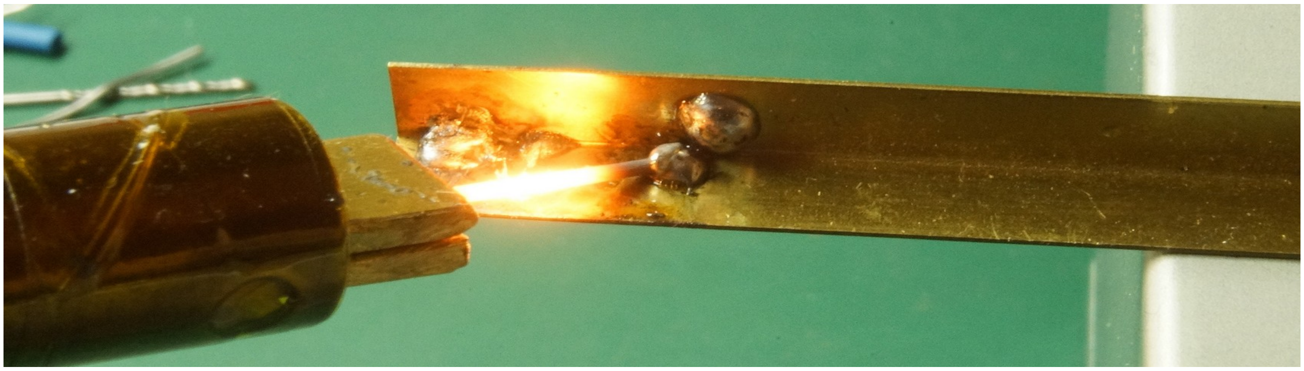


Resistance Soldering Kitbash

March 2014 Printing

NOTE: After I wrote this and used this kit for a while, I'm not sure this setup is ideal. The bottom line is that the carbon produces a residue that can inhibit soldering. I eventually found a used American Beauty resistance soldering station from an auction site and I love it. It is far superior to this kit. I guess if you wanted to tinker more, you could find a way to replace the electrode with something cleaner. But that would require experimentation, and I've moved on. So maybe this can spur new ideas. It's also uncertain how safe this is with long-term use. Maybe you can improve it!

I'd been thinking about a resistance soldering station for years. I had two options before me. I could buy a commercial setup, or I could build my own. The cheap commercial setup I found cost around $200. The better ones cost about $450 and I even saw one at $800. Yikes!

Since I don't mind tinkering, I thought I would explore building my own, but I had a few impediments. First, high amperage seemed a bit scary. Second, while I found some Internet information, I saw generalities, jokes and fluff. Very little was really useful for me.

So there is lots of information on the web. Your search engine can lead you to lots of resources and I encourage you to do your reading and researching. This article is my offering on the subject-- hopefully written in a clear enough manner to take away the mystery and uncertainty that is found in so many articles. Certainly, nothing I found comes even close. In this article, I'm going to: explain concepts, explain EXACTLY what I did, and explain variations. And since this is self-published on the web as a PDF, I didn't have to worry about keeping it concise the way a magazine article would have to be. So you can do EXACTLY what I did (and achieve results the first time out) and hopefully you can make knowledgeable changes since you understand what's happening.

Resistance Soldering

A typical soldering iron uses resistance to work-- but it does it like a toaster. Heating element wire is wrapped around a metal core and it heats up pretty slowly as electricity runs through it (and cools slowly when unplugged). Most soldering irons are rated as to wattage. In the hobby field, 15 watts to 30 watts is a common size and useful for many applications. But 15 watts is not enough to do much for a brass locomotive-- which acts as a heat sink itself, and while 30 watts is better, it takes such a long time to get the area warm that a **huge** area gets hot and you may UN-solder a neighboring part. Heat sinks help, but it still may be tricky.

Resistance soldering is a bit different and has a few advantages. Instead of the electricity running through a heating coil (and secondarily heating up a metal rod), resistance soldering runs the electricity through the metal you are soldering and uses a low resistance tip (thus high amperage and heat). So it is ideal for soldering brass locomotives and other brass creations since electricity flows through the metal. And example where the traditional iron is better would be if you were installing homemade metal handrails on a plastic locomotive. In such a situation it would be hard to ground the delicate handrails and a whole lot of extra trouble to use resistance soldering. An old iron, flux your wire, and zzzzzzp.... a quick touch is all you need for such handrails.

So since I needed to work on some brass locomotives, I knew I needed to go with resistance soldering.

The Plan

I read various articles. Some setups were totally homemade and scratchbuilt. One guy used a car trickle battery charger-- not sure I wanted to go that route. Some people used plain old transformers, and some recommended using a computer power supply. Information was very fuzzy with far too many generalizations for me, so I proceeded with caution and uncertainty. But with great difficulty, I figured it out in the end, made some changes, and hopefully this will be a clear presentation for you.

So first, let's get an overview of how the computer power supply kitbash works conceptually.

Electricity comes in from the wall outlet of your home and the voltage is reduced by the power supply. So we are working with 5 volts, not 115. The output has a ground wire that goes to the metal by something like an alligator clip. So the heating element is really only the positive voltage- or maybe we might say the positive electrode. With the metal part grounded, electricity can flow when the iron's tip touches the metal. Since the tip is where all the resistance is, only the tip gets immediately hot (though the longer you work with your locomotive, the hotter the area on the locomotive gets!). The iron handle itself never gets hot, the metal housing barely even gets warm and the tip cools quickly when the electricity stops flowing. The resistance tip is often made of carbon.

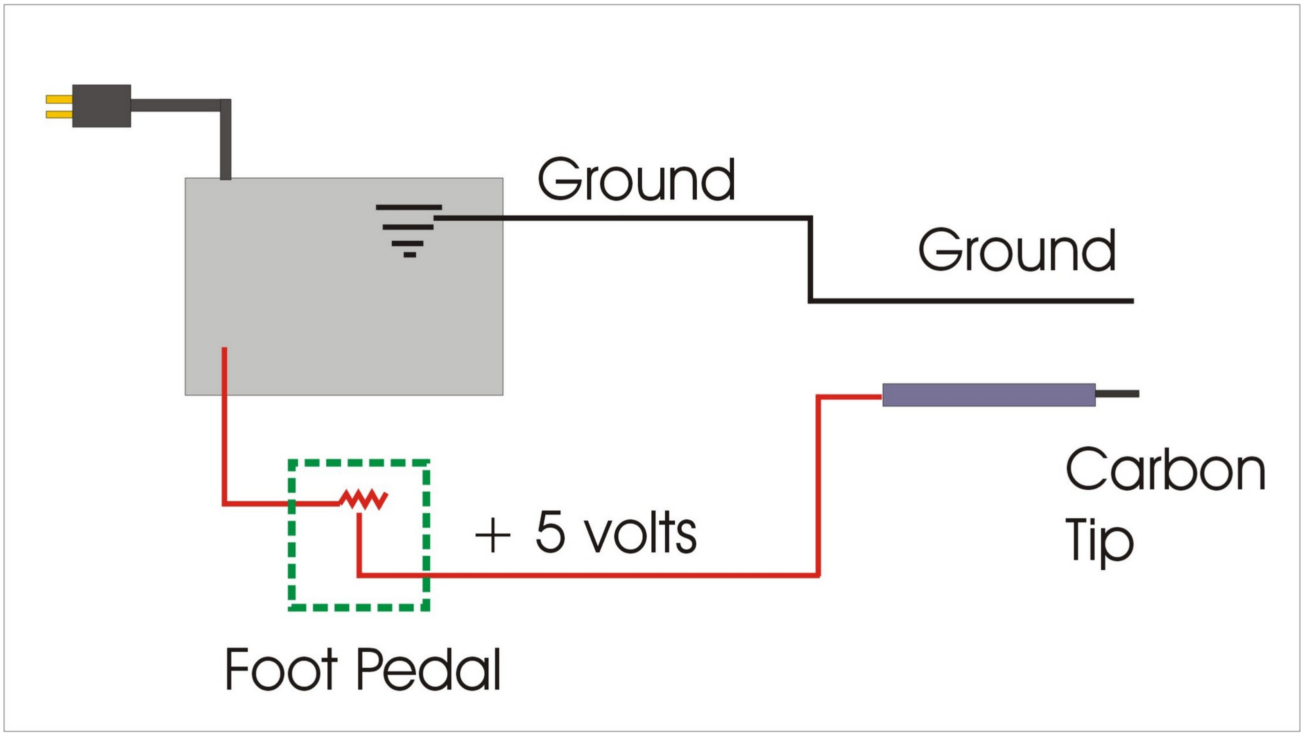
Now, this is ALL that's <u>required</u>. But some kind of on/off foot control is helpful since not using it means the positive electrode tip is ALWAYS electrified! Touch anything grounded and you are in for an unwanted surprise- including burning yourself. It is good to have it **normally** off, and turn on only when you want it. Second (though a bit minor), if the tip is already electrified before it touches the metal, then it will arc when the tip gets close to the soldering surface. Arcing (though small with our hobby application) may pit the metal so you will want to be cautious. I just think it is better to touch the tip to the metal, turn the electricity on with a foot switch and tip heats up instantly, foot off.

You don't HAVE to use a foot switch (for example, you could place a finger switch on the iron itself), but I have found that when you are soldering, you already need THREE hands without having to worry about turning a switch on and off. The three hands are: one to hold the soldering tip, one to hold the locomotive (sometimes holding the part in place is tricky), and one hand to apply some solder. Trust me, unless you want to go to a LOT more complexity and place a push button switch on the soldering electrode itself, you really do need some kind of foot switch.

So the foot switch will go between the output of the power supply and the soldering iron.

You could make your own foot switch with a momentary switch on a hobby box. But that is a lot of trouble (and extra expense). A possible easier solution is to not reinvent the wheel and just use a sewing machine foot pedal. That's the route I went.

So now you have the basic conceptual setup. A computer power supply. Output to the foot pedal and the “iron” (positive electrode).



Since my goal was to save as much money as possible (the heart of a do-it-yourself project!), I was off to the thrift store. I live in a small town and we are blessed with not 1, but about 4 or 5 thrift stores. There are even more in the nearby large city. People donate their used stuff (some new, some junk) and then it is sold for cut rate prices. I love it.

At my thrift stores, I was able to secure a computer power supply ($3), a sewing machine foot pedal ($3), and an old soldering iron ($3- that was a little high since new ones can be had for $9).

Radio Shack or any other electronics supply stores provided the plugs and switches if you don't already have some in a parts box. I already had LEDs and resistors in my parts box, but you can buy them too.

