PROJECT NAME

CHROMA

aion
DIY GUITAR EFFECTS

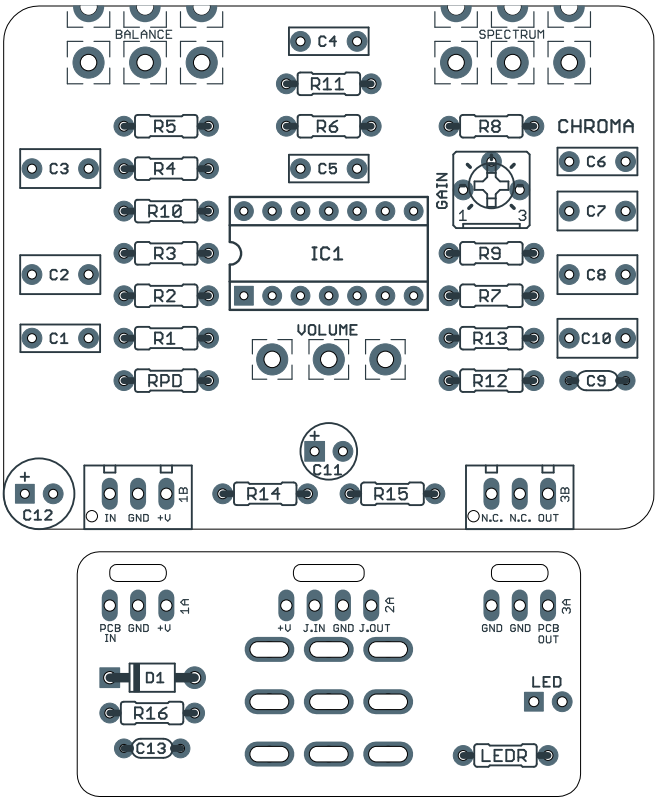
BASED ON
BOSS® SP-1 Spectrum

BUILD DIFFICULTY
Easy

EFFECT TYPE
Parametric equalizer / boost

DOCUMENT VERSION
1.0.0 (2021-10-22)

PROJECT SUMMARY
One of the rarest BOSS effects, a single-band swept-frequency EQ. Modified to boost the overall signal level so it can be used as a boost pedal if desired.



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

IMPORTANT NOTE

This project requires a dual 10kA/10kC potentiometer, which is not available from any of the normal suppliers. It’s easy to make your own, but make sure to read the instructions on page 5 before undertaking the project.

TABLE OF CONTENTS

INTRODUCTION

The Chroma Parametric Boost is a clone of the BOSS® SP-1 Spectrum, one of the three original BOSS compact stompboxes released in 1977. (The other two were the OD-1 OverDrive, which is available as the Parhelion project, and the PH-1 Phaser.) It was discontinued in 1981, and due to its extreme rarity, today it routinely sells for $500 or more on eBay.

The original SP-1 is a parametric equalizer with only two knobs. The frequency knob adjusts the boosted frequency between 500Hz and 5 kHz, and the balance (or mix) knob adjusts the dry-to-wet signal ratio. The gain and Q are fixed. Unlike some other parametric equalizers, it only boosts frequencies—it doesn't have the ability to cut. Its function is very similar to a fixed wah, and you can hear a wah-like effect if you turn the Spectrum knob while a signal is being passed.

The updated version of the Chroma adds one new feature: the output volume has been increased and it now includes a volume knob. This way, the output volume can be precisely trimmed for unity gain (which is inexact in the original Spectrum depending on where the Balance control is set), or it can be used as a booster with an adjustable frequency emphasis. When used in front of another overdrive pedal or to overdrive an amplifier, you can get some really unique drive tones that wouldn't otherwise be attainable.

USAGE

The Chroma has three controls:

- **Spectrum** sets the frequency of the boost.
- **Balance** pans between the dry signal and wet signal, acting as a sort of depth control.
- **Volume** sets the overall output of the effect. The original unit was fixed at unity gain and did not have a volume control.

