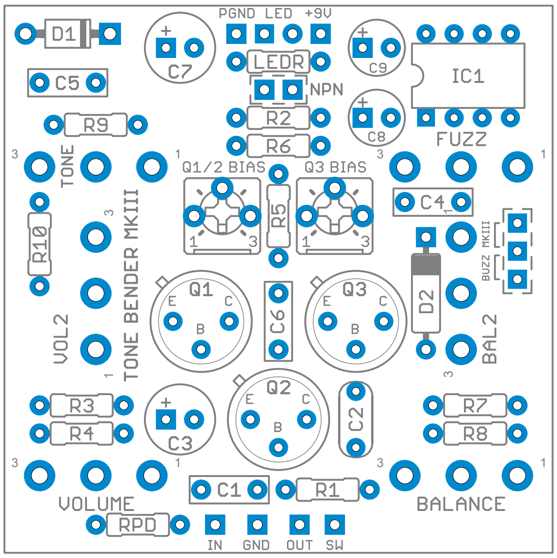
Phobos Fuzz

Coloursound Tone Bender Mark III

Overview

Phobos Project Link



The Phobos Fuzz is a clone of the Coloursound Tone Bender Mark 3 (three-knob). While the first version was essentially a slightly tweaked Fuzz Face, and the second version added a gain stage in front, this third version was a completely different circuit, using a Darlington-pair transistor configuration to drive a third transistor, followed by a tone control.

The original Sola Sound unit was not called the "Mark III", but the Vox-licensed version was. As a result, this circuit is commonly called both the "Mark III" and the "three-knob" Tone Bender.

The Phobos project has a voltage inverter which allows you to power the effect with a standard center-negative adapter while maintaining the positive-ground operation of the original. The PCB also includes space for biasing trim pots so you can dial in a perfect bias without having to swap out resistors.

Controls & Usage

- **Fuzz** controls the attenuation of the signal coming out of the first boost stage, which changes the amount of gain going through the third transistor. As you reduce the attenuation, the "fuzz" effect is increased.
- **Tone** pans between two filters to balance out the treble response of the circuit.
- **Volume** is the output level of the effect.
- **Balance** is only used in the Buzzaround variant. It acts as an external bias control for Q3, which affects the fuzz character as well as the overall volume.

Modifications

The TB Mk III has a whole lot of variants which are very similar in circuit topology but have a couple of key differences. Alongside the original Sola Sound Tone Bender, this PCB will allow you to build the Baldwin-Burns Buzzaround, Park Fuzz Sound, Vox Tone Bender Mk III, and Prescription Electronics Yard Box.

There are four different PCB-mounted pots on this board. None of the stock variants uses all four, though the board does allow for this if you want to use them. Specifically, the Buzzaround has a "Balance" control that comes before the tone control and acts in place of a standard volume, and the output is then taken directly from the tone control's middle lug. As a result, the "Volume" and "Balance" pots each have two different orientations, allowing you to maintain a symmetrical "triangle" knob layout on any version.

Pay special attention to the parts list and notes for the version you are building—it's a simple circuit, but the different configurations can get confusing!

Important note: There are three jumper pads on the right side of the board. You must jumper two of these pads regardless of which version you are building or the effect **will not work**. If you're building a Buzzaround, jumper the middle and bottom pads (marked "BUZZ"). For any of the other versions, jumper the middle and top pads (marked "MKIII").

Sola Sound Tone Bender (3-knob)

Capacitors

C1	100n film
C2	220pF ceramic / MLCC
C3	10µF electro
C4	220n film
C5	100n film
C6	2n2 film
C7	47µF electro
C8	10µF electro [1]
C9	10µF electro [1]

Resistors

R1	47k
R2	220k
R3	10k
R4	3k3
R5	1k [2]
R6	1k [2]
R7	18k
R8	10k
R9	10k
R10	220k [3]
RX1	jumper
RPD	2M2
LEDR	4k7

Semiconductors

Q1–Q3	PNP Ge [4]
IC1	TC1044S [1]
D1	1N4742 [1]
D2	1N270 or similar
LED	5mm LED

Potentiometers

Fuzz	100kB [5]
Tone	100kB
Volume	100kA [3, 6]
Balance	(bypass)
Q1/2 Bias	10k trim (3362P) [2]
Q3 Bias	10k trim (3362P) [2]

Build Notes

[1] **Part of the voltage inverter circuit.** Omit these and use a standard 1N4001 for D1 if you want to either (1) use NPN transistors, or (2) power the circuit with an isolated supply and reverse the DC jack wiring. Both of these are outside the scope of this documentation—in other words: if you don't know how, don't try!—but in either case you will want to jumper the pads marked **NPN** up near the top of the PCB.

