

## Assembly Instructions MP-09 Microprocessor Board

### Introduction

The MP-09 processor, board is intended for use in Southwest Technical Products Corporation or, similar computer systems using the SS-50 bus system. It consists of the MC6809 processor, ROM monitor, memory management system and buffering circuits. The board requires a 7 to 9 Volt unregulated DC voltage at approximately 1.0 Amp. The MP-09 may be used to replace 6800 processor boards in most any SWTPC 6800 computer system.

The new MP-09 board may be used in place of 6800 processor boards originally provided with the SWTPC 6800 Computer System and has the following features:

#### HARDWARE FEATURES

- \* SWTPC SS-50 bus compatible
- \* Paged memory addressing capability
- \* Extended addressing capability (up to 384K bytes)
- \* Sockets provision for up to 8K of Intel 2716 pinout EPROM, PROM, ROM or RAM.
- \* Tight address decoding

#### ARCHITECTURAL FEATURES

- \* Two 8-bit accumulators can be concatenated to form one 16-bit accumulator
- \* Two 16-bit arithmetic
- \* Two 16-bit indexable stack pointers
- \* Direct page register allows direct addressing throughout memory space

#### INSTRUCTION SET

- \* Extended range branches
- \* 16-bit arithmetic
- \* Push/pull any register or set of registers to/from either stack
- \* 8 x 8 unsigned multiply
- \* Transfer/exchange any two registers of equal size
- \* Enhanced pointer register manipulation

#### ADDRESSING MODES

- \* All MC6800 modes, plus PC relative, extended indirect, indexed indirect, and PC relative indirect
- \* Direct addressing available for all memory access instructions
- \* Index mode options include accumulator or up to 16-bit constant offset, and auto increment/decrement (by 1 or 2) with any of the four pointer registers

When the SWTPC 6809 Computer is being assembled, work on only one board at a time. Each of the system's boards and their associated parts must not be intermixed to avoid confusion during assembly. The MOS integrated circuits supplied with this kit are susceptible to static electricity damage and for this reason have been packed with their foil leads impressed onto a special conductive foam or possibly wrapped in a conductive foil. In either case, do not remove the protective material until specifically told to do so later in the instructions.

Scanned and edited by Michael Holley    Nov 6, 2000 Southwest Technical Products Corporation Document    Circa 1980
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## PC Board Assembly

NOTE: Since all of the holes of the PC board have been plated thru, it is only necessary to solder the components from the bottom side of the board. The plating provides the electrical connection from the "BOTTOM" to the "TOP" foil of each hole. Unless otherwise noted it is important that none of the connections be soldered until all of the components of each group have been installed on the board. This makes it much easier to interchange components if a mistake is made during assembly. Be sure to use a low wattage iron (not a gun) with a small tip. Do not use acid core solder or any type of paste flux. We will not guarantee or repair any kit on which either product has been used. Use only the solder supplied with the kit or a 60/40 alloy resin core equivalent. Remember, all of the connections are soldered on the bottom side of the board only. The plated-thru holes provide the electrical connection to the top foil.

- ( ) Before installing any parts on the circuit board, check both sides of the board over carefully for incomplete etching and foil "bridges" or "breaks". It is unlikely that you will find any, but should there be one, especially on the "TOP" side of the board, it will be very hard to locate and correct after all of the components have been installed on the board.
- ( ) Attach all of the resistors to the board. As with all other components unless noted, use the parts list and component layout drawing to locate each part and install from the "TOP" side of the board bending the leads along the "BOTTOM" side of the board and trimming so that 1/16" to 1/8" of wire remains. Solder. You should have a 1M ohm resistor left over.
- ( ) Install all of the capacitors on the board. Be sure to orient the electrolytic capacitors correctly. The polarity is indicated on the component layout drawing. Solder.
- ( ) Attach and solder crystal Y1 to the circuit board. Leave about 1/8" between the top of the board and the base of the crystal so that none of the printed circuit traces short out against the body of the crystal.
- ( ) Attach crystal Y2 to the circuit board. It should be oriented so its length lies flat across the circuit board as shown in the outline on the component layout drawing. If the crystal has long thin wire leads, they may be bent down 90 degrees at the base of the crystal so they fit into the two holes provided for the crystal on the circuit board. If the crystal has short heavy wire leads, solder onto and at a 90 degree angle to the crystal's leads some heavy bus wire. The bus wire with the crystal attached may then be inserted into the board. In either case the crystal must be attached so its metal case could never inadvertently come into contact with either the foil on the circuit board or either one of its own two leads. Solder. If desired, the crystal may be firmly secured by strapping the body of the crystal to the circuit board using a piece of light gauge wire. The wire need not be insulated. Pads are provided for attaching the wire adjacent the sides and just beneath the body of the crystal.
- ( ) Starting from one end of the circuit board install each of the five, 10-pin Molex female edge connectors along the lower edge of the board. These connectors must be inserted from the "TOP" side of the board and

must be pressed down firmly against the board. Make sure the body of the connector seats firmly against the circuit board and that each pin extends completely into the holes on the circuit board. Not being careful here will cause the board to either wobble and/or be crooked when plugged onto the motherboard. It is suggested that you solder only the two end pins of each of the five connectors until all have been installed, at which time, if everything looks straight and rigid, you should solder the as yet unsoldered pins.

