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Analog Electronics Lab #8 – Study the sinusoidal and non-sinusoidal oscillators using LM741

Objectives

To study the sinusoidal and non-sinusoidal oscillators using op-amp IC LM741

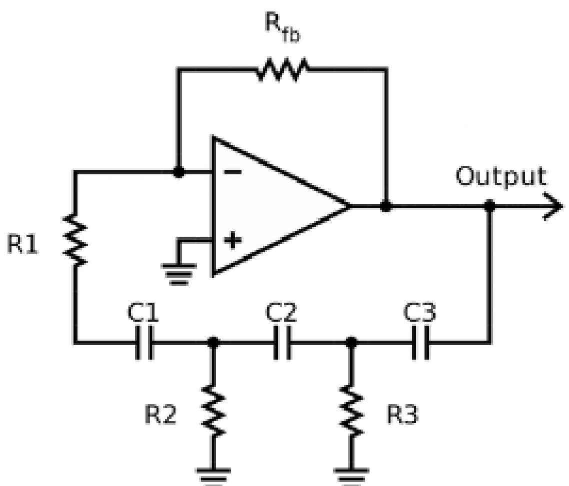
1. RC phase shift oscillator
2. Wein Bridge oscillator

and draw output waveforms in each case.

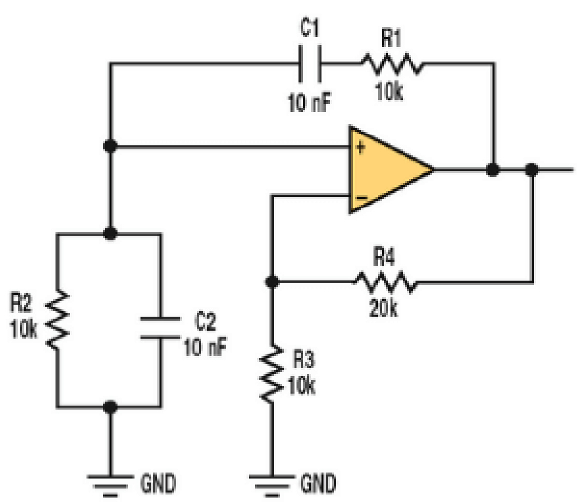
Also draw the schematic for each filter and compare theoretical values with simulated ones.

Oscillators

An **oscillator** is a circuit which produces a continuous, repeated, alternating waveform without any input. Oscillators basically convert unidirectional current flow from a DC source into an alternating waveform which is of the desired frequency, as decided by its circuit components.



