MODULE 6: Photodiodes and VLC

BU SUMMER CHALLENGE
Electrical Engineering: Smart Lighting Project

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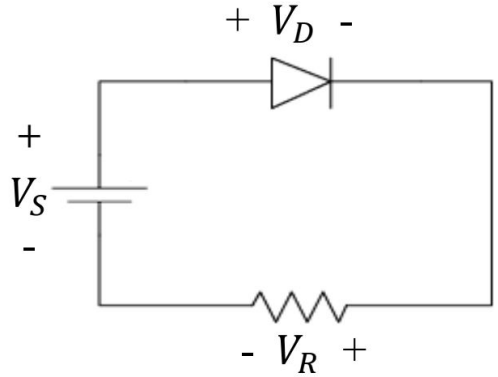
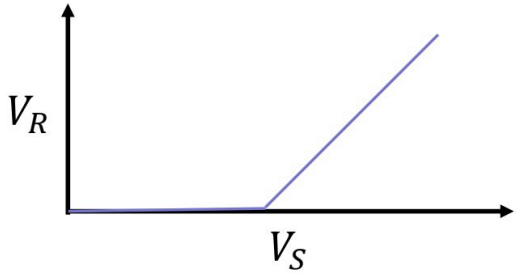
Overview

- Recap
- Photodiodes
- Integrated Circuits (ICs)
- Visible Light Communication
- Experiment
  - Photodiodes
  - Optical Channel
  - Optical Signaling

Recap - LED Drivers

- How does the VR relate to the current through the resistor?
- How does the current through the resistor relate to the current through the diode?
- What does the current through an LED relate to?





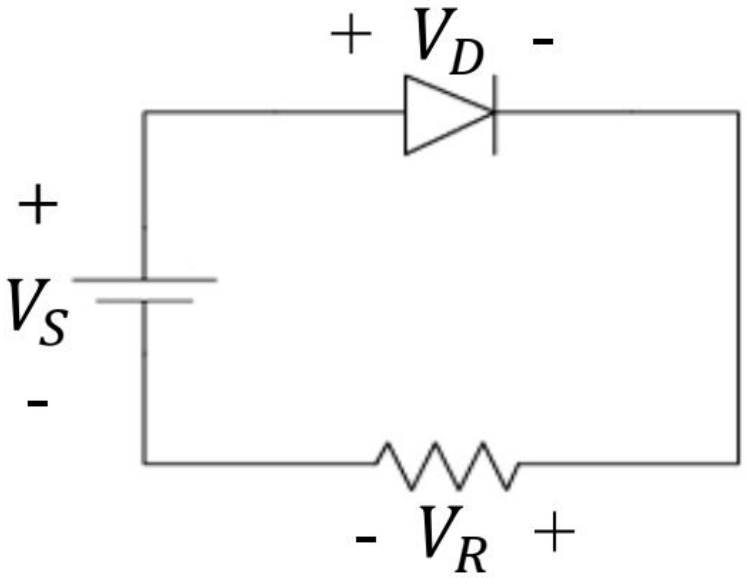
Recap - Electrical Power

- Power is the rate at which energy is consumed.
  - Voltage = Potential energy difference per unit charge [V] or [J/C]
  - Current = Rate of flow of charge [A] or [C/s]

$$P = VI$$

- Power is measured in Watts [W] or [J/s]
- Energy sources (such as batteries) produce power while the load of the circuit absorbs power.

Recap - Electrical Power



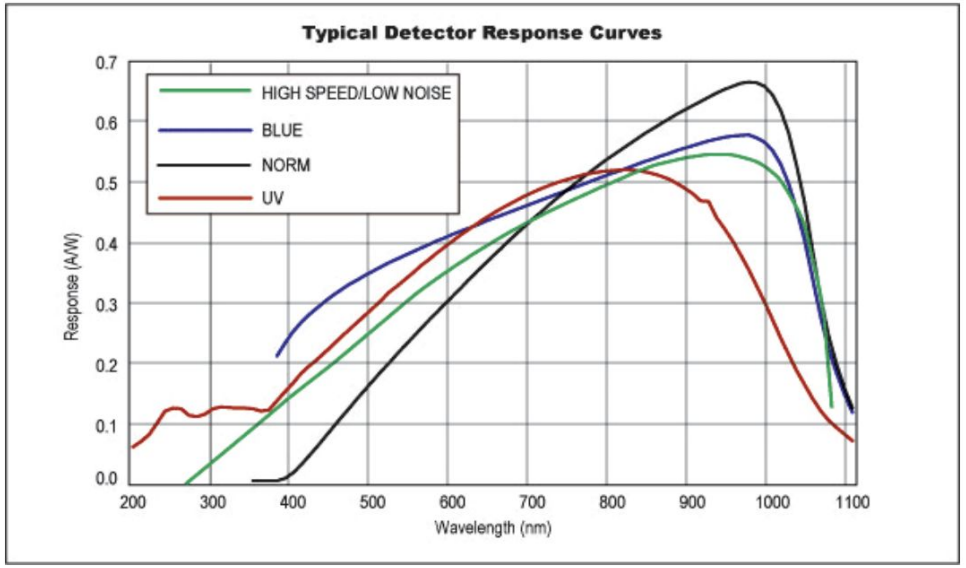
$$I = \frac{V_R}{R} = \frac{V_S - V_D}{R}$$

