Board 1 Report

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February 2024

Contents

1 Setup

1.1 POR

1. A power plug to use an external 5 V AC to DC charger to power your board
2. A 555 timer chip and circuitry designed for about 500 Hz and 60
3. Use components from the provided JLC PCB library. I only use components from other libraries if I have a strong, compelling reason to do so.
4. Add 4 LEDs of all the same color and series resistors of 10k, 1k, 330, and 47 Ohms.
5. Use indicator lights, test points, and isolation switches as appropriate.
6. Design to measure the 5 V input rail, the 555 output voltage, and the current through the 50 Ohm LED.
7. Select a 555-timer IC that can source enough current for all 4 LEDs.

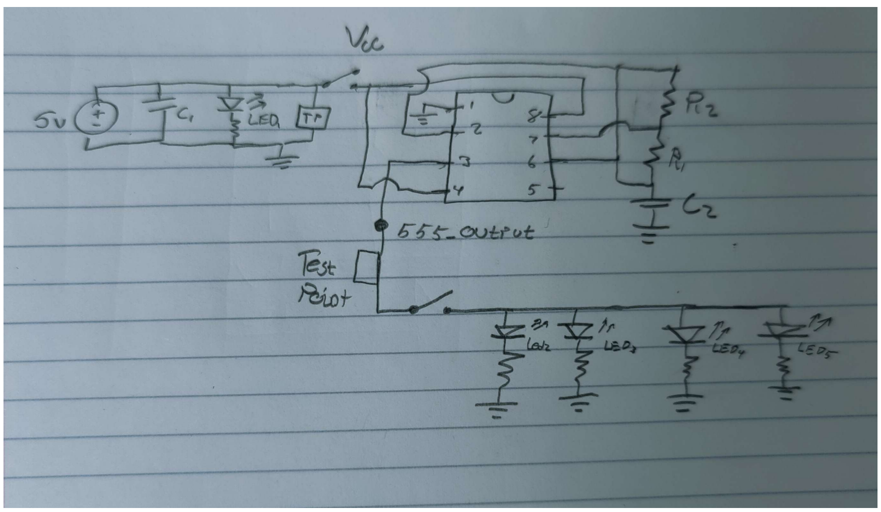


Figure 1: BON Sketch of Circuit

1.2 Desgin in Altium

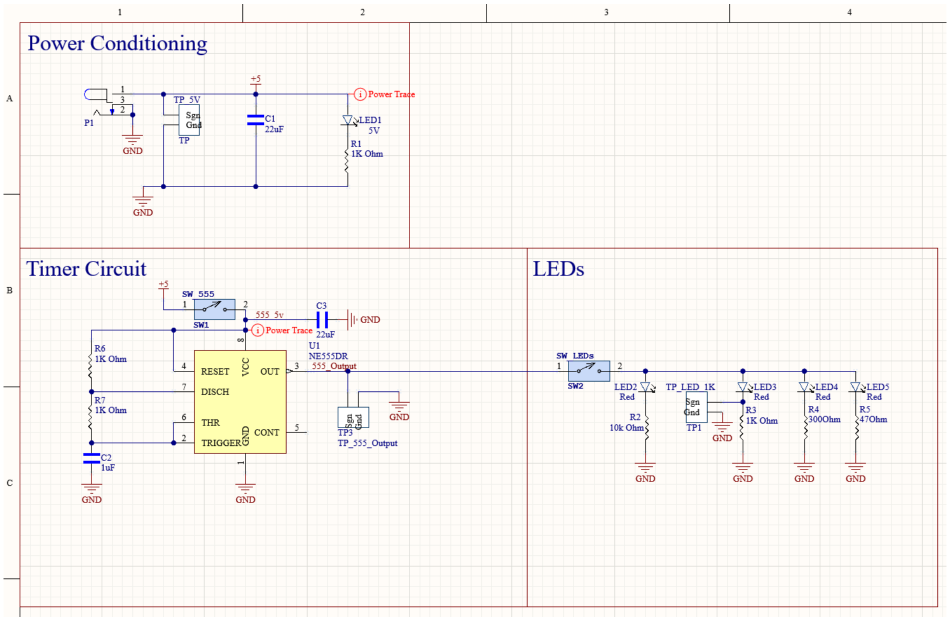


Figure 2: Altium Schematic

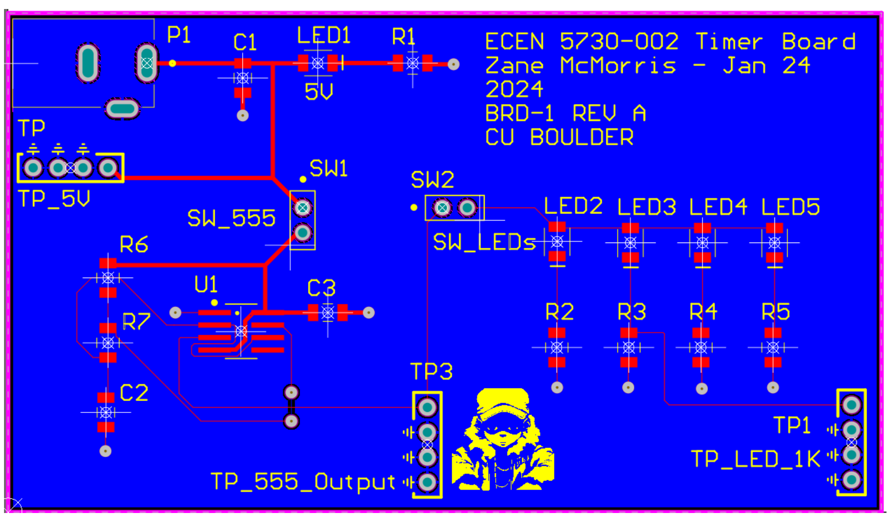


Figure 3: Altium layout of the board

1.3 Assembled PCB

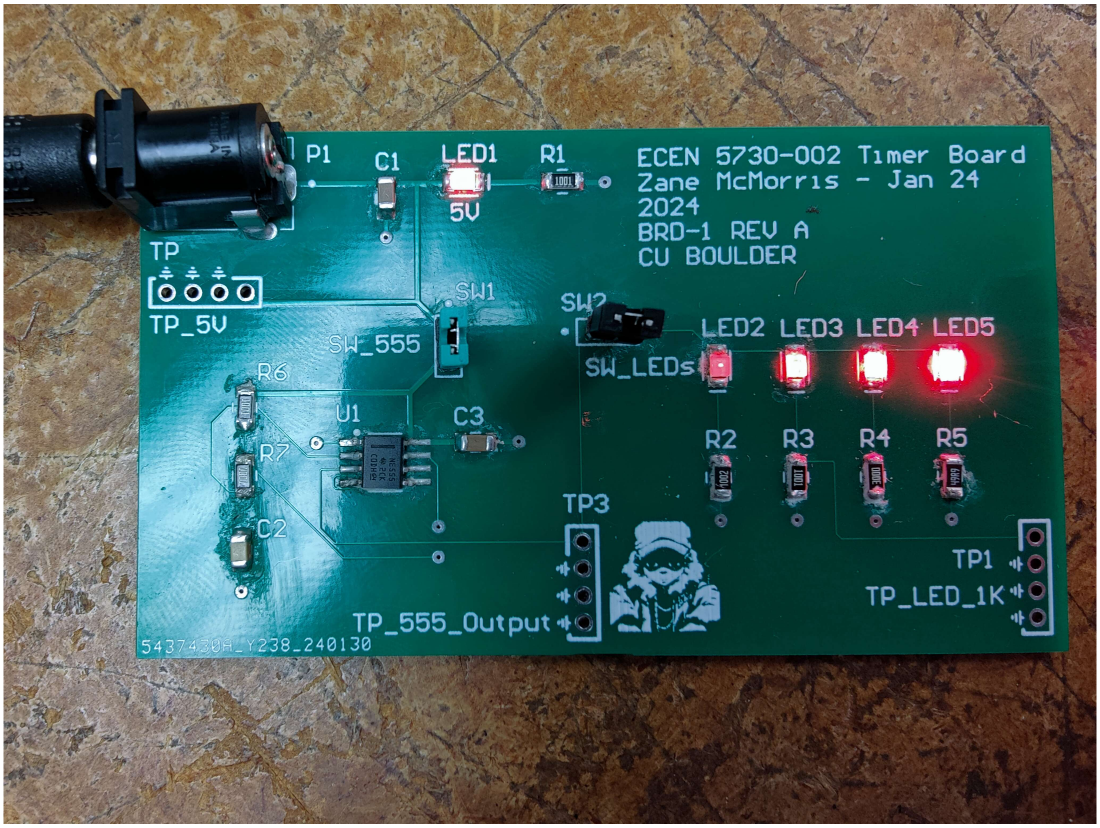


Figure 4: Assembled board

1.4 What it means to work

1. 5v is supplied to the +5v rail from the AC barrel jack connector.
2. The 5v status LED should be lit
3. The 555 timer outputs a squarewave with our desired characteristics, with an arbitrary error margin of 5%.
4. The test LEDs all light up with varying levels of brightness depending on their series resistor value.
5. The voltage across the 1K resistor should closely match the output directly from the 555 timer.

