

PROJECT NAME

# SKYWAVE



BASED ON

Hudson Electronics Broadcast

BUILD DIFFICULTY

■■■■□ Intermediate

EFFECT TYPE

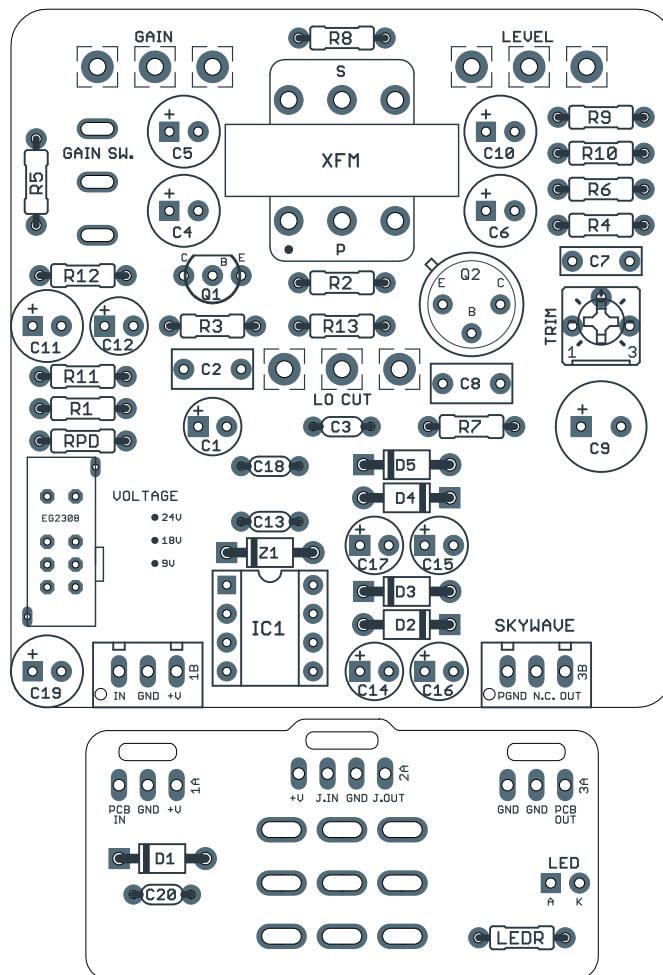
Germanium fuzz/overdrive

DOCUMENT VERSION

1.0.0 (2023-07-04)

## PROJECT SUMMARY

A hybrid silicon/germanium boost & drive pedal with a transformer-coupled output, with tones spanning the decades from vintage to modern.



Actual size is 2.3" x 2.43" (main board) and 1.78" x 0.90" (bypass board).

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## INTRODUCTION

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The Skywave Germanium Drive is an adaptation of the Hudson Electronics Broadcast, a germanium preamp/overdrive pedal based on vintage broadcast consoles from the 1960s. It uses a hybrid of silicon and germanium transistors in class-A configuration, plus a transformer at the output that saturates on higher drive levels.

The Broadcast was originally released in 2015, and has since had a few new variants including one that runs on 24V and another with a second footswitchable gain mode with its own level control. (There was also a limited-run version that combined both of these features into one.)

The Skywave is primarily based on the original Broadcast, but it adds a voltage-tripler circuit to allow selectable 18V or 24V power from a standard 9V supply. It also incorporates a 3-way gain switch, adding an extra position adapted from the 24V version of the Broadcast.

## USAGE

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The Skywave has three knobs, one toggle, and one internal slide switch:

- **Gain** sets the amount of feedback from the germanium transistor stage that is fed back into the initial silicon transistor stage.
- **Low Cut** cuts the bass frequencies as it's turned up, going from mushy or flabby to tight, with the right mix of fullness somewhere in between.
- **Level** is an output volume control.
- **Gain Mode** (toggle) selects between three gain ratios for the first transistor stage—low, medium and high—which affect the range of the Gain knob.
- **Voltage** (slide switch) selects between 9V, 18V and 24V supply voltages.

