



METROAMP 100 WATT PLEXI KIT

ASSEMBLY INSTRUCTIONS

REVISED DECEMBER 2007

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Thank you for your purchase of our 100 watt plexi kit. I hope you will enjoy building and playing your new amp. These instructions will take you step by step through the assembly and testing process. Revisions to these instructions include more detail in each step, more photos to guide you, and the inclusion of technical notes with several steps. These notes point out details and component values relevant to vintage Marshalls and tube amps in general.

These instructions are in Adobe Acrobat PDF format, allowing you to view, zoom, and print pages and individual images. You can download a free copy of Adobe Acrobat Reader at: <http://www.adobe.com/products/acrobat/readstep2.html>

Only basic hand tools are required to assemble the kit:

screwdrivers -- standard and Philips
adjustable wrench (standard pliers will suffice)
needlenose pliers
diagonal cutters
wire strippers
5/64" Allen wrench (for set screw knobs)
soldering iron -- 15 to 40 watts
solder
multimeter -- AC/DC rated for at least 500volts DC, resistance
round file

We also suggest these optional tools:

nut drivers -- 1/4", 5/16", 11/64", 3/8" and 1/2"
heat gun -- for shrink tubing (a hair dryer works well too)
drill and several small bits
masking tape

The steps are best followed in order. You'll also find extra diagrams, schematics, and alternate wiring layout files in the appendix (for example, a wiring diagram for wiring the power transformer for 220V operation.)

Tech support is available online at our forum: <http://www.forum.metroamp.com>

Thanks,

George Metropoulos

!!! DISCLAIMER !!!

THIS AMP KIT OPERATES AT UP TO 500 VOLTS DC. THIS VOLTAGE IS POTENTIALLY LETHAL!!! PLEASE USE EXTREME CAUTION WHILE ASSEMBLING AND TESTING THIS KIT. METROAMP AND METROPOULOS AMPLIFICATION INC. ACCEPT NO LIABILITY FOR DAMAGE OR INJURY INCURRED FROM OR WHILE USING THIS KIT.

100 WATT PLEXI KIT

QTY DESCRIPTION

1	Large Head Case
1	Aluminum 100 Watt Chassis
4	Cage Nuts
4	Chassis Mounting Bolts
1	Plexi Panels (Front/Rear)
1	1203-80-MS Power Transformer
1	C1998 Output Transformer
1	Mercury Magnetics MAR100 Choke

OPTIONAL TRANSFORMERS

1	Mercury Magnetics MP-100-460 Power
1	Mercury Magnetics O100JM-SL Output

1	JJ E34L Matched Quad Power Tubes
1	JJ 12AX7 Preamp Tubes
12	#10 Brass Screw, Flat Washer, Lock Nut
36	#6 Brass Screw, Lock Washer, Nut
12	#4 Brass Screw, Lock Washer, Nut
6	#4 Board Mount Bolts
12	2 Hole Ground Lugs
4	Micallex Octal Tube Socket
3	Micallex 9 Pin Tube Socket w/Shield
4	EL34 Tube Retainer

SoZo CAPS -- LEAD SPEC

6	SoZo .022uF @ 400V
1	SoZo .0022uF @ 400V
2	SoZo .1uF @ 400V
2	SoZo .68uF @ 400V

SoZo CAPS -- BASS SPEC

5	SoZo .022uF @ 400V
4	SoZo .1uF @ 400V

1	100 Watt PTP Turret Board
6	CE 50x50uF Filter Capacitor Cans
6	Can Capacitor Mounts
2	Vishay .22uF @ 630V

QTY DESCRIPTION

2	56K 2 Watt Metal Oxide Resistors
4	Xicon 1K 5 Watt Resistors
1	Marshall Impedance Switch
2	Toggle Switches DPST
2	Chrome Ring For Toggle Switches
2	Panel Mount Fuse Holders
1	120V Indicator Lamp
1	Potentiometer Kit (3-1M, 1-250K, 1-25K, 1-5K)
6	Marshall Set Screw Knobs
6	Cliff Old Style Jacks
5	1/2" Grommets
1	3/8" Grommet
8"	1/8" Shrink Tubing
12	3" Cable Ties
1	8' Power Cable
1	Strain Relief
1	Full Amp Wire Kit
2	AGC 1A Fuse
2	AGC 4A Fuse
1	Marshall Board Components Kit - see detail on page 2
1	MetroAmp Reference CD

MARSHALL BOARD COMPONENTS KIT -- DETAILED LISTING

QTY DESCRIPTION

1 WATT CARBON FILM RESISTOR

1	470 OHM
2	820 OHM
1	1K
4	1.5K
1	2.7K
4	5.6K
1	10K
1	15K
1	27K
1	33K
1	47K
1	56K
5	68K
1	82K
4	100K
1	150K
3	220K
2	270K
3	470K
4	1M

1 WATT METAL OXIDE RESISTOR

4	1 OHM
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2 WATT METAL OXIDE RESISTOR

2	820 OHM
1	8.2K
3	10K
1	27K
1	47K
2	100K

SILVER MICA CAPACITOR

1	47 PF
1	100 PF
1	250 PF
3	500 PF

ELECTROLYTIC CAPACITOR

2	10 UF @ 150V
1	220 UF @ 25V
1	330 UF @ 25V

QTY DESCRIPTION

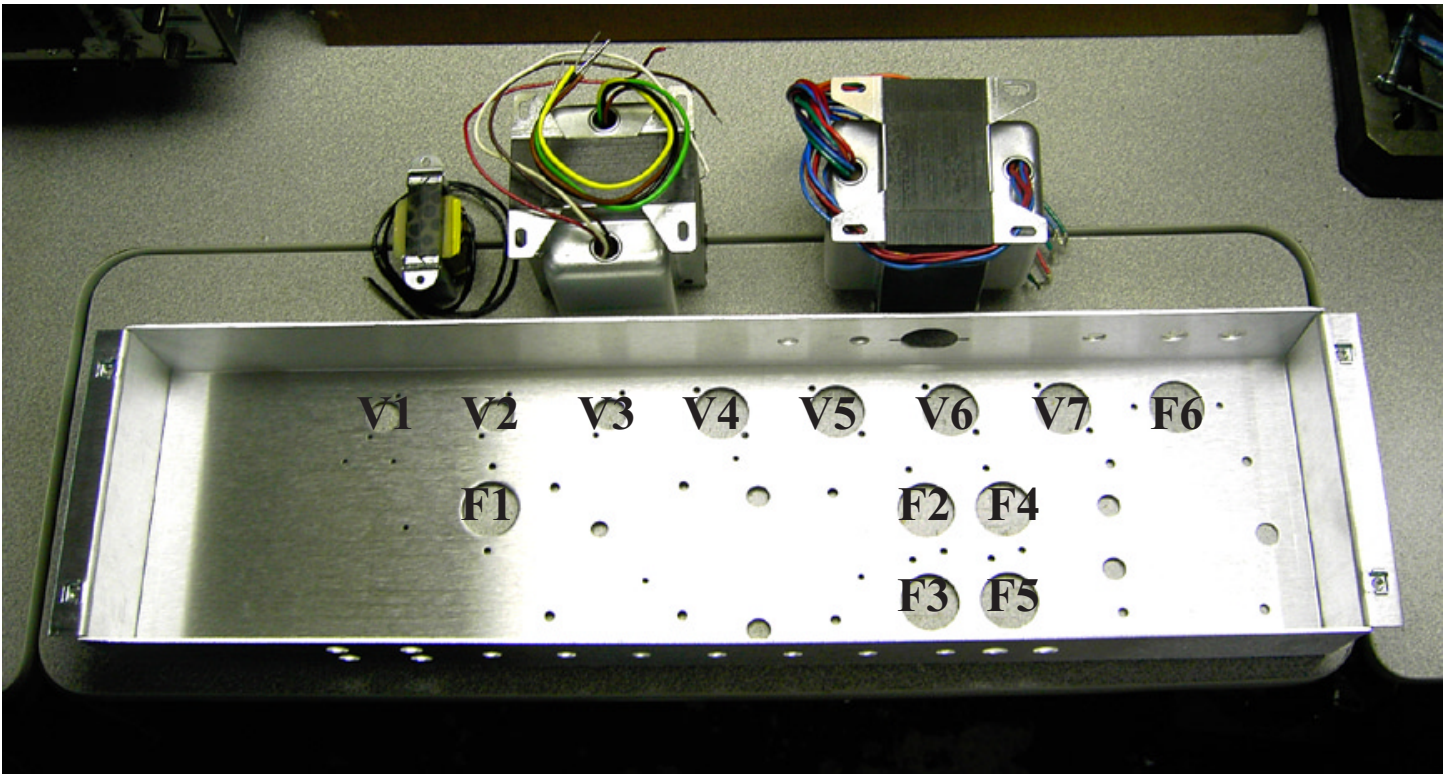
DIODES

5	1N4007 (ALTERNATE PART #UF4007)
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BIAS POTS

