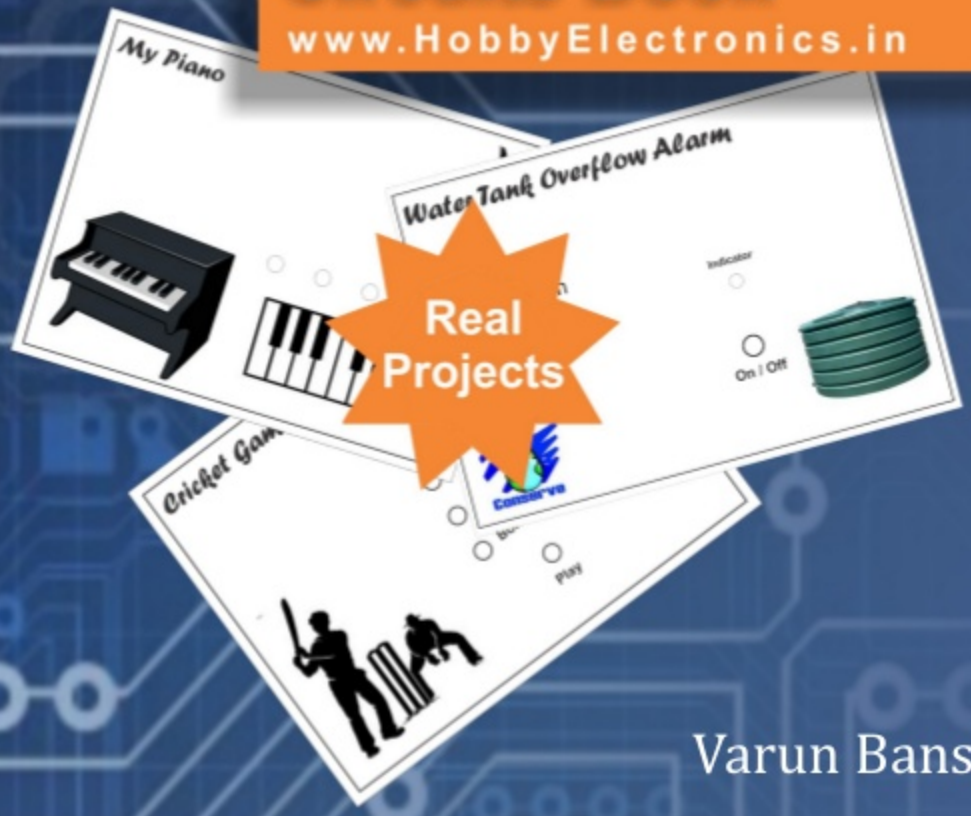
Revised Edition 3.1

Electronics Projects

Hobby Electronics
Student Projects & Kits
Made In India

Circuits Book

www.HobbyElectronics.in



Varun Bansal

How to use the book -

Know the basics—To start working with electronics circuits ad projects, one should be very well aware about all basic electronic components like Resistor, capacitors, transitors etc. It is important to know how the components behave when they are connected in a closed circuitfor example—The purpose of a capacitor is to store charge and once charged capacitors cut off current supply through them. It is also important to understand what voltages should be applied to different components and the direction these components should be connected. For example—capacitors have a maximum possible permisable voltage rating along with polarity written on them , for resistors polarity doesnt matter. For most of electronics components manufactured today a voltage of around 5 volt is sufficient.

Testing circuits—After a circuit is assembled the level of excitement rises to test it right away, but it is important to check the connections and start with correct voltage for a short time just to check if circuit is working correctly , If not you should disconnect battery as soon as possible because the reason of no output of circuit can be wrong connections and if its a case then it can damage the components of circuit.

Words of caution—Throughout this book I have mentioned the warnings whereever nessecary with a warning icon on the left side. Warning text are written where it is very essential to inform a hobbyist about the possibilities of harming the circuit components. For example in The LEDs Circuit section , It is important to use a resistor to prevent LED to get destryed by 4.8 or more voltage.

Ideas—In many circuits I have mentioned the ideas which were worth mentioning, There are some circuits which can be turned into useful projects . For eample the simple LED lights project can be used as a bedroom lamp.

Finally a project is worthless if it isnt portable and useful. And what makes a circuit useful is actually the cabinet. Which hides all the tiny sensitive componnets from user. In all professional systems circuits are first assembled in a printed circuit board (PCB) and then it is fitted in a cabinet, exposing the only needed controls to user. Though PCBs provide good platform to assemble circuit, they are not a good testing platform. There are problems working with PCB that you cant take out assemble components easily for replacements apart from this long contact with Soldering iron may damage sensitve components. Breadborad provides a perfect platform for testing circuits so we recommend using breadboard . For cabinet enclosure www.hobbyelectronics.com - MY Kit provdes a good option but you can also go for any other box if you not using MY Kit.

For more free circuits and projects please connect to www.hobbyelectronics.in and click on blog section.

A word for Students and Hobbyists -

As a hobbyist I had always struggled to buy the components what I needed for my circuits, i used to search local radio repair shops and used to visit old Lajpat Rai market opposite to red fort, old Delhi. 10 years back it was quite different situation, with less shops, very few online websites and nearly no online shopping site, Today things have changed and we have very good and rich online knowledge like blogs, sites and online shopping stores.

But some of the rules for shopping still remains the same. As For most of the basic components you should first search local radio shops And If you are from Delhi and around you can always find most of components from old Lajpat Rai market only some shopkeepers here are not interested in retail buyers as they are bulk dealers, So better to find shops which are selling retail.

If, However you want to buy online there are some options available. Just Google for electronics spares, There are sites which are selling spares and some selling complete kits also but i would recommend to start with basic and assemble your our circuits instead of using a ready made project.

