Assembly Instructions MP-A Microprocessor/System Board

Introduction

The MP-A board is the primary logic board for the system. It is a 5 1/2" x 9" double sided plated thru hole circuit board containing the 6800 microprocessor chip, the 6830 ROM which stores the Mini-Operating system and the 6810 128 byte scratch pad memory for the ROM. There is a crystal controlled processor clock driver and baud rate generator providing serial interface baud rates of 110, 150, 300, 600 and 1200 baud for all but the control interface which is operable at 110 or 300 baud. The board also contains a power up/manual reset circuit which loads the ROM stored operating system when activated. Full I/O buffering is provided for the 16 address lines and 8 bi-directional data lines with these and other inter-connections made to the rest of the system thru a fifty pin connector to the mother board (MP-B). +5 volt power for the board is supplied by an on board +5 volt regulator with heatsink at a total current consumption of 0.8 A typical.

When the SWTPC 6800 Computer System is being assembled, work on only one board at a time. Each of the sytem'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.

PC Board Assembly

NOTE: Since all of the holes on 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 one 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.

( ) Install the transistors on the board. The transistors must be turned to match the outlines on the component layout drawing. Solder.

( ) Attach crystal XTAL1 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 degress 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, the crystal's leads some heavy buss wire. The buss 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 inadvertantly come into contact with either the foil on the circuit board or either one of its own two leads. Solder.

( ) 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 mother board. 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 mother board incorrectly.

( ) Install integrated circuits IC5 thru IC16 and IC18 thru IC20. As each one is installed make sure it is down firmly against the board and solder only two of the leads to hold the pack 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.

( ) Install integrated circuit IC17 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 1/4" screw, lockwasher and nut. The three leads of the integrated circuit 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 two zero force integrated circuit sockets to the board in the IC1 and IC2 positions only. The 40 pin socket goes in the IC1 position while the 24 pin socket goes in the IC2 position. Orient each socket so the corner having the projecting tab is adjacent the pin indicated by the "dot" within the integrated circuit outline on the component layout drawing. Solder.

NOTE: MOS integrated circuits are susceptable 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 1 M 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. On those MOS IC's being soldered in place; the tip of the soldering iron should be grounded as well (separately from your body ground) either with or without a 1 Meg ohm resistor. Most soldering irons having a three prong line cord plug already have a grounded tip. 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 IC3 and IC4 following the precautions given in the preceding section. As each is installed, make sure it is down firmly against the board before soldering all of its leads. 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 "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.

( ) 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.

( ) 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 check out. Also look for solder "bridges" and "cold" solder joints which are another common problem.

This completes the assembly phase for the MP-A board. Integrated circuits IC1 and IC2 should not be installed until the board goes thru a preliminary checkout detailed in the System Checkout Instructions supplied with the MP-B mother board kit. The System Checkout Instruction are used after having assembled the MP-A Microprocessor/System Board, MP-B mother board, MP-C serial, control interface, and the MP-P power supply.

Since the MP-A circuit board now contains MOS devices it is susceptable 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.

How It Works

The entire 6800 Computer System is built around IC1, the 6800 Microprocessor Unit (MPU). Most of the components within the system are used to provide the clocks, buffering and decoding necessary to interface to this integrated circuit. Complete details of the operation and specifications of IC1 are contained in the 6800 Hardware section of the System Documentation Notebook and will not be repeated here.

Integrated circuit IC2 is a 1024 x 8 bit read only memory (ROM) which permanently stores the computer's mini-operating system described in the Operating System section of the System Documentation Notebook. Whenever the computer system 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. Since the mini-operating system uses only 512 words of the ROM, the upper 512 words have been disabled from access and the ROM operating system addresses have been located from E000 to E1FF inclusive.

The ROM stored mini-operating requires a small amount of random access memory (RAM) for operation. It uses IC3, a 128 x 8 bit static memory. What is nice here

Parts List MP-A Microprocessor/System Board

Resistors

R1, R2, R4	1M ohm 1/4 watt resistor
R3, R7, R12, R13	10K " " " "
R5, R6	6.8K " " " "
R8, R9, R19	1K " " " "
R10, R11	4.7K " " " "
R14, R17	10 " " " "
R15, R16	22 " " " "
R18	470 " " " "

Capacitors

C1, C2, C4, C14, C15	0.1 mfd disc. capacitor
C3	100 mfd @15 VDC electrolytic capacitor
C5	0.01 mfd mylar capacitor
C6	0.1 mfd mylar capacitor
C7	0.47 mfd tantalum capacitor
C8	1000 pF polystyrene capacitor
C9, C10	33 pfd polysytrene capacitor
C11, C12	120 pfd polystyrene capacitor
C13	1000 pfd polystyrene capacitor

Semiconductors

IC-1	MC6800 MPU (MOS)
IC-2	MC6830L7 ROM (MOS)
IC-3	MC6810L-1 RAM (MOS)
IC-4	MC14411 Baud Rate Generator (MOS)
IC-5, IC-6, IC-7	DM8097 Hex Tri-State Buffer
IC-8, IC-9	DM8835 Quad Bi-directional Transceiver
IC-10	7404 Hex Inverter
IC-11	555 or 1455 Timer
IC-12, IC-13	7400 Quad NAND gate
IC-14	74L04 HP Hex Inverter
IC-15	DM8098 Hex Tri-State Buffer
IC-16	7420 Dual 4-Input NAND Gate
IC-17	7805 +5 VDC Voltage Regulator
IC-18	74H00 HS Quad NAND Gate
IC-19	74H08 HS Quad AND Gate
IC-20	7474 Dual "D" Flip-Flop
Q1, Q2	2N5087 transistor
Q3, Q4	2N5210 transistor

Misc.

