Project 1, Part 3

Transferring Your Distortion Circuit To Perfboard (Before Mounting It in a Box)

v02, 10.15.11

What happens next:

In Parts 1 and 2 of this series, we assembled a simple distortion circuit on an electronics breadboard and explored some possible modifications. In this installment, we'll transfer the circuit—or whatever variations you concocted in Part 2—to a small piece of perfboard. Once we've done this, we'll be ready to mount all the components in a stompbox enclosure, which we'll do in the project's fourth and final segment.

See "Project 1, Part 1" for a list of necessary tools and parts, plus some recommended reading.

A note before proceeding: If you have the parts to spare, it's great to leave your working circuit in the breadboard while you assemble the perfboard. That way, you can use the breadboarded circuit as a visual reference, and take measurements with your multimeter should the perfboard circuit require troubleshooting. (Don't sweat it if you don't have extra parts on hand—just keep it in mind for the future.)

Also, some builders like assembling everything in duplicate. That's another great way to troubleshoot, and you'll build two units in not much more time than needed to assemble a single one.

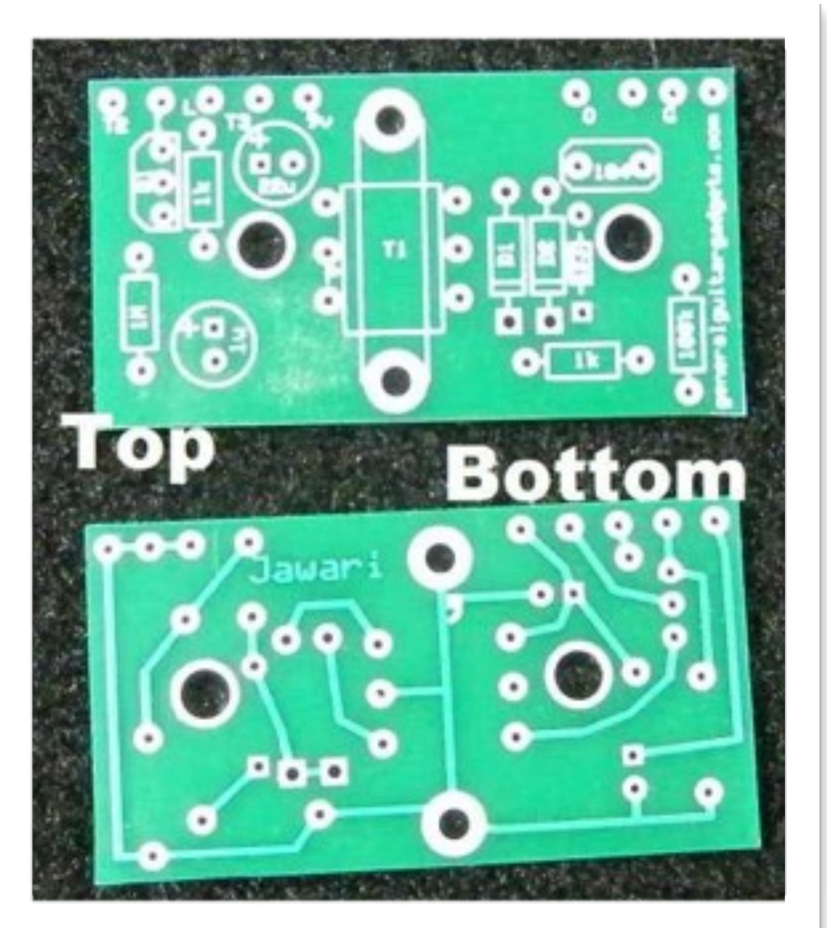
Whichever way you go, have your schematic handy. You'll need it.

PCB vs. Perfboard

Most stompboxes—and nowadays, many amps—are assembled on printed circuit board (PCB). A PCB is a piece of layered fiberboard or plastic in which all the components are connected by internal conductive traces. You just solder the components into the designated holes, and all the connections are ready to go.

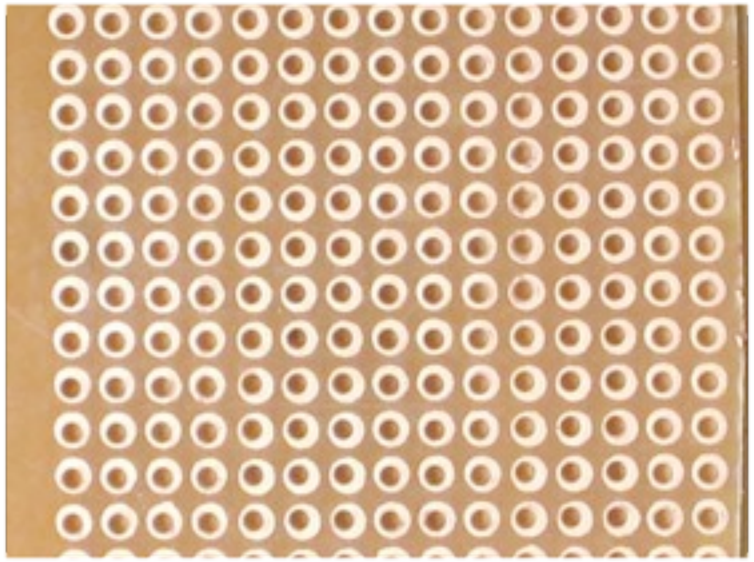
Commercial stompbox kits usually come with a PCB and a bag of parts. It's definitely faster and easier to build this way. (It's also surprisingly easy to make your own PCBs, but that's a lesson for another day.)

Instead, we're going to assemble all the parts using perfboard, which consists of rows of tiny, copper-lined holes, and we'll manually make all connections on the back side of the perfboard. It's a cumbersome technique, but it has its advantages: You'll develop more of an understanding of how circuits work, and in the future, you'll find it easy to turn a simple schematic into a working circuit.



A typical commercial stompbox PCB (from General Guitar Gadgets). The location of components is indicated on the top side. The internal connections are visible from the bottom side, where the solder goes.

Perfboard vs. Vero Board



As you can see in this image of the underside of a piece of perfboard [upper right], each hole is surrounded by conductive copper, but none of the holes are connected to each other.

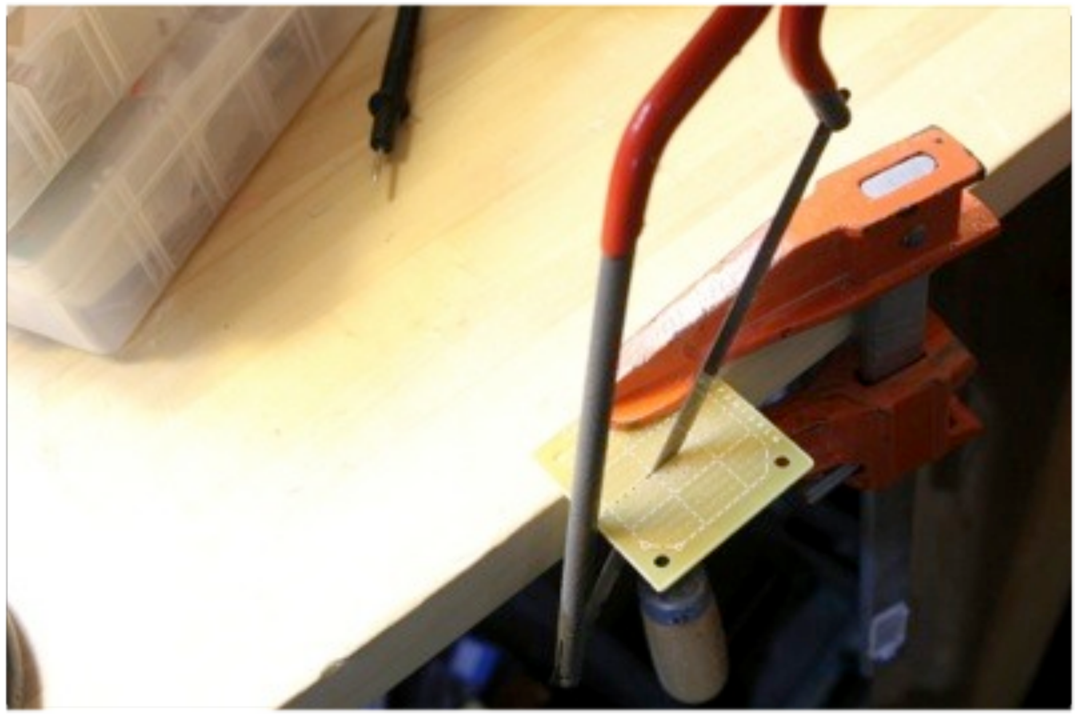
There's another alternative called vero board [lower right], which is constructed more along the lines of your breadboard: All holes in each row are pre-connected. This is also a great way to build circuits without a printed board. But we're starting with perfboard because it's easier to find and a great way to learn.

Cut the Perfboard

Perfboard is available in various sizes. In order to accommodate all the components for this project and fit the whole shebang into an enclosure, you'll need a piece of perfboard about 7 holes in height and 15 holes in width. (It's okay if it's a little larger, but not *too* much. Just check to see whether it fits into your enclosure before proceeding.)

If you need to cut your perfboard, it may help to mark where you intend to cut with a felt pen.

I don't need to tell you to be careful when using sharp tools.

