

PROJECT NAME

# APOLLO MK. II



BASED ON

Catalinbread® RAH

BUILD DIFFICULTY

■■■■□ Intermediate

EFFECT TYPE

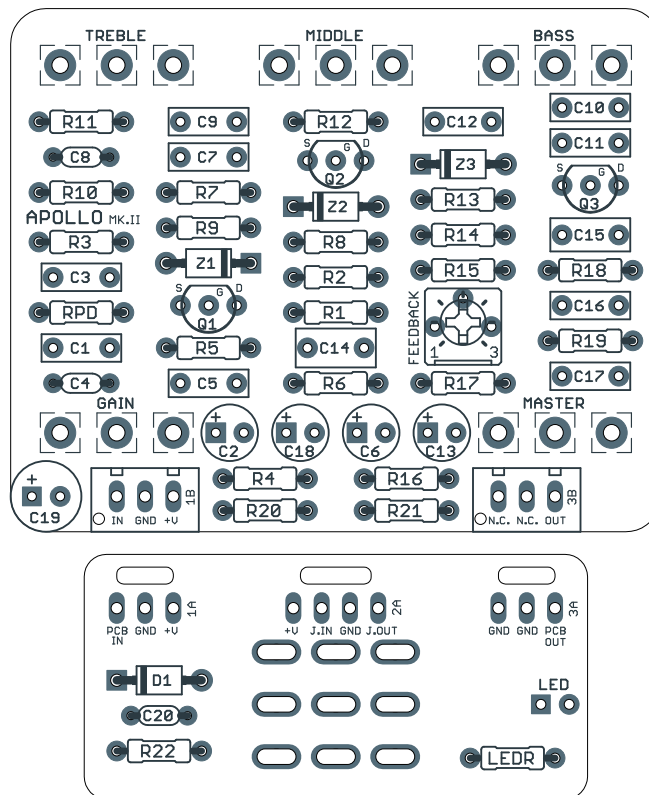
Overdrive / Amp Emulation

DOCUMENT VERSION

1.0.1 (2022-01-10)

### PROJECT SUMMARY

An adaptation of the custom Hiwatt amplifier used by Jimmy Page of Led Zeppelin during their “Royal Albert Hall” 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. II** version of the project. There is also a [Mk. I](#) version, based on the WIIO. While the names are similar, the circuit and part numbering are different. Please be sure your PCB is labeled “Apollo Mk. II” before proceeding with this build document.

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## INTRODUCTION

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The Apollo Preamp Drive Mk. II is an adaptation of the Catalinbread RAH, based on the custom Hiwatt amplifier used by Jimmy Page in Led Zeppelin's Royal Albert Hall performance from 1970.

The RAH was originally released in 2011 as the "Royal Albert Hall Edition WIIO". (The WIIO was an earlier circuit that was also based on the Hiwatt amplifier, but voiced for the tone of Pete Townshend from The Who.) After the release of the RAH, the WIIO was discontinued.

The main difference from the WIIO is the tone stack, which was adapted from Jimmy's amp (called the "Custom Hiwatt 100 Jimmy Page") and differs somewhat from their standard amplifiers. Like the original amp, the RAH includes a midrange knob for a full three-band tonestack. A few other values were tweaked to re-voice it for Led Zeppelin's tone, but overall the RAH and WIIO are close siblings.

Due to the use of MOSFETs instead of JFETs, the RAH circuit is stiffer and less compressed than many of Catalinbread's other amp-based circuits. It has been described as "unforgiving" in this regard, including by Catalinbread themselves. It does generate plenty of its own distortion, but it takes pedals very well and benefits from a boosted or overdriven signal at the input.

The Apollo Mk. II is a direct adaptation of the RAH. 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 WIIO is also available as the [Apollo Mk. I](#).

