HALO

AION
DIY GUITAR EFFECTS

BASED ON
Electro-Harmonix Big Muff Pi

BUILD DIFFICULTY
▌▌☐☐☐ Easy

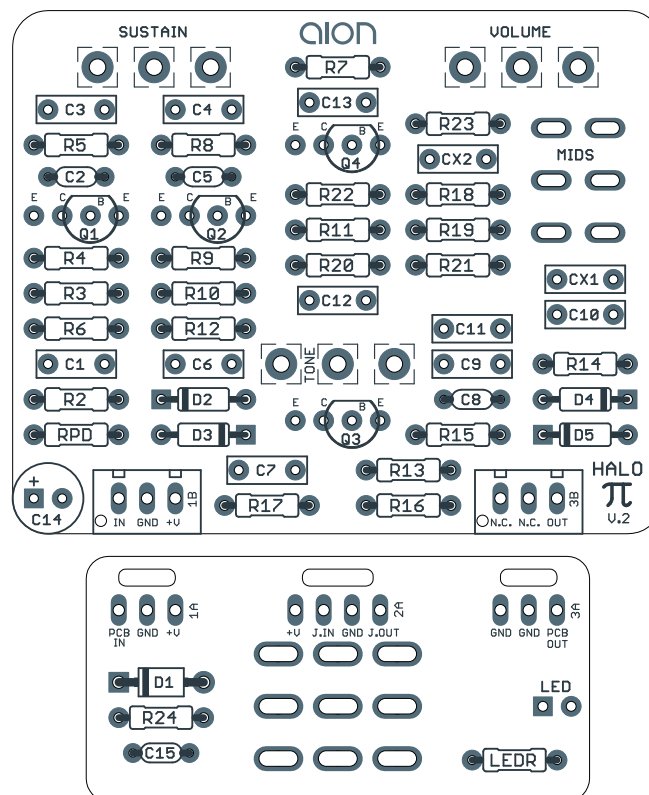**EFFECT TYPE**
Fuzz / Distortion

DOCUMENT VERSION
2.0.1 (2024-08-08)

PROJECT SUMMARY
One of the most classic guitar effects of all time, its sound falls somewhere between a distortion effect and a fuzz with an incredibly long sustain.

Actual size is 2.3" x 1.86" (main board) and 1.78" x 0.87" (bypass board).

───── **IMPORTANT NOTE** ─────

This documentation is for the **PCB-only** version of the project. If you are building the full kit from Aion FX, please use the kit build documentation instead. The instructions are more detailed and may differ in some areas due to the specialized parts and assembly methods used in our kits.

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INTRODUCTION

The Halo Distortion/Sustainer is a recreation of the Electro-Harmonix Big Muff Pi, first released in 1969. Originally marketed as a "harmonic distortion sustain", it has been lumped together with fuzz effects, although it's a very different animal than classic fuzz effects like a Fuzz Face or a Tone Bender.

While the overall circuit has barely changed in 50+ years, Electro-Harmonix was legendary for changing the part values on a whim throughout that time while never advertising the new versions as being different than previous ones. There are around 20 notable variants and many more minor variations within those, with nearly every part in the circuit being tweaked at some point or another.

The Big Muff is a pretty easy build and there aren't a lot of things that can be messed up. There's no biasing or gain sorting for the transistors, and no rare or specialized parts. It's endlessly tweakable, with dozens of different variants that can be replicated by substituting a few parts. For this reason, it's become a very popular DIY build—something of a rite of passage for those getting into the hobby. It's also a great way to experiment and learn how simple audio circuits work, because almost any part substitution will have some sort of audible effect.

The Halo is a faithful recreation of the Big Muff, allowing any standard variant to be built. A versions spreadsheet compiles all the different variants so you can easily see which parts to substitute if you want to build a Triangle, Ram's Head, Civil War, or more than a dozen other flavors.

Also included is a midrange switch that allows for the stock mid-scoop tone, a flat midrange response, or boosted midrange. The presence control mod from the legacy version of the Halo has been removed in this version, but the legacy PCB is still available for those who want it.

USAGE

The Halo has the following controls:

- **Sustain** controls the amount of drive or distortion, which also affects the amount of sustain.
- **Tone** is a control that pans between a low-pass filter (high cut) and a high-pass filter (low cut). At the 12:00 position, the bass and treble are flat, and the midrange tone response is based on the setting of the Mids switch.
- **Volume** is the overall output.
- **Mids** allows you to switch between Mid Scoop (the stock setting), Mid Hump, or Flat Mids.