XTAL 1	1.7971 MHz Parallel Resonant Crystal

is that a large portion of the RAM memory addresses are unassigned which means many short programs such as the diagnostics can be loaded right into the operating system RAM without using any of the large MP-M static memory cards. Complete information regarding the unassigned RAM locations is contained in the Operating System section of the System Documentation Notebook.

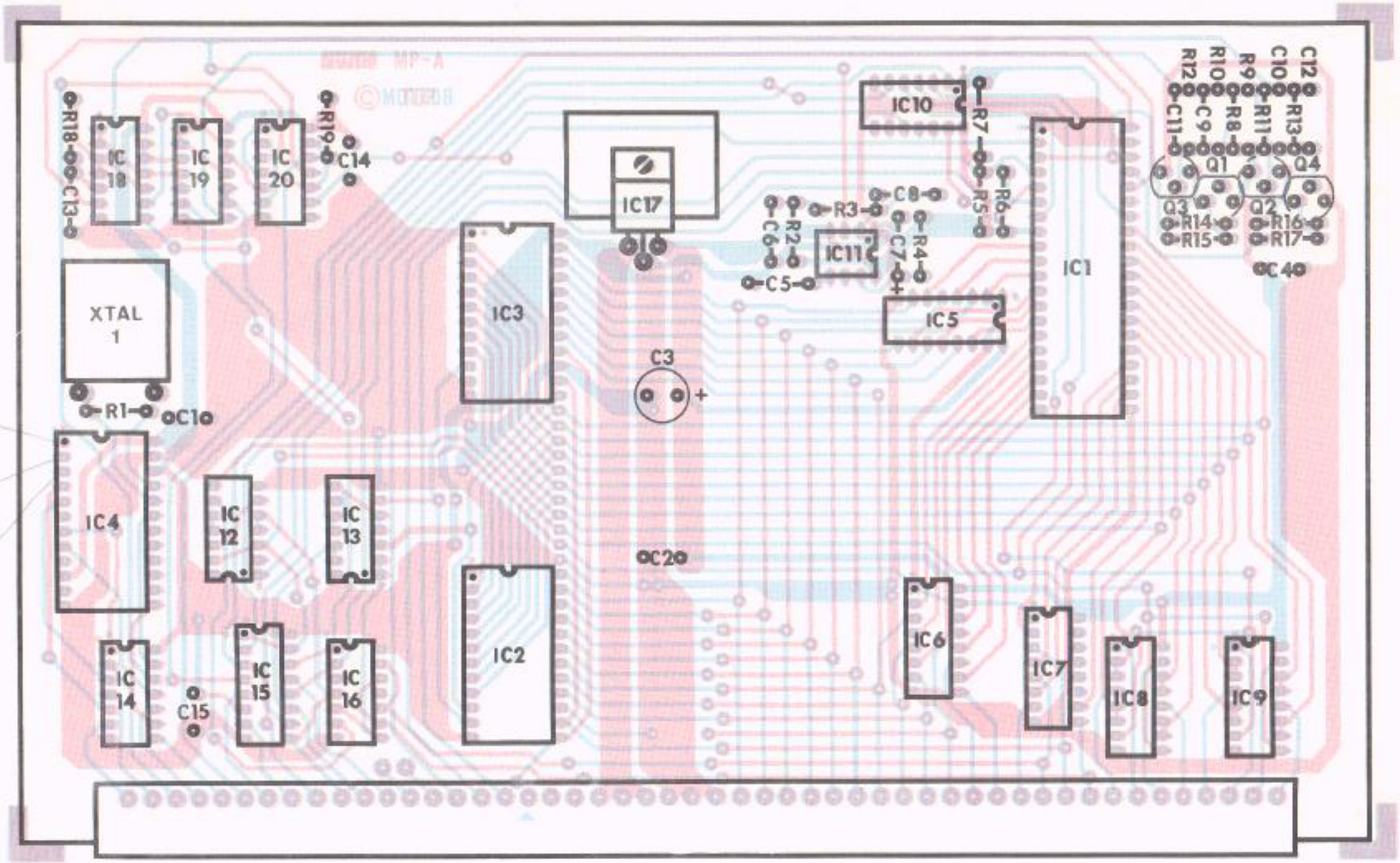
IC4 is the crystal controlled clock/baud rate generator. It produces the five baud rate clock frequencies required by the control and serial interfaces. It also generates a clock which is divided by two by half of IC20, split into two non-overlapping phases by IC18 and IC19 buffered by transistors Q1 thru Q4 and sent onto IC1, the MPU chip. IC14 provides the buffering for each of the used outputs on baud rate generator IC4.

Timer integrated circuit IC11 is responsible for generating the power up/ manual pushbutton RESET which loads the mini-operating system stored in the ROM, IC2.

Half of D flip flop, IC20 is used for timed halting of the processor in direct memory access (DMA) applications.

Integrated circuits IC5, IC6 and IC7 are used as non-inverting address line buffers for each of the sixteen address lines. Integrated circuits IC8 and IC9 are inverting bi-directional transceiver buffers for the system's eight bi-directional data lines. The gates feeding the enable lines of the transceiver IC's guarantee the appropiate receive or transmit data buss buffers are enabled at the proper time.

+5 VDC power for the board is supplied by voltage regulator IC17.


MP-A
IC 18
IC 19
IC 20
IC17
IC10
IC11
IC1
IC3
IC5
IC4
IC2
IC6
IC7
IC8
IC9
IC 12
IC 13
IC 14
IC 15
IC 16
XTAL 1
Q1
Q2
Q3
Q4
R1
R2
R3
R4
R5
R6
R7
R9
R10
R12
R11
R13
R14
R15
R16
R17
R18
R19
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
C15