FOOT-SWITCH WIRING FOR GUITAR PEDALS

Beginners are often confused about how one should correctly wire a 3PDT foot-switch for true bypass operation. Most often, this is due to a lack of understanding of how the 3PDT switch operates. Let's fix that.

Standard Taiwan 3PDT foot-switch

fig.1

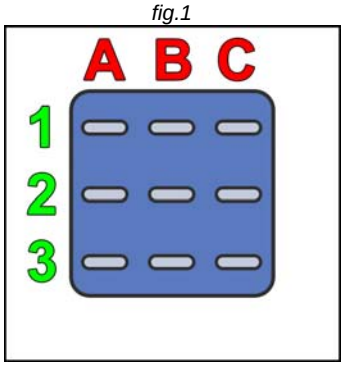


Fig.1 shows a bottom view of the 3PDT foot-switch.

What the? This thing has nine lugs! How can anyone keep track of what they all do? Well, it's actually pretty easy. The 3PDT is nothing more than three SPDT switches sandwiched together.

fig.2

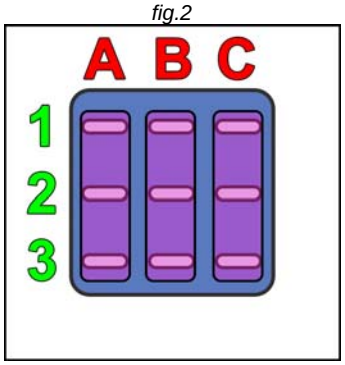


Fig.2 shows the 3PDT as three, independent SPDT switches.

Each SPDT switch is represented by columns A, B and C. In each switch, lug 2 is common. Lugs 1 and 3 are the two states of the switch. In other words, in one state the foot-switch connects lug2 to lug1. In the other state it connects lug2 to lug3. And, it does this simultaneously for all three switches.

fig.3

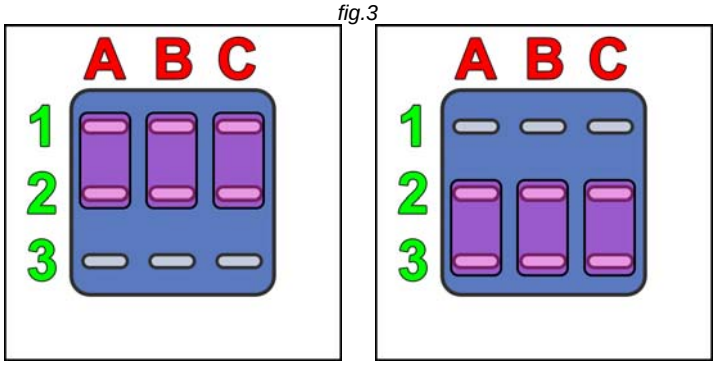
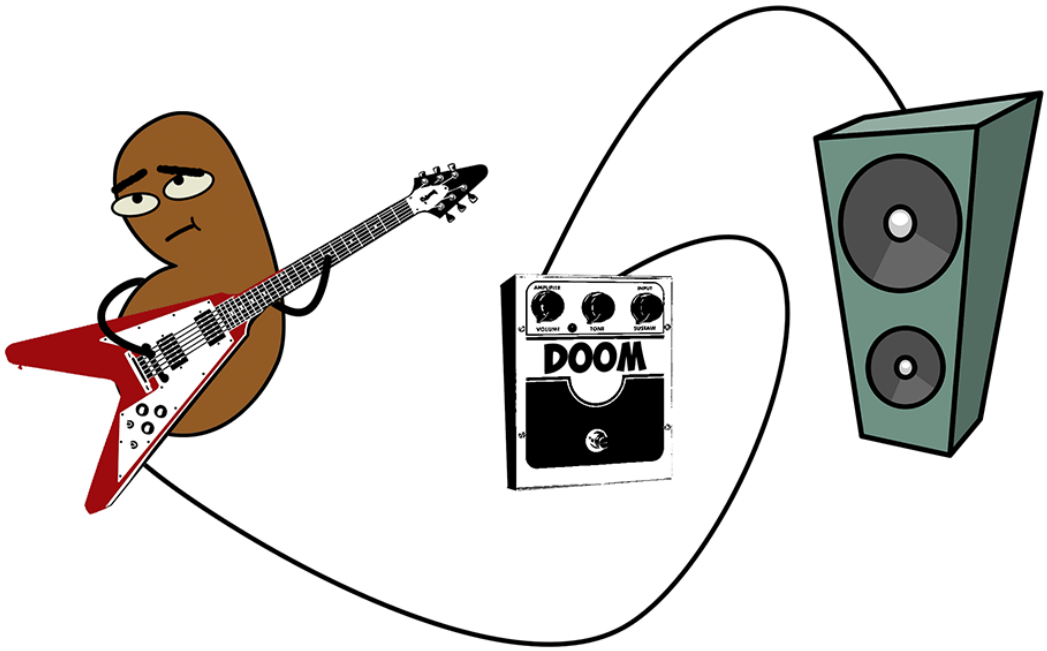


