OHM’S LAW

V= IR

LED EX:

V=3.3 Volts I= 10m Amps R= ? Ohms

R= = Ohms

| **Component** | **Resistor Value(s)** | **Use/Why** | **Voltage Range** | **Current Range** |
| --- | --- | --- | --- | --- |
| **Standard LEDs (5mm)** | 220Ω, 330Ω, 1kΩ | To limit current to safe levels (typically 20mA max). | **2V to 3.3V** (varies by color) | **10mA to 20mA** (for each LED) |
| **Push Buttons** | 10kΩ (pull-up/pull-down) | To define button states (HIGH or LOW) when not pressed. | **5V** (Arduino logic level) | **< 1mA** (minimal current when pressed) |
| **Potentiometers** | 10kΩ | To create adjustable resistance for varying analog input (e.g., brightness). | **0V to 5V**(depending on input voltage) | **< 1mA** (for variable resistance) |
| **Light Dependent Resistor** | 10kΩ | To create a voltage divider for analog light sensing. | **0V to 5V** (depends on power supply) | **< 1mA** (when used with a voltage divider) |
| **Servo Motor** | None (unless using external power) | Controlled via PWM, does not typically require a resistor on the signal pin. | **4.8V to 6V**(common servo voltage range) | **100mA to 1A** (depends on servo type and load) |
| **Passive Buzzer** | 100Ω, 220Ω | Limit current through the buzzer to prevent damage. | **5V** (Arduino logic level) | **10mA to 40mA**(depends on buzzer) |
| **DC Motors** | No specific resistor, but may use flyback diodes | Protect motor and driver circuit, use external power for larger motors. | **5V to 12V**(depending on motor specs) | **100mA to 500mA**(depends on motor size and load) |
| **LCD (16x2)** | 220Ω, 330Ω | Limit current for the backlight LED. | **5V** (Arduino logic level) | **20mA to 40mA** (for backlight) |
| **General Sensors (e.g., DHT11, Ultrasonic)** | 10kΩ | For pull-up or voltage divider circuits with analog sensors. | **3.3V to 5V** (varies by sensor type) | **< 10mA** (very low current for most sensors) |

### **Explanation of Voltage and Current Requirements:**

1. **LEDs**:
   * **Voltage**: The forward voltage of an LED depends on the color. Red LEDs typically have a forward voltage around **1.8V**, while blue and white LEDs can have a forward voltage of **3.0V to 3.3V**.
   * **Current**: Standard LEDs typically operate at **10mA to 20mA**. Exceeding this current could damage the LED.
2. **Push Buttons**:
   * **Voltage**: Push buttons typically operate at **5V** (the Arduino's logic voltage).
   * **Current**: When pressed, the current is very minimal, often under **1mA**.
3. **Potentiometers**:
   * **Voltage**: Potentiometers typically operate within the **0V to 5V** range, depending on the Arduino's power supply.
   * **Current**: The current drawn by the potentiometer is very low, typically under **1mA**, since it's used as a variable resistor in an analog circuit.
4. **Light Dependent Resistor (LDR)**:
   * **Voltage**: The voltage range will depend on the circuit you're using. An LDR commonly works with **0V to 5V**in a voltage divider setup.
   * **Current**: The current drawn by an LDR is minimal, typically under **1mA** when used in a voltage divider circuit.
5. **Servo Motors**:
   * **Voltage**: Common servo motors require a voltage of around **4.8V to 6V**, but larger servos may require up to **12V** for more power.
   * **Current**: A small hobby servo typically uses between **100mA to 500mA** under load, but this can spike during operation. Larger servos can draw **1A or more**.
6. **Passive Buzzer**:
   * **Voltage**: A passive buzzer typically operates at **5V**, supplied by the Arduino pin.
   * **Current**: A passive buzzer usually draws **10mA to 40mA**, depending on its size and loudness.
7. **DC Motors**:
   * **Voltage**: DC motors in the starter kit typically run on **5V to 12V** depending on the motor's power requirements. Higher voltages may be needed for larger motors.
   * **Current**: Small DC motors can draw **100mA to 500mA** depending on their load. Larger motors can exceed **1A** under load.
8. **LCD (16x2)**:
   * **Voltage**: The **16x2 LCD** typically operates at **5V**.
   * **Current**: The backlight of the LCD draws around **20mA to 40mA**, depending on the brightness.
9. **General Sensors (e.g., DHT11, Ultrasonic)**:
   * **Voltage**: Most sensors like the **DHT11** or **Ultrasonic Sensor** (HC-SR04) run on **3.3V to 5V**.
   * **Current**: These sensors typically draw very little current, often less than **10mA**, except for certain power-hungry sensors (like motors or servos).

### **Power Considerations:**

* **Arduino Power Supply**: The Arduino Uno operates at **5V** when powered via USB, and can be powered externally through the **Vin** pin or barrel jack with a **7V to 12V** power source. The onboard regulator steps this down to 5V.
* **Current Draw**: The total current drawn from the **5V pin** (from the Arduino) is limited to around **500mA** by the onboard regulator. If you need more power (e.g., for larger motors or multiple peripherals), it's often best to use an external power source and supply power to your components separately.