MP-16 Addendum

The current required by the MP-16 from the +12 Volt supply is a function of clock speed and the amount of memory being addressed. If a low line voltage condition exists and the ripple is excessive on the +12 Volt supply the memory will tend to loose bits. This can be corrected by adding additional capacity to the +12 Volt filter. We suggest at least 4 to 5,000 mfd with a working voltage rating of 15 Volts or more.

If the MP-16 is expanded to 32K the additional capacity is mandatory for proper operation. Factory assembled 68/40 systems using this memory have an additional 29,000 mfd 15 Volt capacitor installed. This is done by mounting the power supply circuit board on edge with two "L" brackets. The capacitor is then mounted in the space previously covered by the circuit board. The +12 Volt supply should be checked with an accurate meter after the 32K memory is installed to be sure that the voltage is not less than 12.0 Volts DC. Anything less can cause improper operation of the memory. The recommemded clock speed for this memory is 900 to 925 KHz.

SWTPC MP-16A Memory Board

Introduction

The MP-16A Memory Board is a 5½" x 9" double sided, plated thru hole board with a maximum storage capability of 32,768 bytes of 8-bit random access memory. The board, however, is supplied with only half (16,384 bytes) of its memory capacity. To bring the board to maximum capacity, you must purchase the optional M-16AX Memory Expansion kit. The circuitry on the board provides all of the address decoding and data buffering to handle a total of 16 (16K x 1 bit) dynamic random access memories. All interconnections to the system are made via a 50-pin connector to the Mother Board. The MP-16A memory is fully assembled and programmed for the lower 16K bytes of memory starting at address location zero. The MP-16A board has passed several rigid test programs and is ready to use. There are no switches or plugs on the board to modify. Just be sure that you have no other boards plugged onto the computer system addressed for the same memory range.

The nominal voltages and currents needed for the operation of the MP-16A Memory Board are as follows:

13.5V @150 mA from the unregulated +12 VDC bus
−12.0V @ 6.2 mA from the unregulated −12 VDC bus
7.5 V @ 750 mA from the unregulated 8 VDC bus

Caution: Do not apply the positive voltages to the board without the negative voltage.

It is not necessary to have this board installed for your initial computer system checkout. In fact, this board should not even be installed when the computer system is first operated. All Random Access Memory (RAM) required by the mini-operating system is in the 6810 RAM memory chip on the MP-A or MP-A2 Microprocessor/System Board.

You may increase the memory capacity of the board to accommodate 32K by purchasing and installing the M-16AX Expansion kit. The standard 16K memory board has all of the extra sockets, capacitors and control logic necessary for 32K of memory. The expansion only requires the user to insert into the sockets the additional memory devices. Only one jumper must be changed to upgrade to the 32K memory size. The 32K expansion is explained further in the following section.

When the SWTPC 6800 Computer System 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 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.

Adding the M-16AX Memory Expansion Kit

NOTE: MOS integrated circuits are susceptible to damage by static electricity. Although some degree of protection is provided internally within the integrated cirucits, 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 ¼ watt resistor. 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.

( ) Insert the MOS integrated circuits (Memory devices) into the sockets following the precautions given in the preceding section. As each is installed, make sure it is down firmly against the socket. Be very careful to install each in its correct position. The "dot" or "notch" 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.

( ) Before checking out the memory board it must be jumper programmed for the proper address decoding. The jumper pads are on the left side of the board when viewing it from the "TOP" side with the connector edge down. The jumper itself looks like a green colored resistor. It is actually a solid piece of wire with a molded insulating body; thus giving the name: zero ohm resistor. This zero ohm resistor should be soldered into position E3 when 0-16K of memory is desired. When the expansion kit (M-16AX) is added and 0-32K is desired, then the zero ohm jumper should be removed from the E3 position and soldered into position E4. Only E3 or E4 may be selected, never both. You may never have more than one MP-16A memory board plugged onto the computer system.

This completes the assembly of the M-16AX Expansion Kit. Since the circuit board 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.

MP-16A Memory Board Checkout Procedure

Before checking out any of the memory boards, you must have a properly working computer system. The memory board should not even be plugged onto the mother board until the system has been completely checked out.

( ) Remove the system's AC power if applied.

( ) Looking at the mother board from the front of the chassis and with the MP-16A Memory Board oriented so you are viewing the "TOP" side, set the board down lightly on one of the connector rows of the mother board. Electrically the board may be plugged onto any one of the seven main board positions. Check to see that the index pin on both the MP-16A and the mother board align. They should align; if not, there is a mistake.

( ) Assuming the index pin aligns, press the MP-16A board down perpendicularly onto the mother board. Be sure the MP-16A board seats firmly against the mother board.

