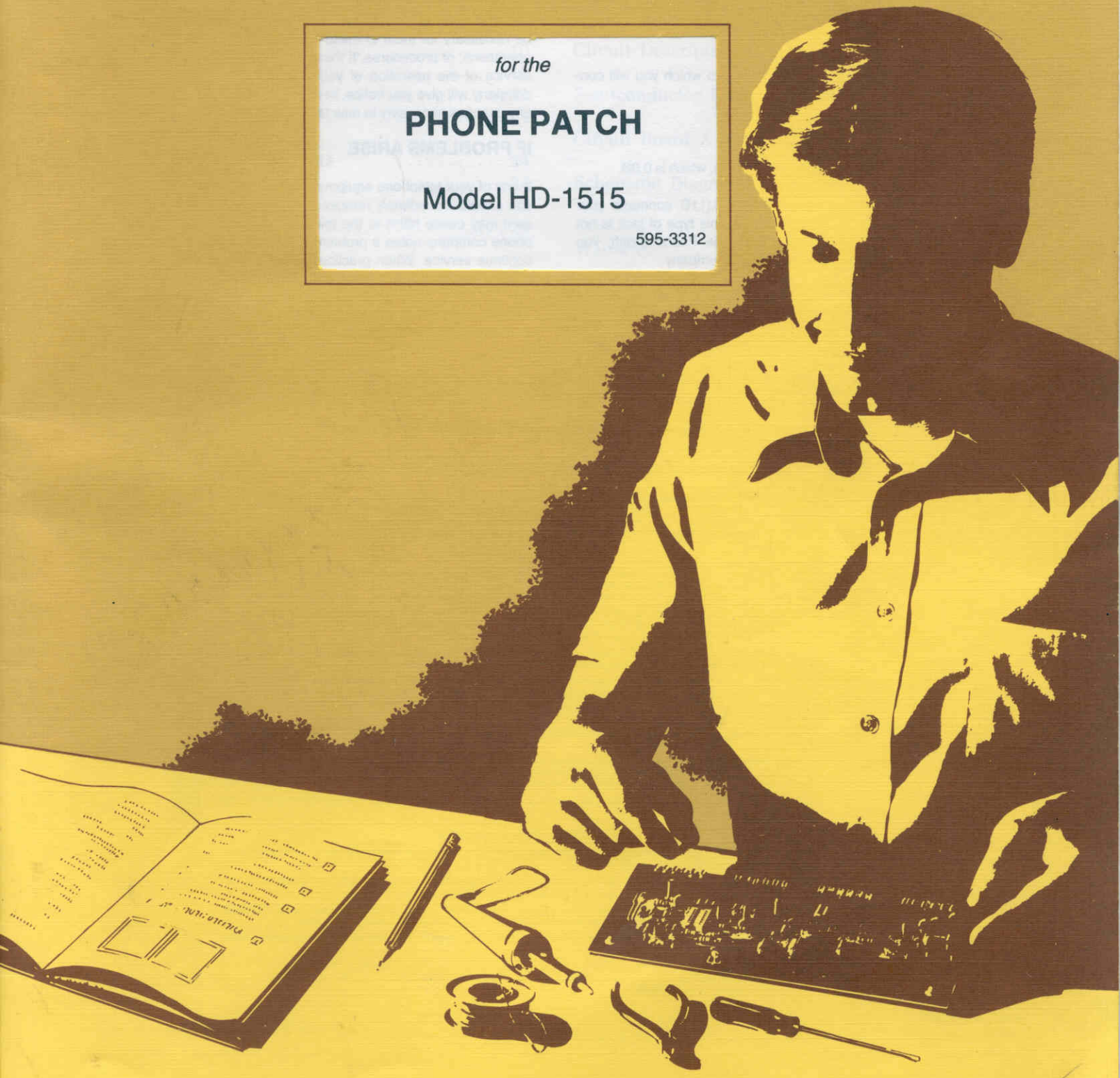
HEATHKIT® MANUAL

for the

PHONE PATCH

Model HD-1515

595-3312



HEATH COMPANY • BENTON HARBOR, MICHIGAN

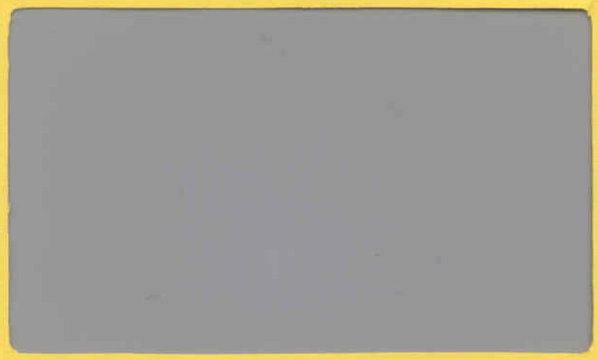
HEATH COMPANY PHONE DIRECTORY

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
Computers — Software: 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.

Heathkit® Manual

for the

PHONE PATCH

Model HD-1515

595-3312

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

FCC REQUIREMENTS

INSTALLATION

When you are ready to install your HD-1515 Phone Patch, call your local telephone company and give them the following information about it:

- The telephone number of the line to which you will connect the Phone Patch.
- Its FCC registration number.
- Its ringer equivalence number (REN), which is 0.0B.

A standard jack called the USOC RJ11C connects your Phone Patch to the telephone line. If this type of jack is not available where you want to install the Phone Patch, you will need to order it from the telephone company.

TYPE OF SERVICE

This Phone Patch is designed to be used on standard-device telephone lines. It should not be used on coin service lines or party lines.

If you have any questions about your telephone line, such as how many pieces of equipment you can connect to it, the telephone company will provide this information upon request.

TELEPHONE COMPANY PROCEDURES

The goal of the telephone company is to provide you with the best service it can. In order to do this, it may occasionally be necessary for them to make changes in their equipment, operations, or procedures. If these changes might affect your service or the operation of your equipment, the telephone company will give you notice, in writing, to allow you to make any changes necessary to maintain uninterrupted service.

IF PROBLEMS ARISE

If any of your telephone equipment is not operating properly, you should immediately remove it from your telephone line, as it may cause harm to the telephone network. If the telephone company notes a problem, they may temporarily discontinue service. When practical, they will notify you in advance of this disconnection. If advance notice is not feasible, you will be notified as soon as possible. When you are notified, you will be given the opportunity to correct the problem and informed of your right to file a complaint with the FCC.

In the event repairs are ever needed on your Phone Patch, they should be performed by Heath Company or an authorized representative of Heath Company.

DISCONNECTION

If you should ever decide to permanently disconnect your Phone Patch from its present line, please call the telephone company and let them know of this change.

TABLE OF CONTENTS

INTRODUCTION

The Heathkit Model HD-1515 Phone Patch enables you to transfer audio signals between a telephone line and two-way radio equipment. The heart of this solid-state Phone Patch is formed by an integrated active speech and transmission circuit, which allows you to connect the Phone Patch directly to a phone line through a built-in active low-voltage polarity-protection interface circuit. These circuits along with an 8-pole low-pass filter, obtain their power directly from the phone line in most installations. You can use an internal battery circuit in installations where the phone line exhibits a very low-voltage condition.

Special speech transmission circuits replace the bulky and sometimes costly hybrid transformers usually used in conventional phone-patch equipment to perform the 4-wire to 2-wire radio-to-phone line conversion. The circuitry provides some automatic gain control that helps you compensate for the varying attenuation that is introduced by different line lengths or loop distance on the external phone circuit.

A high degree of electrical isolation from the radio equipment makes this Patch ideal for voice-operated installations. You can monitor the transmission between your radio and the phone line on your own home phone. A standard, mini-modular jack on the rear panel makes connection to a phone line convenient and simple.

An 8-pole filter in the input circuit makes the Patch compatible with all subscriber loop-frequency voice standards as prescribed in Part 68 of the Federal Communication Commission's Rules and Regulations. Also, a built-in detector circuit enables you to use a VTVM or VOM to adjust for optimum separation between transmit and receive.

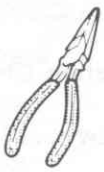
The small, compact, and low-profile design of this Phone Patch makes it a handy addition to any ham-shack, for the newcomer and old timer alike.

ASSEMBLY NOTES

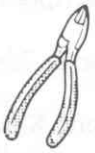
TOOLS

You will need these tools to assemble your kit.

PLIERS



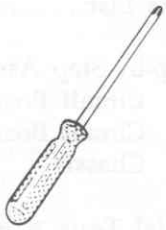
LONG-NOSE PLIERS



DIAGONAL CUTTERS

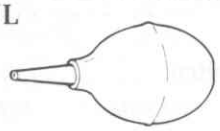
WIRE STRIPPERS

1/8" SCREWDRIVER



PHILLIPS SCREWDRIVER

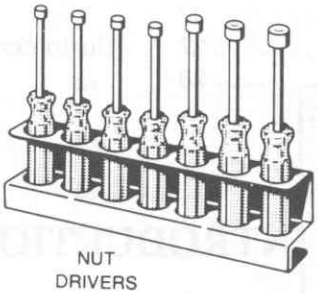
OTHER HELPFUL TOOLS



DESOLDERING BULB*

NUT STARTER (May Be Supplied With Kit)

DESOLDERING BRAID*



NUT DRIVERS

*To Remove Solder From Circuit Connections.

PENCIL SOLDERING IRON (22 to 25 WATTS)

ASSEMBLY

1. Follow the instructions carefully. Read the entire step before you perform each operation.

2. Refer to the separate "Illustration Booklet" for the Pictorials and Details. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in the proper sequence called for in the steps.

3. 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.

4. Position all parts as shown in the Pictorials.

5. Solder instructions are generally given only at the end of a series of similar steps. You may solder more often if you desire.

