

Gizmo With Display Module Building Instructions

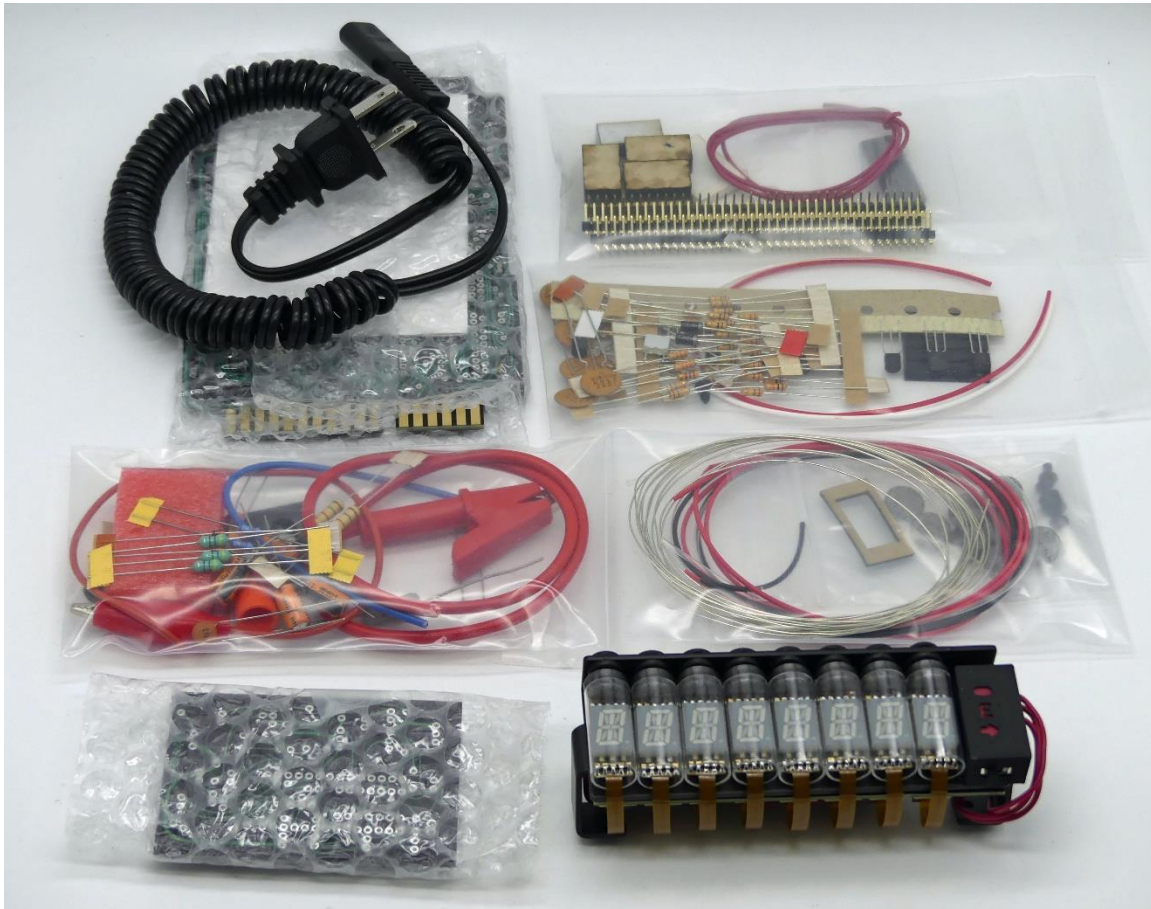
The Gizmo board is made to look very similar to the Sanyo ICC-808D calculator board with gold fingers on the card edge connector, curved traces and the plated through holes that are in the same locations as the original board.

The actual Sanyo boards are also wanted by calculator fans, so they have become hard to find and very expensive.

The main changes from the last run of Gizmo board kits:

- 1) No electronics kits parts to solder onto the circuit board
- 2) The Display Module assembly is pre-assembled and is a stand alone component.
 - a. Powered by a single 18650 battery that can be (slowly) recharged by a USB type C connection to the underside of the display stand.

Lots of parts in the full Gizmo + Daughterboard + cord kit:



The top portion of the image has the same sets of parts and dry rubs as the previous kit (upper left and the two bags of parts on the upper right).

The lower left hand side of the image has the daughterboard parts and the daughterboard circuit board (PCB).

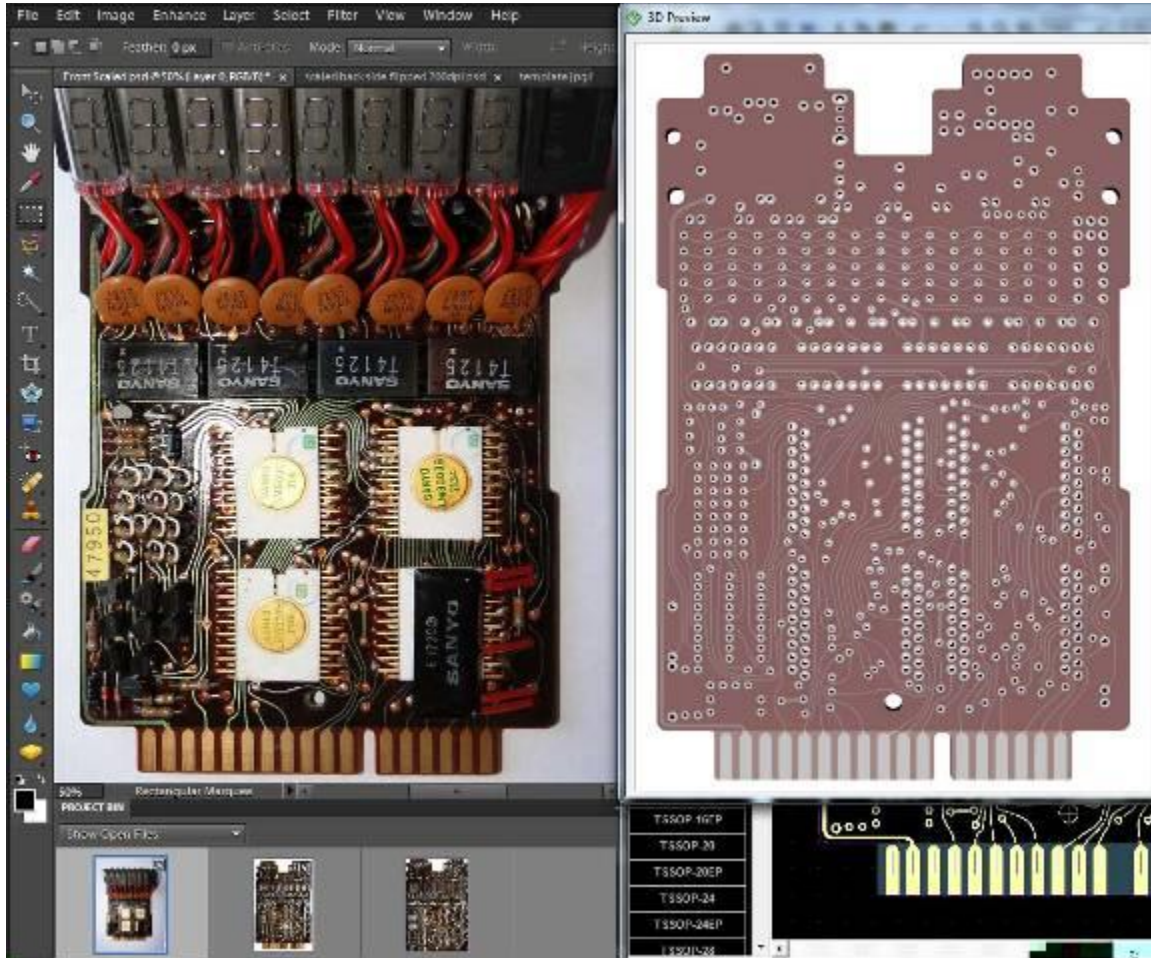
The lower right hand side has a bag of parts connect the bottom of the display tubes to the circuit board and the display module assembly.

Below is a picture of the prop makers holding the finished kits from a previous “Final” run of my full Gizmo kits:



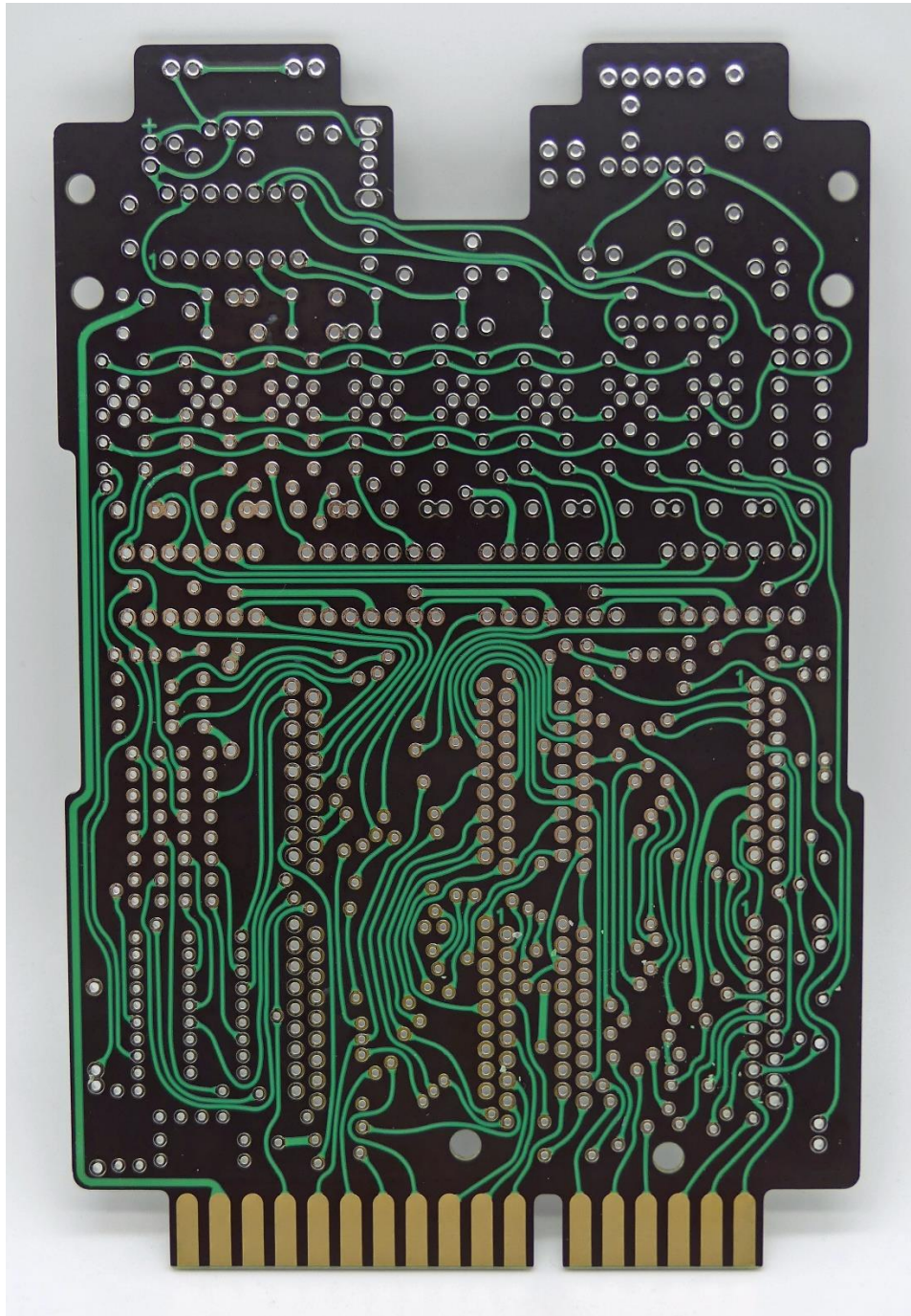
These kits are based on a real Sanyo ICC-808D board and the component values and locations as close as possible to match what was used on that Sanyo board.

The Actual Sanyo Board and a render of the Gizmo Printed Circuit Board from my CAD software:



Note: You may want to start with the “Detailed Daughterboard Instructions” at the end of this document if you are not a veteran electronics assembly person.

Here is a photo of the latest Gizmo kit's main printed circuit board:



This is the top side of the board where all of the components will be placed. The back side of the board has only a few traces (lines of copper that connect different holes together) and is where you will solder the part leads to the holes.

“BP” Basic Parts kit assembly

This is the basic parts kit for the real components that go on the bottom half of the board.



Transistors (Black device with 3 legs) quantity 10

Capacitors

8x Brown Ceramic Disk Capacitors, approximately 12mm in Diameter

1x White capacitor

White and Red Heat Shrink tubing

Enough to cover the leads of the 14 resistors that are standing up on the board

Screw, #4, 1/4" Philips head to secure the shaver cord to the board

Not used until the end of the build!

Diodes

2x Black Diodes (2 leads)

2x Red/Clear Diodes (2 leads)

1/4W Resistors that lie flat on the board:

2x 2.7K (Red Violet Red Gold)

3.3K (Orange Orange Red Gold)

10K (Brown Black Orange Gold)

15K (Brown Green Orange Gold)

33K (Orange Orange Orange Gold)

39K (Orange White Orange Gold)

100K (Brown Black Yellow Gold)

1/4W Resistors standing up on the board with white or red sleeves covering one lead:

7x 220K (Red Red Yellow Gold)

7x 560K (Green Blue Yellow Gold)

It is easiest to build up the board with the shortest parts first. This allows you to place the parts on the board and then flip the board over, resting on the parts, when you go to solder the parts on the board. The order is not necessary, and I didn't do this because I was too excited and just quickly built up the board without sticking to this philosophy. It also makes it more difficult when portions of the electronics should be included earlier, but hey that is in a separate bag of parts so lets build up one bag of parts at a time.

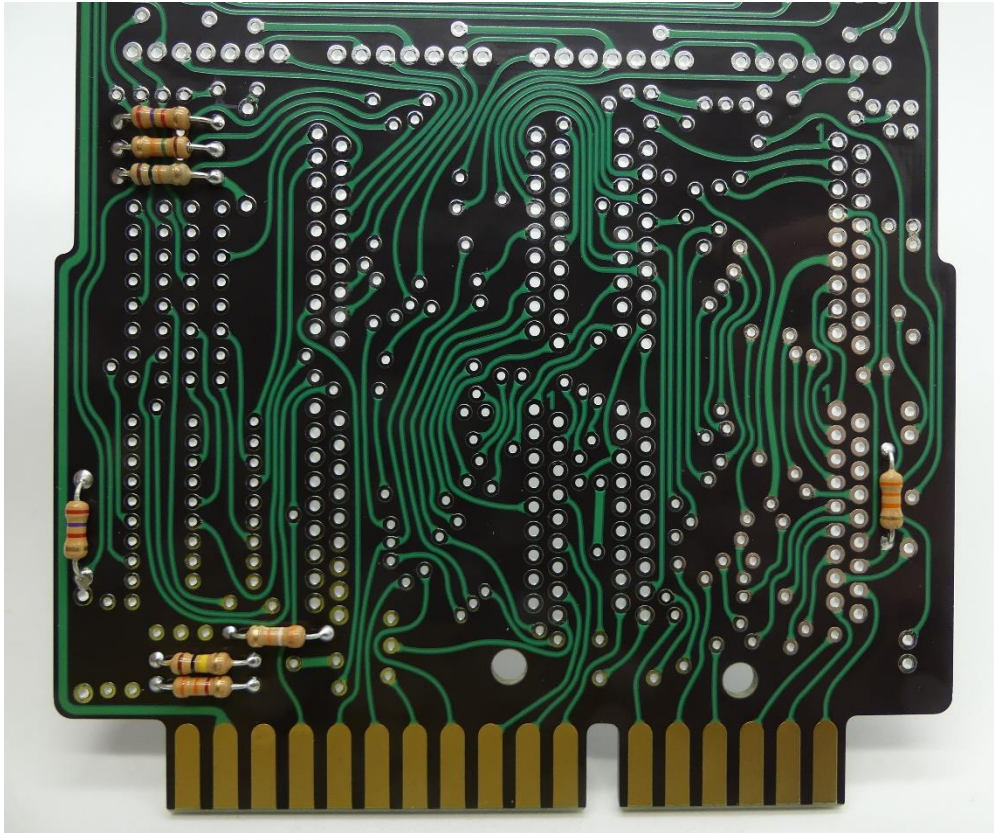
*** NOTE ***

When building up the kits for this run of boards, I put in 2 each of the 1/4W Resistors that are to lie flat on the board even though only the 2.7K resistor value needs two parts. This will leave you with an extra 6 resistors when completed. If you want, you can use 3 of these on the daughterboard to replace the green inductors. The green inductors were used in the Afterlife props, but with the new green traces on these circuit boards, you may like the look of the tan resistors instead of the green inductors that are a close color match to the color of the green traces...

*** ANOTHER NOTE ****

It may be easier to install the display leads without the set of 8 larger tan capacitors installed. I left those off until after the display install and put them in just before I added the pillow part.

Place the 8 “lying flat” resistors in the correct holes in the board:



You can match the color codes with the parts as seen in this photo or you can just randomly select a resistor if you want it to be different. The two sets of 7 resistors will be used for the stand-up section of parts. In the actual board each group of standing resistors had the same value (same colors). You can choose to do this or not – it is your board!

Resistors in real circuits can be placed in either direction. The gold band can go to the left or the right, so each real board may have them in either direction and there is no right or wrong way.

To place the resistor in the board, bend the wires up to form a “U” shape and then insert the wires into the holes as seen above. (They are shown above after I soldered them in). Be careful about finding the correct holes. The ICs do need access to the larger holes nearby, so we don’t want to mount a resistor in one of those holes.

After a resistor has its two leads placed in the holes, the resistor should be lying flat on the circuit board, and the leads should be sticking way out on the back side of the board. You can bend the leads on the back of the board at a 45-degree angle or so to help keep the part from falling out when you flip the board over to solder the leads to the circuit board pads.

You can do this one at a time or you can place all 8 resistors before you solder them.

Flip the board over and solder the leads to the pads on the back side of the circuit board. For these parts, the solder is only used to make the part stay in place and look correct. No actual functioning circuitry is being added so shorts or bad solder joints aren't much of an issue. If you end up also putting in the LED parts, those are actual electrical circuits, so the soldering is much more important.

If needed, you could glue the parts in, but soldering is more accurate.

*** WARNING ***

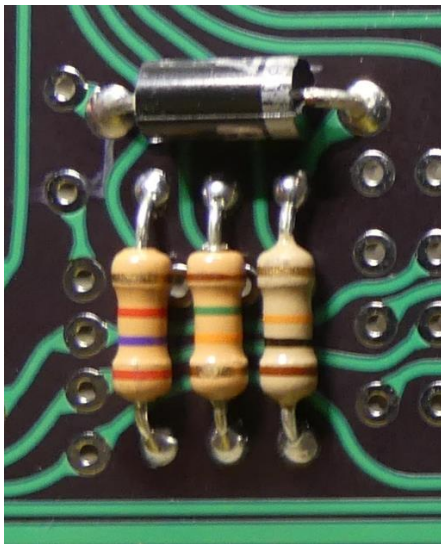
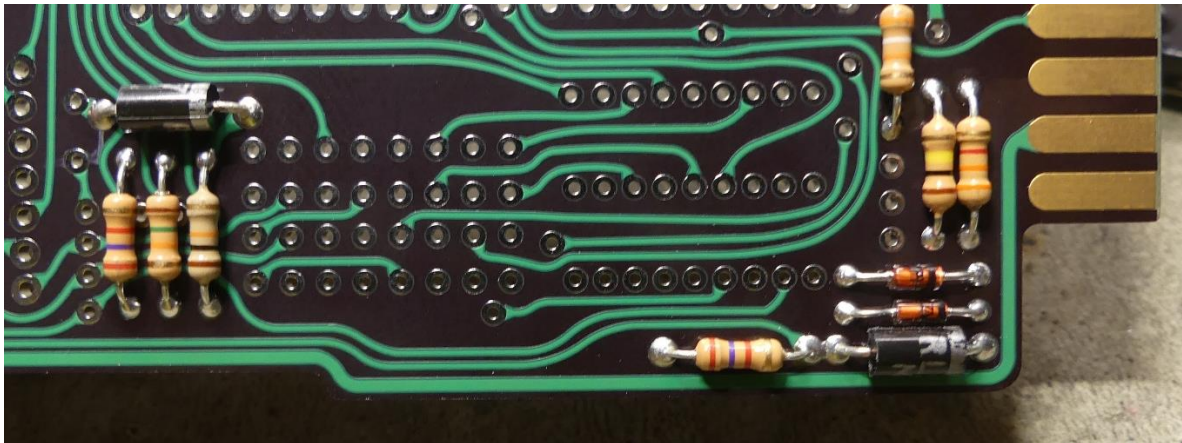
Solder can contain lead and that is a poisonous substance, so be sure to keep the solder out of kids reach and wash your hands after handling the solder and before you eat or prepare food. It is best not to directly breathe in the smoke when soldering, so a ventilated area is best and a light breeze from a fan can be very beneficial if you do not solder equipment designed to remove the fumes (much more expensive than the typical soldering tools most people have or purchase).

*** END OF WARNING ***

After the part or parts are soldered, cut off the excess part of the leads on the back side of the board. I use small diagonal cutters and cut the lead as close to the board as possible. The small stubs that are left can be fairly sharp, so be careful. Depending on how this is mounted to your belt, you may want to file them down a bit to remove any sharp edges. This is not normally done, but this won't hurt anything and since it is not a working circuit this should not cause any issues. When all done be sure and clean off any filings from the filing/sanding especially if you plan on building the operational LED circuit later on.

Add the 4 diodes, in the same way as you did the resistors. The parts should be flat on the board, and the leads should stick out the back side and be bent to hold the part in place. Flip the board over, solder the leads to the board and then trim the excess leads from the backside of the board.

Here are the two red/clear diodes and the two black diodes mounted and soldered to the board:



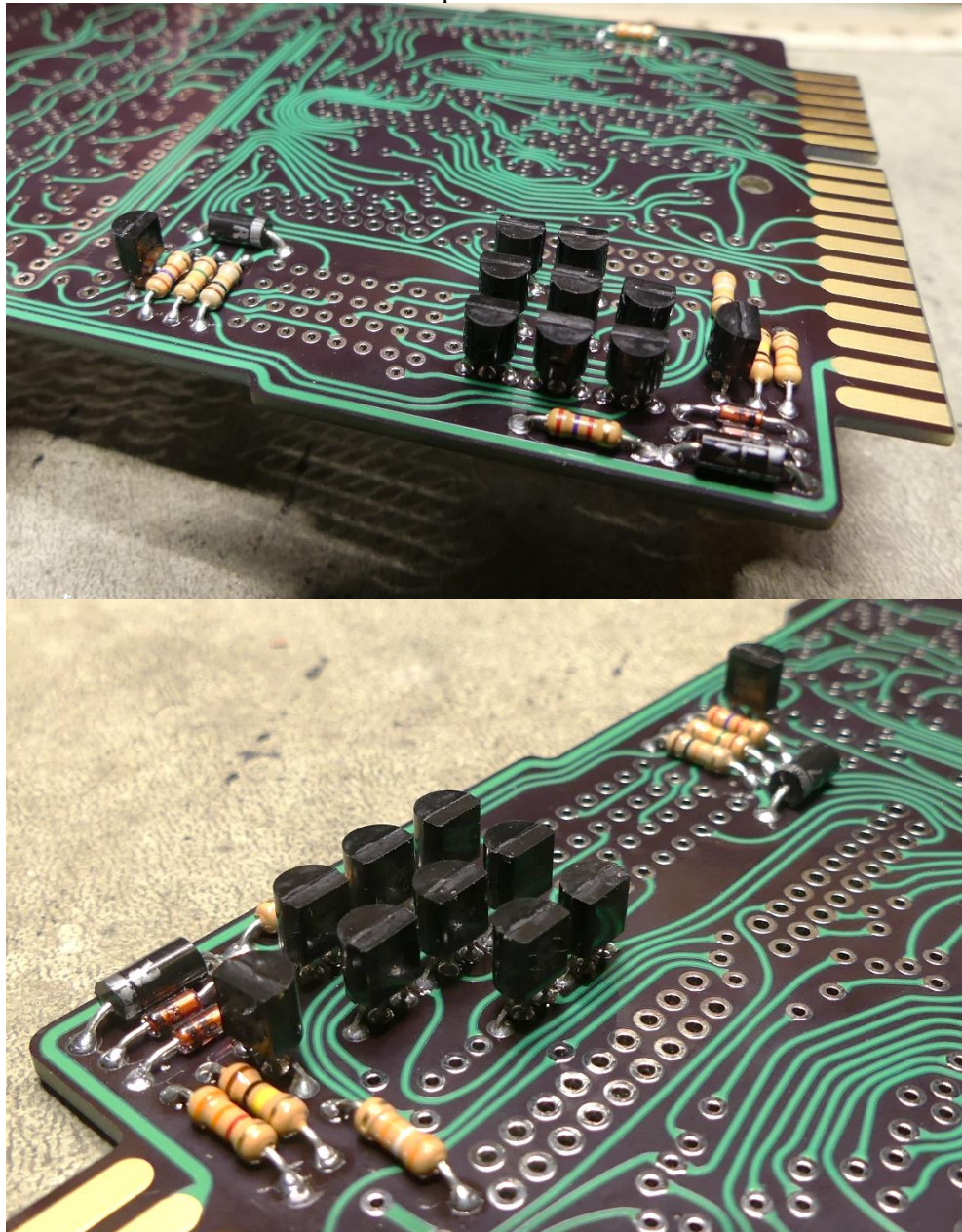
Real diodes have polarity indicators and must go in the correct direction. They have a silver or black band to indicate a particular side of the diode for you to care about. Since this is non-functional, you can put them in “backwards” here and it is fine. In the real Calculator board, they would always be placed with the same orientation, unlike the resistors that can be loaded in either orientation.

Next mount the transistors, the black devices with three wires coming out all on the same side. In the last set of kits, you had to bend the wires to make them fit, but I found some parts with pre-formed leads, so you don't have to!

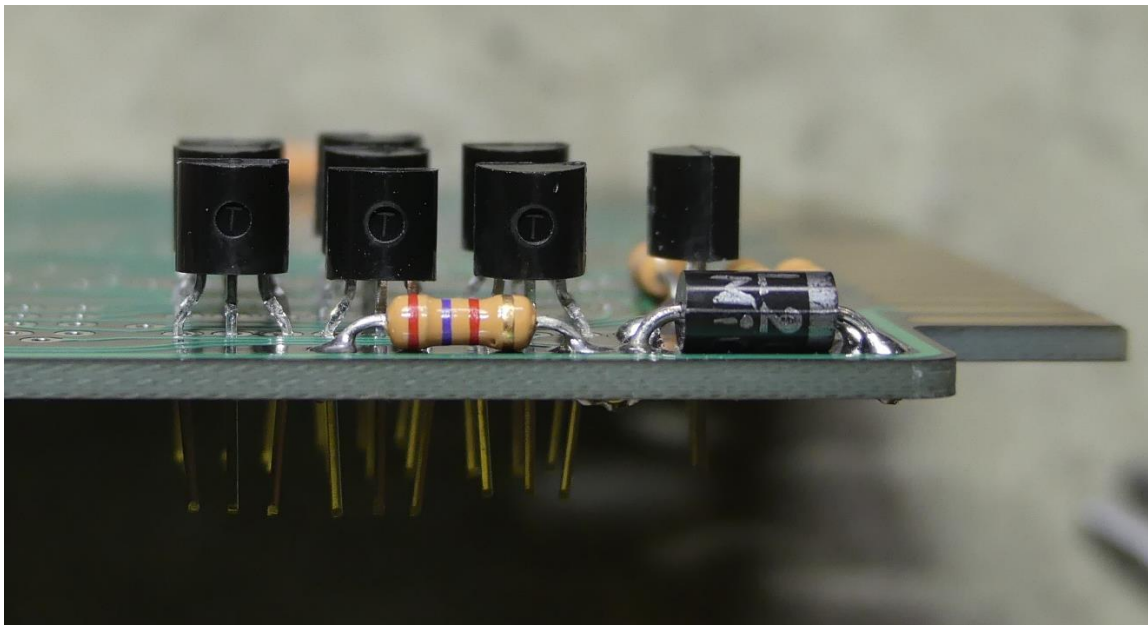
Transistors also must be oriented properly in a real board so all boards should have the parts facing in a particular direction.

To help make the tops about level, I only solder in the center lead of each part. Then it is easier to adjust the height and make them all the same before you solder the other two leads on each part. After soldering, trim off the excess portion of the leads.

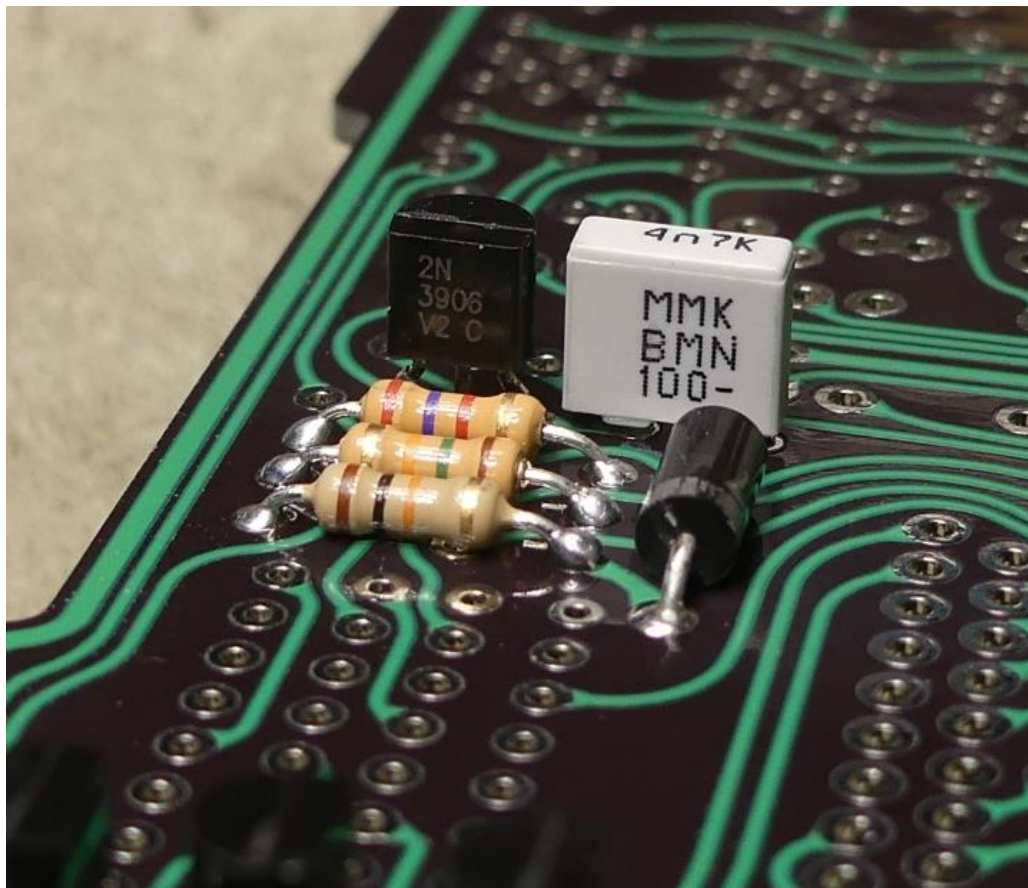
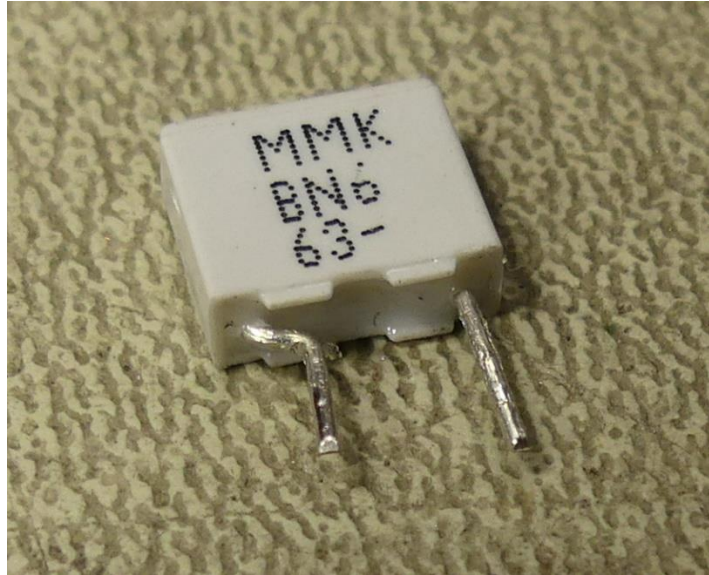
Here is where the 10 transistors are to be placed and the desired orientation:



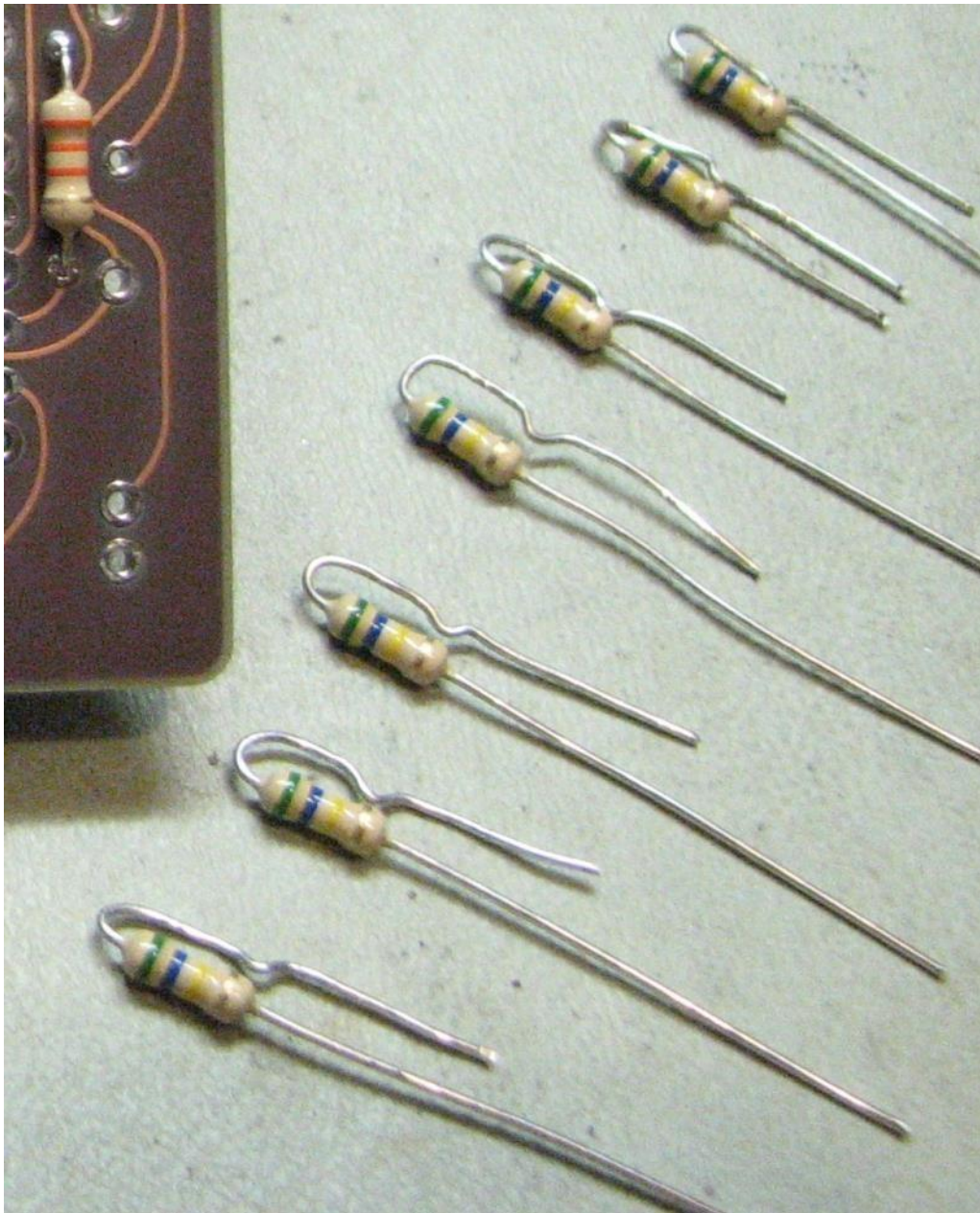
Here are the group of nine soldered transistors on the lower left-hand portion of the board.



