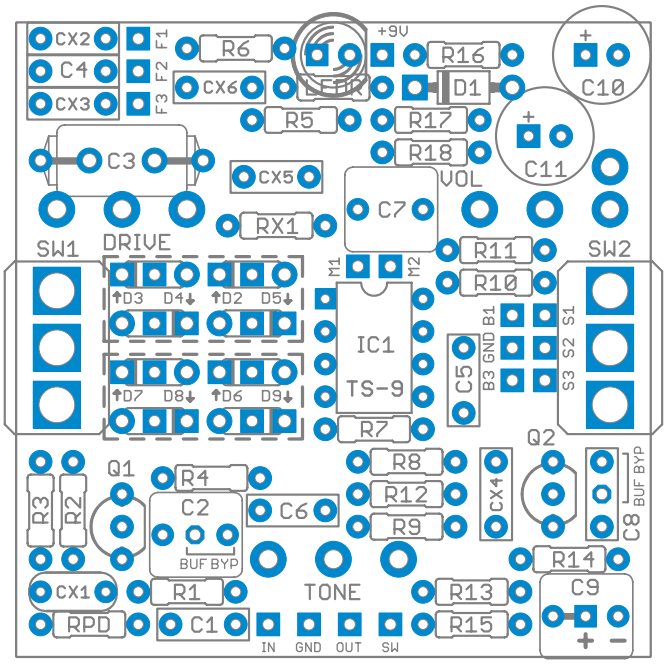
Stratus Overdrive

Ibanez TS-9 Tube Screamer

Overview



The Stratus Overdrive project is a clone of the Ibanez TS-9 Tube Screamer, which needs no introduction. If you've ever wanted to mod the living daylights out of a Tubescreamer, I believe mine is by far the most versatile board you can use—I tried to incorporate all of the best modifications as options. Further along in this document you'll find component values and notes for a few of the more popular variants.

There are two switches available: one for clipping diodes (with enough pads available for any diode combination you can dream of, as well as "comp cut" or diode lift in the middle), and a second one that can be used for any of three other mods using jumper wires. More details on this below.

Controls & Usage

The Tube Screamer has the same control layout as most overdrive or distortion effects:

- **Tone** controls the treble response of the effect.
- **Drive** controls the amount of gain in the op amp feedback diode clipping stage.
- **Volume** controls the overall output.

Modifications & Experimentation

The **Clipping** switch mod allows you to set up a second set of diodes to toggle back and forth from stock. Extra pads have been provided so you can stack two diodes in a row if desired. (The middle two pads are connected in each diode.) If you use a SPDT center-off switch, the middle position becomes a diode lift mode (called "comp cut" on the Fulldrive), but you can also use a regular SPDT if you don't care about this. See further down for detailed diagrams on a few different diode configurations.

The second switch is a peculiarity. I couldn't pick just one mod, so I made it one-size-fits-all. By running jumper wires from different places on the board to the pads by the switch, you can "assign" a mod to it.

- The most popular mod is the **Bright** switch, allowing you to change the response of the tone stack.
- The **Fat** control from AMZ controls the bass corner frequency.
- The last one is the **Flat Mids** switch from the Fulldrive 2, which is just what it sounds like.

Parts (Stock Circuit)

Resistors

R1	1k
R2	510k
R3	10k
R4	10k
R5	4k7
R6	51k
R7	1k
R8	10k
R9	220R
R10	1k
R11	1k
R12	510k
R13	10k
R14	100R
R15	10k
R16	47R
R17	10k
R18	10k
RX1	47k [1]
RPD	1M to 2M2
LEDR	4k7

Capacitors

C1	22n
C2	1uF film
C3	51pF [2]
C4	47n
C5	220n [3]
C6	220n
C7	1uF film
C8	100n
C9	1uF film
C10	47uF 25v
C11	10uF 25v
CX1	20pF [1]
CX2	22n [1]
CX3	68n [1]
CX4	100n [1]
CX5	10n [1]
CX6	100n [1]

Semiconductors

Q1 - Q2	2N5088
IC1	JRC4558D
D1	1N4002
D2, 4, 6, 8	1N914 [4]
D3, 5, 7, 9	jumper [4]
LED	5MM

Potentiometers

Tone	20kW
Drive	500kB
Volume	100kA

Other

SW1 - SW2	SPDT center off

[1] **Part of a mod.** All the parts with an “X” in the number (e.g. CX4) are modifications. See next page.

[2] **Can be film, ceramic, silver mica or polystyrene.** I included space for the huge Xicon polystyrene caps, which I like a lot, but the pads in the middle have been provided for other caps with 5mm lead spacing.

