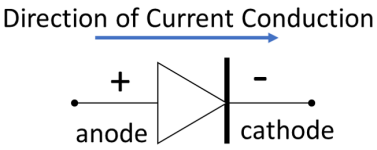
Activity Sheet - Week 1 Lab-Based Studio

Learning Objectives

To revise and be able to

- set up a DC circuit on bread-board as per schematic
- use the power supply in providing a DC voltage
- use the multimeter in measuring voltages, currents and resistances
- apply Ohm's Law and Kirchoff's Laws
- characterize the I-V characteristics of each of the R/G/B LEDs
- bias the RGB LED at specific currents to identify mystery colour

Revision Notes



- A diode is a polarized device that allows current to flow in only one direction. The positive side "+" is the anode where current enters, and the negative side "−" is the cathode where current leaves. The symbol of a diode is a triangle and a line where the triangle points to the direction in which the current flows.
- An LED (Light Emitting Diode) is a type of diode. A RGB LED houses three coloured LEDs inside the lens : Red (R), Green (G) & Blue (B).
- **Voltage (Potential difference)** : A measure of the energy transferred per unit charge when charge moves from one point to a second point in a circuit. Units : Volts (V), equivalent to Joules/Coulomb (J/C).
  Voltages are measured using voltmeters / multimeters in PARALLEL.
- **Current** : The time rate of flow of electrical charge through a circuit. Units : Ampere (A), equivalent to Coulomb/sec (C/S). It is measured as the net flow of charge across a cross-section.
  Currents are measured using ammeters / multimeters in SERIES.

Studio Session #1

Time	Duration	Activity
0:15	15 mins	Review on Equipment and Measurements
0:30	30 mins	Briefing on Activity
1:00	60 mins	Activity #1a
2:00	30 mins	Activity #1b

Activity 1a: I-V Characterization of R/G/B LEDs

Time allotted: 60 mins

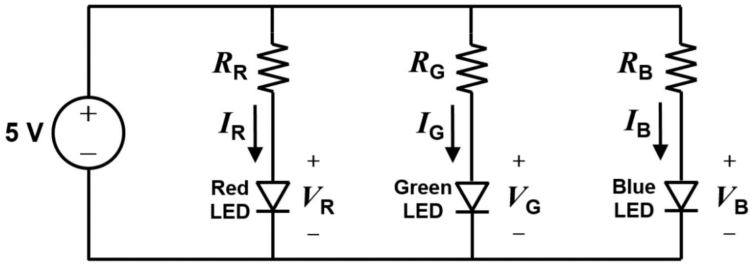
The objective of this activity is to characterize the I-V characteristics of each of the R/G/B LEDs.

Components & Equipment:

1. RGB LED (KingbrightL-154A4SURKQBDZGW)
2. Resistors
3. Breadboard, tools and wires
4. Benchtop multimeter
5. Benchtop power supply

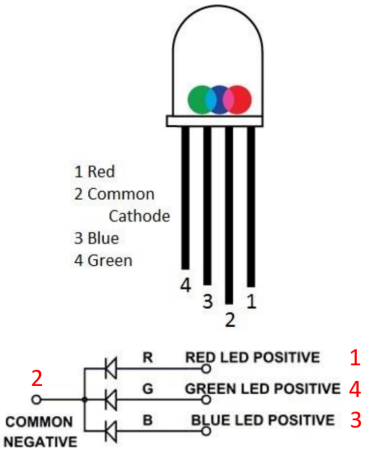
Steps:

1. Each student has been provided with an RGB LED and access to resistors.
2. Each of the R, G & B LEDs has different I-V characteristics, which you will determine experimentally.
3. Using the breadboard, construct the circuit shown below.
4. By varying resistances R_R, R_G, and R_B according to the values given below, tabulate the currents and voltages for each LED.
5. For each of the R, G and B LEDs, plot the I-V curves in Microsoft Excel. Compare your graphs with those provided in the datasheet for the RGB LED Lamp.



Notes :

1. The RGB LED Lamp can be very bright! To reduce its potential risk of harming your eyes, a strip of PTFE white tape is wrapped around the lens of the LED.
2. For the RGB LED used, the cathodes for the three LEDs are shared and common (pin 2 - the longest pin). The other pins, 1, 3, and 4, are the anodes of the respective colour LEDs.



		Values for R_R, R_G and R_B				
Nominal Resistance →		150Ω	330Ω	560Ω	820Ω	1500Ω
Measured Resistance →						
Red LED	Voltage V_R					
	Current I_R					
Green LED	Voltage V_G					
	Current I_G					
Blue LED	Voltage V_B					
	Current I_B					

Activity 1b: What's the Mystery Colour?

Time allotted: 30 mins

Objective:
In this activity, you will be identifying the mystery colour assigned to you!

Steps:

1. Each student will be assigned one particular mystery colour for which its corresponding current values I_R, I_G and I_B are given in the table below.

Mystery Colour	Current I_R	Current I_G	Current I_B
A	20 mA	2 mA	2 mA
B	20 mA	1.5 mA	0 mA
C	20 mA	0 mA	1.5 mA
D	3 mA	13.5 mA	1.5 mA
E	2.5 mA	0 mA	1.5 mA
F	2 mA	1.5 mA	12.5 mA

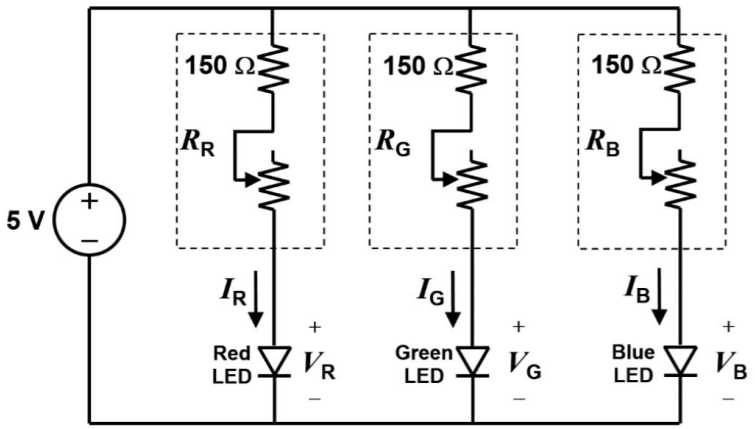
2. Using your plots from Activity 1a, determine the appropriate values of the resistances R_R, R_G and R_B for the mystery colour assigned to your group.

   Hints:
   (i) Use the I-V plots, as well as Ohm's Law and Kirchhoff's Voltage Law to determine the resistance values.

3. After determining the required resistance values R_R, R_G and R_B, construct the circuit using resistors or trimmers (variable resistors) and identify the colour you have obtained to a Graduate Assistant (GA).

4. ***Optional:***
   In this extra activity, the objective is to bias the RGB LED Lamp to get as close to white colour as possible, with the help of trimmers (variable resistors).

   (a) Modify your circuit to the one shown below. Now, the current-limiting resistor for each LED is formed using a series connection of a 150Ω resistor and a 2 kΩ variable resistor.



(b) The pin layout of the variable resistor is shown on the right. You only need to connect the middle pin (pin 2) and one other pin (either pin 1 or pin 3). Using the trimming tool provided, you can adjust the variable resistor for each of the RGB LEDs and try to get the combined light as close to white colour as possible.

(c) What are the corresponding current values I_R, I_B, and I_C? Are they equal? Discuss your observation.

Variable Resistor :