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[5E3 assembly manual]

WARNING! This amp operates at voltages that may exceed 400V! Use extreme caution when building and testing. If you are not comfortable working with high voltages, refer assembly and testing to a qualified technician.

Neither the manufacturer nor the seller of this kit assume any responsibility for damages or injuries incurred during assembly, testing, repair, or usage of this device.

Note: There are some minor variations between this 5E3 kit and the original Fender 5E3. Most of these changes improve the noise and hum characteristics, and do not alter the tone or the sound in any way. We have provided a schematic diagram at the end of this document. You can find the original 5E3 schematic on many websites, if you wish to compare the two.

Recommended tools:

Screwdrivers -- Standard and Philips

Adjustable wrench (standard pliers will suffice)

Needle Nose Pliers

Diagonal Cutters

Wire Strippers

Soldering Iron -- 15 to 40 watt or temperature controlled solder station

High Power Soldering Iron or Gun – 100 watts or more

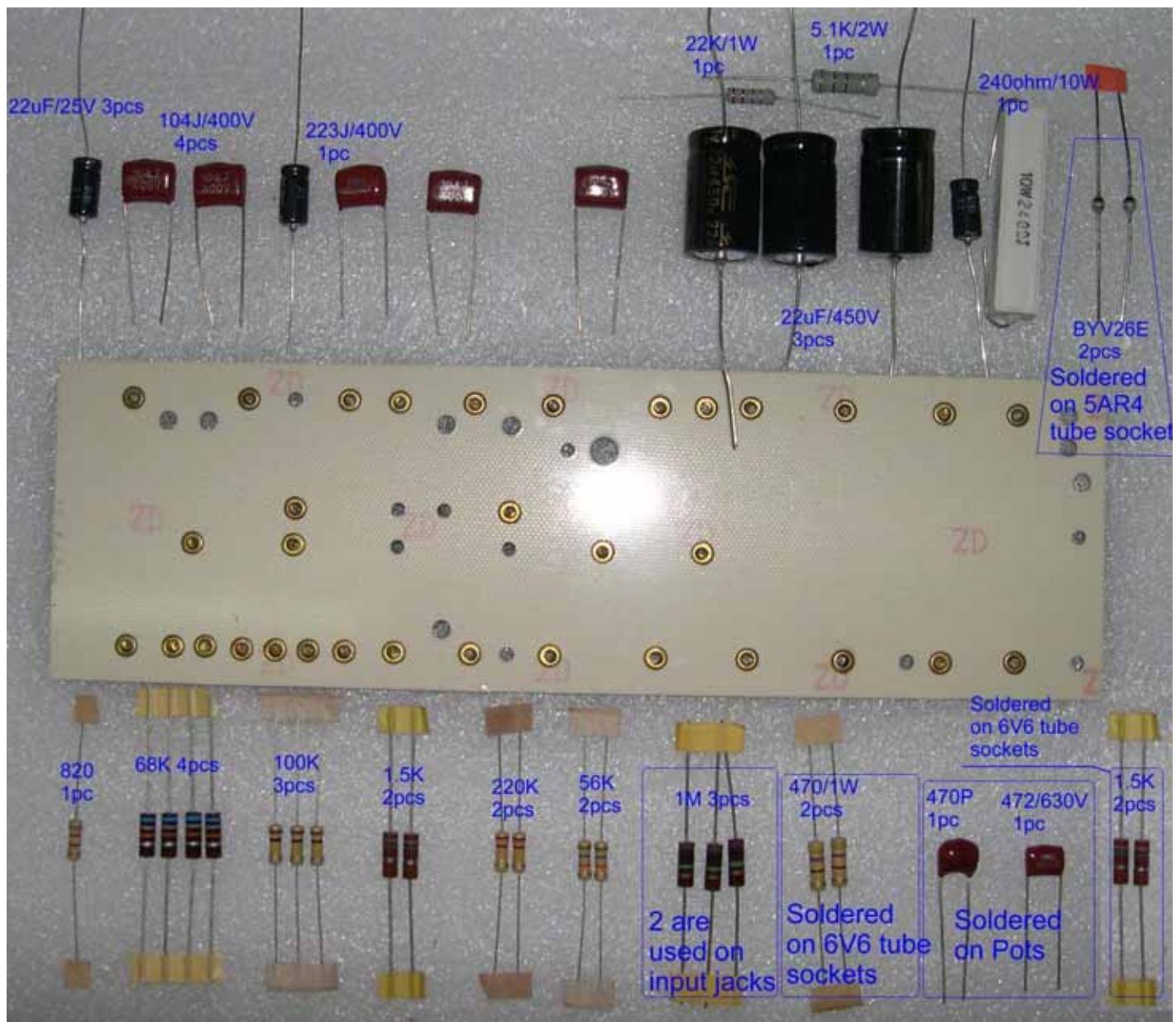
Solder

Multimeter -- AC/DC rated for at least 450V DC, resistance

Power Drill or Dremel rotary tool with grinder attachment, or a small to medium file

Eyelet Board and parts

Verify that you have all the necessary parts shown:



Board Assembly

Carefully install all parts in the positions shown in the bottom image below. Remember that electrolytic capacitors (22uf/450v and 22uf/25v) are polarized and need to be placed in the direction shown.

Eyelet board (shown): Pull wires through the eyelets and solder. Cut excess wire from the other side of the board. To make things easier, you can hold off on soldering until the wires are attached in the next step.

Turret board (see third image, top row): Position each component by running wires through the turrets and bend wires as necessary. Remove the component and cut the wires so that only 1/8-1/4in. or 3-6mm is inside the turret. Then reinsert the leads and solder.

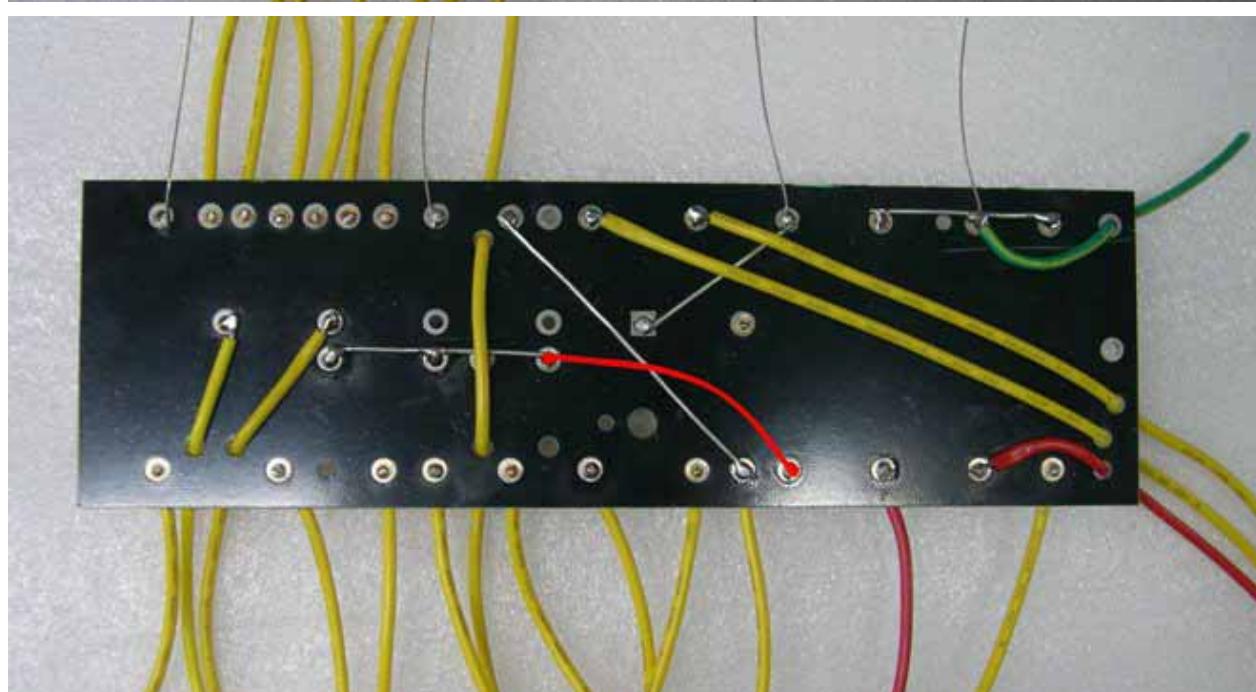
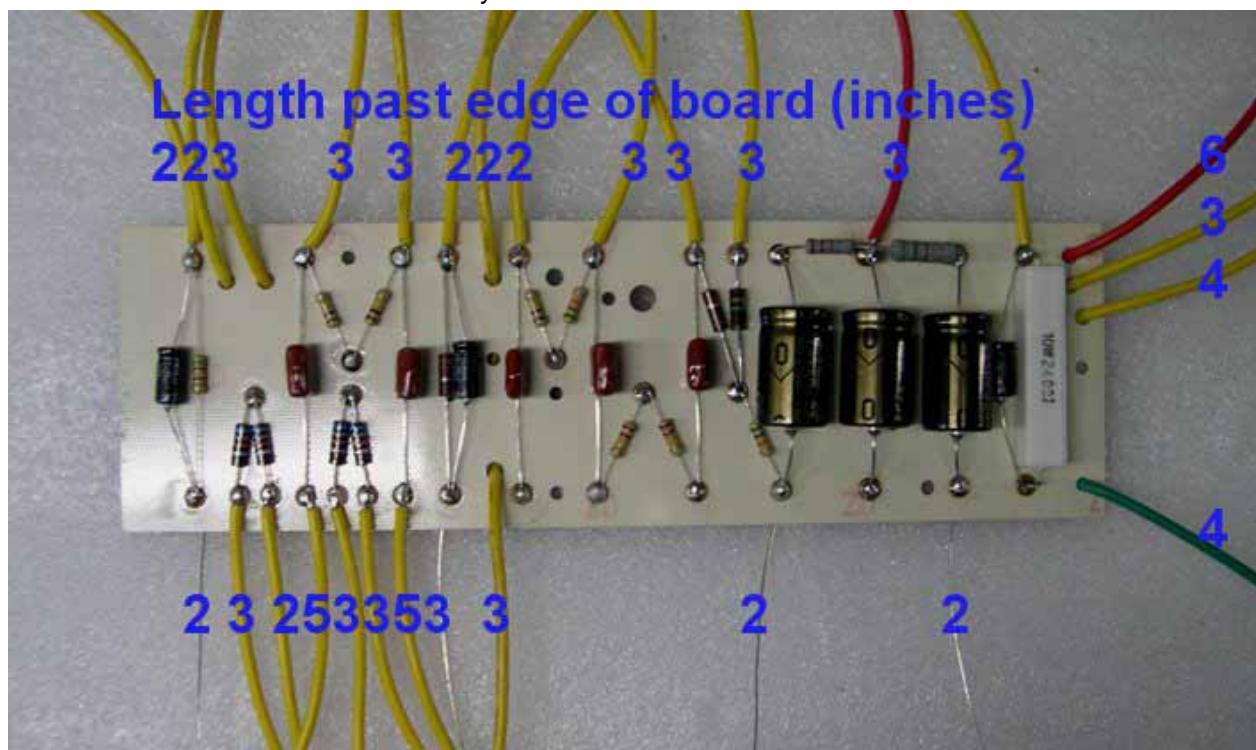


Circuit Board Wiring

Tip: It may be easier to work with wire ends if you “tin” them first. Strip insulation off the end as needed. Then, heat the wire with your soldering iron and touch solder to the wire just enough so the solder flows into the strands. Don’t let the solder blob or glob onto the wire.

Solder wires in place as shown. Measure and cut each wire so that it hangs off the board by the specified number of inches (1in = 25.4mm). It’s OK if you cut them longer than specified. Excess will be cut off at final assembly.

If your board has turrets, attach the wires on the top of the board (component side) by stripping 3/8in or 9mm from the end of the wire, and then wrap the wire around the turret (see image to the right). To solder, hold your soldering iron where it is touching both the wire and the turret until solder flows and solder all the way around where the wire touches the turret.



Chassis Level assembly

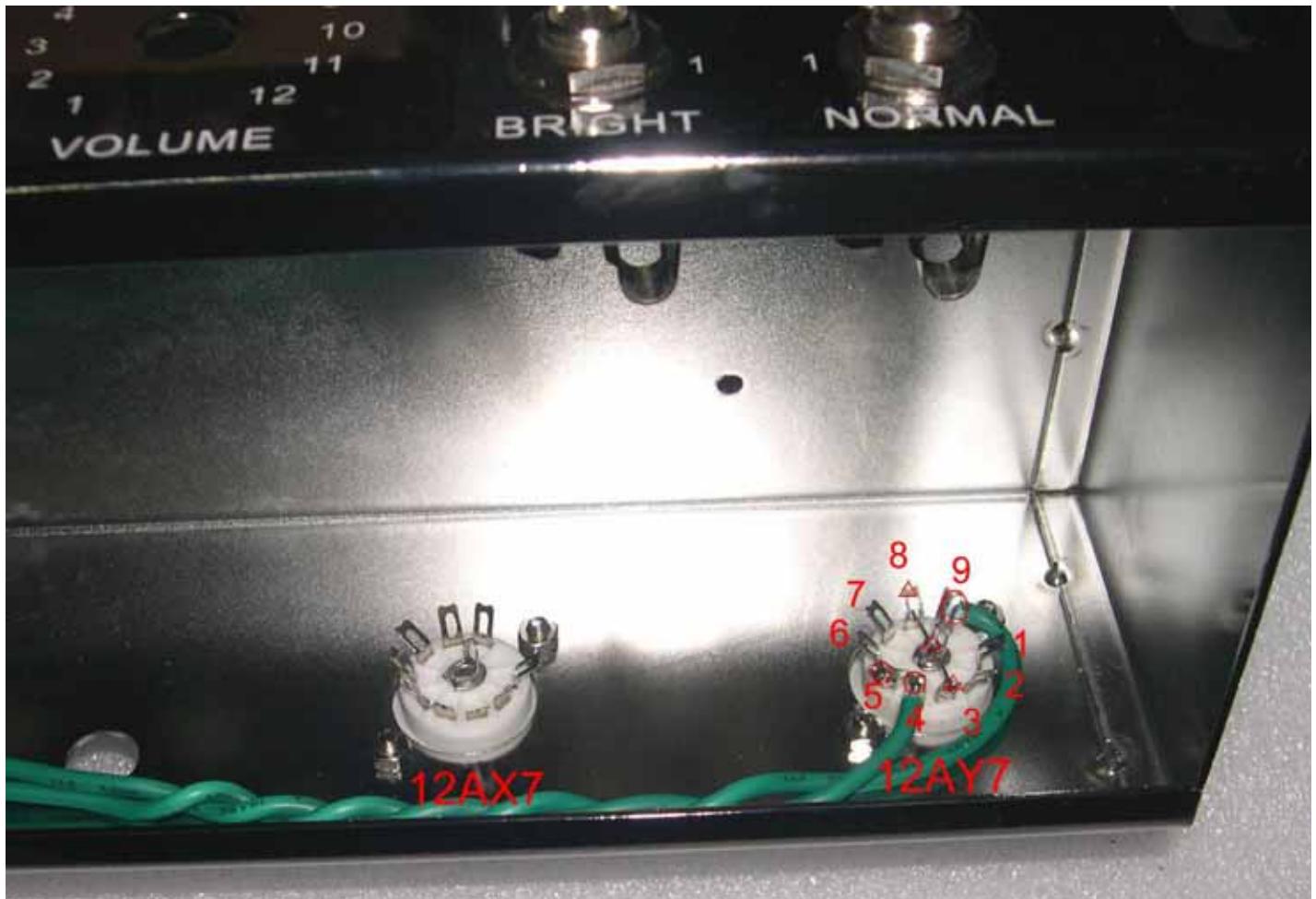
Tip: Wear white cloth gloves when handling the chassis to avoid getting fingerprints on the chrome surface.

Check to see that all necessary parts are present.



Mount the two 9-pin mini sockets in the orientation shown, with the gap between Pin 1 and Pin 9 towards the top of the chassis. Mount four $\frac{1}{4}$ in. jacks to the front of the chassis at this time as well. Next, twist two green wires together as shown to make the filament wires. Solder one lead to Pin 9, and the other across Pins 4 and 5 of the first preamp tube (12AY7). Your first segment will go from here to Pin 9 and Pins 4 and 5 of the second preamp tube (12AX7).

Tip: Tight, consistent twists will make your amp operate quieter.



Twist and cut the second segment of green filament wire to go from Pin 9 and Pins 4 and 5 of the second preamp socket (12AX7) to the nearest output tube socket hole. Make sure it is long enough to follow along the lip at the bottom of the chassis.



Install two 1/4 in. jacks into the next two holes in the rear of the chassis. Connect a black wire from Pin 1 on Jack B to Pins 1 and 2 on Jack A. Connect a green wire from Pin 3 on Jack A to Pin 3 on Jack B,

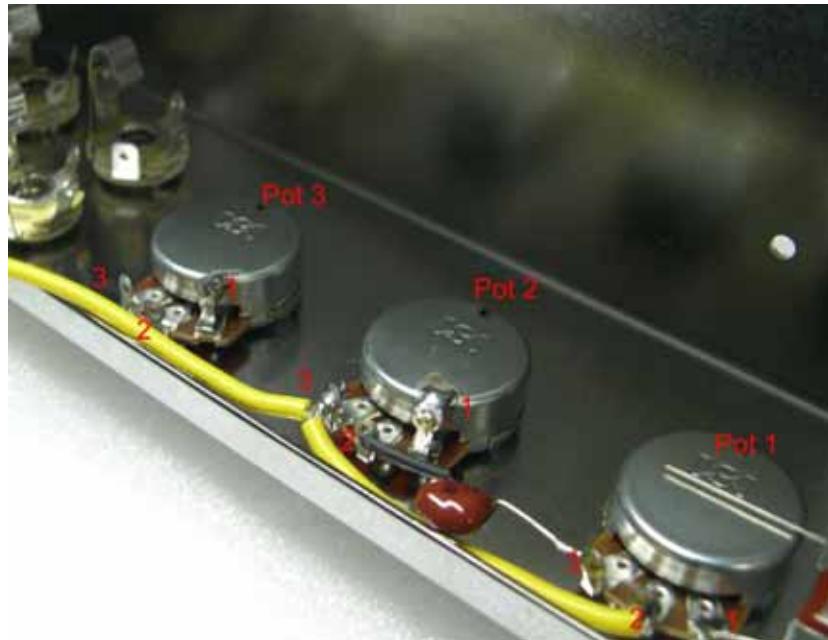


Install a potentiometer into the first position (Pot 1) as shown. Take a .0047uf 630V capacitor and bend the leads as shown below. Solder one lead to Pin 1, and leave the other lead along the back of the potentiometer to be soldered later. Solder a short length of yellow wire to Pin 2.



Find the other two potentiometers. On each of them, bend Pin 1 back and solder it to the metal casing as shown.

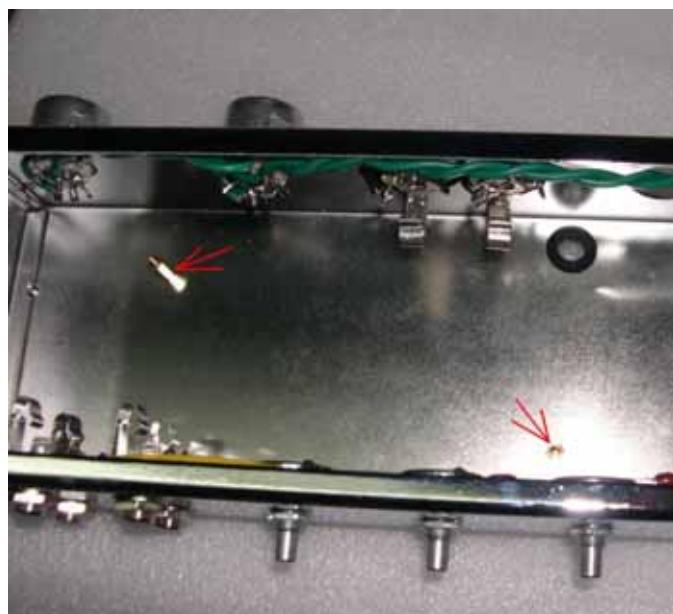
Tip: To get solder to stick to a solid metal surface such as the back of a potentiometer, it helps to "rough up" the surface first. You can do this with a power drill or Dremel tool with a grinding attachment. You can also use a file.