1	25K VERTICAL MOUNT
1	25K HORIZONTAL MOUNT

STEP 1: BEFORE YOU BEGIN



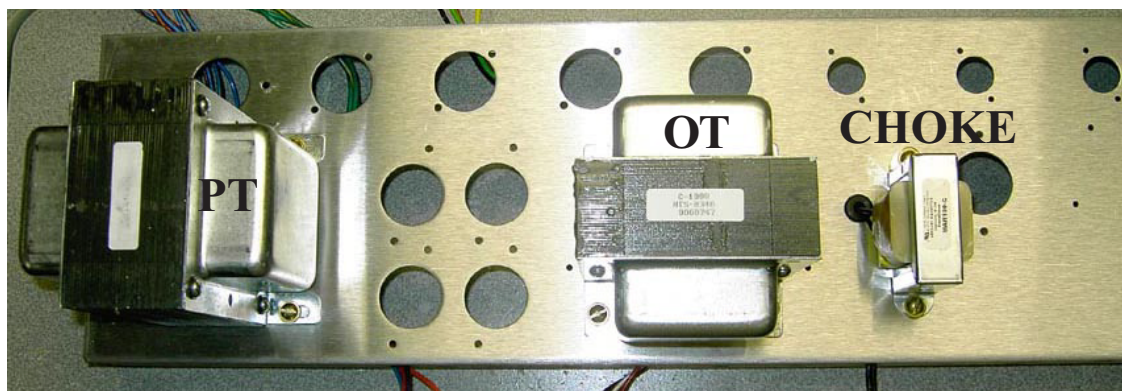
Before starting to assemble your amplifier, we suggest looking over the parts and instructions to get familiar with your kit. The preceding parts list can be used as a checklist.

For best results assemble your kit in a clean area with good lighting. We suggest working for 2 to 3 hours per sitting. The steps in these instructions are divided into specific tasks; you should be able to complete several steps in each session.

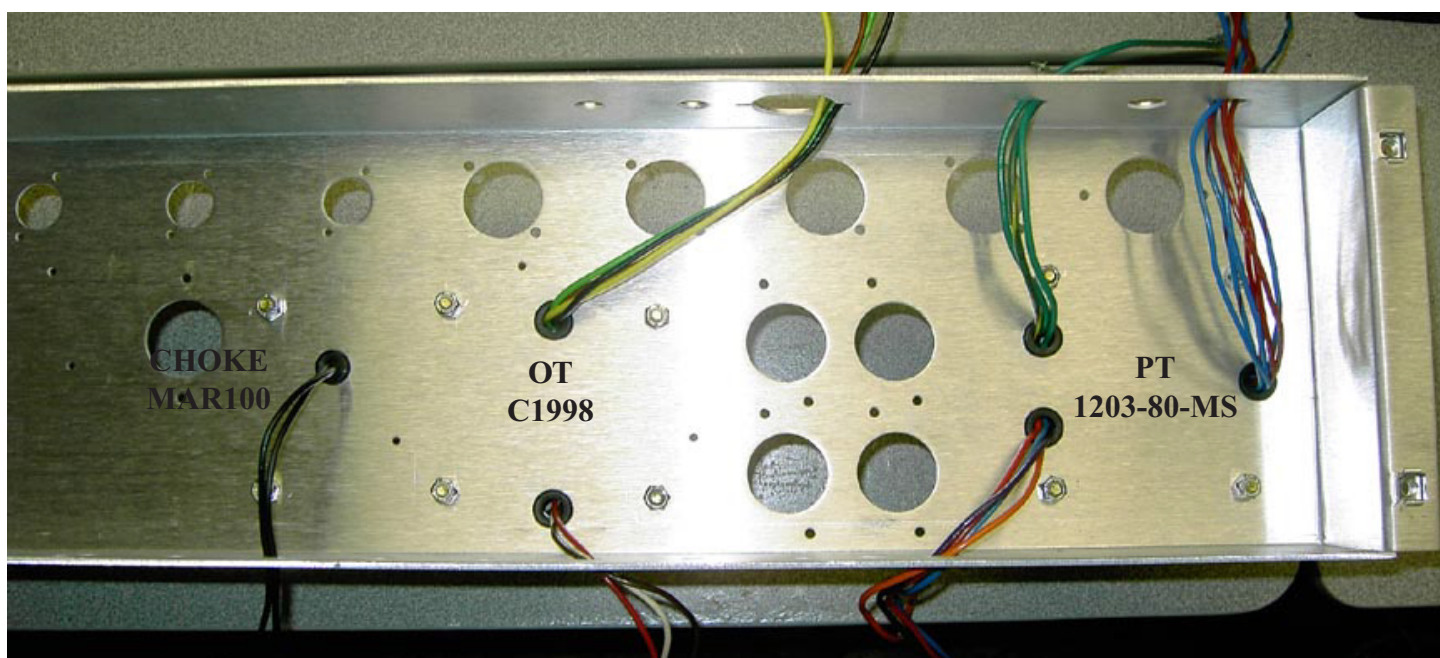
Throughout these instructions we will refer to tube sockets and filter capacitor positions as indicated in the above photo. Looking inside the chassis with the front facing you, the tube sockets are labelled from left to right: V1 (“V” stands for “valve”) through V7. Likewise the filter capacitors are labelled F1 through F6.

The power transformer is abbreviated as “PT” and the output transformer is abbreviated as “OT”.

STEP 2: INSTALLING THE TRANSFORMERS AND CHOKE



- A. Install (2) 1/2" grommets in the output transformer wire holes in the chassis; (3) 1/2" grommets in the power transformer holes; and (1) 3/8" grommet in the choke wire hole.
- B. Install the power transformer (1203-80-MS) on the chassis with the wires oriented as in the picture below. Mount using (4) #10 brass bolts, (4) washers and (4) self-locking nuts. The hardware sequence from the top is:
BOLT - FLAT WASHER - PT BRACKET - CHASSIS - LOCK NUT
Use a 3/8" socket or nut driver, or adjustable wrench, to tighten the lock nuts.
- C. Install the output transformer (C1998) on the chassis with the wires oriented as pictured below. Mount using (4) #10 brass bolts, (4) washers and (4) self-locking nuts. The hardware sequence from top to bottom is the same as on the PT.
- D. Install the choke (MAR-100) on the chassis as pictured below. Use (2) #10 brass bolts, (2) washers and (2) self-locking nuts. The hardware sequence from top to bottom is the same as the PT and OT.



STEP 3: INSTALLING FILTER CAPACITORS



- A. Install (6) capacitor clamps on (6) CE 50 x 50uF filter capacitor cans as shown above. Line the ground terminal of each can (marked with black) up with one of the mounting holes on the clamp.
- B. Install the filter cans on the chassis using (12) #6 brass bolts, (12) lock washers, (12) nuts, and (5) 2-hole grounding lugs. Bend the grounding lugs in the middle at a right angle.

#6 brass nuts require a 5/16" socket or nut driver.

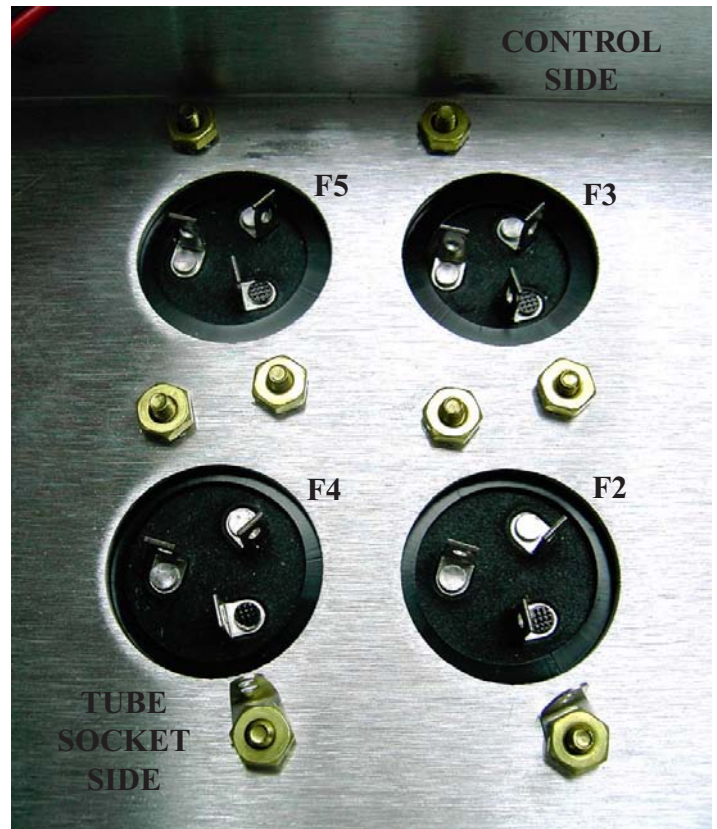
The first can goes in the middle of the chassis in position F1. Position the can as shown in the picture, with one of the ground lugs on the control side mounting bolt. The hardware sequence from top to bottom is:



BOLT - CAP CLAMP - CHASSIS - GROUND LUG - LOCK WASHER - NUT

Step 3 cont.

