

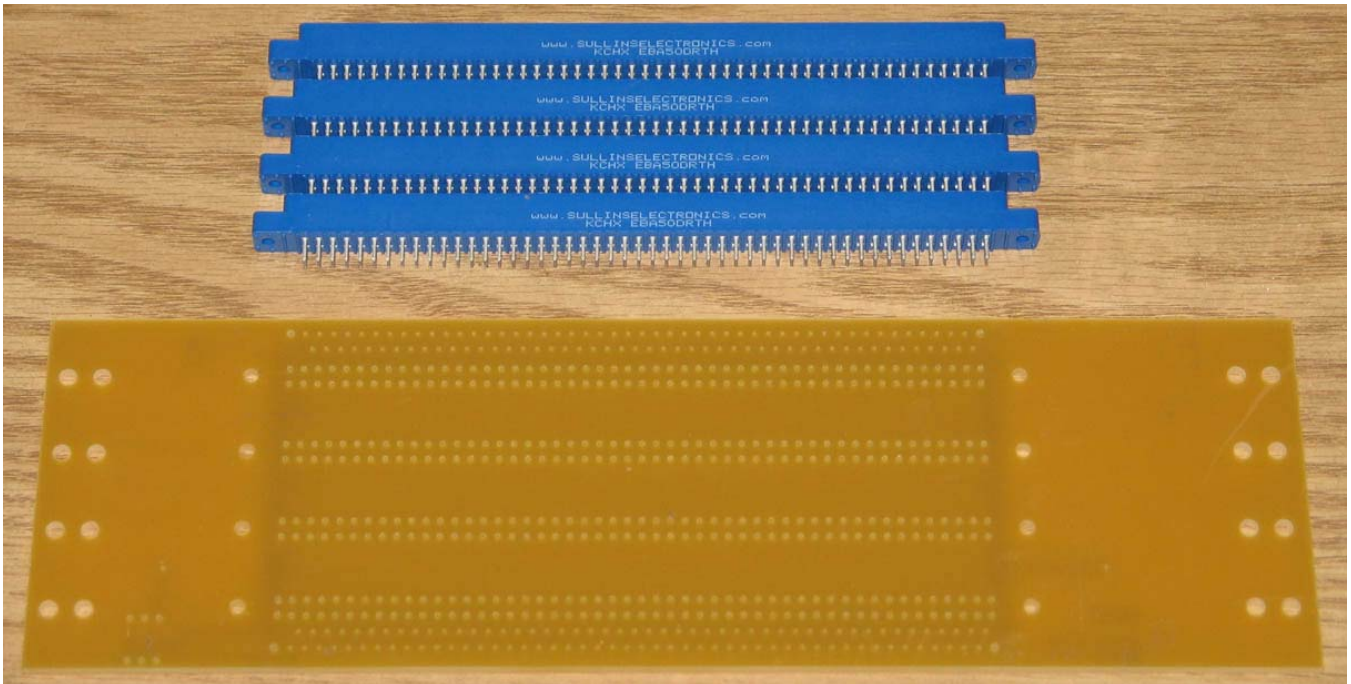
88-EC - 8800 Expander Card Kit Assembly Guide

This is the easiest of the sub kits which make up the basic Altair 8800.

The MITS assembly instructions for this board start on page 64 of the “ALTAIR 8800 ASSEMBLY MANUAL”.

There are a total of 400 solder joints to make on this board. Make sure that you do not bridge any pins together! Read through the “MITS Kit Assembly Hints” booklet for soldering tips.

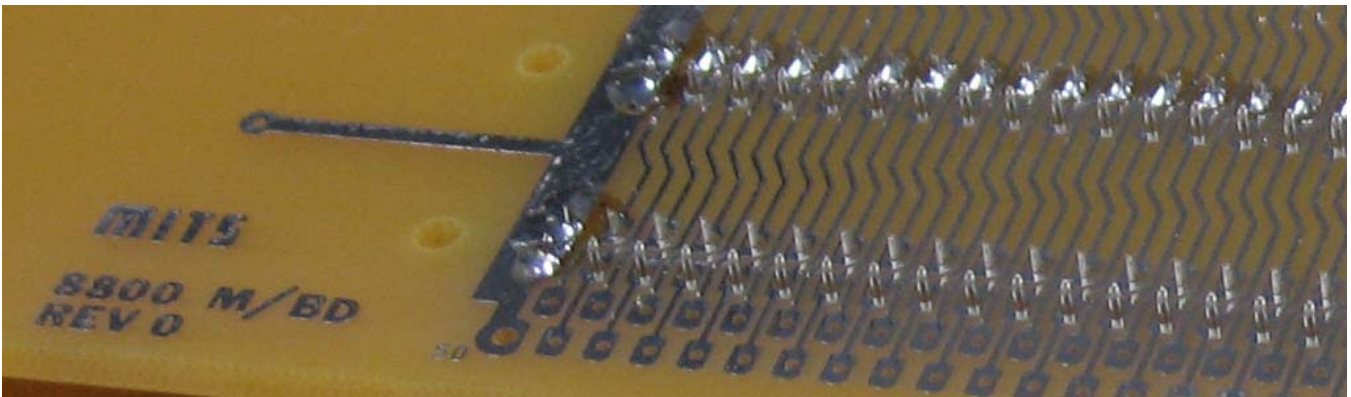
The first step is to verify that you have all of the parts required to complete this kit. You will need a non-blunt tipped soldering iron, and some solder. I recommend .031 or smaller rosin core. **DO NOT USE ACID CORE SOLDER!**



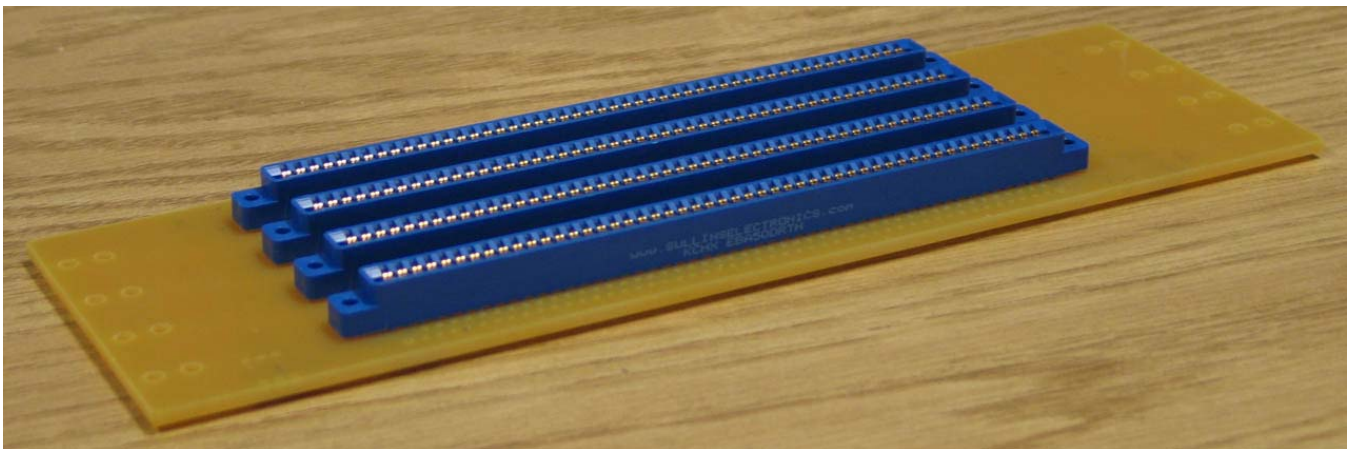
Contents of the 88-EC Kit



The connectors fit fairly snug in the holes. The easiest way to insert it is by starting on one end and rocking it in. Insert all 4 connectors, and make all 100 solder joints on each connector. Make sure the connectors are fully inserted into the board before soldering!



A partial row of pins has been soldered.



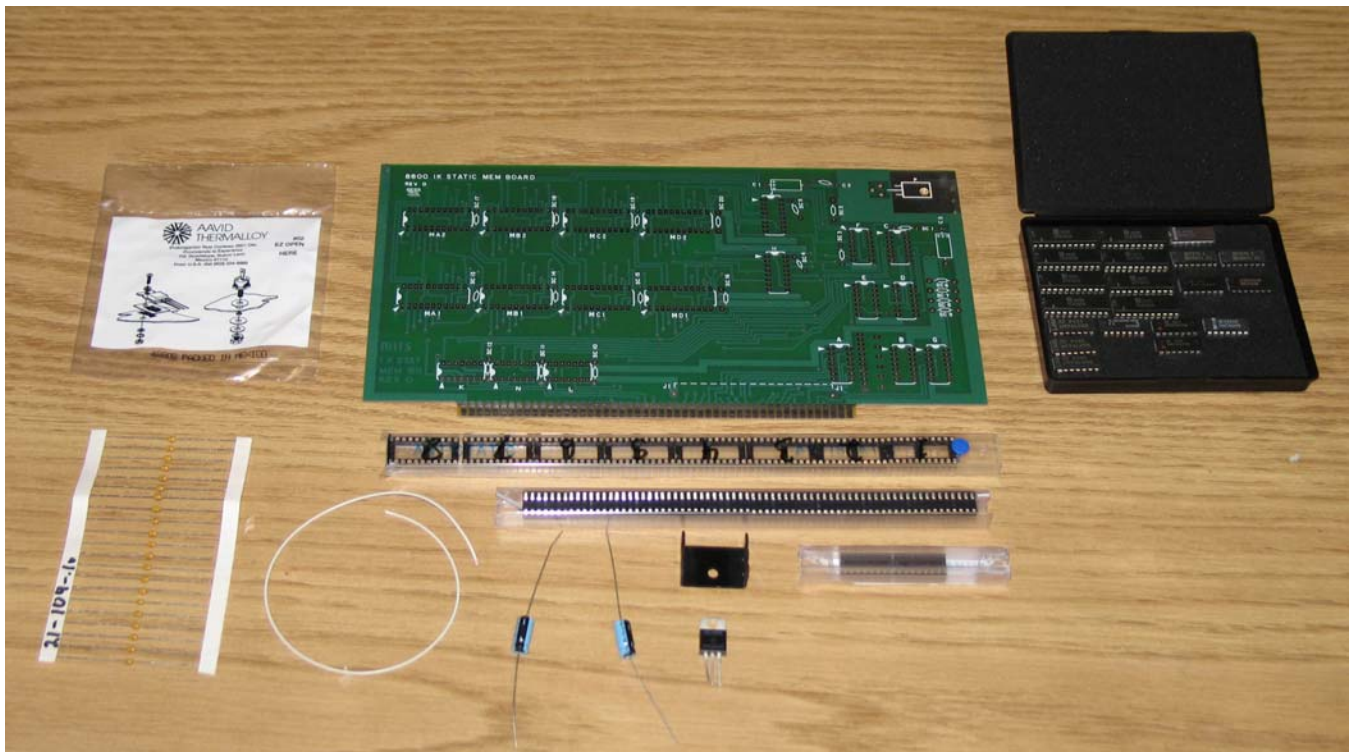
Here is the completed 88-EC board! The wiring for this board will be covered in the enclosure section.

88-MCS - 8800 1K Static Memory Board Kit Assembly Guide

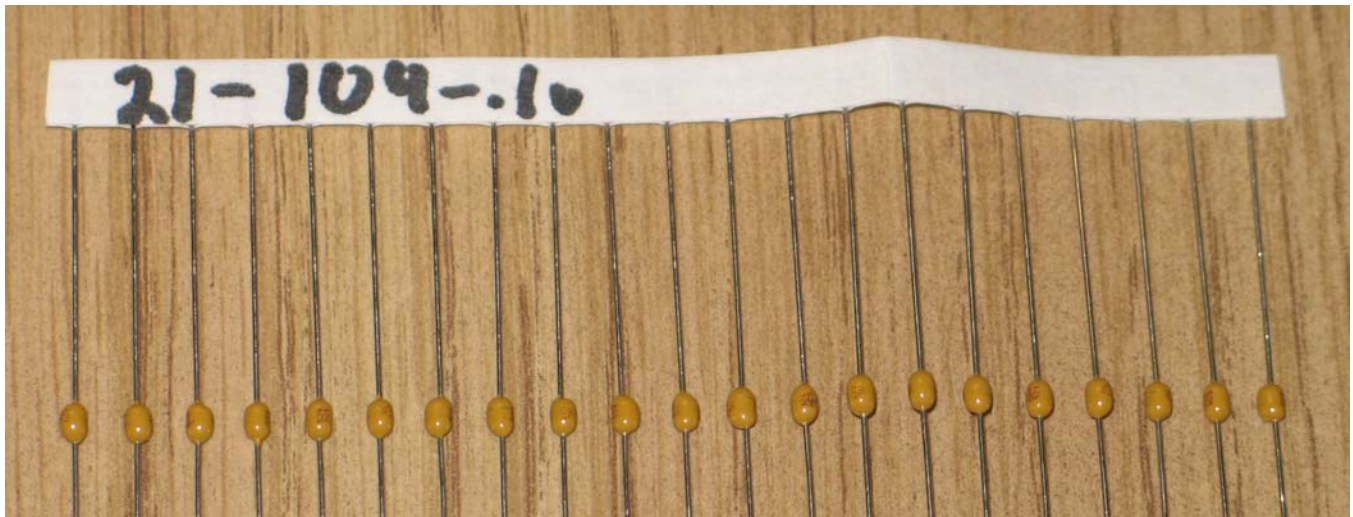
This is what I consider to be the second easiest kit to assemble in the Altair 8800 Computer kit. There are not any different but similar capacitor/resistors. Parts have clear values and designations.

The MITS assembly instructions for this board start on page 40 of the “ALTAIR 8800 ASSEMBLY MANUAL”. I recommend that you read through BOTH the instructions in that manual and this. My instructions may have a different order for the steps. One reason is that I include sockets for all ICs and MITS did not. It is your choice which one you will follow.

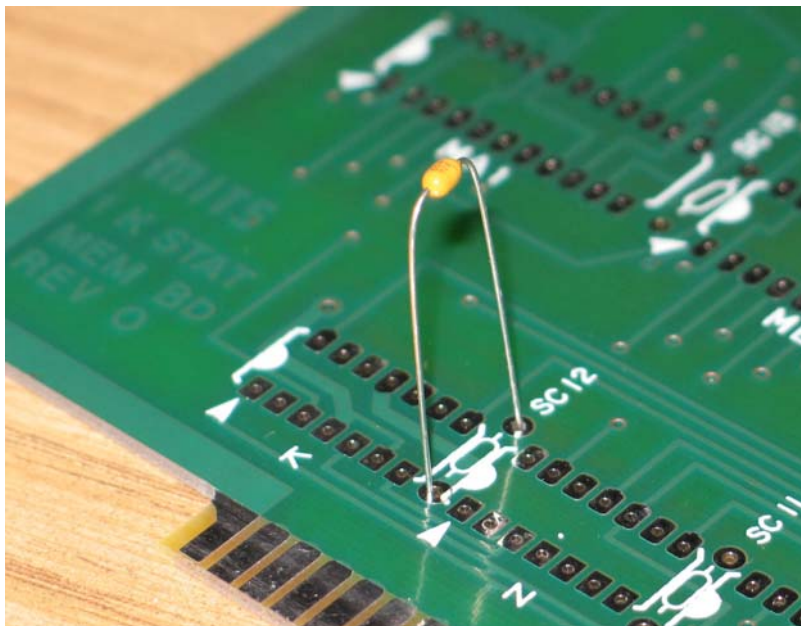
The first step is to verify that you have all of the parts required to complete this kit. You will need a stripper for 26ga wire, a non-blunt tipped soldering iron, and some solder. I recommend .031 or smaller rosin core. **DO NOT USE ACID CORE SOLDER!**



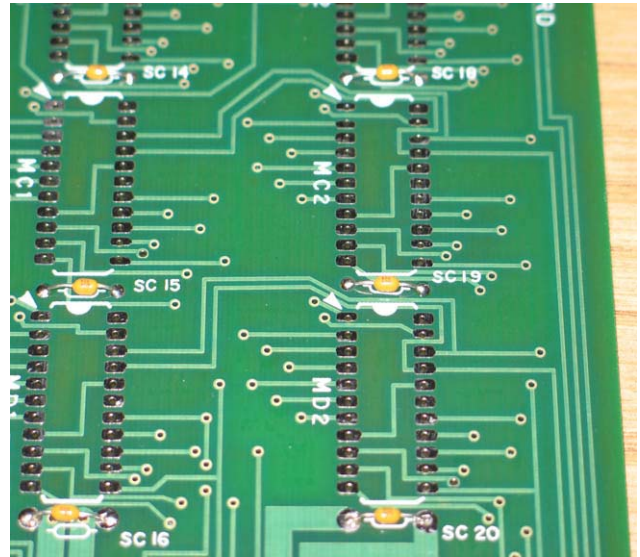
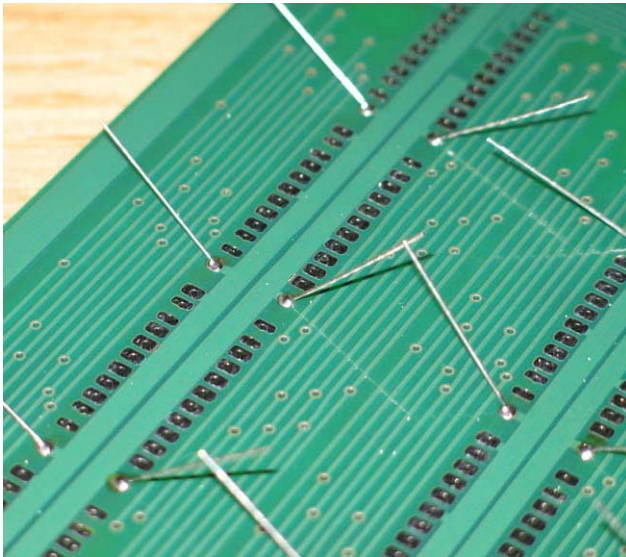
Contents of the 88-MCS Kit



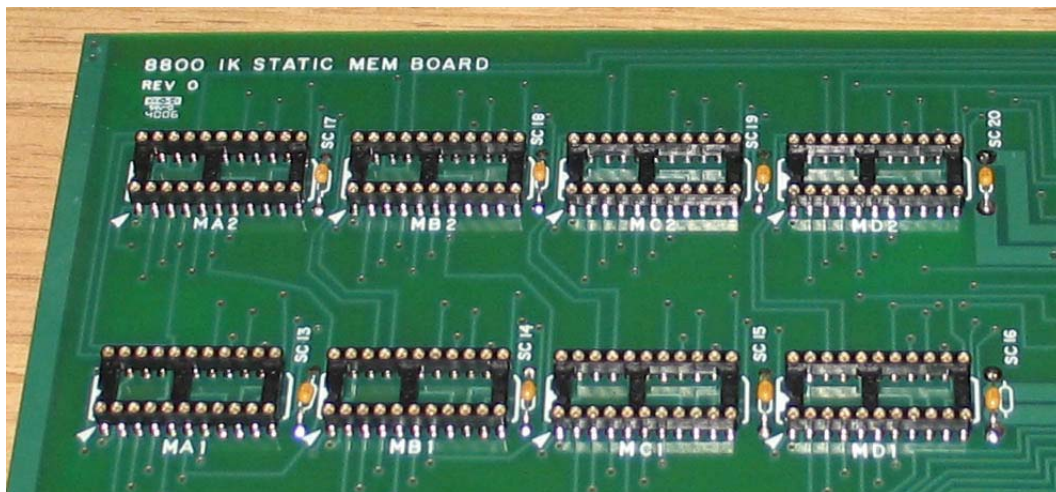
There are 21 104 (.1uF) capacitors to install on the card. These axial capacitors are much smaller than the radial capacitors that MITS included in their kits. The larger radial disc capacitors can be brittle. Because of their height they can be folded and break. The bad thing about these axial capacitors is that it can be hard to read the value. If you can't read them without glasses, then use a magnifying glass.



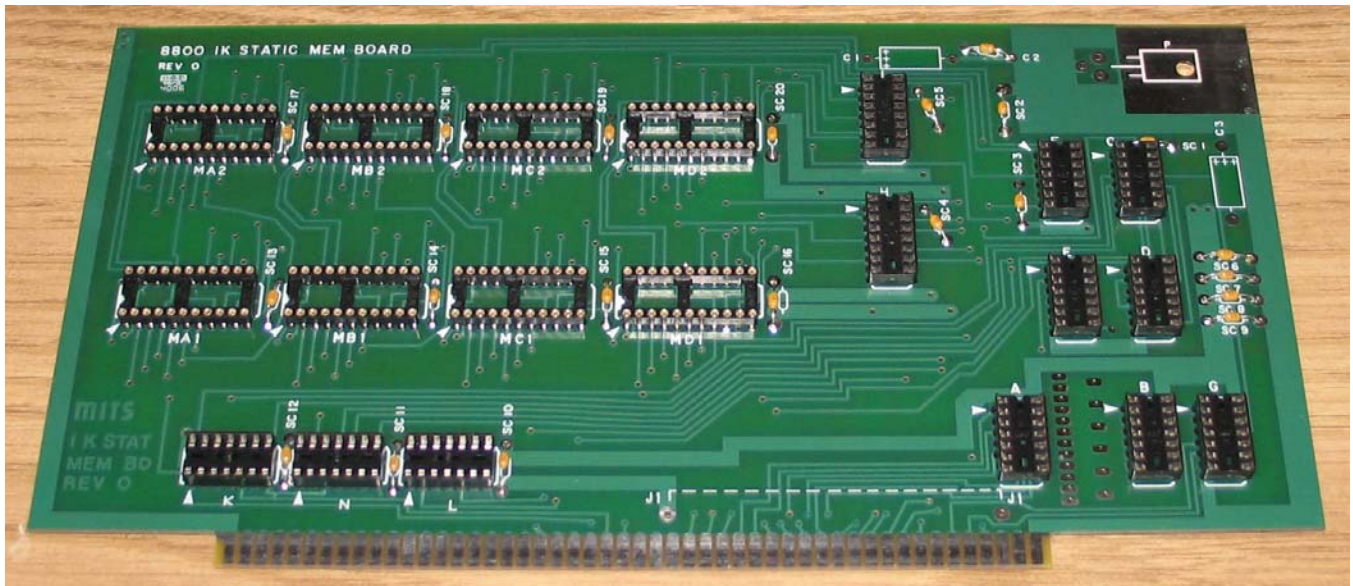
SC1 through SC20 and C2 are all 104 (.1uF) axial capacitors. Install the capacitors with the number on the capacitor body facing upward. On the other kits there are more than one capacitor value in the kit. It would be a good idea to get accustomed to making sure the value is facing up so that if the card requires troubleshooting you can verify them for correct installation. Otherwise they will all look the same. Page 42 of the "ALTAIR 8800 ASSEMBLY MANUAL" has MITS's instructions for capacitor installation, page 43 of the same manual has a picture of the silkscreen.