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	1k	Metal film resistor, 1/4W	
R2	470k	Metal film resistor, 1/4W	
R3	10k	Metal film resistor, 1/4W	
R4	10k	Metal film resistor, 1/4W	
R5	1k	Metal film resistor, 1/4W	
R6	10k	Metal film resistor, 1/4W	
R7	18k	Metal film resistor, 1/4W	
R8	10k	Metal film resistor, 1/4W	
R9	22k	Metal film resistor, 1/4W	
R10	10k	Metal film resistor, 1/4W	
R11	10k	Metal film resistor, 1/4W	
R12	47k	Metal film resistor, 1/4W	Originally 10k. 47k increases the output going into the volume control so it can be used as a boost. Increase the value even further to raise the maximum volume.
R13	470R	Metal film resistor, 1/4W	
R14	33k	Metal film resistor, 1/4W	
R15	33k	Metal film resistor, 1/4W	
R16	100R	Metal film resistor, 1/4W	
RPD	2M2	Metal film resistor, 1/4W	Input pulldown resistor.
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	
C2	1uF	Film capacitor, 7.2 x 3.5mm	Original uses 4.7uF. There is space for the 4.7uF film capacitor, but 1uF is sufficient.
C3	1uF	Film capacitor, 7.2 x 3.5mm	Original uses 4.7uF. There is space for the 4.7uF film capacitor, but 1uF is sufficient.
C4	100n	Film capacitor, 7.2 x 2.5mm	
C5	3n3	Film capacitor, 7.2 x 2.5mm	
C6	3n3	Film capacitor, 7.2 x 2.5mm	
C7	1uF	Film capacitor, 7.2 x 3.5mm	
C8	1uF	Film capacitor, 7.2 x 3.5mm	Original uses 4.7uF. There is space for the 4.7uF film capacitor, but 1uF is sufficient.
C9	47pF	MLCC capacitor, NP0/C0G	
C10	1uF	Film capacitor, 7.2 x 3.5mm	
C11	47uF	Electrolytic capacitor, 5mm	Reference voltage filter capacitor.

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C12	100uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C13	100n	MLCC capacitor, X7R	Power supply filter capacitor.
D1	1N5817	Schottky diode, DO-41	
IC1	NJM3403AD	Operational amplifier, quad, DIP-14	
IC1-S	DIP14 socket	IC socket, DIP-14	
GAIN	1k trimmer	Trimmer, 10%, 1/4”	See build notes (pg. 6) for notes on setting this trimmer.
BAL.	10kA/10kC	16mm right-angle PCB mount pot	Must be made from a 10kA dual and 10kA single pot. See build notes for how to do it.
SPECT.	100kB dual	16mm right-angle PCB mount pot	
VOL.	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.

Making the dual 10kA/10kC “Balance” pot

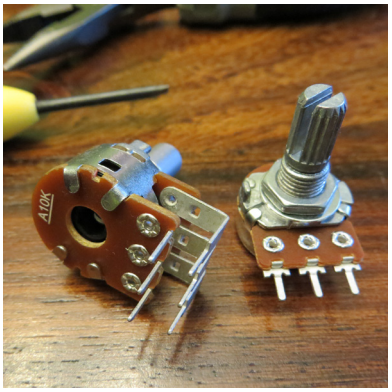
The main reason the SP-1 has never been cloned before is due to the odd 10kA/10kC Balance pot. This pot is unique to the pedal, and to custom-order it from Alpha would mean ordering at least 1,000 minimum. This has historically made the SP-1 prohibitive to DIYers wanting to build their own.

Fortunately, dual 10kA pots are available, and it’s very easy to switch out the top wafer of these pots since the top wafer is identical in construction to the wafers used in single pots.