Fig.3 shows the two different "states" of the 3PDT foot-switch.

How does knowledge relate to our switching? Let's look at an example.

Here is Bean with his guitar, plugged into his DOOM pedal which is plugged into his amp. The pedal is in bypass. Bean's blooze are boring. His riffs are not stank.

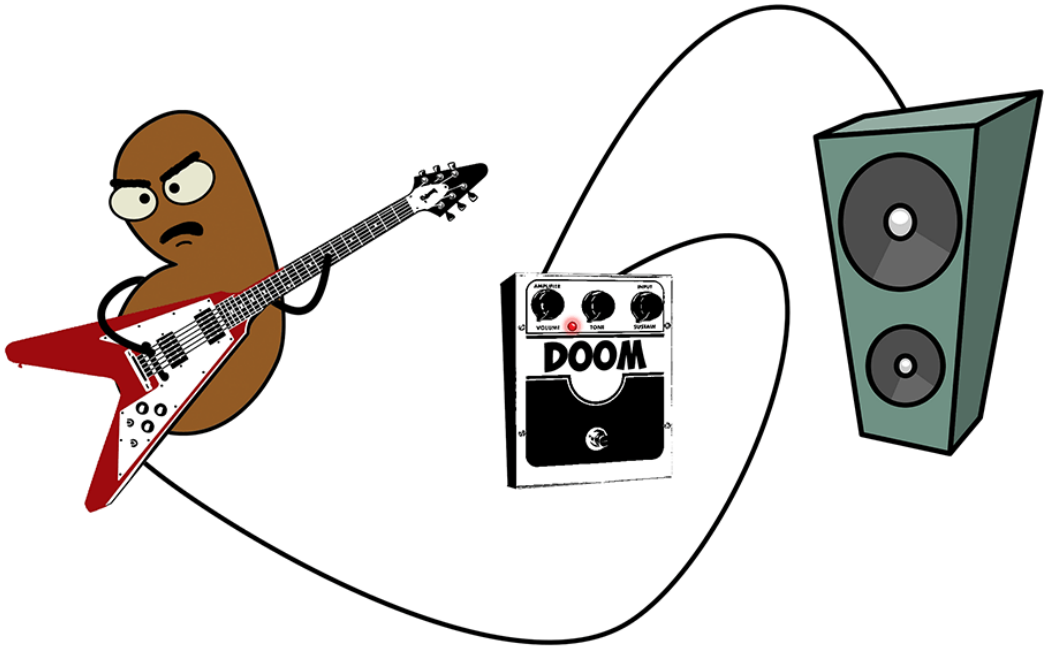
fig.4



His penta-ma-tonics…they suck.

Now let's look at Bean when Doom is on. See how happy he is? He's crushing fat stacks. His "Smoke on the Water" is divine!

