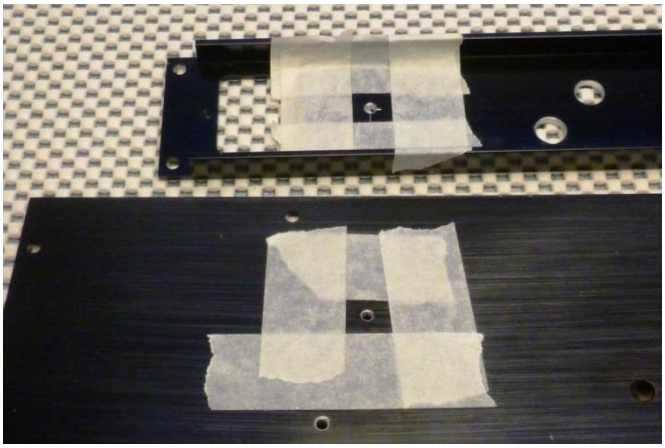
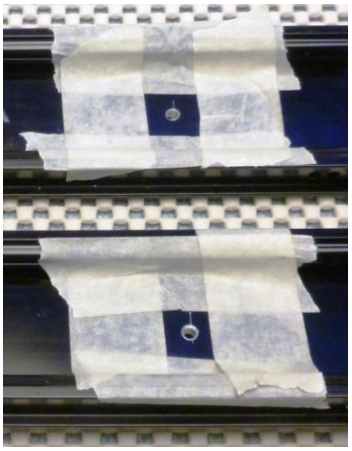
Chassis Pre-assembly, Transformer Wiring & Preliminary Testing:

Chassis Pre-assembly:

The chassis I bought for this project was a little low with an inside height of 48mm. This required shorter spacers (¼") so that the power supply capacitors will clear the top. These spacers (quantity: 5) are included on the Mouser parts list. Do not order the ¼" spacers if you are using a higher case (52mm or higher). The stock spacers supplied with the 12Vac kit are 3/8" long.

1. On the inside of the chassis **back**, **sides** and **bottom** panels mask off squares about 12 x 12mm as shown below.



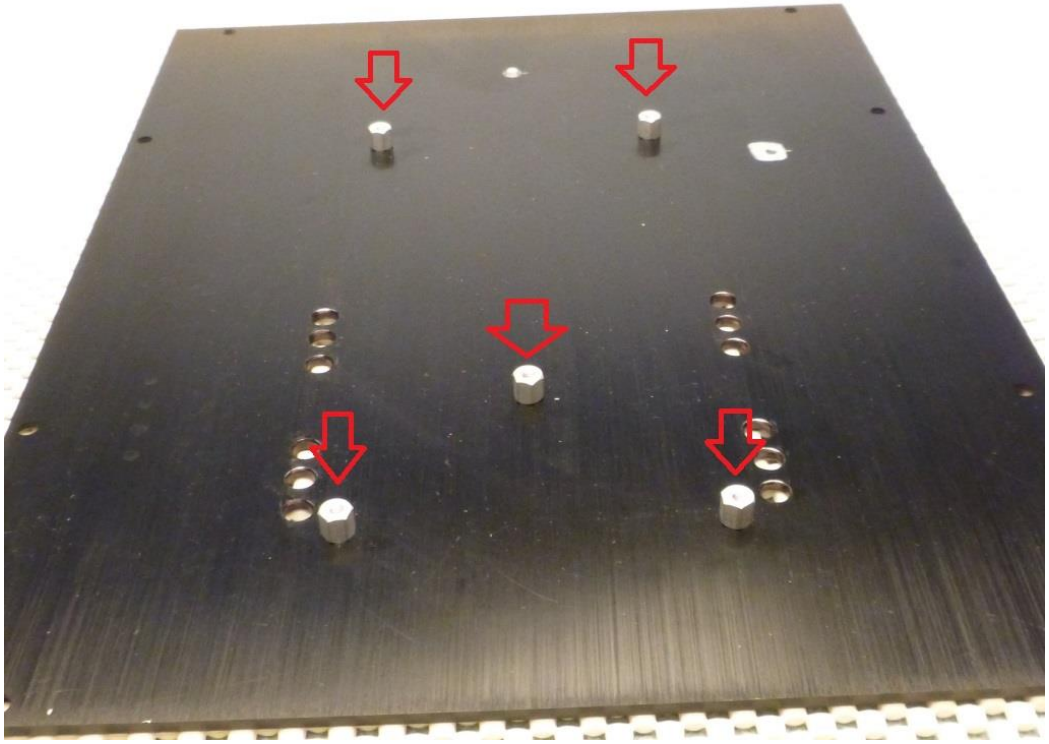


2. Using the corner of a palm sander with about 220 grit paper, sand through the anodizing (anodizing is an insulator) until you see bare aluminum in the masked areas.

