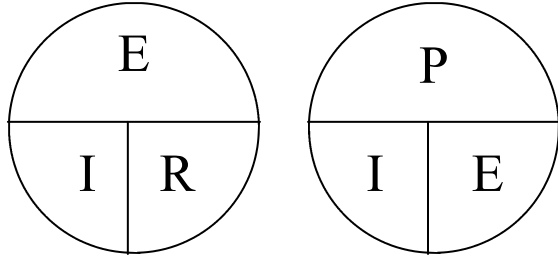


# Cheat Sheet

## Ohm's Law



P= Watts  
I= Current/Amperage  
E= Voltage  
R= Resistance

Cover the variable you need and the formula is the rest.

### Common Formula's

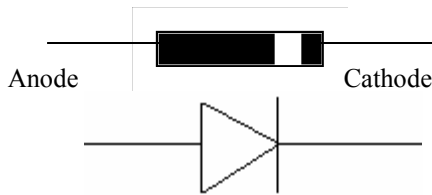
$P=I \times E$  (Watts= Amperage times Voltage)  
 $I=E/R$  (Amperage= Voltage divided by Resistance)  
 $E=I \times R$  (Voltage= Amperage times Resistance)

$$P = \frac{\text{Voltage times Voltage}}{\text{Resistance}}$$

Usage. Say you have an amplifier that produces 100 watts at 4 ohms.  $100=(E \times E)/4$ . Multiply both sides by the resistance and  $400=E \times E$  or Voltage = 20v.

Then.  $20/4$  gives you 5 amps. Now you know you need to move 5 amps at 20 volts to your speakers.

## Diodes



In simple terms, Positive electricity flows from the anode to the cathode. When you apply a positive charge to the anode, it flows to the cathode. You can try to reverse this for grounds, but it is easier for some to think in terms of positive coming from the source going to the nearest ground.

A way to remember this is Anode first alphabetically so it is positive. Cathode comes after Anode, so it is negative. When looking at a diode, the connection nearest the stripe is the cathode. Think of the stripe as a — to denote negative.

**Note:** The diodes we use will have a 0.7v drop when properly biased, and no voltage flow when reverse biased.

## LEDs

LED is an acronym for Light Emitting Diode. Like the diode above it consist of an Anode and Cathode, and electricity flows through them in the same direction. Unlike incandescent bulbs, diodes are wattage and polarity sensitive.

A short cut to finding the resistor needed,

$$\text{Resistance} = \frac{\text{Supply Voltage} - \text{LED Voltage Drop}}{\text{LED's amperage rating}}$$

If you are using more than one LED and are wiring them Positive to negative (series), then add the voltage drop for each LED for this formula. For Example, using 3 diodes. 3.1 volts and 20ma each.

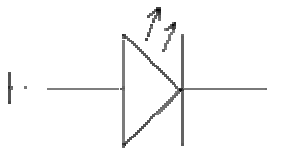
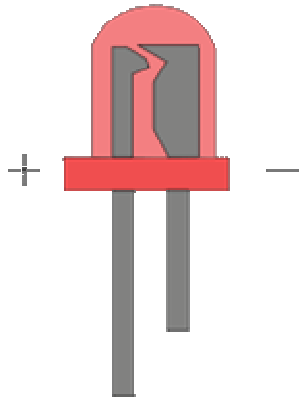
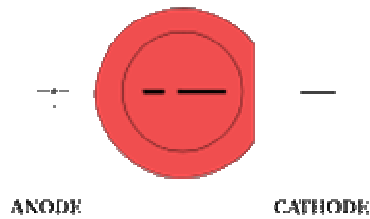
Resistance needed is  $12.6-9.3/0.020$ ,  $3.3/0.020=165$  ohm. You will need a resistor with 165 ohm value.

Because of the low current draw of the LEDs, they do not trip a flasher relay as incandescent bulbs do. Even with a resistor, you will need to use an electronic flasher.

**Metering a resistor.** Place one probe on one lead and the other lead on the other end, read Ohms on meter.

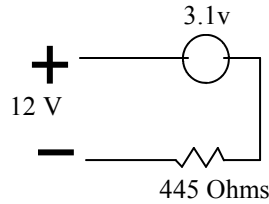
Pneumonic	Color	First #	2nd #	Multiplier
Bad	Black	0	0	1
Boys	Brown	1	1	10
ravish	red	2	2	100
often	orange	3	3	1,000
young	yellow	4	4	10k
girls	green	5	5	100k
but	blue	6	6	1,000k
violet	violet	7	7	10m
gives	grey	8	8	
willingly	White	9	9	

# Simple LED wiring



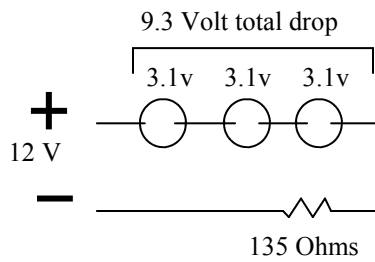
$$\text{Resistance} = \frac{\text{Supply Voltage} - \text{LED Voltage Drop}}{\text{LED's amperage rating}}$$

Find the voltage and amperage for each LED from the manufacture.  
 In this example I'll use 3.1v and 20mA using Ohm's Law the resistance of these LEDs is 155 ohms.



## One LED with a resistor.

12-3.1 is 8.9. 8.9/0.02 equals 445 ohms. For a total of 600 ohms which will draw 20mA.



## Three LEDs in series with a resistor.

So, 12-9.3 is 2.7. 2.7/0.020 equals 135 ohms. For a total of 600 ohms, which draws 20mA.