Here is a complete parts and tools list:

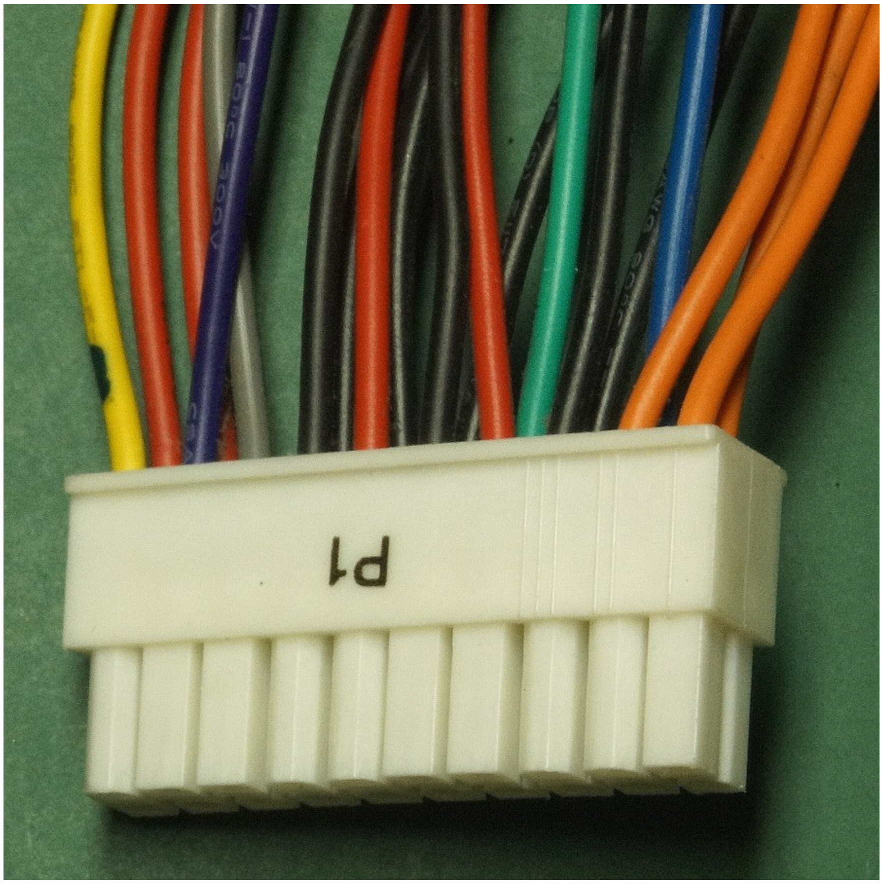
<u>Parts:</u>
Computer Power Supply (broken computer in your closet or Thrift store)
Computer plug (if it did not come with the power supply)
Old soldering iron (junk draw or thrift shop)
K&S Brass bar, I like #8245, .064 x ¼ brass strip
sockets and plugs (I like Cinch Jones and headphone plugs)
LED and mount
On/Off switch
Old Sewing Machine foot pedal (wife, or Thrift store)
Heat Shrink Tubing
Kapton (or black electrical) Tape
Resistors for LED
Solder paste
Solder

<u>Tools:</u>
Phillips Screwdriver
Soldering Iron (probably 30 watt)
A gas torch might help
Motor Tool for mounting sockets and cutting brass
MultiMeter (Harbor Freight and Wal-Mart have them cheap). Beep continuity helpful.

<u>The Computer Power Supply</u> (NOTE: computers are changing and modern power supplies may differ.)

Now, let's de-mystify the computer power supply.

None of the resources I read gave this much detail- though I'm sure the information is commonly available. It is not a secret and modern power supplies are fairly standardized.



A “modern” switching power supply will have one very large plug with 20 pins (though one pin may be empty. This is the main plug that goes to the motherboard. On many of these, the plug will be labeled “P1”. Key for our purposes is that you will find several black wires, about 4 red, about 3 orange, and a yellow, purple, gray, blue and green.

There are also several other wires and plug bundles that come out of the supply. If you are familiar with computers, most of these are for powering your peripherals, like hard drives, CD-ROMs, and floppy drives.

These power supplies are rated on a sticker on the box. Notice on this label that the unit provides 22 amps at 5 volts output. That will be sufficient for my needs.

Now, it is POSSIBLE to create a resistance soldering station without opening the case. You would just make your mods to the wires, but I wanted something that was less tangled and neater (and heck- more “professional” looking).

So we are going to open up the case.

Standard WARNING: There are capacitors in there that may be charged. You can get a serious shock (and die) if you are not careful. Proceed at your own risk if you are uncertain about working with electricity and electrical components.

But since you are even considering doing this project, I assume you have enough sense not to touch bare wires when you don't know what they are and to stay away from charged capacitors.

Having said the standard Armageddon “proceed at your own risk warnings”, what we are going to do is pretty simple. You do NOT need to pull the circuit board out (unless you want to). All we are going to do is trim and solder a couple of wires (and drill a couple of holes).

Now, let's see what all those wires do.

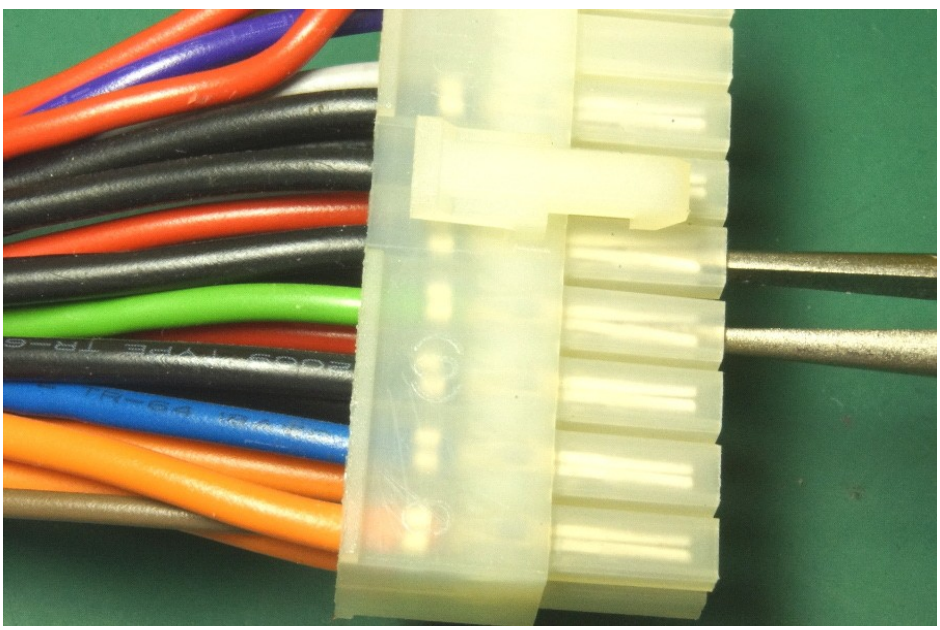
Black wires are ground- just like the case and the ground wire on your electrical plug to the wall.

All the rest of the wires are the hot wires. But when you plug the power supply in, nothing visibly happens. That's because the capacitors and electronics are pre-charged with electricity when the supply is plugged in.... but most of the active outgoing circuits are NOT active until an electronic switch is thrown.

Let's look at that again with more specificity. When you merely plug the box into the wall (and turn it on if some boxes have on/off switches- most don't), then **<u>all</u>** the red, orange, and yellow wires are OFF. The purple, gray and blue wires are ON. An electronic switch turns power on to the red, orange and yellow wires.

That switch is the green wire. It is low voltage, low amperage, and when it goes to ground, then the power supply turns some of the wires “on”.

If you remove the green wire from ground, the associated transistor logic circuits turn the power to those wires off. So the green wire is perfect for wiring as a switch.



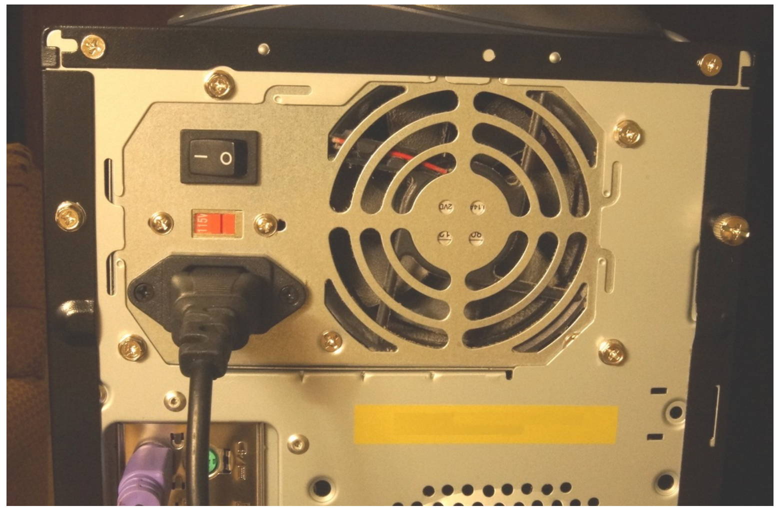
In fact, you can test a power supply easily. Just take that big 20 pin plug and find the single green wire and a black wire (they should be next door). Jumper the green and a black wire. Now plug the power supply in.... and the fan should come on indicating the power supply is good and not fried from a lightning strike.

In this photo, notice there are three black wires above the green and one black below. So it is pretty hard to mess this up. Just jump the green with a black. Here, I have inserted some very sharp needle nose hobby pliers into the appropriate holes.

Another great thing about using these supplies is that they really are designed with safety in mind. Not only safety for you, but also for your valuable computer. So if there is a dead short in one of the main wires, the WHOLE output shuts off instantly-- which is just the same kind of circuitry that our railroad DCC systems use. If there is a short, you have to turn off the green wire (take it off ground) and then turn it back on again (put it back on ground).

So here are the voltages I measured on the wires with my multimeter (with the supply fully ON with the green wire at ground:

Wires:	
Green	**Control**
Black	**Ground**
Red	**+5**
Yellow	**+12**
Orange	**+3.2**
Gray	**+4.7**
Purple	**+5**
Blue	**-9**



Now some power supplies actually have an on/off switch on the back (see the black switch above). It would be helpful if your power supply had one, but it is not necessary. Mine don't have it. In fact, another variation I have seen is that some power supplies have a power LED. That's a plus.

Ready to buy a supply?

While they are all the same size and have about the same exact wire outputs, there is some variation in the **venting** and **lid configuration**. Sine I wanted to install plugs and LEDs in my kitbash, I chose a supply where I could see there was some **empty space** above the capacitors and components where the vents were on the outside surface. This would give me room for the sockets I planed to mount.

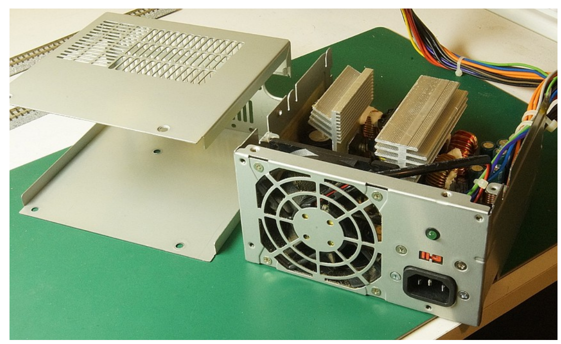
So, here is a good one (left). The vents are on the "front" (where the wires come out). Note the yellow transformer in the middle. On either side, to the left and right, there is empty space- perfect for installing new components.

Here is another feature I look for. The lid must come off either by being a separate top piece, or a U-shaped piece from side-top-side.

In this photo, the lid goes from the left side, up top, and down the right side.

The reason this is important is because the plugs should NOT be installed in the lid. So if all the vents are in the LID.... then you will have problems with wires when the lid is taken off.