( ) Again, apply AC power to the unit. Using one of the GND pins on the mother board as a reference, measure the following voltages on the MP-16A Memory Board.

MEMORY DEVICE U1	VOLTAGE
Pin 1	−5 Vdc ±5%
Pin 8	+12 Vdc ±5%
Pin 9	+5 Vdc ±5%

( ) Enter and run the memory diagnostic programs listed in the software section of the System Documentation Notebook. Use the tables listed at the end of this instruction set to determine the proper starting and ending memory addresses to be entered for the programs. For example, if the memory board to be tested is board address selected for 0-16K, then the lowest address on the board is 0000 and the highest would be 3FFF. There is always the chance of a bad IC but experience has shown that most problems will be the result of a solder or foil conductor "bridge" or "break" or socket problem. So get out the magnifying glass and check the board over very carefully if you have problems.

Memory Board Operation

Each of the memory chips on the board is a 16K x 1 bit dynamic random access memory IC storing one of the eight bits of each word.

All signals to and from the memory board are buffered from the bus to minimize the loading conditions. The board is selected by the correct combination of the address lines (AØ-A15) and the valid memory address line (VMA). Address line A14 selects one of the two possible rows of 16K memory. Address lines AØ-A13 choose a specific word from the selected 16K row. The read/write line (R/W) engages the board into the specific type of transfer of data. The eight bit data bus for the system is bi-directional, thus bi-directional transceiver/buffers (U21 and U22) control the incoming and outgoing data to and from the memory board to the data bus. The R/W line gated with the board select signal (U3, pin 11) control the data transceiver/buffers through a flip flop U12. When the memory transfer is a read, the transceivers are driving data onto the data bus. When the memory transfer is a write, the transmitter portion of the data transceiver is disabled and only the receivers are connected to the data bus.

The control signals ($\overline{RAS}$,$\overline{CAS}$, R/W) to the memory chips are generated during a memory transfer to/from the memory card. ($\overline{RAS}$, Row Address Strobe; $\overline{CAS}$, Column Address Strobe; R/W, Read/Write signal). The $\overline{CAS}$ and R/W signals are common to all the memory chips, regardless of row. The gate U4 generates one of two $\overline{RAS}$ signals depending on which row of memory chips are to be selected by address line A14. The dynamic memory chips used on this board require a refresh cycle to maintain data in the memory chips. This refresh cycle (only a $\overline{RAS}$ signal is generated) occurs during the time that $\overline{Ø_2}$ is high.

There are three voltage supplies that are required to operate the memory card. Each supply is regulated on the board (VR1, VR2, VR3), thus allowing the board to use unregulated power supplies.

Memory Address Assignments

Each memory integrated circuit stores one bit of a eight-bit word over a 16K byte memory segment. The table below shows which integrated circuit is responsible for storing each bit of data over the maximum Ø-32K memory range on the MP-16A board.

Range	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit Ø
Ø-16K (ØØØØ -3FFF)	U23	U24	U25	U26	U27	U28	U29	U30
16K-32K (4ØØØ - 7FFF)	U31	U32	U33	U34	U35	U36	U37	U38

Parts List - M-16AX Memory Expansion Kit

Integrated Circuits

____	U31	*MCM6616L25	16K x 1 dynamic memory IC
____	U32	"	" " " " " "
____	U33	"	" " " " " "
____	U34	"	" " " " " "
____	U35	"	" " " " " "
____	U36	"	" " " " " "
____	U37	"	" " " " " "
____	U38	"	" " " " " "

*Note: Components flagged with a * must be oriented as shown in the component layout drawing.

Note also, that the numbers printed on the memory integrated circuits may vary from time to time.

