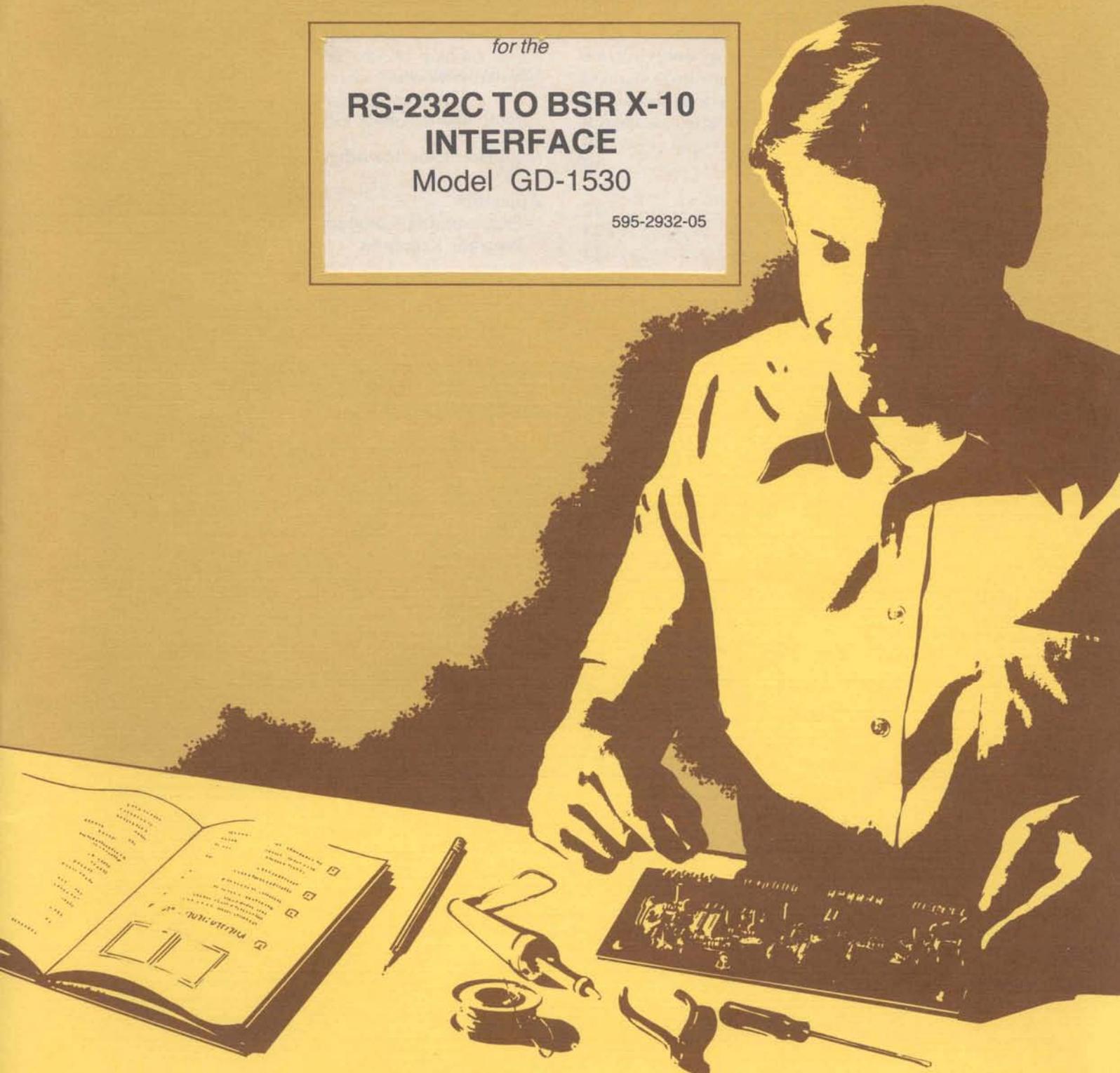


HEATHKIT[®] MANUAL

for the

**RS-232C TO BSR X-10
INTERFACE**
Model GD-1530

595-2932-05



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 component, 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

RS-232C TO BSR X-10 INTERFACE Model GD-1530

595-2932-05

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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TABLE OF CONTENTS

Introduction	3	Final Assembly	27
Assembly Notes	4	Operation	28
Tools	4	In Case of Difficulty	28
Assembly	4	Troubleshooting Chart	29
Soldering	5	Specifications	31
Parts	6	Circuit Description	32
Parts List	7	Circuit Board X-Ray View	33
Step-By-Step Assembly	9	Semiconductor Identification Chart	34
Circuit Board Assembly	9	Appendix	37
Circuit Board Checkout	19	Programming Command Syntax	37
Cabinet Assembly	19	Program Examples	38
Initial Test	23	Schematic Diagram	
Resistance Checks	23 (Illustration Booklet, Page 5)	
Voltage Checks	23		
Calibration	24		
Alignment Verification Without Instruments .	25		
Alignment With Instruments	26		

WARNING

This equipment has been verified to comply with the limits for a Class B computing device, pursuant to Subpart J of part 15 of FCC Rules.

This equipment generates and uses radio frequency energy for its operation and if not installed and used properly, that is, in strict accordance with the instruction manual, may cause interference to radio and television reception. It has been type tested and found to comply with the RF emission limits for a Class B computing device which is intended to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Move the equipment away from the receiver being interfered with.
- Relocate the equipment with respect to the receiver.
- Reorient the receiving antenna.

If additional help is needed, consult the dealer or ask for assistance from the manufacturer. Customer service information may be found on the inside back cover of this manual or on an insert sheet supplied with this equipment. The user may also find the following booklet helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20401. — Stock No. 004-000-00345-4.

INTRODUCTION

The Heathkit Model GD-1530 is a computer Interface device which allows you to operate your BSR X-10 modules from a computer having an RS-232C output.

With the RS232/BSR Interface, you can write a program on your computer to control various appliances, lights, and other devices controlled by modules in your BSR X-10 Control System.

Your computer system must be equipped with an RS-232C Serial Interface Port (no protocol required or available) capable of a baud rate between 110 baud and 2400 baud to work correctly with the GD-1530 Interface.

Programming syntax and simple program examples are provided in the Appendix at the back of this Manual. You may develop more sophisticated programs for your own applications, or you may find programs available in various user's groups.

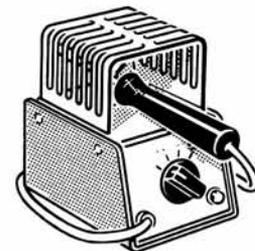
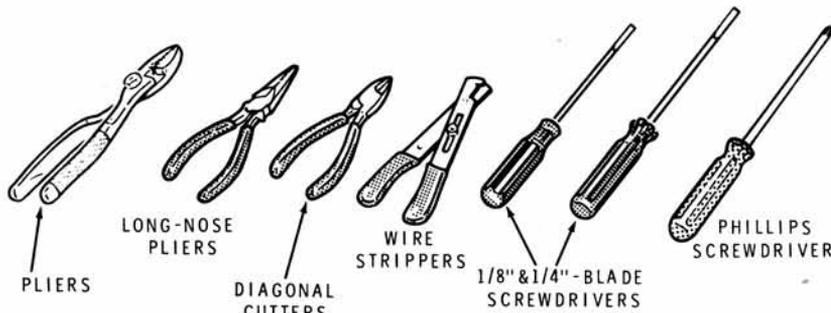
WARNING

Federal Communications Commission requirements prescribe verification of computing devices in Part 15 Subpart J of the rules and regulations. This computing device will meet these requirements when constructed in strict accordance with the instructions in this manual, using only components and materials supplied with the kit or the exact equivalent thereof.

ASSEMBLY NOTES

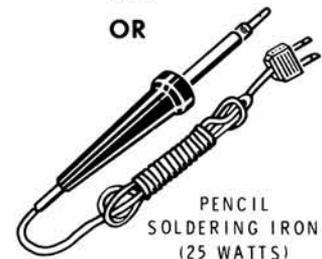
TOOLS

You will need these tools to assemble your kit.

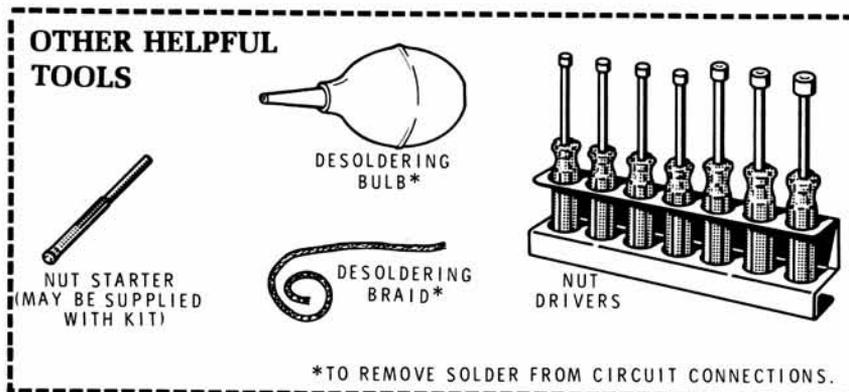


SOLDERING
IRON

OR



PENCIL
SOLDERING IRON
(25 WATTS)



OTHER HELPFUL TOOLS

DESOLDERING
BULB*

DESOLDERING
BRAID*

NUT
DRIVERS

*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS.

ASSEMBLY

- Follow the instructions carefully. Read the entire step before you perform each operation.
- 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.
- 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.
- Position all parts as shown in the Pictorials.
- 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

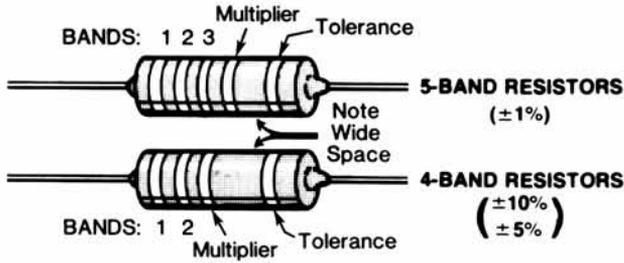
Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating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

PARTS

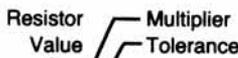


Resistors are identified in Parts Lists and steps by their resistance value in Ω (ohms), k Ω (kilohms), or M Ω (megohms). They are usually identified by a color code of four or five color bands, where each color represents a number. See the "Resistor Color Code" chart. These colors are given in the steps in their proper order (except for the last band, which indicates a resistor's "tolerance"; see the "Resistor Tolerance" chart). You do not need to know the color code.

Occasionally, a "precision" or "power" resistor may have the value stamped on it. The letter R, K, or M may also be used at times to signify a decimal point, as in: 2R2 = 2.2 Ω

2K2 = 2.2 k Ω , or 2200 Ω
2M2 = 2.2 M Ω

Precision resistors may also be marked as shown in the following examples. The values of the multipliers are shown in the "Multiplier Chart," and the tolerance values are shown in the "Resistor Tolerance" chart.



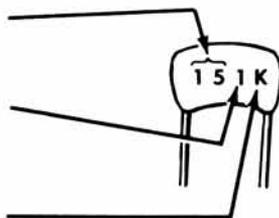
EXAMPLES: 1009C = 100 \times 0.1 = 10 Ω , \pm 0.25%
1001D = 100 \times 10 = 1000 Ω , \pm 0.5%

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

First and second digits of capacitor's value: 15

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

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



RESISTOR COLOR CODE

	Band 1	Band 2	Band 3 (if used)	Multiplier
Color	1st Digit	2nd Digit	3rd Digit	
Black	0	0	0	1
Brown	1	1	1	10
Red	2	2	2	100
Orange	3	3	3	1,000
Yellow	4	4	4	10,000
Green	5	5	5	100,000
Blue	6	6	6	1,000,000
Violet	7	7	7	0.01
Gray	8	8	8	0.1
White	9	9	9	

RESISTOR TOLERANCE

	COLOR OR LETTER	
\pm 10%	SILVER	
\pm 5%	GOLD	J
\pm 2%	RED	G
\pm 1%	BROWN	F
\pm 0.5%	GREEN	D
\pm 0.25%	BLUE	C
\pm 0.1%	VIOLET	B
\pm 0.05%	GRAY	

MULTIPLIER CHART

FOR THE NUMBER:	MULTIPLY BY:	FOR THE NUMBER:	MULTIPLY BY:
0	1	4	10,000
1	10	5	100,000
2	100	8	0.01
3	1000	9	0.1

CAPACITOR TOLERANCE

LETTER	10 pF OR LESS	OVER 10 pF
B	\pm 0.1 pF	
C	\pm 0.25 pF	
D	\pm 0.5 pF	
F	\pm 1.0 pF	\pm 1%
G	\pm 2.0 pF	\pm 2%
H		\pm 3%
J		\pm 5%
K		\pm 10%
M		\pm 20%

EXAMPLES: 151K = 15 \times 10 = 150 pF
759 = 75 \times 0.1 = 7.5 pF

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

PARTS LIST

Unpack the parts and check each part against the following list. The key numbers correspond to the numbers on the Parts Pictorial (Illustration Booklet, Page 1). Any part that is packaged in an individual envelope with a part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not discard any packing materials until all the parts are accounted for.

Some parts are marked with a "171-" or "172-" packaging number. These numbers are used for packaging purposes only and do not appear in the "Manual Parts List."

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

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

RESISTORS

All resistors are 1/4-watt, 5% (fourth band gold) unless stated otherwise.

A1	6-150-12	1	15 Ω (brn-grn-blk)	R13
A2	6-220	1	22 Ω, 1/2-watt (red-red-blk)	R1
A1	6-331-12	1	330 Ω (org-org-brn)	R11
A1	6-821-12	1	820 Ω (gry-red-brn)	R14
A1	6-102-12	1	1000 Ω (brn-blk-red)	R3
A1	6-182-12	1	1800 Ω (brn-gry-red)	R7
A1	6-222-12	1	2200 Ω (red-red-red)	R10
A1	6-392-12	2	3900 Ω (org-wht-red)	R5, R8
A1	6-512-12	2	5100 Ω (grn-brn-red)	R4, R12
A1	6-103-12	1	10 kΩ (brn-blk-org)	R6
A1	6-153-12	1	15 kΩ (brn-grn-org)	R15
A1	6-334-12	1	330 kΩ (org-org-yel)	R2

CAPACITORS

Mica

B1	20-173	2	20 pF	C8, C9
B2	20-122	1	1000 pF	C11

Ceramic

B3	21-164	1	1500 pF (.0015 μF)	C14
B4	21-72*	1	.005 μF	C16
B5	21-192	4	.1 μF (104 M)	C4, C10, C12, C15

* Safety critical component. Replace only with the exact Heath Company replacement part.

