MULTIVIBRATORS

A Multivibrator is a two-stage resistance coupled amplifier with positive feedback from the output of one amplifier to the input of the other.

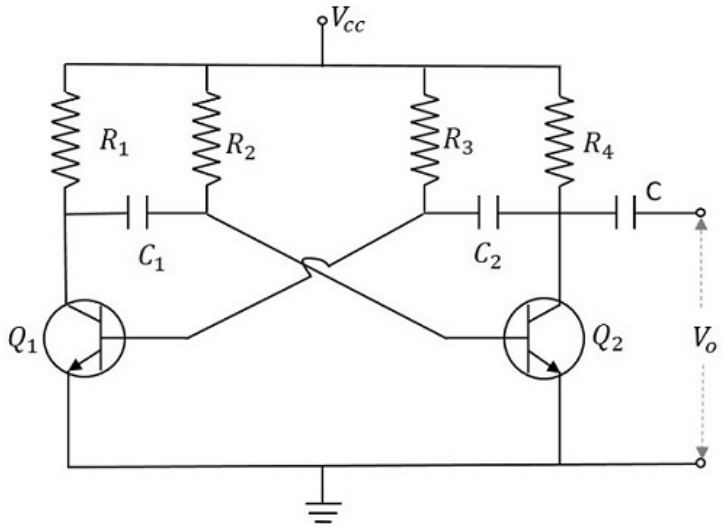
They are basically two-stage amplifiers with positive feedback from the output of one amplifier to the input of the other. This feedback is supplied in such a manner that one transistor is driven to saturation (ON state) and other to cut-off (OFF state). The action is reversed after a certain time, depending upon the circuit conditions i.e., the saturated transistor is driven into cut-off and the cut-off transistor is driven into saturation.

A **multivibrator** circuit is nothing but a **switching circuit**. It generates non-sinusoidal waves such as Square waves, Rectangular waves and Saw tooth waves etc. Multivibrators are used as frequency generators, frequency dividers and generators of time delays and also as memory elements in computers etc.

1. Astable multivibrator

An astable multivibrator has **no stable states**. Once the Multivibrator is ON, it just changes its states on its own after a certain time period which is determined by the R_C time constants. A dc power supply or V_{cc} is given to the circuit for its operation.

Construction of Astable Multivibrator



Two transistors named Q_1 and Q_2 are connected in feedback to one another. The collector of transistor Q_1 is connected to the base of transistor Q_2 through the capacitor C_1 and vice versa. The emitters of both the transistors are connected to the ground. The collector load resistors $R_1$and R_4 and the biasing resistors R_2 and R_3 are of equal values. The capacitors C_1 and C_2 are of equal values.

Operation of Astable Multivibrator

When V_{cc} is applied, the collector current of the transistors increase. As the collector current depends upon the base current,

$$I_C = \beta I_B$$

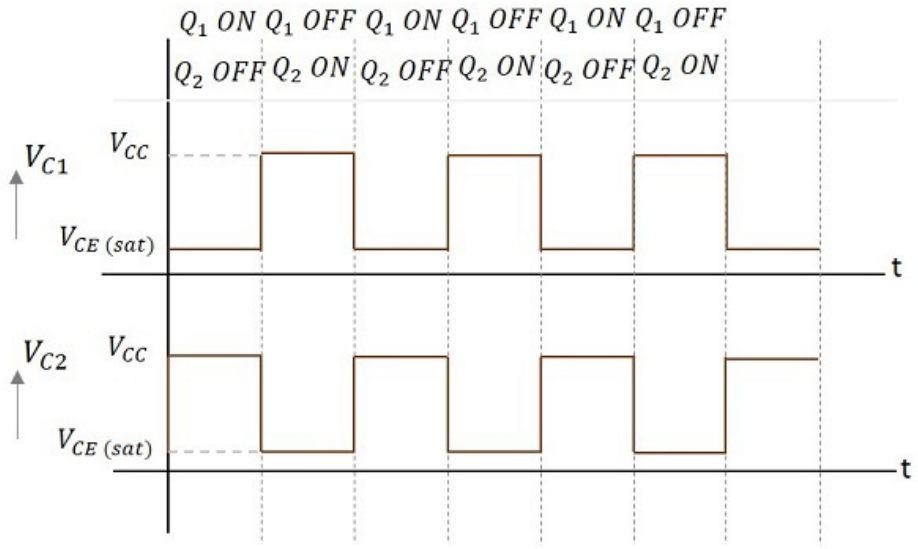
As no transistor characteristics are alike, one of the two transistors say Q_1 has its collector current increase and thus conducts. The collector of Q_1 is applied to the base of Q_2 through C_1. This connection lets the increased negative voltage at the collector of Q_1 to get applied at the base of Q_2 and its collector current decreases. This continuous action makes the collector current of Q_2 to decrease further. This current when applied to the base of Q_1 makes it more negative and with the cumulative actions Q_1 gets into saturation and Q_2 to cut off. Thus the output voltage of Q_1 will be $V_{CE\ (sat)}$ and Q_2 will be equal to V_{CC}.

