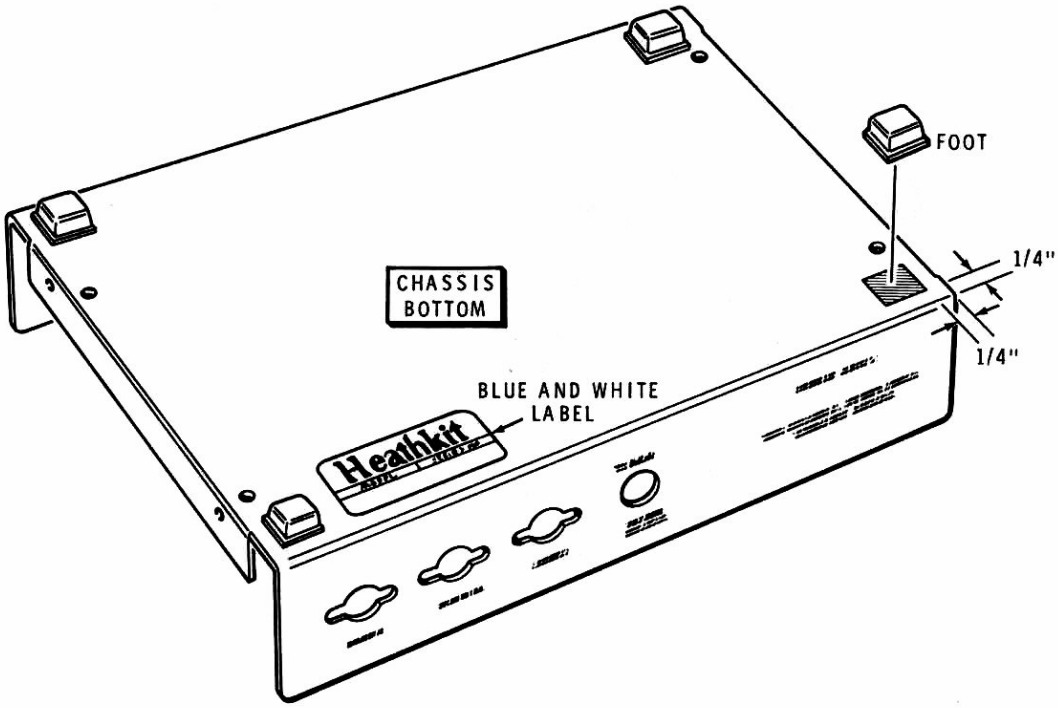
( ) Diodes for the proper **type** and **installation** (correct position of the banded end).

( ) Transistor for the proper installation.

( ) Integrated circuits for the proper **type** and **installation.**

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





Detail 1-7A

CHASSIS ASSEMBLY

Refer to Pictorial 1-7 (Illustration Booklet, Page 8) for the following steps.

( ) Refer to Detail 1-7A and position the chassis upside down. Carefully peel the backing paper from the four feet and press them into place near each corner of the chassis. Be careful not to cover any holes in the chassis.

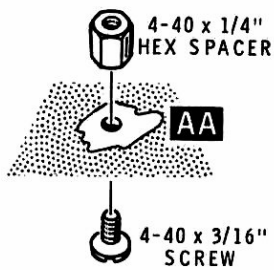
( ) Carefully peel the backing paper from the blue and white label. Then press the label onto the bottom of the chassis in the area shown. Be sure to refer to the numbers on the label in any communications you have with the Heath Company about your kit.

( ) Reposition the chassis right-side-up as shown in Pictorial 1-7.

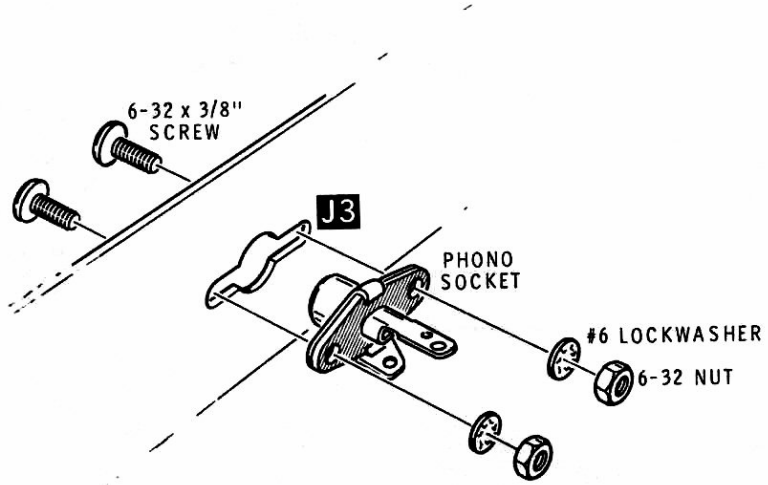
( ) Use sandpaper or a knife to scrape away any excess paint from the inside of the chassis around holes AA, AB, AC, and AD in the bottom, and J3, J4, and J5 in the rear of the chassis.

( ) Refer to Detail 1-7B and mount a 4-40 × 1/4" hex spacer onto the chassis at AA. Use a 4-40 × 3/16" screw.

( ) Similarly, mount 4-40 × 1/4" hex spacers onto the chassis at AB, AC, and AD.



Detail 1-7B



Detail 1-7C

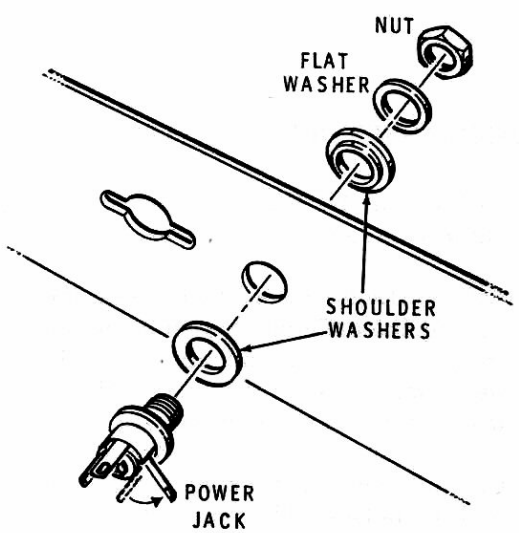
( ) J3: Refer to Detail 1-7C and mount a phono socket onto the rear of the chassis at J3. Use two 6-32 × 3/8" screws, two #6 lockwashers, and two 6-32 nuts. Be sure to position the socket as shown in the Pictorial.

( ) J4: Similarly, mount a phono socket onto the rear of the chassis at J4. Be sure to position the socket as shown in the Pictorial.

( ) J5: Similarly mount a phono socket onto the rear of the chassis at J5. Be sure to position the socket as shown in the Pictorial.

( ) Refer to Detail 1-7D and mount a power jack onto the rear of the chassis at J2. Use two shoulder washers and the flat washer and nut supplied with the jack. Be sure the shoulders on the washers enter the chassis hole. Also be sure to position the jack as shown in the Pictorial.

( ) Bend lug 3 of power socket J2 over as shown in the Pictorial. Do not allow the lug to touch the chassis.

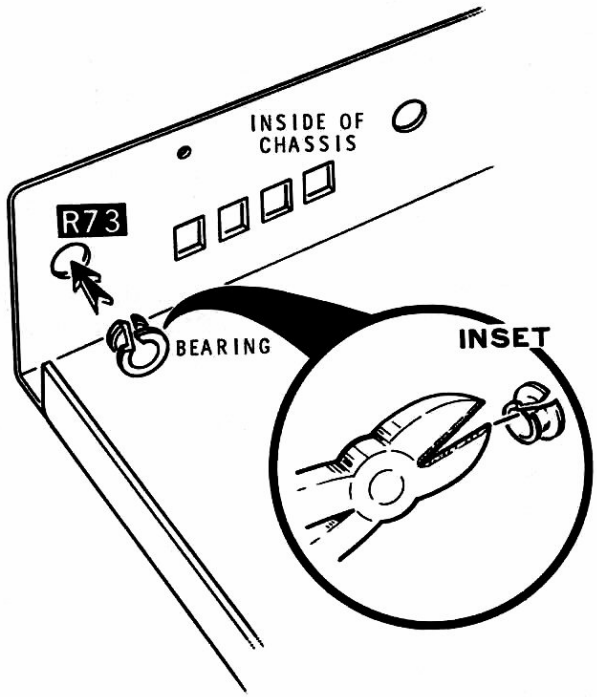


Detail 1-7D

NOTE: When you install the bearings in the next step, you will have to cut them a small amount so they will fit in the chassis hole. Cut away only as much of each bearing as necessary so you can push it into the hole (see the inset drawing). It is important that the control shafts that will pass through these bearings cannot touch the chassis.

( ) Refer to Detail 1-7E and push a bearing into hole R73 in the front of the chassis. Be sure to install the bearing from inside the chassis.

( ) Similarly, push bearings into holes R76/R89, R92, and R91 in the front of the chassis. Be sure to install each bearing from inside the chassis.



Detail 1-7E

Refer to Pictorial 1-8 (Illustration Booklet, Page 9) for the following steps.

