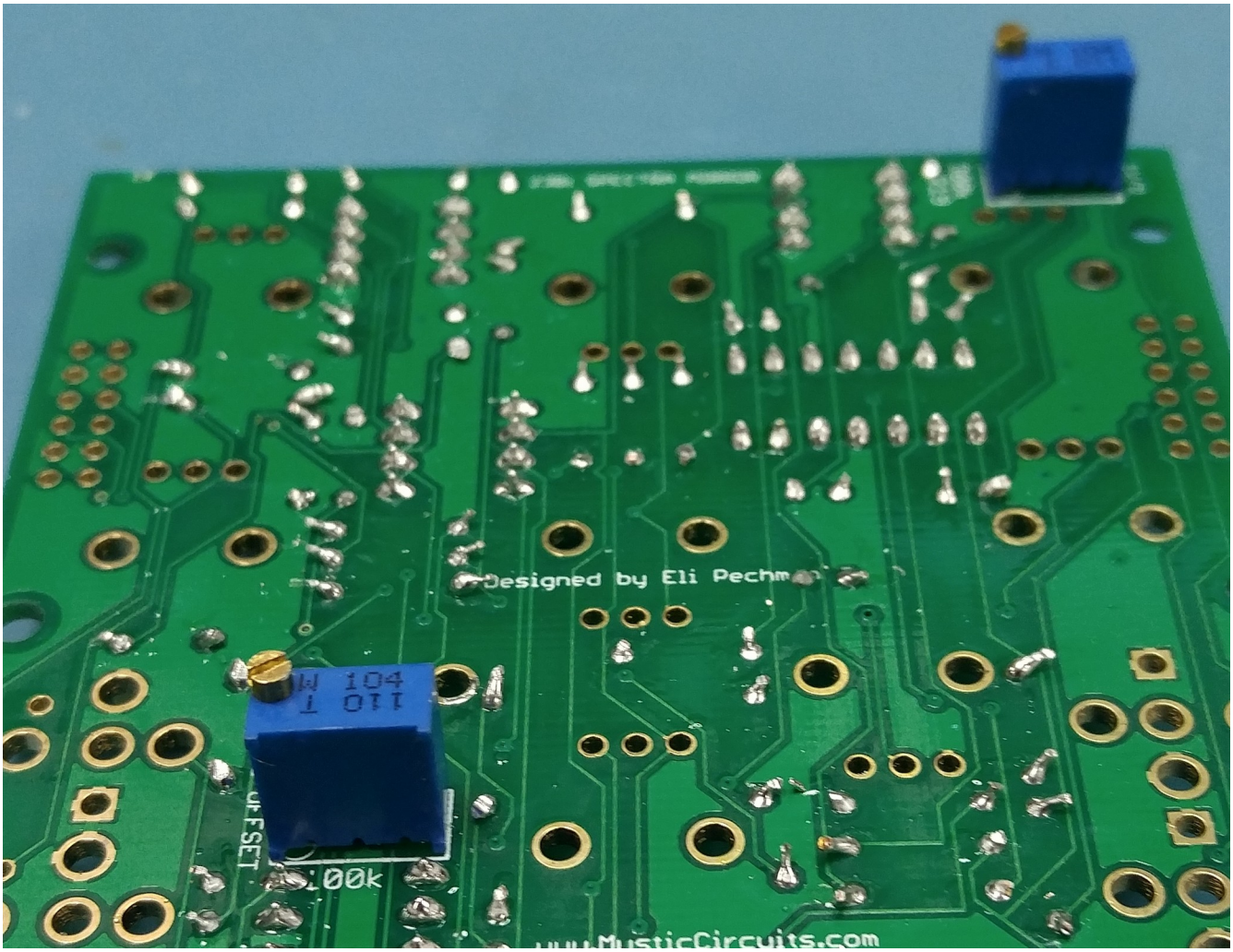
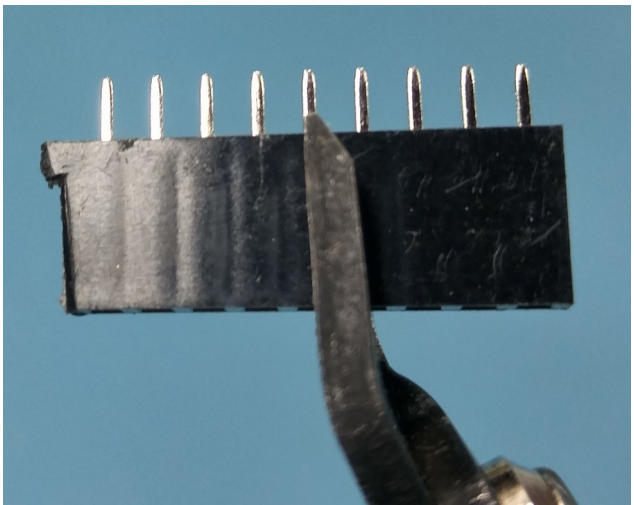
Solder in the trimmer resistors, I use a 500k for the one marked 300k.  BE AWARE that these go on the opposite side from the rest of the resistors and sockets.

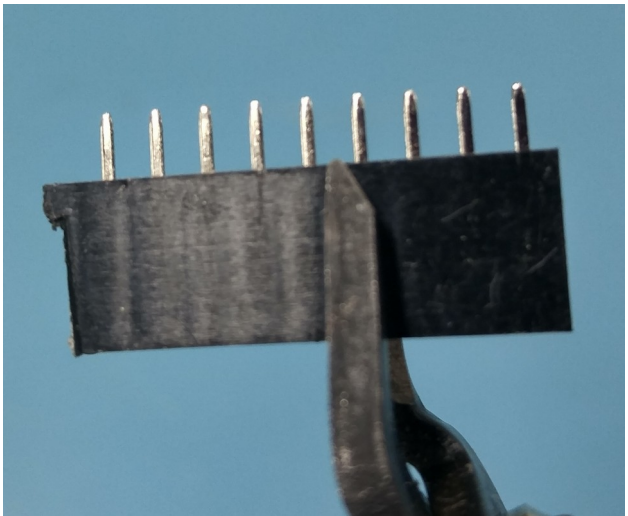



Now solder in the header sockets.  If you bought a kit from me or bought these from my BOM you will need to cut down the header sockets that are included to size.  I always cut in the middle of the socket instead of in the crease because if you cut in the crease then quite often the adjacent pins will be broken.  It is better to lose a pin rather than have a header which is 1 pin too short.

