

BizNiz Build Document

July 2018 v0.96

www.graybloomfield.com/guitar/docs/bizniz.pdf

SUMMARY

What is it?

It's my business card.

But if you turn it over, it can be used to make an effect for electric guitar. It's a simple boost and dirt circuit, which will distort your guitar signal nicely. It's a nice distortion that you could take home to meet your mum.

You could also use it for a back scratcher, a drinks coaster for a very small glass, or a small red tag to mark your tomatoes in the veggie garden. Up to you.



What will you need to build it?

You will need to source the **required components**, and you will need some other things, such as:

- A **soldering iron**
- Some **solder**
- The **ability** to use the soldering iron and solder, without burning yourself, your pets or your house.
- **Wire cutters** and **wire strippers** will make things much easier
- An **electric guitar** and **amp**
- **9 volt** DC power supply (a 9v battery, or wall adaptor that gives 9v DC)
- Optionally, some sort of **enclosure** to put it in if you want to use it long term
- No, seriously, **don't** burn down your house

REQUIRED COMPONENTS

The components that you need are marked on the board. This table summarises what you'll need - see 'Building it' on the next page for more details if you haven't done this before.

Part	Value
R1	2.2M
R2	68k
C1	100 nF - adjust to your taste
C2	100 nF
C3	100 μ F
Q1	2n3904, or 2n5088, or 2n5089
D1	1n5817
D2	1n4148, or other - see 'Building it'
D3	1n4148, or other - see 'Building it'
Gain	C10k pot
Volume	A100k pot
Input, Output jacks	6.35mm mono audio jacks
9v supply	9v battery clip and battery, or a DC 2.1mm jack
<i>Optional</i> - stomp switch	3PDT latching switch
<i>Optional</i> - LED	Colour of your choice, to show the effect is on
<i>Optional</i> - Resistor	4.7k or thereabouts. You will need this if you use the optional LED to show the effect is on.

Where can you buy this stuff?

In Australia, I would recommend the following places, but this is by no means an exhaustive list:

- diyguitarpedals.com.au - focused on guitar pedal electronics, with a good range for this purpose.
- jaycar.com.au - has actual physical stores that you can walk into and ask questions
- au.rs-online.com - general electronics, with free shipping.
- au.element14.com - general electronics
- littlebirdelectronics.com - focused more towards hobby electronics and makers
- taydaelectronics.com - Best range of cheap potentiometers, stomp switches, and metal enclosures. Shipping is cheap, even though it comes from overseas.

BUILDING IT

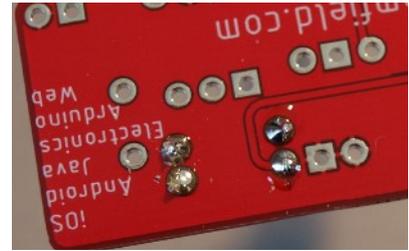
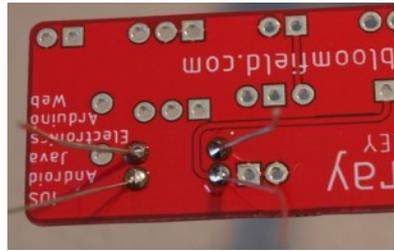
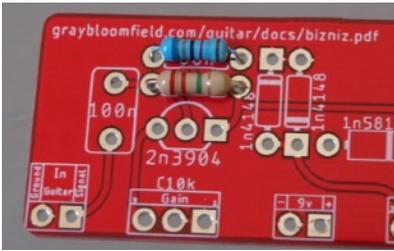
It helps to solder things in order of height - resistors first, diodes, transistors (or transistor sockets), then capacitors. Finally, solder on some wire to go to your input, output and 9v supply.

