PROJECT NAME

# APOLLO MK. I

aion DIY GUITAR EFFECTS

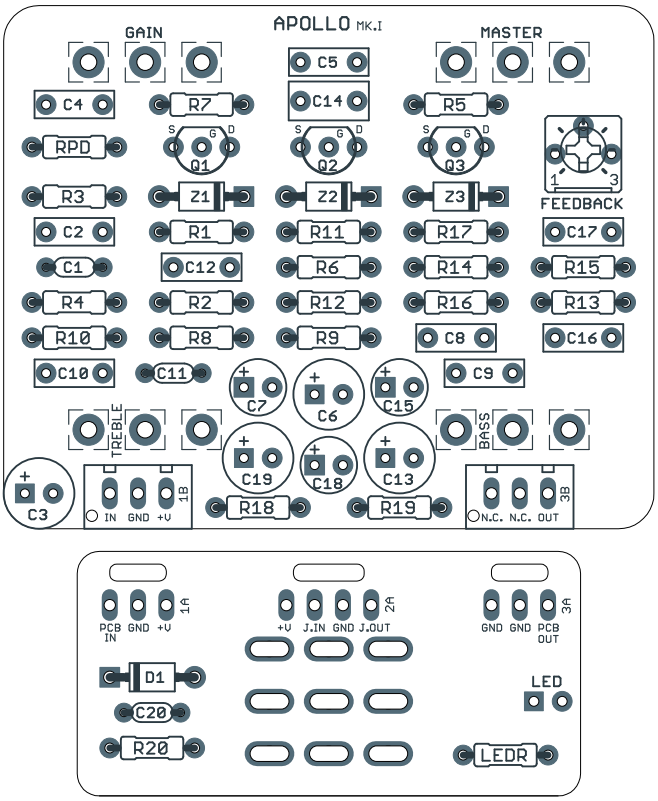
**BASED ON**
Catalinbread® WIIO

**BUILD DIFFICULTY**
Intermediate

**EFFECT TYPE**
Overdrive / Amp Emulation

**DOCUMENT VERSION**
1.0.1 (2022-01-10)

**PROJECT SUMMARY**
An adaptation of the Hiwatt amplifier used by Pete Townshend of The Who during their “Live at Leeds” performance from 1970.




*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 **Mk. I** version of the project. There is also a Mk. II version, based on the RAH. While the names are similar, the circuit and part numbering are different. Please be sure your PCB is labeled “Apollo Mk. I” before proceeding with this build document.

## TABLE OF CONTENTS



## INTRODUCTION

The Apollo Preamp Drive Mk. I is an adaptation of the Catalinbread WIIO, based on the Hiwatt amplifiers used by Pete Townshend of The Who, particularly their Live at Leeds show from February 14, 1970. (The artwork for the original pedal makes it obvious that "WIIO" is intended to resemble "WHO".)

The WIIO was originally released in 2009 as a limited run of 100. The limited availability caused a huge debacle as people from gear forums bought up all the preorders and flipped them for profit, capitalizing on Catalinbread's favored status among gear aficionados.

Catalinbread was not happy with the way the circuit turned out, so before releasing the non-limited version, they overhauled the circuit to reduce the gain and tweak the EQ so it was more versatile as an amp platform. Most people agree that the second version is superior, but the hype surrounding the first version has given it a lasting reputation.

The WIIO was succeeded by the RAH, which is largely the same circuit but with a midrange knob added, and the circuit re-voiced for Led Zeppelin's famous show at the Royal Albert Hall. (They even referred to the RAH as the "Royal Albert Hall Edition of the WIIO" in the manual.) The WIIO was discontinued shortly after the release of the RAH.

The Apollo Mk. I is a direct adaptation of the V2 WIIO (non-limited version). The only modification is the addition of a trimmer that makes a feedback resistor variable, allowing adjustments to the gain, tone and feel of the circuit. The RAH is also available from Aion FX as the Apollo Mk. II.

## USAGE

The Apollo Mk. I has the following controls:

- **Gain** controls the amount of gain coming out of the first amplifier stage.
- **Bass** and **Treble** form a 2-band tone stack adapted from the original amplifier.
- **Master** is the overall output level.
- **Feedback** (internal trimmer) controls the global feedback from the third stage back to the first. Set it just past the halfway point for the stock circuit, and then adjust it to taste.