By
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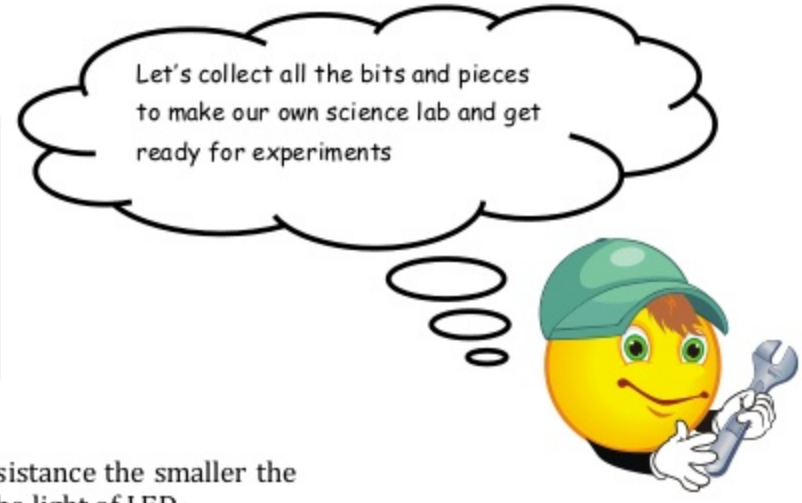
Basic Electronics Components



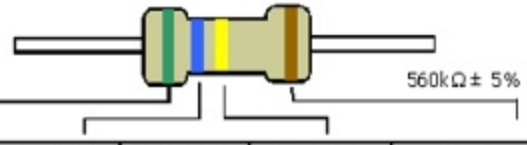
In this section we will see :

1. Resistor
2. LED
3. Electrolytic Capacitor
4. Ceramic Capacitor
5. Variable Resistance
6. Preset
7. Light Dependent Resistor
8. IC – Integrated Circuits
9. Thermistor
10. Transistor
11. Breadboard
12. Breadboard Wire

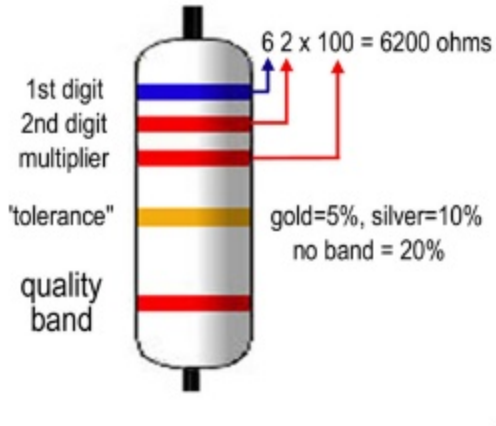
1. Resistor

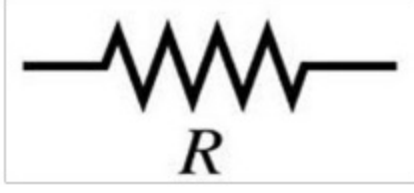
As name suggest it resists direct current in the circuit. The greater the resistance the smaller the current will be. For example—A resistance attached to a LED will dimmer the light of LED.

Resistances have a color coding scheme, you can calculate the value of it by just looking at color bands, This is because resistances are small and numbers can't be printed on them directly. In the right hand side figure, you can see the table showing all the colors and their values. Gold and silver color is present in every resistor to show its tolerance, Gold means that it value will be +/- 5% precise. For ex—A 100 ohm resistor with gold band means that it can be 105 ohm or can be 95 ohm also.

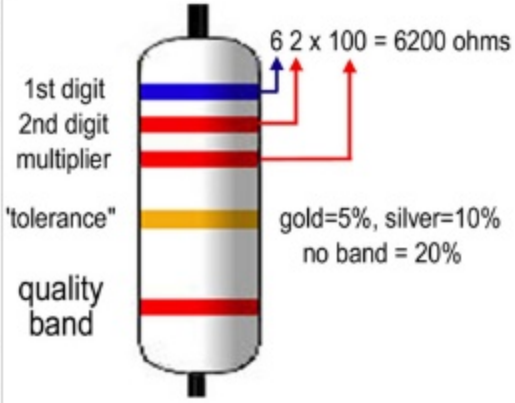


COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE	
Black	0	0	0	1Ω		
Brown	1	1	1	10Ω	± 1%	(F)
Red	2	2	2	100Ω	± 2%	(G)
Orange	3	3	3	1KΩ		
Yellow	4	4	4	10KΩ		
Green	5	5	5	100KΩ	±0.5%	(D)
Blue	6	6	6	1MΩ	±0.25%	(C)
Violet	7	7	7	10MΩ	±0.10%	(B)
Grey	8	8	8		±0.05%	
White	9	9	9			
Gold				0.1	± 5%	(J)
Silver				0.01	± 10%	(K)





Calculation of resistance : For calculation of resistance we need to read color from the opposite side of gold or silver band. Which means the first color should not be golden or silver. As you can see the figure on right side., the first color is blue whose number is 6, second is red whose number is 2 and third is also red whose multiplier is two zeros (remember last color number is always multiplied), forth is gold and we don't include gold in calculation. So the resistance would be -
Blue (6) , red (2) and red (100) = 6200 ohm, quiet easy isn't it?



2. LED—Light Emitting Diode

A light-emitting diode (LED) is a semiconductor light source. It is same as a diode we have discussed earlier, It passes current only when connected in right direction (positive of diode to positive of battery and negative to negative) and do not pass any current when connected in opposite direction, with only difference that when it passes current it also emits light with it.

LED Symbol

A LED – Light Emitting Diode

Warning:
while connecting LED to a battery, the voltage should not exceed to 4.5 volts, if you are using 4 cells = 6volt battery, Add a 100 ohms resistance to bring down voltage. LED are sensitive to voltage and high voltage can damage it permanently. In simple words, never connect a LED directly to power supply.

3. Electrolytic Capacitor

A capacitor (originally known as condenser) is a passive two-terminal electrical component used to store energy in an electric field. When there is a potential difference (voltage) across the conductors, a static electric field develops across the dielectric, causing positive charge to collect on one plate and negative charge on the other plate.
In simple words it stores electricity and is polar in nature (means positive terminal of this capacitor should be connected to the positive of battery and negative to negative)
Capacitance is measured in microfarads (µf) and a voltage is written on capacitors which tell the maximum voltage this capacitor can handle. If you see in the figure right hand side, The capacitor is of 15 µf and can handle a voltage of 400 v.

Capacitor Symbol

An Electrolytic Capacitor

4. Ceramic Capacitor

It is same as electrolytic capacitor and stores electricity with the only difference that it is not polar and can be connected in any direction. ceramic capacitors are generally available in smaller values, smaller then 1microfarad (µf), whereas electrolytic capacitors are available in values greater than 1 microfarad

Symbol of Ceramic Capacitor

Ceramic Capacitor

5. Potentiometer or Variable Resistance

It is a resistance with a knob to increase or decrease the resistance. When the spindle is rotated to a direction it will increase the resistance and when it rotated to another direction the resistance decreases. **Use only two pins - middle pin and one pin from either side for circuit making.**

Symbol for preset or variable resistance

A Variable Resistance

6. Preset

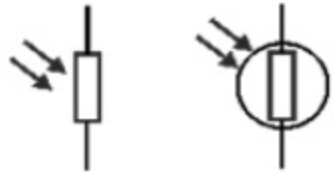
These are miniature versions of the standard variable resistor. They are designed to be mounted directly onto the circuit board and adjusted only when the circuit is built.