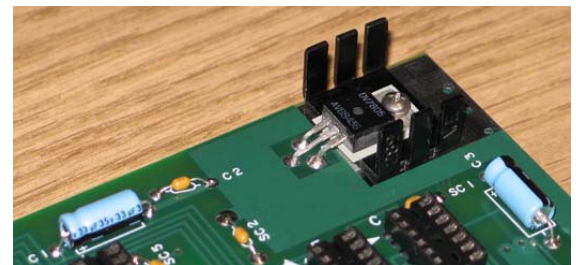
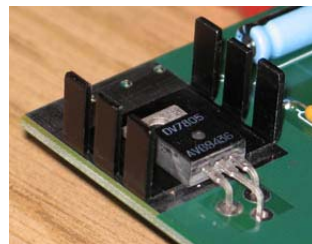
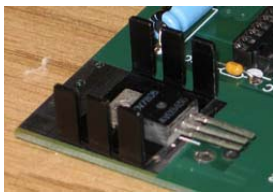
Bend the legs slightly outward. This will help them stay in place until they are soldered. Solder the capacitors in place.



Next, locate and place all of the IC sockets for the RAM chips. Only solder one pin on each end of the socket at first. Then check the sockets to make sure they are inserted completely. After you checked, completely solder all 8 RAM sockets. Page 40 of the “ALTAIR 8800 ASSEMBLY MANUAL” has MITS’s instructions for IC placement, however originally there were no sockets included in the kit. I recommend you wait until the end to place them. Page 41 of the same manual has a picture of the silkscreen.



Insert the remaining 16 and 14 pin IC sockets. Solder two pins on opposite ends of each socket, then check to make sure all of the sockets are completely inserted. After that, completely solder all IC sockets.



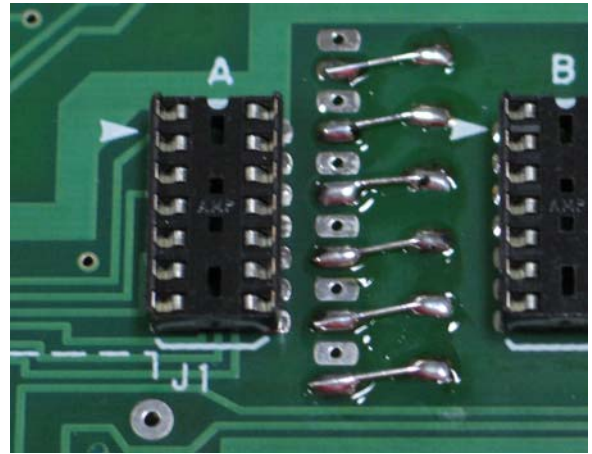
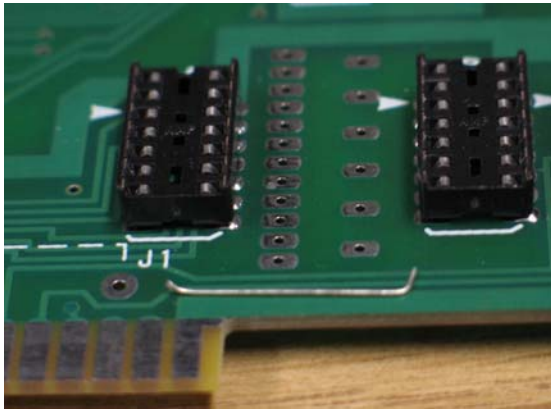
Left: Align regulator and heat sink with hole in PCB.

Middle: Pinch each leg with pliers and bend so that they will fall into the holes.

Right: Follow instructions on the included heat sink mounting kit. Mount the regulator and heat sink to the board. After the regulator has been mounted to the PCB go ahead and solder it. Install the two axial electrolytic capacitors.

Page 44 of the “ALTAIR 8800 ASSEMBLY MANUAL” has MITS's instructions for installation of the 7805 and heat sink.

Note: Use the heat sink isolator included with the heat sink mounting kit. It is not necessary to isolate the 7805 from the card, but it will help heat transfer from the 7805 to the heat sink. You may use heat sink grease instead of you wish.

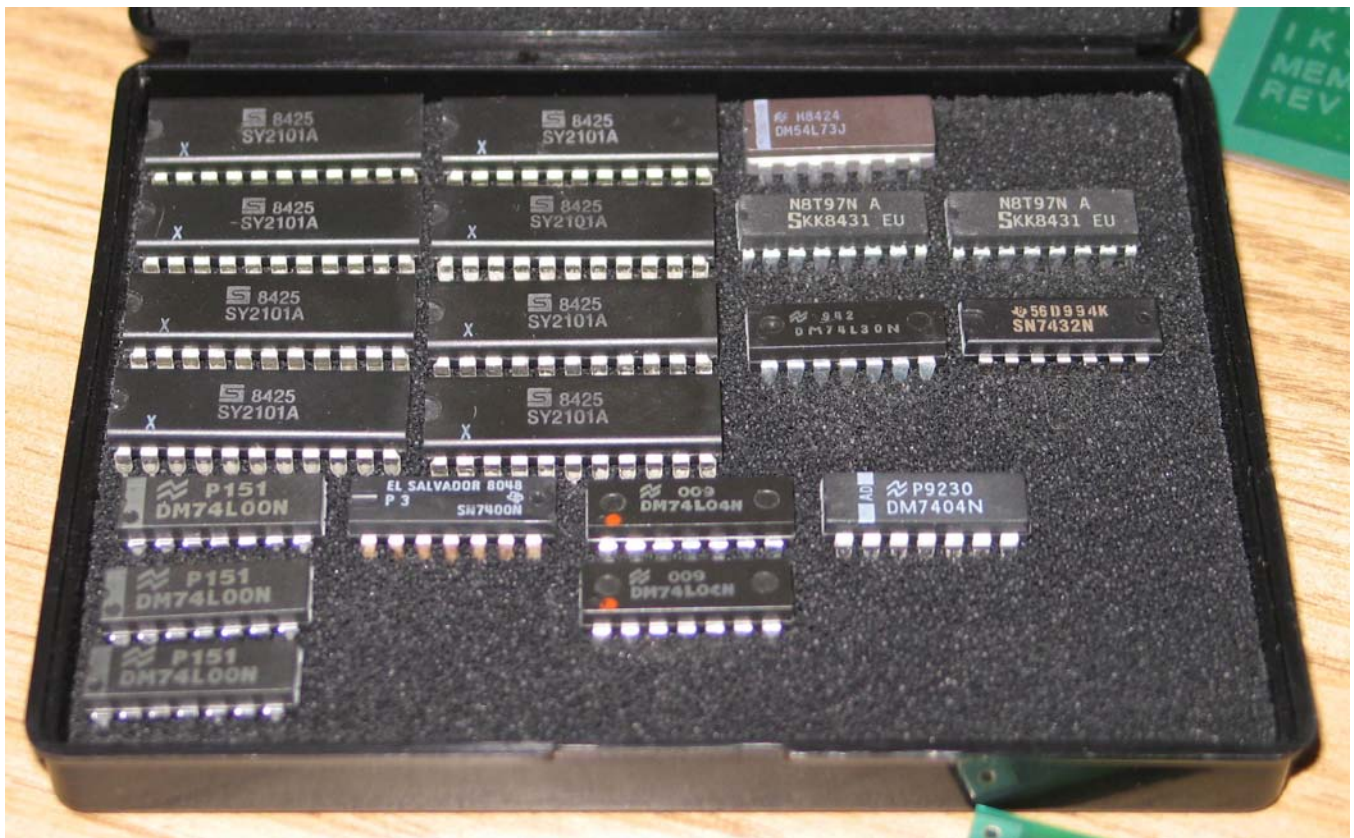


Top Left: You can either use small loops of white wire for address selection or the legs trimmed off of your capacitors. It is easier to change the cards address with the capacitor legs than with the white wire. If you bend one end of the leg to fall in the series of the holes on the right and trim the other end straight, then changing the address of the card only involves heating up the jumper and pivoting it to the other pad. For more information on address selection for the board, view page 78 (unnumbered, but the page after number 77) in the “ALTAIR 8800 ASSEMBLY MANUAL”.

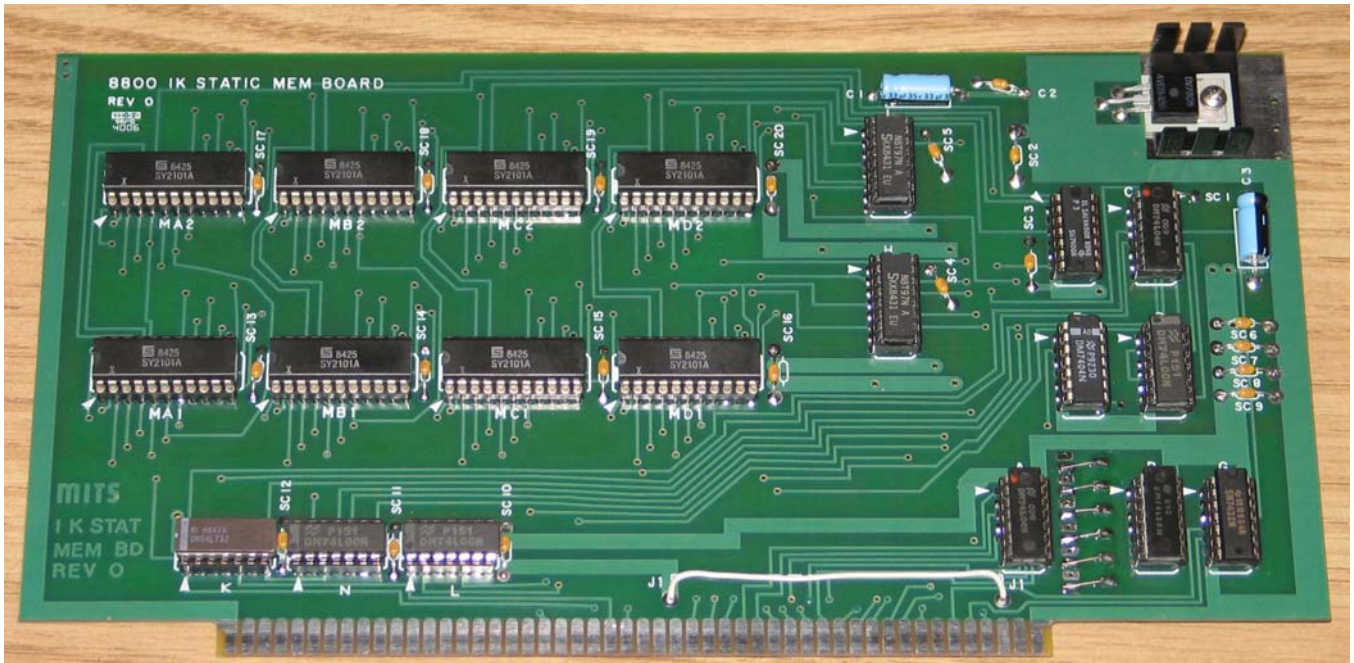
Top Right: This is the default address setting for the card. This will place the card in memory space from 0x0000 to 0x03FF (000000 to 001777 octal). Unless you know why you would want a different configuration (more than one card for example), then wire your card like the picture above.

Bottom Middle: Install jumper J1.

Page 45 of the “ALTAIR 8800 ASSEMBLY MANUAL” has MITS's instructions for the hardware jumper connections. Page 46 of the same manual has a picture of the silkscreen.



You are now ready to install the ICs. Please see page 41 of the “ALTAIR 8800 ASSEMBLY MANUAL” for a picture of the silkscreen and instructions for locating the ICs in their sockets.



CONGRATULATIONS! You are done with the board! If you are building an entire Altair 8800 Computer kit, then the project has just begun...

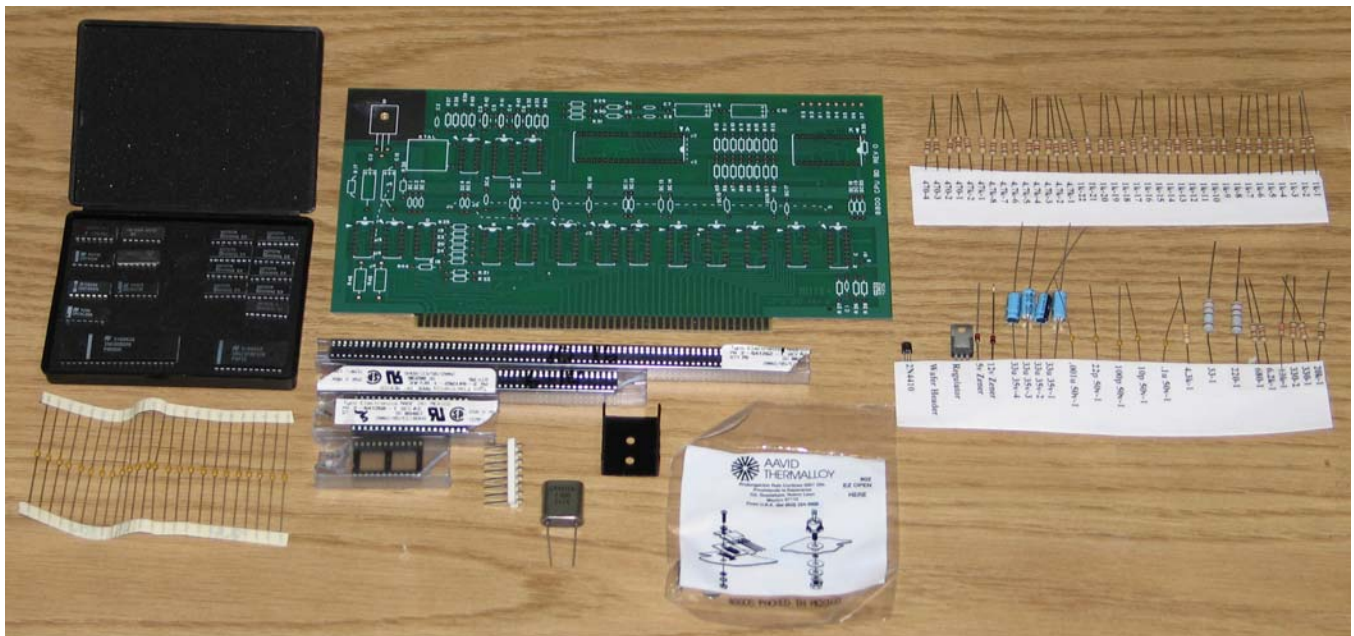
88-CPU - 8800 8080 CPU Board

Kit Assembly Guide

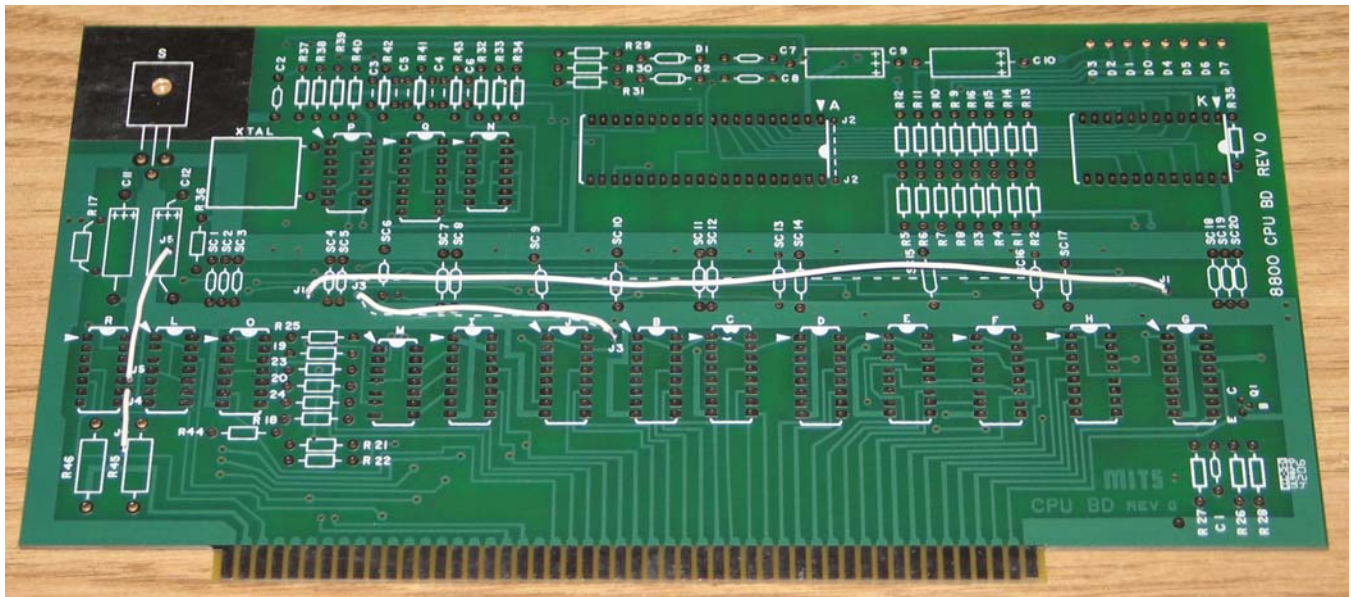
This kit is a little more complex than the 88-MCS 1k memory board. The 88-MCS only had one value of capacitor and the CPU board has several. The CPU board also has several different resistor values.

The MITS assembly instructions for this board start on page 26 of the “ALTAIR 8800 ASSEMBLY MANUAL”. I recommend that you read through BOTH the instructions in that manual and this. My instructions may have a different order for the steps. One reason is that I include sockets for all ICs and MITS did not. It is your choice which one you will follow.

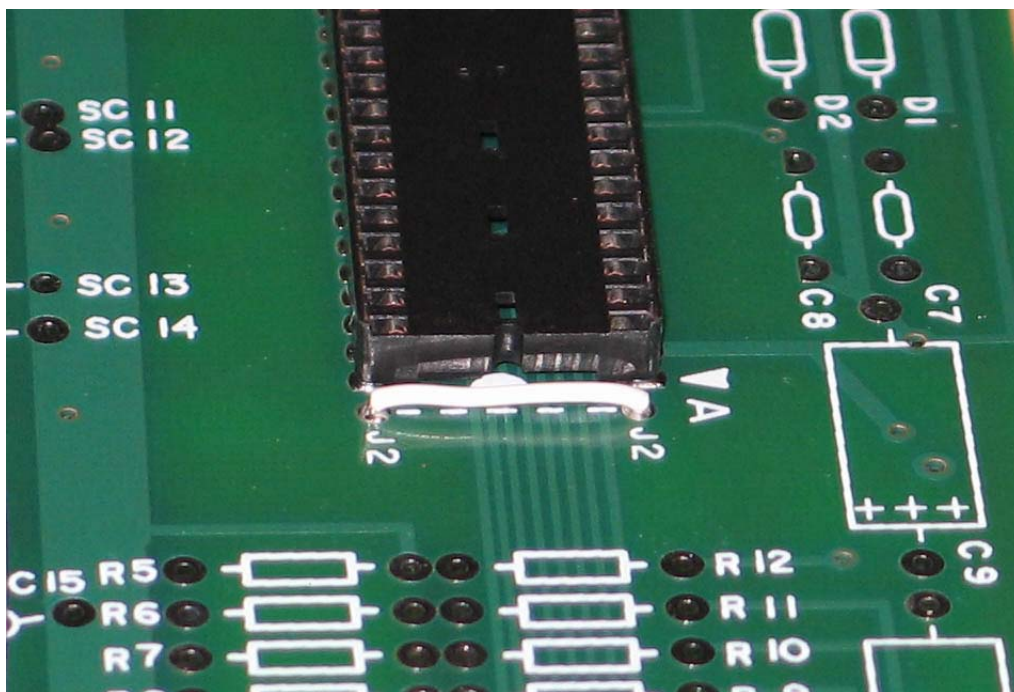
The first step is to verify that you have all the parts required to complete this kit. You will need a stripper for 26ga wire, a non-blunt tipped soldering iron, and some solder. I recommend .031 or smaller rosin core. DO NOT USE ACID CORE SOLDER!



