CSE2209: Digital Electronics and Pulse Techniques

Course Conducted By:

Nowshin Nawar Arony

Lecturer, Dept of CSE, AUST

Multivibrators

A MULTIVIBRATOR is an electronic circuit that generates square, rectangular, pulse waveforms, also called nonlinear oscillators or function generators.

Multivibrator is basically two amplifier circuits arranged with regenerative feedback.

There are three types of Multivibrator:

Astable Multivibrator: Circuit is not stable in either state—it continuously oscillates from one state to the other. (Application in Oscillators)

Monostable Multivibrator: One of the state is stable but the other is not. (Application in Timer)

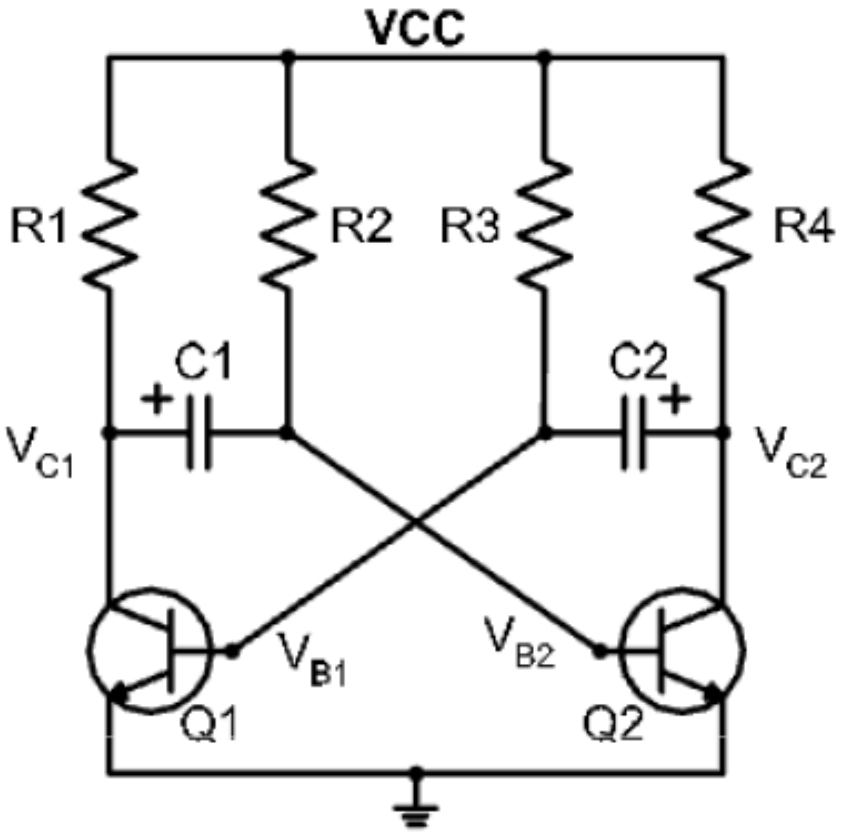
Bistable Multivibrator: Circuit is stable in both the state and will remain in either state indefinitely. The circuit can be flipped from one state to the other by an external event or trigger. (Application in Flip flop)

Astable Multivibrators

The astable circuit has no stable state. With no external signal applied, the transistors alternately switch from cutoff to saturation at a frequency determined by the RC time constants of the coupling circuits.

Astable multivibrator circuit consist of two cross coupled RC amplifiers.

Consists of two amplifying devices cross-coupled by resistors and capacitors.
Typically, R2 = R3, R1 = R4, C1 = C2 and R2 >> R1.



