PROJECT NAME

TS-50 PREAMP

aion DIY GUITAR EFFECTS

BASED ON
Traynor TS-50 Guitar Preamp

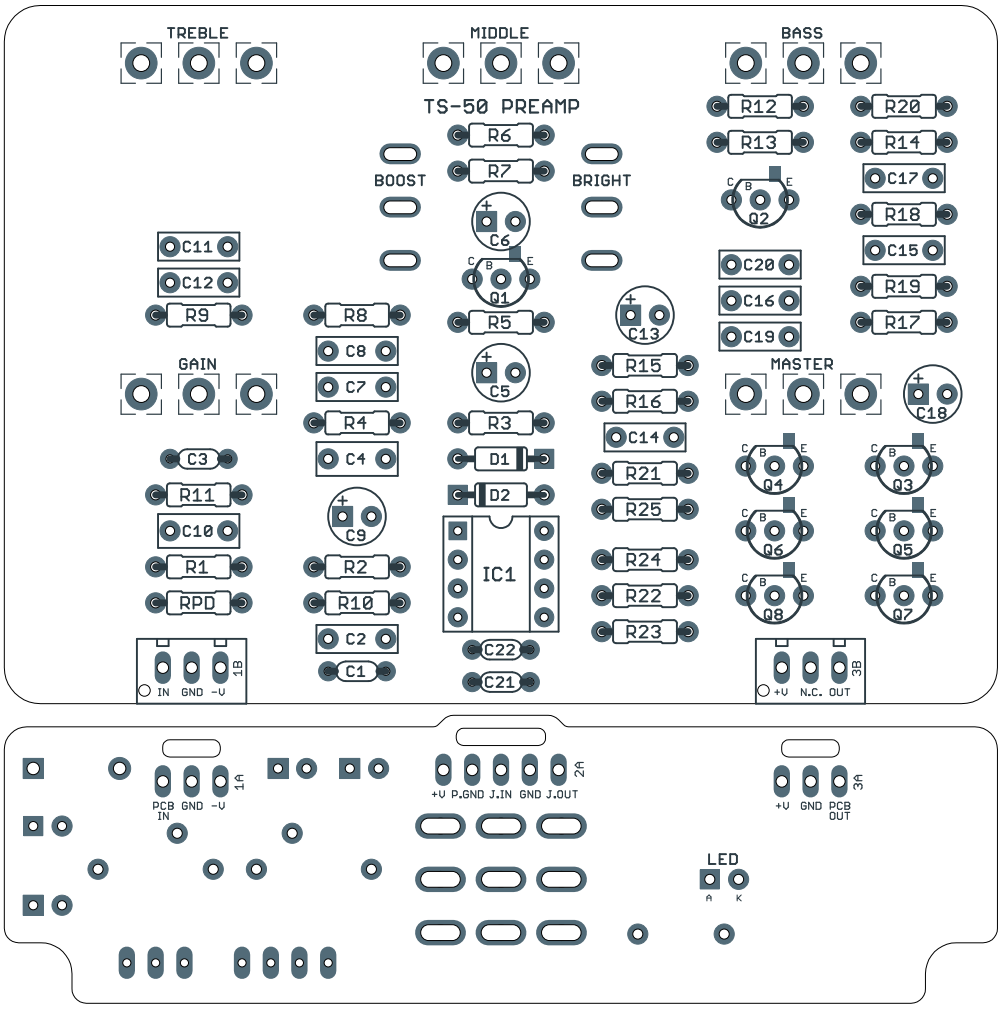
BUILD DIFFICULTY
Advanced

EFFECT TYPE
Preamp & overdrive

DOCUMENT VERSION
1.0.2 (2024-08-05)

PROJECT SUMMARY

A pedal recreation of the preamp section of the Traynor TS-50 guitar amp, a solid-state combo first released in 1979 with a unique frequency-dependent drive circuit.



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

IMPORTANT NOTE

This documentation is for the **guitar** version of the amplifier, the TS-50. There’s also a bass version, the TS-50B. While the names are similar, the schematic and part numbering are different. Confirm your PCB is labeled “TS-50 Preamp” and that it looks like the above graphic before proceeding.

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INTRODUCTION

The TS-50 Guitar Preamp is based on the Traynor TS-50 combo amp, originally released in 1979. It didn't get as much attention as the bass version, the TS-50B, mainly due to the lack of big-name users, but both circuits are very unique and they don't resemble anything else that came before or after.

