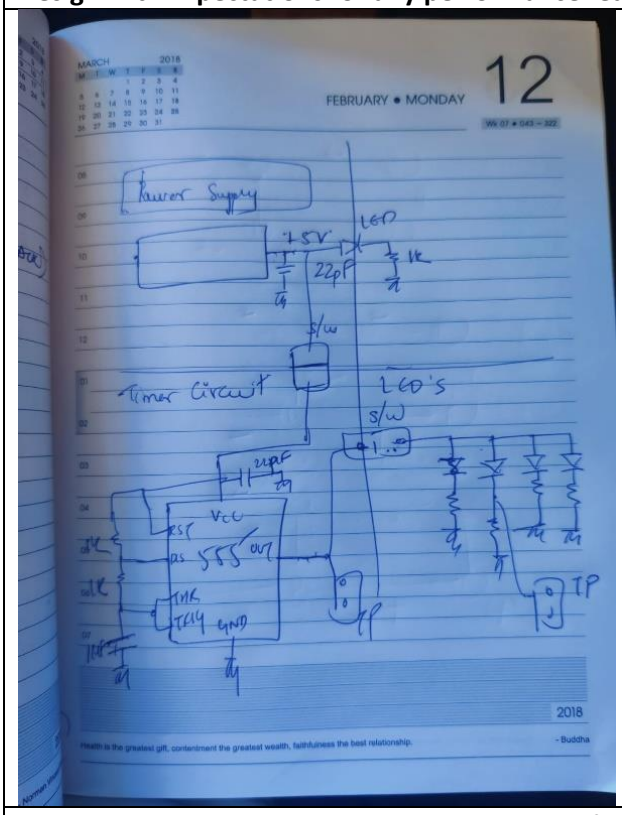
555 Timer Board 1 Report (02/20/2022) **Rishab Shah**

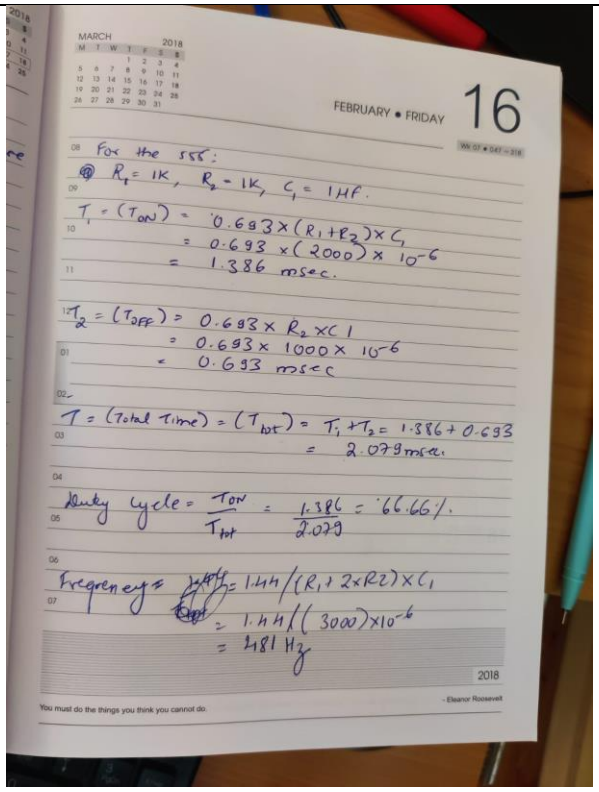
Project Overview/Definition of work:

The Output of the 555 time should drive 4 LEDs with different brightness and should have a duty cycle of 60 percent and 500 Hz. It was to understand the behavior of switching noise experienced at fast rise times.