( ) Refer to Detail 1-8A and use the following procedure to mount the circuit board into the chassis:

1. Position the back edge of the circuit board into the chassis so it is against the rear of the chassis under the jacks mounted on the rear of the chassis. Be sure the free ends of the wires and coils coming from the circuit board are on top of the circuit board. You will connect them to the jacks later.

2. Slide three fiber control flat washers onto the bushing of phone jack J1. Then lower the front edge of the circuit board into the chassis. The controls mounted on the circuit board should just clear the front of the chassis.

3. Slide the circuit board forward so the bushing of phone jack J1, the shafts of the controls, and the knobs on the pushbutton switches pass through their corresponding holes in the chassis.

4. Secure the circuit board to the hex spacers on the bottom of the chassis at AA, AB, AC, and AD with four 4-40 × 3/16" screws and four #4 lockwashers. If a spacer does not line up with the hole in the circuit board, loosen the screw on the bottom of the chassis and reposition the spacer. Then retighten the screw.

5. Use a decorative control nut to secure phone jack J1 to the front of the chassis.

NOTE: In the following steps, (NS) means not to solder the connection because you will add other wires later. "S-" with a number, such as (S-1), means to solder the connection. The number following the "S-" shows you how many wires should be at the connection. This helps you check your work for errors as you go.

( ) Connect the free end of the black wire coming from circuit board hole B to jack J3 lug 2 (S-1).

( ) Connect the free end of the wire coming from coil L4 to jack J3 lug 1 (S-1).

( ) Connect the free end of the black wire coming from circuit board hole D to jack J4 lug 2 (S-1).

( ) Connect the free end of the orange wire coming from circuit board hole C to jack J4 lug 1 (S-1).

( ) Connect the free end of the black wire coming from circuit board hole F to jack J5 lug 2 (S-1).

( ) Connect the free end of the orange wire coming from circuit board hole E to jack J5 lug 1 (S-1).

( ) Connect the free end of the wire coming from coil L2 (and circuit board hole G) to jack J2 lug 1 (S-1).

( ) Connect the free end of the wire coming from coil L1 (and circuit board hole H) to jack J2 lug 2 (S-1).

( ) Cut the following bare wires:

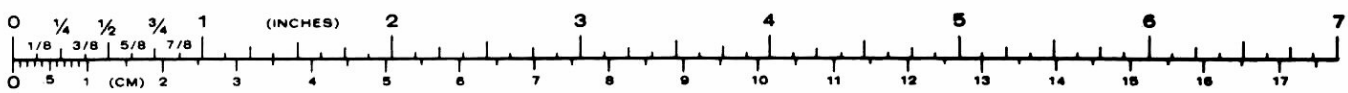
Two 1-1/2"
One 3-1/2"

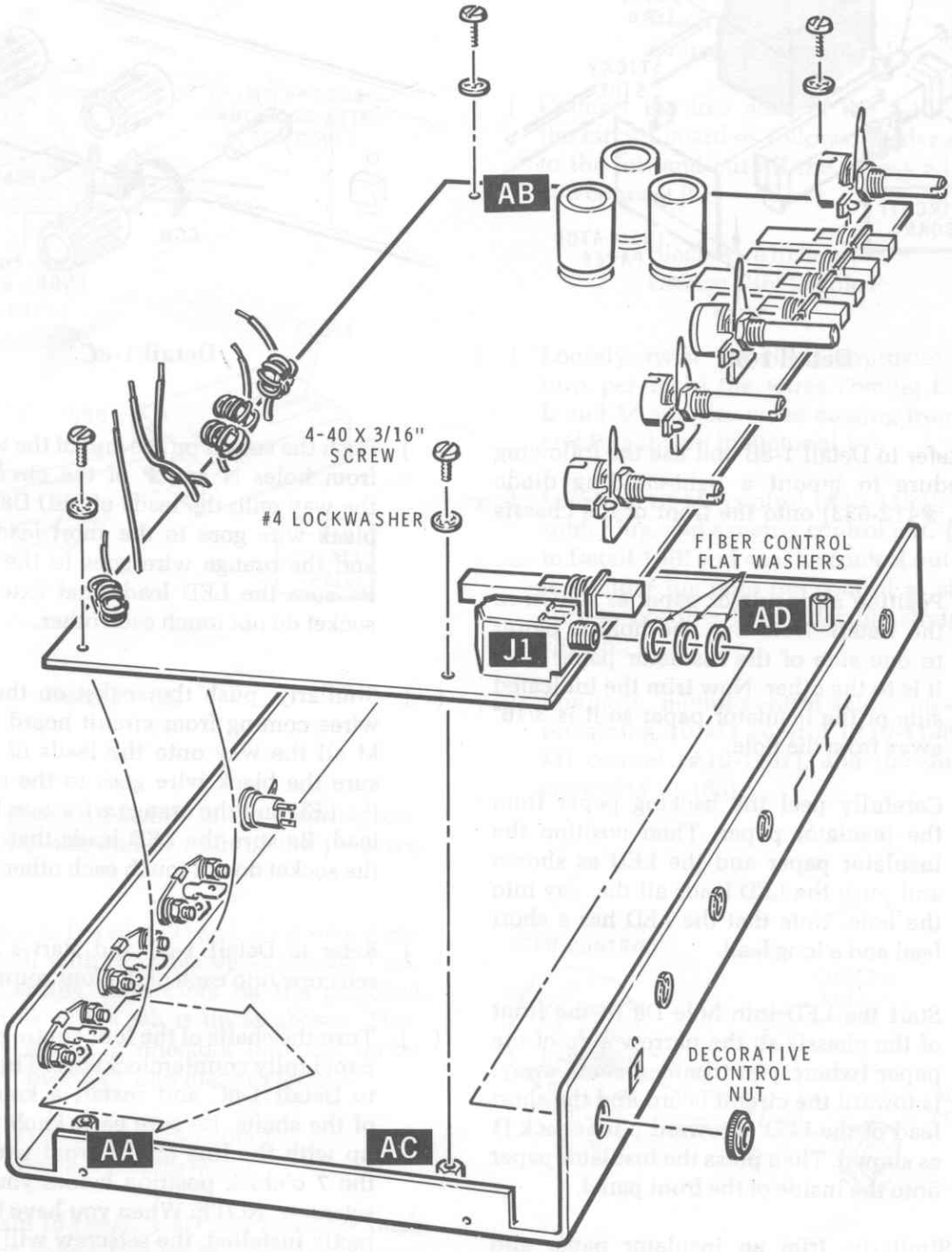
( ) Connect a 1-1/2" bare wire from the solder lug on control R91 (S-1) to the solder lug on control R92 (NS).

( ) Connect a 1-1/2" bare wire from the solder lug on control R92 (S-2) to the solder lug on control R76/R89 (NS).

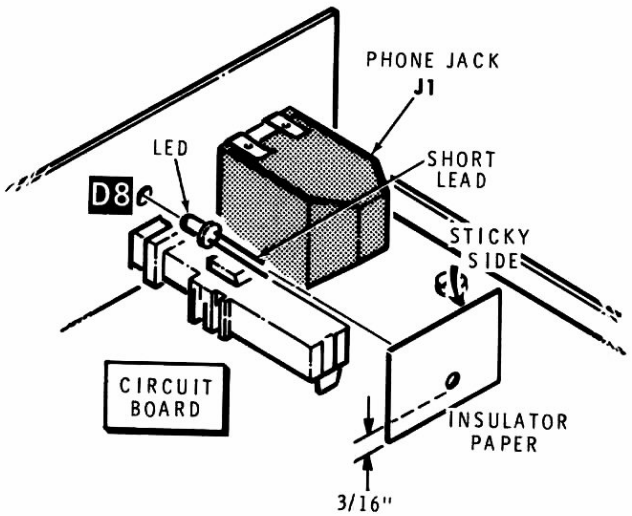
( ) Connect a 3-1/2" bare wire from the solder lug on control R76/R89 (S-2) to the solder lug on control R73 (NS).

( ) Connect the free end of the wire coming from circuit board hole X to the solder lug on control R73 (S-2).

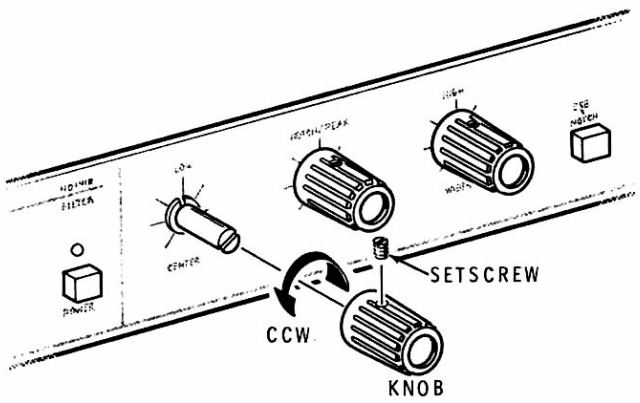



AB
4-40 X 3/16"
SCREW
#4 LOCKWASHER
FIBER CONTROL
FLAT WASHERS
AD
J1
DECORATIVE
CONTROL
NUT
AA
AC

Detail 1-8A



Detail 1-8B



Detail 1-8C

( ) D8: Refer to Detail 1-8B and use the following procedure to mount a light-emitting diode (LED, #412-633) onto the front of the chassis at D8:

1. Position an insulator paper as shown in the Detail. Note that the hole is closer to one side of the insulator paper than it is to the other. Now trim the indicated side of the insulator paper so it is 3/16" away from the hole.

