PROJECT NAME

VULCAN

aion DIY GUITAR EFFECTS

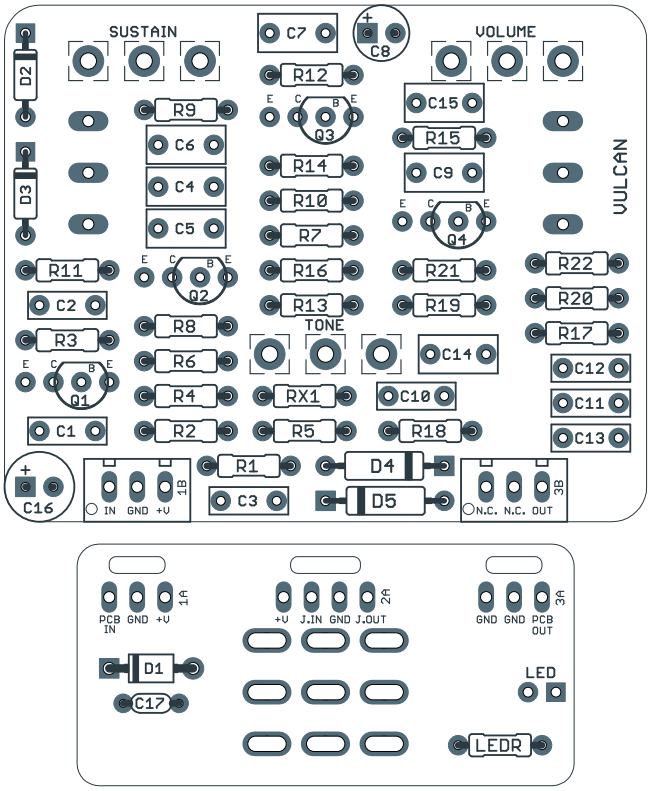
BASED ON
fOXX Tone Machine

BUILD DIFFICULTY
▮▮▯▯▯ Easy

EFFECT TYPE
Octave Fuzz

DOCUMENT VERSION
1.0.1 (2019-08-21)

PROJECT SUMMARY
A classic untamed fuzz from the 1970s that adds an octave-up overtone.



Actual size is 2.3” x 1.86” (main board) and 2.3” x 0.86” (bypass board).

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INTRODUCTION

The Vulcan Octave Fuzz is a recreation of the fOXX Tone Machine, first released in 1971 and discontinued in 1978. The Tone Machine is a thick fuzz that uses a phase splitter and complementary rectifier to create an octave overtone.

The Tone Machine has a lot in common with the Fender Blender, but with a more pronounced octave and smoother tone, as well as the ability to disable the octave by turning off half of the phase splitter.

The Vulcan is faithful to the original, but with two added modifications. First, the octave switch (normally just “on” or “off” in the original) now has a 3rd setting allowing you to bypass the series diode in non-octave mode. See build notes for more details on this.

The second modification is to the tone control. The tone control of the original is somewhat similar to the Big Muff, but many people find it’s difficult to get good sounds from the treble side of the rotation. By increasing the value of the treble-side tone capacitor, it improves the usability. A switch has been added to let you choose between two different capacitors in addition to the original.

USAGE

The Vulcan has the following controls:

- **Sustain** is the overall distortion or fuzz level of the effect.
- **Tone** pans between a low-pass and high-pass filter similar to a Big Muff tone control.
- **Volume** controls the overall output of the effect.
- **Octave** (toggle switch) selects between octave, no octave (original) and no octave (modified).
- **Midrange** (toggle switch) selects between two tone control capacitors that impact the midrange frequencies, as well as allowing you to select just the stock capacitor.

PARTS LIST

This parts list is also available in a spreadsheet format which can be imported directly into Mouser for easy parts ordering. Mouser doesn't carry all the parts (most notably potentiometers) so the second tab lists all the non-Mouser parts as well as sources for each.

