PROJECT NAME

TS-50 BASS PREAMP

aion DIY GUITAR EFFECTS

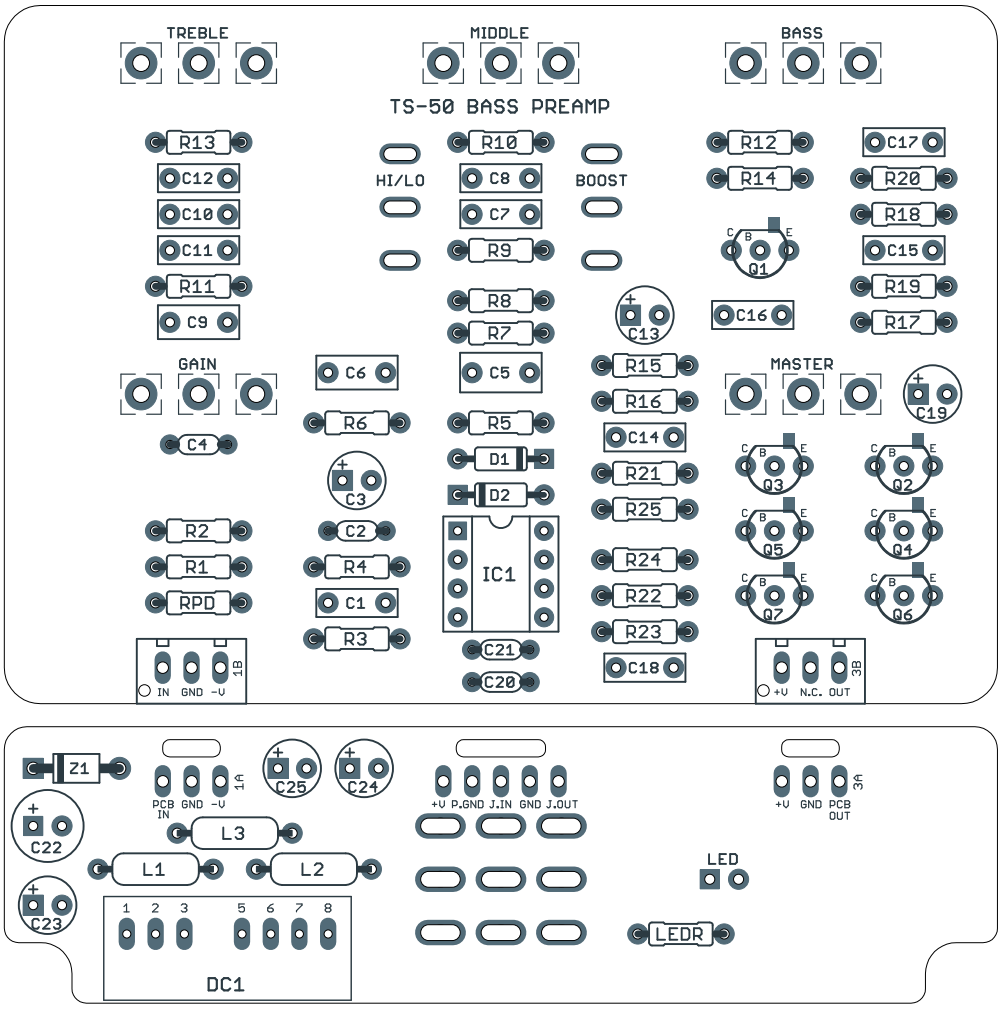
BASED ON
Traynor TS-50B Preamp

BUILD DIFFICULTY
Advanced

EFFECT TYPE
Bass preamp & overdrive

DOCUMENT VERSION
1.0.2 (2022-06-16)

PROJECT SUMMARY
A pedal recreation of the preamp section of the Traynor TS-50B bass amp, first released in 1979 and revered for its unique drive tone.



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

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INTRODUCTION

The TS-50 Bass Preamp is an adaptation of the Traynor TS-50B, a solid-state bass amplifier that was first released in 1979 and is considered one of the best bass amps ever, with its signature grinding drive tone. It's far from a clean amplifier, but it imparts its own distinctive character that doesn't quite sound like anything else. It is notably associated with Bob Weston and Steve Albini (Shellac) and David Wm. Sims (The Jesus Lizard).

