

**TRIONYX ELECTRONICS, INC.**

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**INVOICE**

2929

TO

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DATE	7-24-81
CUSTOMER ORDER NO.	
SALESPERSON	Bill Perry
VIA	

TERMS: 50.00 Down, Balance COD

QUANTITY	DESCRIPTION	PRICE	AMOUNT	
1	T-H90 Motherboard		75	00
1	25 pin connectors, set of 20		45	00
	Shipping & handling		3	50
	Total		123	50
	Amount remitted		50	00
	Total now due		73	50

ORIGINAL

*Thank You!*

## T-H90 Motherboard - Assembly Instructions

The new T-H90 motherboard must be assembled with gold-plated bus connectors. Tin-plated connectors are not reliable and are not acceptable. If gold-plated connectors are reclaimed from the original Heath motherboard, each pin must be wiped clean of solder. The fit on the T-H90 motherboard is very tight. The use of new connectors is recommended for this reason.

Three different connector sets are available for the T-H90 motherboard. The set of 20, 25-pin connectors will build the T-H90 motherboard to the original Heath H8\* standard. This will provide the H8 computer with gold-plated connectors and some additional signal grounding. These connectors should be installed in slots P1 through P10, as on the original H8 motherboard.

Addition of 18, 20-pin connectors will make the additional 40 lines included on the T-H90 motherboard available to each module which plugs into the motherboard. This will be necessary to provide additional ground connections to the plug-in modules. Finally, 14, 25-pin connectors can be added to the motherboard to provide 7 auxiliary slots for port-addressable peripheral cards. These are special cards, similar in appearance to the Heath HA8-8 Extended Configuration card, which will be made available by Trionyx Electronics, Inc. The HA8-8 card can plug into one of these slots immediately behind the CPU board without occupying any of the standard motherboard slots.

The connectors fit tightly into the plated-through mounting holes on the T-H90 motherboard. This will force the connectors to stand up perfectly straight after they are inserted on the board. Absolutely true vertical pin alignment is required for the dual connector plug-in method used on the T-H90 motherboard. Each connector should be forced into its mounting holes along its entire length before it is soldered in place on the motherboard. Be careful not to push on the pins, themselves. Use a tool to push down on the insulating strip holding the pins.

Each connector should be initially soldered in place using a few widely spaced pins, only. This will permit reseating of the connector on the board, if required. The connections can be individually reheated for this purpose. Once this is done, the remaining connector pins can be soldered to the motherboard. Each of the solder connections should be carefully inspected for solder bridges.

The power supply parts may be removed from the original H8 motherboard and installed on the T-H90 motherboard. The mounting hole spacing for each part is identical on each of the two motherboards. An additional +18 volt filter capacitor may be installed on the T-H90 motherboard, if desired. This will increase the current output of the +18 volt power supply by a small amount.

The original motherboard must be removed from the H8 computer and the T-H90 motherboard installed in its place. The computer must be disassembled to a considerable extent to do this. It is recommended that all of the connectors be installed on the T-H90 motherboard at the same time so that the H8 need be disassembled only once. The wires (5) from the H8 power supply must be unsoldered from the original H8 motherboard and connected to the T-H90 motherboard. The wire connection pattern is identical on the two motherboards.

After the H8 power supply wires are soldered in place, the T-H90 motherboard can be installed in the H8 computer. Mounting screws with insulating washers are supplied with each motherboard for this purpose. The right front rubber foot on the bottom panel of the H8 computer should be relocated in one of the ventilation holes about an inch or so from its original location. This will allow insertion of the CPU board with a connector adaptor kit installed.

\* H8 is a registered trademark of the Heath Company.

