

SP.764, Practical Electronics
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Lecture 1: Course Introduction

Topics:

- 1) Resistors, and the voltage divider.
- 2) Voltage divider as a power supply. (Make 3 volts out of 5 volts with voltage divider.) Know when it is a good idea and when it is not.
- 3) Get intuitive sense of voltage divider.
- 4) Simple rules of thumb.
- 5) Diodes: Diodes are one of the fundamental building blocks of electrical circuits. Most common diode is the LED (Light Emitting Diode).

Demos:



Red Light Emitting Diode (LED)

The LED lens gathers the light and focuses it into a beam. If an LED is introduced in water, light disperses in every direction. Since the index of refraction of plastic is similar to that of water, the LED plastic casing doesn't act as a lens anymore.



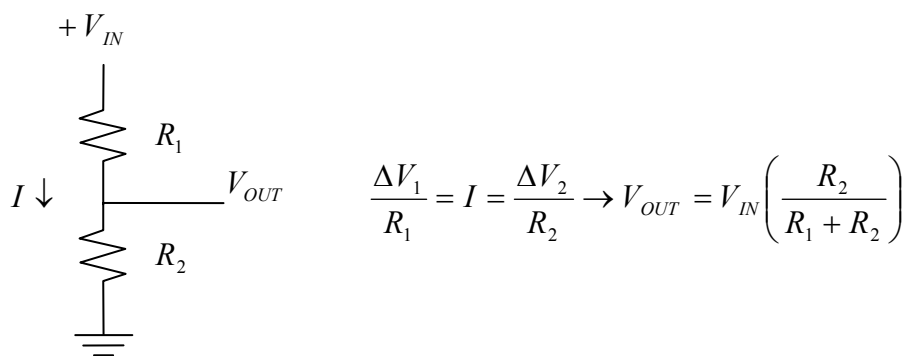
120-LED array.

The 120-LED array shown above has an intense cyan color with a broad angle of light. About 25-30 watts are being put into the apparatus. (The red LED was about a 10th of a watt.)

Some LED arrays may appear to be more efficient (while consuming less power) than others. However, this is because a lens is used to concentrate the light, as opposed to the 120-LED array shown above that was designed to disperse light.

Theory:

- 1) Voltage dividers
 - a. Review
 - b. As Voltage Source
- 2) Diodes
 - a. Ideal Diode
 - b. Our Model Diode
 - c. Real Diodes
 - d. Driving LEDs
 - e. Diodes as Voltage Source



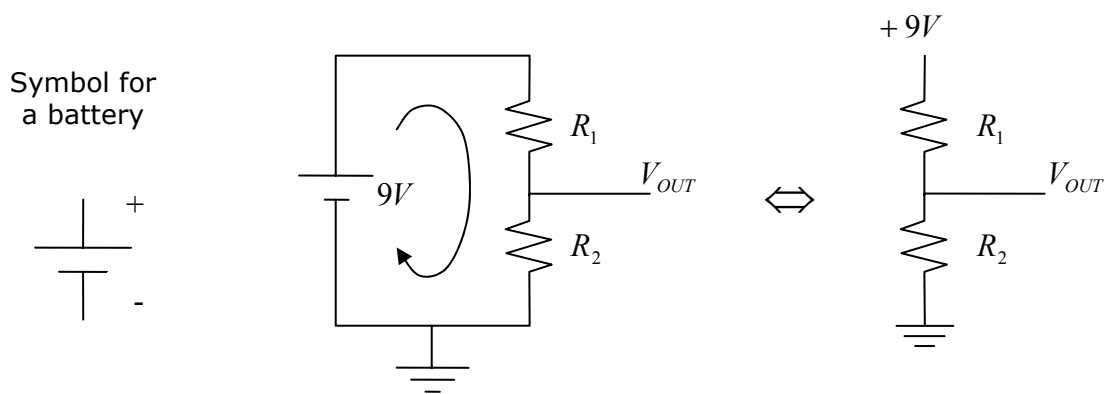
Always analyze extreme cases.