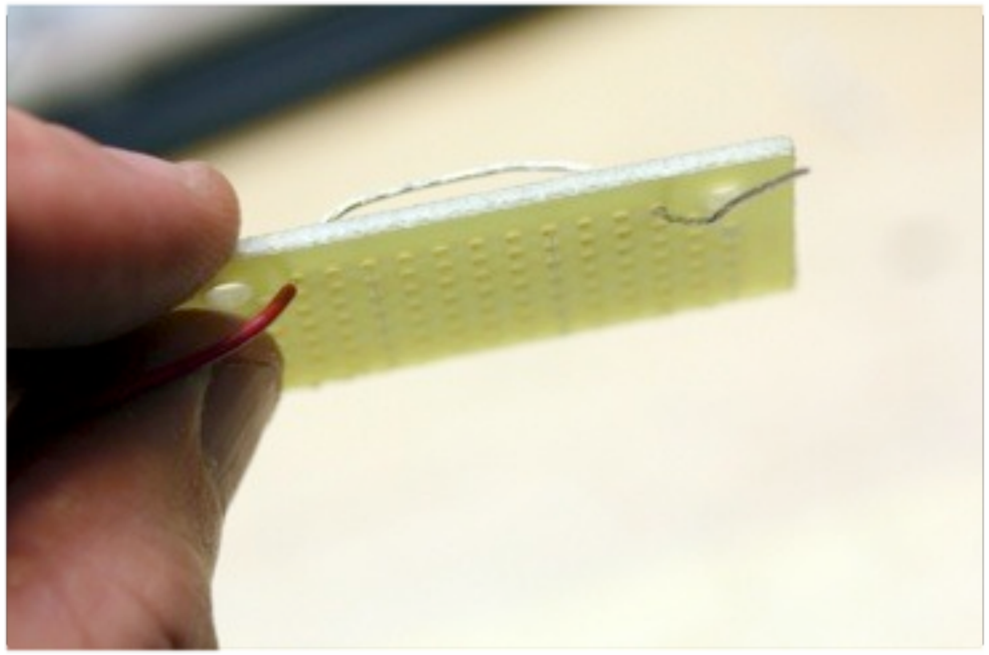


You can cut perfboard with a small saw. You can also score it with an X-Acto knife, clamp the board in a vise, and then snap it with pliers.

Create a Positive Bus

We're going to wire our piece of board with positive and negative busses, just like your breadboard.

Strip a couple of inches from a piece of red wire. Insert it through the rightmost holes of the top row, and then draw it back out through the leftmost hole. Pull it fairly tight

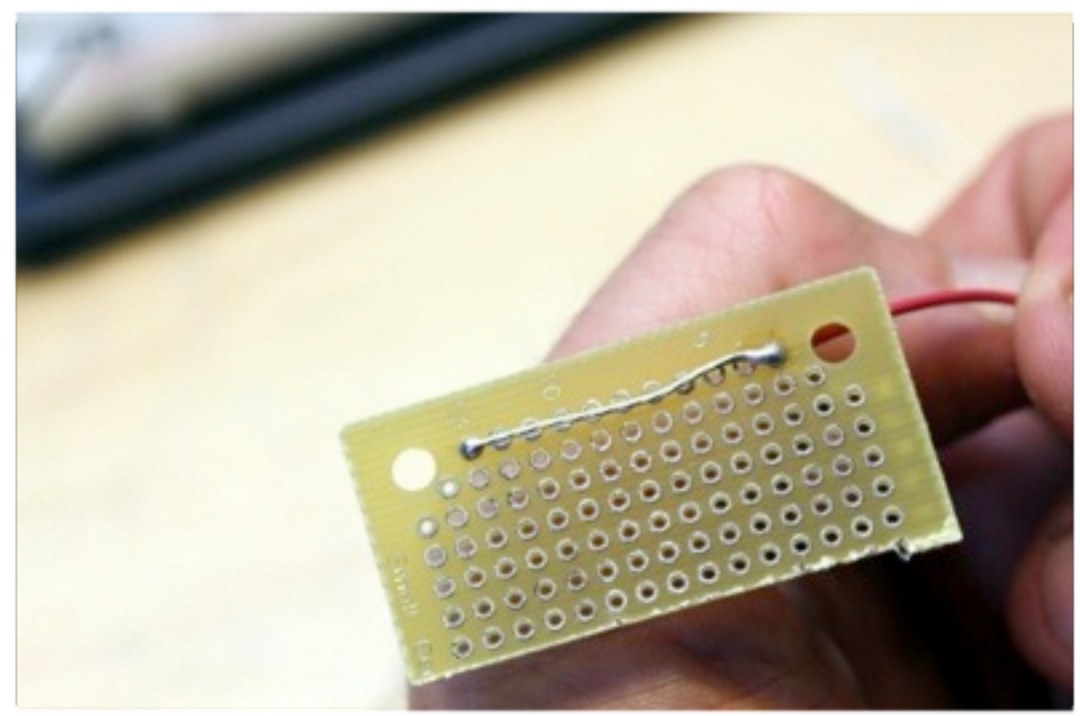


Remember: Wires and components are usually inserted from the top side of the board—*not* the side on which the metal holes are most visible.

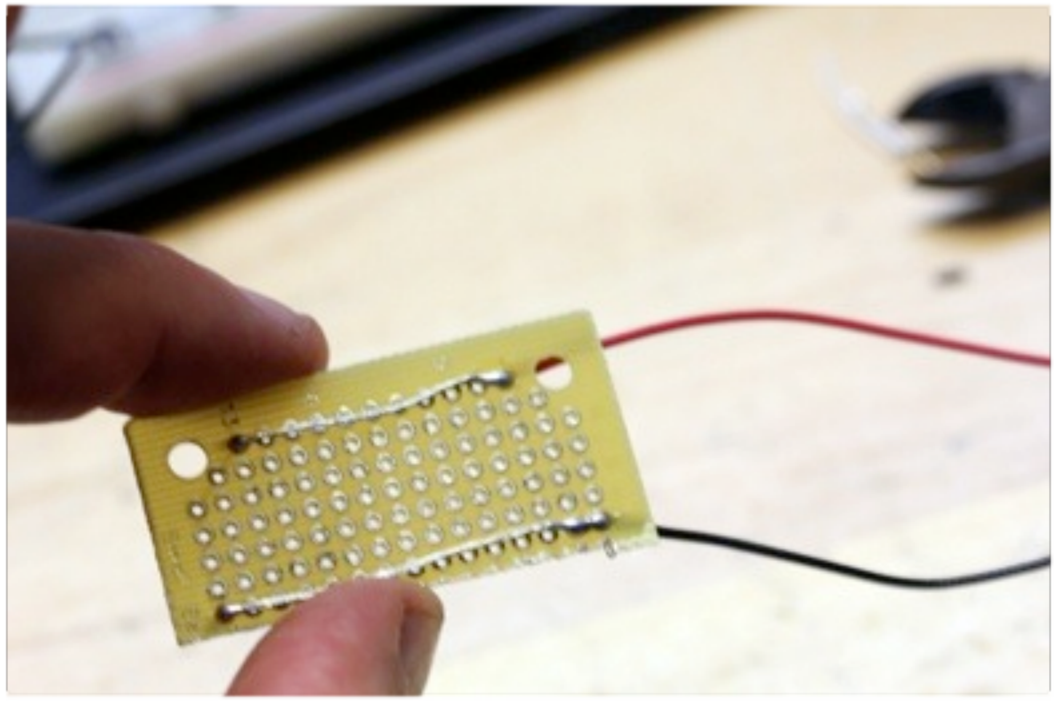
Solder the Positive Bus

Flip the board over and solder the two ends of the wire into place. Don't solder between these points yet. We'll be weaving several components that connect to the positive bus through and around this wire.

Use wire lengths of five or six inches here and elsewhere in this section. We'll trim them shorter when we insert the perfboard into the enclosure in Part 4, but you'll want that much length when we test the assembly in your breadboard at the end of the section.



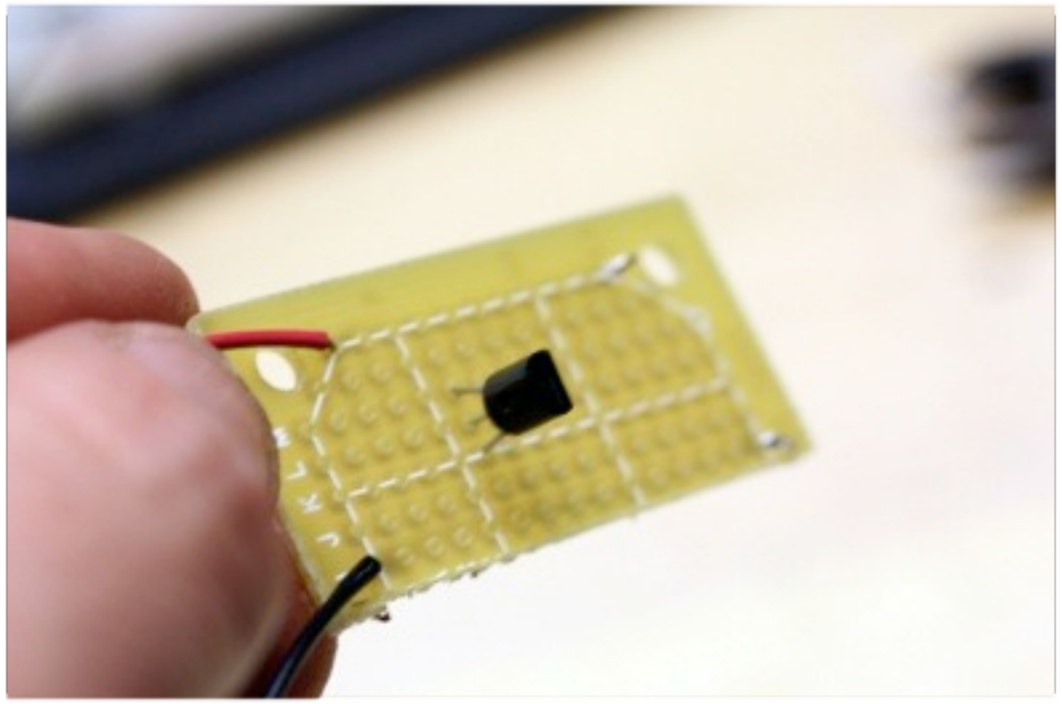
Add the Negative Bus



Repeat what you just did, this time on the lower perimeter side of the perfboard, and using black wire.

Insert the Transistor

Insert your transistor of choice near the midpoint of the board. (If you're using any of the transistors discussed in parts 1 and 2, the curved side of the component should face left.) It may help to bend the transistor's legs after inserting it so it stays in place when you flip the board over to solder. (Which we are *not* doing just yet.)



You may be wondering why we're starting at the center of the circuit rather than, say, working from left to right. Generally speaking, it's a good idea to start at the portion of the circuit where the most components and wires intersect.