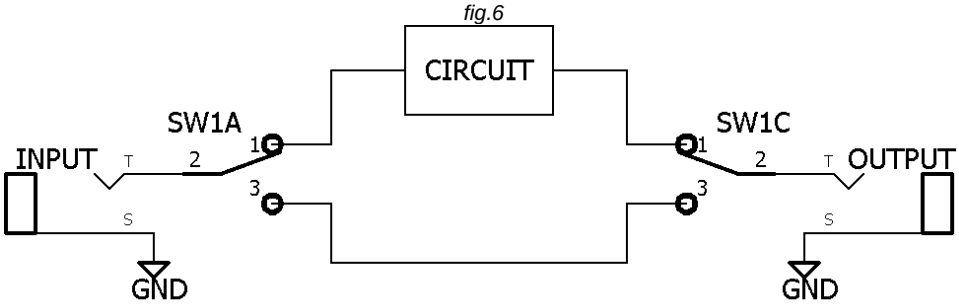
fig.5



His riffs are now stank.

So, Bean has two states; just like our switch! Yes, I realize these illustrations were not necessary to make the point, but are you going to tell *him* that?
Now let's look at a schematic representation of our bypass switching. Since the foot-switch has two "states" we should designate one as "on" and the other as "off". On the 3PDT it doesn't matter which set of lugs goes to which state, but generally we consider the "up" position (when lug2 and lug1 are connected) to be "on" and the down position (when lug2 and lug3 are connected) to be "off".

fig.6

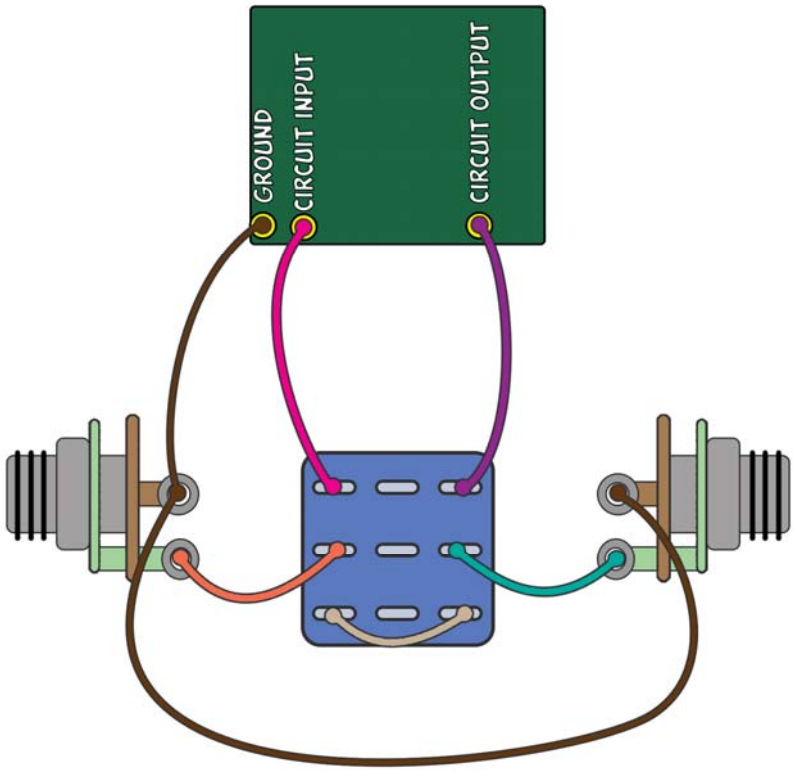


SW1A correlates column A in figure2. SW1C correlates to column C.

Hey, this is pretty easy! When SW1A and SW1C are in the up position, the input travels from lug2 to lug1 on SW1A and then to the input of the circuit. The output of the circuit goes to lug1/2 of SW1C and to the output. When it's in the down position the input goes straight from SW1A lug2/3 to lug3/2 of SW1C and to the output. So, when it's down it bypasses the circuit entirely eg. TRUE BYPASS.

