

WORKSHOP
FUZZ_001

Assembly
Guide



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Worksheets and Kits Provided by:

Maker Electronics Ireland Limited
A4 Sounds, St. Josephs Parade, Dublin 1
www.maker.ie
@__maker
facebook.com/makenoisemakemusic

If you have any questions or suggestions email: info@maker.ie

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WARNING

REPLACE WITH SAME BATTERY TYPE

USE ONLY 9V POWER SOURCE.

OR USE APPROVED POWER SUPPLY

AGAIN, 9V ONLY.



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FUZZ_001

GUITAR PEDAL WORKSHOP

In this workshop we are going to make a distortion pedal called the FUZZ_001. This circuit is based on the Bazz Fuss design created by Christian H. His design is a great introduction to the world of DIY pedal building because of its simplicity and great sounding results.

First we are going to go through the basics of soldering and then get started with soldering connecting wires to the stomp switch, volume knob, input and output. These wires will be used to connect the components to the circuit board, where the magic happens. Following this we will solder each component onto the circuit board. We are using a special type of circuit board known as vero board. This allows you the freedom to modify the circuit if you wish (and we hope you do!).

We will then place the stomp switch, volume knob, input, output and battery into the circuit and connect their wires to the vero board. With the external components connected to vero board, and the components placed into their sockets, all that is left to do is screw on the back of the enclosure and plug in in your instrument!

At the end of this handout there is information about all the components used in the workshop, what they do, and how they affect the circuit.

DIY electronics is extremely rewarding and loads of fun, but try not to get frustrated! You will make every mistake it is possible to make, but that is part of the fun.



TOOLS

Below is a brief overview of the tools you'll see today.

Soldering Iron- The tip of this is extremely hot. Do not touch, even if you think it's off. Always keep in its holder for safe keeping

Soldering Iron Stand- Where your soldering iron lives. It has a sponge for keeping the tip clean

Helping Hands Assembly Aid- Very handy

Electrical Tape- Useful for insulating and holding stuff in place

Solder- Making connections happen

De-solder Pump- Ironically it sucks

Heat Shrink- You heat it, it shrinks around the ends of your components, insulating them.

TOOLS & COMPONENTS

COMPONENTS

Below is a brief overview of the components you'll see today

Transistor- three legs!

Electrolytic Capacitor- Affects the frequencies allowed into the circuit

Resistor- resisting the flow of current

Vero Board- Strips of copper with holes

Diode- Combined with the transistor we get distortion

Multilayer Capacitor- Affects the frequencies allowed out of the circuit

Stomp Switch- Convenient on/off functionality with your foot
Volume Potentiometer

Battery and Battery Clip- 9 volts of magic in a convenient cuboid

Stereo jack Socket- The input jack. Actually for mono use, but being cleverly exploited for switching on the current when a plug is inserted.

Mono Jack Socket- The output jack. for delivering the signal out of the pedal.



SOLDERING IS EASY; HERE'S HOW TO DO IT

Wire cutter



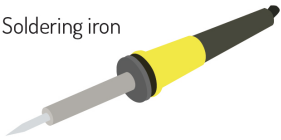
Solder



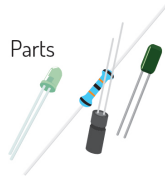
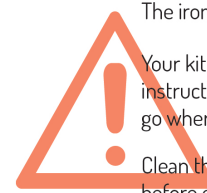
PCB



Soldering iron



Parts

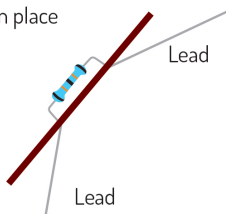


The iron is hot, be careful !

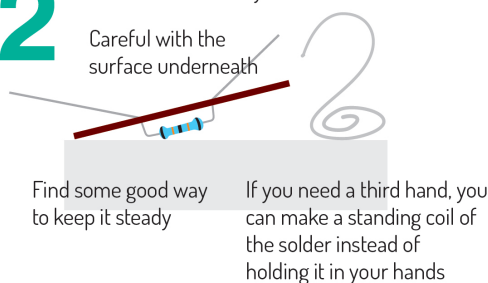
Your kit should come with instructions for what parts go where and what way !

Clean the tip of your iron before each solder connection !

