



IDC102:Hands-on Electronics

Lecture - 6

ELECTRONICS COMPONENTS

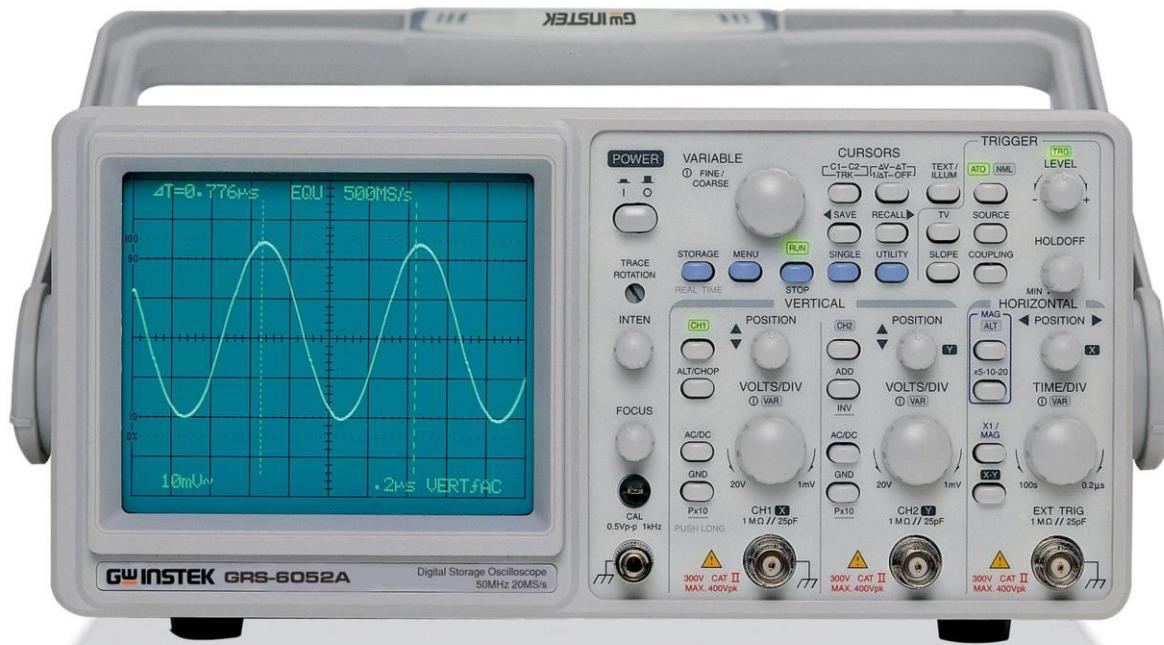
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Satyajit Jena, 09/05/2022
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Oscilloscope: Some Handson

- An oscilloscope is an instrument that allows observation of constantly varying signal voltages, usually as a two-dimensional graph of one or more electrical potential differences using the vertical or 'Y' axis, plotted as a function of time, (horizontal or 'x' axis).



DEMO

Measuring Instruments: Multimeter

Analog

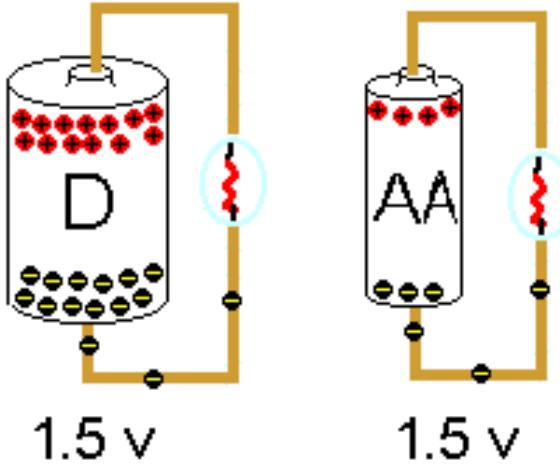


Digital

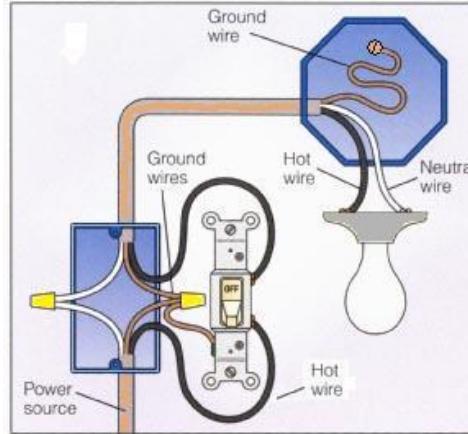


IDC102 - Basics: Type of Circuit

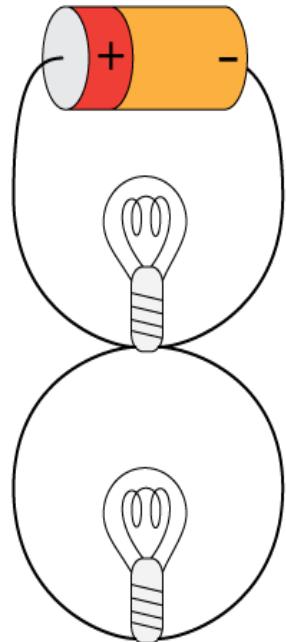
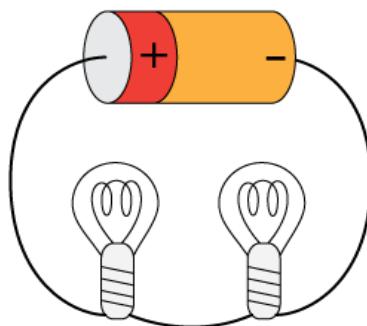
To be able to effectively use electricity, one must understand how electricity moves through different materials in a pathway.



©1999 Science Joy Wagon



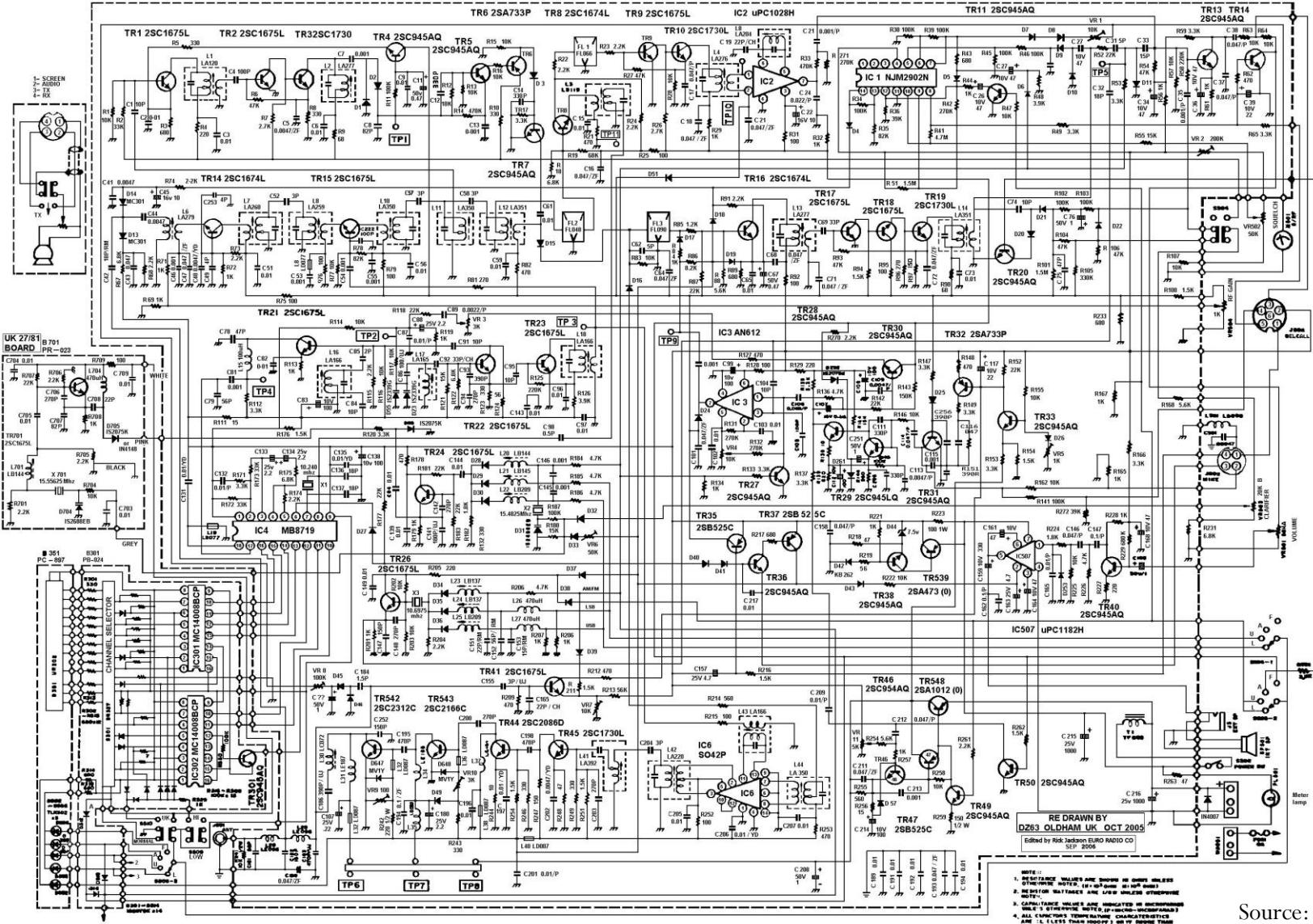
Therefore, we need to know the types of circuits: **Circuits are distinguished based on the way in which loads are connected.**





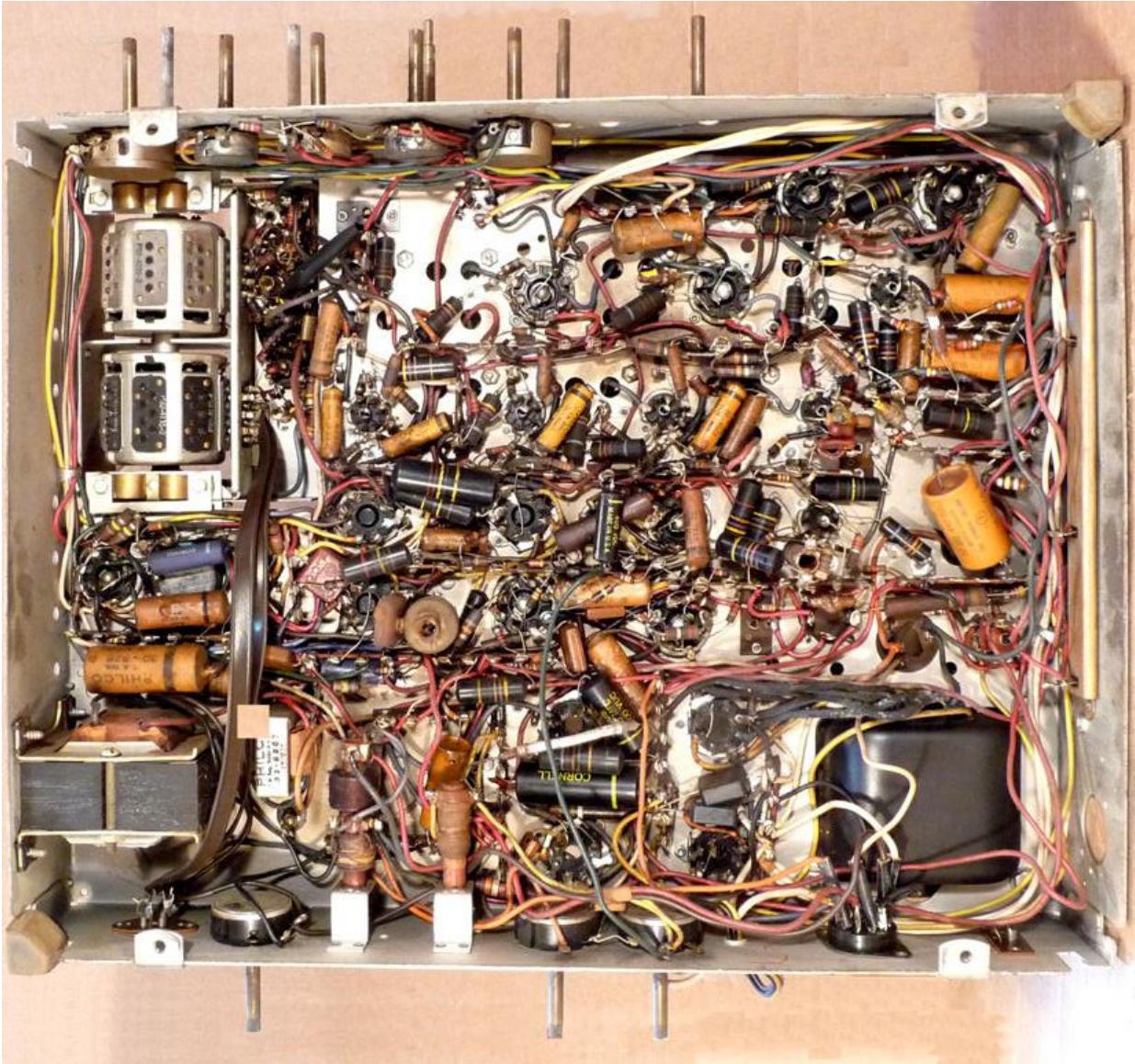
A complex circuit

PC 893 STALKER 9F DX



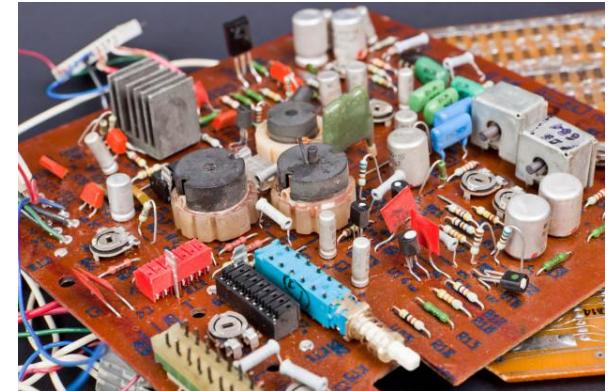
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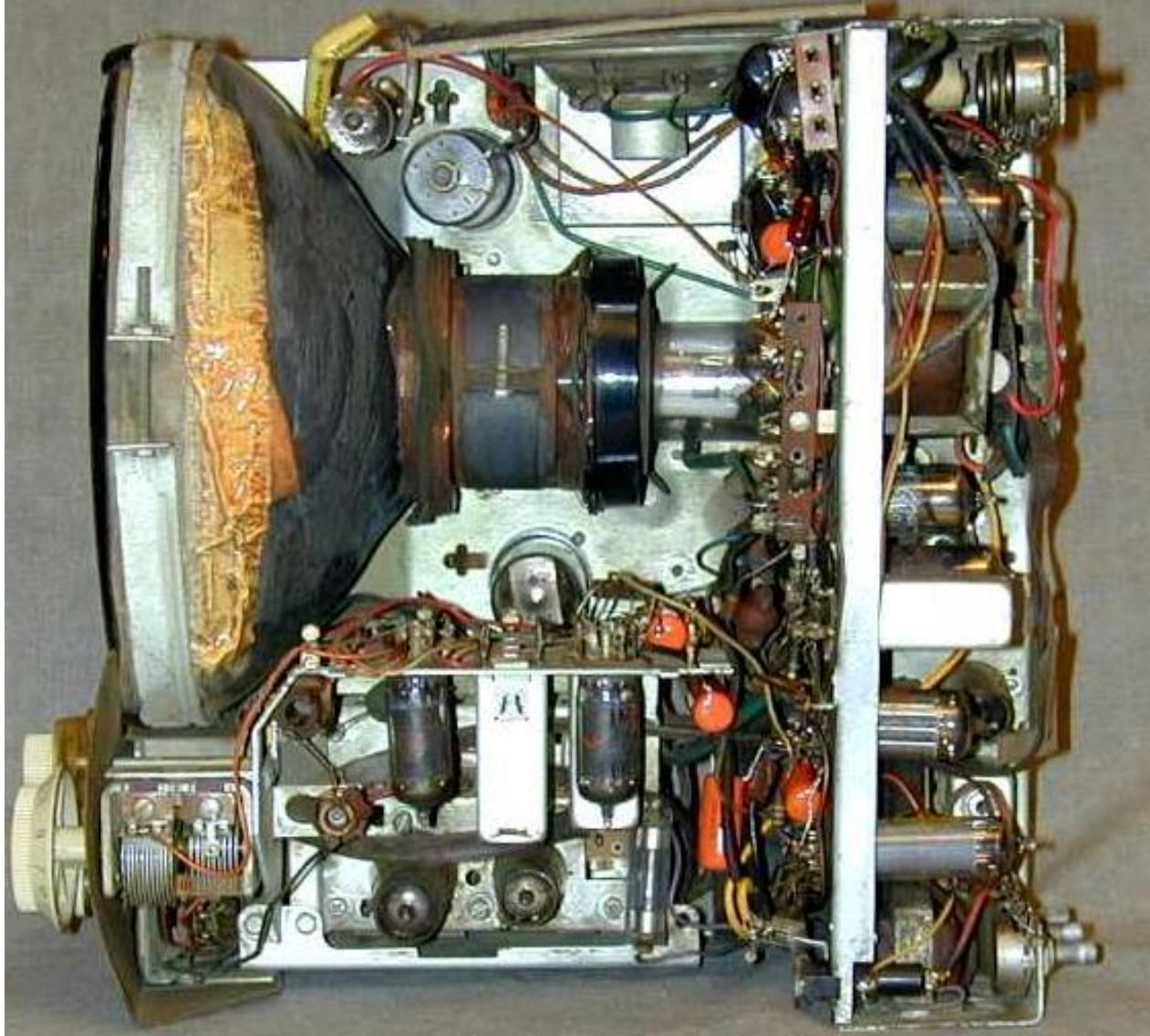
Some Circuit Board