3. Remove the tape and clean the bare areas with solvent.

4. Put a small drop of nail polish on the threads of each of the five <u>short</u> 4-40 screws <u>supplied with the Aikido kit</u>.

5. Attach the five board spacers with the screws to the **bottom** panel, in the position where the circuit board will go, just finger tight as shown below.



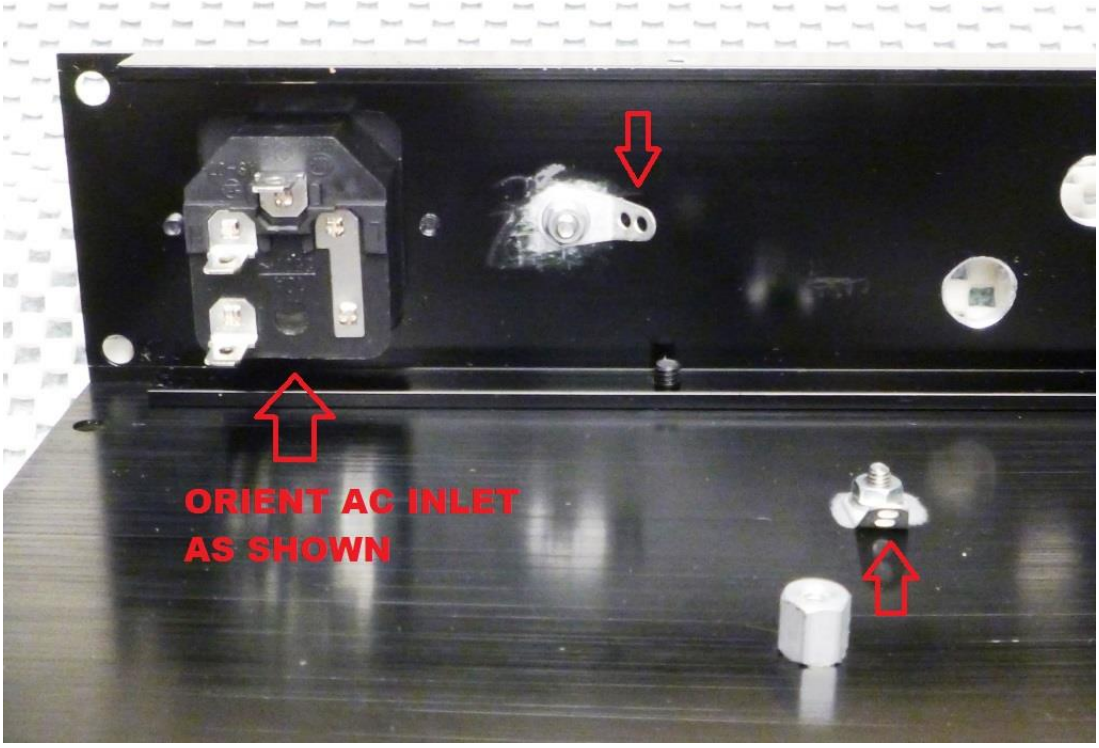
6. Place the board over the spacers and start the five <u>long</u> 4-40 screws <u>supplied with the Aikido kit</u>. See picture below. You may need to temporarily loosen a few of the screws holding the spacers to the chassis to get all of the five holes in the board to line up. If you are using ¼" spacers the long screws going through the board into the spacers will bottom out before the board is tight. Back them off slightly to allow the screws on the bottom to be tightened. When the board is permanently attached later the O-rings included with the kit will be placed above and below the board on the screws. These will allow the board to be retained securely.

7. When all of the screws retaining the board to the spacers line up Tighten the 5 bottom screws securely.

8. Remove the screws securing the board to the spacers and set the board aside.

9. Flip the chassis over and clean the bottom near the corners with solvent. Apply the self-adhesive feet supplied with the chassis.

10. Assemble a grounding lug (Mouser part no. 534-7311) to the bare spot on the **bottom** panel of the chassis as shown below and secure with a 4-40 or M3 screw, flat washer and nut. Lock in place with a drop of nail polish across the thread of the screw and the nut.



