

PROJECT NAME

TEMPEST



BASED ON

Friedman® BE-OD / Dirty Shirley

BUILD DIFFICULTY

■■■■□ Intermediate

EFFECT TYPE

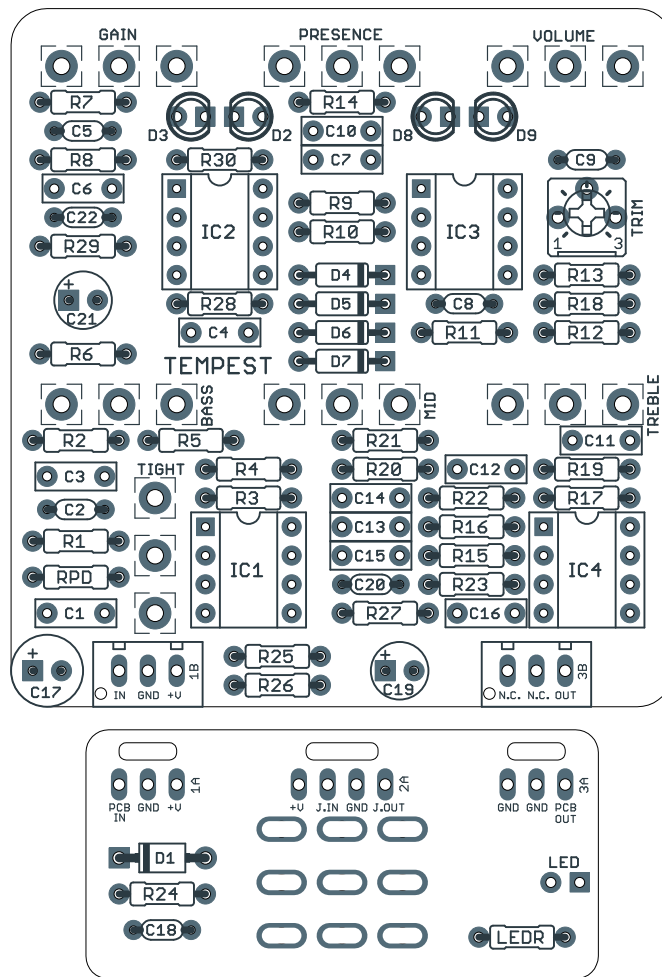
Amp-Like Distortion

DOCUMENT VERSION

1.0.1 (2019-03-08)

PROJECT SUMMARY

A pedal recreation of the Friedman® BE-100 and Dirty Shirley amplifiers.



Actual size is 2.3" x 2.42" (main board) and 1.78" x 0.86" (bypass board).

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INTRODUCTION

The Tempest Amp Distortion is a combination of the Friedman® BE-OD and Dirty Shirley pedals, two very similar circuits that were designed to emulate high-gain amplifiers.

It's not a true amp emulator of the sort that replace the tubes with JFETs, as Runoffgroove is famous for. Instead, it's fully driven by op-amps, but very carefully designed in a way to mimic the response and character of a Friedman amplifier. And by all accounts it has succeeded, quickly becoming one of the most revered "amp in a box" pedals on the scene today.

The original Friedman BE-OD is missing a midrange control, while the Dirty Shirley has a midrange control but converts the Tight knob into a toggle switch. The Tempest project combines these together, preserving the midrange control while also leaving the Tight control as a knob instead of a switch, for a total of seven knobs.

USAGE

The Tempest has the following controls, which correspond to the same controls on the BE-100 or Dirty Shirley amplifiers.

- **Gain** is the overall distortion or drive level of the effect.
- **Volume** controls the overall output of the effect.
- **Presence** is low-pass filter that sets the high-end cutoff frequency between 1.3 KHz and 7.2 KHz.
- **Tight** is a high-pass filter that sets the low-end cutoff frequency between 150Hz and 3.3 KHz near the beginning of the circuit.
- **Bass, Mid** and **Treble** form a 3-band EQ. These controls are all at different stages in the circuit, so they are not interactive with each other in the same way that a Marshall or Fender-style tonestack would be.

