

PROJECT NAME

BETA PREAMP



BASED ON

Sunn® Beta Lead / Bass

BUILD DIFFICULTY

■■■■□ Advanced

EFFECT TYPE

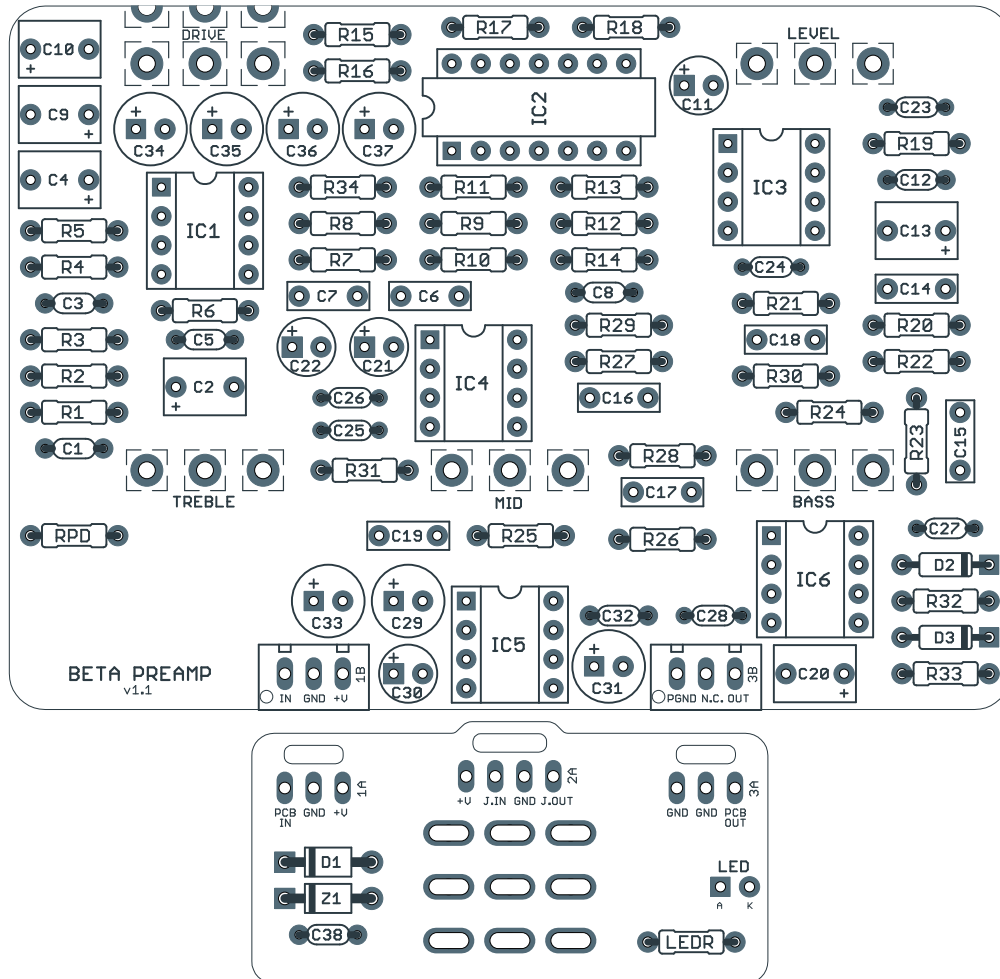
Preamp & high-gain drive

DOCUMENT VERSION

1.1.0 (2022-09-08)

PROJECT SUMMARY

A single-channel pedal recreation of the Sunn® Beta Lead and Beta Bass amplifiers, unique in using overdriven CMOS stages for their drive tone.



Actual size is 3.44" x 2.42" (main board) and 1.77" x 0.87" (bypass board).

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INTRODUCTION

The Beta Preamp is based on the Sunn® Beta Bass and Beta Lead amplifiers, first released in 1979. The guitar and bass models were identical except for a handful value changes that made the EQ more suitable for the frequency range of each instrument.

The Beta amps were unique in that they used overdriven CMOS gain stages for their drive tone. This had been previously pioneered by Craig Anderton for his [Tube Sound Fuzz](#) circuit in 1977, and Electro-Harmonix released their [Hot Tubes](#) pedal in 1978 with a similar topology, but the Beta was the first time this method had been used in an amplifier.