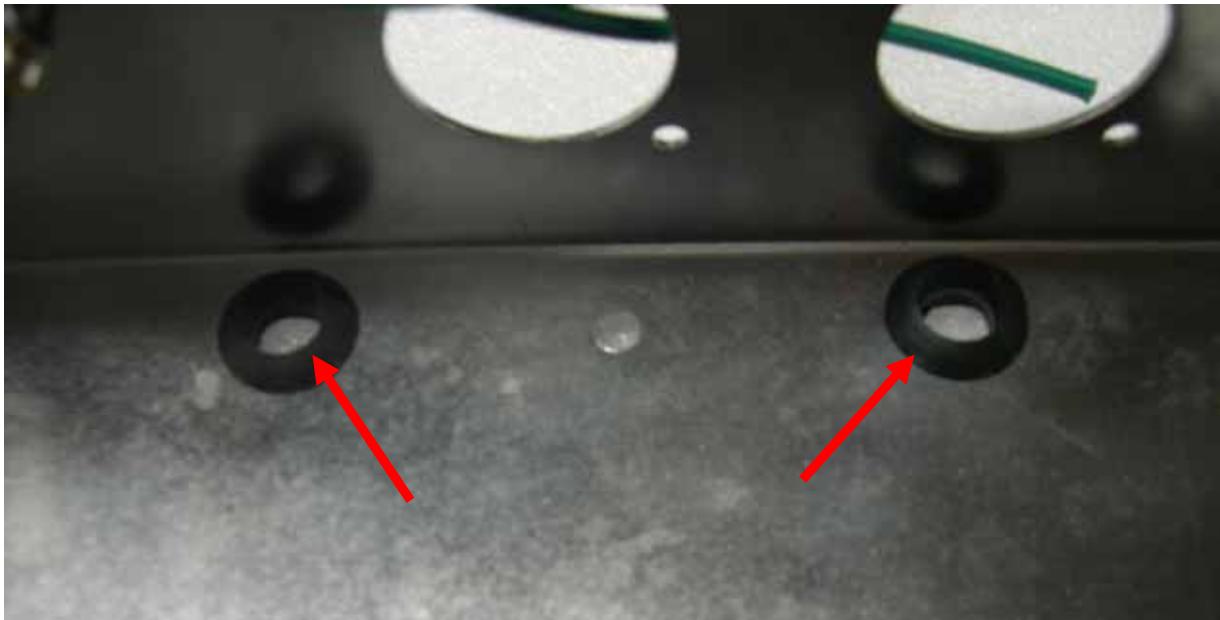
Install these potentiometers in the two open positions (Pot 2 and Pot 3) and solder a 470pf capacitor from Pin 3 on Pot 1 to Pin 2 on Pot 2. Use a small piece of tubing, heat shrink, or insulation stripped from a wire to insulate the lead that goes to Pot 2 from touching the grounded lead.

Solder the yellow wire from Pin 2 on Pot 1 to Pin 3 on Pot 2.

Install two threaded standoffs to the chassis for circuit board mounting



Install two rubber grommets for the output transformer wires to pass through

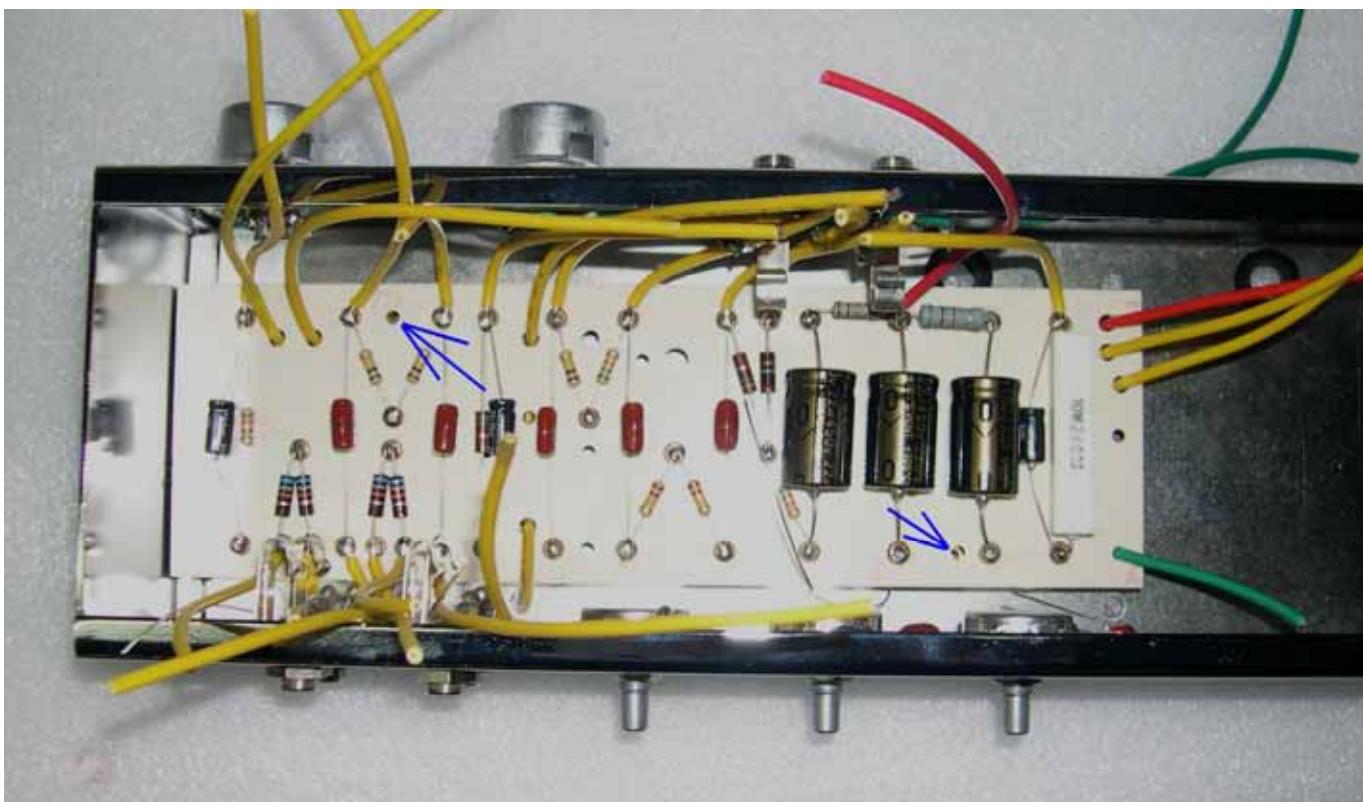


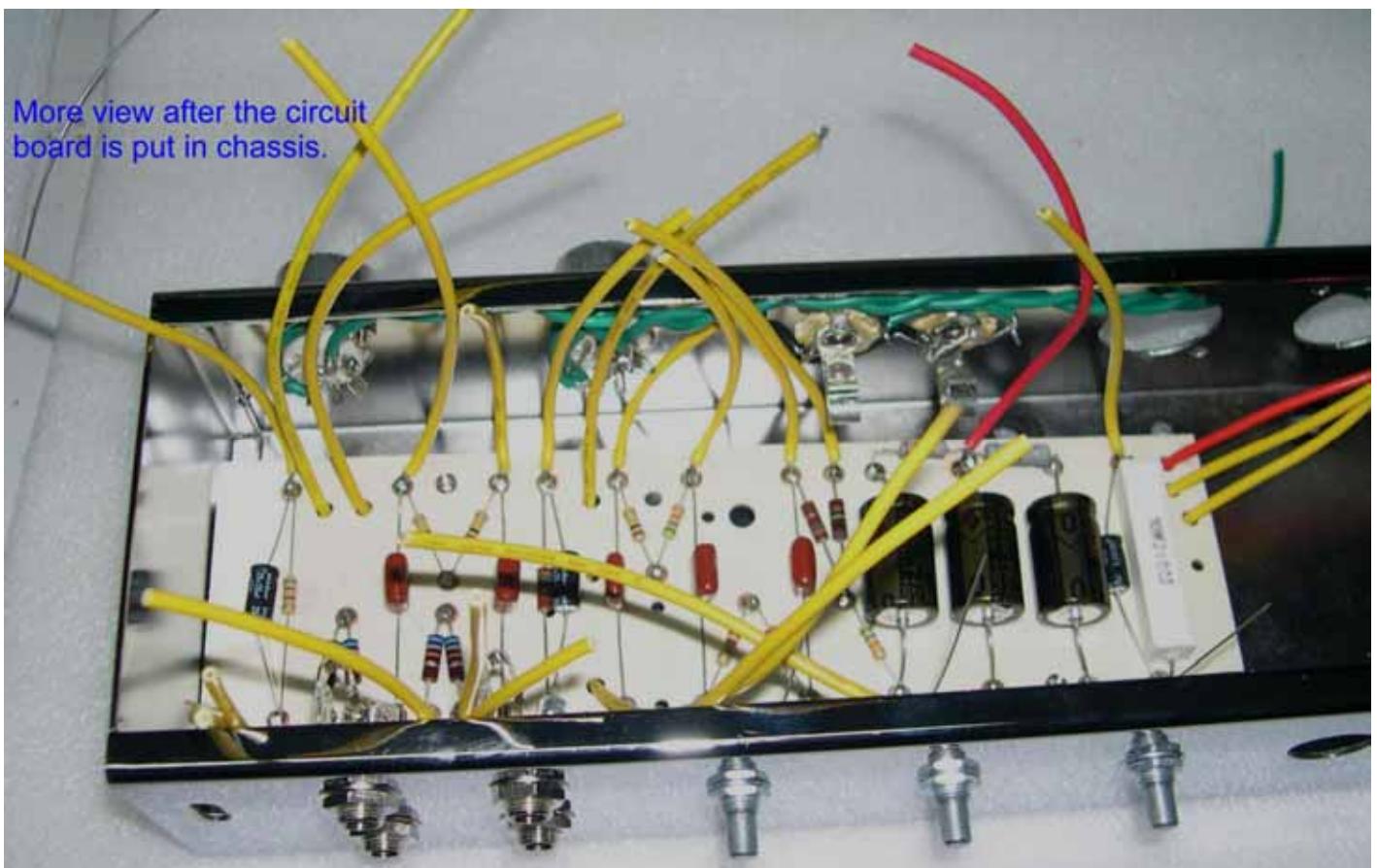
Install the output transformer with the green and black leads towards the output jacks. Run the wires through the grommets, and pull them towards the rear of the chassis to keep them out of the way of the circuit board.

Note: If you wish, you may hold off on installing the output transformer until later. This will make it easier to complete the next few steps, but it will be more difficult to bolt the transformer down if you do it this way.

Make sure that all the wiring on the back side of the circuit board is correct before proceeding to the next step! Any errors made will be extremely difficult to repair after the board is wired in.

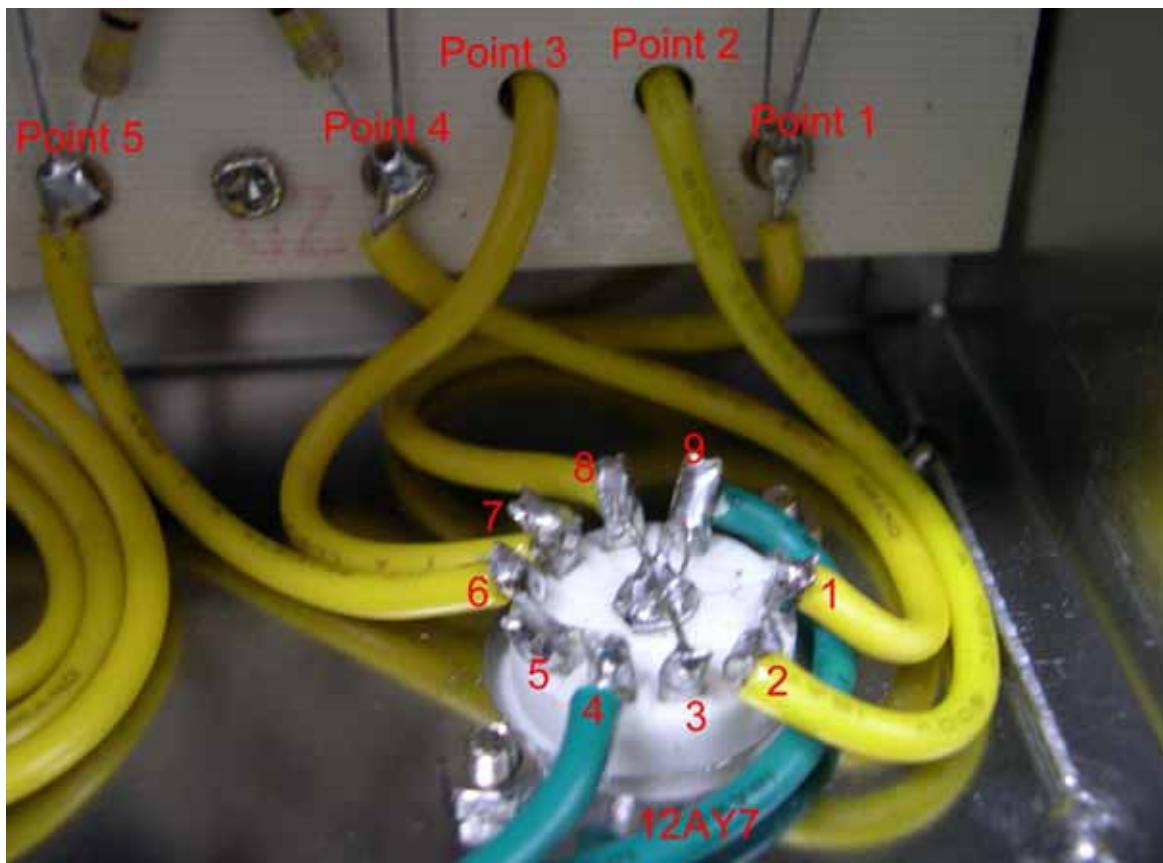
Before installing the circuit board, make sure that all of the wires are bent upwards, so none of them become buried under the board. Align the two screw holes with the standoffs and carefully screw the board down. Don't force the screws if the board doesn't want to go all the way into place.





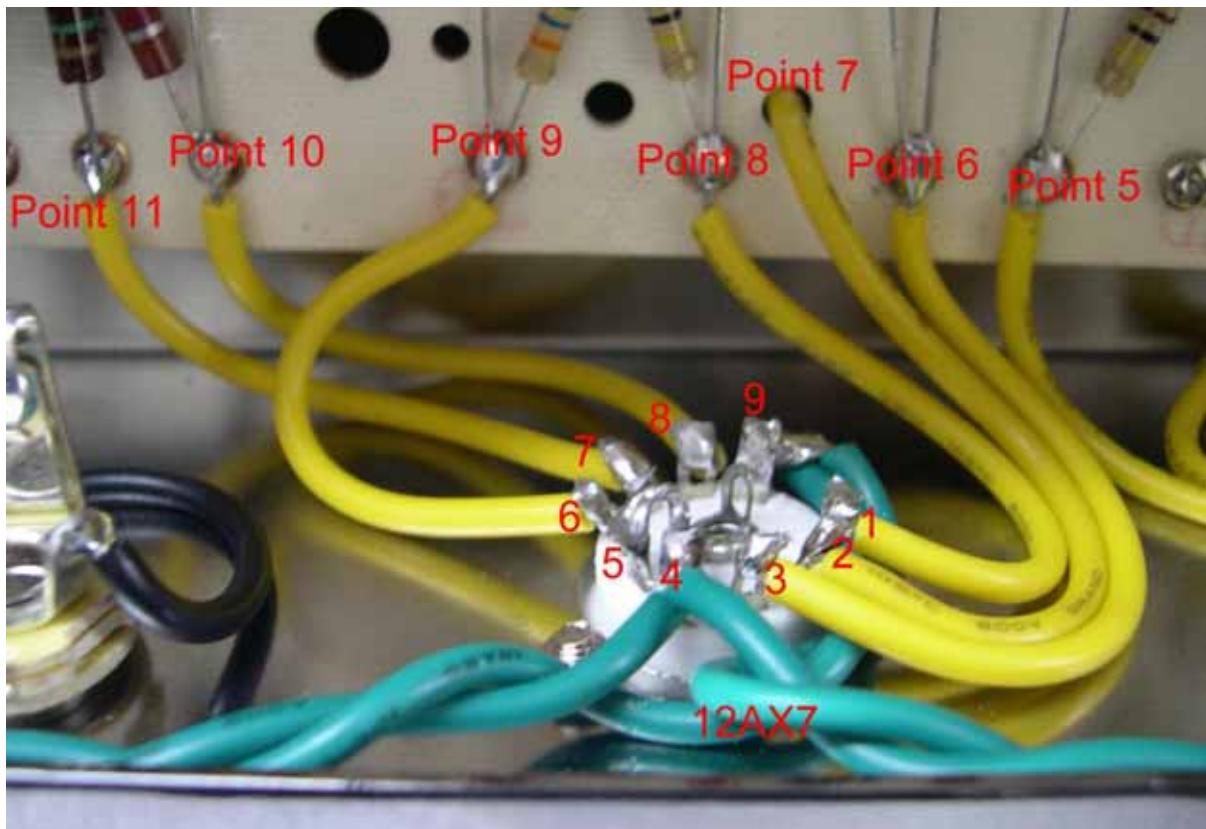
First Preamplifier tube (12AY7):

Wire as follows: Point 1 to Pin 8, Point 2 to Pin 2, Point 3 to Pin 7, Point 4 to Pin 1, and Point 5 to Pin 6.
Cut off excess wire as needed.

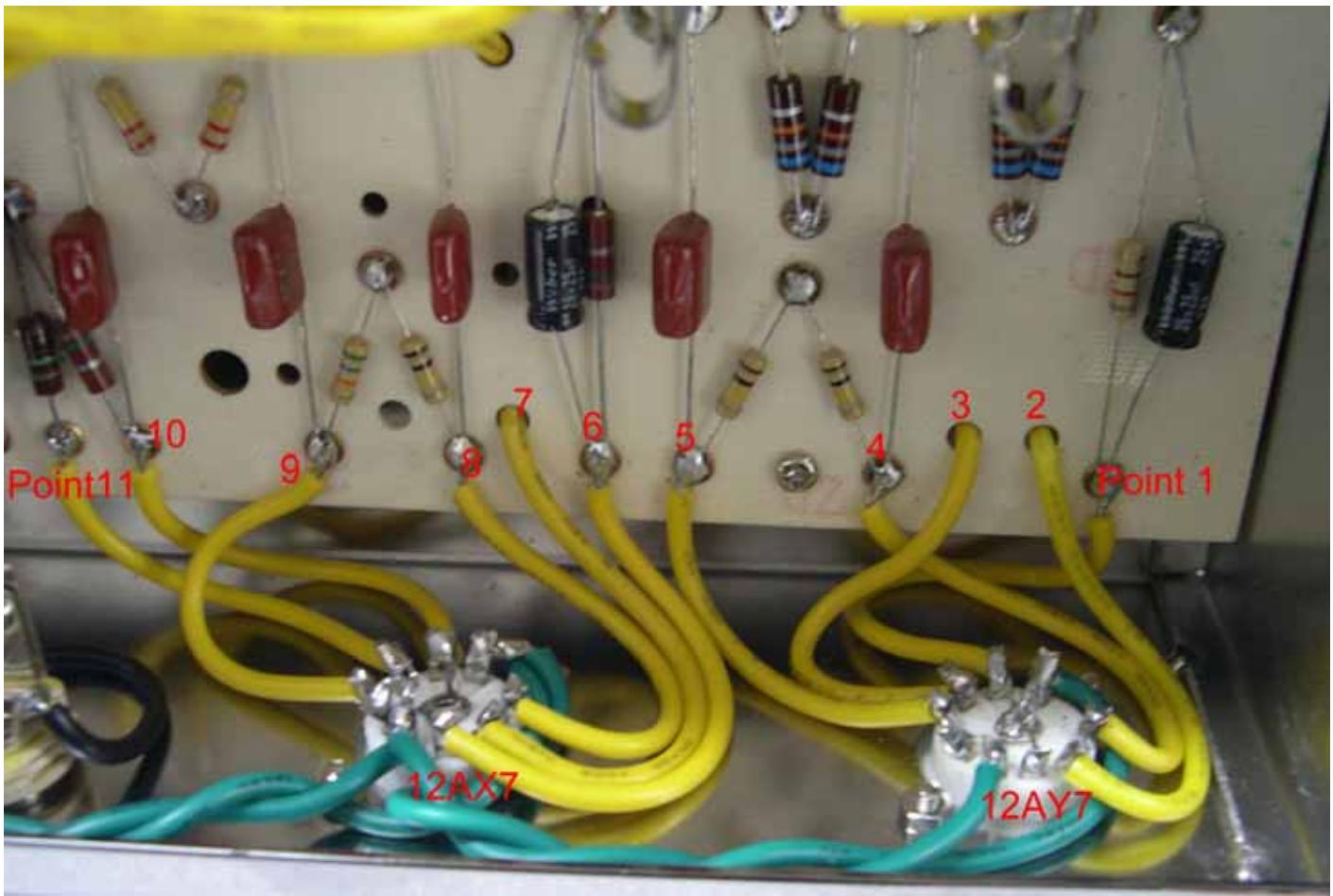


Second preamp tube (12AX7):

Connect Point 6 to Pin 3, Point 7 to Pin 2, Point 8 to Pin 1, Point 9 to Pin 6, Point 10 to Pin 8, and Point 11 to Pin 7.