View parts list spreadsheet →

PART	VALUE	TYPE	NOTES
R1	1M	Metal film resistor, 1/4W	
R2	47k	Metal film resistor, 1/4W	
R3	1k	Metal film resistor, 1/4W	
R4	47k	Metal film resistor, 1/4W	
R5	100k	Metal film resistor, 1/4W	
R6	100k	Metal film resistor, 1/4W	
R7	4k7	Metal film resistor, 1/4W	
R8	4k7	Metal film resistor, 1/4W	
R9	100k	Metal film resistor, 1/4W	
R10	100k	Metal film resistor, 1/4W	
R11	100k	Metal film resistor, 1/4W	
R12	220R	Metal film resistor, 1/4W	
R13	150k	Metal film resistor, 1/4W	
R14	15k	Metal film resistor, 1/4W	Some variants have a 1n capacitor in parallel with R14.
R15	1k	Metal film resistor, 1/4W	
R16	10k	Metal film resistor, 1/4W	
R17	22k	Metal film resistor, 1/4W	
R18	4k7	Metal film resistor, 1/4W	
R19	470k	Metal film resistor, 1/4W	
R20	47k	Metal film resistor, 1/4W	
R21	10k	Metal film resistor, 1/4W	
R22	1k5	Metal film resistor, 1/4W	
RX1	OMIT	Metal film resistor, 1/4W	Modification for more pronounced filter, similar to Big Muff tone stage. Leave empty for stock, or use 22k here for modification.
C1	100n	Film capacitor, 7.2 x 2.5mm	
C2	1n	Film capacitor, 7.2 x 2.5mm	
C3	100n	Film capacitor, 7.2 x 2.5mm	
C4	1uF	Film capacitor, 7.2 x 3.5mm	
C5	1uF	Film capacitor, 7.2 x 3.5mm	
C6	1uF	Film capacitor, 7.2 x 3.5mm	
C7	1uF	Film capacitor, 7.2 x 3.5mm	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C8	10uF	Electrolytic capacitor, 5mm	
C9	1uF	Film capacitor, 7.2 x 3.5mm	
C10	1n	Film capacitor, 7.2 x 2.5mm	
C11	2n2	Film capacitor, 7.2 x 2.5mm	Modification - alternate capacitors for tone section, switched in via the Midrange switch.
C12	15n	Film capacitor, 7.2 x 2.5mm	Modification - alternate capacitors for tone section, switched in via the Midrange switch.
C13	47n	Film capacitor, 7.2 x 2.5mm	
C14	1uF	Film capacitor, 7.2 x 3.5mm	
C15	1uF	Film capacitor, 7.2 x 3.5mm	
C16	100uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C17	100n	MLCC capacitor, X7R	Power supply filter capacitor.
D1	1N5817	Schottky diode, DO-41	
D2	BAT46	Schottky diode, DO-35	Substitute. Original uses 1N34A or other germanium.
D3	BAT46	Schottky diode, DO-35	Substitute. Original uses 1N34A or other germanium.
D4	1N34A	Diode, germanium, NOS	
D5	1N34A	Diode, germanium, NOS	
Q1	2N5089	BJT transistor, NPN, TO-92	Modern substitute. The original used 2N3565 or 2N5133. For best results, sort for hFE (gain) of 400 or more.
Q2	2N5089	BJT transistor, NPN, TO-92	
Q3	2N5089	BJT transistor, NPN, TO-92	
Q4	2N5089	BJT transistor, NPN, TO-92	
SUST.	50kB	16mm right-angle PCB mount pot	
TONE	50kB	16mm right-angle PCB mount pot	
VOL.	50kB	16mm right-angle PCB mount pot	
MID	SPDT	Toggle switch, SPDT on-on	Modification to improve usefulness of tone control. See build notes.
OCTAVE	SPDT cntr off	Toggle switch, SPDT on-off-on	Slight modification to the original. See build notes.
LED	5mm	LED, 5mm, red diffused	
IN	1/4" stereo	1/4" phone jack, closed frame	Switchcraft 112BX or equivalent.
OUT	1/4" mono	1/4" phone jack, closed frame	Switchcraft 111X or equivalent.
DC	2.1mm	DC jack, 2.1mm panel mount	Mouser 163-4302-E or equivalent.
BATT	Battery snap	9V battery snap	Optional. Use the soft plastic type—the hard-shell type will not fit.
FSW	3PDT	Stomp switch, 3PDT	
ENC	125B	Enclosure, die-cast aluminum	Can also use a Hammond 1590N1.