11. Assemble another grounding lug (Mouser part no. 534-7311) to the chassis **rear** panel.

12. Apply nail polish to the screws used to secure the AC inlet.

13. Assemble the AC inlet to the **rear** panel in the orientation shown above.

14. Assemble the **rear** panel of the case to the **bottom** as shown above securing with screws that have had a drop of nail polish applied to their threads before assembly.

Transformer Assembly and Wiring:

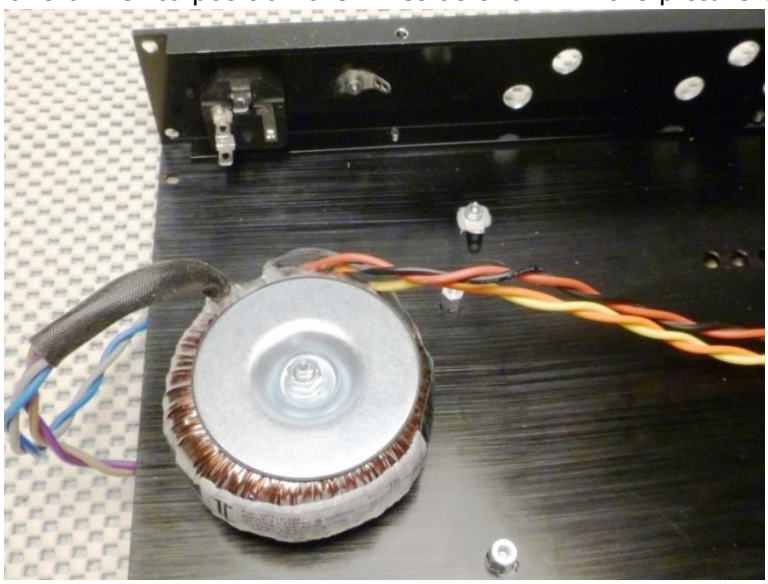
IMPORTANT: As mentioned in the parts list, if you use another transformer its secondary should not be rated for more than nominally <u>12 volts</u> AC. Using a transformer rated for more than this could exceed the voltage rating of some of the filter capacitors.

1. Place the transformer retaining bolt (mounting hardware is included with transformer) up through the **bottom** panel.

2. Place one of the rubber washers over the bolt.

3. Place the transformer over the bolt and centre it.

4. Rotate the transformer to position the wires as shown in the picture below.



5. Place a rubber washer over the bolt.

6. Place the clamping disk, a flat washer and a lock washer over the bolt.

7. Thread the nut over the bolt and tighten securely.

8. Place a drop of nail polish over the nut and protruding thread of the bolt to lock in place.

Note: Twisting pairs of wires as described below is to reduce radiation of AC fields.

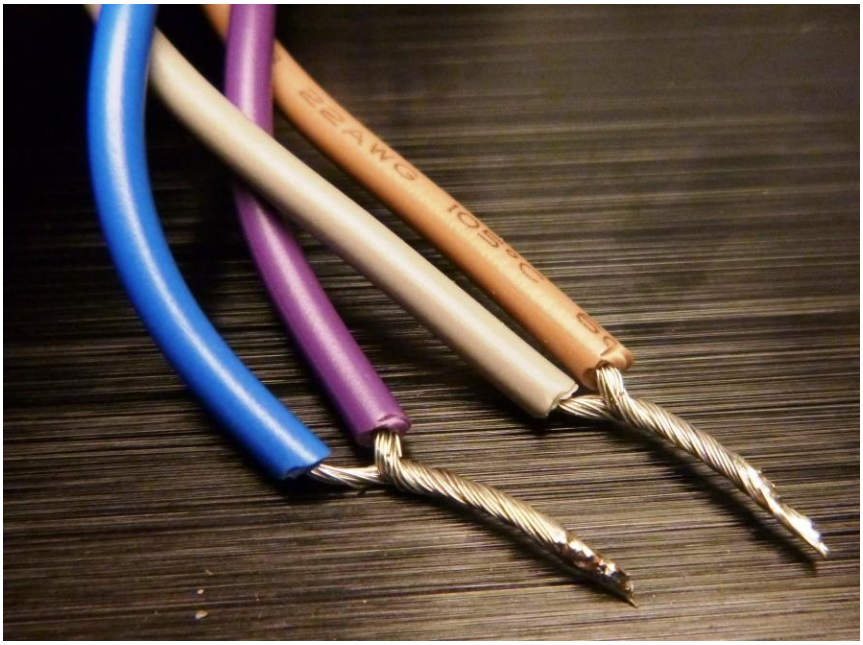
9. The wires coming from the black tube on the transformer are the primary leads.

