

Diode Characteristics

Prelab:

You are tasked to determine experimentally the characteristic curve of a diode and to compare your data with a theoretical model of the diode response. With your lab partner, brainstorm on the following ideas:

- How can you determine quantitatively the shape of the characteristic curve of a forward-biased diode?
- How do you construct a laboratory experiment that will allow you to make this determination and measure the characteristic curve? What will you vary? Over what range? What will you measure? What instruments will you use for your observations?
- What differences do you expect if you were to measure the characteristics of a small signal diode (1N914), a power rectifier diode (1N4001), a red LED, and a blue LED (C503B-BCN-CVZ0461)? (You will need to study the data sheets for these devices to address this question.) What would you change in your experimental approach?

A theoretical model of the diode characteristic curve is given by the equation: $I_D = I_s \cdot \exp(V_D/V_{th})$ where I_D is the current through the diode and V_D is the voltage drop across the diode. Parameters I_s and V_{th} are constants. Research the names for these parameters and values you can expect for them. Derive a method to determine experimentally values for the two parameters.

You will turn-in a draft of your answers and your preliminary experimental plan as prelab for this assignment.

- Collect in a single folder the data sheets of all the diodes (use any red LED datasheet you can find online).
- Draw a schematic of the circuits you plan to build. Use Multisim to draw the circuit. Keep the Multisim file.
- Summarize what parameters you intend to vary and over what range of values.
- Indicate what instruments you will use and what you will measure.
- Explain how you will apply the theoretical model to the data.
- Regroup all this information in a single document.

At the beginning of the laboratory, we will discuss your ideas and finalize the experimental approach.

Report:

Each work group will submit a report due one week after the laboratory experiment which should include the following sections:

1. All the initial answers to the questions of the assignment (i.e. the prelab corrected and augmented by the discussion).
2. A quantitative description of the experimental approach you settled in after the lab discussion.
3. Your data (measurements and calculations) for the four types of LEDs listed in the prelab.

4. Your analysis of the data.
5. Your assessment of the theoretical model. Does it fit the data you collected? Were you able to estimate the model parameters?
6. The data sheets for the components you used in the laboratory, including a discussion of what information you used in the data sheets for your experiments.
7. A summary of your investigations and recommendations for improving the experiment if you were to repeat it.