The Beta Preamp is a single-channel adaptation of the original amplifier. It can be built in either Bass or Lead configurations by swapping out a few components. While it can be used as a drive pedal, it works best as a true preamp driving a power amp directly.

The original Beta amplifiers ran on +/-15V, but in this adaptation the supply voltage has been reduced to +/-9V so it can be powered conveniently by a standard 9V supply. In the original amp, the drive tone is generated by CMOS hex inverters run on a reduced 8V single-supply, so the heart of the distortion tone remains exactly like in the original amplifier. All of the other active components will perform the same on the slightly reduced voltage since there is a great deal of headroom either way.

USAGE

The Beta Preamp has five controls:

- **Drive** controls the amount of gain going into the overdriven CMOS stages.
- **Treble, Mid** and **Bass** form a 3-band active tone stack. The Lead and Bass amplifiers have different resistor & capacitor values in this section to optimize the tone stack for the frequencies of the namesake instruments.
- **Level** sets the overall output of the preamp.

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	47k	Metal film resistor, 1/4W	
R2	47k	Metal film resistor, 1/4W	
R3	2M2	Metal film resistor, 1/4W	
R4	100k	Metal film resistor, 1/4W	
R5	120k	Metal film resistor, 1/4W	
R6	1M	Metal film resistor, 1/4W	
R7	100k	Metal film resistor, 1/4W	
R8	47k	Metal film resistor, 1/4W	
R9	330k	Metal film resistor, 1/4W	
R10	22k	Metal film resistor, 1/4W	
R11	68k	Metal film resistor, 1/4W	
R12	22k	Metal film resistor, 1/4W	
R13	68k	Metal film resistor, 1/4W	
R14	10k	Metal film resistor, 1/4W	
R15	100k	Metal film resistor, 1/4W	
R16	100k	Metal film resistor, 1/4W	
R17	470k	Metal film resistor, 1/4W	
R18	100k	Metal film resistor, 1/4W	
R19	120k	Metal film resistor, 1/4W	
R20	15k	Metal film resistor, 1/4W	
R21	4k7	Metal film resistor, 1/4W	
R22	10k	Metal film resistor, 1/4W	Lead value. Use 15k for Bass version.
R23	12k	Metal film resistor, 1/4W	Lead value. Use 27k for Bass version.
R24	22k	Metal film resistor, 1/4W	Lead value. Use 12k for Bass version.
R25	100k	Metal film resistor, 1/4W	
R26	4k7	Metal film resistor, 1/4W	
R27	91k	Metal film resistor, 1/4W	Lead value. Use 180k for Bass version.
R28	12k	Metal film resistor, 1/4W	
R29	8k2	Metal film resistor, 1/4W	
R30	12k	Metal film resistor, 1/4W	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
R31	3k3	Metal film resistor, 1/4W	
R32	220k	Metal film resistor, 1/4W	
R33	150R	Metal film resistor, 1/4W	
R34	100R	Metal film resistor, 1/4W	
RPD	2M2	Metal film resistor, 1/4W	Input pulldown resistor. Can be as low as 1M.
LEDR	4k7	Metal film resistor, 1/4W	LED current-limiting resistor. Adjust value to change LED brightness.
C1	200pF	MLCC capacitor, NP0/C0G	Can also use 220pF.
C2	2.2uF	Film capacitor, 7.2 x 5mm	
C3	33pF	MLCC capacitor, NP0/C0G	
C4	2.2uF	Film capacitor, 7.2 x 5mm	
C5	5pF	MLCC capacitor, NP0/C0G	
C6	47n	Film capacitor, 7.2 x 2.5mm	
C7	2n2	Film capacitor, 7.2 x 2.5mm	
C8	82pF	MLCC capacitor, NP0/C0G	
C9	2.2uF	Film capacitor, 7.2 x 5mm	
C10	2.2uF	Film capacitor, 7.2 x 5mm	
C11	10uF	Electrolytic capacitor, 5mm	
C12	33pF	MLCC capacitor, NP0/C0G	
C13	2.2uF	Film capacitor, 7.2 x 5mm	
C14	22n	Film capacitor, 7.2 x 2.5mm	Lead value. Use 56n for Bass version.
C15	100n	Film capacitor, 7.2 x 2.5mm	
C16	10n	Film capacitor, 7.2 x 2.5mm	
C17	10n	Film capacitor, 7.2 x 2.5mm	
C18	4n7	Film capacitor, 7.2 x 2.5mm	Lead value. Use 10n for Bass version.
C19	27n	Film capacitor, 7.2 x 2.5mm	Lead value. Use 47n for Bass version.
C20	2.2uF	Film capacitor, 7.2 x 5mm	
C21	10uF	Electrolytic capacitor, 5mm	
C22	10uF	Electrolytic capacitor, 5mm	
C23	100n	MLCC capacitor, X7R	
C24	100n	MLCC capacitor, X7R	
C25	100n	MLCC capacitor, X7R	
C26	100n	MLCC capacitor, X7R	
C27	100n	MLCC capacitor, X7R	
C28	100n	MLCC capacitor, X7R	
C29	100uF	Electrolytic capacitor, 6.3mm	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C30	10uF	Electrolytic capacitor, 5mm	
C31	100uF	Electrolytic capacitor, 6.3mm	
C32	470n	MLCC capacitor, X7R	
C33	100uF	Electrolytic capacitor, 6.3mm	
C34	220uF	Electrolytic capacitor, 6.3mm	
C35	220uF	Electrolytic capacitor, 6.3mm	
C36	220uF	Electrolytic capacitor, 6.3mm	
C37	220uF	Electrolytic capacitor, 6.3mm	
C38	100n	MLCC capacitor, X7R	
Z1	1N4742A	Zener diode, 12V, DO-41	
D1	1N5817	Schottky diode, DO-41	
D2	1N458A	Rectifier diode, DO-35	Can also use 1N4001.
D3	1N458A	Rectifier diode, DO-35	Can also use 1N4001.
IC1	RC4558P	Operational amplifier, DIP8	
IC1-S	DIP-8 socket	IC socket, DIP-8	
IC2	CD4069UBE	CMOS hex inverter, 6 circuit, DIP14	
IC2-S	DIP14 socket	IC socket, DIP-14	
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	
IC5	LT1054CP	Operational amplifier, DIP8	
IC5-S	DIP-8 socket	IC socket, DIP-8	
IC6	RC4558P	Operational amplifier, DIP8	
IC6-S	DIP-8 socket	IC socket, DIP-8	
DRIVE	1MB dual	16mm dual pot, right angle	
BASS	100kB	16mm right-angle PCB mount pot	
MID	100kB	16mm right-angle PCB mount pot	
TREBLE	100kB	16mm right-angle PCB mount pot	
LEVEL	100kA	16mm right-angle PCB mount pot	Original uses linear taper (B), but audio taper works better.

