

Electronic Shop Practice (EEE242)

How to design & implement circuits,
and make it work better

Why learn design?

- EEE courses teach the theory needed to do real engineering.
- Applying that theory happens later in projects, and some coursework. It helps you:
 - Motivate theoretical work
 - Become better at solving real problems
 - Perform better in your 4th year project work
 - Have fun (!) on your EEE course

Before start

- ☐ Need to think about a circuit
- ☐ Design and Simulate the circuit using CAD tools
- ☐ Collect the required parts
- ☐ Implement the circuit in a Breadboard
- ☐ Permanently build the circuit in PCB

What is a circuit?

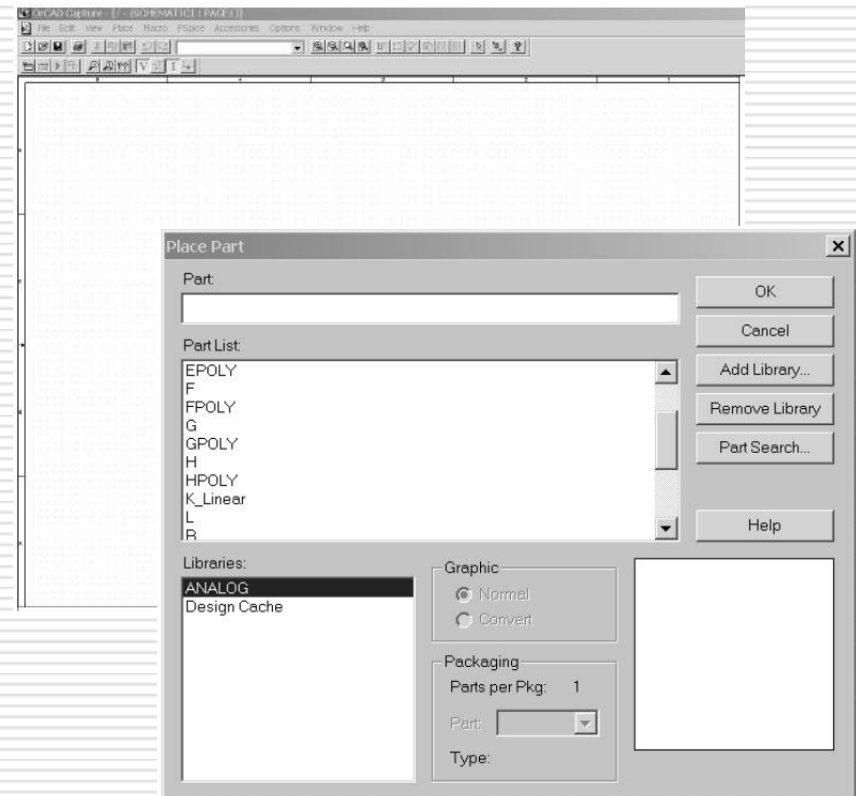
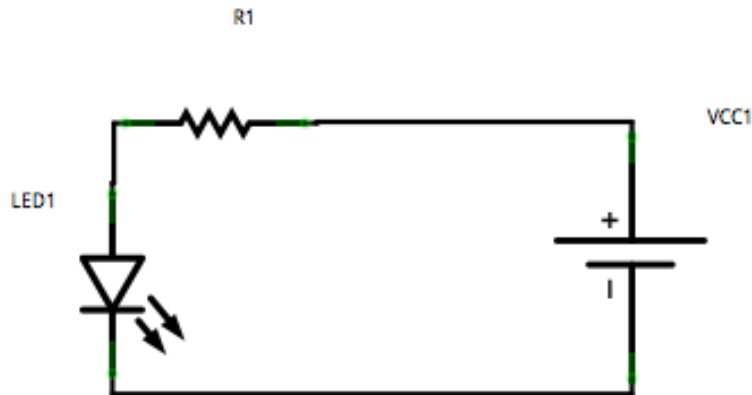
- ❑ Combination of electronic parts, wires connected between power sources.
- ❑ Take example to glow a LED.

What is CAD tools?

- ❑ Computer-aided design (CAD) software tools that are used to design and simulate electrical and electronic circuits/systems.
- ❑ e.g.
 - **PSpice** is a PC version of SPICE
 - **Cadence**
 - **PROTEUS**
 - **Electronics workbench**
 - **CircuitMaker**
 - **Electronic design studio etc.**

Using PSpice

Now start placing components and connecting them (*this part is quite similar to what you have done in L-2, T-1's lab*)



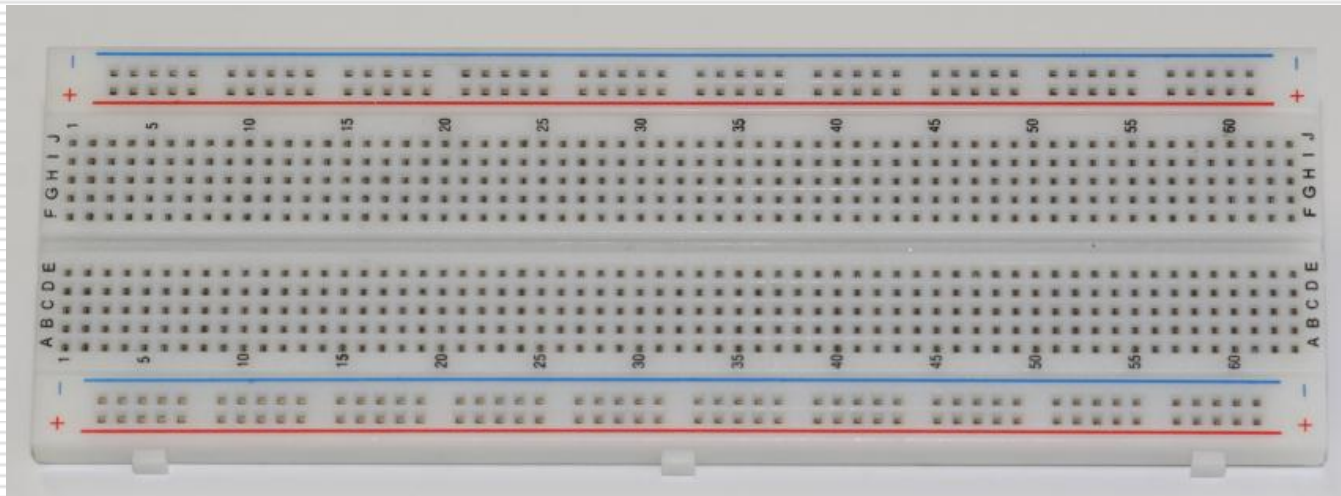
Parts collection

- ❑ Go to local market and buy your required components



What is a Breadboard?

- ❑ Sometimes called a proto-board
- ❑ Reusable platform for temporarily built electronic circuits



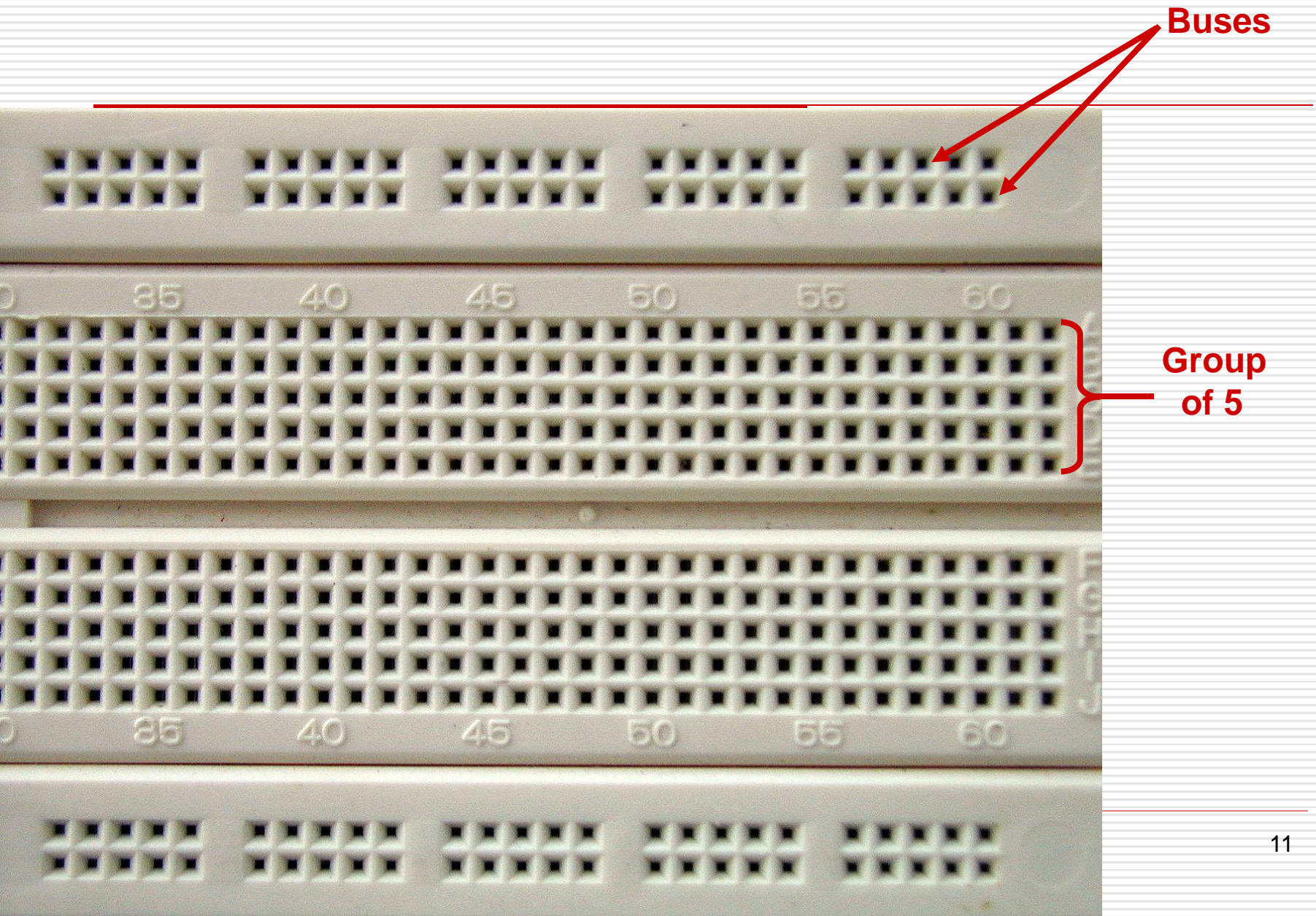
Why Breadboard?

