ECEG 201 Laboratory 1: Characterizing an LED

Introduction

In this laboratory exercise you will characterize the forward voltage, V_F, as a function of forward current, I_F, for a light-emitting diode (LED).

The forward voltage of an LED is defined as the voltage from cathode to anode when the diode is forward-biased. The forward current of an LED is defined as the current entering the LED's anode.

In an LED's datasheet you will usually be given a range of expected values for V_F for a specified value of forward current. The value of I_F used to specify V_F will typically be a value that causes the LED to be relatively bright but is well below the absolute maximum rating for the LED.

For example, let's look at two excerpts from Kingbright's datasheet for their WP710A10PGD green LED. Fig. 1 shows how the forward voltage **specification** is given in the table of electrical characteristics. Note that only the typical (2.1 V) and maximum (2.45 V) values are given, and they are for the case where $I_F = 10\,\text{mA}$. The maximum allowed forward current for this diode is 25 mA.

Forward Voltage I_F = 10mA	V_F [2]	Pure Green	2.1	2.45	V

Figure 1: LED forward voltage specification

Kingbright also provides a graph illustrating how V_F varies as a function of I_F, as shown in Fig. 2. However, the graph only describes **typical** behavior... the actual value of V_F for any given LED might be 20% above or below the typical value.

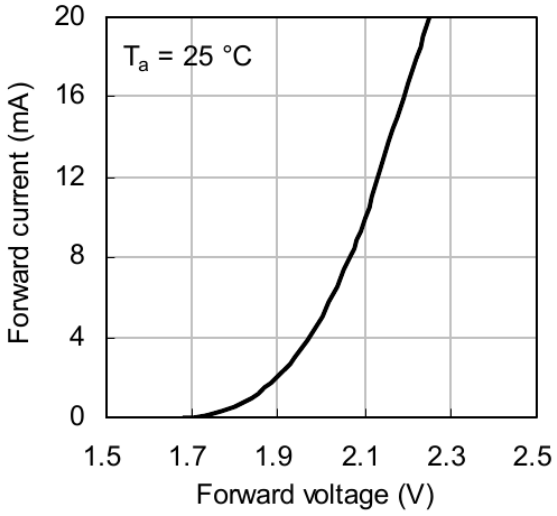

Figure 2: LED typical forward voltage graph

Your task for this activity is to take appropriate measurements of a specific LED (provided by the instructor) and create a graph similar to the one shown in Fig. 2.

Deliverables

You must turn in report for this activity by the beginning of class on Monday, 2020-01-27. Each student will work individually on this activity. You may discuss the activity with other students but you must do your own work and the report you submit must be entirely your own work.

Your report may be **neatly** handwritten or created by computer. If hand drawn, the data graph must be done on preprinted graph paper. Your name, the course name, and the date must be printed at the top of the first page. **Do not** add a title page.

Your report should include the following content:

- A short paragraph summarizing the purpose of the activity
- A discussion of how your data was collected. This should include:
  - The number written on the LED's tag
  - Schematics of test circuit(s) you used
  - Descriptions of the **quantities** you measured and the instruments used to make those measurements
  - Presentation and explanation of any equations you used to calculate values that were not directly measured
- A presentation of the test data. The value of every measurement you make should be provided in some way.

  Single, isolated measurements and calculated values should be given in narrative form. You will typically have a short paragraph for each of these measurements.

  Repeated measurements or calculations of the same quantity, either over time or after changing some input condition, should be presented in tabular form.
- A well-designed graph of the final characterization data, V_F vs. I_F, that is no larger than one-half page
- A brief (single paragraph) discussion of the sources of uncertainty in your data, including a rough estimate of how many significant digits there are in your graphed data points.

Including all figures, tables, and graphs your report will likely be 3 to 5 pages. However, quality is more important than quantity.

Procedure

1. If you haven't calibrated your Analog Discovery in the last six months you should do it now.
   https://projects.digilentinc.com/kaitlyn1franz/how-to-calibrate-the-analog-discovery-2-f016c0
2. Note that you can not directly measure resistance or current using the Analog Discovery. For this activity, you may use another instrument to measure resistance values (but not current). All other measurements must be made with the Analog Discovery.
3. The Analog Discovery must be the only source of power for your test circuit.
4. In addition to the LED itself and your Analog Discovery, you may use one or more fixed resistors in your test circuits. No other components or devices may be used.
5. The minimum value of V_F measured in your data and shown on your graph must be not greater than 1 V. The maximum value of I_F measured in your data and shown on your graph must be not less than 5 mA.
6. The difference between two adjacent measured and graphed data points must be no greater than 0.25 V and no greater than 1 mA. You should expect to have at least twelve data points, and perhaps as many as twenty.