2. Carefully peel the backing paper from the insulator paper. Then position the insulator paper and the LED as shown and push the LED leads all the way into the hole. Note that the LED has a short lead and a long lead.

3. Start the LED into hole D8 in the front of the chassis so the narrow side of the paper (where you trimmed some away) is toward the circuit board and the short lead of the LED is toward phone jack J1 as shown. Then press the insulator paper onto the inside of the front panel.

( ) D9: Similarly, trim an insulator paper and mount an LED (#412-633) on the front of the chassis at D9. This time, be sure the narrow side of the insulator paper is **away from** the circuit board and the short lead is toward the previously installed LED.

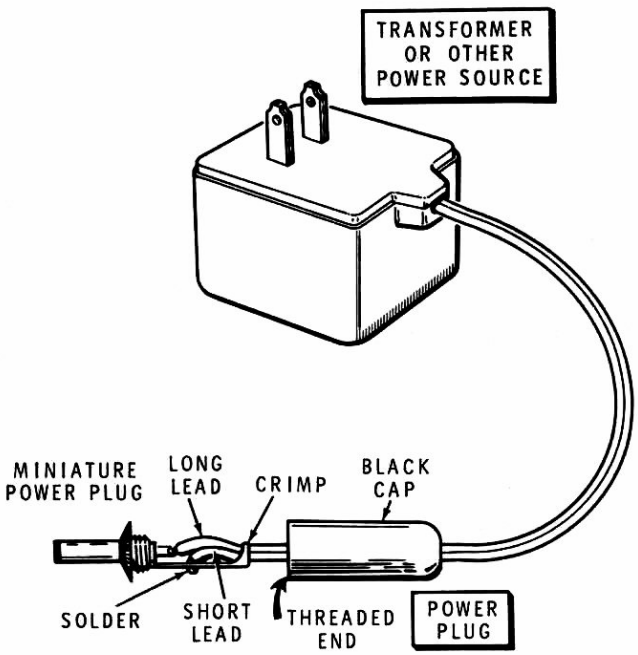
( ) Push the socket on the end of the wires coming from holes N and P of the circuit board all the way onto the leads of LED D8. Be sure the black wire goes to the short lead of the LED and the orange wire goes to the longer lead. Be sure the LED leads that extend from the socket do not touch each other.

( ) Similarly, push the socket on the end of the wires coming from circuit board holes L and M all the way onto the leads of LED D9. Be sure the black wire goes to the short lead of the LED and the orange wire goes to the longer lead. Be sure the LED leads that extend from the socket do not touch each other.

( ) Refer to Detail 1-8C and start a 6-32 × 1/8" setscrew into each of the four round knobs.

( ) Turn the shafts of the four controls on the front panel fully counterclockwise. Then refer again to Detail 1-8C and install a knob onto each of the shafts. Be sure each knob pointer lines up with the line on the front panel that is in the 7 o'clock position before you tighten the setscrew. NOTE: When you have the knob correctly installed, the setscrew will line up with the line on the front panel that is approximately in the 2 o'clock position.

This completes the assembly of your Active Audio Filter. Shake out any loose pieces of wire and solder.



PICTORIAL 1-9

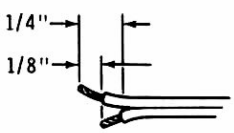
POWER PLUG

For this kit, you will need a power source that provides either 7 to 13.5 VAC or 9 to 18 VDC at up to 400 mA. The Heath PS-5012 power cube (for connection to 120 VAC power), or the PS-5024 (for connection to 240 VAC) are ideally suitable for use with this kit.

Refer to Pictorial 1-9 for the following steps.

( ) Prepare the ends of your power cord as shown in Detail 1-9A. Either side of the cord may be used as the long lead, since the HD-1418 takes care of polarity considerations internally. However, good general wiring practice dictates that you use the smooth or marked wire (from a commercial power cube) as the long lead. If you use your own DC supply, you can connect the wires to the power plug without regard to polarity.

( ) Remove the black cap from the miniature power plug. Slide the cap over the end of the transformer cable with the threaded end as shown.



Detail 1-9A

( ) Solder the long and short wires to the indicated lugs on the miniature power plug. NOTE: You may find it easier to clamp the power plug in a small vice to hold it steady while you solder.

( ) After the connections cool, crimp the indicated lugs around the cable as shown. Replace the cap on the power plug.

( ) This completes the "Step-By-Step Assembly." Proceed to "Initial Tests."

INITIAL TESTS

IMPEDANCE CHECKS

You will need a volt-ohmmeter to perform the following tests. If you do not have one, move ahead to the "Operational Checks." Refer to Pictorial 2-1 (Illustration Booklet, Page 10) for test points mentioned in the steps.

If you get the correct results in the following tests, proceed to the "Operational Checks." If you do not get the correct results, disconnect the power. Then troubleshoot your Filter using the information from the "In Case Of Difficulty" section of this Manual and the schematic diagram.

( ) Set your ohmmeter to the R × 100 scale and make these three measurements at the power jack (J2). Each measurement must be at least 500 Ω, although your meter may give a much higher reading.

1. Lug 1 to ground.
2. Lug 2 to ground.
3. Lug 1 to lug 2.

( ) Connect your power source to the Filter and push the **Power** button. The power LED (D8) should light, and you should be able to measure at least 7.5 VDC at the emitter (E) of regulator transistor Q1.

OPERATIONAL CHECKS

Perform these checks to verify that the various functions of the Filter are all working properly. If you find that a function is not working, turn your Filter off and troubleshoot the difficulty before you proceed any further.

( ) Connect your receiver's speaker output to the **Input** connector on the back of the Filter. Set the **Low** control fully counterclockwise, and the **High** control fully clockwise. Leave the four filter operation pushbuttons in the out position. Supply power to the **9-18 VDC Supply** power jack, but do not turn the Filter on.

( ) Connect your speaker to the Filter's **Output** jack, or connect headphones to the front panel **Phones** jack.

( ) Turn your receiver on and tune to a station. With the Filter off, you should hear your receiver's output at normal volume.

( ) Turn the Filter on, set the **SSB** and **SSB & Peak** pushbuttons to their in position, and turn the **Gain** control fully clockwise. The Filter's gain is about unity, so the speaker volume should be about the same as before.

Checking Peak Operation

( ) Leave the Filter connected as it was in the previous step, and set the pushbuttons so that only the **SSB & Peak** button is in.

( ) Tune to a station that is transmitting a continuous carrier wave. (If your receiver has a calibrator, you could turn it on and use its signal.)

( ) Adjust the **Notch/Peak** control until you obtain maximum volume of the tone. If moving the control to other positions gives less volume, then the peak filter is operating.

Checking Notch Operation

( ) Begin with all controls set as they were in the previous step. Tune to a station that is transmitting a continuous carrier wave. (If your receiver has a calibrator, you could turn it on and use its signal.) Then release the **SSB & Peak** and press the **SSB & Notch** button. Turn the **Notch/Peak** control slowly in each direction. When the notch is directly on the tone's frequency, you should be able to hear a noticeable decrease in the volume of the tone.

Checking Low Filter

( ) Reset the Filter pushbuttons, so that **SSB** is in and the others are out, and set the **Low** control fully counterclockwise. Slowly turn the **Low** control clockwise. You should hear the change in sound as the lower frequency sounds are attenuated.

Checking High Filter

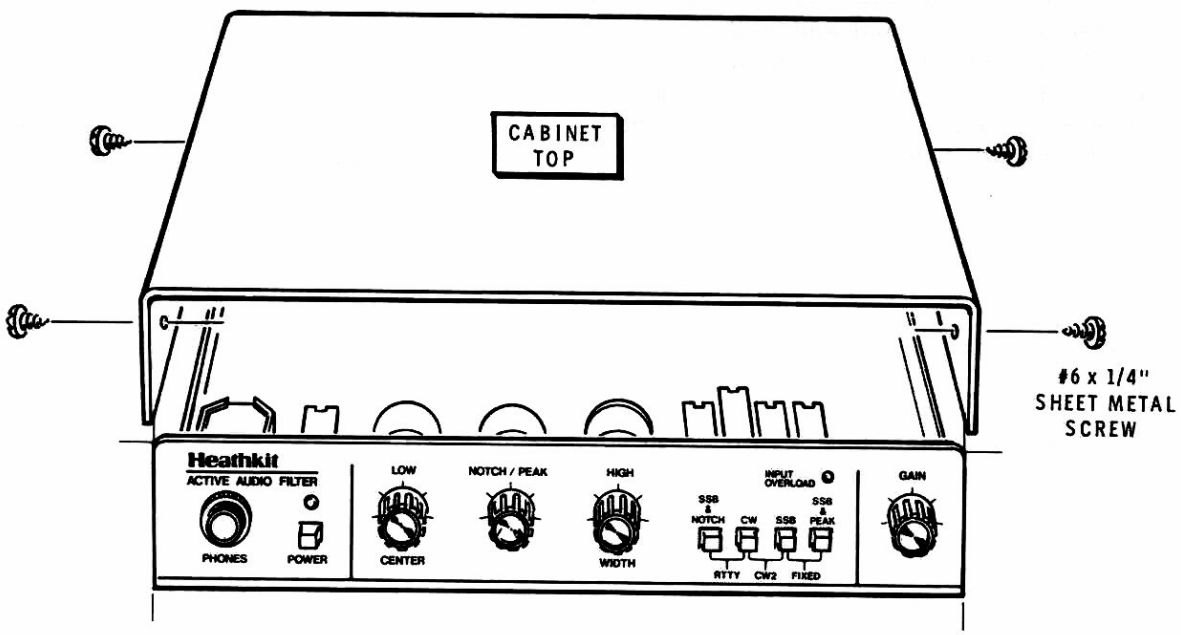
( ) Return the **Low** control to its counterclockwise end and begin with the **High** control fully clockwise. Slowly turn the **High** control counterclockwise. You should hear the change as the higher ferquency sounds are attenuated.