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	

BUILD NOTES, CONT.

Version 1.0 CMOS supply fix

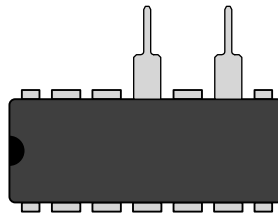
The initial release of the Beta Preamp disabled the unused CMOS stages by tying them to the positive supply, which is typically recommended as best practice. The original two-channel Sunn Beta tied one of the chips to ground and the other to +V, so either way is “correct” per the original unit.

However, in version 1, the gates were tied to VA (the main positive supply) rather than VB (the slightly lower CMOS supply), meaning they were very slightly higher than the chip’s supply voltage. In some cases, this caused the CMOS chip to draw excessive current, and while it didn’t overheat or fail, it would get pretty hot.

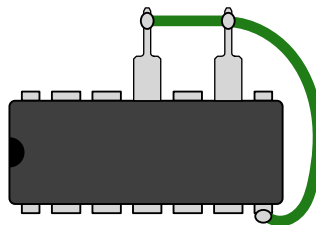
Version 1.1 fixes this by tying the gates to ground. This version began shipping on September 8, 2022 and can be identified by “v1.1” in the bottom left corner, as shown in the diagram on page 1. The first version has no version number.

We recommend doing this fix to any v1.0 builds. It’s very quick and does not require disassembly.

First, remove IC2 (CD4069) from the socket. Bend pins 9 and 11 straight out so that they do not make contact with the socket when it is re-inserted, as shown in the following diagram:



Next, with the IC back in the socket, solder a jumper wire between pins 9 and 11 (you can use a clipped resistor lead for this) and then another wire between that point and any ground pad on the board. The nearest one is pin 7, if you feel comfortable soldering directly to an IC pin and can do it quickly:



Otherwise, the right-most pin of the Mid pot farther down is also grounded and is a much larger target.

