Do All Electrical Devices Have Internal Resistance?

Yes, **every electrical component, sensor, actuator, or device that uses electricity has some form of internal resistance.** Even if it's not an explicit resistor, there is always an **impedance** that limits current flow.

1. Why Doesn't an LED Draw Unlimited Current?

When you connect an LED directly to a power supply with:
✔ **Fixed voltage** (e.g., 5V)
✔ **Unlimited current supply capability**

The LED **won't** draw infinite current because:

1. **LEDs have an internal electrical property called "forward resistance" or "dynamic resistance."**
    - When voltage is applied, some resistance **inside the LED** limits how much current flows.
    - However, this resistance is **very low** when the LED is fully conducting, which is why **you need an external resistor to prevent too much current.**
2. **Semiconductor junctions have a threshold voltage.**
    - An LED has a **forward voltage** (e.g., ~2V for red LEDs, ~3.2V for white/blue).
    - If the power supply provides more than this, the LED enters "avalanche mode" and can **burn out** without a resistor.
3. **The power supply isn't "pushing" current—it only allows the circuit to draw what it "wants."**
    - If the LED had **zero** resistance, then yes, unlimited current would flow.
    - But in reality, every component has **some** resistance or **current-limiting behavior**.

2. Do Sensors and Actuators Have Internal Resistance?

✔ Yes! Every electrical device has an inherent resistance.

Examples:

- **Resistive sensors** (e.g., thermistors, strain gauges) *directly* change resistance when sensing.
- **Motors and actuators** have **coil resistance**, which limits how much current they draw.
- **Microcontrollers and ICs** have **input impedance**, which affects how much power they consume.
- **Even a simple wire has resistance**, although very small.

This is why **power dissipation and heat** exist—resistance causes voltage drops and power loss.

3. Key Takeaways

Everything that conducts electricity has some resistance.
Even "perfect" conductors (like superconductors) have practical limits.
Without resistance, current would be infinite—but that never happens in real-world circuits.
Designers use external resistors, current limiters, and circuit protection to control current flow.