

Synth.BT build Guide V1.1

Worker Audio: Current as of 26/3/2020

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Description:

Your HP is sacred, you shouldn't waste it on things like multiples, attenuators and gate combiners.

Synth.BTs packs together a bunch of super handy passive synth tools into one neat kit that is as simple to build as it is useful.

Put one of these packs in your cable bag and always be ready to solve those synth routing problems live, or in the studio.

Synth.BTs are a beautiful matt black PCB with gold ENIG finish. Reminiscent of a model plane kit, you build up the board, solder it and then cut out the different components to create:

2 X 4 way multiples

2 X touch pads

1 X 3.5mm to ¼' adapter

1 X 3-in-1 out gate combiner

2 X attenuators with mute and stutter

Warnings:

Be carefull!! When you are building electronics you are often working with harmful materials and it is important to take the appropriate safety precautions.

Risks and Suggested Actions:

Specific to this project are these safety concerns and suggestions for mitigating these risks:

Risk	Suggested Action
Burns from soldering iron	Turn off when not in use, use a soldering iron stand
Fiberglass particles from cutting out components	Wear safety glasses and a face guard or respirator to avoid being hit in the eye or breathing in fiberglass dust
Breathing in solder fumes	Use lead free solder if possible and a fume extractor, and/or work in a well ventilated place
Animals and children	Never perform this type of work around animals or children, soldering irons are dangerous and can cause severe burns, fumes from solder and leads particles from leaded solder may be harmful to animals with small lungs.

*It is also important to note that, one off exposure to these risks is extremely unlikely to cause noticeable harm, but it is important to exercise best practice when working with electronics.

Before you begin:

Soldering:

For this project you will need to solder, there are many great tutorials on how to solder, and rather than attempt to cover that here, I will link to some of the great online resources.

<https://www.youtube.com/watch?v=Qps9woUGkvI>

<https://www.makerspaces.com/how-to-solder/>

<https://learn.sparkfun.com/tutorials/how-to-solder-through-hole-soldering/all>

A place to work:

Ideally this is a clean well lit table with bright lighting and adequate ventilation as well as the tools listed below in the equipment section.

Safety:

Be sure to review the safety information above. Best practice safety is something to aim for, but we are not always able to achieve it. It is however important to know the risks and decide which safety measures you will put in place.

Equipment:

To complete the build of the Synth.BT you will need the following equipment:

- Soldering Iron (any kind will do)
- Solder (lead free or leaded, see warnings above) *lead-free is harder to work with, but doesn't have lead in it*
- Side cutters, to cut out the pieces out
- Safety gear (as listed above)



Additional optional equipment includes*:

- Flux pen (to make soldering easier)
- IPA (Isopropyl Alcohol) for cleaning the board when done.
- Sandpaper (for cleaning up edges of circuit boards once cut out)
- Respirator mask (for safety when sanding or soldering)

**These are nice to have but not mandatory.*

Parts:

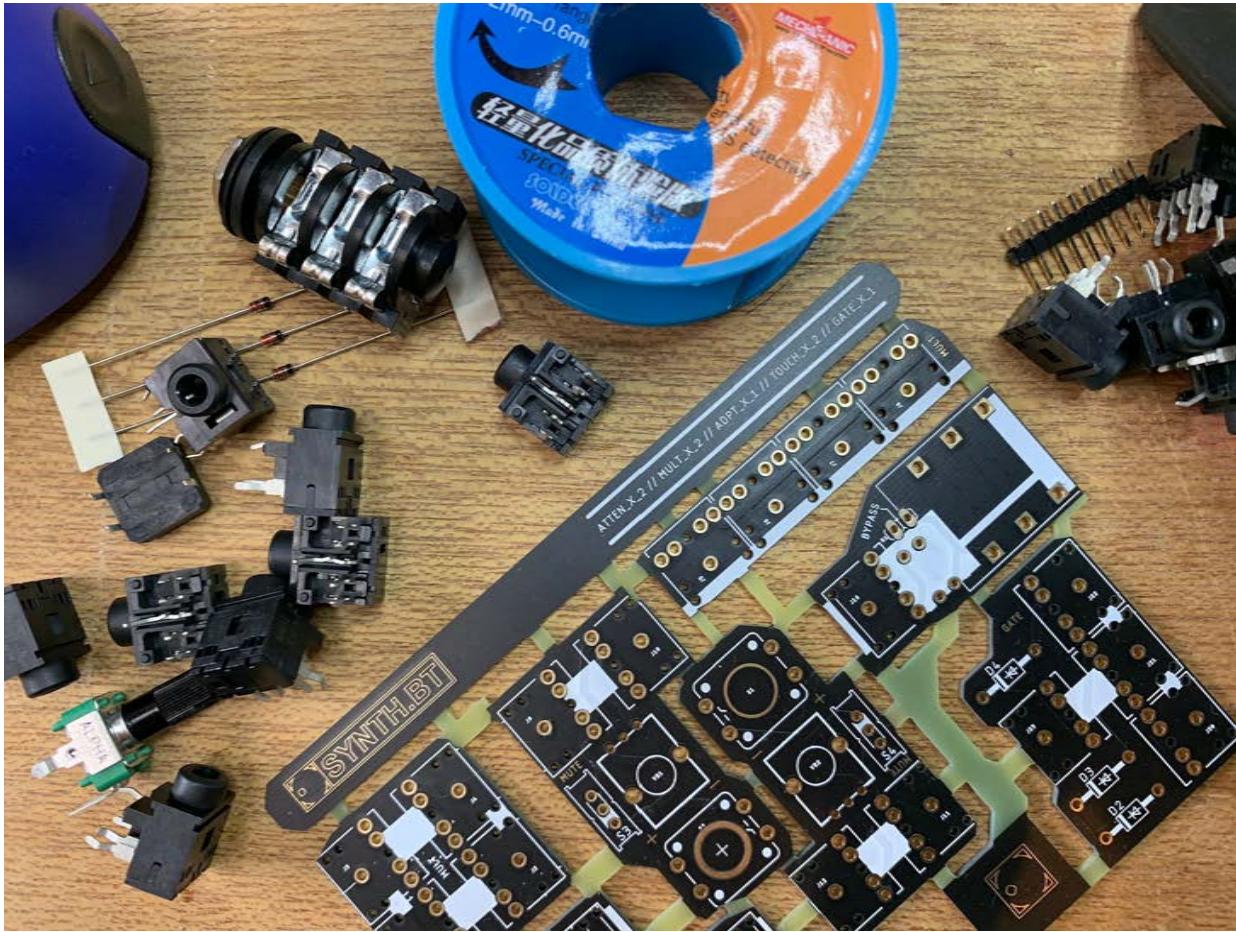
Designator	ITEM	NUMBER	LINK Generic
s1,s2	button	2	https://au.mouser.com/ProductDetail/SparkFun/COM-09190?qs=sGAEpiMZZMuWWq7rhECaKRN1t1Mzr7UJuC9h6wUZv1c
n/a	pin/shunt	1	https://au.mouser.com/ProductDetail/Molex/22-28-4027?qs=sGAEpiMZZMs%252BGHln7q6pm%252BS0pk2Wo0XxNI9H%252BWJw8G8%3D
r1,r2	Resistors	2	https://au.mouser.com/ProductDetail/Yageo/CFR-25JR-52-1K?qs=sGAEpiMZZMsPqMdJzcrNwnsX4eOwulRJFZTTNxqsg0o%3D

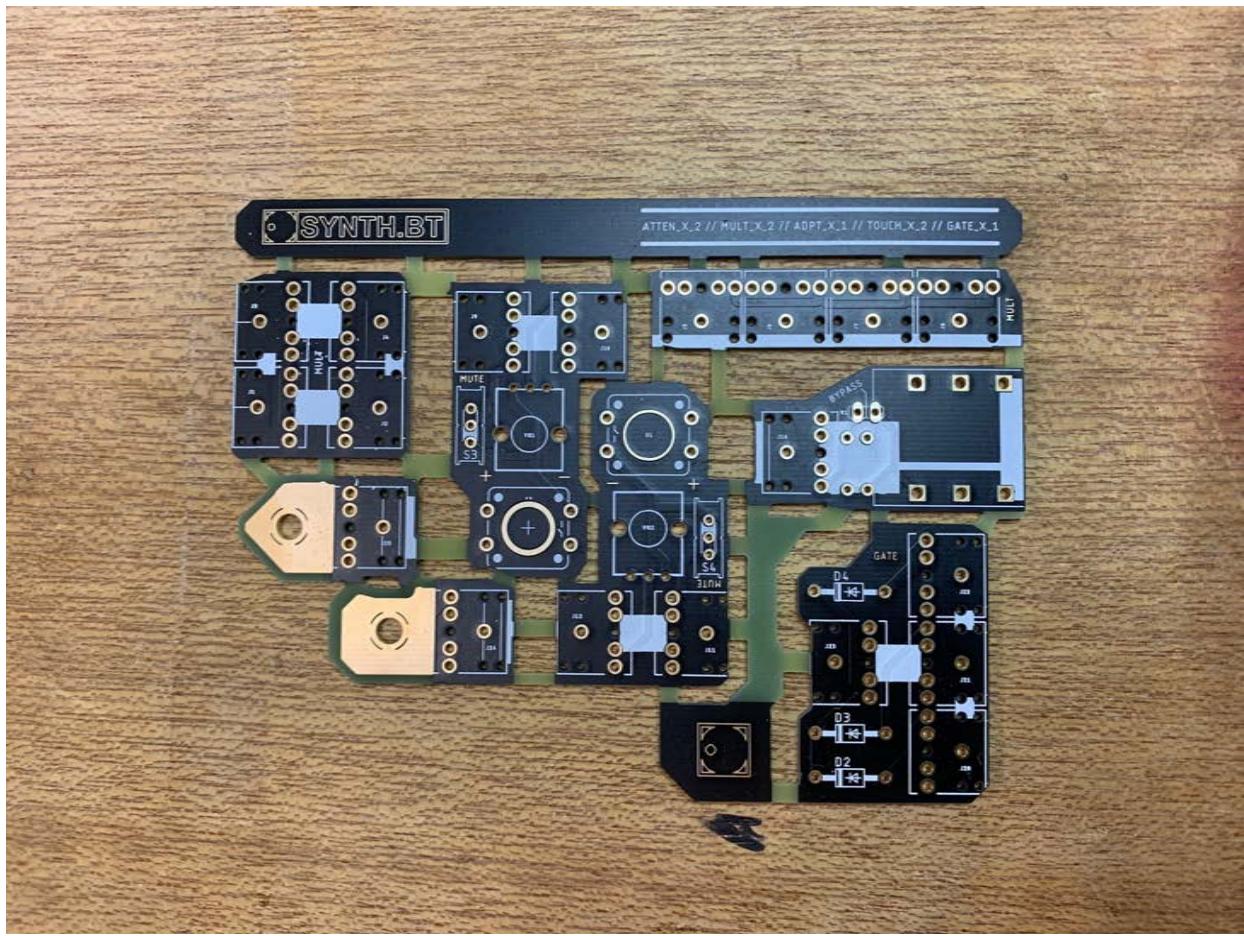
	PCB	1	
all j's	3.5 audio jack	19	https://www.ebay.com.au/itm/5Pcs-3-5mm-female-stereo-audio-socket-headphone-jack-connector-5-pin-PCB-mounJCA/192932008740?hash=item2ceba4d324:g:ZV4AAOSwMjpclgJu
vr1, vr2	Potentiometer	2	https://au.mouser.com/ProductDetail/Bourns/PTV09A-4025F-B103?qs=sGAEpiMZZMtC25I1F4XBU7WMi1wGK3ZvZ15ABC5GIFs%3D
n/a	1/4 audio jack	1	https://www.ebay.com.au/itm/5PCS-6-35mm-1-4-6Pin-Female-Stereo-Jack-Socket-Panel-PCB-Welding3CAU/333218281931?trkparms=aid%3D555021%26algo%3DPL_SIMRVI%26ao%3D1%26asc%3D59672%26meid%3D696f731aa1e848428ed24a154ffb8f67%26pid%3D100752%26rk%3D5%26rkt%3D16%26mehot%3Dco%26sd%3D192932008740%26itm%3D333218281931%26pmt%3D1%26hoa%3D0%26pg%3D2047675&_trksid=p2047675.c100752.m1982
s3,s4	Slide switch	2	https://au.mouser.com/ProductDetail/E-Switch/EG1218?qs=sGAEpiMZZMtHXLepoqNyVZDOWY7elTCOE4MJ3sXRkSs%3D
d2,d3,d4	diodes	3	https://au.mouser.com/ProductDetail/ON-Semiconductor-Fairchild/1N916?qs=sGAEpiMZZMtHjESLtvkoBU6cp6%252BZs9x%2Fzpl7lhris%3D

You should have all these parts, i've included links to buy them if you don't. Pretty much all of these components are very common and you could interchange just about any of them for one from a compatible supplier*.