*A bit of trivia: the WIIO and RAH were developed based on recordings of concerts that were held five weeks apart (Led Zeppelin on January 6, 1970, and The Who on February 14).*

## USAGE

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The Apollo Mk. II has the following controls:

- **Gain** controls the amount of gain coming out of the first amplifier stage.
- **Bass, Middle** and **Treble** form a 3-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   | 1M    | 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   | 22k   | Metal film resistor, 1/4W   |       |
| R6   | 1M    | 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  | 220k  | Metal film resistor, 1/4W   |       |
| R11  | 22k   | Metal film resistor, 1/4W   |       |
| R12  | 100k  | Metal film resistor, 1/4W   |       |
| R13  | 1M    | Metal film resistor, 1/4W   |       |
| R14  | 3k3   | Metal film resistor, 1/4W   |       |
| R15  | 3k3   | Metal film resistor, 1/4W   |       |
| R16  | 130R  | Metal film resistor, 1/4W   |       |
| R17  | 47k   | Metal film resistor, 1/4W   |       |
| R18  | 10k   | Metal film resistor, 1/4W   |       |
| R19  | 10k   | Metal film resistor, 1/4W   |       |
| R20  | 62k   | Metal film resistor, 1/4W   |       |
| R21  | 100k  | Metal film resistor, 1/4W   |       |
| R22  | 100R  | Metal film resistor, 1/4W   |       |
| RPD  | 2M2   | Metal film resistor, 1/4W   |       |
| LEDR | 4k7   | Metal film resistor, 1/4W   |       |
| C1   | 3n3   | Film capacitor, 7.2 x 2.5mm |       |
| C2   | 22uF  | Electrolytic capacitor, 5mm |       |
| C3   | 100n  | Film capacitor, 7.2 x 2.5mm |       |
| C4   | 47pF  | MLCC capacitor, NP0/COG     |       |
| C5   | 47n   | Film capacitor, 7.2 x 2.5mm |       |
| C6   | 10uF  | Electrolytic capacitor, 5mm |       |

## PARTS LIST, CONT.

| PART   | VALUE        | TYPE                           | NOTES                            |
|--------|--------------|--------------------------------|----------------------------------|
| C7     | 1n           | Film capacitor, 7.2 x 2.5mm    |                                  |
| C8     | 220pF        | MLCC capacitor, NP0/COG        |                                  |
| C9     | 1n           | Film capacitor, 7.2 x 2.5mm    |                                  |
| C10    | 47n          | Film capacitor, 7.2 x 2.5mm    |                                  |
| C11    | 47n          | Film capacitor, 7.2 x 2.5mm    |                                  |
| C12    | 100n         | Film capacitor, 7.2 x 2.5mm    |                                  |
| C13    | 22uF         | Electrolytic capacitor, 5mm    |                                  |
| C14    | 680n         | Film capacitor, 7.2 x 4.5mm    |                                  |
| C15    | 220n         | Film capacitor, 7.2 x 2.5mm    |                                  |
| 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   | 500kB        | 16mm right-angle PCB mount pot |                                  |
| BASS   | 500kA        | 16mm right-angle PCB mount pot |                                  |
| MID    | 100kB        | 16mm right-angle PCB mount pot |                                  |
| TREBLE | 250kB        | 16mm right-angle PCB mount pot |                                  |
| MSTR.  | 250kA        | 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

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### MOSFET selection and pinouts

The original RAH 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. II 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

