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INTELLIROTOR™

Model HD-1780

ASSEMBLY

595-4322

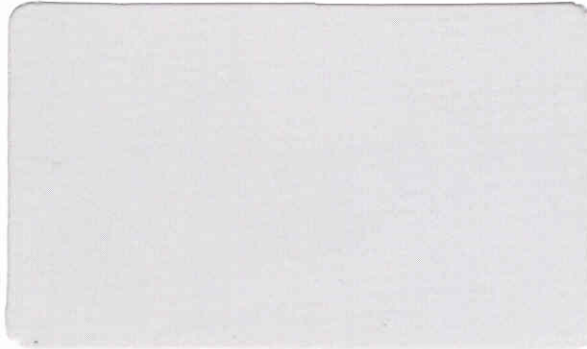
HEATH COMPANY PHONE DIRECTORY

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 4:30 P.M. Eastern Time, Weekdays Only)

Education Products 616-982-3980
Amateur Radio 616-982-3296
Test Equipment, Weather Instruments,
Clocks 616-982-3315
Television 616-982-3307
Home Products, Stereo, Security, Telephone,
Marine, Automotive 616-982-3496
Computer — Hardware 616-982-3309



YOUR HEATHKIT 1 YEAR 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 1 year 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 1 year from the date of purchase, any malfunction caused by defective parts or materials will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heath/Zenith Computers and Electronics 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 our 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 FORESEEABLE.

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.

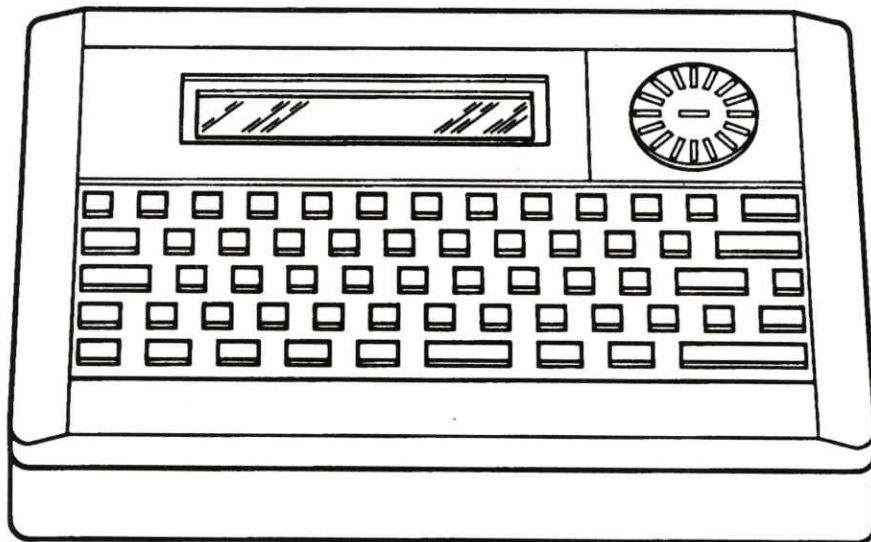
If you are not satisfied with our service (warranty or otherwise) or our products, write to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

INTELLIROTOR™

Model HD-1780

ASSEMBLY

595-4322



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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PHOTOPLANT

100-100-100

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INTRODUCTION

The Heath Model HD-1780 IntelliRotor™ allows you to quickly obtain short or long path bearing and distance to any location on the globe and, if you wish, aim your beam toward the corresponding direction in the shortest possible time.

You can rotate your beam manually, or you can enter any of the following to specify a desired location or heading:

- Country name (or the first few letters)
- Amateur radio prefix (or partial prefix)
- Coordinates (latitude and longitude)
- Grid square
- Bearing in degrees.

You can also make a selection from one of ten user-defined names.

The IntelliRotor displays the current date, day of week, local time or UTC (Universal Coordinated Time), and actual antenna bearing. Additional "windows" also display as much of the following information about the destination as may be determined from the entry:

- Time*
- Distance in miles or kilometers*
- Bearing*
- Latitude and longitude*
- Grid square*
- Country (state or province) name
- Prefix(es)
- User-defined name.

Although the internal database is permanent, you can edit it from the keyboard. Any changes made will remain in effect until you intentionally reset the unit.

You can optimize the IntelliRotor for your particular rotator/beam combination by pressing a few keys.

To help prevent jammed brake problems, the IntelliRotor first rotates your beam in a direction that is opposite to the selected direction. It then stops and rotates the beam in the proper direction until it reaches the bearing you desire. The beam rotation slows down prior to reaching the target bearing for better accuracy and to prevent damage near the ends of rotation.

A built-in serial interface allows you to remotely control the IntelliRotor from a terminal or computer. You can read the date, time, bearing, and select a new bearing through this interface. In addition, a List function allows you to print a listing, alphabetized by country name, of prefixes, latitudes and longitudes, grid squares, distances, bearings, and offsets from UTC. There is even a Dump function that allows you to make the edited database and setup entries permanent if you have access to an EPROM programmer.

For sight-impaired users, the current bearing may be annunciated in Morse Code.

Built-in diagnostics test the program ROM, database ROM, RAM, serial port, LCD, and LEDs.

These and other thoughtful features will make the IntelliRotor a favorite operating accessory for many years.

SPECIFICATIONS

Displays	40-character (2 line x 20) liquid crystal; 16-point LED compass rose with 32-point resolution.
Bearing Resolution	LED compass rose: 11.25 degrees. LCD: 1 degree.
Bearing Selection	Manual or by keyboard entry of: bearing, country name*, prefix*, grid square, latitude and longitude, or user-defined bearing.
Database	Over 400 entries in ROM. Data is copied to battery-backed RAM, where you can edit it.
Clock/Calendar	24-hour or 12-hour (AM/PM) time format, automatic leap year correction, and day of week.
Keyboard	61 keys, with audible and/or tactile feedback.
Calibration	Implemented in software; no adjustment is required. Accommodates rotators capable of greater than 360 degree rotation.
Serial Interface Baud Rates	300, 600, 1200, 2400, 4800, and 9600 baud.
Compatible Rotators	Hygain/Telex HAM-M (Series 3, 4, 5, & 6), HAM-II, HAM-III, HAM-IV, T2X, CDE TR-44, CD-45 (Series 2), M2, and HDR-300.
Beam Orientation	North- or south-centered.
Power Requirements	120/240 VAC, 50/60 Hz.

*You need to only enter enough characters to make the entry unique.

Dimensions

Controller 5-1/2" H x 7-3/4" W x 1-3/8" D (13.8 x 19.7 x 3.5 cm).
Power Unit 3-3/4" H x 8-5/8" W x 5-3/8" D (9.5 x 21.9 x 13.7 cm).

Weight

Controller 1-1/4 lbs. (570 g).
Power Unit 6-1/2 lbs. (3 kg).

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

UNPACKING INSTRUCTIONS

Do NOT unpack your kit until this Manual directs you to do so.

Locate the "Pack Index Sheet" that is packed inside the shipping carton. Note that the shipping carton is divided into six smaller sections. These sections make up Packs 1 through 3 and the Final Pack, which may be made up of several bags, envelopes, small boxes, and loose parts. Do not unpack any of these parts until a step specifically directs you to do so.

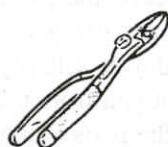
When you check parts against a "Parts List", return any part or group of parts packaged in a container, with the part number on it, back into its container after you identify it. Leave these parts there until you actually use them in a step. This will help prevent you from mixing up the parts, and help you identify the parts when you need them.

Save all of the packaging material until you account for all of the parts.

ASSEMBLY NOTES

TOOLS

You will need these tools to assemble your kit.

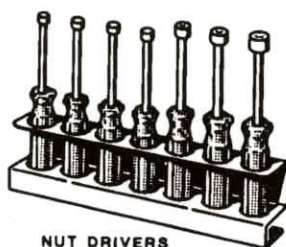


PLIERS

LONG-NOSED
PLIERSDIAGONAL
CUTTERSWIRE
STRIPPERSPHILLIPS
SCREWDRIVER

SCREWDRIVER

OTHER HELPFUL TOOLS

NUT STARTER
(MAY BE SUPPLIED
WITH KIT)DESOLDERING
BULBDESOLDERING
BRAID*

NUT DRIVERS

PENCIL
SOLDERING IRON
(22 to 25 WATTS)VOM, VTVM,
OR DMM

*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 to use 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 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, C2, 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.

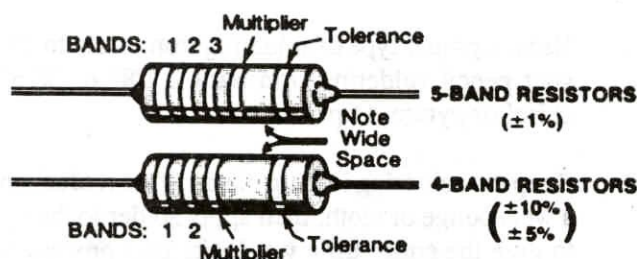
It is easy to make a good solder connection if you follow a few simple rules:

1. Use the proper 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 the 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 flux has been used.

RESISTORS

Resistors are identified in Parts Lists and steps by their resistance value in Ω (ohms), $k\Omega$ (kilohms), or $M\Omega$ (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 the last band, which indicates a resistor's "tolerance"; see the "Resistor Tolerance" chart). You do not need to memorize the color codes.



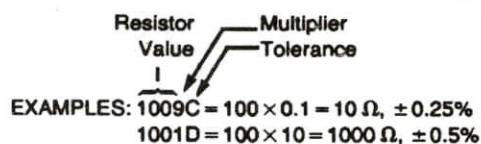
Occasionally, a "precision" or "power" resistor may have the value stamped on it. The letter R, K, or M may also be used at times to signify a decimal point, as in:

$$2R2 = 2.2 \Omega$$

$$2K2 = 2.2 k\Omega, \text{ or } 2200 \Omega$$

$$2M2 = 2.2 M\Omega$$

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.



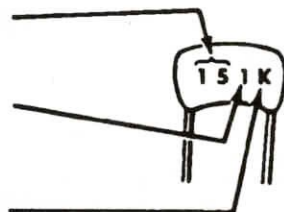
IDENTIFYING CAPACITORS

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:

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	10,000,000
Gray	8	8	8	100,000,000
White	9	9	9	—
Silver	—	—	—	.01
Gold	—	—	—	.1

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 CHART

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

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

POWER UNIT

PARTS LIST

Remove the parts from Pack #1 and check each part against the following list. The key numbers correspond to the numbers on the "Power Unit Parts Pictorial." Do not remove components that are supplied on a tape 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 it is called for in a step. 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.

