Heathkit® Manual

for the

4K STATIC MEMORY

Model H8-1

595-2028-01

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

TABLE OF CONTENTS

INTRODUCTION

The H8-1 4K Static Memory circuit board uses the latest in static memories. These memories require a minimum amount of power while providing fast response. This memory circuit board is organized to allow for the addition of memory in 4K blocks. On-board jumpers allow you to locate the memory board throughout the available memory area. Plug-in capability combined with low density makes this circuit board easy to build and service. Your H8 Digital Computer provides for the addition of memory up to 32K.

NOTE: Build your H8 kit first, the memory board second, and the remainder of the accessories in any order you desire.

PARTS LIST

( ) Unpack the kit and check each part against the following list. The key numbers correspond to the numbers on the "Parts Pictorial" (Illustration Booklet, Page 1). Return any part that is packed in an individual envelope, with the part number on it, back in its envelope after you identify it until that part is called for in a step.

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

— In the Parts List,

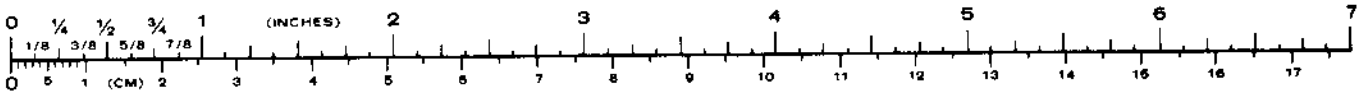
— At the beginning of each step where a component is installed,

— In some illustrations,

— In the Schematic,

— In the section at the rear of the Manual.

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



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

RESISTORS — CAPACITORS

NOTE: The following resistors are 1/4-watt and have a tolerance of 5% (gold fourth band).

A1	1-69-12	4	1000 Ω (brown-black-red) resistor	R101, R102, R103, R104
A2	21-95	20	.1 μF ceramic capacitor	C103, C104, C105, C106, C107, C108, C109, C111, C112, C114, C115, C116, C117, C118, C119, C121, C122, C123, C124, C125
A3	25-221	3	2.2 μF tantalum capacitor	C101, C102, C113

HARDWARE

B1	250-56	6	6-32 × 1/4" screw
B2	252-3	4	6-32 nut
B3	254-1	4	#6 lockwasher

CONNECTORS

C1	432-865	2	Connector shell
C2	432-866	7	Spring connector (1-extra)
C3	432-947	2	Circuit board socket
C4	434-298	2	14-pin IC socket
C5	434-299	1	16-pin IC socket
C6	434-310	8	18-pin IC socket
C7	434-311	4	20-pin IC socket

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

INTEGRATED CIRCUITS (IC's)

IMPORTANT

If any components are missing from the sealed IC package, return the **unopened** package for replacement. Claims for missing IC's will not be honored.

If you locate damaged or defective IC's, order individual replacements. Be sure to follow the standard instructions on the "Parts Order Form" and on the inside rear cover of the Manual. Save defective or damaged components for return instructions.

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

1. Part number.
2. Type number. (For integrated circuits this refers only to the numbers, the letters may vary.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

D1	442-54	2	7805	IC124, IC125
D2	443-728	2	74LS00	IC104, IC105
D3	443-53	1	7442	IC103

CAUTION: The #443-832 IC's can be damaged by static electricity. Do not remove these IC's from the conductive foam until you are instructed to do so in a step.

D4	443-832	8	4044	IC114, IC115, IC116, IC117, IC118, IC119, IC120, IC121
D5	443-754	4	74LS240	IC101, IC102, IC122, IC123

MISCELLANEOUS

	85-2023-1	1	Memory circuit board
E1	204-2308	1	Bracket
E2	266-966	1	Connector key
	490-185	1	Package of Soder Wick* (desoldering braid)
	73-151	1	Double-sided tape (1-3/4")
	344-111	6"	Orange wire
	344-120	6"	Black wire
	344-121	6"	White wire
E3	352-13	1	Silicone grease
	597-260	1	Parts Order Form
	391-34	1	Blue and white label
		1	Assembly Manual (See Page 1 for part number.)

Solder

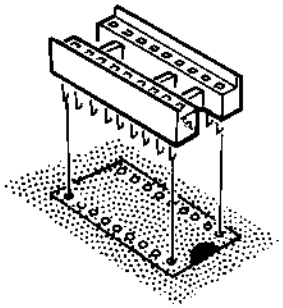
*Registered Trademark, Solder Removal Company

STEP-BY-STEP ASSEMBLY

START

( ) Position the circuit board as shown. Then complete all of the steps in the following Pictorials.

NOTE: The IC sockets that you will install in the following steps can be installed either way in the circuit board. Be sure the pins are straight, insert the pins into the circuit board holes, and solder the pins to the foil as you install each socket.



Install 18-pin IC sockets at:

(✓) IC121 .....

( ) IC114 .....

( ) IC120 .....

( ) IC115 .....

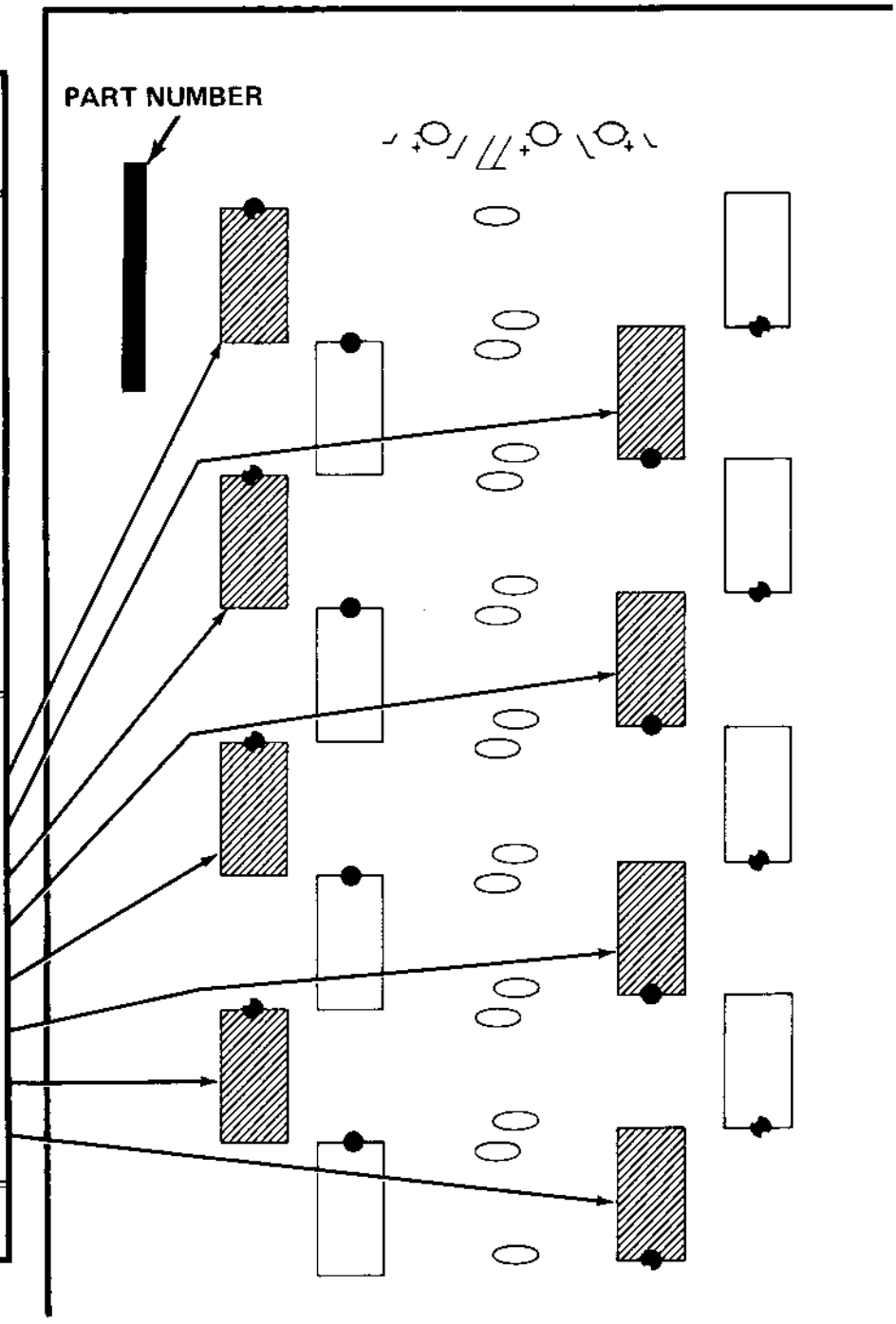
( ) IC119 .....