# 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 | 10M | Metal film resistor, 1/4W | |
| R2 | 3k3 | Metal film resistor, 1/4W | |
| R3 | 3k3 | Metal film resistor, 1/4W | |
| R4 | 1k | Metal film resistor, 1/4W | |
| R5 | 12k | Metal film resistor, 1/4W | |
| R6 | 10M | Metal film resistor, 1/4W | |
| R7 | 3k3 | Metal film resistor, 1/4W | |
| R8 | 3k3 | Metal film resistor, 1/4W | |
| R9 | 100k | Metal film resistor, 1/4W | |
| R10 | 10k | Metal film resistor, 1/4W | |
| R11 | 10M | Metal film resistor, 1/4W | |
| R12 | 3k3 | Metal film resistor, 1/4W | |
| R13 | 3k3 | Metal film resistor, 1/4W | |
| R14 | 130R | Metal film resistor, 1/4W | |
| R15 | 47k | Metal film resistor, 1/4W | |
| R16 | 12k | Metal film resistor, 1/4W | |
| R17 | 12k | Metal film resistor, 1/4W | |
| R18 | 62k | Metal film resistor, 1/4W | |
| R19 | 82k | Metal film resistor, 1/4W | |
| R20 | 100R | Metal film resistor, 1/4W | |
| RPD | 2M2 | Metal film resistor, 1/4W | |
| LEDR | 4k7 | Metal film resistor, 1/4W | |
| C1 | 270pF | MLCC capacitor, NP0/C0G | |
| C2 | 100n | Film capacitor, 7.2 x 2.5mm | |
| C3 | 100uF | Electrolytic capacitor, 6.3mm | |
| C4 | 100n | Film capacitor, 7.2 x 2.5mm | |
| C5 | 47n | Film capacitor, 7.2 x 2.5mm | |
| C6 | 100uF | Electrolytic capacitor, 6.3mm | |
| C7 | 4.7uF | Electrolytic capacitor, 4mm | |
| C8 | 4n7 | Film capacitor, 7.2 x 2.5mm | |

## PARTS LIST, CONT.

| PART | VALUE | TYPE | NOTES |
|---|---|---|---|
| C9 | 10n | Film capacitor, 7.2 x 2.5mm | |
| C10 | 10n | Film capacitor, 7.2 x 2.5mm | |
| C11 | 470pF | MLCC capacitor, NP0/C0G | |
| C12 | 100n | Film capacitor, 7.2 x 2.5mm | |
| C13 | 100uF | Electrolytic capacitor, 6.3mm | |
| C14 | 470n | Film capacitor, 7.2 x 3mm | |
| C15 | 10uF | Electrolytic capacitor, 5mm | |
| C16 | 2n2 | Film capacitor, 7.2 x 2.5mm | |
| C17 | 2n2 | Film capacitor, 7.2 x 2.5mm | |
| C18 | 47uF | Electrolytic capacitor, 5mm | |
| C19 | 100uF | Electrolytic capacitor, 6.3mm | |
| C20 | 100n | MLCC capacitor, X7R | |
| D1 | 1N5817 | Schottky diode, DO-41 | |
| Z1 | 1N4739A | Zener diode, 9V, DO-41 | |
| Z2 | 1N4739A | Zener diode, 9V, DO-41 | |
| Z3 | 1N4739A | Zener diode, 9V, DO-41 | |
| Q1 | 2N7000 | MOSFET, N-channel, TO-92 | |
| Q2 | 2N7000 | MOSFET, N-channel, TO-92 | |
| Q3 | 2N7000 | MOSFET, N-channel, TO-92 | |
| GAIN | 500kA | 16mm right-angle PCB mount pot | |
| BASS | 500kA | 16mm right-angle PCB mount pot | |
| TREBLE | 500kB | 16mm right-angle PCB mount pot | |
| MSTR. | 100kA | 16mm right-angle PCB mount pot | |
| FDBK. | 250k trimmer | Trimmer, 10%, 1/4" | See build notes. |
| 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

## MOSFET selection and pinouts

The original WIIO uses BS170 MOSFETs. These are identical in specification to the 2N7000, but with the major difference that *sometimes* the pinout is different. Some manufacturers use D-S-G and others use D-G-S, while the 2N7000 is always D-G-S. Therefore, it's recommended to use 2N7000 when building this project.

## MOSFET pin labels

The initial run of the Apollo Mk. I PCB mistakenly has the pin labels reversed for the MOSFETs. This will be corrected in future orders, but note that the "D" pin should be on the right and the "S" pin on the left regardless of what the PCB silkscreen shows. The physical outline is correct for the 2N7000, so as long as you install it according to the silkscreen, the pin labels can be ignored.

