Multivibrators

- The Sequential Circuits depends on frequency of clock waveform for their operation.
- Clock waveforms are Square waves with sharp leading and trailing edges.
- Square waves are generated by using Square wave relaxation oscillators called ASTABLE MULTIVIBRATORS.

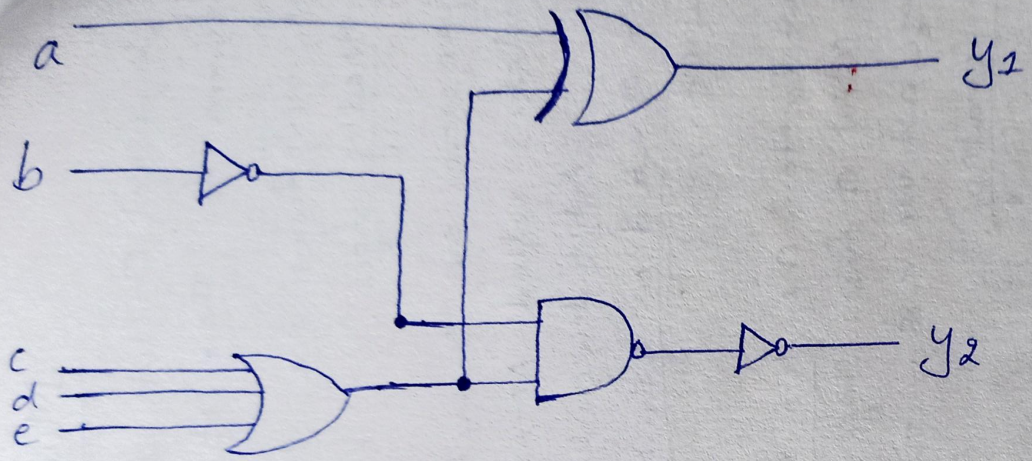
  Active devices such as BJT, FET, opAmp etc.. are operated in their relaxed modes of Saturation and Cut-off.

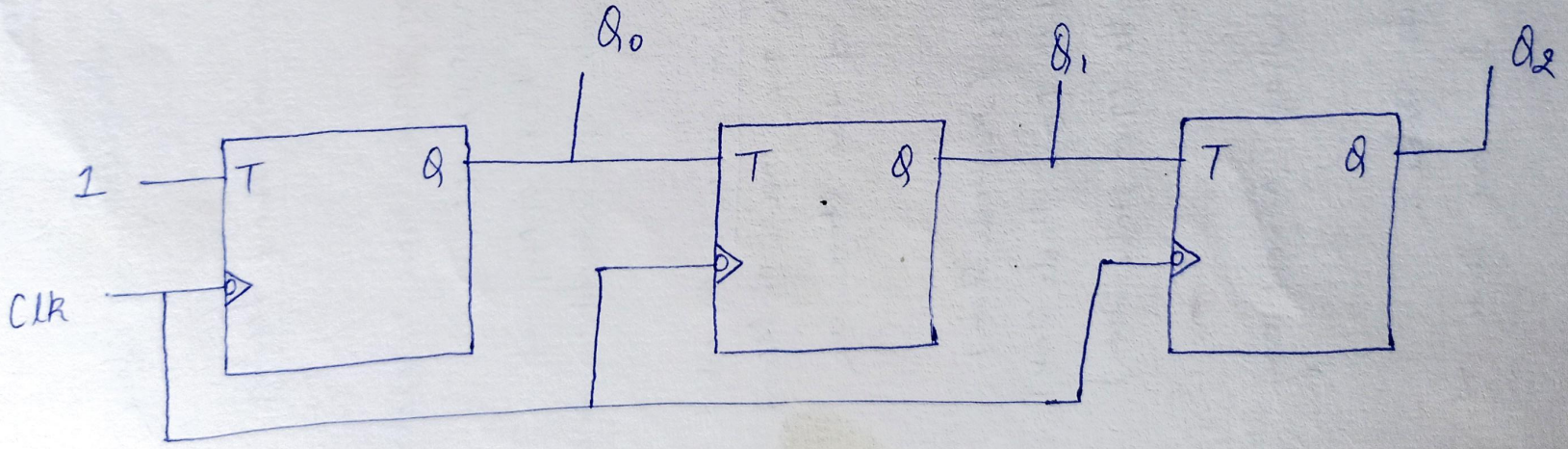
- Multivibrators are two-stage Switching Circuits in which the output of first stage is fed to the input of Second Stage and vice-versa. The outputs of two Stages are Complementary.
- Types of Multivibrators: (i) Astable (NO Stable State)
  (ii) monostable (One Stable State)
  (iii) Bi-Stable (Two Stable State)