LIMITED WARRANTY MP-16A Memory

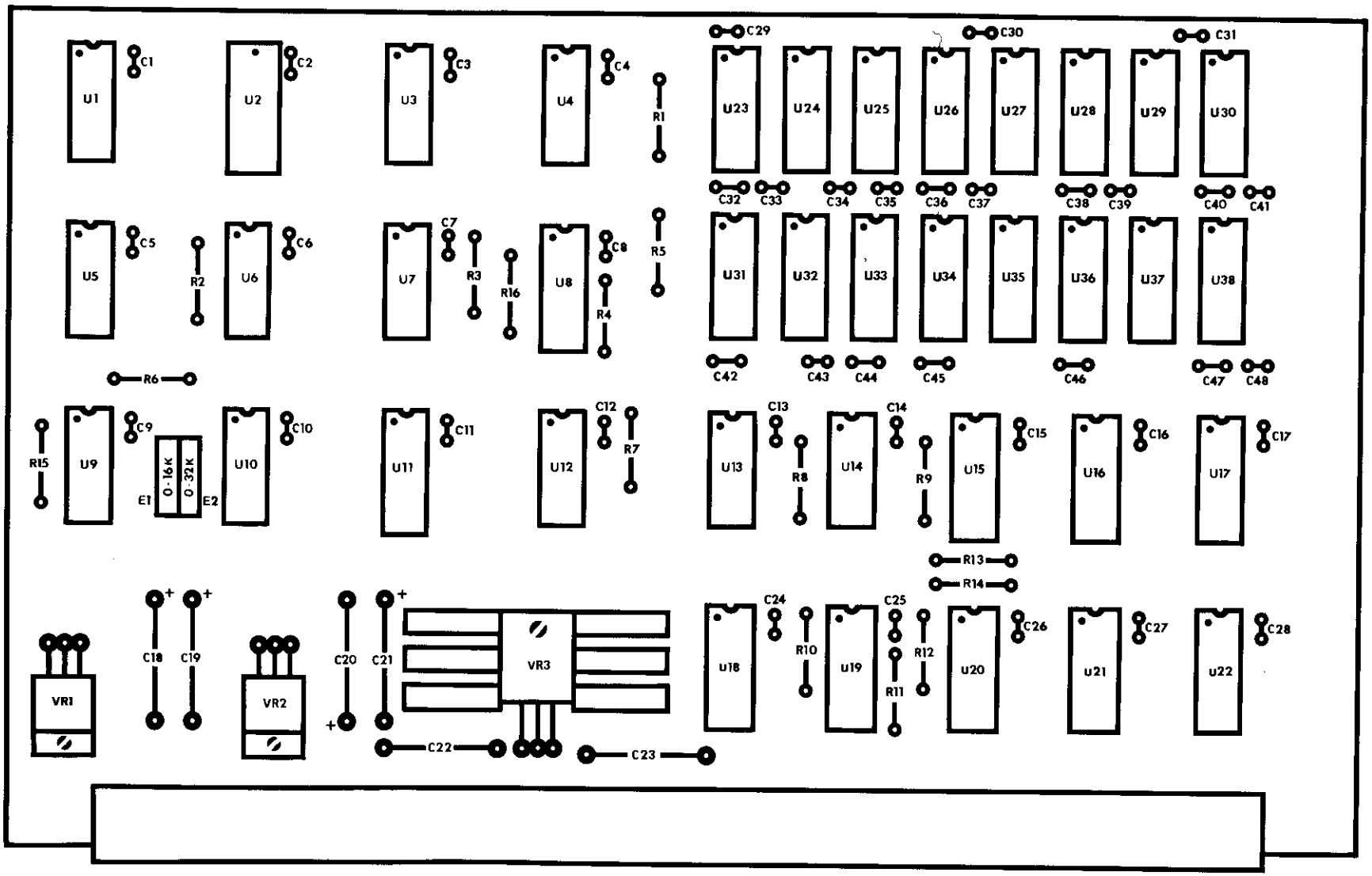
Southwest Technical Products Corporation provides the following limited warranty to the original purchaser of this product. If this product fails to function normally when used in a properly working Southwest Technical Products 6800 Computer System, it will be repaired, or replaced for a period of one year from date of purchase.

This warranty will be void and not apply to any products which have been physically modified, or damaged in any way—mechanically, or electrically. Eligibility for warranty shall be determined by Southwest Technical Products Corporation.

If warranty service appears to be necessary, return the MP-16A to:

Warranty Service—Sw. T. P. C.
219 W. Rhapsody
San Antonio, Texas 78216

If needed repairs are covered by warranty, the memory will be returned to you prepaid. If the problem is not covered by warranty, you will be notified of repair cost and authorization to do the work will be requested.


U1
C1
U2
C2
U3
C3
U4
C4
R1
U23
U24
U25
U26
U27
U28
U29
U30
C29
C30
C31
C32
C33
C34
C35
C36
C37
C38
C39
C40
C41
U5
C5
R2
U6
C6
U7
C7
R3
R16
U8
C8
R4
R5
U31
U32
U33
U34
U35
U36
U37
U38
C42
C43
C44
C45
C46
C47
C48
R6
R15
U9
C9
E1
0·16K
0·32K
E2
U10
C10
U11
C11
U12
C12
R7
U13
C13
R8
U14
C14
R9
U15
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U17
C17
R13
R14
VR1
C18
C19
VR2
C20
C21
VR3
C22
C23
U18
C24
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R11
R12
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C26
U21
C27
U22
C28