10. Twist the blue and grey wires together.

11. Twist the violet and brown wires together.

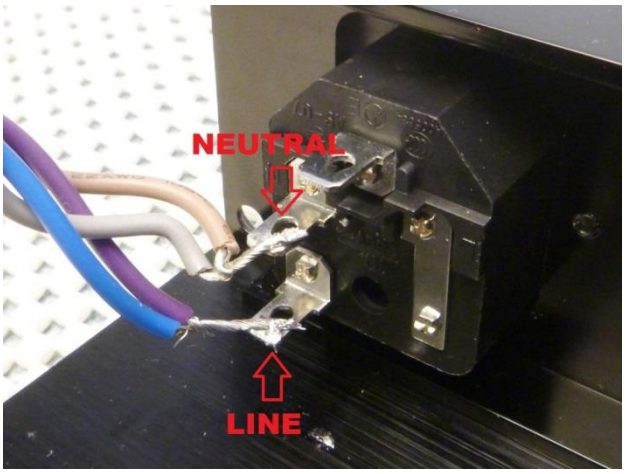
12. Cut the two pairs of primary wires to about 160mm long (including the black tube) measuring from where they emerge from the transformer.

13. Separate about 20mm of the blue and violet wires out of the two twisted pairs of secondary wires. Strip off 10mm of insulation and twist the bare ends together. Melt a little solder on them to fuse the tips of the wires together. See picture below.



14. Strip 10mm of insulation from the grey and brown wires and twist the bare ends together. Melt a little solder on them to fuse the tips of the wires together. See picture above.

15. Tack one of the pairs of primary wires to the line (L) terminal **not** putting the wires through the hole in the terminal of the AC inlet. See picture below. This is just a temporary connection for initial voltage testing. These wires will be removed after testing.



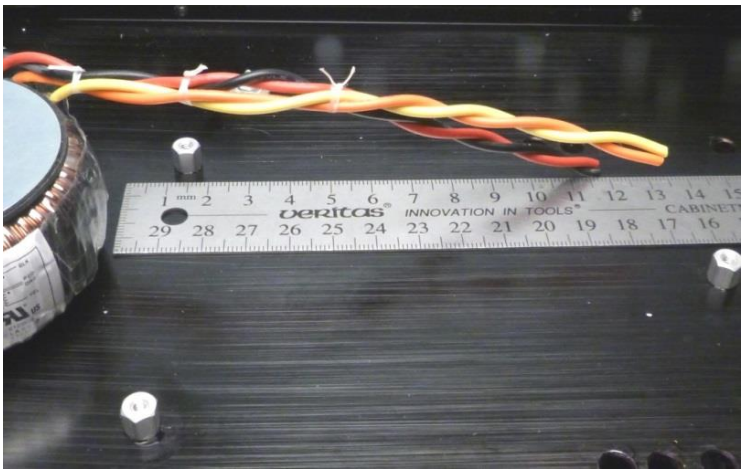
16. Tack the remaining pair of primary wires to the neutral (N) terminal on the AC inlet as shown in the picture above. These wires will be removed after testing.

17. Twist the yellow and orange secondary wires together.

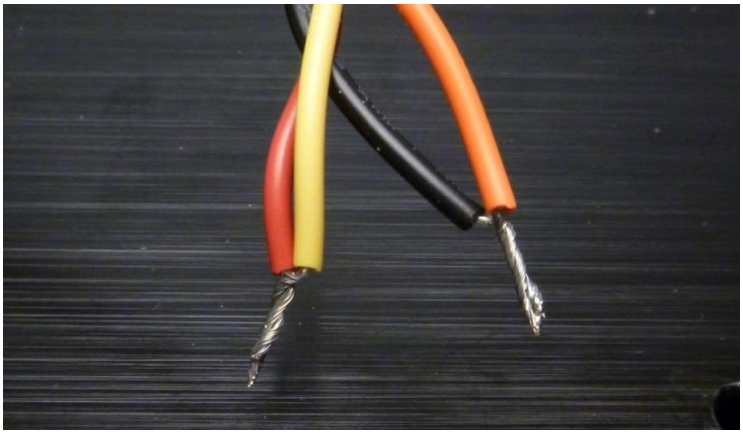
18. Twist the black and red secondary wires together.