Overall view of the preamp wiring:



Front panel wiring:

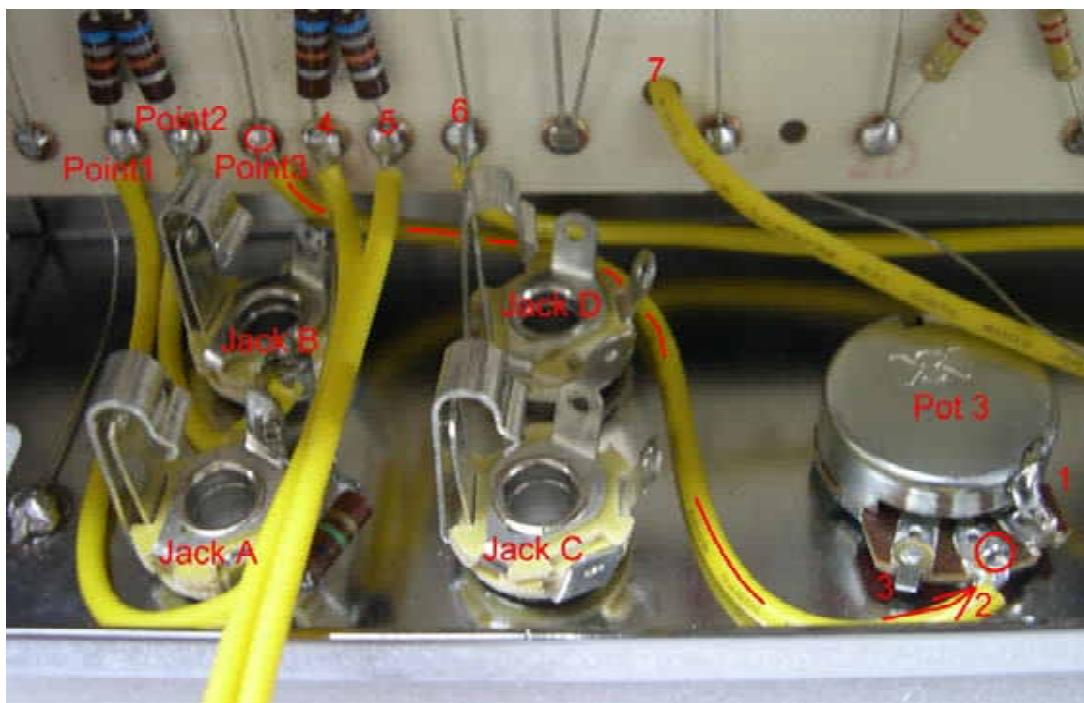
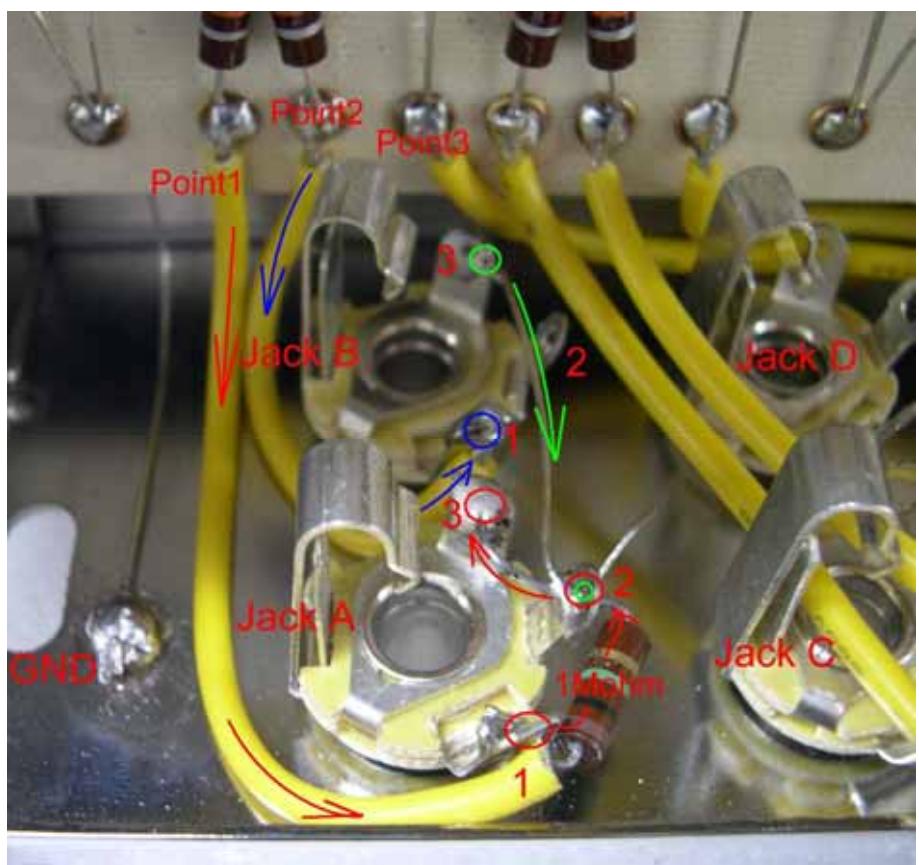
To solder the ground lead to the chassis, it helps to remove some of the chrome surface using a drill or Dremel tool with a grinder attachment. You can also scrape it off with a screwdriver, a knife, or the edge of a file. Heat the spot with a high power (100+ watt) soldering gun until solder flows and sticks. Then, solder the wire down to the spot.



Input Jack Wiring

Jack A: Connect Point 1 to Pin 1. Solder a 1 Meg Ohm resistor between Pin 1 and Pin 2. Connect Pins 2 and 3 together.

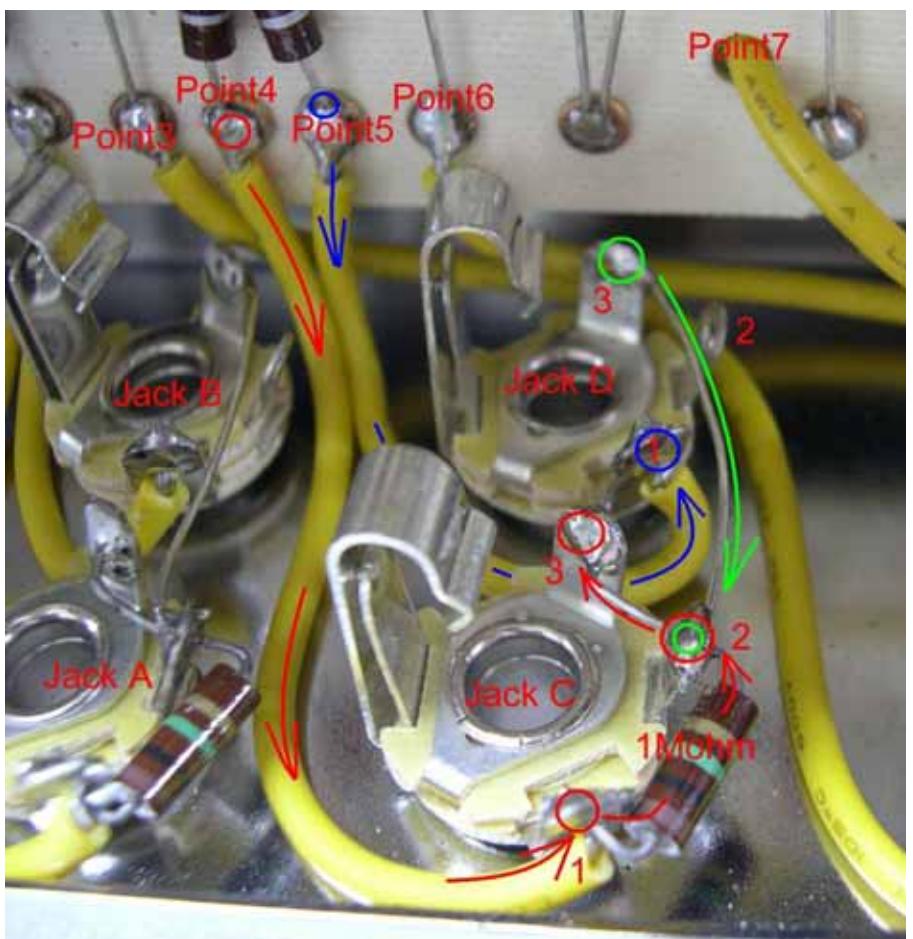
Jack B: Connect Point 2 to Pin 1. Connect Pin 3 to Pin 2 on Jack A. Leave Pin 2 empty.



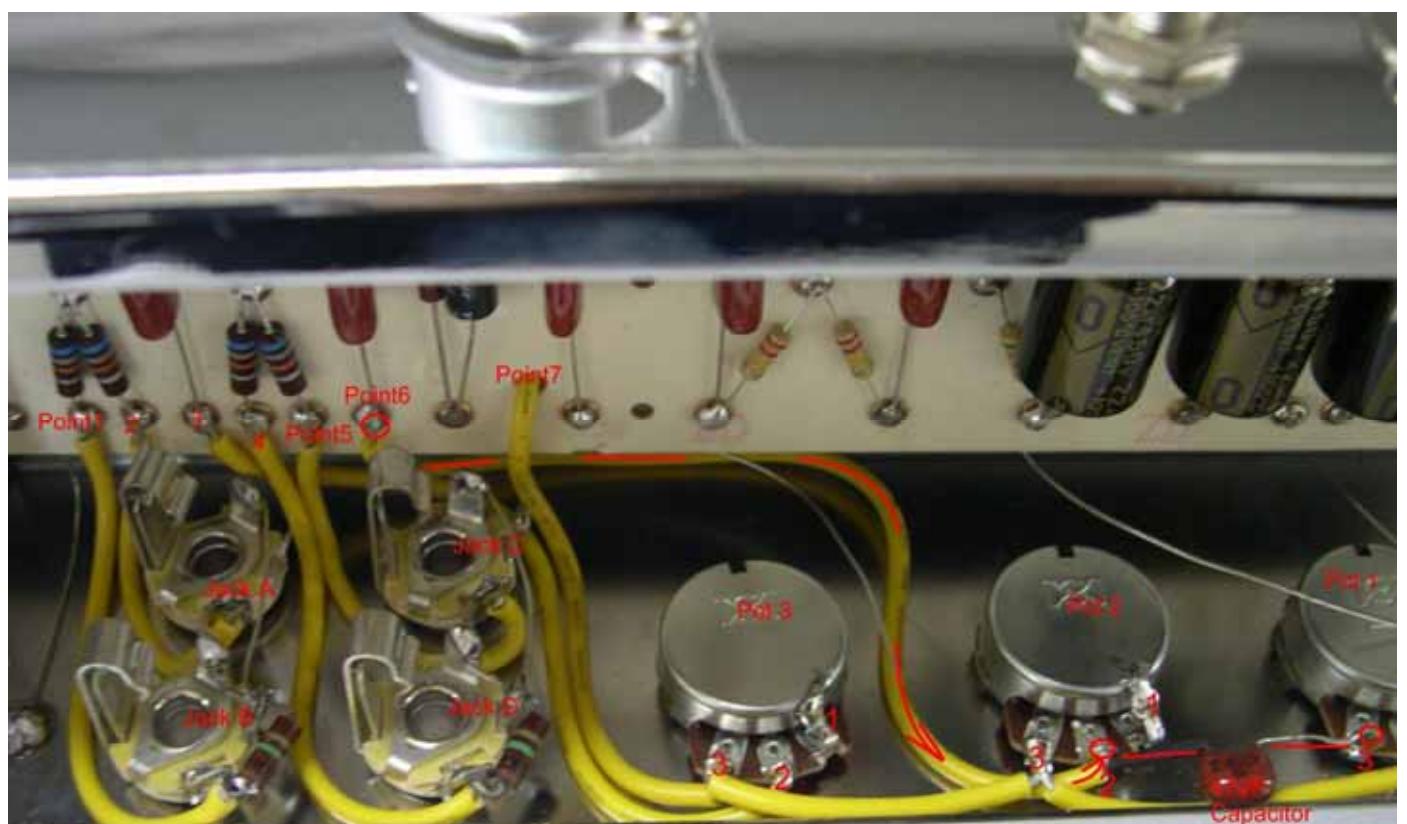
Connect Point 3 to Pin 2 on Pot 3.

Jack C: Connect Point 4 to Pin 1. Solder a 1 Meg Ohm resistor between Pin 1 and Pin 2. Connect Pins 2 and 3 together.

Jack D: Connect Point 5 to Pin 1. Connect Pin 3 to Pin 2 on Jack C. Leave Pin 2 empty.

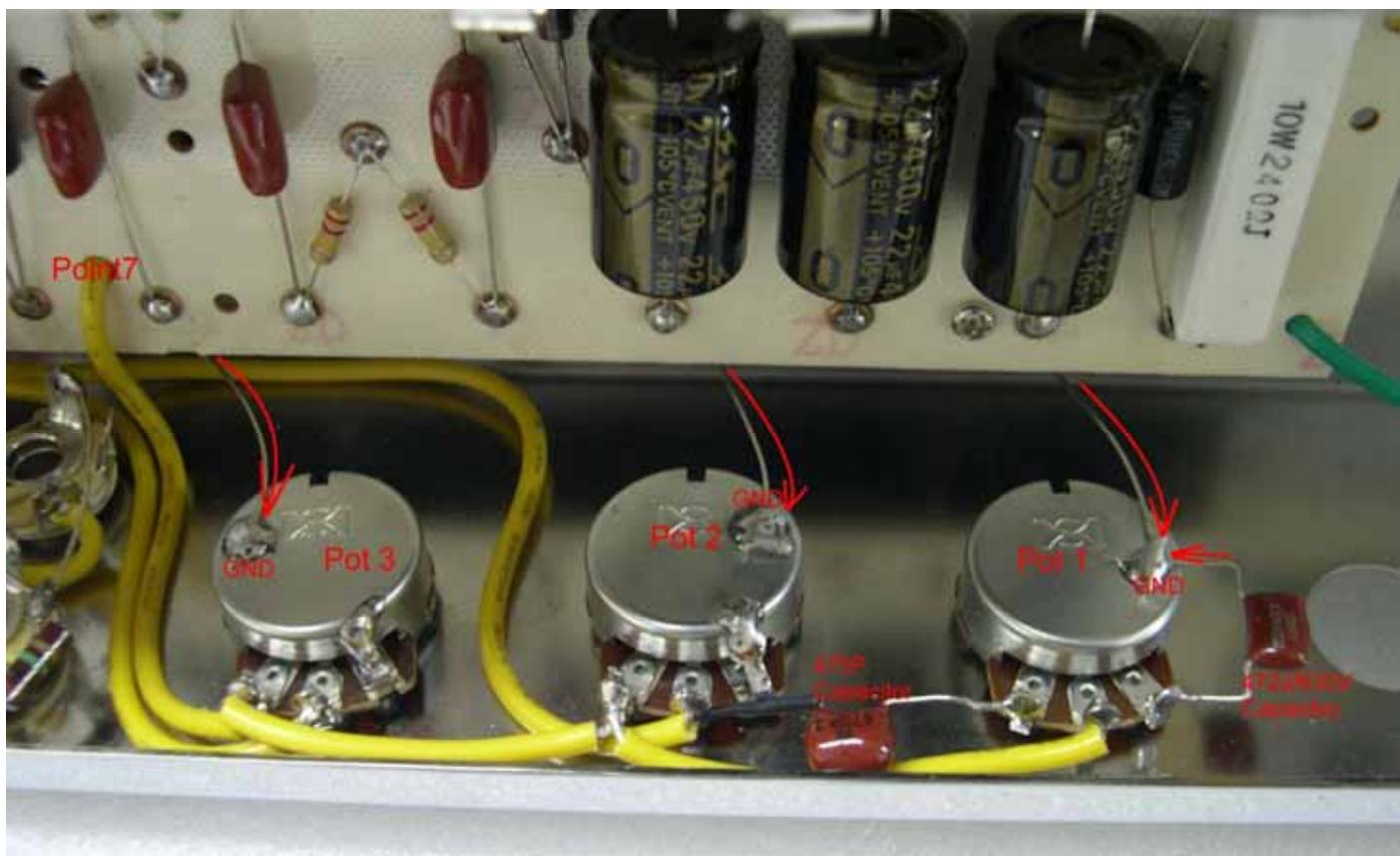


Connect Point 7 to Pin 3 on Pot 3. Connect Pin 3 on Pot 2 to Pin 3 on Pot 3. Connect Point 6 to Pin 2 on Pot 2.



Solder the remaining three bare ground wires to the backs of the three potentiometers:

Tip: To get solder to stick to a solid metal surface such as the back of a potentiometer, it helps to "rough up" the surface first. You can do this with a power drill or Dremel tool with a grinding attachment, or a file.