## Setting feedback trimmer

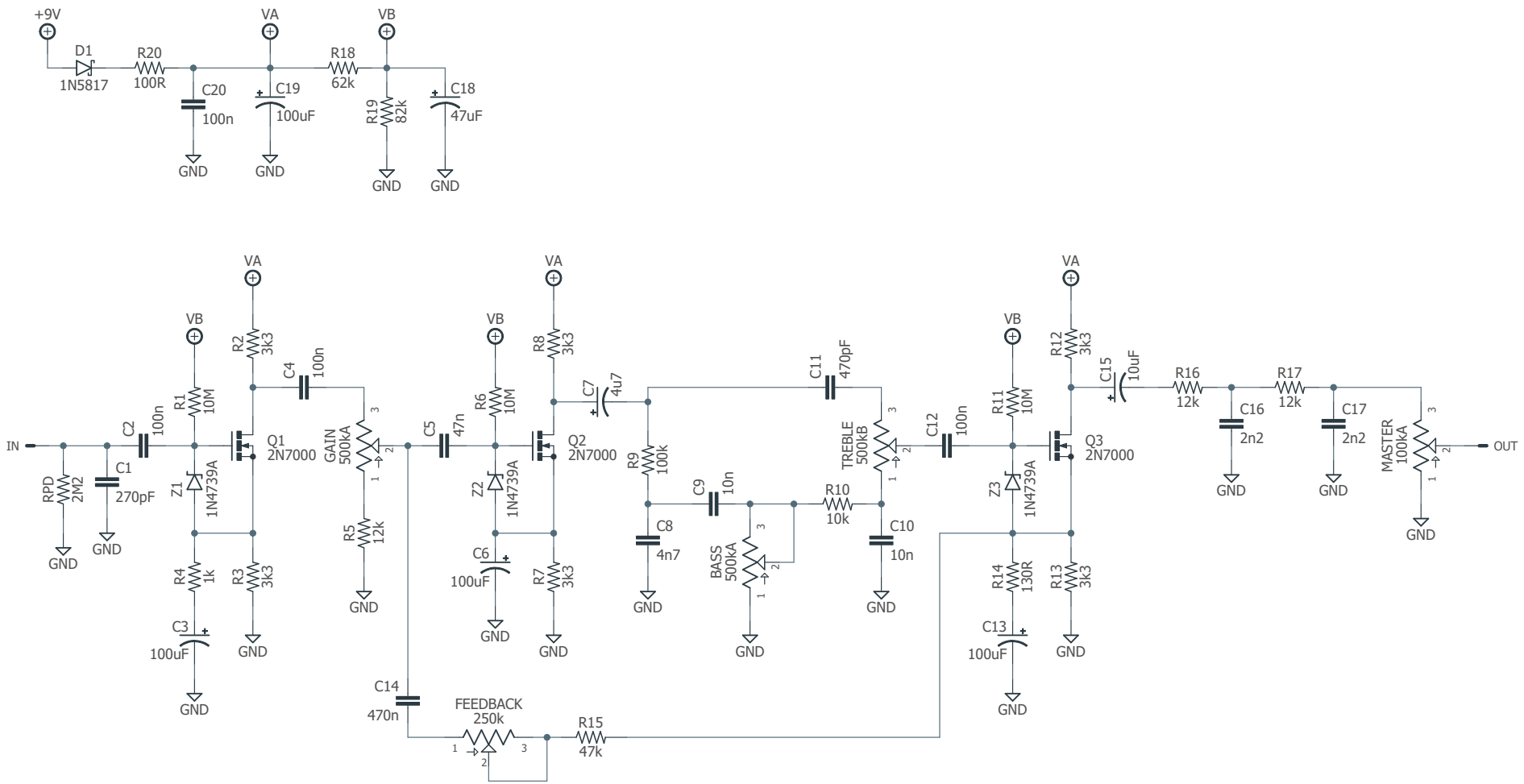
The WIIO circuit contains a global feedback loop similar to the amplifier it's based on. A 200k resistor and 470n capacitor send the output from the third stage back to the point just after the gain control between the first and second stage, which reduces the gain, cuts some of the top end, and makes it feel more "amp-like".