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 →

Note: The parts list is taken from the "Gilmour '73 Ram's Head" version. See the Big Muff Versions spreadsheet for a compilation of all major versions of the Big Muff with part number references.

PART	VALUE	TYPE	NOTES
R2	33k	Metal film resistor, 1/4W	
R3	100k	Metal film resistor, 1/4W	
R4	470k	Metal film resistor, 1/4W	
R5	100R	Metal film resistor, 1/4W	
R6	10k	Metal film resistor, 1/4W	
R7	560R	Metal film resistor, 1/4W	
R8	10k	Metal film resistor, 1/4W	
R9	100k	Metal film resistor, 1/4W	
R10	470k	Metal film resistor, 1/4W	
R11	100R	Metal film resistor, 1/4W	
R12	10k	Metal film resistor, 1/4W	
R13	10k	Metal film resistor, 1/4W	
R14	100k	Metal film resistor, 1/4W	
R15	470k	Metal film resistor, 1/4W	
R16	100R	Metal film resistor, 1/4W	
R17	10k	Metal film resistor, 1/4W	
R18	33k	Metal film resistor, 1/4W	
R19	33k	Metal film resistor, 1/4W	
R20	470k	Metal film resistor, 1/4W	
R21	100k	Metal film resistor, 1/4W	
R22	10k	Metal film resistor, 1/4W	
R23	2k7	Metal film resistor, 1/4W	
R24	100R	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	470pF	MLCC capacitor, NP0/C0G	
C3	100n	Film capacitor, 7.2 x 2.5mm	
C4	100n	Film capacitor, 7.2 x 2.5mm	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C5	470pF	MLCC capacitor, NP0/C0G	
C6	100n	Film capacitor, 7.2 x 2.5mm	
C7	100n	Film capacitor, 7.2 x 2.5mm	
C8	470pF	MLCC capacitor, NP0/C0G	
C9	100n	Film capacitor, 7.2 x 2.5mm	
C10	3n9	Film capacitor, 7.2 x 2.5mm	
C11	12n	Film capacitor, 7.2 x 2.5mm	
C12	100n	Film capacitor, 7.2 x 2.5mm	
C13	100n	Film capacitor, 7.2 x 2.5mm	
C14	100uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C15	100n	MLCC capacitor, X7R	Power supply filter capacitor.
CX1	12n	Film capacitor, 7.2 x 2.5mm	For other variants, this value should always be the same as C11.
CX2	3n9	Film capacitor, 7.2 x 2.5mm	For other variants, this value should always be the same as C10.
Q1	2N3904	BJT transistor, NPN, TO-92	Can also use 2N5088.
Q2	2N3904	BJT transistor, NPN, TO-92	Can also use 2N5088.
Q3	2N3904	BJT transistor, NPN, TO-92	Can also use 2N5088.
Q4	2N3904	BJT transistor, NPN, TO-92	Can also use 2N5088.
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	
TONE	100kB	16mm right-angle PCB mount pot	
SUST.	100kB	16mm right-angle PCB mount pot	
VOL.	100kA	16mm right-angle PCB mount pot	
MIDS	DPDT on-on-on	Toggle switch, DPDT on-on-on	
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.
FSW	3PDT	Stomp switch, 3PDT	
ENC	125B	Enclosure, die-cast aluminum	Can also use a Hammond 1590N1.

BUILD NOTES

Variants

The Big Muff is famous for having dozens of variations that sound very different from each other, and Kit Rae's fantastic Big Muff π Page is the best source documenting these variations. The default parts list for the Halo is based on the "Gilmour '73 Ram's Head" schematic from Kit Rae, but the PCB supports any of the versions.

The Big Muff Versions spreadsheet compiles all of the Kit Rae schematics into one reference so that you can easily retrieve a list of values for a particular variant and build the Halo to those specifications. Note that for all versions, the transistors, diodes and potentiometers are the same, so only the resistor and capacitor values are provided.

Mids Switch

The midrange switch is a DPDT on-on-on. For this type of switch, depending on the manufacturer, there are two different types of configurations for the center position:

TYPE 1   TYPE 2

Fortunately, the way the switch is used in this circuit, it doesn't matter which type of switch you have. The EQ response will still be flat in the middle. Just make sure not to use an on-off-on switch.

If you aren't able to find a DPDT on-on-on switch, you can also just use a standard DPDT on-on switch. You will still have the mid hump and mid scoop modes, but you will not have the flat mode.