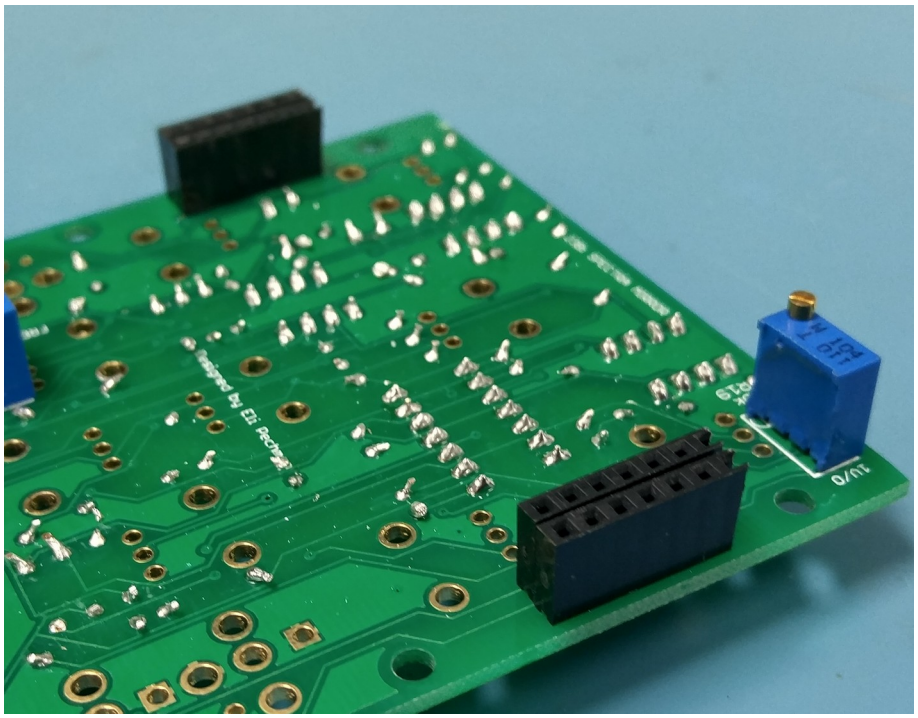
GOOD – cut in middle of socket

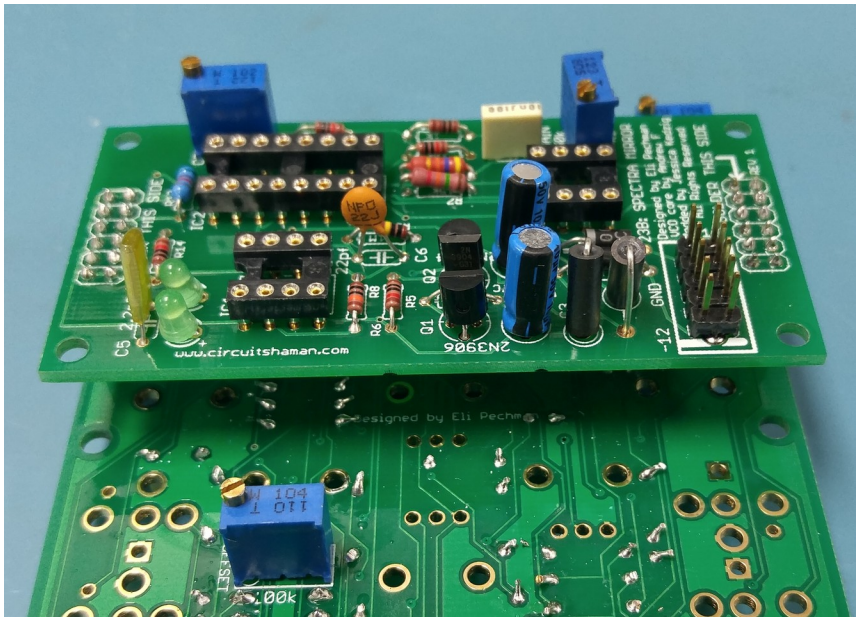


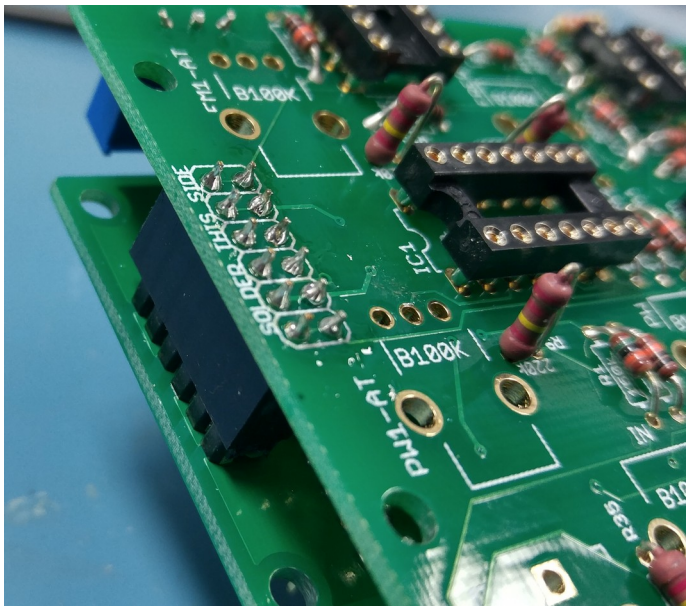
BAD – cut on crease of socket



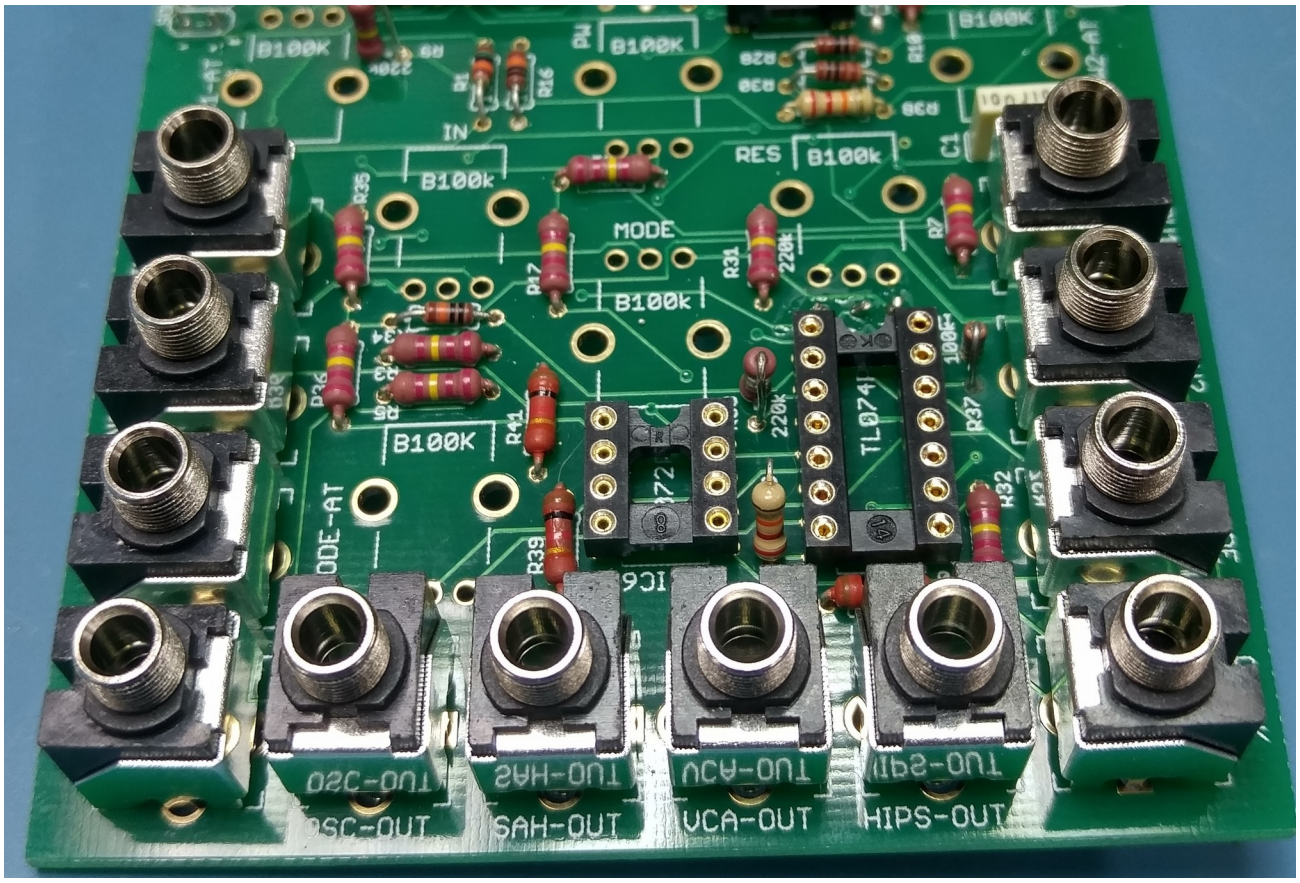
Be careful to solder the headers in on the right side of the board, with the sockets facing the same direction as the trimmers. This means that your are soldering on the side with all of the resistors. I have accidentally soldered on the wrong side, it is a huge PITA to desolder these kinds of headers without some fancy equipment. Measure twice, cut once. Also because each header is a single row and we need a double row it is good to place in the top PCB into the sockets just to make sure that none of the headers are slanted in such a way that will prevent the top PCB from fitting in nicely.

