

Project Report

Project Title:

Design and Implementation of a BJT-Based Astable Multivibrator

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1. Introduction

An astable multivibrator is an oscillator circuit that continuously switches between its two unstable states without requiring any external triggering. This project explores the design and working of a BJT (Bipolar Junction Transistor)-based astable multivibrator using fundamental electronic components. The circuit generates a square wave output and serves as a building block in applications such as timers, blinking LEDs, and pulse generators.

2. Objective

To design, construct, and analyze the performance of an astable multivibrator using NPN BJTs and passive components.

3. Components Used

- NPN Transistors (e.g., BC547 or 2N3904) – 2
 - Resistors (e.g., 1kOhm to 100kOhm) – 4
 - Capacitors (e.g., 10 μ F to 100 μ F) – 2
 - LEDs (optional for output visualization) – 2
 - Power Supply – 5V to 12V DC
 - Breadboard or PCB for assembly
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4. Circuit Explanation

The BJT astable multivibrator consists of two cross-coupled NPN transistors. Each transistor's collector is connected to the base of the opposite transistor through a capacitor, and the bases are also connected to ground via resistors.

When power is applied, one transistor turns ON slightly faster due to component tolerances, causing the other to turn OFF. The ON transistor charges a capacitor, which then discharges into the base of the other transistor, toggling its state. This cycle continues indefinitely, generating a square wave at both collectors.

5. Working Principle

1. When power is applied, a small mismatch causes one transistor (say Q1) to turn ON first.
2. Q1 conducts, pulling its collector low and turning Q2 OFF.
3. The capacitor connected between Q1's collector and Q2's base charges and then discharges, triggering Q2 to turn ON and Q1 OFF.
4. This switching continues indefinitely, forming an oscillating square wave output at both collectors.

The time period (T) of one complete cycle is approximately given by:

$$T \approx 1.38 \times R \times C$$

Where R is the base resistor and C is the coupling capacitor.

6. Applications

- LED blinking circuits
- Clock pulse generation
- Tone generation
- Timing control circuits
- Signal generators

7. Observations

- The oscillation frequency depends on the resistor and capacitor values.
 - Both outputs are square waves but 180 degrees out of phase.
 - LEDs blink alternately, indicating proper switching.
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8. Future Work

- Implement the circuit using SMD components for compact design.
 - Add a variable resistor (potentiometer) to adjust frequency.
 - Simulate the design using software like LTspice or KiCad for waveform analysis.
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9. Conclusion

The BJT astable multivibrator is a simple and effective way to generate a square wave without external triggering. It demonstrates basic principles of transistor switching, timing components, and feedback. This project successfully shows how two transistors can be used in a feedback loop to create an oscillating output, and is foundational for understanding digital electronics and waveform generation.