Thanks to Brad from [Nerd Knuckle Effects](#) for diagnosing the issue and running noise tests to determine the optimal way to disable the CMOS gates. At max volume & gain with all tone controls at noon, the noise was measured at -36.1dBV when gates were tied to ground and -34.1dBV when tied to VB, so we opted for ground in version 1.1.

BUILD NOTES

Series & parallel operation

While the original Beta Lead and Beta Bass amps each had two channels, the channels were identical with the same internal circuitry and external controls. This would normally only be useful for effectively switching between two presets, except for the unique feature that the channels could be run in parallel and blended together.

We are planning to release a full dual-channel Beta at some point, but in the mean time, you can run two of these single-channel units in parallel using a passive splitter and mixer to get the same sound.

You can also try running two of these units in series, which is a trick mentioned in the owner's manual of the original amplifier that is accomplished by patching the preamp output of "A" into the input of "B".

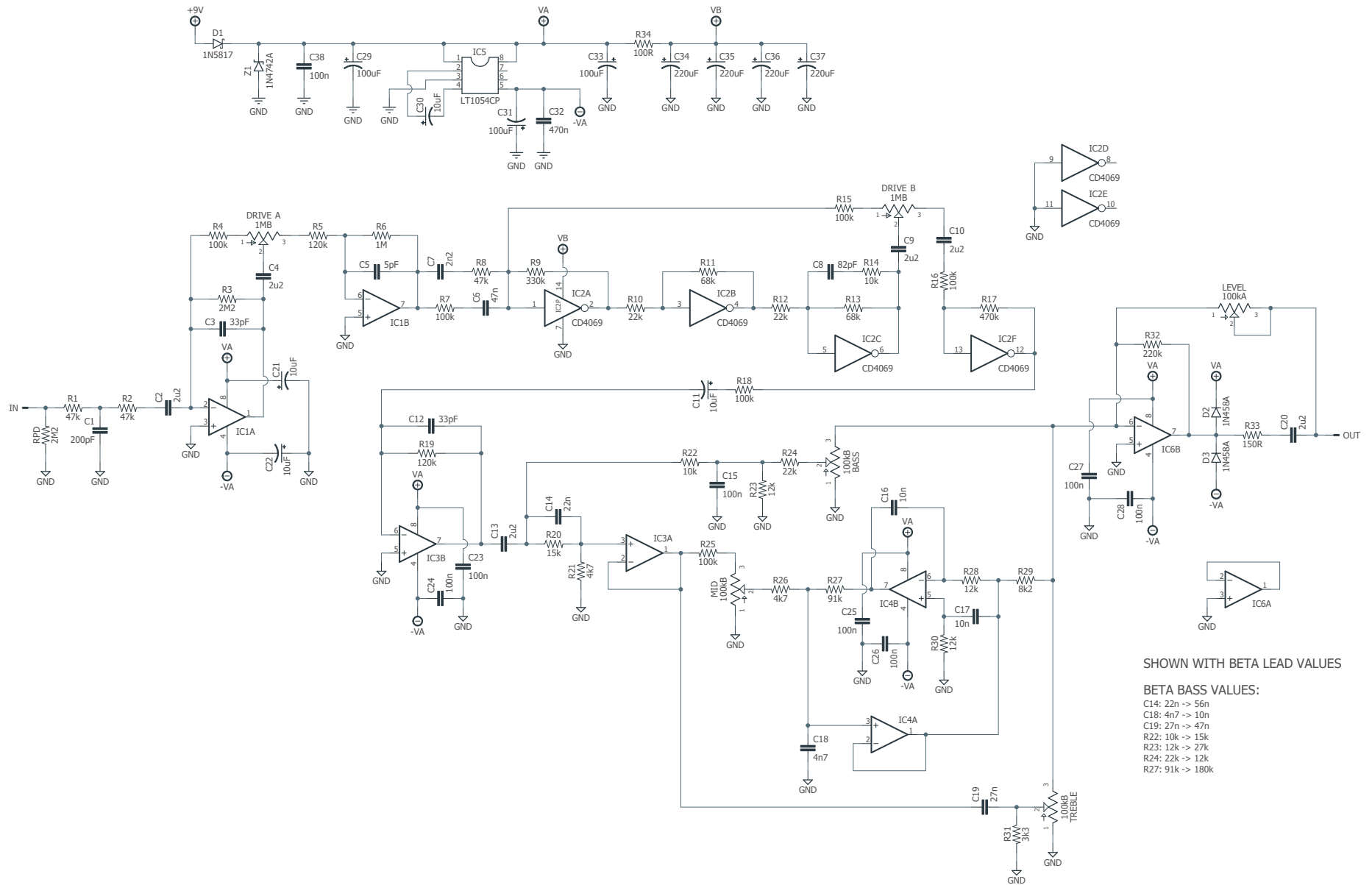
Enclosure size

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!

