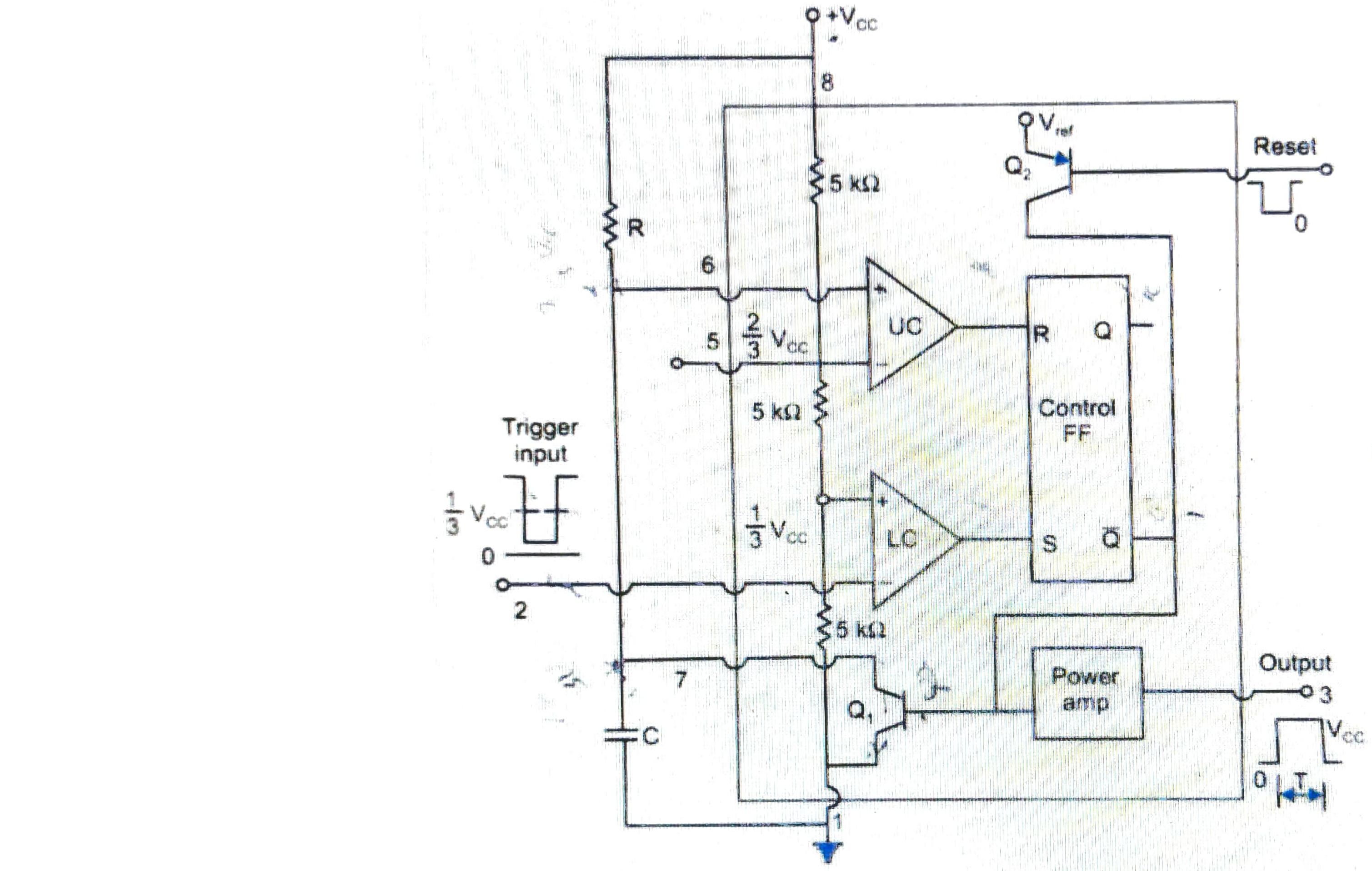
Functional diagram of Monostable operation of 555