<u>Here is an illustration of how that is wired on a 3PDT</u>

fig.7

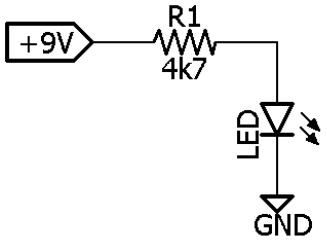


Here the orange wire is the input and the green wire is output. In the up position, the orange and pink wires are connected and the purple and blue wires are also connected. In the down position, the orange, beige and blue wires are connected to create our bypass. The sleeves of the two jacks are wired together which are then tied to a common grounding point on the circuit board.

But wait! What about an LED? Gotta know when the thing is on, after all. Easy enough. We left the middle SPDT switch unwired, so let's use that to create an LED indicator.

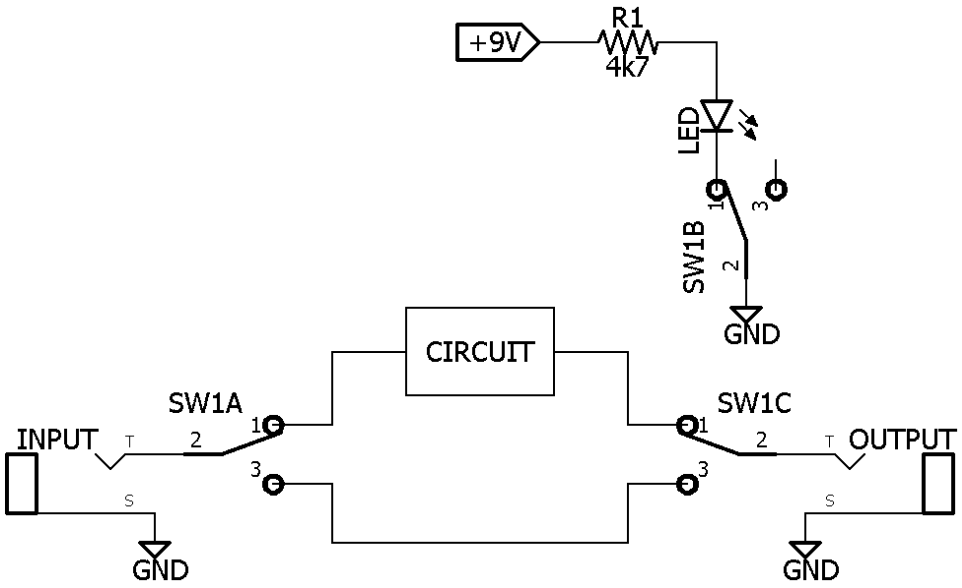
Here is our typical LED sub-circuit. We supply +9v (or whatever DC voltage we are using for our effect) into a current limiting resistor which connects to the ANODE (+) of the LED. The CATHODE (-) of the LED is connected to ground and our LED lights up. The value of the resistor determines the overall brightness. 4k7 is generally a good value for diffused LEDs and 10k – 22k is good for super-bright, water clear LEDs.

fig.8



However, this isn't quite right. If we connect it this way, our LED will always be on! We only want it to come on when the circuit is being used, not when it is bypassed. IOW, we want the LED activated when the foot-switch is in the "up" position. There are different ways to do this and the most common is to switch out the ground from the LED cathode to turn it off. Now our circuit looks like this:

fig.9

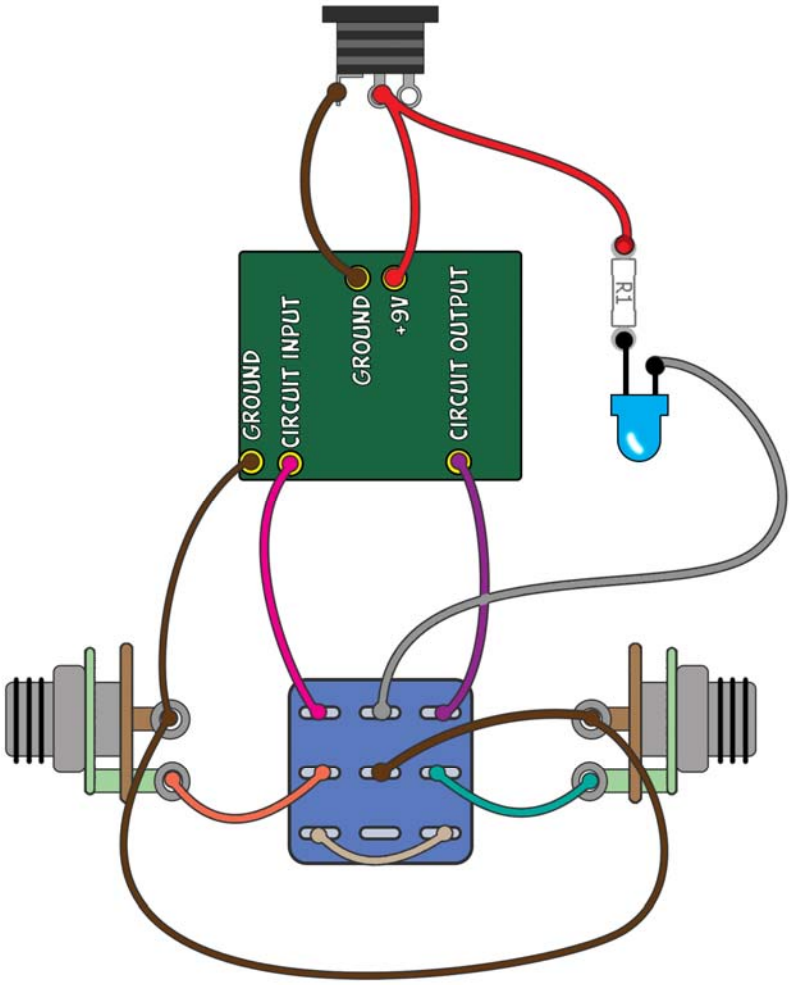


So, when our rows of lugs 1 and 2 are connected across the three SPDT switches in our 3PDT, the LED is connected to ground and lights up. When lugs 2 and 3 are connected, the ground from the LED is removed and the LED goes dark.

BTW: it doesn't matter if we flipped SW1B and connected lug2 to the LED and lug1 to ground. The results would be the same. However, if we used lug3 instead of lug1, then our LED would actually light up in bypass instead!

Here is the completed 3PDT wiring

fig.10



But what if, unlike Bean, you are stuck in the 1970's and still use environment destroying batteries for pedals? How do we include that?

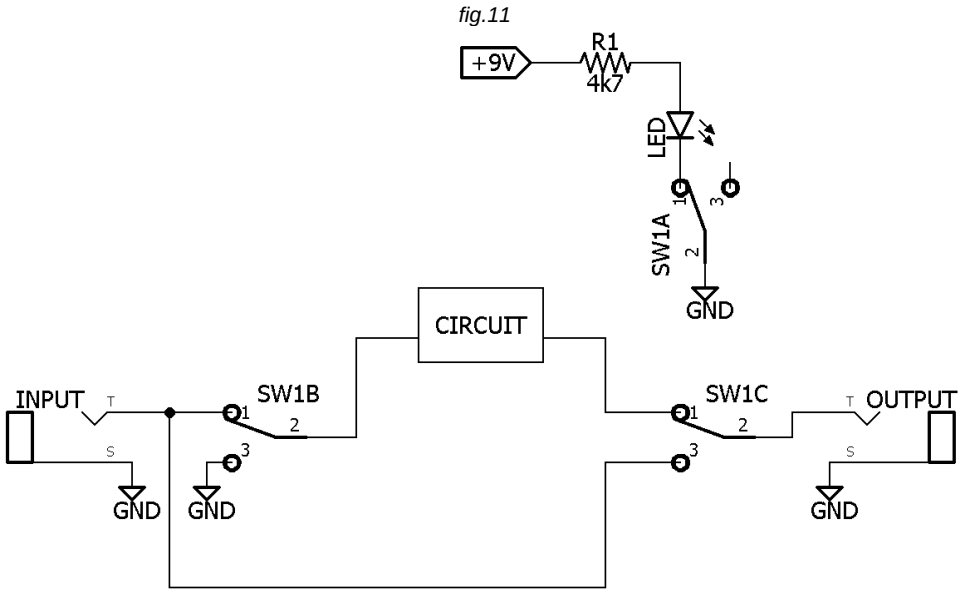
Get with the program. It's 2015 and the only time you should use batteries is to put them in your flashlight during the zombie apocalypse. I won't be an enabler!

