

PROJECT NAME

# HELIODOR



BASED ON

BOSS® OD-3 Overdrive

BUILD DIFFICULTY

■■■■□ Intermediate

EFFECT TYPE

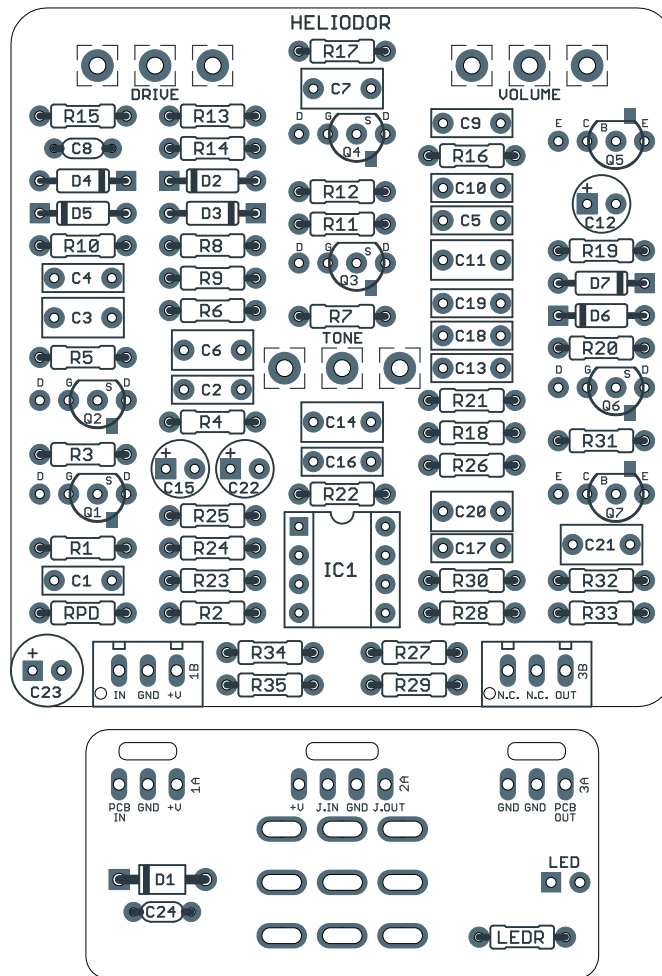
JFET overdrive

DOCUMENT VERSION

1.0.0 (2021-11-26)

## PROJECT SUMMARY

The final entry in a series of legendary pedals using BOSS's "discrete op-amp" topology that overdrives more like an amplifier than traditional drive circuits.



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

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## INTRODUCTION

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The Heliodor Amp Overdrive is based on the BOSS® OD-3 Overdrive, released in 1997 as the successor to the OD-2r Turbo Overdrive.

The OD-3 continues in the tradition of the OD-2/r and BD-2 Blues Driver with BOSS's signature "discrete op-amp" topology, using two JFETs and a PNP transistor to create a variable gain stage that can be controlled like an op-amp but clips gracefully when overdriven. Unlike the two earlier units, though, the OD-2 uses clipping diodes in the this stage to achieve a more traditional soft clipping.

Due to the circuit similarities with the BD-2, it's been theorized that the OD-3 was actually designed as the successor to the Blues Driver, but that BOSS didn't want to make changes to such a commercially successful pedal—and as a result, the OD-3 was released under the Overdrive umbrella.

Regardless of what went on in the product development meetings, the OD-3 does borrow ideas from both the OD-2 and BD-2 and manages to improve on both of them from a design standpoint. The Blues Driver may get more attention, but the OD-3 remains the crowning achievement of BOSS's discrete op-amp topology.

The Heliodor is a direct adaptation of the OD-3 with no changes other than converting to true bypass.

