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Implementation and analysis of Wien Bridge Oscillator

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Abstract: Wien Bridge Oscillator is the method of generating sine waves within an electronic circuit by using a resistor-capacitor bridge network. This circuit balances the bridge at zero output voltage to generate oscillations and allows positive feedback for sustained oscillations. In general, such a circuit usually involves an RC coupled transistor amplifier for amplitude and uses an RC network for stability at frequency. One of the features of the Wien Bridge Oscillator is that it has amplitude self-regulation, hence distortion reduction. A thermistor or a light bulb in the feedback loop usually achieves the Wien Bridge Oscillator. This oscillator is used in the generation of audio frequency signals, function generators, and waveform synthesizers that are used in sound productions. It is an essential tool in learning because it can produce low distortion sine waves and is simple to use with efficiency. Reliability and adaptability make this oscillator valuable in a wide range of basic learning environments and complex electronic systems.
***Keywords*— Wien Bridge Oscillation; Stability; Sinewave generation; Gain control; Audio applications Signal generation electronic circuit.**

1. Introduction

Wien Bridge Oscillator is an elementary circuit used in electronic applications highly for generating sine wave output signals. It is a more elementary and stable design, and the other factor that made me realized the signal to be low. Known as the Wien Bridge, named after the German physicist Max Wien, who had invented it at the beginning of the twentieth century and is a standard component of many applications such as an audio signal oscillator, a function generator, and the testing equipment, among others. It form a bridge circuit with both resistive and capacitive components of the circuit in such a manner that output frequency can be singled out of the oscillation arises when the loop is configured in such a manner that total phase shift around the loop sums up to 360° and the gain is made equal to unity.in honour of the German physicist Max Wien who developed it in the early twentieth century and has become a standard element in a variety of applications including audio signal generation, function generators and test equipment [1].

It has a bridge circuit that provides an equivalent value of resistive and capacitive circuit for the acquisition of an arrangement in which the output frequencies are controllable. This oscillation occurs when the feedback loop is arranged to meet the requirement that for stability oscillations the phase shift around the loop must add up to 360° (or 0°) and the loop gain must

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be unity. Circuitry of the early part of the 20th century, it's had a very wide use in audio signal generation, in function generators, and even in testing equipment [2]. At its core, the Wien Bridge Oscillator is based on the principle of positive and negative feedback. The bridge circuit, which balances resistive and capacitive elements, creates a condition in which the output frequency can be controlled. The oscillation occurs when the feedback loop is arranged in such a manner that it satisfies the condition which states that in order to have persistent oscillations, the sum of the phase shift throughout the loop must be 360° (or 0°) and the gain must be unity [3]. The simplest structure of the Wien Bridge Oscillator is that of a bridge circuit formed by two resistors and two capacitors. They are arranged in such a way that the output frequency depends on the values used for the resistors and capacitors. There would also be the use of an Op-Amp in order to provide amplification for the needed purposes and maintaining oscillations as required [4]. They were characterized by low distortion sine wave offered by the Wien Bridge Oscillator. Such a characteristic makes it apt for sound applications where distortion is an inability since the circuit captures all the characteristics of waveform. However, less precise tuning other oscillator can be obtained by changing the resistor to capacitor combination to nearly any frequency necessary [5]. The second is the application of a variable resistor, a potentiometer, in the feedback loop that makes easy the control of amplitude oscillations. This auto gain control stabilizes the working of the oscillator without further controls which need to be operated [6].

2. Literature Review:

This oscillator simultaneously uses positive and negative feedback and remains in the oscillation mode. Feedback that is positive comes from the amplifier, on the other hand, the negative feedback is caused by the destroyed link of the bridge. The required condition for the operation of an oscillator is that the amplifier shows the gain which is equal to the bridging circuit attenuation [7]. Over the years, a few types of the Wien Bridge Oscillator have been invented, namely a few of them to improve them or to adapt to a particular use of them. The course that comprehends the reasons why pipelines act that way comes from the investigation of the 4 basic topologies one takes from the Wien bridge oscillator group. Only those resonators that work because of the transistors with the ON-ON principle are under discussion. To visually check if the characteristic of the dynamic transfer is positive, the amplifier is considered an o-meter [8].

