Basic Electronics Course – Part 1

Simple Projects using basic components

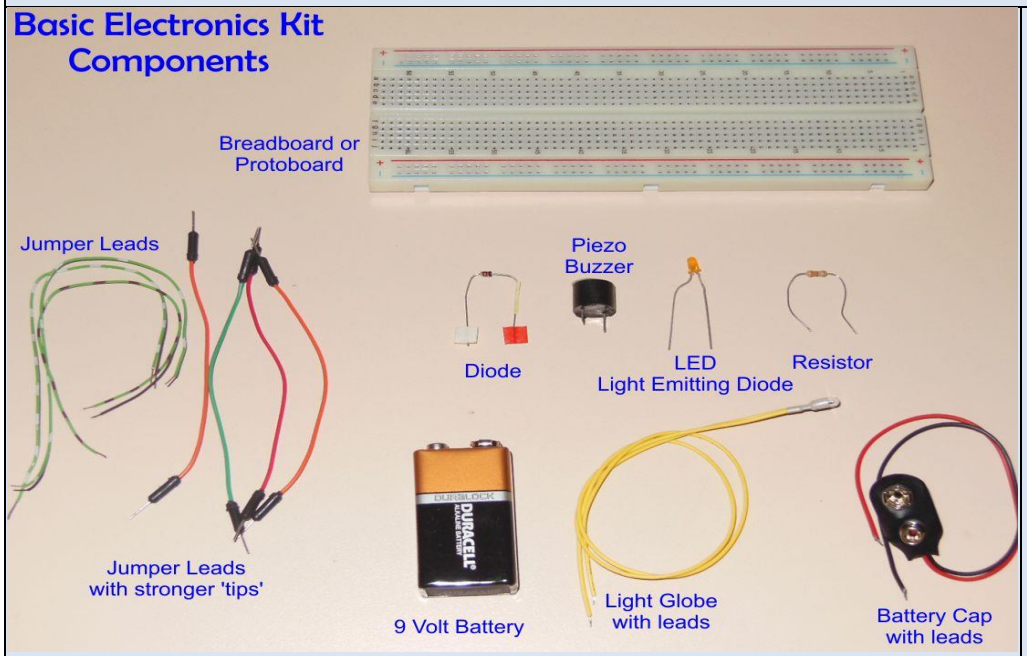


Image 1.

Following are instructions to complete several basic electronic projects

- **Identify each component in your kit – Image 1. [**There are other components in the kit – leave them aside for later use]
- **For each <u>Demo</u> refer to an Image and Description.** The image & text will assist you to duplicate what is expected
- **<u>More detailed notes are attached</u>. Some steps** require more information so additional notes are provided at the end of this document. A <u>"see ***Note xx***"</u> alerts you to extra notes for this step or component. Find and read that 'note' if unsure about a step or a component
- **Get to know your components & remember the golden rule…** a circuit only works if it is an unbroken line of power running through it. If leads come loose or you miss joining one component to the next 'row', your Demo won't work
- **Look critically at your board and follow the line of power**

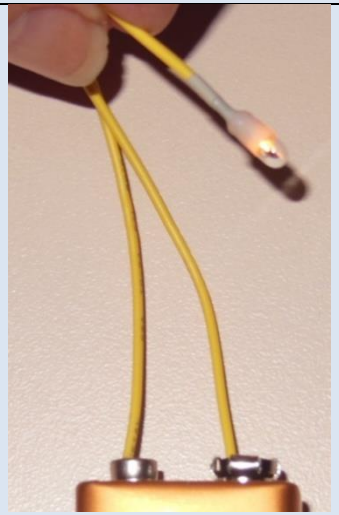


Image 2.