This completes the Initial Tests. Proceed to "Final Assembly."

FINAL ASSEMBLY

( ) Position the cabinet top onto the chassis as shown in Pictorial 3-1. Then use four #6 × 1/4" sheet metal screws to secure the cabinet top to the chassis.

This completes the "Final Assembly."



PICTORIAL 3-1

OPERATION

In an effort to make this Manual as useful as possible, we will address the Filter's operation from two points of view. First we will address controls and connection points separately, and tell what each does. This section is useful when you are first becoming familiar with the Filter, and can be a valuable reference section later if you have questions.

Next is the "Applications" section, where we will show and discuss frequency response curves you will commonly use, and tell what buttons you push to obtain them. The "Applications" section also contains information about how you might typically install a Filter in your system.

BACK PANEL CONNECTIONS

Refer to Pictorial 4-1 (Illustration Booklet, Page 11) for a drawing of the Filter's back panel. Each connection is labeled and discussed in that Pictorial. For further information about how you might choose to connect the Filter into your specific system, you may wish to refer to Page 39.

FRONT PANEL, SINGULAR CONTROLS

Refer to Pictorial 4-2 for an illustration of the Filter's front panel. Some of the Filter's controls are "interactive." That is, changing the setting of one of them directly affects the other(s). The controls and outputs discussed in the following paragraphs are "singular" (NOT interactive).

Phones

This provides a front-panel processed and amplified audio output that you may use for headphones or speaker (4 ohms or higher). If you Plug into the **Phones** jack, the **Output** at the rear panel will automatically be disconnected.

Power

The **Power** switch turns the Filter on and off. While the power is on, the LED above the **Power** switch will glow and the processed amplified signal will be output to either the **Phones** or **Output** jacks. The processed (but not amplified) signal will also be at **Tape Out** jack. With the **Power** switch off, the input to the Filter will not be processed but will go straight to **Tape Out** and either **Phones** or **Output**.

Gain

While the Filter is on, this control determines the gain of the Filter's amplifier section (the output to either **Phones** or **Output**).

Input Overload

This LED lights if the input signal coming to the Filter from your tranceiver or receiver is more than 3 volts peak-to-peak and may cause distortion in teh Filter's circuitry.

FRONT PANEL, INTERACTIVE CONTROLS

Continue to refer to Pictorial 4-2 for the following.

NOTE: In this section of the Manual, colored panel labels are shown in *italic* letters, and the white labels are shown in **bold** letters.

Some controls directly affect each other. The position of the four pushbuttons determine what the three control knobs actually control. Look at the front panel of your Filter and notice that some of the knob and button labels are printed in white while others are in color; this coding is to illustrate how they interact. If the **push-button** positions correspond to a colored label, the **knob** functions also correspond to their colored labels. (For instance, pressing **SSB & Notch** and *CW* puts the Filter in *RTTY* operation. This causes the controls to work as *CENTER*, and *WIDTH* with the **Notch/Peak** control inoperative.)

Low-*Center*

As a **Low** control, this knob moves the low cutoff end of the bandpass filter up or down, between 300 and 2500 Hz. When you select it as a *CENTER* control, the knob moves the center of the passband up and down from 300 Hz to 2500 Hz, and is coupled with the *WIDTH* control.

High-*Width*

As a **High** control, this knob moves the high cutoff end of the bandpass filter up or down, between 300 and 2500 Hz. When you select it as a *WIDTH* control, the knob widens or narrows the band around the frequency selected by the *CENTER* control.

Notch/Peak

This control has a special limitation that is different from the others. It is activated only by the pushbuttons that have **Notch** or **Peak** as part of their label, but it will be deactivated if you push the **SSB** pushbutton. This control can move the notch or peak anywhere within the bandpass, including either edge to make the roll-off steeper.

Pushbuttons

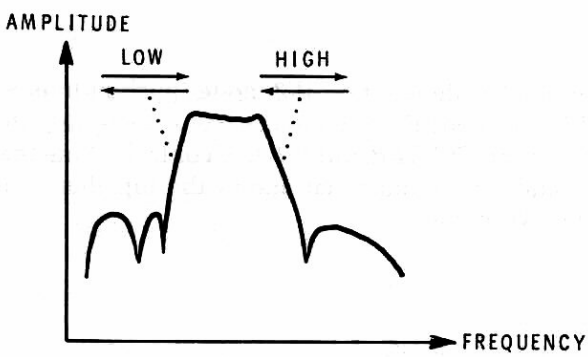
There are seven common modes of operation you can select by pressing either one or two pushbuttons in the patterns shown on the front panel. These combinations are listed and discussed under the following "Applications" section.

APPLICATIONS

Curves and Applications

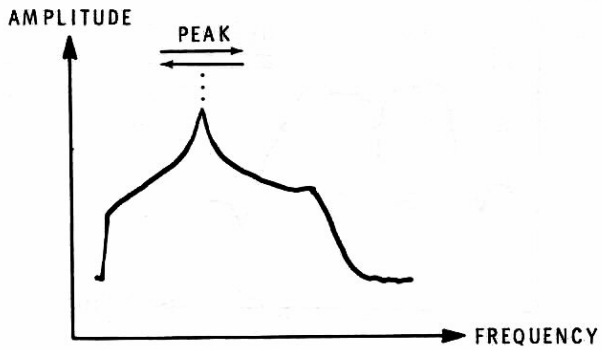
Refer to the following Pictorials to see the approximate filter bandpass characteristics, and the control actions, for the seven different combinations of pushbutton positions. While the name for each mode describes the typical use for that mode, you may also think of other times when it might suit a special need.

Pictorial 4-3 shows the SSB mode (pushbutton S4 pressed) Filter characteristics, including the effect of the **High** and **Low** controls. (In this and the following paragraphs, only the controls that will be active are mentioned.)



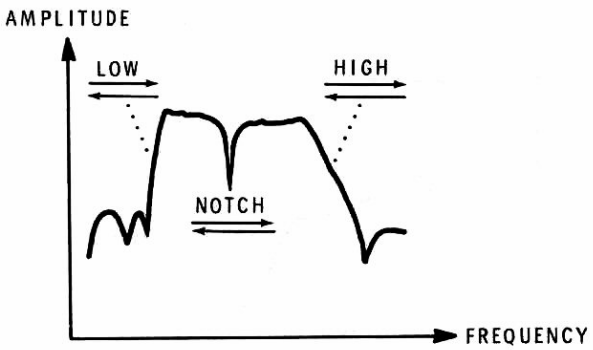
PICTORIAL 4-3

Pictorial 4-4 shows the SSB & PEAK mode (pushbutton S5 pressed) Filter characteristics, including the effect of the **Peak** control (only the **Peak** control is active). You may use this mode to pinpoint an interference source with the **Peak** control, then switch to the SSB & NOTCH mode to suppress that interference.



PICTORIAL 4-4

Pictorial 4-5 shows the SSB & NOTCH mode (pushbutton S2 pressed) Filter characteristics, including the effect of the **Low, Notch,** and **High** controls. If you switch to this mode from the SSB & PEAK mode, you may fine tune the **Notch** control to help reduce the interference source.

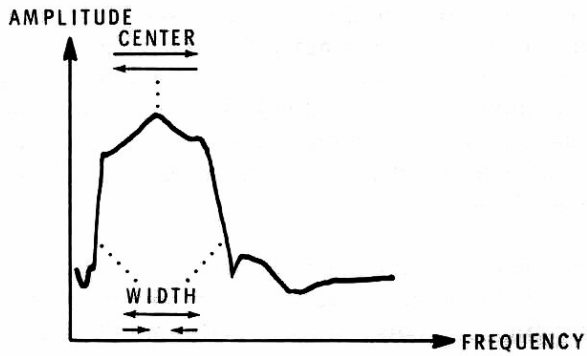


PICTORIAL 4-5

Pictorial 4-6 shows the **FIXED** mode (**SSB** and **SSB & Peak** pushbuttons pressed) Filter characteristics. The controls do not act since this is a fixed filter.