Old Harman Kardon
Stereo Box, hand
Soldered

Old Circuit: 1990s

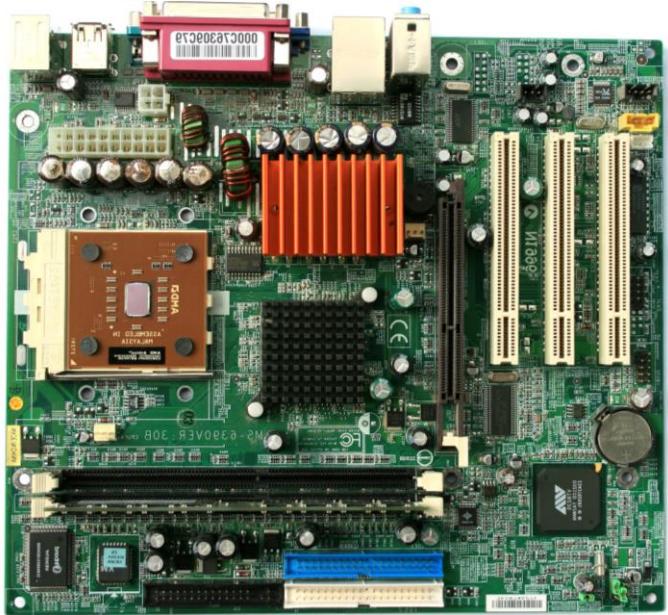




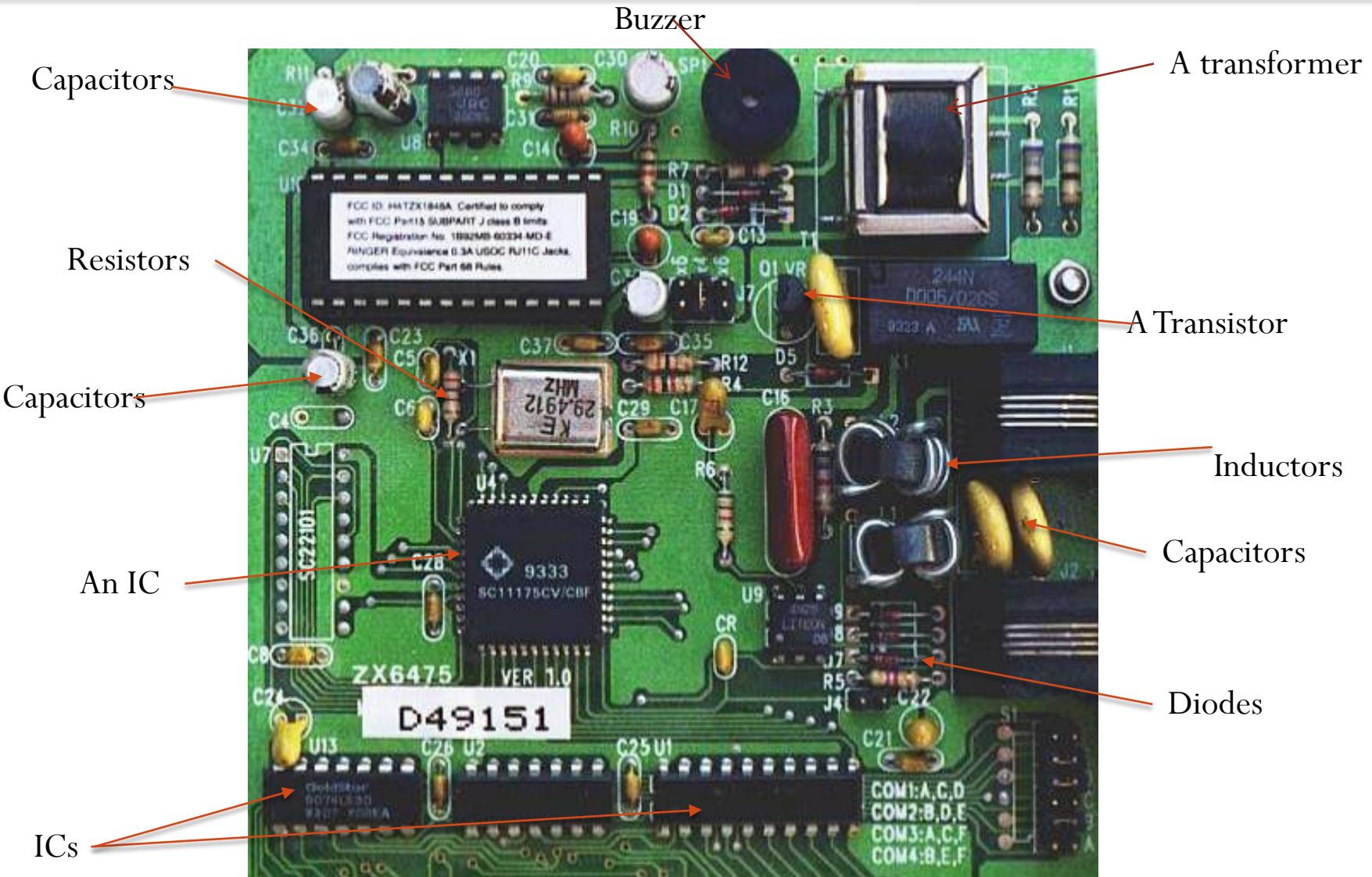
Any Old TV



Electronics: A Computer Circuit Board



What are these?

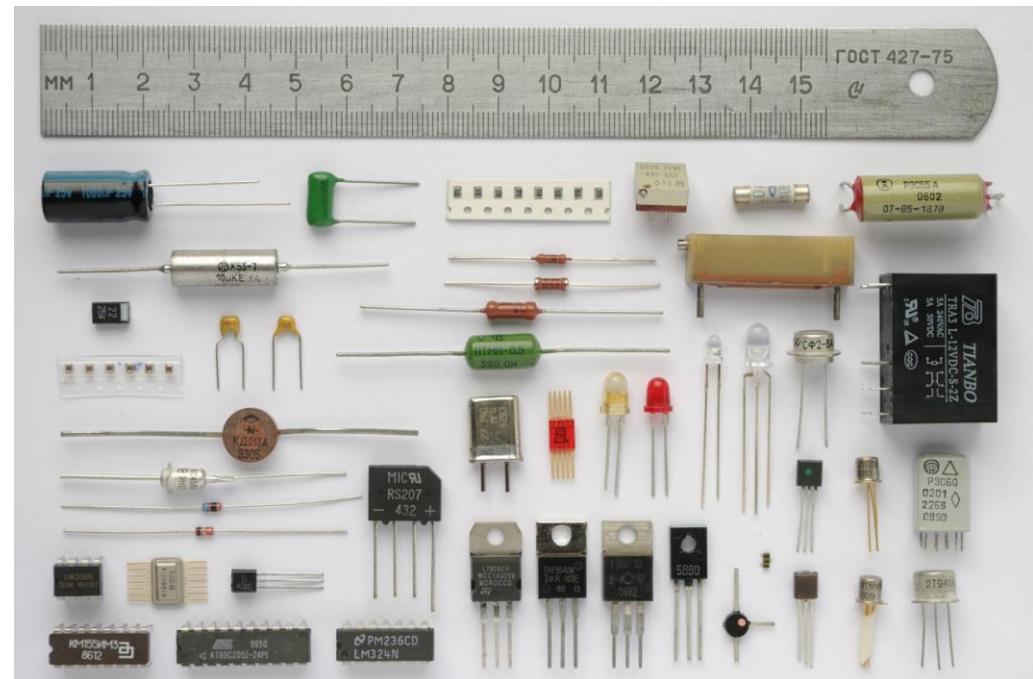


An electronic component is any physical entity in an electronic system used to affect the electrons or their associated fields in a manner consistent with the intended function of the electronic system.

Components are generally intended to be connected together, usually by being soldered to a printed circuit board (PCB), to create an electronic circuit with a particular function (for example an amplifier, radio receiver, or oscillator).

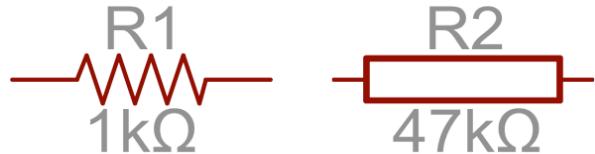
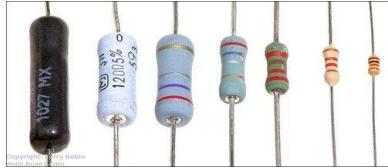
Components may be packaged singly, or in more complex groups as integrated circuits. Some common electronic components are capacitors, inductors, resistors, diodes, transistors, etc. Components are often categorized as active (e.g. transistors and thyristors) or passive

Each discrete component has a specific symbol when represented on a schematic diagram.

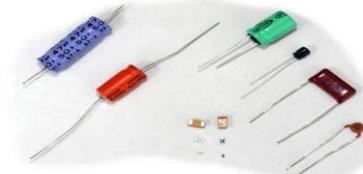


Components

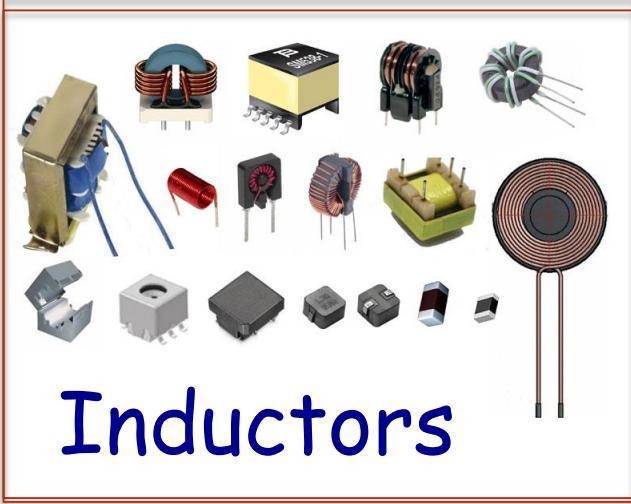
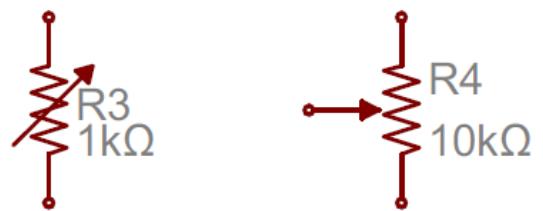
Resistor



Capacitors

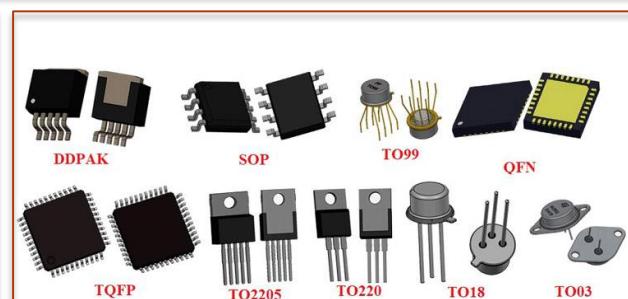


Variable Resistor



Inductors

Diodes



Transistor and IC

Components

- There are two types of components: *passive components and active components.*
- **Passive Components :**

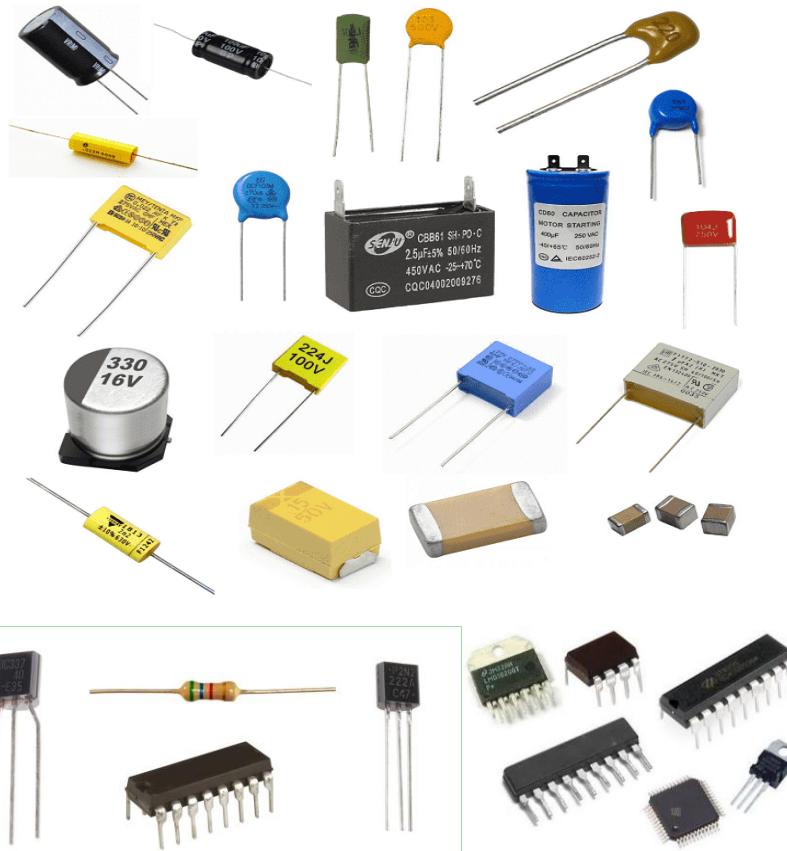
A passive device is one that contributes no power gain (amplification) to a circuit or system. It has no control action and does not require any input other than a signal to perform its function. Since passive components always have a gain less than one, they cannot oscillate or amplify a signal. A combination of passive components can multiply a signal by values less than one; they can shift the phase of a signal, reject a signal because it is not made up of the correct frequencies, and control complex circuits, but they cannot multiply by more than one because they basically lack gain. Passive devices include resistors, capacitors and inductors.

- **Active Components:**

Active components are devices that are capable of controlling voltages or currents and can create a switching action in the circuit. They can amplify or interpret a signal. They include diodes, transistors and integrated circuits. They are usually semiconductor devices.

Discrete and Integrated

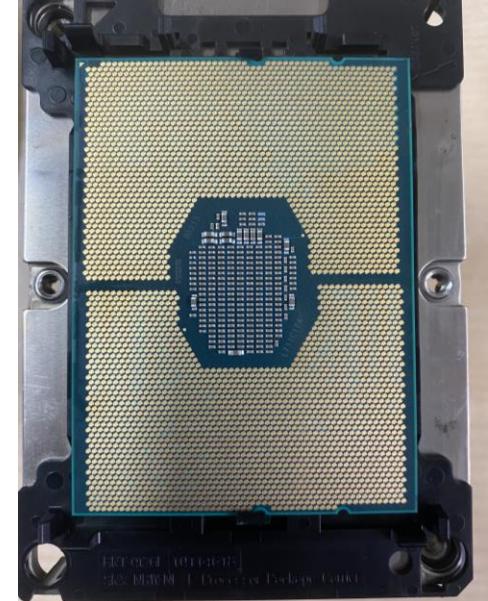
- When a component is packaged with one or two functional elements, it is known as a *discrete* component.
 - For example, a resistor used to limit the current passing through it functions as a discrete component.
- On the other hand, an *integrated circuit* is a combination of several interconnected discrete components packaged in a single case to perform multiple functions.
 - A typical example of an integrated circuit is that of a microprocessor which can be used for a variety of applications.