Demo 1: A basic circuit – Lighting a globe with a battery

- ***Using 9v battery & Light Globe with leads – Image 2.*** *Hold one lead on the Positive terminal on top of the Battery [marked +ive]*
- ***Hold the other lead on the Negative Terminal*** *[marked -ive]*
- ***Light Globe will light***
- ***That is a basic circuit*** *–power is running from one battery terminal through the leads & globe to the other battery terminal – the circuit is complete and the light glows*
- ***If you break the circuit….*** *– lift one of the leads off the battery – the light WILL NOT glow*
- ***Current must be flowing in a complete 'loop' -*** what stops a circuit operating? Flat battery, faulty globe, bad connection, a short circuit (e.g. plastic wire covering breaks & wires touch, wire broken inside of plastic
- ***Electronic equipment is basically small individual circuits –*** *Using many smaller circuits together simply makes a more complicated machine or device*

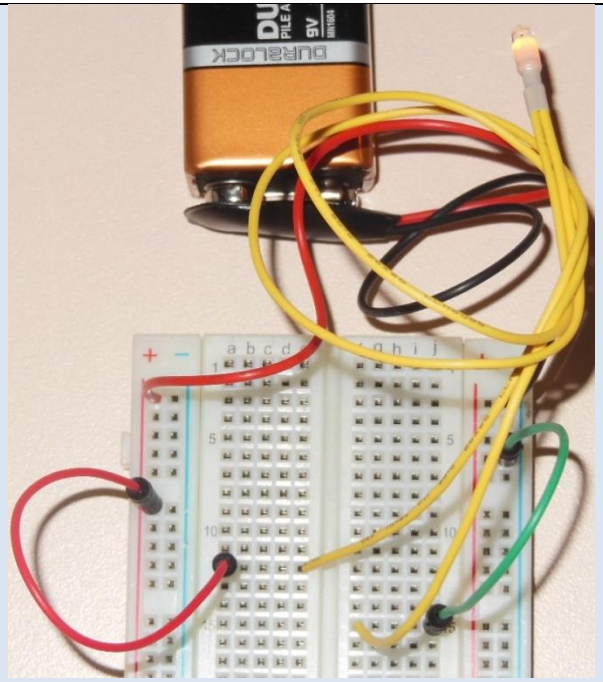


Image 3.
See "Note 1" on breadboard

Demo 2: Light Globe on Breadboard

- **How is a Breadboard Constructed? – See Note1 -** Read the Note and compare your breadboard
- **Using a 9v battery: Attach the Battery cap with leads**
- **Push Red battery lead into a hole on Red +ive rail line on Breadboard**
- **Push Black battery lead into a hole on the Blue –ive rail line.** The Board now has power
- **Using a jumper lead. Push one end into a hole on the Red +ive rail line. Push other end into any short cross-row of holes –**That puts +Positive power to that short cross-row
- **Use another jumper lead. Push one end into a hole on the Blue –ive rail line. Push other end into a hole on a short cross-row of holes on 'other side' of board –**That completes -Negative power link
- **The board has power but no components in the centre to complete a 'loop'**
- **Using a Globe with leads. P**ush one end into <u>any hole in the same row that has the +ive jumper</u> & push the other Globe Lead into any hole on the -ive jumper cross-row.
- Note <u>Image3</u> - The Globe leads span across the dividing line of the breadboard and each lead is in a row that has either +ive or –ive power – so the power Loop is now complete
- **Light Globe will light** – if not. Check the line of 'power' does it flow from one line to the next? Is it a complete 'loop'? Are the jumper ends and the globe-lead ends cross-rows with +ive & -ive power leads?
- **Current must be flowing in a complete 'loop' – or else the Globe will not light**

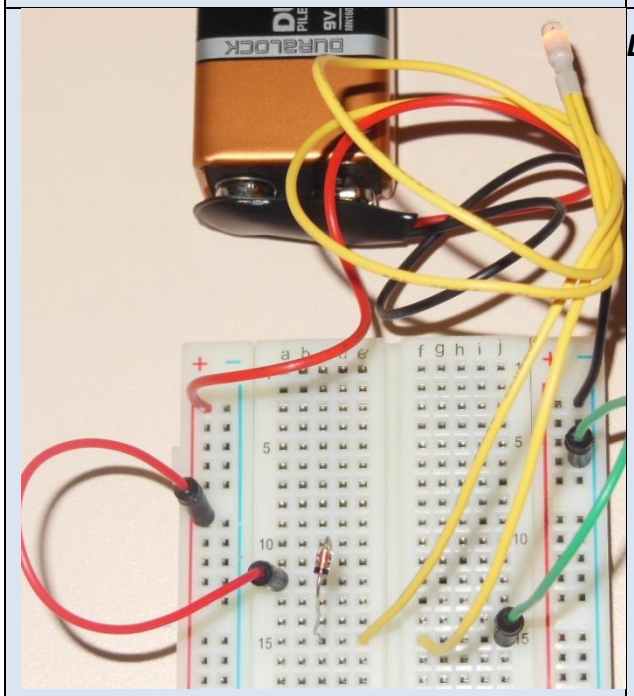


Image 3.