- ❑ 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.
- ❑ As a complement to circuit simulation, breadboarding allows designers to observe how, and if, the actual circuit functions.

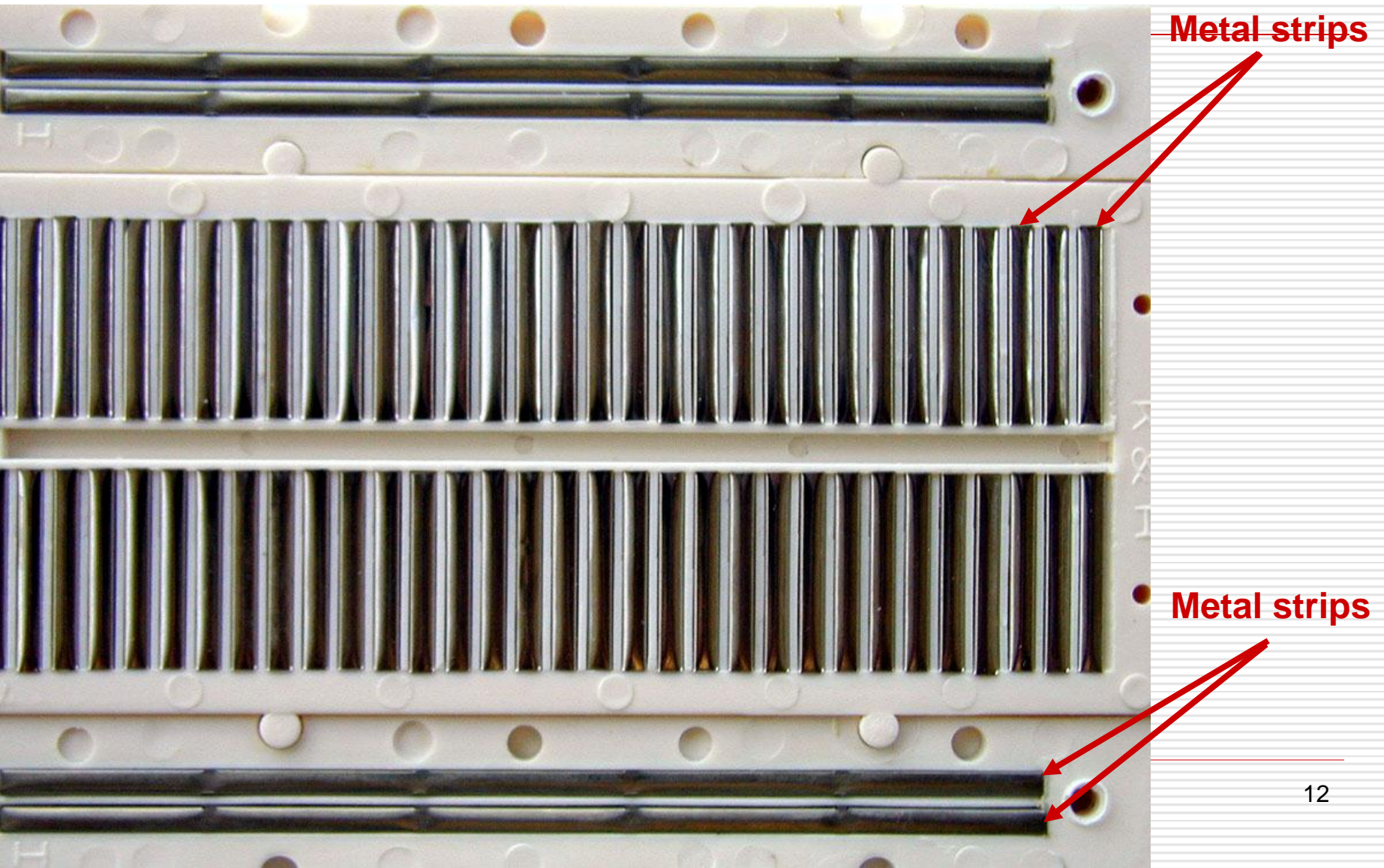
Why Breadboard?...

- ❑ Breadboards give designers the ability to quickly change components during development and testing, such as swapping resistors or capacitors of different values.
- ❑ Breadboards allow designers to easily modify a circuit to facilitate measurements of voltage, current, or resistance.

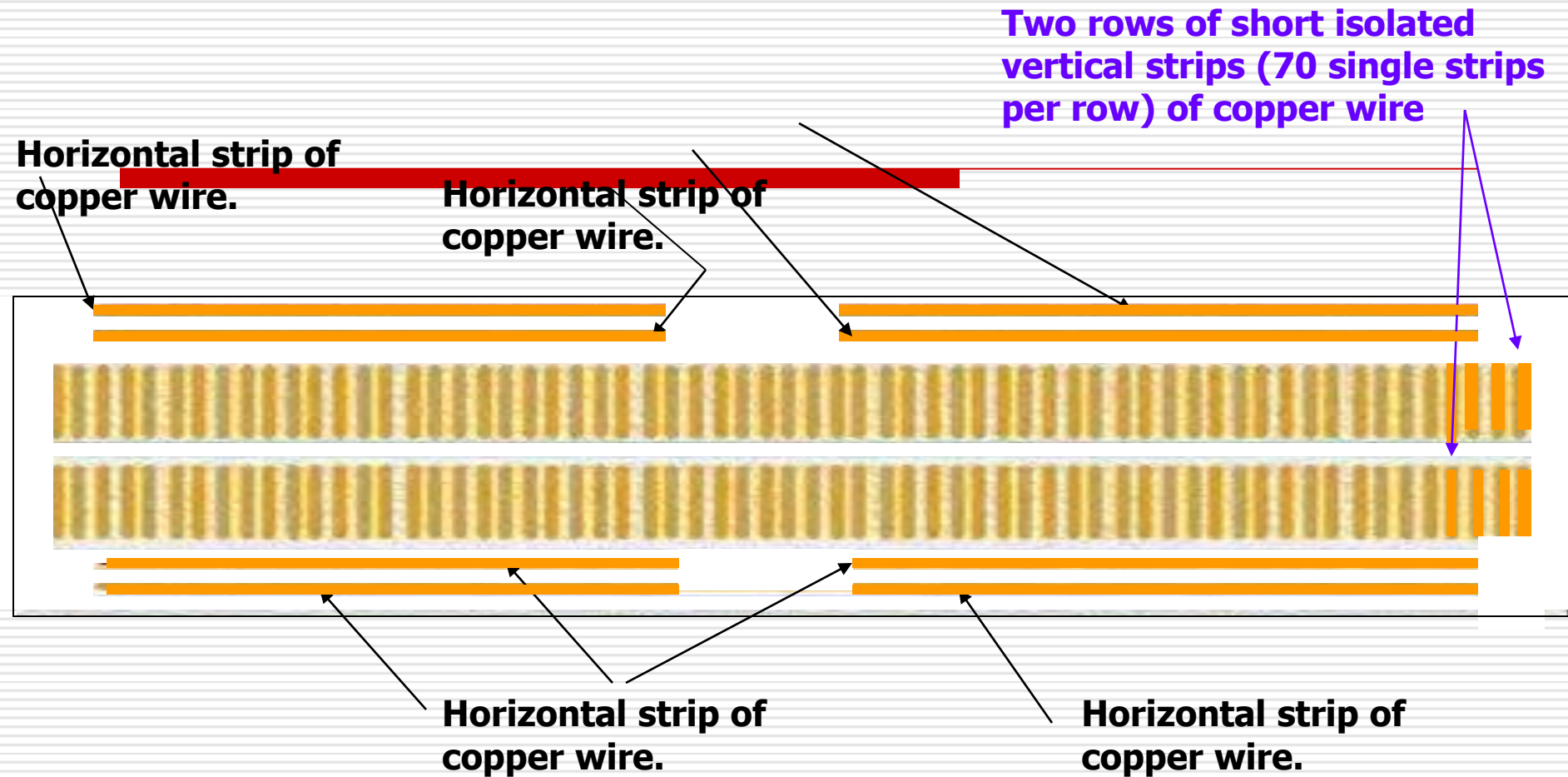
The front side of a breadboard



The back side of a breadboard

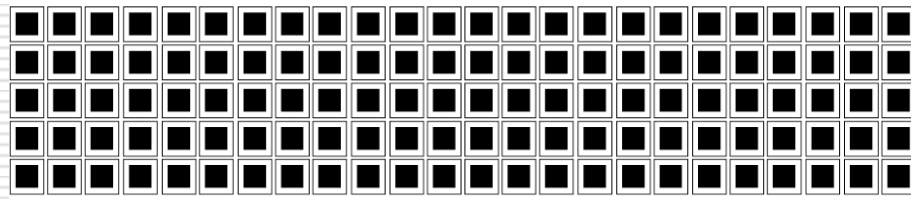
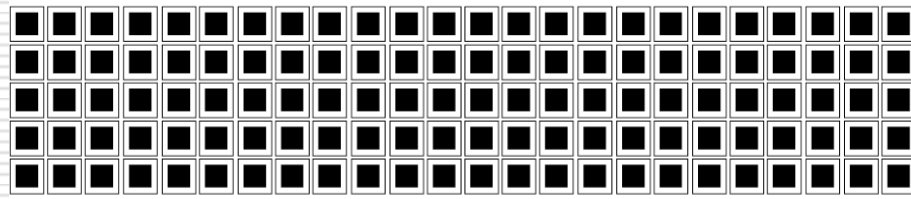


What You Don't See



Four separate buses and 48 separate groups of 5 are shown here.