(✓) IC116 .....

( ) IC118 .....

( ) IC117 .....

NOTE: IC sockets will not be installed at IC106 through IC113.



PICTORIAL 1-1

START

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

Install eight .1 μF ceramic capacitors at:

( ) C123 .....

( ) C118 .....

( ) C122 .....

( ) C117 .....

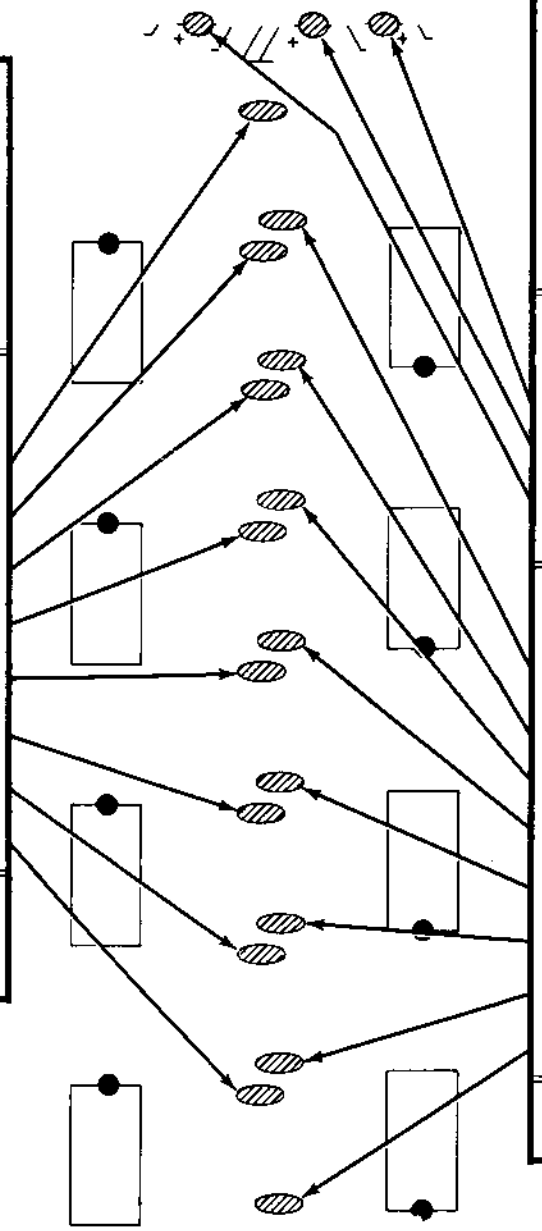
( ) C121 .....

( ) C116 .....

( ) C119 .....

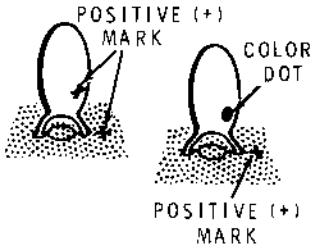
( ) C115 .....

( ) Solder the leads to the foil and cut off the excess lead lengths. Save two cutoff leads for use later.



CONTINUE

NOTE: When you install a tantalum capacitor, always position the positive (+) or dot marked lead of the capacitor in the positive (+) marked hole.



Install three 2.2 μF tantalum capacitors at:

( ) C102.

( ) C101.

( ) C113.

Install eight .1 μF ceramic capacitors at:

( ) C104.

( ) C108.

( ) C105.

( ) C109.

( ) C106.

( ) C111.

( ) C107.

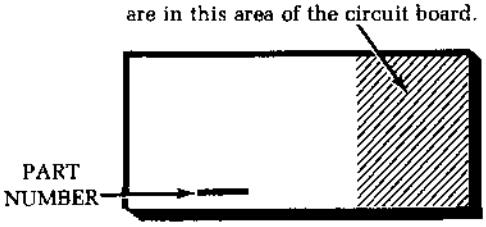
( ) C112.

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

PICTORIAL 1-2

IDENTIFICATION DRAWING

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



START

NOTE: Reposition the circuit board as shown in the identification drawing at the top of this page. The drawing indicates the area of the circuit board that you will be working in.

NOTE: Solder the pins of each IC socket to the foil as you install it.

( ) 16-pin IC socket at IC103.

( ) 20-pin IC socket at IC101.

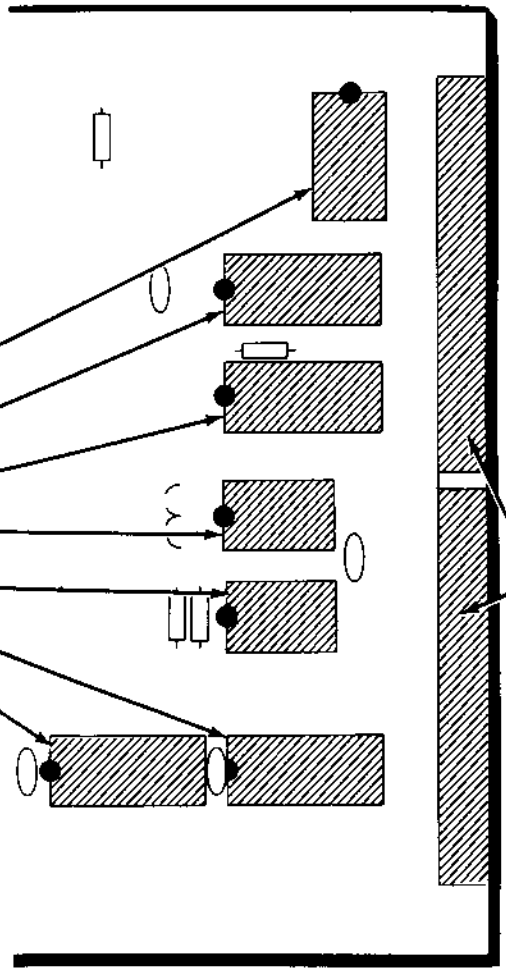
( ) 20-pin IC socket at IC102.

( ) 14-pin IC socket at IC104.

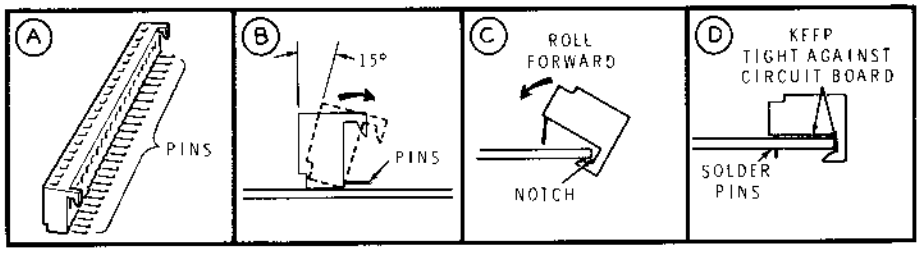
( ) 14-pin IC socket at IC105.

( ) 20-pin IC socket at IC123.

( ) 20-pin IC socket at IC122.



PICTORIAL 1-3



Detail 1-3A

CONTINUE

NOTE: Use the following procedure when you install a circuit board socket:

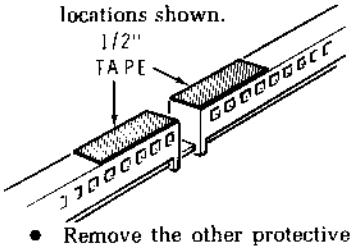
1. Refer to Detail 1-3A, Part A, and position the socket on a hard flat surface with the pins along the surface as shown.
2. Refer to Part B of the Detail, roll the socket forward, and bend the pins up approximately 15°.
3. Refer to Part C and position the connector with its notches against the edge of the circuit board and the pins over the circuit board holes.
4. Refer to Part D, roll the connectors forward, and insert the pins into the circuit board holes. Make sure the socket is tight against the circuit board; then solder two pins at each end of the socket to the foil. Check the socket to make sure it is still tight against the circuit board. Then solder the remaining pins to the foil.

( ) Circuit board socket.

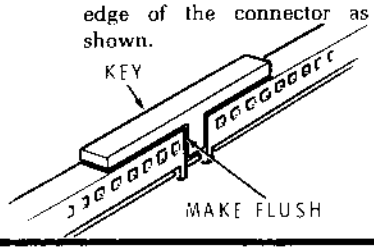
( ) Circuit board socket.

( ) Install the connector key as follows:

- Cut two 1/2" × 1/4" lengths of tape, remove the protective covering from one side of each length, and apply the tape to the connectors at the locations shown.



- Remove the other protective covering from the lengths of tape and press the connector key down onto the tape. Be sure the key is flush with the edge of the connector as shown.