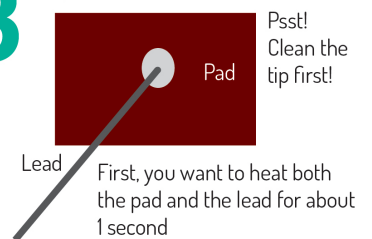
1 Put your part in place. Bend out the leads so it stays in place



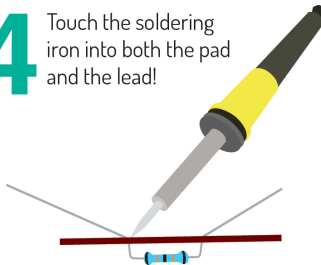
2 Put the PCB down so you can solder



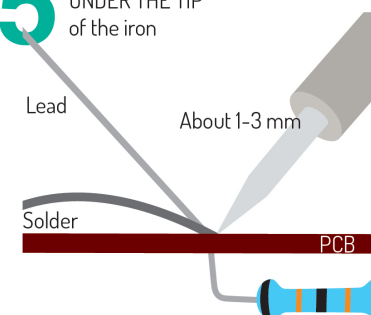
3 O.K, Lets solder!



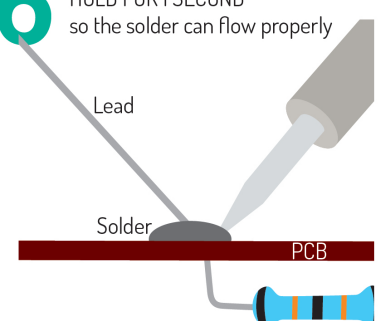
4 Touch the soldering iron into both the pad and the lead!



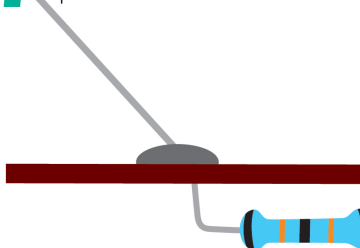
5 Now feed the solder UNDER THE TIP of the iron



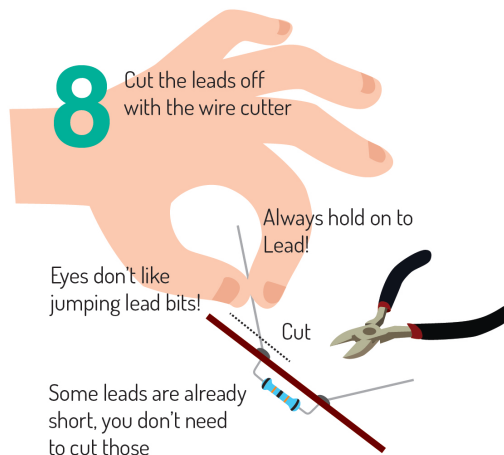
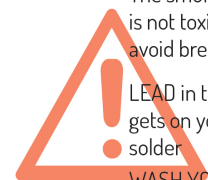
6 Stop feeding the solder then HOLD FOR 1 SECOND so the solder can flow properly



7 A good connection covers the pad without touching other pads and surrounds the lead



8 Cut the leads off with the wire cutter



The smoke from the melting solder is not toxic, but blow gently on it to avoid breathing it.

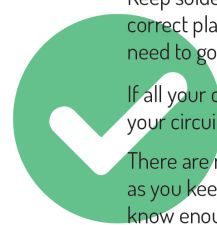
LEAD in the other hand is TOXIC, and gets on your skin when holding the solder

WASH YOUR HANDS WHEN YOU'RE DONE

Keep soldering each part in its correct place. Remember some parts need to go in a certain way!

If all your connections are good, your circuit will just work!

There are more tricks you will learn as you keep soldering, but now you know enough to make many cool things.



HEAT SHRINKING

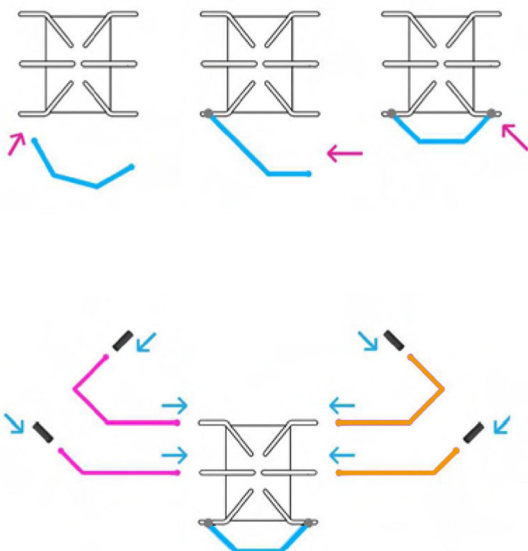
Heat-shrink tubing is used to seal electrical connections. The tubing is placed over the connection to be protected and then heated with a hot air gun or flame from a lighter. These processes cause the tubing to contract as much as one sixth of its original diameter (depending on the heat shrink, a ratio of 2:1 is the most common), providing a snug fit over irregularly shaped joints. This provides good electrical insulation, protection from dust, solvents and other foreign materials, as well as strain relief. If overheated, heat shrink tubing can melt, scorch or catch fire like any other plastic. We recommend applying heat-shrink to all connections where there are exposed metal contacts

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LET'S
DO
THIS!

