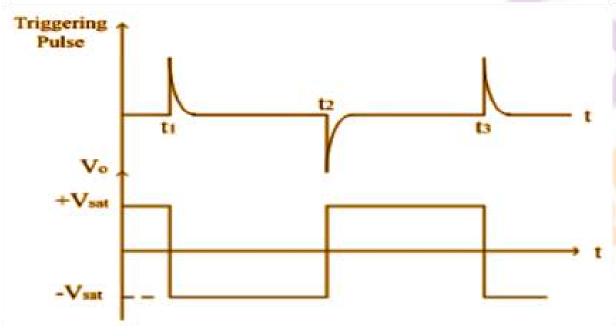
Bistable Multivibrator

A bistable multivibrator operates in two states and comprises two cross-coupled transistors, one cut off and the other in saturation. This means that the bistable circuit can remain in either stable state indefinitely.

Bistable Multivibrator Diagram



To change the bistable from one state to the other, the bistable circuit requires a suitable trigger pulse, and two such pulses are required for a full cycle. It is more commonly known as a "flip-flop" due to its actual operation, in which it flips into a logic state, remains there, then changes back to its original state.

Triggering in the Circuit of Bistable Multivibrator

The kind of triggering can be either asymmetric or symmetric.

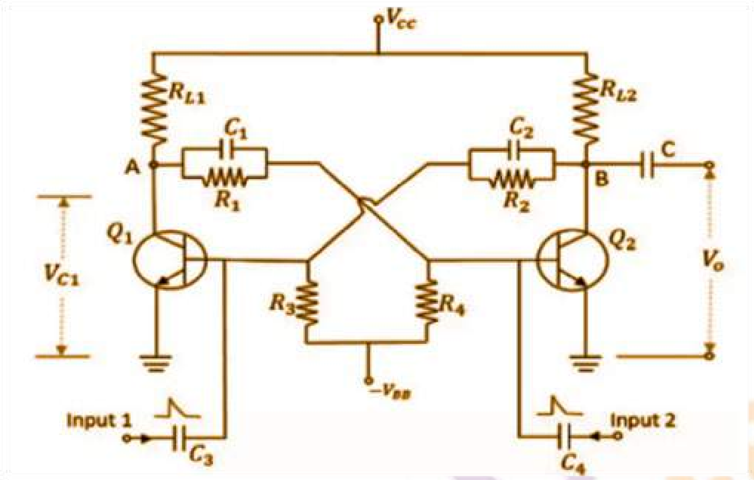
- Asymmetric triggering involves obtaining the trigger for each transistor independently and from separate sources.
- In the case of symmetric triggering, the trigger for each transistor is obtained from similar sources and is preferred to be linearly dependent on each other.

Design and Working of Bistable Multivibrator

A Bistable circuit runs in two different modes. They require two input signals to switch between them. Additionally, since bistable circuits need user input to change states, they are not self-triggering.

Circuit Diagram of a Bistable Multivibrator

Two NPN transistors, Q_1 and Q_2, are connected to two load resistors, R_{L1} and R_{L2}, on the collectors of a bistable multivibrator circuit.



Using R_1, the output terminal of the first transistor is connected to the input terminal of the second transistor. In contrast, R_2 connects the second transistor's output to the input of the first transistor. The resistances R_1 and R_2 are connected in parallel with two capacitors, also known as commutating capacitors, to improve the switching capability of the circuitry.

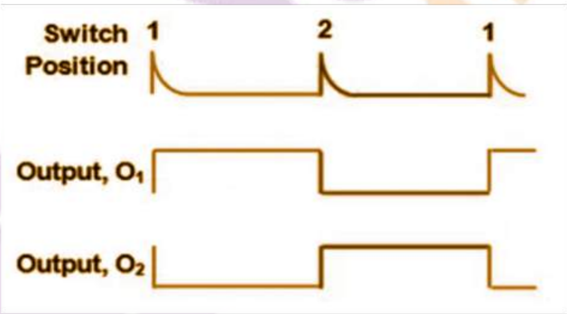
The circuit can also be called a flip-flop or latch. Flip-flops and latches are basic components of any electronic system that stores information as they have two stable states. But there exist a few differences between flip-flop and latch which helps in deciding the usage of one among the two.