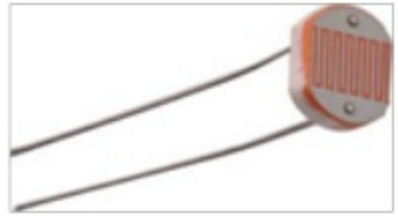
A Preset (same as variable resistance)

7. Light Dependent Resistance

A Photo resistor or Light Dependent Resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity. When Light falls on it, Its resistance becomes low and in dark its resistance is high.

Two possible symbols of the Light Dependent Resistance

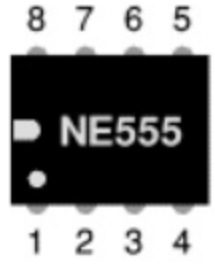




A Light Dependent Resistance

8. IC – Integrated Circuits

Integrated Circuits are usually called ICs or chips. They are complex circuits which have been etched onto tiny chips of semiconductor (silicon).
The pins are numbered anti-clockwise around the IC (chip) starting near the notch or dot. The diagram shows the numbering for 8-pin and 14-pin ICs, but the principle is the same for all sizes.

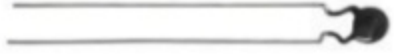


The most popular 555 timer IC

Warning: ICs are sensitive to voltages and wrong connections can damage them permanently.

9. Thermistor

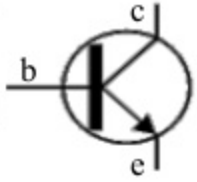
A thermistor is a type of resistor whose resistance varies significantly with temperature. When heated, its resistance gets small, when cooled its resistance increases.

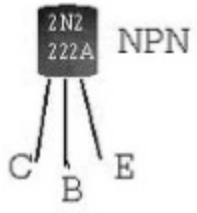


A Thermistor and its symbol

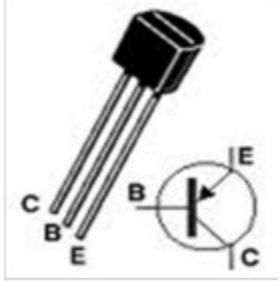
10. Transistor

A transistor is a semiconductor device used to amplify and switch electronic signals and electrical power. It is composed of semiconductor material with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals changes the current flowing through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal.





NPN transistor – E-emitter, B-base, C - collector



PNP transistor

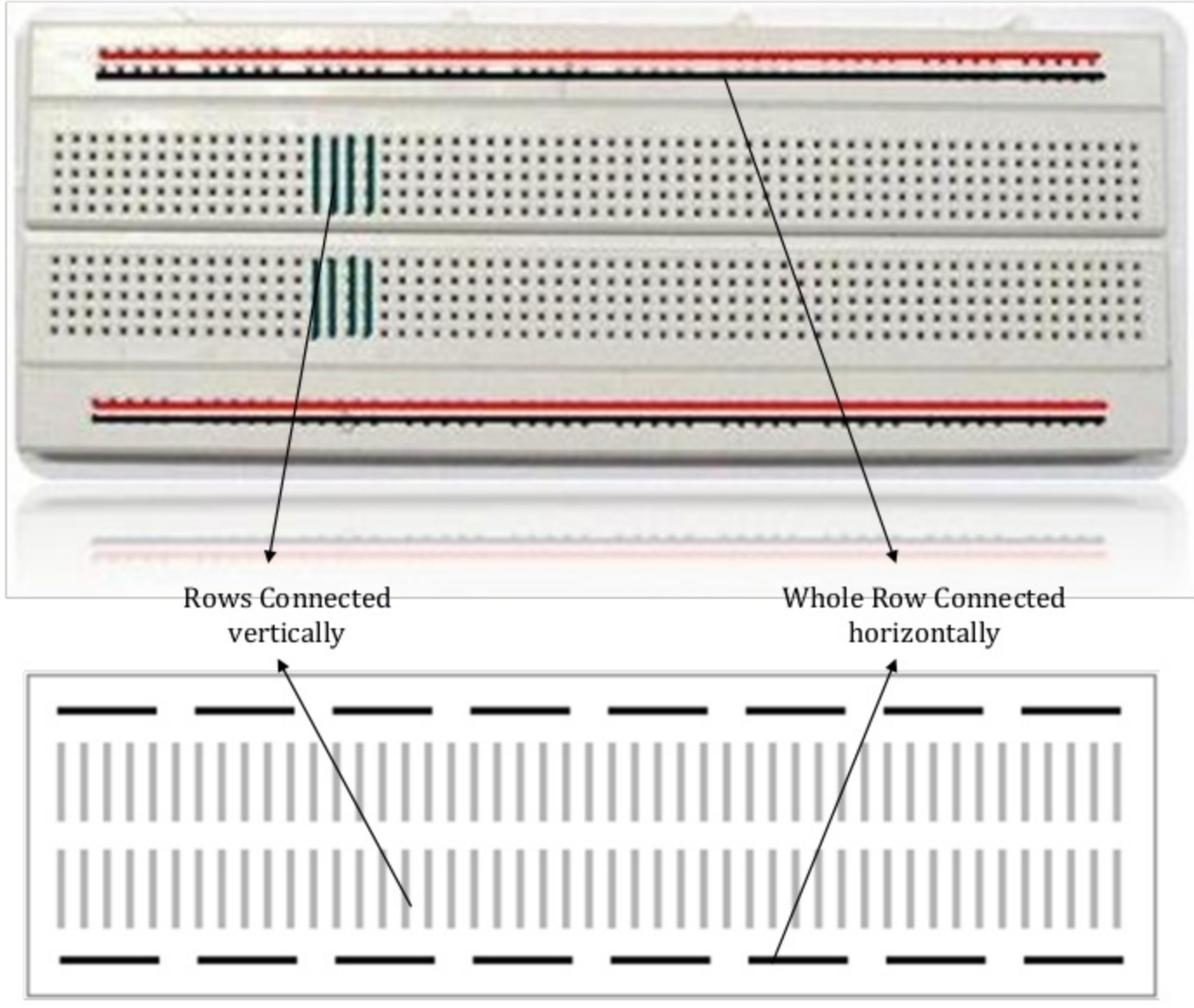
Caution: Transistors should be correctly connected or a wrong connection may damage transistor.

11. Breadboard

Using breadboard to design a circuit is the easiest and safest way. It not only protects you from warm soldering temperatures and smoke but it also protect the circuit components from being damaged by high temperatures.
It provides a fastest method of making a circuit and you can experiment with circuits by changing joints quickly and easily.

