

PROJECT NAME

# PHOBOS

BASED ON

Tone Bender Mk. III (3-knob)

BUILD DIFFICULTY

■■■■■ Easy

EFFECT TYPE

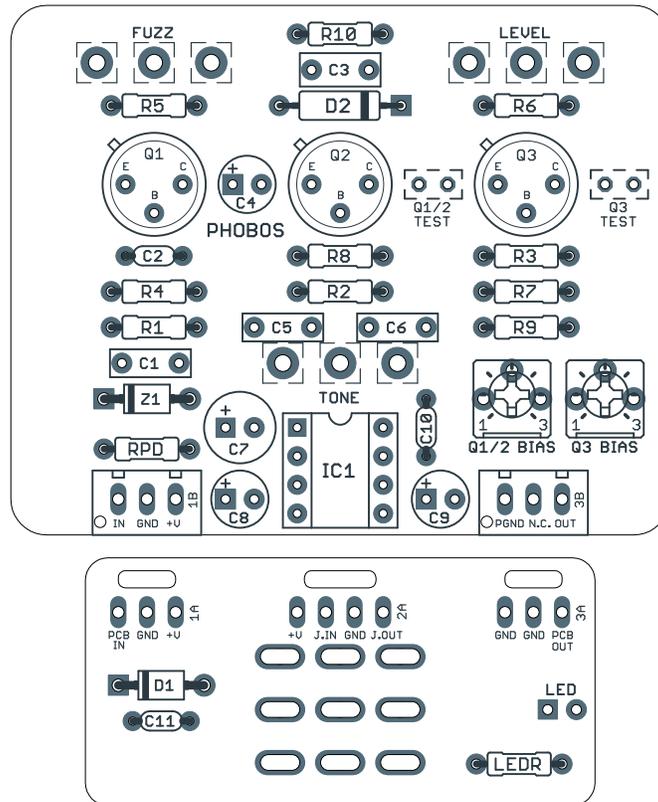
Germanium fuzz

DOCUMENT VERSION

1.0.1 (2022-10-18)

## PROJECT SUMMARY

A reproduction of the third version of the Tone Bender germanium fuzz sold by Macaris in London in the late 1960s.



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

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## INTRODUCTION

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The Phobos Germanium Fuzz is a clone of the Colorsound / Sola Sound Tone Bender Mk III. While the first version was essentially the same topology as a Fuzz Face, and the second version added a gain stage in front, this third version from 1967-1968 was a completely different circuit, using a Darlington-pair transistor configuration to drive a third transistor, followed by a tone control which the earlier versions were missing.

While the Mk. III Tone Bender was itself a variation of the Baldwin-Burns Buzzaround, it had a few variants of its own, both official and unofficial. The Vox Tone Bender was a licensed variant with a few parts substitutions. The Park Fuzz Sound by Park Amplification (Jim Marshall's side-brand) was a contemporary clone. The Elka Dizzytone and the Prescription Electronics Yard Box were two others. Aside from the Buzzaround, all of the rest of these variations can be build on this PCB.

A note about the name: the original Colorsound / Sola Sound unit was not called the "Mark III", but the Vox-licensed version was. As a result, this circuit is commonly called both the "Mark III" and the "three-knob" Tone Bender. This project will refer to it as the Mk III to differentiate it from the Mk II, which is available as another project called the [Deimos](#).

The Phobos project has a voltage inverter which allows you to power the effect with a standard center-negative adapter while maintaining the positive-ground operation of the original. The PCB also includes biasing trim pots so you can dial in a perfect bias without having to swap out resistors.

## USAGE

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The Phobos has three controls:

- **Fuzz** controls the amount of gain from the input stage that is sent to the third transistor where the clipping occurs.
- **Tone** pans between two filters, with a treble emphasis on to the left and a bass emphasis to the right.
- **Volume** is the output volume 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—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	47k	Metal film resistor, 1/4W	
R2	220k	Metal film resistor, 1/4W	
R3	1k	Metal film resistor, 1/4W	
R4	10k	Metal film resistor, 1/4W	
R5	3k3	Metal film resistor, 1/4W	
R6	18k	Metal film resistor, 1/4W	
R7	1k	Metal film resistor, 1/4W	
R8	10k	Metal film resistor, 1/4W	
R9	10k	Metal film resistor, 1/4W	
R10	220k	Metal film resistor, 1/4W	
RPD	1M	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	100n	Film capacitor, 7.2 x 2.5mm	
C2	220pF	MLCC capacitor, NP0/COG	
C3	220n	Film capacitor, 7.2 x 2.5mm	
C4	10uF	Electrolytic capacitor, 5mm	
C5	100n	Film capacitor, 7.2 x 2.5mm	
C6	2n2	Film capacitor, 7.2 x 2.5mm	
C7	100uF	Electrolytic capacitor, 6.3mm	
C8	10uF	Electrolytic capacitor, 5mm	
C9	47uF	Electrolytic capacitor, 5mm	
C10	470n	MLCC capacitor, X7R	
C11	100n	MLCC capacitor, X7R	
Z1	1N4742A	Zener diode, 12V, DO-41	
D1	1N5817	Schottky diode, DO-41	
D2	Germanium	Germanium diode, DO-07	Original uses 1N270, but part number isn't important. Just use any NOS germanium diode.

## PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
Q1	Germanium	Germanium transistor, PNP	Recommended to buy a selected Tone Bender Mk III set. See build notes.
Q1-S	TO-5 socket	Transistor socket, TO-5	
Q2	Germanium	Germanium transistor, PNP	Recommended to buy a selected Tone Bender Mk III set. See build notes.
Q2-S	TO-5 socket	Transistor socket, TO-5	
Q3	Germanium	Germanium transistor, PNP	Recommended to buy a selected Tone Bender Mk III set. See build notes.
Q3-S	TO-5 socket	Transistor socket, TO-5	
IC1	TC1044SCPA	Voltage inverter, DIP8	
IC1-S	DIP-8 socket	IC socket, DIP-8	
Q1-2B	50k trimmer	Trimmer, 10%, 1/4"	Bias trimmer for Q1 and Q2. See build notes.
Q3B	50k trimmer	Trimmer, 10%, 1/4"	Bias trimmer for Q3. See build notes.
FUZZ	100kB	16mm right-angle PCB mount pot	
TONE	100kB	16mm right-angle PCB mount pot	
LEVEL	100kA	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

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## Transistor notes

For this circuit, as with many other vintage fuzzes, it's not so much the part number of the germanium transistor as it is the properties—specifically, gain (hFE) and leakage.

The Tone Bender Mk III is less finicky about transistors than the Mk II, but still moreso than other germanium circuits like the Fuzz Face or Rangemaster. You can save a lot of time by just buying a [matched set from Small Bear Electronics](#) or eBay. However, if you don't have access to pre-matched transistors or you just want to source your own, here's what to look for.

## Characteristics

This is just a general guideline. There may be some transistors that meet these characteristics that won't sound right, and others that are outside this nominal range that will work just fine.

- **Q1:** hFE 50-100, low leakage (<100 $\mu$ A)
- **Q2:** hFE 50-100, low leakage (<100 $\mu$ A)
- **Q3:** hFE 90-120, medium leakage (100-300 $\mu$ A)

The characteristics of Q1 and Q2 are less important than Q3 due to their Darlington configuration. In fact, many people have even used low-gain silicons for Q1/2 with no reported change in tone, since this stage just boosts the signal and all the actual fuzz comes from overloading Q3.

## Biasing

As a starting point, set the two bias trimmers to around 9:00 (approximately 10k total resistance when combined with R3 and R7). Then, with a multimeter, touch the black and red leads to the pads marked "Q1/2 TEST", which is the shared collector of Q1/2. Rotate the trimmer until the multimeter reads **-3.5V**. This voltage may be positive if the test leads are reversed, but what's important is the absolute value.

Next, touch the multimeter leads to the pads marked "Q3 TEST". This is equivalent to the collector of Q3. Turn the trimmer until you read **-3V**.

Then, turn the Tone and Fuzz controls up all the way, and turn Level up to a reasonable volume. Adjust Q3 between -2V and -4V listening for the amount of low end, and stop when the maximum amount of bass is to your liking—keeping in mind that the tone control also cuts bass even further when turned down. Lower voltages (i.e. more negative) will give more low-end fullness, but the Mk. III usually sounds best when the bass is cut back slightly.

Then, with the black lead touching ground, touch each leg of each of the transistors and see how they line up with these target voltages.

- **Q1:** Collector -3.5V, Base -1.5V, Emitter -1.4V
- **Q2:** Collector -3.5V, Base -1.5V, Emitter -1.4V
- **Q3:** Collector -2V to -4V, Base -0.05V, Emitter 0V

The collector voltages are just a baseline. For Q1/2, anything from 3V to 7V will work fine and will sound roughly the same. For Q3, the EQ does change a bit depending on the bias, but as long as the transistors have the right characteristics, the overall character of the fuzz will be the same across the range.