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T-H90 MOTHERBOARD - CONNECTOR PIN ASSIGNMENTS

CONNECTOR A		B CONNECTOR		C CONNECTOR	
+8V	49	49	GND	49	+8V
+8V	48	48	GND	48	+8V
+18V	47	47	+18V	47	+18V
ROM DISABLE-L	46	46	BS4-L	46	ROM DISABLE-L
A15-L	45	45	BS3-L	45	GND
A14-L	44	44	C-44 **	44	B-44 **
A13-L	43	43	GND	43	B-42 **
A12-L	42	42	C-43 **	42	B-41 **
A11-L	41	41	C-42 **	41	B-40 **
A10-L	40	40	C-41 **	40	B-39 **
A9-L	39	39	C-40 **	39	B-38 **
A8-L	38	38	C-39 **	38	GND
A7-L	37	37	A17-L	37	A7-L
A6-L	36	36	GND	36	A6-L
A5-L	35	35	A16-L	35	A5-L
A4-L	34	34	BS2-L	34	A4-L
A3-L	33	33	BS1-L	33	A3-L
A2-L	32	32	**	32	A2-L
A1-L	31	31	Ø1-L	31	A1-L
AØ-L	30	30	GND	30	AØ-L
RESET-L	29			29	RESET-L
MEMR-H	28			28	GND
HOLD-H*	27			27	**
I/OR-H	26			26	I/OR-H
HLDA-L*	25			25	GND
GND*	24			24	GND*
MEMW-H	23			23	GND
Ø2-L	22			22	Ø2-L
I/OW-H	21			21	I/OW-H
RDYIN-L*	20			20	RDYIN-L*
M1-H	19	19	GND	19	M1-H
GND*	18	18	MRQ-L	18	GND*
D7-L	17	17	D15-L	17	D7-L
D6-L	16	16	D14-L	16	D6-L
D5-L	15	15	D13-L	15	D5-L
D4-L	14	14	D12-L	14	D4-L
D3-L	13	13	GND	13	D3-L
D2-L	12	12	D11-L	12	D2-L
D1-L	11	11	D10-L	11	D1-L
DØ-L	10	10	D9-L	10	DØ-L
INT2-L*	9	9	D8-L	9	GND
INT1-L*	8	8	C-8 **	8	B-8 **
INT7-L	7	7	C-7 **	7	B-7 **
INT6-L	6	6	GND	6	***
INT5-L	5	5	C-5 ***	5	B-5 ***
INT4-L	4	4	C-4 ***	4	B-4 ***
INT3-L	3	3	C-3 ***	3	B-3 ***
-18V	2	2	-18V	2	-18V
GND	1	1	GND	1	GND
GND	Ø	Ø	GND	Ø	GND

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T-H90 MOTHERBOARD - CONNECTOR PIN DEFINITIONS

Three distinct connector sets are used on the Trionyx T-H90 motherboard. Connector set "A" is identical with the connector set used on the original Heath motherboard for the H8\* computer. The motherboard is functional with this connector set alone.

Connector set "B" is used in conjunction with connector set A and makes an additional 40 bus lines available to the H8 plug-in printed circuit boards. A bus adaptor kit is used to convert the original H8 boards to the new 90 pin bus.

Connector set "C" provides 7 additional 50 pin card slots for the H8 computer. Some of the A connector bus lines and some of the B connector bus lines connect to the C connector. The C connector thus has a unique pin assignment and has been planned for use with various kinds of port addressable cards. These will be short cards with special connectors similar to the Heath HA8-8 card. A number of these cards will become available in the future. Some of these cards will interface the H8 to peripheral devices. Other cards will provide additional hardware for the H8 bus.

The pin functions on connector set A are identical with the pin definitions established by the Heath Company for the original bus used in the H8 computer. These definitions can be found in the Heathkit H8 Computer Operating Manual.

Some new functions have been assigned by Trionyx Electronics, Inc. to connector B. These include two additional address lines (A16 and A17), 8 additional data lines (D8 through D15) and 4 bank select lines (BS1 through BS4). A memory request line (MRQ) has also been added.

Lines marked with a double asterisk (\*\*) are unassigned lines which will be later defined and used by Trionyx Electronics, Inc. Lines marked with a triple asterisk (\*\*\*) are unassigned lines which will not be used by Trionyx. These lines may be defined by the user.

Most of the unassigned lines have common connections on the B and C connectors. Connections to the other connector in each case are indicated on the connector pin assignment sheet.

A single asterisk (\*) indicates a function on the A connector which may be changed by the Heath Company. Ground lines marked with a single asterisk do not connect to the ground system on the T-H90 motherboard. These are individual unused lines on the T-H90 motherboard.

The voltage levels of signals asserted on the bus are indicated on the connector pin assignment sheet with either an "H" (high) or an "L" (low) following the signal designation. These signals are "true" or in the logical "1" state at the indicated voltage levels.

H8\* is a registered trademark of the Heath Company.

