PROJECT NAME

L5 PREAMP

aion
DIY GUITAR EFFECTS

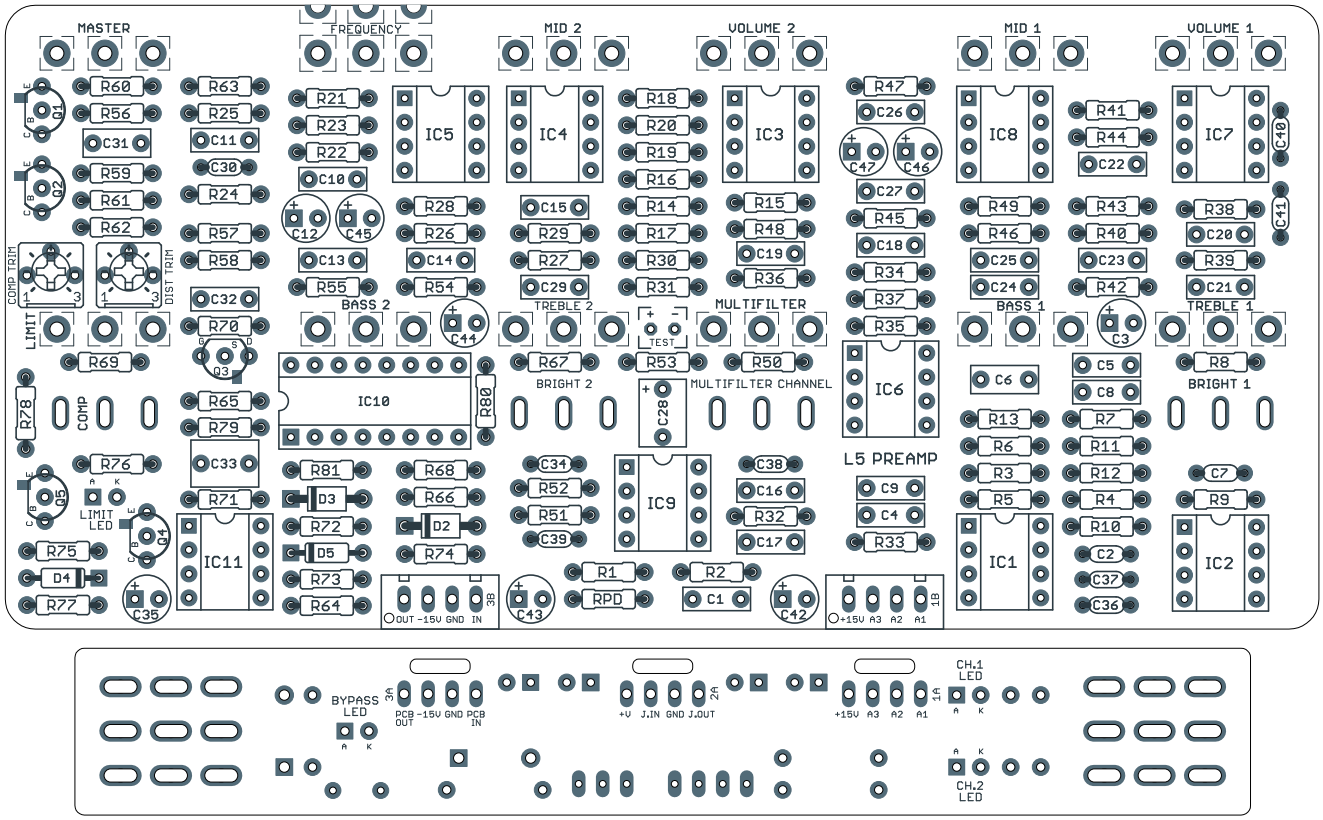
BASED ON
Lab Series® L5 Preamp

BUILD DIFFICULTY
Advanced

EFFECT TYPE
Preamp, overdrive & compressor

DOCUMENT VERSION
1.0.1 (2025-01-04)

PROJECT SUMMARY
A pedal adaptation of the two-channel preamp of the Lab Series® L5 amplifier from the late 1970s, often considered to be the best solid-state amp ever designed.



Actual size is 5.48” x 2.61” (main board) and 4.90” x 0.71” (bypass board).

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INTRODUCTION

The L5 Preamp is a pedal conversion of the preamp of the Lab Series® L5 guitar amplifier, a Moog-designed solid-state amplifier from the late 1970s that is widely considered the best and most tube-like solid-state amplifier ever made. It has two channels which are both merged into a shared distortion/master volume circuit as well as a compressor/limiter.

The original amps had the preamp integrated with the power amp. By splitting out the preamp, we can use this either as a normal pedal in a chain (e.g. tuner → overdrive → L5 Preamp → modulation / delay → amp input) or as a true preamp by plugging its output straight into a power amp (either a dedicated power amp or just the "return" jack of an amp with an effects loop). The main difference will be the volume setting. It's capable of enormous signal levels, far more than any stompbox—so if you're using it like a pedal, it's normal to keep the master volume down really low.

The updated L5 Preamp is a full redesign of our original project from 2016. The biggest difference is that it's much easier to build, with greatly simplified wiring and a cleaner layout. It also now runs on standard 9V DC power instead of AC like our earlier one.

There are also a few circuit tweaks. The first is a new feature: making the Multifilter section switchable so that it can be applied to either channel. There's still only one of them, but now people who prefer channel 1 can also experience the unique sounds of the multifilter.

The second tweak was to reconfigure the input op-amp stages as non-inverting, which cuts down on noise and is typically viewed as better design practice. We've done simulations and A/B tests to ensure the tone is unchanged.

The third change is to remove the hi/lo switches for each channel, which corresponded to the hi/lo inputs in the original amp, and hardwired it to "Lo" mode (i.e. the one intended for low-level signals, providing more gain boost at the input). The only function of the "Hi" input was to attenuate the input, but the attenuated input sounds dull and lifeless in nearly any normal use case. You'll generally get better results just turning down the channel volume if the "Lo" input is too hot with your instrument.