Resistors

Resistors are marked with coloured bands to show their value. The colours can vary slightly, depending on whether you are using carbon or metal film resistors (either type is fine for this project). You will need:

Resistor	Value	Markings
R1	2.2M	Red Red Black Yellow Brown or Red Red Green Gold
R2	68k	Blue Grey Black Red Brown or Blue Grey Orange Gold

Bend the leads of the resistors, and slot them into the spaces on the board. Make sure you put the correct value into each place. Flip the board over, and solder resistor leads on the back. Once they are in place and soldered, you can clip off the excess wire leads.



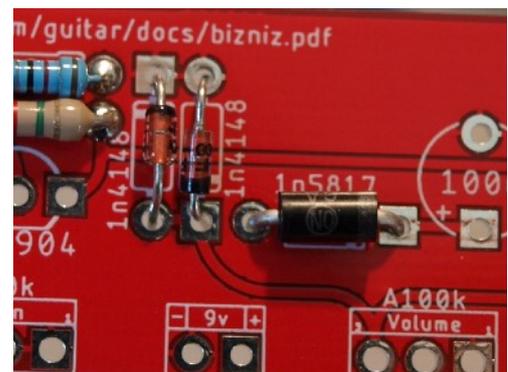
Diodes

Solder the diodes next. Note that the diodes need to go in a certain way. The diodes will have a thin stripe on their body, which should be matched up to the stripe on the PCB markings.

The 1n5817 diode will be black, with a silver stripe at one end - make sure the silver stripe matches the marking on the board. This diode is protecting the circuit in the unlikely even that some muppet hooks up the battery backwards. If you put this diode in backwards, the circuit will not work at all.

The 1n4148 diodes have a black stripe at one end - match that up to the marking on the board. (Note that the two diodes go in opposite directions here. One will have the stripe closer to the top of the board, the other closer to the bottom).

The 1n4148 diodes are used to clip the peaks of the sound wave, which will cause some of the distorted sound you will hear. Instead of the 1n4148 diodes, you can try other ones here - 1n4001, BAT41, 1n34A, or even red LEDs. You can mix and match your clipping diodes, they don't always have to be a pair of the same type.

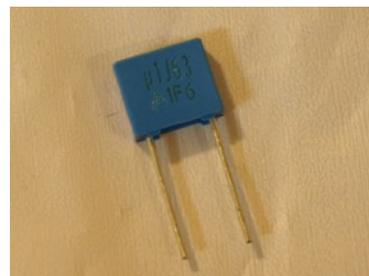


Capacitors

There are three capacitors on the board:

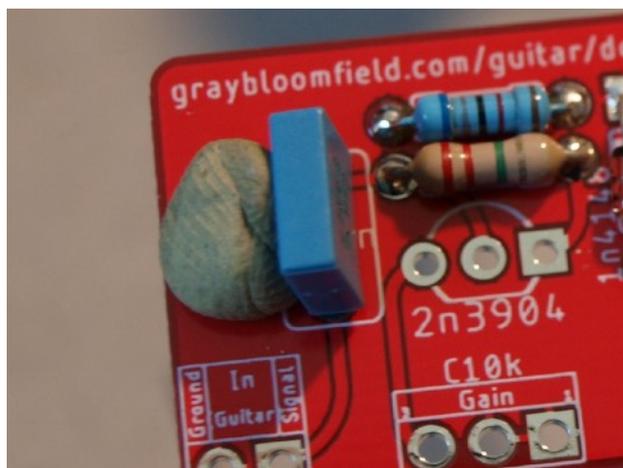
Capacitor	Value	Markings
C1	100 nF	100n, or $\mu 1$, or '104'
C2	100 nF	100n, or $\mu 1$, or '104'
C3	100 μ F	100 μ F, 16v or higher.

The value for **C1** capacitor is 100nF (or 0.1 μ F, or ' $\mu 1$ '). Changing this value will affect how much bass signal gets through into the pedal. To cut more bass, you could try a 68nF (683) or 47nF (473) capacitor instead. For more bass, try 220nF or 470nF. **C1** is on the left hand side of the board, labelled '100n'.