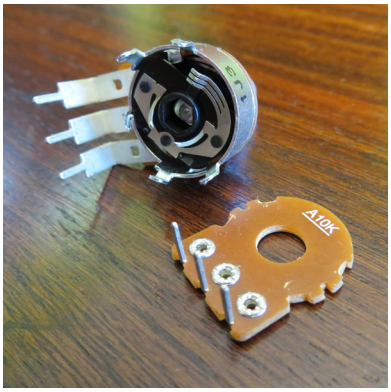
But, here’s the catch: since the top wafer is upside down, its taper is actually mirrored. The top wafer of a dual 10kA pot is the same as a 10kC. Because of this, you will need to pull the replacement wafer from a single 10kA pot, which will give you the correct “C” taper when used upside-down in a dual pot.

So for this, you will need one 10kA dual pot (preferably right-angle PCB mount) and one 10kA single pot (preferably straight-pin PCB mount). It’s recommended to order at least two 10kA single pots in case you break one while taking it apart.

Once you have the dual 10kA and single 10kA pots, follow these steps for making the dual pot.

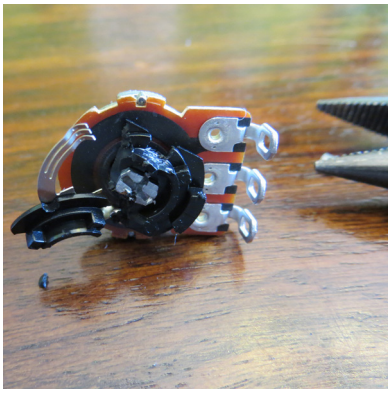


1. Start with a 10kA dual pot (right angle PCB mount) and a 10kA single pot (straight-pin PCB mount).



2. On the dual pot, bend out the four tabs with needle-nose pliers to separate the top wafer.

3. On the single pot, bend out the four tabs near the nut to separate the metal cover from the rest.



4. On the single pot, break away all the black plastic from the metal shaft, taking care not to scratch the carbon on the wafer itself. This will take a fair amount of force. You could also use a utility knife or Dremel tool to cut it away.

5. Once the plastic has been broken away, set aside the wafer and throw the rest away. (Note that this photo shows a solder-lug wafer, which won’t fit the PCB without cutting down the lugs. Use a straight-pin pot as shown in step 1.)

6. Place the 10kA wafer on the dual pot as shown, carbon side down, and bend the four tabs inward to secure it in place. Bend the pins straight upward. This wafer will act as a C-taper pot since it is upside-down.

Setting the gain trimmer

According to the SP-1 service manual, the Gain trimmer should be set as follows:

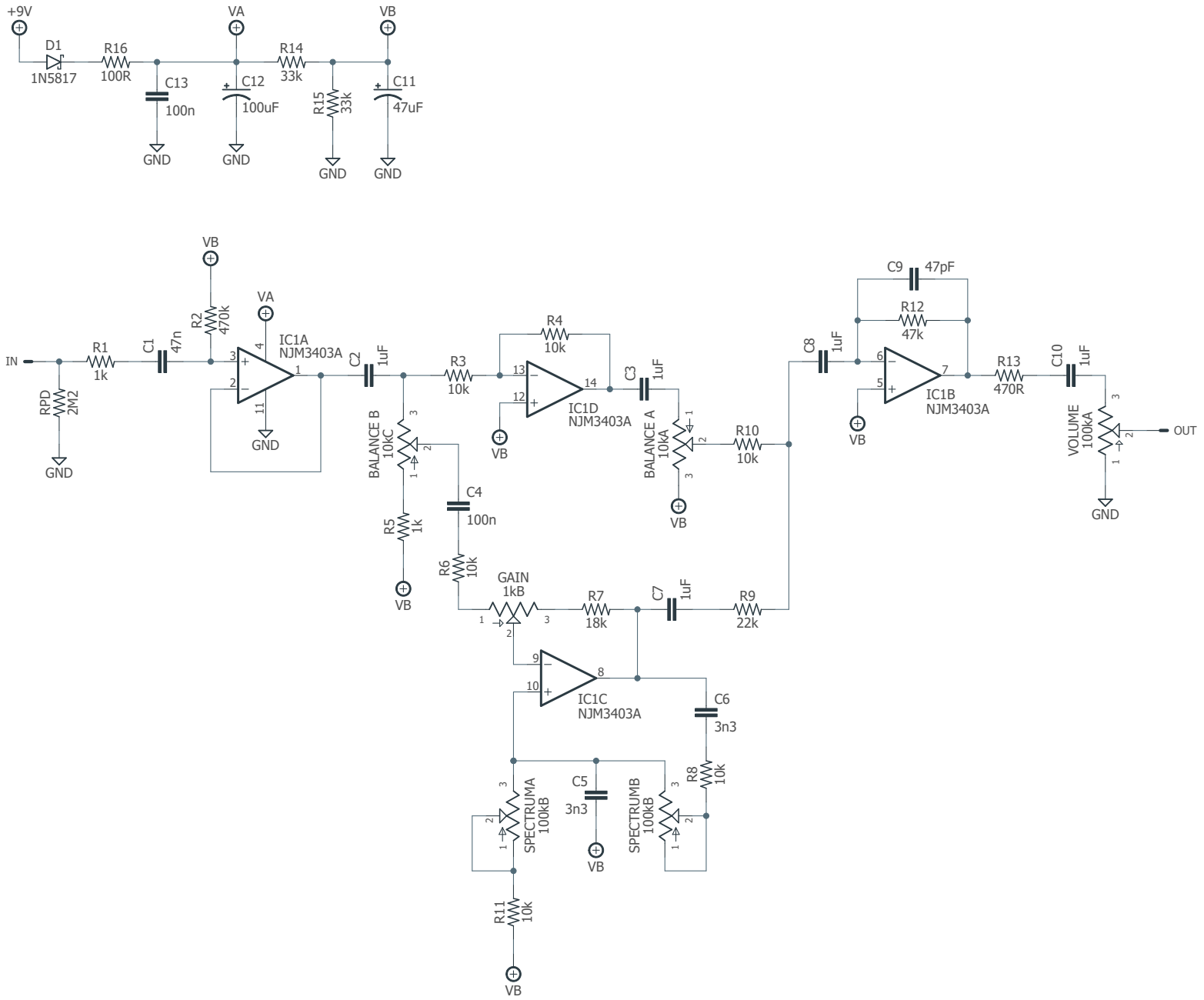
> Test signal: 5KHz +/- 10% sine, -20dBm, set SPECTRUM, BALANCE at max (FCW), adjust trimmer pot 1K for 2.5dBm output at peaking freq. (5KHz +/-10%)

Follow the process if you want, but it's definitely overkill and an effect this simple does not need that kind of precision. We couldn't hear much difference across the whole sweep of the trimmer, but it would be most noticeable at full clockwise (wet) on the Balance control. You might be able to make its impact more pronounced by raising the value of R7.

IC selection

The original SP-1 used the Raytheon RC3403A "ground-sensing" quad op-amp. Raytheon hasn't manufactured analog components in several decades, and originals are scarce today—but fortunately the New Japan Radio NJM3403A is an exact substitute and still in production.

SCHEMATIC


+9V
D1
1N5817
R16
100R
C13
100n
GND
VA
C12
100uF
GND
R14
33k
R15
33k
GND
VB
C11
47uF
GND
VB
R2
470k
VA
IC1A
NJM3403A
IN
R1
1k
C1
47n
RPD
2M2
GND
GND
C2
1uF
R3
10k
R4
10k
IC1D
NJM3403A
VB
C3
1uF
BALANCE B
10kC
BALANCE A
10kA
VB
R10
10k
C4
100n
R5
1k
VB
R6
10k
GAIN
1kB
R7
18k
C7
1uF
R9
22k
IC1C
NJM3403A
C6
3n3
C5
3n3
VB
SPECTRUMA
100kB
SPECTRUMB
100kB
R8
10k
R11
10k
VB
C8
1uF
C9
47pF
R12
47k
VB
IC1B
NJM3403A
R13
470R
C10
1uF
VOLUME
100kA
GND
OUT