Now you can locate the white capacitor. This cap can go in either way and you can decide which side you would like to face which way. The leads are a bit wider than would be ideal for this board, so it will sit a bit above the board, and the left side wire lead needs to be bent to be able to get the part near the board. Make sure it is oriented fairly straight, flip over and solder the wires then trim off the excess portion of the leads.



In the Sanyo board, the resistors stand up and one leg is folded over and gets a kink in it and then goes into the board. You can just make the lead form a very narrow “n” or you can add the kink if you want to have the resistors look even more accurate. The parts can be oriented either way, but I like to have the Gold band on the bottom for all of the parts to make them look more uniform. I just bent the leads over by hand by making a nice arch at the top of the resistor with the lead. Then I used needle nose pliers to make a kink in the wire near the base of the resistor body.

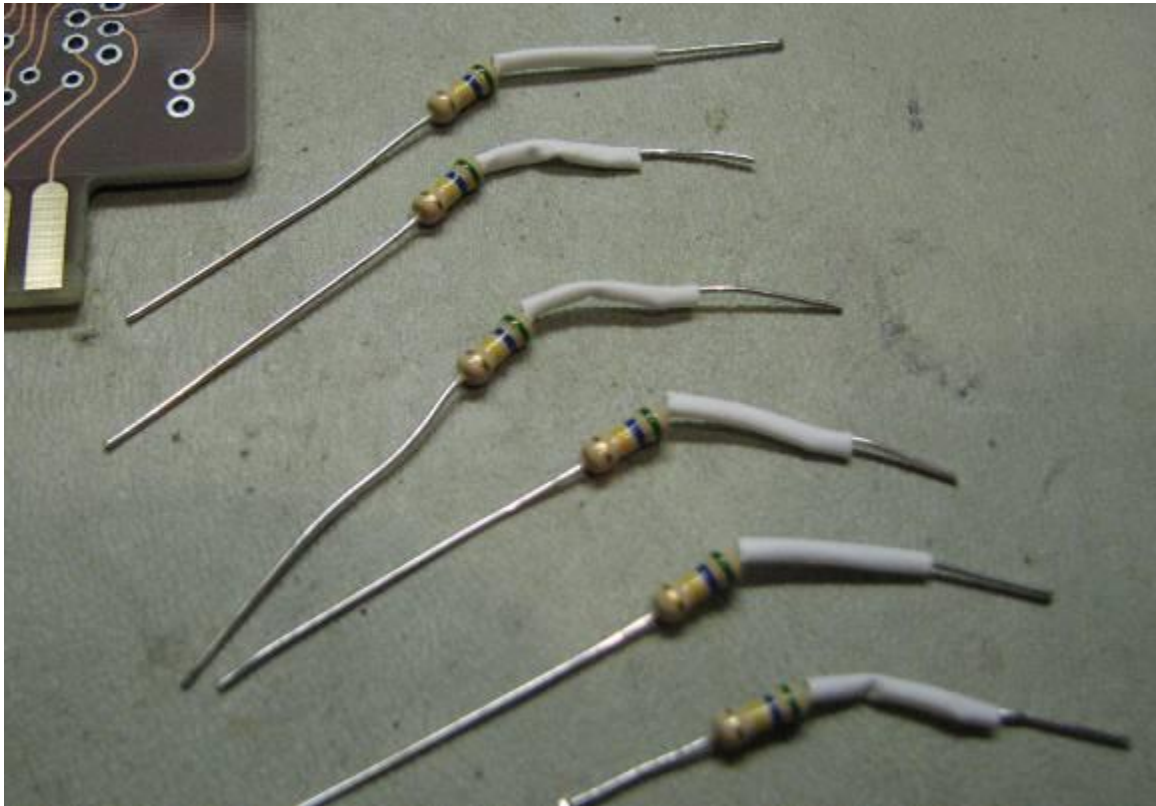


Then cut up the white or red tubing. Reference images from boards show that the 7 same value resistors have the same color tubing. Some reference boards have both sets the

same color (usually white), some have one red set and one set white, and maybe some have all red?

About a ½” of tubing for each resistor is needed but depends on how you bend your leads. The tubing should go over the leads and extend from the top of the resistor to the bottom of the body of the resistor.

Unbend the leads somewhat at the top of the resistor body and slip on the tubing:



The tubing is a bit larger than ideal and if you use a heat gun (designed to shrink heat shrink tubing – hotter than a hair dryer) it will shrink down to a very snug fit and look even better. I found that the top bend would not be covered as well if you shrink the wire in this bent position, so I measured and cut a piece of tubing and bent the lead out to make the bend much less sharp, used the heat gun and then waited a few minutes for the heated tubing to cool before I bent the lead back to the tight angle shown above.

Then shrink the tubing with the heat shrink gun, let them cool and then bend back:

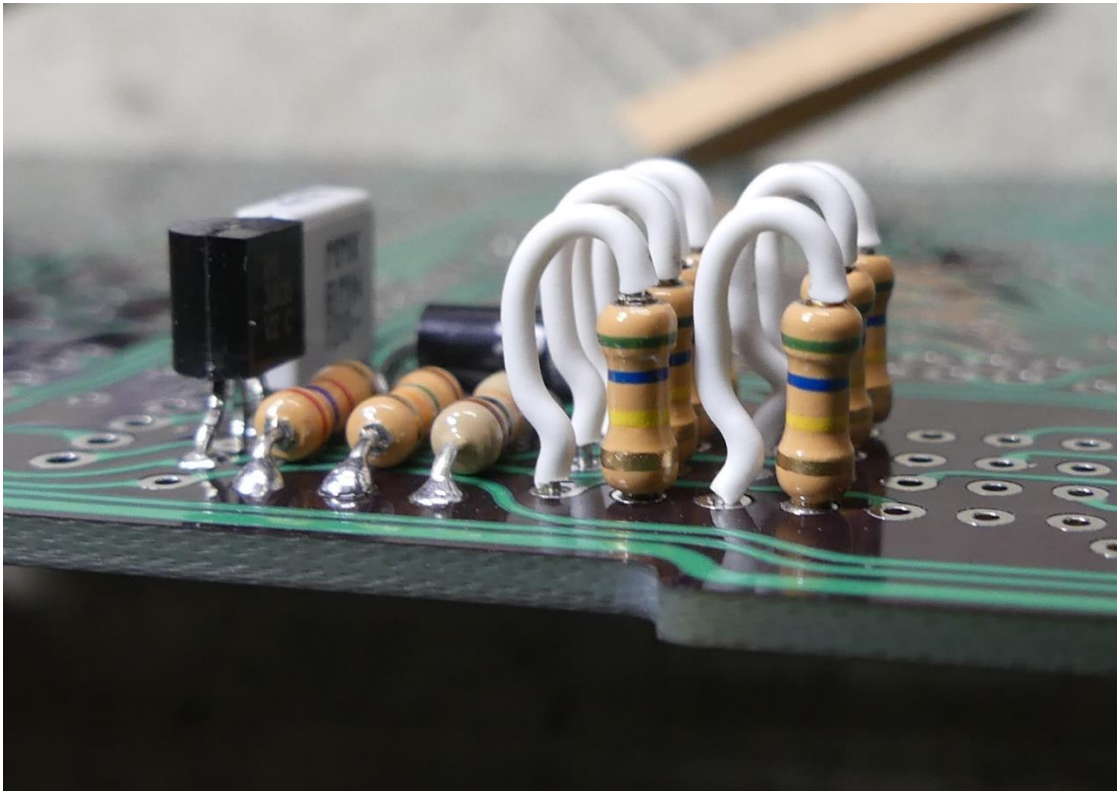


There should be seven resistors in each set that have the same color tubing.

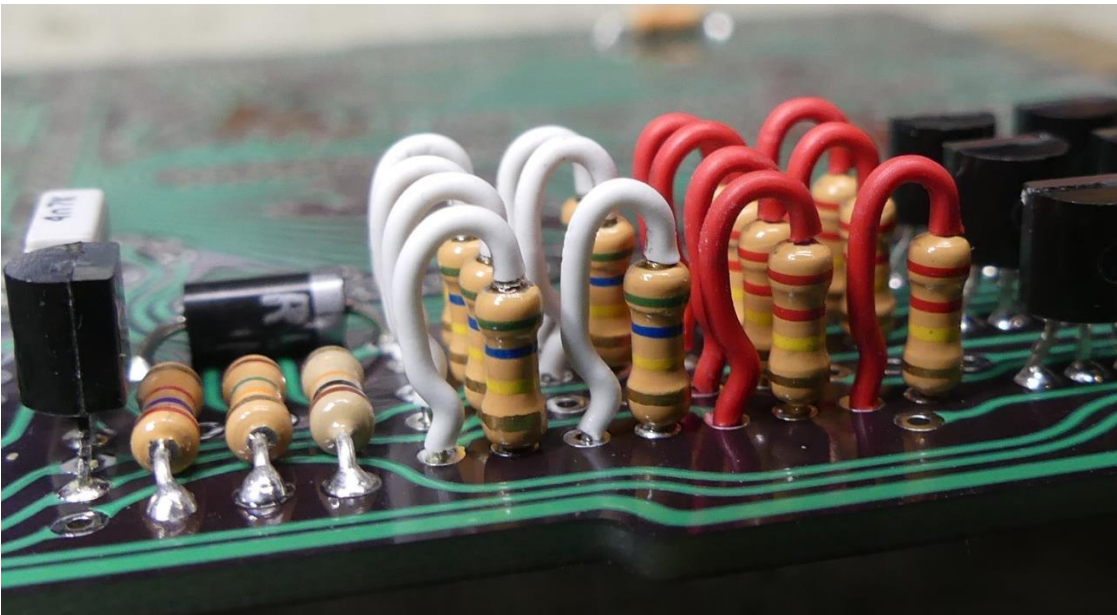
You can test place each resistor and use a standard wire stripper to cut off the excess tubing if it holds the resistor up off the board. You want the part to stand fairly straight up, and one side of the resistor should be very close to the board. See the reference photos on the next page.

Like before, place the leads through the board, you can bend the leads on the backside to hold them in place and then flip the board over, solder and then trim off the excess lead. I did use a trick to get them better aligned: Just solder the longest lead (the lead that does not have any tubing on it). Then you can position the part and adjust the tubing covered lead a bit before it gets soldered. Use your fingers or wider blade flat tweezers if you are adjusting the tubing covered lead. Pliers (and even your fingernails) can leave noticeable marks in the tubing if they are aggressively handled.

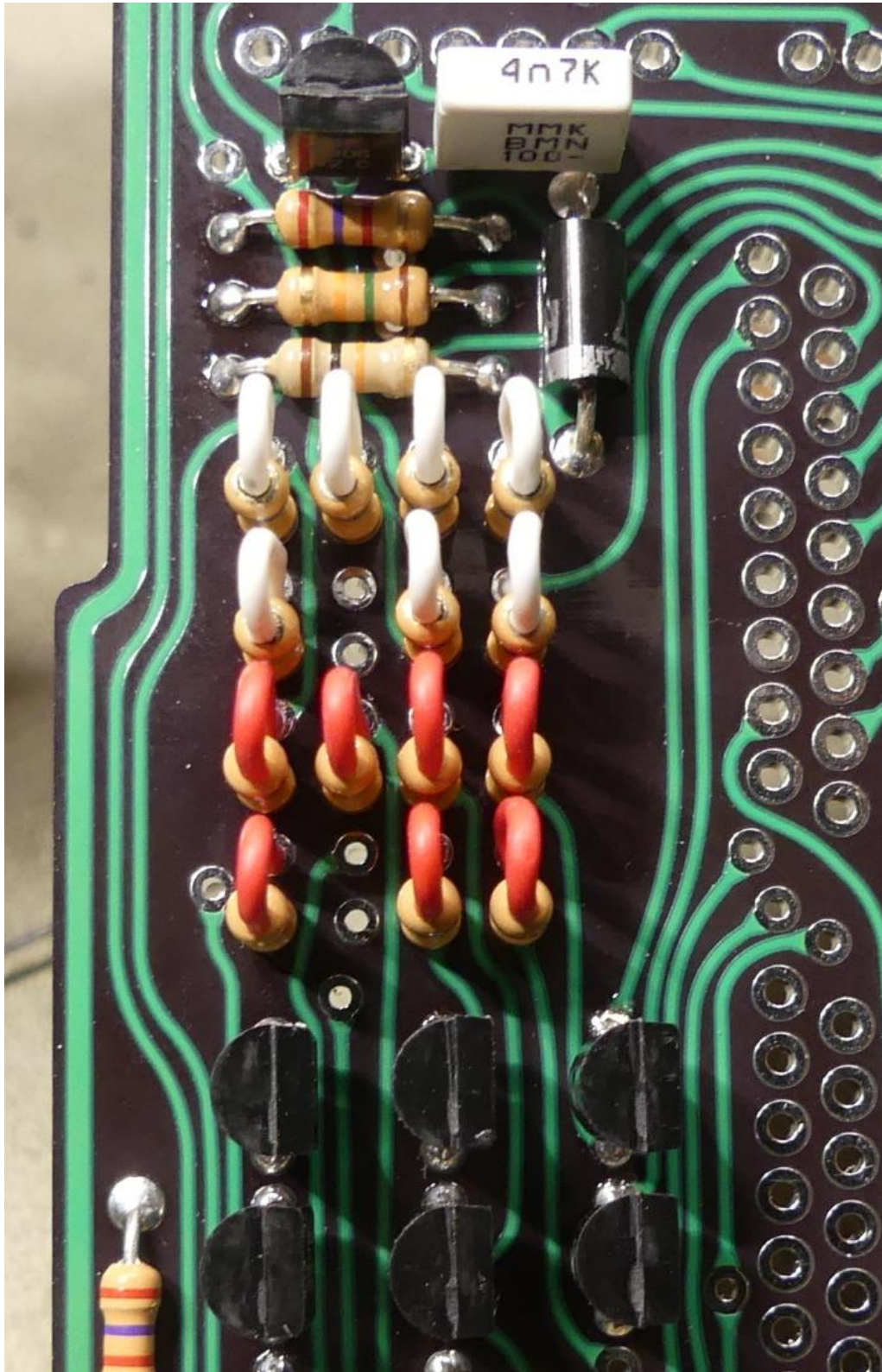
Now mount them all facing the same way with 4 across in one row and one missing in the second row.



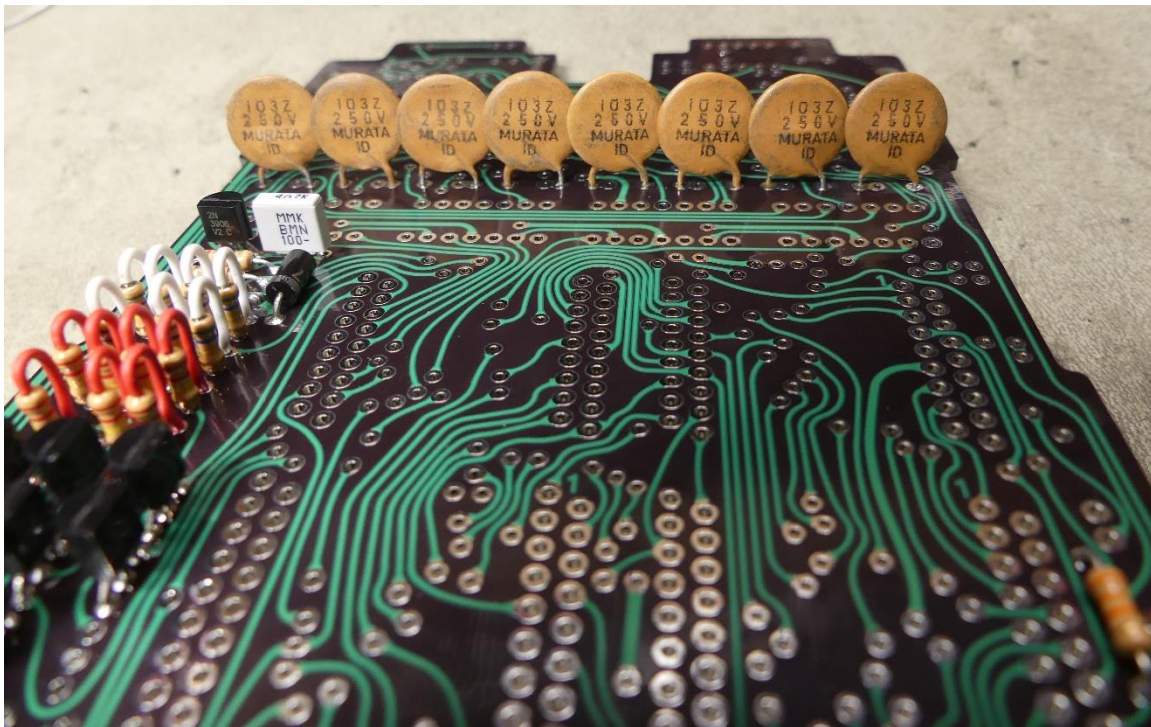
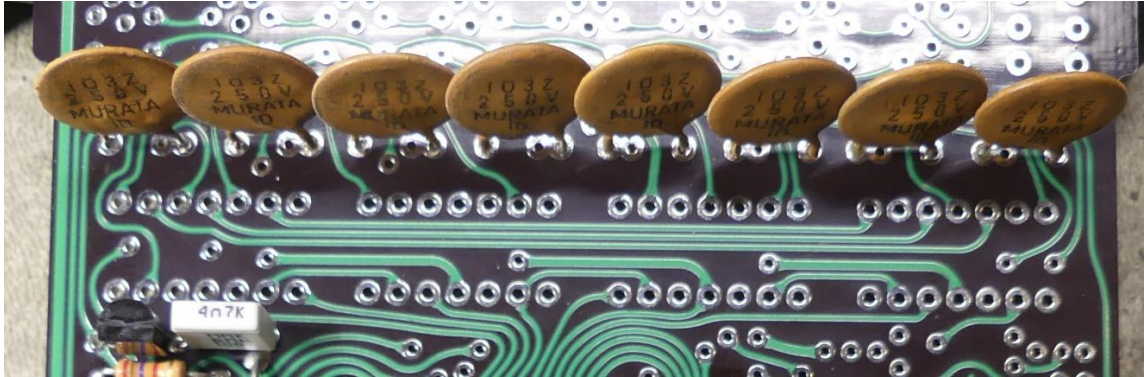
Do the same with the other group of seven resistors. You can use either color of tubing for each set.



Just a different view after all 14 resistors are soldered in place:



Now you can place the 8 larger brown ceramic disk capacitors across the board. Bend leads on the back side to hold them in place, flip the board over and solder then in. You may want to solder just one lead, make sure the part is positioned well, and then solder the other lead.



Now all of your basic parts should be mounted, and there are a few parts that were not used:

- Six 1/4W resistors – because I cannot follow my own directions
- One #4 1/4" black screw. You will need this later, so keep in a safe place (back in the bag?) for use at the very end when the shaver cord is to be attached to this circuit board.

“IC” Integrated Circuit parts kit assembly

More parts for the bottom portion of the circuit board. Most of these parts are replicas of real parts in the Sanyo calculators.



4x 40-pin Gold Right Angle Connectors

4x Thick Black Acrylic rectangles, with paper protective covers on both sides

4x Thin White Acrylic rectangles, with paper protective covers on both sides

24" #22 AWG solid core red insulated copper wire. Used for the “pillow part” and the “Error Box” connections to the circuit board.

4x copper discs that go on the white acrylic parts

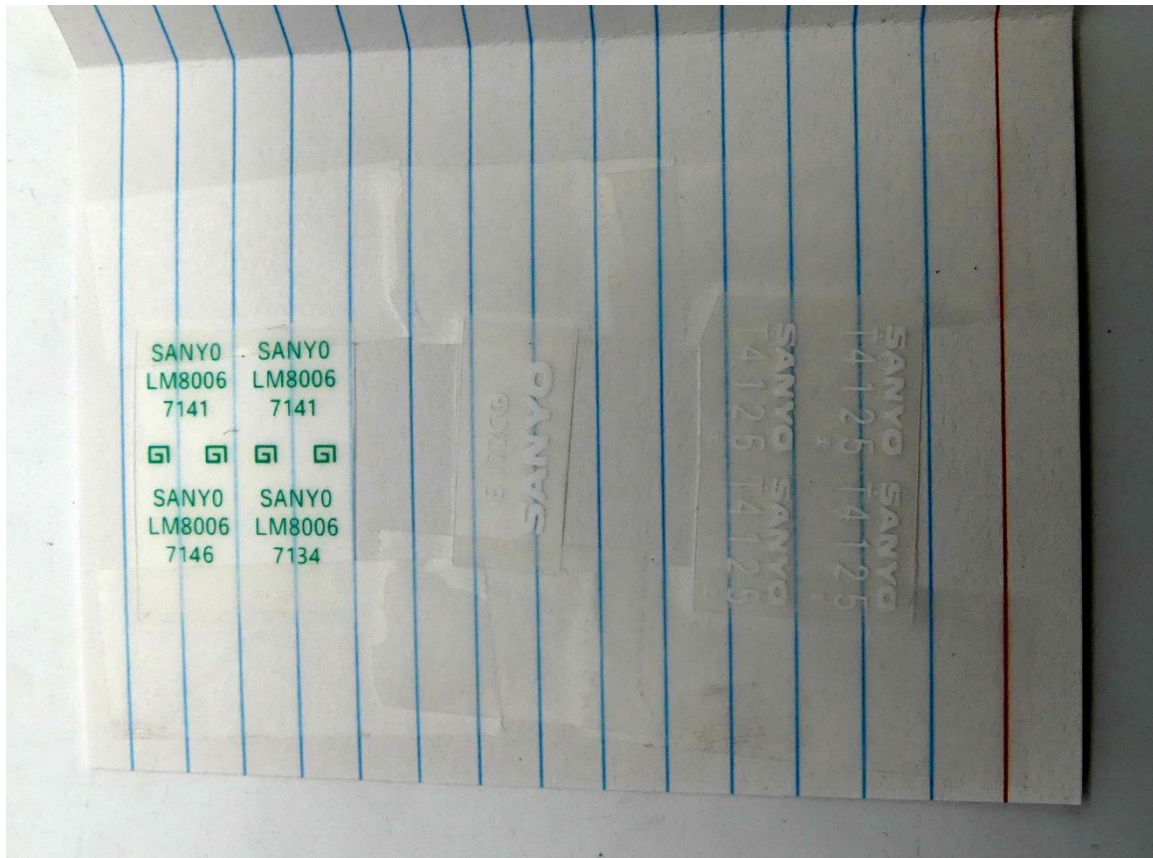
1mm wide adhesive backed gold strip. For use on the white acrylic part.

The error box is already on the Display module!

1x Error box (already on display assembly)

1x Foam gasket for error box (with the display kit)

1x Black Pillow part



Also needed: Folded notecard that contains the dry-rub transfers that was packaged inside the bubble-wrapped main circuit board.

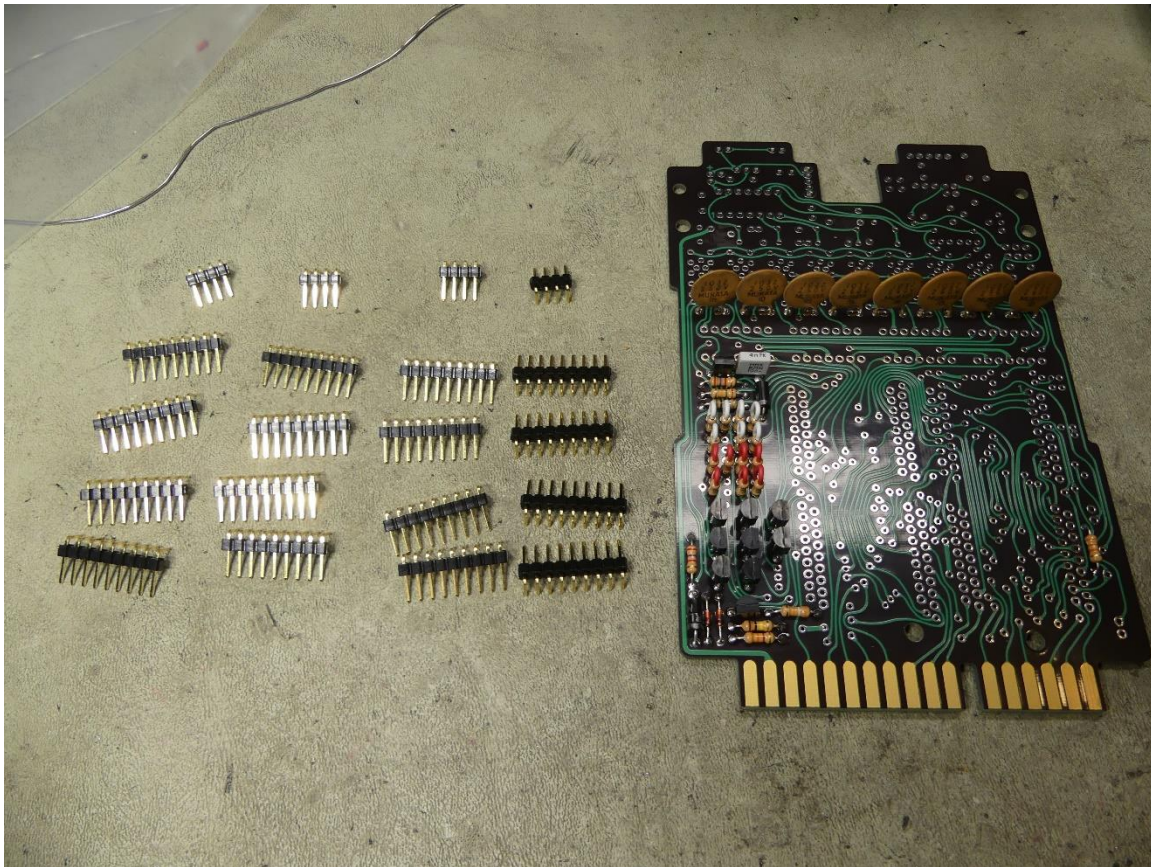
- 4x Green Sanyo labels for the white acrylic parts
- 4x Green Logos (small rectangular spirals) for the white acrylic parts
- 1x White Sanyo label for the "Pillow Shape" part
- 4x White Sanyo labels for the black acrylic parts

There are 4 40 pin angled gold connectors included in this kit. Each connector has enough pins (and a few spares) for the 36 pins that are needed for each of the four white “Integrated Circuits” that sit on the bottom half of the board.

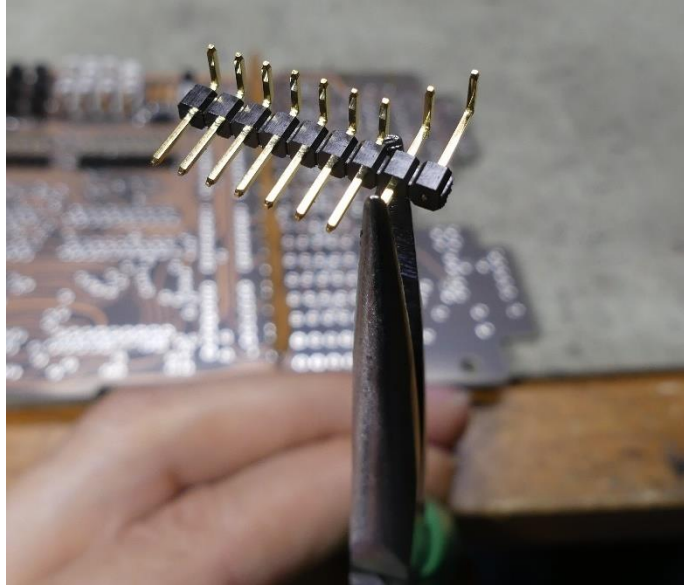
The procedure described for each of the four ICs will be identical.

The angled gold portion of the connector will end up being the visible part of the lead for the IC. The problem is that the black plastic portion of the connector is too close to the bend and would not look right. We want to keep the black portion of the part around for a while since it can hold the pins in place and at a great angle while we are soldering the pins in place. If you had to solder each bent pin in place individually it would be very difficult to make them look uniform.

First break each 40-pin part into four separate 9-pin sections and you will be left with a 4-pin section that we are not going to use.



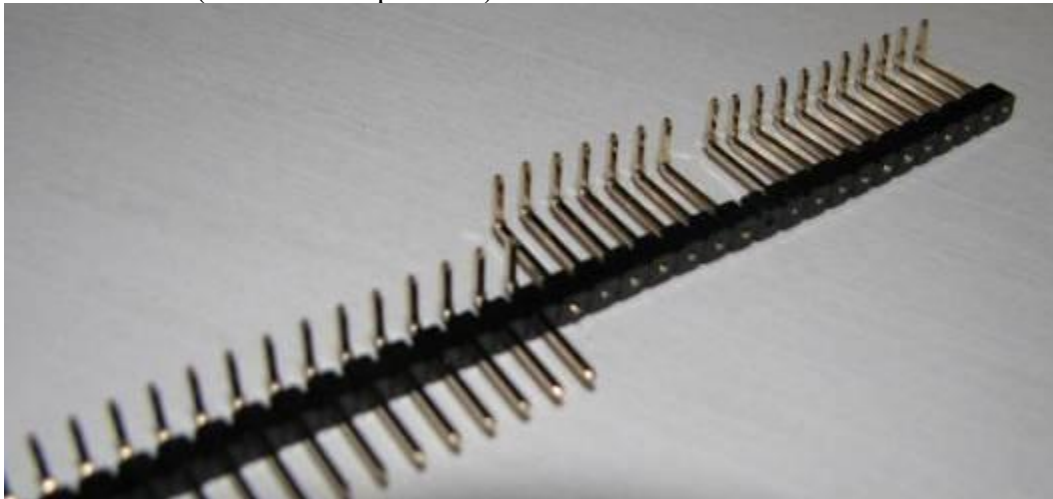
I used to heat them up a bit to aid in moving the pins, but needle nose pliers also worked pretty well just squeezing the pins down into the holder 1 or 2 at a time.



*** NOTE ***

Practice on the 4-pin pieces first since they are not needed for the Gizmo!

The end result (with a minor problem):



Notice that one of the pins fell out in the middle of the section I was heating up. You can just put the pin back in, but they can be loose enough that you must be careful when handling the parts after you pressed the pins up to the edge of the black portion like in the upper right-hand portion in the photo above.

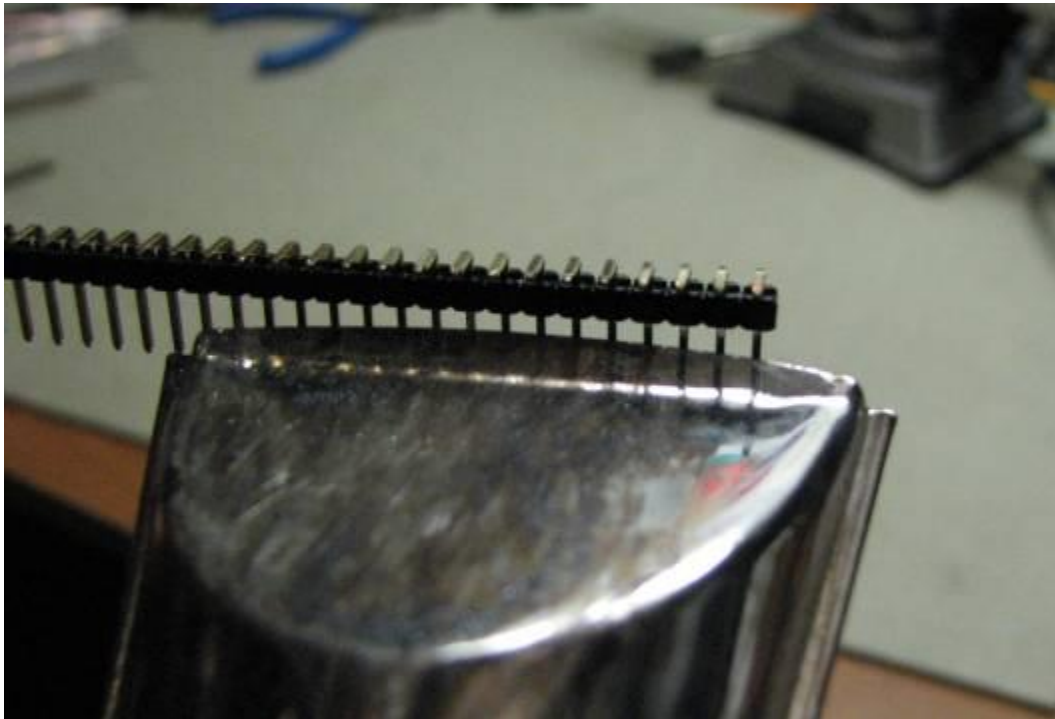
I also tried cutting the 40 pin parts into the 9 pin sections first and just applying pressure like shown above and the black plastic was able to be moved down to the end without any heating of the part.

Here is the heat method:

Heat up a bit more than half of the pins since you are holding on to some of the others and you don't want to burn your fingers. I heated them with my heat gun for about 8 seconds. The pins should be hot enough to loosen the connection between the pins and the black plastic. On a hard surface that will probably get marked up a bit, put the heated pins against the surface (only the half that were heated) and use something like very narrow pliers or heavy duty tweezers and push down on the top of the black portion and slide it down to the hard surface.

All of the pins may not move at the same time; you may have to work from side to side pressing on the black portion and having it slide just a little. Once you get all of them started, the black portion will slide down much more easily.