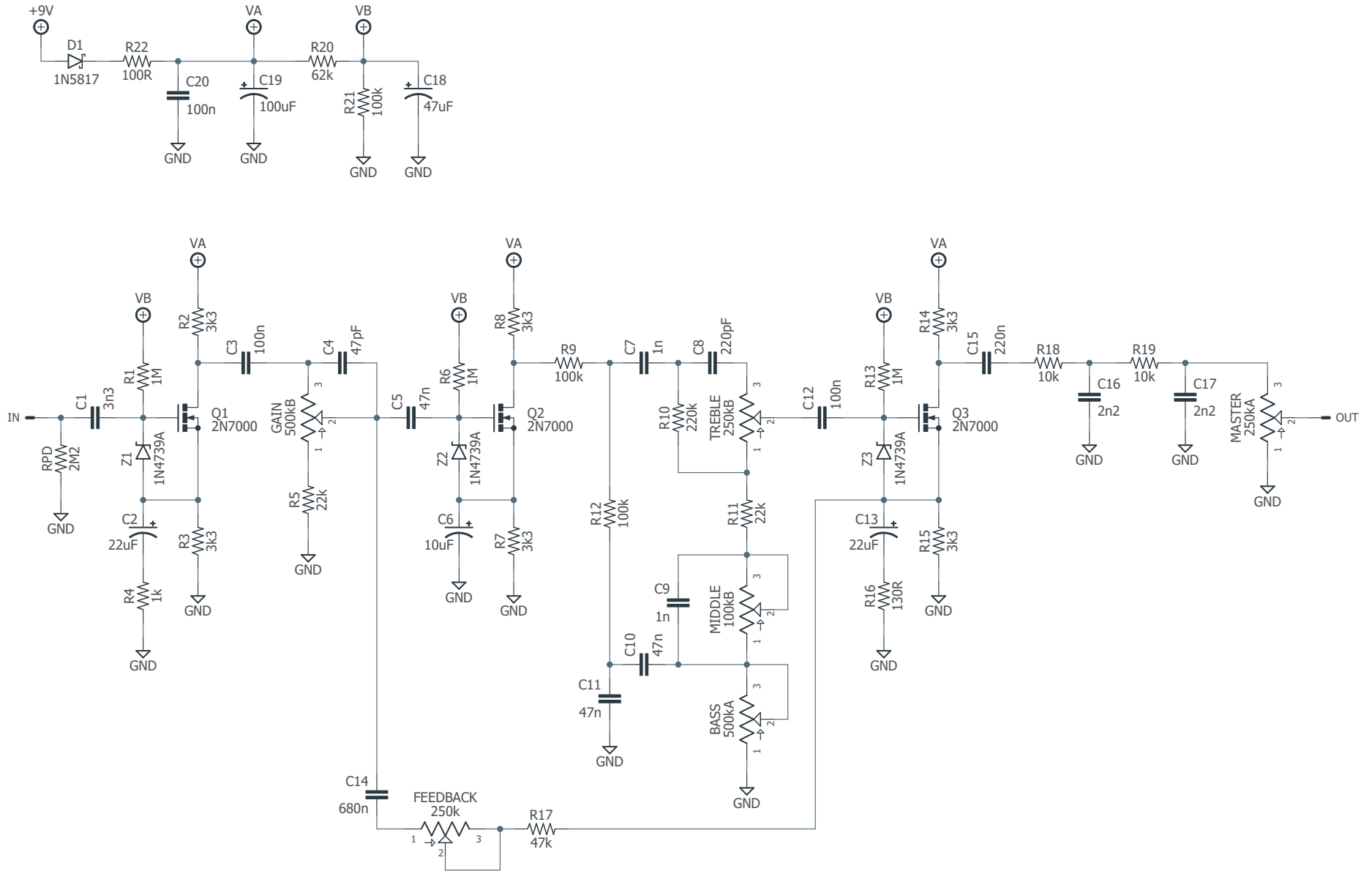
The RAH circuit contains a global feedback loop similar to the amplifier it's based on. A 200k resistor and 680n capacitor send the output from the third stage back to the point just after the gain control between the first and second stage, which reduces the gain, cuts some of the top end, and makes it feel more "amp-like".

The Apollo Mk. II 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 R17.

