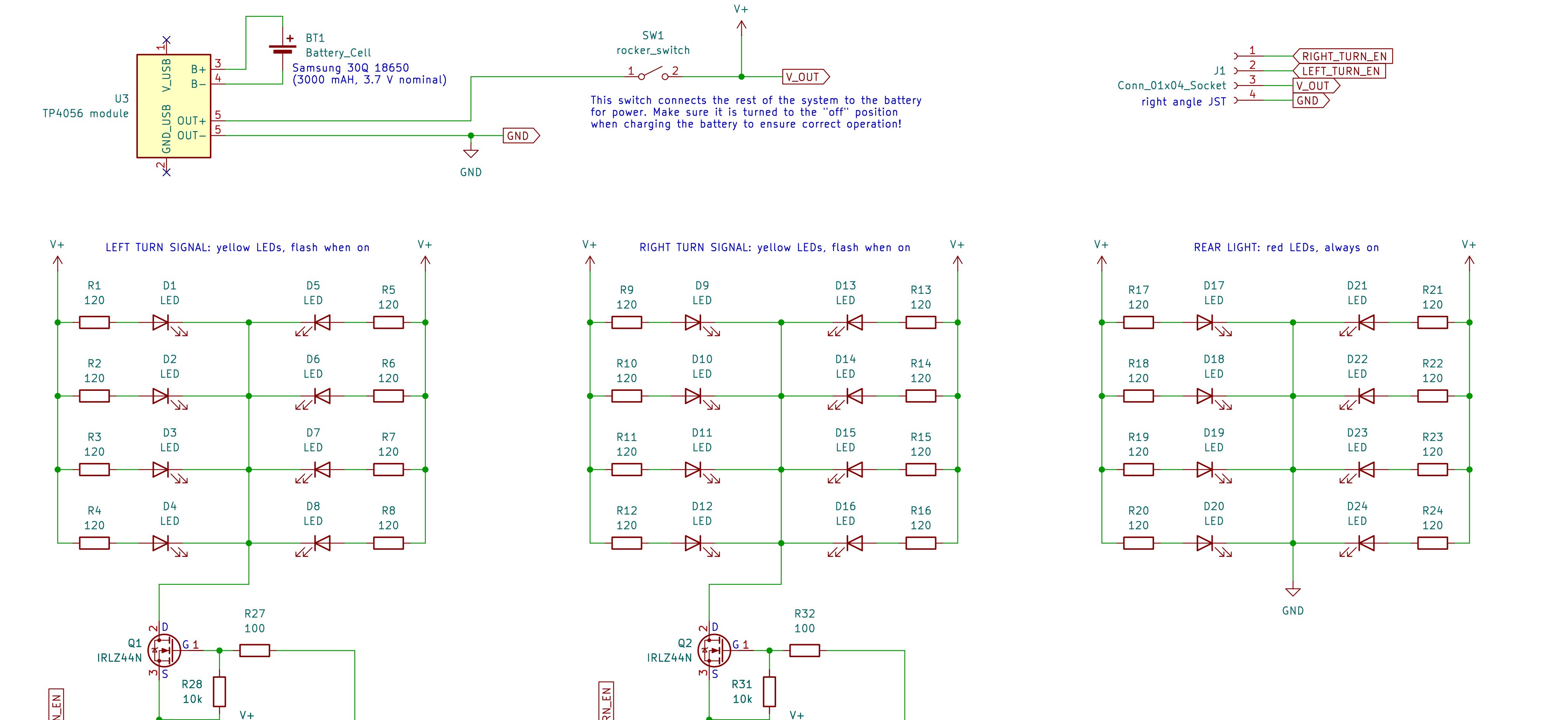

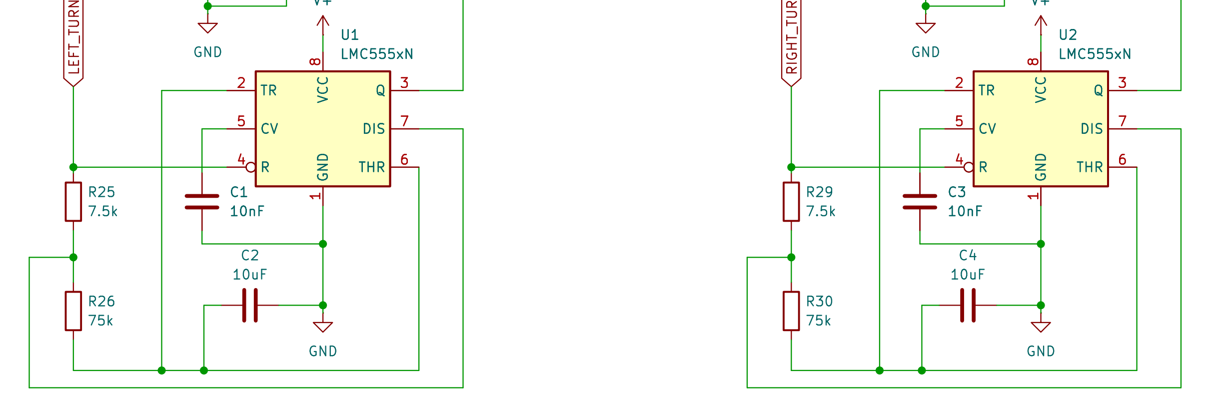

NOTES

All LEDs used are CHANZON brand, 5 mm packages. Each has a forward voltage of 2 V and a forward current of 20 mA.
To calculate the current limiting resistor value at maximum battery voltage: $V = IR = (4.2\ V - 2\ V) = (20\ mA)R \rightarrow R = 110$ ohms.
To account for resistor tolerances, I rounded up to the next standard value of 120 ohms. Calculating the current through the LEDs at minimum battery voltage with this resistor gives: $2.5 - 2\ V = I(120\ ohms) \rightarrow I = 4.17$ mA.

I am running each of the 555 timers in astable mode. To determine timing, 3 values need to be chosen: Ra, Rb, and C.
It is generally recommended to choose a value for Ra that is 10% of Rb's value, so I picked standard values of 7.5 kohms for Ra and 75 kohms for Rb. This gives an adequate duty cycle as follows: $D = Rb/(Ra + 2Rb)*100 = 47.62\%$.
I wanted to aim for a frequency of about 1 Hz for each timer so that the LEDs are on for about 0.5 seconds. Choosing a standard C value of 10 uF gives the following frequency: $f = 1.44/[(Ra + 2Rb)C] = 1.44/[(7500 + (2*75000))*10^{-5}] = 0.914$ Hz.

I decided not to do anything very sophisticated for the battery for this circuit. The 18650 batteries I selected have a discharge cutoff voltage of 2.5 V, which is the threshold at which the DW01A chip on the TP4056 module disconnects the battery from the load to prevent over-discharge. I know that it is recommended to stop discharge on 18650s before they reach their cutoff (at about 3 V, for example) to increase their overall lifespan, but I have opted to keep things simpler here. I will see how it goes! This is definitely an area for improvement in future iterations, in addition to adding reverse polarity protection (it's not like the battery will be replaced any time soon, but still). It might also be worth looking into switching the load more elegantly.

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Title: FarrhadTech Rear Lights Unit

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Rev: 0	
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