The Electron's Path: Fundamental of EEE (ECE1001-Lab.)

Experiment 4 **Multivibrator using IC555** **Monsoon 2025**

An extremely adaptable integrated circuit, the 555 timer is used in a wide range of electronic devices. Its ability to produce an oscillating waveform for many purposes allow it to be utilised as three different kinds of oscillators.

- The IC-555 operates as a precision timer with a preset duration while in its monostable mode. Applications needing exact timing, like delay circuits or pulse generators, frequently use monostable oscillators.
- When connected in bistable mode, it switches like a flip-flop. Applications requiring a steady on/off status, like toggling an output or memory storage, can benefit from this setup.
- The 555 timer IC should be set up in Astable mode to produce an oscillator circuit that is extremely steady. A highly accurate, free-running waveform is produced by this setup. Applications including tone creation, pulse-width modulation, and clock generation also frequently use it.

IC555 is an 8 pin DIP (Dual in Package) IC as shown in fig.1.

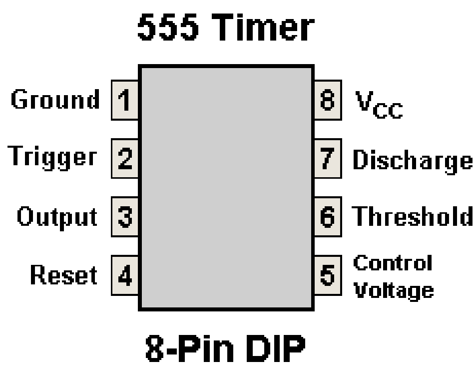

Fig. 1(a) Pin Connection of IC555 Timer

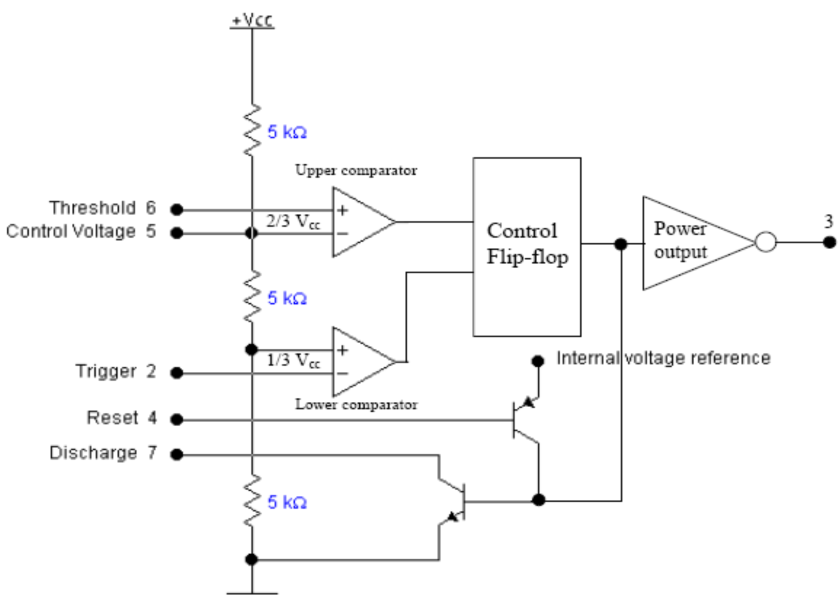

Fig. 1(b) Internal diagram of of IC555 Timer

<u>**A. Astable Multivibrator**</u>

The circuit of an Astable multivibrator is shown in **Fig. 2**. The selection of R_1, R_2 and C is important to form the wave. The capacitor 'C' undergoes charging through series combination of R_1 & R_2 and when the voltage across the capacitor reaches 2/3 of the supply voltage Vcc, pin 6 detects this condition and turns the output OFF. Hence charging time is