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

Capacitors (Cont'd)

Electrolytic

B6	25-900	1	1 μF	C7
B7	25-872	1	220 μF	C5
B7	25-875	2	1000 μF	C2, C6

Polypropolene

B8	27-60	1	.22 μF	C13
B9	27-90	1	2.2 μF	C1

Mylar

B10	27-110	1	.047 μF	C3
-----	--------	---	---------	----

DIODES

C1	56-26	1	1N191 (brn-wht-brn)	D5
C1	57-65	6	1N4002	D1, D2, D3, D4, D7, D8
C1	56-84	2	1N4148	D6, D9
C1	56-605	1	1N4746	D11

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

TRANSISTOR — INTEGRATED CIRCUITS (IC's)

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

1. Part number.
2. Type number. (On integrated circuits this refers only to the numbers and letters listed. Any additional letters or numbers on an IC are not significant.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

D1	417-811	1	MPSL01 transistor	Q2
D1	417-875	1	2N3904 transistor	Q1

NOTE: "Protected" IC's can be damaged by static electricity. DO NOT remove them from their foam pad until you are instructed to do so in a step.

D2	442-54	1	UA7805 IC	U5
D3	442-741	1	2209 IC	U3
D3	443-603	1	4011 IC	U2
D3	443-205-1	1	8748 IC	U1
D3	443-1109	1	HCPL2531 IC	U4

OTHER CIRCUIT COMPONENTS

E1	10-311	1	5000 Ω (5k) control	R9
E2	45-604	1	100 μH (101K) choke	L1
E3	52-192	1	Module transformer	T2
E4	54-1020	1	Power transformer	T1
E5	404-647	1	6 MHz crystal	Y1
E6	412-640	1	LST5053 light-emitting diode (LED)	V1
E7	421-26*	1	.125 (1/8) ampere slow-blow fuse	F1

HARDWARE

#4 Hardware

F1	252-2	2	4-40 nut
F2	254-9	3	#4 lockwasher
F3	255-757	2	4-40 hex stud

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

#6 Hardware

F4	250-1280	2	6-32 × 3/8" phillip's head screw
F5	250-1434	4	#6 × 3/8" self-tapping screw
F6	250-1322	1	#6 × 5/8" self-tapping screw
F7	252-3	2	6-32 nut
F8	254-1	1	#6 lockwasher
F9	259-1	2	#6 solder lug

CLIPS - CONNECTORS - SOCKETS

G1	260-65	2	Fuse clip	
G2	432-134	7	Wire connector (1-extra)	
G3	432-866	3	Spring connector (1-extra)	
G4	432-1033	4	Male connector (2-extra)	
G5	432-1030	1	2-hole socket shell	
G6	432-1032	1	25-hole socket	J1
G7	434-230	2	8-pin IC socket	
G8	434-298	1	14-pin IC socket	
G9	434-253	1	40-pin IC socket	

LINE CORD - WIRE

89-23	1	Line cord
340-8	8"	Bare wire
344-125	15"	Black wire
344-134	15"	White wire

MISCELLANEOUS

H1	75-710	4	Circuit board spacer (See ** below)
H2	75-753	1	Line cord strain relief
H3	90-1291-1	1	Cabinet top
H4	90-1292-1	1	Cabinet bottom
H5	215-677	1	Transistor heat sink
H6	260-700	1	LED grommet
H7	260-701	1	LED retainer ring
H8	261-43	4	Rubber foot
H9	352-13	1	Silicone grease
	85-2755-1	1	Circuit board
	490-185	1	Solder-wick*** Solder
	390-1255	1	Caution label
	390-1872	1	FCC label
		1	Blue and white label
	597-260	1	Parts Order Form Assembly Manual (See Page 1 for Part Number.) Illustration Booklet (See Page 1 for Part Number.)

** Soak these spacers in water until they are called for in a step.

*** Registered Trademark, Solder Removal Co.

* Safety critical part. Replace with only the same rated part.

STEP-BY-STEP ASSEMBLY

CIRCUIT BOARD ASSEMBLY

START

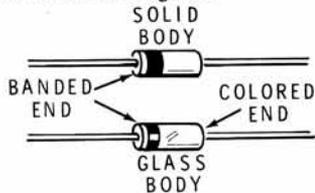
Position the circuit board as shown.

NOTE: Only a portion of the circuit board is shown in the following Pictorial. The small "Identification Drawing" at the top of the page shows the area of the circuit board to be assembled.

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: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD. See Detail 1-1A.

If your diode has a solid body, the band is clearly defined. If your diode has a glass body, do not mistake the colored end **inside** the diode for the banded end. Look for a band painted on the **outside** of the glass.



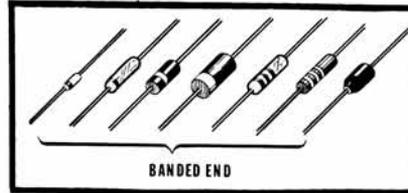
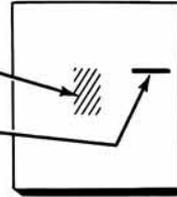
- () 1N191 diode (brn-wht-brn, #56-26). Hold the diode with pliers as shown and bend the leads straight down.



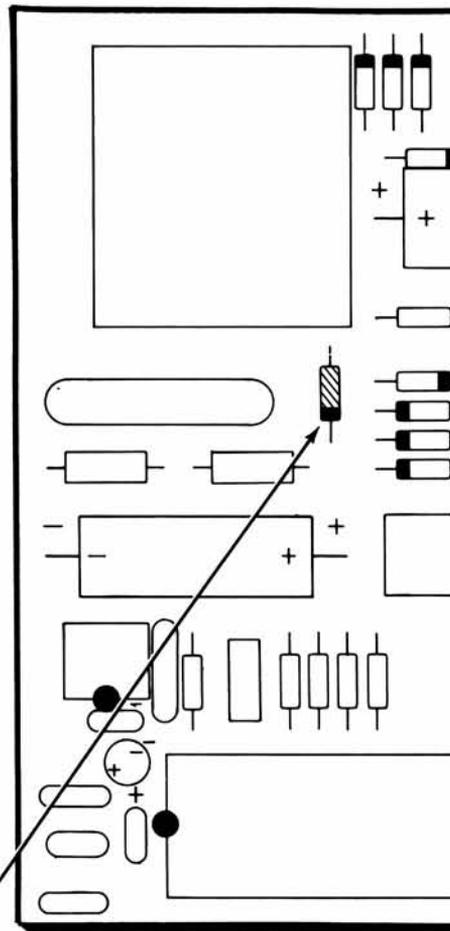
- () D5: Position the end with the band as shown. Push the leads through the holes at the proper location on the circuit board.

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

PART NUMBER IDENTIFICATION DRAWING



Detail 1-1A



PICTORIAL 1-1

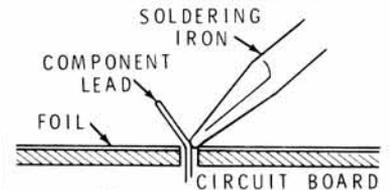
CONTINUE

- () Position the diode against the circuit board. Then bend the leads outward slightly to hold the diode in place.

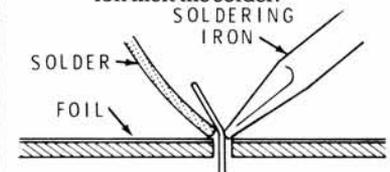


- () Turn the circuit board over, and solder the diode leads to the circuit board as follows:

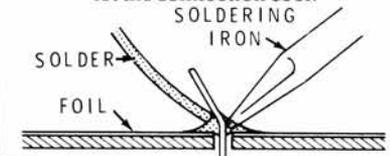
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



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

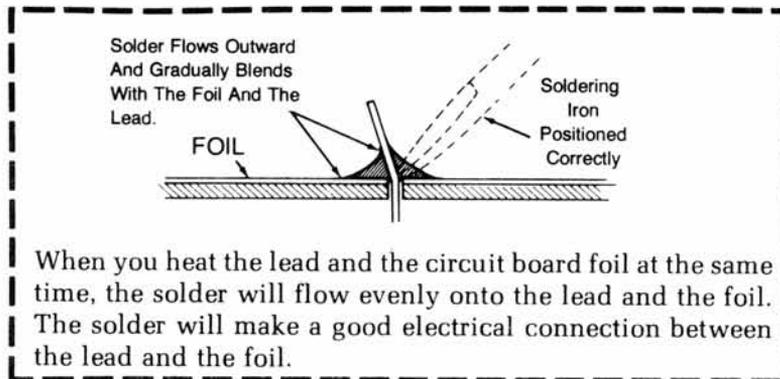
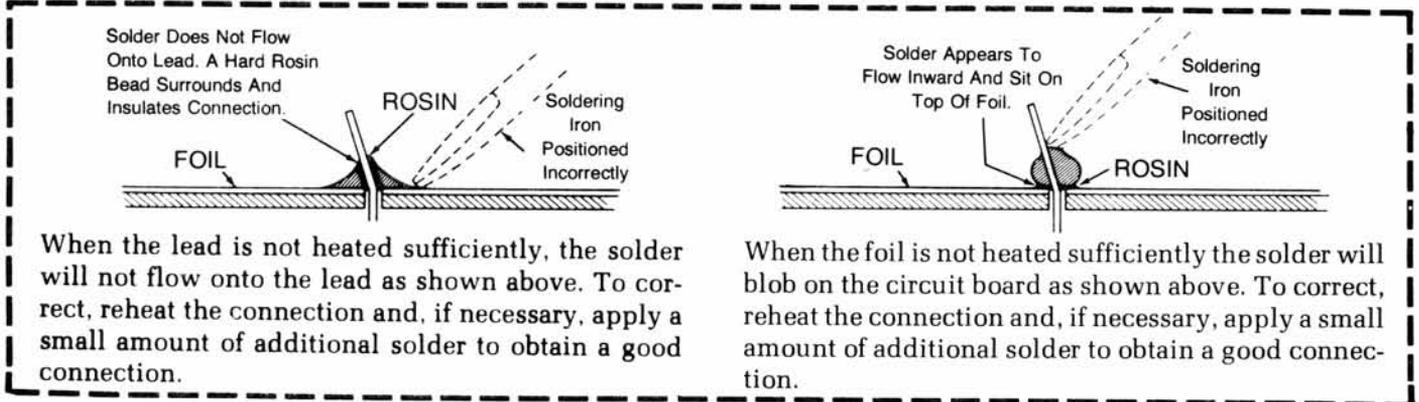


3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



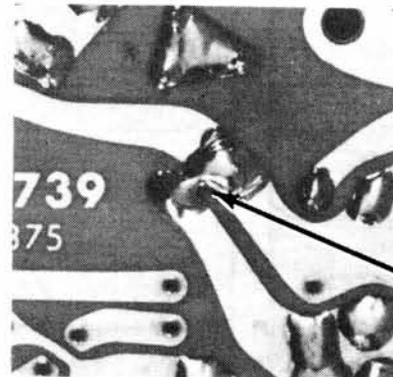
- () Cut off the excess lead lengths close to the connection. **WARNING:** Clip the leads so the ends will not fly toward your eyes.

- () Check each connection. Compare it to the illustrations on Page 10. After you have checked the solder connections, proceed with the assembly on Page 11. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION**POOR SOLDER CONNECTIONS****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.

**SOLDER BRIDGE**

START ↘

- () D1: 1N4002 diode (#57-65).

- () D2: 1N4002 diode (#57-65).

- () D3: 1N4002 diode (#57-65).

- () D4: 1N4002 diode (#57-65).

- () D6: 1N4148 diode (#56-84).

- Be sure you installed diode D5 in Pictorial 1-1.

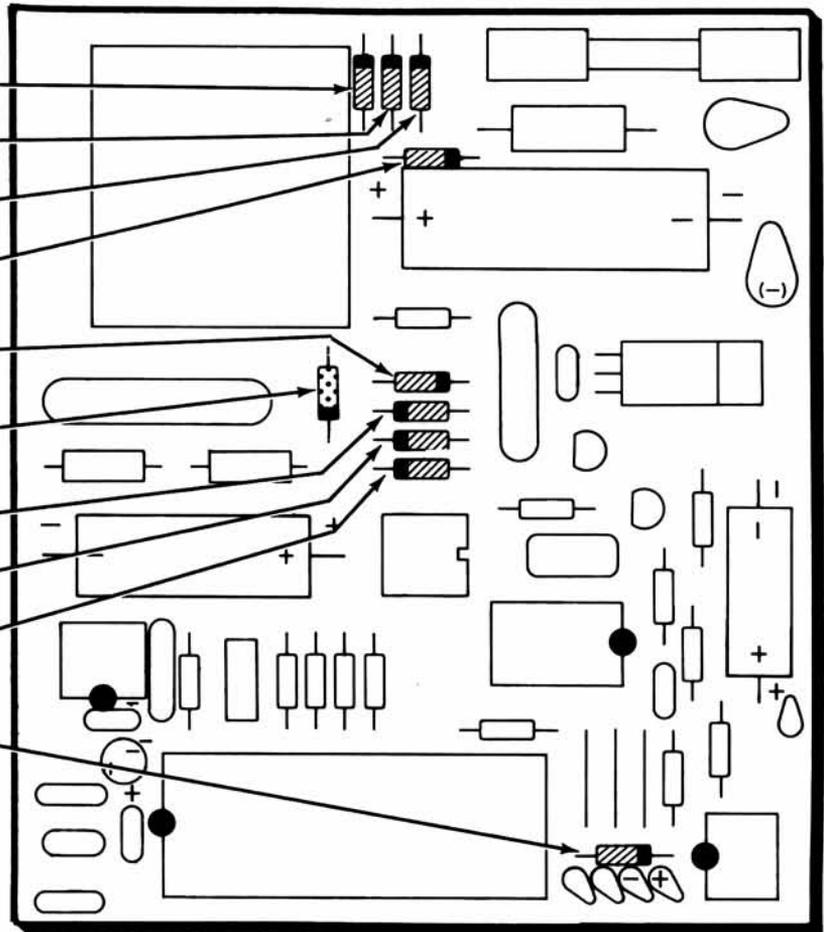
- () D7: 1N4002 diode (#57-65).

- () D11: 1N4746 diode (#56-605).

- () D8: 1N4002 diode (#57-65).

- () D9: 1N4148 diode (#56-84).

