Practical PCB Design and Manufacture

Lab-2 Report SSB-Build 555 Timer

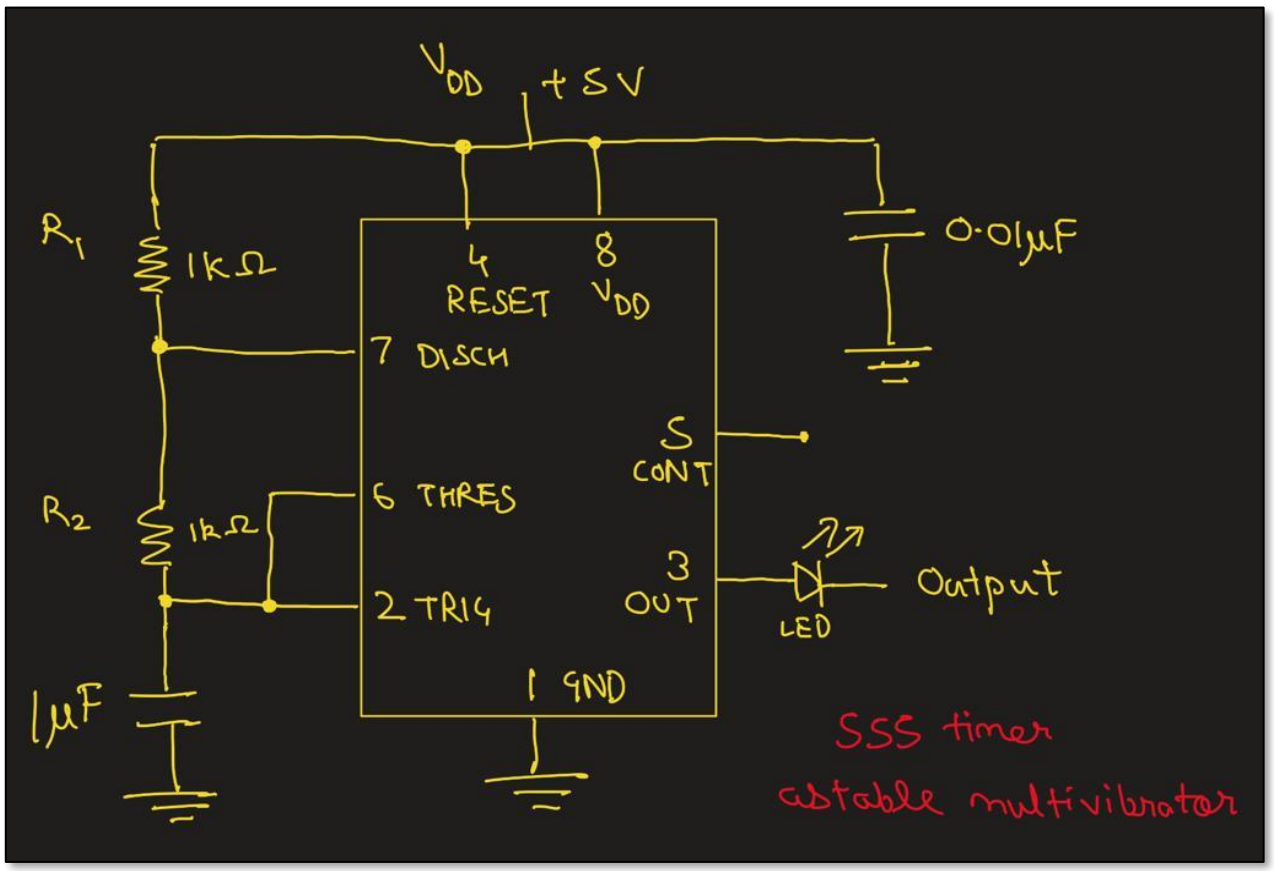
Objective / Purpose of the Lab:

- The purpose of this lab on building an SSB-based 555 Timer circuit is to demonstrate an understanding of the 555 timer in astable mode and its application in generating continuous oscillations. This provides the person with hands-on experience in designing, building, and testing a basic electronic circuit, as well as an understanding of the principles underlying the 555 timer's operation.