*Not the switch (s3/s4) tho, there are not many alternatives for this switch footprint.

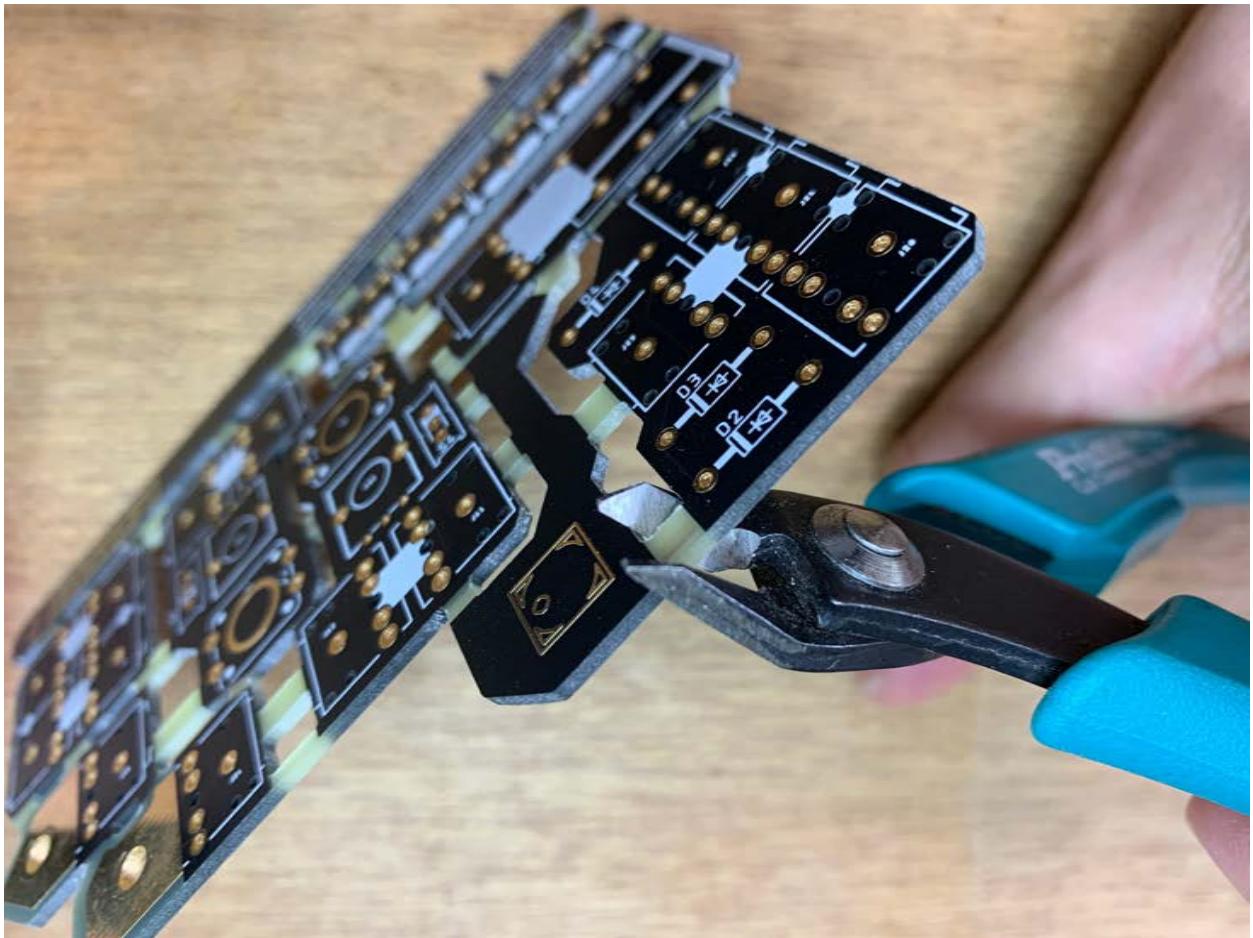
Build Process:





Gather all the parts you need together with your tools. Get a clean well lit place to work.

Cut out the parts?



You can decide now whether to cut out your parts before soldering. Here is the trade off:

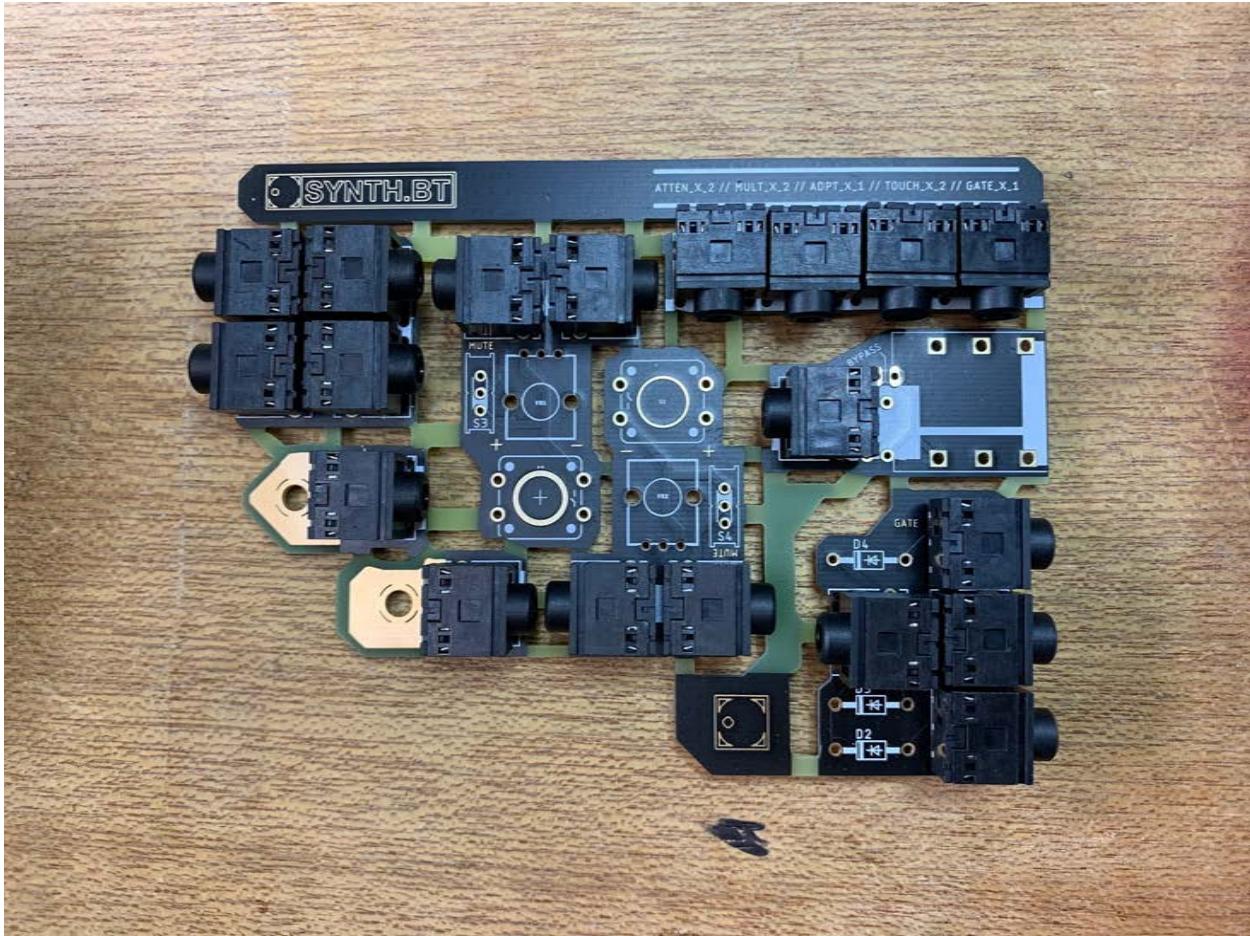
***If you cut out all the parts now, soldering will be more work, but you will be more easily able to get smooth sanded edges.**

***If you cut the parts out later, soldering will be easier, as you are working on one PCB rather than eight.**

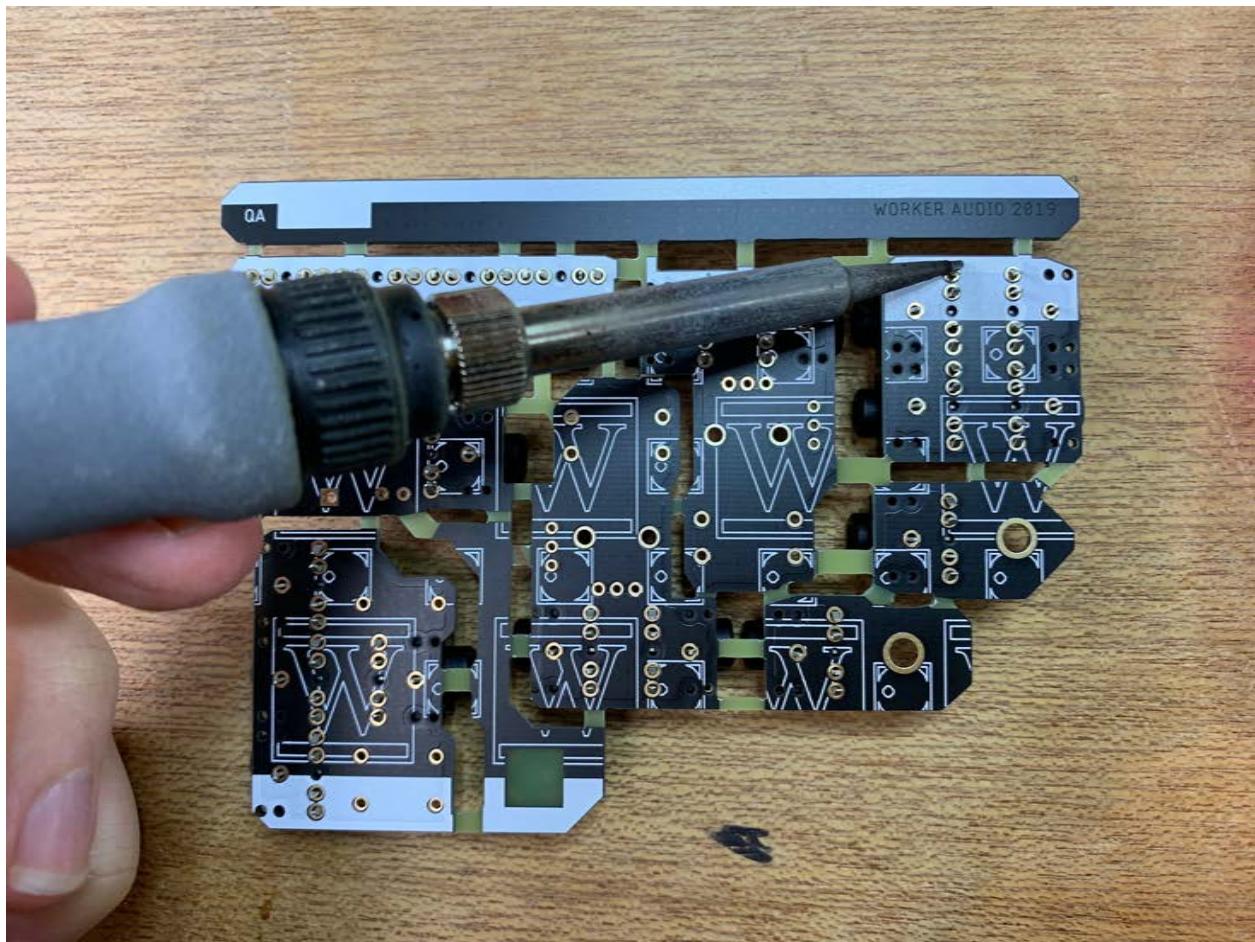
When you cut out the individual pieces will not affect the final product, it is a preference.