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 Troubleshooting Charts,

   — In the Schematic,

   — In the sections at the rear of the Manual.

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

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

SOLDERING

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

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

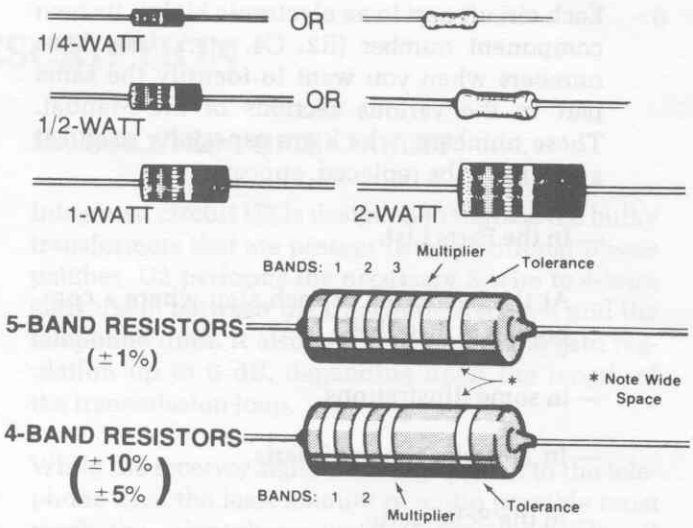
1. Use the right type of soldering iron. A 22 to 25-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.

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

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

PARTS

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



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

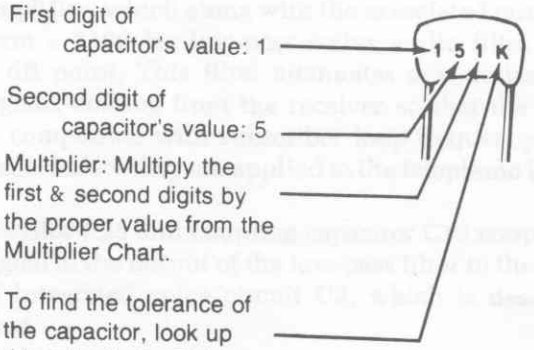
Band 2 2nd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

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

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

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

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



EXAMPLES:

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

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

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

*DuPont Registered Trademark.

Heathkit®

PARTS LIST

Unpack the kit and check each part against the following list. The key numbers correspond to the numbers on the "Parts Pictorial." Do not remove components from the tape until you use them in a step. If a part is packed in an individual envelope with the part number on it, identify the part; then return it to the envelope until a step calls for it. Do not throw away any packing material until you account for all of the parts.

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."

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
CAPACITORS				
Ceramic				
A1	21-17	3	270 pF	C1, C17, C25
A1	21-140	1	.001 µF (1000 pF)	C29
A1	21-27	2	.005 µF (5000 pF)	C31, C32
A1	21-143	1	.05 µF	C22
Electrolytic				
A2	25-858	3	.33 µF	C2, C19, C24
A2	25-859	1	.47 µF	C21
A2	25-900	4	1 µF	C12, C14, C18, C23
A2	25-912	2	3.3 µF	C13, C16
A2	25-879	1	4.7 µF	C28
A2	25-880	1	10 µF	C15
Mylar				
A3	27-161	7	.01 µF	C3, C4, C5, C7, C8, C9, C11
A3	27-151	1	.013 µF	C6
CONTROLS—SWITCH				
B1	10-1228	1	1000 Ω (1k) control	R43
B2	10-318	2	2000 Ω (2k) control	R27, R33
B1	10-1197	1	20 kΩ control	R5
B3	64-920	1	Pushbutton switch	SW1

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
SHEET METAL PARTS			
C1	90-1327-1	1	Cabinet shell
C2	200-1484-1	1	Chassis
C3	203-2248-1	1	Front panel
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).

#3 Hardware			
D1	250-49	2	3-48 × 1/4" screw
D2	252-1	2	3-48 nut
D3	254-7	2	#3 lockwasher
#4 Hardware			
D4	250-1412	4	4-40 × 3/8" screw
D5	250-1413	4	4-40 × 1/2" screw
D6	252-2	16	4-40 nut
D7	254-9	12	#4 lockwasher
#6 Hardware			
D8	250-33	2	6-32 × 1/8" setscrew
D9	250-1307	7	#6 × 1/4" sheet metal screw

KEY No.	HEATH Part No.	QTY.	DESCRIPTION

Other Hardware

E1	259-34	2	Control solder lug
E2	811-1	2	Control nut (metric)
E3	812-1	2	Control flat washer (metric)

WIRE—CABLE—SLEEVING

134-~~1411~~ 1248	1	Modular cable
340-8	1"	Bare wire
343-15	12"	Shielded cable
344-59	18"	White solid wire
344-90	6"	Black stranded wire
344-99	6"	White stranded wire
346-6	1	Fiber sleeving (1-1/4" long)

TRANSISTORS—INTEGRATED CIRCUITS (ICs)

NOTES:

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

   a. Part number.

   b. Type number. (For integrated circuits, this refers only to the numbers and letters shown in **bold** print in the Parts List. Disregard any other numbers or letters on the IC.)

   c. Part number and type number.

   d. Part number with a type number other than the one listed.

2. Some integrated circuits may be packed in conductive foam. Do not remove these ICs from the conductive foam until a step directs you to do so.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
F1	417-294	2	MPSA42 transistor	Q1, Q3
F1	417-836	2	MPSD51 transistor	Q2, Q4
F2	442-602	1	LM**324**N IC	U1
F2	442-778	1	TCM**1705**A IC	U2

SOCKETS—CONNECTORS

G1	432-134	3	Wire socket	
G2	432-798	1	Battery snap connector	
G3	432-866	3	Spring connector (includes 1 extra)	
G4	432-1030	1	2-pin socket shell	
G5	432-1411	1	Modular duplex jack	
G6	434-82	1	Dual phono socket	J2/J3
G7	434-298	1	14-pin IC socket	
G8	434-299	1	16-pin IC socket	
G9	434-363	1	4-pin right-angle socket	J1

MISCELLANEOUS

H1	9-88	1	MOV (Metal Oxide Varistor)	MOV
H2	51-205	2	Line transformer	T1, T2
H3	75-743	1	Insulator	
	85-3050-1	1	Circuit board	
H4	208-42	1	Battery clamp	
H5	261-29	4	Foot	
H6	390-1192	1	Manufacturer's label*	
H7	390-2750	1	FCC label*	
H8		1	Blue and white label*	
H9	412-654	1	LED (light-emitting diode)	D1
H10	455-44	2	Snap-in bearing	
H11	462-1138	1	Pushbutton knob	
H12	462-1157	2	Round knob	
H13	475-10	6	Ferrite bead	FB1, FB2, FB3, FB4, FB5, FB6
H14	490-5	1	Nut starter	
		1	Assembly Manual (See Page 1 for the part number.)	
	597-260	1	Parts Order Form*	
		1	Taped Component Chart*	
			Solder	

*These parts may be packed inside the Manual.

TAPED COMPONENT CHART

NOTE: These parts are taped on a strip which was checked before shipment. Since these parts are taped in the order of assembly, it is not necessary to check them against the following list.

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.

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
6-220-12	1	22 Ω (red-red-blk)	R38
6-680-12	1	68 Ω (blu-gry-blk)	R23
6-221-12	2	220 Ω (red-red-brn)	R28, R29
6-471-12	1	470 Ω (yel-viol-brn)	R31
6-621-12	2	620 Ω (blu-red-brn)	R36, R42
6-681-12	1	680 Ω (blu-gry-brn)	R37
6-102-12	2	1000 Ω (brn-blk-red)	R26, R35
6-222-12	2	2200 Ω (red-red-red)	R39, R41
6-432-12	1	4300 Ω (yel-org-red)	R32
6-562-12	1	5600 Ω (grn-blu-red)	R17
6-682-12	1	6800 Ω (blu-gry-red)	R13
6-822-12	7	8200 Ω (gry-red-red)	R2, R3, R9, R11, R14, R18, R19
6-103-12	1	10 kΩ (brn-blk-org)	R7
6-123-12	1	12 kΩ (brn-red-org)	R34
6-153-12	1	15 kΩ (brn-grn-org)	R16
6-223-12	3	22 kΩ (red-red-org)	R15, R21, R44
6-333-12	2	33 kΩ (org-org-org)	R1, R22
6-473-12	2	47 kΩ (yel-viol-org)	R12, R24
6-104-12	2	100 kΩ (brn-blk-yel)	R6, R25
6-204-12	1	200 kΩ (red-blk-yel)	R45
6-334-12	1	330 kΩ (org-org-yel)	R8
6-155-12	1	1.5 MΩ (brn-grn-grn)	R4

CAPACITORS

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
21-762	2	.1 µF (104) axial-lead ceramic	C26, C27

DIODES

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
56-26	2	1N191 (may be banded brn-wht-brn)	D2, D3
56-90	1	1N4742	D5
57-65	1	1N4002	D4

STEP-BY-STEP ASSEMBLY

CIRCUIT BOARD ASSEMBLY

Refer to Pictorial 1-1 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. Refer to the "Taped Component Chart." Note that it is divided into numbered sections that match the sections on the circuit board.

3. 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 component in an area out of sequence. These components are each identified in the step and on the Pictorial with a special callout.

4. 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.

5. In general, solder instructions are given only at the end of a series of steps. You may solder more often, if you desire.

NOTE: Refer to the "Taped Component 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.

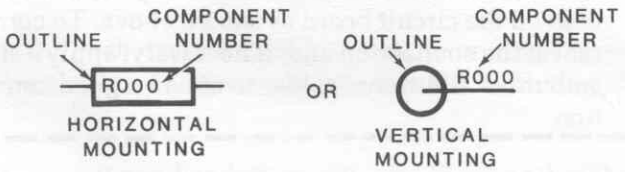
Note that the circuit board has foil on one side and component outlines on the other. The side with the component outlines is referred to as the "component side."

