PROJECT NAME

ARCTURUS

aion DIY GUITAR EFFECTS

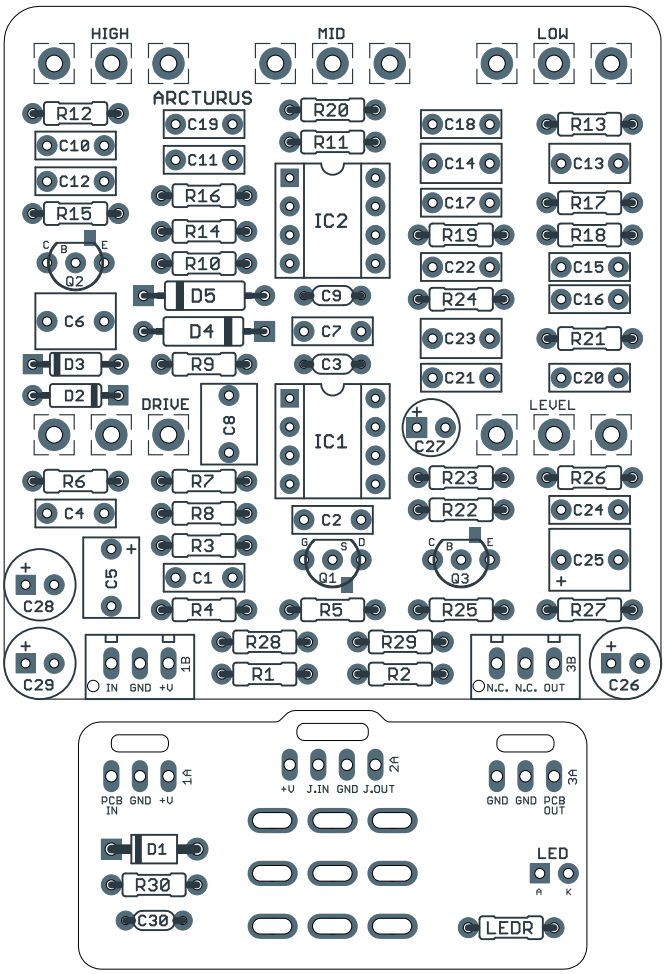
BASED ON
Nobels ODR-S Overdrive Special

BUILD DIFFICULTY
Intermediate

EFFECT TYPE
Overdrive

DOCUMENT VERSION
1.0.0 (2023-09-08)

PROJECT SUMMARY
A variation of the more famous ODR-1 with a full three-band tonestack and germanium diode clipping.



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

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INTRODUCTION

The Arcturus Natural Overdrive is based on the Nobels ODR-S Overdrive Special, first released in 1993 as a sibling of their more famous ODR-1.

Compared to the ODR-1, the ODR-S has a nearly identical drive section, except that the hard-clipping diodes are germanium instead of silicon. The main difference is in the tone stack. The ODR-1's Spectrum control has been replaced by a full 3-band EQ. The midrange control uses the same transistor gyrator concept as the Spectrum control, though it's tuned very differently, while the bass and treble controls are a standard Baxandall arrangement.

The Arcturus is a direct adaptation of the ODR-S, but with the JFET switching removed in favor of true bypass. We have also added an optional correction for what has been seen as an error in the original design related to the input bias of the second op-amp stage. This is described in detail in the build notes if you're curious.

In 2023, Kai Tachibana, the original designer of the ODR-1 and ODR-S, released a pedal called the ODR-CS Custom Special under his company Nordland Electronics in honor of the original pedal's 30th anniversary. The ODR-CS is a re-engineered version of the ODR-S that uses better quality components than the original Nobels unit as well as true bypass switching. It also has a few editorial changes, primarily in the three bands of the tone stack.

The Nordland ODR-CS has not been traced as of this writing, so we are not sure what exact schematic changes were made. But Nordland makes a fantastic product, so we strongly recommend buying one from them if you are interested!

