PROJECT NAME

ACHILLES

aion
DIY GUITAR EFFECTS

BASED ON
Analogman Prince of Tone

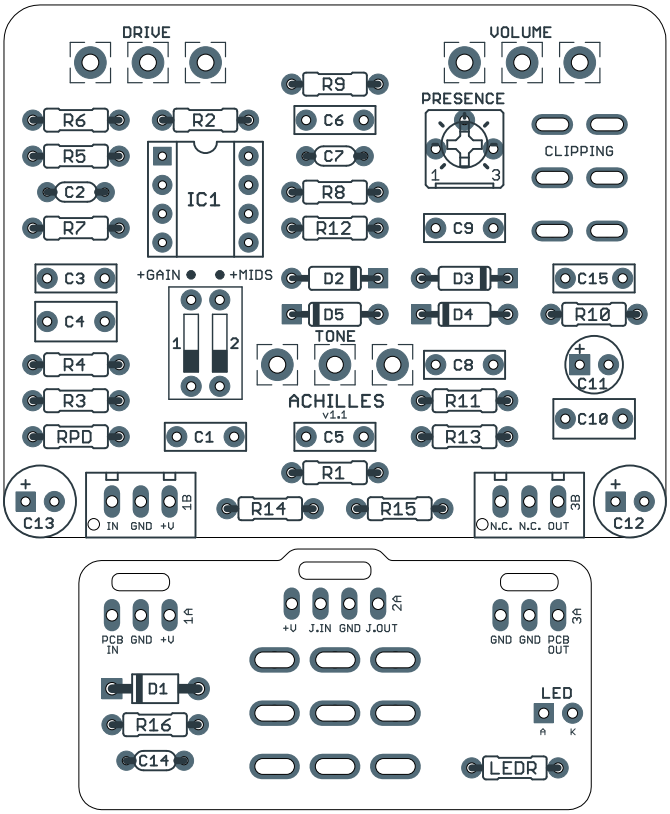
BUILD DIFFICULTY
▮▮▯▯▯ Easy

EFFECT TYPE
Amp-like overdrive

DOCUMENT VERSION
1.1.1 (2024-08-08)

PROJECT SUMMARY

A single-channel adaptation of the legendary King of Tone, with a few added features not found in the original dual-channel pedal.



Actual size is 2.3" x 1.86" (main board) and 1.78" x 0.87" (bypass board).

IMPORTANT NOTE

This documentation is for the **PCB-only** version of the project. If you are building the full kit from Aion FX, please use the kit build documentation instead. The instructions are more detailed and may differ in some areas due to the specialized parts and assembly methods used in our kits.

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INTRODUCTION

The Achilles Amp Overdrive is based on the Analogman Prince of Tone, the single-channel adaptation of the King of Tone that was first released in 2012. Unlike the King of Tone, the Prince was designed for mass production and is assembled in China. As a result, it's much more affordable as well as being readily available (the King of Tone has a 4 ½-year waiting list).

The Prince of Tone converts the internal diode DIP switch into an external toggle switch, allowing for soft clipping, hard clipping or no clipping to be selected without needing to open up the back. It also has the high gain mod from the King of Tone as standard.

Internally, in addition to the Presence control, there are two DIP switch settings that are new to this pedal. One of them adds low-mid frequencies to the first gain stage. The other is called "Turbo" mode that essentially doubles the gain of the second stage, meaning it reaches the clipping threshold sooner and has more apparent drive on tap.

The Achilles is a direct clone of the Prince of Tone with no modifications.

USAGE

The Achilles has four external controls:

- **Drive** controls the amount of gain going into the op-amp feedback diode clipping stage.
- **Tone** controls the treble response via a passive filter.
- **Volume** controls the overall output.
- **Clipping** (toggle switch) selects between soft clipping (overdrive), hard clipping (distortion) and no clipping (clean boost).

There are also three internal controls:

- **Presence** (trimmer) is an additional passive treble control. The default position is all the way down (full CCW) and as you turn it up it adds high-end. Noise or hiss will increase as well.
- **+Mids** (DIP switch) adds low-mids to the signal by increasing the filter frequency of the first op-amp gain stage.
- **+Gain** (DIP switch) doubles the gain ratio of the second op-amp stage so that the diodes clip more easily.

