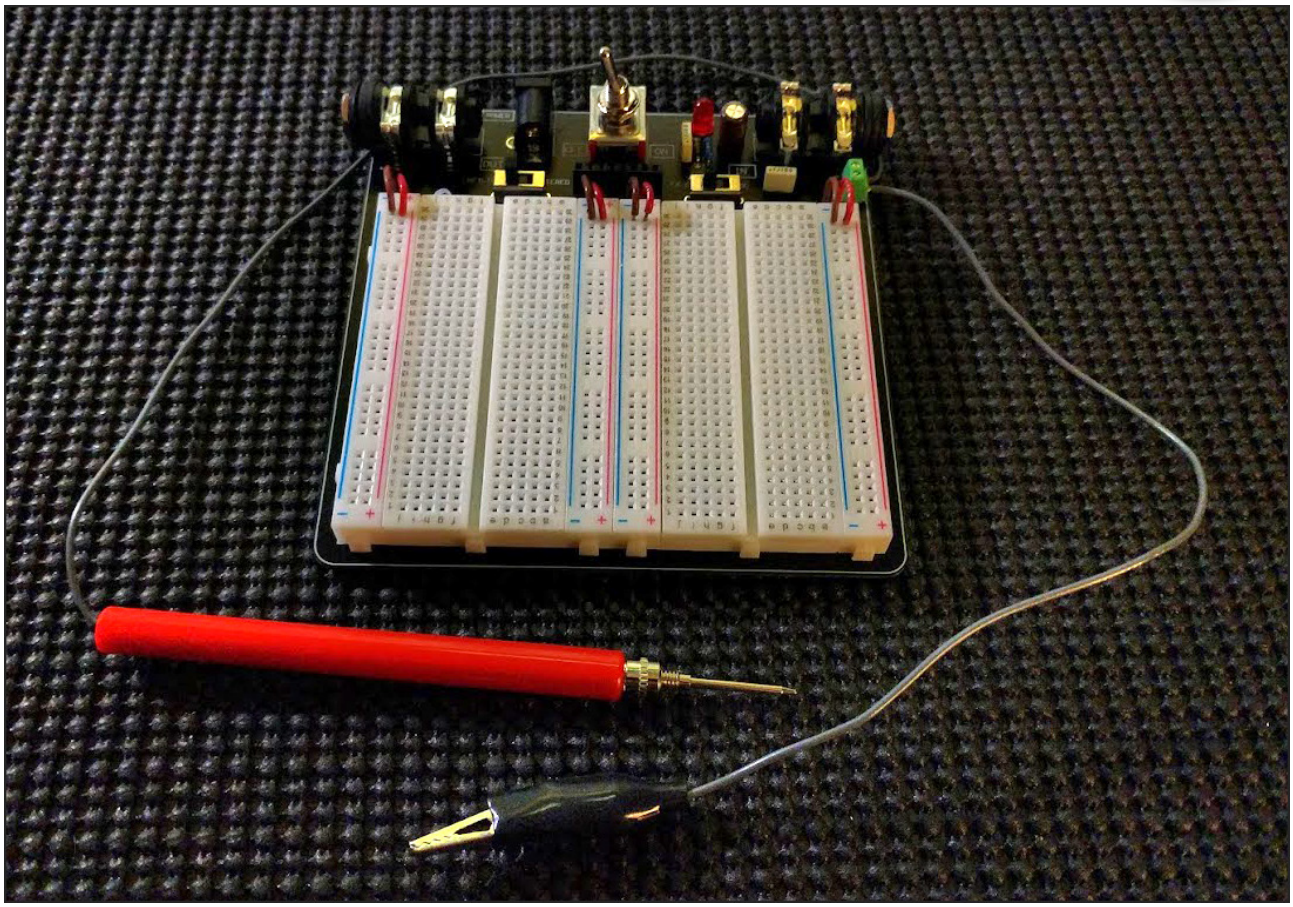
PROTORIG



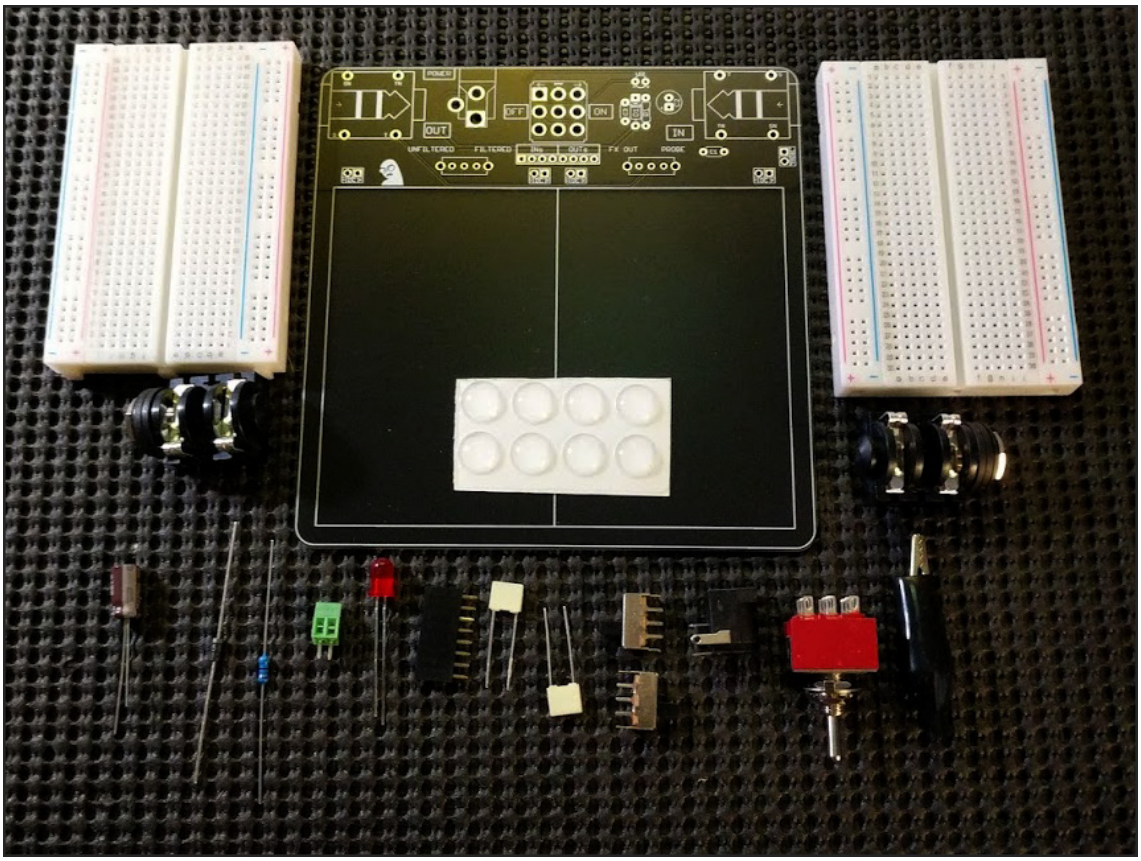
Building pedals is a lot of fun, but spending time and money on something that doesn't work correctly (or at all) is extremely frustrating. And, every pedal builder will experience that frustration at some point. If you are me, it's almost guaranteed. That's why it is critical for every serious pedal maker to have the ability to quickly identify and diagnose problems to get to the fun part - making lovely noise.

The Prototyping & Testing Rig has the essentials tools to make the testing, debugging and prototyping easy. The other critical part is thinking and patience, of course! With this simple kit, you can:

1. Quickly breadboard circuit snippets and even a complete pedal circuit for testing, evaluation and experimentation.
2. Test built PCBs for proper function *before* final pedal assembly.
3. Debug problem areas in misbehaving builds.

Technical assistance for your build(s) is available via the madbeanpedals forum. Please go there rather than emailing me for assistance on builds. This is because (1) I'm not always available to respond via email in a timely and continuous manner, and (2) posting technical problems and solutions in the forum creates a record from which other members may benefit.

Before you start make sure you have all the items in the kit. The pic below shows everything included except the two long jumper wires (those came at the last minute).

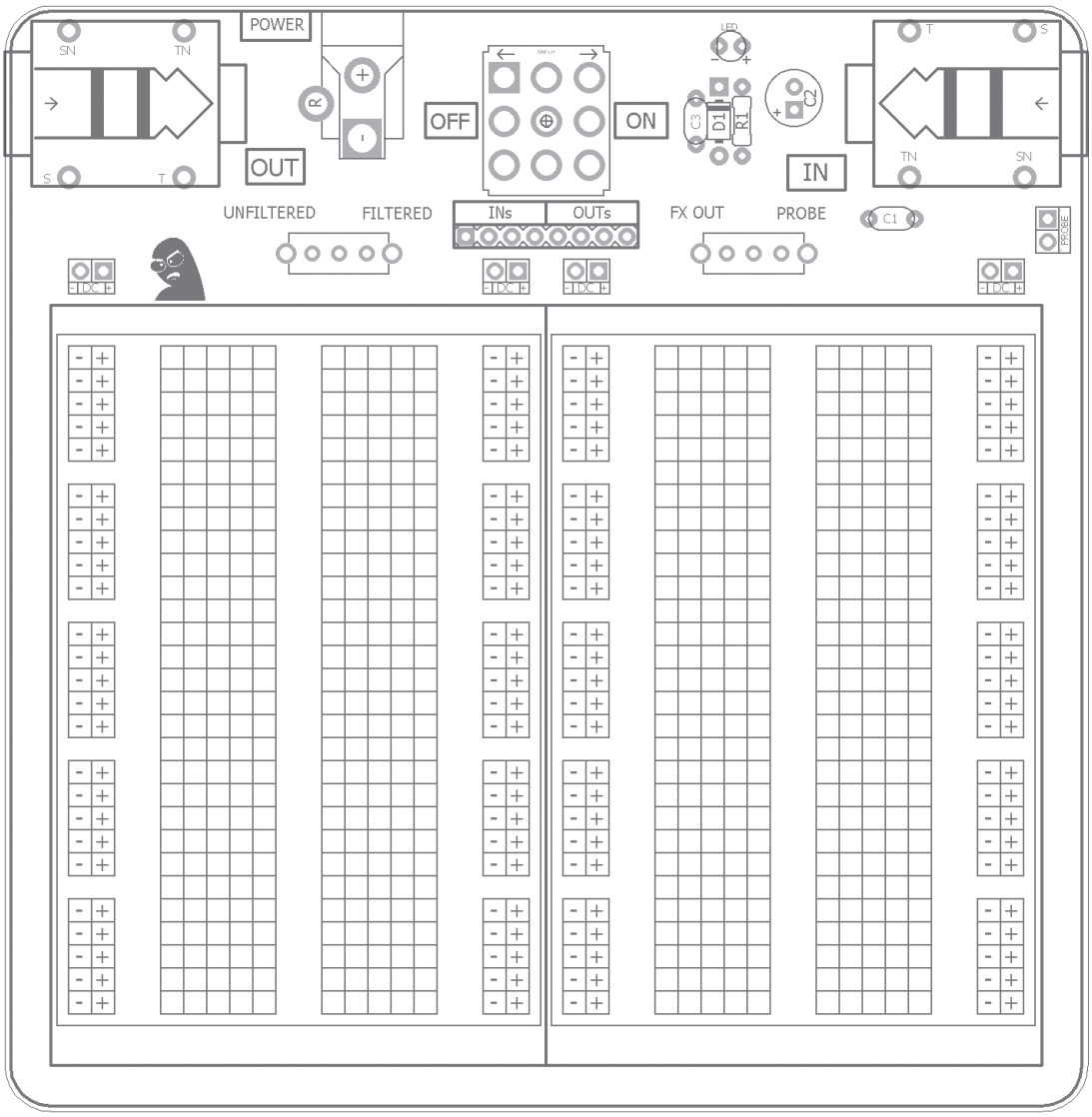


QTY	ITEM
1	100uF Cap
1	1N5817
1	3PDT Switch
1	4k7 Resistor
1	8 Pin Header
1	Aligator Clip
1	DC Jack
1	LED
1	PCB
1	Terminal Block
1	Test Probe
2	100n Caps
2	Jumper Wires
2	Mono Jacks
2	Slide Switches
8	Rubber Feet

What's not included
- Hookup wire (use either 22 or 24AWG)
- Power Supply

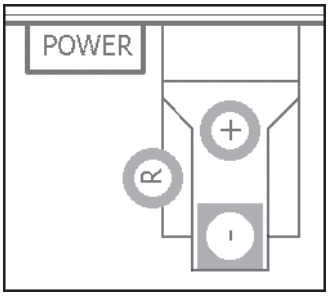
What's recommended to have
- BluTack or some other removable adhesive putty
- A small flathead jeweler's screwdriver for the terminal block.
- If you do a lot of breadboarding, a wire kit like this comes in very handy: https://www.amazon.com/AUSTOR-Lengths-Assorted-Preformed-Breadboard/dp/B07CJYSL2T/

04.2.2022 update: Due to the extra shipping cost required, the 2 breadboards are no longer included. The cost for the ProtoRig has been reduced accordingly. You can find the exact breadboards used here: https://www.taydaelectronics.com/400-point-solder-less-plug-in-breadboard-white.html



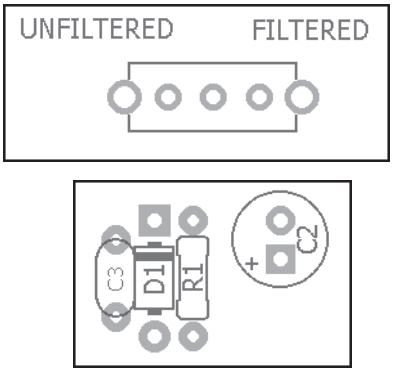
The Prototyping & Testing Rig has several components.