Connections

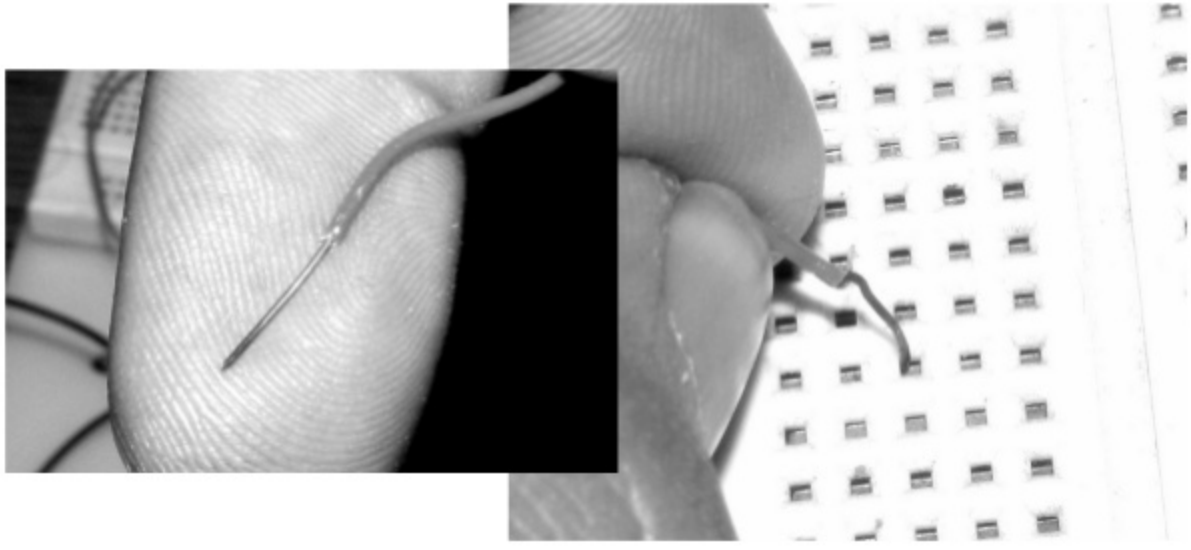
The figure on right side is showing the internal pins connections of a breadboard. The holes in the middle portion of board are connected vertically as shown by highlighted lines. The outer two rows of holes are connected horizontally as shown by red/black lines in the figure.



Internal Wiring Diagram of a Breadboard

12. Breadboard Wire

The best wire for breadboard is single core (Only one thick wire with insulting sleeve) copper wire, Please refer the picture below. Its not so tough to find this wire, mostly telephone wires and LAN wires are single core

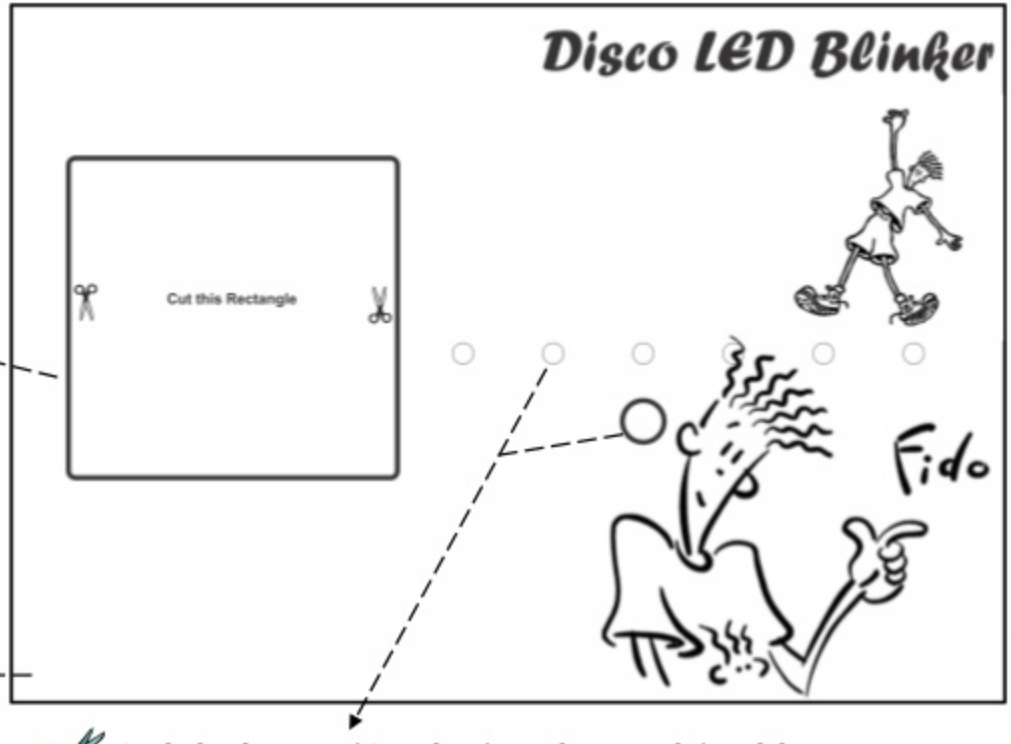


Working with paper panels

Paper panels are included in this book as drawings with each circuit. You can print them with printer or you can make your own panel

You can cut the paper if you want your viewers to see your circuit, this will decrease there curiosity and it will help them understand the working of your project.

Cut the holes for nuts. Just make a plus sign by paper cutting blade.



Cut holes for LEDs/ Switches/ Regulator Knob/ Push buttons etc as required by circuit.

What is a Paper Panel?