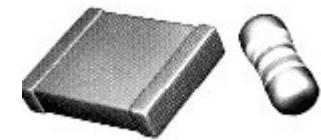
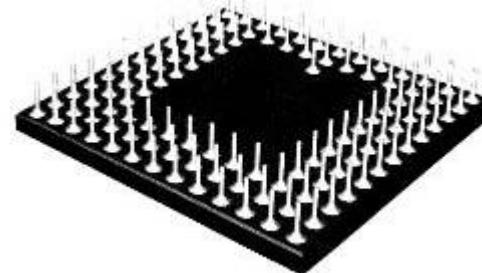
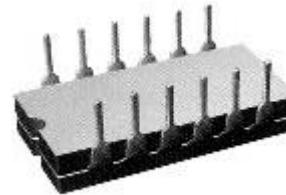
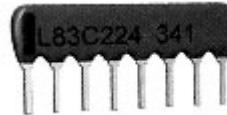
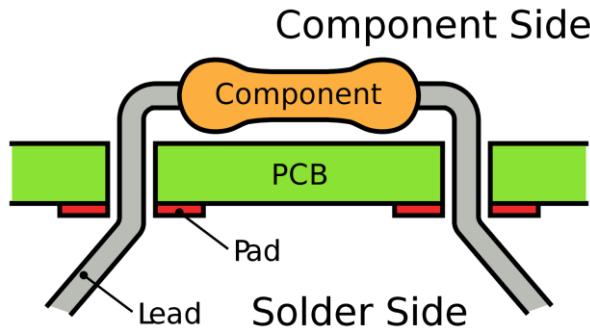


Connecting the components

- Components can be classified into two types on the basis of the method of their attachment to the circuit board. *Through-hole components* are those components which have leads that can be inserted through mounting holes in the circuit board.
- On the other hand, *surface mount* components are so designed that they can be attached directly on to the surface of the board.
- Two types of lead configurations are commonly found in discrete components. The components with *axial leads have two leads*, each extending from each side of the component like arms. These leads need to be bent for insertion through the holes of a printed circuit board. The other configuration of leads in the components is *radial* where the leads emanate from the bottom of the components like legs.

- In the case of integrated circuits, there are a large number of leads which are placed in a row in single line (single in-line package), or in two parallel rows (dual in-line package) These leads can be inserted in the through-holes in the PCB.
- High density integrated circuits now come in the form of *pin-grid arrays* that have several rows of round pins extending from the bottom of the component.
- *Leadless components* are also available in the surface mount devices in which no metal leads stick out of the component body. They are attached to a circuit board using some type of metallized termination.





Classification of components based on the lead configuration (a) through-hole component (b) surface mount component (c) component with axial leads (d) components with radial leads (e) single-in-line package (f) dual-inline package (g) pin grid arrays (h) leadless components.

Other Components

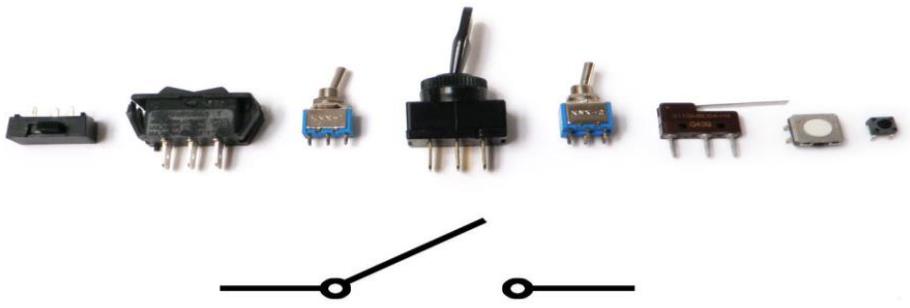
A battery is a container which converts chemical energy into electricity. To over-simplify the matter, you can say that it "stores power."



A switch is basically a mechanical device that creates a break in a circuit. When you activate the switch, it opens or closes the circuit. This is dependent on the type of switch it is.

Normally open (N.O.) switches close the circuit when activated.

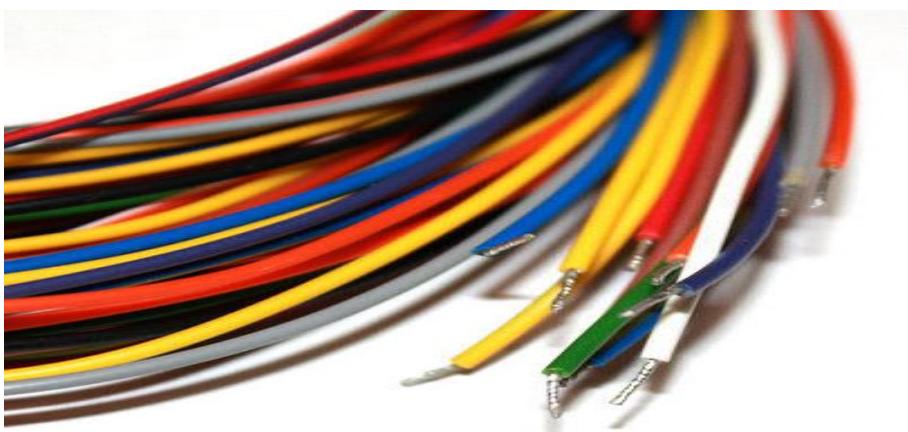
Normally closed (N.C.) switches open the circuit when activated



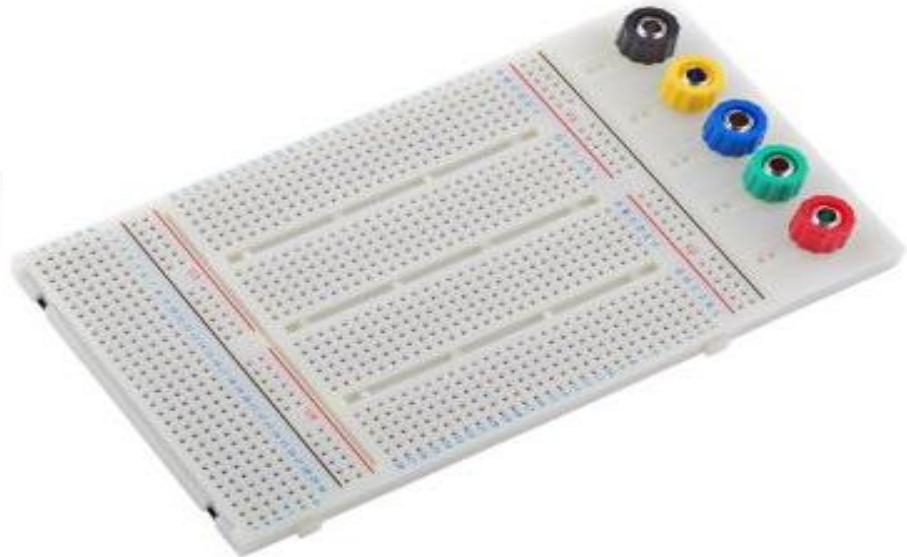
Other Components

In order to connect things together using a breadboard, you need to use a wire.

Wires are nice because they allow you to connect things without adding virtually no resistance to the circuit. This allows you to be flexible as to where you place parts because you can connect them together later with wire. It also allows you to connect a part to multiple other parts.

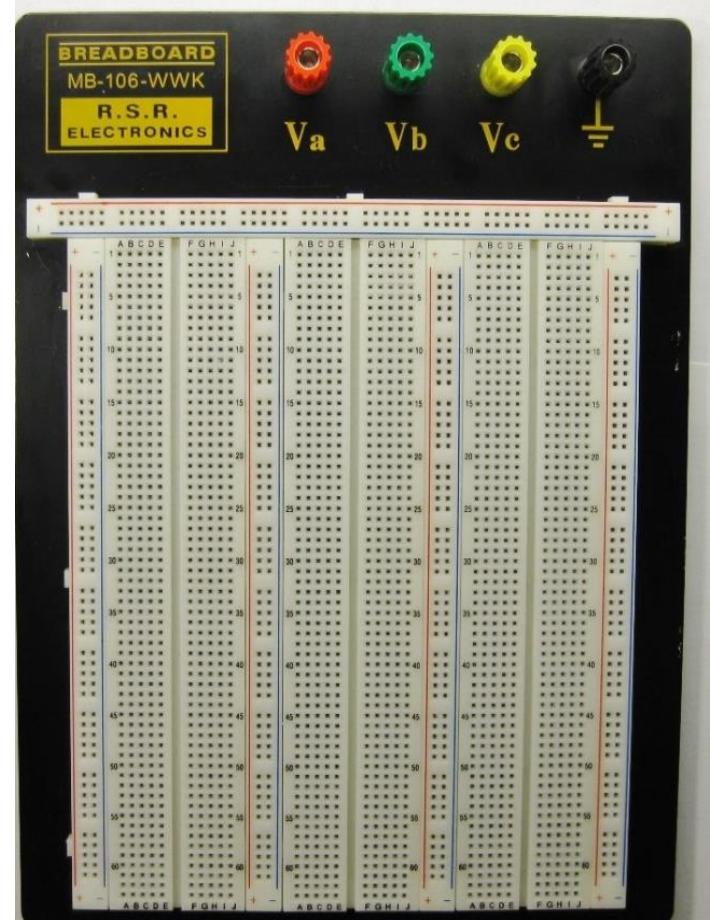
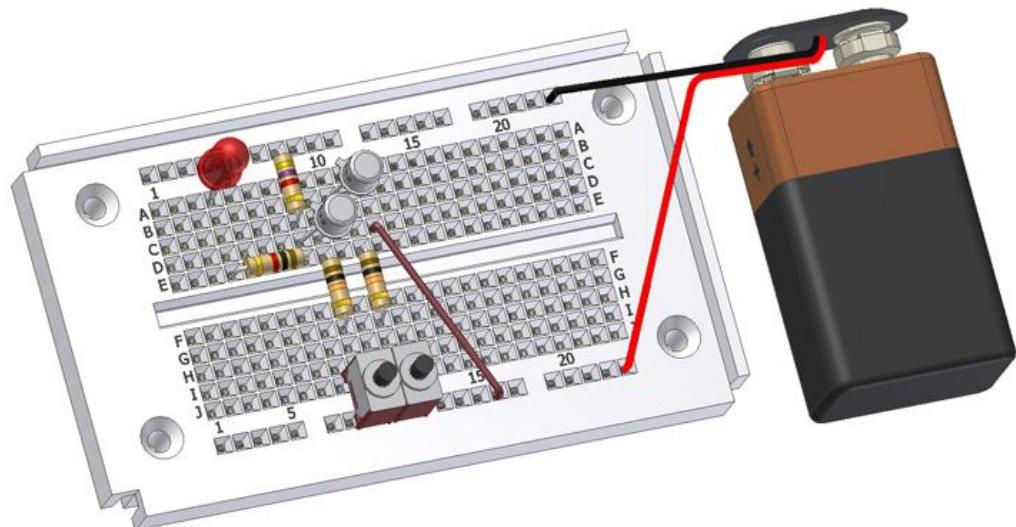
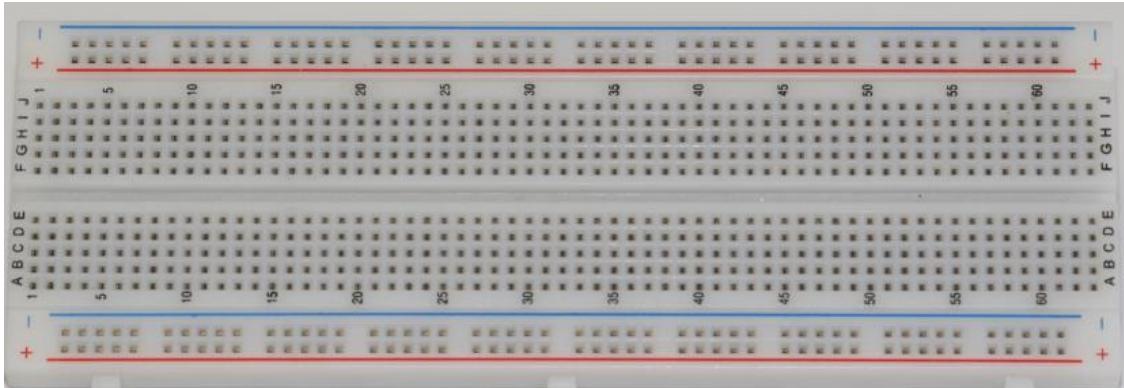


Breadboards are special boards for prototyping electronics. They are covered with a grid of holes, which are split into electrically continuous rows.



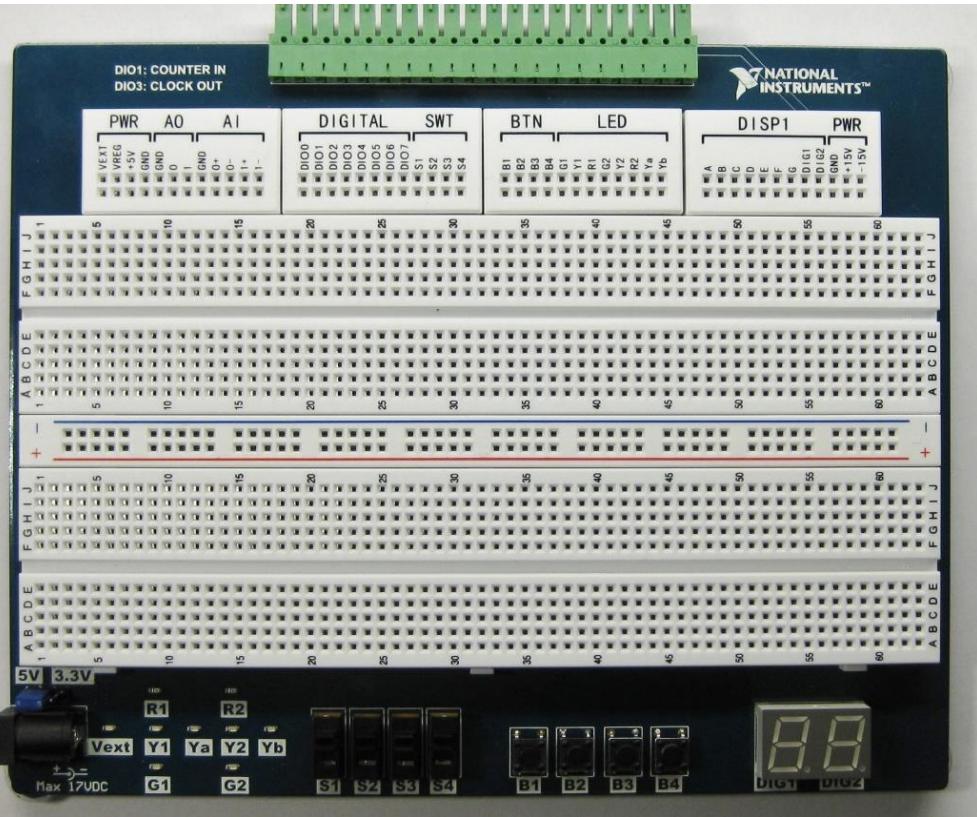
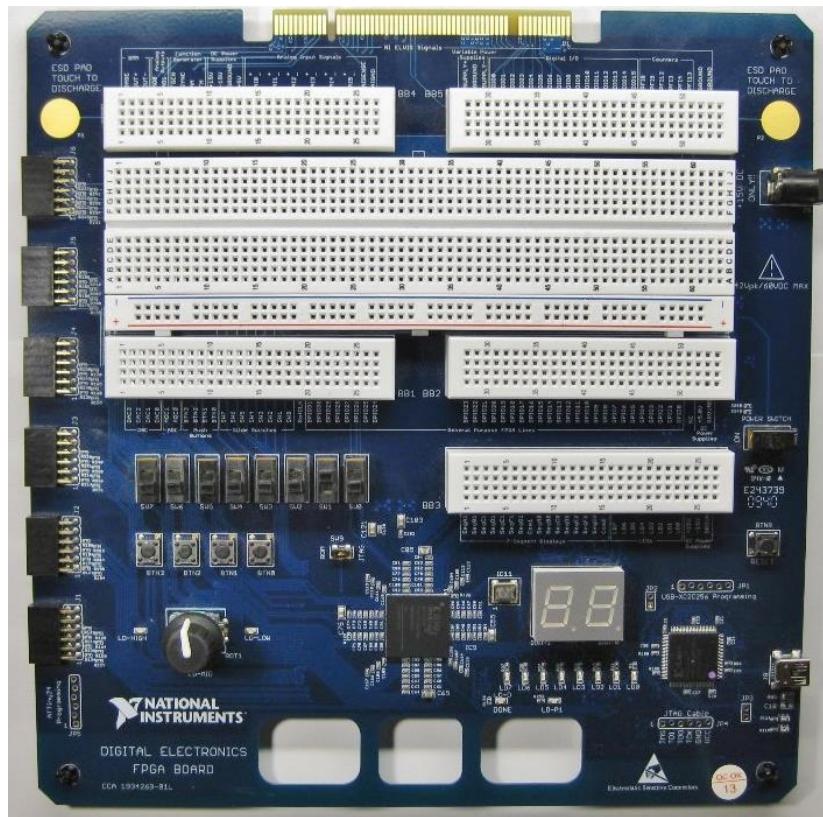
Breadboard

- A breadboard, sometimes called a protoboard, is a reusable platform to temporarily build electronic circuits.



