PROJECT NAME

TESSERACT

aion DIY GUITAR EFFECTS

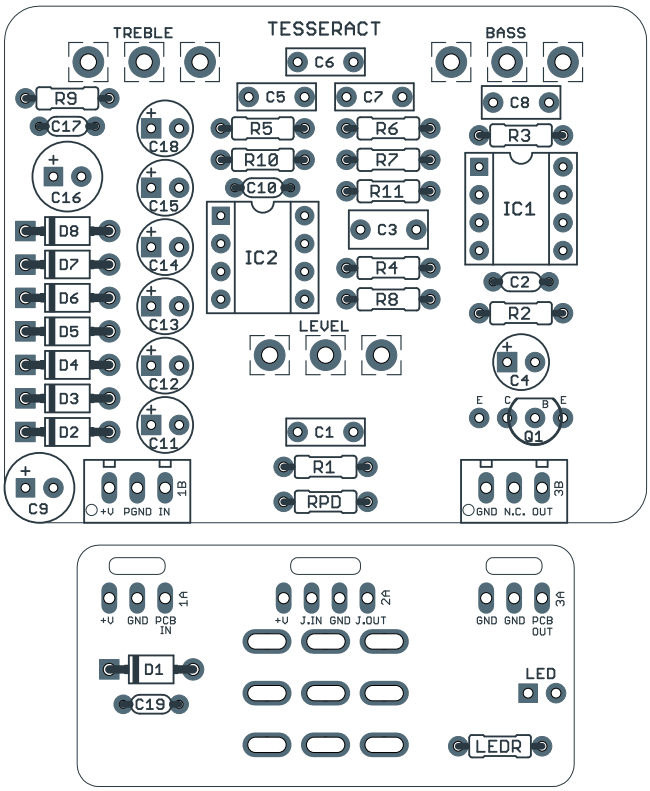
BASED ON
TC Electronic Integrated Preamp

BUILD DIFFICULTY
Intermediate

EFFECT TYPE
Boost/preamp

DOCUMENT VERSION
1.0.0 (2020-08-28)

PROJECT SUMMARY
A pedal adaptation of the legendary booster and tone shaper famously used by Meshuggah.



Actual size is 2.3” x 1.86” (main board) and 1.78” x 0.86” (bypass board).

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INTRODUCTION

The Tesseract Boost/Preamp is an adaptation of the TC Electronic Integrated Preamp, a boost & EQ from the late 1970s. The Integrated Pre is so named because it's designed to connect directly to your guitar, which is why the original unit did not have a bypass switch.

The Integrated Preamp gained fame as the secret behind Meshuggah's guitar tone in the 1990s. The boost was perfect for pushing the front of their Mesa/Boogie Dual Rectifiers and they used the EQ to cut the bass for a tighter driven tone.

The original unit could run on as much as 32V using an external supply, or it could operate at the standard 9V using a battery. Since 32V supplies are hard to come by, the Tesseract Boost/Preamp includes an on-board charge pump that quadruples the input voltage (minus a few diode drops), allowing a 32V operation from a standard 9V supply.

The only other modification is the removal of a pop-suppression circuit at the input. This is designed to prevent the loud pop when the input jack is first plugged in. It's essential in the original unit that connected straight to the guitar, since the preamp would reasonably be plugged & unplugged in a live setting and there's no way to mute it. However, in pedal format, the suppression circuit has no function other than to increase the current consumption as it is always bleeding some of the supply voltage to ground. There is no impact to the tone or functionality if it's omitted.

USAGE

The Tesseract has the following controls:

- **Bass** allows boosting or cutting of the 100 Hz band by +/-15dB.
- **Treble** allows boosting or cutting of the 10 KHz band by +/-15dB.
- **Level** controls the overall output of the effect.