USAGE

The Arcturus has five knobs:

- **Gain** controls the amount of gain in the first op-amp stage.
- **Low** boosts or cuts low frequencies centered around 100-200 Hz.
- **Mid** boosts frequencies centered at 800-900 Hz.
- **High** boosts or cuts high frequencies centered around 3-4kHz.
- **Level** is the overall output level.

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	33k	Metal film resistor, 1/4W	
R2	1M	Metal film resistor, 1/4W	
R3	3k3	Metal film resistor, 1/4W	
R4	2k7	Metal film resistor, 1/4W	
R5	10k	Metal film resistor, 1/4W	
R6	1k	Metal film resistor, 1/4W	
R7	1k	Metal film resistor, 1/4W	
R8	1k8	Metal film resistor, 1/4W	
R9	10k	Metal film resistor, 1/4W	
R10	43k	Metal film resistor, 1/4W	
R11	22k	Metal film resistor, 1/4W	
R12	12k	Metal film resistor, 1/4W	
R13	47k	Metal film resistor, 1/4W	
R14	200k	Metal film resistor, 1/4W	
R15	3k3	Metal film resistor, 1/4W	
R16	1k5	Metal film resistor, 1/4W	
R17	22k	Metal film resistor, 1/4W	
R18	10k	Metal film resistor, 1/4W	
R19	5k6	Metal film resistor, 1/4W	
R20	2k4	Metal film resistor, 1/4W	
R21	5k6	Metal film resistor, 1/4W	
R22	4k7	Metal film resistor, 1/4W	
R23	10k	Metal film resistor, 1/4W	
R24	15k	Metal film resistor, 1/4W	
R25	200k	Metal film resistor, 1/4W	
R26	2k2	Metal film resistor, 1/4W	
R27	200k	Metal film resistor, 1/4W	
R28	10k	Metal film resistor, 1/4W	
R29	10k	Metal film resistor, 1/4W	
R30	47R	Metal film resistor, 1/4W	Power supply filter resistor.
LEDR	10k	Metal film resistor, 1/4W	LED current-limiting resistor. Adjust value to change LED brightness.
C1	68n	Film capacitor, 7.2 x 2.5mm	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C2	10n	Film capacitor, 7.2 x 2.5mm	
C3	150pF	MLCC capacitor, NP0/C0G	
C4	68n	Film capacitor, 7.2 x 2.5mm	
C5	2.2uF	Film capacitor, 7.2 x 5mm	Can substitute electrolytic (polarity is marked on PCB).
C6	2.2uF	Film capacitor, 7.2 x 5mm	
C7	3n9	Film capacitor, 7.2 x 2.5mm	
C8	2.2uF	Film capacitor, 7.2 x 5mm	
C9	330pF	MLCC capacitor, NP0/C0G	
C10	12n	Film capacitor, 7.2 x 2.5mm	
C11	56n	Film capacitor, 7.2 x 2.5mm	
C12	2n7	Film capacitor, 7.2 x 2.5mm	
C13	1uF	Film capacitor, 7.2 x 3.5mm	
C14	1uF	Film capacitor, 7.2 x 3.5mm	
C15	100n	Film capacitor, 7.2 x 2.5mm	
C16	33n	Film capacitor, 7.2 x 2.5mm	
C17	1n8	Film capacitor, 7.2 x 2.5mm	
C18	18n	Film capacitor, 7.2 x 2.5mm	
C19	8n2	Film capacitor, 7.2 x 2.5mm	
C20	22n	Film capacitor, 7.2 x 2.5mm	
C21	1n	Film capacitor, 7.2 x 2.5mm	
C22	82n	Film capacitor, 7.2 x 2.5mm	
C23	1uF	Film capacitor, 7.2 x 3.5mm	
C24	100n	Film capacitor, 7.2 x 2.5mm	
C25	3.3uF	Film capacitor, 7.2 x 5.5mm	Can substitute electrolytic (polarity is marked on PCB) or use 1uF.
C26	220uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C27	47uF	Electrolytic capacitor, 5mm	Power supply filter capacitor.
C28	220uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C29	220uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C30	100n	MLCC capacitor, X7R	Power supply filter capacitor.
Z1	1N5232B	Zener diode, 5.6V, DO-35	
D1	1N5817	Schottky diode, DO-41	
D2	1N914	Fast-switching diode, DO-35	
D3	1N914	Fast-switching diode, DO-35	
D4	Germanium	Germanium diode, DO-7	Any germanium diode should work about the same in this circuit, so use whatever you can find.
D5	Germanium	Germanium diode, DO-7	
Q1	2N5457	BJT transistor, NPN, TO-92	Substitute. Original uses BF245C.
Q2	2N5088	Operational amplifier, dual, DIP8	Substitute. Original uses 2SC3198-BL.