BUILD NOTES

Octave switch

The octave in this effect is generated by splitting the signal into two, one in-phase and one out of phase, and then rectifying the signals to cancel out half of the waveform of each. The signals are then combined back together which emphasizes the octave overtone.

The octave switch lets you disable half of the phase splitter to cancel out the octave effect. However, the non-octave signal still passes through a series diode (D2) which introduces something called “crossover distortion”. While this crossover distortion is part of the sound of the Tone Machine, it sounds very good without it as well and justifies having its own setting.

As a result, the octave switch has been modified to have Octave, No Octave (original) and No Octave (modified) settings.

Tone control modifications

Midrange switch

The biggest flaw in the Tone Machine is the tone control. It’s reminiscent of the Big Muff in its topology, but missing a resistor to ground on the treble side to complete the filter, and with a very low value for the treble capacitor. By changing the capacitor to a higher value, the frequency range is increased and the treble side of the control becomes a lot more usable.

Big Muff resistor

As mentioned previously, the tone control is one resistor away from a Big Muff tone control. An optional resistor, RX1, has been added in case you want to experiment to see how it sounds. Start with 22k as a value. You may want to look through different Big Muff schematics for other ideas as well. R17 and C13 can be adjusted as well to match a Big Muff variant.

Minimum bass value resistor

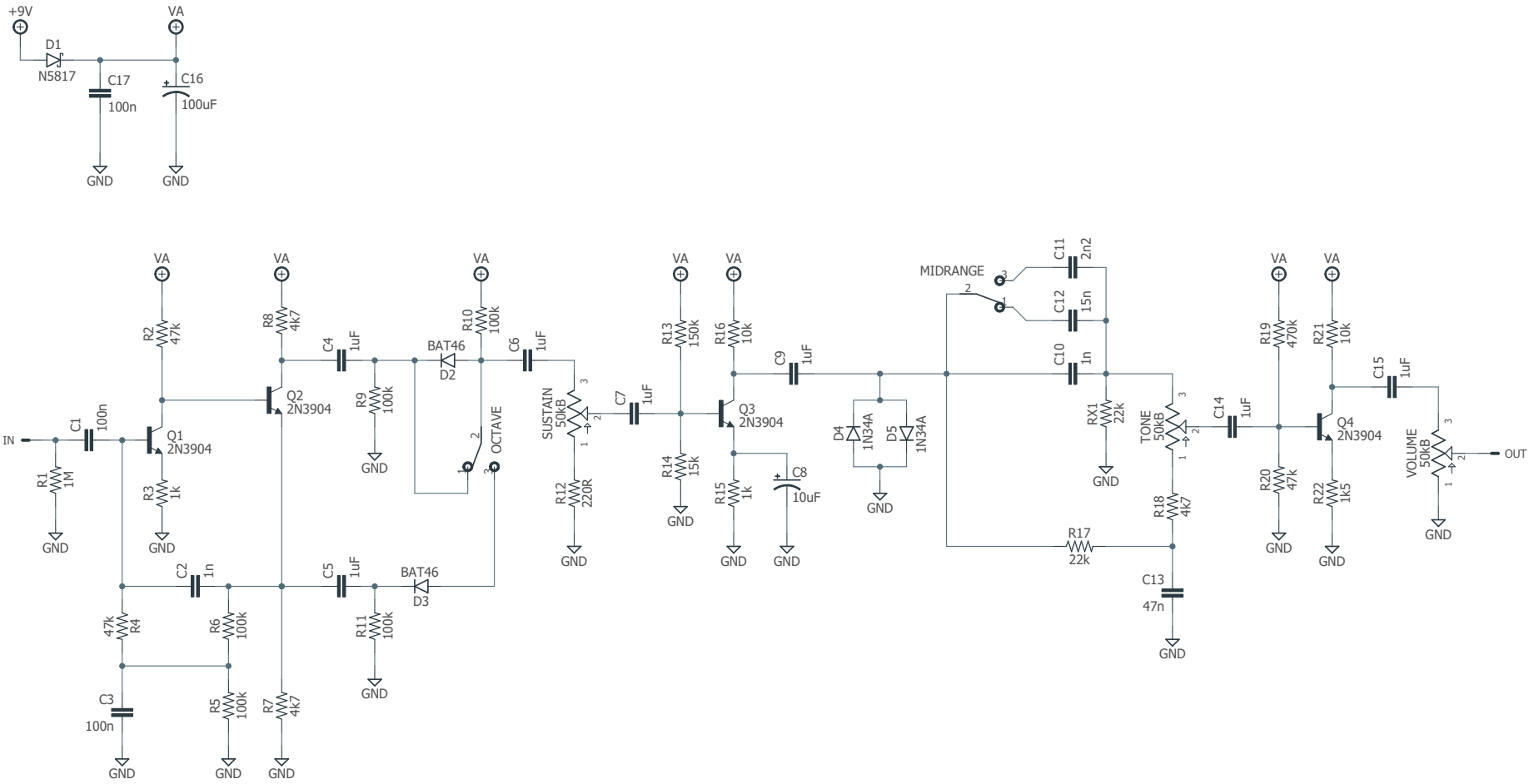
R18 sets the minimum value for the bass side of the knob rotation, setting it approximately 10% higher than a standard Big Muff tone sectioin. If you want more bass (especially if using modified filter values to be more like a Big Muff) then you may want to jumper this resistor to give the control more range.