If you do decide to cut out your parts now jump to the “**CUTOUT AND CLEANUP**” part of this guide before coming back here.

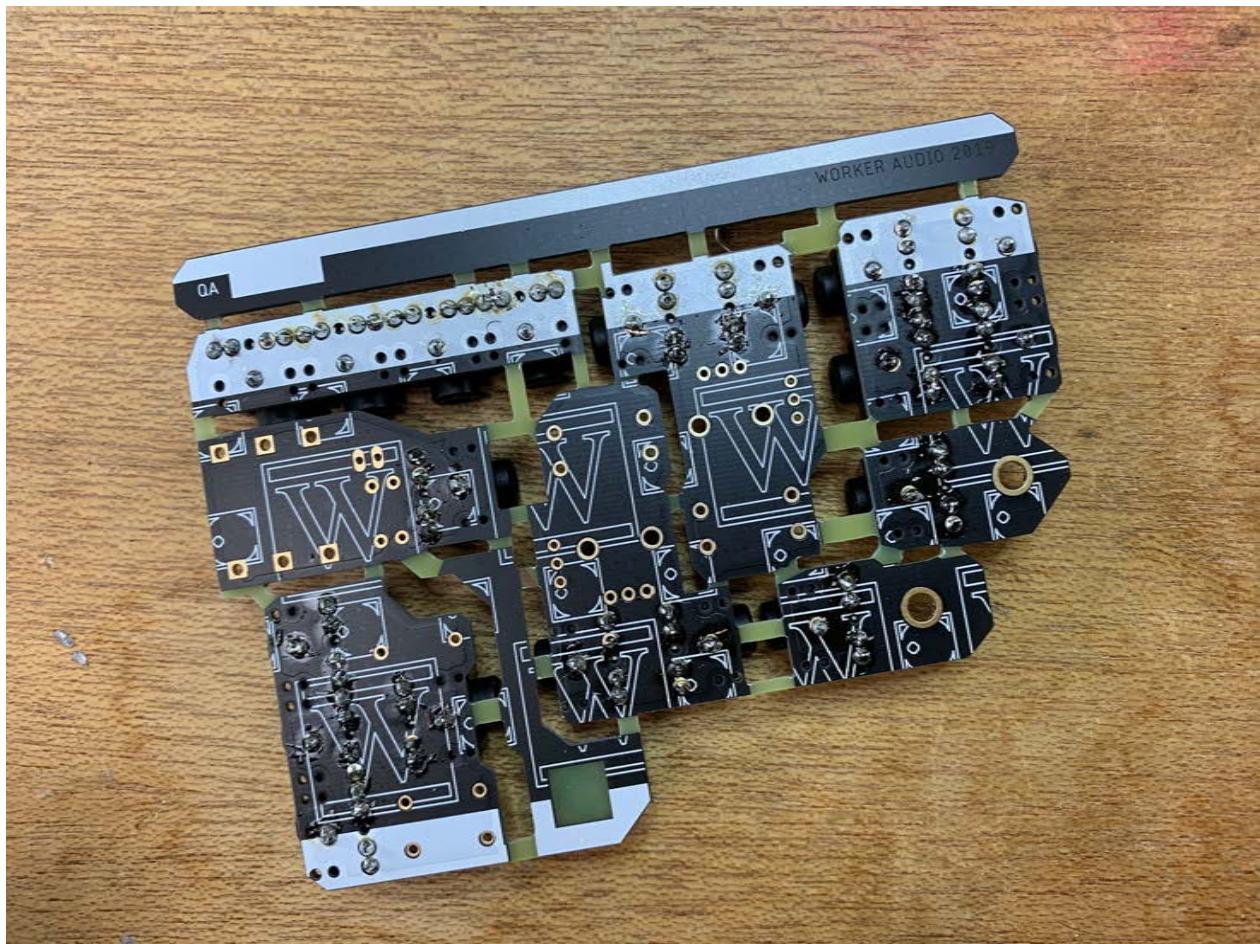
Solder the Jacks



Get together the 3.5mm jacks, you should have 19 of them, place them on the circuit board. They only go in one way.

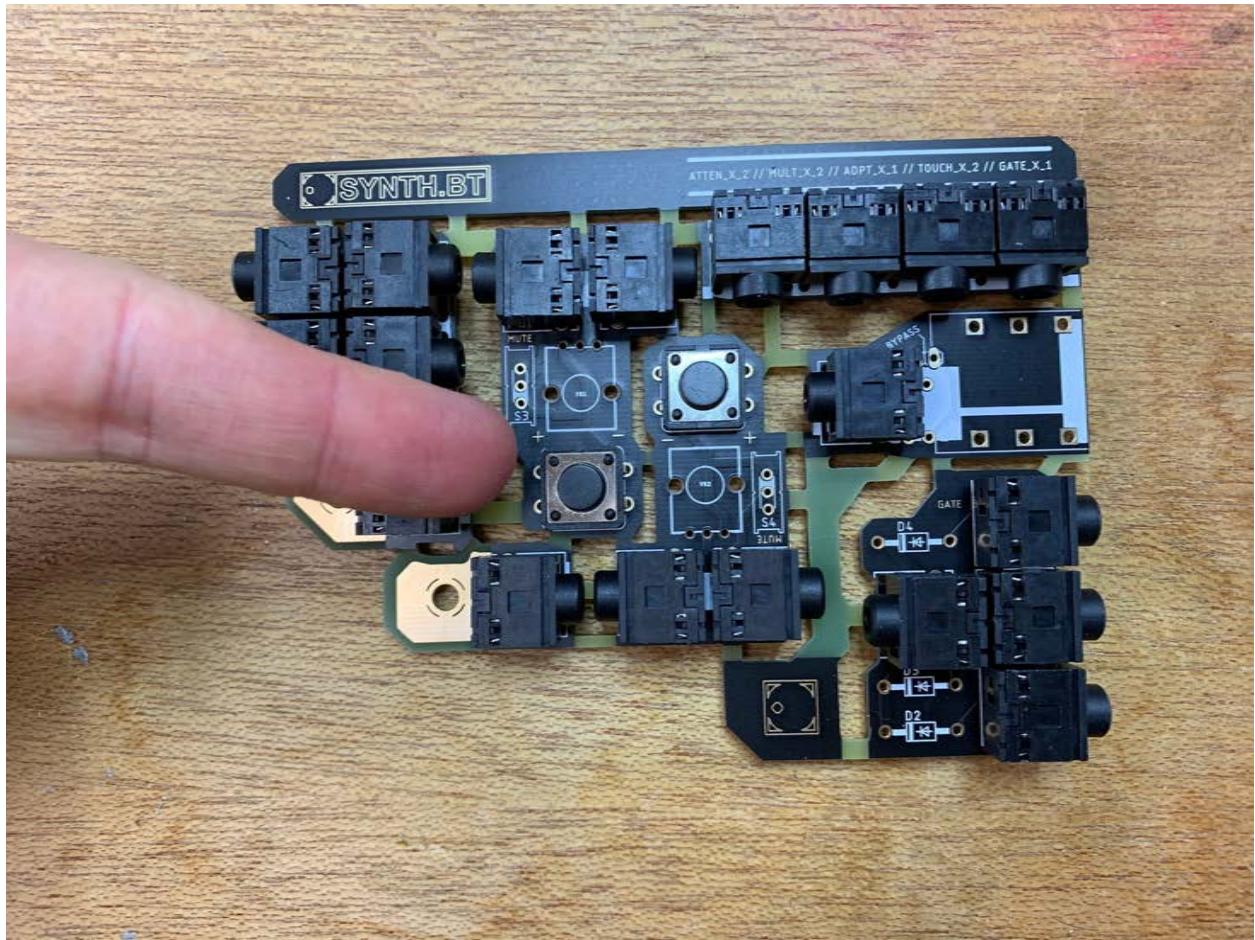


Flip the whole thing over, make sure it is all flat, and then solder only the points where the legs of the 3.5mm jacks stick through the board.

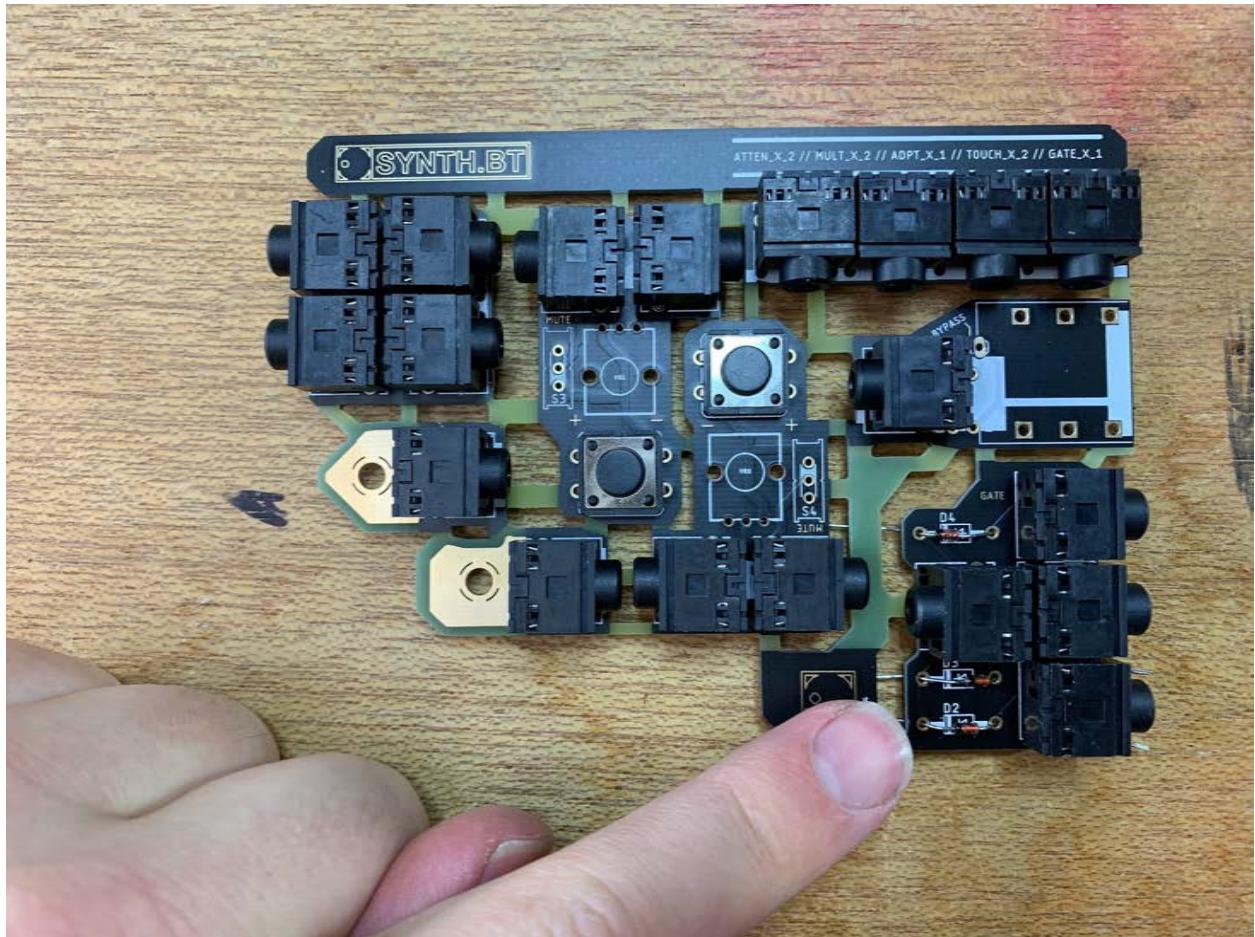


You will end up with something like this.