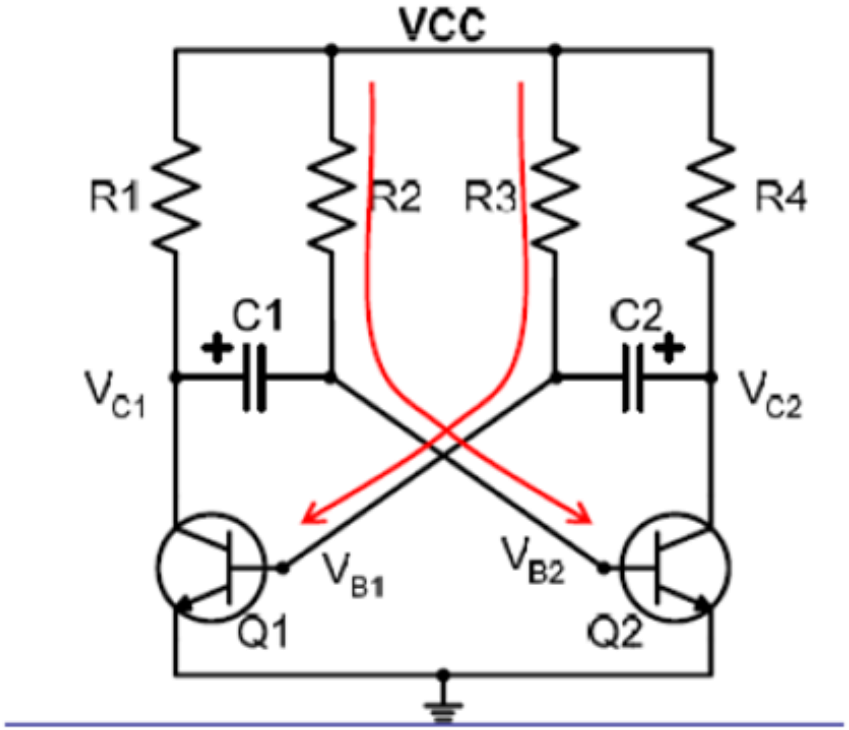
Astable Multivibrator

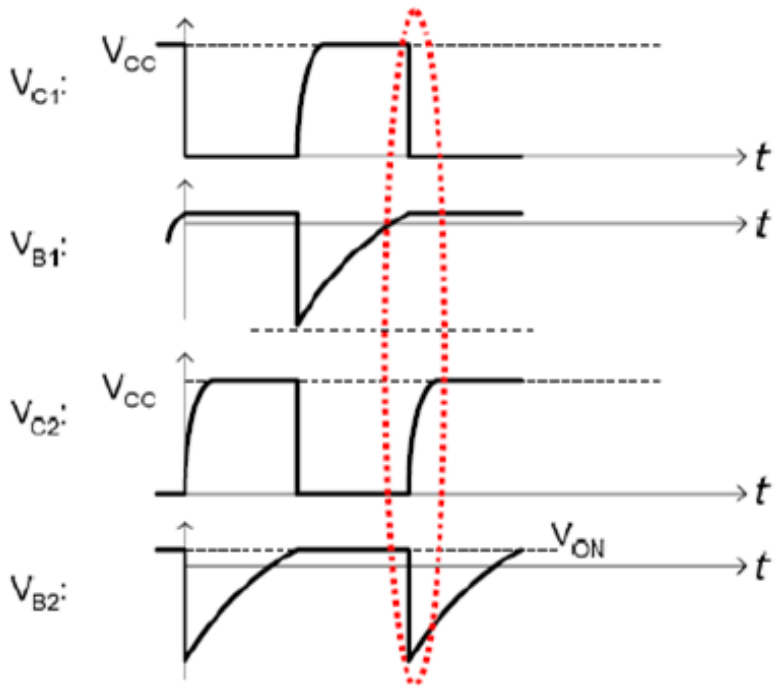
- The circuit has two states

State 1: V_{C1} LOW, V_{C2} HIGH, Q_1 ON (saturation) and Q_2 OFF.
State 2: V_{C1} HIGH, V_{C2} LOW, Q_1 OFF and Q_2 ON (saturation).

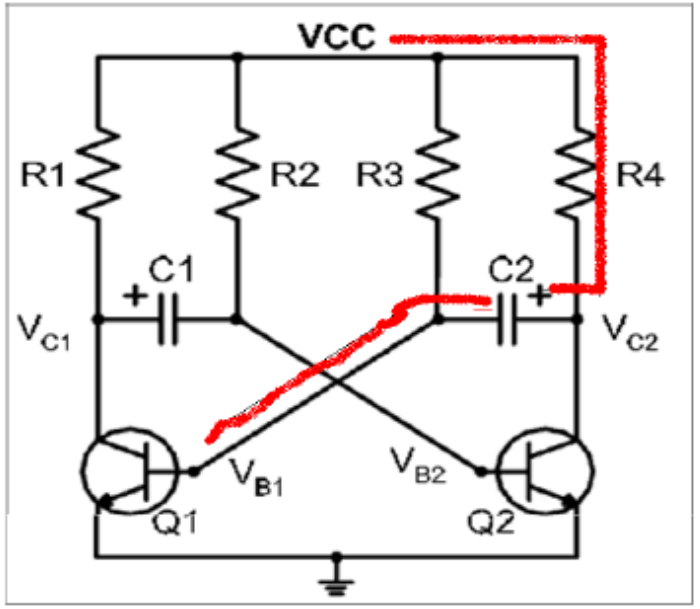
- It continuously oscillates from one state to the other.

