

LABORATORY 1

SCOPE: This laboratory assignment is designed to familiarize you with basic test equipment and apply it to a basic light emitting diode (LED) circuit.

MEL: You will need the following equipment: Resistors, LED, breadboard, wire, multi-meter and a power supply.

When working with electronic circuits, it is generally good practice to current limit the power supply in case the circuit you are evaluating gets damaged or is incorrectly connected. While the power supply is turned off, connect the positive and negative leads together (while the other ends are connected to the power supply). Rotate the voltage control knob approximately 25% full scale and the current control knob approximately 25% full scale. Turn on the power supply and note the current delivered by the power supply on the display. For this assignment, you will need at-most 100mA. Rotate the current control knob until the supply reads 100mA (+/- 10%), then rotate the voltage control knob to 0% of full scale, then turn off the supply and untie the positive and negative leads from each-other. Your supply is now current limited to 100mA and is ready to be applied to your circuit.

Diodes are effectively a one-way valve for current to flow. When the anode is at a higher potential than the cathode, current flows through the component. The minimum voltage that must be setup across the anode and cathode is the knee voltage. When the cathode is at a higher potential than the anode, no current will flow until the avalanche breakdown voltage is reached. This condition is considered a failure mode condition because excessive current can be conducted through the device causing it to heat up and burn out extremely quickly.

To determine which lead is the anode and cathode, configure the multi-meter to diode measurement mode (diode symbol). Connect the two wires across the terminals of the diode, in the configuration that causes the display to read something other than “1”, the red terminal is connected to the anode and the black terminal is connected to the cathode and you have just determined the polarity of the component.

Next, measure the resistance of the resistors included in your components kit. To do this, configure the multi-meter to ohms mode. If using the multi-meter in the class, these are non auto-ranging devices which do not change the measurement scale automatically. Therefore, you will need to ensure that the value you are trying to measure is less than the measurement range. You can manually adjust this range using the buttons on the device. Record the resistances for each resistor.

Wire up the circuit as is illustrated in the schematic shown in FIGURE 1. Turn on your power supply and adjust the voltage control knob until its output voltage is +5VDC. Verify that the supply is delivering this voltage by configuring the multi-meter to voltage mode and place the terminals across the power supply terminals. As with measuring resistance, the multi-meter may need to be configured manually such that the measured voltage is less than the measurement range and can be adjusted using the buttons on the device. Once done, connect the power supply to your circuit and record the voltage drop across the resistor and the diode.

Next, configure the multi-meter into current mode. As with voltage mode, the multi-meter may need to be configured manually such that the measured current is less than the measurement range and can be

adjusted using the buttons on the device. Unlike voltage, resistance and diode measurements, the probes on the multi-meter must be manually reconfigured to the current measurement ports. Additionally, current measurements must be placed in-circuit and can be facilitated by placing the multi-meter in series between the power supply and the resistor. Record the current flowing through your circuit. Why do you believe most multi-meters require manually reconfiguring the probe connections on the device?

Verify that your circuit follows ohms law ($V=IR$), by calculating the expected current flowing through your resistor utilizing the measured resistance and voltage drop across the component. Record the expected current and the percent difference between your measured and calculated results.

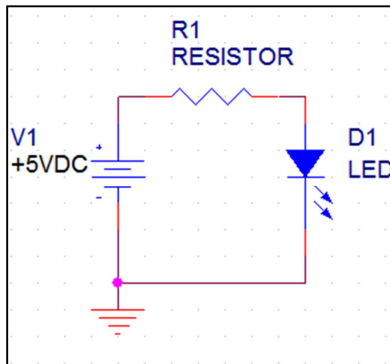


FIGURE 1: LED Test Circuit

QUESTIONS:

1. What is the resistance of each resistor

Resistor 1: _____

Resistor 2: _____

2. With the supply delivering +5VDC and using “Resistor 1”, measure the following:
 - a. Voltage drop across the resistor
 - b. Voltage drop across the diode
 - c. Current through the circuit
 - d. Using ohms law, how much current should be flowing through the resistor
 - e. What is the percent difference between the measured and calculated currents
 - f. Repeat (2) with “Resistor 2”
3. Why do you believe most multi-meters require manually reconfiguring the test ports connected to the device when measuring current vs when measuring voltage?
4. What observations did you make about the brightness of the LED between the two resistors. Can you explain the mechanisms that cause this?