- ( ) Insert the small nylon indexing plug into the edge connector pin indicated by the small triangular arrow on the "BOTTOM" side of the circuit board. This prevents the board from being accidentally plugged onto the motherboard incorrectly.
- ( ) Install integrated circuits IC5 thru IC7, IC9 thru IC13, IC15 thru IC23. As each one is installed, make sure it is down firmly against the board and solder only two of the leads to hold the IC in place while the other IC's are being inserted. Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The semicircle notch or dot on the end of the package is used for orientation purposes and must match with the outlines shown on the component layout drawing for each of the IC's. After inserting all of the integrated circuits go back and solder each of the as yet unsoldered pins.
- ( ) Cut off the center pin on integrated circuit IC22.
- ( ) Install integrated circuit IC22 on the circuit board. This component must be oriented so its metal face is facing the circuit board with the small metal heatsink sandwiched between the two. The heatsink and IC are secured to the circuit board with a 4 - 40 x 3/8" screw, lockwasher and nut. The leads of the integrated circuits must be bent down into each of their respective holes and trimmed, and the heatsink must be oriented as shown in the component layout drawing. Solder.
- ( ) Attach the seven integrated circuit sockets to the board in the IC1 thru IC4, IC8, IC14 and IC24 positions only. The 40-pin socket goes in the IC14 position while the 24-pin sockets are used for IC1 thru IC4 and IC24. A 16-pin socket goes in the IC8 position. Turn each socket so the corner having the indexing tab is adjacent the pin indicated by the "dot" within the integrated circuit outline on the component layout drawing. Solder.
- ( ) Attach DIP switch S1 to the circuit board. The switch must be mounted so the switches are ON when flipped toward the top edge of the circuit board. Solder.
- ( ) Insert the eight 3-pin programming strips into the positions indicated on the component layout drawing. The strips must be installed from the top side of the board with the short pinned side of the blocks soldered into the board. Solder. Programming blocks will be plugged onto these strips as outlined later in this instruction set.
- ( ) Orient and insert the 4-pin right angle male connector along the top edge of the board as shown in the component layout drawing. Some units may be shipped with a 5-pin connector instead of the required 4-pin. If so, remove the center pin by pulling it out with a pair of pliers. Solder.

- ( ) Working from the "TOP" side of the circuit board, fill in all of the feed-thru's with molten solder. The feed-thru's are those unused holes on the board whose internal plating connects the "TOP" and "BOTTOM" circuit connections. Filling these feed-thru's with molten solder guarantees the integrity of the connections and increases the current handling capability.

NOTE: MOS integrated circuits are susceptible to damage by static electricity. Although some degree of protection is provided internally within the integrated circuits, their cost demands the utmost in care. Before opening and/or installing any MOS integrated circuits you should ground your body and all metallic tools coming into contact with the leads, thru a 1M ohm 1/4 watt resistor (supplied with the kit). The ground must be an "earth" ground such as a water pipe, and not the circuit board ground. As for the connection to your body, attach a clip lead to your watch or metal ID bracelet. Make absolutely sure you have the 1 Meg ohm resistor connected between you and the "earth" ground, otherwise you will be creating a dangerous shock hazard. Avoid touching the leads of the integrated circuits any more than necessary when installing them, even if you are grounded. Static electricity should be an important consideration in cold, dry environments -- it is less of a problem when it is warm and humid.

- ( ) Install MOS integrated circuits IC4, IC14 and IC24 following the precautions given in the preceding section. As each is installed, make sure it is down firmly into the socket. Be very careful to install each in its correct position. The "dot" on the end of the package is used for orientation purposes and must match with that shown on the component layout drawing for each of the IC's. IC4 is the 24-pin IC supplied with the kit that will function as the system's monitor. Do not get it confused with the other 24-pin IC, the 14411.
- ( ) Now that most of the components have been installed on the board, double check to make sure all have been installed correctly in their proper location.
- ( ) Check very carefully to make sure that all connections have been soldered. It is very easy to miss some connections when soldering which can really cause some hard to find problems later during checkout. Also, look for solder "bridges" and "cold" solder joints which are another common problem.

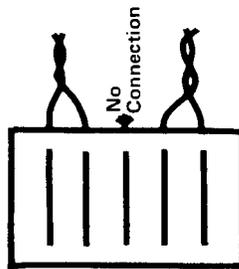
This completes the assembly phase for the MP-09 board. The System Checkout instructions are used after having assembled the MP-09 Microprocessor/System Board, MP-B3 Motherboard, MP-S2 Serial Interface, and the MP-P2 Power Supply.

Since the MP-09 Circuit Board now contains MOS devices, it is susceptible to damage from severe static electrical sources. One should avoid handling the board any more than necessary and when you must, avoid touching or allowing anything to come into contact with any of the conductors on the board.

### Reset/Abort Cable Assembly

The MP-09 processor board requires that a separate cable be run from the top edge of the processor card to the RESET and in some cases ABORT buttons on the front panel of the chassis. If the computer is mounted in the SWTPC desk, a different RESET cable is used. Construct the front panel switch cable as follows:

- ( ) Twist together two pair of two 15" pieces of heavy gauge insulated wires for their entire length.
- ( ) Attach the two small spaded lug connectors to each wire on one end of each pair of cables.
- ( ) Attach the two small connector pins to each wire on the other end of each pair of cables. After these pins have been attached, slide each into the five position nylon connector shell as shown below. This completes the Reset/Abort Cable Assembly.



### How It Works

The entire computer is built around IC14, the 6809 Microprocessor Unit (MPU). Most of the components within the computer are used to provide the clocks, buffering and decoding necessary to interface to this integrated circuit.

Integrated circuit IC4 is a 2048 x 8 bit read only memory (ROM). Whenever the computer is first powered up or when the front panel RESET switch is depressed the computer jumps to this operating system firmware (programming stored in ROM) which gives the user terminal control.

IC24 is the crystal controlled clock/ baud rate generator. It produces the baud rate clock frequencies required by the serial interfaces. IC23 provides the buffering for each of the used outputs on baud rate generator IC24.

