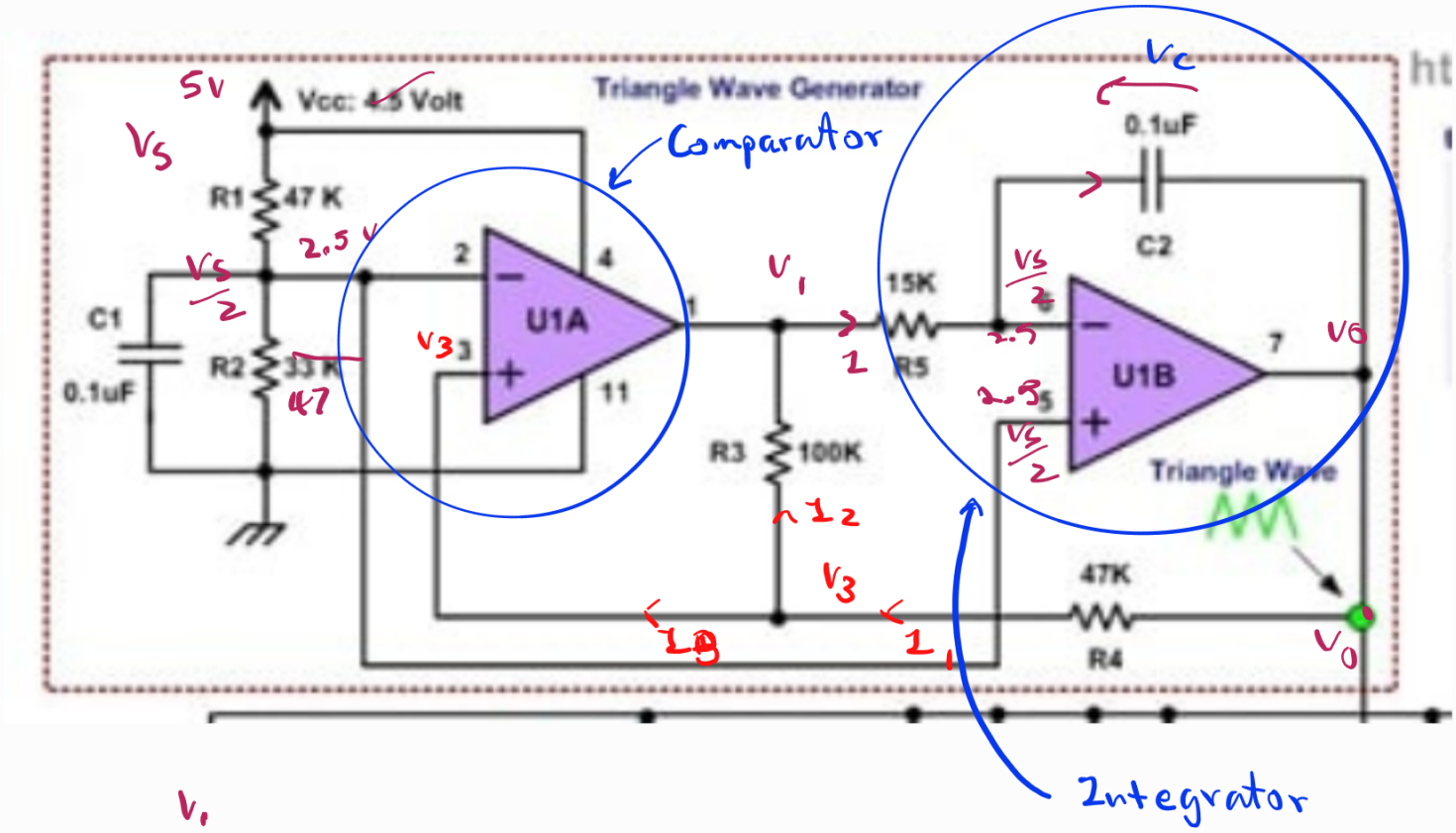


V_1

$V_1 - V_0$ { R_3, V_3, R_4, V_0

$$V_3 = \frac{R_4}{(R_3+R_4)} (V_1 - V_0)$$

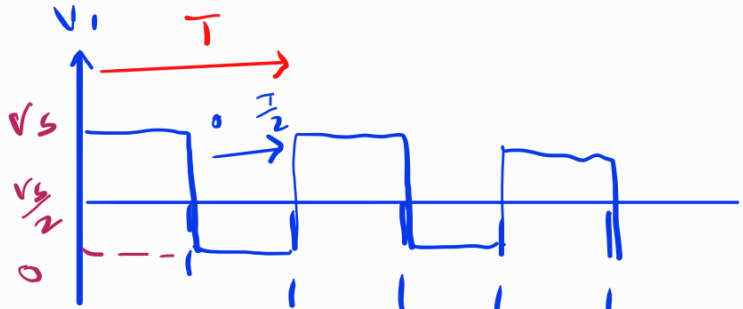
$$V_1 = A(V_3 - 2.5) = \begin{cases} V_{max} ; & V_3 > \frac{V_s}{2} \\ V_{min} ; & V_3 < \frac{V_s}{2} \end{cases}$$