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.

Section 1

( ) R39: Hold a 2200 Ω (red-red-red) resistor as shown and bend the leads straight down to fit the hole spacing on the circuit board.

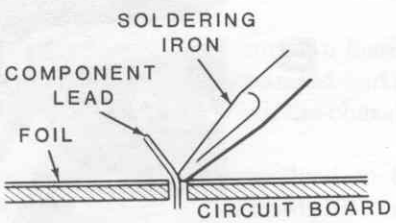
( ) Start the leads into the holes at the resistor's location in Section 1 of the circuit board. The end with the color bands may be positioned either way. NOTE: Resistors are identified on the circuit board by the following outlines:



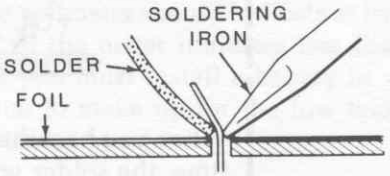
( ) Press the resistor against the circuit board. Then bend the leads outward slightly to hold it in place.

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

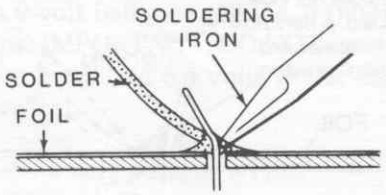
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



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



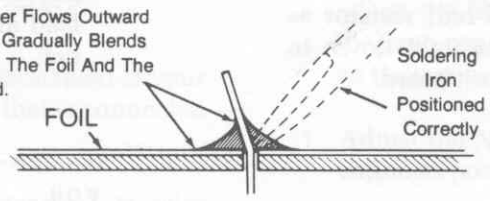
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



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

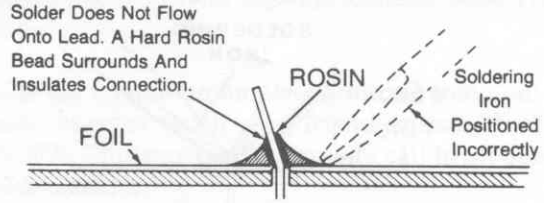
( ) Check the connection. Compare it to the illustrations on Page 12. After you have checked the solder connections, proceed with the assembly on Page 13. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION

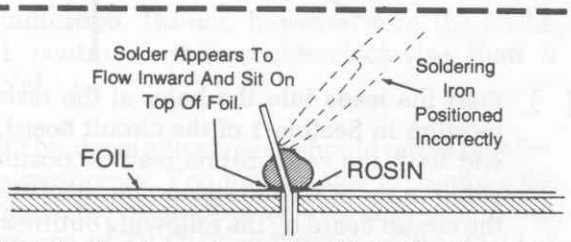


When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS



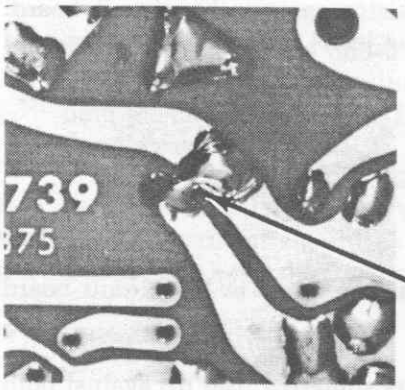
When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.



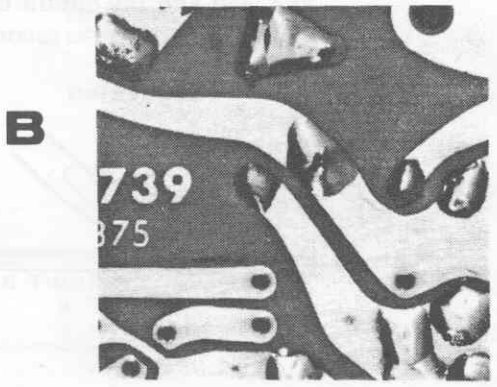
When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

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



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.



(✓) R41: Install a 2200 Ω (red-red-red) resistor in Section 1 of the circuit board at R41.

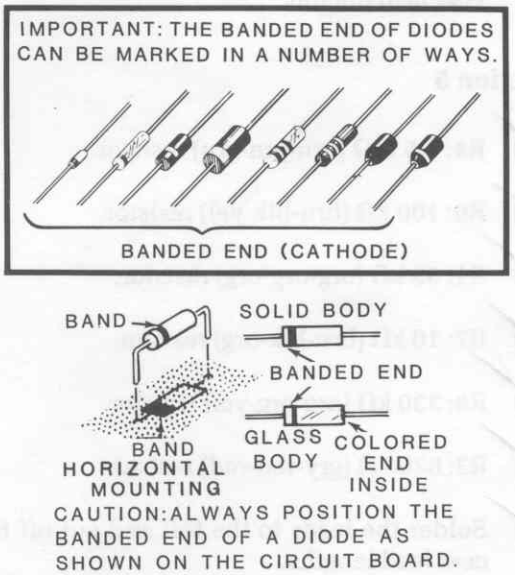
(✓) Solder the leads to the foil and cut off the excess lead lengths. NOTE: Make sure you installed resistor R39 in an earlier step.

Section 2

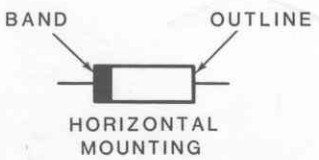
NOTES:

1. 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. The circuit will not work properly if the diode is installed backwards.

2. The banded end of diodes will always be positioned toward the colored tape on the "Taped Component Chart."



(✓) D5: 1N4742 diode (#56-90). NOTE: Diodes are identified on the circuit board by the following outline:



(✓) D4: 1N4002 diode (#57-65).

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

Section 3

(✓) R38: 22 Ω (red-red-blk) resistor.

(✓) R29: 220 Ω (red-red-brn) resistor.

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

Section 4

(✓) R42: 620 Ω (blu-red-brn) resistor.

(✓) R44: 22 kΩ (red-red-org) resistor.

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

Section 5

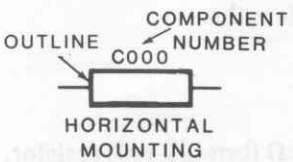
(✓) R18: 8200 Ω (gry-red-red) resistor.

(✓) R21: 22 kΩ (red-red-org) resistor.

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

Section 6

(✓) C26: .1 μF (104) axial-lead ceramic capacitor. NOTE: Axial-lead ceramic capacitors are identified on the circuit board by the following outline:



(✓) D2: 1N191 diode (#56-26). NOTE: This diode may be marked brn-wht-brn.

(✓) D3: 1N191 diode (#56-26). NOTE: This diode may be marked brn-wht-brn.

(✓) C27: .1 μF (104) axial-lead ceramic capacitor.

(✓) R9: 8200 Ω (gry-red-red) resistor.

(✓) R2: 8200 Ω (gry-red-red) resistor.

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

Refer to Pictorial 1-2 for the following steps.

NOTE: Mount the following resistors vertically as shown below:

Section 1

( ) R37: 680 Ω (blu-gry-brn) resistor.

( ) R36: 620 Ω (blu-red-brn) resistor.

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

Section 2

( ) R23: 68 Ω (blu-gry-blk) resistor.

( ) R35: 1000 Ω (brn-blk-red) resistor.

( ) R31: 470 Ω (yel-viol-brn) resistor.

( ) R32: 4300 Ω (yel-org-red) resistor.

( ) R28: 220 Ω (red-red-brn) resistor.

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

Section 3

( ) R26: 1000 Ω (brn-blk-red) resistor.

( ) R24: 47 kΩ (yel-viol-org) resistor.

( ) R45: 200 kΩ (red-blk-yel) resistor.

( ) R15: 15 kΩ (brn-grn-org) resistor.

( ) R16: 22 kΩ (red-red-org) resistor.

( ) R17: 5600 Ω (grn-blu-red) resistor.

( ) R19: 8200 Ω (gry-red-red) resistor.

( ) R22: 33 kΩ (org-org-org) resistor.

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

Section 4

( ) R25: 100 kΩ (brn-blk-yel) resistor.

( ) R14: 8200 Ω (gry-red-red) resistor.

( ) R13: 6800 Ω (blu-gry-red) resistor.

( ) R11: 8200 Ω (gry-red-red) resistor.

( ) R12: 47 kΩ (yel-viol-org) resistor.

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

Section 5

( ) R4: 1.5 MΩ (brn-grn-grn) resistor.

( ) R6: 100 kΩ (brn-blk-yel) resistor.

( ) R1: 33 kΩ (org-org-org) resistor.

( ) R7: 10 kΩ (brn-blk-org) resistor.

( ) R8: 330 kΩ (org-org-yel) resistor.

( ) R3: 8200 Ω (gry-red-red) resistor.

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

NOTE: Cut the leftover 12 kΩ (brn-red-org) resistor from this part of the "Taped Component Chart" and save it for use later.

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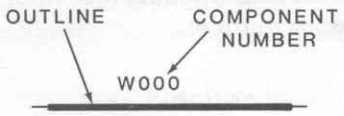
Refer to Pictorial 1-3 for the following steps.

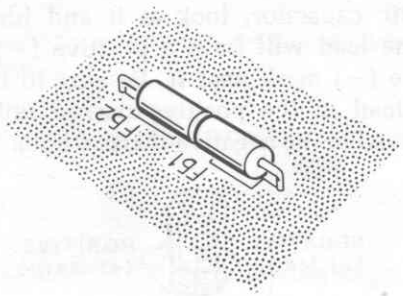
Section 1

NOTE: When a step direct you to prepare a **solid** wire, cut the wire to the indicated length and remove 1/4" of insulation from each end.

