Physics 375, Laboratory 5
Diodes

Overview

The purpose of these experiments is to use virtual instruments to measure the properties of a signal diode and zener diode, and to observe rectifying by diodes in circuits.

Background

A diode is made from the junction of a p-type and n-type semiconductor. The internal potentials of the semiconductors make the diode have a current to voltage relationship of:

$$I = I_0(e^{eV/kT} - 1)$$

For negative voltages the current approaches a small current $-I_0$. For positive voltages the current grows exponentially with the voltage. This has the effect of looking like the diode permits current to flow without resistance for positive voltage (forward direction) but blocks current for negative voltage (reverse direction). The diode becomes very useful in letting current flow in only one way. A zener diode is designed to run in reverse direction but the diode's barrier breaks down at a well defined voltage, so the zener diode can be operated to produce a fixed voltage across the zener diode.

1. Diode Reverse Current

Connect the variable power supply, a silicon signal diode (1N914), resistor, and DMM:

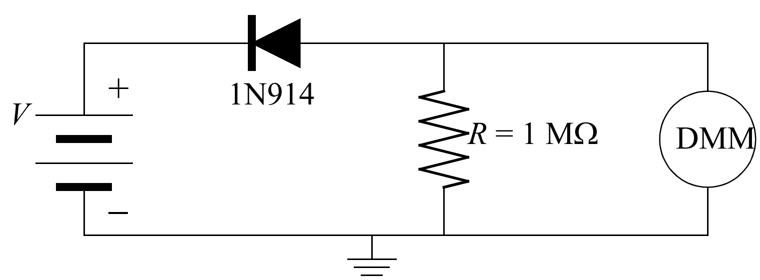

Figure 1: Diode Reverse Current Measurement

Make sure the negative terminal of the power supply is connected to ground. Measure the voltage drop across the resistor for supply voltages of 0.1, 0.2, 0.5, 1.0, 2.0 and 5.0 V. Calculate the current through the resistor which equals the reverse current through the diode, and the voltage across the diode which is the difference between the supply voltage and the voltage across the resistor. Plot the current vs. voltage for the diode.

2. Zener Diode

Build the circuit in figure 1 with a zener diode (1N750) instead of the signal diode and a 1kΩ resistor instead of the 1 MΩ resistor. Set the power supply voltage so that the current is 1.0 mA through the resistor ($I = V/R$), and calculate the voltage drop across the zener diode. Repeat for currents of 2 mA, 5 mA, 10 mA and 15 mA. What is the percentage change in V_Z from $I_Z = 5$ mA to $I_Z = 15$ mA?

3. Diode Rectifier

The following circuit is a extension of a differentiating circuit.

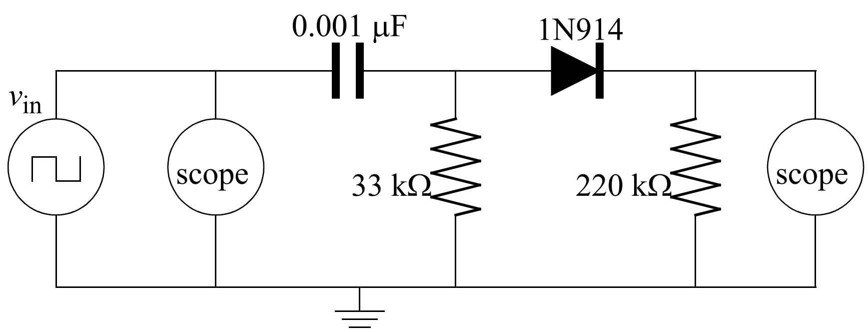

Figure 3: Diode Rectifier

Set the function generator for square waves of 1 kHz and 1 V amplitude. Use both channels of the oscilloscope to compare the input signal with the output signal. How does the output compare with the pure differentiating signal? Remove the 220 kΩ resistor and observe the output again. Try to explain what the 220 kΩ resistor does, using a couple of other values to see a pattern.