EE254

Project 6

12/6/13

# Oscillator Circuits

The main objective of this experiment is to learn, design, simulate and build two different types of oscillator and then test the two circuits. The two oscillators built were op-amp based oscillator and a discrete oscillator. Both circuits were simulated in microcap and the components were adjusted accordingly to achieve the required specification.

## Op-amp based Oscillator

The Wien-bridge circuit type was the choice of op-amp based oscillator designed. Figure 1 shows the circuit that was designed using 5 KHz as the frequency specification. In order to achieve the required frequency, the resistor and capacitor values were calculated as shown in the calculation section. The op-amp was connected in a non-inverting configuration and two RC networks connected as the frequency-selecting feedback circuit. The circuit was analyzed from loop gain as shown in the calculation section.

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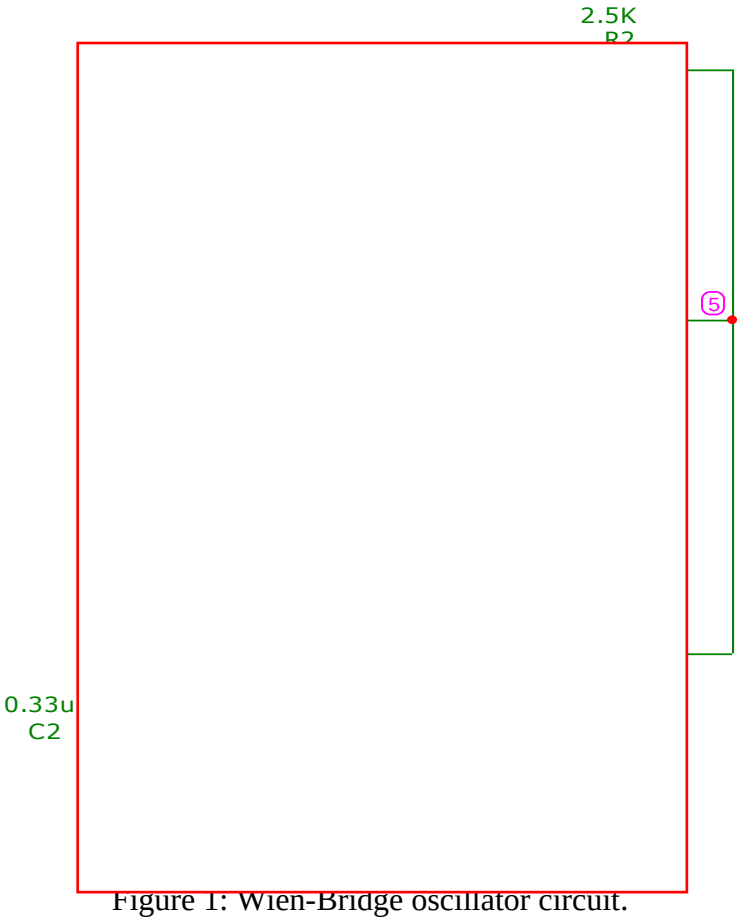



Figure 1: Wien-Bridge oscillator circuit.