19. Route the two pairs together towards the circuit board and put a zip tie or tie with waxed dental tape near the transformer and 2 or 3 more places along the wire length.

20. Cut both pairs of secondary wires about 120mm from the right side edge of the transformer as shown below.



21. Separate about 20mm of the black and orange wires out of the two twisted pairs of secondary wires. Strip off 10mm of insulation and twist the bare ends together. Melt a <u>very</u> little bit of solder on them to fuse together. See picture below.



22. Strip 10mm of insulation off the red and yellow wires and twist the bare ends together. Melt a <u>very</u> little bit of solder on them to fuse together. See picture above.

23. Insert one of the pairs of secondary wires through one of the **Vac** holes on the circuit board as shown below. Solder and trim the leads.

24. Insert the other pair of secondary wires through the other **Vac** hole on the circuit board as shown below. Solder and trim the leads.

25. Dress the twisted pairs with another zip tie or dental tape close to the circuit board.

26. Temporarily secure the circuit board to the five spacers with 4-40 screws.

27. Insert tubes into the four tube sockets. Support the board while inserting tubes. See picture below.

28. Insert a ½ amp slow-blow fuse (Mouser part no. 693-0034.3114) into the fuse drawer of the AC inlet and push into the inlet.

Voltage Testing:

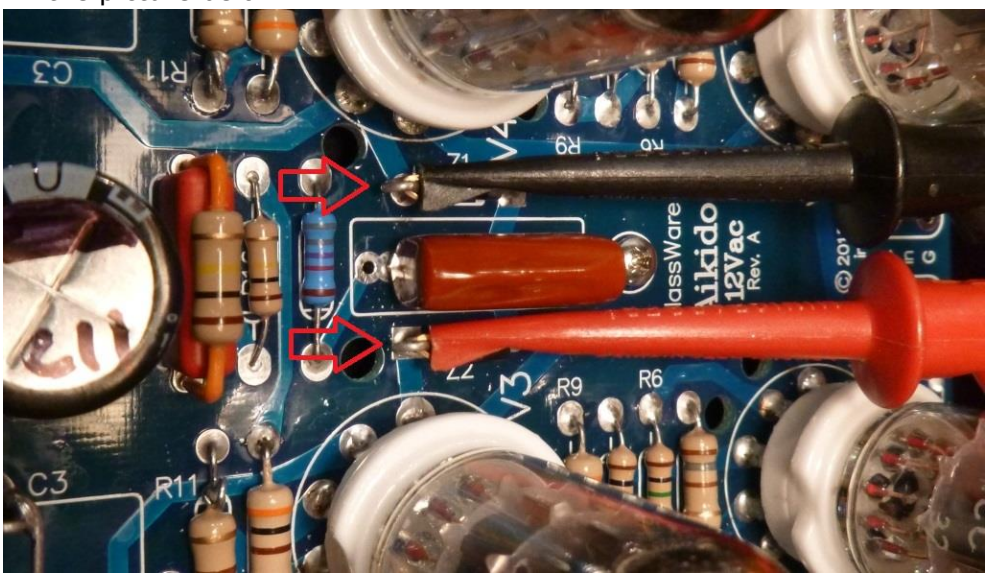
In this section the filament and B+ voltage will be checked to ensure that the values for resistors R12 and R15 are correct. The filament voltage must **<u>not</u>** exceed 6.3 volts on each tube or tube life will be severely shortened. As the filaments of all four tubes are connected in series the total filament supply must not exceed 25.2 volts (4 x 6.3). To be on the safe side I've set an upper limit of 24.5 volts for the filament supply.