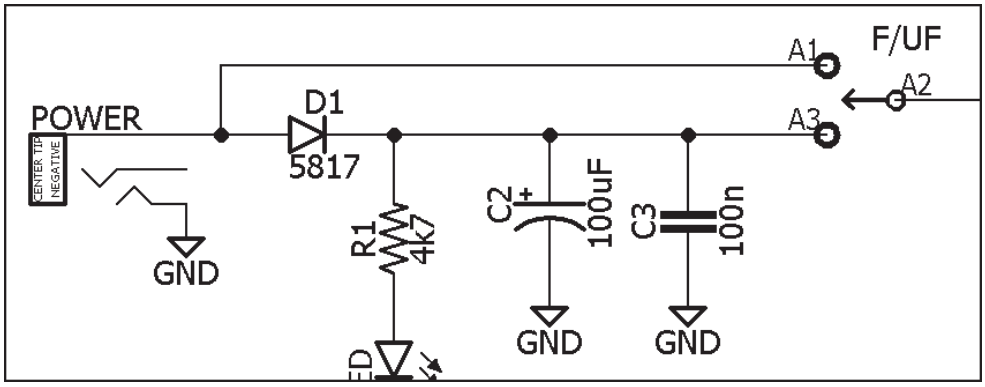
1. Power
2. Power Filtering
3. I/O (input, output)
4. FX send and return
5. Bypass
6. Audio Probe
7. Ground Probe
8. Breadboards



The Prototyping and Testing Rig is standard 2.1mm center tip negative. You can use any power supply up to 18v max. If you need to test a lot of 24v effects for some reason, replace the included 100uF cap with one rated at 50v.

I recommend investing in a dedicated power supply for a testing rig. It saves a lot of hassle of having to move the same supply between your pedals and your testing apparatus. I use the OneSpot and recommend it, but any well regulated, low noise supply is fine.

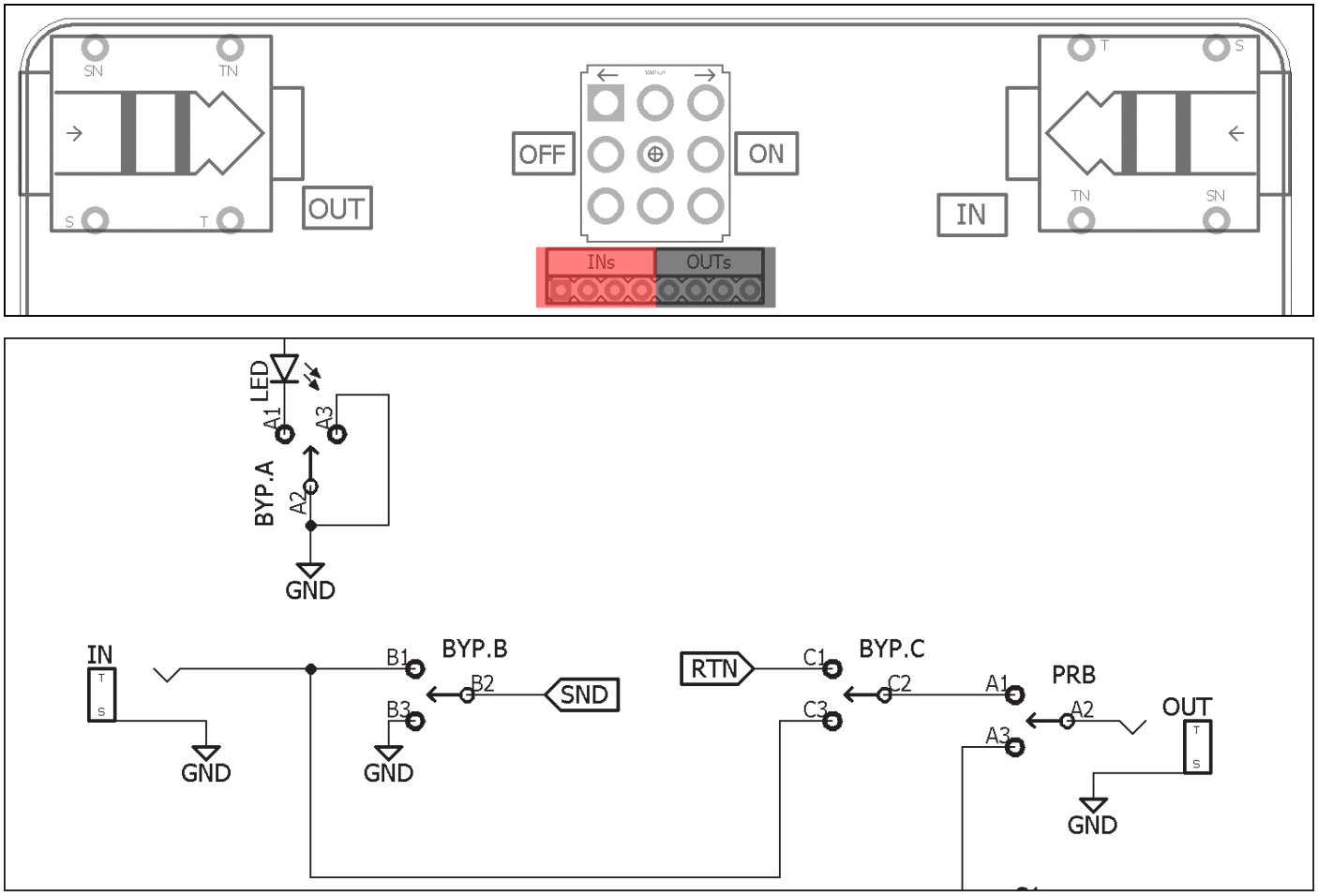




The filter switch lets you choose between unfiltered or filtered power. In the left position, no power decoupling or reverse voltage protection is used. In the right position, a standard reverse voltage diode and de-couplers (100uF and 100n in parallel) are used to filter the power supply. Note that the bypass LED will always activate whether or not you choose unfiltered or filtered power.

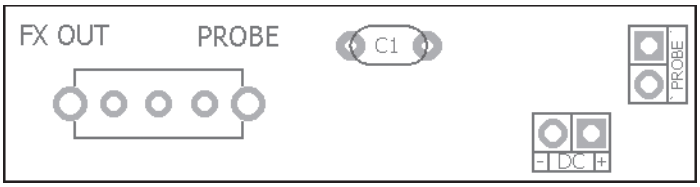
When breadboarding a circuit from scratch, setting the switch to “Filtered” simply lets you bypass a couple of parts that you would normally use for power decoupling. However, when testing a built PCB (any madbeanpedals project, etc) you should set the switch to “Unfiltered”. This is because any decently designed PCB will already include reverse voltage protection and power supply decoupling already. Setting it to “Filtered” in that case would simply reduce the power supply voltage to the PCB and increase current consumption.

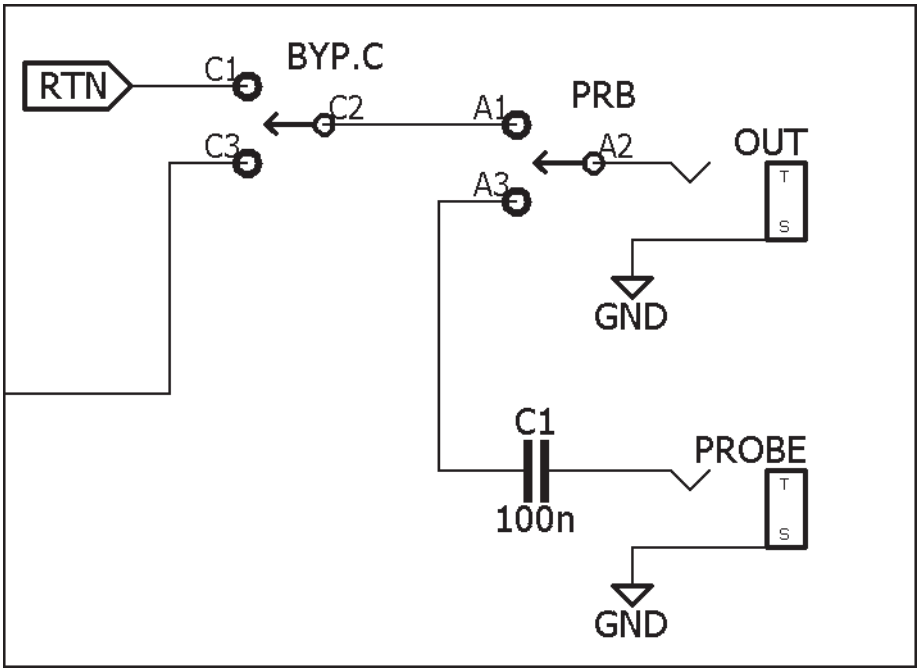
TIP: Keep the power unplugged when not in use. This will lengthen the lifespan of the components. The 100uF chosen has a longer lifespan than typical (3000 hours vs. 2000) so it should not fail or need to be replaced for many, many years.



The bypass and FX I/O are handled exactly the same way as the standard madbeanpedals project: True Bypass via a 3PDT switch with the fx input grounded on bypass. In this case I've utilized a toggle switch instead of a pushbutton for bypass. The reason for that it takes a lot of force to actuate a pushbutton switch. Over time that could damage the solder joints or even the PCB itself. (You can ignore the "PRB" switch as that is explained later).

The effect send and return are located directly under the toggle switch. There are four each for send and return. I did it this way to use a single 8-pin header so you can just insert the included jumper wires to connect to your effect input and output (whether that is a breadboarded circuit or PCB). So, they are redundant. You will only use one of each at a time.



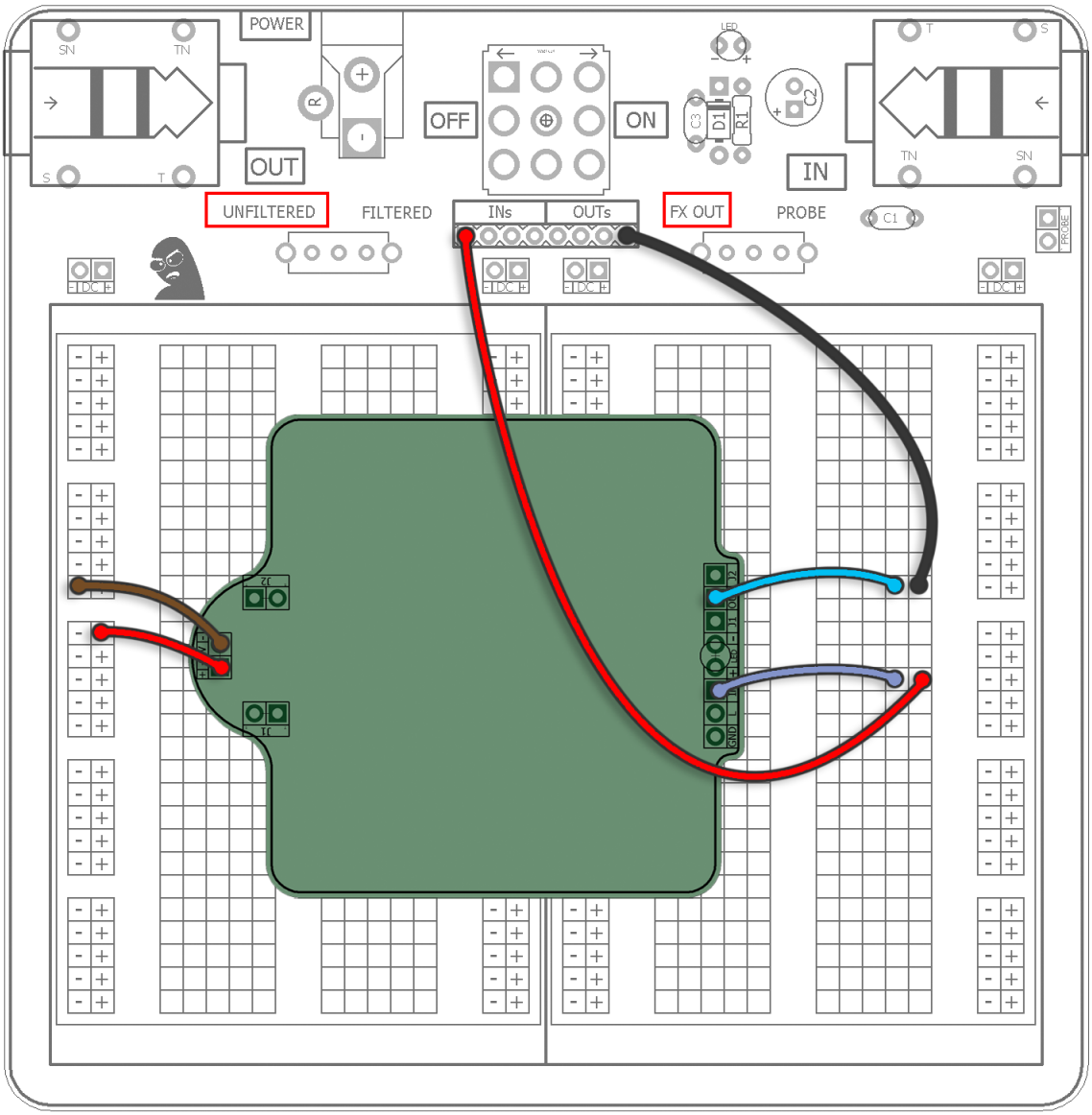


The Audio Probe is one of the most beneficial components to this entire project. It lets you listen to the audio output of any point of a circuit under test, whether it is a breadboarded circuit or built PCB. I cannot stress enough how essential this tool is to pedal building. Audio probing, along with voltage measurements, solve a huge number of problems that can arise. The third best tool is probably frequency measurement but that is usually available in most inexpensive digital multimeters.