Next install the four cans in positions F2, F3, F4 and F5. F3 and F5 (on the control panel side of the chassis) simply bolt in with the #6 brass bolts. F2 and F4 will need one ground lug each as shown in the picture. Hardware sequence is the same, just leave out ground lugs where none are called for.

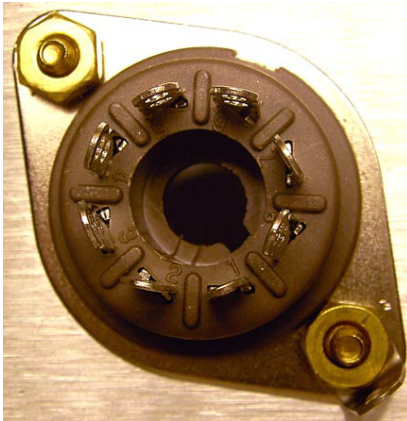


The last can goes in position F6 and requires two ground lugs to be installed on the inside bolt, closest to the power tube sockets, as shown in the picture.

Hardware sequence is the same as the other cans.

STEP 4: INSTALLING TUBE SOCKETS

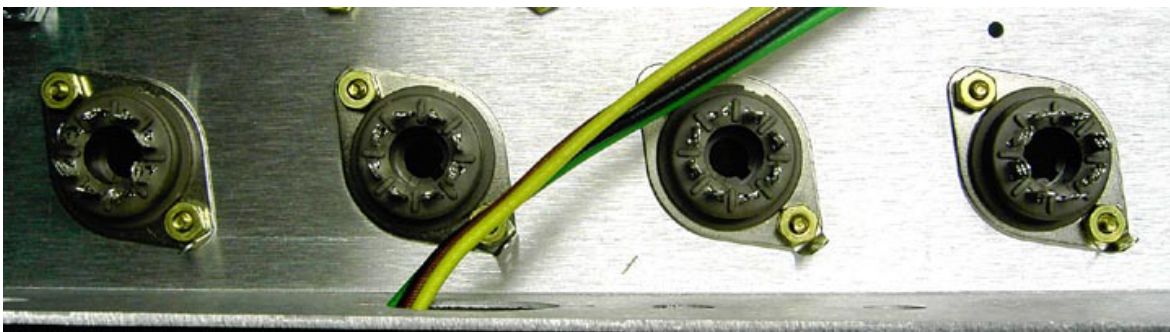
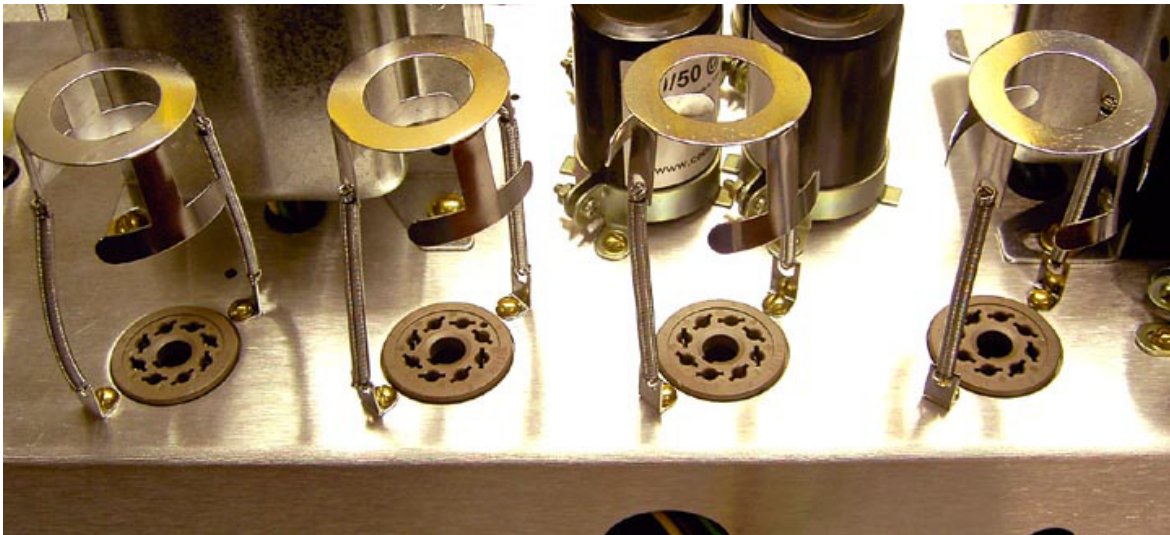
- A. Install the (4) Micallex Octal Sockets and (4) EL34 Tube Retainers using (8) #6 brass bolts, (8) lock washers, (8) nuts and (4) ground lugs. Be sure to orient the notch in each socket towards the rear of the chassis as in the picture below. The ground lugs go on the rear bolt of each socket as well and are bent in the middle at right angles.



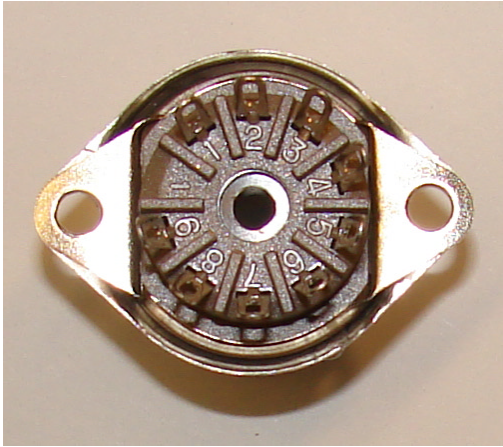
The hardware sequence is:

BOLT - TUBE RETAINER - CHASSIS - TUBE SOCKET - GROUND LUG - LOCK WASHER - NUT

#6 brass nuts require a 5/16" socket or nut driver.

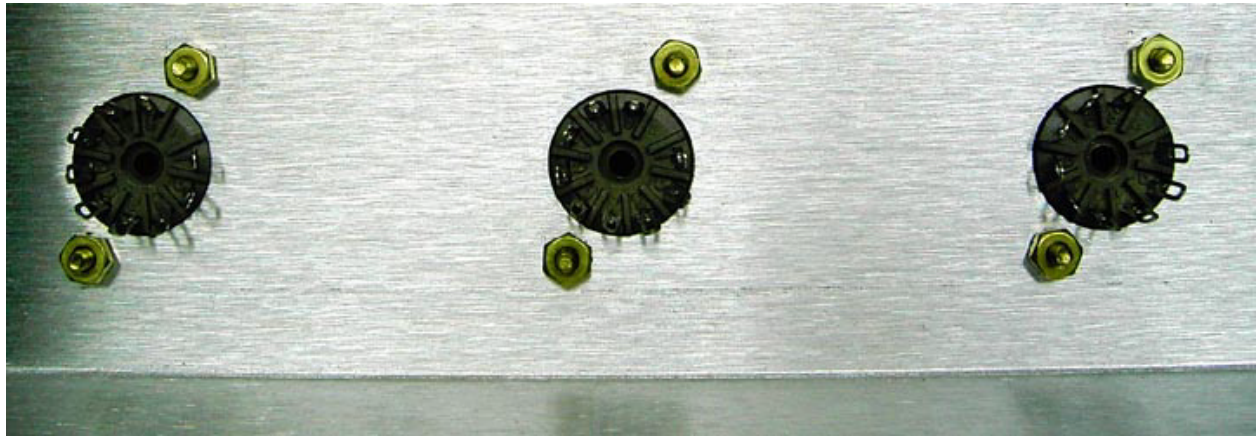


Step 4 cont.



Install the (3) 9 pin Preamp Tube Sockets using (6) #4 brass bolts, (6) lock washers, and (6) nuts. Note the gap between pins 1 and 9 on the sockets; be sure to orient the gap towards the front of the chassis as in the picture below.

