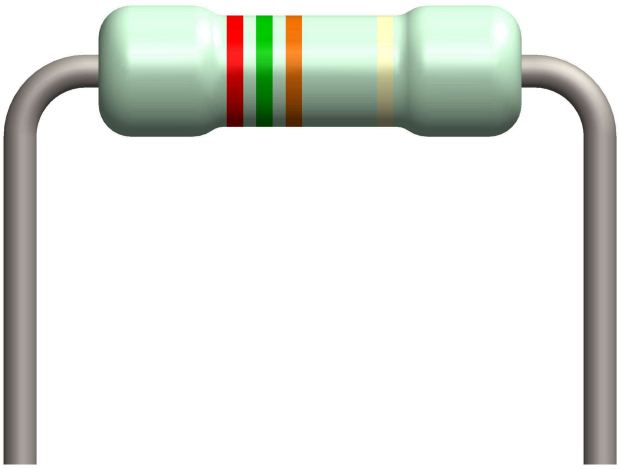
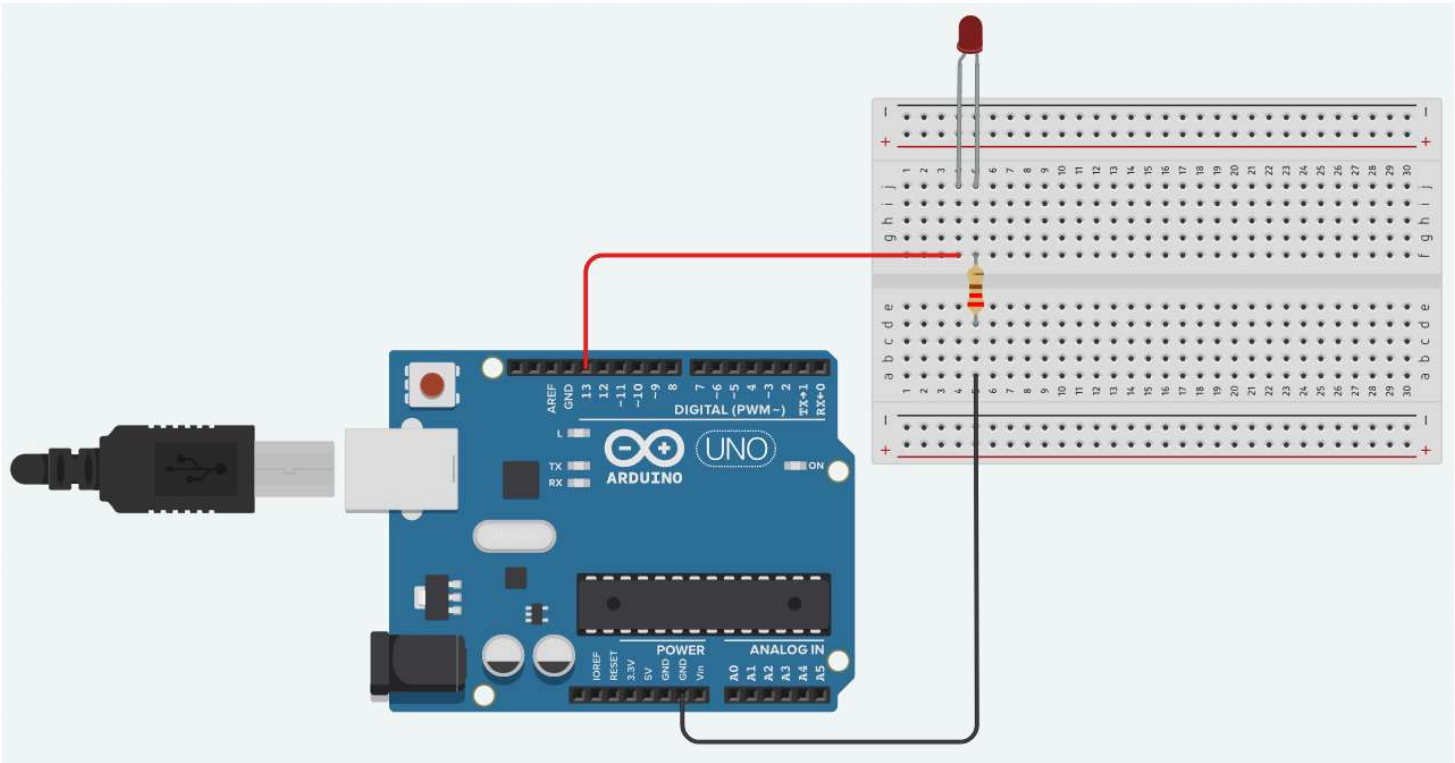
Resistor



KEY SPECS

What It Does	Restricts electrical current by providing resistance. Used to protect components like LEDs from overheating and for voltage division in circuits.
Common Values	220Ω, 330Ω, 1kΩ, 10kΩ
Power Rating	1/4W (0.25W)
Tolerance	±5% (Gold band)
Material	Carbon film
Connection	Non-polarized