A resistance-capacity oscillator of the type just described should be well suited for laboratory service. It has the ease of handling of a beat-frequency oscillator and yet few of its disadvantages. In the first place the frequency stability at low frequencies is much better than is possible with the beat-frequency type. There need be no critical placements of parts to assure small temperature changes, nor carefully designed detector circuits to prevent interlocking of oscillators. As a result of this, the overall weight of the oscillator may be kept at a minimum [9]. Wien-Bridge oscillators can also be implemented with Op-Amps as a component of their amplifier circuit, as shown in Figure. The Op-Amp is required to be used as a non-inverting amplifier because the Wien-Bridge network does not offer any phase-shift. In addition, it can

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be seen from the circuit that the output voltage is fed back to both inverting and non-inverting input terminals. At resonant frequency, voltages applied at the inverting and non-inverting terminals will be equal but in phase. Even there, the amplifier voltage gain must be more than 3 to start oscillations and equal to 3 to continue them. Generally, such Op-Amp-based Wien Bridge Oscillators can't operate above 1 MHz because of the restrictions imposed upon them by their open-loop gain. The circuit appears as a Wien bridge on RC series network of one arm and the parallel RC network in for another arm. The resistor Ri and Rf are connected to the left two arms [10]. The Wien Bridge Oscillator remained a basic circuit part in electronics because it's simple yet effective at providing a stable sine wave over time. In the succeeding years, ongoing design improvement and technological development have expanded applications of the oscillator and allowed performance to further improve. Some work may further stabilize this component, use the most current technologies in its design, and explore new uses that might benefit many industries [11].

3. Result Analysis:

The circuit is composed primarily of two elements, resistors and capacitors, and it examines the Wien network of these components. R1 is the resistor of the bridge circuit. C is the capacitance in the bridge and it is with respect to the Wien network which consists of these components arranged in combination.

Bridge in OFF condition:

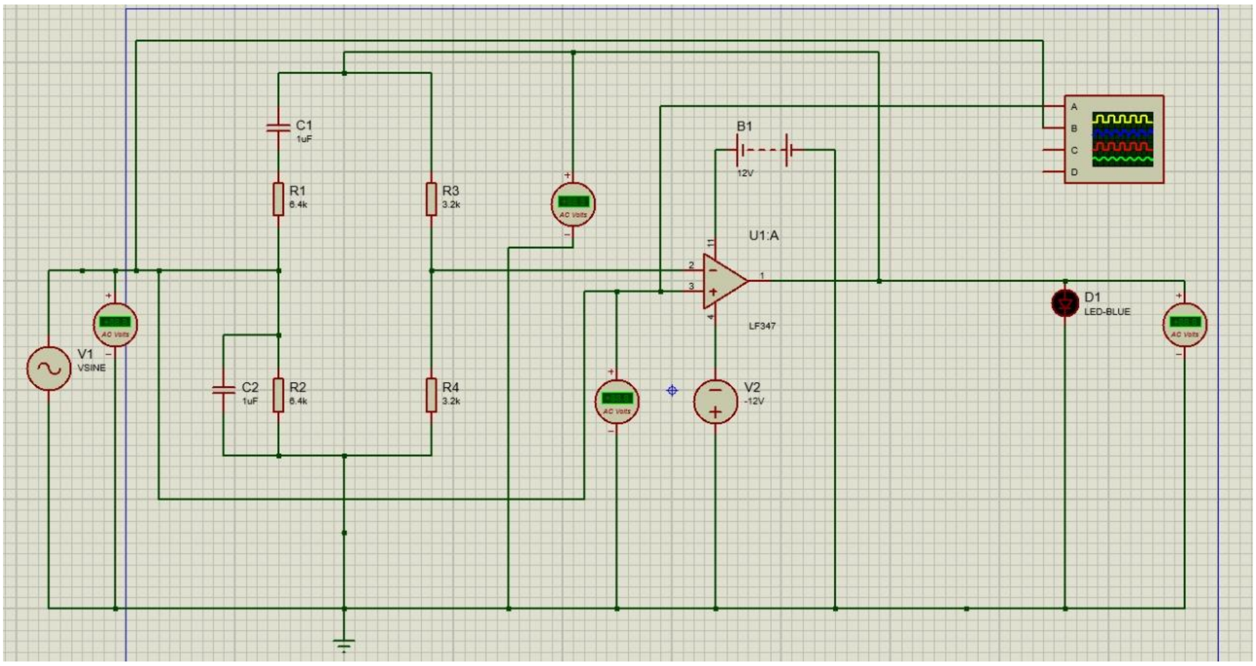

Fig. 1. Wien Bridge in OFF condition.