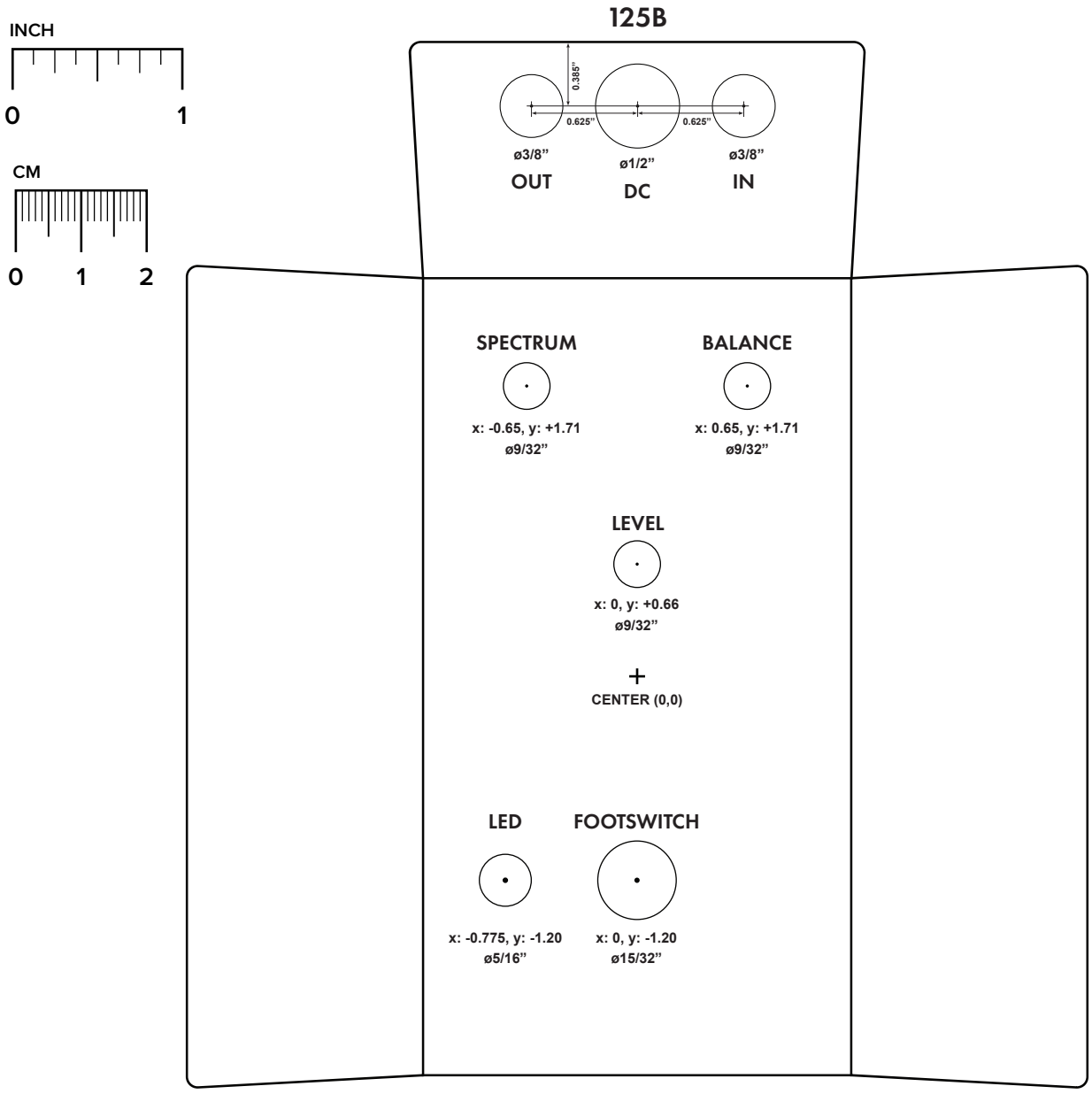
DRILL TEMPLATE

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.

