

- w02/22--Today Tony and I went over all my deliverables for this project. Next I spent the rest of the day soldering all my DIP sockets on my PCB.
- 02/2--Today I was finishing up my project grading, along with my rough draft cover letter and resume. All I had time for was soldering in all my capacitors, so I soldered on 9 1uF caps.
- 02/27--I soldered on all of my comparator voltage dividers today
- 02/28--Today I need to figure out what size of resistor to use for my current limiting resistors from the output of the comparators to the optocoupler. Looking at the datasheets it seems like the output of my comparator is Max -0.3V to V_{DD}, and my max output current is 20mA. For my optocoupler the max current for the input is 50mA. So to be safe it seems like I should go with 10mA to not damage my comparator's output. Also to be extra safe I am going with the upper limit of the output pin of the comparator which would be roughly 4.7V and the diode drops around 1.2V to 1.4V so I took (4.7V - 1.3V = 3.4V) that the resistor should drop. The needed resistance should be 340 Ohms (3.4V / 10mA = 340 Ohms). As far as power dissipation though that would make this resistor drop 34mW. However we do not have a 340 Ohm resistor so I could use 330 Ohms giving me 10.3mA which is well within the safe zone for both components.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

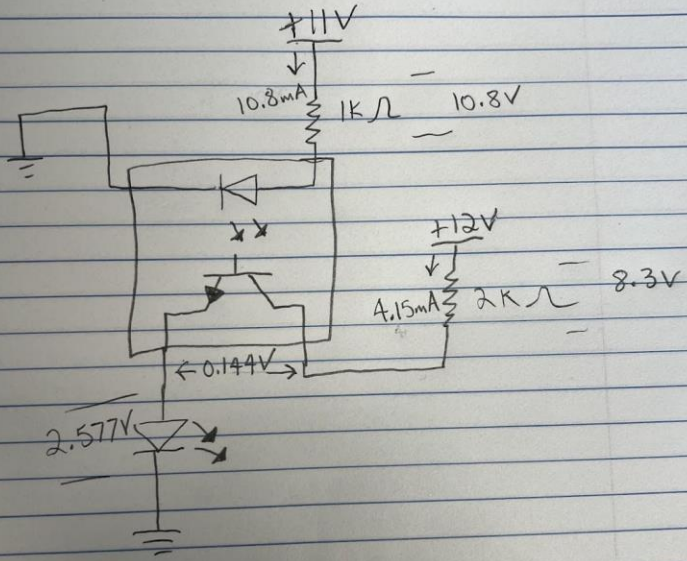
Supply voltage range, V _{DD} (see Note 1)	-0.3 V to 18 V
Differential input voltage, V _{ID} (see Note 2)	± 18 V
Input voltage range, V _I	-0.3 to V _{DD}
Output voltage range, V _O	-0.3 to V _{DD}
Input current, I _I	±5 mA
Output current, I _O (each output)	±20 mA

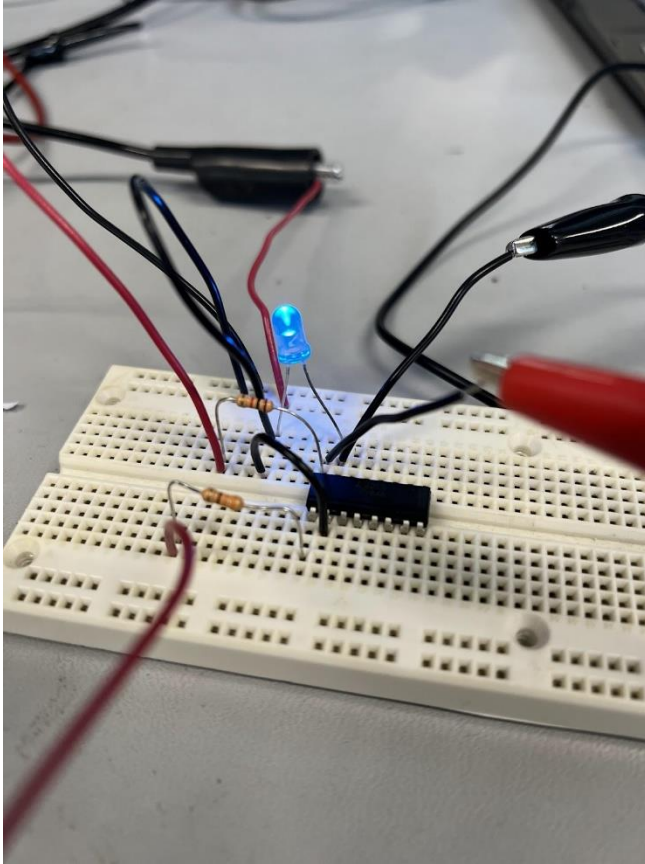
V _{OH}	High-level output voltage	V _{ID} = 1 V,	I _{OH} = -4 mA	25°C	4.5	4.7	V
				125°C	4.2		
V _{OL}	Low-level output voltage	V _{ID} = -1 V,	I _{OH} = 4 mA	25°C		210	300
				125°C			500

	Parameter	Symbol	Rating	Unit
Input	Forward Current	I _F	50	mA
	Reverse Voltage	V _R	6	V
	Power Dissipation	P	70	mW
	Junction Temperature	T _J	125	°C

	Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Input	Forward Voltage	V _F	—	1.2	1.4	V	I _F =20mA
	Reverse Current	I _R	—	—	10	μA	V _R =4V
	Terminal Capacitance	C _T	—	30	250	pF	V=0, f=1KHz

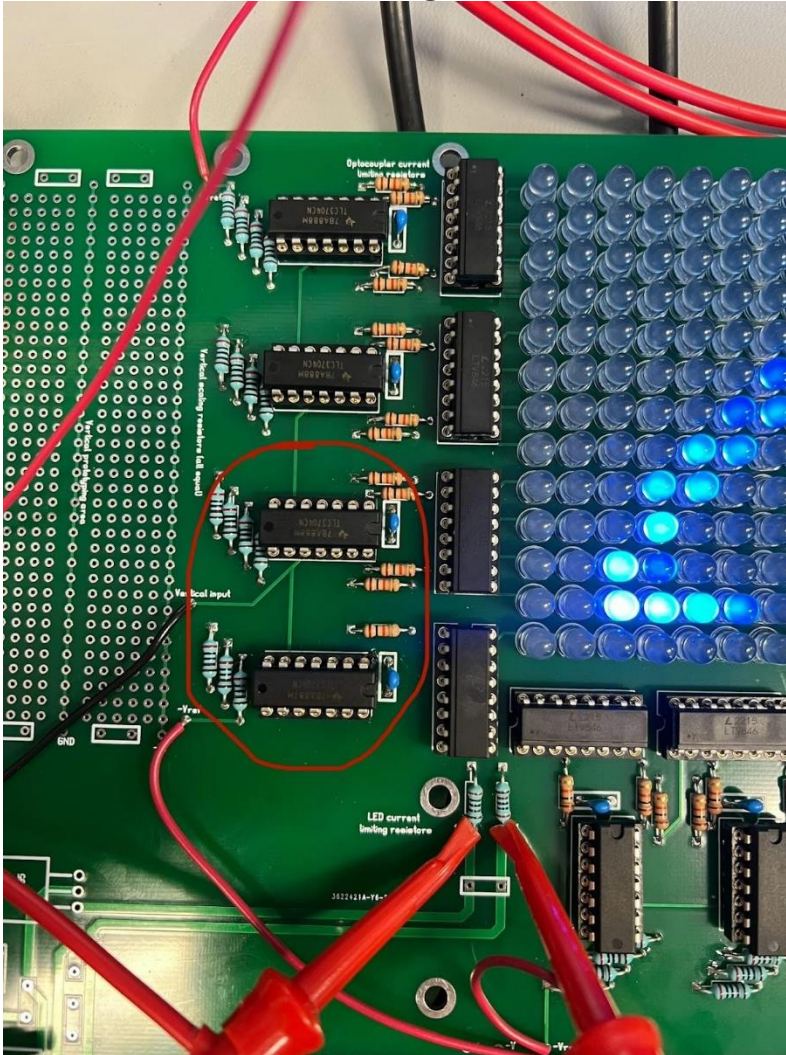
- 03/04—I made a tiny circuit out of my optoisolator this way I can get the correctly sized current limiting resistor that goes from the output of my comparator to the optoisolator and have it also make a good brightness for that LED. I found that 7.9V was a nice brightness. However I then realized I needed to be thinking about how my circuit needs to run off of the 12V battery. So I redid my calculations ($12V - 1.3V = 10.7V$ output of the comparator) next I found the new resistor value ($10.7V / 10mA = 1,070$ Ohms) For this experiment I will be using a 1k Ohm resistor. Next I needed to find a safe current for my collector on the optoisolator, the max is 50mA ($12V / 1000 = 12mA$), so with this resistor size I will be safe. The last thing I need to make sure is that my collector to emitter saturation voltage drop doesn't go over it's max which is 0.2V. When I first turned on everything my LED was nice and bright however my voltage drop from collector to emitter was 0.27V so I change the resistor size to 2k Ohms, and now my voltage drop is 0.142V. With Tony's approval of the brightness and all my calculations, I have the go ahead to use the 1k Ohm resistor size.





- 03/05–Today my plan is to start soldering in all those LED's
- 03/06–Today I finished soldering all my LED's WOOHOO!!!! Now onto my next deliverable of powering this circuit up and finding the best frequencies for my lissajous figures.
- 03/11–Today Tony was gone again :(so Robert and I were trying to figure out all the connections for my circuit in order to power it on, and also hook up the two signal generators. We were not successful in powering on the circuit because I don't think we had to the connections correct
- 03/12–After touching base with Tony I figured out exactly how I needed to hook up my circuit in order to make it work. Since I am using a 12V battery, I need 6V to hook in series to get my +6V and my -6V. So once I also hooked up my ground properly and did this my circuit works. I started with a 2:1 ratio at 20Hz and 40Hz to get an infinity symbol. Then I did a 1:1 ratio to get a circle. However I noticed there is 1 row of LED's that always seem to be dimly lit and my figures aren't centered they are a tad higher. So now I need to figure out what is causing this. I found that my output voltage seems to be what sets the grid for the LEDs, so I adjusted it and was able to get my figure to stay in the frame, however the bottom row of LED's always stays 3 rows high and not lower. I moved my board and my x and y axis shifted so I think my temporary jumper wires were touching a pad they weren't supposed to. I soldered on some temporary wires to avoid this.
- 03/13–So turning on my circuit again I still had that solid line of LED's on so with some help and troubleshooting I found that my left column of comparators