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

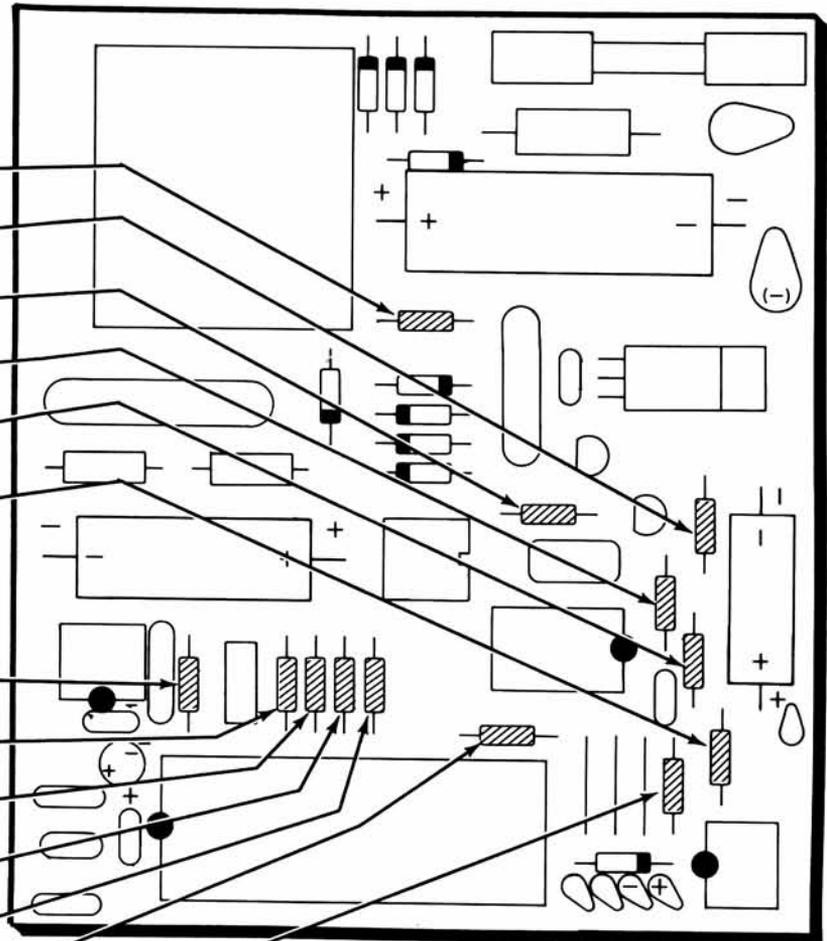


PICTORIAL 1-2

START →

- () R2: 330 k Ω (org-org-yel).
- () R13: 15 Ω (brn-grn-blk).
- () R15: 15 k Ω (brn-grn-org).
- () R14: 820 Ω (gry-red-brn).
- () R12: 5100 Ω (grn-brn-red).
- () R10: 2200 Ω (red-red-red).
- () Solder the leads to the foil and cut off the excess lead lengths.
- () R8: 3900 Ω (org-wht-red).
- () R7: 1800 Ω (brn-gry-red).
- () R5: 3900 Ω (org-wht-red).
- () R4: 5100 Ω (grn-brn-red).
- () R6: 10 k Ω (brn-blk-org).
- () R3: 1000 Ω (brn-blk-red).
- () R11: 330 Ω (org-org-brn).
- () Solder leads to the foil and cut off the excess lead lengths.

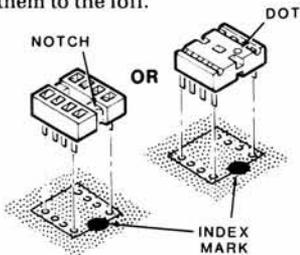
The remaining resistor will be installed later.



PICTORIAL 1-3

START 

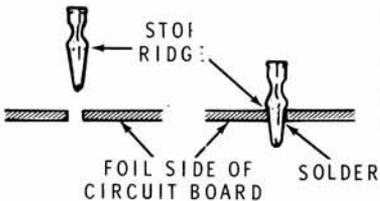
NOTE: Before you install an IC socket, make sure the pins are straight. If there is any kind of identification mark (notch, dot, arrowhead, etc.) at or near one end of the socket, place this marked end toward the index mark on the circuit board (this index mark should still be visible after you install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



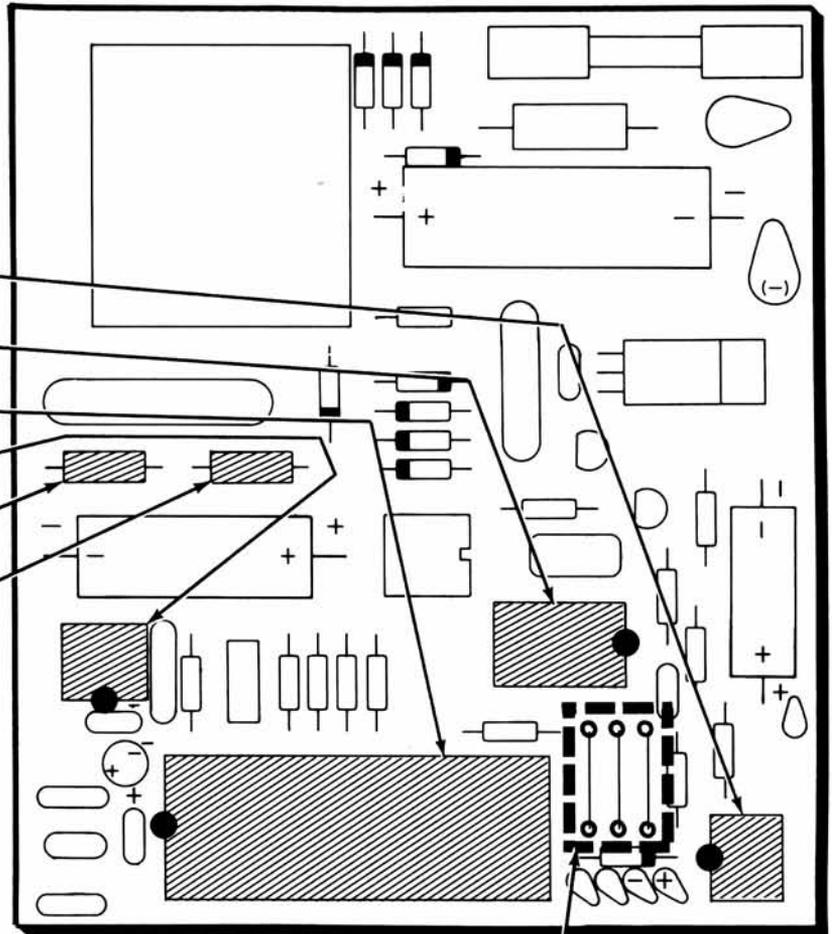
Solder the socket pins to the foil after you install each socket.

- () 8-pin IC socket at location U4.
- () 14-pin IC socket at location U2.
- () 40-pin IC socket at location U1.
- () 8-pin IC socket at location U3.
- () R1: 22 Ω, 1/2-watt (red-red-blk).
- () L1: 100 μH (101K) choke (#45-604).
- () Solder the leads to the foil and cut off the excess lead lengths.

NOTE: Install wire connectors in the following steps as shown. Solder each connector to the foil as you install it.



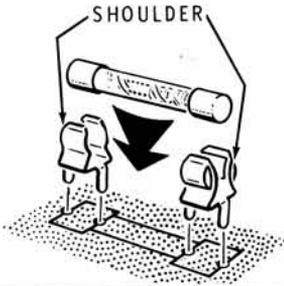
- () 6-wire connectors.



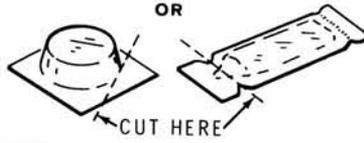
PICTORIAL 1-4

START 

() F1: Install a fuse clip on each end of the .125 (1/8) ampere fuse. Insert the clips in the circuit board and solder them as quickly as possible to the foil.

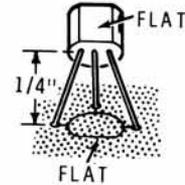


WARNING: The silicone grease you will use in the following step(s) helps transfer heat from the transistor to the heat sink. The grease is not caustic, but make sure you do not get it into your eyes, ears, nose, mouth, or clothing. Always wash your hands after you use the grease. Keep this and all chemicals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



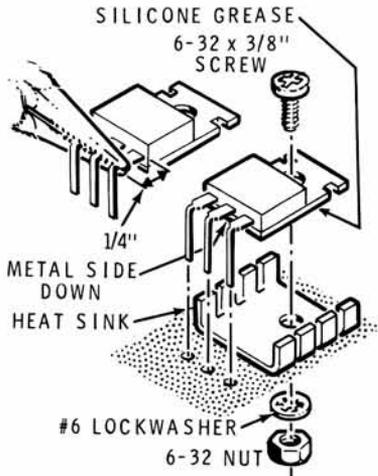
Detail 1-5A

NOTE: When you install a transistor in each of the following steps, align its flat with the flat on the board. Insert the leads into their correct holes. Position the transistor 1/4" above the board. Then solder the leads to the foil and cut off the excess lead lengths.



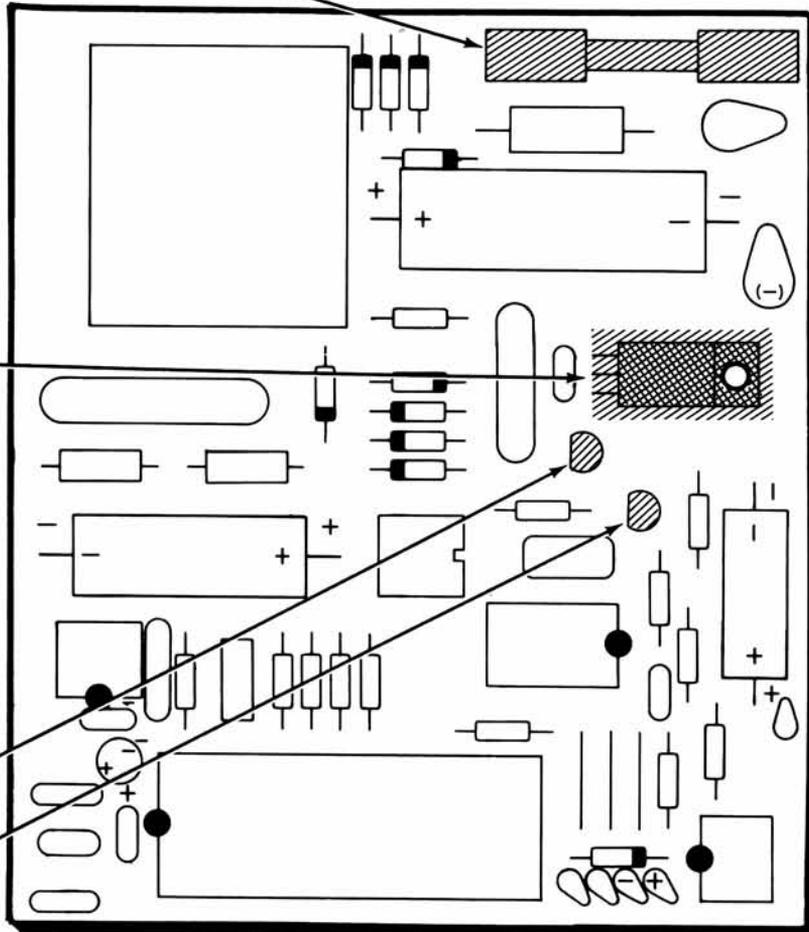
Detail 1-5B

() U5: UA7805 IC (#442-54). Hold the IC leads with long-nose pliers and bend the leads as shown. Refer to Detail 1-5A and open the silicone grease. Apply a thin layer of silicone grease to the indicated side of the IC. Mount the IC and the heat sink to the board with a 6-32 x 3/8" screw, #6 lockwasher, and 6-32 nut. Then solder the leads to the foil and cut off the excess lead lengths.



() Q1: 2N3904 transistor (#417-875). See Detail 1-5B.

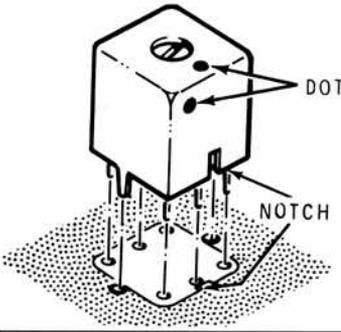
() Q2: MP5L01 transistor (#417-811).



PICTORIAL 1-5

START

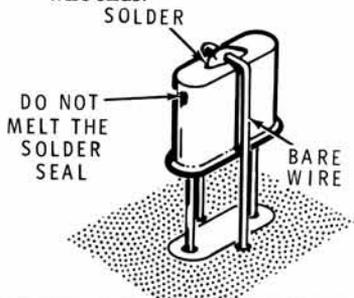
- () C4: .1 μ F (104M) ceramic.
- () C14: 1500 pF (.0015 μ F) ceramic. See Detail 1-6A.
- () T2: Module transformer (#52-192). Align the notch or dot on the transformer with the notch outline on the circuit board. Insert the pins into the board holes and solder them to the foil.



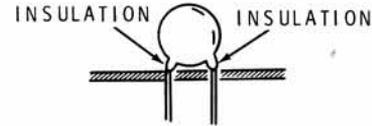
- () C15: .1 μ F (104M) ceramic.
- () C12: .1 μ F (104M) ceramic.
- () C10: .1 μ F (104M) ceramic.
- () C9: 20 pF mica.
- () C8: 20 pF mica.

