PROJECT NAME

HELIOSPHERE

aion
DIY GUITAR EFFECTS

BASED ON
Stamps Drive-O-Matic

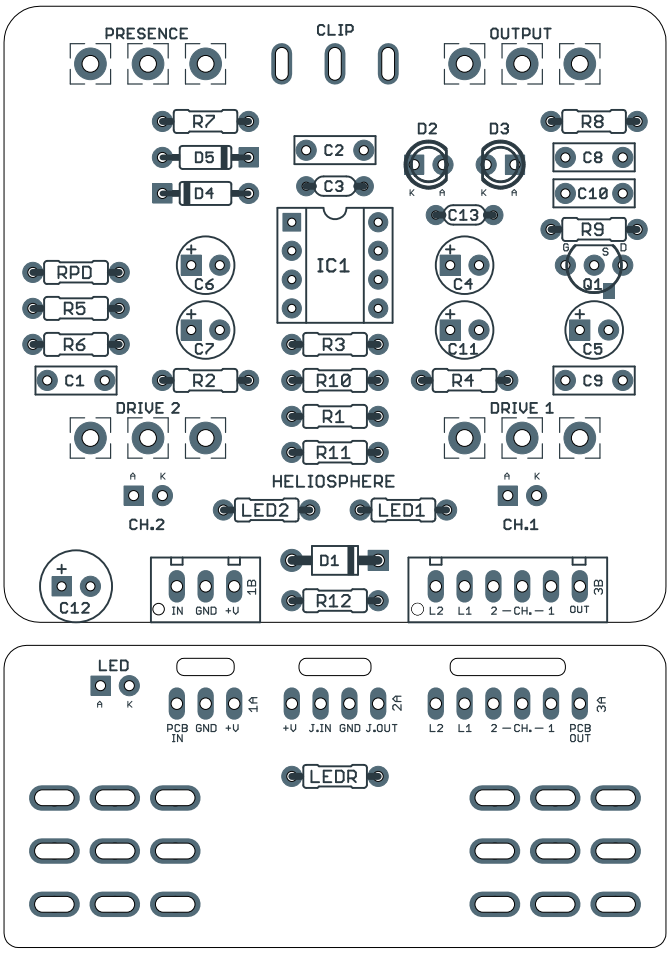
BUILD DIFFICULTY
Intermediate

EFFECT TYPE
Dual-channel distortion

DOCUMENT VERSION
1.0.0 (2023-11-24)

PROJECT SUMMARY

A boutique two-channel drive based on the RAT Distortion, with selectable gain presets and a diode-clipping switch.



Actual size is 2.3” x 2.14” (main board) and 2.3” x 1.05” (bypass board).

TABLE OF CONTENTS

1 Project Overview
2 Introduction & Usage
3-4 Parts List
5 Build Notes
6 Schematic
7 Drill Template
8 Enclosure Layout
9 Wiring Diagram
10 Licensing
10 Document Revisions

INTRODUCTION

The Heliosphere Dual Distortion is based on the Stamps Amplification Drive-O-Matic, a very rare distortion pedal built by Robert Stamps of The Amp Shop in Los Angeles in the mid-1990s long before boutique pedals were mainstream. Despite the relative obscurity, the Drive-O-Matic was used by a few professional musicians such as Bonnie Raitt and Rick Vito. It was traced by Aion FX in 2023.

The Drive-O-Matic is clearly derived from the RAT Distortion, with a nearly identical circuit topology but several part value changes for a different voicing. The major feature addition is the channel-switching, in which a second footswitch engages an alternate drive knob and also switches out a filter that changes the tone somewhat.

Robert Stamps only made one other pedal under the Stamps Amplification name, a higher-gain variant called the Drive-O-Matic XL. This version removes the diode switch in favor of an added “Saturation” control (which may control the diodes directly), and presumably has some circuit tweaks to increase the gain based on the description. The Drive-O-Matic XL is extremely rare and has not yet been traced, but if we ever come across one then we’ll open it up and see what’s different about it.