The topology is fairly basic at the beginning of the circuit, but after the tone stack it gets interesting. The signal is split into 3 bands (low, medium and high), and each band is run into a pair of PNP transistors that distorts the bands separately before combining them back together. They named this the "Tri-Comp Network"—in this case using the term "compression" to refer to distortion and clipping, as opposed to clean compression as it's normally thought of today.

Traynor's lead engineer Eric Von Valtier invented the Tri-Comp Network as a method of rounding out the harsh square waves normally associated with bass distortion (actually more like fuzz). The result was, as they called it, "a round-shouldered, three-tiered pyramid" waveform that resembled a sine wave, but with a jagged sort of clipping that actually occurred *within* the waveform rather than just cutting off the peak as with most other types of clipping.

The TS-50B was notably adapted by Tronographic for their Rusty Box, first released in 2007 and still in production. The TS-50 Bass Preamp presumably shares a lot in common with the Rusty Box, but we have not seen inside one and our TS-50B is not based directly on that pedal.

USAGE

The TS-50 Bass Preamp has five controls and two switches:

- **Gain** controls the amount of gain in the first op-amp stage.
- **Mid** is a variable bridged-T filter allowing the mids to be scooped or boosted.
- **Treble** and **Bass** form a 2-band amp-style tone stack.
- **Master** sets the overall output of the preamp.
- **Hi/Lo** (toggle) is an optional input attenuator for high-output instruments.
- **Boost** (toggle) is a fixed gain-boost that changes the gain ratio of the first stage and also tweaks the EQ slightly.

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 7 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	10k	Metal film resistor, 1/4W	
R2	10k	Metal film resistor, 1/4W	
R3	10k	Metal film resistor, 1/4W	
R4	270k	Metal film resistor, 1/4W	
R5	1M5	Metal film resistor, 1/4W	
R6	6k8	Metal film resistor, 1/4W	
R7	6k8	Metal film resistor, 1/4W	
R8	2k2	Metal film resistor, 1/4W	
R9	1k5	Metal film resistor, 1/4W	
R10	39k	Metal film resistor, 1/4W	
R11	27k	Metal film resistor, 1/4W	
R12	680R	Metal film resistor, 1/4W	
R13	470R	Metal film resistor, 1/4W	
R14	1M	Metal film resistor, 1/4W	
R15	6k8	Metal film resistor, 1/4W	
R16	4k7	Metal film resistor, 1/4W	
R17	27k	Metal film resistor, 1/4W	
R18	4k7	Metal film resistor, 1/4W	
R19	2k2	Metal film resistor, 1/4W	
R20	15k	Metal film resistor, 1/4W	
R21	18k	Metal film resistor, 1/4W	
R22	18k	Metal film resistor, 1/4W	
R23	18k	Metal film resistor, 1/4W	
R24	8k2	Metal film resistor, 1/4W	
R25	1k5	Metal film resistor, 1/4W	
RPD	2M2	Metal film resistor, 1/4W	
LEDR	4k7	Metal film resistor, 1/4W	
C1	68n	Film capacitor, 7.2 x 2.5mm	
C2	47pF	MLCC capacitor, NP0/C0G	
C3	4.7uF	Electrolytic capacitor, 4mm	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C4	47pF	MLCC capacitor, NP0/C0G	
C5	1uF	Film capacitor, 7.2 x 3.5mm	
C6	220n	Film capacitor, 7.2 x 2.5mm	
C7	47n	Film capacitor, 7.2 x 2.5mm	
C8	47n	Film capacitor, 7.2 x 2.5mm	
C9	220n	Film capacitor, 7.2 x 2.5mm	
C10	1n5	Film capacitor, 7.2 x 2.5mm	
C11	100n	Film capacitor, 7.2 x 2.5mm	
C12	6n8	Film capacitor, 7.2 x 2.5mm	
C13	4.7uF	Electrolytic capacitor, 4mm	
C14	33n	Film capacitor, 7.2 x 2.5mm	
C15	33n	Film capacitor, 7.2 x 2.5mm	
C16	47n	Film capacitor, 7.2 x 2.5mm	
C17	33n	Film capacitor, 7.2 x 2.5mm	
C18	10n	Film capacitor, 7.2 x 2.5mm	
C19	4.7uF	Electrolytic capacitor, 4mm	
C20	100n	MLCC capacitor, X7R	
C21	100n	MLCC capacitor, X7R	
C22	100uF	Electrolytic capacitor, 6.3mm	
C23	47uF	Electrolytic capacitor, 5mm	
C24	10uF	Electrolytic capacitor, 5mm	
C25	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	
Q1	MPSA18	BJT transistor, NPN, TO-92	
Q2	2N3906	BJT transistor, PNP, TO-92	Substitute. Original uses MPS8598 or MPS8599.
Q3	2N3906	BJT transistor, PNP, TO-92	Substitute. Original uses MPS8598 or MPS8599.
Q4	2N3906	BJT transistor, PNP, TO-92	Substitute. Original uses MPS8598 or MPS8599.
Q5	2N3906	BJT transistor, PNP, TO-92	Substitute. Original uses MPS8598 or MPS8599.
Q6	2N3906	BJT transistor, PNP, TO-92	Substitute. Original uses MPS8598 or MPS8599.
Q7	2N3906	BJT transistor, PNP, TO-92	Substitute. Original uses MPS8598 or MPS8599.
L1	10uH	Inductor, 10uH	Bourns 78F100J-RC
L2	10uH	Inductor, 10uH	Bourns 78F100J-RC
L3	10uH	Inductor, 10uH	Bourns 78F100J-RC