A replacement part may look slightly different than the original part, or may have different printing on it. In any case, the performance of the replacement part will meet or exceed the requirements of the original part. For example: A 15-volt capacitor (10 μ F, 15V) may be replaced with a 25-volt capacitor (10 μ F, 25V).

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

ELECTRONIC COMPONENTS

A1	231-402	1	120-160 μ F, 125 VAC nonpolarized electrolytic capacitor	C502
A2	25-947	1	6800 μ F electrolytic capacitor	C501
A3	231-411	3	Relay	K501, K502, K503
A4	417-865	3	MPSA55 transistor	Q501, Q502, Q503
A5	421-27	1	1/16-ampere (62.5 mA) slow-blow fuse	F502 (for 220 VAC)
A5	421-26	1	1/8-ampere (125 mA) slow-blow fuse	F502 (for 120 VAC)
A5	421-23	1	1-ampere slow-blow fuse	F501 (for 220 VAC)

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

A5	421-3	1	2-ampere slow-blow fuse	F501 (for 120 VAC)
A6	54-1066	1	Logic power transformer	T501
A7	54-1067	1	Rotator power transformer	T1
A8	65-85	2	Circuit breaker with hardware	CB1, CB2

HARDWARE

B1	810-34	3	M3 x 6 mm self-tapping screw
B2	810-31	4	M3 x 16 mm self-tapping screw

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

Hardware (cont'd)

B3	810-35	1	M3.5 x 6 mm self-tapping screw	
B4	810-36	4	M4 x 14 mm screw	
B5	810-39	2	M4 x 10 mm screw	
B6	811-8	2	M4 nut	
B7	812-34	4	M4 flat washer	
B8	812-17	2	M4 lockwasher	
B9	255-909	2	2-1/4" tapped spacer	

MISCELLANEOUS

C1	73-92	1	Double-stick foam tape	
	89-54	1	Line cord	
	85-3698-1	1	Circuit board	
C2	92-975	1	Cabinet top	
C3	92-954	1	Cabinet bottom	
C4	205-2096	1	Capacitor bracket	
C5	260-65	4	Fuse clip	
	231-405	1	9-wire shielded cable (6' long, with connectors)	
	340-2	6"	Bare wire	
	344-2	30"	Black stranded wire	
C6	354-7	2	Cable tie	
C7	432-1450	1	10-pin plug	P501

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

Miscellaneous (cont'd)

C8	432-1806	1	8-screw terminal block (may be in three sections)	P502
		1	Assembly Manual (See Page 1 for the part number.)	
		1	Operation Manual (See Page 1 for the part number.)	
	597-260	1	Parts Order Form	
C9	390-1255	2	Fuse label	
C10	390-3529	1	Ratings label	
C11	490-185	1	Package of desoldering braid	
C12	204-3376	1	Breaker mounting bracket	
	448-551	1	3-1/2" program disk	
	448-541	1	5-1/4" program disk	
			Solder	

BINDER PARTS*

D1	485-70	1	Binder fasteners	
	597-4460	1	Binder cover	
	701-233	1	3-ring assembly	

*Used when you assembled the Assembly Manual.

TAPED COMPONENTS

The remaining parts in this pack are supplied on taped strips. It is not necessary to check them against the following list.

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

RESISTORS

NOTE: All resistors are rated at 1/4-watt and have a tolerance of 5% (fourth band gold) unless otherwise noted.

6-102-12	3	1000 Ω (brn-blk-red)	R502, R504, R506
6-103-12	4	10 k Ω (brn-blk-org)	R503, R505, R507, R508
6-225-12	1	2.2 M Ω , 1/2-watt (red-red-grn)	R501

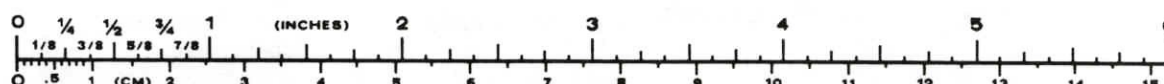
HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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CAPACITORS

21-786	3	.1 μ F (104) axial-lead ceramic capacitor	C503, C504, C505
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DIODES

57-65	5	1N4002 diode	D501, D502, D503, D504, D505
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STEP-BY-STEP ASSEMBLY

CIRCUIT BOARD ASSEMBLY

Refer to Pictorial 1-1 while you read the following notes and steps.

NOTES:

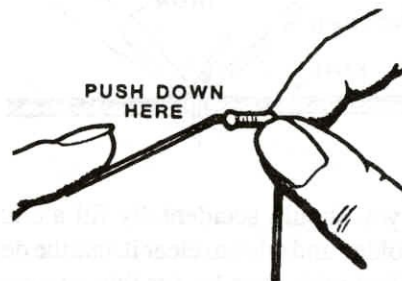
1. Many circuit board drawings, such as the one shown in Pictorial 1-1, are divided into two or more sections. You will be working on each of these sections in a specific series of steps.
 2. In each series of steps, you will install parts in a top-to-bottom, left-to-right sequence. Occasionally, you may be directed to install a part out of sequence.
 3. Check off each step as you perform it. You may also wish to place a check mark near each component on the Pictorial as you install it.
 4. In general, solder instructions are given only at the end of a series of similar steps. You may solder more often if you wish.
- () Remove the "Taped Components Chart" from the back of the Illustration Booklet. Make sure you read the instructions at the top of the chart before you use it. Note that it is divided into numbered sections which correspond to the numbered sections on the circuit board pictorial. The components are listed in the order of assembly.

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

Note that the circuit board has foil patterns on one side and the other side has outlines of components (parts) shown on it. The "foil" side of the board will be referred to as such, and the side with the outlines will be called the "component" side of the board.

Section 1

- () Position the circuit board as shown in Pictorial 1-1 with the component side facing up. Then start in Section 1 to install the first component, as described in the next step.
- () Cut the first component, a 10 k Ω (brn-blk-org) resistor from the Taped Components Chart as outlined in the instructions. Then hold the resistor by the body as shown and bend the leads straight down with your finger to fit the circuit board hole spacing at R508.

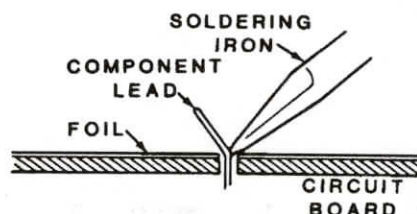


- () R508: Start the resistor leads into their circuit board holes at the indicated location.
- () Press the resistor body against the circuit board and bend the leads outward slightly to hold it in place.

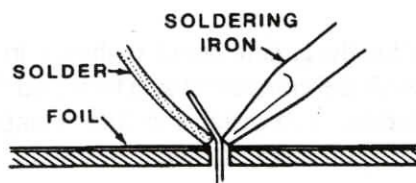


Solder the resistor leads to the circuit board as follows:

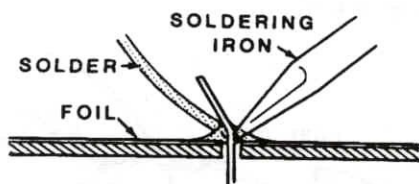
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat both for two or three seconds.



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

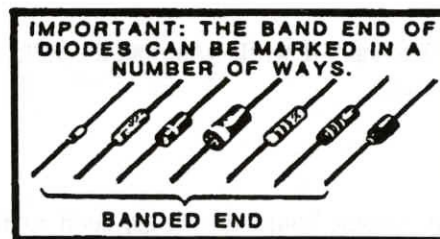


NOTE: If you should accidentally fill a circuit board hole with solder and wish to clear it, use the desoldering braid supplied with your kit for this purpose. The instructions are on the package.

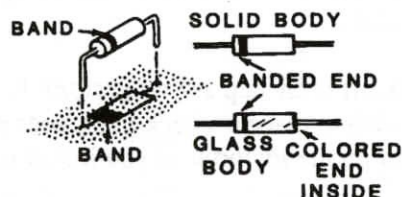
- () Cut off the excess lead lengths close to the connection. **WARNING:** Clip the leads so the ends will not fly toward your eyes. We recommend that you wear eye protection when you build this kit.
- () Check each solder connection and compare it to Detail 1-1A. After you have checked the connections, proceed with the assembly. Use the same soldering procedure for each component.

IMPORTANT: Make sure you installed the first component on Page 1-3 before you proceed.

NOTE: When you install a diode, always match the band on the diode with the band mark on the circuit board. The circuit will not work properly if a diode is installed backwards.



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 one or more bands painted on the outside of the glass.



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

- () D501: 1N4002 diode (#57-65).
- () D502: 1N4002 diode (#57-65).
- () D503: 1N4002 diode (#57-65).
- () D504: 1N4002 diode (#57-65).
- () R501: 2.2 MΩ (red-red-gm) resistor.
- () Solder the leads to the foil and cut off the excess lead lengths.



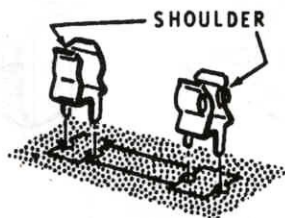
Section 2

- () R507: 10 k Ω (brn-blk-org) resistor.
- () R505: 10 k Ω (brn-blk-org) resistor.
- () R503: 10 k Ω (brn-blk-org) resistor.
- () R502: 1000 Ω (brn-blk-red) resistor.
- () R504: 1000 Ω (brn-blk-red) resistor.
- () R506: 1000 Ω (brn-blk-red) resistor.
- () C503: .1 μ F (104) axial-lead ceramic.
- () C504: .1 μ F (104) axial-lead ceramic.
- () C505: .1 μ F (104) axial-lead ceramic.
- () D505: 1N4002 diode (#57-65).
- () Solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 1-2 while you perform the following steps.

Section 1

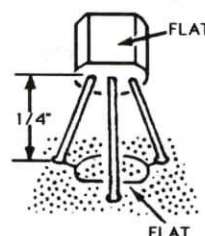
- () Install two fuse clips in the circuit board at F502 as shown. Position the clips so their shoulders are away from each other. Then solder the clips to the foil.



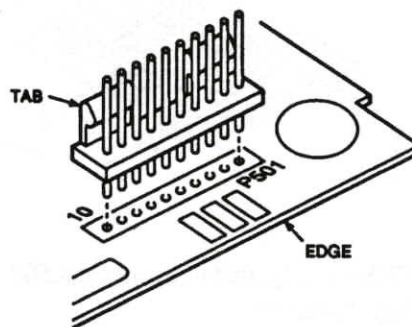
- () Similarly, install two fuse clips in the circuit board at F501.