( ) W1: Prepare a 4" white **solid** wire. Then install and route the wire on the circuit board as shown. Make sure you use the correct holes. NOTE: Wires are indicated on the circuit board by the following outline:



( ) FB1 & FB2: Cut a 1-1/4" bare wire. Then use the bare wire to install two ferrite beads on the circuit board as shown below:



( ) Solder the wire ends to the foil and cut off any excess wire ends.

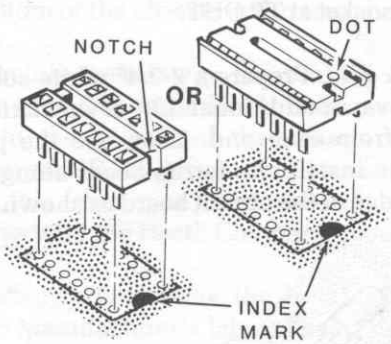
Section 2

( ) W2: Prepare a 1-3/8" white **solid** wire. Then install the wire on the circuit board at W2.

( ) W3: Prepare a 1-1/4" white **solid** wire. Then install the wire on the circuit board at W3.

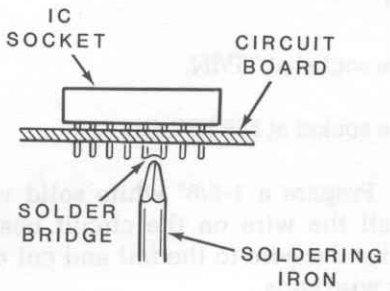
NOTES:

1. In some of the following steps, you will be directed to install IC sockets. Before you install each IC socket, make sure the pins are straight. If there is any kind of identification mark (notch, dot, arrowhead, etc.) at or near one end of the socket, place this marked end toward the index mark on the circuit board (this index mark should still be visible after you install the socket). Then start the pins into the circuit board holes and solder them to the foil.

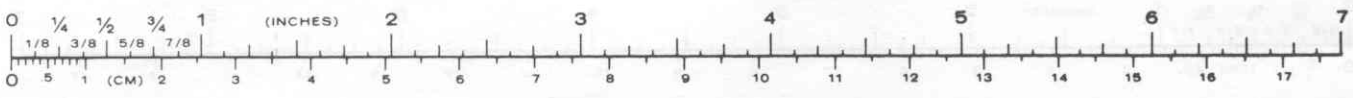


2. It is very easy to form a solder bridge between foils when you install an IC socket. After you install each socket, carefully inspect the foil for solder bridges and remove any that you find, as described below. If you suspect that you have a solder bridge, but are not positive, you can check your foil pattern against the one shown in the "X-Ray View" Page 35.

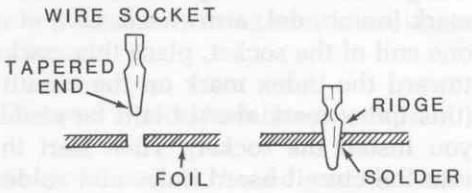
   To remove a solder bridge, hold the circuit board so the component side is up as shown and hold your soldering iron tip between the two points that are bridged. The solder will flow down the soldering iron tip.



( ) 16-pin IC socket at U2. NOTE: You may wish to use a pencil, or something similar, to hold the socket in place while you solder the pins to the foil.

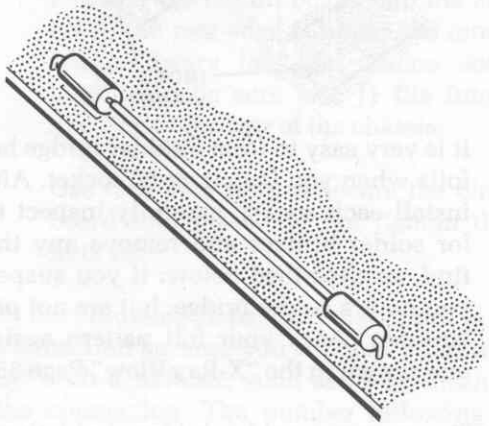


NOTE: When a step directs you to install a wire socket, push the tapered end of the socket as far as possible into the circuit board hole. Then turn the circuit board over and solder the socket to the foil. Try not to fill the socket with solder.



(✓) Wire socket at TP OUT.

( ) FB3 & FB4: Prepare a 2-3/4″ white **solid** wire. Remove an additional 3/8″ of insulation (total 5/8″) from each end. Then use the prepared wire to install two ferrite beads along the bottom edge of the circuit board as shown below:



( ) Solder the wires to the foil and cut off the excess wire ends.

Section 3

(✓) Wire socket at TP/IN.

(✓) Wire socket at METER/OUT.

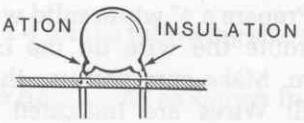
( ) W4: Prepare a 1-5/8″ white **solid** wire. Then install the wire on the circuit board at W4. Solder the wire to the foil and cut off any excess wire ends.

(✓) 14-pin IC socket at U1.

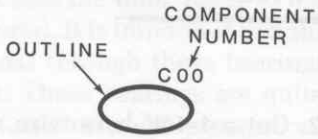
Refer to Pictorial 1-4 for the following steps.

Section 1

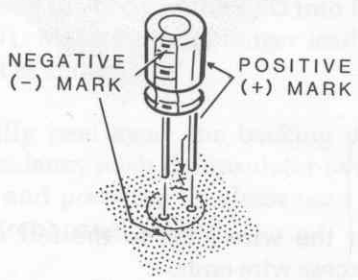
NOTE: In some of the following steps, you will install disc-type ceramic capacitors. When you install these capacitors, do not push the insulated portion of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil.



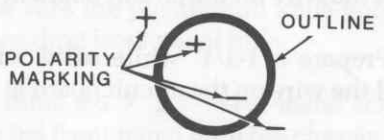
(✓) C29: .001 µF ceramic capacitor. NOTE: Ceramic capacitors are identified on the circuit board by the following outline:



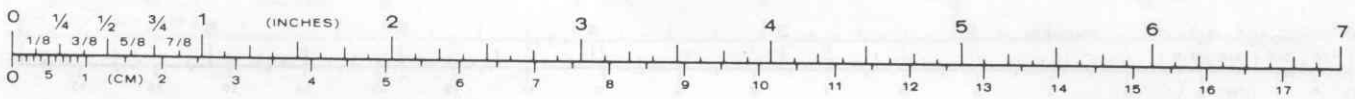
NOTE: In some of the following steps, you will install electrolytic capacitors. Before you install an electrolytic capacitor, look at it and identify the leads. One lead will have a positive (+) mark or a negative (−) mark near it. Be sure to install the positive lead in the positive-marked hole, or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



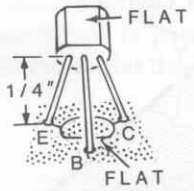
(✓) C23: 1 µF electrolytic capacitor. NOTE: Electrolytic capacitors are identified on the circuit board by the following outline:



(✓) C31: .005 µF ceramic capacitor.



NOTE: When you install a transistor, position it so the flat side is over the outline of the flat on the circuit board. Then start the leads into the 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.



( ) Q1: MPSA42 transistor (#417-294).

( ) Q3: MPSA42 transistor (#417-294).

( ) C32: .005 µF ceramic capacitor.

( ) Q2: MPSD51 transistor (#417-836).

( ) Q4: MPSD51 transistor (#417-836).

( ) MOV: Install the MOV (Metal Oxide Varistor, #9-88) on the circuit board at MOV. Use the same procedure as you use to install disc ceramic capacitors.

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

Section 2

( ) C17: 270 pF ceramic capacitor.

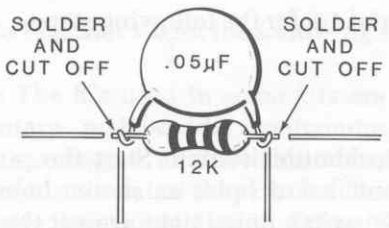
( ) C19: .33 µF electrolytic capacitor.

( ) C16: 3.3 µF electrolytic capacitor.

( ) C18: 1 µF electrolytic capacitor.

( ) C21: .47 µF electrolytic capacitor.

( ) Wrap the leads of a .05 µF ceramic capacitor around the leads of a 12 kΩ (brn-red-org) resistor as shown. Solder the leads of the capacitor to the leads of the resistor. Then cut off the excess resistor leads.



( ) R34/C22: Install the prepared resistor-capacitor combination on the circuit board at R34/C22.

( ) C24: .33 µF electrolytic capacitor.

( ) C28: 4.7 µF electrolytic capacitor.

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

Section 3

( ) C15: 10 µF electrolytic capacitor.

( ) C12: 1 µF electrolytic capacitor.

( ) C13: 3.3 µF electrolytic capacitor.

( ) C14: 1 µF electrolytic capacitor.

( ) C8: .01 µF Mylar capacitor.

( ) C7: .01 µF Mylar capacitor.

( ) C9: .01 µF Mylar capacitor.

( ) C11: .01 µF Mylar capacitor.

( ) C3: .01 µF (MYLAR) electrolytic capacitor.

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

Section 4

( ) C1: 270 pF ceramic capacitor.

( ) C6: .013 µF Mylar capacitor.

( ) C5 .01 µF Mylar capacitor.

( ) C4: .01 µF Mylar capacitor.

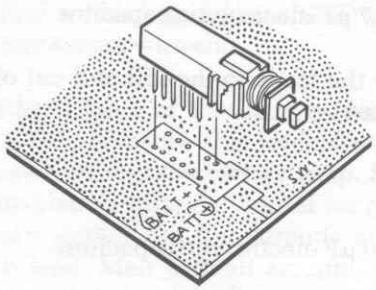
( ) C2: .33 µF electrolytic capacitor.

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

Refer to Pictorial 1-5 for the following steps.