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	4k7	Metal film resistor, 1/4W	
R2	6M8	Metal film resistor, 1/4W	
R3	100k	Metal film resistor, 1/4W	
R4	220k	Metal film resistor, 1/4W	
R5	470R	Metal film resistor, 1/4W	
R6	4k7	Metal film resistor, 1/4W	
R7	8k2	Metal film resistor, 1/4W	
R8	220R	Metal film resistor, 1/4W	
R9	10k	Metal film resistor, 1/4W	
R10	100k	Metal film resistor, 1/4W	
R11	1M	Metal film resistor, 1/4W	R11 is shown as 820k in one of the two known factory schematics.
RPD	2M2	Metal film resistor, 1/4W	Input pulldown resistor.
LEDR	4k7	Metal film resistor, 1/4W	LED current-limiting resistor. Adjust value to change LED brightness.
C1	47n	Film capacitor, 7.2 x 2.5mm	
C2	100pF	MLCC capacitor, NP0/C0G	
C3	1uF	Film capacitor, 7.2 x 3.5mm	
C4	4.7uF	Electrolytic capacitor, 4mm	
C5	4n7	Film capacitor, 7.2 x 2.5mm	
C6	47n	Film capacitor, 7.2 x 2.5mm	
C7	22n	Film capacitor, 7.2 x 2.5mm	
C8	220n	Film capacitor, 7.2 x 2.5mm	
C9	100uF	Electrolytic capacitor, 6.3mm	
C10	470n	MLCC capacitor, X7R	
C11	10uF	Electrolytic capacitor, 5mm	Must be rated for at least 50V.
C12	10uF	Electrolytic capacitor, 5mm	Must be rated for at least 50V.
C13	10uF	Electrolytic capacitor, 5mm	Must be rated for at least 50V.
C14	10uF	Electrolytic capacitor, 5mm	Must be rated for at least 50V.
C15	10uF	Electrolytic capacitor, 5mm	Must be rated for at least 50V.
C16	47uF	Electrolytic capacitor, 6.3mm	Must be rated for at least 50V.
C17	470n	MLCC capacitor, X7R	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C18	10uF	Electrolytic capacitor, 5mm	Must be rated for at least 50V.
C19	100n	MLCC capacitor, X7R	
D1	1N5817	Schottky diode, DO-41	
D2	1N4742A	Zener diode, 12V, DO-41	
D3	1N5817	Schottky diode, DO-41	
D4	1N5817	Schottky diode, DO-41	
D5	1N5817	Schottky diode, DO-41	
D6	1N5817	Schottky diode, DO-41	
D7	1N5817	Schottky diode, DO-41	
D8	1N5817	Schottky diode, DO-41	
Q1	2N5088	BJT transistor, NPN, TO-92	Original uses BC548C, which will need to be rotated 180 degrees if used since the pinout is mirrored.
IC1	LM741	Operational amplifier, DIP8	Factory schematic also specifies TL071 and LF356, but all photos of real units show LM741.
IC1-S	DIP-8 socket	IC socket, DIP-8	
IC2	LT1054CP	Charge pump, DIP8	
IC2-S	DIP-8 socket	IC socket, DIP-8	
BASS	50kC	16mm right-angle PCB mount pot	
TREBLE	50kC	16mm right-angle PCB mount pot	
LEVEL	50kA	16mm right-angle PCB mount pot	
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

Q1 transistor

The original unit uses a BC548C for the Q1 transistor, which is a high-gain BJT that is nearly identical to the more common 2N5088. The BC548 is still available. However, Aion FX projects use a universal transistor pad layout, and the outline is for the USA E-B-C pinout (2N5088, 2N3904, etc.). If using an original BC548, note that due to the European C-B-E convention, it will need to be rotated 180 degrees from the outline on the PCB.

R11 resistor

The R11 resistor is shown as 820k in one early factory schematic. The other factory schematic shows 1M. Using 820k it would have the effect of lowering the bias voltage slightly, but in general it shouldn't impact the sound. It's not known which resistor was used more often in production units, but the 1M value appears to be the later version, so it's likely they made the change from 820k for a reason.

Charge pump operation

The Tesseract uses a charge pump to generate approximately +32V from a standard 9V supply. This is done by using a charge pump IC in a configuration that quadruples the input voltage. (In actuality, it's a little less than quadruple due to the forward-voltage loss from the diodes.)

The Integrated Preamp user manual says it can be powered by "up to" 32V. The circuit can handle a fair amount higher than this, so it's not a hard limit—it was likely just a standard power supply interval at the time. It could also be powered by a standard 9V battery, so there were a lot of options.

If you want the Tesseract to run on less than 32V, you can jumper some of the diodes and omit some capacitors to either omit the voltage multiplication entirely or else use it as a doubler or tripler instead:

- For 9V operation, omit **IC1**, jumper **D3-D8** and omit **C11-C15**.
- For 18V operation (voltage doubler), jumper **D5-D8** and omit **C13-C15**.
- For 27V operation (voltage tripler), jumper **D7-D8** and omit **C15**.