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	330k	Metal film resistor, 1/4W	
R2	10k	Metal film resistor, 1/4W	
R3	22k	Metal film resistor, 1/4W	
R4	39k	Metal film resistor, 1/4W	
R5	4k7	Metal film resistor, 1/4W	
R6	10k	Metal film resistor, 1/4W	
R7	22k	Metal film resistor, 1/4W	
R8	22k	Metal film resistor, 1/4W	
R9	22k	Metal film resistor, 1/4W	
R10	220k	Metal film resistor, 1/4W	
R11	22k	Metal film resistor, 1/4W	
R12	27k	Metal film resistor, 1/4W	
R13	10k	Metal film resistor, 1/4W	
R14	2k2	Metal film resistor, 1/4W	
R15	33k	Metal film resistor, 1/4W	
R16	33k	Metal film resistor, 1/4W	
R17	2k2	Metal film resistor, 1/4W	
R18	470k	Metal film resistor, 1/4W	
R19	2k2	Metal film resistor, 1/4W	
R20	2k2	Metal film resistor, 1/4W	
R21	22k	Metal film resistor, 1/4W	
R22	100k	Metal film resistor, 1/4W	
R23	2k2	Metal film resistor, 1/4W	
R24	10R	Metal film resistor, 1/4W	Power supply filtering resistor.
R25	20k	Metal film resistor, 1/4W	
R26	22k	Metal film resistor, 1/4W	
R27	2k2	Metal film resistor, 1/4W	
R28	20k	Metal film resistor, 1/4W	
R29	22k	Metal film resistor, 1/4W	
R30	2k2	Metal film resistor, 1/4W	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
RPD	2M2	Metal film resistor, 1/4W	Input pulldown resistor. Can be as low as 1M.
LEDR	4k7	Metal film resistor, 1/4W	LED current-limiting resistor. Adjust value to change LED brightness.
C1	22n	Film capacitor, 7.2 x 2.5mm	
C2	47pF	MLCC capacitor, NP0/COG	
C3	10n	Film capacitor, 7.2 x 2.5mm	
C4	1n	Film capacitor, 7.2 x 2.5mm	
C5	47pF	MLCC capacitor, NP0/COG	
C6	100n	Film capacitor, 7.2 x 2.5mm	
C7	47n	Film capacitor, 7.2 x 2.5mm	
C8	120pF	MLCC capacitor, NP0/COG	
C9	220pF	MLCC capacitor, NP0/COG	
C10	10n	Film capacitor, 7.2 x 2.5mm	
C11	4n7	Film capacitor, 7.2 x 2.5mm	
C12	22n	Film capacitor, 7.2 x 2.5mm	
C13	220n	Film capacitor, 7.2 x 2.5mm	
C14	2n2	Film capacitor, 7.2 x 2.5mm	
C15	10n	Film capacitor, 7.2 x 2.5mm	
C16	220n	Film capacitor, 7.2 x 2.5mm	
C17	100uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C18	100n	MLCC capacitor, X7R	Power supply filter capacitor.
C19	22uF	Electrolytic capacitor, 5mm	Reference voltage filter capacitor.
C20	100n	MLCC capacitor, X7R	Reference voltage filter capacitor.
C21	22uF	Electrolytic capacitor, 5mm	Reference voltage filter capacitor.
C22	100n	MLCC capacitor, X7R	Reference voltage filter capacitor.
D1	1N5817	Schottky diode, DO-41	
D2	3mm	LED, 3mm, red diffused	
D3	3mm	LED, 3mm, red diffused	
D4	1N914	Fast-switching diode, DO-35	
D5	1N914	Fast-switching diode, DO-35	
D6	1N914	Fast-switching diode, DO-35	
D7	1N914	Fast-switching diode, DO-35	
D8	3mm	LED, 3mm, red diffused	
D9	3mm	LED, 3mm, red diffused	
TRIM	100k trimmer	Trimmer, 10%, 1/4"	Adjusts the overall gain range of the effect.