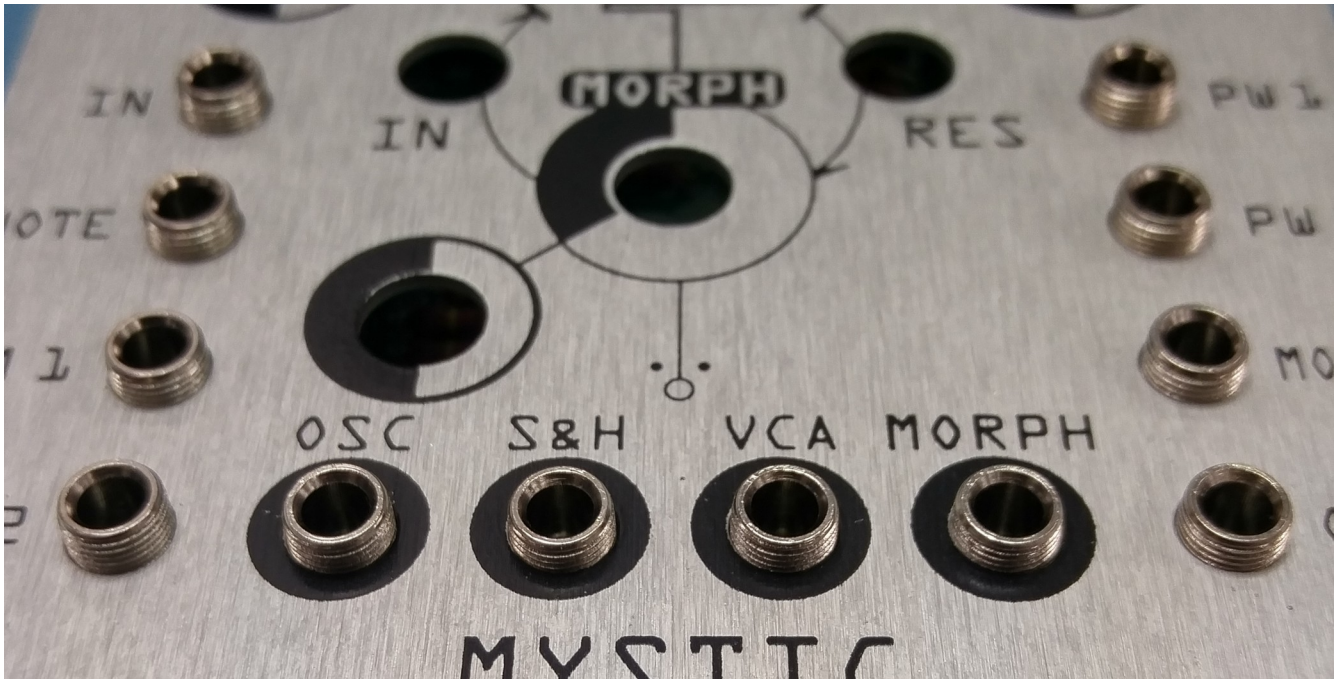




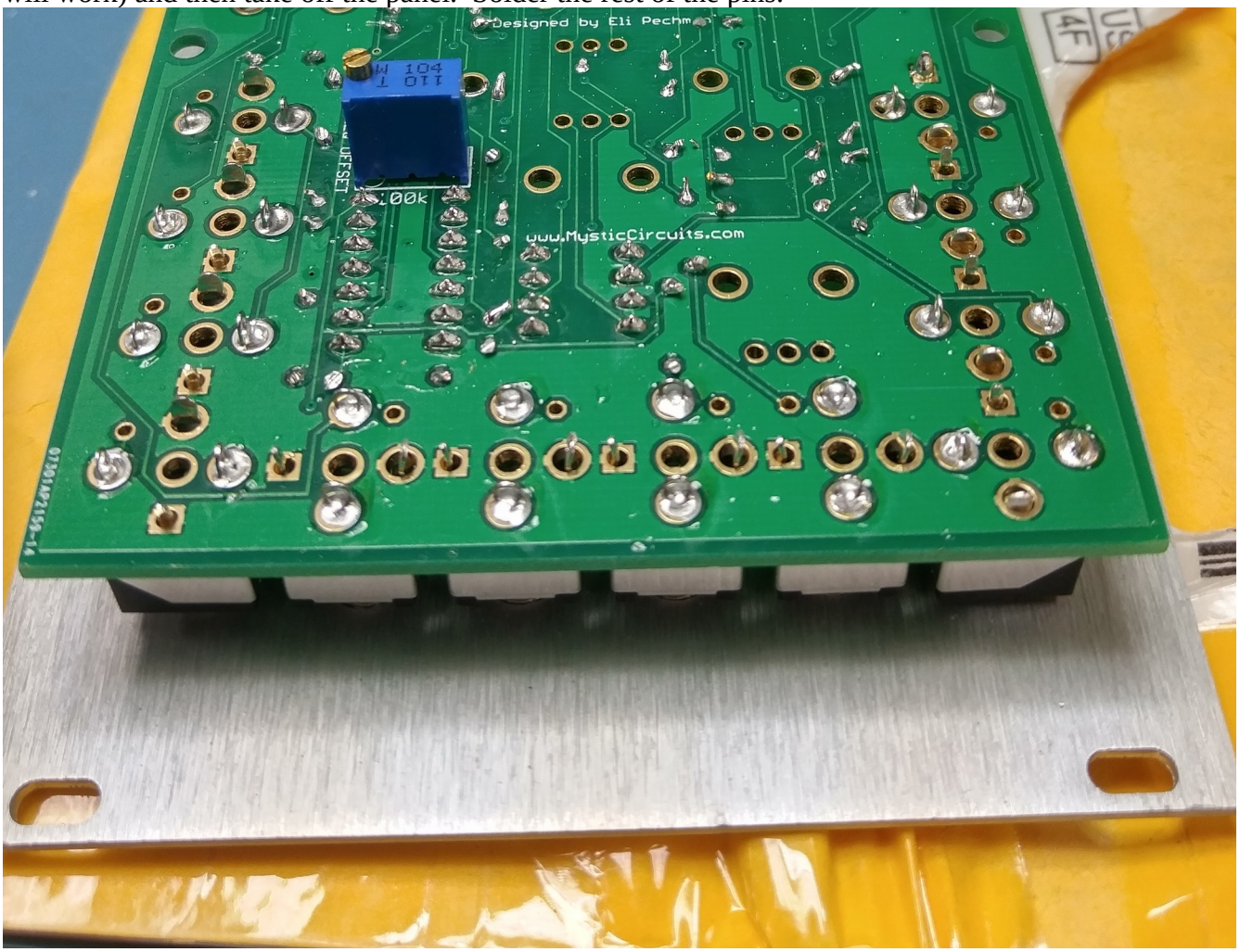



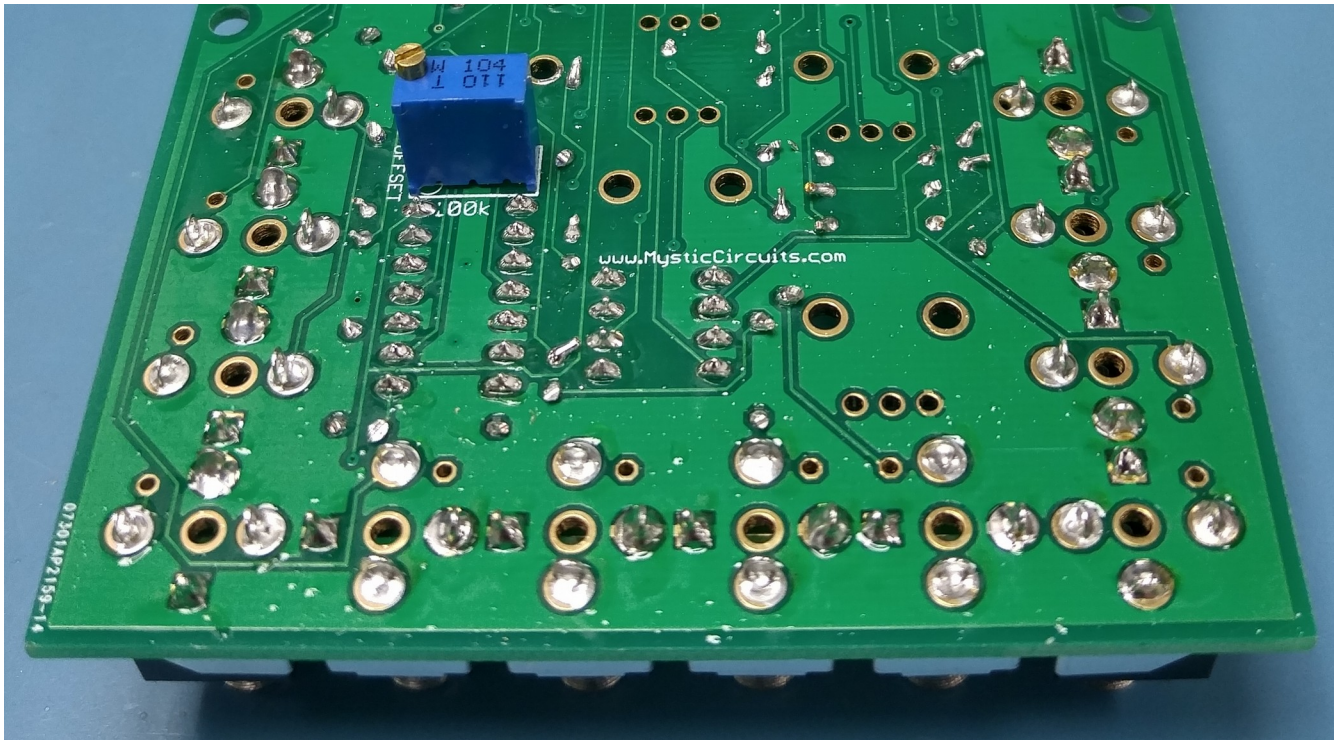
If you haven’t already take the top PCB out of the headers and grab your panel.  Place all of the 3.5mm jacks into their sockets and then fit the panel onto them.  This will ensure that once everything is soldered in place none of the sockets will be slanted and cause a tight fit.



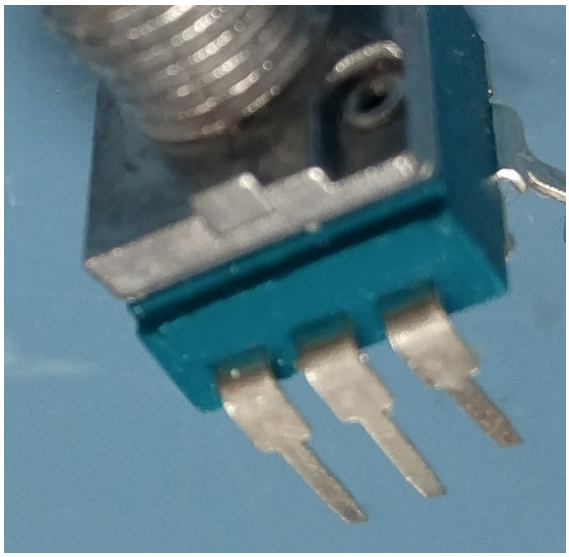

IN
MORPH
IN
RES
PW 1
PW
OSC
S&H
VCA
MORPH
MYSTIC

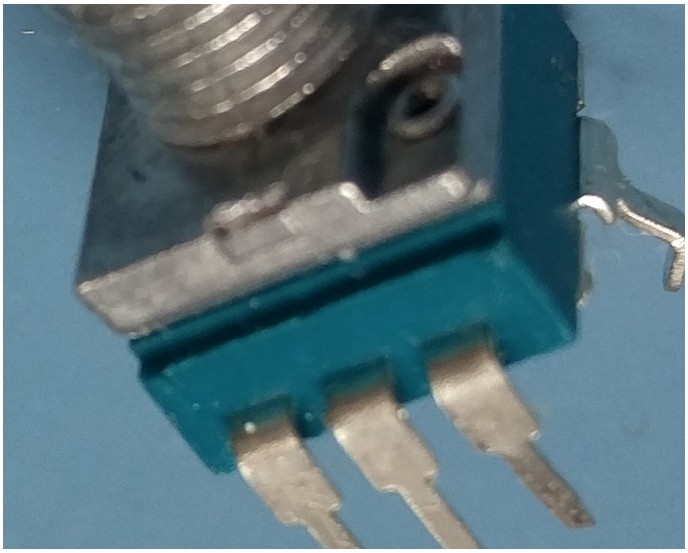
To solder the sockets you will need to place the panel face down so use a paper towel or something similar to prevent scratches.  Solder two pins on each socket (any two pins on opposite sides of the jack will work) and then take off the panel.  Solder the rest of the pins.



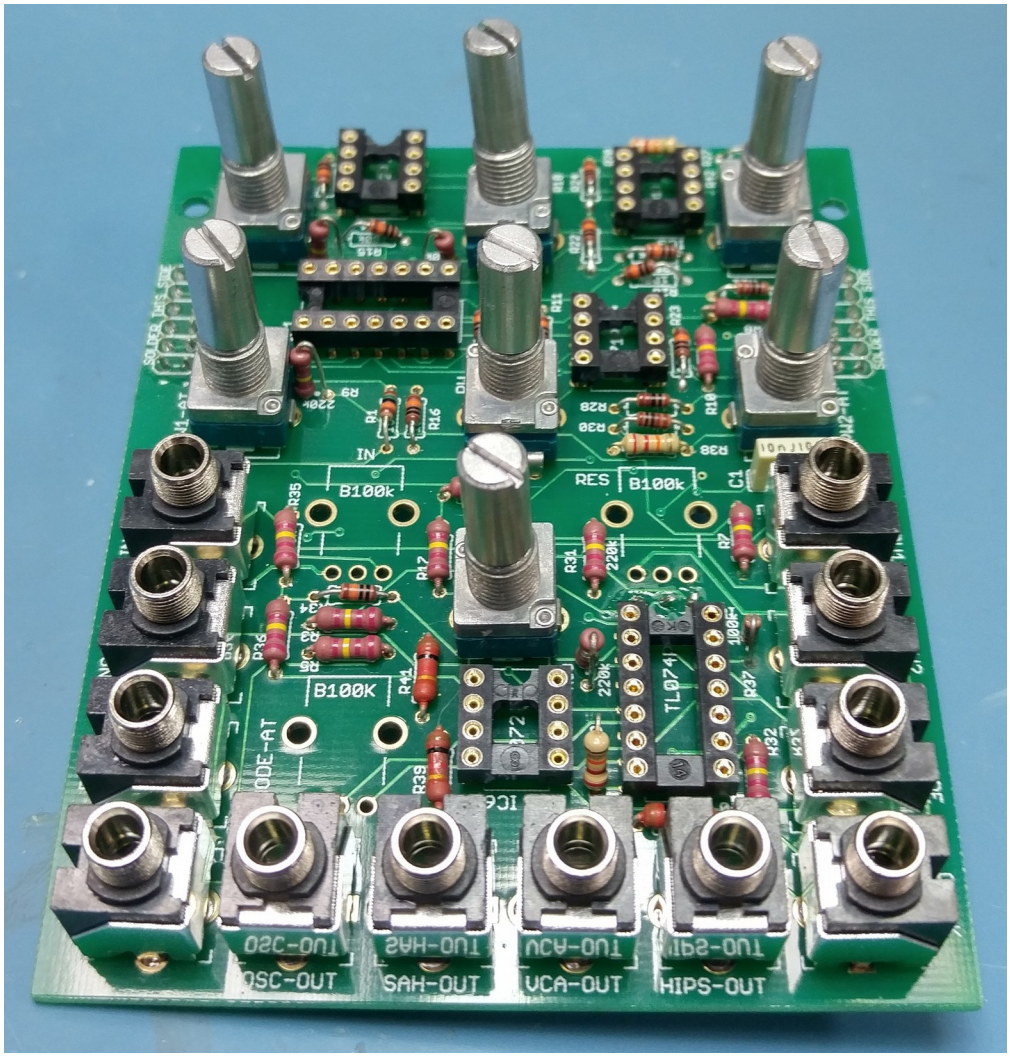



Now we are at the final stage: soldering the pots. All of the pots are the same value however some of them are plastic shaft and some are metal shaft to accommodate knobs. Lets start with the metal shaft locations. First you must cut a tab off of the top of the pot, go ahead and take the tabs off of all of them at first. Sorry the pictures are so blurry, left is with the tab, right is with the tab removed.





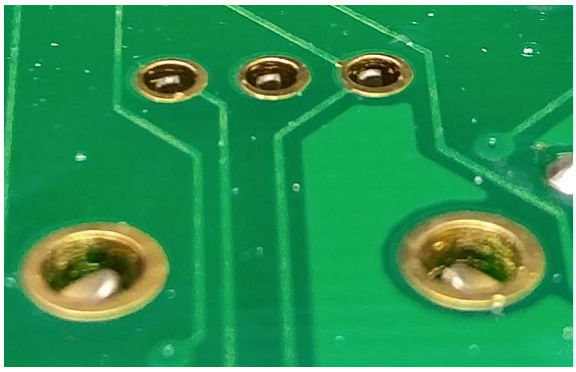
Next place the pots in the following locations: FM-AT1, FREQ, FM-AT2, PW-AT1, PW, PW-AT2, and MODE. The only locations left open should be INPUT, RES, and MODE AT. Check the picture below if you are at all unsure.



