



# ***Analog electronics***

***Tenth lecture***

## ***Multivibrators***

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## 10.1 Multivibrators

An electronic circuit that generates square waves (or other non-sinusoidals such as rectangular, saw-tooth waves) is known as a multivibrator. The name multivibrator is derived from the fact that a square wave actually consists of a large number of (fourier series analysis) sinusoidals of different frequencies. A multivibrator is a switching circuit which depends for operation on positive feedback. It is basically a two-stage amplifier with output of one feedback to the input of the other as shown in Figure 1.

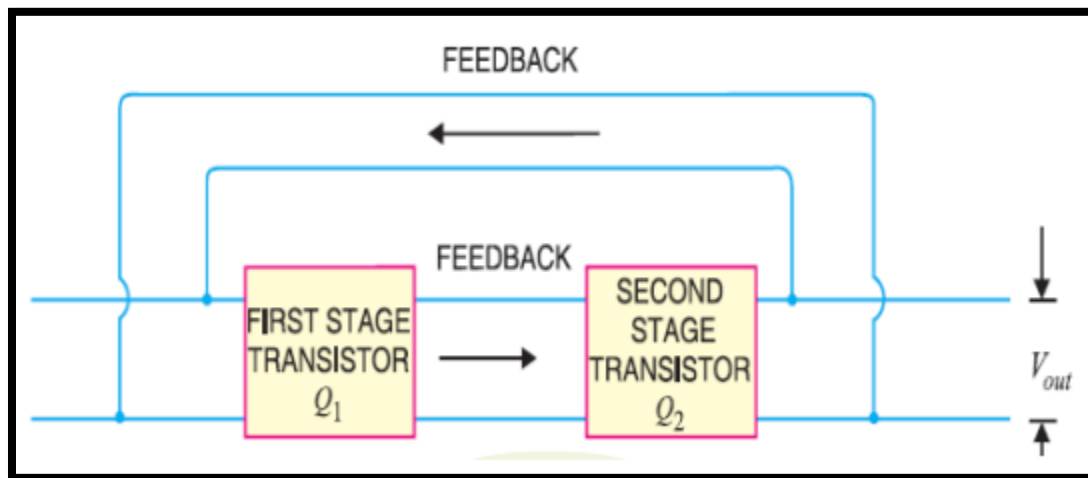


Figure 1. show A multivibrator

The circuit operates in two states (ON and OFF) controlled by circuit conditions. Each amplifier stage supplies feedback to the other in such a way that will drive the transistor of one stage to saturation (ON state) and the

other to cut off (OFF state). After a certain time controlled by circuit conditions, the action is reversed i.e. saturated stage is driven to cut off and the cut off stage is driven to saturation. The output can be taken across either stage and may be rectangular or square wave depending upon the circuit conditions. It is a two-stage amplifier with 100% positive feedback. Suppose output is taken across the transistor Q2. At any particular instant, one transistor is ON and conducts  $I_C(\text{sat})$  while the other is OFF. Suppose Q2 is ON and Q1 is OFF. The collector current in Q2 will be  $I_C(\text{sat})$ .

## 10.2 Types of Multivibrators

A multivibrator is basically a two-stage amplifier with output of one feedback to the input of the other. At any particular instant, one transistor is ON and the other is OFF. After a certain time depending upon the circuit components, the stages reverse their conditions – the conducting stage suddenly cuts off and the non-conducting stage suddenly starts to conduct.

The two possible states of a multivibrator are:

|                     | ON    | OFF   |
|---------------------|-------|-------|
| <i>First State</i>  | $Q_1$ | $Q_2$ |
| <i>Second State</i> | $Q_2$ | $Q_1$ |

Depending upon the way in which the two stages interchange their states, the multivibrators are classified as:

- (i) **Astable or free running multivibrator**
- (ii) **Monostable or one-shot multivibrator**
- (iii) **Bi-stable or flip-flop multivibrator**