When the Probe switch is set to the left side, the output is taken directly from the effect return. When set to the right position, the audio probe is active. You can touch the probe to any portion of the circuit to isolate its output. The 100n cap ensures that no DC is leaked to the output.

Of course, it's also important to know WHAT to audio probe when debugging. There's no way to tell you that comprehensively. It simply comes with experience and the ability to read and understand schematics. But, you also have a great resource with the madbeanpedals forum if you are unsure where to probe a circuit for a certain problem. We are always there to help!

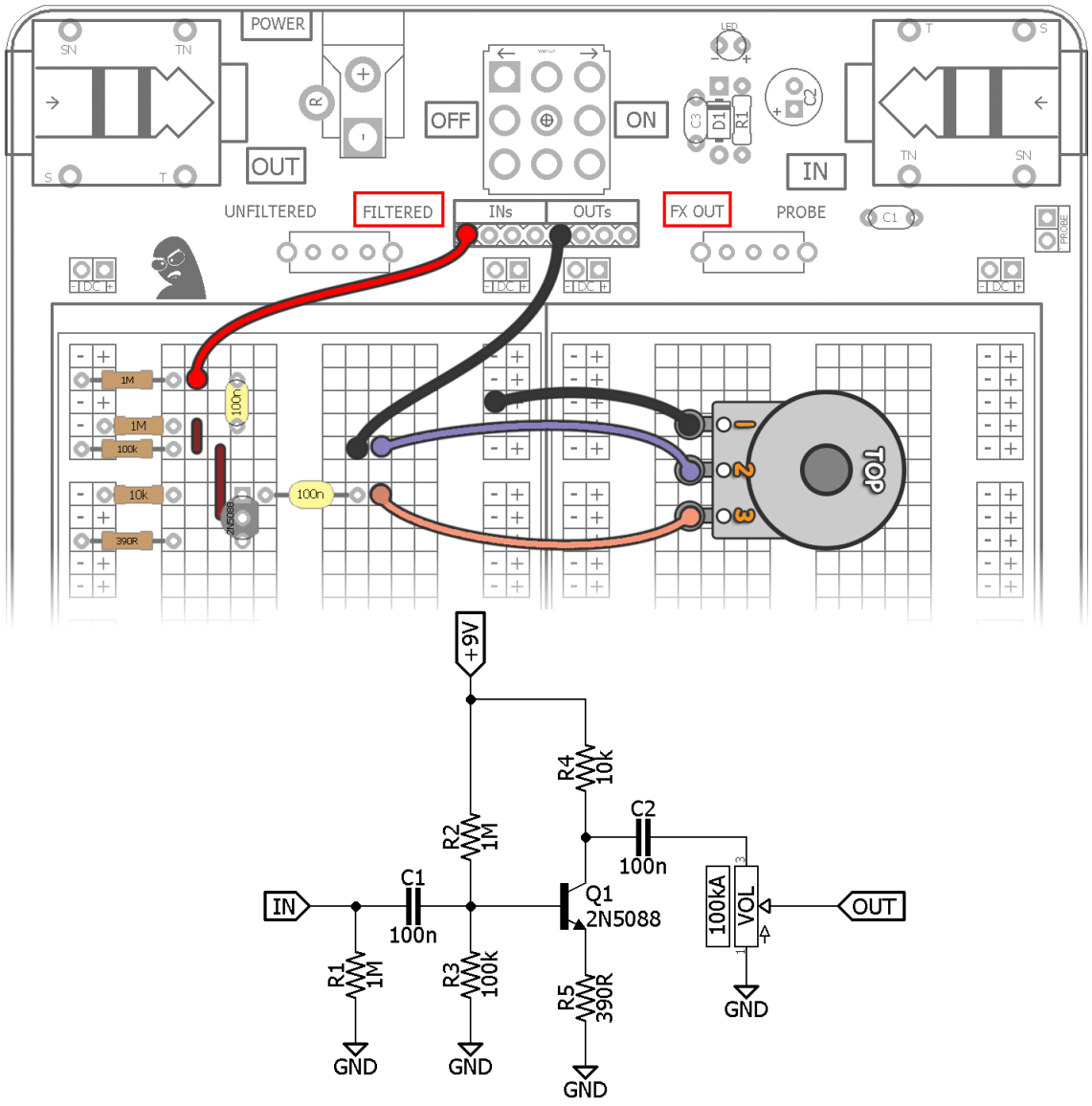
You also get a ground probe with the audio probe. This is just a ground wire soldered to an alligator clip. It's extremely helpful when taking voltage measurements on a circuit. Simply connect the ground clip to the black probe on your multimeter, then you can use your red probe to take voltage measurements wherever needed.



Here's a test case example of how you could use this as a testing rig for a pre-built PCB. You only need four wires to test most effects: power, ground, fx send and return (you can always solder the remaining needed wires when you are ready to assemble the pedal). Since the PCB already has reverse voltage protection and power decoupling, set the left switch to "Unfiltered". And, because you want to listen to the final effect output, set the right switch to "FX Out". Now you can listen to both the bypass tone and effect output by togging the 3PDT bypass switch.

If you have a problem with no effect output or if something doesn't sound quite right, then set the right switch to "PROBE" and use the audio probe on any number of test points on the PCB to find where the problem resides.

If you need to check voltages on an active component like a transistor or IC, then clip the Ground Probe to the black lead of your digital multimeter and use its red probe to check the voltage reading.

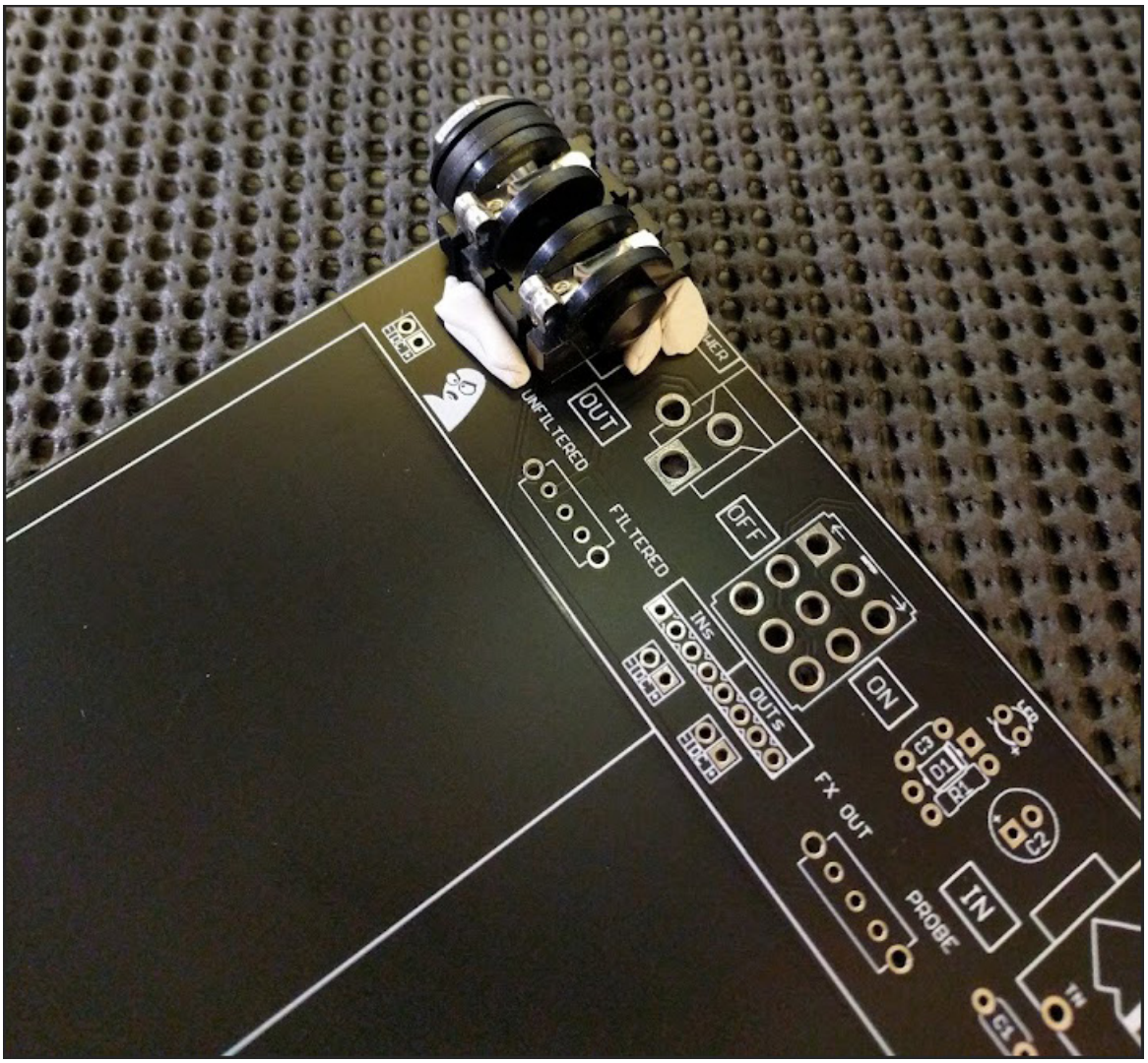


Here's another scenario. This example shows the EHX LPB-1 boost and one way you might lay it out on a breadboard. In this case the left switch is set to "Filtered" so we can skip breadboarding reverse voltage protection and power decoupling.

This also shows a wired 16mm pot. If you have PCB Pin Mounted pots, you can stick them directly in the breadboard. However, this is not advisable. My experience is that it will wear out the breadboard much more quickly. Better to have a few wired pots for prototyping. Or, you can use 9mmBB boards available in the mbp store. Those let you mount 9mm pots directly to breadboards. https://www.madbeanpedals.com/projects/_folders/BreadBuddies/pdf/9mmBB.pdf

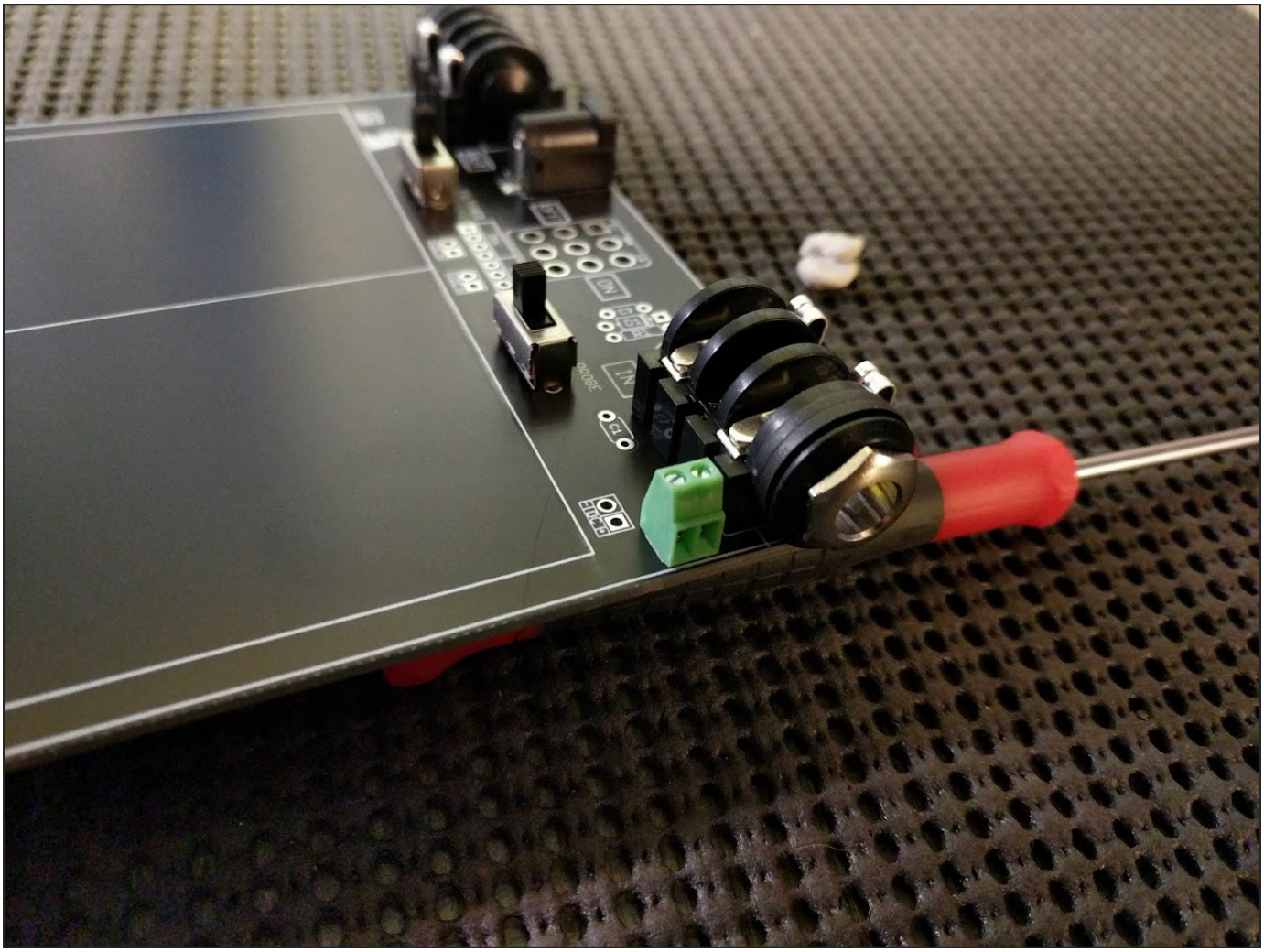
If you want to practice with the Audio Probe, you could probe either the Base of Q1 to listen to the signal going into the transistor, or the Collector to hear the output of the transistor before the Volume pot. Keep in mind some audio probing may produce loud signals (for example, before a volume control), so be ready to turn your amp down.