Section 1

( ) SW1: Pushbutton switch. Start the pins into the circuit board holes as shown below and push the switch down tight against the board. Solder one pin at two opposite corners to the foil. Check to make sure the switch is still down tight against the circuit board. Then solder the remaining pins to the foil.

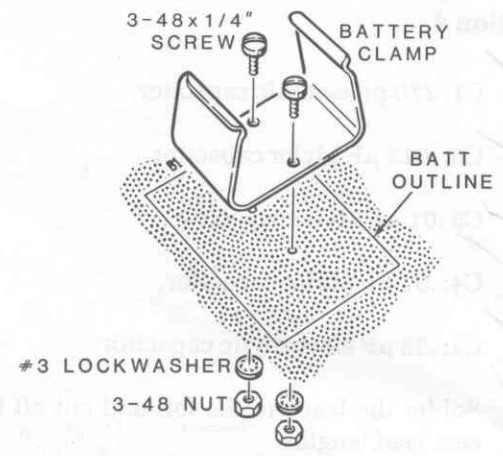


NOTES:

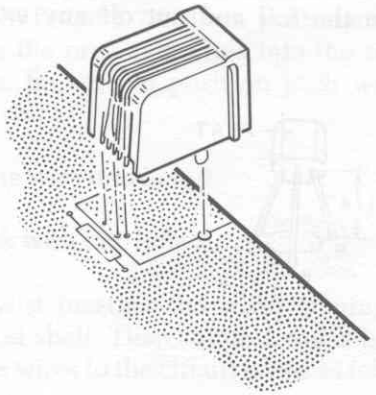
1. When a step calls for hardware, only the screw size is given. If a step calls for "3-48 × 1/4" hardware", for example, it means you should use a 3-48 × 1/4" screw, one or more #3 lockwashers, and a 3-48 nut. The Pictorial, Detail, or drawing referred to in the step shows the proper number of lockwashers and their proper use.

2. Use the plastic nut starter to hold and start 6-32, 4-40, and 3-48 nuts on screws.

( ) Mount the battery clamp to the circuit board within the BATT outline as shown below. Use 3-48 × 1/4" hardware.



( ) J1: Start the pins of the 4-pin angle socket into their corresponding circuit board holes at J1 as shown. Push the socket down tight against the circuit board and solder the pins to the foil.

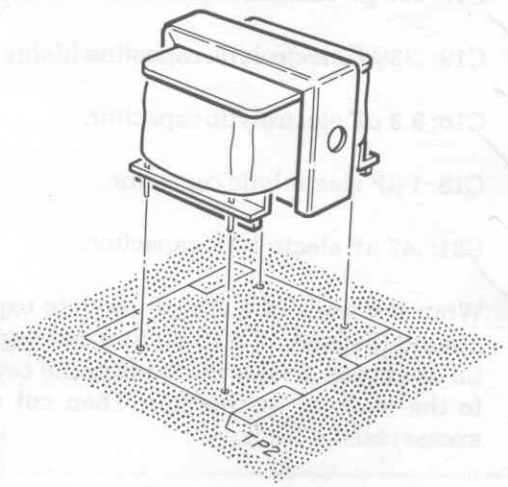


Section 2

( ) R33: 2000 Ω (2k) control (#10-318). Start the lugs into their corresponding circuit board holes. Push the control down tight against the circuit board. Then solder the lugs to the foil.

( ) R27: 2000 Ω (2k) control (#10-318). Solder the lugs to the foil.

( ) T2: Line transformer (#51-205). Start the lugs into the circuit board holes (it does not matter which way you install this transformer). Then push the transformer down tight against the circuit board and solder the lugs to the foil.



( ) Refer to Detail 1-5A and use a control flat washer and a control nut to mount a control solder lug onto the 1000 Ω (1k) control (#10-1228). Position the solder lug straight up from the control before you tighten the hardware.

( ) R43: Install the prepared 1000 Ω control on the circuit board at R43. Make sure the shaft of the control is parallel to the circuit board before you solder the lugs to the foil.

Section 3

( ) T1: Line transformer (#10-205). Push the transformer down tight against the circuit board and solder the lugs to the foil.

( ) Mount a control solder lug onto the 20 kΩ control (#10-1197). Use the same procedure as you did for control R43 (refer again to Detail 1-5A, if necessary).

( ) R5: Install the prepared 20 kΩ control on the circuit board at R5. Make sure the shaft of the control is parallel to the circuit board before you solder the lugs to the foil.

Refer to Pictorial 1-6 for the following steps.

NOTE: The ICs used in some kits 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. Other ICs are of a type that is not susceptible to static electricity. Nevertheless, you should treat all ICs as if they were CMOS types, since this will avoid all possible confusion between ICs and provide protection in all cases. Use the procedure shown in Detail 1-6A whenever you are directed to install ICs.

( ) U2: TCM**1705**A integrated circuit (#442-778).

( ) U1: LM**324**N integrated circuit (#442-602).

Refer to Pictorial 1-7 for the following steps.

( ) Cut a 4-1/2″ bare wire. Insert one end of the wire into circuit board hole GND near control R43. Be sure to use the GND hole that is farthest away from the edge of the board. Then solder the wire to the foil.

( ) Route the wire through the control solder lugs on controls R43 and R5. Then push the free end of the wire into circuit board hole GND near control R5. Now solder the wire to the control solder lugs and the GND hole and cut off any excess wire end.

( ) Cut both leads of the battery snap connector to 2-1/2″. Measure the leads from the point where they exit the battery snap. Remove 1/4″ of insulation from the end of each lead. Then twist together the fine strands at the end of each lead. Melt a small amount of solder on these ends to hold the fine strands together.

Loosely twist together the two battery snap connector leads, then connect the end of these leads to the circuit board as follows:

( ) Red lead to hole BATT+.

( ) Black lead to hole BATT−.

( ) Cut a 5″ black and a 5″ white **stranded** wire. Remove 1/4″ of insulation from one end of each wire and only 1/8″ from the other end. Then prepare the ends. Use the same procedure to prepare the ends of these wires that you used to prepare the ends of the battery snap connector leads.

( ) Refer to the inset drawing on Detail 1-7A and install a spring connector on the **1/8″ end** of each prepared wire.

Position the 2-pin socket shell so the slots are up as shown in Detail 1-7A. Then push the spring connectors on the prepared wires into the socket shell as follows. Be sure to push on each wire until it locks into place.

( ) White wire into hole 1.

( ) Black wire into hole 2.

Loosely twist together the wires coming from the 2-pin socket shell. Then connect and solder the free ends of the wires to the circuit board as follows:

( ) White wire to hole A.

( ) Black wire to hole B.

( ) Cut a 5″ length and a 2-1/2″ length of shielded cable. Then refer to Detail 1-7B and prepare the ends of each cable as shown. Note that the inner wire at one end of the cable has 1/4″ of insulation removed and the other end has 1/2″ removed.

Connect and solder **end A** of the 5″ shielded cable to the circuit board as follows:

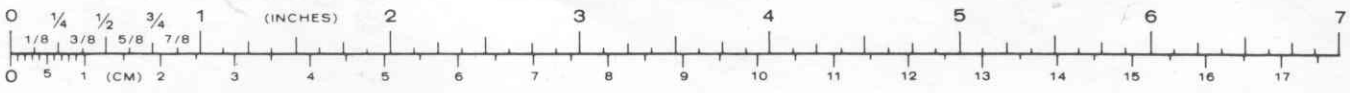
( ) Inner wire to hole TX AUDIO OUT.

( ) Shield wires to nearby hole GND.

Connect and solder **end A** of the 2-1/2″ shielded cable to the circuit board as follows:

( ) Inner wire to hole REC/IN.

( ) Shield wires to nearby hole GND.



CIRCUIT BOARD CHECKOUT

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

( ) Unsolderd connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

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

Refer to the illustrations where parts are 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**.

( ) Transistors for the proper **type** and **installation**.

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

Set the circuit board aside temporarily.

CHASSIS

Refer to Pictorial 2-1 for the following steps.

( ) Position the chassis as shown in the Pictorial. Note the locations of the three holes along the front edge.

( ) Carefully peel away the backing paper from a foot. Then press the foot onto the bottom of the chassis near one of the rear corners as shown.

( ) Similarly, install feet on the bottom of the chassis near the remaining three corners. Note that the dimensions for the locations of the two feet along the front edge of the chassis are different than the rear feet.

( ) Carefully peel away the backing paper from the FCC label. Then press the label onto the bottom of the chassis in the area shown.

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

( ) Carefully peel away the backing paper from the Manufacturer's label. Then press the label onto the bottom of the chassis in the area shown.

Refer to Pictorial 2-2 for the following steps.

( ) Position the chassis as shown in the Pictorial.

NOTE: If there is paint on the inside of the chassis around the mounting holes for the hardware that you will install in the following steps, be sure to scrape it off.

( ) Mount 4-40 × 1/2″ hardware onto the chassis at hole A.

( ) Similarly, mount 4-40 × 1/2″ hardware onto the chassis at holes B, C, and D.

( ) J2/J3: Use 4-40 × 3/8″ hardware to mount the dual phono socket onto the rear of the chassis at J2/J3. Make sure the sockets are centered in the rectangular opening before you tighten the hardware.

Refer to Pictorial 2-3 for the following steps.

( ) Refer to Detail 2-3A and use the following procedure to mount the circuit board in the chassis:

1. Turn a 4-40 nut all the way onto each of the four screws at A, B, C, and D. Then slide a #4 lockwasher onto each of the four screws.
2. Position the circuit board into the chassis so the rear edge is under the mounting hardware for dual phono socket J2/J3. Also be sure jack J1 fits into its opening in the rear of the chassis.
3. Use four 4-40 nuts to secure the circuit board into place. Do not tighten these nuts yet.

