

PROJECT NAME

SUNSTONE

BASED ON

Electro-Harmonix® Small Stone

BUILD DIFFICULTY

■■■■ Intermediate

EFFECT TYPE

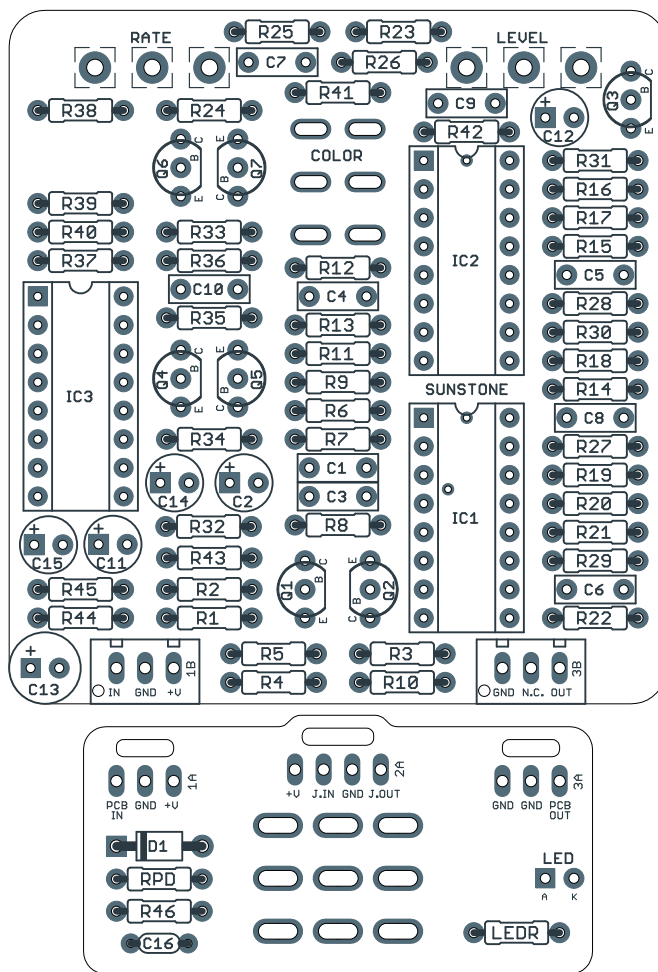
Phaser

DOCUMENT VERSION

1.0.1 (2022-09-25)

PROJECT SUMMARY

A classic phaser from the late 1970s, notably used by Jonny Greenwood, David Gilmour and Carlos Alomar (guitarist for David Bowie and Iggy Pop).



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

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INTRODUCTION

The Sunstone OTA Phaser is an adaptation of the classic Electro-Harmonix Small Stone, perhaps the second-most famous phaser of all time next to the MXR Phase 90.

Originally released in 1975 as a more compact alternative to the earlier Bad Stone, the Small Stone used operational transconductance amplifiers (OTAs) instead of the matched JFETs used in the Phase 90 and original Bad Stone.

In 1977, EHX made some improvements to the Small Stone that resulted in the most well-regarded version of the circuit, called “Issue J” after the text on the PCB.

The Sunstone is based on Issue J with a few changes. It replaces the CA3094 OTA with the LM13700, which is essentially two CA3094s in one package and is still in production. The output buffer from the CA3094 has been added in discrete format (Q6/Q7 in the Sunstone) since the built-in Darlington buffer in the LM13700 is not compatible with the way the LFO is configured. With these conversions, it will perform exactly the same as an original 1977 Issue J unit, but using modern parts.

The Sunstone also adds an output volume control to help compensate for the change in volume between the two Color switch settings for which the original unit was notorious. This is preceded by an added gain stage based on the EHX LPB-1 booster so that there is plenty of extra signal to turn down.

The Small Stone Issue J is also the base circuit for the Blackout Whetstone (available from Aion FX as the [Redshift Deluxe Phaser](#)), so if you like the sound of this one and want more features, the Whetstone has just about every modification imaginable.