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USAGE

The L5 Preamp has the following controls:

Channel 1

- **Bright** (toggle switch) adds a treble-bleed capacitor to the volume control, which preserves some of the treble at lower volume levels to keep it from getting dull.
- **Treble**, **Mid** and **Bass** form a standard Fender-style 3-band passive EQ.
- **Volume** controls the amount of gain in the first stage, before the EQ and drive section.

Channel 2

- **Bright** (toggle switch) adds a treble-bleed capacitor to the volume control, which preserves some of the treble at lower volume levels to keep it from getting dull.
- **Volume** controls the amount of gain in the first stage, before the EQ and drive section.
- **Treble** and **Bass** form a standard 2-band Baxandall control. Each band is flat at the 12:00 position, and can either cut (CCW) or boost (CW).
- **Mid** boosts (CCW) or cuts (CW) the midrange frequency selected by the **Frequency** control.
- **Frequency** selects the frequency that will be boosted or cut by the **Mid** control, from 100 Hz at full CCW to 6.4kHz at full CW.

Both channels

- **Multifilter** blends a six-band fixed EQ boost, adding harmonics to the instrument signal.
- **Multifilter Channel** (toggle) moves the multifilter between channel 1 or channel 2.
- **Master** sets the output volume after the drive section of the preamp.
- **Limit** sets the threshold of the compressor at the end of the circuit.
- **Comp** (toggle) engages or disengages the compressor.

CIRCUIT DESIGN NOTES

Power supply design

Like most solid-state preamplifiers of the era, the L5 ran 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, 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, including this new version of the original L5 project that started it all.

See the build notes on page 11 for more information on the specific DC-DC converters that are recommended for use in this project.

Multifilter

The multifilter is a patented Moog invention that uses a set of six fixed-frequency resonant filters to add a unique harmonic sheen to an instrument signal, sometimes described by Lab Series owners as making their electric guitar sound more like an acoustic.

On the original amps, the multifilter was hard-wired to take its input signal from channel 2 and had no function when channel 1 was used. However, in developing this updated version of the L5 project, we experimented with taking the input from channel 1 instead, and the results were stellar.

There's a bit of a switch pop when moving the multifilter from one channel to the other, so it's not something you'll want to adjust in a live environment. Also beware that depending on the EQ settings, there may be feedback on the upper end of the multifilter since it's operating in a way it wasn't originally designed to. Just turn down the multifilter level slightly and it will go away.

