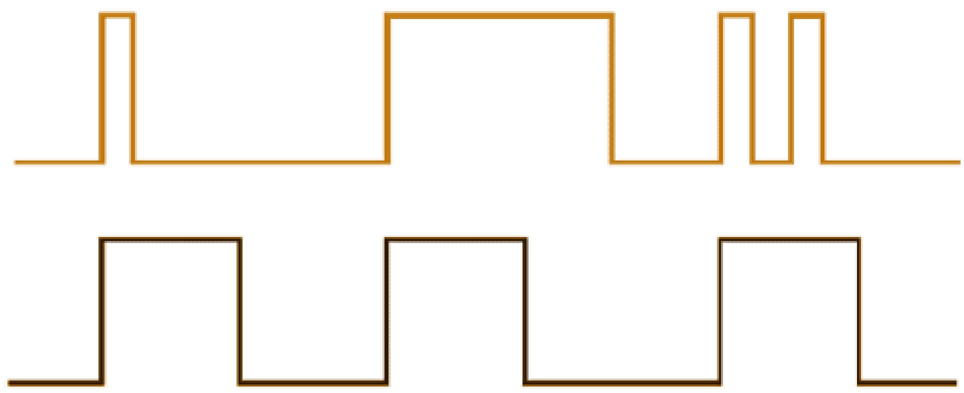
Monostable Multivibrator

In a monostable multivibrator, one of the states is permanent, i.e., stable, and the other one is temporary, i.e., quasi-stable. When an external trigger pulse is applied to the monostable at an appropriate point, the monostable changes its state from a stable state to a quasi-stable state. It stays in the quasi-stable state for a predetermined length of a certain interval and remains there until another pulse is applied. Thus, a monostable multivibrator cannot generate a square wave of its own like an astable multivibrator. Only external pulses will cause it to generate the square wave.

Monostable Multivibrator Diagram



The above figure illustrates the functioning of the monostable multivibrator, where the green pulse represents the trigger pulse, and the red wave represents the response of the monostable multivibrator circuit. Notice that the response pulse changes its state for a brief duration on detecting a trigger and returns to its stable state.

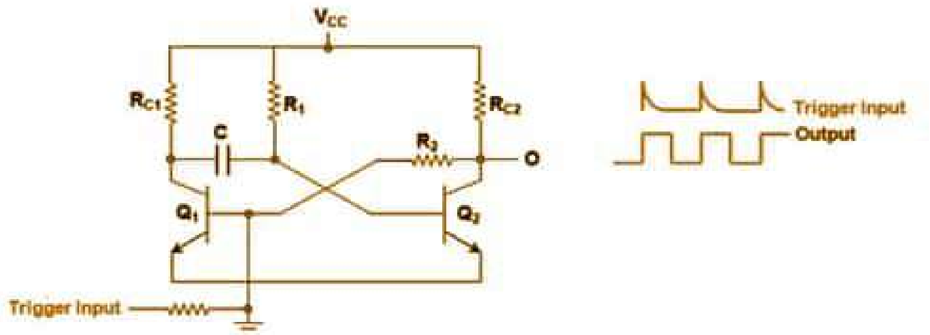
Design and Working of Monostable Multivibrator

When one of the transistors gets into a stable state, an external trigger pulse is given to change its state. After changing its state, the transistor remains in this quasi-stable state or Meta-stable state for a specific period, determined by the RC time constants' values, and returns to the previous stable state.

Circuit Diagram of a Monostable Multivibrator

Generally monostable multivibrator circuits comprise passive (resistors and capacitors) and active (transistors, Op-Amps, or 555 timers ICs). For example, the figure below shows a circuit designed using two bipolar junction transistors (BJTs) Q_1 and Q_2, one capacitor C and four resistors R_1C_1, R_2C_2, R_1, and R_2.

The frequency of their output signal can be changed by varying the values of the capacitors and the resistors in the circuit.

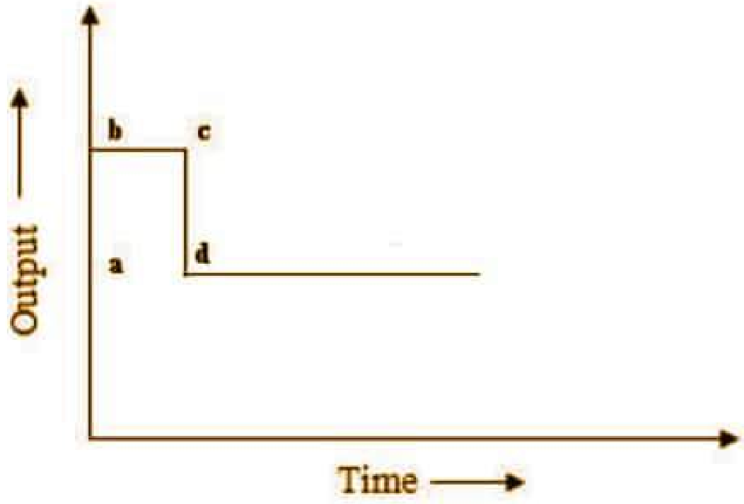


It consists of two similar transistors, Q_1 and Q_2, with equal collector loads, i.e., $R_{L1} = R_{L2}$. The values of $-V_{gg}$ and R_2 are such as to reverse bias Q_1 and keep it at cut off. The collector supplies V_{CC} and R_2 forward bias Q_1 and keeps it at saturation. Finally, a trigger pulse is given through C_2 to obtain the square wave.