The Heliosphere is an exact clone of the Drive-O-Matic based on our trace. Full details are available in the tracing journal. We do recommend some small changes to the base circuit to make it more versatile, which are described in the build notes.

USAGE

The Heliosphere has four knobs, one toggle and one extra stomp switch:

- **Drive 1** sets the gain of the first channel.
- **Drive 2** sets the gain of the second channel.
- **Presence** cuts treble after the clipping stage.
- **Output** sets the overall volume level of the output.
- **Clipping** (toggle) selects between silicon diodes, LEDs, or no clipping.
- **Channel** (stomp switch) selects between Drive 1 and Drive 2 settings. An LED shows which knob is active.

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	2M2	Metal film resistor, 1/4W	1M in original RAT.
R2	1k	Metal film resistor, 1/4W	
R3	680R	Metal film resistor, 1/4W	560R in original RAT.
R4	100R	Metal film resistor, 1/4W	47R in original RAT.
R5	100R	Metal film resistor, 1/4W	47R in original RAT.
R6	1k	Metal film resistor, 1/4W	
R7	1k5	Metal film resistor, 1/4W	
R8	1M	Metal film resistor, 1/4W	
R9	10k	Metal film resistor, 1/4W	
R10	100k	Metal film resistor, 1/4W	
R11	100k	Metal film resistor, 1/4W	
R12	100R	Metal film resistor, 1/4W	Power supply filter resistor.
RPD	2M2	Metal film resistor, 1/4W	Input pulldown resistor. Can be as low as 1M.
LED1	10k	Metal film resistor, 1/4W	Channel 1 LED resistor. Adjust value to change LED brightness.
LED2	10k	Metal film resistor, 1/4W	Channel 2 LED resistor. Adjust value to change LED brightness.
LEDR	10k	Metal film resistor, 1/4W	Bypass LED resistor. Adjust value to change LED brightness.
C1	22n	Film capacitor, 7.2 x 2.5mm	
C2	10n	Film capacitor, 7.2 x 2.5mm	Recommend substituting 100pF MLCC. See build notes.
C3	OMIT		Use 27pF or 33pF if using LM308N for IC1.
C4	4.7uF	Electrolytic capacitor, 4mm	
C5	2.2uF	Electrolytic capacitor, 4mm	
C6	22uF	Electrolytic capacitor, 5mm	
C7	4.7uF	Electrolytic capacitor, 4mm	
C8	22n	Film capacitor, 7.2 x 2.5mm	
C9	3n3	Film capacitor, 7.2 x 2.5mm	
C10	10n	Film capacitor, 7.2 x 2.5mm	1uF in original RAT.
C11	47uF	Electrolytic capacitor, 5mm	Reference voltage filter capacitor.
C12	100uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C13	100n	MLCC capacitor, X7R	Power supply filter capacitor.
D1	1N5817	Schottky diode, DO-41	
D2	3mm red LED	LED, 3mm, red diffused	
D3	3mm red LED	LED, 3mm, red diffused	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
D4	1N914	Fast-switching diode, DO-35	
D5	1N914	Fast-switching diode, DO-35	
Q1	2N5457	JFET, N-channel, TO-92	2N5458 in original circuit. Any general-purpose JFET will work here.
IC1	OP07	Operational amplifier, single, DIP8	Original uses LM308. See build notes.
IC1-S	DIP-8 socket	IC socket, DIP-8	
DRIVE_1	50kA	16mm right-angle PCB mount pot	Audio (log) taper. 100kA in original RAT.
DRIVE_2	50kA	16mm right-angle PCB mount pot	Audio (log) taper. 100kA in original RAT.
PRESENCE	100kA	16mm right-angle PCB mount pot	Audio (log) taper.
OUTPUT	100kA	16mm right-angle PCB mount pot	Audio (log) taper.
CLIP	SPDT cntr. off	Toggle switch, SPDT on-off-on	
CH. 1 LED	3mm red LED	LED, 3mm, red diffused	
CH. 2 LED	3mm red LED	LED, 3mm, red diffused	
BYP. 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.
BYPASS	3PDT	Stomp switch, 3PDT	
CHANNEL	3PDT	Stomp switch, 3PDT	
ENC	125B	Enclosure, die-cast aluminum	Can also use a Hammond 1590N1.