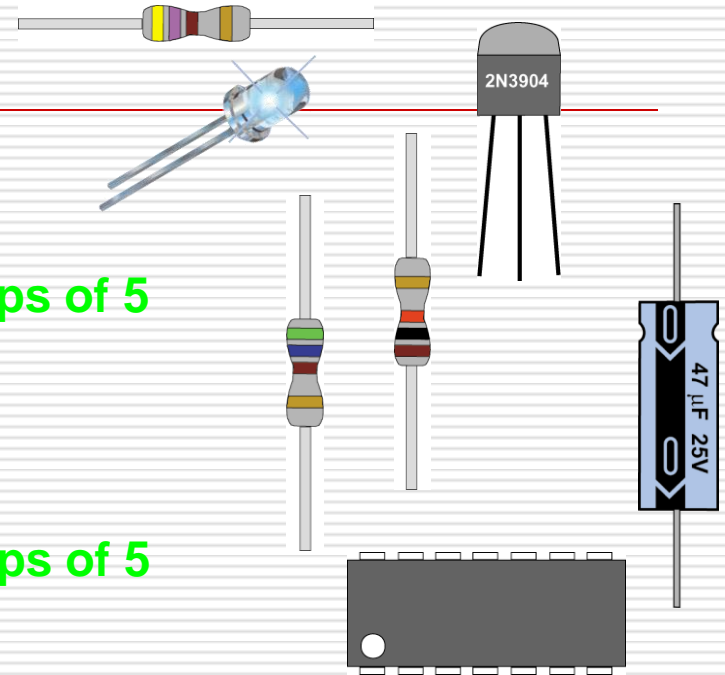
Buses



Buses

Groups of 5

Groups of 5



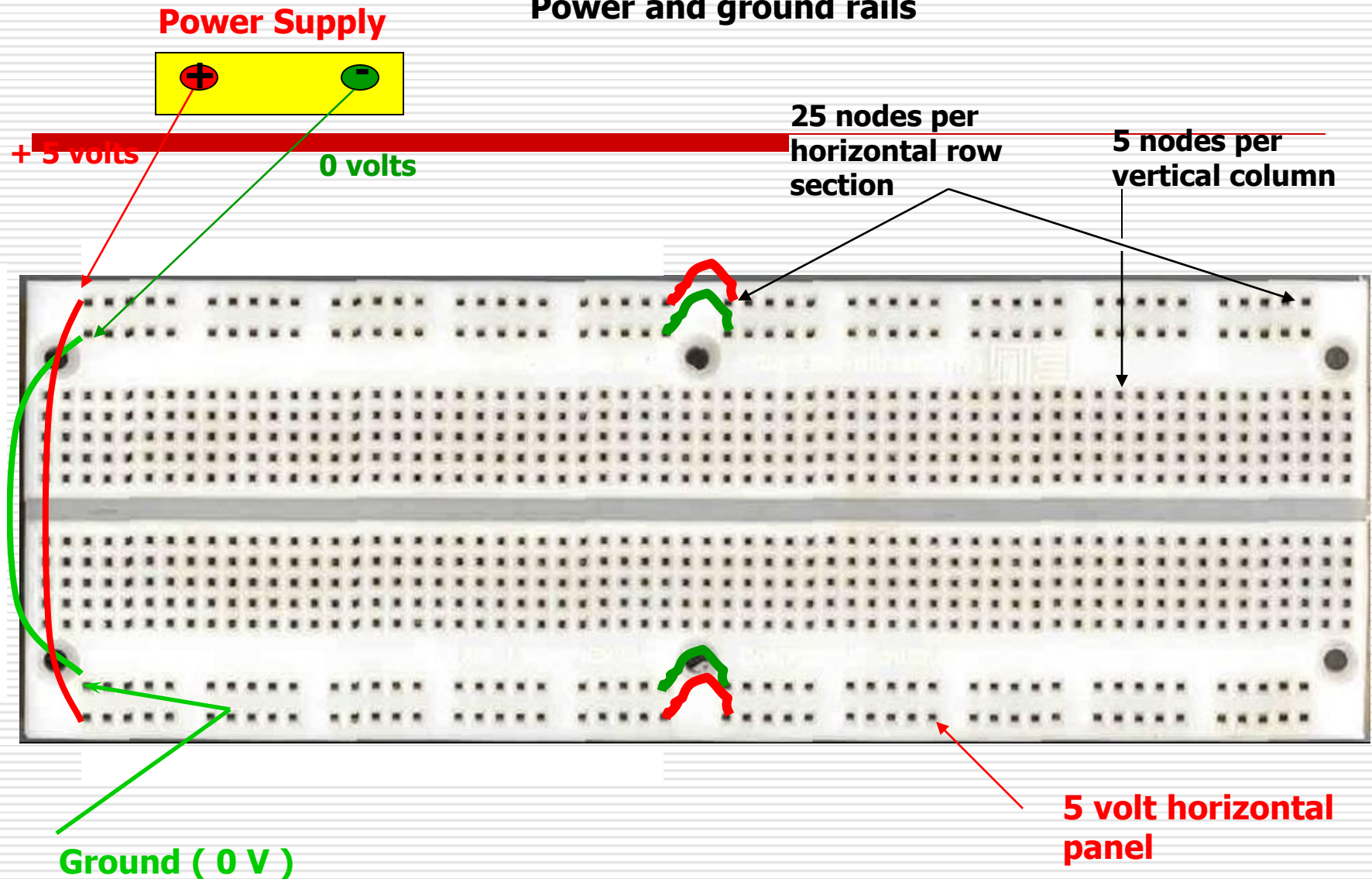
Many components have compatible leads.



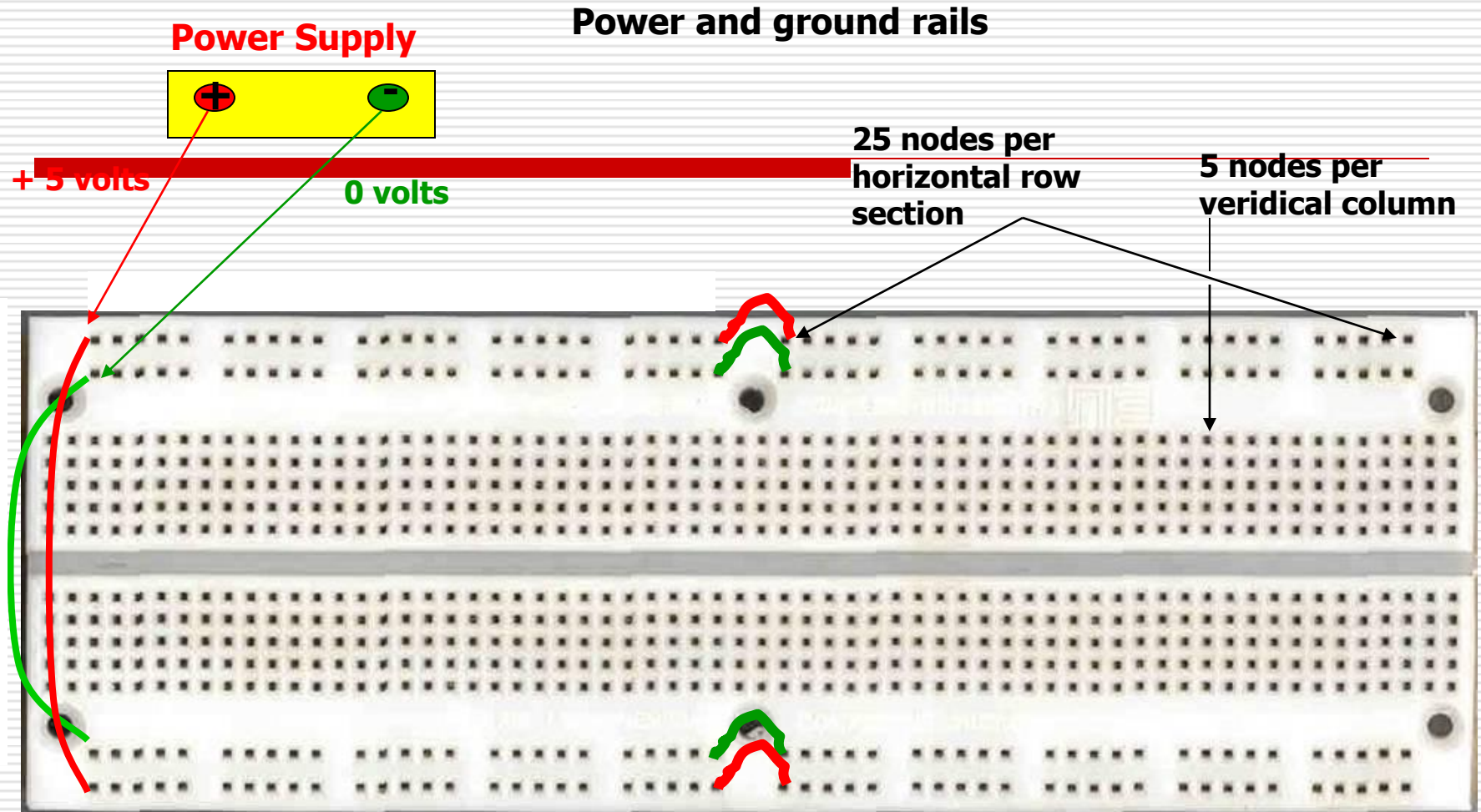
Strip #22 solid wire 1/4 inch to 3/8 inch on each end.