Note: If you are building a variant other than the default, you may need to adjust CX1 and CX2.

- CX1 should always be the value specified for **C11**
- CX2 should always be the value specified for **C10**

Hardwiring the midrange switch

If you'd like to leave off the midrange switch and hardwire it in the stock mid-scoop position, install wire jumpers as follows:
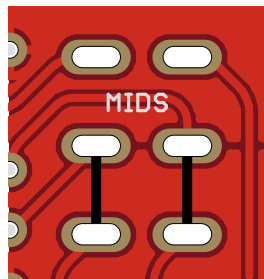
Mids switch vs. Presence control

The legacy version of the Halo came with an optional modification, adding a fourth knob to control the midrange contour, called "Body" or "Presence". This mod was created by Jack Orman of AMZ. More information can be found in his AMZ Presence Control article.
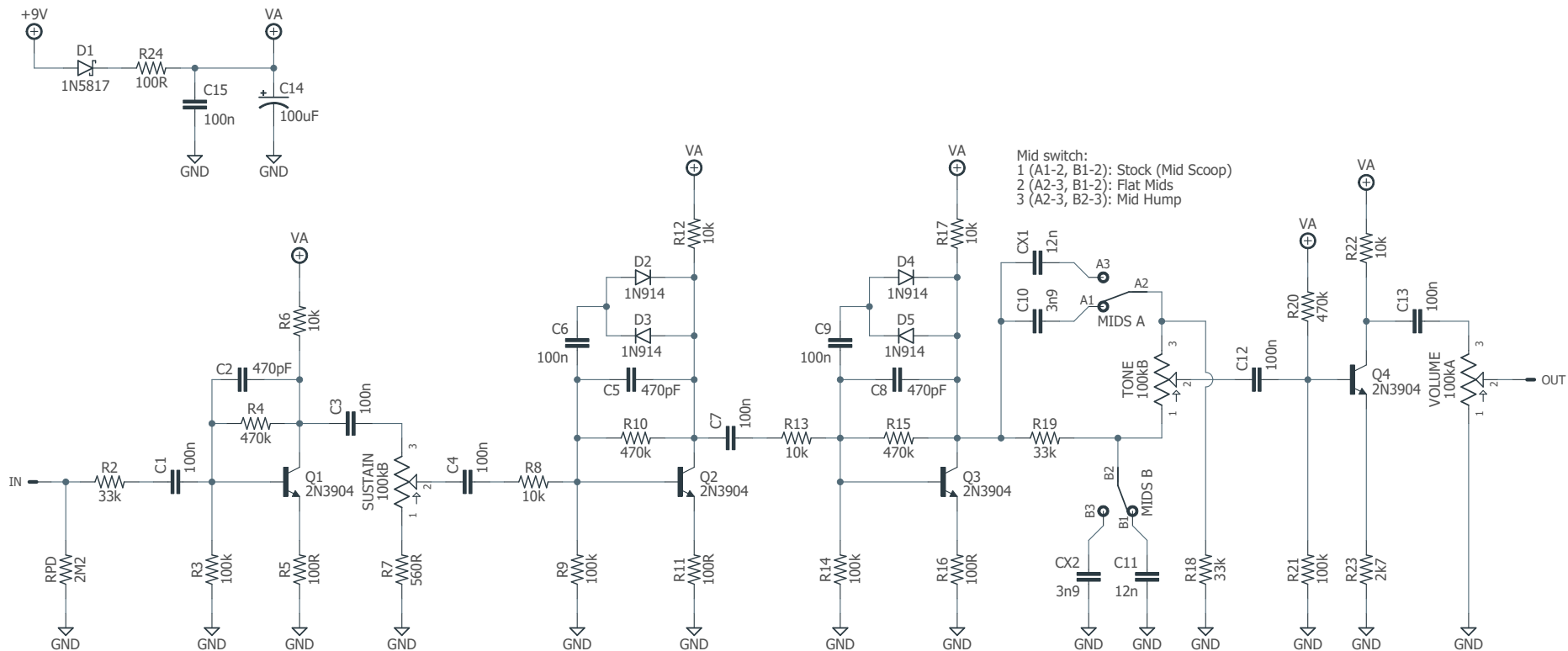
While this modification adds a good deal of tonal flexibility, there is no position on the body knob that removes it from the circuit and makes it 100% identical to a regular 3-knob Muff. If you look at an EQ graph of the tone control with the presence modification, it just doesn't have quite the same response as the original circuit in any of the positions.