## 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	220k	Metal film resistor, 1/4W	
R2	5k6	Metal film resistor, 1/4W	
R3	5k6	Metal film resistor, 1/4W	
R4	68R	Metal film resistor, 1/4W	
R5	470R	Metal film resistor, 1/4W	
R6	5k6	Metal film resistor, 1/4W	
R7	4k7	Metal film resistor, 1/4W	
R8	5k6	Metal film resistor, 1/4W	
R9	15k	Metal film resistor, 1/4W	
R10	33k	Metal film resistor, 1/4W	
R11	1k	Metal film resistor, 1/4W	
R12	56k	Metal film resistor, 1/4W	
R13	33k	Metal film resistor, 1/4W	
RPD	1M	Metal film resistor, 1/4W	Input pull-down resistor.
LED R	10k	Metal film resistor, 1/4W	LED current-limiting resistor. Adjust value to change LED brightness.
C1	10uF	Electrolytic capacitor, 5mm	
C2	1uF	Film capacitor, 7.2 x 3.5mm	
C3	330pF	MLCC capacitor, NP0/C0G	
C4	100uF	Electrolytic capacitor, 6.3mm	
C5	100uF	Electrolytic capacitor, 6.3mm	
C6	100uF	Electrolytic capacitor, 6.3mm	
C7	1n	Film capacitor, 7.2 x 2.5mm	
C8	330n	Film capacitor, 7.2 x 2.5mm	
C9	330uF/35V	Electrolytic capacitor, 8mm	See build notes for sourcing information.
C10	100uF	Electrolytic capacitor, 6.3mm	
C11	220uF	Electrolytic capacitor, 6.3mm	120uF in original. See build notes.
C12	10uF	Electrolytic capacitor, 5mm	Power supply filter capacitor.
C13	470n	MLCC capacitor, X7R	Power supply filter capacitor.
C14	10uF	Electrolytic capacitor, 5mm	Power supply filter capacitor.
C15	10uF	Electrolytic capacitor, 5mm	Power supply filter capacitor.
C16	10uF	Electrolytic capacitor, 5mm	Power supply filter capacitor.
C17	10uF	Electrolytic capacitor, 5mm	Power supply filter capacitor.

## PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C18	470n	MLCC capacitor, X7R	Power supply filter capacitor.
C19	220uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C20	100n	MLCC capacitor, X7R	Power supply filter capacitor.
D1	1N5817	Schottky diode, DO-41	
D2	1N4001	Rectifier diode, DO-41	
D3	1N4001	Rectifier diode, DO-41	
D4	1N4001	Rectifier diode, DO-41	
D5	1N4001	Rectifier diode, DO-41	
Z1	1N4742A	Zener diode, 12V, DO-41	
Q1	2N5088	BJT transistor, NPN, TO-92	Original uses BC549C, but 2N5088 is the USA equivalent.
Q2	2N404A	Transistor, PNP germanium	See build notes. Original uses either Russian MP20 or NTE 2N404A.
IC1	LT1054CP	Operational amplifier, single, DIP8	Can also use TC1044SCPA.
IC1-S	DIP-8 socket	IC socket, DIP-8	
TRIM	1k trimmer	Trimmer, 10%, 1/4"	
GAIN	250kA	16mm right-angle PCB mount pot	
LO CUT	10kA	16mm right-angle PCB mount pot	
LEVEL	100kA	16mm right-angle PCB mount pot	
GAIN SW.	SPDT cntr off	Toggle switch, SPDT on-off-on	
XFM	TY-141P	Transformer, audio, 10KCT/10KCT	Triad Magnetics TY-141P.
VOLTAGE	DP3T slide	Slide switch, DP3T	E-Switch EG2308
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

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### Silicon transistor selection

The Broadcast uses a BC549C for Q1, the NPN transistor. The Skywave layout uses the USA E-B-C convention, so the 2N5088 is specified as an equivalent, but if you want to use the BC549C then just rotate it 180 degrees from the silkscreen.

