CERTIFICATE

This is to Certify that Project Report entitled

" Astable Multivibrator "

Has been duly completed by following student in satisfactory manner under my guidance asa partial fulfillment for practical in B.sc . Final year (Physics)
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Multivibrator

Definition: An electronic device that produces a non-sinusoidal waveform as its output is known as a **Multivibrator**. The generated non-sinusoidal waveforms are basically a square wave, rectangular wave, a triangular wave, sawtooth wave, or ramp wave etc.

A multivibrator is an electronic circuit used to implement a variety of simple two-state systems such as light emitting diodes, timers and flip-flops. It is characterized by tow amplifying devices (transistors, electron tubes or other devices) cross-coupled by resistors and capacitors.

In its simplest form the multivibrator circuit consists of two cross-coupled by transistors. Using resistor-capacitor networks within the circuit to define the time periods of the unstable states, the various types may be implemented.

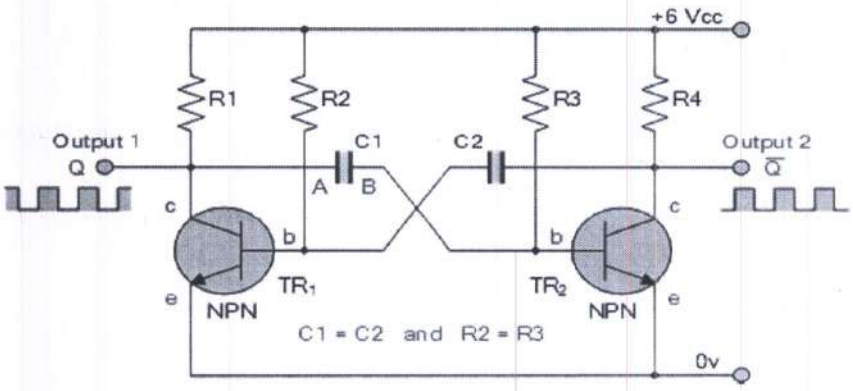
Types of Multivibrator

- Astable Multivibrator
- Monostable Multivibrator
- Bistable Multivibrator

Astable Multivibrator

Astable Multivibrators are free running oscillators which oscillate between two states continually producing two square wave output wavef

Diagrame:



Working :

Astable Multivibrator are the most commonly used type of relaxation oscillator because not only are they simple, reliable and ease of construction they also produce a constant square wave output waveform.

Unlike the Monostable Multivibrator or the Bistable Multivibrator we looked at in the previous tutorials that require an "external" trigger pulse for their operation, the **Astable Multivibrator** has automatic built in triggering which switches it continuously between its two unstable states both set and reset.

The **Astable Multivibrator** is another type of cross-coupled transistor switching circuit that has **NO** stable output states as it changes from one state to the other all the time. The astable circuit consists of two switching transistors, a cross-coupled feedback network, and two time delay capacitors which allows oscillation between the two states with no external triggering to produce the change in state.

In electronic circuits, astable multivibrators are also known as **Free-running Multivibrator** as they do not require any additional inputs or

external assistance to oscillate. Astable oscillators produce a continuous square wave from its output or outputs, (two outputs no inputs) which can then be used to flash lights or produce a sound in a loudspeaker.

Assume a 6 volt supply and that transistor, TR_1 has just switched "OFF" (cut-off) and its collector voltage is rising towards Vcc, meanwhile transistor TR_2 has just turned "ON". Plate "A" of capacitor C1 is also rising towards the +6 volts supply rail of Vcc as it is connected to the collector of TR_1 which is now cut-off. Since TR_1 is in cut-off, it conducts no current so there is no volt drop across load resistor R_1.

The other side of capacitor, C1, plate "B", is connected to the base terminal of transistor TR_2 and at 0.6v because transistor TR_2 is conducting (saturation). Therefore, capacitor C1 has a potential difference of +5.4 volts across its plates, (6.0 – 0.6v) from point A to point B.

Since TR_2 is fully-on, capacitor C_2 starts to charge up through resistor R_2 towards Vcc. When the voltage across capacitor C_2 rises to more than 0.6v, it biases transistor TR_1 into conduction and into saturation.

The instant that transistor, TR_1 switches "ON", plate "A" of the capacitor which was originally at Vcc potential, immediately falls to 0.6 volts. This rapid fall of voltage on plate "A" causes an equal and instantaneous fall in voltage on plate "B" therefore plate "B" of C1 is pulled down to -5.4v (a reverse charge) and this negative voltage swing is applied the base of TR_2 turning it hard "OFF". One unstable state.