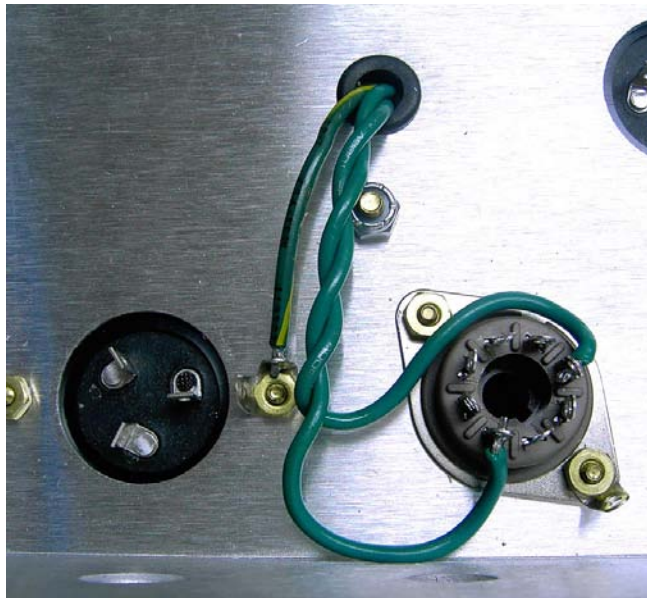
**Hardware sequence from top to bottom is:
*BOLT - TUBE SOCKET - CHASSIS - LOCK
WASHER - NUT***



STEP 5: INITIAL CONNECTIONS

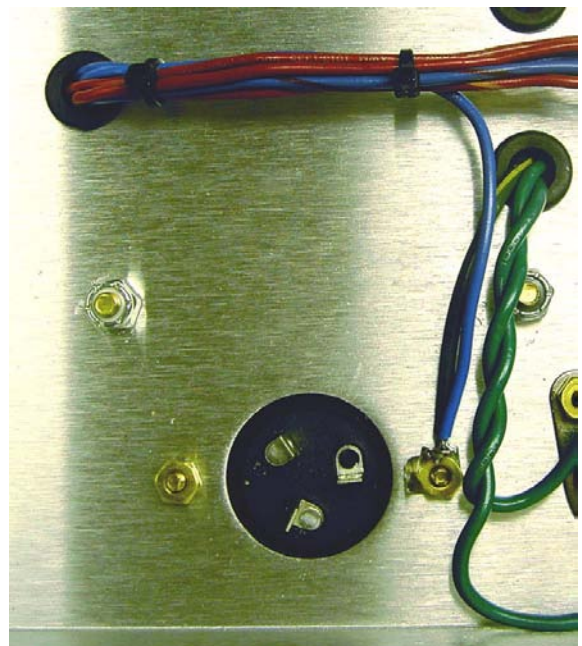
- A. Twist and route the two solid green wires from the PT to the V7 power tube socket, where one lead will connect to pin 2 and the other to pin 7. These are the heater wires for the tubes. Twist them tightly and evenly for best hum rejection. The green wire with the yellow stripe is the center tap for this part of the PT and needs to be routed to one of the ground lugs on the F6 cap can as shown in the photo below. Solder these wires in place.

NOTE: Mercury Magnetics MP100-460 PT uses two black wires in place of the two green wires. Route the two black wires to the V7 socket pins 2 and 7. The center tap for these wires is a green wire with a black stripe - route it to the F6 ground lug. Solder these wires in place.



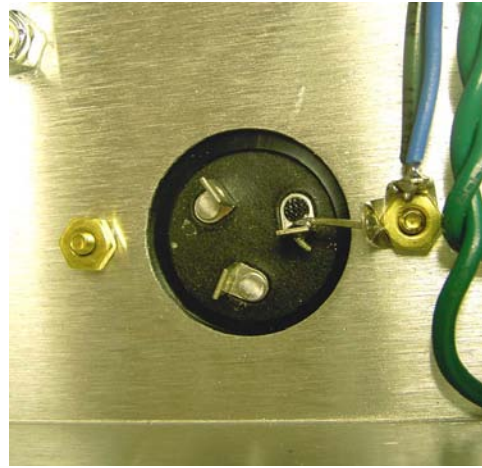
- B. Neatly bundle the wires from the PT at the far end of the chassis and tie with two wire ties as shown. There are two plain blue wires for the amp's bias circuit - one of them needs to route to the same ground lug that the heater center tap was soldered to. (It makes no difference which of the blue wires you use.)

NOTE: MP100-460 PT has a green and a white wire for the bias. Route the green wire to the ground lug and solder in place.



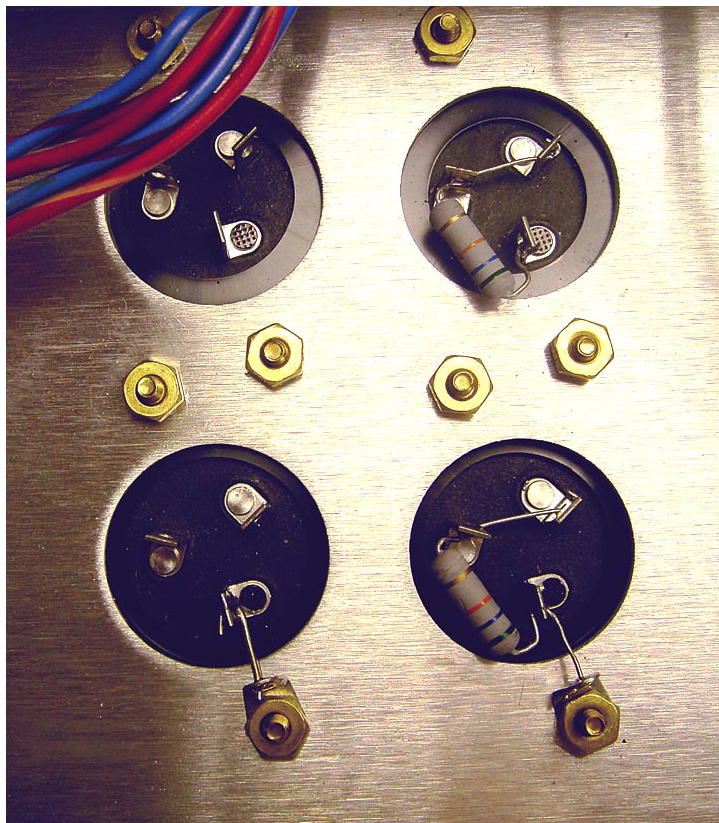
Step 5 cont.

- C.** Cut a 1" piece of 18ga buss wire. Solder this wire from the black ground terminal of the F6 cap can to the remaining ground lug on its mounting bolt as shown. You may find it helpful to bend a small hook at one end to help keep it in place while you solder. Trim any excess wire with wire cutters.



- D.** Cut a 1" piece of 18ga buss wire. Solder this wire from the black ground terminal of the F4 cap can to its ground lug.

Find the (2) 56K 2watt metal oxide resistors. On the F3 cap can, solder one end of one 56K resistor to the black ground lug. Run the other end through BOTH of the remaining lugs on the F3 can and solder in place as shown. Trim any excess wire. Route one end of the other 56K through F2's black ground terminal and on to the ground lug on its bolt. Route the other end through BOTH the remaining terminals as above and solder these connections in place as shown.



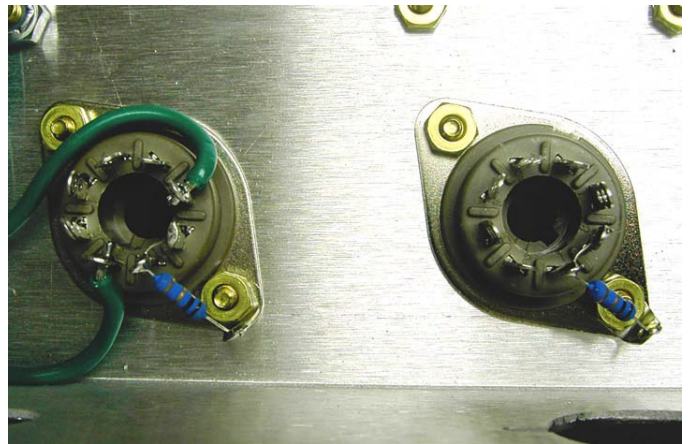
- E.** Cut a 4" piece of black wire. Strip 1/4" off each end. Solder one end to the F1 cap can's black ground terminal and the other end to F1's ground lug as shown at right. (You may use buss wire if you choose, but using a length of wire allows you to replace the capacitor in the future by lifting it out from above the chassis, instead of having to remove the turret board.)