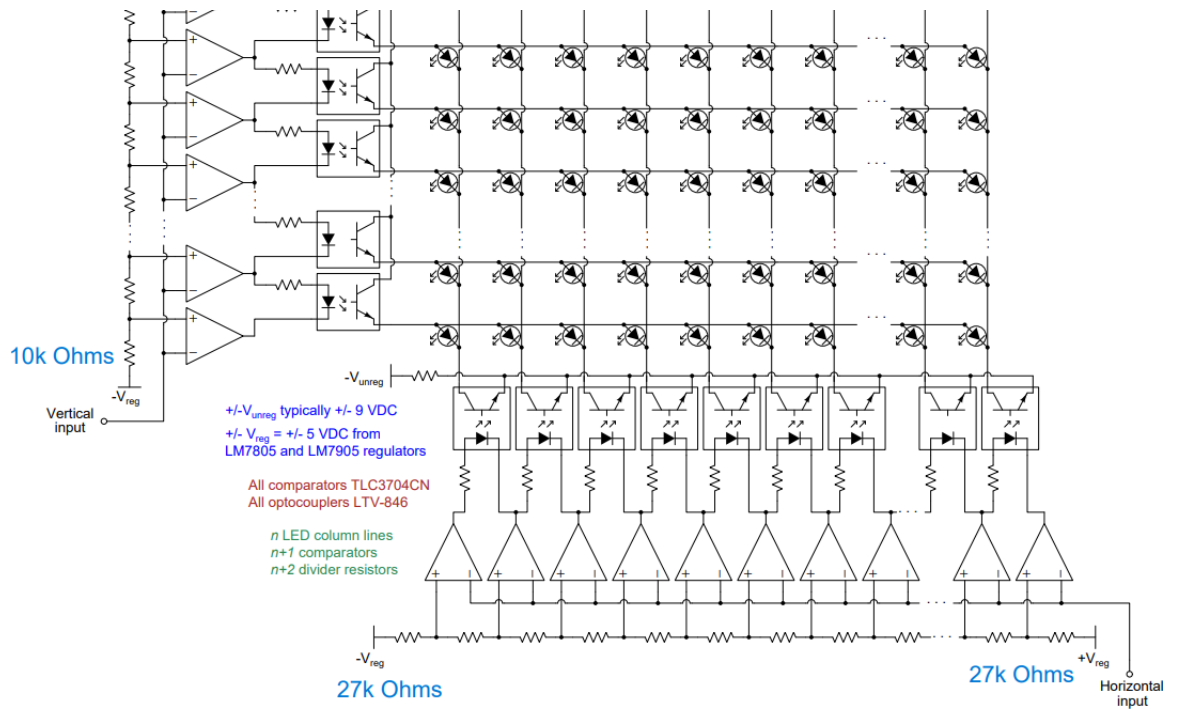
second from the bottom one had a bad output or input so swapping the bottom two chips made the problem go away since the very bottom one isn't using all outputs. So now with my circuit working we found that the best frequencies to stick between are 20-100Hz 😊