The next few pages will demonstrate how to assemble the Prototyping and Testing Rig. You can assemble it in any order you like. I start with all the mechanical parts (jacks, switches, etc), then the passives (caps, diode, resistor, etc), then the probes and finally the odds and ends. It might actually be easier to do the passive components before the mechanicals. It's up to you.



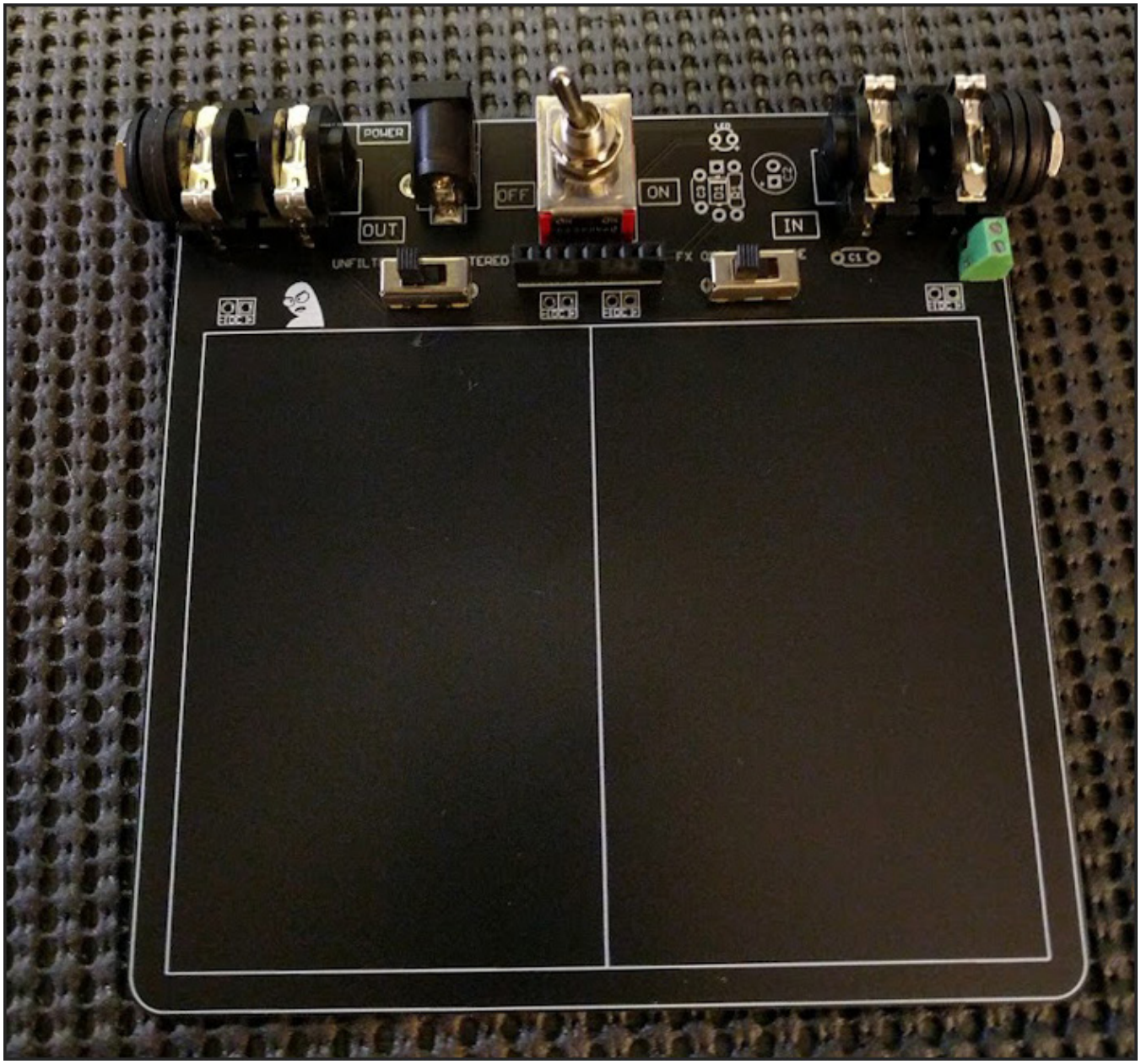
For the mechanical parts, I suggest using some BluTack or a similar removable adhesive putty. This will hold the parts in place while you solder them in on the bottom of the PCB. I use adhesive putty on lots of pedal building. It's cheap and it lasts nearly forever.

Here I've got the output jack held in place for soldering.



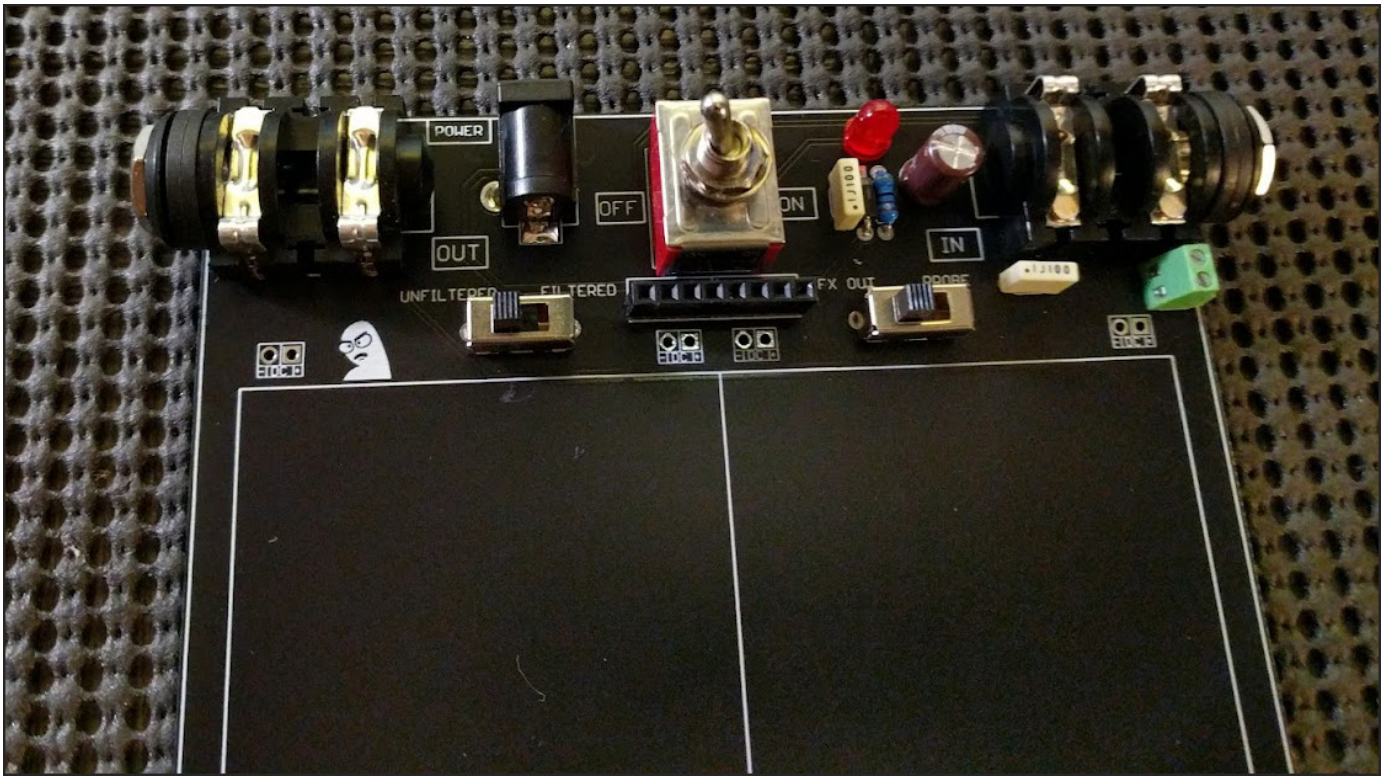
Repeat the same process for the DC Jack, slide switches and terminal block. Note the orientation of the terminal block and be sure to do the same. Later on, the audio and ground probes will be threaded and screwed in. You will need a small screwdriver to do this (from a jeweler's set). Most builders probably already have these. If not, they are very inexpensive - look at Harbor Freight or any big box store.

If you don't want to go through the trouble of buying a jeweler's screwdriver set, just solder the probe wires directly to the PCB and skip the terminal block. Over time, the wires may start to break if you solder them directly, so they may need to be re-soldered at some point if you do this.

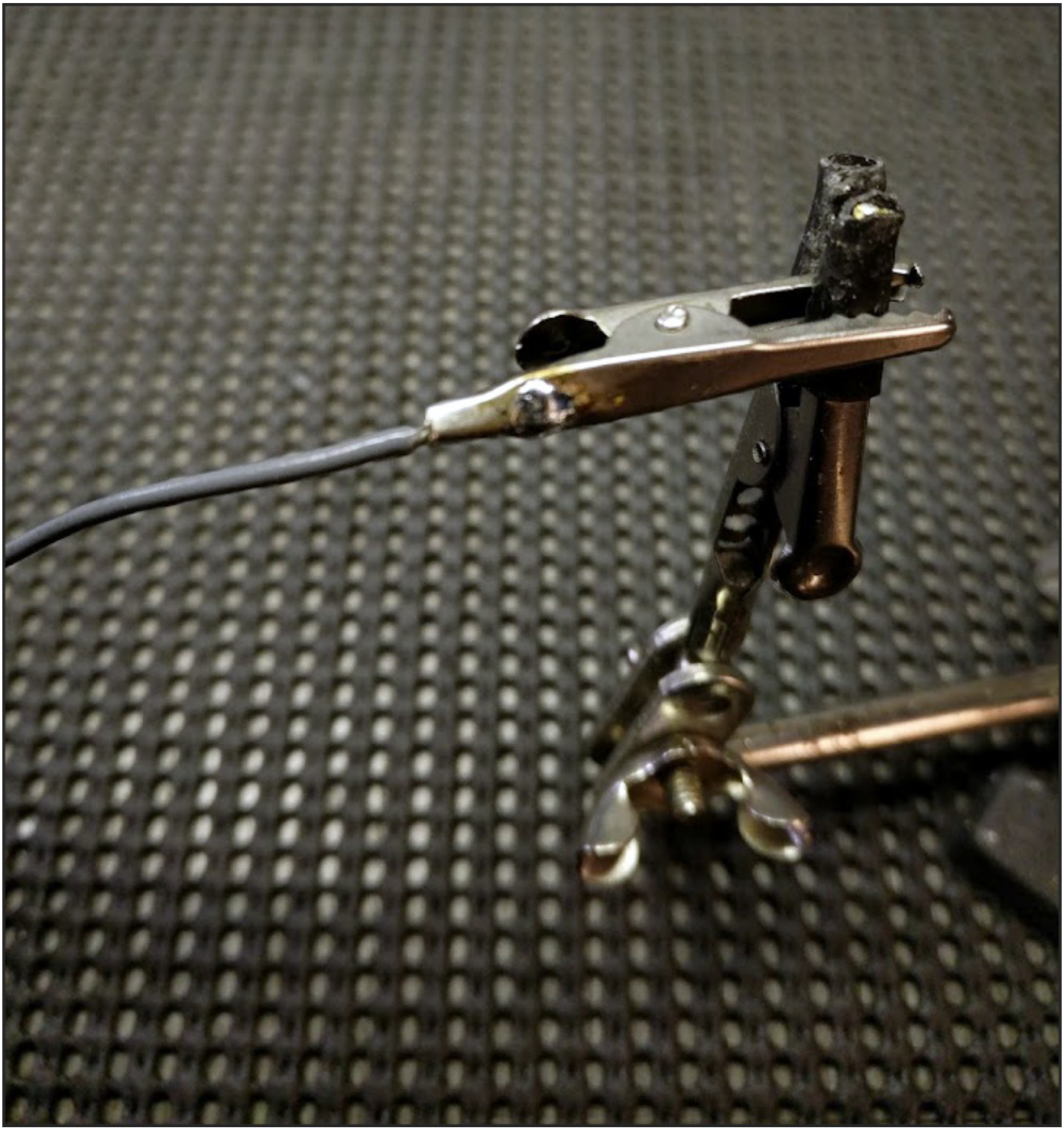


Finish up the mechanicals (3PDT and 8-pin header) using the adhesive putty to hold them in place. It's helpful to have something to prop up one end of the PCB when soldering the switch so the switch bat clears the table. I used my wire cutters for propping.