[2] **Bias resistors:** Use 1k for R5 and R6 if you are using the bias trimmers. If you want to omit the trimmers, jumper pads 1 and 2 (left and top) and use **10k** for both R5 and R6. See page 5 for biasing information.

[3] **Output volume:** The stock 220k resistor drops the volume by a good amount. To get more output, try a **68k** resistor here, and change the output volume pot to 250kA. This gives you the same total resistance (~320k) so the tone and output impedance is unaffected, but you have a higher available output volume.

[4] **Germanium transistors:** For this circuit, as with other vintage fuzzes, it's not so much the part number of the germanium transistor as it is the properties (gain and leakage). See page 5 for more information.

[5] **Jumpers:** Make sure to jumper the **top and middle** pads below the Fuzz control (marked "MKIII").

[6] **Volume pot taper:** The original uses a linear (B) taper, but an audio (A) taper will be much more usable here. The available range is the same either way.

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.
- 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.

Baldwin-Burns Buzzaround

Capacitors

C1	100n film
C2	(omit)
C3	4μ7 electro
C4	4μ7 electro
C5	100n film
C6	1n film
C7	47μF electro
C8	10μF electro [1]
C9	10μF electro [1]

Resistors

R1	100k
R2	470k
R3	10k
R4	3k3
R5	1k [2]
R6	27k
R7	jumper
R8	(omit)
R9	10k
R10	(omit)
RX1	15k
RPD	2M2
LEDR	4k7

Semiconductors

Q1–Q3	PNP Ge [3]
IC1	TC1044S [1]
D1	1N4742 [1]
D2	1N270 or similar
LED	5mm LED

Potentiometers

Fuzz	100kB [4]
Tone	100kB
Volume	(bypass) [5]
Balance	10kB [6]
Q1/2 Bias	10k trim (3362P) [2]
Q3 Bias	jumper pads 1 & 2

Build Notes

[1] **Part of the voltage inverter circuit.** Omit these and use a standard 1N4001 for D1 if you want to either (1) use NPN transistors, or (2) power the circuit with an isolated supply and reverse the DC jack wiring. Both of these are outside the scope of this documentation—in other words: if you don't know how, don't try!—but in either case you will want to jumper the pads marked **NPN** up near the top of the PCB.

[2] **Bias resistor:** Use 1k for R5 if you are using the Q1/2 bias trimmer. If you want to omit the trimmer, jumper pads 1 and 2 (left and top) and use **10k** for R5. See page 5 for biasing information.

[3] **Germanium transistors:** For this circuit, as with other vintage fuzzes, it's not so much the part number of the germanium transistor as it is the properties (gain and leakage). See page 5 for more information.

[5] **Jumpers:** Make sure to jumper the **middle and bottom** pads below the Fuzz control (marked "BUZZ").

[5] **Volume:** The stock Buzzaround does not have a volume control. Instead, it uses the "Balance" control as a volume of sorts, although it's not very effective because it actually just biases the Q3 transistor. As a result, many people elect to add a true volume control as well. To do this, **jumper R10** and use **100kA** for Volume. If using all 4 knobs, you'll want to orient them all in the alternate (downward) position for a square knob layout.

[6] **Balance control:** Some versions of the Buzzaround use **5kB** here instead. You can increase it to **25kB** to have a greater control range.

Other Variants

There were a number of other variants of TB Mk III that each had minor changes. Start with the original Sola Sound Tone Bender parts list on page 2 of this documentation and make the following changes.

Vox Tone Bender Mk III

- R1 → 100k; R2 → 680k; C3 → 6.4μF; C6 → 2n
- Note: C6 doesn't make much of a difference; you can just use 2n2 here like the Sola Sound version.

Park Fuzz Sound (2-knob)

- R1 → 100k; R2 → 680k; R10 → 470k; C2 → 220pF; C4 → 25μF
- The 2-knob version omits the Fuzz control and hardwires it full-on all the time. If you're building this version I recommend keeping the Fuzz control in place. If it's turned all the way up, the unit is stock, but this way you still have the option to turn it down.