Demo 3: Add a Diode to Globe circuit on Breadboard

- **Continuing from Demo 2 – MOVE one Globe lead – On the** +ive side of the board, move lead to another Cross-Row – breaking the power 'loop' [move it down a couple of cross-rows]
- **Add a small, low voltage, low current diode <u>in *Series</u> with the Globe** [see last 'dot'point]
- **Note the Diode has one end marked +ive –** and the +ive leg is longer
- **Push +ive Diode leg into a hole <u>on the same Cross Row</u> as the +ive power jumper lead**
- **Push the other end into any hole in the <u>same Cross-Row</u> as the moved Globe lead**
- **What is demonstrated?** A Diode only passes current in one direction ie with diode in the correct way, the globe lights, **if the diode is reversed, globe not light**
- **Check this out:** Connect the diode back the correct way, note the Globe lights, NOW reverse the battery (polarity) and note the Globe will not light
- *What use is a Diode? It protects components:* If the globe was a sensitive electronic component that would fail if it was accidently connected "reverse polarity", we've demonstrated that a Diodes provide <u>reverse polarity protection</u> to that sensitive electronic component (or our globe)
- * **"In series" means it follows – end to end - with the Light Globe**

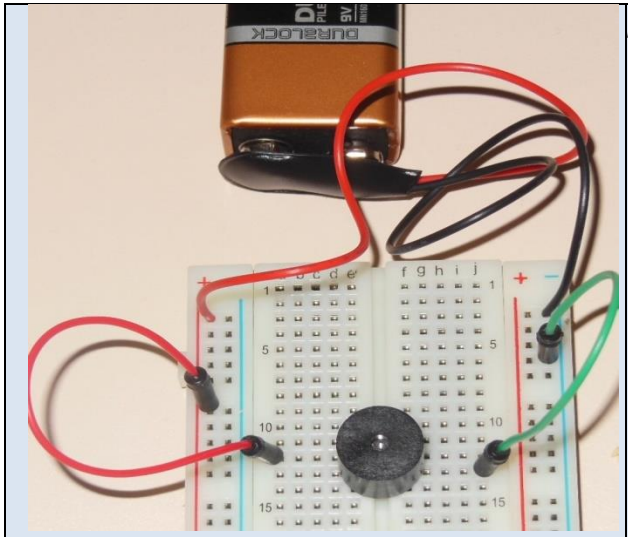


Image 4.

Demo 4: Piezo Buzzer on Breadboard

- **Continuing from Demo 3 – REMOVE the Diode & Light Globe –** take Globe & Diode out of the circuit
- **Add a small 12Volt Piezo Buzzer - Note Buzzer has one side marked +ive. –** and that +ive leg is longer
- **Push +ive Buzzer leg into a hole <u>on the same Cross Row</u> as the +ive power jumper lead**
- **Push the other leg into any hole in the <u>same Cross-Row</u> as the –ive power jumper lead**
- **Buzzer legs are <u>spanning the gap in the board – with one leg in each +ive and –ive Cross-Rows</u>** - power loop is complete
- **When the Circuit is complete the Buzzer will sound –** and won't stop until a wire is removed from the board to 'break' the circuit.
- **Buzzer goes Off and On as final wire is pushed In or Taken Out of the Circuit**
- **What is demonstrated?** That a small 12V Piezo Buzzer <u>or any small</u> motor or relay [coil] could be used in a simple circuit instead of the light globe.

