PROJECT NAME

MINIMA

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DIY GUITAR EFFECTS

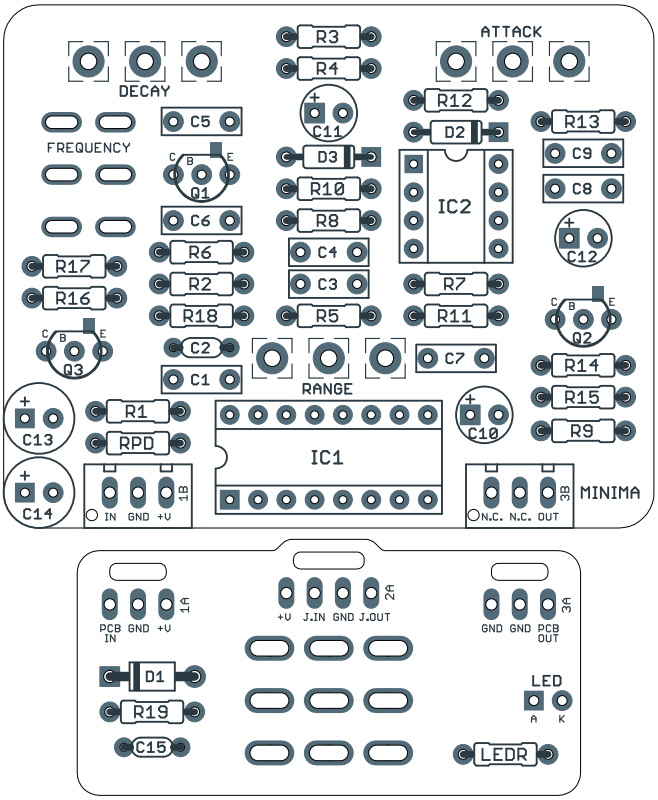
BASED ON
Mu-tron® Micro V

BUILD DIFFICULTY
▮▮▯▯▯ Easy

EFFECT TYPE
Envelope filter / auto-wah

DOCUMENT VERSION
1.0.0 (2023-09-08)

PROJECT SUMMARY
A simplified version of the more famous Mu-tron III envelope filter, originally designed as a lower-cost alternative.



Actual size is 2.3” x 1.86” (main board) and 1.78” x 0.86” (bypass board).

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INTRODUCTION

The Minima Resonant Filter is based on the Mu-tron Micro V envelope filter, designed by Mike Biegel and first released in the mid-1970s as a lower-cost alternative to the Mu-tron III.

The Micro V has a very practical origin story. The original Mu-tron Phasor (now referred to as the Phasor I) used CA3080 OTAs for the phase stages. When this was discontinued in favor of the more popular Phasor II, the company had a lot of surplus CA3080 chips and no active products that used them. At the same time, they realized they didn't have any low-cost pedal offerings. The Micro V was designed with the goal of filling both needs.

The end result is a similar effect to the Mu-tron III, but with a completely different circuit topology. It was discontinued in 1980 along with the other pedals in the Mu-tron lineup not long after the company's sale to ARP.

The Minima is a slightly expanded version of the original Micro V circuit. The two fixed resistors that set the attack and release of the envelope detector have been made variable, and we've added a third in-between position to the "Hi/Lo" switch. It also replaces the CA3080 with the LM13700, which performs identically but is much easier to find.

USAGE

The Minima has the following controls:

- **Range** sets the reaction of the filter in response to the input signal. As it's turned up, it's much more sensitive and responds more quickly.
- **Attack** sets the time constant of the filter's rise to the peak frequency.
- **Decay** sets the time constant of the filter's fall back to the resting state.
- **Frequency** (toggle switch) selects the frequency range of the filter, with Low and Hi settings as well as an in-between Mid.