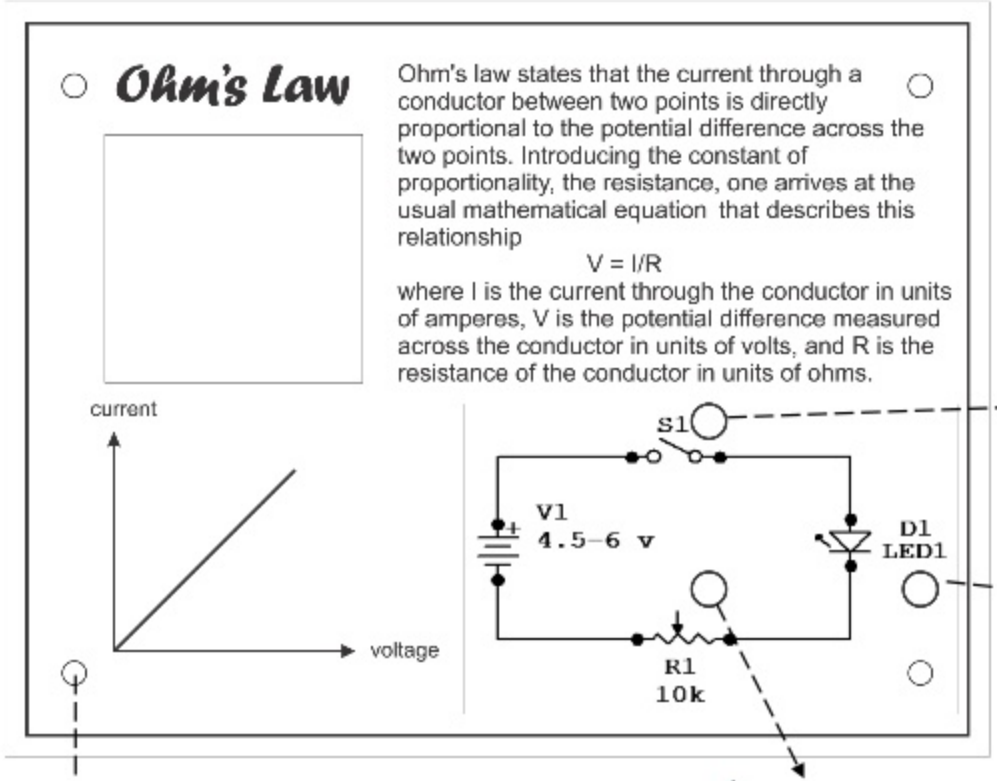
A Paper panel is a interface for viewers, as like every control panel of any equipment, It should be attractive, informative and easy to understand. It should describe your project very well. Now you can be more casual if you are making your project for fun or more serious and descriptive if you are making your project from a science fair.

<— A casual panel

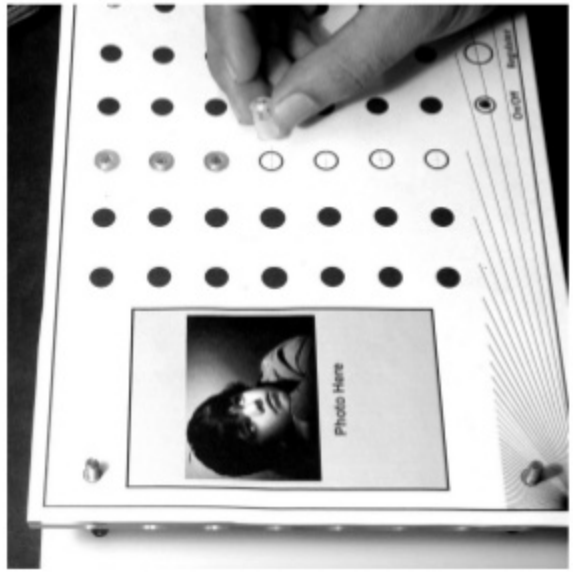
Learn with fun

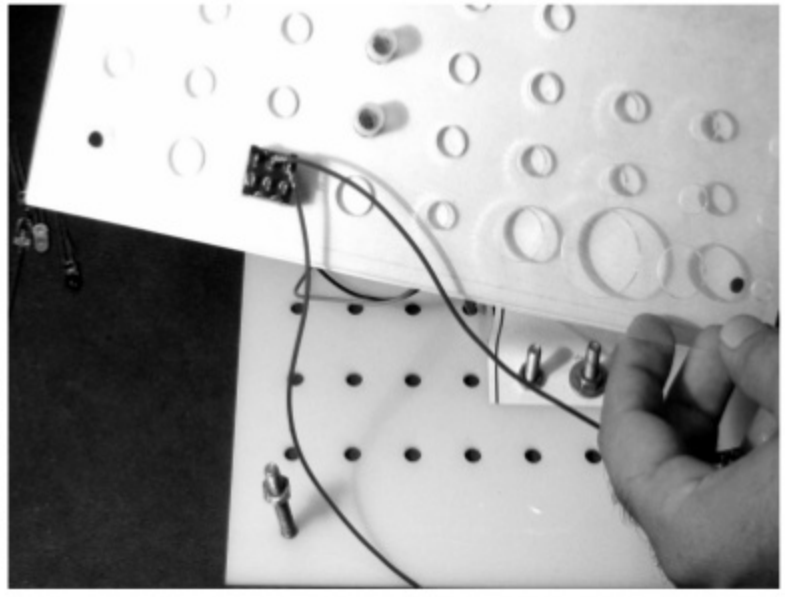
Here's is an example for a panel for school **science fairs and class projects**. As you see there is some theoretical knowledge provided to teach the circuit to fellow students and yourself.

A formal panel -->



Finalizing The Design

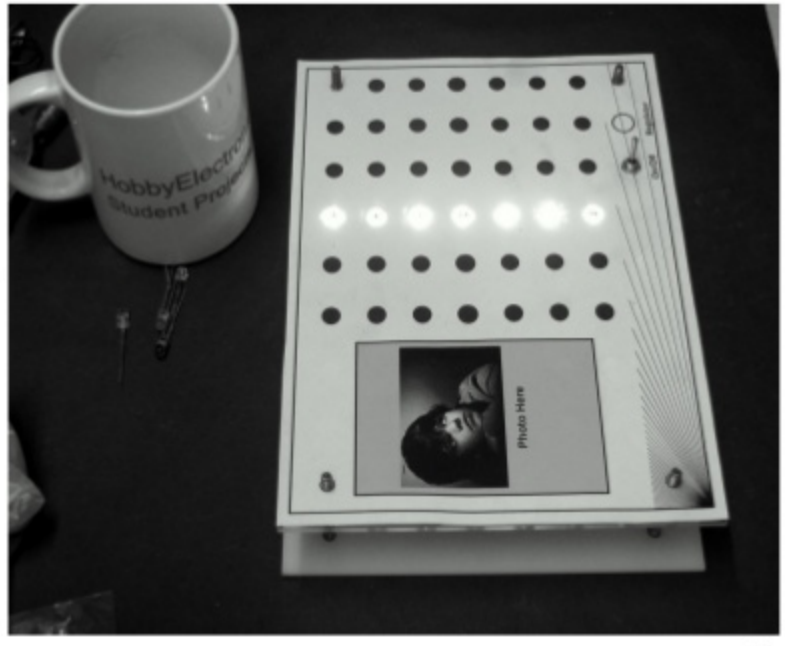


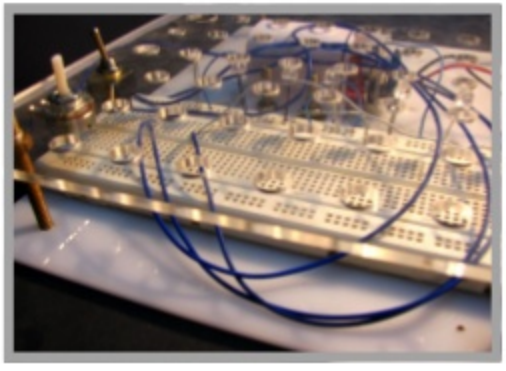


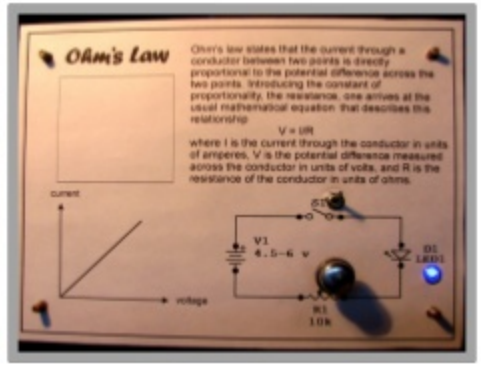
To support fragile paper panel, we need some card board or plastic board.