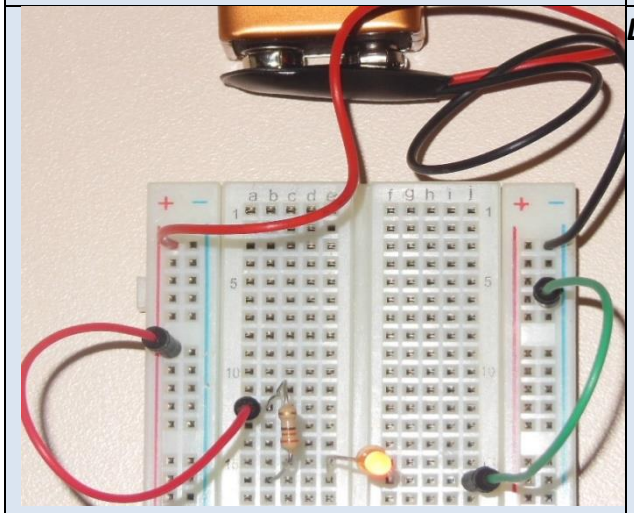


Image 5.
See "Note 2"– Reduce Voltage to Protect LED

Demo 5: Introducing a Light Emitting Diode [LED]

- **Connect 9v battery leads to Red+ & Blue- rail lines on Breadboard**
- **Use jumper leads to power <u>2 different Short Cross-Row of holes</u> –** 1 row +ive & 1 row -ive
- **<u>Don't insert LED</u> until a Resistor is <u>in Series</u> with LED -** *See Note 2 Reduce Voltage to Protect LEDs*
- **Using 330Ohm Resistor - Push 1 'leg' into a hole <u>on the same Cross Row</u> as the +ive power jumper lead**
- **Push other Resistor leg into a Cross-Row –** several rows down on the same side of the Board
- **Insert LED – <u>LED needs correct polarity</u>** +ive leg is longer; –ive has 'flat spot' in coloured plastic
- **Push +ive LED leg into a hole <u>on the same +ive Cross Row</u> as the Resistor leg**
- **Push -ive LED leg into a hole <u>on the same -ive Cross Row</u> as the –ive power Jumper lead –** spanning the gap in the Breadboard
- **Light Globe will light…. –** if not. Check the line of 'power' does it flow from one line to the next? Is it a complete 'loop'? Are the jumper ends and the LED legs all correct Cross-rows?
- **Current must be flowing in a complete 'loop' – or else the LED will not light**
- **What is demonstrated?** When Resistor is placed in Series with an LED (with correct polarity) – LED will light. Resistors are inserted either way [Resistor ends are **<u>not +ive or –ive</u>** <u>polarity</u>]
- Substitute a 1,000 ohm [brown, black, red] Resistor - LED still lights, but not as bright.
- *Conclusion; Using a Resistor three times the value of the initial 330 ohm one, the LED is reasonably bright. Using Resistors of much higher value? LED would still light, but much dimmer.*

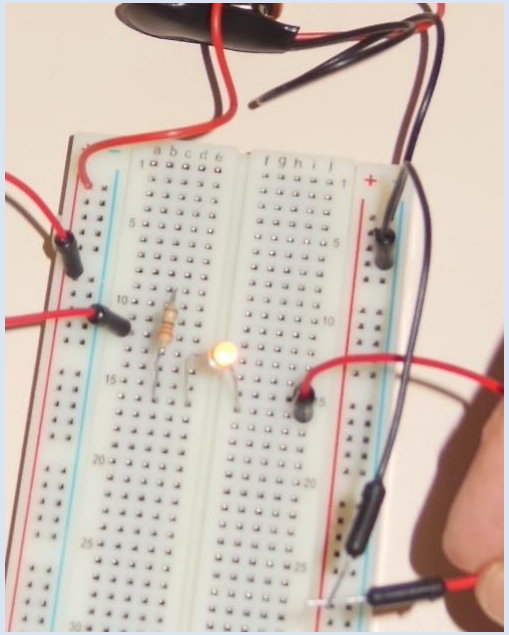


Image 6.
See "Note 3" Effect of Corrosion on Conductors

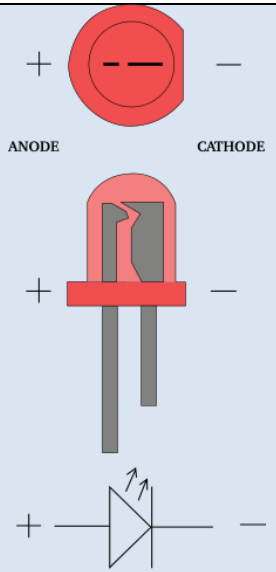
Demo 6. Turning a circuit into a simple Continuity Tester