# SCHEMATIC



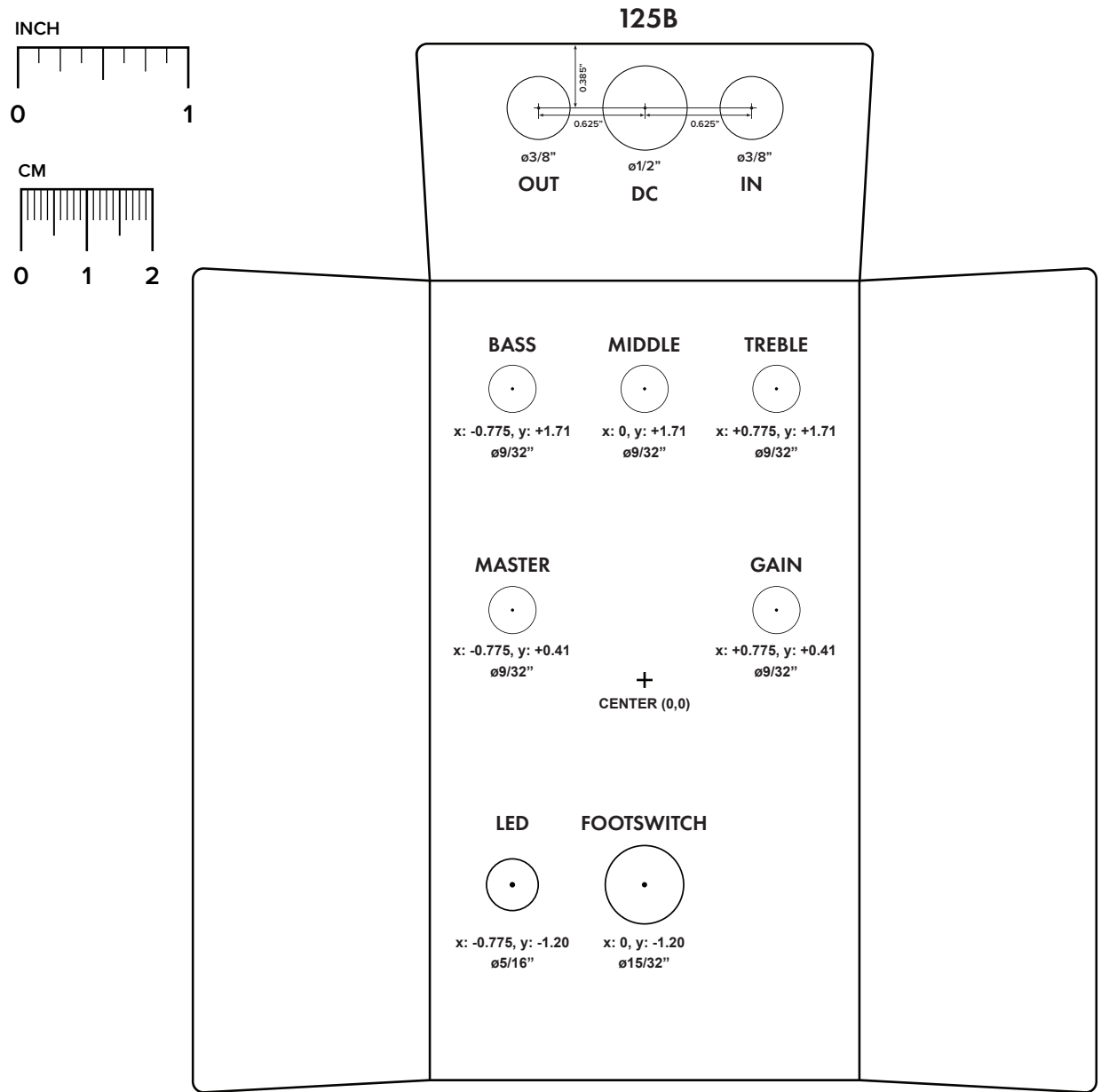
# DRILL TEMPLATE

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](#). Open-frame jacks will not fit in layouts with 5 or more knobs due to the placement of the DC jack.