The Breadboard

Power and ground rails



The Breadboard

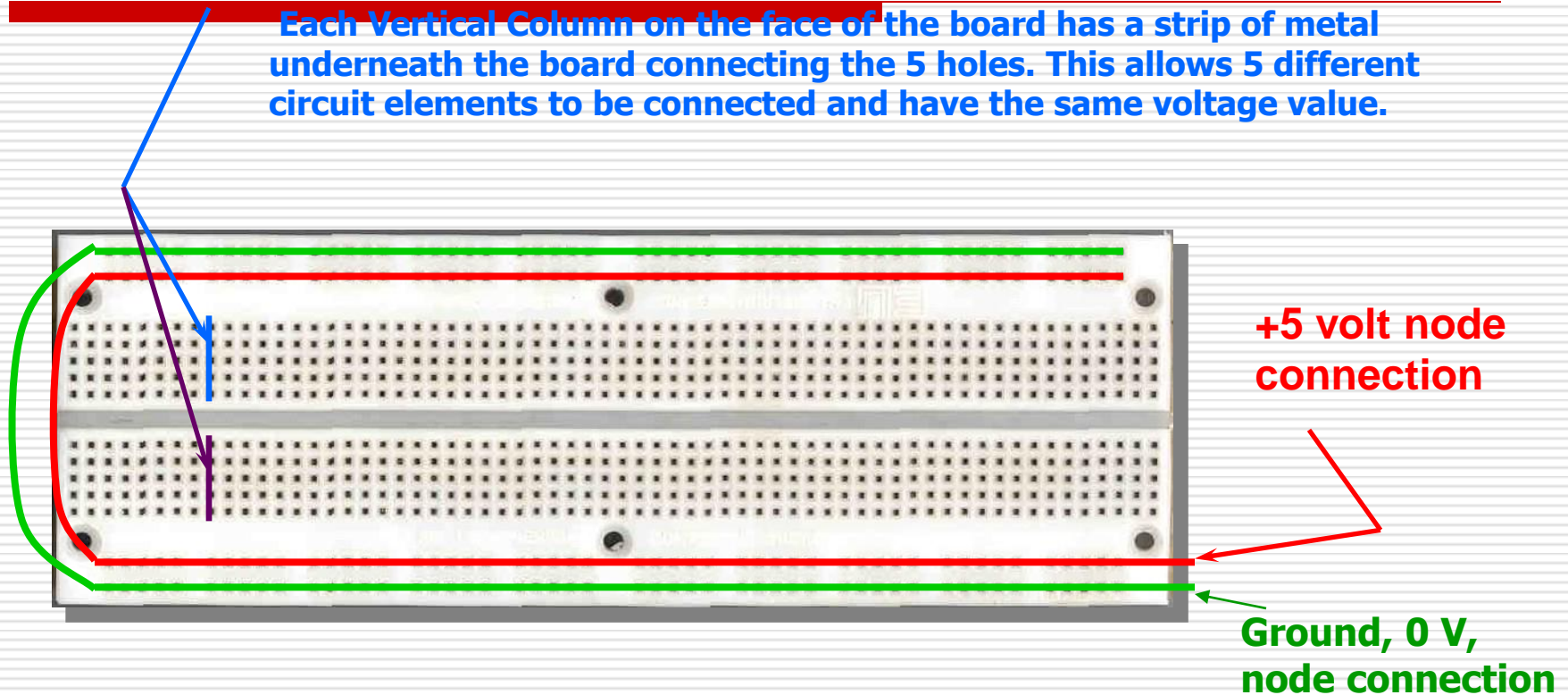


A node is a point where two components of a circuit can be connected.

The Breadboard

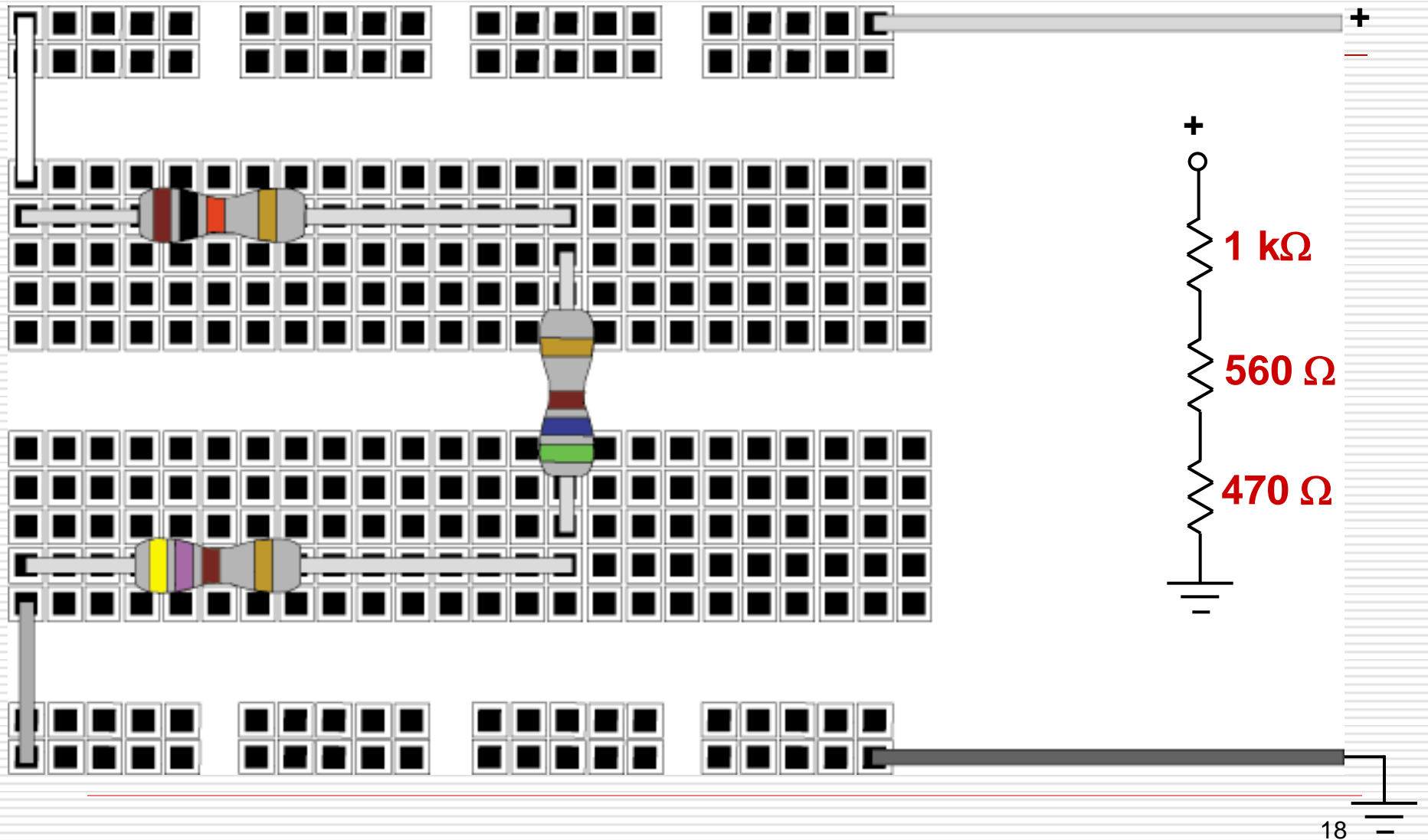
Vertical Column (5 Node) :

Each Vertical Column on the face of the board has a strip of metal underneath the board connecting the 5 holes. This allows 5 different circuit elements to be connected and have the same voltage value.

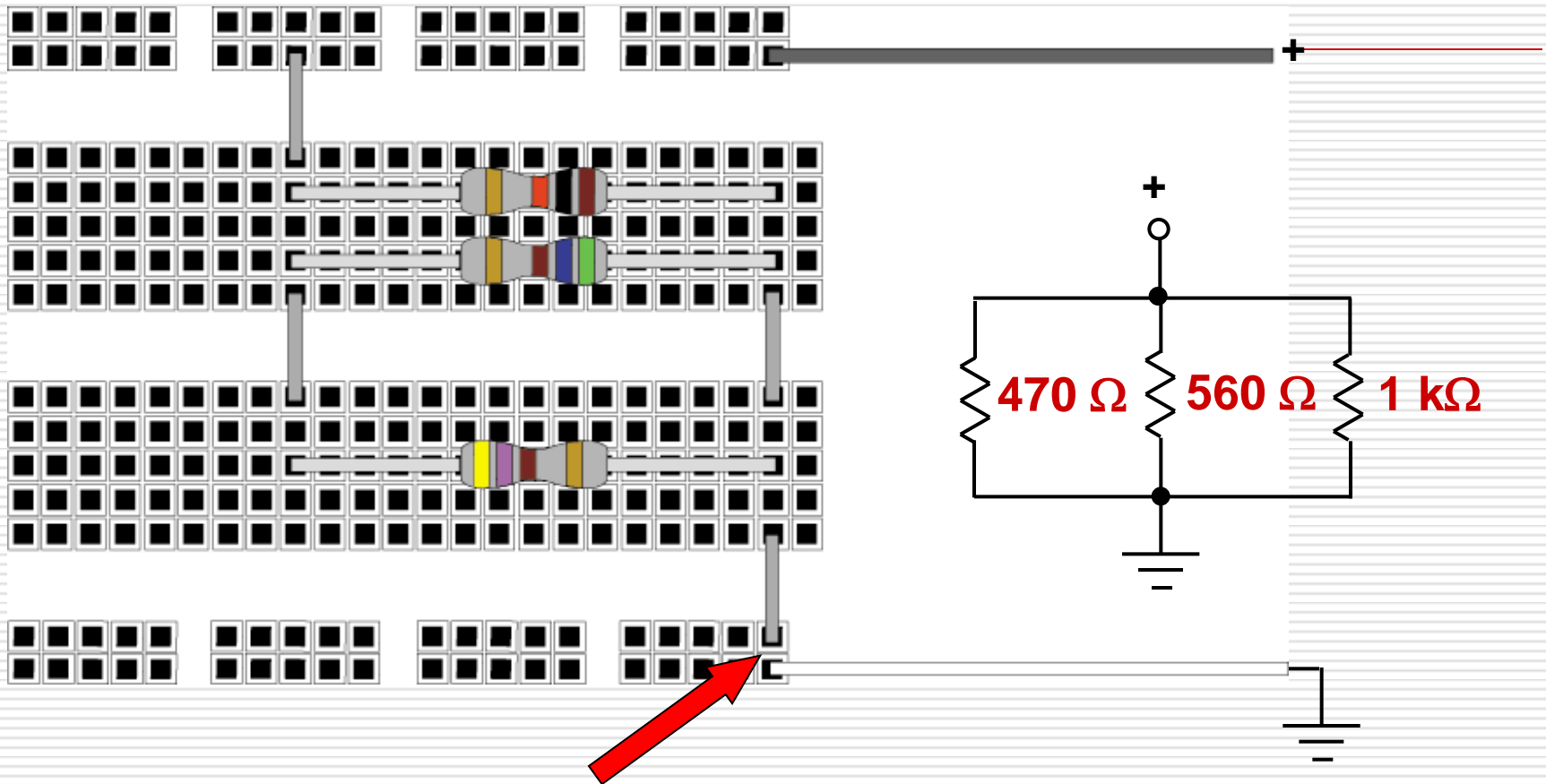


Each column of the breadboard is electrically isolated from its neighbor

Series circuit



Parallel circuit (with a common mistake)