There are a few R12 and R15 resistors supplied with the Aikido kit but they might not be optimal. My parts list specifies the R12 and R15 resistors needed for a maximum line voltage of 125 volts AC **with the transformer specified in my parts list. If you use a different transformer than the one specified in the parts list you will likely need to use different resistor values for R12 and R15.**

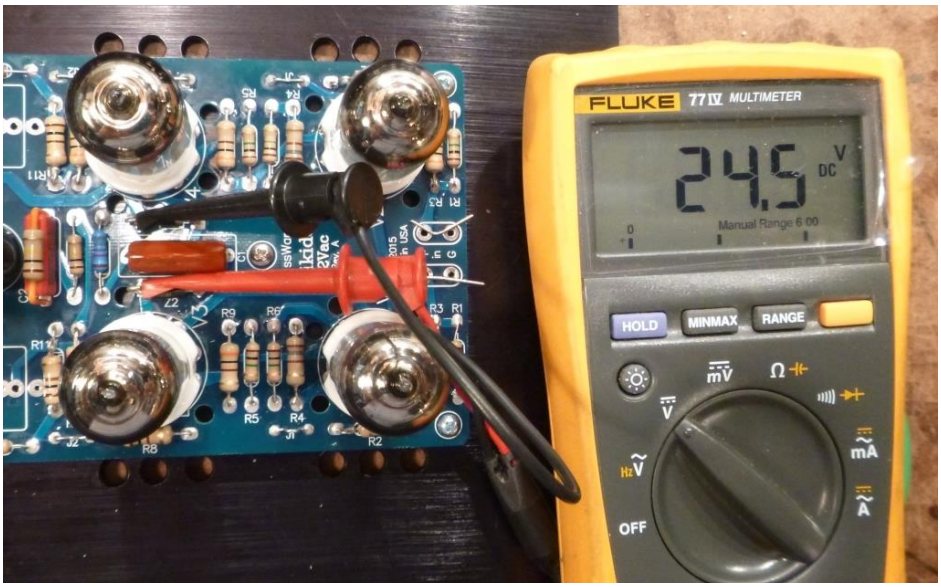
1. Plug an AC cord into the AC inlet.

2. **Be careful as the chassis is not grounded at this stage of assembly.**

3. Set your multimeter to measure DC volts and connect it to the loops on Z1 and Z2 as shown in the picture below.



4. Plug the AC cord into an outlet and observe the multimeter. The voltage should settle down to between 22.5 and 24.5 volts after about a minute.

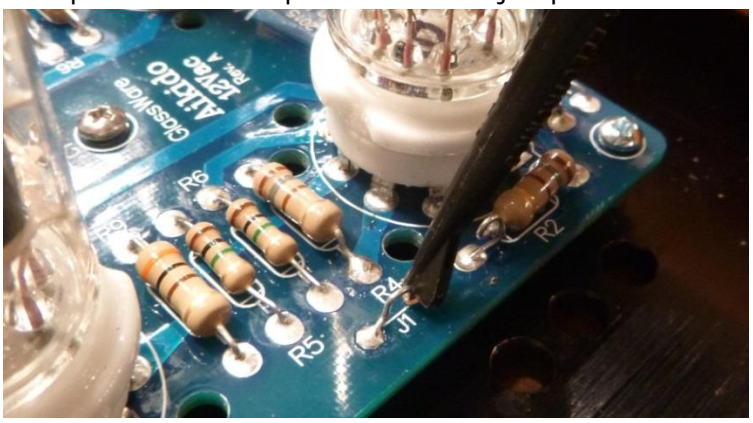


5. If it does not resistor R15 will need to be changed. Use a lower resistance if the voltage is too low, use a higher resistance if the voltage is too high.

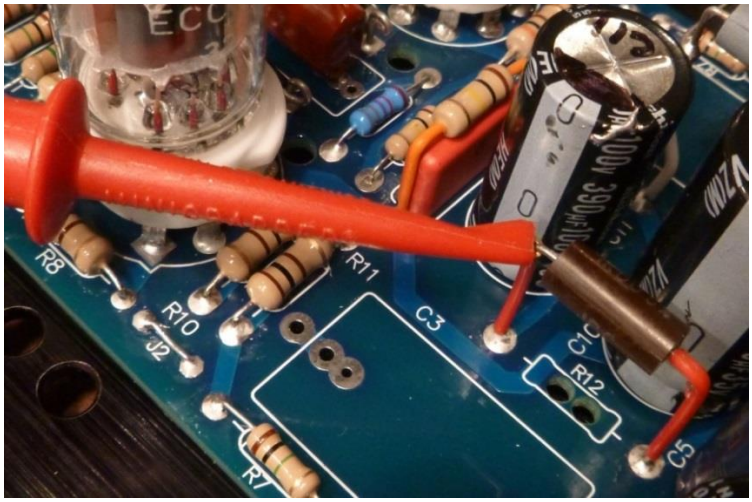
6. If the filament voltage is in the correct range (22.5 to 24.5 volts) carefully remove the multimeter probes from Z1 and Z2.