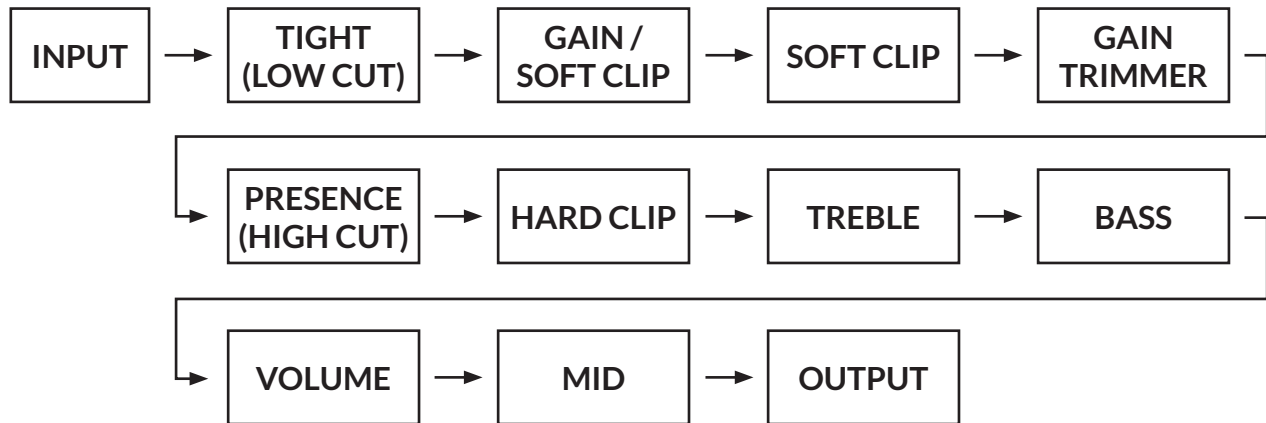
PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
IC1	TL072	Operational amplifier, DIP8	
IC2	TL072	Operational amplifier, DIP8	
IC3	TL072	Operational amplifier, DIP8	
IC4	TL072	Operational amplifier, DIP8	
IC1-S	DIP-8 socket	IC socket, DIP-8	
IC2-S	DIP-8 socket	IC socket, DIP-8	
IC3-S	DIP-8 socket	IC socket, DIP-8	
IC4-S	DIP-8 socket	IC socket, DIP-8	
BASS	100kC	16mm right-angle PCB mount pot	
TREBLE	100kB	16mm right-angle PCB mount pot	
MID	100kC	16mm right-angle PCB mount pot	
PRES.	10kC	16mm right-angle PCB mount pot	
TIGHT	100kC	16mm right-angle PCB mount pot	
GAIN	1MA	16mm right-angle PCB mount pot	
VOL.	50kA	16mm right-angle PCB mount pot	
LED	5mm	LED, 5mm, red diffused	
IN	1/4" mono	1/4" phone jack, closed frame	Switchcraft 111X 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

Circuit architecture

This circuit has several cascaded gain & clipping stages, but overall it's pretty linear without a lot of interaction between the sections. Here is a block diagram of how the circuit is arranged:



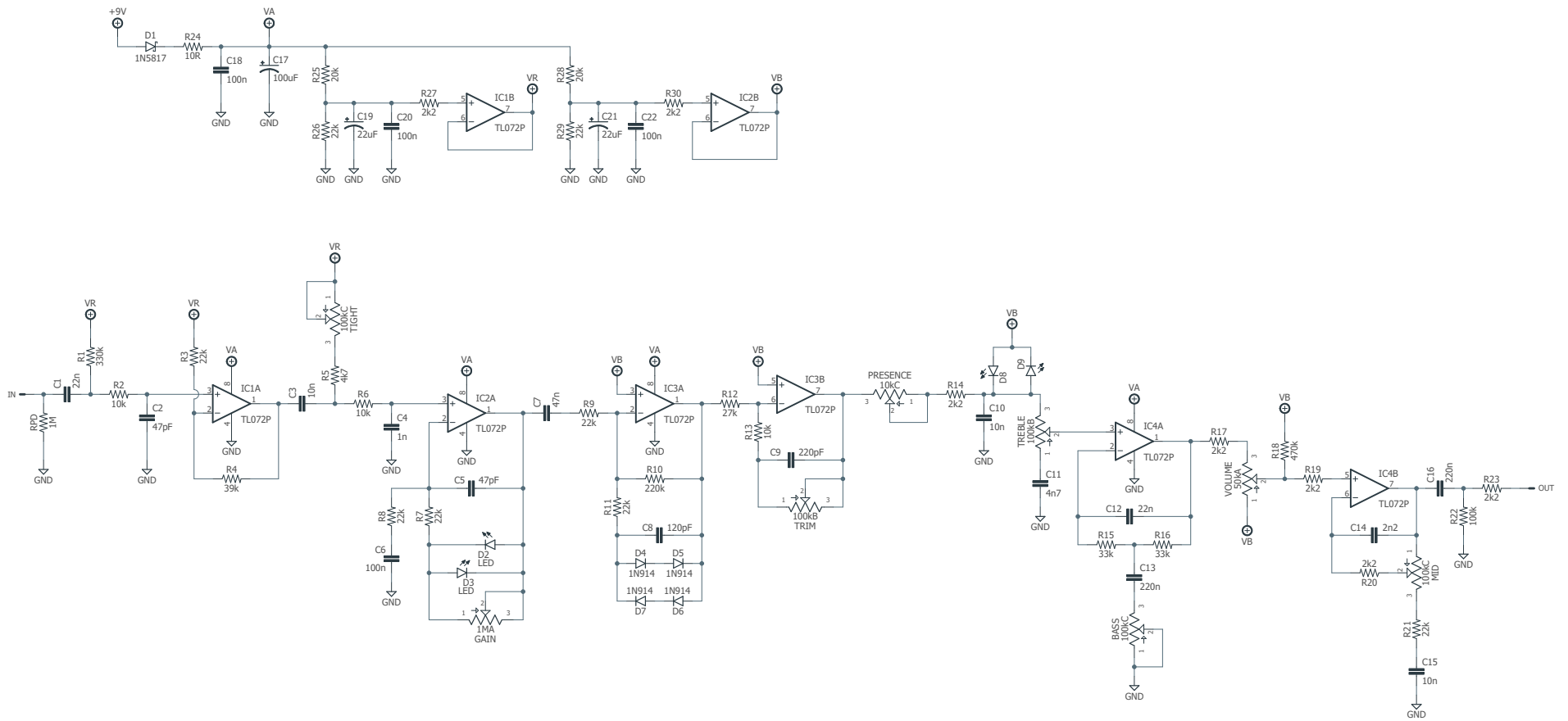
Setting the gain trimmer

The circuit has an on-board internal trimmer to adjust the overall gain range of the circuit. This is different from the external gain control. As you can see in the block diagram above, this gain stage comes after the two soft-clipping stages, but before the final hard-clipping stage. It's a simple op-amp stage that boosts or cuts the signal going into the hard clipping stage, so it primarily impacts the amount of hard clipping.

At its stock setting of 12:00, the pedal could be considered a medium-gain drive. By turning it up, you can shift it into the mid-to-high gain range.

Conversely, by turning it down, you can have better control over the low gain range, but the pedal will lack the high-gain tones that you might expect from it.

