

## Research Migration Project

<https://esim.fossee.in/research-migration-project>

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**Topic:** Design and Simulation of Colpitts Oscillator using Transistor

### Abstract

The Colpitts oscillator is a widely used electronic circuit designed to generate high-frequency sinusoidal waveforms. This project focuses on the design and simulation of a Colpitts oscillator. The circuit employs a common NPN transistor as the active element and an LC tank circuit for frequency determination.

The design parameters were selected to achieve an output frequency of approximately 1.27 MHz. Key components include a 1 mH inductor and two capacitors (1 nF and 15 nF), which form the resonant circuit. Biasing resistors and a DC power supply of 12V were used to ensure proper transistor operation.

### Keywords

Colpitts oscillator, circuit simulation, LC tank circuit, sinusoidal waveform.

### Introduction

The Colpitts oscillator is a widely used electronic oscillator that generates sinusoidal waveforms. It finds applications in radio frequency (RF) signal generation, communication systems, and frequency modulation.

The Colpitts oscillator uses a combination of an LC tank circuit and a transistor-based amplifier to produce sustained oscillations. The tank circuit consists of an inductor (L) and a capacitive divider (C1 and C2), which determine the oscillator's

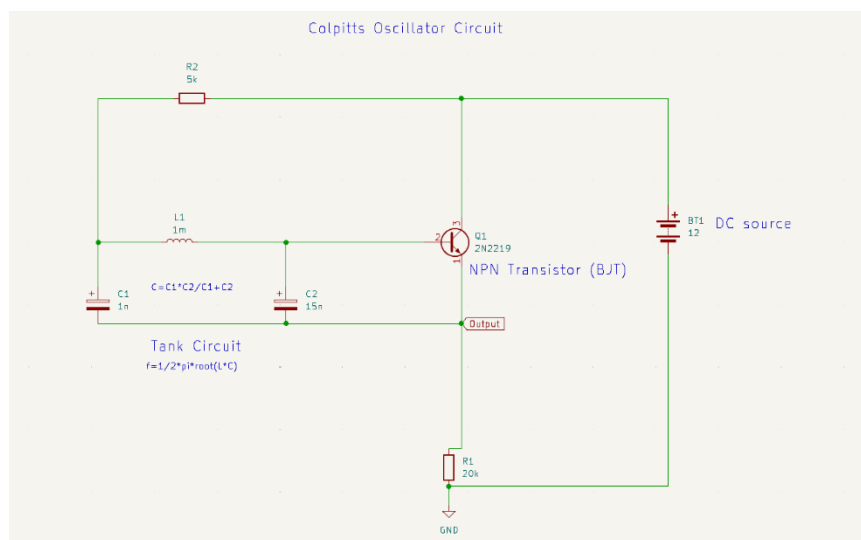
resonant frequency,  $f = \frac{1}{2\pi\sqrt{L \cdot C_{eq}}}$ , where  $C_{eq} = \frac{C_1 \cdot C_2}{C_1 + C_2}$

## Circuit Design

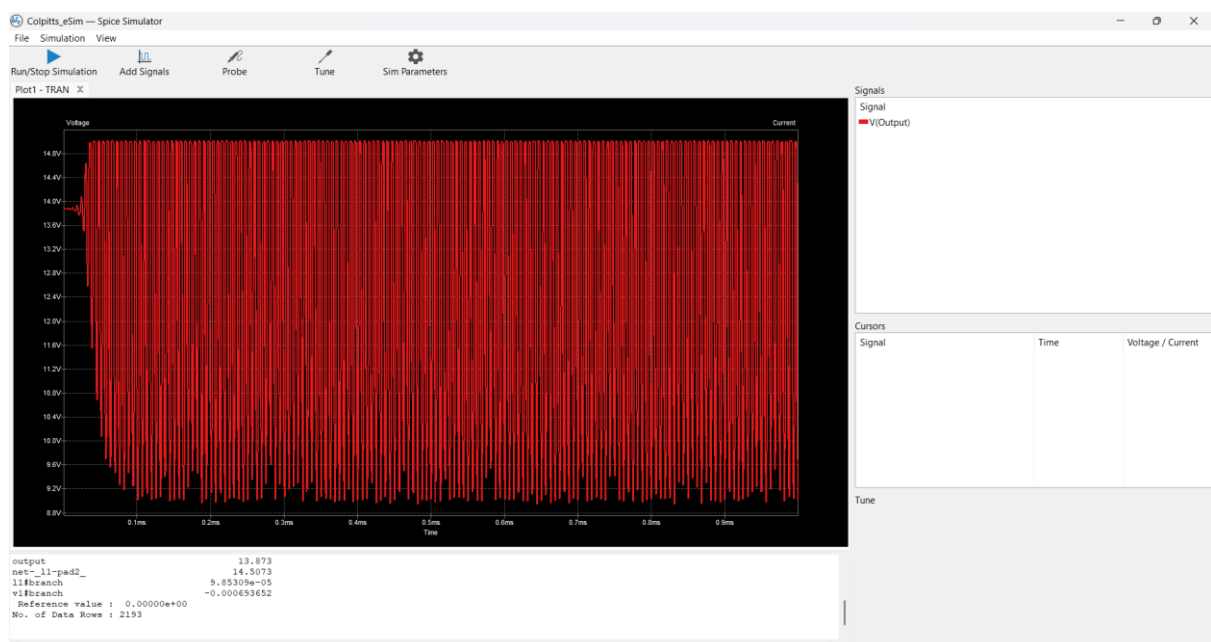
The Colpitts oscillator circuit was designed with the following components:

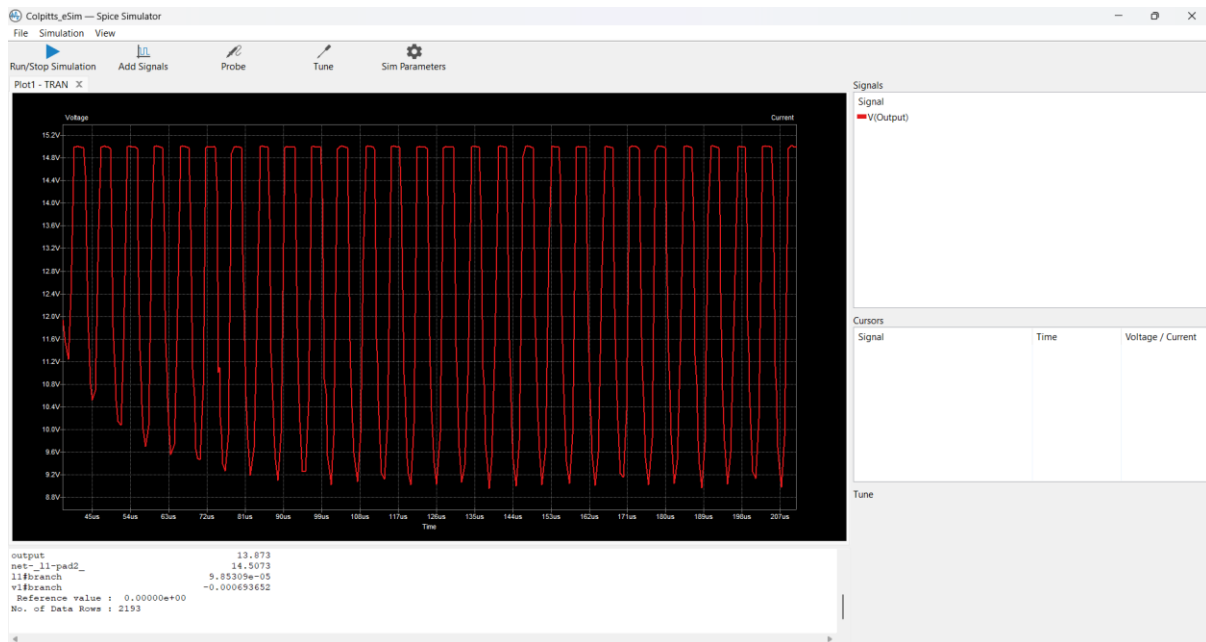
- **Active Element:** NPN transistor (Q1)
- **Capacitors:** C1 = 1 nF, C2 = 15 nF
- **Inductor:** L1 = 1 mH
- **Resistors:** R1 = 20 k $\Omega$ , R2 = 5 k $\Omega$  (biasing network)
- **Power Supply:** DC voltage source (12 V)

## Circuit Schematic



## Output Waveform





## Results

The simulation produced a stable sinusoidal output waveform at the desired frequency of approximately 1.27 MHz. The results confirmed the expected behavior of the Colpitts oscillator.

Key observations include:

- Start-up time for oscillations to stabilize.
- Output amplitude of the sinusoidal signal.

## Conclusion

This project successfully demonstrated the design and simulation of a Colpitts oscillator using transistor. The results validate the functionality of the oscillator circuit and its capability to generate sinusoidal waveforms at a specific frequency.

## References

<https://www.electronics-tutorials.ws/oscillator/colpitts.html>

<https://www.elprocus.com/colpitts-oscillator-circuit-working-and-applications/>