Transistor TR_2 is driven into cut-off so capacitor C1 now begins to charge in the opposite direction via resistor R3 which is also connected to the +6 volts supply rail, Vcc. Thus the base of transistor TR_2 is now moving upwards in a positive direction towards Vcc with a time constant equal to the C1 x R3 combination.

However, it never reaches the value of Vcc because as soon as it gets to 0.6 volts positive, transistor TR_2 turns fully "ON" into saturation. This action starts the whole process over again but now with capacitor C2 taking the base of transistor TR_1 to -5.4v while charging up via resistor R2 and entering the second unstable state.

Then we can see that the circuit alternates between one unstable state in which transistor TR_1 is "OFF" and transistor TR_2 is "ON", and a second unstable in which TR_1 is "ON" and TR_2 is "OFF" at a rate determined

by the RC values. This process will repeat itself over and over again as long as the supply voltage is present.

The amplitude of the output waveform is approximately the same as the supply voltage, Vcc with the time period of each switching state determined by the time constant of the RC networks connected across the base terminals of the transistors. As the transistors are switching both "ON" and "OFF", the output at either collector will be a square wave with slightly rounded corners because of the current which charges the capacitors. This could be corrected by using more components as we will discuss later.

If the two time constants produced by C2 x R2 and C1 x R3 in the base circuits are the same, the mark-to-space ratio (t1/t2) will be equal to one-to-one making the output waveform symmetrical in shape. By varying the capacitors, C1, C2 or the resistors, R2, R3 the mark-to-space ratio and therefore the frequency can be altered.

We saw in the RC Discharging tutorial that the time taken for the voltage across a capacitor to fall to half the supply voltage, 0.5Vcc is equal to 0.69 time constants of the capacitor and resistor combination. Then taking one side of the astable multivibrator, the length of time that

transistor TR_2 is "OFF" will be equal to 0.69T or 0.69 times the time constant of C1 x R3. Likewise, the length of time that transistor TR_1 is "OFF" will be equal to 0.69T or 0.69 times the time constant of C2 x R2 and this is defined as.

Astable Multivibrators Periodic Time

$$\text{Periodic Time, } T = t_1 + t_2$$
$$t_1 = 0.69 C_1 R_3$$
$$t_2 = 0.69 C_2 R_2$$

Where, R is in Ω's and C in Farads.

By altering the time constant of just one RC network the mark-to-space ratio and frequency of the output waveform can be changed but normally by changing both RC time constants together at the same time, the output frequency will be altered keeping the mark-to-space ratios the same at one-to-one.

If the value of the capacitor C1 equals the value of the capacitor, C2, C1 = C2 and also the value of the base resistor R2 equals the value of the base resistor, R3, R2 = R3 then the total length of time of the **Multivibrators** cycle is given below for a symmetrical output waveform.

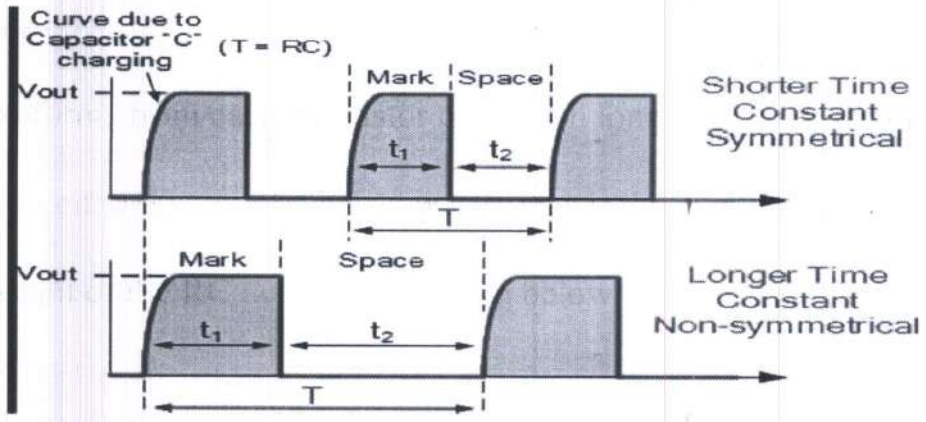
Frequency of Oscillation

$$f = \frac{1}{T} = \frac{1}{1.38RC}$$

Where, R is in Ω's, C is in Farads, T is in seconds and f is in Hertz.

and this is known as the "Pulse Repetition Frequency". So **Astable Multivibrators** can produce TWO very short square wave output waveforms from each transistor or a much longer rectangular shaped output either symmetrical or non-symmetrical depending upon the time constant of the RC network as shown below.

Astable Multivibrator Waveforms



Result :

In the session 2020-21 physics department group wise project are done for the topic Astable Multivibrator. In this project different types of components are used . Work are done during practical period and project successful done.

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Topic : Project

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