RC Phase shift oscillator

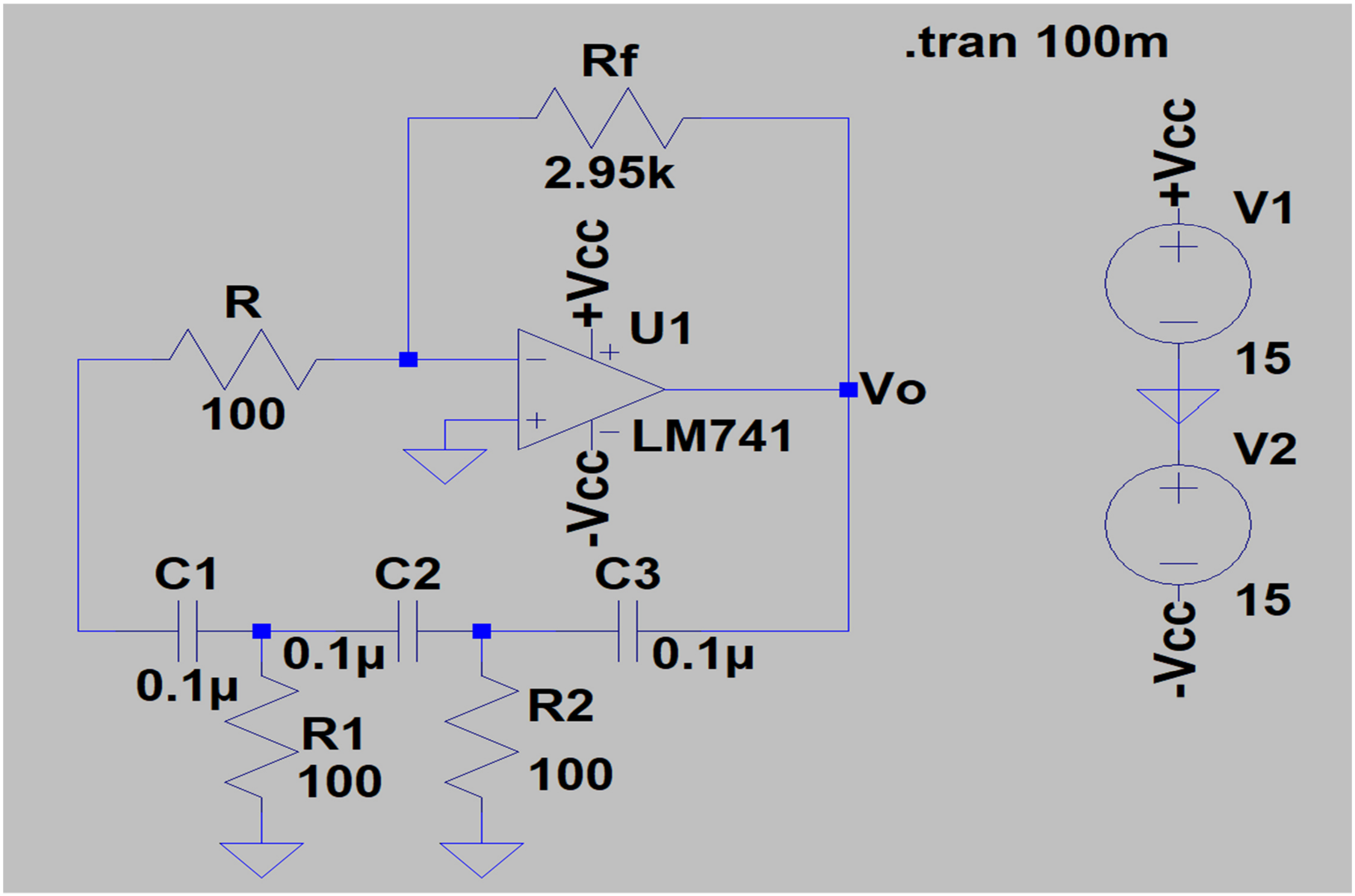


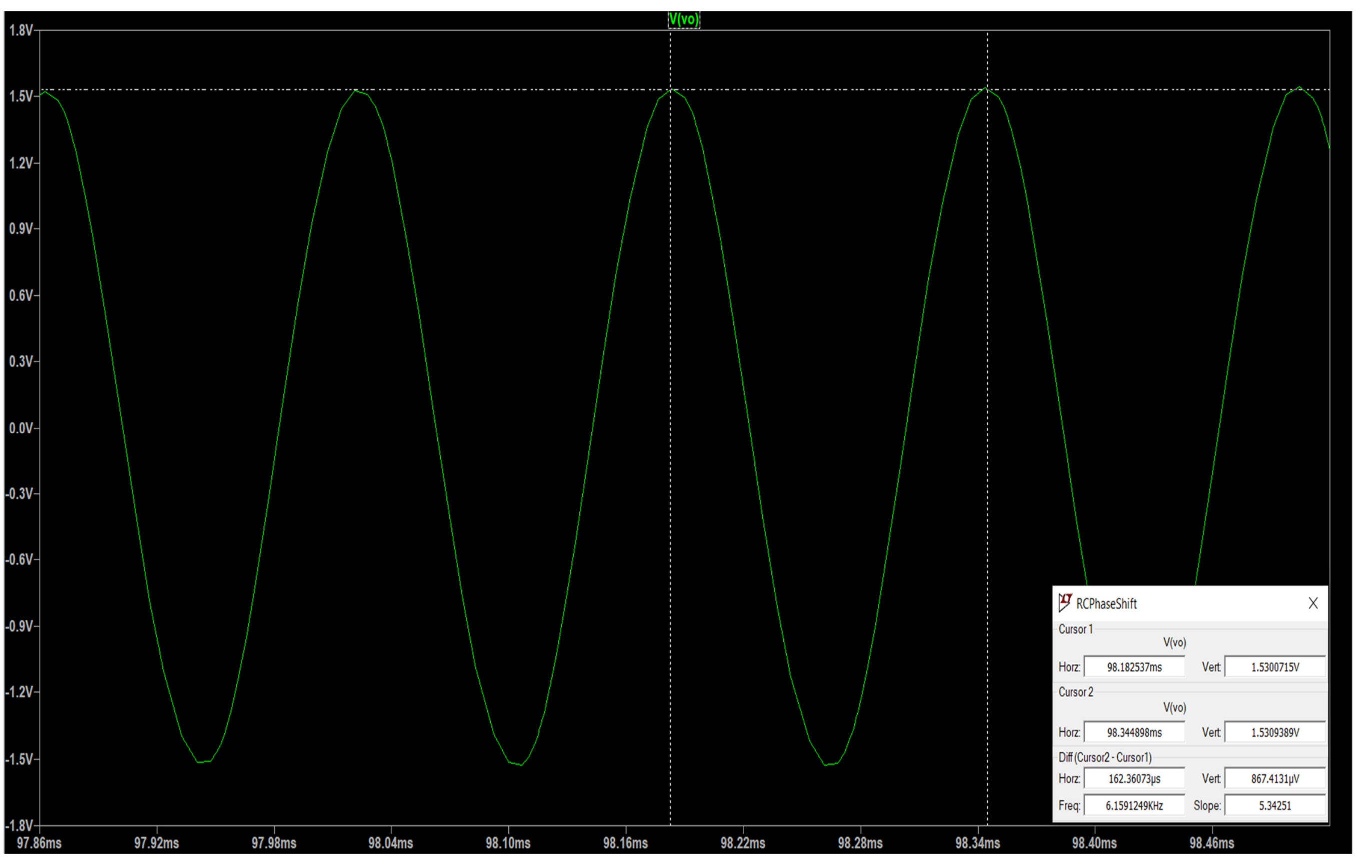
Wein Bridge oscillator