Integrated circuit IC18 is responsible for generating the power-up RESET which loads the mini-operating system stored in the ROM. IC9 generates a NMI (non-maskable interrupt).

integrated circuits IC12 and IC13 are used as non-inverting address line buffers for each of the sixteen address lines. Integrated circuit IC 19 is an inverting bi-directional transceiver buffer for the system's eight bi-directional data lines. The gates feeding the enable lines of the transceiver IC's guarantee the appropriate receive or transmit data bus buffers are enabled at the proper time.

Address translation for address lines A12 thru A15 is handled by write only memory IC11.

+5 VDC power for the board is supplied by voltage regulator IC22.

### Configuring the MP-09 Processor Board

If you will be using the MP-09 processor board in a 69K or, 69A computer, refer to the 69A/69K Computer System Initial Jumpers section of this manual for complete jumper programming information. If you are upgrading from a 6800 computer, read the information below.

The MP-09 processor board has one four-position DIP switch anti eight two-position programming strips that must be configured before the board is plugged into the computer system.

The four switches on DIP switch S1 are described as follows from left to right.

LOW BAUD: Leaving the switch ON generates low interface baud rate of 110, 150 or 9600, 300, 600 or 4800, and 1200 baud. Flipping the switch OFF generates interface high baud rates of 440, 600, or 38,400, 1200, 2400 or 19,200 and 4800 baud. These higher baud rate clocks are carried respectively on the same baud rate lines. This switch should normally be ON which is the LOW BAUD mode.

E000-E7FF  
ROM/RAM  
SELECT (IC1) Flipping this switch ON activates the ICI ROM/RAM socket the processor board. The socket is intended for controller applications. Since the physical address of the component conflicts with that of the interface address the switch must be flipped OFF. The component plugged into the socket may be any 5V 2716 compatible EPROM, PROM, ROM or RAM.

E800-EFFF  
ROM/RAM  
SELECT (IC2) Flipping this switch ON activates the IC2 ROM/RAM socket on the processor board. The socket is intended for dedicated controller applications. Since the physical address of the component may conflict with that of the interface addresses the switch should be flipped OFF. The component plugged into the socket may be any 5V 2716 compatible EPROM, PROM, ROM or RAM.

F000-F7FF  
ROM/RAM  
SELECT (IC3) Flipping this switch ON activates the IC3 ROM/RAM socket on the processor board. The socket is intended for dedicated controller applications. Since the physical address of the component conflict with that of the DMA controller address assignment, the switch must be flipped OFF. The component plugged into the socket may be any 5V 2716 compatible EPROM, PROM, ROM or RAM.

There are eight two-position programming strips on the MP-09 board. The specified function for each programming strip is selected by plugging the shorting block between the center pin of the strip and the pin adjacent the noted function. The functions for most of the programming strip pins are noted on the TOP side of the board adjacent the appropriate pins.

150b/9600b This option causes the MP-09 to generate either a 150 or 9600 baud clock on the 50-pin bus line marked 150b(S3) when the LOW BAUD switch is ON on switch S1. When the LOW BAUD switch is OFF these become 600 and 38,400 baud clocks respectively.

4800b/600b This option causes the MP-09 to generate either a 4800 or 600 baud clock on the 50-pin bus line marked 600b (S1) when the LOW BAUD switch is ON on switch S1. When the LOW BAUD switch is OFF these become 19,200 and 2400 baud clocks respectively.

110b/BR The option selects either the baud rate or bus request function on the MP-09 board. For now it is suggested that you set this option for the BR function. This will cause the MP-09 board to be able to respond to bus requests on the 110b/BR line. The 110b position should only be used when a device requiring 110 baud is used and the bus request function is not required.

2S/3S           The 3S option provides the ability to float the drivers driving the baud rate lines when the MP-09 board is halted. It is an option reserved for use in S/09 computers and should not be selected. Install the jumper in the 2S position.

BA/BA&BS       This option gives the MP-09 board the ability to float the address and data bus when both BA and BS are high or just when BA is high. Install the jumper in the BA position unless a DMF1 (not DMF2) disk controller is being used. In this case use the BA&BS jumper.

RAM/ROM  
for IC3         This option gives the ability to use either a 2716 pinout RAM or ROM for IC3. The position of the jumper is not important.

RAM/ROM  
For IC2         This option gives the ability to use either a 2716 pinout RAM or ROM for IC2. The position of the jumper is not important.

RAM/ROM  
for IC1         This option gives the ability to use either a 2716 pinout RAM or ROM for IC1. The position of the jumper is not important.

Parts List - MP-09B Processor Board  
Integrated Circuits

__*IC1	2516 pin compatible ROM or RAM	__*IC13	74LS244 octal buffer
__*IC2	2516 pin compatible ROM or RAM	__*IC14	68B09 processor
__*IC3	2516 pin compatible ROM or RAM	__*IC15	74LS74 dual flip flop
__*IC4	2516 pin compatible ROM or RAM	__*IC16	74LS21 dual AND gate
__*IC5	74LS30 8 input NAND gate	__*IC17	74LS86 exclusive OR gate
__*IC6	74LS02 quad NOR gate	__*IC18	555 timer
__*IC7	74LS138 1 of 8 decoder	__*IC19	74LS640 octal inverting transceiver
__*IC8	†74S189 RAM memory	__*IC20	74LS241 octal buffer
__*IC9	555 timer	__*IC21	74LS00 quad NAND gate
__*IC10	74LS157 data selector	__*IC22	7805 voltage regulator
__*IC11	74S189 RAM memory	__*IC23	74LS240 octal inverting buffer
__*IC12	74LS244 octal buffer	__*IC24	†14411 baud rate generator