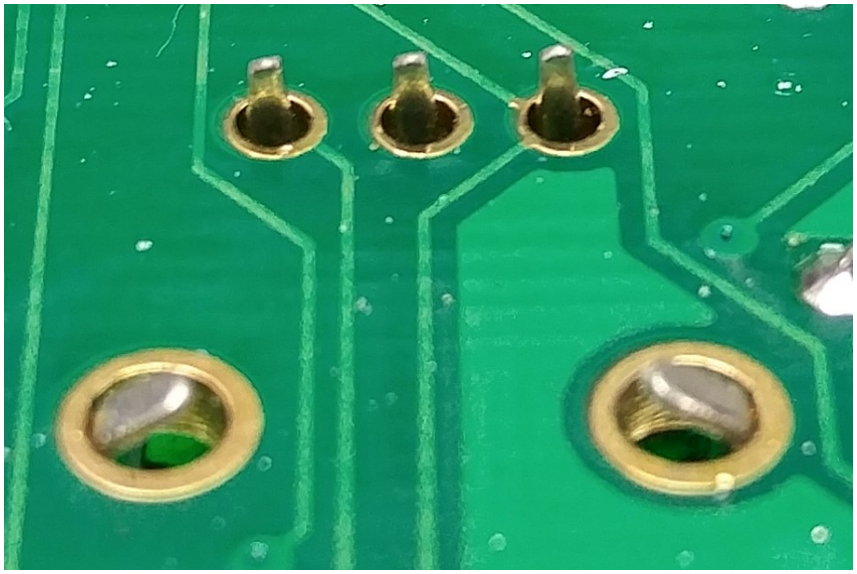
Now place the panel over the top of the pots and tighten nuts onto 2 of the 3.5mm jacks. This will give you an idea of the final position of your panel versus the PCB. You will notice that the pots sit pretty far into the panel and that the threading does not give much room to tighten a nut on top of them. The pots need to be pulled out a bit in order for the nuts to be able to tighten onto them, but not so far that they aren't secure in the PCB footprint. Go ahead and pull the pots out of the panel enough to lightly tighten a nut onto the threading. Now slowly tighten the nut (using your fingers is fine) while watching the bottom of the pot in the PCB and stop once the pins from the pot are just barely sticking through the bottom. The nut will not be all the way tightened. This is kind of a Goldilocks type of situation, not too close and not too far. Check the pictures below for reference.

Not far enough:


Too far:

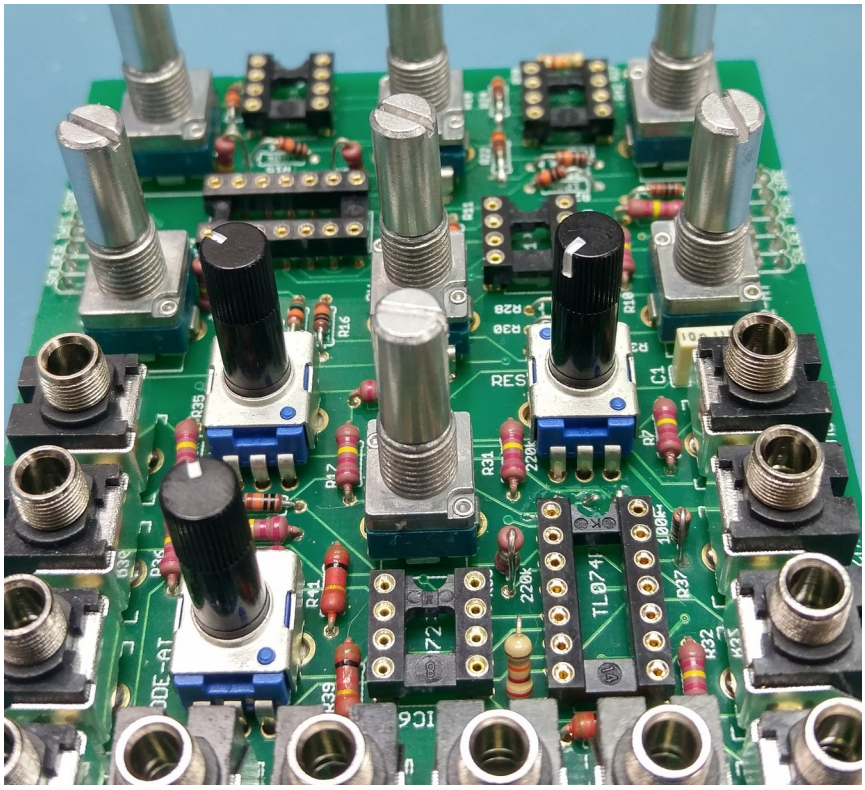


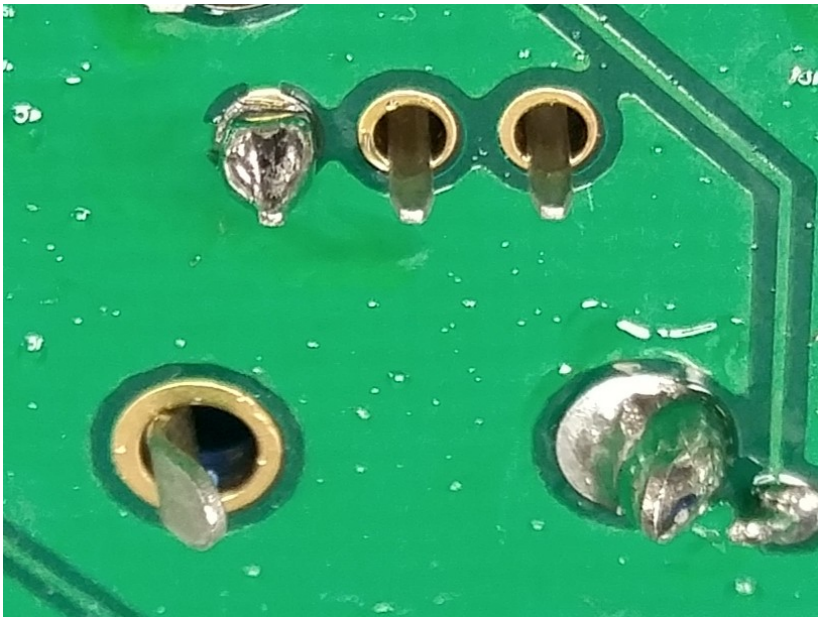
Just right:



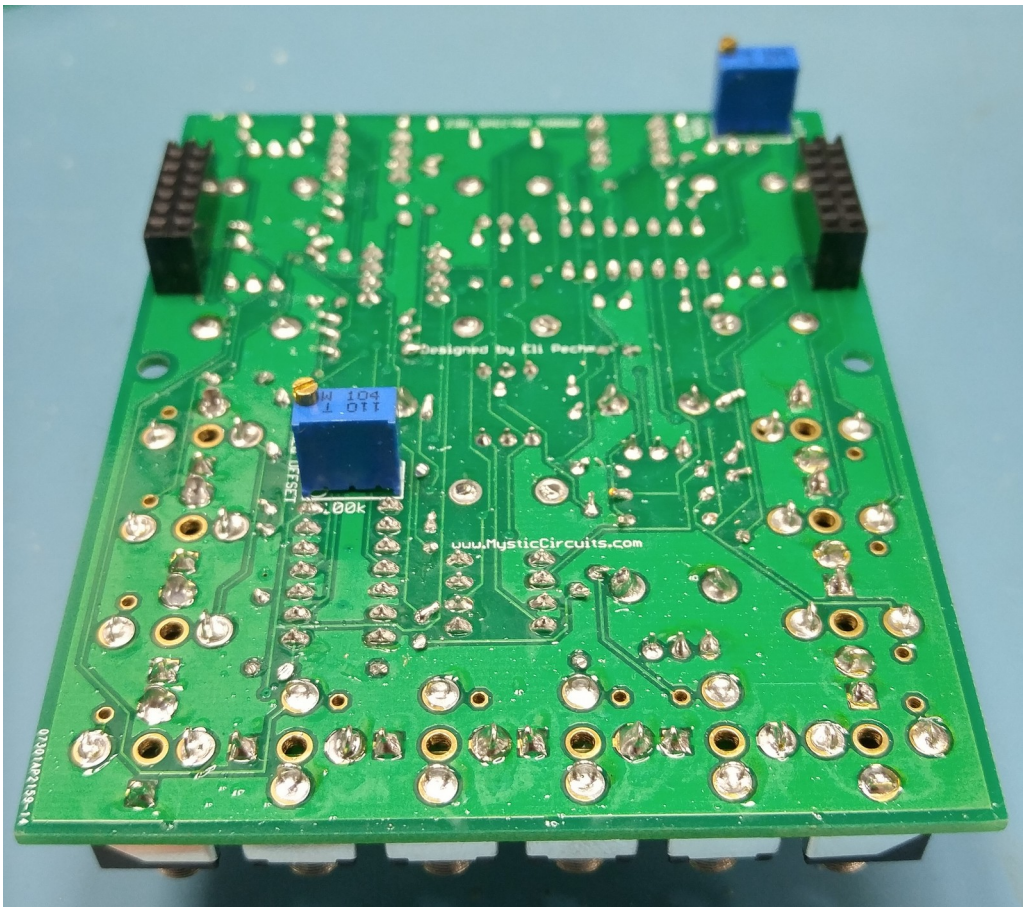
At this stage you can solder 2 opposing pins of each pot to secure them in place, just as we did with the jacks. Double check that everything seems to be straight and at a good height and then finish soldering these pots.

Now on to the plastic shaft pots. Place a plastic shaft pot in the “INPUT” “RES” and “MODE-AT” sockets. Rather than solder them in place with the panel on, press the pot into the PCB firmly (but not forcefully) while soldering 2 pins at opposite corners of the pot. The panel holes are slightly too large for these pots so this helps keep them upright. Do this for all 3 pots and THEN place the panel over everything to make sure that everything will fit. Make any adjustments that are needed and then solder the rest of the pins.