Transistor selection

The unit sounds best with transistors over 400 hFE. The original 2N3565 was a very high-gain transistor for the time, but it still had to be sorted for gain during the manufacturing process. The 2N5088 is the go-to high-gain/low-noise transistor today, but while the datasheet allows for a gain range of 300 to 900, in practice, most of them are actually under 300-400 hFE so they would not be ideal.

The 2N5089 is a much better choice since the datasheet specifies a minimum of 400. However, any bipolar transistor above 400 hFE should work, including the 2N5088.

SCHEMATIC


+9V
VA
D1
N5817
C17
100n
C16
100uF
GND
IN
C1
100n
Q1
2N3904
R1
1M
R2
47k
R3
1k
Q2
2N3904
R8
4k7
C4
1uF
BAT46
D2
R9
100k
R10
100k
C6
1uF
OCTAVE
SUSTAIN
50kB
C7
1uF
R12
220R
R13
150k
R16
10k
Q3
2N3904
C9
1uF
R14
15k
R15
1k
C8
10uF
D4
1N34A
D5
1N34A
MIDRANGE
C11
2n2
C12
15n
C10
1n
RX1
22k
TONE
50kB
R17
22k
R18
4k7
C13
47n
C14
1uF
R19
470k
R21
10k
Q4
2N3904
R20
47k
R22
1k5
C15
1uF
VOLUME
50kB
OUT
C2
1n
C5
1uF
BAT46
D3
47k
R4
R6
100k
R11
100k
C3
100n
R5
100k
R7
4k7