The Apollo Mk. I adds a trimmer in series with the feedback resistor, allowing the feedback to be varied to taste. Global feedback does several things at once with the gain, EQ and compression

The stock position is between 1-2:00 on the trimmer and this should be the starting point for any builds. From there, adjust it up or down and see if you like what it does.

If you want to omit this control, jumper the outer pins of the trimmer and use **200k** for R15.

# SCHEMATIC


+9V
D1
1N5817
R20
100R
C20
100n
VA
C19
100uF
R18
62k
VB
R19
82k
C18
47uF
GND
IN
RPD
2M2
C1
270pF
C2
100n
R1
10M
Z1
1N4739A
R4
1k
R3
3k3
C3
100uF
Q1
2N7000
R2
3k3
C4
100n
GAIN
500kA
R5
12k
C5
47n
R6
10M
Z2
1N4739A
C6
100uF
R7
3k3
Q2
2N7000
R8
3k3
C7
4u7
R9
100k
C8
4n7
C9
10n
BASS
500kA
C11
470pF
R10
10k
TREBLE
500kB
C10
10n
C12
100n
R11
10M
Z3
1N4739A
R14
130R
C13
100uF
R13
3k3
Q3
2N7000
R12
3k3
C15
10uF
R16
12k
C16
2n2
R17
12k
C17
2n2
MASTER
100kA
OUT
C14
470n
FEEDBACK
250k
R15
47k