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—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	10k	Metal film resistor, 1/4W	
R3	27k	Metal film resistor, 1/4W	
R4	33k	Metal film resistor, 1/4W	
R5	100k	Metal film resistor, 1/4W	
R6	10k	Metal film resistor, 1/4W	
R7	10k	Metal film resistor, 1/4W	
R8	220k	Metal film resistor, 1/4W	
R9	6k8	Metal film resistor, 1/4W	
R10	1k	Metal film resistor, 1/4W	
R11	1k	Metal film resistor, 1/4W	
R12	6k8	Metal film resistor, 1/4W	
R13	1M	Metal film resistor, 1/4W	
R14	47k	Metal film resistor, 1/4W	
R15	47k	Metal film resistor, 1/4W	
R16	100R	Metal film resistor, 1/4W	Power supply filter resistor.
RPD	1M	Metal film resistor, 1/4W	Input pull-down resistor.
LEDR	10k	Metal film resistor, 1/4W	LED current-limiting resistor. Adjust value to change LED brightness.
C1	22n	Film capacitor, 7.2 x 2.5mm	10n in some units.
C2	100pF	MLCC capacitor, NP0/C0G	750pF in some units.
C3	10n	Film capacitor, 7.2 x 2.5mm	
C4	1uF	Film capacitor, 7.2 x 3.5mm	
C5	10n	Film capacitor, 7.2 x 2.5mm	
C6	100n	Film capacitor, 7.2 x 2.5mm	
C7	47pF	MLCC capacitor, NP0/C0G	Not in original pedal, but recommended to prevent high-end oscillation.
C8	10n	Film capacitor, 7.2 x 2.5mm	
C9	10n	Film capacitor, 7.2 x 2.5mm	
C10	1uF	Film capacitor, 7.2 x 3.5mm	
C11	1uF	Electrolytic capacitor, 4mm	
C12	100uF	Electrolytic capacitor, 6.3mm	Reference voltage filter capacitor.
C13	100uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitors.
C14	100n	MLCC capacitor, X7R	Power supply filter capacitors.

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C15	100n	Film capacitor, 7.2 x 3.5mm	
D1	1N5817	Schottky diode, DO-41	
D2	BAS33	Switching diode, DO-35	Original uses MA856 diodes. The BAS33 is the closest available diode currently in production.
D3	BAS33	Switching diode, DO-35	
D4	BAS33	Switching diode, DO-35	
D5	BAS33	Switching diode, DO-35	
IC1	JRC4580D	Operational amplifier, DIP8	
IC1-S	DIP-8 socket	IC socket, DIP-8	
MODE	2-pos. DIP	DIP switch, 2-position	
PRES.	50k trimmer	Trimmer, 10%, 1/4”	
DRIVE	100kB	16mm right-angle PCB mount pot	
TONE	25kB	16mm right-angle PCB mount pot	
VOL.	100kA	16mm right-angle PCB mount pot	
CLIP	DPDT cntr. off	Toggle switch, DPDT on-off-on	
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.
FSW	3PDT	Stomp switch, 3PDT	
ENC	125B	Enclosure, die-cast aluminum	Can also use a Hammond 1590N1.

BUILD NOTES

Clipping diodes

The Prince of Tone uses MA856 diodes, which clip at a slightly higher threshold than standard silicon diodes such as 1N914 (approximately 0.82V compared to 0.7V). These diodes are long out of production and have almost entirely disappeared from the old-stock market, likely all bought up by Analogman and other cloners.

The BA282 and BA283 are very close to the MA856, and were the popular substitute among builders for awhile... until they dried up too.

Now, the closest option is the BAS33. These clip at around 0.8V, still significantly higher than the 1N914 and only slightly lower than the MA856. We've compared the curves on a Peak DCA75 and confirmed that they closely match the MA856 across the current test range.

The only problem is that the BAS33 went end-of-life in early 2022. Availability is still high, but eventually they'll join the ranks of the others.