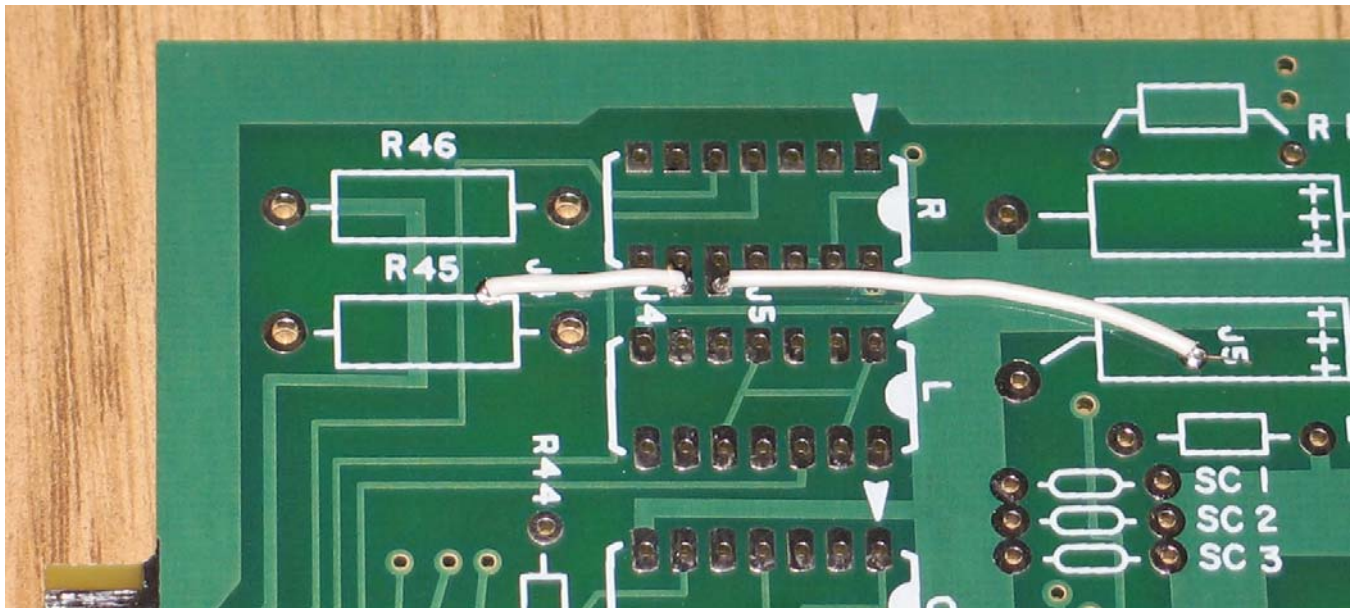
Contents of the 88-CPU Kit



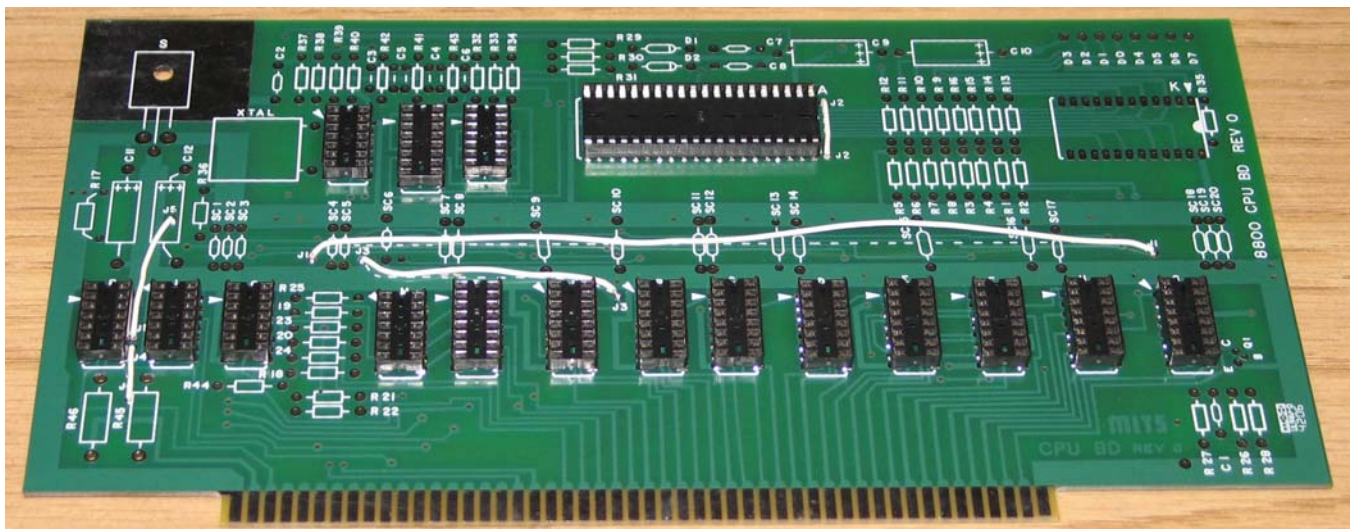
It will be hard to install the jumpers if you wait. I recommend you install them all now! NOTE, I missed a jumper next to the 8080 processor (J2). MITS instructions for the jumpers are on page 28.



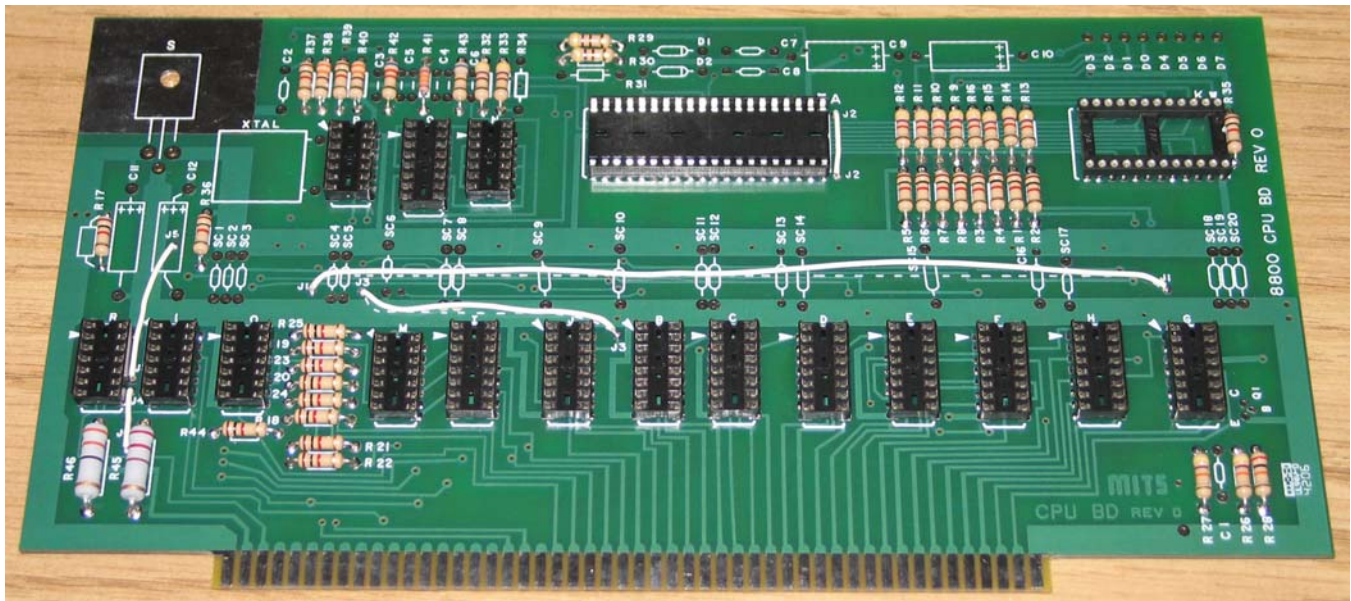
To the right is the location of J2, which I missed in the picture above.



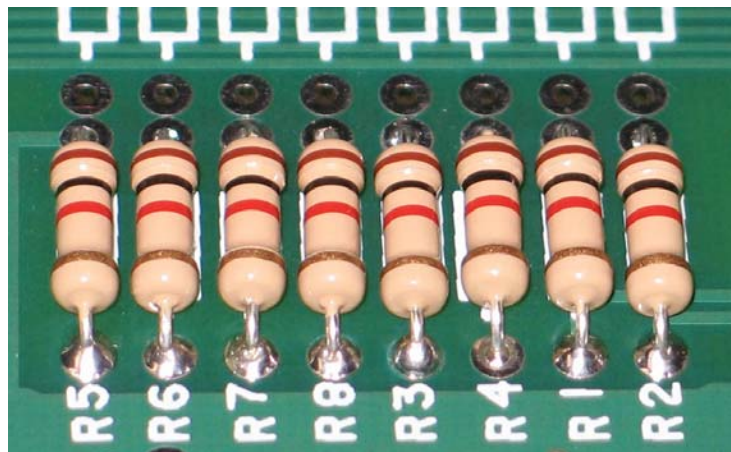
You can install J4 as indicated on the PCB legend, or you can install it in the hole below. I chose the hole below because its easier to handle a slightly longer jumper (stripping, etc)



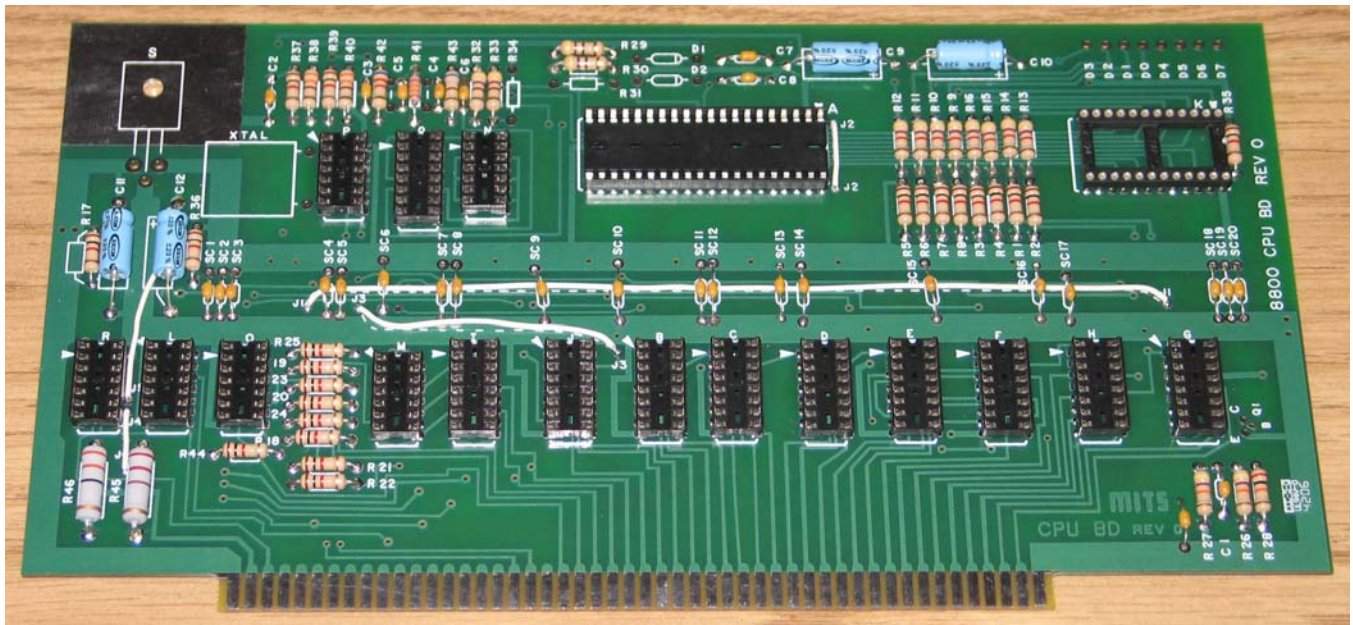
Next install all of the sockets. The 24 pin socket is not shown installed but it should be soldered at this time. MITS does not include instructions for socket installation except for the 40 and 24pin sockets.



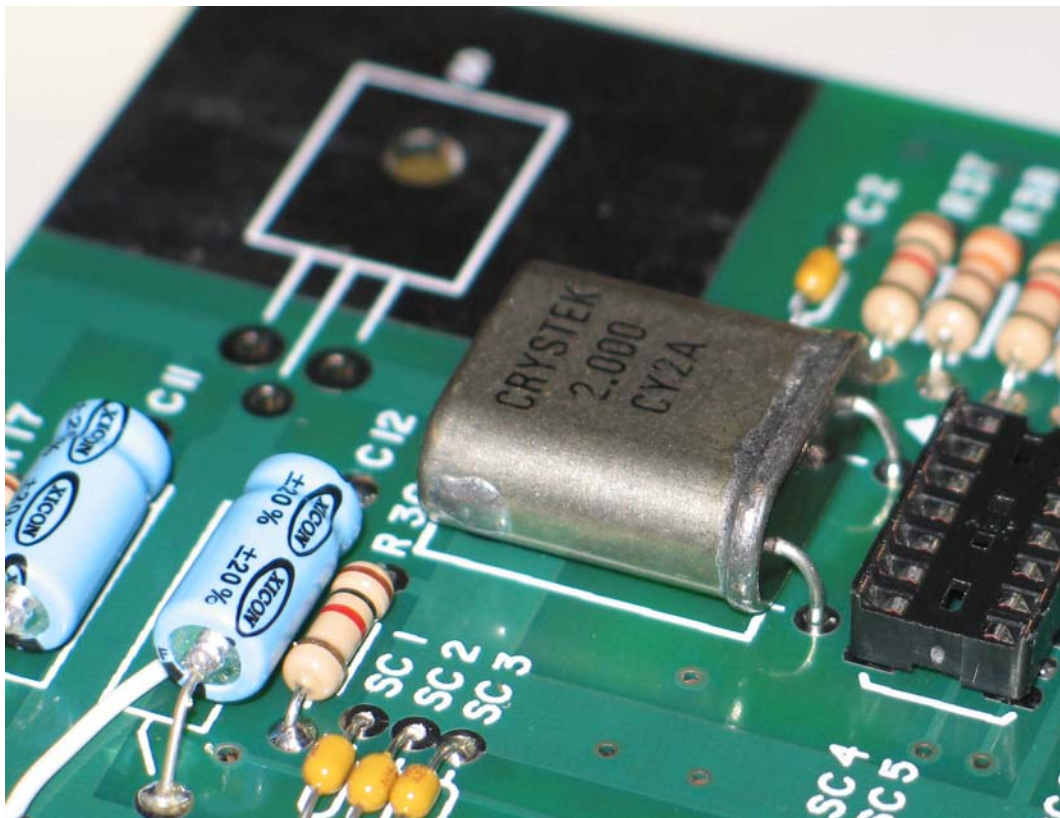
Follow the instructions on page 30-31 for installing the resistors. NOTE: I've found that at least R42 must be substituted for a 4.3k resistor for the clock circuit to function properly. Included is the resistor MITS calls for in the manual, as well as a 4.3k resistor.



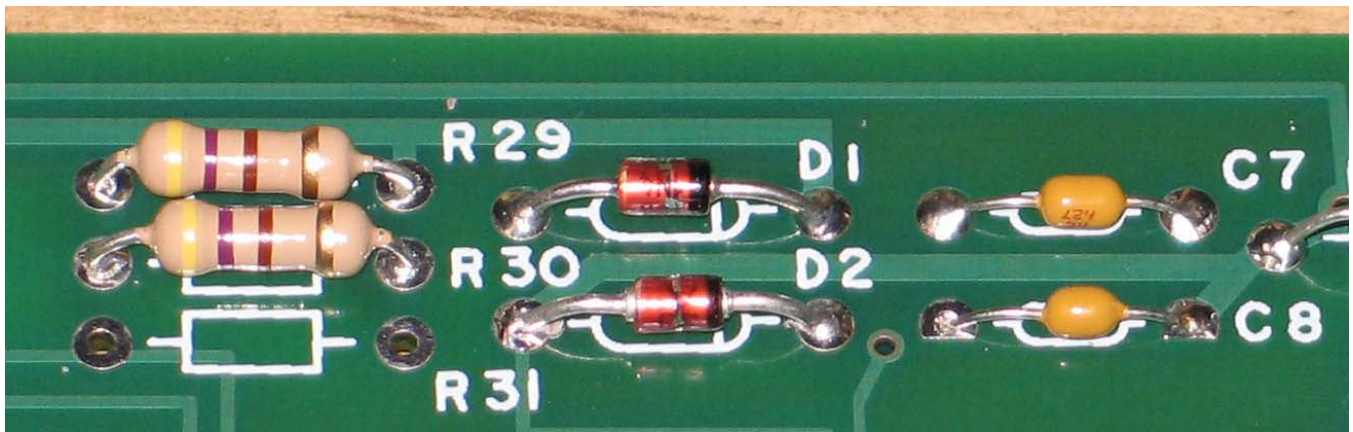
I recommend that you take your time installing all of the resistors and capacitors so that your board looks as good as possible. For example, insert all of the resistors so that the gold band is facing the same direction. Orient all of the capacitors so that the value is facing upwards. NOTE: Make sure to install the electrolytic capacitors as indicated! They are polarized and should only be inserted one way!



Install all of the capacitors. MITS's installation instructions for the capacitors are on page 32-33.



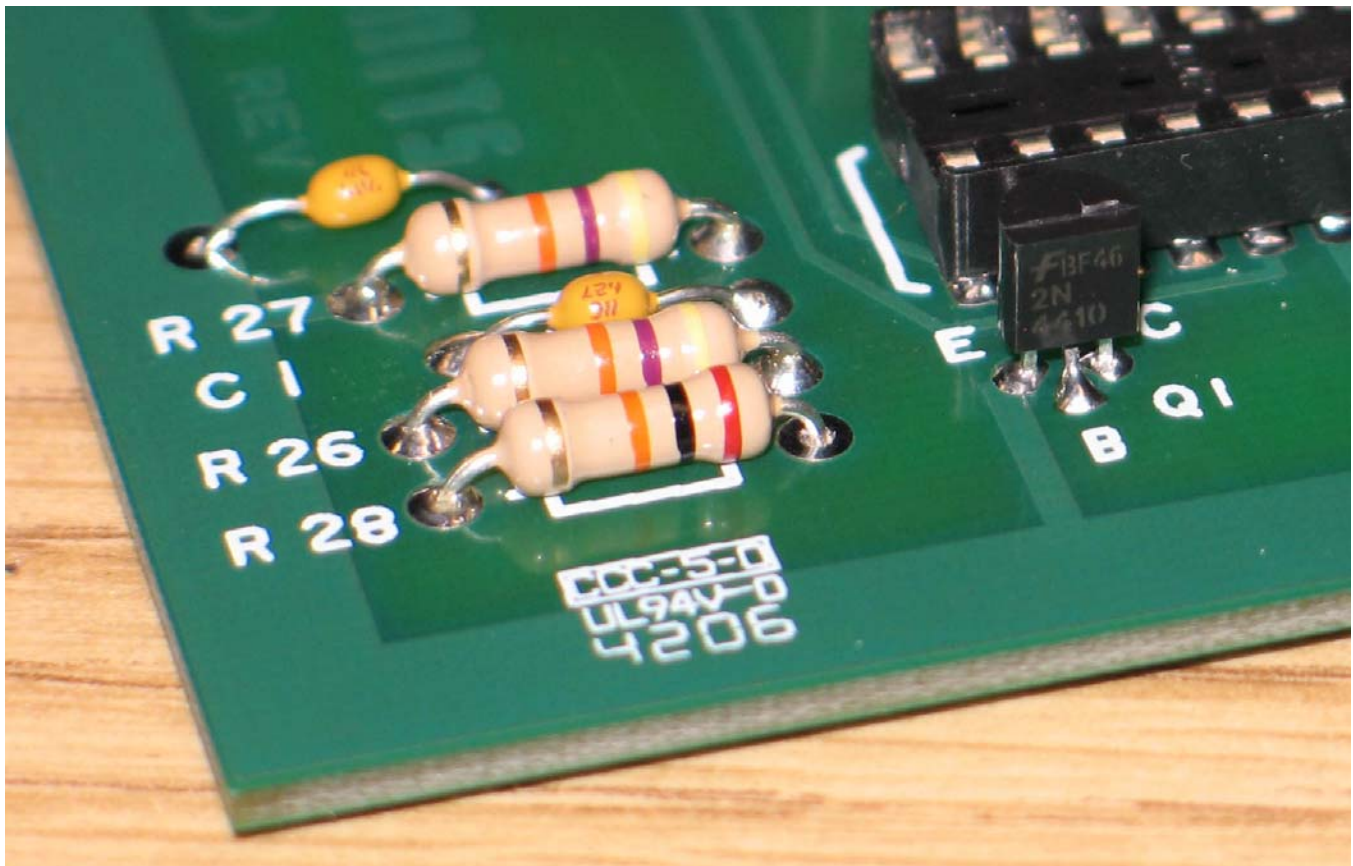
Now install the crystal. MITS's instructions on page 34 calls for either taping the crystal or using a cardboard shell. This is because the original MITS PCBs had no solder mask. Because they didn't have a solder mask the large +5v trace under the crystal could get shorted to the heat sink ground plane through the crystal. You do not need to insulate the crystal with tape.



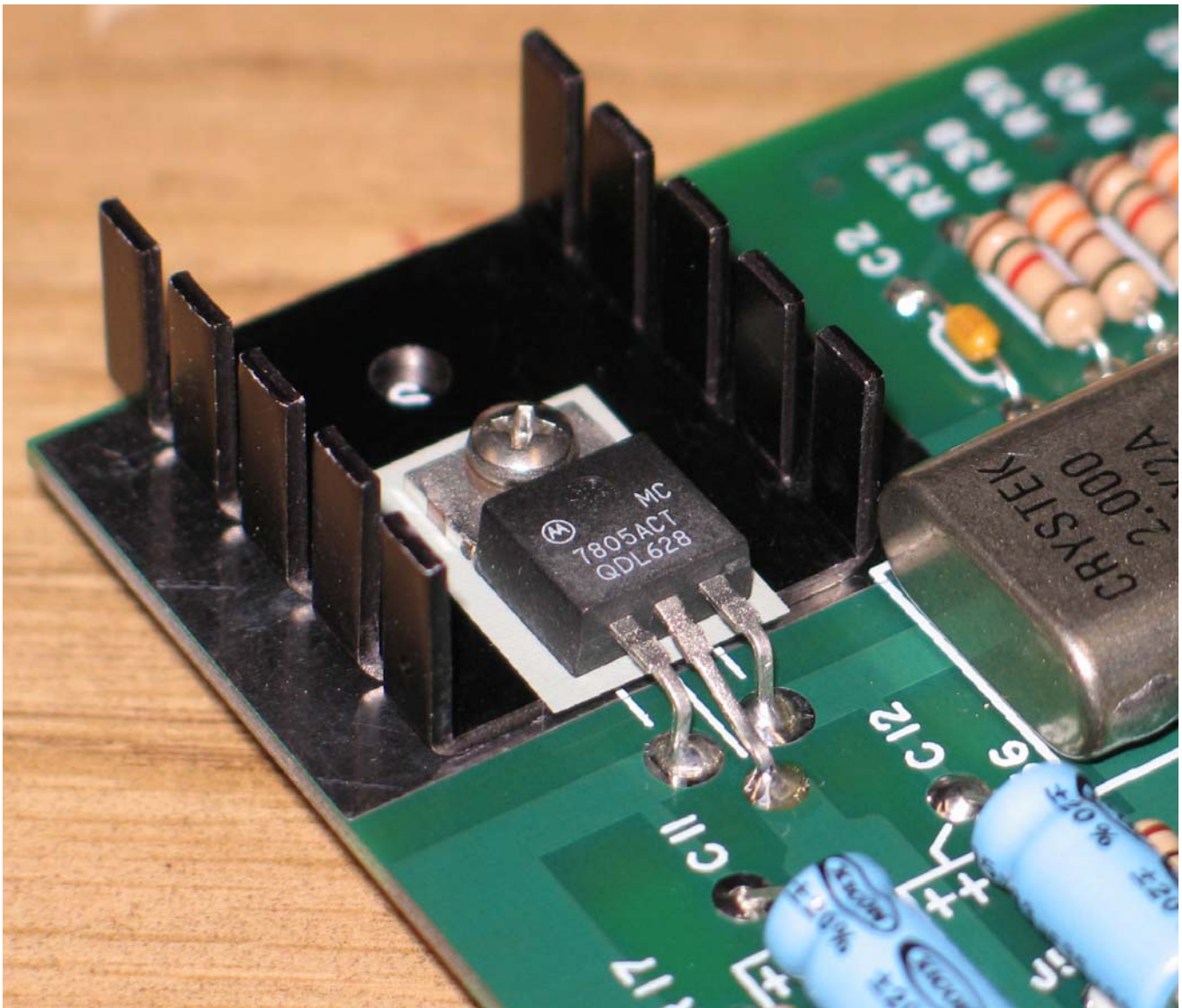
Next install the zener diodes. These along with the two 2-watt resistors in the lower left corner make up two voltage regulators for the CPU. MITS's instructions for installing the zener diodes are on page 34-35.