The original OD-3 uses the 2SK184-GR JFET, a low-cutoff type similar to J201, but no longer made in through-hole format. 2SK209-GR is the SMD version that is still in production and will perform exactly the same as the originals. Each of the JFETs have extra pads for soldering SMD parts, but if you don't feel confident in your SMD skills, Aion FX sells [2SK209-GR pre-soldered to adapter boards](#) to be used in through-hole applications.

## USAGE

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The Heliodor has three controls:

- **Drive** increases the gain of the discrete op-amp stage, which clips on its own as well as pushing the second JFET stage into clipping.
- **Tone** is a passive treble cut before the output volume control.
- **Volume** sets the overall output of the effect signal.

## 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	10k	Metal film resistor, 1/4W	
R2	1M	Metal film resistor, 1/4W	
R3	10k	Metal film resistor, 1/4W	
R4	100k	Metal film resistor, 1/4W	
R5	10k	Metal film resistor, 1/4W	
R6	10k	Metal film resistor, 1/4W	
R7	3k3	Metal film resistor, 1/4W	
R8	10k	Metal film resistor, 1/4W	
R9	220k	Metal film resistor, 1/4W	
R10	220k	Metal film resistor, 1/4W	
R11	2k7	Metal film resistor, 1/4W	
R12	6k8	Metal film resistor, 1/4W	
R13	470R	Metal film resistor, 1/4W	
R14	3k3	Metal film resistor, 1/4W	
R15	2k7	Metal film resistor, 1/4W	
R16	100k	Metal film resistor, 1/4W	
R17	33k	Metal film resistor, 1/4W	
R18	10k	Metal film resistor, 1/4W	
R19	1k	Metal film resistor, 1/4W	
R20	2k2	Metal film resistor, 1/4W	
R21	4k7	Metal film resistor, 1/4W	
R22	47k	Metal film resistor, 1/4W	
R23	150k	Metal film resistor, 1/4W	
R24	1k	Metal film resistor, 1/4W	
R25	6k8	Metal film resistor, 1/4W	
R26	12k	Metal film resistor, 1/4W	
R27	4k7	Metal film resistor, 1/4W	
R28	12k	Metal film resistor, 1/4W	
R29	4k7	Metal film resistor, 1/4W	
R30	100k	Metal film resistor, 1/4W	
R31	10k	Metal film resistor, 1/4W	
R32	100k	Metal film resistor, 1/4W	

## PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
R33	1k	Metal film resistor, 1/4W	
R34	10k	Metal film resistor, 1/4W	
R35	10k	Metal film resistor, 1/4W	
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	47n	Film capacitor, 7.2 x 2.5mm	
C1	47n	Film capacitor, 7.2 x 2.5mm	
C2	18n	Film capacitor, 7.2 x 2.5mm	
C3	1uF	MLCC capacitor, NP0/C0G	
C4	10n	Film capacitor, 7.2 x 2.5mm	
C5	56n	Film capacitor, 7.2 x 2.5mm	
C6	1uF	Film capacitor, 7.2 x 2.5mm	
C7	470n	Film capacitor, 7.2 x 2.5mm	
C8	47pF	MLCC capacitor, NP0/C0G	Not in original unit. See build notes.
C9	56n	Film capacitor, 7.2 x 2.5mm	
C10	1n2	Film capacitor, 7.2 x 2.5mm	
C11	470n	Film capacitor, 7.2 x 2.5mm	
C12	10uF	Film capacitor, 7.2 x 3.5mm	
C13	12n	Electrolytic capacitor, 5mm	
C14	1uF	Film capacitor, 7.2 x 3.5mm	
C15	10uF	Film capacitor, 7.2 x 2.5mm	
C16	6n8	Film capacitor, 7.2 x 3.5mm	
C17	18n	Electrolytic capacitor, 5mm	
C18	33n	Electrolytic capacitor, 6.3mm	
C19	22n	Electrolytic capacitor, 5mm	
C20	1uF	Electrolytic capacitor, 5mm	
C21	1uF	Electrolytic capacitor, 5mm	
C22	47uF	Electrolytic capacitor, 5mm	Reference voltage filter capacitor.
C23	100uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C24	100n	MLCC capacitor, X7R	Power supply filter capacitor.
D1	1N5817	Schottky diode, DO-41	
D2	1N914	Fast-switching diode, DO-35	
D3	1N914	Fast-switching diode, DO-35	
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	

## PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
Q1	2SK209-GR	BJT transistor, PNP, TO-92	Original uses 2SK184-GR. 2SK209-GR is the SMD equivalent.
Q2	2SK209-GR	JFET, N-channel, SOT-23	Original uses 2SK184-GR. 2SK209-GR is the SMD equivalent.
Q3	2SK209-GR	JFET, N-channel, SOT-23	Original uses 2SK184-GR. 2SK209-GR is the SMD equivalent.
Q4	2SK209-GR	BJT transistor, PNP, TO-92	Original uses 2SK184-GR. 2SK209-GR is the SMD equivalent.
Q5	2N3906	BJT transistor, NPN, TO-92	Substitute. Original uses 2SA1048.
Q6	2SK209-GR	BJT transistor, PNP, TO-92	Original uses 2SK184-GR. 2SK209-GR is the SMD equivalent.
Q7	2N5088	BJT transistor, NPN, TO-92	Substitute. Original uses 2SC2458-GR.
IC1	JRC4558D	Operational amplifier, DIP8	Substitute. Original uses M5218AL.
IC1-S	DIP-8 socket	IC socket, DIP-8	
DRIVE	100kA	16mm right-angle PCB mount pot	
TONE	10kB	16mm right-angle PCB mount pot	
VOLUME	100kB	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.

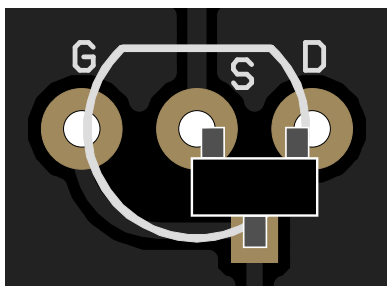
## BUILD NOTES

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### Using SMD JFETs

The 2SK117-GR JFET is no longer available in through-hole format. This PCB uses a hybrid through-hole/SMD outline for each JFET. An extra “G” (gate) pad is included to accommodate surface-mount devices without the need for adapters.

SMD JFETs should be oriented as follows:



All surface-mount JFETs use the same pinout, so this configuration will fit any type that we’re aware of. However, always check the datasheet if you’re uncertain—they’re difficult to desolder.

### Using through-hole adapters

If you’re not confident in your ability to work with surface-mount parts, Aion FX offers [2SK209-GR JFETs](#) (the SMD version of 2SK184-GR and 2SK117-GR) that come pre-soldered to adapters for use in through-hole designs. These are from the same manufacturer as the ones used in the original BOSS pedals and will perform identically.

### Using old-stock transistors

Toshiba has not manufactured through-hole transistors and JFETs in many years, but it’s still possible to find the 2SK184-GR and 2SK117-GR as well as the four types of BJT transistors used in the original. However, be aware that these follow the Japanese pinout conventions, whereas the PCB layout is set up for USA conventions since there are a lot more widely-available substitutes in this format.