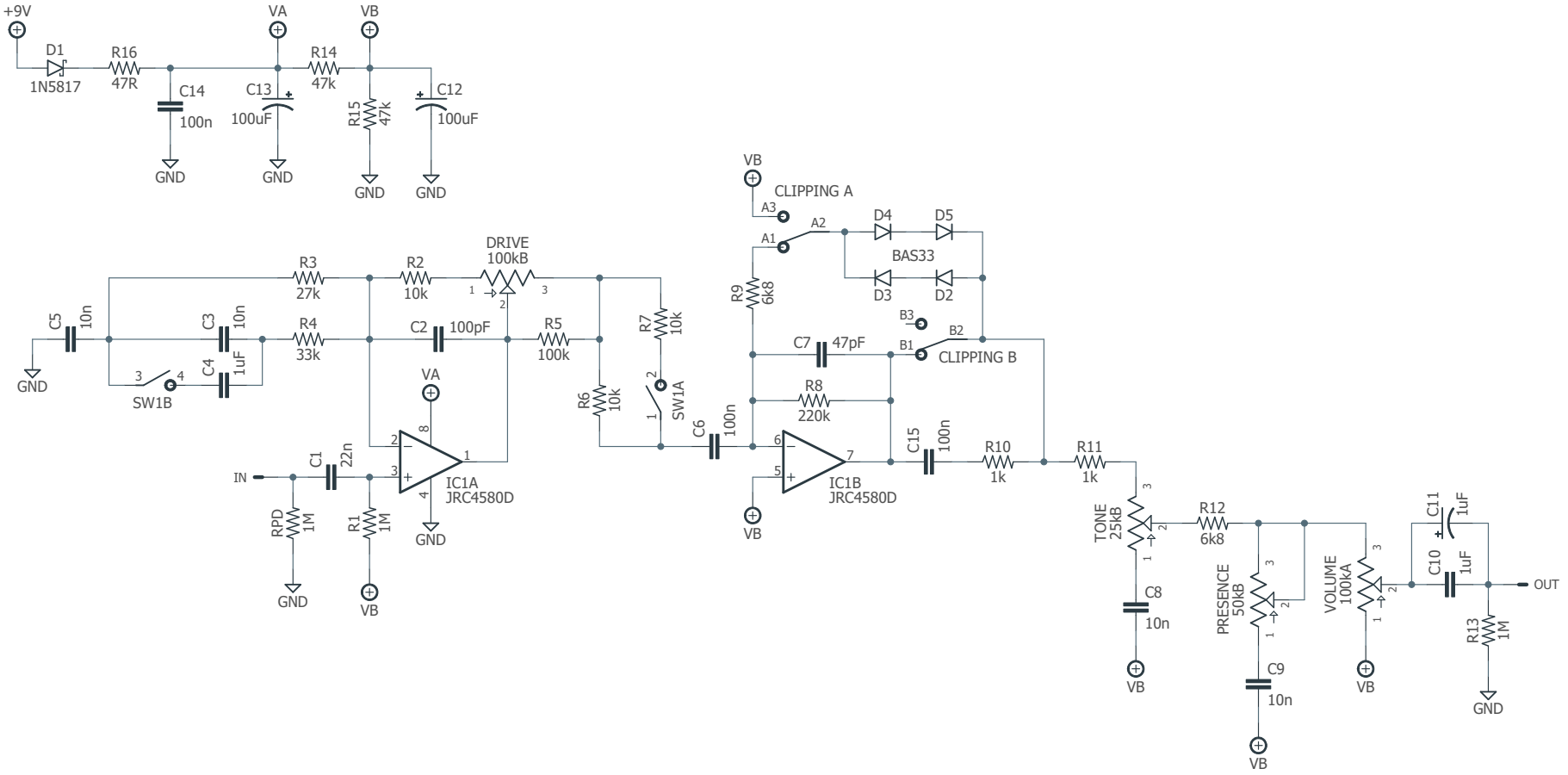
Clipping switch

The DPDT on-off-on switch allows for three settings: soft clipping (diodes in op-amp feedback loop), hard clipping (diodes to ground after the second op-amp stage) or no clipping (all diodes lifted). If you do not need the middle clean boost setting, you can instead use a DPDT on-on switch.

However, note that since the diodes are shared between the two settings and "relocated" in each position, you cannot use an on-on-on switch to use both sets of diodes at the same time or it will cause issues with the circuit.

v1.1 update: Clipping switch wiring has been updated based on review of original trace. C15 and R10 are shorted (removed from the circuit) when in soft-clipping mode and the signal only passes through them in hard-clipping mode. It makes no sonic difference whether these are in or out of the circuit since there is no frequency-shaping. However, we strive for electronic accuracy in everything and not just tonal accuracy, so we've updated the PCB to match the original.