USAGE

The Sunstone has two controls and one switch:

- **Rate** sets the speed of the phaser effect.
- **Level** sets the overall output level of the effect. This helps to compensate for the volume difference between the two different Color settings and allows for some boost if you want it.
- **Color** (toggle switch) engages or disengages a feedback network for the phaser stages,

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	100k	Metal film resistor, 1/4W	
R2	470k	Metal film resistor, 1/4W	
R3	10k	Metal film resistor, 1/4W	
R4	4k7	Metal film resistor, 1/4W	
R5	4k7	Metal film resistor, 1/4W	
R6	30k	Metal film resistor, 1/4W	
R7	30k	Metal film resistor, 1/4W	
R8	1k	Metal film resistor, 1/4W	
R9	27k	Metal film resistor, 1/4W	
R10	10k	Metal film resistor, 1/4W	
R11	27k	Metal film resistor, 1/4W	
R12	1k	Metal film resistor, 1/4W	
R13	27k	Metal film resistor, 1/4W	
R14	10k	Metal film resistor, 1/4W	
R15	27k	Metal film resistor, 1/4W	
R16	1k	Metal film resistor, 1/4W	
R17	27k	Metal film resistor, 1/4W	
R18	10k	Metal film resistor, 1/4W	
R19	27k	Metal film resistor, 1/4W	
R20	1k	Metal film resistor, 1/4W	
R21	27k	Metal film resistor, 1/4W	
R22	10k	Metal film resistor, 1/4W	
R23	3k3	Metal film resistor, 1/4W	
R24	4k7	Metal film resistor, 1/4W	
R25	27k	Metal film resistor, 1/4W	
R26	270k	Metal film resistor, 1/4W	
R27	27k	Metal film resistor, 1/4W	
R28	470k	Metal film resistor, 1/4W	
R29	47k	Metal film resistor, 1/4W	
R30	10k	Metal film resistor, 1/4W	
R31	390R	Metal film resistor, 1/4W	
R32	4k7	Metal film resistor, 1/4W	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
R33	22k	Metal film resistor, 1/4W	
R34	15k	Metal film resistor, 1/4W	
R35	1k	Metal film resistor, 1/4W	
R36	1k8	Metal film resistor, 1/4W	
R37	27k	Metal film resistor, 1/4W	
R38	27k	Metal film resistor, 1/4W	
R39	7k5	Metal film resistor, 1/4W	
R40	2k	Metal film resistor, 1/4W	
R41	47k	Metal film resistor, 1/4W	
R42	100R	Metal film resistor, 1/4W	
R43	15k	Metal film resistor, 1/4W	
R44	10k	Metal film resistor, 1/4W	
R45	100R	Metal film resistor, 1/4W	
R46	100R	Metal film resistor, 1/4W	
RPD	2M2	Metal film resistor, 1/4W	Input pull-down 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	6n8	Film capacitor, 7.2 x 2.5mm	
C2	10uF	Electrolytic capacitor, 5mm	
C3	6n8	Film capacitor, 7.2 x 2.5mm	
C4	6n8	Film capacitor, 7.2 x 2.5mm	
C5	6n8	Film capacitor, 7.2 x 2.5mm	
C6	6n8	Film capacitor, 7.2 x 2.5mm	
C7	100n	Film capacitor, 7.2 x 2.5mm	
C8	100n	Film capacitor, 7.2 x 2.5mm	
C9	100n	Film capacitor, 7.2 x 2.5mm	
C10	100n	Film capacitor, 7.2 x 2.5mm	
C11	33uF	Electrolytic capacitor, 5mm	
C12	22uF	Electrolytic capacitor, 5mm	Omitted in some versions, but recommended to include.
C13	100uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C14	47uF	Electrolytic capacitor, 5mm	Reference voltage filter capacitor.
C15	47uF	Electrolytic capacitor, 5mm	LFO supply filter capacitor.
C16	100n	MLCC capacitor, X7R	Power supply filter capacitor.
D1	1N5817	Schottky diode, DO-41	
Q1	2N5088	BJT transistor, NPN, TO-92	
Q2	2N5087	BJT transistor, PNP, TO-92	
Q3	2N5088	BJT transistor, NPN, TO-92	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
Q4	2N5087	BJT transistor, PNP, TO-92	
Q5	2N5087	BJT transistor, PNP, TO-92	
Q6	2N5088	BJT transistor, NPN, TO-92	
Q7	2N5088	BJT transistor, NPN, TO-92	
IC1	LM13700N	Transconductance amplifier, dual, DIP16	
IC1-S	DIP-16 socket	IC socket, DIP-16	
IC2	LM13700N	Transconductance amplifier, dual, DIP16	
IC2-S	DIP-16 socket	IC socket, DIP-16	
IC3	LM13700N	Transconductance amplifier, dual, DIP16	
IC3-S	DIP-16 socket	IC socket, DIP-16	
RATE	1MC	16mm right-angle PCB mount pot	
LEVEL	100kA	16mm right-angle PCB mount pot	
COLOR	DPDT on-on	Toggle switch, DPDT on-on	
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.