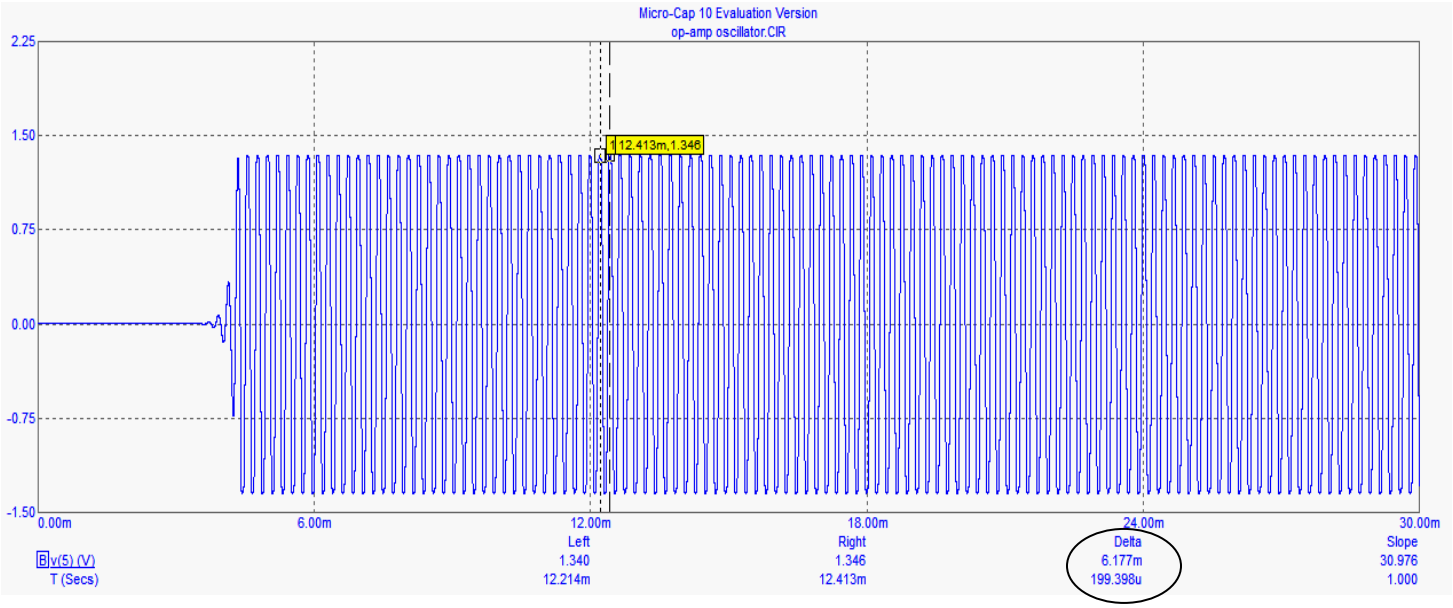



Figure 2: Simulation results from the circuit in figure 1. The period was obtained as 199.398us (circled)