Resistors

__ R1	10K ohm 1/4 watt resistor	__ R13	1K ohm 1/4 watt resistor
__ R2	10K ohm 1/4 watt resistor	__ R14	1K ohm 1/4 watt resistor
__ R3	470 ohm 1/4 watt resistor	__ R15	1M ohm 1/4 watt resistor
__ R4	10K ohm 1/4 watt resistor	__ R16	1M ohm 1/4 watt resistor
__ R5	10K ohm 1/4 watt resistor	__ R17	1M ohm 1/4 watt resistor
__ R6	10K ohm 1/4 watt resistor	__ R18	10K ohm 1/4 watt resistor
__ R7	1K ohm 1/4 watt resistor	__ R19	10K ohm 1/4 watt resistor
__ R8	1M ohm 1/4 watt resistor	__ R20	1K ohm 1/4 watt resistor
__ R9	1K ohm 1/4 watt resistor	__†R21	470 ohm 1/4 watt resistor
__ R10	1K ohm 1/4 watt resistor	__†R22	470 ohm 1/4 watt resistor
__ R11	10K ohm 1/4 watt resistor	__†R23	470 ohm 1/4 watt resistor
__ R12	10K ohm 1/4 watt resistor	__†R24	470 ohm 1/4 watt resistor
		__ R25	6.8K ohm 1/4 watt resistor

Capacitors

__ C1	100 pfd capacitor	__ C11	0.1 mfd capacitor
__*C2	0.47 mfd tantalum capacitor	__ C12	0.1 mfd capacitor
__ C3	0.1 mfd film capacitor	__ C13	0.1 mfd capacitor
__*C4	0.47 mfd tantalum capacitor	__ C14	0.1 mfd capacitor
__ C5	0.01 mfd capacitor	__ C15	0.01 mfd capacitor
__*C6	220 mfd @ 10 VDC electrolytic capacitor	__ C16	20 pfd capacitor
__ C7	0.1 mfd capacitor	__ C17	220 pfd capacitor
__ C8	0.1 mfd capacitor	__ C18	20 pfd capacitor
__ C9	0.1 mfd capacitor	__ C19	0.1 mfd capacitor
__ C10	0.1 mfd capacitor	__ C20	0.1 mfd capacitor

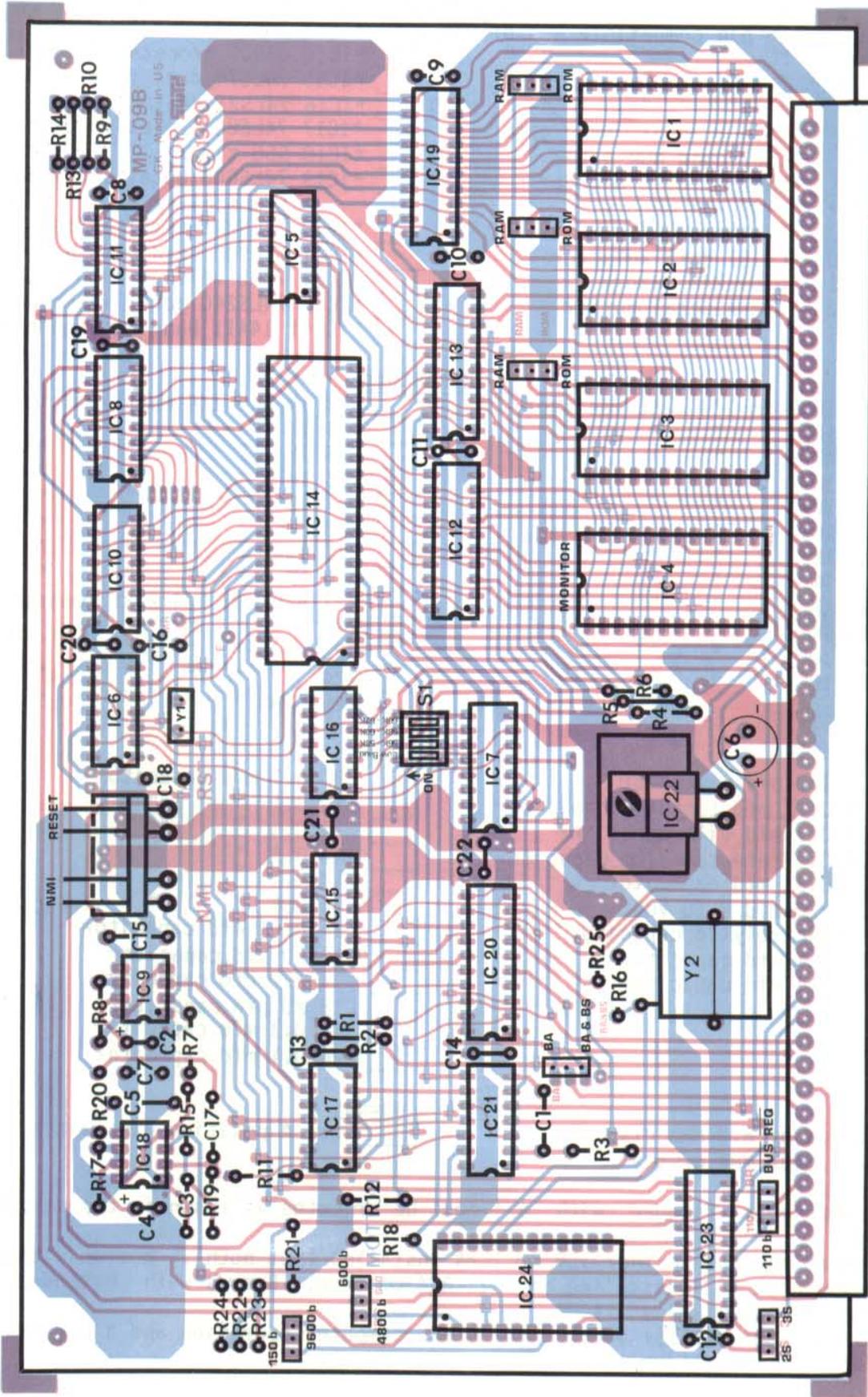
Miscellaneous

__ Y1	4.0 or 8.0 MHz crystal	__ *S1	4-position DIP switch
__ Y2	1.8432 MHz crystal		

\*All components flagged with a \* must be oriented as shown in the component layout drawing.