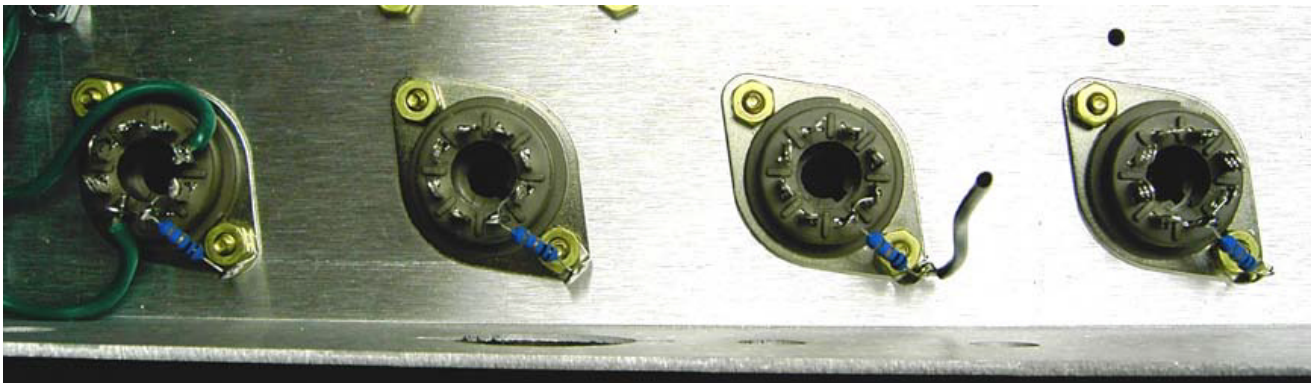
Step 5 cont.

- F. Install the (4) 1-ohm metal oxide resistors on the power tube sockets V4 - V7. Route one end through the ground lug on the socket mounting bolt. Route the other end through pin 8 of the octal socket and then over and through pin 1's hole as shown. Solder these connections and trim any excess lead. These resistors will provide a convenient way to bias the power tubes in the amplifier.

TECH NOTE: On previous kits this resistor was installed between pins 1 and 8. Technically speaking, this new method provides a slightly more accurate bias reading, on the order of a few milliamps. Fortunately, biasing doesn't require operating the output tubes at a static setting. Either method provides usable results. More on this in the testing section.



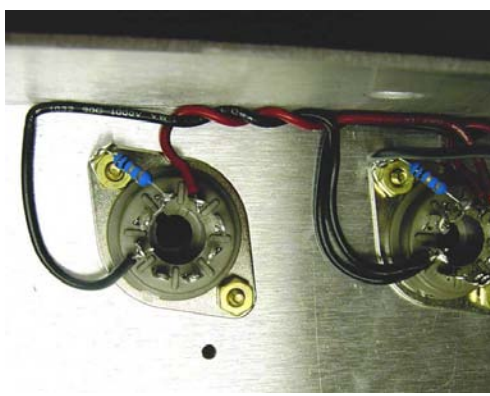
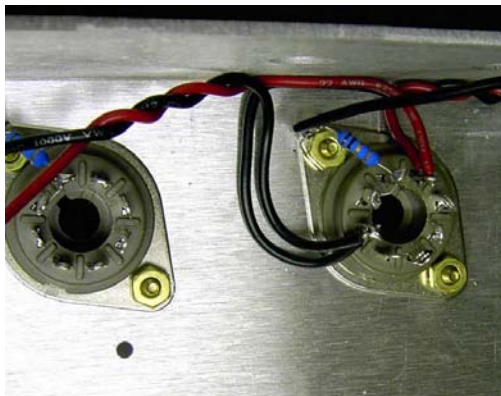
- G. Cut a 4" piece of black wire and strip 1/4" from each end. Solder one end to the V5 socket's ground lug. For now gently bend the wire straight up so it's out of your way for the moment.



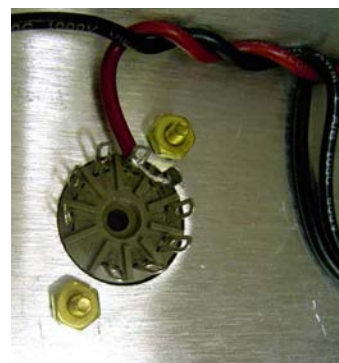
STEP 6: WIRING THE HEATERS

- A. Solder, twist and route heater wires across each of the tube sockets using 22 gauge red and black wire. *This step can not be rushed - careful attention here will pay off in reduced hum and noise in your amplifier.*

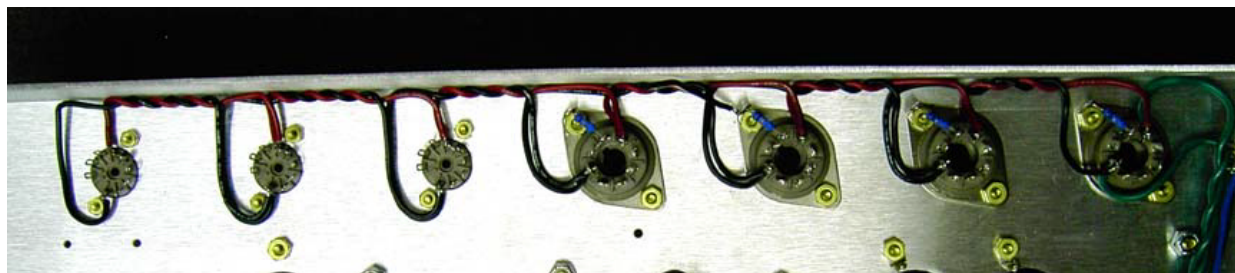
Starting at V7's socket, solder a 6" red wire to pin 2 and a 10" black wire to pin 7. Route these to the rear of the chassis, then twist them together and wire the red to pin 2 of V6 and the black to pin 7 of V6. Twist as tightly and evenly as possible, trying to get at least three twists between each socket as shown. Continue this procedure until you have soldered a red wire to pin 2 of V4 and a black to pin 7 of V4.



- B. Continue on to the preamp tube sockets, but note that the heater pins are now red to *pin 4 & 5* and black to *pin 9*. The same wire lengths work fine and the procedure is the same. (Only the first red wire to the socket needs to bridge pins 4 & 5 together; the second wire can then be soldered to pin 4 only.) Again, strive for at least three full twists between sockets.

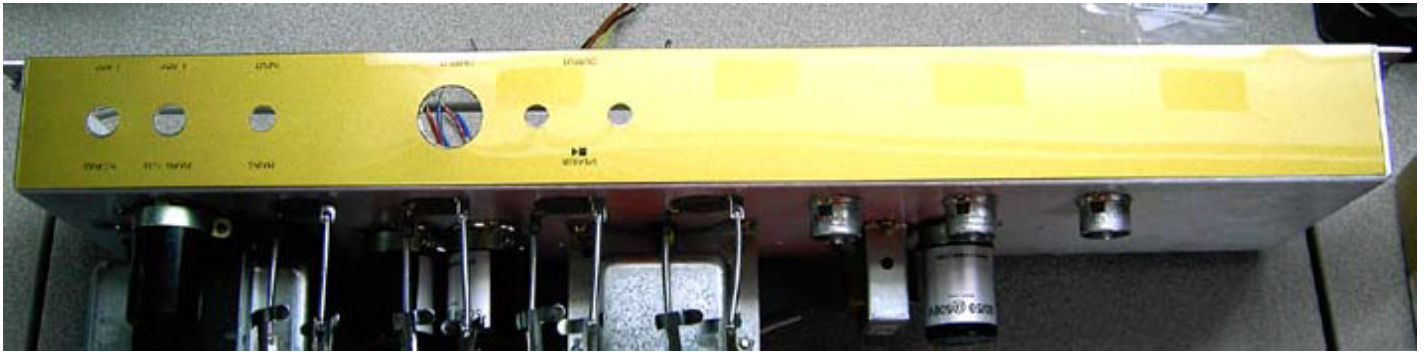
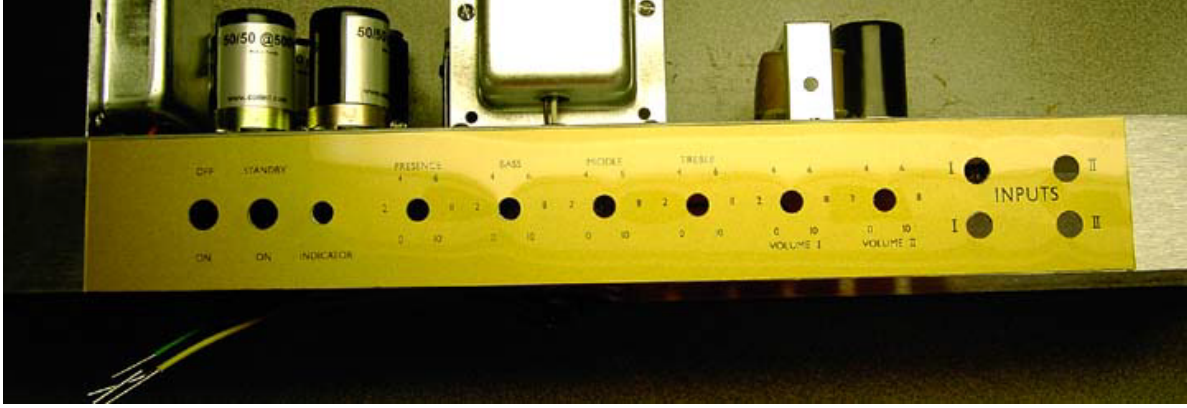


TECH NOTE: Twisting wires that carry AC voltage can prevent hum due to phase cancellation. In this case the AC voltages are out-of-phase due to the center-tapped heater winding in the power transformer.