ASTABLE MULTIVIBRATOR

- Free running square wave oscillator, without any external triggering Pulse.
- Both the States are Quasi-Stable.
- It Switches back & forth from one State to other.
- The time duration of a quasistable State depends on discharging of a capacitive circuit

Q0





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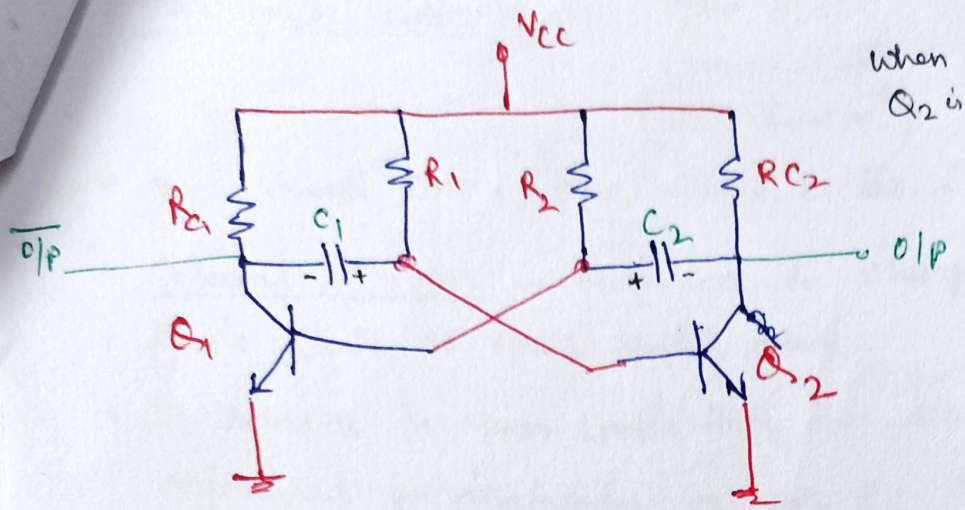
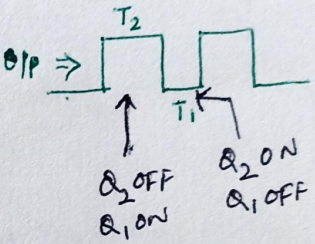


When switched on assume Q_2 is OFF & Q_1 is ON.

$$T_1 = R_1 C_1 \ln 2 = 0.693 R_1 C_1$$

$$T_2 = R_2 C_2 \ln 2 = 0.693 R_2 C_2$$

$$T = T_1 + T_2 = 0.693 (R_1 C_1 + R_2 C_2)$$



If $R_1 = R_2$, $C_1 = C_2$.

Then $\boxed{T = 1.386 RC}$ & $\boxed{f = \frac{1}{T} = \frac{1}{1.386 R}}$

Applications.

(1) As square wave generator, voltage to frequency converter. and in pulse synchronisation, as clock for binary logic circuits.

(2) It is a source of production of harmonics frequencies of higher order.

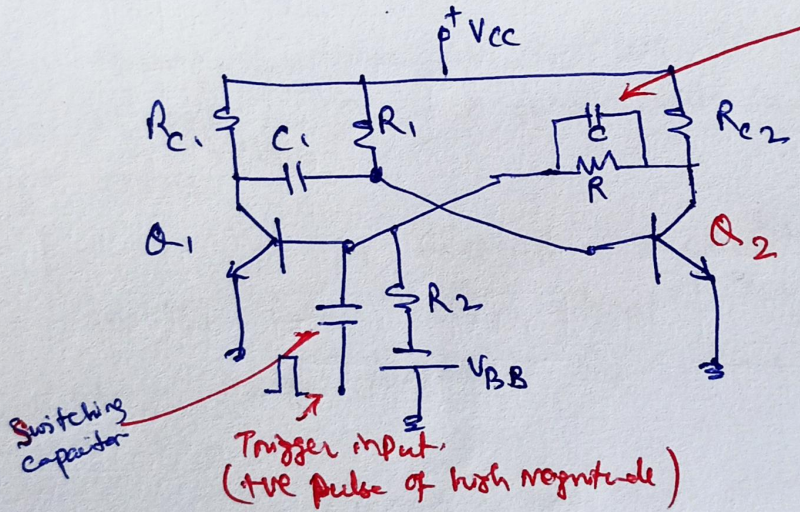
(3) used in DVM & SMPS.

(4) can be operated as oscillator over a wide range of audio & radio frequencies.

Monostable Multivibrator (one shot) (mono shot) (Uni vibrator.)

(92)

- One stable state, one quasi stable state.
- External trigger is required to change it from stable state to quasi stable state.
- It remains in quasi stable state for a limited time determined by discharge of an RC circuit which helps to change to stable state.

