

Experiment 8

Aim:

Simulation of RC Phase Shift Oscillator using LT Spice

Tools and Apparatus:

LTSpice, BJT Transistor, Resistors, Capacitors, Voltage Sources

Theory and Design:

⇒ RC Phase Shift Oscillator :

→ As we are using BJT in Common Emitter configuration, the output signal will be 180° out of phase with input signal.

→ This signal is passed through RC section. Therefore it will be 360° out of phase or exact same phase as that of input signal.

→ This will create sustained oscillations.

→ Signals are generated without any input source.

→ Positive feedback is created through RC Phase shift and smooth sinusoidal waveform is generated with particular frequency.

* There should be:

- ① Positive Feedback
- ② Same phase shift between input and output signals (0° or 360°)
- ③ No input signal needed

* 2 types of gains:

- ① Circuit Gain (A)
- ② Feedback Gain (B)

$AB=1$

- For $AB=1$, any loss or gain in the circuit should be compensated by RC section.
- RC section is a passive circuit so there will be attenuation. This attenuation has to be compensated by amplifier circuit to obtain sustained oscillations.
- Thermal noise will be created due to resistance. This will create a movement in charge which will again get amplified therefore no input signal is needed.

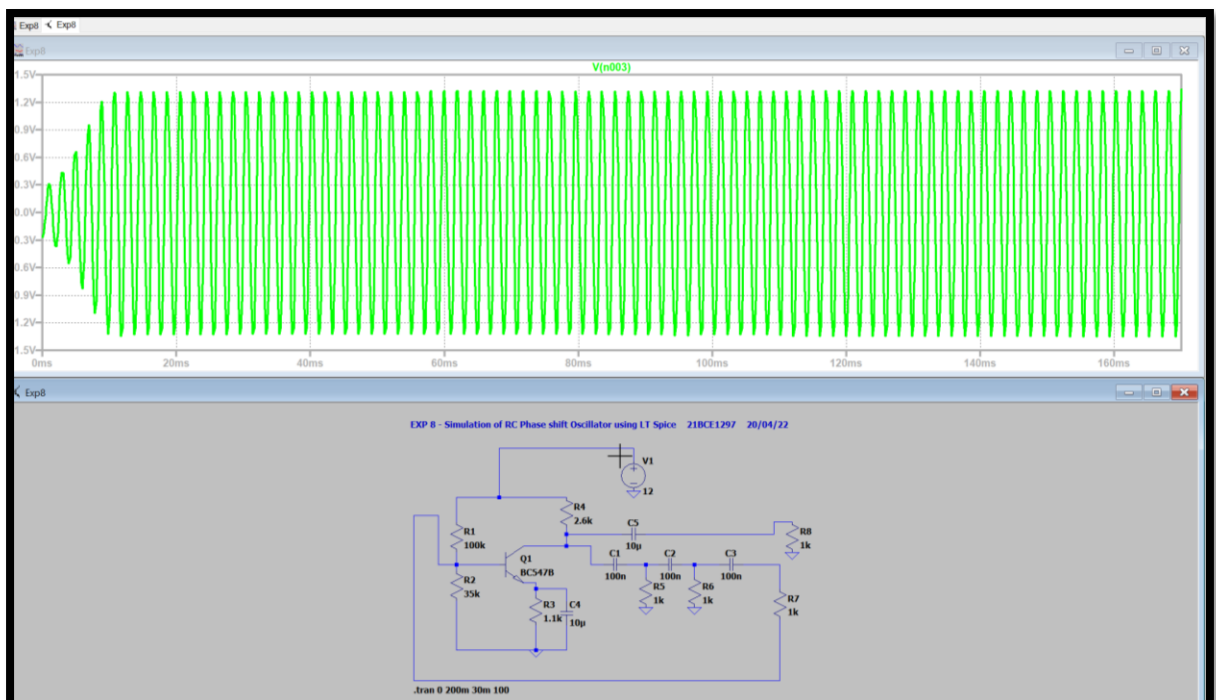
$$\text{Frequency of Oscillation } (f_o) = \frac{1}{2\pi RC\sqrt{2N}} = \frac{1}{\sqrt{2\pi RC\sqrt{6}}}$$

↳ Without Load
Res.