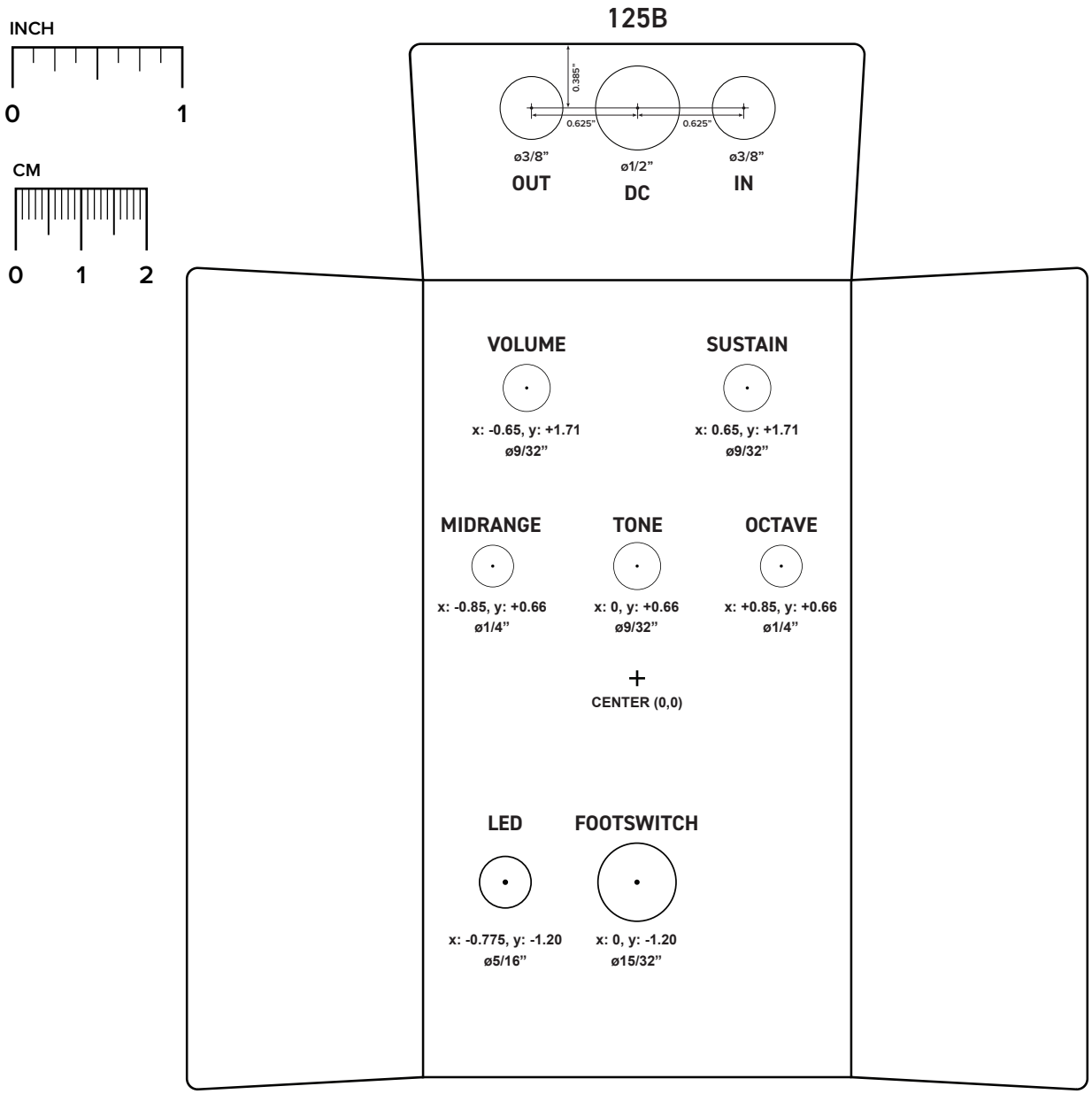
DRILL TEMPLATE

Cut out this drill template, fold the edges and tape it to the enclosure. Before drilling, it's recommended to first use a center punch for each of the holes to help guide the drill bit.

Ensure that this template is printed at 100% or "Actual Size". You can double-check this by measuring the scale on the printed page.