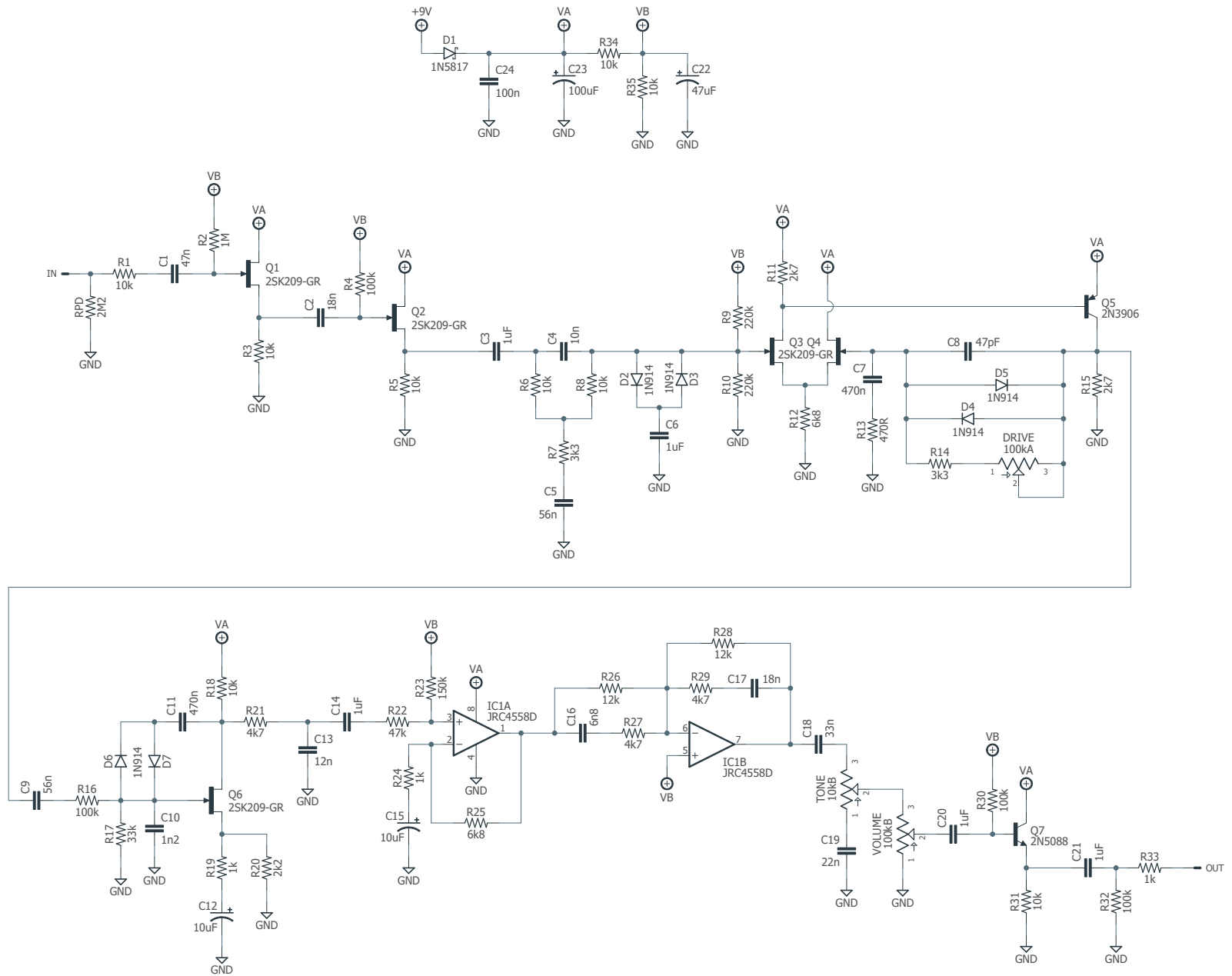
For those using original Toshiba through-hole JFETs or BJTs, an extra pad has been added to the left of the transistor outline (drain for JFETs, emitter for BJTs) so that the Japanese pinout can be easily used without needing to twist the legs around. In both cases, the transistor should be rotated 180 degrees from the silkscreen and shifted over one pad, as shown:



### C8 capacitor

C8 (47pF) is not present in the original unit, but it’s good practice to have a small-value feedback capacitor when dealing with these types of gain stages to prevent high-frequency oscillation. The OD-2 and BD-2 do use this capacitor in similar circuitry.