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 (most 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	100k	Metal film resistor, 1/4W	
R3	10k	Metal film resistor, 1/4W	
R4	47R	Metal film resistor, 1/4W	
R5	330R	Metal film resistor, 1/4W	
R6	330R	Metal film resistor, 1/4W	
R7	6k8	Metal film resistor, 1/4W	
R8	47k	Metal film resistor, 1/4W	
R9	22k	Metal film resistor, 1/4W	
R10	15k	Metal film resistor, 1/4W	
R11	22k	Metal film resistor, 1/4W	
R12	220R	Metal film resistor, 1/4W	Part of the Attack pot modification. Original uses 680R here.
R13	10k	Metal film resistor, 1/4W	Part of the Decay pot modification. Original uses 47k here.
R14	1M	Metal film resistor, 1/4W	
R15	4k7	Metal film resistor, 1/4W	
R16	22k	Metal film resistor, 1/4W	
R17	33k	Metal film resistor, 1/4W	
R18	100k	Metal film resistor, 1/4W	
R19	47R	Metal film resistor, 1/4W	Power supply filter resistor.
RPD	2M2	Metal film resistor, 1/4W	Input pulldown resistor. Can be as low as 1M.
LEDR	10k	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	100pF	MLCC capacitor, NP0/C0G	
C3	47n	Film capacitor, 7.2 x 2.5mm	
C4	33n	Film capacitor, 7.2 x 2.5mm	
C5	68n	Film capacitor, 7.2 x 2.5mm	
C6	33n	Film capacitor, 7.2 x 2.5mm	
C7	2n2	Film capacitor, 7.2 x 2.5mm	
C8	2n2	Film capacitor, 7.2 x 2.5mm	
C9	1n8	Film capacitor, 7.2 x 2.5mm	
C10	10uF	Electrolytic capacitor, 5mm	
C11	4.7uF	Electrolytic capacitor, 4mm	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C12	4.7uF	Electrolytic capacitor, 4mm	
C13	100uF	Electrolytic capacitor, 6.3mm	Reference voltage filter capacitor.
C14	100uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C15	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	
IC1	LM13700N	Transconductance amplifier, DIP16	
IC1-S	DIP-16 socket	IC socket, DIP-16	
IC2	LM1458	Operational amplifier, dual, DIP8	
IC2-S	DIP-8 socket	IC socket, DIP-8	
Q1	2N5088	BJT transistor, NPN, TO-92	Can substitute any NPN, e.g. 2N3904.
Q2	2N5087	BJT transistor, PNP, TO-92	Can substitute any PNP, e.g. 2N3906.
Q3	2N5088	BJT transistor, NPN, TO-92	Can substitute any NPN, e.g. 2N3904.
RANGE	1MB	16mm right-angle PCB mount pot	
ATTACK	2kB	16mm right-angle PCB mount pot	
DECAY	100kB	16mm right-angle PCB mount pot	
FREQ.	DPDT on-off-on	Toggle switch, DPDT center off	
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

R4 resistor

A 47R resistor has been added to this circuit so that the output impedance of Q1 does not have an adverse affect on the filter peak. It limits the high frequency bandwidth when the effect is in “Hi” mode. This resistor mod was suggested by Rob Strand on DIYSB. Note that it’s a mostly theoretical addition—we didn’t do any extensive testing. We recommend keeping it in place by default but you can jumper it if you want.

Frequency switch

The frequency switch on the original Micro V is a 2-position switch with “Lo” and “Hi” modes. The Minima adds a 3rd mode in between the other two with the use of a DPDT on-off-on switch. “Lo” is the bottom position, “Hi” is in the middle, and “Mid” is the top position. (Note that the original Micro V factory schematic reverses the “hi” and “lo” labels; the circuit is in “hi” mode when the resistor and capacitor are disconnected, not when they are engaged.)