Look at another to see what I mean.



I hated this power supply (left and right). At first glance, I was attracted to all the venting. Note that once the screws are removed, the top, front face, and bottom are all one piece that pulls away. Well, where am I going to mount my plugs? They would have to go on the sides- but that is solid metal. Cutting into solid metal would be possible, but I was shooting for EASY. It is so very much simpler to cut into the vents to mount something new.

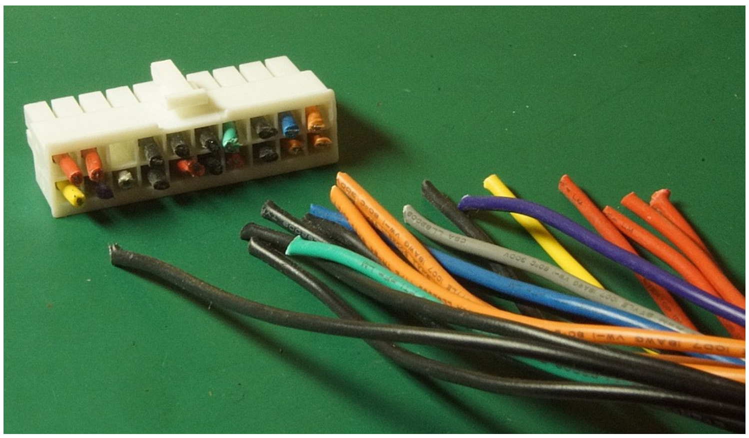
Further, the right photo shows the unit with the “lid” off. But notice that since the “bottom” is a part of the piece that is removed, then **the circuit board underside is now exposed.** This is bad. I don't want to have any chance of being near the capacitor pins that stick out under that board.

Getting Ready

When I get a used power supply I like from the thrift store, I test it to make sure it works and is not burned out from a lightning strike or some other failure. Remember, that is done by jumpering the green and black wires and then plugging the unit in.

Finished? Well, simply removing the jumper is not safe enough since **the capacitors are still charged.** It will drain slowly by itself, but I would rather be sure. So if you plug in the power supply to test it, please note:

the device is in a dangerous state at this moment if you opened it up and tinkered because the capacitors are charged.



Here is how to simply drain them. No big deal. Unplug the power supply from the wall. Now, when you touch the green wire to the black, the fan comes on for about 3 or 5 seconds as the capacitors drain. Then the fan stops. Let it sit that way for a little while longer. OK. Ready to go.

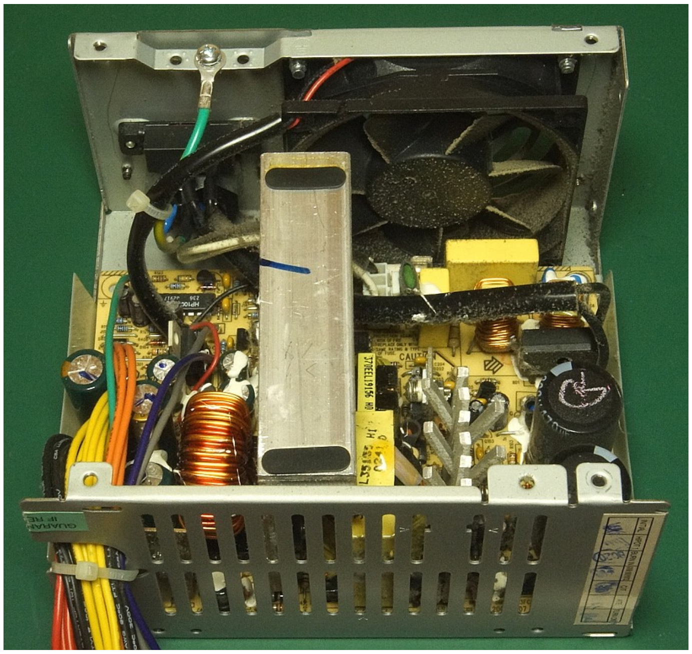
So the FAN acts as a capacitor drain.

WITH the unit unplugged from the wall, **AND drained as described above,** then I now take some wire cutters and remove the plugs by cutting them at the plugs.

Now we are ready to open up the case. If you are ignorant of basic electricity, if you are foolish, or just plain dumb..... then maybe you should not open this case. For example, only an ignorant, foolish, and/or dumb person would do anything with electricity while standing in water. Or.... working on a metal table. If you did not already know this.... then you should stop and go buy a commercial resistance soldering unit. I am not responsible for your ignorance of very basic electricity safety procedures. This is for people who know what they are doing.

Have I warned you enough?

Good.



Time to Open It Up

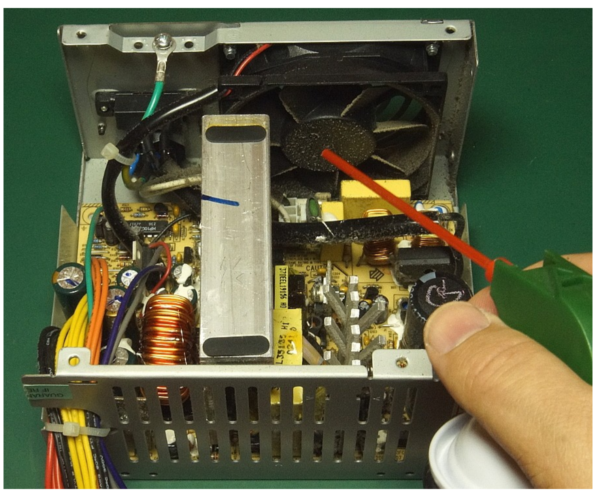
With the box NOT plugged into the wall (you would NEVER be foolish enough to open the case when it is plugged in, would you???) and with the capacitors DRAINED as stated above.... then remove the screws and pull the lid off.

This is something like what you will see.

There is a bundle of wires on the left.

The high voltage from the wall comes in at the back left.

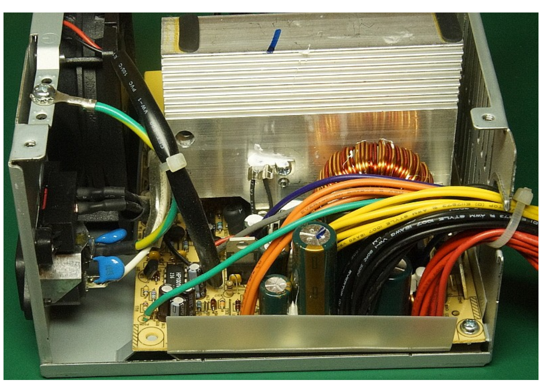
There are some really big heat sinks.



And there are some pretty sizable capacitors- with the biggest on the right.

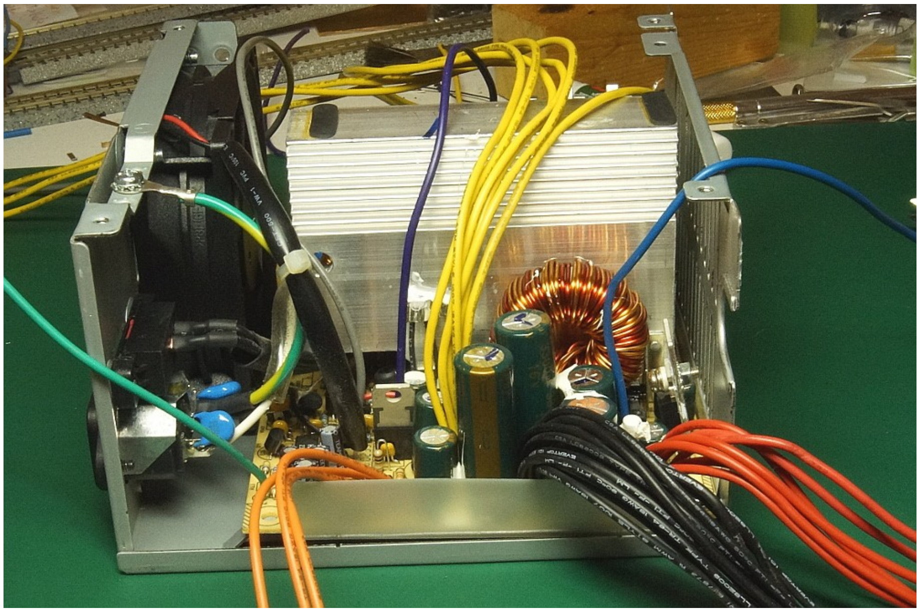
If it is used, it will also probably be absolutely filthy. I take a can of compressed air and blow the crud out of it (while outside of course!). Turn it in all directions and blow air through all sides. Dust and dirt cause the unit to retain excessive heat.

Now, we do not need all those wires coming out from the left front side. So we will cut many of them off.



Left is a side view of where most of the action is.

Notice that there are probably some plastic ties that bundle the wires together neatly. You can cut those off. There will probably be one right where the bundle comes out of the case.- as in this photo.



With all the plugs cut and all the zip ties removed, we can separate the wires. Since these power supplies are all standardized these days, yours will hopefully look almost exactly like this.

Going in a circle starting at the front left. There is one green wire coming out of the board (the other prominent green wire with yellow stripes in this photo is the main ground wire that goes from the outlet plug to the case itself).

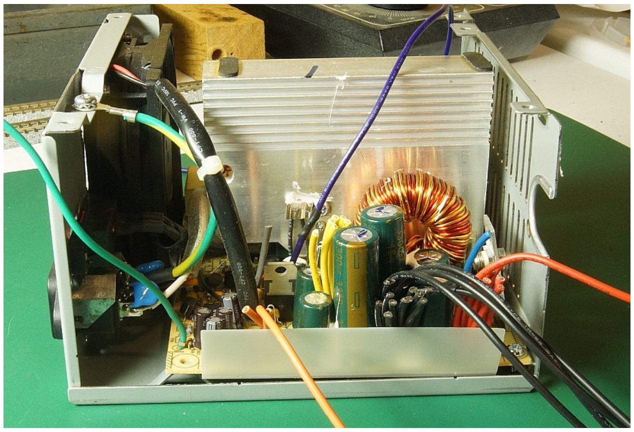
Next is a few orange wires. A bundle of yellow wires is in the center here. Then a LOT of black ground wires. In the right corner there are several red wires. There will be one blue wire, one purple wire, and one gray wire.

We are going to cut the wires we don't need.

We only need 4 black, the green, a red, an orange and the purple. We don't need the gray, yellow, or blue- but be careful with the blue. On one power supply I worked on, the blue exited the board directly- no problem (as in this photo). But on another power supply, the blue made a loop on the board and then left the board and out of the case at a different spot. I cut the loop and the project did not work. When I re-attached the loop, it worked. So the moral is-- ONLY cut wires that EXIT the case and go to the plugs.