The capacitor C_1 charges through R_1 and when the voltage across C_1 reaches 0.7v, this is enough to turn the transistor Q_2 to saturation. As this voltage is applied to the base of Q_2, it gets into saturation, decreasing its collector current. This reduction of voltage at point B is applied to the base of transistor Q_1 through C_2 which makes the Q_1 reverse bias. A series of these actions turn the transistor Q_1 to cut off and transistor Q_2 to saturation. Now point A has the potential V_{CC}. The capacitor C_2 charges through R_2. The voltage across this capacitor C_2 when gets to 0.7v, turns on the transistor Q_1 to saturation.

Hence the output voltage and the output waveform are formed by the alternate switching of the transistors Q_1 and Q_2. The time period of these ON/OFF states depends upon the values of biasing resistors and capacitors used, i.e., on the R_C values used. As both the transistors are operated alternately, the output is a square waveform, with the peak amplitude of V_{CC}.

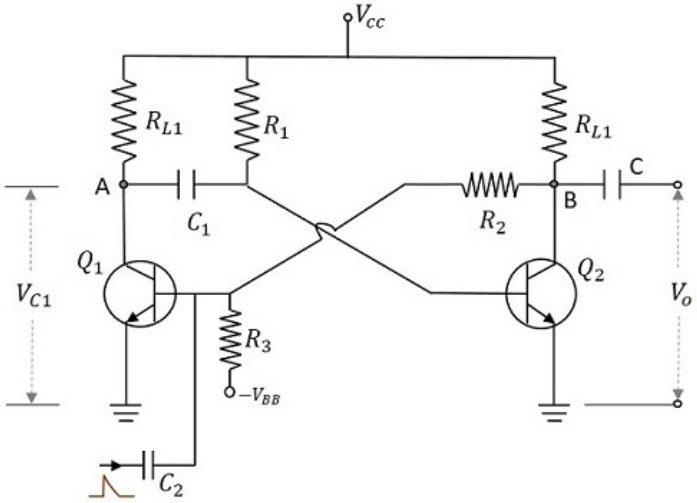
Waveforms

The output waveforms at the collectors of Q_1 and Q_2 are shown in the following figures.



2. Monostable multivibrator

A monostable multivibrator, as the name implies, has only **one stable state**. When the transistor conducts, the other remains in non-conducting state. A stable state is such a state where the transistor remains without being altered, unless disturbed by some external trigger pulse. As Monostable works on the same principle, it has another name called as **One-shot Multivibrator**.



Construction of Monostable Multivibrator

Two transistors Q_1 and Q_2 are connected in feedback to one another. The collector of transistor Q_1 is connected to the base of transistor Q_2 through the capacitor C_1. The base Q_1 is connected to the collector of Q_2 through the resistor R_2 and capacitor C. Another dc supply voltage – V_{BB} is given to the base of transistor Q_1 through the resistor R_3. The trigger pulse is given to the base of Q_1 through the capacitor C_2 to change its state. R_{L1} and R_{L2} are the load resistors of Q_1 and Q_2.

One of the transistors, when 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 time period, which is determined by the values of RC time constants and gets back to the previous stable state.

Operation of Monostable Multivibrator

Firstly, when the circuit is switched ON, transistor Q_1 will be in OFF state and Q_2 will be in ON state. This is the stable state. As Q_1 is OFF, the collector voltage will be V_{CC} at point A and hence C_1 gets charged. A positive trigger pulse applied at the base of the transistor Q_1 turns the transistor ON. This decreases the collector voltage, which turns OFF the transistor Q_2. The capacitor C_1 starts discharging at this point of time. As the positive voltage from the collector of transistor Q_2 gets applied to transistor Q_1, it remains in ON state. This is the quasi-stable state or Meta-stable state.

The transistor Q_2 remains in OFF state, until the capacitor C_1discharges completely. After this, the transistor Q_2 turns ON with the voltage applied through the capacitor discharge. This turn ON the transistor Q_1, which is the previous stable state.

Output Waveforms

The output waveforms at the collectors of Q_1 and Q_2 along with the trigger input given at the base of Q_1 are shown in the following figures.