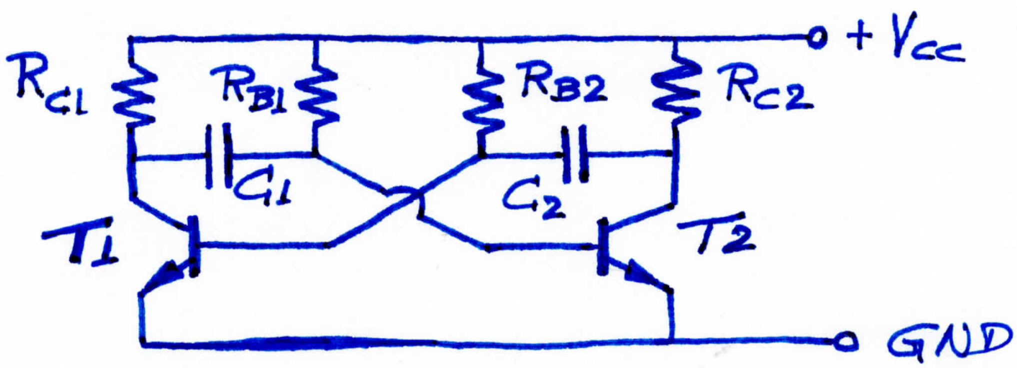
Iconic circuit: Astable flip-flop circuit

Circuit with two states, none stable, always switching between states. ⇒ Astable flip-flop (non-stable flip-flop). Historical name: Multivibrator circuit. ⇒ Oscillation at a range of frequencies and containing harmonics. Also: First product of the **HP** Company.



General observation: $\mathbf{R_B \gg R_C}$

If C charges through R_C ⇒ Fast charge

If C charges through R_B ⇒ Slow charge

Transistors are either ON or OFF

↳ Saturation

How does the circuit work?

⇒ Assume $T_1 = ON$ $T_2 = OFF$

⇒ C_2 charged to $(V_{cc} - 0.7V)$.

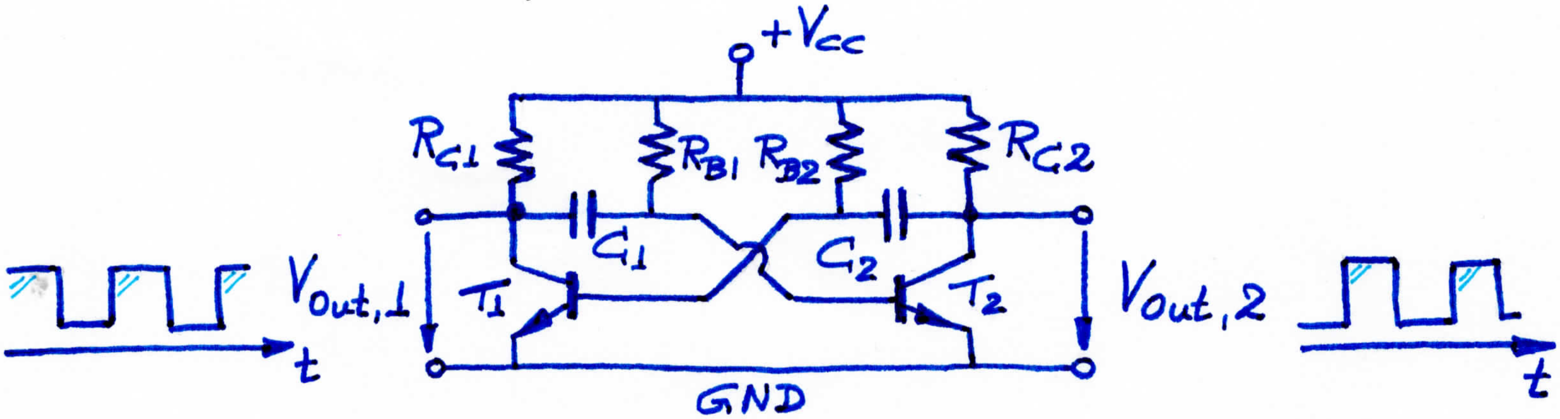
C_1 charges (slowly) through R_{B1} ⇒ Then T_2's V_{BE} becomes $> 0.7V$ ⇒ $T_2 = ON$ ⇒ T_2's $V_C \approx 0$ ⇒ C_2 (which is charged) causes T_1's V_{BE} to be negative ⇒ $T_1 = OFF$

⇒ C_1 charged to $(V_{cc} - 0.7V)$.

C_2 charges (slowly) through R_{B2} ⇒ Then T_1's V_{BE} becomes $> 0.7V$ ⇒ $T_1 = ON$ ⇒ T_1's $V_C \approx 0$ ⇒ C_1 (which is charged) causes T_2's V_{BE} to be negative ⇒ $T_2 = OFF$

... this completes one full cycle of oscillation

Circuit output:



$V_{out,1}$ and $V_{out,2}$ are complementary.

Switching time for symmetric circuit

$$\tau = RC = R_{B1} C_1 = R_{B2} C_2$$

Period of oscillation

$$T = 2\tau = 2 \, R_B C$$

$C = C_1 = C_2$

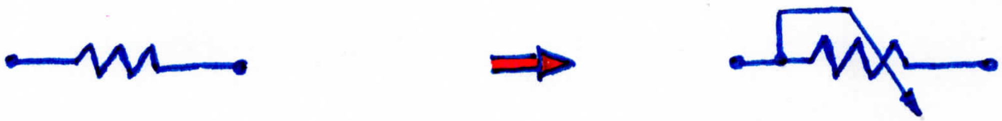
$R_B = R_{B1} = R_{B2}$

Applications for astable flip-flop circuit:

* Audio signals and sounds
* Signal generator
* Frequency synthesizer

How can we change the frequency ?

* Change of R_{B1} and R_{B2}



* Change of C_1 and C_2