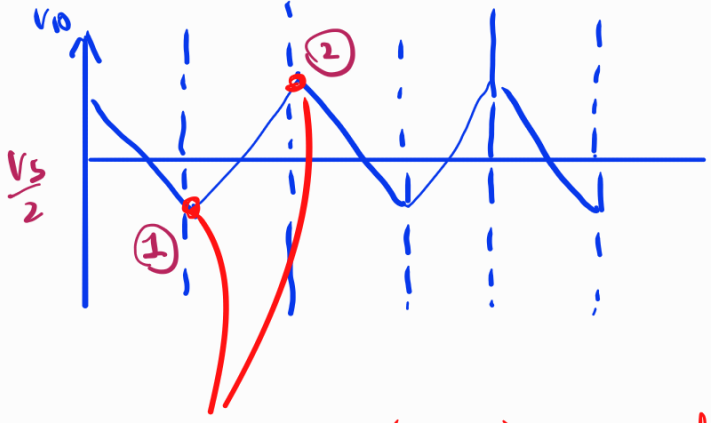
$$i(t) = C \frac{d(V(t))}{dt}$$

Integrator

$V_{max} \rightarrow$ − Ramp

$V_{min} \rightarrow$ + Ramp





In these points, if we calibrate $V_3 =$ after that V_3 can be higher or lower than Then comparator will be saturate according to that value.