STEP 1- SOLDERING WIRES TO THE FOOTSWITCH

The stomp switch we are using is known as a double pole, double throw (DPDT) switch. Solder the coloured wire provided onto the lugs of the stomp switch as shown in the image below.



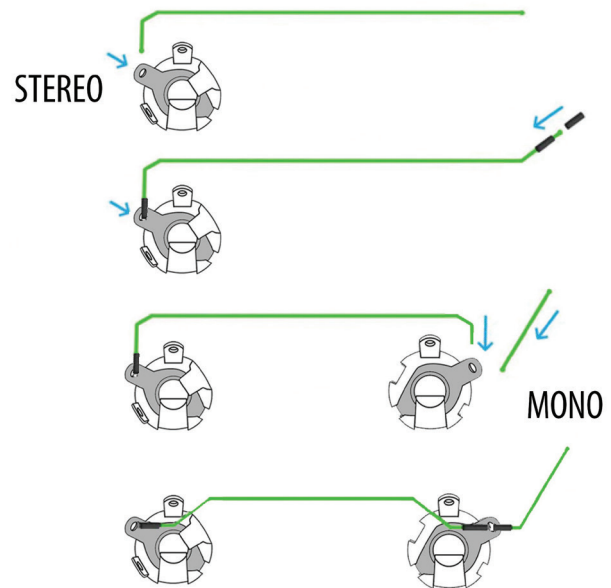
STEP 2- SOLDERING WIRES TO THE INPUT AND OUTPUT SOCKETS

Solder the green wires provided onto the corresponding legs of the socket (stereo) and output (mono) sockets as shown in the image below.

Notice the output socket has two wires connecting it.

Make sure both wires are wrapped round the lug of the socket before soldering. Otherwise, life gets difficult.

Take your time to make doubly sure of the wiring before soldering.



STEP 3- SOLDERING WIRES TO THE VOLUME POT

Solder the coloured wires on the two outside lugs of the pot as shown in the diagram below.

This diagram is showing a view from the back of the volume pot



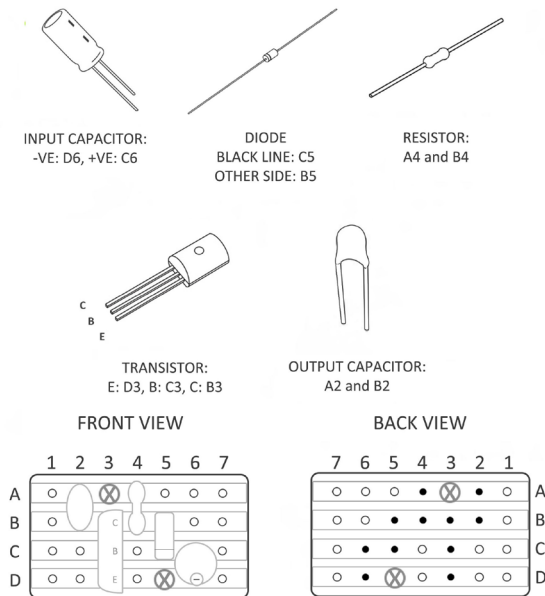
STEP 4- PLACING THE COMPONENTS

Place each component into the veroboard as shown in the diagram, taking note of their coordinates described on the next page. Remember that the legs of each component come from behind the traces.

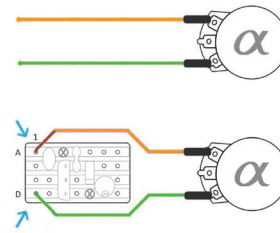
Pay particular attention to orientating the transistor correctly and match up the black line on the diode with the horizontal line on the diode's image on the component map, on the back of the veroboard. Also make sure the negative side (short leg) of the input capacitor is orientated to its negative side in the component map.