[3] **Important**: If you’re not using the Bright mod, you need to **jumper B1 to GND** in order for the tone capacitor to be properly connected.

[4] **Your choice.** The stock TS circuit is shown here, but the clipping section is extremely flexible. See the page further down for a variety of ideas. I recommend using sockets so you can experiment.

Additional Part Notes

- Capacitors are shown in nanofarads (n or nF) where appropriate. 1000n = 1uF. Many online suppliers do not use nanofarads, so you’ll often have to look for 0.047uF instead of 47n, 0.0056uF instead of 5n6, etc.
- The PCB layout assumes the use of film capacitors with 5mm lead spacing for all values 1nF through 470nF. I prefer EPCOS box film or Panasonic ECQ-B/V-series.
- Potentiometers are Alpha 16mm right-angle PCB mount.
- Switches are Taiway (Small Bear) or Mountain Switch (Mouser) brand with solder lugs. I prefer the short-toggle variety, but that’s just a matter of aesthetics.
- I recommend using these dust covers / insulators from Small Bear to insulate the back of the pots from the board and prevent shorts. If you don’t use these, use some electrical tape or cardboard to act as insulation. The right-angle pots will make direct contact with the solder pads otherwise.

Modifications & Experimentation

Fat Mod

Allows you to switch a capacitor value to change the bass corner frequency. Include **CX2** and **CX3** and connect **F1 to S1**, **F2 to S2** and **F3 to S3**. The values given for CX2 and CX3 are arbitrary and can be customized to taste. They are switched in parallel with C4, so the total capacitance will be the sum of C4 and the CX capacitor being switched (e.g. 69n for CX2 + C4 and 115n for CX3 + C4).

Bright Mod

Allows you to switch a capacitor value to change the response of the tone stack. Include **CX4** and connect **B1 to S1**, **GND to S2** and **B3 to S3**. The value given for CX4 is arbitrary, but the idea is that at half of the stock capacitor's value (220n), it will give you a little more brightness, while the center (off) position will give you even more. The other side of the switch is the stock circuit.

Note that if you are **not** using the Bright mod, you need to **jumper B1 to GND** in order for the tone capacitor to be properly connected.

Flat Mids Mod

Taken from the Fulldrive 2, this removes the "mid hump" that the Tube Screamer is known for. Include **RX1** and **CX5** and connect **M1 to S1** and **M2 to S2**. Note that if you use a center-off switch here, you will have two "off" positions and one "on".

Other Mods

CX1 is only found in the Fulldrive. It looks to be a very slight treble bleed at the input before anything happens to the signal, probably related to RF interference I don't know that it has much value unless you're building a straight Fulldrive clone.

CX6 is for power stability / noise reduction. I label it a mod because some TS variants include it and others don't, but it won't affect the sound at all and you might as well include it on any variant.

Drive control range increase: This is another very common TS mod. By reducing the value of **R5**, you'll have more gain at maximum and less gain at minimum. However, you'll also want to increase **C4** proportionally as well, otherwise you'll change the bass response of the circuit. Since R5 and C4 form a simple R-C filter, you can use the R-C filter calculator at AMZ to tweak the values.

For instance, the stock TS-9 circuit has a corner frequency of **720 Hz** with R5 at 4.7k and C4 at 47n (0.047uF). If you wanted to drop the 4.7k resistor to, say, 3.3k, you'd enter **3300** in the Resistor field and enter **720** in the Corner Frequency field, and hit **Calculate** to find the new value of C4 (in this case, **0.067uF**). Since capacitors come in standard values, you'll have to settle for the nearest available value, which is **68n**.

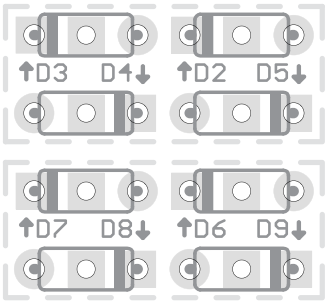
If you want to change the gain range of any variants described below, start with their listed values for R5 and C4 in order to preserve their corner frequency.

Bypassing the buffers: A couple of TS variants such as the Lovepedal Eternity and Fulltone RTO use the core Tube Screamer circuit without one or both of the buffers.

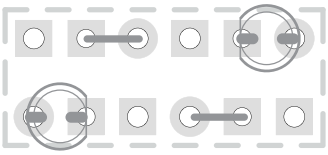
To bypass the input buffer, omit R2, R3, Q1 and C2. Jumper the pads marked "BUF BYP" inside C2.