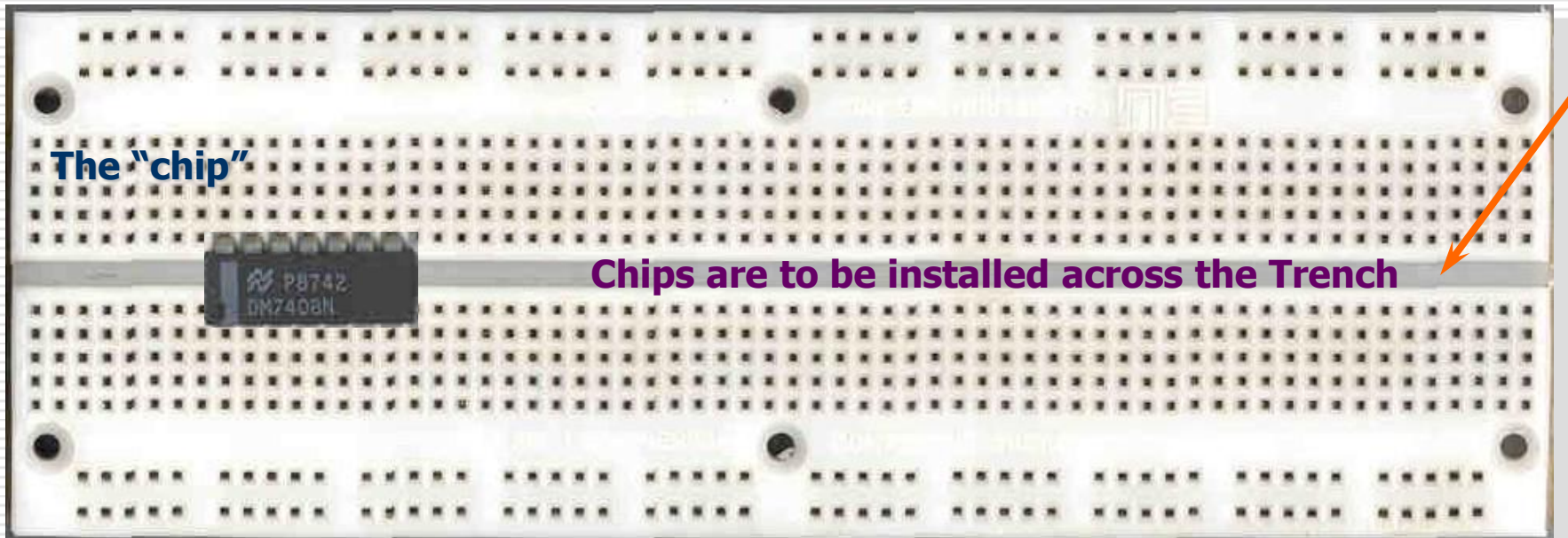
The Breadboard

The Trench

(A nonconductive groove which isolates 2 groups of vertical columns)

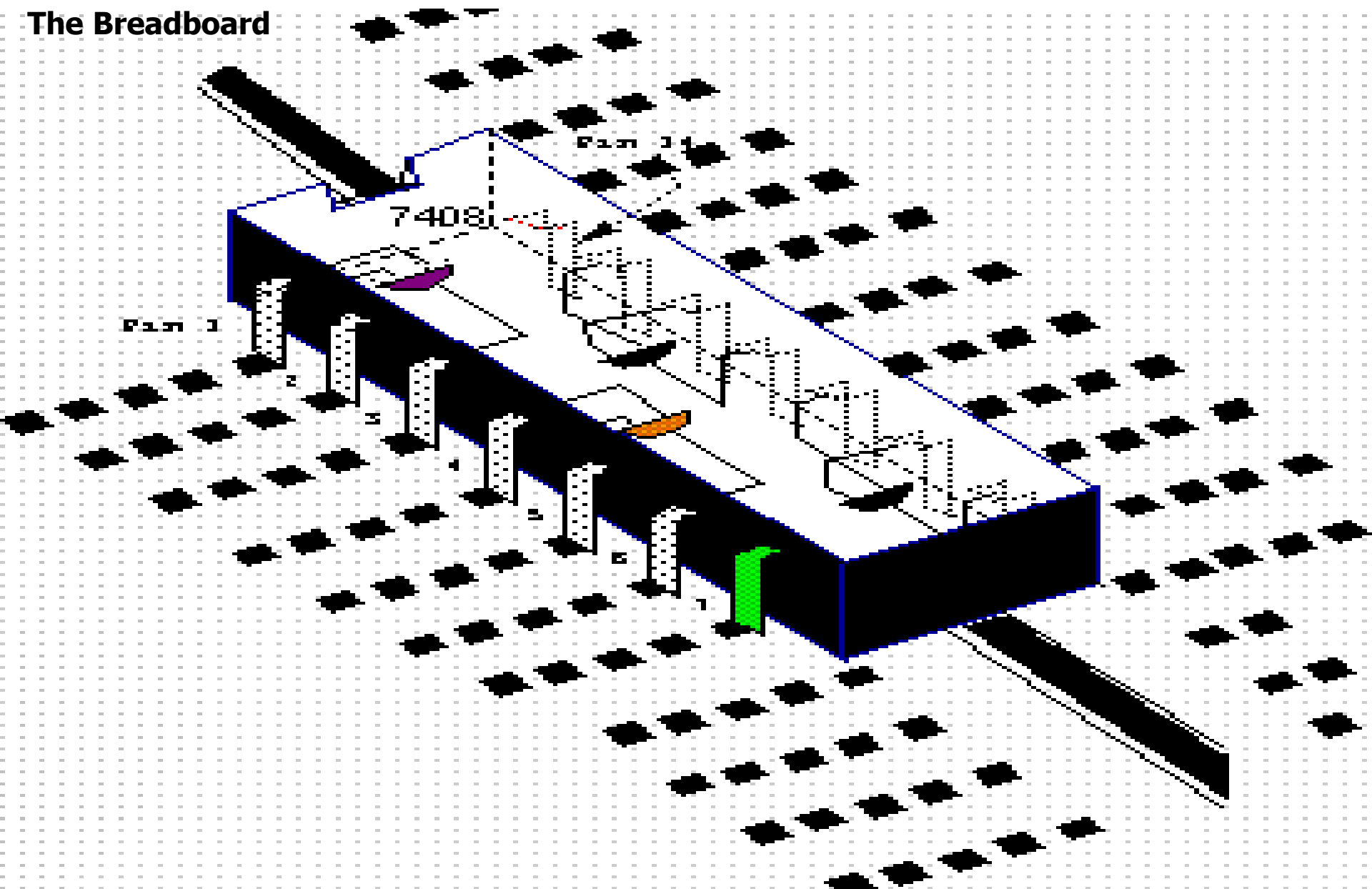
The "chip"

Chips are to be installed across the Trench



In this case, the chip is called a 7408 and it houses four AND logic devices.

The Breadboard

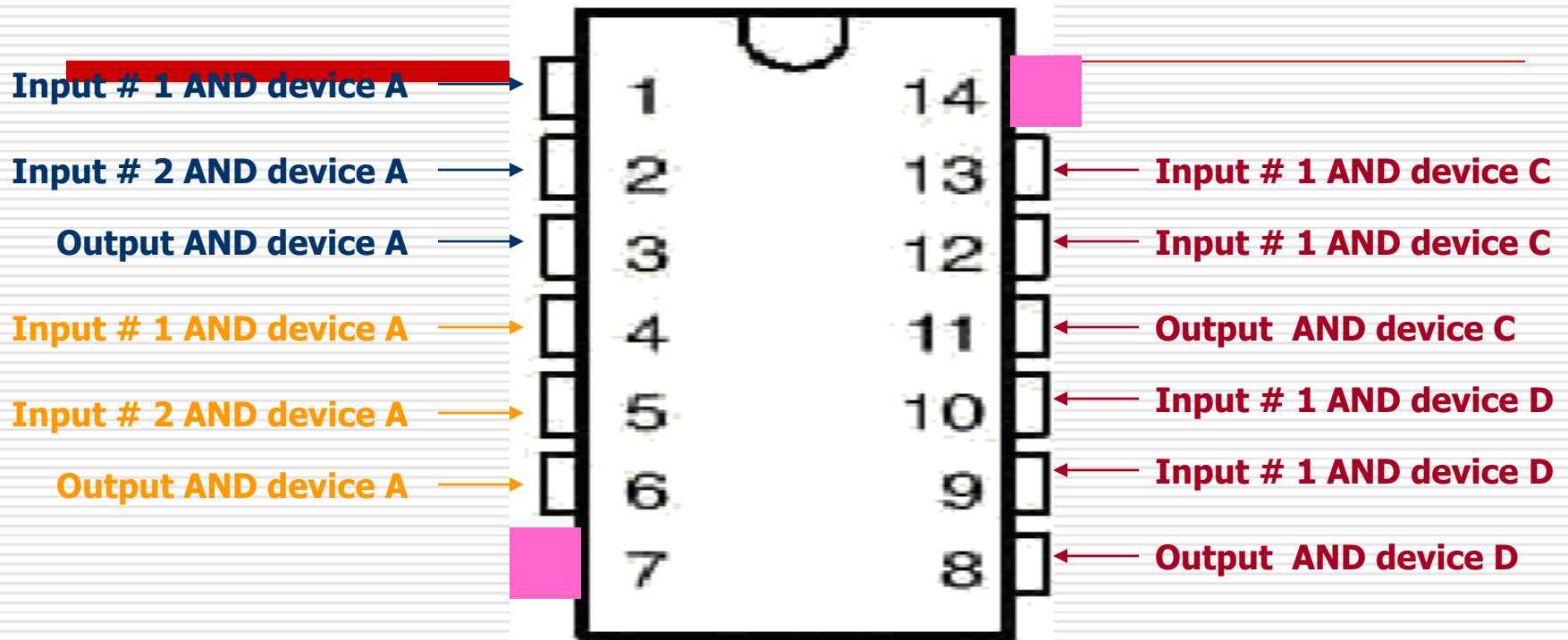


The chip with the identification number 7408 is always a chip that contains AND devices. **How many AND devices are in a 7408 chip?**