Component Listing:

- Solderless Breadboard
- Arduino UNO (For 5V power supply)
- TLC555IDR C6987 (Fast timer)
- NE555DR C7593 (Slow timer)
- Resistors (1k Ω)
- Capacitors (1µF and 10nF)
- Connecting wires
- LEDs
- Oscilloscope

Napkin Sketch:



Calculations:

Time High (T_1) $= 0.693 \times (R_1 + R_2) \times C_1$

$\approx 0.693 \times (2) \times 1$

$= 1.386$ ms

Time Low (T_2) $\approx 0.693 \times R_2 \times C_1$

≈ 0.693 ms

Time Period (T) $\approx 0.693 \times (R_1 + 2R_2) \times C_1$

≈ 2.079 ms

Frequency (F) $= \dfrac{1.44}{(R_1 + 2R_2) \times C_1} = 481$ Hz

Duty Cycle $\approx \dfrac{R_1 + R_2}{(R_1 + 2R_2)} \times 100 = 66.67\%$

Scope Shots with Analysis:

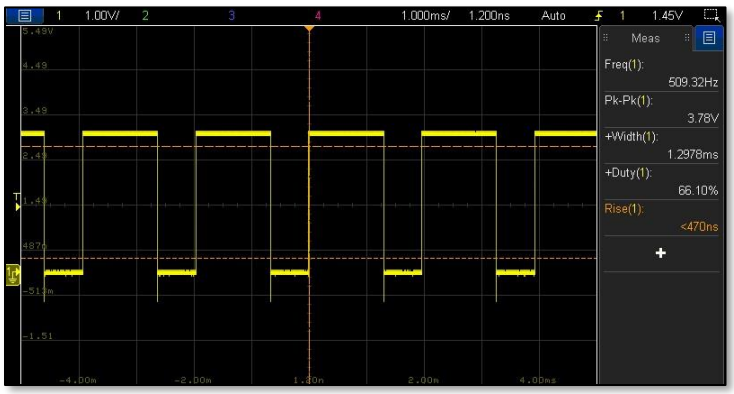


Fig - 1

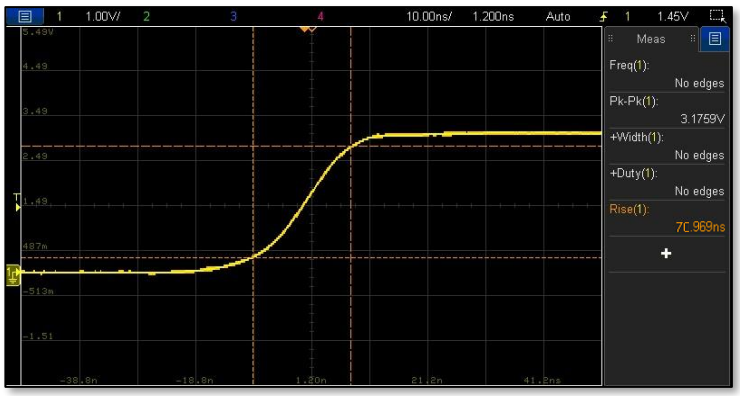


Fig - 2

For TLC555IDR C6987 (Fast timer),

- **In the Fig-1**, we can see the square wave generated when we connect the oscilloscope to the Output (Pin 3) of the 555 Fast Timer IC. The frequency of the square wave generated as we can see is the 509.32 Hz. The duty cycle which we can see is 66.10% which matches approximately with the calculated values.
- **In Fig-2**, we can see the rise time as 70.969 ns. In general, Rise time is the time it takes for the leading edge of a pulse to rise from its minimum to its maximum value. The rise time for the TLC555 as per the datasheet is in the range of 20-75 ns. So, the rise time as per our scope falls in this range. The Peak-to-Peak voltage is 3.17 V.