The 1590C has almost the same dimensions around the base, but due to the increased height and the draft angle of the walls, the dimensions at the bottom of the enclosure are a bit too small and the PCB won't fit.

SCHEMATIC

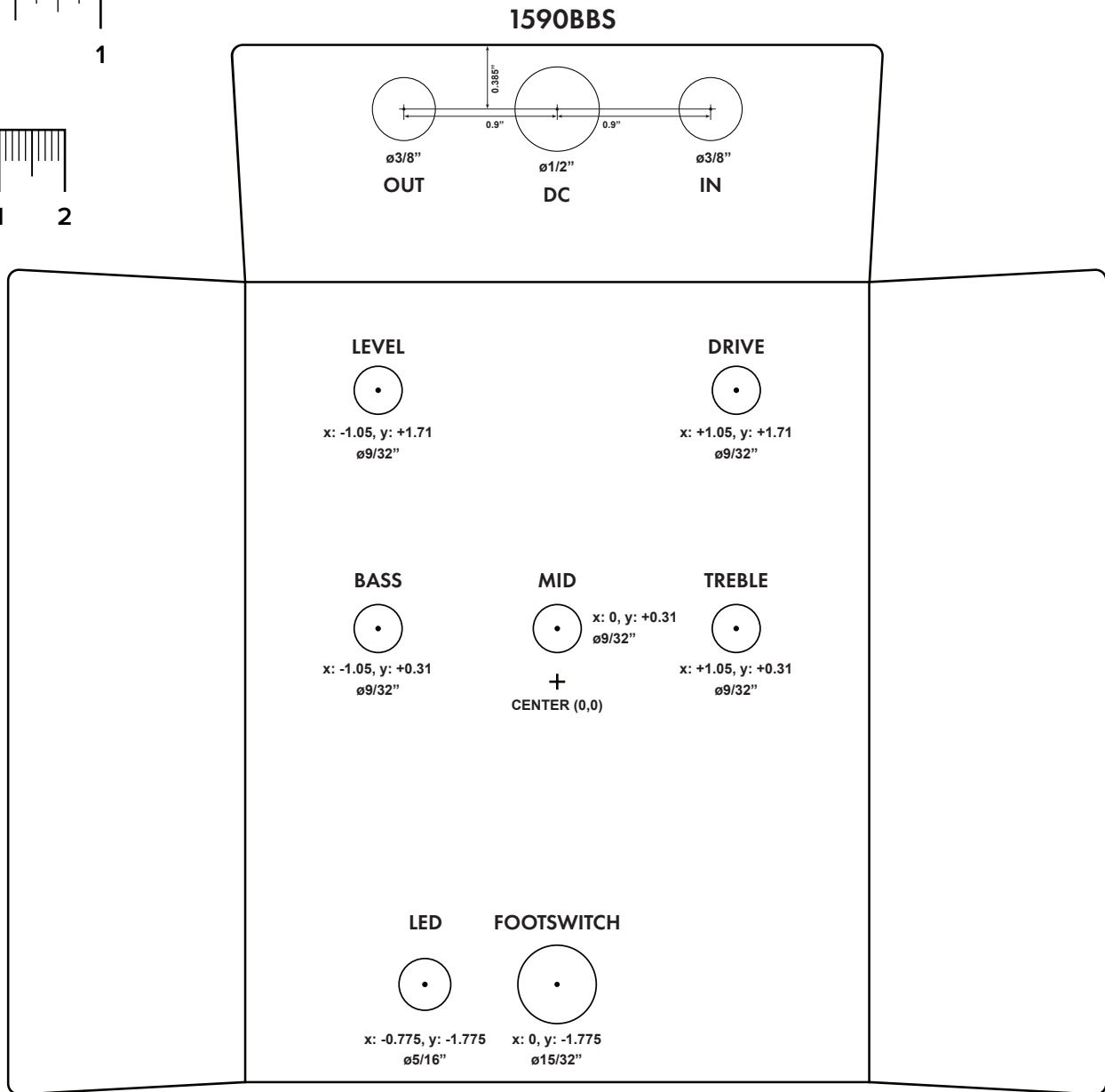
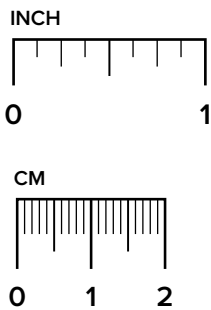


DRILL TEMPLATE

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.