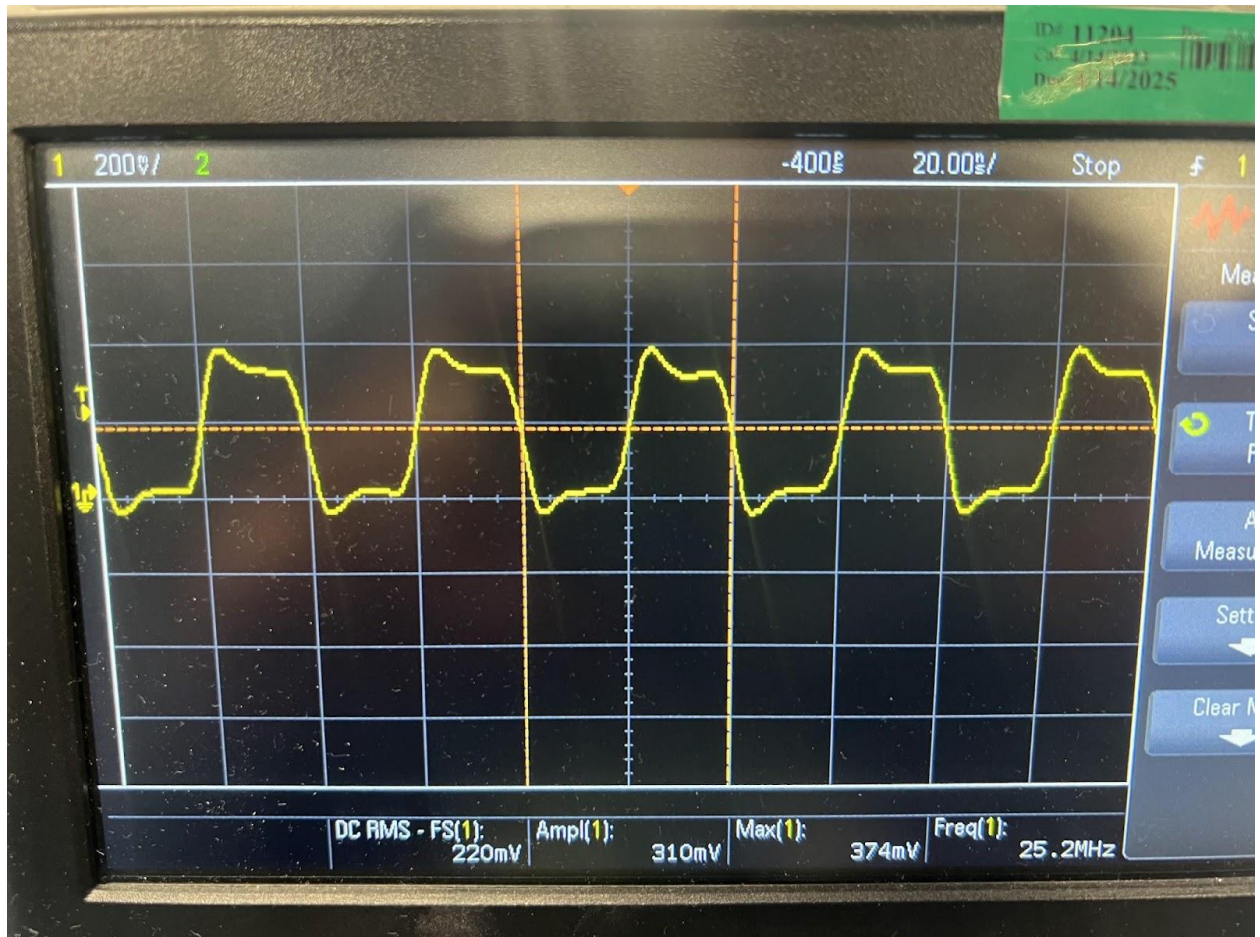


- 03/14—Today I am building a model for my oscillator circuit using a 555 timer and an inverter, until the other 555 timer comes in. First I need to do the calculations to see what resistance I need to stay in between to get 20Hz-100Hz. I ended up getting 67-338 Ohms if I used a 47uF cap. So I built my circuit with a 1k pot. When I powered on my circuit it worked however when I was measuring the frequency with my scope I was only getting a range of 12Hz-38Hz. So what I started doing was changing my capacitor size, I went down to 33uF and got a range of 15Hz-45Hz. Then jumped all the way to 1uF and got 477-1.4kHz. Then went with a 22uF cap and got 23-68Hz. Next a 10uF and got 47uF to 49Hz-157Hz. Next since I was so close I changed the pot from 1k to 5k and now I get a range of 10Hz-156Hz. We found that my DC source had a lot of noise, so I added a 0.1uF cap from Vcc to Vdd which cleaned it up. However it changed my frequency range from 14.2Hz-220Hz.