Node at V_3

$$I_1 = I_2 + I_B \approx 0$$

$$I_1 = I_2$$

$$\frac{V_o - V_3}{R_4} = \frac{V_3 - V_1}{R_3}$$

for point ①

In just before moment

$$V_1 = V_s \qquad V_3 = \frac{V_s}{2}$$

$$\frac{V_o - \frac{V_s}{2}}{R_4} = \frac{\frac{V_s}{2} - V_s}{R_3}$$

$$V_o = \frac{R_4}{R_3}\left(-\frac{V_s}{2}\right) + \frac{V_s}{2}$$

for point ②

just befor switching

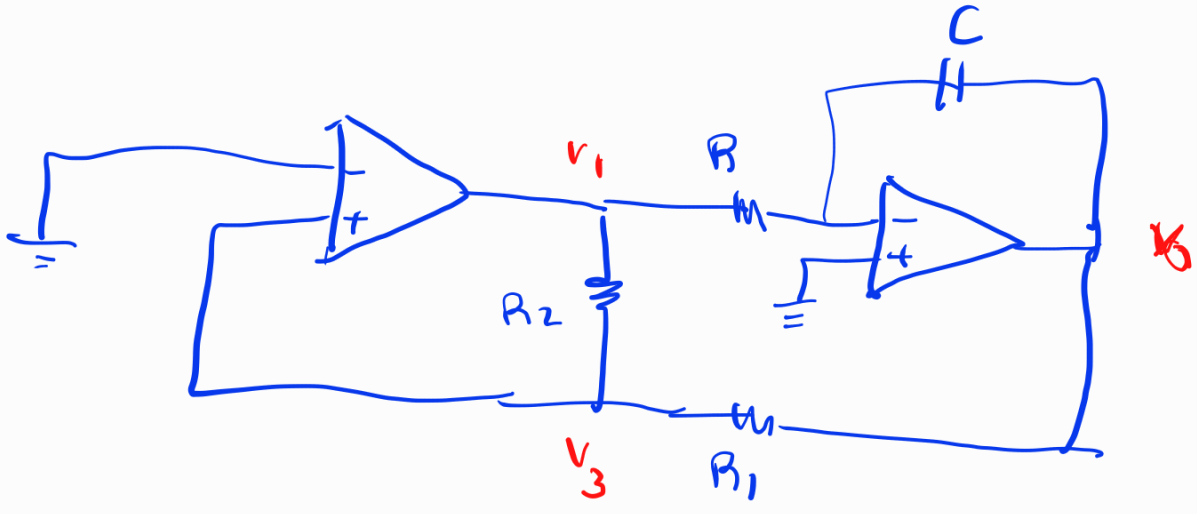
$$V_1 = 0 \qquad V_3 = \frac{V_s}{2}$$

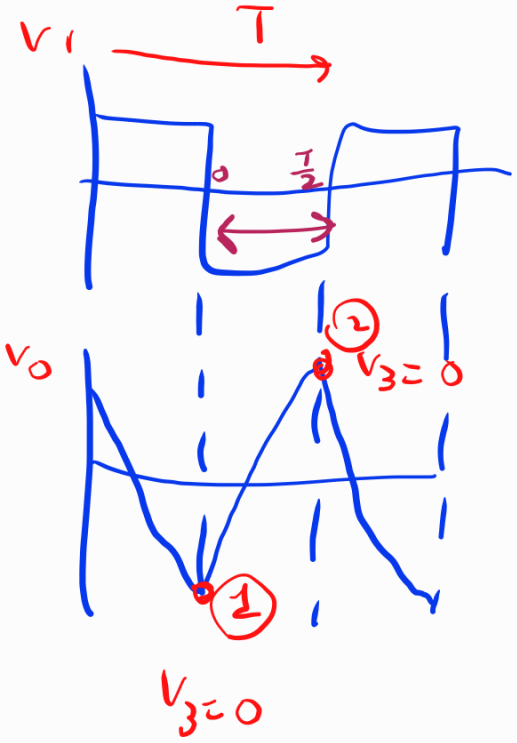
$$\frac{V_o - \frac{V_s}{2}}{R_4} = \frac{\frac{V_s}{2} - 0}{R_3}$$

$$V_o = \frac{R_4}{R_3}\left(\frac{V_s}{2}\right) + \frac{V_s}{2}$$

$$V_{o_{p-p}} = \frac{R_4}{R_3} V_s$$

For integrator circuit





$$\frac{V_0 - V_3}{R_1} = \frac{V_3 - V_1}{R_2}$$

at ①

$$\frac{V_0}{R_1} = \frac{-V}{R_2}$$

$$V_0 = -\frac{R_1}{R_2} V$$

②

$$\frac{V_0}{R_1} = \frac{V}{R_2}$$

$$V_0 = \frac{R_1}{R_2} V$$

$$V_{O_{pk-pk}} = \frac{2R_1 V}{R_2}$$

$$V_C = \frac{1}{RC}\int V_{i-0}\, dt$$

$$0 - V_O = \frac{1}{RC}\int V_i\, dt$$

$$V_O = -\frac{1}{RC}\int V_i\, dt$$

$$V_{O_{pk-pk}} = -\frac{1}{RC}\int_0^{\frac{T}{2}} -V\, dt$$

$$\frac{2R_1 V}{R_2} = 4\frac{V}{RC}\frac{T}{2}$$

$$T = \frac{4R_1RC}{R_2}$$

$$\boxed{f = \frac{R_2}{4R_1RC}}$$

$$\frac{100\,k}{4(47k)(15k)(0.1\mu)}$$

$$\frac{100}{4\times 47\times 15\times 0.1}\ h$$

$$= 354.6$$

$$T = 2.8\ ms$$

$$\approx 3\ ms$$