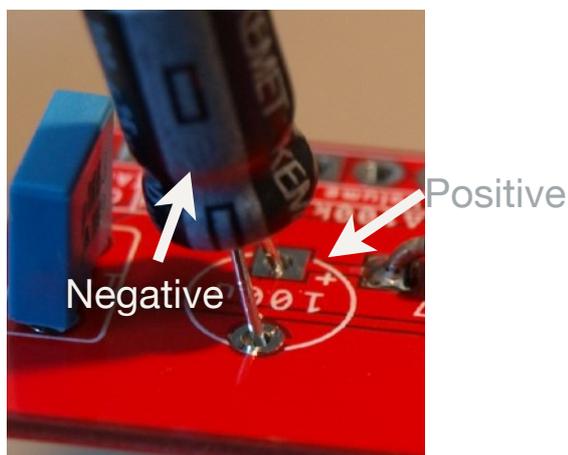
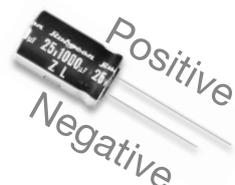


Changing **C2** won't have much effect. Leave it at 100nF.

I find it helps to hold the capacitors in place with some blue-tac when soldering, otherwise they tend to fall out or get soldered wonky.

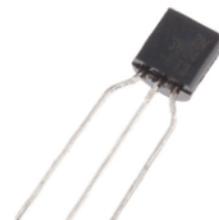


C3 is an *electrolytic capacitor*, and **it matters which way you put it in**. The capacitor has markings showing which side is negative. The other side is positive, and you need to line that side up with the little '+' marking on the board when you insert the capacitor. If you put it in the wrong way, the circuit will probably still work, but eventually the capacitor will burst, and nasty goo will go all over your board.



Transistor

The transistor (**Q1**) is what gives the guitar signal a small boost. The board says '2n3904', but you can also try a 2n5088 or 2n5089 - they will give you more gain (especially the 5089). These three transistors all have the same pinout - so you can interchange them without moving any other parts.



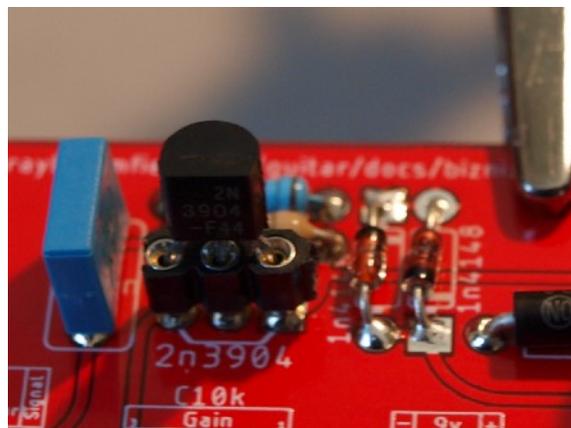
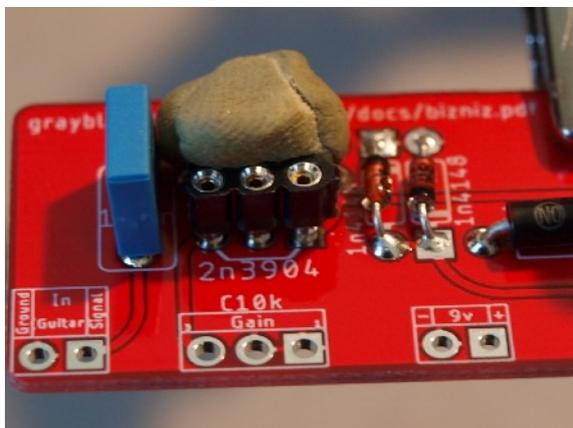
The board has the outline of the transistor marked. Make sure you match up the flat edge on the board, with the flat edge of the transistor.

If nothing is working, the first thing to check is whether you've got the transistor in backwards. Happens to everyone, even professionals who've done heaps of pedals.

I highly recommend that you solder in a socket here, for a few reasons:

- If you put the transistor in backwards, it's easy to remove and turn it around.
- If you want to try a different transistor to see if it has a different sound, you can swap it in easily.
- Transistors are a bit more sensitive than the other components, and using a socket avoids having to heat them up with the soldering iron.