Again, before we cut, here is what we need and plan to do with it:

Green	**Wire to new on/off switch**
Black	**Ground, 1 to new on/off switch, 2 to LEDs, 1 to soldering ground wire. Cut rest.**
Red	**1 to Iron electrode socket**
Yellow	**Cut all**
Orange	**1 to “Ready” LED, cut rest.**
Gray	**Cut**
Purple	**to “plugged in” LED**
Blue	**Cut ONLY the end that goes to the cord. Don't cut loop if present.**

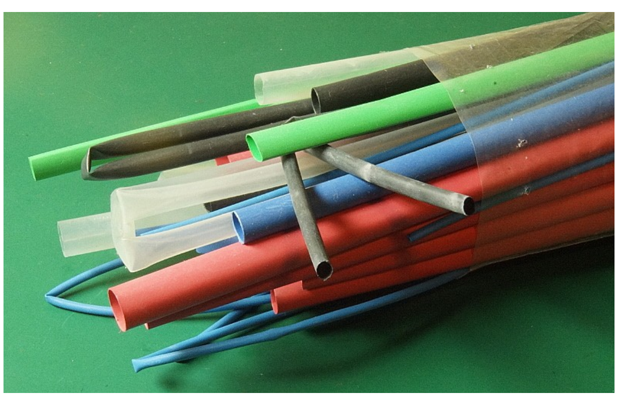


When cutting unneeded wires, leave about 2" for shrink wrap. Don't cut too short- just like in this photo.

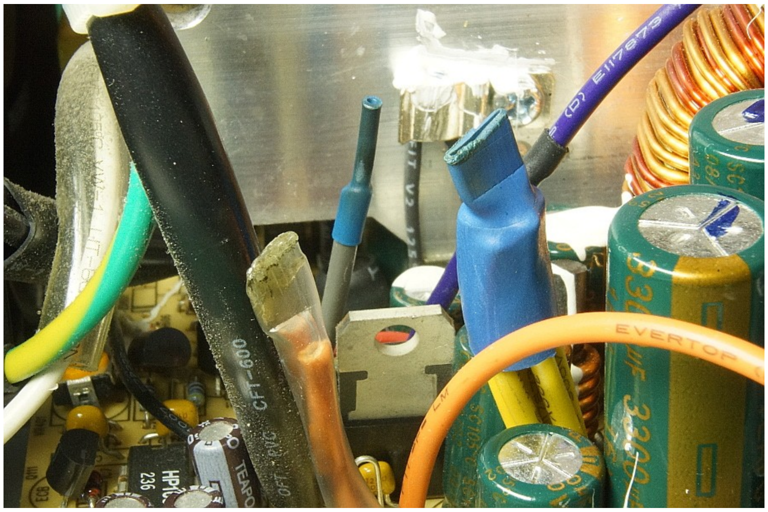
Don't throw away the scraps yet since we might need them.

Oops. Early on in this project, I did not think I would need the purple wire and cut it. Correcting the mistake was easy. I just soldered the halves back together and used heat shrink tubing over the joint.

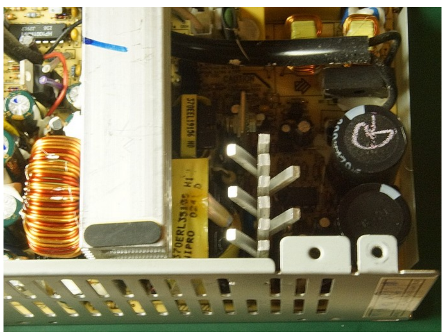
So with all the unneeded wires properly cut, I then shrink wrap the tips to all the wires stubs I left. We don't want stray exposed wires in the box.

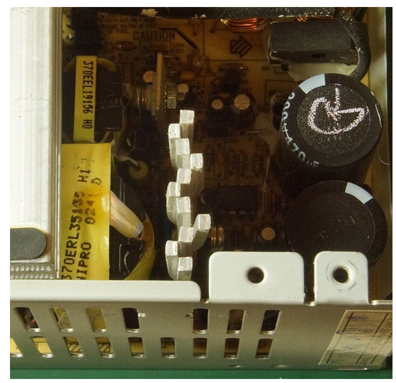


I got tired of always running out of heat shrink tubing so I bought a bulk pack. This project uses heat shrink tubing extensively.



In this shot you can see where I've shrink wrapped individual wires (like the gray wire) and bundles of wires- like all the yellow wires and orange wires.





In the series of photos above, you can see that on one power supply, I encountered a heat sink with wide fingers that took up some of the room I wanted for plugs. Since I was not going to be placing near the wattage strain on this unit that a tower computer with lots of peripherals would, I figured it was safe to compress the fingers. I did not anticipate overheating

You can make the variations you want, but here are the five components I wanted to add- and this actually represents a significant part of the cost of this project. Make substitutions as you like.

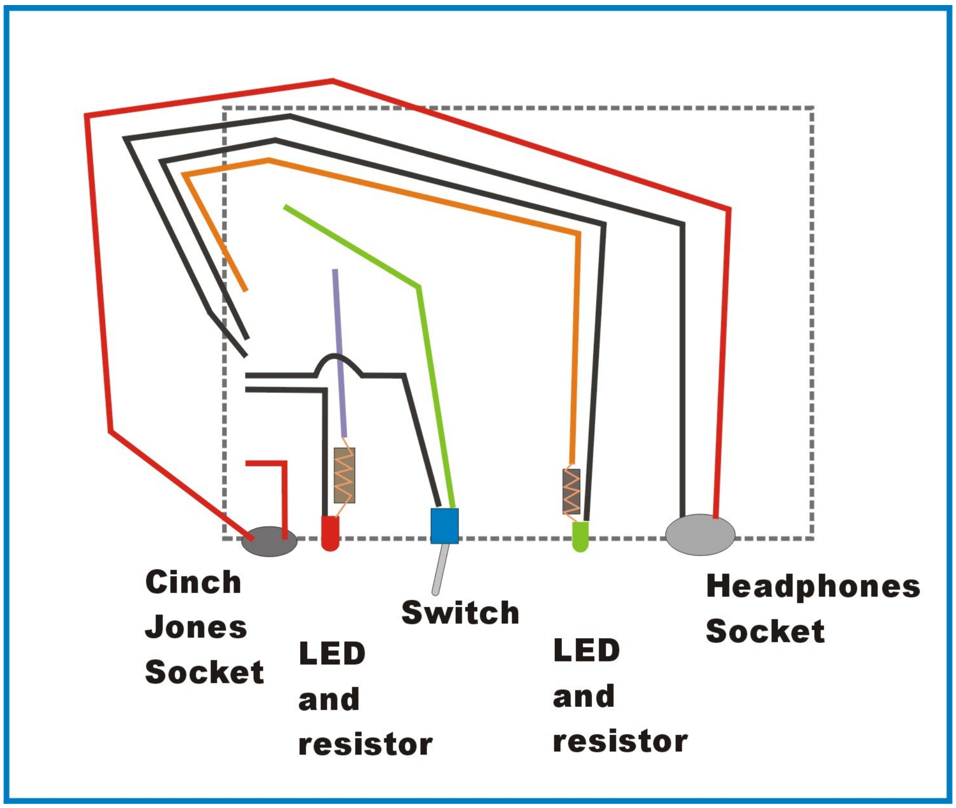
The switch in the center will cause the green wire to go to ground. So this switch will turn on the power to the electrode- thus we're ready to solder.

I wanted two LEDs for visual indicators. The red LED simply shows when the unit is plugged in. Then, when the switch is thrown, the green LED shows that the electrode has power. It also shows if there has been an electrical short and the system has shut down. Each LED of course has a resistor.

Now, I have two things that will plug into this unit- requiring sockets. The first is the “soldering iron” electrode. I decided to use a heavy duty headphone jack. But I didn't want there to be confusion as to where the sewing machine foot pedal went and where the electrode went. So I made the plug/socket combo different.

The black plug I will use is a Cinch Jones 2-pin socket. This was a bit harder to come by, but I found a bag of these on ebay. This is the socket for the foot pedal.

Now, for those who like visual diagrams, here is a simplified schematic of what I'm going to do- and why.



There are 4 black ground wires, and 4 colored wires.

The green wire and ground go to a switch.

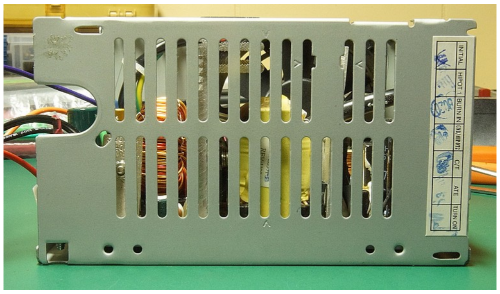
The purple wire is active as soon as the unit is plugged into the wall. So that becomes my red LED “Plugged In” indicator.

The orange wire only comes on when the switch with the green wire is thrown. So this is my “Ready to Solder” green LED.

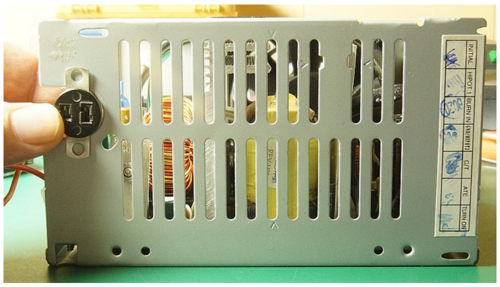
Now, the red wire is our electrode wire. It leaves the board and goes to the Cinch Jones socket. It goes to the foot pedal and back. Thus the purpose of the foot pedal is to activate or restrict the positive red wire. Consequently, juice goes into the pedal but only comes out of the pedal when the pedal is pressed. The socket then has a jumper wire that goes over to the headphones socket.

Pretty simple.

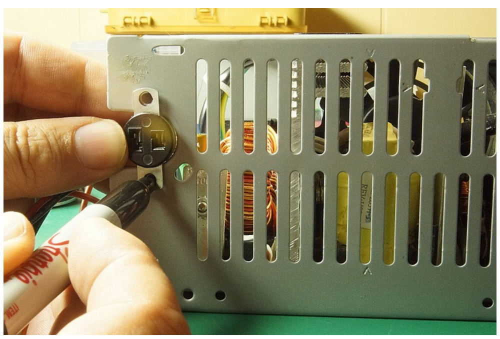
OK. Time to install new hardware.



Here is the stock unit.

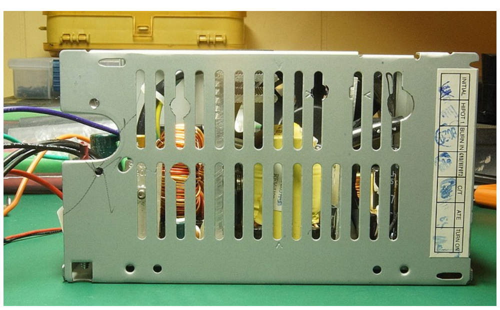


The Cinch Jones socket just happens to fit the hole for the wires.



A permanent marker marks the holes that are to be cut out.

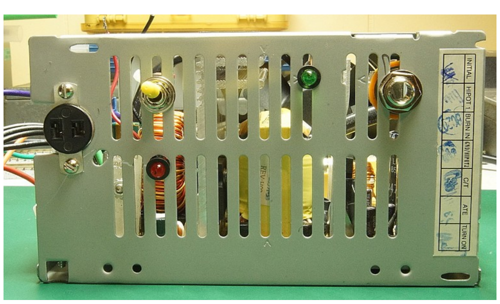
I used a motor tool to cut the openings.