To bypass the output buffer, omit R11-15, Q2, C8 and C9. Jumper R11 and connect pin 1 of the Volume pot to the pad just above the normal pad (this is ground instead of VR). You'll have to bend the leg back and upward a little bit, but it will fit without any trouble. Next, you'll want to connect pin 2 of the Volume pot directly to OUT by jumpering the pads marked "BUF BYP" inside C8.

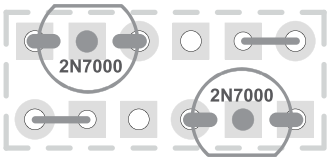
Diode Clipping Options



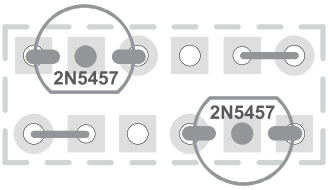
Close-up of silkscreen. (Square pad pairs are always connected.)



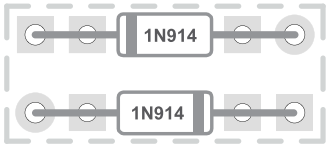
LED clipping



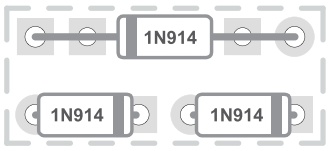
MOSFET clipping



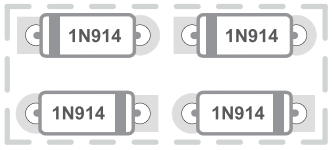
JFET clipping



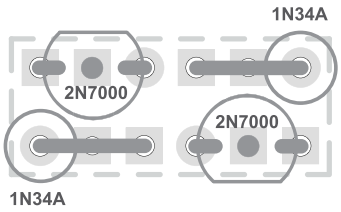
Stock TS-9 (symmetrical clipping)



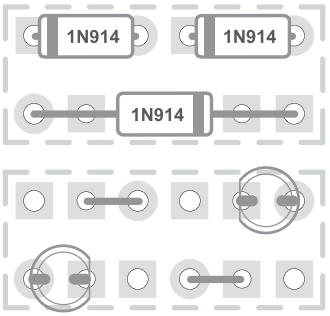
Boss SD-1 (asymmetrical clipping)



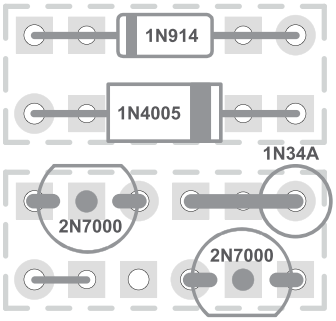
Lovepedal Eternity, Marshall Bluesbreaker