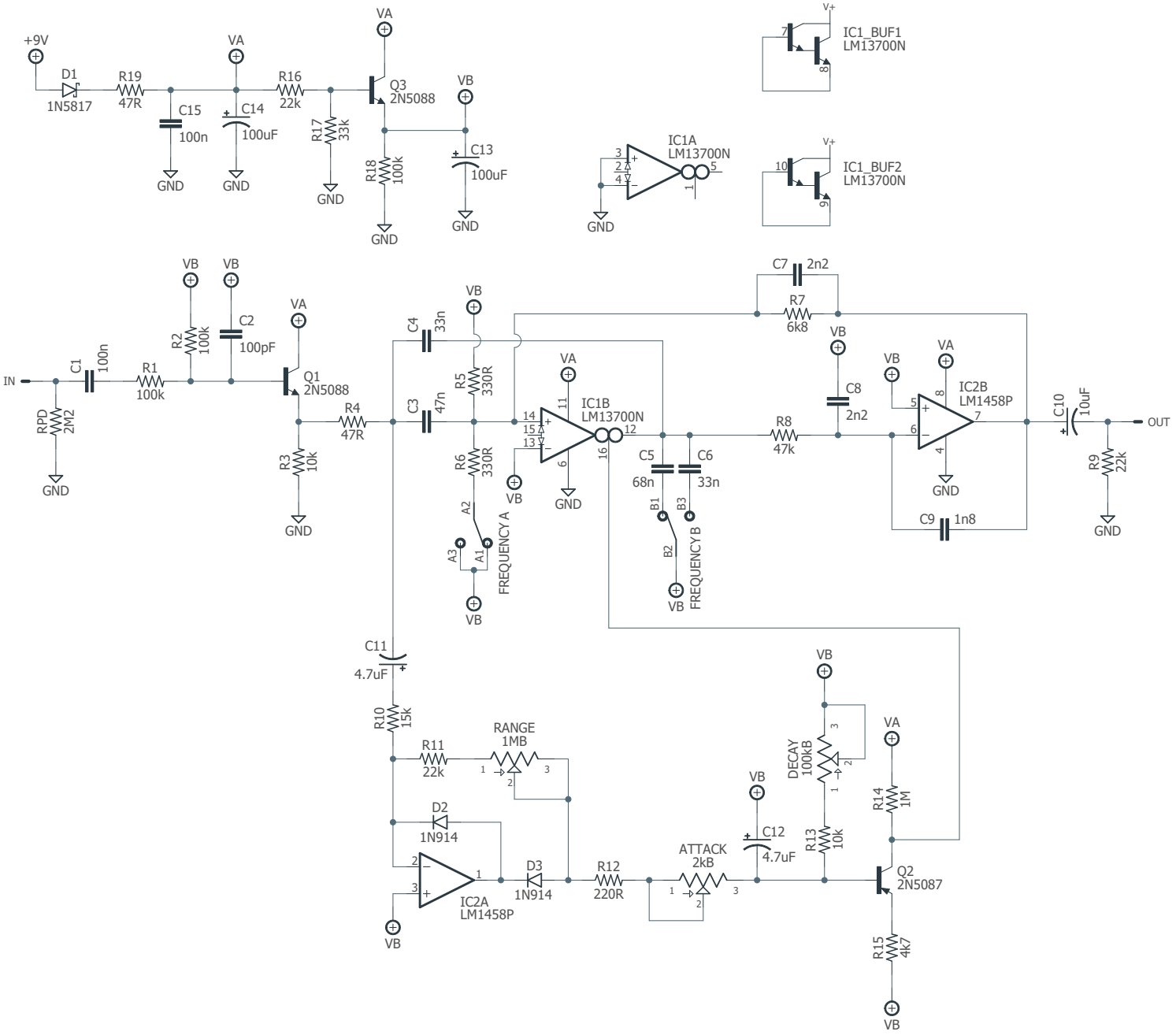
To tweak the frequency of the “Mid” mode, you can try reducing the value of C6, e.g. 22n or 15n.

Attack and Decay knobs

The original Micro V circuit only had a Range knob and a Frequency switch, in keeping with its low-cost philosophy. However, it’s pretty straightforward to add both Attack and Decay knobs, so we’ve included these by default. Here are the specifics on the changes:

- R12 is a 680R resistor in the original unit. This has been replaced by a 220R resistor to set the minimum, and a 2kB potentiometer for an Attack control. The original attack value is found between 9:00 and 10:00 on the rotation.
- R13 is a 47k resistor in the original unit. This has been replaced by a 10k resistor to set the minimum, and a 100kB potentiometer for a Decay control. The original decay value is found between 11:00 and 12:00 on the rotation.