STEP 7: INSTALLING PANELS

- A. Peel away the backing and press the plexi panels into place on the front and rear of the chassis. Make sure to line up the panel to the bottom chassis edge, insuring that the holes are lined up as close as possible before pressing the panel into place.

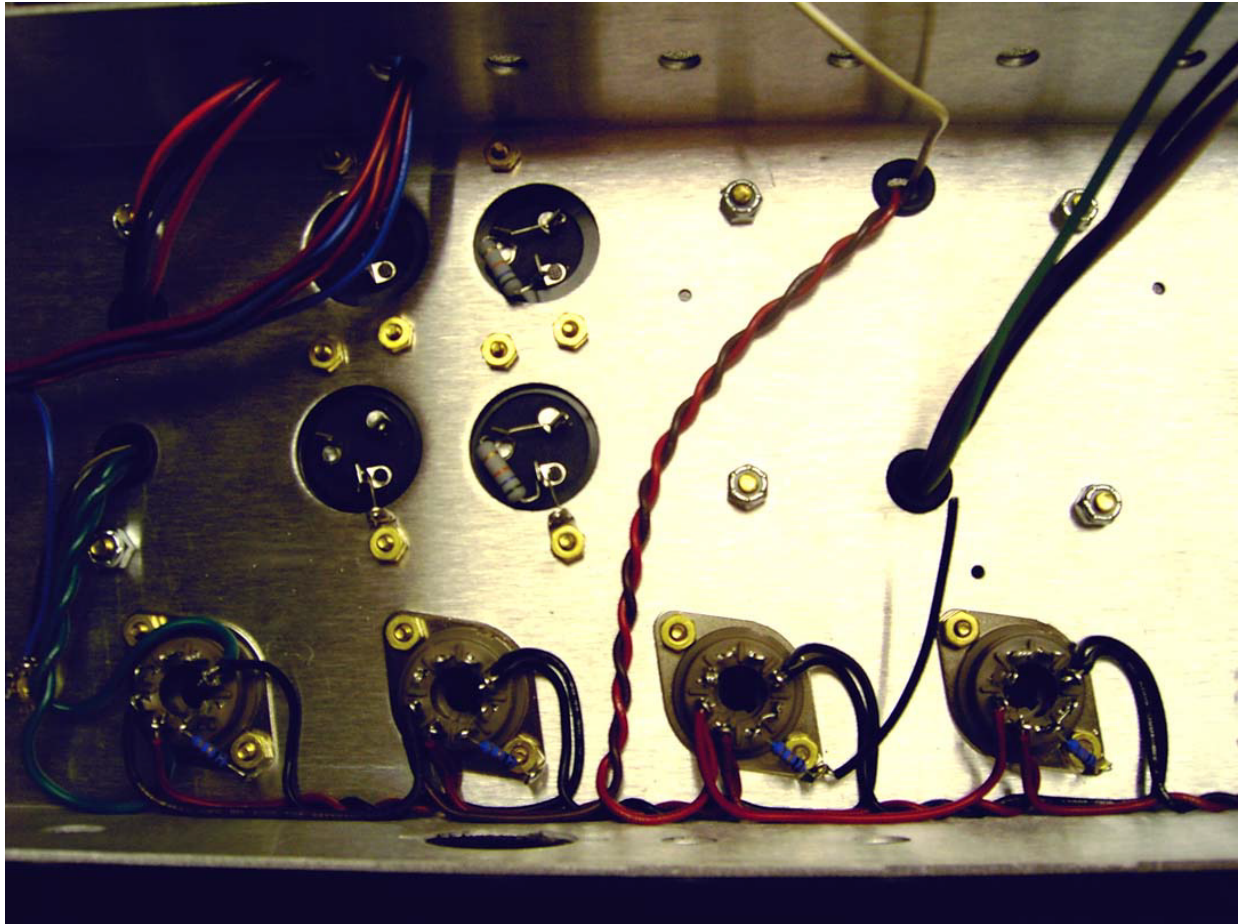


Inspect the holes after pressing the panels firmly in place, and remove any excess panel material with a round file or Dremel tool. Use masking tape around the holes as you file to ensure that the panels don't get scratched.

STEP 8: OUTPUT TRANSFORMER CONNECTIONS

- A. Twist the OT primary wires as shown below. Cut to length and solder in place: **RED to V5 PIN 3** and **BROWN to V6 PIN 3**.

Cut a 4-1/2" length of red wire and connect pin 3 of V5 to pin 3 of V4 as shown below. Cut a 4-1/2" length of brown wire and connect pin 3 of V6 to pin 3 of V7 as shown. (Often there is enough extra wire from the transformer itself for these connections.)

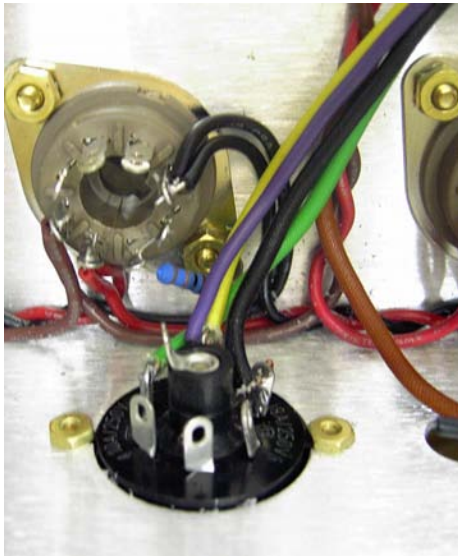


- B. Route the green, yellow and black OT secondary wires through the impedance selector hole and trim to length so that about 1/2" of each wire sticks out past the back of the chassis. Cut back about 1/4" of insulation on each wire. Using a sharp knife or scraper, scrape the red insulating enamel off of each lead -- *failure to do this will result in poor connections and potential damage to your amp!*

Cut a 10" length of purple wire and strip 1/4" off one end. Bend a hook in the exposed bare wire. Install the wires as shown at right and solder into place.



Step 8 cont.



- C. Carefully guide the OT secondary wires back into the hole until you can line up the impedance selector switch with its hole. Drill the panel for mounting holes using a 7/64" (or 3mm) drill bit. (You can simply file the holes out as well.)

Mount using (2) #4 brass bolts and (2) brass nuts. The hardware sequence is:

BOLT - SWITCH - CHASSIS - NUT

TECH NOTE: Mercury Magnetics O100JM-SL output transformer has the same color codes and the same connections. Follow the instructions as written for this transformer.

TECH NOTE: The black wire is the four ohm tap of the OT, the yellow is the eight ohm tap and the green is the sixteen ohm tap. The purple wire is the negative feedback wire and will install to the turret board later. The tap you connect the purple wire to will affect the sound of the amplifier. Connecting to the eight ohm tap was fairly common in the '69 era amps, while earlier amps connected the feedback wire to the sixteen ohm tap and the mid-70's amps often used the four ohm tap. Simply put, the bigger the tap you hook the feedback wire to, the cleaner and tighter the amp is, while hooking to a smaller tap gives the amp a hairier, looser feel. This is something that can be experimented with after the amplifier is assembled and tested to help you tailor the tone to your preferences.

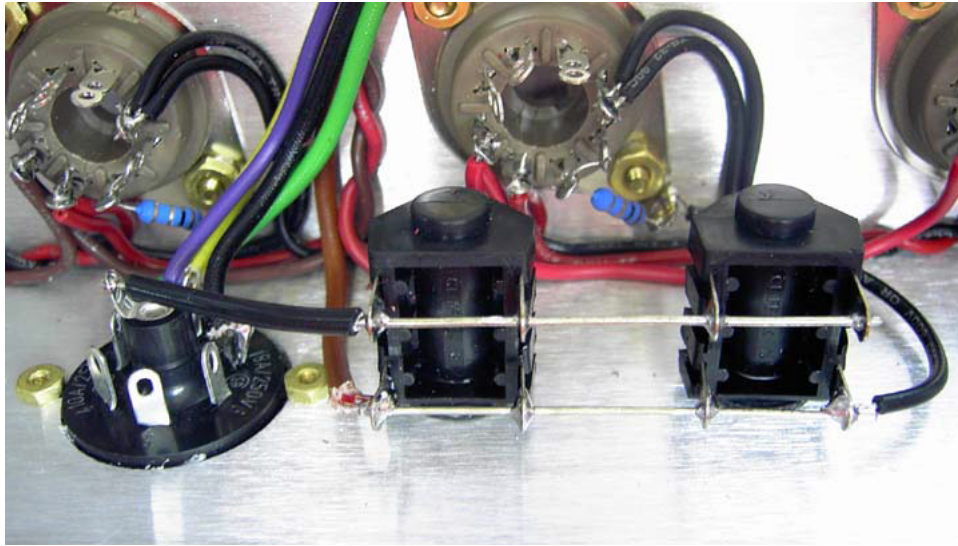
- D. Install (2) old style Cliff jacks into the speaker output holes in the back of the chassis. Cut a 2-3/8" piece of 18 gauge buss wire and run it through the four jack terminals closest to the chassis. Solder the inner two connections to hold it in place.