7. If the voltage is way off unplug the amp and check for component or wiring errors. Otherwise proceed as described below.

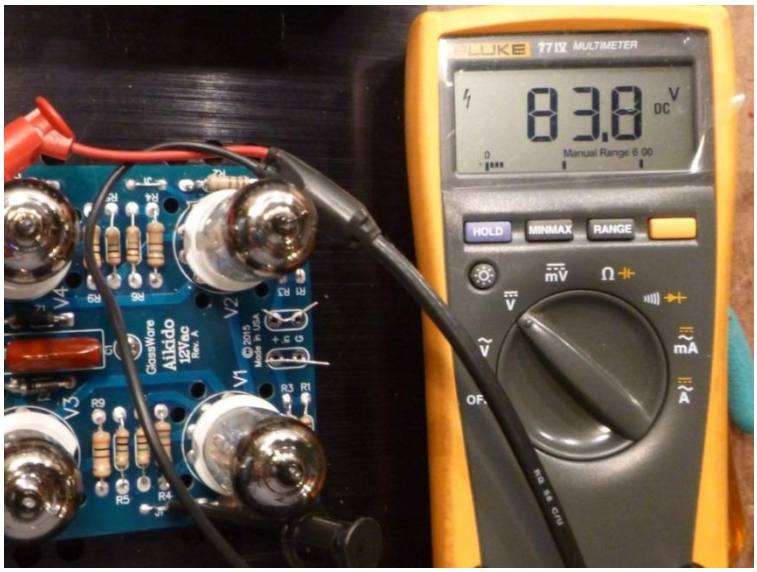
8. Connect the black probe to the loop on one of the jumpers.



9. Connect the red probe to the side of resistor R12 nearest V4 to measure the B+ voltage.



10. The voltage should measure between 75 and 85 volts.



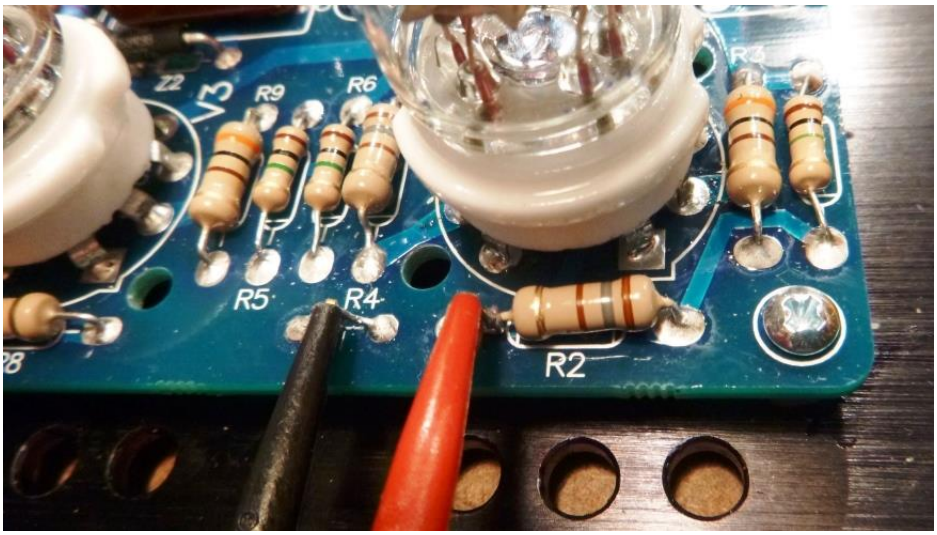
11. If the voltage is way off unplug the amp and check for component or wiring errors.

12. If the voltage is not between 75 and 85 volts resistor R12 will need to be changed. Use a lower resistance if the voltage is too low, use a higher resistance if the voltage is too high. As stated previously the resistor value shown in my parts list should be right <u>for the transformer specified in the parts list.</u>
Note: If for instance R15 needs to be changed (to adjust the filament voltage) the B+ voltage might change slightly as well. The converse is also possible. A bit of iterative substitution of R12 and R15 <u>might</u> be necessary to get both voltages into the proper range.

13. If or once both voltages are within the specified range remove the red probe lead connected to resistor R12. Leave the other probe connected to the jumper.

14. Connect the red probe to the loop on one of the R2 resistors as shown below. The measurement should be between 0.6 to 0.8 volts.