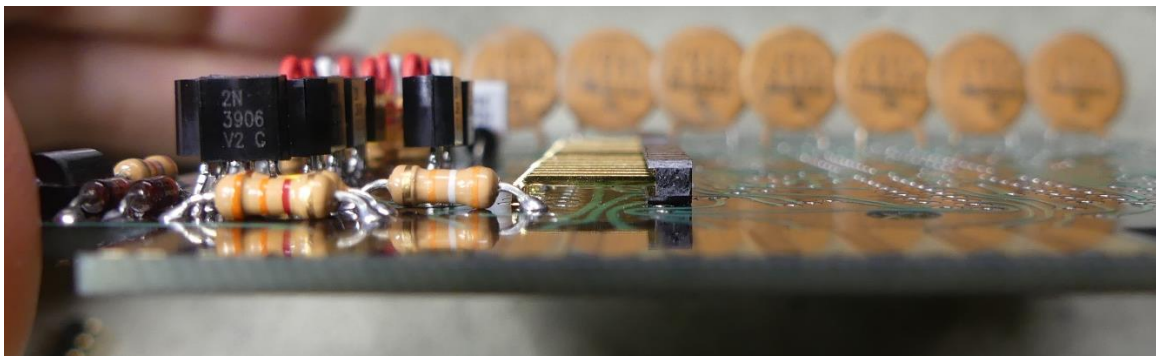
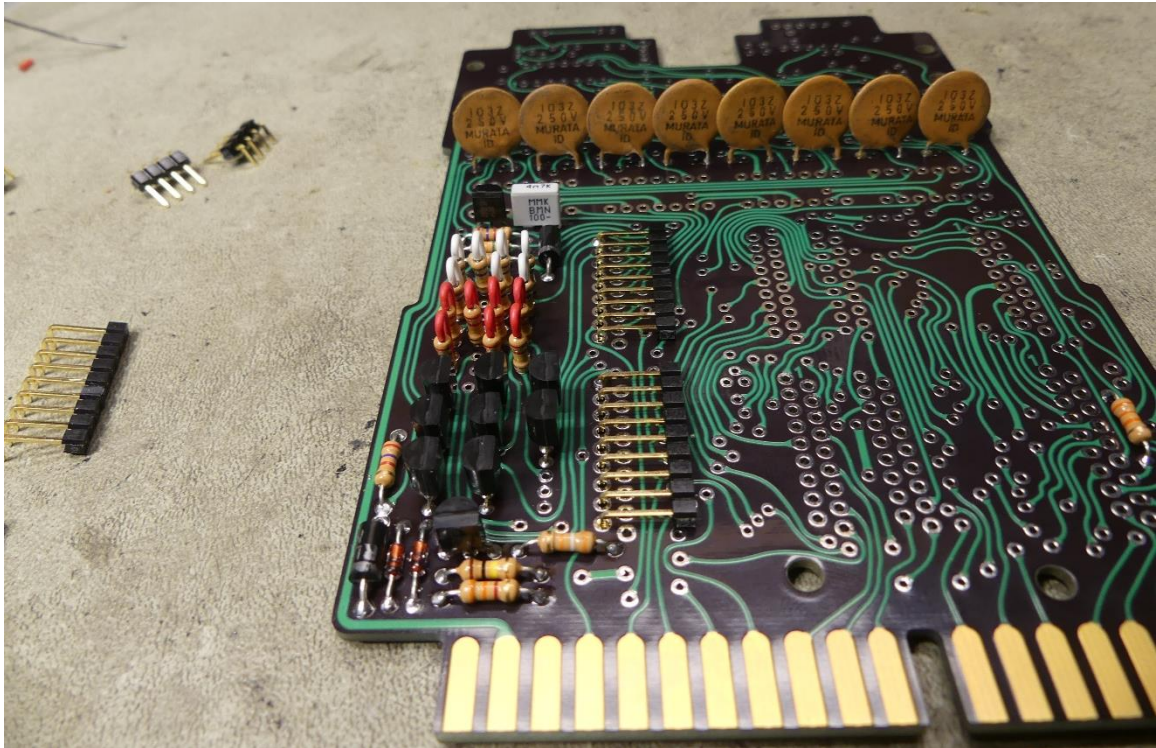
Here are photos of one of the first pieces I was playing around with. Heating up the leads directly (and not the black plastic very directly):



Pressing down on the black plastic while the leads are still hot (against a hard surface):



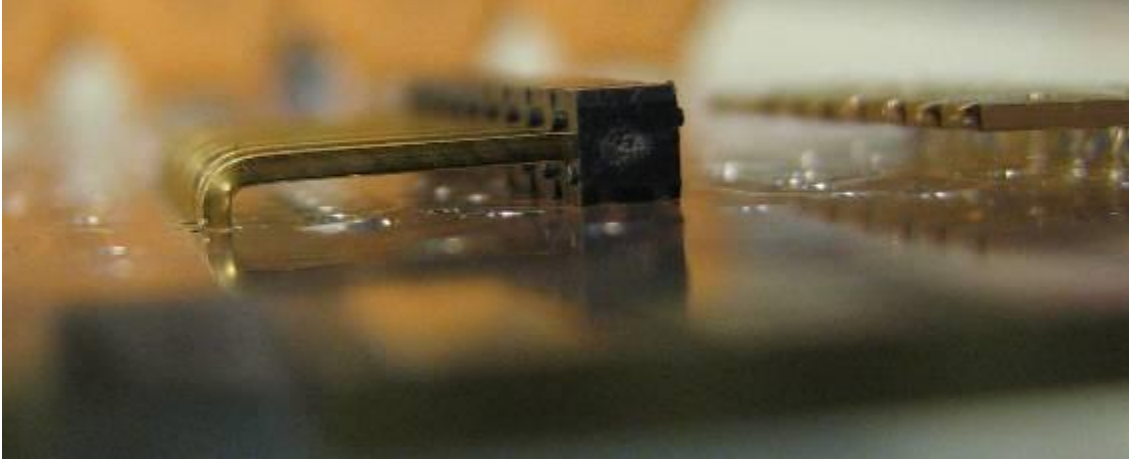
Now you get to place them on the board and solder them down. A single IC has 4 sets of interleaved pins. The holes on the board are the in two sets of 9 holes that are staggered. Work from the outside in (it works better! I had a problem working from the inside out and had to trim the leads on the top of the board after they were soldered in just to be able to slide the black part off).



The parts on the left have the 9 pins set in the outside set of 9 holes. Holding the black portion and keeping the pins flat, flip the board over and only solder the outside pins. Notice that only the top and bottom pins are soldered. Start with soldering just one pin and adjust until the pins are level and horizontally straight. If the black portion is slanted (some leads at one end are sticking in or out differently than the other end) the pins start to become slanted, and you don't want that.

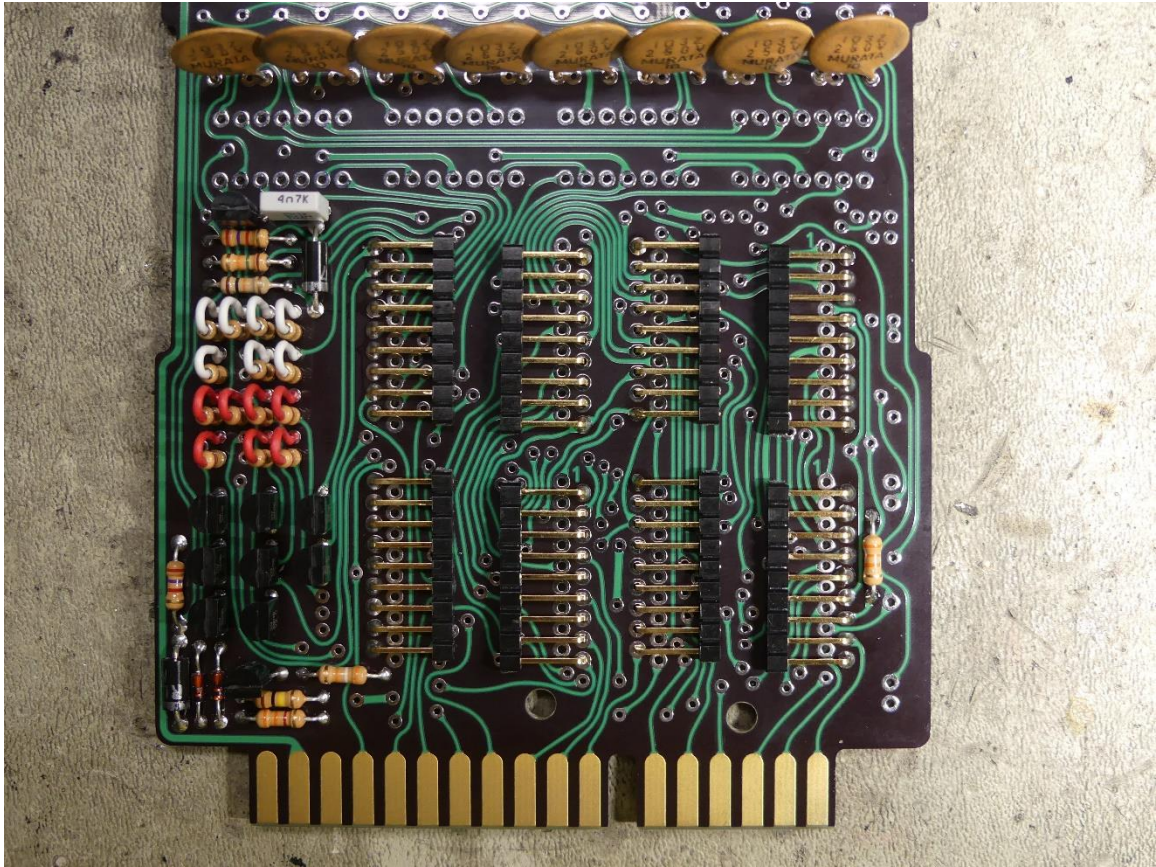
All soldering is done on the backside of the circuit board. You should hold the part in place with your finger when soldering the one pin down. Hold the part at the opposite end of the part so you do not burn your finger that is doing the holding.

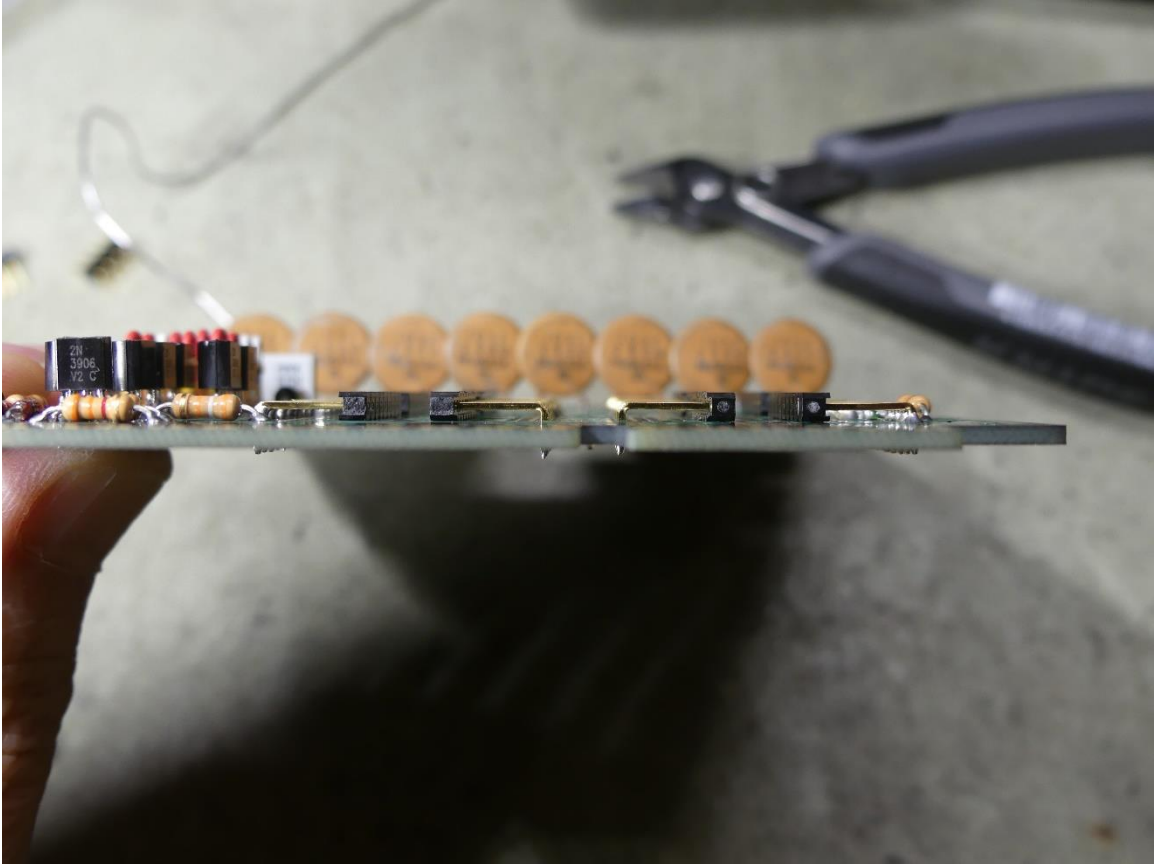
Here is a low angle shot to show that the leads are parallel to the board, and the height is determined by the black plastic part. It does allow the leads to be very uniformly placed:



When one side looks good, solder down the pin at the opposite side of the 9 pins and make sure it also looks good. When you are satisfied with the placement, you should now be able to solder down the middle 7 pins.

Now do the outside column with another set of 9 pins:

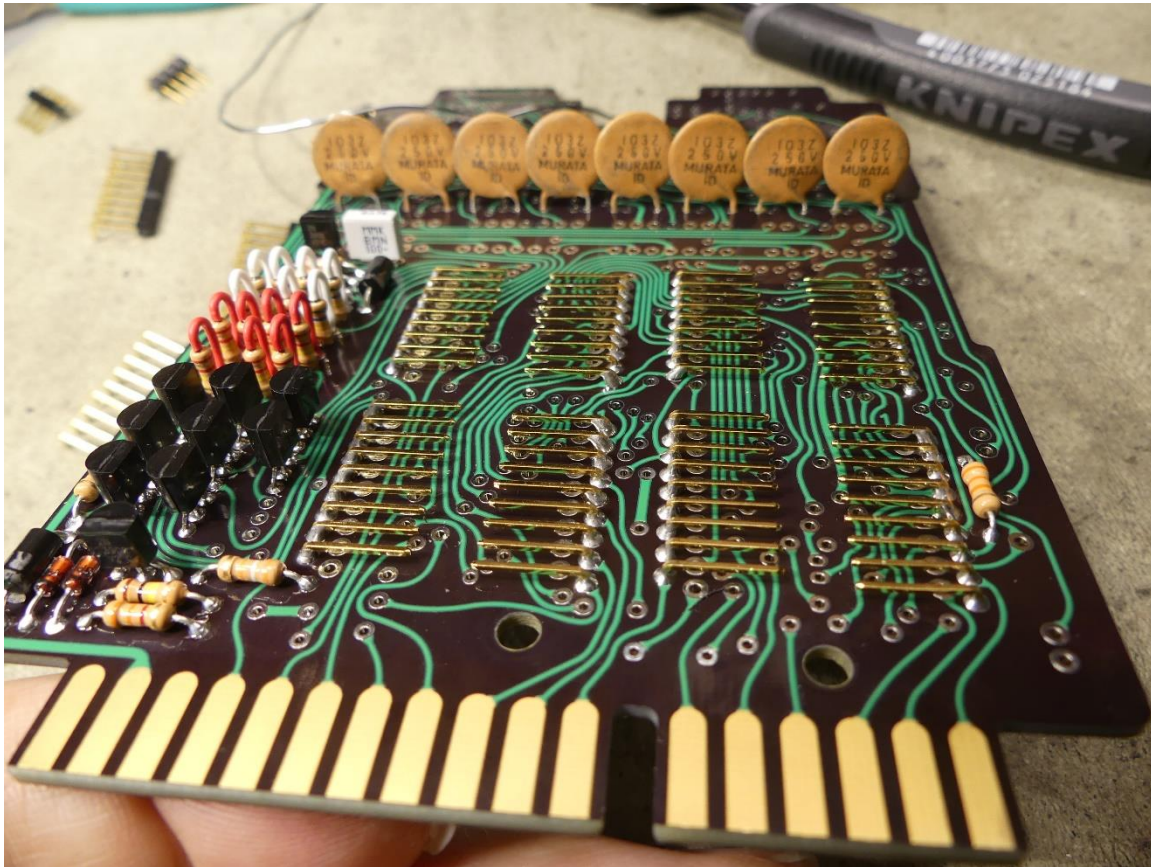




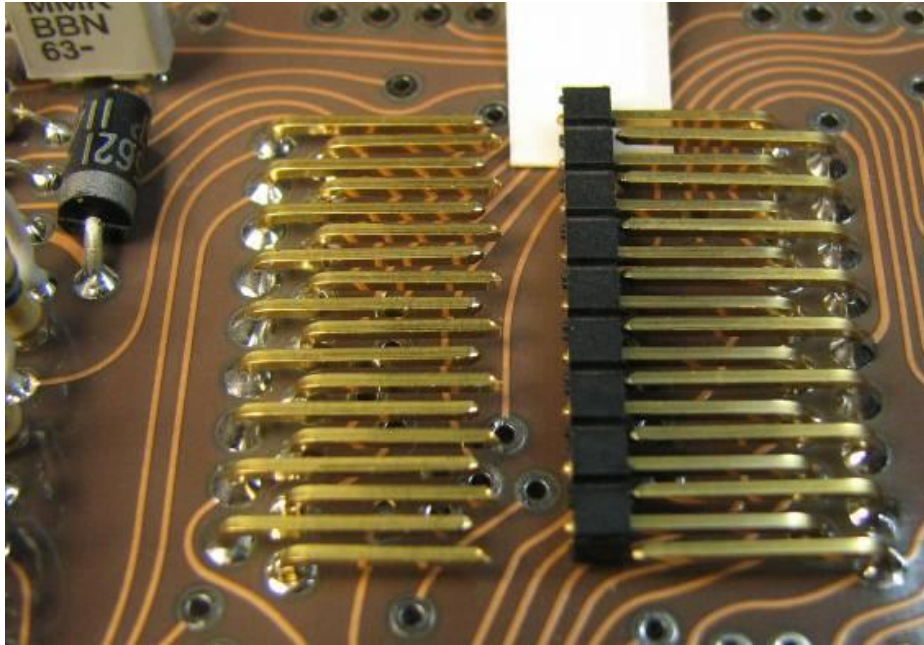
The next step is to slide off the black portion and once you do that you do not want to solder any of the pins again. The black portion is what held the pins in place so without it the pins can move around considerably, and it will be a pain to get them back in place. So now slide off the black pieces so there is room to place the pins for the inner columns of pins.

Once, I forgot to solder the middle pins and when I pulled off the black part the 7 middle pins just fell out. After a mild panic, I just individually put the pins back in the middle positions of the connector and then slid the black connector w/7 pins back onto the 2 soldered down pins. It takes a bit of work, and the outer pins do get bent upwards a little, but it can be done. Got the whole thing back into position and then I soldered down the 7 middle pins.

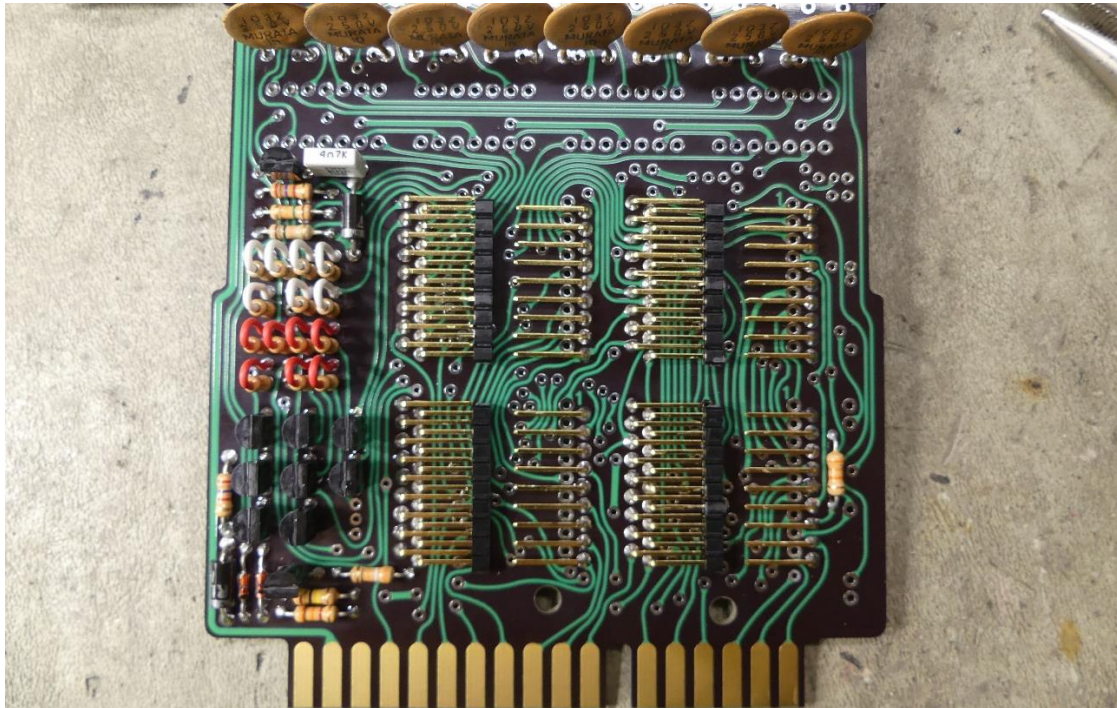
The outer pins should all be soldered and with the black portion removed it should look like this:



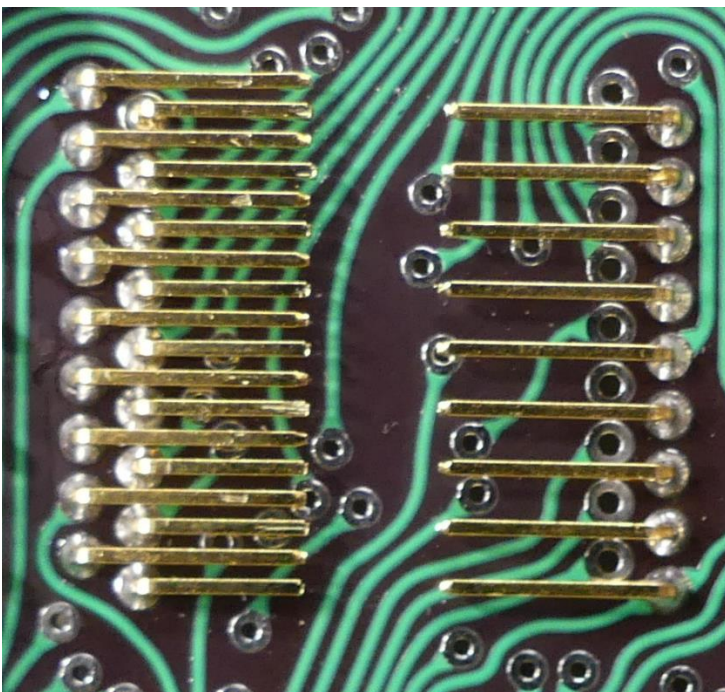
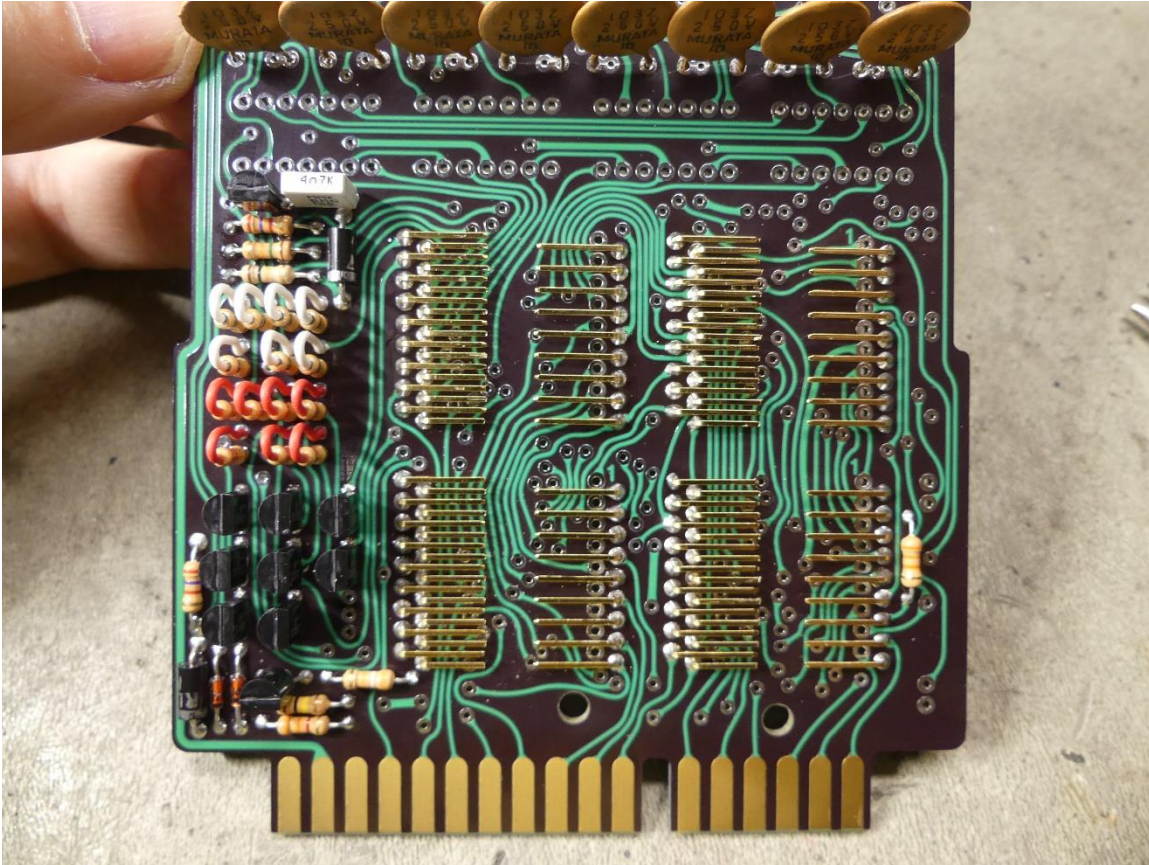
The inner columns should be done one at a time. They also need to be level with the outer pins. Here I am showing the last of the 4 sets being placed and I used a piece of paper to shim the connector to get it level with the outside set of pins I can no longer adjust with the soldering iron. When they looked level with the others, I soldered down just the outside pins and verified the placement. When it looked good, I soldered all of the middle pins and then removed the shim and the black portion.



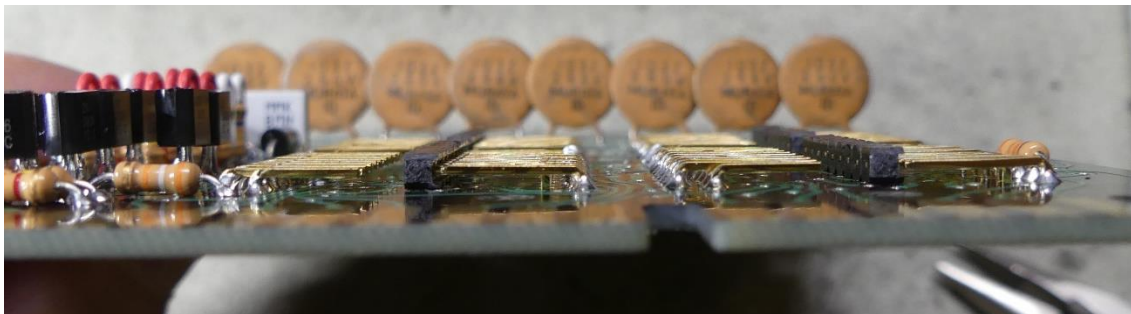
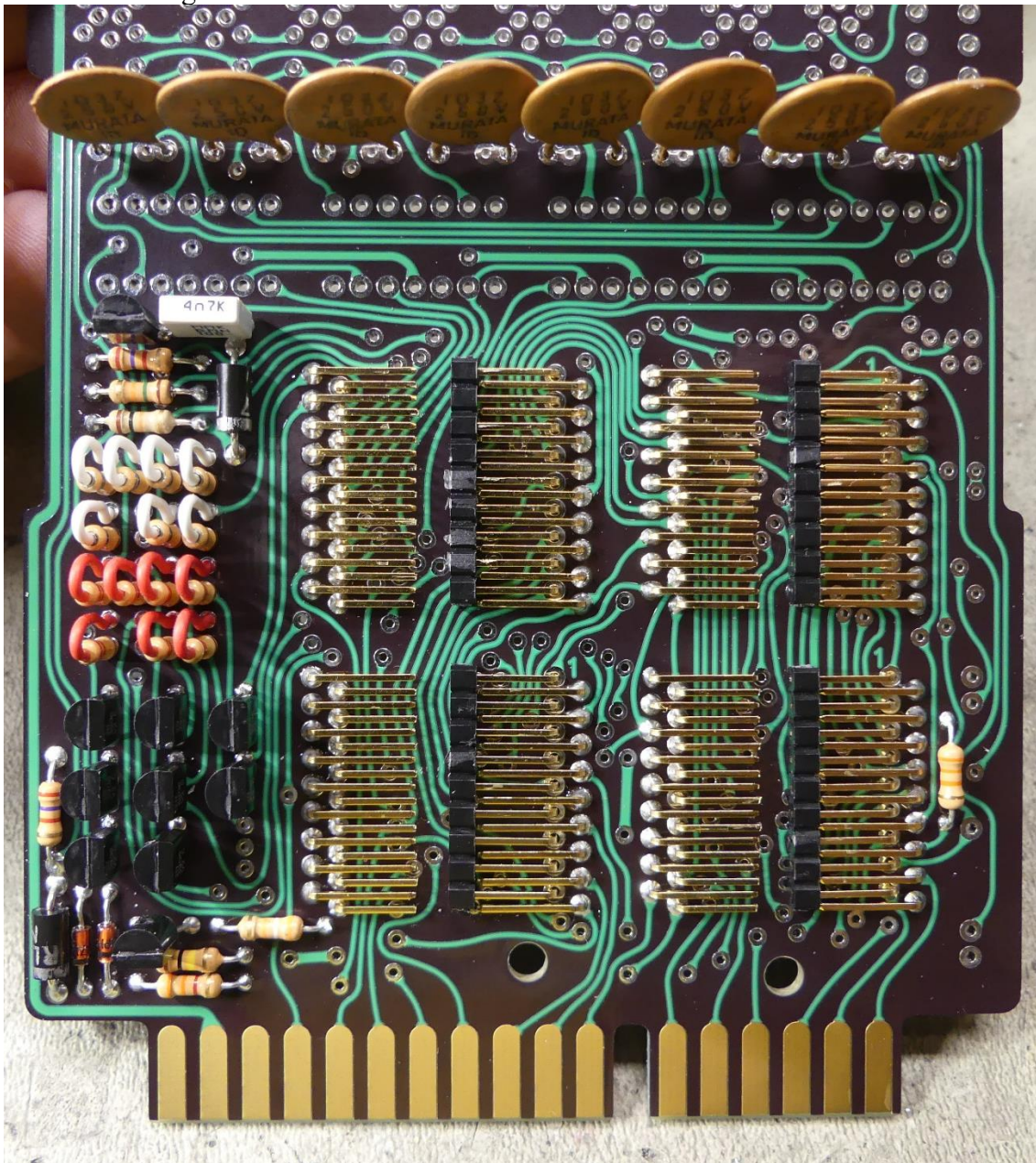
Here is a build where I did the inside rows on the left first:



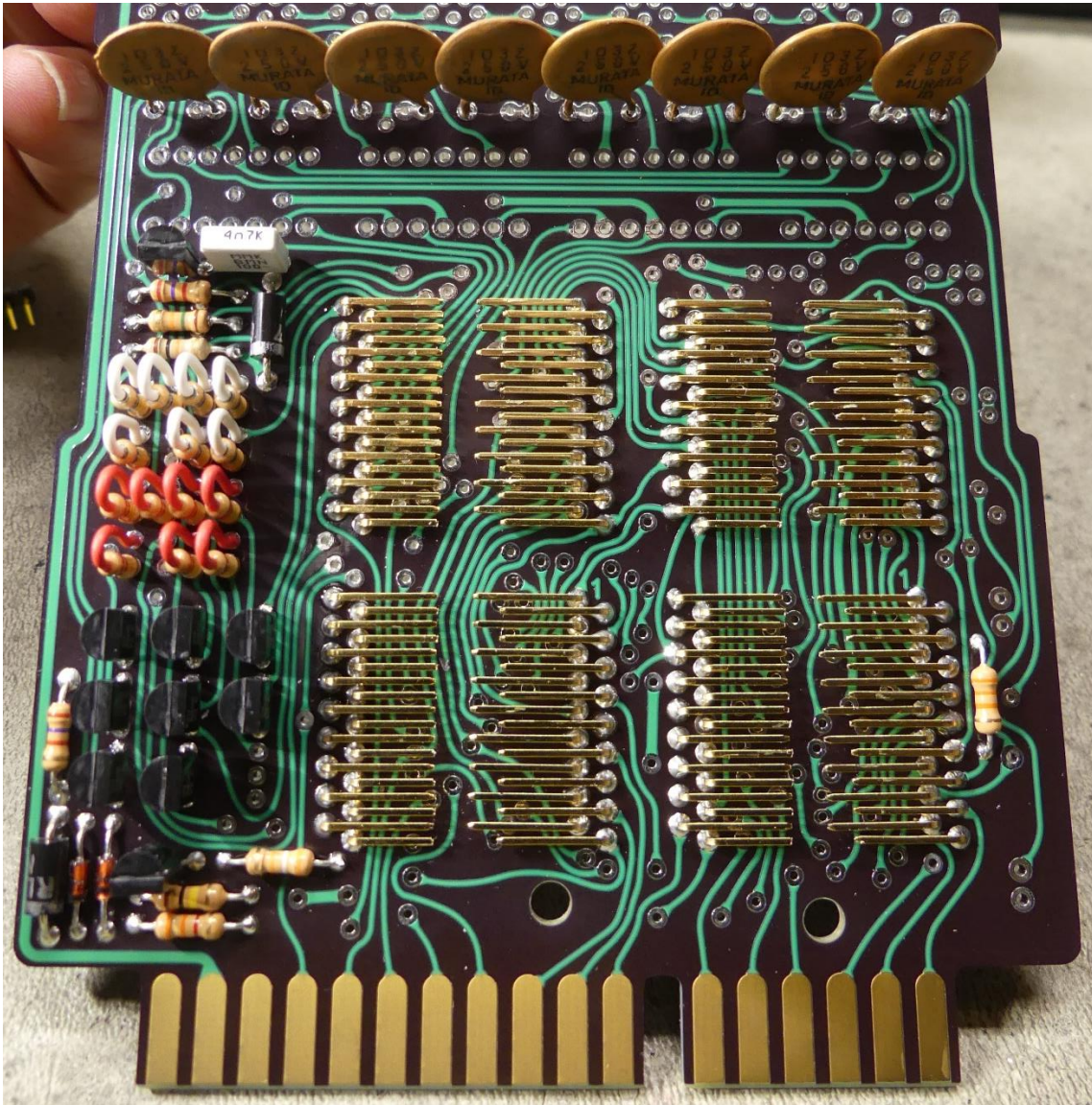
Then remove those black spacers and trim the leads on the inside row that was just completed. This is needed to get the black spacer off of the last (right hand side) inner rows:



Then add the right-hand side inner rows:



With all of the pins soldered and all of the black portions removed, here is what the board looks like:



Now for the Black ICs...

I decided to apply the dry rub on labels before mounting the parts to the board. The Black parts have one side glossy and the other has a matte finish. I chose to have the matte finish on the top side, but whichever you like best use that. I cut the rub on transfers into the individual labels.

Apply with the SANYO label right side up and the small notch in the black acrylic to the left-hand side.



Then use a piece of cellophane tape to hold it in place while it gets burnished:



Try to only rub on the white lettering directly and not just across the entire surface. There is adhesive over the entire surface of the transfer, so you do get extra goop on the part if you just rub across the entire surface. Notice the notch on the left and the lettering is right side up. This extra residue is much harder to see on the matte surface.

Peel up the tape and carrier from one side and make sure all the lettering is transferred. By keeping the other side still taped down if something doesn't transfer this will help keep it all aligned.

When removed, you can use the other portion of the rub-on (the backing that was keeping it from stickling to something else) to place over the finished part and rub down the whole thing again to make sure it is well attached to the black part.

Tips for rubdown application from the dry rub manufacturer:

- Remove the backing sheet and place the rubdown in the appropriate place.
- It is important not to move the sheet once you start burnishing the letters.
- When burnishing, be sure not to miss any part of the letterforms, especially the thinnest parts. Also, try to burnish only the letters to avoid transferring excess adhesive from the back of the sheet. You will see a slight change in color as the rubdown releases.
- When complete, slowly remove the sheet, starting with one corner and taking care that the entire rubdown is releasing. You may need to reburnish any part that was missed.
- Once complete, place the backing sheet over the rubdown and reburnish lightly.
- Excess adhesive can be cleaned with a solvent, such as Bestine®, a rubber cement thinner. Carefully wipe the rubdown area with a soft, cotton pad with the solution.

I haven't tried any solvent and since this is on acrylic, you should test any solvent on the bottom side of the part to make sure it does not do something whacky to the surface you want to clean.

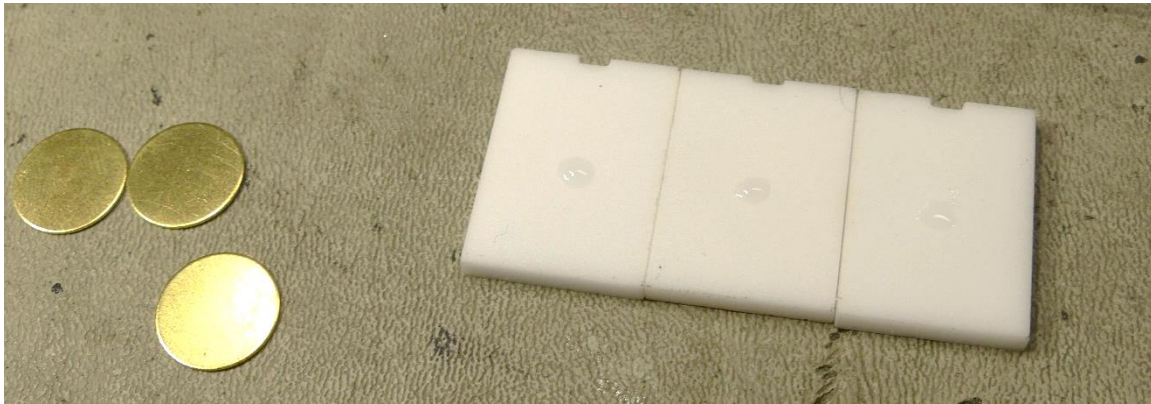


Now for the white ICs...

Grab the white (thinner) laser cut piece of acrylic and peel off the protective paper coating on both sides. One side is glossy and the other has a matte finish. I chose to have the matte finish on the top side, but whichever you like best use that. I also ended up spraying a matte protective finish on the parts so it will end up being matte finish anyway.