$$P_D = V_D I = \frac{V_D(V_S - V_D)}{R}$$

$$P_R = V_R I = \frac{(V_R)^2}{R} = I^2 R$$

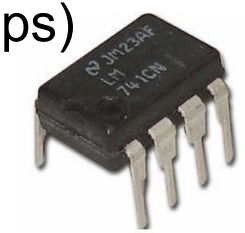
Photodiodes

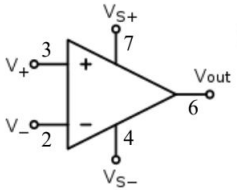
- Current is generated proportional to the received optical power
- Responsivity [A/W] is a function of wavelength

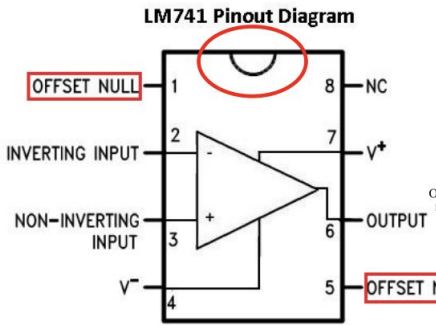


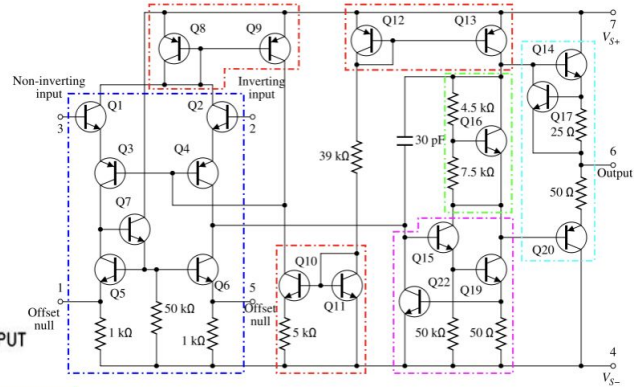
Integrated Circuits (ICs)

- A collection of many electronic components connected together to carry out a common function
- E.g., circuit logic gates, computer memory, operational amplifiers (op-amps)



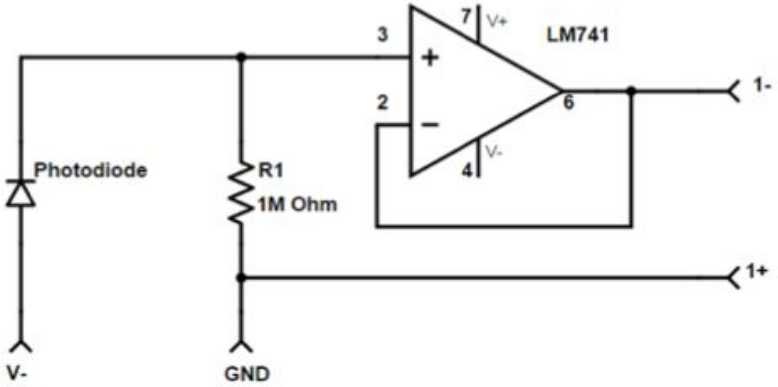




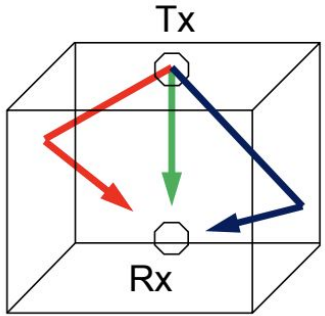


Experiment I

- Photodiode Circuit



- Optical Channel
  - LEDs have an angle dependent emission pattern
  - Photodiodes also have an angle dependent response
  - Distance relates to signal attenuation
  - Multipath attenuation adds time dispersion



Think – Pair – Share

Extra - Introduction to Arduino