Sketch of the schematic:

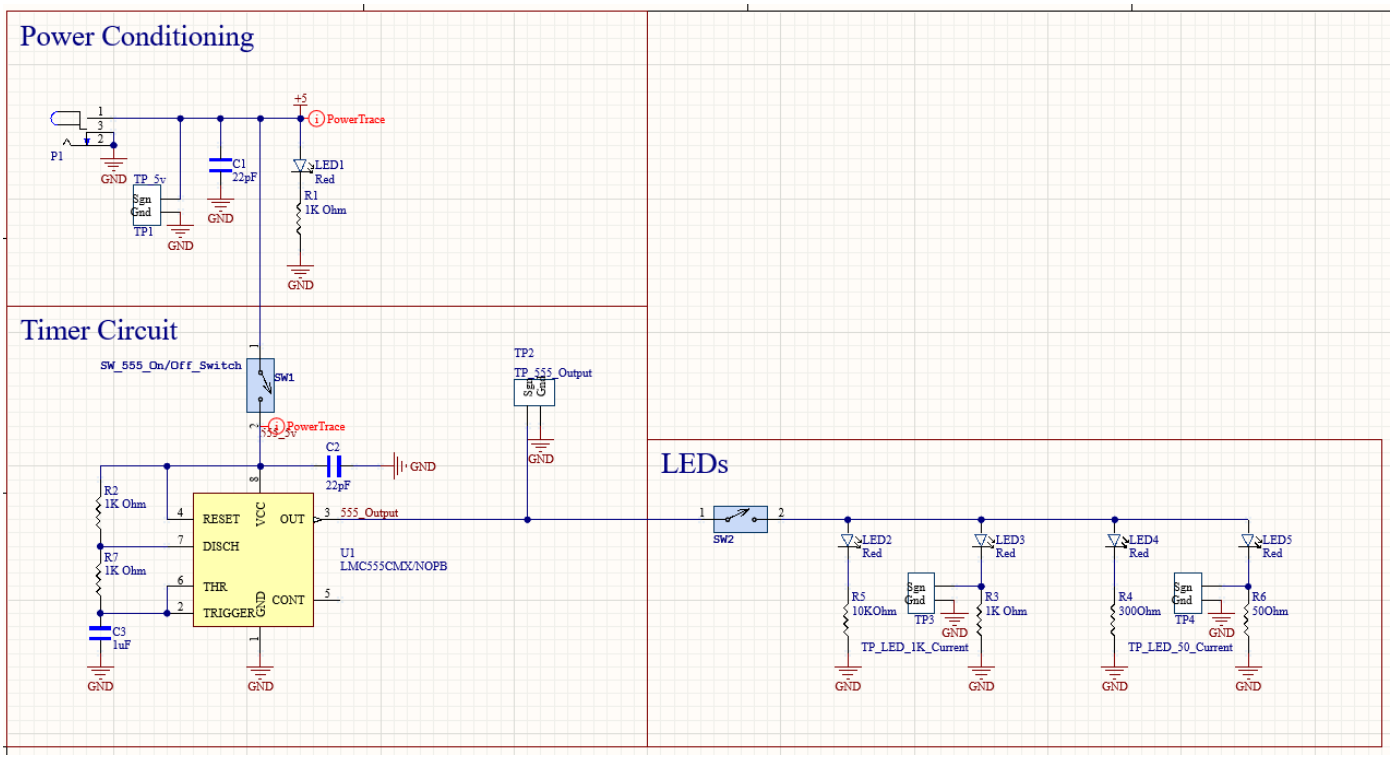
Design with Expectations for any performance features:

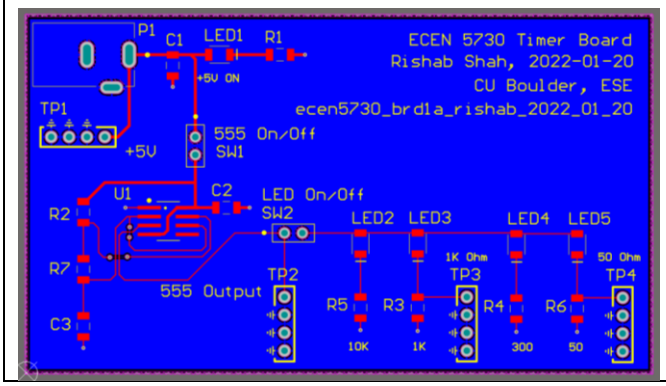
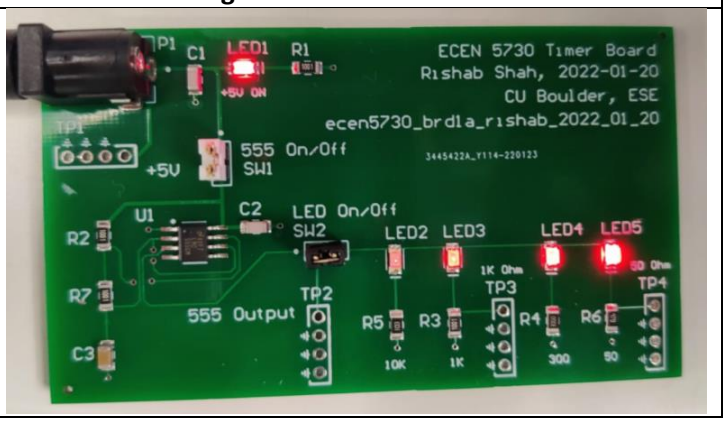




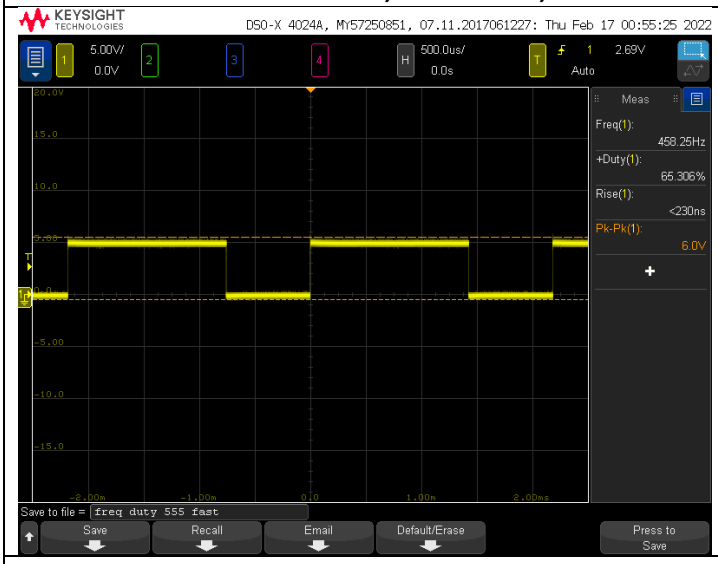
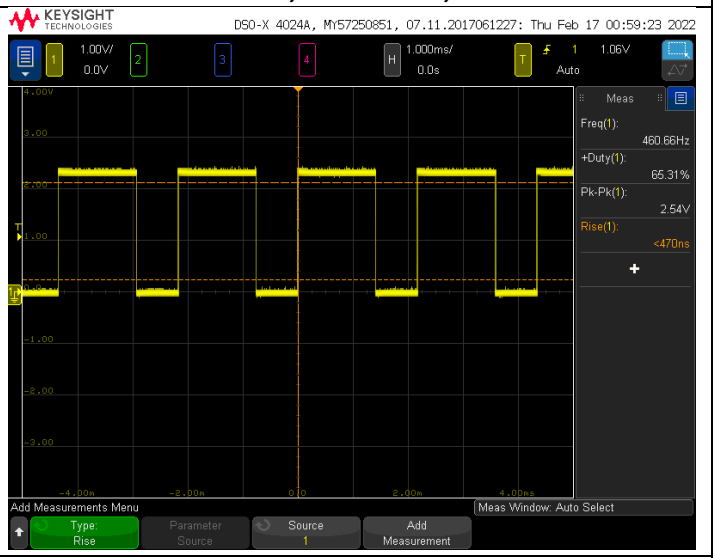
The values were chosen such that the number of unique components are reduced and hereby the cost.