- As a result of circuit imbalances, one transistor, say Q_1, gets switched ON, and the transistor Q_2 gets switched OFF. This is a stable state of the Bistable Multivibrator.
- By applying a negative pulse at the base of transistor Q1, the collector voltage increases, forward biasing transistor Q1. The collector current of transistor Q_2, applied at the base of transistor Q_1, reverses transistor Q_1, thereby making transistor Q_1 OFF and transistor Q_2 ON. This can be seen as another stable state of the Multivibrator.
- Changing this stable state again is possible by applying a negative trigger pulse at transistor Q_2 or a positive one at transistor Q_1.

Operation in a Bistable Multivibrator

In rationality, a mismatch in Q_1 and Q_2 would make the transistors different and draw different currents. Because of this, one of the transistors would come in saturation first, say Q_1.

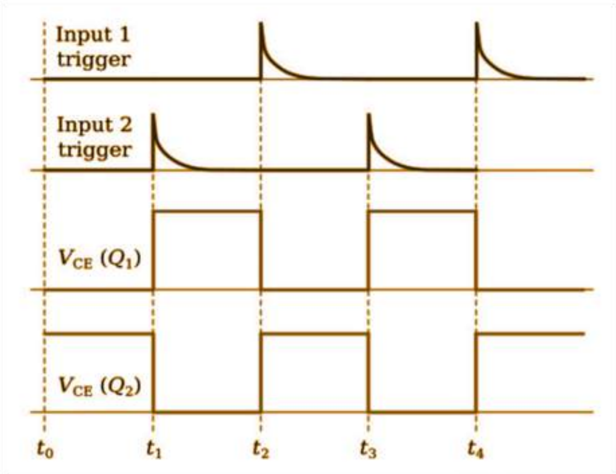
- Due to this, the potential at the collector terminal of Q_1 will decrease. This Q_1 collector is coupled with the base of Q_2 through R_1, so decreasing V_{C1} would drive Q_2 into cut-off.
- We will have low V_{C1} and high V_{C2}.
- This would be the first stage of a bistable multivibrator where one transistor Q_1 is in saturation while Q_2 is in the cut-off.
- This state will continue until an external trigger is given at points 1 or. For example, giving a positive trigger at 2 or a negative one at 1 would force Q_2 towards decreasing voltage V_C. Since C_2 is coupled with B_1, it will drive Q_2 into cut-off, and Q_2 will be in saturation.
- We will have high V_{C1} and low V_{C2}.
- This marks the second stage of the bistable Multivibrator.
- To change it all, we must apply a negative trigger at point 2 or a positive one at point 1.



We can take the output from any of the two collector terminals. The only difference is the response we would get will be the inverse of the other collector terminal. We are getting a response with two stable states for two triggers.

Waveform of the Bistable MUltivibrator

The first end of the rectangle waveform depends on the first input signal and varies according to it, and the second relies on the second input signal. Finally, the resultant waveform is drawn in the given figure.



The output waveforms obtained at the terminal O_1 and O_2 are complementary to each other, always.

Applications of the Bistable Multivibrator

Bistable Multivibrators are widely used in the circuits of latches and counters. It is also used in frequency divider circuits and storage devices.

- It is used in different storage devices and for counting binary numbers.
- Used for frequency division in different circuits.
- It is used for the production of different clock pulses.
- It is used in different circuits as a toggle switch.
- It is used for different relay controllers.

Merits and De-merits of a Bistable Multivibrator

A bistable multivibrator can store previous output until no input trigger is provided. Then, however, a triggering pulse is required every time to transition from one stable state to another.