† The board may have either IC8 or IC24 installed (not both). Boards without extended addressing need IC24 installed and R21-R24 omitted. Boards with extended addressing need IC8 and R21-R24 installed.

Note: A 4.0 MHz crystal is used for 1 MHz computer operation and a 8.0 MHz crystal is used for 2 MHz operation.



MP-09 PROCESSOR BOARD

### Dynamic Address Translator (DAT)

The MP-09 processor board contains an on board Dynamic Address Translator (DAT) that changes (or translates) the addresses output on the upper four address lines by the 6809 processor before these addresses are output onto the system bus. This scheme effectively breaks the system's 64K address space into sixteen 4K segments starting from location 0000. Each memory location within these 4K segments has associated with it a physical and logical address. The physical address is the physical or electrical location of the address within the system's 64K address space. It is the address output onto the 50-pin bus. For example, an 8K memory board jumper programmed for the lower 8K of memory physically resides from 0000 - 1FFF (0 - 8K) and thus has this physical address. The interfaces of an unmodified MP-B or MP-B2 mother board have a physical address starting at 8000 (32K).

The logical address is the unmodified address that must be output by the processor to access these translated physical addresses. The earlier MP-A and MP-A2 boards did not have an address translator and their physical and logical addresses were the same. With the address translator on the MP-09 board a physical address in memory may have from 0 to 16 logical addresses depending upon the configuration of the address translator. To better understand this, refer to the figure 1. As you can see from figure 1, the address translator can be envisioned as a translation table between logical and physical addresses in 4K segments. When you are writing machine language programs for your MP-09 processor all instruction addresses will be to logical addresses. You must know the state of the address translator to determine physical addresses.

Electrically the address translator is a 4-bit wide, 16-position high speed random access memory. It is physically and logically addressed in the upper 16 bytes of memory (FFF0 - FFFF) as write only memory. It is loaded by writing the complement of the desired upper four bits of the physical address using the lower 4 bits of the data byte to the memory location corresponding to the selected logical address. The 4K logical address segments start sequentially from FFF0. As an example, we can create an unmodified modifier where physical and logical address are the same by writing the following to memory:

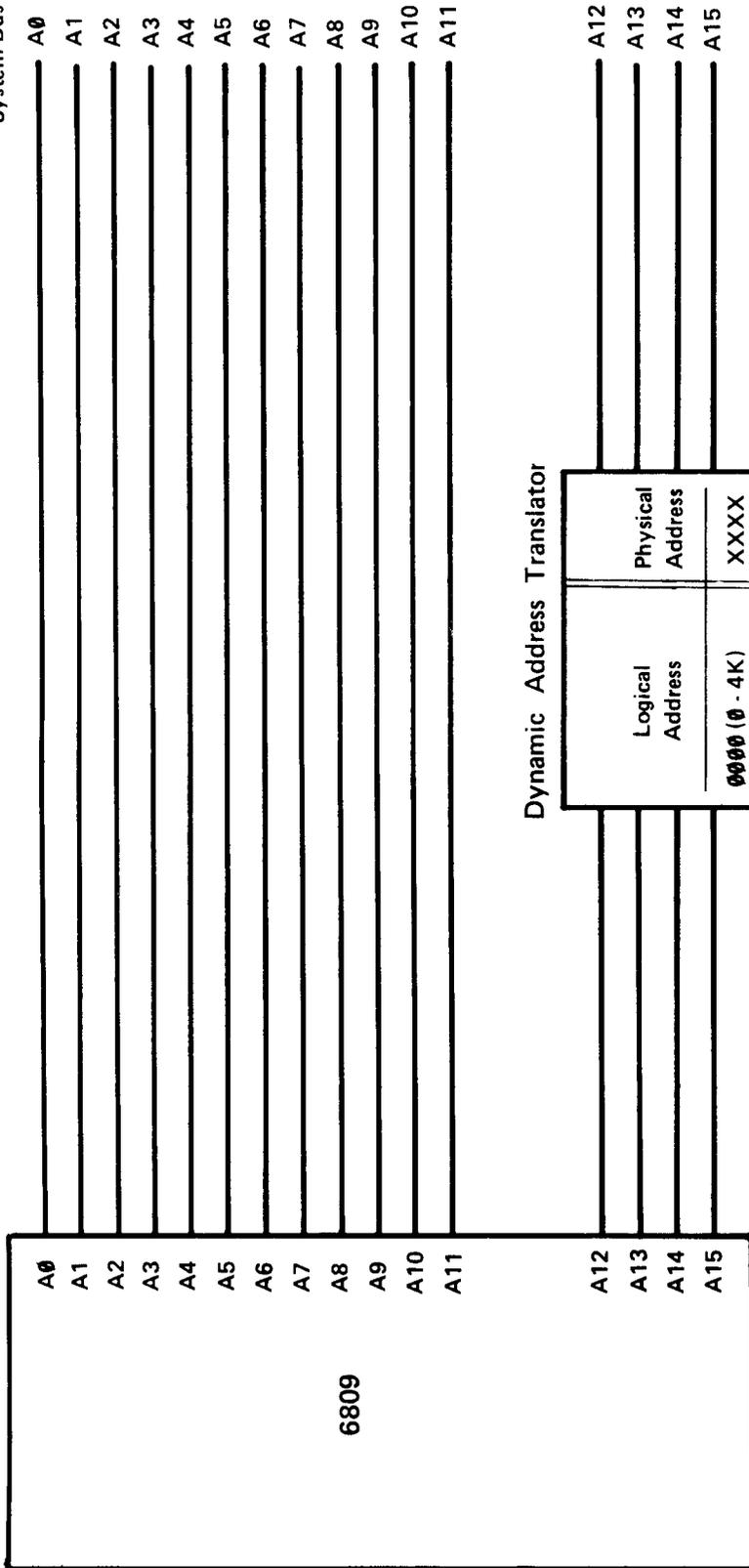
<p>These three paragraphs were not in the MP-09B Assembly Instructions, they appear to be missing. They were taken from the MP-09 Assembly Instructions.</p>
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MEMORY LOCATION	LOGICAL ADDRESS	DATA	PHYSICAL ADDRESS
FFF0	0000-0FFF	0F	0000-0FFF
FFF1	1000-1FFF	0E	1000-1FFF
FFF2	2000-2FFF	0D	2000-2FFF
FFF3	3000-3FFF	0C	3000-3FFF
FFF4	4000-4FFF	0B	4000-4FFF
FFF5	5000-5FFF	0A	5000-5FFF
FFF6	6000-6FFF	09	6000-6FFF
FFF7	7000-7FFF	08	7000-7FFF
FFF8	8000-BFFF	07	8000-8FFF
FFF9	9000-9FFF	06	9000-9FFF
FFFA	A000-AFFF	05	A000-AFFF
FFFB	8000-BFFF	04	8000-BFFF
FFFC	C000-CFFF	03	C000-CFFF
FFFD	D000-DFFF	02	D000-DFFF
FFFE	E000-EFFF	01	E000-EFFF
FFFF	F000-FFFF	00	F000-FFFF