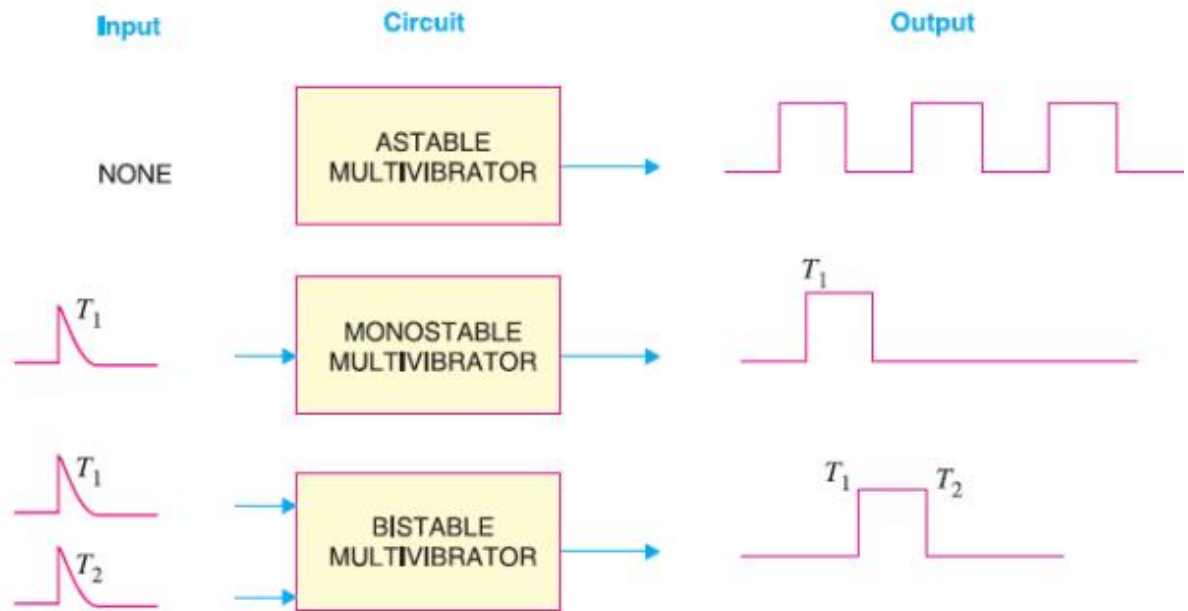


Figure 2. shows the input/output relations for the three types of multivibrators.

### 10.3 Astable Multivibrator

The astable or free running multivibrator **alternates automatically between the two states and remains in each for a time dependent upon the circuit constants.** Thus it **is just an oscillator since it requires no external pulse for its operation.** Of course, **it does require a source of d.c. power.** Because it continuously produces the squarewave output, it is often referred to as a free running multivibrator.