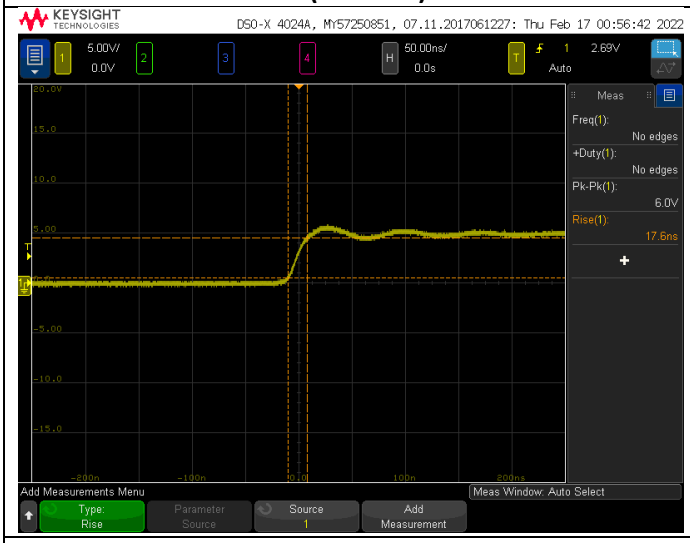
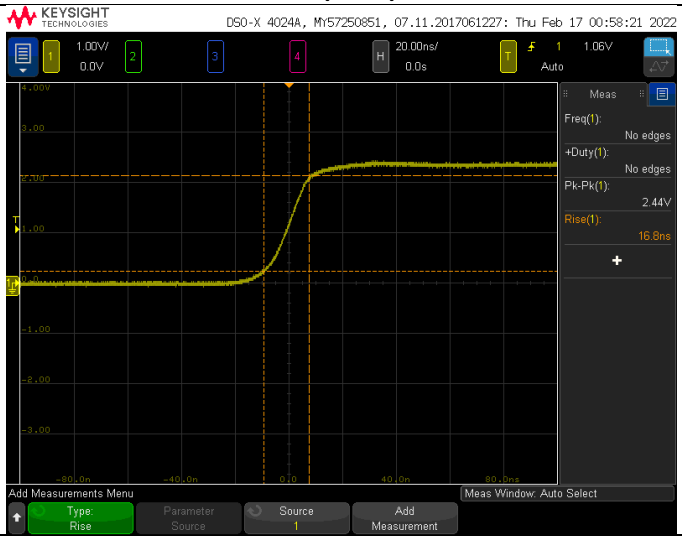
Actual schematic capture:



Board layout:	Picture of Working board:
	

Measurements:

555 timer - Frequency, Duty Cycle and Rise time	
No Load – LEDs not connected, F=458.25Hz,D=65.306%	**Load – LEDs Connected, F=460.66Hz,D=65.31%**
	
Frequency, Duty Cycle do not differ due to connection or disconnection of load.	

Rise Time (No Load) = 17.6 ns	Rise Time (Load)= 16.8 ns
	
Rise time do not differ due to connection or disconnection of load.	

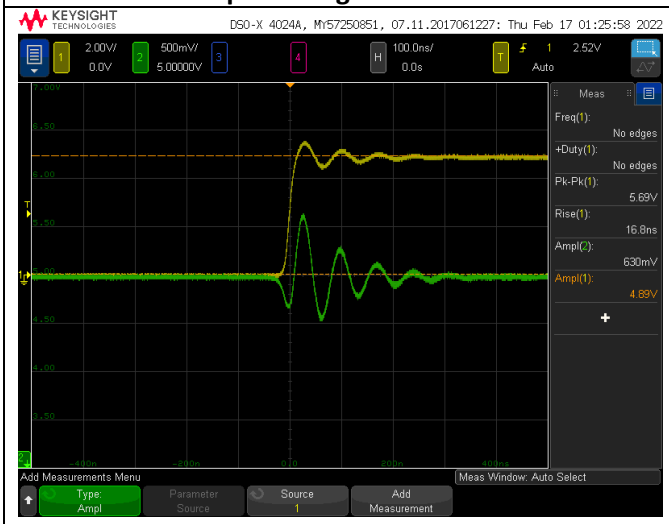
Current through 50 Ohm LED:
Voltage (V) drop across 50 Ohm: 670 mV
Hence, Current = V/R = 670 mV/50 Ohm = 13.4 mA