Clean the copper discs with rubbing alcohol to make sure they are clean and free of oils for better adhesion of the superglue and the dry-rub transfers.

I put a dab of Loctite Ultra Gel Control Super Glue in the middle of the white pieces (on the matte side). For this build I am only putting 3 of the copper discs on the white pieces and am leaving the 4th without the copper disc.



I then put the copper discs on and roughly centered the sticker on the part. Then press down. With only a small dab of blue, there was no squeeze-out, but have a toothpick and paper towel handy (to wipe off anything the toothpick can scrape up) in case you see any superglue coming out from under the disc.

Next, get tape and the Green dry rub transfers. We are going to add the correct markings to the white pieces before we attach them to the board.

I cut the piece out of the folded card first – it was easier for me to do that than to peel off the tape that is holding the dry rub piece to the paper. Now you have one dry rub with just the 4 green logos and the 4 labels for the white acrylic parts.



Attach the tape to just the section of label you are going to use and cut that section out of the larger label set. With the tape still attached, you can lightly place it on the part and use the tape to hold it in the correct place. Too much pressure and the transfer may start, so be gentle!

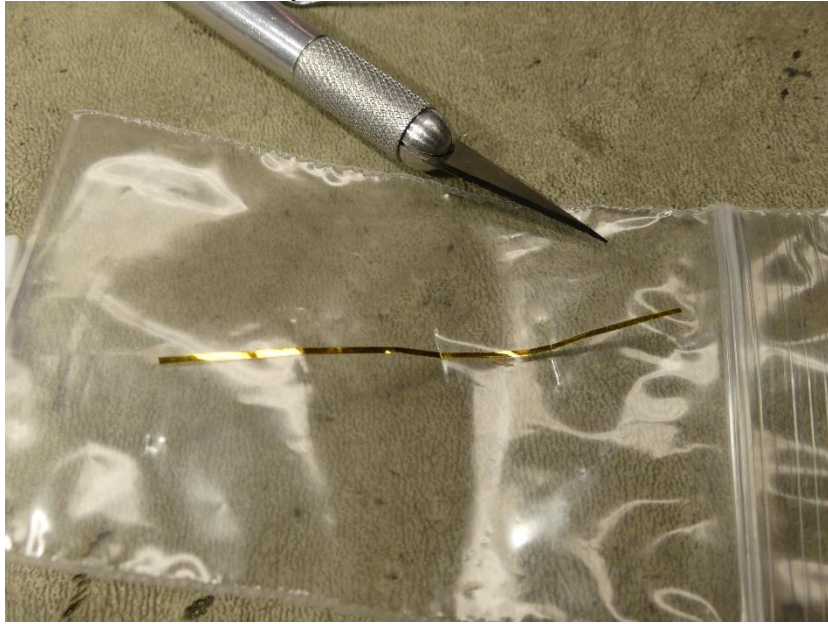


In the actual parts, the labeling was sometimes at a small random angle, but I chose to make them all straight and nearly identical.

I used a toothpick and rubbed across the green lettering first horizontally then vertically. A blunt end works best, so nothing with a sharp point, or use a file to blunt the end of your toothpick.

After the Sanyo labels were attached, I did the same for the tiny green logo (square spiral?). Placing that in the lower right-hand corner of each white acrylic.

Next, I use the thin gold adhesive backed strip to add a line from the brass disk over to the right-hand side of the white acrylic.



Using an Exacto knife (or razor blade), cut the strip into 4 equal sections.

Then align on the top from the brass disk over to the edge of the white part. Once in place, wrap the rest of the gold strip around the acrylic and make sure it adheres to the underside of the white acrylic part.



The dry rub looks great, but can be scratched off fairly easily. Especially on the copper discs, so I decided to coat both the black and the white parts with a matte clear coating for extra protections. I used Rustoleum Matte Clear Enamel rattle can spray for this (and also later for the dry rub on the black “pillow” part).

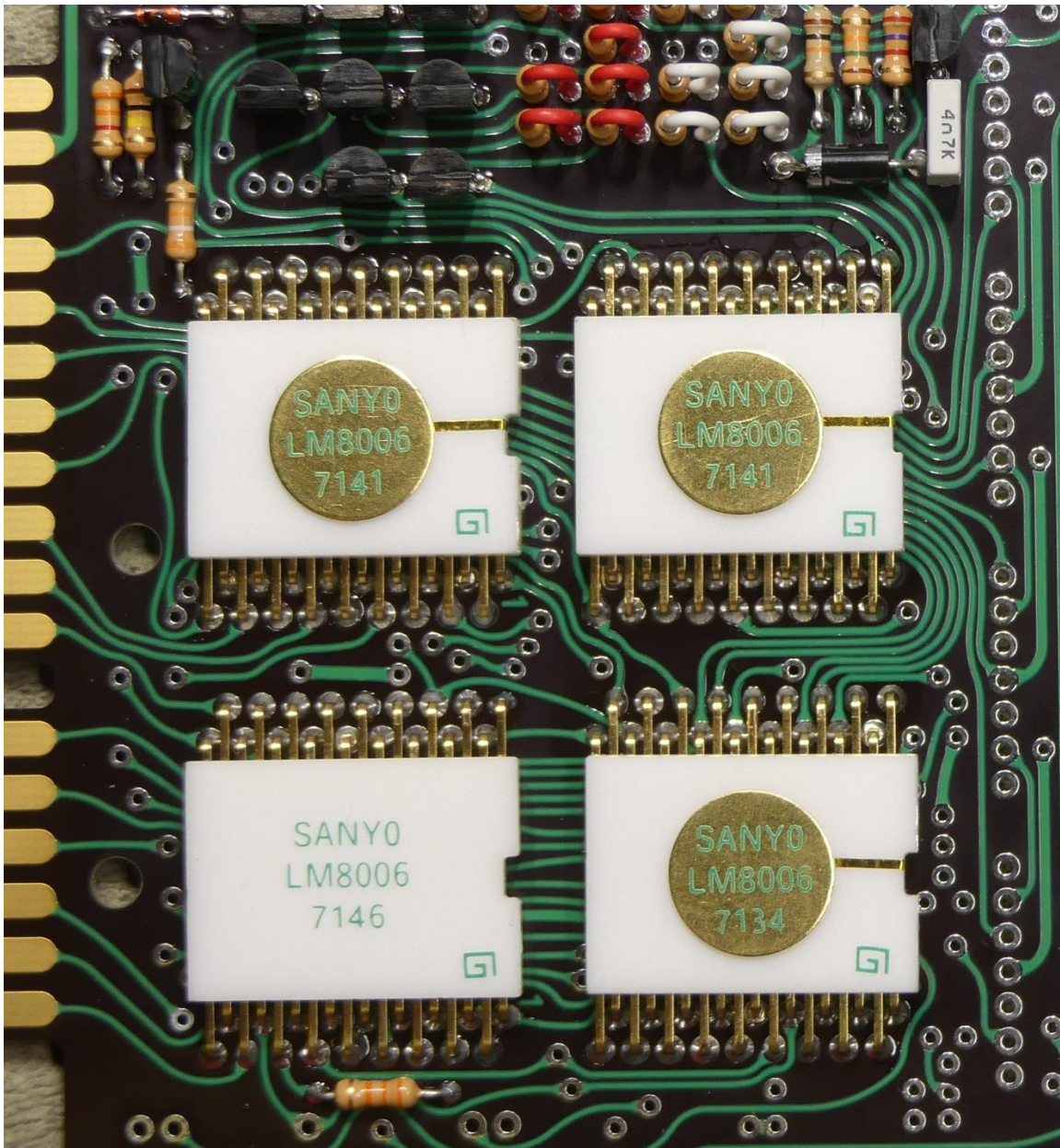


After the coating dried, here are the parts:



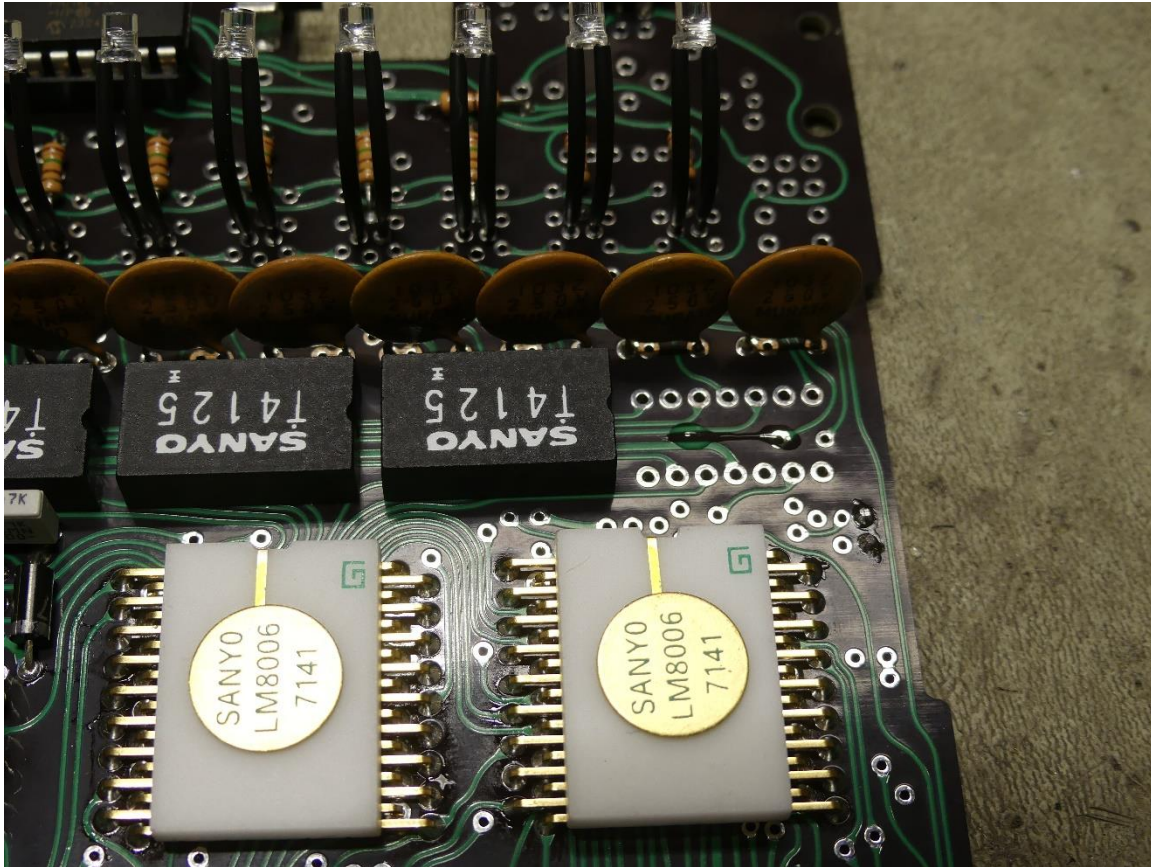
Now ready to mount, the parts need to be attached to the leads on this board. I used Loctite Ultra Gel Control Super Glue. A few drops on the inside tops of the inner portions of pins from all four columns. I did not put glue on the outside pins and only on the inside portion of the pins so no glue would reach the edge of the acrylic part and show. Then I carefully positioned and centered the part on the pins and waited a few minutes for the glue to dry. I did this one at a time, since I tended to bump into the other pieces, I wanted to make sure they were firmly attached before moving on to the next one.

Others have suggested roughening up the underside of the plastic parts for better glue adhesion. Also consider using an epoxy instead of superglue.



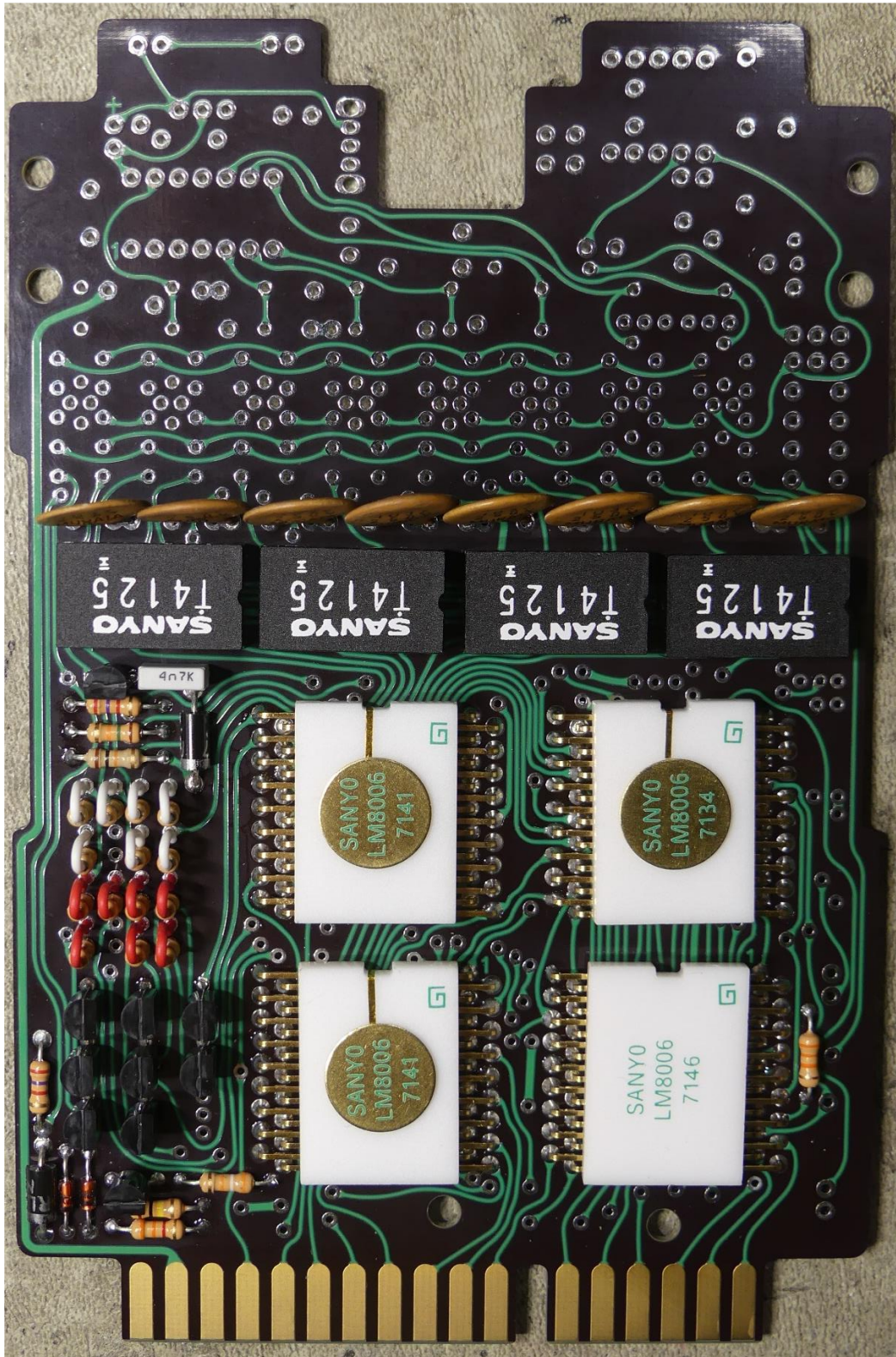
You can glue the part directly to the board, either the gel super glue or a dab of J-B Weld KwikWeld epoxy. I used the gel super glue for this build.

Start with the two middle parts and make sure they are spaced and aligned well, then let them dry (a few minutes). Then you can move to the outer parts without worrying about disturbing the position of the inner parts.



Using the KwikWeld allows a much more forgiving alignment process since the parts do not move around too freely but are easy to adjust – at least for a few minutes! The super glue sets much faster, but I have done this a lot so used super glue...

All of the black parts are mounted with the indent to the right side of the board and the lettering upside down with the board gold edge fingers pointing down. See the reference photos below.



Others have suggested roughening up the underside of the plastic parts for better glue adhesion.

Display Tube parts kit assembly



The bag contains the following:

- 1) Foam gasket for error box (best to put on after all of the handling of the display!)
- 2) 8 tube end-caps
- 3) 2 sets of #4-40 $\frac{1}{4}$ " screws and nuts for attaching the display stand
- 4) 1 #4-40 $\frac{3}{16}$ " screw – spare for attaching the error box (which is already attached)
- 5) 24 AWG tinned solid core wire to simulate tube wire leads (128 inches)
- 6) Heat shrink tubing to cover the wires
 - a. Red
 - b. Black
 - c. Clear

The Display tube do not have any wires coming out of the tubes so these need to be added. They are only for looks and do not carry any electrical signals.

The display tubes will be sitting at an angle, so the front tubing is longer than the back tubing. This also appears to be what was done in the Sanyo board based on some measurements of the wire in the photos.

The first step is to cut the long tinned wire into 4" pieces. 4 per tube, so 32 pieces will be needed (hence the need for 128" of wire!)

To make sure you do not get to the end and find you do not have enough wire, you can cut the wire into 16" sections, one section per tube. Then cut each 16" piece into 4 equal pieces of about 4" each. This is generous, so if some are a bit shorter it will still work out fine.

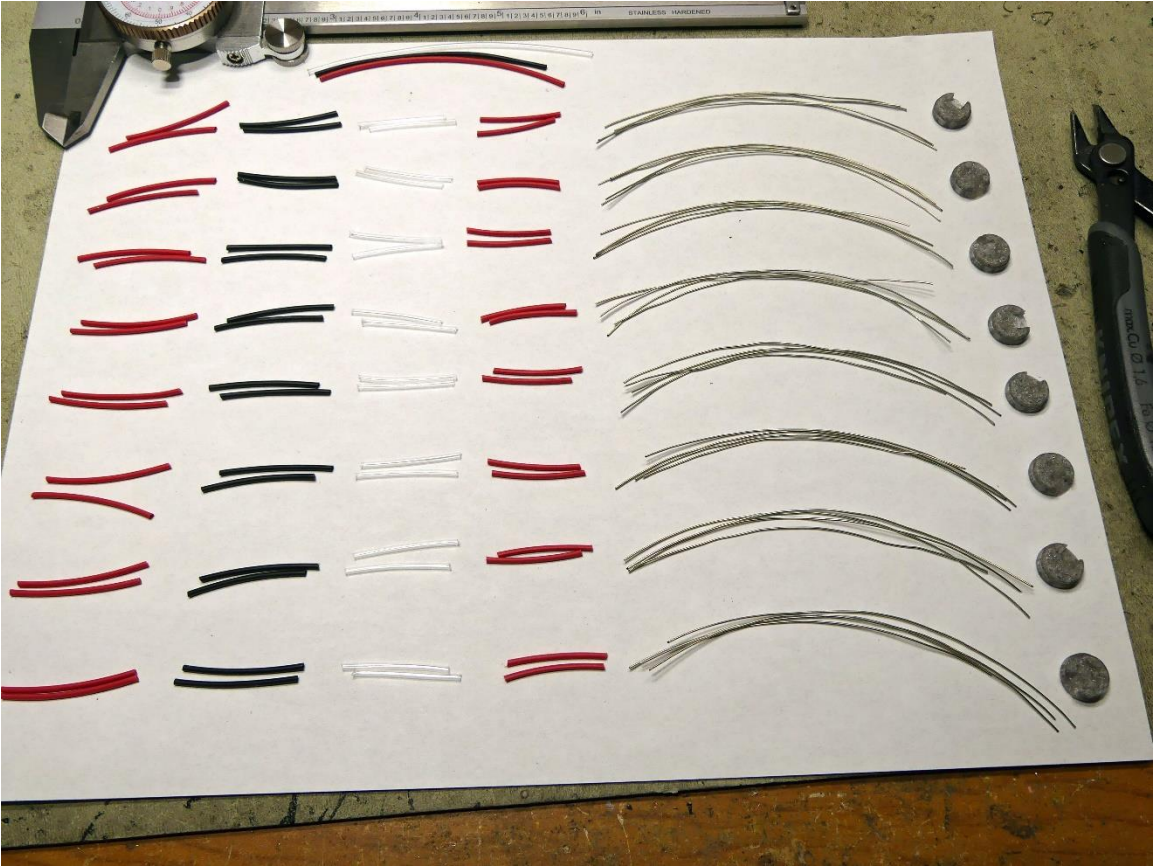
Next start cutting the heat shrink tubing into pieces of the desired length. By cutting one tube of the correct length and then using it as a reference for the next 15 it was easy to get them all about the same length. It also worked well to measure/cut them all to the length the calipers were set to. Whatever works best for you.



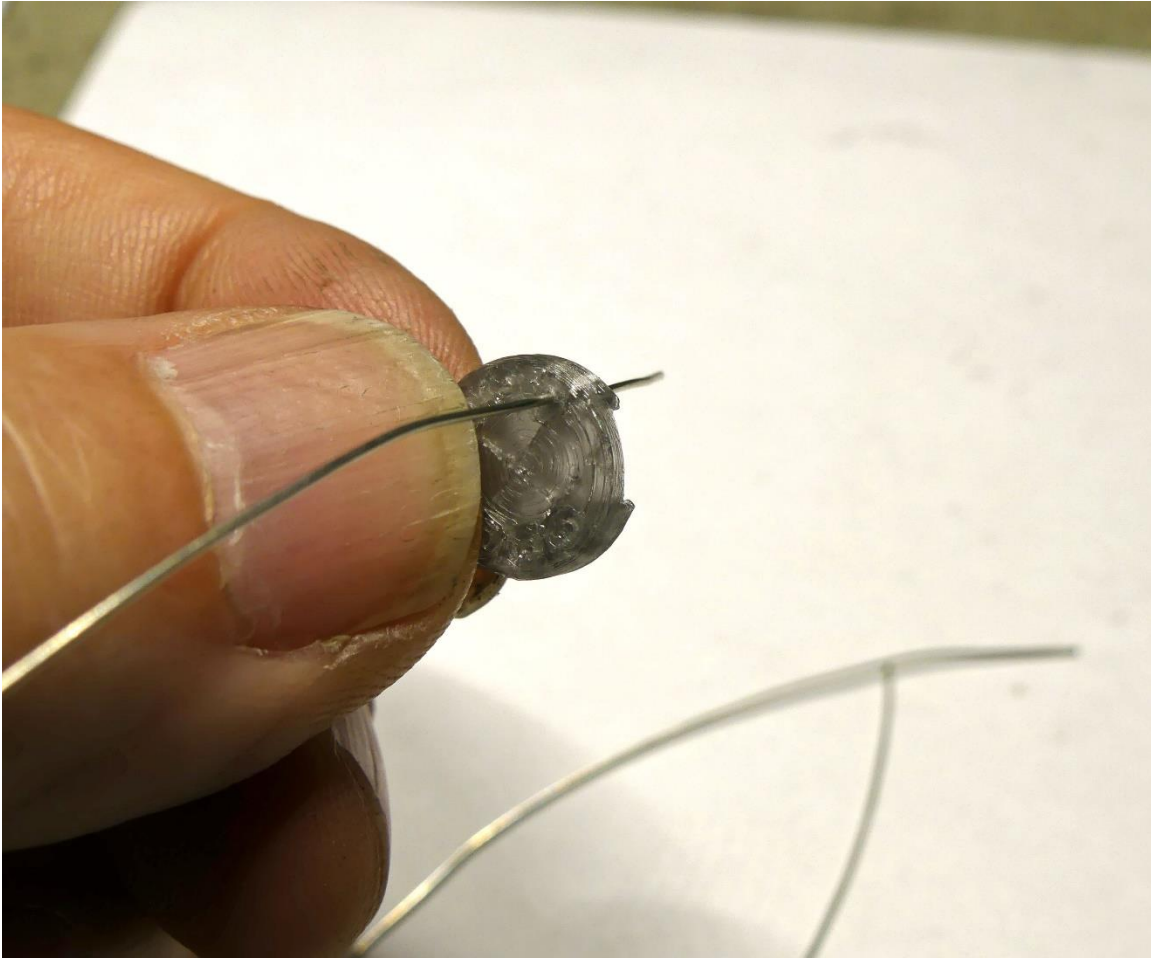
Here is what is needed:

Tubing Color	Length	Quantity
RED	1.25"	16
BLACK	1.175"	16
CLEAR	1.05"	16
RED	0.95"	16

Laying out the cut pieces of tubing, wire and the tube endcaps, one set (row) per display tube:



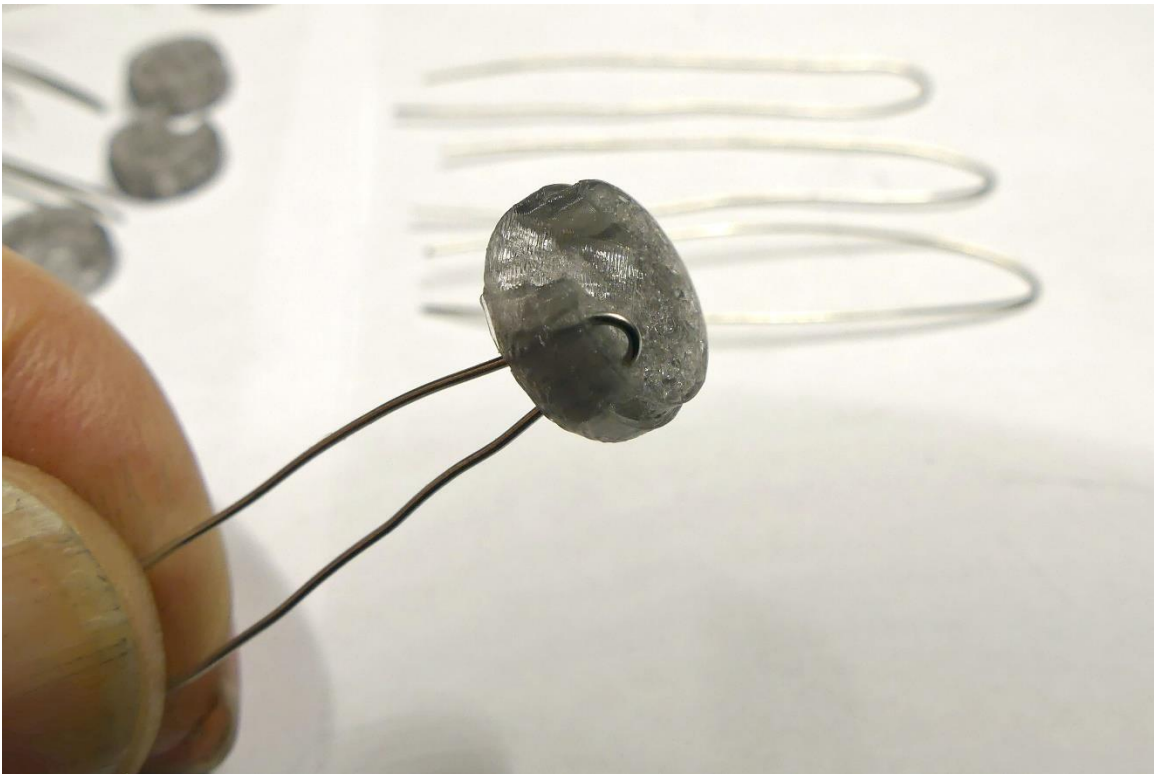
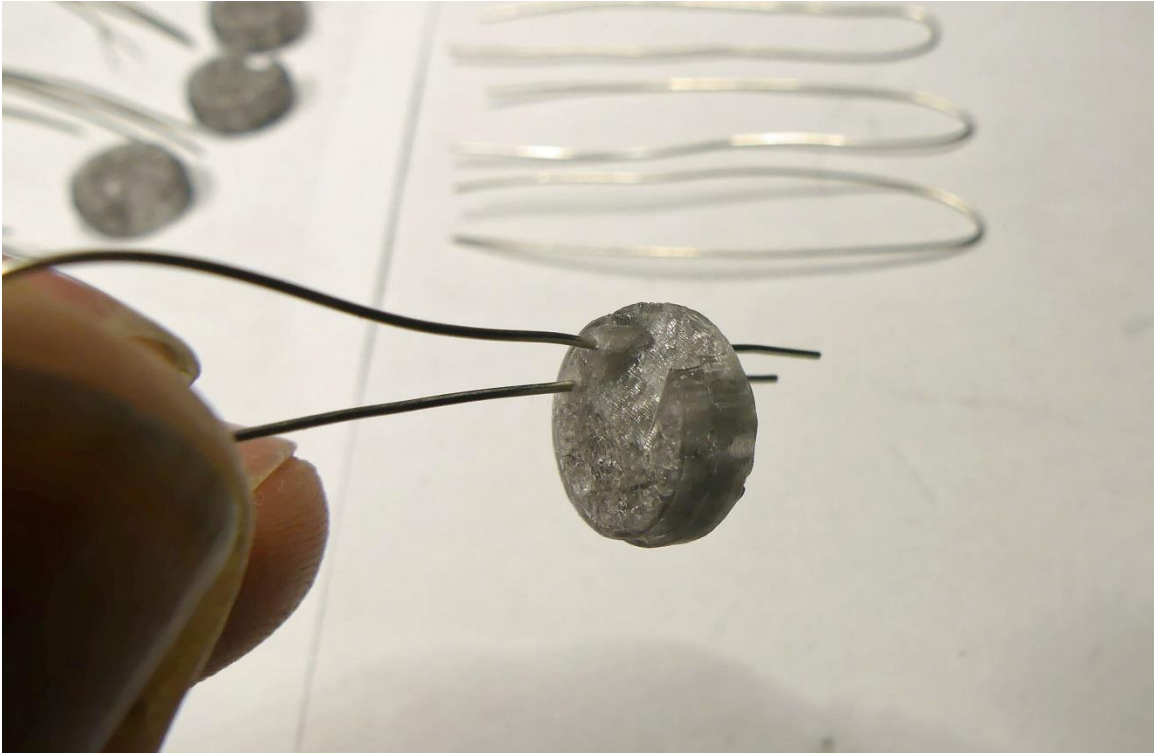
Next, take one of the pieces of wire and make sure all of the holes in the tub end cap are clear and wire can go through them:



There are 8 holes equally spaced around the outer edge.

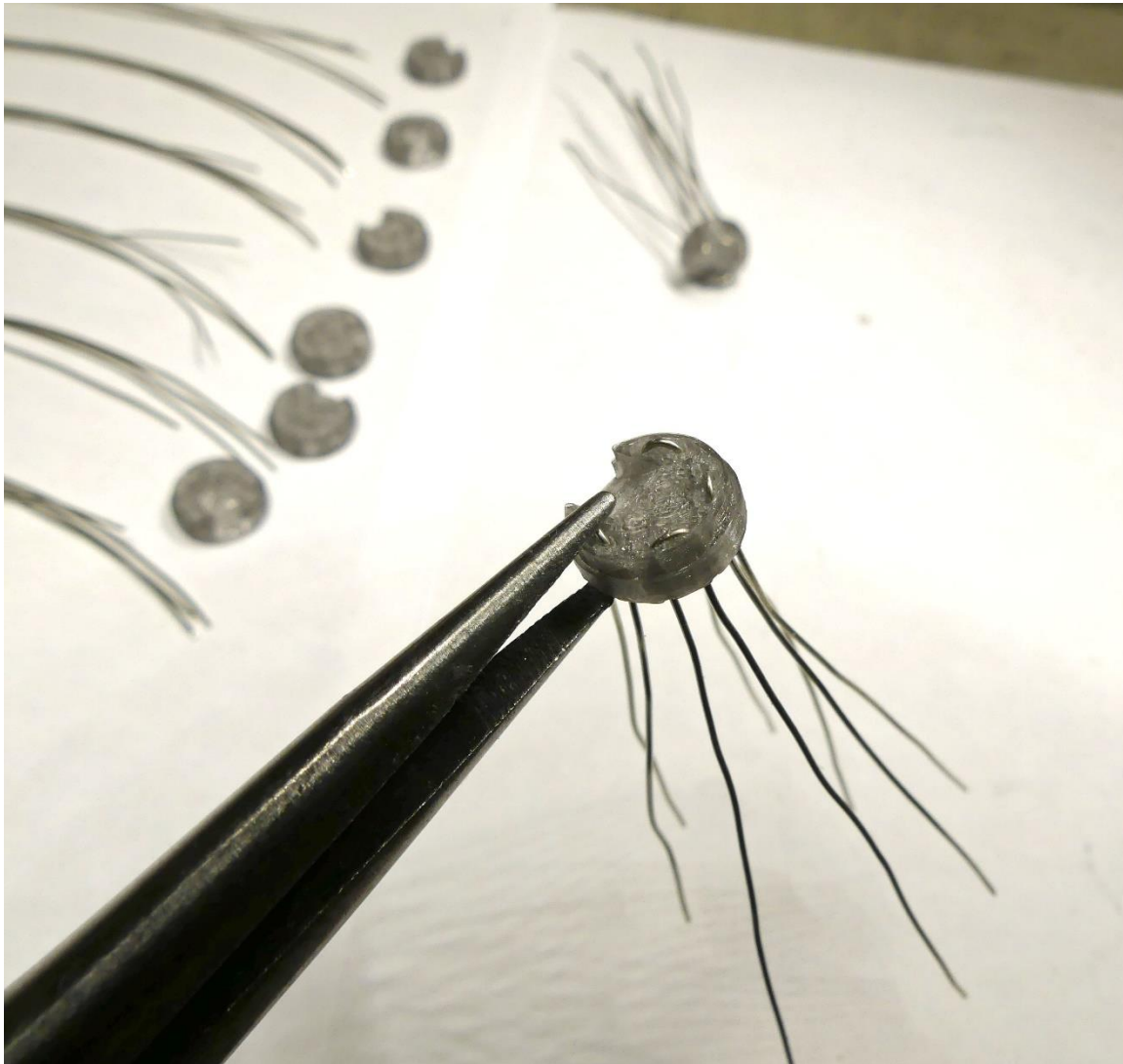
There is a ramp on the inside facing portion of the end cap. This is to let the flex circuit exit each tube. The flex circuit is what provides power to and control of the LED segments inside the display tube.

For each of the four wires, bend in half (no a real tight bend) place the two ends through two adjacent holes and push from the inside towards the outside surface of the end cap.



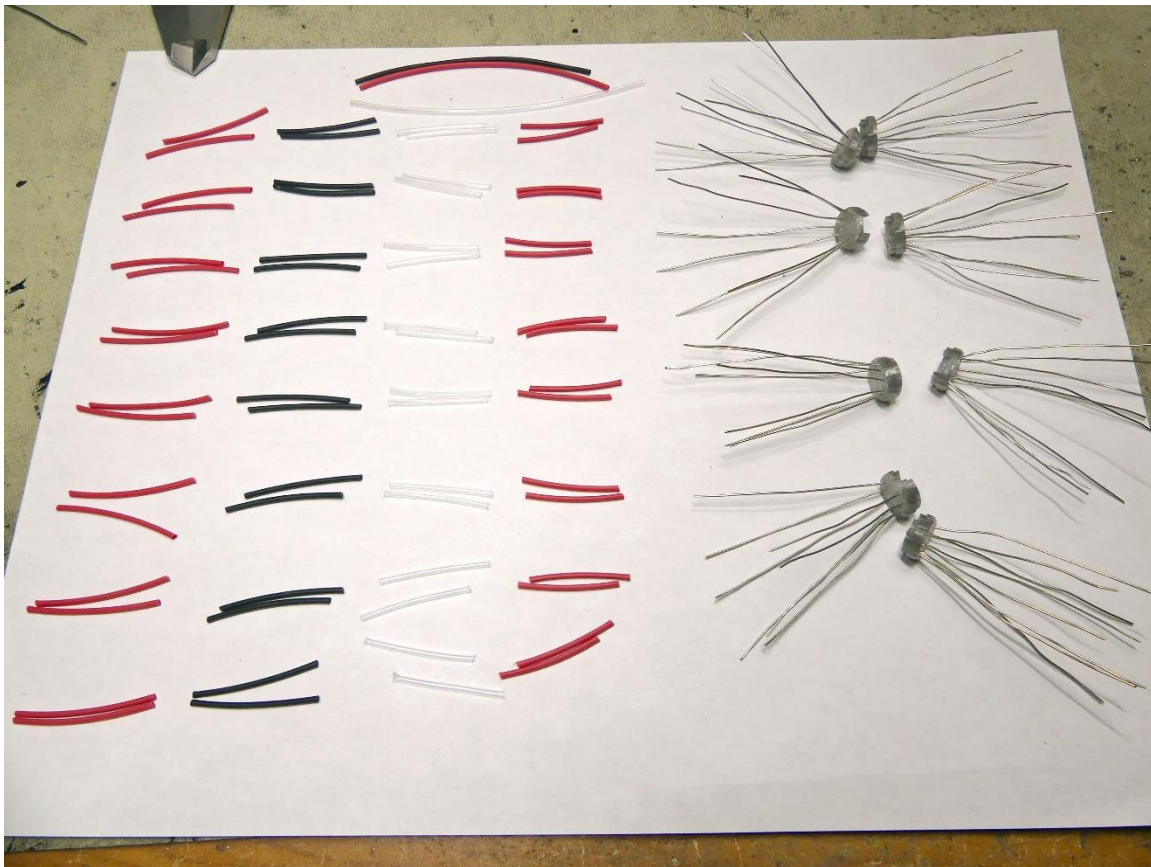
Start next to the “ramp” and work your way around the outside semicircle of holes.