We can move a physical address segment of 1000-1FFF (4K-8K) to logical address of 0000-0FFF (0K-4K) by writing a 0E to address location FFF0. Take note however that the same physical address segment is also at a logical address of 1000-1FFF (4K-8K) as well since we have not changed that part of the address translator.

Although all of this circuitry may seem complicated anti unnecessary, it is an integral part of a system designed for multitasking and multiuser environments. It is a feature rarely found in inexpensive computers but seemed fitting for a system with the computing power of the Motorola 6809 microprocessor. It is not necessary that the user understand how to operate the address translator but it is advisable that the user know that it exists and to understand the meaning of logical and physical addresses.

System Bus Lines



Dynamic Address Translator

Logical Address	Physical Address
0000 (0 - 4K)	XXXX
0001 (4K - 8K)	XXXX
0010 (8K - 12K)	XXXX
0011 (12K - 16K)	XXXX
0100 (16K - 20K)	XXXX
0101 (20K - 24K)	XXXX
0110 (24K - 28K)	XXXX
0111 (28K - 32K)	XXXX
1000 (32K - 36K)	XXXX
1001 (36K - 40K)	XXXX
1010 (40K - 44K)	XXXX
1011 (44K - 48K)	XXXX
1100 (48K - 52K)	XXXX
1101 (52K - 56K)	XXXX
1110 (56K - 60K)	XXXX
1111 (60K - 64K)	XXXX

X= programmable to 0 or 1

FIGURE 1

### Memory Map for the MP-09

In order to expand the RAM memory capacity from the SWTPC 6800 computer's 40K limit to 56K for the MP-09 processor, it will be necessary to modify the MP-B or MP-B2 motherboard (where applicable) and the DMAF-1 disk controller board (where applicable) so they are decoded above 56K in the system's physical memory map. MP-B3 motherboards do not require modification. Take note that by doing this the system becomes incompatible with the original MP-A and MP-A2 6800 processor boards using the MIKBUG®, SWTBUG® and DISKBUG® monitors. This modification is required regardless of the amount of memory installed in the system.

The motherboard modification relocates the I/O addresses from the original 8000-8FFF (32K-36K) assignment to E000-EFFF (56K-60K). The DMAF-1 modification moves the board from the 9000-93FF (36K-37K) assignment to F000-FFFF (56K-64K), only the upper 2K ROM socket (IC4) may be used. IC4 is reserved for the system monitor and is addressed from F800-FFFF (62K-64K).

This configuration leaves 56K of address space available for user RAM memory. A minimum system configuration when using either the MF-68/69 or DMAF-1 disk systems would be 8K of memory just to boot the system. Loading and running Basic or other utilities would, of course, require more memory. A minimum system configuration without a disk would be 4K of RAM memory. The actual physical location of the memory within the system is not important since the monitor locates and logically re-addresses all RAM memory plugged into the system. The user must make sure, however, that there are no memory boards within the system residing in the same physical address. With a minimum 4K system, the 4K of memory will be mapped so that it is logically addressed from D000-DFFF. With 8K of RAM memory, the memory will be sequentially mapped so it is logically addressed from 0000-DFFF. Any additional memory will reside from 0000-BFFF. The DOS, if resident, will reside from C000-DBFF. The monitor loads the system stack pointer with DFFF, and sets the direct page register to zero.

### Chassis Reset Switch Rewiring (6800 mainframes only)

The MP-09 processor card does not use the M.RST (manual reset) line carried on the 50-pin bus as do its 6809 MP-A and MP A2 predecessors. This line has instead been renamed the Memory Ready (M.RDY) line. The MP-09 processor board has been designed so the front panel RESET button connects directly to the processor card. Depressing the RESET button as well as powering the system up generates a RESET sequence.