You can buy a cardboard from stationery shop and cut it in exactly same size as your panel is and make holes for components. Or you can make a plastic panel. Making a plastic panel is bit more complicated and require some manufacturing tools. This panels shown on the right side are made by Laser cutting machine.

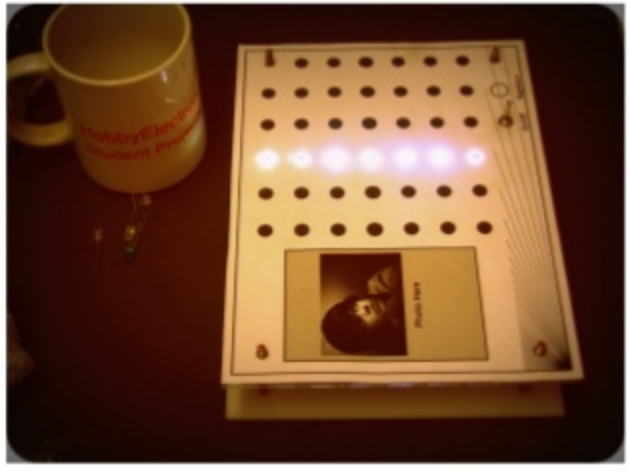
After the board is ready we just need to assemble the panel and components on board, put the nuts and bolts on and we are ready to go.
Easy.. Isn't it?

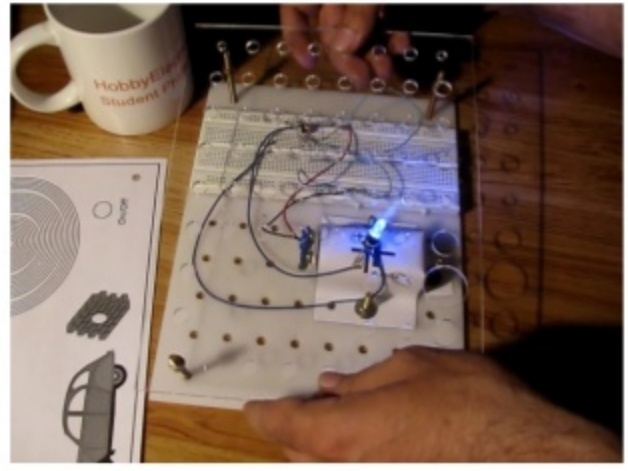


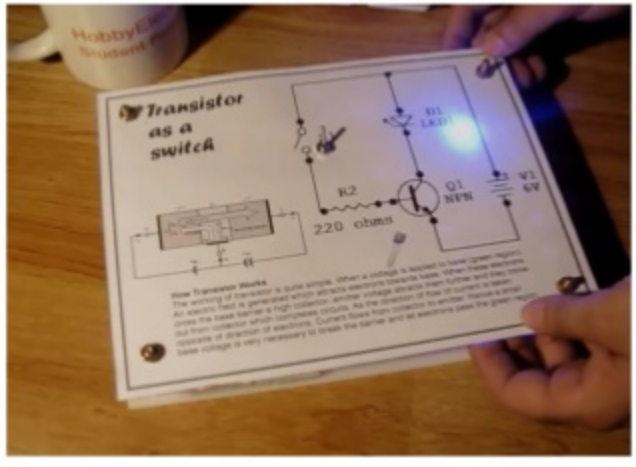




Work Gallery



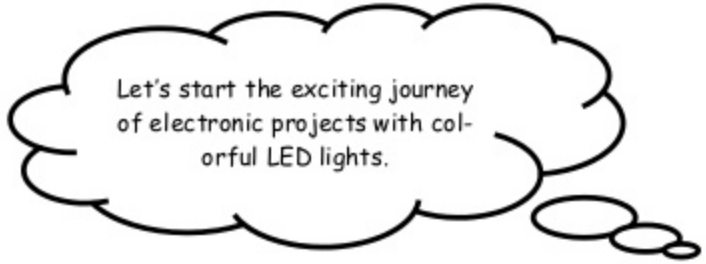




1. The LED Circuits

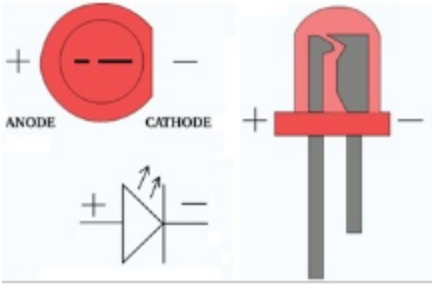
In this section we will make :

1.1 Simple LED Circuit
1.2 Multiple LEDs Circuit
1.3 An Ambient Light on MY Kit.



So what is LED ?
A light-emitting diode (LED) is a semiconductor light source. Please refer to components definition section for more detail.

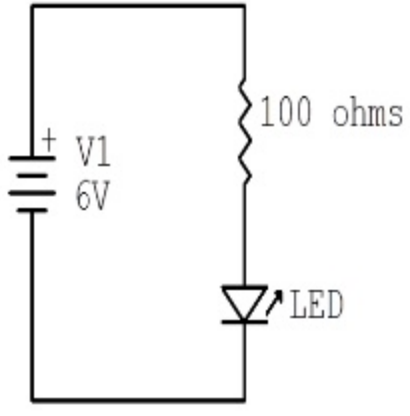
Some Parts of this project are available in Video CD ROM



TIP:
The Longer leg of LED is always positive and must be connected to positive terminal of battery.