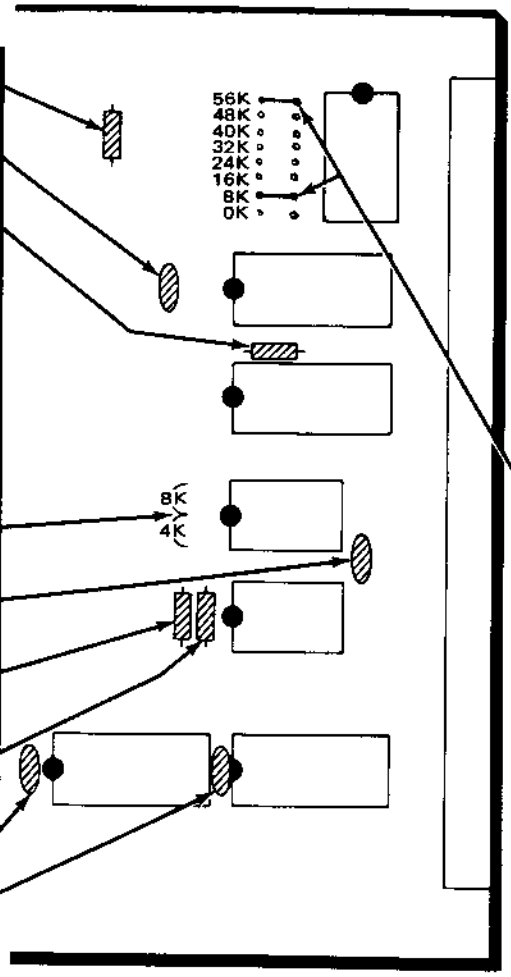


START

- [✓] R101: 1000 Ω (brown-black-red).
- [✓] C103: .1 μF ceramic.
- [✓] R102: 1000 Ω (brown-black-red).

NOTE: When you perform the next step, install the jumper at the 4K position if you do not have the 4K Static Chip Set assessory. If you do have the 4K Static Chip Set accessory, install the jumper at the 8K position.

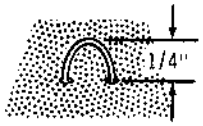
- [✓] 3/4" bare jumper wire. Use a cut off component lead.
- [✓] C114: .1 μF ceramic.
- [ ] R103: 1000 Ω (brown-black-red).
- [ ] R104: 1000 Ω (brown-black-red).
- [ ] C124: .1 μF ceramic.
- [ ] C125: .1 μF ceramic.
- [ ] Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

NOTE: If this is your first (or only) memory circuit board, install the jumper in the next step at 8K. If this memory circuit board is in addition to others that you already have, install the jumper at 56K.

- [ ] Locate a cutoff component lead. Then form the lead into a loop and install it at the proper location (8K or 56K) as described above. Position the top of the loop 1/4" above the top of the circuit board. Then solder the lead to the foil and cut off any excess lead lengths.



PICTORIAL 1-4

START

NOTE: To prepare a wire, as in the next step, first cut the wire to the indicated length, then remove 1/4" of insulation from each end.

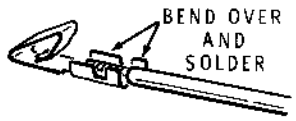
( ) Prepare the following wires:

Two 3" orange

Two 3" black

Two 3" white

( ) Install a spring connector on **one end** of the prepared wires.



NOTE: Disregard any numbers stamped in the housing when you perform the following steps.

( ) Refer to Detail 1-5A and insert the spring connector on the end of an orange wire into hole 3 of a connector shell.

( ) Insert the spring connector on the end of a black wire into hole 2 of the connector shell.

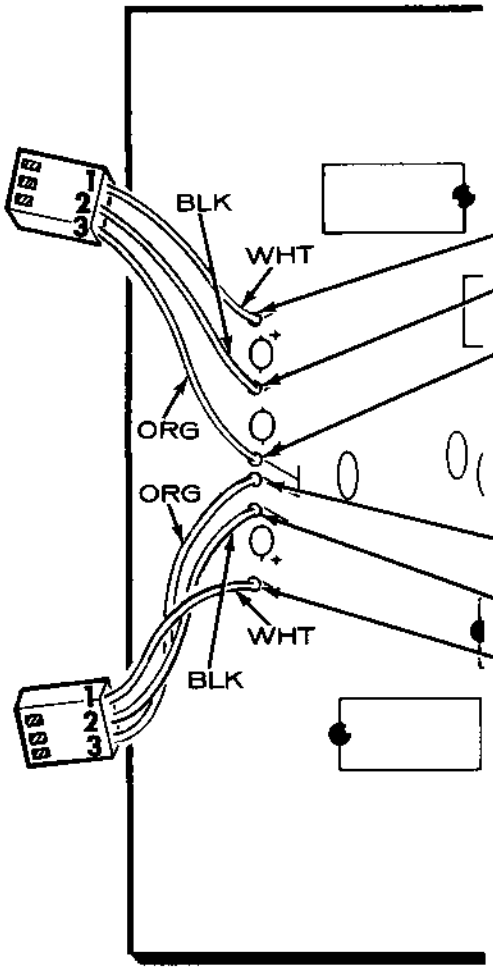
( ) Insert the spring connector on the end of a white wire into hole 1 of the connector shell.

Insert the spring connectors on the remaining wires into the other connector shell as follows:

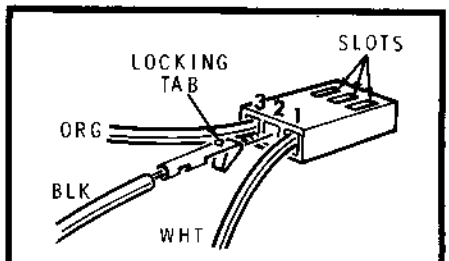
( ) Orange wire into hole 3.

( ) Black wire into hole 2.

( ) White wire into hole 1.



PICTORIAL 1-5



Detail 1-5A

CONTINUE

Connect the wires coming from one of the connector shells to the circuit board as follows. Solder the wires to the foil as you connect them.

( ) White wire to +5V.

( ) Black wire to GND.

( ) Orange wire to +8V.

Connect the wires coming from the remaining connector shell as follows. Solder the wires to the foil as you connect them.

( ) Orange wire to +8V.

( ) Black wire to GND.

( ) White wire to +5V.

CIRCUIT BOARD CHECKOUT

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

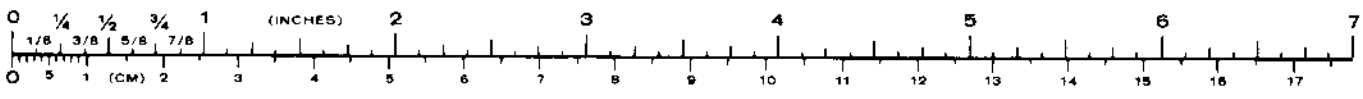
( ) Unsoldered connections.

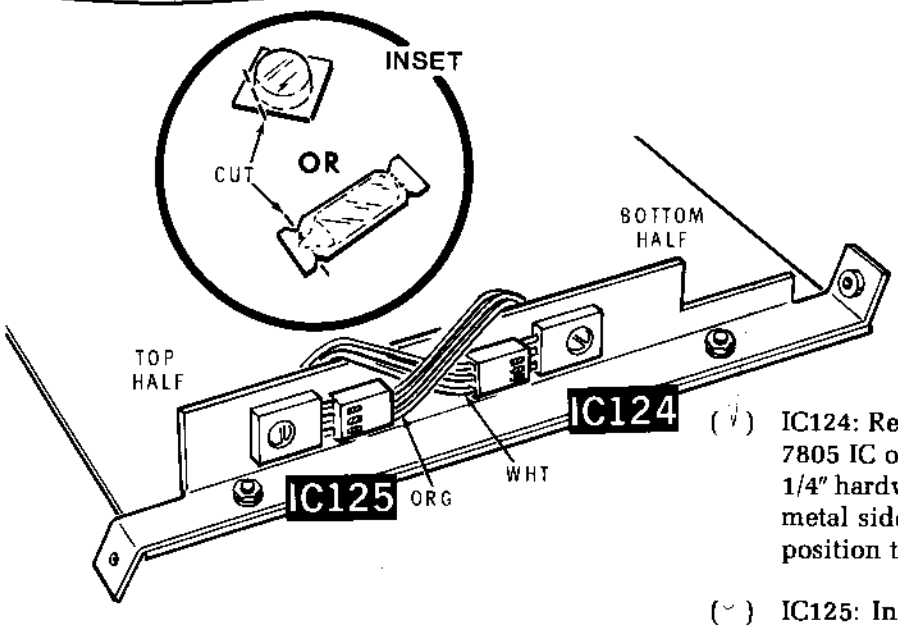
( ) Poor solder connections.