If you are soldering in a socket, you can hold it in place with blue-tac while you solder the back.



Potentiometers

Or 'pot', for short. These are variable resistors, which change their value as you twist the shaft. There are two in this project - 'Gain' which controls how much boost and distortion you will get, and 'Volume' which controls the overall output volume.

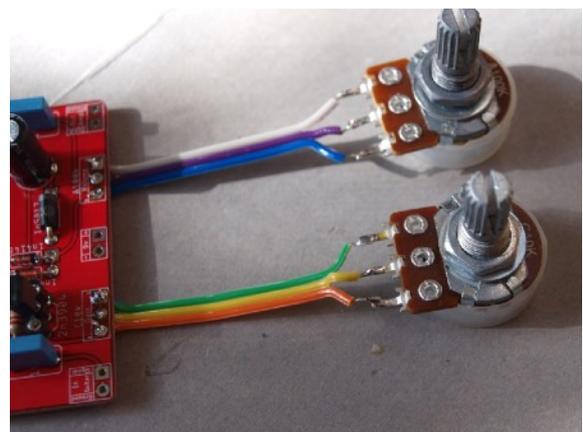
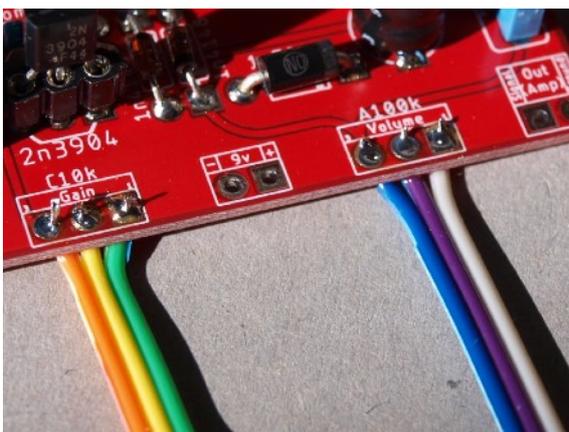
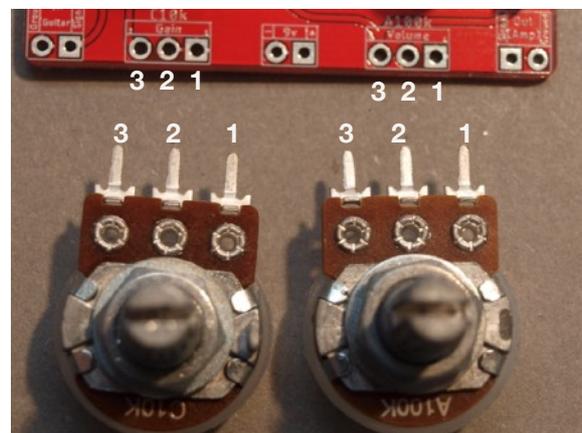
The Volume pot is a *Log* (or *Audio* - **A**) pot. This varies the resistance on a logarithmic scale, which is a fancy way of saying that it varies the resistance more quickly at the top end of the scale. This matches the way that human ears process sounds, so it makes the volume change smoothly as you turn the knob.

The Gain pot is a *reverse log* taper (**C**). This is to spread the gain out across the full turn of the knob. A linear (**B**) pot would also work, but the effect would be 'bunched up' at one end of the knob turn.

Potentiometers come in all sorts of sizes and shapes - for this project, you will most likely want a 'rotary' potentiometer, in either 16mm or 9mm size. The shaft should be 6mm or 6.35mm diameter, and can be 'smooth' or 'splined' or 'knurled' - these describe the edge of the shaft. They will all work, but if you want to put a knob on it, you will need to make sure the knob matches the shaft type.