SCHEMATIC


+9V
D1
1N5817
R19
47R
C15
100n
C14
100uF
VA
R16
22k
R17
33k
Q3
2N5088
R18
100k
C13
100uF
VB
GND
IC1A
LM13700N
IC1_BUF1
LM13700N
IC1_BUF2
LM13700N
V+
IN
C1
100n
R1
100k
R2
100k
C2
100pF
Q1
2N5088
RPD
2M2
R3
10k
R4
47R
C4
33n
C3
47n
R5
330R
R6
330R
IC1B
LM13700N
C7
2n2
R7
6k8
C8
2n2
R8
47k
C5
68n
C6
33n
IC2B
LM1458P
C9
1n8
C10
10uF
R9
22k
OUT
A2
A3
A1
FREQUENCY A
B1
B3
B2
FREQUENCY B
C11
4.7uF
R10
15k
R11
22k
RANGE
1MB
D2
1N914
D3
1N914
IC2A
LM1458P
R12
220R
ATTACK
2kB
C12
4.7uF
DECAY
100kB
R13
10k
R14
1M
Q2
2N5087
R15
4k7

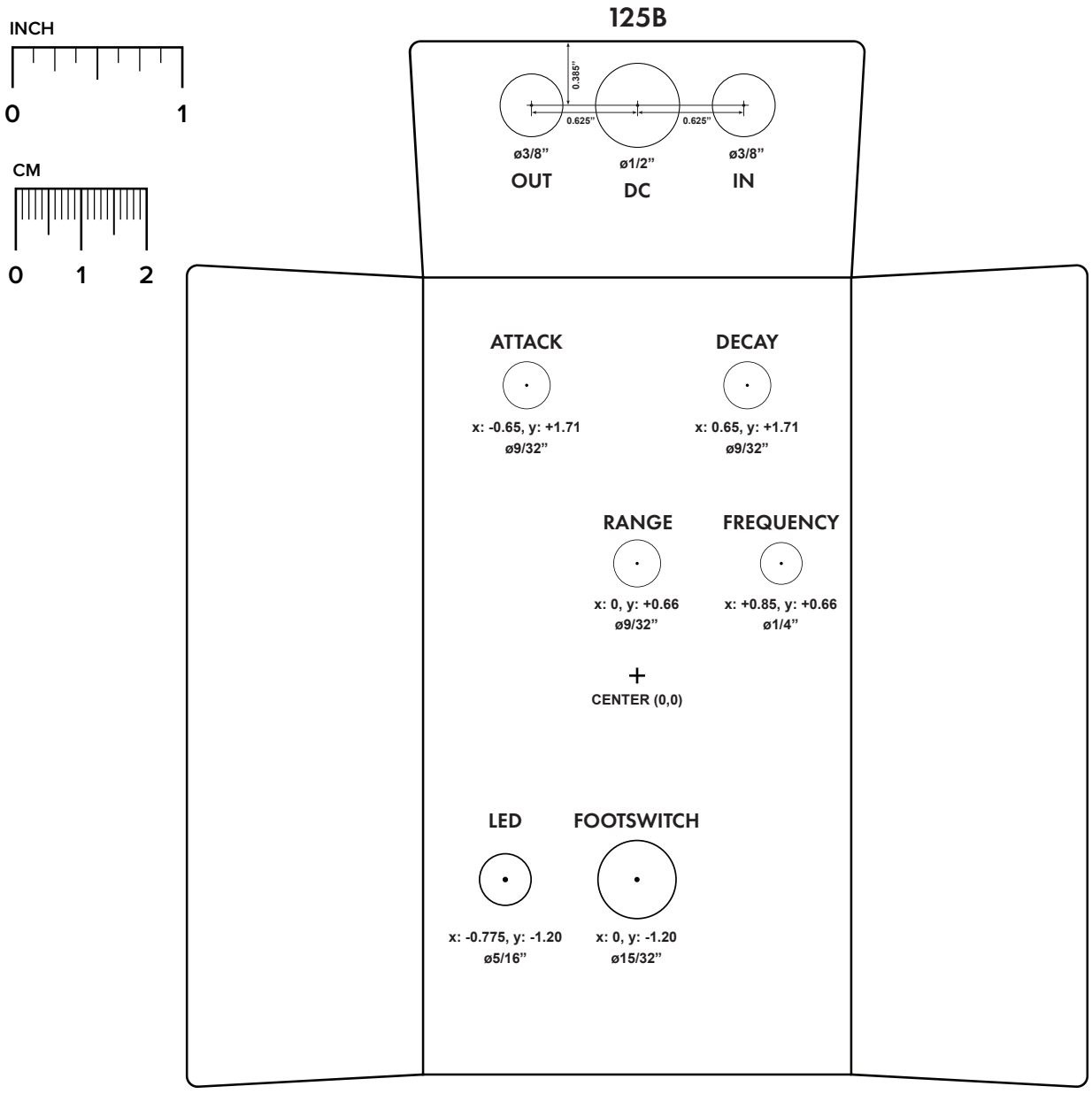
DRILL TEMPLATE

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.

