LED Interfacing and Resistor Calculation

Understanding the Importance of Current-Limiting Resistors

When interfacing LEDs with Arduino pins, it's crucial to include current-limiting resistors in the circuit. LEDs have specific forward voltages and forward currents at which they operate optimally. Without a current-limiting resistor, excessive current can flow through the LED, potentially damaging both the LED and the Arduino pin.

Calculating Resistor Values for Safe LED Operation with Arduino Pins

To calculate the current-limiting resistor value, you can use Ohm's Law:

R = (V_source - V_LED) / I_LED

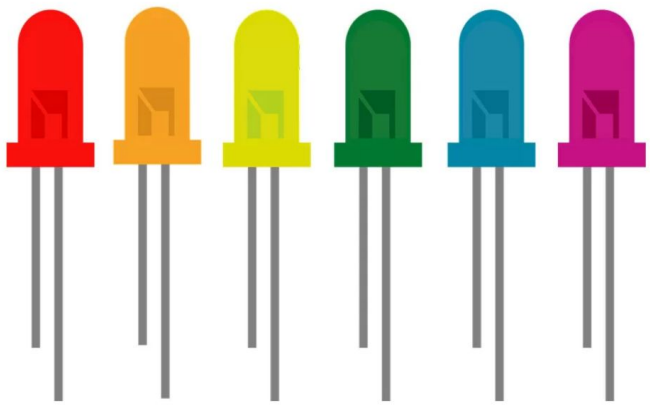
Where:

- R is the resistance in ohms.
- V_source is the source voltage (Arduino pin voltage, typically 5V).
- V_LED is the forward voltage drop across the LED.
- I_LED is the desired LED current.

Let's assume:

- V_source = 5 volts (Arduino HIGH level voltage).
- V_LED is the forward voltage of your LED (check the datasheet).
- I_LED is the desired LED current (choose a safe value, e.g., 10-20 mA for standard LEDs).

Color,Forward Voltage (V) of standard LEDs



- Red: 1.7-2.0 V
- Orange: 2.0-2.2 V
- Yellow: 2.1-2.3 V
- Green: 2.2-2.4 V
- Blue: 3.0-3.3 V
- White: 3.0-3.4 V

Example:

Let's say you have an LED with $V_f = 2.2\,\text{V}$ and $I_f = 20\,\text{mA}$, and you're using a $9\,\text{V}$ power supply.

1. $V_r = 9\,\text{V} - 2.2\,\text{V} = 6.8\,\text{V}$
2. Choose $I_{\text{LED}} = 18\,\text{mA}$ (slightly below the maximum).
3. $R = \frac{6.8\,\text{V}}{0.018\,\text{A}} \approx 377.78\,\Omega$
4. Select a standard resistor value, e.g., $390\,\Omega$.
5. Verify power rating: $P_{\text{resistor}} = 0.018\,\text{A} \times 6.8\,\text{V} \approx 0.1224\,\text{W}$, so a $0.25\,\text{W}$ resistor should suffice.

Choose a resistor close to $390\,\Omega$ with a power rating of $0.25\,\text{W}$, and you should be good to go.