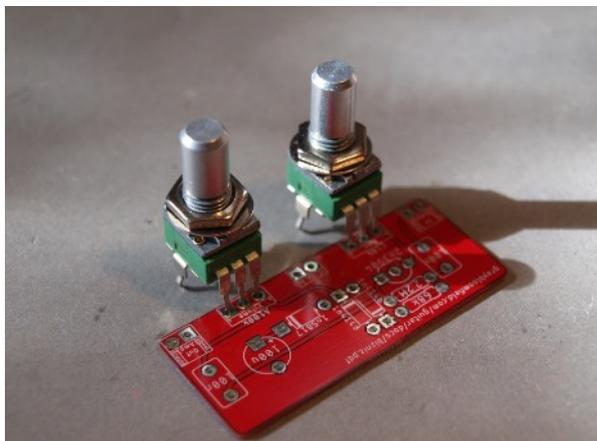
If you use a **16mm potentiometer**, you will need to solder some wires to join the pot to the board. The board has tiny markings for '1' and '3' - these match up to the potentiometer pins as shown in the diagram to the right.

You can use any sort of insulated wire to join the pots to the board - I would recommend some 24 AWG or 26 AWG stranded wire, or a 28 AWG ribbon strip if you want things to be super neat and tidy.



For **9mm pots**, you can solder them directly to the board. They can go on the top or the bottom of the board, but again, make sure that you match up the pin numbers correctly. If you solder the pot on backwards, then twisting the volume will make things quieter going clockwise, which is just all sorts of wrong.

You can solder the 9mm pots on the top or bottom, orientated as so:



If you solder the pots over the board, make sure that the metal legs or bottom of the pots don't short out on any other soldered parts. You can put some electrical tape over the board to stop things shorting out if you need.

Audio jacks

Guitars and guitar amps tend to use a 6.35mm diameter audio jack. We will use a 'mono' jack, rather than 'stereo'.

Mono audio jacks have two connections - these are referred to as the 'tip' and 'sleeve' of the jack - they make contact with the tip of the guitar plug, and the rest. The 'tip' is the signal from the guitar, while the 'sleeve' is the ground part of the circuit.

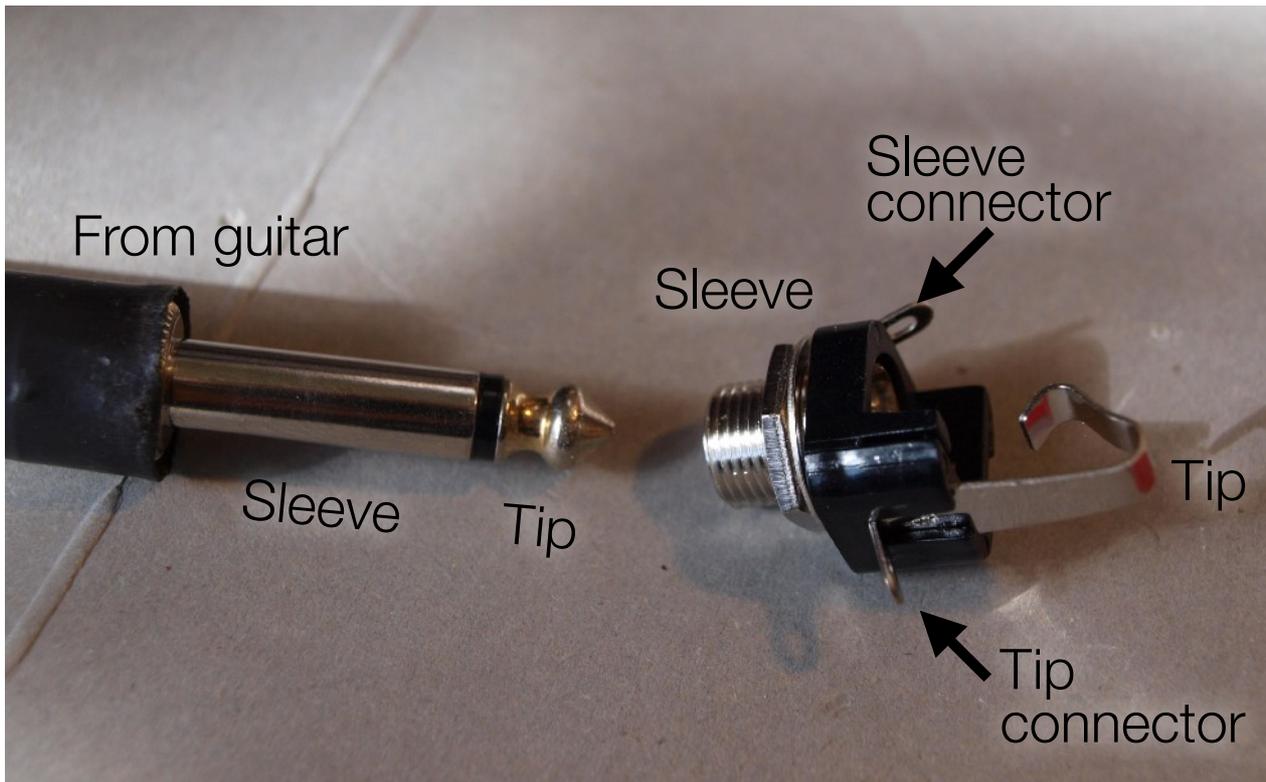
You can buy cheap audio jacks from eBay or elsewhere. The quality will vary. I have had some cheap ones work fine, and others fall apart if you look at them.