Zendrive

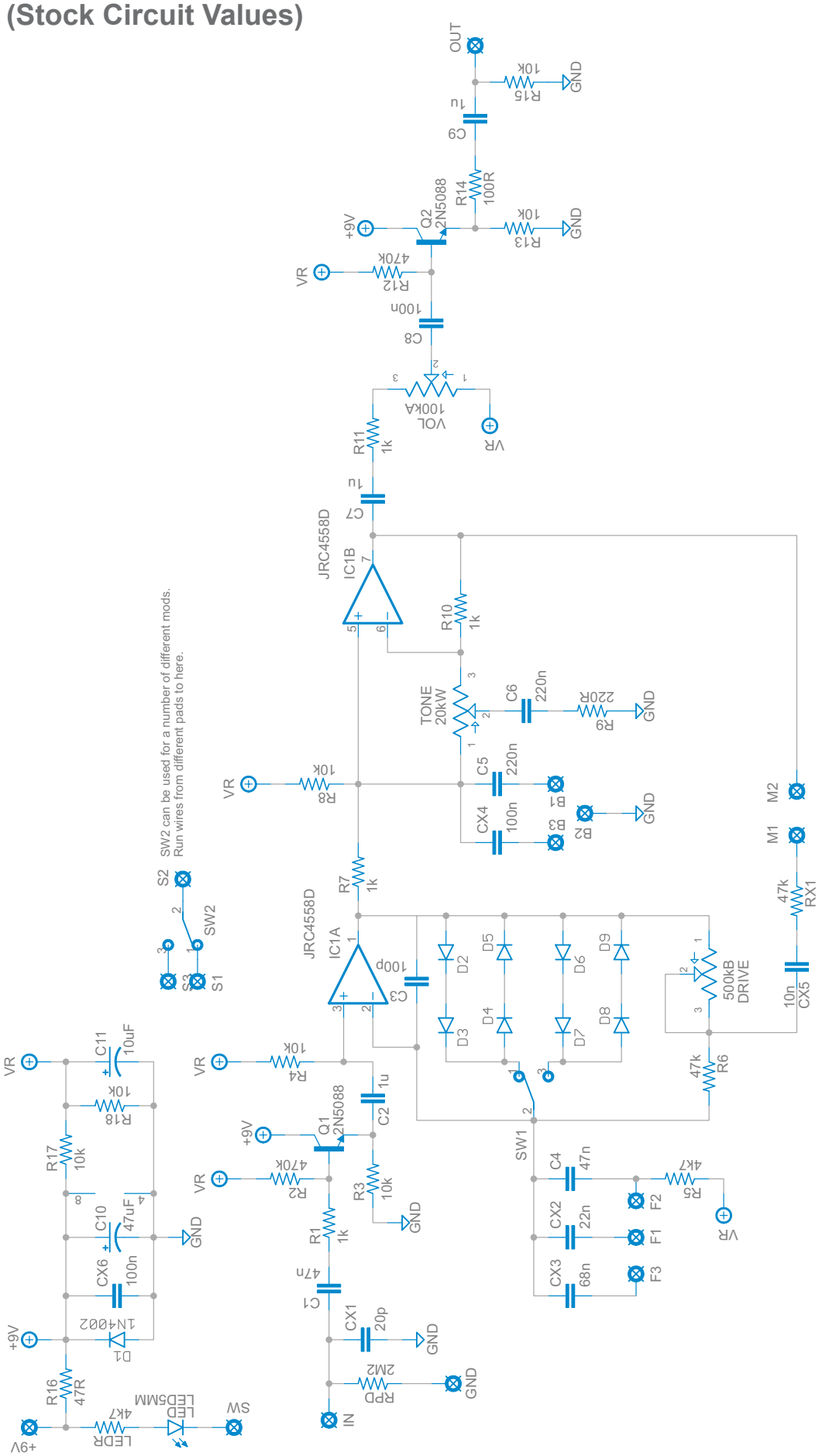


Landgraff Dynamic Overdrive (asymmetrical silicon on top, LED on bottom)



Fulldrive 2 (Silicon top, MOSFET bottom)

Schematic (Stock Circuit Values)



Variations

Fulldrive 2 MOSFET, single-channel version

Resistors

R1	1k
R2	510k
R3	10k
R4	10k
R5	2k7 [2]
R6	19k6 (or 20k) [2]
R7	1k
R8	10k
R9	220R
R10	1k
R11	1k
R12	510k
R13	10k
R14	100R
R15	82k
R16	jumper
R17	10k
R18	10k
RX1	47k [1]

Capacitors

C1	22n
C2	1uF film
C3	51pF
C4	120n [2]
C5	220n
C6	220n
C7	1uF film
C8	100n
C9	10uF
C10	100uF 25v
C11	100uF 25v
CX1	10pF
CX5	10n [1]

Semiconductors

Q1 - Q2	2N5088
IC1	JRC4558D
D1	1N4002
D2	1N914
D4	1N4005
D6	1N34A
D7, D8	2N7000
D3, D5, D9	jumper

Potentiometers

Tone	25kB
Drive	1MB
Volume	100kA

Other

SW1	SPDT center off
SW2	SPDT

Build Notes

[1] To be exactly like the original, you'll want to use the switch for the **Flat Mids** mod: include **RX1** & **CX5** and connect **M1 to S1** and **M2 to S2**.

[2] Since this is the single-channel version, I've tweaked these values so it'll have the same minimum and maximum gain of both channels of the original unit. This is just a simple R-C filter, so these new values won't change the tone at all. The original values are **R5 = 3k3**, **R6 = 22k** and **C4 = 100n**.

Landgraff Dynamic Overdrive / Clay Jones Overdrive (same circuit)

Resistors

R1	1k
R2	510k
R3	10k
R4	10k
R5	1k
R6	10k
R7	1k
R8	10k
R9	220R
R10	1k
R11	1k
R12	510k
R13	10k
R14	100R
R15	10k
R16	jumper
R17	10k
R18	10k

Capacitors

C1	20n (22n is OK)
C2	1uF film
C3	51pF
C4	220n
C5	220n
C6	220n
C7	1uF film
C8	100n
C9	10uF
C10	100uF 25v
C11	47uF 25v

[1] If using a 2SC1815 (E-C-B), you will need to twist the C and B legs around to fit the E-B-C pads. But a 2N5088 would also work fine here.

