Department of Electronic & Telecommunication Engineering
University of Moratuwa

EN3013 - ANALOG CIRCUIT DESIGN

DESIGN OF A WIEN BRIDGE OSCILLATOR

Supervisors:
Dr. Thayaparan Subramaniam

MALANBAN K.	*200373X*
MANIMOHAN T.	*200377M*
PASQUAL A.C.	*200445V*

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1 DESIGN OF WEIN BRIDGE OSCILLATOR

1.1 Objective

1. Understand the fundamentals of Wien Bridge Oscillators, focusing on feedback mechanisms and the condition for sustained oscillation.
2. Learn to design Wien Bridge Oscillator circuits by selecting appropriate resistor and capacitor values to achieve specific oscillation frequencies.
3. Analyze the impact of power supply variations on the circuit's output frequency, shedding light on the role of voltage fluctuations.
4. Explore the limitations associated with the frequency range and discuss the technical constraints that restrict the circuit from exceeding its maximum achievable frequency.
5. Gain practical experience in electronic circuit design and signal generation, enhancing our knowledge and skills in this domain.

In this report, we will explore the theory, operation, and practical implementation of the Wein Bridge Oscillator circuit.

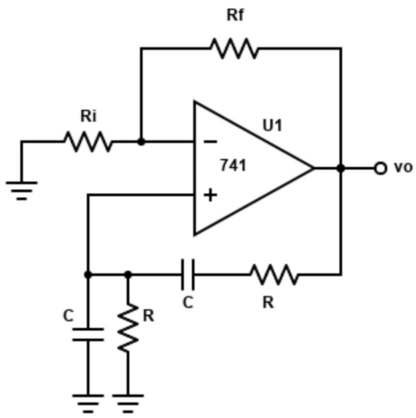

Figure 1 — Circuit

1.2 Calculate Output frequency range

* Group Number = 04
* Typical frequency = 32 kHz
* Output frequency range = Typical frequency ± 3 kHz = 32 ± 3 kHz

1.3 Selection of Resistor values

$$f_{min} < \frac{1}{2\pi\sqrt{R_1 R_2 C}} < f_{max} \tag{1}$$

Consider the 10% of tolerances for the resistors

$$f_{min} \times 1.21 < \frac{1}{2\pi\sqrt{R_1R_2C}} < f_{max} \times 0.81 \tag{2}$$

$$f_{min} \times 1.21 = 29kHz \tag{3}$$

$$f_{max} \times 0.81 = 32kHz \tag{4}$$

$$f_{min} = 23.967kHz \tag{5}$$

$$f_{max} = 43.21kHz \tag{6}$$

$$\tag{7}$$

c = 1 nF

$$23.967kHz \times 1nF \times 2\pi < \frac{1}{\sqrt{R_1R_2}} < 43.21kHz \times 1nF \times 2\pi \tag{8}$$

$$22677 \times 10^{-12} < \frac{1}{R_1R_2} < 73710 \times 10^{-12} \tag{9}$$

$$2.2677 \times 10^{-8} < \frac{1}{R_1R_2} < 7.3710 \times 10^{-8} \tag{10}$$

$$\tag{11}$$

If R1 = 5 kΩ

2.713 k $\Omega < R2 < 8.819k\Omega$

But we know that

$$\frac{Ra}{Rb} = \frac{R1}{R2} + 1 \tag{12}$$

$$\tag{13}$$

Maximum

$$\frac{Ra}{Rb} = \frac{5}{2.713} \times \frac{1.1}{0.9} + 1 \tag{14}$$

$$\frac{Ra}{Rb} = 3.253k\Omega \tag{15}$$

Minimum

$$\frac{Ra}{Rb} = \frac{5}{8.819} \times \frac{0.9}{1.1} + 1 \tag{16}$$

$$\frac{Ra}{Rb} = 1.464k\Omega \tag{17}$$

$$1.464 < \frac{R_a}{R_b} < 3.253 \tag{18}$$

with tolerance

$$r_{min} \times \frac{1.1}{0.9} = 1.464 \tag{19}$$

$$r_{min} = 1.198 \tag{20}$$

$$r_{max} \times \frac{0.9}{1.1} = 3.253 \tag{21}$$

$$r_{min} = 3.976 \tag{22}$$

$$1.198 < \frac{R_a}{R_b} < 3.976 \tag{23}$$

Therefore we decided to take

$$R_b = 3.0k\Omega \tag{24}$$

$$4.313k\Omega < R_a < 14.31k\Omega \tag{25}$$

1.4 Observations

We achieved a frequency range of 24 kHz to 35 kHz.

1.4.1 Typical frequency

Figure 2 — Typical frequency

1.4.2 Frequency Range

(a) Maximum Output frequency

(b) Maximum Output frequency

Figure 3 — Frequency Range

1.5 Challenges Faced

* Component selection was challenging due to considerations such as tolerance, availability, and precision.
* Maintaining stability and achieving the oscillation condition $|A\beta| = 1$ posed challenges during the experiments because of two resistances have to be varied