Trionyx Electronics, Inc.

M-H8/B

256K Byte Memory Board for the H8* Computer

The Trionyx M-H8 memory board for the Heathkit* H8 computer has now been redesigned to use 64K memory chips, in place of 16K memory chips. Four rows of 64K memory chips will provide 256K bytes of memory. The board may be populated with memory chips in 64K byte increments, from 64K bytes to 256K bytes. This new memory board is designated the M-H8/B. The M-H8/A memory board, using 16K memory chips, will continue to be produced.

The M-H8/B may be used in place of either the original M-H8 or the M-H8/A memory boards. In this application, only a single row of eight (8) memory chips will be required. The 64K RAMs use only a single power supply voltage of +5 volts. This voltage is derived from the +8 volt power supply on the H8 buss. The +18 volt and -18 volt power supply voltages on the H8 buss are not used for this memory board.

The M-H8/B memory board is ideally suited for use with the Trionyx X/2-H8 bank select card. A connector on the M-H8/B has been provided for this purpose. The X/2-H8 card can bank select up to 256K bytes of memory on the H8 buss. The M-H8/B memory board occupies only a single slot on the buss. Software provided with the X/2-H8 board will allow the additional memory above 64K bytes to be used either as a disk drive emulator or as an automatically operating cache for programs accessed from the disk drive system. The user can also develop his own software to use the bank selected memory in many other ways.

The M-H8/B memory board may also be used with our new 16-bit CPU board for the H8 computer now under development. In this application, the entire 256K bytes is used as main buss memory for the CPU board. Additional address lines on the Trionyx T-H90 motherboard will be used to access the entire memory. Many 16-bit CPU applications will require at least 256K bytes of main memory. Additional M-H8/B memory boards may be used on the buss, to provide more than 256K bytes of main memory. In this case, individual boards will be selected using an auxillary memory-management half card.

The new M-H8/B memory board is priced as follows:

Assembled	-	$ 350.00
Kit	-	275.00
PC Board	-	125.00

The above prices do not include memory chips. 64K memory chips are priced at $80.00 for a set of eight. Four (4) sets of eight memory chips are required to fully populate the board. Two (2) M-H8/B memory boards, operating in parallel, are required to provide 16-bit WORDS of memory on the expanded 16-bit data buss. A single M-H8/B memory board will provide 8-bit BYTES of memory on the standard 8-bit data buss.

The new M-H8/B memory board is based on the M-H8/A design and provides all of the features of that design. Fully transparent stand-alone refresh operation supports full DMA activity on the buss. This memory board may be used with either an 8080 or a Z80 8-bit CPU board. Both 2 MHz and 4 MHz operation are supported. This is a very versatile product which should soon become the standard memory board for the H8 computer.

* H8 and Heathkit are registered trademarks of the Heath Company.

M-H8/B - Board Assembly Instructions

The M-H8/B memory board may be assembled using the M-H8/A assembly instructions. The assembly differences between the two boards are minor. These differences may readily be determined by making reference to the parts list changes for the M-H8/B memory board.

The same number of Ø.1 MF filter capacitors are used in the M-H8/B memory chip array. The locations for these capacitors are different, however, and should be determined from the parts list. Not all of the capacitor locations will be populated. The +12 volt and -5 volt power supplies have been eliminated on the M-H8/B memory board. The original parts, VR5, VR6 and VR7 are not used. R1, R2, R3 and R4 have been reassigned. C66 and C67 are no longer used.

R7 has been replaced by resistor module RU6. Polarity must be observed when installing RU6. Pin 1 on RU6 is located to the left of the board, as indicated on the silkscreen.

Remove the center pin from a 3-pin strip. Install this strip at P5. Install a 2-pin strip at P2 and P4. Do not install a strip at P3. Nothing should be installed at P3 at this time. Install a 5-pin strip at P1. This should be a Molex strip with longer pins. A plug-in connector will be used with P5. The other pin strips should have shorter pins and will be used with wire-wrap wire.

Install 39 ohm resistors at R1, R2, R3 and R4. Install a 33Ø ohm resistor at R39. Install a 1K ohm resistor at R41. R4Ø and R42 have been relocated. Install a 1K resistor at R42. Install a jumper wire at J2. With J2 installed, R4Ø is not used.

64K, 15Ø ns (4164-2) memory chips are installed in the memory chip array. Populate the board in 8-chip increments, starting with the top row. Each row of memory chips will provide 64K bytes of memory. The board is always timed for 4 MHz operation, without wait states. High-speed memory chips must be used, even when operating at 2 MHz.

Install a 75452 dual peripheral driver in the eight-pin socket at U66.