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 →

Interactive BOM →

PART	VALUE	TYPE	NOTES
R1	10k	Metal film resistor, 1/4W	
R2	220k	Metal film resistor, 1/4W	
R3	47k	Metal film resistor, 1/4W	
R4	2k2	Metal film resistor, 1/4W	
R5	1k	Metal film resistor, 1/4W	
R6	22k	Metal film resistor, 1/4W	
R7	5k1	Metal film resistor, 1/4W	Taper resistor for Mid pot. See build notes.
R8	220k	Metal film resistor, 1/4W	
R9	47k	Metal film resistor, 1/4W	18k in the original amp, but 47k provides better channel matching.
R10	10k	Metal film resistor, 1/4W	
R11	2k7	Metal film resistor, 1/4W	Taper resistor for Volume 1 pot. See build notes.
R12	1k	Metal film resistor, 1/4W	Taper resistor for Volume 1 pot. See build notes.
R13	6k8	Metal film resistor, 1/4W	
R14	10k	Metal film resistor, 1/4W	
R15	1k5	Metal film resistor, 1/4W	
R16	27k	Metal film resistor, 1/4W	
R17	27k	Metal film resistor, 1/4W	
R18	18k	Metal film resistor, 1/4W	
R19	18k	Metal film resistor, 1/4W	
R20	18k	Metal film resistor, 1/4W	
R21	18k	Metal film resistor, 1/4W	
R22	18k	Metal film resistor, 1/4W	
R23	1k5	Metal film resistor, 1/4W	
R24	1k5	Metal film resistor, 1/4W	
R25	2k2	Metal film resistor, 1/4W	
R26	22k	Metal film resistor, 1/4W	
R27	2k2	Metal film resistor, 1/4W	
R28	100k	Metal film resistor, 1/4W	
R29	2k2	Metal film resistor, 1/4W	
R30	24k	Metal film resistor, 1/4W	
R31	39k	Metal film resistor, 1/4W	
R32	270k	Metal film resistor, 1/4W	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
R33	390R	Metal film resistor, 1/4W	
R34	22k	Metal film resistor, 1/4W	
R35	300k	Metal film resistor, 1/4W	
R36	430R	Metal film resistor, 1/4W	
R37	22k	Metal film resistor, 1/4W	
R38	240k	Metal film resistor, 1/4W	
R39	390R	Metal film resistor, 1/4W	
R40	22k	Metal film resistor, 1/4W	
R41	300k	Metal film resistor, 1/4W	
R42	560R	Metal film resistor, 1/4W	
R43	22k	Metal film resistor, 1/4W	
R44	220k	Metal film resistor, 1/4W	
R45	390R	Metal film resistor, 1/4W	
R46	22k	Metal film resistor, 1/4W	
R47	150k	Metal film resistor, 1/4W	
R48	300R	Metal film resistor, 1/4W	
R49	22k	Metal film resistor, 1/4W	
R50	18k	Metal film resistor, 1/4W	
R51	10k	Metal film resistor, 1/4W	
R52	15k	Metal film resistor, 1/4W	
R53	1k	Metal film resistor, 1/4W	
R54	6k8	Metal film resistor, 1/4W	
R55	33k	Metal film resistor, 1/4W	
R56	220R	Metal film resistor, 1/4W	
R57	10k	Metal film resistor, 1/4W	
R58	470k	Metal film resistor, 1/4W	
R59	2k	Metal film resistor, 1/4W	
R60	47k	Metal film resistor, 1/4W	
R61	3k3	Metal film resistor, 1/4W	
R62	330R	Metal film resistor, 1/4W	
R63	100k	Metal film resistor, 1/4W	
R64	6k8	Metal film resistor, 1/4W	
R65	15k	Metal film resistor, 1/4W	
R66	220R	Metal film resistor, 1/4W	
R67	220R	Metal film resistor, 1/4W	
R68	820R	Metal film resistor, 1/4W	
R69	22k	Metal film resistor, 1/4W	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
R70	3k3	Metal film resistor, 1/4W	
R71	33k	Metal film resistor, 1/4W	
R72	10k	Metal film resistor, 1/4W	
R73	10k	Metal film resistor, 1/4W	
R74	47k	Metal film resistor, 1/4W	
R75	47k	Metal film resistor, 1/4W	
R76	100k	Metal film resistor, 1/4W	
R77	100k	Metal film resistor, 1/4W	
R78	10k	Metal film resistor, 1/4W	
R79	22k	Metal film resistor, 1/4W	
R80	10M	Metal film resistor, 1/4W	
R81	2k7	Metal film resistor, 1/4W	
RPD	2M2	Metal film resistor, 1/4W	Input pulldown resistor. Can be as low as 1M.
LEDC	10k	Metal film resistor, 1/4W	Channel 1 LED current-limiting resistor.
LEDD	10k	Metal film resistor, 1/4W	Channel 2 LED current-limiting resistor.
LEDR	10k	Metal film resistor, 1/4W	Bypass LED current-limiting resistor.
C1	150n	Film capacitor, 7.2 x 2.5mm	
C2	22pF	MLCC capacitor, NP0/C0G	
C3	10uF	Electrolytic capacitor, 5mm	
C4	10n	Film capacitor, 7.2 x 2.5mm	
C5	1n2	Film capacitor, 7.2 x 2.5mm	
C6	220n	Film capacitor, 7.2 x 2.5mm	
C7	22pF	MLCC capacitor, NP0/C0G	
C8	47n	Film capacitor, 7.2 x 2.5mm	
C9	4n7	Film capacitor, 7.2 x 2.5mm	
C10	4n7	Film capacitor, 7.2 x 2.5mm	
C11	68n	Film capacitor, 7.2 x 2.5mm	
C12	4.7uF	Electrolytic capacitor, 4mm	
C13	68n	Film capacitor, 7.2 x 2.5mm	
C14	68n	Film capacitor, 7.2 x 2.5mm	
C15	2n2	Film capacitor, 7.2 x 2.5mm	
C16	15n	Film capacitor, 7.2 x 2.5mm	
C17	15n	Film capacitor, 7.2 x 2.5mm	
C18	10n	Film capacitor, 7.2 x 2.5mm	
C19	10n	Film capacitor, 7.2 x 2.5mm	
C20	8n2	Film capacitor, 7.2 x 2.5mm	
C21	8n2	Film capacitor, 7.2 x 2.5mm	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C22	4n7	Film capacitor, 7.2 x 2.5mm	
C23	4n7	Film capacitor, 7.2 x 2.5mm	
C24	4n7	Film capacitor, 7.2 x 2.5mm	
C25	4n7	Film capacitor, 7.2 x 2.5mm	
C26	4n7	Film capacitor, 7.2 x 2.5mm	
C27	4n7	Film capacitor, 7.2 x 2.5mm	
C28	2.2uF	Film capacitor, 7.2 x 5mm	Original amp uses 2.7uF tantalum, but 2.2uF film will work the same.
C29	10n	Film capacitor, 7.2 x 2.5mm	
C30	220pF	MLCC capacitor, NP0/C0G	
C31	330n	Film capacitor, 7.2 x 2.5mm	
C32	68n	Film capacitor, 7.2 x 2.5mm	
C33	2.2uF	Film capacitor, 7.2 x 5mm	
C34	100pF	MLCC capacitor, NP0/C0G	
C35	10uF	Electrolytic capacitor, 5mm	
C36	100n	MLCC capacitor, X7R	
C37	100n	MLCC capacitor, X7R	
C38	100n	MLCC capacitor, X7R	
C39	100n	MLCC capacitor, X7R	
C40	100n	MLCC capacitor, X7R	
C41	100n	MLCC capacitor, X7R	
C42	22uF	Electrolytic capacitor, 5mm	
C43	22uF	Electrolytic capacitor, 5mm	
C44	22uF	Electrolytic capacitor, 5mm	
C45	22uF	Electrolytic capacitor, 5mm	
C46	22uF	Electrolytic capacitor, 5mm	
C47	22uF	Electrolytic capacitor, 5mm	
C48	22uF	Electrolytic capacitor, 5mm	
C49	22uF	Electrolytic capacitor, 5mm	
C50	100n	MLCC capacitor, X7R	
C51	100uF	Electrolytic capacitor, 6.3mm	
C52	47uF	Electrolytic capacitor, 5mm	
D1	1N5817	Schottky diode, DO-41	
D2	1N4004	Rectifier diode, DO-41	
D3	1N4004	Rectifier diode, DO-41	
D4	1N914	Fast-switching diode, DO-35	
D5	1N914	Fast-switching diode, DO-35	
Z1	1N4742A	Zener diode, 12V, DO-41	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
Q1	2N3904	BJT transistor, NPN, TO-92	
Q2	2N3904	BJT transistor, NPN, TO-92	
Q3	2N5457	JFET, N-channel, TO-92	Original uses PN4303, but 2N5457 will perform the same.
Q4	2N3906	BJT transistor, PNP, TO-92	
Q5	MPSA13	Darlington transistor, NPN, TO-92	
IC1	LF356N	Operational amplifier, DIP8	
IC1-S	DIP-8 socket	IC socket, DIP-8	
IC2	RC4558P	Operational amplifier, dual, DIP8	
IC2-S	DIP-8 socket	IC socket, DIP-8	
IC3	RC4558P	Operational amplifier, dual, DIP8	
IC3-S	DIP-8 socket	IC socket, DIP-8	
IC4	RC4558P	Operational amplifier, dual, DIP8	
IC4-S	DIP-8 socket	IC socket, DIP-8	
IC5	RC4558P	Operational amplifier, dual, DIP8	
IC5-S	DIP-8 socket	IC socket, DIP-8	
IC6	RC4558P	Operational amplifier, dual, DIP8	
IC6-S	DIP-8 socket	IC socket, DIP-8	
IC7	RC4558P	Operational amplifier, dual, DIP8	
IC7-S	DIP-8 socket	IC socket, DIP-8	
IC8	RC4558P	Operational amplifier, dual, DIP8	
IC8-S	DIP-8 socket	IC socket, DIP-8	
IC9	RC4558P	Operational amplifier, dual, DIP8	
IC9-S	DIP-8 socket	IC socket, DIP-8	
IC10	LM13700N	Transconductance amplifier, dual, DIP16	Can also use NE5517N.
IC10-S	DIP-16 socket	IC socket, DIP-16	
IC11	RC4558P	Operational amplifier, dual, DIP8	
IC11-S	DIP-8 socket	IC socket, DIP-8	
L1	10uH	Inductor, 10uH	
L2	10uH	Inductor, 10uH	
L3	10uH	Inductor, 10uH	
DC1	TEC 3-0923	DC-DC converter, +9V to +/-15V	See page 11 for more DC converter options.
COMP. TRIM	20k trimmer	Trimmer, 10%, 1/4"	Bourns 3362P
DIST. TRIM	20k trimmer	Trimmer, 10%, 1/4"	Bourns 3362P
BASS 1	50kA	16mm right-angle PCB mount pot	
MID 1	5kA	16mm right-angle PCB mount pot	Original uses 2.5kA. See build notes.
TREBLE 1	50kA	16mm right-angle PCB mount pot	
VOLUME 1	10kB	16mm right-angle PCB mount pot	Original uses 2.5kA. See build notes.

