Breadboard Basics
LEDs and Switches

In-Class Day 2

Breadboard internal connection
Power

- Check the unregulated power with a DMM

Board upright unregulated power on the right.

Light Emitting Diode (LED)

Look for the flat edge too

Anode

Cathode

LED

220 to 470 Ω

+5V

GND
Two rules for LEDs

You MUST put in the LED in the correct direction!

and

You MUST have a resistor in series with the LED!

Math behind forgetting the resistor

Forgetting the resistor causes

\[ I = \frac{V}{R_{LED}} = \frac{5V}{0\Omega} = \text{Large Current} \]
Your turn

The circuit below uses a 12V supply. So if the LED had a forward voltage drop of 1.9 volts and a maximum current rating of 20mA, what would be the absolute minimum size resistor? What size resistor might you use instead to reduce the current flow to half the max current value?

Space for solution

The circuit above uses a 12V supply. So if the LED had a forward voltage drop of 1.9 volts and a maximum current rating of 20mA, what would be the absolute minimum size resistor? What size resistor might you use instead to reduce the current flow to half the max current value?
Resistor color codes

<table>
<thead>
<tr>
<th>Color</th>
<th>1st band</th>
<th>2nd band</th>
<th>3rd band (multiplier)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>0</td>
<td>×10^4</td>
</tr>
<tr>
<td>Brown</td>
<td>1</td>
<td>1</td>
<td>×10^1</td>
</tr>
<tr>
<td>Red</td>
<td>2</td>
<td>2</td>
<td>×10^2</td>
</tr>
<tr>
<td>Orange</td>
<td>3</td>
<td>3</td>
<td>×10^3</td>
</tr>
<tr>
<td>Yellow</td>
<td>4</td>
<td>4</td>
<td>×10^4</td>
</tr>
<tr>
<td>Green</td>
<td>5</td>
<td>5</td>
<td>×10^5</td>
</tr>
<tr>
<td>Blue</td>
<td>6</td>
<td>6</td>
<td>×10^6</td>
</tr>
<tr>
<td>Violet</td>
<td>7</td>
<td>7</td>
<td>×10^7</td>
</tr>
<tr>
<td>Grey</td>
<td>8</td>
<td>8</td>
<td>×10^8</td>
</tr>
<tr>
<td>White</td>
<td>9</td>
<td>9</td>
<td>×10^9</td>
</tr>
</tbody>
</table>

Reading resistor values

Ex. Red-Red-Orange
Red = 2
Red = 2
Orange = 3

Therefore 22000 which means that resistor is 22k ohms.
Your turn

What is the value of this resistor?

Yellow – Violet - Yellow

Demo a web tool

http://www.dannyg.com/examples/res2/resistor.htm

Calculate **Resistor** Values from Color Codes

[Image of resistor with color bands and a web tool interface]

Resistance Value: 3.3 kΩ ±1%

[Image: Resistor; Copyright: 1998 Danny Goodman (ME37); All Rights Reserved]
Common resistor sizes

The first two bands are a certain % larger than the prior value

The third band can be anything

E6 (20%): 10 15 22 33 47 68
E12 (10%): 10 12 15 18 22 27 33 39 47 56 68 82
E24 (5%): 10 11 12 13 15 16 18 20 22 24 27 30 33 36 39 43 47 51 56 62 68 75 82 91

Creating a basic switch

Signal to DMM (later to the PIC)
Forgetting resistors shorts the board

Making a switch

BAD!
Forget resistor

Next start work on Lab 1

Lab 1