As a result, the updated version of the Halo has been changed to have a 3-way switch that goes between the stock setting (scooped mids), a mid hump, or a fully flat frequency response. This gives a similar result but without

If you are interested in the presence knob modification, the legacy version of the Halo will continue to be available.

Shown with "Gilmour '73 Ram's Head" values.
For more variants, please see the Big Muff Versions spreadsheet.

Mid switch:
1 (A1-2, B1-2): Stock (Mid Scoop)
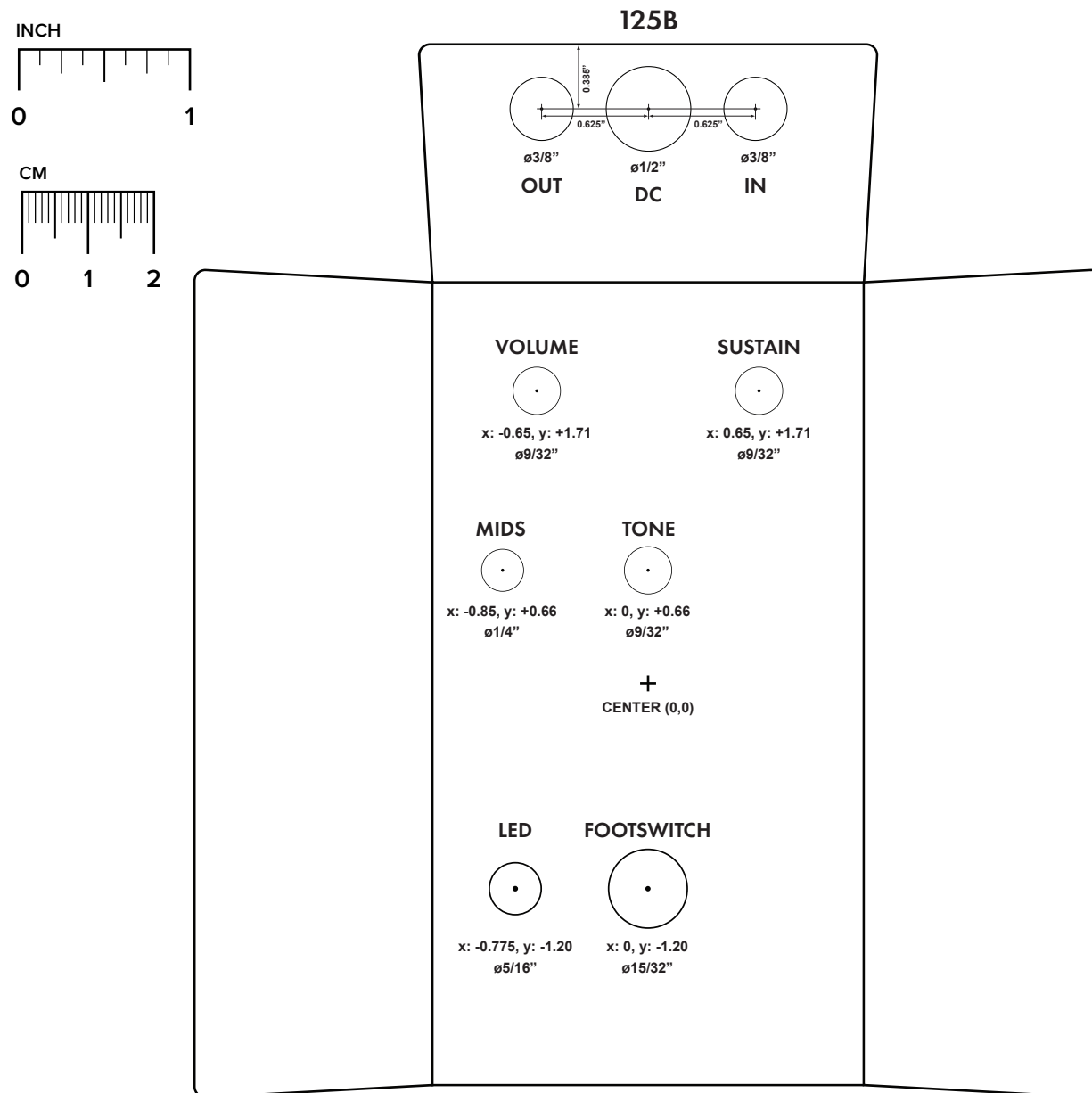2 (A2-3, B1-2): Flat Mids
3 (A2-3, B2-3): Mid Hump