RC phase shift oscillator

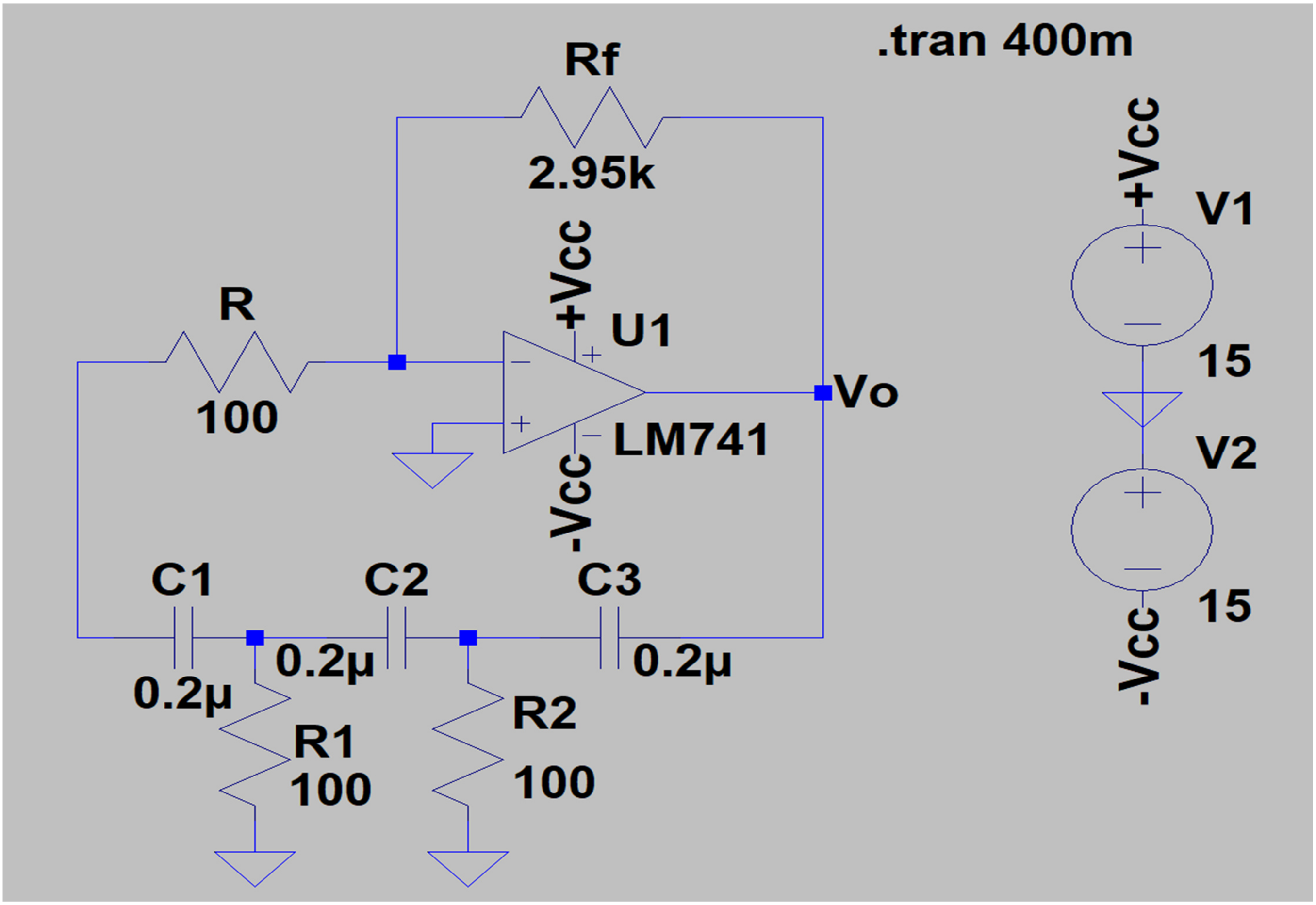
Schematic and waveforms

<u>C = 0.1uF</u>

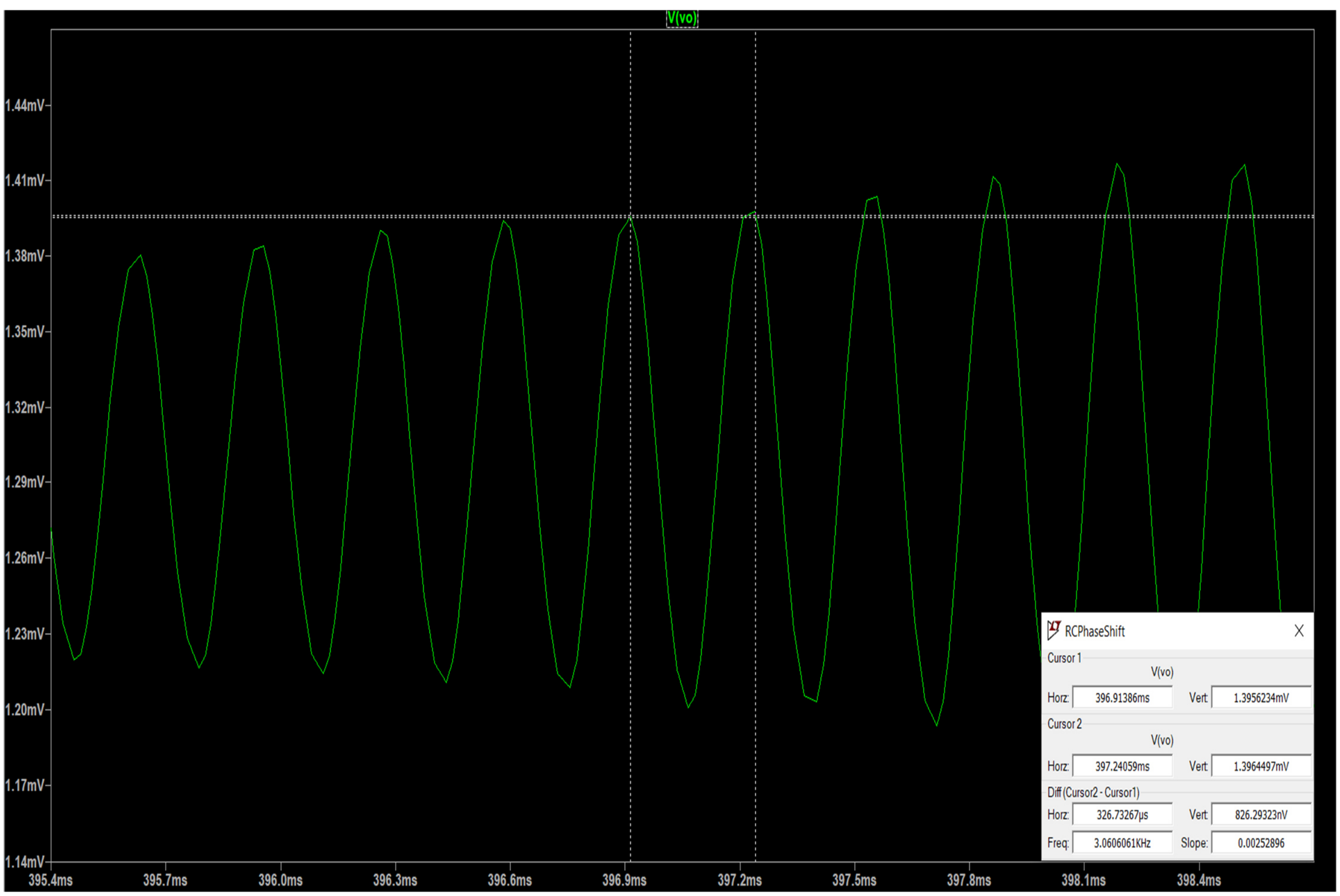




C = 0.2uF



.tran 400m
Rf
2.95k
R
100
U1
LM741
+Vcc
-Vcc
Vo
C1
0.2µ
C2
0.2µ
C3
0.2µ
R1
100
R2
100
V1
15
V2
15
+Vcc
-Vcc