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
BASS 2	25kB	16mm right-angle PCB mount pot	
MID 2	25kB	16mm right-angle PCB mount pot	
FREQUENCY	100kC dual	16mm dual pot, right angle	
TREBLE 2	25kB	16mm right-angle PCB mount pot	
VOLUME 2	25kA	16mm right-angle PCB mount pot	
MULTIFILTER	25kA	16mm right-angle PCB mount pot	
MASTER	25kA	16mm right-angle PCB mount pot	
LIMIT	50kC	16mm right-angle PCB mount pot	
BRIGHT 1	SPDT	Toggle switch, SPDT on-on	
BRIGHT 2	SPDT	Toggle switch, SPDT on-on	
MF CHANNEL	SPDT	Toggle switch, SPDT on-on	
COMP	SPDT	Toggle switch, SPDT on-on	
BYP. LED	5mm red	LED, 5mm, red diffused	
CH. 1 LED	5mm green	LED, 5mm, green diffused	
CH. 2 LED	5mm red	LED, 5mm, red diffused	
LIMIT LED	3mm red	LED, 3mm, red diffused	
DC JACK	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	
CHANNEL	3PDT	Stomp switch, 3PDT	
ENCLOSURE	1590XX	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 3-0923	495-TEC3-0923	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	RS3-1215D	919-RS3-1215D	9-18V	
Mornsun	WRA1215S-3WR2	N/A	9-18V	NAC Semi: https://aionfx.com/link/mornsun/

The Traco TEC 3-0923 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 2-0923 cannot be used since the current handling is not high enough for the full two-channel preamp.

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 3-0923 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 DigiKey, 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.

Calibration

The L5 Preamp has two different calibration trimmers, located on the far-left side of the PCB. To set these, all you will need is a multimeter and a signal generator (which can be a computer or smartphone).

Note that all voltages are taken in AC, not DC, since we are dealing with audio signal levels. The voltages are also all RMS rather than p-p, so confirm that your multimeter measures RMS if you're not sure. Before you start, turn both trimmers all the way down.

Distortion trimmer

The distortion trimmer should be set first. This sets the level at which the overdrive kicks in. The procedure calls for a 1kHz 30mV sine wave to be inserted onto pin 13 of IC10, and for the trimmer to be adjusted until you measure **4.4V** on pin 12 of IC10.

For convenience, there is a pair of pads marked "TEST" right underneath the "Frequency" potentiometer's pads where you can insert your signal. The "+" pad connects to pin 13 of IC10 and the other is connected to ground. It's recommended to solder short pins to these pads (about 3/4" in length) to act as 'posts' for alligator clips to attach to. (The clipped leads from a 1N4004 diode work well for this since they are more rigid than normal component leads.)

If you don't have a signal generator, look for a smartphone or Mac/PC app that allows selection of wave type, frequency and gain level. These come and go, so we can't recommend anything specific, but there are several free ones available at any given time and they all do the same basic thing.

From here, hook up a 3.5mm male-to-male headphone cable and turned up the phone or computer volume to maximum, then set the frequency to 1kHz and the wave type to sine. Using a multimeter set to AC millivolt mode, adjust the volume in the app until you read 30mV. (Don't rely on the app to tell you the output signal level; they have no way of knowing the actual real-world level.)

Now, use alligator clips to connect the sleeve and the tip of the headphone cable to the two wires coming from the test pad. Since it's AC, the polarity does not matter. This will insert the signal to pin 13 of IC10 so you can adjust the trimmer as specified earlier, targeting 4.4V on pin 12.

Once you know the correct factory setting, feel free to adjust the trimmer up or down and see if you prefer it in any other position (but consider first marking the trimmer with a Sharpie so you can get back to the calibrated setting). Since this is a pedal adaptation, you may find it worthwhile to adjust the distortion so it comes on earlier than it did in the original amps.

Compressor/limiter trimmer

With the 30mV sine wave signal still inserted into pin 13 of IC10, turn the master volume up all the way and turn the compressor on (switch in the "up" position). Then turn the compressor knob up to about 2:00 (2/3 of the way up) and touch your probe to the "PCB OUT" pad on the right side of the footswitch board. Turn the trimmer until you measure **1.17VAC**.

This will get you in the range of the original amps. If you're using the L5 primarily as a pedal, you may want to set this lower so it's more sensitive to lower-level signals.

Channel 1 midrange and volume potentiometer values

The Lab Series amplifier used 2.5kA potentiometers for both Midrange and Volume of channel 1. This is a non-standard value today and not available from any standard parts suppliers. Tayda Electronics carries 2kA, which is certainly close enough and will work fine in this circuit. But in the new version of the L5, we included parallel and tapering resistors on the PCB so standard pot values could be used.

For the midrange pot, we recommend using 5kA, with a 5k1 resistor in parallel (R7). Since it's wired as a variable resistor, this drops the resistance value to 2.5k and only steepens the curve slightly.

