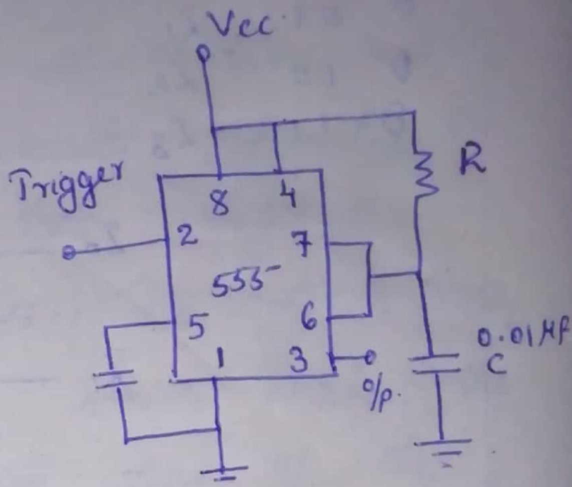
Q) In the monostable multivibrator ckt, R = 100 KΩ and the time delay T = 100 ms. Calculate the value of C.



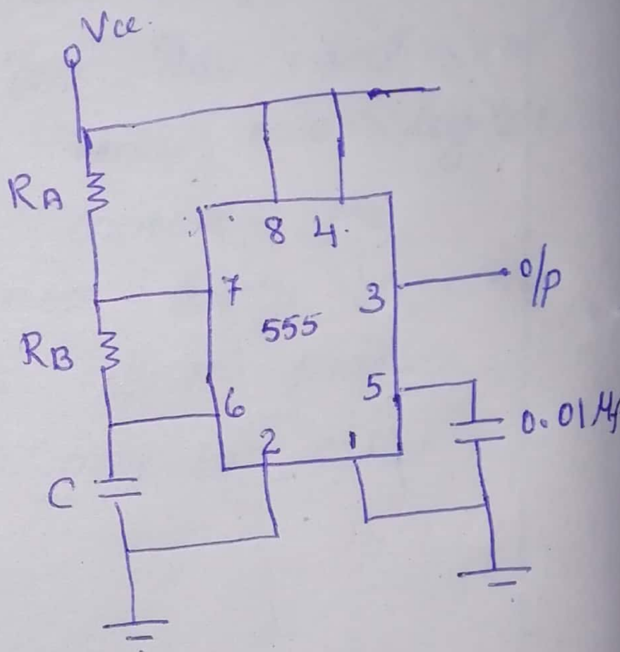
Answ.

$$T = 1.1RC$$

$$C = \frac{T}{1.1R} = \frac{100 \times 10^{-3}}{1.1 \times 100 \times 10^{3}} = 0.9\,\mu F$$

Q) In the astable multivibrator ckt, R_A = 6.8 kΩ, R_B = 3.3 kΩ and C = 0.1 μF. Calculate

ⓐ T_{high} ⓑ T_{low} ⓒ free running frequency ⓓ duty cycle.



Answ

ⓐ $T_{high} = 0.69(R_A + R_B)C$

$= 0.69(6.8 \times 10^{3} + 3.3 \times 10^{3})\,0.1\,\mu F$

$= 0.7\,ms$

ⓑ $T_{low} = 0.69 R_B C = 0.69 \times 3.3 \times 10^{3} \times 0.1 \times 10^{-6}$

$= 0.23\,ms$

(c) $f = \frac{1}{T} = \frac{1}{T_{high} + T_{low}} = \frac{1}{0.7 + 0.23}$

$= \underline{\underline{1.07\,kHz}}$

or

$f = \frac{1.45}{(R_A + 2R_B)\,C} = \frac{1.45}{(6.8 \times 10^3 + 2 \times 3.3\,k\Omega)\,0.1\,\mu F}$

$= \underline{\underline{1.07\,kHz}}$

(d) Dutycycle $= \frac{T_{high}}{T} \times 100 = \frac{.7\,ms}{\cancel{1.07k}\ 0.93} \times 100$

$= \underline{\underline{75\,\%}}$

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Frequency of oscillations,

$$f = \frac{1}{T} = \frac{1}{1.4\ \text{ms}} = 714.3\ \text{Hz}\ \textbf{Ans.}$$

$$\text{Duty cycle} = \frac{T_{HIGH}}{T} = \frac{0.707}{1.4} = 50.5\%\ \textbf{Ans.}$$

Example 33.2. Determine the positive pulse width, negative pulse width and free running frequency for an astable multivibrator using 555 timer. R_A = 4.7 k, R_B = 1 k, C = 1 μF, C_1 = 0.01 μF. What is the duty cycle of output waveform ?