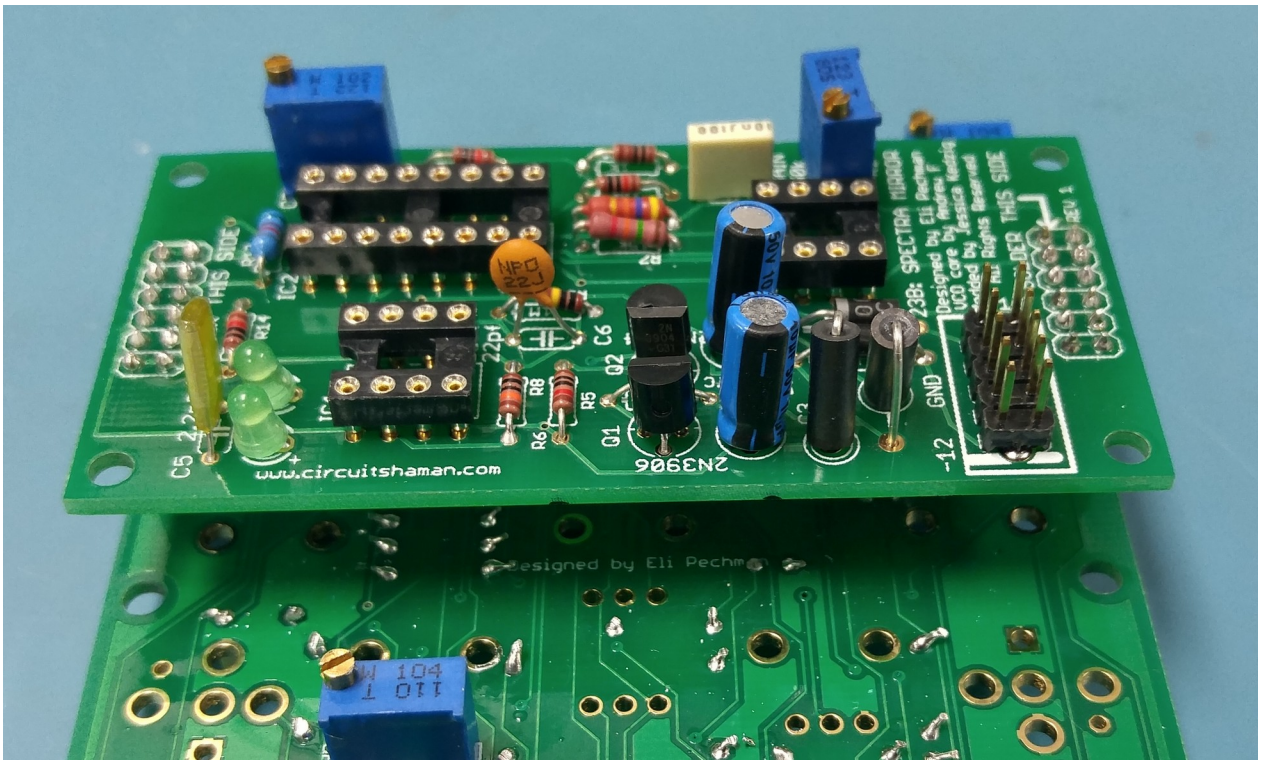


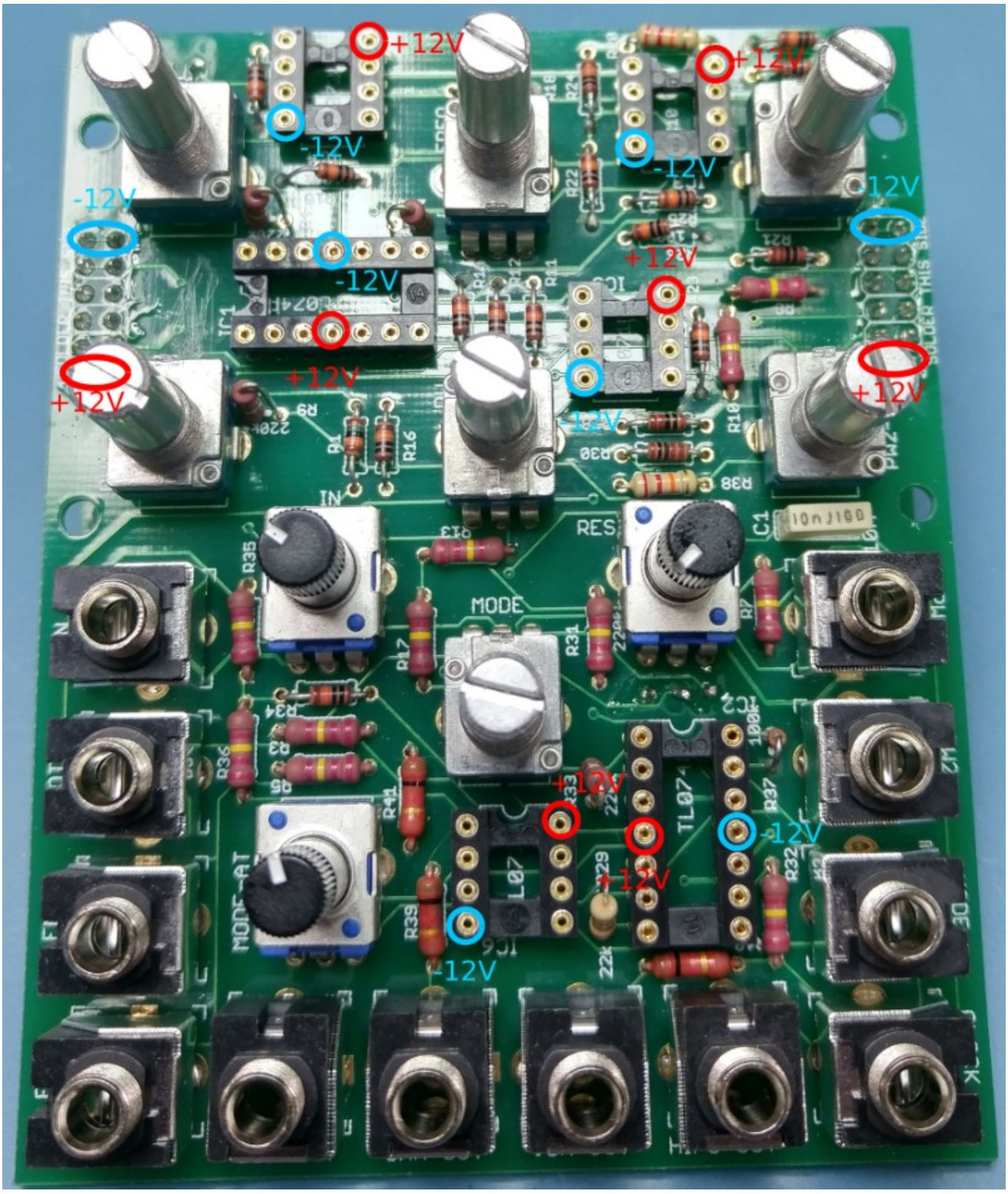
Congratulations, you are finished soldering this project, the back of your board should look like this:



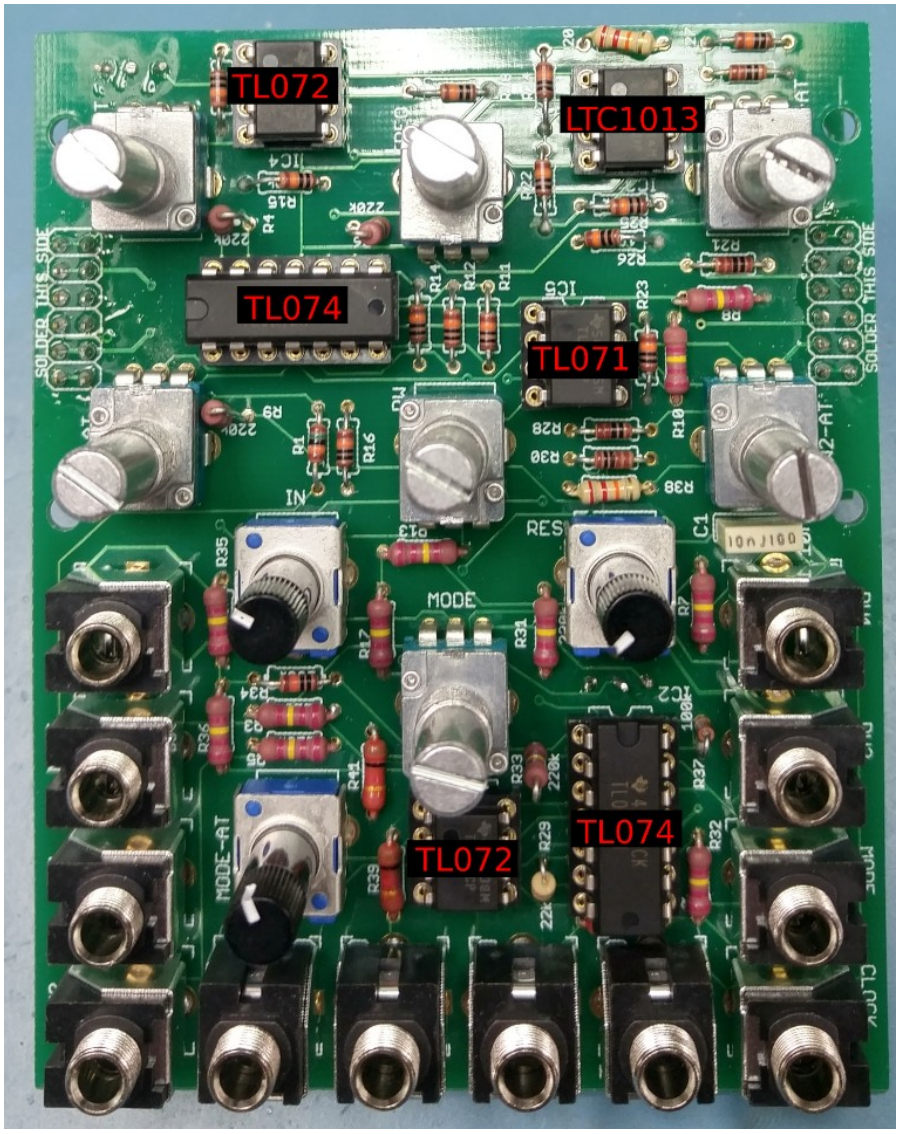

Before populating the chips we should test the voltages on the bottom board just as we did for the top one.  To do this we must place the two PCBs together, go ahead and fit the top board into the bottom board, ensuring that the red stripe marker on the power header for the top board faces the side of the bottom board where all of the jacks are located.  In other words “Red stripe down:.



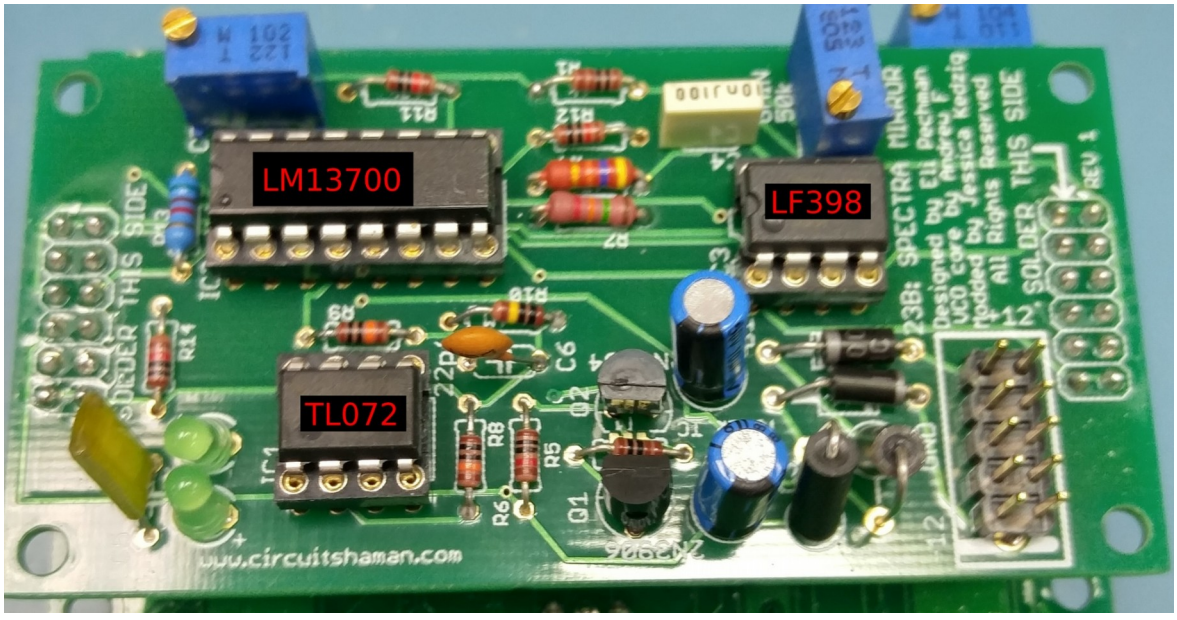
Now plug in the power and test the following points on your bottom board:



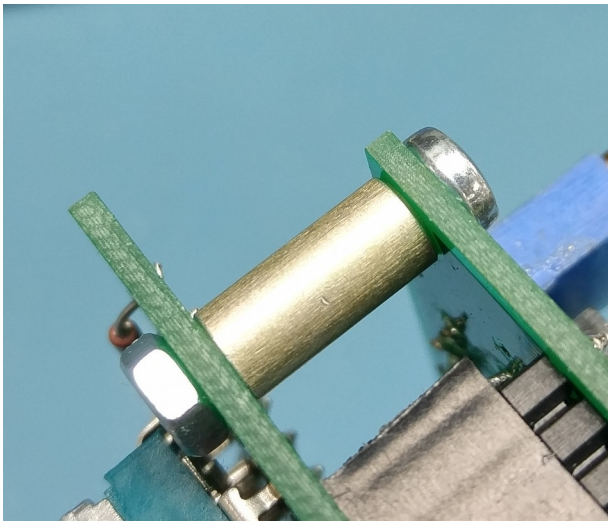
If everything looks fine we will move on to the final assembly, if not look for mistakes.  Populate the bottom board with the necessary chips:  2x TL072, 1x TL071, 1xLTC1013.




And the top board with the following chips: 1xTL072, 1xLF398, 1xLM13700

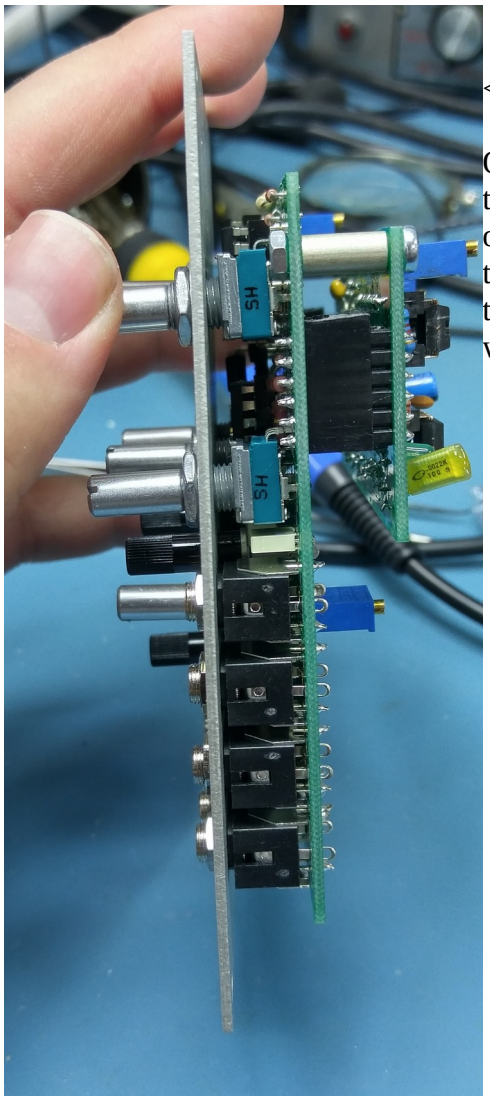


Next place the PCB standoffs in place beneath the top holes on the top PCB. Thread your long M3 screw through the entire thing, holding the standoff in place. It should go through the hole in the top PCB, through the standoff and then through the hole in the bottom PCB, although it does not matter which side this starts from. Next take the included M3 nut and tighten it onto whichever side the bottom of the screw is poking out of. Make sure it isn't going anywhere and then fasten the other side. Note that although there are holes for a PCB standoff on the bottom that they don't actually line up so there is no standoff included for them.



Now put the panel on the board and tighten the jack nuts. I highly recommend doing this with a 3.5mm hex driver since it will keep your jack nuts from wiggling free over time, however you may prefer to tighten everything up by hand and then test things before fully tightening the nuts to ensure that everything is working properly.

Next we will tighten the nuts on top of the pots. Be aware to not fully tighten them as it will cause the board to flex in the back. Some flex will happen but we want to avoid lots of it as it will degrade the board over time. Slowly tighten the top nuts (on the FREQ and 2x FM attenuverter knobs) first, as they will flex the board the most. Next tighten the rest of the nuts (plastic shaft pots require no nuts), you may have to re tighten the top nuts afterward as the tension in the panel has shifted.



<<< This is a good level of panel flex.

Once everything seems good and you are content that there is not too much flex in the PCB board, go ahead and place the knobs onto the pots. I like to turn all the pots fully counter-clockwise and then use the pointers on the plastic shaft pots as a guide for where the other pointers should go. Start with the knobs on the left and work your way right. The FREQ knob is the large one.


Now your Spectra Mirror is fully assembled! Take a quick break, grab a sandwich, and then we will move on to the calibration procedure.

Ok, I am not including any pictures for the calibration procedure because for the most part you are trying to adjust a voltage to be zero, so the oscilloscope picture would have nothing there.

First we will adjust the oscillator trimmers, I do this all by ear so I would plug the “osc” output into a set of speakers or if you are already deaf into some headphones. We will start with the frequency knob all the way clockwise and the pulse width knob at noon. You may not be able to hear anything, this is because the oscillator is in ultrasound. We want the very top of the frequency knob range to end right as the oscillator starts peeking into ultrasound. On the BOTTOM board there is a trimmer labeled “offset”, adjust this until the oscillator is barely audible because the frequency is in ultrasound when the freq knob is fully clockwise, but is audible as soon as you turn the knob counter-clockwise.

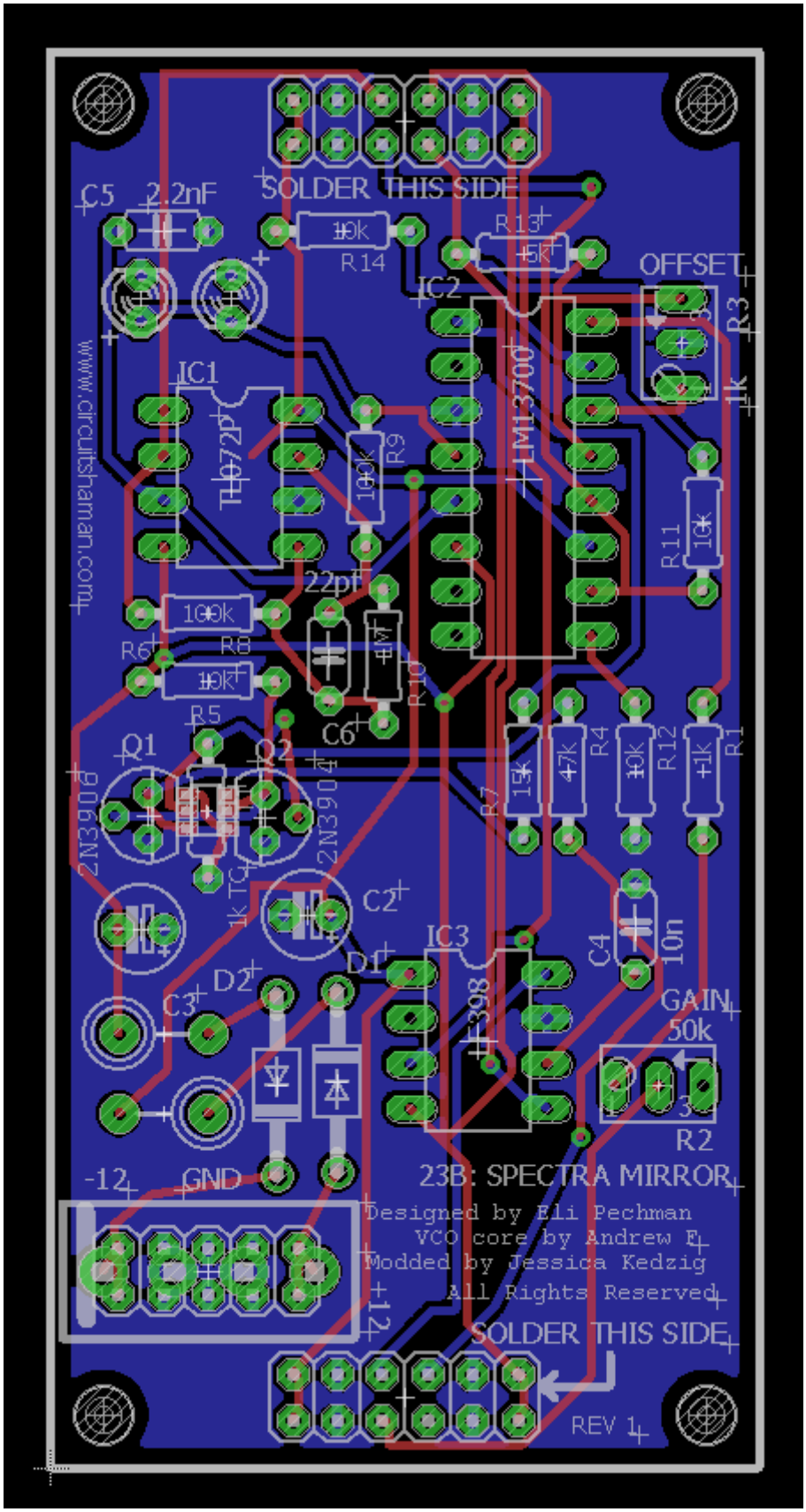
Next we will calibrate the 1v/ octave input for the oscillator, turn the frequency knob to a fairly bassy musical note (not into ultrasound or lfo territory). Now apply 1 volt to the “note” input and adjust the 1v/o trimmer on the bottom board. I do this with a two step sequence (pretty easy to set up on the Korg SQ-1) where one step is 0 and the other step is 1 volt, but be sure to use a sequencer or quantizer source that is a reliable voltage source, or else your calibration may not be so great with other sequencers. Now do the same thing with 2v, 3v etc and adjust the trimmer slightly if needed. When you are happy with your calibration try running in a note sequence just to make sure it sounds accurate. I usually go with something in the major or pentatonic scale because its easy to recognize.