## BUILD NOTES, CONT.

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### Variants

There were a number of other variants of Mk III that each had minor changes. Start with the original Sola Sound Tone Bender parts list on page 3-4 of this documentation and make the following changes.

#### Vox Tone Bender Mk III

- **R1:** 100k
- **R2:** 680k
- **C4:** 6.4uF (nearest standard value today is 6.8uF)
- **C6:** 2n (doesn't make much of a difference; just use 2n2 here like the Sola Sound version)

This is also identical to the Park Fuzz Sound (3-knob version), except the Park uses **2n2** for C6.

#### Park Fuzz Sound (2-knob)

- **R1:** 100k
- **R2:** 680k
- **R10:** 470k
- **C2:** 200pF
- **C4:** 25uF (nearest standard value today is 22uF)

The 2-knob version omits the Fuzz control and hardwires it full-on all the time. If you're building this variant, it's recommended to keep the Fuzz control in place. If it's turned all the way up, the unit is stock, but this way you still have the option to turn it down.

#### Prescription Electronics Yard Box

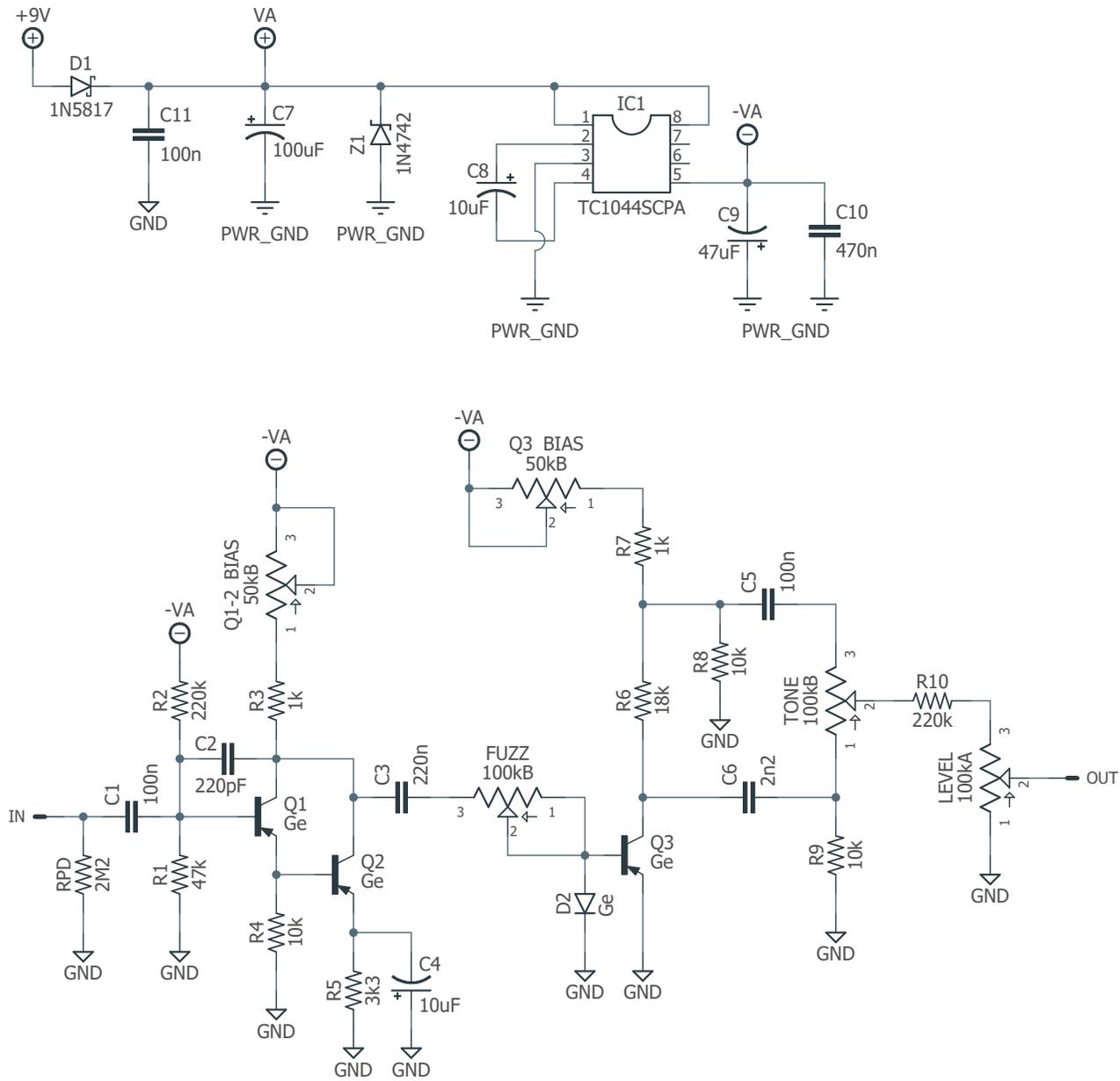
- **C4:** 4.7uF
- **Fuzz:** 250kB

The Yard Box also changes R10 from a 220k fixed resistor to a 250kB pot. Most people do not find this to be very useful since it essentially just increases the maximum volume, acting as a secondary volume control rather than causing any major tonal changes. It's recommended to instead use the output volume mod in the next section.

### Output volume

The 220k resistor before the volume control (R10) reduces the maximum available output volume. While the circuit isn't lacking in available volume, if you'd like to get a little more out of it, you can reduce this resistor to **68k** and then increase the volume control to **250kA**. This gives you the same total resistance (~320k) so the tone and output impedance is unaffected, but available output volume is increased.

