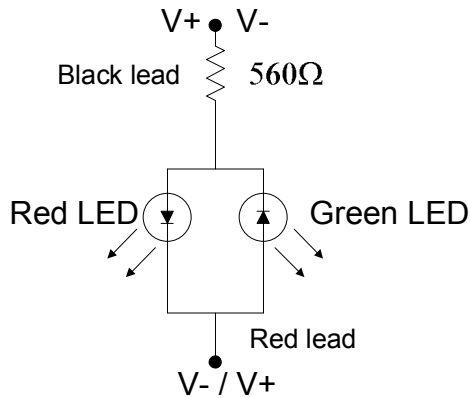
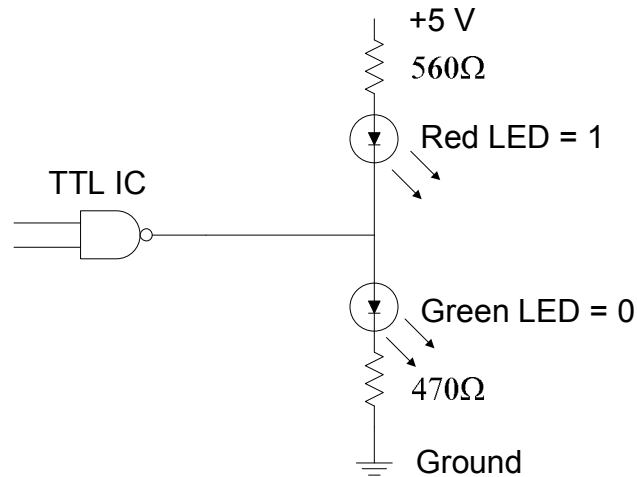


### Polarity Indicator



This circuit will work on voltages between 5 and 12 volts. Green LED = polarity of the probes are correct. Both on = AC.

### Logic Level Indicator



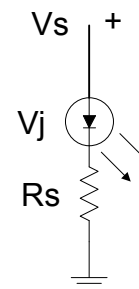
**Notice: Operating Light Emitting Diodes (LED) without a current limiting resistor will case the LED to burnout soon!** Always use a resistor unless the circuit controls the current in some other way.

REVISIONS		

Color	I <sub>F</sub> max.	V <sub>F</sub> typ.	Luminous intensity	Wavelength
Red	30mA	1.7V	5mcd @ 10mA	660nm
Yellow	30mA	2.1V	32mcd @ 10mA	590nm
Green	25mA	2.2V	32mcd @ 10mA	565nm
Blue	30mA	4.5V	60mcd @ 20mA	430nm

**Calculating the LIGHT emitting Diode series resistor.**

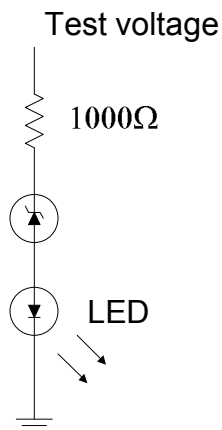
Value. Light Emitting Diodes (LED) require as series resistor to keep them from burning out and to control their brightness. LED's, like all diodes, do not start conducting as soon as an electrical potential (V<sub>f</sub>) appears, as conductors do. When the forward voltage is greater than the diodes junction barrier voltage, current flows. When the LED conducts the current, it acts like a wire that is shorted across the source of voltage and will burnout unless the current is controlled. To find the resistor that will, use the formula below.



$$R_s = (V_s - V_j) / I$$

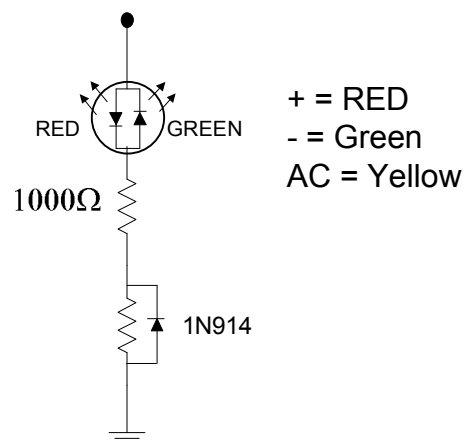
$R_s$  = resistor (series)  
 $V_s$  = Source voltage  
 $V_j$  = Junction forward voltage (V<sub>F</sub>)  
 $I$  = Operating current (less than I<sub>f max</sub>)

### Voltage Level Indicator



Zener diode with selected brakdown voltage. Normal operation in reverse bias.

### Using the TRI Color LED



This is to compensate of the higher voltage drop across the green LED.

TITLE		
Using Light Emitting Diodes		
DATE	SCALE	Parallax BS2 program provided.
3-21-2010	none	
DRAWN BY	PAGES	www.robo-works.net
Paul Ashley	1 of 1	