Pulse Width Calculation

$1\,MHz$

$R_a = 1K\Omega,\; C = 1nF$

$T \simeq 1\mu s$

$f = \frac{1}{T} = 1MHz$

The voltage across the capacitor is,

$$v_c = V_f + (V_i - V_f)e^{-t/R_1C_1}$$

$V_f = +V_{CC}$, $V_i = 0$ V, and the capacitor is charging t

$$\frac{2}{3}V_{CC} = V_{CC} - V_{CC}e^{-t/R_1C_1}$$

$$\frac{2}{3} = 1 - e^{-t/R_1C_1}$$

$$e^{-t/R_1C_1} = 1$$

$$-t/R_1C_1 = \ln\left(\frac{1}{3}\right) = -1.098$$

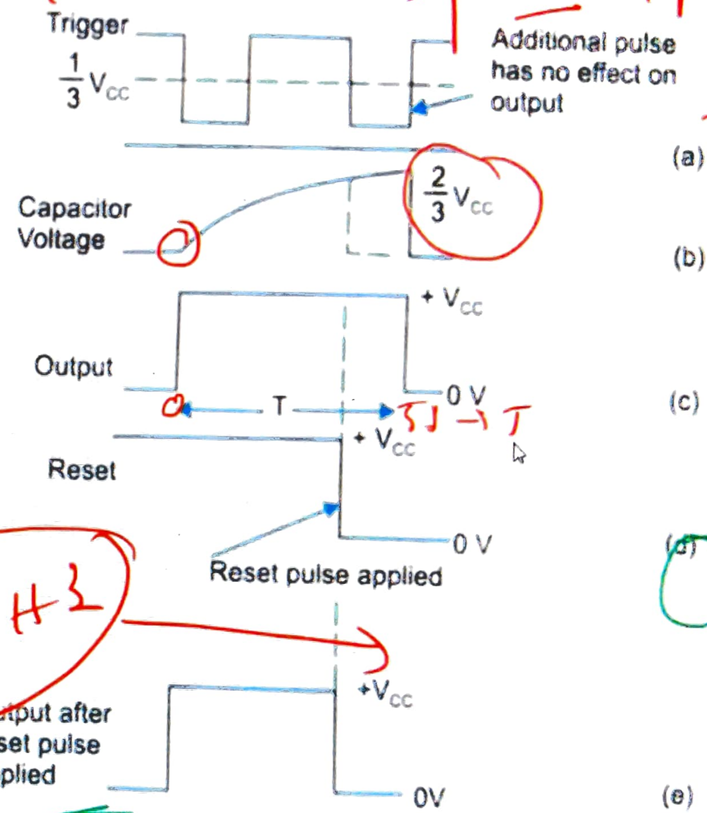
$\cancel{t = 1.1}$

$f = 1KHz$

$T = 1ms$

$1K\Omega,\; C = 1MF$

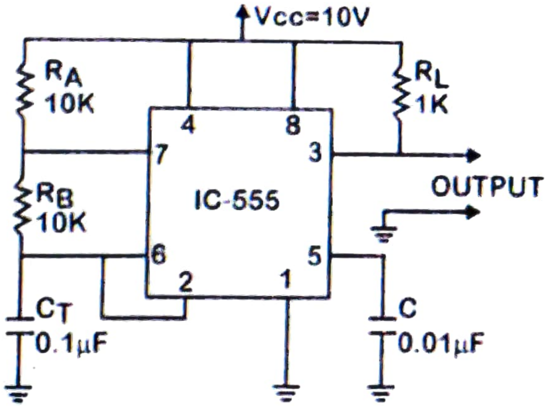
$$\boxed{T = 1.1\,R_aC}$$



- The 555 can operate as
  - Mono/bi-stable
  - Astable mode

  depending on the external components
- It produce
  - a single pulse when triggered, or
  - it can produce a continuous pulse train as long as it remains powered.

- The key external component of the astable timer is the capacitor
- The astable function is achieved by charging/discharging a capacitor through resistors connected, respectively, either to V_{CC} or GND.