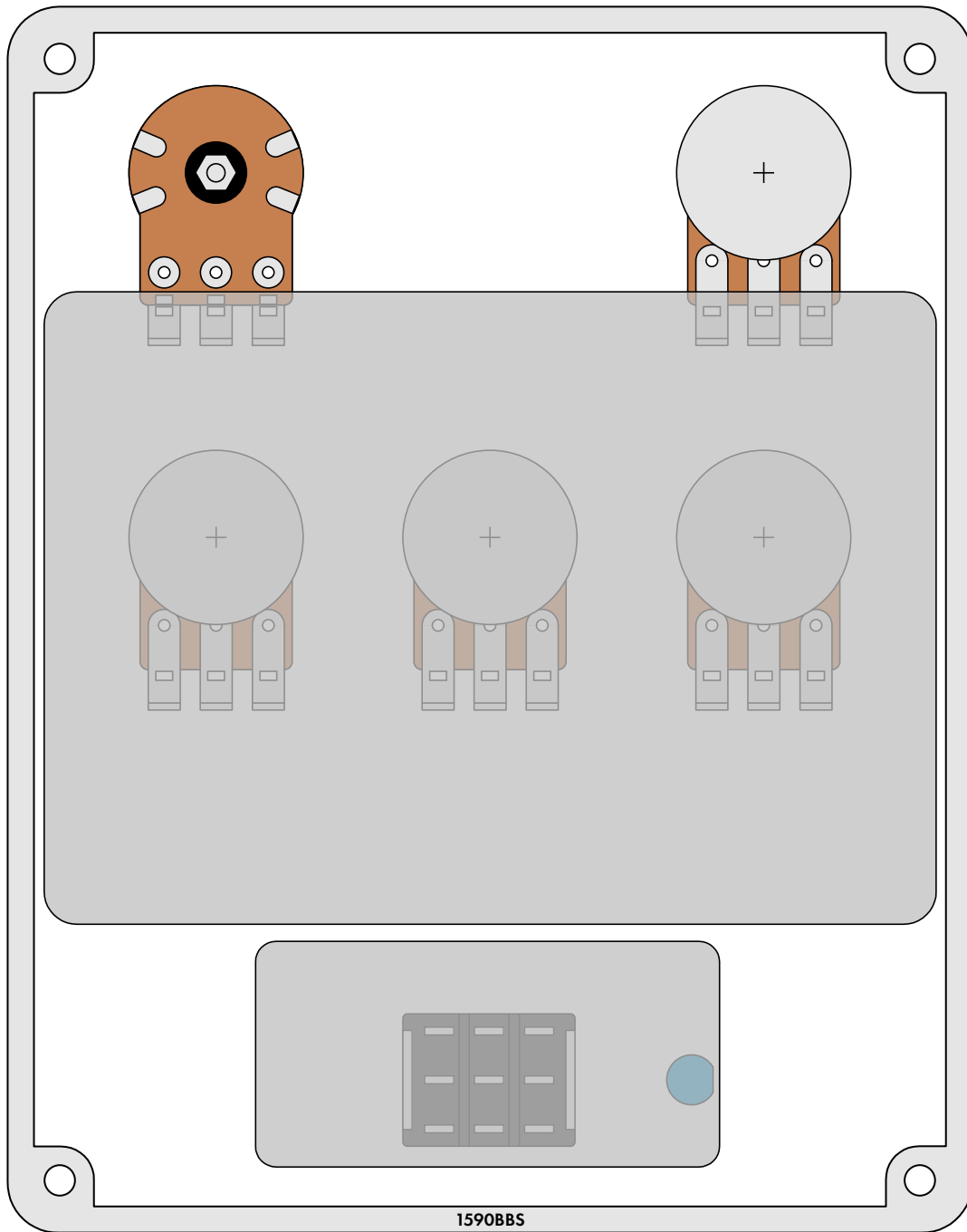
Ensure that this template is printed at 100% or "Actual Size". You can double-check this by measuring the scale on the printed page.