J2 - The upper connection hole for J2 connects to pin 1 of every memory chip in the 32-chip array. Pin 1 of the 64K memory chips is normally not used, but may be used with memory chips from certain manufacturers. This input can be left unconnected if desired. It can also be connected to ground with a jumper wire installed at J2. This input can also be pulled up to +5 volts through a resistor (normally 1K) installed at R4Ø. It is normally recommended that J2 be installed and R4Ø not used.

A 5-pin connector shell is supplied for use with the Molex pin strip, P1. This connector is intended for use with the X/2-H8 bank select card. Use the no. 26 twisted-pair wire supplied with the bank-select card with this connector. Use a wire pair for pins 2 and 3, and another wire pair for pins 4 and 5. Use a separate wire for pin 1, which is ground. The five wires should be about 3 in. long and losely wrapped together. The wire ends can be soldered permanently to the appropriate terminal connections, and ground, on the solder side of the bank select card. Pin no. 2 on P1 controls the first memory bank, P1-3 controls the 2nd memory bank, P1-4 controls the 3rd memory bank, while P1-5 controls the 4th memory bank. The single ground wire provides a signal return path for the four bank select lines.

M-H8/B - Part List Changes

The following changes are made to the M-H8/A parts list for the M-H8/B board.

U1 - U8	4164-2	MEMORY CHIPS - 64K BOARD	$ 80.00 SET
U1 - U16	4164-2	MEMORY CHIPS - 128K BOARD	-
U1 - U24	4164-2	MEMORY CHIPS - 192K BOARD	-
U1 - U32	4164-2	MEMORY CHIPS - 256K BOARD	-
U66	SN75452	DUAL PERIPHERAL DRIVER	1.50
VR5	-	NOT USED	-
VR6 - VR7	-	NOT USED	-
RU6	750-81-R1K	8 PIN - 7 RESISTOR SIP	2.25
R1, R2, R3, R4	RC07GF390J	39 OHM (ORANGE-WHITE-BLACK)	.20 EA.
R7	-	NOT USED	-
R39	RC07GF331J	330 OHM (ORANGE-ORANGE-BROWN)	.20
R40	-	USE OPTIONAL	-
R41, R42	RC07GF102J	1K OHM (BROWN,BLACK,RED)	.20 EA.
C9 - C16, C25 - C32, C41 - C48, C57 - C64, C69, C70, C75, C76, C78, C82, C85, C87, C95, C96, C98, C99, C100	CK05BX104K	.1 MF CERAMIC CAPACITOR	.60 EA.
		NOTICE: NOT ALL OF THE CAPACITORS PROVIDED FOR IN THE MEMORY CHIP ARRAY ARE USED.	
C66, C67	-	NOT USED	-
1	100099-B	M-H8/B PRINTED CIRCUIT BOARD	100.00
1	100098-B	M-H8/B DOCUMENT PACKAGE	20.00
1	000010	NOT USED	-
1	000020	NOT USED	-
4	000270	HEAT TRANSFER PADS	.25 EA.
1	22-10-0041	4-PIN GOLD CONNECTOR	.65
2	22-10-0021	2-PIN GOLD CONNECTOR	.50 EA.
20	000220	IC SOCKET 14-PIN	.70 EA.
2	000230	IC SOCKET 8-PIN	.60 EA.
1	432-970	CONNECTOR SHELL - 5 PIN	1.00
5	432-866	CONNECTOR PINS	.10 EA.

Special Note:

8-Bit CPU Memory Operation beyond 64K Bytes:

NOTICE: The H8 computer can address a maximum of 64K bytes of memory. Using the M-H8/B 256K byte memory board cannot extend the memory capacity of the computer beyond 64K bytes. The additional memory is useful for a number of other applications.

Memory cost for computers of all types has dropped very greatly in the past several years. Memory space and power requirements have also been greatly reduced during this time. 64K bytes of main buss memory no longer seems like a large amount. Perhaps the greatest single technical advantage of the new 16-bit CPU chips is their ability to directly address more than 64K bytes of memory. 8-bit CPU chips can only address up to 64K bytes of memory.

8-bit CPU chips could be manufactured to address one megabyte of memory. This will not happen, as this development has been preempted by the new 16-bit CPU chips. No one is going to put this kind of an investment into an 8-bit CPU chip at this time. It can be fairly stated that development of 8-bit CPU chips has now been halted.

Nevertheless, 8-bit CPU opeartion using more than 64K of memory is entirely possible. The techniques for doing this are well established. Any amount of memory can be addressed by a CPU board, if the proper interfacing to the memory is provided. The Trionyx X/2-H8 bank select card provides the means of extending the addressing range of the 8-bit H8 CPU board to 256K bytes! Using the proper software, the 8-bit CPU board could directly address the entire 256K bytes.