Section 2

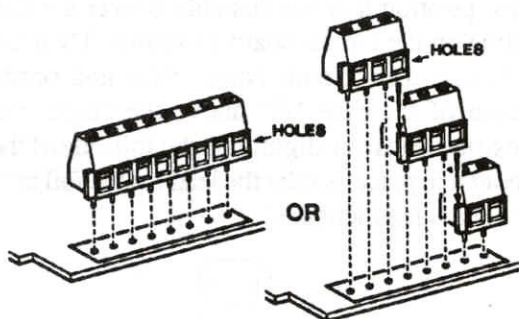
NOTE: When you install a transistor in the following steps, position it so the flat side is over the flat of the outline on the circuit board as shown. Then insert the leads into their circuit board holes and position the bottom of the case 1/4" above the board. Bend the transistor leads out slightly on the foil side of the board to hold it in place. Solder the leads to the foil and cut off the excess lead lengths.



- () Q501: MPSA55 transistor (#417-865).
- () Q502: MPSA55 transistor (#417-865).
- () Q503: MPSA55 transistor (#417-865).
- () P501: Start the short pins of the 10-pin plug into the circuit board holes so the tab is away from the nearby edge and push it down tight against the board. Then solder the pins to the foil.

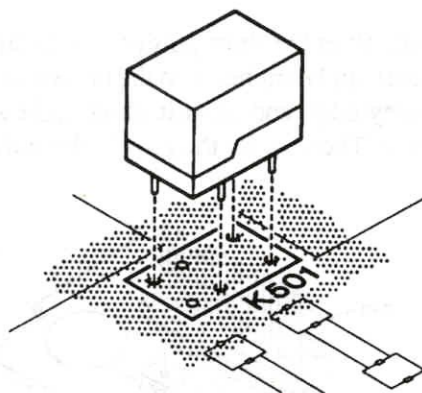


- () P502: If your 8-screw terminal strip is in three parts, first slide the three sections together. Then start the lugs of the strip into the circuit board holes. Make sure the side of the strip with holes is toward the nearby board edge. Then push the strip down tight against the board and solder the lugs to the foil.



Refer to Pictorial 1-3 while you perform the following steps.

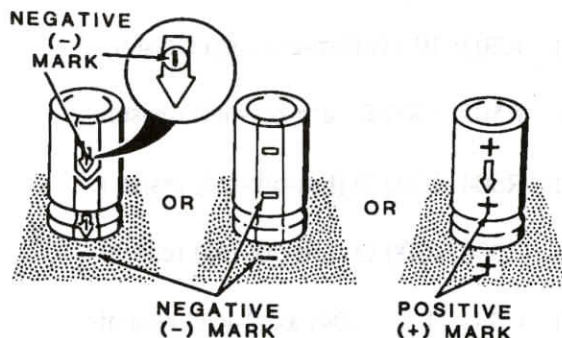
- () K501: Match the lugs of a relay with the circuit board holes at K501. Then push the relay down tight against the board and solder the lugs to the foil. NOTE: Some circuit board holes may not be used.



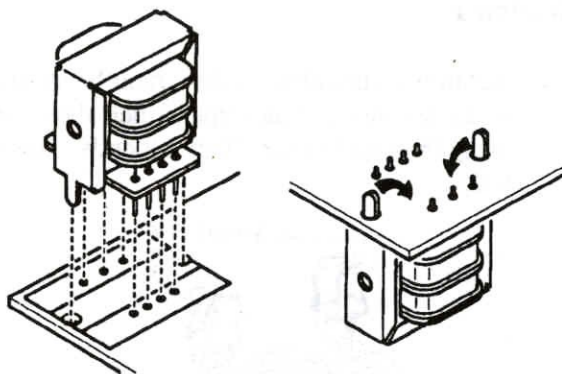
- () K502: Similarly, install a relay at K502 and solder the lugs to the foil.
- () K503: Similarly, install a relay at K503 and solder the lugs to the foil.

NOTE: Before you install an electrolytic capacitor, look at it and identify the leads. One lead will have either a negative (-) mark or a positive (+) mark near it on either side of the capacitor. (The marking for a

negative lead may look like an oblong bar, sometimes with a circle around it, inside an arrow.) Be sure to install the negative lead in the negative-marked hole, and the positive lead in the positive-marked hole.



- () C501: 6800 μ F electrolytic capacitor. Solder the leads to the foil and cut off any excess lead lengths.
- () T501: Match the lugs of the logic power transformer (#54-1066) with the circuit board holes at T501. Then push the transformer down tight against the board and bend the two wide flat lugs over, toward each other, to hold it in place. Solder the lugs to the foil. NOTE: It is not necessary to solder the two wide flat lugs to the foil.



Refer to Pictorial 1-4 while you perform the following steps.

Two sets of line voltage wiring instructions are provided below, one for 120 VAC and one for 240 VAC. In the U.S.A., 120 VAC is most often used, while in other countries, 240 VAC is more common. USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.

120 VAC Line Voltage

- () Cut four 1" bare solid wires. Use these wires in the following steps.

Refer to inset drawing #1 on the Pictorial while you perform the next four steps.

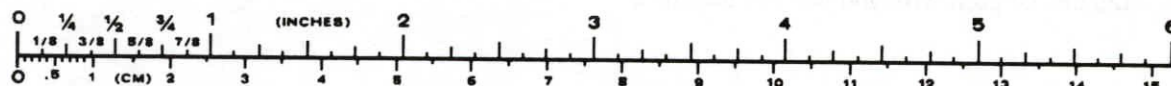
- () W505: Install a 1" bare wire at W505 between circuit board holes R and Q.
- () W504: Install a 1" bare wire at W504 between circuit board holes P and O.
- () W501: Install a 1" bare wire at W501 between circuit board holes E and G.
- () W502: Install a 1" bare wire at W502 between circuit board holes I and K.
- () Solder the wires to the foil and cut off any excess wire ends.
- () F502: Install a 1/8-ampere slow-blow fuse in the fuse clips at F502.
- () F501: Install a 2-ampere slow-blow fuse in the fuse clips at F501.
- () Set the two remaining fuses aside. They will not be used.
- () Write "F502, 1/8-ampere slow-blow" on one of the fuse labels. Then set the label aside for use later.
- () Similarly, write "F501, 2-ampere slow-blow" on the remaining fuse label. Then set the label aside for use later.
- () Write "120" in the space provided on the ratings label. Then set the label aside for use later.
- () Proceed directly to "Common Assembly Continued."

240 VAC Line Voltage

- () Cut two 1" bare solid wires. Use these wires in the following steps.

Refer to inset drawing #2 on the Pictorial while you perform the next two steps.

- () W506: Install a 1" bare wire at W506 between circuit board holes Q and P.
- () W503: Install a 1" bare wire at W503 between circuit board holes G and I.
- () Solder the wires to the foil and cut off the excess wire ends.
- () F502: Install a 1/16-ampere slow-blow fuse in the fuse clips at F502.
- () F501: Install a 1-ampere slow-blow fuse in the fuse clips at F501.
- () Set the two remaining fuses aside. They will not be used.
- () Write "F502, 1/16-ampere slow-blow" on one of the fuse labels. Then set the label aside for use later.
- () Similarly, write "F501, 1-ampere slow-blow" on the remaining fuse label. Then set the label aside for use later.
- () Write "240" in the space provided on the ratings label. Then set the label aside for use later.
- () Proceed to "Common Assembly Continued."



COMMON ASSEMBLY CONTINUED

Refer to Pictorial 1-5 while you perform the following steps.

NOTE: When a step directs you to prepare the end of a stranded wire, as in the next step, first remove the indicated amount of insulation and twist the fine strands tightly together. Then melt a small amount of solder on the wire end to hold the fine strands together.

- () Cut two 6" lengths of black stranded wire. Then remove 1/4" of insulation from both ends of each wire and prepare the ends.

NOTE: After you connect and solder the following wires to the circuit board holes, cut off any excess wire end.

- () Connect and solder one end of a prepared black stranded wire to circuit board hole KK.
- () Connect and solder one end of the remaining prepared black stranded wire to circuit board hole LL.
- () Cut two 8" lengths of black stranded wire. Then remove 1/4" of insulation from both ends of each wire and prepare the ends.
- () Connect and solder one end of a prepared black stranded wire to circuit board hole L.
- () Connect and solder one end of the remaining prepared black stranded wire to circuit board hole M.
- () Refer to Detail 1-5A and use the following procedure to prepare the end of the line cord:
 1. Remove 7-1/2" of outer insulation from the line cord:
 2. Shorten the black wire to 6". Do not shorten the other wires.
 3. Carefully remove 1/4" of insulation from the end of each wire and prepare the ends.

NOTE: When a step directs you to "make a mechanically secure connection" to a circuit board hole, push the end of the wire into the circuit board hole as before. Then refer to the inset drawing on the Pictorial and form a small loop in the end of the wire, push it down against the circuit board foil, and solder the connection.

Connect and solder the prepared ends of the line cord wires to the circuit board as follows. Be sure to make mechanically secure connections.

- () White wire to hole B.
- () Black wire to hole A.
- () Green wire to hole GND.
- () C502: Position the 120–160 μ F, 125 VAC nonpolarized electrolytic capacitor near the circuit board as shown in the Pictorial. Then connect and solder the free ends of the two black stranded wires coming from circuit board holes KK and LL to the lugs of the capacitor. NOTE: You can connect either wire to either lug.

T1: Set the rotator power transformer (#54-1067) near the circuit board as shown in the Pictorial. Then connect the free ends of the wires coming from the transformer to the circuit board as follows. Be sure to make mechanically secure connections.

- () White wire to hole C.
- () Black wire to hole D.
- () Black-green wire to hole H.
- () Black-yellow wire to hole F.
- () Black-red wire to hole J.
- () Yellow wire closest to the circuit board to hole N.

NOTE: The remaining yellow wire will be connected later.

- () CB1: Refer to Detail 1-5B and use the following procedure to mount a circuit breaker to the breaker mounting bracket at CB1:

1. Remove both nuts from a circuit breaker. Set aside the knurled nut; it will not be used.
2. Match the flat on one side of the circuit breaker with the flat in the bracket. Then use the hex nut to mount the breaker to the bracket. Do not overtighten the nut.

- () CB2: Similarly mount a circuit breaker to the breaker mounting bracket at CB2.