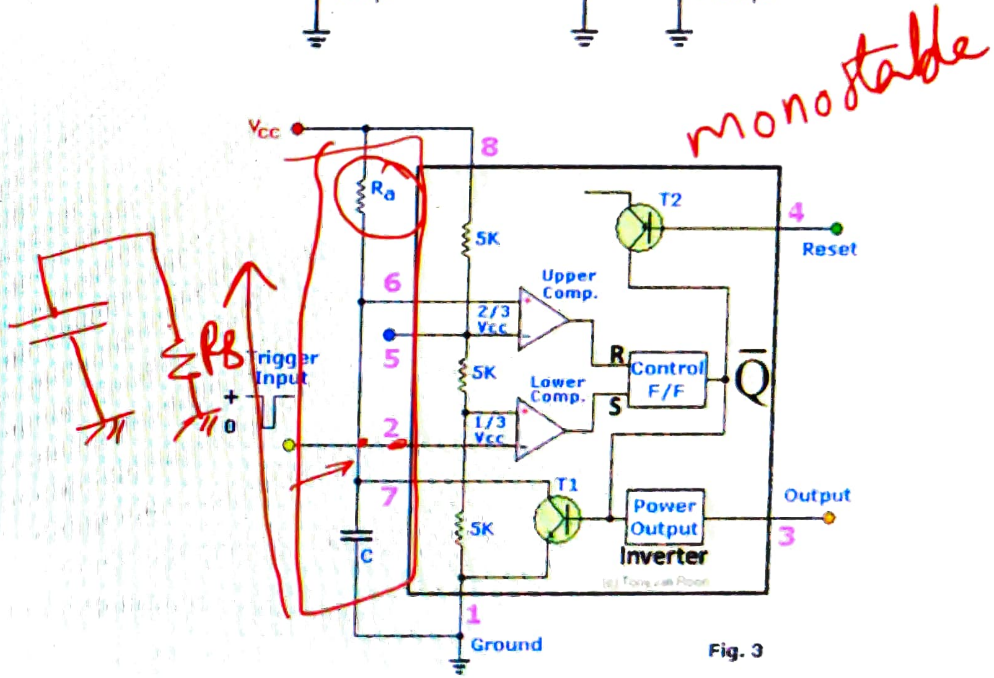
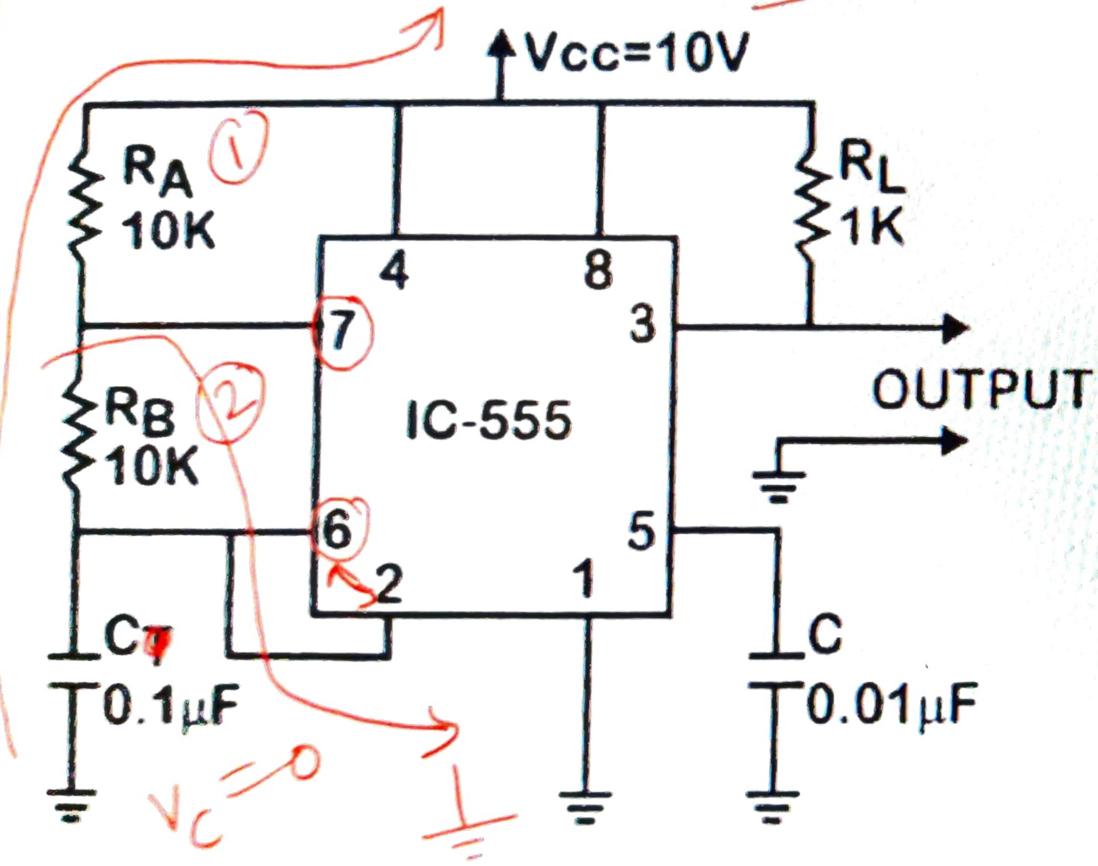