QUICK WIRING



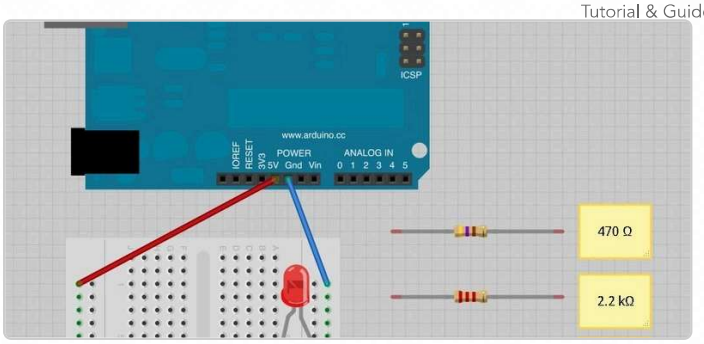
NOTES FOR QUICK WIRING

Non-polarized	Can be connected in either direction: current flows both ways
Current limiting	Protects components by reducing current flow for constant voltage
Ohm's Law	V = I × R - For constant voltage, low current results from high resistance
Power dissipation	P = I^2R - resistor converts excess energy to heat

Common Projects

LED Current Limiting

Tutorial & Guide

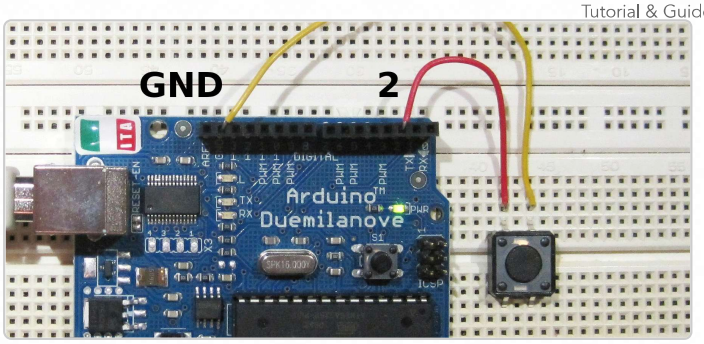


Most fundamental resistor use - protects components from burning out by limiting current. Building block for all LED projects.

Components
220Ω resistor, LED, Arduino, breadboard, jumper wires

Pull-up/Pull-down Resistors

Tutorial & Guide



Prevents floating inputs where voltage fluctuates to provide reliable readings from buttons and photocells.

Components
10kΩ resistor, push button, Arduino, breadboard

Resistors Work Well With

+ LEDs

220Ω resistor prevents LED burnout by limiting current flow to safe levels

+ Push Buttons

10kΩ pull-up resistors ensure reliable digital readings and prevent floating input states

+ Sensors

Voltage dividers and signal conditioning - regulates voltage levels for Arduino analog inputs

+ Motors

Resistors limit current for transistor circuits to control high-power motors

+ Capacitors

Resistor Capacitor circuits for timing, filtering noise, and smoothing voltage fluctuations

+ Potentiometers

Adjustable resistors inside split voltage to control sensor sensitivity - turn the knob to set when sensors trigger

+ Arduino Pins

Resistors prevent pin damage from overcurrent and provide proper signal levels

+ Multiple Resistors

Each parallel LED needs its own resistor (separate paths). Series LEDs share one resistor (same current through all)

Troubleshooting

LED Too Dim

Problem: Your LED barely lights up or gives off very weak light.

Solution: Your resistor value is too high. Replace with a smaller value resistor. If using 1kΩ, try 470Ω or 330Ω. For standard LEDs with 5V Arduino, 220Ω-330Ω works best.

How to Calculate: R = (Vsource - VLED) / ILED. For a red LED: (5V - 2V) / 0.02A = 150Ω minimum. Use next standard value up (220Ω).

LED Burning Out

Problem: LED flashes bright then stops working permanently.

Solution: Too much current is flowing. You need a resistor or your resistor value is too small. Never connect LED directly to power without a resistor.

Prevention: Always use at least 220Ω for standard LEDs with 5V. For 3.3V systems, 150Ω minimum. Higher values are always safer than lower.

No Current Flow

Problem: Circuit appears dead, no LED light, no readings.

Step 1: Check power - Is Arduino powered on? Is the correct pin set to OUTPUT?
Step 2: Check connections - Are breadboard rows properly connected? Push components firmly into breadboard.
Step 3: Test resistor - Use multimeter to verify it's not broken (should read close to labeled value).
Step 4: Check LED polarity - Long leg (anode) goes toward positive.

Resistor Overheating

Problem: Resistor gets hot to touch or shows burn marks.

Cause: Power dissipation exceeds resistor's rating. Standard resistors are 1/4W (0.25W).

Solution: Calculate power: $P = I^2R$. If current is 0.1A through 220Ω: $P = (0.1)^2 \times 220 = 2.2W$. This exceeds 1/4W rating! Use higher wattage resistor or reduce current.

Reading Wrong Value

Problem: Can't determine resistor value or colors are confusing.