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

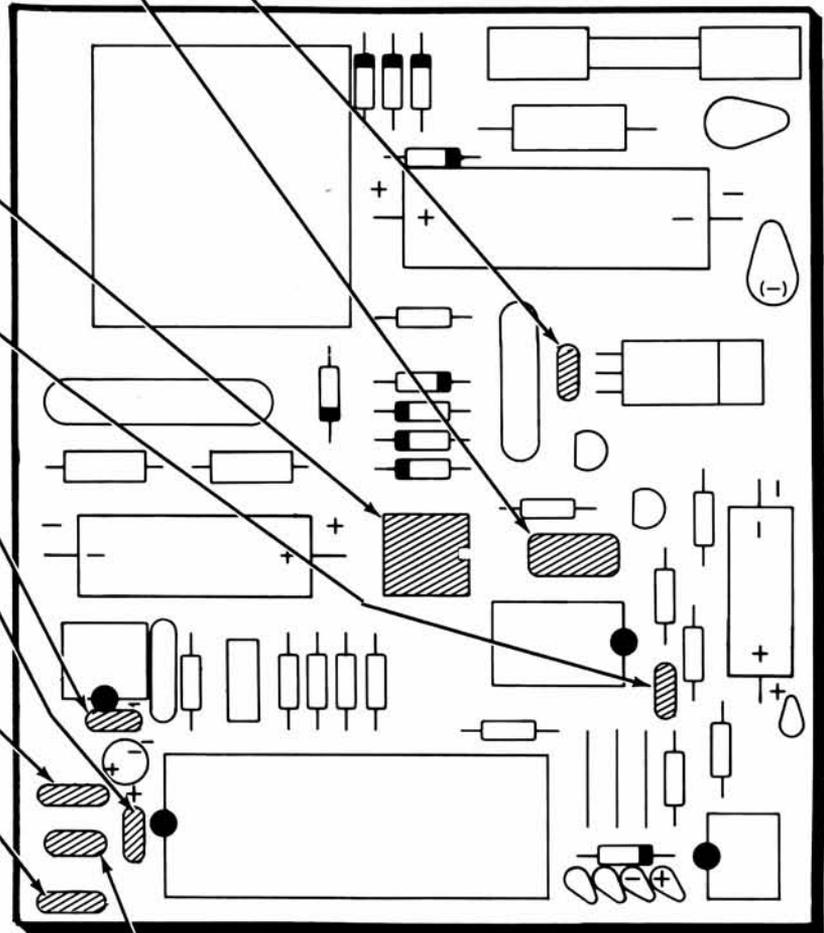
() Y1: 6 MHz crystal (#404-647). Insert the crystal leads into their circuit board holes, solder them to the foil, and cut off their excess lead lengths. Bend a 2" bare wire at its center, fit it over the crystal, and insert its ends into the circuit board holes. Then, quickly, to avoid melting the solder seal, solder the bare wire to the top of the crystal and the board foils and cut off the excess wire ends.



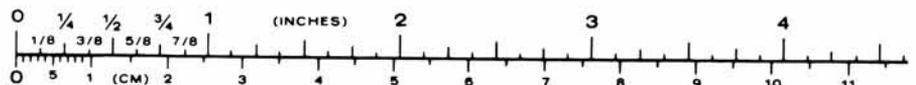
NOTE: When you install ceramic capacitors, do not push the insulated portions of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil.



Detail 1-6A



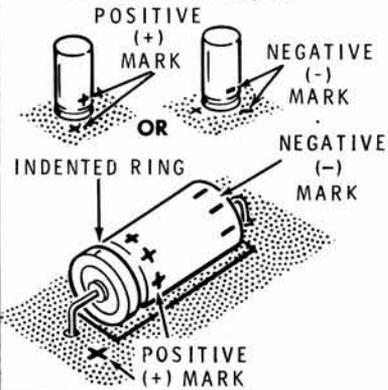
PICTORIAL 1-6



START 

() C3: .047 μ F Mylar.

NOTE: When you install an electrolytic capacitor, be sure to match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board, or match the negative (-) mark on the capacitor with the negative mark on the circuit board.



() C2: 1000 μ F electrolytic.

() C1: 2.2 μ F polypropylene.

() C13: .22 μ F polypropylene.

() C6: 1000 μ F electrolytic.

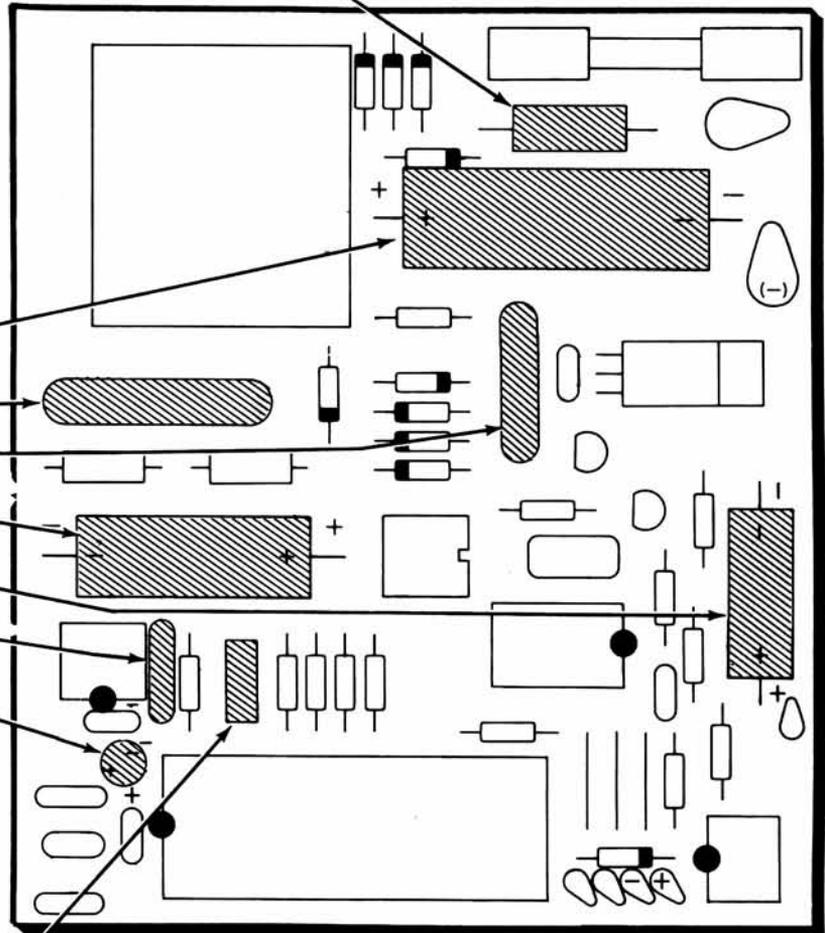
() C5: 220 μ F electrolytic.

() C11: 1000 pF mica.

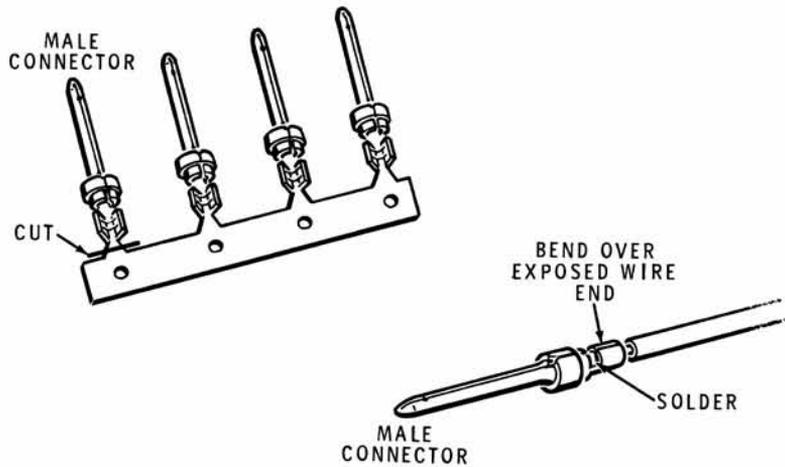
() C7: 1 μ F electrolytic.

() Solder the leads to the foil and cut off the excess lead lengths. The remaining capacitor will be installed later.

() R9: 5000 Ω (5k) control (#10-311). Bend the pins slightly if necessary, and insert them in the board holes. Push the control tight against the board. Then solder the pins to the foil.



PICTORIAL 1-7



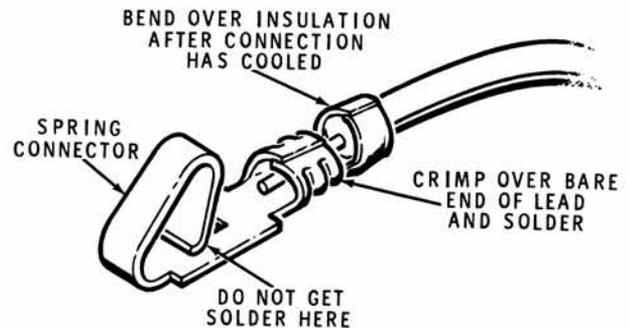
Detail 2-1A

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

When a wire is called for, cut the specified color wire to the indicated length and remove 1/4" of insulation from each end. Then tightly twist the fine wire strands and melt a small amount of solder to the exposed wire end to hold the fine wire strands together.

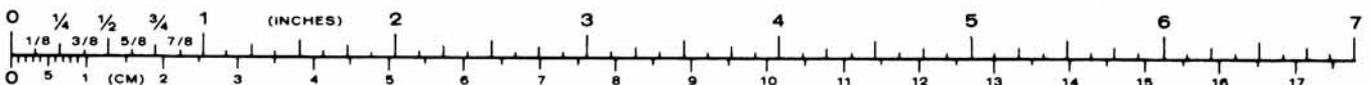
- () Prepare the ends of a 10-1/2" black wire and a 10-1/2" white wire.
- () Refer to Detail 2-1B and cut one exposed end of the 10-1/2" black wire to 1/8". Then solder this wire end to a spring connector.
- () In the same manner, install a spring connector to one end of the 10-1/2" white wire.

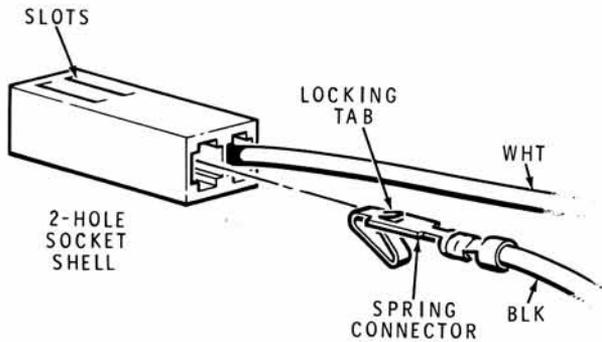
- () Prepare the ends of a 3-1/2" black wire and a 3-1/2" white wire.
- () Refer to Detail 2-1A and cut one exposed end of the 3-1/2" black wire to 1/8". Then solder this wire end to a male connector.
- () In the same manner, install a male connector to one end of the 3-1/2" white wire.
- () Push the male connector on the end of the black wire into hole 7 of the 25-hole socket until it clicks into place. Use a pointed object to push the connector. The hole numbers are molded into the socket.
- () In the same manner, push the male connector on the white wire into hole 3 of the 25-hole socket.



Detail 2-1B

Set the 25-hole socket aside temporarily.



**Detail 2-1C**

- () Refer to Detail 2-1C and position the 2-hole socket shell with the slots up and push the spring connector on the black wire into the left hole until the locking tab snaps into place.
- () In the same manner, push the spring connector on the white wire into the right hole in the 2-hole socket shell. Its free end will be connected later.

Solder the free ends of the wires of the 25-hole socket to the circuit board as follows:

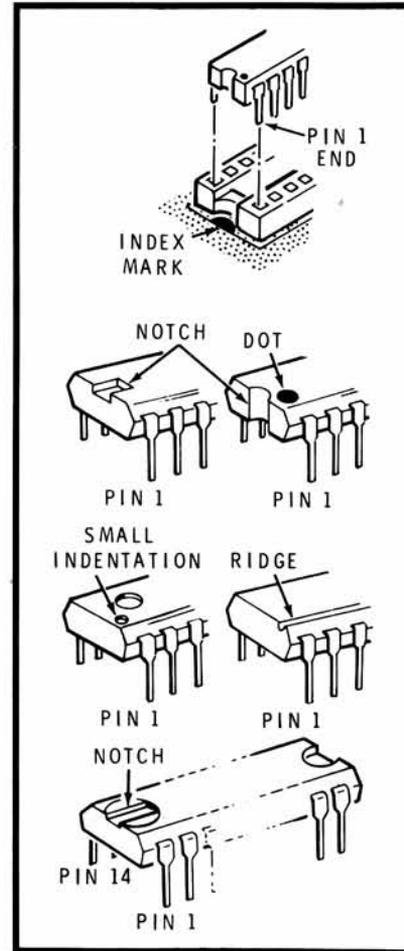
- () White wire to the "+" marked hole.
- () Black wire to the "-" marked hole.

Solder the free ends of the wires of the 2-hole socket to the circuit board as follows:

- () Black wire to hole B.
- () White wire to hole C.
- () T1: Install the power transformer at location T1 on the circuit board. It will only fit one way. With the transformer tight against the board, bend over the transformer mounting tabs against the foil side of the board. Then solder the transformer pins to the foil.

CAUTION: When you install a protected IC (one with a foam pad on its pins), be sure it does not get damaged by static electricity. Once you remove the foam pad from the IC, DO NOT let go of the IC. Install the IC as follows. Read the following six instructions before you pick up the IC.

1. Pick up the IC and touch the foam with both hands.

**Detail 2-1D**

2. Hold the IC with one hand and remove the foam pad with the other hand.
3. Continue to hold the IC with one hand and straighten any bent pins with the other hand.
4. Pick up the circuit board in the other hand.
5. Align the pin 1 end of the IC with the index mark on the circuit board. See Detail 2-1D.
6. Then push the IC pins into the IC socket. Once in the socket, the IC is protected.

- () U1: 8748 IC (#444-205-1) at location U1.
- () U2: 4011 IC (#443-603) at location U2.
- () U3: 2209 IC (#442-741) at location U3.
- () U4: HCPL 2531 IC (#443-1109) at location U4.

CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

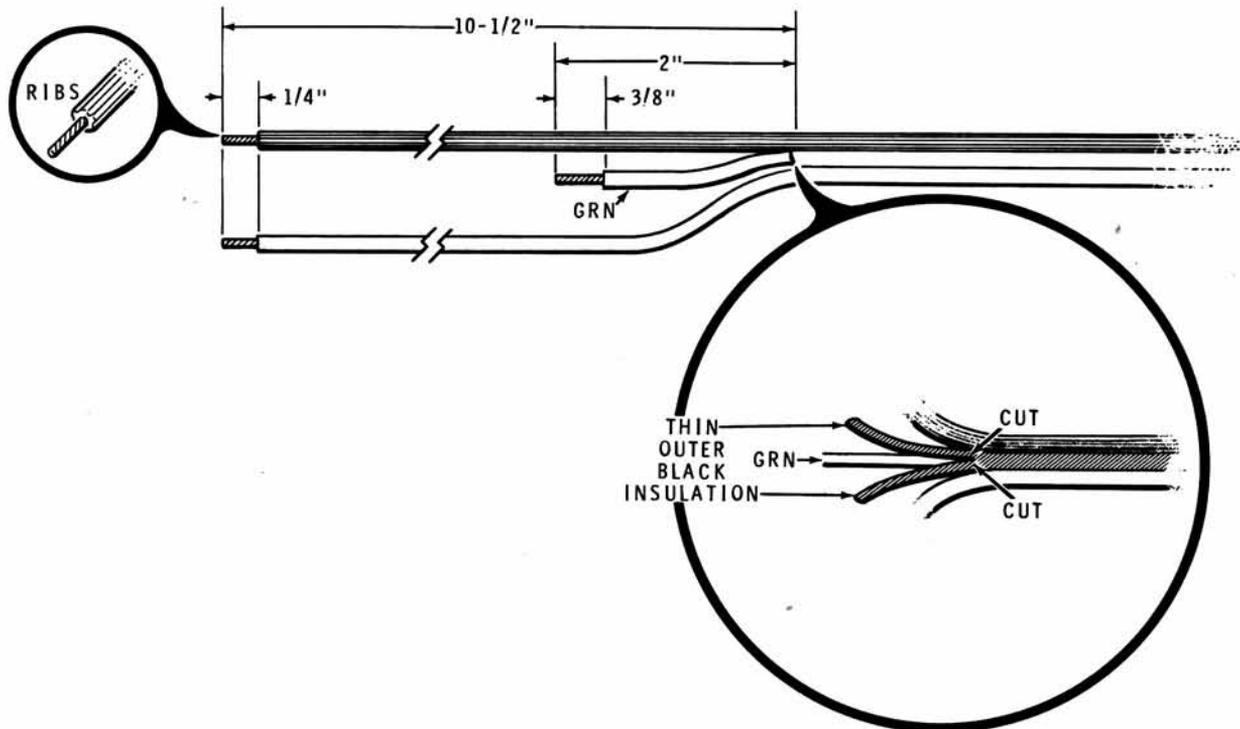
- () Unsolder connections.
- () Poor solder connections.
- () Solder bridges between foil patterns.
- () Protruding leads which could touch together.
- () Transistors and IC's for the proper type and installation.
- () Electrolytic capacitors for the correct position of the positive (+) end.
- () Diodes for proper type and position of the banded end.

Set the circuit board aside temporarily.

CABINET ASSEMBLY

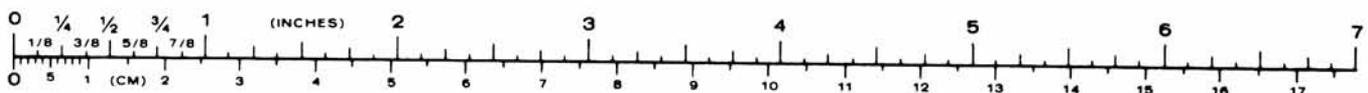
Refer to Pictorial 3-1 (Illustration Booklet, Page 3) for the following steps.

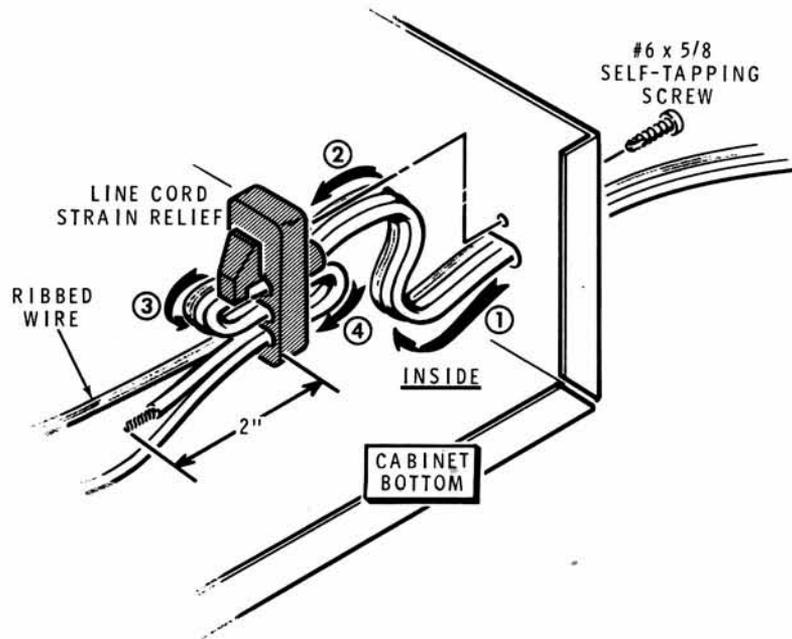
- () Refer to the inset drawing on Pictorial 3-1 and remove the protective backing from a rubber foot. Then press the foot firmly into place at one corner on the bottom of the cabinet bottom.
- () In the same manner, install the remaining three rubber feet on the cabinet bottom.
- () Remove the protective backing from the blue and white label. Press (do not rub) this label into place on the bottom of the cabinet bottom. Always mention the Model and Serial numbers on this label in any communications you have with the Heath Company about this kit.
- () In the same manner, install the FCC label on the bottom of the cabinet bottom.
- () Remove the four circuit board spacers from the water and dry them. Push the short end of one spacer into hole A inside the cabinet bottom until it clicks into place.
- () In the same manner, install the remaining circuit board spacers into holes B, C, and D in the cabinet bottom.



Detail 3-1A

- () Refer to Detail 3-1A and prepare the end of the line cord as follows:
1. Separate the three wires to 10-1/2" from the free end.
 2. Remove 1/4" of insulation from the ends of the ribbed and the smooth wires.
 3. Cut the center wire to 2" from the separation location and remove 3/8" of insulation.
 4. Peel the thin black insulation from the center (green) wire and cut off the insulation at the separation.
 5. Twist together the fine wire strands at the end of each wire and melt a small amount of solder on the exposed wire ends.
- () Refer to Detail 3-1B and pass the line cord through hole G in the cabinet bottom. Be sure you position the ribbed wire as shown.
- () Then feed the line cord through the three holes in the line cord strain relief following the number sequence until the green wire extends 2" from the strain relief as shown in Detail 3-1B. Hold the free end of the line cord and pull the extra back through the strain relief.
- () Refer to Detail 3-1B and secure the line cord strain relief at location G in the cabinet bottom with a #6 × 5/8" self-tapping screw.



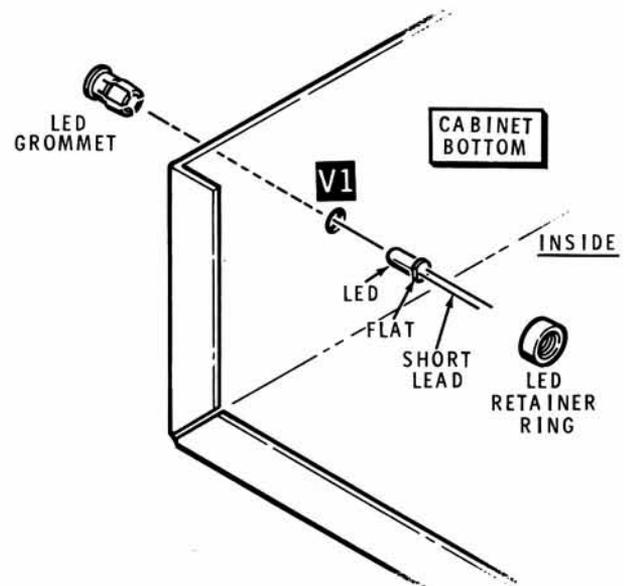


Detail 3-1B

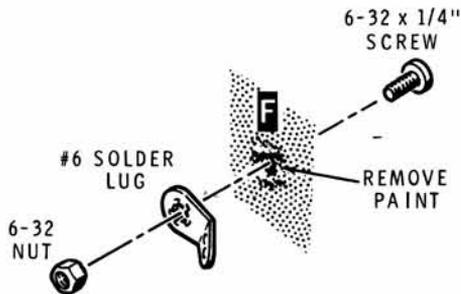
- () V1: Refer to Detail 3-1C and install the LST5053 light-emitting diode (#412-640) at location V1 in the cabinet bottom as follows:

1. Insert the LED grommet in the hole at V1 from the outside of the cabinet bottom.
2. Position the flat (short lead) side of the LED as shown and push it into the LED grommet. DO NOT turn the LED from this position.
3. Push the LED retainer ring all the way onto the LED grommet. DO NOT shorten the leads of the LED.

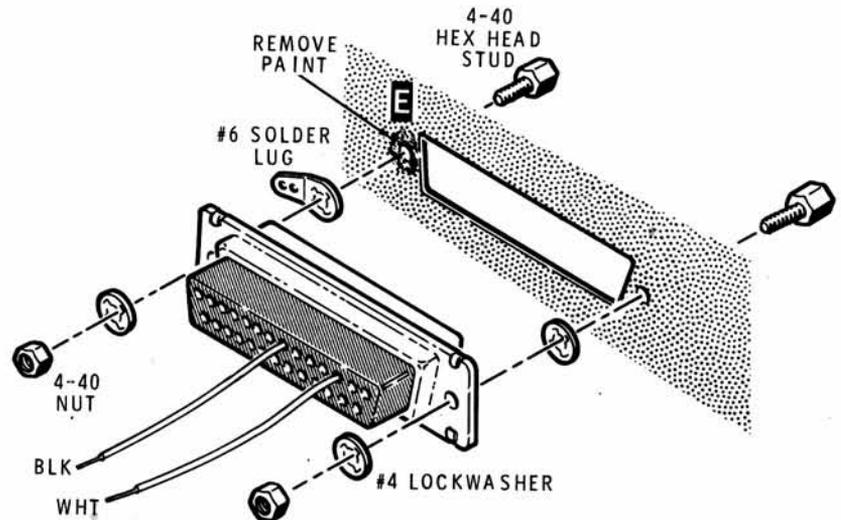
- () Scrape (with a knife) or sand off the paint at holes E and F from the inside of the cabinet bottom.



Detail 3-1C



Detail 3-1D



Detail 3-1E

- () Refer to Detail 3-1D and install a #6 solder lug at hole F with a 6-32 × 1/4" screw and a 6-32 nut.
- () Solder the green line cord wire to the solder lug at location F. Make a mechanically secure connection.
- () Position the free line cord wires around the outside of the circuit board spacers at locations C and A.
- () Lay the circuit board in the cabinet bottom. Now solder the ribbed line cord wire into hole AC(-) and the smooth line cord wire into hole AC(+) in the circuit board.
- () Secure the 25-hole socket at location J1 in the cabinet bottom with a 4-40 hex stud, a #6 solder lug, a #4 lockwasher, and a 4-40 nut at hole E. Use a 4-40 hex stud, two #4 lockwashers, and a 4-40 nut at the other socket hole. Be sure you position the socket so the black and white wires are located as shown.
- () C16: Solder one lead of a .005 μF ceramic capacitor into hole A of the circuit board, and solder the other lead to the solder lug at location E on the cabinet bottom. Position the leads away from the chassis.
- () Push the circuit board down onto the circuit board spacers until they snap into place in the circuit board holes.
- () Be sure the long and short leads of the LED at location V1 are positioned as shown in Pictorial 3-1. Position the slots in the 2-hole socket up and push the socket all the way onto the leads of the LED. Then bend the LED leads around and against the sides of the 2-hole socket. These leads must not touch each other. The leads will hold the socket in place on the LED leads.
- () Locate the "Caution" label and write ".125 (1/8) AMP. Regular Fuse" on it. Remove the protective backing and press the label into place at the indicated location inside the cabinet bottom.

This completes the wiring of the kit. Proceed to the "Initial Test" section on the next Page.

INITIAL TEST

If you do not obtain the specified results as you make the following tests, proceed to the "In Case of Difficulty" section of the Manual and correct the problem before you proceed.

If you have or can obtain a volt-ohmmeter (VOM), perform the following resistance and voltage checks. If you do not have a meter, make another good visual check of all the wiring to be sure all the parts are installed correctly, that all connections are soldered, and that there are no short circuits (solder bridges between the circuit board foils or leads of different components touching each other). Then proceed to the "Calibration" section of the Manual (Page 24).

RESISTANCE CHECKS

NOTE: The polarity of ohmmeters differ. Therefore, if you do not obtain the correct response in a test, reverse the leads (connect the negative lead where the positive lead was etc.) and try again. If you obtain the correct reading now, everything is all right.

Furthermore, different meters use different voltages to test resistance. This may affect resistance readings when diodes are involved. Your reading in some of the next steps may be much greater than the minimum value listed; this is perfectly acceptable.

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

- () Set the ohmmeter to its $R \times 1M$ range.
- () Connect the meter's negative (-) test lead to the round prong of the Interface line cord plug.
- () Touch the positive (+) meter test lead first to one flat prong of the line cord plug, and then to the other flat prong of the line cord plug. In both instances, the indicator on the meter should rise (may move slowly, due to the charging of a capacitor) from a low value to some value near or greater than $1 M\Omega$.
- () Set the ohmmeter to its $R \times 100$ range.

- () Touch one meter lead to either flat prong of the line cord plug and touch the other meter lead to the other flat prong. The meter should indicate approximately 200 ohms.
- () Connect the negative (-) meter lead to the lead of capacitor C16 coming from hole A in the circuit board. Do not move this lead unless you are instructed to do so in a step.
- () Leave the meter set to its $R \times 100$ range.

In each of the following steps, touch the positive (+) meter lead to the indicated location; then compare your meter indication to the meter reading called for in the step. NOTE: In some checks, the meter indicator will rise slowly (a capacitor is charging) before it reaches the specified indication.

- () Positive (+) lead of capacitor C2. The meter should indicate greater than 5000 ohms.
- () Positive (+) lead of capacitor C5. The meter should indicate greater than 700 ohms.
- () Positive (+) lead of capacitor C6. The meter should indicate greater than 600 ohms.

This completes the "Resistance Checks."

VOLTAGE CHECKS

CAUTION: When you make voltage measurements or connect other test equipment to the circuit board in the Interface, you must operate the Interface from an isolation transformer. Otherwise, you may damage circuit components in the Interface.

WARNING: When the line cord of the Interface is connected to an AC voltage source (AC outlet or isolation transformer), AC line voltage is present at a number of locations on the circuit board. Avoid these areas, shown in Pictorial 4-1, so you do not get an electrical shock.

Refer to Pictorial 4-1 as you perform the following voltage checks.

- () Connect the negative (-) voltmeter lead (and leave it connected) to the lead of capacitor C16 that comes from hole A in the circuit board.

AC Voltage Checks

- () Set the voltmeter to a range that is above 120 VAC.
- () Plug the line cord into a 120 VAC outlet. NOTE: The Transmit LED (V1) will not light at this time.