( ) Solder bridges between foil patterns.

( ) Protruding leads which could touch together.

( ) Tantalum capacitors for the correct position of the positive (+) lead.





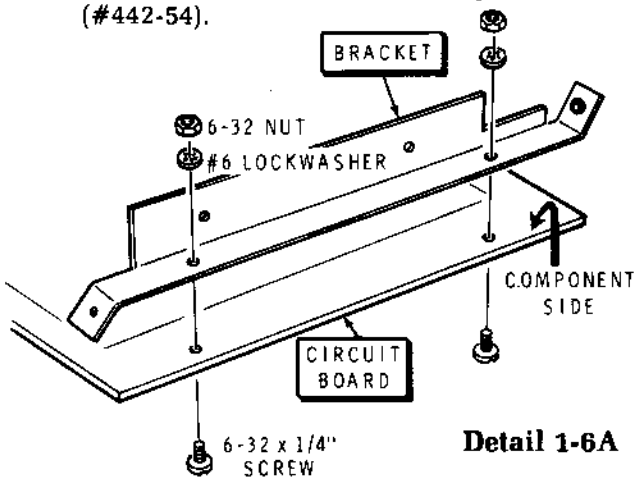
PICTORIAL 1-6

Refer to Pictorial 1-6 for the following steps.

NOTE: When a step calls for hardware, only the screw size is given. For instance, if a 6-32 × 1/4" hardware is called for in a step, it means you should use a 6-32 × 1/4" screw, one or more lockwashers, and a 6-32 nut at each mounting hole. The detail referred to in the step shows the proper number and placement of the lockwashers.

( ) Refer to Detail 1-6A and mount the bracket onto the component side of the circuit board. Use 6-32 × 1/4" hardware and be sure to position the bracket as shown.

( ) Refer to the inset drawing on the Pictorial and open the silicone grease container. Then refer to Detail 1-6B and spread a thin layer of grease on the metal side of two 7805 integrated circuits (#442-54).



Detail 1-6A

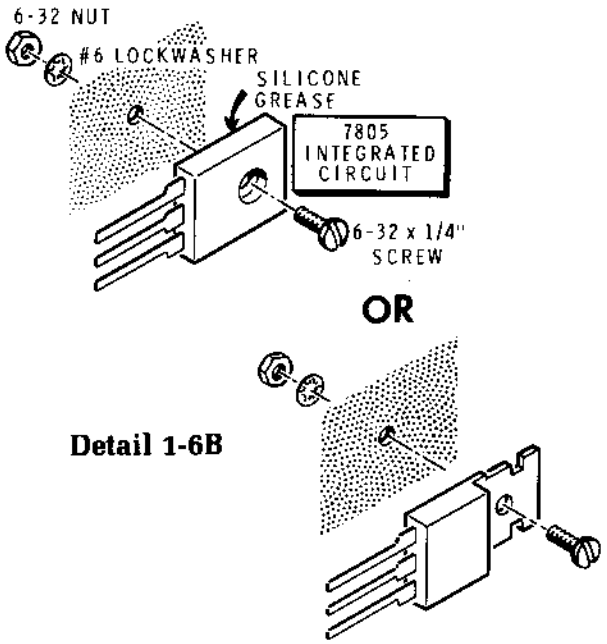
( ) IC124: Refer again to Detail 1-6B and mount a 7805 IC onto the bracket at IC124. Use 6-32 × 1/4" hardware. Be sure to mount the IC with the metal side toward the bracket. Also be sure to position the IC as shown in the Pictorial.

( ) IC125: In the same manner, mount the other 7805 IC onto the bracket at IC125. Use 6-32 × 1/4" hardware and position the IC as shown in the Pictorial.

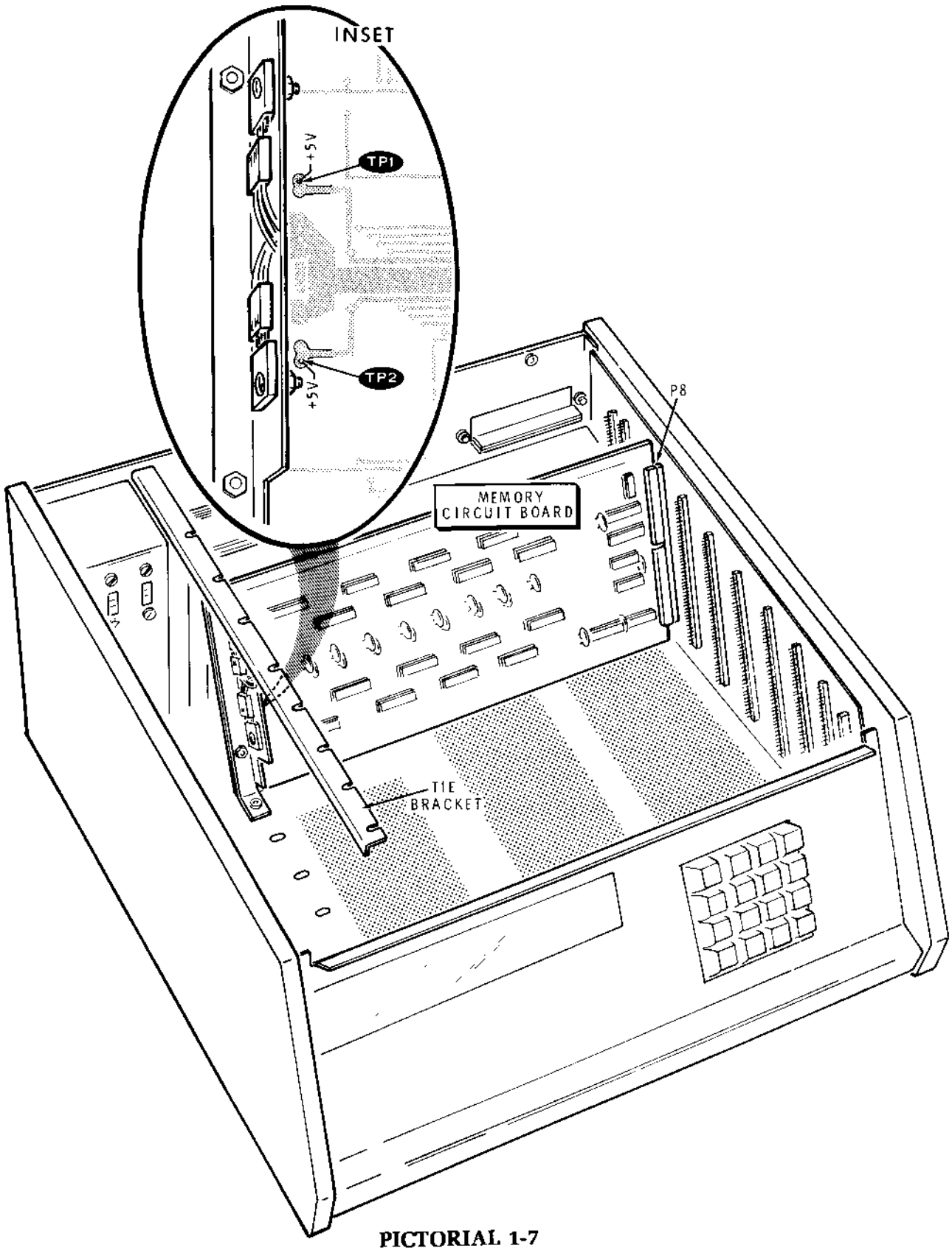
( ) Push the connector shell coming from the top half of the circuit board onto IC124. Be sure to position the connector shell with the white wire as shown.

( ) Push the remaining connector shell (coming from the bottom half of the circuit board) onto IC125. Be sure to position the connector shell with the orange wire as shown.

NOTE: If you have the 4K Static Chip Set accessory at this time, proceed to that kit and assemble it up to "Integrated Circuit Installation." Then return to "Circuit Board Checks" in this Manual.



Detail 1-6B



PICTORIAL 1-7

CIRCUIT BOARD CHECKS

Refer to Pictorial 1-7 for the following steps.

( ) Make sure the POWER switch (on the rear panel of your Computer) is in the OFF position.

( ) Unplug the Computer's line cord.

( ) If not already done, remove the two screws that hold the top cover on the Computer. Then remove the cover.

( ) Remove the tie bracket from the Computer, if not already done.

( ) Position the memory circuit board inside the chassis assembly as shown. Then carefully push the two connectors at S101 on the edge of the circuit board onto the plugs at P8 on the mother circuit board.

( ) Plug the line cord into the proper AC outlet.