The volume pot is wired as a true potentiometer with all three terminals used, so it's a little more complicated. For this, it's recommended to use a 10kB pot with a 2k7 resistor (R11) between pins 2 and 3 and a 1k resistor (R12) between pins 1 and 2. This will give a good approximation of a 2.5k pot, and the resulting taper will be very close to logarithmic.

Potentiometer tapers

In addition to the uncommon potentiometer values mentioned above, the original L5 used several equally uncommon tapers. In particular:

- Channel 1 mid, treble, bass, and volume use 30% log (30A). This means that when the control is at 50%, the resistance between lug 1 and the wiper will be 30% of the pot's value. Standard audio taper is 15%, so this is about halfway between audio and linear taper.
- Channel 2 volume, multifilter level, and master volume use 10% log (10A), meaning it's more gradual than standard audio/log taper.
- Compressor level is 10% reverse audio or antilog. Standard reverse audio taper is 15%, so it's more gradual than standard reverse audio taper.

None of these tapers are stocked by any component supplier we've come across. They can only be special-ordered from a manufacturer in large quantities which are impractical for DIY.

In all cases, these can be replaced with standard audio or reverse audio potentiometers with very little change in operation. All of the same tones are available, it's just that the exact resistance values are found on slightly different points on the knob rotation. Zero and ten are always the same, but for example, "5" on the ch. 1 treble knob in the original amp may be closer to 6 or 7 in the DIY version.

You won't notice any difference in normal use, but if you're wanting to compare it directly with an original L5 amp, be aware of the discrepancies when dialing them in.

Bypass PCB component orientation

Due to the height of the DC converter and electrolytic capacitors, the components on the switching PCB are mounted on the bottom, the same side as the footswitch. This is in contrast with most other Aion FX projects where the switch is mounted on the bottom of the switching sub-board and the components face up. Components are always mounted to the side with the silkscreen footprint.

LM13700 vs. CA3080

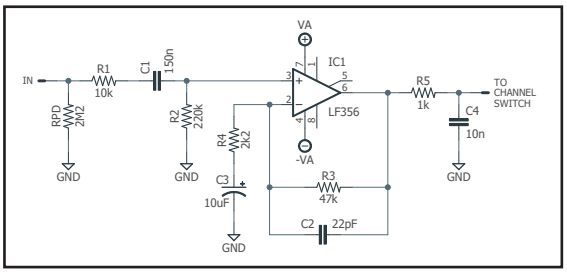
Our original L5 Preamp project used CA3080s as in the original amp. These have been discontinued for a long time, and while they have been reissued and are not terribly hard to find, they are expensive.

The LM13700 is essentially a dual version of the CA3080/CA3094 and is still readily available. Since the L5 circuit uses two CA3080s, it seemed like a good opportunity to replace them with a single LM13700.

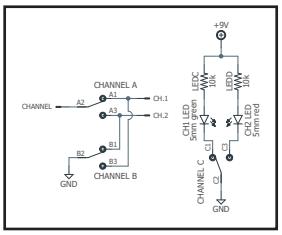
The only change that this required was to add a second 100k resistor (R77) to cut the compressor LED's voltage in half, since the LM13700's I_{ABC} pin sits at twice the voltage of the CA3080's pin. This extra resistor prevents the LED from staying on all the time, which was the only side-effect of substituting the LM13700 in place of the CA3080. It is fully outside the audio path.

SCHEMATIC (INPUT, CH. 1, CH. 2, MULTIFILTER, SWITCHING)