The topology is fairly basic at the start of the circuit: an op-amp gain stage with a gyrator (simulated inductor) that boosts the midrange frequencies. This active midrange control is the main difference from the bass version other than the component values and the bright switch on the output volume control. This is then followed by a passive Fender-style tone stack for bass and treble.

After the tone stack, 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.

USAGE

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

- **Gain** controls the amount of gain in the first op-amp stage.
- **Mid** controls the level of an active mid-boost in the first op-amp stage.
- **Treble** and **Bass** form a 2-band amp-style tone stack.
- **Master** sets the overall output of the preamp.
- **Boost** (toggle) is a fixed gain-boost that changes the gain ratio of the first stage and also tweaks the EQ slightly.
- **Bright** (toggle) engages a bypass capacitor on the volume control that allows the signal to cut through better at lower volume levels.

Power supply design

Like most solid-state preamplifiers of the era, the TS-50 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 original 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	270k	Metal film resistor, 1/4W	
R2	10k	Metal film resistor, 1/4W	
R3	1M5	Metal film resistor, 1/4W	
R4	2k2	Metal film resistor, 1/4W	
R5	3k3	Metal film resistor, 1/4W	
R6	39k	Metal film resistor, 1/4W	
R7	180R	Metal film resistor, 1/4W	
R8	6k8	Metal film resistor, 1/4W	
R9	270k	Metal film resistor, 1/4W	
R10	22k	Metal film resistor, 1/4W	
R11	27k	Metal film resistor, 1/4W	
R12	680R	Metal film resistor, 1/4W	
R13	62k	Metal film resistor, 1/4W	
R14	62k	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	3k3	Metal film resistor, 1/4W	
RPD	2M2	Metal film resistor, 1/4W	
LEDR	10k	Metal film resistor, 1/4W	
C1	47pF	MLCC capacitor, NP0/C0G	
C2	68n	Film capacitor, 7.2 x 2.5mm	
C3	10pF	MLCC capacitor, NP0/C0G	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C4	220n	Film capacitor, 7.2 x 2.5mm	
C5	4.7uF	Electrolytic capacitor, 4mm	
C6	4.7uF	Electrolytic capacitor, 4mm	
C7	33n	Film capacitor, 7.2 x 2.5mm	
C8	22n	Film capacitor, 7.2 x 2.5mm	
C9	4.7uF	Electrolytic capacitor, 4mm	
C10	220n	Film capacitor, 7.2 x 2.5mm	
C11	1n5	Film capacitor, 7.2 x 2.5mm	
C12	100n	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	4.7uF	Electrolytic capacitor, 4mm	
C19	1n	Film capacitor, 7.2 x 2.5mm	
C20	22n	Film capacitor, 7.2 x 2.5mm	
C21	100n	MLCC capacitor, X7R	
C22	100n	MLCC capacitor, X7R	
C23	100uF	Electrolytic capacitor, 6.3mm	
C24	47uF	Electrolytic capacitor, 5mm	
C25	10uF	Electrolytic capacitor, 5mm	
C26	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	MPSA18	BJT transistor, NPN, TO-92	
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.
Q8	2N3906	BJT transistor, PNP, TO-92	Substitute. Original uses MPS8598 or MPS8599.

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
L1	10uH	Inductor, 10uH	Bourns 78F100J-RC
L2	10uH	Inductor, 10uH	Bourns 78F100J-RC
L3	10uH	Inductor, 10uH	Bourns 78F100J-RC
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	
BASS	50kA	16mm right-angle PCB mount pot	
MIDDLE	50kC	16mm right-angle PCB mount pot	
TREBLE	50kB	16mm right-angle PCB mount pot	
MASTER	50kA	16mm right-angle PCB mount pot	
BOOST	SPDT	Toggle switch, SPDT on-on	
BRIGHT	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-50 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-50 circuit, so a 50kC pot can be used in place of 15kC. If by some chance you have a 15kC potentiometer, you can omit R6 (39k).