You can also buy slightly more expensive ones, such as the mini Lumberg model, which is stocked by diyguitarpedals.com.au - I've found these to be good quality.



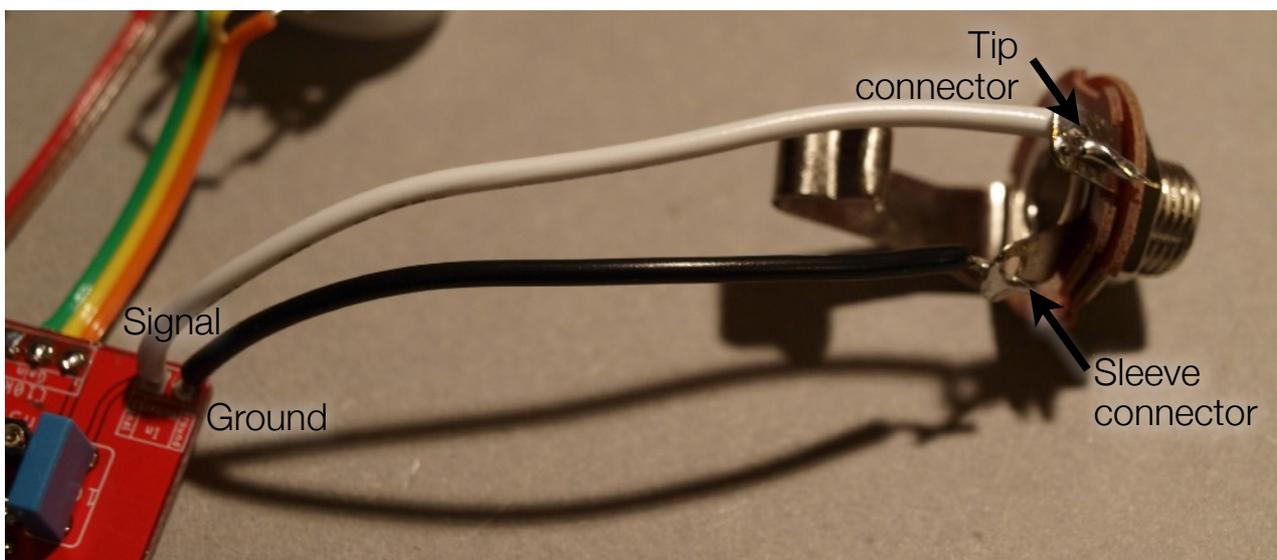
To connect the jack to the board, you will need to work out which side of the jack is the 'tip', and connect that



to the part labelled **In (guitar) 'signal'** on the board. Then connect the other one to **ground** on the board. Then use a second jack in the same way, to connect to the **Out (Amp)** part of the board.