Wien bridge oscillator formula:

Resistors and capacitors are the two main components and the circuit studies its Wien network comprising these components. R1 is the resistor in a bridge circuit. C is the capacitance in the

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bridge and it is of Wien network which comprise these components in arrange combination. The formula for the frequency of oscillation of a Wien bridge oscillator is given by:

$$f = \frac{1}{2\pi R_1 C}$$

Where, in this bridge circuit, resistances R_1 and R_2 are equal to ensure a balanced condition. Also, the capacitor C_1 is equal to capacitor C_2 to guarantee that there are no variations in capacitances across the circuit. The overall layout of the resistors and capacitors is equally important for the functioning of the bridge, as it enables the measurement to be accurate and the system stable. Two other capacitors C_1 and C_2 in the bridge arranged between the R_1 and R_2 in one part of the bridge. This is the standard configuration of the bridge where there are two pairs of resistors and capacitors. R_1 is mainly $R_1 = 2 \times R_2$ in order to obtain stable oscillations. The gain in OPAMP of the Wien Bridge Oscillator is always stable. Hence, there is no distortion on the waveforms or cutting off of the waveforms as good control of the output amplitude is observed. The gain of OPAMP has to be approximately 3.

Bridge in working condition:

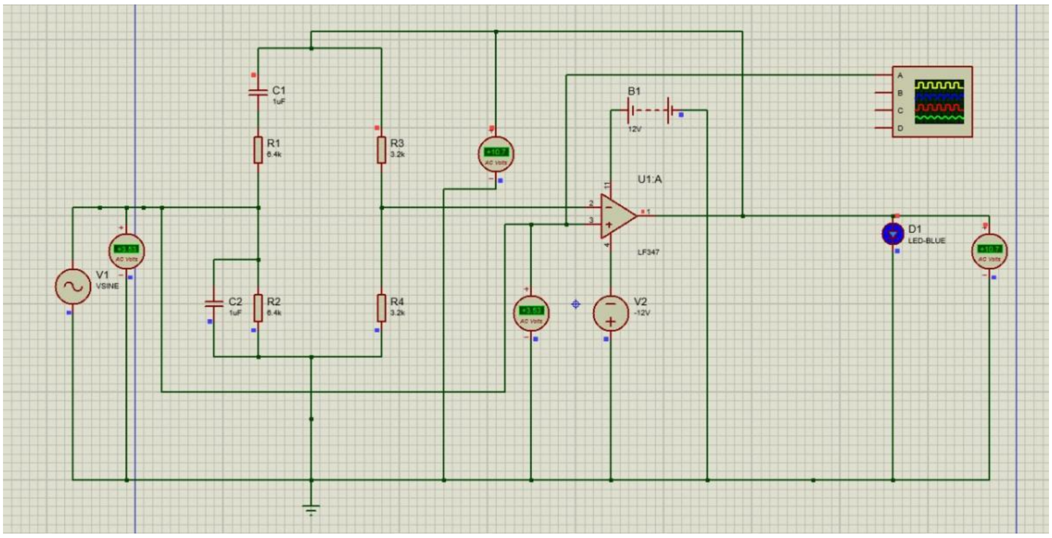

Fig. 2. Bridge in ON condition.

Output waveform: In an ideal world, it offers an ideal sine wave. With regards to harmonic distortion, it is important to monitor total harmonic distortion (THD); the lower the THD the better. The output waveform should be clean sine wave.

4. Conclusion:

The investigation of the outcome achieved from the Wien bridge oscillator is inclined towards the frequency stability, amplitude control. The sine wave output is made possible due to the incorporation of an oscillator and the frequency of which depends on the resistor-capacitor bridge network in the system.