So this method is good, and it will work for 10/10 true bypass builds. But, could it be improved? Are there situations where this particular kind of bypass is not ideal? Turns out there are. Any circuit we are building that is very high gain, or particularly noisy can benefit from a better bypass. This is because unshielded wire can become microphonic in certain settings and even push noise into the bypass signal thereby ruining our true bypass efforts altogether.

To construct a better switch-based bypass we will use a technique to ground the circuit input when the effect is bypassed. This method does not always eliminate potential switching problems, but it gets us there most of the time. When we ground the circuit input, we've eliminated any signal bleed from propagating through the circuit. It also has the advantage that *should our input coupling cap ever fail* or become leaky then any DC voltage present at the circuit input will not dump right back into our guitar.

Here is a schematic drawing of an input grounding bypass

fig.11

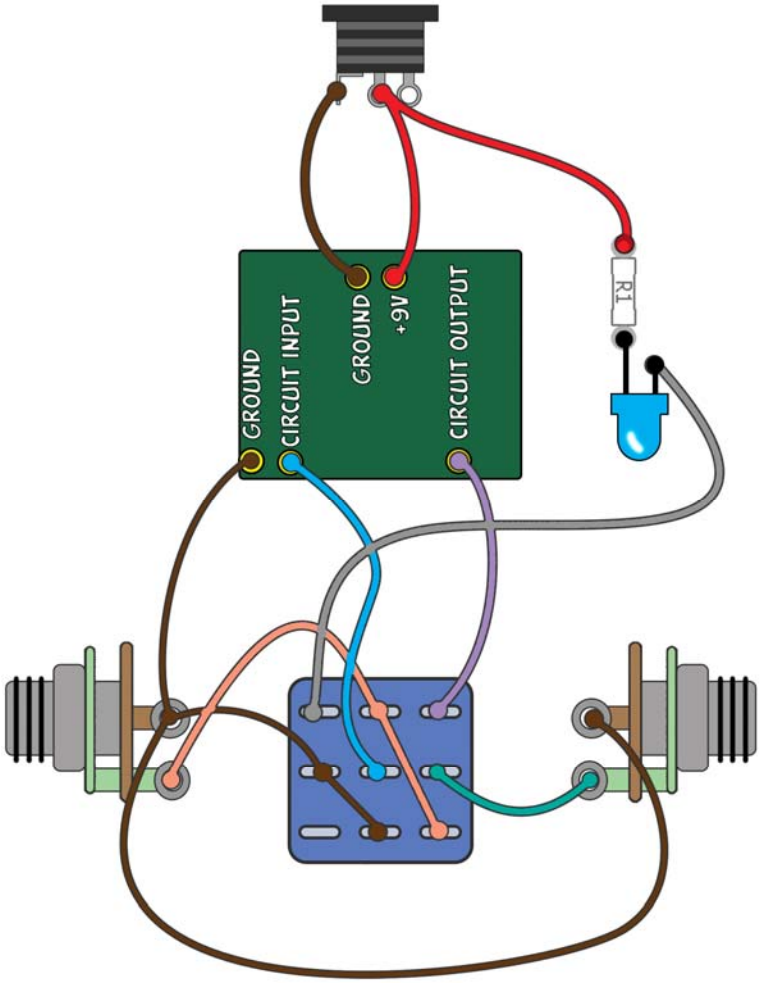


A bit more complicated but not too hard to follow. Let's look.