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-2), means to solder the connection. The number following the "S-" tells you how many wires should be at the connection. This helps you check your work for errors as you go.

( ) C25: Cut both leads of a 270 pF ceramic capacitor to 1/2″. Then connect the capacitor between socket J3 lugs 1 (NS) and 2 (NS).

( ) Slide a ferrite bead onto the inner wire at the free end of the longer shielded cable coming from the circuit board. Then connect the end of this wire to socket J3 lug 1 (S-2). Connect the shield wires at this end of the cable to socket J3 lug 2 (S-2).

( ) Slide a ferrite bead onto the inner wire at the free end of the shorter shielded cable coming from the circuit board. Then connect the end of this wire to socket J2 lug 1 (S-1). Connect the shield wires at this end of the cable to socket J2 lug 2 (S-1).

Set the chassis assembly aside temporarily.

Refer to Pictorial 2-4 for the following steps.

( ) Position the front panel as shown in the Pictorial.

NOTE: When you install the bearings in the next step, you may have to cut them a small amount so they will fit into the front panel holes. Cut away only as much of each bearing as necessary so you can push it into the hole. Refer to inset drawing #1 on the Pictorial. It is important that the control shafts that will pass through these bearings do not touch the chassis. These bearings are quite brittle; therefore, do not use too much pressure when you install them.

( ) Install bearings into holes FA and FB from the indicated side of the front panel.

( ) Locate the LED. Then shorten the shorter of the two leads to 1/2″ and the other lead to 5/8″ as shown in inset drawing #2.

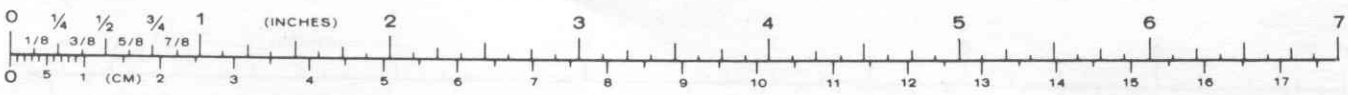
( ) D1: Insert the body of the LED into front panel hole D1. Make sure the longer lead is toward the left as shown.

( ) Carefully peel away the backing paper from the insulator, push the insulator over the LED leads, and press the insulator onto the inside of the front panel.

( ) Push the pushbutton knob onto the shaft of pushbutton switch SW1.

( ) Carefully work the bearings in the front panel onto the shafts of controls R43 and R5. Also make sure the pushbutton knob enters its corresponding front panel hole.

( ) Use three #6 × 1/4″ sheet metal screws to secure the front panel onto the chassis.



( ) Check the operation of the pushbutton switch. Reposition the circuit board as necessary so the switch operates smoothly. Then tighten the circuit board hardware.

( ) Push the 2-pin socket shell on the free end of the black and white wires, coming from the circuit board, onto the leads of LED D1. Be sure the longer LED lead goes into the hole that has the white wire as shown in inset drawing #3. Then bend the LED leads so the socket is positioned as shown in the inset drawing. Also route the wires down against the circuit board.

( ) Turn the shafts of controls R43 and R5 fully counterclockwise.

( ) Start a 6-32 × 1/8" setscrew into each of the knobs. Then install the knobs onto the shafts of controls R43 and R5. Be sure each knob pointer lines up with the "1" on the front panel before you tighten the setscrew.

This completes the internal assembly of your Phone Patch. Check each connection to make sure it is properly soldered and there are no protruding wire ends that could touch each other or the chassis. Also shake out any loose wire clippings, solder, or foreign matter that may be lodged in the wiring.

Proceed to "Initial Tests & Adjustments."

INITIAL TESTS & ADJUSTMENTS

RESISTANCE CHECKS

NOTE: You will need a volt-ohmmeter to perform the following tests. If you do not have one, proceed to "Operational Checks."

Refer to Pictorial 3-1 for the following steps.

If you obtain the proper results in the following tests, proceed to the "Operational Checks." If you do not obtain the correct results, refer to the "In Case of Difficulty" section of this Manual and the Schematic Diagram.

NOTE: Do not connect the Phone Patch to your telephone line until you are directed to do so.

( ) Be sure the PATCH pushbutton is in the OFF position (knob out).

( ) Set controls R33 and R27 on the rear of the circuit board to the centers of their rotation.

( ) Set controls R43 (TRANS) and R5 (RCVR) on the front panel to 5.

( ) Set your ohmmeter to the R × 10 range.

NOTE: This Phone Patch uses two separate ground systems. Make sure you connect the negative (or common ohmmeter) lead to the correct ground, as indicated in the following steps.

( ) Connect the negative (or common ohmmeter) lead to the bare wire that is connected between controls R43 and R5 (chassis ground). Leave this lead connected to this wire until you are directed to disconnect it.

( ) Touch the positive ohmmeter lead to socket J2 lug 1. The ohmmeter should indicate between 30 and 50 ohms.

( ) Set your ohmmeter to the R × 1000 range.

( ) Touch the positive ohmmeter lead to socket J3 lug 1. The ohmmeter should indicate infinity. NOTE: It may take several seconds for the meter to reach the correct indication. This is due to the charging effect of some of the capacitors in the circuit.

( ) Disconnect the negative or common ohmmeter lead from the bare wire and connect it to the lead at the **unbanded** end of diode D5 (circuit board ground).

( ) Set your ohmmeter to the R × 100 range.

( ) Touch the positive ohmmeter lead to integrated circuit U2 pin 8. The ohmmeter should indicate 700 ohms or higher.

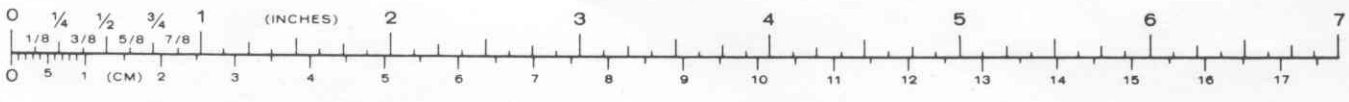
( ) Set your ohmmeter to the R × 10K range.

( ) Touch the positive ohmmeter lead to integrated circuit U1 pin 3. The ohmmeter should indicate 14 kΩ or higher.

( ) Touch the positive ohmmeter lead to the emitter (E) lead of transistor Q1. The ohmmeter should indicate 12 kΩ or higher.

( ) Touch the positive ohmmeter lead to the emitter (E) lead of transistor Q3. The ohmmeter should indicate 12 kΩ or higher.

( ) Disconnect the ohmmeter leads from the circuit board.



OPERATIONAL CHECKS

NOTE: To perform the following checks, you will have to connect the Phone Patch to your telephone line. Use the modular duplex jack and modular cable supplied with this kit. This will allow you to connect the Phone Patch and your telephone to the same wall socket. If you do not already have modular jacks in your home, you can purchase the necessary conversion parts from many department stores or your local Phone Center.

( ) Make sure the PATCH pushbutton on your Phone Patch is OFF (knob out).

( ) Be sure you have read the "FCC Requirements" on Page 2 before you continue.

( ) Refer to Pictorial 3-2 and connect the Phone Patch to your telephone line as shown.

NOTE: Do not install a battery in your Phone Patch unless a step directs you to do so.

( ) Push the PATCH pushbutton on the Phone Patch to ON (knob in). The ON LED should light.

( ) Lift the handset of your telephone and make sure there is a normal dial tone. Then hang up the telephone and release the PATCH pushbutton to OFF.

NOTES:

1. The following steps determine whether or not you need to install a battery in your Phone Patch.
2. For the following test, you will need an isolated VOM or VTVM (one that is not grounded at the AC outlet). If your meter has a 3-wire line cord, you can install a cheater adaptor to disconnect the ground during these tests.

( ) Set your voltmeter to measure 15-volts DC.

( ) Connect the negative or common lead of your meter to the lead at the **unbanded** end of diode D5. Do not let this lead touch the chassis.

( ) Connect the positive meter lead to the lead that passes through ferrite beads FB1 and FB2.

( ) Lift the handset of your telephone and dial an outside number (such as a friend, neighbor, or the weather).

( ) Push the PATCH pushbutton to ON (knob in). The voltmeter should indicate at least 3.5 volts DC. If the meter indicates less than 3.5 volts DC, you must install a battery in your Phone Patch to make up for the low telephone line voltage.

( ) Release the PATCH pushbutton to OFF (knob out) and hang up the telephone.

( ) If the above test determined that you need to install a battery, do so at this time. Some suitable 9-volt batteries (NEDA #1604) are listed below. IMPORTANT: DO NOT install a battery if you measured 5.5 volts DC or higher in the above test.

Eveready #216 or #1222
Mallory #M1604
Mallory #TR-146X (long life)
Burgess #2V6
RCA #XS323
Hellesens #410
Varta #438

( ) If you do not install a battery, refer to the inset drawing on the Pictorial and slide the length of fiber sleeving onto the battery snap connector. Then store the connector in the battery clip.

NULL ADJUSTMENT

NOTE: Before you can perform the following steps, you must have the Phone Patch connected to your telephone line and radio equipment. Refer to the "Installation & Operation" section of this Manual for the proper connections.

Refer to Pictorial 3-3 for the following steps.

( ) Preset the front panel controls as follows:

PATCH pushbutton	OFF (out)
TRANS GAIN control	1
RCVR GAIN control	5

( ) Preset the LINE NULL controls (through their holes in the rear panel to the centers of their rotation).

( ) Prepare a 5" white solid wire. Then push one end of the wire into wire socket TP OUT and the other end into wire socket TP/IN.

( ) Connect the negative (or common) lead of your DC voltmeter to the bare wire that is connected between controls R43 and R5.

( ) Connect the positive voltmeter lead to wire socket METER OUT.

