Lab Activity: Diode I-V Characteristic Curves

Preparation:

Class will be divided randomly in to groups of two to three students. All students should have studied the section review questions listed in (1) below and read the preparation section of Experiment #2 in the Berube lab book. Before beginning the lab activity, each group must discern if all team members are prepared to continue. In order to do this, perform the following steps:

(1) Make sure everyone in the group has studied and understands the answers to the following section review questions from the text book; section 1-2 #1,3,4,5, section 1-3 #1, section 1-4 #1, 3, 4, section 1-5 #1,3,4, section 1-6 #3,4,5 and section 1-7 #2,4,5,8.

(2) Make sure everyone in the group can (i) sketch the diode's I-V characteristic curve, (ii) can describe the ac diode (bulk) resistance, and (iii) can explain how the dc diode resistance is found.

Objective:

To generate the diode's I-V characteristic curve on the lab bench using an oscilloscope.
To measure the ac and dc forward-biased resistance and make comparisons.
To measure the ac reverse-biased resistance.
To approximate the diode's barrier potential from the characteristic curve.

Procedure: (Take notes on all your observations)

1. Construct the circuit shown in Figure 2-2 of the Berube lab book. Make sure to set the function generator and oscilloscope to all the same settings. To put the scope in to XY mode, press the Main/Delayed button on the oscilloscope and the press the XY softkey under the scope's screen. Using grid paper, carefully sketch the scope trace.
2. Using the oscilloscope's cursors, calculate the dc forward-biased diode resistance (R_F) at a forward current level significantly above the knee voltage from the equation $R_F = V_F/I_F$. *Hint: use one cursor to find a Y value of the trace is significantly above the knee (this gives you I_F) and then use the X cursor to find V_F at that point.* **Ask for instructor assistance if you need help with the cursors.**
3. Using the oscilloscope's cursors, calculate the ac forward-biased diode resistance (r_F) around the same value as the previous step from the equation $r_F = V_F/I_F$. *Hint: use the cursors to find the change in the Y value (I_F) of the trace and then use the X cursors to find V_F.* **Ask for instructor assistance if you need help with the cursors.**
4. Using the oscilloscope's cursors, calculate the ac reverse-biased diode resistance (r_R) from the equation $r_R = V_R/I_R$. *Hint: use the cursors to find the change in the Y value (I_R) of the trace and then use the X cursors to find V_R.* **Ask for instructor assistance if you need help with the cursors.**
5. Finally, estimate the diode's barrier potential by placing a cursor at the knee voltage.

Questions

Questions AND answers are to be typed directly in to Microsoft Word.

1. What values were determined for the dc and ac forward-biased resistance? Explain why there is such a large discrepancy between these two values. Which of these two values better represents the diode's actual behavior? Explain your answer.
2. What value was determined for the ac reverse-biased resistance? Is this value what you would have expected? Why? Explain your answer.
3. What was the experimental estimate for the barrier potential? What would you have expected to measure for this diode? How did the two values compare (use percent difference)?

$$\%difference = \frac{measured - theoretical}{theoretical}$$

To Be Submitted

- Each group must submit their answers to the lab questions along with the sketch drawn from procedure step 1. The sketch must be neat, complete, and carefully labeled. The questions, answers, and graph are due within one week of completing the lab. Your team is solely responsible for your submission and you may not work with another team to produce the answers or the graph. If you have any questions that your team can not figure out, you may confer with another team or the instructor. However, paraphrasing or copying from ANY source without identifying the source is considered plagiarism which has serious consequences.
- Individual Team Assessment Forms must be ***fully completed*** or your grade will be affected. A participation grade is determined from these assessment forms and represents an average of your self-assessment and peer-assessment. If you do not ***completely*** fill out the form then you will automatically get a zero. Please submit assessment forms electronically or hard copy no later than during class one week after the lab is performed. In this way you can more effectively assess team members' participation in answering lab questions.

Late submissions are not accepted and a grade of zero is recorded.