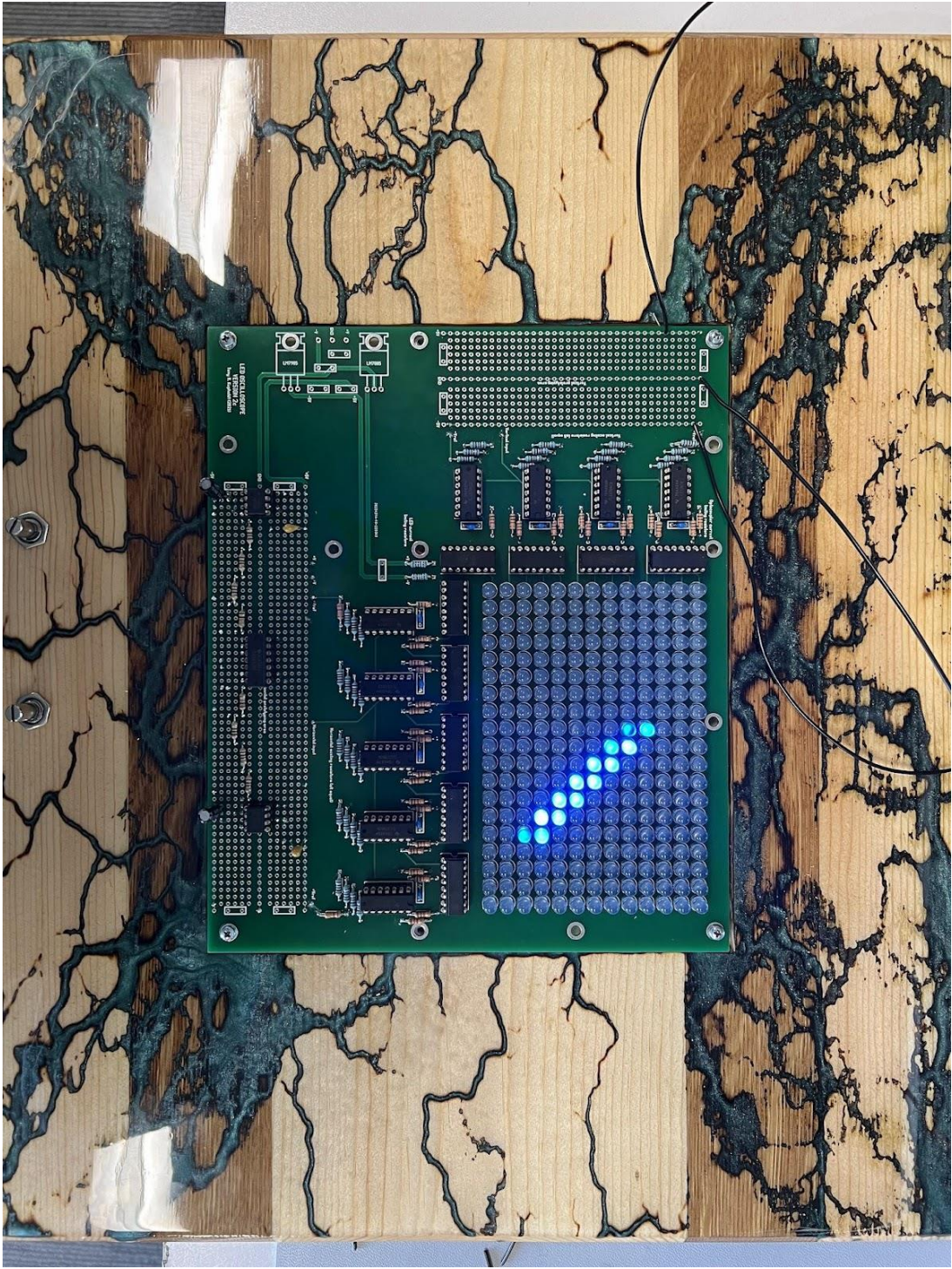
- 03/15—In order to limit the frequency so it can't go lower than 20Hz I need to add a resistor right before my potentiometer, so if I did my calculations correctly it should roughly be a 1.5k Ohm resistor. However I ended up trial and error and found that the best resistor size is 10k Ohms, so my math is way off. To make my life easier I just used a 10k pot so I could find the right resistance for my 100Hz range and adjusted it until I got right in that sweet spot. I ended up measuring my potentiometer at roughly 445 Ohms.
- 03/18—Today I built my second oscillator circuit and used my scope on XY mode to make sure it made some nice figures and it did. Next I soldered my connections from my +5V to +Vreg, and -5V to -5Vreg. This way I can test my bread board circuit on my PCB and see how triangle wave figures look. Hooked it up to my PCB and found out that where it is showing is very small in the upper right hand corner. Come to find out the supply voltage for my oscillator circuit is what controls how big the display is.

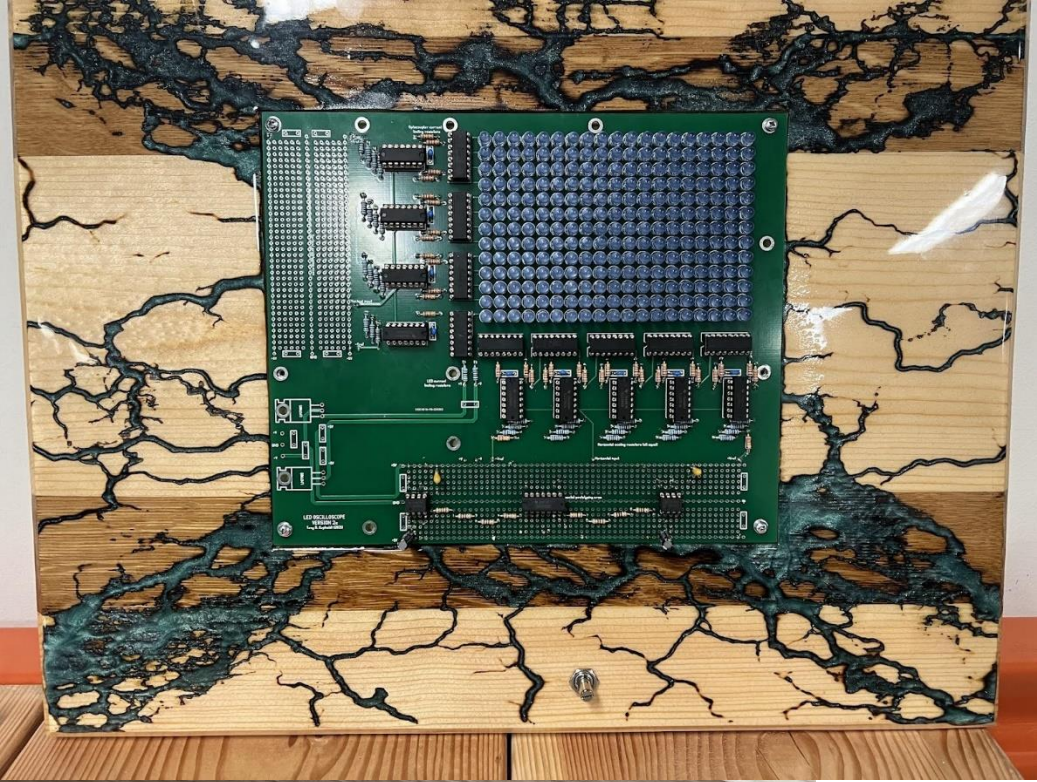
assumed it needed to be the same size however it did not, so the right size ended up being 10k Ohms. After speaking with Tony, we went back and forth on going between a triangle wave or a sine wave, but determined the triangle wave still looks super neat and this way it gives me time to work on my stretch goal of the speaker circuit. So now the next thing is soldering on my oscillator circuit to my PCB.