### Germanium transistor selection

The manufacturer has used different types of germanium transistors for Q2 across the different models. The most common type is the Russian МП20 (MP20), which are typically in the range of 60 to 80 hFE with less than 100 $\mu$ A of leakage current. Others including the Dual Broadcast use the NTE 2N404A, a new-production germanium that is anywhere from 50 to 250 hFE. The 2N404A taken from a Broadcast in [this video](#) measured at 216 hFE with 125 $\mu$ A leakage.

With this said, given the ranges in the originals, the gain of the germanium transistor likely does not make a big impact on the sound. Just use what you can find, taking care that the leakage isn't too high (perhaps 200-300 $\mu$ A maximum).

### 330 $\mu$ F capacitor

The Broadcast uses a 330 $\mu$ F electrolytic capacitor for C9, the low-cut section. It's unlikely that there would be an audible difference between this and a lower value such as 220 $\mu$ F, but we'll assume they chose it for a reason.

330 $\mu$ F is a less common value than 220 $\mu$ F or 470 $\mu$ F, and in this application it needs to be 35V or higher since it connects directly to the positive supply, which may be as high as 24V depending on the Voltage slide switch.

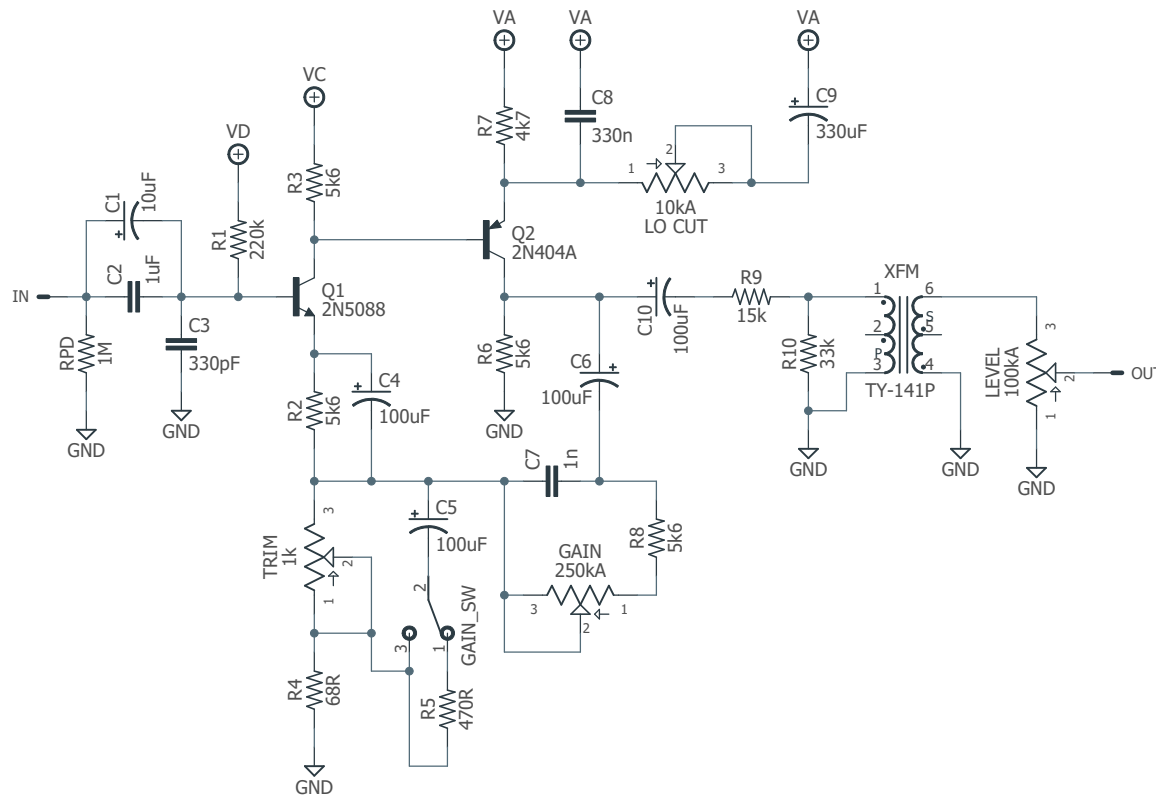
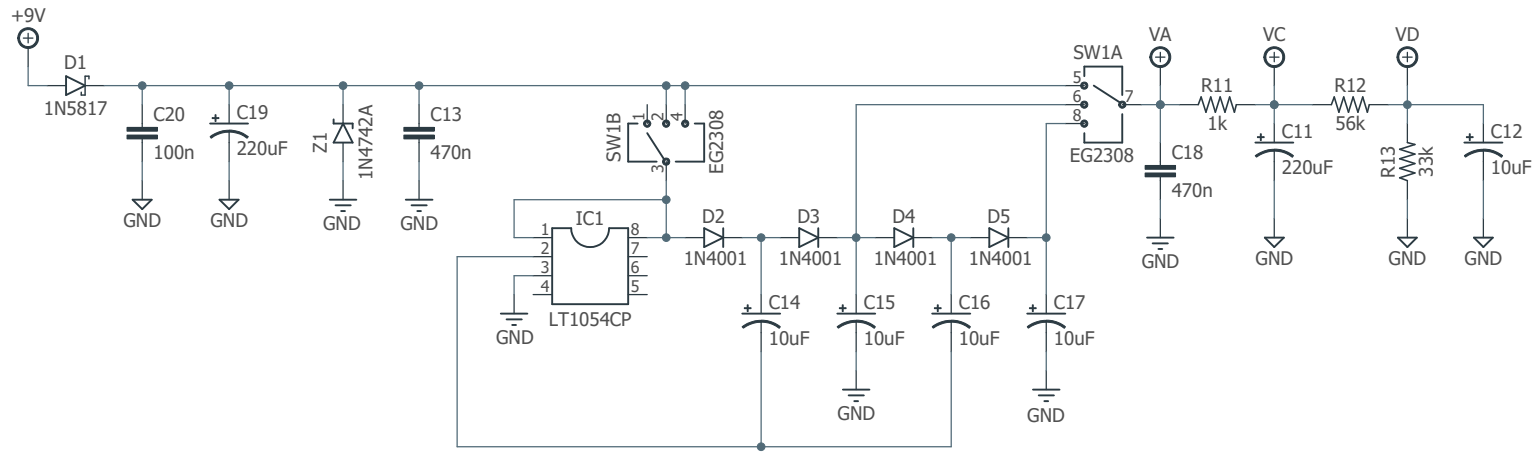
The [Mouser parts list](#) provides a part number that will fit the Skywave layout, but if you source a different one, it may be physically larger than the one we designed around. If this is the case, there is plenty of space for it to be folded over and lay flat on the board if needed.

### Gain trimmer

The internal gain trimmer sets the gain of the silicon transistor in the first amplifier stage. This gain setting applies to all three toggle switch modes. As you turn it up, resistance is reduced and the transistor gain increases.

This is purely a set-to-taste control, not a bias, so there is no calibration procedure or target voltage. In the original Broadcast, it's set to the minimum position by default, but is intended to be user-adjustable. Listen to all three modes of the gain switch across the range of the Gain knob, and adjust the trimmer until each mode is useful.