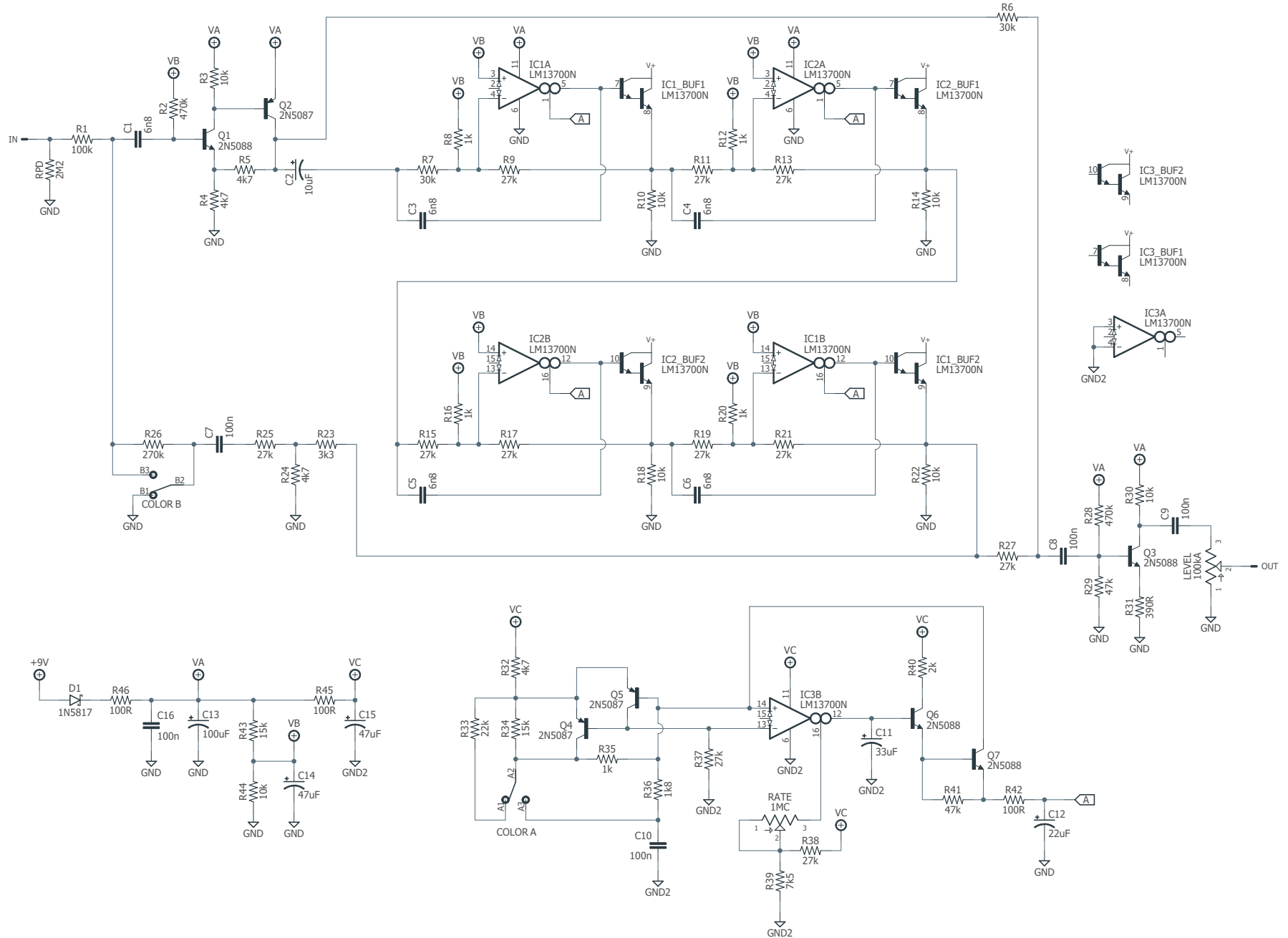
BUILD NOTES

Color switch modification

As mentioned, the Color switch has a significant volume difference. The reissue Small Stone from 2002 attempts to correct this by changing a few component values. If you'd rather not ride the volume control when changing switch settings, you can try these substitute values and see if you like it better:

- **R23:** 3k3 → 2k2
- **R25:** 27k → 68k
- **C7:** 100n → 3n3

SCHEMATIC



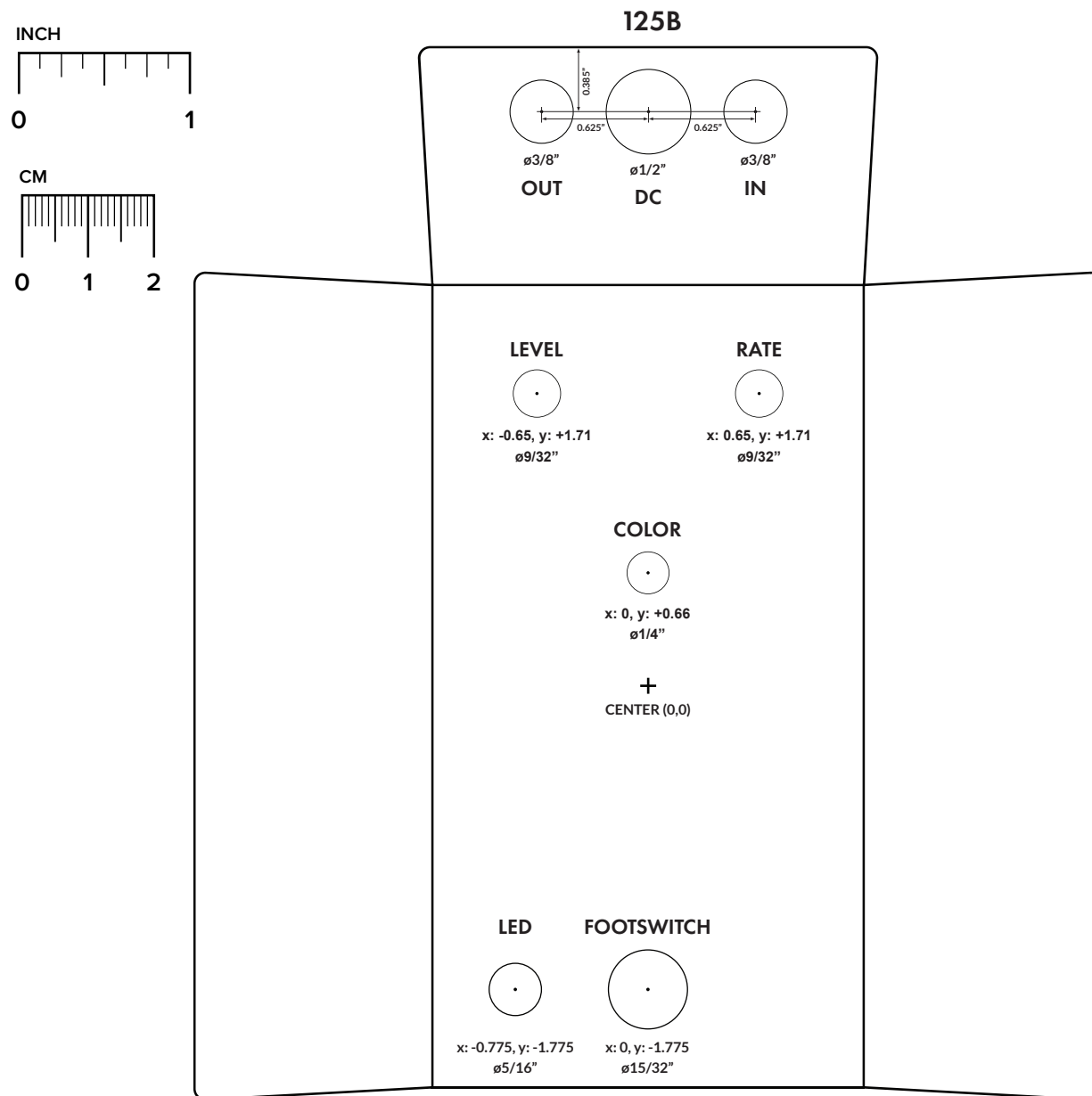
DRILL TEMPLATE

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.