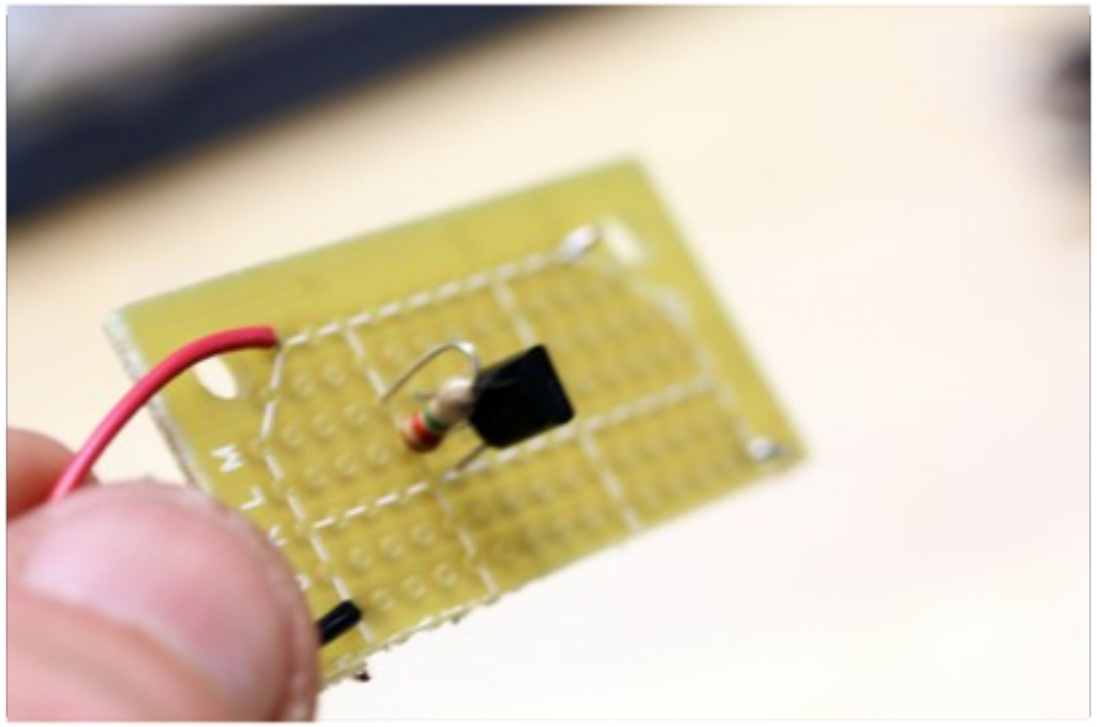
Still, the exact order of tasks isn't set in stone. Over time you'll figure out what works best for you.

Insert R1

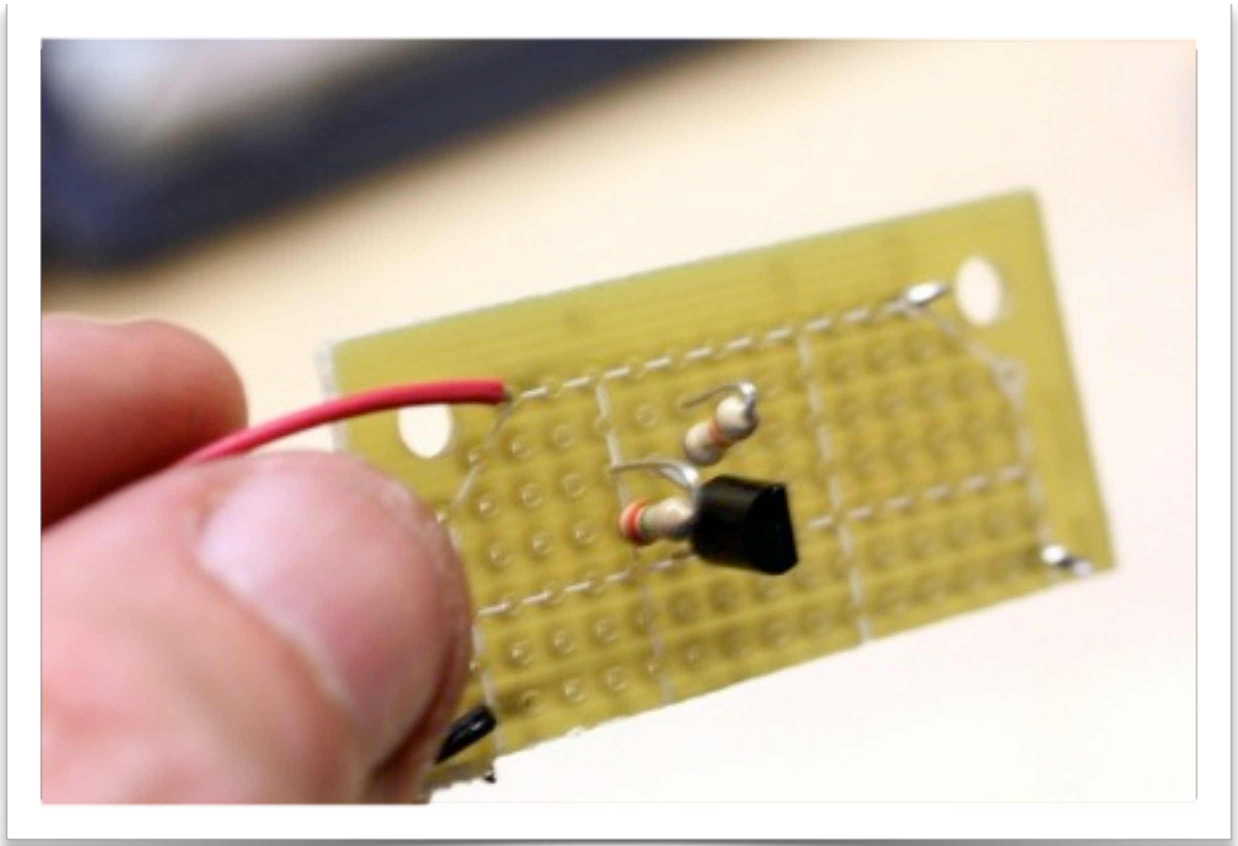
Bend R1, the 2.2M resistor, into a "u" shape and insert it alongside the transistor. (Remember, resistors aren't polarized, so it doesn't matter which end goes where.)

Ideally, the resistor should sit exactly adjacent to the transistor, so that one leg is in the same horizontal row as the transistor's collector (uppermost pin), and the other leg is in the same row as the transistor's base (middle pin).

Whenever possible, insert wires and components so that all parts that connect are on the same horizontal row. These rows are not pre-connected as on your breadboard, but trust me, this practice will make it *much* easier to maintain your bearings when you flip the board over to solder.

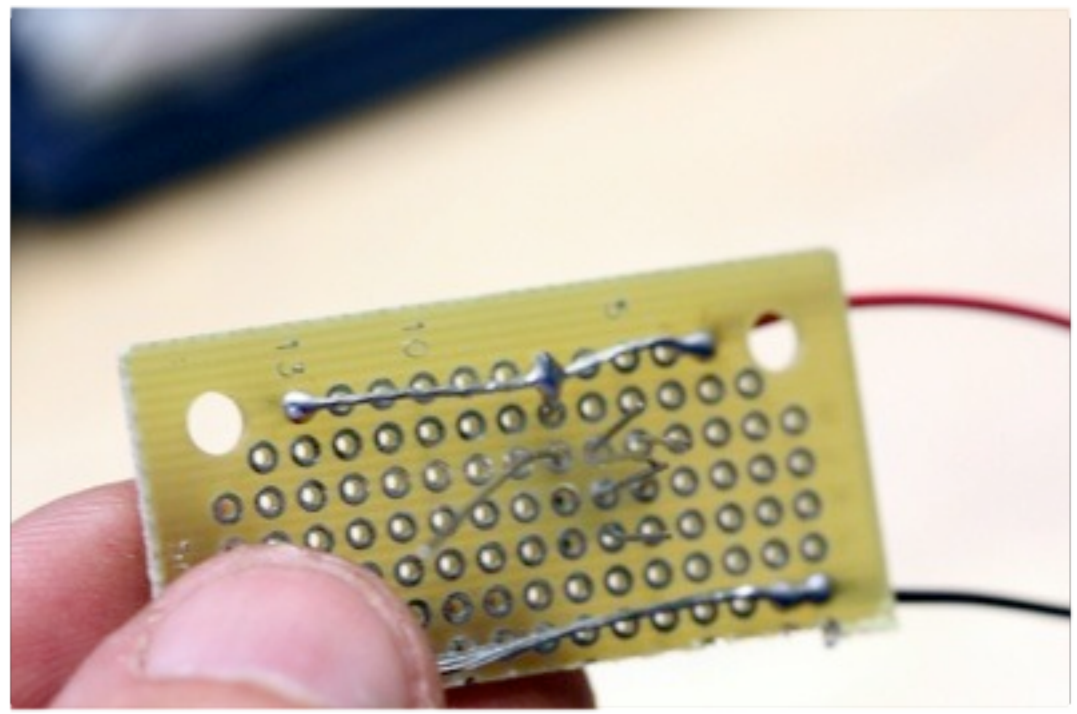


Insert R2



Now insert R2, the 68K resistor linking the transistor's collector (topmost pin) to the positive bus. Now one end of each resistor should reside in the same horizontal row as the collector.

Solder R2 to the Positive Bus

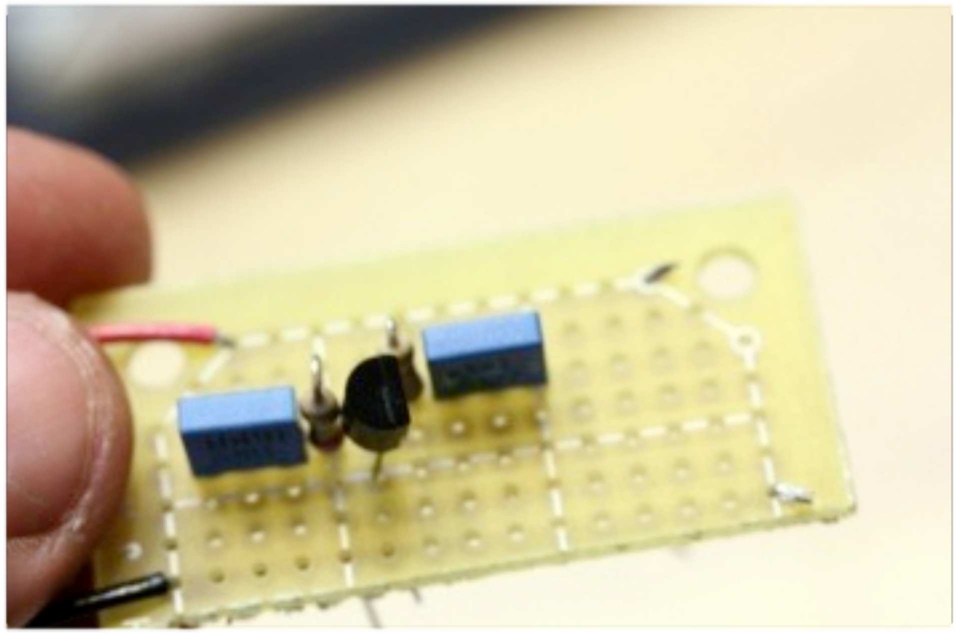


Flip over the board and survey the mess. Solder the topmost end of R2 to the positive bus. (Remember, you can always verify the connection using your multimeter's continuity function.) Snip off the extra wire.

