

PROJECT NAME

VH DRIVE CHANNEL



BASED ON

Ampeg® VH-140C Preamp

BUILD DIFFICULTY

■■■■□ Advanced

EFFECT TYPE

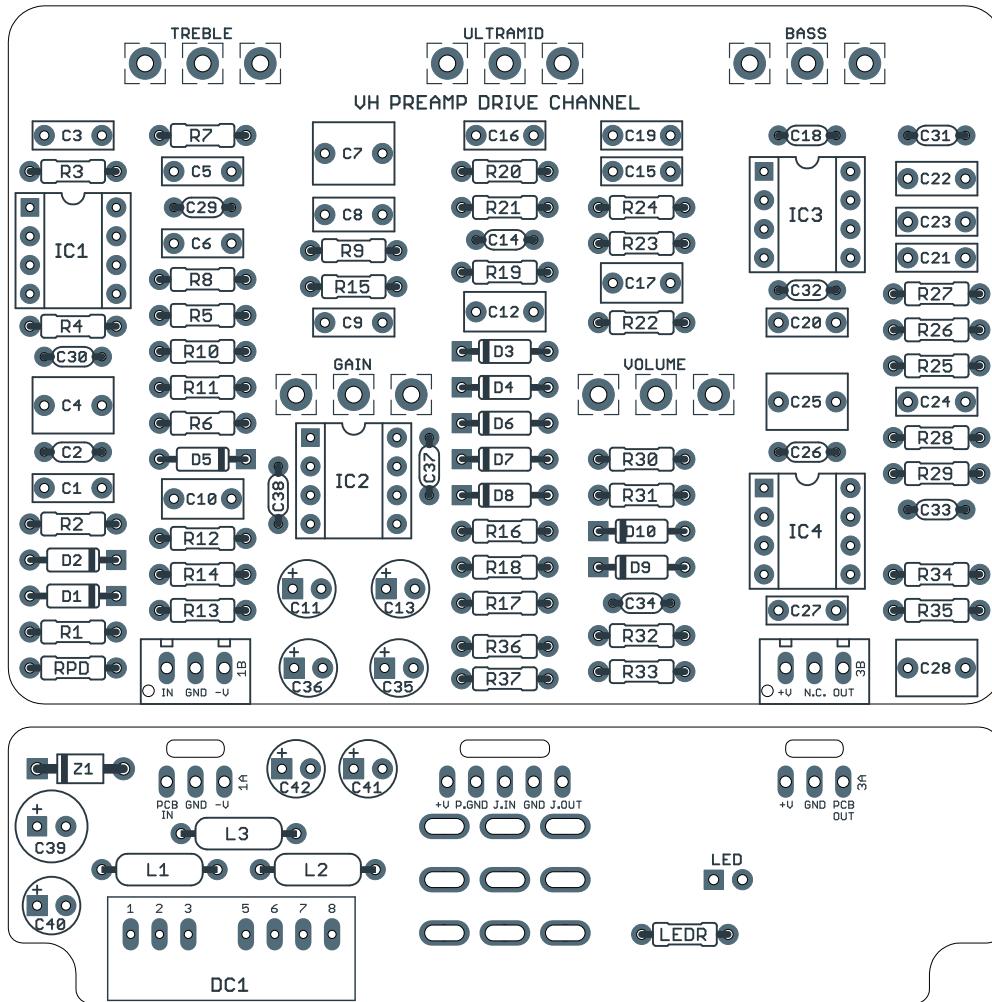
Preamp & high-gain distortion

DOCUMENT VERSION

1.0.1 (2022-06-06)

PROJECT SUMMARY

A pedal recreation of the drive channel of the legendary Ampeg® VH-140C amplifier, a favorite of hardcore and metal bands throughout the 1990s.



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

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INTRODUCTION

The VH Drive Channel is an adaptation of the drive channel of the Ampeg VH-140C amplifier, a classic solid-state amp that provided the signature sound of many death metal and hardcore bands throughout the 1990s.

The original amplifier also had a clean channel and a stereo chorus circuit, but the drive channel is where it gets its character. The VH Drive Channel isolates just that one channel, but it's nevertheless an exact adaptation that runs on the same voltage as the original preamp.

Some interesting history: The drive circuit of the VH-140C was granted a patent when it first appeared in 1989 (patent [#US5032796A](#), "Solid state amplifier simulating vacuum tube distortion characteristics").

This patent was in place for 20 years, which means that up until 2009, the gain stage (consisting of an op-amp, two back-to-back zener diodes, and the particular arrangement of resistors and capacitors) could not be used in any commercial projects by other companies.

This is one of very few patents granted for a guitar audio circuit that was in effect into the 2000's. Today, patent infringement is not even a remote risk among the DIY guitar pedal community, but this was a notable exception for a long time.

The VH Drive Channel is a direct recreation of the drive channel of the original amplifier, running at the same voltage as the original unit. Like our other preamps, it can be used as a standalone drive pedal, but it's optimized to drive a power amp directly.

USAGE

The VH Drive Channel has six controls:

- **Gain** controls the amount of gain from the two op-amp clipping stages.
- **Ultra Mid** is a variable bridged-T filter. At the low end of the rotation, it provides a steep mid-scoop, and midrange is added back in as it is turned up.
- **Treble** is an active treble control that comes after the Ultra Mid control.
- **Bass** is an active bass control that comes after the Ultra Mid and Treble controls.
- **Volume** sets the overall output of the preamp.

CIRCUIT DESIGN NOTES

Power supply design

Like most solid-state preamplifiers of the era, the VH-140C operated on a bipolar +/-15V supply. This voltage can't be supplied by an external adapter, and the current draw of the circuit is too high to use a charge pump.

When developing the [Lab Series L5 Preamp](#), which uses the same supply voltage, we adapted a supply scheme from Alesis rack units in the early 1990s that involved a 9VAC adapter and an AC voltage tripler. This was then rectified to bipolar +/-19V DC and regulated down to 15V on each rail.

This solution used cheap and readily-available parts, and it has worked very well for several years since the L5 Preamp was first developed. But the power adapter requirement has always been the major flaw. A 9VAC adapter will destroy most other pedals if it's plugged in, and if you own one, there's an infinitely higher chance that it'll be mistaken for a 9VDC adapter and plugged into the wrong pedal at some point.

Because of this, when developing the [IVP Preamp](#) project in 2021, we set out to find a reliable way to supply +/-15V from a standard DC adapter. Fortunately, there are a few more options available today than there were in 2015 when the L5 Preamp was originally developed, and a high-quality DC-DC converter module will give us exactly what we need. They're not cheap (USD\$9-15 each), but once you account for the fact that you no longer need a specialized power adapter, the total cost is about the same. We have begun using these DC converters in all of our preamp projects going forward.

See the build notes on page 8 for more information on the specific DC-DC converters that are recommended for use in this project.

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	11k	Metal film resistor, 1/4W	
R2	270k	Metal film resistor, 1/4W	
R3	7k5	Metal film resistor, 1/4W	
R4	1k5	Metal film resistor, 1/4W	
R5	1k5	Metal film resistor, 1/4W	
R6	100k	Metal film resistor, 1/4W	
R7	100R	Metal film resistor, 1/4W	
R8	1k5	Metal film resistor, 1/4W	
R9	47R	Metal film resistor, 1/4W	
R10	1k5	Metal film resistor, 1/4W	
R11	6k8	Metal film resistor, 1/4W	
R12	4k7	Metal film resistor, 1/4W	
R13	10k	Metal film resistor, 1/4W	
R14	10k	Metal film resistor, 1/4W	
R15	10k	Metal film resistor, 1/4W	
R16	100k	Metal film resistor, 1/4W	
R17	10k	Metal film resistor, 1/4W	
R18	10k	Metal film resistor, 1/4W	
R19	10k	Metal film resistor, 1/4W	
R20	47k	Metal film resistor, 1/4W	
R21	47k	Metal film resistor, 1/4W	
R22	100k	Metal film resistor, 1/4W	
R23	47k	Metal film resistor, 1/4W	
R24	47k	Metal film resistor, 1/4W	
R25	270k	Metal film resistor, 1/4W	
R26	2M2	Metal film resistor, 1/4W	
R27	33k	Metal film resistor, 1/4W	
R28	33k	Metal film resistor, 1/4W	
R29	270k	Metal film resistor, 1/4W	
R30	47k	Metal film resistor, 1/4W	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
R31	16.5k	Metal film resistor, 1/4W	Can also use 15k or 18k with no real difference.
R32	4k7	Metal film resistor, 1/4W	
R33	4k7	Metal film resistor, 1/4W	
R34	100k	Metal film resistor, 1/4W	
R35	100k	Metal film resistor, 1/4W	
R36	47R	Metal film resistor, 1/4W	
R37	47R	Metal film resistor, 1/4W	
RPD	2M2	Metal film resistor, 1/4W	
LEDR	4k7	Metal film resistor, 1/4W	
C1	47n	Film capacitor, 7.2 x 2.5mm	
C2	100pF	MLCC capacitor, NP0/C0G	
C3	1n	Film capacitor, 7.2 x 2.5mm	
C4	2.2uF	Film capacitor, 7.2 x 5mm	
C5	47n	Film capacitor, 7.2 x 2.5mm	
C6	47n	Film capacitor, 7.2 x 2.5mm	
C7	3.3uF	Film capacitor, 7.2 x 5.5mm	
C8	220n	Film capacitor, 7.2 x 2.5mm	
C9	1n	Film capacitor, 7.2 x 2.5mm	
C10	1uF	Film capacitor, 7.2 x 3.5mm	
C11	22uF	Electrolytic capacitor, 5mm	
C12	1uF	Film capacitor, 7.2 x 3.5mm	
C13	22uF	Electrolytic capacitor, 5mm	
C14	560pF	MLCC capacitor, NP0/C0G	
C15	4n7	Film capacitor, 7.2 x 2.5mm	
C16	22n	Film capacitor, 7.2 x 2.5mm	
C17	1uF	Film capacitor, 7.2 x 3.5mm	
C18	470pF	MLCC capacitor, NP0/C0G	
C19	2n2	Film capacitor, 7.2 x 2.5mm	
C20	47n	Film capacitor, 7.2 x 2.5mm	
C21	1n	Film capacitor, 7.2 x 2.5mm	
C22	220n	Film capacitor, 7.2 x 2.5mm	
C23	4n7	Film capacitor, 7.2 x 2.5mm	
C24	100n	Film capacitor, 7.2 x 2.5mm	
C25	2.2uF	Film capacitor, 7.2 x 5mm	
C26	47pF	MLCC capacitor, NP0/C0G	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C27	100n	Film capacitor, 7.2 x 2.5mm	
C28	2.2uF	Film capacitor, 7.2 x 5mm	
C29	100n	MLCC capacitor, X7R	
C30	100n	MLCC capacitor, X7R	
C31	100n	MLCC capacitor, X7R	
C32	100n	MLCC capacitor, X7R	
C33	100n	MLCC capacitor, X7R	
C34	100n	MLCC capacitor, X7R	
C35	10uF	Electrolytic capacitor, 5mm	
C36	10uF	Electrolytic capacitor, 5mm	
C37	100n	MLCC capacitor, X7R	
C38	100n	MLCC capacitor, X7R	
C39	100uF	Electrolytic capacitor, 6.3mm	
C40	47uF	Electrolytic capacitor, 5mm	
C41	10uF	Electrolytic capacitor, 5mm	
C42	10uF	Electrolytic capacitor, 5mm	
Z1	1N4743A	Zener diode, 13V, DO-41	
D1	1N5235B	Zener diode, 6.8V, DO-35	
D2	1N5235B	Zener diode, 6.8V, DO-35	
D3	1N5235B	Zener diode, 6.8V, DO-35	
D4	1N5226B	Zener diode, 3.3V, DO-35	
D5	1N914	Fast-switching diode, DO-35	
D6	1N5226B	Zener diode, 3.3V, DO-35	
D7	1N5235B	Zener diode, 6.8V, DO-35	
D8	1N914	Fast-switching diode, DO-35	
D9	1N914	Fast-switching diode, DO-35	
D10	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
DC1	TEC 3-0923	DC-DC converter, +9V to +/-15V	See build notes for alternatives.
IC1	RC4558P	Operational amplifier, DIP8	
IC1-S	DIP-8 socket	IC socket, DIP-8	
IC2	RC4558P	Operational amplifier, DIP8	
IC2-S	DIP-8 socket	IC socket, DIP-8	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
IC3	RC4558P	Operational amplifier, DIP8	
IC3-S	DIP-8 socket	IC socket, DIP-8	
IC4	RC4558P	Operational amplifier, DIP8	
IC4-S	DIP-8 socket	IC socket, DIP-8	
GAIN	100kC	16mm right-angle PCB mount pot	
BASS	250kB	16mm right-angle PCB mount pot	
ULTRAMID	50kB	16mm right-angle PCB mount pot	
TREBLE	50kB	16mm right-angle PCB mount pot	
VOLUME	10kA	16mm right-angle PCB mount pot	
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	

BUILD NOTES

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 2-0923	495-TEC2-0923	4.5-13.2V	Preferred option. More sources on Octopart .
CUI	PQMC3-D12-D15-S	490-PQMC3-D12-D15-S	9-18V	
XP Power	IZ1215S	209-IZ1215S	9-18V	
Recom	RS-1215D	919-RS-1215D	9-18V	
Recom	RS3-1215D	919-RS3-1215D	9-18V	
Mornsun	WRA1215S-3WR2	N/A	9-18V	NAC Semi: https://aionfx.com/link/mornsun/

The Traco TEC 2-0923 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 TEC 3-0923 can also be used if you can't find the 2-0923. It has higher current handling, more than necessary for this circuit, and as a result it is more expensive, but it's otherwise identical.

The other brands 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 regulate 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 2-0923 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. If you need more than one, it quickly becomes much more cost-effective than the other options.

BUILD NOTES, CONT.

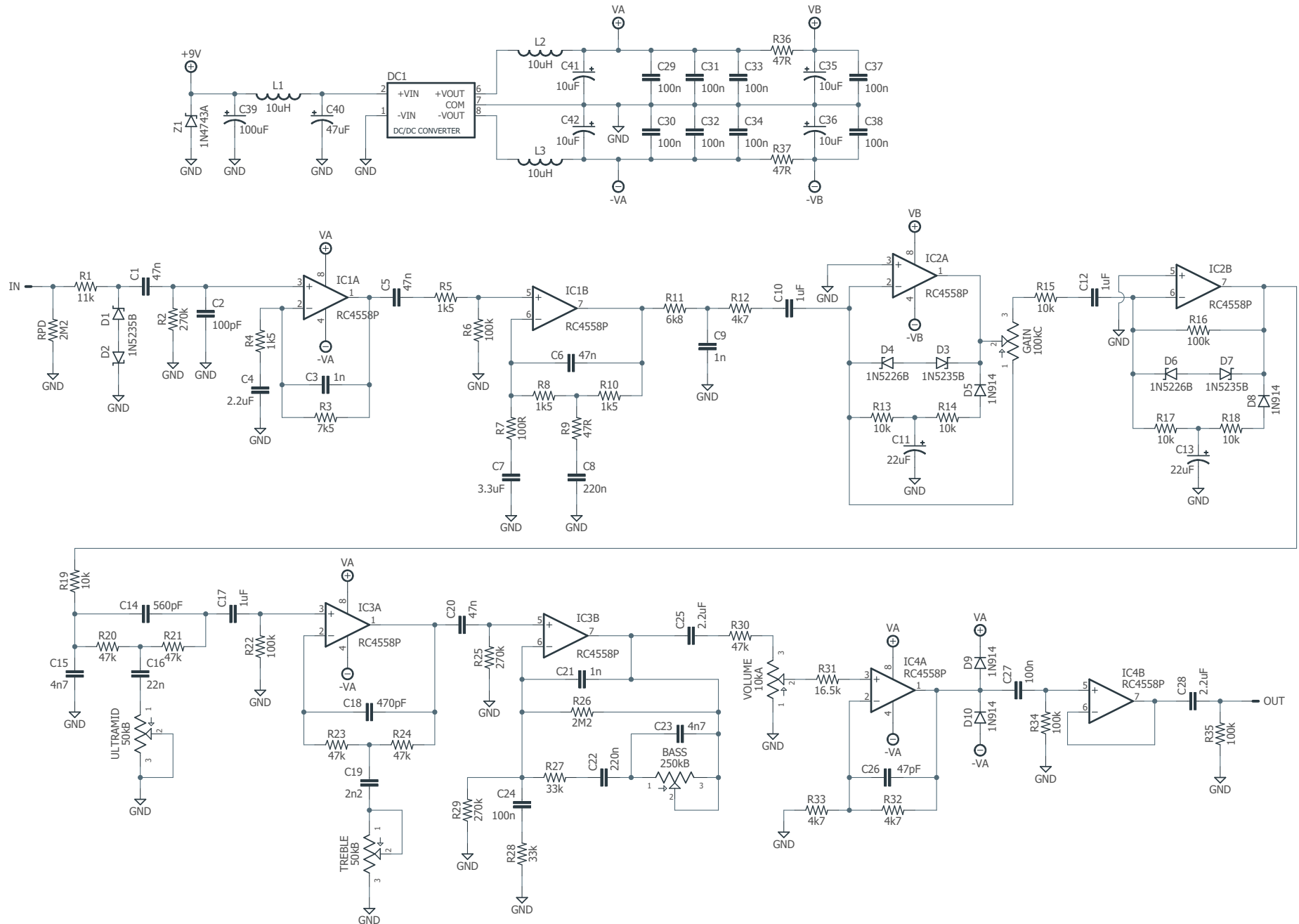
Enclosure size

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

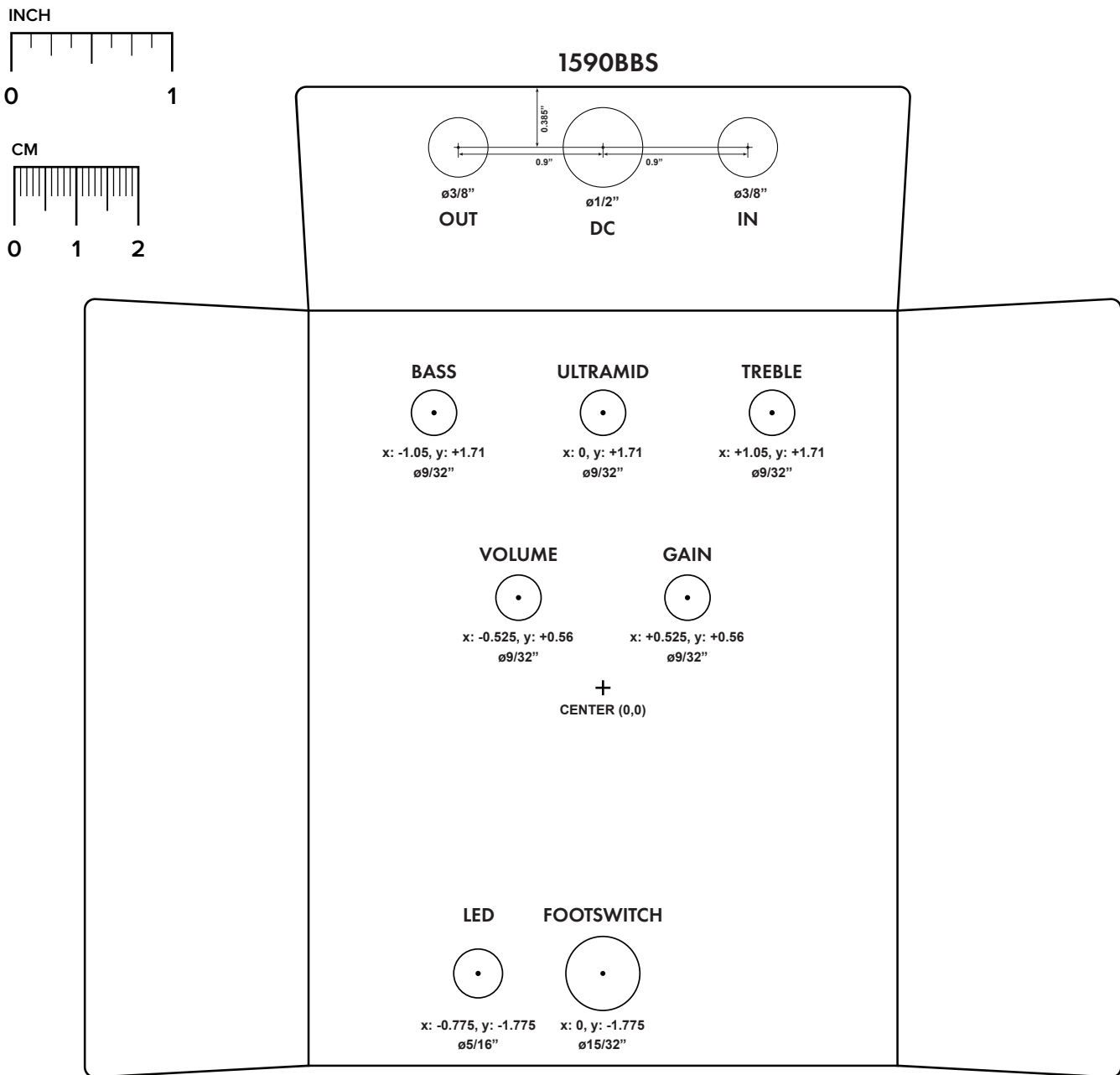


DRILL TEMPLATE

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.

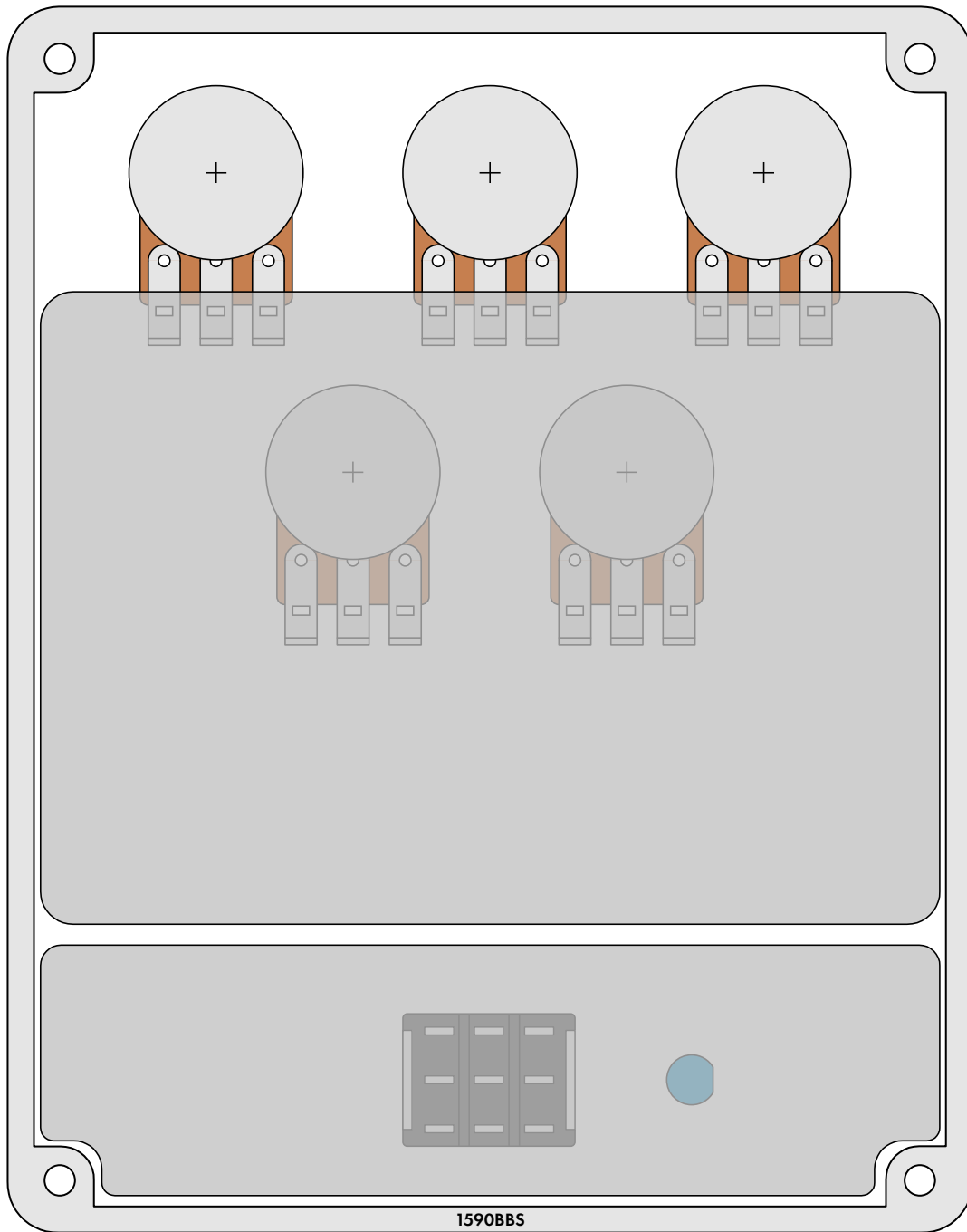
Ensure that this template is printed at 100% or "Actual Size". You can double-check this by measuring the scale on the printed page.

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.

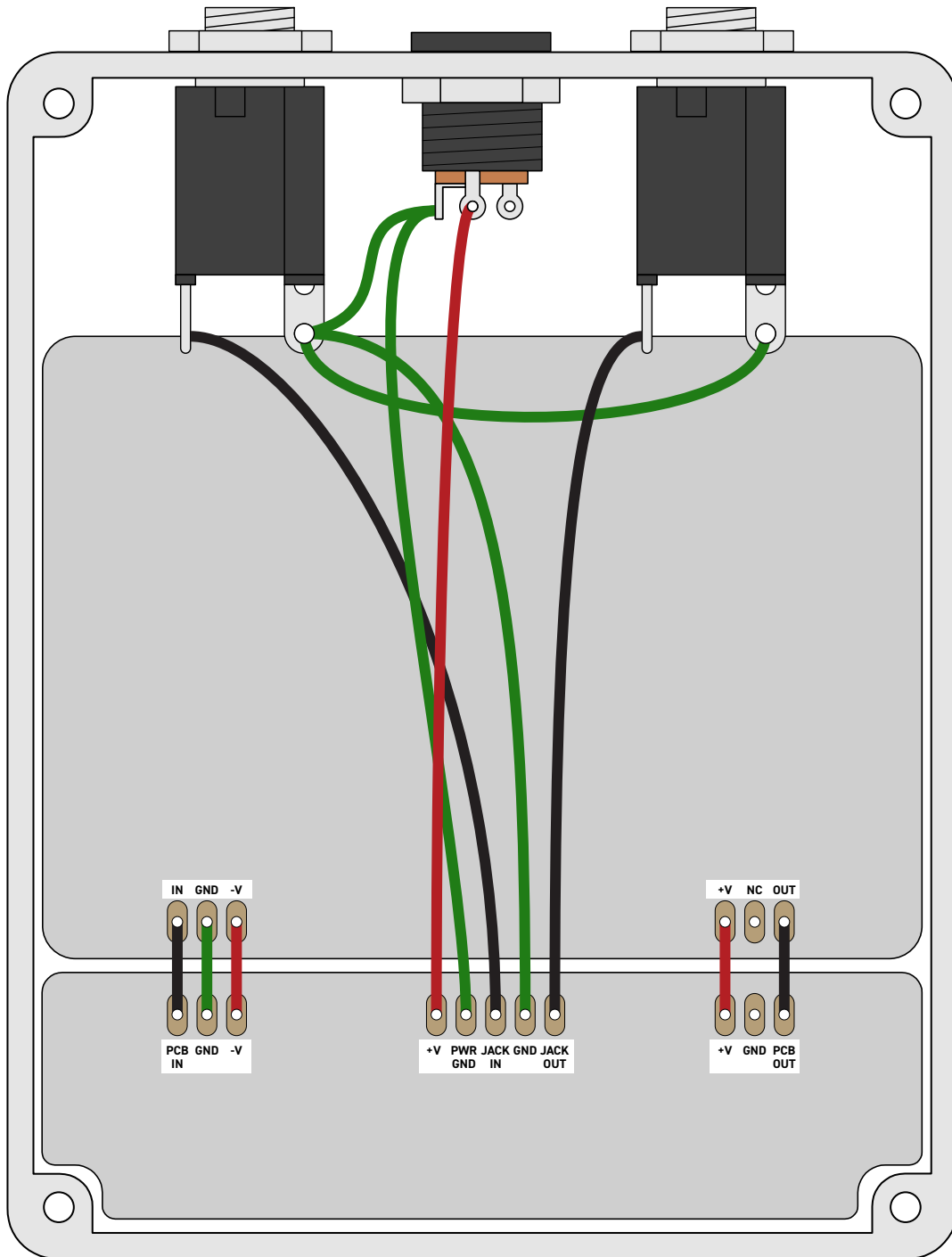


ENCLOSURE LAYOUT

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

1.0.1 (2022-06-06)

Added note about enclosure size.

1.0.0 (2022-06-03)

Initial release.