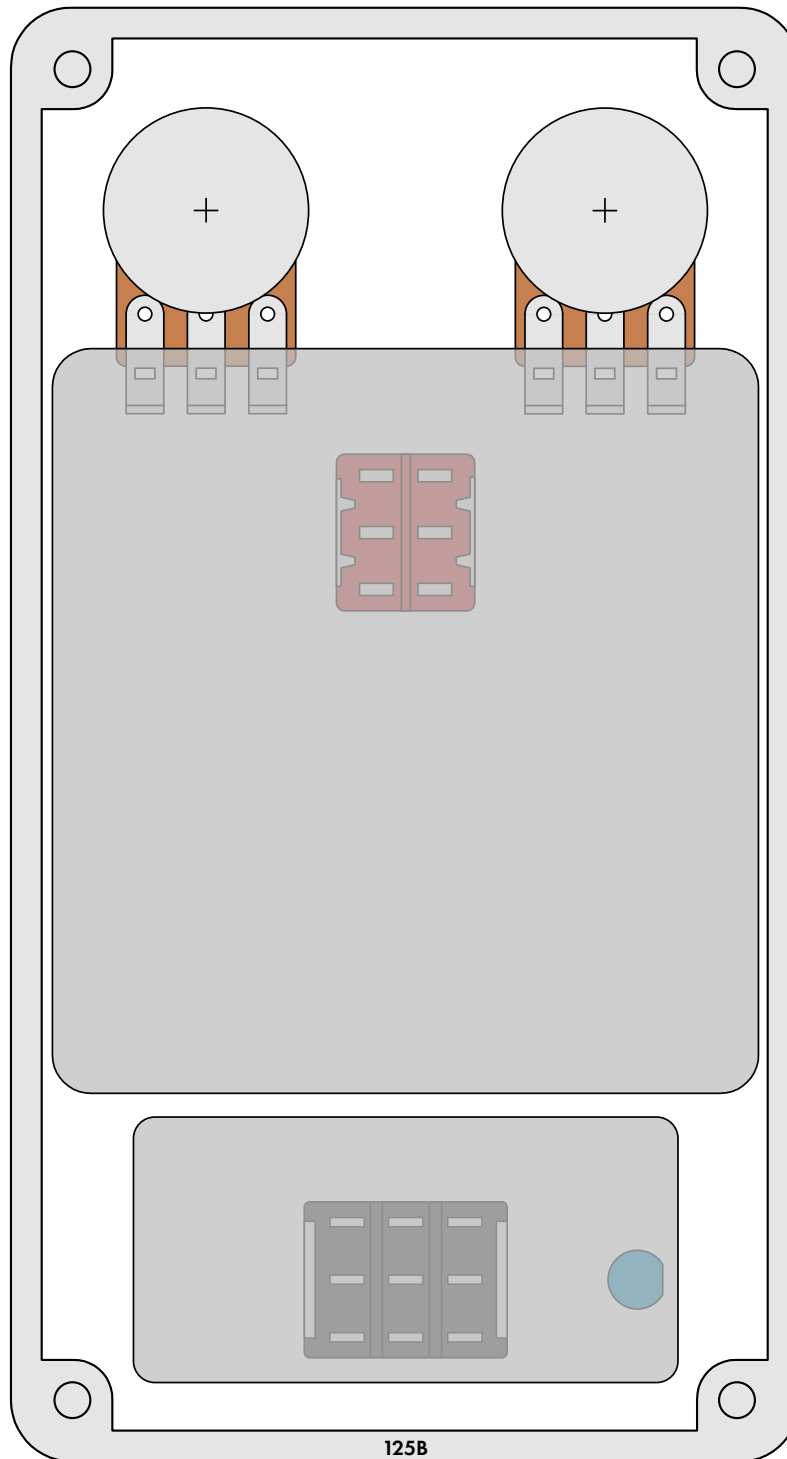
Top jack layout assumes the use of closed-frame jacks like the [Switchcraft 111X](#). If you'd rather use open-frame jacks, please refer to the Open-Frame Jack Drill Template for the top side.