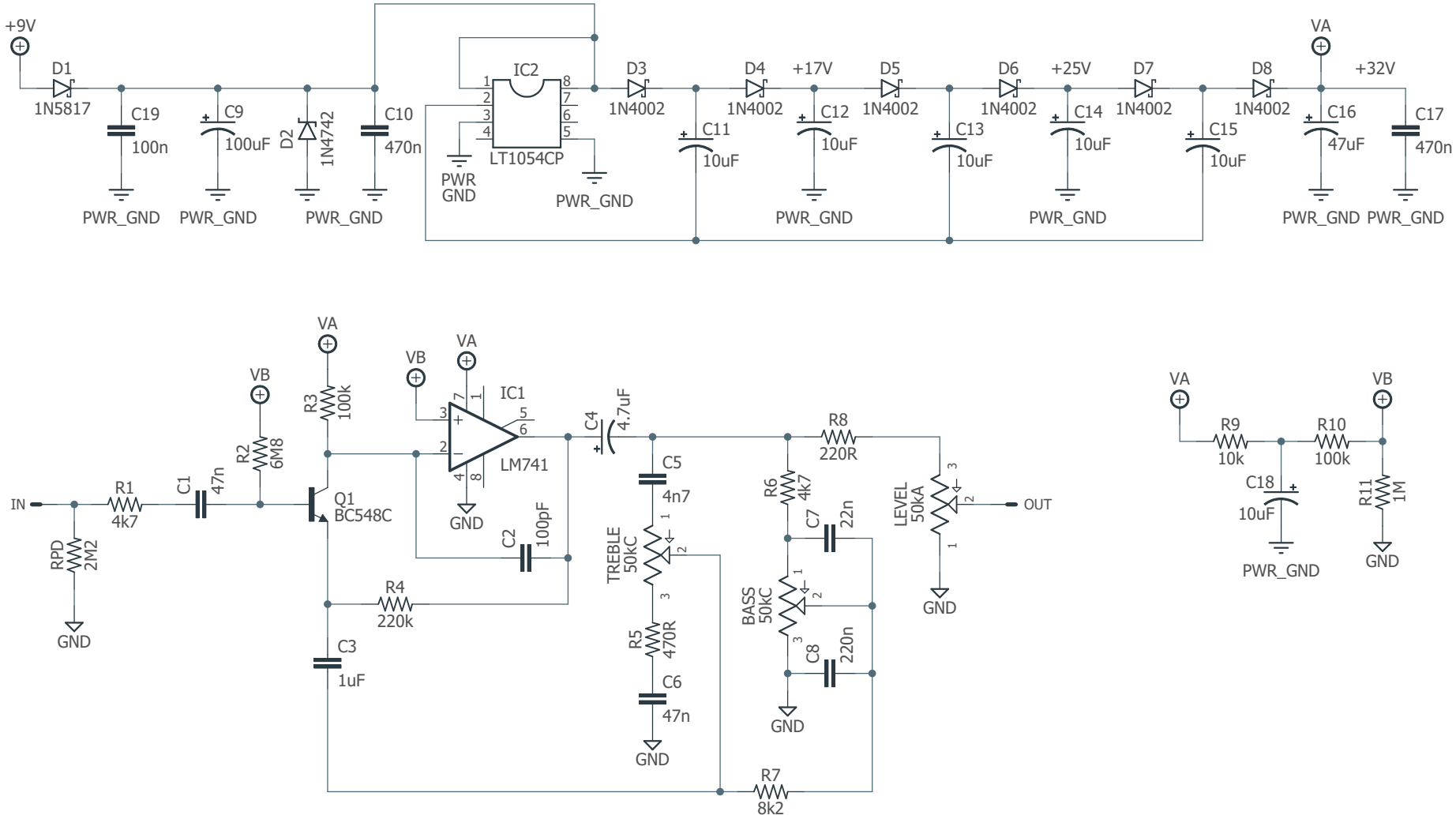
Note that while the circuit will probably work with a standard TC1044SCPA, the LT1054 is recommended for its improved specifications and efficiency. It's doing a lot more work in this application than a standard voltage doubler or inverter.

Voltage vs. gain

A word about the voltage: since the gain of the IC1 op-amp is fixed, higher voltage doesn't mean more available volume. Instead, what it means is that it has more headroom. At 32V supply, the circuit can take a much higher input signal (2.5V peak-to-peak) and boost it to 25V p-p without clipping. Compare this to 9V operation, where it can only handle a 0.7V input signal and boost it to 7V.