# SCHEMATIC



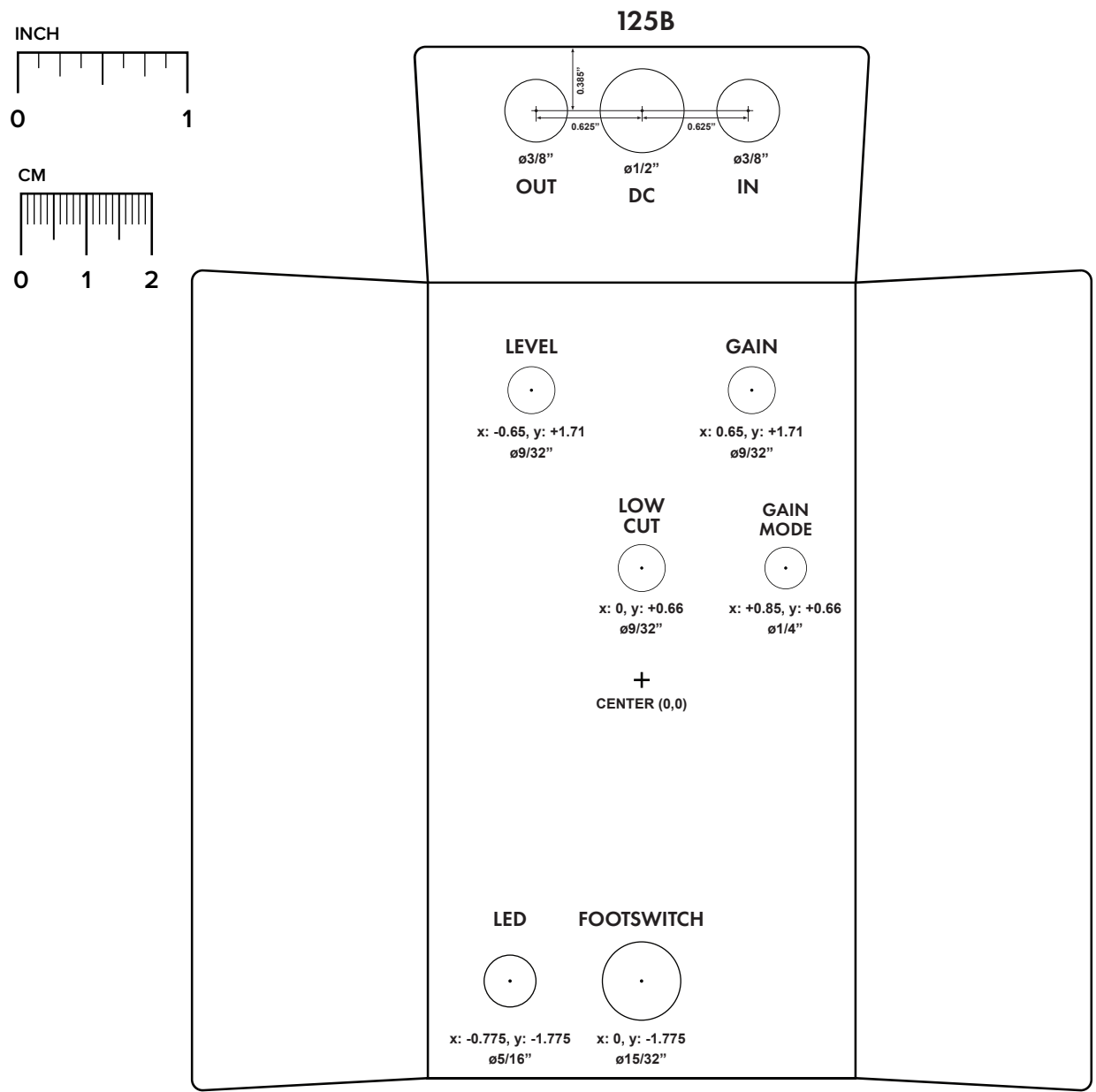
# DRILL TEMPLATE

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** 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.