Attach the terminals of the RESET switch wire harness built earlier to the two RESET switch terminals. Polarity is not important. The other end of the wire harness will plug into the RESET connector terminal along the top edge of the MP-09 board after it is installed in the system. The ABORT switch is not used as 6800 mainframes.

MP-B Mother Board Modification for I/O decoding at E000-EFFF

If your computer system has a MP-B (not MP-B2) mother board, power down the system, unplug the connector going to the power supply board and remove the board. Make the following modifications.

- 1) Cut the foil conductor connecting pin 10 to pin 12 of IC4, the 7400 NAND gate, on the "BOTTOM" side of the mother board.
- 2) Attach and solder an insulated jumper between pin 11 of IC4 (7400 NAND gate) to pin 6 of IC6 (74LS138 decoder) on the "BOTTOM" side of the board.
- 3) Attach and solder a separate insulated jumper between pin 12 of IC4 (7400 NAND gate) and address line A12 on the "BOTTOM" side of the board.
- 4) Cut the PC trace connecting to IC6 pin 11 on the "BOTTOM" side of the board. Cut the trace right at IC6.
- 5) Attach and solder an insulated jumper between IC5 pin 6 and IC6 pin 7 on the "BOTTOM" side of the board.
- 6) Tape the three jumper wires to the "BOTTOM" side of the board so they do not break off or get pinched.
- 7) Remove the wire going to the M. RST pin on the MP-B.
- 8) Cut the wire (with the spade connector) loose from the 12-pin Molex connector pin 9 right at the Molex connector.
- 9) Cut loose the two wires from the UD1 and UD2 lines on the mother board and also the other end of these wires from the 12-pin Molex connector.
- 10) Re-install the mother board and reconnect the connector going to the MP-P power supply board.

This section on the MP-B motherboard was not in the MP-09B Assembly Instructions. It was taken from the MP-09 Assembly Instructions.

#### MP-B2 Motherboard Modification for I/O decoding at E000-EFFF

The MP-B2 motherboard presently decodes all I/O interfaces from 8000-8FFF (32K-36K). To change the MP-B2 (not MP-B) board so the interfaces are decoded from E000-EFFF, unplug the system and remove the motherboard from the chassis.

- 1) Cut the PC trace on the bottom side of the board that goes to pin 15 of IC6. Cut the trace right next to IC6.
- 2) Attach and solder an insulated jumper between IC5 pin 12 (a pad is provided) and IC6 pin 9. Run this jumper on the bottom side of the board.
- 3) Remove the wire going to the MRST pin on the MP-B2.
- 4) Cut the wire (with the spade connector) loose from the 12-pin Molex connector pin 9 right at the Molex connector.
- 5) Cut loose the two wires from the UD1 and UD2 lines on the motherboard and also the other end of these wires from the 12-pin Molex connector. This completes the MP-B2 modification. When you reinstall the board be sure to reconnect the connector going to the MP-P power supply.

#### DMAF1 (not DMAF2) Controller Board Modification for Decoding at F000 - F3FF

The DMAF1 floppy disk controller board must be modified as follows to allow for address decoding at F000-F3FF.

- 1) Cut the foil trace on the BOTTOM side of the board between IC15 pin 4 and 5.
- 2) Cut the foil trace on the TOP side of the board going to IC16 pin 2. Cut the trace right at IC16. Now from the BOTTOM side of the board attach and solder an insulated jumper wire to the trace that you just cut loose. A pad is provided just below IC16. Attach and solder the other end of the jumper wire to IC15 pin 4.
- 3) Attach and solder another insulated jumper from IC16 pin 2 to IC16 pin 7 on the BOTTOM side of the board.
- 4) Disregard the DMAF1 instructions for Configuring the DMAF1 Disk for the SWTPC 6800 Computer System and do as follows:
- 5) Plug one shorting block between the center pin and NOR terminal on the NOR/MR header.
- 6) Plug another shorting block between the center pin and 48K terminal on the 32K/48K header.
- 7) Plug the remaining shorting block between the 4 and the pin immediately below it on the 01234567 header.

## Memory Board Modifications

The Dynamic Address Translator on the MP-09 processor board is capable of logically relocating physical address space in its 64K byte memory capacity. This address translation is limited, however, to 4K byte segments. On power up the monitor checks selected memory locations in each of these 4K segments over the entire 64K address space. It then logically maps the available memory as described in an earlier section of this documentation. This feature essentially lets you physically address your memory boards anywhere from the 0000 - DFFF (0K - 56K) RAM address area with no need for contiguous memory. No two boards, however, may ever be jumper programmed to occupy the same physical address space. It is suggested, however, that you adhere to the following guidelines when configuring your memory boards.

- 1) Physically address your memory boards in order of decreasing size. Example, 32K boards in low physical memory followed by 16K boards, followed by 8K boards, followed by 4K boards.
- 2) Address the lowest order board to start at memory location 0000.
- 3) Make the memory contiguous so there are no "holes" between the bottom and top of RAM memory.
- 4) Never install a 2K MP-M memory board in the system. Make sure all MP-M boards are fully expanded to 4K of memory.

Since the RAM address area is larger now, it is possible to have RAM memory above 8000 (32K). Most of the SWTPC memory boards were not designed for operation above 8000 (32K) but may be modified as follows. Instructions are given for the 4K MP-M, 8K MP-M, 16K MP-16 and 32K MP-32. These are the only memory boards supplied by SWTPC at the time of this writing.