Cut the brown lead from the OT secondary to length, and trim back 1/4" of the insulating sleeve. Scrape off the red enamel coating and solder into place as shown. The ground wire from V5's ground lug solders to the other end.



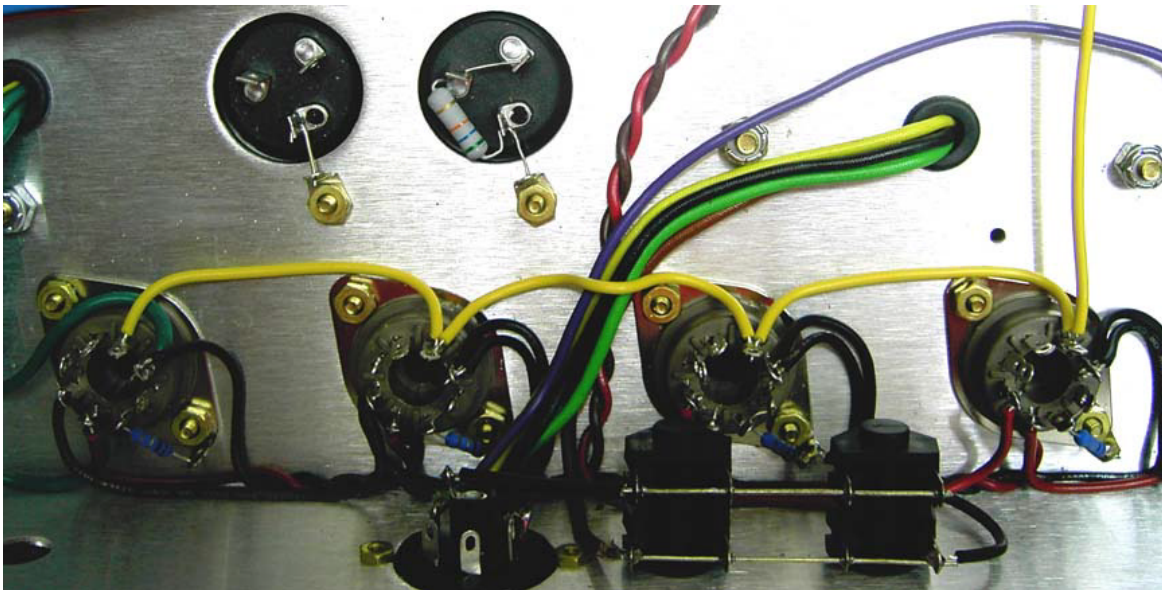
Step 8 cont.

- E. Cut a 3-3/4" piece of 18 gauge buss wire, and a 1-1/4" piece of insulating tubing (NOT shrink tubing.) Run the buss wire through the four remaining jack terminals, then slip the insulation over the buss wire as you bend it down slightly and run it through the center terminal of the impedance selector. Solder these connections in place as shown.**



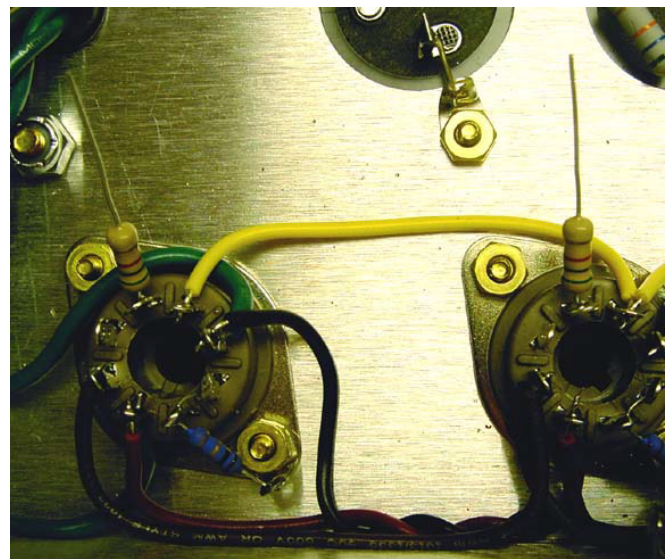
STEP 9: FINISHING POWER TUBE SOCKET CONNECTIONS

- A. Cut (3) 3" pieces of yellow wire and (1) 6" piece of yellow wire and strip 1/8" of insulation off each end of the pieces. Solder the first 3" piece to the bottom hole of pin 6 of the V7 socket. Run the other end to the bottom hole of pin 6 of the V6 socket, and also insert the first end of the next 3" piece through the same hole. Solder this connection. Continue on connecting the bottom holes of the pin 6's until all sockets are connected as shown below. The 6" piece will solder into the bottom hole of V4 and should lay straight out into the chassis to be connected to the turret board in a later step.



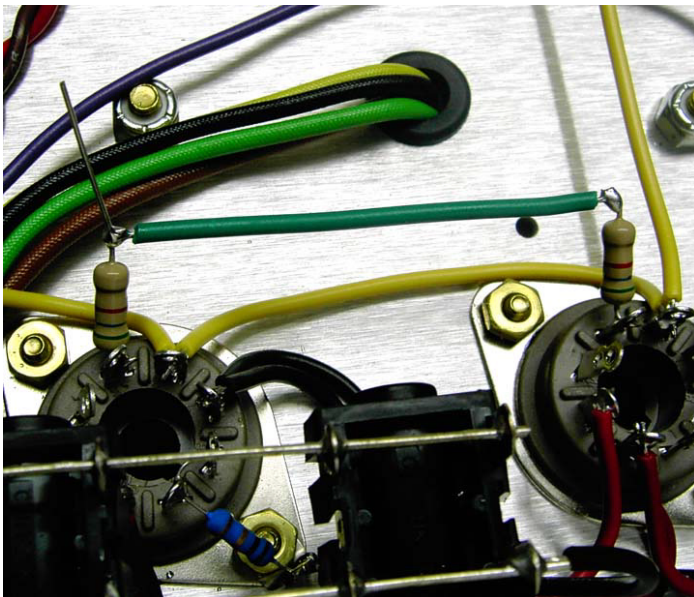
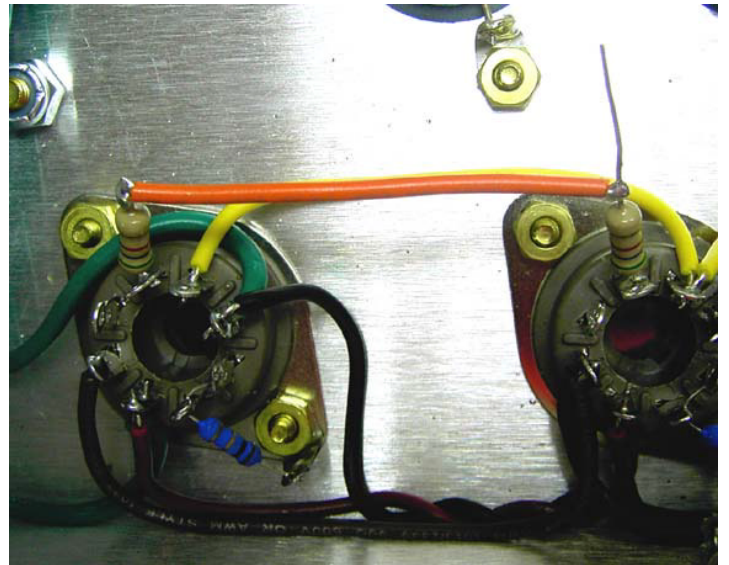
- B. Find (4) 5.6K 1 watt resistors. In one end of each resistor's lead bend a hook close to the resistor body. Run the hook through pin 5 of V4, V5, V6 and V7. Solder and trim the excess lead so that each resistor sticks up from pin 5 as shown at right.

TECH NOTE: These resistors help suppress *oscillation*, where the amplifier creates noises on its own, with no corresponding input signal. The resistors must be as close as possible to pin 5 of each socket in order to be as effective as possible.



Step 9 cont.