( ) Set the DC voltmeter to its lowest range.

( ) Tune your receiver to a strong, steady station (such as standard time and frequency station WWV) so you hear an approximate 1000 Hz tone.

( ) Lift the telephone handset and call some outside number (such as a friend or neighbor). NOTE: This must be a complete call to an outside number.

( ) Explain to the person you have called that there will be noise and tones on the line for a few minutes while you are making adjustments. Also tell the person not to say anything until you are finished. Any sound on the line, other than those mentioned above will affect your adjustments.

( ) Push the PATCH pushbutton to ON (in).

( ) While you listen to the receiver on your telephone, adjust the RCVR GAIN control on the Phone Patch for the volume you desire. NOTE: Do not adjust the control for maximum volume. Excessive audio will result in clipping and distortion.

( ) You should now have an indication on the voltmeter. If you do not have an indication, adjust the NULL 2 control (through a hole in the rear panel of the Patch) until you obtain an indication.

( ) Adjust the NULL 2 control for as low an indication as possible on the voltmeter.

( ) Adjust the NULL 1 control to the 10 o'clock position (as viewed from the rear panel). Then readjust the NULL 2 control for the lowest possible indication. NOTE: You may have to alternate between the NULL 1 control and the NULL 2 control to obtain the lowest possible indication. Do not, however, turn the NULL 1 control farther counterclockwise than 9 o'clock.

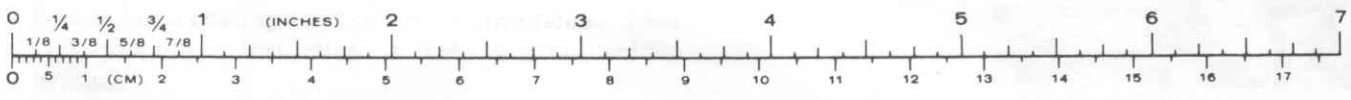
NOTE: The above adjustments should prove satisfactory in most cases. You may be able to improve the adjustment by connecting an AC voltmeter or an oscilloscope to TP OUT and adjusting the NULL 1 and NULL 2 controls for the minimum indication on these instruments.

( ) Hang up the telephone and release the PATCH pushbutton to OFF.

( ) Disconnect the voltmeter and the jumper wire from the Phone Patch.

( ) Refer to Pictorial 3-4 and use four #6 × 1/4" sheet metal screws to mount the cabinet shell onto the chassis as shown. Do not overtighten these screws.

This completes the adjustment of your Phone Patch. No further adjustment should be necessary unless you move the Patch to a different location.



INSTALLATION & OPERATION

INSTALLATION

Before you begin to install your Phone Patch, keep the following functions in mind:

1. Sound on the telephone line passes through the Phone Patch and feeds the microphone input on your transmitter via the MIC jack.

2. Signals from your receiver enter the Phone Patch via the REC jack, pass through the Phone Patch, and are applied to the telephone line.

Interconnection between the Phone Patch and your radio equipment varies from one piece of equipment to another. The following steps show you how to connect the Phone Patch to a typical transceiver. You should then be able to use this information to make the necessary connections to your particular radio equipment.

Refer to Pictorial 4-1 for the following steps.

( ) Use the modular cable and modular duplex jack (supplied) to connect the TELEPHONE jack on the rear panel of the Phone Patch to your telephone line.

NOTES:

1. Be sure to use shielded cable in the following steps when you connect the Phone Patch to your radio equipment.

2. Whenever you use your Phone Patch, you must have some provision to disable your station speaker. During phone patch operation, all station control (such as monitoring and station identification) is done through your telephone.

( ) Connect the REC socket on the rear panel of the Phone Patch to the receiver audio circuitry of your receiver. The simplest way to accomplish this is to connect this cable to the headphone jack on your receiver, since this normally disconnects the speaker automatically. You could also connect this cable to the speaker output on your receiver, but you would need to install a switch to disable the speaker for the reason described earlier. If your receiver does not have a headphone jack or a speaker output jack for an external speaker, you will have to make a direct connection inside your receiver.

( ) Connect the MIC socket on the rear panel of the Phone Patch to the microphone input of your transmitter. Some transmitters have a separate phone patch jack for this purpose. If your transmitter does not already have this provision, you could disconnect your station microphone and connect the Phone Patch to the microphone input of your transmitter. With either of these connections, audio on the telephone line will automatically key your transmitter (assuming your transmitter has VOX capability). In some cases, you may have to install an external push-to-talk switch to key the transmitter. Finally, you could make a direct connection inside your transmitter. In any case, you must be able to disable your station microphone while you are using the phone patch.

There is no reason why your equipment should ever cause harm to the telephone network. If, however, your Phone Patch seems to be malfunctioning, disconnect it until you find the source of the problem and make repairs to your equipment or telephone lines. If harm ever does occur, the telephone company may temporarily disconnect your service. They will notify you of this action promptly and provide you with the opportunity to correct the problem. The Heath Company Service Department or a local Heathkit Electronic Center can provide you with service or other assistance if your Phone Patch should ever require it.

If the telephone company ever makes changes to its communications service, they will officially notify you so the operation of your equipment will not be interrupted.

OPERATION

NOTE: You can leave the Phone Patch connected to your telephone line at all times. When the PATCH switch is in the OFF position, the Phone Patch is completely isolated from the telephone line.

Perform the following steps whenever you use your Phone Patch:

1. Be sure the PATCH switch is in the OFF position.

2. Adjust your transmitter and receiver (or transceiver) for normal voice operation.

3. Lift the handset of your telephone and call the desired party. When the party answers, explain the procedure for speaking over a phone patch. State that he or she will be "on the air" whenever he or she is speaking. Also explain how VOX or push-to-talk works. The person may have to say "over" or some other expression so you know he or she is done speaking and can perform any necessary transmit-receive switching.

4. Push the PATCH pushbutton to ON.

5. Adjust the TRANS GAIN control on the Phone Patch for the desired modulation level, and adjust the RCVR GAIN control for the desired listening level. Do not set these controls any higher than necessary for proper operation, as this could cause cross-talk on the telephone line or interference on the air.

6. If your radio equipment has VOX and ANTI-VOX controls, adjust them as necessary.

NOTE: It is good practice to prevent dial tones, dial clicks, and operator's voices from going out over the air. Be sure to review the Federal Communication's Commission Rules and Regulations that pertain to phone patches.

7. Use the telephone to monitor the transmission and make any required station identifications during operation of the phone patch.

8. Release the PATCH switch to OFF when the phone patch is complete.

IN CASE OF DIFFICULTY

Begin your search for any trouble that occurs after assembly by carefully following the steps listed below in the "Visual Checks." After you complete the "Visual Checks," refer to the "Troubleshooting Charts."

NOTE: Refer to the "Circuit Board X-Ray View" (Page 35) for the physical location of parts on the circuit board.

Visual Checks

1. Recheck the wiring. Trace each lead with a 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 that you have consistently overlooked.

2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered as described in the "Soldering" section of the "Assembly Notes" on Page 5. Be sure there are no solder "bridges" between circuit board foils.

3. Check to be sure all transistors and diodes are in their proper locations. Make sure each lead is connected to the proper point. Make sure each diode band is positioned above the band printed on the circuit board.

4. Check electrolytic capacitors to be sure their positive (+) or negative (−) marked lead is at the correct location.

5. Check to be sure each IC is properly installed in its socket, and the pins are not bent out or under the IC. Also be sure the ICs are installed in their correct positions.

6. Check the values of the parts. Be sure in each step that you wired the correct part into the circuit, as shown in the Pictorial. It would be easy, for example, to install a 680 Ω (blue-gray-brn) resistor where a 68 Ω (blue-gray-black) resistor should be installed.

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

8. A review of the "Circuit Description" may also help you determine where the trouble is.

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

Troubleshooting Chart

The following chart lists problems and possible causes of some troubles you might encounter. If a particular part is mentioned (Q3 for example) as a possible cause, check that part and any other components connected to it to see that they are installed and/or wired correctly. Also check for solder bridges and poor connections in the surrounding area. It is also possible, on rare occasions, for a part to be faulty and require replacement.

CONDITION	POSSIBLE CAUSE
Patch is completely inoperative, no LED indication.	1. Check cable between the Patch and the wall jack. 2. Jumper at FB1/FB2 is missing. 3. Check solder connections on SW1, J1, and Q1 through Q4. 4. Check for DC voltage at U2 pin 8. 5. Diode D5 is installed wrong.
No receiver audio on the telephone line. Transmit function is okay. LED lights.	1. Jumper at FB3/FB4 is missing. 2. Integrated circuit U2. 3. Missing wire at W4. 4. Bad cable at REC IN jack.
No transmitter audio. Receive function is okay.	1. Bad cable at MIC OUT jack.
No transmit or receive audio. LED lights.	1. REC IN and MIC OUT cables interchanged. 2. Integrated circuit U2.
LED does not light. Transmit and receive functions are okay.	1. LED D1. 2. LED cable connected wrong at LED or circuit board.
Audio distorted in both transmit and receive functions.	1. Line voltage less than 3.5 volts. 2. Integrated circuit U2.
Improper VOX operation.	1. Incorrect null adjustment. 2. Incorrect GAIN control settings. 3. Incorrect setting of transmitter Anti-VOX control.

SPECIFICATIONS

Telephone Loop Input Impedance	600 ohms (approx.), polarity protected.
Receiver Output (to phone line)	Limited by FCC regulations: not to exceed −9 dBm (278 mV).
Transmitter Output (to radio equip)	25 mV into a 22 kΩ load at 1000 Hz.
Receiver Input Impedance	3 to 50 ohms, to match a wide range of speaker impedances.
Transmitter (microphone) Output Impedance	22 kΩ (approx.).
Power Requirements	Telephone line powered, provision for a battery if required.
Dimensions (including knobs)	1-3/4″ H × 5-3/4″ W × 3-3/4″ D (4.4 × 14.6 × 9.5 cm).
Weight	12.8 oz. (362.8 g).