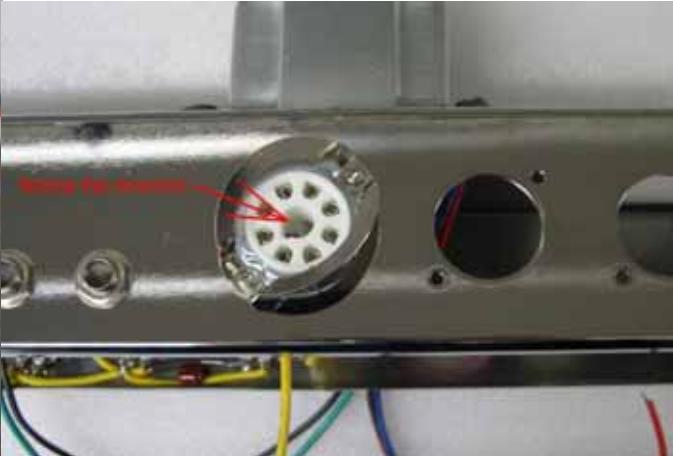
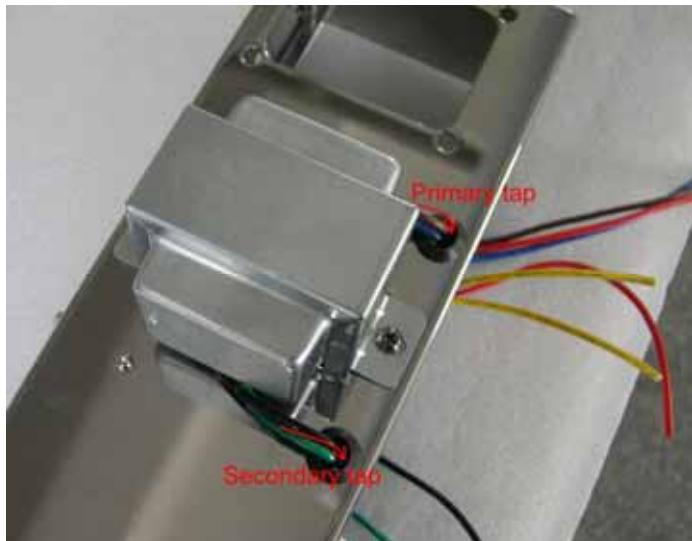
Overall view of the front panel wiring:



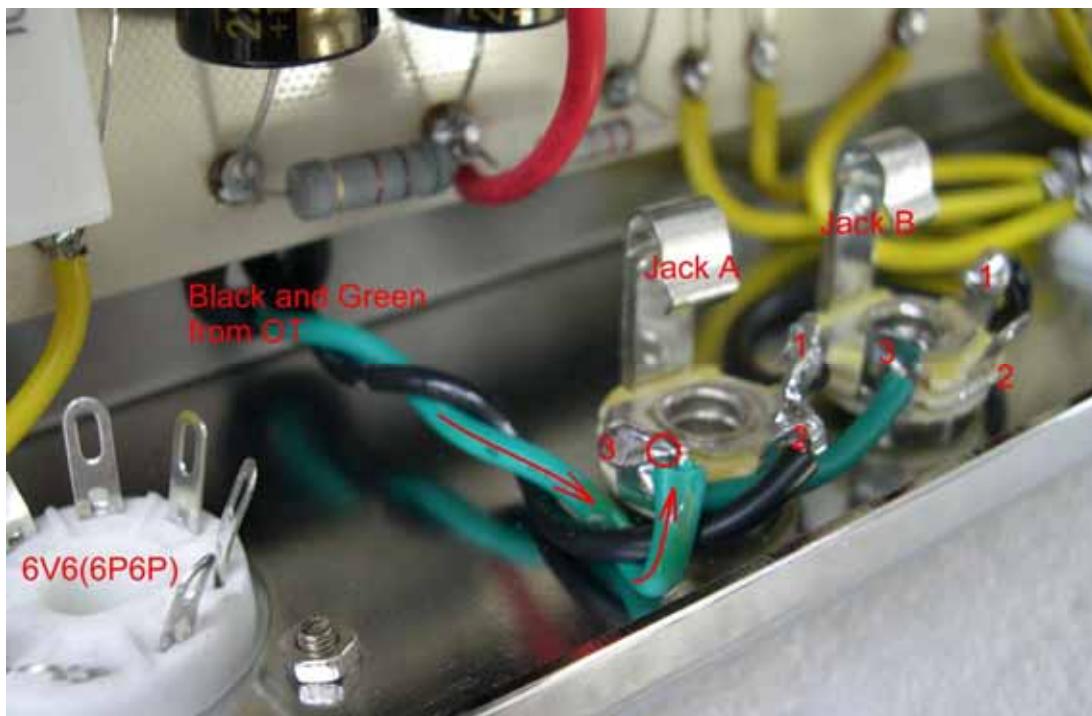
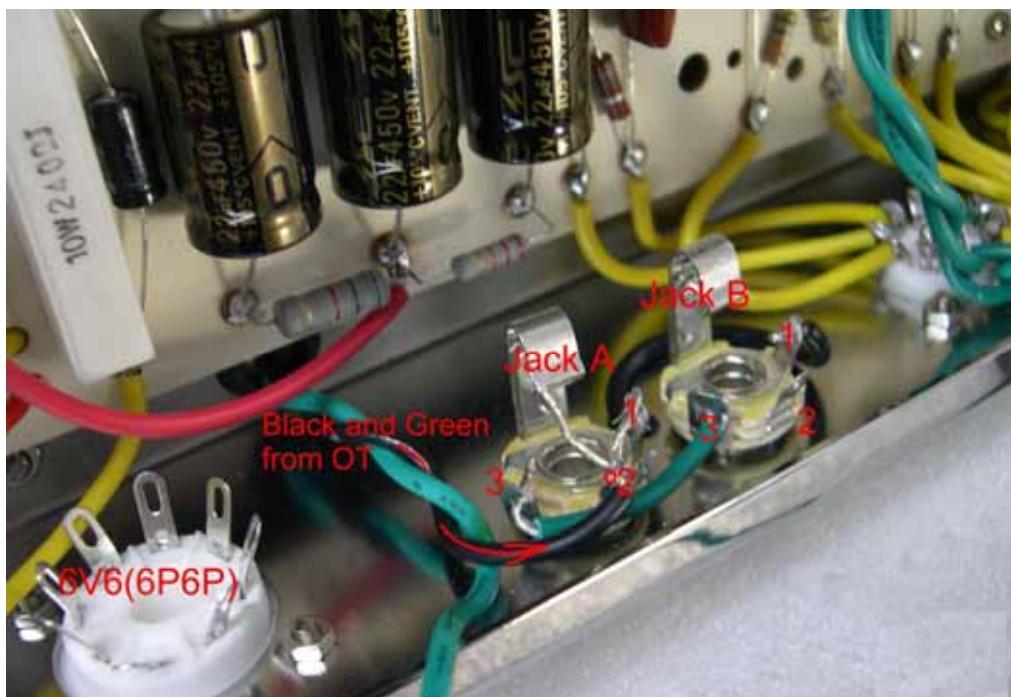
If you have not done so yet, mount the output transformer to the chassis. Make sure that the black and green wires of the secondary tap are closest to the output jacks. Run the wires through the rubber grommets.

Install the three octal tube sockets and tube retainers as shown. Make sure the sockets are turned so that the key notch on the center hole is towards the open bottom of the chassis as shown.

Bend the solder lugs on all three sockets outward, away from the sockets.

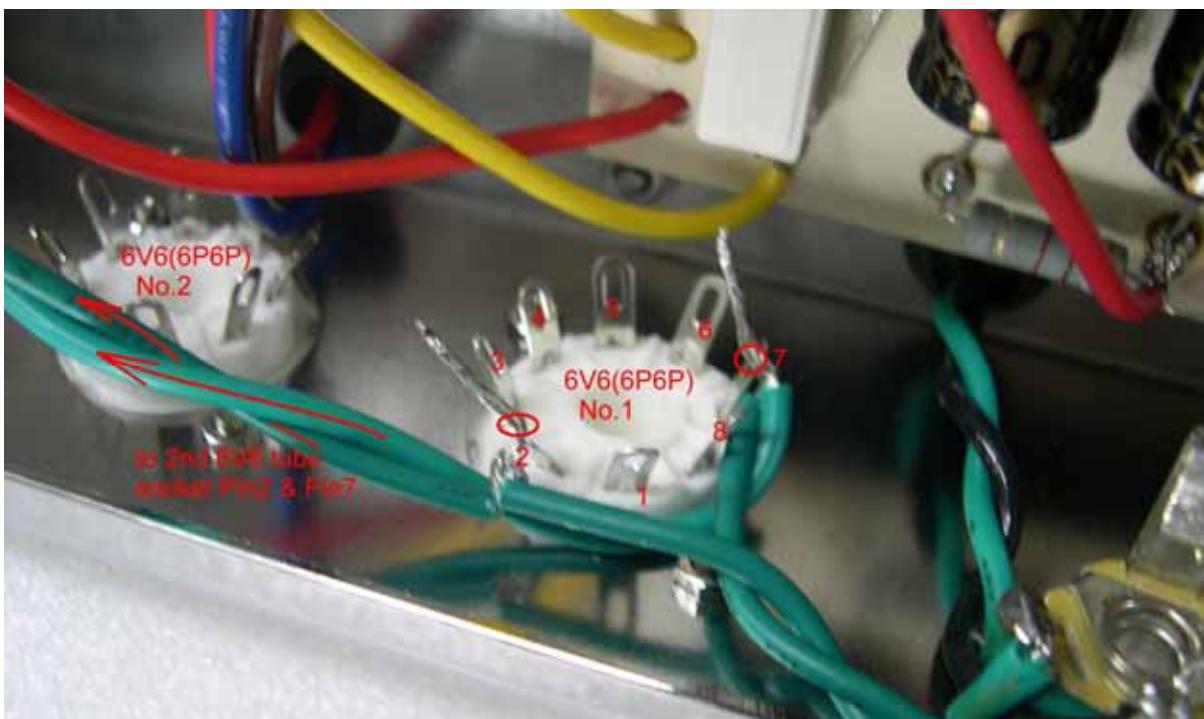
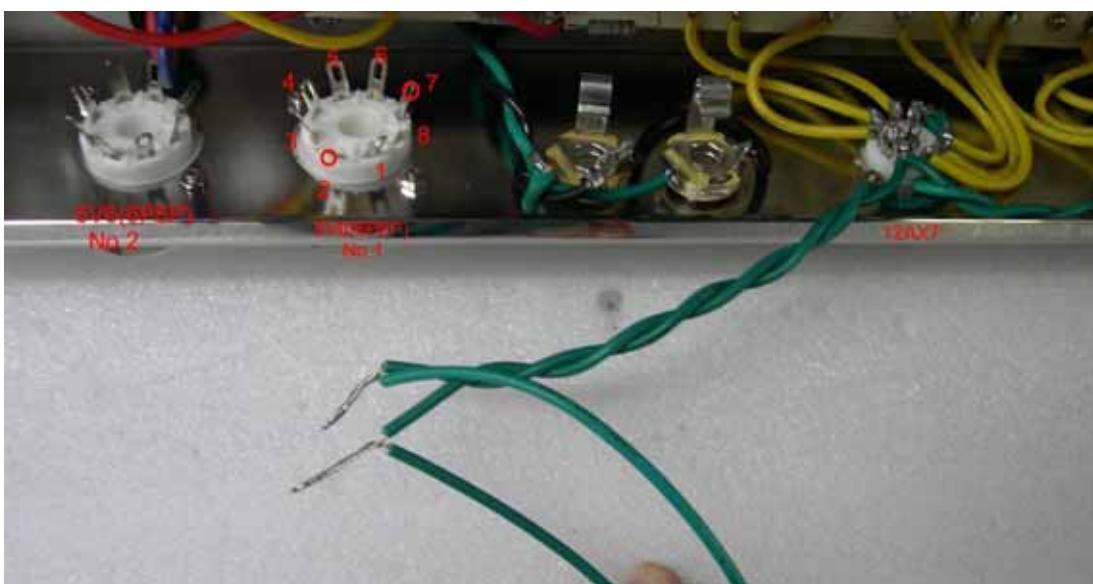


Twist the black and green secondary wires from the output transformer. Connect the black wire to Pin 2 and the green wire to Pin 3 on Jack A.

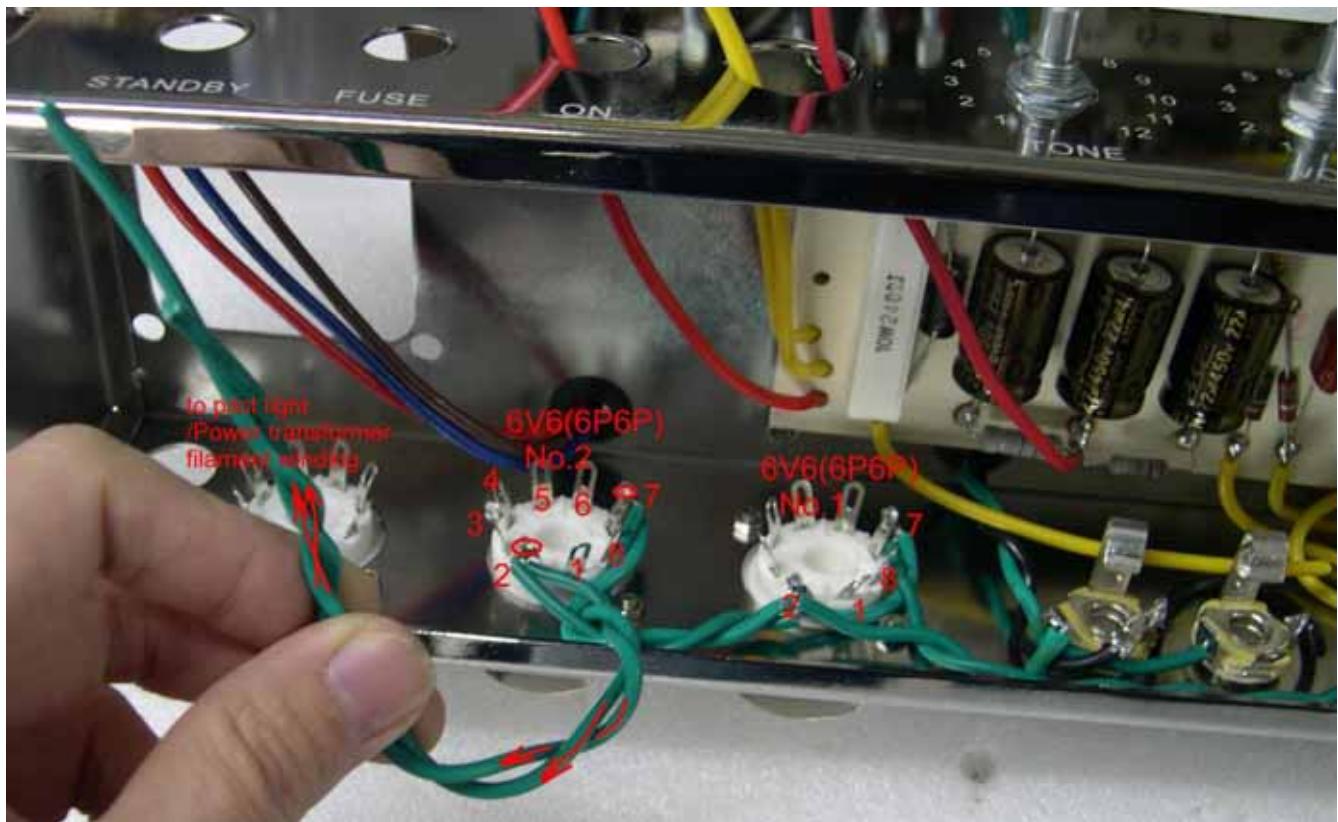


Output tube wiring

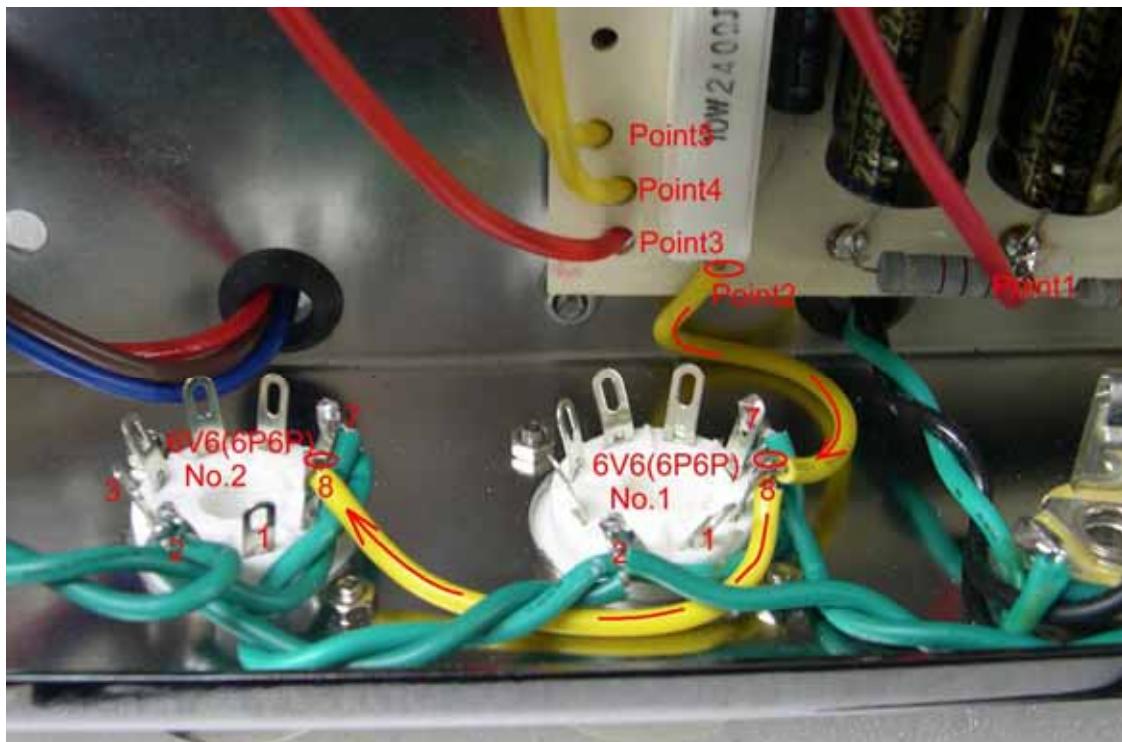
Connect the twisted green filament wires from the 12AX7 tube to pins 2 and 7 on the first 6V6 tube socket



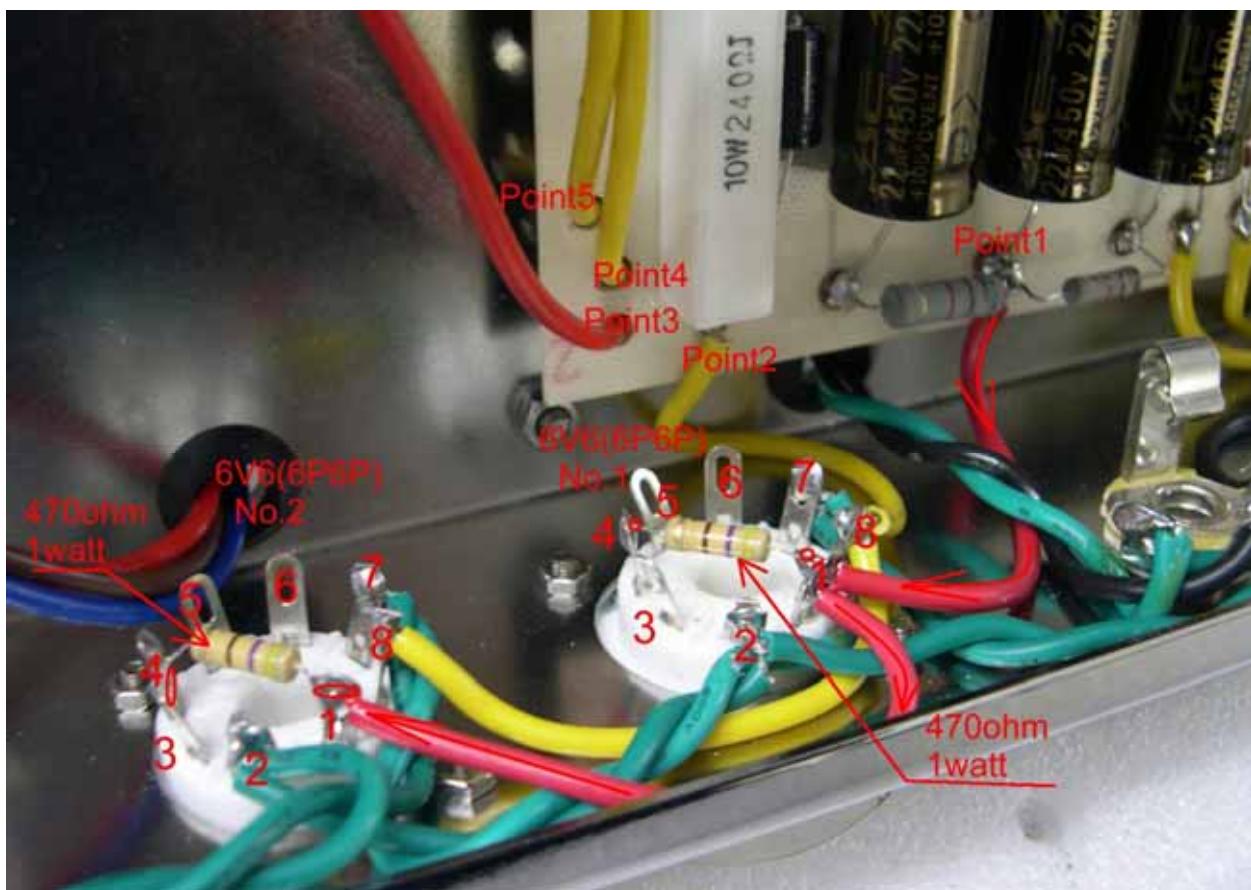
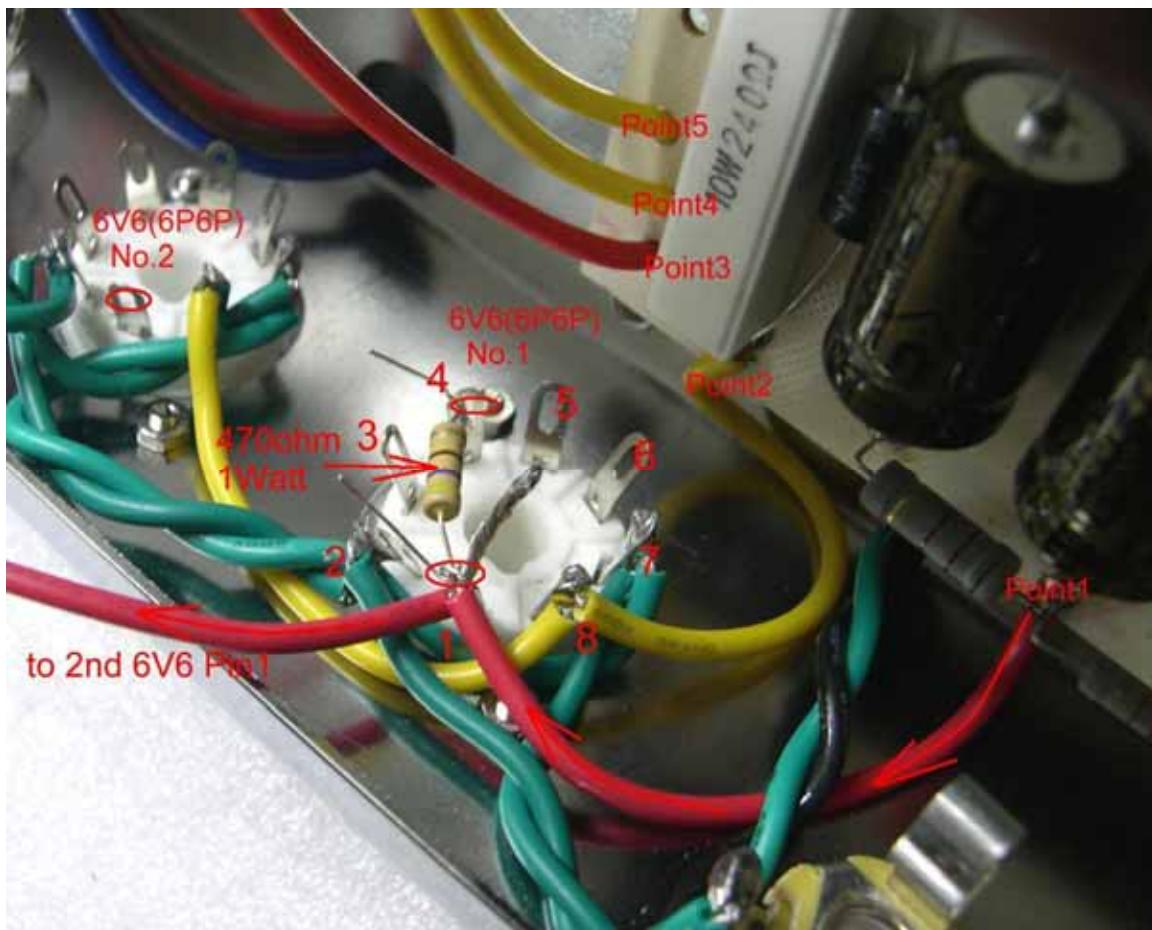
Connect the twisted green filament wires from the first 6V6 tube socket to pins 2 and 7 on the second 6V6 tube socket. Twist together another pair of green wires long enough to go from the second 6V6 socket to the pilot light hole on the front panel. Connect one end to pins 2 and 7 and leave the other end disconnected for now.