Advanced Breadboards

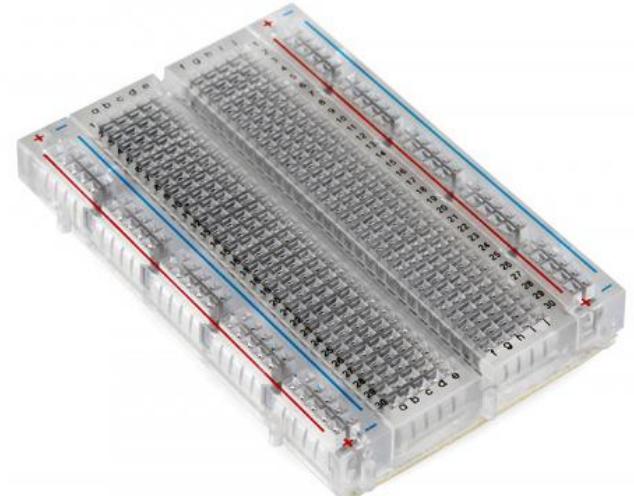
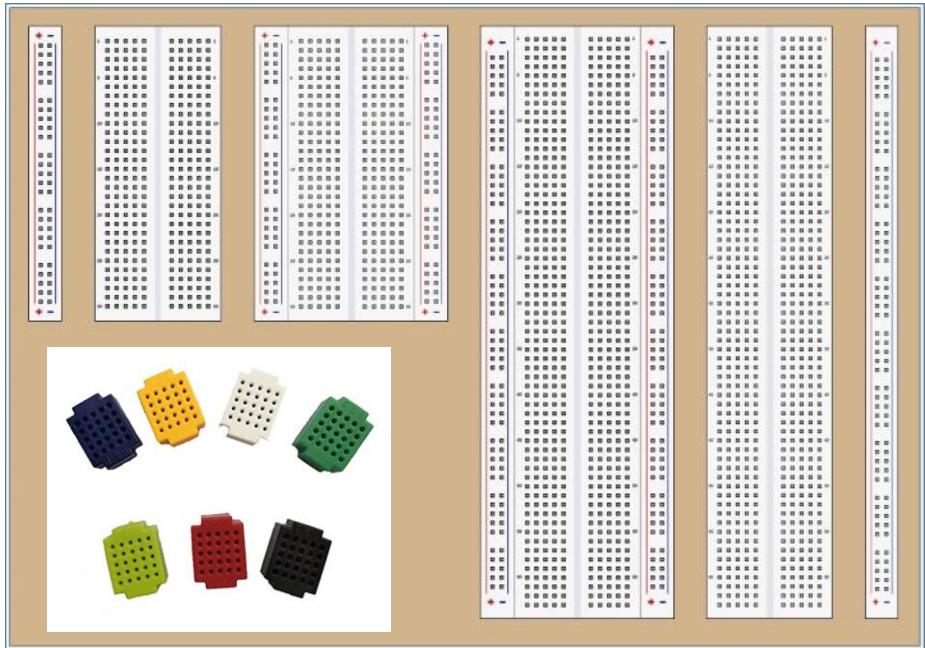
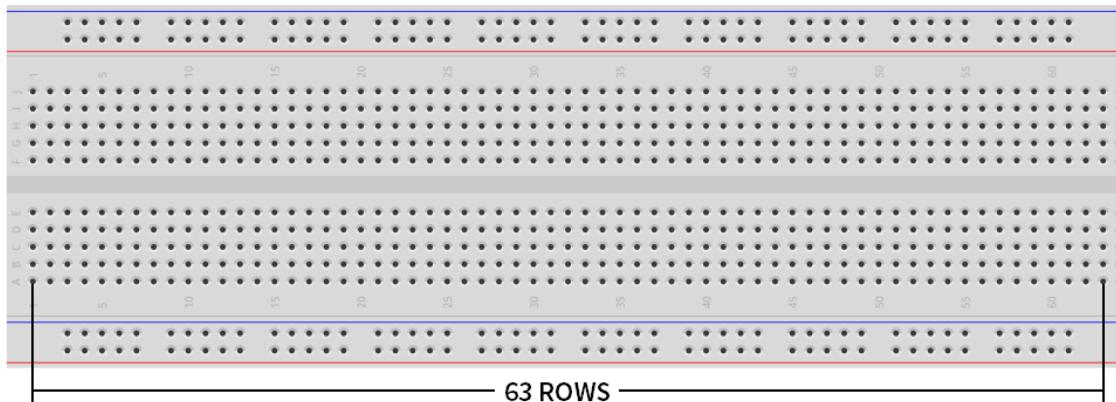
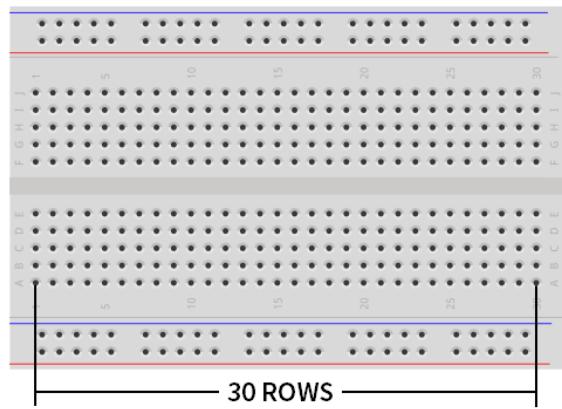
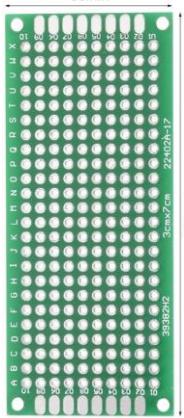
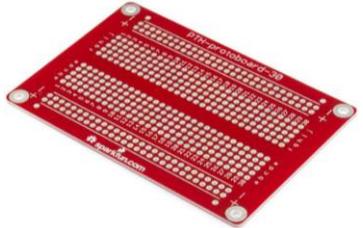
- Digital design tools that already have common components in place for you. They also sometimes have advanced programming ability to create large circuits.



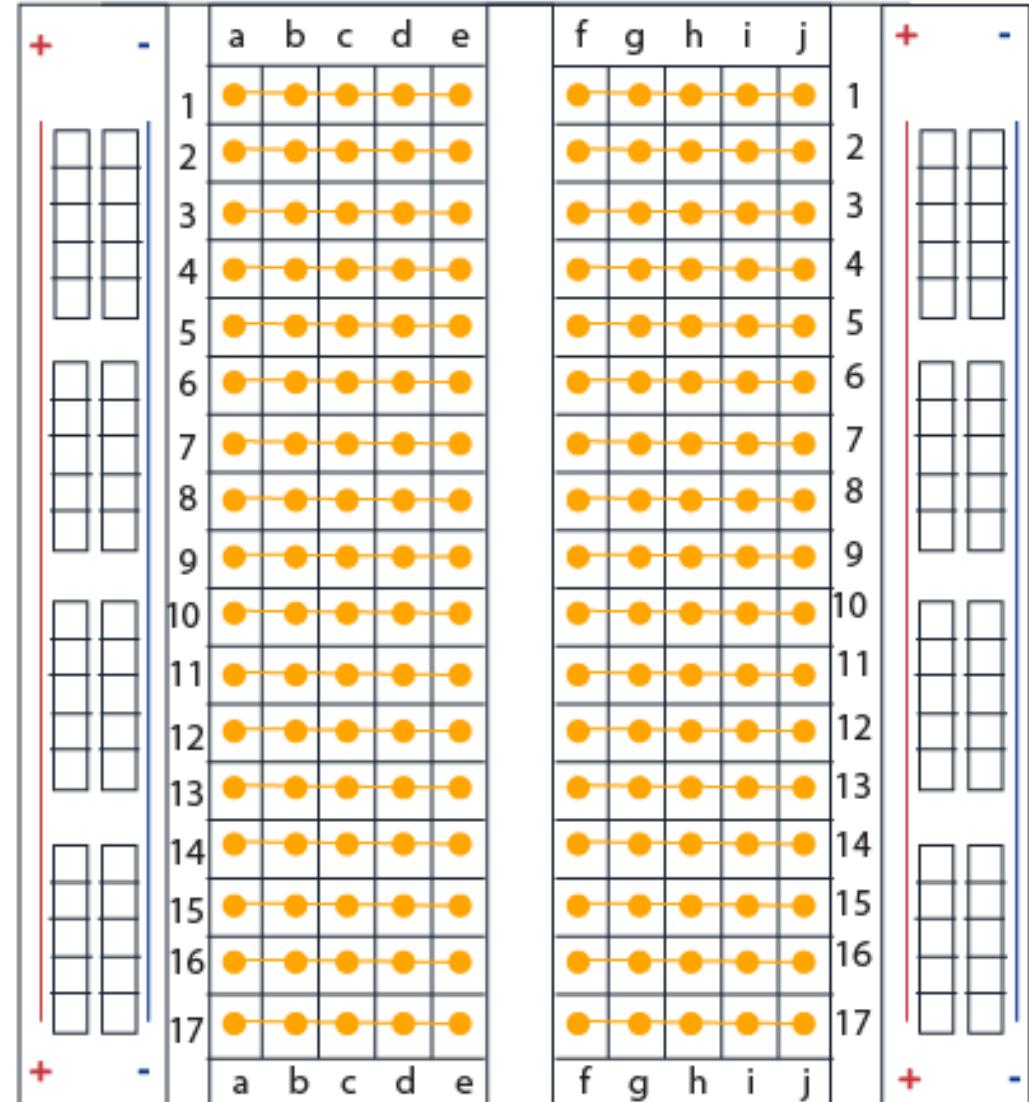
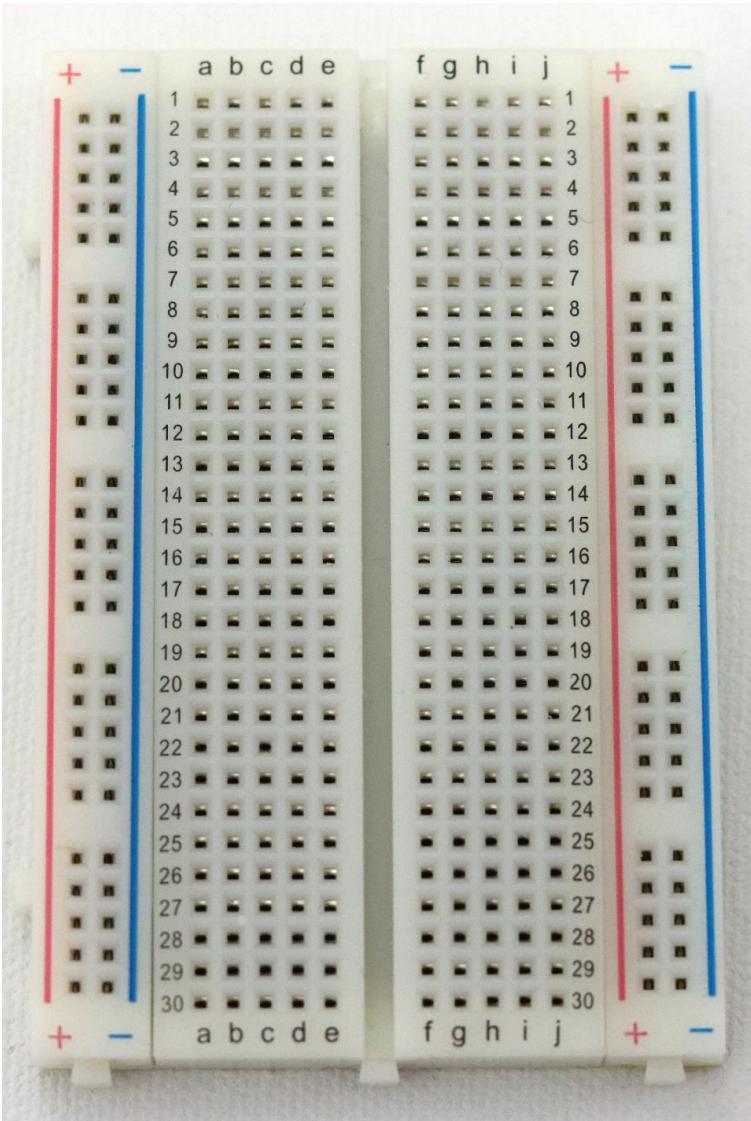
Why Breadboard?

- 1) It takes less time (and money) to breadboard a circuit than to design and fabricate a printed circuit board (PCB).
Because of the cost, a PCB should be reserved for the final working design.
- 2) As a complement to circuit simulation, breadboarding allows the designer to see how, and if, the actual circuit functions.
- 3) Breadboards give the designer the ability to quickly change components during development and testing, such as swapping resistors or capacitors of different values.
- 4) A breadboard allows the designer to easily modify a circuit to facilitate measurements of voltage, current, or resistance.

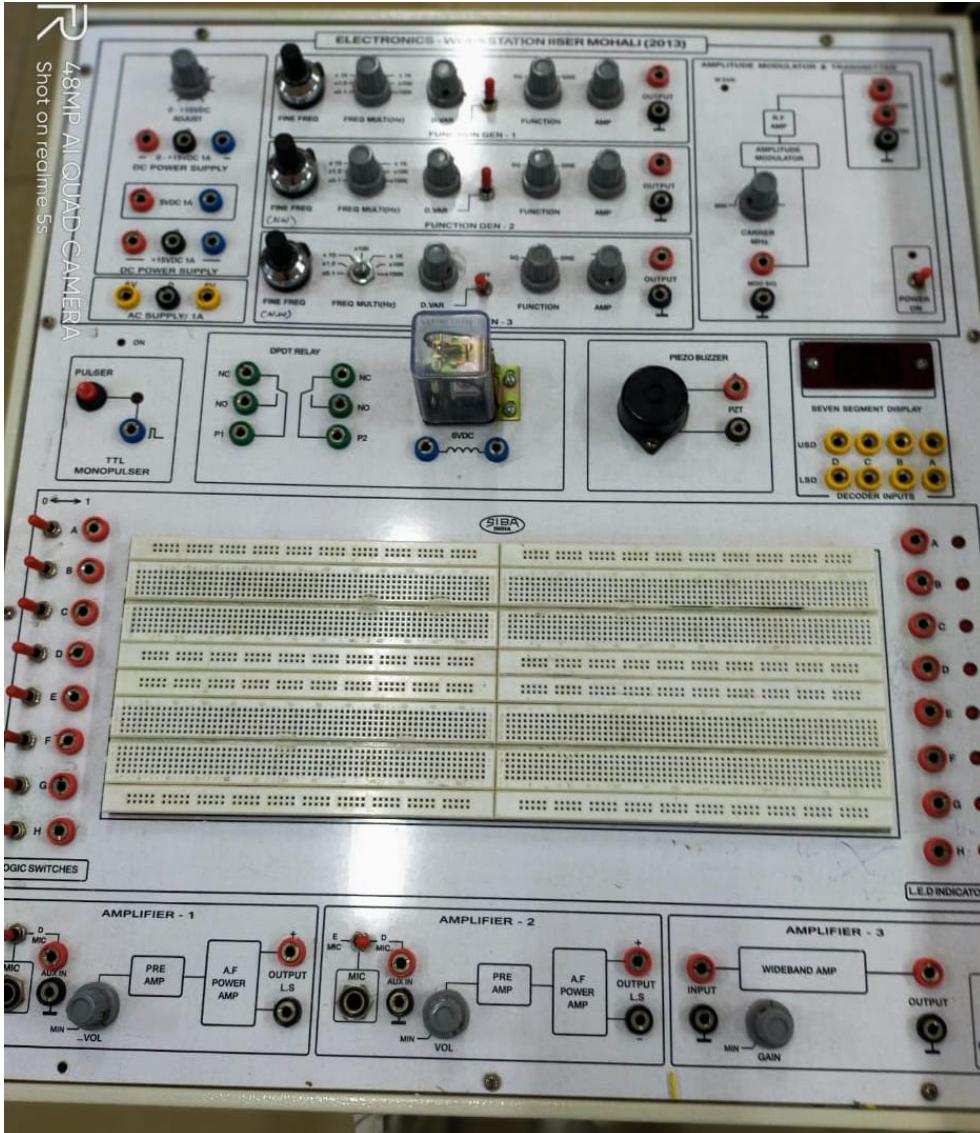
Different Type of Breadboards



Breadboard in Lab



Customize Breadboard in Lab



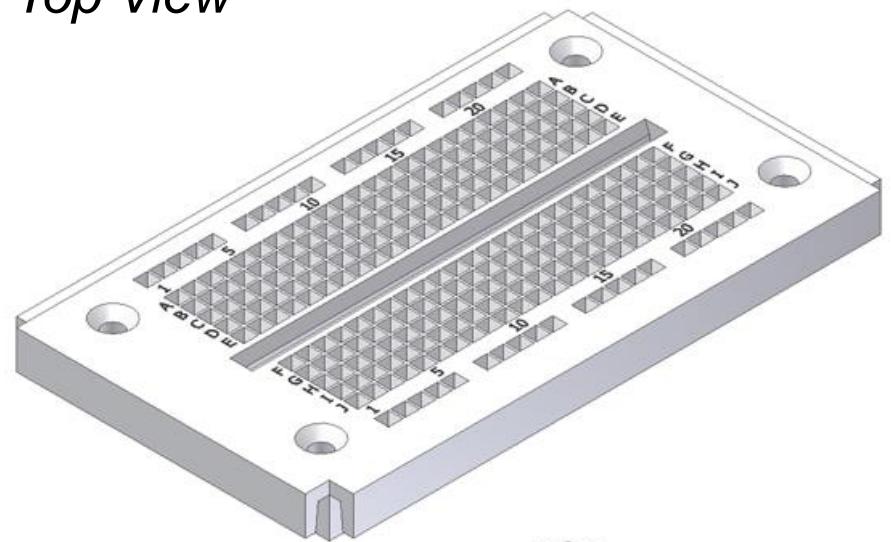
Shot on realme 5s



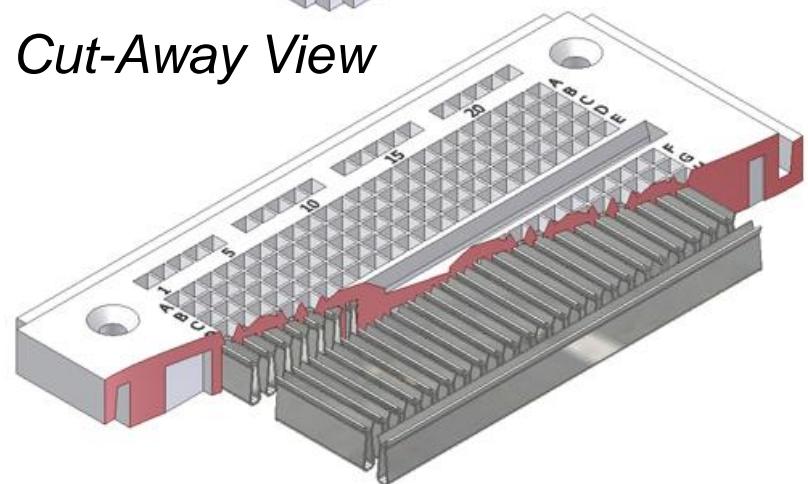
How a Breadboard Works

- Electric component leads and the wire used to connect them are inserted into holes that are arranged in a grid pattern on the surface of the breadboard.
- A series of internal metal strips serve as jumper wires. They connect specific rows of holes.