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

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram while you read the following description.

Audio coming from the receiver and going to the telephone line passes through isolation transformer T1, a filter circuit formed by integrated circuit U1, an integrated voice circuit formed by integrated circuit U2, and a polarity protection interface formed by transistors Q1 through Q4 before it is applied to the telephone lines.

Conversely, audio coming from the telephone line and going to the transmitter passes through the polarity protection circuit formed by transistors Q1 through Q4, the integrated voice circuit formed by integrated circuit U2, and isolation transformer T2 before it is applied to the microphone input of the transmitter.

The Phone Patch circuitry will now be described in detail.

INPUT CIRCUIT

Audio signals coming from the receiver first pass through isolation transformer T1, which isolates both electrical and ground potentials from the remaining circuitry. Resistor R1 and capacitor C2 couple the signals at the secondary of T1 to the input of a low-pass filter formed by integrated circuit U1. Control R5 allows you to set the amplitude of the signal that is applied to the filter circuit. Integrated circuits U1A through U1D form a quad operational amplifier, which along with the associated circuitry, form a 2100 Hz low-pass active audio filter at its 6 dB point. This filter attenuates any undesirable signals coming from the receiver so that the Patch is compatible with subscriber loop frequency standards before they are applied to the telephone lines.

Resistor R25 and coupling capacitor C13 couple the signal at the output of the low-pass filter to the input of integrated voice circuit U2, which is described next.

INTEGRATED VOICE CIRCUIT

Integrated circuit U2 is designed to replace the bulky transformers that are present in conventional phone patches. U2 performs the necessary 2-wire to 4-wire conversion between the transmitter/receiver and the telephone lines. It also performs automatic gain regulation up to 6 dB, depending upon the length of the transmission loop.

While the receiver signal is being applied to the telephone line, the least amount of audio possible must reach the microphone input of the transmitter. If audio was allowed to reach the microphone input, it could undesirably trigger the transmitter VOX circuit. A nulling bridge circuit formed by resistor R26, capacitor C15, and control R27 allows you to set the gain of the voice circuit during receive. Resistor R34 and control R33 allow you to balance the separation between the transmit and receive signals.

Power for integrated circuits U1 and U2 comes from the telephone line after it passes through the polarity protection circuit described next.

POLARITY PROTECTION CIRCUIT

Transistors Q1 through Q4 form an active bridge circuit that makes up the polarity protection circuit. Whenever the Phone Patch is turned on, the voltage drops between the collector-to-emitter junctions of these transistors, causing them to be saturated (or turned on). Depending upon the polarity of the input voltage coming from the telephone line, either transistors Q1 and Q4 or transistors Q2 and Q3 will conduct. If the emitters of transistors Q1 and Q2 are positive and the emitters of transistors Q3 and Q4 are negative, for example, Q2 and Q3 will conduct. Conversely, transistors Q1 and Q4 will conduct for the opposite polarity. The output polarity at the collectors of Q2 and Q4 (positive) or Q1 and Q3 (negative), therefore, is the same regardless of the line polarity.

The MOV (metal oxide varistor) protects the circuitry from high voltage transients and is electrically similar to two zener diodes connected back-to-back. Under normal conditions, its resistance is very high. If a voltage transient occurs on the telephone line, however, the resistance of the MOV decreases and makes sure the voltage does not rise any higher. When the transient voltage is no longer present, the resistance of the MOV again becomes high.

Zener diode D5 and current-limiting resistor R38 provide additional protection on the positive side of the active bridge circuit, to make sure the integrated voice circuit (U2) is not damaged during high voltage conditions. All audio between the telephone line and integrated circuit U2 pin 8 passes through the active bridge circuit.

Diode D4 and resistor R38, in the battery circuit, provide protection and impedance matching for the voice circuitry. The external battery is only used when the telephone line voltage is too low to properly operate the Phone Patch.

TRANSMIT CIRCUIT

While audio from the telephone line is being applied to the transmitter, it takes a somewhat different path than it does during receive. Audio first passes through the polarity protection interface and then enters integrated circuit U2 at pin 8. The processed audio present at pins 6 and 7 passes through fixed-gain series resistors R28 and R29 and capacitor C18 to isolation transformer T2. The output stage at U2 pins 6 and 7 is a double-ended amplifier that is used in a push-pull configuration. Control R43 allows you to set the gain of the audio coming from transformer T2 before it is applied to the transmitter microphone input.

Resistors R31 and R32 adjust the line length regulation and gain in the subscribers telephone loop. Capacitor C16 is a filter capacitor for the internal shunt regulator inside U2.

SEMICONDUCTOR IDENTIFICATION CHARTS

DIODES

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
D1	412-654	LED	A1
D2	56-26	1N191	A2
D3	56-26	1N191	A2
D4	57-65	1N4002	A2
D5	56-90	1N4742	A2

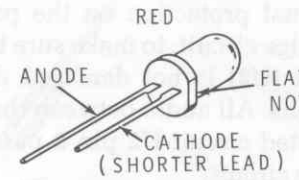
TRANSISTORS

Q1	417-294	MPSA42	B1
Q2	417-836	MPSD51	B1
Q3	417-294	MPSA42	B1
Q4	417-836	MPSD51	B1

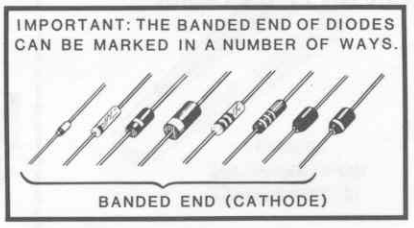
INTEGRATED CIRCUITS

U1	442-602	LM324N	C1
U2	442-778	TCM1705A	C2

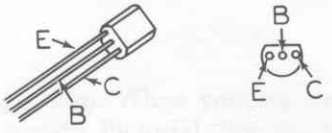
A1



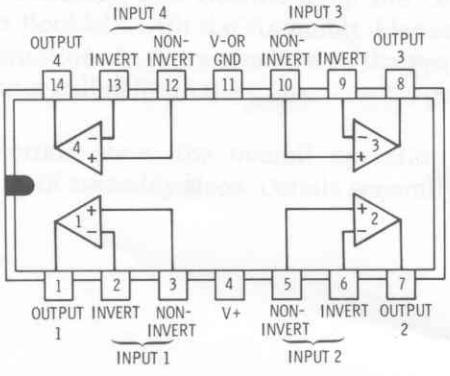
A2



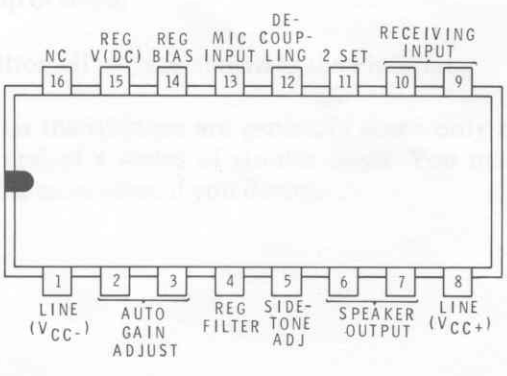
B1



C1



C2



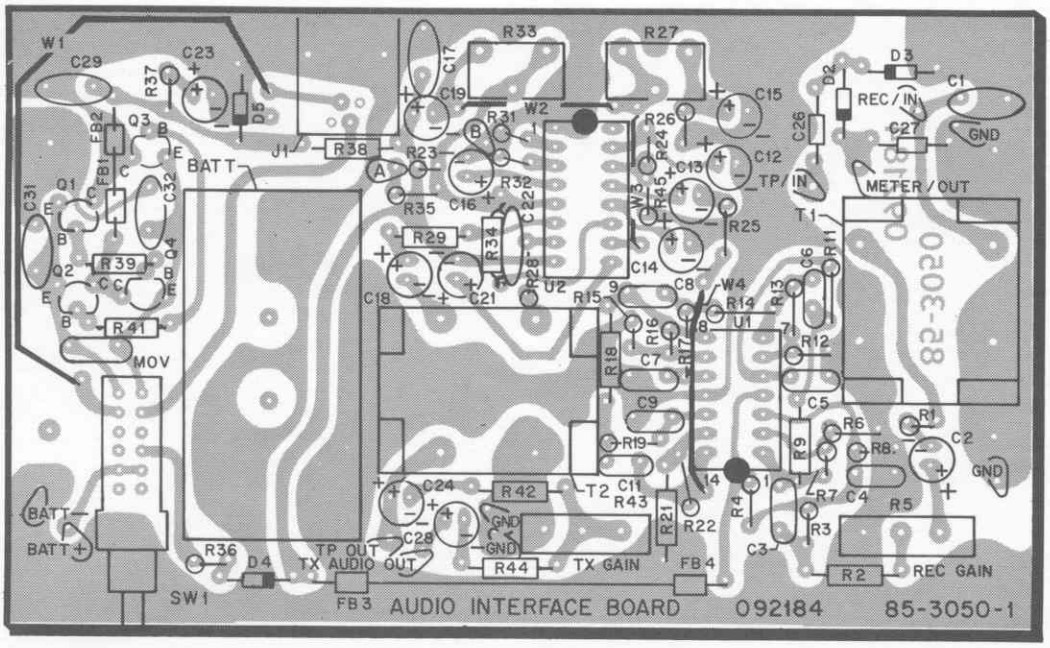
CIRCUIT BOARD X-RAY VIEW

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

A. Find the circuit component number (R5, C3, etc.) on the X-Ray View.

B. Locate this same number in the "Circuit Component Number" column of the "Parts List."

C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



(Shown from the component side.)

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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ZENITH

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