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
DC1	TEC 2-0923	DC-DC converter, +9V to +/-15V	See build notes for alternatives.
IC1	TL071	Operational amplifier, DIP8	
IC1-S	DIP-8 socket	IC socket, DIP-8	
GAIN	1MA	16mm right-angle PCB mount pot	
TREBLE	50kB	16mm right-angle PCB mount pot	
MIDDLE	50kC	16mm right-angle PCB mount pot	
BASS	50kA	16mm right-angle PCB mount pot	
MASTER	50kA	16mm right-angle PCB mount pot	
BOOST	SPDT	Toggle switch, SPDT on-on	
HI/LO	SPDT	Toggle switch, SPDT on-on	
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 2-0923	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.

Middle potentiometer

The midrange potentiometer is 15kC in the original TS-50B amplifier. This is a non-existent value today, and it seems Traynor had a hard time sourcing them as well. Some of their later amplifiers such as the TS-60B (1981) had the same midrange circuitry as the TS-60B, but used a 50kC potentiometer with a 39k resistor in parallel. This results in an effective value of 15k with a slightly steeper taper than a true 15kC pot.

We've ported over this parallel resistor method to the TS-50B circuit, so a 50kC pot can be used in place of 15kC. If by some chance you have a 15kC potentiometer, you can omit R10 (39k).