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
Q3	2N5088	BJT transistor, NPN, TO-92	Substitute. Original uses 2SC3198-BL.
IC1	RC4558P	Operational amplifier, dual, DIP8	
IC1-S	DIP-8 socket	IC socket, DIP-8	
IC2	RC4558P	Operational amplifier, dual, DIP8	
IC2-S	DIP-8 socket	IC socket, DIP-8	
DRIVE	500kA	16mm right-angle PCB mount pot	
LOW	50kB	16mm right-angle PCB mount pot	
MID	25kC	16mm right-angle PCB mount pot	Original uses 30kC. 25kC will work the same.
HIGH	50kB	16mm right-angle PCB mount pot	
LEVEL	50kA	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

Germanium diode selection

Based on the factory schematic, the original ODR-S seemed to use AA-112 germanium diodes. However, according to the designer, this was just a placeholder from the schematic software and not the actual type used in production. He does mention that Nobels eventually switched to a type of diode that he found to be inferior because they weren't able to find enough supply of his preferred type, so at least according to him, the type makes a difference.

If you're curious, Kai Tachibana has written an article about the development of the ODR-S that's a very interesting read.

IC2A bias

IC2A has an odd bias arrangement in the original ODR-S circuit, getting its bias voltage through the one of the germanium diodes instead of from a bias resistor as you'd expect. This may have been an intentional choice and it's possible that it leads to a desirable effect—but from an engineering standpoint, it looks like a mistake.

We've corrected this by adding a capacitor (C8) between the diodes and the IC2A input and adding a separate bias resistor (R10) at the input. We chose 43k because it's the value used in the ODR-1. If you want to omit this, just jumper C8 by running a wire between the pads and omit R10 (leave it empty).