- When the circuit is first powered up, neither transistor is ON.
- Both V_{B1} and V_{B2} rise via base resistor R_3 and R_2 respectively. Any one of the transistor will conduct faster than other due to some circuit imbalance. We cannot say which transistor will turn on first so for analysis purpose we assume Q_1 conducts first and Q_2 off (C_1 is fully charged).
- Since Q_1 conducts and Q_2 off hence $V_{c1} = 0V$ and $V_{c2} = V_{CC}$. - state1

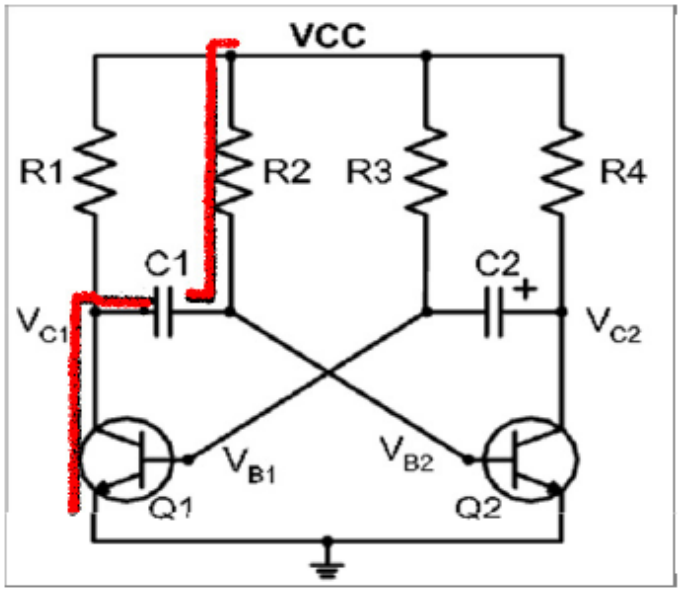


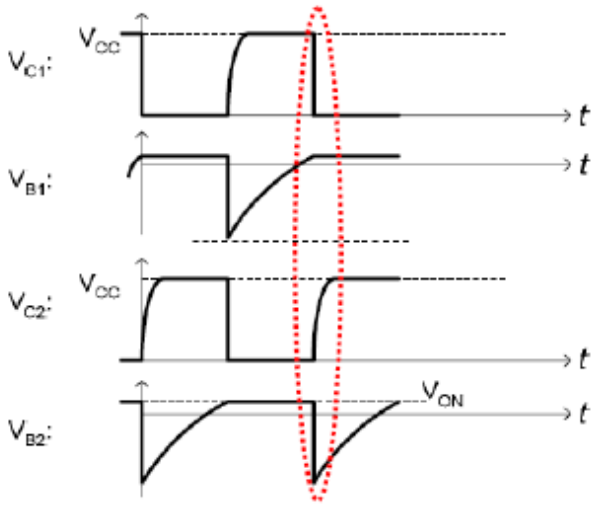


Charging $C_2(T_2 = R_4C_2)$



Discharging $C_1(T1 = R_2C_1)$





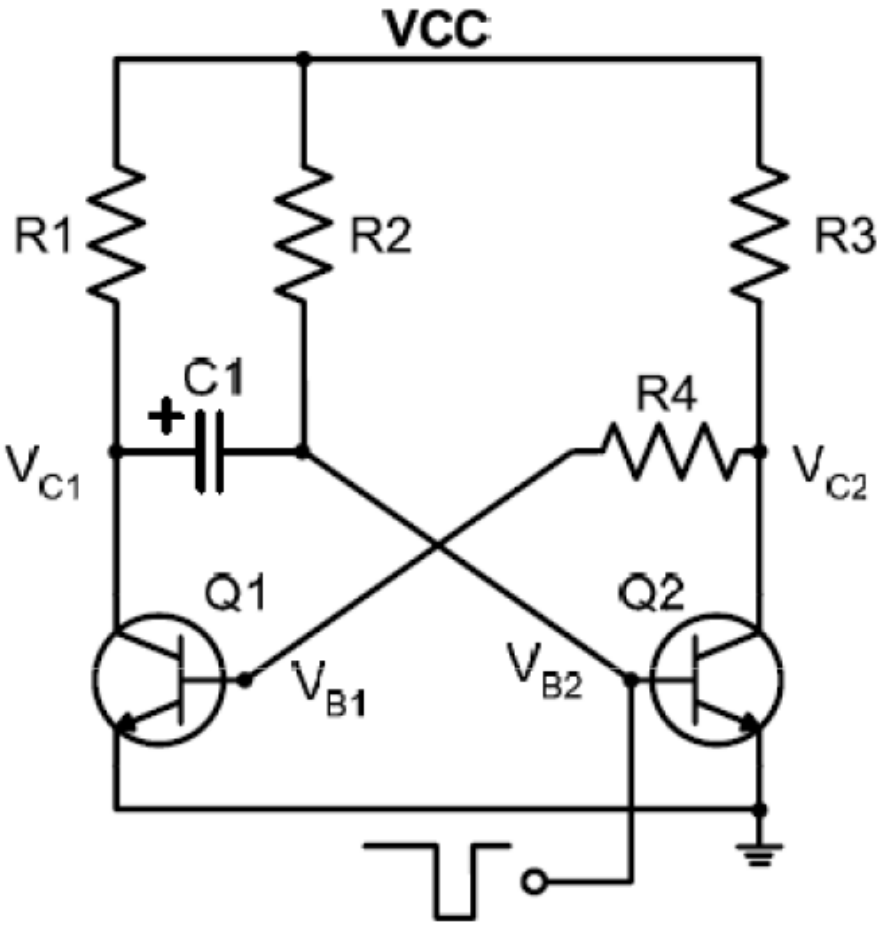
- Since Q_1 conducts and Q_2 off hence V_{c1} = 0V and $V_{c2} = V_{CC}$. Due to higher voltage at V_{c2}, capacitor C_2 will be charged via R_4 (low resistance path because $R_4 < R_2$). C_1 (which was charged earlier, and can not hold the charge for indefinite period) starts discharging via R_2 (high resistance path because $R_2 > R_1$). Time taken to discharge $C_1(T_1 = R_2C_1)$ > time taken to charge C_2 $(T_2 = R_4C_2)$