Since passive electric guitar signals are only around 0.3Vp-p, this won't make a huge practical difference. If you're using it to boost an already boosted signal, though, this circuit can do a much better job than most others.

SCHEMATIC


+9V
D1
1N5817
C19
100n
C9
100uF
D2
1N4742
C10
470n
IC2
LT1054CP
PWR GND
PWR_GND
D3
1N4002
D4
1N4002
+17V
D5
1N4002
D6
1N4002
+25V
D7
1N4002
D8
1N4002
VA
+32V
C11
10uF
C12
10uF
C13
10uF
C14
10uF
C15
10uF
C16
47uF
C17
470n
VB
R3
100k
R2
6M8
IC1
LM741
C4
4.7uF
R8
220R
IN
R1
4k7
C1
47n
RPD
2M2
Q1
BC548C
C2
100pF
R4
220k
C3
1uF
C5
4n7
TREBLE
50kC
R5
470R
C6
47n
R6
4k7
C7
22n
BASS
50kC
C8
220n
LEVEL
50kA
OUT
GND
R7
8k2
R9
10k
R10
100k
C18
10uF
R11
1M

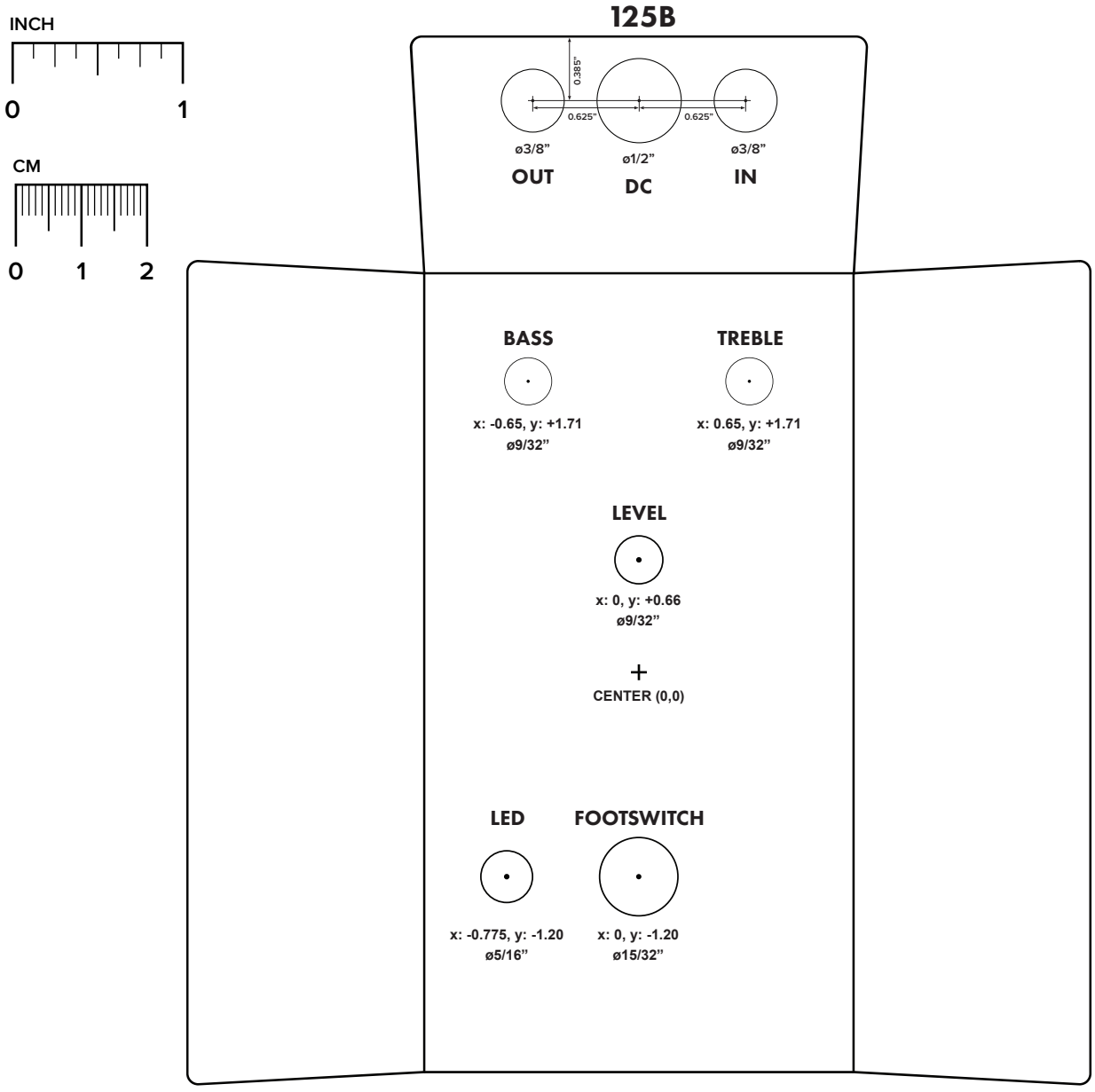
DRILL TEMPLATE

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.

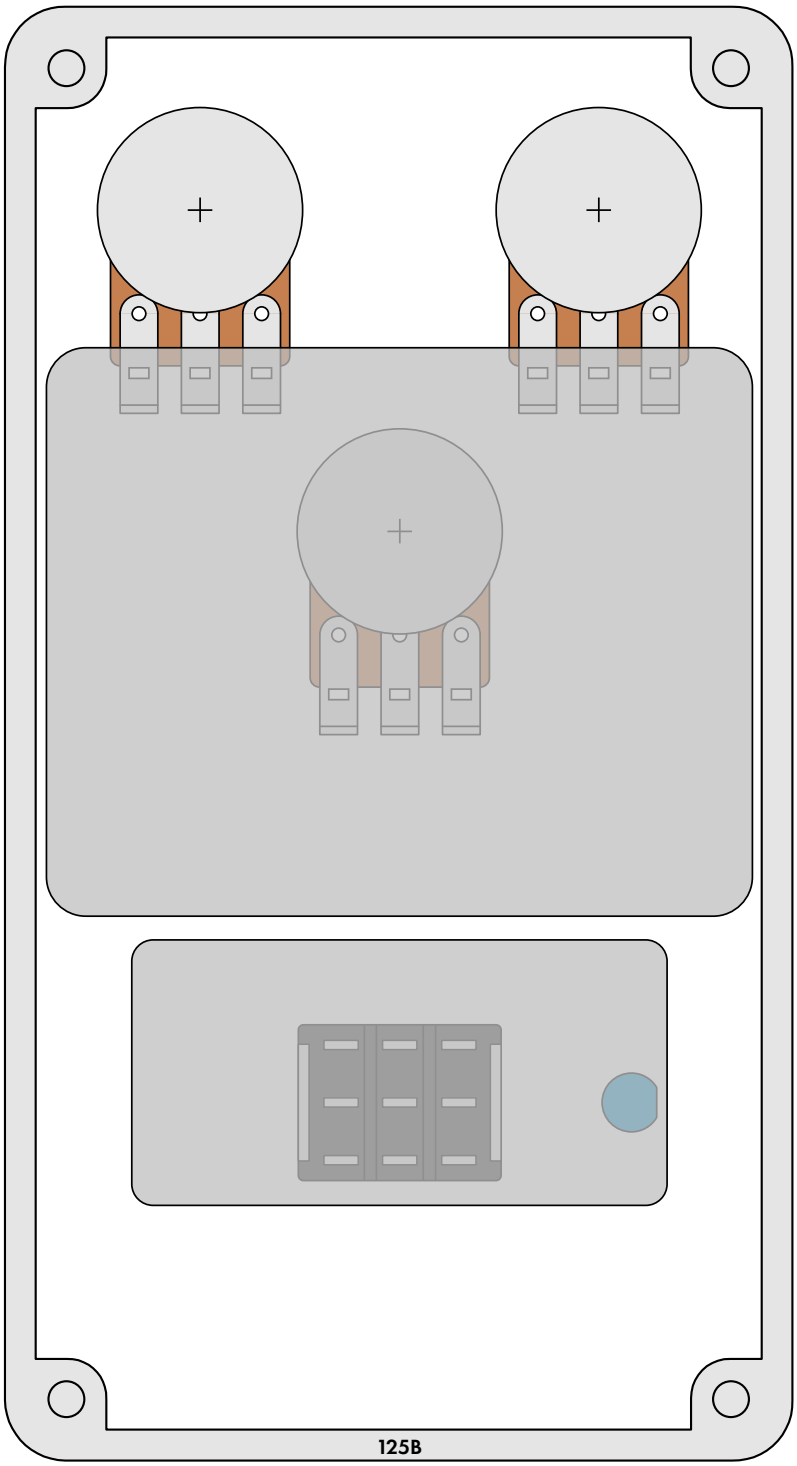
Top jack layout assumes the use of closed-frame jacks like the Switchcraft 111X. If you'd rather use open-frame jacks, please refer to the Open-Frame Jack Drill Template for the top side.