$$\boldsymbol{\tau_c} = 0.693\ (\boldsymbol{R_1} + \boldsymbol{R_2})\ C$$

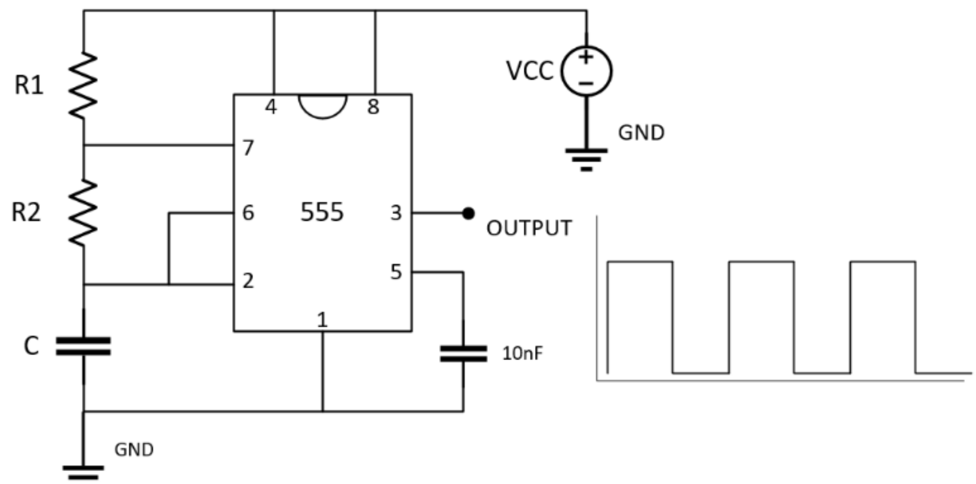

Fig. 2 Astable Multivibrator

When the output goes OFF, pin 7 switches ON and the capacitor discharges through R2, hence discharging time is

$$\boldsymbol{\tau_d} = 0.693\ (\boldsymbol{R_2})\ C$$

Now, as the voltage across the capacitor drops to 1/3 of Vcc, pin 2 detects it and turns OFF pin 7, allowing the capacitor to start charging again. This completes the on/off cycle. This continuous charging and discharging of a capacitor give the rectangular waveform of period

$$\boldsymbol{T} = \boldsymbol{\tau_c} + \boldsymbol{\tau_d} = T_H + T_L = 0.693\ (\boldsymbol{R_1} + \boldsymbol{2\ R_2})\ C$$

The frequency of waveform will be $\boldsymbol{f = 1 / T = 1.44 / [\,(R_1 + 2\ R_2)\ C\,]}$

Duty cycle is the ratio of time for which the output is HIGH to the total time and is given by

$$DC = \boldsymbol{T_H/T * 100} = [(\boldsymbol{R_1} + \boldsymbol{R_2}) / (\boldsymbol{R_1} + \boldsymbol{2\ R_2})]*100$$

Procedure:

1. Build the circuit of Fig. 2 on bread board. Use general purpose IC-555 Timer. Connect a ceramic capacitor of value 0.01 µF at Pin5 (control pin). Apply the DC voltage ***6V*** from the DC voltage source to Pin 8 (Vcc) & Pin4 (reset).

2. Set up the Timer 555 with $\boldsymbol{R_1}$ = 47.00kΩ, ***R2*** = 47.0kΩ, and ***C*** = 10µF. Connect an LED with series resistor of 330 Ohm at output Pin 3 and ground. Connect the Ch-1 of DSO to Pin3 (output) and connect Ch-2 of DSO across the capacitor 'C' (between Pin6 & Pin1). Display the waveforms on the DSO. For the best view, set the DSO in time roll mode (*press Horiz/ select mode*). Measure the **peak-to-peak** voltage as well as the **pulse ON and OFF time** of output signal at Ch-1. Measure the **charging and discharging** time of capacitor as well as **peak to peak** voltage across capacitor 'C' at Ch-2.

3. Repeat step 2 for C = 22µF. Tabulate the peak-to-peak voltage, charging/ discharging time against the theoretically expected values. Record the waveforms and observe the LED.

Observation Table 1

V_{CC} =………V

	Measured o/p Pulse Pin3				*Measured across Capacitor*			*Theoretical o/p Pulse Pin3*				**Theoretical across Capacitor**		
C	T_H	T_L	T	Vpp	Dis charging time τ_d	Charging Time τ_c	Vc=Vmax-Vmin	T_H	T_L	T	Vpp	Dis charging time τ_d	Charging Time τ_c	Vc=Vmax - Vmin
10 µF														
22 µF														

B. Monostable Multivibrator

The output of the monostable multivibrator using 555 timer remains in its stable state until it gets a trigger. In monostable 555 multivibrator, when both the resistor and capacitor are shorted then this state is called as a stable state. When the voltage goes below at the second pin of the 555 IC, the o/p becomes high. This high state is called quasi stable state. When the circuit activates then the transition from a stable state to quasi stable state. Then the discharge transistor is cut off and capacitor starts charging to VCC. The capacitor charging is done via the resistor R_1 with a time constant R_1C_1. Hence, the voltage of the capacitor increases and finally exceeds 2/3 Vcc, it will change the internal control flip flop, thereby turning off the 555 timer IC. Thus, the o/p goes back to its stable state from an unstable state.