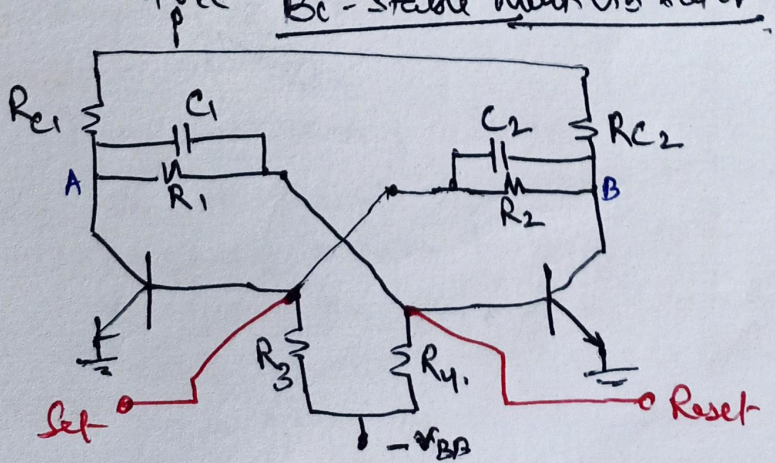


* The values of R_2 & $-V_{BB}$ is so choosen so as to reverse bias Q_1 and keep it in the off state.

Q_2 - ON, Q_1 - off → Stable state (After switch on of the ckt)

Q_1 - ON, Q_2 - off → quasi stable state

Bi-Stable Multivibrator



- C_1 & C_2 are to improve the switching characteristic by passing the high frequency components of square pulses applied at A & B. They are known as commutating capacitor.
- a +ve pulse at B is equivalent to a -ve pulse at A & vice-versa.

Operation

Let the transistor Q_1 is ON & Q_2 is off on switch on of the circuit

A positive triggering pulse applied to the base of Q_2 increase its forward bias, thereby turning the transistor Q_2 ON and an increase in collector current and a decrease in collector voltage.

The fall of collector voltage is coupled to the base of Q_1, where it reverse bias the base-emitter junction of Q_1. Thus Q_1 is turned off.

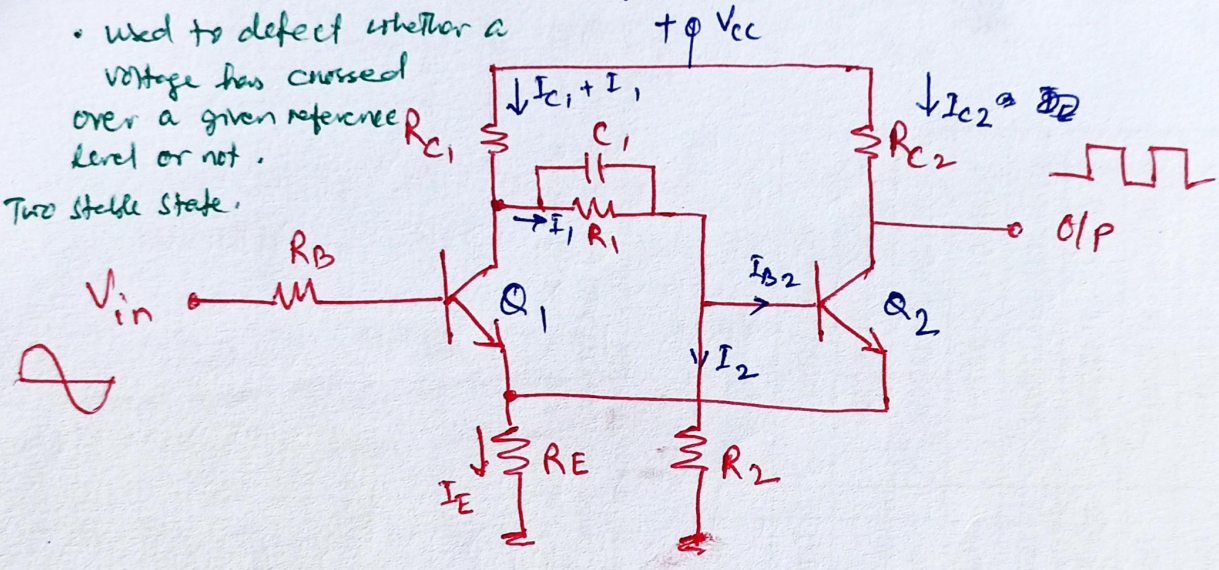
The circuit is now in its 2nd stable state, i.e Q_1 = off, Q_2 - ON. And will remain in this stable state till a +ve trigger pulse is applied to base of Q_1 to switch it ON.

Applications

(1) Used as memory element in shift register, counter etc..
(2) Used to generate square wave of symmetrical shape by sending regular triggering pulse to its inputs. By adjusting the frequency of triggering pulse, the width of the square wave can be altered.
(3) It can be used as frequency divider (Divide by 2).

