Parth Nakar
181090035
S.Y.B.Tech (EXTC)

Assignment : IC 555

Q1. Design a monostable multivibrator using IC 555 for pulse width of 10 msecs.

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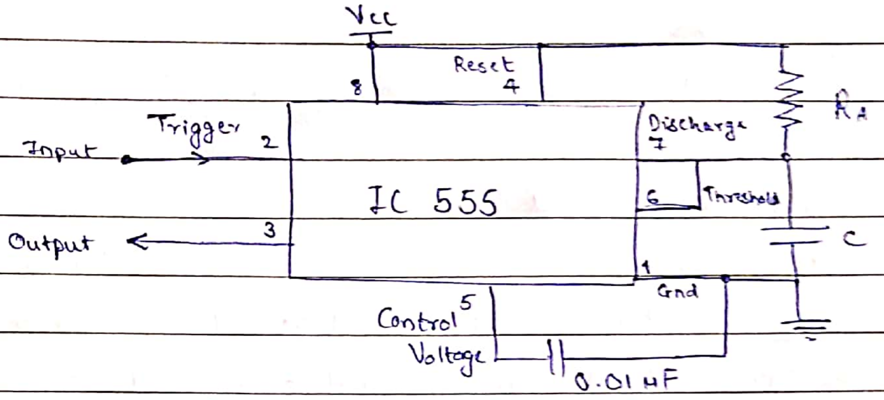


We know that, $t_p = 1.1 \times R_A \times C$

Let $C = 10\ nF$

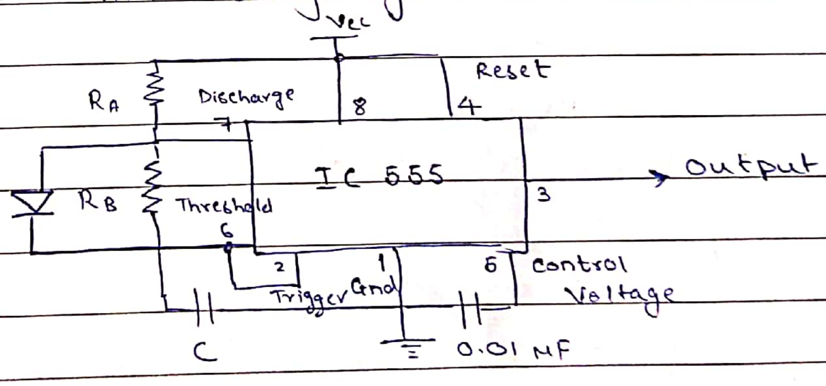
$\therefore$ $10\ msec = 1.1 \times R_A \times 10\ nF$

i.e. $R_A = \dfrac{1}{1.1 \times 10^{-3}} = 909.09\ \Omega$

$\therefore$ $R_A = 909\ \Omega$, $C = 10\ nF$

2. Design an astable multivibrator for output of frequency 5 kHz and duty cycle 40%.

⇒



We know that $f_o = \dfrac{1.45}{(R_A + 2R_B)C}$ i.e. $5 \times 10^3 = \dfrac{1.45}{(R_A + 2R_B)C}$

Let $C = 0.1\ \mu F$, $\therefore$ $R_A + 2R_B = 2900\ \Omega$

also % duty cycle $= \dfrac{R_A \cancel{+ R_B}}{R_A + 2R_B} \times 100$ (for < 50%)

i.e. $40 = \frac{R_A \cancel{+R_B}}{29\cancel{00}} \times 1\cancel{00}$

i.e. $R_A \cancel{+R_B} = 1160\ \Omega$

$\therefore$ $R_B = 1.74\ k\Omega$, $R_A = 1.16\ k\Omega$, $C = 0.1\ \mu F$

3. List few applications of IC 555.

$\Rightarrow$
- Used to provide accurate time delays.
- Used for Duty Cycle oscillations of all range.
- Used as monostable and astable vibrators.
- Used in analog frequency meters.
- Used for generation of PWM and PPM
- Temperature measurement and control devices.

4. Calculate ON time, OFF time, duty cycle and frequency of output generated by an unstable multivibrator using resistors $R_A = 5k\Omega$, $R_B = 5k\Omega$, $C = 10\mu F$

$\Rightarrow$ We know that,

$t_{ON} = 0.69 (R_A + R_B) C$

$= 0.69 (5+5) \times 10 \times 10^{-6+3}$

$t_{ON} = 0.069$ sec

$t_{OFF} = 0.69 (R_B) C$

$= 0.69 \times 5 \times 10^3 \times 10 \times 10^{-6}$

$t_{OFF} = 0.0345$ sec

$\therefore$ $t_{total} = 0.1035$ sec

$\therefore$ $f = \frac{1}{t_{total}} = 9.66$ Hz

$\therefore$ % Duty cycle $= \frac{R_A + R_B}{R_A + 2R_B} \times 100 = \frac{10}{15} \times 100$

$= 66.67\%$

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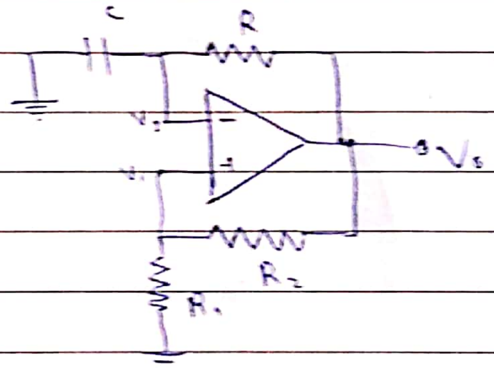
Parth Nakar
1810 90035
S. Y. B. Tech (EXTC)

Assignment: Waveform Generators & Filters.