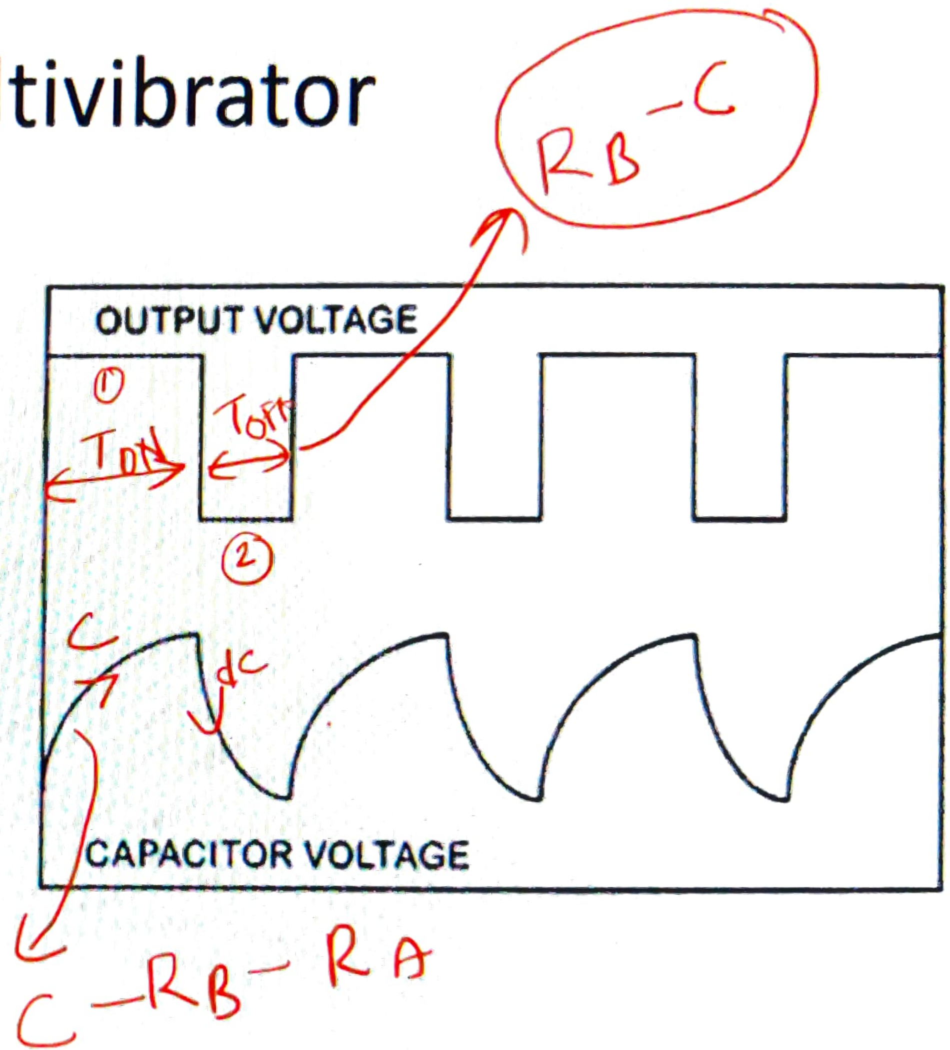