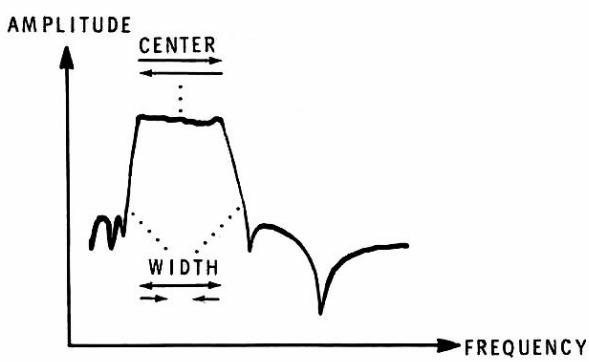
PICTORIAL 4-6

Pictorial 4-7 shows the *CW* mode (pushbutton S3 pressed) Filter characteristics, including the effect of the *WIDTH* and *CENTER* controls.



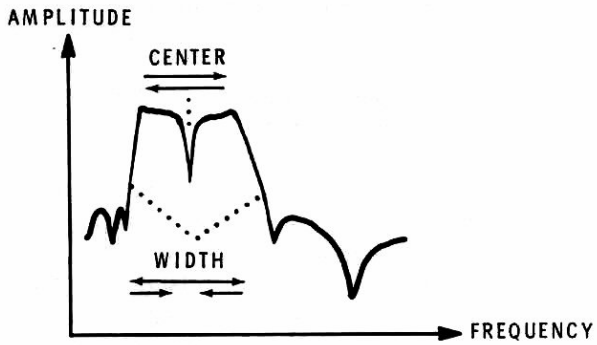
PICTORIAL 4-7

Pictorial 4-8 shows the *CW2* mode (pushbuttons S3 and S4 pushed) Filter characteristics, including the effect of the *CENTER* and *WIDTH* controls. Note that the bandpass is more flat across the top than it is in the *CW* mode.



PICTORIAL 4-8

Pictorial 4-9 shows the *RTTY* mode (**SSB & Notch** and *CW* pushbuttons pushed) Filter characteristics. The *WIDTH* control works as it normally does, but note that the *CENTER* control moves the entire bandpass up and down, with the notch in the center, while the *WIDTH* control changes the bandpass width.



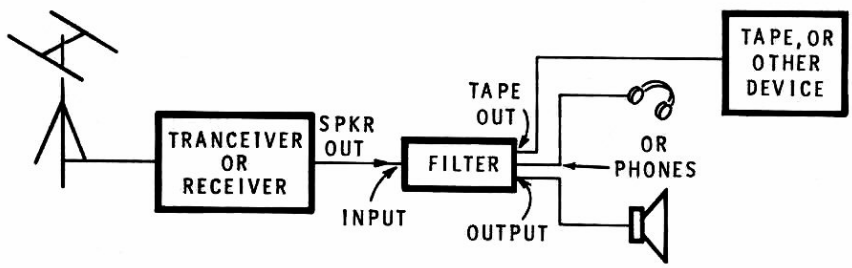
PICTORIAL 4-9

Typical Use in Your System

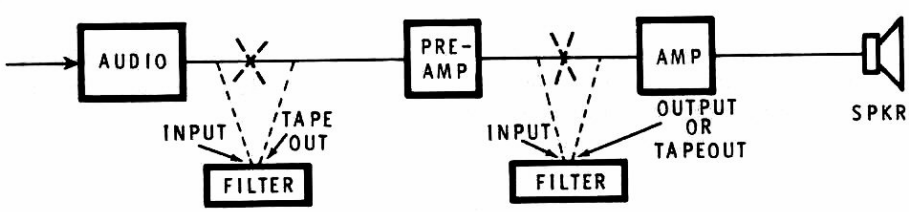
A typical system application is shown in Pictorial 4-10, with the Filter at your receiver or tranceiver's speaker output. This position allows you to adjust volume from either the tranceiver or Filter gain control (although 3 volts peak-to-peak from the tranceiver will cause the INPUT OVERLOAD warning to light).

Pictorial 4-11 illustrates other possibilities you can employ with the Filter. If your system has the proper provisions, you may choose to put the Filter in line ahead of the amplifier or pre-amp. The Filter has a 5 k ohm input impedance and unity gain.

If you have a phone patch connected between your transceiver and speaker, you can install the Filter on either side of the phone patch. To process the audio before it is coupled to the telephone line, insert the Filter between the transceiver and phone patch.



PICTORIAL 4-10



PICTORIAL 4-11

IN CASE OF DIFFICULTY

This part of the Manual will help you locate and correct any difficulty that might occur in your Filter. This information is divided into two sections. The first section, "General," contains suggestions for reviewing your kit to locate possible causes of incorrect performance.

The second section is a "Troubleshooting Chart." This chart calls out specific problems that may occur and lists one or more conditions or components that could cause each difficulty.

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

GENERAL

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

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

3. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, you can often eliminate many troubles by reheating all connections to make sure they are soldered properly, as described in the soldering instructions in the Manual.

4. Check each circuit board foil to be sure there are no solder bridges between adjacent connections. Remove any solder bridges by holding a clean soldering iron tip between the two points that are bridged until the excess solder flows **down** onto the tip of the soldering iron.

5. Be sure each transistor and each integrated circuit is in the proper location (correct part number or type number). Be sure that each transistor lead is in the right hole and has a good solder connection to the foil. Check integrated circuits for proper positioning and for good contact at each pin connection.

6. 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. Check each electrolytic capacitor to be sure the lead near the positive (+) marking is at the correct position.

7. Check each resistor value carefully. It would be easy, for example, to install a 2200 Ω (red-red-red) resistor where a 220 Ω (red-red-brown) resistor is called for. A resistor that is discolored, or cracked, or shows any sign of bulging would indicate that it is faulty and should be replaced.

8. Be sure the correct diode is installed at each diode location, and that the banded end is positioned correctly.

9. Check all component leads connected to the circuit boards. Make sure the leads do not extend through the circuit board and come in contact with other connections or parts, such as the chassis.

10. Check all the wires that are connected to the circuit board plugs. Make sure the wires do not touch the chassis or other lugs. Make sure all wires are properly soldered.

11. When a double-sided circuit board is used (there is a foil pattern on each side), the foil may pass through a hole in the board to carry the circuit from one side of the board to the other. Use an ohmmeter to check continuity of the foil through each hole.

12. If you still cannot locate the trouble and a voltmeter is available, check the voltage readings against those shown on the Schematic Diagram. A review of the "Circuit Description" may help you locate the trouble.

NOTE: To remove faulty multi-lead components from a circuit board, clip all the leads, and then unsolder and remove them one at a time.

NOTE: Refer to the "Circuit Board X-Ray View" on Page 12 of the Illustration Booklet for the physical location of parts.

Troubleshooting

This Troubleshooting Chart lists specific problems that could occur in your Filter and some possible causes. The numbers for the components are the same numbers used in the schematic diagram and circuit description. A circuit board X-ray view is provided (Illustration Booklet, Page 12) to help you locate any circuit board component. If a component is indicated, (such as S1, for example) check that part and any other components connected directly with it to see that they are installed correctly. Also check, if possible, to see that the component is working properly.

PROBLEM	POSSIBLE CAUSE
Output with power off is not the same as input.	1. Jacks J1, J3, J4, J5 and associated wiring. 2. Power switch S1 and wiring.
No power; sound okay in power off position.	1. Power source. 2. Power switch S1. 3. Power jack J2. 4. Diodes D1, D2, D3, D4, and D5. 5. Transistor Q1.
Power LED lights, but no sound.	1. Low control set too high and High control set too low. Gain control not turned up. 2. Transistor Q1. 3. IC U8. 4. IC U13. 5. IC's U14, U15, U18, and U19.
Notch or Peak control does not work.	1. Incorrect pushbuttons pressed. 2. Notch/Peak control not properly set. 3. IC's U2, U3, U18, U19, U20.
High filter does not work.	1. SSB & Peak button must not be in. 2. High control not properly set. 3. IC's U4, U5, U6, U7, U18, U19, U20, and U21.
Low filter does not work.	1. SSB & Peak button must not be in. 2. Low control not properly set. 3. IC's U8, U9, U10, U11, U18, U19, U21, and U22.
Filter works. Power LED does not.	1. LED D8 (and wiring) polarity. 2. R4.
Filter works. Input overload LED does not.	1. Input signal below overload point (2.5 to 3 volts p-p). 2. LED D9 (and wiring) polarity. 3. IC U1.

SPECIFICATIONS

High-pass Filter	5 pole tunable.
Range	300 Hz to 2500 Hz at −6 dB.
Low-pass Filter	5 pole tunable.
Range	300 Hz to 2500 Hz at −6 dB.
Notch/Peak Filter	2 pole tunable.
Range	300 Hz to 2500 Hz.
Width	200 Hz at 6 dB.
Depth	30 dB.
Input Impedance	5 kΩ minimum.
Nominal Gain	Unity.
Audio Amplifier Power	1 watt into 4Ω.
Input/Output Connections	One 1/4" phone jack ("Phones"). Three RCA type phono jacks ("Input," "Output," and "Tape Out"). One power connector.
Controls	
"Low, Center"	Tune high-pass filter, or move bandpass center.
"Notch/Peak"	Tune notch/peak filter.
"High, Width"	Tune low-pass filter, or adjust band-pass width.
"Gain"	Adjust audio gain.
Switches	
"Power"	Controls power and filter bypass.
"SSB & Notch"	Selects optimized SSB filtering, with an adjustable notch.
"CW"	Selects optimized CW filtering.
"SSB"	Selects optimized SSB filtering.
"SSB & Peak"	Selects optimized SSB filtering, with an adjustable peak.
"RTTY"	Selects optimized RTTY filtering.
"CW2"	Selects CW filtering, similar to "CW" with flatter bandpass.
"Fixed"	Selects 300 Hz to 2500 Hz bandpass and disables variable controls.