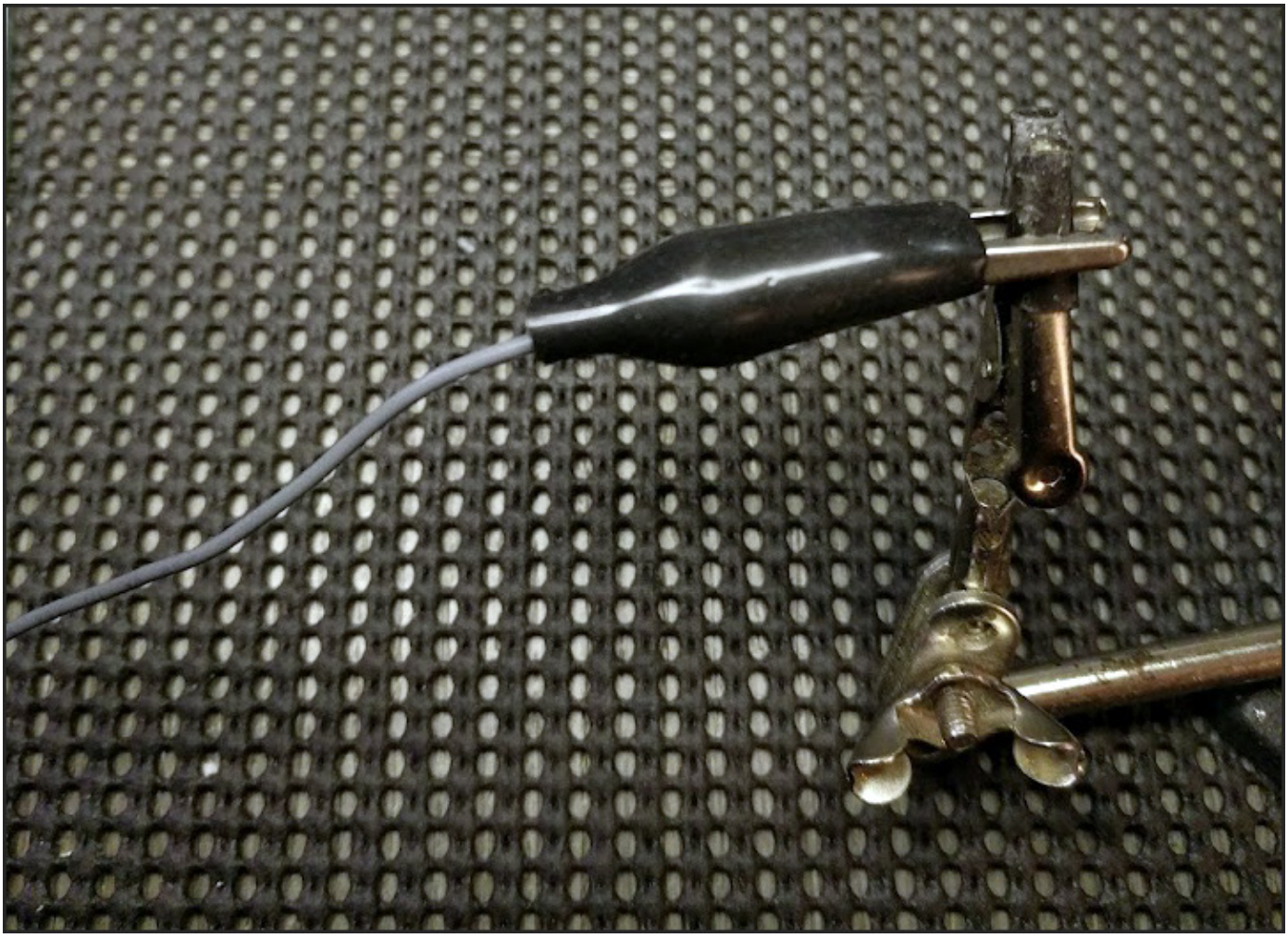
Make sure you mount the 3PDT in the correct orientation. The switch goes from left to right not up and down. Messing this part up will really give you a bad day! Best practice - putty the switch, prop up the PCB a bit and solder one lug. Now inspect the top of the PCB to make sure the entire switch is sitting flush. Then solder the rest of the lugs 2 at a time. Wait 30 seconds between each group of 2 lugs. This prevents the switch from overheating.



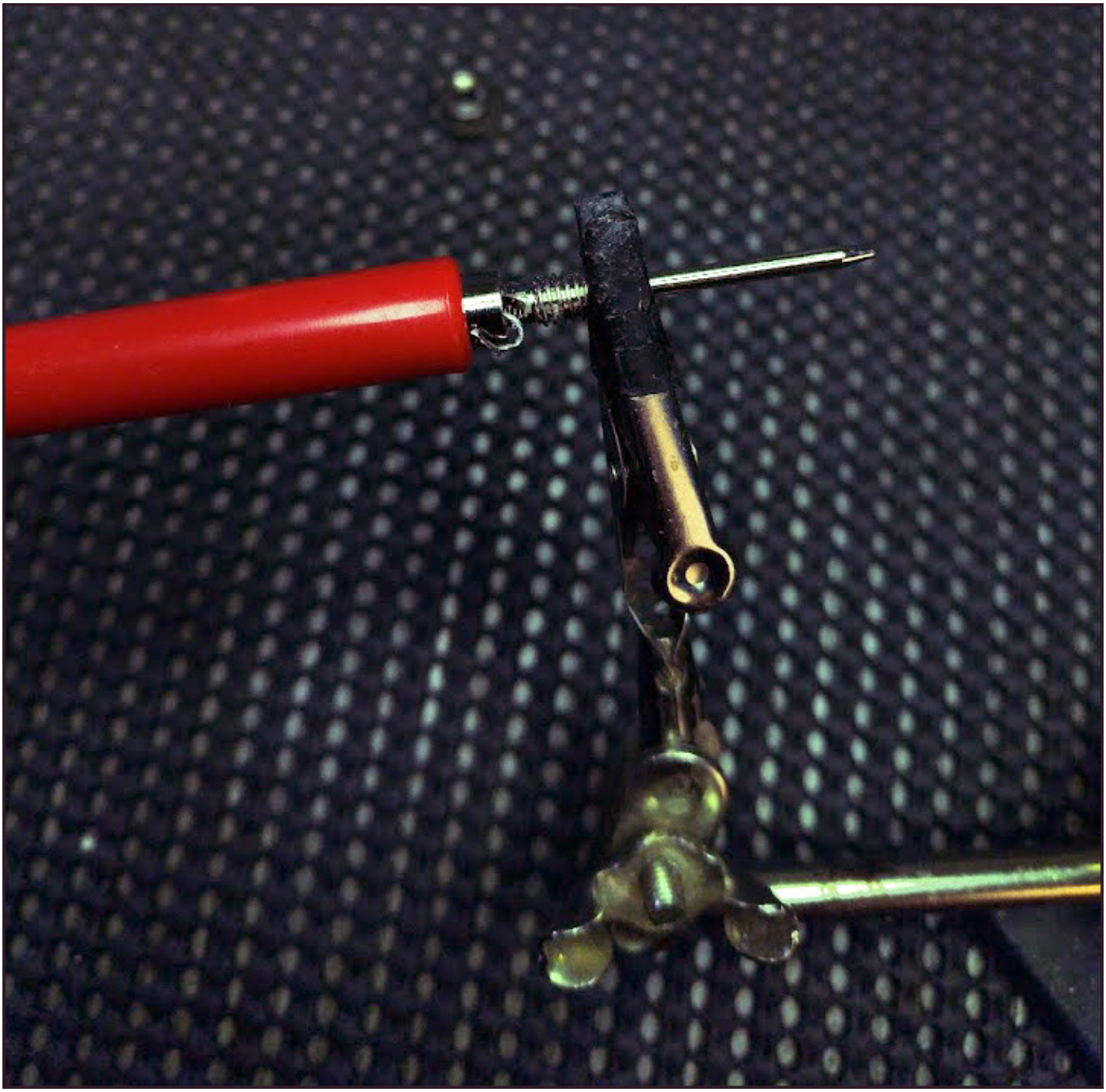
Next up are all the passive components: the two 100n caps, 100uF cap, 1N5817 diode, LED and the 4k7 resistor. You can do these one at a time or load them all in, clip the excess leads and solder it in one go. I generally do it the second way because I am incredibly lazy! Be sure to pay attention to the orientation of the electrolytic cap, diode and LED.



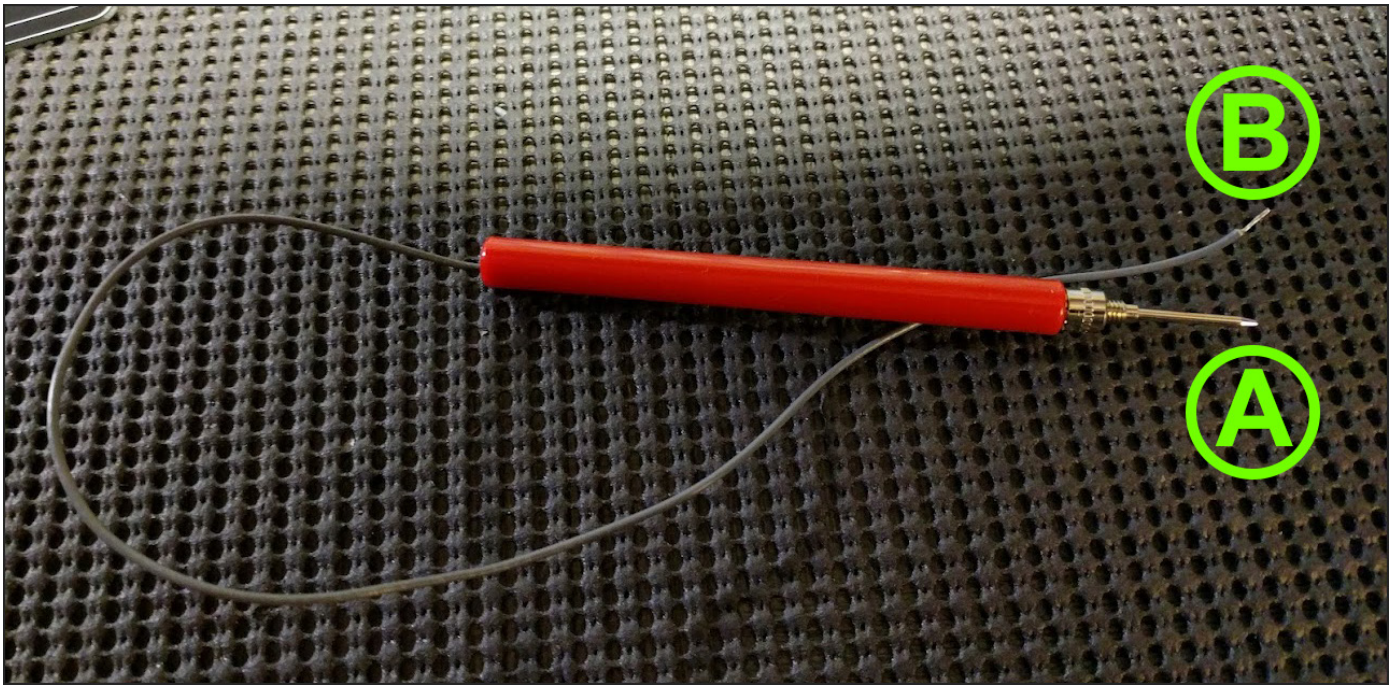
Let’s do some probing! Cut a length of about 10” of hookup wire. Use either 22 or 24AWG. Strip one end to 1/4” and the other to 1/2”. Pre-tin each end with solder. Now solder the 1/2” end to the ground clip as shown. Use pliers to fold the tabs over the soldered end to hold it in place.



The ground clip has a rubber sleeve you can use to cover up the mess. Set the completed ground probe aside for now.