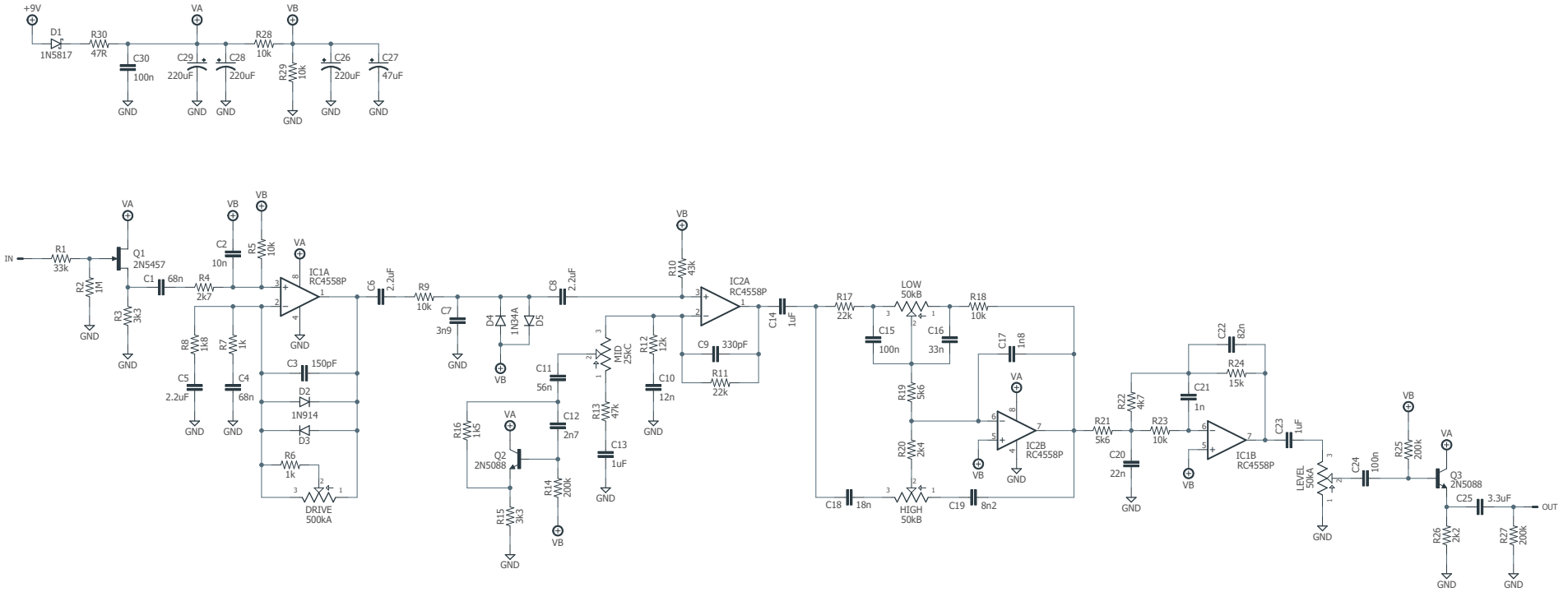
In the ODR-CS, this whole stage has been redesigned so that the midrange control can cut as well as boost, so we can't infer whether the designer would see this as a mistake today upon revisiting the circuit. However, the fact that the IC no longer gets its bias from the diode would indicate that he does not see it as critical to the sound.

Be aware that if you want to put the hard-clipping diodes on a switch, the op-amp will not bias if they're switched out unless you include our C8/R10 fix.

Midrange pot value

The midrange pot is 30kC on the original ODR-S. This value is basically impossible to find without custom-ordering in large quantities, so just use 25kC or even 20kC.

SCHEMATIC


+9V
D1
1N5817
R30
47R
C30
100n
VA
C29
220uF
C28
220uF
R28
10k
VB
R29
10k
C26
220uF
C27
47uF
GND
IN
R1
33k
Q1
2N5457
R2
1M
R3
3k3
C1
68n
R4
2k7
C2
10n
R5
10k
IC1A
RC4558P
C6
2.2uF
R8
1k8
R7
1k
C5
2.2uF
C4
68n
C3
150pF
D2
1N914
D3
R6
1k
DRIVE
500kA
R9
10k
C7
3n9
D4
1N34A
D5
C8
2.2uF
R10
43k
IC2A
RC4558P
C14
1uF
C11
56n
MID
25kC
R12
12k
C10
12n
C9
330pF
R11
22k
R16
1k5
Q2
2N5088
C12
2n7
R13
47k
C13
1uF
R14
200k
R15
3k3
R17
22k
LOW
50kB
R18
10k
C15
100n
C16
33n
C17
1n8
R19
5k6
R20
2k4
IC2B
RC4558P
C18
18n
HIGH
50kB
C19
8n2
R21
5k6
R22
4k7
R23
10k
C22
82n
R24
15k
C21
1n
C20
22n
IC1B
RC4558P
C23
1uF
LEVEL
50kA
C24
100n
R25
200k
Q3
2N5088
C25
3.3uF
OUT
R26
2k2
R27
200k