Unfortunately, the difficulty of writing such a software program cannot be overstated. This would essentially mean rewriting much of the operating system for the computer. The H8 computer uses two operating systems: HDOS and CP/M. Nonetheless, we have been looking at this for a long time and are still considering it.

Software currently provided for the X/2-H8 bank select card enables the additional memory on the buss to be used either in place of a disk drive, as a disk drive emulator, or as an automatically operating cache for programs accessed from the disk drive system. In these applications, the X/2-H8 bank select card and additional electronic memory operate as very useful adjuncts to the disk drive system. The bank select card and additional memory nicely complement any disk drive system.

Electronic memory, operating in place of a disk drive, provides high-speed, quiet operation. When operating as a disk emulator, electronic memory provides additional working storage space for disk activity. Perhaps the greatest advantage of electronic "disk" memory is the saving of wear and tear on the floppy diskettes. Floppy disks will last much longer and their reliability will be greatly improved. Drive wear is also reduced, accordingly.

It will be greatly appreciated when running certain programs, such as adventure games, not having to frequently access the disk drives. The time delay and the noise can be a great distraction.

M-H8/B

Jumper Wire Configuration

P1 - Four inputs from X/2-H8 memory bank select card: These inputs are normally high. A negative-going signal selects one 64K memory bank at a time at each input.

P1-4 Selects top row of 64K memory chips.
P1-3 Selects 2nd row of 64K memory chips.
P1-2 Selects 3rd row of 64K memory chips.
P1-1 Selects bottom row of 64K memory chips.

P1-5 Ground connection. A ground wire must accompany the four memory row select wires.

Note: No connections are made to P1 when bank-select operation is not used.

P2 - Wire-wrap jumper enables memory-chip row-selection address decoder. Omit when using memory bank select card. Install otherwise.

P3 - Not used. Pin strip P3 should not be installed. Raise Pin 3 of U37. U37-3 should be brought down on the outside of the socket for U37 and not be inserted into the socket.

M-H8/B board connection points "A" and "B" connect higher order address lines (A16 and A17) to the 74LS138 address decoder at U37. These addresses select one of the four rows of 64K memory chips.

A Trionyx T-H90 motherboard must be used in the H8 computer to provide the additional address lines for A16 and A17. A second (auxillary, "B") connector must be installed on the M-H8/B memory board to connect to the new address lines. These connectors are regularly sold for use with the T-H90 motherboard. Riser wires (no. 26 bare buss wire can be used for this purpose) connect the A and B connection points on the M-H8/B memory board to the second connector installed on the memory board. The additional address lines on the buss connect to the 16-bit CPU board.

P4 - Install a wire-wrap jumper for operation with an 8080A CPU board. Do not install a jumper for operation with a Z-80 CPU board or a 16-bit CPU board.

P5 - Install a wire-wrap jumper to enable (select) the memory board. When using more than one M-H8/B memory board in the computer, this jumper is not installed. Memory boards are then selected using control lines on the computer buss. The appropriate control line will then connect to either connection point "C" or "D" on the M-H8/B board. Connection points C and D actually constitute a single input, connected together on the printed circuit board.

Either input C or D is connected to the auxillary "B" connector mounted on the M-H8/B memory board for extended memory operation with a 16-bit CPU board. A short riser wire is used for this purpose. A separate control line on the buss is required for each memory board selected. The buss control lines are connected to a memory management "half card" which decodes the higher order memory addresses on the buss and selects the appropriate 256K memory board. In this way, four M-H8/B memory boards will provide one megabyte of memory on the main buss for a 16-bit CPU board.

M-H8/B - Configuration Summary

I. Operation as 64K memory board on H8 buss:

1 - Install wire-wrap jumper at P1 between pins 4 and 5.
2 - No connection at P2.
3 - Connection at P5.

Note: Only the first (top) row of eight memory chips will now be used.

II. Bank Select Operation with 8-Bit CPU Board:

1 - Install connector on P1 to connect X/2-H8 bank select card.
2 - No connection at P2.
3 - Connection at P5.

Install and use as many rows of memory chips (1-4) as desired.

III. Use Up to 256K Bytes of memory on the H8 buss (With 16-Bit CPU):

1 - No connection at P1.
2 - Connection at P2.
3 - Raise U37-3.
4 - Connect points A and B to auxillary buss connector.
5 - Connection at P5.

