**PCB Report – Board 1**

**555 Timer as Astable Vibrator**

**Objective:**

A 555 timer can be used in modes such as Monostable, Bistable, and Astable Multivibrator. Here in this lab, the 555 timer is used as an Astable Multivibrator to output a signal with a certain frequency and duty cycle. Also, comparing the rise time, fall time, and amplitude of voltage output from a slow 555 timer NE555 used.

**Plan of Record:**

Features of board:

* 5V power input rating.
* Slow 555 timer IC(NE555).
* Designed for Duty cycle of 66% and 500Hz.
* Different loads attached 50, 300,1k and 10k to limit current.

Risk Reduction:

* Added LEDs to indicate power supply is working fine.
* Separated the modules as power, 555timer and load using headers/switches.
* Proper labelling for each input and outputs
* Added decoupling capacitor to avoid switching noise in power rail.
* Plane is poured with copper to make it GND to avoid mutual loop inductance due to large loop area.

What does it mean to work?

* Read 5V from power input test point.
* Read 555 timer output signal with nearly 66% duty cycle and 500Hz frequency.
* Observe dimness in load LEDs according to increase in load resistor values.
* Draw current less than 200mA that NE555 supports.
* Rist time and fall time closest to that mentioned in Datasheet.

Components listing:

* Resistors: 1K, 50, 500,10K
* Capacitors: 22uF, 1uF
* Power jack
* Headers
* LEDS

Schematic:

A computer screen shot of a diagram

Description automatically generated

Layout:

A blue circuit board with red and blue text

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A green screen with yellow dots and stars

Description automatically generatedA green circuit board with white text and white letters

Description automatically generatedBoard:

A green circuit board with red lights

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*Assembled board with LEDS lit up.*

**Calculation:**

Here, I have calculated the resistor and capacitor values for a frequency of 500Hz and a duty cycle of Ton as 66.67%.

T = Ton + Toff

Ton = 0.693(R1+R2) C

Toff = 0.693(R2) C

T = 0.693(R1 + 2R2) C

F = 1/T = 1.44/ (R1 + 2R2) C

The components provided are 1K and 1uF so, considering R1=R2= 1K and C = 1uF

**F= 1.44/(3K) 1uF = 480Hz**

T= 1/480 = 2.08ms

Ton = 0.693(1K + 1K) 1uF = 1.386ms

**Duty cycle = Ton/T = 66.6%**

**Scope output:**

1. 5V from power supply

A screen shot of a graph

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1. Figure of merits from 555 timer output

A screen shot of a computer

Description automatically generated  
Noted signal output with amplitude 4.7V, frequency of 489.61Hz and 66.04% duty cycle which is nearest to the design.

1. Rise time of 555 timer output without load

A screen shot of a computer monitor

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Rise time of 68.2ns observed due to use of slow 555 timer output.

1. Fall time of 555 timer output without load

A screen shot of a graph

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Fall time of 27ns indicates the fast turning on of the NPN transistor.

1. Rise time with load connected.

A screen shot of a graph

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Noted rise time of 53.2 which is less compared to without load due to reduce in amplitude of output due to load.

1. Fall time with the load connected.

A screen shot of a graph

Description automatically generated

Observed fall time of 51.4ns which is higher than without load due to slow turning of NPN transistor.

1. Voltage across 50ohm resistor

A screen shot of a graph

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Voltage Amplitude of 1.6V read across 50ohm resistor and current drawn = V/R = 1.6/50 = 32mA.

1. Voltage across 300ohm resistor

A screen shot of a graph

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Voltage Amplitude of 1.8V read across 300ohm resistor and current drawn = V/R = 1.8/300 = 6mA

1. Voltage across 1K resistorA screen shot of a graph

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Voltage Amplitude of 1.8V read across 300ohm resistor and current drawn = V/R = 1.8/1K = 1.8mA.

1. Voltage across 10K resistor

A screen shot of a computer

Description automatically generated

Voltage Amplitude of 2V read across 10K resistor and current drawn = V/R = 2/10K = 0.2mA.

1. Thevenin Voltage

The voltage measured without load is 4.7V which is equal to Thevenin voltage, and the load voltage can be 3.8V from point 5. The Thevenin resistance RL = Rth (Vth – VL)/VL = 40.9(4.7-3.8)/3.8 = **9.7ohm.**

What all worked:

|  |  |  |
| --- | --- | --- |
| Parameters | Result | Remarks |
| Read 5V from power input test point. | Worked |  |
| Read 555 timer output signal with nearly 66% duty cycle and 500Hz frequency. | Worked |  |
| Observe dimness in load LEDs according to increase in load resistor values. | Worked |  |
| Draw current less than 200mA that NE555 supports. | Worked |  |
| Rist time and fall time closest to that mentioned in Datasheet. | Worked |  |

Mistakes:  
No errors seen in the board.

**Key learnings:**

* Switching noise depends on how fast IC switches.
* Benefit of adding decoupling capacitor to compensate sudden surge in current and avoid switching noise.
* How to use Altium software to create schematics, layout and BoM.
* Design board in modules so that can help in bring up and debugging.
* Importance of risk reduction in project development.