- **To test 'continuity' by making TWO Test Leads -** Resistor & LED from Demo5, remain in the circuit
- **9v battery leads are attached to the Breadboard +ive & -ive rails**
- **+ive jumper lead has one end in the Red +ive rail line & other end in same Cross-Row as Resistor leg**
- **<u>Remove one end of the -ive jumper lead that was attached to –ive LED leg</u> –** remove the end from the Cross-Row – leave other end in the Blue –ive rail. One end of jumper is free of the board – this is now a crude Test Lead
- **Use ANOTHER jumper lead to make the other Test Lead**
- **Insert a jumper into where the first lead was removed from the -ive jumper lead connection** – leave the other end free of the board – that's the second Test Lead
- **Check the Breadboard circuit should be**… +ive rail to +ive jumper, through resistor, through LED to a Test Lead.
- **Other side of board -** -ive rail to a –ive Test lead **– LED is not lit -** power loop is NOT complete until 'something' joins these two test leads
- **When the two Test Leads are touched together, the LED will light** – that is a Continuity Test
- **Test for continuity in other metals** ie touch them on pieces of metal, or another jumper lead, to show that metallic materials conductor electricity.
- See "Notes 3 Effect of Corrosion on Metal Conductors

Notes on Components and steps

<u>1. How is a Breadboard constructed?</u>

Note "Red +" and "Blue –" long Rails/Rows.
All holes along the Red rail are connected.
All the holes along the Blue Rail are connected.
Look at the shorter 'Cross-Rows'. All holes in each short Row are connected.
The board is split in TWO long-ways.
It can be 2 separate boards or you can 'jumper' across and make it ONE board.
Connecting a 9V battery: Attach battery cap to battery & insert the red battery lead into a hole in the Red +ive rail [any hole in the long row – now ALL holes have +ive power <u>in that rail</u>.
Insert Black battery lead in a hole in the Blue -ve rail [any hole in the long row – now ALL holes <u>in that rail</u> have -ive power. 'Negative' is also called 'Ground' or be marked GND in circuits or diagrams.
A complete loop of power is required for a current to flowing and as components like lights or buzzers are added they must all be connected within the 'loop' or the circuit will not work.
You notice the board soon becomes jumbled & it's a tight fit for fingers.
This is why we expand across to the 'other side' of the breadboard.
Spread projects out so you can see the flow of components but remember….
IF you use the Other side of the board… you must "join the two short cross rows" to make it <u>one board</u>.



An LED
'Flat' side indicate –ive
Longer leg indicates +ive
& the LED symbol seen in circuit diagrams

2. **Protecting LEDs:**

Led's have a +ive & -ive side and they must be inserted into a circuit with the correct leg in Positive & Negative – see image showing a 'flat' side for Negative AND +ive has a longer leg.
Common LEDs are rated at around 2V and just 20mA
Our battery is 9V - if we don't limit the Voltage we will damage/destroy the LED.
To limit the Voltage we insert a series Resistor in the circuit.

Problem: We need to reduce the voltage by 7V (9V battery minus the 2V LED) at 20mA.
Solution: Using ohms law: R=E/I i.e. desired resistance R = voltage/current (amps)
or 7 divided by .02 (20Ma) = 350 Ohms.
That means; we need 350 Ohm of Resistance in the circuit to reduce the voltage from 9V to 2V.

Use the 330 Ohm (orange, orange, brown) resistor (small one parts kit) – 330 is ***close enough*** *to the required 35Ohm.*

3. **Effect of Corrosion on Metal Conductors**

In Demo 6 testing continuity we expected that metal in the components would Conduct current around the breadboard/circuit - however metal doesn't always behave as we expect.
Rusty or painted steel will corrode and aluminium can become 'anodized' and when tested no current flows through the metal.
That thin layer of corrosion or oxidation is enough to restrict flow of electrons.
This demonstrates the possibility of BAD connections and why shiny bright metal is best.

The test leads can also be touched on insulating materials ie wood, plastic rubber etc. to demonstrate those types of materials are insulators - meaning they DO NOT conduct electricity.