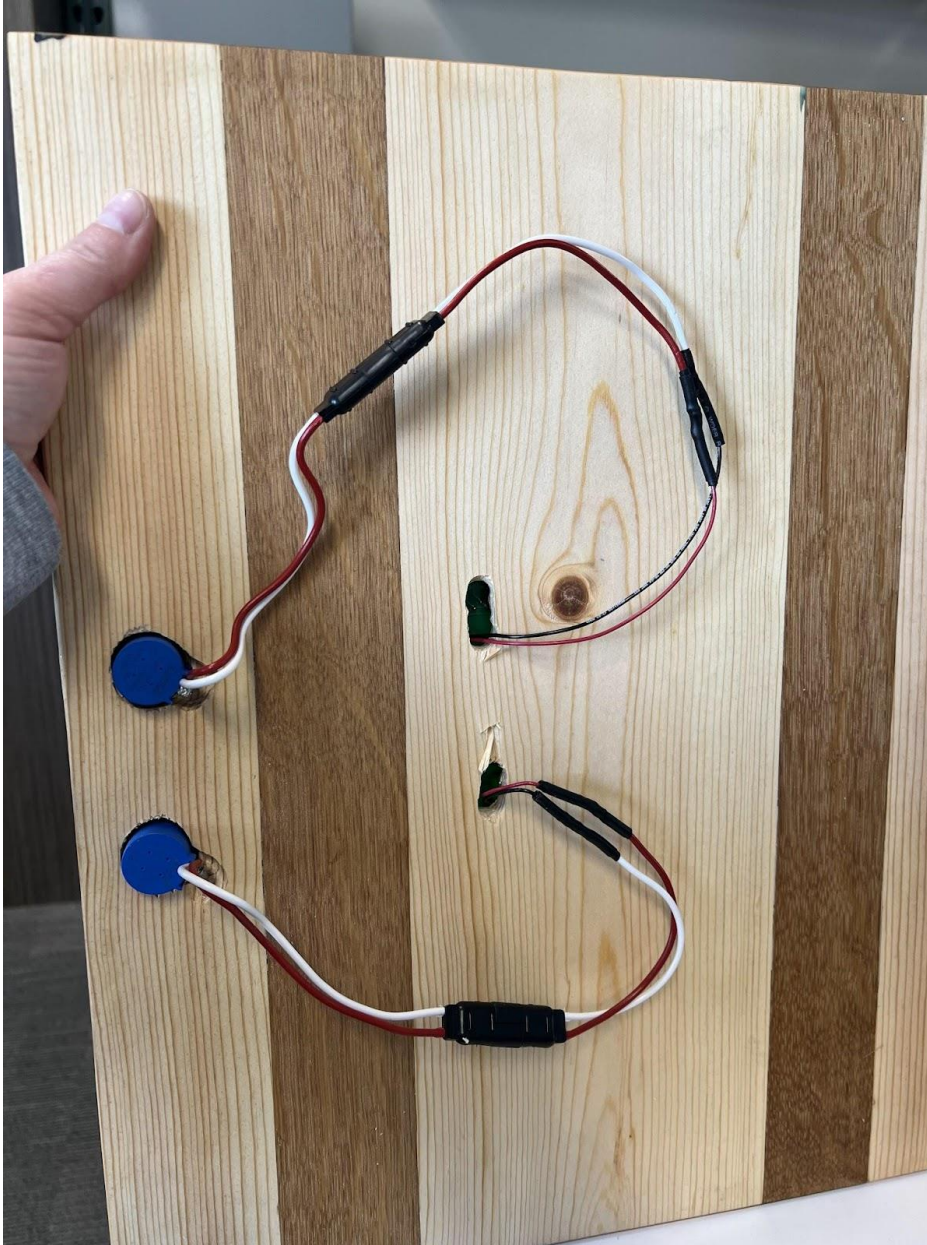




- 04/01—All I did today was work on and submit my final draft for my cover letter
- 04/02—Today I soldered the rest of my components for my oscillating circuit onto my PCB board
- 04/03—I had to figure out how to mount my POT into the board, which Justin ended up having a tool that I could use. After drilling and cleaning up the rough edges with the dremel I was able to sit my POT into the board far enough where I could fit the nut on there.
- 04/04—I mounted my second POT today so next I can work on solder the wires from the PCB to the potentiometers through the back of the board so it's hidden and also using a trailer power cord so you are still able to disconnect the PCB if needs to be worked on
- 04/08—Today I finished soldering in my POT's into my circuit board. Then after soldering everything in I powered it on and it worked!!! Woohoo!! Tomorrow I need to adjust my positive and negative unregulated voltage so my LED's can be even brighter. All in all though I am so happy it worked after doing all that soldering.