The Breadboard

In order to perform its function each chip must have a connection to the Power (5V) and to the Ground (0V)

What are the possible pins that could be used for the power and ground connection?



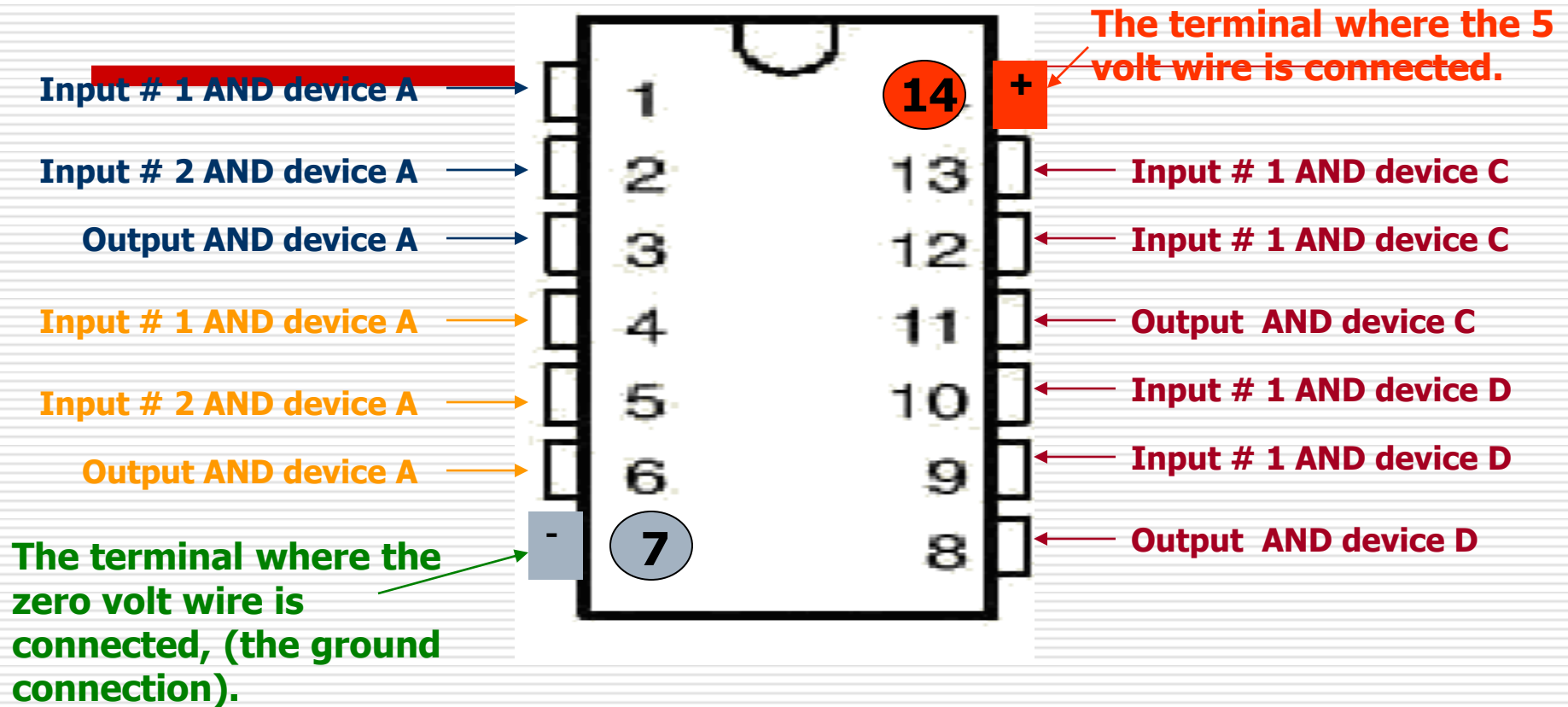
There are two pins left. One is for the power connection, the other is for the ground connection.

Which one goes to which pin?

The Breadboard

In order to perform its function each chip must have a connection to the Power (5V) and to the Ground (0V)

What are the possible pins that could be used for the power and ground connection?



The Breadboard

Where are the power and ground connections for this 7408?

Which one is the pin where the 0 volts, the ground connection, is made?

Which pin is pin number 8?

Note:

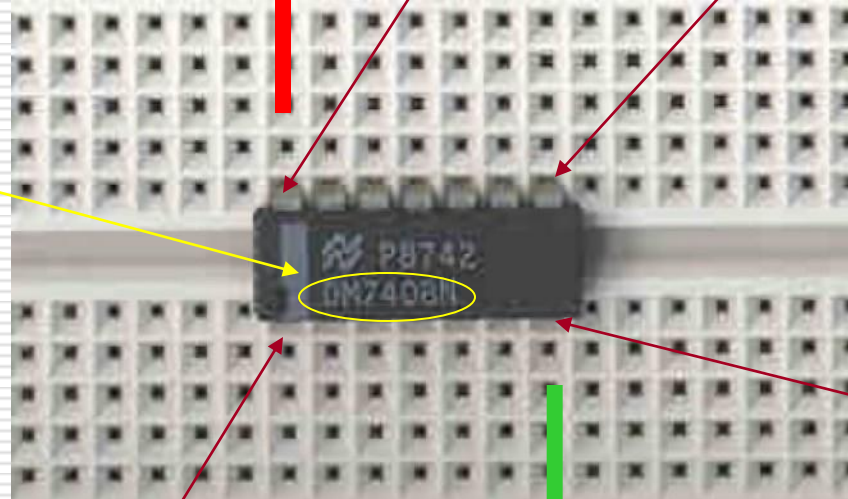
If you hold the chip so you can read the label "DM 7408N",

Then the 5 volt pin is the last pin on the left side of the top row of pins.

Power (+5 Volts)

Which pin is pin number 14?

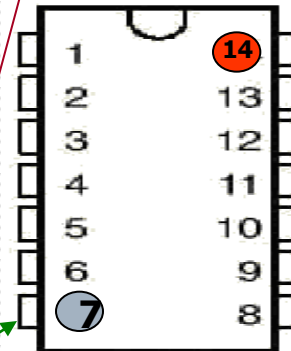
Which pin is pin number 7?



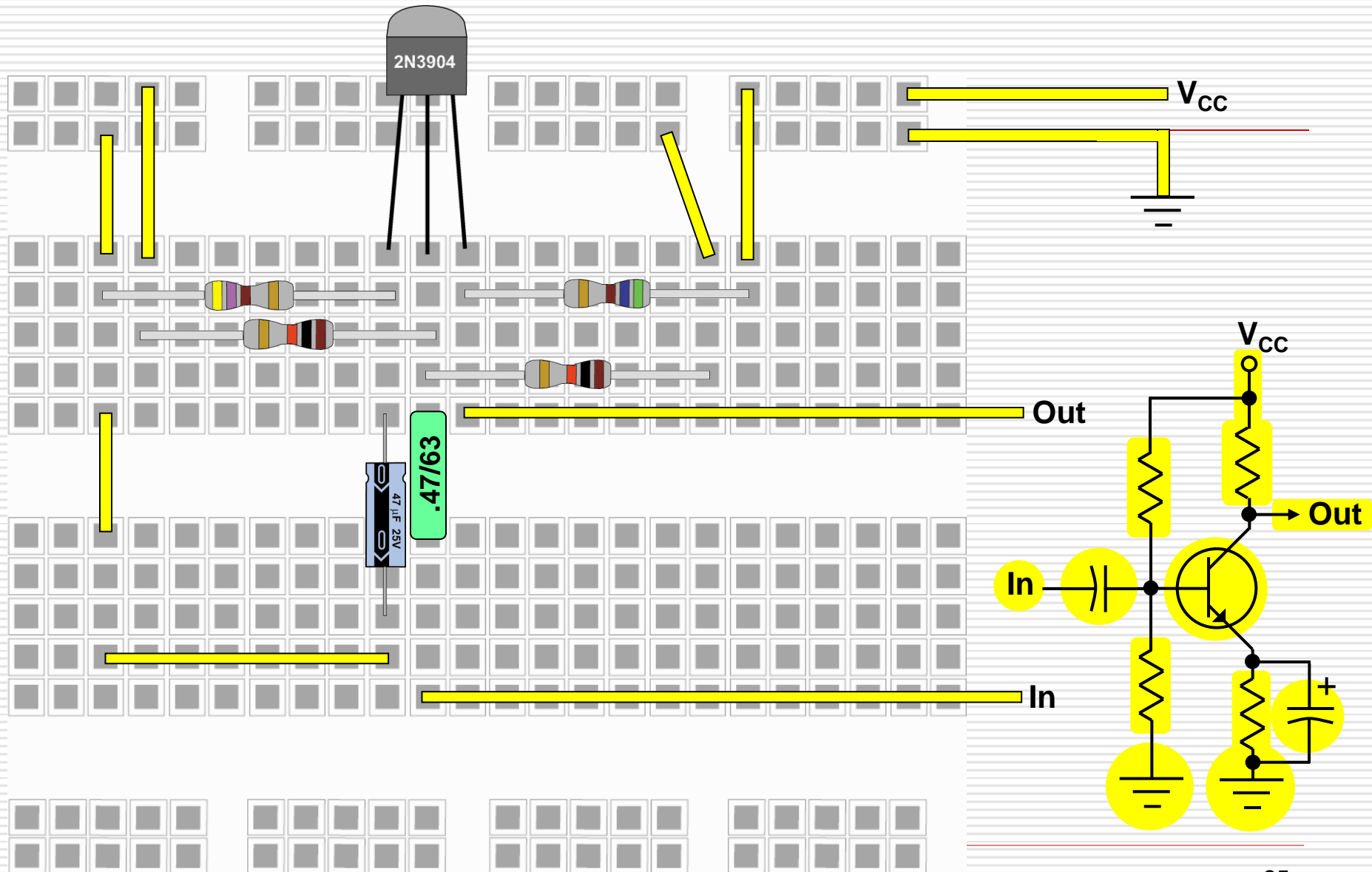
Which pin is pin number 1?