Semiconductors

Q1 - Q2	2SC1815 [1]
IC1	JRC4558D
D1	1N4002
D2	1N914
D4	1N914
D6	LED
D8	LED
D3, 5, 7, 9	jumper

Potentiometers

Tone	25kB
Drive	1MB
Volume	100kA

Other

SW1	SPDT center off

Boss SD-1 (true bypass)

Resistors

R1	10k
R2	470k
R3	10k
R4	100k
R5	4k7
R6	33k
R7	10k
R8	18n **capacitor** [1]
R9	470R
R10	10k + 10n [2]
R11	4k7
R12	1M
R13	10k
R14	1k
R15	100k
R16	jumper
R17	33k
R18	33k

Capacitors

C1	47n
C2	18n
C3	(omit)
C4	47n
C5	(omit)
C6	27n
C7	1uF film
C8	47n
C9	1uF film
C10	100uF 25v
C11	47uF 25v

[1] Yep, a capacitor.

[2] There's not enough space on the board for both of these. I recommend soldering the 10n capacitor in the resistor's place and then soldering the resistor across the lugs on the bottom of the board. However, you can also just solder the capacitor across the top of the resistor.

Semiconductors

Q1 - Q2	2N5088
IC1	RC4558P
D1	1N4002
D2, D3, D4	1N914
D5	jumper

Potentiometers

Tone	20kW
Drive	1MB
Volume	10kB

Lovepedal Eternity (Original)

Resistors

R1	(jumper)
R2	(omit) [1]
R3	(omit) [1]
R4	1M
R5	1k
R6	10k
R7	1k
R8	(omit) [1]
R9	470R
R10	1k
R11	(jumper) [1]
R12	(omit) [1]
R13	(omit) [1]
R14	(omit) [1]
R15	(omit) [1]
R16	390R
R17	10k
R18	10k

Capacitors

C1	56n
C2	(omit) [1]
C3	(omit) [1]
C4	220n
C5	150n
C6	150n
C7	22uF 25v
C8	(omit) [1]
C9	(omit) [1]
C10	47uF 25v
C11	47uF 25v

Semiconductors

Q1 - Q2	(omit) [1]
IC1	LM1458 [2]
D1	1N4002
D2, D3, D4	1N914
D5	(jumper)

Potentiometers

Tone	5kB
Drive	100kA
Volume	100kA [1]

[1] See “Bypassing the buffers” above in the Mod section and follow the instructions to bypass both of the buffers. Lug 1 of the pot must be bent and connected to the upper pad (ground instead of Vref).

[2] The exact type of IC is unknown, though the general consensus is that it’s probably an LM1458. Many others have been tried and the OPA2604 or NE5532 have both been reported to sound great in this circuit as well.

Lovepedal Eternity (“Burst” Edition)

Resistors

R1	(jumper)
R2	(omit) [1]
R3	(omit) [1]
R4	1M
R5	3k3
R6	20k
R7	1k
R8	(omit) [1]
R9	330R
R10	1k
R11	(jumper) [1]
R12	(omit) [1]
R13	(omit) [1]
R14	(omit) [1]
R15	(omit) [1]
R16	330R
R17	10k
R18	10k

Capacitors

C1	47n
C2	(omit) [1]
C3	(omit) [1]
C4	100n
C5	220n
C6	150n
C7	10uF 16v
C8	(omit) [1]
C9	(omit) [1]
C10	47uF 25v
C11	47uF 25v

Semiconductors

Q1 - Q2	(omit) [1]
IC1	LM1458 [2]
D1	1N4002
D2-D5	1N914

Potentiometers

Tone	5kB
Drive	500kA
Volume	500kA [1]

[1] See “Bypassing the buffers” above in the Mod section and follow the instructions to bypass both of the buffers. Lug 1 of the pot must be bent and connected to the upper pad (ground instead of Vref).

[2] The exact type of IC is unknown, though the general consensus is that it’s probably an LM1458. Many others have been tried and the OPA2604 or NE5532 have both been reported to sound great in this circuit as well.

Fulltone RTO (Robin Trower Overdrive)

Resistors

R1	1k
R2	(omit) [1]
R3	(omit) [1]
R4	1M
R5	4k7
R6	18k
R7	1k
R8	10k
R9	220R
R10	1k
R11	1k
R12	510k
R13	10k
R14	100R
R15	100k
R16	(jumper)
R17	10k
R18	10k

Capacitors

C1	22n
C2	(omit) [1]
C3	51pF
C4	100n
C5	220n
C6	150n
C7	1uF film
C8	100n
C9	10uF
C10	47uF 25v
C11	10uF 25v

Semiconductors

Q1	(omit) [1]
Q2	2SC1815 [2]
IC1	LF353
D1	1N4002
D2	jumper
D3, D5	2N7000
D4	BAT41

Potentiometers

Tone	25kB
Drive	1MB
Volume	100kB

[1] Input buffer is bypassed. See “Bypassing the buffers” above in the Mod section and follow the instructions to bypass the input buffer only.