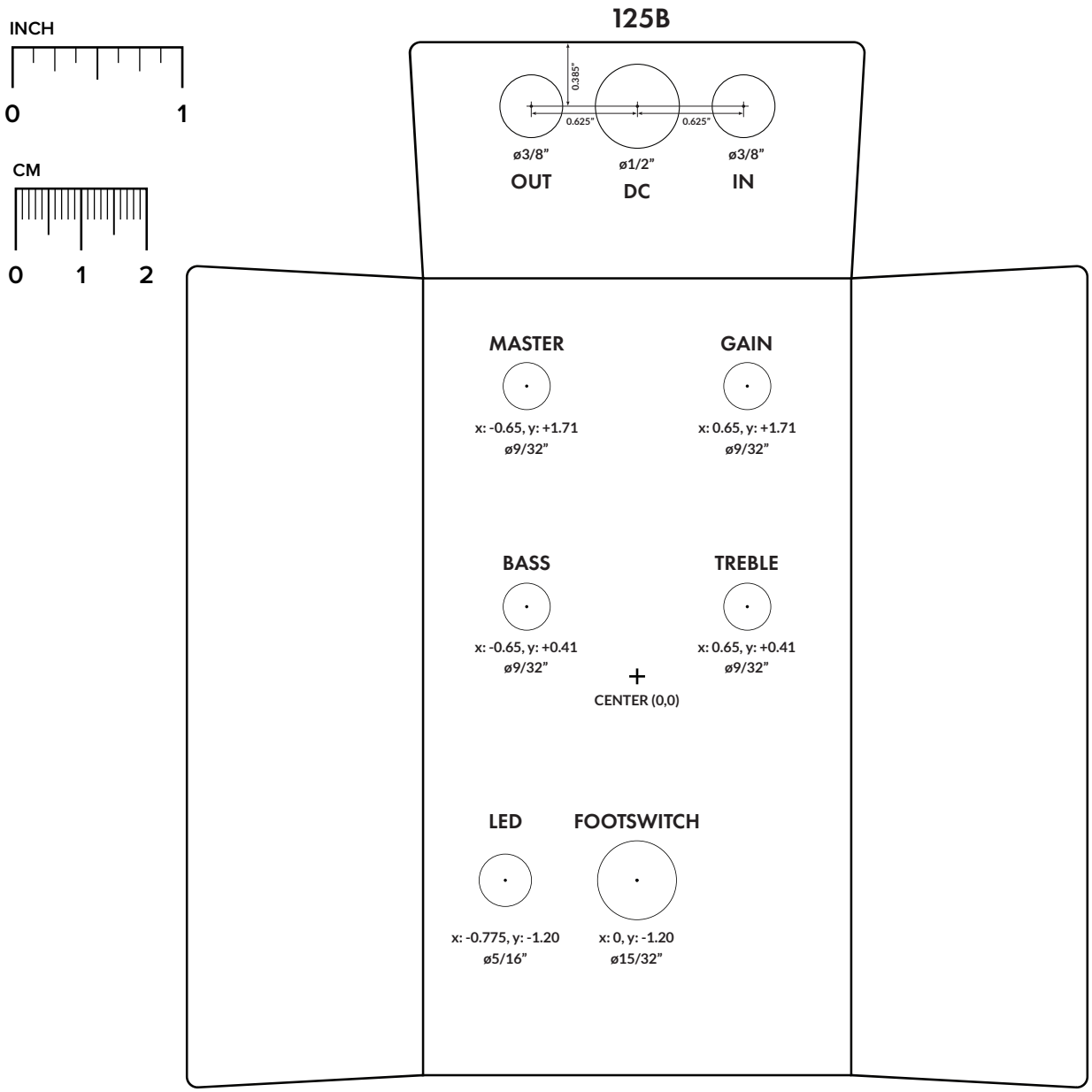
# DRILL TEMPLATE

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.

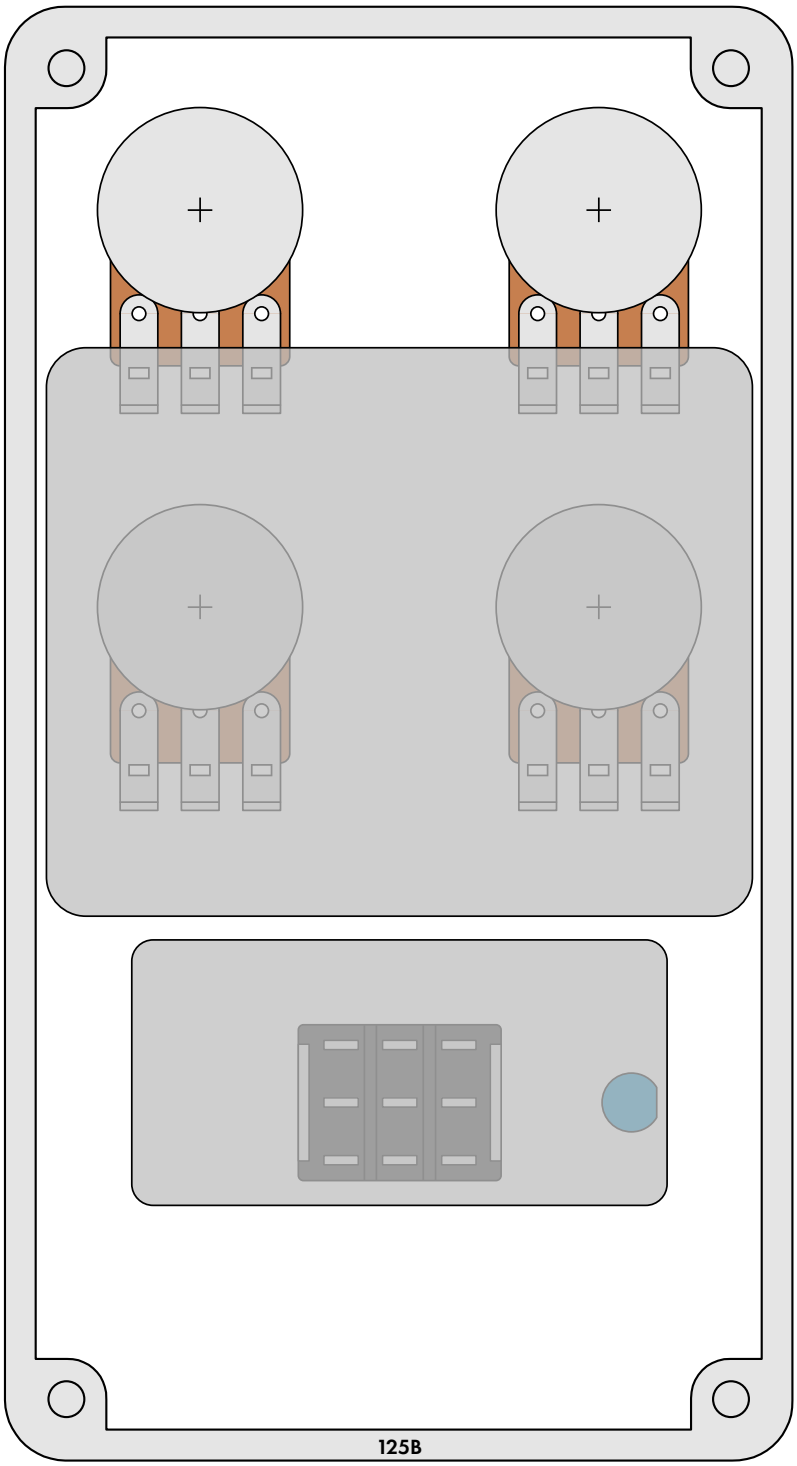
**Top jack layout** assumes the use of closed-frame jacks like the Switchcraft 111X. If you'd rather use open-frame jacks, please refer to the Open-Frame Jack Drill Template for the top side.