Color Band Reading: Hold resistor with gold/silver band on right. Read left to right:
Band 1: First digit
Band 2: Second digit
Band 3: Multiplier (number of zeros)
Band 4: Tolerance

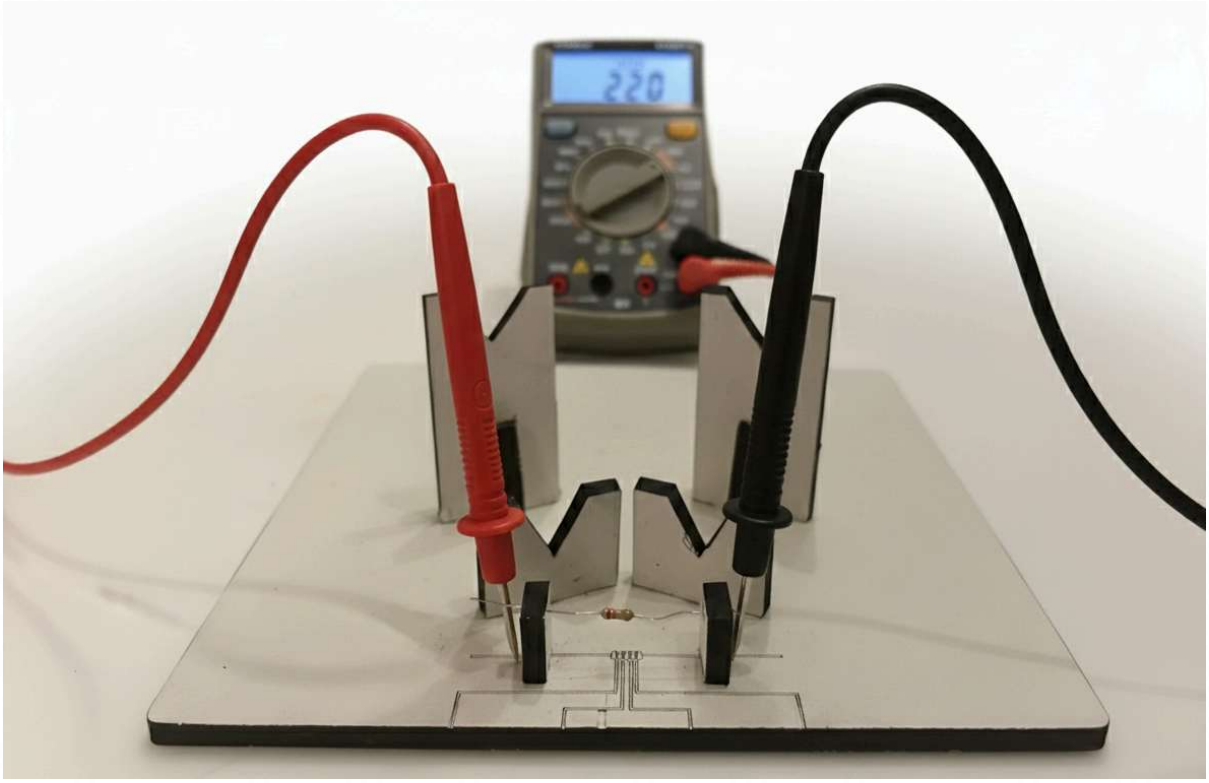
Example: Red-Red-Brown-Gold = 2-2-×10-±5% = 220Ω

Measuring with Multimeter

Need exact value? Use the testing station on page 4.

Quick Steps:
1. Turn dial to Ω (omega) symbol
2. For auto-range: Wait for display to stabilize
3. For manual: Start at 200Ω range, increase if needed
4. Touch probes to resistor ends
5. Read value - should be within tolerance of marked value

Resistor Testing Station



How to use the resistor testing station:

1. Place resistor in suspended clamps with terminals accessible

2. Set multimeter to resistance (Ω) mode. Most multimeters turn on automatically when dial is turned from OFF position

3. Touch red probe to left terminal, black probe to right terminal

4. Resistance value on display should match color band calculation within tolerance

5. If reading shows "OL" or "1", check probe contact that the probe is touching the resistor

6. Put multimeter in right range

6a. For Manual Range Multimeters:
No reading? Start at 200Ω, increase to 2kΩ → 20kΩ → 200kΩ until value displays

6b. For Auto-Range Multimeters:
Press "Range" button for 2+ seconds to power on, auto-selects range

Resistor Reference Chart

Color	Sample	1st Digit	2nd Digit	Multiplier	Tolerance
Black		0	0	×1	-
Brown		1	1	×10	±1%
Red		2	2	×100	±2%
Orange		3	3	×1K	-
Yellow		4	4	×10K	-
Green		5	5	×100K	±0.5%
Blue		6	6	×1M	±0.25%
Violet		7	7	×10M	±0.1%
Gray		8	8	-	±0.05%
White		9	9	-	-
Gold		-	-	×0.1	±5%
Silver		-	-	×0.01	±10%