[2] If using a 2SC1815 (E-C-B), you will need to twist the C and B legs around to fit the E-B-C pads. But a 2N5088 would also work fine here.

Mad Professor / BJFE Little Green Wonder (with different tone section)

Resistors

R1	5k6
R2	1M
R3	10k
R4	27k
R5	2k
R6	5k6
R7	2k
R8	10k
R9	470R
R10	2k
R11	5k6
R12	(omit) [2]
R13	(omit) [2]
R14	(omit) [2]
R15	(omit) [2]
R16	47R
R17	27k
R18	27k

Capacitors

C1	47n
C2	1uF & 5k6 [1]
C3	100pF
C4	220n
C5	100n
C6	47n
C7	1uF film
C8	100n
C9	10uF
C10	100uF 25v
C11	100uF 25v

Semiconductors

Q1	2SK170 [3]
Q2	(omit) [2]
IC1	TLC272CP
D1	1N4002
D2, D4	Green LED
D3, D5	jumper

Potentiometers

Tone	20kW
Drive	500kB
Volume	50kB

[1] You’ll need to cram a 1uF cap and a 5k6 resistor in series in this single spot. It might be easier to do this from the bottom of the board so you have more space.

[2] See “Bypassing the buffers” above in the Mod section and follow the instructions to bypass the output buffer. Lug 1 of the pot must be bent and connected to the upper pad.

[3] If using a 2SK170, reverse the orientation from the PCB silkscreen.

[4] The LGW uses a dual-pot tone control to control the bass as well as the treble. This version does NOT have that. I recommend using the Fat Mod to help compensate, but you might also need to tweak some values in the tone section (C5, C6 and R9).

General Build Instructions

These are general guidelines and explanations for all Aion Electronics DIY projects, so be aware that not everything described below may apply to this particular project.

Build Order

When putting together the PCB, it's recommended that you do not yet solder any of the enclosure-mounted control components (pots and switches) to the board. Instead, follow this build order:

1. Attach the **audio jacks**, **DC jack** and **footswitch** to the enclosure.
2. Firmly attach the **pots** and **switches** to the enclosure, taking care that they are aligned and straight.
3. Push the **LED**[1] into the hole in the enclosure with the leads sticking straight up, ensuring that the flat side is oriented according to the silkscreen on the PCB.
4. Fit the **PCB** onto all the control components, including the leads of the LED. If it doesn't fit, or if you need to bend things more than you think you should, double-check the alignment of the pots and switches.
5. Once you feel good about everything, **solder them from the top**[2] as the last step before wiring. This way there is no stress on the solder joints from slight misalignments that do not fit the drilled holes. You can still take it out easily if the build needs to be debugged, but now the PCB is "custom-fit" to that particular enclosure.
6. Wire everything according to the wiring diagram on the last page.

[1] **For the LED**: You can use a bezel if you'd like, but generally it's easier just to drill the proper size of hole and push the LED through so it fits snugly. If you solder it directly to the PCB, it'll stay put even if the hole is slightly too big. Make absolutely sure the LED is oriented correctly (the flat side matches the silk screen) before soldering, as it'll be a pain to fix later! After it's soldered, clip off the excess length of the leads.

[2] **Note on soldering the toggle switch(es):** It will require a good amount of solder to fill the pads. Try to be as quick as possible to avoid melting the lugs, and be prepared to feed a lot of solder as soon as the solder starts to melt. I recommend waiting 20-30 seconds between soldering each lug to give it time to cool down.