Ground (0 Volts)



Breadboarding a transistor amplifier

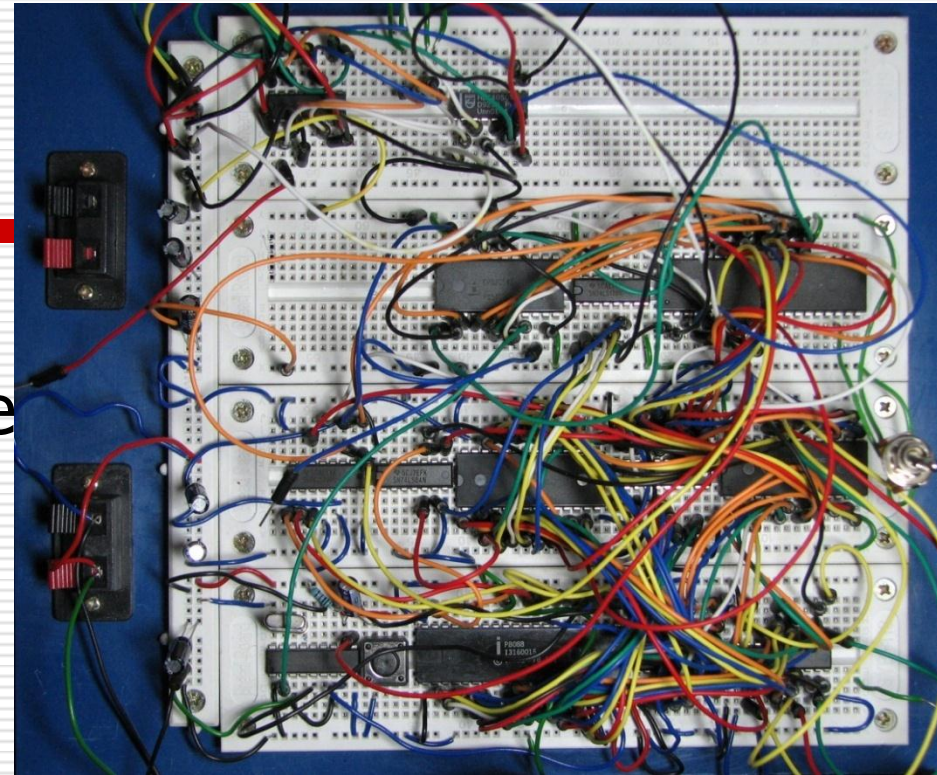


What is a PCB?

- ❑ PCB means Printed Circuit Board
- ❑ Connects circuit components through board
- ❑ Made of alternating layers of conducting and insulating materials

Why use a PCB?

- Features
 - Surprisingly Affordable
 - Highly reliable
 - Compact
 - rugged
 - Professional
- Drawbacks
 - Requires more layout than other board types
 - Higher initial cost



EDA Software

- Electronic design automation (EDA) is a category of software tools for designing electronic systems such as printed circuit boards.
- PCB design software package
 - Design the circuit (Schematics editor)
 - Place the components (PCB editor)
 - Route the wires (Autorouter module)
- Examples:
 - EAGLE
 - ExpressPCB

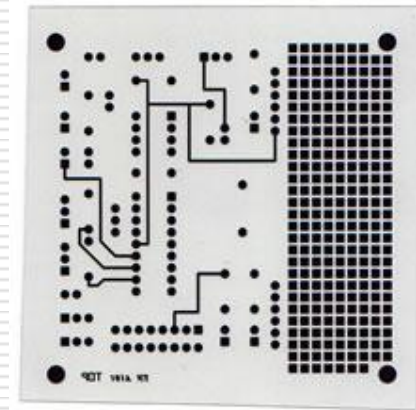
Steps in PCB design

1. Raw Material (Cu board)

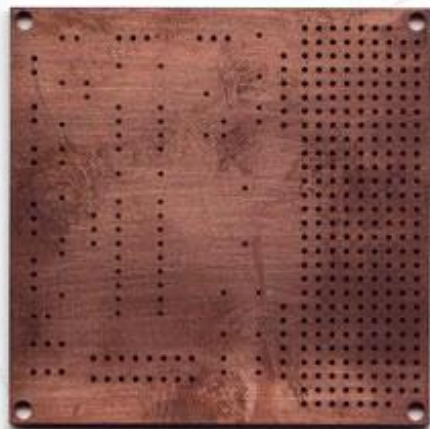


Industry
standard 0.059"
thick, copper
clad, two sides

2. Print PCB layout on Cu board

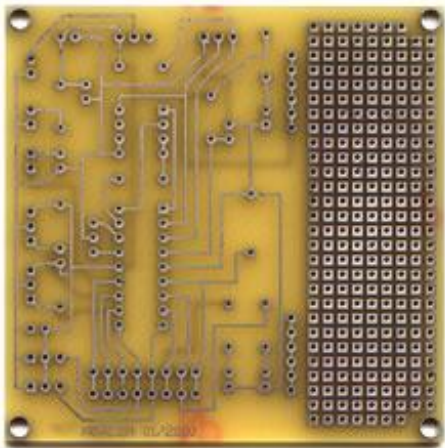


3. Drill Holes



Steps in PCB design...

4. Etch and dry

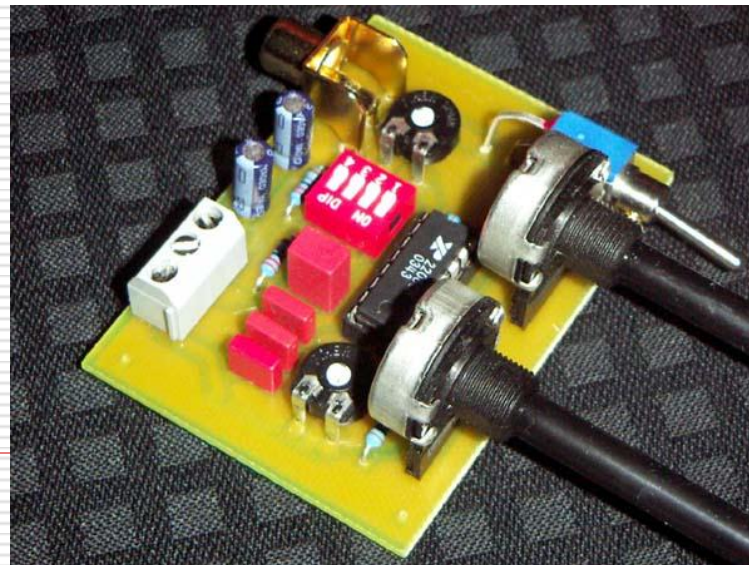
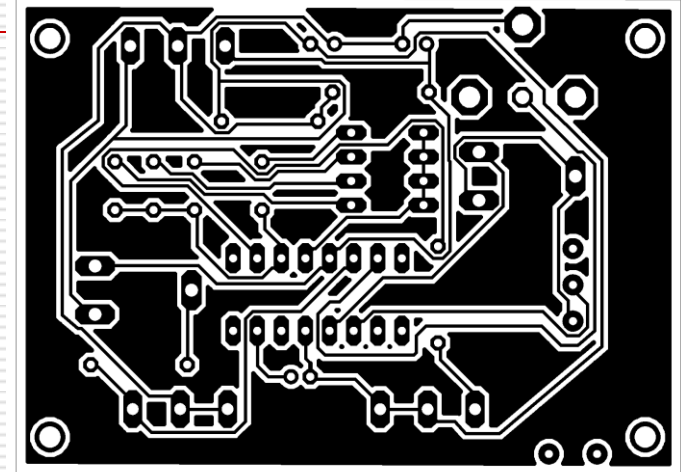
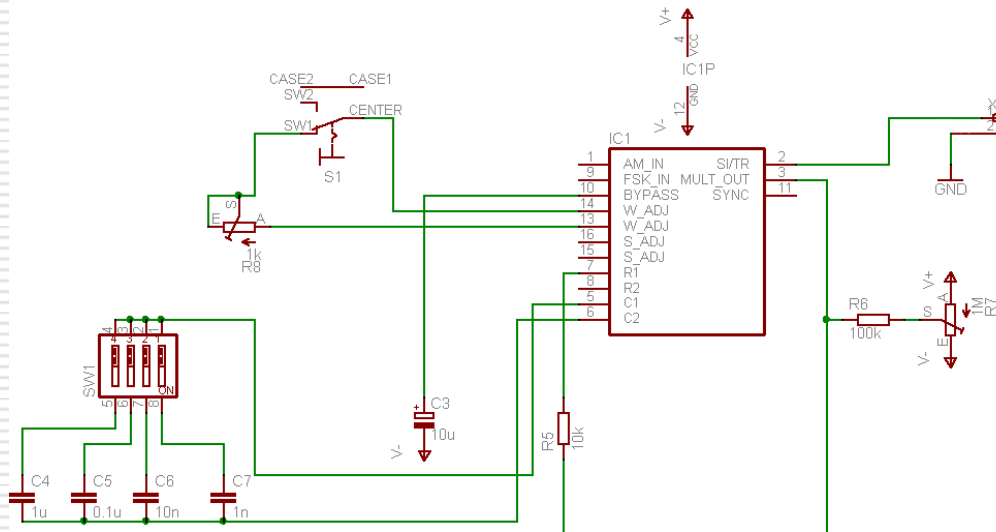