D1 is a 12v 1N4742

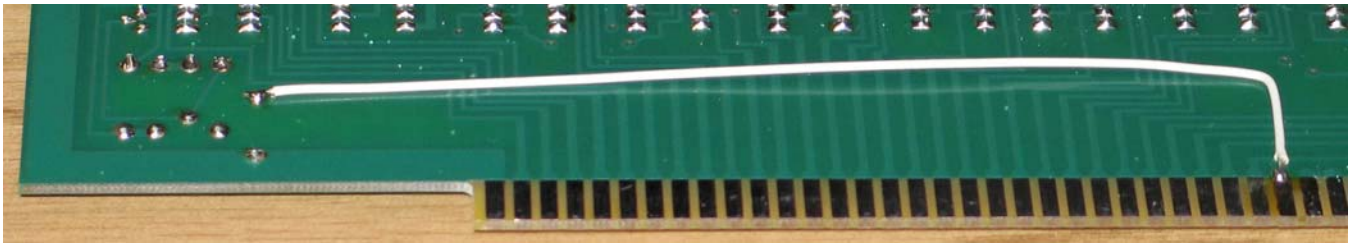
D2 is a 5v 1N4733



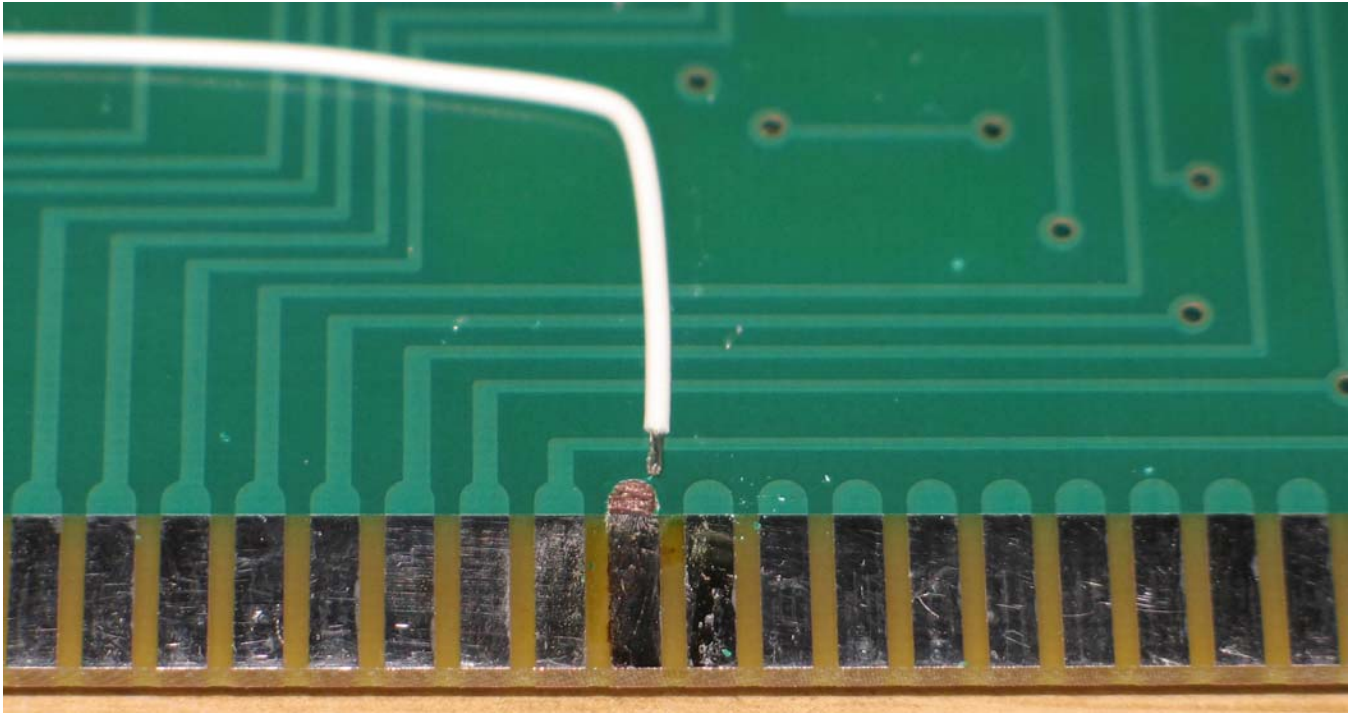
Now install the transistor. This transistor is responsible for generating a "Power On Clear" to reset I/O devices when power is applied. MITS's instructions for installing the transistor are on page 36.



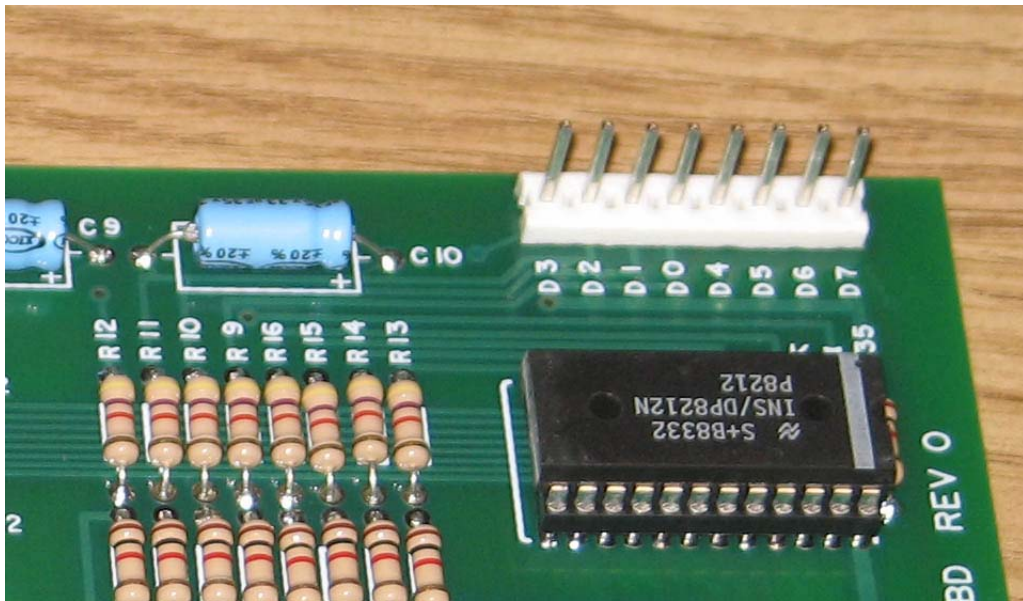
Now install the voltage regulator. MITS's instructions are on page 37. I include a heat sink mounting kit that includes an isolation pad. The isolation pad is not needed, however it conducts heat and can be used in place of heat sink grease.



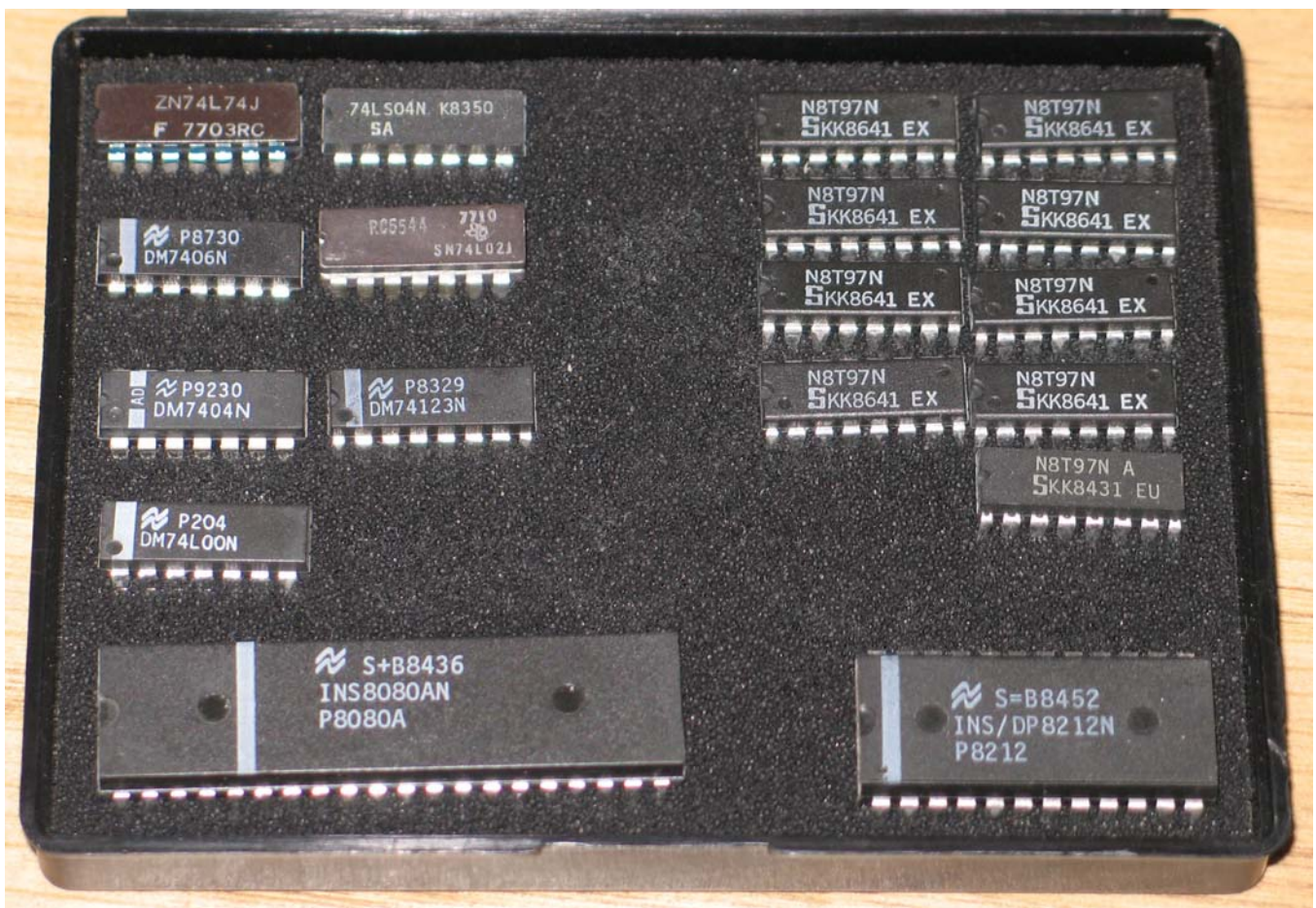
One of the modifications required is adding a .001uf capacitor to the CPU board. The capacitor is located next to R27. Look on page MITS's page 38A for more details.



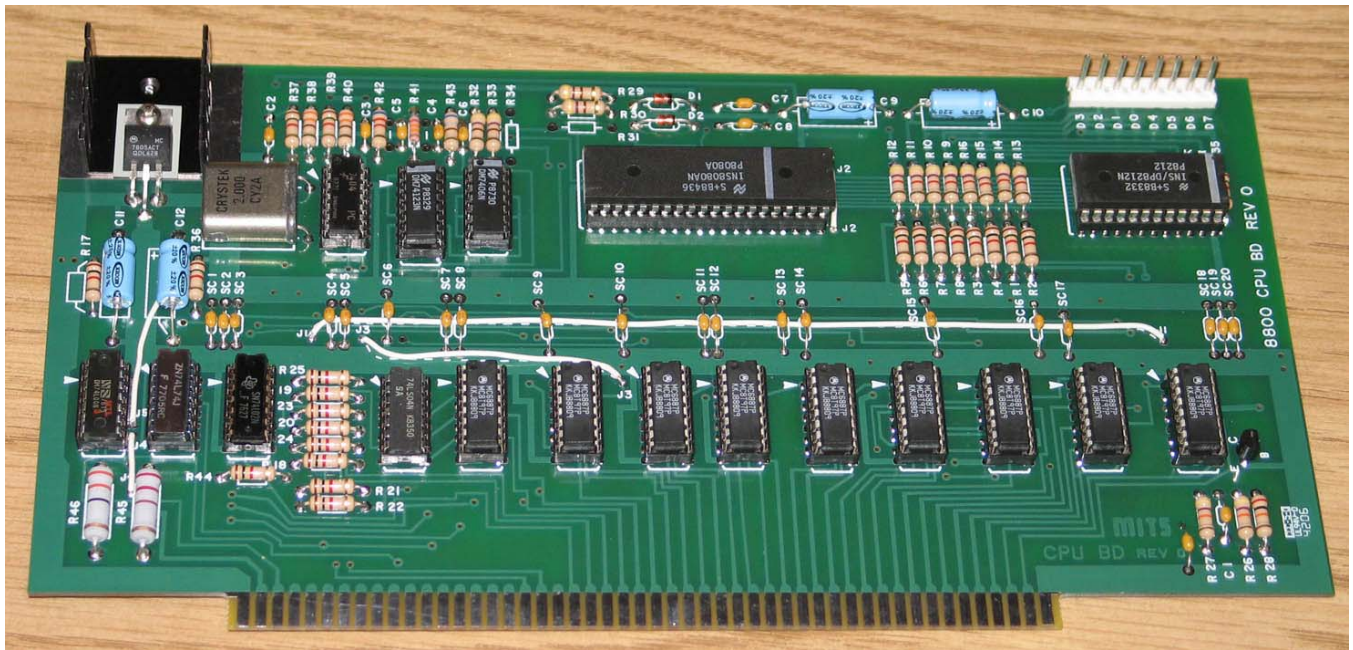
Lightly scratch the solder mask off of the pad to enable soldering. Do not use excessive solder on this connection. The solder should be limited to the top half circle shape at the top. If the card edge blade has excessive solder it could damage the connector on the motherboard.



The last item to solder on the CPU board is the 8-pin wafer connector. MITS's instructions for this are on page 39.



Next install all of the ICs. MITS's instructions on page 27 tells you exactly where each IC goes.



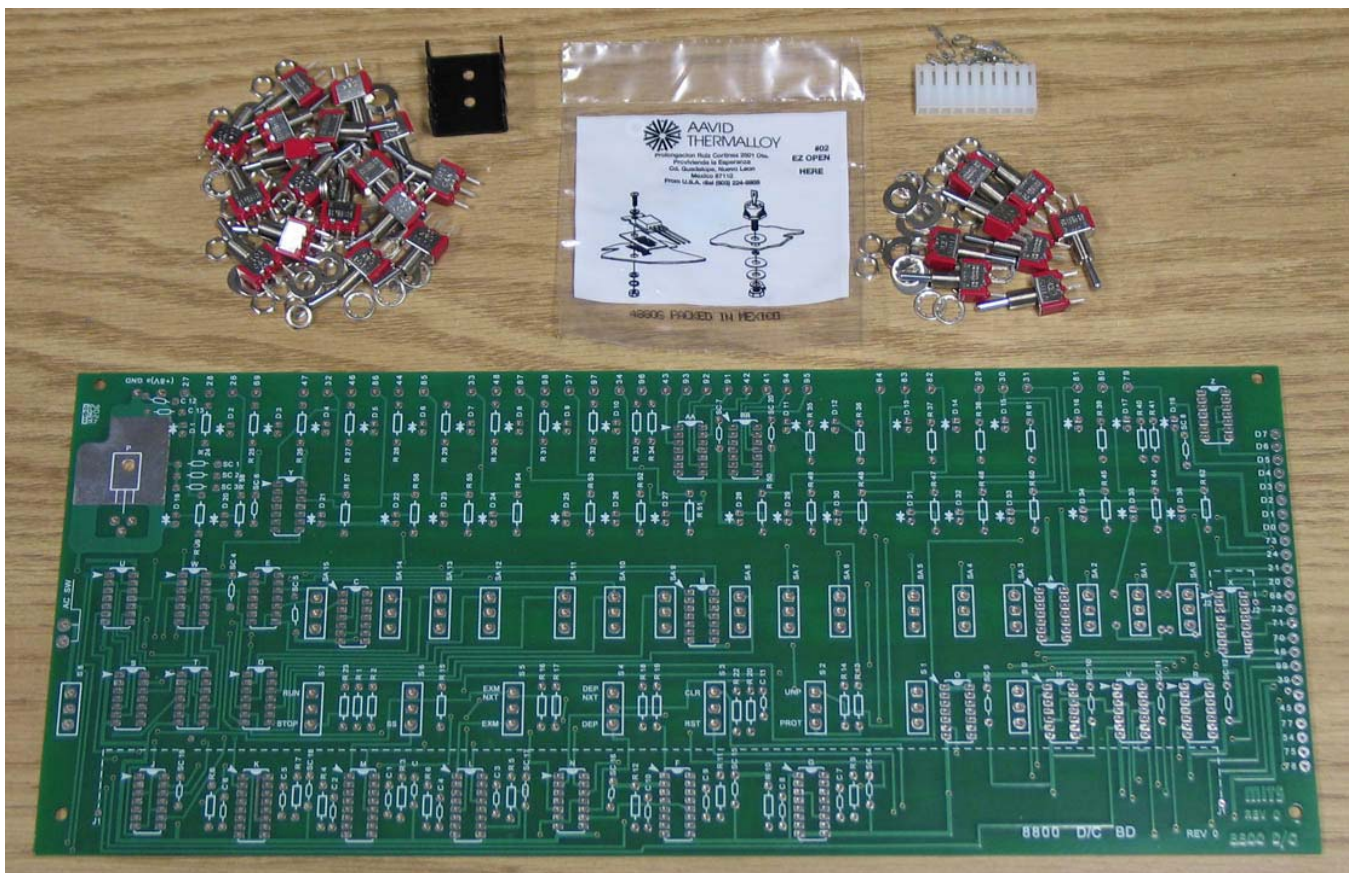
Now you are done with the CPU board! Time for the Display/Control card!

88-DC - 8800 Display/Control Board Kit Assembly Guide

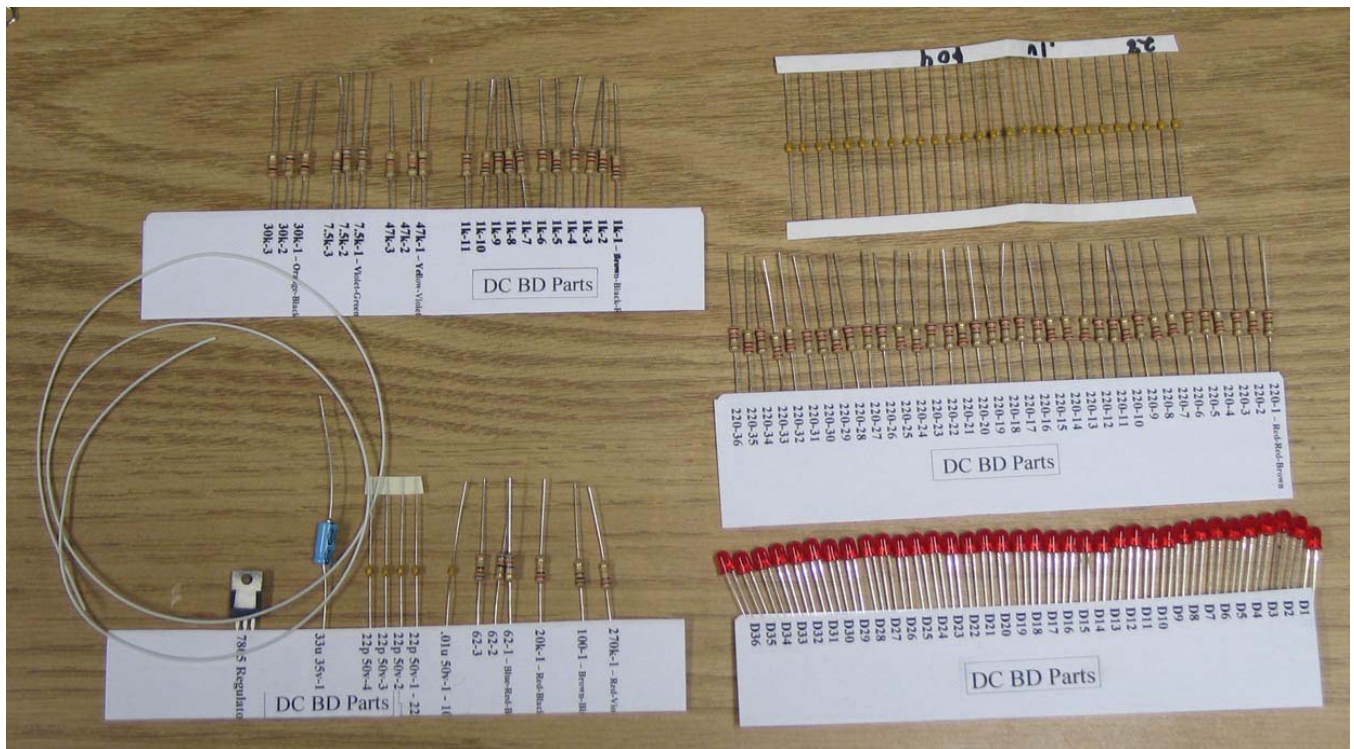
This is the hardest kit to assemble in the Altair 8800 Computer kit.

The MITS assembly instructions for this board start on page 6 of the “ALTAIR 8800 ASSEMBLY MANUAL”. I recommend that you read through BOTH the instructions in that manual and this. My instructions may have a different order for the steps. One reason is that I include sockets for all ICs and MITS did not. It is your choice which one you will follow.