"RPD" and "LEDR" resistors

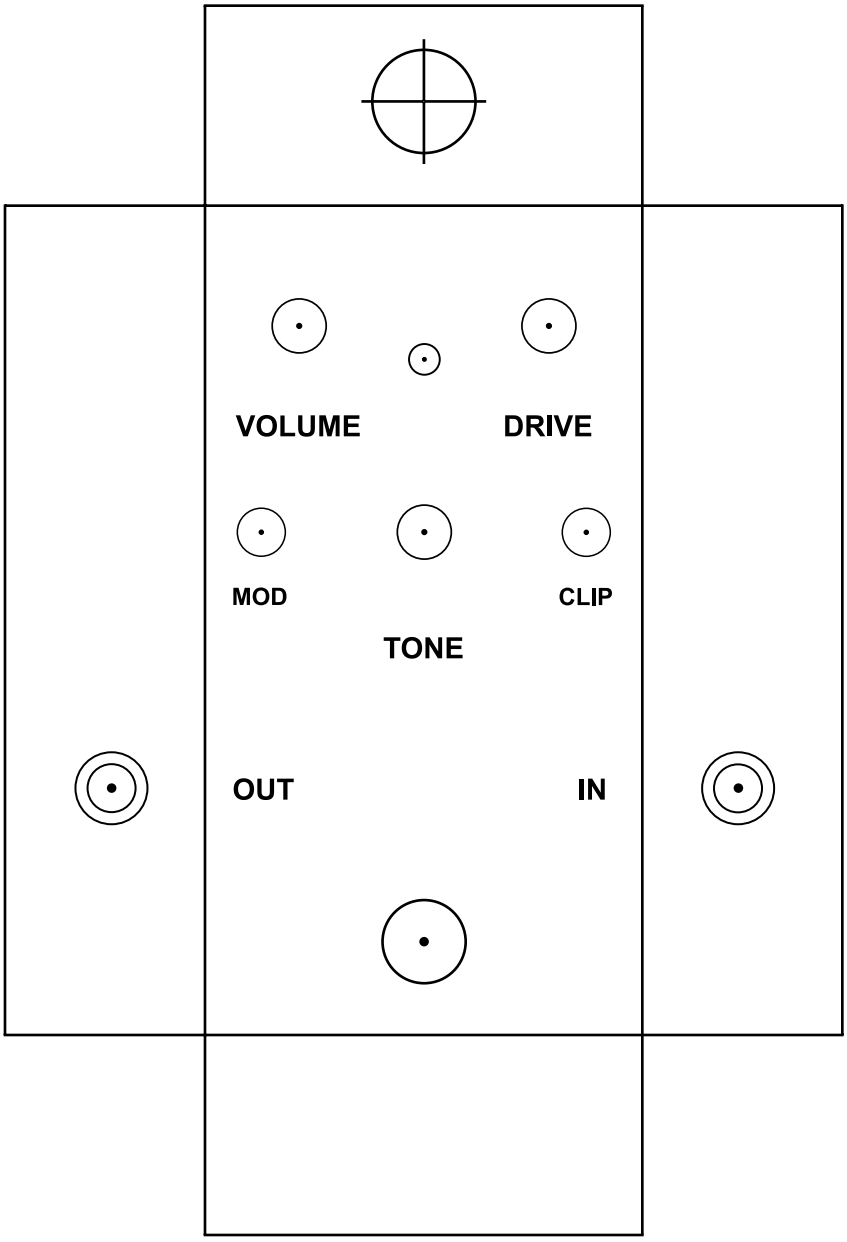
The resistors marked "RPD" and "LEDR" are generally not original to the circuit and can be adjusted to preference. "RPD" is the pulldown resistor to help tame true-bypass popping, while "LEDR" controls the brightness of the LED. I generally use 2.2M for the pulldown resistor and 4.7k for the LED resistor.

Sockets

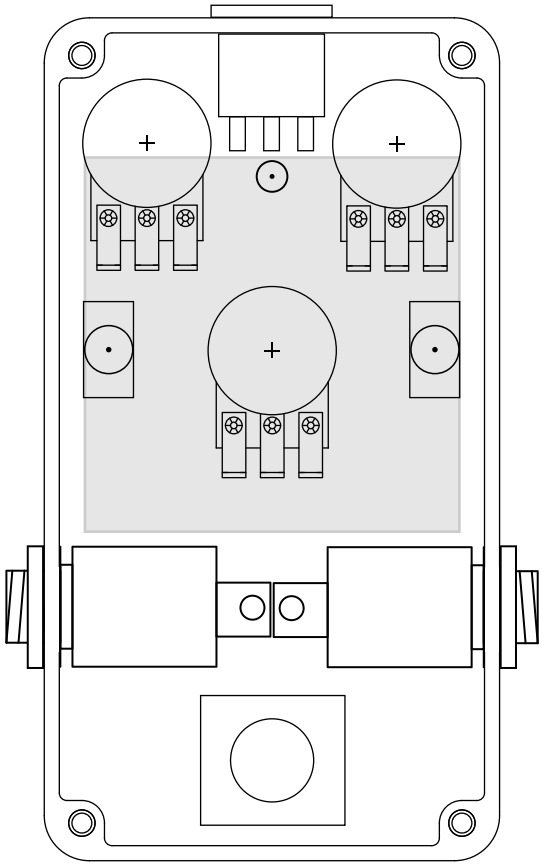
Since double-sided boards can be very frustrating to desolder, especially components with more than 2 leads, it is recommended to use sockets for all transistors and ICs. It may save you a lot of headaches later on.

Drilling & Placement

Print this page and have an adult cut out the drilling template below for you. Tape it to the enclosure to secure it while drilling. Note that the holes are shown slightly smaller than they need to be, so drill out the holes as shown and then step up until they are the correct size for the components.