**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.

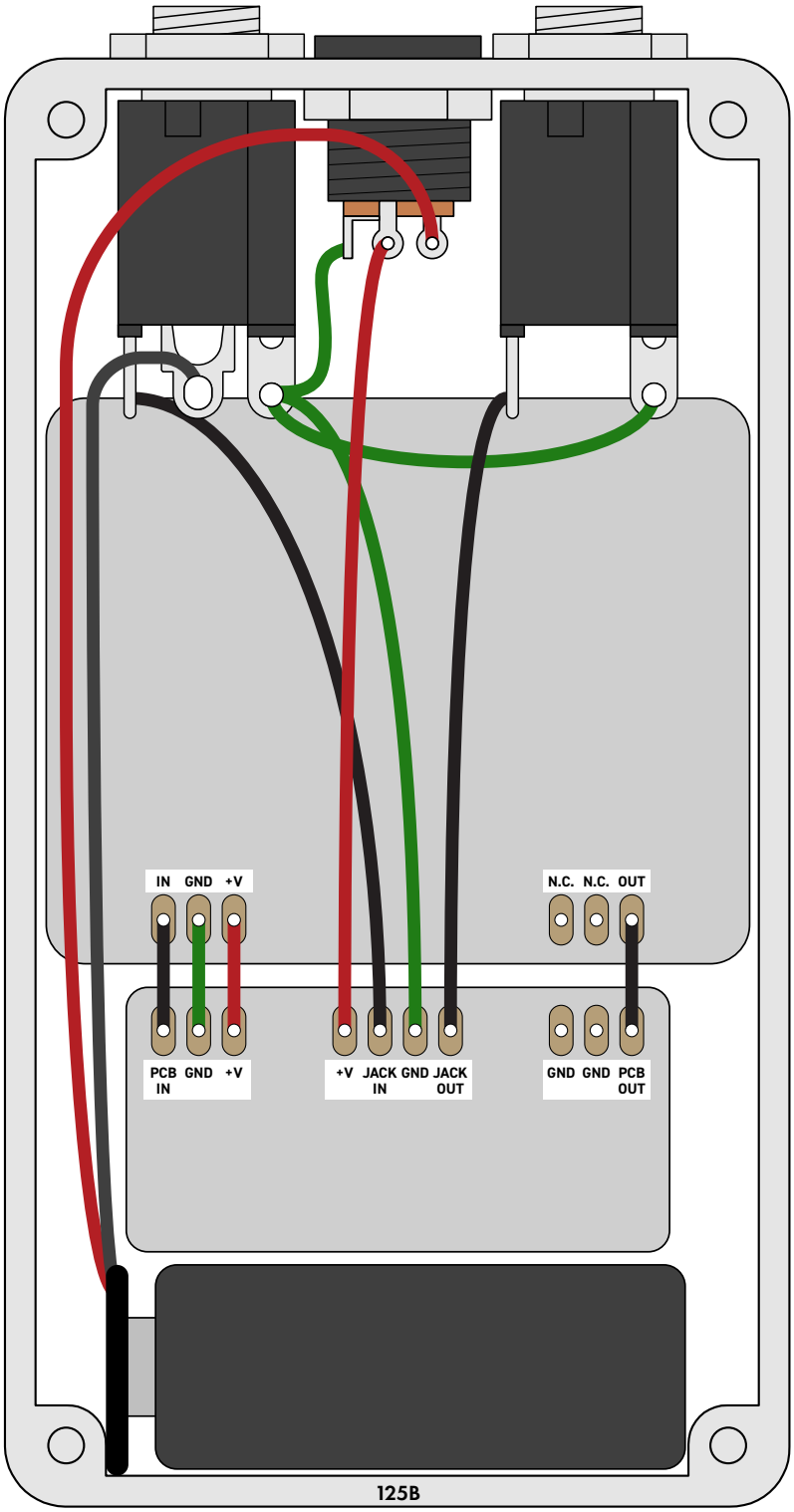


## ENCLOSURE LAYOUT

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 (2022-01-10)**
Added information about MOSFET selection and pinouts.

**1.0.0 (2021-02-19)**
Initial release.