Fig. 3

Astable multivibrator

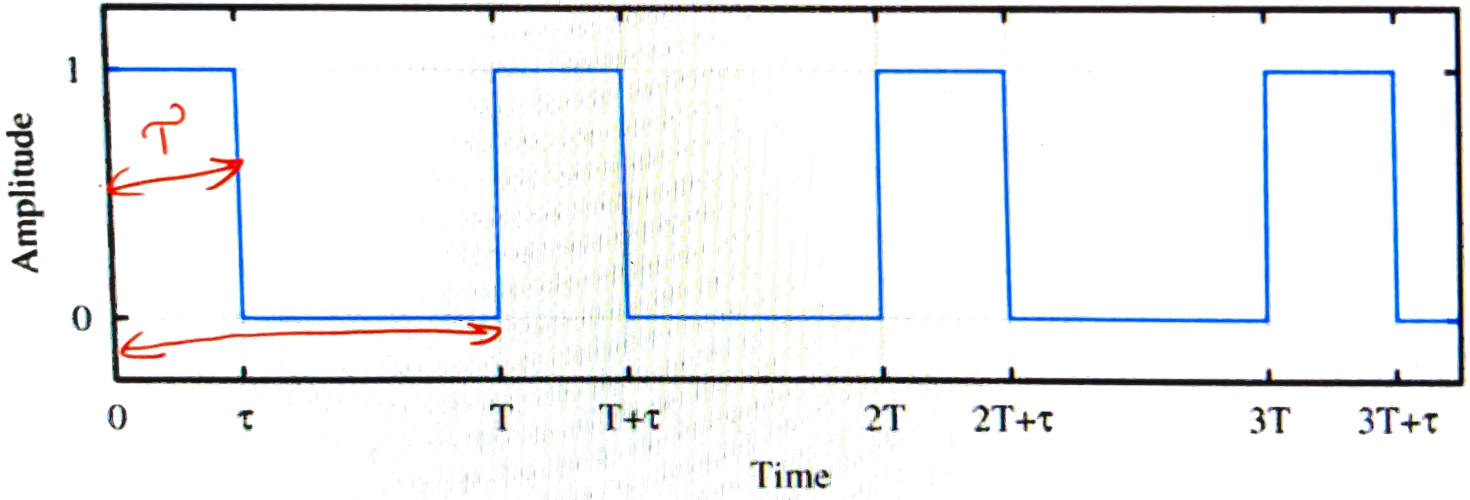




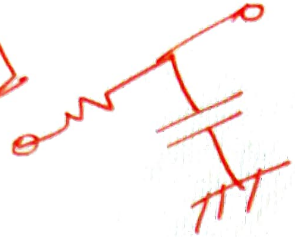
Rectangular waveform

$\delta = \frac{\tau}{T} \times 100\%$

- Referring to the above figure of a rectangular waveform, the time period of the pulse is defined as T and duration of the pulse (ON time) is τ.
- Duty cycle can be defined as the On time/Period that is, τ/T in the above figure. Obviously, a duty cycle of 50% will yield a square wave.



$\boxed{\tau = RC}$



$\frac{1}{3}V_{cc} \rightarrow \frac{2}{3}V_{cc}$

T_{ON} $T = T_{ON} + T_{OFF}$

$\delta = \frac{T_{ON}}{T} \times 100$

The time for charging C from 1/3 to 2/3 Vcc, i.e, **ON Time = 0.693 (R_A + R_B). C**

The time for discharging C from 2/3 Vcc to 1/3 Vcc, i.e. **OFF Time = 0.693 R_B. C**

To get the total oscillation period, just add the two: T_{OFF}

$$T_{osc} = 0.693 \cdot (R_A + R_B) \cdot C + 0.693 \cdot (R_B) \cdot C = 0.693 \cdot (R_A + 2 \cdot R_B) \cdot C$$

Thus,

$$f_{osc} = 1/T_{osc} = 1.44/(R_A + 2 \cdot R_B).C$$

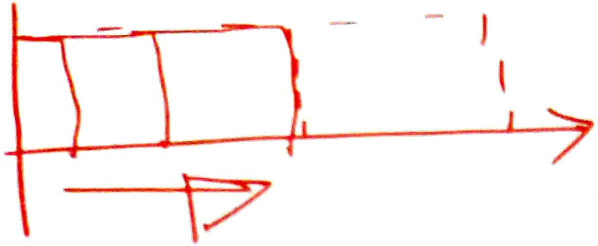
$$\text{Duty cycle} = \cancel{R_A + R_B / R_A + 2 \cdot R_B}$$

$$f = \frac{1.44}{(R_A + 2R_B)C}$$

$$\delta = \frac{R_A + R_B}{R_A + 2R_B}$$

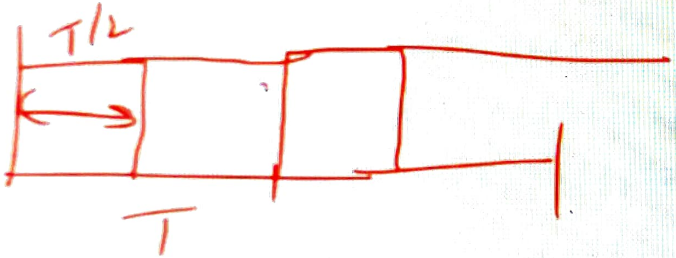
Astable MV

- R1 = 1 k, R2 = 2k, C = 10 μF.
- Calculate duty cycle
- Frequency



Astable MV

- R1 = 1 k, R2 = 2k, C = 10 μF.
- Calculate duty cycle → δ
- Frequency → f



SCR

$T_{ON} =$

$T_{OFF} =$

$\delta =$

$f =$