1.5 Expectations

For my circuit design, I expect a 66% duty cycle and a frequency of 500Hz. Given my 5% allowable margin of error, it can have a duty cycle between 62.7% and 69.9% and a frequency between 475Hz and 525Hz.

2 Results

Given the specs in the POR and the circuit design, I expect a roughly 66% duty cycle and a frequency of 500Hz. The factors that would affect these values would be the tolerance of the components used, as well as the non-transparent interconnects. Even with commodity parts and rudimentary PCB layout, I was able to observe measurements that very closely matched my expected outcome.

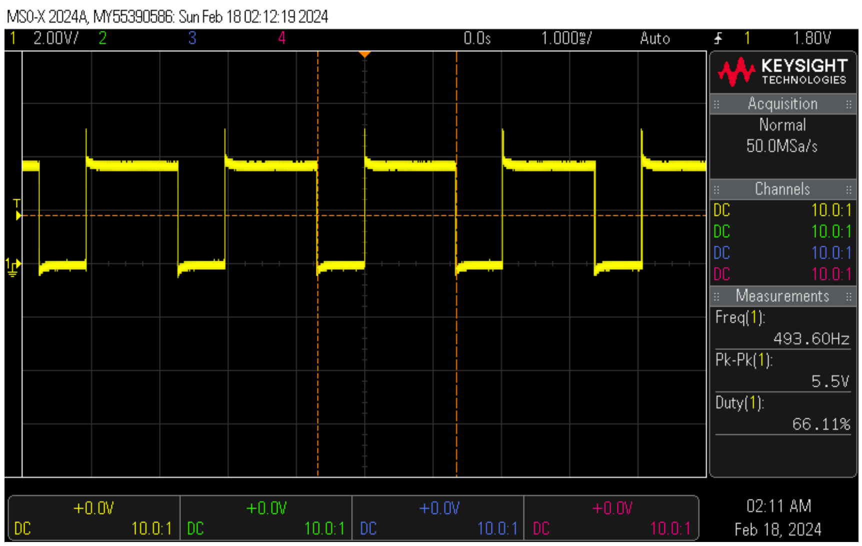
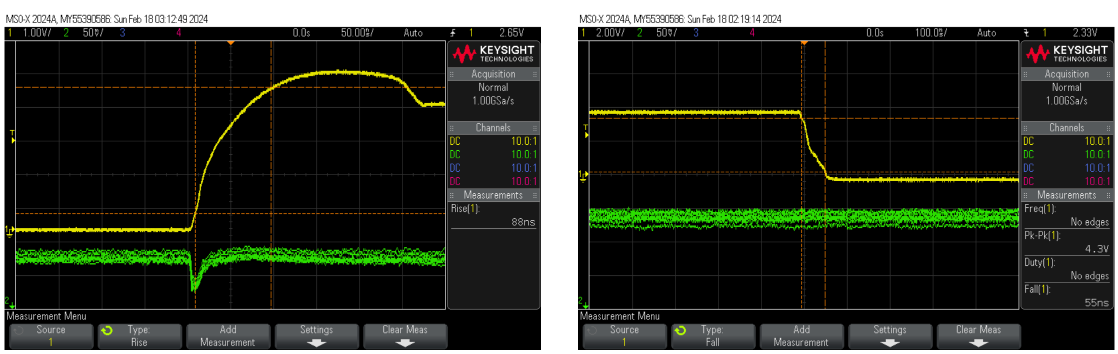