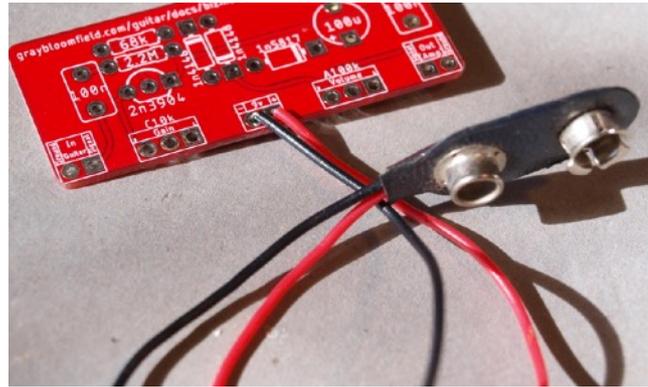
What will happen if you mix up the tip and sleeve connections? Not a lot. You won't hear any noise from the circuit though. Likewise, if you connect the guitar and amp into the wrong plugs, it won't work. If you find things aren't working, double check you have the right things plugged into the right jack.

You should end up connecting the jack something like this (and another similar one on the other side of the board):



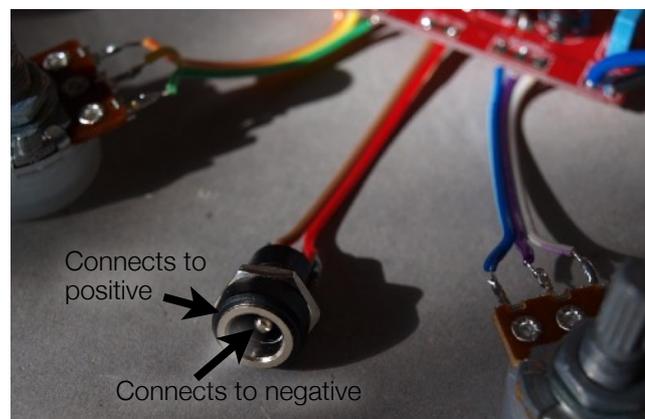
Power (9 volts DC)

To make the circuit work, you need to provide 9v DC power. If you don't already have a guitar pedal power supply lying around, the easiest thing to use is probably a 9v battery. Solder a 9v battery clip on to the board. The black wire goes to the '-' pad, and the red wire goes to '+' pad.



If you already have some pedals, or plan on building more, you may want to solder on a 2.1mm DC socket, instead of the battery, and use that with a power supply.

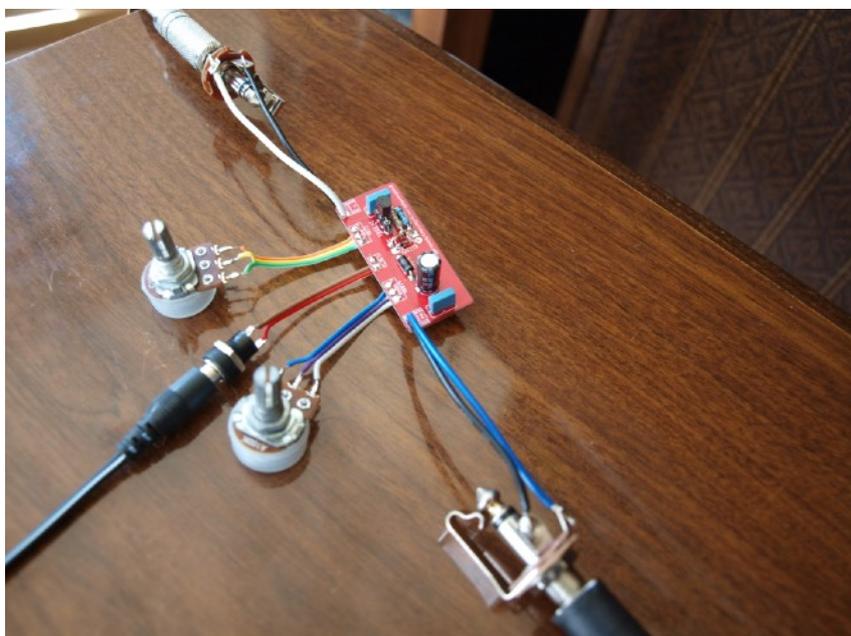
Note that due to some stupid historical choice by an early manufacturer, guitar pedals have 'centre negative' connections - the middle pin of the power socket goes to negative ('-') on the board, and the outside rim goes to positive ('+'). This is the opposite to most other electrical appliances, which are 'centre positive'. So you can't just plug a 9v wall plug from a different appliance into a guitar pedal - it will most likely connect the power backwards, which will either make the pedal not work, or short out the power supply, or destroy the pedal. If you do have a spare 9v wall plug, you can cut the wires and reverse the plug to make it into a guitar pedal supply. But then you can't use it for other appliances any more.