Current estimation through each LED/Board working verification:

	Output Voltage at 555 = 2.34 V	LED2	LED3	LED4	LED5
Measured	Voltage Drop at LED (V)	1.109	1.16	1.19	1.25
Measured	Voltage-drop at Resistor (mV)	650	600	570	670
Theoretical	Resistor Value	10000	1000	300	50
Measured	Current measured (mA)	0.065	0.6	1.9	13.4
Theoretical	Voltage-drop at RED LED(V)	1.8	1.8	1.8	1.8
Theoretical	Voltage at Resistor (V)	0.54	0.54	0.54	0.54
Theoretical	Current calculated (mA)	0.054	0.54	1.8	10.8
Total current					
Theoretical (mA)	13.194				
Measured (mA)	15.965				

Measurement Analysis: It is visible that the theoretical and practical measurements match. The slight mismatch is due to current sourcing capability of 555-timer. Had a slow timer chosen the estimated and practical values would have been closer.

Switching noise on power rail:

No Load: The output voltage is 4.89 V	**Load: The output voltage is 2.34V**
	
Switching noise = 630mV	Switching noise = 440mV

Thevenin Output Resistance of the 555-timer:

Vth = 4.89V
Vl= 2.34V
Rl = Resistors in parallel = 0.0244
Rth = Rl*(Vth-Vl/Vl)
= 0.0244*(4.89-2.34/2.34)
= 0.0266 Ohm
= 26.6 mOhm

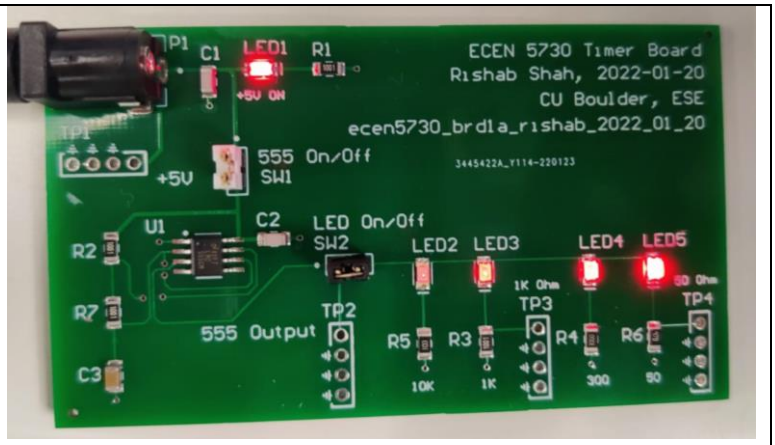
Demonstration of best design practices and best measurement practices:

Spring tips were used for measurement using CRO to reduce the inductance and decoupling capacitor was placed close to the power of the 555 IC.

