EE 43/100 FINAL PROJECT: AN AUDIO AMPLIFIER

Part 1: Power Supply

Prelab

1 Bridge Rectifier

In this lab we'll be using a circuit known as a bridge rectifier. This circuit is used to convert AC voltages to DC voltages. You may have noticed that we use a DC power supply in nearly every circuit we build in lab. However, the power coming out of a wall outlet in the US is 120 Vrms, 60 Hz AC. This means that nearly every electronic device incorporates a small AC to DC converter, and the bridge rectifier is one of the key pieces in this converter.

Figure 1 shows a typical bridge rectifier setup. A transformer is used to reduce the voltage, and then the signal is fed to a bridge rectifier. Often, there is a large capacitor present on the output of the bridge rectifier.

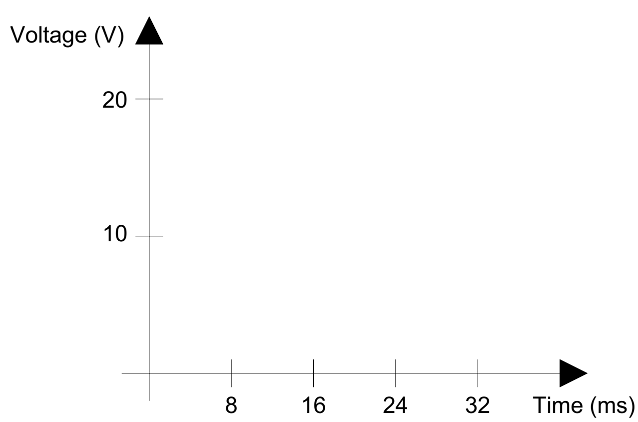
In this problem use the following assumptions:

- The wall outlet provides power in the form of a sinusoid. This sinusoid provides 120 Vrms at 60 Hz.
- The transformer has winding ratio 10 : 1.
- The diodes in the bridge rectifier can be approximated with the large signal model. Use $V_{th} = 0.7V$.

1.1 No Output Capacitor

First we'll assume that there is no output capacitor. Ignore C.

Sketch V_{out} as a function of t.



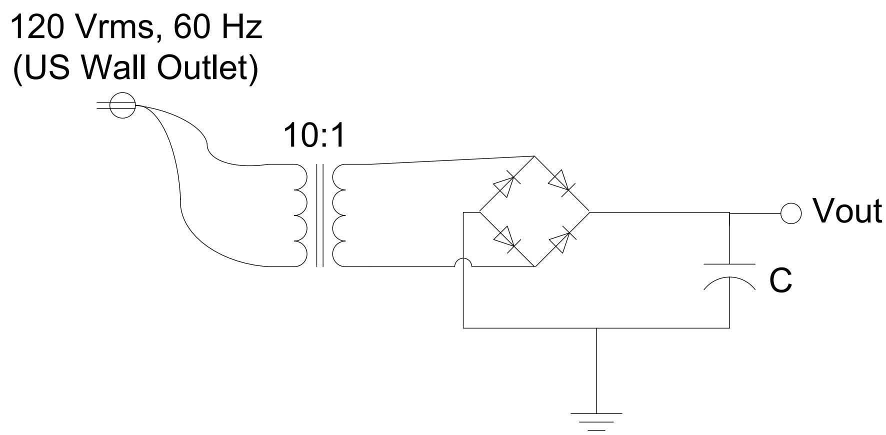
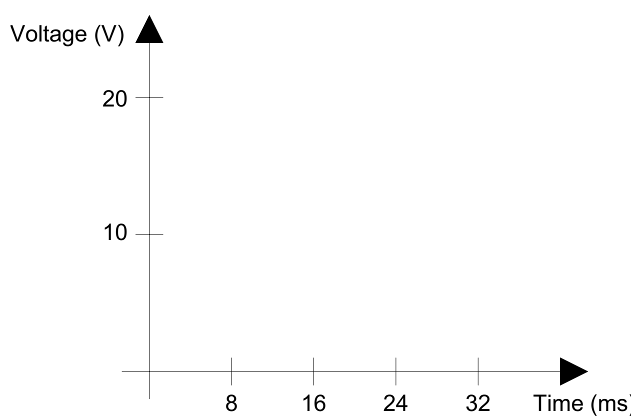


Figure 1: Bridge rectifier circuit.

What is the maximum voltage seen at V_{out}?

1.2 With Output Capacitor

Now assume that there is a large output capacitor on the output of the bridge rectifier. Sketch V_{out}.



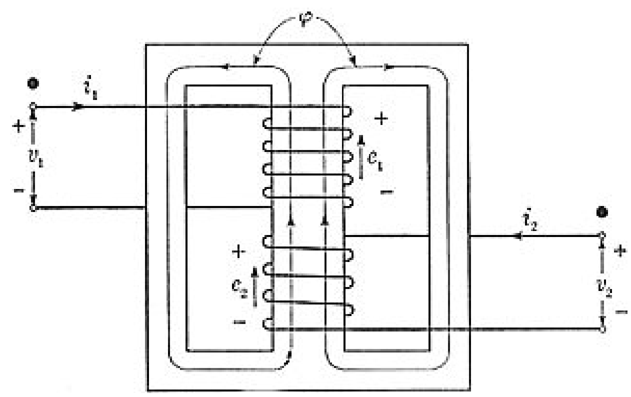


Figure 2: A typical transformer.

If we also place a load resistor in parallel with the output capacitor, how will the waveform change?

2 A Closer Look At The Transformer

A typical transformer design is shown in Figure 2. It consists of two pieces of wire would around a piece of iron. The wire on the left is known as the primary winding. The wire on the right is the secondary winding. We call the piece of iron the core.

Current $i_1$entering the primary winding induces a magnetic field ϕ in the core. This magnetic field then in turn induces a voltage e_1 in the primary winding. Because of e_1, we are not short-circuiting the primary. The magnetic field also induces a voltage e_2 in the secondary. If we hook the secondary to a circuit, a voltage i_2 would be induced.

All wire in the real world has some non-zero resistance. In addition, the longer the wire, the higher the resistance will be. Assume that the resistance of the secondary is 5Ω. Also, assume that the turns ratio is $10 : 1$ and that the primary side is fed with 120 Vrms.

If we short the secondary side, how much current will flow through the secondary winding?

How much power will be dissipated in the secondary winding?

When a resistor absorbs energy, it heats up. What will likely happen to the secondary winding when we short it?