SCHEMATIC



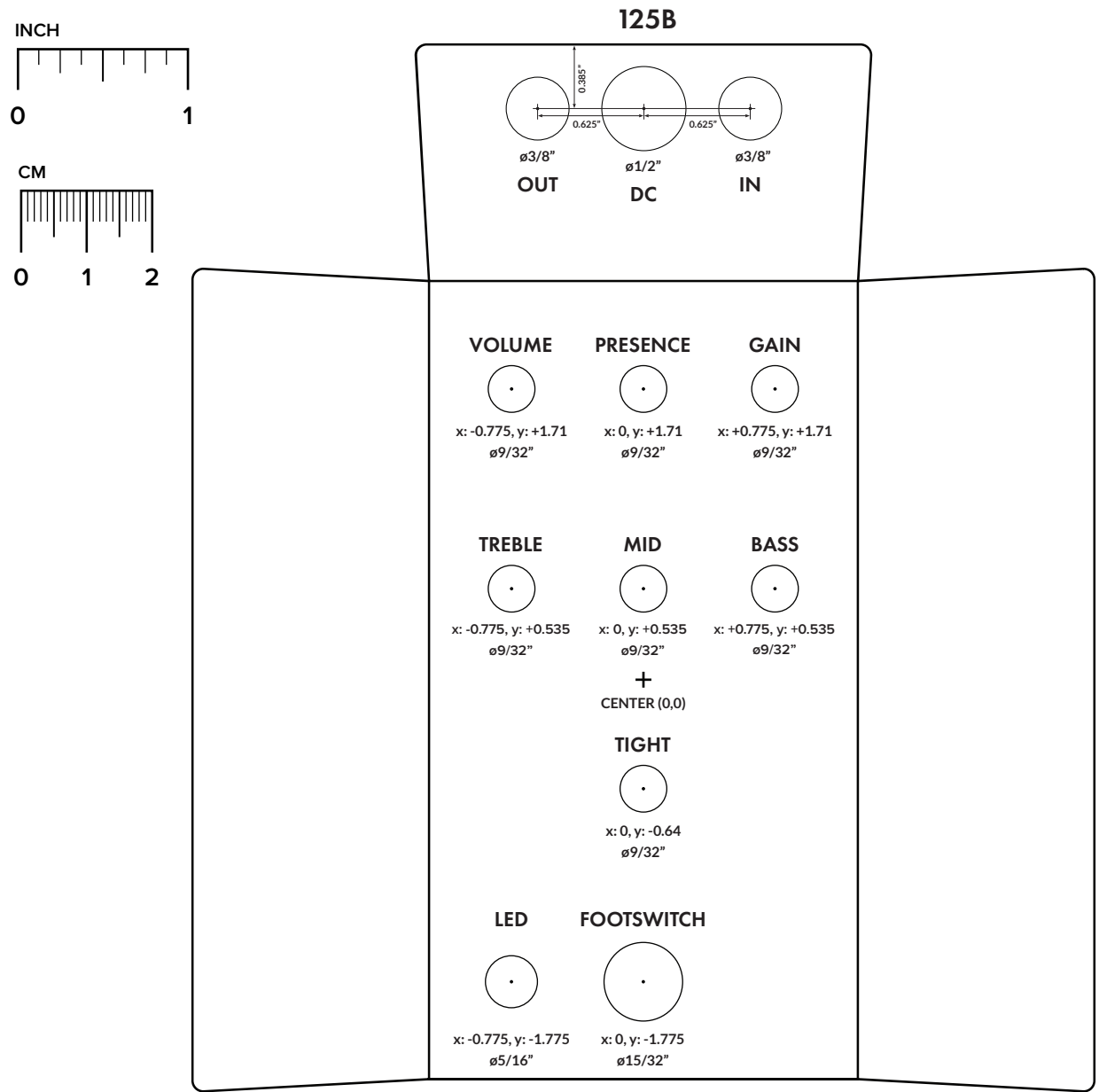
DRILL TEMPLATE

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.