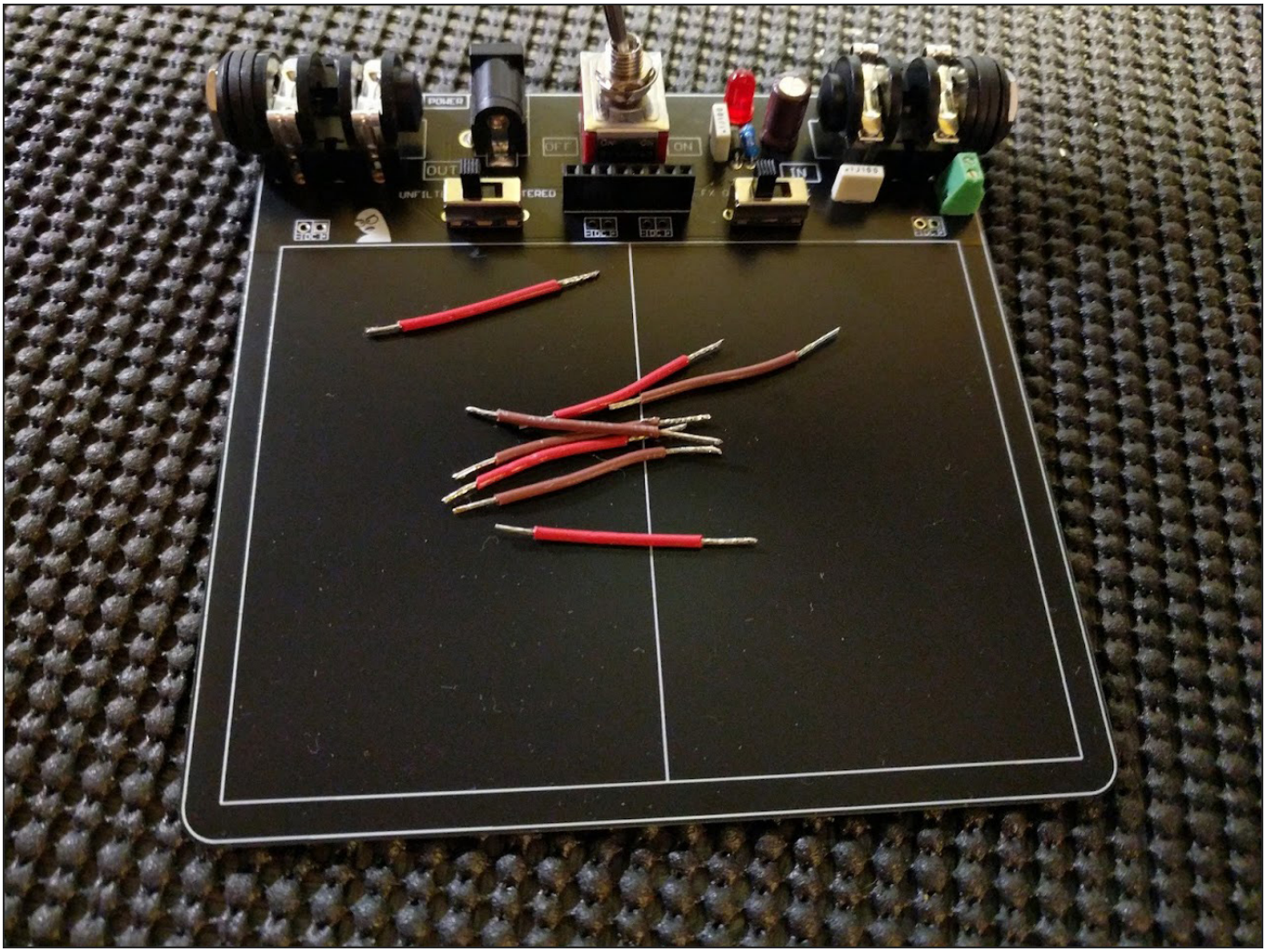


Next we'll do the Audio Probe. Cut another 10" length of wire just like before and be sure to pre-tin each end. Unscrew the cap on the probe and feed the 1/2" end of the wire through the hollow core of the probe. Now fold the wire end back at the tip. We want the soldered wire to make contact with the metal end of the probe when the cap is screwed back on.



You should have something like this when you are done.

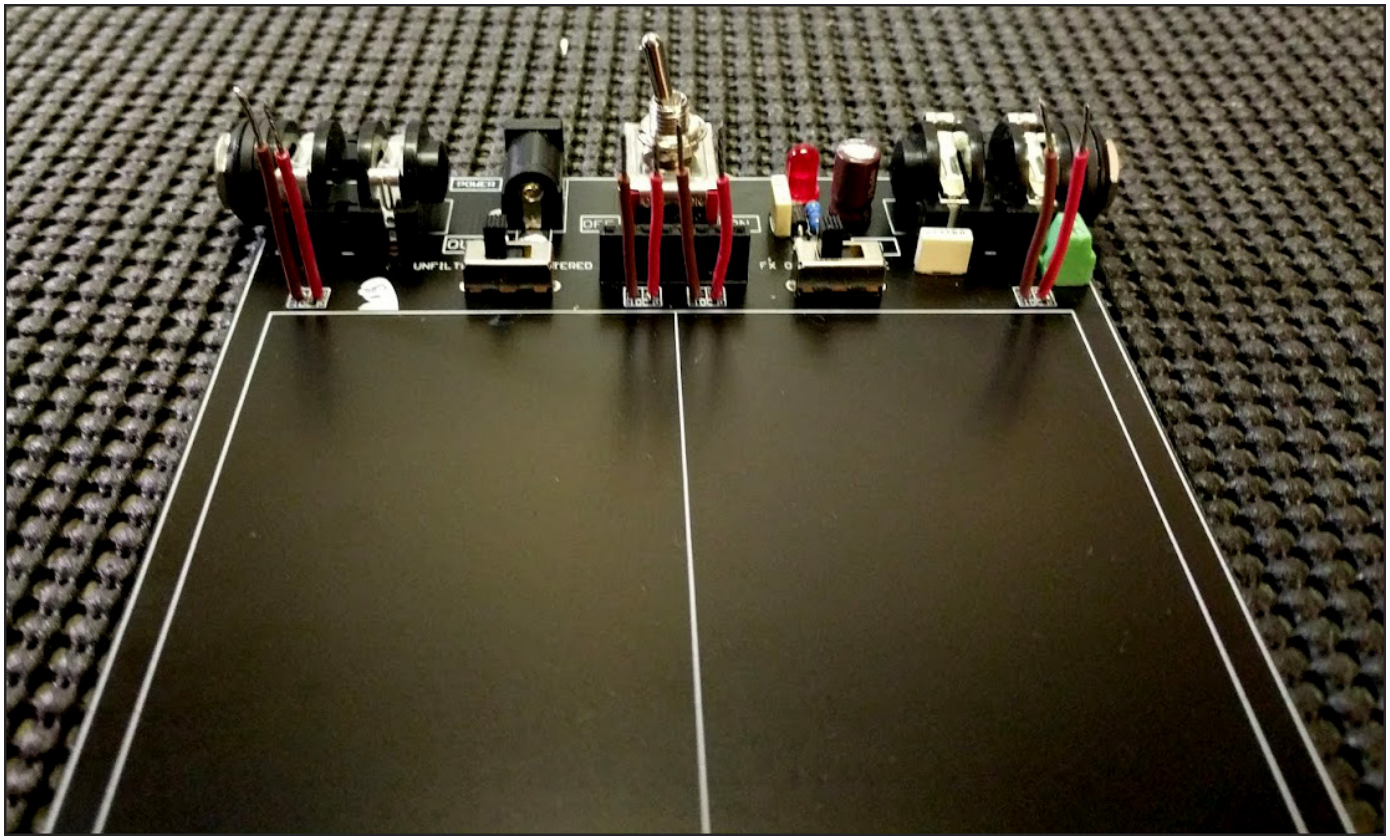
If you have a continuity checker on your digital multimeter, test for continuity between the tip of the probe and the 1/4” lead (points A and B). I suggest doing the same with the ground probe. It’s imperative to have good continuity on both the probes for them to work properly.



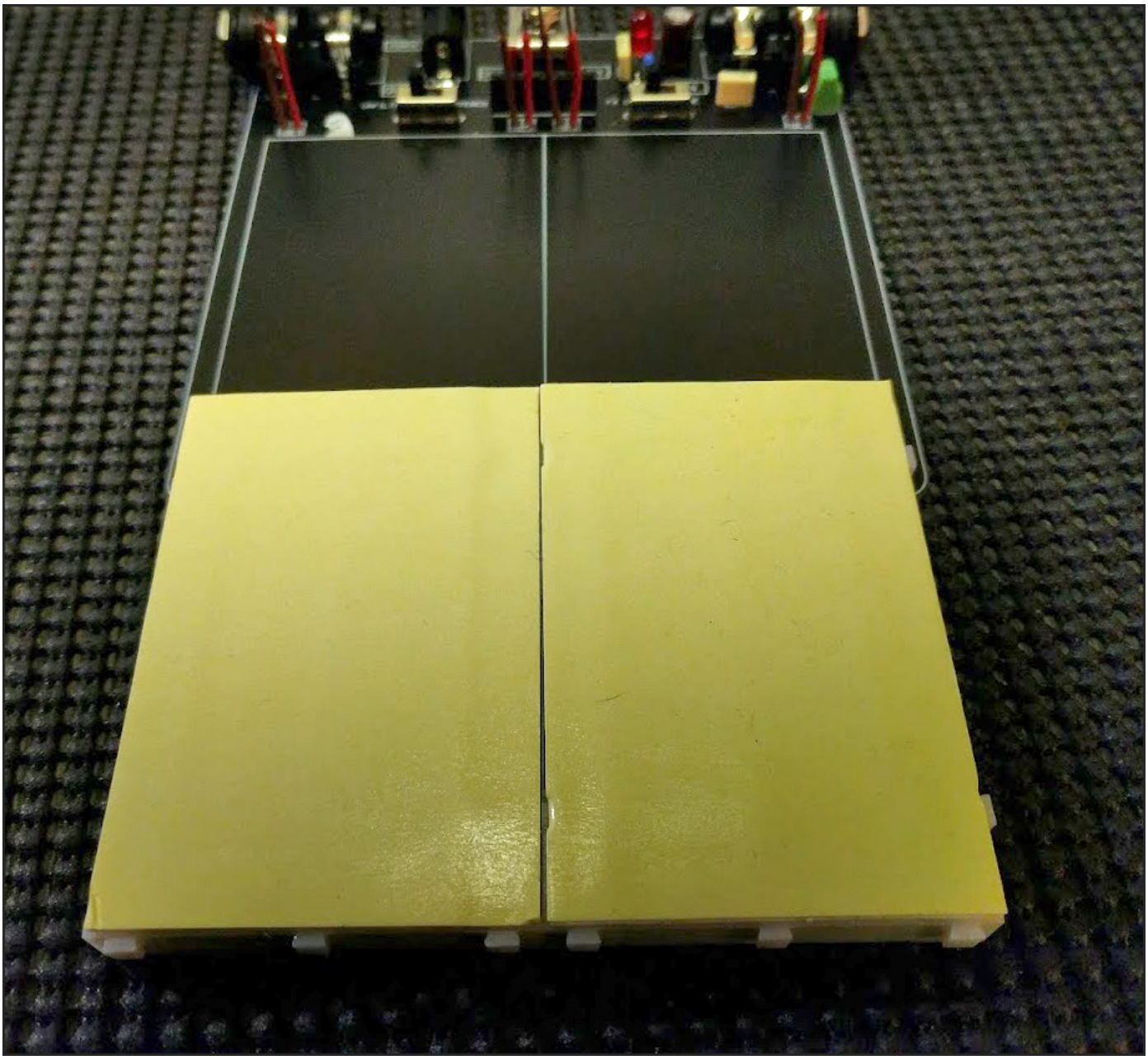
Warning: this next part is tedious. Luckily it only lasts a few minutes!

Trim 8 lengths of wire at about 1” to 1.5” each. Strip back both ends at 1/4” and 1/2” just like we did with the probes. Pre-tin both ends of each wire.

You don’t have to use color coded wire here. I just happen to do that on most of my builds.



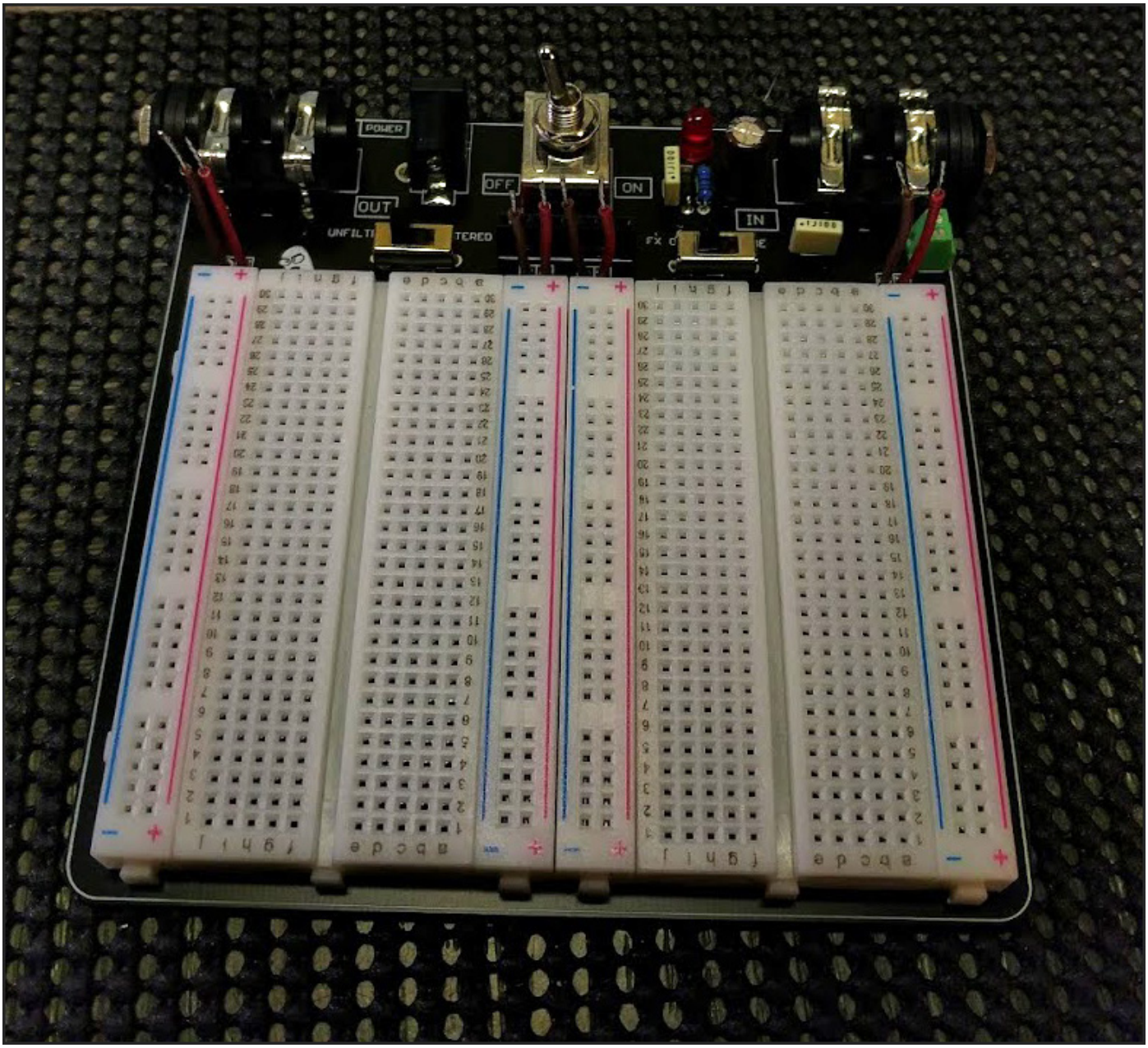
Now solder each pair of wires to the 4 DC connections on the PCB as shown. Here I used brown for ground, and red for power. Our goal is to have enough wire to fold them over and connect to the power rails on the breadboards after they are mounted.