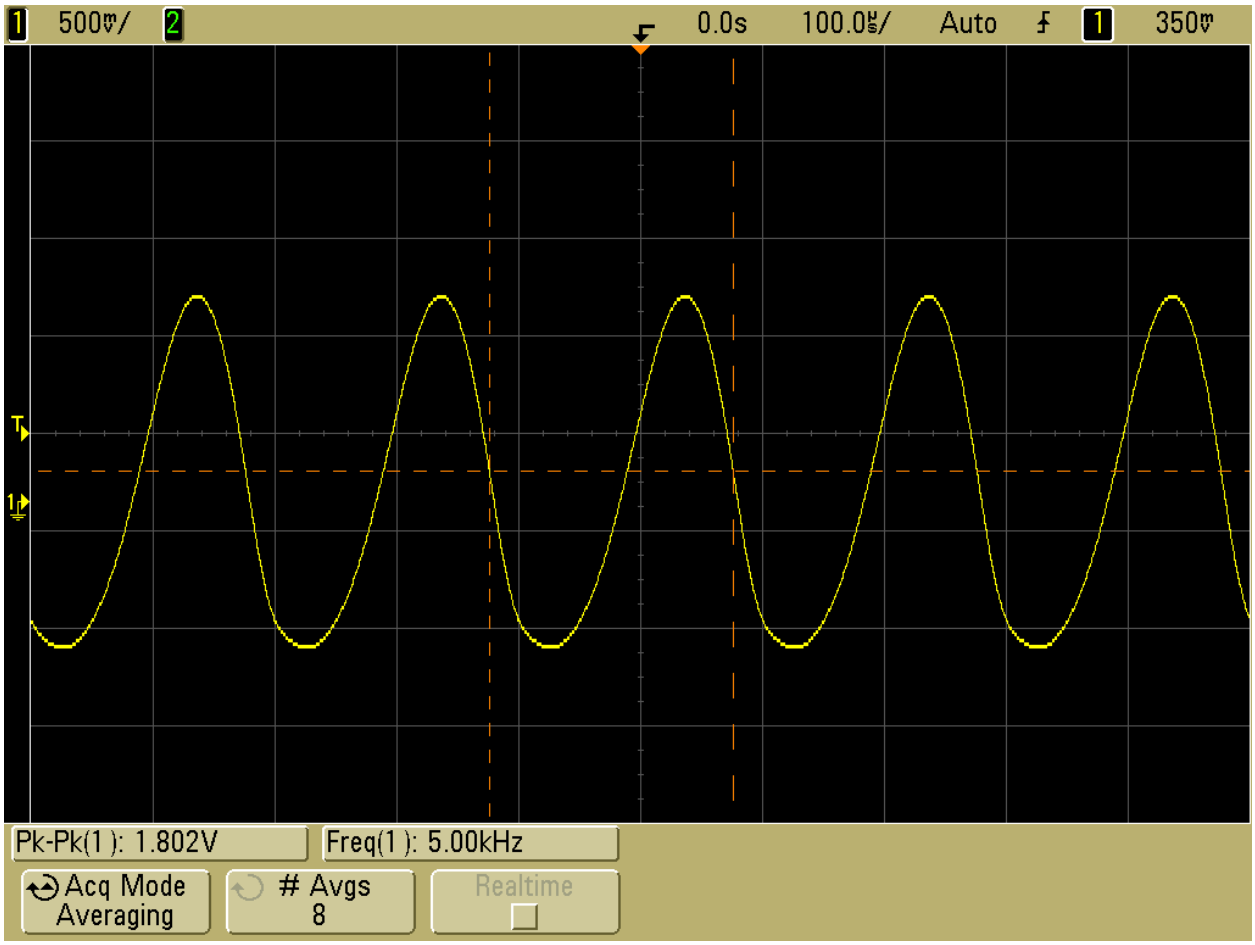



Figure 3: Vo obtained from the built circuit. $R_2$ resistor and the V+/V- were changed several times to achieve a smooth waveform.

**Discrete Oscillator Circuit**

The Colpitts Oscillator with a BJT transistor was designed and the component values calculated as shown in the calculation section. The capacitors were chosen then using the appropriate formula, the inductance value was obtained. The simulated circuit is shown in figure 4 then the obtained waveform is shown in [redacted]e frequency calculated as shown below.

$f$ [redacted]

The circuit was built using electrolytic capacitors but did not produce the right results so the values were recalculated as shown in the calculation section in order to use the available ceramic capacitors. After building the circuit, the right result was obtained and the waveform was saved as shown in figure 6.

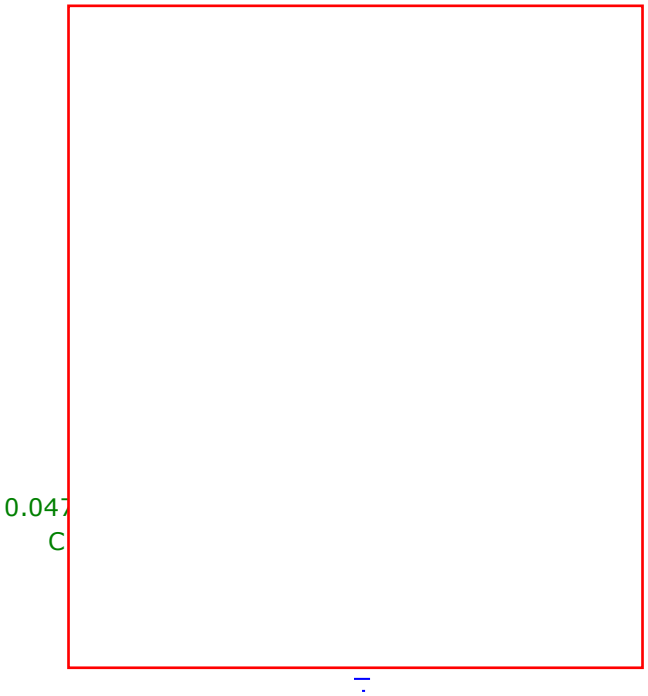



Figure 4: Colpitts oscillator circuit using BJT transistor.