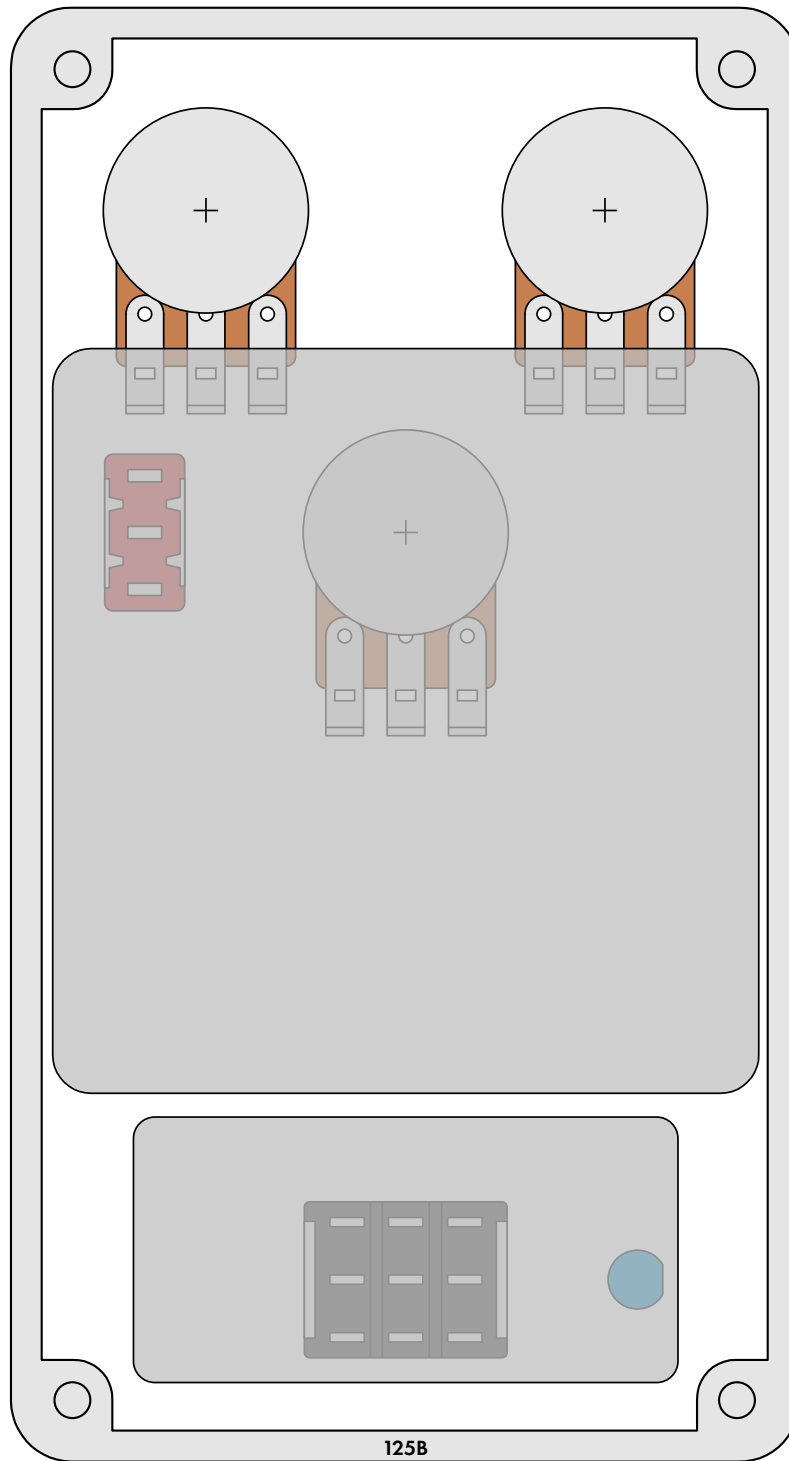
**LED hole drill size** assumes the use of a [5mm LED bezel](#), available from several parts suppliers. Adjust size accordingly if using something different, such as a 3mm bezel, a plastic bezel, or just a plain LED.