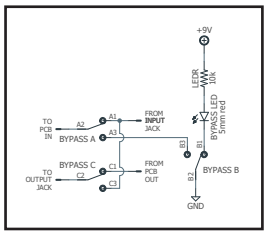
Input



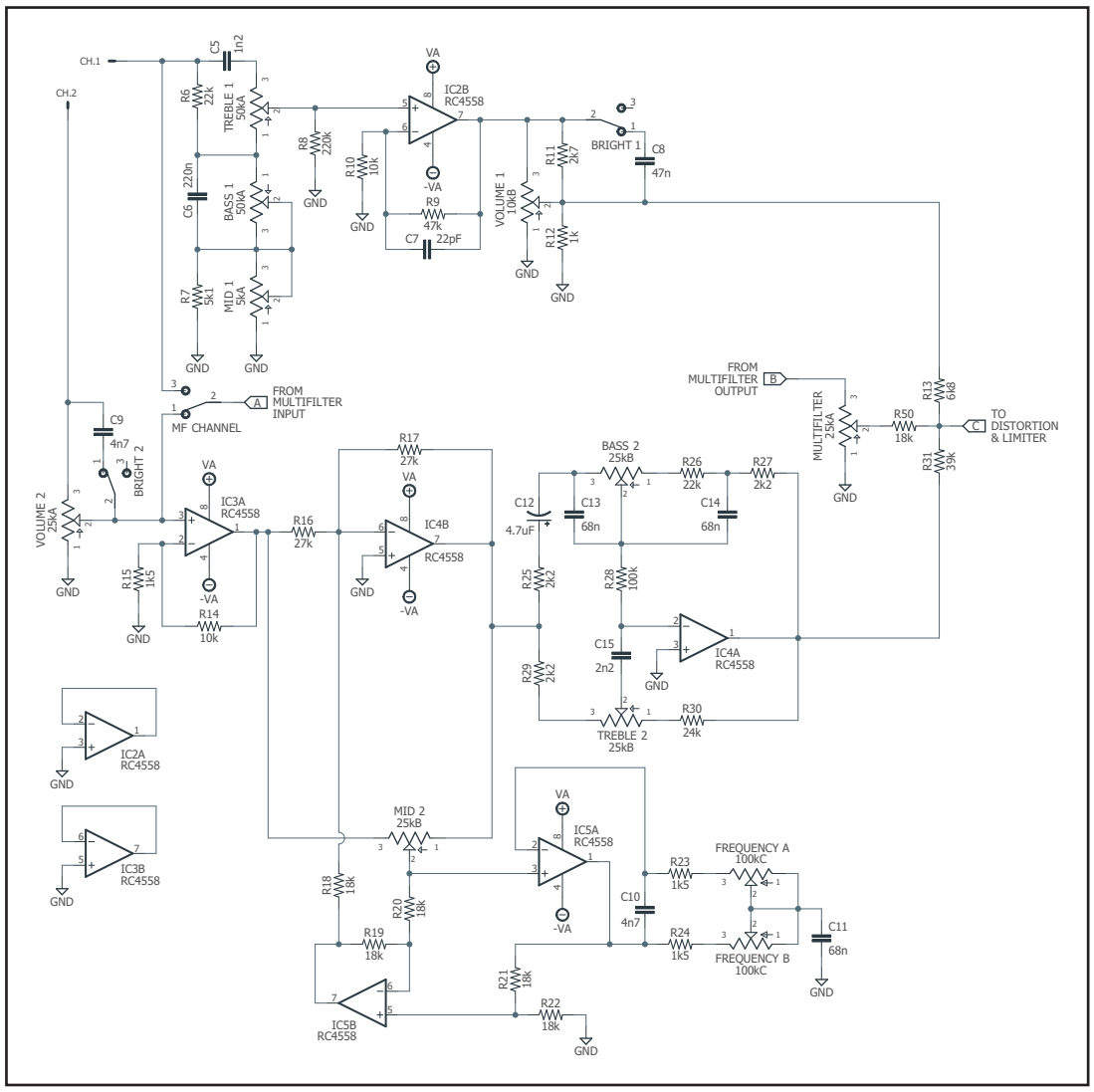
Channel switching



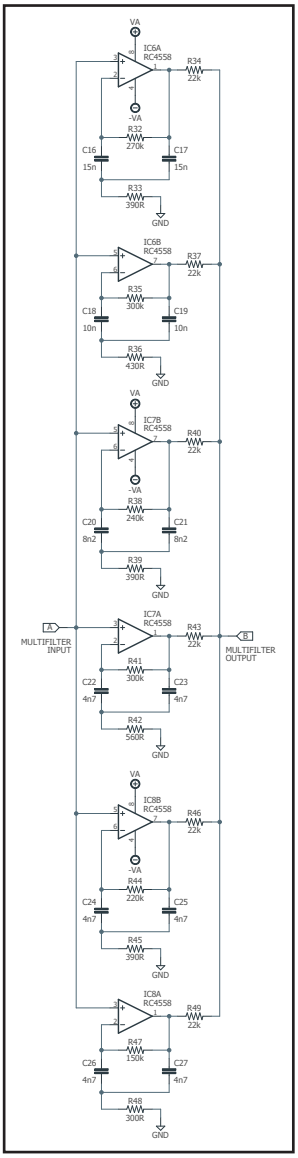
Bypass switching



Channel 1 & 2

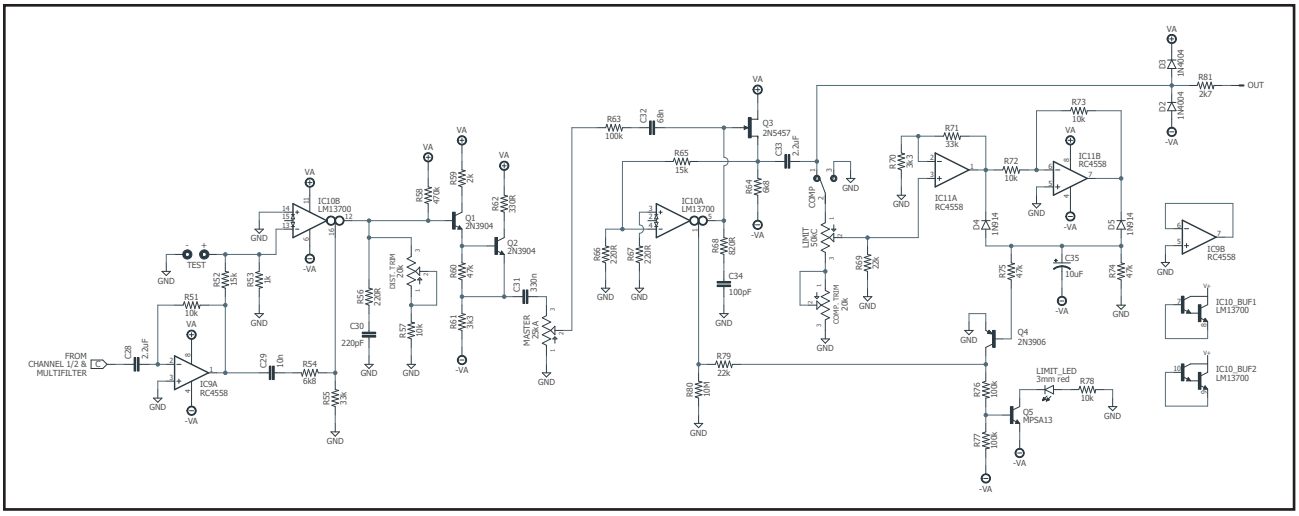


Multifilter

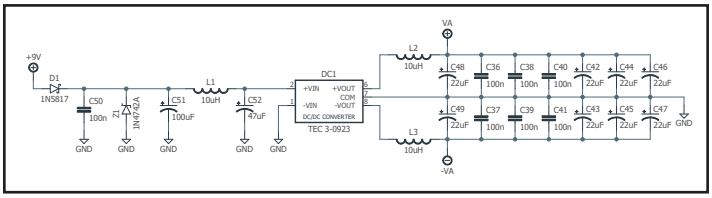


SCHEMATIC (DISTORTION, COMPRESSOR, POWER)

Distortion & compressor



Power supply



DRILL TEMPLATE INSTRUCTIONS

Cut out the drill template on the following page, 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.