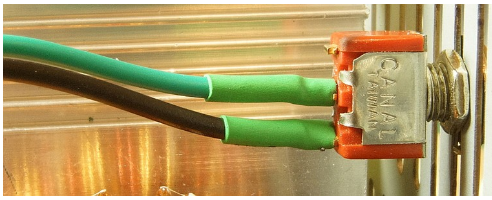
All the holes have been made. A little hard to see what's going on, but compare this shot to the next.

Now, obviously, metal particles go all inside this thing. I gently hit the box (up-side-down) to get particles out. I also used about half a can of compressed air. The goal is to get **all** of it out so there is no shorting problem.

If I had wanted, I could have pulled the board out.

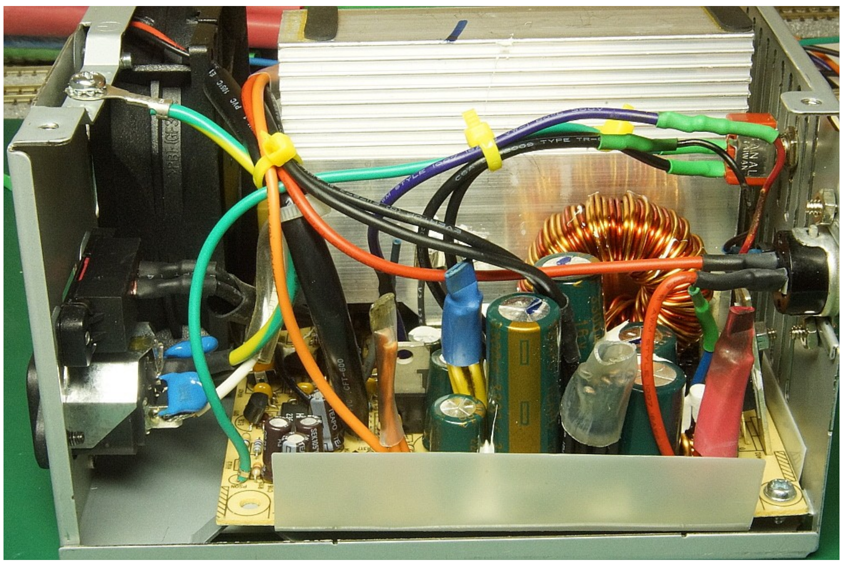


All the hardware has been installed in the chassis.



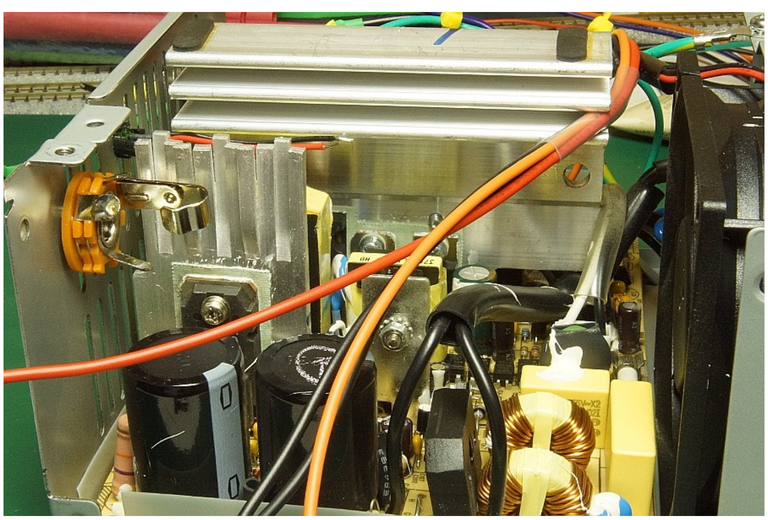
Green and ground go to the switch.

Purple and ground (with a resistor) goes to the red LED.

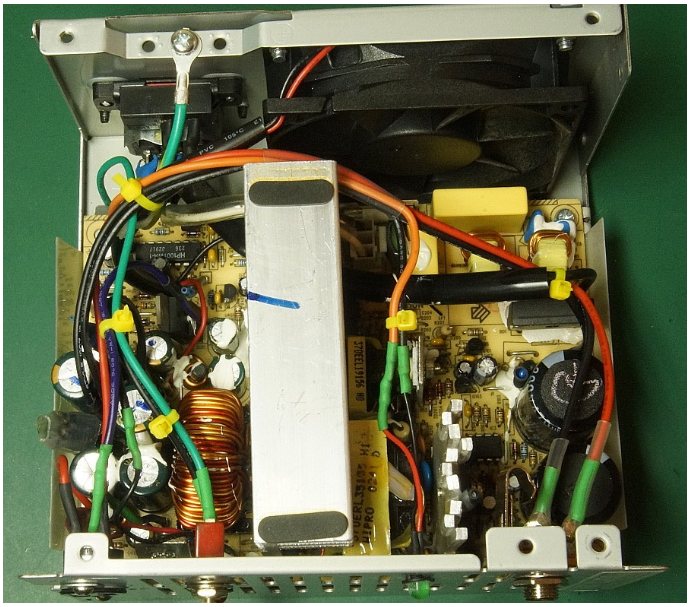


Red wire goes to the Cinch Jones socket (foreground right).

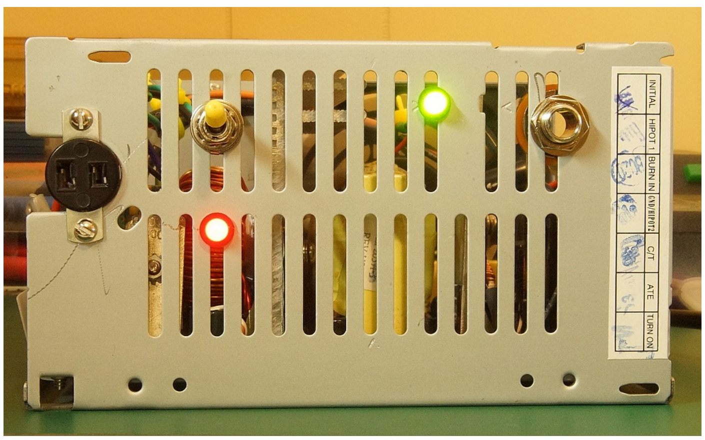
Now 4 wires go to the other side.
2 black and an orange.
Then a red jumper goes from the socket to the other side.



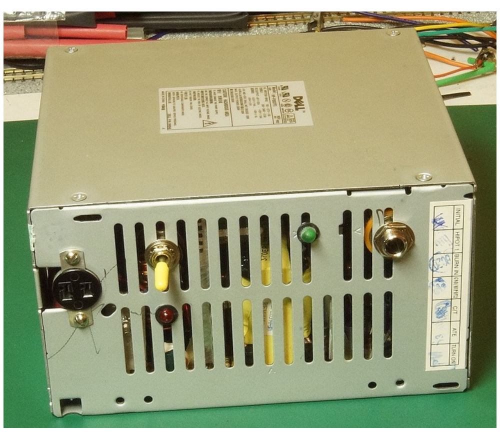
Those 4 wires come over to the other side. But we don't want wires to hit the fan. Since it will be near that heat sink, I placed some clear heat shrink tubing as a protector.



Here is the completed box.



Ready to go!



The lid can be replaced. No need to get inside of this any more.

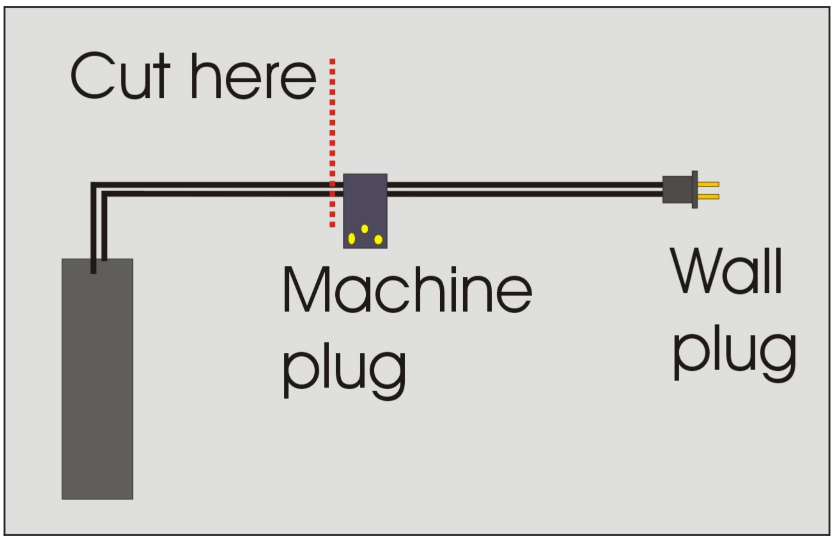
All this work was just to get the power supply.

Now let's get some parts to make it solder!

Foot Pedal
This is a sewing machine foot pedal.

It probably has a massive resistor inside. When you press the pedal all the way, you get full contact with zero resistance.

The first box I built, my wife gave me one from a broken machine she had. For the second project, I found this at a thrift store for 3 bucks.



A typical sewing machine pedal has two plugs. One goes to the wall and one to the machine. All we care about is two continuous wires, so cut it at the machine plug.

Below, you will find a 2-pin Cinch Jones plug that matches the socket we installed. You pull that pin out of the side, and the housing can slide off.

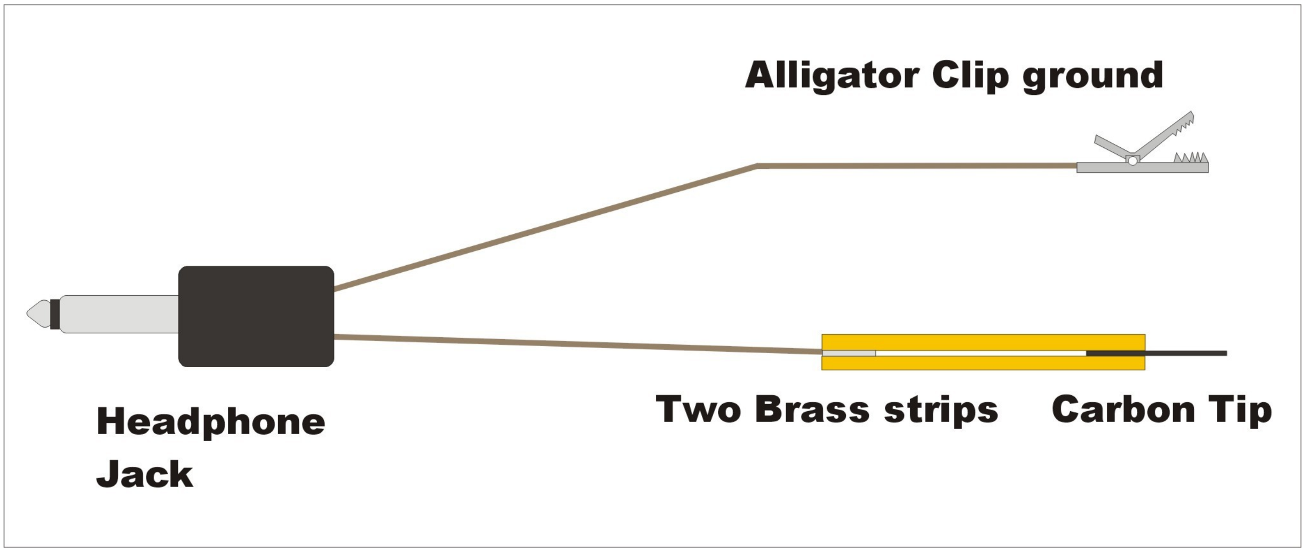
Be sure and slide the housing and heat shrink tubing onto the pedal wire BEFORE you solder to the contacts (I often seem to forget).