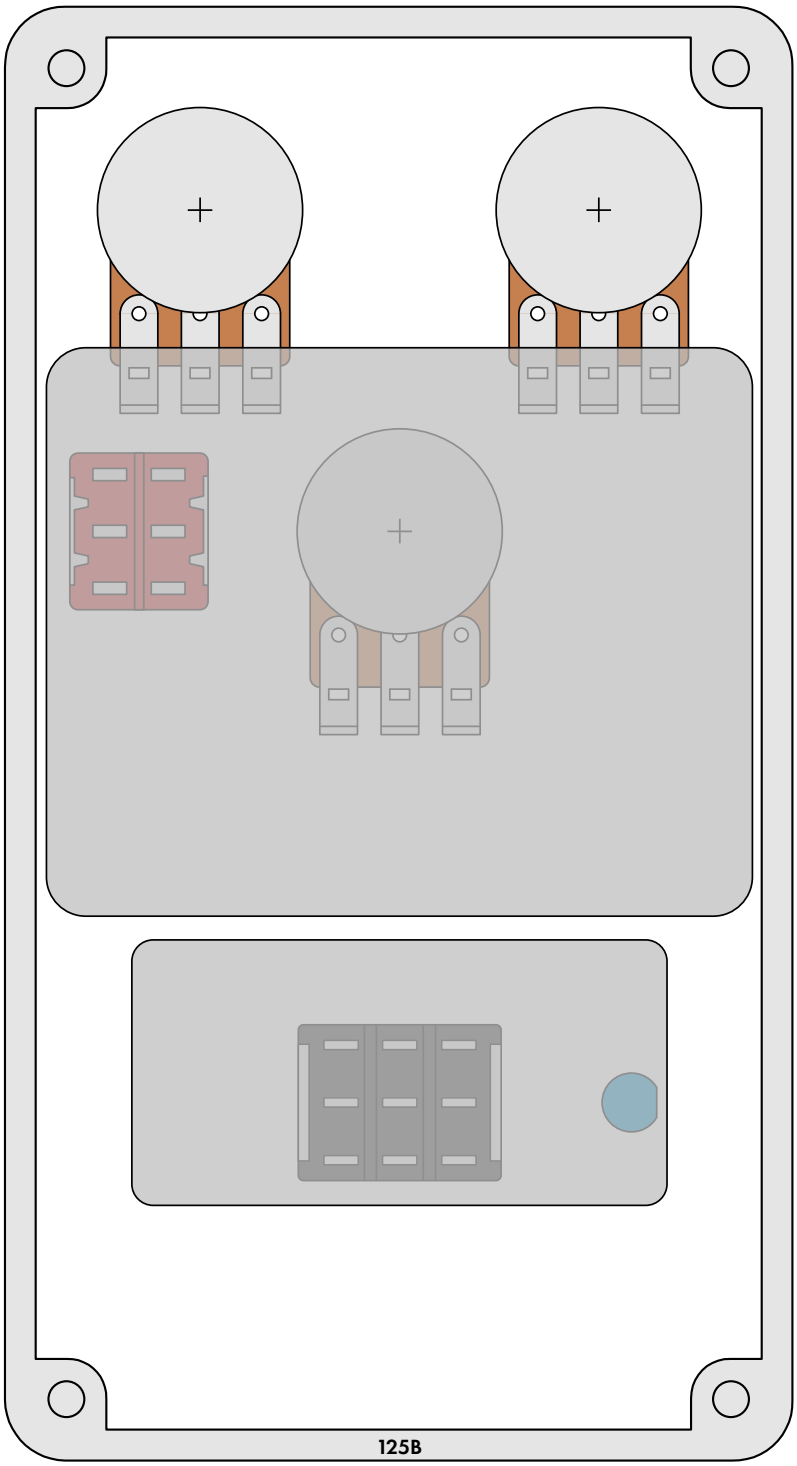
Top jack layout assumes the use of closed-frame jacks like the Switchcraft 111X. If you'd rather use open-frame jacks, please refer to the Open-Frame Jack Drill Template for the top side.