Read the next two pages carefully!

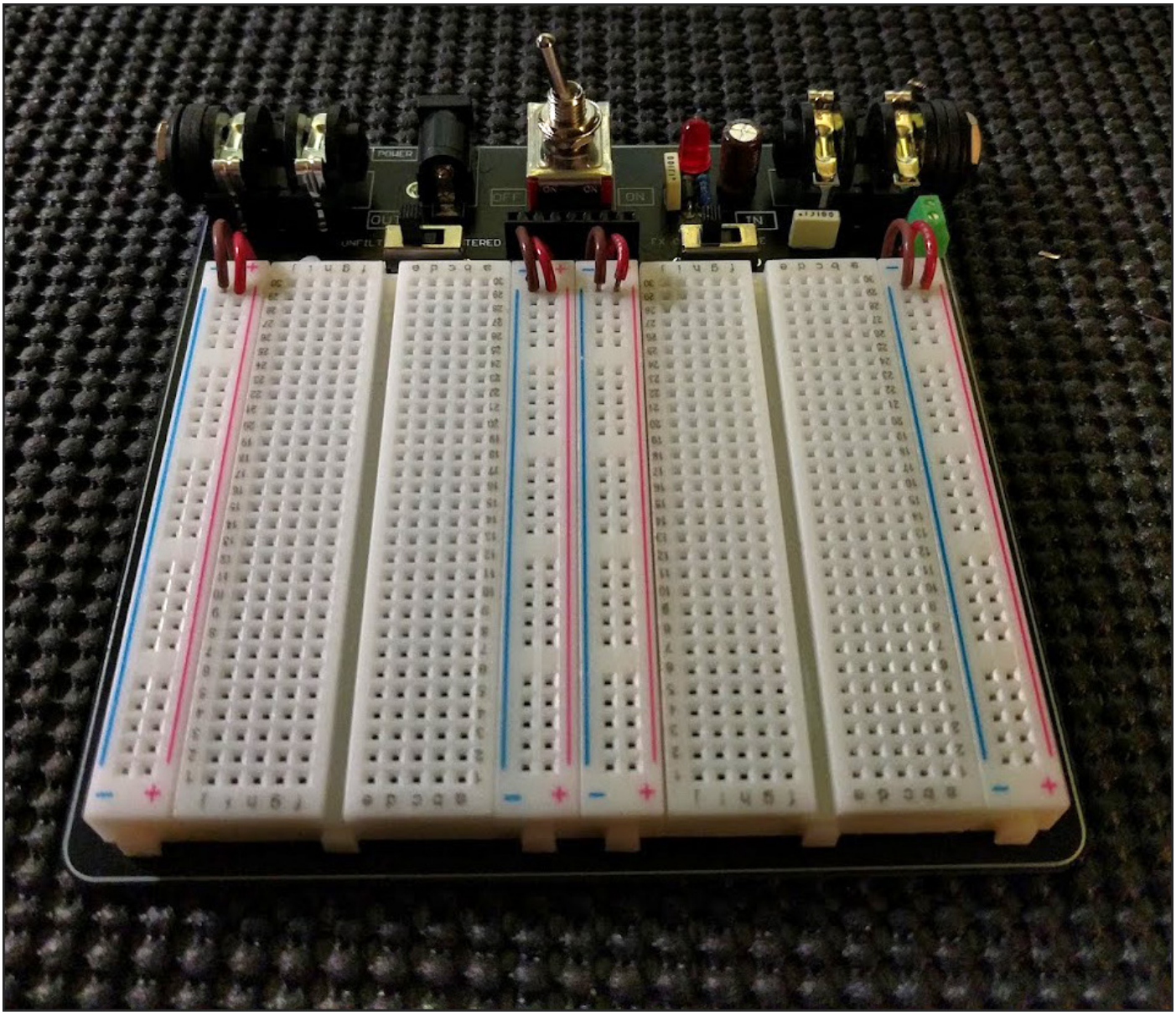
Before attaching the breadboards, snap them together so the form a single unit. There are two ways you can affix them to the PCB - peel the film off the stickyback tape and seat them directly to the PCB or use Velcro and attach them like a pedal to a pedal board.

You might consider the second method. Breadboards have a lifespan and with regular use they can wear out after a few years. Small indentations can form on the metal rails underneath the plastic causing intermittent contact with inserted parts. If you use Velcro (or any hook and loop) you can easily replace them a few years down the road if needed. If you attach them directly with the stickyback you might have a very tough time getting them off. The stuff is hella strong and it's a real job to peel breadboards off this way. It's up to you. I did it the first way b/c I'll probably build a few of these rigs for myself.



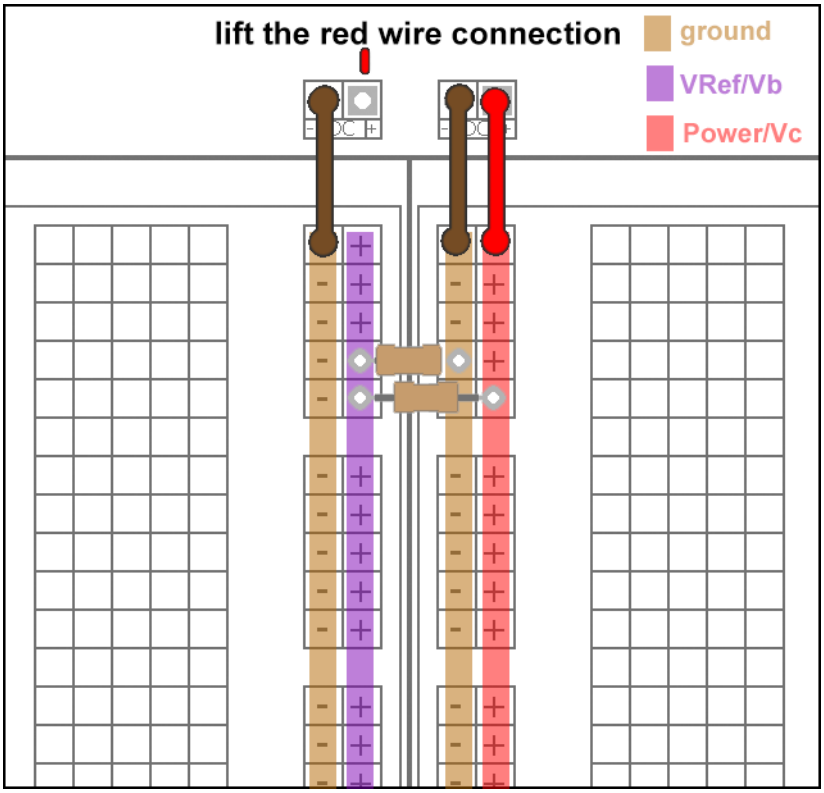
Whichever method you choose to stick them on, make sure you orient them correctly! Note how the power rails go “-” then “+” to line up with the power wires.

Technically, these are mounted upside down as you can see from the row/column lettering on the breadboards. This was a bit of a goof on my part since I never pay attention to those. If, for some reason, this bothers you turn it 180 deg so the letters and numbers are the right way around. You’ll just need to cross the power wires over each other to hook it up correctly. It won’t look as clean, but this is your kit - do it how you want!



Now fold the power wires over and insert them in their respective slots. Ground to “-” and power (DC) to “+”.

Each of these columns now create a buss for ground and power. This makes breadboarding circuits cleaner. However, you could use a column as a buss for something else. For example, say you are breadboarding an overdrive that has a reference voltage of 4.5v (a very common thing). In that case you could lift one of the “+” wires out then use the resistors needed to create the voltage divider for that reference voltage. Now you have a buss along that entire column to connect all the parts that use a reference voltage.



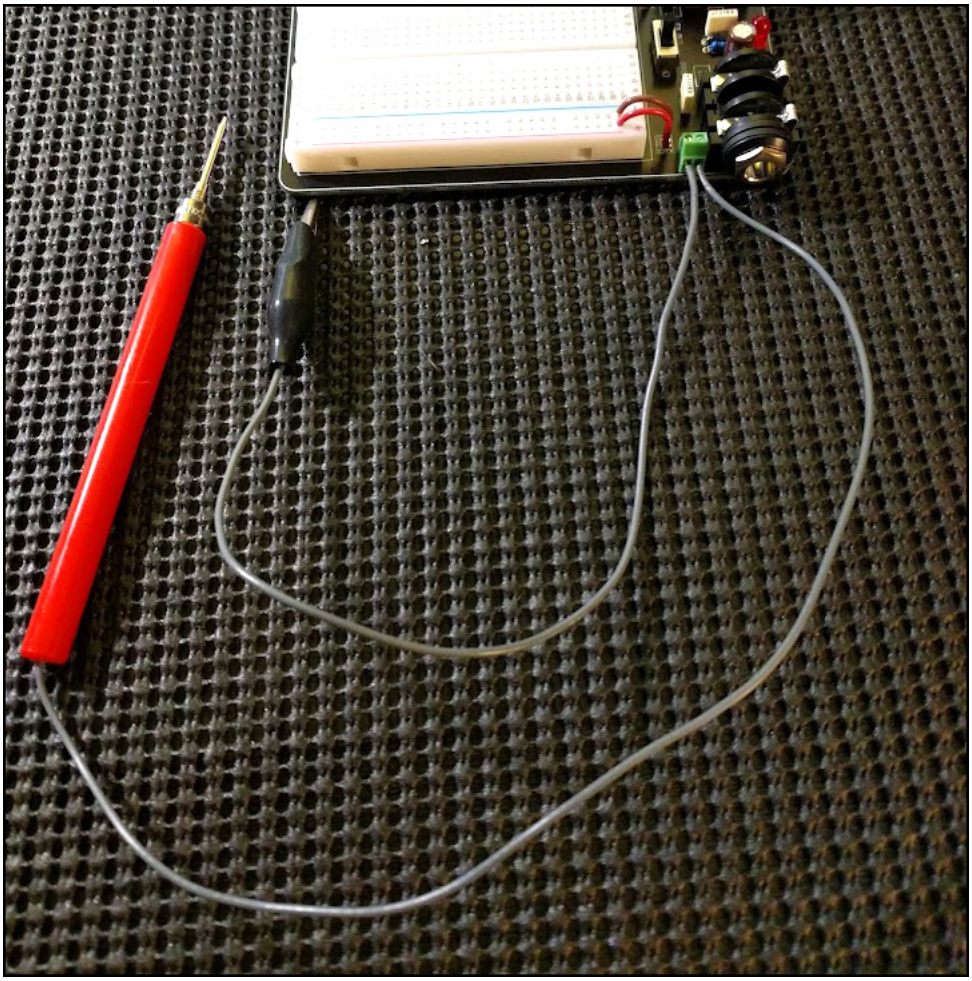
Here's an example of what I'm talking about. One of the red wires has been lifted, then two resistors create the voltage divider. Now you have an entire column free for your new "Vb" voltage. The resistor values don't matter in this example - 10k, 100k, whatever.

You would probably also want to add a cap for power decoupling between Vb and ground but it's not shown here.

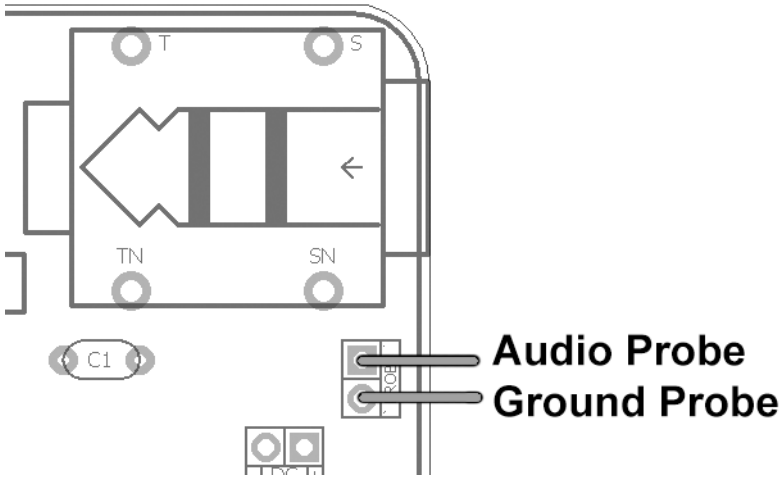
Almost done!