Buttons and Diodes



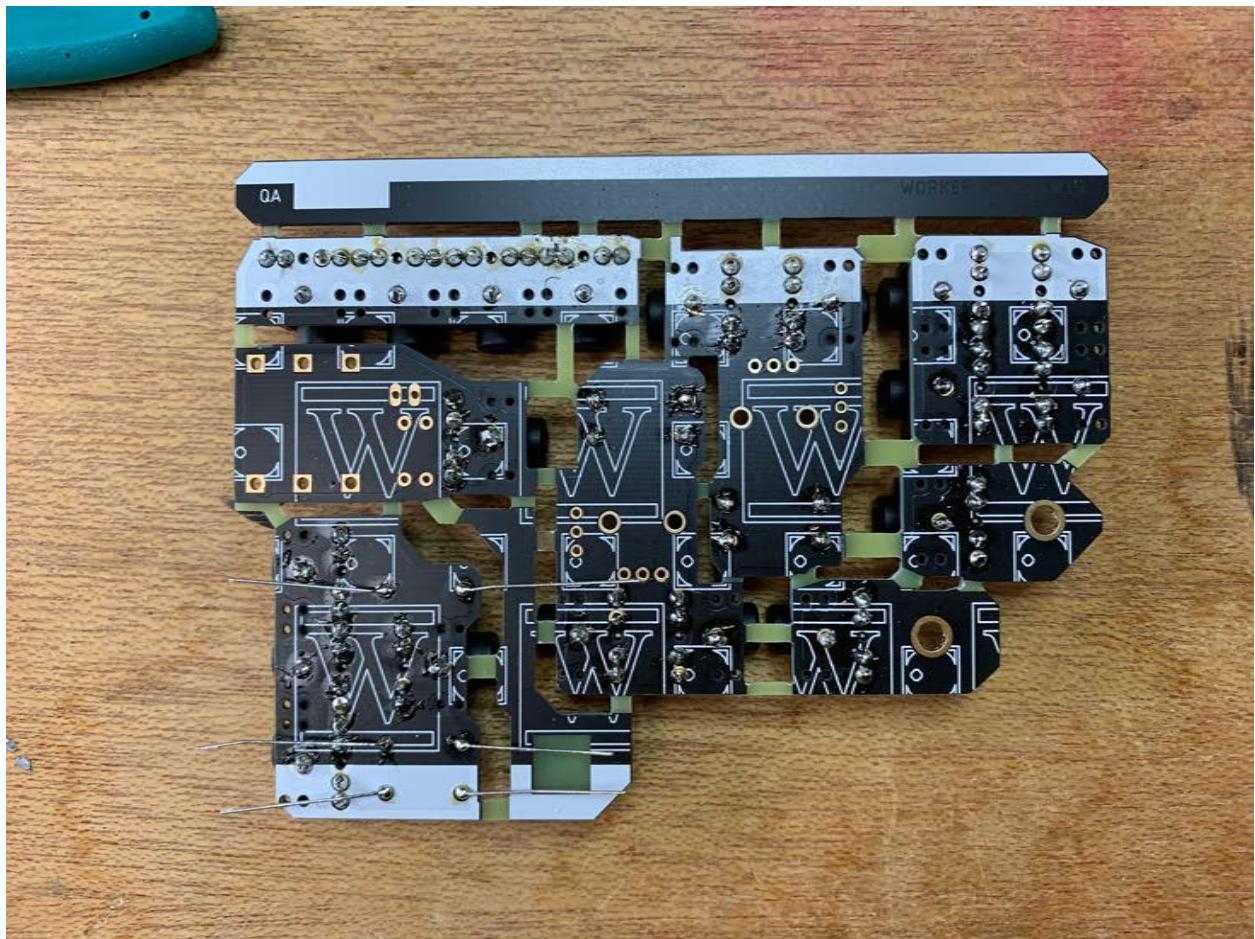
Now Insert the two push buttons, again there is only one way to put them in, anyway that fits will work.



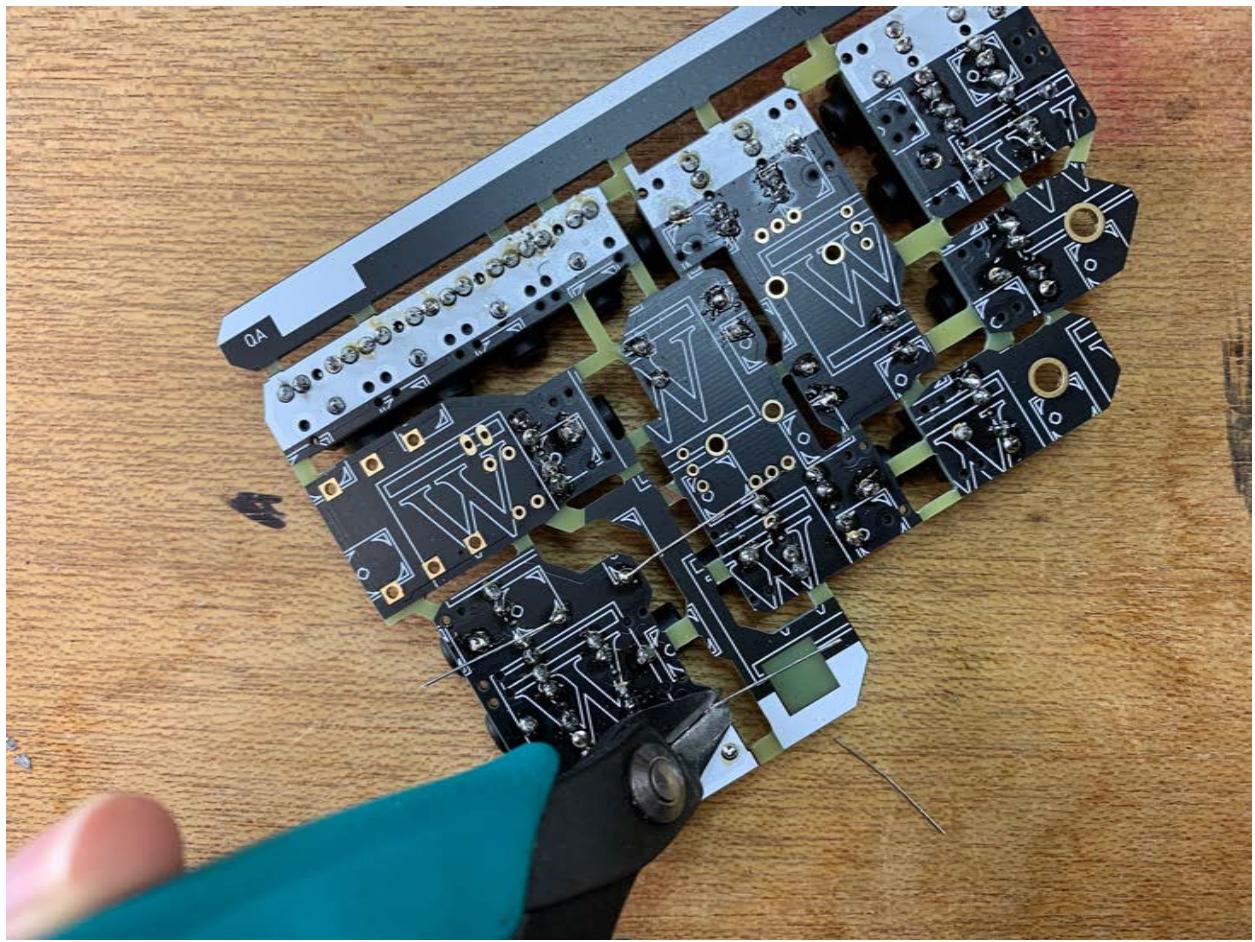
Now for the diodes, you will have 3, notice there is a black line on each one, make sure the black line is facing in the same direction as the line on the silk screen (as shown in the picture).

Black line faces left when the board is like this

Bend out the legs of your diodes to keep them in place as you work.

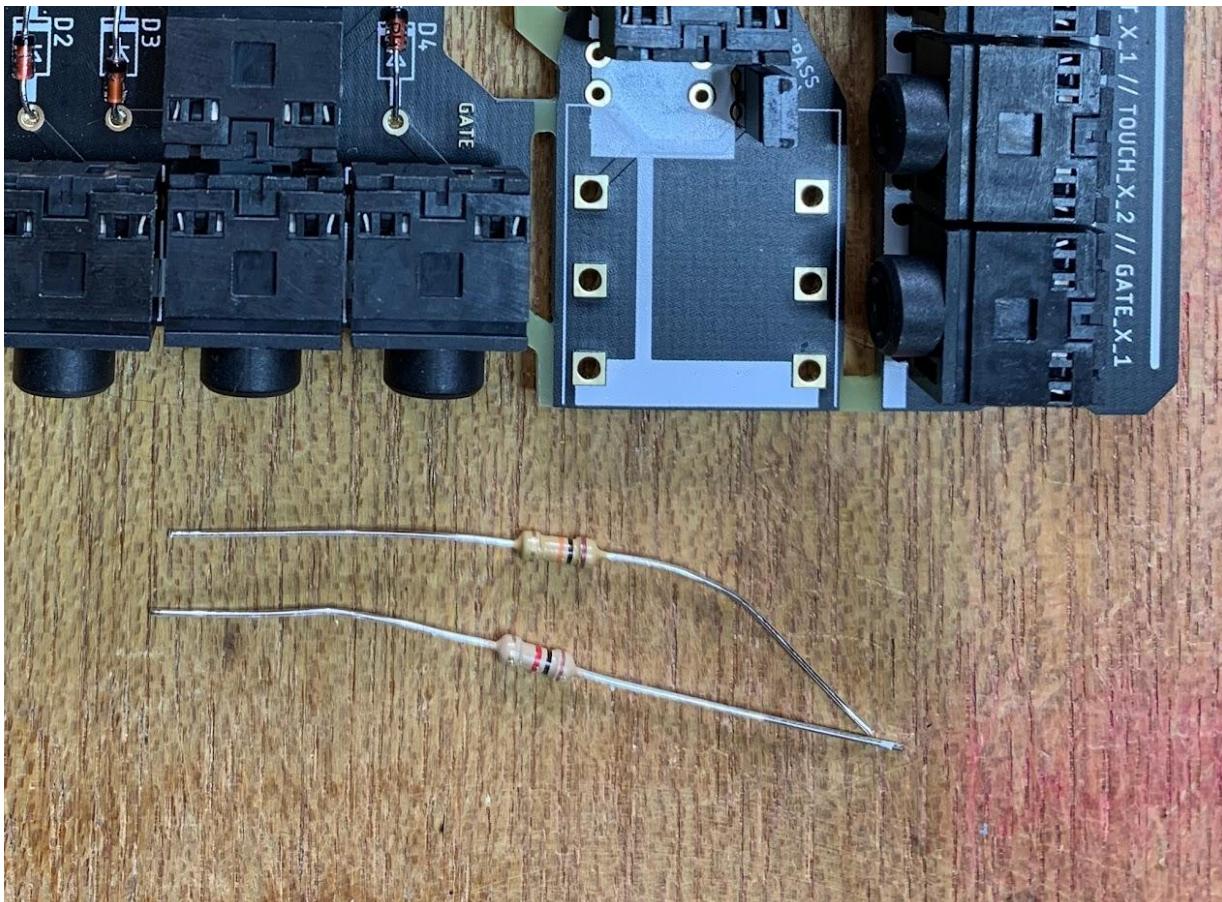
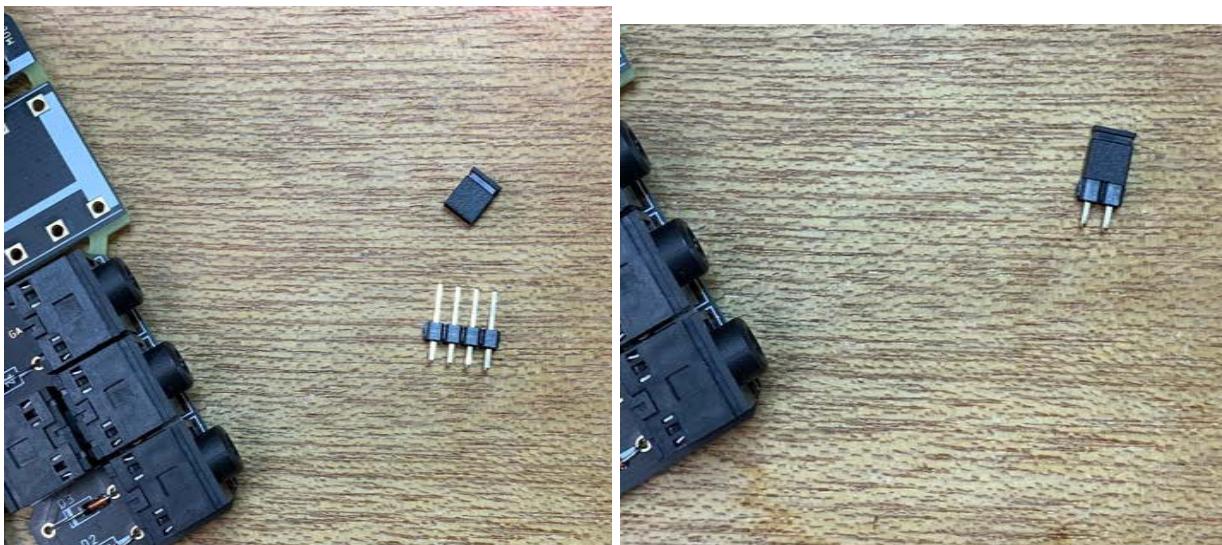