I sometimes used my skinny needle nosed pliers to make sure the loop did not extend too far out from the end cap:



The above is how each end cap should look when the wires are inserted.

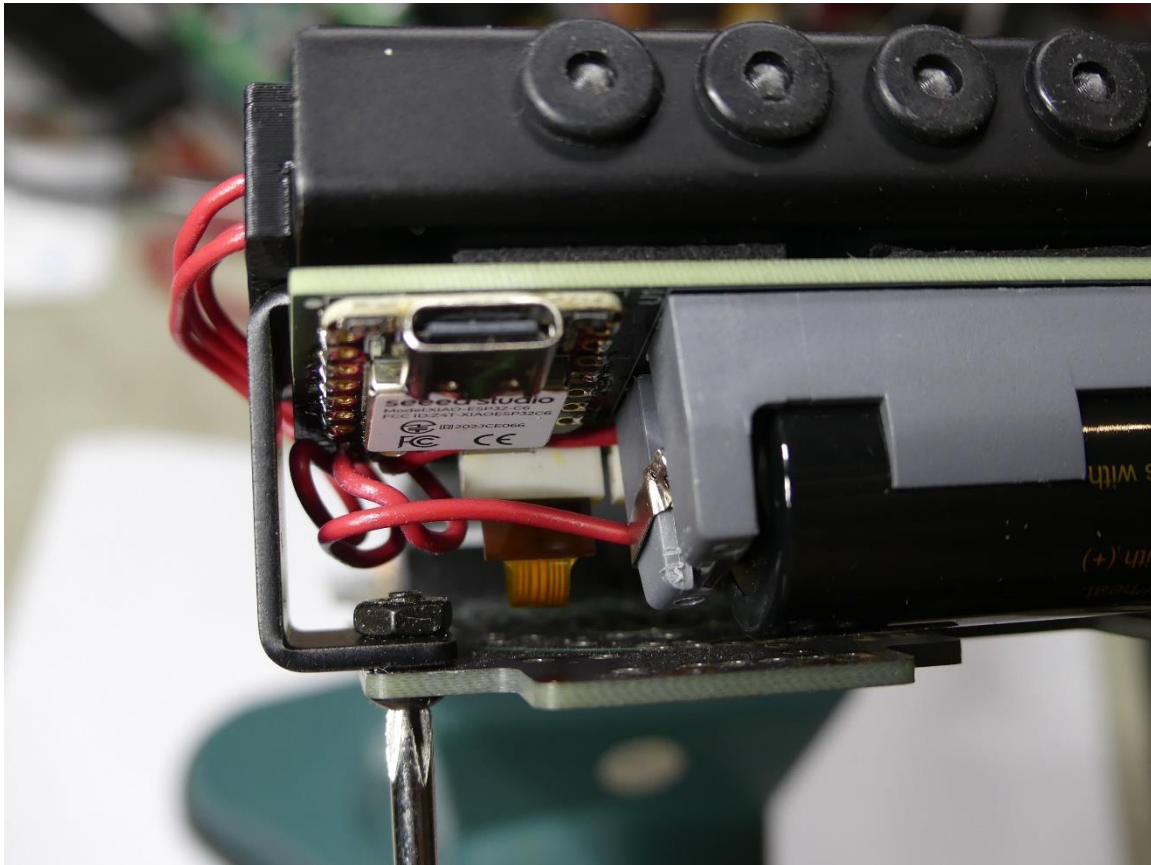
Here is a picture of the completed endcaps with all of the wires installed. It is fine to have the wires slightly uneven in length. The wires are long enough this should not be a problem as long as they are approximately the same length.



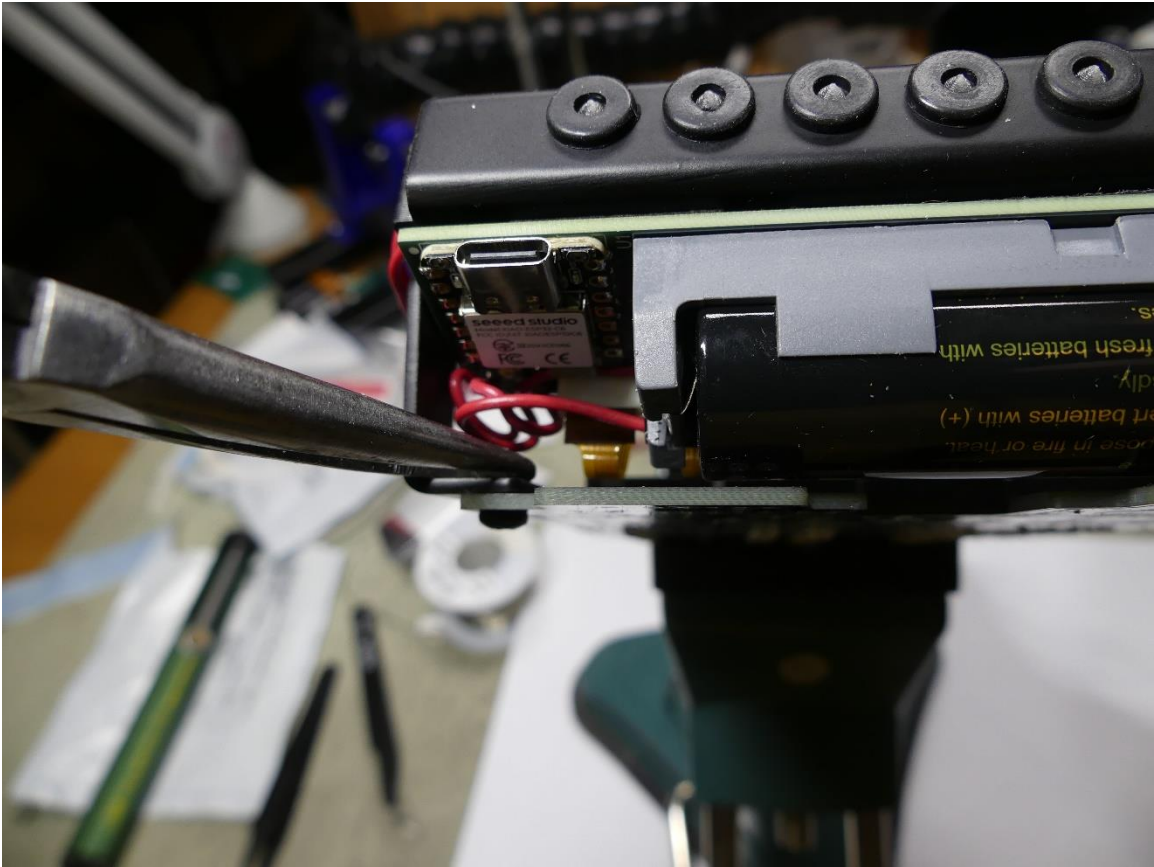
The next step is to install the display assembly onto the circuit board. This uses the two sets of #4-40 1/4" screws with nuts. One set on each side.

The display stand needs to sit on top of the circuit board since the battery holder and battery extend far enough that they almost touch the circuit board. Removing the battery would require removing the display stand, so best to avoid that if possible. The battery can be charged with a USB cable from a wall charger or computer. A cable with a USB C connector on at least one end is needed to plug into the USB connector on the underside of the display stand.

Start on the side under the USB connector, there is the most clearance for this side. If needed you can adjust the red wires to give a bit more room.

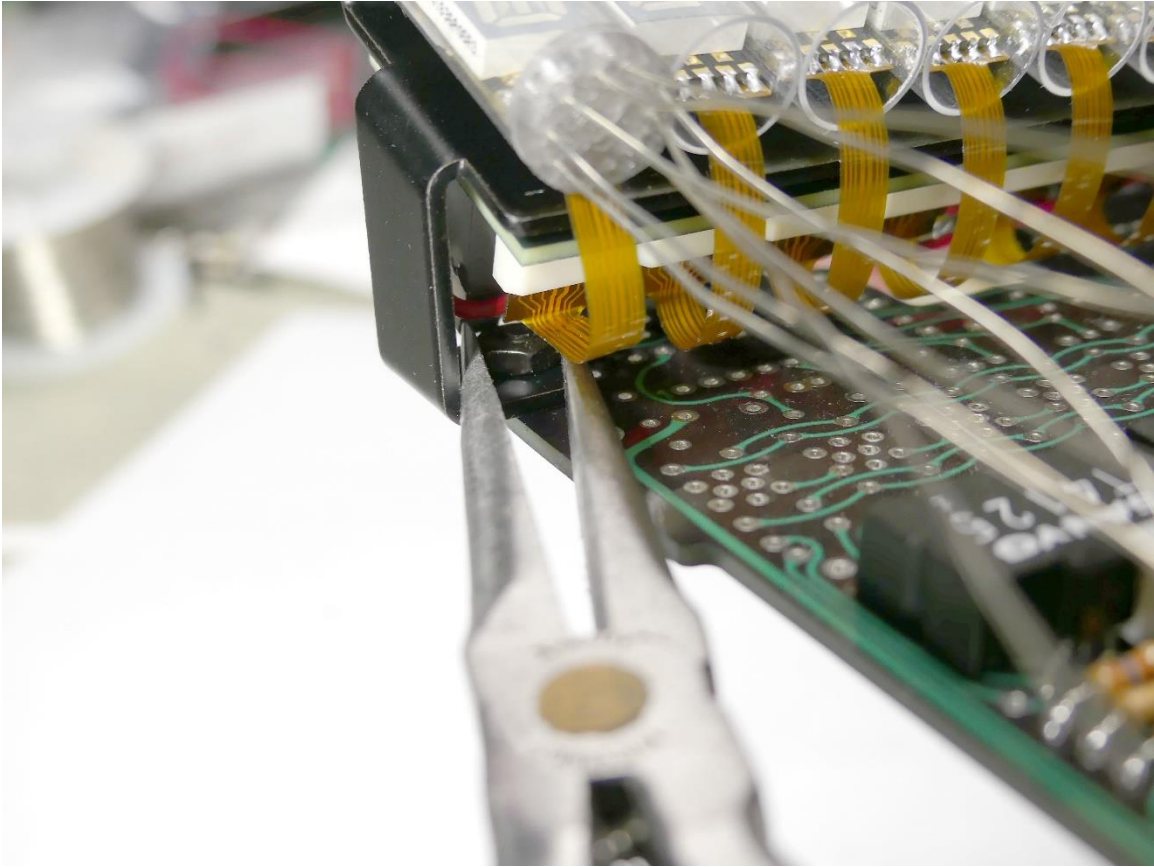


I sometimes use my needle nose to hold the nut to get it started:



Now align the other side and tighten the one installed screw so that it does not move easily while working on getting the other screw in place.

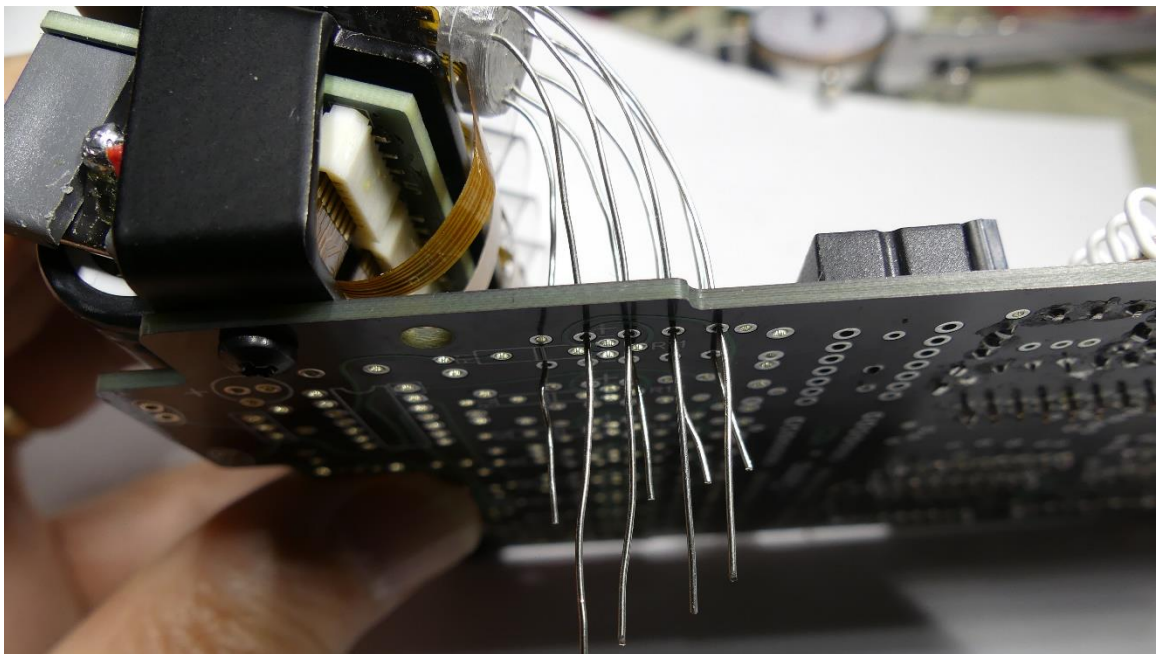
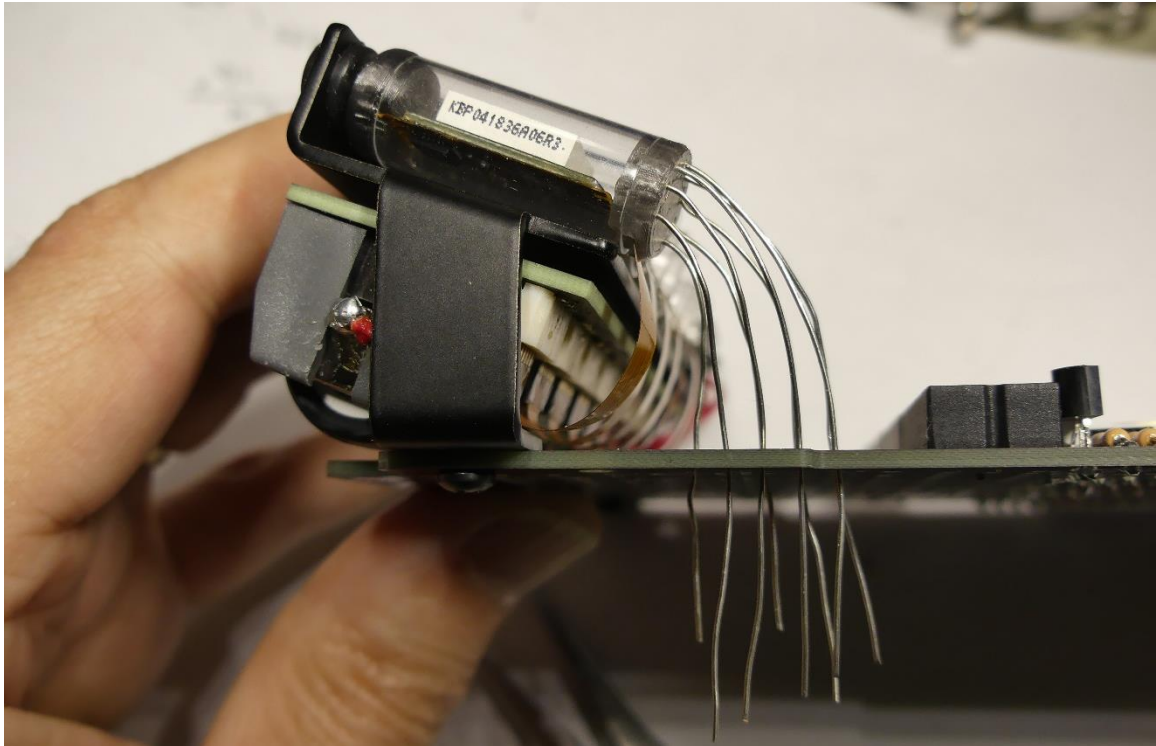
Great care must be used on this other side since you do not want to damage the flex of the display tube that (of course) is directly in the way of getting the nut in place...



You can see that the needle nose pliers I am using are lifting up a bit on the flex circuit. This is fine but take care not to bend it too much (putting a kink in the flex is not good).

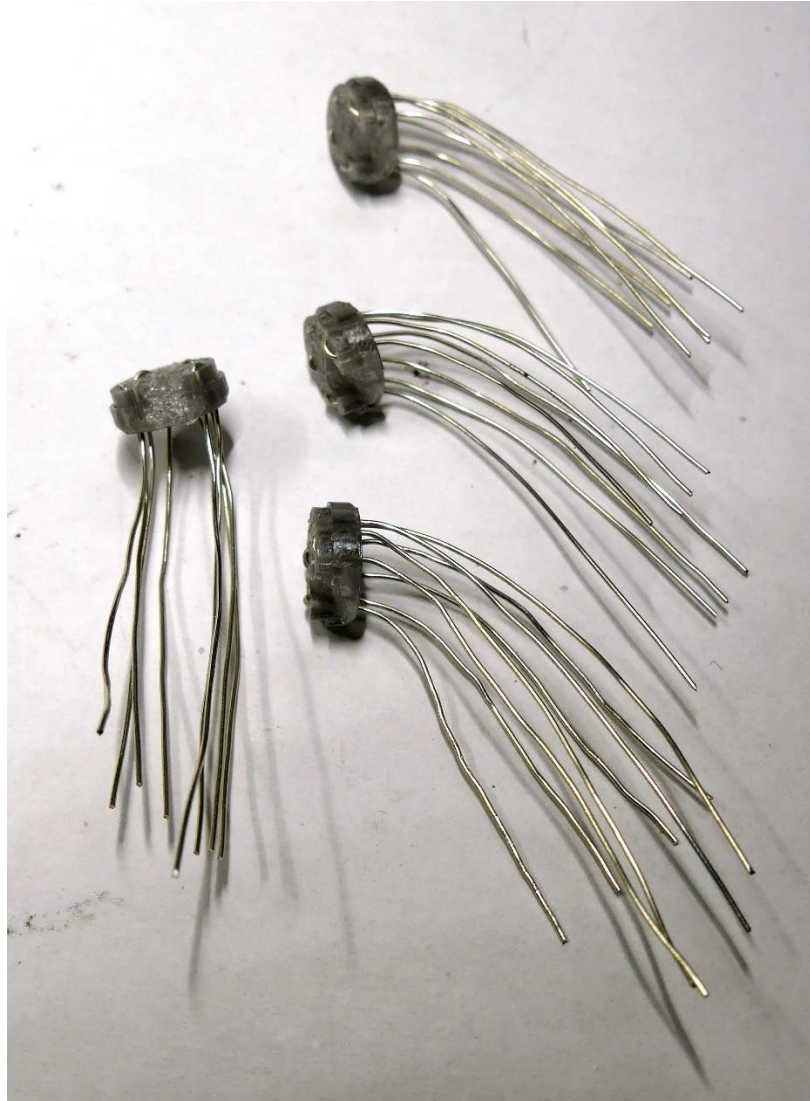
Next dress the wire leads on one of the end caps and do a test fit to see how the leads need to be bent. 4 leads on each side of the “ramp” in the end cap need to be in a row since the holes on the circuit board are in a row.

With each set of 4, the leads need to be shaped like shown so they can go from the top down into the circuit board.



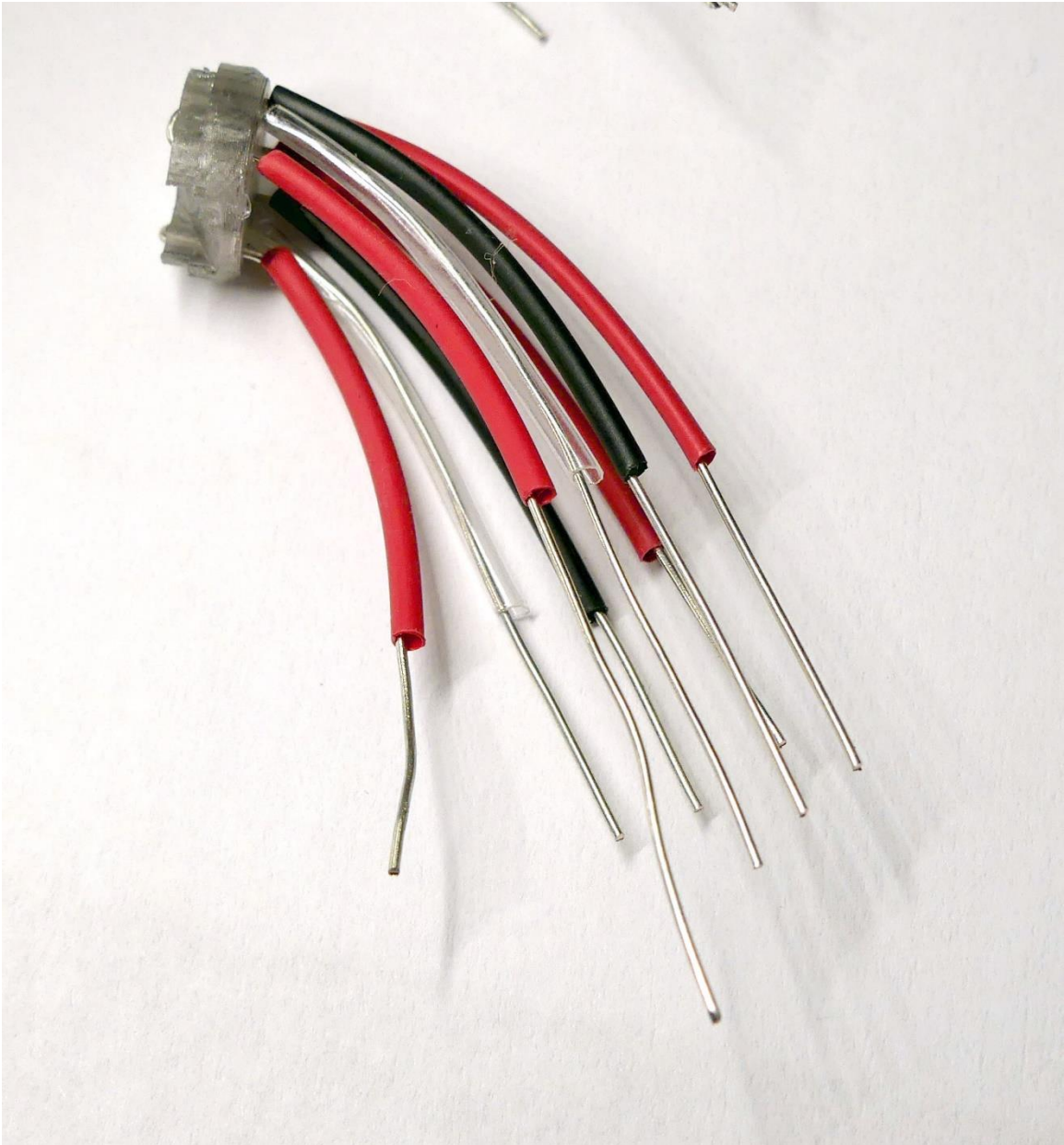
DO NOT SOLDER THIS IN YET! This is just a test fit and a way for you to have a reference to bend all of the wires. We need to add the heat shrink tubing before we actually mount and solder all of the end caps with wires.

Examples of the bent and dressed wires:



The set on the left is looking from the bottom side so you can see how the wires on the left and right sides are in straight rows. The three sets on the right hand side are a side view so you can see how they are curved.

Once bent, the heat shrink needs to be added to the wires.
The same sequence for each side, starting with the wires closest to the tube:
Short Red, Clear, Black, Long Red



Here is a picture of all 8 ready to be attached. The one on the lower right hand corner is angled so you are looking between the two straight rows. All of the others are shown from the side.



Time to attach the ends!

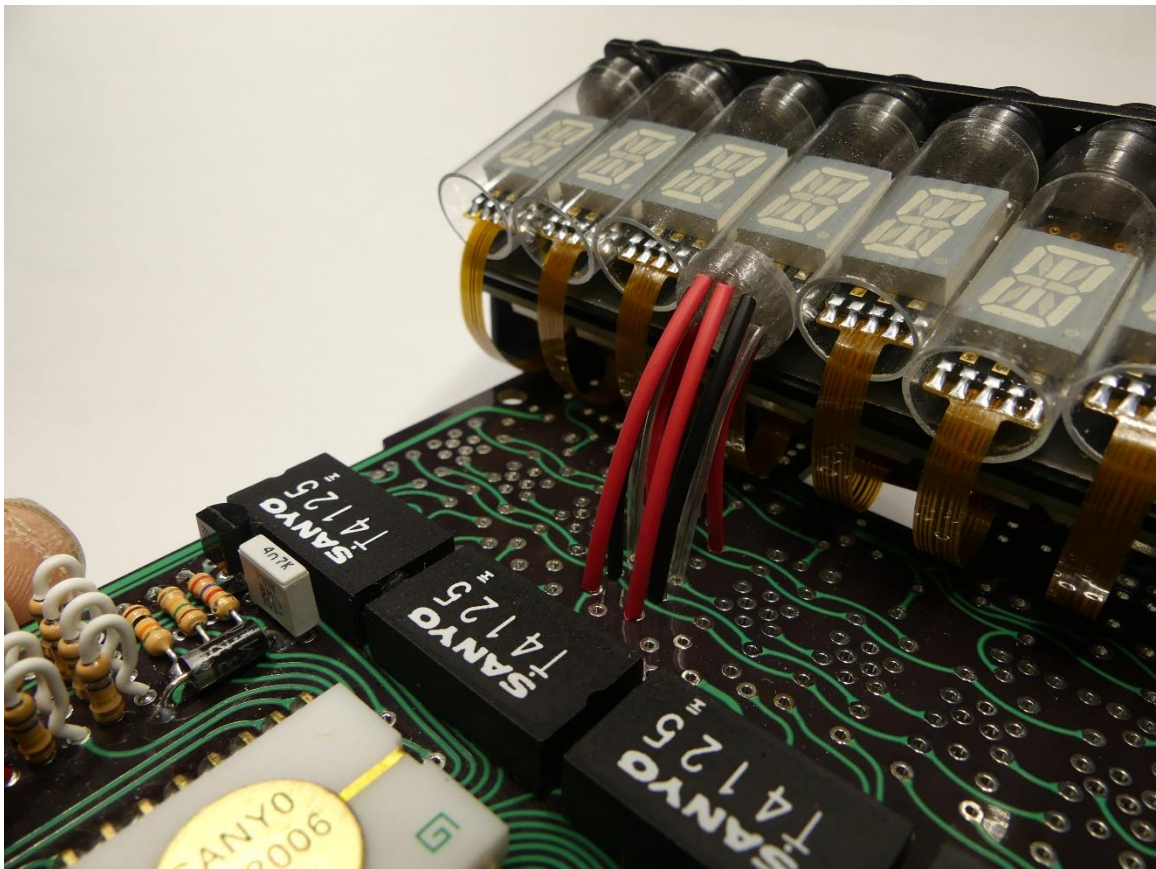
From the top view here is the color coding of the leads that will be going into the two columns of holes:

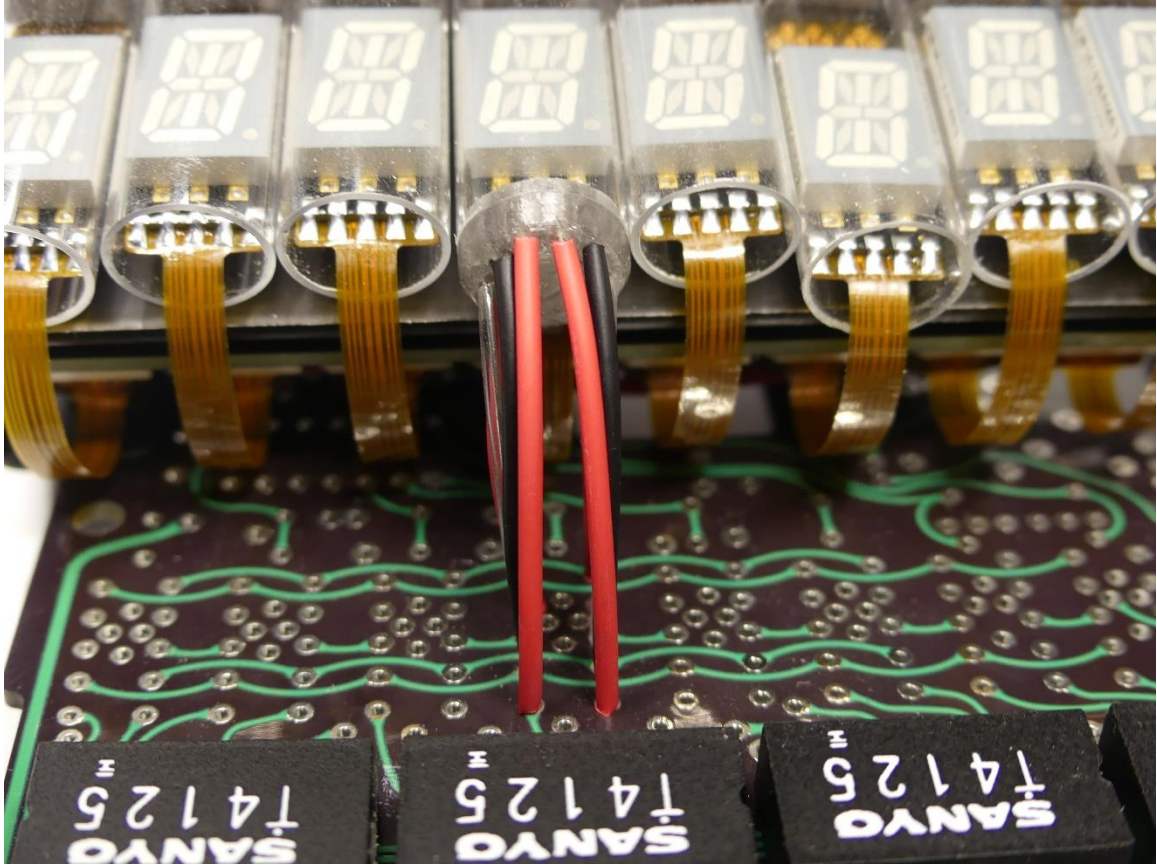
Closest to tube

X	Short RED
Short RED	X
CLEAR	CLEAR
BLACK	BLACK
Front RED	Front RED

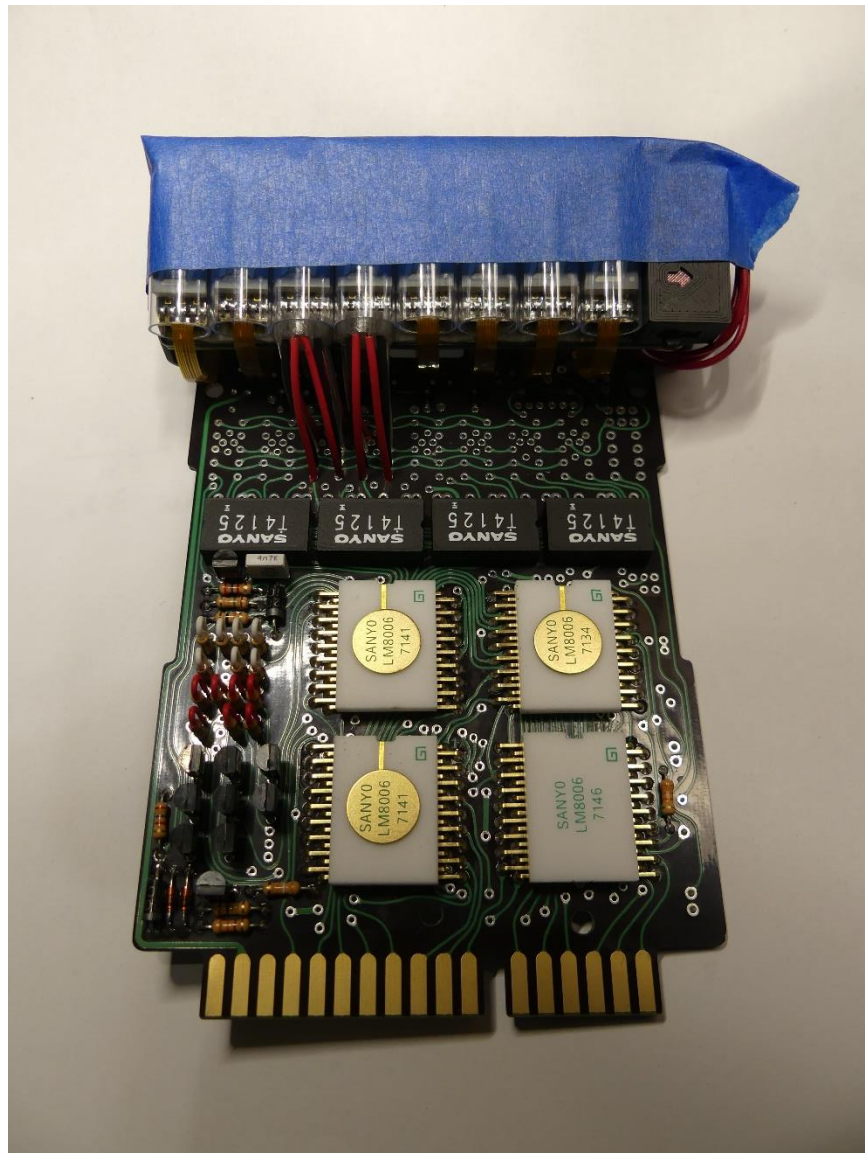
Closest to row of caps and black Sanyo ICs

Not sure the best place to start. Probably from one side. So of course I started in the middle...