Park Fuzz Sound (3-knob)

- R1 → 100k; R2 → 680k; C3 → 6.4μF
- Almost identical to the Vox version; the only difference is C6, which is 2n in the Vox and 2.2n here. However, this will make almost no tonal difference and was probably just a manufacturing convenience. Note that this is very different from the 2-knob version above!

Prescription Electronics Yard Box

- C3 → 4.7μF; Fuzz → 250kB
- The Yard Box changes R10 from a 220k fixed resistor to a 250kB pot. Most people do not find this to be very useful since it essentially just increases the maximum volume, acting as a second volume control rather than causing any major tonal changes. I recommend leaving off this control, but if you do want to use it, you can omit R10 and wire a pot between the pads.

Jumpers

For each of the above variants, you will want to set the jumpers the same as a stock Mk III: jumper the top and middle pads under the "Fuzz" control (the two marked "MKIII"), and jumper the "BALANCE BYPASS" pads below the Balance control.

Each of the above units is positive ground, so the voltage inverter circuit will work for any of them and can be implemented as described on page 2.

Transistor Selection & Biasing

A person could write a book, or at least a pretty lengthy essay, about germanium transistors and their use in vintage fuzz circuits. I don't have the level of expertise to do this, so what follows is far from the full story, but it's what you need to know to get a great-sounding fuzz that's as close to the original units as possible.

Sourcing

First off: **you can save yourself a lot of time by buying a matched set of Tone Bender Mk III transistors.** They aren't terribly cheap, but compared to buying a bunch of old-stock transistors and testing and sorting them yourself, probably throwing away a number of them in the end, it's a bargain. So I very strongly recommend going that route if you can. Here are a few great sources:

Small Bear Electronics (USA) - One of the first companies to offer selected and matched germanium transistors and still the best. International shipping can be a little pricey, but you know you're getting a set that was matched by people who know what to look for. You'll want a set marked "3-Knob Tone Bender" or "Buzzaround" depending on which variant you are building.

LIC Pedals (USA) - This eBay seller has great prices on a number of different types of sets.

Musikding (Germany) - For European DIYers, Musikding has a great selection of NOS transistors. They don't sell sets, so you'll have to buy them individually based on desired gain range. (See "Characteristics" below.)

Characteristics

What follows is some very general information about what makes an ideal Tone Bender Mk III transistor, since some online stores only sell transistors individually by gain range. (These are ideal, but it'll be fine if yours are a few HFe outside the range. That's what the bias trimmers are for.)

Q1: 60-70 HFe, low leakage
Q2: 60-70 HFe, low leakage
Q3: 90-120HFe, medium leakage (100-400µA)

The characteristics of Q1 and Q2 are less important than Q3 due to the Darlington configuration. In fact, some people have even experimented with low-gain silicons here with no change in tone since this stage just boosts the signal a bit. This can also significantly reduce the noise since silicon is much quieter than germanium.