BUILD NOTES

C2 capacitor

In the stock circuit, at higher gain settings, the tone control must be at absolute maximum otherwise the treble is overly muffled. This is entirely caused by the 10n feedback capacitor which cuts a significant amount of treble in the first gain stage, with a corner frequency of 318 Hz (!) at max gain. Compare this to the RAT whose feedback capacitor is 100pF in this position, filtering above 31.8kHz at max gain.

We strongly recommend changing the C2 capacitor to 100pF, which solves this problem entirely and turns the circuit into a really interesting lower-gain RAT.

RAT modifications

The Drive-O-Matic is essentially a modded RAT, so if you want your build to be a little closer to the source circuit, you can make any or all of the following changes. Even if you revert back to a standard RAT, it's still well worth building due to the footswitchable drive channels.

- **C2:** 10n → 100pF (restores the treble frequencies)
- **C10:** 10n → 1uF (increases bass at output)
- **R1:** 2M2 → 1M (reduces input impedance for lower op-amp noise)
- **R3:** 680R → 560R (increases gain of both channels)
- **R4:** 100R → 47R (increases gain of channel 1)
- **R5:** 100R → 47R (increases gain of channel 2)
- **DRIVE 1:** 50kA → 100kA (increases gain of channel 1)
- **DRIVE 2:** 50kA → 100kA (increases gain of channel 2)

LM308 and OP07

Like the original RAT, the Stamps Drive-O-Matic used the LM308, an early op-amp with a very low slew rate compared to modern alternatives. The slew rate is critical to the unique sound of the RAT.

In the mid-1990s, the LM308 supply began to dry up, so after some research & experimentation, Pro Co changed over to the OP07 for their production RATs. Despite insistence from gear enthusiasts that the LM308 sounds better and the OP07 is inferior, it's been shown on more than one occasion (both by the DIY community and more thoroughly by JHS) that the OP07 performs and sounds identical when used in the same circuit with the same settings.

