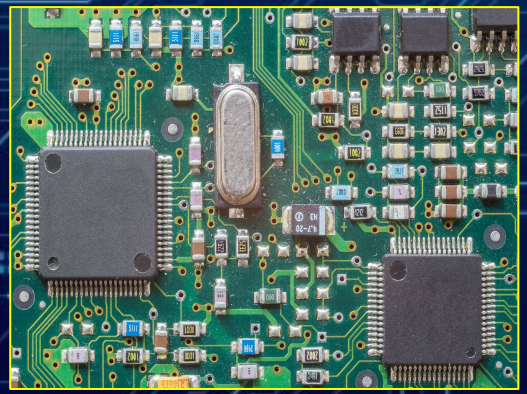
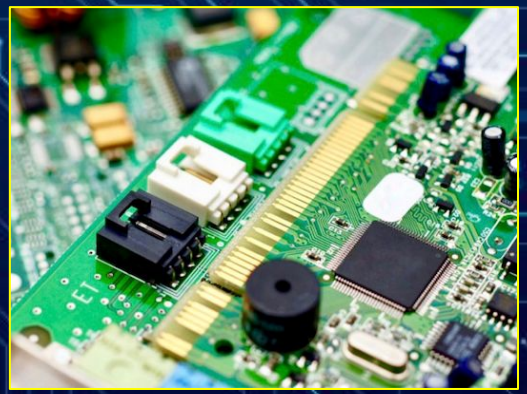
Circuits Workshop

By Dallas and Daniel

What Are Circuits?

- A circuit is a continuous path through which electricity flows.
- It starts at a power source, such as a battery, travels through a load to perform a specific task, and then returns to the source.
- Circuits are essential to many devices and systems that power and support our daily lives.





What Will We Be Making?

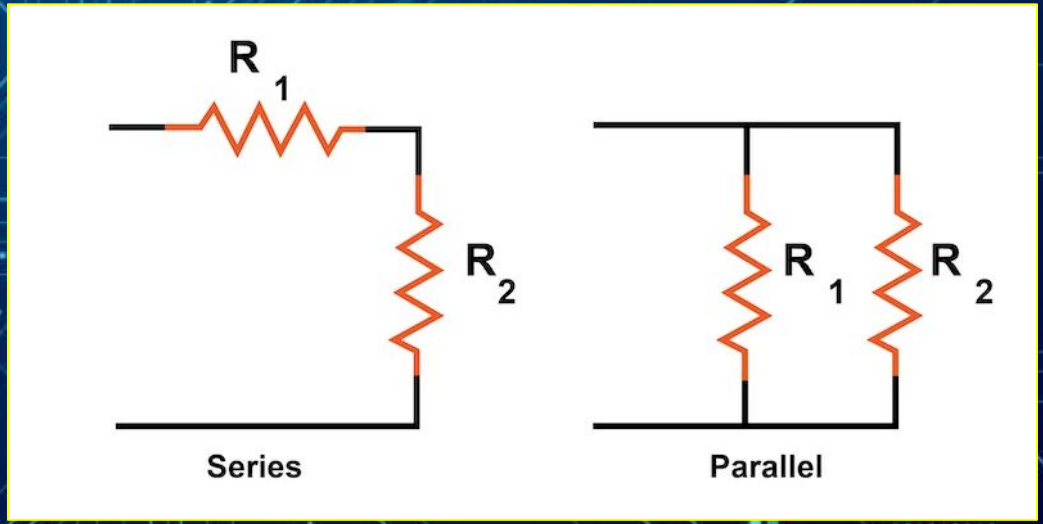
- We will be soldering a small circuit that allows you to press three buttons - each one lighting up a different LED: blue, green, or red.

Voltage, Current, and Resistance

- Voltage is the difference in electric potential energy per unit charge.
  - The unit for voltage is the volt, symbolized as V.
- Current represents the flow of electrons and indicates the rate at which they move.
  - The unit for current is the ampere (amp), symbolized as I.
  - Think of it like water flow: if the water flows quickly, the current is higher; if it flows slowly, the current is lower.
- Resistors are used to provide resistance.
  - Resistors limit the flow of current.
  - The unit for resistance is the Ohm, symbolized by the Greek letter omega (Ω).
- Use the equation V = IR to calculate voltage. This formula can be rearranged to solve for current or resistance.

Series and Parallel Circuits

- Series Circuit
  - Electricity flows from one component to the next in a single path.
  - As the current passes through each component, the voltage gradually decreases.
  - The current is constant across the circuit.
- Parallel Circuit
  - All components are connected across the same two points, so each one receives full voltage from the power source.
  - The current is divided among the parallel branches.
  - The voltage is constant across the circuit.