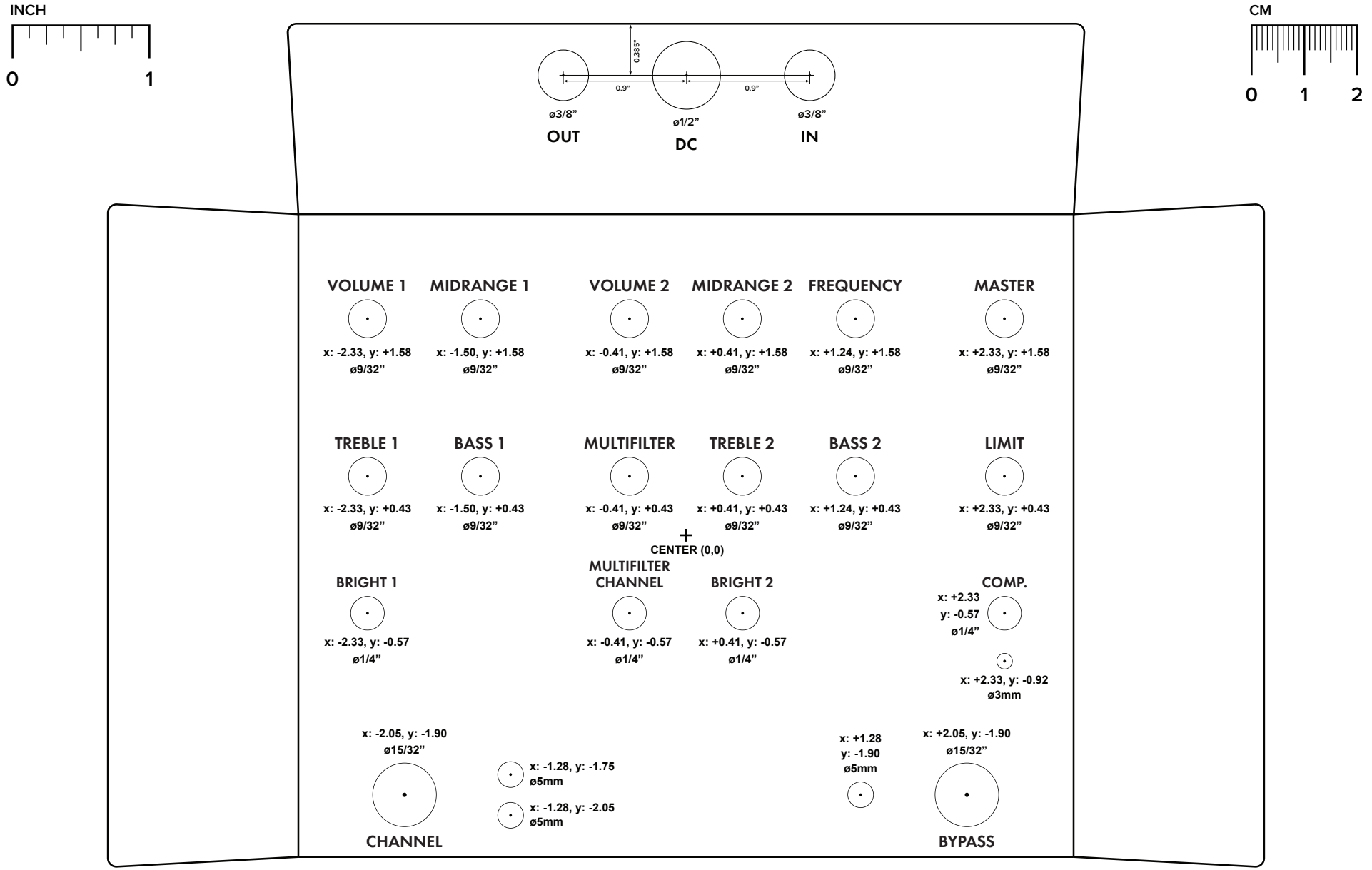
Ensure that the template is printed at 100% or "Actual Size". You can double-check this by measuring the scale on the printed page with a ruler or calipers.

The LEDs are sized for plain LEDs with no bezel, mounted directly to the PCB. If you don't have a 5mm bit for the bypass and channel LEDs, use 7/32". If you don't have a 3mm bit for the limit LED, use 1/8".

Important: Due to the high number of PCB-mounted parts, it's crucial that the drilling be accurate. Since the PCB uses slotted holes for the toggles, there's not a lot of room for error.

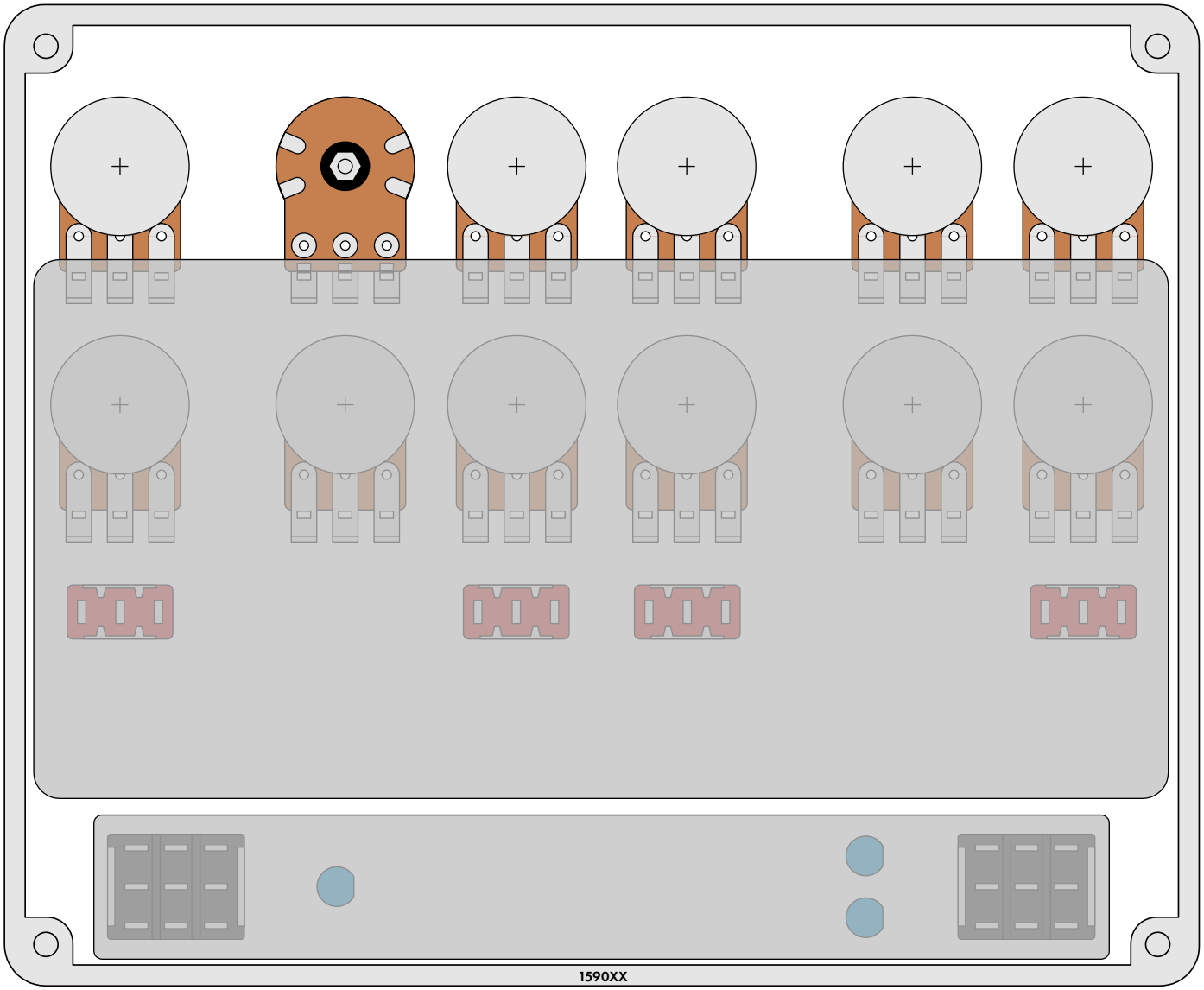
If the toggles don't align to the PCB, you can always drill one step larger (9/32") to allow a little more room correct any errors. The toggle switch washer and nut will still fully cover the hole.