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.

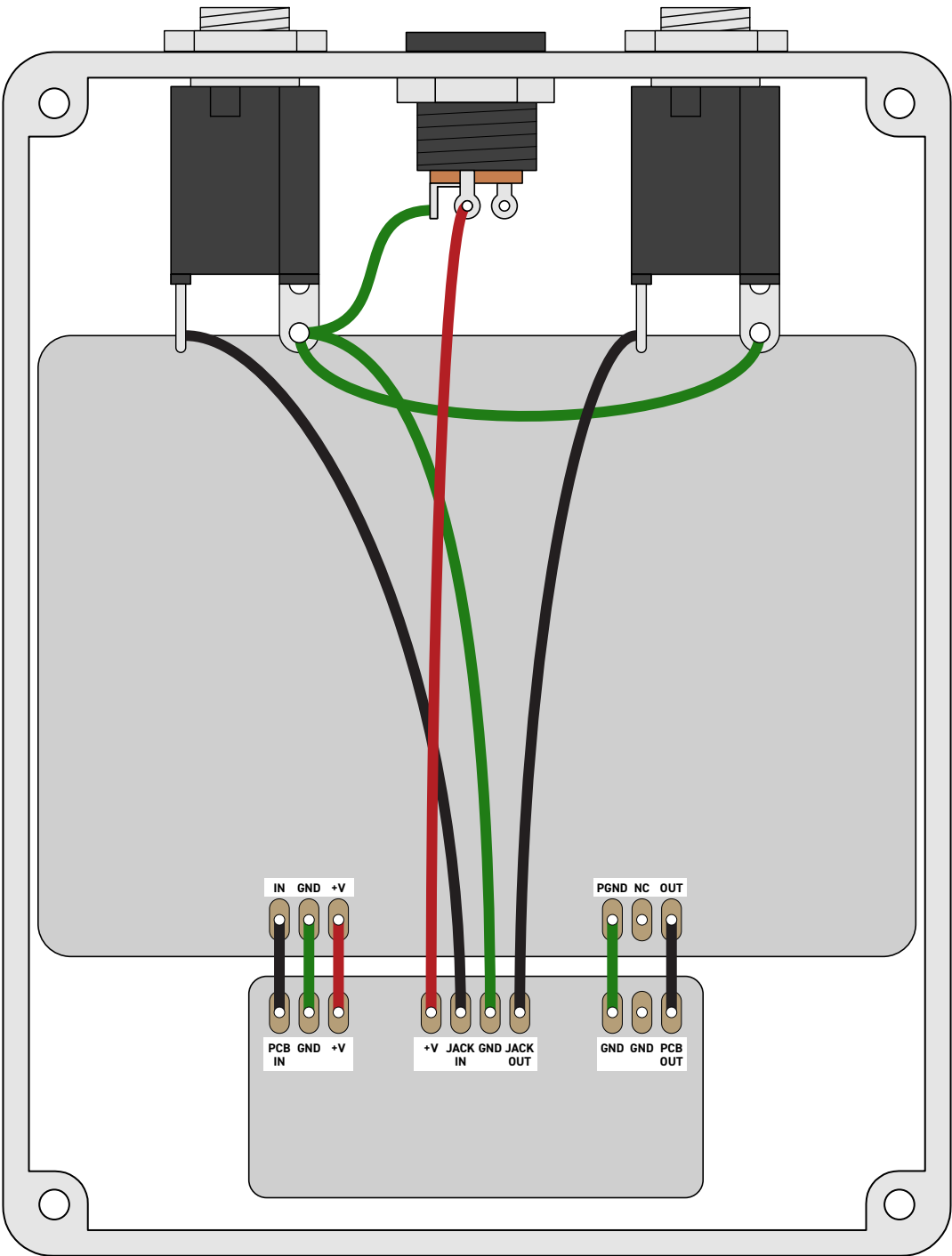


ENCLOSURE LAYOUT

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

1.1.0 (2022-09-08)

Minor layout change, tying the unused CMOS gates to ground instead of +V. See page 7 for instructions on retrofitting this fix to version 1.0.

1.0.1 (2022-06-06)

Added note about enclosure size. Corrected link to Mouser parts spreadsheet.

1.0.0 (2022-06-03)

Initial release.