Power Requirements	7 to 13.5 VAC, or 9 to 18 VDC, 400 mA. Heath's PS-5012 (for 120 VAC) or PS-5024 (for 240 VAC) is recommended.
Dimensions	1-7/8" H × 8-7/8" W × 6-5/8" D. (4.5 × 22.5 × 17 cm)
Weight	1.5 lbs.(0.7kg).

Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligations to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

You may use this Circuit Description if you wish to learn more about the operation of the Filter, or as an aid in troubleshooting your circuit. Refer to the fold-in Schematic diagram as you read.

The Filter consists of two five-pole elliptical filters (a high pass and a low-pass), plus a two pole notch (or peak) filter.

CONTROL OSCILLATOR CIRCUIT

The oscillator is the source of the 22 kHz triangular wave that the Filter uses to control the action of the high, low, and notch/peak filters. Block Schematic 1 shows the phase shift oscillator using U14 and U18D. Resistor R104 and capacitor C55 shape the voltage waveform at pin 11 of U18D into the desired triangular wave. This wave goes to comparators U18A, B, and C. U18D provides feedback to U14 to keep the oscillator running.

HIGH FILTER AND LOW FILTER

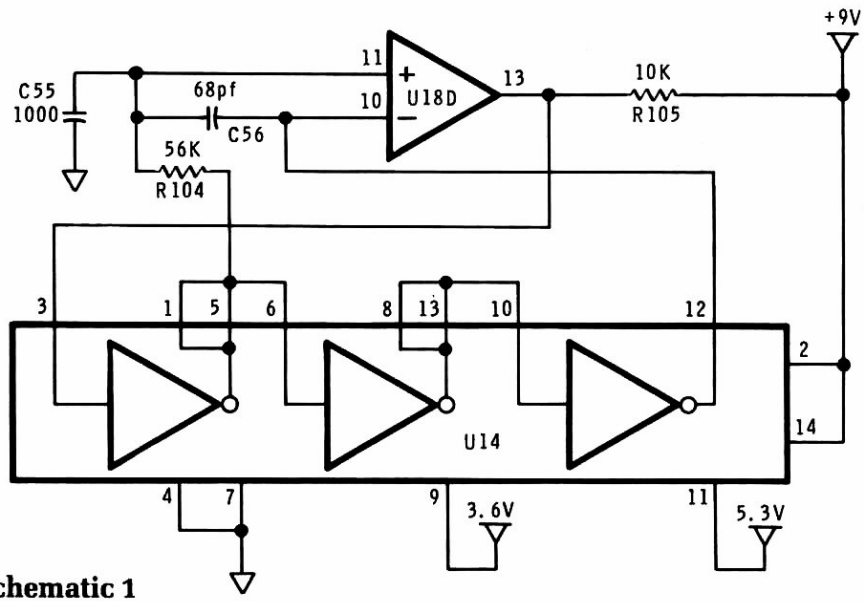
The filters are five pole filters with a variable cutoff frequency. The high filter consists of U4B, U5A & B, U6A & B, U7A & B, and U8B, plus FET switches U21B, C, and D, and U20C and D. The low filter consists of U9A & B, U10A & B, U11A & B, and U12A & B, plus FET switches U21A, U22A, B, C, and D. Consider the FET switches to be variable resistors, to make this discussion easier.

Refer to the waveforms shown in Pictorial 5-1 (Illustration Booklet, Page 11) as you read about the filter operation. Since the high and low filters operate essentially the same, only the high filter will be discussed here. You may use the same principles to understand how the low filter works.

The filters are controlled through the comparators. U18A is the high filter control. The inputs to the comparator are shown in the Comparator Input section of Pictorial 5-1. The first input, to pin 5, is the 22 kHz triangular wave from the control oscillator. The second input is a DC control voltage that is set by R89, the High control. Three different settings of the DC voltage are shown in the Comparator Input section of Pictorial 5-1, and are labeled "A," "B," and "C." Both the triangular and the DC control voltages vary between 3.6 and 5.2 VDC.

The comparator output that results from DC control voltages "A," "B," and "C" is also shown in Pictorial 5-1. Note from the Pictorial how the duration ("on time") of the output increases as the DC control voltage decreases.

This comparator output pulse is routed through two inverter-buffers, U19A and U19B, to the FET switches. These "switches" act as variable resistors in the filter circuit, providing lower resistance as the "on time" increases. Higher resistance moves the filter cutoff point lower in frequency.



Block Schematic 1

To sum up the control action, assume High control R89 is adjusted to increase the DC control voltage at comparator U18A.. This produces a shorter duration "on time" at the comparator's output. The output goes through the two inverters, ending up not inverted. This short "on time" causes the FETs to act as higher resistances and thus moves the filter's cutoff point lower in frequency.

NOTCH/PEAK FILTER

The notch/peak filter is a two-pole filter composed of U2A & B, U3A & B, and FET switches U20A & B. The circuitry responds (and is controlled) essentially in the same way as the high and low filters.

CONTROL VOLTAGES

U15A and B provide the fixed voltages needed by the High, Low, and Notch/Peak controls (R89, R91, and R92). The voltages from the resistors' wipers then go to the switches. The switch settings determine which voltages go to the control oscillator's U18 comparators and finally end up controlling the filters.

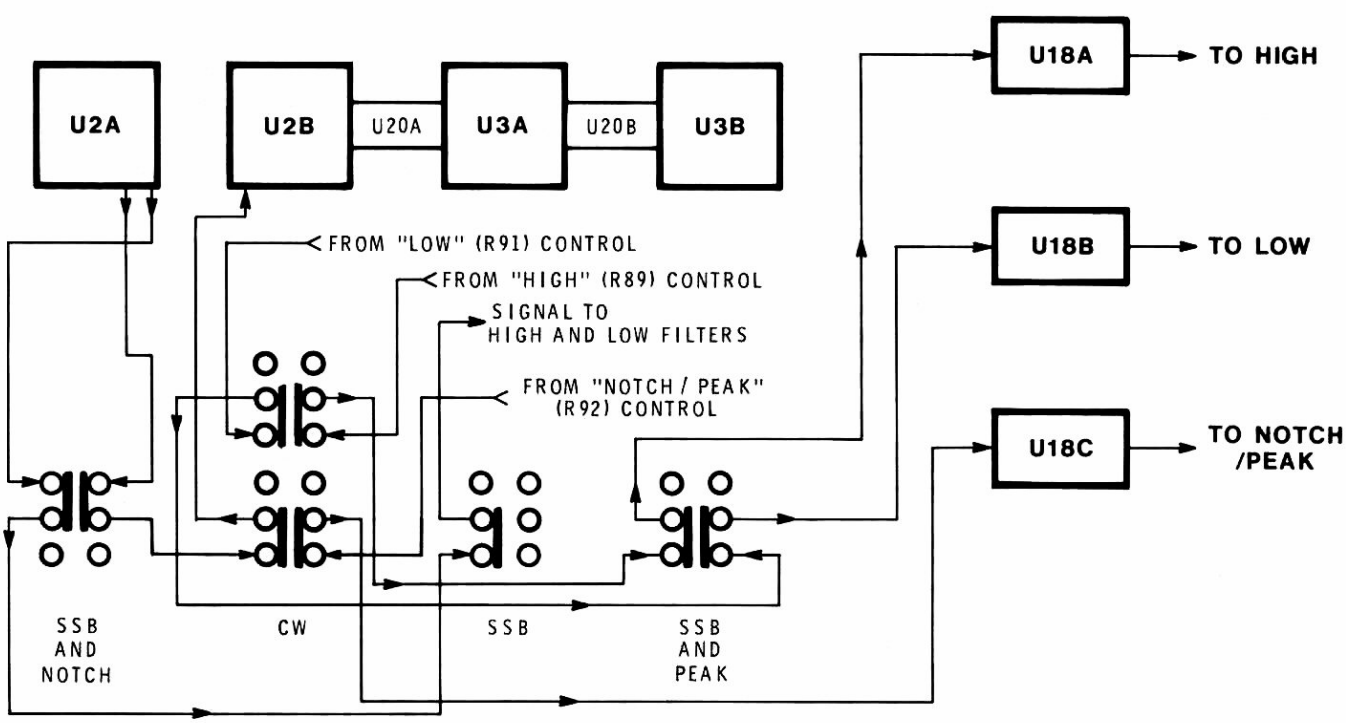
PUSHBUTTON SWITCHING

It is possible to understand what happens when you press a pushbutton if you study the schematic, but this can be a rather time-consuming task, requiring careful attention. To make this understanding more easy to come by, the following blocks and discussions handle each pushbutton separately.