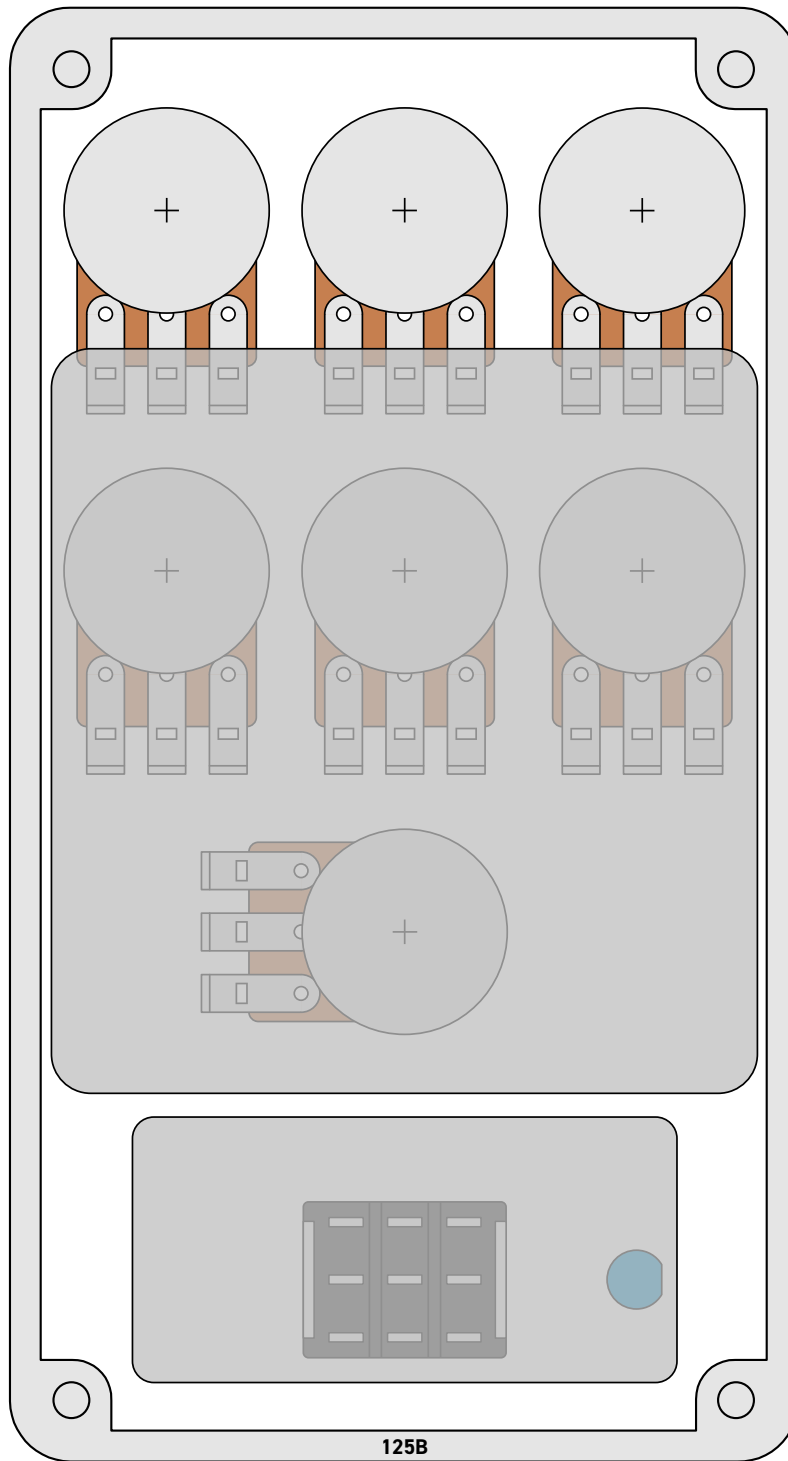
Top jack layout requires the use of closed-frame jacks like the [Switchcraft 111X](#). Open-frame jacks will not fit in layouts with 5 or more knobs due to the placement of the DC jack.

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.