Figure 5: Frequency and Duty Cycle of 555 Timer

As seen in 5 I was able to measure a duty cycle of 66.11% and a frequency of 493Hz. This measured duty cycle had an error of 0.8%, and the frequency had an error of 1.4%. Both of these values are good enough and show that the design of the board and circuit was sufficient to meet our required specs.



(a) Rising Edge (b) Falling Edge

Figure 6: Rising and Falling edges with PDN noise

The rising and falling times of the 555 timer nearly matched my SBB circuit results. In the SBB I saw a rise time of 66ns, which was faster than my observed 88ns rise time in the PCBA. This discrepancy could be due to the differences in load in the two cases. The fall time between the SBB and the PCBA was similarly close but likely was different because of the different loads and non-transparent interconnects.

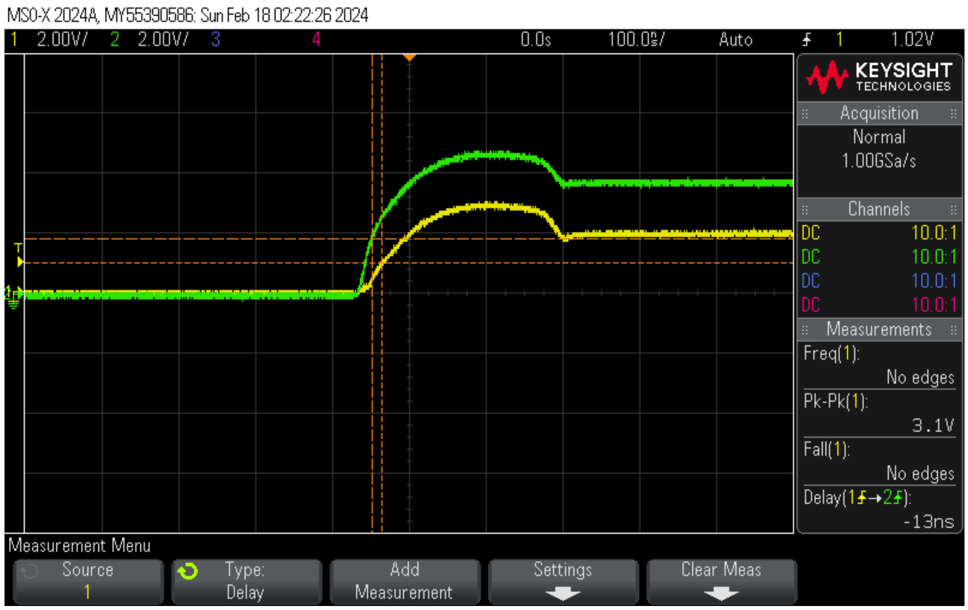


Figure 7: 555 Output vs Voltage across R3

This measurement matched our expectations as well. The voltage across R3 (in yellow) is lower than the voltage of the 555 Timer due to the voltage drop across the LED. The signals are very close to each other in time with only a few ns of delay. This delay is due to the time it takes for the signal to propagate through the board.

3 Conclusion

Overall I learned the proper way to design and bring up a PCB. My design and assembly went well, and I didn't encounter any hard or soft errors. One thing I will change in my future PCB revisions is to have the test points near and parallel to the edge of the board to allow for clip probes to be attached easily. I had some minor difficulty in gathering these measurements because the flat bottom and the long scope probes wanting to fall over.