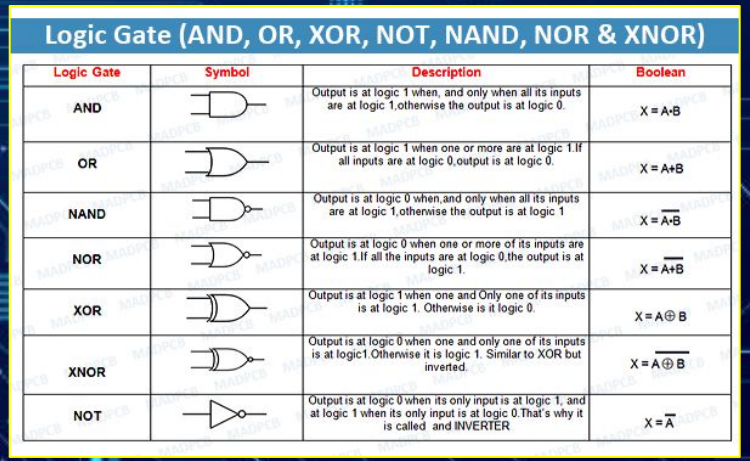


Capacitors

- A capacitor is an electronic component that stores electrical charge.
- It consists of two conductive plates separated by an insulating material called a dielectric.
- When connected to a power source, positive charge accumulates on one plate and negative charge on the other.
- Once the capacitor reaches its capacity and the electrical field is removed, it discharges the stored energy.
- Capacitors are commonly used in sensing, signal processing, energy storage, and motor starters.

Comparators and Gates

- A comparator in a circuit compares two input voltages and determines which is higher. It outputs either a 0 or a 1.
- A logic gate performs a Boolean logic operation on one or more binary inputs and produces a single binary output.
- There are seven types of basic logic gates, shown in the diagram on the right, but we will focus on three today: AND, OR, and NOT.
- The AND gate outputs 1 only if both inputs are 1.
  - For example, if both inputs are 1, the output will be 1.
  - If one input is 0 and the other is 1, the output will be 0.
- The OR gate outputs 1 if one or both inputs are 1.
  - If both inputs are 0, the output will be 0.
- The NOT gate, which is an inverter, reverses the input.
  - If the input is 1, the output will be 0.
  - If the input is 0, the output will be 1.

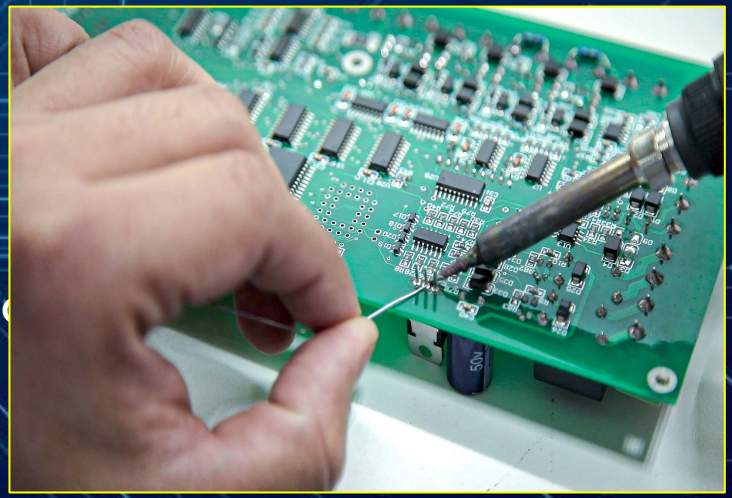


Logic Gate (AND, OR, XOR, NOT, NAND, NOR & XNOR)

Logic Gate	Symbol	Description	Boolean
AND		Output is at logic 1 when, and only when all its inputs are at logic 1,otherwise the output is at logic 0.	$X = A \cdot B$
OR		Output is at logic 1 when one or more are at logic 1.If all inputs are at logic 0,output is at logic 0.	$X = A + B$
NAND		Output is at logic 0 when,and only when all its inputs are at logic 1,otherwise the output is at logic 1	$X = \overline{A \cdot B}$
NOR		Output is at logic 0 when one or more of its inputs are at logic 1.If all the inputs are at logic 0,the output is at logic 1.	$X = \overline{A + B}$
XOR		Output is at logic 1 when one and Only one of its inputs is at logic 1. Otherwise is it logic 0.	$X = A \oplus B$
XNOR		Output is at logic 0 when one and only one of its inputs is at logic1.Otherwise it is logic 1. Similar to XOR but inverted.	$X = \overline{A \oplus B}$
NOT		Output is at logic 0 when its only input is at logic 1, and at logic 1 when its only input is at logic 0.That's why it is called and INVERTER	$X = \overline{A}$

What Is Soldering?

- Soldering is the process of joining two or more metal components together by melting a filler metal called solder.
- Soldering requires a few key tools: a soldering iron to heat the solder, solder wire as the bonding material, a soldering stand to safely hold the hot iron, and flux t clean the tip of the iron.



Soldering Tutorial

Thanks for Attending!

We hope you enjoy the remainder of HackBI IX!