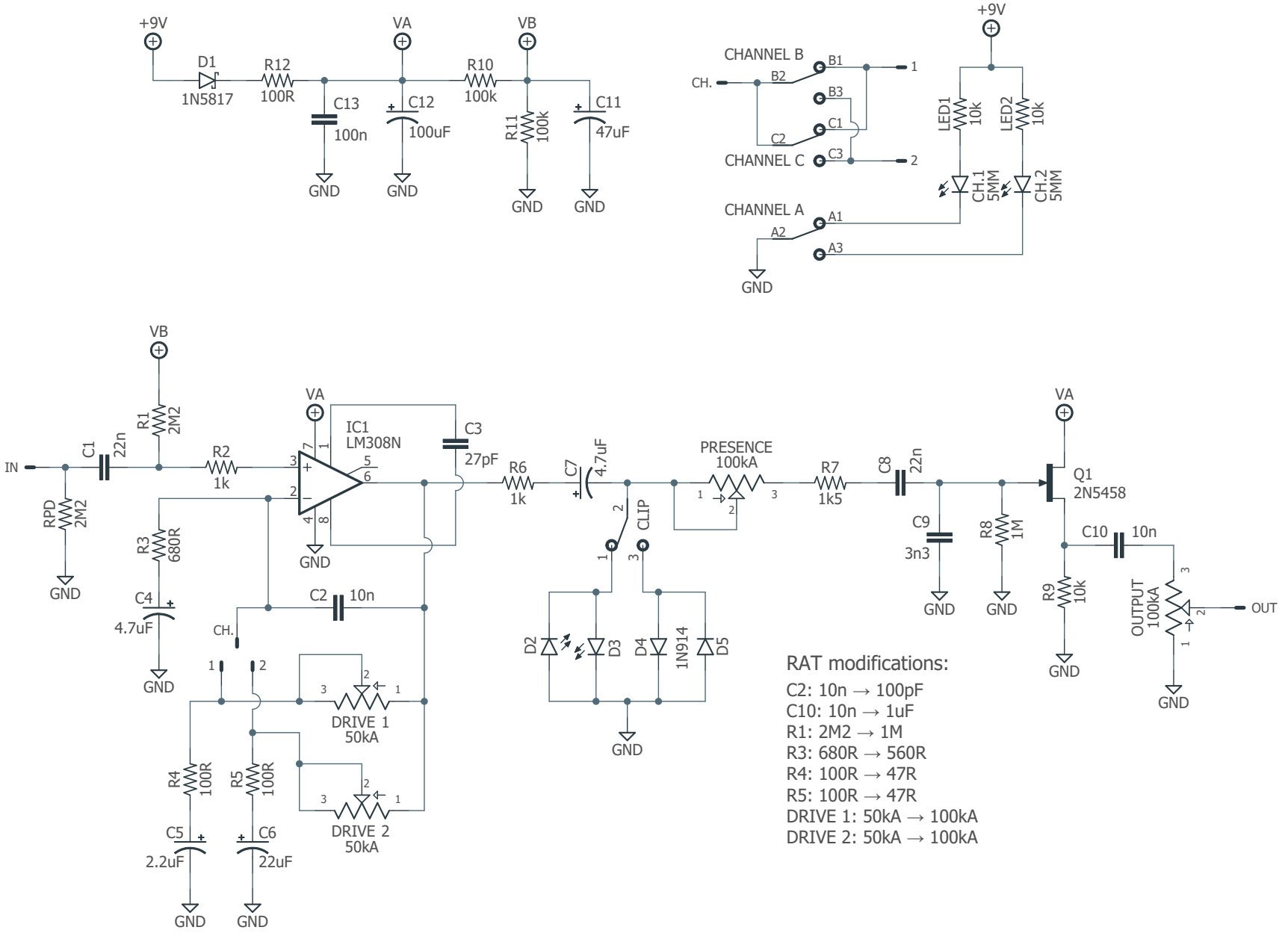
Because of this, we have specified the OP07 for this build and recommend it over the LM308.

The LM308 has been obsolete for a long time, and most of what's available today on eBay and component distributors in Asia are relabeled fakes, so it's not recommended to risk using one. Let the article from JHS convince you the LM308 is not special, and use the OP07 with a clear conscience!

C3 compensation capacitor

The OP07 op-amp has an internal slew-rate compensation capacitor while the LM308 does not. C3 (27pF) should be omitted when using the OP07, but it's required for the LM308 to work properly.

SCHEMATIC



RAT modifications:

C2: 10n → 100pF
C10: 10n → 1uF
R1: 2M2 → 1M
R3: 680R → 560R
R4: 100R → 47R
R5: 100R → 47R
DRIVE 1: 50kA → 100kA
DRIVE 2: 50kA → 100kA