As we proceed, try to keep the nest of soldered wires close to surface, so the component will fit easily into the enclosure. (It will rest atop the back side of the pots.)

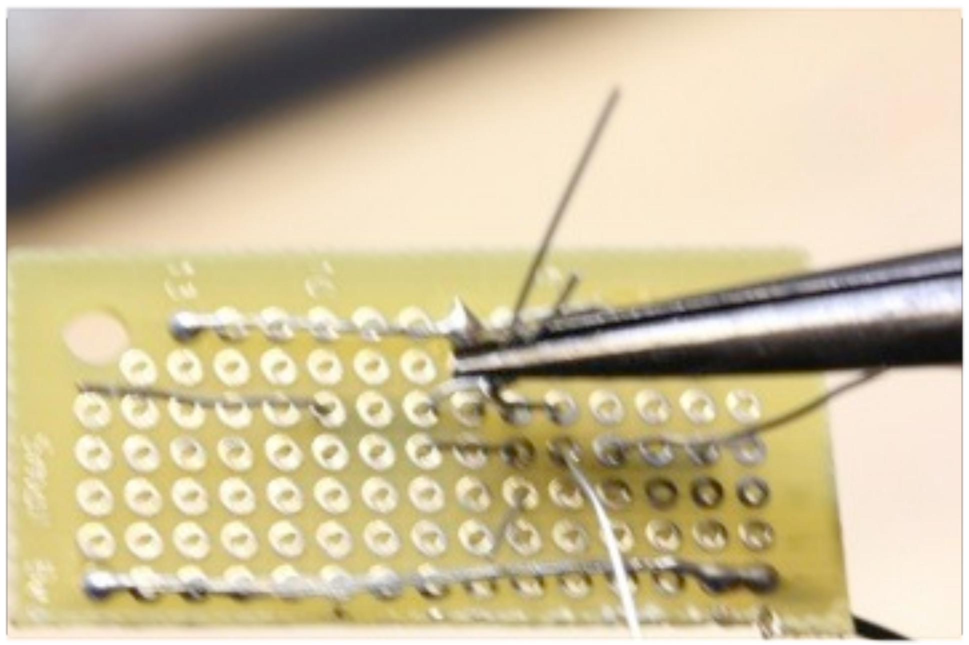
Soon we will also solder together the adjacent components in the same horizontal row—but not just yet.

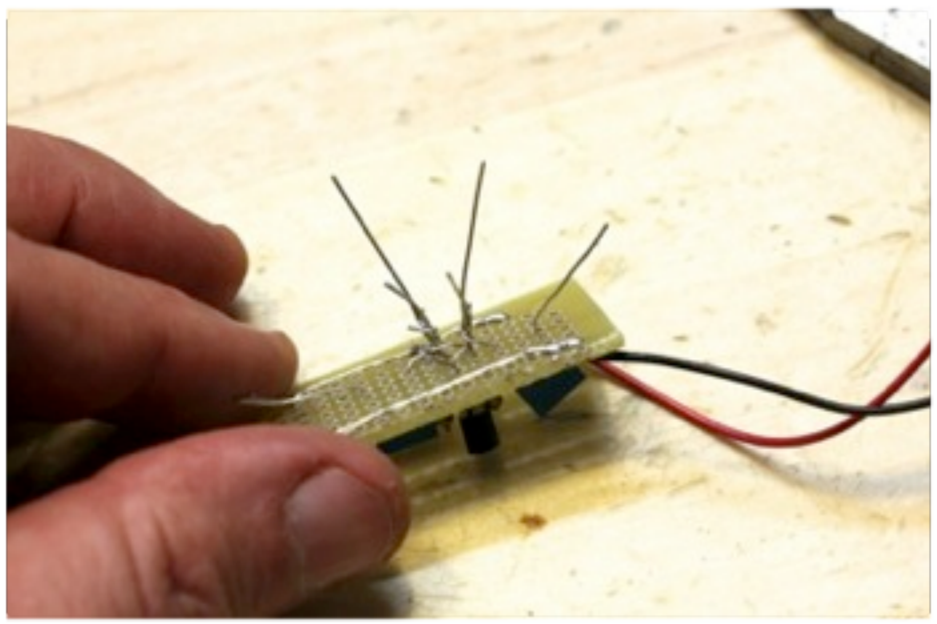
Add Caps 1 and 2



Now let's add the caps. For C1, use whatever value you prefer based on your experiments in Part 2. Cap 2 is a 104. Cap 1 should reside on the same horizontal row as the transistor's base (middle pin). C2 should be on the same row as the transistor's collector (top pin).

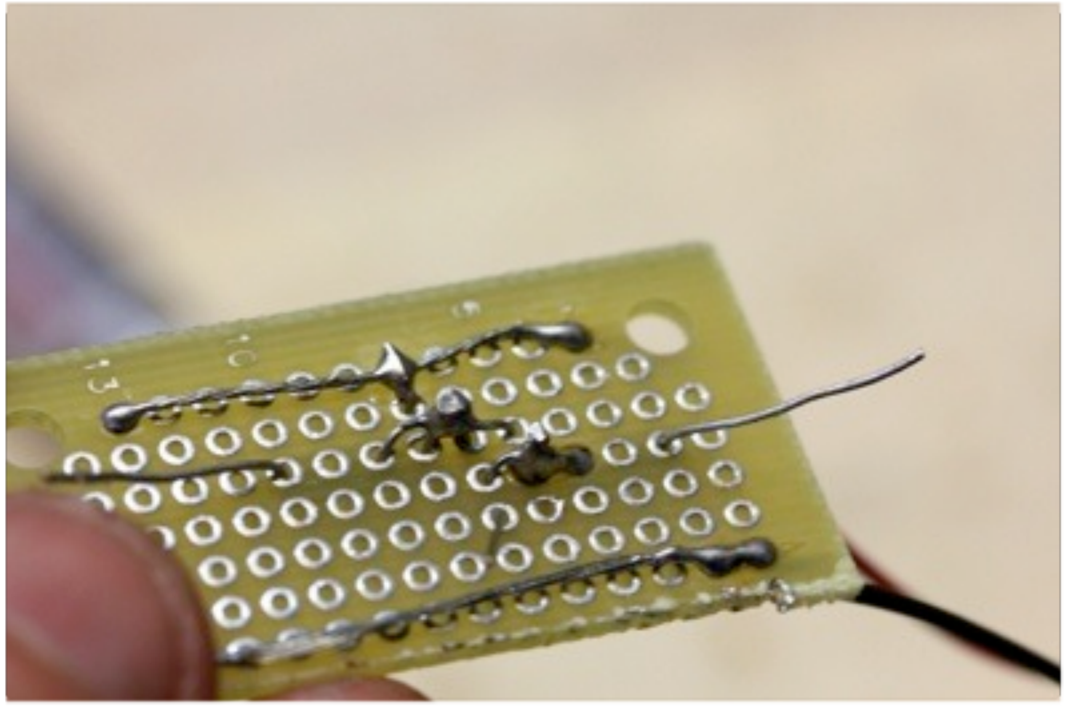
Sort Out the Mess!





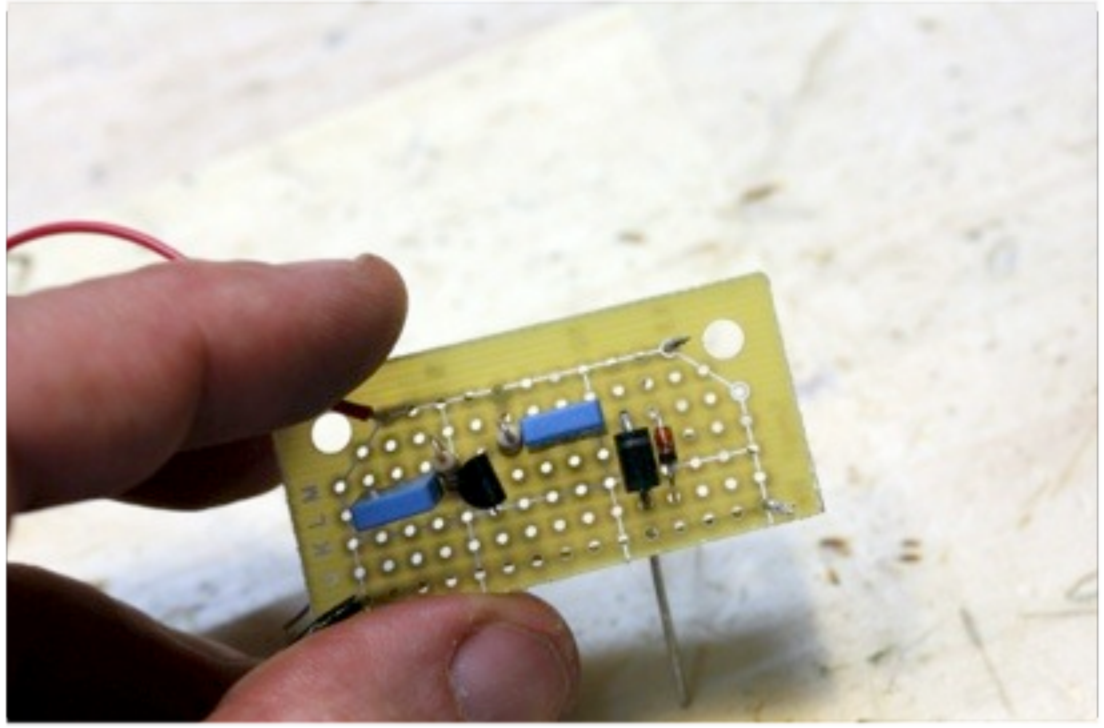
Flip the board over again. Using your needle nose pliers, twist together the wires located on adjacent holes on the same row. Specifically, connect one end each of R1 and R2 to the transistor's collector (top pin) and the nearest side of C2 (four wires total). Next, connect the other end of R1 to the transistor's base (middle pin) and the nearest side of C1 (three wires total). The outermost legs of C1 ands C2 and the transistor's emitter (bottom pin) aren't connected to anything yet.