SCHEMATIC


+9V
D1
1N5817
R16
47R
C14
100n
GND
VA
C13
100uF
GND
R14
47k
VB
R15
47k
GND
C12
100uF
GND
R3
27k
R2
10k
DRIVE
100kB
C5
10n
C3
10n
R4
33k
C2
100pF
R5
100k
R7
10k
C4
1uF
SW1B
SW1A
R6
10k
VA
C1
22n
IN
RPD
1M
R1
1M
IC1A
JRC4580D
GND
VB
C6
100n
VB
CLIPPING A
A3
A2
A1
D4
D5
BAS33
D3
D2
R9
6k8
B3
B2
B1
CLIPPING B
C7
47pF
R8
220k
IC1B
JRC4580D
VB
C15
100n
R10
1k
R11
1k
TONE
25kB
C8
10n
VB
R12
6k8
PRESENCE
50kB
C9
10n
VB
VOLUME
100kA
VB
C11
1uF
C10
1uF
OUT
R13
1M
GND

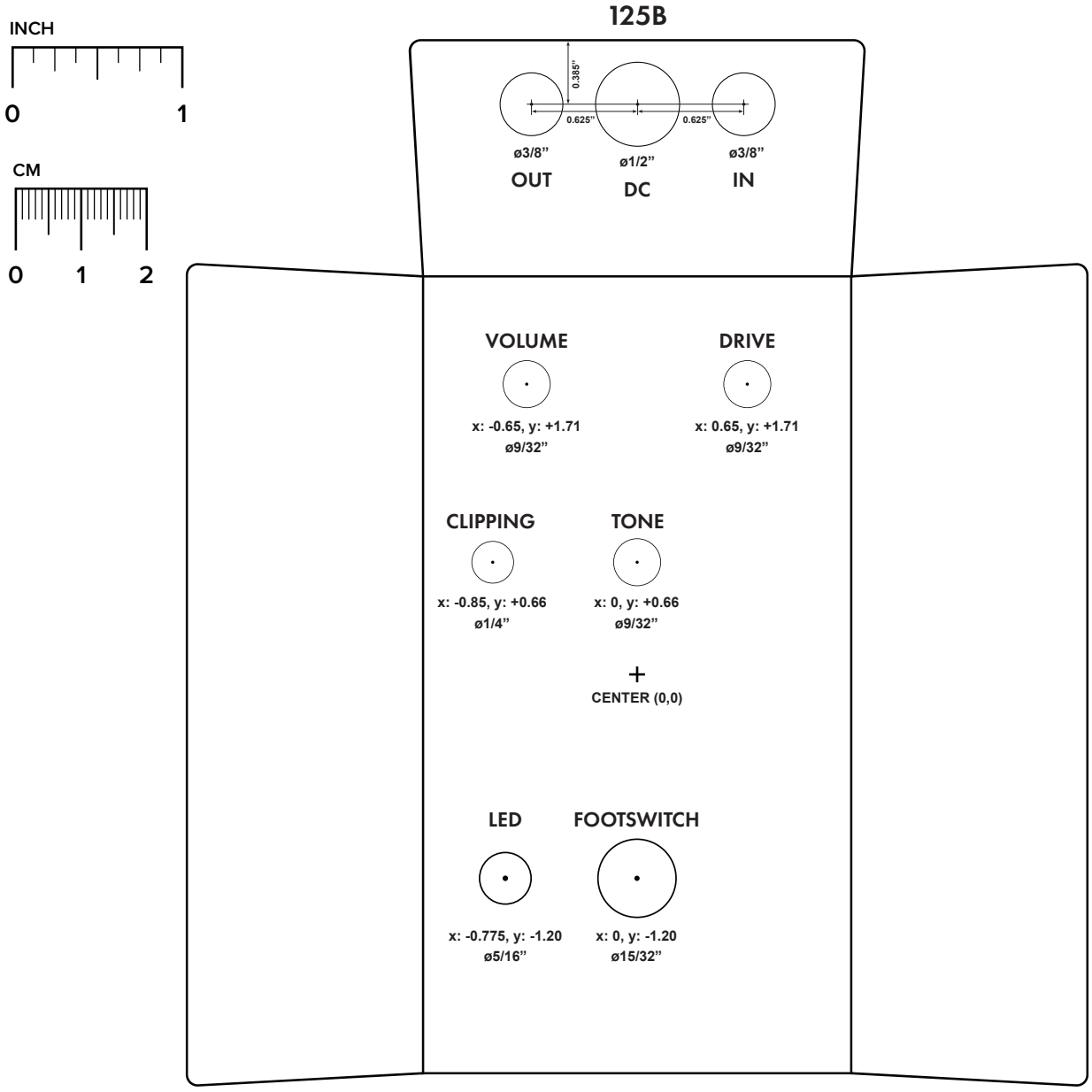
DRILL TEMPLATE

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.