Test it out!

Assuming that everything is soldered in the right spot, and that you've attached the pots, jacks and power supply, you should now have a working distortion effect. Plug your guitar into the 'In' jack, and then connect the 'Out' jack to your amp.

Turning the 'Gain' pot clockwise should boost the signal more, to the point where it will break up and distort. The 'Volume' pot can then be used to control the overall final volume of the effect.



OPTIONAL STUFF

Enclosure

If you're thinking of using this thing longer term, you will want to put it into an enclosure to protect it.

I recommend a metal enclosure - usually aluminium. The metal will act as electromagnetic shielding, which stops radio interference in the circuit. You may have noticed that if you put your hand near the board when it's operating, you can pick up local radio stations! A metal enclosure fixes this.

The most popular type of enclosure for guitar effects is the Hammond brand, in sizes 1590A, 1590B and 1590BB. You can get genuine Hammond enclosures of this size from Element14 and RS Australia. You can get same size, but generic brand from diyguitarpedals.com.au, and you can get cheap ones from Tayda. There are other places online to get them, in all sorts of colours, but shipping from the USA or Europe tends to be expensive for enclosures.

Knobs

If you've put it in an enclosure, you probably want to add some bling. Putting knobs on the pots will be a good start. Most of the places that I've mentioned sell knobs of all shapes and sizes, and there are many more places to buy them. Make sure that you match the shaft size and shaft shape to fit the knobs that you are purchasing.

Stomp switch, and 'on' LED (Optional)

If you want to be able to stomp your foot on a switch to make the effect turn on and off, you can do that with a 3PDT stomp switch. (Having things in a metal enclosure at this point is a must - you can't stomp on it if it's just a bare board lying on the floor. That will not end well.)

They can be purchased from many places, including diyguitarpedals.com.au, and Tayda.

To wire up the stomp switch, you will have to disconnect the 'In' and 'Out' jacks, and rewire them through the switch.

There is an excellent 'beginners guide' to wiring a stomp switch available on the MadbeanPedals forum. Rather than try to reproduce it, I suggest you head to <http://www.madbeanpedals.com/tutorials/index.html> and look at the 'Footswitch wiring essentials' guide (PDF).

Decorate

OK, so it's in an enclosure, with knobs, and a stomp switch. Now it's artistic time. You can finish these things with paint, text, ink stamps, waterslide decals, acid etching, lasers, or whatever takes your fancy.

Some example finishes:





WHAT NEXT?

If you want to build more of these things, have a look online for places that sell PCBs for guitar effects. Some examples include: www.diyguitarpedals.com.au 1776effects.com lectric-fx.com jmkpcbs.com aionelectronics.com www.parasitstudio.se www.nucleonfx.com www.madbeanpedals.com

If you want to learn and discuss building these things, check out the Madbeanpedals forum:

<http://www.madbeanpedals.com/forum/>

SCHEMATIC

This is how the parts are all connected together, for the curious:

