PROJECT NAME

DZ4 PREAMP

aion DIY GUITAR EFFECTS

BASED ON
Diezel VH4 Pedal

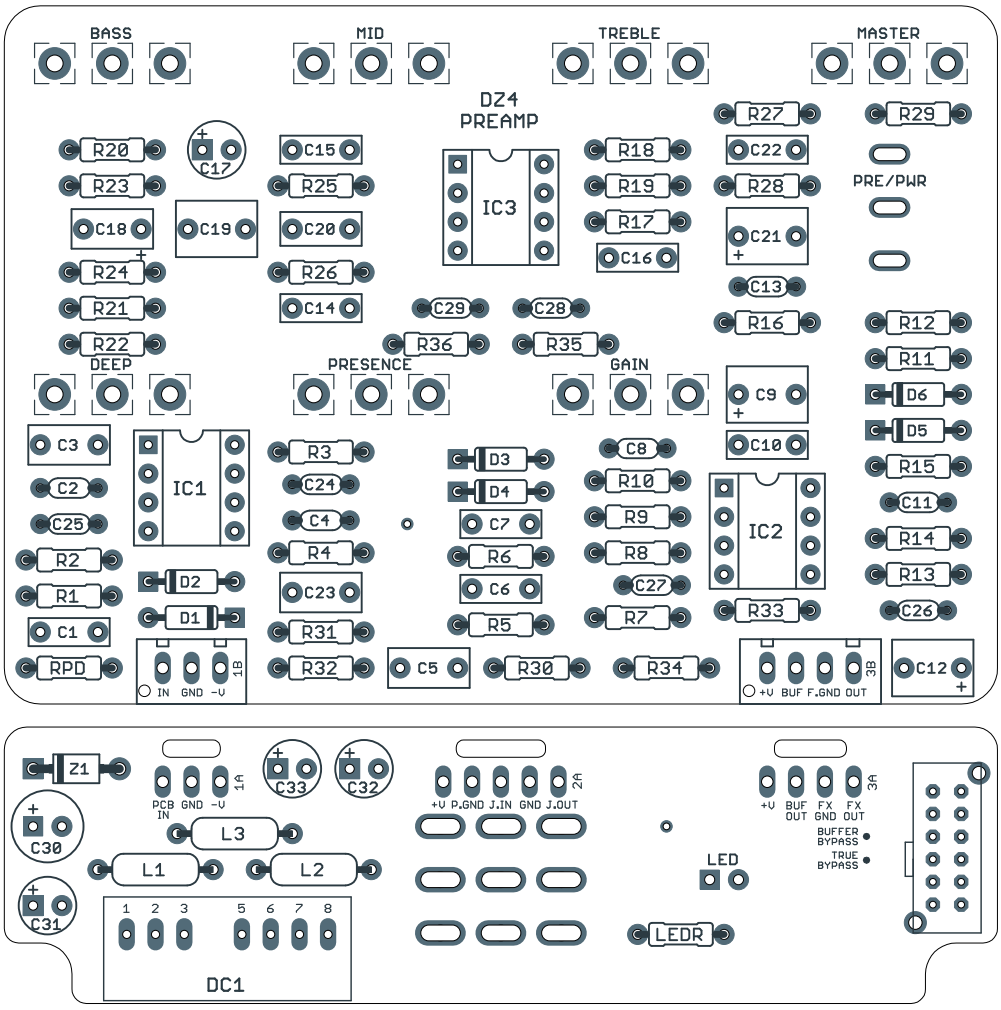
BUILD DIFFICULTY
Advanced

EFFECT TYPE
Preamp & high-gain overdrive

DOCUMENT VERSION
1.0.3 (2022-08-15)

PROJECT SUMMARY

A pedal recreation of the “Mega” channel of the Deizel VH4 amplifier, used by countless hard rock, metal and alternative bands from the 1990s to the present.



Actual size is 3.44” x 2.42” (main board) and 3.44” x 0.97” (bypass board).

TABLE OF CONTENTS

INTRODUCTION

The DZ4 Preamp is based on the Diezel VH4 pedal, first released in 2016 as an adaptation of the classic amplifier of the same name. The pedal version was intended to capture the feel of the VH4 amplifier's third channel, called "Mega". It's intended as a true preamp, with suitable output level to drive a power amp directly, but can also be used as a traditional drive pedal in combination with others.

The DZ4 is an exact adaptation of the audio path of the VH4, but with some minor convenience & usability tweaks to the overall circuit. The first is the power supply, which has been updated to support a 9V input while reliably delivering +/-12V as in the original circuit. (More on this in the Circuit Design Notes section.)

The second minor change is the handling of the two outputs. The original pedal had two output jacks, one for using it as a standard pedal (with some attenuation and tone shaping) and one for connecting straight to a power amp. This has been changed to a toggle switch so you can select between the two types of outputs without having to unplug anything.

The third change is to the bypass. The original unit was buffered bypass only, but we've added a true bypass/buffered bypass slide switch if you'd rather keep the buffer out of your signal path when the pedal is disengaged.

The end result is a faithful adaptation of the VH4 pedal, but with a few quality-of-life tweaks so it integrates better with the rest of your rig.

CIRCUIT DESIGN NOTES

Power supply design

The VH4 circuit is designed for +/-12V. Most of the distortion is achieved by overdriving the op-amps themselves as opposed to relying on clipping diodes, and this type of clipping is directly impacted by the supply voltage, so it's important to ensure that a clone operates at the same voltage.

The original VH4 pedal uses an odd power supply arrangement: to get +/-12V, they put a 12V regulator on the DC input and then use a charge pump to invert the supply voltage.

However, regulators require some level of voltage headroom (exceeding the dropout voltage spec of the regulator, usually 1 to 1.5V) in order to function properly. The Diezel pedal comes with a 12V supply, but this won't actually cause the regulator to pass the full 12 volts. It also comes with a jumper cable to get 18V from two 9V supplies, such as from a Pedal Power 2 brick, which will result in a solid 12V—but the regulator will be putting out a lot of heat. 15V would work best, but these supplies are rare.

Therefore, the DZ4's major departure from the original VH4 pedal is in the power supply. It uses a DC-DC converter that will output a clean +/-12V from a standard 9V input with a minimal number of external parts, so you don't have to worry about finding a special power supply, running it at a less-than-ideal supply voltage, or stressing the regulator.

See build notes on page 9 for information on sourcing these DC converters.

USAGE

The DZ4 has the following controls.

Potentiometers

- **Gain** attenuates the signal before the fixed-level clipping stage.
- **Bass**, **Mid**, and **Treble** form a 3-band Fender/Marshall/Vox-style tone stack after the drive stage.
- **Deep** is an active bass boost/cut centered around 115 Hz.
- **Presence** is intended to control the high-frequency content, but it acts as more of a full-range volume/gain control. See build notes section for modifications to make it more functional.
- **Master** is the master volume of the unit.

Switches

- **Pre/Pwr** selects between two types of outputs. This comes after the master volume in the circuit.
    - **To Preamp** (down position) is the standard effects pedal mode, used if it will be followed by other effects or will be sent to a guitar amp's input. The signal is attenuated and the highs are rolled off slightly above 480 Hz.
    - **To Power Amp** (up position) is suitable for going directly to a power amp.
- **Buffer Bypass / True Bypass** (internal slide switch) sets the bypass mode, either buffered bypass (stock) or true bypass where the pedal is fully out of the circuit when disengaged.

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	100k	Metal film resistor, 1/4W	
R3	220k	Metal film resistor, 1/4W	
R4	10k	Metal film resistor, 1/4W	
R5	470k	Metal film resistor, 1/4W	
R6	680k	Metal film resistor, 1/4W	
R7	220k	Metal film resistor, 1/4W	
R8	220k	Metal film resistor, 1/4W	
R9	1M	Metal film resistor, 1/4W	
R10	10k	Metal film resistor, 1/4W	
R11	100k	Metal film resistor, 1/4W	
R12	470k	Metal film resistor, 1/4W	
R13	220k	Metal film resistor, 1/4W	
R14	220k	Metal film resistor, 1/4W	
R15	10k	Metal film resistor, 1/4W	
R16	39k	Metal film resistor, 1/4W	
R17	1M5	Metal film resistor, 1/4W	
R18	100k	Metal film resistor, 1/4W	
R19	10k	Metal film resistor, 1/4W	
R20	4k7	Metal film resistor, 1/4W	
R21	1k	Metal film resistor, 1/4W	
R22	51k	Metal film resistor, 1/4W	Taper resistor for "Presence" pot. See build notes.
R23	100R	Metal film resistor, 1/4W	
R24	51k	Metal film resistor, 1/4W	Taper resistor for "Deep" pot. See build notes.
R25	47R	Metal film resistor, 1/4W	
R26	56k	Metal film resistor, 1/4W	
R27	1k	Metal film resistor, 1/4W	
R28	150k	Metal film resistor, 1/4W	
R29	100k	Metal film resistor, 1/4W	
R30	100k	Metal film resistor, 1/4W	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
R31	10R	Metal film resistor, 1/4W	
R32	10R	Metal film resistor, 1/4W	
R33	10R	Metal film resistor, 1/4W	
R34	10R	Metal film resistor, 1/4W	
R35	10R	Metal film resistor, 1/4W	
R36	10R	Metal film resistor, 1/4W	
RPD	1M	Metal film resistor, 1/4W	
LEDR	4k7	Metal film resistor, 1/4W	
C1	22n	Film capacitor, 7.2 x 2.5mm	
C2	100pF	MLCC capacitor, NP0/C0G	
C3	1uF	Film capacitor, 7.2 x 3.5mm	
C4	100pF	MLCC capacitor, NP0/C0G	
C5	1uF	Film capacitor, 7.2 x 3.5mm	
C6	22n	Film capacitor, 7.2 x 2.5mm	
C7	2n2	Film capacitor, 7.2 x 2.5mm	
C8	47pF	MLCC capacitor, NP0/C0G	
C9	2.2uF	Film capacitor, 7.2 x 5mm	
C10	4n7	Film capacitor, 7.2 x 2.5mm	
C11	100pF	MLCC capacitor, NP0/C0G	
C12	2.2uF	Film capacitor, 7.2 x 5mm	
C13	560pF	MLCC capacitor, NP0/C0G	
C14	22n	Film capacitor, 7.2 x 2.5mm	
C15	22n	Film capacitor, 7.2 x 2.5mm	
C16	1n	Film capacitor, 7.2 x 2.5mm	
C17	10uF	Electrolytic capacitor, 5mm	
C18	1uF	Film capacitor, 7.2 x 3.5mm	Recommended to use a lower value. See build notes.
C19	2.2uF	Film capacitor, 7.2 x 5mm	
C20	330n	Film capacitor, 7.2 x 2.5mm	
C21	2.2uF	Film capacitor, 7.2 x 5mm	
C22	2n2	Film capacitor, 7.2 x 2.5mm	
C23	1uF	Film capacitor, 7.2 x 3.5mm	
C24	100n	MLCC capacitor, X7R	
C25	100n	MLCC capacitor, X7R	
C26	100n	MLCC capacitor, X7R	
C27	100n	MLCC capacitor, X7R	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C28	100n	MLCC capacitor, X7R	
C29	100n	MLCC capacitor, X7R	
C30	100uF	Electrolytic capacitor, 6.3mm	
C31	47uF	Electrolytic capacitor, 5mm	
C32	10uF	Electrolytic capacitor, 5mm	
C33	10uF	Electrolytic capacitor, 5mm	
Z1	1N4743A	Zener diode, 13V, DO-41	
D1	1N914	Fast-switching diode, DO-35	
D2	1N914	Fast-switching diode, DO-35	
D3	1N5232B	Zener diode, 5.6V, DO-35	
D4	1N5232B	Zener diode, 5.6V, DO-35	
D5	1N914	Fast-switching diode, DO-35	
D6	1N914	Fast-switching diode, DO-35	
L1	10uH	Inductor, 10uH	Bourns 78F100J-RC
L2	10uH	Inductor, 10uH	Bourns 78F100J-RC
L3	10uH	Inductor, 10uH	Bourns 78F100J-RC
IC1	OPA2134	Operational amplifier, DIP8	
IC1-S	DIP-8 socket	IC socket, DIP-8	
IC2	TL072	Operational amplifier, DIP8	
IC2-S	DIP-8 socket	IC socket, DIP-8	
IC3	TL072	Operational amplifier, DIP8	
IC3-S	DIP-8 socket	IC socket, DIP-8	
DC1	TEC 2-0922	DC-DC converter, +9V to +/-12V	See build notes for alternatives.
TB/BUF	4PDT slide	Slide switch, 4PDT	E-Switch EG4208
GAIN	250kA	16mm right-angle PCB mount pot	
TREBLE	250kB	16mm right-angle PCB mount pot	
MID	25kB	16mm right-angle PCB mount pot	
BASS	1MA	16mm right-angle PCB mount pot	
PRESENCE	50kC	16mm right-angle PCB mount pot	Original uses 25kC, which is an uncommon value. R22 (51k) has been added in parallel so 50kC will have the same effective value.
DEEP	50kC	16mm right-angle PCB mount pot	Original uses 25kC, which is an uncommon value. R24 (51k) has been added in parallel so 50kC will have the same effective value.
MASTER	10kA	16mm right-angle PCB mount pot	
PRE/PWR	SPDT on-on	Toggle switch, SPDT on-on	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
LED	5mm	LED, 5mm, red diffused	
DC	2.1mm	DC jack, 2.1mm panel mount	Mouser 163-4302-E or equivalent.
IN	1/4" mono	1/4" phone jack, closed frame	Switchcraft 111X or equivalent.
OUT	1/4" mono	1/4" phone jack, closed frame	Switchcraft 111X or equivalent.
BYPASS	3PDT	Stomp switch, 3PDT	
ENCLOSURE	1590BBS	Enclosure, die-cast aluminum	

DC converter selection

There are several brands and models available, all with the same pinout and similar specifications. Here are the DC converters we've found that will work in this circuit.

BRAND	PART #	MOUSER #	SUPPLY	NOTES
Traco	TEC 2-0922	495-TEC2-0922	4.5-13.2V	Preferred option. More sources on Octopart.
CUI	PQMC3-D12-D12-S	490-PQMC3-D12-D12-S	9-18V	
XP Power	IZ1212S	209-IZ1212S	9-18V	
Recom	RS3-1212D	919-RS3-1212D	9-18V	
Mornsun	WRA1212S-3WR2	N/A	9-18V	NAC Semi: https://aionfx.com/link/mornsun-12v/

The Traco TEC 2-0922 is preferred for this circuit because its supply voltage range (4.5V to 13.2V) is perfectly suited for any type of pedal power supply.

The other models all have a minimum supply voltage of 9V. Most nominally 9VDC adapters put out around 9.6V, which is more than enough—but one very notable exception is the Voodoo Labs Pedal Power series (and likely other similar pedalboard supplies) which regulates to exactly 9.00V.

These DC converter modules are usually specced very conservatively, so it's very unlikely that there would be any issues even if the supply voltage was slightly lower than 9V. However, operating on the extreme lower end of a spec is not ideal from an engineering standpoint, so if we're going to point you to a specific module, it's going to be the one that works reliably in all use cases.

If you are using a standard wall-wart supply that puts out more than 9V, then all this is immaterial and any of the five units listed above will work the same. All significant specifications are the same aside from this input voltage range. We haven't tried all of them directly, but their datasheets indicate they will perform identically and they have the same pinout and physical dimensions.

This is fortunate, because most suppliers don't stock more than 20 or 30 of each type at a time. So while we recommend the Traco TEC 2-0922 as the best overall, it will likely not always be in stock, especially as we release more preamp projects with converters and more people are using them.

If you're having a hard time finding any that will work, try searching Octopart for the part number shown in the Part # column. Most of these brands are also carried by Digi-Key, Newark, and several other suppliers, and this engine will search all of the major distributors at once for easier sourcing.

The Mornsun unit is not available from Mouser, but it's included here because it's cheaper than the others (USD$8.22 as of the time of this writing) with the exact same specs. So if you need more than one, it quickly becomes much more cost-effective than the other options.

Presence control

The presence control is set up as a high-pass filter with a low-end roll-off frequency of around 160 Hz, meaning that in practice it's an almost full-range gain boost. This is because of the value of C18 (1uF).

This value was confirmed correct in the original VH4 pedal, so it's not a mistake in the trace, but it does prompt the question of whether it was a design mistake since "presence" is typically thought of as a high frequency above the standard range of treble tone controls.

Fortunately, if you want to experiment, it's an easy change. Dropping the value of C18 to **100n** will raise the frequency band to 1.6k at maximum rotation, which is a factor of 10 and well inside the reasonable range of a presence control. Some people have tried this value and reported good results.

We could take it a step further, though, and reference the functionality of the presence control on the original VH4 amp. The center frequency is listed at 4kHz in the owner's manual. If you used a **39n** capacitor for C18, the roll-off frequency at maximum rotation would be around 4.1kHz, which is almost spot-on. You could also use the more common value of **47n**, which is around 3.2kHz.

These values have not been tested, and we want to make sure to point out that raising the frequency to the amp's specs will not necessarily make the pedal sound more like the original amp since the pedal and amp are very different from each other. However, since the presence control isn't as functional in the original pedal as it could be, some level of modification is probably worthwhile.

Tone stack

The tone stack in the VH4 pedal is a traditional Fender/Marshall/Vox-style 3-band control. Specifically, it's a Fender style, although the actual Diezel VH4 amps use the Marshall style, having originally evolved from hot-rodded Marshalls in the 1980s.

It's a quick and easy modification to convert from Fender-style to Marshall-style in the DZ4 pedal: just cut the trace on the underside of the PCB between the midrange pot lugs 2 and 3. You can always jumper them back together if you prefer the sound the original way, so it's easy to reverse—but if you're up for experimentation then it's worth trying it out.

Deep and Presence pot values

The "Deep" and "Presence" potentiometers are 25kC in the original VH4 pedal. This is a very uncommon value, but fortunately they are both wired as variable potentiometers, so by adding a resistor in parallel we can drop the effective value to 25k without much impact to the taper.

R22 and **R24** are included to facilitate this, and should be 51k if using 50kC potentiometers. Omit these resistors entirely if using 25kC pots.

You can also use a higher value potentiometer with a lower parallel resistor, such as 100kC and 33k. The taper will be noticeably steeper, but it's still probably better than using a linear taper.

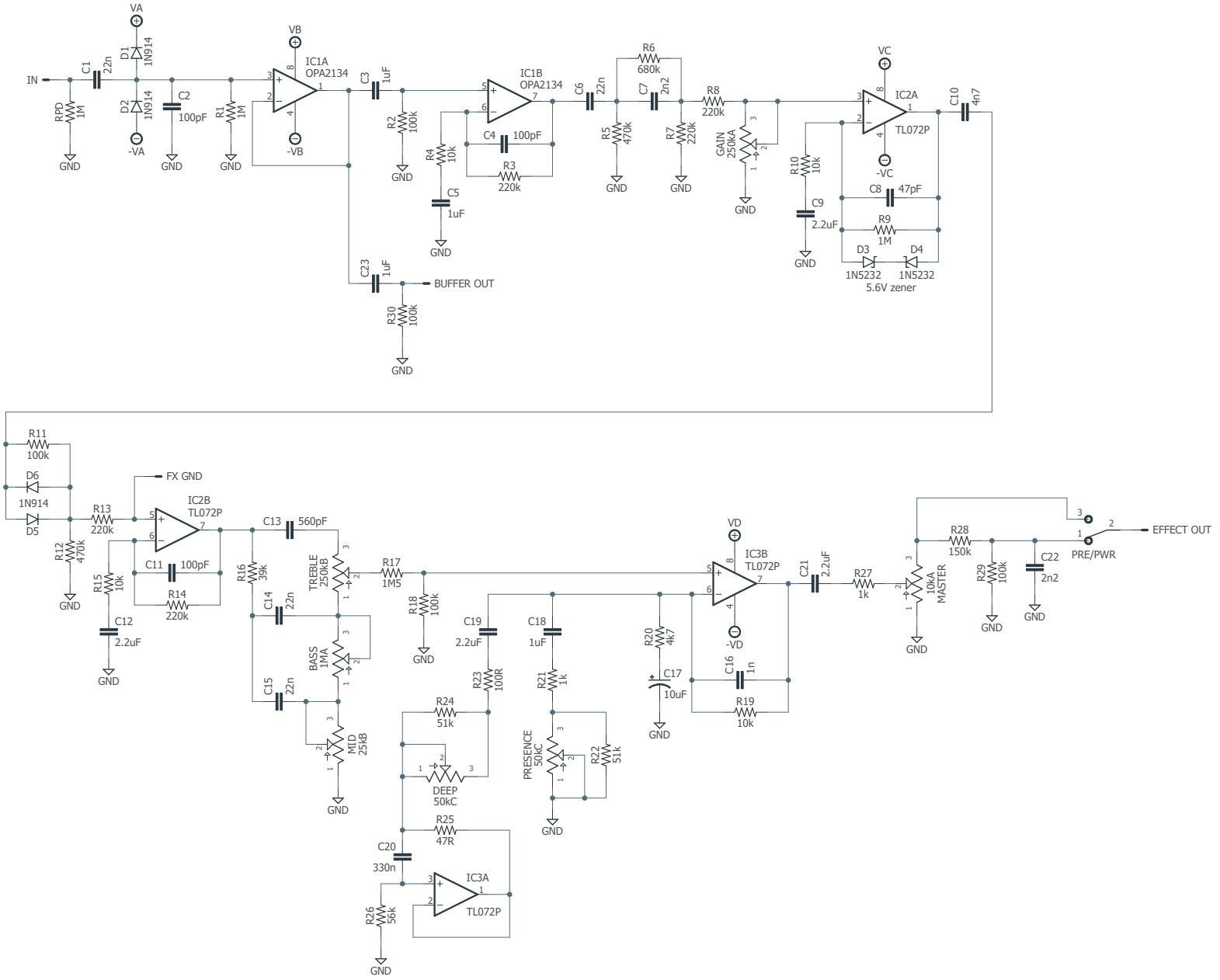
Enclosure size

This project was designed for the **Hammond 1590BBS** enclosure, which has the same height as the 125B or 1590N1. If you don't use the Hammond brand, be careful—not all 1590BBS enclosures are the same. For example, Love My Switches sells two different types, and the CNC Pro version is correct while the standard one is too short.

The 1590BB2 seems like a close equivalent, but it's about 4mm shorter. It may be possible to fit this circuit in a 1590BB2, but we have not tested it, so you're on your own!

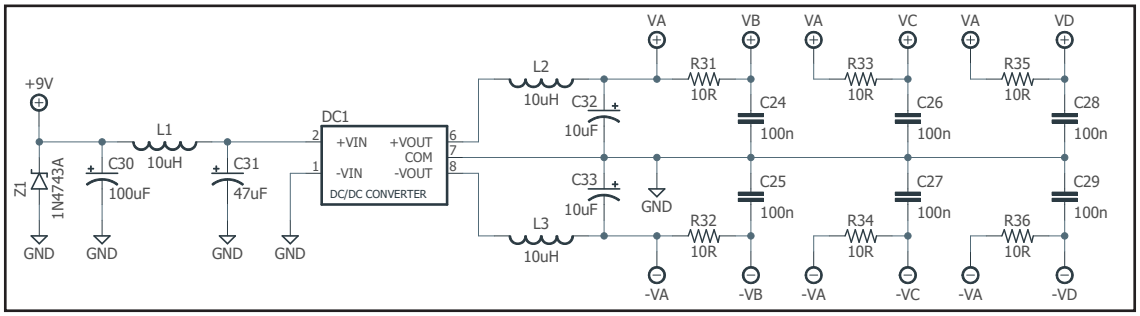
Another alternative is the 1590C (also available from Tayda and Love My Switches). It's about 10mm taller than necessary, but if that's all you can find then it will definitely work.

SCHEMATIC (MAIN CIRCUIT)

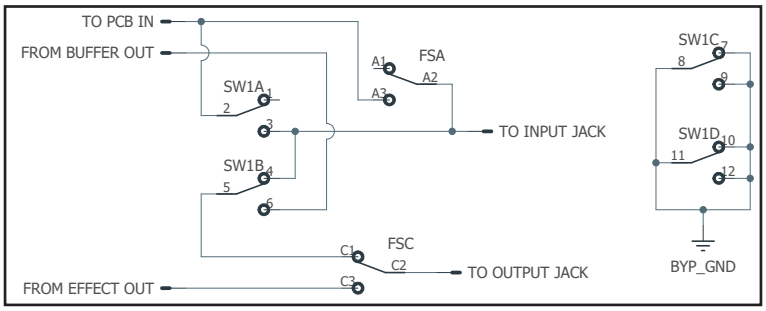


SCHEMATIC (POWER AND BUFFER SWITCH)

Power supply



True bypass / buffer switch

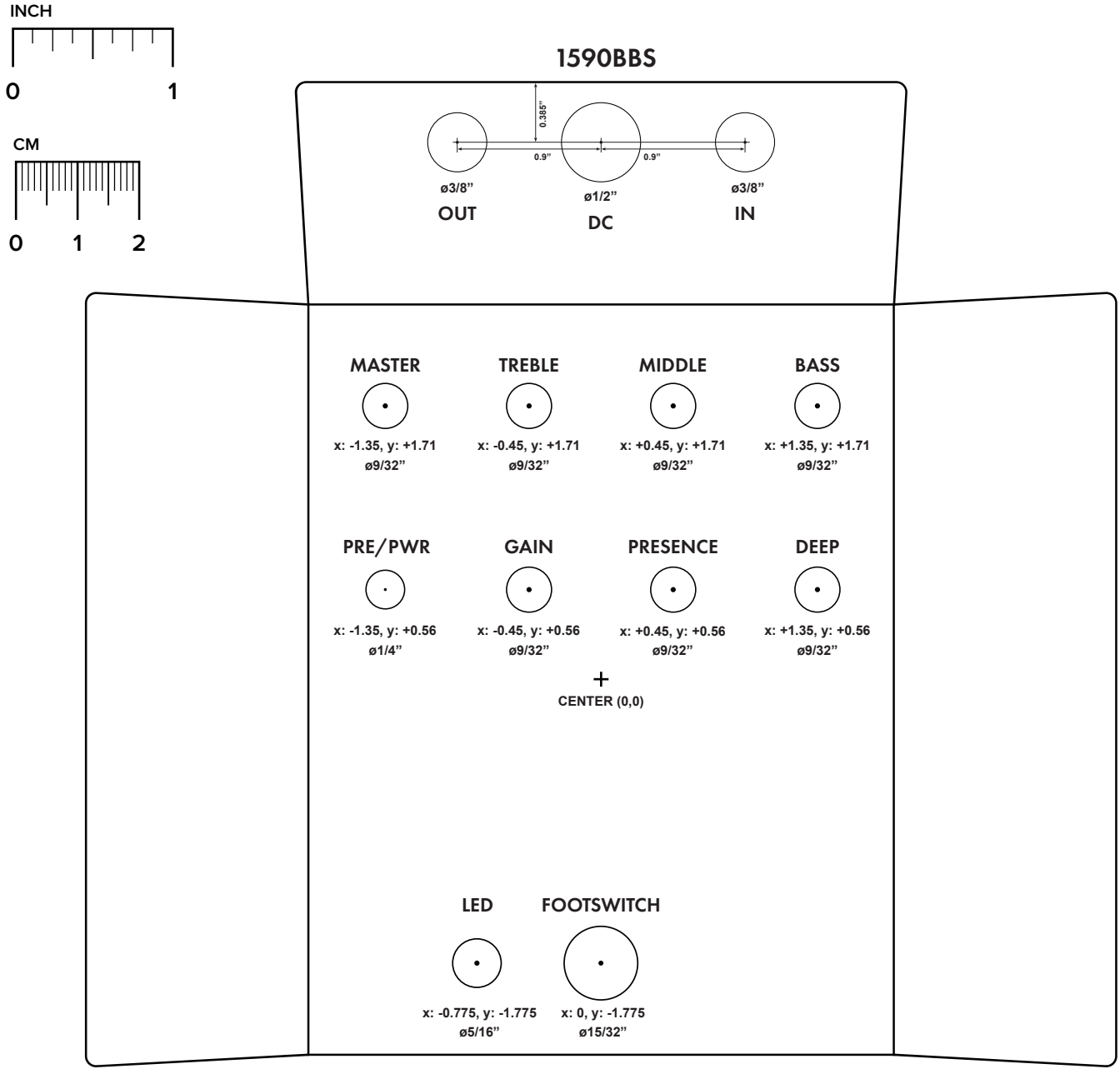


DRILL TEMPLATE

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.

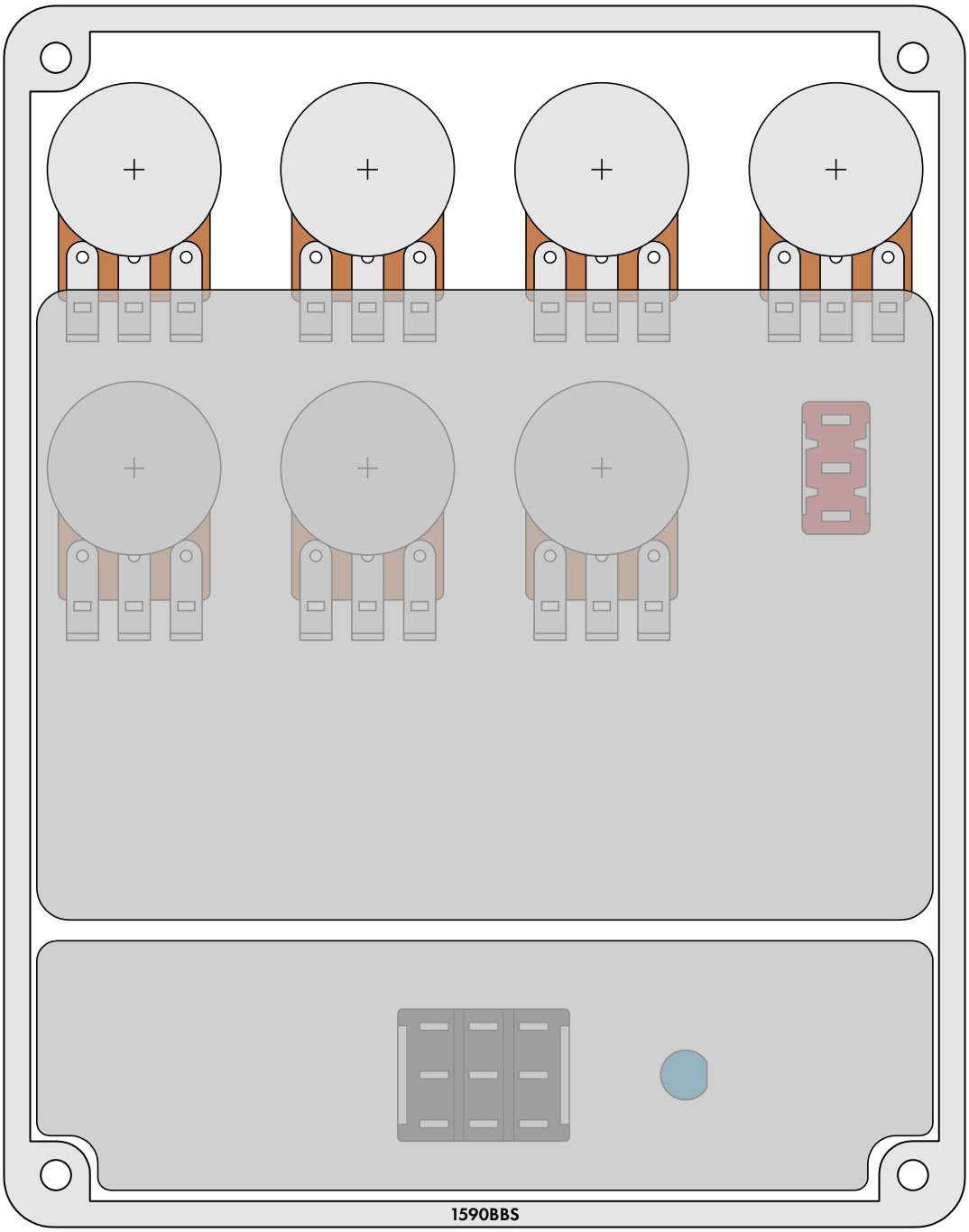
Ensure that this template is printed at 100% or "Actual Size". You can double-check this by measuring the scale on the printed page.