4.1- COORDINATES

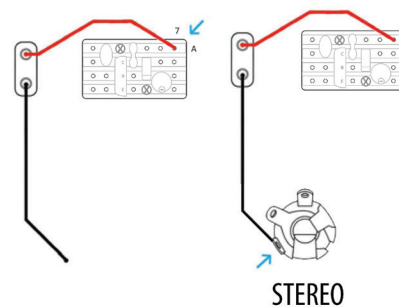
IMPORTANT: DO NOT TEAR OFF PAPER FROM VERO BOARD



connect the leads from the volume pot to the vero boards as shown in the diagram below



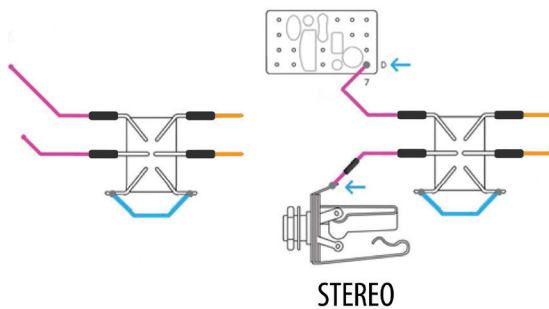
Now connect the leads from the battery clip to the vero board and input socket.



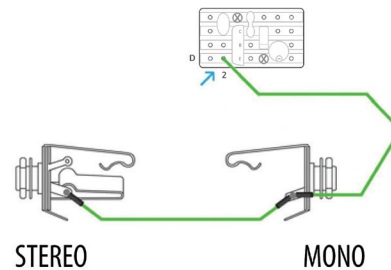
STEP 5- SOLDERING THE REMAINING UNCONNECTED WIRES

Connect the pink wires from the stomp switch to the input socket and vero board as shown in the diagram below.

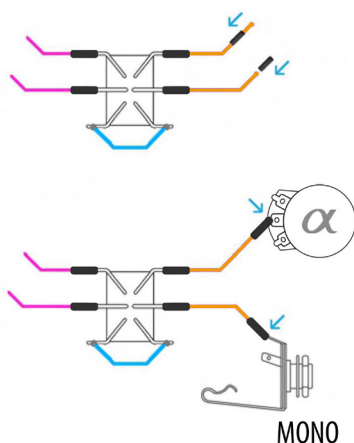
Double check you have this in the correct position before soldering!



Finally, connect the ground leads from the output socket to the vero board.

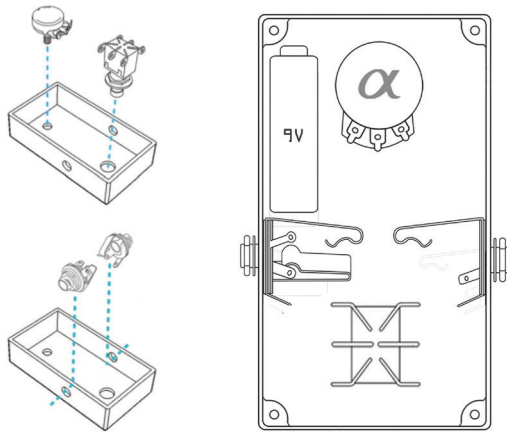


Connect the orange wires from the stomp switch to the output socket and volume pot as shown in the diagram below.



STEP 6- PLACING THE STOMP SWITCH, INPUT, OUTPUT, VOLUME POT AND BATTERY INTO THE ENCLOSURE.

Place each component into the enclosure as shown in the diagram below. Use a pair of pliers to rotate the hex-nut while holding the component to ensure a secure fitting. Connect the battery clip to the battery. The battery should fit in beside the volume pot, below the input jack and to the left of the stomp switch, with the wires from the battery clip facing towards you.



Make sure the legs of any components are not touching

STEP 7- FINISHING THE PROJECT!

Your project should be all soldered up now and secure in the enclosure. If you do have any unsoldered wires, or solder joints you are not 100% on, now is the time to go back over the worksheet or to ask for help.

If you're happy with everything, finish off the project by putting some electrical tape over the traces on the veroboard (this will protect from short-circuits).

Now screw on the back of the enclosure, plug into your favourite electric instrument and amp, and get filthy your new FUZZ_001 distortion pedal.

TROUBLESHOOTING

The most likely causes of a lifeless FUZZ_001 pedal are, in descending order:

-BAD SOLDER (OFTEN BETWEEN A WIRE AND COMPONENT)

A bad solder can be caused by a number of reasons. Often dirt can get in and create a weak bond or the surface you are trying to solder to isn't cooperative. Use flux on the surface and re-applying solder can help in these situations. Be careful re-soldering on certain components, as extended periods of heat can damage them.