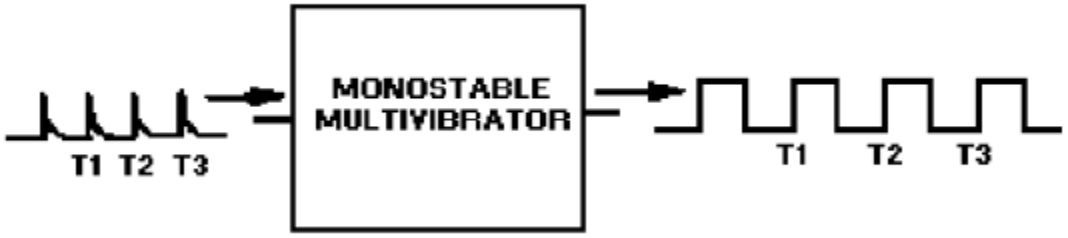
- When C_2 is fully charged then left plate of C_2 will be at $-V_{cc}$ which switch off the Q_1. When C_1 is fully discharged then left plate of C_1 will be at $+V_{cc}$ which switch on the Q_2. – State 2

When V_{B2} reaches V_{on}, the circuit enters in state 1 again, and the process repeats.

Monostable Multivibrators

- One of the state is stable but the other is not. For that capacitive path between V_{C2} and V_{B1} removed.
- In stable state any one transistor conducts and other is off.
- Application of external trigger change the state.
- When the external signal goes high
  - ✓ V_{B2} charges up to V_{CC} through R_2
  - ✓ After a certain time T, $V_{B2}=V_{ON}$, Q2 turns on
  - ✓ V_{C2} pulled to 0V, Q1 turns off.
- Enters state 1 and remains there
- When V_{B2} is momentarily pulled to ground by an external signal
  - ✓ V_{C2} rises to V_{CC}
  - ✓ Q1 turns on
  - ✓ V_{C1} pulled to 0V





