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Analog lab

Exp - I

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I. expression for amplitude of V_m :-

The comparator switches its state when voltage at +ve terminal of it is greater than V_{cm}.

∴ the ratio $\frac{R_2}{R_3}$ controls the voltage swing of V_{ramp}.

→ for voltage divider;

let's say $V_{cm}+V_m/2$ is the max V_{ramp} attains & $V_{cm}-V_m/2$ is the min V_{ramp} reaches.

$$V_{ramp} = V_{cm} \pm \left(\frac{R_2}{R_3}\right) V_{cm}$$

Hence, Peak to peak amplitude of V_m is:-

$$\boxed{V_m = 2\left(\frac{R_2}{R_3}\right) V_{cm}}$$

II Deriving the oscillation Freq F_{sw}:-

→ Freq. depends on current thru the capacitor.

From,

$$I = \frac{V_{SAR} - V_{cm}}{R_1}$$

$$= C_1 \frac{dV_{ramp}}{dt}$$

$$\therefore \frac{dV_{ramp}}{dt} = \frac{V_{SAR} - V_{cm}}{R_1 C_1}$$

Integrating ... & time period is $\frac{T_{sw}}{2}$.

(∵ ramp switches at every $T_{sw}/2$)

$$V_m = \left(\frac{V_{SAR} - V_{cm}}{R_1 C_1}\right) \times \frac{T_{sw}}{2}$$

$$T_{sw} = \frac{2 R_1 C_1 V_m}{V_{SAR} - V_{cm}} \quad \left(\because V_m = 2\left(\frac{R_2}{R_3}\right) \cdot V_{cm}\right)$$

$$T_{sw} = \frac{4 R_1 C_1 V_{cm} \left(\frac{R_2}{R_3}\right)}{V_{SAR} - V_{cm}}$$

If $V_{SAR} = V_{DD}$ & $V_{cm} = \frac{V_{DD}}{2}$

$$T_{sw} = \frac{4 R_1 R_2 C_1}{R_3}$$

$$F_{sw} = \frac{1}{T_{sw}} = \frac{R_3}{4 R_1 R_2 C_1}$$

Values used:-

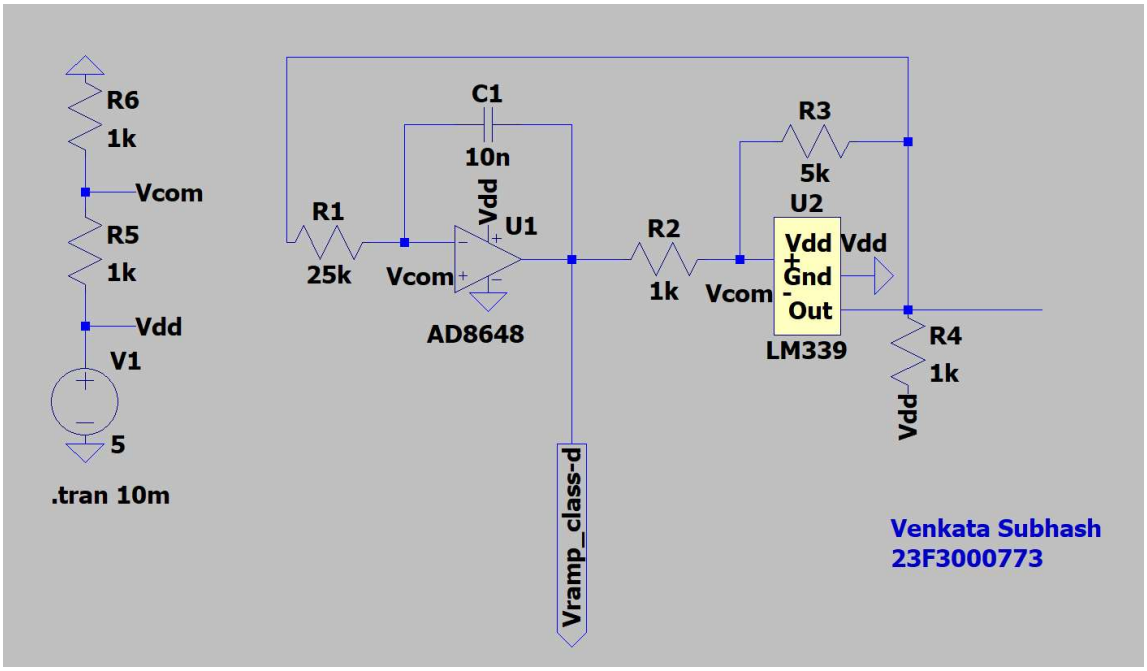
R1- 25K

R2- 1K

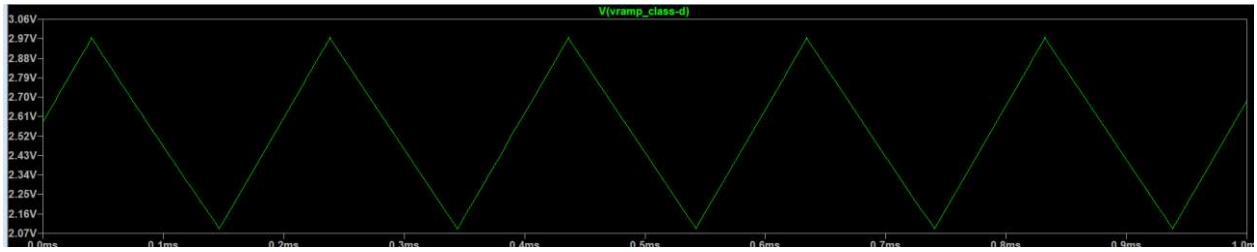
R3- 5K

C1- 10nF

LT spice Circuit:-



MCP 6004 output (Ramp):- (Amplitude = 0.5v)



LM 339 output (square) :-