# SCHEMATIC



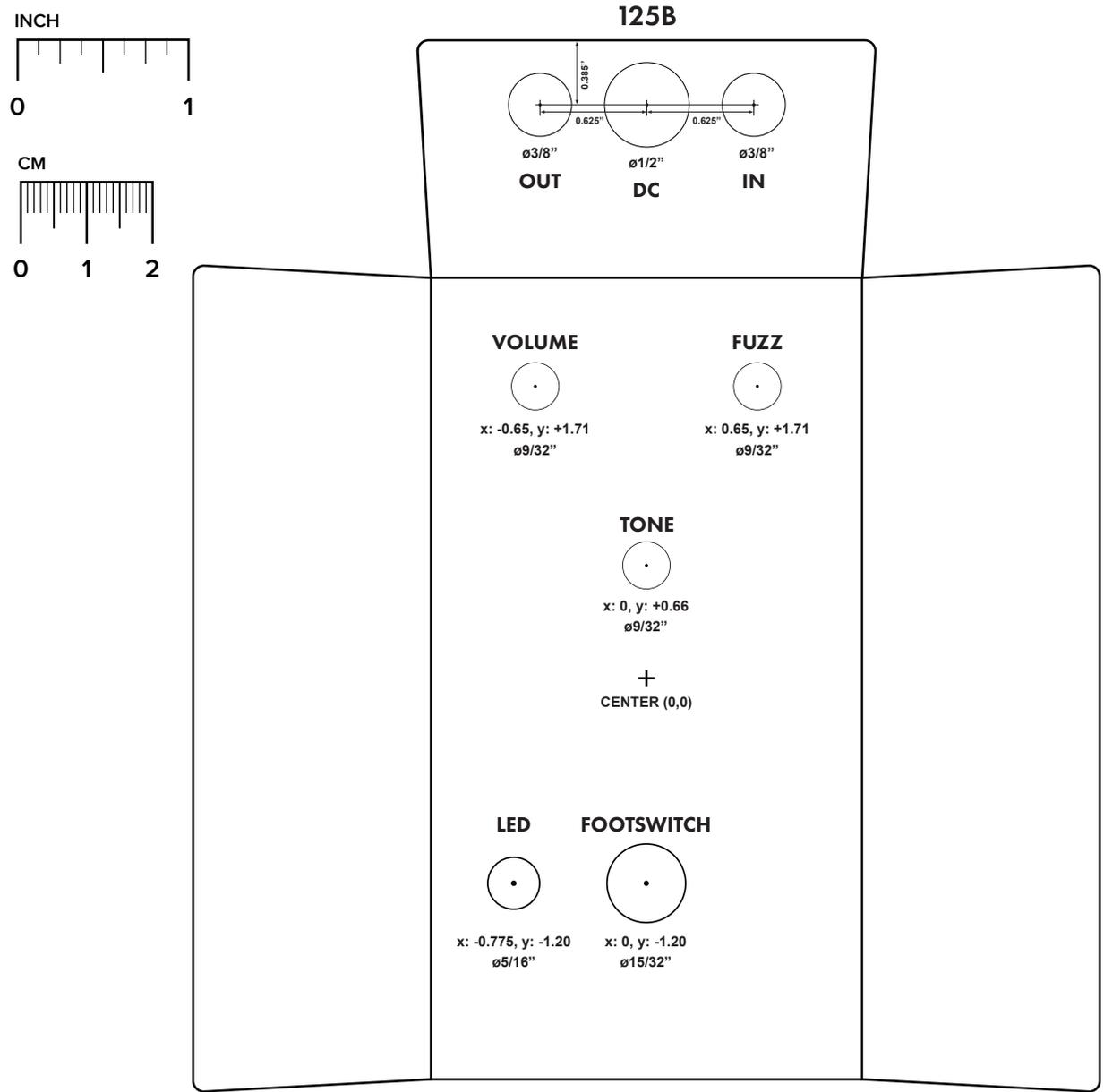
# DRILL TEMPLATE

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.

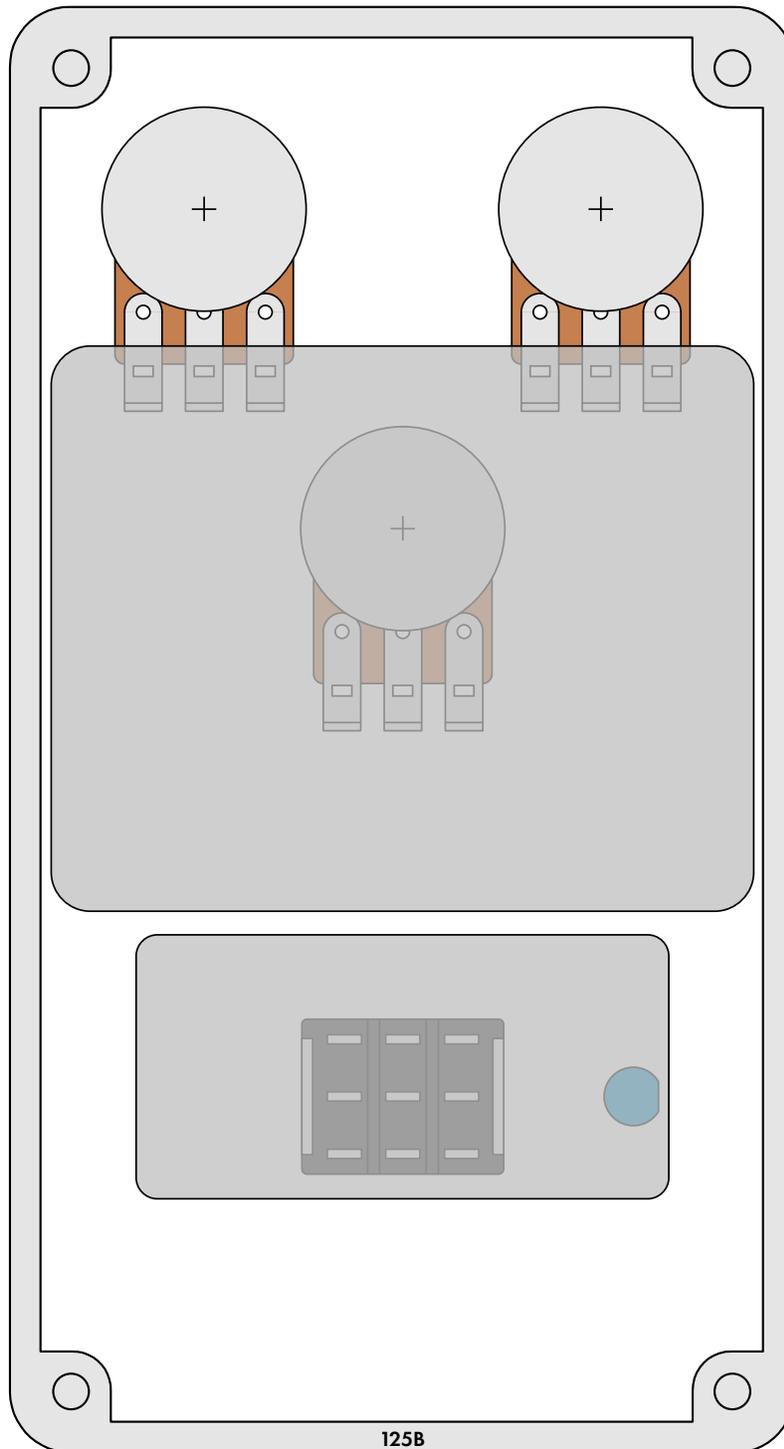
**LED hole drill size** assumes the use of a [5mm LED bezel](#), available from several parts suppliers. Adjust size accordingly if using something different, such as a 3mm bezel, a plastic bezel, or just a plain LED.