Hammond 1590B
(bottom/inside view)



Parts Used

- Switchcraft #111A enclosed jacks
- Kobiconn-style DC jack with internal nut

Standard Wiring Diagram

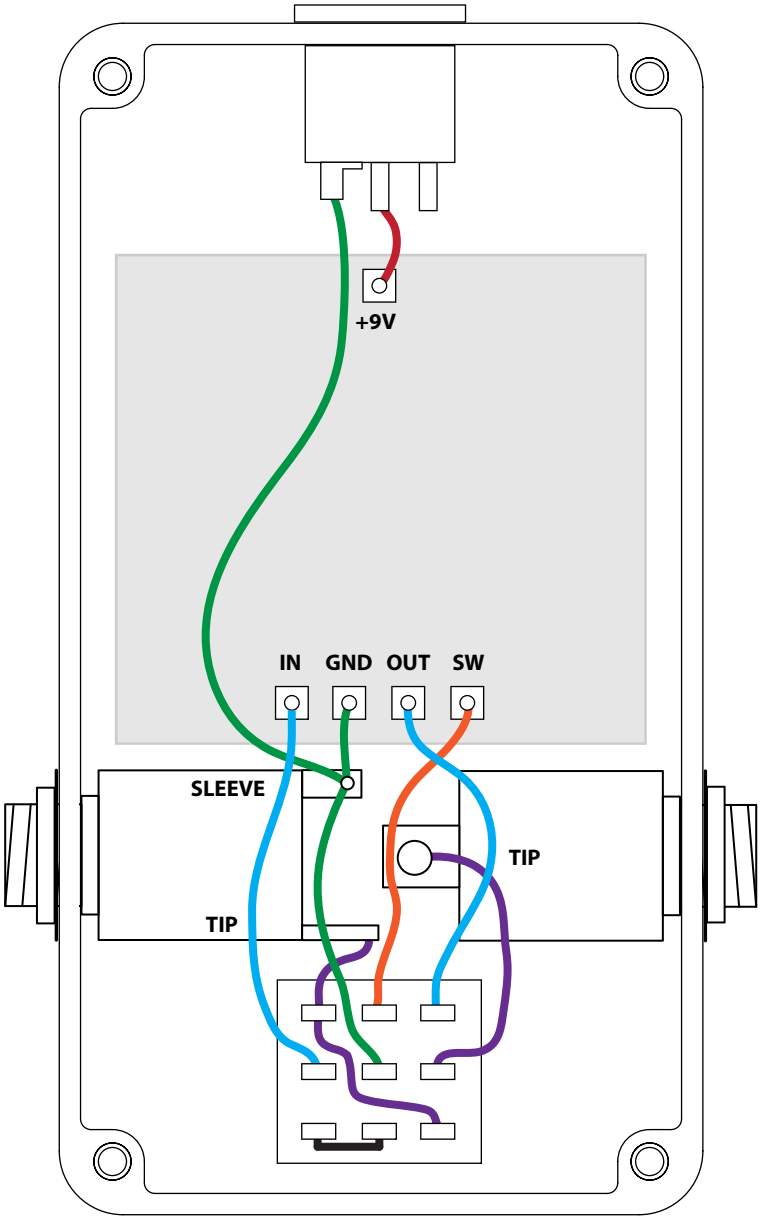
This diagram shows standard true-bypass wiring with a 3PDT switch. When the switch is off, the input of the circuit is grounded and the input jack is connected directly to the output jack.

The **SW** pad is the cathode connection for the LED. This will connect to ground to turn it on when the switch is on. Usage of the on-board LED connection is not required if you have specific placement needs for your enclosure, but's incredibly convenient.

The wiring diagram also makes use of **star grounding** principles where all of the grounds connect to a single ground point (in this case the sleeve of the input jack). This is best practice to avoid added noise caused by improper grounding. The sleeve of the output jack is unconnected.

If using a painted or powdercoated enclosure, **make sure both jacks have solid contact with bare aluminum** for grounding purposes. You may need to sand off some of the paint or powdercoat on the inside in order to make this happen.

Make sure to double-check the markings of the pads on the PCB for your particular project – they are not always in the order shown here!



License / Usage

No direct support is offered for these PCBs beyond the provided documentation. It is assumed that you have at least some experience building pedals before starting one of these. Replacements and refunds will not be offered unless it can be shown that the circuit or documentation are in error. I have in good faith tested all of these circuits. However, I have not necessarily tested every listed modification or variation. These are offered only as suggestions based on the experience and opinions of others.

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