Design Planning

What will you make and how?

Define Goals

What are you trying to make?

What does the board need to accomplish?

What inputs? What outputs?

Get as much information from others working on the project as soon as possible, hold many design reviews

Power

Any electronics will require a power source

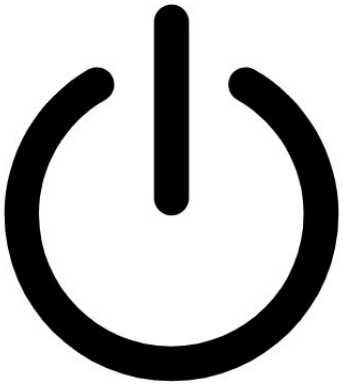
Plugged into the wall? Running off battery?

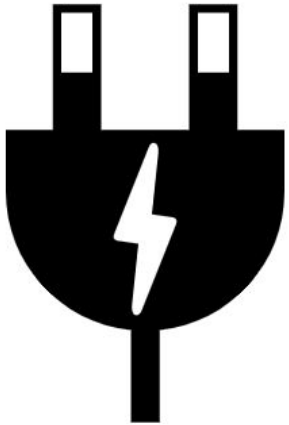
- Highly suggest not plugging things directly into the wall; consider using pre-existing converter

How much power will it draw? Required voltage, current?

Will you need to regulate voltage on board? AC -> DC, stepping down 5V->3V?

If really high power, can use thicker copper on boards depending on ability of manufacturer





Power - Determining Requirements

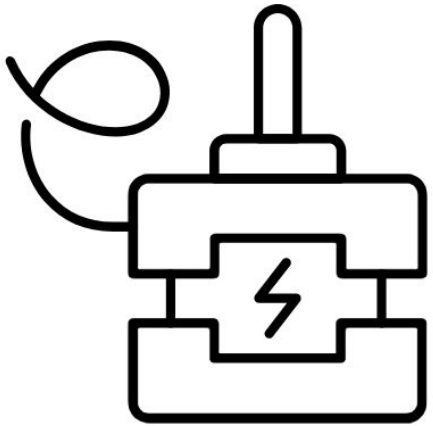
This is a cyclic process as you determine what components you will need

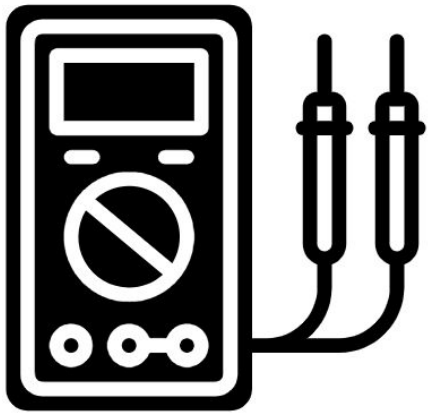
Big, power heavy components such as motors often set limits

Use higher current rating than you think you need

If you have >1 voltage level, you can regulate up or down using designated ICs

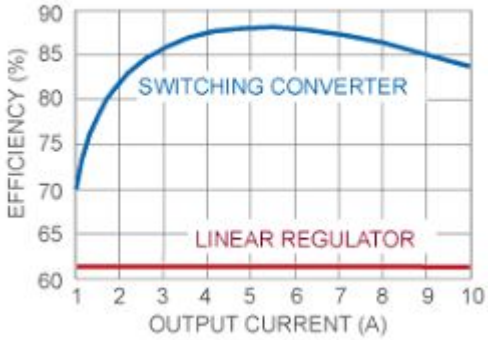
- Easiest in small increments, ie 5V to 3V easier than 120V to 3V





Voltage Regulation - Switching vs Linear

Linear Regulator	**Switching regulator**
Step down in voltage only	Can step up or down
Smaller, cheaper	Larger, more complex
Only input/output capacitive filtering required	Often require more complex filtering/external components
Low power or low delta V	Can do high power, high delta V
Lower efficiency	Higher efficiency
Can be very low noise	Have switching noise at frequency of switching



Types of batteries

Great for embedded, on the go applications

Battery Type	Pros	Cons
Lipo	Very high power density Come in many voltages	Volatile, uneven charge/discharge curves
Coin Cell	Very small, cheap and easy	Small capacity, can't recharge
Alkaline (AA/9V)	Cheap and easy, easy to find, safe	Often not rechargeable, low density/capacity
USB Battery Pack	High capacity, predictable, easy to recharge	Large, limited discharge rate
NiMH	Rechargeable, small	Not high density/capacity
Lithium Ion	High energy density, small	Volatile

Microcontroller (or other computer)

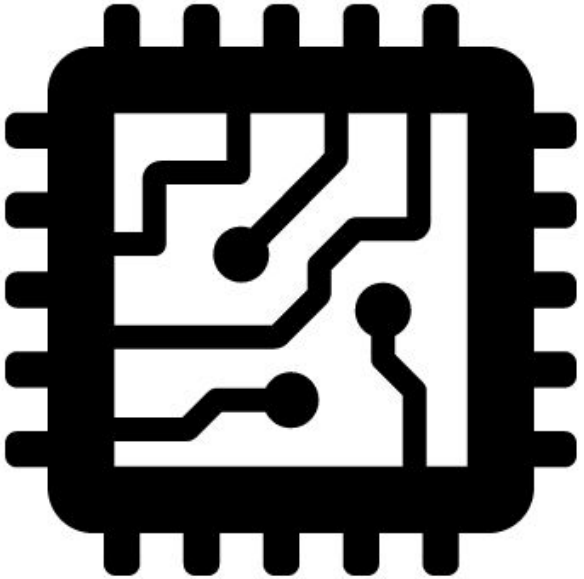
What will run your device? If dumb enough (blink an LED, etc) no need for computer

Simple tasks can use simple MCUs

Often nice to use well documented, oft-used MCUs at first for help debugging

MCU criteria

- Power level (5V, 3V, low power)
- Core processor
- # input/output ports
- Connections to peripherals (i2c, spi, serial)
- Memory size



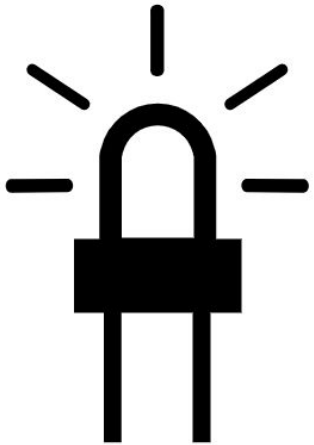
Active Components

Will there be connected motors, LEDs, other boards, LCDs, potentiometers, etc?

Note what **type of connections** these have, how much **power** they draw, how they will be **mounted** to the board

Will they require special **inputs/outputs**? ADC for pot, DAC for audio devices, etc

If you have multiple non-bussed devices, ensure you have enough **ports on MCU**



Connectors

What is connected to the board?

How will you connect **power**? Good to set up **reverse polarity protection** to stop yourself from frying board if plugged in incorrectly

Anything that will be not permanently mounted, careful to use strong enough connectors

Useful to use **directional (keyed) connectors** so things can’t be plugged in backwards, particularly anything with power