### Modifying the 4K MP-M Memory Board for Operation above 32K

To modify the MP-M memory board for operation above 32K, break the conductor foil between pin 6 of integrated circuit IC22 and pin 1 of IC24 as well as the conductor foil between pin 4 of IC22 and connector pin A15. Break the conductors near IC22 using a small screwdriver or knife to scribe a small line across the trace deep enough to break the conductive path. Using a piece of light gauge hookup wire connect pin 6 of IC22 to connector pin A15. Using a separate piece of hookup wire connect pin 4 of IC22 to pin 2 of IC24. Check your modifications and wiring for accuracy. This completes the modification. Use the table below to determine the proper position for the address select programming jumper which must be installed on the memory board.

TABLE 1

MP-M Memory Address Assignment Table (Hex) Above 32K

Board #	Memory Quadrant (K of memory)	Starting Address	Ending Address
0	1	8000	83FF
	2	8400	87FF
	3	8800	8BFF
	4	8C00	8FFF
1	1	9000	93FF
	2	9400	97FF
	3	9800	9BFF
	4	9C00	9FFF
2	1	A000	A3FF
	2	A400	A7FF
	3	A800	ABFF
	4	AC00	AFFF
3	1	8000	B3FF
	2	8400	B7FF
	3	8800	BBFF
	4	BC00	BFFF
4	1	C000	C0FF
	2	C400	C0FF
	3	C800	CBFF
	4	CC00	CFFF
5	1	D000	D3FF
	2	D400	D7FF
	3	D800	DBFF
	4	DC00	DFFF
6	1	E000	E3FF
	2	E400	E7FF
	3	E800	EBFF
	4	EC00	EFFF
7	1	F000	F3FF
	2	F400	F7FF
	3	F800	FBFF
	4	FC00	FFFF

MP-MP/MP-MX Memory IC Assignment Map

	<u>Bit7</u>	<u>Bit6</u>	<u>Bit5</u>	<u>Bit4</u>	<u>Bit3</u>	<u>Bit2</u>	<u>Bit1</u>	<u>Bit0</u>
Quadrant 1 (1K)	IC15	IC13	IC11	IC9	IC7	IC5	IC3	IC1
Quadrant 2 (2K)	IC16	IC14	IC12	IC10	IC8	IC6	IC4	IC2
Quadrant 3 (3K)	IC40	IC38	IC36	IC34	IC32	IC30	IC28	IC26
Quadrant 4 (4K)	IC25	IC39	IC37	IC35	IC33	IC31	IC29	IC27

00 hex = 0000 0000 binary	08 hex = 0000 1000 binary
01 hex = 0000 0001 binary	10 hex = 0001 0000 binary
02 hex = 0000 0010 binary	20 hex = 0010 0000 binary
04 hex = 0000 0100 binary	40 hex = 0100 0000 binary
	80 hex = 1000 0000 binary

Modifying the 8K MP-8M Memory Board for Operation above 32K

To modify the MP-8M memory board for operation above 32K first flip all of the address select slide switches on the memory board to their OFF position. For operation from 40K to 48K (8000 to 9FFF) solder a piece of light gauge hookup wire from pin 1 of IC22 to pin 11 of IC18. For operation from 48K to 56K (C000 to DFFF) solder a piece of light gauge hookup wire from pin 1 of IC22 to pin 9 of IC18. For operation from 56K to 64K (E000 - FFFF) solder a piece of light gauge hookup wire from pin 1 of IC22 to pin 7 of IC18. Only one of the three above mentioned jumpers may be installed at a time. Check your wiring for accuracy. This completes the modification. Table II gives the new memory assignments of each of the memory integrated circuits.

TABLE II

MP-8M Memory Address Assignment Table (Hex) Above 32K

<u>Board Select</u>	<u>Half of Memory</u>	<u>Starting Address</u>	<u>Ending Address</u>
IC18 pin 11	lower	8000	8FFF
	upper	9000	9FFF
IC18 pin 10	lower	A000	AFFF
	upper	8000	BFFF
IC18 pin 9	lower	C000	CFFF
	upper	D000	DFFF
IC18 pin 7	lower	E000	FFFF
	upper	F000	FFFF

### MP-8M Memory IC Assignment Table

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Lower 4K	IC7	IC6	IC5	IC4	IC3	IC2	IC1	IC0
Upper 4K	IC15	IC14	IC13	IC12	IC11	IC10	IC9	IC8

### Hex to Binary Conversion

00 hex = 0000 0000 binary	08 hex = 0000 1000 binary
01 hex = 0000 0001 binary	10 hex = 0001 0000 binary
02 hex = 0000 0010 binary	20 hex = 0010 0000 binary
04 hex = 0000 0100 binary	40 hex = 0100 0000 binary
	80 hex = 1000 0000 binary

### Modifying the Motorola SMS3508 16K/32K Dynamic Memory Board for Operation Above 32K

To modify the Motorola SMS3508 board for operation above 32K, do the following using the attached drawing for reference.

- 1) Cut the foil trace connecting U11 pin 14 to ground on the component side of the board.
- 2) Cut the foil trace connecting U11 pin 11 to U9 pin 4 on the bottom side of the board. Cut the trace right at U9 pin 4.
- 3) Attach and solder a light gauge insulated wire on the component side of the board between U11 pin 11 and U11 pin 14.
- 4) Attach and solder a light gauge insulated wire on the component side of the board between U11 pin 13 and U9 pin 4.
- 5) The E1 jumper should be installed and the E2 jumper removed.
- 6) Check your modifications for accuracy.

The memory board is now functional from 32K thru 48K. After making the above modifications only 16K of memory on the board will be used -- the board may not be used as a 32K board above address 8000. After modification, the board will not operate below 32K.

The original document has Red and Blue circuit board layouts for the MP-B, MP-B2, DMAF1, MP-M, MP-8M, MP-16, MP-32 boards