DRILL TEMPLATE



ENCLOSURE LAYOUT

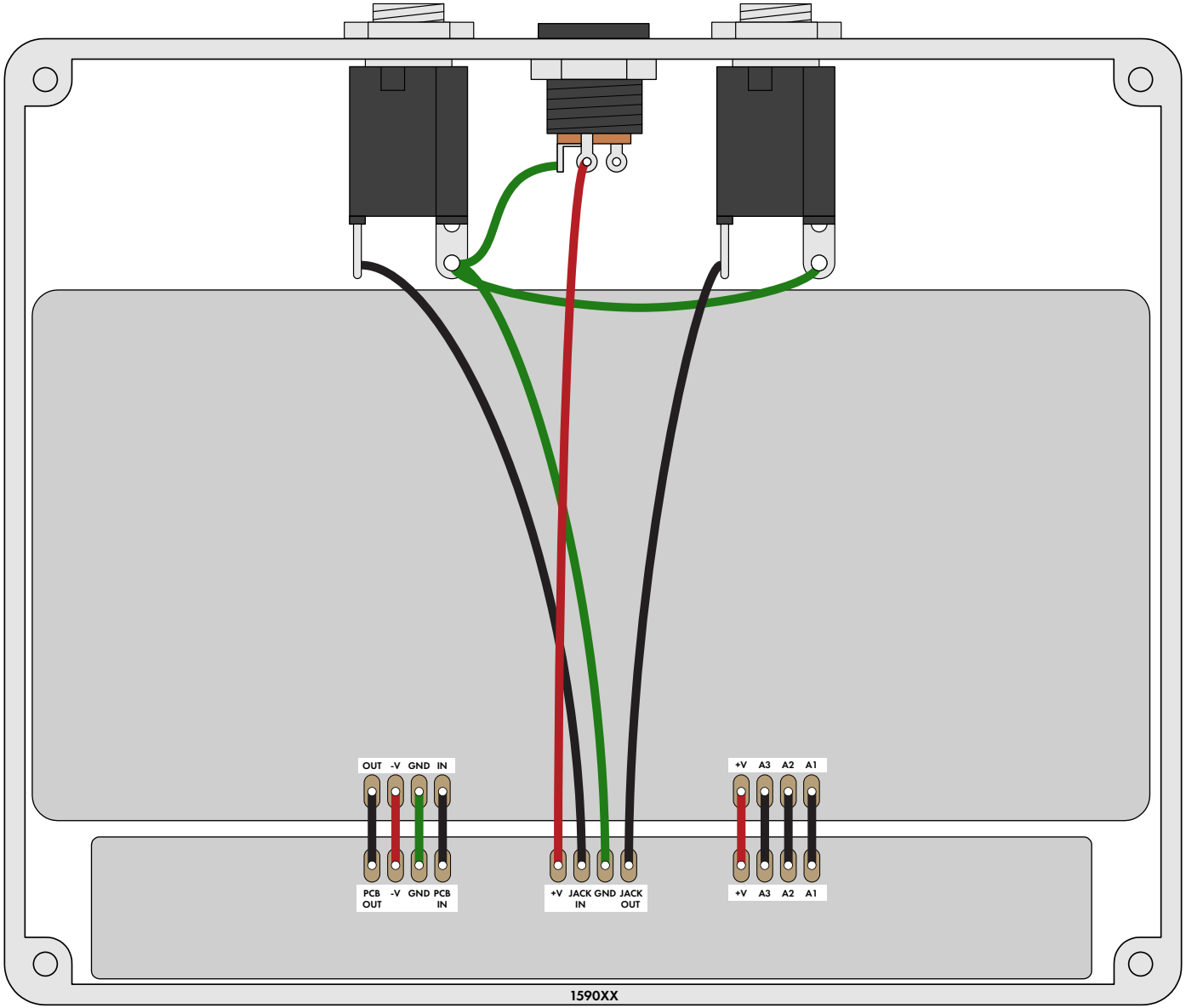
Enclosure is shown without jacks. See next page for jack layout and wiring.



Note: The upper pads for the dual-gang gain potentiometer appear to be cut in half. **This is intentional!** It's called a *plated half-hole* or *castellated via*, and it's used so that the PCB can lay flat across the pots instead of angling upward for the dual pot.

Solder these like you would if they were normal pads, but bend the upper set of pins forward slightly so they make contact with the inside of the pads.

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 (2025-01-04)

- Corrected Ch. 1 treble & bass pot values which were mistakenly listed as 25kB. Both should be 50kA.
- Added section about non-standard potentiometer tapers to the build notes.

1.0.0 (2023-07-04)
Initial release.