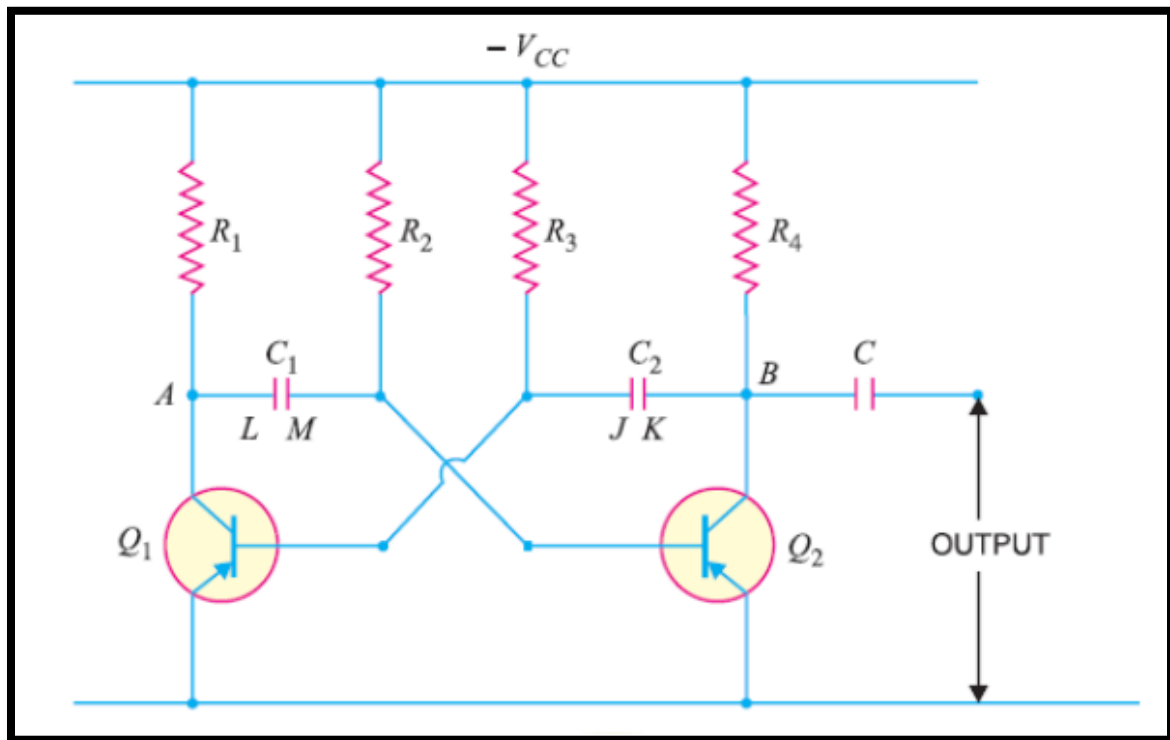


Figure 3. Astable Multivibrator

## 10.4. Monostable Multivibrator

The monostable or one-shot multivibrator has one state stable and one quasi-stable (i.e. half-stable) state. The application of input pulse triggers the circuit into its quasistable state, in which it remains for a period determined by circuit constants. After this period of time, the circuit returns to its initial stable state, the process is repeated upon the application of each trigger pulse. Since the monostable multivibrator produces a single output pulse for each input trigger pulse, it is generally called oneshot multivibrator.