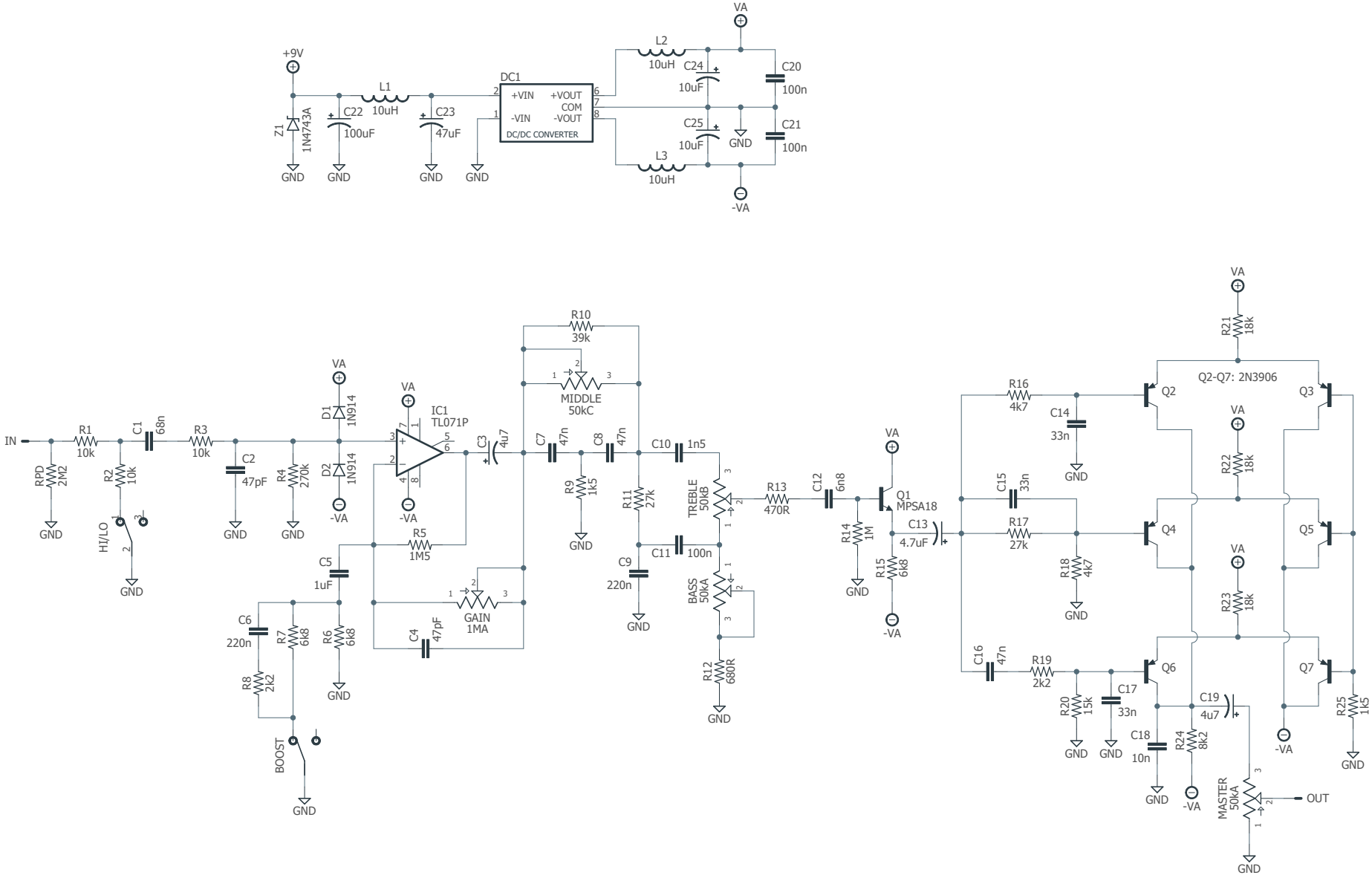
Enclosure size

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


+9V
L1
10uH
Z1
1N4743A
C22
100uF
C23
47uF
GND
DC1
+VIN
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+VOUT
COM
-VOUT
DC/DC CONVERTER
VA
-VA
L2
10uH
L3
10uH
C24
10uF
C25
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C20
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C1
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R4
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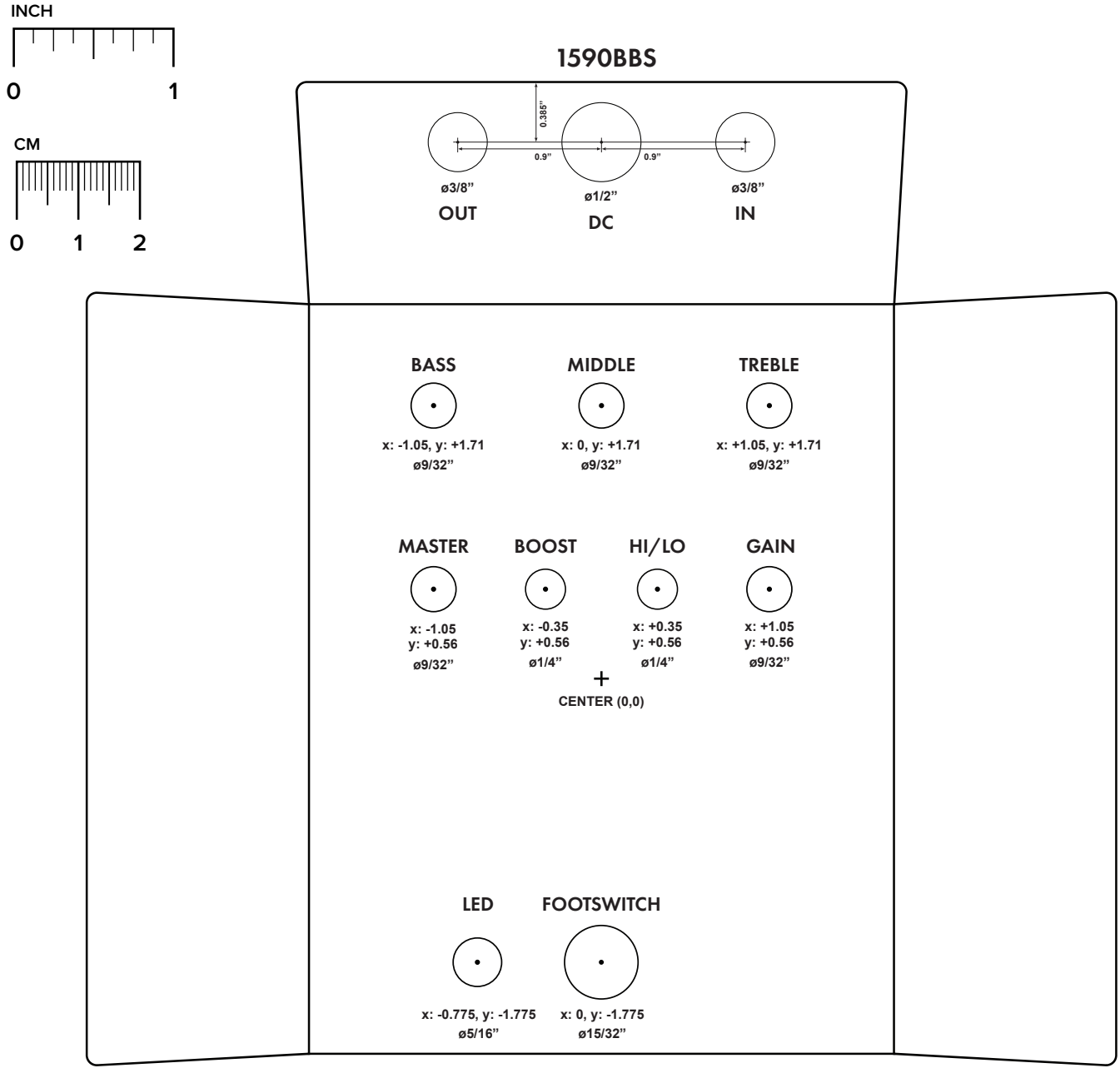
R2
10k
HI/LO
D1
1N914
D2
1N914
IC1
TL071P
C3
4u7
R10
39k
MIDDLE
50kC
C7
47n
C8
47n
C10
1n5
R9
1k5
R11
27k
TREBLE
50kB
C11
100n
C9
220n
BASS
50kA
R12
680R
R13
470R
C12
6n8
Q1
MPSA18
C13
4.7uF
R14
1M
R15
6k8
R5
1M5
C5
1uF
C6
220n
R7
6k8
R6
6k8
R8
2k2
C4
47pF
GAIN
1MA
BOOST
R21
18k
Q2-Q7: 2N3906
R16
4k7
C14
33n
C15
33n
R17
27k
R18
4k7
R22
18k
R23
18k
C16
47n
R19
2k2
R20
15k
C17
33n
C18
10n
R24
8k2
C19
4u7
R25
1k5
MASTER
50kA
OUT
Q2
Q3
Q4
Q5
Q6
Q7

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.