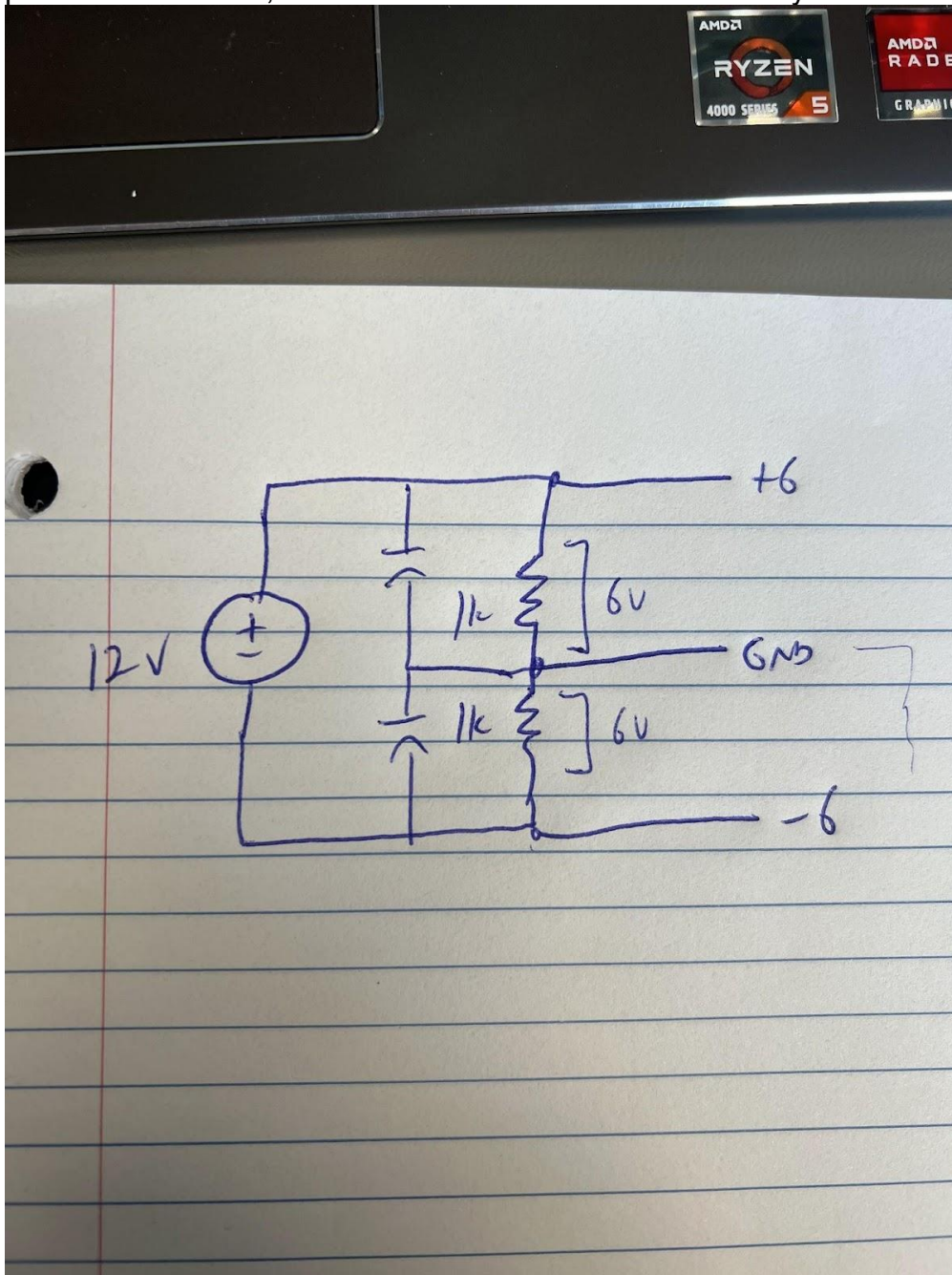






- 04/09—Today I soldered in 4 potentiometers for my negative and positive regulated voltage resistors. This way you can fine tune and adjust the height of the LED display along with the width.
- 04/11—Today instead of waiting for the rail splitter Tony had an idea to just build a simple series circuit with two 1k Ohm resistors and 2 capacitors to help with any filtering. I assembled this and then powered it up with 12V using the bench top DC power supply and it worked!! This also kind of blew my mind on how you can make a positive and negative voltage rail so simple! Once this was tested and

proven to work well, I went ahead and soldered this into my PCB.



- 04/15—I spent most of the day working on my final draft of my resume. After that was done I built the amplifier speaker circuit, but did not power it on.
- 04/16—Today I powered on my speaker circuit with a signal generator first. I had some minor hiccups because I hooked my signal generator up incorrectly, but once I got that figured out it worked! Then I found that my triple output is current limiting, which ended up being that the gain of the amplifier was 50 so I needed to adjust the volume knob in order to bring that gain a little lower to be in a good current range. Next we hooked up a different speaker since the volume was lower we could hardly hear it. With this new speaker it was much louder and you

could still hear the lower frequencies. Finally I hooked it up to my circuit board, which sadly I couldn't figure out why I couldn't hear anything. After talking everything through with Tony, I increased the size of the decoupling capacitor from 0.1uF to 4.7uF and as soon as I did that it worked you could hear me adjusting the frequency on my circuit board!! Now tomorrow I will need to change my pots wires because it is adjusting counter clockwise instead of clockwise.