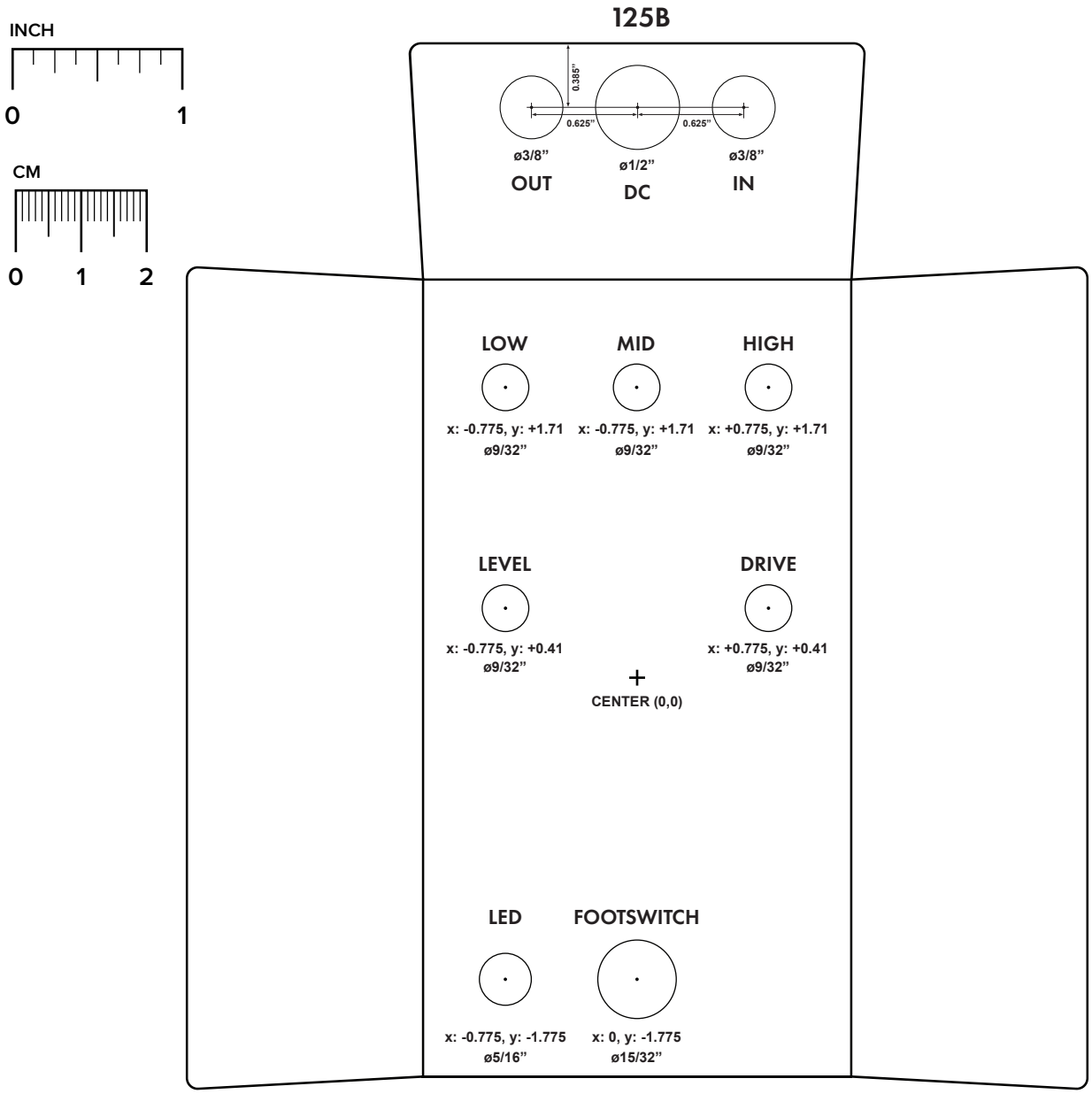
DRILL TEMPLATE

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.