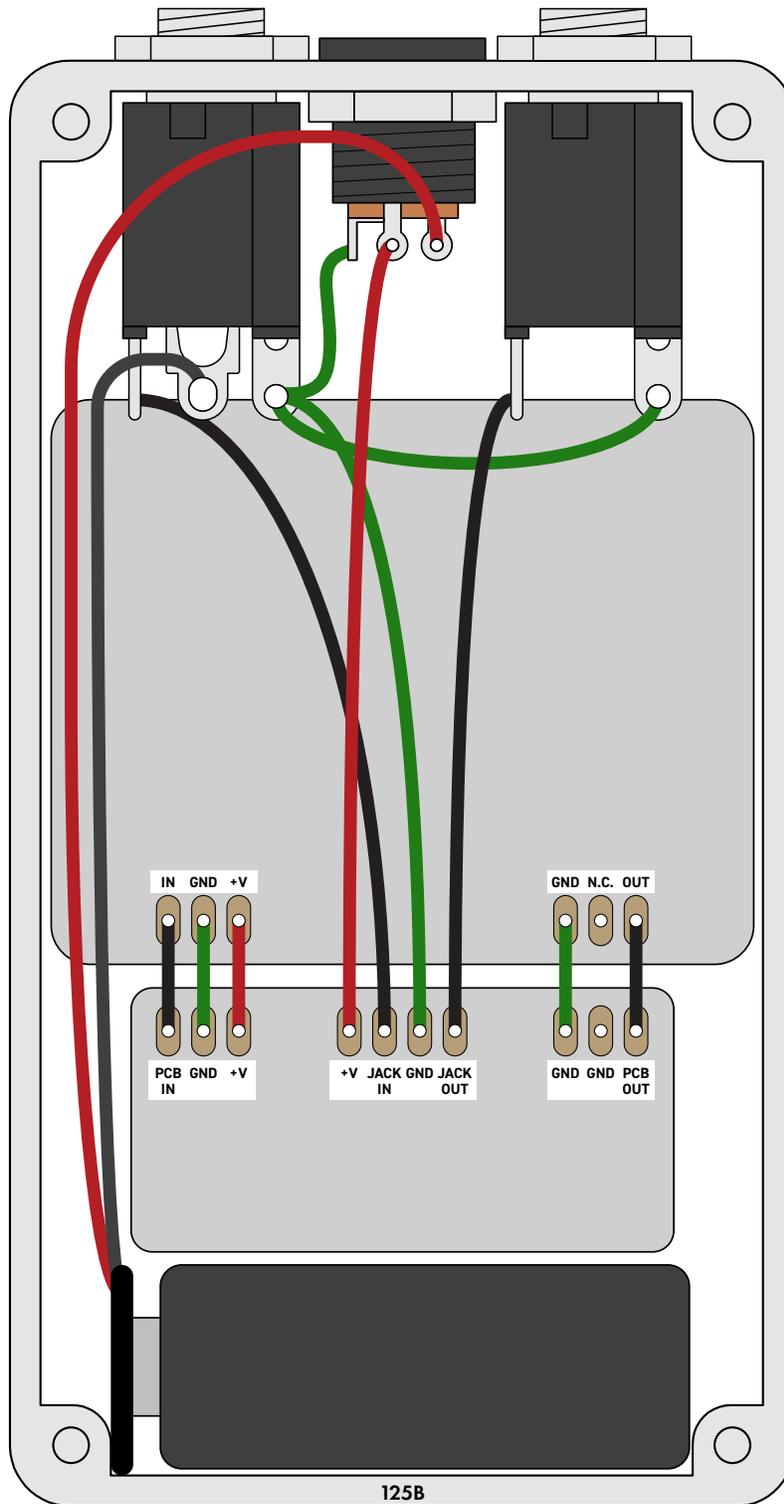
# ENCLOSURE LAYOUT

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



# WIRING DIAGRAM



*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

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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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### 1.0.1 (2022-10-18)

Revised biasing instructions and changed both bias trimmers to 50k to allow for easier biasing of a wider variety of transistors.

### 1.0.0 (2020-07-03)

Initial release.