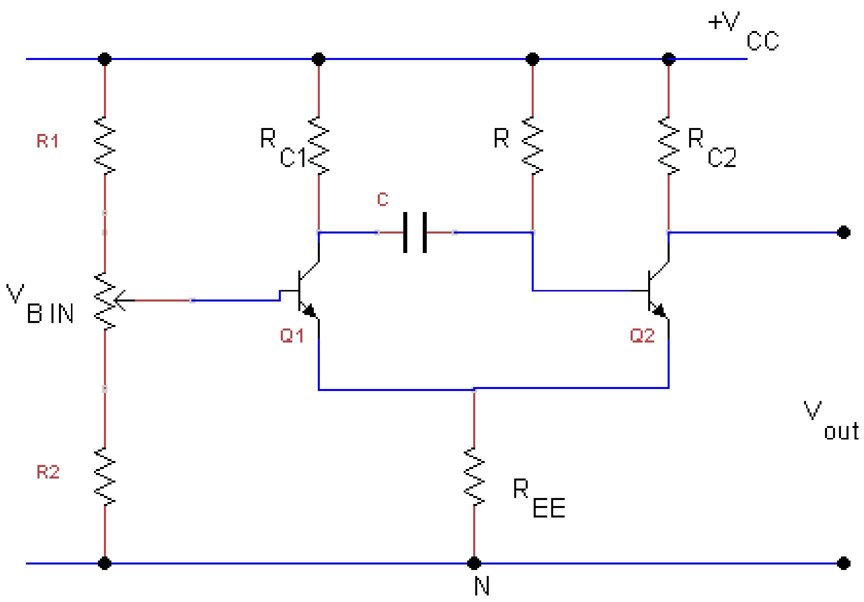
Emitter Coupled Monostable Multivibrator

Below figure shows the circuit diagram of an emitter coupled mono-stable multi-vibrator.



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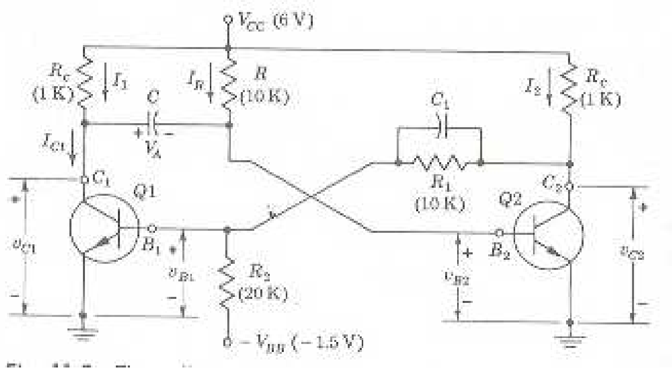
It can be observed that the feedback resistive coupling network from the collector of transistor Q_2 to the base of transistor Q_1 is absent. instead, the regenerative feedback at the change over from one state to other is provided by the common emitter resistor R_{EE}. The absence of any coupling from the collector of the transistor Q_2 makes it an excellent output point. This has the further advantage of making the mono stable period independent of any load variation. Further the common emitter resistor voltage drop $V_{E,}$ Swamps the temperature variation in V_{BE}, on with temperature and thus makes time period or delay period stable. Further it is possible to have the voltage controlled delay, by controlling delay , by controlling the collector current to the transistor Q_1 during quasi-stable state. The collector current of transistor Q_1 can be varied by changing the forward bias of the transistor $Q_{1.}$

The emitter coupled mono-stable multi-vibrator has the limitation of lower input voltage. In the normal stable state transistor Q_2 is in the saturation region and transistor Q_1 is OFF. On application of an appropriate trigger pulse, the transistor Q_2 starts to work in the active region reducing the common emitter voltage and forward biasing the transistor Q_1. When transistor Q_1 begins to conduct its collector voltage falls from V_{CC}. This is a negative change and is transferred by the timing capacitor C, the base of the transistor Q_2 reducing the forward bias. Thus both the transistors are in active region and regenerative feedback ultimately forces transistor Q_2 OFF and transistor Q_1 in the ON state, which may be in the active region of saturation region depending upon the circuit.

Problem:

Compute the voltage levels for the below waveforms for a collector-coupled multi Whose components and supply voltages are as given in figure. Silicon transistors are

Used with $r_{bb'} = 200\Omega and h_{FE} = 30$.



Solution:

for t<0 , Q1 OFF & Q2 ON ,

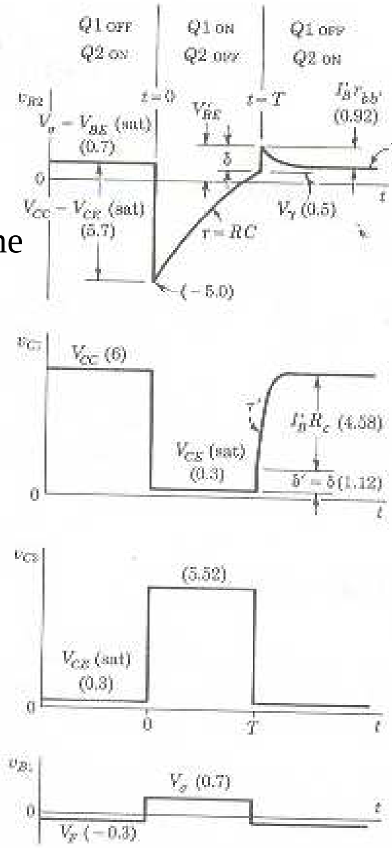
Here $v_{C1} = V_{CC}, v_{C2} = V_{CE(sat)}, v_{B2} = V_{BE(sat)}$

And $v_{B1} = \dfrac{-V_{BB}R_1}{R_1 + R_2} + \dfrac{V_{CE(sat)}R_2}{R_1 + R_2} = V_F$

By substituting all the values,

$v_{C1} = 6V, v_{C2} = V_{CE(sat)} = 0.3V, v_{B2} = V_{BE(sat)} = 0.7V$

v_{B1}= -0.3V



As a result of trigger applied at t=0 ,

Q2 goes OFF and Q1 conducts.

So the voltages v_{C1} and v_{B2} drop abruptly by the same

Amount.

Under these circumstances

$v_{C1} = V_{CE(sat)} = 0.3V, v_{B1} = V_{BE(sat)} = 0.7V$ and

$v_{B2} = V_{BE(sat)} - (V_{CC} - V_{CE(sat)}) = -5V$

$$v_{C2} = \frac{V_{CC} R_1}{R_1 + R_C} + \frac{V_{BE(sat)} R_C}{R_1 + R_C} = 5.52V$$

For t >T , we know

$\delta = I_B{}' r_{bb'} + V_{BE(sat)} - V_\gamma$ and $\delta' = V_{CC} - I_B{}' R_c - V_{CE(sat)}$

$$I_B{}' = \frac{V_{CC} - V_{CE(sat)} - V_{BE(sat)} + V_\gamma}{R_c + r_{bb'}} = 4.58\text{mA}$$

Hence $\delta = \delta' = 1.12V$