Solder and Snip



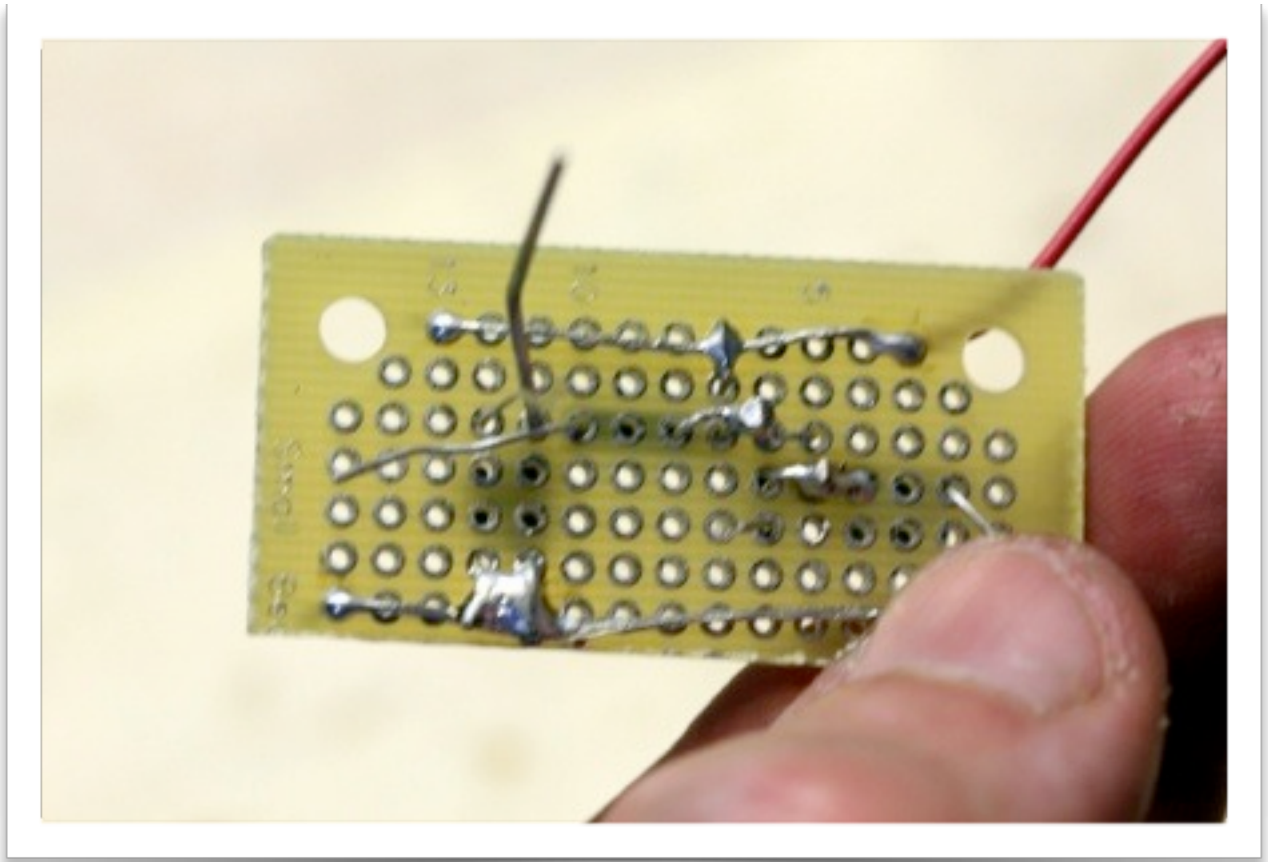
Solder each "bundle" of wires close to the holes, and then snip off the extra. It should look something like this.

Add the Diodes



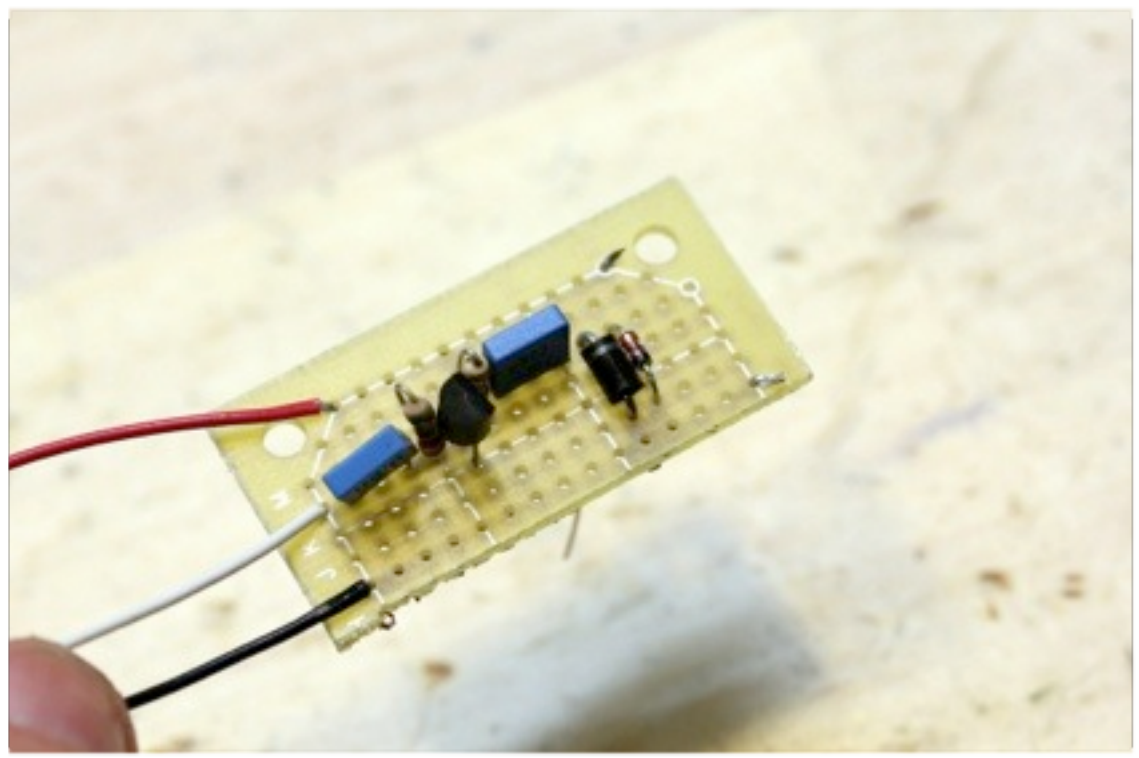
Add whichever combination of diodes you preferred in Part 2. Double-check their orientation. At least one should have the cathode (banded) end oriented toward the negative bus, and at least one should be positioned the opposite way. If you prefer more than two diodes, place additional ones alongside the the first two with their legs inserted into the same horizontal rows.

Solder the Diodes to Ground



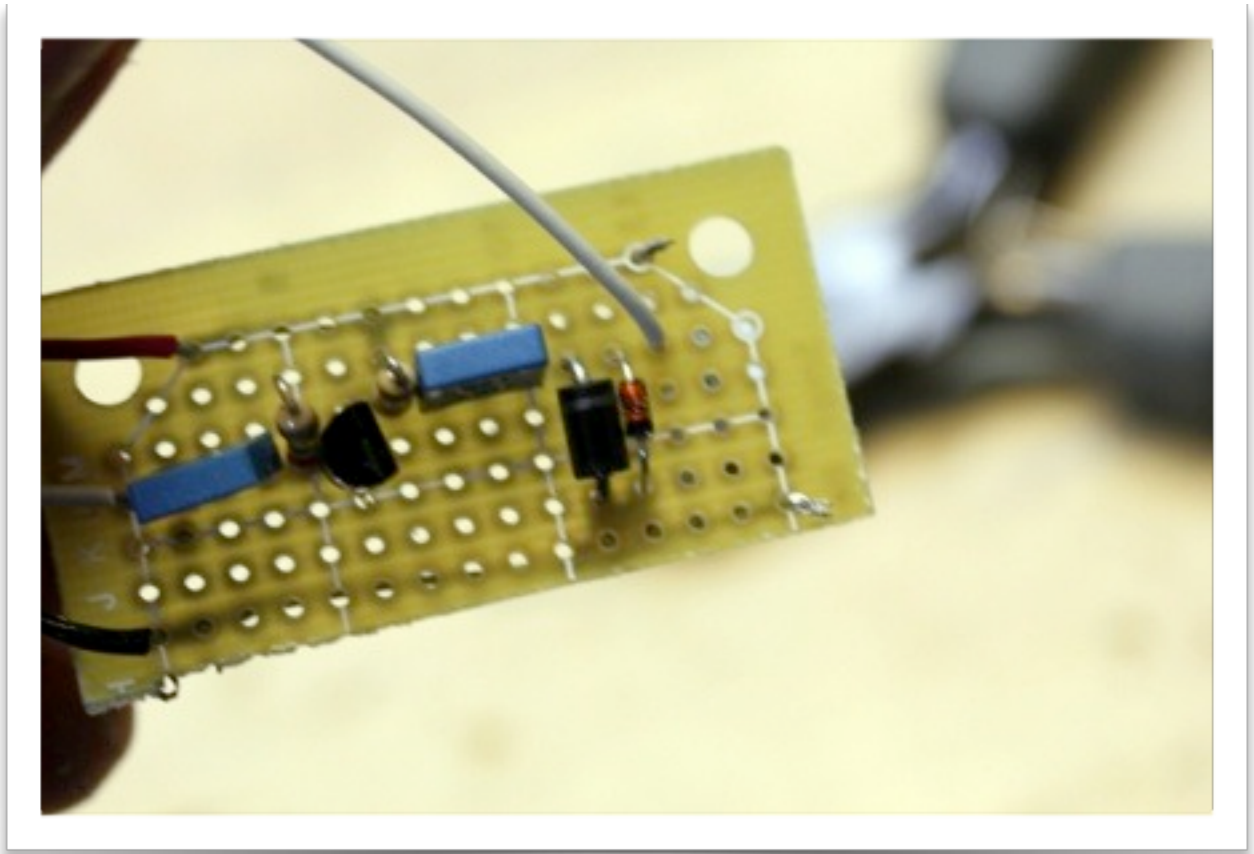
Solder one leg of each diode to ground. Meanwhile, the other leg of of each diode and the outermost leg of C2 should be arranged on the same row in consecutive holes. But don't solder these just yet.