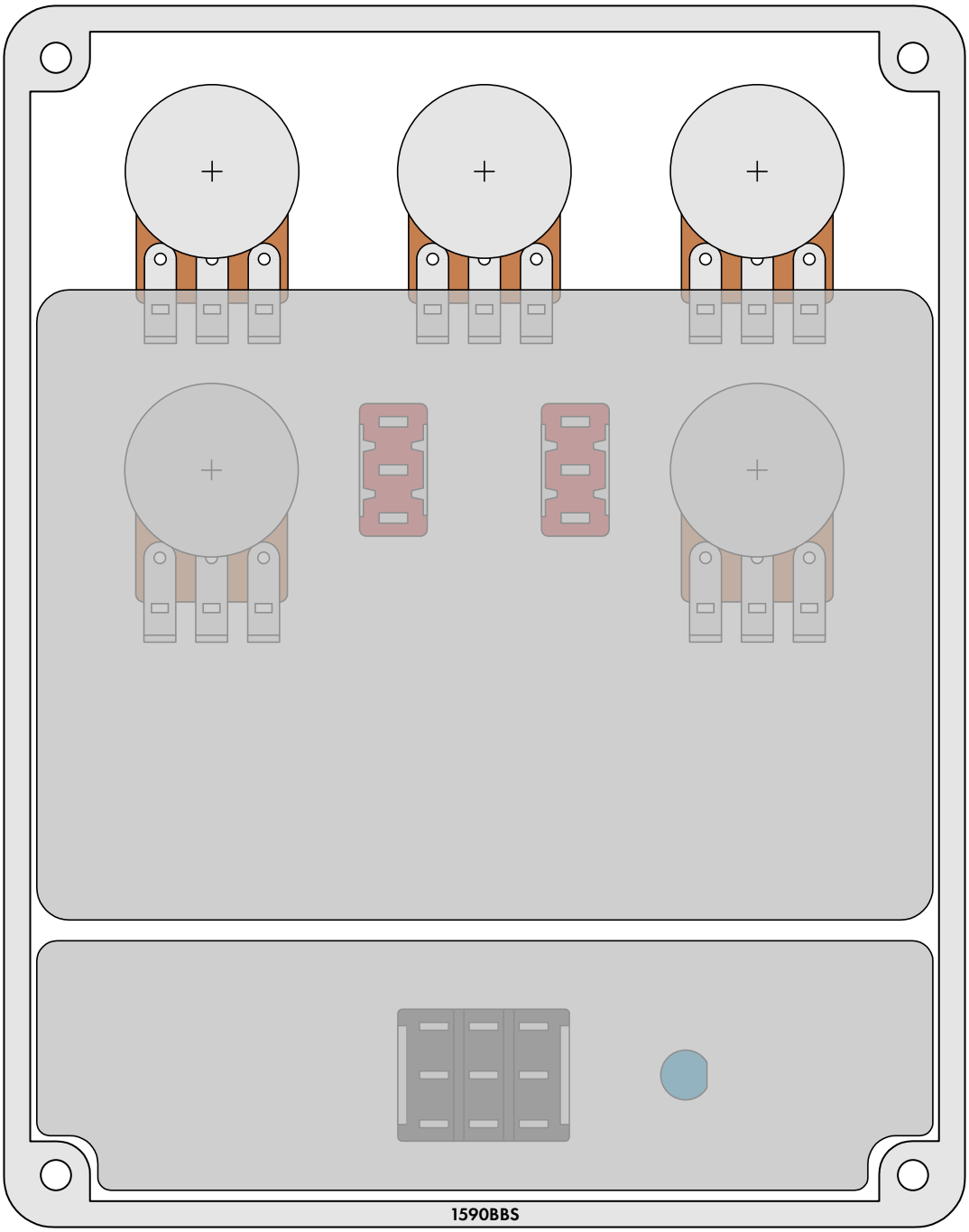
Ensure that this template is printed at 100% or "Actual Size". You can double-check this by measuring the scale on the printed page.

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.