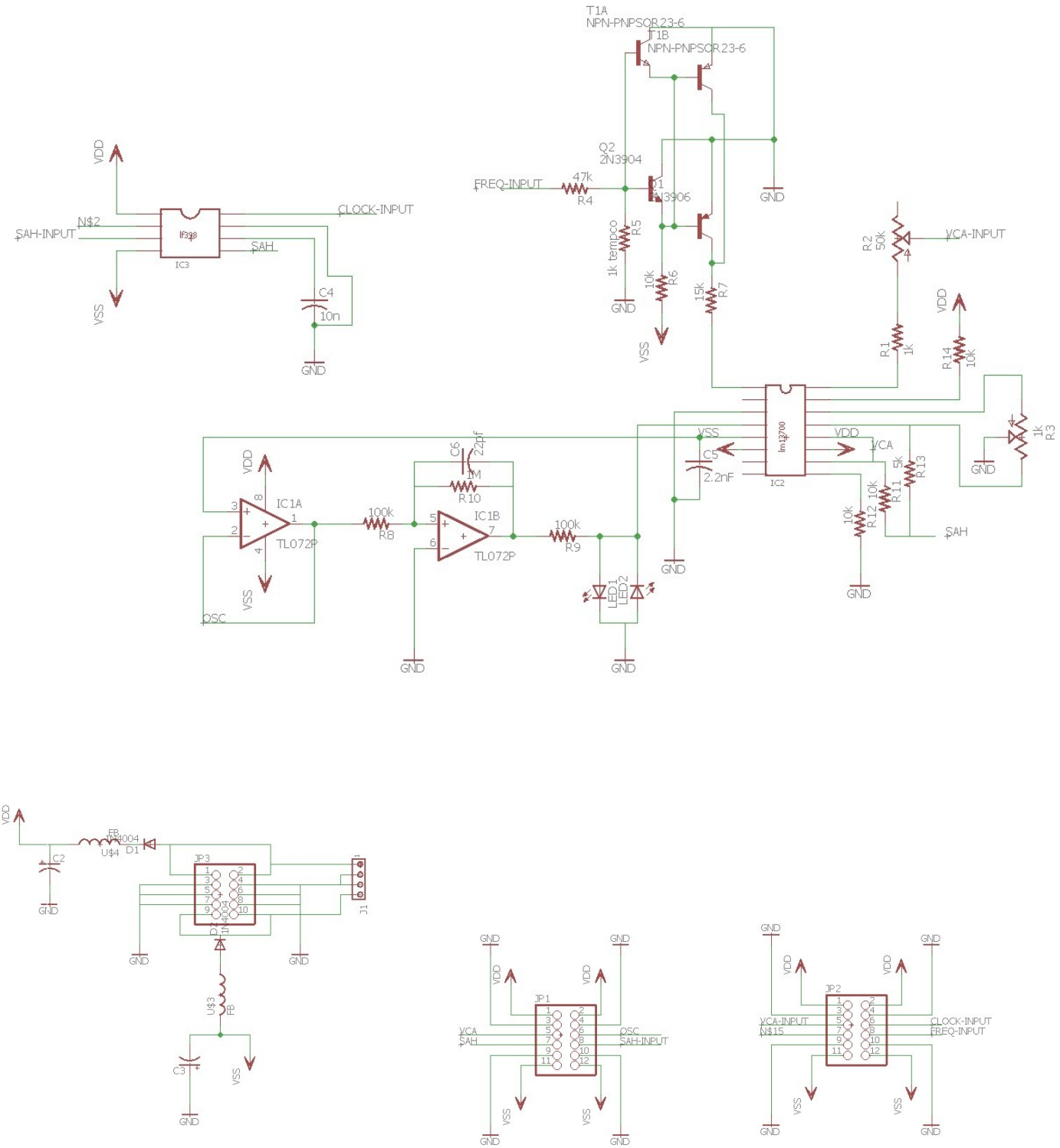
Next we will be adjusting the VCA, take your multimeter or oscilloscope and test the output of the VCA jack. With nothing plugged into any of the inputs, turn the morph knob all the way clockwise and then slowly turn it counter clockwise. There will be a point where the voltage at the output starts to drift away from 0, adjust the offset trimmer on the TOP board to bring that voltage down to zero. If the voltage jumps quickly try changing the “gain” trimmer but be very careful not to let the voltage get too high as I have burnt out a lm13700 doing this. Once you have gotten to the point where the voltage is still very close to 0v once you have turned the morph knob fully counter clockwise, move to the final step.

In this step you will need to apply a signal to the input and either look at the morph output on an oscilloscope or if you don’t have one listen to the morph output. Turn the input, frequency, pulse width and morph knobs fully clockwise, RESonance knob fully counter clockwise. Now apply your signal (for simplicity I use a sine wave but anything will work) to the input, you should hear/ see it at the morph output with a gain of two (amplitude x2). Now turn the morph knob clockwise, once the knob has hit 12 o’clock you should see/ hear the signal with a gain of 1 (aka a clean signal). Turn the knob further counter clockwise and as you do so notice if the signal is raising in amplitude/ getting louder or losing amplitude/ getting quieter. We want the signal to get quieter so that when the morph knob is fully counter-clockwise the signal is completely attenuated/ quiet. Adjust the “GAIN” trimmer on the TOP board so that the input signal is getting quieter as you turn the Morph knob counter clockwise, then when it has reached the end of its travel adjust the gain trimmer until the signal is very faint. There will always be a little bit of bleed on this output, something on the level of 100-200 mV. If you can get this output to be as quiet as possible that is the goal. You may notice that once you adjust the trimmer too far that the signal will start gaining amplitude again: this is normal. The trimmer has a sweet spot where the signals cancel, anything to the sides of this sweet spot will cause the amplitude to grow. After this is done unplug the input and repeat the above step to make sure that the output is still at 0v when there is no input and the Morph knob is fully counter clockwise.

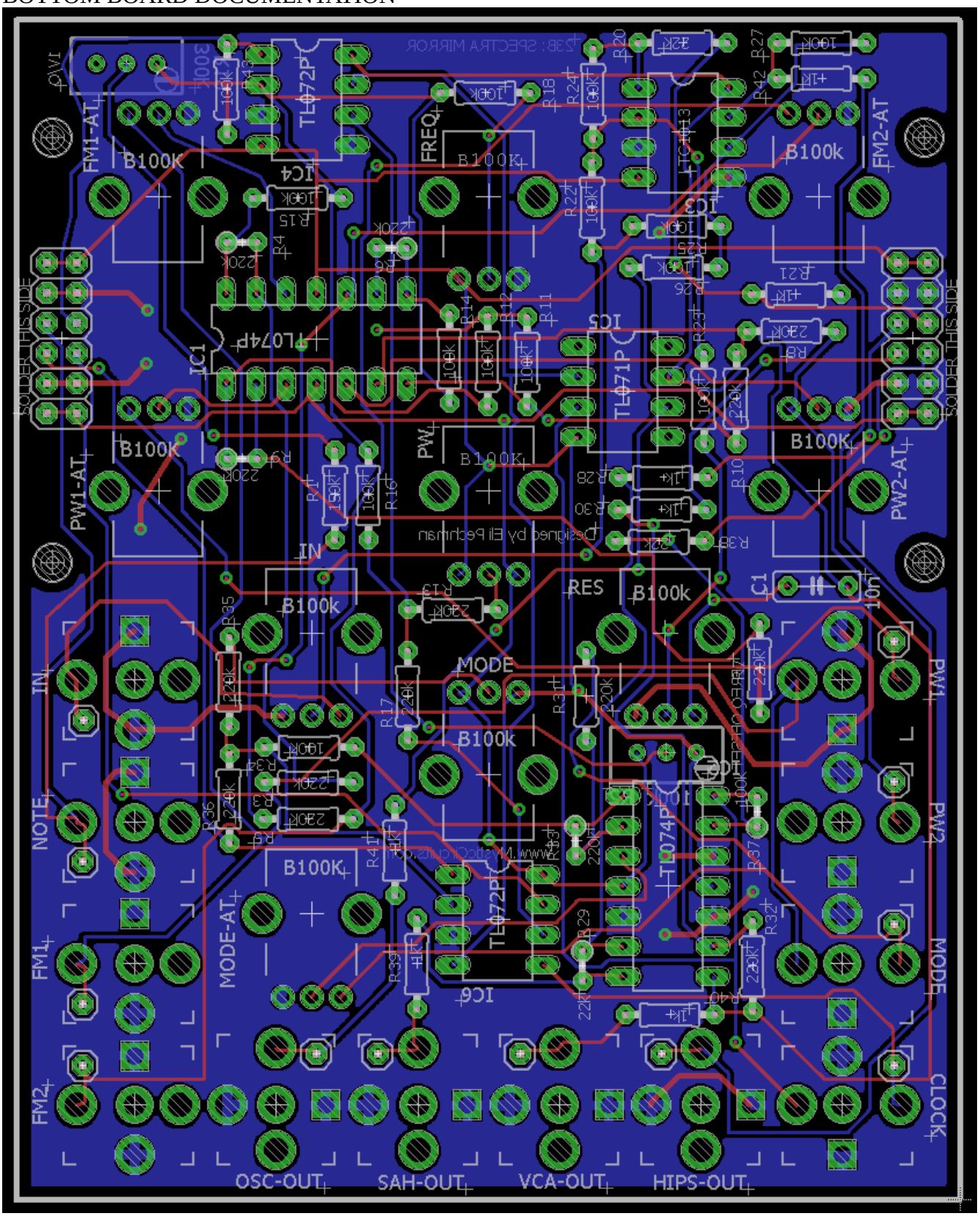
Look at you, you are done.  High five!