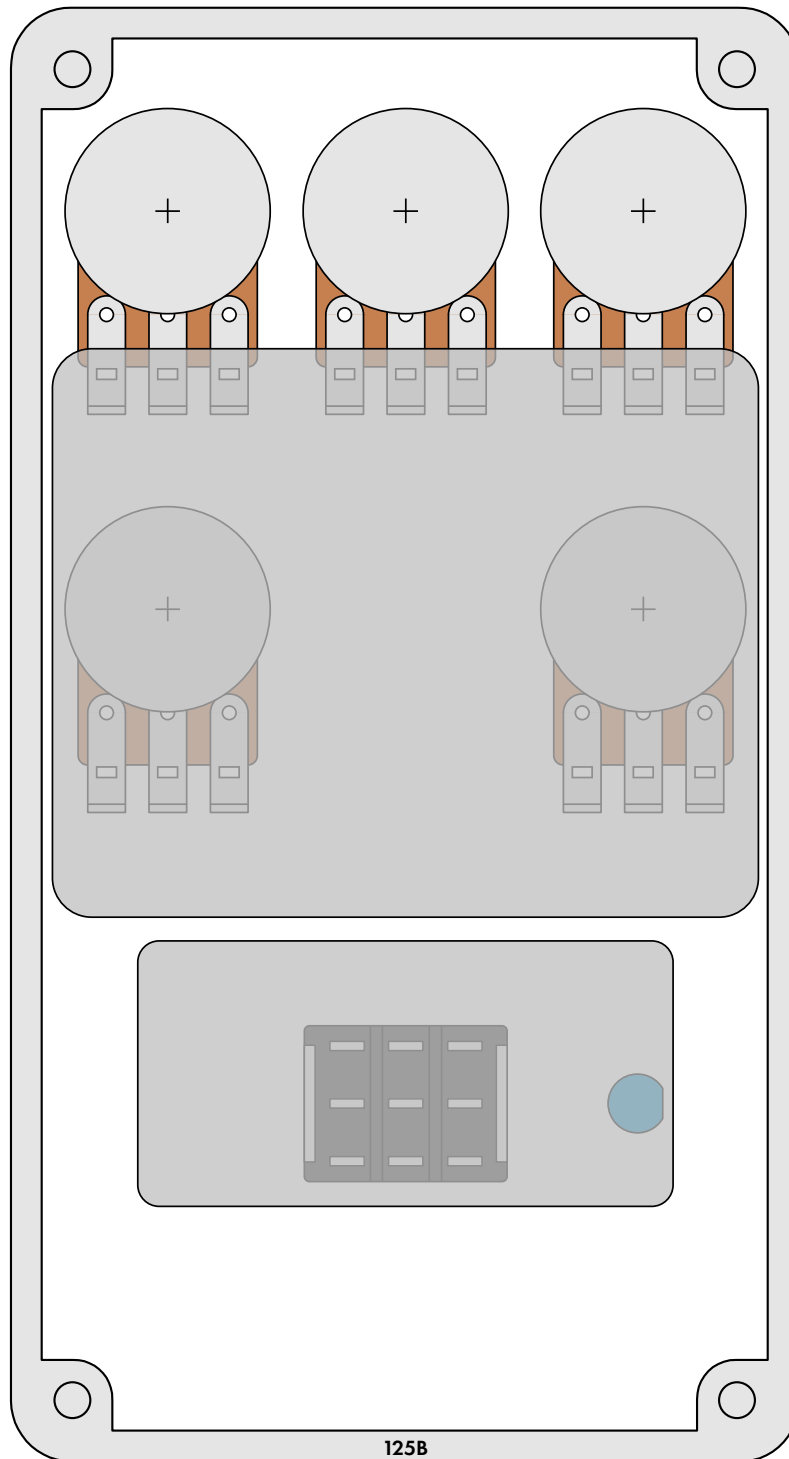
**LED hole drill size** assumes the use of a [5mm LED bezel](#), available from several parts suppliers. Adjust size accordingly if using something different, such as a 3mm bezel, a plastic bezel, or just a plain LED.