Top View

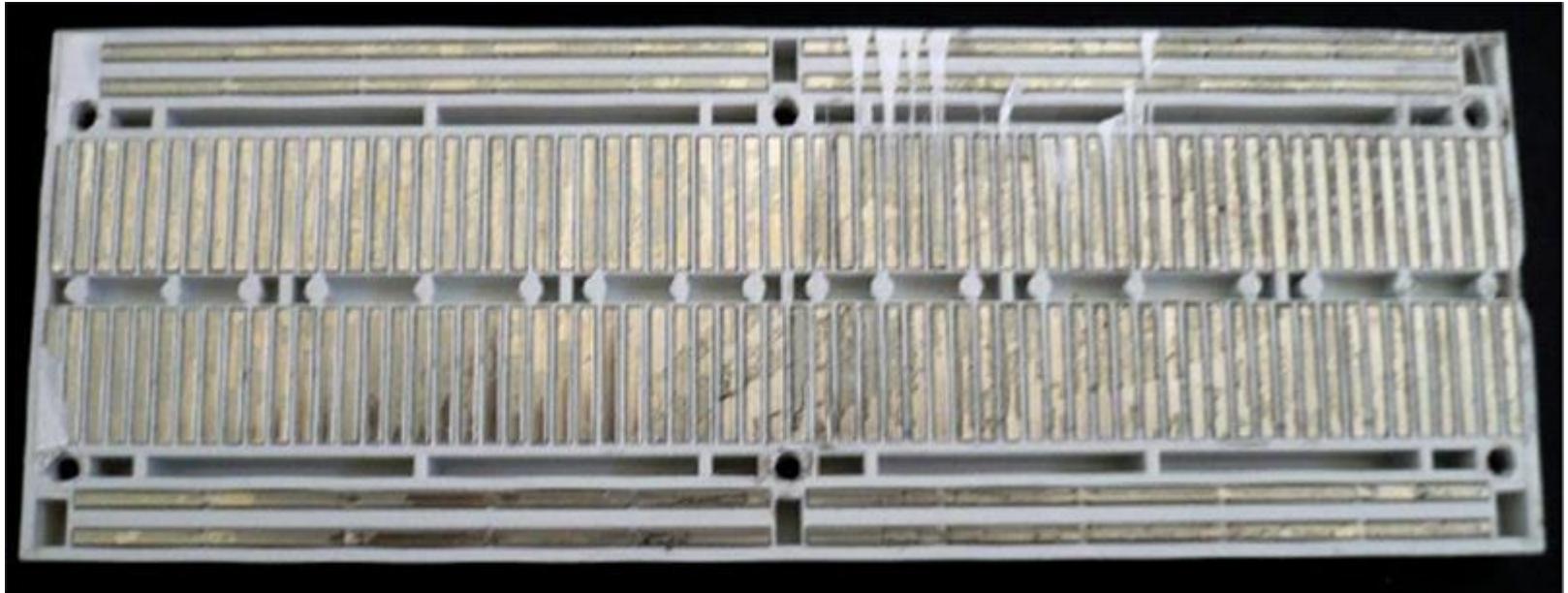


Cut-Away View



Breadboard: internal connection

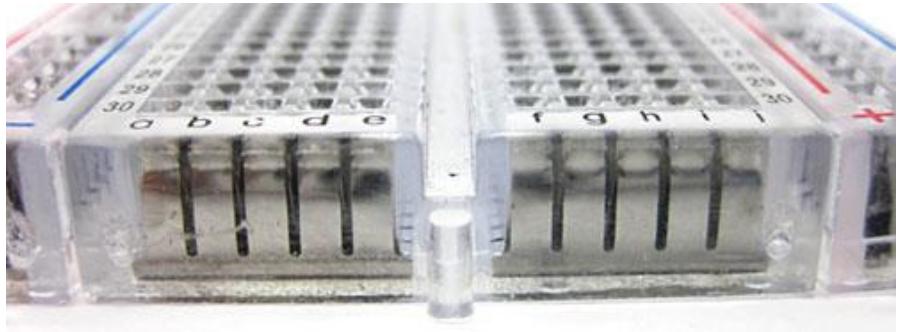
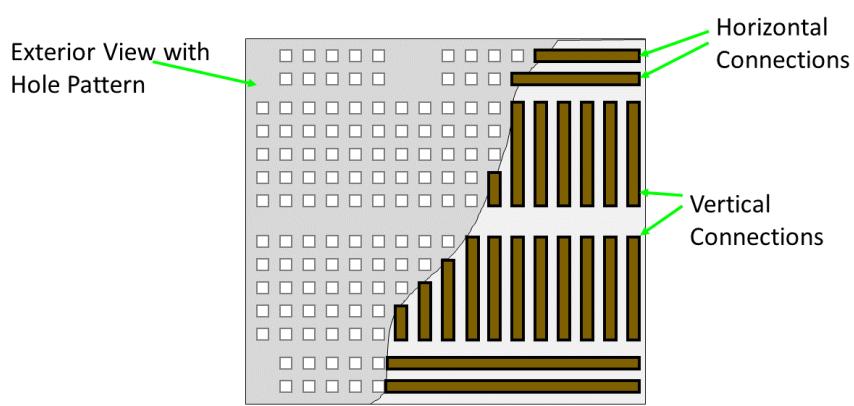
- This is the back surface of the breadboard
- Some metal strips run horizontally and some run vertically.
 - These strips create a low resistance connection between the sets of square holes along the metal strip to allow you to easily connect ends of components together without running wires between them.
 - Wires are used to make jumpers between metal strips.
 - Maximum frequency of operation is 4 MHz, due to parasitic capacitance



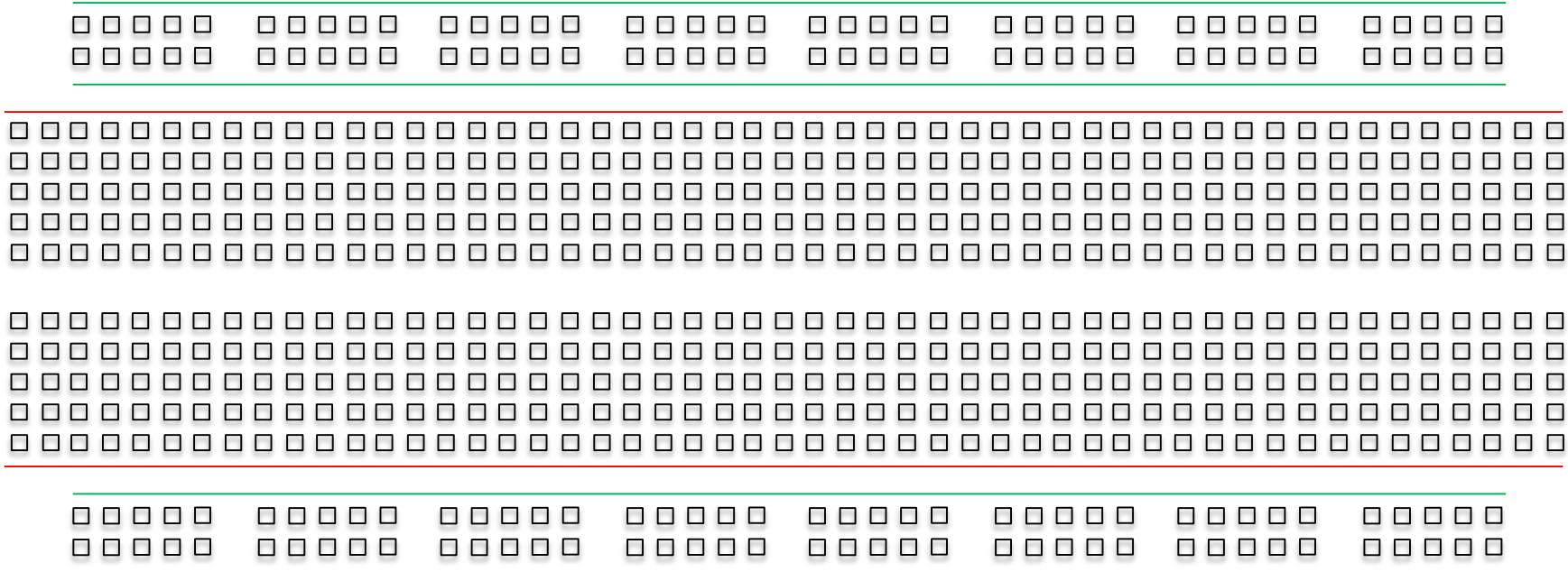
How breadboard is internally connected



Breadboard Internal Wiring



How breadboard is internally connected

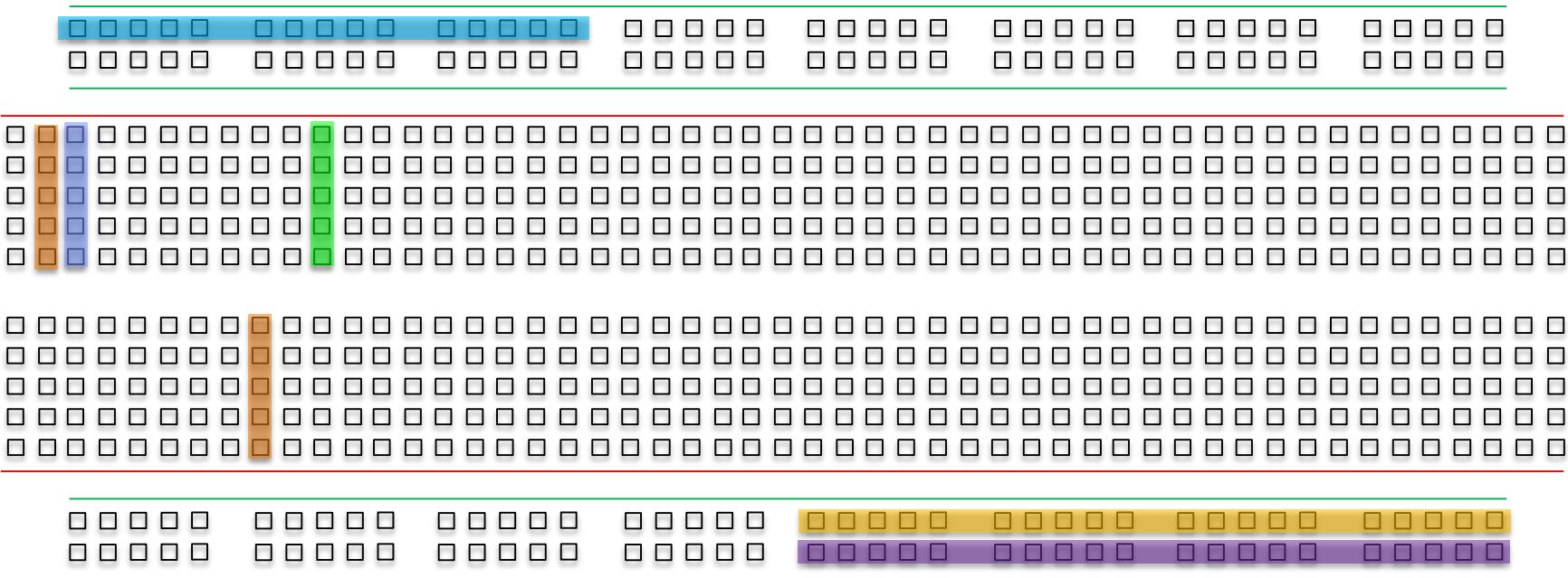


A breadboard consists of two areas called strips and are often separated from the middle portion (commonly known as ravine).

Bus strips are mainly used for power supply connections

Terminal strips are mainly used for electrical components: Each strip consist of 5 pinholes, indicating that you only can connect up to 5 components in one particular section

How breadboard is internally connected

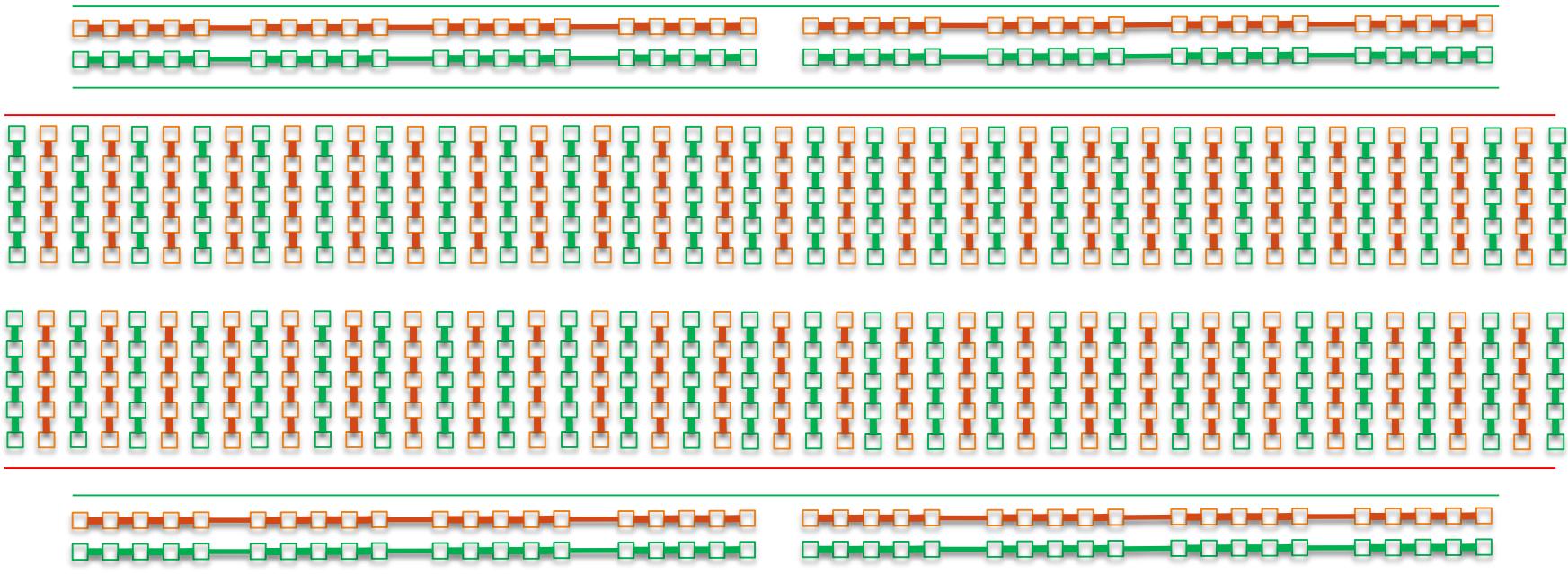


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How breadboard is internally connected