TOP BOARD DOCUMENTATION

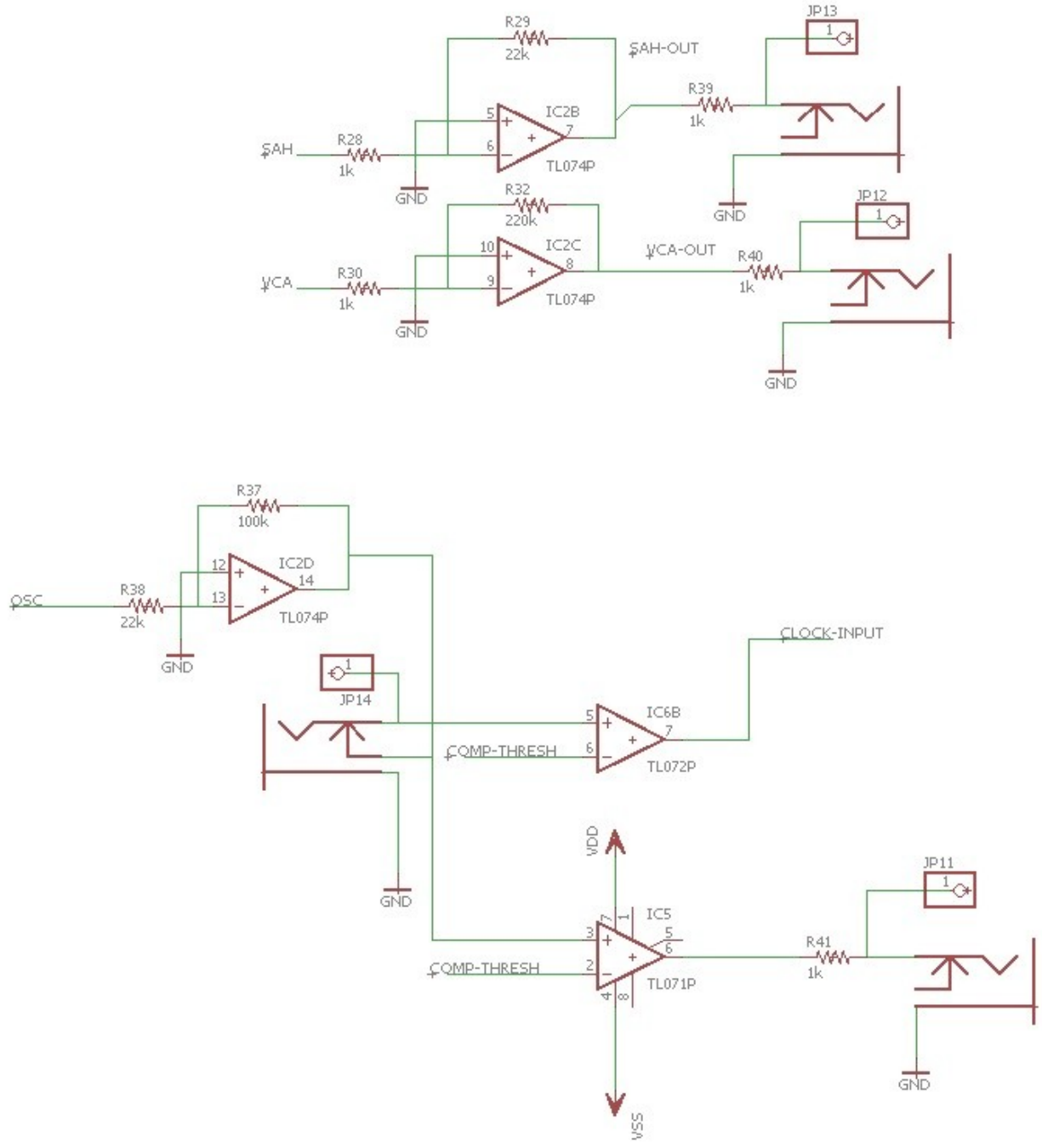



T1A
NPN-PNPSOR23-6
T1B
NPN-PNPSOR23-6
Q2
2N3904
Q1
2N3906
FREQ-INPUT
47k
R4
1k tempco
R5
10k
R6
15k
R7
GND
VSS
VDD
R2
50k
VCA-INPUT
R1
1k
R14
10k
1k
R3
VSS
VDD
VCA
5k
R13
10k
R11
10k
R12
SAH
GND
C5
2.2nF
IC2
C6
22pF
1M
R10
IC1A
IC1B
TL072P
100k
R8
100k
R9
LED1
LED2
OSC
VDD
VSS
SAH-INPUT
CLOCK-INPUT
N$2
C4
10n
IC3
VDD
C2
U$4
D1
JP3
J1
U$3
FB
C3
VSS
GND
JP1
VCA
SAH
OSC
SAH-INPUT
JP2
VCA-INPUT
N$15
CLOCK-INPUT
FREQ-INPUT

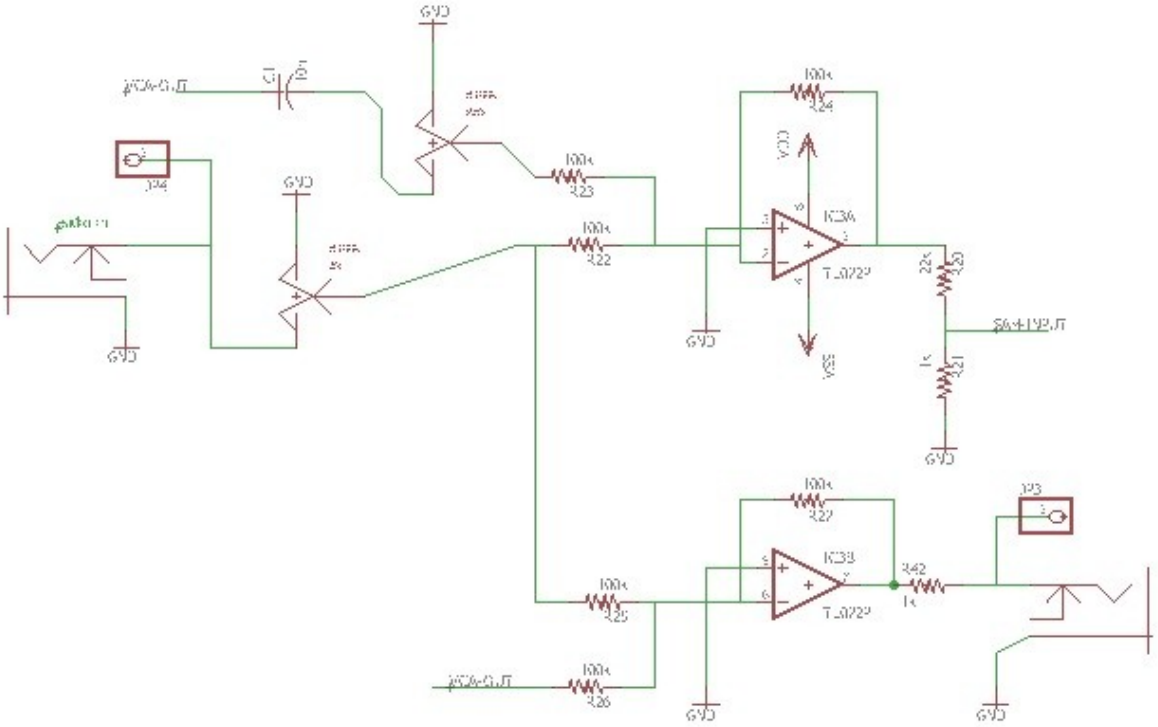
BOTTOM BOARD DOCUMENTATION

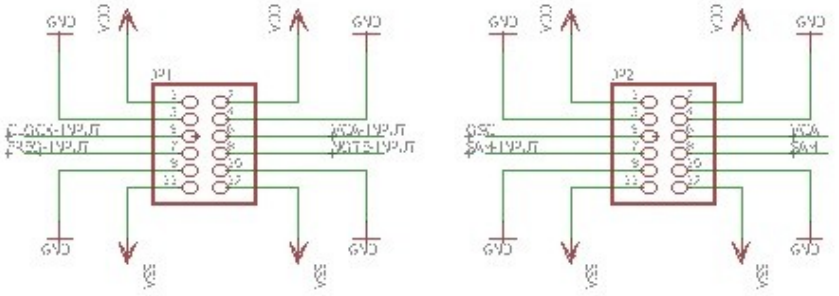


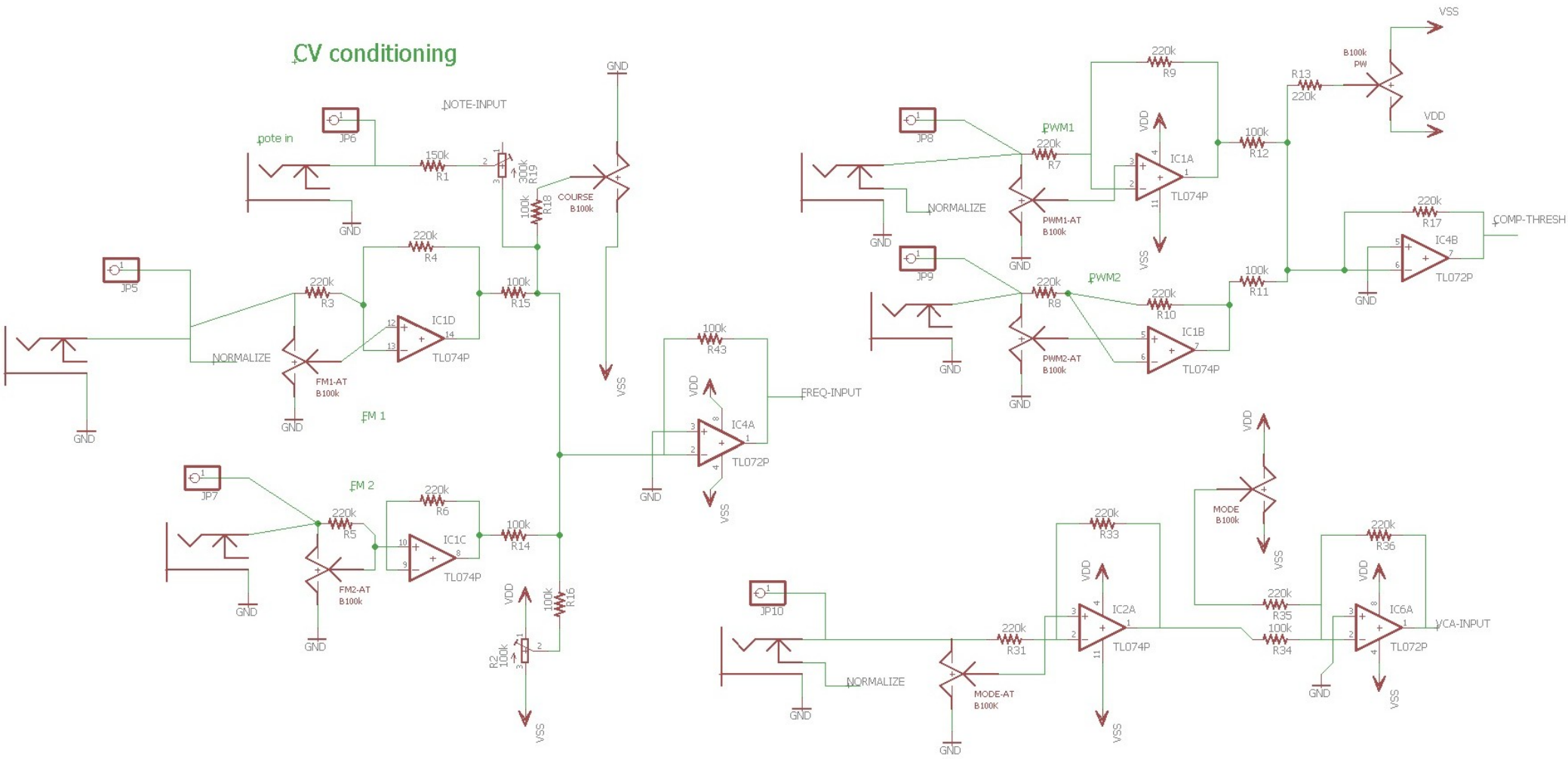
# Output amplification



## Input/ resonance summing




CV conditioning
NOTE-INPUT
pote in
JP6
150k
R1
300k
R19
100k
R18
COURSE
B100k
GND
220k
R4
JP5
220k
R3
100k
R15
IC1D
TL074P
NORMALIZE
FM1-AT
B100k
FM 1
JP7
FM 2
220k
R6
220k
R5
IC1C
TL074P
FM2-AT
B100k
100k
R14
VDD
100k
R16
R2
100k
VSS
100k
R43
IC4A
TL072P
FREQ-INPUT
JP8
PWM1
220k
R9
220k
R7
IC1A
TL074P
PWM1-AT
B100k
100k
R12
B100k
PW
R13
220k
VDD
JP9
PWM2
220k
R8
220k
R10
IC1B
TL074P
PWM2-AT
B100k
100k
R11
220k
R17
IC4B
TL072P
COMP-THRESH
JP10
220k
R33
220k
R31
IC2A
TL074P
NORMALIZE
MODE-AT
B100K
MODE
B100k
220k
R35
100k
R34
220k
R36
IC6A
TL072P
VCA-INPUT