SSB And Notch Pushbutton Switch

Refer to Block Schematic 2.

Note that the signal output from the notch filter (U2A) goes to both sides of the SSB/Notch switch. The signal to the left side of the switch goes through the SSB switch and becomes the input to the high and low filter circuitry. The signal to the right side of the SSB/Notch switch is fed to the notch filter (again, through the CW switch) to support the notch filter action. R92 positions the notch, through another contact set of the CW switch, by varying the voltage at U18C.

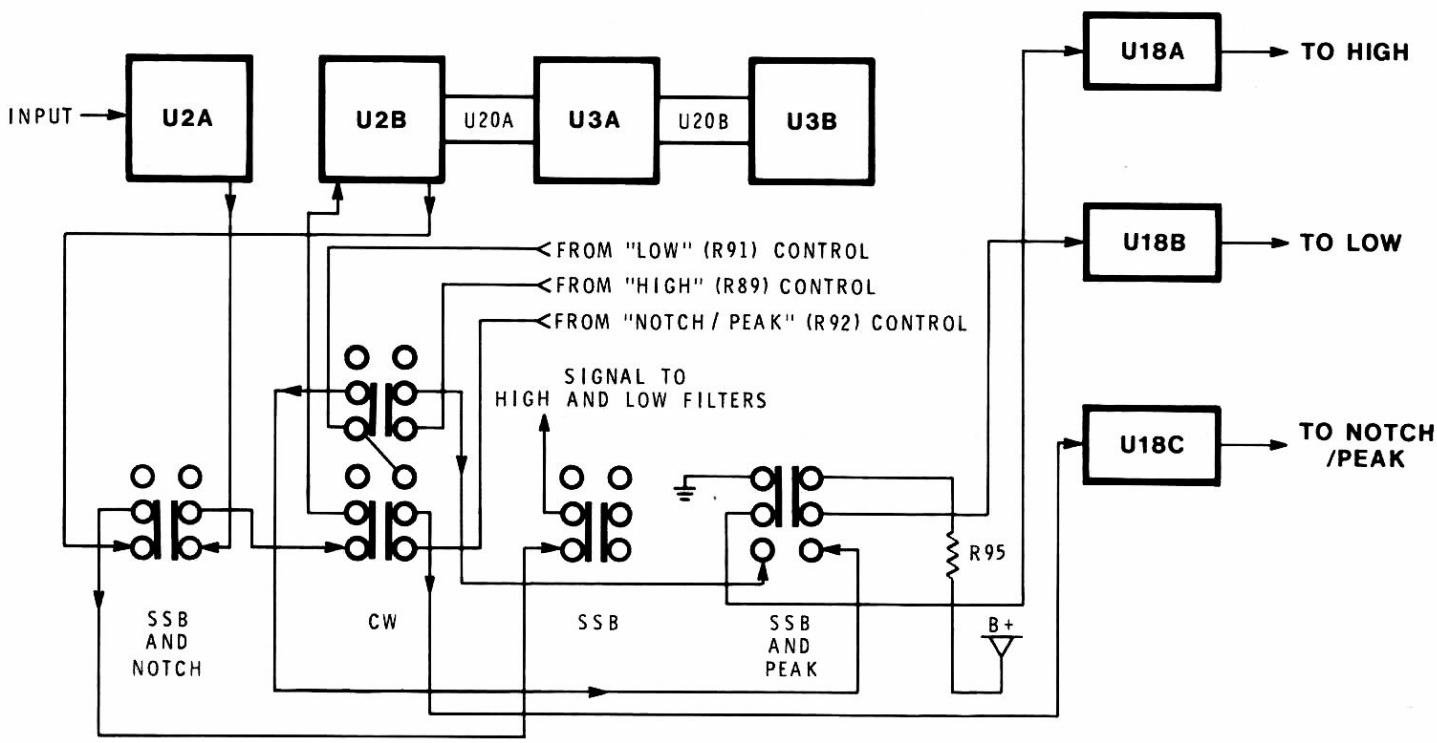


Block Schematic 2

SSB And Peak Pushbutton Switch

Refer to Block Schematic 3.

When you compare this configuration to Block 2, you will note that the signal to the high and low filters (through switch SSB) comes from the output of U2B for this (peak) operation, whereas it came from U2A for notch operation. As before, the voltage from the Peak control (R92) is processed through switch CW. Note, however, that the High and Low controls are disconnected at the SSB/Peak switch. Instead, SSB/Peak connects U18A to ground, and U18B to B+ to fix the positions of the high and low filters.



Block Schematic 3

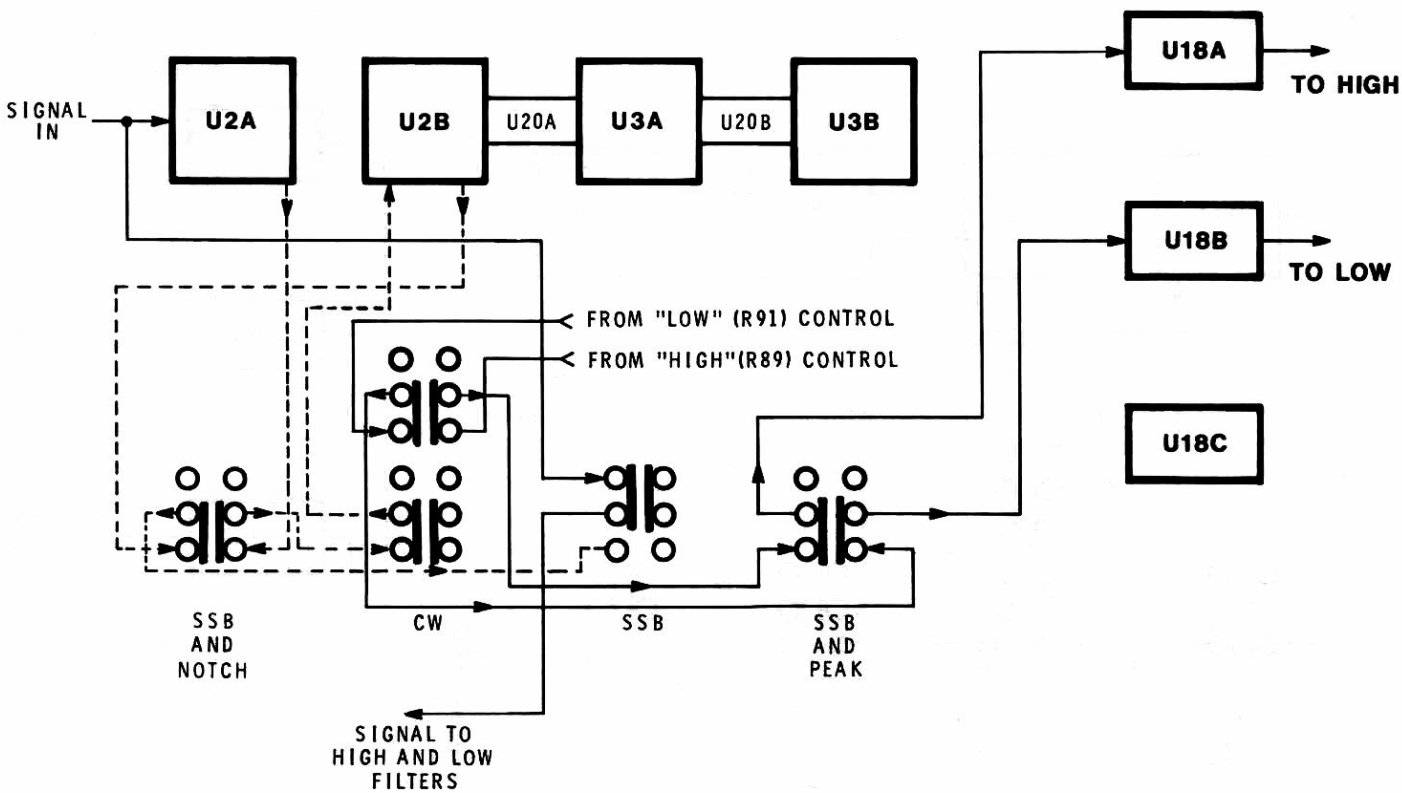
SSB Pushbutton Switch

Refer to Block Schematic 4.

Note first that the normal output from the notch filter reaches a dead-end at the SSB switch. Instead the "signal in" is taken from the U2A input, and fed through the SSB switch to the high and low filters (without any processing from the notch/peak). As before, the voltage from the High and Low controls (R91 and R89) are processed through the CW and SSB/Peak switches.

Filter Shift

U16A and B are active when the CW pushbutton is pressed (refer ahead to Block Schematic 5), They shift the voltages applied to U18A and U18B; this shifts the high and low filters. The Low control shifts both filters in the same direction, effectively moving the bandpass up or down. The High control shifts the two filters in opposite directions, to control the width of the bandpass.



Block Schematic 4

CW Pushbutton Switch

Refer to Block Schematic 5.