The first step is to verify that you have all of the parts required to complete this kit. You will need a stripper for 26ga wire, a non-blunt tipped soldering iron, and some solder. I recommend .031 or smaller rosin core. **DO NOT USE ACID CORE SOLDER!**



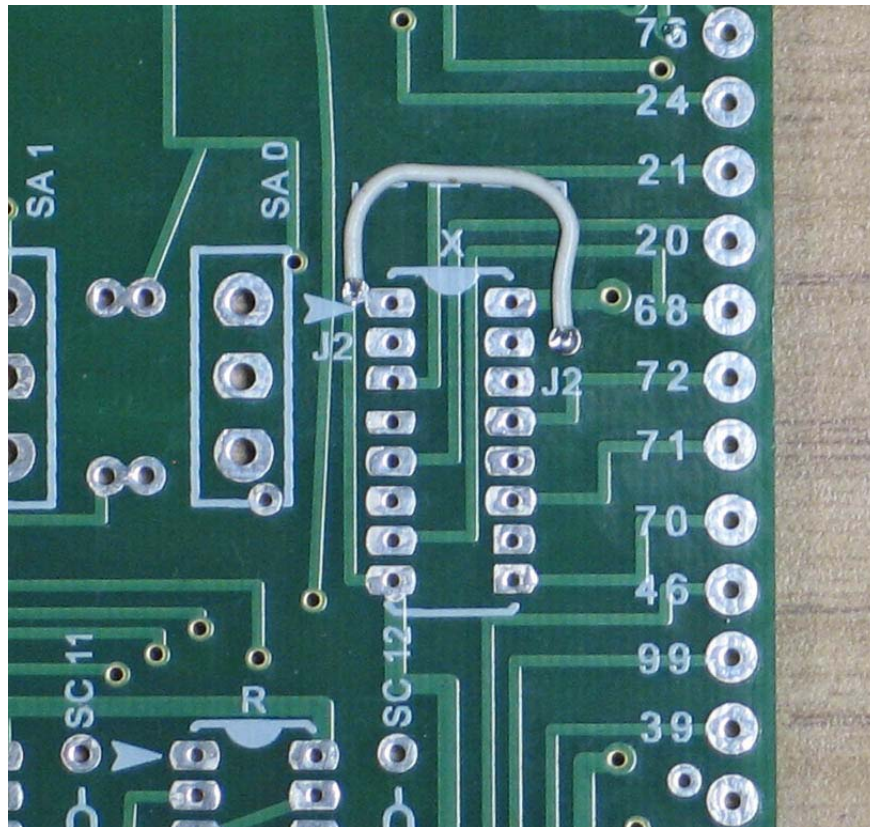
Contents of the 88-DC Kit (First of three pictures)



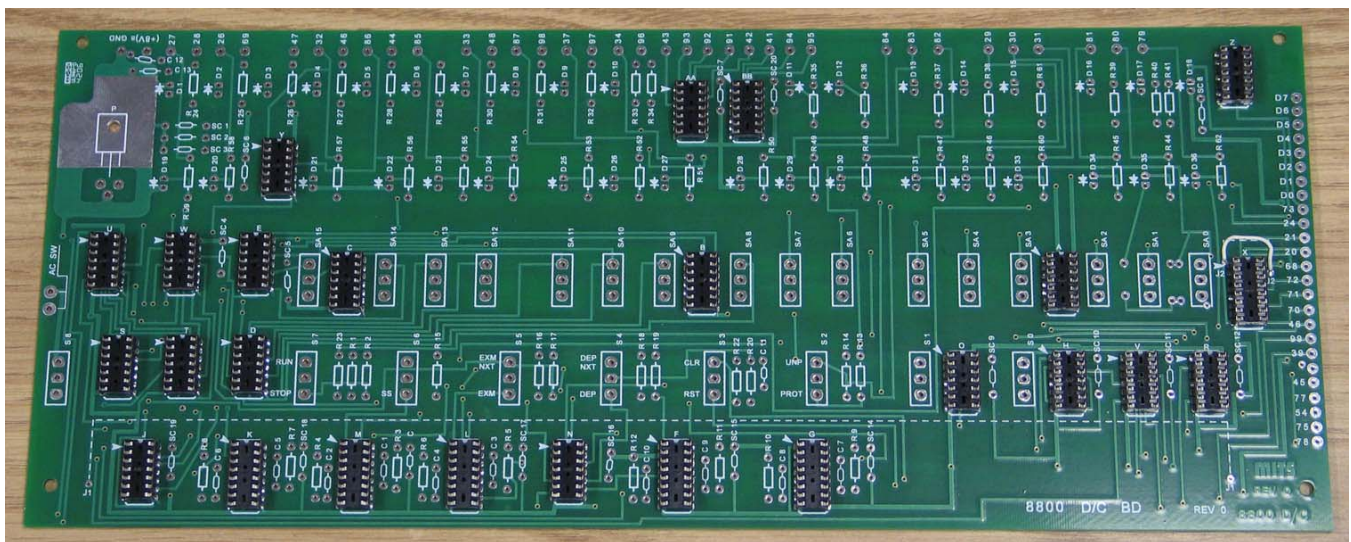
Contents of the 88-DC Kit (Second of three pictures)



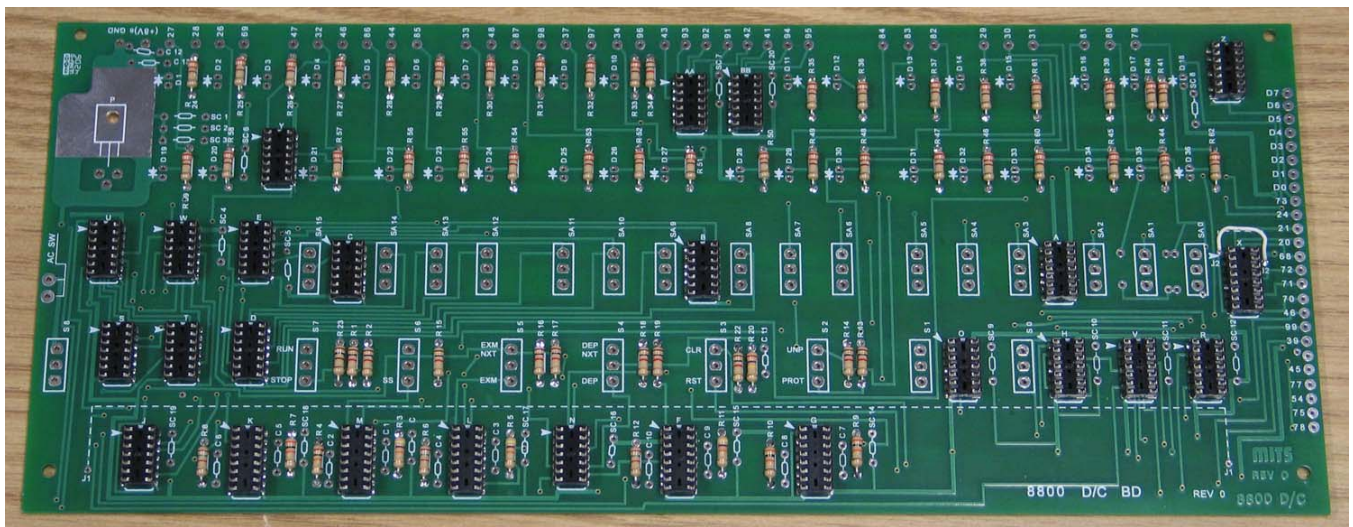
Contents of the 88-DC Kit (Third of three pictures)



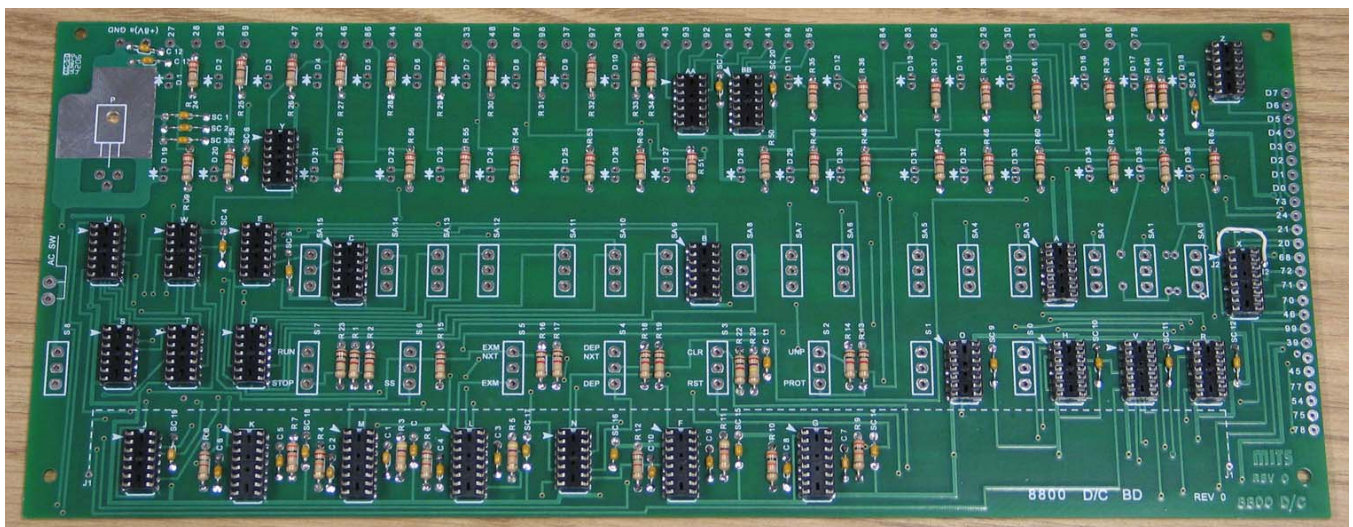
First I recommend you install J2. After the IC sockets are installed it will be a little harder.



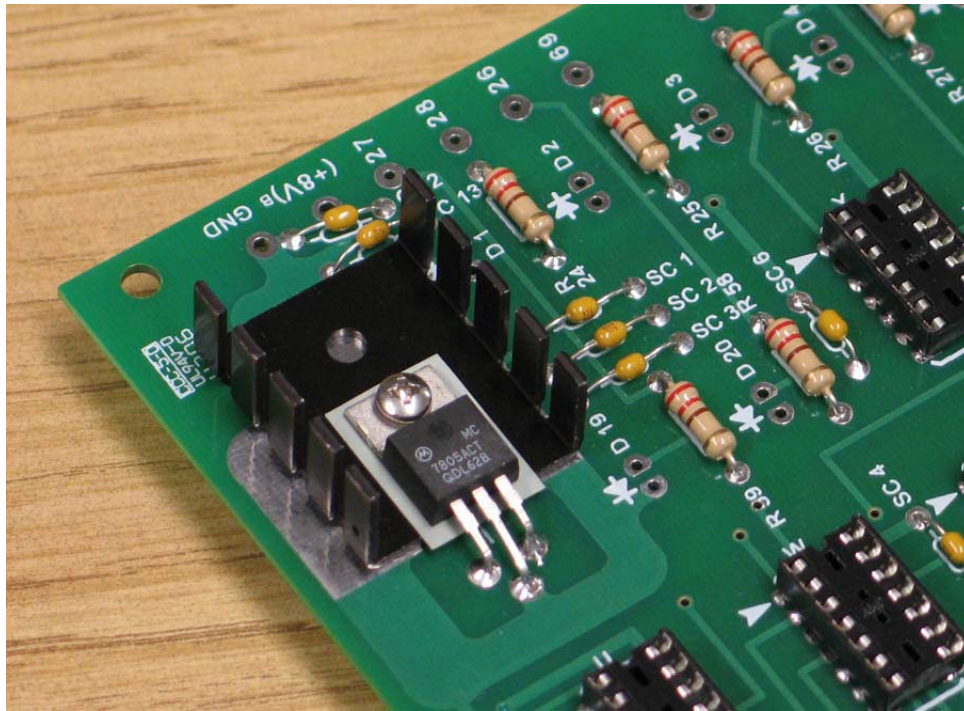
Now install all of the IC sockets. MITS did not include instructions for socket installation because they did not include sockets.



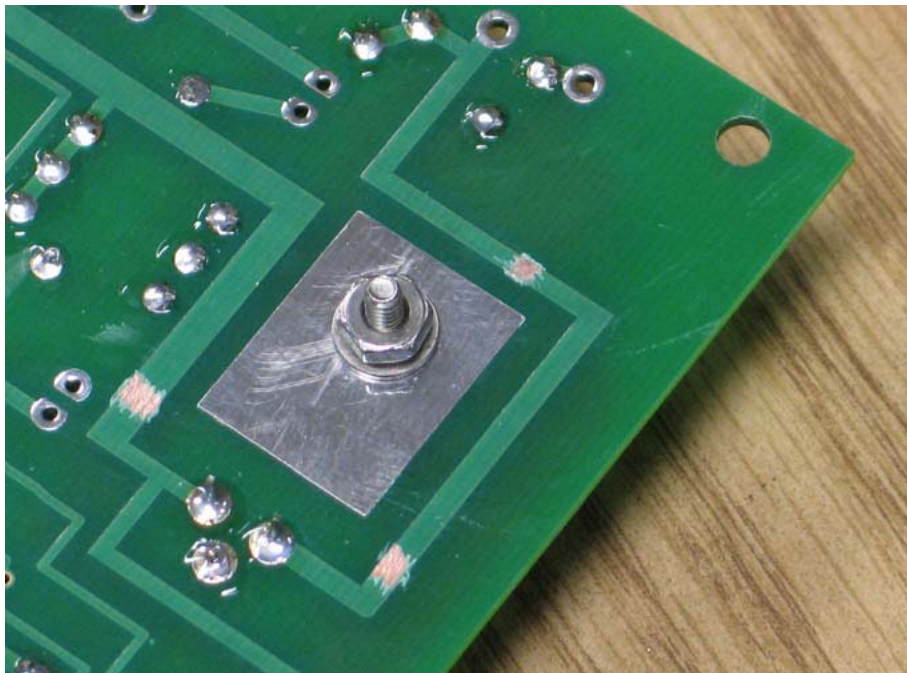
Install all of the resistors. MITS's instructions for installing the resistors is on pages 8 and 9.



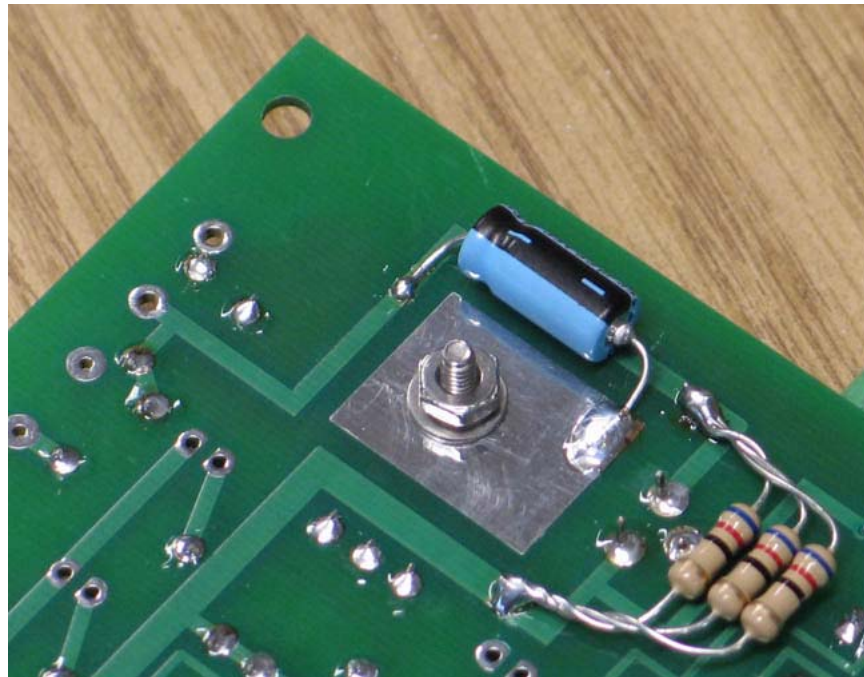
Install all of the capacitors. MITS's instructions for installing the capacitors is on pages 10 and 11.



Install the voltage regulator. MITS's instructions for installing the voltage regulator is on page 12.



The Display/Control board has some component additions. MITS has details about these component additions on page 13A. You will have to lightly scratch away the solder mask in those 3 areas in order to install the parts.



The extra components have been added to the Display/Control board.

At this point it makes sense to start working with the case. The construction of the Display/Control board will continue in the next section.

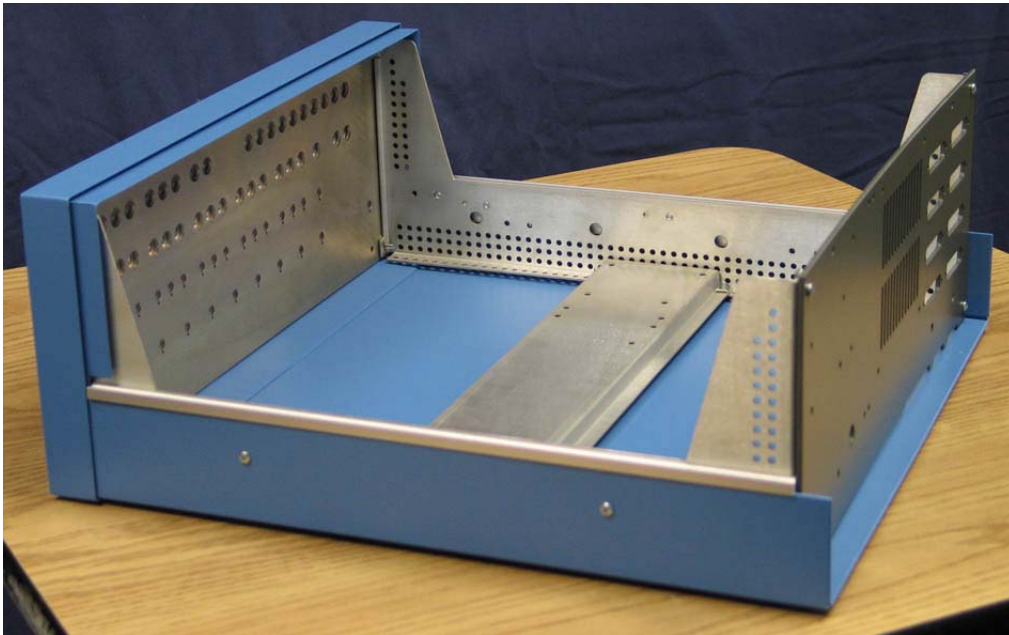
Optima Enclosure Kit Assembly Guide

The MITS assembly instructions for this section start on page 16 of the “ALTAIR 8800 ASSEMBLY MANUAL”.

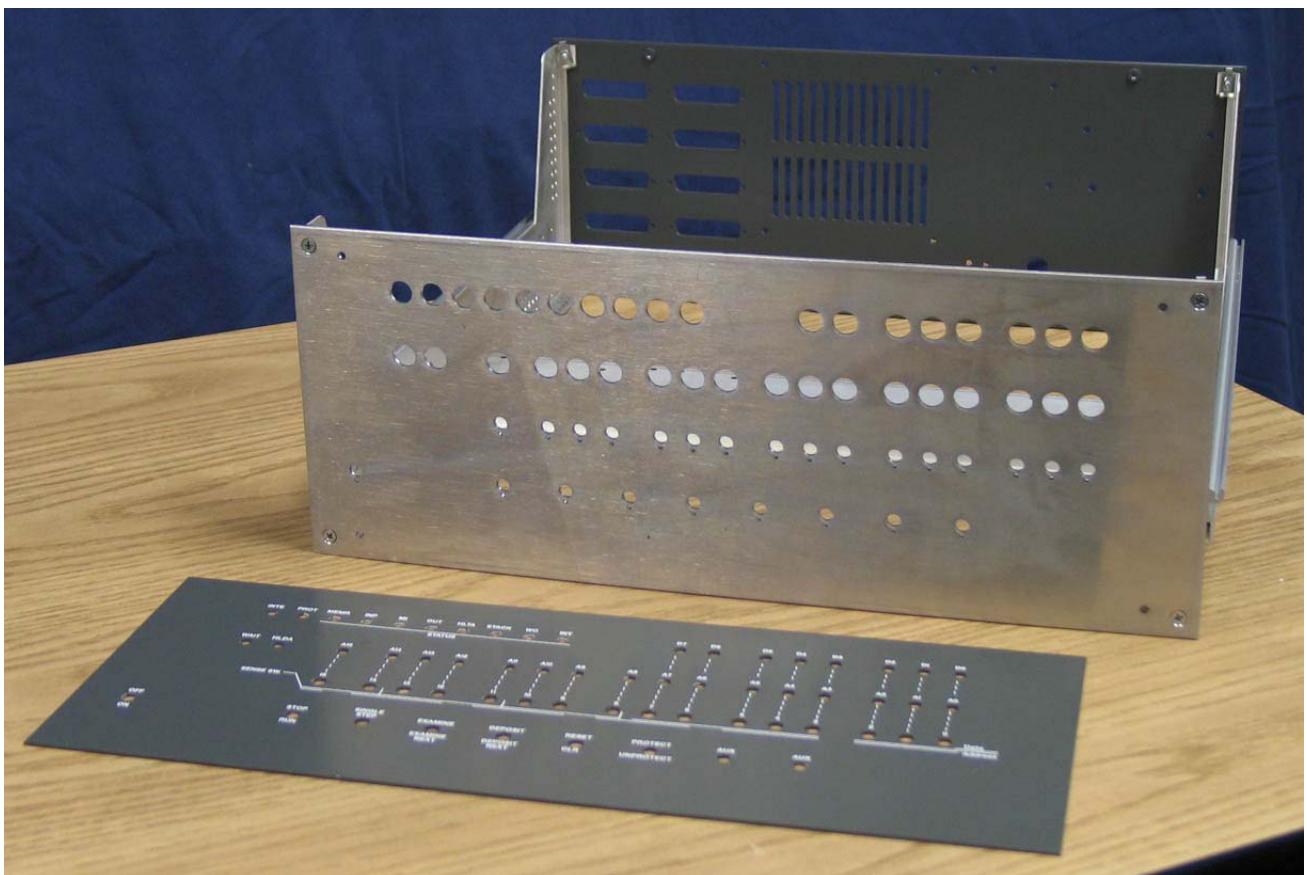
The first step is to verify that you have all of the parts required to complete this kit. You will need a non-blunt tipped soldering iron, and some solder. I recommend .031 or smaller rosin core. DO NOT USE ACID CORE SOLDER!