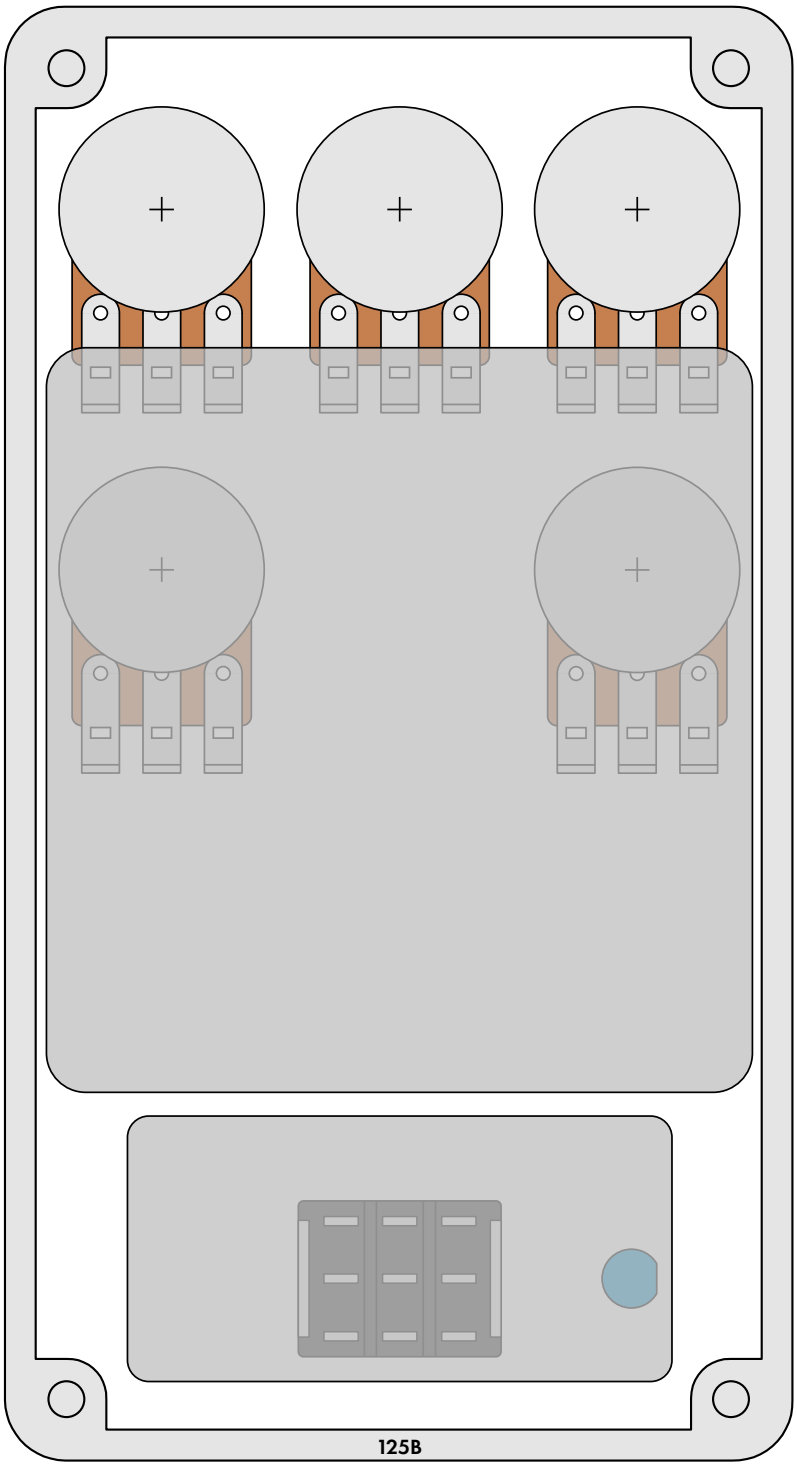
Top jack layout assumes the use of closed-frame jacks like the Switchcraft 111X. Open-frame jacks will not fit in layouts with 5 or more knobs due to the placement of the DC jack.

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.