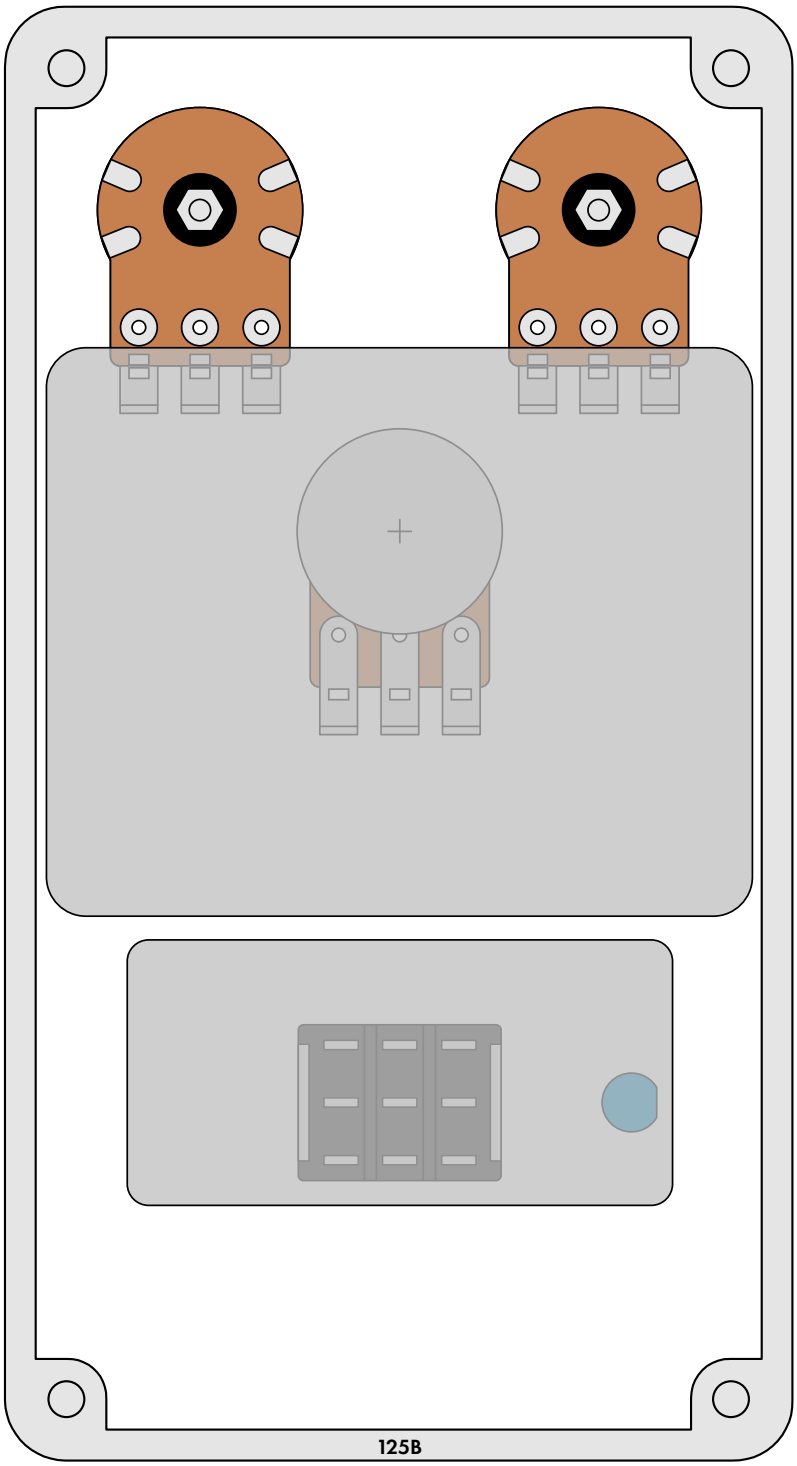
Top jack layout assumes the use of closed-frame jacks like the Switchcraft 111X. If you'd rather use open-frame jacks, please refer to the Open-Frame Jack Drill Template for the top side.

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.

