INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Introduction to Electronics Laboratory

School of Electrical Sciences

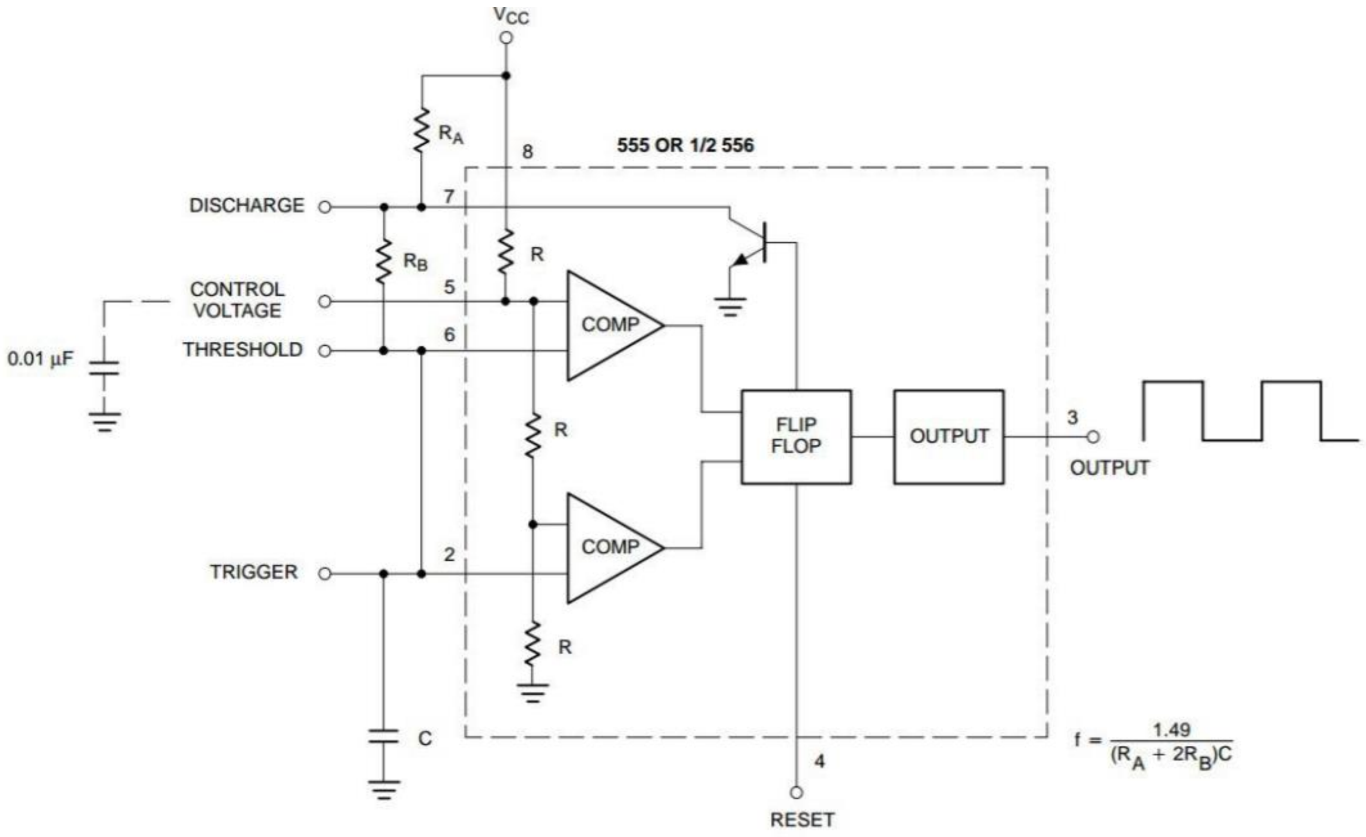
Name: Shorya Sharma
Roll Number: 19EE01017

Aim:

Design and simulate astable and monostable multivibrator using a 555 chip.