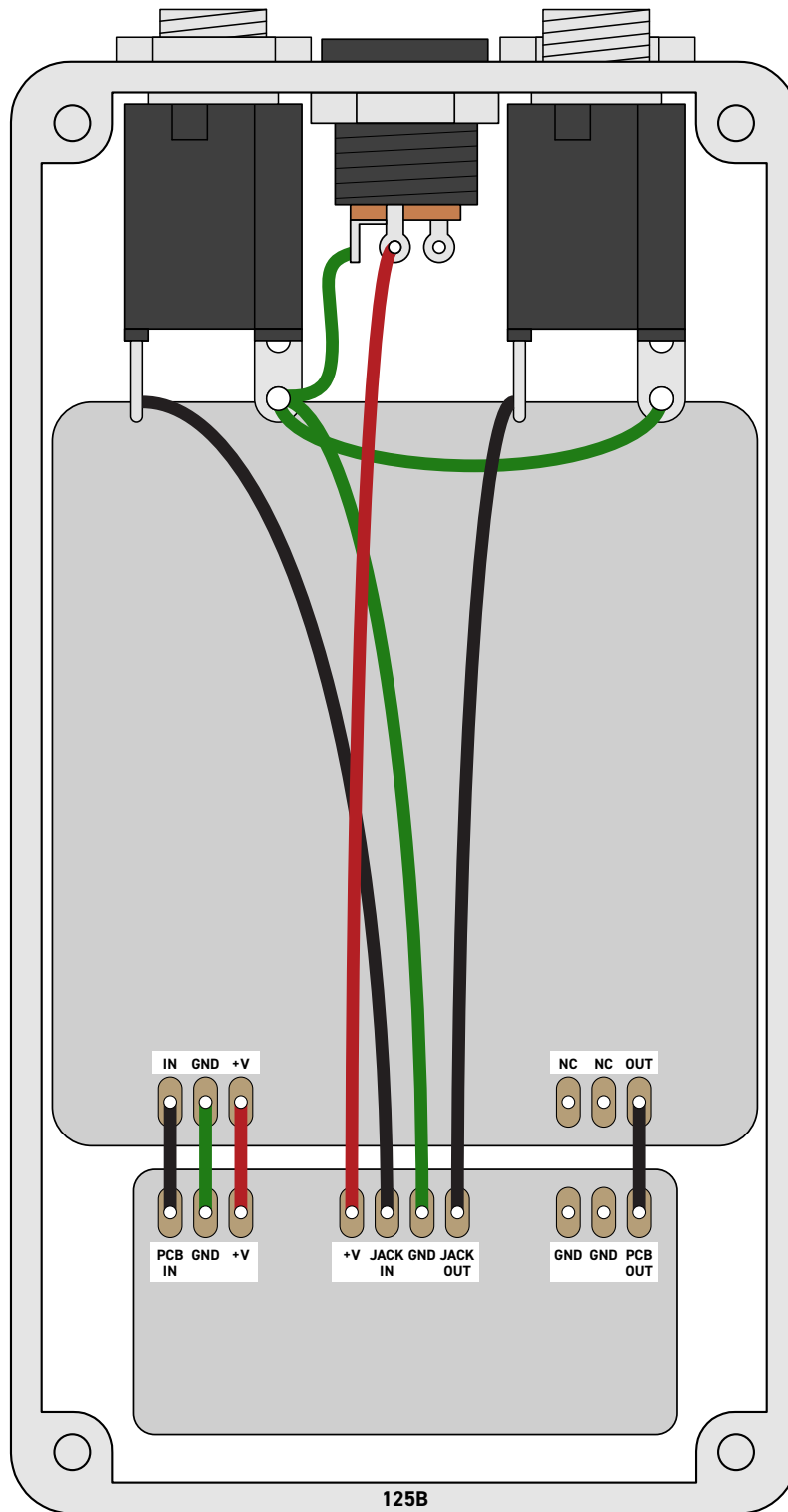


ENCLOSURE LAYOUT

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



WIRING DIAGRAM



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 (2019-03-08)

Corrected an error in the drill template measurements. (The graphic was correct, but some of the inch measurements were not.)

1.0.0 (2019-02-01)

Initial release.