TS-25 variant (higher gain)

The TS-25 amplifier is almost identical to the TS-50, but with a few key part substitutions that result in higher overall gain. Here are the substitutions to build the TS-25:

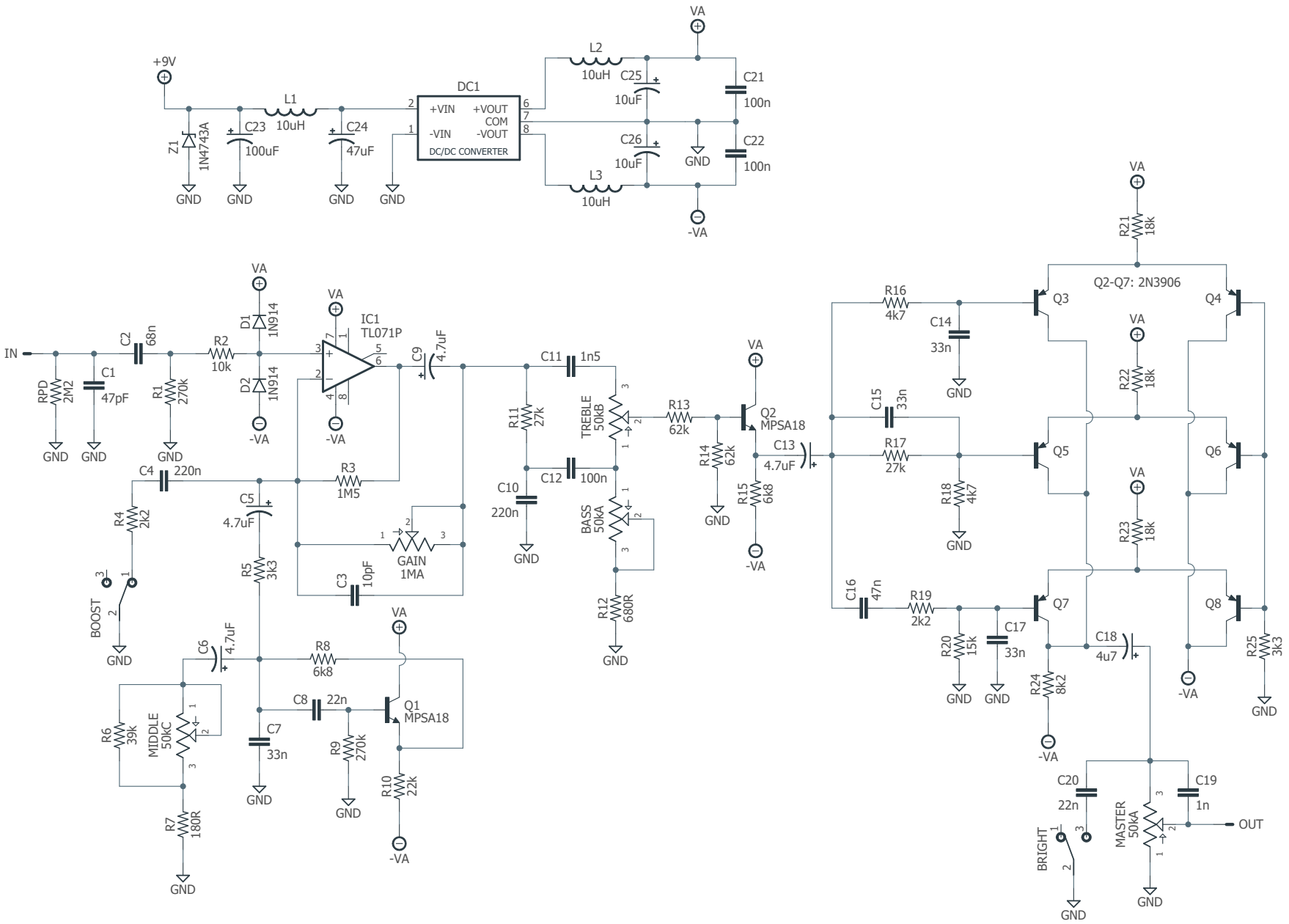
- **R4:** 2k2 → 1k8 (increases gain of boost mode)
- **R13:** 62k → 27k (increases signal level going into clipping stage)
- **R14:** 62k → omit (increases signal level going into clipping stage)
- **C4:** 220n → 150n (reduces bass in boost mode to compensate for increased gain)

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.