NOTE: If you do not obtain the proper results in the following steps, push the POWER switch to OFF and refer to the "Possible Cause" chart which follows each check.

( ) Push the POWER switch to ON. The PWR LED and the RUN LED on the front panel should light.

PROBLEM	POSSIBLE CAUSE
PWR LED and RUN LED do not light.	A. Solder bridge on memory circuit board. B. IC124 or IC125. C. C101.

NOTE: The following checks require a VTVM or VOM. If you do not have one available, remove the memory circuit board from the Computer and carefully inspect the circuit board for solder bridges. Then proceed to "Integrated Circuit Installation."

( ) Connect the common lead of your meter to the chassis.

( ) Set your meter to measure +5 volts DC.

( ) Touch the probe of your VTVM to the indicated foil at TP1 (+5V, white wire). The meter should indicate between +4-3/4 and +5-1/4 volts.

PROBLEM	POSSIBLE CAUSE
TP1 does not indicate between 4-3/4 and 5-1/4 volts.	A. Solder bridge on memory circuit board. B. Wiring error on memory circuit board at IC124. C. IC124. D. C102.

( ) Touch the VTVM probe to the indicated foil at TP2 (+5V, other white wire). The meter should indicate between +4-3/4 and +5-1/4 volts.

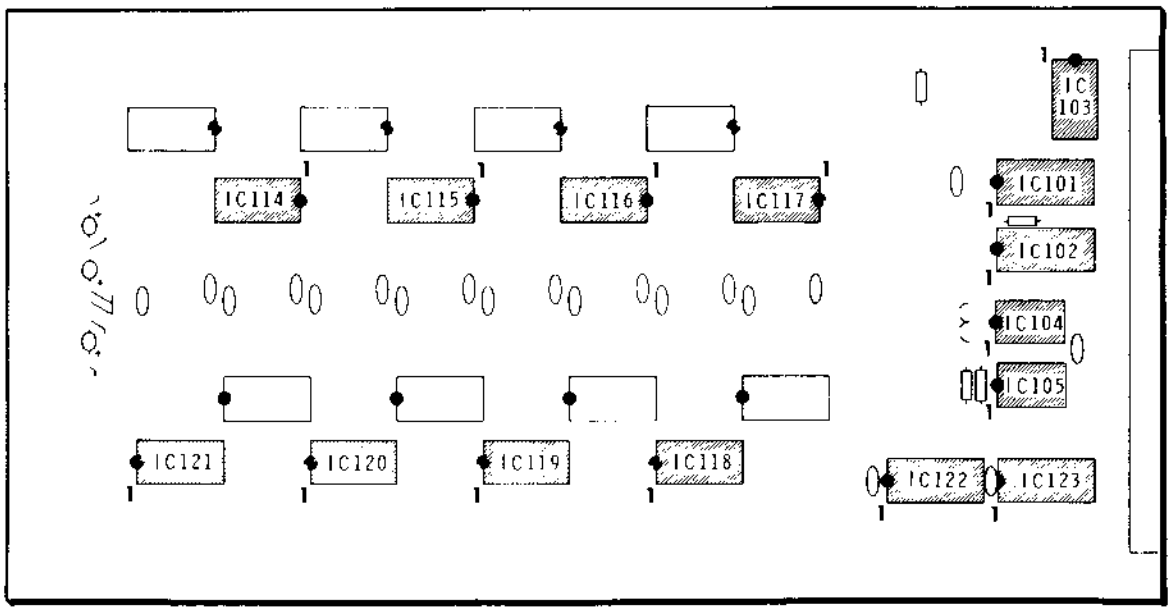
PROBLEM	POSSIBLE CAUSE
TP2 does not indicate between 4-3/4 and 5-1/4 volts.	A. Solder bridge on memory circuit board. B. Wiring error on memory circuit board at IC125. C. IC125. D. C113.

( ) Push the POWER switch to OFF and unplug the line cord.

( ) Disconnect the VTVM from the chassis and memory circuit board.

NOTE: The blue and white label shows the Model Number and Production Series Number of your kit. Refer to these numbers in any communications with the Heath Company about your kit. This assures you that you will receive the most complete and up-to-date information in return.

( ) Carefully peel the backing paper from the blue and white label. Then press the label onto the lower left corner of the rear panel of your H8 Computer. Do not cover up any other labels that may already be preset.



PICTORIAL 1-8

INTEGRATED CIRCUIT INSTALLATION

Refer to Pictorial 1-8 for the following steps.

( ) Be sure the POWER switch is in the OFF position.

( ) Remove the memory circuit board from the Computer.

NOTE: Refer to Detail 1-8A and, as you install each IC in the following steps, position the pin 1 end of each IC (as shown in Part A of the Detail) toward the index mark on the circuit board (see Part B). Then insert the IC leads into the socket and push the IC down into place.

Install IC's as follows:

( ) IC103: 7442 IC (#443-53).

( ) IC101: 74LS240 IC (#443-754).

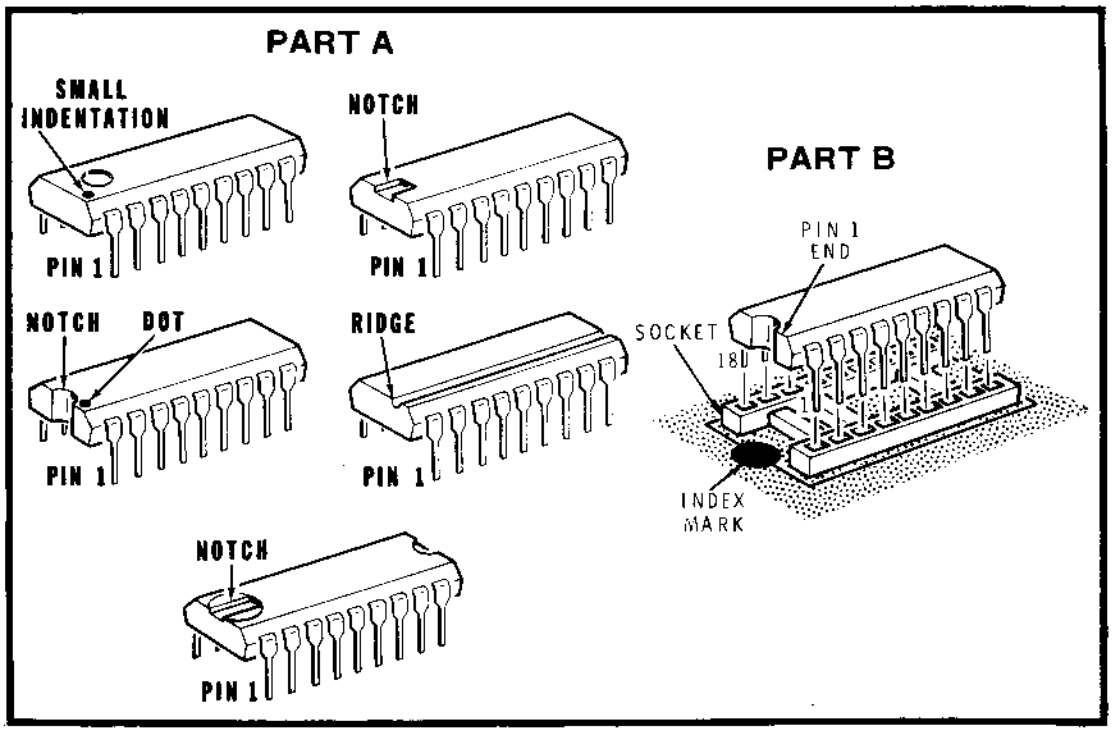
( ) IC102: 74LS240 IC (#443-754).

( ) IC104: 74LS00 IC (#443-728).

( ) IC105: 74LS00 IC (#443-728).

( ) IC122: 74LS240 IC (#443-754).

( ) IC123: 74LS240 IC (#443-754).



Detail 1-8A

NOTE: The integrated circuit that you install in the next step is a rugged and reliable component. However, normal static electricity discharged from your body through an integrated circuit pin to an object can damage the integrated circuit. Read the entire instruction first. Then carefully perform each step without interruption.

( ) IC114: Install a 4044 IC (#443-832) at IC114 as follows:

1. Remove the IC from the conductive foam.
2. Hold the IC in one hand and straighten any bent pins with the other hand.
3. Continue holding the IC, being careful not to touch it to anything and touch the circuit board with your other hand.
4. Install the IC in its socket.

Use the same procedure to install seven 4044 IC's (#443-832) at the following locations:

( ) IC115.

( ) IC116.

( ) IC117.

( ) IC121. **Note the changed position of the index mark.**

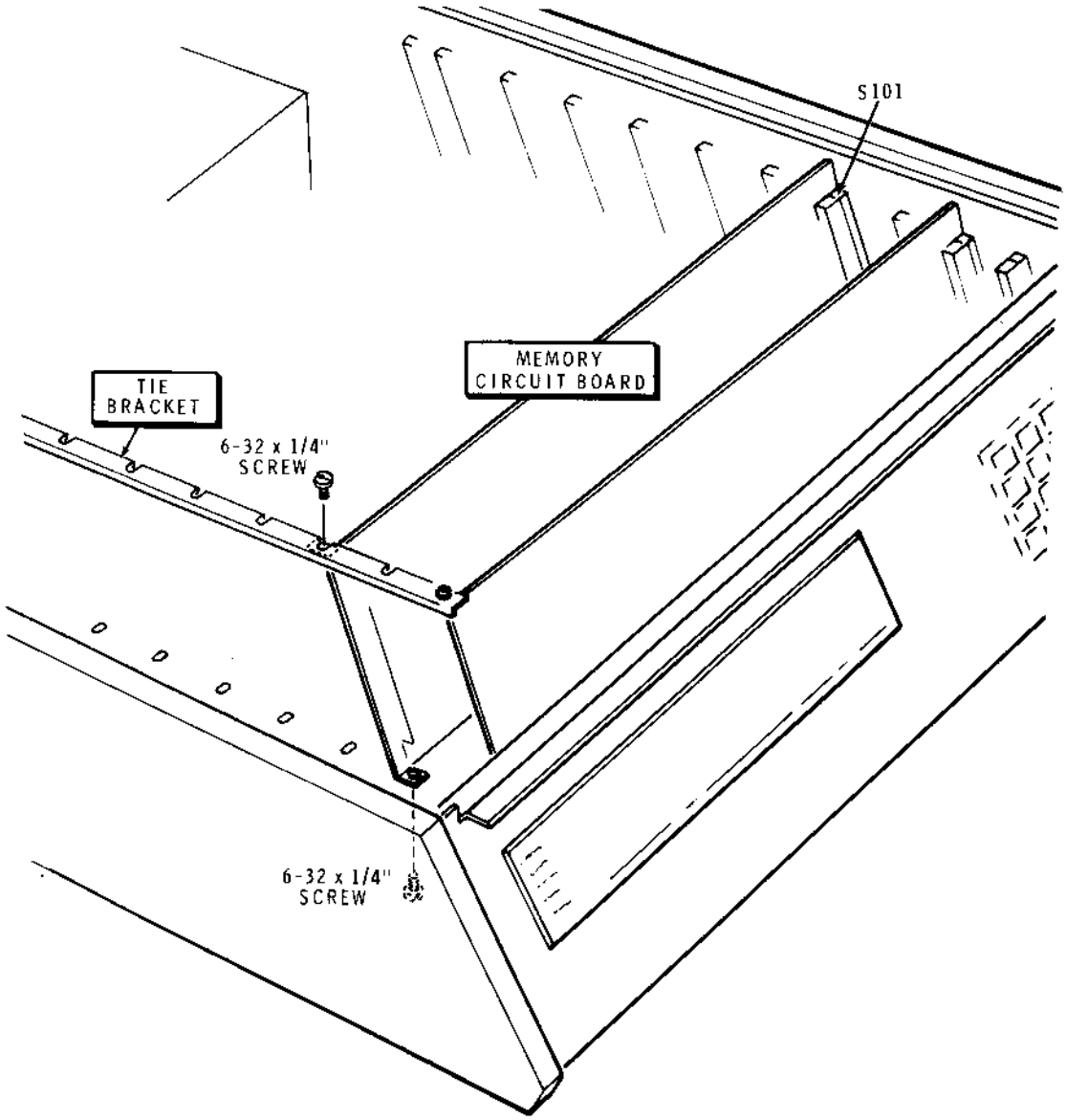
( ) IC120.

( ) IC119.

( ) IC118.

( ) Check all of the IC's in the circuit board for the proper type and installation. **NOTE: If any IC's are incorrectly installed, all of the IC's will be damaged.**

( ) If you are also building the 4K Chip Set accessory at this time, use the same procedure to install the eight 4044 IC's (#443-832) supplied with that kit in the sockets at IC106 through IC113.



PICTORIAL 1-9

Refer to Pictorial 1-9 for the following steps.

NOTE: When you perform the next step, you will be directed to plug the memory circuit board onto a plug on the mother circuit board. Plug this circuit board behind the CPU circuit board or any previously installed memory circuit boards. If possible, leave a space between this circuit board and the other circuit boards. This will give the circuit board extra ventilation.

(✓) Position the memory circuit board inside the chassis assembly as shown. Then carefully push the two connectors at S101 on the circuit board onto the selected plugs on the mother circuit board.

( ) Secure the circuit board to the bottom of the chassis with a 6-32 × 1/4" screw.

( ) Reinstall the tie bracket and top cover on the Computer. Be sure to secure the memory circuit board to the tie bracket with a 6-32 × 1/4" screw.

( ) Make sure the POWER switch is in the OFF position.

( ) Plug the line cord into the proper AC outlet.

( ) Push the POWER switch to ON. The PWR, RUN, MON, and ION LED's should light and the nine LED displays should indicate random numbers.

PROBLEM	POSSIBLE CAUSE
All four LED's do not light. LED displays do not indicate random numbers.	A. Solder bridge on memory circuit board. B. IC101 - IC123 installed wrong. C. 8K or 56K jumper not installed properly. D. Proceed to 2 or 4 in the next step.

( ) Proceed as directed in one of the following:

1. If the ØK-56K jumper is installed at 8K in your circuit board and you obtained the proper results in the above check, proceed to your H8 Operation Manual.

2. If the ØK-56K jumper is installed at 8K in your circuit board and you did not obtain the proper results in the above check, proceed to "Troubleshooting Chart 1" in your H8 Operation Manual.

3. If the ØK-56K jumper is installed at 56K in your circuit board and you obtained the proper results in the above check, proceed to "Memory Test Routine" in this Manual.

4. If the ØK-56K jumper is installed at 56K in your circuit board and you did not obtain the proper results in the above check, proceed to "Troubleshooting" in this Manual.

MEMORY TEST ROUTINE

This test routine exercises the 4K or 8K blocks of memory, which are located at 56K (by the ØK-56K jumper). You will compare the B register in the Computer with the memory while the HL registers hold the address that is being tested. To start the test, you will write 000 into all memory locations, set the B register to 000, and set HL to the starting address. The HL register then increments up to the ending address as it compares each location with the B register. The B register is then incremented to 001 and each memory location is incremented and compared with the B register. This process continues until the B register reaches 377 and repeats the test.

If the content of the memory location (that corresponds to the address in the HL register) does not agree with the value in the B register, the test halts and the alarm "beeps." This returns control to the front panel so you can isolate the failure.

Refer to "Use of the Front Panel" in your H8 Operation Manual to enter the following routine. NOTE: A more complete listing of this routine is in your H8 Operation Manual.

( ) Press MEM and enter 040 100.

( ) Press ALTER and enter the following bytes:

Address	data	
040 100	041	
040 101	000	
040 102	340	
040 103	021	
040 104	377	For 4K board, use 357
040 105		For 8K board, use 377
040 106	066	
040 107	000	
040 110	315	
040 111	147	
040 112	040	
040 113	043	
040 114	302	
040 115	106	
040 116	040	
040 117	006	
040 120	000	
040 121	052	
040 122	101	
040 123	040	
040 124	004	
040 125	064	

040 126	176
040 127	270
040 130	312
040 131	135
040 132	040
040 133	166
040 134	000
040 135	315
040 136	147
040 137	040
040 140	043
040 141	302
040 142	125
040 143	040
040 144	303
040 145	121
040 146	040
040 147	172
040 150	254
040 151	300
040 152	173
040 153	255
040 154	311

( ) Press MEM.

( ) Enter 040 100.

( ) Press the + key and verify that you have entered the routine correctly.

( ) Press REG.

( ) Press PC.

( ) Press ALTER.

( ) Enter 040 100.

( ) Press REG.

( ) Press BC.

( ) Press GO.

If the test routine is executed without difficulty, the B register (left 3 digits in the display) will increment from 000 to 377. When the display reaches 377, the test is complete and may be halted (press RESET and ∅). Proceed directly to "Memory Assignment."

If the test routine fails, the speaker will sound and the B register will indicate the memory **content** at which the test failed. The HL registers (press REG and HL) will display the memory **address** at which the test failed.

Memory failures generally fall in two categories: address and data. In a data failure, a particular number (or group of numbers) between 000 and 377 can not be written and then recalled from the memory. This may be caused by faulty data buffers, a solder bridge, or defective cells in the memory IC's. Since there are eight memory IC's, one for each bit of the byte, it is possible to write a combination of bytes at the address where the test failed and determine which IC is at fault. Observe the static electricity precautions required by MOS devices and interchange the memory IC's. The difficulty should move when the memories are interchanged between bits. Table A will help you locate each memory IC.

		LOWER 4K	UPPER 4K
Least significant data digit.	D_0	IC114	IC106
	D_1	IC115	IC107
	D_2	IC116	IC108
	D_3	IC117	IC109
	D_4	IC118	IC110
	D_5	IC119	IC111
Most significant data digit.	D_6	IC120	IC112
	D_7	IC121	IC113

Table A

Addressing faults are the most difficult to isolate. They can be caused by solder bridges on the circuit board or by failures in the memory IC's. When address lines are bridged together, held high or low, the CPU is unable to access the memory locations requested. Often, more than one address will access the same location. If you recall the way the memory test operates, you can see that a given location will be incremented too often and cause the test to fail. When the memory test halts, try to write the current number (in the B register) in that memory location. If you can write the number into the location, the fault is address related.

These faults are difficult to locate, but a pattern will be evident if you study all of the failed address locations. (When Computer is displaying the HL register, press the GO button after each failure and the test will proceed to the next failure.) The most practical approach is to inspect the circuit board for mechanical faults and then substitute the memories, one at a time, until you locate the problem.

If the memory test does not operate at all, proceed to "Troubleshooting" in this Manual.

MEMORY ASSIGNMENT

The H8 system requires the memory to start at 8K (refer to "System Considerations" in your H8 Operation Manual and the address table under "Circuit Description" in this Manual). This memory is normally located in one continuous block. Since your first H8-1 circuit board must be located at 8K, additional circuit boards must be located at 16K, 24K, etc. to 56K. Since a memory circuit board with only 4K installed (H8-1 without H8-3 accessory) would leave a 4K opening, only one 4K circuit board should be used and it should be located at the top or high end of the memory.

( ) Push the Computer POWER switch to OFF.

( ) Remove the memory circuit board from the Computer.

( ) Remove the 56K jumper wire from the circuit board and install it at the proper location (as determined above). Also be sure the 4K/8K jumper is in the correct location (at 4K for 8 memory IC's and at 8K for 16 memory IC's).

( ) Reinstall the circuit board in the Computer.

TROUBLESHOOTING

Refer to the "X-Ray Views" and "Schematic Diagram" to locate the various components.

The following symbols and procedures are used in the troubleshooting charts:

Follow the "YES" arrow when you obtain the proper result or condition.

Follow the "NO" arrow when you do not obtain the proper result or condition.

This symbol indicates a bus pin connection.

This symbol indicates a wire connection to a circuit board.

- N/O means non-operative. If a component is N/O, be sure to check the associated circuitry for wiring errors, assembly errors, and solder bridges, (etc.) on customer-assembled units. For factory-assembled units, disregard any references to wiring errors or solder bridges (etc.) as possible causes of trouble.

- Unless they are specifically called for, pulse width and pulse shape are not measured. Only the excursion between TTL high and TTL low states is important for these tests.

- You may use a logic probe instead of an oscilloscope for all measurements. Where noted, a logic probe is preferred instead of an oscilloscope.

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

TROUBLESHOOTING TEST ROUTINE

Enter the following memory test routine:

( ) Press MEM and enter 040 100.

( ) Press ALTER and enter the following data bytes:

Address	Data
040 100	062
040 101	000
040 102	340
040 103	057
040 104	062
040 105	000
040 106	340
040 107	072
040 110	000
040 111	340
040 112	062
040 113	000
040 114	360
040 115	057
040 116	062
040 117	000
040 120	360
040 121	072
040 122	000
040 123	360
040 124	303
040 125	100
040 126	040

( ) Press MEM and enter 040 100.

( ) Press the + key and verify that you have entered the routine correctly.

( ) Press REG.

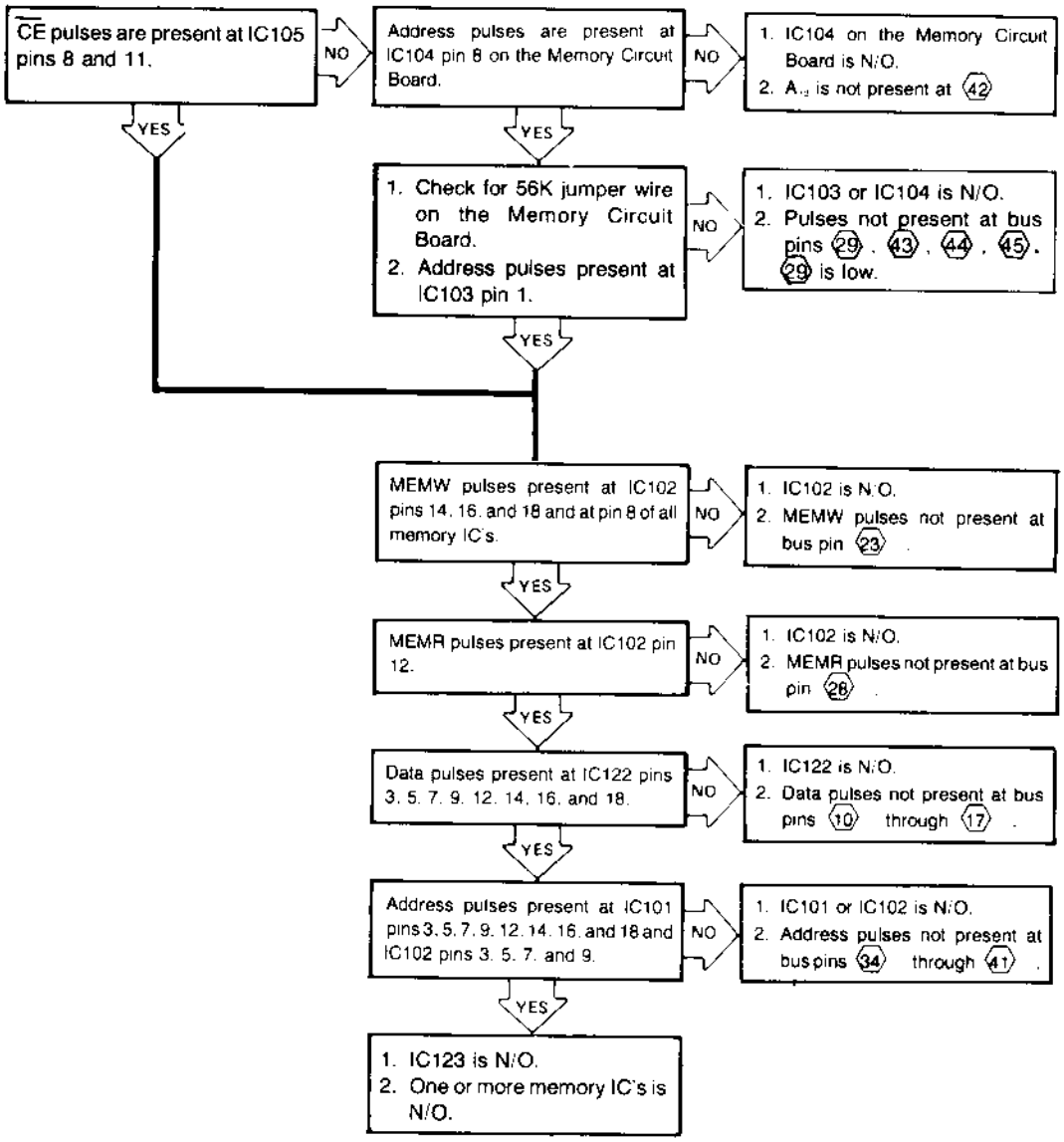
( ) Press PC.

( ) Press ALTER and enter 040 100.

( ) Press ALTER.

( ) Press GO.

( ) Proceed to the following test chart.


$\overline{CE}$ pulses are present at IC105 pins 8 and 11.
NO
Address pulses are present at IC104 pin 8 on the Memory Circuit Board.
NO
1. IC104 on the Memory Circuit Board is N/O.
2. A_{15} is not present at (42)
YES
YES
1. Check for 56K jumper wire on the Memory Circuit Board.
2. Address pulses present at IC103 pin 1.
NO
1. IC103 or IC104 is N/O.
2. Pulses not present at bus pins (29), (43), (44), (45). (29) is low.
YES
MEMW pulses present at IC102 pins 14, 16, and 18 and at pin 8 of all memory IC's.
NO
1. IC102 is N/O.
2. MEMW pulses not present at bus pin (23).
YES
MEMR pulses present at IC102 pin 12.
NO
1. IC102 is N/O.
2. MEMR pulses not present at bus pin (28).
YES
Data pulses present at IC122 pins 3, 5, 7, 9, 12, 14, 16, and 18.
NO
1. IC122 is N/O.
2. Data pulses not present at bus pins (10) through (17).
YES
Address pulses present at IC101 pins 3, 5, 7, 9, 12, 14, 16, and 18 and IC102 pins 3, 5, 7, and 9.
NO
1. IC101 or IC102 is N/O.
2. Address pulses not present at bus pins (34) through (41).
YES
1. IC123 is N/O.
2. One or more memory IC's is N/O.

SPECIFICATIONS

Organization	4096 × 8. 8192 × 8 with the H8-3 accessory.
Access Time	450 nsec maximum.
Interface	Compatible with H8 bus. All inputs are 1 TTL load or less. Data out buffer: 74S240.
Power Requirements	7 - 12 volts DC at 1.25 amperes for 8192 bytes; .75 amperes for 4096 bytes.

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

CIRCUIT DESCRIPTION

Refer to the Schematic while you read this "Circuit Description." The following paragraphs are broken down into two groups called "Address Decoding" and "Read and Write Control."

ADDRESS DECODING

Integrated circuit IC103 operates as a 3-line to 8-line decoder which looks at the three highest address lines ($\overline{A15}$, $\overline{A14}$, and $\overline{A13}$). This decoder resolves the 16-bit address domain into eight blocks of 8,192 locations (8-bit bytes). A given block of addresses is enabled by a jumper which connects the appropriate decoder output. These addresses are abbreviated on the memory circuit board as follows:

ABBREVIATION	DECIMAL	OCTAL (HIGH BYTE)
ØK	0	000
8K	8,192	040
16K	16,384	100
24K	24,576	140
32K	32,768	200
40K	40,960	240
48K	49,152	300
56K	57,344	340

Integrated circuits IC104 and IC105 use address line $\overline{A12}$ to further decode the address into two blocks of 4,096 addresses. Thus, if the $\overline{A12}$ line is not asserted (is not high), the lower half of the selected 8,192 addresses is enabled. When $\overline{A12}$ is asserted (is high), the upper half is enabled.

The lower 12 bits of the address are buffered and inverted by IC101 and 1/2 of IC102 and are then applied directly to all of the memory IC's (IC106 through IC121). All of the remaining address decoding is done internally in the memory IC's.

Integrated circuits IC114 through IC121 comprise the lower 4,096 bytes while IC106 through IC113 comprise the upper 4,096 bytes.

READ AND WRITE CONTROL

When the chip enable ($\overline{CE}$) terminal of a memory IC is asserted, the storage cell selected by address lines AØ through A11 is connected to the data out pin of the IC. This memory output is buffered by IC123 and is then interconnected to the data bus of the Computer.

When both the upper and lower groups of an 8K memory block are present on the circuit board, the decoded 8K signal from IC103 is connected to the control gate of the remaining half of IC102. This allows the memory read signal on the bus to turn on the output buffers when you address any location in the selected 8K block.

When the circuit board is only populated to 4,096 bytes, the $\overline{CE1}$ signal is connected to the control gate (pin 1) of IC102.

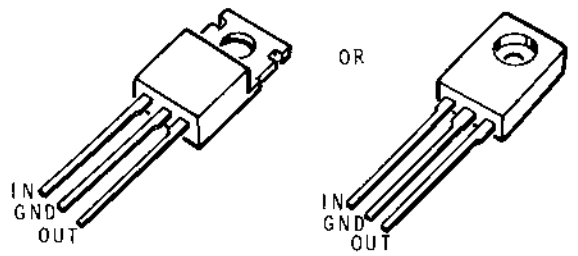
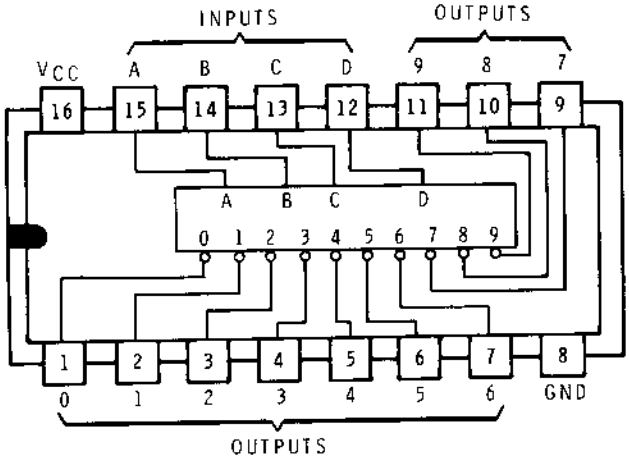
When the chip enable ($\overline{CE}$) and write enable ($\overline{WE}$) signals are both present, the logic state present at the input terminal of the memory IC will be stored in the memory cell that is addressed by the A0 through A11 lines.

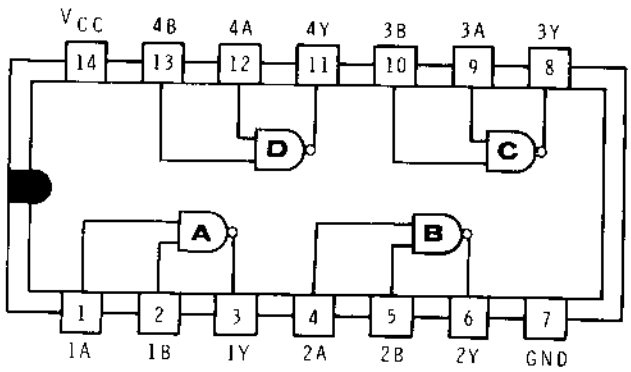
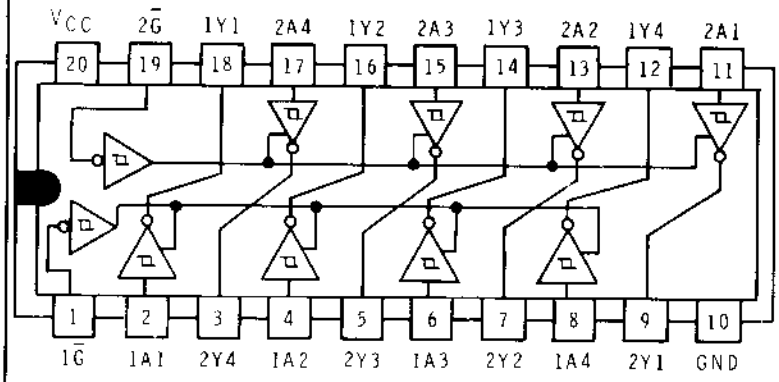
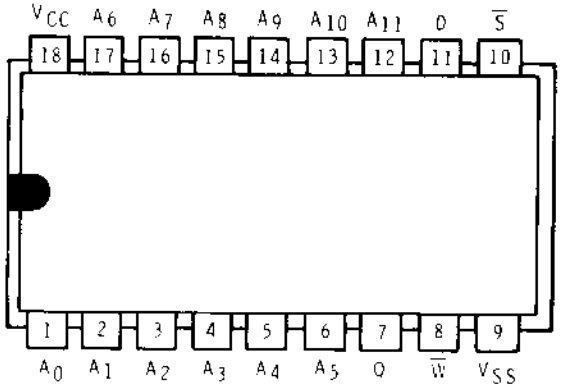
The memory write (MW) pulse is buffered and controlled by IC102 and the memory write signal is then gated to the memory IC's, if the selected 8K block has been addressed. The $\overline{WE}$ signal pulse also turns on the data receiver, IC122.

INTEGRATED CIRCUIT IDENTIFICATION CHART

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER
IC101, IC102	443-754
IC103	443-53
IC104, IC105	443-728
IC106-IC121*	443-832
IC122	443-754
IC123	443-753
IC124, IC125	442-54

*IC106-IC113 ARE PART OF THE 4K CHIP SET ACCESSORY.

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
442-54	7805	IC124, IC125	5 VOLT REGULATOR	
443-53	7442	IC103	4 LINE TO 10 LINE DECODER	

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-728	74LS00	IC104, IC105	QUAD 2-INPUT POSITIVE NAND GATE	
443-754	74LS240	IC101, IC102, IC122, IC123	OCTAL BUFFERS 3-STATE OUTPUTS	
443-832	4044	IC106-IC121*	4096 WORD BY 1-BIT STATIC RANDOM-ACCESS MEMORY	

* IC106 - IC113 ARE PART OF THE 4K CHIP SET ACCESSORY.