-EXPOSED METAL CAUSING A SHORTCIRCUIT

Are lugs or bits of wire from one component touching another? This may be causing a short circuit. Adjust the component's position or add electrical tape/ glue to prevent the contact.

-CONNECTIONS BETWEEN COMPONENTS/ VERO IN THE WRONG PLACE.

It's quite easy to get confused where each wire needs to be connected. Double check your wiring with the diagrams and schematic and if anything needs to be changed get help de-soldering and replacing the position of wire/component.

-TRACES ON VERO BOARD BEING CONNECTED BY WAYWARD SOLDER

The distance between the traces on the vero board is quite small and it is common for the gap to be bridged by a thread of solder. If this happens, a combination of the soldering iron and the de-solder pump should remove the thread.

As with all DIY electronics you can experiment with the components in the circuit to tweak the sound to your liking. Not everything will affect the sound (such as the resistor in the circuit) but there is a surprising amount of flexibility in most circuits. Usually most capacitors, resistors (maybe try a variable resistor?), diodes and transistors can be swapped out or tinkered with to produce new tone. By learning each component's function in the circuit, looking at schematics and veroboard layouts of other people's work, posting in and reading forums, and watching video tutorials, you'll start to get ideas of what works and what doesn't.

Never be afraid to try something for the sake of experiment.

EXPERIMENTING

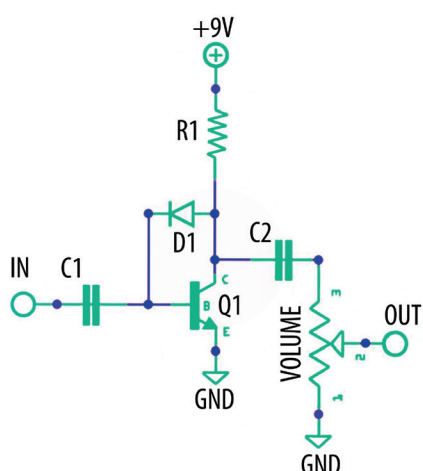
EXPERIMENTING WITH THE FUZZ_001

Varying the input capacitor will have a strong effect on the tone. Try using extreme changes in values (0.01 μF - 1000 μF) to see the difference. Also try the same with the output capacitor.

Changing the type of diode will affect the level at which the waveform will begin to 'clip'. This will affect the tone greatly. Try perhaps a Germanium diode? By changing the transistor you will change the amount the input signal will get amplified. If you get a strange (and horrible sounding) fading or gating of the signal, you may need to experiment with the resistor value in the circuit

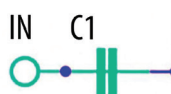
CIRCUIT DESCRIPTION

WHAT'S HAPPENING IN THE CIRCUIT?



WHAT'S HAPPENING IN THE CIRCUIT?

The input Capacitor (C1) filters the signal's frequencies as it enters the circuit. The larger the capacitor, the higher the frequencies that pass through. We recommend experimenting here to find a tone that suits your taste.

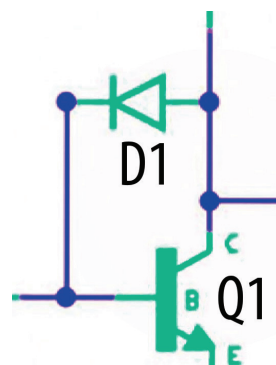


This controls the amount of current coming from the battery into the circuit. Changing this won't affect the tone of the pedal, but may stop the circuit working if too little or too much current is arriving at the transistor.

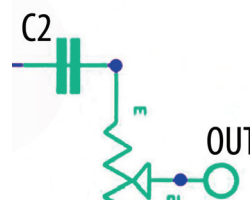


Here we can see that we have a diode connected across the collector and base of our transistor. The transistor is amplifying the signal coming from the input with the diode limiting the amount of amplification in a very strict manner.

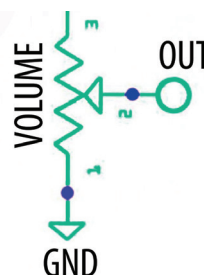
This causes the top of the waveform to be 'clipped', creating the distinctive 'fuzz' tone. Changing the diode will affect the point at which this limiting will occur and changing the transistor will affect the amount the signal is trying to be amplified by.