Operation of Monostable Multivibrator Circuit

When there is no external trigger to the circuit, one transistor will be in a saturation state, and the other will be in a cutoff state. Q_1 is the cutoff mode at negative potential until the external trigger operates. Then, Q_2 is in saturation mode.

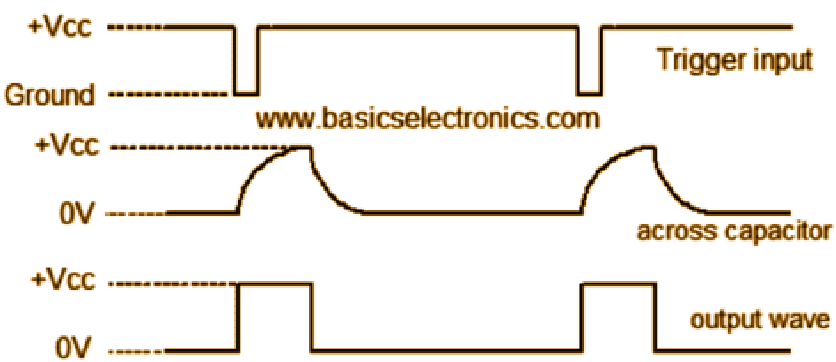
Once the external trigger is given to the input, Q_1 will get turned on, and when the Q_1 reaches saturation, the capacitor, which is connected to the collector of Q_1 and base of Q_2, will make the transistor Q_2 turn off. This state of turning off the Q_2 transistor is called astable stable or quasi-state.



When the capacitor charges to V_{CC}, the Q_2 will turn on again, and automatically Q_1 is turned off. So the time period for charging the capacitor through the resistor is directly proportional to the quasi or astable state of the multivibrator when an external trigger occurs (t=0.69RC).

Waveform of the Monostable Multivibrator

We can change the time constant of Monostable Multivibrators by varying the values of the capacitor, C_1 resistor, R_1, or both Monostable multivibrators are generally used to increase the width of a pulse or to produce a time delay within a circuit as the frequency of the output signal is always the same as that for the trigger pulse input, the only difference is the pulse width.



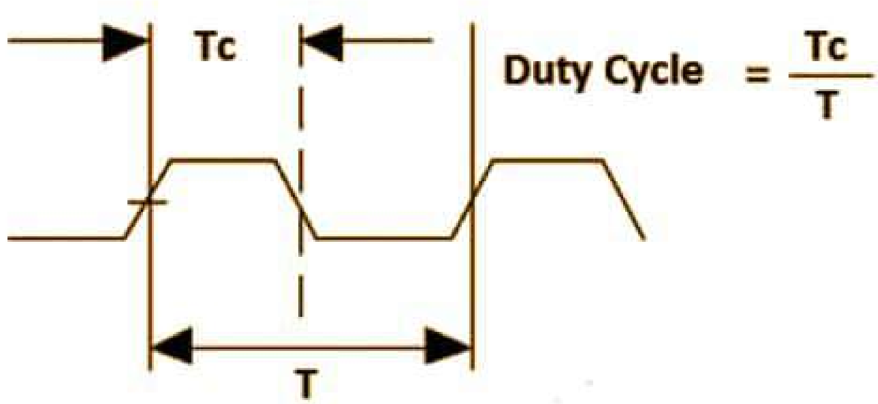
Frequency and Time Calculations of Monostable Multivibrator

The width of this output pulse depends upon the RC time constant. Hence it depends on the values of R_1C_1. The duration of the pulse is given by:

$T=0.69\ R_1C_1$

Duty Cycle

It is the ratio of time Tc during which the output is high to the total time period T of the cycle.



Thus, **Duty Cycle = $T_{OFF}/(T_{OFF} + T_{ON})$** when the output is taken from the collector of the transistor T.

Applications of Monostable Multivibrator

Monostable Multivibrators are used in applications such as television circuits and control system circuits.

- The falling part of the output pulse from MMV is often used to trigger another pulse generator circuit, thus producing a pulse delayed by a time T concerning the input pulse.
- MMV is used for regenerating old and worn-out pulses. For example, various pulses used in computers and telecommunication systems become somewhat distorted during use. An MMV can be used to generate new, clean and sharp pulses from these distorted and used ones.