Since this is all the red wire- in and out- then it does not matter which wire goes where.

(Now, on the soldering iron electrode, orientation WILL matter).

Resistance Soldering Iron Electrode

Here is a simplified drawing of the electrode components.



You could try and remove a headphone plug from an old cord, or just buy a new one.

This do-it-yourself plug from Radio Shack was very roomy. The little tip is the "hot" red wire, and the longer shank is the ground black wire.

The heart of the electrode is just two brass strips. I solder mine together at one end with the cord wire.

Since the two pieces are ONLY soldered together at the cord end, they make kind of a pincer for the carbon tip.

A piece of pencil lead is inserted at the very end for our resistive electrode.

The second wire is ground and terminates in some kind of clamp. You clip it and then don't worry about it while soldering.

So if the "electrode" is just two pieces of brass which hold a piece of pencil lead, then you have unlimited ways to mount such a configuration.

Whatever you do, you probably want the housing to be insulated- you don't want to be actually touching the positive and the ground with your hands.

I heard about a guy who mounted his electrodes on a pair of bamboo salad tongs. He made two identical electrodes: two brass plates and a carbon pencil lead tip on each. He mounted each one on a tong. One was the positive, the other was the ground.

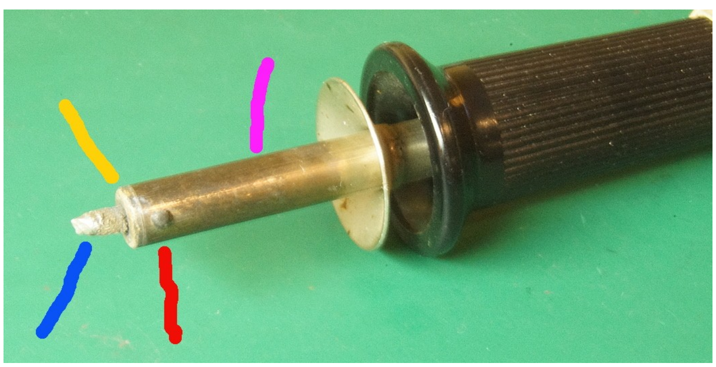
Interesting idea. I assume it worked.

I decided to go a more traditional route. I decided to mount the electrode in an old soldering iron. Many people have more than one, and you could probably find one at a thrift store.

The reason I like mounting the electrode in a soldering iron is twofold. First, since I will be soldering with this device, my brain and my hand are already used to wielding a soldering iron. Second, an iron is already build with heat-resistive plastic (in the old days, we used to call this Bakelite plastic). The reason you need at least a little heat resistance is because the carbon tip gets red/white hot. That is good for the side you are soldering, but the holder of the tip gets a bit hot too.

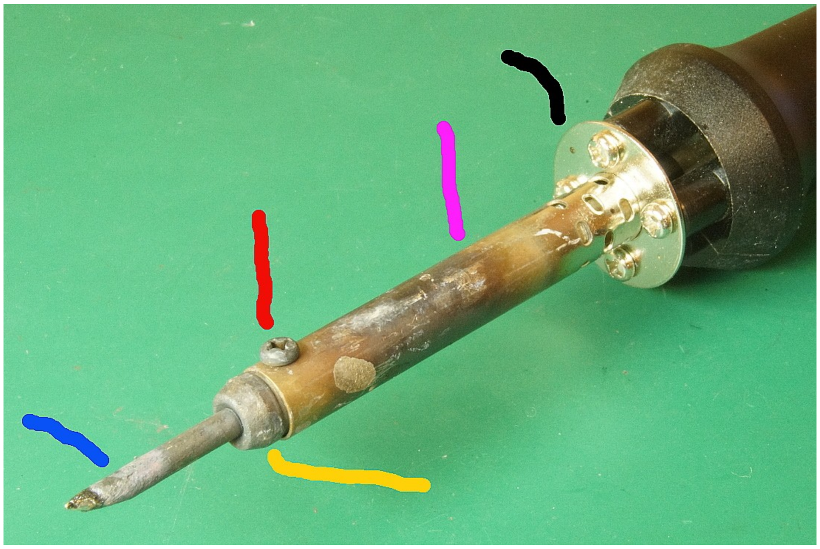
We can minimize this heat by using two somewhat substantial pieces of brass which will not only conduct electricity, but will also act as heat sinks. These brass plates can be slid into a soldering iron for an overall cool device. The tip of the brass plates will get a bit warm, but it is NOTHING like the heat in a regular soldering iron.

Having experimented a bit, I have found some variations in soldering irons and what to look for so that we have the easiest materials to work with.



Look at this iron. It did not work well for this project. The soldering tip just screws in (blue). I want to mount my brass strips inside the housing (purple). But to get inside the housing, I need to remove the tip holder (yellow). But the tip holder is retained by some kind of rivet (red). That rivet was a problem. Even trying to drill it out, I could not get the tip holder out of the housing. FAIL.

This one is ideal for soldering electronics with its very pointed tip, but is too thin for all the parts we want to add.



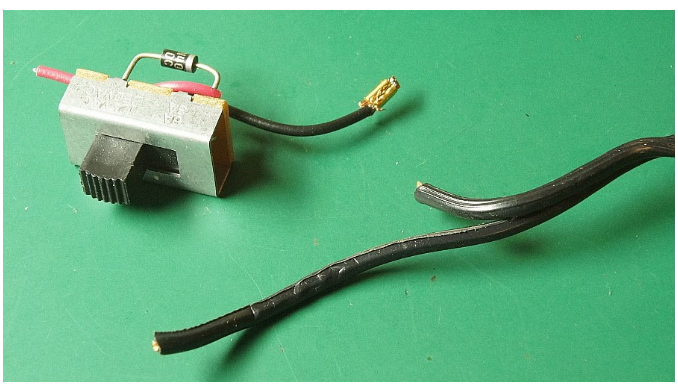
Now, this one has all the features I have come to like for this kitbash. The barrel is wide (purple) and the tip holder (yellow) is retained by a screw (red).

Remove the screw and the tip and tip holder slide out.

The barrel is attached to the handle with screws (black) so it is really easy to disassemble the whole thing.

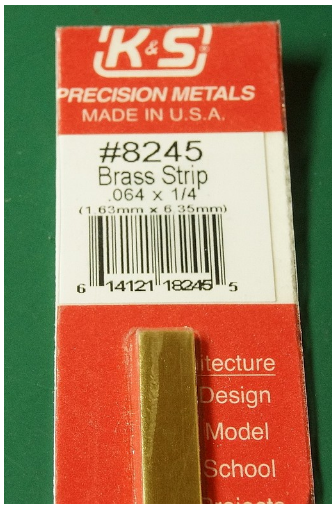
Screws are removed and the unit is disassembled.

Cut the heating coil wires and the heating element can easily be slid out of the barrel.



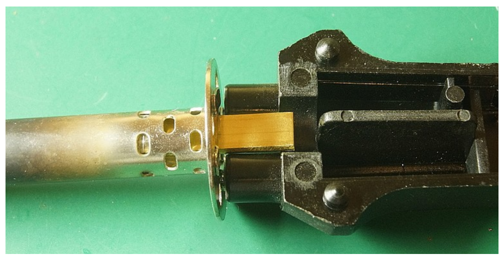
Cut anything else off of the cord. This was a duel soldering iron at 30 and 15 watts. All I need is the cord.

Pull the wires apart about a foot.



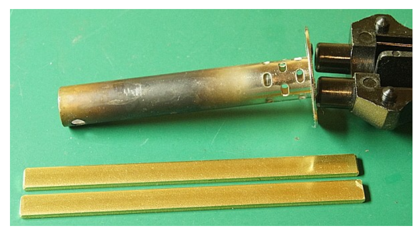
K&S Brass strip from my hobby shop sure made things easy.
The first time I made a resistance soldering iron, I had a huge piece of brass that I cut to get what I needed- what a lot of work!

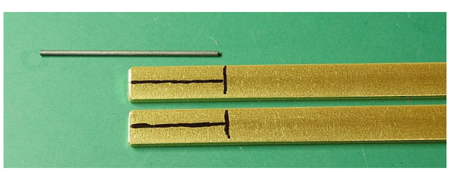
This is so much easier. .064 x ¼ is probably a good size for most any iron.



Here, I am testing it in the barrel and lining it up with the handle. Once a wire is soldered to it, that is about have far down it will go.

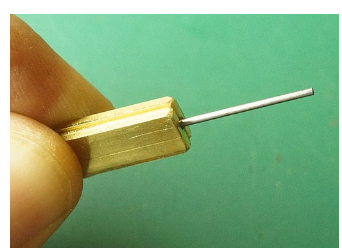
I make a mark just outside of the barrel. I need two of these this long (right).



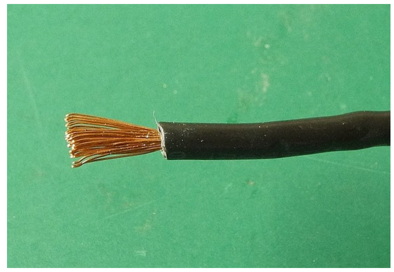


I then take a pencil lead and break it in half. Half a lead will be my carbon tip. I then draw a line for the depth I want. Then, I use a motor took with a cutoff wheel to cut a groove at the line.

Time for a quick test to make sure all is well.



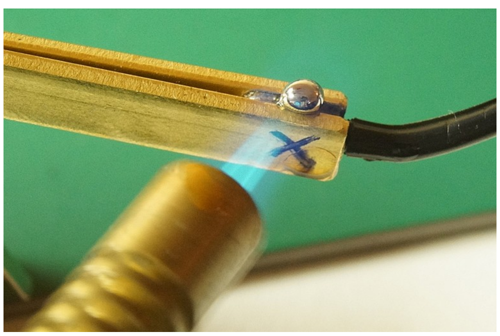
I then rough up the opposite end of the brass bar (same side), flux, and tin with



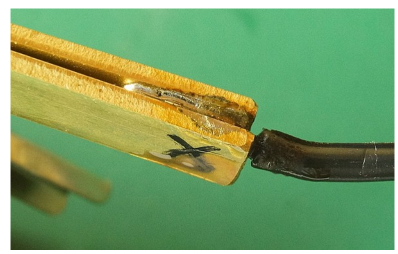
solder. This is the same side as the grooves.

I then strip one end of a cord wire and flatten it. Flux and tin.