- () Position the circuit breaker assembly near the power transformer as shown in the Pictorial.

- () Cut a 1" length of bare wire. Then connect it from circuit breaker CB1 lug 2 to circuit breaker CB2 lug 1. Solder both lugs.

- () Cut the remaining yellow wire coming from the power transformer to 4". Measure the wire from the point where it exits the transformer. Then remove 1/2" of insulation from the free end and prepare the end. Loop the bare end around the bare wire that is connected between the circuit breakers and solder the connection.

- () Connect and solder the free end of the black stranded wire coming from circuit board hole M to circuit breaker CB2 lug 2.

- () Connect and solder the free end of the black stranded wire coming from circuit board hole L to circuit breaker CB1 lug 1.

Circuit Board Checkout

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

- () Unsoldered connections.
- () Poor solder connections.

- () Solder bridges between foil patterns.

- () Protruding leads which could touch together.

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

- () Transistors for the proper installation.

- () Diodes for the proper installation.

- () Electrolytic capacitor for the correct position of the positive (+) or negative (-) lead.

- () Jumpers and fuses for the desired AC voltage.

CABINET ASSEMBLY

Refer to Pictorial 1-6 while you perform the following steps.

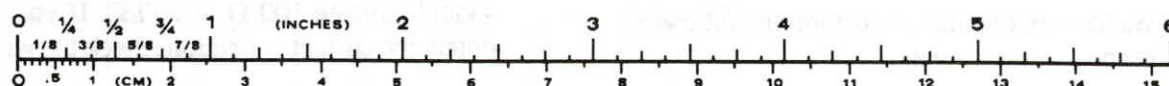
- () Position the cabinet bottom as shown in the Pictorial. Note the locations of the ventilation slots.

- () Carefully set the rotator power transformer and the circuit board assembly into the cabinet bottom as shown.

- () Use an M4 x 14 mm screw, M4 flat washer, M4 lockwasher, and M4 nut to loosely secure the power transformer mounting feet at CD and CE to the cabinet bottom. Be careful not to pinch any wires between the transformer and the cabinet bottom.

- () Refer to Detail 1-6A and use two M4 x 10 mm screws to mount two 2-1/4" tapped spacers to the circuit breaker assembly as shown.

- () Refer again to Detail 1-6A and use two M4 x 14 mm screws and two M4 flat washers to mount the circuit breaker assembly and the remaining power transformer mounting feet to the cabinet bottom at CF and CG. Then tighten all power transformer mounting hardware.



- () Use three M3 x 6 mm self-tapping screws to secure the circuit board to the cabinet bottom at CA, CB, and CC. Do not overtighten these screws. Be careful not to pinch any wires between the circuit board and the cabinet bottom.
- () Carefully peel away the backing paper from one of the fuse labels. Then press the label onto the top of the rotator power transformer in the area shown.
- () Similarly, peel away the backing paper from the remaining fuse label. Then press the label onto the top of the rotator power transformer in the area shown.
- () Similarly, peel away the backing paper from the ratings label. Then press the label onto the bottom of the power unit cabinet.

INITIAL TESTS

In the following steps, you will perform certain tests to verify that your power unit is wired properly. If you do not obtain the correct results in any of the steps, check the items listed in some of the steps or refer to the "Troubleshooting Chart" on Page 5-3.

CAUTION: Do not connect the line cord to an AC outlet until a step directs you to do so.

Primary Wiring

Refer to Pictorial 1-7 for the locations of the test points called out in the following steps.

IMPORTANT: A wiring error in the primary wiring circuit (line cord, etc.) of your power unit could cause you to receive a severe electrical shock. These "Primary Wiring Tests" will help you eliminate any such errors that may exist.

- () Be sure the line cord plug is **NOT** connected to an AC outlet.

NOTES:

1. If you do not have an ohmmeter, carefully check the line cord and rotator power transformer wiring against that shown on Pictorial 1-5 (Illustration Booklet, Page 4). Make sure there are no fine strands of wire or solder globs touching adjacent leads or components.
2. If you have an ohmmeter, perform the following resistance measurements.
 - () Set the ohmmeter to the R x 10 range.
 - () Connect the negative ohmmeter lead to the indicated lead of resistor R501. Leave this lead connected to the resistor lead until a step directs you to disconnect it.
 - () Touch the positive ohmmeter lead to either flat prong of the line cord plug. The ohmmeter should indicate infinity. If you do not obtain the correct indication, check the wiring of the rotator power transformer and the line cord.
 - () Touch the positive ohmmeter lead to the other flat prong of the line cord plug. The ohmmeter should indicate infinity. If you do not obtain the correct indication, check the wiring of the rotator power transformer and the line cord.
 - () Touch the positive ohmmeter lead to the round prong of the line cord plug. The ohmmeter should indicate zero ohms. If you do not obtain the correct indication, make sure the green line cord lead is properly soldered to circuit board hole GND. Also make sure the leads of resistor R501 are properly soldered to the foil.
 - () Disconnect the negative ohmmeter lead from the resistor lead and connect it to either flat prong of the line cord plug.
 - () Connect the positive ohmmeter lead to the other flat prong of the line cord plug. The ohmmeter should indicate 100 Ω to 200 Ω . If you do not obtain the correct indication, check the wiring of

the rotator power transformer and the line cord. Also check the locations of the jumper wires on the circuit board.

- () Disconnect the ohmmeter leads from the line cord plug.

Secondary Wiring

- () Reconnect the negative ohmmeter lead to the indicated lead of resistor R501. Leave this lead connected to the resistor lead until a step directs you to disconnect it.
- () Set the ohmmeter to the R x 10K range.
- () Touch the positive ohmmeter lead to the lead at the banded end of diode D501. The ohmmeter should indicate 10 k Ω or higher. It may take several seconds for the ohmmeter to reach the indicated reading. This is due to the charging effect of some of the capacitors in the circuit.
- () Disconnect the ohmmeter leads from the power unit.

Voltage Checks

You will need a VOM (volt-ohmmeter), a VTVM (vacuum-tube voltmeter), or a DMM (digital multime-

ter) to perform the voltage tests in this kit. If you do not have one of these meters, try to obtain one from a friend. If you do not obtain the proper voltage indications, check for unsoldered connections or solder bridges. Make sure the voltage is correct before you proceed.

NOTE: Do not connect the line cord to an AC outlet until a step directs you to do so.

- () Set your voltmeter to measure at least +20 volts DC.
- () Connect the negative voltmeter lead to plug P501 pin 10. It is alright for this lead to touch pin 9, but do not allow it to touch anything else.

CAUTION: When you connect the line cord in the next step, hazardous voltage is present at several points in the power unit. Do not touch anything in the assembly unless a step specifically directs you to do so. After you make the necessary measurement, immediately unplug the line cord.

- () Connect the line cord to a proper AC outlet.
- () Touch the positive voltmeter probe to plug P501 pin 1. The voltmeter should indicate between +11 and +16 volts DC.
- () Disconnect the line cord.
- () Disconnect the voltmeter leads from plug P501.

FINAL ASSEMBLY

Refer to Pictorial 1-8 while you perform the following steps.

- () Locate the 9-wire shielded cable. Then push the 10-pin socket, on one end of the cable, onto circuit board plug P501. Be sure to position the socket so the side with slots is toward the nearby circuit board edge.
- () Refer to inset drawing #1 on the Pictorial and install a cable tie around the shielded cable 1/8" away from the end of the outer insulation as shown. Pull the cable tie as tight as possible; it will be used as a strain relief. Then cut off the excess tie.
- () Similarly, install a cable tie around the line cord 1/8" away from the end of the outer insulation as shown. Then cut off the excess tie.
- () Cut the length of double-stick foam tape in half so you have two 3/4" x 2" pieces. Then peel the backing paper from one side of each piece and press them onto the inside of the cabinet top in the areas shown in inset drawing #2.
- () Use an M3.5 x 6 mm self-tapping screw and the capacitor bracket to mount capacitor C502 to the inside of the cabinet top as shown.
- () Position the line cord and the 9-wire shielded cable in their cabinet bottom slots so the cable ties are inside the cabinet as shown. Then install the cabinet top onto the cabinet bottom. Use four M3 x 16 mm self-tapping screws to secure the cabinet top in place.

This completes the assembly of the power unit. Set it aside until it is called for later.



DISPLAY, LED, AND KEYBOARD CIRCUIT BOARDS

PARTS LIST

Remove the parts from Pack #2 and check each part against the following list. The key numbers correspond to the numbers on the "Display, LED, and Keyboard Circuit Boards Parts Pictorial." 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 it is called for in a step. 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.

A replacement part may look slightly different than the original part, or may have different printing on it. In any case, the performance of the replacement part will meet or exceed the requirements of the original part. A 15-volt capacitor (10 μ F, 15V) may be replaced with a 25-volt capacitor (10 μ F, 25V).

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	231-410	1	Yellow LED (light-emitting diode)	D401
A1	231-409	16	Green LED	D402, D403, D404, D405, D406, D407, D408, D409, D410, D411, D412, D413, D414, D415, D416, D417

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A2	150-412	1	LCD module*	V201
A3	231-414	1	14-pin plug	P201
A4	231-412	1	20-pin plug	P401
	85-3644-1	1	Keyboard circuit board**	
	85-3466-1	1	LED circuit board	
A5	231-406	1	Keyboard cable	P301
A6	255-896	1	LED spacer	

* Handle the LCD carefully at all times; it can easily be broken if it is dropped.

**When you handle the keyboard circuit board, avoid touching the gold-colored contact pads. Normal finger moisture could cause the keyboard to become intermittent.

STEP-BY-STEP ASSEMBLY

DISPLAY CIRCUIT BOARD

Refer to Pictorial 2-1 while you perform the following steps.

- () Place a soft cloth on your work surface to protect the LCD (liquid-crystal display) while you perform the following steps.

CAUTION: Handle the LCD carefully at all times; it can easily be broken if it is dropped.