Theory:

ASTABLE MULTIVIBRATOR:



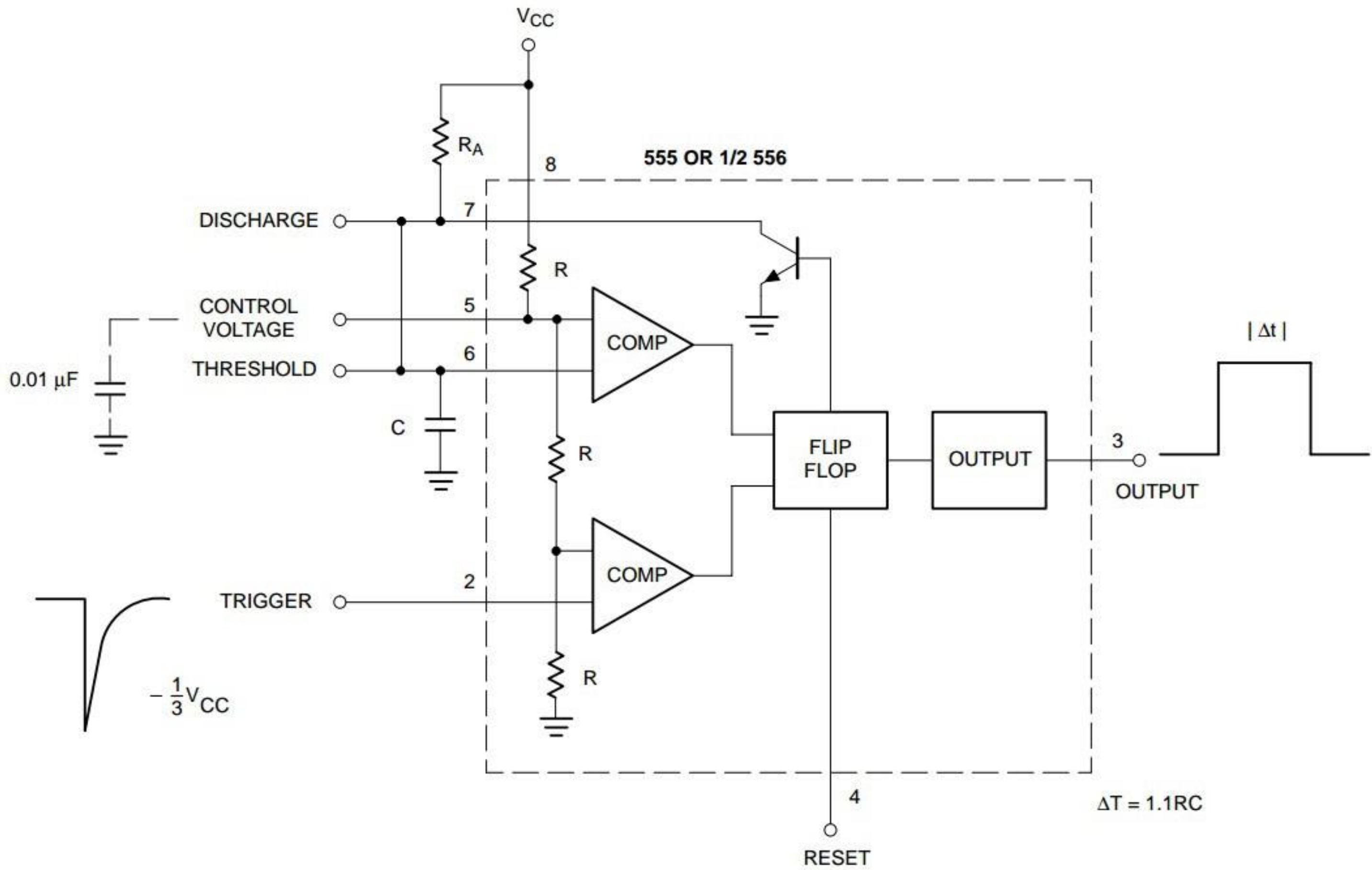
An astable multivibrator can be designed by adding two resistors (RA and RB in circuit diagram) and a capacitor (C in circuit diagram) to the 555 Timer IC. These two resistors and the capacitor (values) are selected appropriately so as to obtain the desired ‘ON’ and ‘OFF’ timings at the output terminal (pin 3). So basically, the ON and OFF time at the output (i.e the ‘HIGH’ and ‘LOW’ state at the output terminal) is dependent on the values chosen for RA, RB and C. Above figure shows an astable multivibrator.

