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Section 13

Assignment 04

CSE350

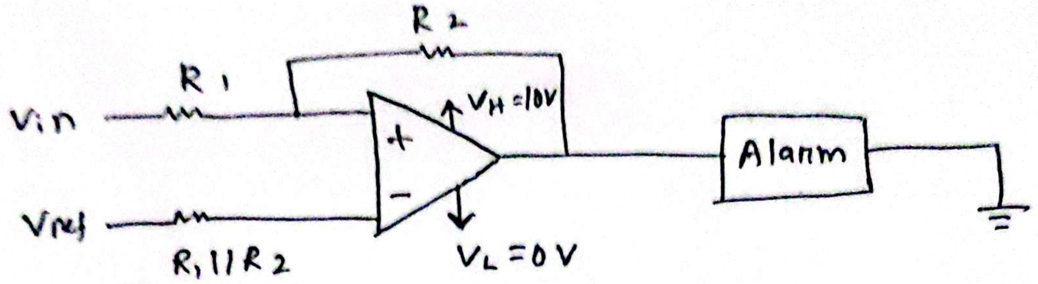
①

a)

The complete circuit of smoke detection and alarm system.

$V_H = 10V$

$V_L = 0V$



b)

Here,

for 100% opacity change $\Delta V = 10V$

for 1% " " $\Delta V = \frac{10}{100} = 0.1V$

$0.1V = 1\%$ opacity

$\therefore$ 95% opacity $\rightarrow 9.5V$

$$V_{UT} = -\frac{R_1}{R_2} V_L + \frac{R_1+R_2}{R_2} \cdot V_{ref}$$

$$\Rightarrow 9.5 = -\frac{R_1}{R_2} \times 0 + \frac{R_1+R_2}{R_2} \times V_{ref}$$

$$\Rightarrow 9.5 = 0 + \left(1+\frac{R_1}{R_2}\right) V_{ref} \quad \cdots (i)$$

$$V_{TL} = -\frac{R_1}{R_2} V_H + \frac{R_1+R_2}{R_2} V_{ref}$$

$$\Rightarrow 0.5 = -\frac{R_1}{R_2} \times 10 + \left(1+\frac{R_1}{R_2}\right) V_{ref} \quad \cdots (ii)$$

(i) − (ii) :

$$9.5 - 0.5 = \left(1 + \frac{R_1}{R_2}\right)V_{ref} + \frac{R_1}{R_2} \times 10 - \left(1 + \frac{R_1}{R_2}\right)V_{ref}$$

$$\Rightarrow 9 = \frac{R_1}{R_2} \times 10$$

$$\Rightarrow \frac{R_1}{R_2} = \frac{9}{10}$$

$\therefore R_1 = 9\,k\Omega$

$\therefore R_2 = 10\,k\Omega$

Putting the values of R_1 and R_2 in eqn (i);

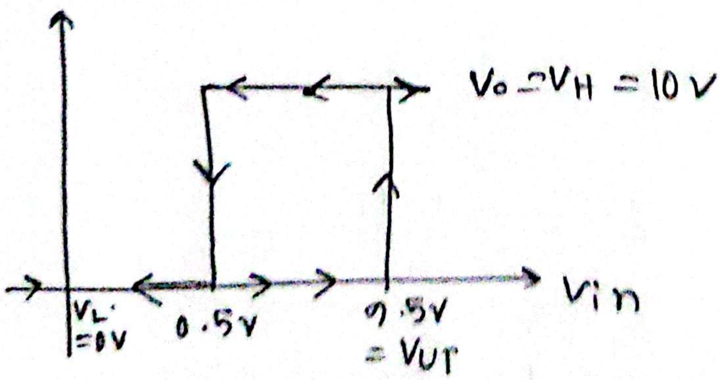
$$9.5 = \left(1 + \frac{9}{10}\right)V_{ref}$$

$$\Rightarrow V_{ref} = \frac{95}{19}\ V$$

$\therefore V_{ref} = 5V$

(e)

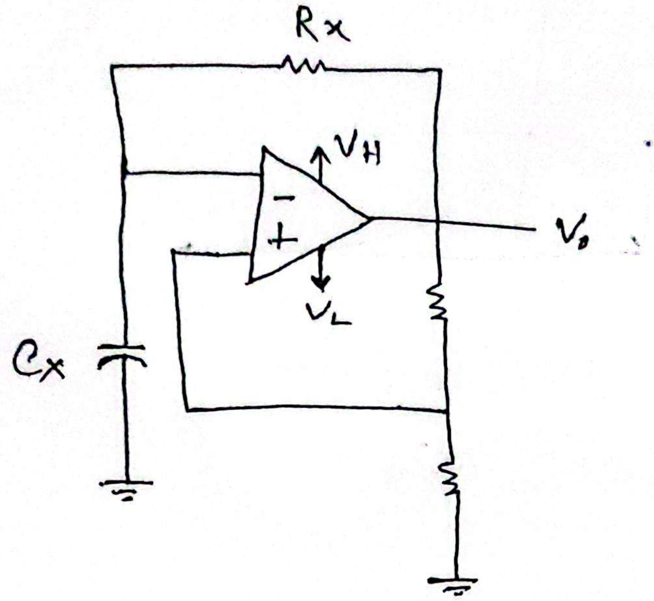
Voltage transfer characteristics curve,



non - inverting

②

(a)



(b)

$V_H = 12V$

$V_L = 0V$

Let $R_1 = R_2$,

$$V_{TH} = \left(\frac{R_1}{R_1+R_2}\right) V_H = 6V$$

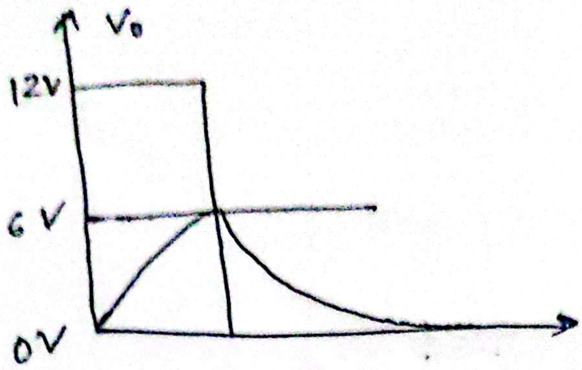
$$V_{TL} = \left(\frac{R_1}{R_1+R_2}\right) V_L = 0V$$

Let, $C_x = 1\mu F$

$\therefore R_x = 1.433 k\Omega$

$V_{TL} = V_L$, for this circuit, this will not work properly as square wave generator, this will be high once and again will turn off after 1ms.

(C)



50% of total capacity

Duty cycle = 50%.

$T_1 = T_2$

$T = T_1 + T_2 = T_1 + T_1 = 2T_1$

$f = 500$ Hz

$T = \frac{1}{f} = \frac{1}{500} = 0.002$

$\Rightarrow 2T_1 = 2$

$\Rightarrow T_1 = 1$ ms

capacitor voltage equation,

$V_x = V_0 + (V_{in} - V_0)\, e^{-\frac{t_2 - t_1}{R_x C_x}}$

$\Rightarrow 6 = 12 + (0 - 12)\, e^{-\frac{T_1 - 0}{R_x C_x}}$

$\Rightarrow 0.5 = e^{-\frac{T_1}{R_x C_x}}$

$\Rightarrow T_1 = -R_x C_x \ln(0.5)$

$\therefore R_x C_x (0.693) = 1$ ms