1 The expression for time period of a square wave generator is $T = 2RC \ln[(2R_1+R_2)/R_2]$

2. Triangular wave is derived from square wave generator by connecting integrator at the output

3. Design a square wave generator to produce a perfect wave of 50% duty cycle with an output frequency equal to 1kHz using IC 741. Assume feedback factor to be 0.05



Feedback factor $= 0.05 = \dfrac{R_1}{R_1+R_2}$

$\therefore 0.05 R_2 = 1.05 R_1$

i.e. $R_2 = 21 R_1$, Let $R_1 = 1k\Omega$ $\therefore R_2 = 21k\Omega$

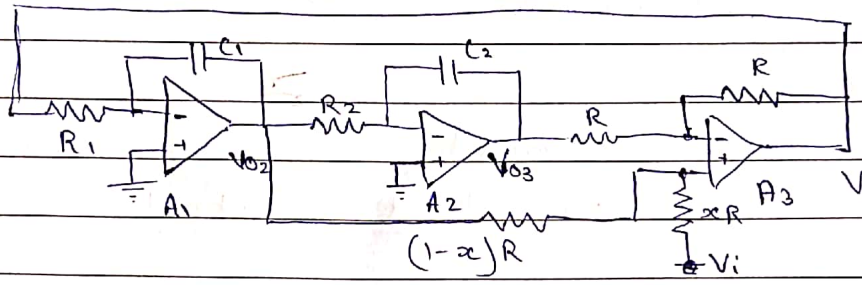
$f = 1kHz = \dfrac{1}{2RC \ln\left(\frac{2R_1+R_2}{R_2}\right)}$

i.e. $1kHz = \dfrac{1}{2RC \ln\left(\frac{2+21}{21}\right)} = \dfrac{10.99}{2RC}$

Let $C = 1\mu F$ $\therefore R = \dfrac{10.99}{2\times10^{3}\times10^{-6}} = 5.495\,k\Omega$

As charging and discharging time of capacitor is same
$\therefore$ % duty cycle $= 50\%$, $R_1 = 1k\Omega$, $R_2 = 21k\Omega$, $R = 5.495k\Omega$, $C = 1\mu F$

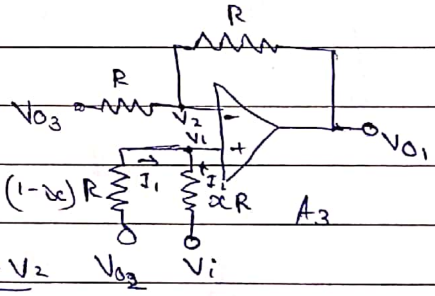
4. For the circuit shown, compute transfer functions of V_{o1}/V_i, V_{o2}/V_i, V_{o3}/V_i



for A_1, $V_{o2} = -\frac{1}{sR_1C_1} V_{o1}$

for A_2, $V_{o3} = -\frac{1}{sR_2C_2} V_{o2} = \frac{1}{s^2(R_1C_1)(R_2C_2)} V_{o1}$

A_3 can be seen as a summing amplifier,



At node V_1, $I_1 + I_2 = I_{b1} = 0$

$\therefore \frac{V_{o2} - V_1}{(1-x)R} + \frac{V_i - V_1}{xR} = 0$

$\therefore V_1 = x V_{o2} + (1-x) V_i$

Similarly at node V_2, $\frac{V_2 - V_{o3}}{R} + 0 = \frac{V_{o1} - V_2}{R}$

i.e. $V_2 = \frac{(V_{o1} + V_{o3})}{2}$

As $V_1 = V_2$ ——————— (Virtual short)

$\therefore x V_{o2} + (1-x) V_i = (V_{o1} + V_{o3})/2$

i.e. $-\frac{x}{sR_1C_1} V_{o1} + (1-x) V_i = \frac{V_{o1}}{2} + \frac{V_{o1}}{2s^2(R_1C_1)(R_2C_2)}$

$\therefore \frac{V_{o1}}{V_i} = \frac{(1-x)\left[2s^2(R_1C_1)(R_2C_2)\right]}{s^2(R_1C_1)(R_2C_2) + 2xs(R_2C_2) + 2}$

$\therefore \frac{V_{o2}}{V_i} = \frac{-(1-x)\left[2sR_2C_2\right]}{s^2(R_1C_1)(R_2C_2) + 2xs(R_2C_2) + 2}$, $\frac{V_{o3}}{V_i} = \frac{(1-x)}{s^2(R_1C_1)(R_2C_2) + 2s(R_2C_2) + 2}$

5. Resonant frequency = 6.286 kHz