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EE 316-08
Electric Circuits & Electronics Design Lab

Lab 6: Rectification AC signals, Transformers and Bridge Rectifiers

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Lab Due: 03/03/2021

1. Introduction:

This laboratory introduces AC signals, transformers, and diodes. To learn about the topics, we will report AC voltages and learn how transformers and diodes can be utilized to rectify sinusoidal signals. We will examine RMS vs DC and peak voltages, phase difference, and ripple frequency. We will use theoretical analysis, and Multisim simulations to cover these topics.

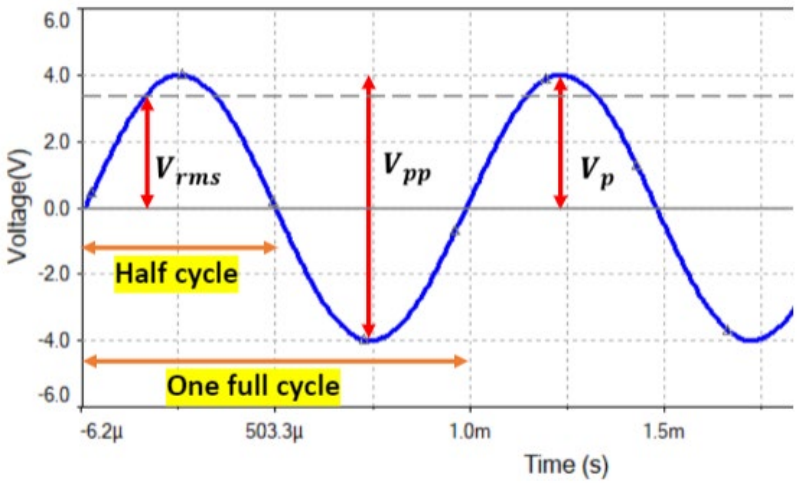
2. Theoretical Analysis:

2.1 AC Waveforms

AC waveforms comprise of peak voltage and peak to peak voltages. Peak voltages are measured from ground to the maximum amplitude, and peak to peak voltages are measured to min to max amplitude. The peak voltages is measured in Vrms (root means squared).

$$V_{rms} = \frac{1}{\sqrt{2}} V_{peak}$$

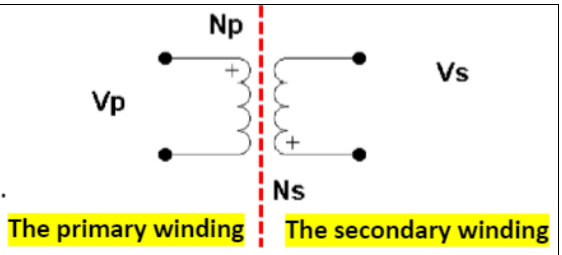
RMS is also called the AC equivalent to DC voltage.



2.2 Transformers

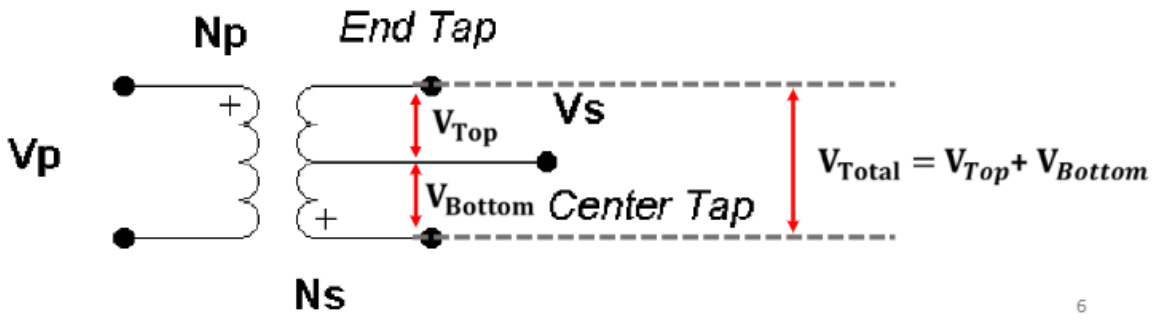
Transformers are devices made of two or more coils, the primary and secondary winding. Source is connected to the primary and load is connected to the secondary. Using transformers, you can either step up or step-down AC voltages and currents.