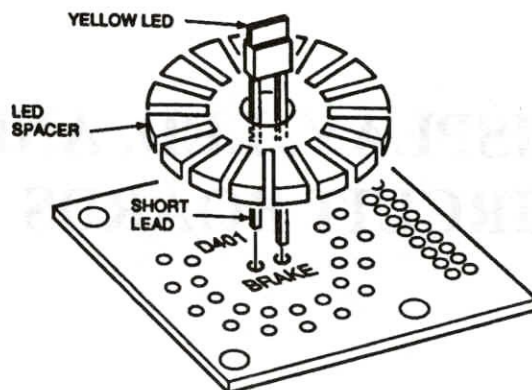
- () Position the LCD module as shown in the Pictorial so the LCD display faces downward.
- () P201: Start the shorter pins of the 14-pin plug into the circuit board holes and push it down tight against the board. Make sure the plug is on the side of the circuit board that is opposite to the LCD. Then solder two pins at diagonally opposite corners to the foil on the LCD side. Check to make sure the plug is down tight and perpendicular to the circuit board (reheat the solder connections and make any necessary adjustments). Then solder the remaining pins to the foil.
- () Check the plug solder connections to make sure there are no solder bridges between adjacent foils.
- () Set the display assembly aside in a safe place until it is called for later.

LED CIRCUIT BOARD

Refer to Pictorial 2-2 while you perform the following steps.

- () Position the LED circuit board as shown in the Pictorial.
- () D401: Pass the leads of the yellow LED through the center hole of the LED spacer and then into the holes of the circuit board at BRAKE. Make sure the shorter lead is toward the left as shown. Push the LED down tight against the spacer and circuit board. Then bend the leads out to hold the LED in

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



- () D402 — D417: Similarly pass the leads of green LEDs through the LED spacer and circuit board at A through P. Make sure you install each LED so the shorter lead is away from the yellow LED. Push each LED down tight against the board and bend the leads out to hold it in place. Then solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 2-3 while you perform the following steps.

- () Position the LED circuit board so the LEDs are away from you as shown in the Pictorial.
- () P401: Start the shorter pins of the 20-pin plug into the circuit board holes and push it down tight against the board. Make sure the plug is on the side of the circuit board that is opposite to the LEDs. Then solder two pins at diagonally opposite corners to the foil. Check to make sure the plug is down tight and perpendicular to the circuit board (reheat the solder connections and make any necessary adjustments). Then solder the remaining pins to the foil.
- () Carefully check the circuit board plug and LED leads to make sure there are no solder bridges between adjacent foils.
- () Set the LED assembly aside in a safe place until it is called for later.

KEYBOARD CIRCUIT BOARD

CAUTION: Avoid touching the gold-colored contact pads on the keyboard circuit board while you handle it. Normal finger moisture could cause the keyboard to become intermittent.

Refer to Pictorial 2-4 while you perform the following steps.

- () Position the keyboard circuit board so the gold-colored contact pads are down as shown in the Pictorial.
- () Start the plug pins at one end of the keyboard cable into the circuit board holes at P301 (disregard any stripe that may be on one side of the cable). Make sure the plug is on the side of the circuit board that is opposite to the contact pads. Then solder two

pins at diagonally opposite corners to the foil. Check to make sure the plug is down tight and perpendicular to the circuit board (reheat the solder connections and make any necessary adjustments). Then solder the remaining pins to the foil and cut off the excess pin lengths.

- () Make a sharp fold in the cable near the plug as shown in the Pictorial.
- () Carefully check the plug solder connections to make sure there are no solder bridges between adjacent foils.
- () Set the keyboard assembly aside in a safe place until it is called for later. **NOTE:** You may wish to wrap some packing material around the circuit board to keep the contacts clean while you assemble the remainder of your kit.

MAIN CIRCUIT BOARD

PARTS LIST

Remove the parts from Pack #3 and check each part against the following list. The key numbers correspond to the numbers on the "Main Circuit Board Parts Pictorial." Do not remove components that are supplied on a tape 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 it is called for in a step. 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.

A replacement part may look slightly different than the original part, or may have different printing on it. In any case, the performance of the replacement part will meet or exceed the requirements of the original part. For example: A 15-volt capacitor (10 μ F, 15V) may be replaced with a 25-volt capacitor (10 μ F, 25V).

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
CAPACITORS				
A1	20-100	2	30 pF (300J) mica	C111, C112
A2	25-924-1	1	2.2 μ F electrolytic	C104
A2	25-900-1	2	1 μ F electrolytic	C103, C120
A2	25-917-1	1	10 μ F electrolytic	C110
A2	25-915-1	4	47 μ F electrolytic	C115, C116, C117, C118
A2	25-887	1	220 μ F electrolytic	C128

SOCKETS — PLUGS

B1	231-415	1	14-pin socket	P101
B2	231-413	1	20-pin socket	P105
B3	432-1978	1	9-pin "D" plug	P104
B4	432-1979	1	9-pin "D" socket	P106
B5	434-230	2	8-pin IC socket	
B5	434-253	1	40-pin IC socket	

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Sockets — Plugs (cont'd)

B5	434-298	1	14-pin IC socket	
B5	434-299	3	16-pin IC socket	
B5	434-311	3	20-pin IC socket	
B5	434-312	2	28-pin IC socket	

TRANSISTORS — INTEGRATED CIRCUITS (ICs)

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

1. Part number.
2. Type number. (For integrated circuits, this refers only to the numbers and letters shown in **BOLD** print. Disregard any other numbers or letters shown on the IC.)

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

3. Part number and type number.
4. Part number with a type number other than the one listed.

CAUTION: Some of the integrated circuits can be easily damaged by static electricity. Do not remove the ICs that are packed in conductive foam pads until a step directs you to do so.

C1	417-874	2	2N3906 transistor	Q101, Q108
C1	417-801	6	MPSA20 transistor	Q102, Q103, Q104, Q105, Q106, Q107
C2	442-22	1	741 IC	U114
C3	442-54	1	7805 IC	U101
C1	442-627	1	78L05 IC	U102
C2	442-801	1	555 IC	U113
C1	442-772	1	LM317 IC	U115
C2	443-1301	1	74HC132 IC	U109
C2	443-1311	2	74HC138 IC	U104, U107
C2	443-1331	3	74HC373 IC	U103, U110, U111
C2	443-1576	1	MAX232CPE IC	U112

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

C2	231-416	1	Custom microprocessor IC	U108
C2	231-417	1	Custom program EPROM IC	U105
C2	443-1553	1	6264LP-15 or CXK5864PS-15L IC	U106

MISCELLANEOUS

D1	10-311	1	5000 Ω (5 k Ω) control	R109
	85-3463-2	1	Main circuit board	
D2	230-8412	1	Battery holder	
D3	810-9	9	M3 x 6 mm screw	
D4	231-401	1	4700 Ω (x8) resistor pack	RP-101
D5	231-407	1	Piezo transducer	A101
D6	231-408	1	11.059 MHz crystal	Y101
D7	255-917	4	12.65 mm x 5 mm tapped spacer	
D8	231-421	5	14 mm x 5 mm tapped spacer	
D9	235-229	5	35 μ H choke	L101, L102, L103, L104, L105
D10	490-111	1	IC lifter	

TAPED COMPONENTS

The remaining parts in this pack are supplied on taped strips. It is not necessary to check them against the following list.

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

NOTE: All resistors are rated at 1/4-watt and have a tolerance of 5% (fourth band gold) unless otherwise noted. 1% resistors have a brown fifth color band, which is not called out in the steps.

6-151-12	2	150 Ω (brn-grn-brn)	R111, R125
6-271-12	1	270 Ω (red-viol-brn)	R127
6-471-12	2	470 Ω (yel-viol-brn)	R112, R116
6-102-12	2	1000 Ω (brn-blk-red)	R104, R128
6-222-12	1	2200 Ω (red-red-red)	R106
6-332-12	3	3300 Ω (org-org-red)	R110, R118, R120
6-822-12	1	8200 Ω (gry-red-red)	R107

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

6-103-12	11	10 k Ω (brn-blk-org)	R101, R102, R103, R105, R113, R114, R117, R119, R129, R130, R131
6-273-12	2	27 k Ω (red-viol-org)	R108, R126
6-1003-12	4	100 k Ω , 1% (brn-blk-blk-org)	R121, R122, R123, R124

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

21-784	1	.001 μ F (102) axial-lead ceramic	C121
21-769	1	.01 μ F (103) axial-lead ceramic	C124
21-786	16	.1 μ F (104) axial-lead ceramic	C101, C102, C105, C106, C107, C108, C109, C113, C114, C119, C122, C123, C125, C126, C127, C129

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

DIODES

56-56	5	1N4149	D101, D102, D104, D113, D114
56-655	17	1N6263 or SD101A	D103, D105, D106, D107, D108, D109, D110, D111, D112, D115, D116, D117, D118, D119, D121, D122, D123

STEP-BY-STEP ASSEMBLY

Refer to Pictorial 3-1 and the "Taped Components Chart" while you perform the following steps.

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

Section 1

- () R110: 3300 Ω (org-org-red) resistor.
- () C129: .1 μ F (104) axial-lead ceramic.
- () R126: 27 k Ω (red-viol-org) resistor.
- () R124: 100 k Ω , 1% (brn-blk-blk-org) resistor.
- () R122: 100 k Ω , 1% (brn-blk-blk-org) resistor.
- () C125: .1 μ F (104) axial-lead ceramic.
- () C127: .1 μ F (104) axial-lead ceramic.
- () R127: 270 Ω (red-viol-brn) resistor.
- () C123: .1 μ F (104) axial-lead ceramic.
- () Solder the leads to the foil and cut off the excess lead lengths.

Section 2

- () R108: 27 k Ω (red-viol-org) resistor.
- () C113: .1 μ F (104) axial-lead ceramic.

NOTE: If you plan to use your IntelliRotor with a Telex Model HDR-300 rotator, install a 220 Ω , 1/4-watt, 5% resistor* at R125 instead of the 150 Ω resistor called for in the next step. Install the 150 Ω resistor for all other compatible models. The 220 Ω resistor will work in all cases, but resolution and noise rejection might be affected slightly.

- () R125: 150 Ω (brn-grn-brn) resistor.
- () R123: 100 k Ω , 1% (brn-blk-blk-org) resistor.

- () R120: 3300 Ω (org-org-red) resistor.
- () R121: 100 k Ω , 1% (brn-blk-blk-org) resistor.
- () R107: 8200 Ω (gry-red-red) resistor.

NOTE: If your 1N4149 diodes (#56-56) have color bands, the wide yellow or black band indicates the banded end.

- () D113: 1N4149 diode (#56-56).
- () C114: .1 μ F (104) axial-lead ceramic.
- () C122: .1 μ F (104) axial-lead ceramic.
- () C124: .01 μ F (103) axial-lead ceramic.
- () C126: .1 μ F (104) axial-lead ceramic.
- () R118: 3300 Ω (org-org-red) resistor.
- () R119: 10 k Ω (brn-blk-org) resistor.
- () C121: .001 μ F (102) axial-lead ceramic.
- () C119: .1 μ F (104) axial-lead ceramic.
- () D114: 1N4149 diode #56-56).
- () Solder the leads to the foil and cut off the excess lead lengths.