Add the Input Wire



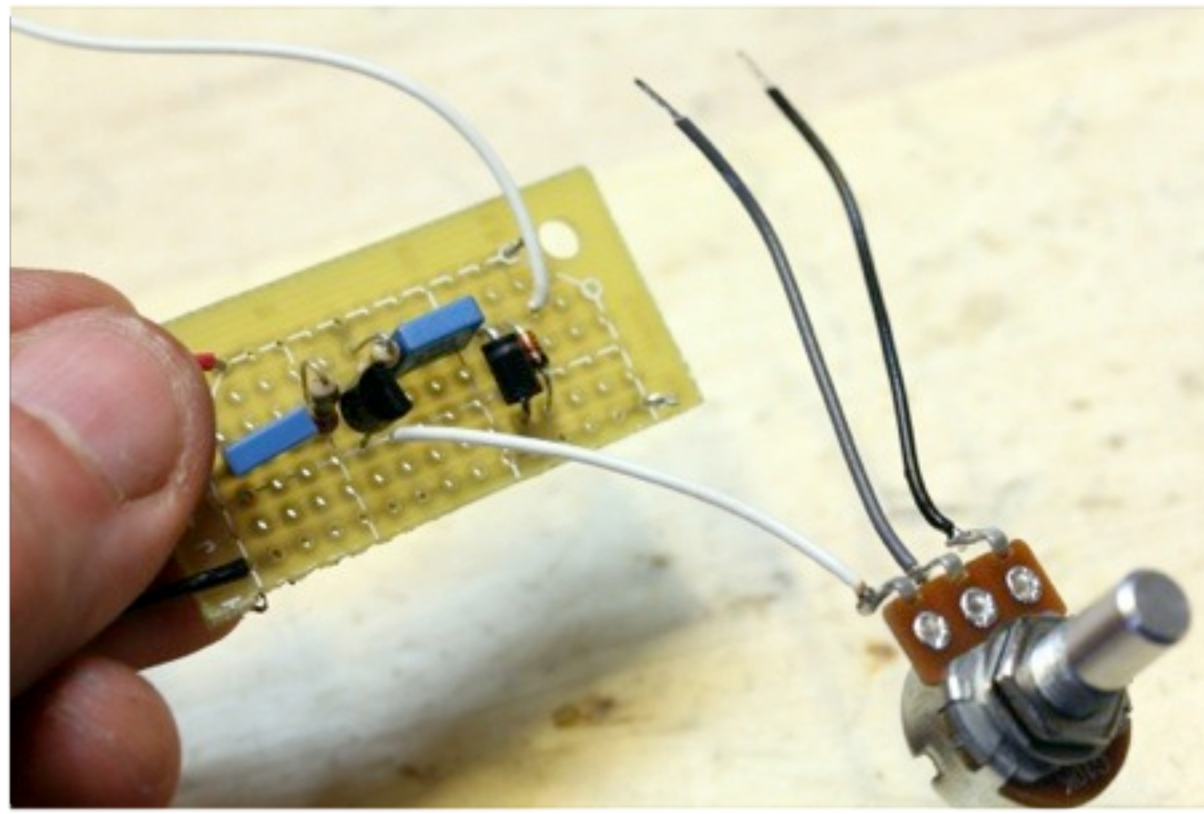
Strip about an inch of insulation from a length of white wire, and insert it alongside the outermost leg of C1. Turn the board over, twist the two wires together, solder, and then snip.

Add the Output Wire



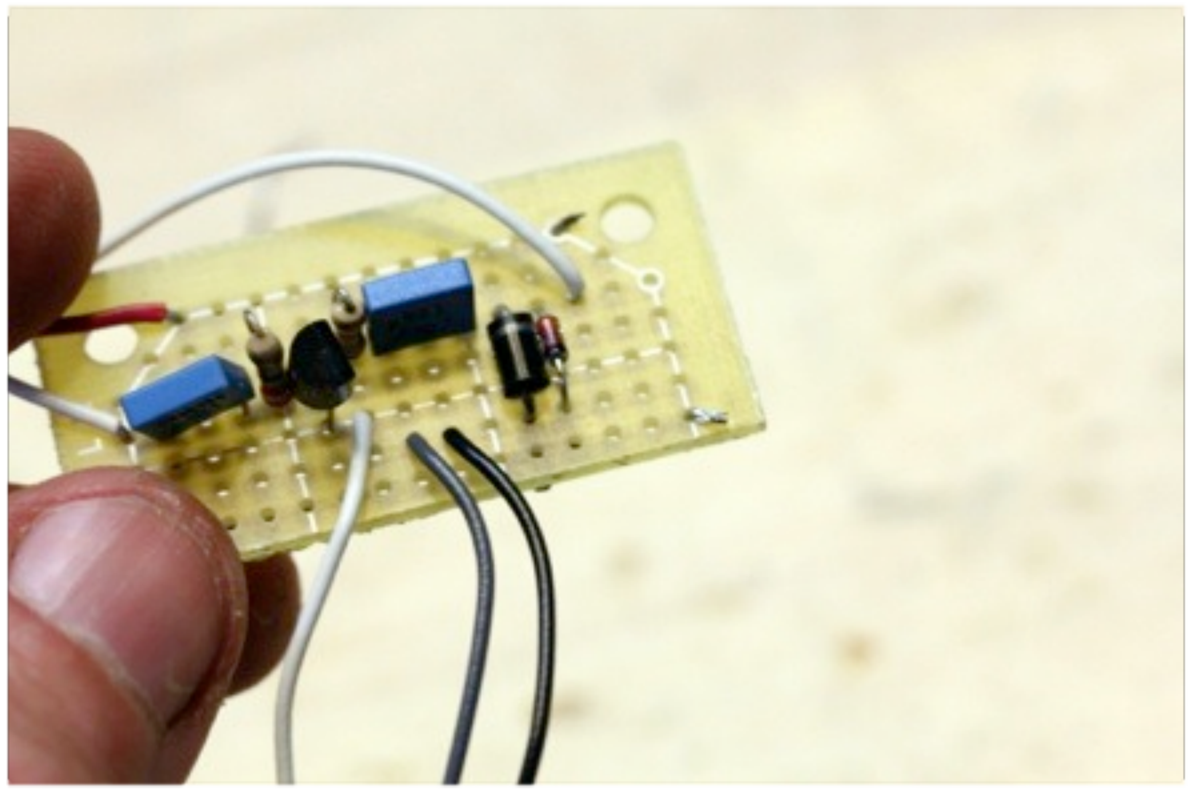
Do the same with the output wire, twining it together with the uppermost legs of your diodes and the outermost leg of C2 (four wires total). Solder and snip.

Connect the Gain Pot to the Emitter



If you haven't already done so, trim the wire connected to the C10 gain pot to about 3 inches in length, and strip about half an inch of insulation from each wire. Insert the wire connected to lug 3 alongside the transistor's emitter (lower pin). Turn the board over, twist the two wires together, and then solder and snip.

Connect the Gain Pot to Ground



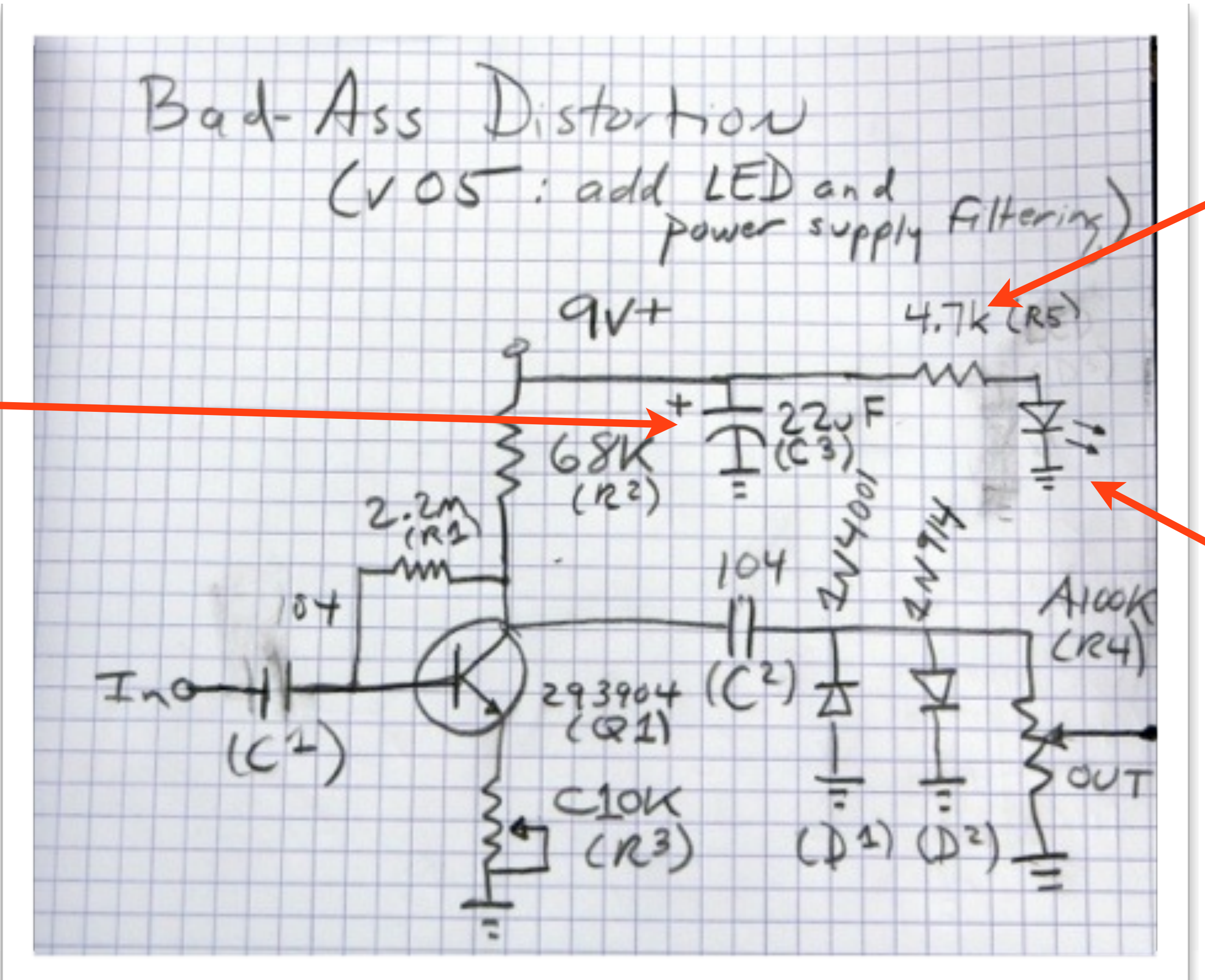
Insert the wires connected to lugs 1 and 2 of the C10K pot alongside your ground bus. Flip the board over, solder the two wires to the ground bus, and then snip.