# SCHEMATIC



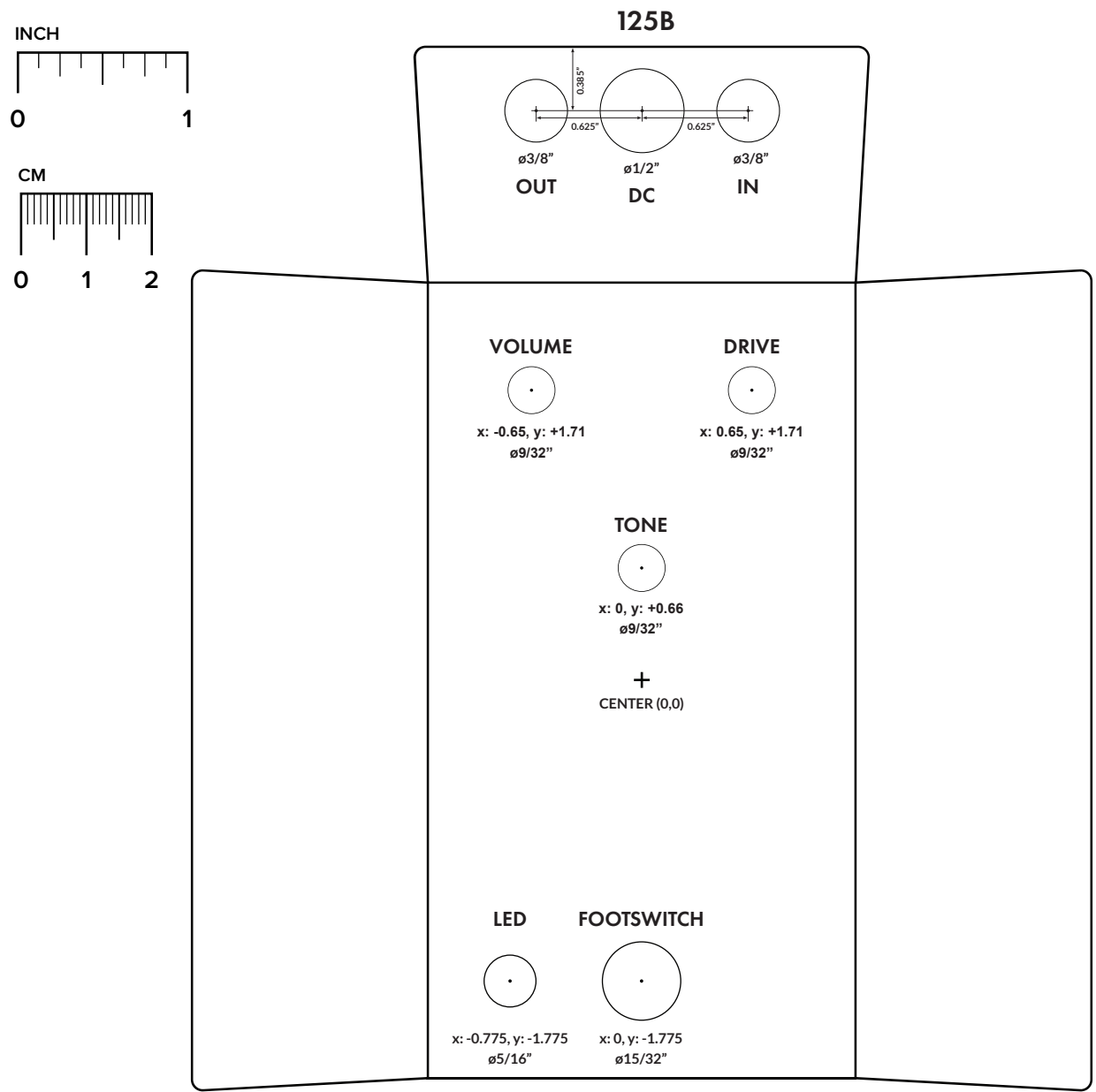
# DRILL TEMPLATE

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.