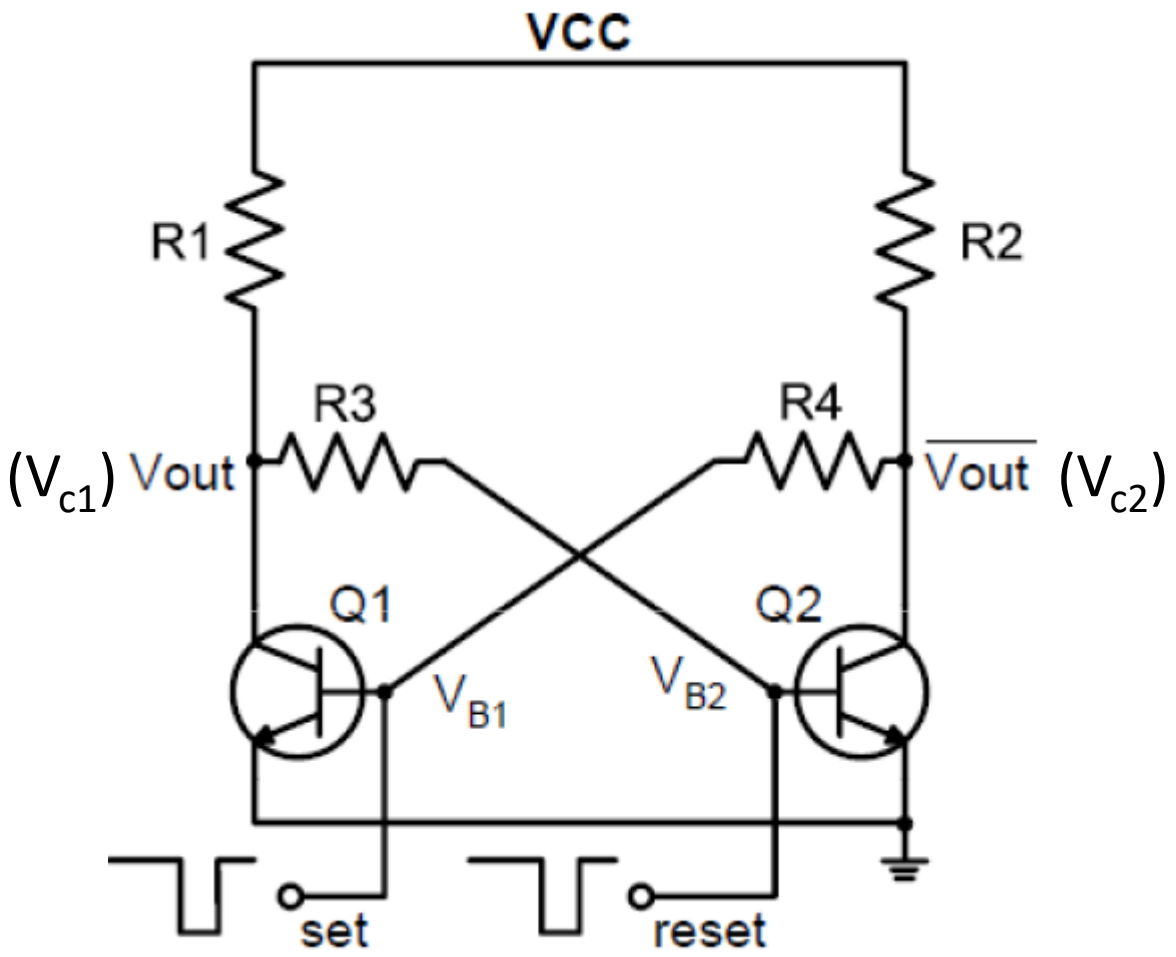
Bistable Multivibrators

- Both capacitors removed
  - ✓ Stable for either state 1 or 2
  - ✓ Can be forced to either state by Set or
  - ✓ Reset signals

- If Set is low,
  - ✓ Q1 turns off
  - ✓ V_{C1} (Vout) and V_{B2} rises towards V_{CC}
  - ✓ Q2 turns on
  - ✓ V_{C2} pulled to 0V
  - ✓ V_{B1} is latched to 0V
  - ✓ Circuit remains in state 2 until Reset is low

- If Reset is low
  - ✓ Similar operation
  - ✓ Circuit remains in state 1 until Set is low
  - ✓ Behave as an RS flip-flop (memory element)

- Behave as an RS flip-flop (memory element)



- Multivibrators find applications in a variety of systems where square waves or timed intervals are required.

Question:

Why multivibrator is used in electrical circuit? Explain the working principle of different types of multivibrator with their application.

Reference:

- Dr. A. P. VAJPEYI, Lec-18: Multivibrators , Analog & Digital Electronics, Course No: PH-218, Department of Physics, Indian Institute of Technology Guwahati, India

- Chapter 18 – Transistor Oscillators and Multivibrators, Electronic Devices and Circuits by Allen Mottershed