Connect Point 2 on the circuit board to the Pin 8 on the second 6V6 tube socket. Run a yellow wire from Pin 8 on the first 6V6 tube to Pin 8 on the second 6V6 tube socket.



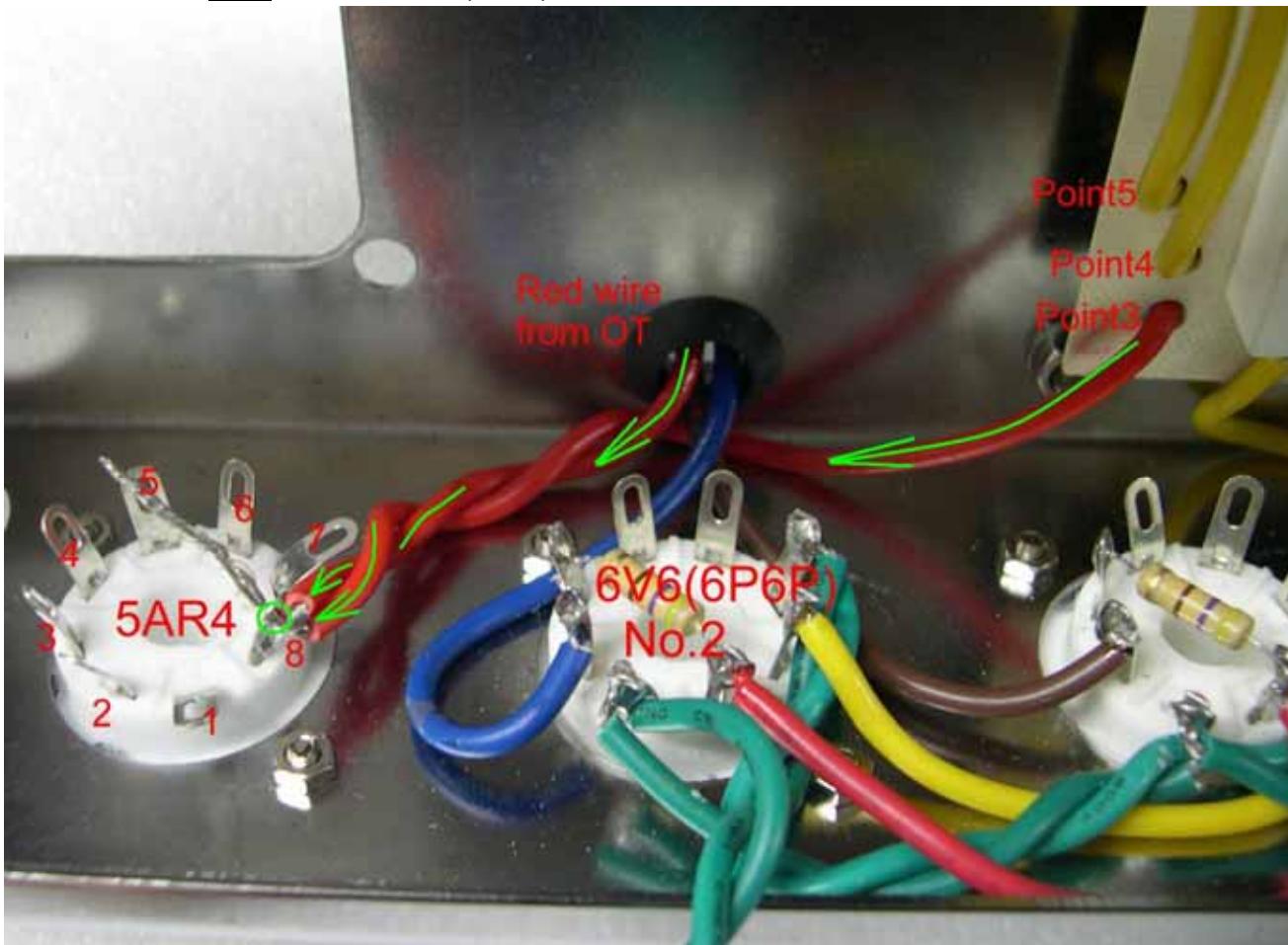
Connect Point 1 on the circuit board to Pin 1 on the first 6V6 tube socket. Connect a red wire from Pin 1 on the first 6V6 tube socket to the Pin 1 on the second 6V6 tube socket. Solder a 470 Ohm 1W resistor between Pin 1 and Pin 4 on both 6V6 tube sockets.



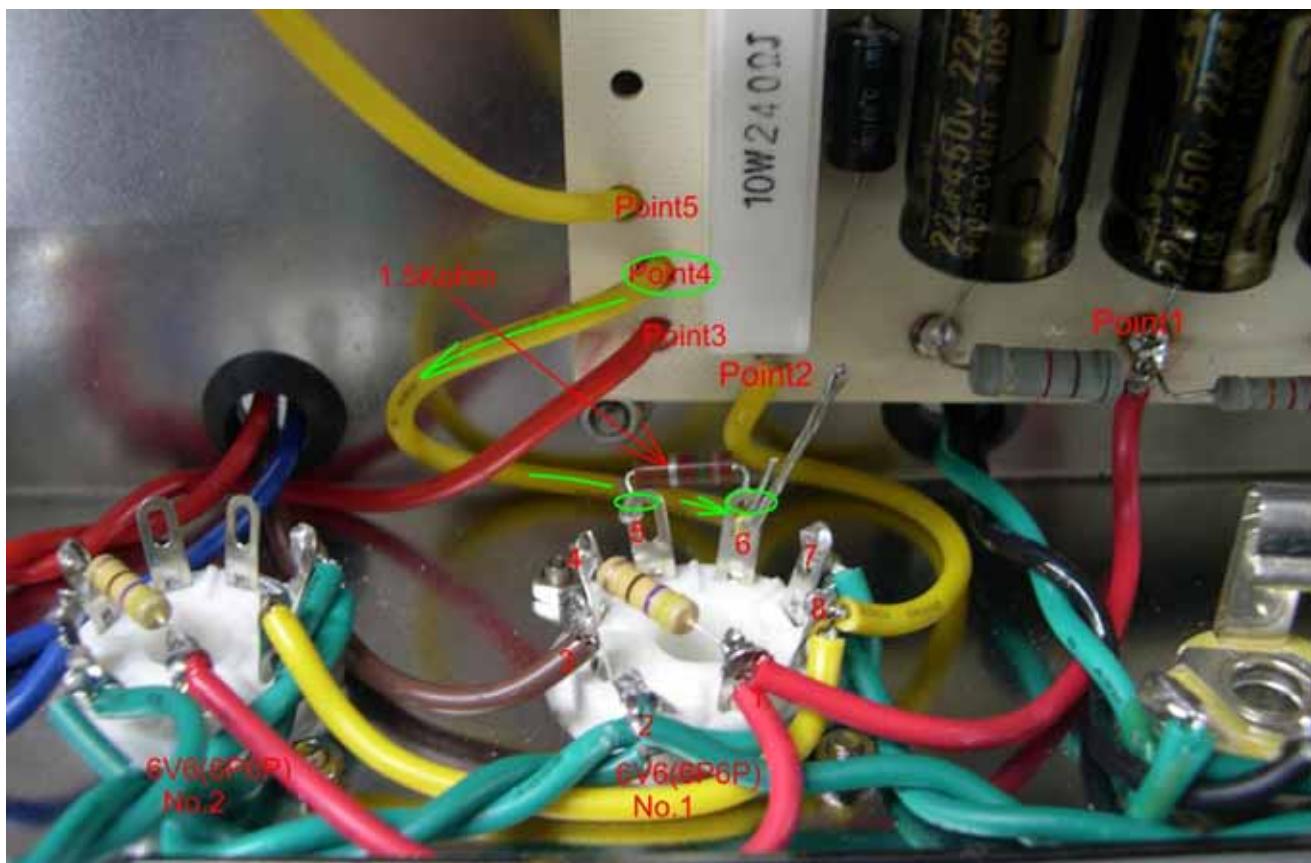
Connect the Blue wire from the primary of the OT to Pin 3 on the second 6V6 tube socket. Connect the Brown wire from the OT to Pin 3 on the first 6V6 tube socket.



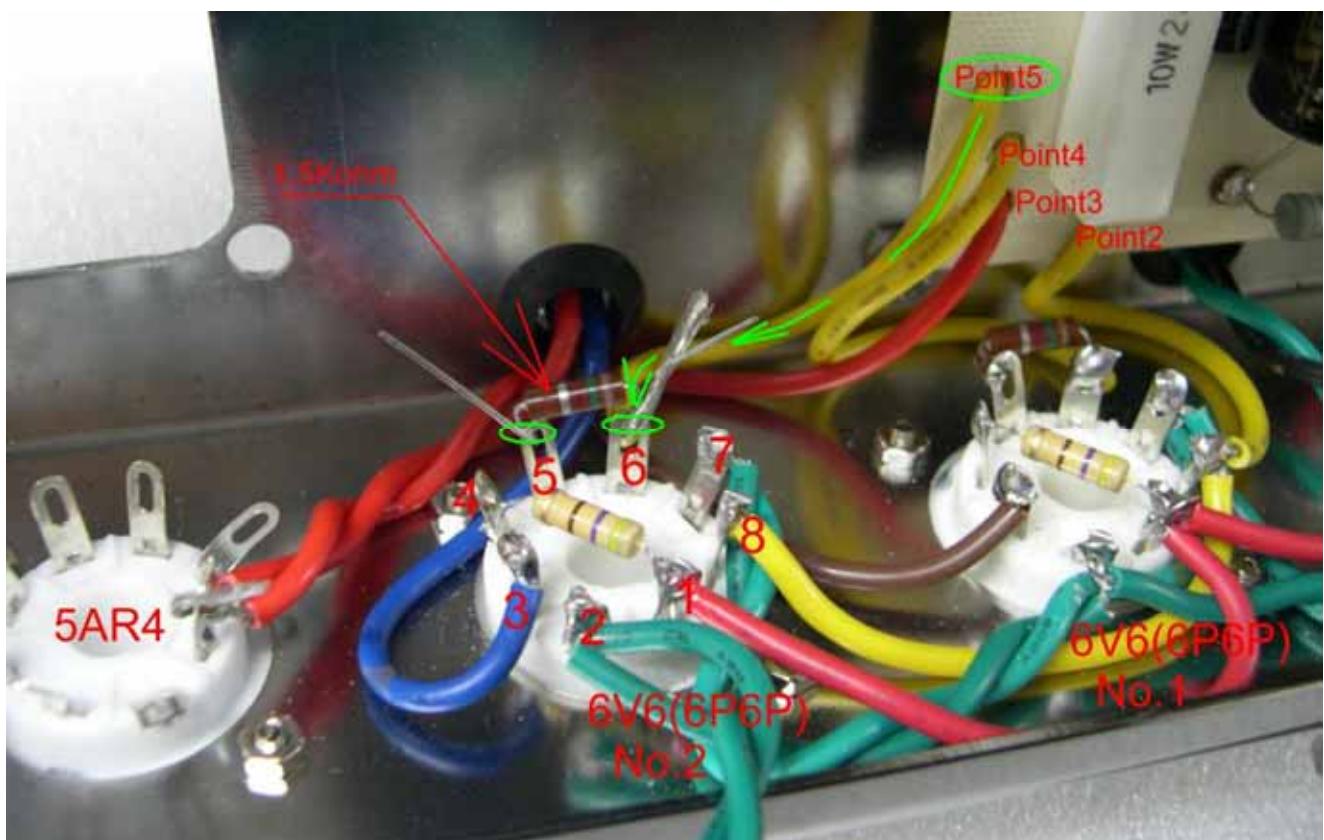
Twist the red wire from the Output Transformer with the red wire from Point 3 on the circuit board together and connect them to Pin 8 on the rectifier (5AR4) tube socket.



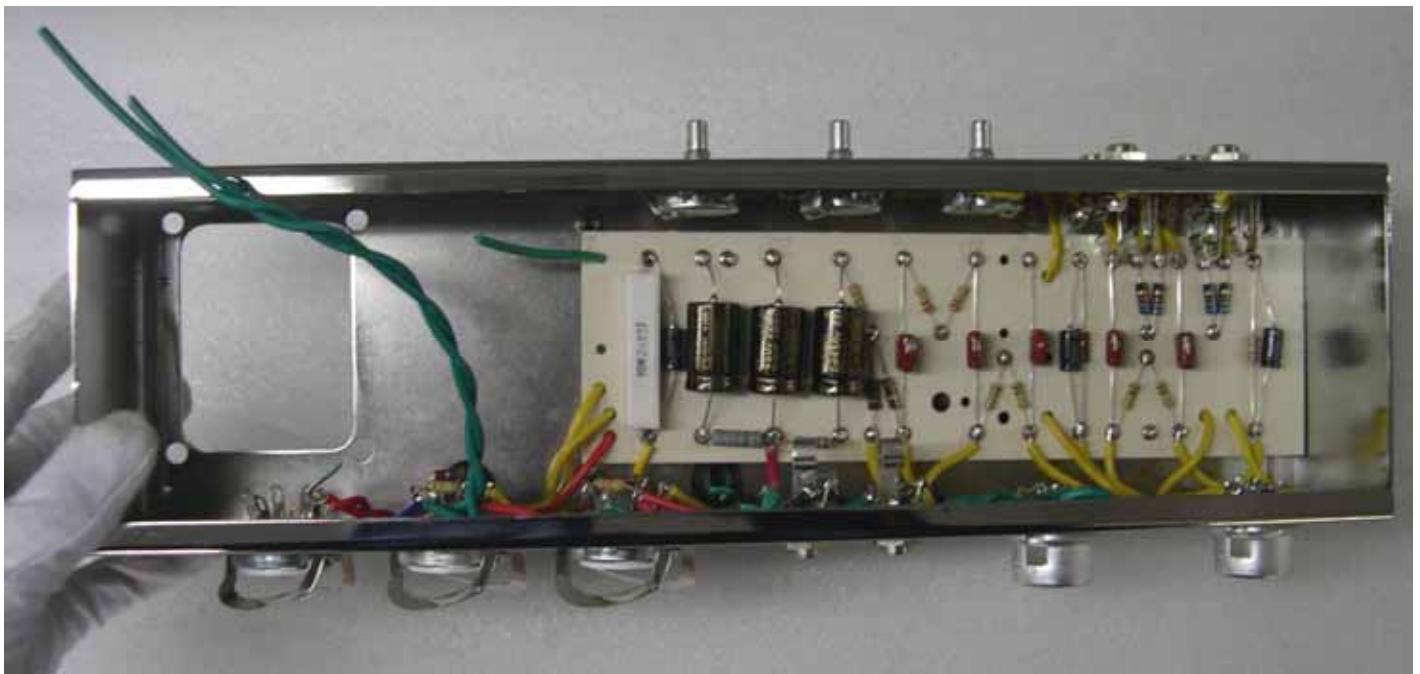
Connect Point 4 on the circuit board to Pin 6 on the first 6V6 tube socket. Solder a 1.5K ohm resistor between Pins 5 and 6 on the first 6V6 tube socket.



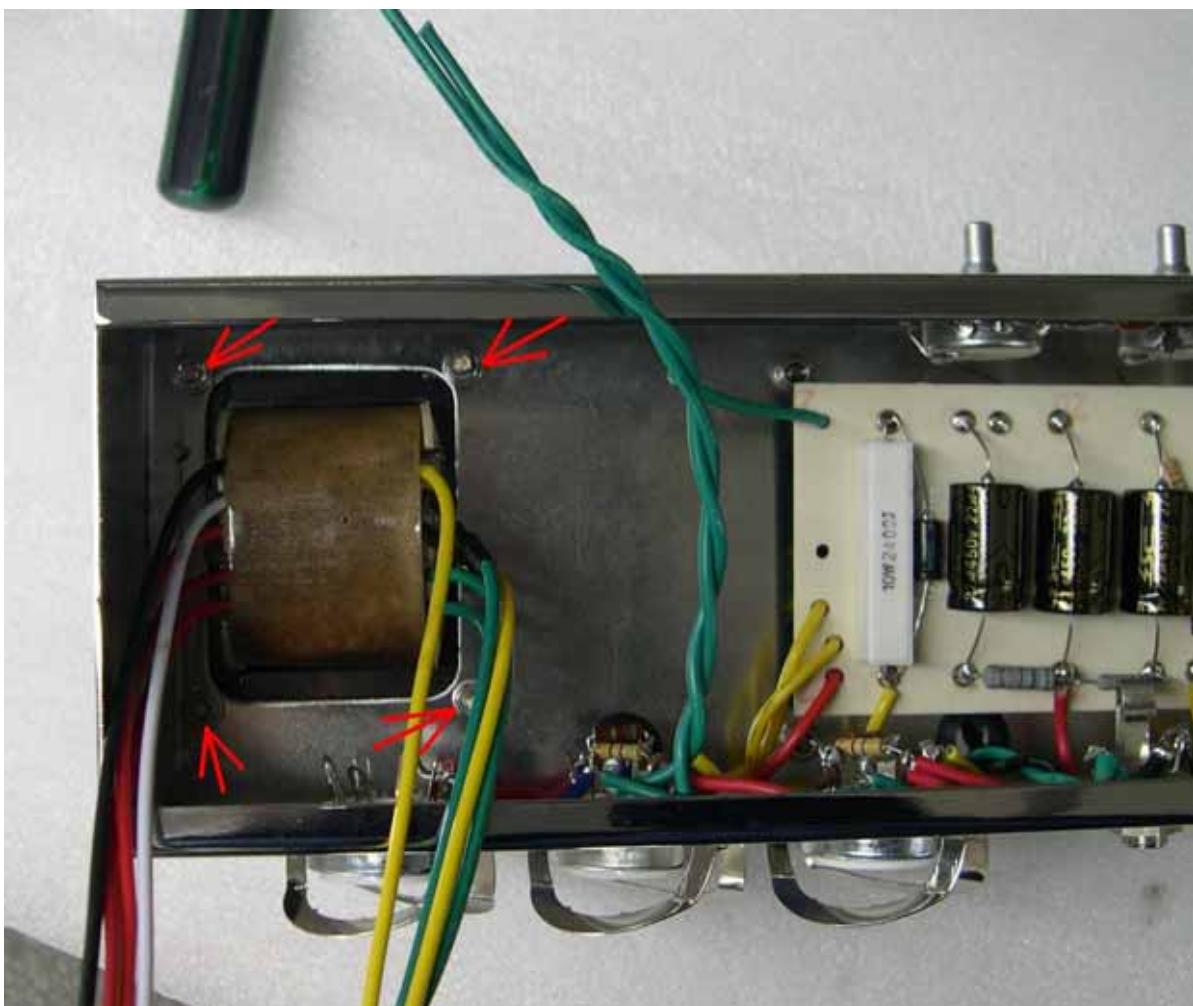
Connect Point 5 on the circuit board to Pin 6 on the second 6V6 tube socket. Solder a 1.5K ohm resistor between Pins 5 and 6 on the second 6V6 tube socket.