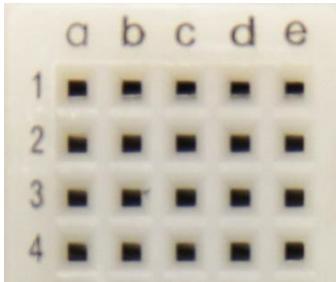
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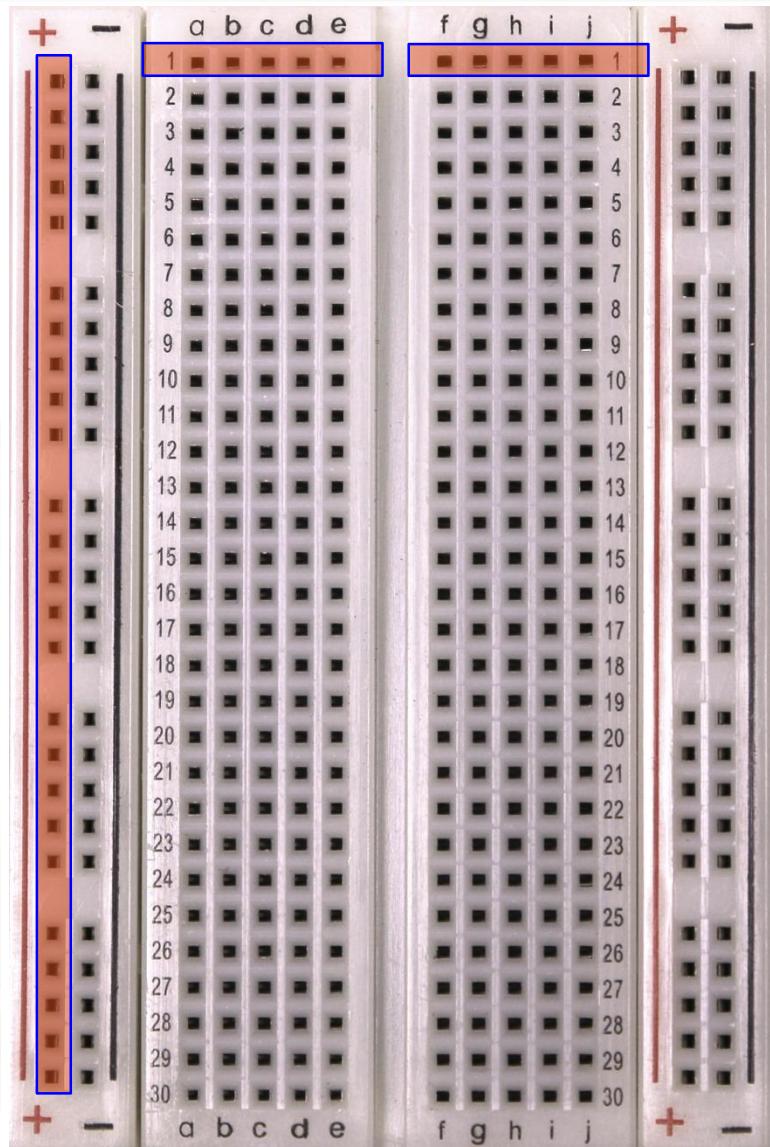
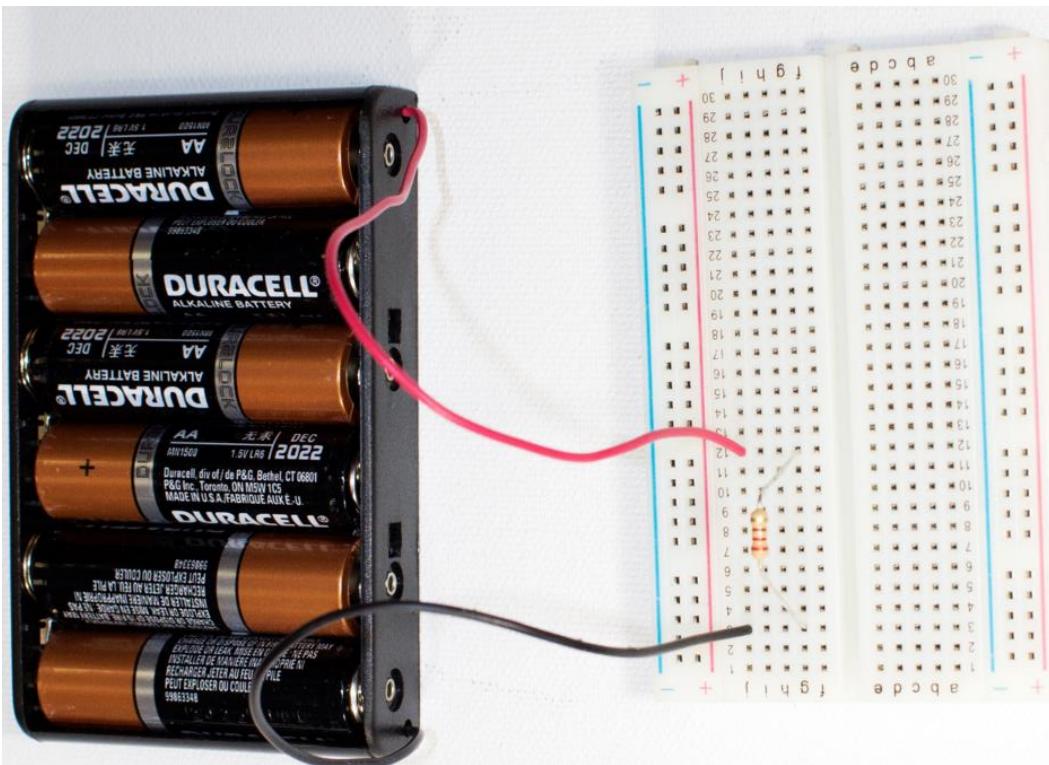
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How to use a Breadboard

- Columns and rows connected

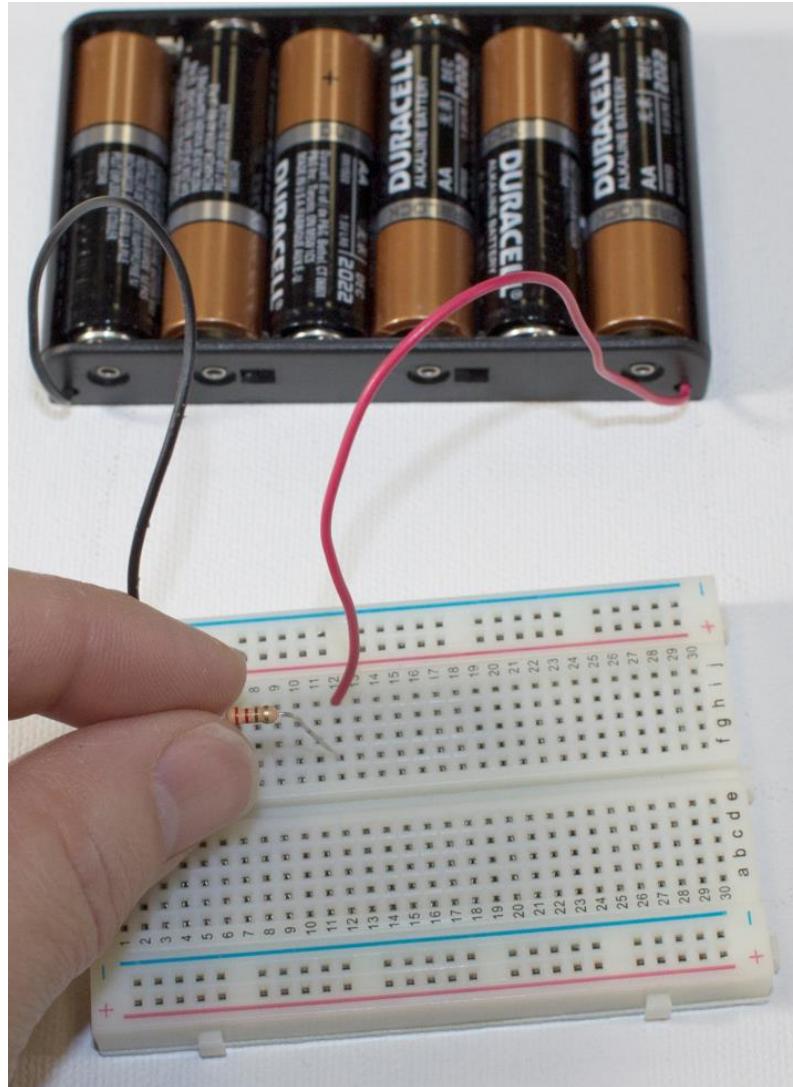
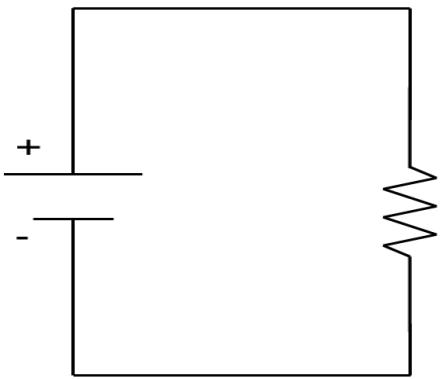


Holes to connect wires



Do I need any tools to use a breadboard?

- You do not need any special tools to use a solderless breadboard. However, many electronic components are very tiny, and you may find them difficult to handle. A pair of miniature needle nose pliers or tweezers may make it easier to pick up small components.



How to use a Breadboard

We need some components, breadboard, batteries, wires and multimeter.

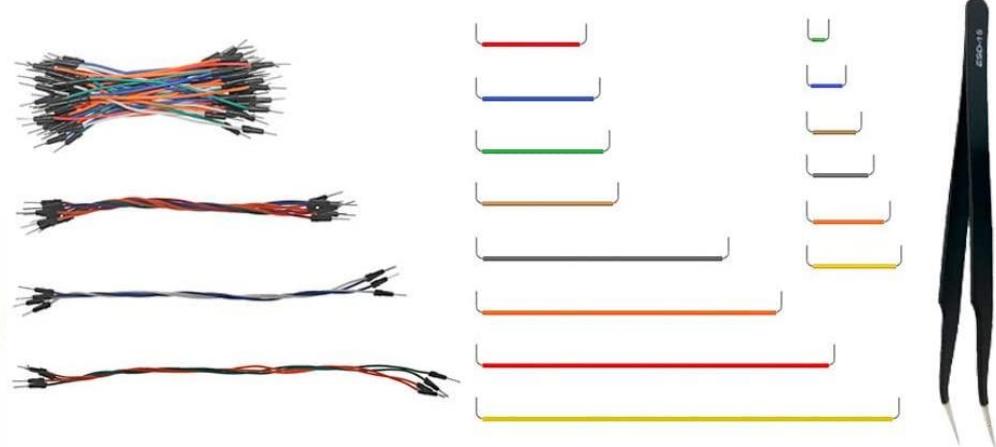
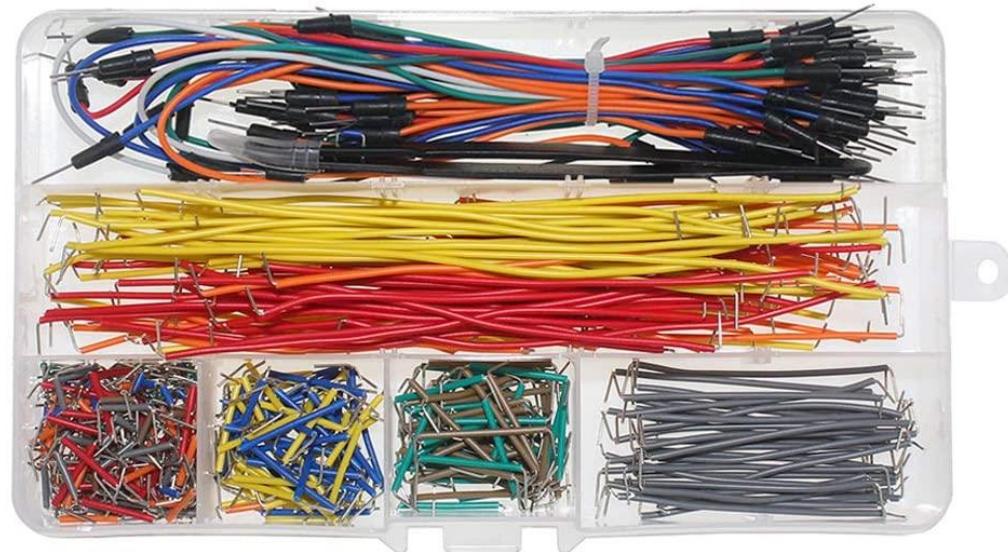


- 3 LEDs
- 220-ohm resistor
- 1,000-ohm resistor
- 10,000-ohm resistor
- battery pack
- jumper wire kit
- breadboard
- multimeter

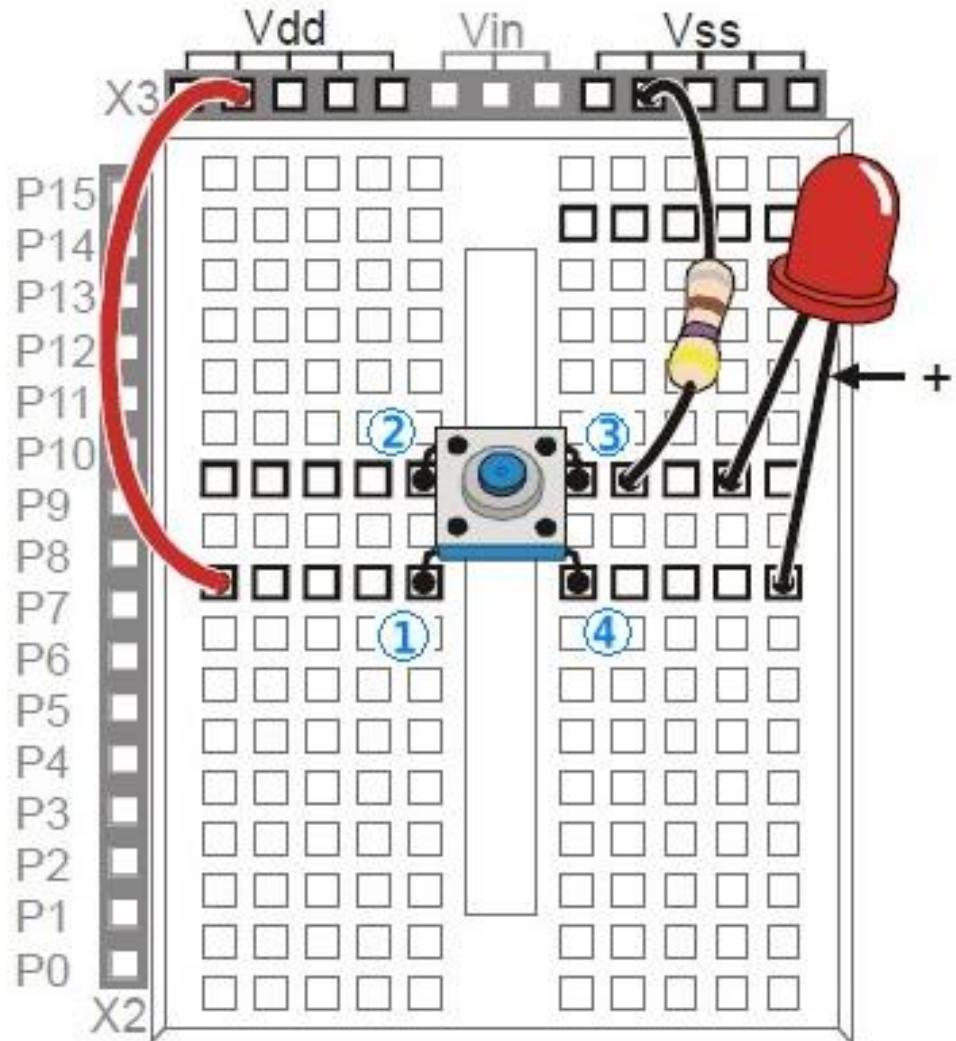
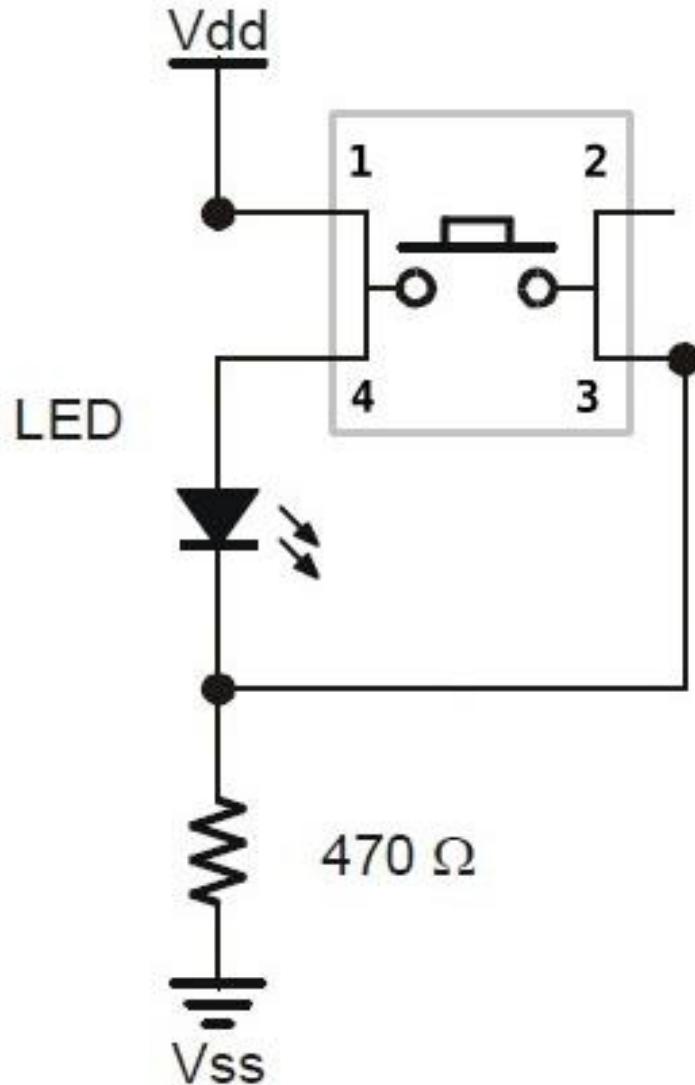
We need, of course, a circuit diagram to prototype on.