- FeCl_3 solution is used to etch Cu

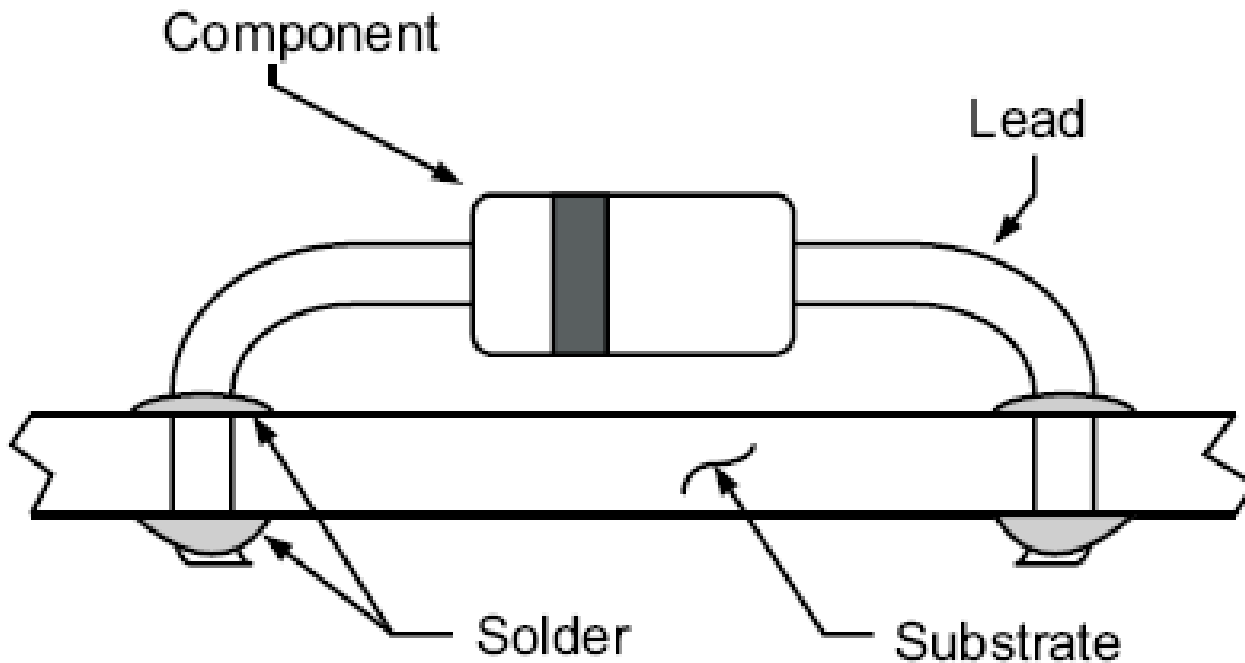
5. Place components and Solder



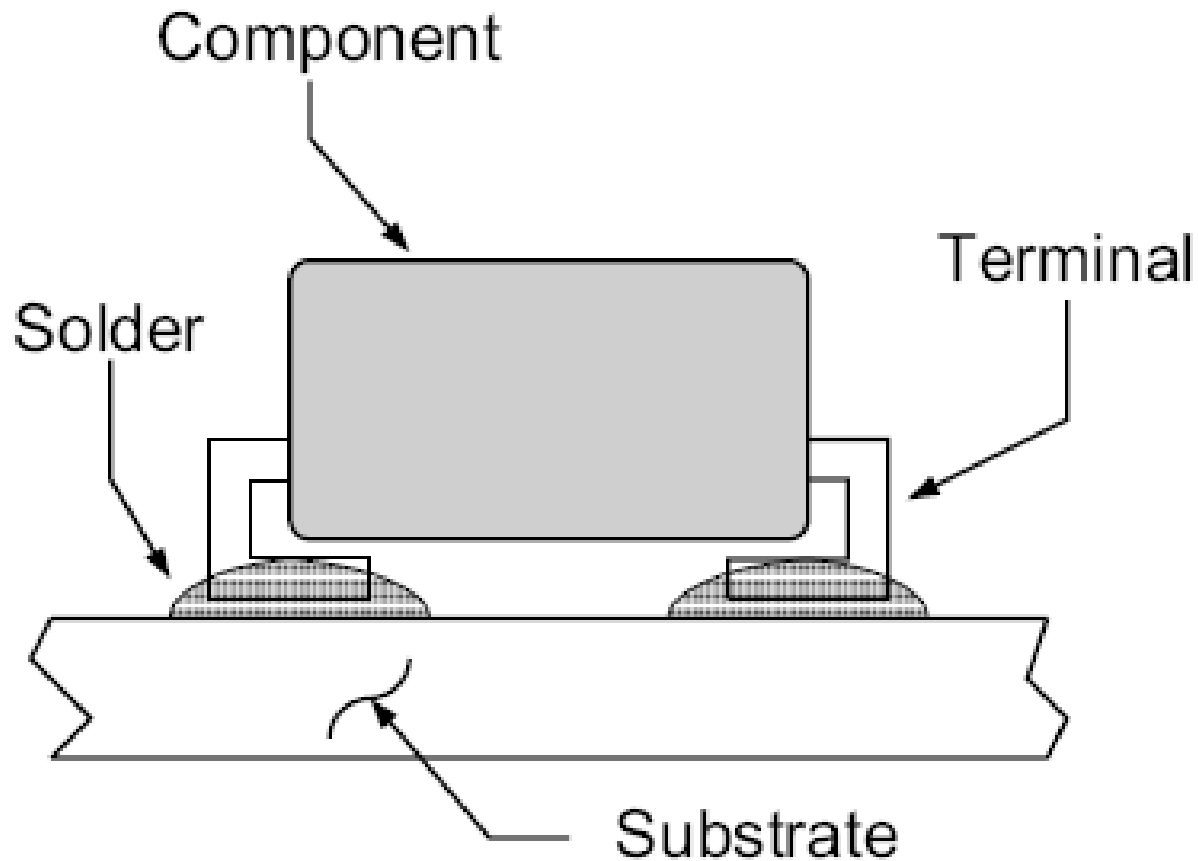
Example of PCB Design



Solder: Through-Hole Components



Solder: Surface-Mount Component



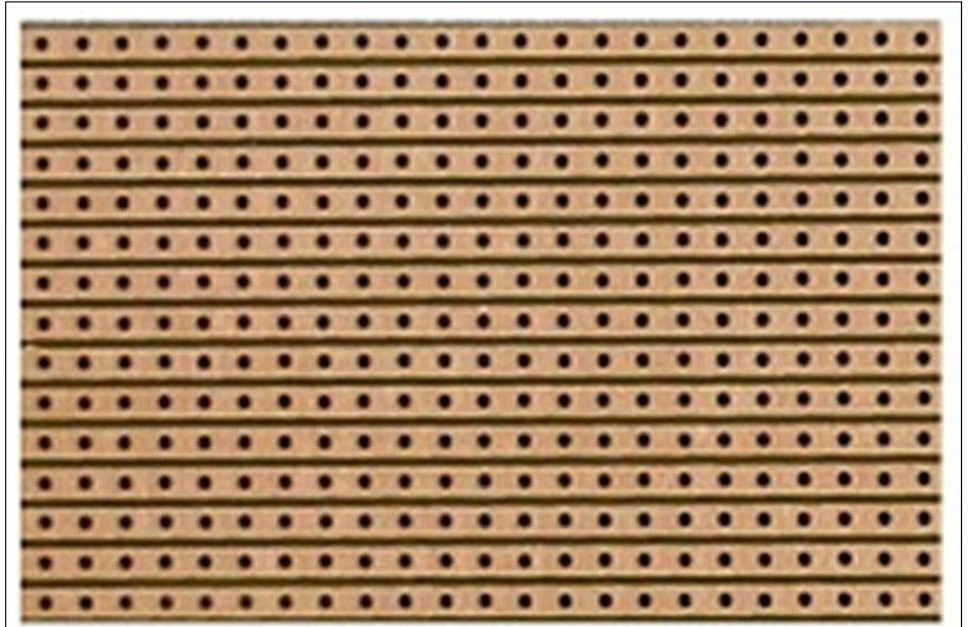
Through-Hole vs. Surface Mount



- ❑ SMT technology is newer.
- ❑ SMT components are much smaller.
- ❑ Through-Hole still used for
 - High-Force Connectors
 - High-Current and “Big” Parts

Veroboard

- ❑ Veroboard is a brand of stripboard, a pre-formed circuit board material of copper strips on an insulating board.
- ❑ Alternate of PCB.



What we have to do?

1. Make a group with two members.
2. Write your propose project name and description (circuit diagram with components name and possible outcome) on a A4 size page with you and your partners name & ID. Write at least three project names.
3. After project selection, do the necessary steps up to breadboard implementation.

What we have to do...

4. Goes for PCB implementation.
5. Submit your project with a report. Report must contain objectives, required parts, circuit diagrams, operating principles, simulation results, picture of your PCB implemented project, applications/discussion/conclusion.
6. Report will be discussed later in detail..
7. Finally wait for your result....

Timeline

Task	Weeks
Project choose	1-2
Simulation and breadboard implementation	5
Report writing and PCB implementation	3

Questions?