An overall view of the chassis

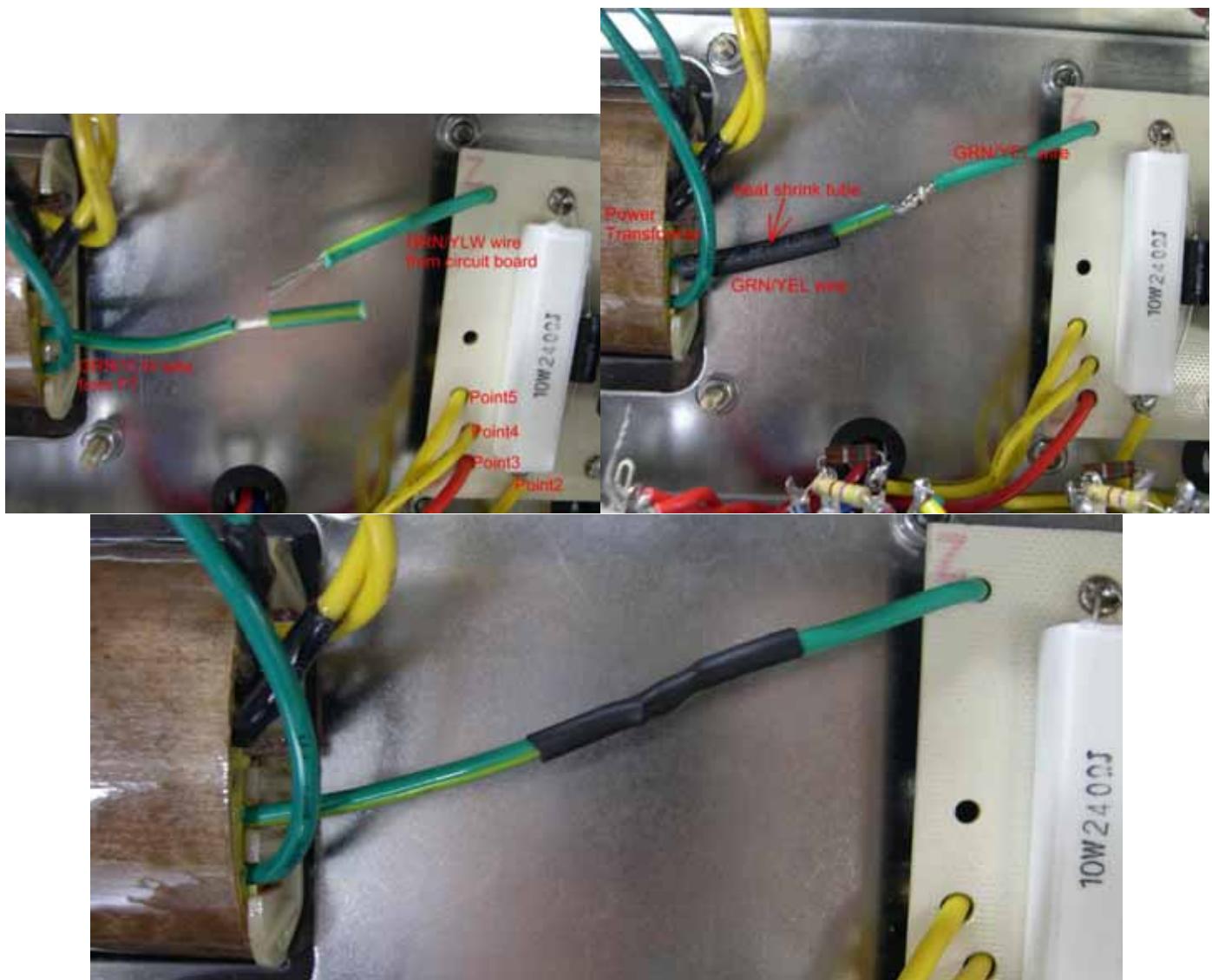


Mount the power transformer as shown below.

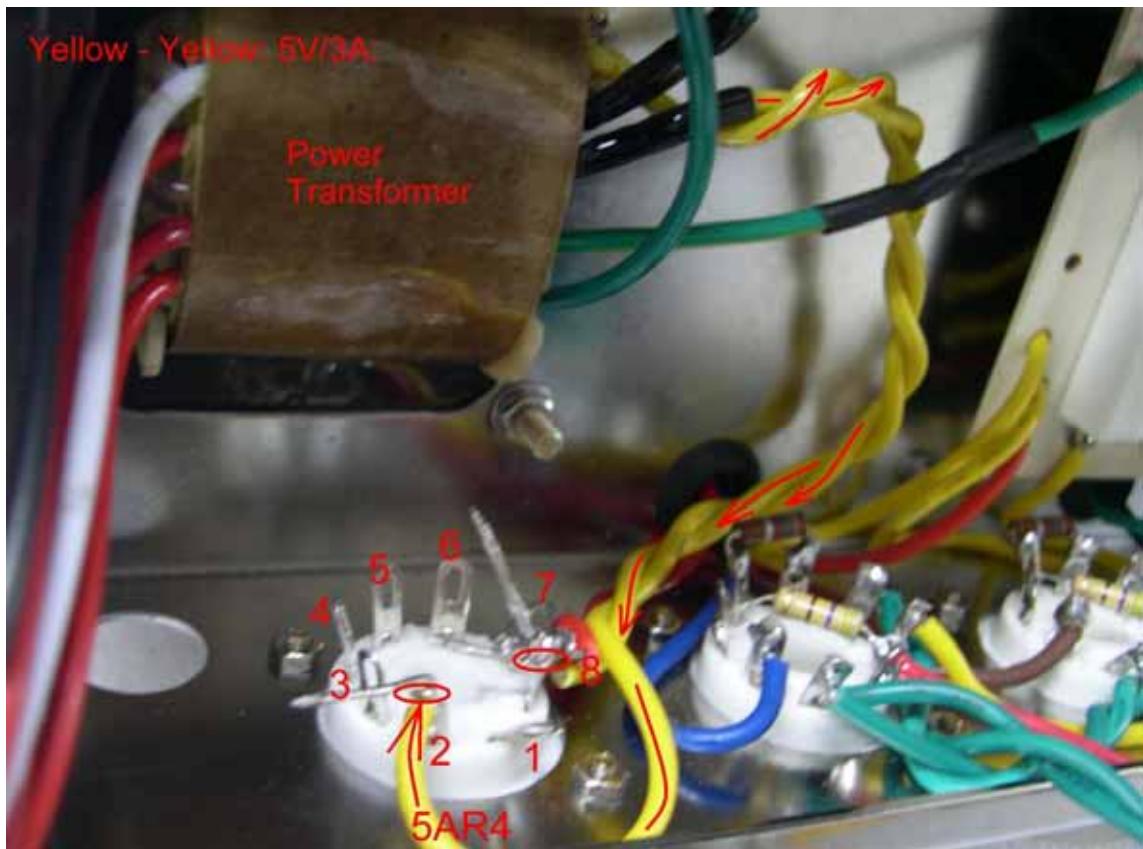




Connect the Green/Yellow wire from Power Transformer to the Green wire from the circuit board. See below:

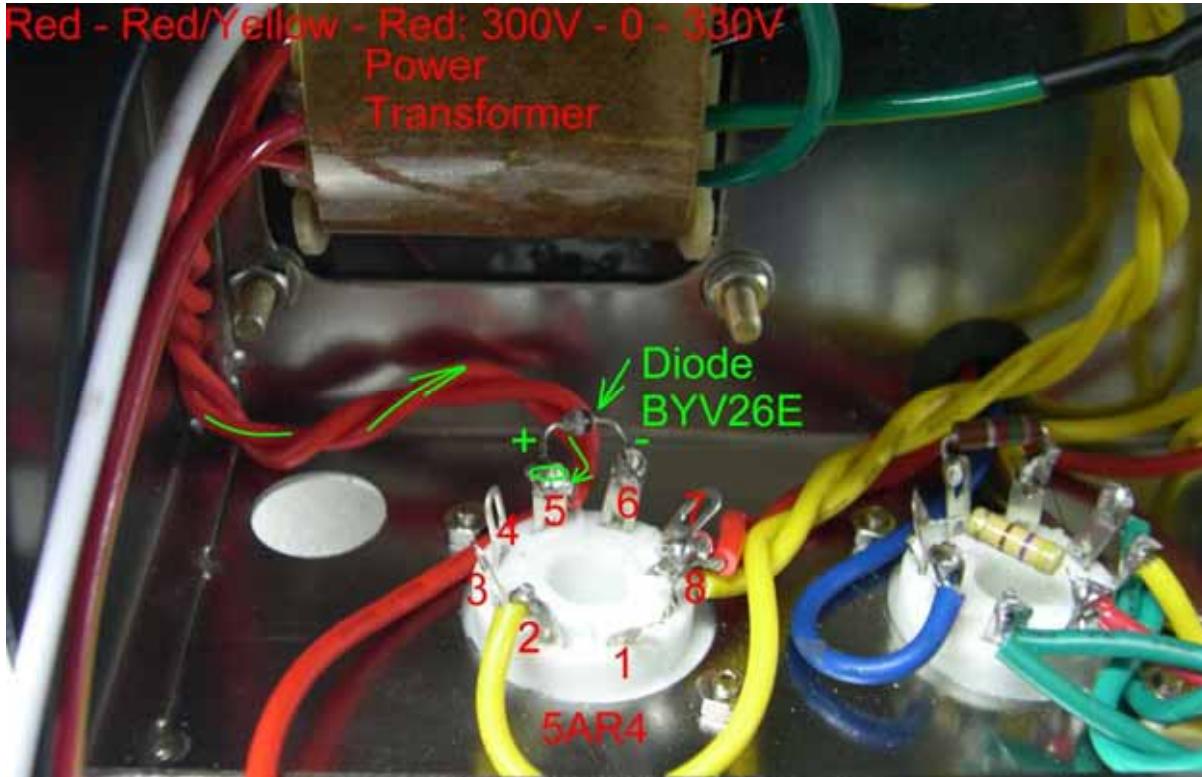


Twist the two yellow wires (5V 3A tap) from the Power Transformer and connect them to Pin 2 and Pin 8 on the rectifier tube socket. See red arrow below:

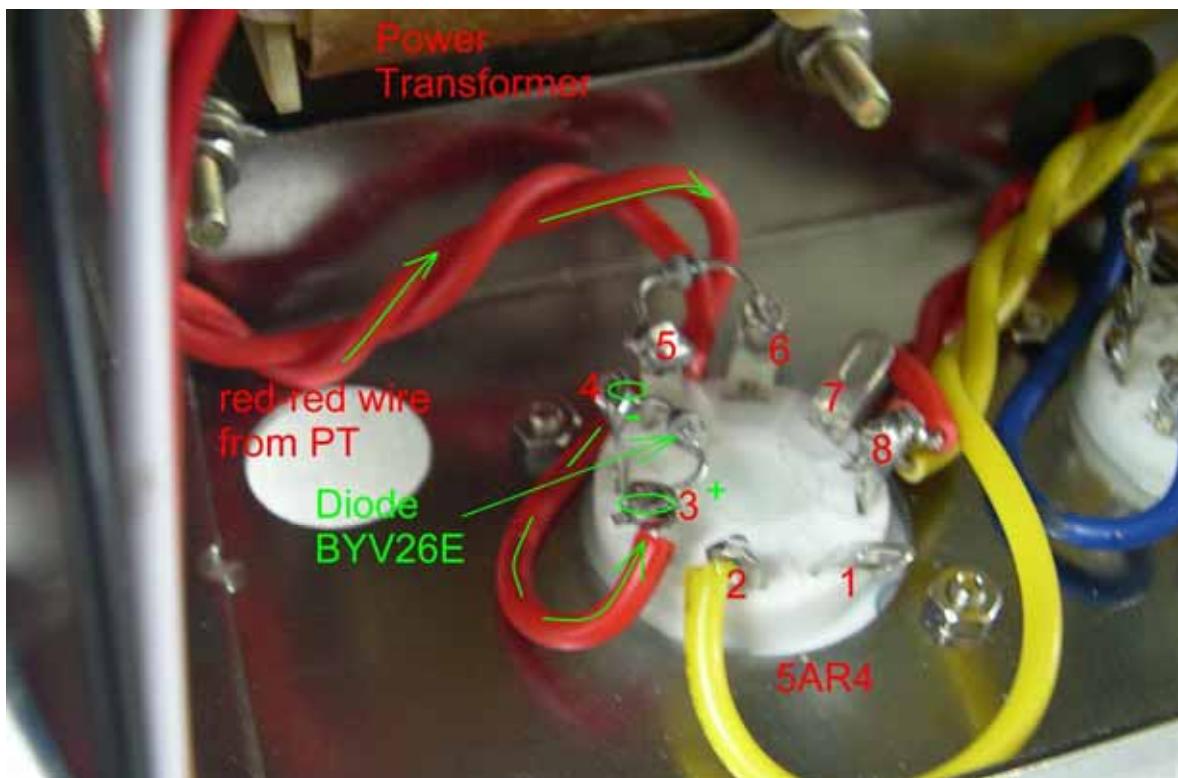


Note: The following two steps are to be followed if you wish to use a 5AR4 rectifier (included) with this amp. If you wish to use a 5Y3 rectifier, twist the two red wires from the power transformer (PT) and connect them directly to Pins 4 and 6 on the rectifier tube socket. **DO NOT use a 5AR4 without the diodes installed!**

Twist the two red wires from the PT together and run one of them to Pin 5 on the rectifier tube socket (5AR4). Solder a BYV26E diode from Pin 5 to Pin 6. The negative lead (with the black band) goes to pin 6, and the positive lead goes to Pin 5.



Connect the other red wire from the PT to Pin 3 on the rectifier tube socket. Solder a BYV26E diode from Pin 3 to Pin 4. The negative lead (with the black band) goes to pin 4, and the positive lead goes to Pin 3.

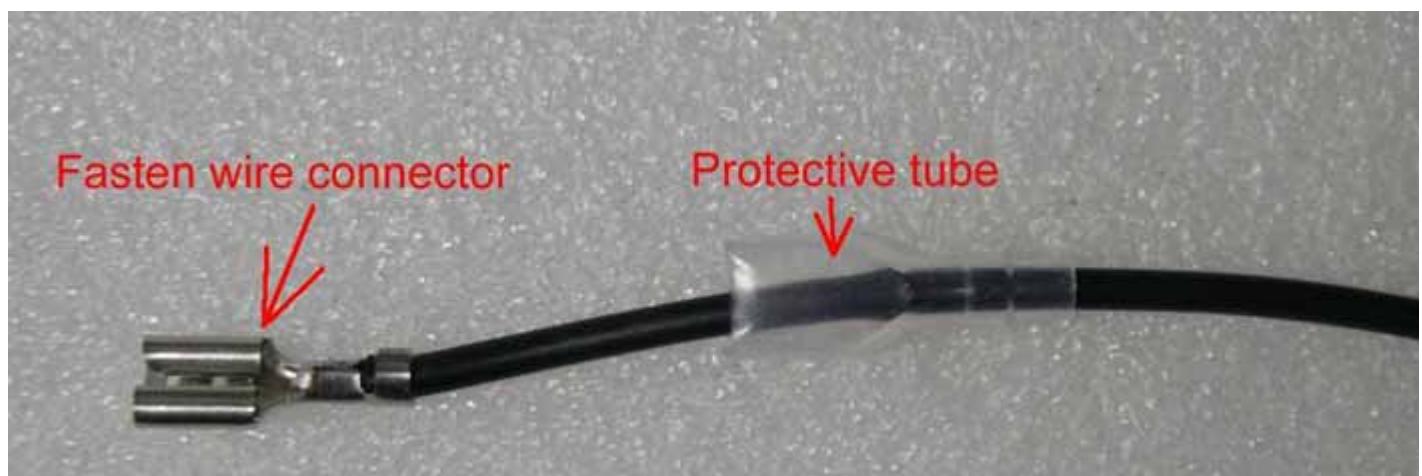


Mount the SPST (2-pin) Standby switch, fuse holder, DPST (4-pin) Power switch and the pilot light to the front panel.