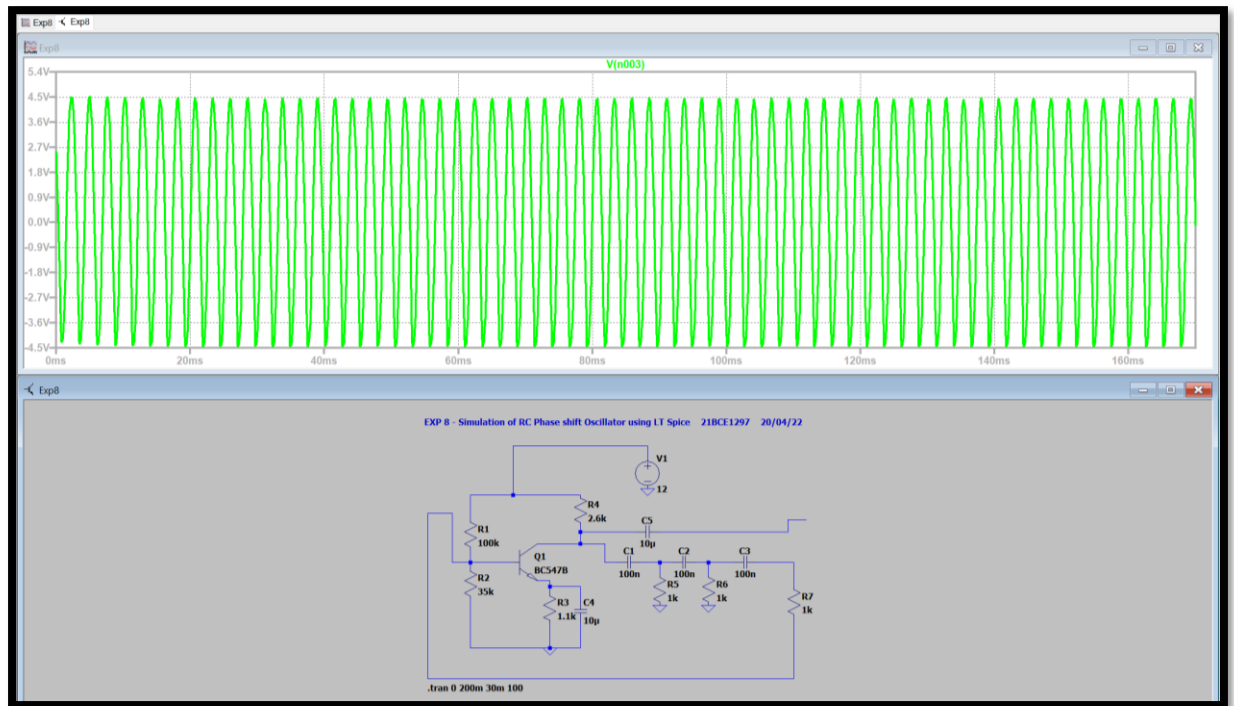
$$\text{Frequency of Oscillation } (f_o) = \frac{1}{2\pi RC\sqrt{6 + \frac{4R_L}{R}}}$$

Simulation Results:

1. With Load



2. Without Load



Conclusion:

1. With Load:

- $f_0 = \frac{1}{T} = \frac{1}{63.80-61.87} \times 10^3 = 517.15 \text{ Hz (Simulated)}$
- $f_0 = \frac{1}{2\pi RC\sqrt{2N}} = \frac{1}{2\pi(1k\Omega)(100nF)\sqrt{6}} = 649.75 \text{ Hz (Calculated)}$

2. Without Load:

- $f_0 = \frac{1}{T} = \frac{1}{62.41-59.82} \times 10^3 = 386.6 \text{ Hz (Simulated)}$
- $f_0 = \frac{1}{2\pi RC\sqrt{2N+4\times\frac{R_C}{R}}} = \frac{1}{2\pi(1k\Omega)(100nF)\sqrt{6+4\times\frac{2.6}{1}}} = 393.005 \text{ Hz (Calculated)}$

Inferences:

1. Oscillation frequency (f_0):
 - a. With Load: 500-600 Hz
 - b. Without Load: 350-400 Hz
2. It gives positive feedback and no input source is needed.
3. Minimum 3 RC sections should be connected to obtain better waveform
4. Marginal error occurs between stimulated and calculated values due to loading effect.
5. Connect all components properly.