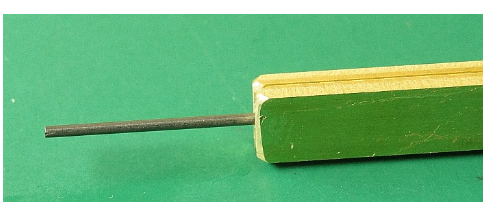
I clamp the end where my carbon tip will go to keep it from moving.



A couple of other clamps help. I then wedge the flattened wire on the tinned end. Notice my X to keep me straight as to the correct end.



To solder all this together and make it all stick, this is one point where a small torch may be helpful. The end must be pretty hot. With the tinned wire sandwiched between the brass,

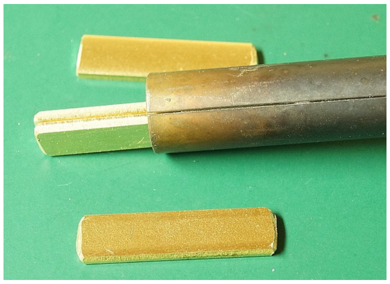


there is probably enough solder to hold it- but I add more. It beads up at first. Then melts into the slot.

The electrode holder is constructed. Now, I wash it to get it all clean and then dry.

A quick check shows the lead still fits well.

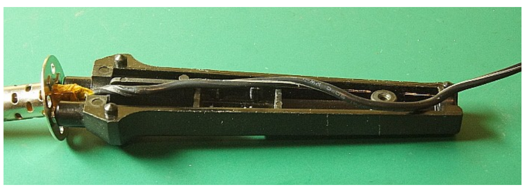
Also the whole thing slides into the barrel easily-- in fact there is too much room. I'll add some shims.



Here are my shims. I will add them to the middle. No need to solder.

I just wrap most of it with Kapton tape. This tape is non-conductive and highly heat resistant.

Perfect. It all slides into the barrel snugly- not too loose or tight.

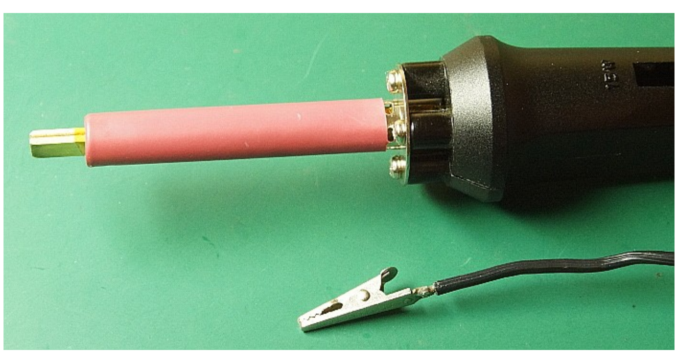


Put everything in place and measure for a knot in the cord. This is needed as a strain relief. You don't want a wire to pull out in the future.

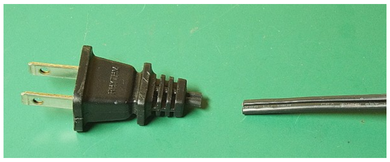
Reassembled. Now we are getting somewhere.

I added heat shrink tubing as a final insulator over the barrel. Probably overkill, but I like it.

On the other wire, I stripped it and placed the tip in a small alligator clip. I fluxed and soldered it in place.



This end is finished!

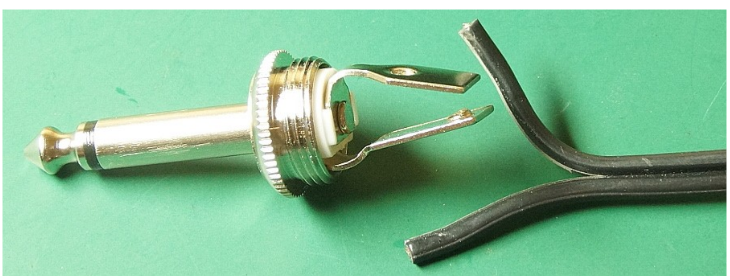


Cut the cord off the other end.

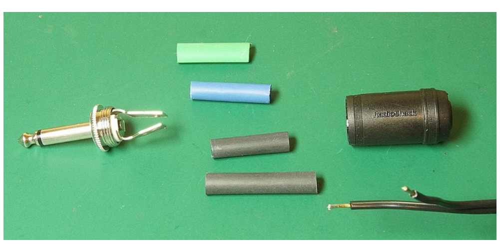
But note! The two wires will almost certainly not be the same. In my case, one side has writing (red) and the other side has ribs (yellow). It is absolutely important that I know which one goes to the electrode and which one goes to the ground alligator clip.

I look at my soldering iron handle and see that it has writing on that wire. The ribs are on the alligator clip.

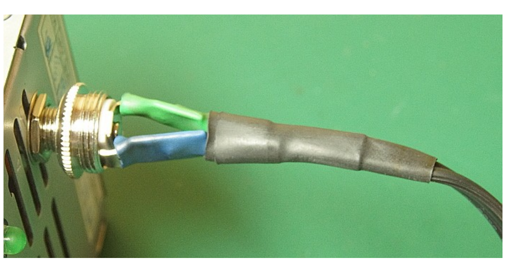
So ribs are ground, writing is hot.



Study this photo and you will see that the blade on TOP goes to the center. So the hot wire (with writing) goes there. The bottom blade goes to the housing and is ground- so the ribbed wire to the alligator clip goes here.



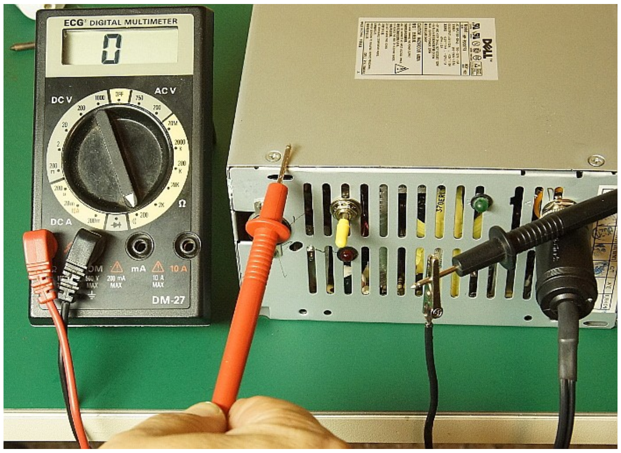
I can't tell you how often I forget this step. BEFORE you solder anything, the parts have to be slid onto the wire. Here is the order: slide the housing down the wire first, then the long outer black heat shrink, then the short inner black heat shrink. The blue and green go on the individual wires.



Inserting the plug into the base unit aids in soldering. It acts as a third hand.

Soldering is completed as well as the heat shrink tubing. Time to screw the housing on, and we are DONE!

Final Assembly and Testing



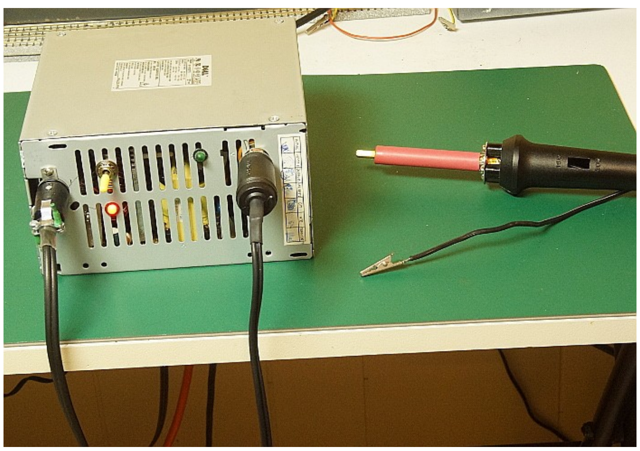
With the unit NOT plugged in (see, the red light is NOT on), let's do a final check. Plug in the soldering iron.

Now use a multimeter and test the resistant from the alligator clip to the metal housing of the box.

Resistance should be zero and if you have a multimeter that beeps, it should beep.

When you do the same thing to the positive electrode (electrode to case) then NOTHING should happen. No beep, no continuity.

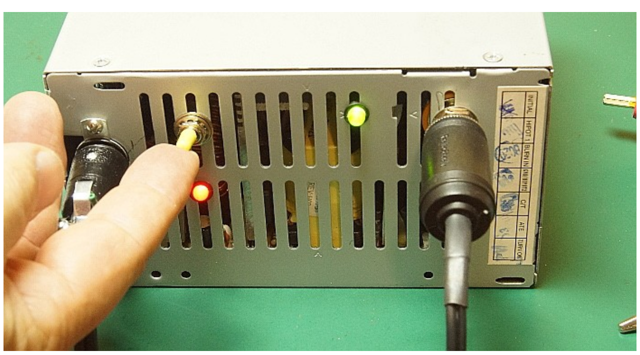
Now, let's put it all together and do one more important test.



Plugged into the wall, red light on. Check.

Foot pedal plugged in. Check.

Soldering iron plugged in. Check.

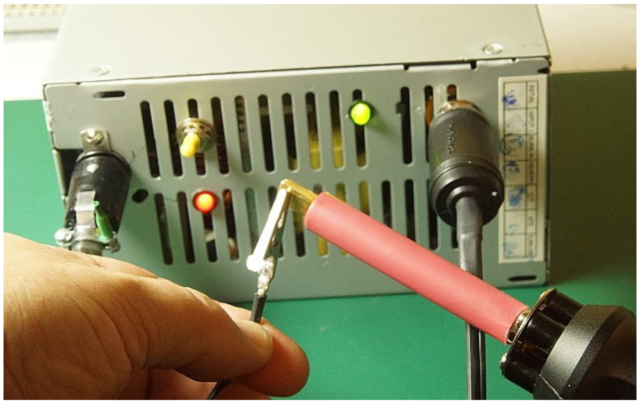


Flip the electrode activation switch.

Green light comes on. Check.

Everything is ready.

Final Safety Check



Here is a final safety check. We are checking the short circuit detection.

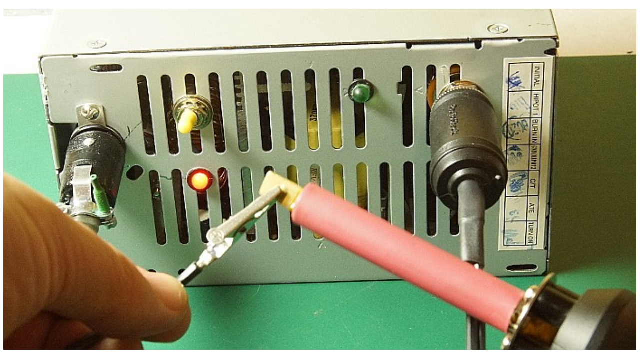
With your foot OFF the pedal, touch the ground to the positive electrode.

Nothing happens. No spark. Green light still on.

Good. That is because no power goes to the electrode UNTIL the foot pedal is depressed.

Now, with the ground NOT touching the electrode......

Press the foot pedal all the way.