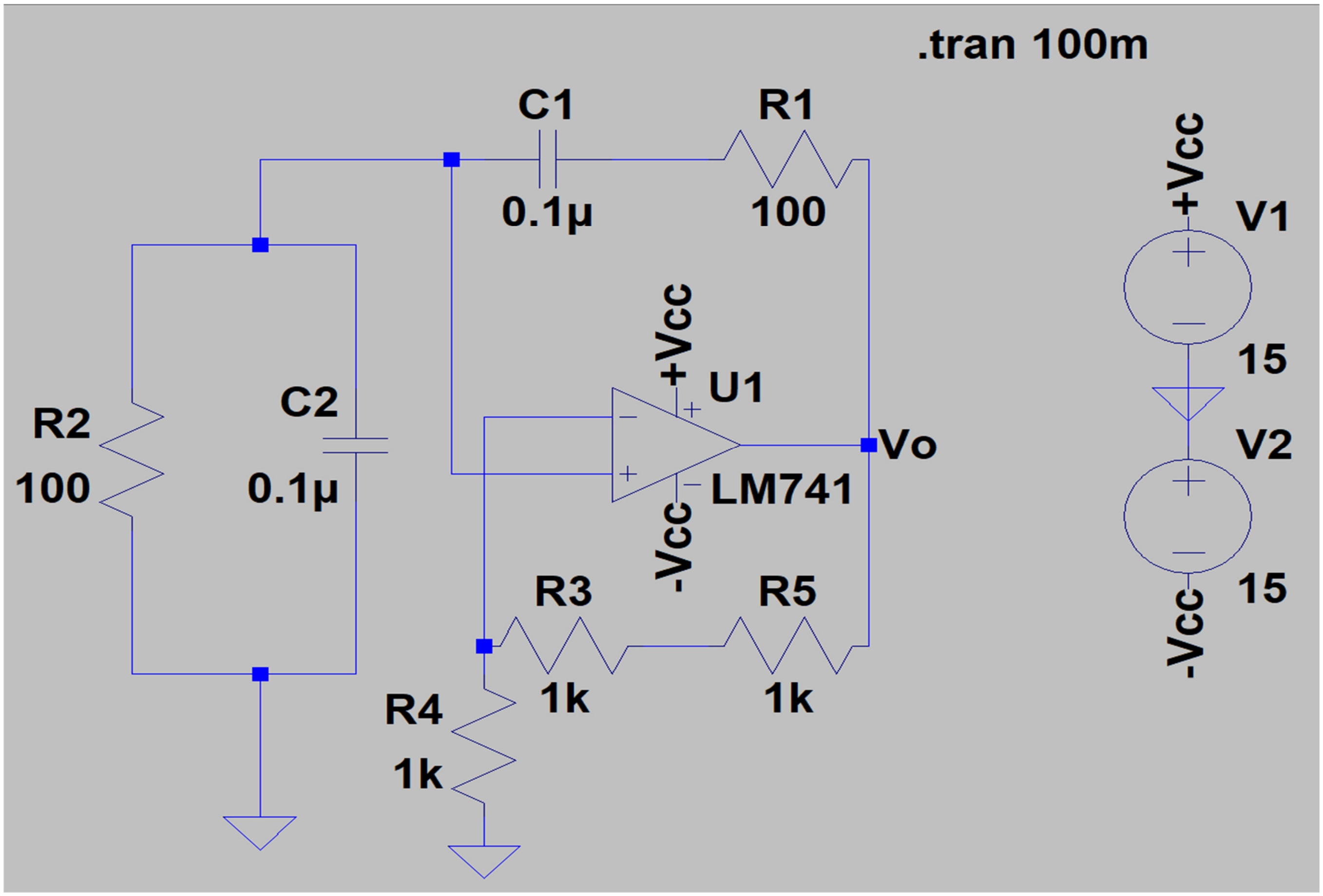


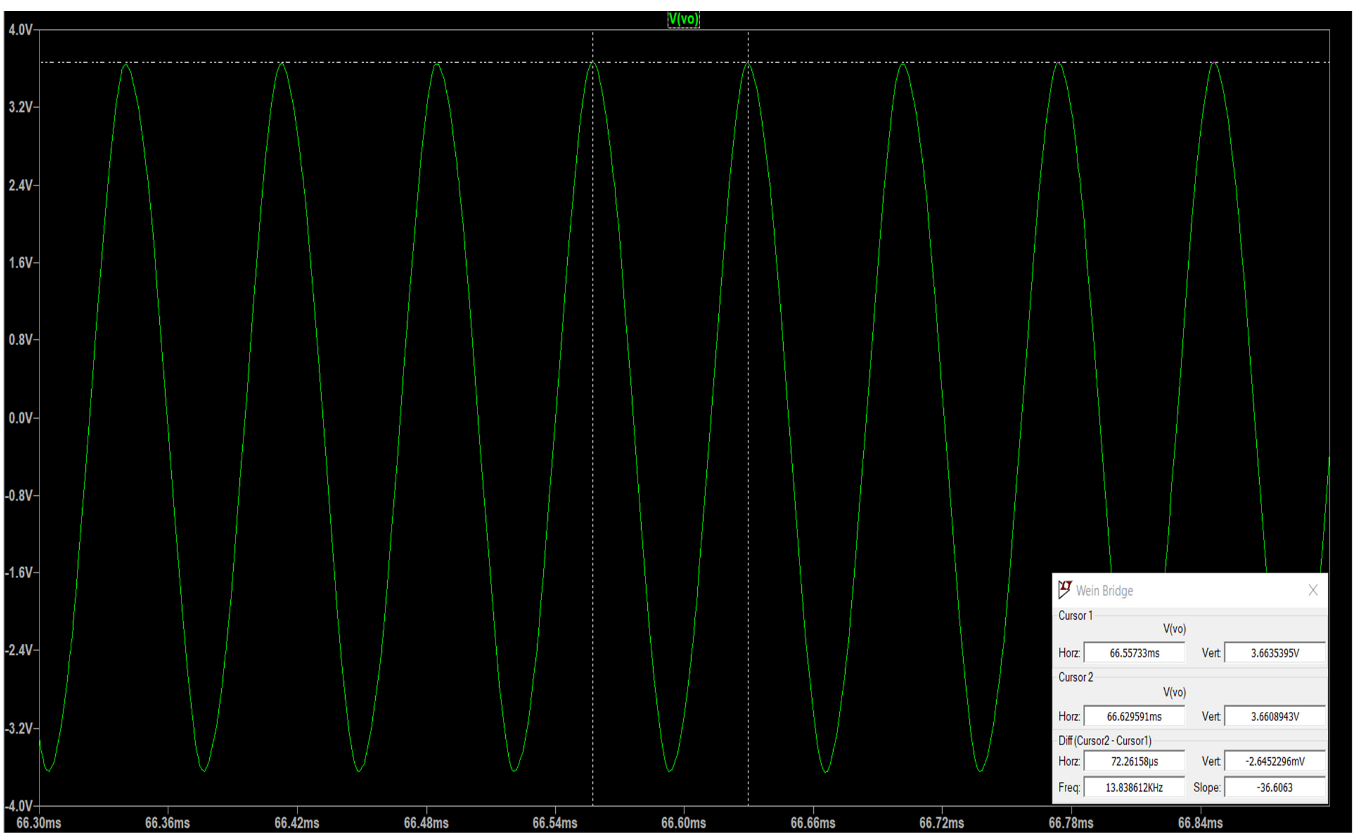
V(vo)
1.44mV
1.41mV
1.38mV
1.35mV
1.32mV
1.29mV
1.26mV
1.23mV
1.20mV
1.17mV
1.14mV
395.4ms
395.7ms
396.0ms
396.3ms
396.6ms
396.9ms
397.2ms
397.5ms
397.8ms
398.1ms
398.4ms
RCPhaseShift
Cursor 1
V(vo)
Horz: 396.91386ms
Vert: 1.3956234mV
Cursor 2
V(vo)
Horz: 397.24059ms
Vert: 1.3964497mV
Diff (Cursor2 - Cursor1)
Horz: 326.73267µs
Vert: 826.29323nV
Freq: 3.0606061KHz
Slope: 0.00252896