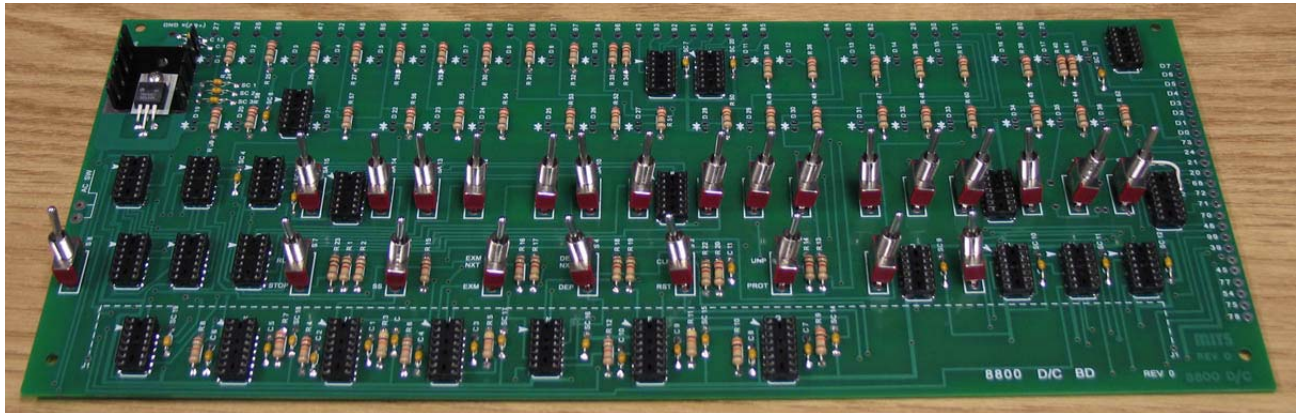
To remove the top cover, take out the two top screws.



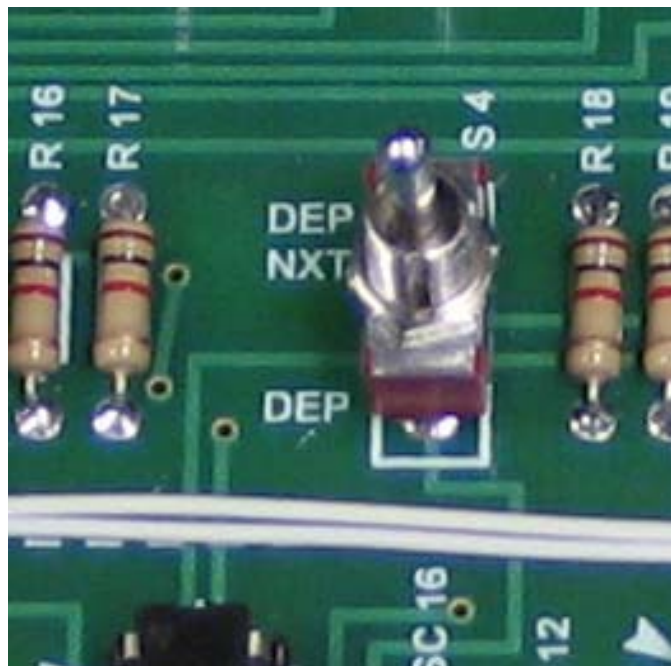
To remove the dress panel and front panel, remove the 4 screws in the sides. Look on page 17 of MITS's instructions for a diagram.



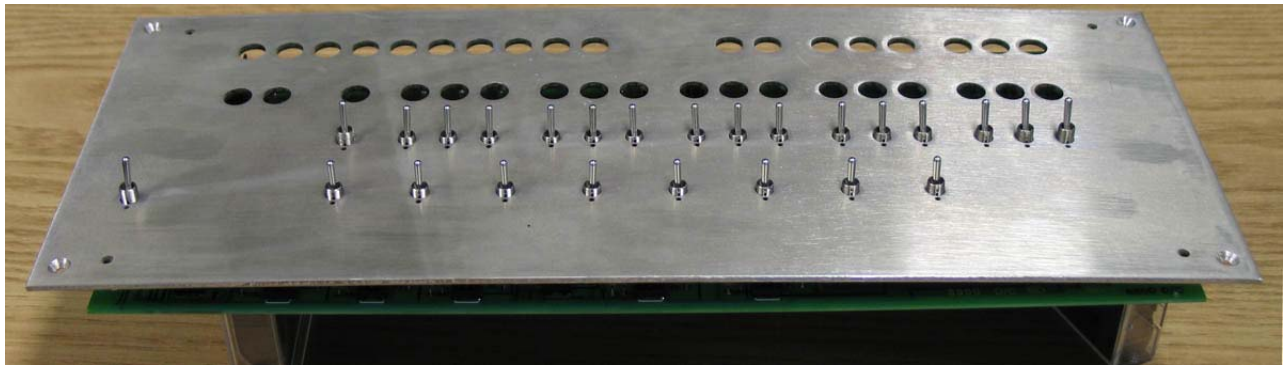
Remove the 4 screws holding the front panel to the frame.



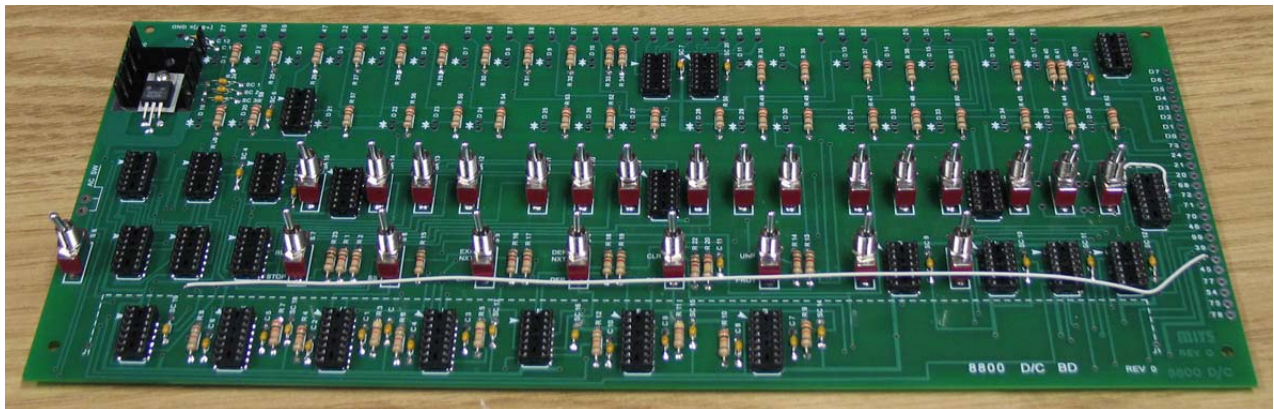
Insert all of the switches into the PCB. MIT's instructions are on page 18.



I've found that installing a nut on the top of each switch will help space the front panel away from the PCB to clear the heat sink. The switches used in 1975 had a slightly taller shoulder.



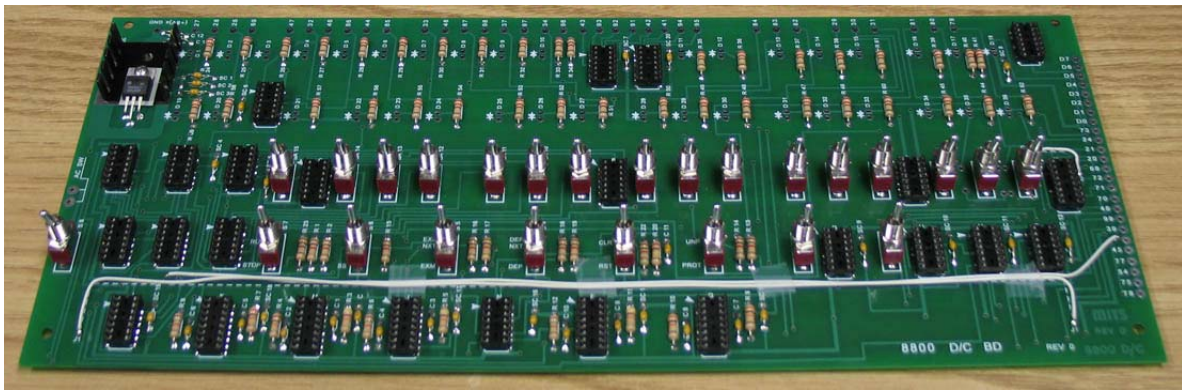
Place the front panel over the switches to hold them in place while soldering. It is also a good idea to place the dress panel over the switches too. You can use rubber bands to hold the 3 pieces together as shown on MITS's page 22. Once everything is aligned, solder the switches. I would recommend only soldering the middle pin and verifying that all switches are flush with the panel and that the PCB is flush with the bottom of the switch before soldering everything.



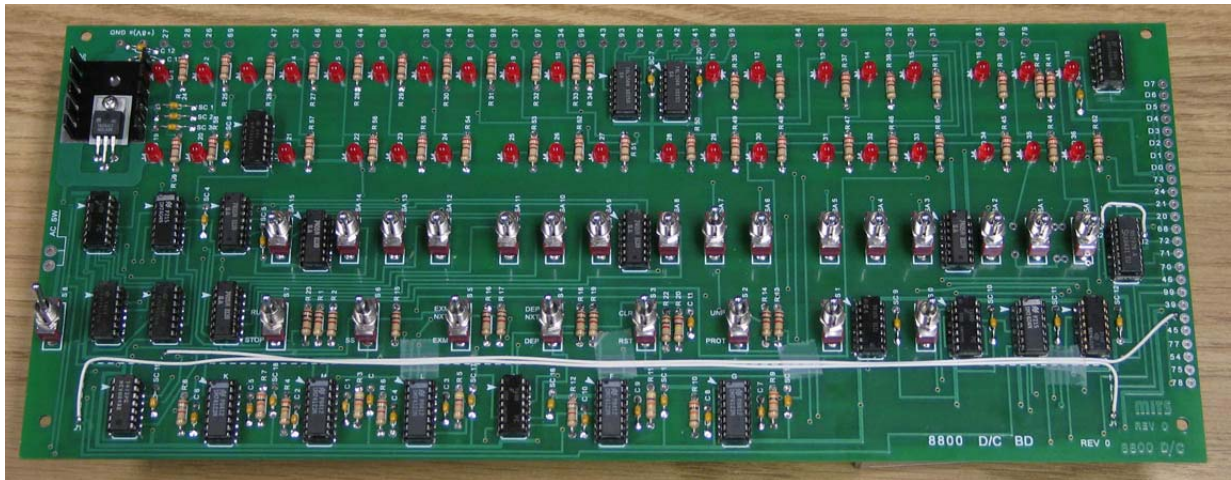
Remove the Display/Control board and install the jumper wires. I wait until now to install the jumpers because the can get in the way.

Installed is J2 and an unmarked jumper. The unmarked jumper allows the Altair 8800 to read the switches A8-15 (sense switches).

MITS's instructions are on page 14A.



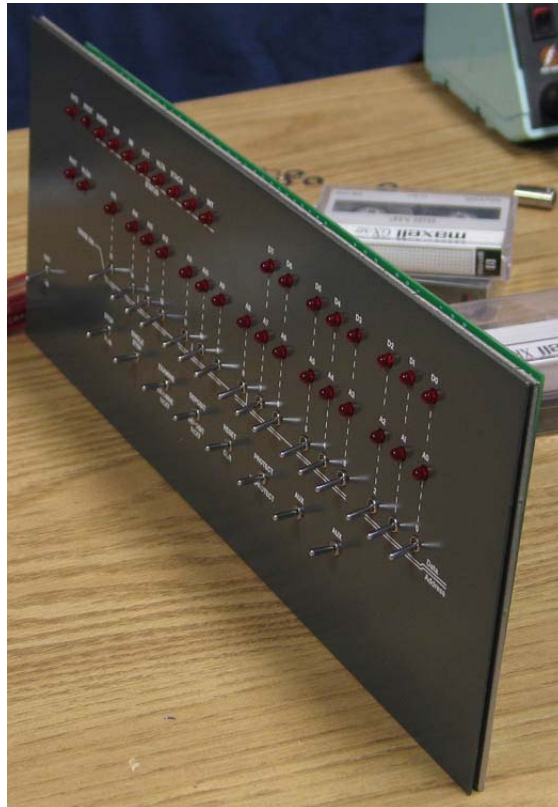
Here are all 3 jumpers installed and taped down. MITS instructions are on page 15.



Next, Install all of the ICs (MIT's instructions are on page 7) and insert all of the LEDs (pages 21-23). Pay attention to the polarity with the LEDs. There is a diagram on page 21 of MIT's instructions showing the LED.



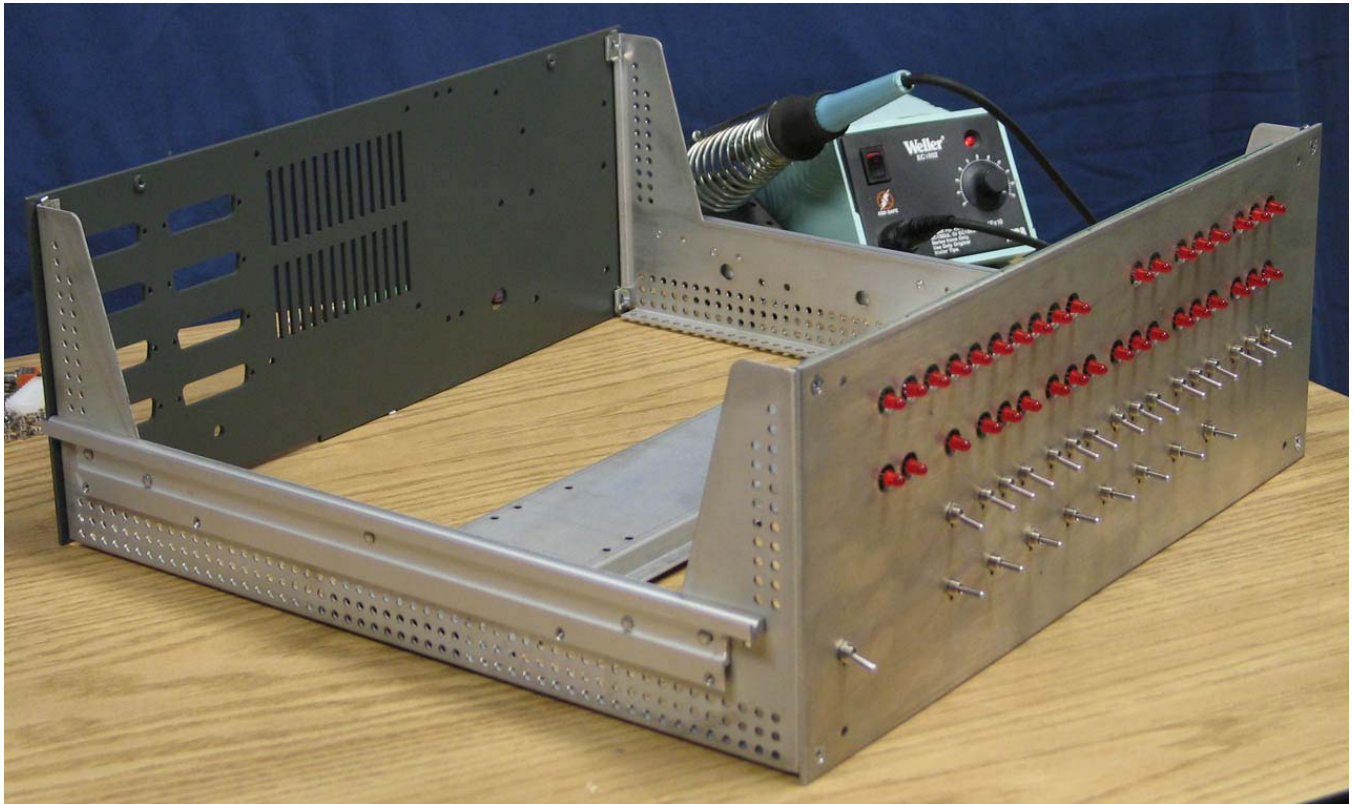
Reinstall the front panel to the the PCB except this time use nuts on top of the front panel. I don't use every single nut because it isn't necessary. I used about 5 of them.



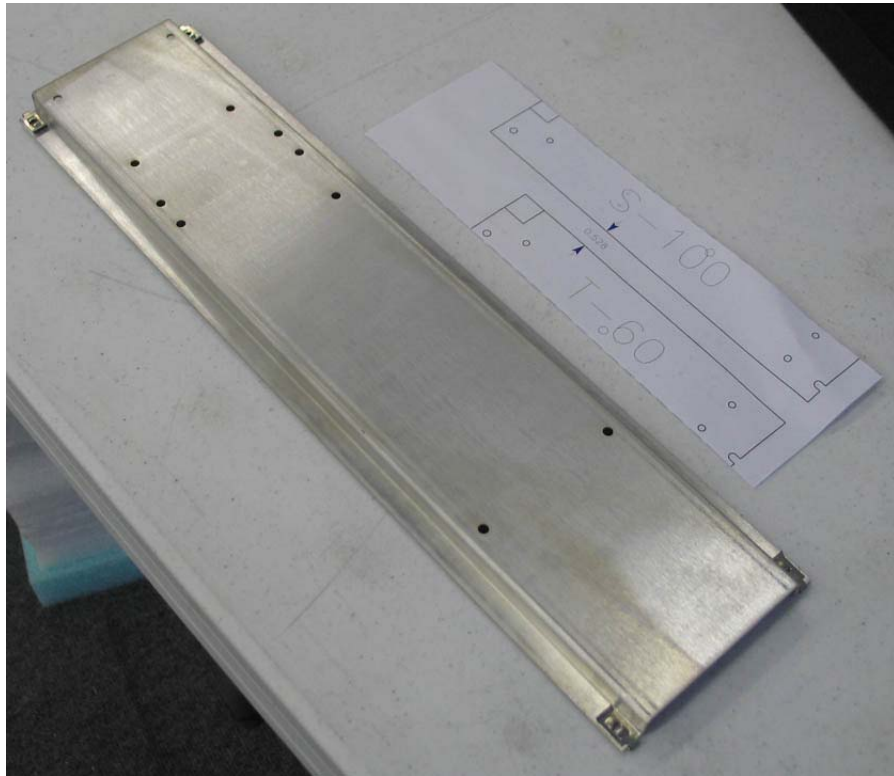
Place the dress panel over the front panel and switches. Push the LEDs from the back to the depth that you want. I like my LEDs out as far as they go. Others like the LEDs flush with the dress panel because they say it improves the contrast. It doesn't change the way the Altair operates...



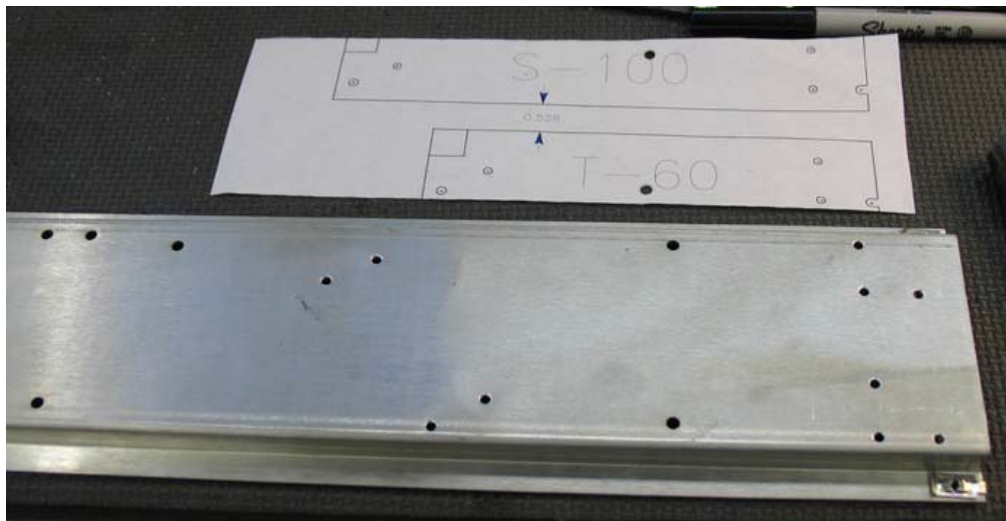
After soldering in the LEDs remove the dress panel. This is where my instructions get different from MITS's instructions. Either way works beyond this point. The method I describe below works for me.



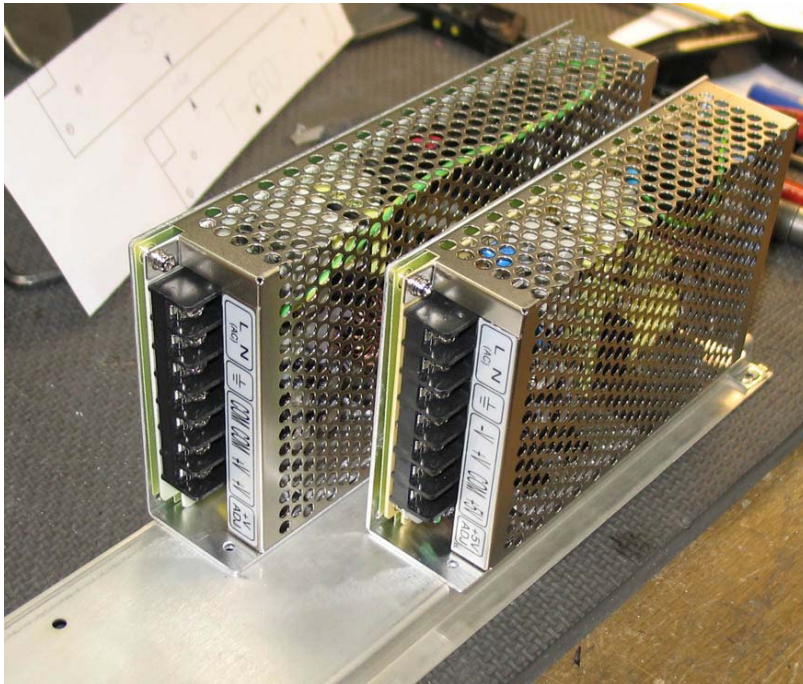
Here is the front panel with PCB attached to the case framework. Put the front panel aside in a safe place. You won't need it for a while.