DRILL TEMPLATE

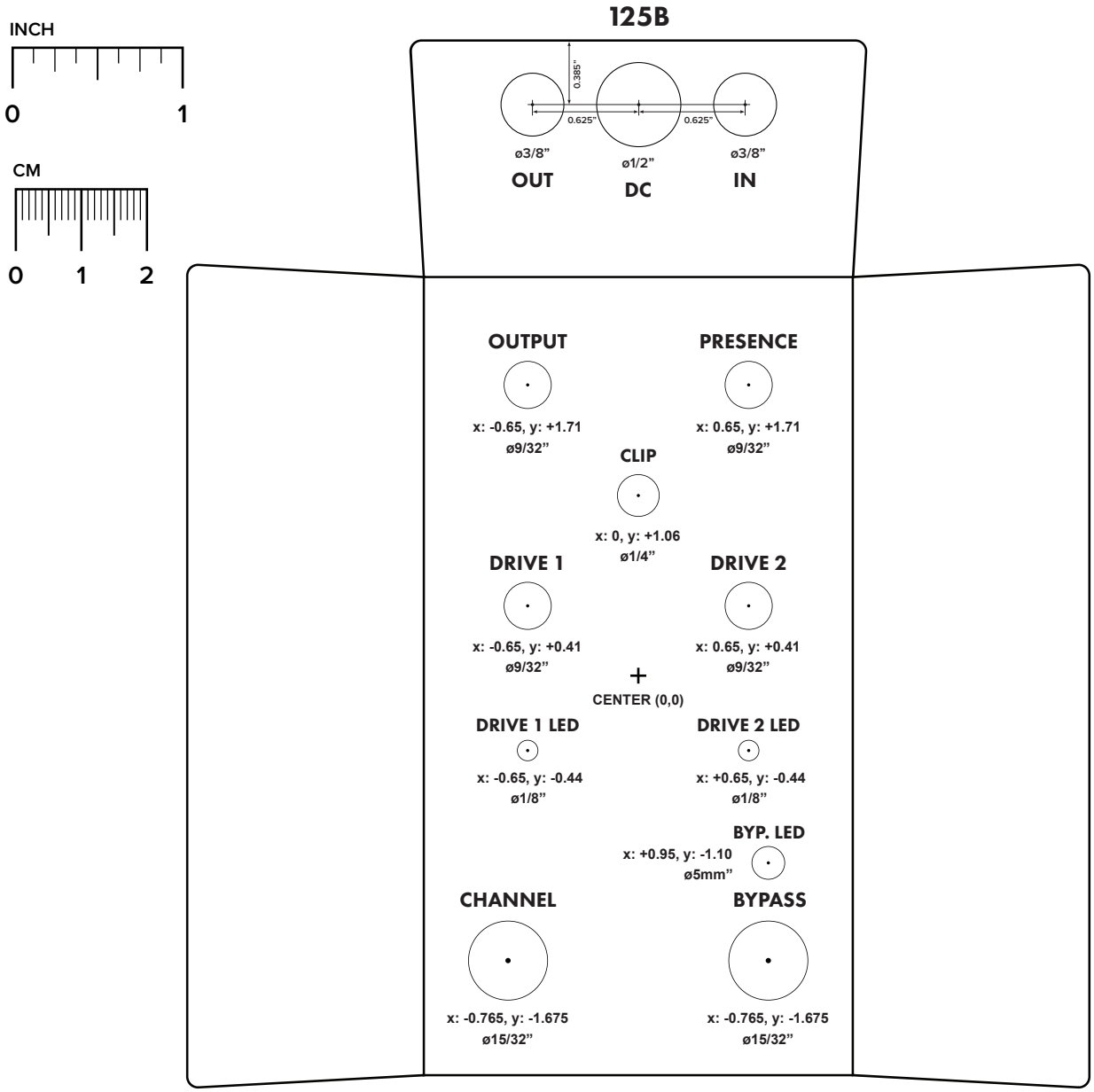
Cut out this drill template, fold the edges and tape it to the enclosure. Before drilling, it's recommended to first use a center punch for each of the holes to help guide the drill bit.

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.