# ENCLOSURE LAYOUT

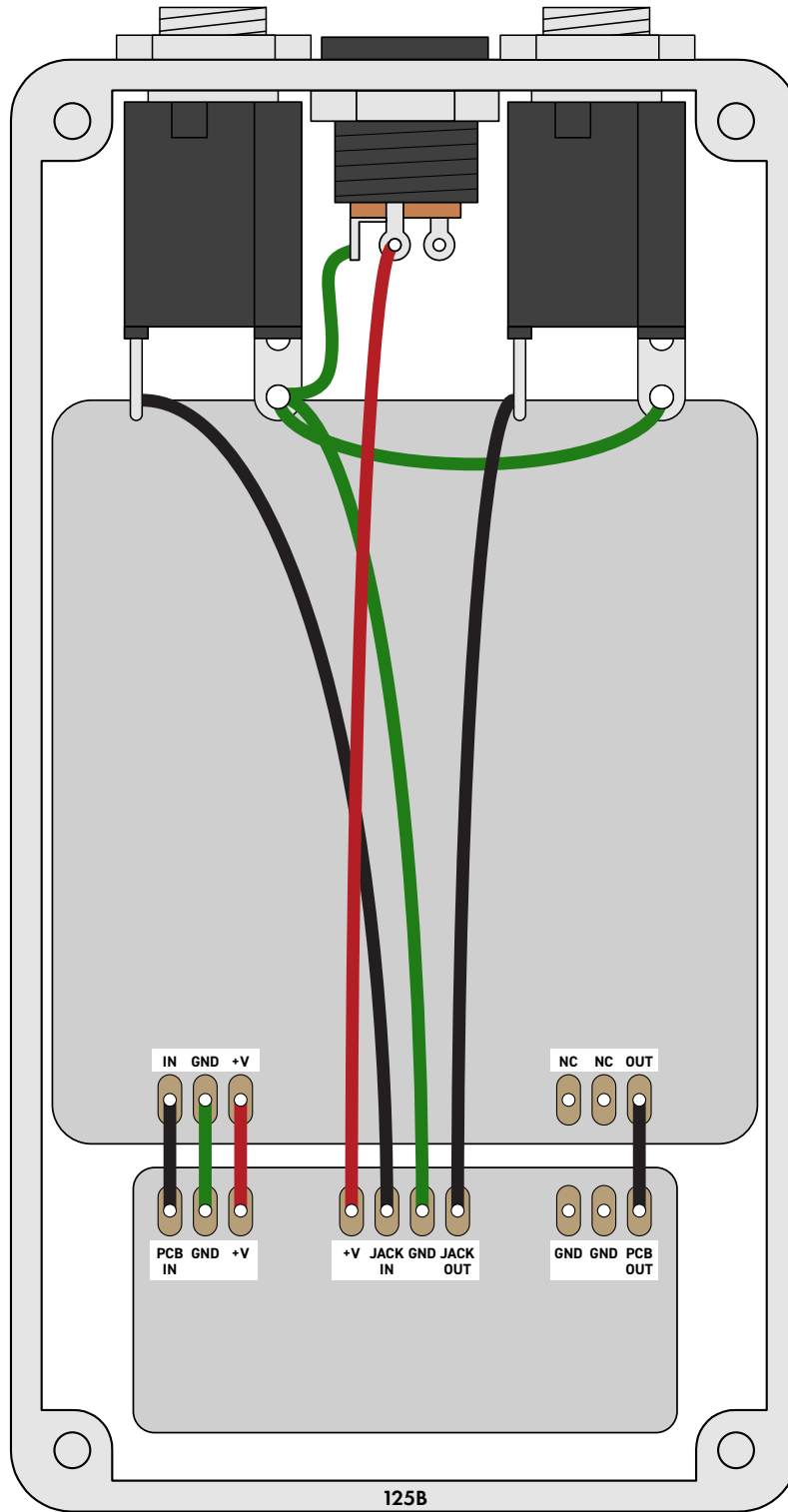
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Enclosure is shown without jacks. See next page for jack layout and wiring.





# WIRING DIAGRAM



## LICENSE & USAGE

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**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

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**1.0.0 (2023-07-04)**

Initial release.