Using LEDs in Your Model – Allan Wing 3/4/2005

In the past few years there has been a steady advance in the number and types of LEDs available. A LED operates on a variety of low voltages and this coupled with its low current draw, small size, long life and lack of heat make an ideal replacement to the incandescent light bulb in today's models. LEDs can be integrated into almost any model with the knowledge of just a few basics. Below I will give a few pointers that I hope will allow you to use LEDs in your model.

There are a few terms we need to review before talking about the actual design.

Vf – Forward voltage. This is the voltage across the LED when it is operating

If max – Often just stated "If" This is the maximum current in milli-amps (1/1000 amps) to be used with the LED.

View Angle – This is the angle where the light is half as bright as it is when viewed directly from the top.

Mcd – Millicandelas, A measure of brightens when viewed directly form the top.

View angle and mcd are related. The smaller the view angle (15degrees is about the smallest I have seen) the brighter the spot will be very much like a flashlight. So if you are using a white LED as a spot light pick one with a small view angle, if using a red or green for running lights you would want to pick a larger view angle.

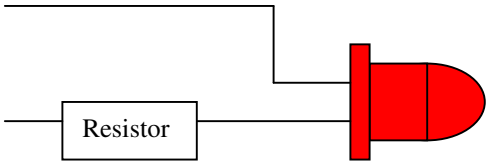
LEDs should be wired singularly or in series. LEDs in parallel do not always work, they will not share current equally. (I hooked up two in parallel sharing 20 Ma and one took 8 Ma and the other took 12 Ma)

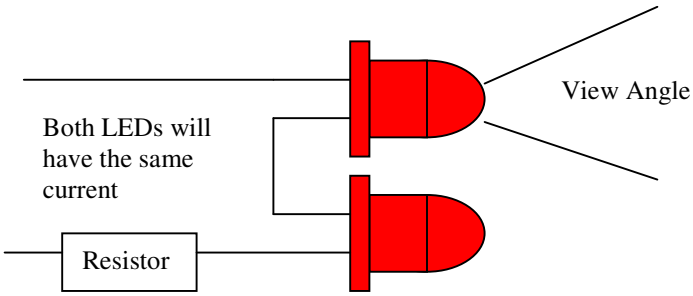
Wiring a single LED is easy. It is just an LED and a resistor. The longer lead on the LED goes to the + side of the battery and the shorter goes to the – side. The resistor can go on either lead, but you must include a resistor.
The value of the resistor is found as follows

R=(Battery voltage-Vf)/If

If you are using a red LED with a Vf of 2.2V and you want the Max current of 20 MA with a 6-volt battery this becomes

R= (6-2.2)/.02 or 190 Ohms





When using two or more LEDs in series the value of R is found
R=(Battery Voltage – Vf-Vf) Or R=(6-2.2-2.2)/.02 or 80 Ohms

Resistors come in standard values so the value you calculate may not be available. In the Values we are most concerned about 180 or 220 for the 190 Ohm resistor of the first example and 75 or 82 for the second example. In these cases use the next higher value or 220 and 82 respectively.
For 10% resistors the standard values are

100	110	120	130	150	160	180	220	240	270	300
330	360	390	470	510	560	620	680	750	820	1000

Some Values to use if you don't want do the calculations

Color	Vf	6 Volt	12 Volt
Red	2.2	220	510
White	3.0	150	470

Most of the colors such as yellow, orange and green are the same Vf as Red so you can use the same resistor

¼ watt resistors can be used for all applications where current is limited to 20 Ma. If size is really a concern you can go as small as 1/8 watt when using a 6-volt source. If you are using one of the new larger current LEDs then larger watt resistors must be used. A 100 Ma White LED will require a minimum of ¼ watt for 6 volts and a 1 watt resistor for 12 volt applications.