RC-Phase_Oscillator -- Overview

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OBJECTIVES

To design a RC phase shift oscillator to generate sine wave form of required frequency.

COMPONENTS

- Transistor- BC 547
- Resistors
- Capacitors
- Breadboard & connecting wires

EQUIPMENTS

- TBS1KB-Edu Oscilloscope from Tektronix (or any other DSO)
- Regulated Power Supply

PRELAB QUESTIONS

1. State the Barkhausen criteria for sustained oscillation.
2. What type of feedback is used for oscillator?
3. How oscillation is produced?
4. Differentiate between an amplifier and an oscillator?

THEORY

- An oscillator is a circuit, which generates AC output signal without giving any input AC signal. This circuit is usually applied for audio frequencies only.
- The basic requirement for an oscillator is positive feedback.
- The operation of the RC Phase Shift Oscillator:
  - The starting voltage is provided by noise, which is produced due to random motion of electrons in resistors used in the circuit.
  - The noise voltage contains almost all the sinusoidal frequencies.
  - This low amplitude noise voltage gets amplified appears at the output terminals.

The amplified noise drives the feedback network which is the phase

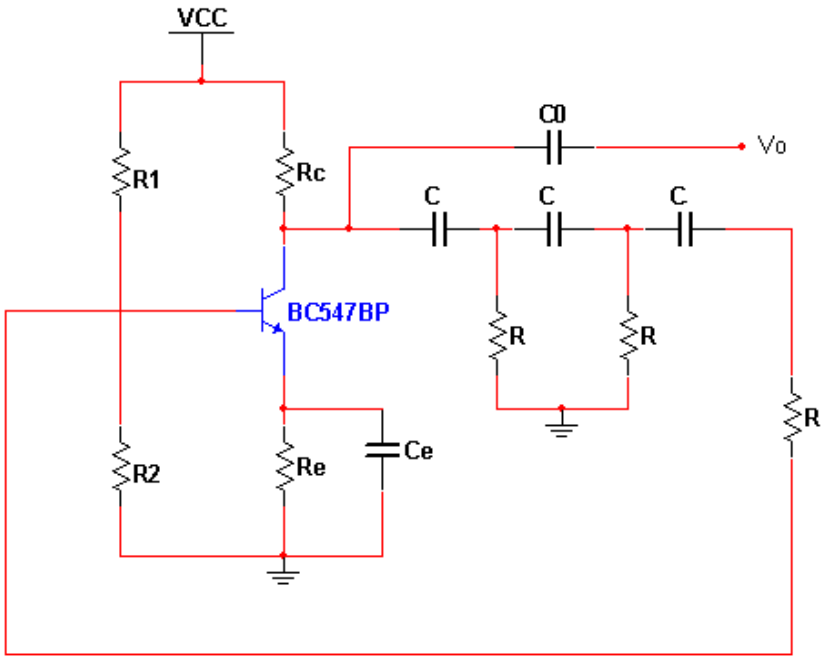
shift network. Because of this the feedback voltage is maximum at a particular frequency, which in turn represents the frequency of oscillation.

  - Furthermore, the phase shift required for positive feedback is correct at this frequency only.
- The expression for frequency of oscillation for RC Phase Shift Oscillator is

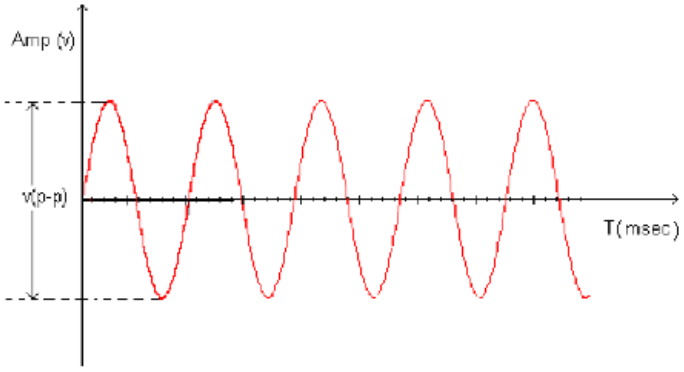
$$f = \frac{1}{2\Pi RC\sqrt{6+4\left(R_C/R\right)}}$$

- Hence, RC Phase Shift Oscillator produces an output which is 180 degree out of phase to the input and also the desired frequency selection can be obtained.