In each of the following steps, touch the positive (+) meter lead to the indicated location; then compare your meter indication to the meter reading called out in the steps.

- () The bare end of the smooth AC line cord wire coming from the AC(+) hole on the circuit board. The meter should indicate the AC line voltage (approximately 120 VAC).
- () The indicated fuse (F1) clip (nearest diode D3). The meter should indicate the AC line voltage (approximately 120 VAC).

DC Voltage Checks

- () Set the voltmeter to a range that is 20 VDC or higher.

In each of the following steps, touch the positive (+) voltmeter lead to the indicated location; then compare your meter indication to the meter reading called out in the steps.

- () Positive (+) lead of capacitor C2. The meter should indicate approximately 13 VDC.

- () Positive (+) lead of capacitor C5. The meter should indicate approximately 5 VDC.
- () Positive (+) lead of capacitor C6. The meter should indicate approximately 17 VDC.
- () Pin 1 of U5. The meter should indicate approximately 13 VDC.
- () Pin 3 of U5. The meter should indicate approximately 5 VDC.
- () Pin 40 of U1. The meter should indicate approximately 5 VDC.
- () Pin 13 of U2. The meter should indicate approximately 5 VDC.
- () Pin 1 of U3. The meter should indicate approximately 6.5 VDC.
- () Pin 5 of U3. The meter should indicate approximately 2.2 VDC.
- () Pin 7 of U4. The meter should indicate approximately 5 VDC.
- () Pin 8 of U4. The meter should indicate approximately 5 VDC.
- () Collector lead of Q2. The meter should indicate approximately 17 VDC.

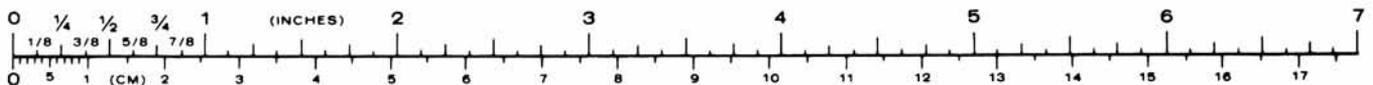
This completes the "Voltage Checks." Unplug the Interface from the AC outlet and disconnect the meter leads.

CALIBRATION

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

- () Set control R9 to the position shown in the Pictorial (pointing between 10:00 and 11:00 O'clock).
- () Refer to the following chart and install jumper wires into the wire connectors at locations W1, W2, or W3 on the circuit board to obtain the correct baud rate to match your computer system. Use 1-1/4" bare wires and bend them as shown on Pictorial 4-1.

BAUD RATE	WIRE JUMPER AT:		
	W1	W2	W3
110	YES	YES	YES
150	NO	YES	YES
300	YES	NO	YES
600	NO	NO	YES
1200	YES	YES	NO
2400	NO	YES	NO



NOTES:

1. The interface alignment adjustments are quite broad and the unit may not require the following alignment procedure except in the more demanding applications.
2. The following instructions are divided into two sections, "Alignment Verification Without Instruments" and "Alignment With Instruments." If you do not have an isolation transformer, oscilloscope, and frequency counter, perform the "Alignment Verification Without Instruments." If you do have these instruments, skip the "Alignment Verification Without Instruments" and perform the "Alignment With Instruments."
3. This Manual is only for the Interface, and cannot anticipate the programming and operation specifics of your computer system. We must rely on your ability to operate your system for the specific programming and output expertise.

For CP/M® (see footnote)

```

1Ø LPRINTΔ"A1"
2Ø FOR X=1ΔTOΔ1ØØØ:NEXT X
3Ø LPRINTΔ"AON"
4Ø END

```

- () The LED at V1 on the Interface should light briefly (about 1/2 second) to indicate that the unit has transmitted the "turn on" code to module one, house code "A." If the LED does not light, verify that your computer is providing the proper signal to the Interface, then use the "In Case Of Difficulty" section to troubleshoot the Interface. If you cannot find any obvious problems, you will need to troubleshoot the system using test instruments.

This completes "Calibration." Proceed to the "Final Assembly" section of the Manual.

ALIGNMENT VERIFICATION WITHOUT INSTRUMENTS

- () Connect the RS-232 accessory cable between connector J1 on the Interface and your computer or terminal.
- () Connect the line plug of the Interface to an AC outlet.
- () Set the driver to the same baud rate you selected on Page 24.
- () Generate and run the following MBASIC® language program that corresponds to your operating system. The program assumes that you are using an alternate terminal device driver (AT.DVD) that has been loaded prior to loading MBASIC.

For HDOS®

```

1Ø OPEN "0",1,"AT:"
2Ø PRINT #1,"A1"
3Ø CLOSE #1
4Ø FOR I=1 TO 1ØØØ:NEXT I:REM PAUSE BETWEEN COMMAND WORDS
5Ø OPEN "0",1,"AT:"
6Ø PRINT #1,"AON"
7Ø CLOSE #1
8Ø END

```

FOOTNOTE: The special sign (Δ) is used in the CP/M program to signify that a space is required wherever the Δ is found.

ALIGNMENT WITH INSTRUMENTS

- () Connect the frequency counter signal lead to pin 8 of IC U2, and the ground lead to the lead of capacitor C16 coming from hole A in the circuit board.
- () Plug the line plug of the Interface into the isolation transformer. Then connect the isolation transformer to an AC outlet.
- () Turn on the test equipment.
- () Adjust control R9 on the circuit board for a frequency of 120 kHz.
- () Turn off the isolation transformer and frequency counter, and disconnect them from the Interface.
- () Connect the oscilloscope signal lead to the indicated lead of capacitor C13 on the circuit board. Be sure you do not short the capacitor lead to the board foil with the oscilloscope lead. Connect the oscilloscope ground lead to the lead of capacitor C16 that comes from circuit board hole A.
- () Connect an RS-232 accessory cable between connector J1 on the Interface and your computer or terminal.
- () Connect the line cord of the Interface to an AC outlet.

- () Generate and run an MBASIC program like the following:

For HDOS

```

1Ø OPEN "0",#1,"AT:"
2Ø PRINT #1 "A1"
3Ø CLOSE #1
4Ø FOR X=1 TO 1ØØØ:NEXT X
5Ø GOTO 1Ø

```

For CP/M (see footnote)

```

1Ø LPRINTΔ"A1"
2Ø FOR X=1 TO 1ØØØ:NEXT X
3Ø GOTO 1Ø

```

The LED at V1 on the Interface should flash to indicate that the unit is transmitting.

- () Adjust transformer T2 to give the maximum output indication on the oscilloscope while the LED is lit.
- () Disconnect the oscilloscope and the Interface. This completes the "Calibration."

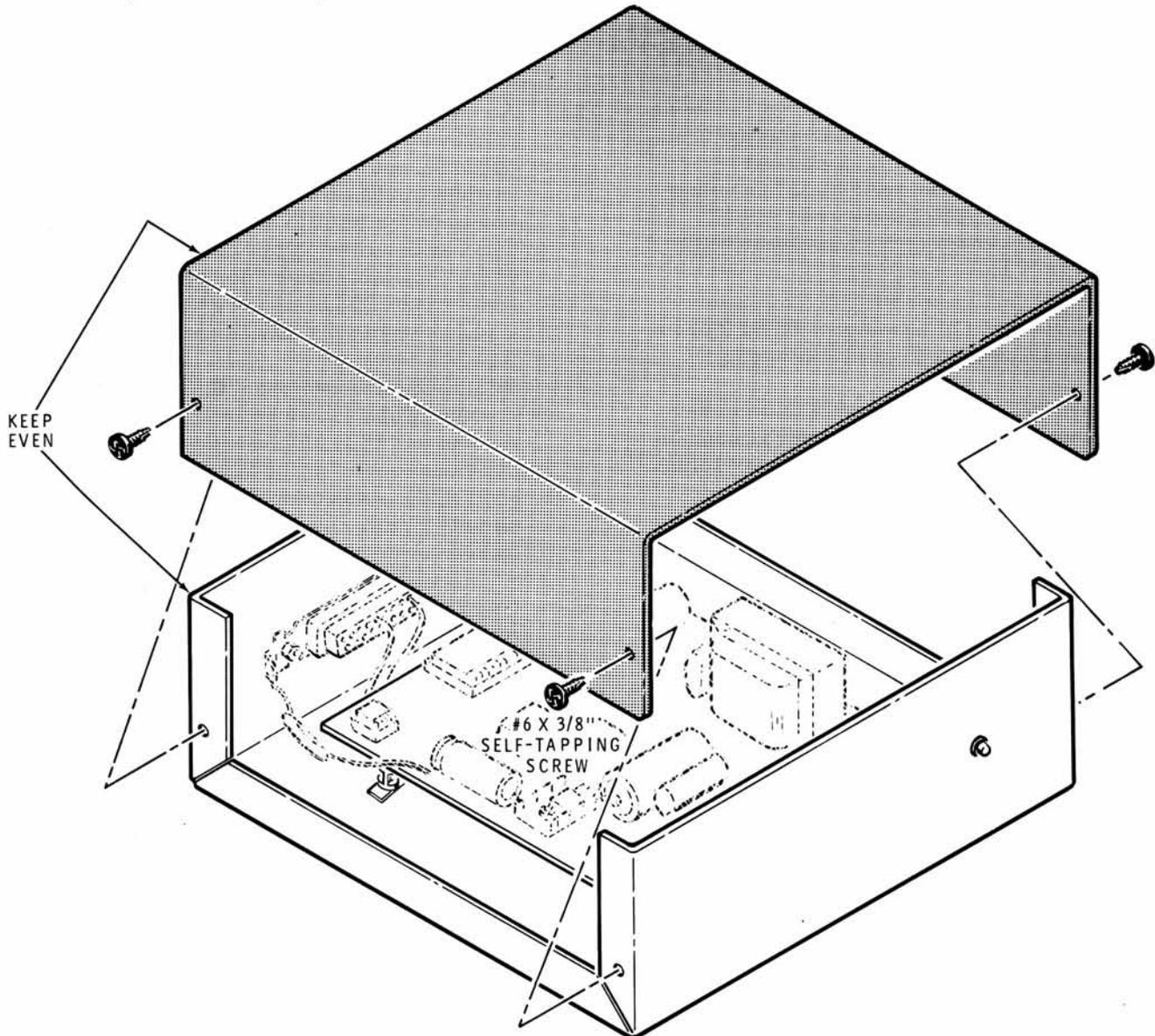
FOOTNOTE: The special sign (Δ) is used in the CP/M program to signify that a space is required wherever the Δ is found.

FINAL ASSEMBLY

Refer to Pictorial 5-1 for the following steps.

- () Position the cabinet top onto the cabinet bottom. When their holes are aligned, their rear edges should be even with each other.
- () Secure the cabinet top to the cabinet bottom with four #6 × 3/8" self-tapping screws.

This completes the assembly of the kit.



PICTORIAL 5-1

OPERATION

- () Program your BSR X-10 modules.
- () Connect an RS-232C accessory cable (not supplied) from the DTE connector on your Interface to the DCE connector on your computer or terminal.
- () Plug the line cord of the Interface into an AC outlet.
- () Write your desired program to control your BSR X-10 System. See the sample programs in the Appendix on Page 37.

This completes the "Operation" section of the Manual.

IN CASE OF DIFFICULTY

CAUTION: When the line cord is connected to an AC outlet, AC voltage will be present at several places on the chassis. Do not contact this voltage or you will receive an electrical shock.

This section gives you some suggestions for locating and resolving difficulties.

The first part, "Visual Checks," deals with problems that exist when you have just completed the assembly of your kit. This information primarily covers soldering and assembly problems.

The second part consists of a "Troubleshooting Chart," which gives difficulties and likely causes.

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

VISUAL CHECKS

1. Recheck the wiring. Trace each lead in color pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something you have consistently overlooked.
2. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by a careful inspection of connections to make sure they are soldered as described in the "Soldering" section of the "Assembly Notes." Reheat any doubtful connections. Be sure all the wires are soldered at places where several wires are connected.
3. Be sure the transistors and the integrated circuit are in the proper locations (correct part number and type number). Be sure that each transistor lead is in the right hole and has a good solder connection. Check the integrated circuit for proper positioning and for good contact at each pin connection.
4. Check capacitor values carefully. Be sure the proper part is wired into the circuit at each capacitor location. Check each electrolytic capacitor to be sure the lead near the positive (+) marking is at the correct position.
5. Check each resistor value carefully.
6. Be sure the correct diode is installed and that the banded end is positioned correctly.
7. Check all component leads connected to the circuit board.
8. Make sure bare wires do not touch the chassis or other lugs and make sure all wires are properly soldered.

Troubleshooting Chart

This chart lists the condition and possible causes of several malfunctions. If a particular part is mentioned (capacitor C6 for example) as a possible cause, check that part to see if it was installed correctly. Also check

it and the parts connected to it for poor connections. It is also possible, on rare occasions, for a part to be faulty and require replacement.

PROBLEM	POSSIBLE CAUSE
<p>A. Very low or "0" resistance indication between the round prong and either flat prong of the line cord plug.</p>	<ol style="list-style-type: none"> 1. Circuit board foil shorted to the cabinet. 2. Lead from capacitor C16 to circuit board hole A also touching cabinet. 3. Smooth or ribbed wire touching green wire of line cord. 4. Transformer T1.
<p>B. Very high or infinite resistance indication between flat prongs of line cord plug.</p>	<ol style="list-style-type: none"> 1. Bad solder connection at circuit board hole AC(+) or AC(-). 2. Fuse F1 open. 3. Poor solder connections at transformer T1 pins. 4. Transformer T1.
<p>C. Very low (below about 200) or "0" resistance indication between flat prongs of line cord plug.</p>	<ol style="list-style-type: none"> 1. Short circuit between AC(+) and AC(-) circuit board foils. 2. Transformer T1.
<p>D. Resistance at positive (+) lead of capacitor C2 considerably lower than infinity.</p>	<ol style="list-style-type: none"> 1. Capacitor C2. 2. Diodes D1-D4. 3. IC's U3 and U5.
<p>E. Resistance at positive (+) lead of capacitor C5 considerably lower or higher than 900 Ω.</p>	<ol style="list-style-type: none"> 1. Capacitor C5. 2. Diode D6. 3. IC U5. 4. All components connected to the 5 volt circuit board foils. See the Schematic Diagram in the Illustration Booklet, Page 5.
<p>F. Resistance at positive (+) lead of capacitor C6 considerably lower or higher than 800 Ω.</p>	<ol style="list-style-type: none"> 1. Capacitor C6. 2. Diode D11. 3. Transformer T2 (pins 1 and 2). 4. Transistor Q2.
<p>G. No AC line voltage (120 VAC) at the AC(+) hole in the circuit board.</p>	<ol style="list-style-type: none"> 1. No line voltage at the AC outlet where the Interface is connected. 2. Poor solder connection at AC(+) or AC(-) circuit board holes.
<p>H. No AC line voltage (120 VAC) at the fuse (F1) clip nearest diode D3.</p>	<ol style="list-style-type: none"> 1. Fuse F1 blown (check D1-D6 and U5 for cause). 2. Diodes D1-D6. 3. IC U5.