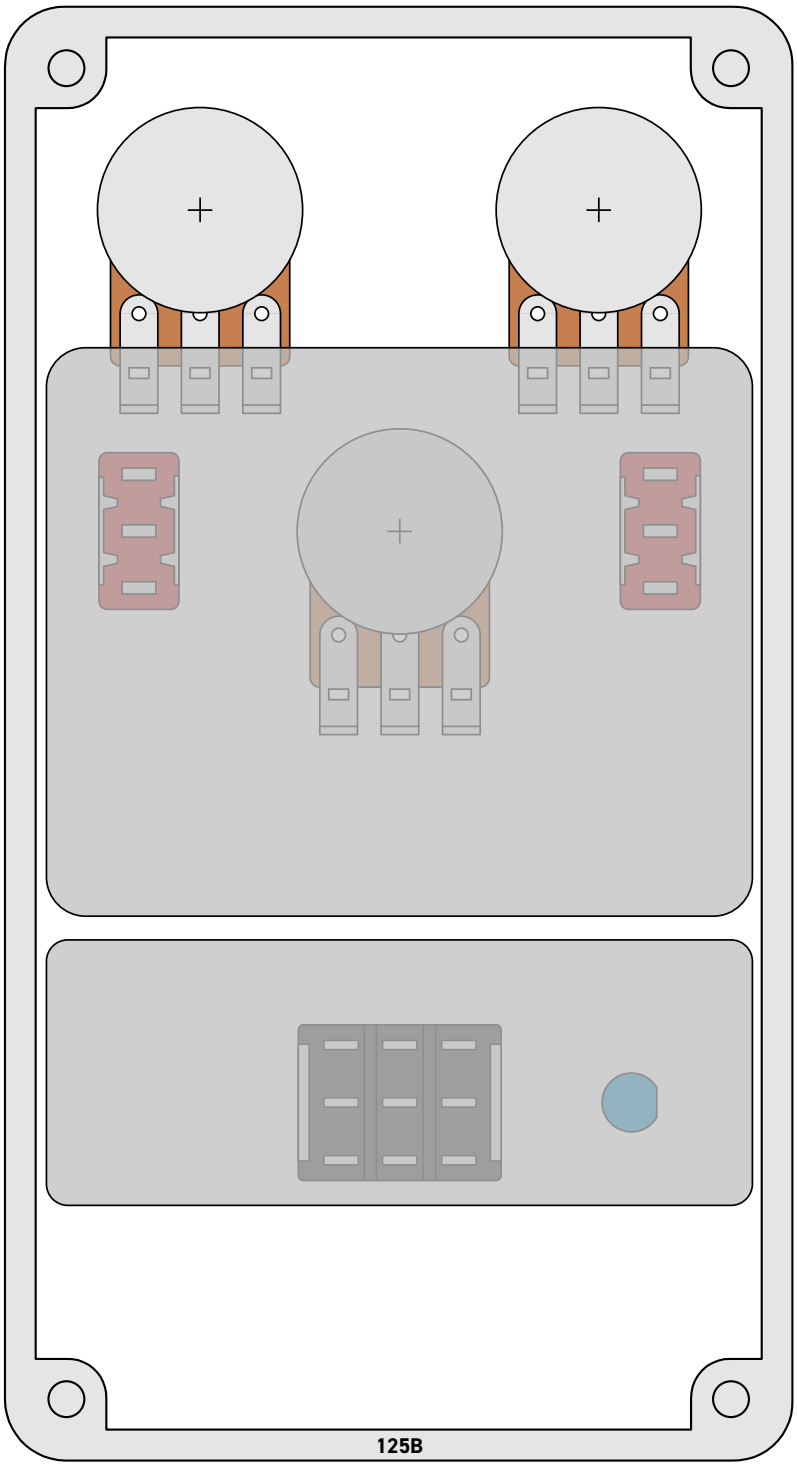
Top jack layout assumes the use of closed-frame jacks like the Switchcraft 111X. If you'd rather use open-frame jacks, please refer to the Open-Frame Jack Drill Template for the top side.

LED hole drill size assumes the use of a 5mm LED bezel, available from several parts suppliers. Adjust size accordingly if using something different, such as a 3mm bezel, a plastic bezel, or just a plain LED.