- 1) What if R_1 goes to infinity? Output voltage is zero.
- 2) What if R_1 goes to 0? Output voltage is equal to the input voltage.
- 3) What happens if $R_1=R_2$? Output voltage is half the input voltage.
- 4) What if $R_2 = 2R_1$? Two-thirds of input voltage.
- 5) $R_2 = 9R_1$? Nine-tenths of input voltage

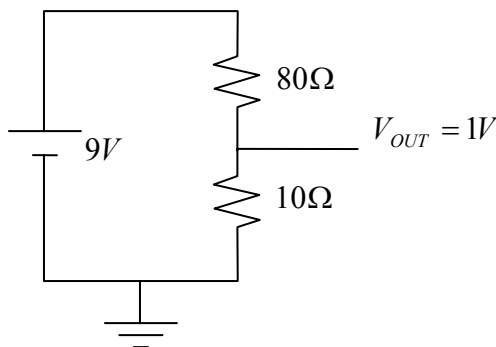
Note:

- A) V_{OUT} is closest to the voltage at the other end of the lower-valued resistor.
- B) $R_1 \approx R_2$, $V_{OUT} \approx \frac{1}{2} V_{IN}$.

Kirchhoff's Voltage Law (KVL)



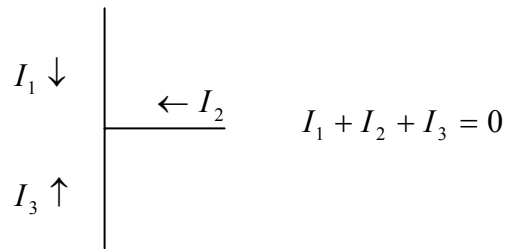
KVL: The sum of voltage drops going around a closed loop path is zero.



$$V_{OUT} = 9V \left(\frac{10\Omega}{80\Omega + 10\Omega} \right)$$
$$= 1V$$

$$\sum_{loop} \Delta V = (9V - 1V) + (1V - 0V) + (0V - 9V)$$

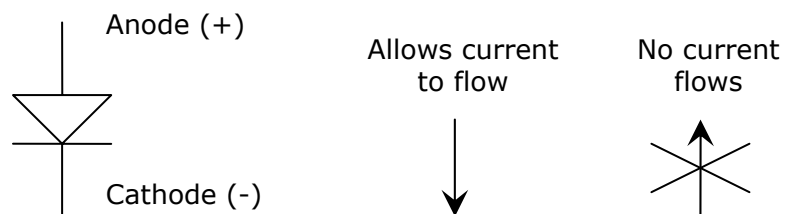
Kirchhoff's Current Law (KCL)



As long as currents are given a direction, the total sum of the currents equals zero.

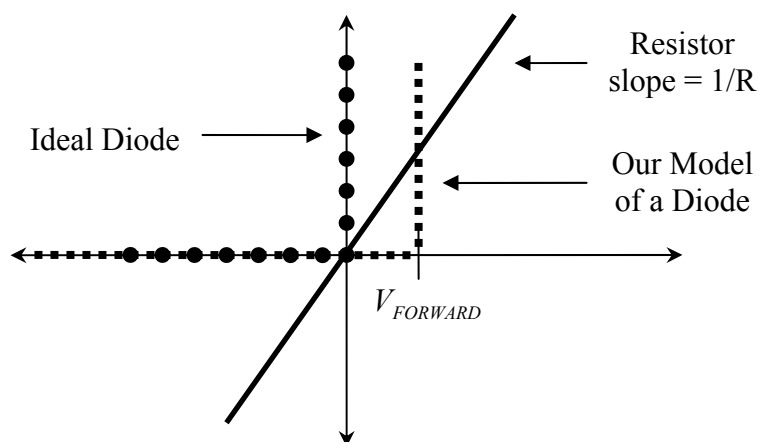
Diodes

The "ideal" diode only allows current to flow in one direction.

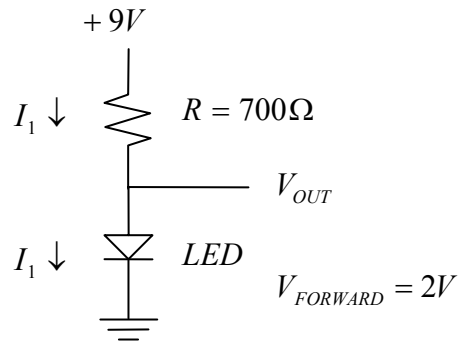


An easy way to tell difference between the anode and the cathode is that electrons come from the cathode (i.e. CRT tube in a TV – cathode rays emitted hit the TV screen).

Plot of I vs. V for Diode and Resistor



Example:



Questions:

- 1) What is I_1 ? Current that goes in, must go out. Well, $V_{OUT} = 2V$ (the LED holds the voltage at that value)

$$\begin{aligned}\Delta V_{resistor} &= 9V - 2V \\ &= 7V\end{aligned}$$

$$\begin{aligned}I &= \frac{\Delta V}{R} = \frac{7V}{700\Omega} = \frac{1}{100} A \\ &= 0.01A = 10mA\end{aligned}$$