The output capacitor (C2) will also affect the tone of the circuit but does not have as strong an influence on frequency as the input capacitor. The main job of this capacitor is to remove the DC current, introduced by the battery, from the signal before outputting.



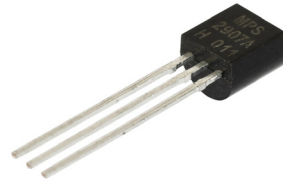
The volume pot's job is to vary the amount of resistance the current experiences before the output. By turning the knob so the contact (2) is closest to the ground (1), the amount of resistance the signal experiences, and the lower the volume of the output will be.



WHAT DO THE COMPONENTS DO?

TRANSISTOR

A transistor is a small electronic device that can cause is a large electrical output signal by small changes in a small input signal. That is, a weak input signal can be amplified (made stronger) by a transistor. For example, very weak radio signals in the air can be picked up by a wire antenna and processed by transistor amplifiers until they are strong enough to be heard by the human ear.



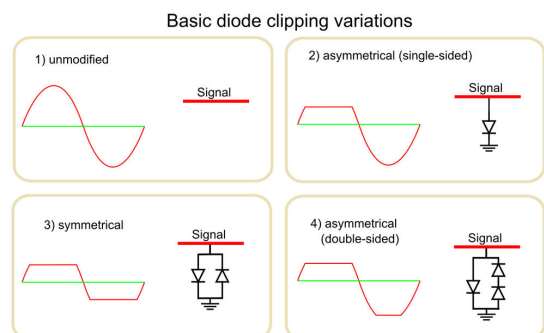
For more detailed information on how transistors work check out : 101science.com/transistormenu.htm which includes video tutorials and links to further reading

DIODE

A diode is an electrical device allowing current to move through it in one direction with far greater ease than in the other. The most common kind of diode in a modern circuit design is the semiconductor diode, although other diode technologies exist. Semiconductor diodes are symbolized in schematic diagrams such as the figure above.



The image below demonstrates how different arrangements of diodes in a circuit can affect the signal.

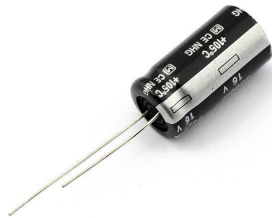


CAPACITOR

Capacitors are components that are used to store an electrical charge and are measured in Farads (F) but it is common to see capacitors in values of millionths (μ -micro) of Farads. This charge is then released over time. The bigger the capacitor, the bigger the charge it can hold.

As capacitors store charge (often for a very long time), be very careful around large value capacitors or capacitors rated with a high voltage even if they are not seemingly connected to a circuit. However, in this circuit and 99.9% of all circuits you will be dealing with in DIY electronics, this is not a concern. The energy stored in a capacitor is related to the voltage and capacitance in the equation: $E = 1/2 CV^2$

Capacitors come in a variety of for as such the electrolytic and multi-layered ceramic versions seen in this project. Other types include polyester film, Tantalu bead, and meta Illised polypropelene. all these do pretty much the same job, and are differentiated by their ability to hold charge.



RESISTOR/VARIABLE RESISTOR (POTENTIOMETER)

Resistors determine the flow of current in an electrical circuit. Where there is a high resistance in a circuit the flow of current is small and conversely, where the resistance is low, the flow of current is large. Resistance (R), voltage (V), and current (I), are related in an electrical circuit by Ohm's Law which states: $I = V/R$.



Variable resistors (known as potentiometers or "pot") allow a range of resistor values to be selected, usually by soe for of slider or rotating knob. There are a number of ways a variable resistor can scale. The two most common are liar and logarithimic. In this project we have chosen a logarithimic potentiometer to imic the sensitivity of the human ear.



SWITCH

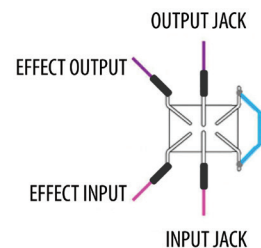
There are an incredible variety os switches, varying from simple on/off toggle switches, to mercury tilt swithces, rotary swithces, key swithces and more. They all have the same basic function. That is, to break a connection in a circuit and/ or make a new connection within the circuit.

They are described by the number of sets of contacts (poles) and the number of positions they can be in (throws).

In this project we are using a double pole, double throw switch, which has two sets of contacts and two positions it can be in.



Below is a diagram showing the wiring on the DPDT switch used in this project.





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A4 sounds, St. Josephs Parade
Dublin 7, Dublin, Ireland
www.maker.ie