Lab 4
Diode IV Characteristics

Pre-Lab

1. Find the data sheets for the diodes 1N4001, 1N5229, and 1N5237.
2. Design the circuit described in step 2.
3. Answer the questions in step 5.
4. Design the circuit described in step 8.
5. Design the circuit described in step 11.

In this lab we will we will explore the current-voltage characteristics of rectifier diodes and zener diodes.

Measure IV Characteristics of Rectifier Diode

In this section you will measure the IV characteristics of the 1N4001 rectifier diode using a floating function generator. The floating function generator is not grounded and can thus be inserted in a circuit anywhere. This allows you to choose ground where it is convenient for your measurement. Use a transformer (to be handed out) between the wall socket and the function generator to float the function generator, and make sure you then don't connect the function generator ground to ground of the oscilloscope or DC power supply.

1. Build a circuit which can be used to measure the IV characteristics of the diode using a floating function generator. The circuit consists of the floating function generator, the diode, and a $100\,\Omega$ resistor connected in a loop with the point between the diode and the resistor grounded. Measure the voltage across the diode to get V, and the voltage across the resistor to get I.
2. Use the scope XY mode to plot the IV characteristics of the diode with a forward current up to $20\,\mathrm{mA}$. What maximum energy dissipation in the diode does this correspond to? Estimate the average energy dissipation in the diode.
3. What is the turn-on voltage of the diode? What voltage corresponds to $1\,\mathrm{mA}$ current? $10\,\mathrm{mA}$ current?

Measure IV Characteristic of Zener Diodes

In this section you will measure the IV characteristics of the zener diodes 1N5229 and 1N5237 using the same experimental setup.

4. Obtain the IV characteristics for both the 1N5229 and the 1N5237 in forward and reverse modes using the same circuit as in step 2.

5. The two Zener diodes have a maximum power rating of 500 mW. What maximum reverse and forward voltages does this correspond to? By how much can you exceed this since you are using an AC signal? (This is a question of duty-cycle)

6. What is the reverse turn-on voltage? What reverse voltage corresponds to 1 mA current? 10 mA current?

7. Measure the slope in the reverse breakdown region and use it to estimate the zener resistance. Compare with the data sheet.

Measure n and I_S

8. Build a new circuit which is the loop connection of a DC power supply of approximately 10 V, a resistor, and the 1N4001 diode.

9. Choose resistors to obtain currents of approximately 1 mA (10 kΩ) and 10 mA (1 kΩ).

10. In each case measure the voltage across the diode and the voltage across the resistor carefully (using a multimeter) to get v_D and i_D. Use these two measurements to calculate n and I_S in the diode current-voltage equation.

Measure equivalent resistance

In this section you will measure the small-signal resistance of the zener diodes by biasing them and applying a small voltage signal.

11. Modify the circuit from step 2. Add a DC bias from the laboratory power supply between the resistor and ground. Measure the voltage across the diode with one scope probe and the voltage across the DC bias and the resistor with another, AC couple both, and plot them in the XY mode. The slope tells you the resistance. You can adjust the DC bias to get the bias current that you want, e.g. 1 mA and 10 mA.

12. Measure the reverse resistances of the two zener diodes at 1 mA and 10 mA and compare with the data sheet.