The frequency ***f*** of the output waveform is 1.49 / ((RA+2RB) * C), this is the theoretical frequency.

The capacitor charging time Tc = 0.693(RA + RB)C and the capacitor discharging time is Td= 0.693*RB * C. The total time T =Tc + Td and f = 1/T.

The duty cycle can be calculated as:
Duty cycle = (On Time/Total time) = (RA + RB)/(RA + 2RB).

MONOSTABLE MULTIVIBRATOR:



The Monostable 555 Timer circuit triggers on a negative-going pulse applied to pin 2 and this trigger pulse must be much shorter than the output pulse width allowing time for the timing capacitor to charge and then discharge fully. Once triggered, the 555 Monostable will remain in this “HIGH” unstable output state

until the time period set up by the RA * C network has elapsed. The amount of time that the output voltage remains “HIGH” or at a logic “1” level, is given by the time constant equation ***ΔT***. This is called the on time.

ΔT=1.1*RA*C

555-TIMER DIAGRAM AS AN IC:

PIN CONFIGURATION

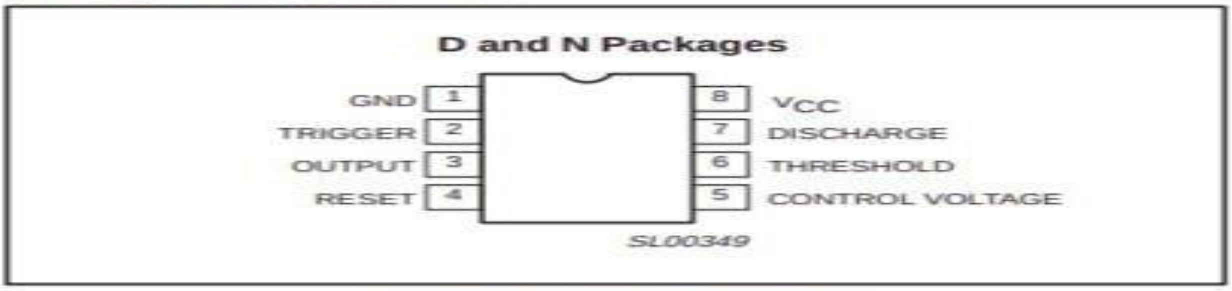


Figure 1. Pin configuration

BLOCK DIAGRAM

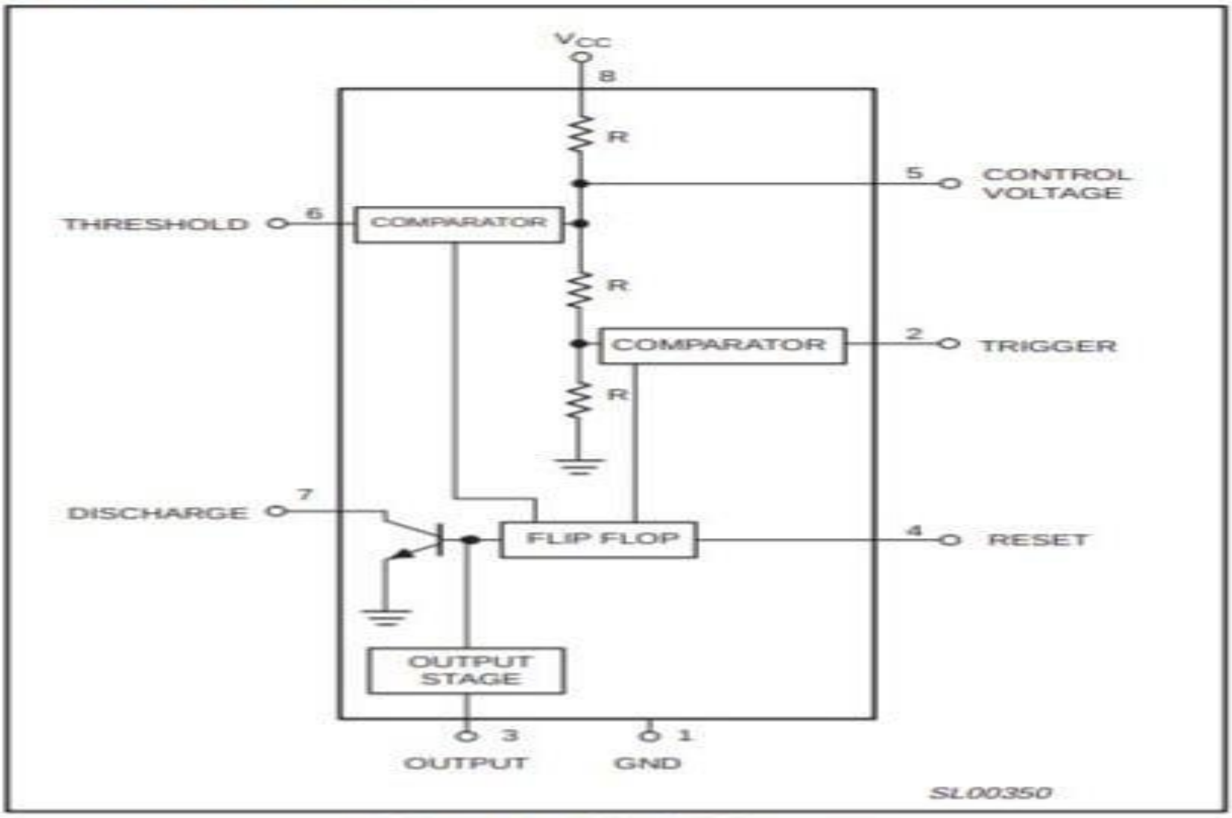


Figure 2. Block Diagram

Design Specifications:

For 19EE01017:

Parameter	Value
ΔT for Monostable operation	(X +Y) µs = **8 µs**
'f' for Astable operation	(X +Y) KHz = **8 KHz**

Design methodology:

For astable multivibrator:

$$f = \frac{1.44}{(Ra+2Rb) \times C}$$

Given **f = 8KHz**

Taking R_A = **3 KΩ** and R_B **= 5 KΩ**
We obtain **C = 13.8461 nF**

For Monostable multivibrator:

$$\Delta T = 1.1 \times Ra \times C$$

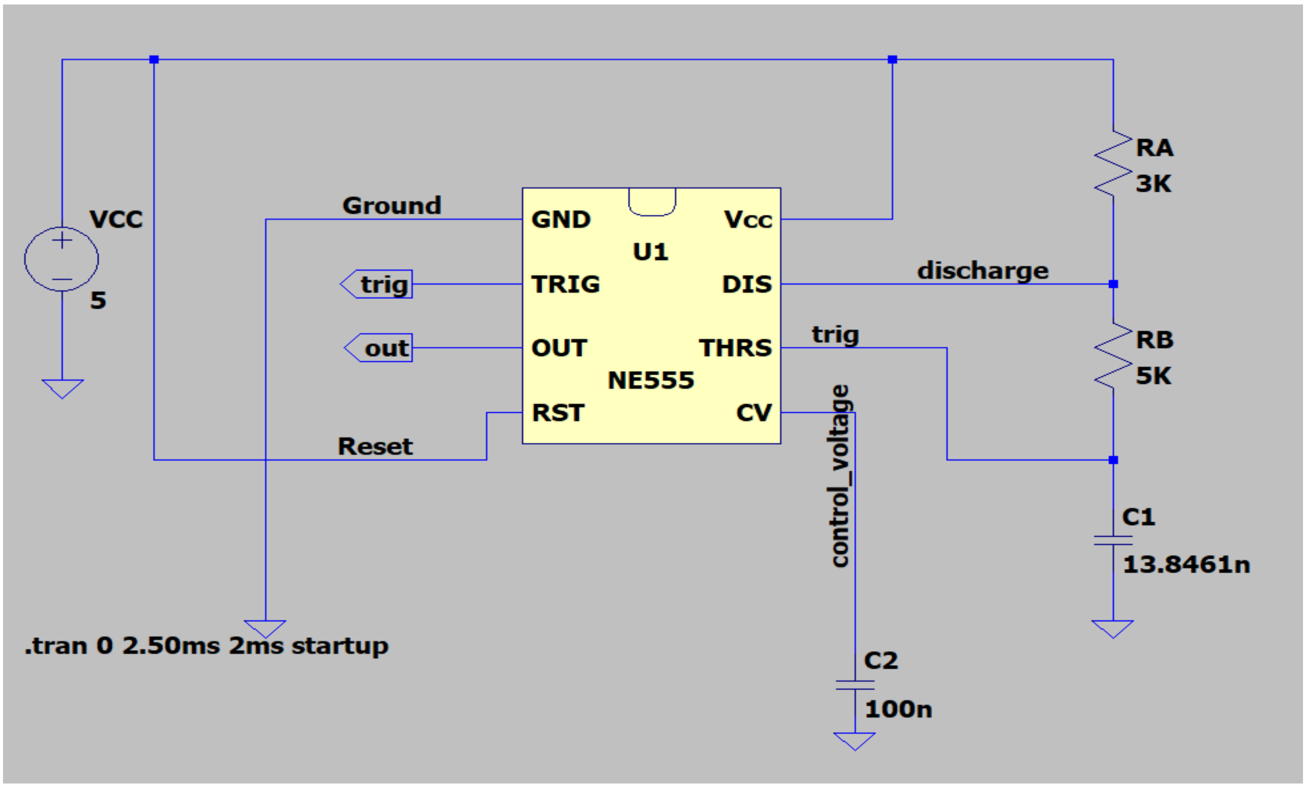
Given **ΔT = 8 µsecond**