IV. Use more than 256K bytes of memory on H8 buss (With 16-Bit CPU):

1 - No connection at P1.
2 - Connection at P2.
3 - Raise U37-3.
4 - Connect points A and B to auxillary buss connector.
5 - No connection at P5.
6 - Connect either point C or D to auxillary buss connector.

Testing the Memory Board:

Each row of memory chips may be tested in the computer by enabling one bank at a time and using the selected bank as the standard 64K-byte memory in the computer. This is done by connecting pin 5 (ground) of pin-strip P1 to each of the other pins of P1. The memory test programs supplied on the diskette with the memory board can then be used to test the memory chips.

PC BOARD SILKSCREEN DESIGNATOR	PART	DESCRIPTION	PRICE
U1 - U8	4116-2	MEMORY CHIPS - 16K BOARD	$ 3Ø.ØØ SET
U1 - U16	4116-2	MEMORY CHIPS - 32K BOARD	-
U1 - U24	4116-2	MEMORY CHIPS - 48K BOARD	-
U1 - U32	4116-2	MEMORY CHIPS - 64K BOARD	-
U33, U4Ø, U41 U43, U48, U49, U55, U56	SN74SØ4	HEX INVERTER	.7Ø EA.
U34, U35	SN74S51	AND-OR-INVERT GATES	1.5Ø EA.
U36	SN74ØØ	QUAD 2-INPUT POS-NAND GATE	.55
U37	SN74LS138	3-TO-8 LINE DECODER/MUX	3.15
U38, U42, U45, U57, U59, U61	SN74123	DUAL ONE-SHOT MULTIVIBRATOR	1.35 EA.
U39	NE555	TIMER	.75
U44	SN74S74	DUAL D-TYPE FLIP/FLOP	.95
U46, U47, U54 U62, U63	SN74LS373J	OCTAL D-TYPE LATCH	3.75 EA.
U5Ø, U51	SN74Ø8	QUAD 2-INPUT POS- AND GATE	.55 EA.
U52	SN74SØØ	QUAD 2-INPUT POS-NAND GATE	.75
U53	SN74393	DUAL 4-BIT BINARY COUNTER	2.85
U58, U65	SN7474	DUAL D-TYPE FLIP/FLOP	.75 EA.
U6Ø	SN74SØ2	QUAD 2-INPUT POS-NOR GATE	.75
U64	SN74Ø2	QUAD 2-INPUT POS-NOR GATE	.55
U66	SN7438	QUAD 2-INPUT POS-NAND GATE	.65
Q1	2N44ØØ	TRANSISTOR - NPN	.45
CR1 - CR4	1N914	SILICON DIODE	.2Ø EA.
VR1 - VR4	LM34ØT-5	POSITIVE 5-VOLT REGULATOR	2.15 EA.
VR5	LM34ØT-12	POSITIVE 12-VOLT REGULATOR	2.45
VR6 - VR7	1N5231	ZENER DIODE	.75 EA.

PC BOARD SILKSCREEN DESIGNATOR	PART	DESCRIPTION	PRICE
RU1 - RU5	316B390	39 OHM RESISTOR MODULE	2.25 EA.
		RESISTORS, 1/4 WATT, 5%	
R1, R7, R10, R18, R25, R34, R35, R36, R38, R39	RC07GF102J	1K OHM (BROWN-BLACK-RED)	.20 EA.
R2, R11, R17	RC07GF472J	4.7K OHM (YELLOW-VIOLET-RED)	.20 EA.
R3	RCO7GF100J	10 OHM (BROWN-BLACK-BLACK)	.20
R4, R40, R41, R42	RCO7GF331J	330 OHM (ORANGE-ORANGE-BROWN)	.20 EA.
R5, R6, R14, R15, R21, R22, R26, R27	RC07GF390J	39 OHM (ORANGE-WHITE BLACK)	.20 EA.
R8, R19	RC07GF103J	10K OHM (BROWN-BLACK-ORANGE)	.20 EA.
R9	RC07GF393J	39K OHM (ORANGE-WHITE-ORANGE)	.20
R12, R29	RC07GF153J	15K OHM (BROWN-GREEN-ORANGE)	.20 EA.
R13, R37	RC07GF101J	100 OHM (BROWN-BLACK-BROWN)	.20 EA.
R16, R28, R30 R33	RC07GF183J	18K OHM (BROWN-GRAY-ORANGE)	.20 EA.
R20	RC07GF163J	16K OHM (BROWN-BLUE-ORANGE)	.20
R23, R24	RC07GF221J	220 OHM (RED-RED-BROWN)	.20 EA.
R31, R32	RC07GF223J	22K OHM (RED-RED-ORANGE)	.20 EA.
L1, L2	WEE8.2	8.2 UH INDUCTOR	1.80 EA.
L3	WEE22	22 UH INDUCTOR	1.80