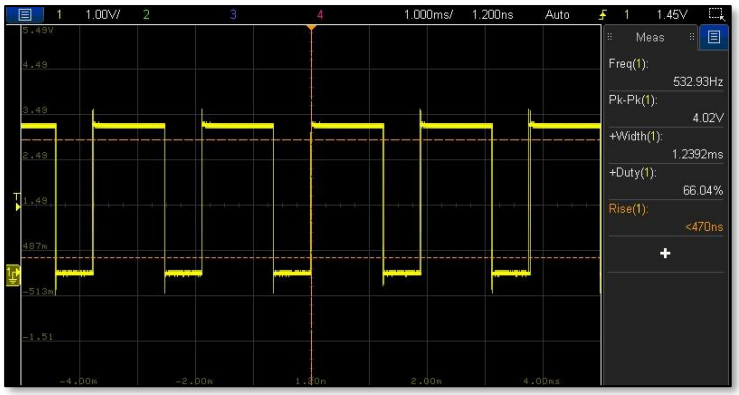


Fig - 3

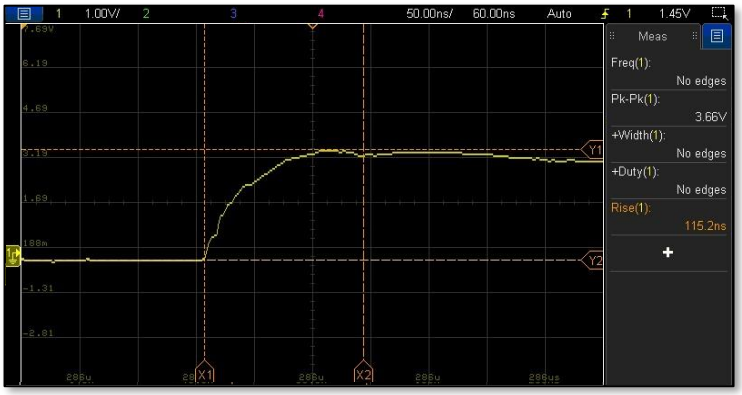


Fig - 4

NE555DR C7593 (Slow timer),

- **In the Fig-3**, we can see the square wave generated when we connect the oscilloscope to the Output (Pin 3) of the 555 Slow Timer IC. The frequency of the square wave generated here is 532.93 Hz which is almost same as that of the fast timer. The duty cycle which we can see is 66.04% which matches with the calculated values.
- **In Fig-4**, the rise time comes out to be 115.2 ns. As per the datasheet, the range for the output-pulse rise time is 100–300 ns and the scope values come in this range. The Peak-to-Peak voltage is 3.66 V.

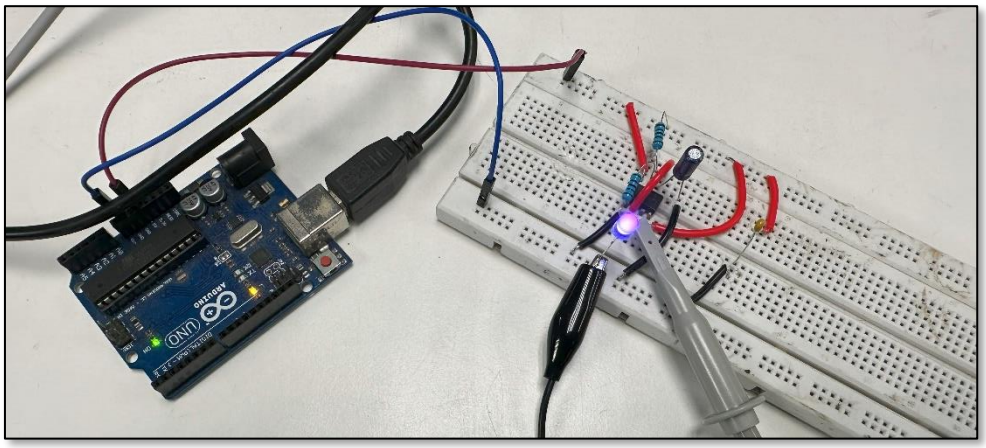


Fig – 5 Board connections

Conclusion / Inference:

In this lab involving two different 555 timer astable multivibrator circuits with fast and slow ICs, the key conclusions are:

- The difference in operating speeds between fast and slow ICs is quite evident, with the fast IC producing higher frequency oscillations compared to the slow IC.
- This experiment demonstrates the basic principles of astable multivibrators, showcasing how varying component values affect the frequency and duty cycle of the output waveform.
- This lab also highlights the practical applications of different speed ICs in various electronic systems.