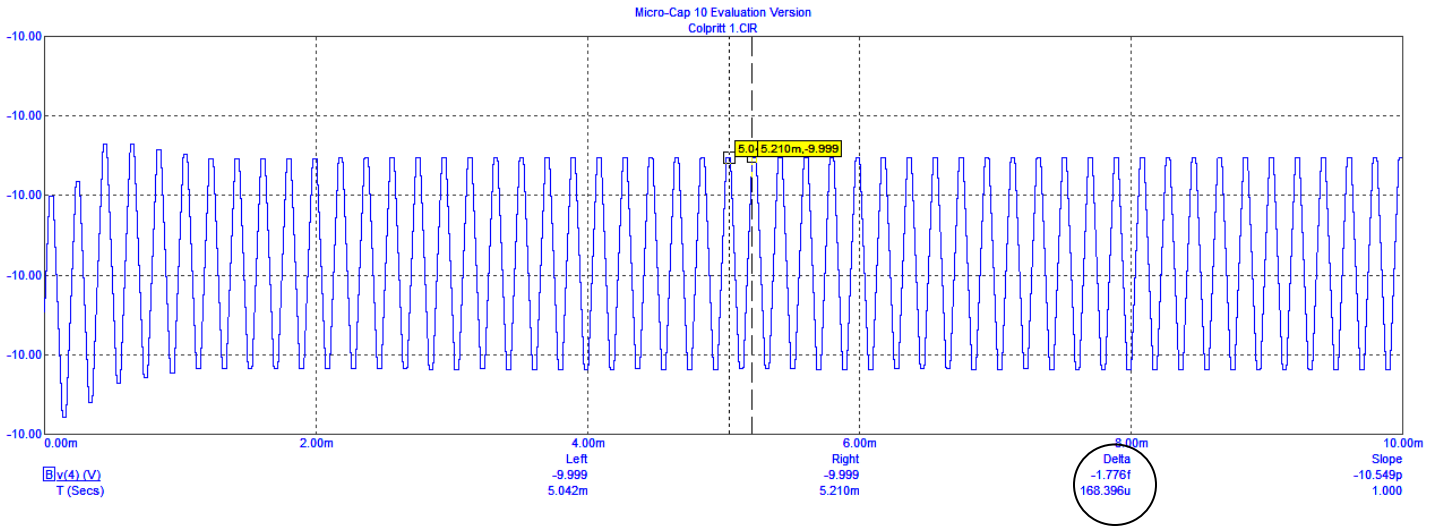



Figure 5: Simulation results from the circuit in figure 4. The period was obtained as 168.396us (circled)

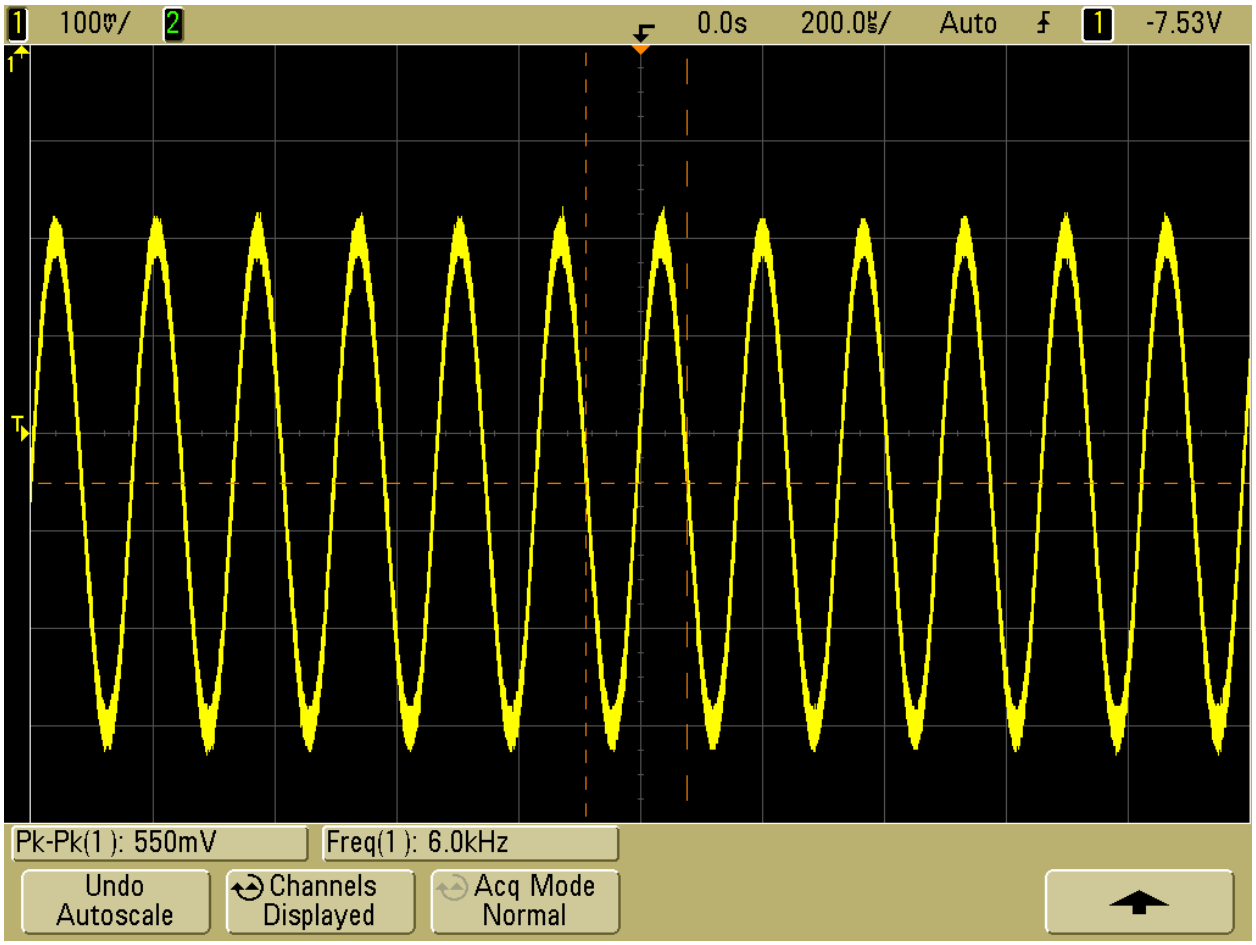
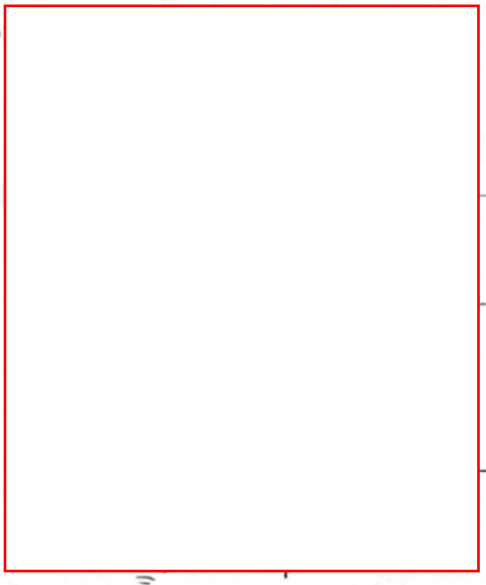