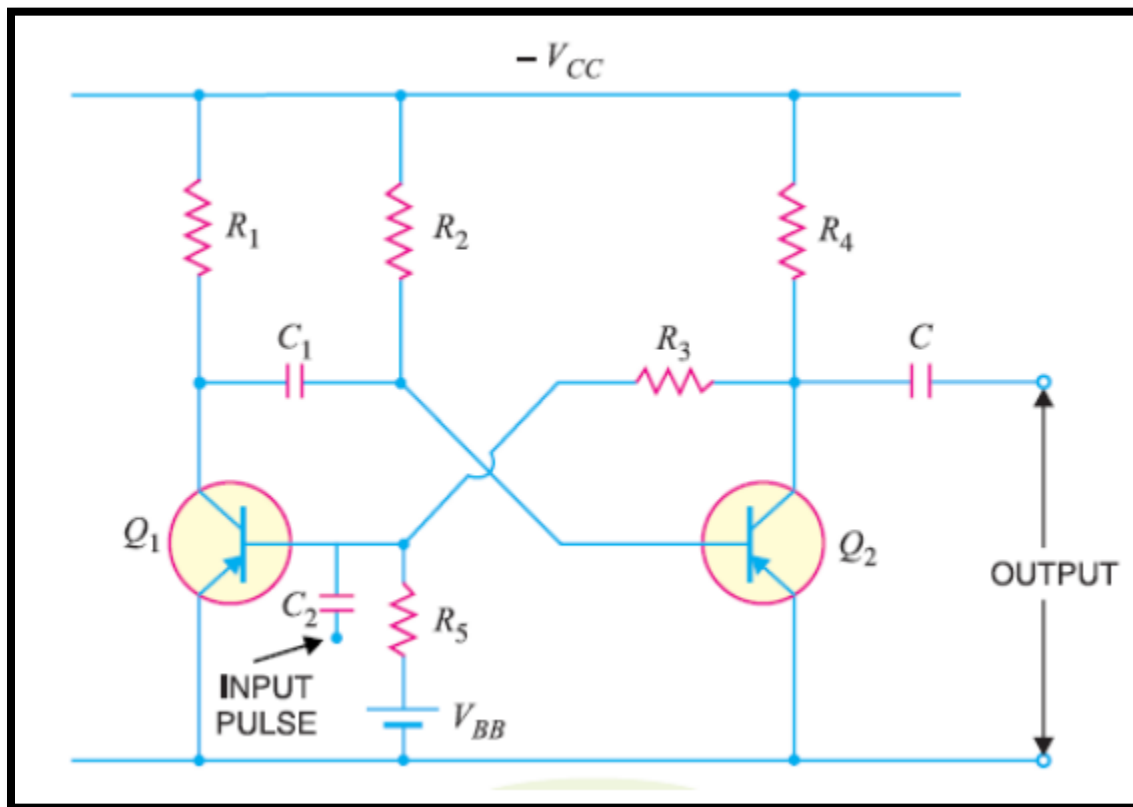


Figure 4. Monostable Multivibrator

## 10.5. Bistable Multivibrator

The bistable multivibrator has both the two states stable. It requires the application of an external triggering pulse to change the operation from either one state to the other. Thus one pulse is used to generate half-cycle of square wave and another pulse to generate the next half-cycle of square wave. It is also known as a flip-flop multivibrator because of the two possible states it can assume.

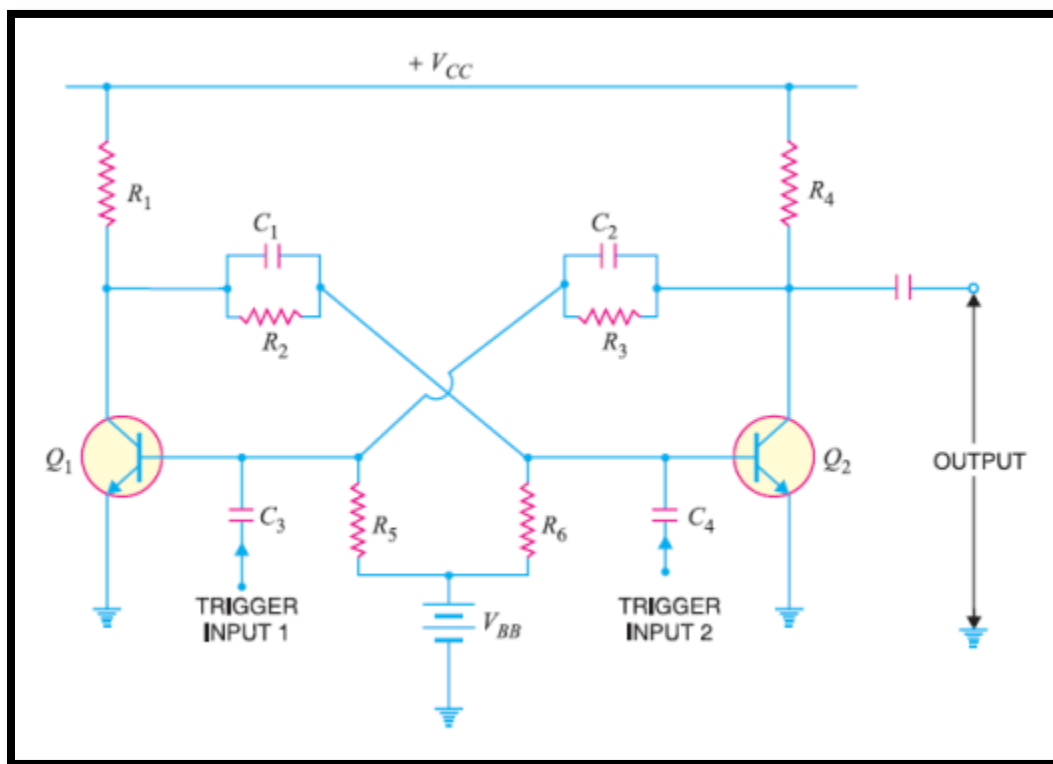


Figure 5. Bistable Multivibrator

## 10.6 References

Reference and Image Courtesy: Principles of Electronics, V.K. Mehta and Rohit Mehta, 11th Edition