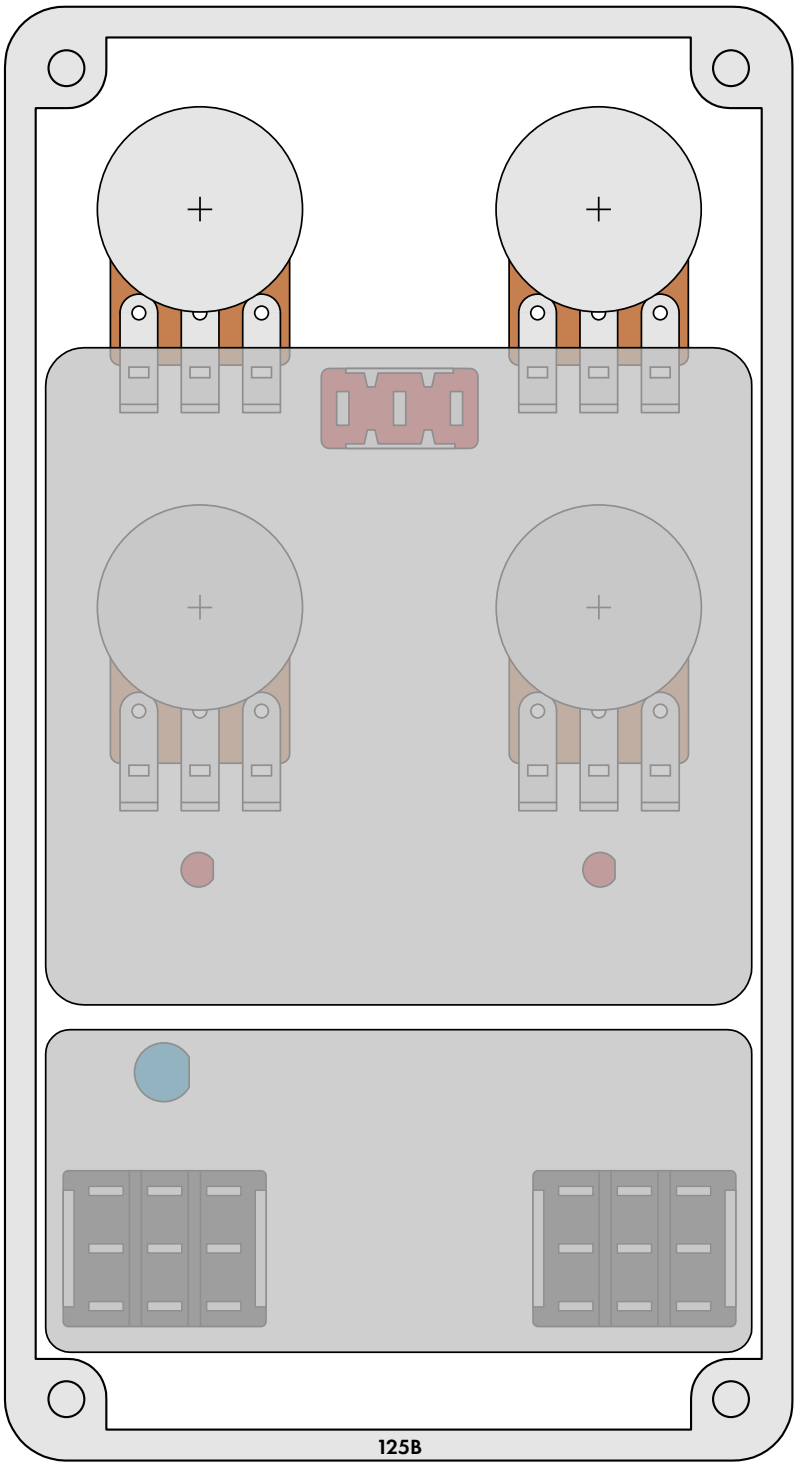
LED hole drill sizes assume plain LEDs with no bezel. For the 5mm LED, a 5mm or 13/64" bit is recommended. 7/32" will work if it's all you have, but there will be some extra space around the LED.

A 5mm LED bezel will also fit for the bypass LED if you prefer, in which case use a 5/16" drill bit.