The o/p stays in a low state until it gets a trigger i/p. This type of operation is used in push-to-operate systems. When the input is triggered, then the o/p will go to high state & comes back to its original state.

$$\tau_c = 1.1\, R_1\, C$$

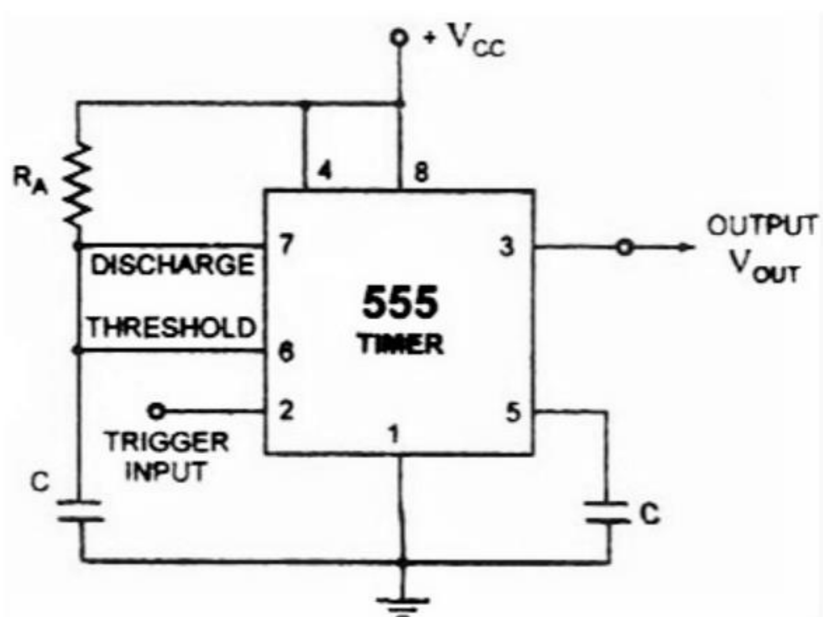

Fig. 3 Monostable Multivibrator

Procedure:

1. Build the circuit of Fig. 3 on bread board. Use general purpose IC-555 Timer. Connect a ceramic capacitor of value 0.01 µF at Pin5 (control pin). Apply the DC voltage ***6V*** from the DC voltage source to Pin 8 (Vcc) &

Pin4 (reset). Connect a wire to PIN 2(Trigger).

2. Set up the Timer 555 with ***R1*** = 47.00kΩ, and ***C*** = 100μF. Connect an LED and series resistor of 330 Ohm at output Pin 3 and ground. Connect the Ch-1 of DSO to Pin3 (output) and connect Ch-2 of DSO across the capacitor 'C' (between Pin6 & Pin1). Display the waveforms on the DSO. For the best view, set the DSO in time roll mode (*press Horiz/ select mode*). Touch the trigger wire and observe LED. Measure the **peak-to-peak** voltage as well as the **pulse ON and OFF time** of output signal (Pin3) at Ch-1. Measure the **charging and discharging** time of capacitor as well as **peak to peak** voltage across capacitor 'C' at Ch-2.
3. Repeat step 2 for ***C*** = 10μF. Tabulate the peak-to-peak voltage, charging/ discharging time against the theoretically expected values. Record the waveforms and observe the LED.

Observation Table 2 **V_{CC} =.........V**

	Measured o/p Pulse Pin3				***Measured across Capacitor***			***Theoretical o/p Pulse Pin3***				**Theoretical across Capacitor**		
C	T_H	T_L	T	Vpp	Dis charging time τ_d	Charging Time τ_c	Vc=Vmax-Vmin	T_H	T_L	T	Vpp	Dis charging time τ_d	Charging Time τ_c	Vc=Vmax - Vmin
100μF														
10 μF														

4. Repeat step 3 with triggered input. In this step connect the **wavegen to trigger Pin2**. Apply **square waveform** of 1Hz, 1Vpp, duty cycle of 80%, offset=0V to trigger Pin2. Record the Trigger waveform (connect DSO Ch-2 at Pin 2) and o/p waveform (DSO Ch-1 at Pin 3) as well as observe the LED.

Results:

Conclusion: It must be in your words and be based on your understanding/ learning in the experiment.