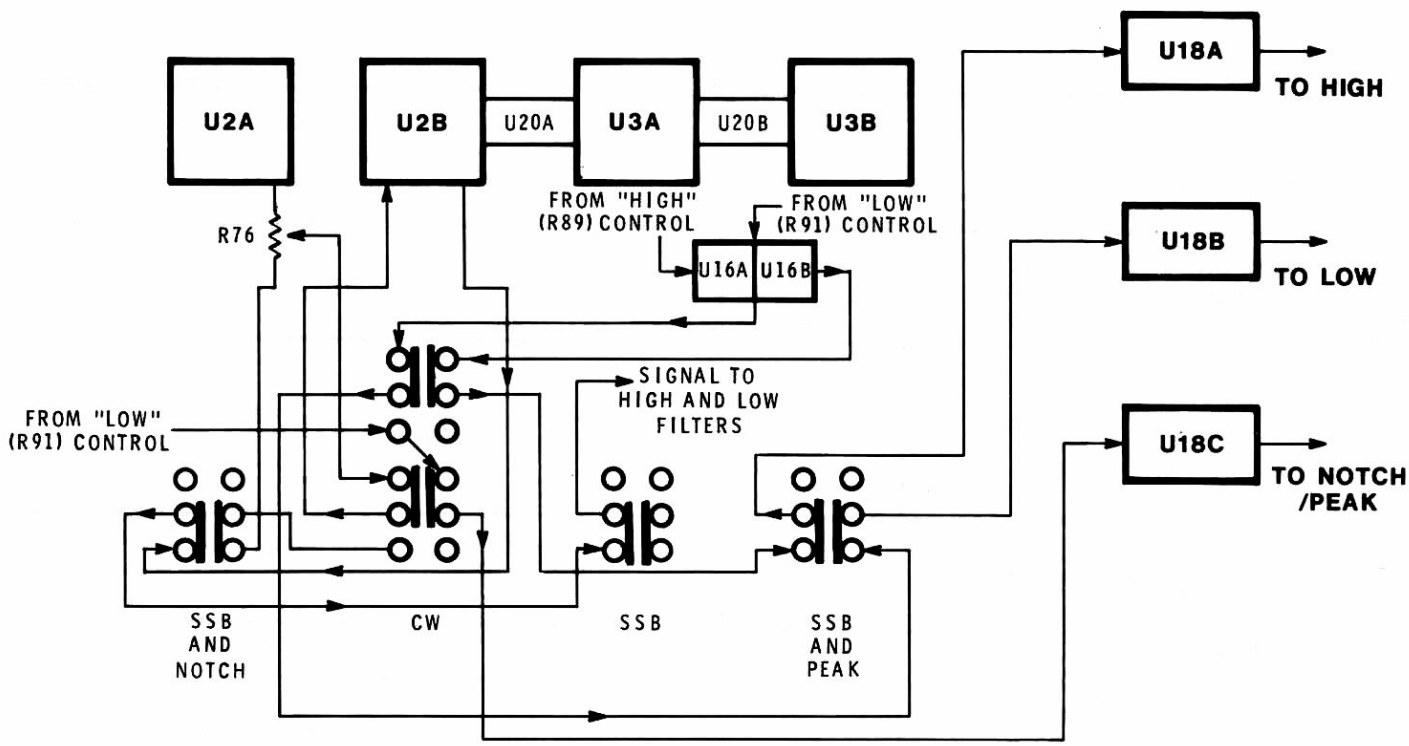
In this configuration, the CW switch uses the input from U16A and U16B (see "Filter Shift") to move the high and low filters. Low control R91 moves high and low filters in the **same** direction to effectively move the whole bandpass up or down. High control R89 moves the high and low filters in **opposite** directions to effectively set the width of the bandpass. The Notch/Peak control voltage reaches a dead-end at the CW switch. The small peak is controlled by the High control (R89).

SUPPLY VOLTAGE

The input voltage, whether it is AC or DC, is filtered and rectified as necessary by L1, L2, L3, D1, D2, D3, D4, and C5. This unregulated voltage goes through the Power switch to light power LED D8, and is supplied to the PA (audio amp) through R5 with C6 and C7, providing added filtering. Q1 regulates the power for the filter portion of the unit. U8A then acts as a voltage divider to provide the reference voltage for the filter.

INPUT OVERLOAD INDICATOR

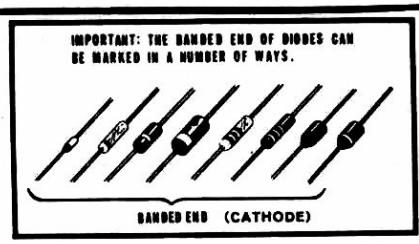
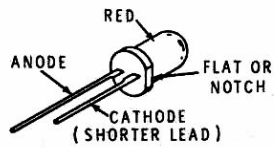
U1 compares the input voltage (pin 3) to the voltage on pin 2 (determined by voltage divider R8 and R9). If the input exceeds the pin 2 voltage, the output (pin 7) goes low, turning on LED D9.



Block Schematic 5

SEMICONDUCTOR IDENTIFICATION CHARTS

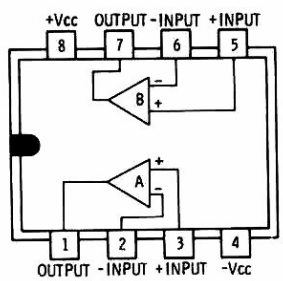
DIODES

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
D6, D7	56-56	1N4149	
D5	56-608	1N4739A	
D1, D2, D3, D4	57-65	1N4002	
D8, D9	412-633	Light-emitting diode (LED)	

TRANSISTOR

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q1	417-801	MPSA20	

INTEGRATED CIRCUITS

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U2 THROUGH U12, U15, U16, U17	442-21	MC1458	

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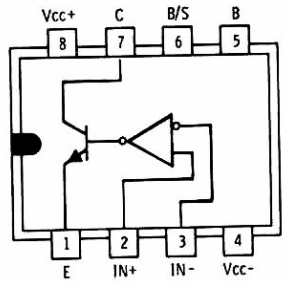
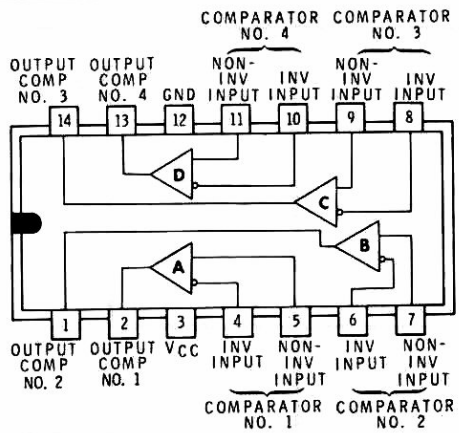
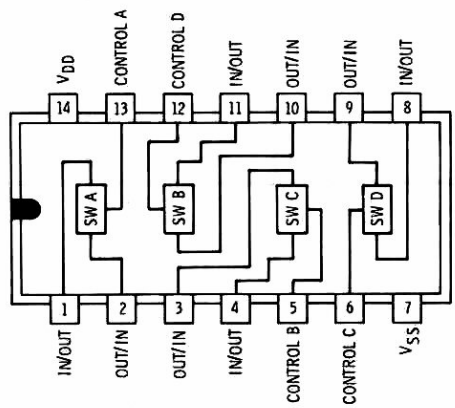
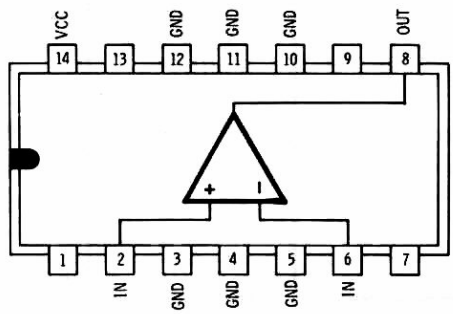
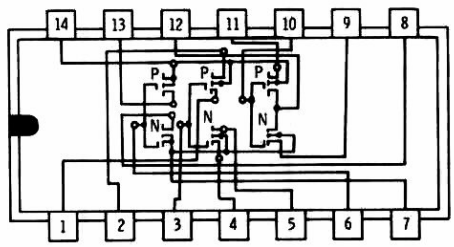
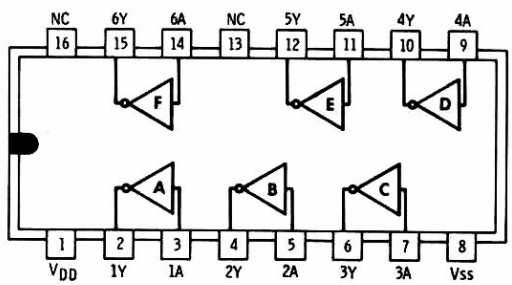
COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U1	442-75	LM311	
U18	442-616	LM2901	
U20, U21, U22	442-744	CD4066	

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U13	442-748	ULN2280B	
U14	443-604	CD4007AE	
U19	443-701	MC14049CP	

CUSTOMER SERVICE

REPLACEMENT PARTS

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

ORDERING FROM THE FACTORY

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

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

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

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

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

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

TECHNICAL CONSULTATION

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

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

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

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

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

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

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

REPAIR SERVICE

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

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

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

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

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

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

Heath Company
Service Department
Benton Harbor, Michigan 49022

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