Turn over and solder before snipping the legs off. Snip as close to the solder joint as you can without cutting the solder joint.



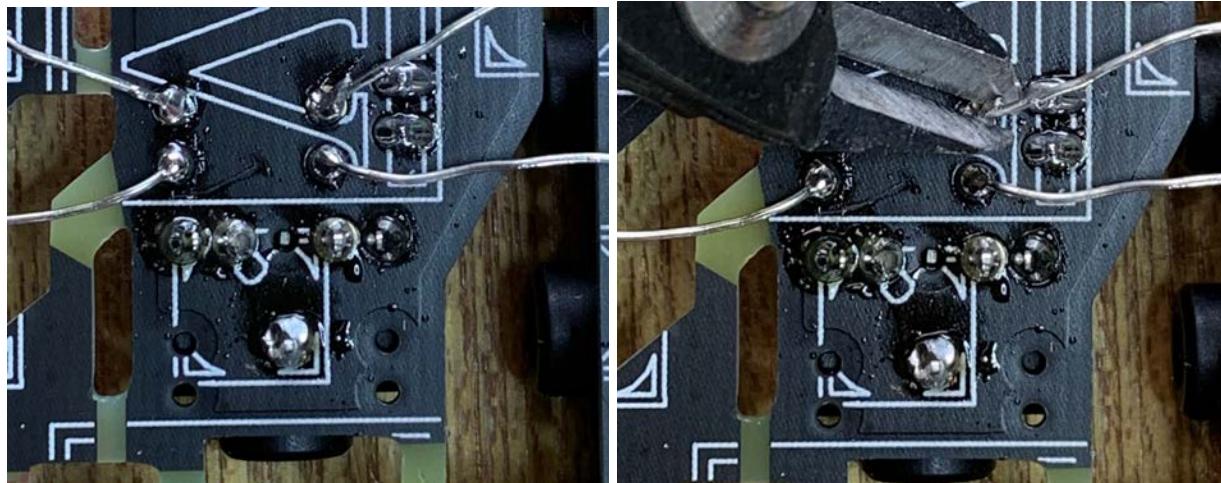
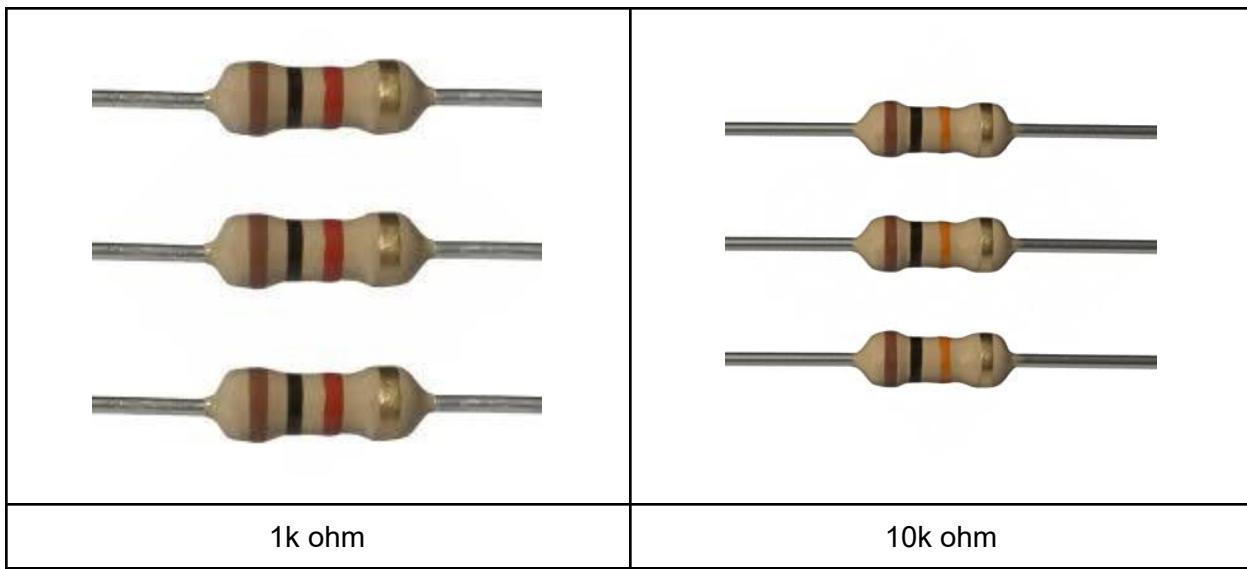
Resistors and Shunt

Next get your pinheader and shunt (shown below) you only need 2 pins. Insert them into the shunt, and then pull them out until the whole thing is the same height as the 3.5mm jacks, this will stop it falling out when you flip it over.



The pins and shunt go next to the word bypass shown above.

You will also find that you have two resistors, 1k ohm and 10k ohm. The 10k goes next to the 3.5mm jack (r1) whilst the other goes next to it.



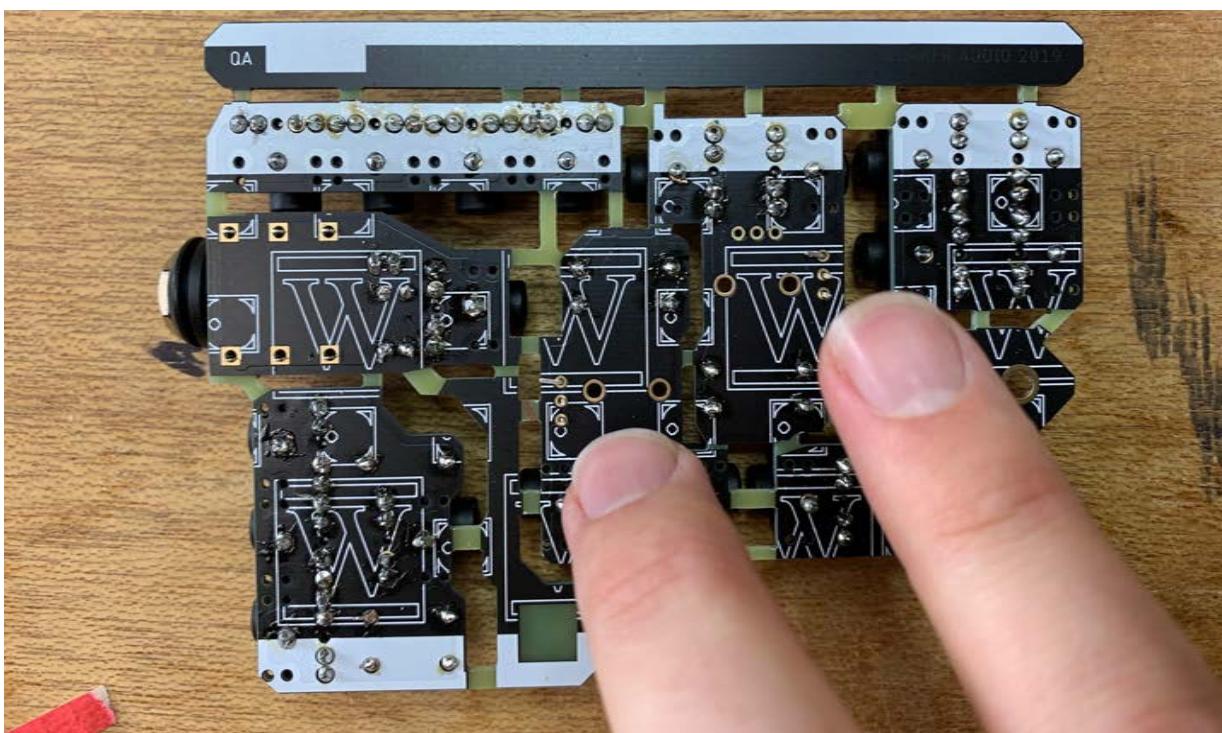
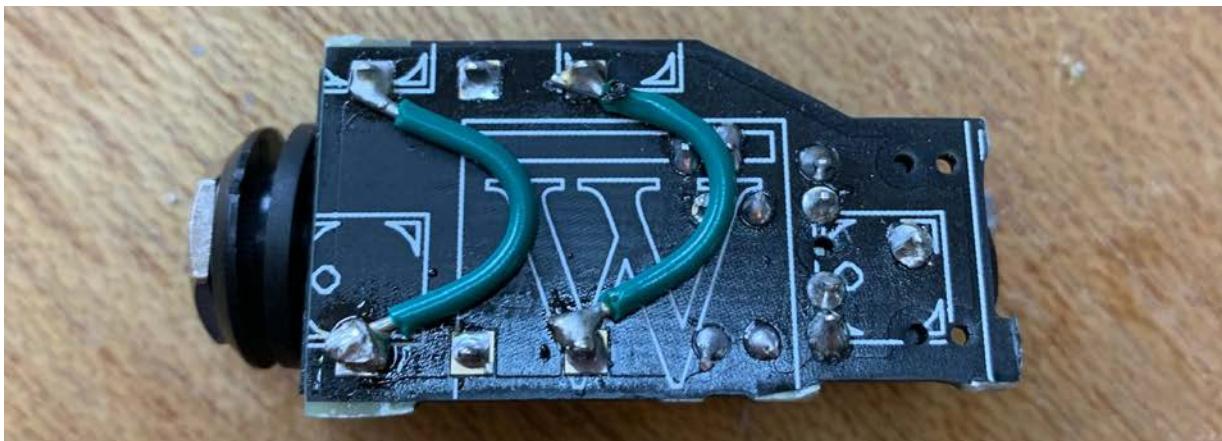
Again fold over, solder and cut. If your solder joints look messy it is always possible to come back and tidy them up by remelting the solder.