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.

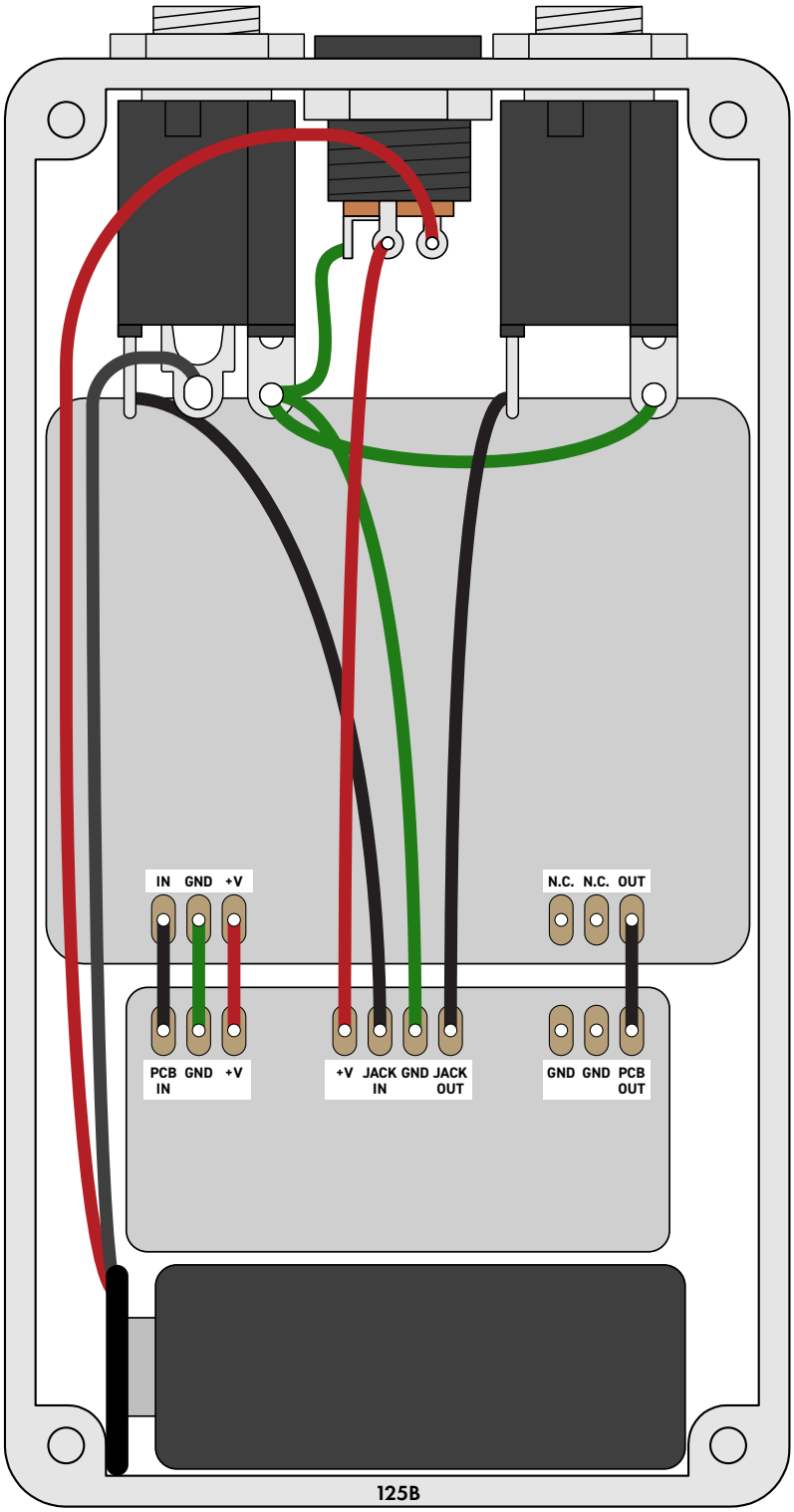


ENCLOSURE LAYOUT

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 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

1.0.0 (2023-09-08)
Initial release.