CIRCUIT DIAGRAM



MODEL GRAPH / EXPECTED OUTPUT



RC-Phase_Oscillator -- Procedures

Step 1

Design of Circuit Components

V_{cc} =12V I_C = 4mA h_{fe} = 200

a) To determine voltages

$$V_{Rc} = 40\%\ V_{cc}$$

$$V_{Re} = 10\%\ V_{cc}$$

$$V_{Ce} = 50\%\ V_{cc}$$

b) To design Rc, Re

$$V_{Rc} = I_C \times Rc$$

$$V_{Re} = I_E \times \mathrm{Re}$$

c) To design R1, R2

$$I_B = \frac{I_C}{h_{fe}}$$

$$I_{R1} = 10\ I_B$$

$$I_{R2} = 9\ I_B$$

$$V_{R2} = V_{BE} + V_{Re}$$

$$R_2 = \frac{V_{R2}}{9 I_B}$$

$$V_{R1} = V_{cc} - V_{R2}$$

$$R_1 = \frac{V_{R1}}{10 I_B}$$

d) To design bypass capacitor:

$$X_{CE} = \frac{R_E}{10}$$

$$C_E = \frac{10}{2\pi f R_E}$$

e) To design feedback circuit:

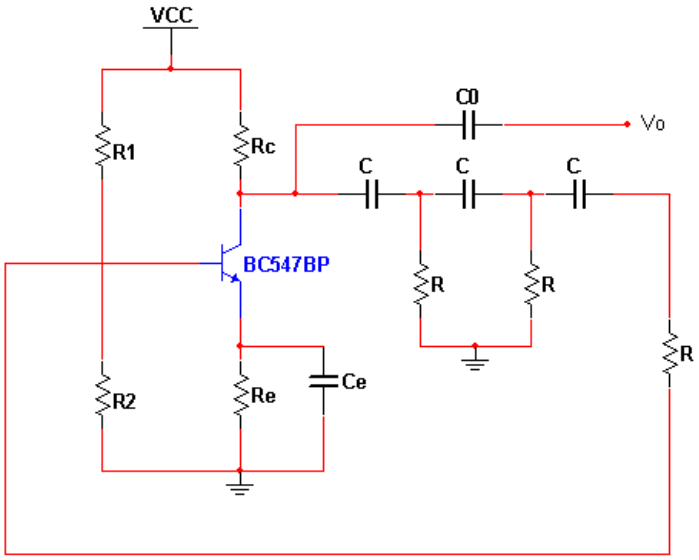
Let frequency, f= 5 kHz, R = 1kΩ

Using the formula, compute the value of capacitance.

$$f = \frac{1}{2\Pi RC\sqrt{6+4\left(R_C/R\right)}}$$

Step 2

Build the circuit with designed component values.



Step 3

Connect the oscilloscope at the collector terminal and observe the waveform after providing DC supply.

Step 4

Add FREQUENCY measurement on the acquired waveform on digital oscilloscope

Step 5

Tabulate the readings and compare the measured frequency against calculated frequency of oscillation

Signal	Amplitude (Volts)	Time period (seconds)

Step 6

Post-Lab Questions:

- What are the practical apllications of RC phase shift oscillator?

- The feedback components used in RC phase oscillator are ____.
- RC phase shift oscillator belongs to the category of _____.
- What happens when CE is removed? Why?

Step 7

Result:

Amplitude of the sinewave = _____

Frequency of the Sinewave =_____