Typical Applications

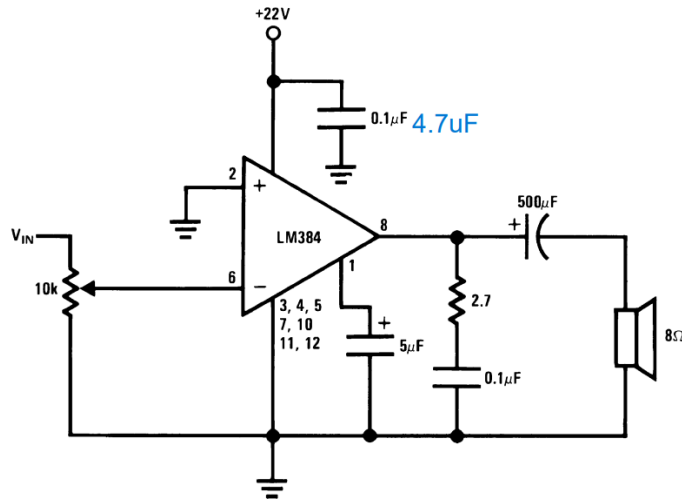
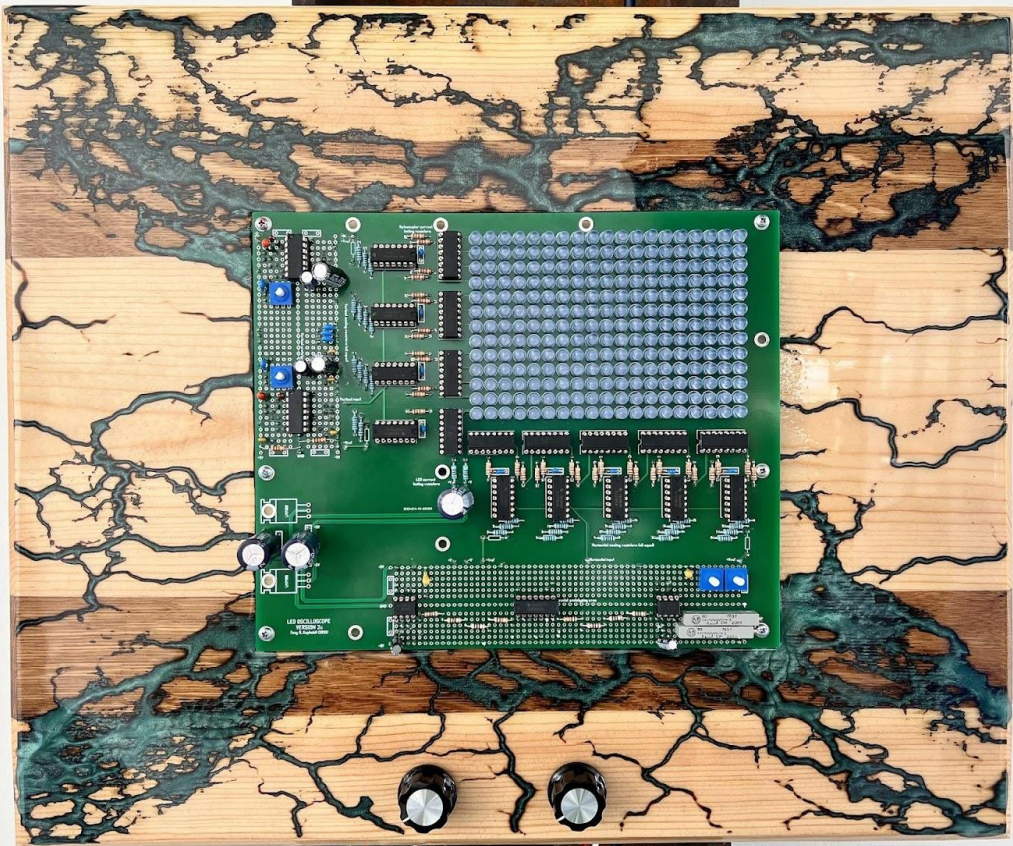


Figure 13. Typical 5W Amplifier

- 04/17–Today I worked on my final draft of my resume and then changed my potentiometer connections to go the correct way.
- 04/18–Today I started soldering on my two amplifier circuits
- 04/23–Today I continued soldering my amplifier circuit
- 04/24–I finally finished soldering my amplifier circuit, but when I went to power it on and test it, it was not working properly. I was able to find out what I did wrong, I had one of my capacitors hooked up wrong, and I also did not have my two frequency outputs going to the circuit. Once I fixed that it worked great 😊
- 04/25–Today I started finalizing my construction. I mounted two plates on the back with magnets so I could mount it out in the hallway on the steel beam. Then I started working on my functional and conformance testing criteria. I need to go to Ace to get screws to mount my speakers.
- 04/26–I mounted my speakers on the back of my board and soldered those wires on there. I then had to dremel trenches in the board and secure the solid core wires so they wouldn't break and the metal beam wouldn't hit it. After this I was able to power it on and it worked however we found that the ripple voltage was causing the amplifier circuits to sag. I ended up adding 3 2200uF capacitors in order to help this way we can turn the volume up louder.



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