



الجامعة الألمانية الأردنية
German Jordanian University

Electronics 1 Lab (CME 2410)

School of Informatics & Computing
German Jordanian University

Laboratory Experiment (6)

Optical Diodes and BJT Transistors

1. Objective:

To learn how to characterize photodiodes, LEDs and transistors. To improve design skills.

2. Equipment & Instruments

DC Supply Source
Multimeter
Breadboard
NPN Transistor
Photodiode
LEDs
Resistors

3. Procedure

Perform the following procedure in the lab. Any time the procedure asks you to measure something, make sure you record the measured values in your notebook.

Part 0: Obtain the following parts:

1. Photodiode.
2. Red, Yellow and Green LEDs.
3. NPN transistor 2N2222.
4. Resistors: 470k Ω , 10k Ω , and as needed.

Part I: Characterizing a photodiode

Perform the following procedure to determine the sensitivity of the photodiode:

1. Determine the anode and cathode side of the photodiode.

2. Connect the photodiode in series with the $470\text{k}\Omega$ resistor. Then connect them to 5V DC source such that the photodiode is reverse biased.
3. Measure the current through the photodiode in the following conditions:
 - a. Full Light (use a light source if needed).
 - b. Medium Light (photodiode partially covered).
 - c. Dark (photodiode completely covered).

Part II: Characterizing LEDs

Perform the following procedure to determine the amount of current and voltage required to turn on the LEDs:

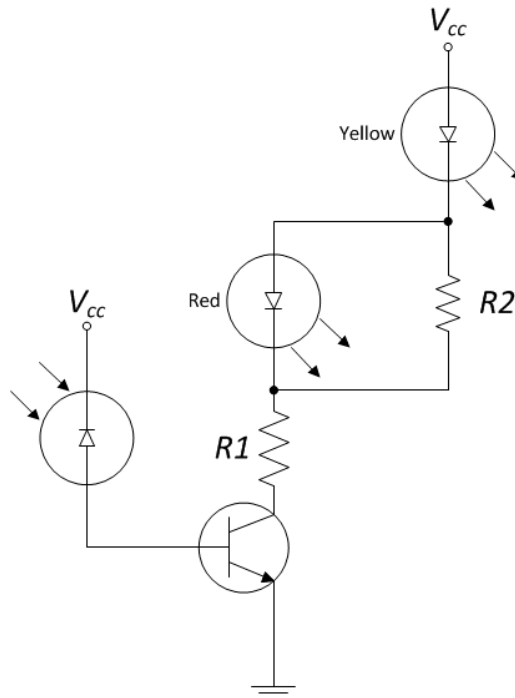
4. Connect the red LED in series with the $470\text{k}\Omega$. Then connect them to a 5V DC source such that the LED is forward biased.
5. Is the LED on?
6. Change the resistor to a smaller value and determine the amount of current and voltage drop on the LED for the following cases:
 - a. LED starts to come ON.
 - b. LED generates medium amount of light.
 - c. LED is bright.
7. Repeat the procedure for the yellow and green LEDs.

Part III: Designing and building a light level indicator

In this part, you will be guide to design a 3-level light indicator. The indicator consists of two LEDs (red and yellow). When it is dark. The two LEDs should be off. When the light is medium, only the yellow LED should be on and during full brightness, both the yellow and red LEDs should be on.

- A. Review the results of parts 1 and 2. Is the photodiode capable of directly turning on the LEDs?
- B. You will notice that the photodiode only conducts a small amount of current. We will therefore have to use a transistor to amplify the current. We will first have to determine the amount of current amplification that the transistor can perform.
 1. Connect a +5V DC source to the cathode of the photodiode and the other end of the photodiode to the base of the transistor. Connect the emitter to ground and the collector to a $10\text{k}\Omega$ resistor then to the +5V DC source.
 2. Measure the amount of collector current for the following cases:
 - a. Full Light (use a light source if needed).
 - b. Medium Light (photodiode partially covered).
 - c. Dark (photodiode completely covered).

- C. Is the collector current sufficient to turn on the LEDs?
- D. Calculate beta for this transistor.
- E. We can now use cascaded LEDs for the indicator as shown in the following circuit:



- F. R1 is used to protect the LEDs while R2 is used to bypass the red LED during medium light condition. Determine the appropriate resistance values for R1 and R2.
- G. Build and test the circuit. Adjust values of R1 and R2 until the circuit is operating as intended.