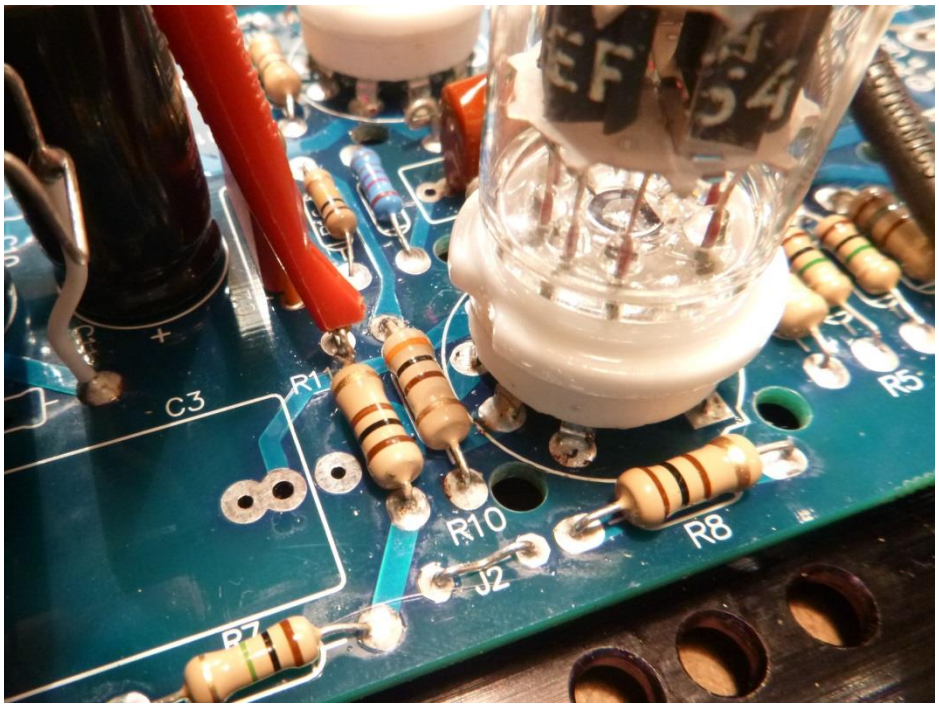
    If the voltage is lower than 0.45 volts (assuming there has not been a wiring error) then the measured tube is probably weak and should be replaced. If the voltage is higher than 0.9 volts then the measured tube is drawing too much current and might be about to go 'supernova' (I've seen this happen) and take other components with it when it expires. Power down immediately and replace the tube.



15. Move the red probe to the other R2 resistor. The measurement should also be between 0.6 to 0.8 volts.

16. Connect the red probe to the loop on one of the R11 resistors as shown below. The measurement should be between 0.4 to 0.6 volts.

    If the voltage is lower than 0.3 volts (assuming there has not been a wiring error) then the measured tube is probably weak and should be replaced. If the voltage is higher than 0.7 volts then the measured tube is drawing too much current and might be about to go supernova. Power down immediately and replace the tube.



17. Move the probe to the other R11 resistor. The measurement should be between 0.4 to 0.6 volts.

    Though not a definitive tube "test" the voltage measurements across resistors R2 and R11 can be indicative of approximate tube health. They are also fairly safe measurements to make on a powered-up circuit. Don't get bent out of shape if for instance the voltage across one R2 measures 0.62 volts and the other R2 measures 0.72 volts. These will likely drift a bit from these values anyway once the tubes have aged a bit. If desired you may power down the unit and swap tubes around to try and get a better "balance" of voltage readings.

18. Connect the red probe back to the side of resistor R12 nearest V4.

19. Unplug the AC cord from the wall outlet and unplug the cord from the line stage AC inlet.

20. Watch the voltage on the multimeter. Wait until the voltage drops to less than 10 volts before proceeding.

21. Disconnect both probes.

22. Once the tubes have cooled remove them by grasping the tube socket with one hand and pulling on the tube with the other hand. Put the tubes in a safe place.

23. Remove the two pairs of transformer primary wires temporarily soldered to the AC inlet terminals.

24. Remove the two input jumpers temporarily soldered in place earlier.

25. Remove the screws securing the board to the spacers.

26. Fold the board back carefully to minimize stress on the wires from the transformer.

27. Assemble capacitors C3 to the board (2 places), solder and trim the leads.

Proceed to the last set of instructions:

Final Wiring & Assembly