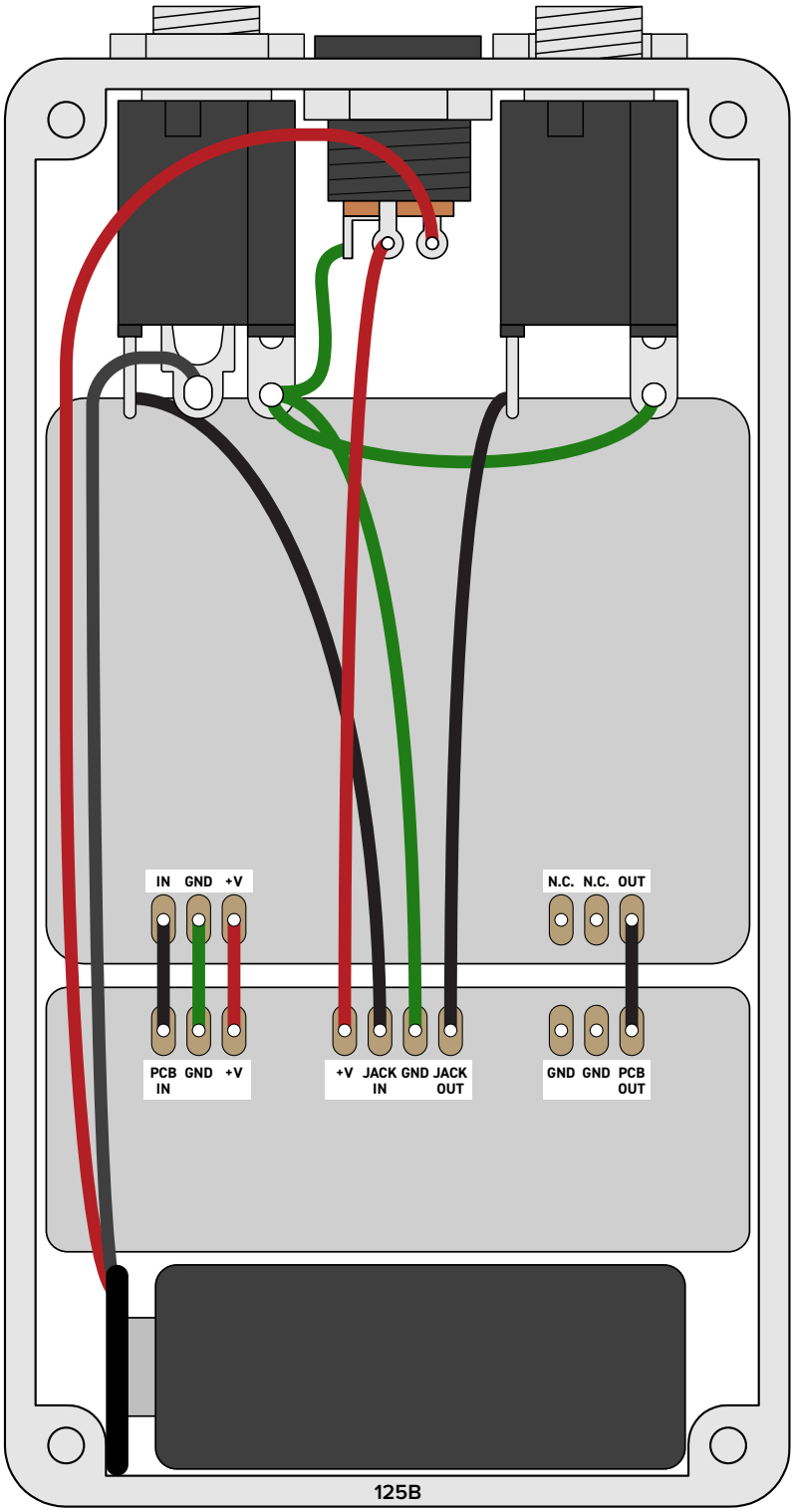


ENCLOSURE LAYOUT

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



WIRING DIAGRAM



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

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 (2021-10-22)
Initial release.