Section 3

- () D103: 1N6263 diode (#56-655).
- () C102: .1 μ F (104) axial-lead ceramic.
- () R106: 2200 Ω (red-red-red) resistor.
- () R105: 10 k Ω (brn-blk-org) resistor.
- () R104: 1000 Ω (brn-blk-red) resistor.
- () D104: 1N4149 diode (#56-56).
- () D102: 1N4149 diode (#56-56).

* Not supplied, but you should be able to obtain this resistor locally.

- () D101: 1N4149 diode (#56-56).
- () R103: 10 k Ω (brn-blk-org) resistor.
- () R101: 10 k Ω (brn-blk-org) resistor.
- () R102: 10 k Ω (brn-blk-org) resistor.
- () R129: 10 k Ω (brn-blk-org) resistor.
- () R130: 10 k Ω (brn-blk-org) resistor.
- () R131: 10 k Ω (brn-blk-org) resistor.
- () C105: .1 μ F (104) axial-lead ceramic.
- () R114: 10 k Ω (brn-blk-org) resistor.
- () R128: 1000 Ω (brn-blk-red) resistor.
- () R113: 10 k Ω (brn-blk-org) resistor.
- () R117: 10 k Ω (brn-blk-org) resistor.
- () R116: 470 Ω (yel-viol-brn) resistor.
- () C109: .1 μ F (104) axial-lead ceramic.
- () C106: .1 μ F (104) axial-lead ceramic.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () D115: 1N6263 diode (#56-655).
- () D118: 1N6263 diode (#56-655).
- () D116: 1N6263 diode (#56-655).
- () C108: .1 μ F (104) axial-lead ceramic.
- () D105: 1N6263 diode (#56-655).
- () D106: 1N6263 diode (#56-655).
- () D107: 1N6263 diode (#56-655).
- () D108: 1N6263 diode (#56-655).
- () D109: 1N6263 diode (#56-655).
- () D110: 1N6263 diode (#56-655).
- () D111: 1N6263 diode (#56-655).
- () D112: 1N6263 diode (#56-655).
- () Solder the leads to the foil and cut off the excess lead lengths.

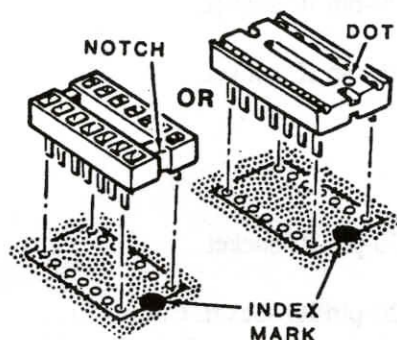
Section 4

- () C101: .1 μ F (104) axial-lead ceramic.
- () C107: .1 μ F (104) axial-lead ceramic.
- () R112: 470 Ω (yel-viol-brn) resistor.
- () R111: 150 Ω (brn-gm-brn) resistor.
- () D119: 1N6263 diode (#56-655).
- () D122: 1N6263 diode (#56-655).
- () D121: 1N6263 diode (#56-655).
- () D123: 1N6263 diode (#56-655).
- () D117: 1N6263 diode (#56-655).

Refer to Pictorial 3-2 while you perform the following steps.

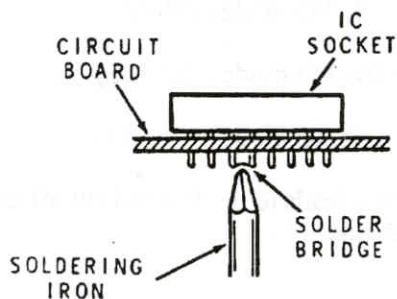
Section 1

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.



Hold the socket in place while you turn the board over and lay it on top of the socket on your work surface. The board will hold the socket in place. At first, solder only two pins at diagonally opposite corners of the socket. When the solder cools, check to make sure the socket is tight against the circuit board. If not, reheat the pins while you press against the socket to reseal it. Then solder the remaining pins to the foil.

NOTE: A solder bridge may occur when you solder connections at closely-spaced foils. Therefore, after each solder step, carefully inspect the foil for solder bridges and remove any that have formed. To remove a solder bridge, hold the soldering iron tip between the two points that are bridged. The solder will flow down the soldering iron tip to clear the bridge.



- () U112: 16-pin IC socket.
- () U114: 8-pin IC socket.
- () U113: 8-pin IC socket.

Section 2

- () U108: 40-pin IC socket.
- () U109: 14-pin IC socket.
- () U103: 20-pin IC socket.
- () U107: 16-pin IC socket.

Section 3

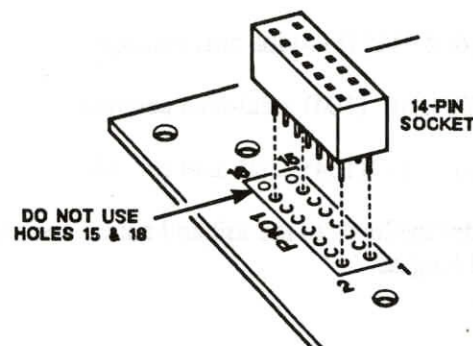
- () U110: 20-pin IC socket.
- () U111: 20-pin IC socket. Cut off the pins of this socket as close as possible to the solder connections.

- () U105: 28-pin IC socket.
- () U106: 28-pin IC socket.
- () U104: 16-pin IC socket.

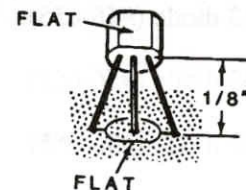
Refer to Pictorial 3-3 while you perform the following steps.

Section 1

- () P101: 14-pin socket. Start the pins into the circuit board holes and push it down tight against the board. **Do not use holes 15 and 16.** Then solder only two pins at diagonally opposite corners of the socket. Check the socket to make sure it is still down tight against the board. Reheat the pins and reposition the socket as necessary. Then solder the remaining pins to the foil.

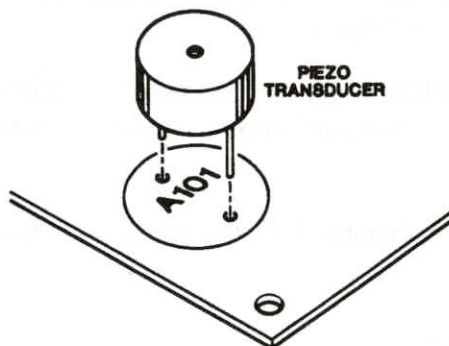


NOTE: When you install a transistor or integrated circuit (IC) in some of the following steps, position it so the flat side is over the flat of the outline on the circuit board, as shown. Then insert the leads into their circuit board holes and position the bottom of the case 1/8" above the board. Bend the leads out slightly on the foil side of the board to hold it in place. Solder the leads to the foil and cut off the excess lead lengths.



- () U115: LM317L integrated circuit (#442-772).

- () A101: Piezo transducer (#231-407). Start the pins into the circuit board holes (use the holes that best fit your transducer) and push it down tight against the board. Disregard any polarity (+ or -) markings on the transducer. Solder the pins to the foil and cut off any excess pin lengths.

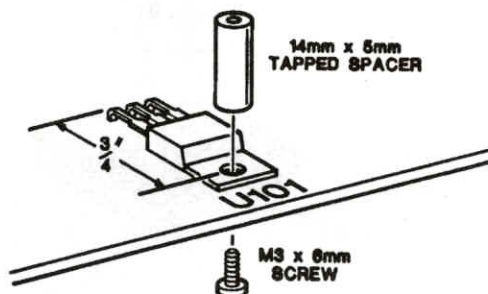


- () If there is a protective label or foil on the top of the piezo transducer, peel it off.

Section 2

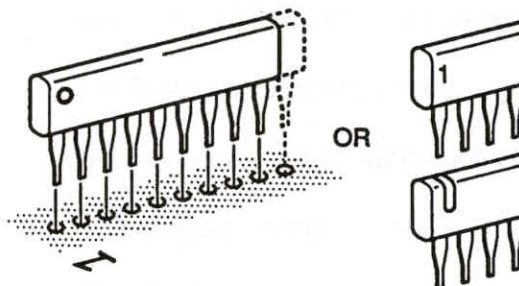
- () U101: Use the following procedure to install a 7805 IC (#442-54) at U101:

1. Use long-nose pliers to bend the leads 90° at a point 3/4" from the center of the hole as shown.
2. Start the leads into the circuit board holes and push the IC down against the board.
3. Use an M3 x 6 mm screw and a 14 mm x 8 mm tapped spacer to secure the IC to the board as shown.
4. Solder the leads to the foil and cut off any excess lead lengths.

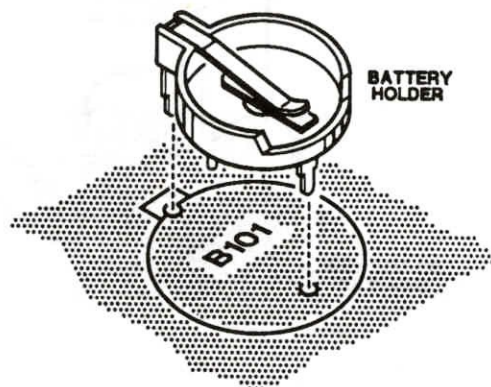


- () Q102: MPSA20 transistor (#417-801). Solder the leads to the foil and cut off the excess lead lengths.

- () RP101: Resistor pack. Position the index mark (dot, line, or number) near one end of its body toward the number "1" on the circuit board and start the leads into the holes (be sure the lead at the marked end goes into the first hole in the outline). If your resistor pack has only nine leads, the last hole in the outline will not be used. Then solder the leads to the foil.



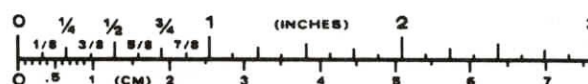
- () B101: Match the outline of the battery holder with the outline on the circuit board. Then start the pins into the circuit board, push it down tight against the board (the plastic bosses will not let it rest flat against the board), and solder the pins to the foil. Cut off the excess pin lengths.



- () Q108: 2N3906 transistor (#417-874).