Switches and ¼" Jack

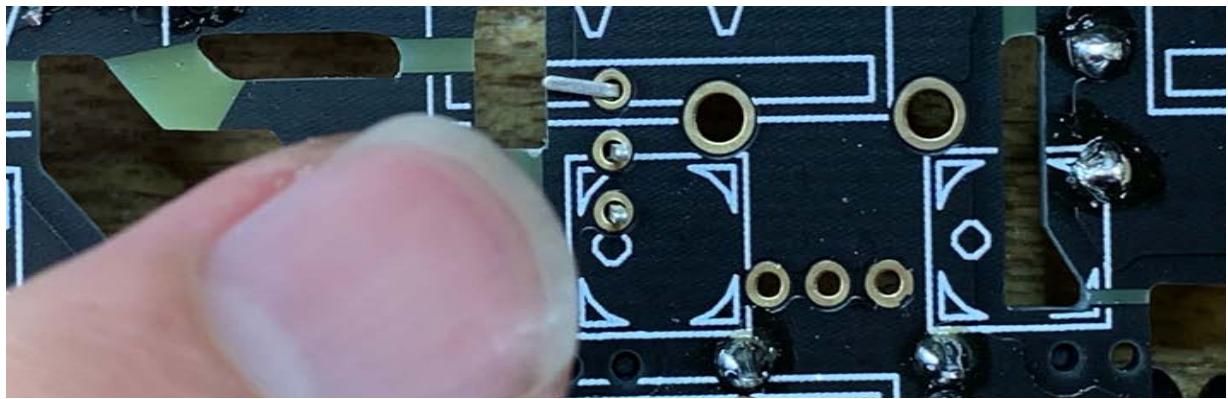
Now insert the large ¼" jack shown here on the far right and the 2 small slide switches pointed to below.

NOTE THERE IS AN ISSUE WITH THE ¼' JACK ADDRESSED BELOW

Due to an issue with the component footprint you will need to use two wires to bridge the pins shown below. Alternatively with very thin wire it is possible ro make these links on the top side of the board and then insert the ¼' jack before soldering to make an invisible link between the pins.



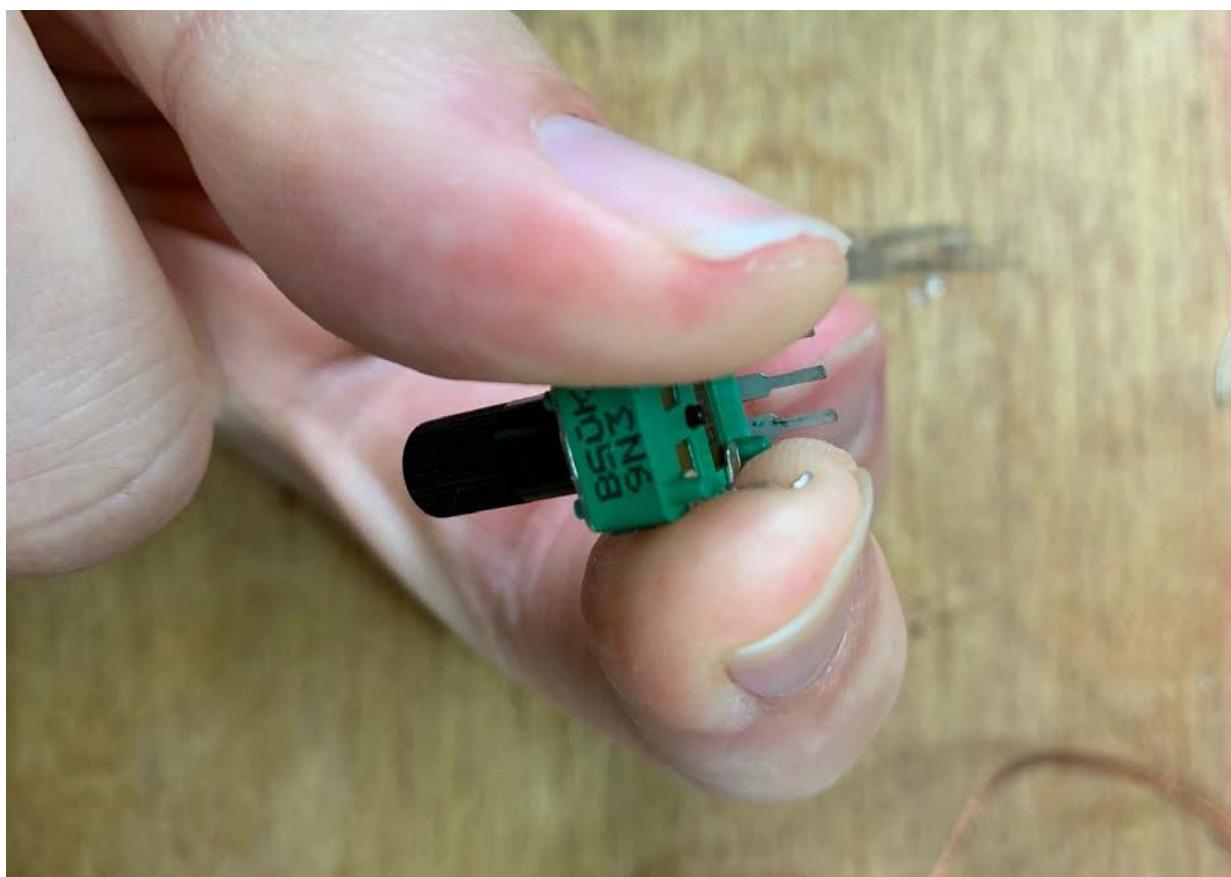
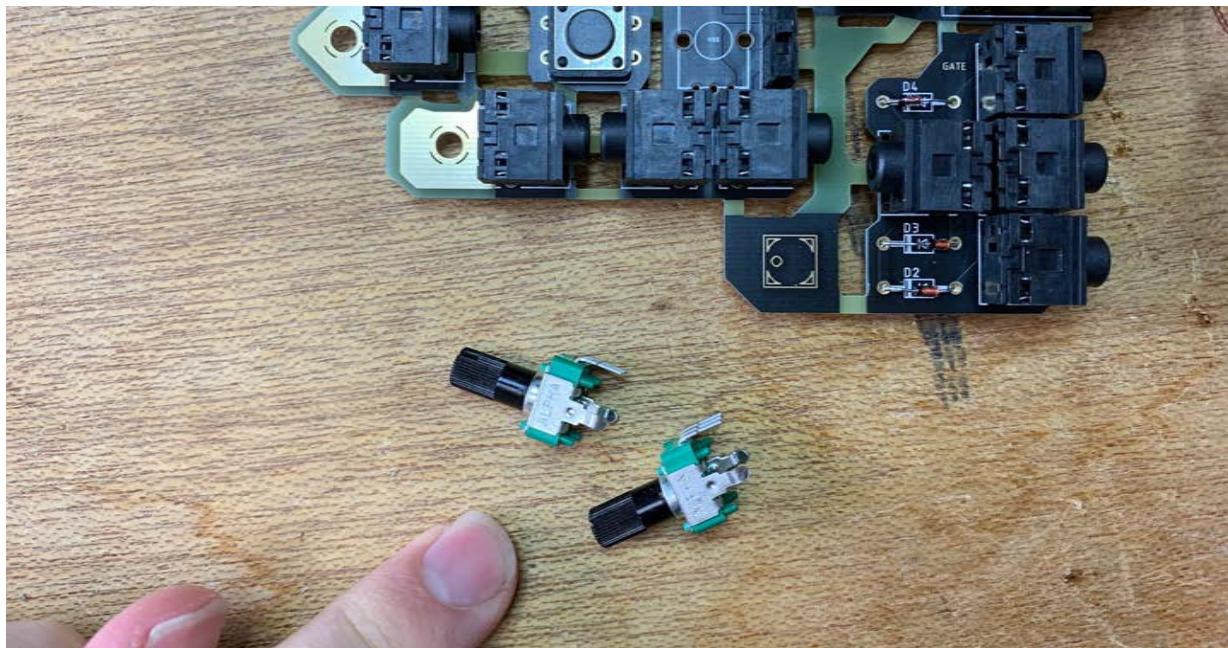
In order to get these switches to stay flush with the board when you solder you will likely need to bend one of the legs on the back, once the switch has been inserted (pictured below)