Taking R_A**= 4 KΩ**

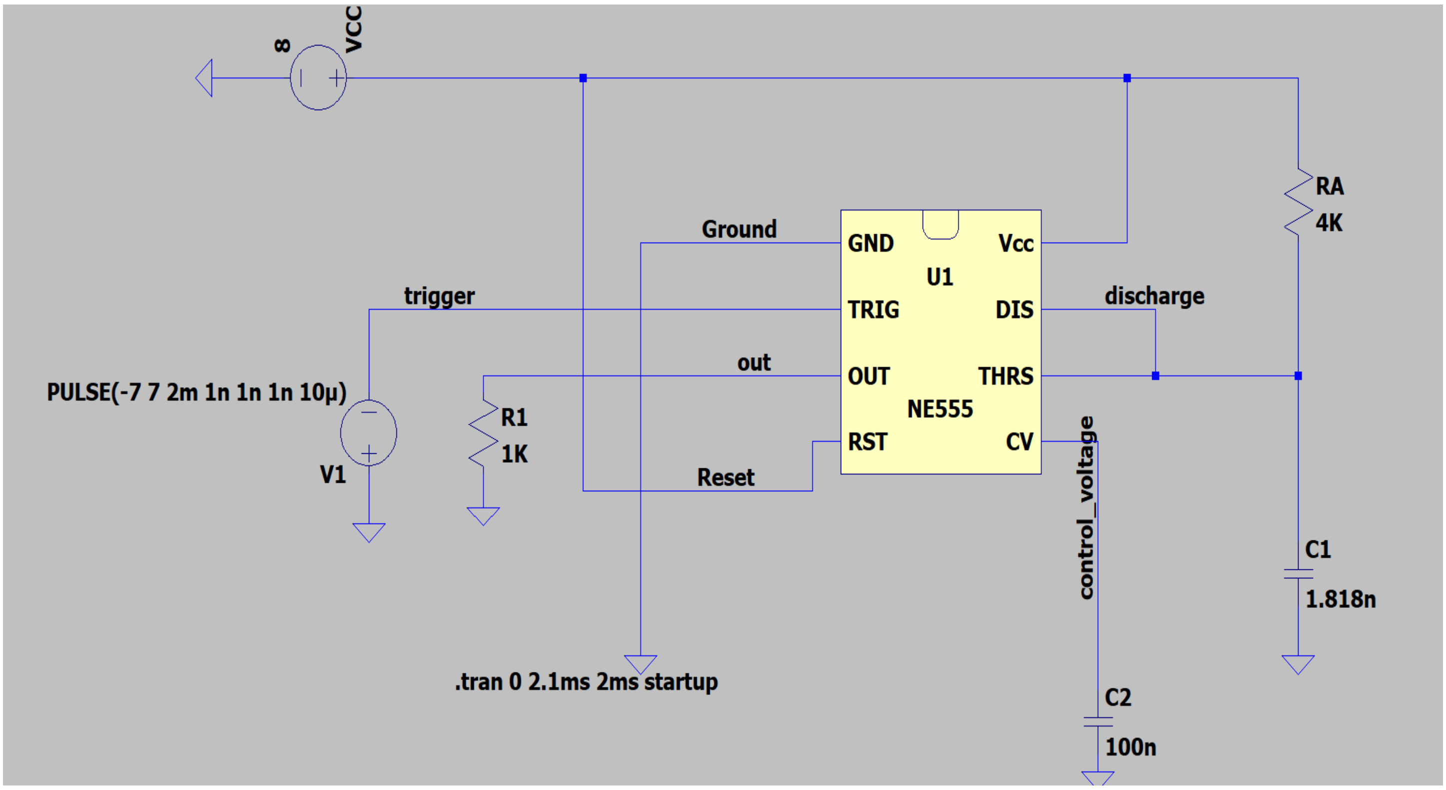
C = 1.818 nF

Circuit Diagrams:

For astable multivibrator:

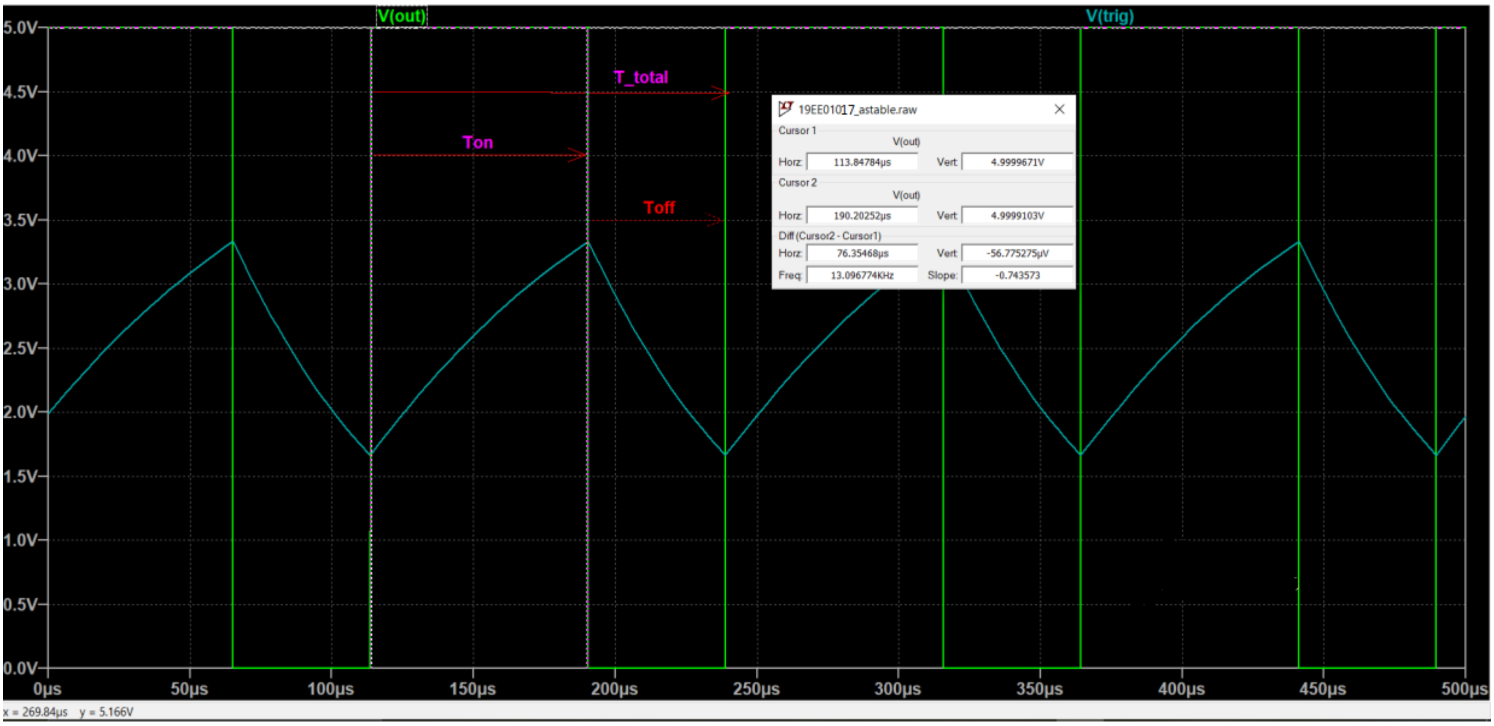


For Monostable multivibrator:



Observations and results:

For astable multivibrator:



T_{ON} = 76.35 microseconds

T_{OFF} = 48.440066μs

T_{Total} = 124.79475μs and Frequency = 8.01 KHz

Duty cycle (From observed values) = $T_{on}/T_{Total} = \frac{76.35\mu s}{124.79475\mu s}$ = 61.18 %

Duty cycle (from resistor values) = $\frac{((RA+RB))}{((RA+2\times RB))\times 100}$ = 3+5/3+10 = 61.53 %