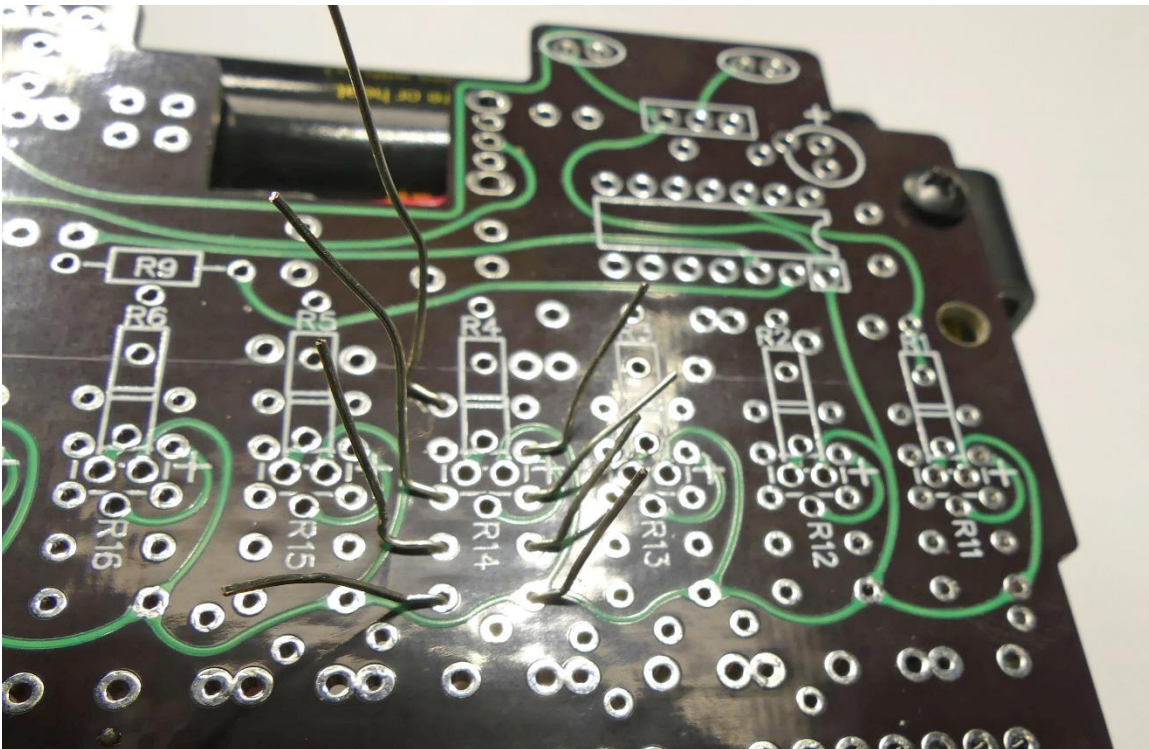
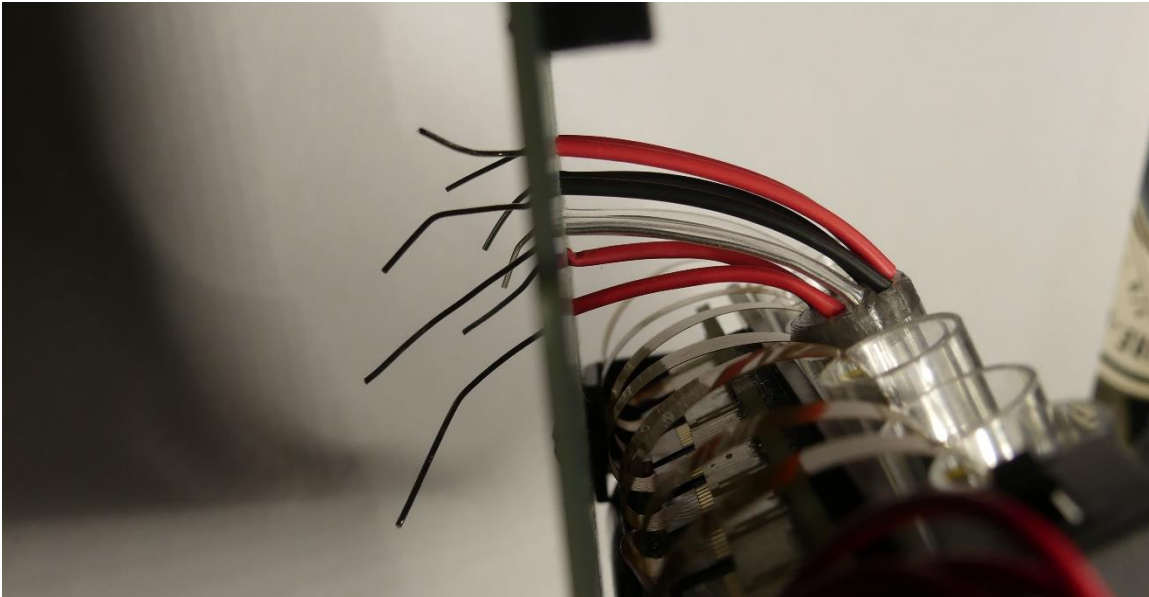




You can see one of the tubes to the right popped out of the tube top. This happened to me a lot, so I decided to use some painter's tape to hold all of the tubes in place while I was working on getting the wires added.



For each set of tube wires, I start by getting one side's set of 4 wires in first. Then to hold those in place I bend the long leads on the underside of the board (shown below all 8 wires are in!)



Reminds me of the Alien face hugger legs...

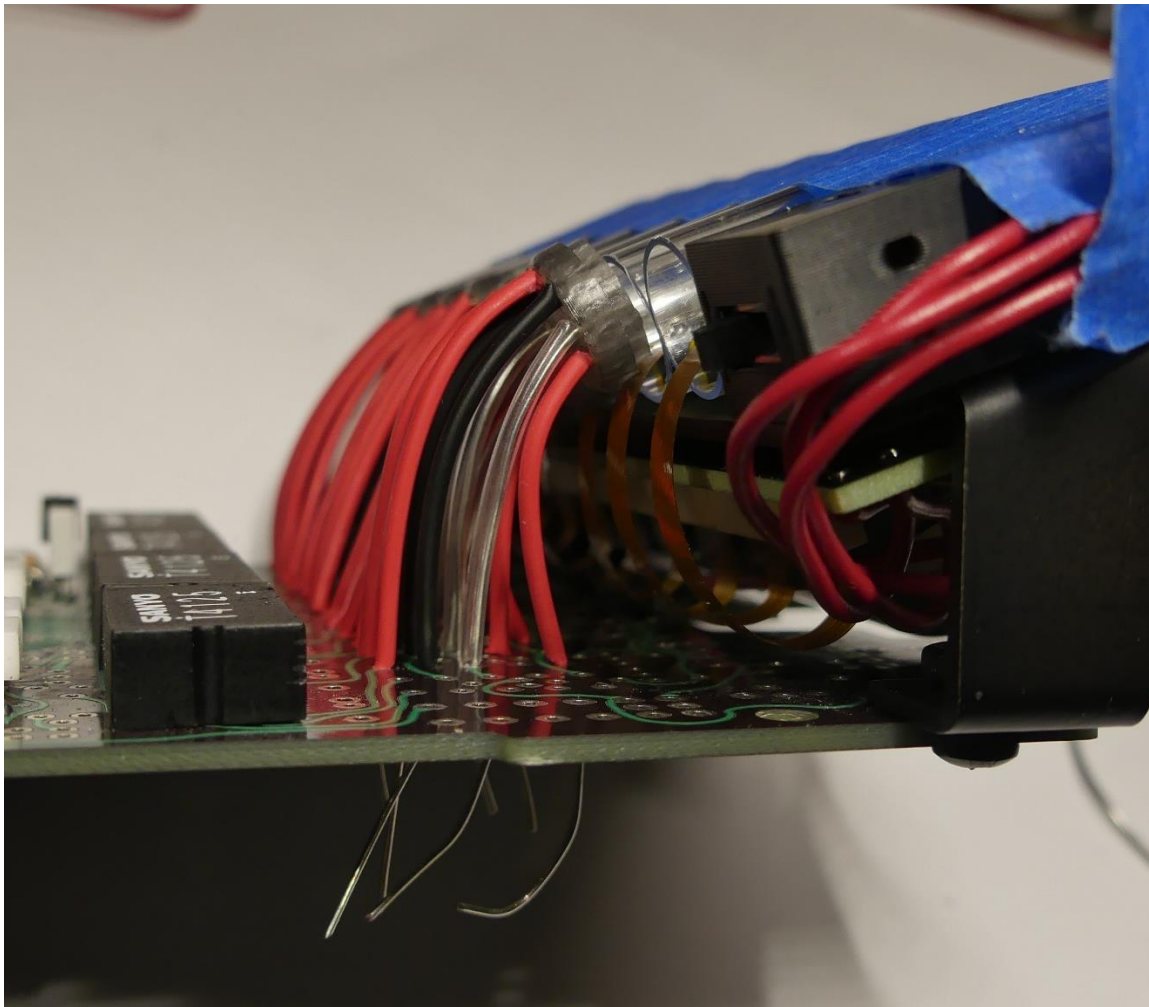
Then insert the other 4 wires from the other side of the tube,

Then move back to the tube side and make sure the end cap for the tube is fully seated into the tube. Then make sure the wires are all covered by the heat shrink. If bare wire is still showing, pull on the wire from the bottom side of the board to shorten the wire on the top side of the board.

Once the end cap is securely in place and the wires look covered and about correct, then it is time to solder those 8 wires in place and then trim off the excess lead from the bottom side of the board.

*** NOTE ***

When soldering the leads, if the lead is heated for a long time it will cause the heat shrink to shrink. This is probably not desired, so try and solder as quickly as possible. (Keep contact to about a second or two at most). The soldering is for mechanical reasons only, so do not be too concerned about shorts or poor electrical connection soldering joints. If you need to go back and solder a lead again, wait for a few minutes so it can completely cool before the next soldering attempt.



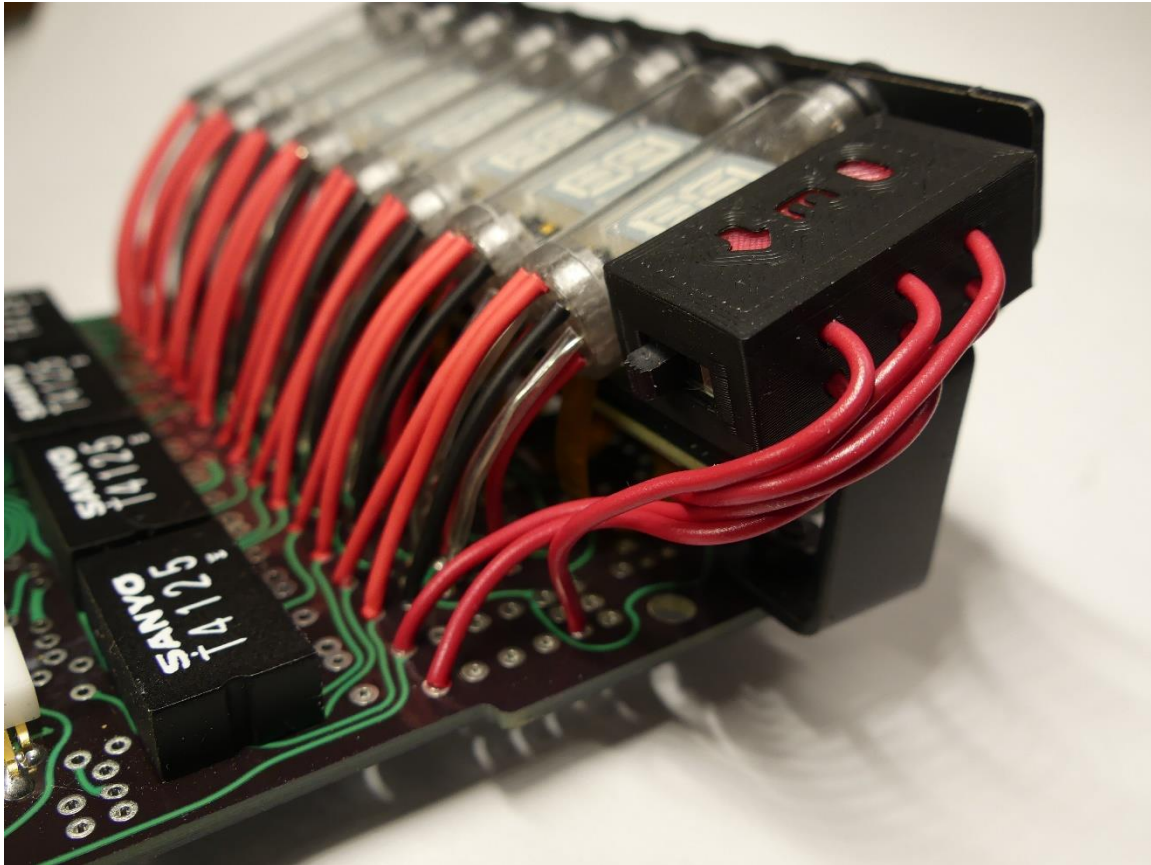
Error Box

Add Error Box 3 Wires to circuit board

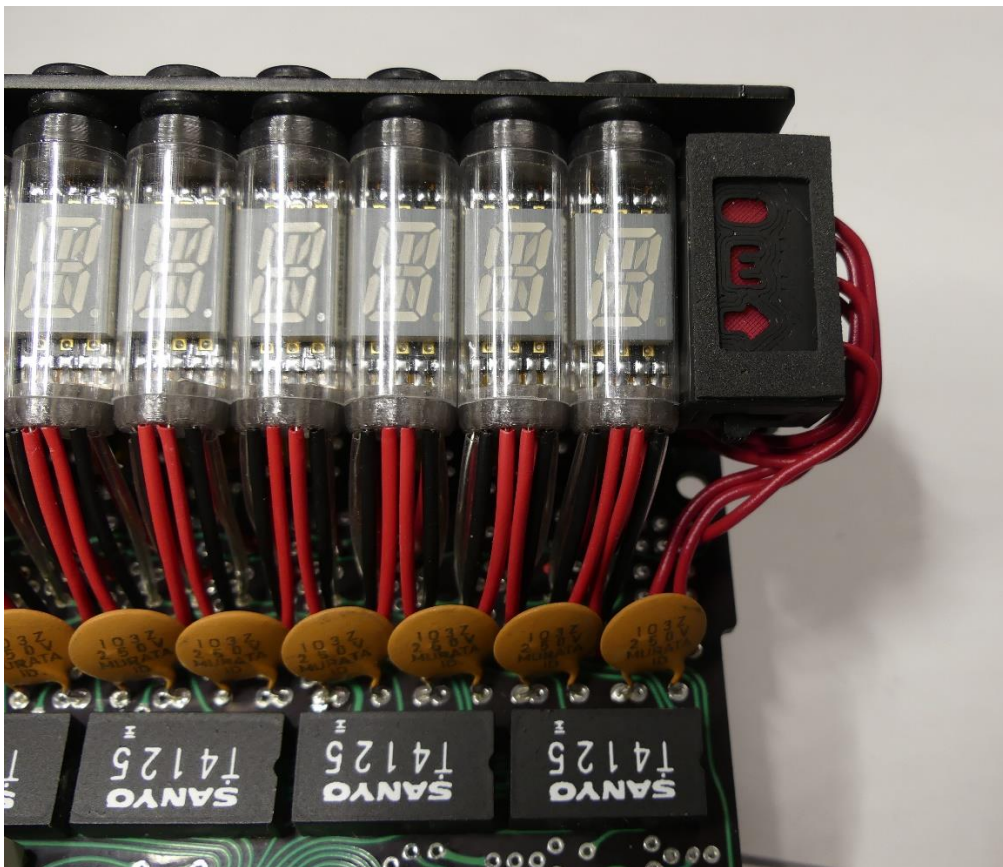
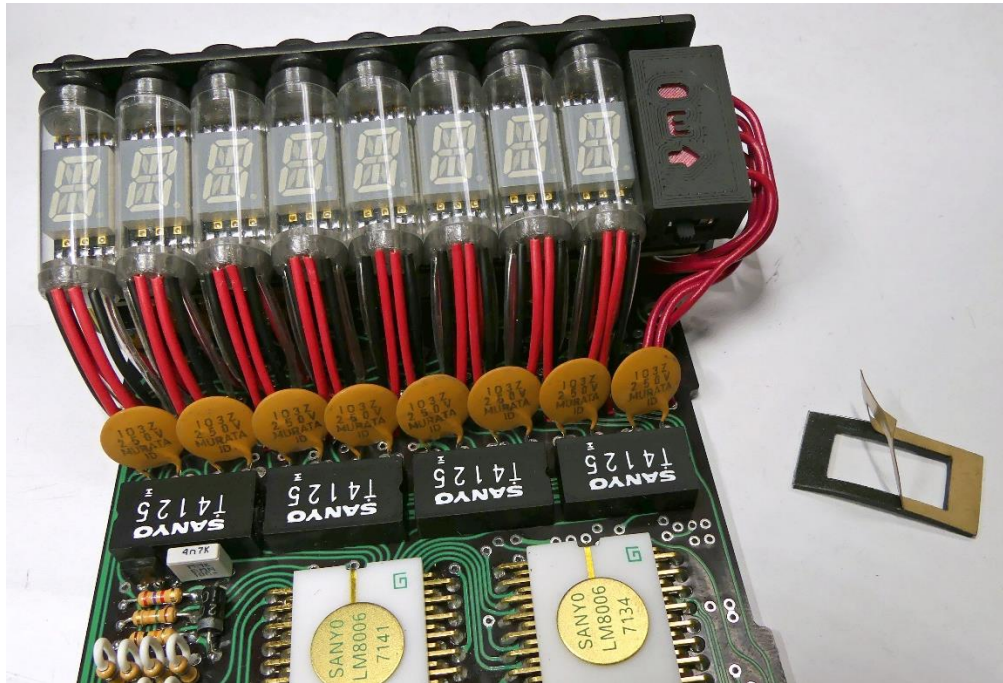
The Error box on the Display module already has 3 wires attached and used by the display electronics. For appearances, 3 more wires need to be attached and connected to the circuit board.

Cut 3 wires about 3" long from the red wire that was included in the main circuit board kit. I used a small drop of gel superglue into the hole and then inserted the end of the wire into the hole. Glue the other 2 wires in place and then allow the glue to dry (cure) before dressing the wires.

You can choose whatever holes you want. The pictures are of the holes that I decided to use because I thought they looked good.



Now to apply the gasket to the error box.
First, peel up the adhesive backing from the foam gasket:



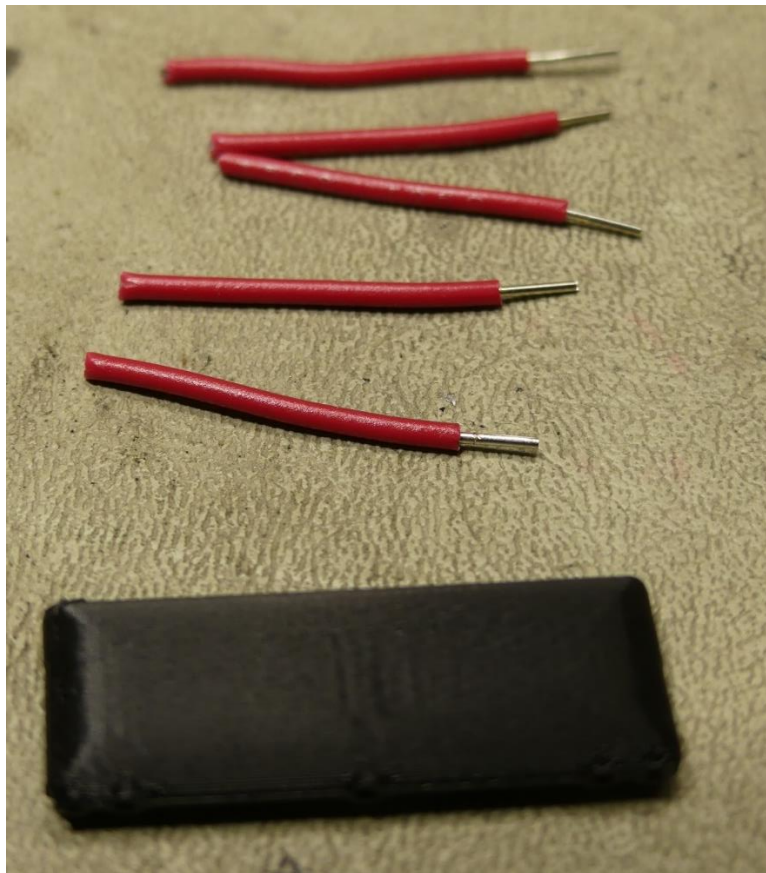
Pillow Shaped Part

I originally glued two 0.1" thick pieces of styrene together (1 1/8" x 0.5") and sanded it down around the edges for the shape, used solid wire, heated with the soldering iron and melted each of the 5 wires into the end of the glued styrene pieces. The placement of the wires was based on the holes that will be used in the circuit board.

Now a 3D printed part that is black is included and has been designed and tested to make sure the holes will accept a 22AWG solid core wire. The wire will be snug, but I also added a small amount of super glue to ensure the wire will be held firmly.

First cut 5 pieces 7/8" pieces out of the 24" Red wire.

Strip 3/16" of the wire insulation off of one end of each of these pieces so they can be inserted into the black "pillow part".

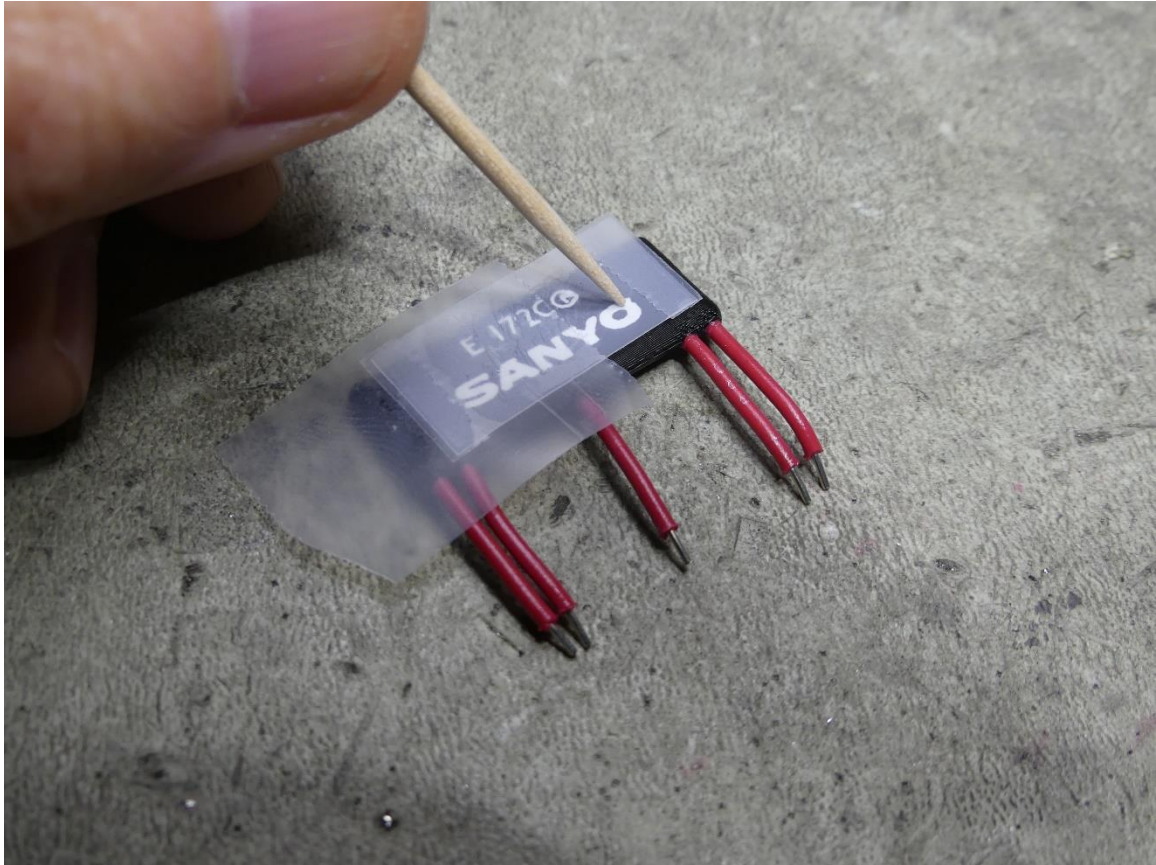


Test fit the bare wires in the 5 holes on one side of the pillow part. Once you are sure they will go all of the way in (no bare wire should be showing), add a small amount of super glue to the hole. I put a few drops on a piece of paper and then used a toothpick with a sharp end to get a small amount of glue on the end of the toothpick. I then touched this on the hole I was going to insert the wire into and then pushed the wire in.

You can also just get a bit of glue on the bare wire and then push the wire into the hole. Both worked, and not too much cleanup for either method. I did have a separate toothpick and a paper towel to wipe off the toothpick to use as a cleanup tool for and squeeze-out.



You could use some black plasti-dip, but the new prints are quite reasonable without doing that. For this build I cut out the Sanyo label, added tape to the top side (not the transfer side!) and used the tape to hold the dry-rub in place. I then used a toothpick to rub on the white transfer areas to attach the dry-rub to the pillow part.

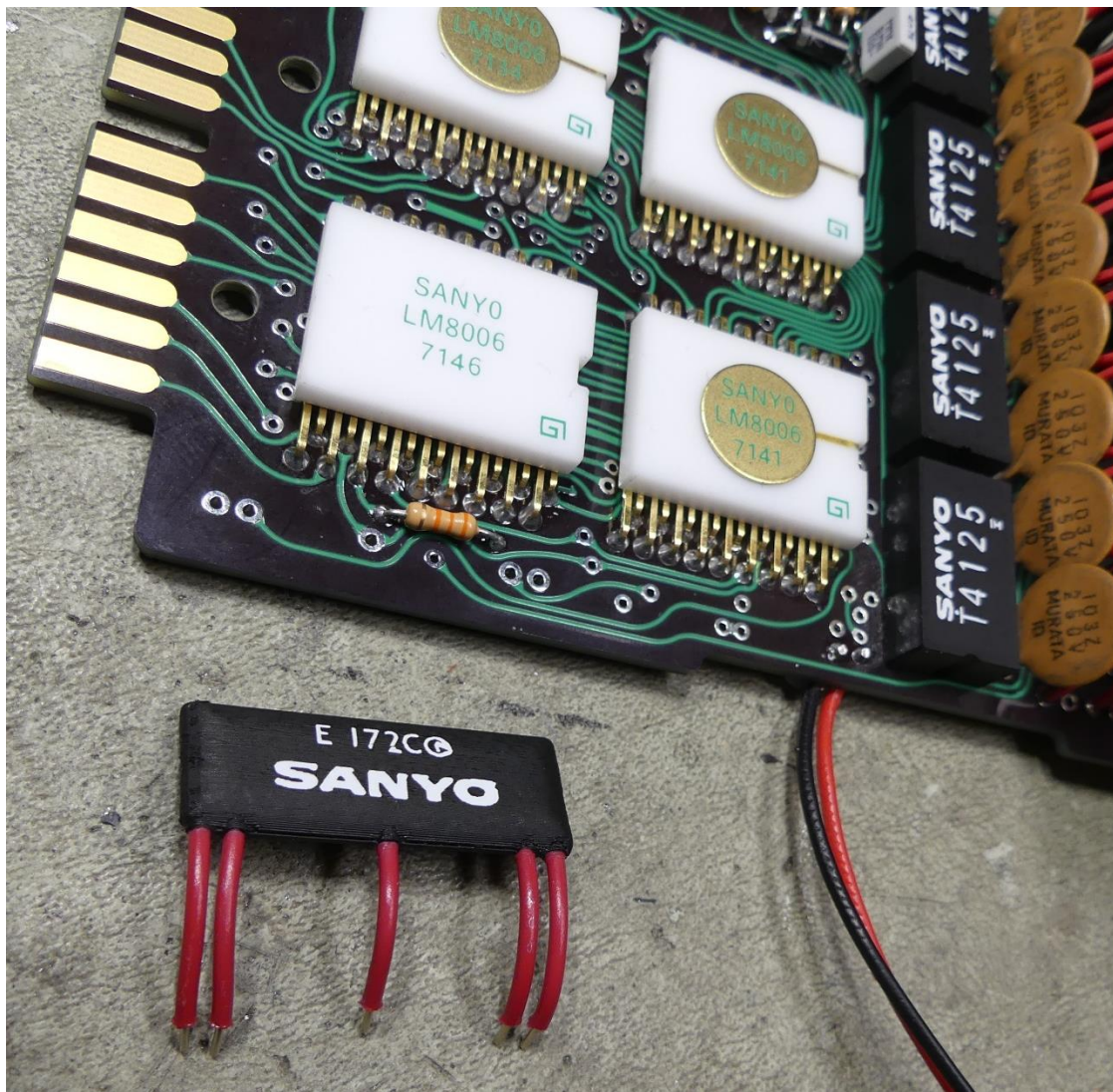


After I made sure the transfer was sufficiently rubbed, the part looked great. Since I had applied a clear matte spray to the other dry-rub parts I also applied it to this part. I did let it dry for 24 hours, so had to wait to mount the pillow part.

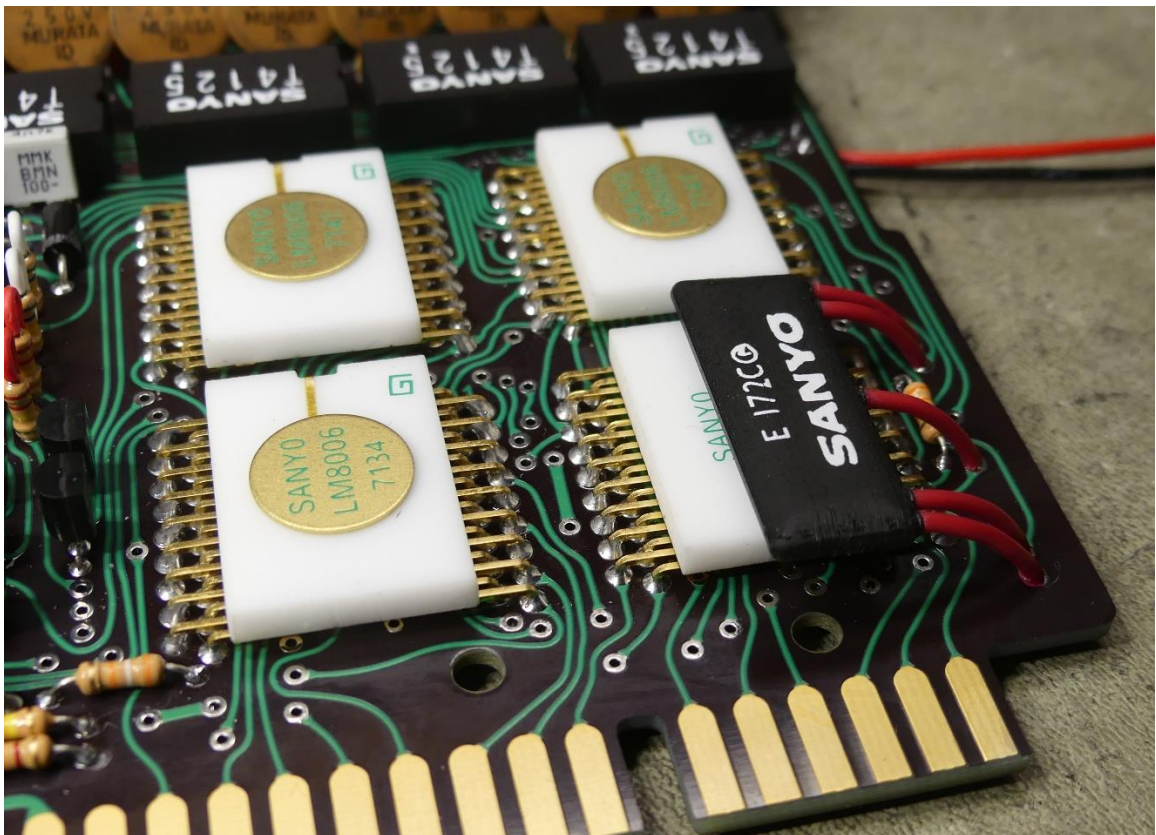
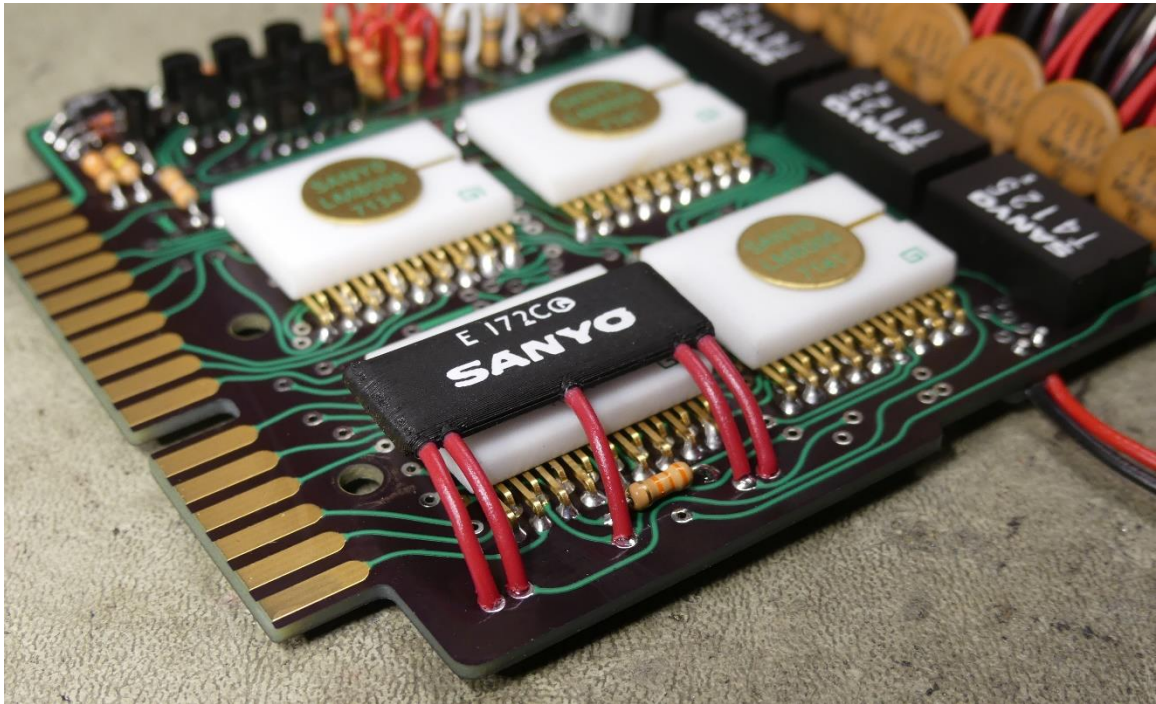
Before coating the part, I placed a piece of tape over the red wires – I did not want to paint those since they were going to be bent after the part was attached to the circuit board.



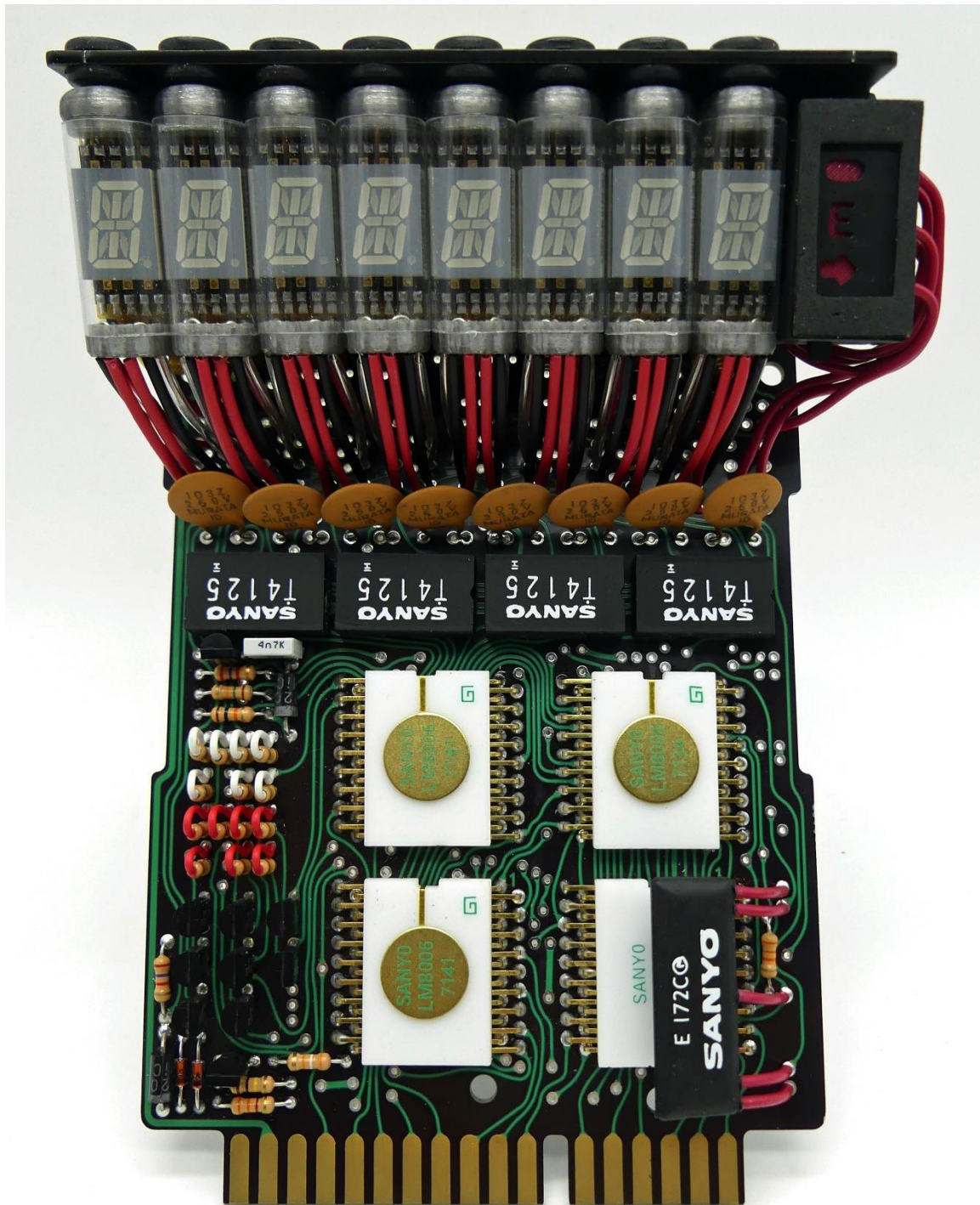
After the part had dried, the other ends of the wire were stripped about 3/16" and I test fit the part and slightly bend (rounded?) the leads. For the first test the red insulation was a bit too long, so I just stripped a bit more off of the wires and test fitted again.