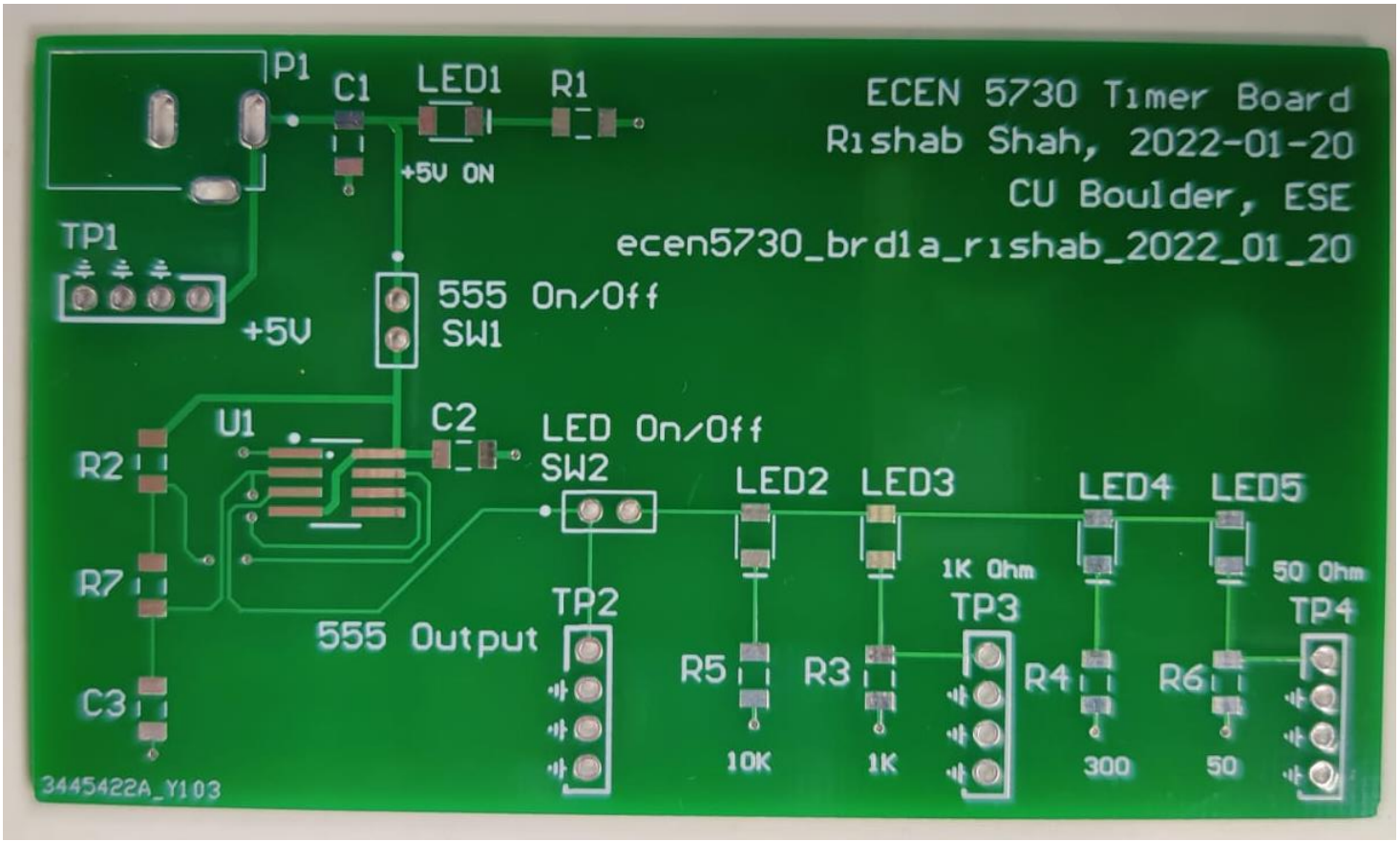
Improvement/Care for next time:

The voltage dropped when load was connected. It happened because the current sourcing capacity of the IC was less than that was consumed by the load. Hence, proper IC to be chosen with current capability.

Indicator LED:

Based upon the environment conditions, either LED2 or LED 3 is appropriate. LED3 would work anytime but LED2 will be more effective in a night environment as it be easy to view at that time.	

Picture of Board



Analysis of your project:

Q. What worked and you did well and want to do in future design

- Labelling every component and division of the blocks beforehand helped to visualize and breakdown tasks.

Q. What did not work, and you will want to do differently in future designs.

- The usage of Fast Timer 555 caused voltage to drop when load was connected. In future, will keep current considerations in mind unless it is required to develop a board to test a particular functionality.

Q. Were there any hard errors- why did they go wrong

- No hard errors

Q. Were there any soft errors that you would like to do differently next time?

- The placement of the components could be more precise and optimum usage of space can be made. I will also make use of 0402 parts compared to 1206 to make use of the manufacturing facility abilities.