SW1A and SW1B have been swapped on the input and LED. There's a good reason for this which you will see in the wiring illustration below.

Our input is now connected to two places; SW1B lug1 and SW1C lug 3. Why? When our foot-switch is in the up position, the input connects to the circuit input, just like the previous wiring. Our input is also connected to lug3 of SW1C, but in the up position it is left open…it doesn't connect to anything else. When the foot-switch is down, that input is now connected to lug2 of SW1C and thus the output. But, now the input of the circuit is grounded! Our LED still connects in the same way as before, just to a different SPDT in the 3PDT foot-switch.

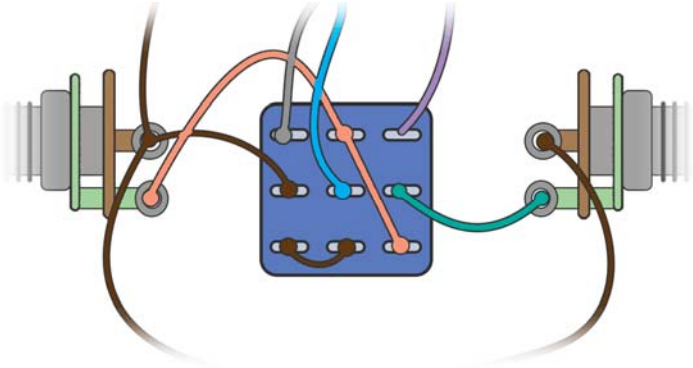
Here is the completed input grounded wiring



Now you can see why we changed the order of the individual SPDTs in our foot-switch. It makes the input (orange) wiring much easier!

We can make one final adjustment. We've got an open lug on the bottom left. Rather than leave that, let's ground it too!

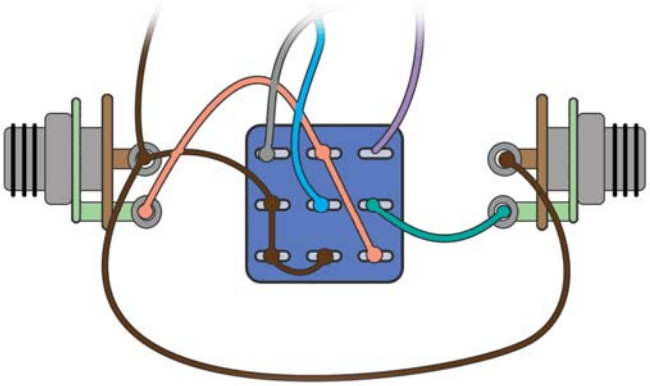
fig.12



Now lug2 and lug3 of SW1A connects the ground to the circuit input and we have no open lugs on the 3PDT.

Let’s go even one step further! What if our 3PDT gets dusty and the connections get bad? How does that affect our switching? Well, it pretty much bones it, but you can at least keep the grounding intact in case of a switch failure. Just add one extra wire between lugs 2 and 3 of SW1A. The wire means the grounds stay connected even if our switch fails. PS I learned this trick from Marc Skreddy.