- **Vp** is the primary (input) voltage
- **Vs** is the secondary (output) voltage
- **Np** is the number of turns of the primary coil
- **Ns** is the number of turns of the secondary coil.



2.3 Center Tapped Transformers

A CT is equivalent to two secondary windings. If the secondary side is made up of two coils, the coils may be wound in the opposite direction of each other. This allows for two different output voltages. One output voltage is between the top end tap and the center tap. The other voltage is between the center tap and the bottom.



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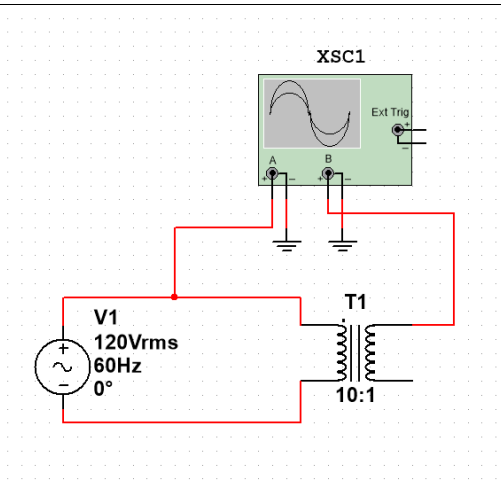
3. Simulations:

3.1 Transformer Figure 6.3



Circuit 1: Figure 6.1 In Multisim

Part 1 – Transformer Figure 6.3

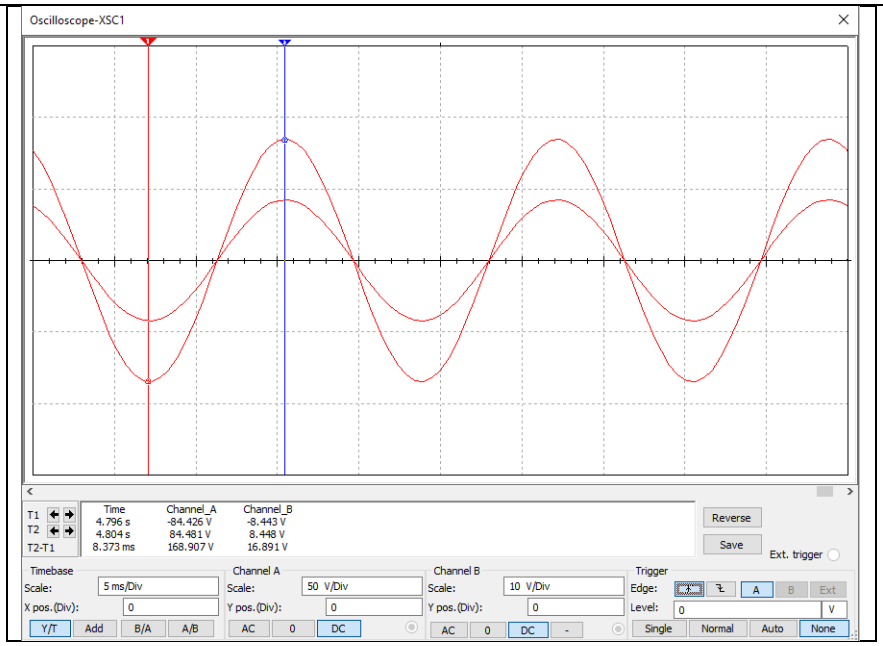


Figure 1: Peak Voltage graph Figure 6.3

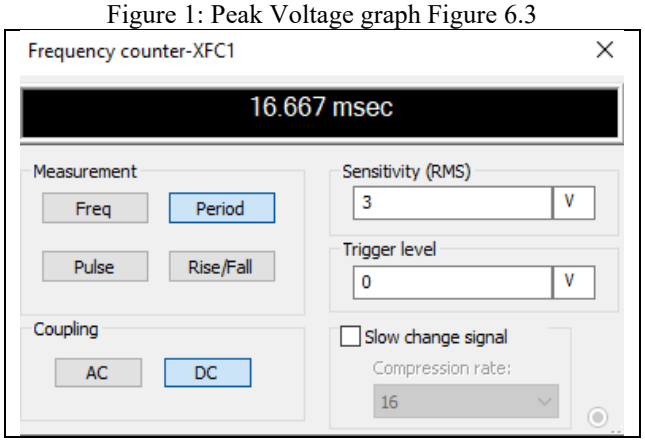


Figure 2: Period from Frequency Counter

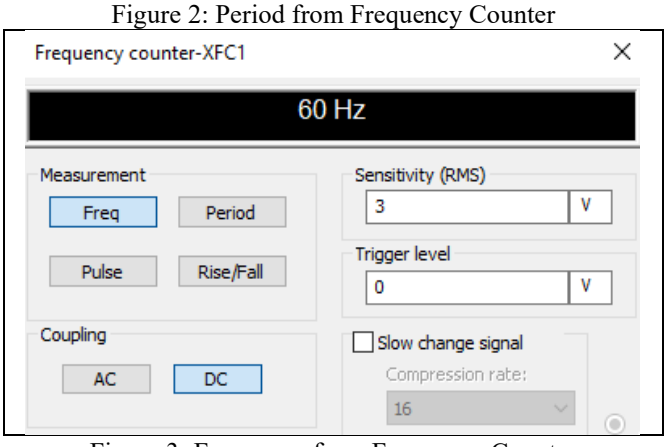


Figure 3: Frequency from Frequency Counter

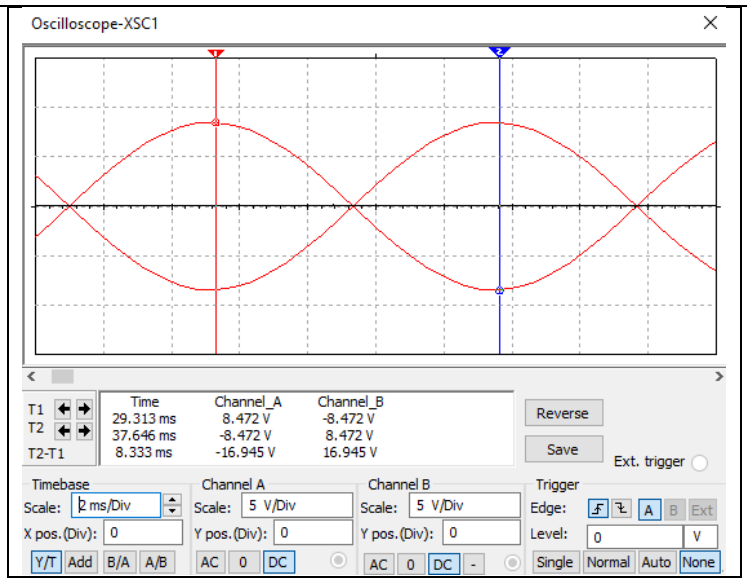
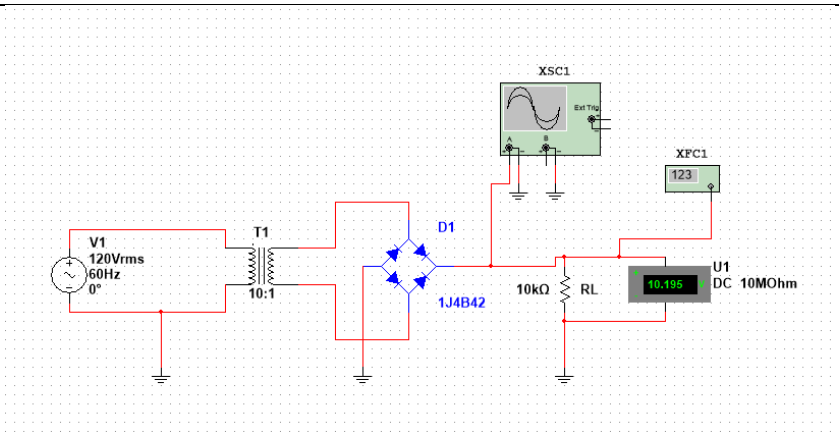