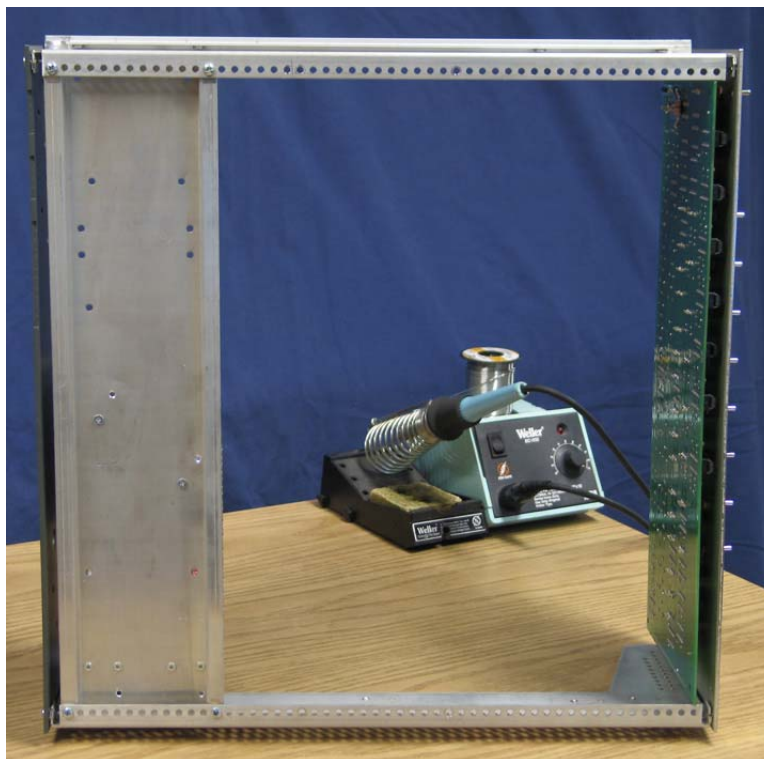
Here is the crossbar. It comes drilled like the original part from MITS. In order to mount the switching power supplies you will need to drill new holes. A drill pattern is included to make this easy. It gives hole placement and pattern alignment.



Here is the crossbar with the additional holes drilled.



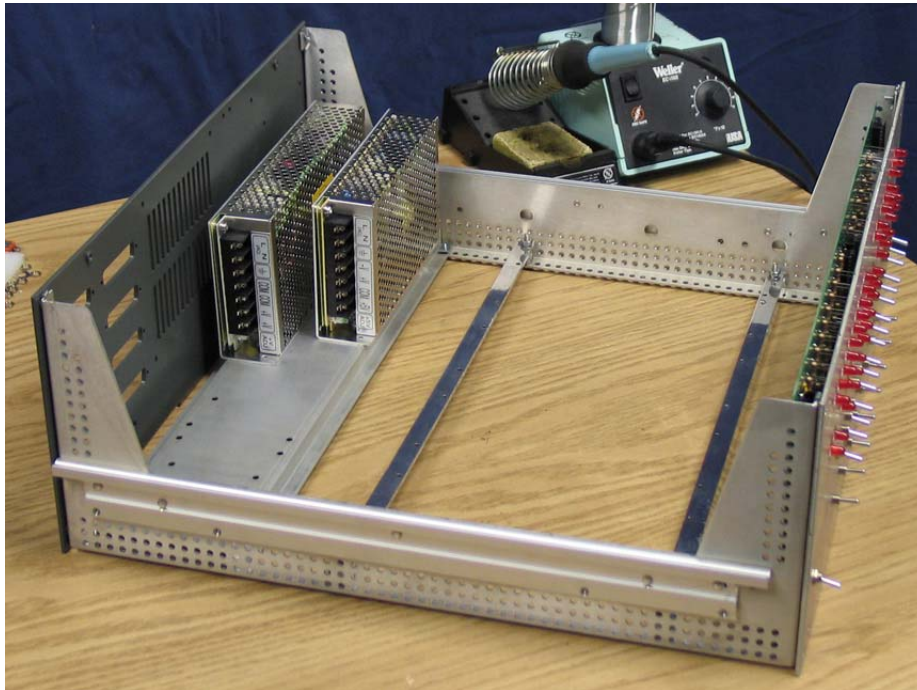
The power supplies are the only part in the project which requires a metric screw. M3 size metric countersink fasteners have been supplied.



Install the power supply crossbar as shown on page 57 of the MITS manual.



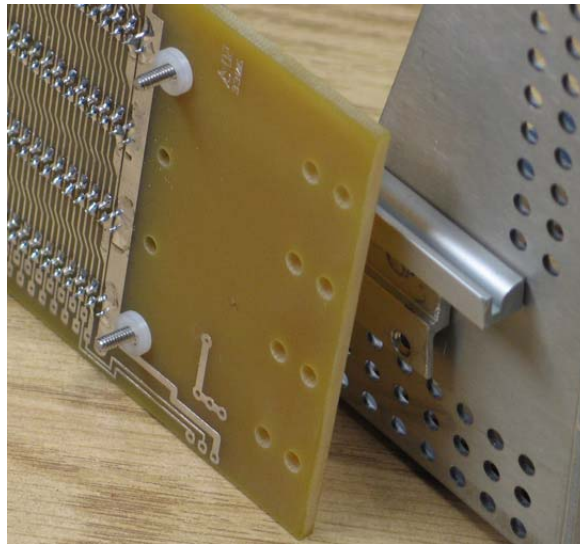
Fastener parts required for attaching the aluminum card rail motherboard supports.



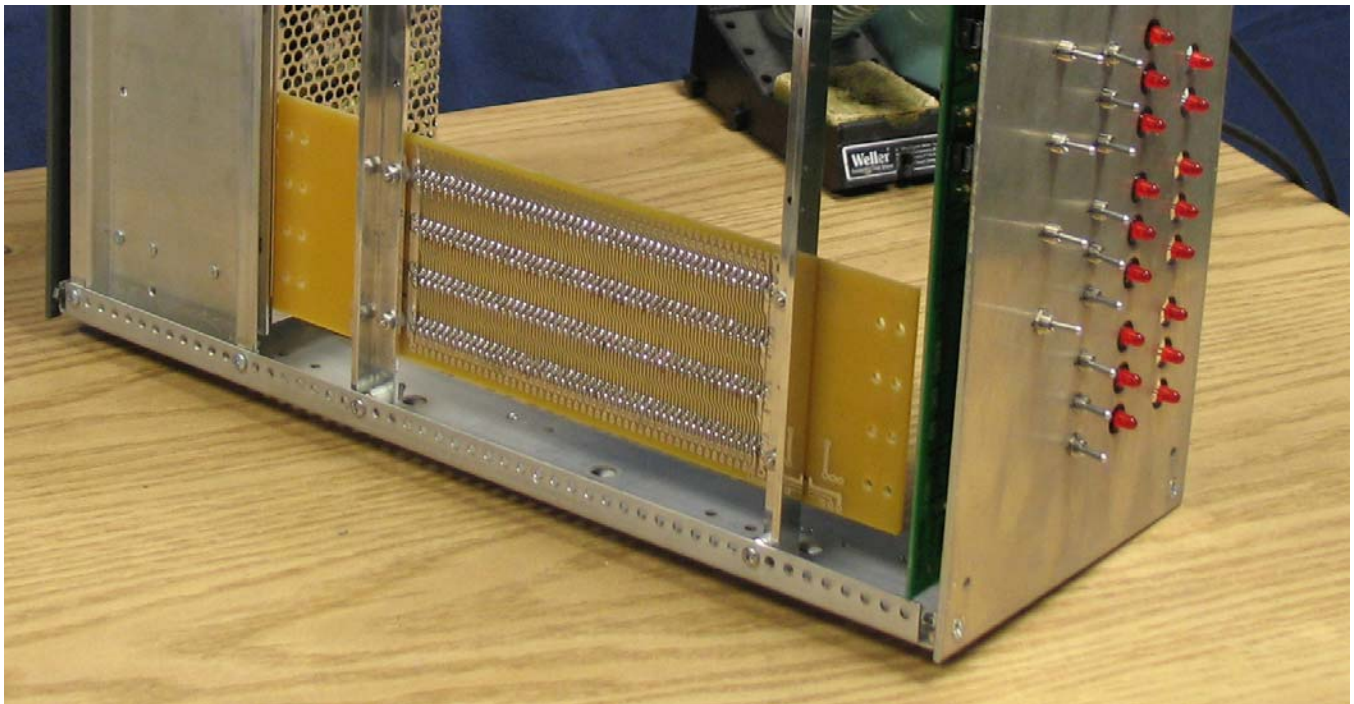
Install according to page 57 of the MITS manual.



Fastener parts required for attaching the motherboard to the aluminum card rails.



I recommend using the supplied nylon washers instead of the electrical tape that MITS suggests.



The motherboard has been installed.



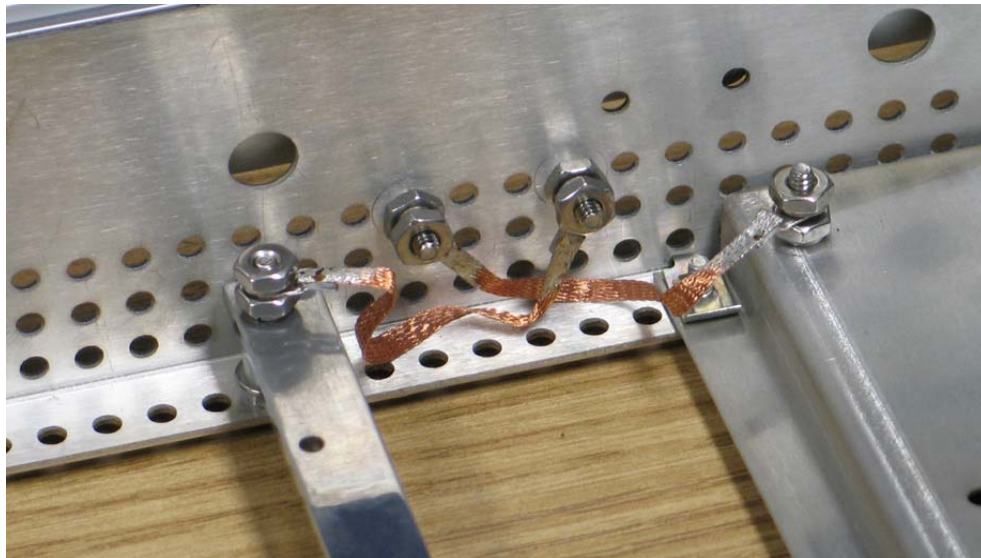
Some of the parts required for the grounding modification. The grounding modifications are listed in reproduction of the MITS manual.



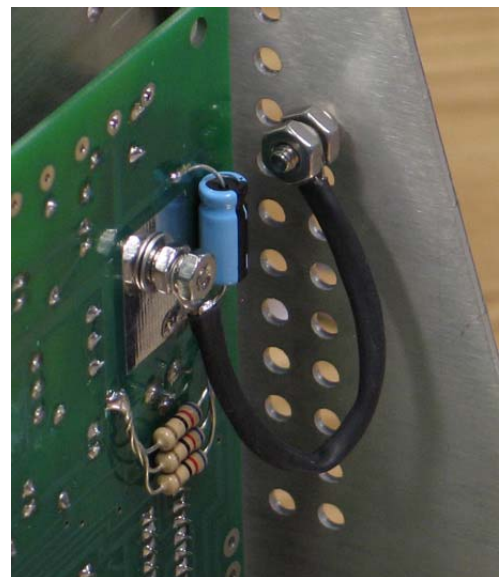
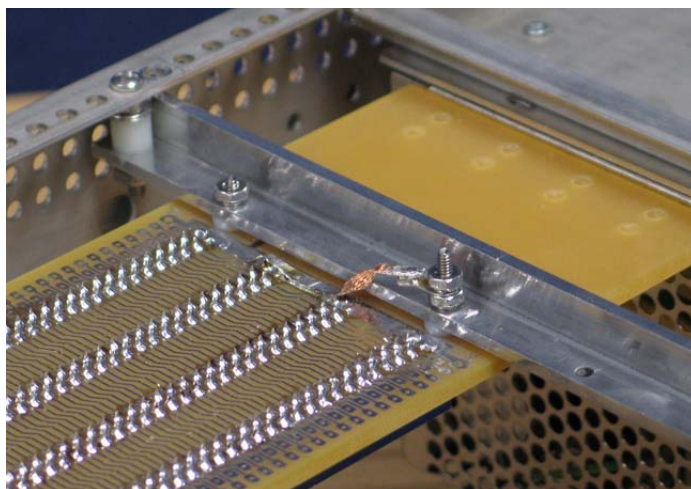
Grounding straps made, except for the motherboard support.



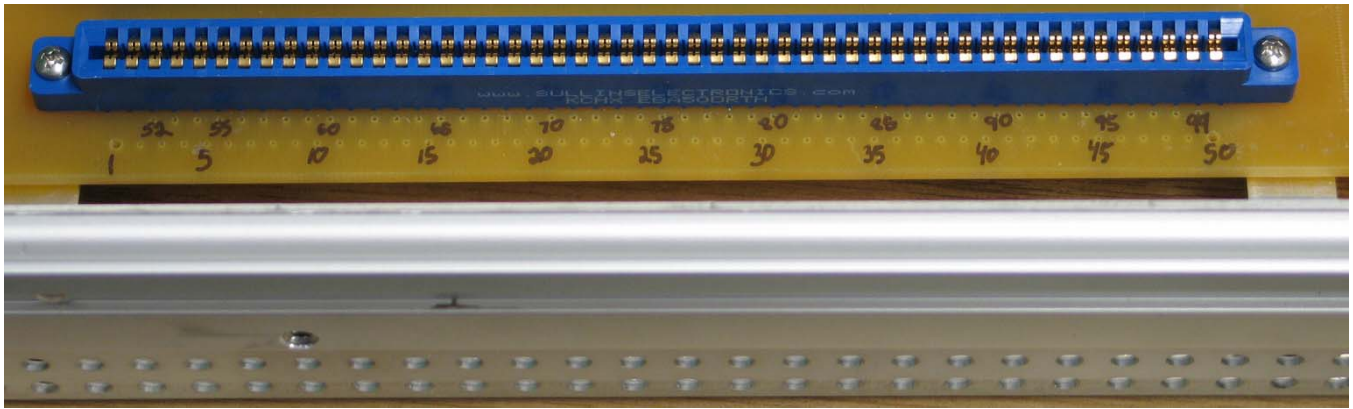
Fastener parts required to add chassis ground points to the case side rails.



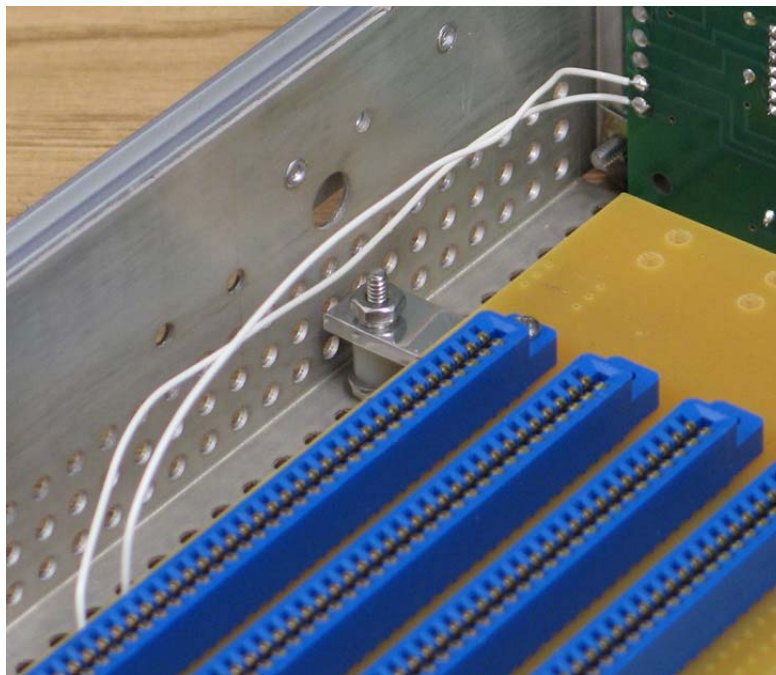
There have been 3 grounding points added to the chassis. Two of the above straps have been used.



LEFT: Grounding strap added between the ground rail of the motherboard and the card rail.
 RIGHT: The ground strap going from the regulator on the D/C board to the chassis.



The next step is to wire the motherboard to the D/C board. I find it helpful to number every 5 holes in the motherboard. MITS's instructions for wiring between the two boards is on pages 66 and 67.

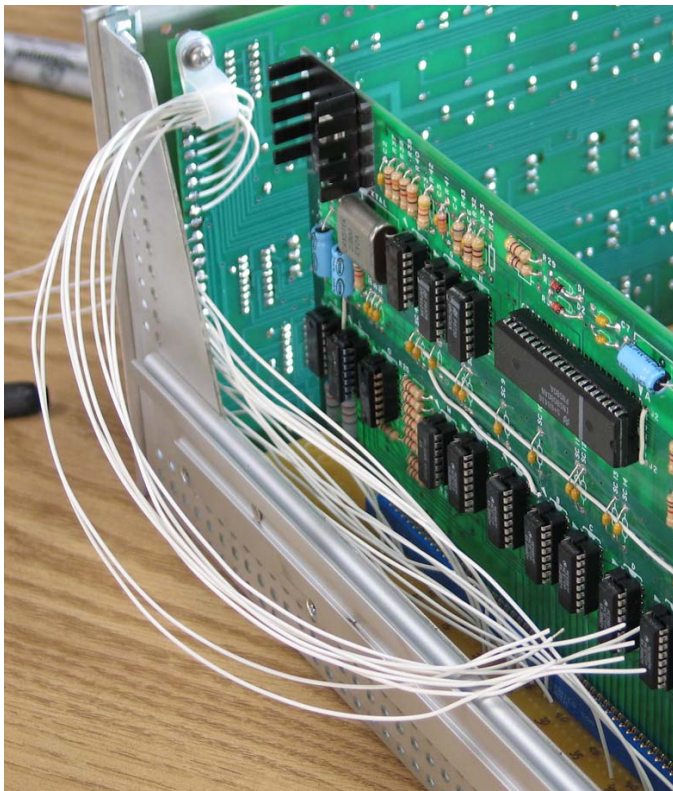
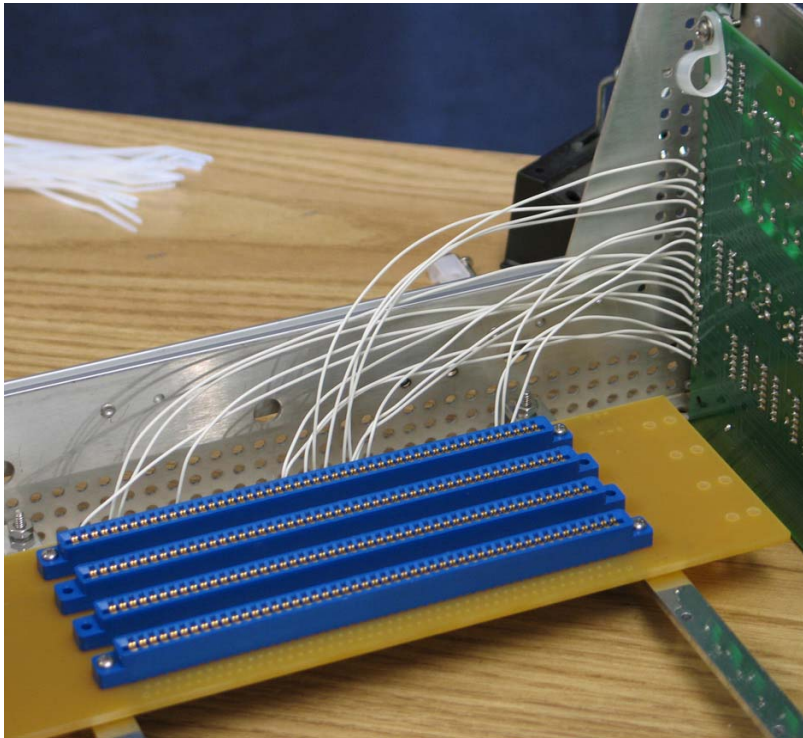


A lot of people don't know where to start when getting to this point. I wired every single connection following these steps:

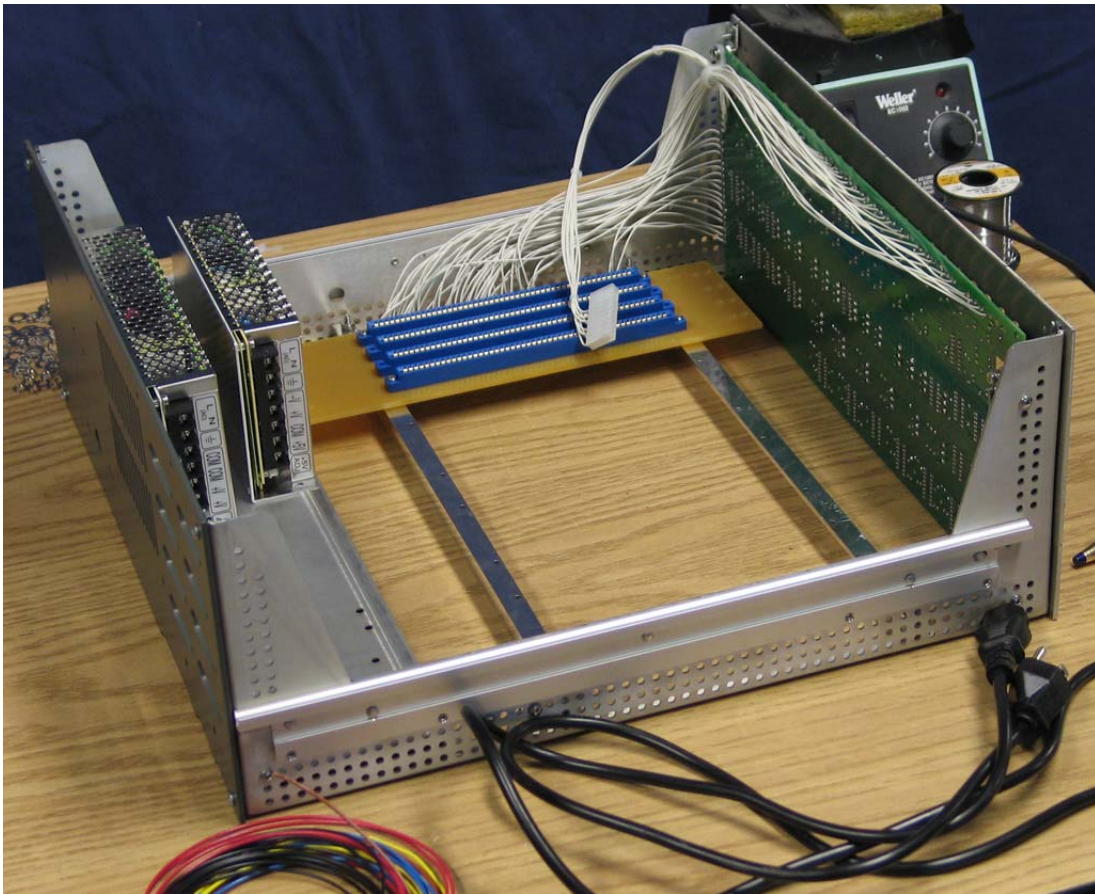
1. Strip 1/8" off the wire, tin, and solder to the D/C board.
2. Route the wire where you want to go, leaving room for bending radiuses and strain relieving.
3. Cut the wire to length, strip 3/8", insert into the motherboard, and solder

Often I would poke 3-4 wires into the motherboard before soldering. When complete you can cut off the excess lead from the bottom of the motherboard.