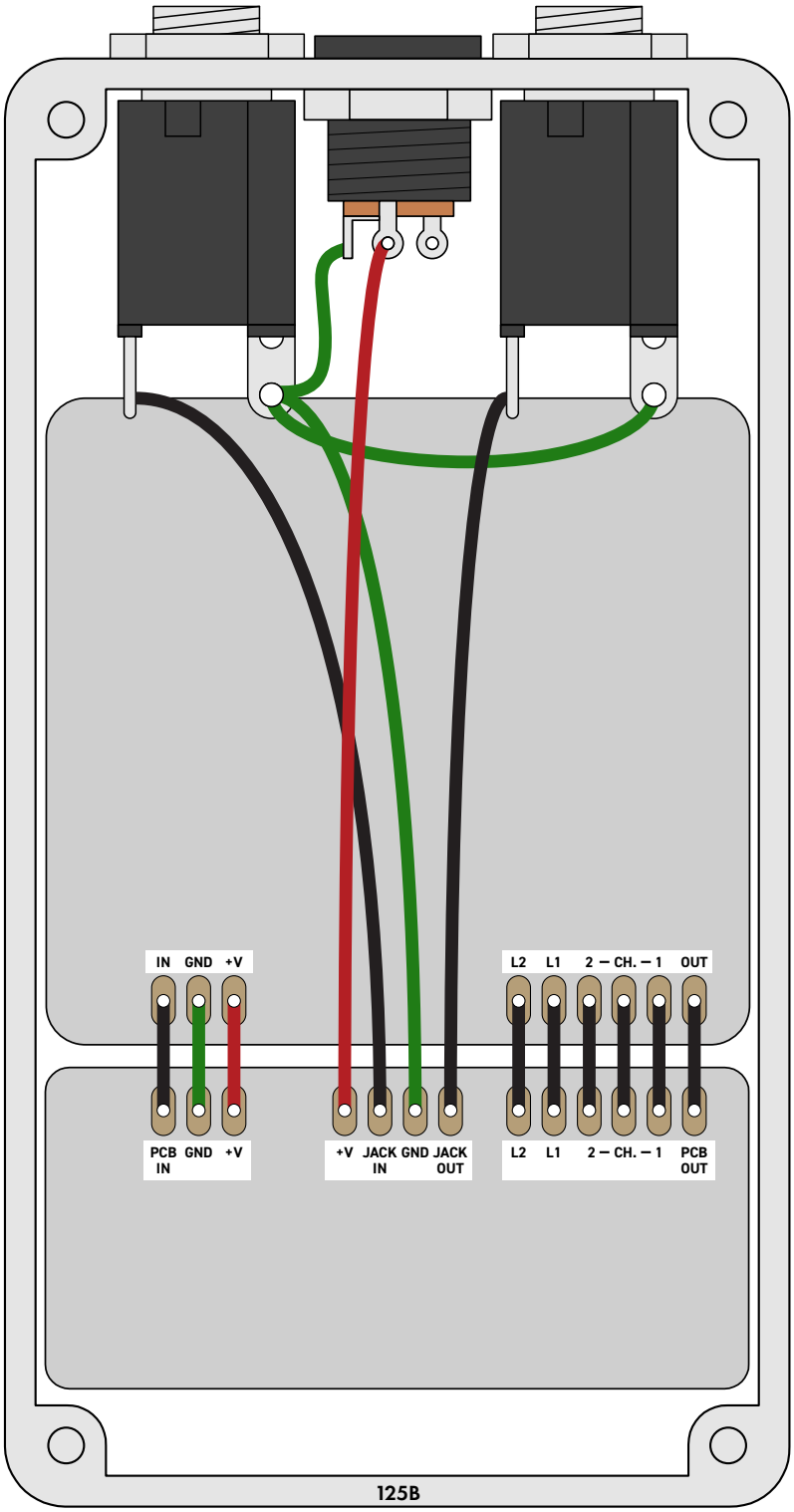


ENCLOSURE LAYOUT

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 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

1.0.0 (2023-11-24)
Initial release.