WIEN BRIDGE OSCILLATOR

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***Abstract*—This projectis about the study of Wien bridge oscillator.The main objective of this project is two analyze the wien bridge oscillator using OpAmp.**

I. Introduction

An oscillator is a circuit that produces periodic electrical signals such as sine wave or square wave 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.

An oscillator consists of an amplifier(active device i.e, Opamp) and a feedback network(passive components such as RC or LC combinations). To start the oscillation with constant amplitude oscillator must satisfy
Barkhausen conditions:

- Magnitude of the loop gain(Avβ) = 1
- Phase shift around the loop must be 360 or 0degrees.

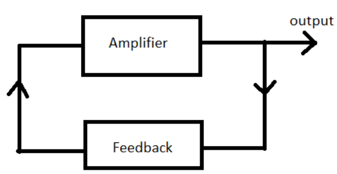

Fig. 1. Basic oscillator block diagram

Wien bridge oscillator: One of simplest sine wave oscillators which uses RC network is Wien bridge oscillator.This is a two-stage RC coupled amplifier circuit that has good stability at its resonant frequency.TThe feedback signal in this circuit is connected to the non-inverting input terminal so that the op-amp is working as a non-inverting amplifier.The Wien bridge oscillator uses a feedback circuit consisting of series RC circuit connected with a parallel RC circuit of the same component values producing a phase delay or phase advance circuit depending on the frequency.The Wien Bridge Oscillator is so called because the circuit is based on a frequency-selective form of the Wheatstone bridge circuit

II. Mathematical Analysis

Considering the feedback shown in fig2,on applying voltage divider rule

$$Vf(s) = \frac{Vo(s) * Zp(s)}{Zp(s) + Zs(s)} \tag{1}$$

$$where Zs(s) = R1 + \frac{1}{sC1} \qquad Zp(s) = R2||\frac{1}{sC2} \tag{2}$$

$$Let R1 = R2 = R \qquad C1 = C2 = C \tag{3}$$

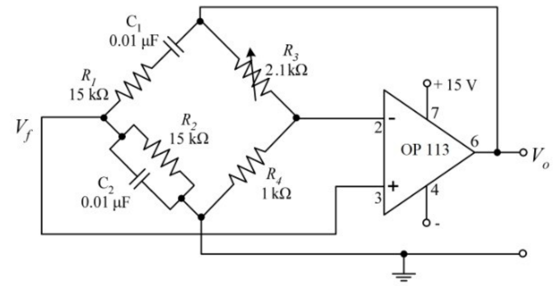

Fig. 2. Wien bridge oscillator

$$feedbackgain, beta = \frac{RsC}{(RsC) * *2 + 3RsC + 1} \tag{4}$$

$$gain, Av = \frac{Vo(s)}{Vf(s)} = 1 + \frac{R3}{R4} \tag{5}$$

Applying conditions Av*β = 1 and substituting s = jω.

$$j\omega[(1 + \frac{R3}{R4})RC - 3RC] = 1 - R2C2\omega 2 \tag{6}$$

To obtain frequency of oscillation equate real part to zero

$$f = \frac{1}{2piRC} \tag{7}$$

To obtain the condition for gain at the frequency of oscillation equate imaginary part to zero

$$j\omega[(1 + \frac{R3}{R4})RC - 3RC] = 0 \tag{8}$$

$$\frac{R3}{R4} = 2 \tag{9}$$

Therefore, R3 =2*R4 is the required condition.

III. Calculation

Frequency of Oscillation ,

$$f = \frac{1}{2pi\sqrt{R1C1R2C2}} \tag{10}$$

$$\tag{11}$$

R1 = R2 = R and C1 = C2 = C

$$f = \frac{1}{2piRC} \tag{12}$$

Consider f = 1kHz and C = 0.01microF we get **R = 15.9kohm** and consider **R4 =1kohm** then **R3 = 2kohm(considering 2.1kohm)**

IV. RESULTS

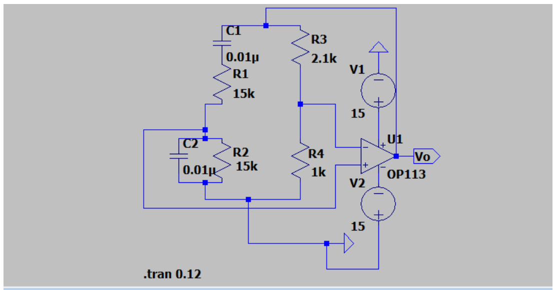

Fig. 3. Wien bridge oscillator circuit

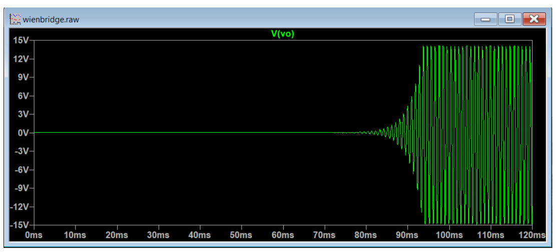

Fig. 4. output graph(voltage vs time)

A Wien bridge oscillator was designed and setup for a frequency of 1kHz and the output waveform is as shown in fig4.Hence, we can observe the sinusoidal output without any input.