Breadboard: Guidelines and Tips

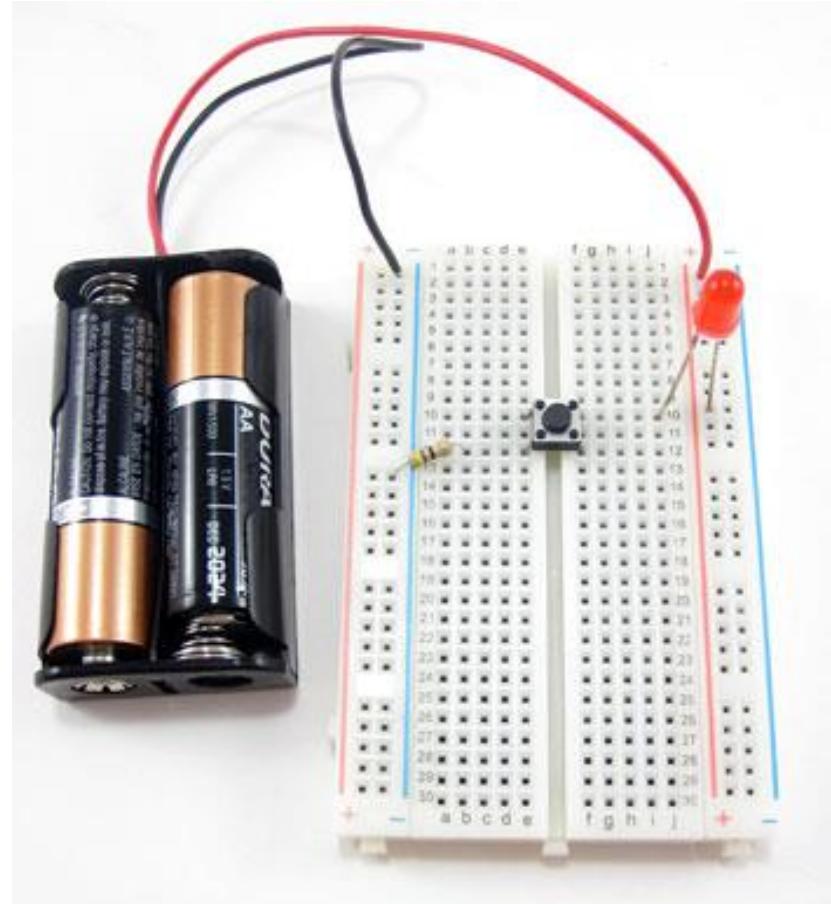
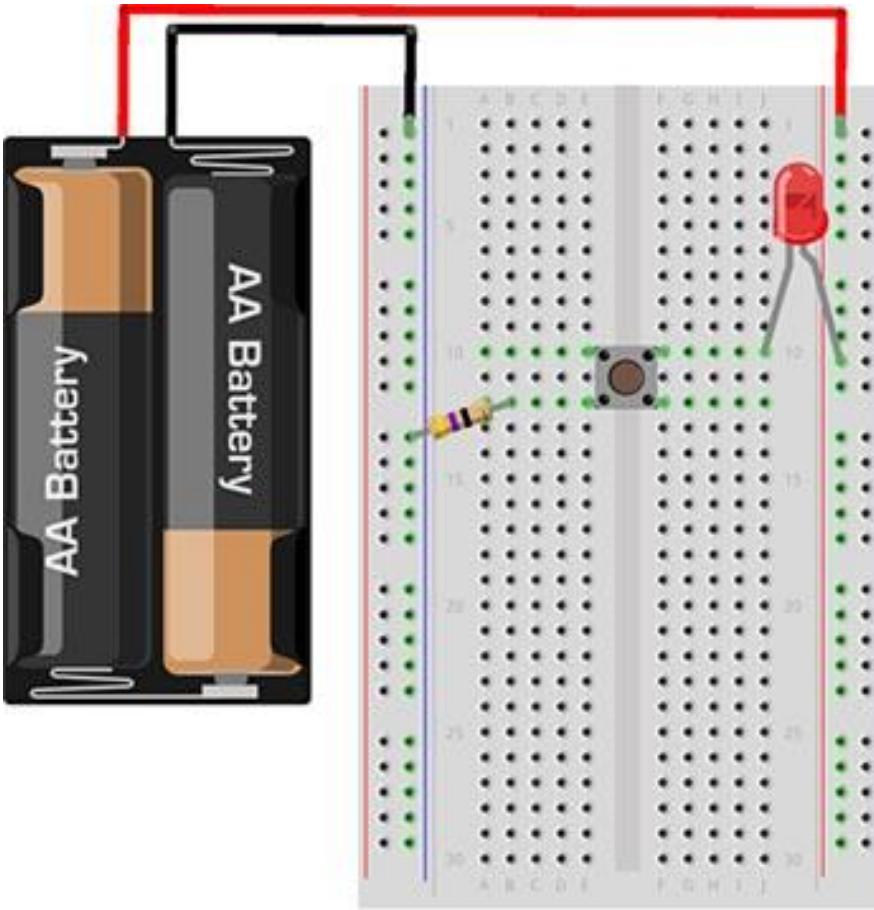
- Use as few jumper wires as possible. The breadboard should be used to make the majority of the connections between the components.
- Keep jumper wires as short as possible. A jumble of wires is difficult to troubleshoot.
- Breadboard a circuit so that it looks as close as possible to the layout of the schematic circuit. This makes troubleshooting easier.



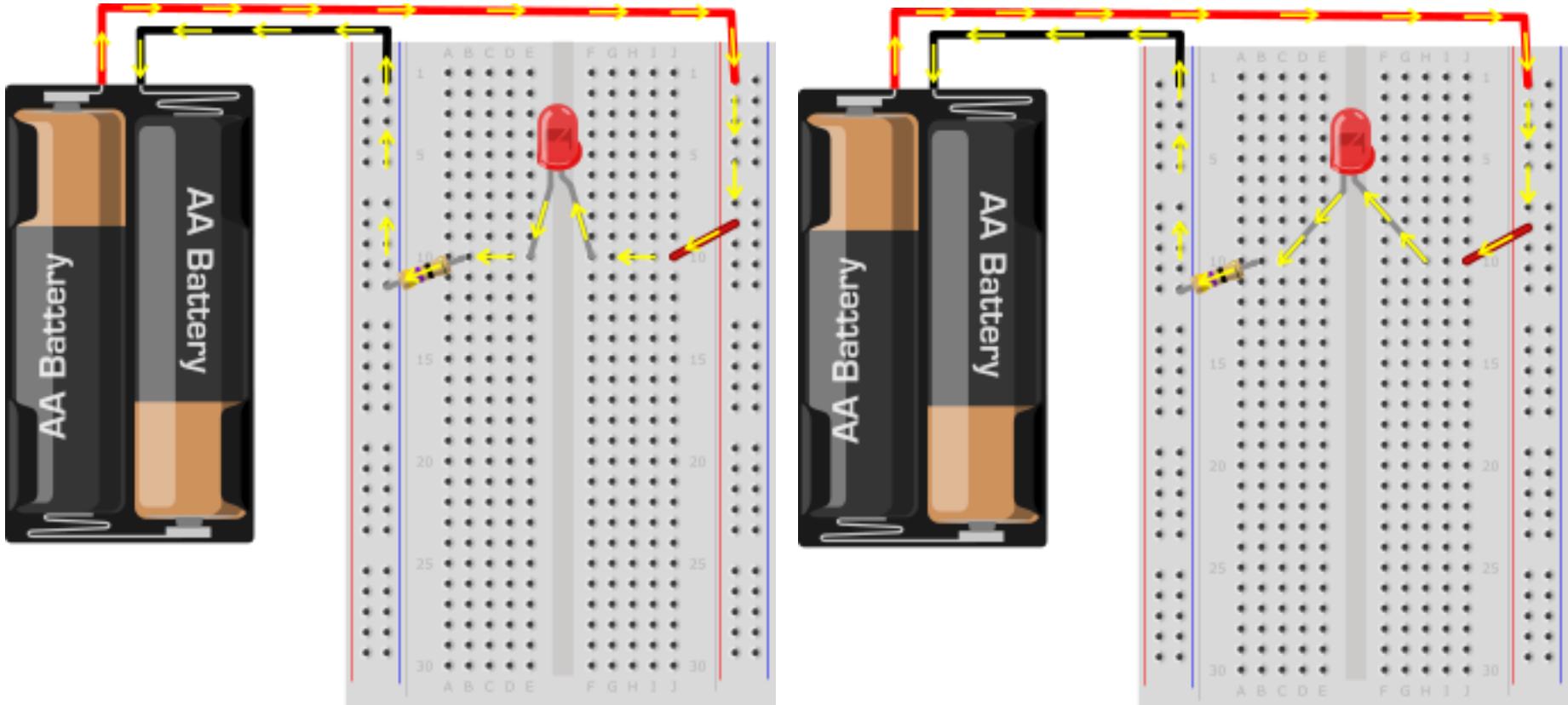
How to use a Breadboard



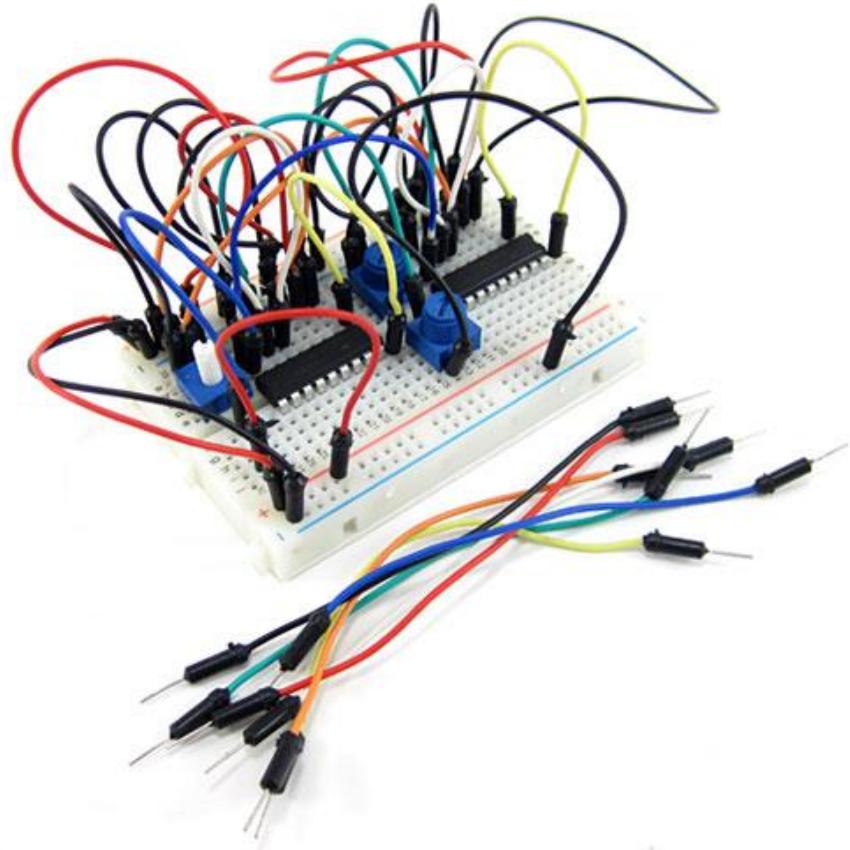
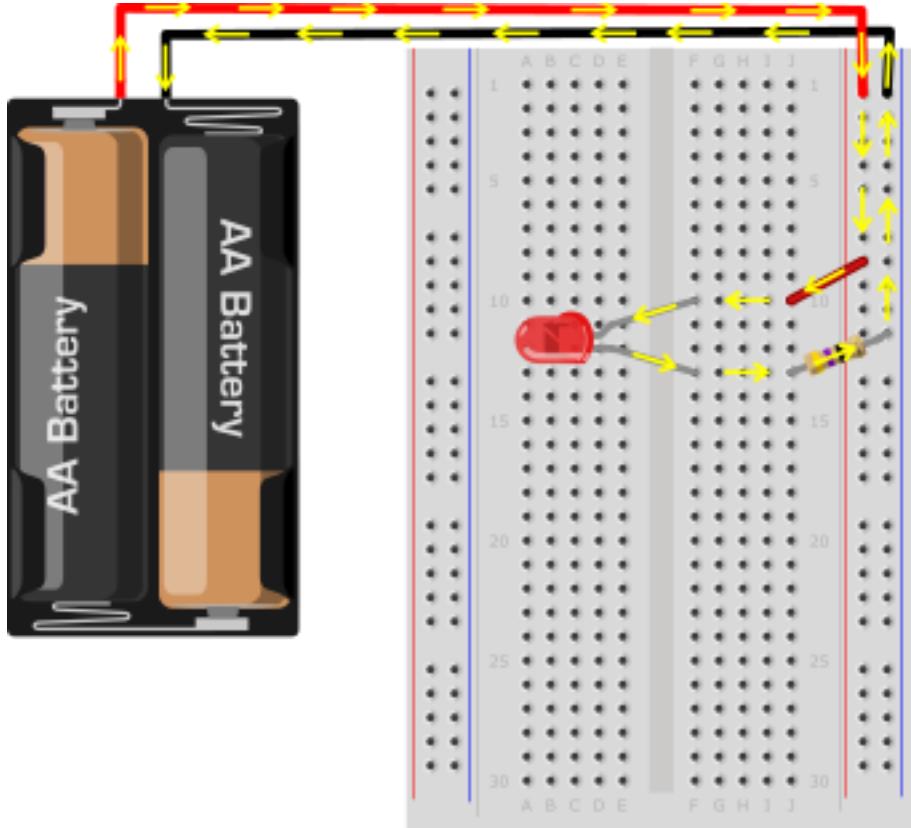
How to use a Breadboard



How to use a Breadboard

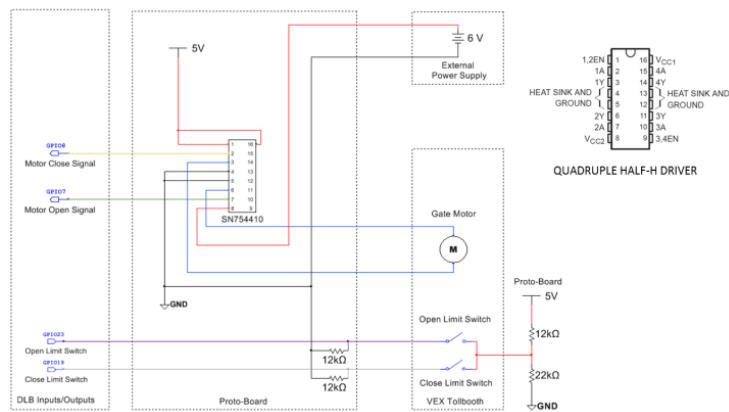
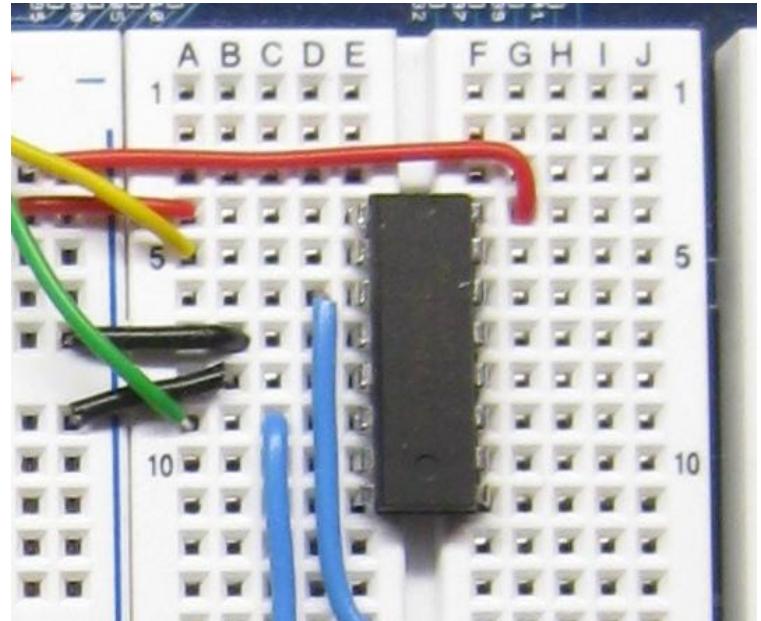


How to use a Breadboard



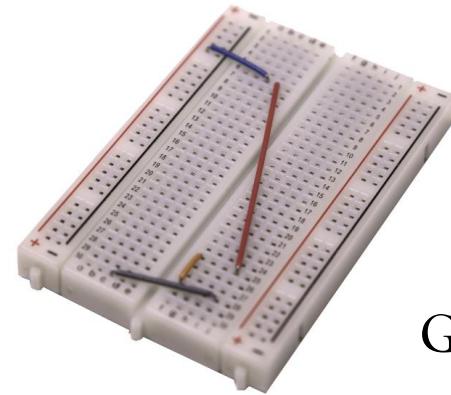
Breadboard: Guidelines and Tips

- Place IC chips in the middle of the breadboard.
- Work from a schematic and check off the component and wires as they are implemented on the breadboard.
- Cut component leads to manageable lengths. Component leads that are too long may touch and short each other out.
- Have someone check your circuit for errors.