Biasing

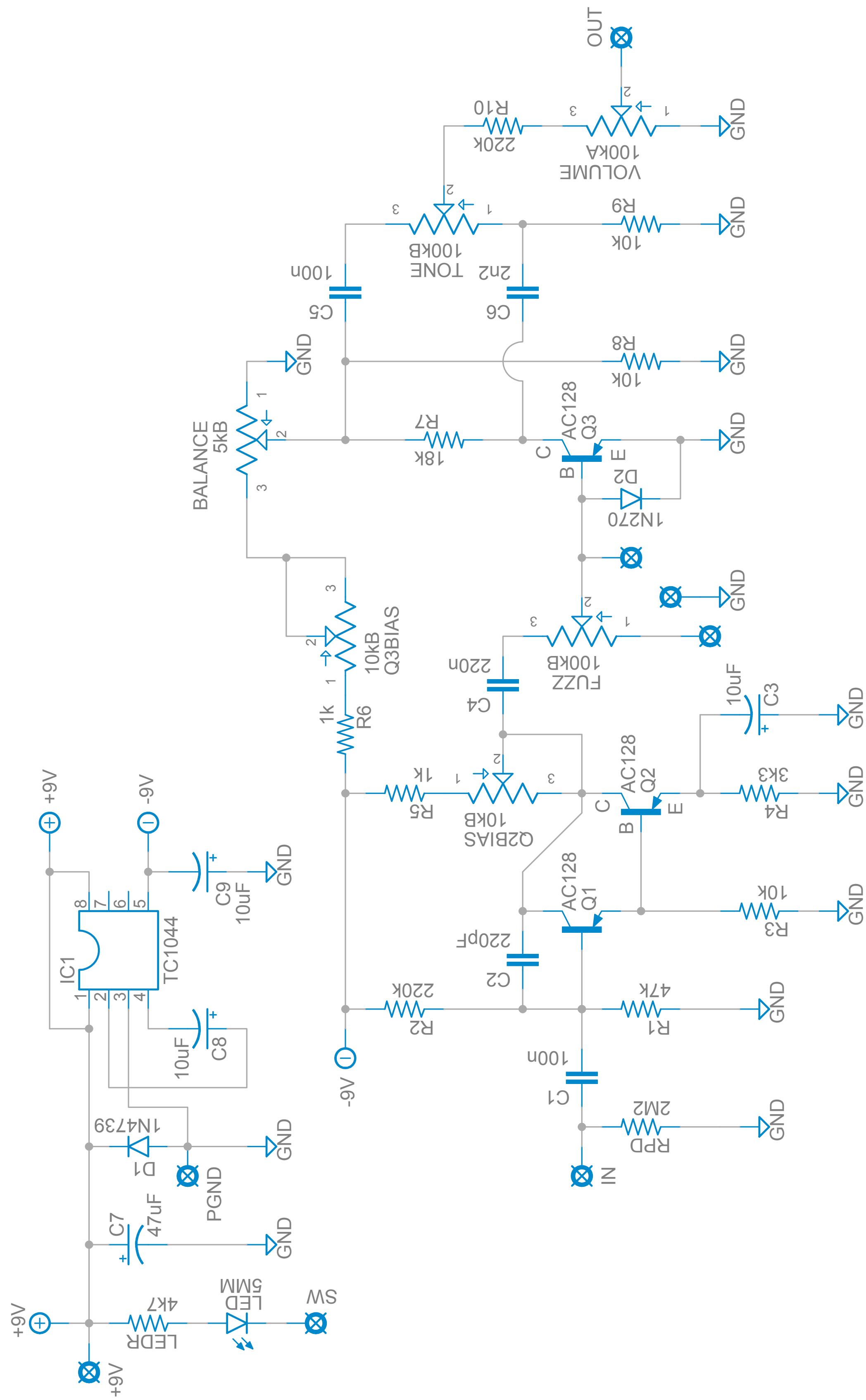
The Phobos Fuzz project is set up to allow for **easy biasing of the Q1/Q2 and Q3 transistors via trim pots** without having to swap out resistors. As a starting point, set the two bias trimmers to around 90% rotation (approximately **10k total resistance** when combined with R5 and R6). Then, with a multimeter, touch the black (common) lead to ground and touch the red lead to each leg of each of the transistors. You're looking for something near these voltages.

Q1: Collector -3.5v, Base -1.5v, Emitter -1.4v
Q2: Collector -3.5v, Base -1.5v, Emitter -1.4v
Q3: Collector -2v, Base -0.05v, Emitter 0v

The collectors of Q1 and Q2 are tied together, so they will always carry the exact same voltage—you don't need to measure both collectors when biasing.

The -3.5v target voltage of Q1/Q2 is just a baseline. Some have reported great sounds with collector voltages as high as -6.5v. Use your ears and don't be afraid to stray from what's listed.

Schematic


OUT
R10
220k
VOLUME
100kA
GND
TONE
100kB
R9
10k
C5
100n
C6
2n2
BALANCE
5kB
R8
10k
R7
18k
AC128
Q3
D2
1N270
Q3BIAS
10kB
FUZZ
100kB
C4
220n
R6
1k
C3
10uF
R5
1k
Q2BIAS
10kB
AC128
Q2
R4
3k3
AC128
Q1
R3
10k
C2
220pF
R2
220k
R1
47k
C1
100n
RPD
2M2
IN
-9V
+9V
IC1
TC1044
C9
10uF
C8
10uF
D1
1N4739
PGND
C7
47uF
LEDR
4k7
LED
5MM
SW