Figure 4: Node C vs. Node D

Figure 4 shows that Node C and D are off by 180 degrees and perfectly out of phase. The difference between the out terminals of the transformer is just sign.

3.2 Transformer figure 6.4



Circuit 2: Figure 6.4

Part 2 – Transformer Figure 6.4

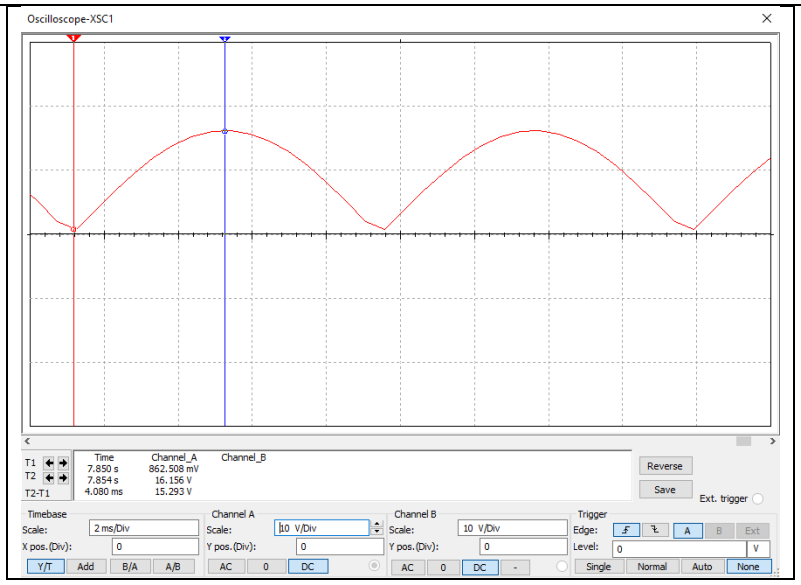


Figure 5: Peak Voltage graph Figure 6.4

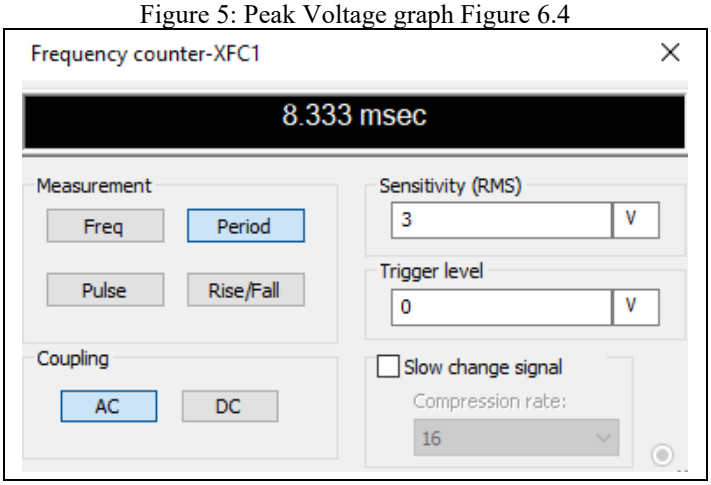


Figure 6: Period from Frequency Counter

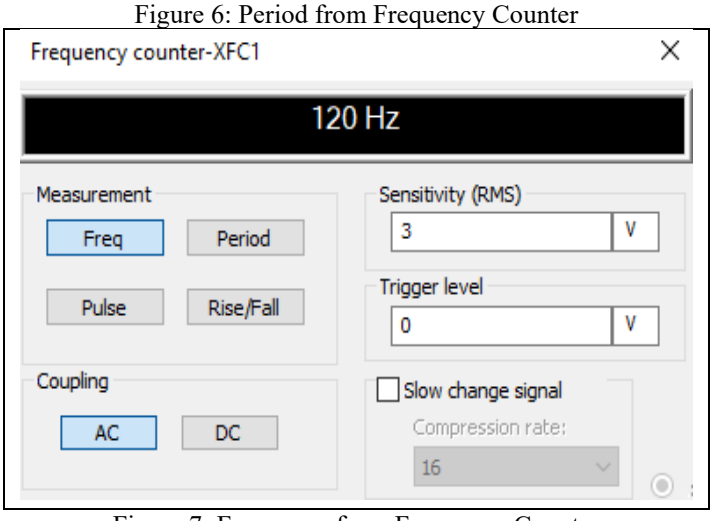
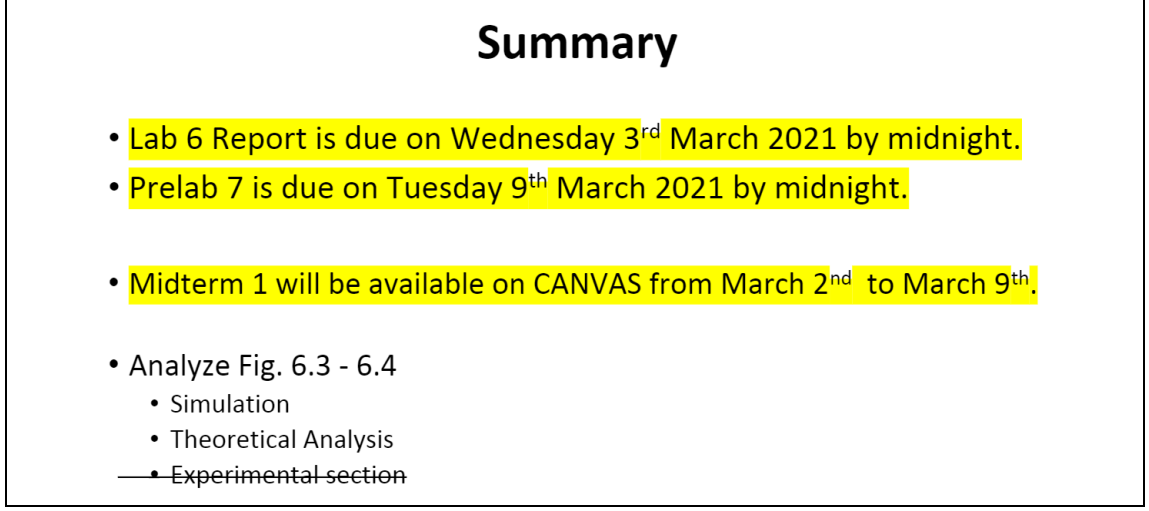


Figure 7: Frequency from Frequency Counter

~~4. Experimental:~~

We were not instructed to provide experimental results for this lab, see the following screenshot.



5. Results and Discussion:

The ripple frequencies of both the transformer and rectifier matched the simulated and theoretical calculations. The simulated and calculated Vrms are close to expected values. This shows that the simulations are an accurate representation of a transformer and rectifier. When looking at the peak voltage for the rectifier, however, it is about 1% off a hand calculated value of 10.313v. This is different from the 10.196v found on the voltmeter, but this can be summed up as the tolerance of the resistor.

6. Conclusion:

This lab was very helpful in introducing and understanding basic transformers and AC wave signals.