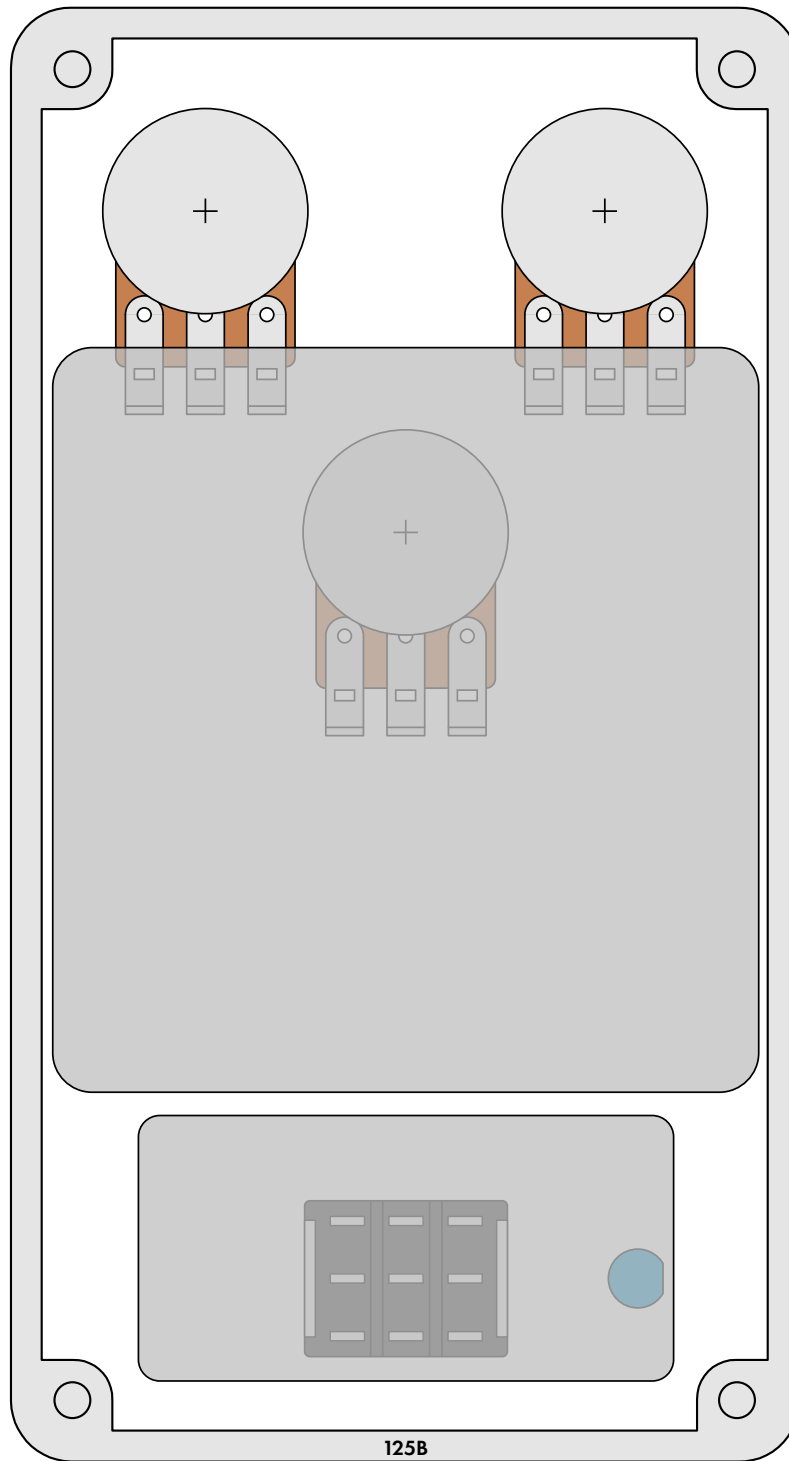




# ENCLOSURE LAYOUT

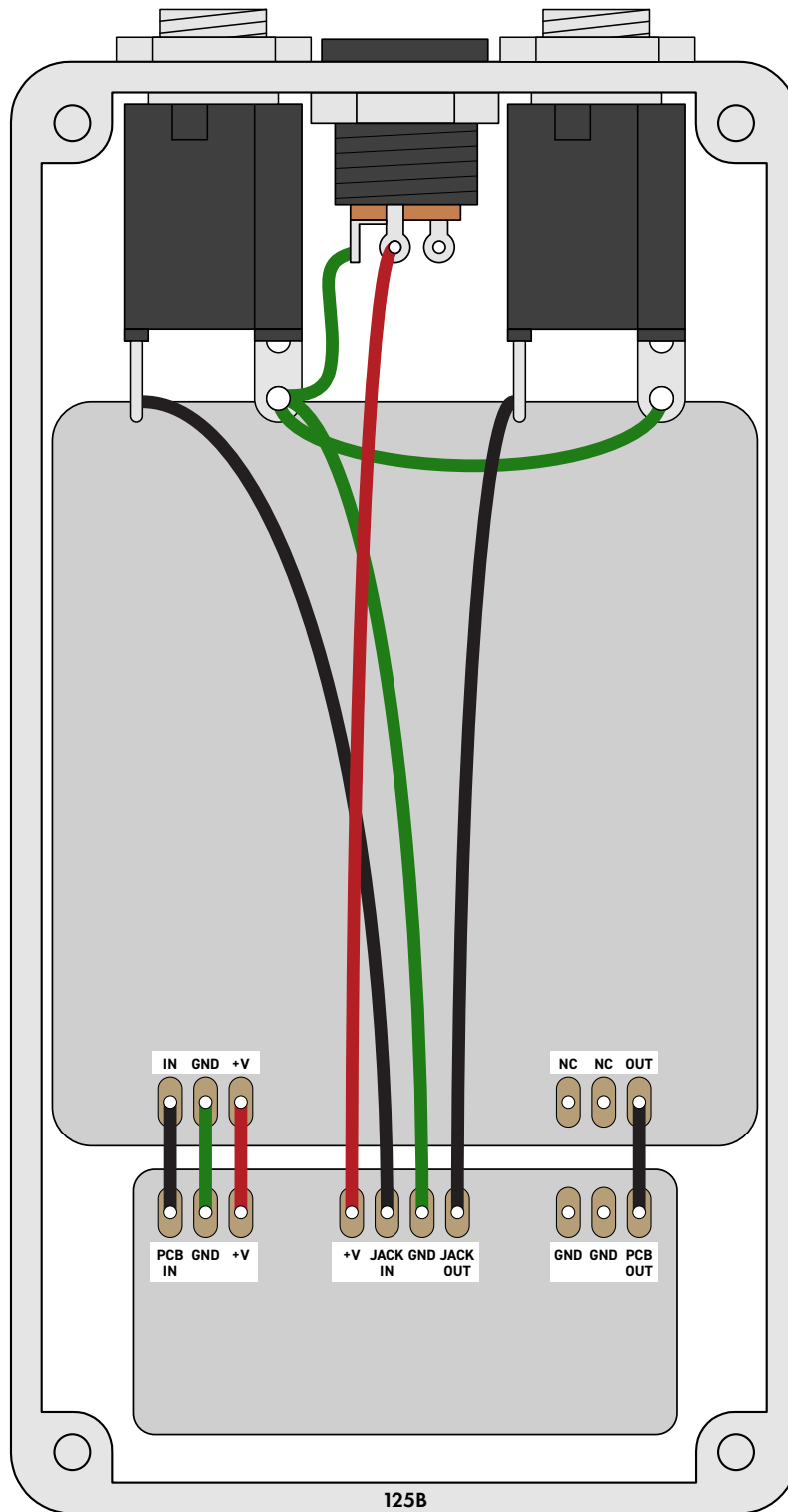
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Enclosure is shown without jacks. See next page for jack layout and wiring.



# WIRING DIAGRAM

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## 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 (2021-11-26)

Initial release.