Frequency (from resistor values) = 8KHz

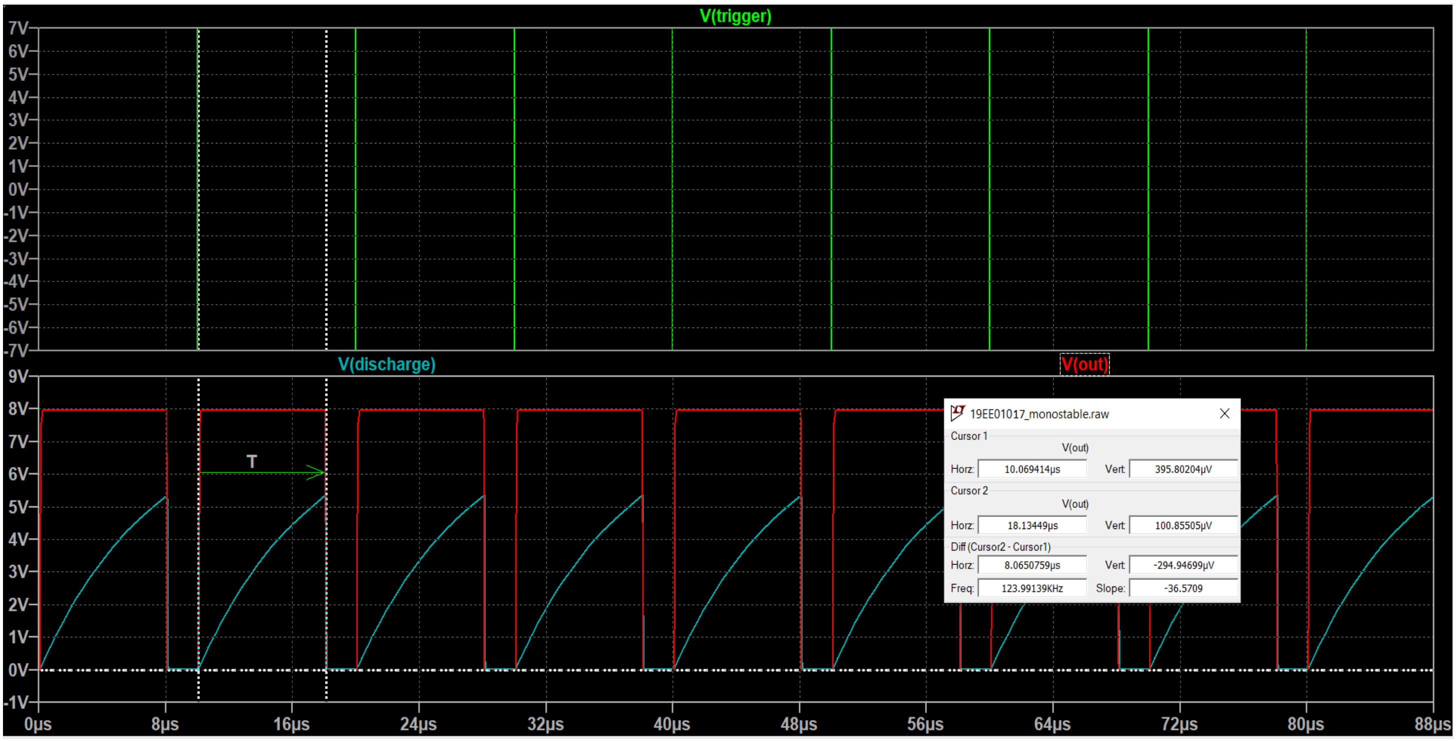
Frequency (observed) = 8.01 KHz

On and Off time (calculated) = $0.693 \times (RA+RB) \times C$ *and* $0.693 \times RB \times C$

= 76.76 microseconds and 47.97 microseconds

For monostable multivibrator:

ΔT = 8.06 microseconds. Trigger impulse = 7 V



Discussions:

Multivibrators are sequential logic circuits that operate continuously between two distinct states of HIGH and LOW. A *multivibrator* circuit oscillates between a “HIGH” state and a “LOW” state producing a continuous output. Astable multivibrators generally have an even 50% duty cycle, that is that 50% of the cycle time the output is “HIGH” and the remaining 50% of the cycle time the output is “OFF”. In other words, the duty cycle for an astable timing pulse is 1:1.

The two above discussed Multivibrators include:

- **Astable** – A *free-running multivibrator* that has NO stable states but switches continuously between two states this action produces a train of square wave pulses at a fixed known frequency.
- **Monostable** – A *one-shot multivibrator* that has only ONE stable state as once externally triggered it returns back to its first stable state.

These multivibrator circuits can be easily designed using different combinations of simple logic gates like NAND, OR, XOR etc.

Conclusions:

Through this experiment we learnt about constructing two typical configurations of multivibrator circuits based on some initial criterion: Astable and monostable; both of which have various applications in the field of Electrical and electronic usages.

The monostable multivibrator is used as delay and timing circuits. It is also used for temporary memories. It is often used to trigger another pulse generator. It is used for regenerating old and worn out pulses.

The applications of Astable multivibrators involve in radio gears to transmit and receive radio signals and also in time, morse code generators and some systems which require a square wave like analog integrated circuits and TV broadcasts.