

Heathkit[®] Manual

for the

BREADBOARD/ INTERFACE CARD Model H8-7

ASSEMBLY

595-2081

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

Your Heathkit Model H8-7 Breadboard/Interface Card allows you to easily breadboard interfaces, memory, experimental, or other custom circuits for special applications. The Card has:

- Bidirectional data buffers.
- Address decoding circuitry.

- Two, 1-ampere, 5-volt regulators.
- Many solderless connectors for breadboarding.

NOTE: Be sure you build the H8 Computer first, the memory board second, and the H9 Terminal third before you assemble this Breadboard/Interface Card.

This product is intended for those who are experienced with computer interfacing circuits and techniques. Since the components supplied on this Card become part of the circuit designed by the user, Heath Consultation services can only verify proper operation of these components.



PARTS LIST

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 sections at the rear of the Manual.

A separate "Illustration Booklet" contains numbered illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. The Step-by-Step Assem-

bly instructions will direct you to the proper illustration in the booklet. After you complete the assembly of your kit, place the Illustration Booklet with the Assembly Manual and save it for future reference.

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

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

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

CAPACITORS

A1	21-95	6✓	.1 μ F ceramic	C101, C102, C103, C104, C105, C106
A2	25-221	4✓	2.2 μ F tantalum	C107, C108, C109, C110

TRANSISTORS — INTEGRATED CIRCUITS (IC's)

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

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one shown.

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 the package has been opened.

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

Transistors — Integrated Circuits (cont'd.)

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.

B1	442-54	2✓	μ A7805	IC9, IC10
B2	443-728	1✓	74LS00	IC107
B2	443-730	1✓	74LS74	IC106
B2	443-872	2✓	74LS14	IC104, IC105
B3	443-53	1✓	7442	IC101
B3	443-822	1✓	74LS139	IC102
B4	443-754	2✓	74LS240	IC103, IC108

CONNECTORS

C1	432-865	2✓	3-hole connector shell
C2	432-866	7✓	Spring connector (1 extra)
C3	432-875	4✓	Large connector block with connector strips
C4	432-913	5✓	Medium connector block
C5	432-973	5✓	Small connector block
C6	432-947	2✓	25-pin connector



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

SOCKETS

D1	434-298	4-	14-pin socket	
D2	434-299	2-	16-pin socket	
D3	434-311	2-	20-pin socket	

HARDWARE

E1	250-163	22	#4 × 5/16" self-tapping screw	
E2	250-56	6-	6-32 × 1/4" screw	
E3	252-3	4	6-32 nut	
E4	254-1	4	#6 lockwasher	

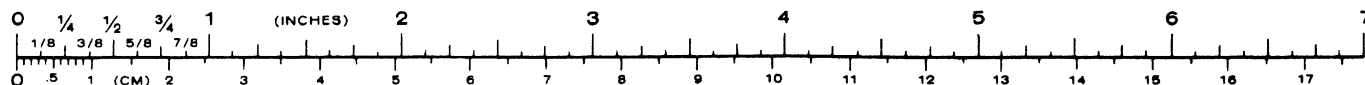
WIRE

344-111	6"	Orange wire
344-120	6"	Black wire
344-121	6"	White wire

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

MISCELLANEOUS

	73-151	1-3/4"	Double-sided tape	
	85-2071-1	1	Circuit board	
F1	204-2308	1	Bracket	
F2	266-966	1-	Connector key	
F3	352-13	1	Silicone grease	
F4	391-34	1	Blue and white label	
	490-185	1-	Solder braid	
F5	490-189	1	IC puller	
			Solder	
	597-260	1	Parts Order Form	
			Assembly Manual (See Page 1 for part number.)	



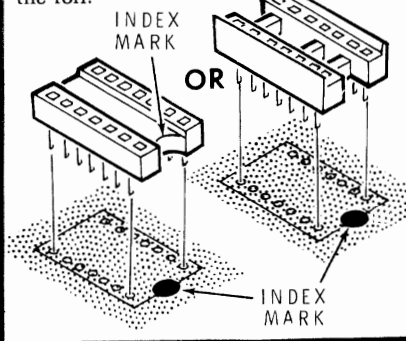
STEP-BY-STEP ASSEMBLY

CIRCUIT BOARD

START

NOTE: If you ever have to unsolder a connection, use the solder braid. See the instructions provided with the braid.

NOTE: 14-pin, 16-pin, and 20-pin IC sockets are used in this kit. Be very careful when you install the sockets, as it is possible to place a 14-pin socket in a 16-pin socket location by mistake. Make sure all pins are straight and insert the socket pins into the circuit board holes. The index mark on the circuit board must still be visible after a socket is installed. Solder the pins to the foil.



16-pin IC sockets at:

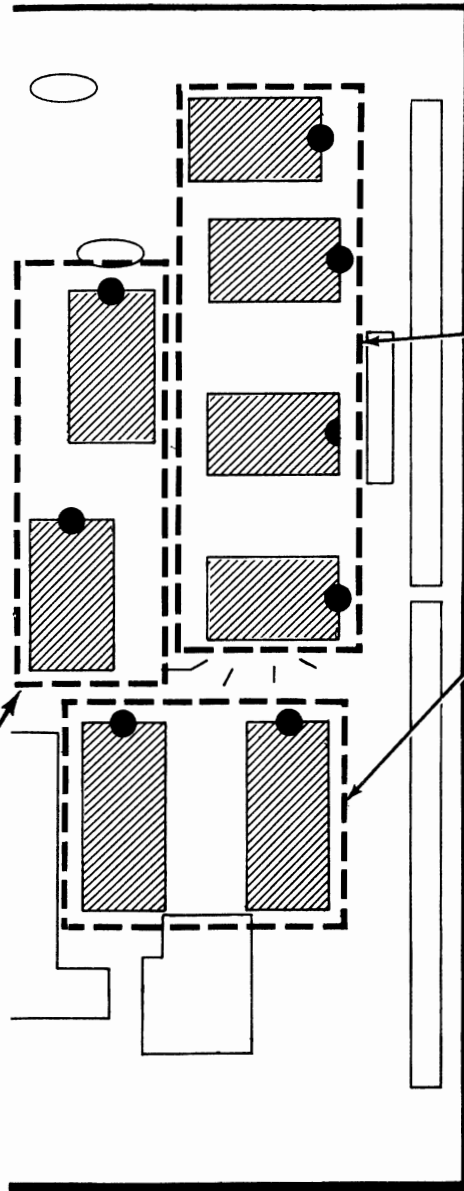
- (/) IC101
- (/) IC102

IDENTIFICATION DRAWING

PART NUMBER



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



CONTINUE

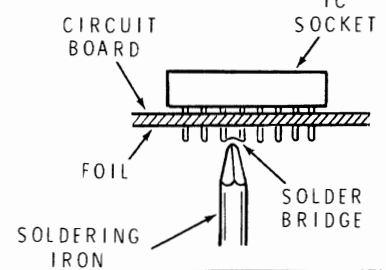
14-pin IC sockets at:

- (/) IC104.
- (/) IC105.
- (/) IC106.
- (/) IC107.

20-pin IC sockets at:

- (/) IC103.
- (/) IC108.

Carefully check each socket for solder bridges between pins. If a solder bridge has occurred, hold the circuit board foil-side-down as shown, and hold the soldering iron tip between the two points that are bridged. The solder will flow down the soldering iron tip.



PICTORIAL 1-1

IDENTIFICATION
DRAWING

PART
NUMBER

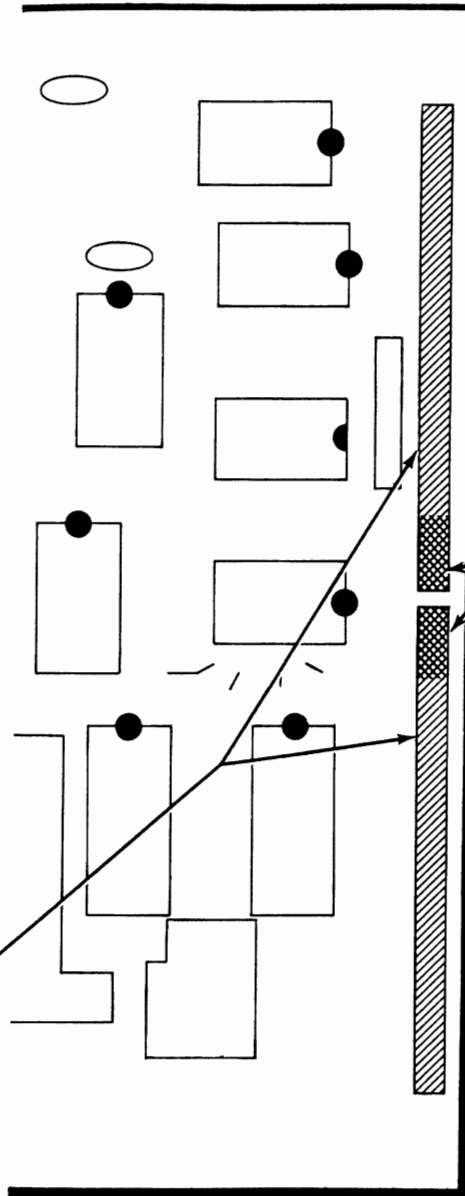
The steps performed in this Pictorial are
in this area of the circuit board.

START →

NOTE: When you install a 25-pin connector:

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

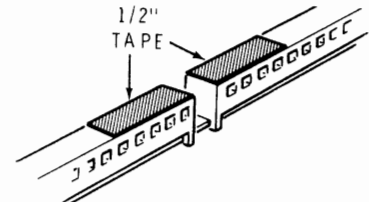
() S101: Install two 25-pin connectors.



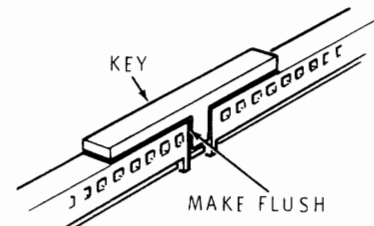
CONTINUE →

(✓) Install the connector key as follows:

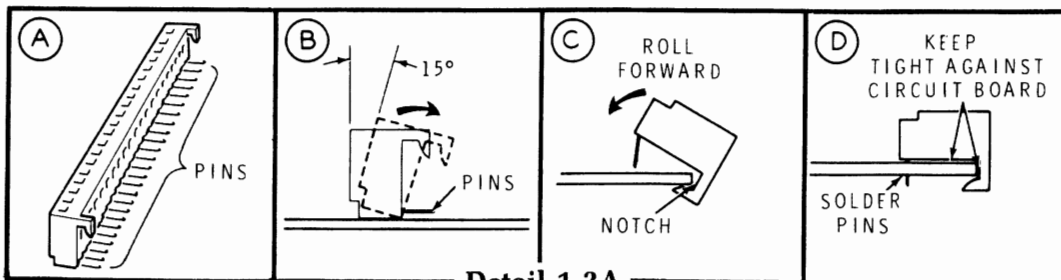
- Cut two 1/2" × 1/4" lengths of double-sided tape, remove the protective covering from one side of each length, and apply the tape to the connectors at the locations shown.



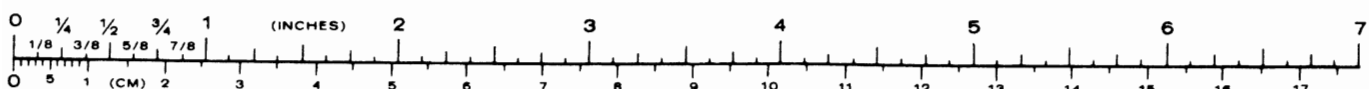
- Remove the other protective covering from the lengths of tape and press the connector key down onto the tape. Be sure the key is flush with the edge of the connector as shown.

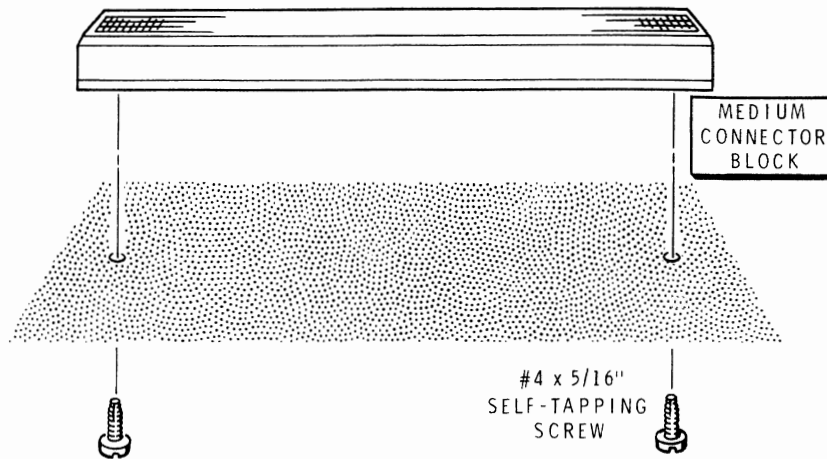


PICTORIAL 1-2



Detail 1-2A



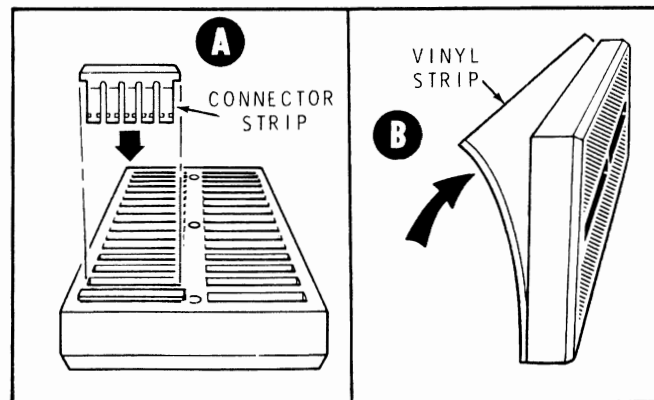


Detail 1-3A

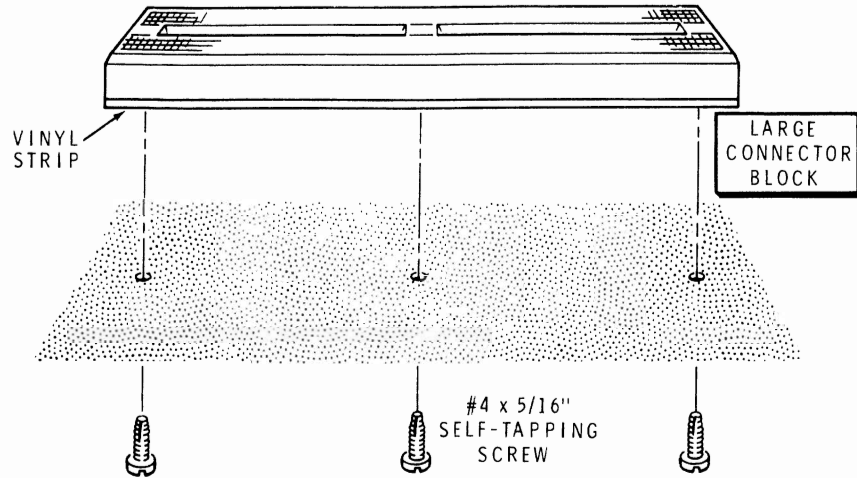
Refer to Pictorial 1-3 (Illustration Booklet, Page 2) for the following steps.

- (/) Refer to Detail 1-3A and mount a medium connector block at B. Use two #4 × 5/16" self-tapping screws.
- (/) In a similar manner, mount the other four medium connector blocks at D, G, K, and N.
- (/) Refer to part A of Detail 1-3B and install the connector strips (supplied with a large connector block) into a block in the manner shown. NOTE: You may have some connector strips left over.

- (/) Turn the connector block right side up and, with a screwdriver handle or similar tool, tap on the top of the block until all the connector strips are fully seated up into the block.
- (/) Refer to part B of Detail 1-3B and remove the paper backing from the vinyl strip supplied with the connector block. Position the connector as shown, line up the long edge of the vinyl strip with the long edge of the connector block, and firmly press the strip onto the block.
- (/) In a similar manner, install connector strips in the other three large connector blocks.



Detail 1-3B



Detail 1-3C

Refer to Detail 1-3C and mount a large connector block at C. First, use a knife point or other sharp instrument and poke the three holes in the vinyl strip. Then mount the block with three #4 × 5/16" self-tapping screws.

- (✓) In a similar manner, mount the other three large connector blocks at F, J, and M.
- (✓) Refer to Detail 1-3D and mount a small connector block at A.
- (✓) In a similar manner, mount the other four small connector blocks at E, H, L, and P.
- () C101: Refer to Detail 1-3E and install a .1 μF ceramic capacitor at C101. Solder the leads to the foil and cut off the excess lead lengths.
- () C102-C106: In a similar manner, mount .1 μF ceramic capacitors at C102, C103, C104, C105, and C106.

INSTALL SMALL CONNECTOR BLOCKS IN THE FOLLOWING MANNER:

A

SMALL CONNECTOR BLOCK

BE SURE THE METAL TABS ARE STRAIGHT THEN INSTALL THE BLOCK.

B

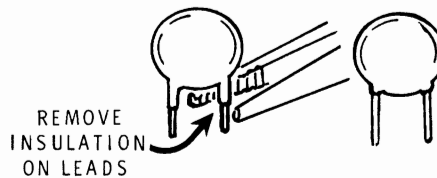
SOLDER THE METAL TABS TO THE FOIL.

C

FLATTEN THE END POSTS WITH YOUR SOLDERING IRON TIP.

Detail 1-3D

BEFORE YOU INSTALL CERAMIC CAPACITORS, USE LONG-NOSE PLIERS TO REMOVE THE EXCESS INSULATION FROM THE CAPACITOR LEADS.

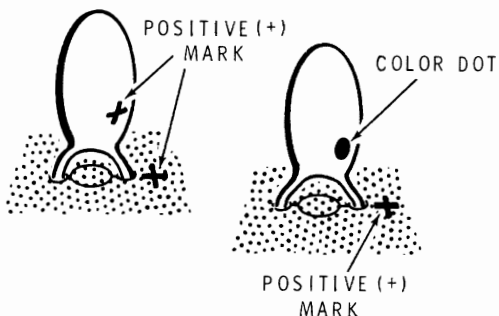


Detail 1-3E





NOTE: WHEN YOU INSTALL TANTALUM CAPACITORS, BE SURE TO POSITION THE POSITIVE (+) OR COLOR DOT MARKED LEAD IN THE POSITIVE MARKED HOLE IN THE CIRCUIT BOARD.

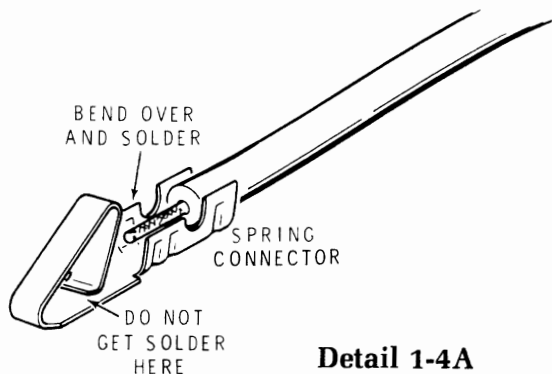


Detail 1-3F

- (✓) C107: Refer to Detail 1-3F and install a 2.2 μ F tantalum capacitor at C107. Solder the leads to the foil and cut off the excess lead lengths.
- (✓) C108-C110: In a similar manner, mount 2.2 μ F tantalum capacitors at C108, C109, and C110.

Refer to Pictorial 1-4 (Illustration Booklet, Page 2) for the following steps.

- (✓) Prepare the following lengths of stranded wire. Remove 1/8" of insulation from one end of each wire and 1/4" from the other end.
 - (2) 3" orange
 - (2) 3" black
 - (2) 3" white
- (✓) Refer to Detail 1-4A and install a spring connector onto the 1/8" end of an orange wire.
- (✓) In the same manner, install a spring connector onto the 1/8" end of each of the other prepared wires.

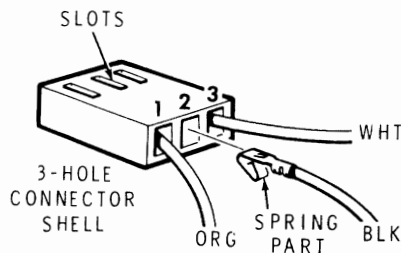


Detail 1-4A

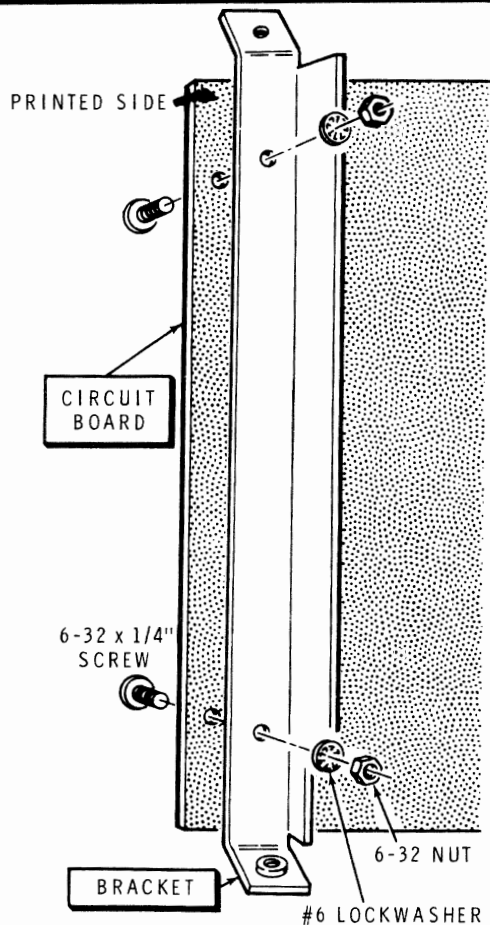
- (✓) Refer to Detail 1-4B and position a 3-hole connector shell as shown with the slotted side up. Then insert the spring connector on one of the orange wires into hole 1. Be sure to position the spring part of the connector away from the slotted side of the connector shell.

NOTE: If it is ever necessary to remove a spring connector from a connector shell, press a small screwdriver into the slot in the shell while you pull on the wire.

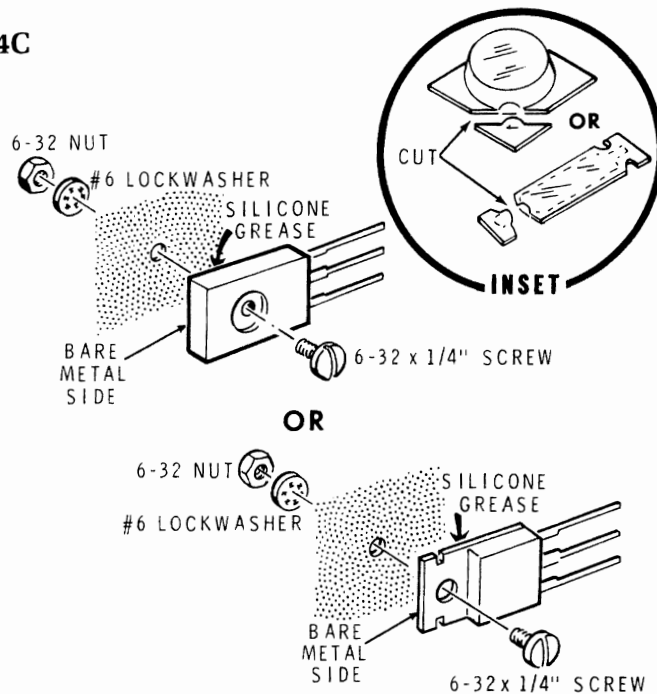
- (✓) Insert the spring connector on one of the black wires into hole 2.
- (✓) Insert the spring connector on one of the white wires into hole 3.
- (✓) Gently pull on each wire to make sure it is locked into the connector shell. Then set this connector shell aside temporarily.
- (✓) Locate the other 3-hole connector shell and install the remaining three wires in the same manner.
- (✓) Solder the orange wire coming from one of the 3-hole connector shells to hole +8V on the circuit board. This will be connector shell A. NOTE: There are two sets of holes in the circuit board with identical markings. Use the hole that is nearest the bottom edge of the circuit board.
- (✓) Solder the white wire coming from 3-hole connector shell A to hole +5V. Use the hole that is nearest the bottom edge of the circuit board.
- (✓) Solder the black wire coming from 3-hole connector shell A to the indicated hole marked GND.



Detail 1-4B



Detail 1-4C



Detail 1-4D

Solder the wires coming from 3-hole connector shell B to the other circuit board holes as follows:

- Orange wire to +8V.
- White wire to +5V.
- Black wire to GND.
- Refer to Detail 1-4C and mount the bracket to the printed side of the circuit board with two 6-32 x 1/4" screws, two #6 lockwashers, and two 6-32 nuts.
- Refer to the inset drawing of Detail 1-4D and open the silicone grease pod. Apply a liberal amount of grease to the bare metal side of both μ A7805 integrated circuits (#442-54).
- IC9: Refer to Detail 1-4D and mount one of the μ A7805 integrated circuits (#442-54) to the bracket at IC9. Use a 6-32 x 1/4" screw, a #6 lockwasher, and a 6-32 nut. Position the bare metal side of the IC toward the bracket.

- IC10: In the same manner, mount the other IC to the bracket at IC10.
- Push connector shell A onto the leads of IC9 as shown in the inset drawing. Dress the leads over the bracket as shown.
- Push connector shell B onto the leads of IC10. Dress the leads over the bracket as shown.

CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

- 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 (+) end.

Proceed to the "Regulator Tests."



REGULATOR TESTS

Refer to Pictorial 1-5 (Illustration Booklet, Page 3) for the following steps.

- () Make sure the POWER switch (on the rear of your Computer) is in the OFF position.
- () Unplug the Computer's line cord.
- () If it has not already been done, remove the two screws that hold the top cover on the Computer. Then remove the cover. See the inset drawing on the Pictorial.
- () Remove rear panel screw FD. Then loosen the other screws in the tie bracket, remove the bracket, and set it aside.
- () Position the Breadboard/Interface Card inside the chassis as shown. Then carefully push the connectors on the edge of the circuit board onto an unused plug on the mother circuit board near the rear of the Computer. Do not use plug P10. It is reserved for other applications.
- () Plug the line cord into the proper AC outlet.

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

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

PROBLEM	POSSIBLE CAUSE
PWR LED does not light. Fuse F1 is open.	A. Solder bridge on breadboard circuit board.

NOTE: The following checks require a VTVM or VOM. If you do not have one available, remove the Breadboard/Interface Card from the Computer and carefully inspect the circuit board for solder bridges. Then proceed to "Integrated Circuit Installation" on Page 13.

- () Connect the common lead of your meter to the chassis.
- () Set your meter to measure +15 volts DC.
- () Touch the probe of your meter to the indicated slot in the connector shell at TP1 (+8V, orange wire). The meter should indicate between 7.5 and 11.5 volts.
- () Touch the probe of your meter to the indicated slot in the connector shell at TP2 (+8V, other orange wire). The meter should indicate between 7.5 and 11.5 volts.

PROBLEM	POSSIBLE CAUSE
TP1 and TP2 do not indicate 8 volts.	A. Solder bridge on circuit board. B. Wiring error on circuit board at IC9 and IC10. C. IC's 9 and 10 are defective.

- () Touch the meter probe to the indicated slot at TP3 (+5V, white wire). The meter should indicate 5 volts ($\pm .25$ volts).

PROBLEM	POSSIBLE CAUSE
TP3 measures below 2 volts.	A. Solder bridge on circuit board. B. Wiring error on circuit board at IC9.
TP3 measures 0 volts.	A. IC9 is defective. B. Capacitor C108 is defective.

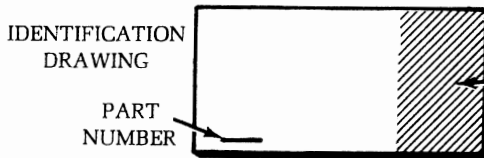
- () Touch the meter probe to the indicated slot at TP4 (+5V, other white wire). The meter should indicate 5 volts ($\pm .25$ volts).

PROBLEM	POSSIBLE CAUSE
TP4 measures below 2 volts.	A. Solder bridge on circuit board. B. Wiring error on circuit board at IC10.
TP4 measures 0 volts.	A. IC10 is defective. B. Capacitor C110 is defective.

- () Push the POWER switch to OFF and unplug the line cord.
- () Disconnect the meter from the chassis and the Breadboard/Interface Card.
- () Remove the Breadboard/Interface Card from the Computer.

This completes the "Regulator Tests." Proceed to "Integrated Circuit Installation."

INTEGRATED CIRCUIT INSTALLATION

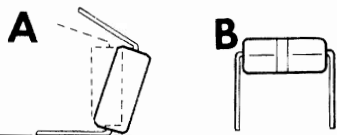


The steps performed in this Pictorial are in this area of the circuit board.

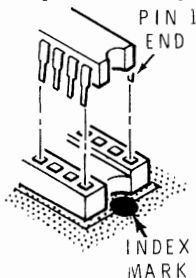
START

In the following steps, install IC's in the designated sockets. Be careful to match the pin 1 end of each IC to the index mark on the circuit board. See Detail 1-6A.

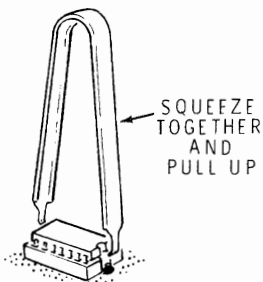
Before you install an IC, first be sure the pins are straight. Lay it down on one of its rows of pins, as shown below in Part A, and roll it over until the pins are at right angles or are bent in slightly as shown in Part B. Repeat this process for the other row of pins.



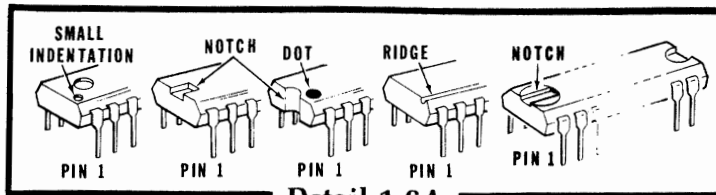
Before you apply downward pressure, make sure each IC pin is centered in its proper socket hole. Handle IC's with care, as their pins bend very easily.



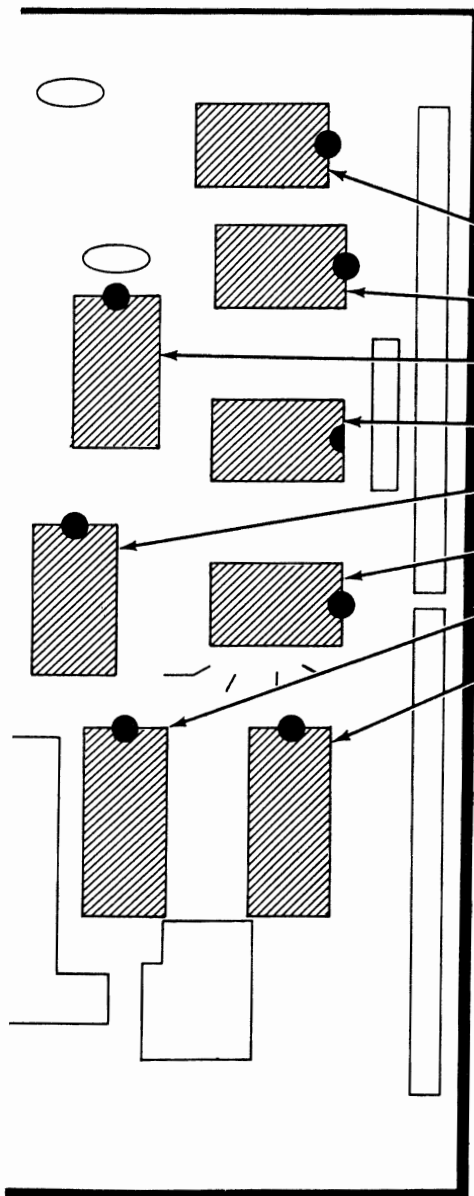
NOTE: An IC puller has been furnished so you can remove an inline IC from its socket if necessary.



Insert the hooks of the puller beneath the IC; then gently rock the tool back and forth to lift the IC.



Detail 1-6A



CONTINUE

- (/) IC104: 74LS14 (#443-872).
- (/) IC105: 74LS14 (#443-872).
- (/) IC101: 7442 (#443-53).
- (/) IC106: 74LS74 (#443-730).
- (/) IC102: 74LS139 (#443-822).
- (/) IC107: 74LS00 (#443-728).
- (/) IC103: 74LS240 (#443-754).
- (/) IC108: 74LS240 (#443-754).

This completes the assembly of your Breadboard/Interface Card.

FINISH

PICTORIAL 1-6

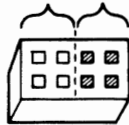
INSTALLATION

Refer to Pictorial 1-5 (Illustration Booklet, Page 3) for the following steps.

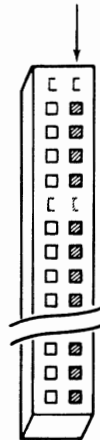
- () Be sure your Computer is turned off.
 - () Remove the two rear panel screws holding the top cover. Set the top cover aside if this has not already been done.
 - () Remove rear panel screw FD. Then loosen the other screws in the tie bracket, remove the bracket, and set it aside.
- NOTE:** In the next step, you will install the Card into the Computer. Install the Card in one of the unused plugs near the rear of the Computer, but do not try to install it at P10. It will not fit.
- () Plug the Breadboard/Interface Card onto the selected plug in your Computer.
 - () Locate the blue and white label and remove the protective paper backing. Then press the label onto the rear panel of your H8 Computer as shown. Refer to the numbers on this label in any correspondence you may have with the Heath Company about this kit.
 - () Install a 6-32 \times 1/4" screw through the bottom of the computer chassis to hold the Card in place.

OPERATION

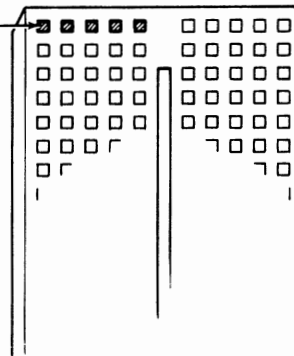
EACH GROUP OF FOUR CONNECTORS IS INTERNALLY CONNECTED TOGETHER.



THE 36 CONNECTORS OF EACH LONG COLUMN ARE INTERNALLY CONNECTED TOGETHER.



THE FIVE CONNECTORS OF EACH ROW ARE INTERNALLY CONNECTED TOGETHER.



PICTORIAL 2-1



Refer to Pictorial 2-1 to see how the connector blocks are electrically arranged.

NOTES:

1. Do not use component leads that are larger than .032" in diameter (#22 wire). Larger leads can damage the connectors.
2. To avoid frequent soldering to the circuit board, install wires between the solder pads and the nearest connector block.
3. You may find it convenient to install a PC type DIP switch on a connector block for address selection.
4. When you connect to unbuffered bus circuits, be careful that you do not overload the bus.

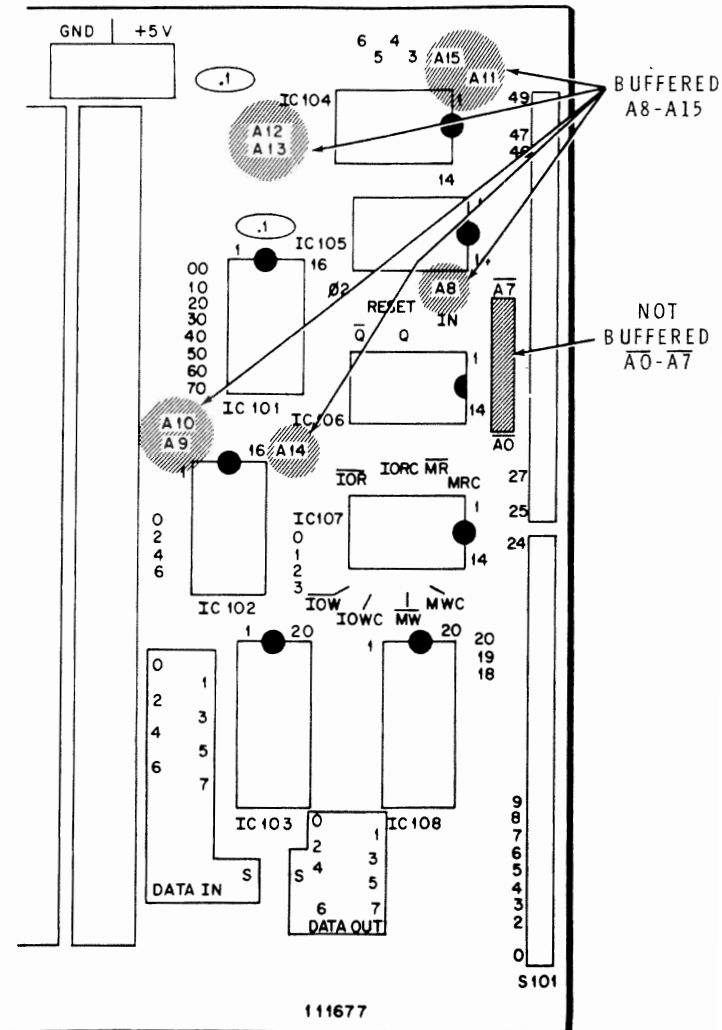
The following information presents some basic information about the H8 Computer and how to use the circuits on the Breadboard/Interface Card. Refer to the Schematic Diagram (Illustration Booklet, Page 5) and Pictorials 2-2 (Illustration Booklet, Page 3) through 2-5 as you read this information.

ADDRESSING

The H8 uses 16 address lines (A_0 - A_{15}) for memory-related functions. (See Pictorial 2-3.) This allows 2^{16} ($65,536_{10}$) unique addresses. However, in the input/output (I/O) mode, only eight of the sixteen address lines are used (allowing for $2^8 = 256_{10}$ unique I/O addresses). In the I/O modes, the address present on the lower eight lines (A_8 - A_{15}) is repeated on the upper eight lines (A_0 - A_7).

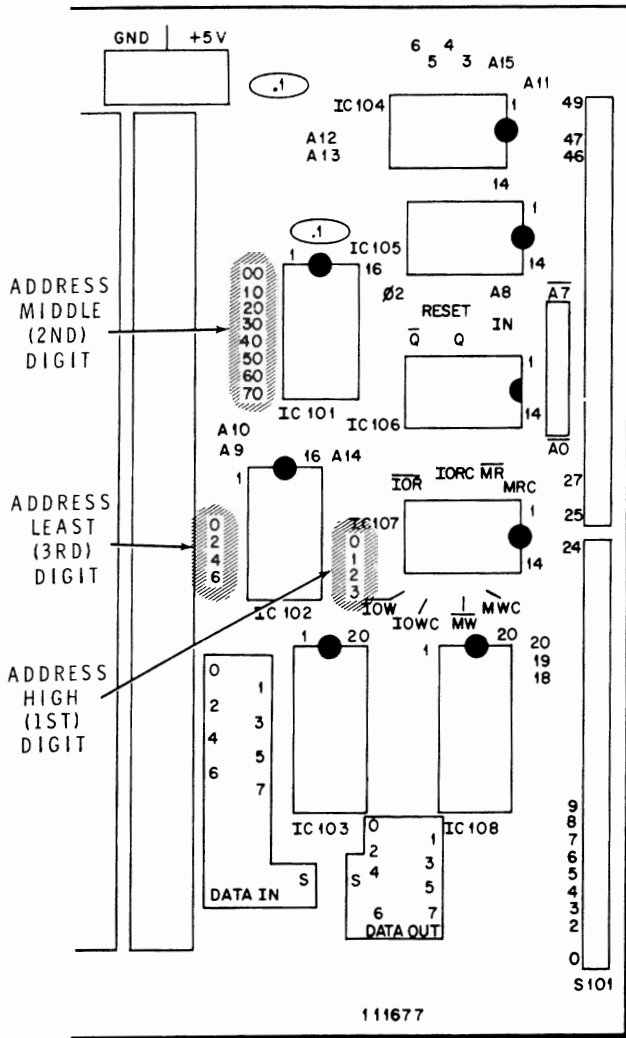
Address lines A_0 - A_7 are not buffered on the Breadboard/Interface Card. Therefore, be careful that you do not interfere with the H8 bus if you use these lines.

The upper eight address lines (A_8 - A_{15}) are buffered and are available at solder pads A_8 through A_{15} . Lines A_9 through A_{15} are then decoded to simplify interfacing. When used with memory controls (IC107), the decoding logic can select 128_{10} blocks of 512_{10} addresses.



PICTORIAL 2-3

For input/output operation, the control logic will decode 128_{10} pairs of addresses. The buffered least significant bit (A_8) can also be decoded to then provide a total of 256_{10} addresses. The screening on the circuit board is in octal (0-377).

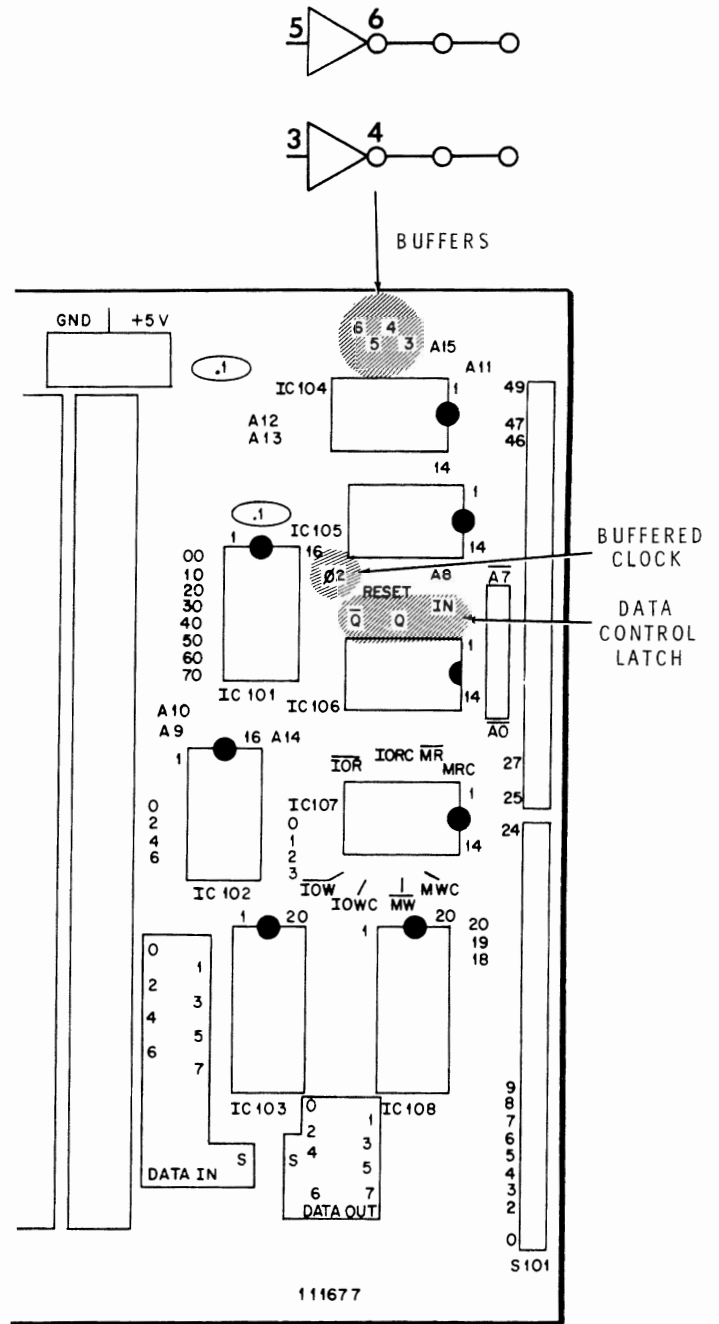


PICTORIAL 2-4

Address Decoding

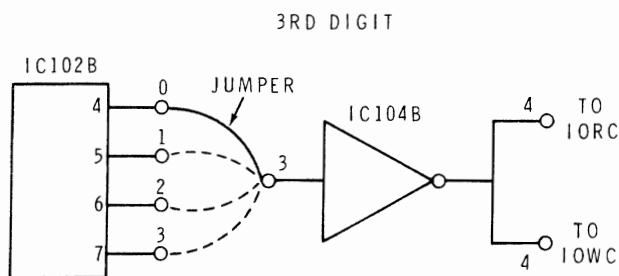
IC102A decodes the four combinations of the two highest address lines (A₁₄ and A₁₅). Install a jumper wire to select the desired first digit (0, 1, 2, or 3). (See Pictorial 2-4.) The signal from IC102A then enables the second decoder, IC101. Here, the seven possible codes of the next three address lines (A₁₁-A₁₃) are decoded. Again, install a jumper wire to select the desired second digit. The signal from IC101 enables IC102B, which decodes the four combinations of lines A₉ and A₁₀. These outputs are labeled 0, 2, 4, and 6. Since line A₈ is not decoded, the:

- 0 output will be low for inputs 0 and 1.
- 2 output will be low for inputs 2 and 3.
- 4 output will be low for inputs 4 and 5.
- 6 output will be low for inputs 6 and 7.



PICTORIAL 2-5

The selected output from IC102B must be inverted before it is connected to the selected control gate of IC107. Use inverter IC104B or IC104C. See Pictorials 2-5 and 2-6.



PICTORIAL 2-6

To decode line A_8 for a total of 256_{10} addresses, use two NAND gates as shown in Pictorial 2-7.

CONTROL LOGIC

Control Signals

One of four control pulses from the H8 bus is normally used to operate a peripheral device. These are:

Pin 21, IOW (Input/Output Write) — Indicates that the CPU is writing (sending) data to an output device.

Pin 26, IOR (Input/Output Read) — Indicates that the CPU is reading (accepting) data from an input device.

Pin 23, MW (also MEMW; Memory Write) — Indicates that the CPU is writing (sending) data to a memory location.

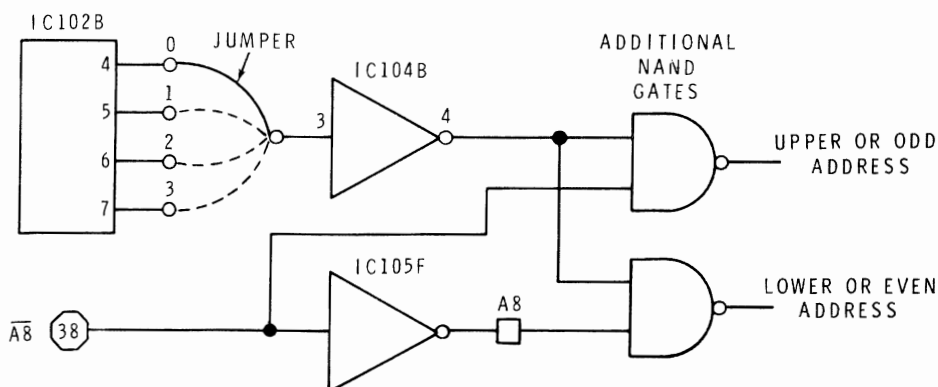
Pin 28, MR (also MEMR; Memory Read) — Indicates that the CPU is reading (accepting) data from a memory location.

In all the above cases, the information present on the address lines at the time the control pulse is present determines which device is being communicated with.

The four input control lines are all true high. In the send modes, the data is sampled near the center of the read pulse. In the write modes, the falling edge of the write pulse should be used to strobe (sample) the data. The bus data is not valid at the leading edge of a write pulse.

Since the data buffers must be turned on only when the correct control pulse and address are present simultaneously, the decoded address must be ANDed with the control signals. This is done in one of four NAND gates of IC107.

Each NAND gate of IC107 has one of its inputs connected to a bus control signal (IOW, IOR, MW, or MR). For any of these gates to be functional, the second input (the control input) of a gate (IOWC, IORC, MWC, and MRC) must be connected to the appropriate decoded address (the output from IC104B or IC104C). The outputs of these four gates are true low and may be connected directly to the data buffer strobe lines (S). NOTE: \overline{MR} or \overline{IOR} go to the "data out" strobe and \overline{MW} or \overline{IOW} go to the "data in" strobe.



PICTORIAL 2-7

Control Latches (IC106)

Many memory and other storage devices require that the data to be latched must be present at the input terminals until after the write strobe (MW or IOW) has fallen. However, since this same strobe is used to activate the bus "data in" buffer, the data can be interrupted prematurely.

One solution to premature interruption is to tie the "data in" strobe line permanently low; the data buffer will always be on. This is acceptable provided the stream of data from the computer bus does not interfere with associated circuits.

If, however, you are using a bidirectional device (such as a memory or UART), the buffer cannot be on all the time. For these applications, a data buffer latch has been provided (IC106A) to turn a buffer on and off.

When a latch is connected as shown in Pictorial 2-8, the IOW or MW pulse will clear the latch ($Q = 0$) to enable the data buffer. The rise of $\overline{\text{P2}}$ after the write pulse will clock the latch and set Q equal to one. This will turn off the data buffer after the write pulse has fallen.

DATA BUFFERS

Data In

Data from the H8 data bus ($\overline{\text{D}}_0\text{--}\overline{\text{D}}_7$) is coupled through "data in" buffer IC103 whenever the strobe (S) line of IC103 is at logic low. This strobing makes it possible to "see" the data bus only at selected times. When the strobe line is high, the outputs of IC103 are in a high impedance state and therefore have no effect on the data lines.

The "data in" outputs (0—7) and the "data out" inputs (0—7) may be connected together to form a bidirectional data port provided the "data in" and "data out" strobes are never both low at the same time.

Data Out

Signals connected to the input of "data out" buffer IC108 will be connected to the H8 bus when the strobe line of IC108 is low. If this buffer is not turned off when the CPU is communicating with other devices (memory, I/O ports, etc.) inoperative programs and possible damage to hardware will result. When the strobe line is high, the outputs of IC108 will be in the high impedance state.

UNBUFFERED SIGNALS

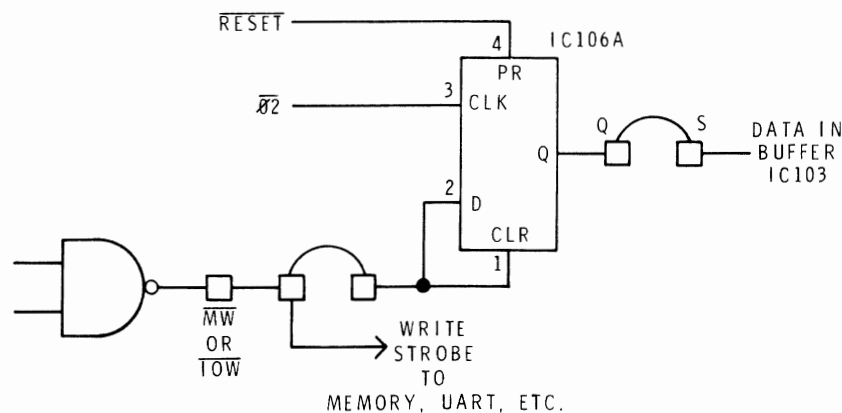
The following unbuffered signals (See Pictorial 2-9) are also available from the H8 bus. These signals are not required for most peripheral or memory functions, but you need to be familiar with 8080A CPU operation before you attempt to use them.

Pins 3-9 — Interrupt. (See Pictorial 2-2.) These lines must only be converted to an open collector TTL driver.

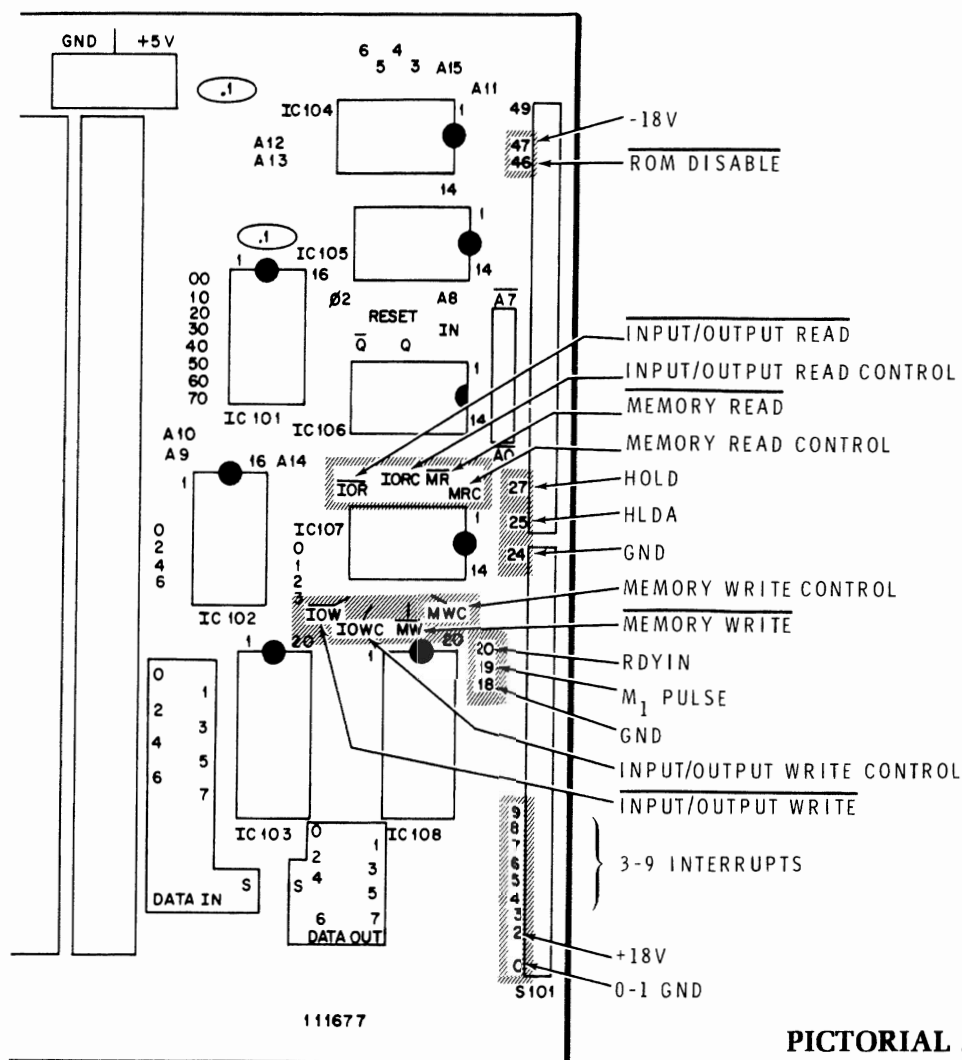
Pin 19 — M1 pulse. Indicates that CPU is in the fetch state.

Pin 20 — RDYIN. A low on this line causes the CPU to enter a wait state.

Pin 25 — HLDA. Hold acknowledge. Jumpers J1, J2, and J3 on the CPU set the polarity.



PICTORIAL 2-8



PICTORIAL 2-9

Pin 27 — HOLD. Causes the CPU to stop operation and disconnect the address, data, and control drivers. The user must then control these lines or they may float to an ambiguous state.

Pin 46 — ROM disable. Normally, memory addresses 0_{10} through 1023_{10} are read from the ROM on the CPU board. When this line is low, the ROM will not be enabled for address 0 through 1023 and the CPU will read the bus data lines. NOTE: The X jumper must be installed on the CPU board.

Pin 2 — +18 volts DC. 250 milliamperes, unregulated and unprotected source.

Pin 47 — -18 volts DC. Primarily for serial outputs.

Pins 48-49 — +8 to +11 volts DC, unregulated. Caution: This is a 10-ampere supply that can damage bus foils if it is shorted.

+5-VOLT POWER SUPPLY

The +5-volt supply consists of two 3-terminal voltage regulators (IC9 and IC10). These devices are internally protected and limit current at one ampere. IC9 supplies the top three power connector blocks and IC10 supplies the lower three power connector blocks.

The H8, low-voltage supply can provide 10 amperes of current. The CPU and control panel require 2 amperes. Check the specifications of all the other cards in your H8 to determine how much current is available for your Breadboard/Interface Card.

IN CASE OF DIFFICULTY

Use the "Visual Tests" first to find a difficulty that shows up right after your kit is assembled. The "Troubleshooting and Repair Precautions," point out the care that you should use when you service the unit to prevent damaging components.

Refer to the Schematic Diagram (Illustration Booklet, Page 5) to help you determine where the trouble is. Refer to the X-Ray View (Illustration Booklet, Page 4) for the physical location of parts on the circuit board.

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

VISUAL TESTS

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something you consistently overlook.
2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered.
3. Check to be sure that each of the IC pins are properly installed in their connectors, and not bent or under the IC. Also be sure the IC's are installed in their correct positions.
4. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

TROUBLESHOOTING AND REPAIR PRECAUTIONS

1. Make sure you do not short any adjacent terminals or foils when you make tests or voltage measurements. If a probe or test lead should slip, for example, and short together two adjacent connectons, it is very likely to damage one or more of the IC's.
2. Be especially careful when you test any circuit that contains an IC. Although these components have an almost unlimited life when used properly, they are much more vulnerable to damage from excess voltage and current than many other parts.
3. Do not remove any components while the unit is turned on.
4. When you make repairs, make sure you eliminate the cause as well as the effect of the trouble. If, for example, you find a damaged component, be sure you find out what damaged the component. If the cause is not eliminated, the replacement may also become damaged when you put the unit back into operation.
5. In several areas of the circuit boards, 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.

Components

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

Foil Repair

To repair a break in a circuit board foil, bridge solder across the break. Bridge large gaps in the foil with bare wire. Lay the wire across the gap and solder each end to the foil. Carefully trim off any excess bare wire.



SPECIFICATIONS

Logic	All H8 bus signals available. Address, data, read, and write lines buffered, TTL. Address decoding. Control logic.
Power Supply	Two, 1-ampere, 5-volt regulators.
Operating Temperature	0° to 40° Celsius.

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.

SEMICONDUCTOR IDENTIFICATION CHART

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED BY	IDENTIFICATION
IC101	443-53	7442	
IC102	443-822	74LS139	
IC103, IC108	443-754	74LS240	

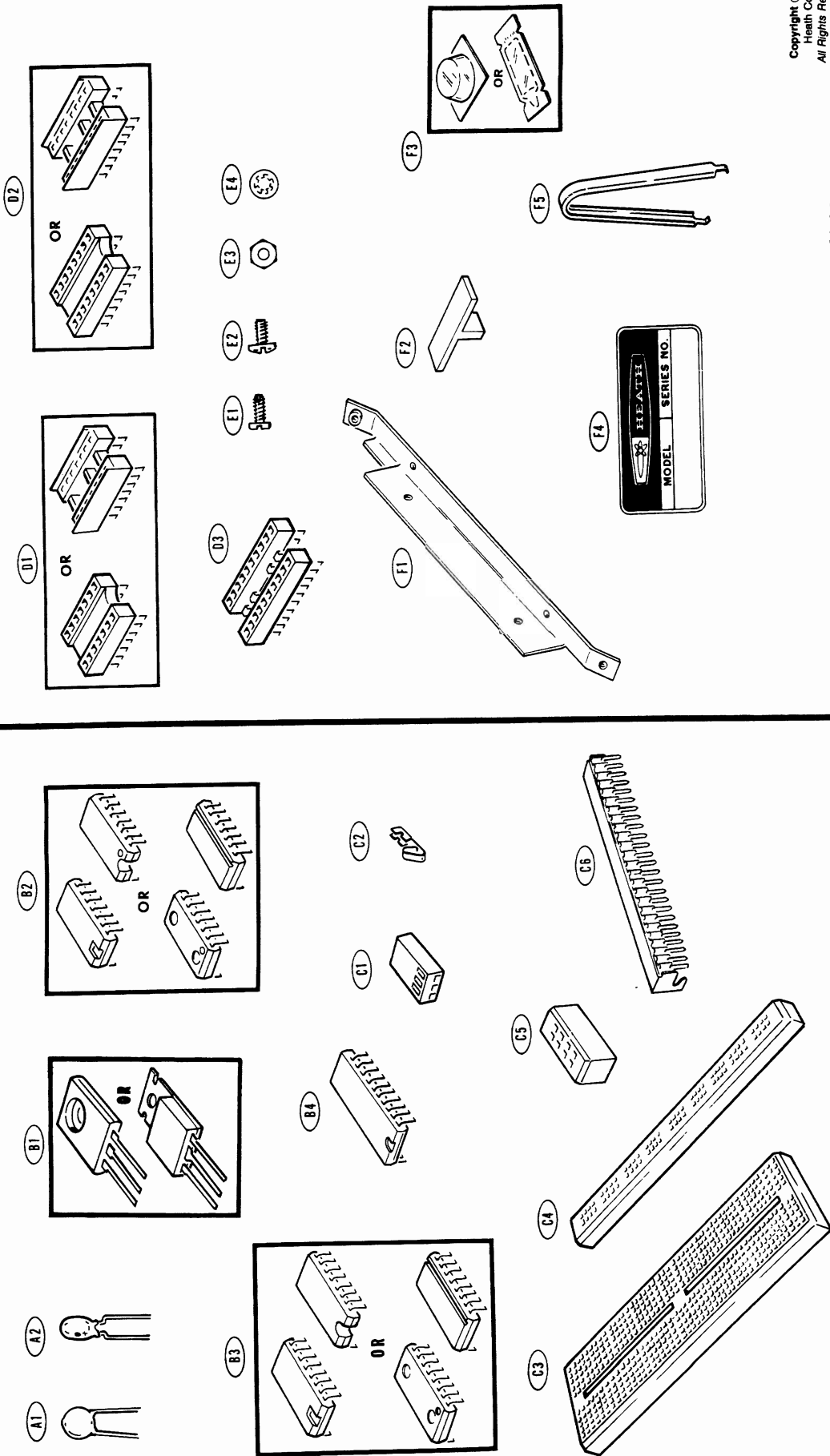


COMPONENT	HEATH PART NUMBER	MAY BE REPLACED BY	IDENTIFICATION
IC104, IC105	443-872	74LS14	
IC106	443-730	74LS74	
IC107	443-728	74LS00	
IC9, IC10	442-54	μ A7805	<p style="text-align: center;">OR</p>

ILLUSTRATION BOOKLET

Part of 595-2081

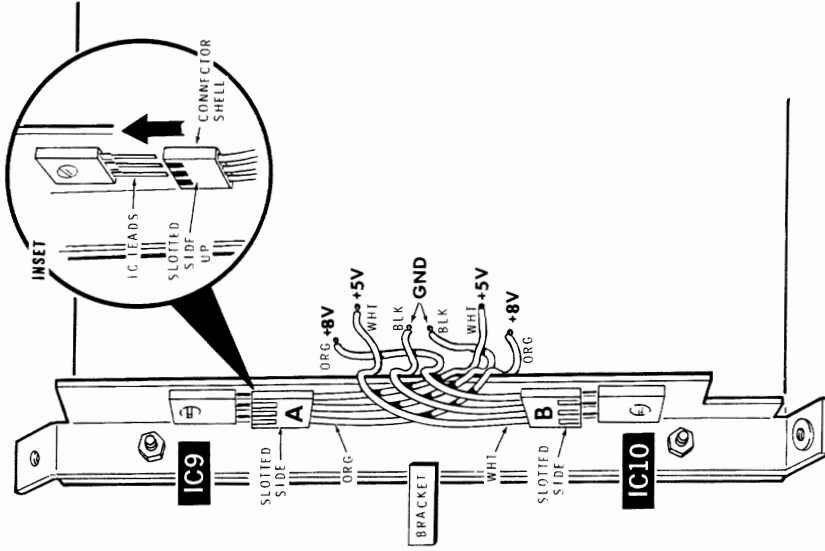
PARTS PICTORIAL



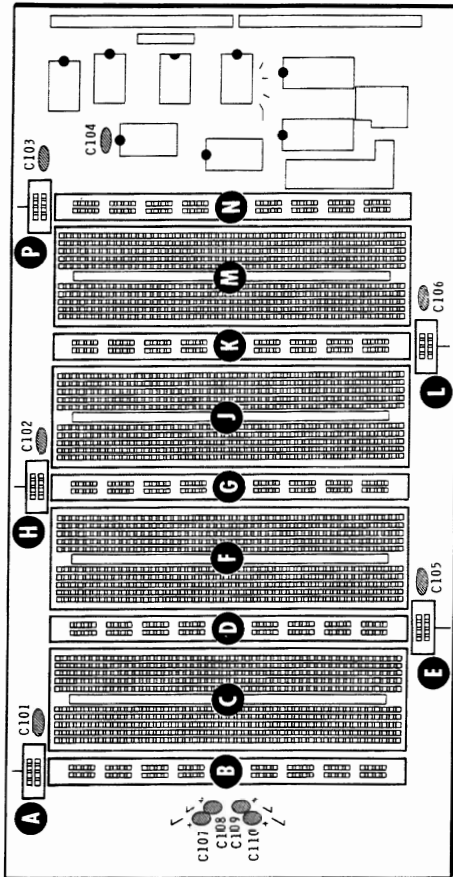
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Model H18-7

Printed in the United States of America



PICTORIAL 1-4

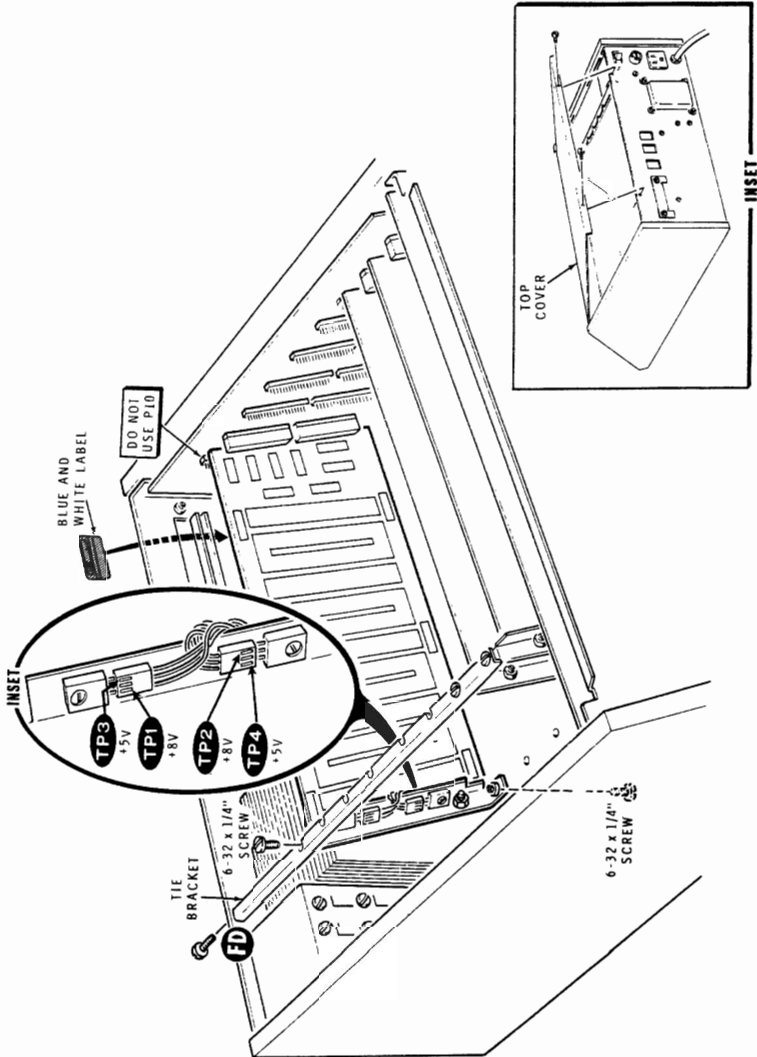


PICTORIAL 1-3

BUS DESIGNATIONS

S201 -	24	GND *	S201	49	+8V
	23	MEMW		48	+8V
	22	$\beta 2$		47	+18V
	21	I/OW		46	ROM DISABLE
	20	RDYIN *		45	A15
	19	M1		44	A14
	18	GND *		43	A13
	17	D7		42	A12
	16	D6		41	A11
	15	D5		40	A10
	14	D4		39	A9
	13	D3		38	A8
	12	D2		37	A7
	11	D1		36	A6
	10	D0		35	A5
	9	INT2 *		34	A4
	8	INT1 *		33	A3
	7	INT7		32	A2
	6	INT6		31	A1
	5	INT5		30	A0
	4	INT4		29	RESET
	3	INT3		28	MEMR
	2	-18V		27	HOLD *
	1	GND		26	I/OR
	0	GND		25	HLDA *

*HEATH COMPANY RESERVES THE RIGHT TO CHANGE THESE PIN DESIGNATIONS.



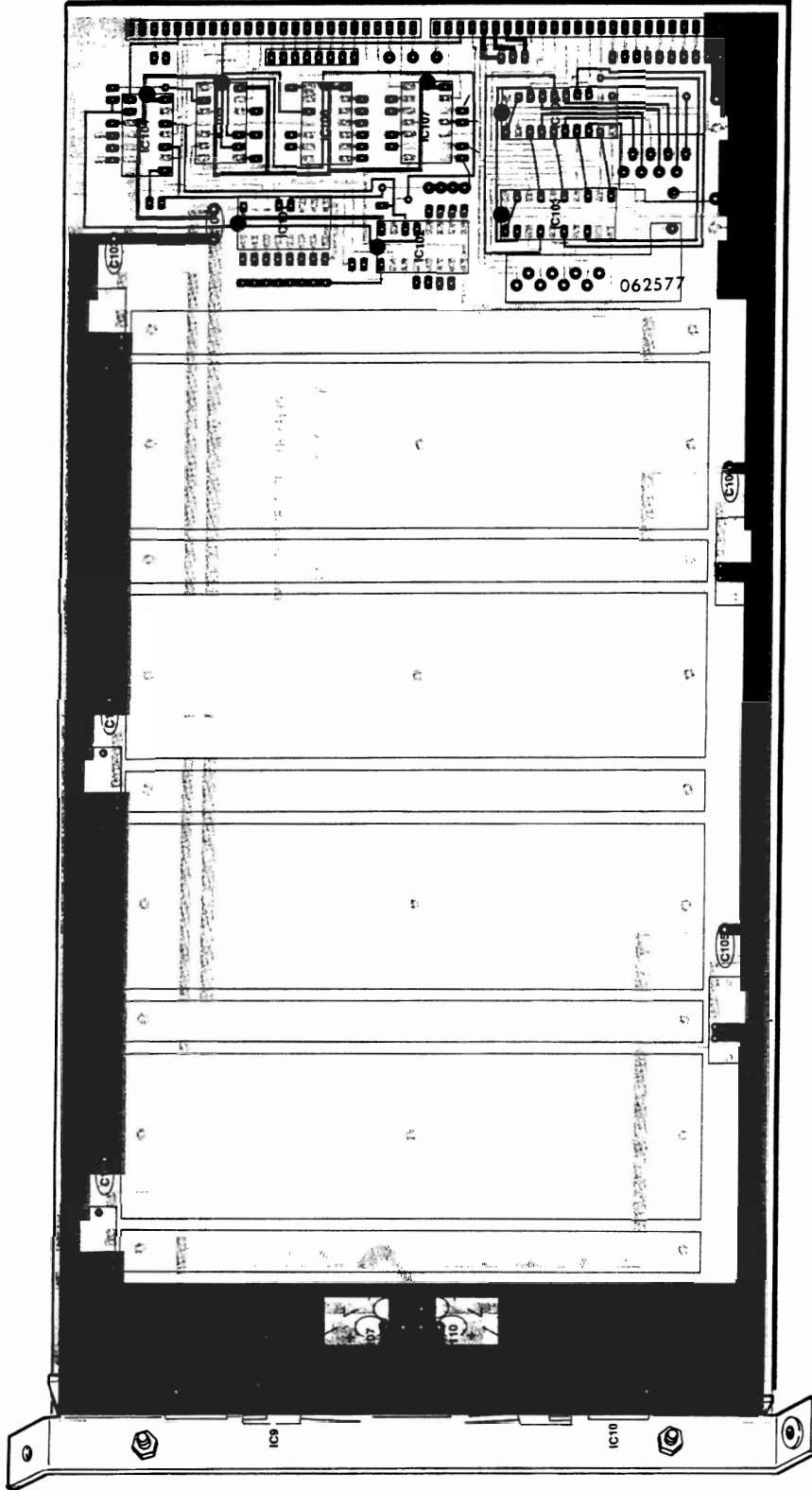
PICTORIAL 1-5

PICTORIAL 2-2

CIRCUIT BOARD X-RAY VIEW

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

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



(Shown from component side.
Component side foil shown in red).

SCHEMATIC OF THE HEATHKIT® BREADBOARD/INTERFACE CARD MODEL H8-7

NOTES:

1. ALL CAPACITORS ARE IN μ F.
2. Δ THIS SYMBOL INDICATES CIRCUIT BOARD GROUND.
3. \bigcirc THIS SYMBOL INDICATES THE SYSTEM BUS CONNECTION.
4. \square THIS SYMBOL INDICATES WHERE A WIRE IS OR CAN BE SOLDERED TO THE CIRCUIT BOARD.