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.

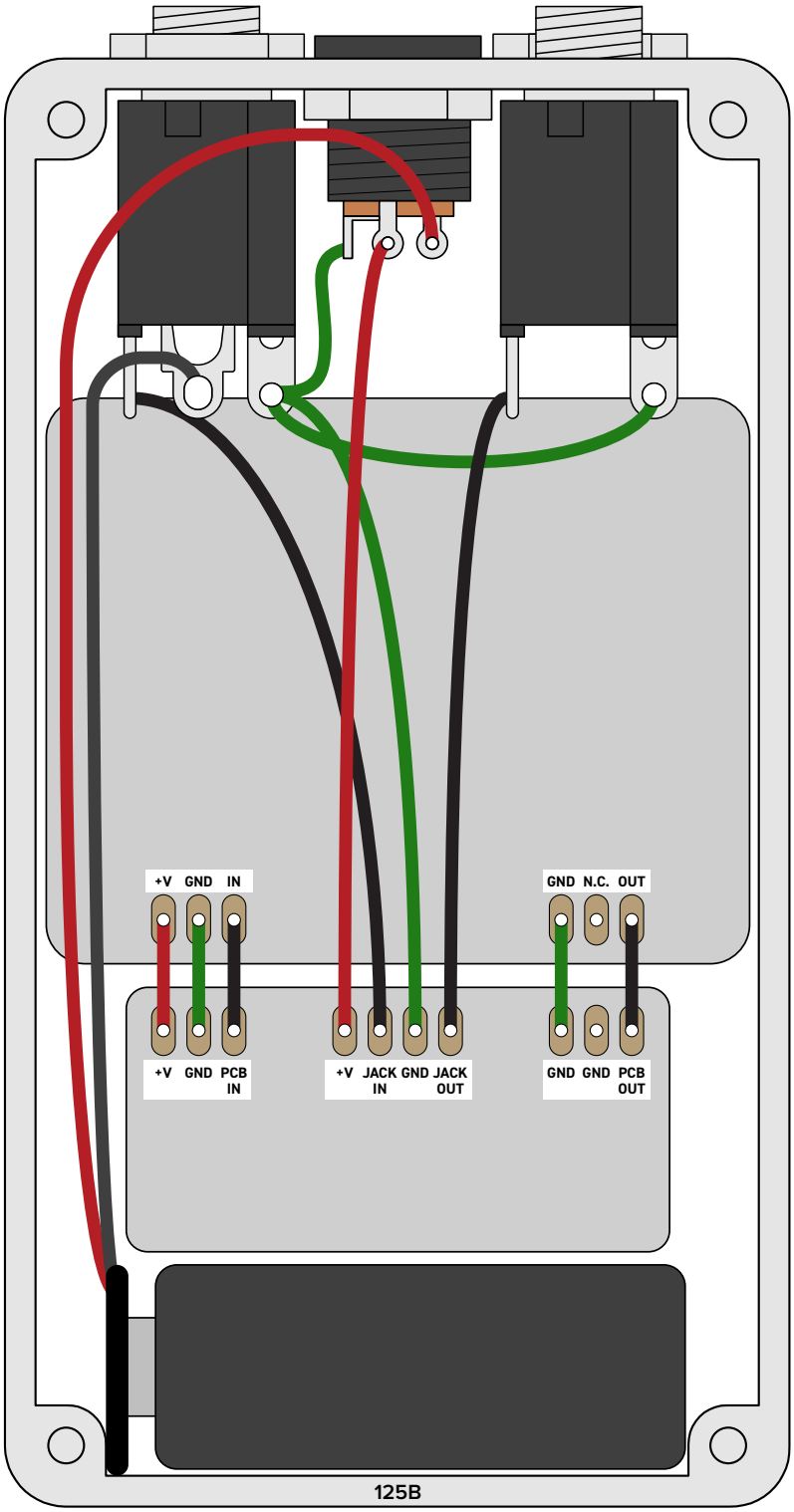


ENCLOSURE LAYOUT

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

1.0.0 (2020-08-28)
Initial release.