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.
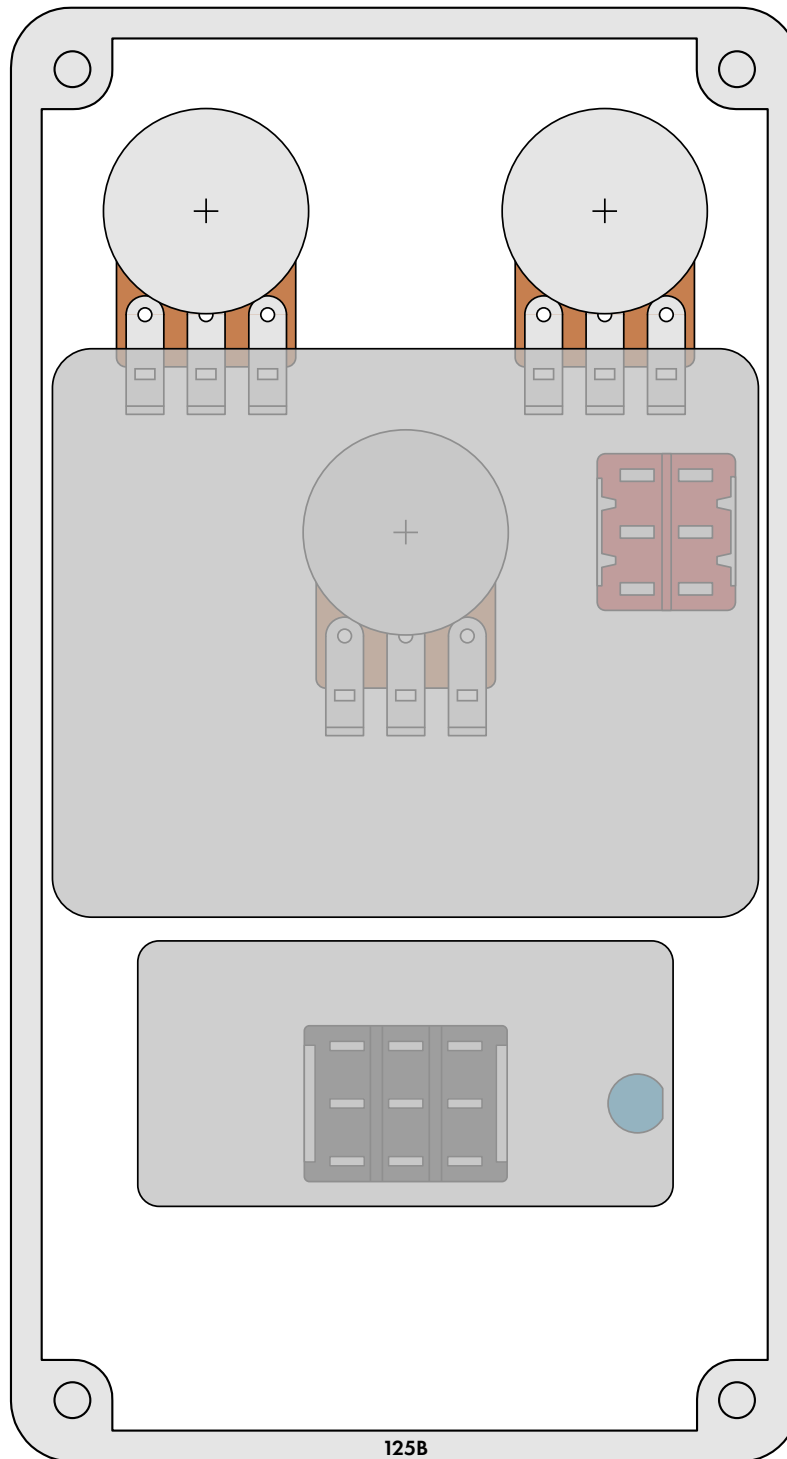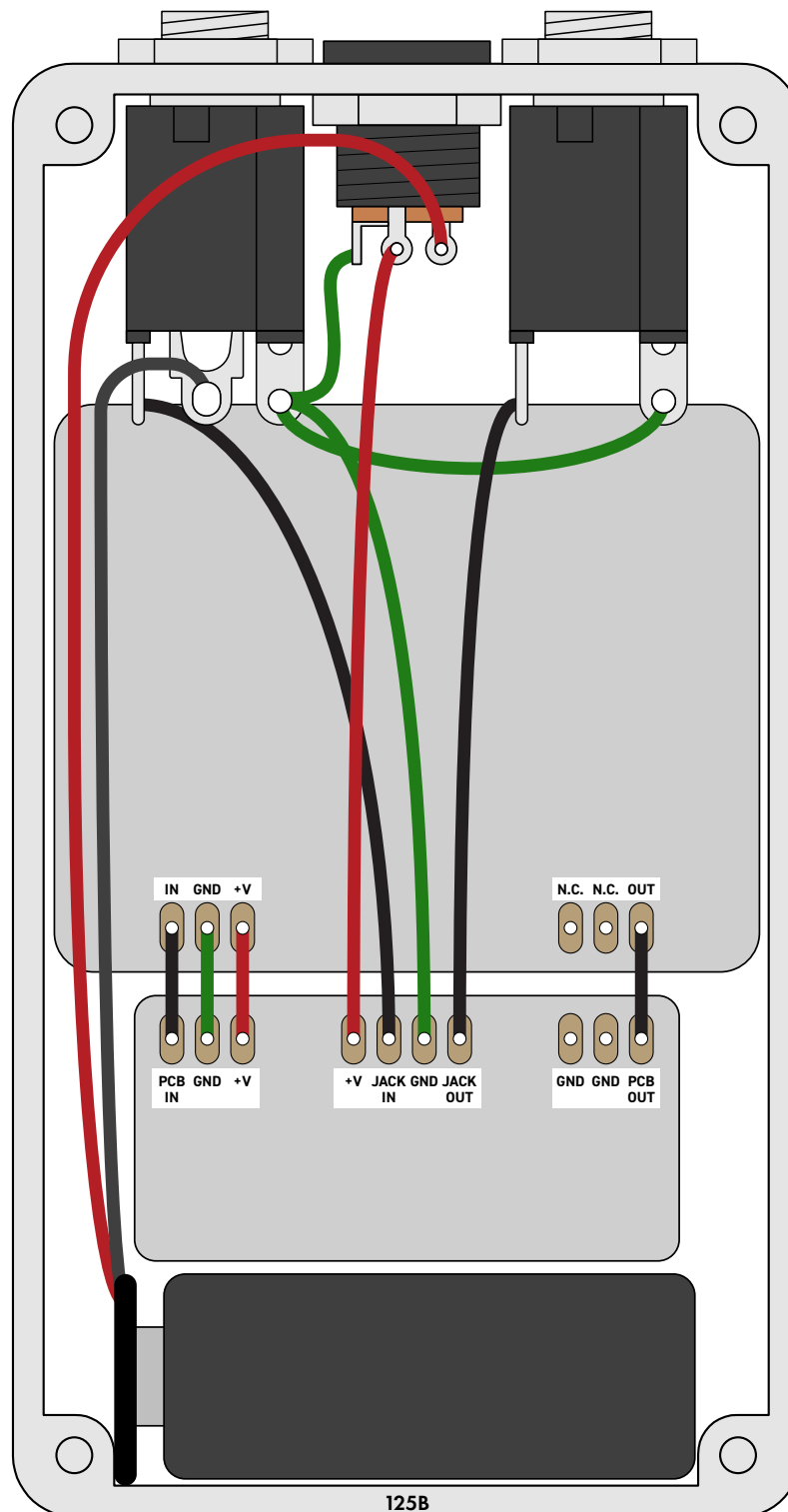
INCH

0   1

CM

0   1   2

125B

0.385"

0.625"   0.625"

ø3/8"   ø1/2"   ø3/8"

OUT   DC   IN

VOLUME   **SUSTAIN**

x: -0.65, y: +1.71   x: 0.65, y: +1.71
ø9/32"   ø9/32"

MIDS   **TONE**

x: -0.85, y: +0.66   x: 0, y: +0.66
ø1/4"   ø9/32"

+
CENTER (0,0)

LED   **FOOTSWITCH**

x: -0.775, y: -1.20   x: 0, y: -1.20
ø5/16"   ø15/32"

ENCLOSURE LAYOUT

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

125B

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

2.0.1 (2024-08-08)
Changed LEDR to 10k to work with a wider variety of LEDs.

2.0.0 (2019-12-14)

- New PCB layout.
- Removed CX3 along with support for the 3-transistor variants (e.g. Jumbo Tone Bender) in favor of a more straightforward build process. The 3-transistor variant will be released as a different project in the future.
- Changed default part values to "Gilmour" '73 Ram's Head.
- Added versions spreadsheet with part references for 18 different variants.

1.0.0 (2018-07-04)
Initial release.