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

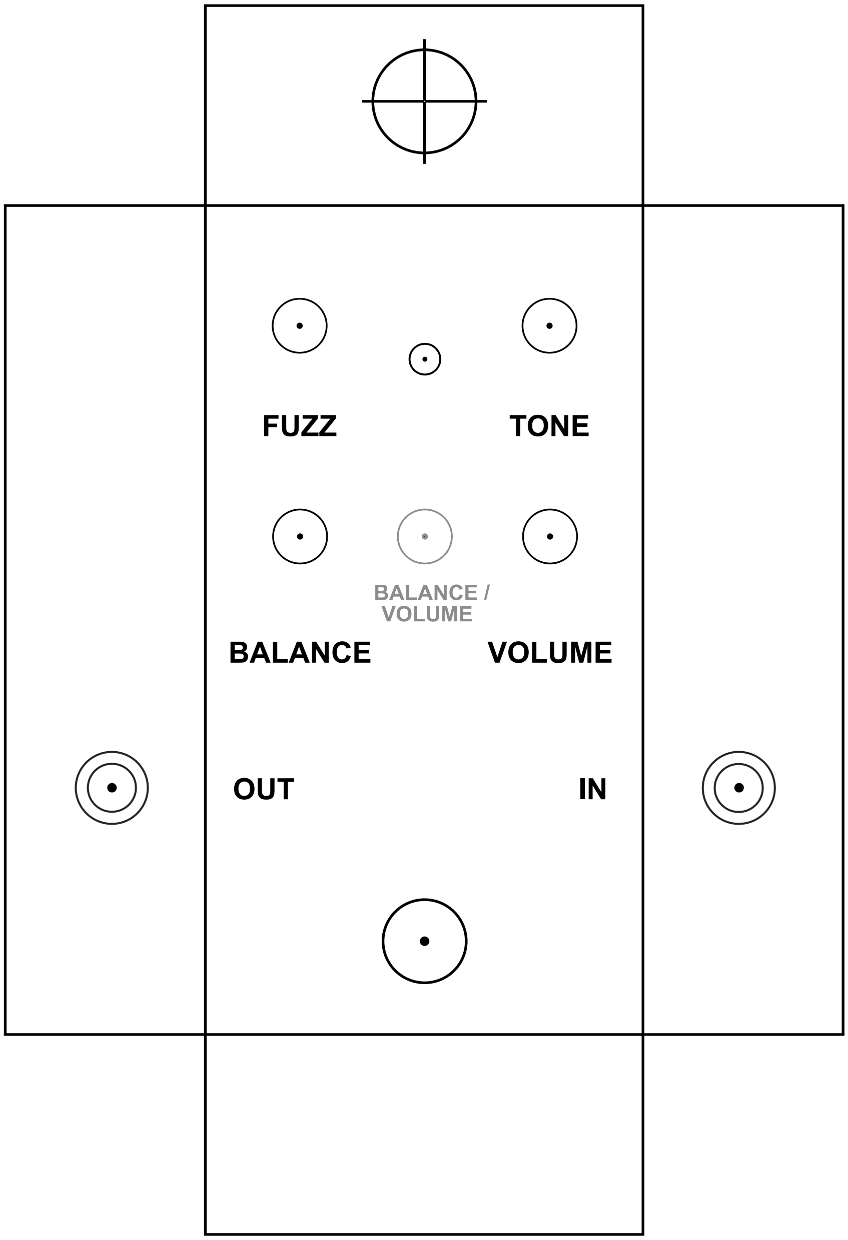
The resistors marked "RPD" and "LEDR" are generally not original to the circuit and can be adjusted to preference. "RPD" is the pulldown resistor to help tame true-bypass popping, while "LEDR" controls the brightness of the LED. I generally use 2.2M for the pulldown resistor and 4.7k for the LED resistor.