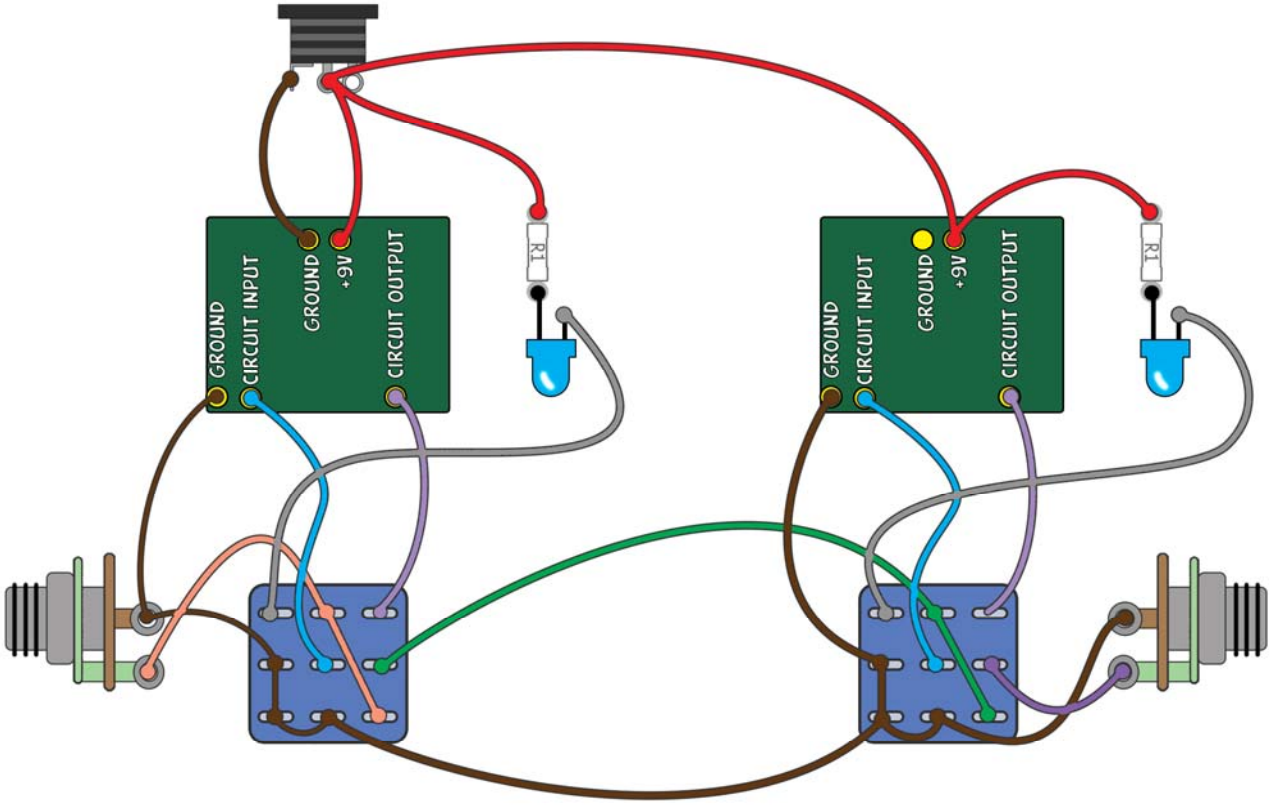
fig.13



Bonus Round!

What do you do when you want to wire up two circuits in one box? Hey, it's easy! So long as the circuits are independent of one another we can simply replicate the wiring we already have. The only change is that the output from the first 3PDT gets wired to the input of the second 3PDT and the output of the second circuit is also wired to the second 3PDT.

Here is the completed wiring for two circuits in one box



You might notice two things here:

1) There is no wire connecting the ground at the top of circuit 2. We don't need it. We've already connected the ground to the circuit board from the second foot-switch. It doesn't matter how you do it, just as long as one ground wire goes to that second circuit board and to the second switch.
2) There are two R1 resistors. That's because I am lazy and did not generate a separate image labeled "R2" for the second LED.

Congratulations! You are now and expert in true bypass wiring for guitar pedals. I suggest mentioning this to your significant-other at least 4 times in the next 3 days. S/He will be thrilled!