Let's Do It

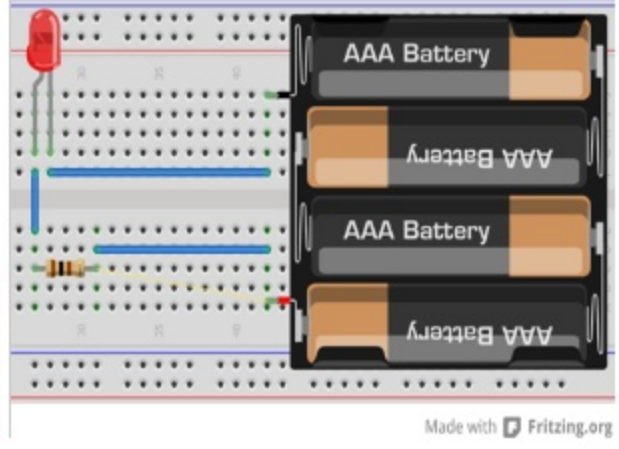
To start working with electronic circuits, Let's make a super simple circuit first. The circuit is all about lighting LEDs with battery. This circuit will also teach you how to use kit and connect wires in bread-

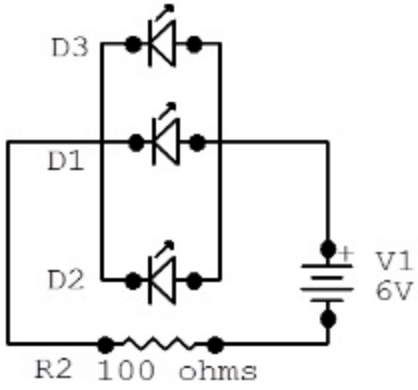


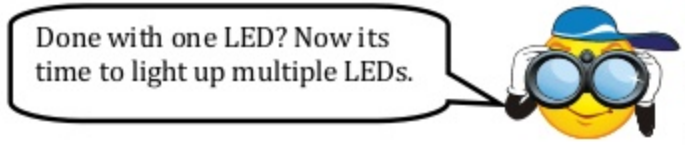
1.1 Simple LED Circuit

Step1: As Simple as it is, just Connect the batteries, resistance and one LED and try to light up the LED.
If it is not lighting then swap its legs, The longer leg of LED should be connected to positive of battery as told in tip.

Warning:
A Resistance of 100 ohms or above should be connected with LED as most of the LEDs don't like voltages more than 4.5 v.



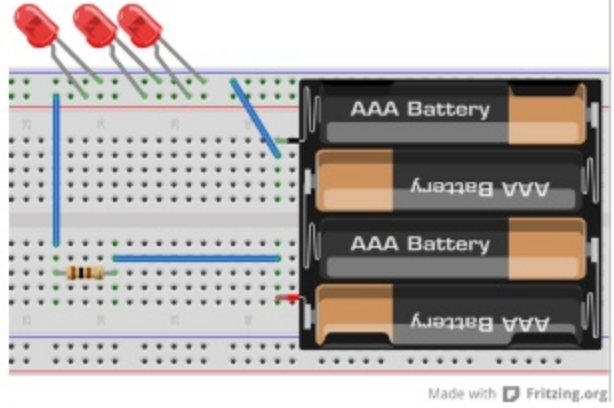




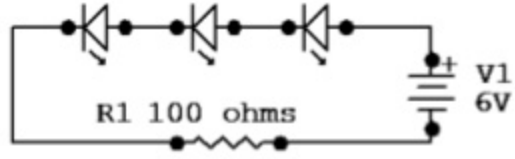
1.2 Multiple LEDs Circuit

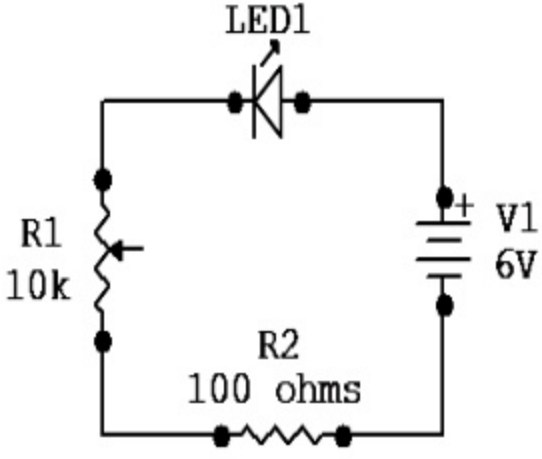
To make a multiple LED circuit we will add up more LEDs in parallel to previous circuit of single LED.

Step 1: Just add more LEDs in the holes which are parallel to first LED. Please refer diagram.



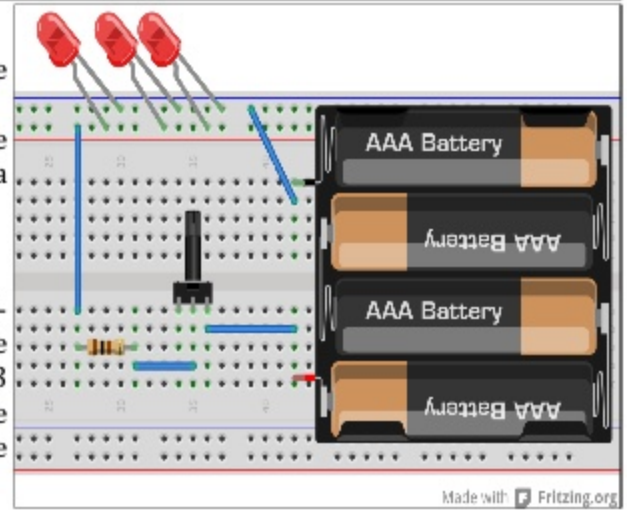
TIP:
If you are thinking to make a multiple LED circuit by connecting LEDs in series then **it will not work** with 6 volts. As LEDs have high resistance and it is not possible to light up LEDs in series with lower voltages.





1.3 LED Ambient Lamp

Lets now make a project using what all we have learnt about lighting a LED with 4 AA cells.
What we are going to do is just assemble the multiple LEDs circuit on MY Kit and design a front panel for our project.



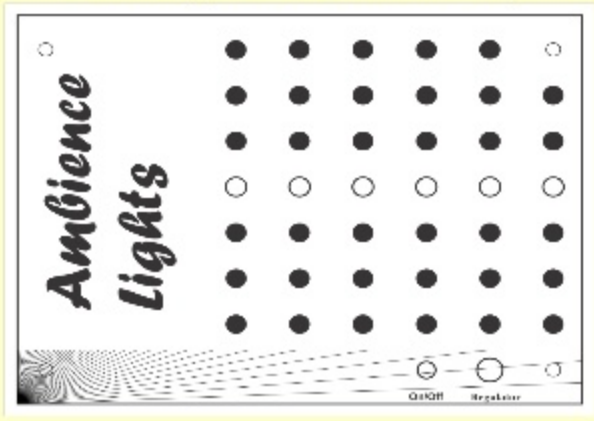
Let's Do it

Step 1: Lets assemble the circuit, In the previous circuit we have added a variable resistance to dim the lights if needed. To convert the 3 wires into 2, Join the first 2 wires of variable resistance and use the joint and remaining one wire. (Please refer video).

