

What are physicists' motivations to study electronics?

- Extension of our sensory

Temperature : thermocouple $T \rightarrow$ Voltage
thermistor $T \rightarrow$ Resistance
thermometer $T \rightarrow$ Volume

Light (EM wave) : Photodiode, solar cell
CCD, photodiode, antenna

Pressure : pressure pad
water gauge
vacuum gauge

B field : Hall probe, fluxgate, NMR, SQUID

E field : Voltage, current, charge.

Others : humidity, velocity, accelerometer, rotation, sound.

- Extension of our processing ability

Signal conditioning : Amplification, filtering, format conversion

Data sharing : teleportation, storage, communication

Computation : Analysis, searching, simulation, calculation

- Extension of our control

Motion actuator: motor, piezo, micromirror, solenoids

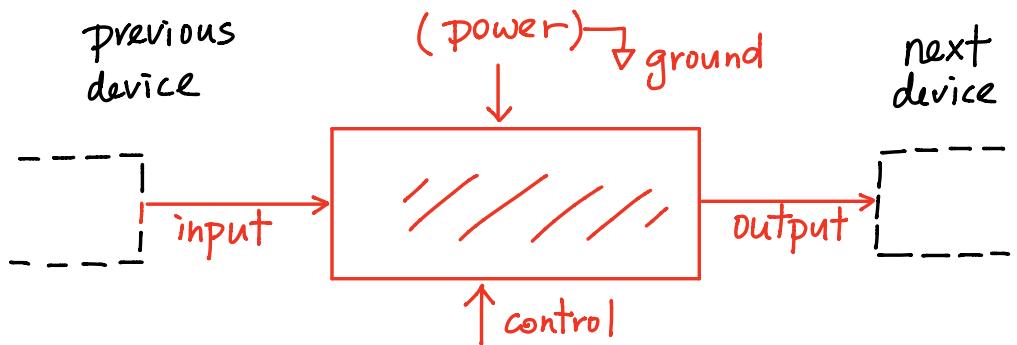
Light control: light emitting diodes (LEDs), lamp, lasers.

B field control: magnetic coils

Temperature control: heater, Peltier cooler

Sound: Speaker.

Building block of electronics:



Terminology: 1. passive component: no power supply needed

e.g.: resistor,

active component: power is needed

e.g.: amplifier, iphone

2. DC (direct current): time-indep. signal

AC (alternating current): time-dep. signal

3. Gain: $G_{DC} = \text{Output}/\text{Input}$

$$G_{AC} = \Delta \text{output} / \Delta \text{input}$$

4. Bandwidth: The speed (in unit of Hz) that output can follow a time-dependent input. (precise def. later)

5. Rail: Max or min output values, typically set by power supply.

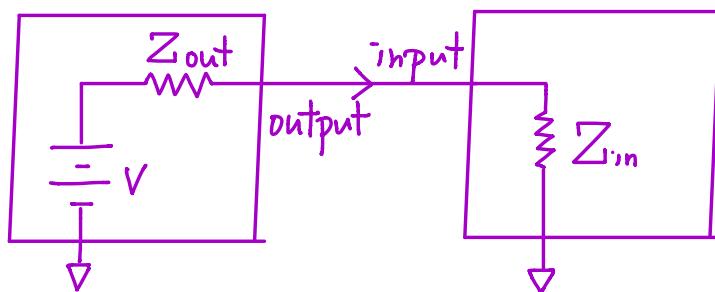
6. Ground: Voltage reference point.

(There should be one & only one ground. Multiple grounds or ground loops will induce instability)

7. Input impedance: $Z_{in} = \frac{\Delta V_{input}}{\Delta I_{input}}$

Output impedance: $Z_{out} = \frac{\Delta V_{output}}{\Delta I_{output}}$

Example:
power supply



Consider 10V. $Z_{out} = 10\Omega$, $Z_{in} = 990\Omega$

real output = 9.9V and would be ideal if

$Z_{in} = 0$ or $Z_{out} = \infty$; acceptable if $Z_{in} \ll Z_{out}$.