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.

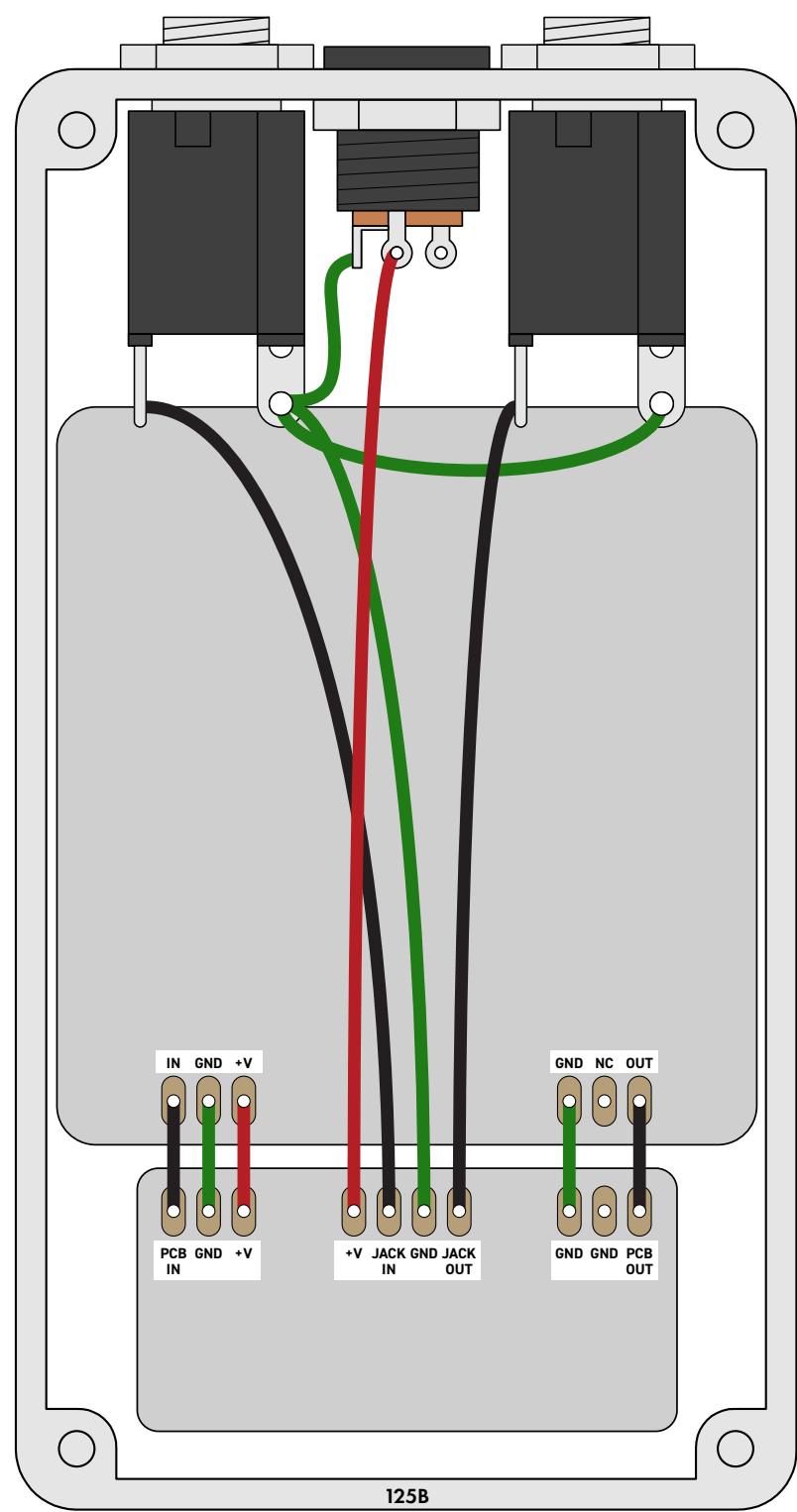


ENCLOSURE LAYOUT

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 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

1.0.1 (2022-09-25)

Corrected R15 value to 27k (was mistakenly listed as 30k in schematic & parts list).

1.0.0 (2022-09-24)

Initial release.