PC BOARD SILKSCREEN DESIGNATOR	PART	DESCRIPTION	PRICE
C1, C3, C5, C7 C9, C11, C13, C15, C18, C2Ø, C22, C24, C25, C26, C28, C3Ø, C32, C33, C35, C37, C39, C41, C43, C45, C47, C5Ø, C52, C54, C56, C57, C58, C6Ø, C62, C64, C69, C7Ø, C75, C76, C78, C82, C85, C87, C95, C96, C98, C99, C1ØØ	CKØ5BX1Ø4K	Ø.1 MF CERAMIC CAPACITOR	.6Ø EA.
	NOTICE:	NOT ALL OF THE CAPACITORS PROVIDED FOR IN THE MEMORY CHIP ARRAY ARE USED.	
C74	CKØ5BX1Ø2K	1ØØØ PF CERAMIC CAPACITOR	.85
C84	CKØ5BX33ØK	33 PF CERAMIC CAPACITOR	.85
C88	CKØ5BX332K	33ØØ PF CERAMIC CAPACITOR	.85
C72, C91, C92	CMØ5ED1ØØJØ3	1Ø PF MICA CAPACITOR	.6Ø EA.
C73	CMØ5ED1Ø2JØ3	1ØØØ PF MICA CAPACITOR	.95
C81	CMØ5ED221JØ3	22Ø PF MICA CAPACITOR	.6Ø
C93	CMØ5ED33ØJØ3	33 PF MICA CAPACITOR	.6Ø
C94	CMØ5ED22ØJØ3	22 PF MICA CAPACITOR	.6Ø
C97	CMØ5ED561JO3	56Ø PF MICA CAPACITOR	.95
C65, C66, C67, C68, C71, C77, C1Ø1	15ØD156XØØ2ØB2	15 MF, 2Ø VOLT TANT. CAPACITOR	1.65 EA.

MISCELLANEOUS PARTS

QUANTITY REQUIRED	PART NUMBER	DESCRIPTION	PRICE
1	1ØØ99	M-H8/A PRINTED CIRCUIT BOARD	$ 7Ø.ØØ
1	1ØØ98	M-H8/A DOCUMENT PACKAGE	1Ø.ØØ
1	ØØØ2ØØ	METAL MOUNTING BAIL	4.5Ø
1	1ØØ2Ø6	MOUNTING BAIL BUMBER	.5Ø
2	22-16-2251	MOLEX GOLD PC BOARD CONNECTOR	6.5Ø EA.
1	ØØØ2Ø1	CONNECTOR KEY	1.5Ø
1	ØØØ3Ø6	DOUBLE-SIDED ADHESIVE FILM	.3Ø
5	ØØØØ6Ø	ROUND HEAD 6-32 X 3/8 SCREW	.2Ø EA.
2	ØØØØ7Ø	TRUSS HEAD 6-32 X 3/8 SCREW	.2Ø EA.
5	ØØØØ8Ø	HEX NUT 6-32	.1Ø EA.
5	ØØØØ9Ø	LOCK WASHER NO. 6	.1Ø EA.
5	ØØØØ92	FIBER WASHER NO. 6	.1Ø EA.
1	ØØØØ1Ø	PLASTIC 4-4Ø X 1/4 SCREW	.1Ø
1	ØØØØ2Ø	PLASTIC HEX NUT 4-4Ø	.1Ø
1	ØØØØØ2	SOLDER .Ø32 DIA. 6Ø FEET	3.ØØ
1	ØØØ15Ø	BUSS WIRE NO. 26 TINNED 6 IN.	.1Ø
1	ØØØ16Ø	SLEEVING FOR NO. 26 BUSS WIRE 6 IN.	.2Ø
5	ØØØ27Ø	TO-22Ø HEAT TRANSFER PADS	.25 EA.
1	22-1Ø-ØØ21	2-PIN GOLD CONNECTOR	.5Ø
2	22-1Ø-ØØ31	3-PIN GOLD CONNECTOR	.6Ø EA.
1	22-1Ø-ØØ51	5-PIN GOLD CONNECTOR	.75
4	ØØØ187	WIRE WRAP WIRE 1/2 IN.	.Ø5 EA.
5	ØØØ2ØØ	IC SOCKET 2Ø-PIN GOLD	.95 EA.
39	ØØØ21Ø	IC SOCKET 16-PIN GOLD	.75 EA.
21	ØØØ22Ø	IC SOCKET 14-PIN GOLD	.7Ø EA.
1	ØØØ23Ø	IC SOCKET 8-PIN GOLD	.6Ø