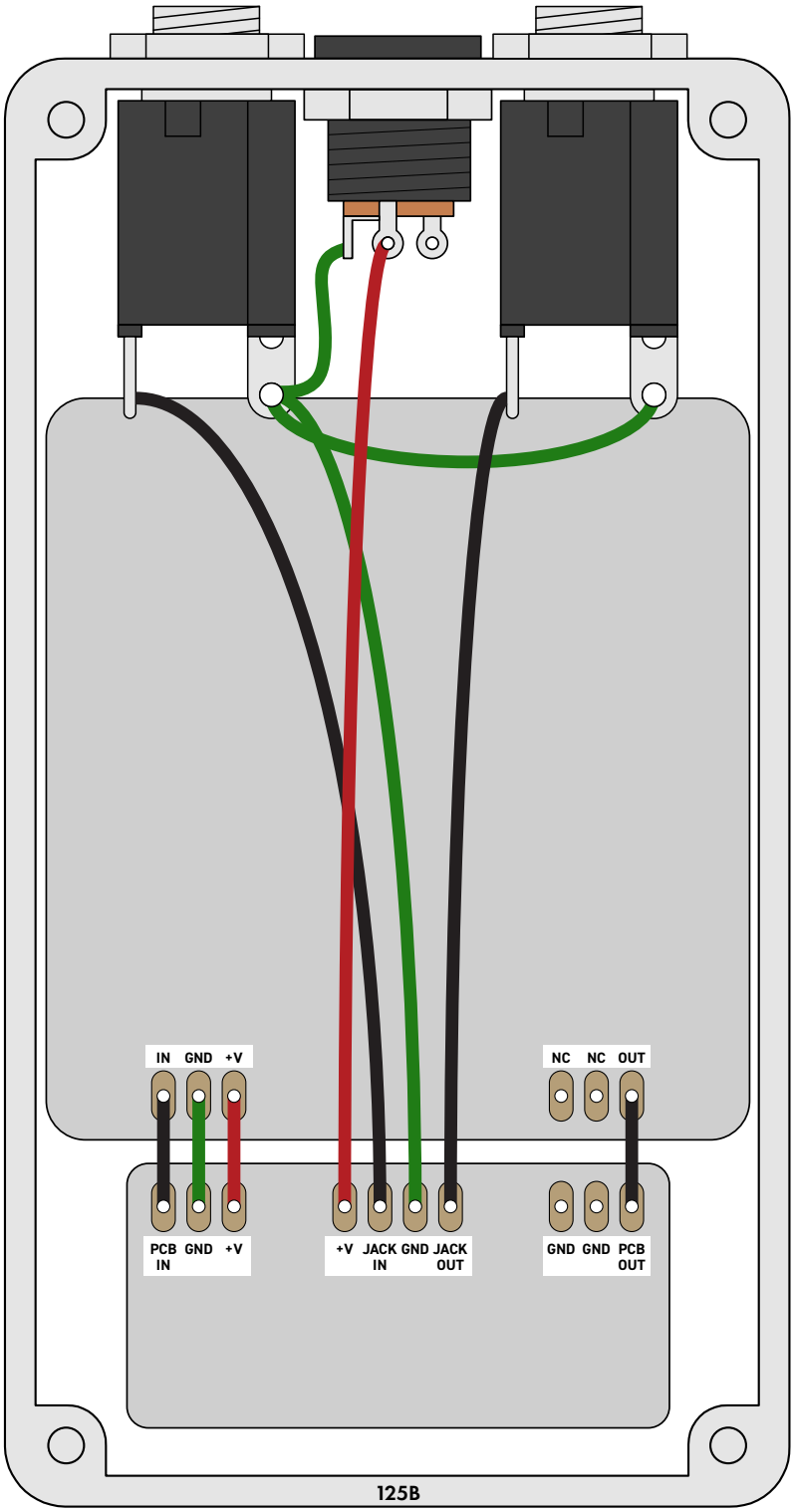


ENCLOSURE LAYOUT

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



WIRING DIAGRAM



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 (2023-09-08)
Initial release.