Then placed the part, soldered the 5 leads on the back side of the board and then cut off the back side leads close to the circuit board.

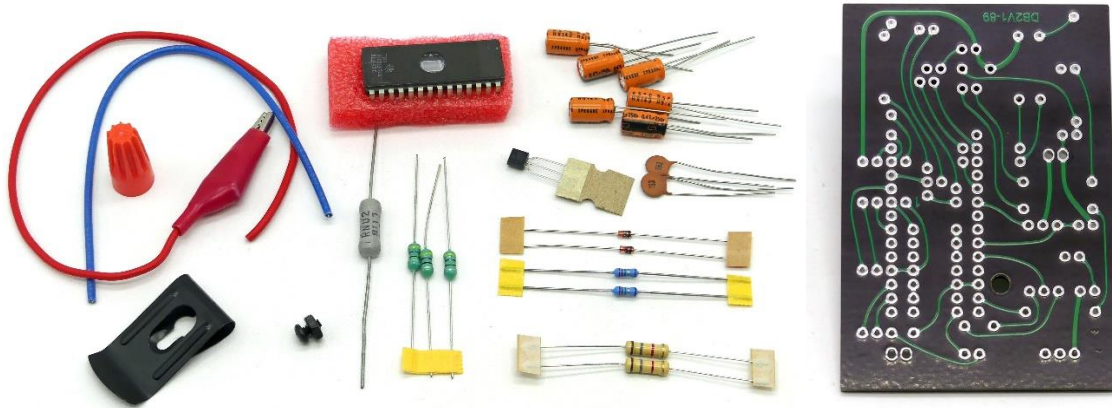


Almost finished – you only have to attach the shaver cord, but that is left to be done until after the daughterboard is finished.



Detailed Daughter Board Instructions

The Daughterboard can be built up in many different ways, but here is a detailed write-up for the version that was used in the Afterlife props.



- 1x Red Alligator clip and attached wire
- 1x Blue Wire
- 1x Belt Clip
- 1x Short screw and nut to attach the belt clip to the circuit board.

- 1x Large 28-pin Integrated Circuit (EPROM)
- 1x Large grey wire wound power resistor
- 3x Green inductors
- 6x Orange cylindrical electrolytic capacitors
- 1x Black transistor (3 leads)
- 2x small tan colored ceramic disc capacitors
- 2x small glass diodes
- 2x 1/4W blue resistors
- 2x larger tan colored resistors

If needed, you could glue the parts in, but soldering is recommended.

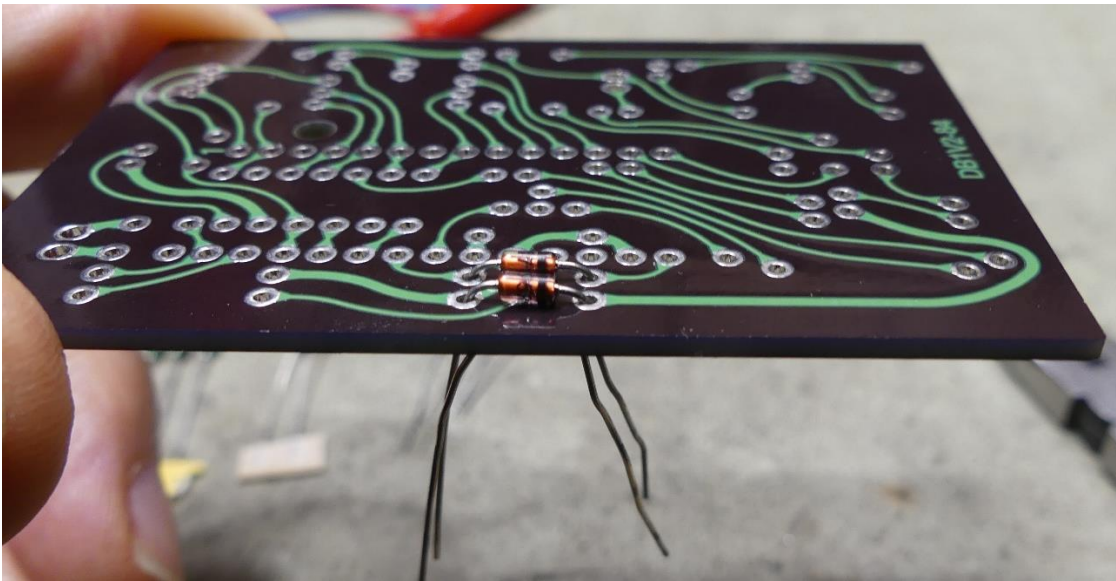
*** WARNING ***

Solder can contain lead and that is a poisonous substance, so be sure to keep the solder out of kids reach and wash your hands after handling the solder and before you eat or prepare food. It is best not to directly breath in the smoke when soldering, so a ventilated area is best and a light breeze from a fan can be very beneficial if you do not solder equipment designed to remove the fumes (much more expensive than the typical soldering tools most people have or purchase).

*** END OF WARNING ***

It is best to build up the board with the shortest parts first. This allows you to place the parts on the board and then flip the board over, resting on the parts, when you go to solder the parts on the board. This order is not necessary, and I don't always remember, and it still works out OK, though it may be a bit more difficult.

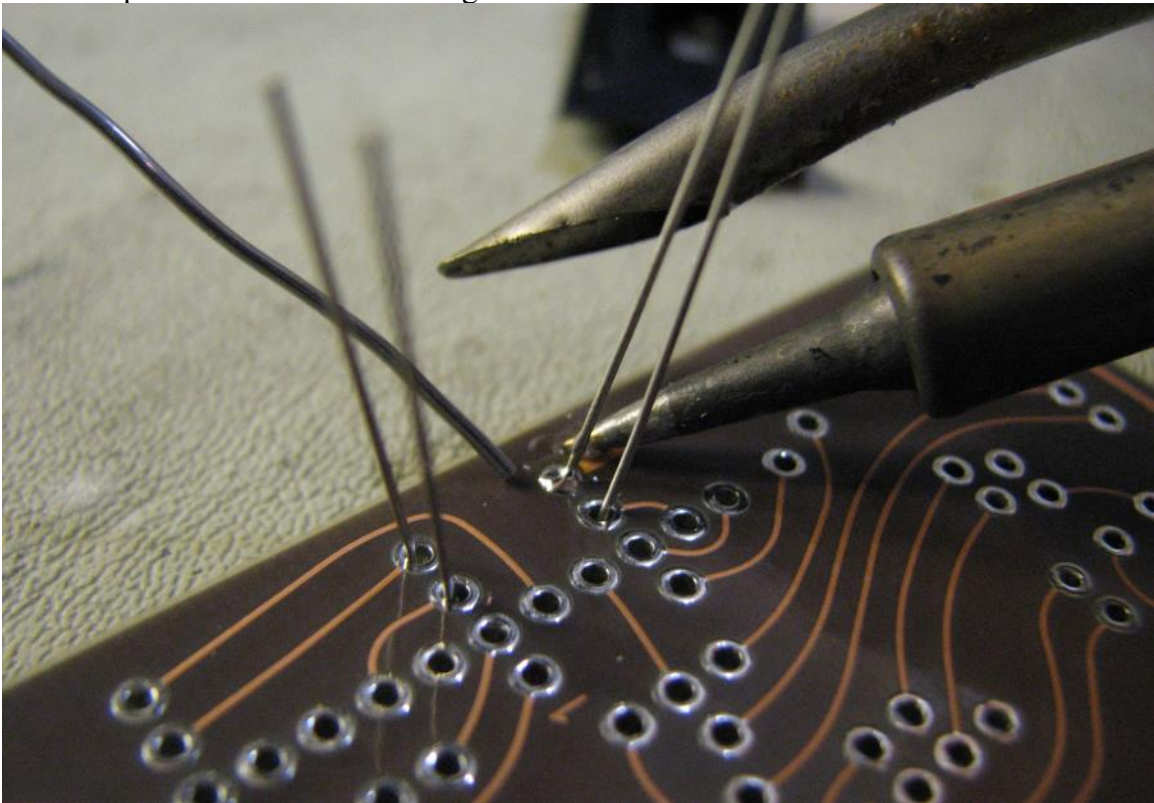
The shortest parts are the two diodes, so let's start with those. Bend the leads, insert the leads in the holes and press the diodes flat against the board:



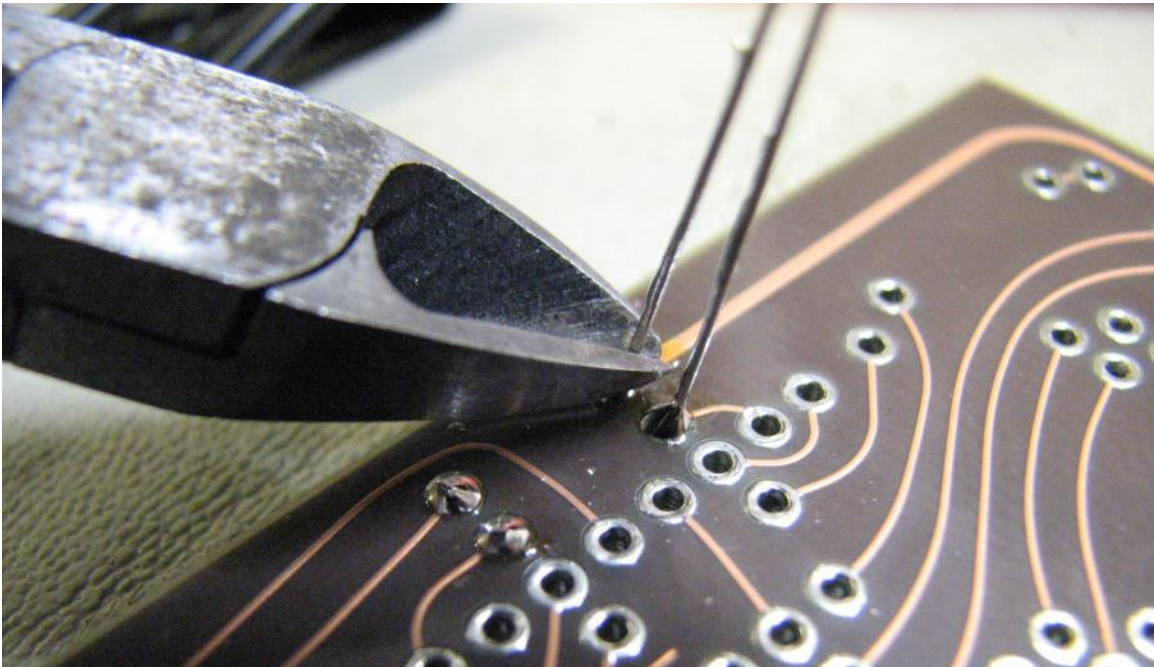
Now flip the board over (you can bend the leads a bit to hold the diodes in place or hold on to the leads or parts as you flip the board over, so they do not fall out), and make sure the parts are still flat against the board.

Now solder at least one wire from each component to the board. By only soldering one wire, you can flip the board over and make sure the part is positioned properly. It is much easier to adjust the part position with only a single wire soldered to the board!

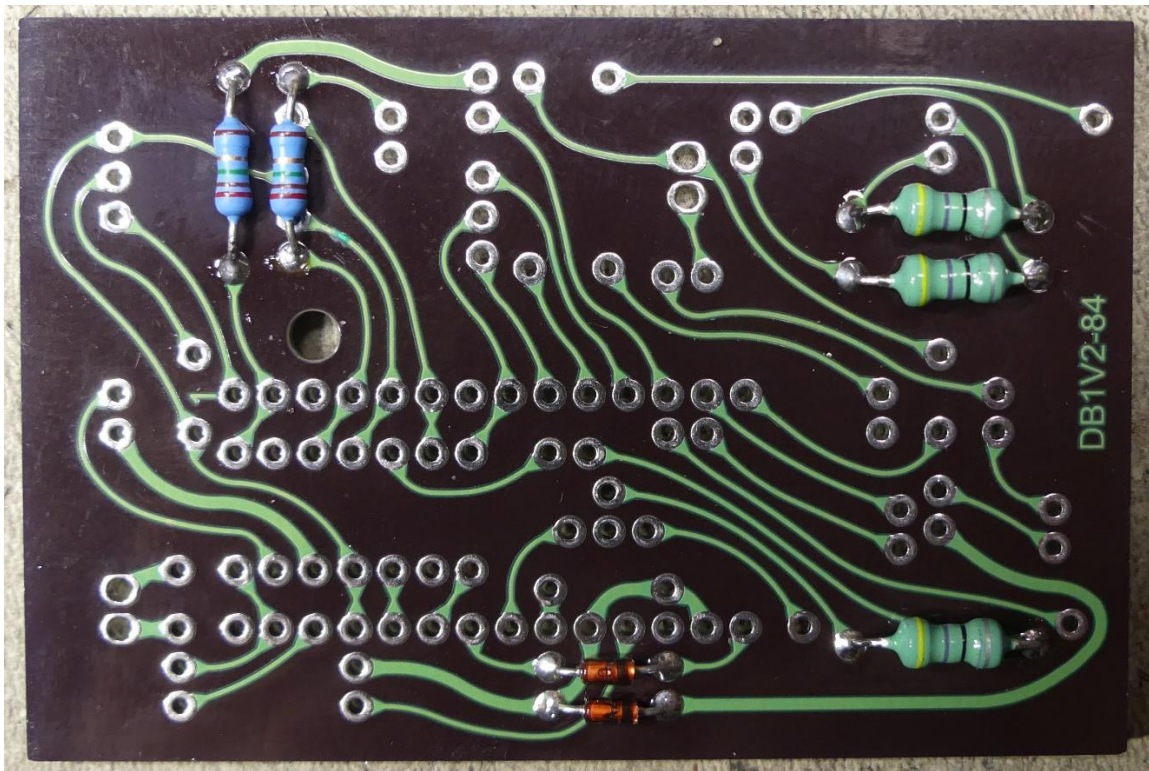
Here is a photo of the first lead being soldered:



After the part is verified to be in the correct position and all the leads are soldered, use some diagonal cutters to trim the leads on the solder side of the board very close to the board:

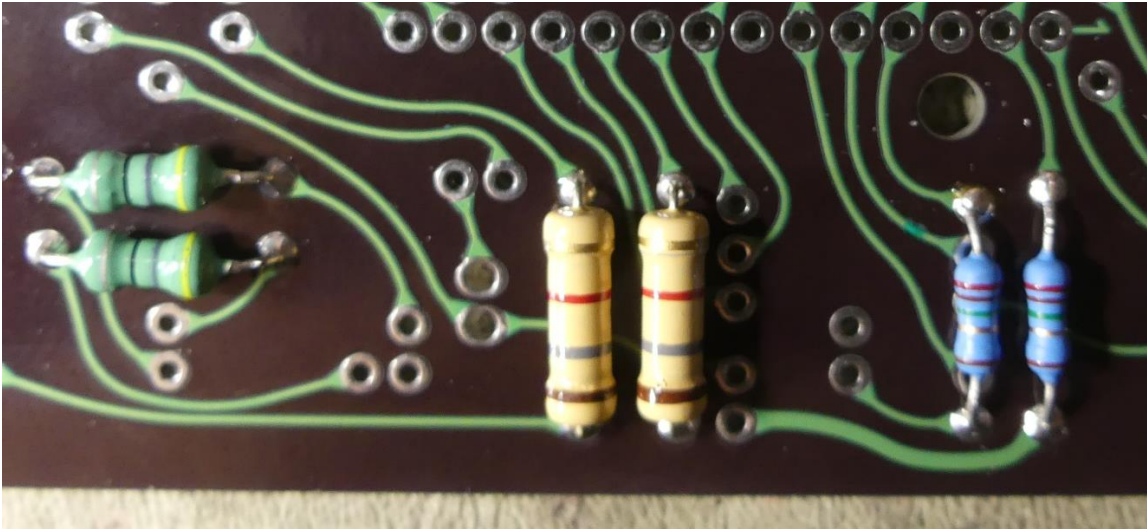


Next, mount the 2 smaller blue resistors and the 3 green inductors (or use three of the leftover resistors from the basic parts kit) at the same time since they are about the same size:

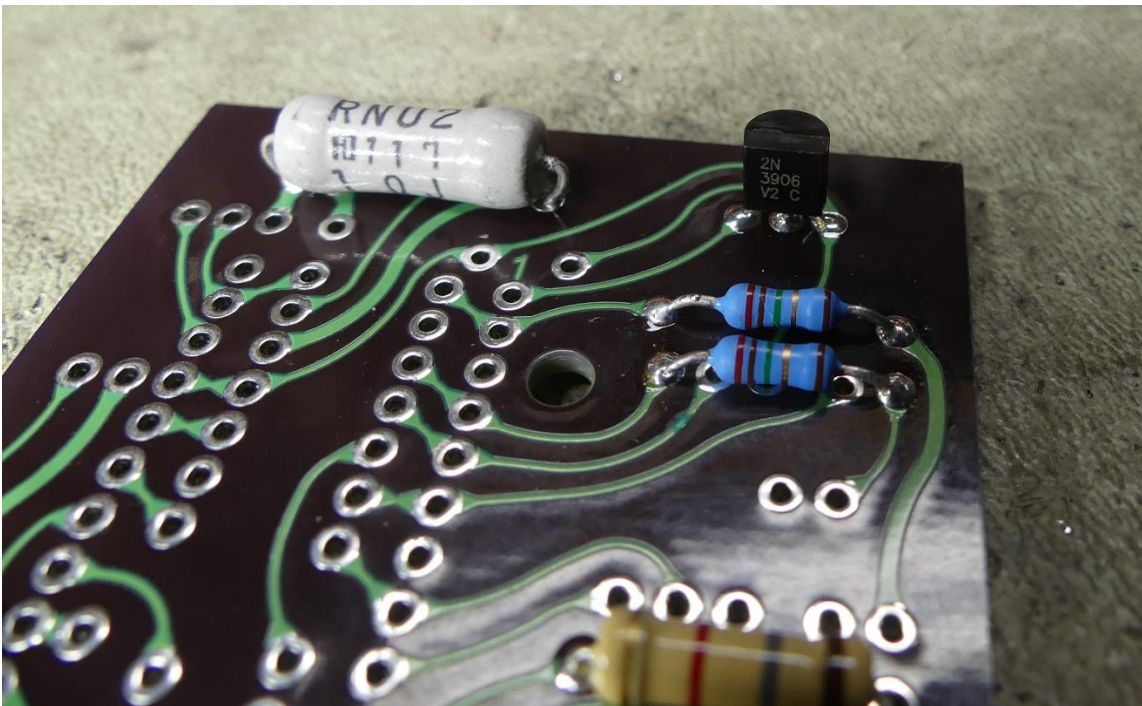


Flip the board over, solder and then trim off those long leads.

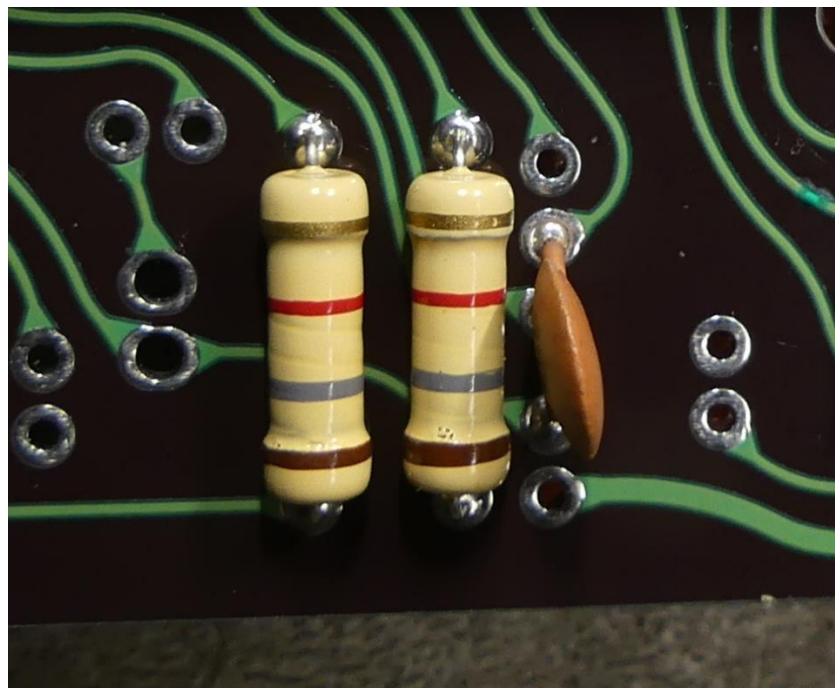
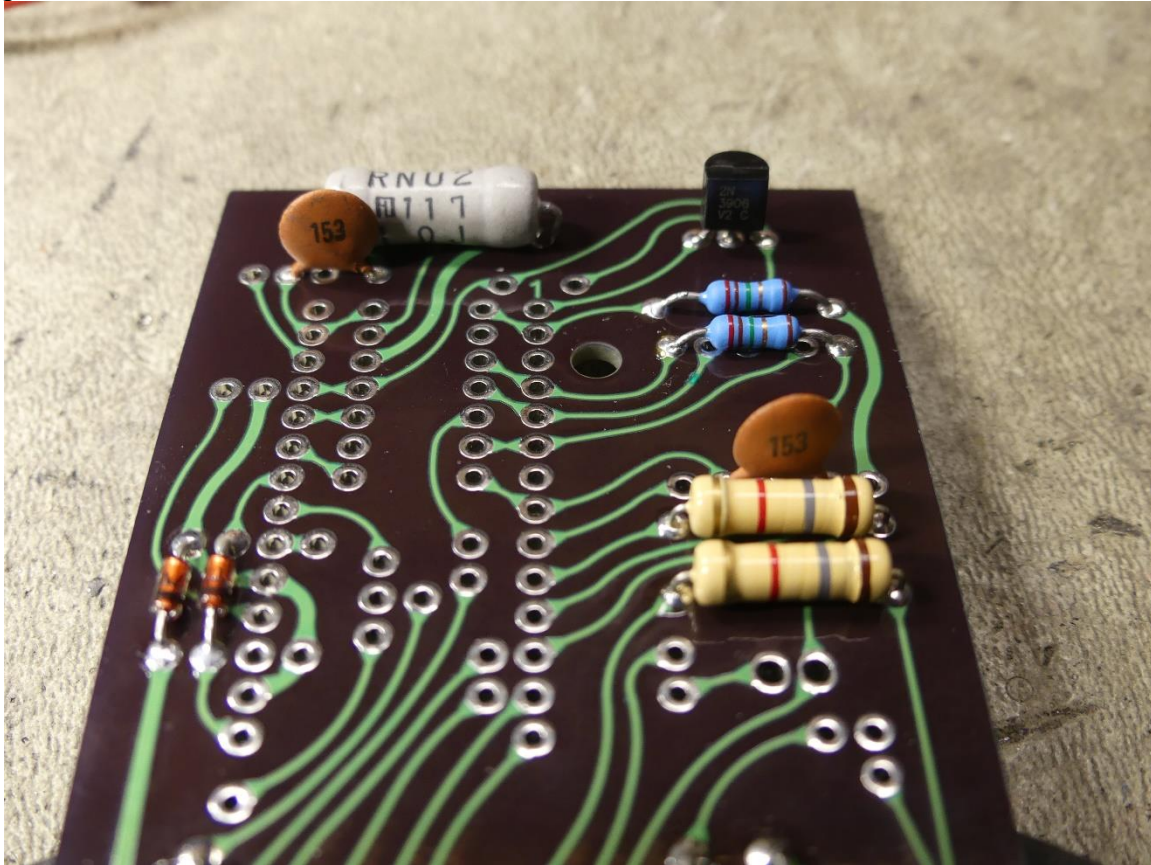
Add the two slightly larger resistors, solder and trim off the excess leads. The parts can be oriented either way, but I like to make the pairs both have the color code in the same direction.



Then the large resistor. This one is a bit wider than the hole spacing, so you have to bend the leads quite a bit and add some shape to them to get the part centered and close to the board. This is the same part that was used in the Afterlife kit, so we are keeping the same part for this build! The part does not require a specific orientation.

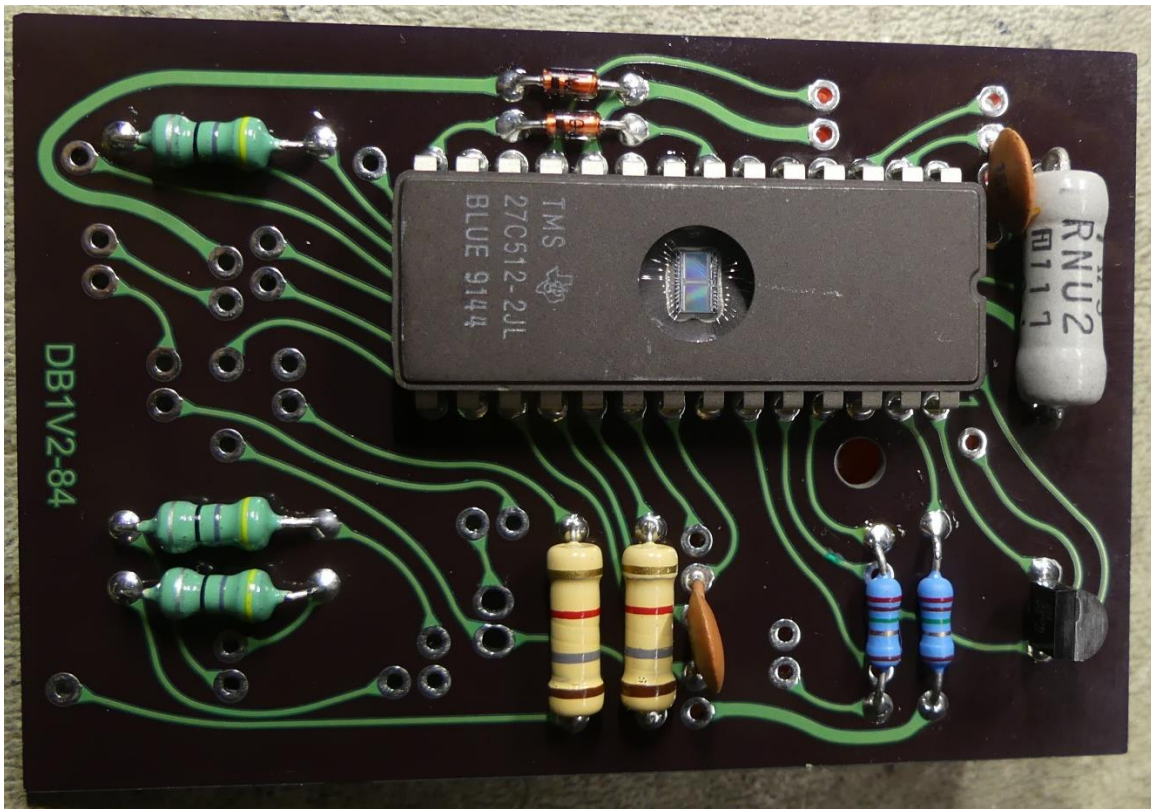


Next are the two ceramic disc capacitors and the black transistor. The capacitors can go in either way, but I like having the markings show the same way. The transistor has a preferred orientation.

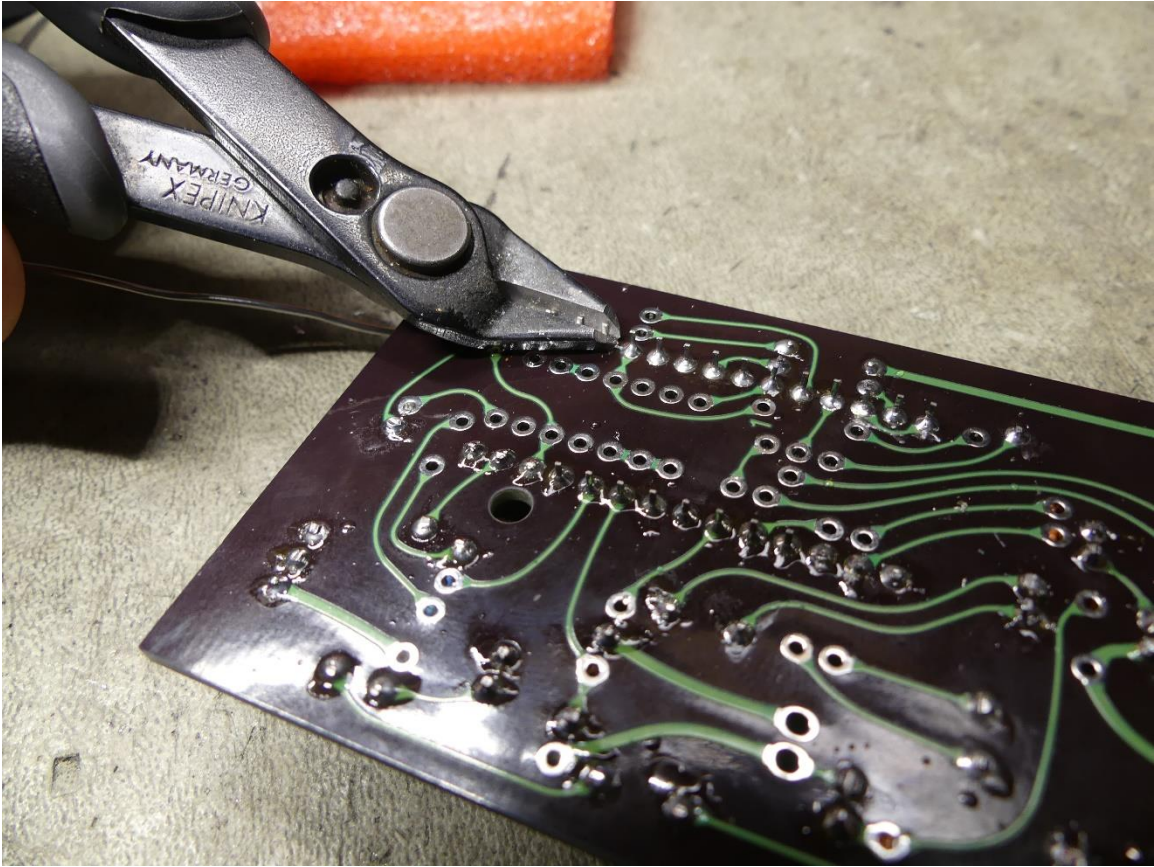


The large Integrated Circuit (EPROM) is next. It is a bit shorter than the caps, so when you flip the board over it helps you to have something under the part to hold it against the board. I used the pink foam from this bag of parts. Orientation is critical for this part if it is actually functional.

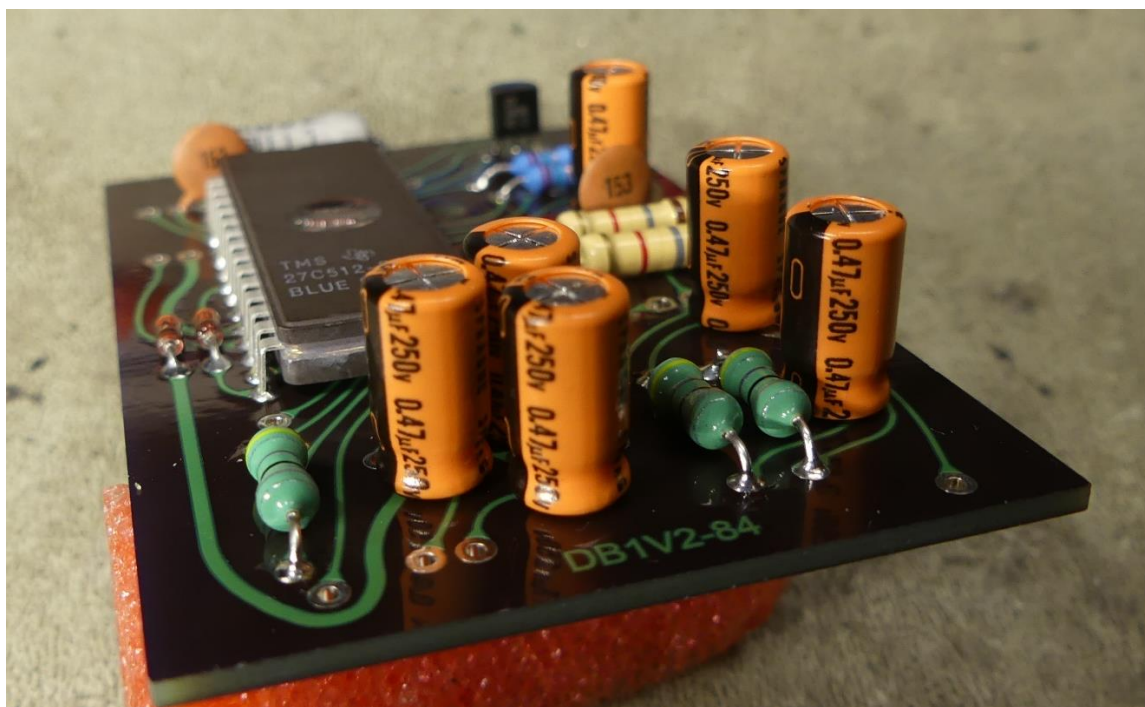
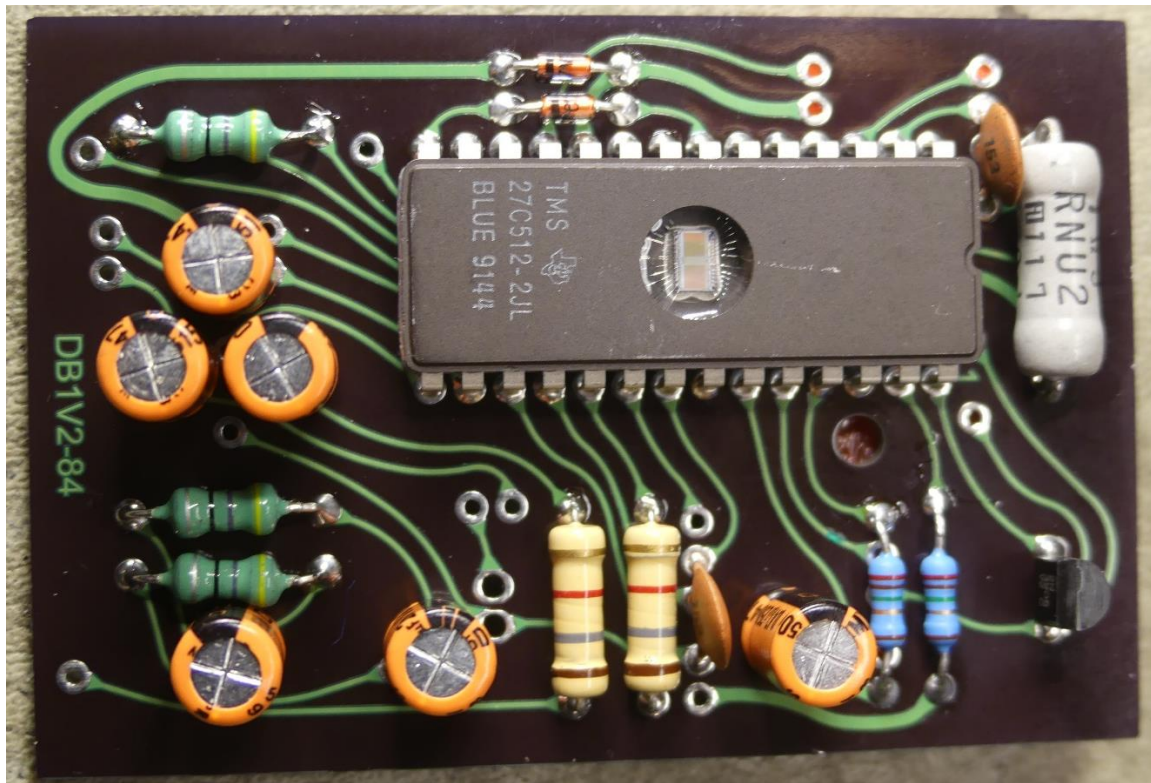
Only solder two pins on opposite corners and then flip the board over and make sure the part is sitting against the board. If you solder a lot of pins before you check for this, it will be very difficult repositioning the part. If the part is not quite on the board you can hold the board up, put the soldering iron on the pin you want to adjust and press on the part at the same time. When the solder melts, you should be able to press the part into the board.