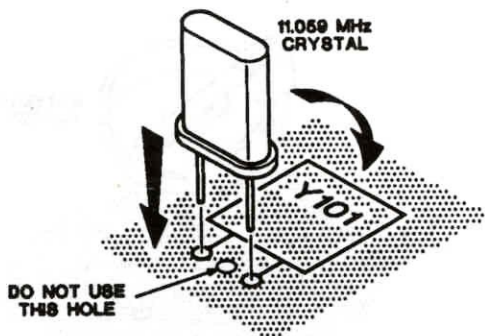
- () Q106: MPSA20 transistor (#417-801).

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



Section 3

- () U102: 78L05 IC (#442-627).
- () Q101: 2N3906 transistor (#417-874).
- () L105: 35 μ H choke (#235-229).
- () L104: 35 μ H choke (#235-229).
- () L103: 35 μ H choke (#235-229).
- () Q103: MPSA20 transistor (#417-801).
- () Q104: MPSA20 transistor (#417-801).
- () Q105: MPSA20 transistor (#417-801).
- () C111: 30 pF (300J) mica capacitor.
- () Y101: 11.059 MHz crystal (#231-408). Form the leads of the crystal to fit the circuit board hole spacing at Y101. Then start the leads into the holes and position the crystal down flat against the board. Solder the leads to the foil and cut off the excess lead lengths.



- () C112: 30 pF (300J) mica capacitor.
- () Solder the leads to the foil and cut off the excess lead lengths.

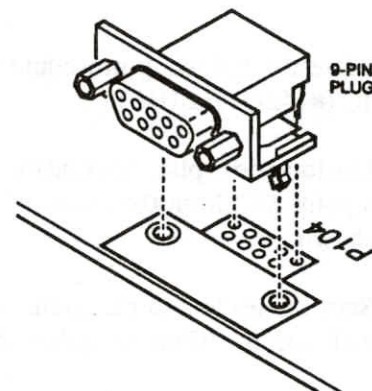
Section 4

- () L101: 35 μ H choke (#235-229).
- () L102: 35 μ H choke (#235-229).
- () Solder the leads to the foil and cut off the excess lead lengths.
- () P105: 20-pin socket. Push the plug down against the board before you solder the pins to the foil.

Refer to Pictorial 3-4 while you perform the following steps.

Section 1

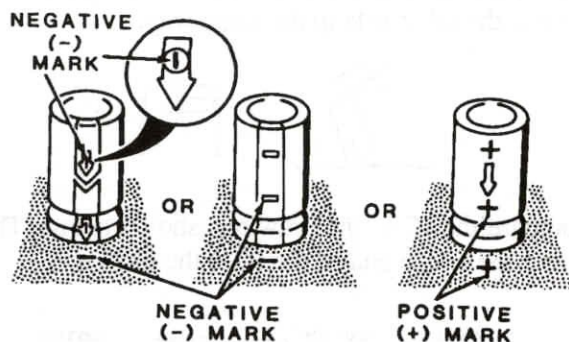
- () P104: 9-pin plug (with holes). Line up the pins with the circuit board holes and snap the plug into place. Then solder the 9 pins and two mounting lugs to the foil.



- () R109: 5000 Ω (5 k Ω) control. Start the lugs into the circuit board holes and push the control down tight against the board. Then solder the lugs to the foil.



NOTE: Before you install an electrolytic capacitor, look at it and identify the leads. One lead will have either a negative (-) mark or a positive (+) mark near it on the side of the capacitor. (The marking for a negative lead may look like an oblong bar, sometimes with a circle around it, inside an arrow.) be sure to install the negative lead in the negative-marked hole, and the positive lead in the positive-marked hole.



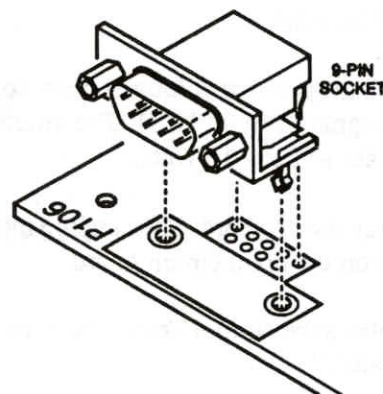
- () C117: 47 μ F electrolytic capacitor.
- () C115: 47 μ F electrolytic capacitor.
- () C116: 47 μ F electrolytic capacitor.
- () C118: 47 μ F electrolytic capacitor.
- () C128: 220 μ F electrolytic capacitor.
- () C110: 10 μ F electrolytic capacitor.
- () Solder the leads to the foil and cut off the excess lead lengths.

Section 2

- () C104: 2.2 μ F electrolytic capacitor.
- () C103: 1 μ F electrolytic capacitor.
- () C120: 1 μ F electrolytic capacitor.
- () Solder the leads to the foil and cut off the excess lead lengths.

Section 3

- () P106: 9-pin socket (with pins). Push the socket down tight against the circuit board. Then solder the 9 pins and two mounting lugs to the foil.



INITIAL TESTS

The following steps are designed to check the main circuit board for errors that could damage the integrated circuits after they are installed.

Refer to Pictorial 3-5 while you perform the following steps.

- () Set the main circuit board assembly on an insulated (not metal) surface.
- () Connect the free end of the 9-wire cable coming from the power unit to the indicated connector on the rear edge of the main circuit board.
- () Preset CONTRAST control R109 to the center of its rotation.
- () Plug the line cord coming from the power unit to the proper AC outlet.
- () Connect the negative lead of a DC voltmeter (capable of measuring 20 VDC) to the spacer that extends from integrated circuit U101.

NOTE: When you make the following tests, do not allow the probe to slip and short two points together.

- () Touch the positive voltmeter probe to the OUT lead of integrated circuit U101. The voltmeter should indicate +4.75 to +5.25 volts.
- () Touch the positive voltmeter probe to socket U106 pin 28. The voltmeter should indicate +4.75 to +5.25 volts.
- () Touch the positive voltmeter probe to the IN lead of integrated circuit U101. The voltmeter should indicate +11 to +16 volts.
- () Unplug the line cord. Then unplug the cable from P106 on the main circuit board.

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

ASSEMBLY CONTINUED

Refer to Pictorial 3-6 while you perform the following steps.

CAUTION: Integrated circuits (ICs) are complex electrical devices that perform many complicated operations in a circuit. Read all of the following information before you install the ICs.

Some of the ICs used in this kit may be MOS (metal-oxide semiconductor) devices; these ICs are shipped in a foam pad or antistatic tube to protect them. These are rugged and reliable devices. However, if you do not handle them properly, they can be damaged by static electricity. Other ICs may be of a type that is not susceptible to static electricity. Nevertheless, treat all ICs as if they are MOS. This will help insure that no ICs will be damaged.

The pins on the IC may be bent out at an angle and thus will not line up with the holes in the IC socket. Do not try to install the IC without first bending the pins as described below or you may damage the IC pins or the socket, causing intermittent contact.

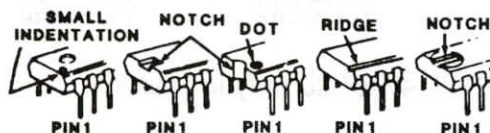


Remove the IC from the protective foam pad or tube, but **do not let go of it until it is installed in its socket**. Hold the IC in one hand and place your other hand on your work surface before you touch the IC to your work surface. This will equalize the static electricity between the work surface and the IC.

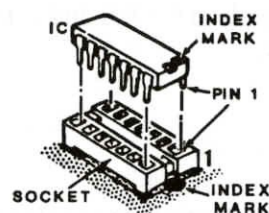
Very carefully roll the IC toward the pins to bend the lower pins into line. Then turn the IC over and bend the pins on the other side in the same way.



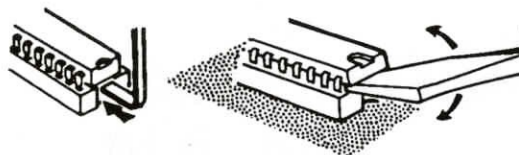
Compare the IC to the drawings shown below. Then determine which end of the IC is the pin 1 end.



Hold the IC in one hand and the circuit board in the other. Then position the pin 1 end of the IC over the index mark on the circuit board and start the pins into the socket. Make sure that all of the pins are started; then push the IC down firmly. **NOTE:** An IC pin can become bent under the IC and it will look as though it is correctly installed in the socket.



If it ever becomes necessary to remove an IC from its socket, use an IC lifter (if one was supplied with your kit) or a small-bladed screwdriver as shown. Push it between the IC and the socket and carefully lift the IC free. If any IC pins become bent, carefully straighten them.



Install ICs at the following locations:

- () U112: MAX232CPE IC (#443-1576).
- () U114: 741 IC (#442-22).
- () U113: TLC555CP IC (#442-801).
- () U108: Custom microprocessor IC (#231-416).
- () U109: 74HC132 IC (#443-1301).
- () U103: 74HC373 IC (#443-1331).
- () U107: 74HC138 IC (#443-1311).
- () U110: 74HC373 IC (#443-1331).
- () U111: 74HC373 IC (#443-1331).
- () U105: Custom program EPROM IC (#231-417).
- () U106: 6264LP-15 or CXX5864PS-15L IC (#443-1553).
- () U104: 74LS138 IC (#443-1311).

Refer to Pictorial 3-7 while you perform the following steps.

- () Use an M3 x 6 mm screw to mount a 14 mm x 5 mm tapped spacer on the circuit board at AA as shown in the inset drawing.
- () Similarly use M3 x 6 mm screws to mount 14 mm x 5 mm tapped spacers on the circuit board at AB, AC, and AD.

- () Similarly use M3 x 6 mm screws to mount 12.65 mm x 5 mm tapped spacers on the circuit board at AE, AF, AG, and AH.

CIRCUIT BOARD CHECKOUT

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

- () Unsoldered connections.
- () Poor solder connections.
- () Solder bridges between foil patterns.
- () Protruding leads which could touch together.

Refer to the illustrations where parts were installed while you make the following visual checks.

- () Transistors for the proper type and installation.
- () Diodes for the proper type and installation.
- () Integrated circuits for the proper type and installation.
- () Electrolytic capacitors for the correct position of their positive (+) or negative (-) leads.

Set the main circuit board aside until it is called for later.

FINAL ASSEMBLY

PARTS LIST

Remove the remaining parts from the shipping carton and check each part against the following list. The key numbers correspond to the numbers on the "Final Assembly Parts Pictorial." 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 it is called for in a step. Do not throw away any packing material until you account for all of the parts.

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

A1	92-976	1	Cabinet top	
A2	92-977	1	Cabinet bottom	
A3	92-699	1	Adjustable foot	
A4	446-765	1	Window	

HARDWARE

B1	810-9	8	M3 x 6 mm self-tapping screw	
B2	810-50	2	M3.5 x 12 mm self-tapping screw	

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.