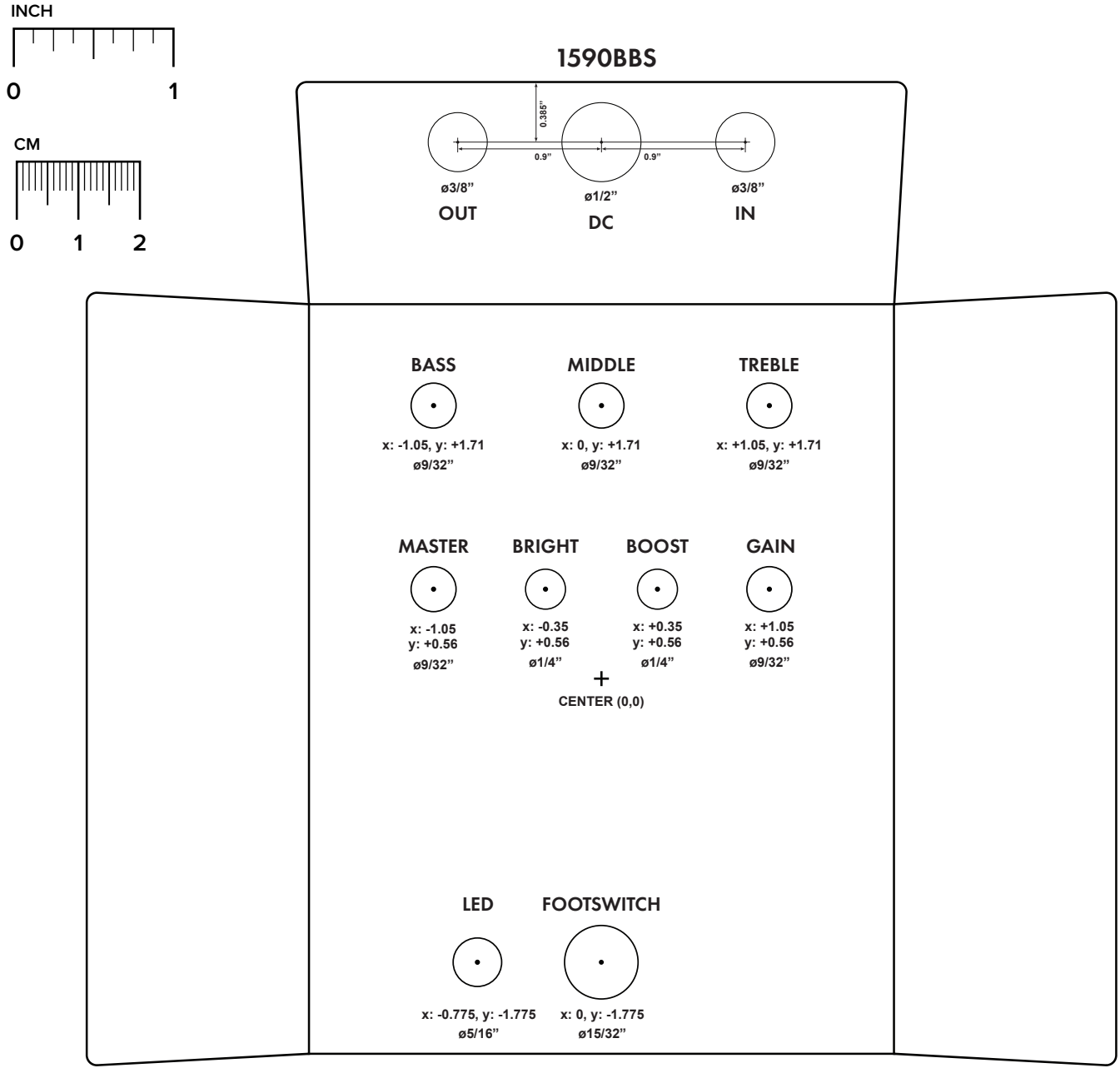

+9V
L1
10uH
C23
100uF
C24
47uF
Z1
1N4743A
GND
DC1
+VIN
-VIN
+VOUT
COM
-VOUT
DC/DC CONVERTER
L2
10uH
L3
10uH
C25
10uF
C26
10uF
C21
100n
C22
100n
VA
-VA
IN
C1
47pF
RPD
2M2
C2
68n
R1
270k
R2
10k
D1
1N914
D2
1N914
IC1
TL071P
C9
4.7uF
C4
220n
R3
1M5
C5
4.7uF
R4
2k2
R5
3k3
BOOST
C3
10pF
GAIN
1MA
C11
1n5
R11
27k
C12
100n
C10
220n
TREBLE
50kB
BASS
50kA
R12
680R
R13
62k
R14
62k
R15
6k8
Q2
MPSA18
C13
4.7uF
C6
4.7uF
R8
6k8
C8
22n
Q1
MPSA18
R6
39k
MIDDLE
50kC
C7
33n
R9
270k
R10
22k
R7
180R
Q2-Q7: 2N3906
R21
18k
R16
4k7
C14
33n
R22
18k
C15
33n
R17
27k
R18
4k7
R23
18k
C16
47n
R19
2k2
C17
33n
R20
15k
C18
4u7
R24
8k2
R25
3k3
Q3
Q4
Q5
Q6
Q7
Q8
C20
22n
C19
1n
MASTER
50kA
BRIGHT
OUT

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.