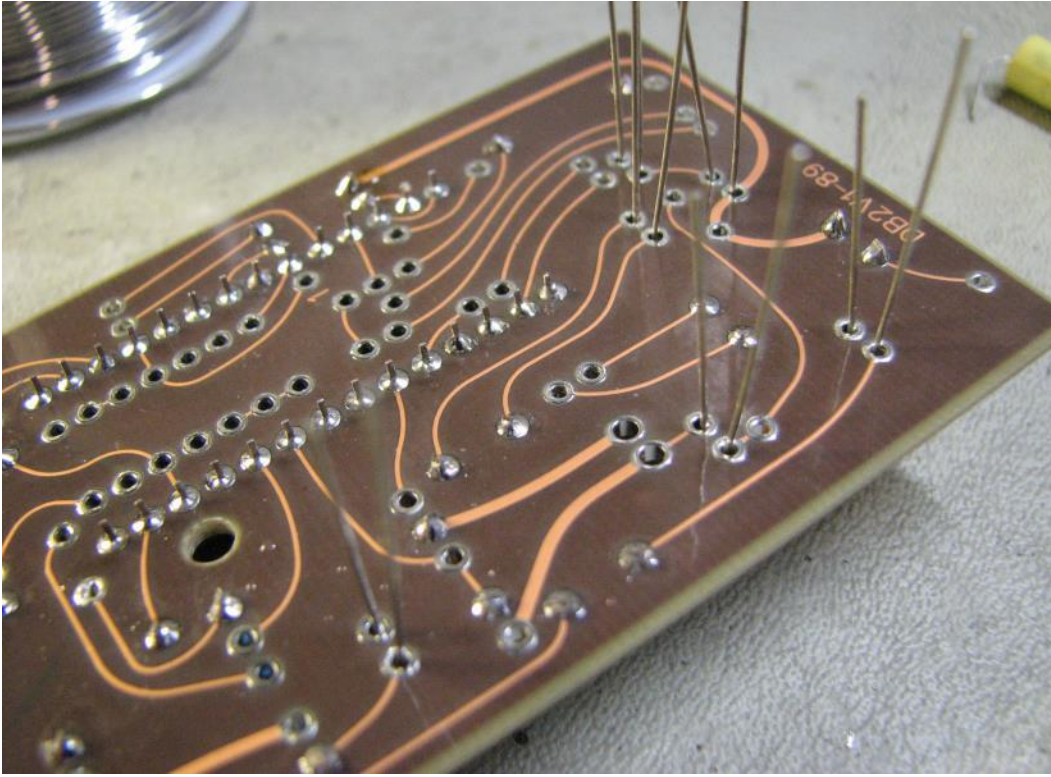
The black belt clip needs to lie flat against the circuit board, so the leads of the large integrated circuit (EPROM) needs to have the leads trimmed close to the board surface:



Next put in the 6 orange capacitors. These capacitors do have a preferred orientation so look for the black stripe and make sure they are all facing the correct direction:

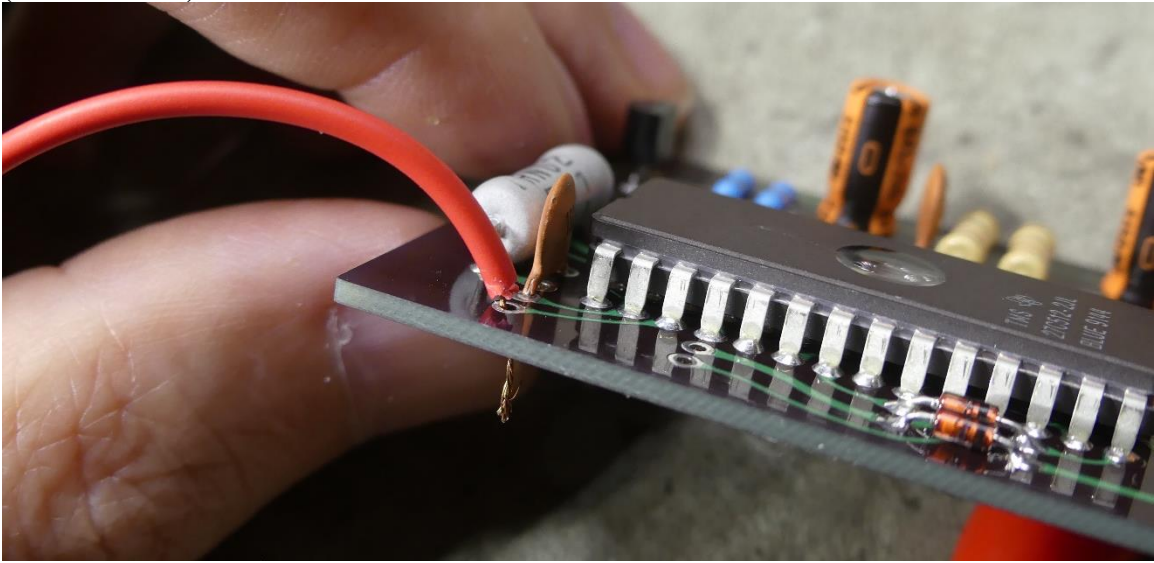


Flip the board over and solder one lead from each of the orange capacitors. Then flip the board over and make sure they are flush with the board and also standing straight up.

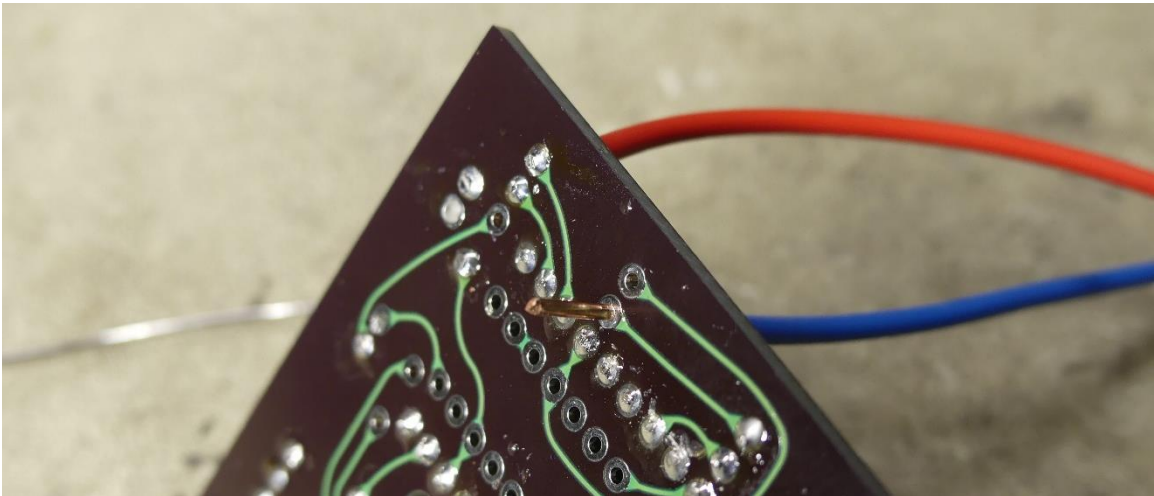


I forgot to get a picture of this with the new board, so just imagine this as a dark board with green traces...

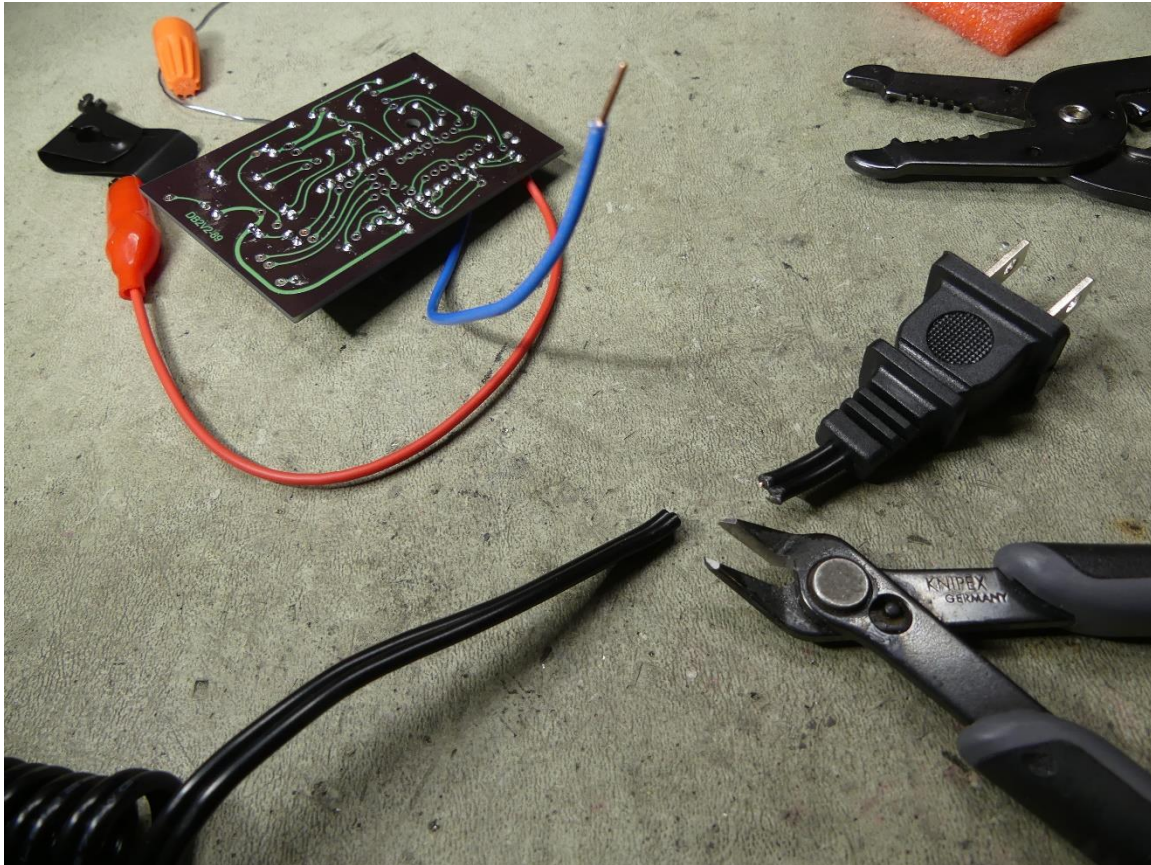
Next strip the end of the red wire with the alligator clip on it and solder it into the board (stranded wire):



And the same for the Blue solid core wire:

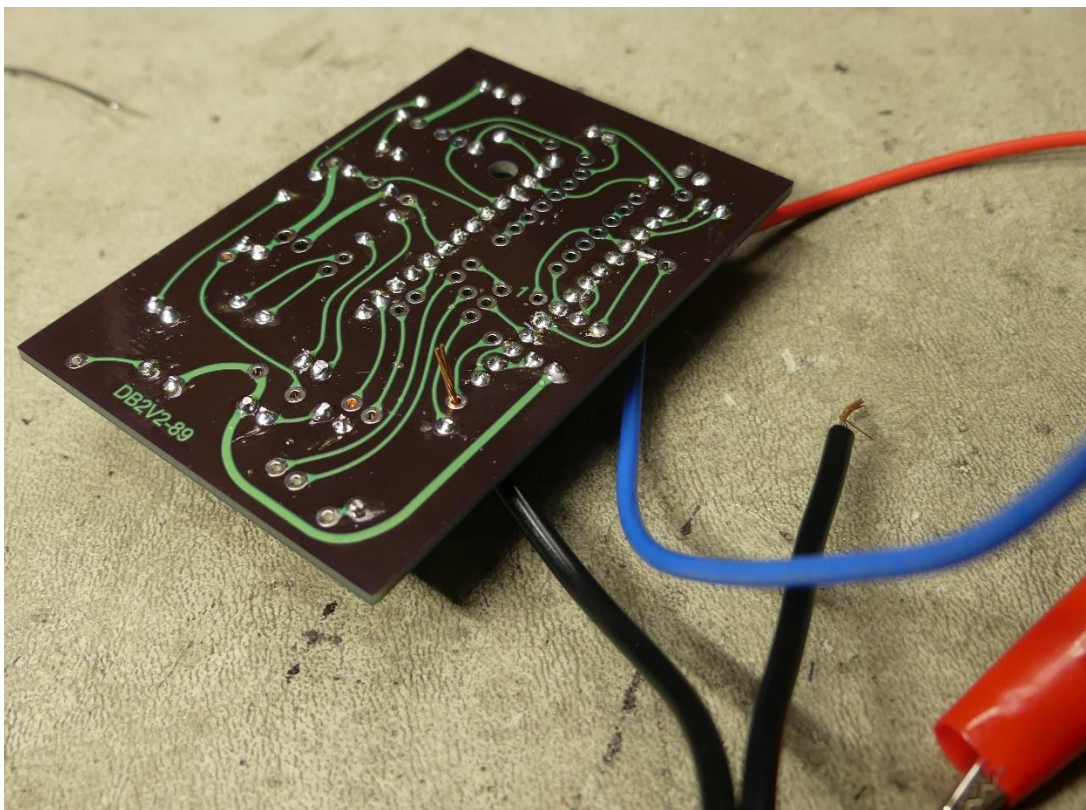
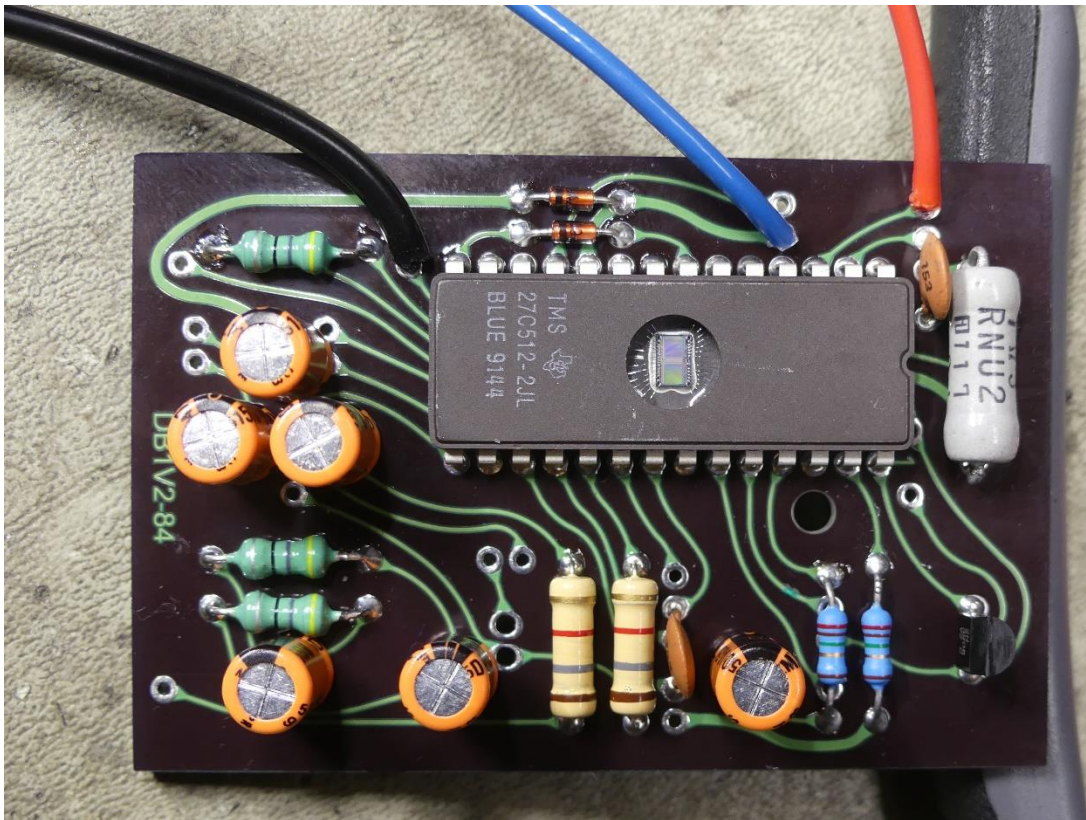


Get the shaver cord, cut the US Plug end off to a desired length and strip the wires:



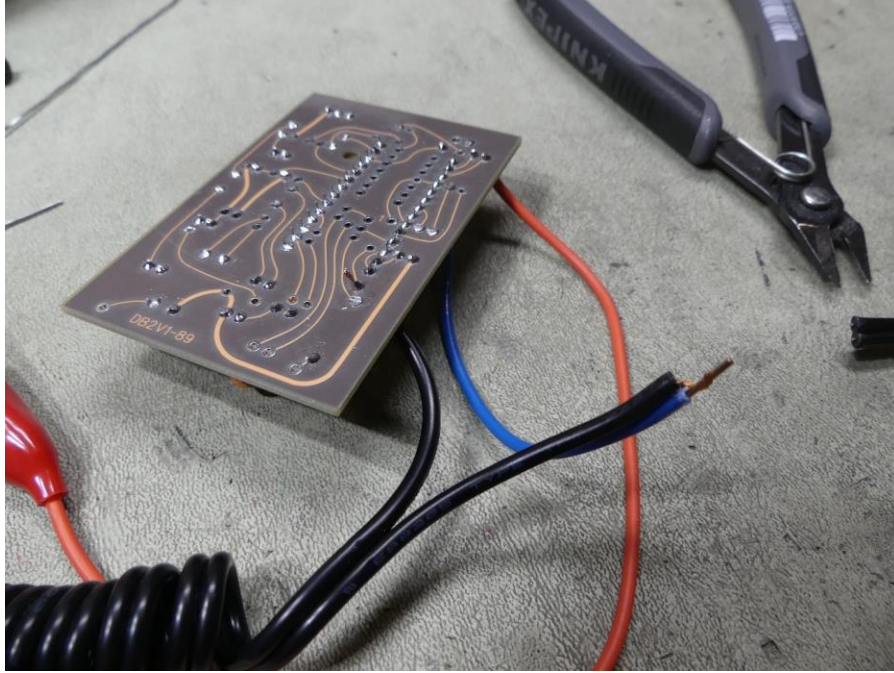
The shaver cord has VERY fine wires, so take great care when stripping the wire. You may want to practice stripping the wire before you decide on the overall length of the straight section, so you have some wire to practice on.

Solder one end of the shaver cord's wire to the board.

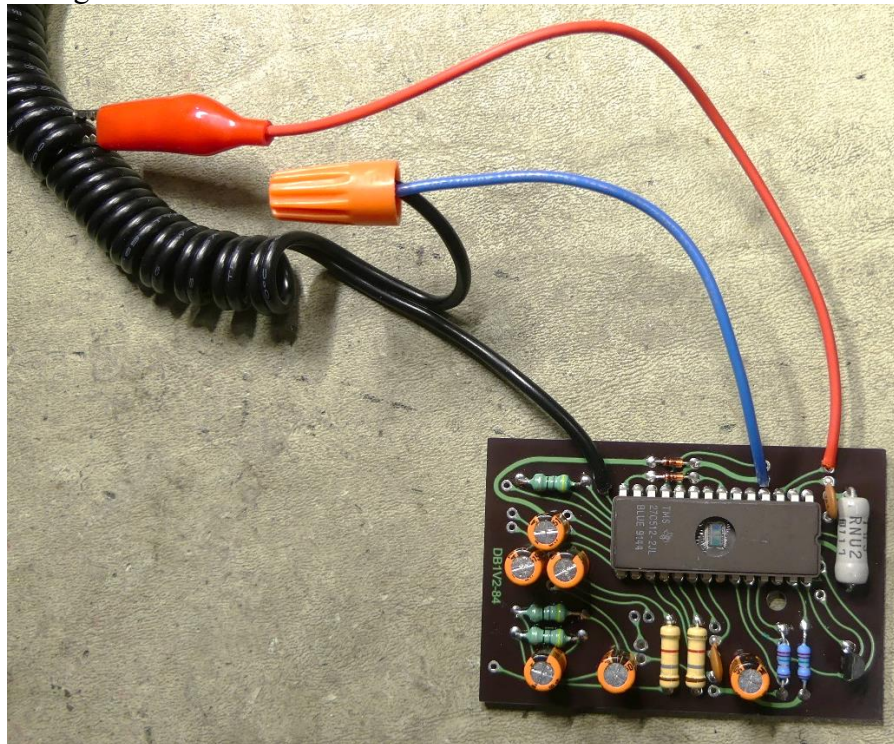


The Orange wire nut that is normally used to hold wires together will not work very well with the shaver cord's tiny wires, so it is best to solder this other black wire to the blue wire.

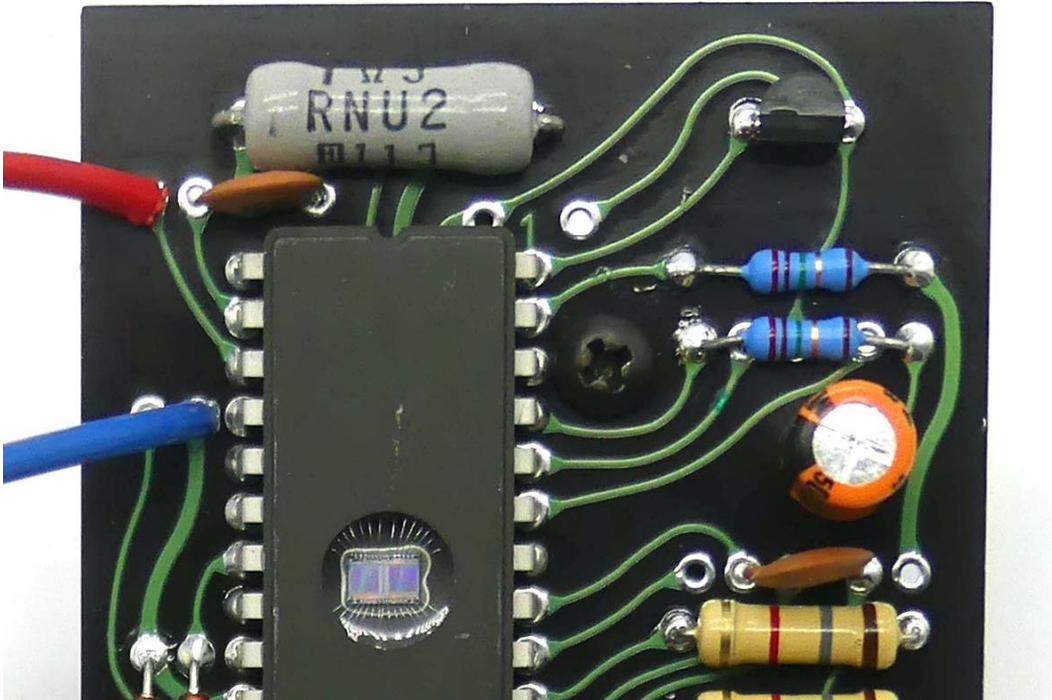
Trim the blue lead to the desired length and then strip about a ½" of the wire. Solder the remaining black cord to the blue wire:



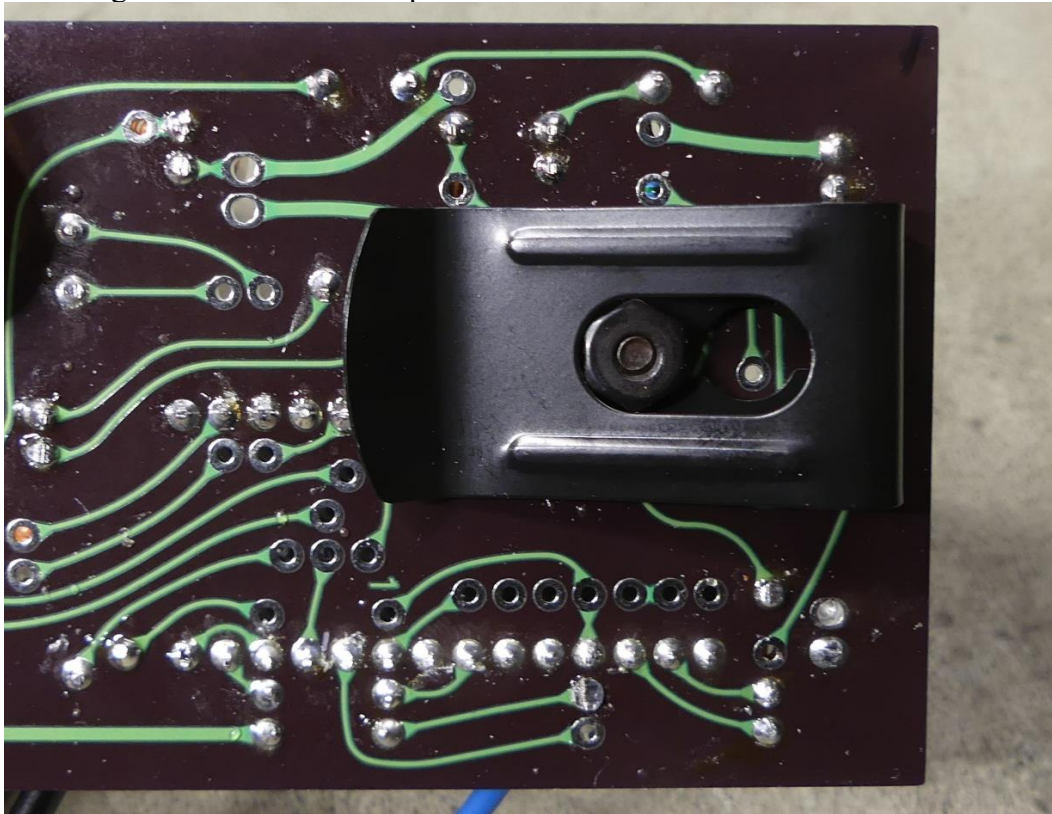
Attach the orange wire nut to the Blue wire.



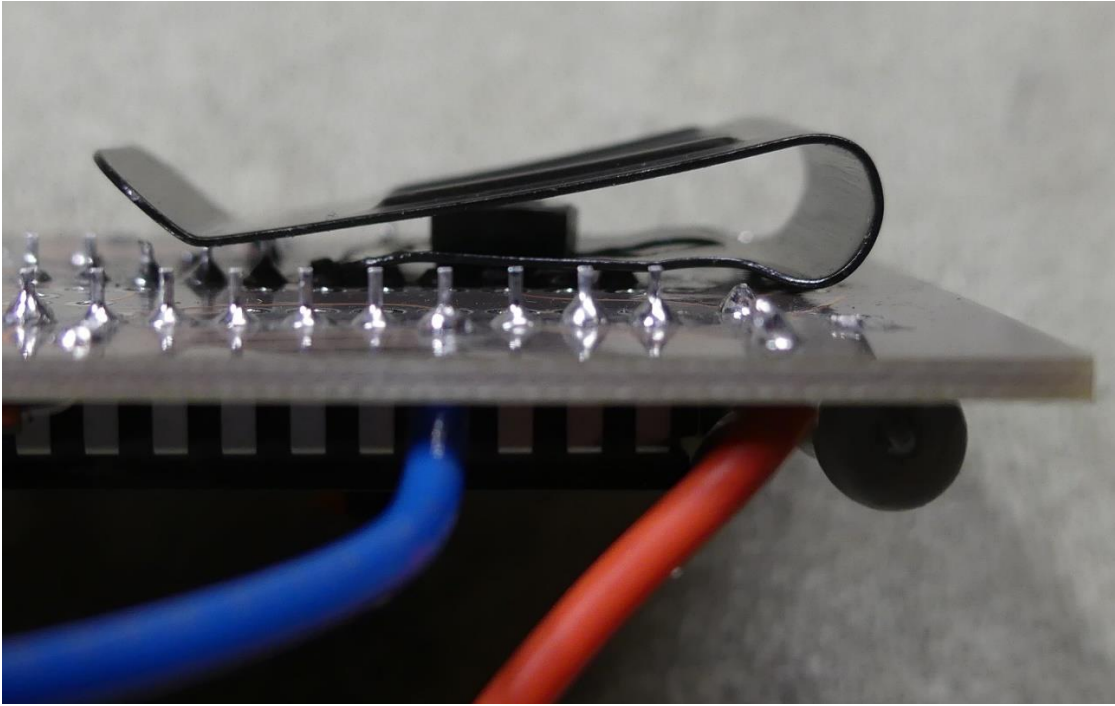
Next add the belt clip. The black Philips head screw goes on the top next to the large IC and the Blue resistors:



The bottom gets the nut and belt clip:



I did use diagonal cutters to clip off the seven or so leads of the large IC to make the attachment of the nut on the screw easier:



This allowed the back side of the clip to rest closer to the circuit board instead of on top of the taller IC leads.

Last step – Attaching the Shaver Cord

The last step is to connect the other end of the coiled black cord to the Gizmo board. I held the end of the cord in place and marked through the center of the hole from the backside of the circuit board with a pencil onto the shaver cord end.



The mark was about the center of the logo for me but may vary a bit based on how the white acrylic part was placed on the gold leads on the main Gizmo board.

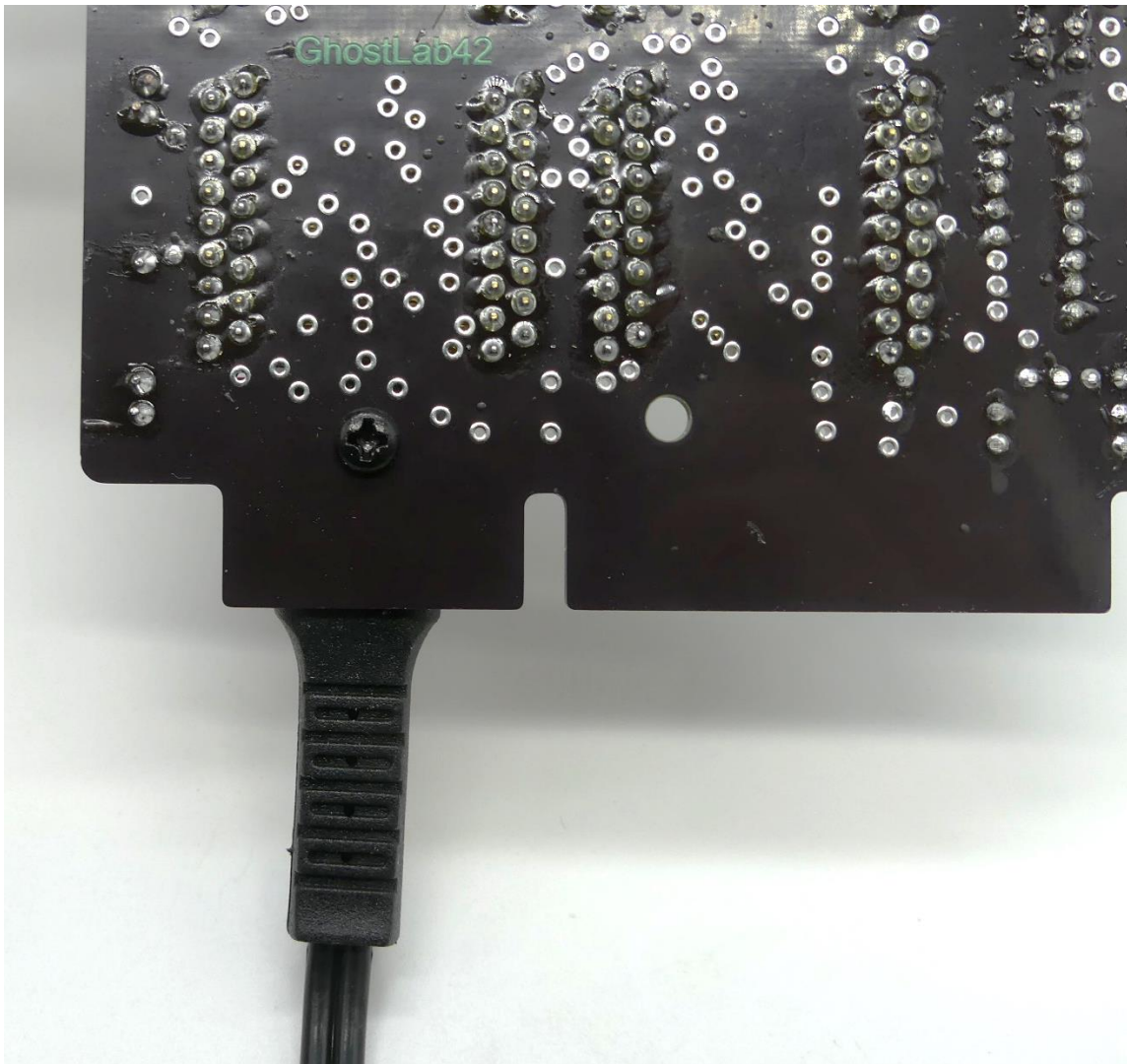
Using a 1/16" drill I drilled a hole where this was marked. Take great care not to drill all of the way through the cable since you do not want a hole to show up on the other side of this connector!

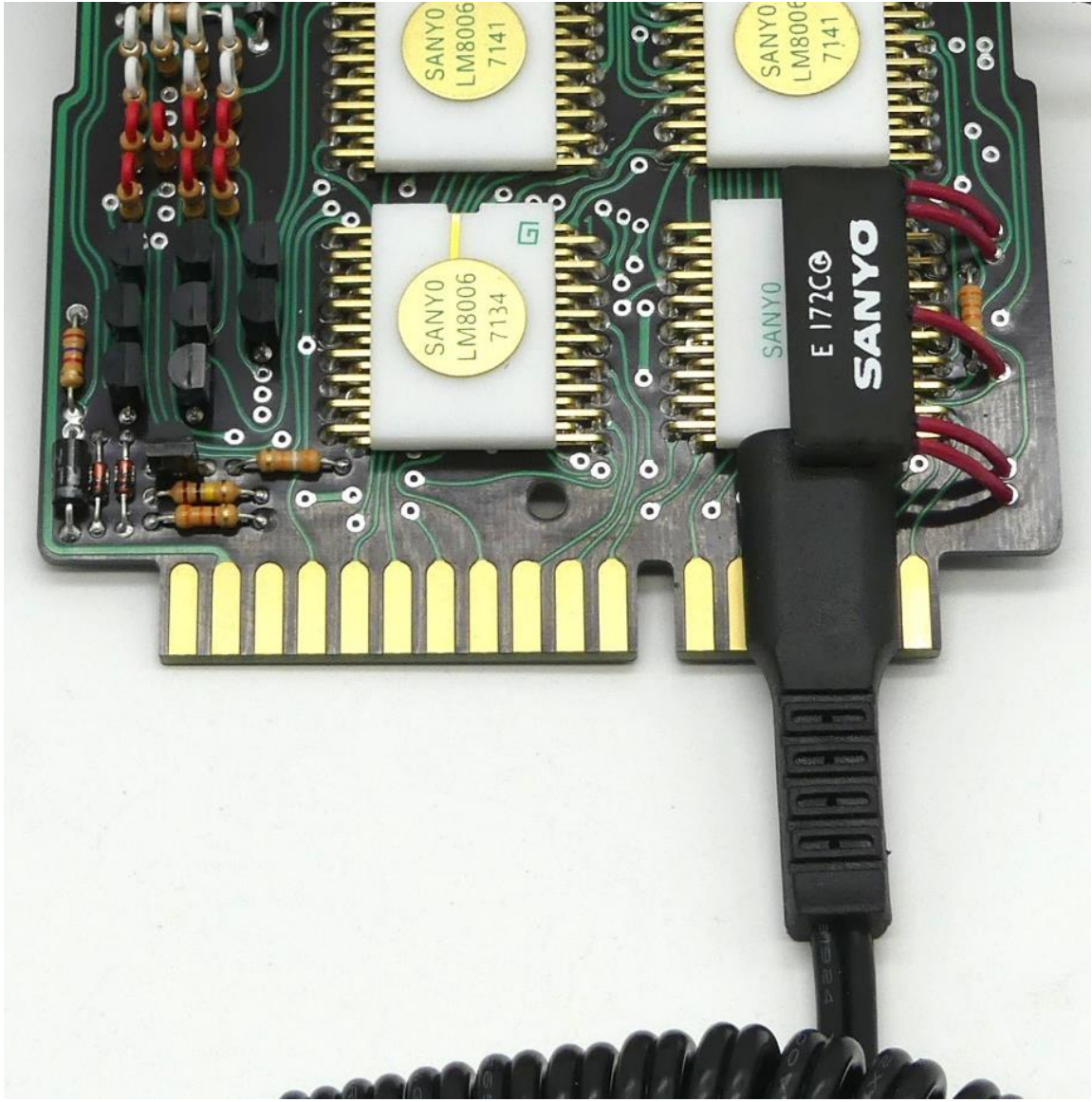
Now go get the #4 1/4" screw from the bag that held the Basic Parts kit. It is finally time to use it!

With a small Philips head screwdriver drive the screw partway in to make sure it would be easy to get started when actually mounting this end of the cable to the main gizmo board.



Remove the screw, then mount the cable onto the board by holding it in place and driving the screw into the connector from the bottom side of the board.





Now you can sit back and enjoy the amazing creation you just completed!