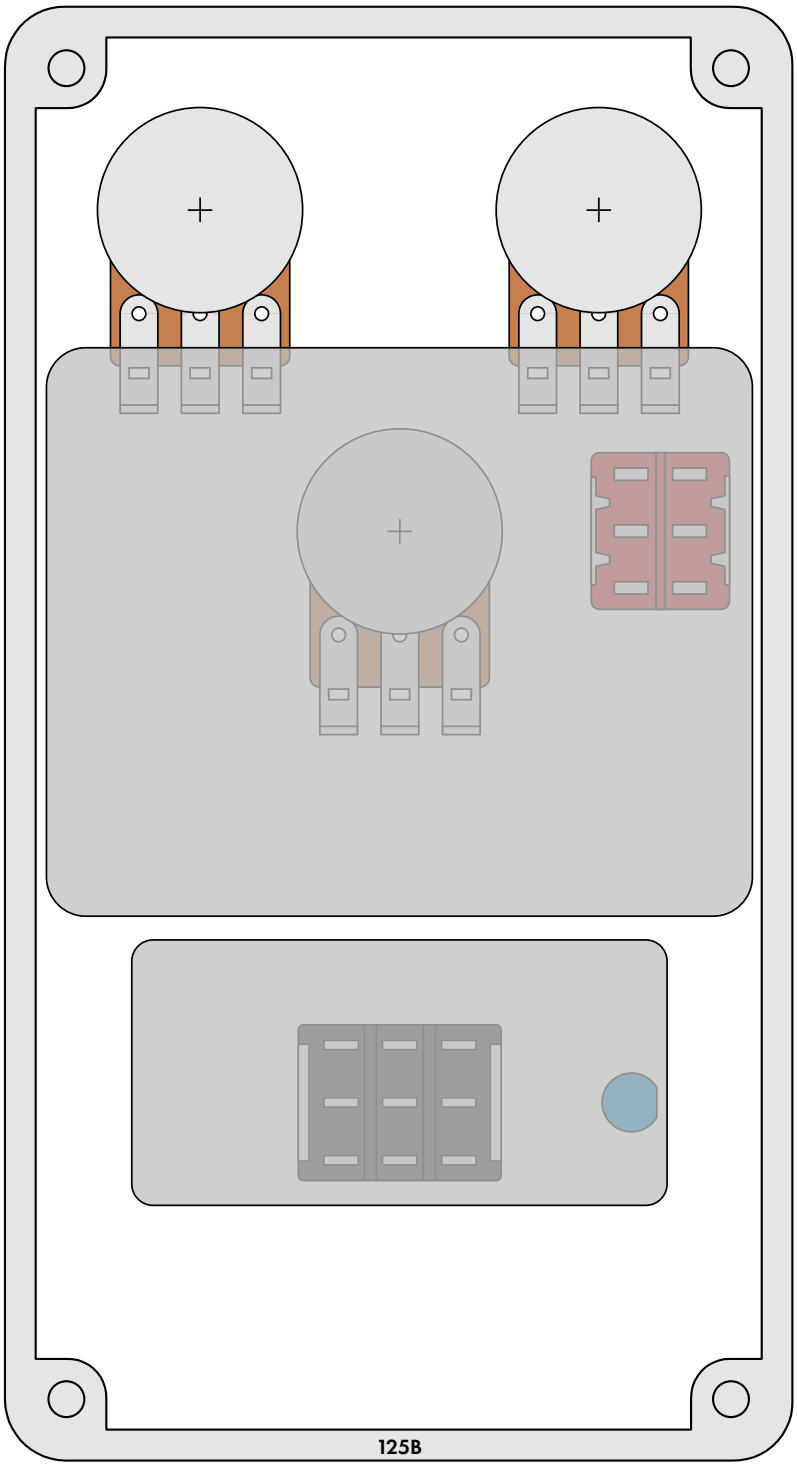
Top jack layout assumes the use of closed-frame jacks like the Switchcraft 111X. If you'd rather use open-frame jacks, please refer to the Open-Frame Jack Drill Template for the top side.

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.