Figure 6: Waveform obtained from the colpitts circuit. A 0.01uF was connected in parallel with C2 and the right frequency was produced.

# Calculation

(1) Wien

Freq




Loop gain $= T(s) = \left(1 + \frac{R_2}{R_1}\right)\left(\frac{Z_p}{Z_p + Z_s}\right)$ $\qquad Z_p = \frac{R}{1 + sRC}$ , $Z_s = \frac{1 + sRC}{sC}$

$T(s) = (1 + R_2$

$T(j$

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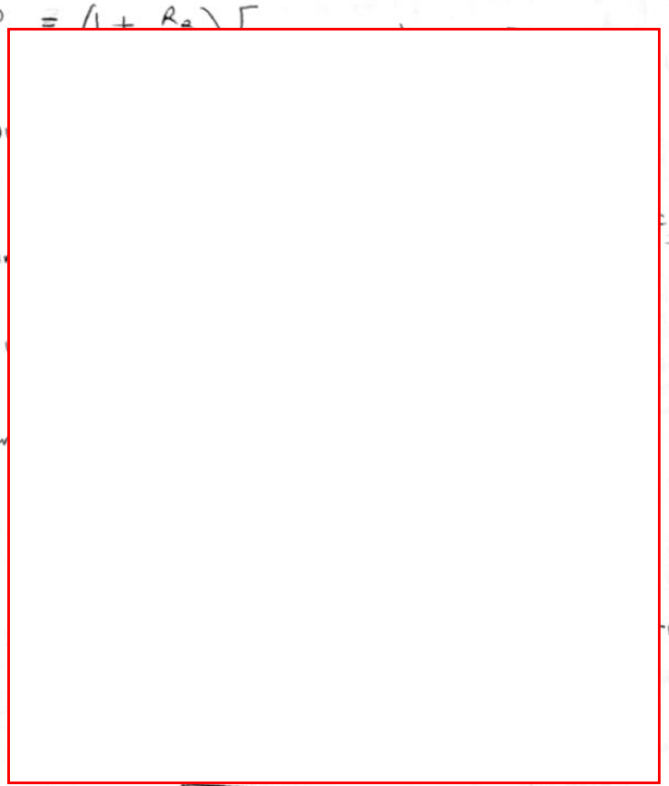
$\therefore$ j

$\therefore$ Freque



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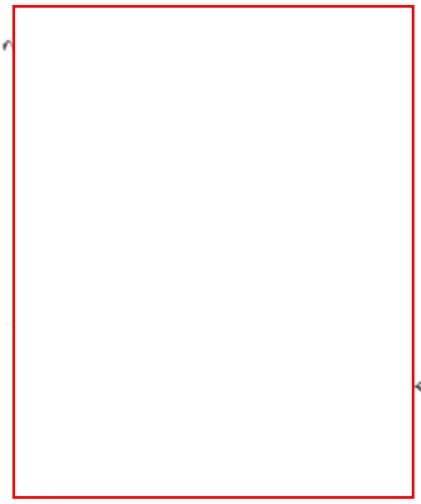

ensure startup of oscillation.

$\left(\frac{R_3}{R_1}\right) > 2$

ed value = 2.34 kΩ

COLPITTS

Freq

capacitors

0.047 μF

0.01 μF

$8.2456 \times 10^{-9}$ F

f =