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.

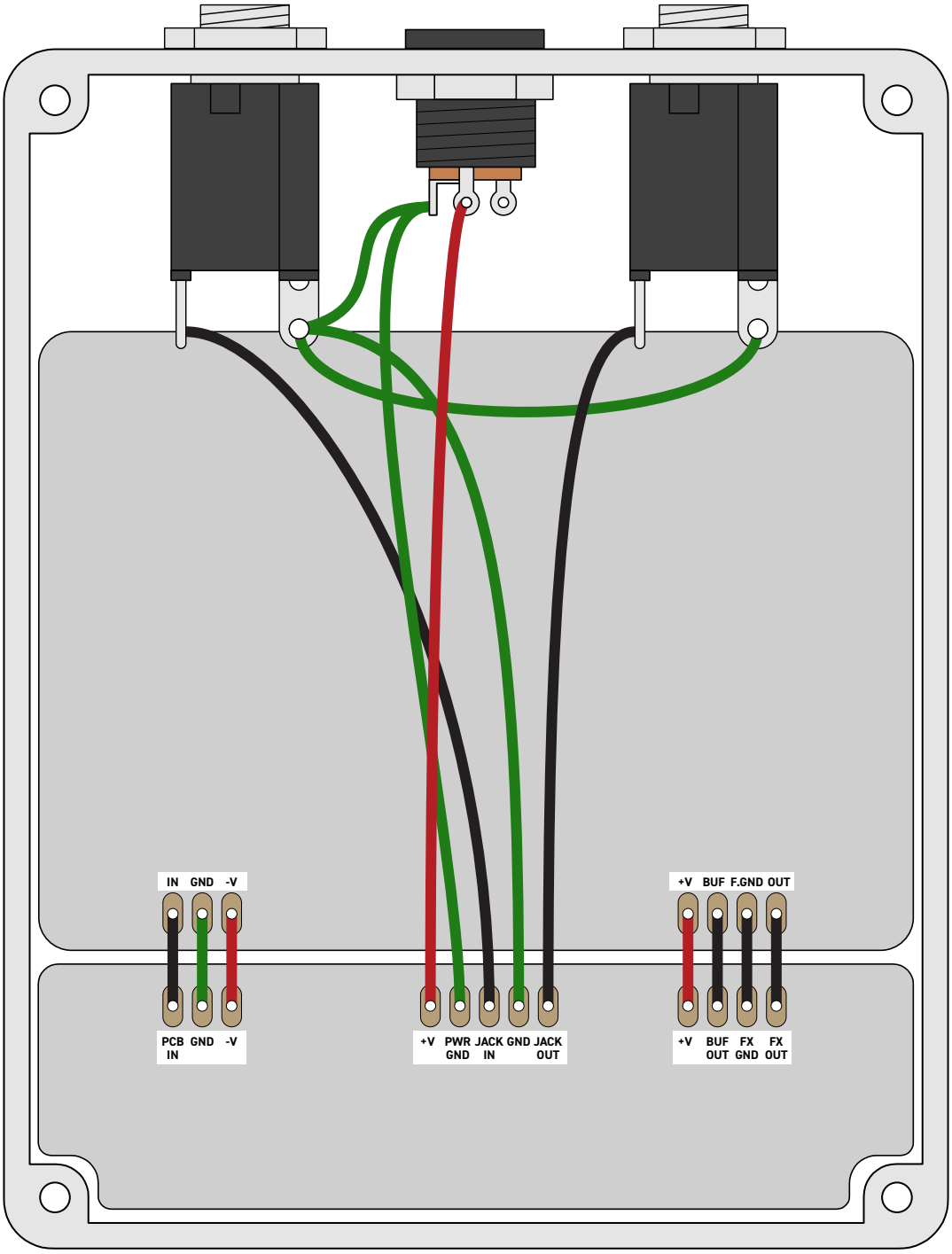


ENCLOSURE LAYOUT

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

1.0.3 (2022-08-15)
Corrected drill template which had a few x-values listed incorrectly. (The physical positioning of the drill holes was correct.)

1.0.2 (2022-07-28)
Corrected wiring diagram, which previously showed two wires omitted on the switch PCB.

1.0.1 (2022-06-06)
Added note about enclosure size.

1.0.0 (2022-06-03)
Initial release.