Solution :

$$T_{on} = 0.693\,(R_A + R_B)\,C$$
$$= 0.693\,(4.7 + 1)\,10^3 \times 1 \times 10^{-6}$$
$$= 3.95\ \text{ms}\ \textbf{Ans.}$$
$$T_{off} = 0.693\,R_B C = 0.693 \times 1 \times 10^3 \times 1 \times 10^{-6}$$
$$= 0.693\ \text{ms}\ \textbf{Ans.}$$

$$f = \frac{1.4}{(R_A + 2R_B)C}$$
$$= \frac{1.4}{(4.7 + 2\times1)10^3 \times 1 \times 10^{-6}} = 208.9\ \text{Hz}\ \textbf{Ans.}$$

$$D = \frac{R_A + B_B}{R_A + 2R_B} \times 100 = \frac{4.7+1}{4.7+2\times1} \times 100$$
$$= 85\%\ \ \textbf{Ans.}$$

Example 33.3. The timer IC555 is used as astable multivibrator. It is desired to have square-wave output with 50% duty cycle of 1 kHz. The timing capacitor is of 0.01 μF. Find the values of resistors required and draw the circuit.

Solution : For 50% duty cycle

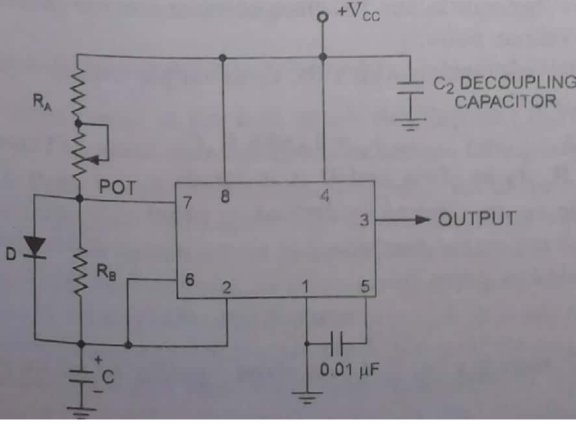
$$T_{on} = T_{off} = \frac{T}{2}$$
$$R_A = R_B$$
$$C = 0.01\ \mu F = 1 \times 10^{-8}\ F$$
$$f = 1\ \text{kHz} = 1{,}000\ \text{Hz}$$

Frequency is given by equation

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

$$\text{or } R_B = R_A = \frac{1.44}{2 \times f \times C}$$
$$= \frac{1.44}{2 \times 1{,}000 \times 1 \times 10^{-8}}$$
$$= 72\ k\Omega\ (68\ k\Omega \text{ standard value})\ \textbf{Ans.}$$

Circuit diagram is shown in Fig. 33.12.



Example 33.4. Design a 555 timer as an astable multivibrator with an output signal frequency of 800 Hz and 60 percent duty cycle. [*U.P. Technical Univ. Analog Integrated Circuits 2005-06*]

Solution : Percent duty cycle,

$$D = \frac{R_A + R_B}{R_A + 2R_B} \times 100 = 60 \quad \text{[Refer to Eq. (33.5)]}$$

$$\text{or} \quad R_A + R_B = 0.6R_A + 1.2R_B$$
$$\text{or} \quad R_B = 2R_A$$

Frequency is given by

$$f = \frac{1.44}{(R_A + 2R_B)C} \quad \text{...[Refer to Eq. (33.4)]}$$

Substituting f = 800 Hz, $R_B = 2R_A$ and C = 0.01 μF (assumed value in above equation) we have

$$800 = \frac{1.44}{5R_A \times 0.01 \times 10^{-6}}$$

$$\text{or } R_A = \frac{1.44}{800 \times 5 \times 0.01 \times 10^{-6}} = 36{,}000\ \Omega \text{ or } 36\ k\Omega$$

$$\text{and } R_B = 2R_A = 2 \times 36 = 72\ k\Omega$$

Thus C = 0.01 μF; R_A = 36 kΩ and R_B = **72 kΩ Ans.**

Example 33.5. Design a 555 timer as an astable multivibrator with an output signal frequency of 700 Hz and 50% duty cycle. [*U.P. Technical Univ. Analog Integrated Circuits 2004-05*]

Solution : For 50% duty cycle

$$T_{on} = T_{off}$$
$$R_A = R_B$$

and frequency is given by equation

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

Substituting f = 700 Hz; $R_B = R_A$ and C = 0.01 μF (assumed value) in above equation, we have

$$700 = \frac{1.44}{2R_A \times 0.01 \times 10^{-6}}$$

$$\text{or } R_A = R_B = \frac{1.44}{700 \times 2 \times 0.01 \times 10^{-6}}$$
$$= 103\ k\Omega\ (100\ k\Omega \text{ standard value})$$

Thus C = 0.01 μF

$R_A = R_B$ = 100 kΩ **Ans.**

Example 33.6. Determine the frequency of the free-running ramp generator circuit given in Fig. 33.7 (*a*) if C = 0.05 μF, R = 12 kΩ, V_{CC} = 5 V and $V_{BE} = V_{D_1}$ = 0.7 V.

Solution : Collector current,

$$I_C = \frac{V_{CC} - V_{BE}}{R} = \frac{5 - 0.7}{12 \times 10^3} = 0.000358\ A$$

Free-running frequency,

$$f_0 = \frac{3I_C}{V_{CC} \times C} = \frac{3 \times 0.000358}{5 \times 0.05 \times 10^{-6}} = 4.3\ \text{kHz}\ \textbf{Ans.}$$

33.7. THE 555 TIMER AS A MONOSTABLE MULTIVIBRATOR

A monostable multivibrator (MMV) often called a *one-shot multivibrator* is a pulse generator circuit in which the