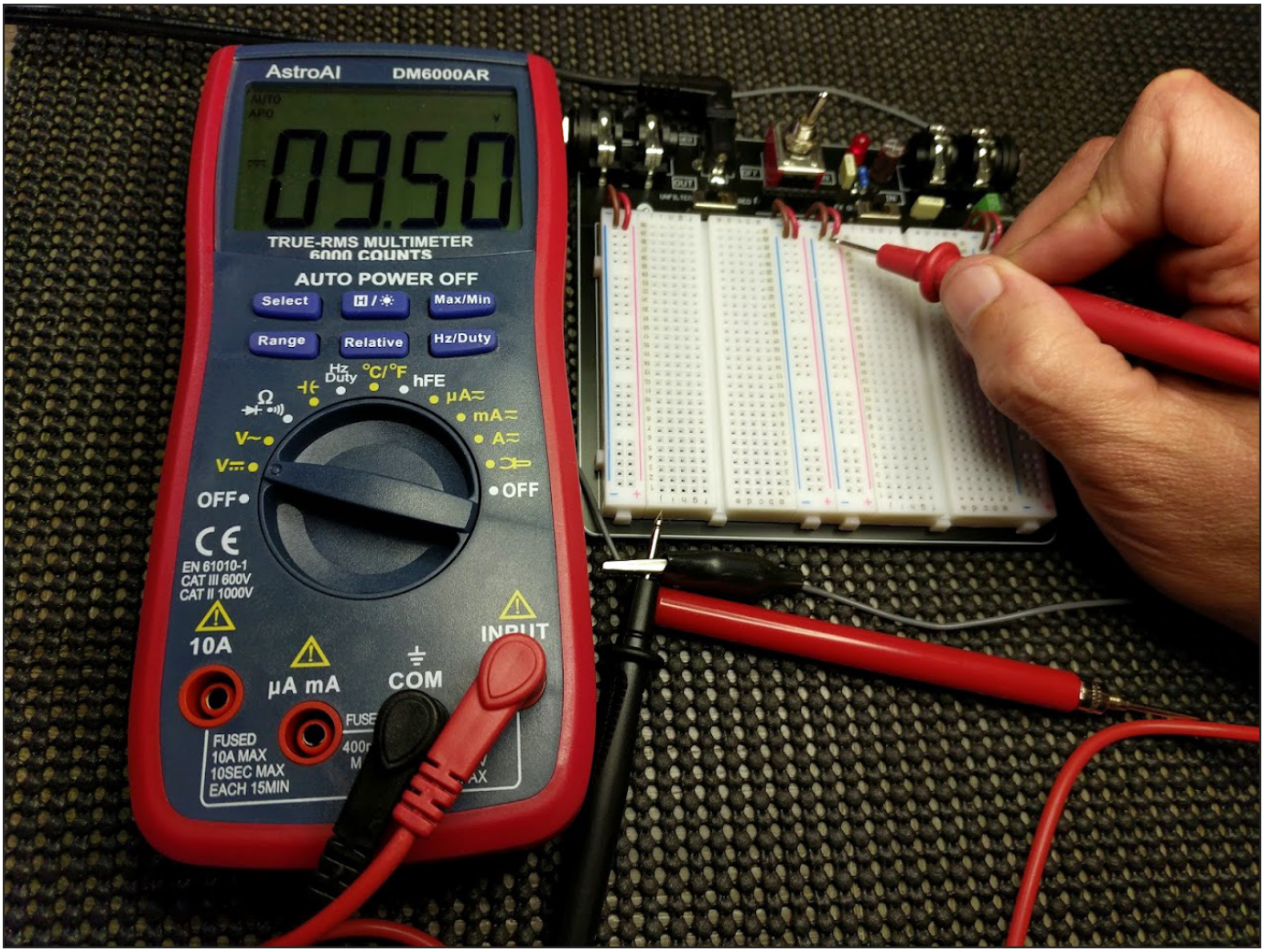
Attach the rubber feet to the bottom of the PCB. These should be tall enough to clear the leads from the In/Out/DC jacks but if you are having a problem sitting the rig flush gently snip the ends off those leads with sharp cutters. You don’t want to disturb the solder joints in any way.

There’s a quick reference chart for resistors on the back, if you need it.



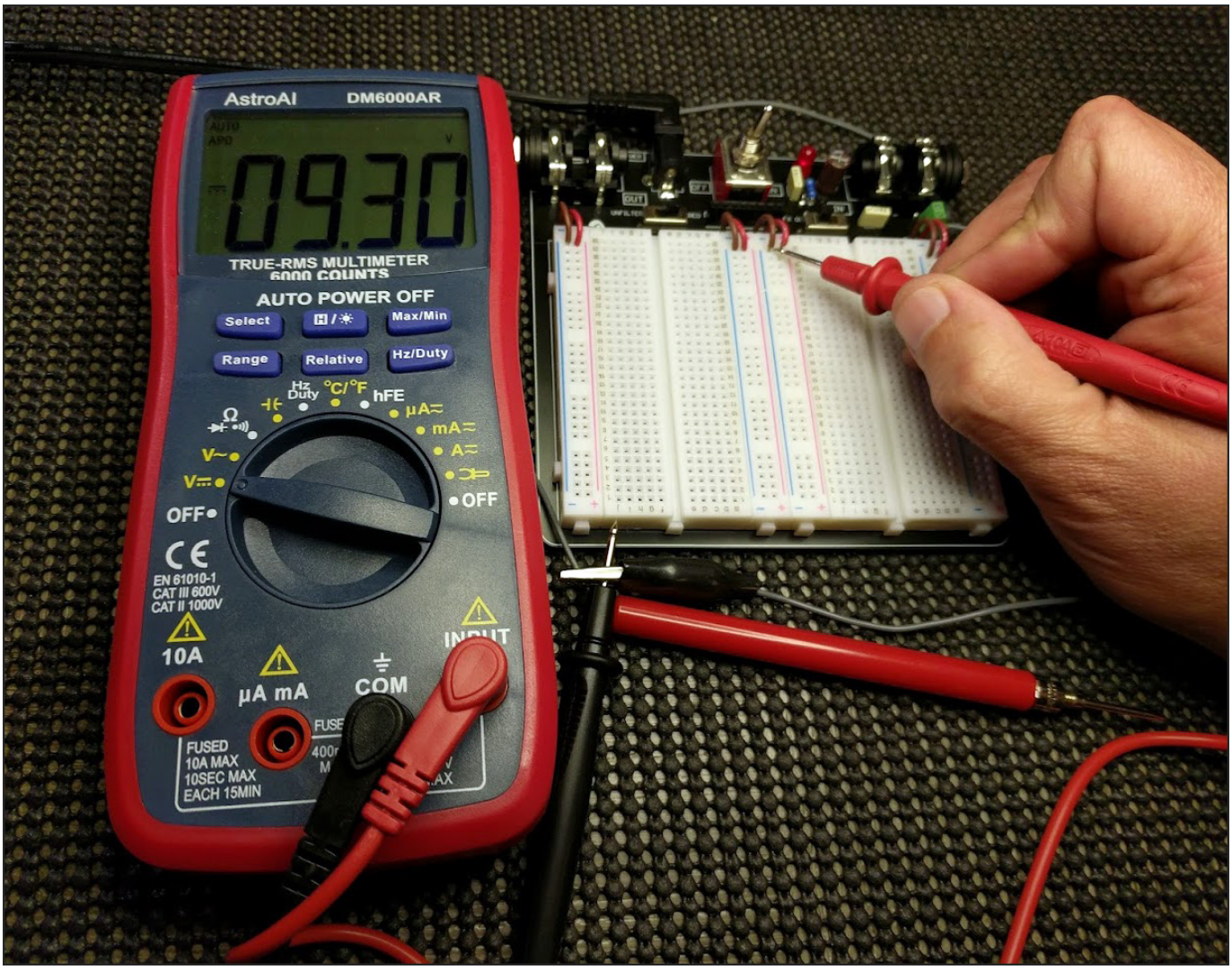
Now you can attach the two probes to the terminal block and screw down the connections. Make sure you attach the probes as shown.





Let's make sure things are working. Connect your DC supply to the PCB via the DC Jack. Flip the 3PDT toggle switch to "On". The LED should light up. If not, recheck to make sure you have soldered everything on the back of the PCB and that the LED is oriented correctly..

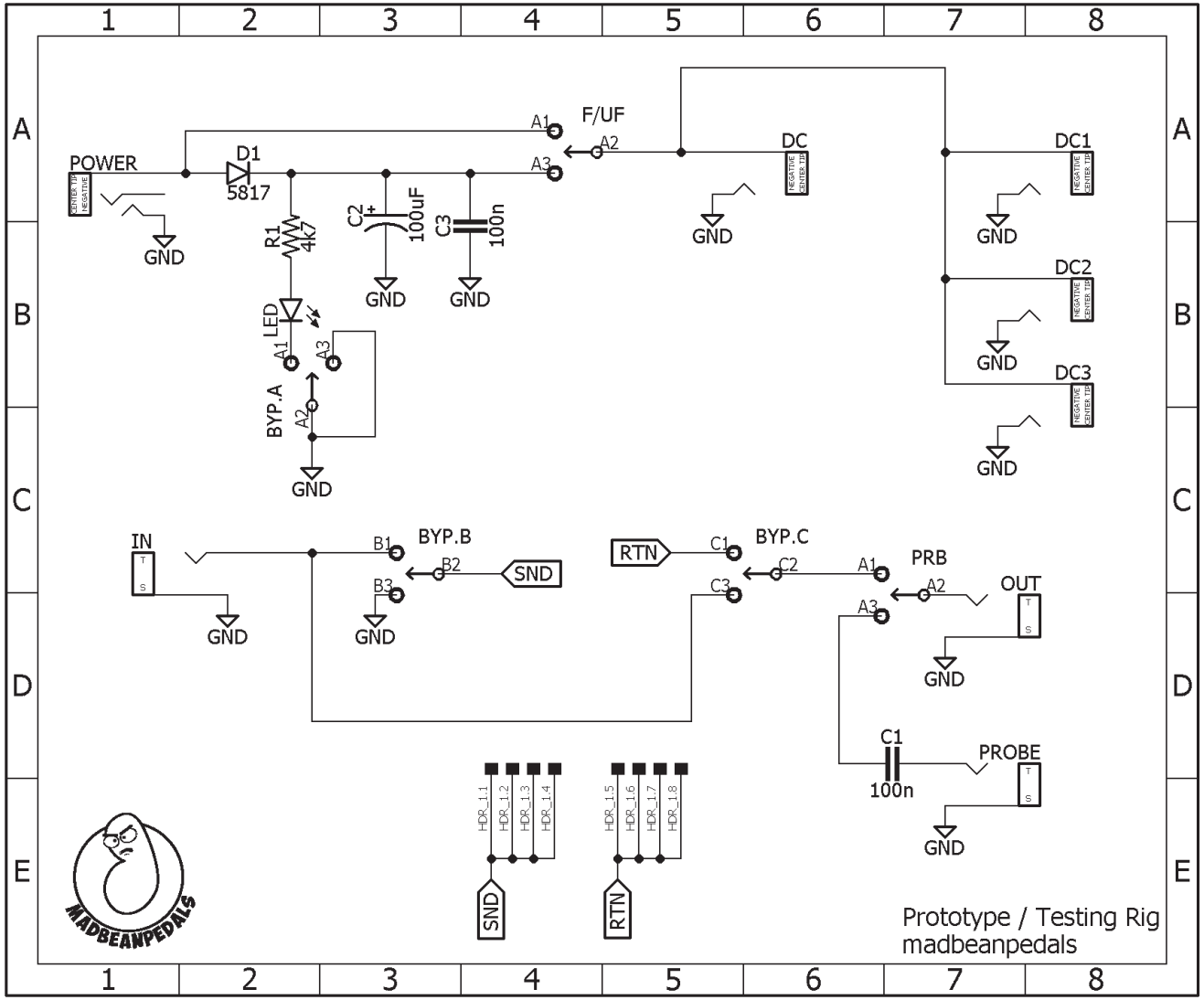
Attach the Ground Probe to the black lead of your digital multimeter. Set the left switch to "Unfiltered". Now use your red lead to check one of the power wires to make sure voltage is getting to the breadboard. In this case, my power supply reads 9.5v with no load, just as expected.



Flip the switch to “Filtered” and take the same reading again. It should be lower than the previous. In this case I got 9.3v. Some voltage drop across the reverse protection diode is expected. Everything looks good to go!

If you are not getting a reading, again check all your solder joints, cap orientation (for the electrolytic), etc. If you need help, visit the madbeanpedals forum for assistance.

I hope you get a lot of use out of the Prototyping and Testing Rig! It will likely become an indispensable tool for your pedal building.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RTN
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OUT
C1
100n
PROBE
HDR_1.1
HDR_1.2
HDR_1.3
HDR_1.4
HDR_1.5
HDR_1.6
HDR_1.7
HDR_1.8
Prototype / Testing Rig
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