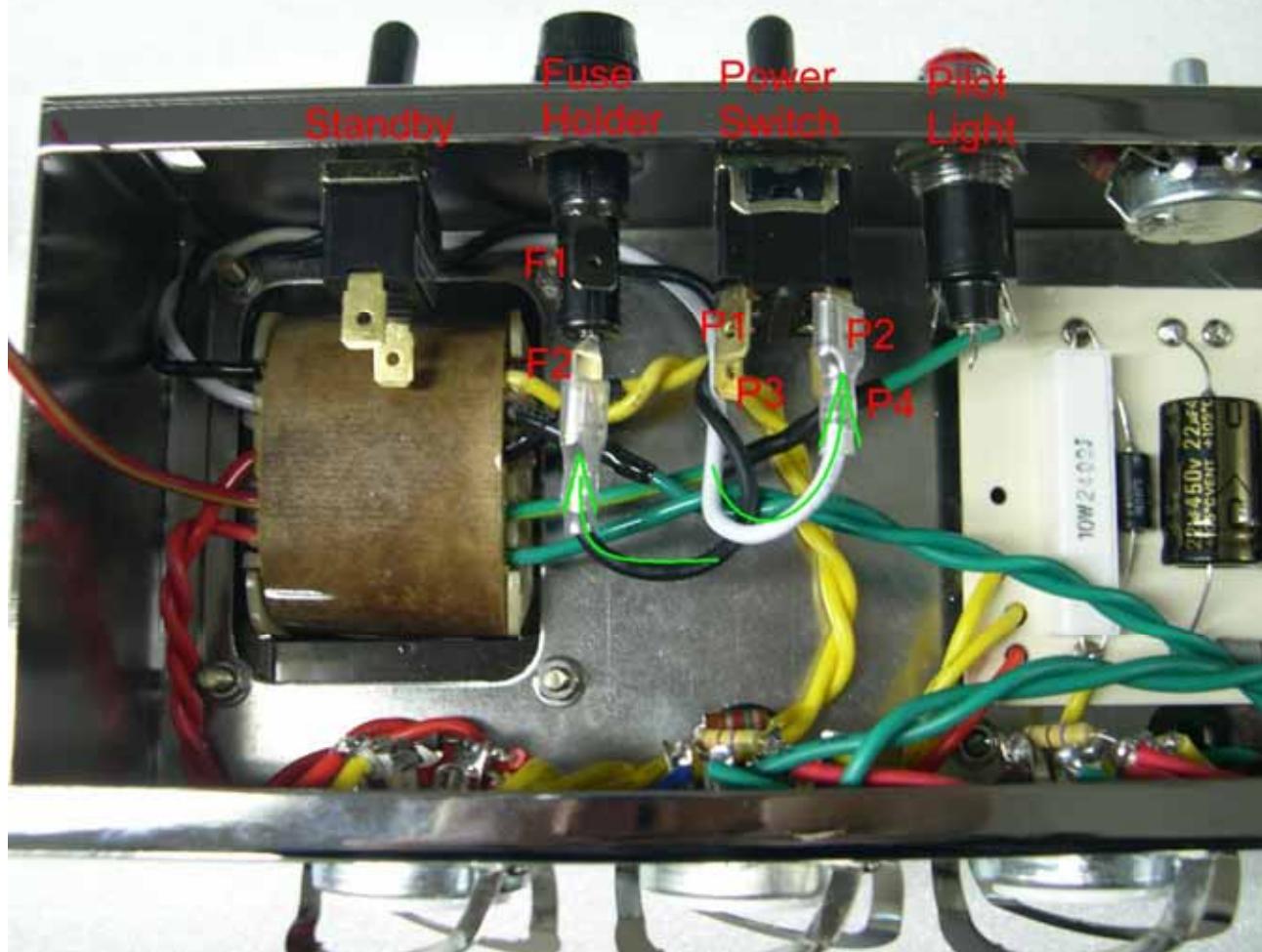
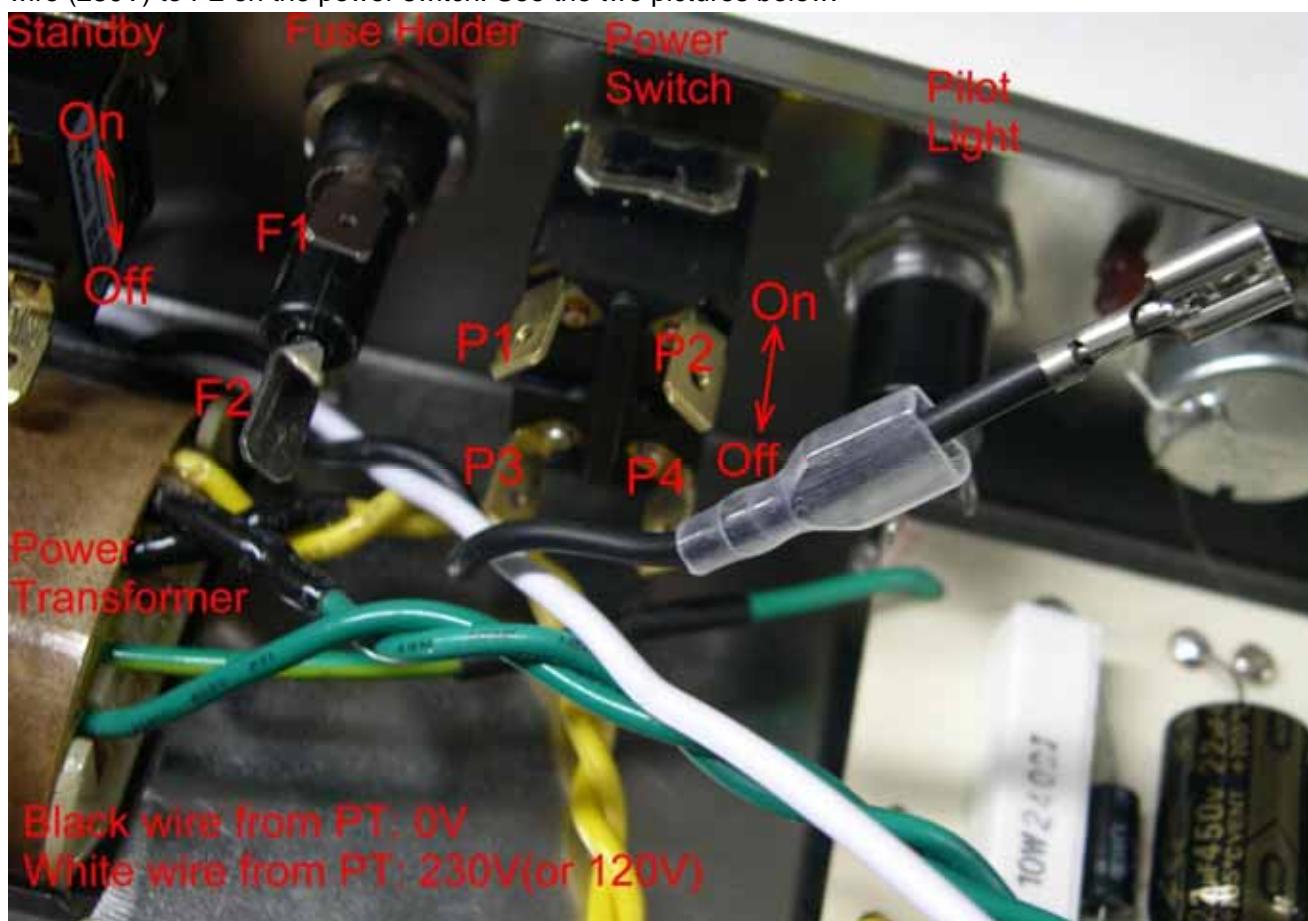


From this point on, most of our connections will be made with push-on spade connectors. To install these connectors, do the following:

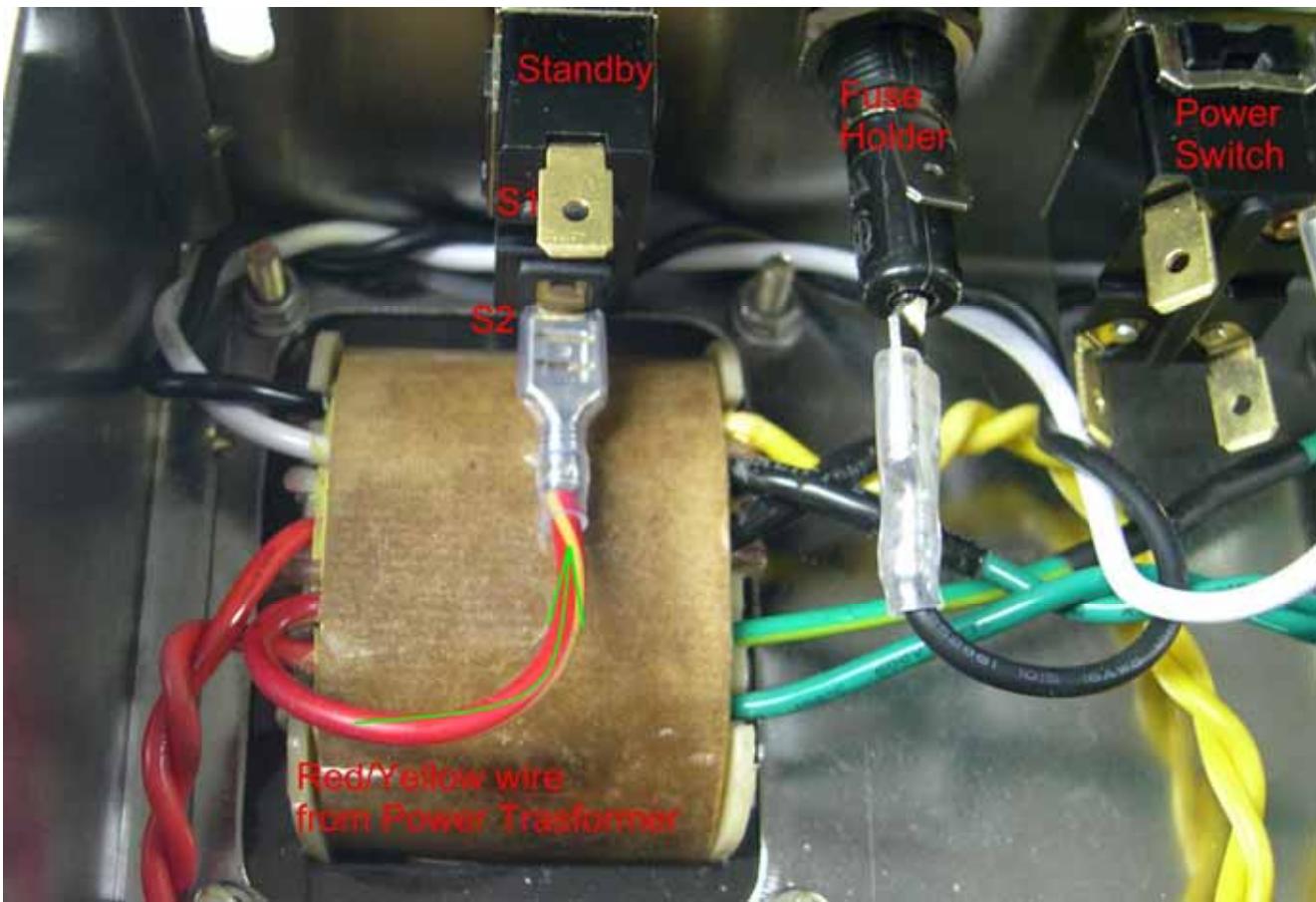
1. Strip approximately 1/8in or 3mm from the end of the wire
2. Slip the clear insulating cover over the wire
3. Using needle nose pliers, bend the two smaller tabs onto the wire, and bend the larger tabs onto the insulation. Make sure the wire is held in place firmly
4. Solder the wire where it meets the metal on the connector



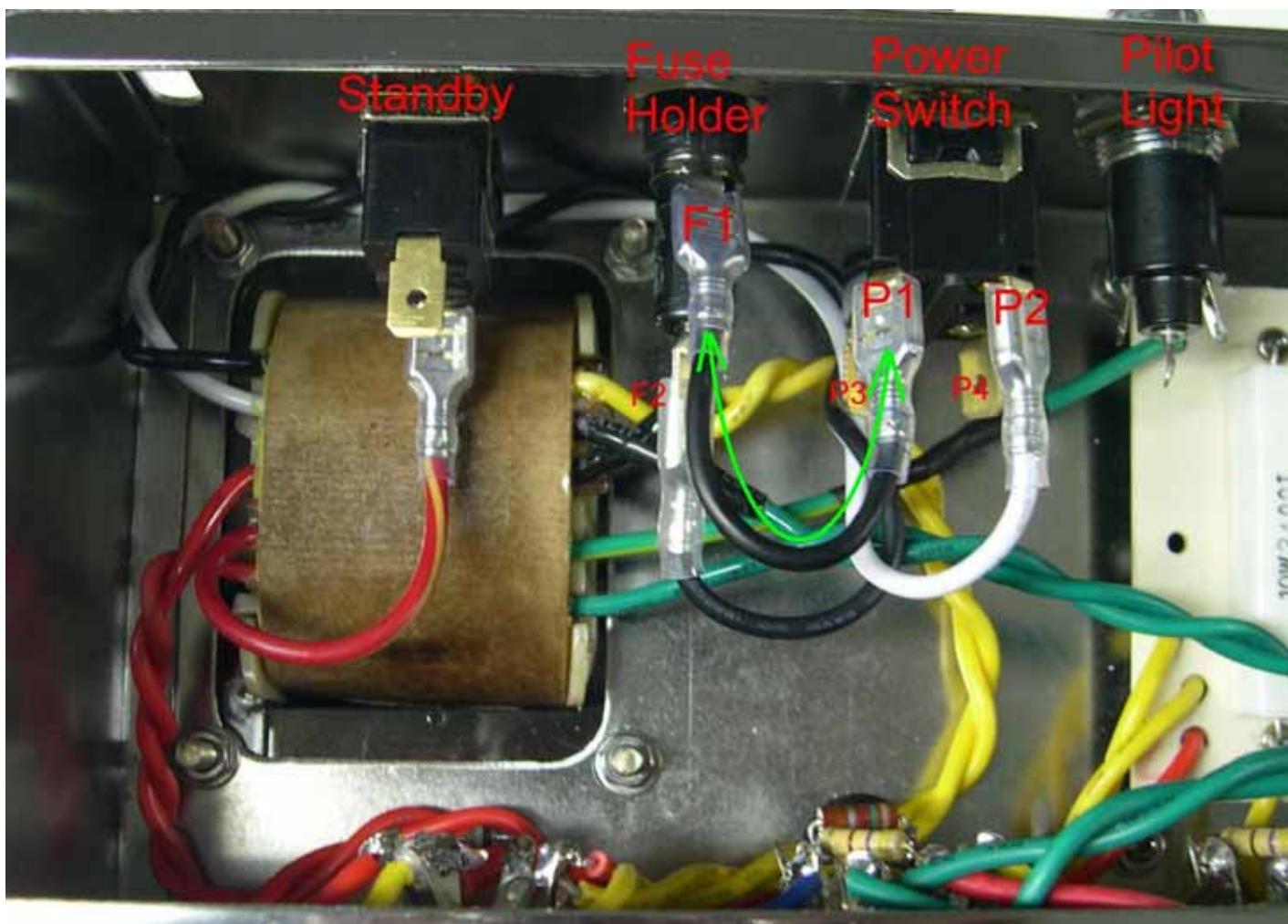
Connect the black primary wire from the Power transformer to F2 on the fuse holder. Connect the white primary wire (230V) to P2 on the power switch. See the two pictures below:



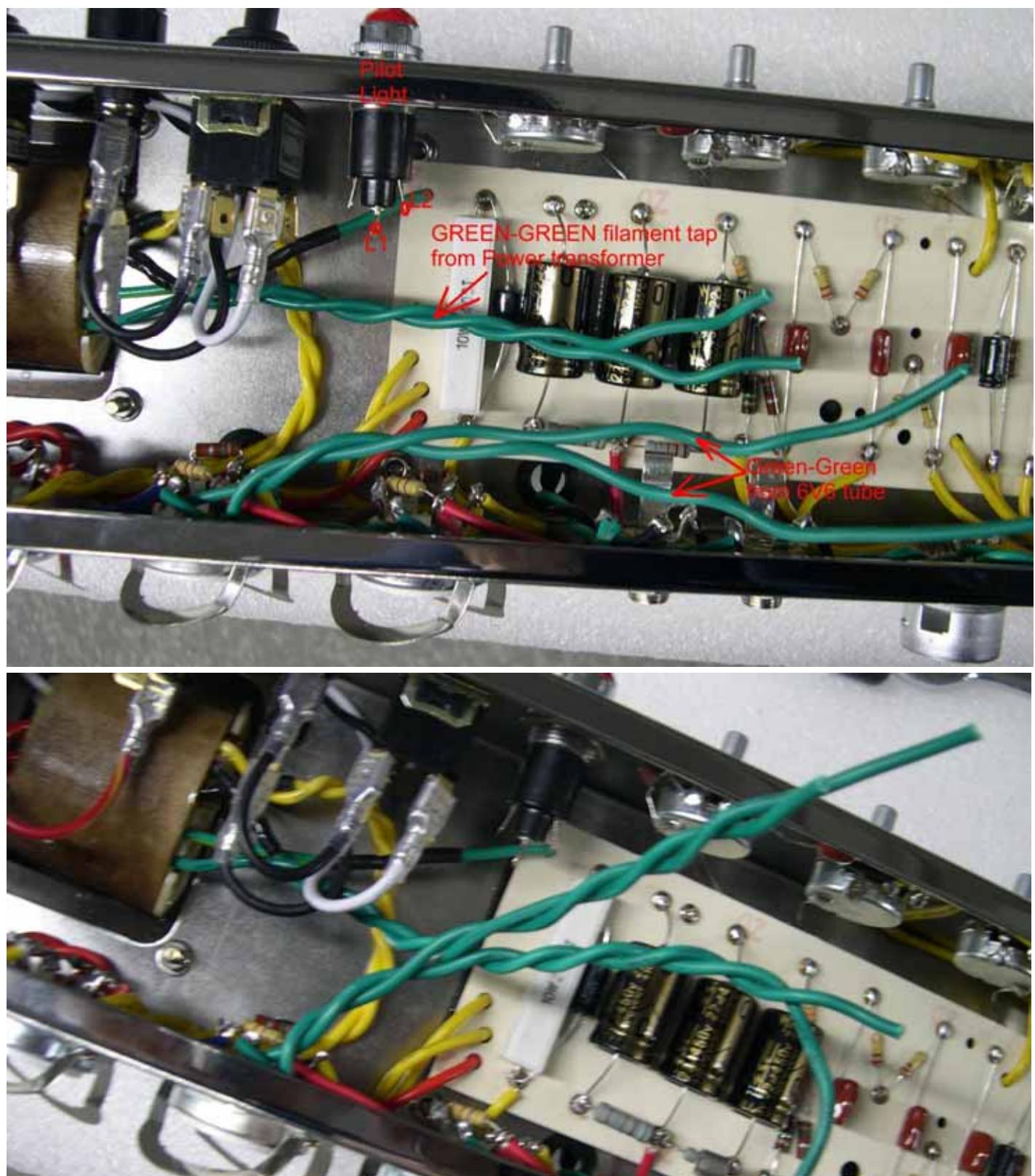
Connect the Red/Yellow wire from Power transformer to S2 on the Standby switch. See below:

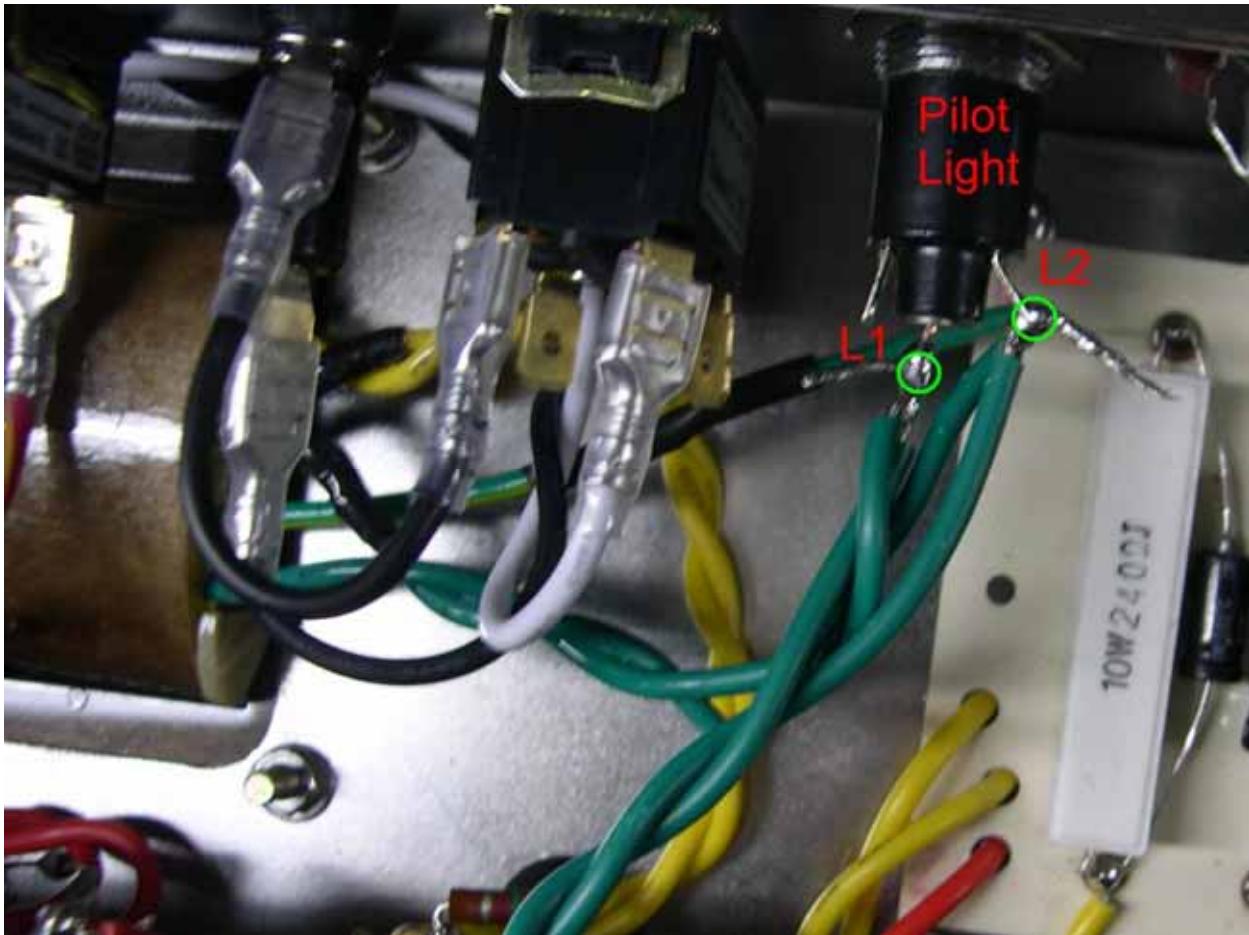


Make a short black wire and connect F1 on the fuse holder to P1 on the power switch.