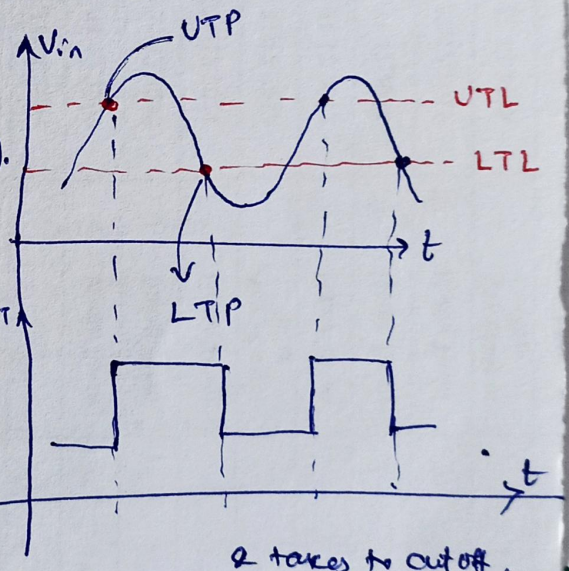
Schmitt TRIGER (Regenerative Comparator)

- It is a wave shaping circuit used for generation of a square wave from a sine wave input.
- It is a bistable Circuit in which two transistors Switches are Connected REGENERATIVELY.
- used to defect whether a voltage has crossed over a given reference level or not.
- Two stable state.



- Consist of two identical transistor Q_1 & Q_2 coupled through a emitter register R_E.
- R_1 & R_2 form a voltage divider across V_{C1} & ground. This Provide a the voltage to Base-Emitter junction of Q_2.
- when the Supply is switched ON, with no input signal, the transistor Q_2 starts Conducting.
- The rise in current I_E of Q_2 due to rise in I_{C2} of Q_2 causes a voltage droop across R_E.
- The voltage droop across R_E Provides a reverse bias across EB junction of Q_1 and it is driven to cut off.

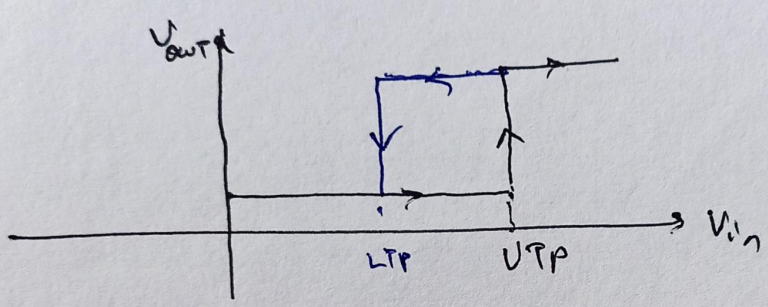
- Since Q_1 is in off state, the voltage at its Collector rises to V_{cc}.
- Since, the Collector of Q_1 is coupled to the base of Q_2 through R_1, the forward bias of transistor Q_2 is increased. Thus Q_2 is driven in to Saturation.
- At this state, $V_{C_1} = V_{cc}$, & $V_{C_2} = V_{CE}(sat)$.
- Now Consider an a.c Signal of Sinusoidal or triangular variation is applied to base of Q_1.
- when the voltage increases above zero, nothing will happen till it crosses the upper Trigger level(UTL).



- As the input > UTL i.e $V_{in} \geq V_{RE} + V_{BE1}$, Q_1 conduct
- As Q_1 conduct, its collector voltage falls below V_{cc} and. is coupled to base of Q_2, whose forward bias is reduced. This in turn reduces I_E and Corrector current of Q_2 ∴ O/p is high = V_{cc}.
- & takes to cut off.
- Reverse bias Q_2, so turn it off.
- Transistor Q_1 conduct till the input reaches @ LTL. The BE junction of Q_1 became small enough to make Q_1 ON. so Q_1 goes to off state and $V_{C_1} = V_{cc}$.
- $V_{C_1} = V_{cc}$ makes Q_2 forward biased due to speed up capacitor and make Q_2 ON.

- No change in the state of Q_1 & Q_2, for -ve half cycle (if any) in input voltage as it is below LTL.

- The Difference between UTP and LTP is known as hysteresis voltage (V_H). This is also known as Dead Zone of Schmmit Trigger.



Applications

1. Used as wave shaping circuit.
2. Used for generation of sharp edged rectangular wave form from other wave forms
3. It can be used as voltage Comparator.
4. The hysteresis in Schmmit trigger is valuable when conditioning noisy signals for use in digital circuits. The noise does not cause false Triggering and so the O/p is free from noise. (Provide noise immunity)
5. hysteisis can be eliminated by keeping $R_{C_1} = R_{C_2}$ in the circuit.

Reducing hysteresis increases rise & fall times of the output.