# ENCLOSURE LAYOUT

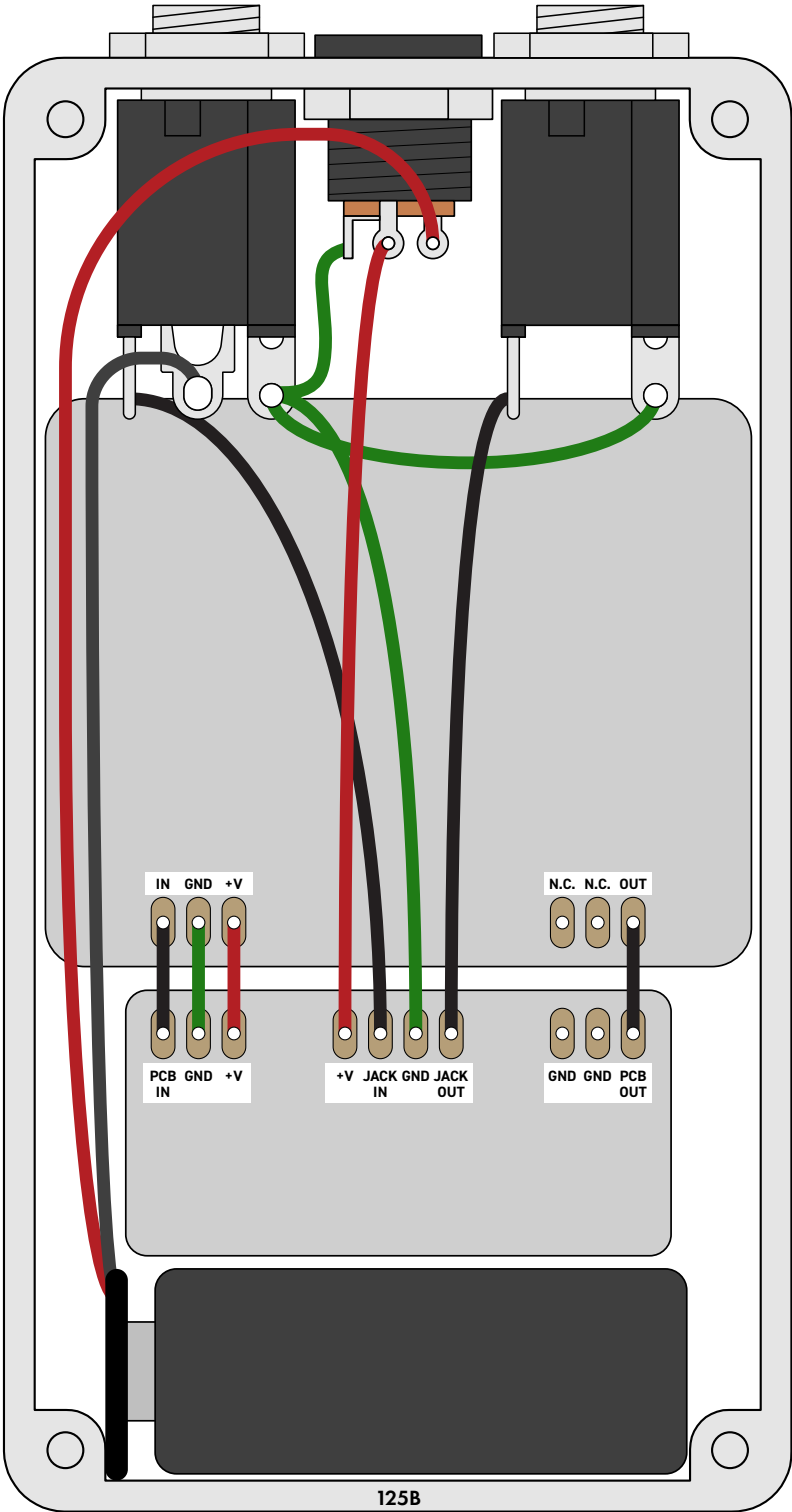
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Enclosure is shown without jacks. See next page for jack layout and wiring.





# WIRING DIAGRAM



## LICENSE & USAGE

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**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

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### 1.0.1 (2022-01-10)

Added information about MOSFET selection and pinouts.

### 1.0.0 (2021-02-19)

Initial release.