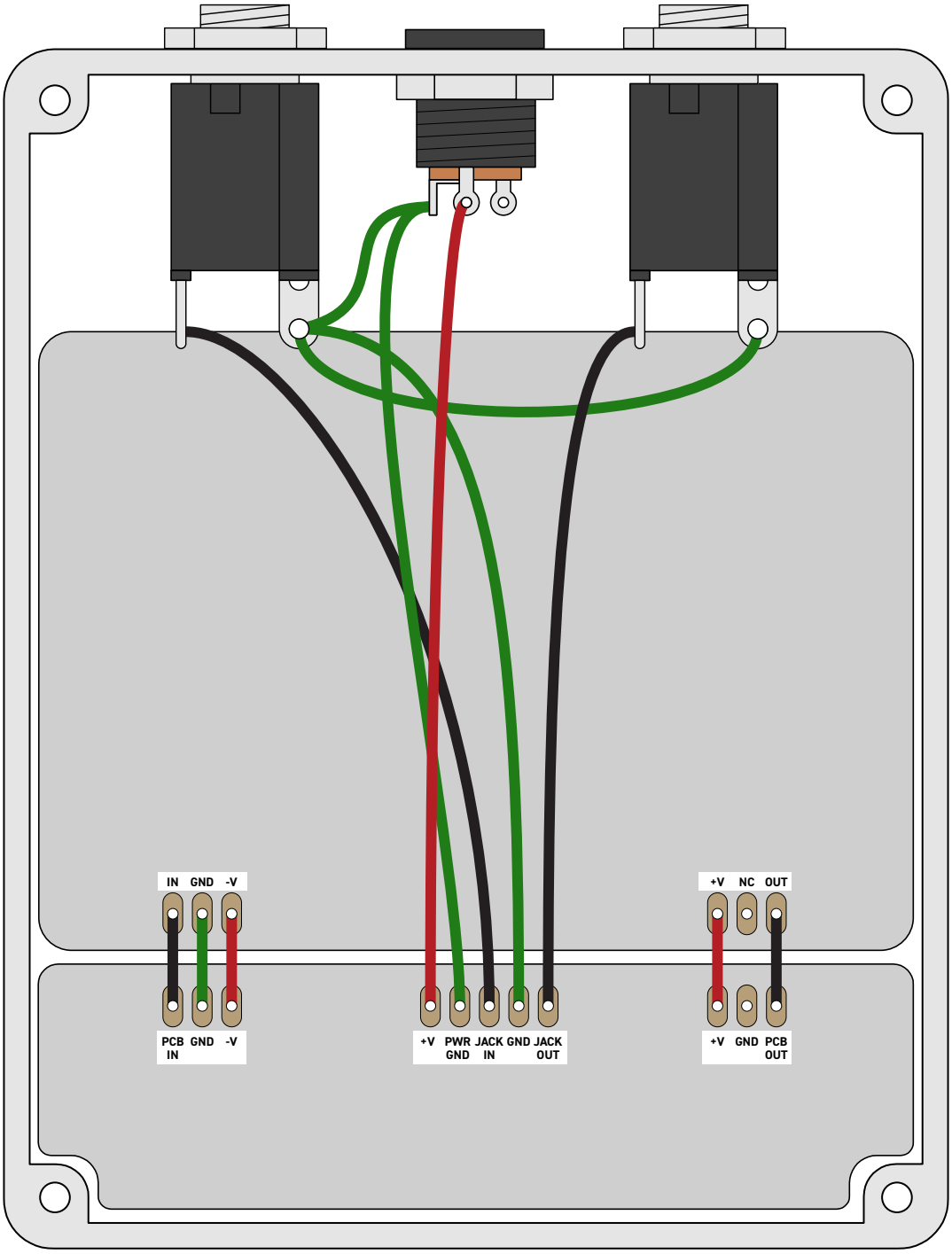


ENCLOSURE LAYOUT

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

1.0.2 (2022-06-16)
More corrections to parts list. Schematic and Mouser spreadsheet were correct.

1.0.1 (2022-06-06)
Corrected parts list (some parts were inadvertently duplicated). Added note about enclosure size.

1.0.0 (2022-06-03)
Initial release.