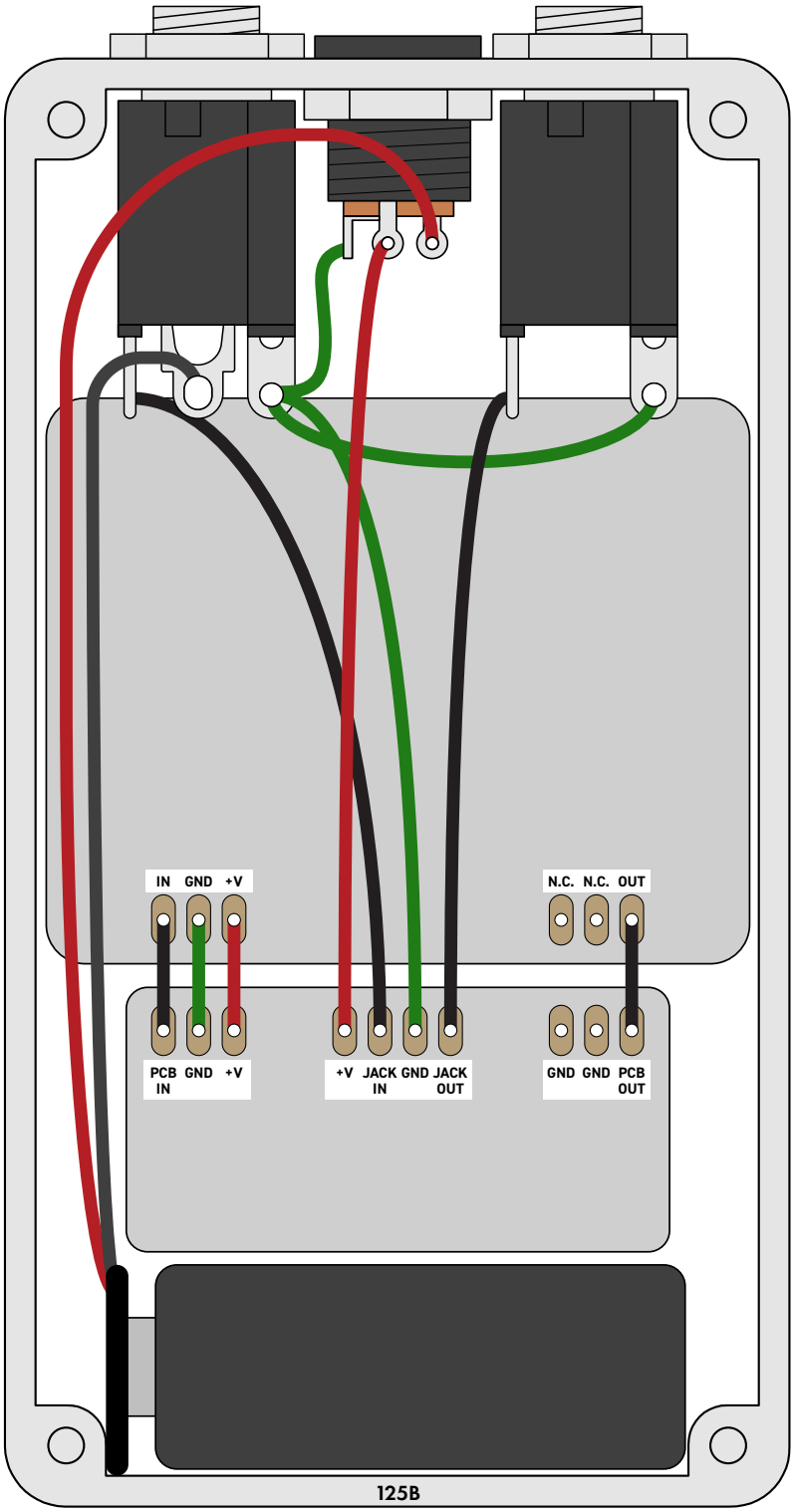


ENCLOSURE LAYOUT

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 cannotbe 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

1.1.1 (2024-08-08)

Changed LEDR to 10k to work with a wider variety of LEDs.

1.1.0 (2023-05-15)

- Updated clipping switch configuration based on reviewing original trace. See page 5 for details.
- Changed R2 to 10k (mistakenly listed as 100k in schematic and parts list).

1.0.1 (2022-09-02)
Changed RPD value to 1M (shown as 2M2 in schematic and omitted from PDF parts list). The Mouser parts list was correct.

1.0.0 (2022-04-08)
Initial release.