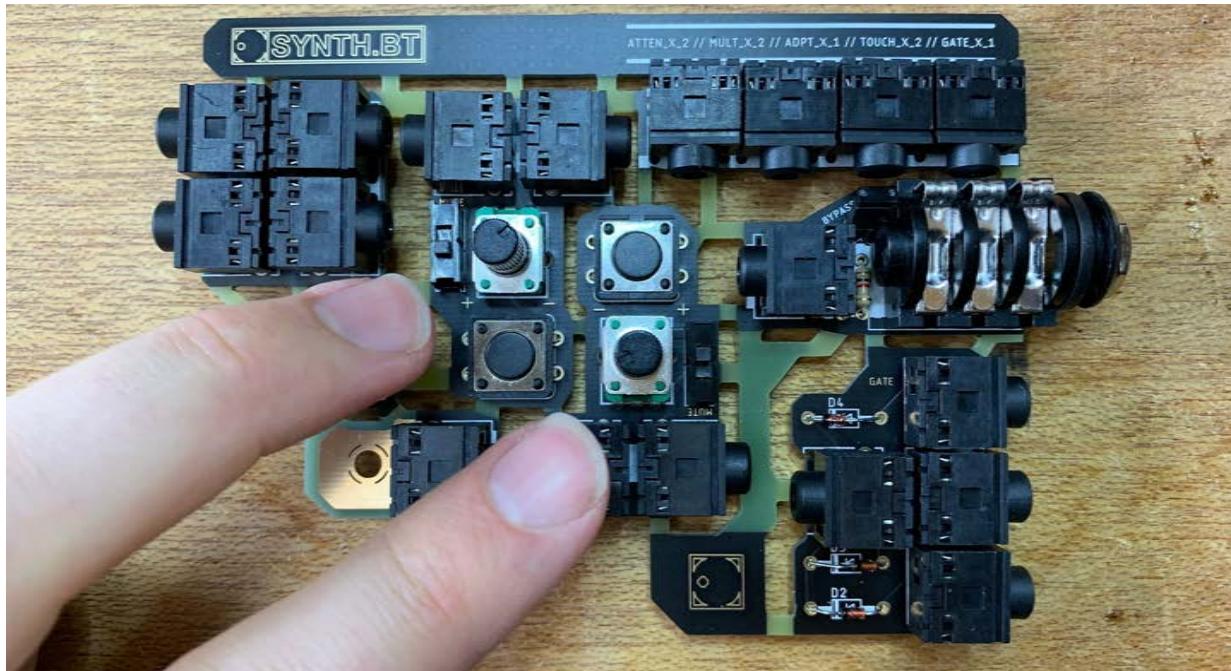


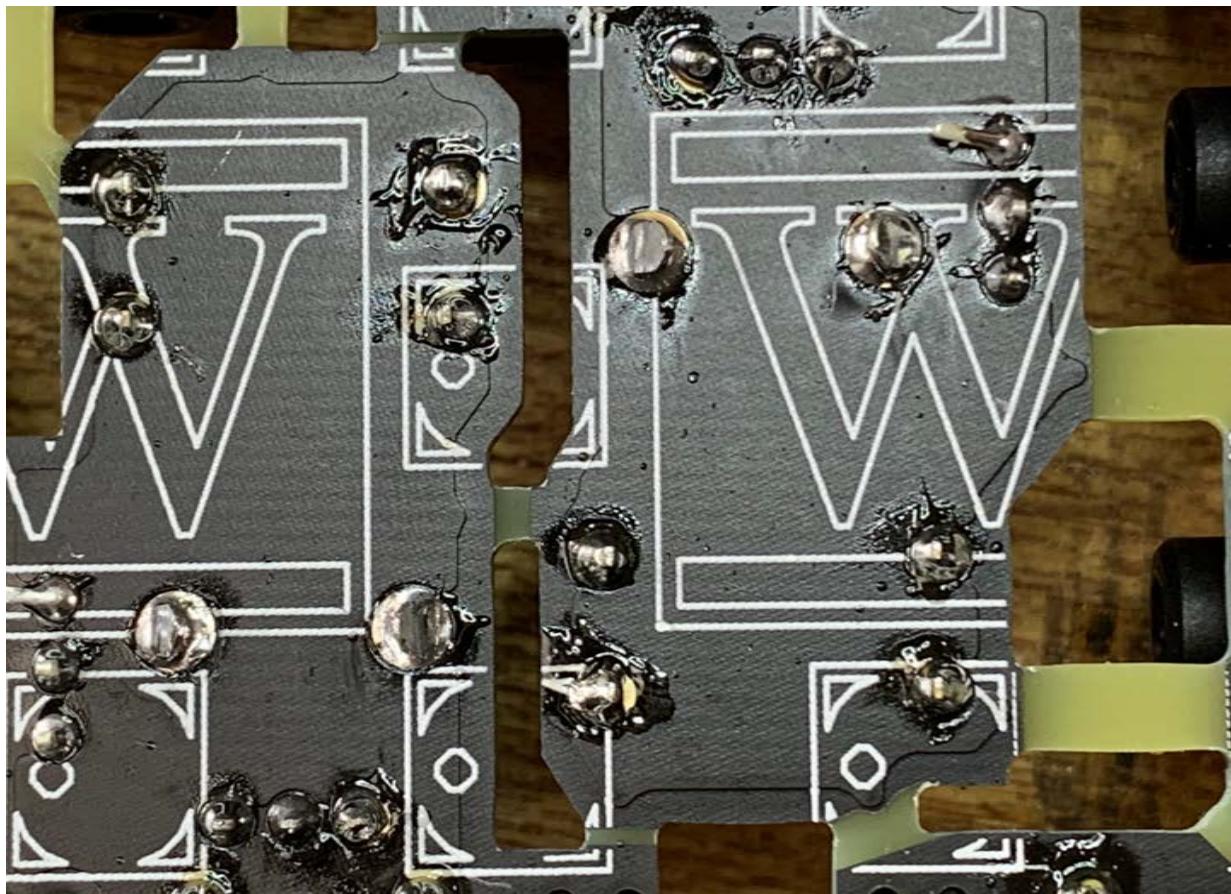
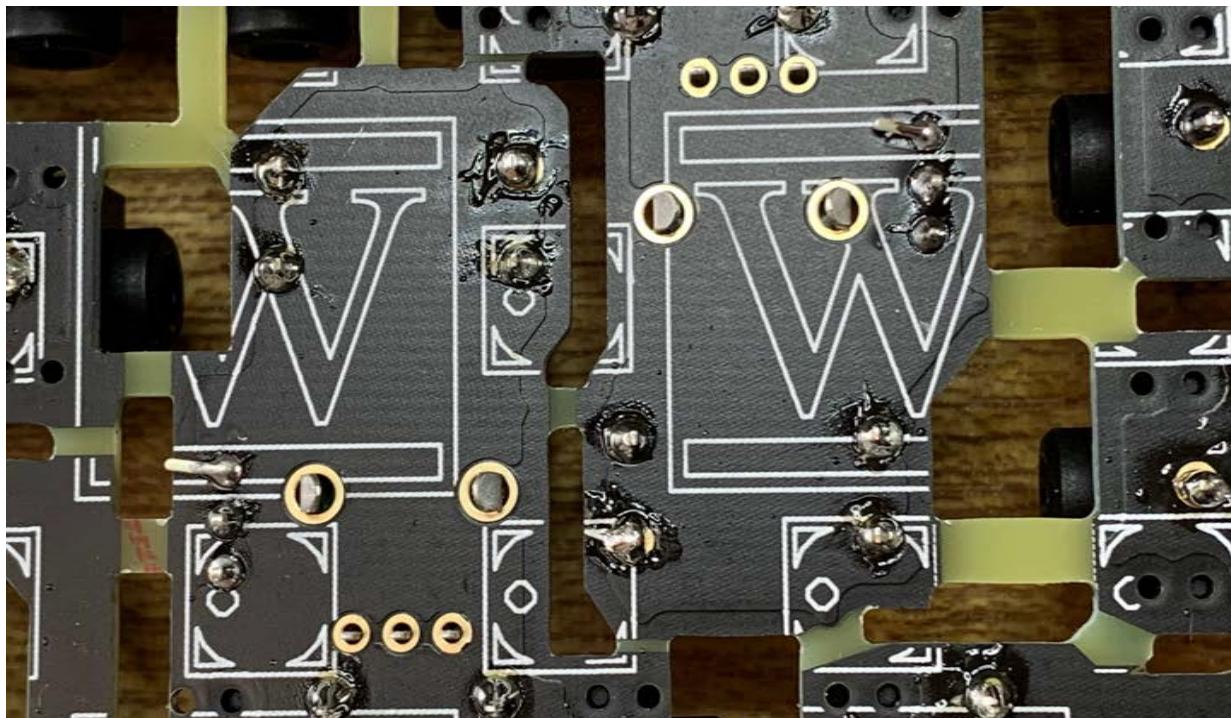
Again, solder these joints.

Potentiometers

You will have two potentiometers. In order to get them to sit on the board you may need to squeeze the outside legs as shown below. You will not need to bend them much to get them to fit.







This time when soldering you will need to use quite a bit of solder on the large tabs you just bent. This will keep the pot in place as you turn it and acts as a mechanical joint between the potentiometer and the PCB.

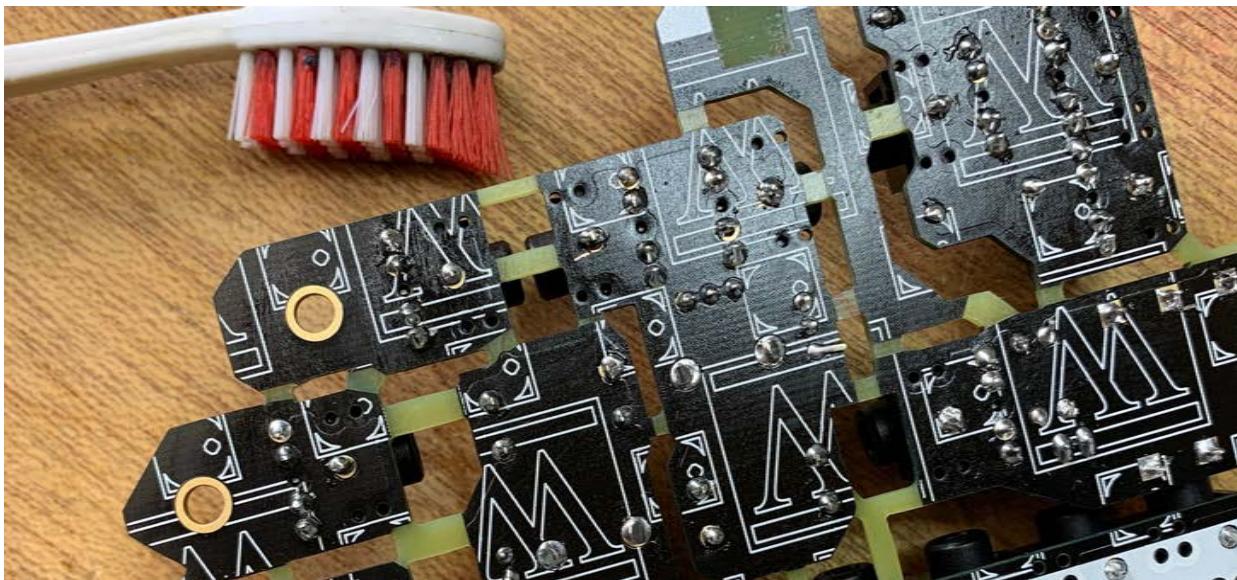
You are finished soldering!

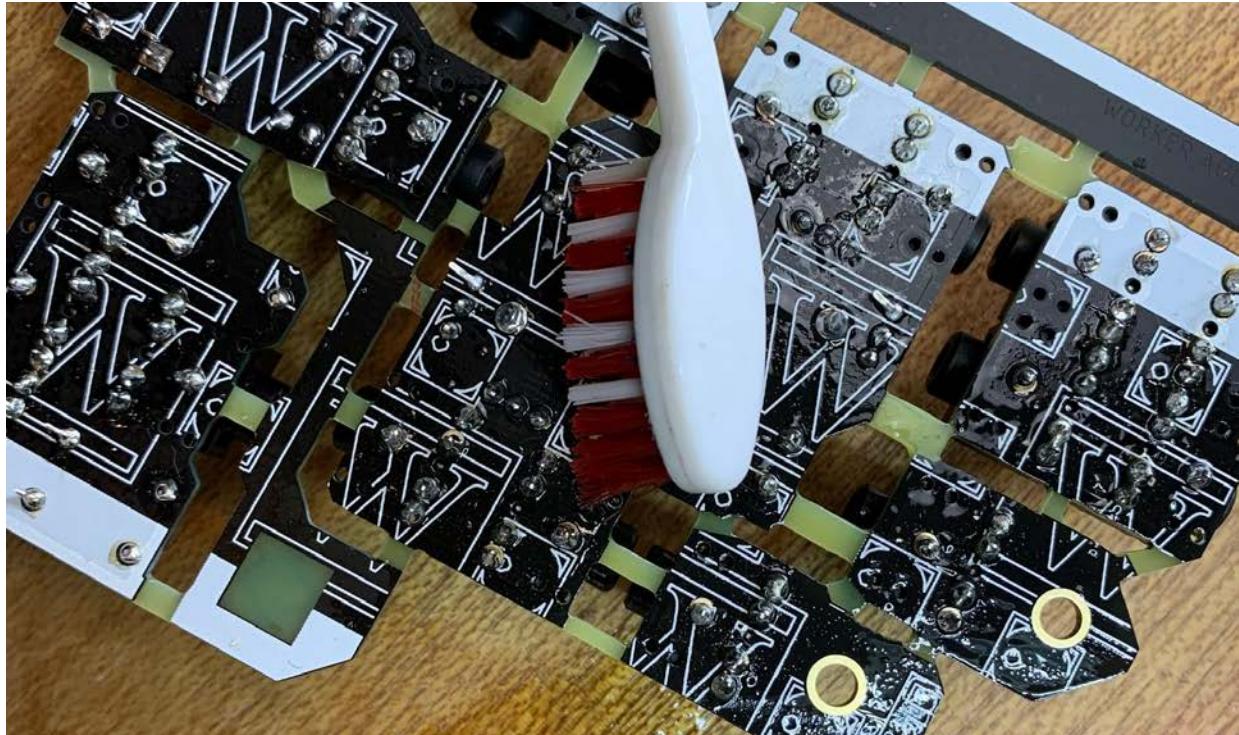
Clean up:

Now that you are all done, it is a good idea to clean your work. You may have noticed that soldering has left some shiny clear spots on our board. THis is the FLUX that we used, or was present in the solder.

The best way to clean it is to use an old toothbrush and some isopropyl alcohol, spray the alcohol onto the tooth brush and scrub the back of the board to clean.

Leave to dry, and you are done.