Connect the two green wires from the power transformer to the two terminals on the pilot light. Connect the two green filament wires from the second 6V6 to the pilot light as well.



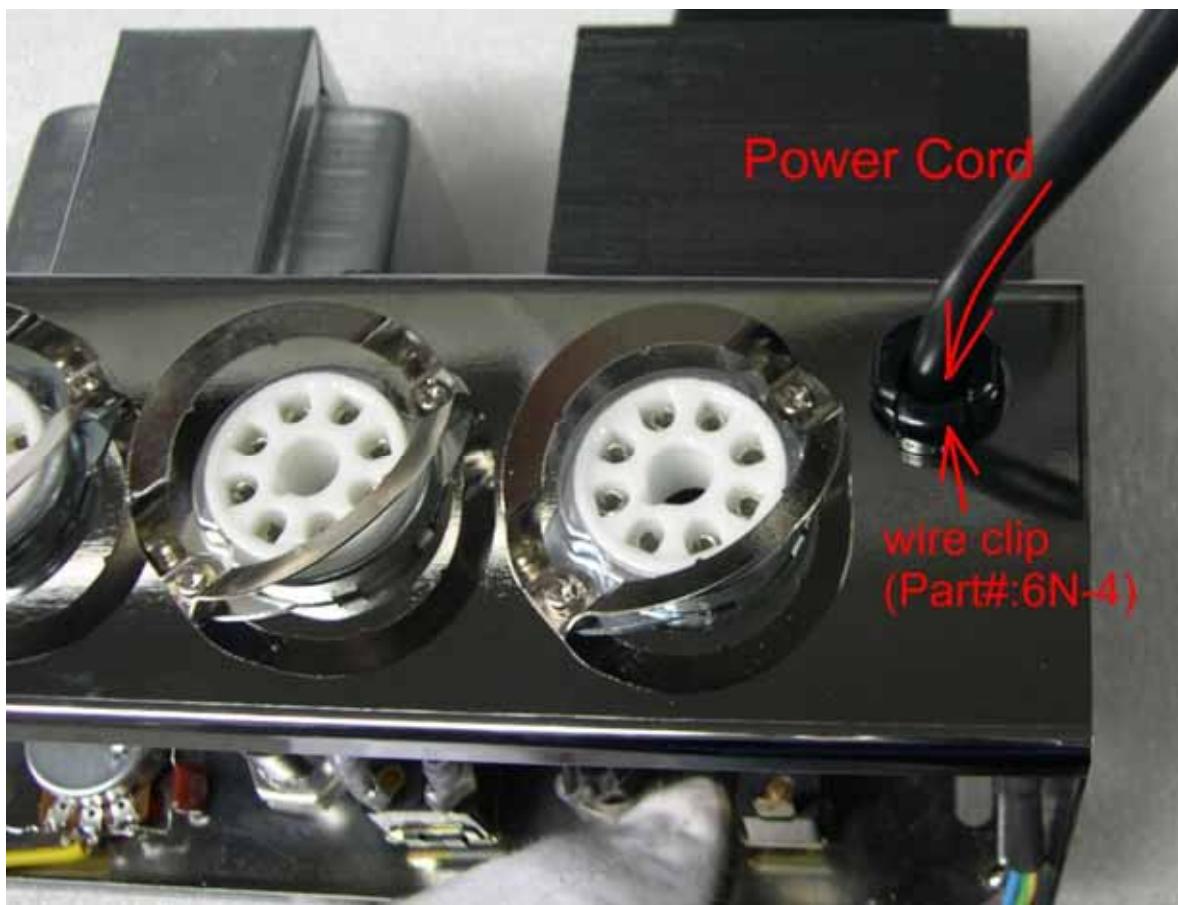


Power cord wiring

Cut the IEC connector off the end of the end of the power cord. Strip off outer insulation and install connectors as shown:



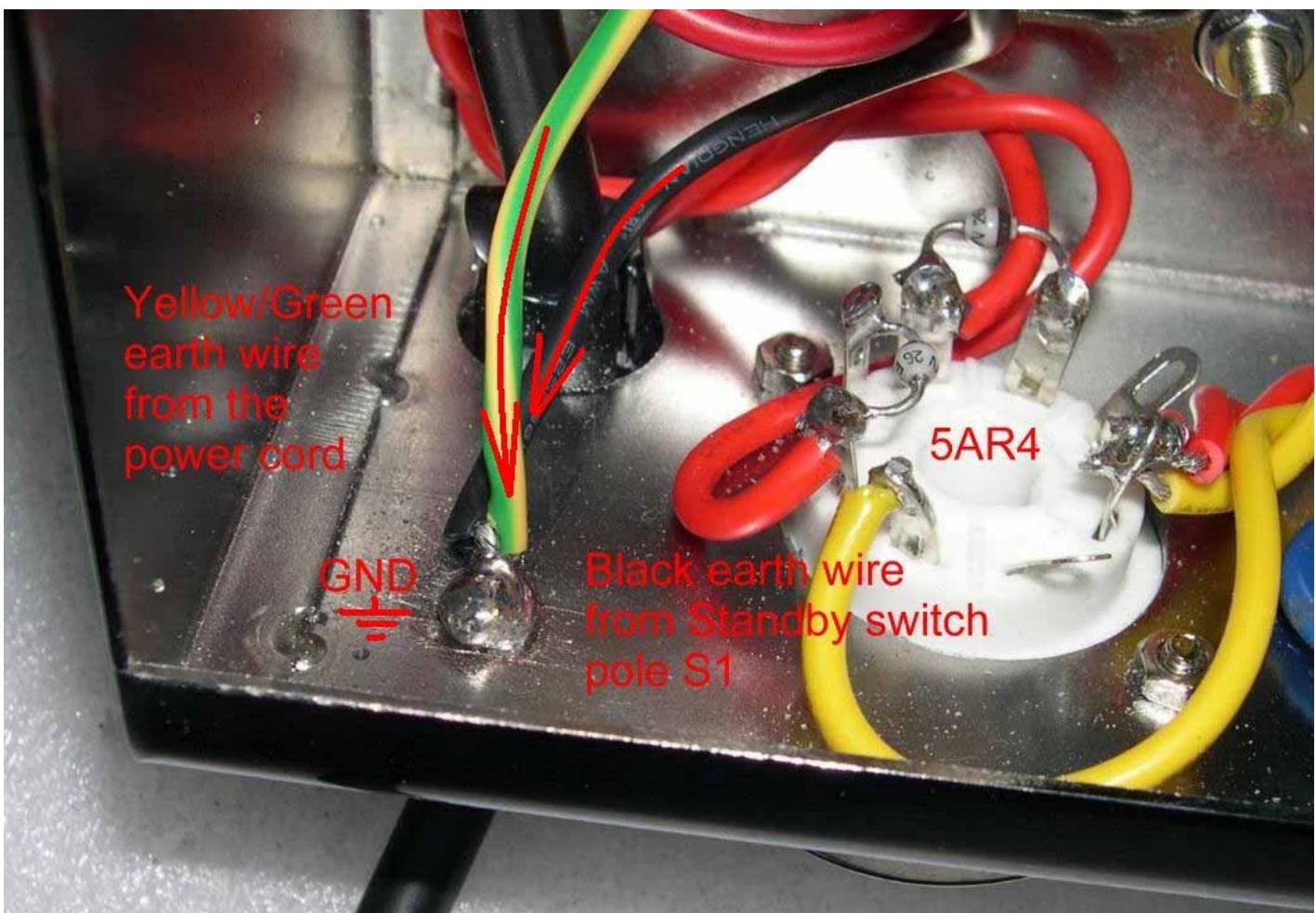
Run the power cord through the rear of the chassis and fasten in place with the plastic strain relief clip. Make sure there is enough wire inside to reach the power switch. You may need to use a pair of pliers to squeeze the clip together to get it through the hole.

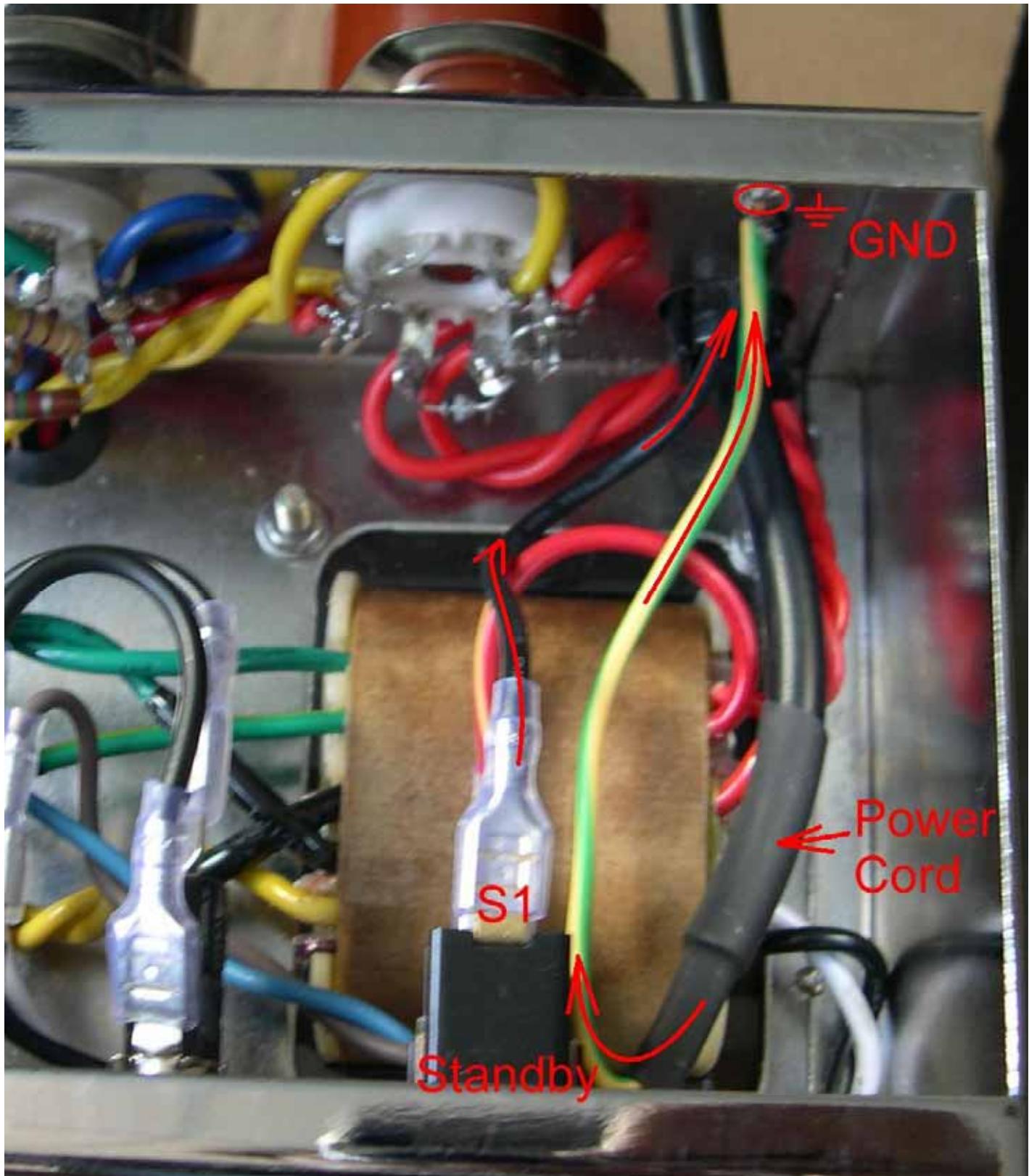


Connect the brown wire to P3 and the blue wire to P4 on the power switch.

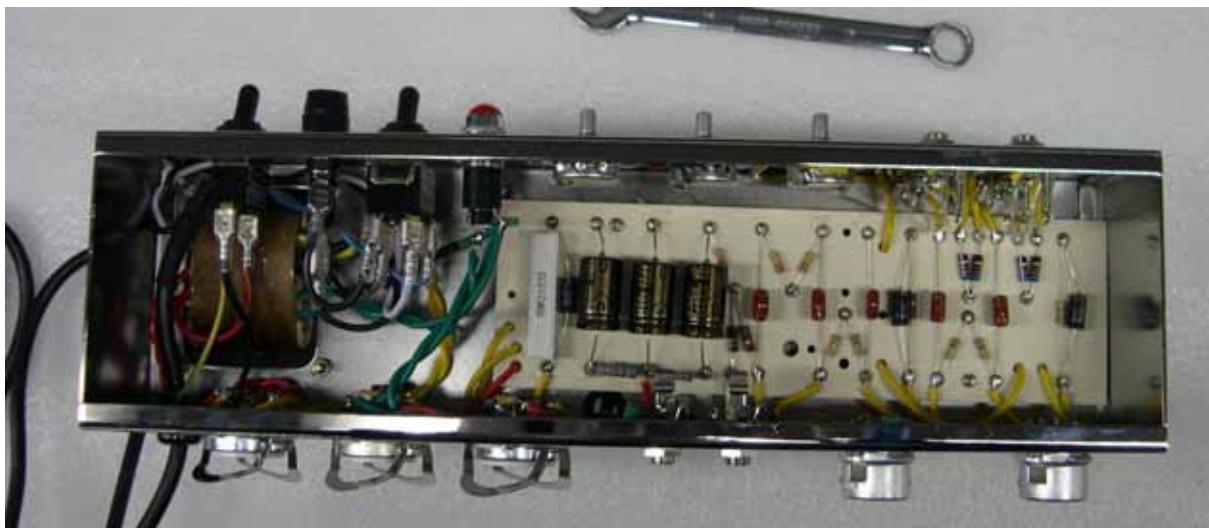


Make a short black wire and connect S1 on the Standby switch to the chassis ground. Connect the Yellow/Green wire from the Power Cord to the same chassis ground point.





Congratulations! You have just finished wiring the chassis. Compare your work to the pictures below and double-check all of your wiring. Pat yourself on the back, have a cup of tea (or the beverage of your choice), and take a break. We'll have your new amp up and jamming in no time.



Initial testing:

Install the knobs and fuse, but **don't install the tubes at this time**. Put the standby switch in standby mode, the power switch off, and both volume knobs all the way down.

Now, with the amp sitting on your workbench wiring side up, plug in the power cord and turn the power switch on. The pilot light should turn on at this point. If it doesn't, turn the amp off, unplug it, and check your wiring again. Check to see if the fuse is blown. If it is, there is a short somewhere in your wiring, or the AC line to the power switch is miswired. Don't proceed to the next step until the problem is fixed.

Set your multimeter to the 20V AC range (or any AC range that will read voltages below 10V) and test the filament wires to each tube socket. Check to see that there is 6.3VAC between pins 2 and 7 on each 6V6/6P6 socket, and between pins 4/5 and 9 on each preamp socket. Check to see that there is 5VAC between pins 2 and 8 of the 5AR4 power tube socket.

Note: Without the tubes installed, these voltages will run high. It is not unusual to see 6.8VAC on the 6.3v lines and 5.6VAC on the 5V line.

If these voltages are half or double what they should be, you may have the wrong power transformer for your AC line current. Contact the seller for the correct transformer. Do not proceed until you have the correct voltages.

From now on, we will be working with high voltages. Observe the following cautions:

- ✓ Connect the negative (black) lead of your multimeter to the grounded chassis, and measure all voltages in reference to ground with the red lead.
- ✓ Follow the “one hand” rule when testing. Only one hand should be in the chassis at a time. Keep your other hand in your pocket.
- ✓ Wear a heavy long sleeve shirt or jacket without any metal buttons on the sleeves.
- ✓ When you power off the amp to do work, unplug the amp from the wall and discharge the big capacitors (22uf 450v) first. Use a pair of pliers to hold a 10K (or thereabouts) resistor between the positive side of the middle capacitor (where the red wire connects) and the chassis ground for about 5 seconds. Use your multimeter to see that the voltages on the positive ends of each capacitor have dropped to a safe level.

With the negative (black) lead of your multimeter attached to the chassis ground, flip the standby switch to turn on the high voltage supply. Set your multimeter to the 500V AC range or higher, and check the voltage at Pin 3 of the rectifier tube socket, and then at Pin 5. Both voltages should be around 355VAC. If you are using a 5Y3 rectifier without the diodes, do this test at pins 4 and 6 instead. There is no need to discharge the capacitors at this point without the rectifier tube in place.

Turn the power off and install the rectifier tube. Make sure the key on the middle of the base of the tube matches up with the notch in the socket. You may need a helper to push down the “wings” of the tube retainer while you carefully press the tube firmly into place.

With the standby switch in standby mode, turn the main power switch on. The rectifier tube should glow. Give it a couple of minutes to warm up and flip the standby switch to turn on the high voltage.

First, let's measure the positive side of each big capacitor. Set your meter to the 500V DC range or higher. You should get high voltage (400+ volts) at the positive end of each capacitor. Each voltage will be different.

Now, measure the voltage at each pin of the 6V6/6P6 tube sockets. You should get high voltage (400+ VDC) at pins 1, 3, and 4 and 0VDC on pins 2, 5, 6, 7, and 8. Remember pins 2 and 7 carry 6.3VAC, but there should be no DC on those pins. On the preamp tubes, you should get high voltage on pins 1 and 5, and 0v on the rest of the pins.

If you get high voltage on pins that should be 0V, check your soldering for solder bridges on the tube sockets.

Final test:

Discharge the capacitors and Install the rest of the tubes. Remember to line up the key on the output tubes to the notch in the tube socket. On the preamp tubes, there is a gap between pin 1 and pin 9 that needs to be lined up between the tube and the socket. Leave the tube shields off for now. Connect an 8 ohm speaker to the jack closest to the output tubes.

Start with the standby switch in standby mode. Turn on the main power and observe the tubes. They should begin to glow. After the tubes warm up for a few minutes, flip the standby switch. With no instrument plugged in, there should be almost no noise coming from the speaker. Turn the tone all the way up, and then turn each volume control up and down and observe the noise level. No amp is 100% quiet, but if you did things right, you should hear almost no noise or hum even with all three knobs turned all the way up.

Install tube shields on the preamp tubes, turn the volumes all the way down, and plug your guitar into one of the input jacks. Turn the corresponding volume knob up and start playing. Test all four input jacks. Try each one out at different volumes, and make sure the tone knob does what it should do.

Troubleshooting:

If you get no sound at all, there are still a few things to try. Concentrate on the output tubes and the output transformer wiring. Make sure that the green and black wires are connected to the tip and ground tabs on the output jacks respectively (Page 17). Go back to the output tube wiring on page 18 and check that you did everything right.

Chopstick Test:

It is a fact that most American amp technicians eat Chinese food with a fork, but ask for chopsticks anyway. A plain wood chopstick is a very useful diagnostic tool. Sure, you can use any non conductive stick like a pen, pencil, or a wand from Hogwarts, but where's the fun in that?

Put the amp chassis on your workbench wiring side up with a speaker connected. Turn it on and wait for the tubes warm up. Turn the tone control all the way up, and both volumes at about $\frac{1}{2}$ up (if you get a loud hum already, you can turn the volume down so the noise doesn't drive you crazy). Hold the chopstick vertical and tap the end on each component and soldering joint. You may hear a very soft click from the speaker, which is normal. When you hear a loud click, buzz, or hum, you've just found a bad component or solder joint!

This method works well for finding bad components on an older amp too.

To standby or not to standby:

In a cathode biased amp with a tube rectifier like the 5E3, it is not necessary to wait for the tubes to warm up before taking it off standby. In fact, you can just leave it off standby unless you need to take a break from playing, so the tubes are warm and ready to play immediately. However, if you are going to leave the amp for longer than $\frac{1}{2}$ an hour, you should shut it off. Leaving tubes hot for hours without high voltage will reduce their lifespan.

5E3 Schematic