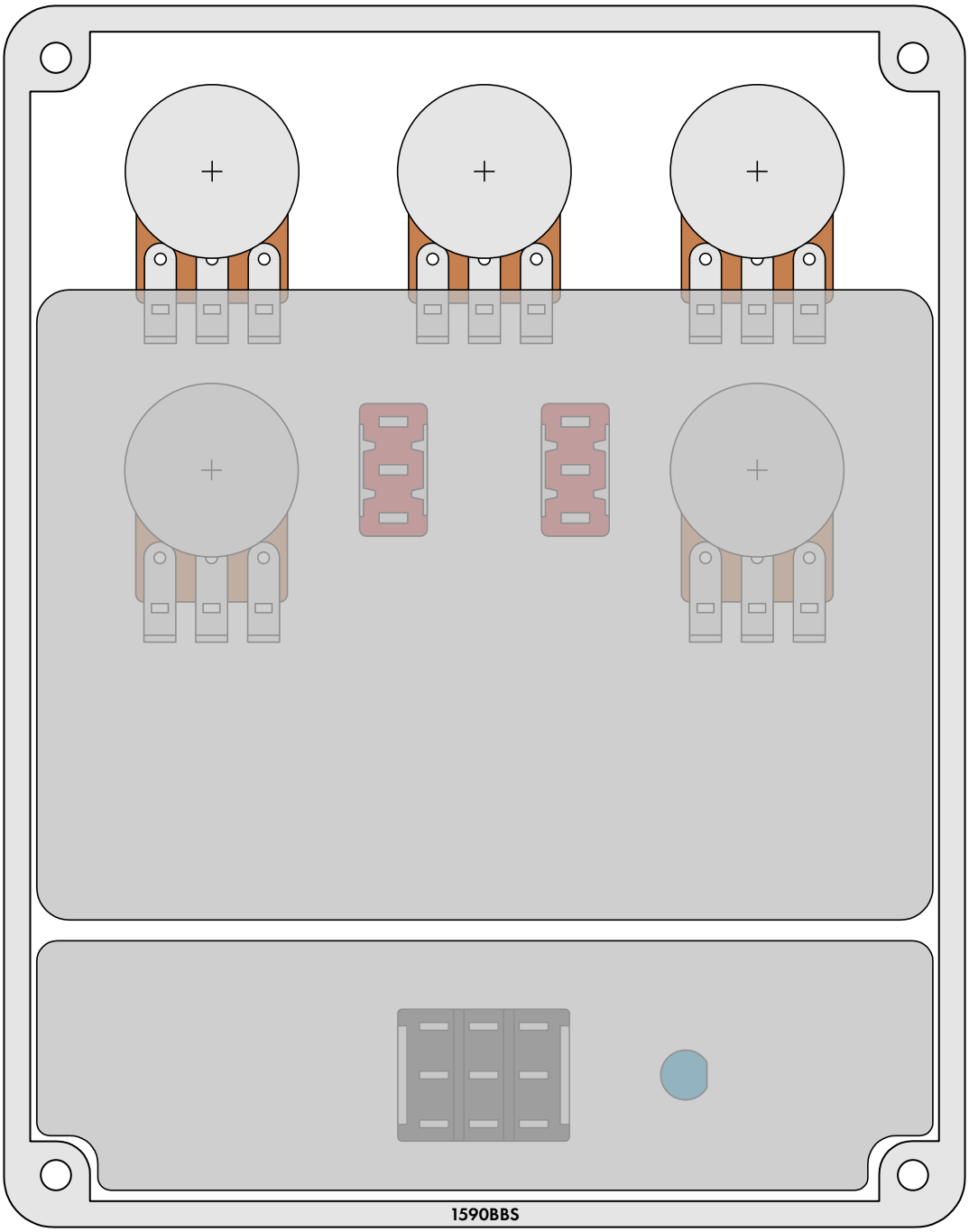
Ensure that this template is printed at 100% or "Actual Size". You can double-check this by measuring the scale on the printed page.