You can of course follow MITS's instructions or try your own method.



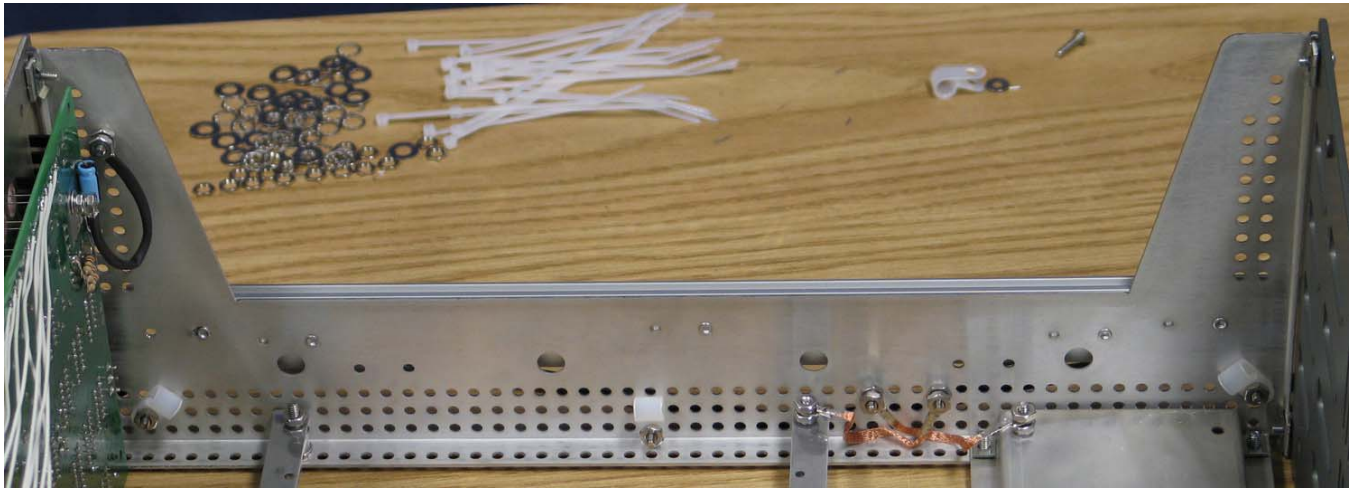
On the left we have a D/C board wired and waiting for the KK connector. On the right is the KK connector and crimp pins. Follow MITS's instructions on page 24 for wiring instructions.



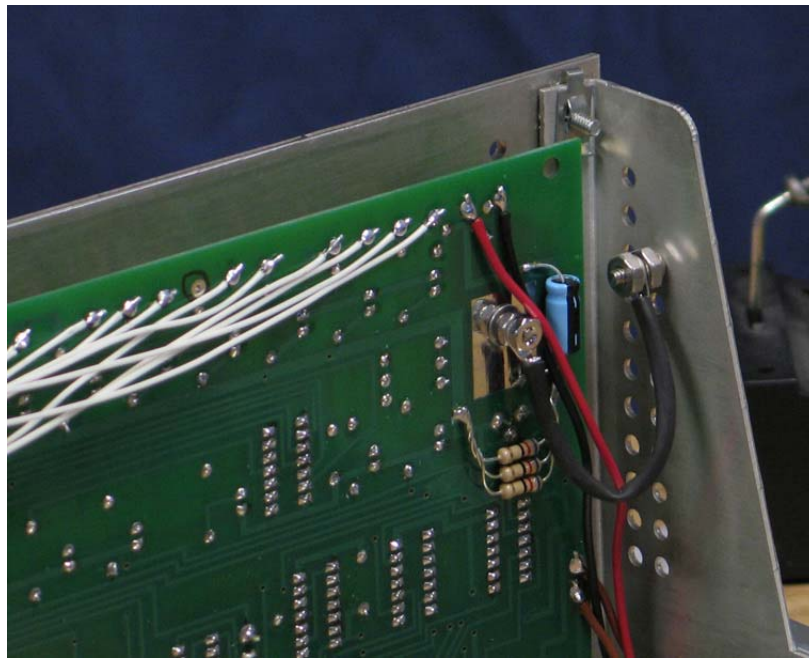
The D/C to motherboard and CPU wiring is done. The next steps are for wiring the AC and DC connections.



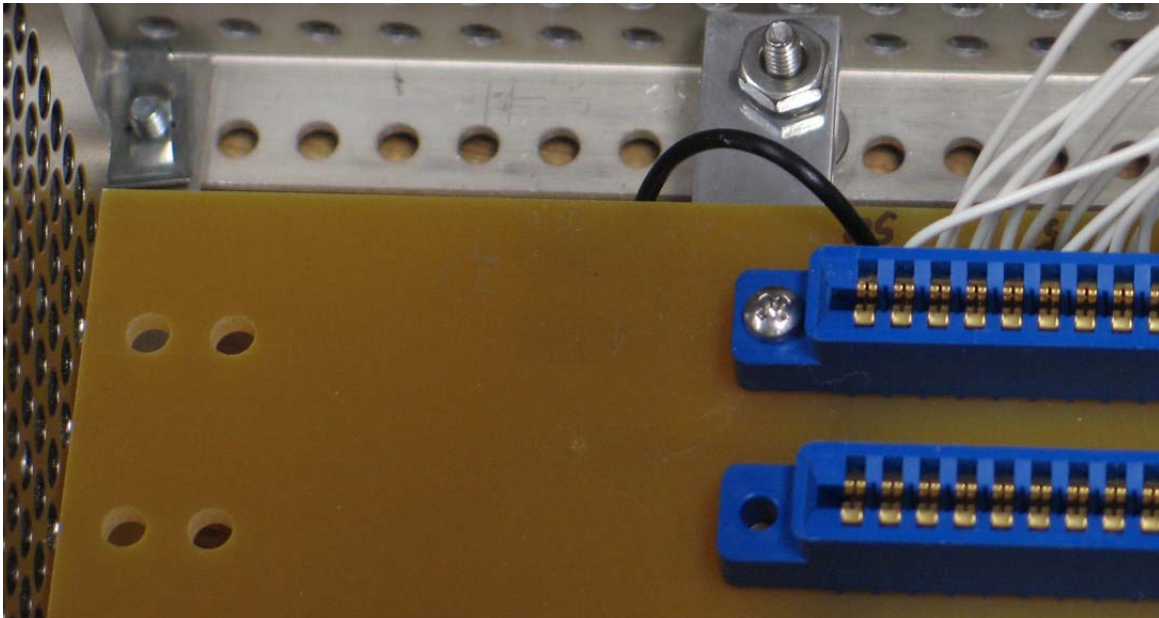
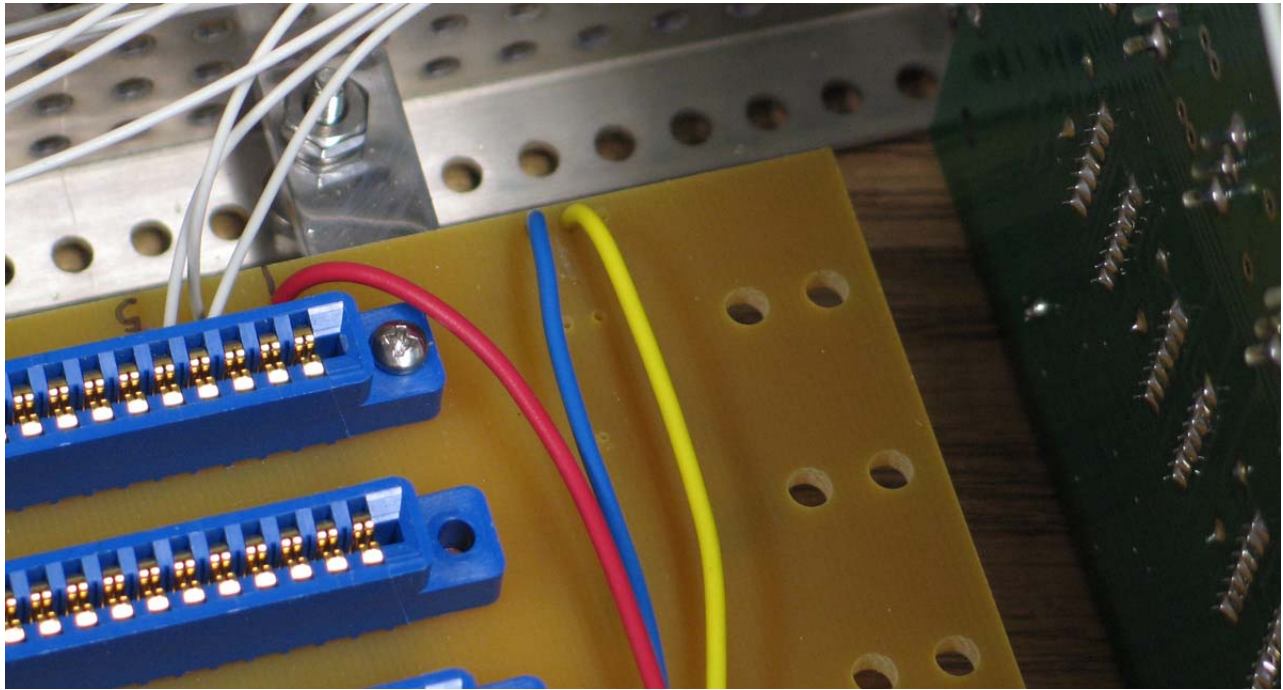
There are two AC cable strain reliefs provided. One of them has a retaining nut. I recommend you use it instead of the compression fitting.



Plastic wire clamp routing for the AC/DC connections to the D/C board.



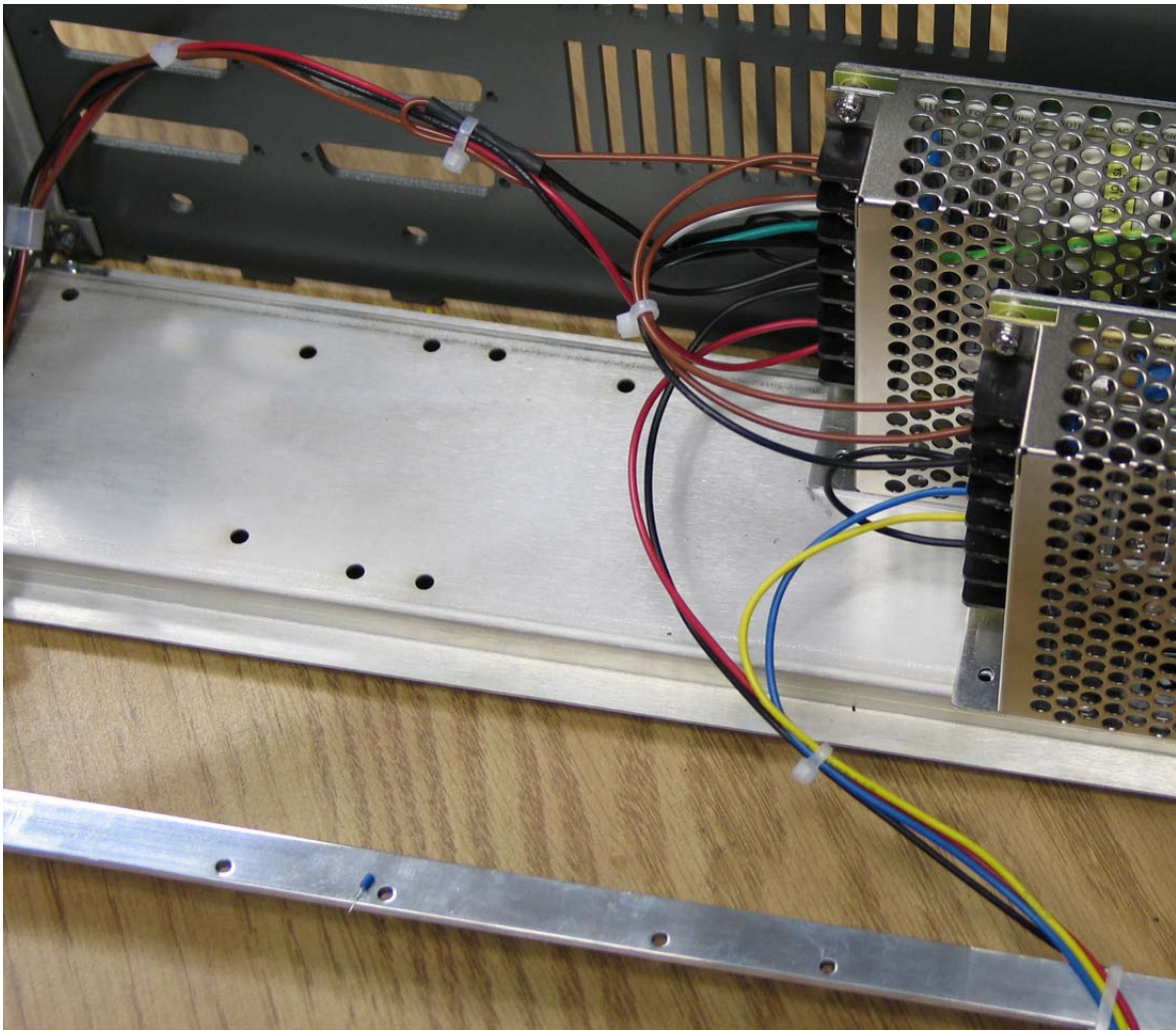
AC and DC connections to the D/C board. I wired my AC connections directly to the switch without using any electrical tape. I plan to be careful. :)



In this case, I've used the following colors for the following voltages:

RED: +8vDC
BLUE: -16vDC
YELLOW: +16vDC

BLACK: Ground



Connect:

BLUE wire to V- on the smaller power supply

YELLOW wire to V+ on the smaller power supply

BLACK wire between COM and GND on the smaller power supply.

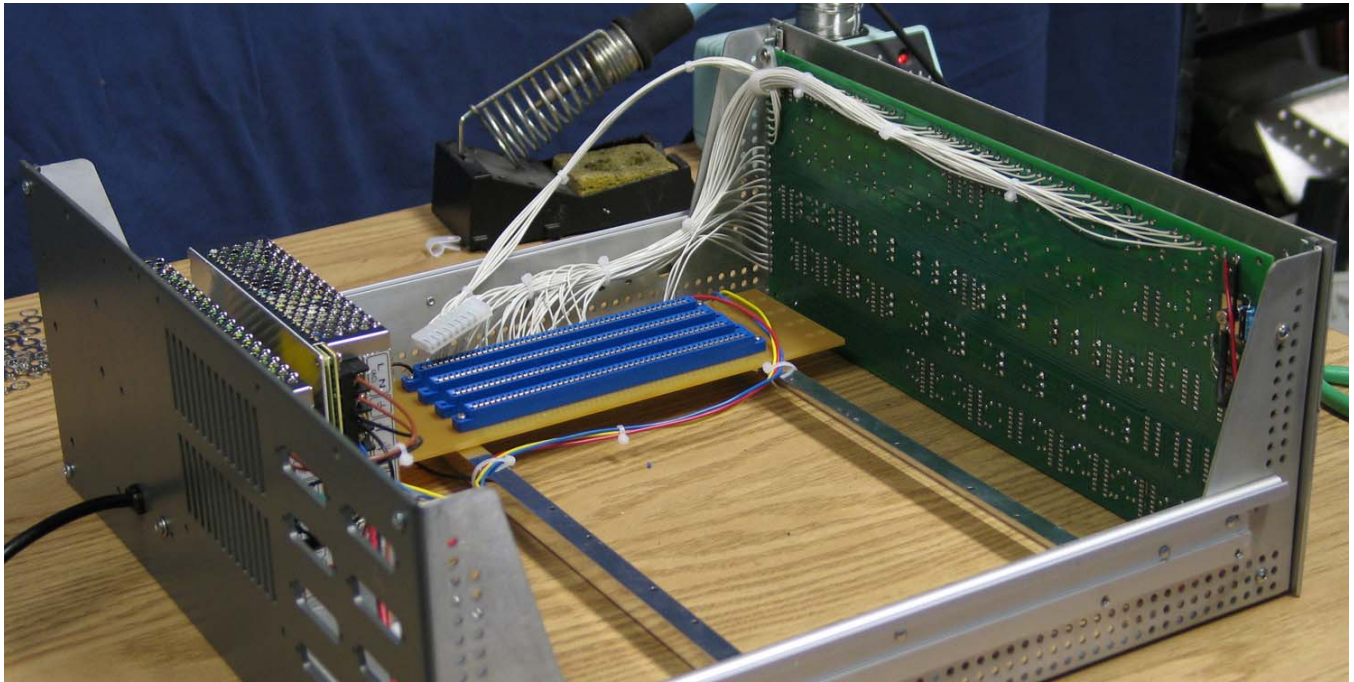
BLACK wire between GND on the smaller power supply to GND on the large power supply

RED wire from V+ on the large power supply to the +8v on the D/C board

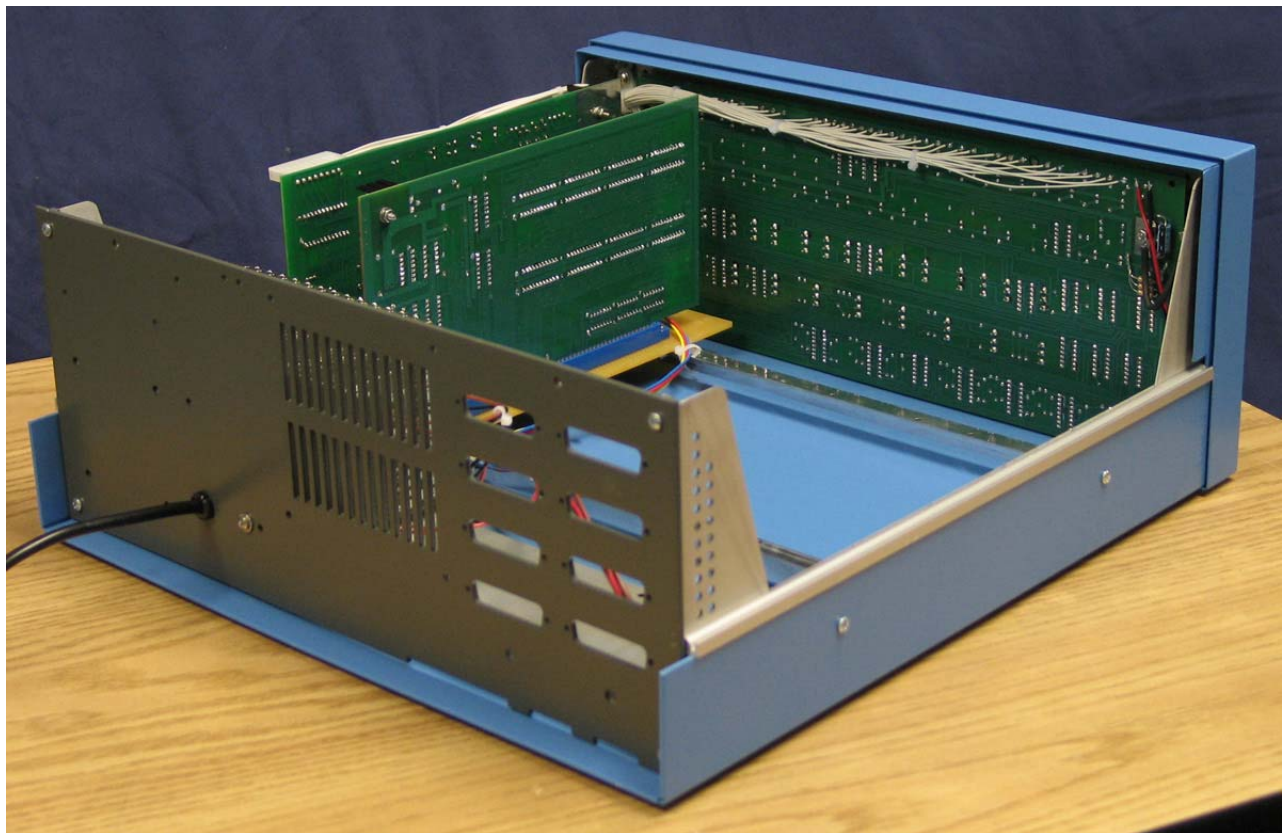
RED wire from V+ on the large power supply to the motherboard

BLACK wire between COM to GND on the large power supply

I installed my switch between the hot AC line and the power supplies. The power supplies have internal fuses. Please consult an electrician if you have any questions or concerns wiring the high voltage AC connections.



After the system has been tested is when I recommend you tie up the internal wiring. Just in case a wiring change is needed you won't waste any tie wraps. ;)



Reinstall the case bottom



That's it! I hope you had fun assembling the Altair 8800 reproduction!

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