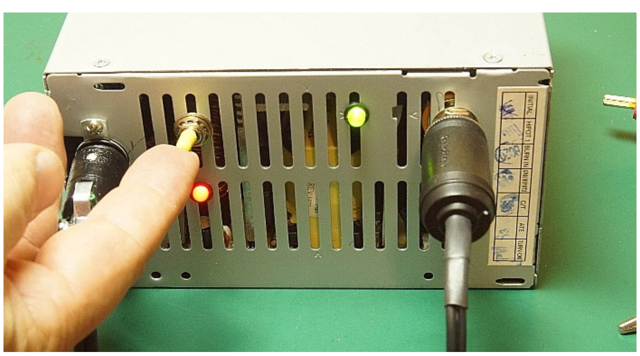


Now touch the ground to the electrode.

Spark happens. Check.

Then , the green light goes out and you can hear that the fan has stopped. Red light stays on.

Check. Short circuit protection is working.



Now since we tripped the short circuit protection, we have to reset the device. Flip the switch off. Then flip it on- and the green light comes on.

Ready to go again.

We are ready to solder.

Carbon Electrodes

I went to my office supply store and ended up trying two different pencil leads.

The first was by Pentel. Notice the label says “Hi-Polymer”.

This did not work as well- maybe because of the polymers.

It made a good deal of ash, and worse, left an oily residue on the soldering surface which hindered soldering.

While I'm sure these are GREAT for writing and drawing, they did not work very well for soldering.

The brand that work satisfactorily was Foray.

This brand left very little residue and almost no ash.

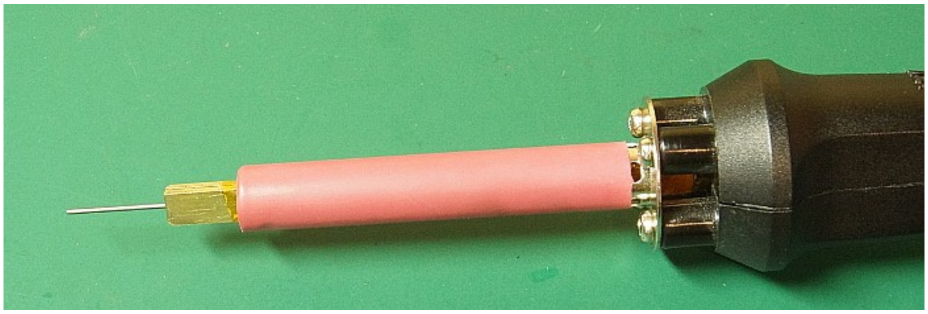
My favorite size is the .9 mm because they are thicker and tougher.

But the .7 mm size will work as well.

These were just the two brands I experimented with. You may have different results with other brands your store may sell.

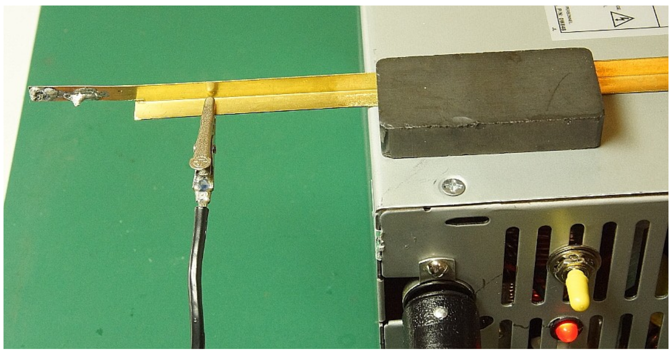
You are looking for mechanical pencil refills.

Soldering



Break a pencil lead in half and insert a half into the end of the iron. This is your carbon electrode.

Obviously, don't store it this way when finished because the tip will most certainly break. It is only pencil lead, after-all.



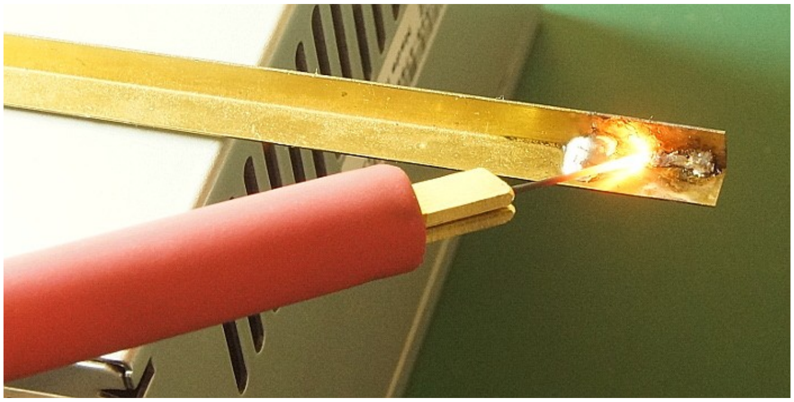
With the unit turned on and the switch thrown so that the green light is on.....

Attach the ground alligator clip to the piece of metal you will solder. This is a good time to practice and get the hang of it.

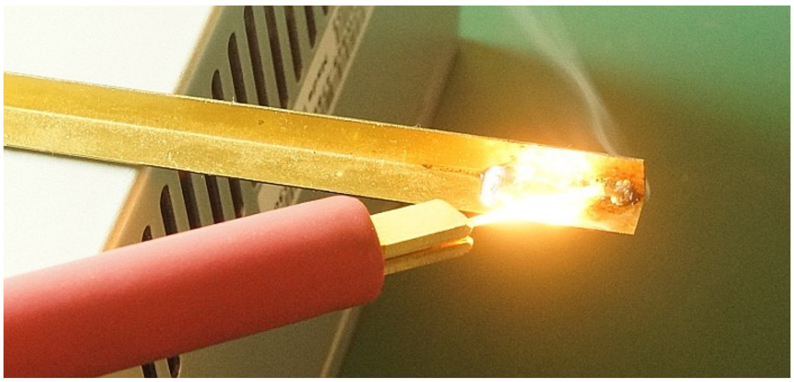
You almost need three hands to do this soldering. Big magnets could help (the magnet will probably stick to the power casing). Here, a magnet is helping to hold down an angle of brass. I see that Micro-Mark makes an item that is designed for holding pieces while modeling. This might be helpful.

Add flux to the spot you want to solder.

Depress the foot pedal- thus sending juice to the electrode.

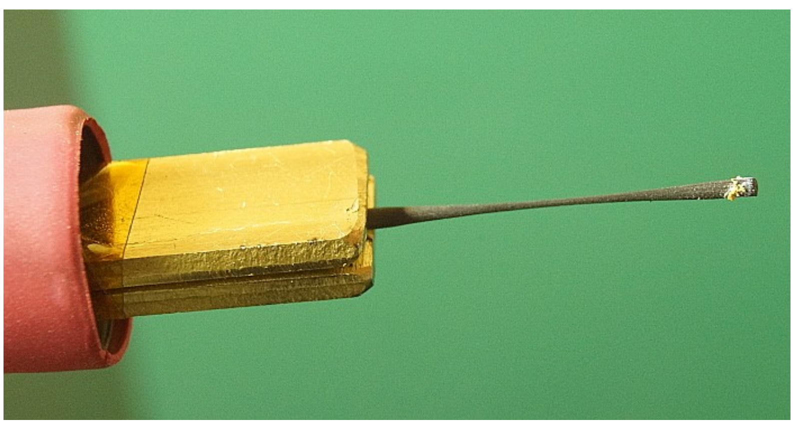


As soon as you touch the metal with the carbon tip, electricity begins to flow and the carbon tip heats up.



And the longer you hold the foot pedal down, the hotter it gets.

And the brighter it gets. Be careful, it can actually get bright enough to hurt your eyes. And obviously, this metal is now hot.

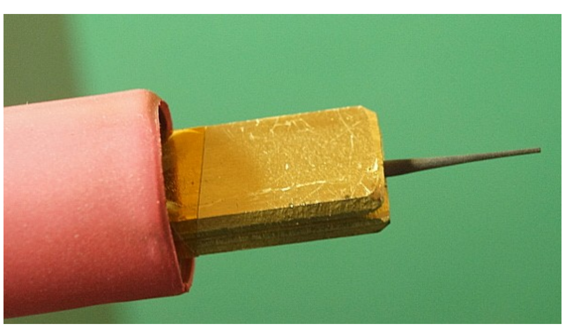


Take your foot off the pedal (and/or remove the electrode from the metal) and the tip begins to cool immediately.

Be careful, the metal at the base of the electrode may be pretty warm- but I would avoid touching that anyway.

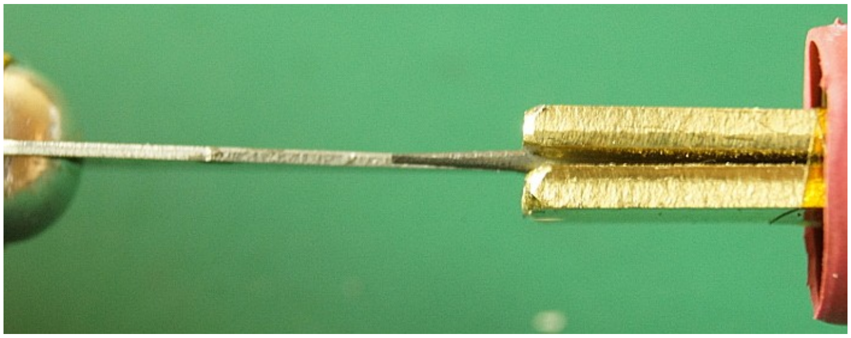
The heat shrink covered barrel does not even get warm.

The photo above shows that after a bit of use, the carbon tip begins to thin in the middle (where it gets hottest- since both ends acts as a heat sink and are cooler).



At some point, it will just break off. Or go can break it off intentionally. You can then keep on using it, or pull the carbon tip out a bit more.

Miscellaneous Points



When the carbon electrode gets stuck, just insert a #11 Xacto knife blade to pry the halves open. The electrode will easily come out.

Here is a trick. You really need three hands for this solder work.
One to hold the soldering iron.
One to hold the item you are soldering.
And one to hold the solder.

If you can support or somehow hold the item you are soldering with various supports, then that frees up a hand. I already mentioned magnets and a holder by Micro-Mark. Some kind of cradle might be helpful as well- although remember that your item you are soldering will get hot.

If your brass item is supported, then you could attach the ground alligator clip to the solder ribbon itself. You can even touch the tip of the ribbon to some flux. Touch the carbon electrode to the solder spot. Press your foot pedal, and then touch the solder ribbon. The solder will instantly melt and when you pull it loose, the electricity will stop flowing.

Experimentation is definitely the order of the day. The more you do resistance soldering, the better you will get at it.

What about higher voltage. I experimented with using other wires on the power supply. Unfortunately, the amperage draw was too high and the unit shut down very quickly. So I just went with the 5 volt red wire.

Now that you understand and have built one of these resistance soldering stations, you could add variety. For example, you can buy just the tips to commercial soldering stations. They are a bit larger than our .9 mm pencil lead used here. But you could build a NEW holder just for those larger tips. And since all you need is the same head phone jack, the irons will be interchangeable.

Another kind of variety would be an extension cord for the foot pedal. Many people like to use resistance soldering for trackwork on their layout. Obviously, the foot cord might not reach. Just add a Cinch Jones extension cord.

No doubt this work may be revised, corrected, and/or expanded. Each version will have a date.
This is the first printing.