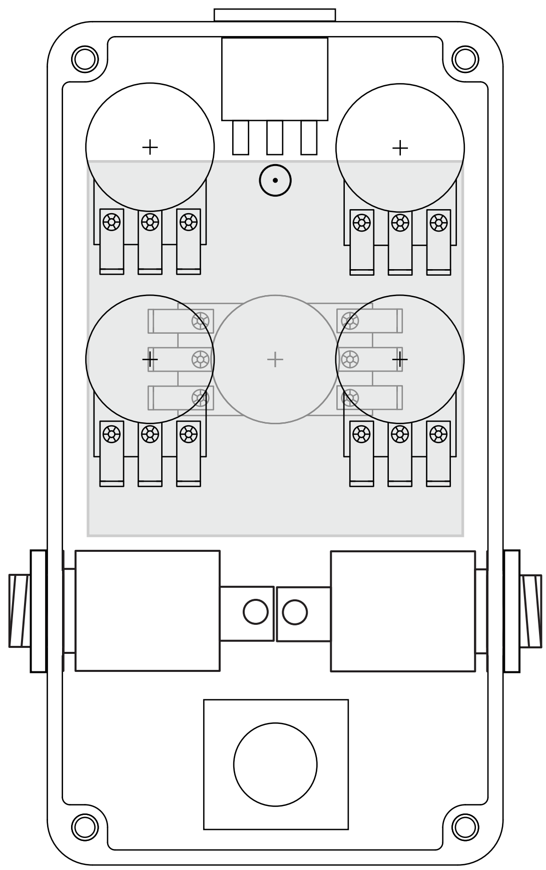
Sockets

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 cut out the drilling template below. Fold the flaps down the sides of the enclosure and use tape 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.





Parts Used

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

Standard Wiring Diagram

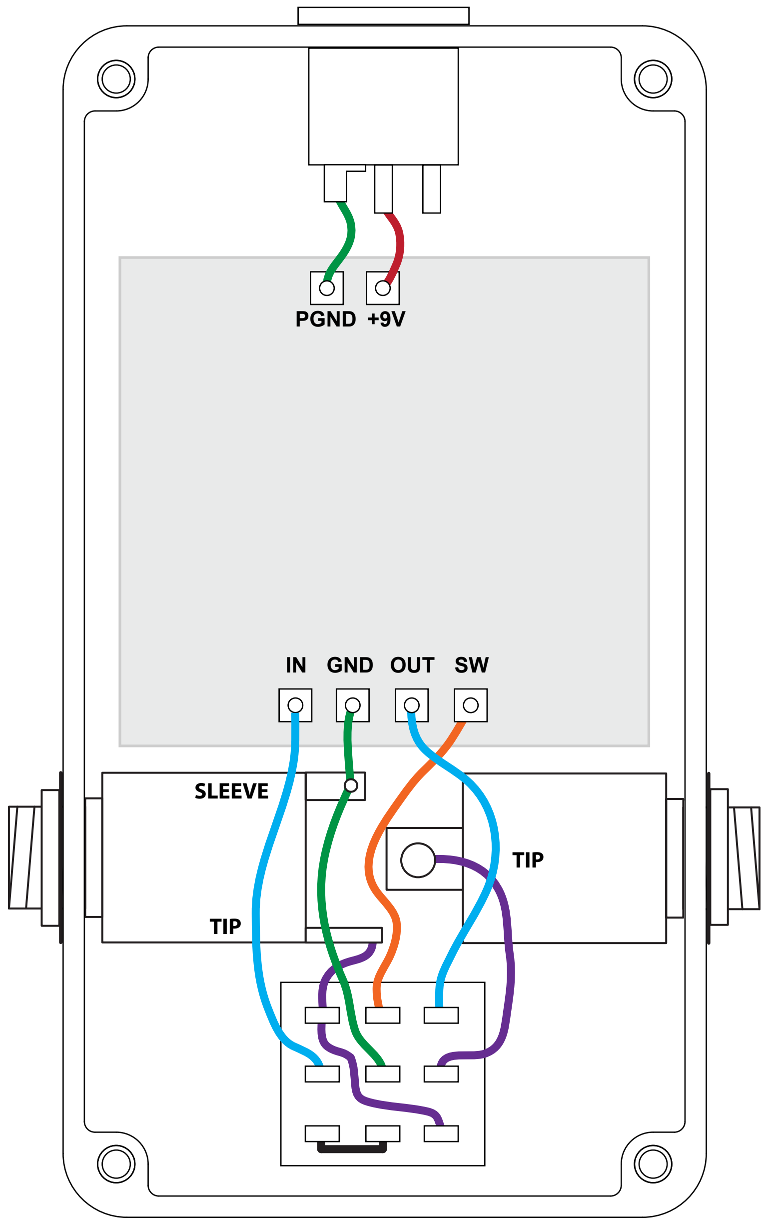
This diagram shows standard true-bypass wiring with a 3PDT switch. When the switch is off, the input of the circuit is grounded and the input jack is connected directly to the output jack.

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.

Projects may be used for commercial endeavors in any quantity unless specifically noted. No bulk pricing or discounting is offered. 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**, 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 pedal industry needs more transparency, not less!)