Wein Bridge oscillator

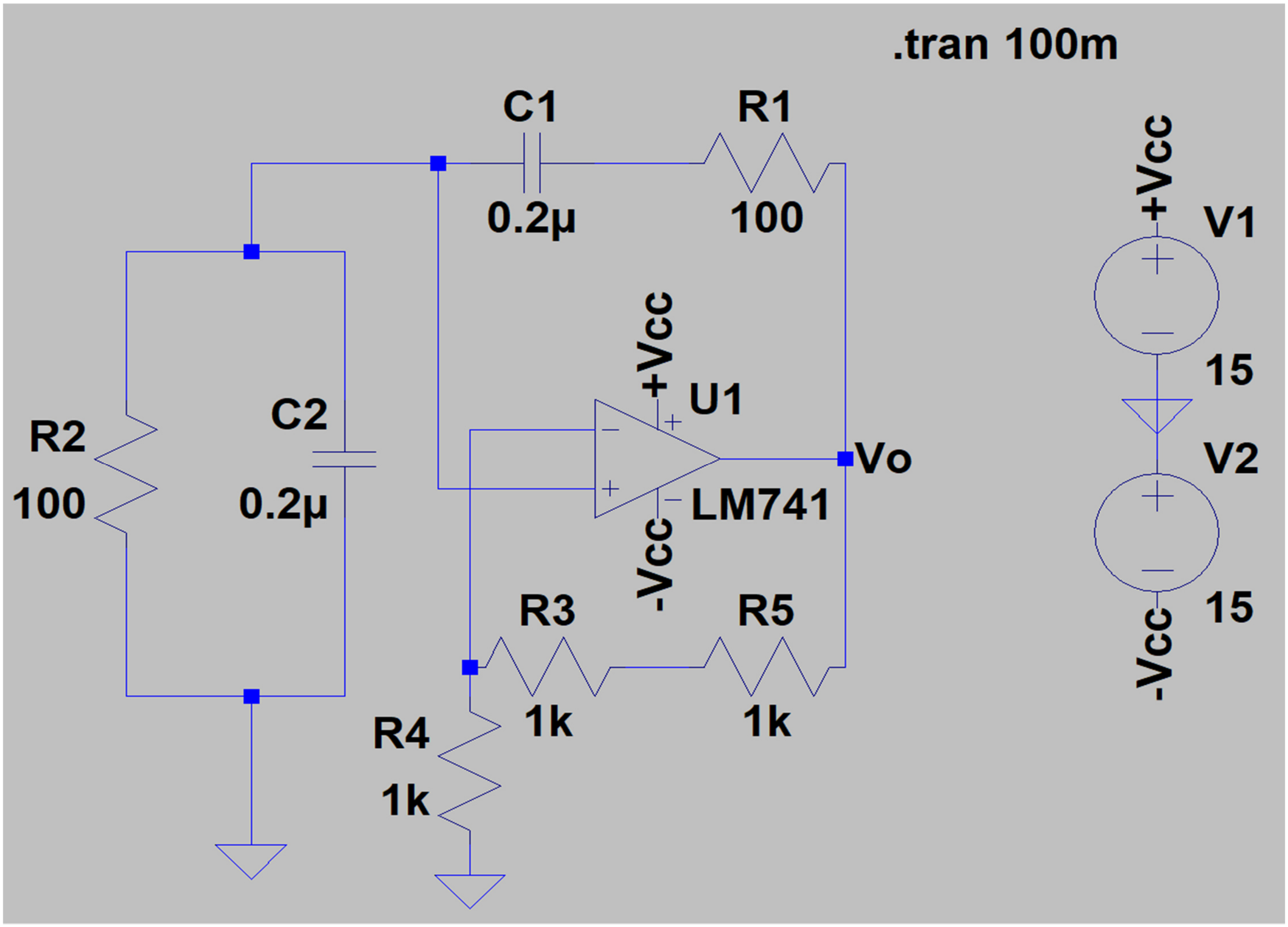
Schematic and waveforms

<u>C = 0.1uF</u>

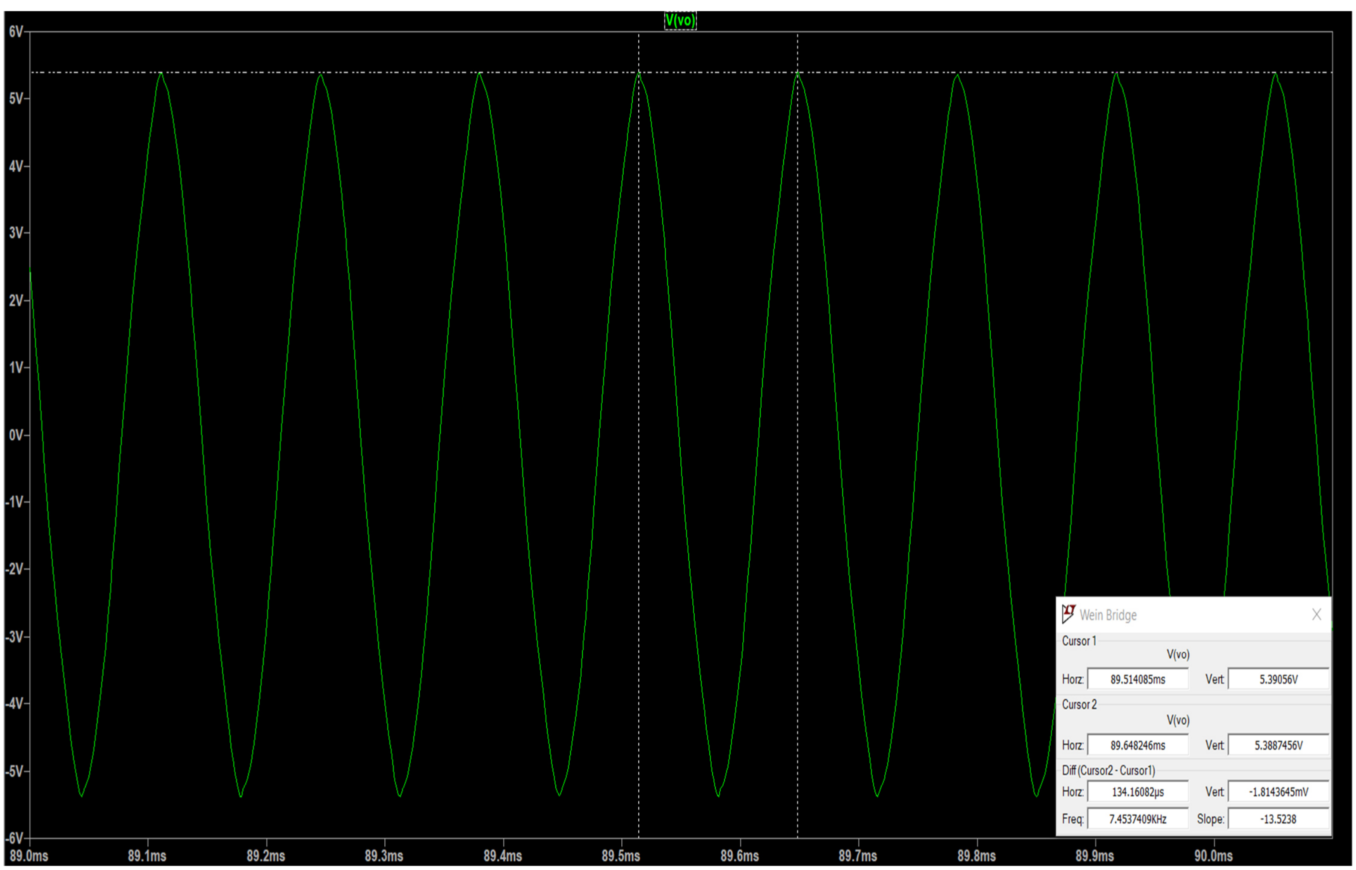




<u>C = 0.2uF</u>



.tran 100m
C1
0.2µ
R1
100
+Vcc
V1
15
V2
15
-Vcc
R2
100
C2
0.2µ
+Vcc
U1
LM741
-Vcc
Vo
R3
1k
R5
1k
R4
1k



V(vo)
6V
5V
4V
3V
2V
1V
0V
-1V
-2V
-3V
-4V
-5V
-6V
89.0ms
89.1ms
89.2ms
89.3ms
89.4ms
89.5ms
89.6ms
89.7ms
89.8ms
89.9ms
90.0ms
Wein Bridge
Cursor 1
V(vo)
Horz: 89.514085ms
Vert: 5.39056V
Cursor 2
V(vo)
Horz: 89.648246ms
Vert: 5.3887456V
Diff (Cursor2 - Cursor1)
Horz: 134.16082µs
Vert: -1.8143645mV
Freq: 7.4537409KHz
Slope: -13.5238

Results

Comparison of simulated and theoretical values oscillator frequencies:

Oscillator	Theoretical value of oscillator frequency	Best simulated value of oscillator frequency
RC phase shift oscillator C = 0.1uF	$\frac{1}{2\pi\sqrt{6}RC} = \frac{1}{2\pi \times \sqrt{6} \times 100 \times 0.1u} = 6.497\text{ kHz}$	6.16 kHz
RC phase shift oscillator C = 0.2uF	$\frac{1}{2\pi\sqrt{6}RC} = \frac{1}{2\pi \times \sqrt{6} \times 100 \times 0.2u} = 3.249\text{ kHz}$	3.06 kHz
Wein Bridge oscillator C= 0.1uF	$\frac{1}{2\pi RC} = \frac{1}{2\pi \times 100 \times 0.1u} = 15.915\text{ kHz}$	13.84 kHz
Wein Bridge oscillator C= 0.2uF	$\frac{1}{2\pi RC} = \frac{1}{2\pi \times 100 \times 0.2u} = 7.958\text{ kHz}$	7.454 kHz

Conclusions

The minimum value of potentiometer resistance possible is 2.95 kΩ for RC phase shift oscillator and 1 kΩ for Wein Bridge oscillator below which the simulation is not possible. The values of frequencies obtained are shown in table above. At double value of capacitor, we get approximately half the frequency as expected.