Fully grounding each of the individual computer boards to the bus should result in considerable improvement of any bus problems. Full grounding of the boards may provide a complete solution in many cases. If bus problems persist beyond this point, however, the bus should be passively terminated in its characteristic impedance of about 130 ohms. Ideally, both ends of the bus should be terminated. Termination at the rear of the bus however, is more important. A termination card for the rear of the bus will soon be made available from Trionyx Electronics, Inc. The new Z80 CPU board also to become available from Trionyx Electronics, Inc. will include an optional termination network for the front end of the bus. The Z80 board will also have heavy duty bus drivers to drive termination networks at both ends of the bus. The bus terminations will eliminate signal reflections from the ends of the bus which would distort the signals on the bus.

Finally, the bus drivers and receivers on the original H8 boards can be replaced with tiny bus driver and receiver modules which will be available from Trionyx Electronics, Inc., if needed. These will plug into the IC sockets for the original bus drivers and receivers on the H8 boards. The new bus drivers will have the capability of driving termination networks at both ends of the bus. The new receivers will have a high input impedance and will not load the bus.

Some computer board types are inherently more sensitive to bus problems than others. Dynamic memory boards require better bus conditions than static memory boards. Static memory boards respond to signal levels rather than signal edges and are very forgiving if noise or distorted signal waveforms are present on the bus. Dynamic memory boards have an internal cycle independent of the bus commands. Noise or signal reflections on the bus can more easily interfere with the operation of dynamic memory boards.

Computer bus problems are generally undefined and vary greatly from system to system. The solution in all cases is to have a well-grounded, properly terminated and adequately driven bus. There will be a minimum of system noise and signal reflections on a properly implemented bus. Most commercial computers have signal transmission busses configured in the manner outlined above. This is a well established and standard practice. It should be noted that there are other kinds of system problems not related to the bus signal transmission characteristics. These include bus signal timing problems and the mutual incompatibility of circuits connected to the bus.

The original motherboard for the Heathkit H8 computer is not well designed and has been demonstrated to be the cause of a number of problems as the complexity of the H8 system has been increased. Use of the Trionyx T-H90 motherboard will improve the reliability and performance level of the H8 computer. Full implementation of the capabilities of the T-H90 motherboard will provide the H8 computer with a professional quality bus.

T-H90 Motherboard for the Heathkit H8\* Computer

Preliminary Documentation

We plan to provide an elaborate document package for the T-H90 motherboard. Included will be an easy to follow, but comprehensive explanation of electrical transmission line principles as they apply to a computer bus. There are several successive levels of implementation through which the T-H90 motherboard may be adapted to the H8 computer. Physical components and documentation for the more advanced levels of motherboard implementation are not available at this time. They will be introduced over the next several months as our experience using the new motherboard begins to accumulate. Information received from users of our new motherboard during this period will be very valuable.

The motherboard, itself, may be used initially in the H8 computer with a minimum of instruction. We are now shipping motherboards with gold connectors and plug-in board adaptor kits without the complete document package. The document package is now in preparation and should be available soon. The complete document package will be sent to all purchasers of the T-H90 motherboard when it is ready.

The T-H90 motherboard is the basis of a comprehensive system to increase the reliability and performance level of the H8 computer. Using the motherboard, there are a number of different things which can be done to upgrade the performance and reliability of the computer. These upgrade improvements should be implemented successively, on a progressive basis, as experience indicates they are required. There is no reason to immediately incorporate all of the improvements possible using the new motherboard, unless they are needed, as this will require considerable effort. Many of the improvements to the bus can be made at a later date as the opportunity or need arise.

The use of gold-plated connectors should provide an immediate and noticeable improvement in computer reliability in cases where tin-plated connectors were used previously. The ground plane on the T-H90 motherboard will by itself improve the quality of the waveforms on the bus. These improvements alone may prove sufficient in many cases.

Motherboard bus problems are a function of the type, number and arrangement of the printed circuit boards plugged into the bus. The existence of bus problems is well demonstrated by changes in performance obtained by rearranging the positions of the boards plugged into the bus. Extender boards used for troubleshooting also change the bus conditions and should be used with this in mind. Some individual boards will work better than other boards of the same type in the presence of bus problems. Such boards would work equally well if there were no bus problems.

If bus problems persist after installation of the T-H90 motherboard, the individual boards which plug into the motherboard should be grounded to the motherboard using each of the grounds provided on the new 40 pin "B" connectors added to the motherboard. Connector adapter kits must be used to convert the original H8 boards to use the new B connectors on the T-H90 motherboard. Bus ground additions should be made initially only to the primary boards in the computer such as the CPU board and the memory board. If problems persist after these boards are well grounded to the bus, ground additions to the bus should then be made to the remaining boards in the computer.

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