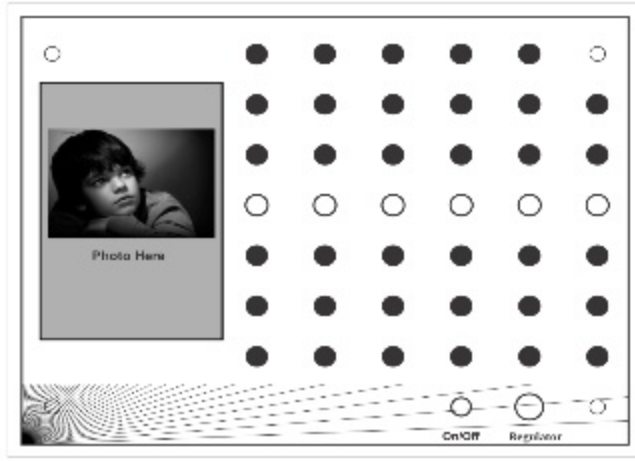
Step 2: Cut the panel design page and paste it on MY Kit.

Step 3: Screw the snap over LEDs and paste a small paper cutting on snap, to hide the LEDs and to give a diffused light.(A direct light is irritating for eyes) I have tried to give a designer look to our lamp, The dots give a mysterious look to the lamp when it is lighted up in dark.

Panel Design for LED ambient Lamp



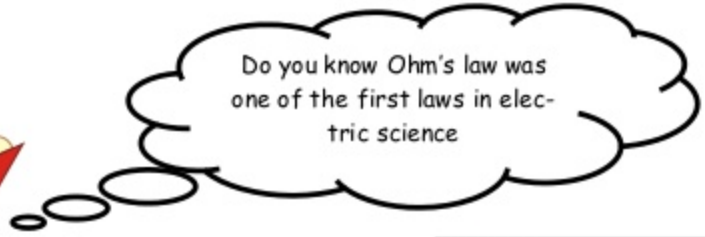
More Ideas -
You also use this lamp as a photo frame, and stick your photo on the left space of panel, Use plastic tape and a paper to make a envelope, in which you can slide your photo in and it will protect your picture from dust and it will stay long.



2. Ohm's Law

In this section we will make :

2.1 Ohm's Law Circuit
2.2 Demonstration Project



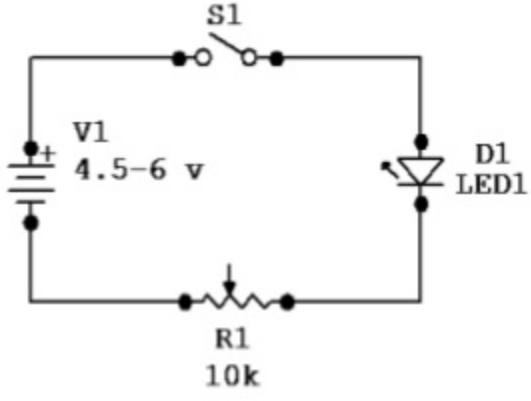
Some Parts of this project are available in Video CD ROM

What is Ohm's Law ?

Ohm's law states that the current through a conductor between two points is directly proportional to the potential difference across the two points. Introducing the constant of proportionality, the resistance, one arrives at the usual mathematical equation that describes this relationship —

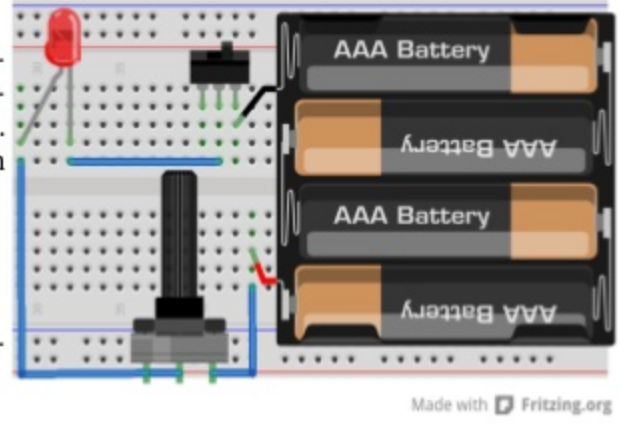
$$V = I/R$$

where I is the current through the conductor in units of amperes, V is the potential difference measured across the conductor in units of volts, and R is the resistance of the conductor in units of ohms. In Simple language, the law states that as voltage increases in a circuit, current also increases. Or as resistance decreases in a circuit, voltage increases.



Let's Do It

To verify Ohm's Law we will make a simple circuit with variable resistance and see what happens when resistance is decreased or increased. As stated by law, LED should get dimmer when resistance is increased in the circuit.



2.1 Ohm's Law Circuit

Materials : D1- LED, R1 –10 k ohms Potentiometer, 4.8-6 v battery, S1 switch.

Step1: Short left two wires of potentiometer and then lengthen the third wire and one wire from shorted pins. Insert the two wires in breadboard.
Step2: Place the battery and switch as shown in figure, we are using only two pins of switch .
Step3: Switch on to test the circuit, If LED doesn't light up, turn the potentiometer knob to right most corner to see if LED is dimming.
Step4: As per Ohm's law LED should gets bright when resistance is decreased in the circuit and gets dimmer when resistance is increased.

2.2. Demonstration Project

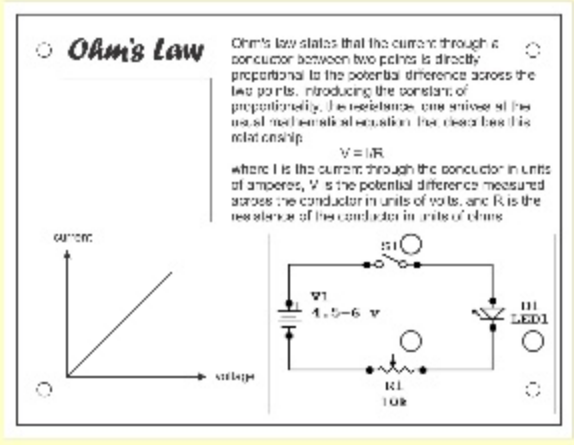
Lets assemble the circuit on MY Kit and make a demonstration project for school science fair or for your friends.

Step 1: Put LED in cover and lengthen the LED wires by joining some more wire with them.

Step2: Similarly lengthen the switch wires also by adding some more wire to it. Remember we are only using two wires of switch.

Step3: Screw LED and switch to panel.

Step4: Cut the panel drawing sheet and paste it on MY Kit panel. And your project is ready for display.



Panel Design for Ohm Law demonstration