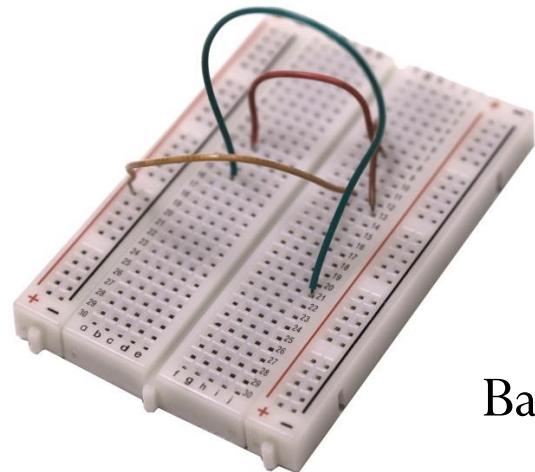


Breadboard: Guidelines and Tips

- Use as few jumper wires as possible. Internal breadboard strips should make the majority of connections
- Keep jumper wires as short as possible to avoid jumbled wires which are difficult to troubleshoot
- Breadboard circuit closely to layout of the schematic circuit to aid troubleshooting
- Use schematic and check off component and wires as added to breadboard
- Cut component leads to short lengths to avoid contact and shorts
- Have someone check the circuit for errors

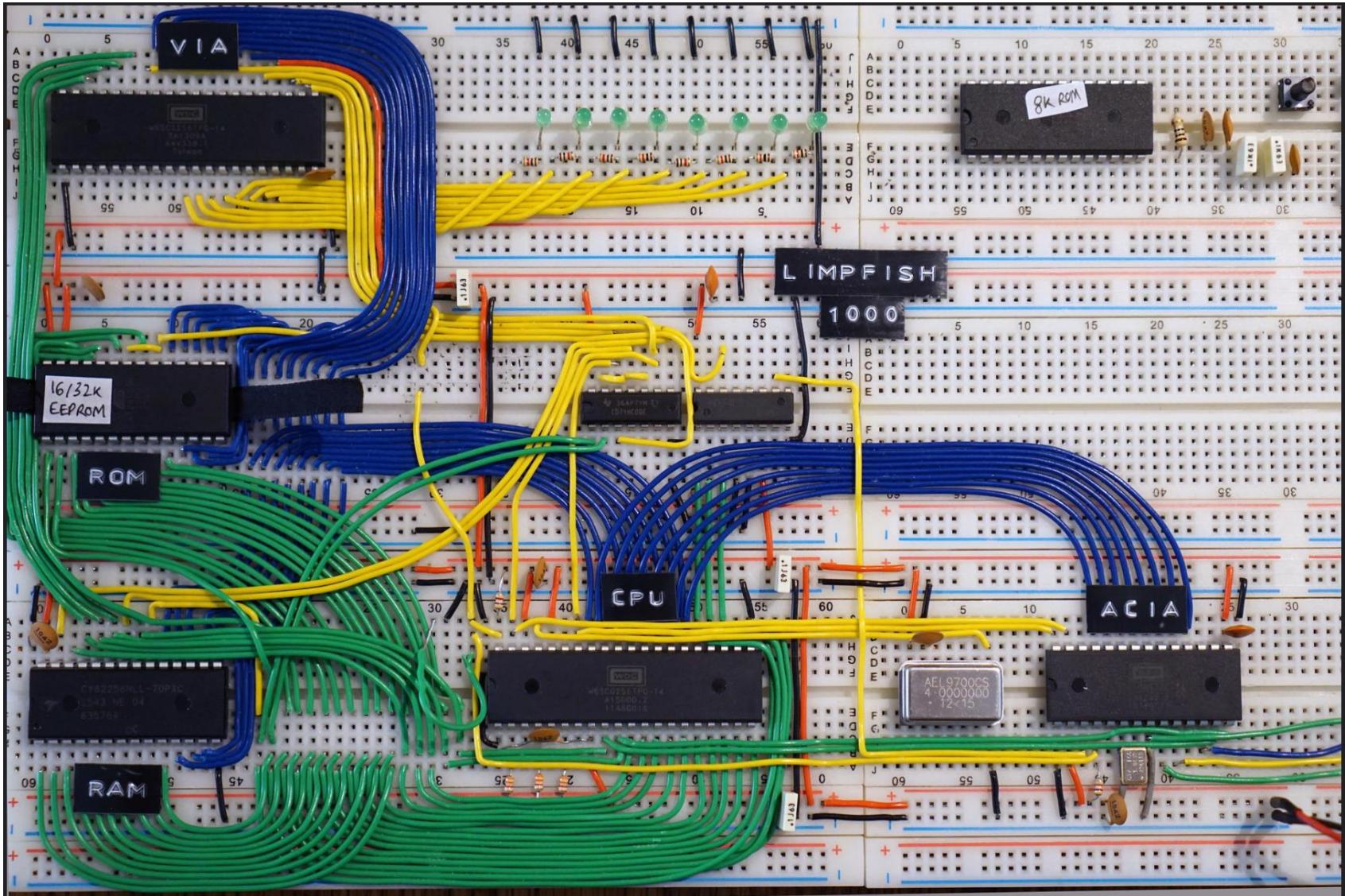


Good

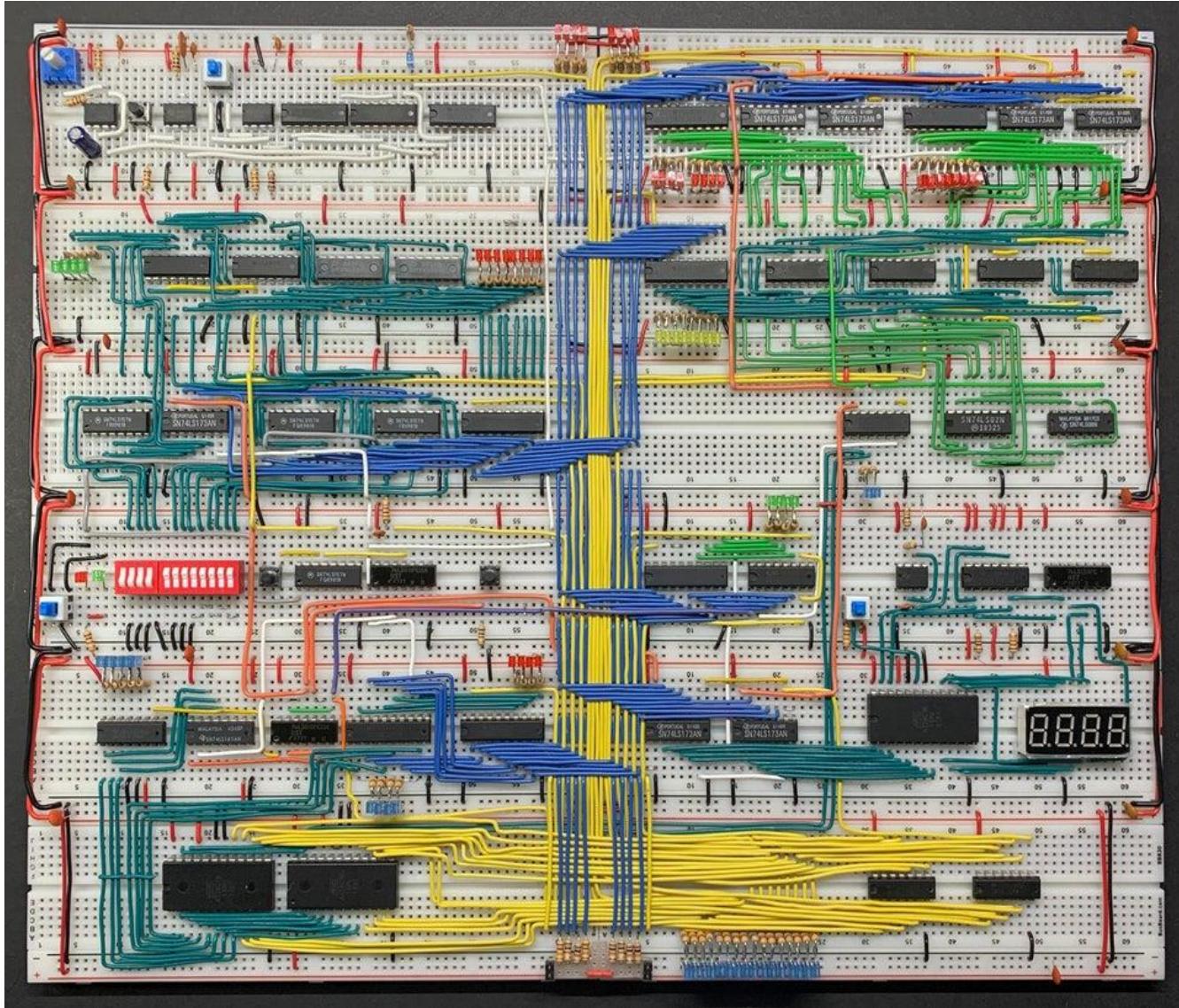


Bad

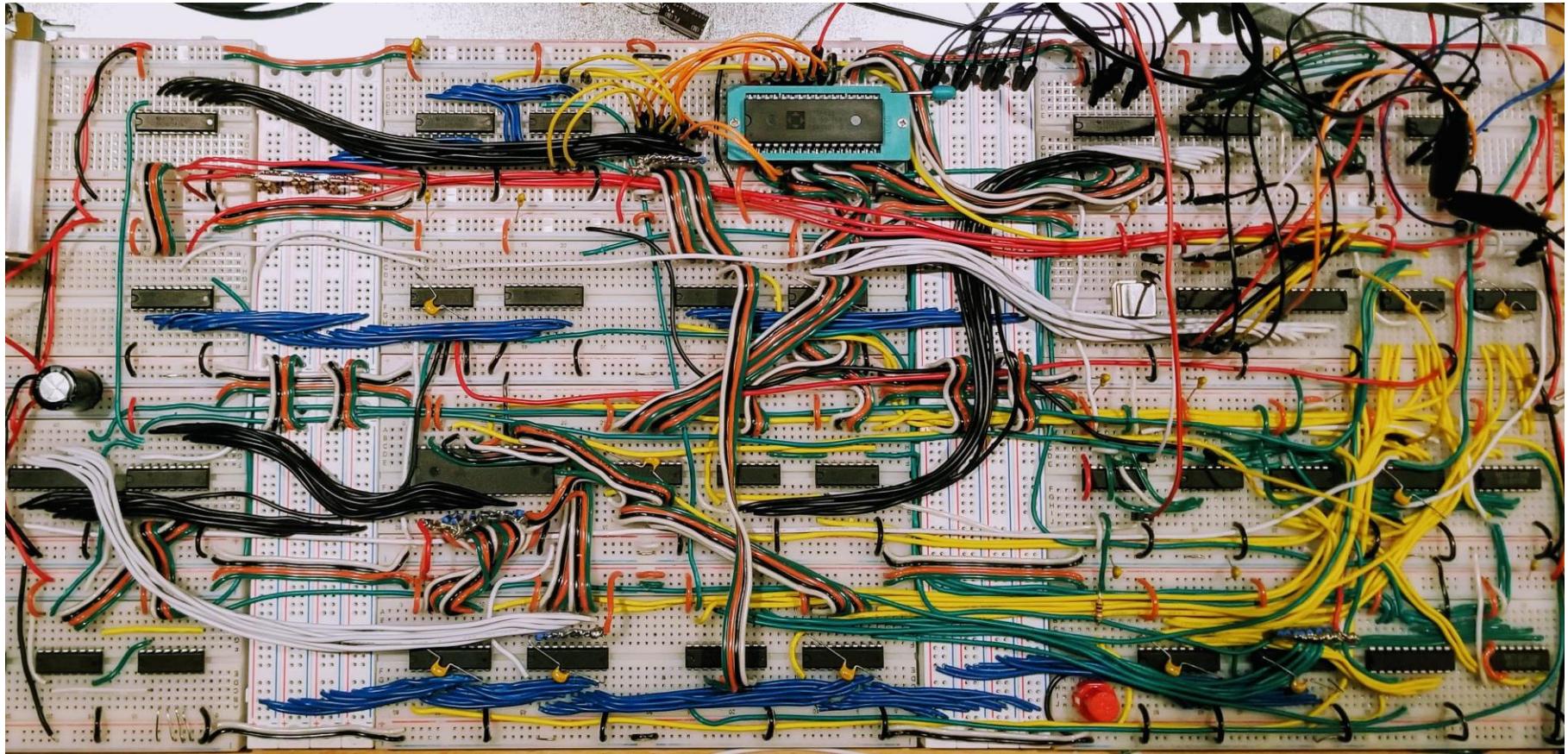
Home made 6502 8bit breadboard computer



8-Bit Computer

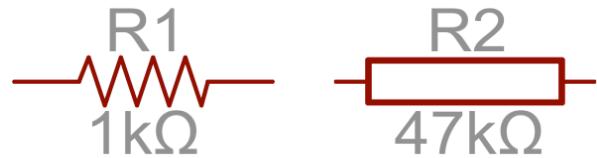


An interesting Project

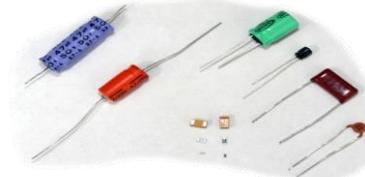


Components: we will study in detail

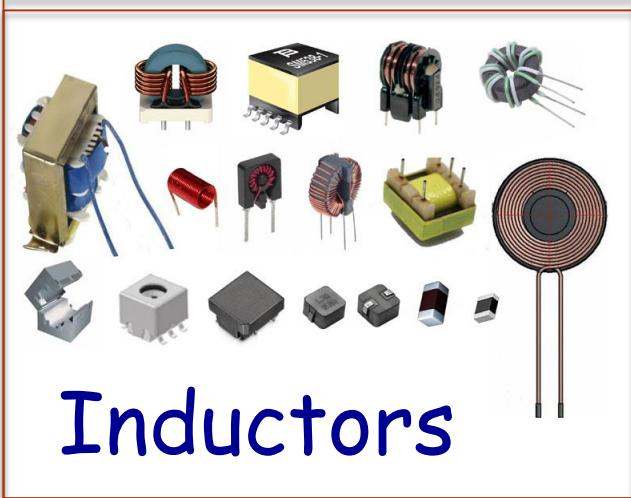
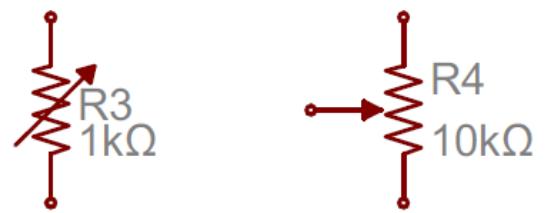
Resistor



Capacitors

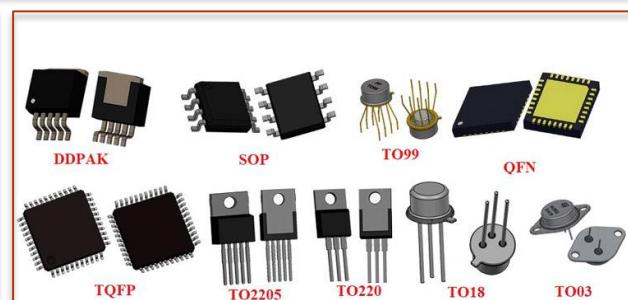
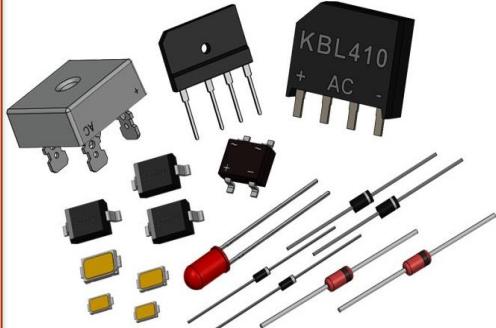


Variable Resistor



Inductors

Diodes



Transistor and IC