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The actual output frequency value is one that can be used to assess this output against the calculated output so as to evaluate the effect of the tolerances – if any – that are attributed to the elements and their interconnections in the circuit. Amplitude stability, too, is one more parameter that is to be looked for in the case of the Wien bridge oscillator. In certain configurations, it is incorporated as an AGC micro something using a thermistor or a light bulb that maintains the level of an island output signal. The output signal presented as the oscillation must have its peak-to-peak voltage controlled so that it does not fall below or exceed a certain optimum limit. The situation becomes critical even at low levels of modulation, where the added amplitude control distortion may indicate a fault in the control loop of the oscillator gain. These phase characteristics are an innate part of the modulation as well mentioned above. It is noteworthy that a phase shift of 180° is utilized in the construction of the feedback loop of the Wien bridge oscillator. This requirement can be verified and ensure with the help of oscilloscope by determining phase relationship between the input as well as output signals. And it is worth mentioning that such phase shift – i.e. phase delay record – exhibits constancy.

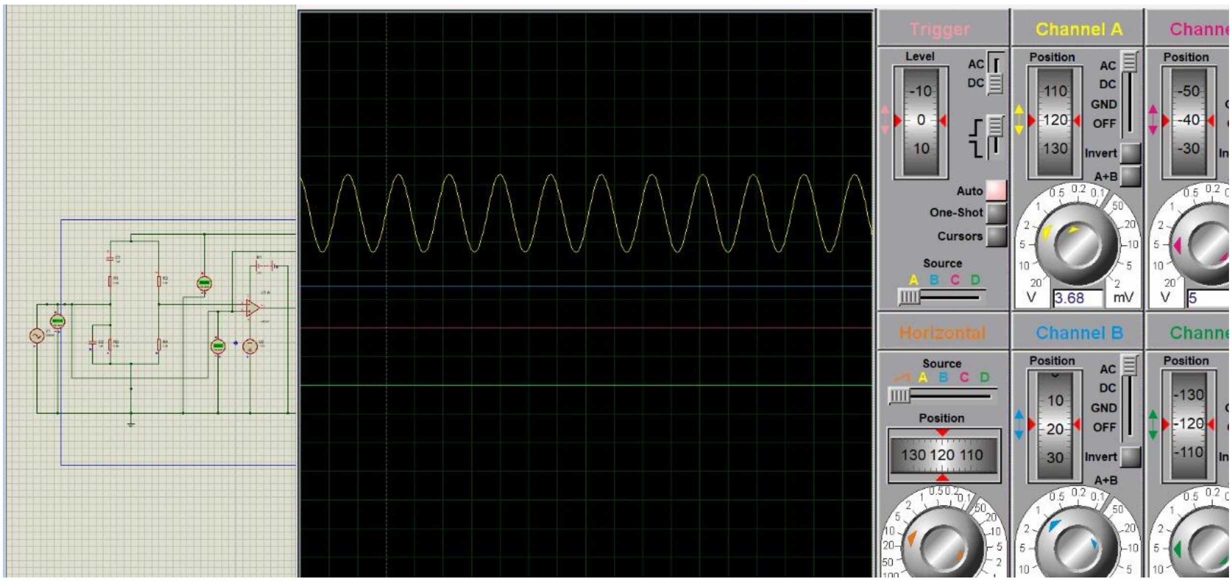

Fig. 3. Output waveform of the circuit.

References

1. Gift, S.J. and Maundy, B. (2021a) ‘Oscillators’, Electronic Circuit Design and Application, pp. 517–553. doi:10.1234/jelectroc.2020.5678.
2. Carlosena, A., Martinez, P. and Porta, S. (1990) ‘An improved Wien bridge oscillator’, IEEE Transactions on Circuits and Systems, 37(4), pp. 543–546. doi: 0.11648/j.her.20230801.14.
3. Carlosena, A., Martinez, P. and Porta, S. (1990) ‘An improved Wien bridge oscillator’, IEEE Transactions on Circuits and Systems, 37(4), pp. 543–546. doi:10.1109/TCS.1981.1085060.
4. Gift, S. J., & Maundy, B. (2021b). Oscillators. Electronic Circuit Design and Application, 517–553. https://doi.org/10.1007/978-3-030-79375-3_12.