We're Almost Done, But...

We've pretty much completed the perfboard at this point, but we're going to add two more parts in advance of boxing the thing: a resistor to protect our LED-to-be, and a large capacitor to filter the power supply and minimize noise. Neither affects the tone of the circuit.

These additions appear in our *final* version of the Bad-Ass Distortion schematic.

This 22uF electrolytic capacitor filters out noise. Electrolytic caps are polarized, and their orientation is shown using this symbol.



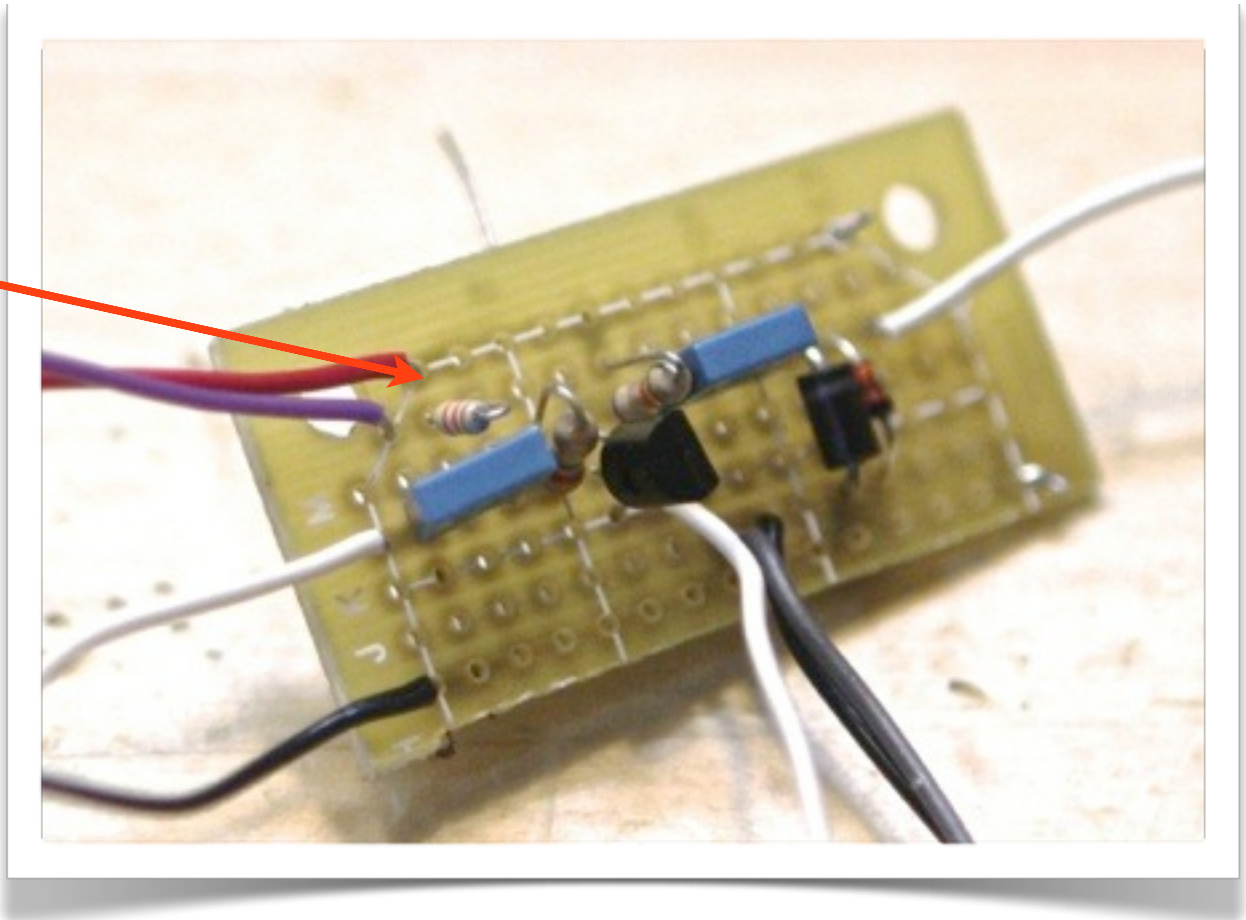
This 4.7K resistor is needed to keep the LED from frying.

The LED symbol is like the diode symbol, but with a pair of arrows to signify emanating light.

Add R5 (LED protection)

One end of R5 (4.7K) connects to the positive bus. The other connects to a new wire that will eventually connect to the positive leg of our power- indicator LED.

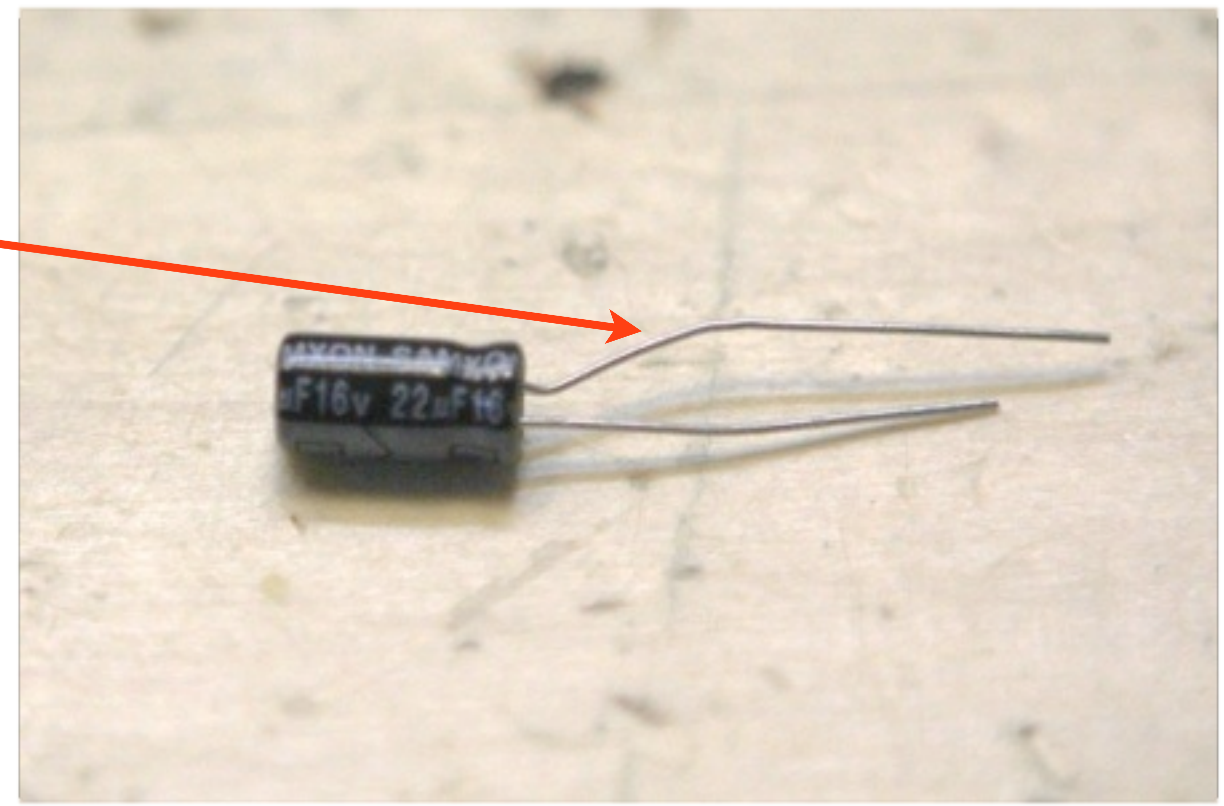
As these circuits get more complex, you start to see the advantage of using multiple wire colors, just to keep track of what goes where. Here I used purple wire for the positive LED connection.



Insert a 4.7K resistor (R5) above C1. Strip about an inch of insulation from a new length of wire and insert it alongside the resistor. Flip the board over and twine the new wire around one leg of the resistor. Solder and snip. Solder the other leg of R5 to the positive bus.

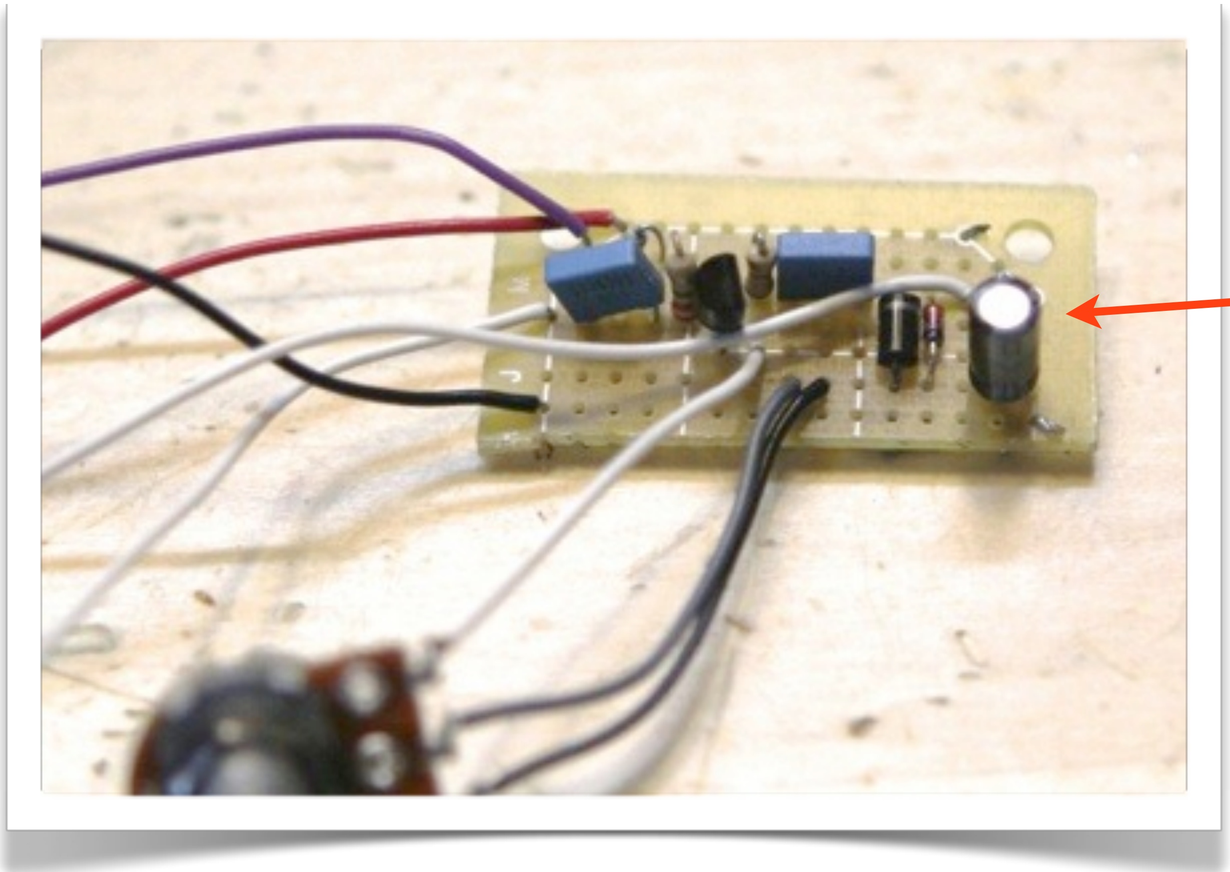
Meet the Electrolytic Cap

The long leg is positive.



Electrolytic caps are used when capacitance values over 1uF are needed. Unlike the other caps in this circuit, these are polarized—the orientation *does* matter.

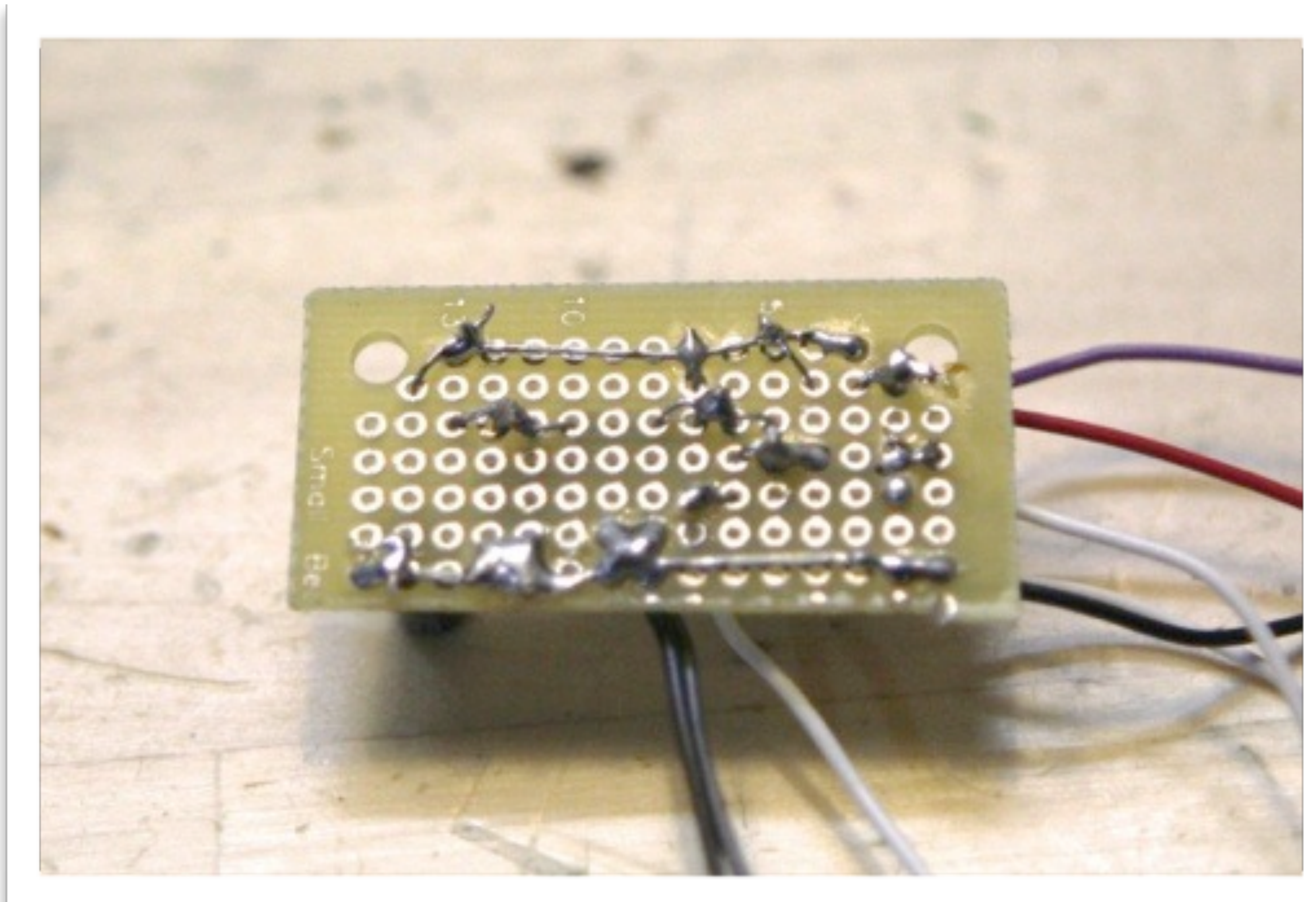
Add C3



The long (positive) leg connects to the positive bus, the short (negative) leg to the negative bus.

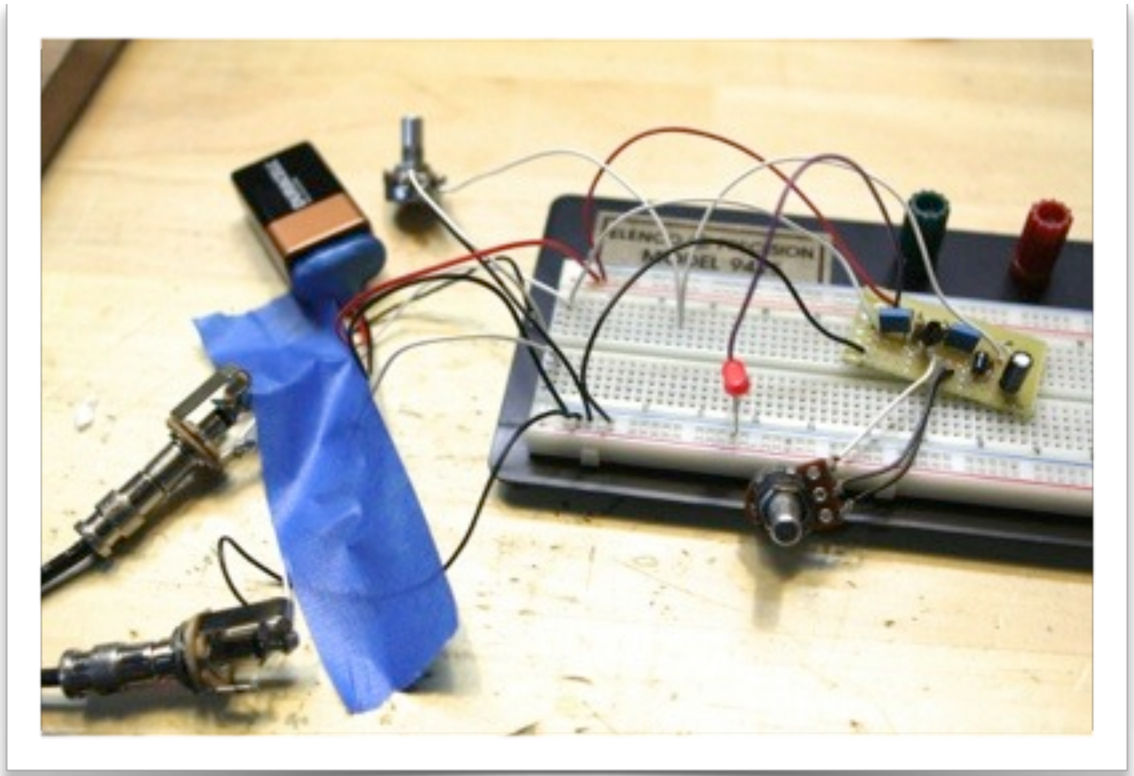
Insert the 22uF electrolytic cap somewhere toward the left edge of the perfboard. Flip the board over and bend the capacitor's legs so that the long one touches the positive bus, and the short one touches the negative bus. Solder in place and snip.

Inspect Your Work



It ain't pretty, but it'll work great (if you wired it correctly). Double-check the integrity of the solder joints (a magnifying glass helps). Make sure nothing's touching that shouldn't be touching. Check that no wires or solder clumps protrude too far above the surface of the board.

Test Your Work!



Now plug your creation into your breadboard, and see if it goes! Connect the red wire to the positive bus, the black wire to the negative, the input wire to the input jack, and the output wire to the output jack. It should sound the same as your breadboarded version.

Connect an LED as well. Plug its short leg into the negative bus, and connect its long leg to the wire you just connected to R5. It should glow brightly.

You can also add your A100K volume knob if you like. Disconnect the perfboard's output wire from the output jack and connect it to the wire extending from lug 3 of the pot. Connect lug 2 to the output jack, and lug 1 to ground.

Coming in the fourth and final part: We box the accursed thing!