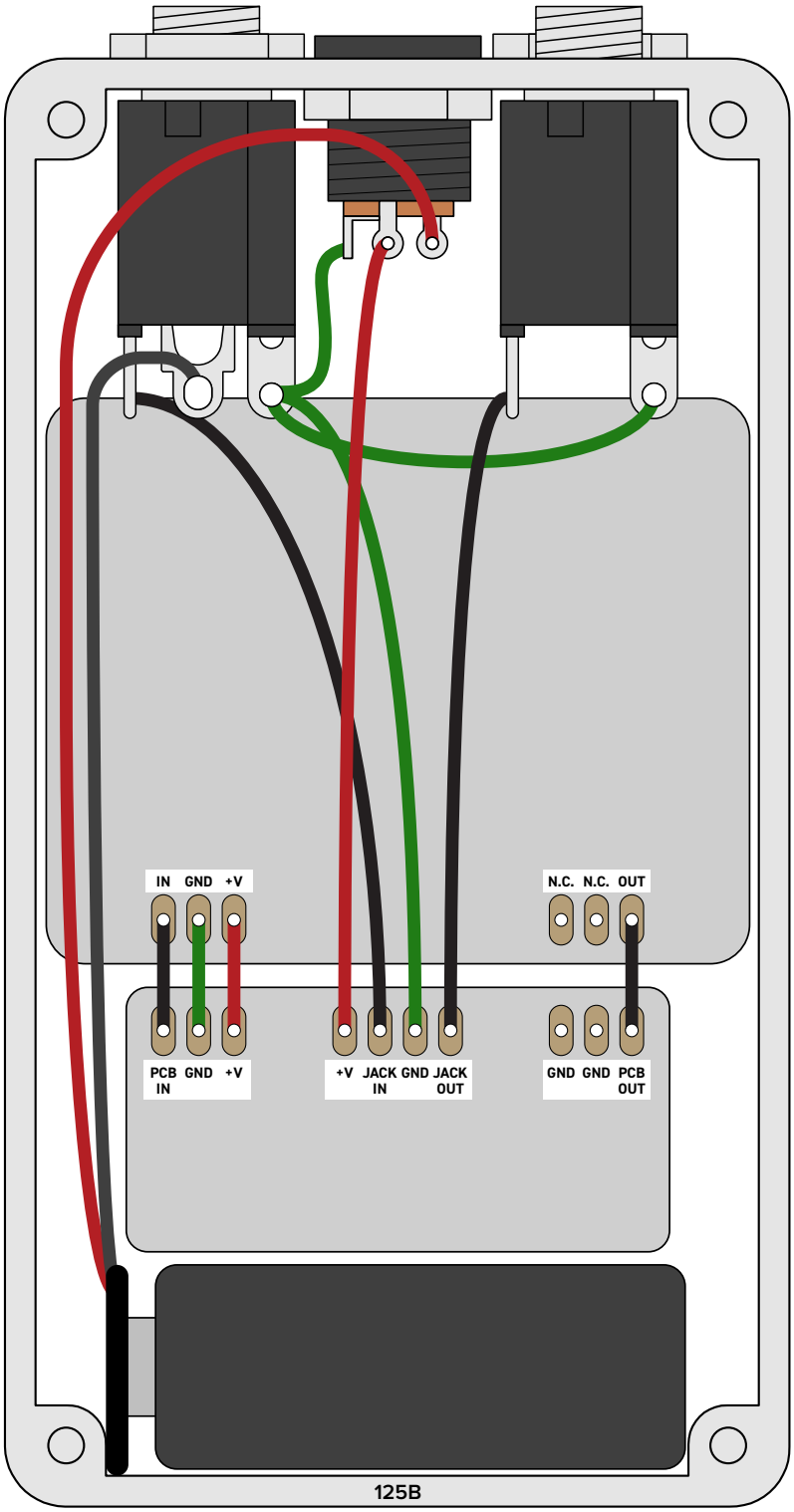


ENCLOSURE LAYOUT

Enclosure is shown without jacks. See next page for jack layout and wiring.



WIRING DIAGRAM



Shown with optional 9V battery. If battery is omitted, both jacks can be mono rather than one being stereo. Leave the far-right lug of the DC jack unconnected.

LICENSE & USAGE

No direct support is offered for these projects beyond the provided documentation. It's assumed that you have at least some experience building pedals before starting one of these. Replacements and refunds cannot be offered unless it can be shown that the circuit or documentation are in error.

All of these circuits have been tested in good faith in their base configurations. However, not all the modifications or variations have necessarily been tested. These are offered only as suggestions based on the experience and opinions of others.

Projects may be used for commercial endeavors in any quantity unless specifically noted. No attribution is necessary, though a link back is always greatly appreciated. The only usage restrictions are that **(1) you cannot resell the PCB as part of a kit without prior arrangement**, and **(2) you cannot "goop" the circuit, scratch off the screenprint, or otherwise obfuscate the circuit to disguise its source**. (In other words: you don't have to go out of your way to advertise the fact that you use these PCBs, but please don't go out of your way to hide it. The guitar effects industry needs more transparency, not less!)

DOCUMENT REVISIONS

1.0.1 (2019-08-21)
Removed RPD from parts list, mistakenly copied from another project.

1.0.0 (2019-02-01)
Initial release.