(Cont'd)

Troubleshooting Chart (Cont'd)

PROBLEM	POSSIBLE CAUSE
I. Voltage at positive (+) lead of capacitor C2 below 15 VDC.	1. See D.
J. Voltage at positive (+) lead of capacitor C5 not 5 VDC.	1. See E.
K. Voltage at the positive (+) lead of capacitor C6 lower than 17 VDC.	1. See F.
L. Pin 40 of U2 not 5 VDC.	1. See E.
M. Pin 13 of U2 not 5 VDC.	1. See E.
N. Pin 1 of U3 not 6.5 VDC.	1. See D. 2. R7.
O. Pin 5 of U3 not 2.2 VDC.	1. See E. 2. R4 or R5.
P. Pin 7 of U4 not 5 VDC.	1. See E.
Q. Pin 8 of U4 not 5 VDC.	1. See E.
R. Pin 1 of U5 not 15 VDC.	1. See D.
S. Pin 3 of U5 not 5 VDC.	1. See E.
T. Collector lead of Q2 not 17 VDC.	1. See F.
U. LED V1 does not light.	1. V1 (wrong polarity or damaged). 2. No RS232 input at J1, pins 3 & 7. (Verify by connecting a printer where the Interface is.) 3. Computer baud rate wrong. 4. Data input not reaching U1, pin 1.
V. LED V1 lights, but modules do not respond.	1. Module plugged into different house circuit from Interface; plug module into same outlet to test. 2. Command programming wrong; you must send two "words." The first word addresses the module, the second tells it what to do.
W. LED V1 turns on at right time, but does not turn off.	1. D5. 2. U1. 3. U2.

SPECIFICATIONS

Line Carrier Frequency	120 kHz.
Baud Rates	110, 150, 300, 600, 1200, and 2400.
Input Interconnect	DCE connector for connection with RS-232C cable (not supplied).
Input Format	RS232 asynchronous signal, no parity, 1 stop bit, ASCII coded format.
Output	Standard BSR X-10 compatible line carrier output.
Output Connection	AC line receptacle.
Power Requirements	120 VAC, 60 Hz; 3 watts.
Dimensions	3" high × 6-3/8" wide × 6-3/8" deep. (7.6 × 16.2 × 16.2 cm).
Weight	1 pound, 11 ounces (0.77 kg).

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

CIRCUIT DESCRIPTION

The Heathkit RS232/BSR Interface is an intelligent command unit that is connected between your computer and your BSR X-10 Modules. As you run your program on your computer, its RS-232C serial interface output is coupled to the input of the GD-1530 Interface, where these ASCII signals are converted to BSR X-10 format carrier current signals. These signals are then transmitted through the AC line to the BSR X-10 system modules.

POWER SUPPLY

Transformer T1 in the Interface steps the standard AC line voltage down to approximately 10 volts. Diodes D1 through D4 form a full-wave bridge rectifier that converts this AC voltage to about 13 volts DC. Capacitor C2 provides additional filtering to reduce ripple. C3 functions as a high frequency bypass. This results in a fairly clean 13 VDC source for IC's U5 and U3.

U5 is a 5-volt regulator device that provides a steady 5 VDC source voltage for IC's U1 through U4. Added filtering is provided by capacitors C4, C5, C10, and C15.

The circuit consisting of C1, R1, L1, D7, and D8 taps off some of the voltage from the AC line, through fuse F1 and converts it to DC. This voltage is regulated by zener diode D11 and filtered by C6 to provide an 17 VDC supply voltage for the operation of output stages Q1 and Q2.

DATA INPUT

The computer signal in serial RS-232C format is fed to the Interface through socket J1, R11, and D9 to the input of U4. U4 is an optical isolator that couples the signal from the computer to the Interface, but isolates the units from each other. The electrical data signal from the computer causes the LED connected between pins 1 and 2 of U4 to flash on and off. A diode photo detector, also in U4, sees these light flashes and converts them back to electrical signals. These signals are amplified by the transistor in U4 and fed to the input (pin 1) of central processor U1.

CENTRAL PROCESSOR

When the power cord is plugged in, capacitor C7 initially holds the RESET line (U1 pin 4) low to reset U1. Then C7 builds up a charge, removing the reset signal and allowing U1 to react to incoming commands.

Crystal Y1, along with capacitors C8 and C9, stabilize the 6 MHz clock in U1. Jumper wires at W1 through W3 determine the operating baud rate of 110, 150, 300, 600, 1200, or 2400.

U2A, along with D5 and D6, detects the zero crossings of the input (line) voltage and notifies U1 (pin 24) at each zero. U1 can then send the commands (pin 27) to the modules while the "line is clear."

The serial input pulses at pin 1 of U1 are converted to the BSR X-10 format and appear at output pin 27. U2B, an AND gate buffer, turns on and off at this output rate. The resulting pulsed output at pin 4 is fed directly to pin 9 of U2C.

Integrated circuit U3 and its associated circuitry form a 120 kHz oscillator. The exact frequency is determined by the setting of control R9. The oscillator output signal at pin 7 of U3 is connected directly to pin 8 of U2C.

The 120 kHz oscillator output signal at pin 10 of U2C is pulsed on and off at the BSR X-10 coded rate from U2B. This pulsed 120 kHz signal at the output (pin 10) of U2C is coupled through R12 to Q1 and then to Q2. These transistors amplify this signal and feed it to the primary winding of transformer T2.

OUTPUT

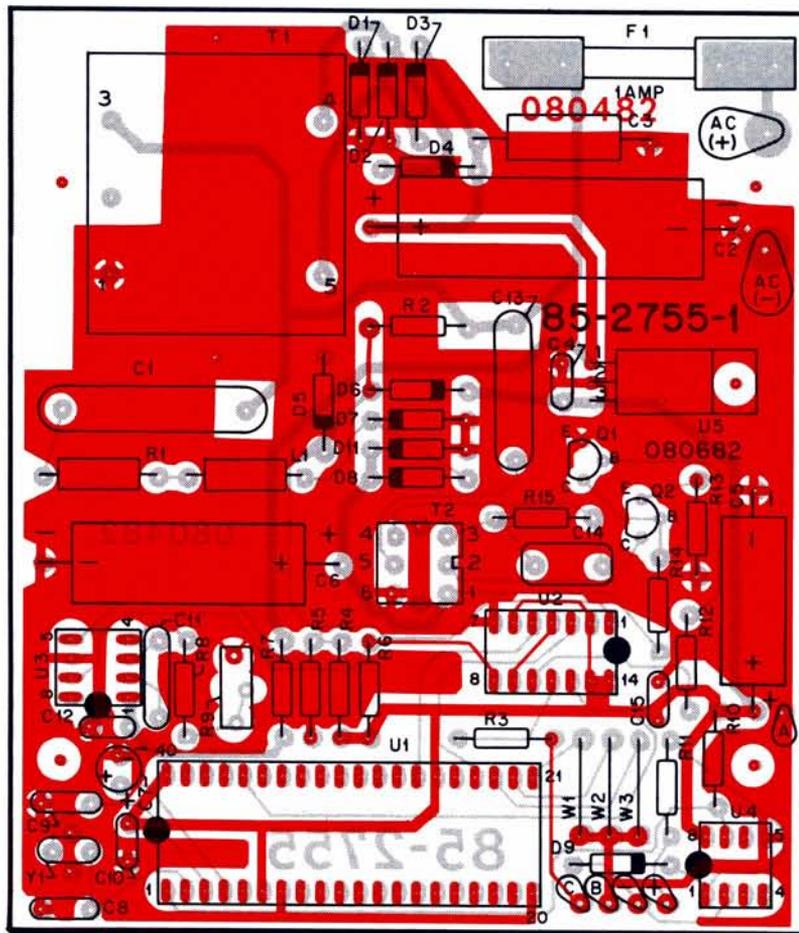
Modulation transformer T2 isolates transistors Q1 and Q2 from the AC line, but couples the coded pulsed 120 kHz signal from its secondary winding through C13 and F1 to the AC line through the line plug. The BSR X-10 modules, also connected to the AC line, decode these coded pulsed signals. When a Module receives its signal, it is activated and performs its function.

U2D turns on the Interface LED (V1) when processor U1 sends BSR X-10 compatible control pulses into the AC line cord.

CIRCUIT BOARD X-RAY VIEW

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

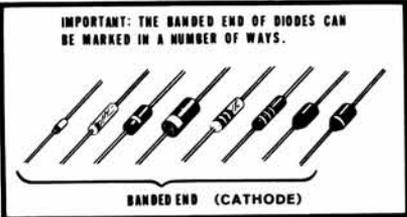
- A. Find the circuit component number (R5, C3, etc.) on the "Circuit Board X-Ray View."
- B. Locate this same number in the "Circuit Component Number" column of the "Parts List."
- C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



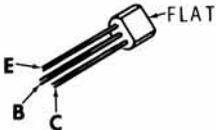
(Shown from the component side. The foil on the component side is shown in red.)

SEMICONDUCTOR IDENTIFICATION CHART

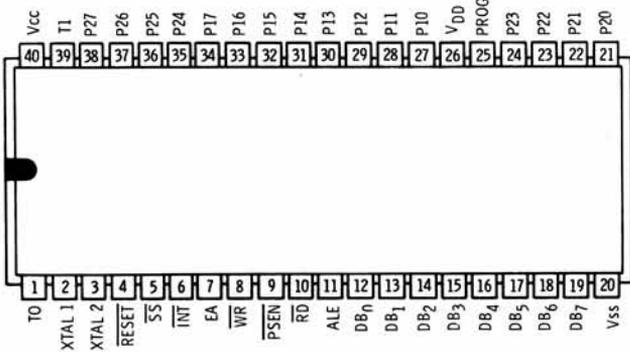
DIODES

COMPONENT NUMBER	HEATH PART NUMBER	TYPE NUMBER	DESCRIPTION
D1, D2, D3, D4, D7, D8	57-65	1N4002	
D5	56-26	1N149	
D6, D9	56-84	1N4148	
D11	56-605	1N4746	

TRANSISTORS

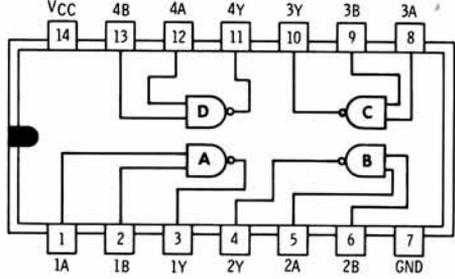
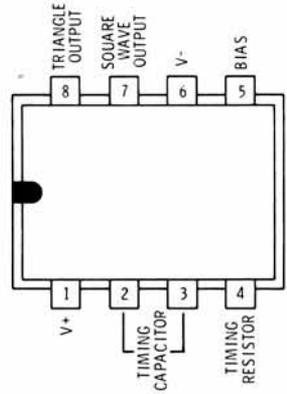
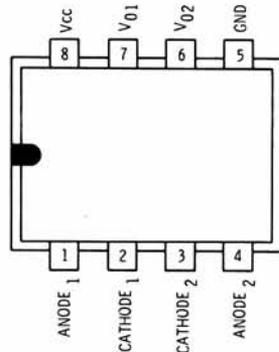
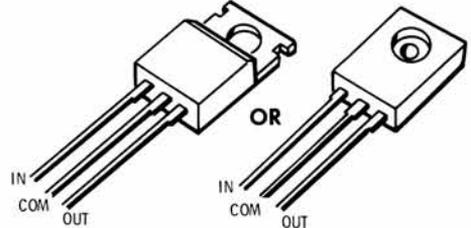
COMPONENT NUMBER	HEATH PART NUMBER	TYPE NUMBER	DESCRIPTION
Q1	417-875	2N3904	
Q2	417-811	MPSL01	

INTEGRATED CIRCUITS

COMPONENT NUMBER	HEATH PART NUMBER	TYPE NUMBER	DESCRIPTION
U1	444-205-1	Available only from Heath Co.	

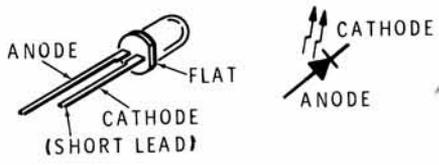
(Cont'd)

Integrated Circuits (Cont'd)

COMPONENT NUMBER	HEATH PART NUMBER	TYPE NUMBER	DESCRIPTION
U2	443-603	4011	
U3	442-741	2209	
U4	443-1109	2531	
U5	442-54	UA7805	

(Cont'd)

LIGHT EMITTING DIODE (LED)

COMPONENT NUMBER	HEATH PART NUMBER	TYPE NUMBER	DESCRIPTION
V1	412-640	LST5053	 <p>The diagram shows two representations of the LED. On the left is a perspective view of the component with labels: 'ANODE' pointing to the longer lead, 'FLAT' pointing to the flat surface on the top of the component, and 'CATHODE (SHORT LEAD)' pointing to the shorter lead. On the right is a schematic symbol for an LED, consisting of a triangle pointing to the right with two vertical lines of unequal height extending upwards from its top vertex. The label 'CATHODE' is placed above the symbol and 'ANODE' is placed below it.</p>

APPENDIX

PROGRAMMING COMMAND SYNTAX

The command syntax for program control with the Interface is defined by the BSR format as shown below. **Normally, two commands are required to implement a complete control action.**

[House Code] [Command Word 1] [RETURN]

[House Code] [Command Word 2] [RETURN]

For example:

A 1 [RETURN]

A ON [RETURN]

The **House Code** is any upper case ASCII character between A and P. It specifies which group of modules is selected.

The **Command Word #1** is the unit code number (1 — 16), or the special commands "A" and "C." Note that "A" and "C" do not require the second command word, since they constitute a complete command.

A = All on (turns on all light control modules, but not appliances)

C = Clear (turns all modules off)

Command Word #2 tells the selected unit what to do. One or two letters are required as shown below. Additional letters, shown inside the parentheses, are acceptable but are not required.

B(R) = Bright. If a bulb is on, brightens it one step*; if the bulb is off, turns it on full.

D(IM) = Dim. If a bulb is on, dims the bulb one step*; if the bulb is off, turns it on full.

ON = On. Turns the specified unit on full.

OF(F) = Off. Turns the specified unit off.

NOTE: You cannot send a new command to the Interface while the Transmit LED is lit (about one-half second).

*The BSR 1-ampere dimming wall and lamp modules have 16 levels between full on and full off.

PROGRAM EXAMPLES

For an example, suppose you wanted to turn on a light (at house code "A", unit number 3), then dim the light ten steps, and finally turn it off. These are the necessary commands:

[A][3][RETURN]	[A][ON][RETURN]	Selects the unit and turns it on.
[A][3][RETURN]**[A][D]		Dims the unit one step; you will need to generate nine more "dim" commands to reach the desired level. For your own software, you will want to be able to type in the level of light that you wish and have the computer send the right number of "dim" or "bright" commands.
repeat		
nine		
more		
times		
[A][3][RETURN]**[A][OF]		Turns the unit off. You could also use "[C]" by itself, to turn everything off.

The following is a simple program to accept commands from the keyboard and send them to the Interface. This program repeats without changing the house code, which is entered only once, in line 10. The program runs on HDOS MBASIC and uses the LPH14.DVD driver, renamed LP.DVD. NOTE: You must set the baud rate of the LP.DVD driver to the same rate you programmed your GD-1530.

10	LINE INPUT"ENTER HOUSE CODE : ";H\$	Get house code
20	OPEN"0",1,"LP:"	Open RS-232 output channel
30	LINE INPUT"ENTER COMMAND : "A\$	Get control command
40	PRINT #1,H\$;A\$	Send command string to buffer
50	CLOSE #1	Clear buffer (send)
60	GOTO 20	Go back for another

Below is an example with the operator using the program to turn on module A1. The operator's responses are in bold type.

```
ENTER HOUSE CODE : A[RETURN]
ENTER COMMAND   : 1[RETURN]
ENTER COMMAND   : ON[RETURN]
```

The program will continue to prompt for COMMAND input.

** The first command word is optional if you have previously selected the desired unit, and have not altered the selection by sending another code, on a "C" or an "A" command.

The next program adds the ability to check the input for errors.

For HDOS

```

10 GOSUB 210:REM GET HOUSE CODE
20 OPEN "O",1,"AT:"
30 PRINT:LINE INPUT"ENTER COMMAND: ";A$
40 IF LEFT$(A$,1)="N" OR LEFT$(A$,1)="n" THEN GOSUB 210:GOTO 30
50 IF LEFT$(A$,1)="Q" OR LEFT$(A$,1)="q" THEN END
60 IF VAL(A$)>0 AND VAL(A$)<17 THEN GOTO 160
70 IF LEFT$(A$,1)="C" OR LEFT$(A$,1)="c" THEN A$="C":GOTO 160
80 IF LEFT$(A$,1)="A" OR LEFT$(A$,1)="a" THEN A$="A":GOTO 160
90 IF LEFT$(A$,1)="D" OR LEFT$(A$,1)="d" THEN A$="D":GOTO 160
100 IF LEFT$(A$,1)="B" OR LEFT$(A$,1)="b" THEN A$="B":GOTO 160
110 IF LEFT$(A$,1)="O" OR LEFT$(A$,1)="o" GOTO 130
120 GOTO 150
130 IF MID$(A$,2,1)="N" OR MID$(A$,2,1)="n" THEN A$="ON":GOTO 160
140 IF MID$(A$,2,1)="F" OR MID$(A$,2,1)="f" THEN A$="OF":GOTO 160
150 PRINT:PRINT CHR$(7);"INPUT ERROR":GOTO 30
160 PRINT "SENDING ";H$;" ";A$
170 PRINT#1,H$;A$
180 CLOSE#1
190 FOR I=1 TO 200:NEXT
200 GOTO 20
210 PRINT:LINE INPUT "ENTER NEW HOUSE CODE : ";H$:IF H$="" THEN 210
220 IF ASC(H$)<65 THEN 210
230 IF ASC(H$)<81 THEN RETURN
240 IF ASC(H$)<97 THEN 210
250 IF ASC(H$)>112 THEN 210
260 H$=CHR$(ASC(H$)-32):RETURN

```

This last program is expanded further, and uses H-19/H-89 graphics for a more impressive display. Note the special symbol (Δ), which is used to represent a space. Since spaces are critical to proper appearance of the graphics, all spaces in this program are represented using this symbol.

For CP/M

```

10 $\Delta$ REMA $\Delta\Delta\Delta\Delta\Delta$ *****
20 $\Delta$ REMA $\Delta\Delta\Delta\Delta\Delta$ * $\Delta$ HEATH $\Delta\Delta$ BSRAX-10 $\Delta\Delta$ SYSTEM $\Delta$ CONTROLLER $\Delta$ *
30 $\Delta$ REMA $\Delta\Delta\Delta\Delta\Delta$ * $\Delta$ VERSION $\Delta\Delta\Delta$ 1.2. $\Delta\Delta$ (01-DEC-82) $\Delta$ <JWF> $\Delta$ *
40 $\Delta$ REMA $\Delta\Delta\Delta\Delta\Delta$ * $\Delta$ COPYRIGHT $\Delta$ (C) $\Delta$ 1983 $\Delta\Delta$ HEATH $\Delta\Delta$ COMPANY $\Delta$ *
50 $\Delta$ REMA $\Delta\Delta\Delta\Delta\Delta$ *****
60 $\Delta$ REM
70 $\Delta$ CLEAR:ESC$=CHR$(27):HOME$=ESC$+"H":CR$=ESC$+"y5":WIDTH $\Delta$ 255:VERS$="1.2"
80 $\Delta$ REVV$=ESC$+"p":NOMV$=ESC$+"q":BK$=CHR$(8):ERA$=ESC$+"E":BEL$=CHR$(7)
90 $\Delta$ GRF$=ESC$+"F":CHAR$=ESC$+"G":TAB$=CHR$(9):CO$=ESC$+"x5":H$="A"

```

```

100PRINTAERA$;:GOTO220
110AREMΔBLANKΔLINEAROUTINE
120PRINTATAB$;REVV$;"AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA";
130PRINTA"AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA";NOMV$:RETURN
140AREMΔINPUTΔHOUSEΔCODEΔSECTION
150PRINTATAB$;"InputΔHouseΔCodeΔ(useΔlettersΔAΔthruΔP)"
160AA$=INPUT$(1):IFAASC(A$)>64ΔANDΔASC(A$)<81ΔTHENΔH$=A$:GOTO210
170ΔIFΔASC(A$)>96ΔANDΔASC(A$)<113ΔTHENΔH$=CHR$(ASC(A$)-32):GOTO210
180ΔIFΔA$=ESC$ΔTHENΔGOTO2210
190PRINTABEL$;ESC$+"A";TAB$;"InputΔError.";BEL$;"AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA"
200ΔFORΔX=1ΔTOΔ750:NEXTΔX:PRINTABEL$;ESC$+"A";ESC$+"J";:GOTO150
210PRINTΔESC$+"A";ESC$+"J";:RETURN
220AREMΔMAINΔMENUΔSECTION
230PRINTΔHOMES$;:PRINT:PRINT:GOSUB110
240PRINTATAB$;REVV$;"ΔΔΔΔΔHeath/BSRΔController/ComputerΔInterfaceΔProgram";
250PRINTA"ΔΔΔΔΔ";NOMV$:GOSUB110:PRINT:PRINT:GOSUB110
260PRINTATAB$;REVV$;"ΔΔΔΔVersionΔ";VER$;"ΔΔΔΔΔ";NOMV$;"ΔCΔOΔMΔMΔAΔAΔNΔAΔSΔ";
270PRINTΔREVV$;"ΔΔΔΔΔHouseΔcodeΔ=Δ";H$;"ΔΔ";NOMV$:GOSUB110
280PRINTATAB$;REVV$;
290PRINTA"ΔΔΔΔCΔ=ΔClearΔΔΔΔΔAΔ=ΔAllΔOnΔΔΔΔΔOΔ=ΔOnΔΔΔΔΔFΔ=ΔOffΔΔΔΔ";NOMV$
300PRINTATAB$;REVV$;"ΔΔΔΔBΔ=ΔBrightΔΔΔΔΔDΔ=ΔDimΔΔΔΔΔEΔ=ΔEndΔΔΔΔ";
310PRINTA"ΔΔHΔ=ΔHouseΔΔ";NOMV$
320PRINTATAB$;REVV$;"ΔΔΔΔTΔ=ΔTestΔAllΔΔΔRΔ=ΔRestartΔΔΔΔΔ01-16,ΔunitsΔ";
330PRINTA"ZΔ=ΔHelpΔΔΔ";NOMV$:GOSUB110:PRINTΔCO$;
340AA$=INPUT$(1)
350ΔIFΔA$="C"ΔORΔA$="c"ΔTHENΔA$="C":GOSUB520:GOTO340
360ΔIFΔA$="A"ΔORΔA$="a"ΔTHENΔA$="A":GOSUB520:GOTO340
370ΔIFΔA$="E"ΔORΔA$="e"ΔORΔA$=ESC$ΔTHENΔPRINTAERA$;CR$;NOMV$;:END
380ΔIFΔA$="H"ΔORΔA$="h"ΔTHENΔGOSUB140:GOTO230
390ΔIFΔA$="R"ΔORΔA$="r"ΔTHENΔGOTO10
400ΔIFΔA$="Z"ΔORΔA$="z"ΔTHENΔGOSUB550:GOTO100
410ΔIFΔA$="O"ΔORΔA$="o"ΔTHENΔA$="ON":GOSUB520:GOTO340
420ΔIFΔA$="F"ΔORΔA$="f"ΔTHENΔA$="OFF":GOSUB520:GOTO340
430ΔIFΔA$="D"ΔORΔA$="d"ΔTHENΔA$="D":GOSUB520:GOTO340
440ΔIFΔA$="B"ΔORΔA$="b"ΔTHENΔA$="B":GOSUB520:GOTO340
450ΔIFΔA$="T"ΔORΔA$="t"ΔTHENΔA$="A":GOSUB520:A$="C":GOSUB520:GOTO340
460ΔIFΔA$="O"ΔTHENΔGOTOΔ480
470ΔIFΔAVAL(A$)=1ΔTHENΔGOTOΔ490ΔELSEΔGOTOΔ500
480AA$=INPUT$(1):IFAVAL(A$)>.5ΔANDΔAVAL(A$)<10ΔTHENΔGOSUB520:GOTO340ΔELSEΔ500
490AA$=A$+INPUT$(1):IFAVAL(A$)>9ΔANDΔAVAL(A$)<17ΔTHENΔGOSUB520:GOTO340
500PRINTATAB$;"InputΔError.";BEL$:FORΔX=1ΔTOΔ100:NEXTΔX
510PRINTABEL$;:FORΔX=1ΔTOΔ200:NEXTΔX:PRINTΔESC$+"A";ESC$+"J";:GOTO340
520AREMΔMOVEΔTOΔDEVICEΔDRIVER
530ΔFORΔX=1ΔTOΔ250:NEXTΔX
540ΔLPRINTΔH$;A$+CHR$(13):PRINTABEL$;:RETURN
550AREMΔHELPΔSECTION

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560PRINTAERA$;
570PRINTATAB$;TAB$;"HELPALISTAFORATHEABSRACONTROLLERASYSTEM":PRINT
580PRINTATAB$;"COMMANDLETTERAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAACOMMANDAFUNCTION"
590PRINTATAB$;GRF$;"aaaaaaaaaaaaaaaaAAAAAAAAAAAAAAAA";
600PRINTA"aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa";CHAR$
610PRINTATAB$;"AA-Δ(AllΔon)AAAAAAAAAAAAAAAATurnsΔonΔallΔlightΔunits."
620PRINTATAB$;"CΔ-Δ(Clear)AAAAAAAAAAAAAAAAMasterΔClear,ΔallΔunits."
630PRINTATAB$;"HA-Δ(HouseΔCode)AAAAAAAAAllowsΔyouΔtoΔenterΔaΔdifferent"
640PRINTATAB(35);"houseΔcode.ΔΔPresentΔtheΔhouseΔcodeΔis"
650PRINTATAB(35);"displayedΔinΔupperΔrightΔofΔscreen."
660PRINTATAB$;"OΔ-Δ(On)AAAAAAAAAAAAAAAATurnsΔonΔtheΔselectedΔunit(s)Δonly."
670PRINTATAB$;"FΔ-Δ(Off)AAAAAAAAAAAAAAAATurnsΔoffΔselectedΔunit(s)Δonly."
680PRINTATAB$;"DΔ-Δ(Dim)AAAAAAAAAAAAAAAADimsΔselectedΔlight(s)Δonly."
690PRINTATAB$;"BΔ-Δ(Bright)AAAAAAAABrightensΔselectedΔlight(s)Δonly."
700PRINTATAB$;"TΔ-Δ(TestΔrun)AAAAAAAACausesΔallΔlightsΔtoΔbeΔturnedΔon"
710PRINTATAB(35);"andΔthenΔoffΔonce."
720PRINTATAB$;"EΔ-Δ(End)AAAAAAAAAAAAAAAAEndsΔProgramΔandΔclearsΔscreen."
730PRINTATAB$;"RΔ-Δ(Restart)AAAAAAAARestartsΔProgram."
740PRINTATAB$;"01ΔthruΔ16AAAAAAAANumbersΔΔ01ΔthruΔ16ΔselectΔunitΔto"
750PRINTATAB(35);"actedΔonΔbyΔsuchΔcommandsΔasΔB,0,D"
760PRINTATAB(35);"andΔF.ΔForΔnumbersΔbelowΔ10ΔaΔzero"
770PRINTATAB(35);"mustΔbeΔtypedΔinΔfirst."
780PRINTATAB$;"ZΔ-Δ(Help)AAAAAAAAPrintΔthisΔlist."
790PRINTATAB$;GRF$;"aaaaaaaaaaaaaaaaAAAAAAAAAAAAAAAA";
800PRINTA"aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa";CHAR$
810PRINTATAB$;TAB$;TAB$;TAB$;"ΔΔ";REVV$;
820PRINTA"ΔhitΔanyΔkeyΔtoΔReturnΔtoΔProgram.Δ";NOMV$;:A$=INPUT$(1):RETURN

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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



HEATH COMPANY • BENTON HARBOR, MICHIGAN
THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM