HERO ROBOT

Model ET-18-6

Memory Expansion Accessory

595-3133

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

INTRODUCTION

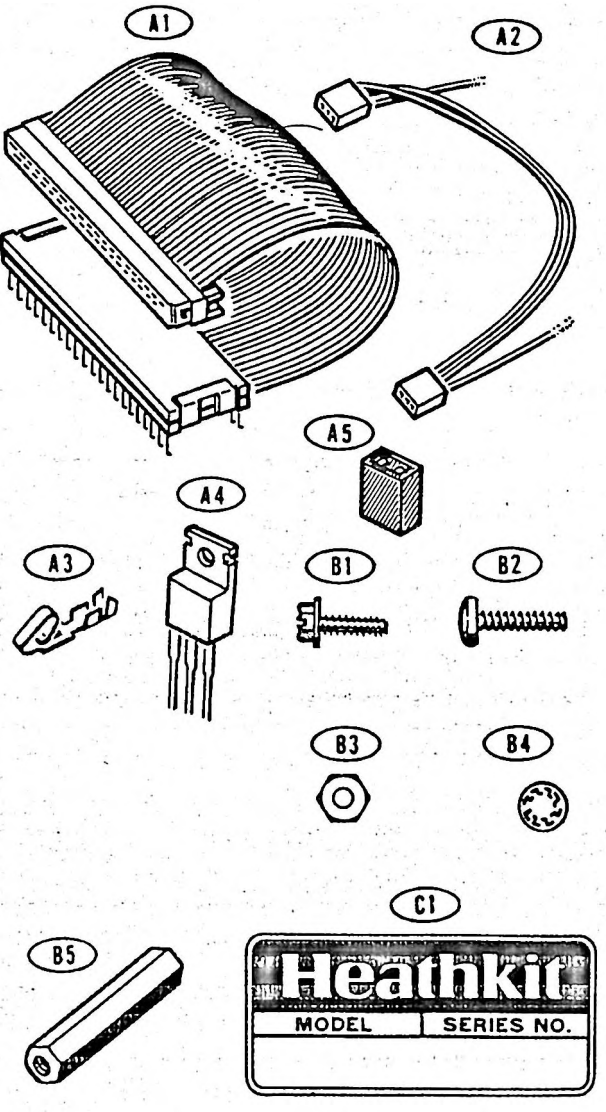
The Memory Expansion Accessory, Model ET-18-6, allows you to install additional memory devices to expand HERO 1's memory from its present 12k bytes (4k RAM, 8k ROM) to 56k bytes in various configurations. The new memory expansion circuit board directly accommodates most single-voltage byte-wide memory chips, including 6116 and 6264 RAMs and 2716, 2532, 2732, and 68764 EPROMS. It also will accept all of the current and proposed accessory ROMs.

PARTS LIST

Check each part against the following list and the "Parts Pictorial" in the right column. The key numbers correspond to the numbers on the "Parts Pictorial." Return any part that is packed in an individual envelope, with the part number on it, back into its envelope until that part is called for in a step. Do not throw away any packing material until you have accounted for all the parts.

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

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
GENERAL			
	181-4938	1	Assembled circuit board
	75-737	1	6" × 8" paper insulator
	75-756	1	2" × 3-1/2" foam pad
A1	134-1383	1	40-conductor interface cable
A2	134-1419	1	4-wire (2 socket) cable assembly
A3	432-753	3	Spring connector (1 extra)
A4	442-603	1	78M05 IC
A5	432-1041	24	Program jumpers
HARDWARE			
B1	250-1264	2	6-32 × 3/8" screw
B2	250-1430	1	6-32 × 1/2" screw
B3	252-3	1	6-32 nut
B4	254-1	3	#6 lockwasher
B5	255-724	2	Hex spacer
			Solder
PRINTED MATERIALS			
C1		1	Blue and white label
	597-260	1	Parts Order Form
		1	Assembly Manual (See title page for part number.)



STEP-BY-STEP ASSEMBLY

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

( ) Set the Robot on your work bench or work table so you have easy access to its back panel and internal cavity.

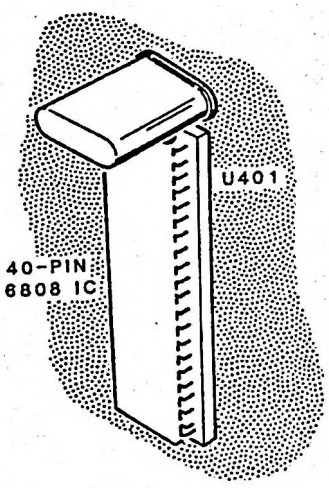
NOTE: Make sure the power switch on your HERO 1 Robot is turned off; do not turn on the power again until you are directed to do so in a step.

( ) If necessary, rotate the Robot head and arm out of the way of the back panel.

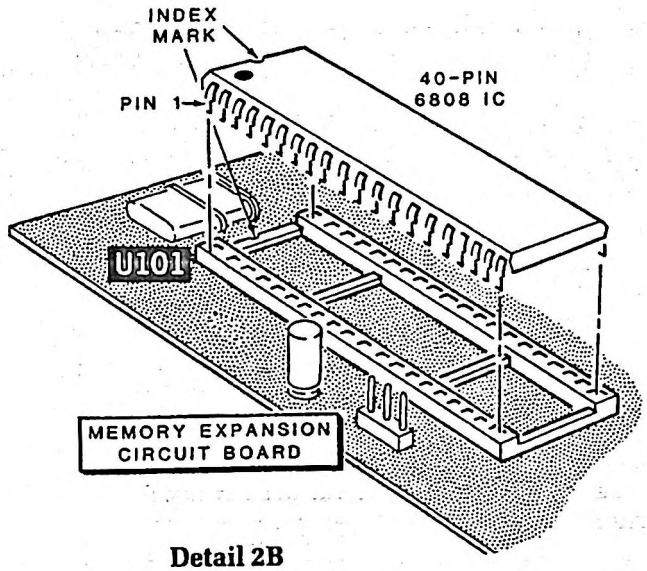
( ) Carefully lift the back panel from the Robot. Then remove the two door screws, A and B, from the door. Set the panel and screws aside temporarily.

IMPORTANT: Carefully read the following steps and all of the information on Figure 1 (Illustration Booklet, Page 1) through the removal of the microprocessor IC from the CPU board and its installation in the new memory board, before you perform the steps. The IC is sensitive to static charges and may be damaged if incorrectly handled during this transfer.

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



Detail 2A



Detail 2B

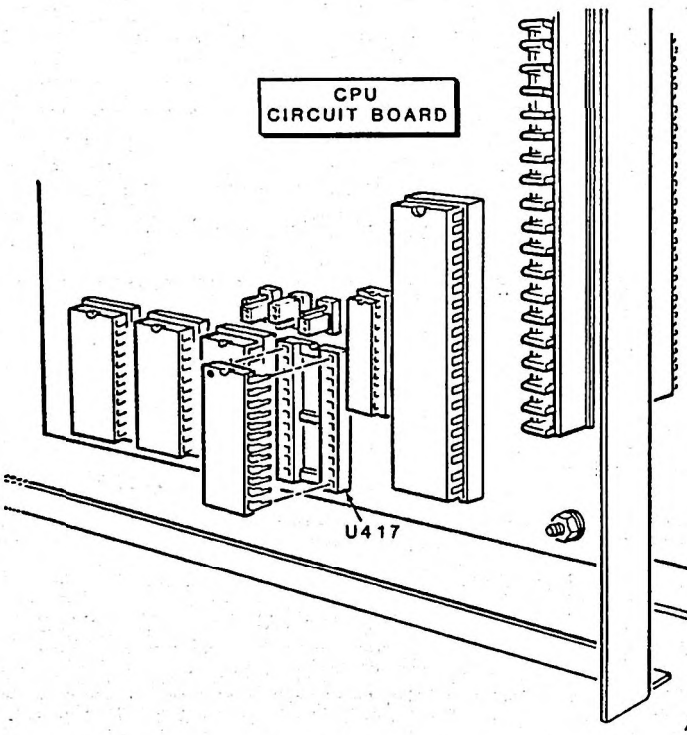
( ) Refer to Detail 2A and, using an IC lifter or a small screwdriver, carefully work the 40-pin 6808 microprocessor IC from CPU circuit board socket U401. If you have accidentally bent any of the IC pins during its removal, be sure to straighten them before you proceed.

( ) Refer to Detail 2B and, holding the IC in one hand, pick up the new memory expansion circuit board with the other hand. Note the position of the marked end of memory board socket U101; then push the pins of the 6808 microprocessor into socket U101, matching the pin 1 end of the IC with the indexed end of the socket.

( ) Carefully check all of the pins of U101 to make sure that none are bent under the IC and that all of them are properly seated in the socket holes. Set the memory expansion circuit board aside temporarily.

NOTE: If you have previously purchased either the ET-18-4 utility ROM or the ET-18-7 Automatic Mode ROM, and if either of these devices is presently installed on the circuit board at U417, proceed as follows. Note that both devices are static sensitive and must be handled in the same manner as outlined for the 6808 microprocessor.

( ) Refer to Detail 2C and, using an IC lifter or small screwdriver, carefully remove the IC from socket U417. Place this IC into the foam pad temporarily. NOTE: Socket U417 will no longer be used. Do not move its jumpers.

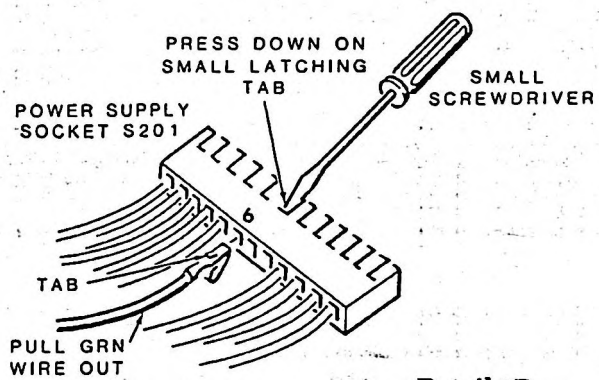


Detail 2C

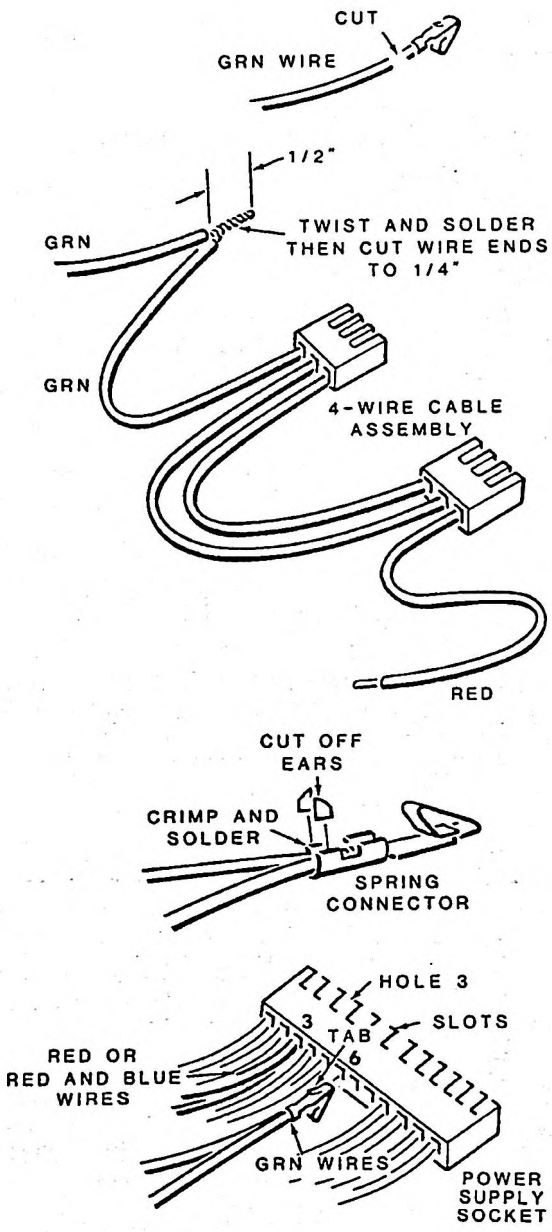
NOTE: Do **not** install any component in memory expansion sockets U102 – U107 until you are instructed to do so in a step.

( ) On the inside of the Robot cavity, in the upper right corner of the inside of the front panel, locate and disconnect the "POWER SUPPLY" (1-12) socket, S201. With as little strain on the wire harness or cable as possible, pull the socket as far to the rear opening of the Robot as you can.

( ) On the Power Supply socket, locate the green wire going to socket hole 6. Refer to Detail 2D and, using the blade of a small screwdriver, press down on the small latching tab on the connector in hole 6 as you pull on the green wire to free it from the socket.



Detail 2D



Detail 2E

Refer to Detail 2E for the following steps.

( ) Cut the spring connector from the end of the green wire just removed from socket S201.

( ) Remove 1/2" of insulation from the the end of the green wire. Tightly twist the end of this wire and the green wire from the 4-wire (2-socket) cable assembly together and add a small amount of solder to hold them securely. Cut the soldered wires to 1/4".

( ) Cut the ears from a spring connector as shown. Then crimp and solder the bare ends of the green wires into the spring connector. CAUTION: Do not get solder into the spring-end of the connector.

( ) Making sure the tab on the spring connector is up, toward the socket slot, push the green wire connector into Power Supply socket hole 6.

( ) Locate hole 3 in the Power Supply socket. Note that hole 3 may have a single red wire, or it may have a red and a blue wire. In the same manner as in the previous steps, remove the connector from hole 6 and prepare the wire end(s).

( ) Tightly twist the end of the red (and the blue) wire(s) together with the red wire coming from the 4-wire (2-socket) cable assembly.

( ) As in the previous steps, prepare the wire ends, install a spring connector on the wires, and push this connector into hole 3 of the Power Supply socket.

( ) Gently tug on the wires you just installed in socket holes 3 and 6 to make sure they are properly latched in the socket.

( ) Making sure the slots of Power Supply socket S201 face downward, push the socket back onto chassis power plug P201.

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

( ) Remove and discard the nuts from CPU circuit board screws C and D. Then, making sure the #6 lockwashers are still in place on the screws, resecure the circuit board with the two threaded spacers provided with this kit.

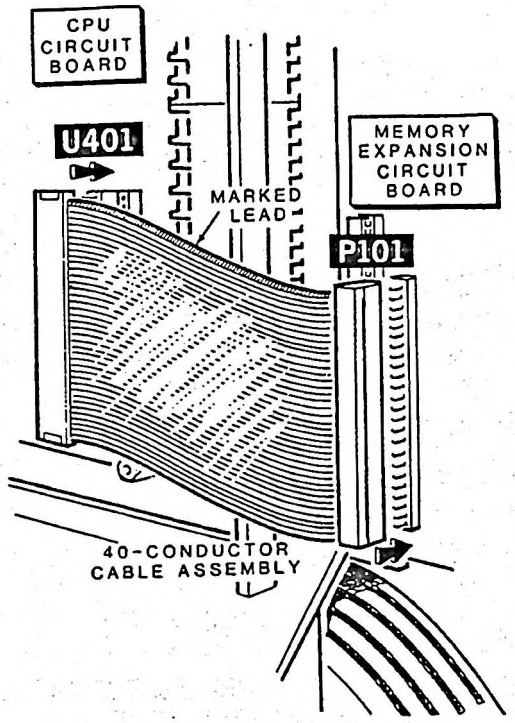
( ) Using the template shown in Detail 3A (Illustration Booklet, Page 3), cut and prepare the 6" × 8" paper insulator in the following manner:

1. Cut the insulator to 5" × 6".
2. Turn the insulator white-paper-side up. Then place the circuit board, component side up, onto the insulator, making sure to align one edge as shown.
3. Score a heavy indentation into the surface of the insulation along the side of the circuit board as shown. Do not cut through the insulator.
4. Mark the two corner mounting holes through the circuit board into the insulator. Remove the circuit board and enlarge these holes to approximately 1/8".

( ) Refer to Detail 3B. Locate the 40-conductor interface cable assembly and push the larger, flat plug into IC socket U401 on the CPU board in the manner shown. Push the plug on the other end of this cable onto memory expansion circuit board P101.

NOTE: Make sure the pins at both ends of the 40-conductor interface cable are properly positioned onto the correct socket holes and plug pins.

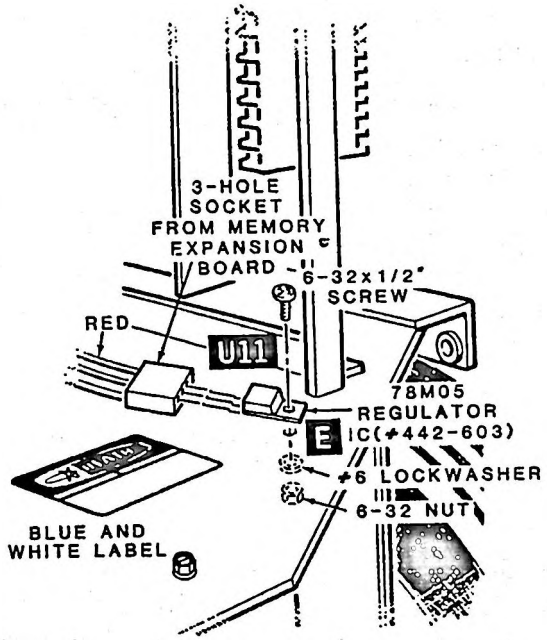
( ) Push the 3-hole socket with the orange, black, and green wires onto memory expansion board plug P102. Make sure the green wire is toward the bottom as shown in the Pictorial.



Detail 3B

( ) Place the paper insulator on the underside of the circuit board with the flap positioned as shown. Push a 6-32 × 3/8" screw through each of the corner holes in the circuit board, and through the holes in the insulator. Then mount the circuit board onto the two spacers at C and D, as you form the 40-conductor interface cable into a loop toward the front panel.

NOTE: In the following step, be **very careful** that you do not unplug any of the connectors along the top and bottom edges of the CPU circuit board as you mount the new expansion board. **Carefully** reposition these cables as necessary.



PICTORIAL 4

Refer to Pictorial 4 for the following steps.

( ) Locate, remove, and discard the 3/8" hardware from chassis hole E.

( ) U11: Mount the 78M05 regulator IC (#442-603) onto the chassis at U11 (hole E) in the manner shown. Use a 6-32 × 1/2" screw, a #6 lockwasher, and a 6-32 nut. Position the IC as shown in the Pictorial.

( ) Push the 3-hole socket with the red, orange and black wires coming from the memory expansion board onto the leads of IC U11. Make sure the **red** wire is positioned as shown.

( ) Remove the paper backing from the blue and white label and press the label in place on the Robot chassis as shown. NOTE: Be sure to refer to the Model and Series numbers on the blue and white label in any correspondence you have with the Heath Company about your kit.

( ) Check the closing of the Robot door. You will find it necessary to reposition some of the cables slightly to prevent an interference.

Except for closing the Robot cabinet, this completes the step-by-step installation of your memory expansion circuit board.

INITIAL TESTS

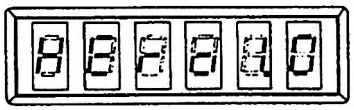
NOTES:

1. Make sure there are no memory devices (ROM or RAM) installed in circuit board sockets U102 through U107.

2. Twenty-four program jumpers have been provided for use on the memory expansion circuit board. These will be used in groups of four when you install an IC in any of sockets U102 through U107.

3. In the following test, if you fail to obtain the desired results, turn off the Robot power. Then refer to the "In Case of Difficulty" section of the Manual and follow the instructions to locate the source of your problem. Do not further operate your Robot until you have found and corrected the problem.

( ) On the rear of the Robot, turn the power switch to ON. If your Robot has the voice accessory, make sure you hear the "Ready" signal. Check the digital readout; you should observe the letters and numbers "HEro1.X", where the "X" represents the revision level of the Monitor, as shown in Pictorial 5.



PICTORIAL 5

( ) Turn OFF the Robot power switch.

This completes the "Initial Tests" of your Memory Expansion circuit board.

MEMORY DEVICE INSTALLATION

DEVICE	JUMPER COLUMN 1	2	3	4
6116*	B	A or B	B	B
6264	C	A or B	B	B
2716*	A	B	B	B
2532*	A	B	A	A
2732*	C	B	B	B
2764	C	B	B	B
68764 *	D	B	A	A
ET-18-4*	A	B	A	A
ET-18-7*	A	B	A	A

*24-pin devices.

Jumper Configuration
Figure 2

Refer to Figures 2 (above) and 3 (Illustration Booklet, Page 4) as you read the following information.

NOTE: If you have any ROM, RAM, or EPROM devices you wish to install in the memory expansion circuit board at this time, the following will assist you to correctly install them, and to provide the correct jumper programming for each device.

All IC sockets, U102 through U107 will support 6116* RAMs and 2716*, 2532*, and 2732* EPROMs, as well as the ET-18-7* automatic mode ROM.

Sockets U103 through U106 will support 6264 RAMs and 2764 and 68764* EPROMs.

Socket U103 will support the ET-18-4* utility ROM. CAUTION: Do not install this ROM at any other location on the memory expansion circuit board.

IMPORTANT: Note that each of the devices shown in Figure 2 with an asterisk (*) has only 24 pins. You must install each of these devices in holes 3 through 26 of its socket, as shown in Pictorial 5 (Illustration Booklet, Page 4).

Note that the table shown in Figure 2 specifies the types of devices listed, while the circuit board in Figure 3 is keyed to the jumpers listed in the columns in Figure 2. If you install a device in the socket at U104, for example, locate the device in the first column of Figure 2. Then at U104, locate the four jumpers associated with that socket (J110, J109, J112, and J111, respectively) and move each jumper as indicated in the four columns in the chart.

Assume that you have installed a 2764 EPROM at U104. Reposition the jumpers as directed in columns 1, 2, 3, and 4: **J110** jumper to its **C** position, **J109** to its **B** position, **J112** to its **B** position, and **J111** to its **B** position.

Proceed as follows:

( ) 1. Make sure the Robot power is OFF.

( ) 2. Install any one of the devices you may have as outlined above, and set all jumpers according to the listing in Figure 2. Be sure to handle all devices as outlined previously in Figure 1 (Illustration Booklet, Page 1).

NOTE: If you have jumpers left over for use with open sockets, you may place them on the pins at the four open-socket jumper blocks, Each In The "A" Position.

( ) 3. Turn ON the Robot power and listen for a "ready!" Check the digital readout for "HEro1.X".

( ) 4. Turn OFF the Robot power.

Repeat steps 1 through 4 until you have all your devices installed. Refer to each device's Operation Manual to recheck for its proper program functions.

( ) Secure the door of the Robot with the two 6-32 × 3/8" hex head screws previously removed.

( ) Position the back panel onto the rear of the robot.

OPERATION

JUMPER SELECTION

When you install a new integrated circuit in your memory expansion circuit board, you will need to set each of the four jumpers associated with the IC. The directions for doing this have been covered in an earlier paragraph. In Figure 2, each of the currently acceptable devices is shown with its specific jumper arrangements.

Note that for type 6116 and 6264 RAMs, either position of jumper 2 is permitted. This allows these RAMs to be powered by the main V_{cc} supply (in position B) or the V_{sb} supply (in position A). When the Robot is sleeping, the main supply is turned off to conserve power. The V_{sb} supply remains on during the sleep cycle to provide power to any RAM that needs to retain its data.

MEMORY MAP

Figure 4 shows which portion of memory is enabled for any given address. Most of the previously mentioned devices, including the ET-18-7, will work in any of the six expansion sockets. Notice however, that the ET-18-4, if present, must be located at U103, and that U102 will not fully support 6264 RAMs or 2764 and 68764 EPROMs with the standard configuration of the memory decoder PAL.

ET-18-6 MEMORY MAP

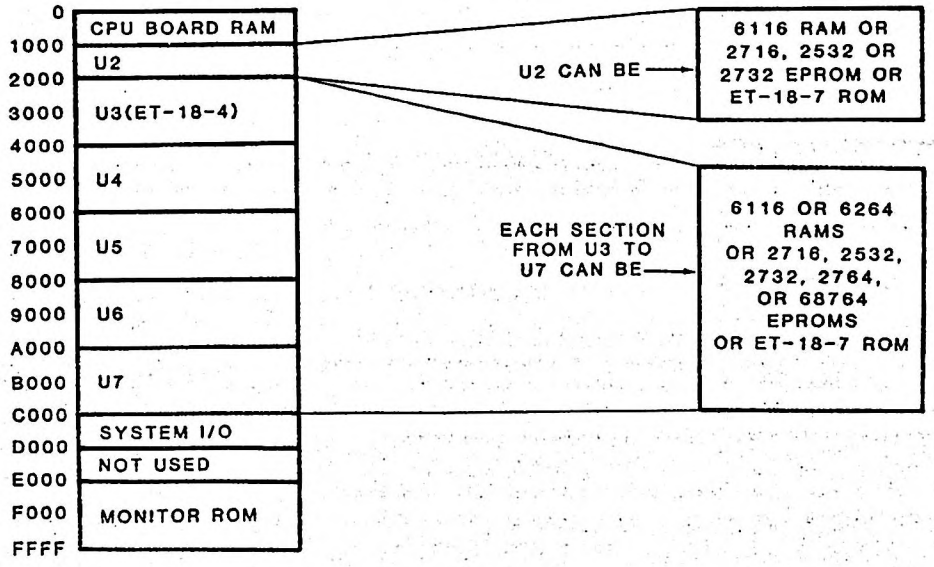


Figure 4

IN CASE OF DIFFICULTY

If you have a problem with the memory expansion circuits immediately after you have installed your preassembled, factory tested memory expansion circuit board, there are only a few specific areas which may cause the problem. You should proceed as follows:

1. Carefully check all the newly installed wire connections. Make sure each wire is connected to the correct pin in socket S201 and that each connector is properly latched in its socket hole.

2. Make sure that 6808 microprocessor IC U101 is properly positioned in its socket and that all of its pins are correctly seated in their holes; often a pin bent under the IC is difficult to see.

3. Make sure that any devices you have installed in sockets U102 through U107 are correctly positioned and that none of their pins are bent under. IMPORTANT: Any **24-pin** device you install in these sockets must be in socket holes **3 through 26.** See Pictorial 5, Illustration Booklet, Page 4.

4. Make sure all of the jumpers, where you have any device installed in sockets U102 through U107, are positioned correctly as listed in the chart on Figure 2 on Page 10.

5. Check for the proper V_{cc} and V_{sb} supply voltages. These may be measured at pins 1 and 3 of jumpers J101, J105, J109, etc.

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

SPECIFICATIONS

Crystal Frequency	4.00 MHz.
System Clock Frequency	1.00 MHz.
U102-U107	Will support 6116 RAMs, 2716, 2532, and 2732 EPROMs, and the ET-18-7 automatic mode ROM.
U103-U107	Will support 6264 RAMs, 2764 and 68764 EPROMs, in addition to those listed above.
U103	Will support ET-18-4 Utility ROM.

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (fold-in) as you read the following circuit description.

The main +5-volt V_{cc} supply comes from the CPU circuit board to the memory expansion circuit board through pins 8 and 35 of the interface cable. Ground is connected through pins 1, 21, and 36 of the cable, and through pin 2 of the power cable connected to plug P102. Chassis mounted regulator U11 is the source for the +5-volt RAM standby V_{sb} supply. U11's input comes from the Robot +12-volt logic supply at pin 3 of power socket S201, connected to the power supply circuit board, and regulates it to +5 volts DC at its output.

IC socket U101 holds the 6808 microprocessor (MPU) which was moved from the CPU circuit board. Capacitors C101, C102, and crystal Y101 are connected to pins 38 and 39 of the microprocessor, forming a 4.00 MHz clock oscillator. From this circuit, the CPU derives its 1.00 MHz system clock (E).

The signals HALT and MR are not used by the Robot or the memory expansion board, but are tied to the V_{cc} supply by R401 on the CPU board. IRQ and NMI are not used by the expansion board, but are tied directly to the CPU board by the interface cable.

RESET, VMA, and R/W are connected to the CPU board by the interface cable and to the memory decoder PAL. The R/W line is also sent to the bus transceiver to determine the direction of data transfer and to the memory expansion sockets and their associated jumpers to determine whether a RAM READ or WRITE operation is taking place. Also, the RESET line is connected to memory decoder PAL U108 to prevent a WRITE to any RAM during a "Sleep Mode Reawakening."

The 16 address lines, A0 through A15, are sent through the interface cable to the CPU board for I/O decoding and system ROM and RAM decoding and addressing. A0-A12 are used on the expansion circuit board to address the devices installed at U102 through U106. Also, A11-A15 are used by U108 to select U102-U106 and the bus transceiver, U109.

Data is transferred between MPU U101 and the memory expansion devices and bus transceiver U109 on the eight data lines, D0 through D7. These data lines form a bus which connects to all of the memory expansion sockets and the bus transceiver. When selected by the PAL, and if the R/W line is low, in the WRITE state, the bus transceiver sends data to the CPU board through the interface cable. Conversely, when U109 is selected and if the R/W line is high, in the READ state, data is received from the CPU board.

The SLEEP signal originates on the Robot's I/O board. It is the output from the Sleep Timer that signals the power supply to turn off the V_{cc} supply. This signal is tapped as it enters the power supply board at P201 pin 6 and is routed to the memory decoder PAL on the memory expansion board through P102 pin 1.

Memory decoder PAL U108 uses address lines A12-A15 to generate chip enable signals, CE2-CE7, for the memory expansion devices and the bus transceiver, CE9. It also generates output enable signal OE from the VMA, RESET, E, and SLEEP signals. OE is active (low) when VMA, RESET, and E are high and SLEEP is low.

Jumpers J101, J105, J109, J113, J117, and J121 select V_{cc} or V_{sb} voltages for each of the memory expansion devices. V_{cc} should be selected for any ROM or EPROM you install on the memory expansion board, but V_{sb} may be selected as the supply for any RAM that will retain its data while the Robot is sleeping.

The remaining jumpers are used to configure each memory expansion socket to the device being installed in it. These jumpers connect the proper address and output control lines.

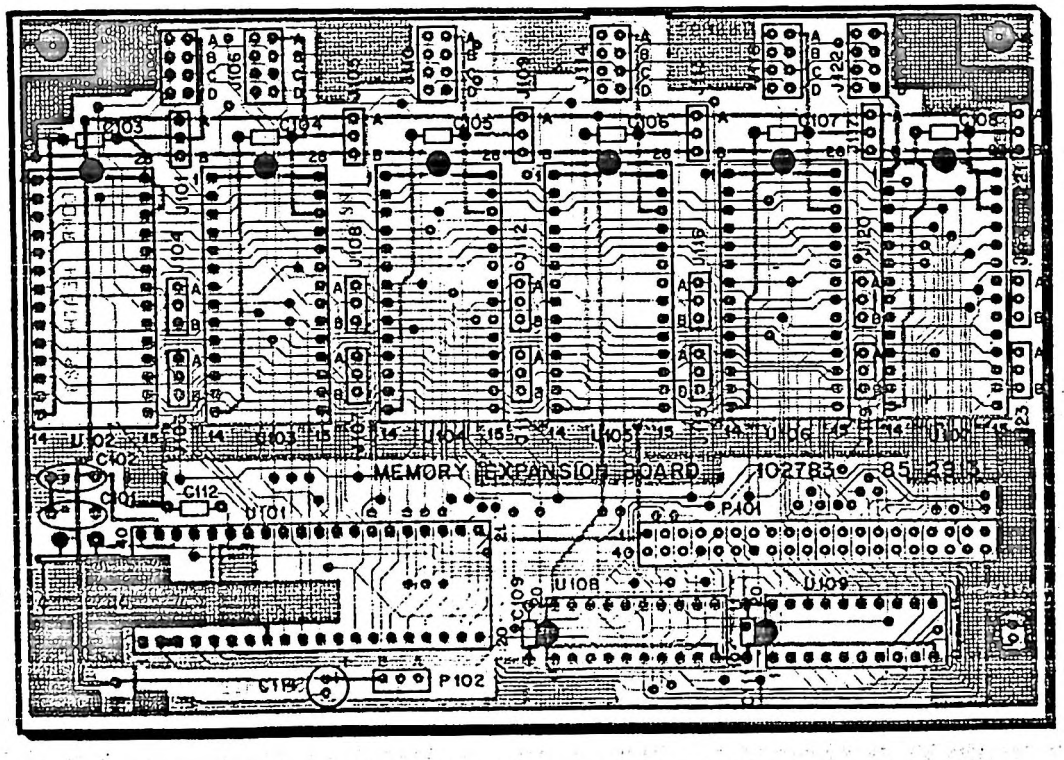
CIRCUIT BOARD X-RAY VIEW

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

A. Find the circuit number (R105, C103, etc.) on the "Circuit Board X-Ray View."

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

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



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

Memory Expansion Circuit Board

REPLACEMENT PARTS LIST

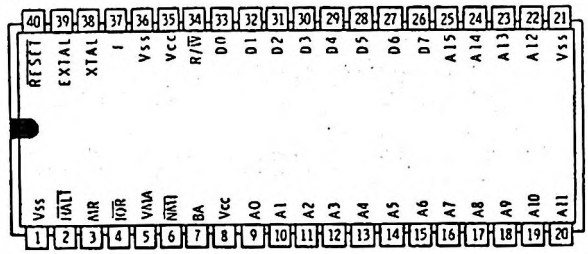
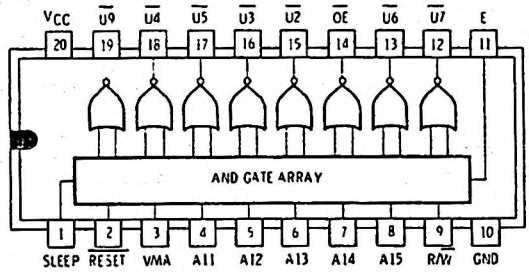
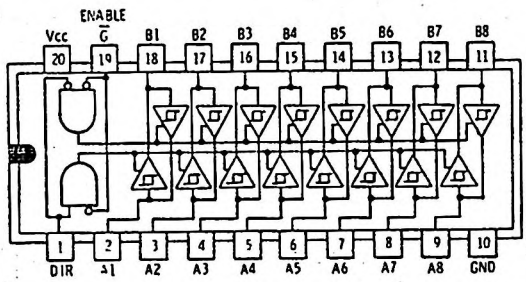
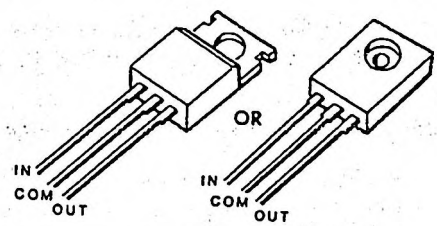
CAPACITORS

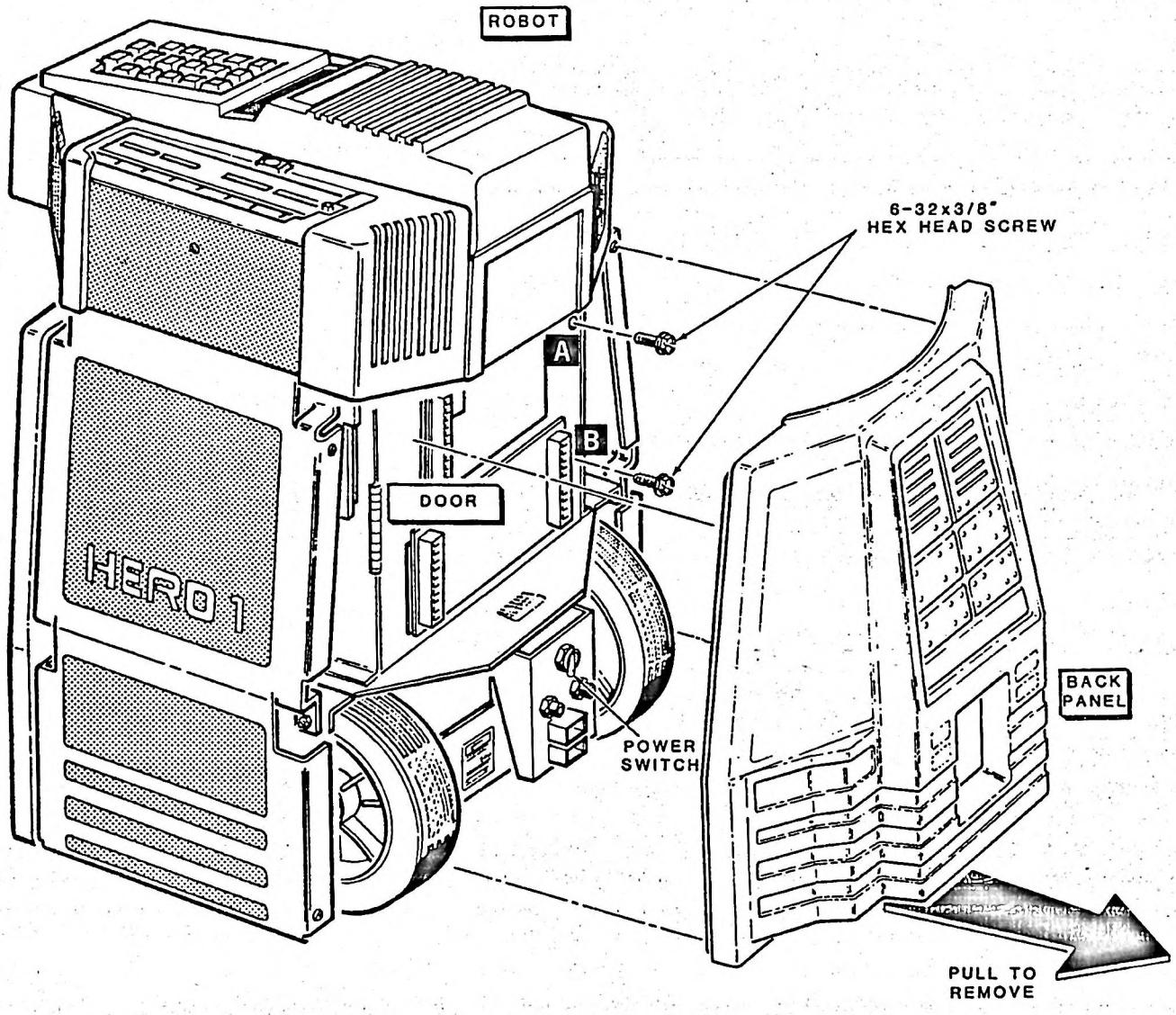
C101	21-6	27 pF ceramic
C102	21-6	27 pF ceramic
C103	21-769	.01 µF ceramic
C104	21-769	.01 µF ceramic
C105	21-769	.01 µF ceramic
C106	21-769	.01 µF ceramic
C107	21-769	.01 µF ceramic
C108	21-769	.01 µF ceramic
C109	21-769	.01 µF ceramic
C110	NOT USED	
C111	21-769	.01 µF ceramic
C112	21-769	.01 µF ceramic
C113	25-858	.33 µF electrolytic
C114	25-858	.33 µF electrolytic

OTHER COMPONENTS

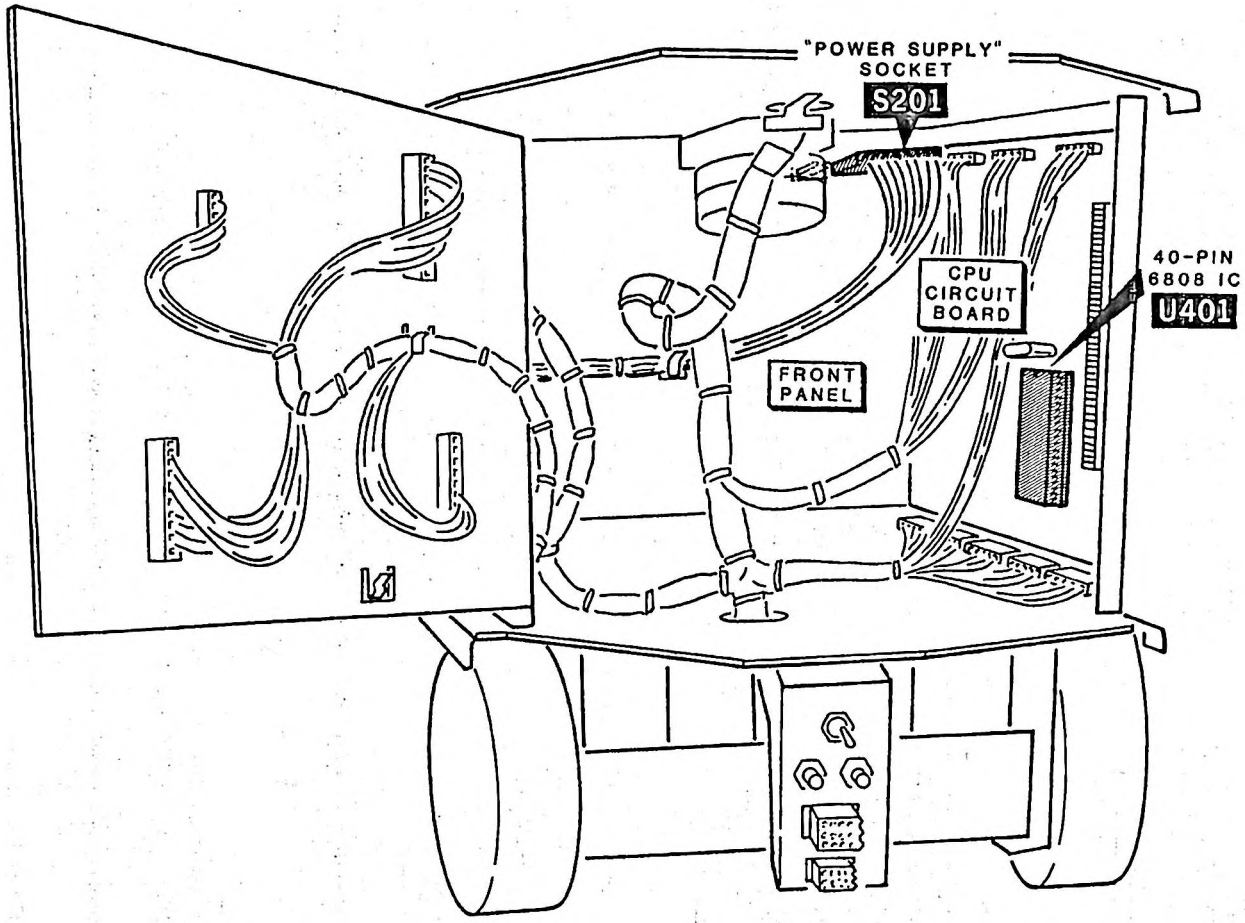
Y101	404-536	4 MHz crystal
U11	442-603	78M05 regulator
U101	443-939	6808 microprocessor IC
U108	444-249	PAL10L8 memory decoder IC
U109	443-885	74LS245 transceiver IC

SEMICONDUCTOR IDENTIFICATION CHART

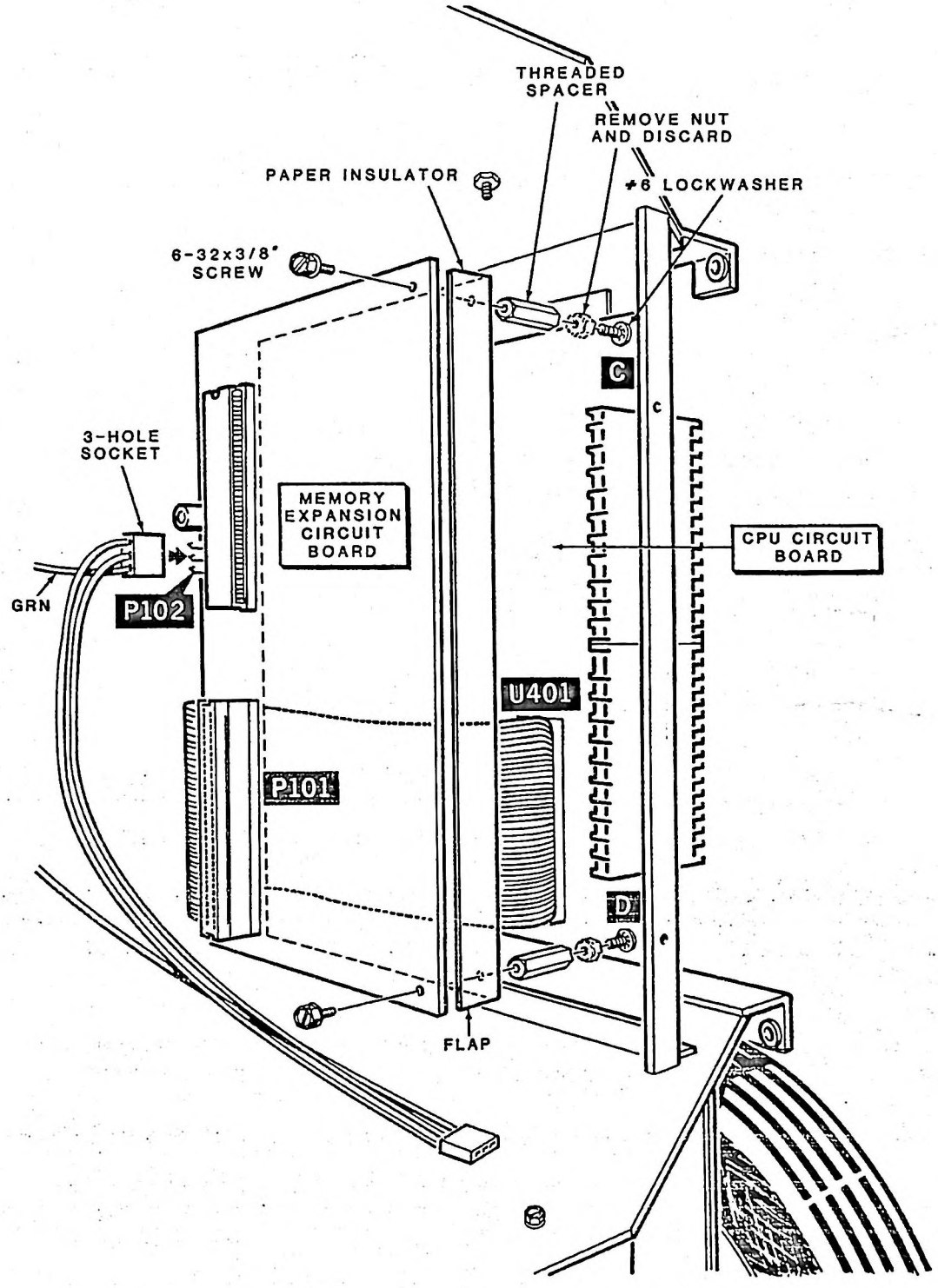
CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION (TOP VIEW)
U101	443-939	MC6808	
U108	444-249	(Available only from Heath Co.)	
U109	443-885	74LS245	
U11	442-603	78M05	


ROBOT
6-32x3/8"
HEX HEAD SCREW
A
B
DOOR
HERO 1
POWER
SWITCH
BACK
PANEL
PULL TO
REMOVE

PICTORIAL 1


"POWER SUPPLY"
SOCKET
S201
CPU
CIRCUIT
BOARD
40-PIN
6808 IC
U401
FRONT
PANEL

PICTORIAL 2


THREADED SPACER
REMOVE NUT AND DISCARD
PAPER INSULATOR
#6 LOCKWASHER
6-32x3/8" SCREW
C
3-HOLE SOCKET
MEMORY EXPANSION CIRCUIT BOARD
CPU CIRCUIT BOARD
GRN
P102
U401
P101
D
FLAP

PICTORIAL 3

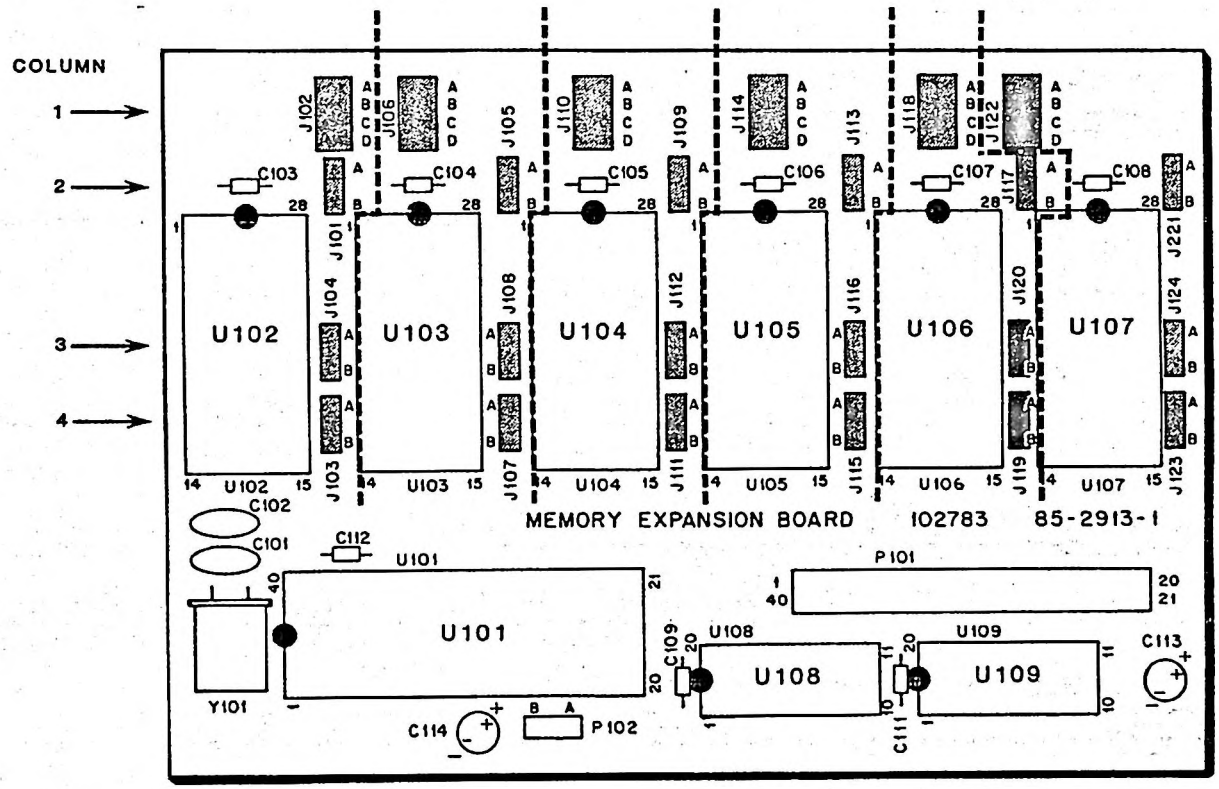
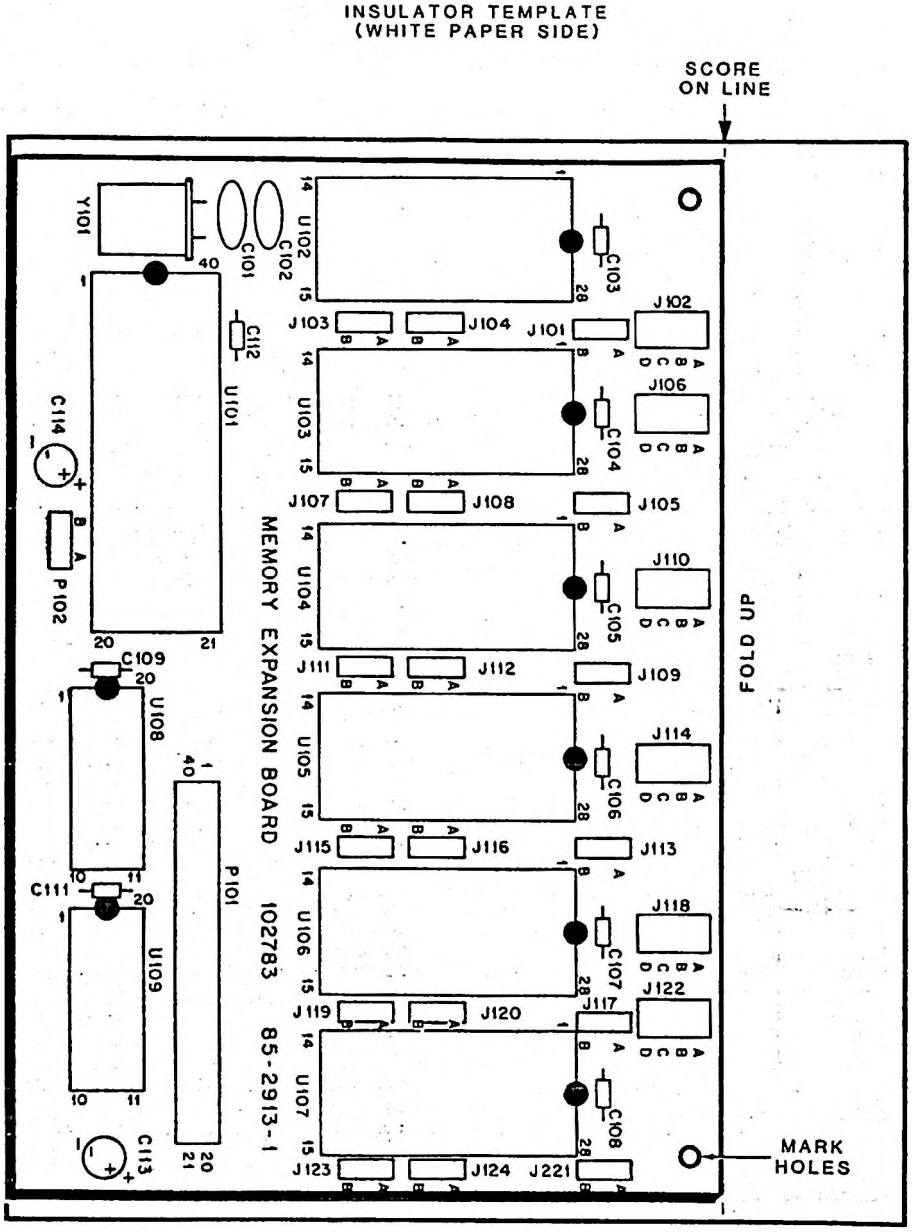
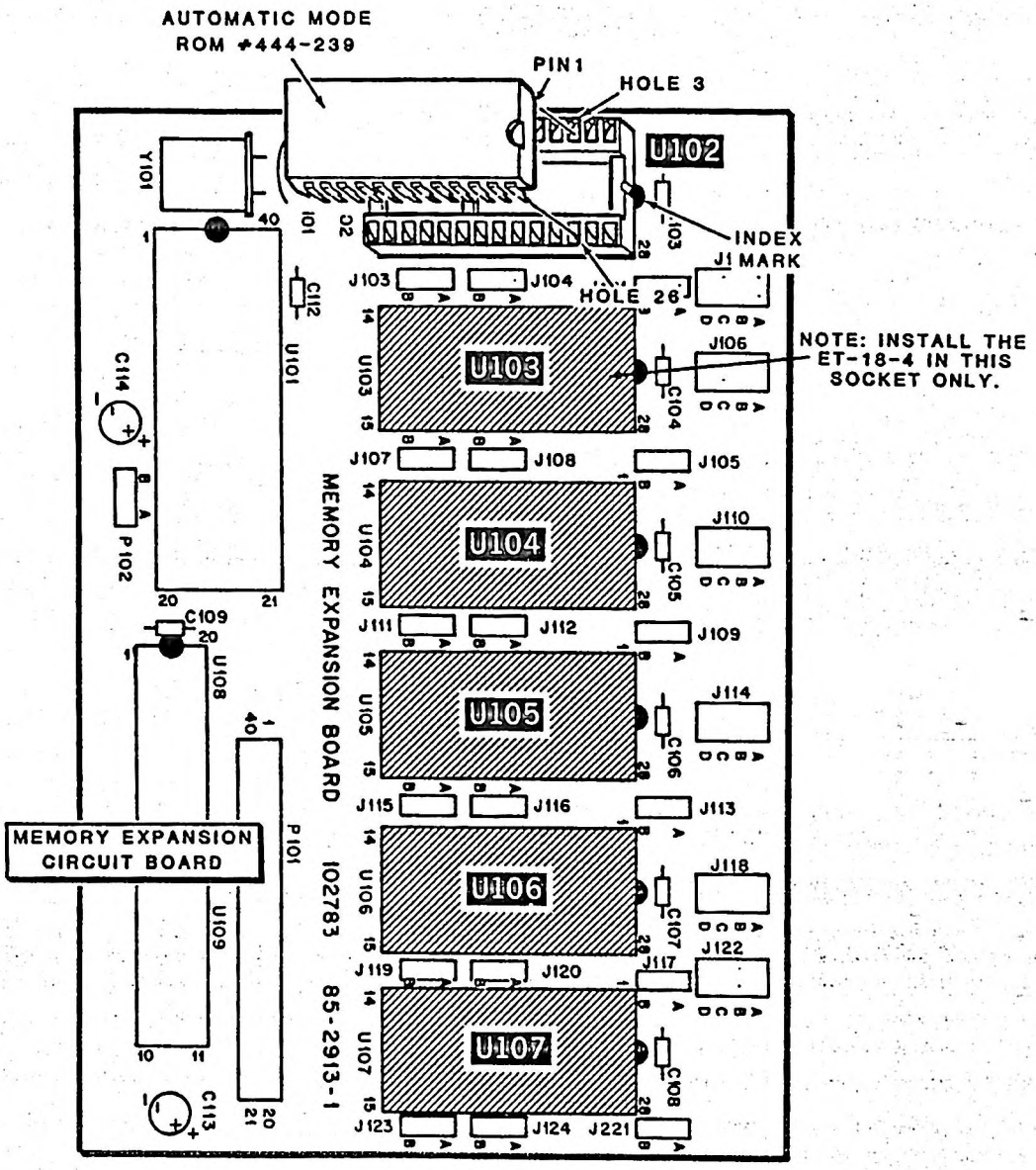

COLUMN
1
2
3
4
U102
U103
U104
U105
U106
U107
U101
U108
U109
MEMORY EXPANSION BOARD
102783
85-2913-1
P101
P102
Y101
C101
C102
C103
C104
C105
C106
C107
C108
C109
C111
C112
C113
C114

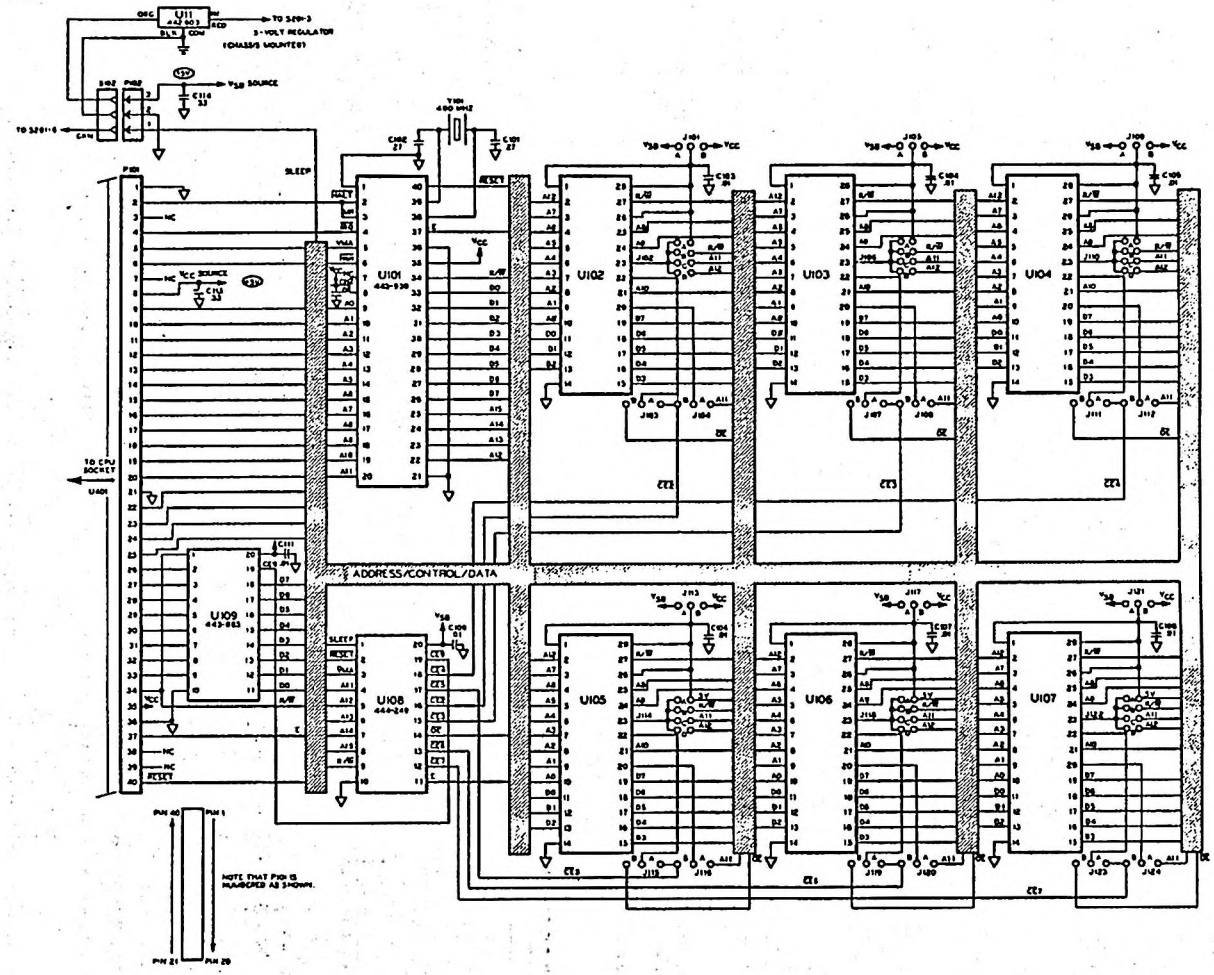
Figure 3


INSULATOR TEMPLATE
(WHITE PAPER SIDE)
SCORE
ON LINE
FOLD UP
MARK
HOLES
MEMORY EXPANSION BOARD 102783 85-2913-1
Y101
C101
C102
C103
C104
C105
C106
C107
C108
C109
C111
C112
C113
C114
U101
U102
U103
U104
U105
U106
U107
U108
U109
P101
P102
J101
J102
J103
J104
J105
J106
J107
J108
J109
J110
J111
J112
J113
J114
J115
J116
J117
J118
J119
J120
J122
J123
J124
J221

Detail 3A


AUTOMATIC MODE
ROM #444-239
PIN1
HOLE 3
U102
INDEX
J1 MARK
HOLE 26
NOTE: INSTALL THE
ET-18-4 IN THIS
SOCKET ONLY.
U103
U104
U105
U106
U107
MEMORY EXPANSION BOARD 102783 85-2913-1
MEMORY EXPANSION
CIRCUIT BOARD
Y101
C112
C114
C109
C113
P102
P101
U101
U108
U109
J103
J104
J106
J107
J108
J105
J110
J111
J112
J109
J114
J115
J116
J113
J118
J119
J120
J117
J122
J123
J124
J221
C104
C105
C106
C107
C108

PICTORIAL 5


U111
TO 5201-3
5-VOLT REGULATOR
(CHASSIS MOUNTED)
TO 5201-6
SLEEP
U101
U102
U103
U104
U105
U106
U107
U108
U109
ADDRESS/CONTROL/DATA
TO CPU SOCKET
U401
NOTE THAT PIN 1 IS MARKED AS SHOWN.
PIN 40
PIN 1
PIN 21
PIN 20