Cutout and Cleanup

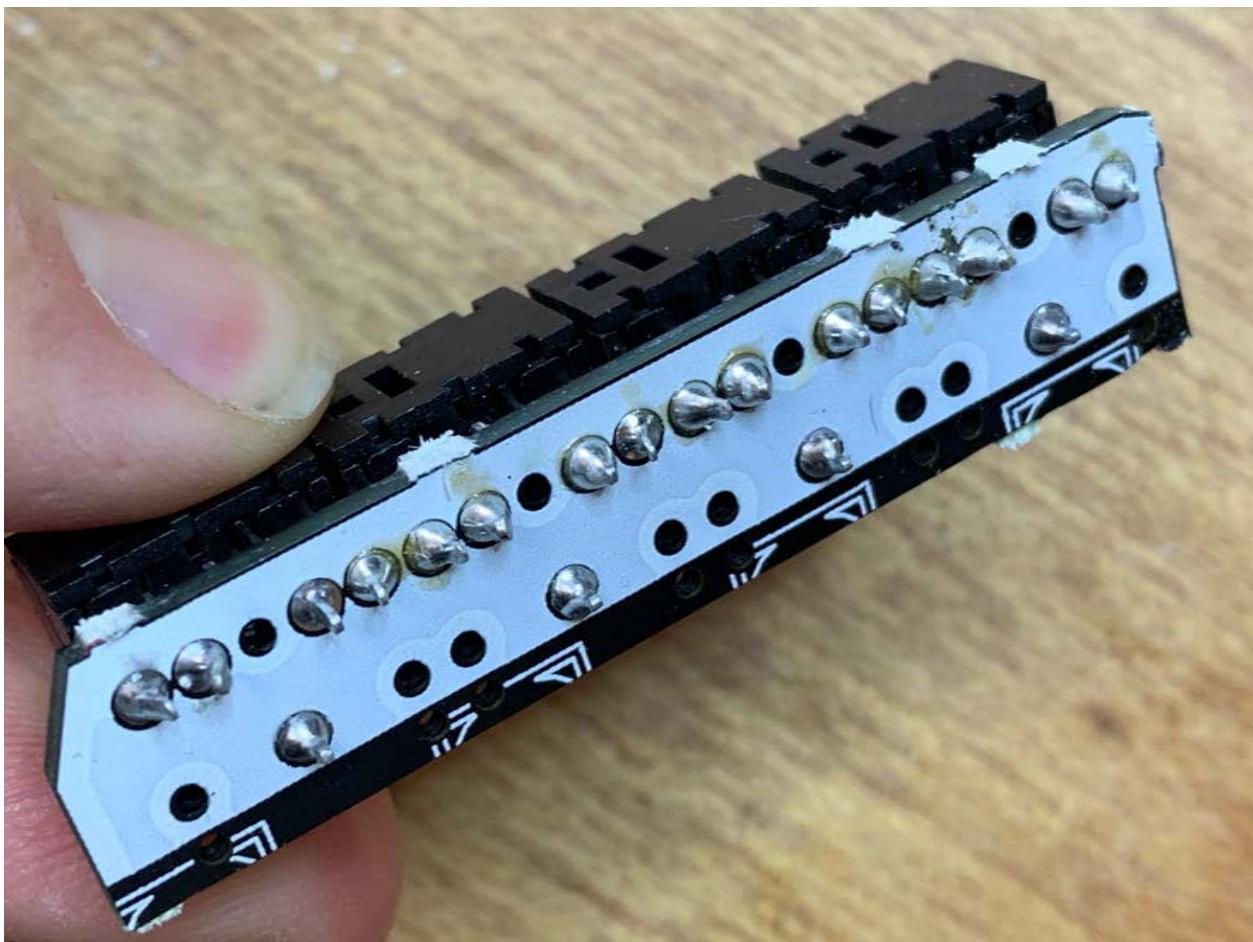
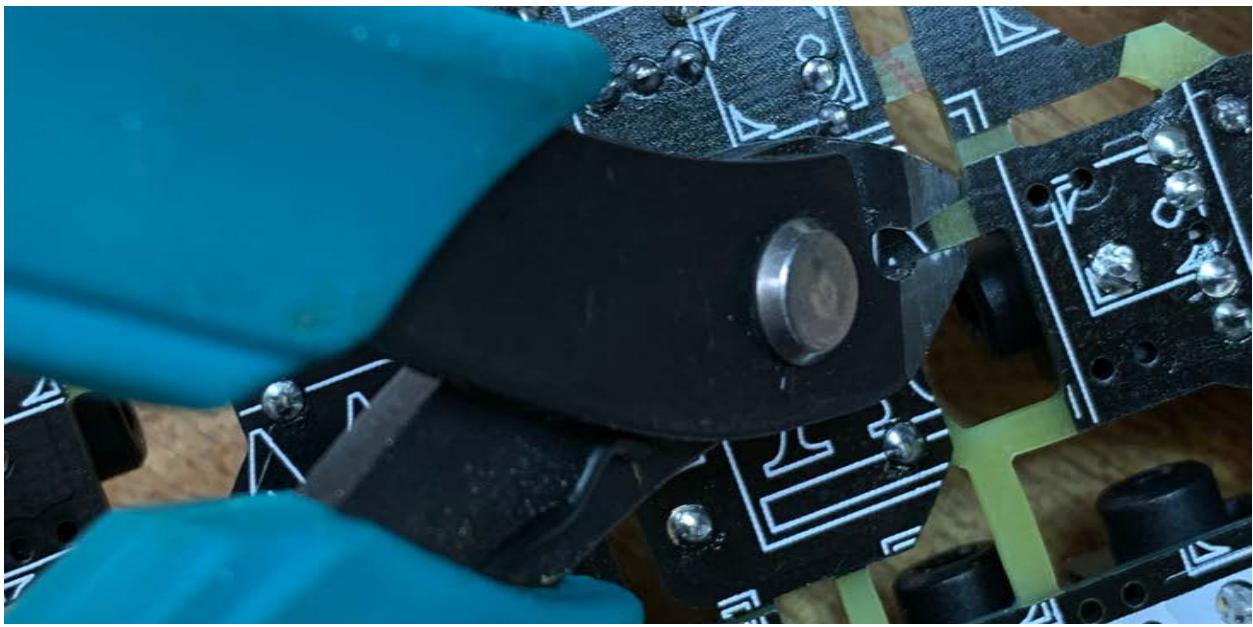
Looking at the circuit board you will see that the components you want are separated by sections that do not have the black solder mask on them.

Below you can see me cutting one of these.

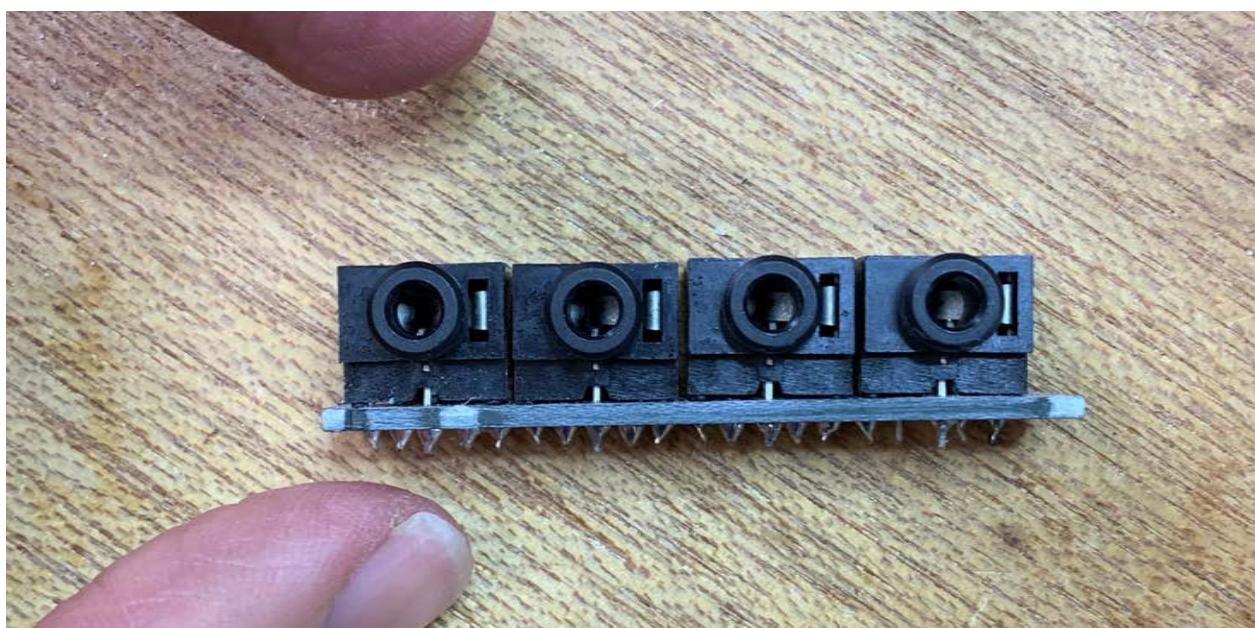
If you cut as close to the element you want, you will have less clean up later.

AGAIN, PLEASE WEAR EYE PROTECTION. Fiberglass can hold a lot of tension and a piece could fly off and hit you in the eye.

Some carefully used rough sand paper will let you smooth out the sides for a clean finish.

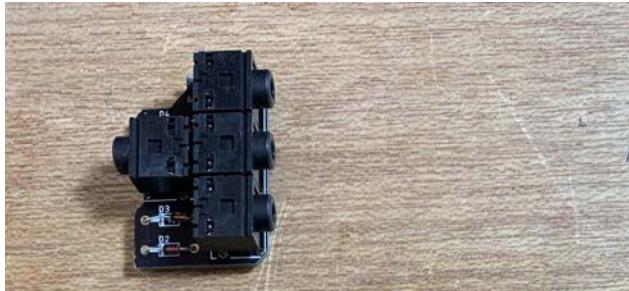






Testing

Gate Combiner:



This module lets you mix together three logic level signals together. Plug any kind of gate, clock or trigger into the three jacks on the right, and then take the summed output from the left. Great for making complex rhythmic patterns.



Adapter with Volume Attenuation:

This module adapts the standard 3.5mm mono audio jack to a 1/4' TS audio jack common on mixing desks and sound cards. The small black shunt next to the word bypass acts as an attenuator. When the shunt is present there is no change in volume. With the shunt removed the incoming signal will be reduced by 10X, this is a good ratio to reduce the very loud audio signal of eurorack to the much lower line level mixers and other audio equipment uses.

PLEASE NOTE THERE IS AN ISSUE WITH THIS ADAPTER ADDRESSED IN THE BUILD GUIDE



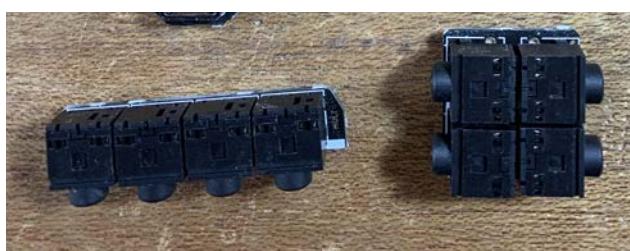
Touch Pad:

These modules let you pass voltages from your modular through your skin to affect them. If you plug one of these into an oscillator the pressure of your touch will affect the parameter you are plugged into, (like pitch). You can use two of these to mix signals using your fingers, plug one into the output of an LFO and the other into the cutoff of a filter. As you touch both pads with your fingers you will pass the lfo to the filter.



Attenuator with Mute and Stutter:

These modules allow you to control the level of a signal via the knob on top. They work for CV or audio, but are more suited to CV signal (audio volume is logarithmic, cv is linear). The mute switch will disconnect the input from the output. The button at the bottom, will temporarily silence the signal by connecting it to ground, creating a stuttering effect.



Multiples:

These modules split your signal into three. The input can be any of the four jacks. For some signals splitting may reduce the voltage slightly, this happens with passive mults.

Troubleshooting

Plug won't fit into the jack?

Soldering at high temp, or for too long can bend the pins inside the 3.5mm jack. Typically a bit of force will push them back into shape. Insert an old plug into the jack carefully increasing the force until it pops in.