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.

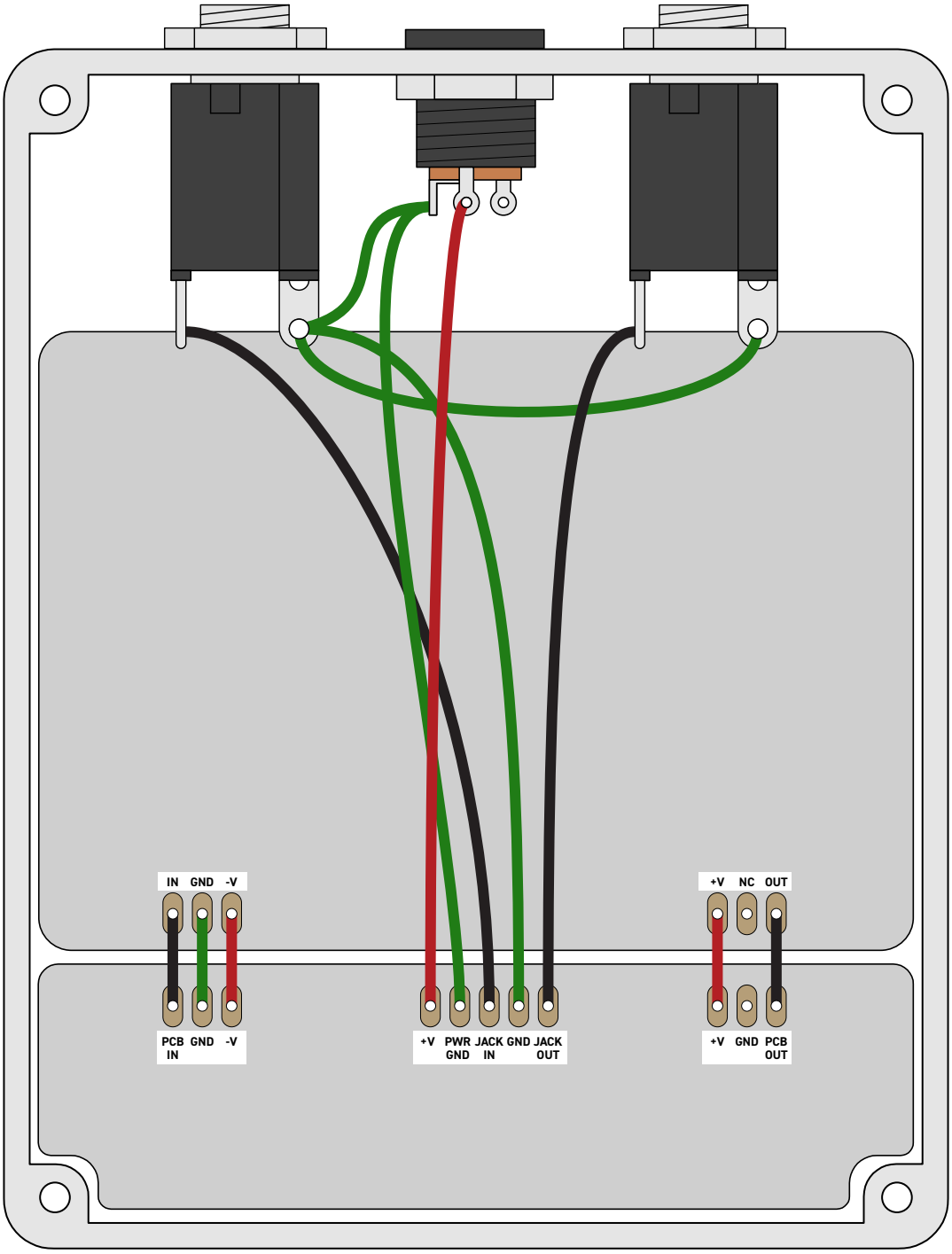


ENCLOSURE LAYOUT

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 (2024-08-05)
Added info for building the TS-25 version of the circuit, which is nearly identical to the TS-50 but has more gain.

1.0.1 (2024-07-24)
Corrected parts list. Q1-7 were incorrectly listed as the TS-50B values and Q8 was missing. The schematic and Mouser parts spreadsheet were correct.

1.0.0 (2024-07-04)
Initial release.