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

B3	810-51	2	M3.5 x 18 mm self-tapping screw	
B4	231-79	6	Press-on retainer	

MISCELLANEOUS

C1	64-963	1	Keypad*	
C2	261-71	4	Rubber foot	
C3	230-8403	1	3-volt lithium battery	B101

* **CAUTION:** When you handle the keypad, avoid touching the black contact pads. Normal finger moisture could cause the keypad to become intermittent.

STEP-BY-STEP ASSEMBLY

Refer to Pictorial 4-1 while you perform the following steps.

- () Position the cabinet bottom upside-down on your work surface as shown in the Pictorial.
- () Carefully peel away the backing paper from the four rubber feet. Then press a foot into each of the smooth areas on the cabinet bottom as shown.
- () Start the sides of the adjustable foot into their retainers as shown. Then push the foot into its recess as shown.
- () Position the main and keyboard circuit boards as shown in Pictorial 4-2. Start the pins of the plug on the free end of the cable coming from the keyboard into the main circuit board holes at P102. Make sure the plug is down tight against the main circuit board. Then solder the pins to the foil.
- () Temporarily position the keyboard circuit board on top of the main circuit board so its cable is not flexed too much while you perform the remaining steps.

Refer to Pictorial 4-3 while you perform the following steps.

- () Reposition the cabinet bottom right-side-up as shown in the Pictorial.
- () Refer to Detail 4-3A and use the following procedure to mount the main circuit board in the cabinet bottom:
 1. Set the rear edge of the main circuit board into the cabinet bottom so socket P104 and plug P106 pass through their cutouts in the rear edge of the cabinet.
 2. Lower the front edge of the circuit board into place until the catch near each side of the

circuit board locks it into place. NOTE: Make sure the small bosses near the front corners of the circuit board are in their corresponding circuit board holes. Readjust the circuit board as necessary.

- () B101: Locate the 3-volt lithium battery and remove it from its package. Note that one side of the battery has a positive (+) mark. Lift the end of the battery holder clip with your fingernail. Then slide the battery all the way into the battery holder so the positive side is up and the clip rests against the top (positive) side of the battery.
- () Match the pins of the plug on the bottom of the display circuit board with the holes in main circuit board socket P101. Then push the plug into the socket. Use four M3 x 6 mm screws to secure the display circuit board to the main circuit board spacers.
- () Similarly match the pins of the plug on the bottom of the LED circuit board with the holes in main circuit board socket P105. Then push the plug into the socket. Use four M3 x 6 mm screws to secure the LED circuit board to the main circuit board spacers.
- () Carefully remove any protective covering from the front of the window. Then carefully peel away the backing paper from the adhesive strips. Carefully wipe any dust from the LCD display module and press the window into place on the module as shown. Be sure to center the window on the module.

Refer to Pictorial 4-4 while you perform the following steps.

CAUTION: Avoid touching the black contact pads on the keypad while you handle it. Normal finger moisture could cause the keyboard to become intermittent.

() Use the following procedure to mount the keyboard to the cabinet top:

1. Hold the keyboard circuit board by its edges and position it as shown in Part A.
2. Align the rubber bosses on the keypad with their corresponding holes in the keyboard circuit board. Then set the keypad onto the circuit board. Push down on the keypad where the rubber bosses are to make sure they are down as far as possible into the circuit board holes.
3. Refer to Part B and carefully set the cabinet top onto the keyboard assembly so the keys enter their corresponding holes in the cabinet top. Also make sure the bosses on the cabinet top pass through their corresponding holes in the keypad and circuit board.

4. Hold the keyboard assembly together while you reposition it as shown in Part C. Then use six press-on retainers to secure the keyboard and keypad to the cabinet top bosses. Use a nutdriver or similar tool to press the retainers against the board.

Refer to Pictorial 4-5 while you perform the following steps.

- () Carefully set the cabinet top onto the cabinet bottom as shown. Be sure all of the LEDs on the LED circuit board enter their corresponding holes in the cabinet top.
- () Use two M3.5 x 12 mm self-tapping screws to secure the front edge of the cabinet and two M3.5 x 18 mm self-tapping screws to secure the rear edge.

This completes the assembly of your IntelliRotor. Proceed to "Installation" in the Operation Manual.

IN CASE OF DIFFICULTY

This section of the Manual is divided into three parts. Use the first part, "General Troubleshooting Information," to search for any trouble that may occur right after you assemble the kit.

The second part, "Troubleshooting Precautions," describes care you should use when you troubleshoot and repair your IntelliRotor. These suggestions are provided to help prevent you from damaging components during servicing.

The third part contains a "Troubleshooting Chart" that lists some specific problems and checks that you can make.

NOTE: It is important that you read the "General Troubleshooting Information" and "Troubleshooting Precautions" sections before you attempt to troubleshoot your IntelliRotor.

GENERAL TROUBLESHOOTING INFORMATION

1. Recheck the circuit board assemblies and wiring. 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. You can, therefore, eliminate many troubles by reheating all of your connections to make sure they are soldered as described on Pages 1-3 and 1-4 of this Manual.
3. Closely examine each circuit board foil to make sure that no solder bridges exist between foils. If you think that you have a solder bridge but are not sure, you can check the foil pattern against the one shown in the "Circuit Board X-Ray Views" beginning on Page 33 of the Operation Manual. To remove a solder bridge, hold a clean soldering iron tip between the two points that are bridged until the excess solder flows down onto the hot tip of the soldering iron. Also examine the component side of the circuit board for solder that may have built up on it.
4. Check each transistor and soldered-in IC to make sure it is correctly installed and properly soldered to the foil.
5. Check the plug-in ICs for proper installation. Make sure the pin 1 end of each IC is toward the index mark on the circuit board (the pin 1 end of each IC should be toward the left). Make sure each pin is in its socket and not bent out or under the IC. If you are not sure about the installation of an IC, remove it so you can check for bent pins.

6. Check each capacitor value. Make sure the correct value capacitor is installed at each capacitor location. Also check electrolytic capacitors to make sure the positive (+) or negative (-) marked lead is in its corresponding circuit board hole.
7. Check each resistor value carefully to be sure that you have wired the correct part into the circuit, as shown in the Pictorials. A resistor that is discolored, cracked, or shows signs of bulging indicates that it is damaged and should be replaced. Since damaged resistors are often the result of some other difficulty (such as incorrect wiring), you should try to determine the cause as well as the effect of the difficulty.
8. Make sure the banded end of each diode is positioned correctly.
9. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.
10. Be sure all component leads are cut off close to the foil on the circuit boards so the leads do not touch together or other foils.

Refer to the "Circuit Board X-Ray Views" and the Schematic to locate the components or circuit areas listed in the "Possible Cause" column of the "Troubleshooting Chart."

Refer to "Semiconductor Identification" beginning on Page 39 of the Operation Manual for identification of diodes, transistors, and IC basing. A cross-reference of Heath part numbers to manufacturer's type numbers is also included.

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.

COMPONENT REPLACEMENT

To remove faulty resistors, capacitors, or diodes, first clip them from their leads on the component side of the circuit board. Then heat the solder on the foil side and allow each lead to fall out of its hole. Preshape the leads of the replacement part and insert them into the circuit board holes. Solder the leads to the foil and cut off any excess lead lengths.

FOIL REPAIR

To repair a break in a circuit board foil, first remove the solder resist coating to expose clean foil. Then bridge solder across the break. Use a length of bare wire to bridge large gaps in the foil. Lay the wire across the gap and solder each end to the foil. Carefully trim off any excess bare wire.

TROUBLESHOOTING PRECAUTIONS

CAUTION: Be especially careful when you remove or install any CMOS integrated circuits. To avoid any confusion, treat all ICs as if they are of this type. Refer to Page 3-10 for special handling procedures.

1. When you make repairs to the IntelliRotor, be sure you eliminate the cause as well as the effect of the trouble. If, for example, you should find a damaged resistor, be sure you find out what damaged the resistor. If the cause is not eliminated, the replacement resistor may also become damaged when you put the IntelliRotor back into operation.
2. In several areas of the circuit board, the foil patterns are quite narrow. When you unsolder a part

to check or replace it, avoid excessive heat while you remove the part. A suction-type desoldering tool makes part removal easier. You can also use the desoldering braid that is supplied with the kit.

3. When you make ohmmeter tests, use only the R x 10, R x 100, or R x 1000 ranges. Higher or lower ranges may impose excessive current or voltage on the IntelliRotor circuitry.

NOTE: In any area where circuit operation appears to be improper, but is not clearly so, you may find it helpful to review the "Circuit Description" in the Operation Manual.

TROUBLESHOOTING CHART

The following chart lists the "Condition" and some "Possible Causes" of some problems you may encounter with your IntelliRotor. If a particular part or area is mentioned (U101, D103, etc.) as a possible cause, check that part to see if it is correctly installed. Also check the parts connected to it for faulty connections. It is also

possible, on rare occasions, for a part to be faulty and require replacement.

NOTE: There is additional troubleshooting information in the Operation Manual beginning on Page 24.

CONDITION	POSSIBLE CAUSE
Missing or incorrect voltage in the power unit at plug P501 pin 1.	<ol style="list-style-type: none">1. Capacitor C501.2. Diodes D501 and D502.3. Fuse F502.4. Jumpers W504 and W505 (120 VAC) or W506 (240 VAC).5. Power transformer T501.
Missing or incorrect voltage in the controller at the OUT lead of U101.	<ol style="list-style-type: none">1. Integrated circuit U101.2. Capacitor C102 or C129.3. Cable between the power unit and the controller.
Missing or incorrect voltage in the controller at U106 pin 28.	<ol style="list-style-type: none">1. Integrated circuit U102.2. Capacitor C101 or C103.3. Diode D101 or D102.4. Cable between the power unit and the controller.
Missing or incorrect voltage in the controller at the IN lead of U101.	<ol style="list-style-type: none">1. Cable between the power unit and the controller.

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath/Zenith Computers and Electronics 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/ZENITH COMPUTER AND ELECTRONICS CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath/Zenith Computer and Electronics 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/Zenith Computer and Electronics 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.

Heath/Zenith Computer and Electronics 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 Heath/Zenith Computers and Electronics 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 bottom half of the page features a series of horizontal stripes. It begins with a thin red line, followed by a wide dark blue band, a thin white line, a wide medium blue band, another thin white line, and finally a wide bright blue band at the very bottom.