- C. Cut a 2-1/2" piece of orange wire and a 2-1/2" piece of green wire. Strip a small amount of insulation from each end of the two wires and bend a small hook in each end. Bend a hook in the remaining end of the 5.6K resistors on pin 5 of the V4 and V7 sockets **ONLY**, again as close as possible to the resistor body. Do **NOT** modify the resistors on V5 and V6 at this time. Trim the excess lead so it looks as shown in the picture at left.
- Hook one end of the orange wire to the hook in your V7 resistor, crimp the hooks together with needlenose pliers, and solder. Hook the other end of the orange wire over the lead of the V6 resistor and solder so the assembly looks as shown below. Leave the extra lead on V6's resistor sticking up for now.



- D. Repeat the procedure above for the V4 and V5 resistors with the green wire so it looks as shown at left.

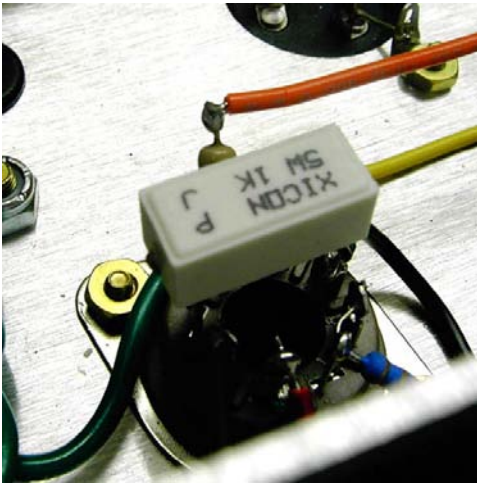
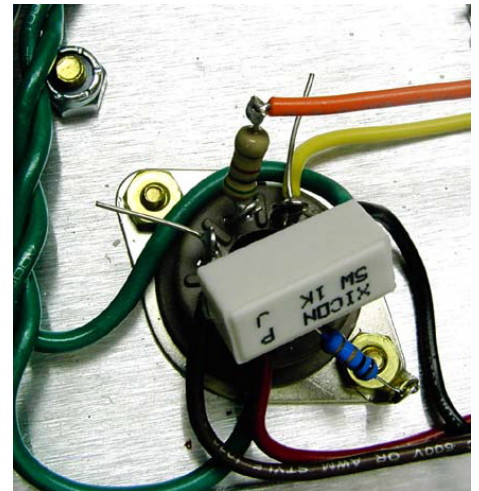
When complete, the two middle sockets (V5 and V6) will have the extra leads sticking up.

Carefully bend all the resistors so they are sticking up at slightly more than a 45 degree angle at this point.

Step 9 cont.

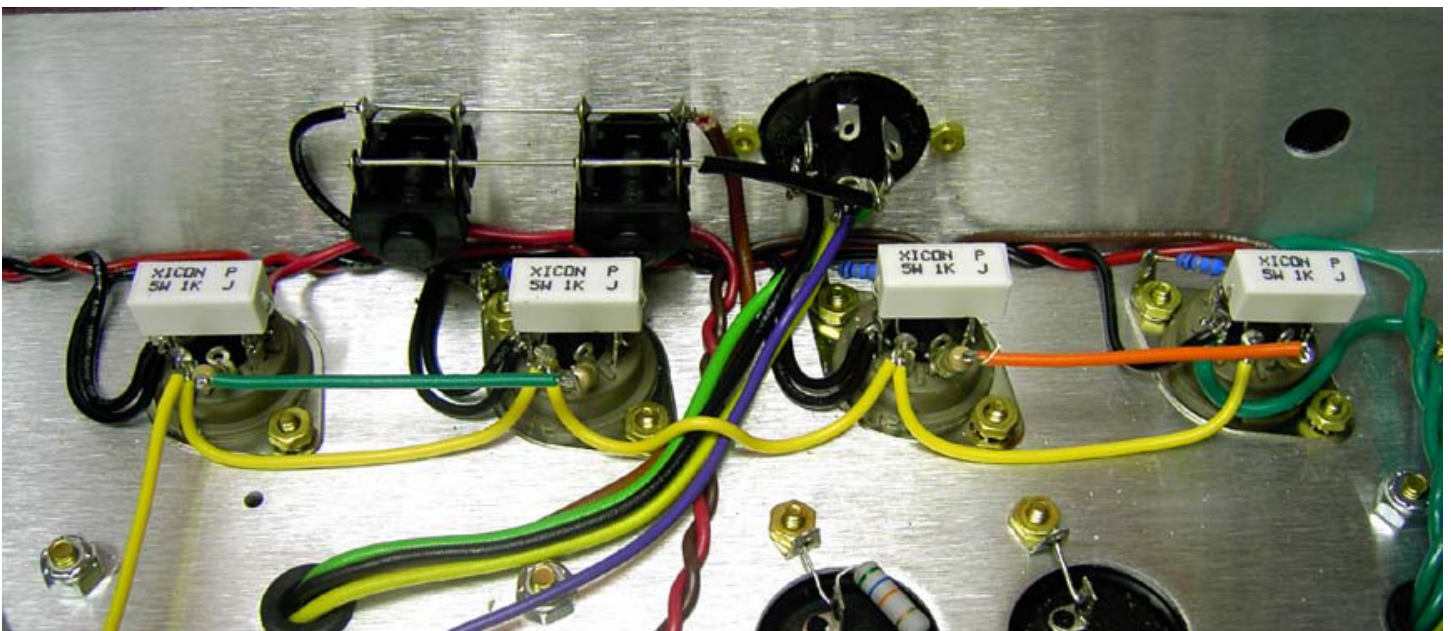
- E. Find the (4) 1K 5 watt resistors. Run one lead of one of the resistors through V7 pin 6's top hole; run the other lead through V7 pin 4's top hole.**

Reference the picture at right.



Solder the connections at pins 4 and 6; then carefully bend the resistor up straight. It is critical to make sure that after bending the resistor up, neither of its leads touch any other pins on the tube socket. Use needlenose pliers to move the leads around so that there is plenty of clearance from the other tube socket pins if needed.

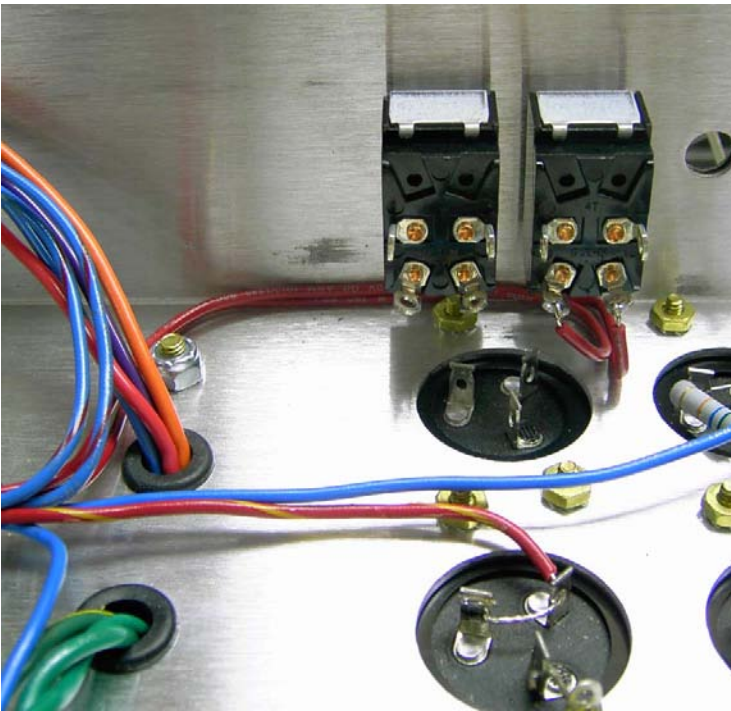
Repeat this procedure for the other three tube sockets. When finished it should look like the picture below:



STEP 10: SWITCHES, FUSE HOLDERS AND WIRE HARNESS

This will be one of the most intense steps in the assembling of your amplifier. Plan on spending at least one full session on this step, as a neat and orderly job will greatly enhance not only the performance of your amplifier, but also make any troubleshooting down the road simpler.

- A. Install the (2) DPST switches and (2) chrome rings. Orient the switches inside the chassis as shown below.



- B. Route the two red wires from the PT secondary around to the front of the chassis as shown. Solder one wire to each of the bottom terminals of the standby switch. (These red wires will be in a group with two blue w/red stripe wires, two blue wires, and one red w/yellow stripe wire from the transformer.)

- C. Route the red w/yellow stripe wire as shown to the F4 capacitor. Strip enough insulation from the end (about 3/4") to join the two positive terminals of the F4 cap together as shown. Solder these connections, but leave some open space on the terminal that the wire goes to first for now; we have more wires to add to this terminal soon.

TECH NOTE: MM MP100-460 transformer uses a blue and a grey wire in place of the two red wires in part B, and a yellow wire in place of the red w/yellow stripe in part C. Refer to the diagram for this transformer in the appendices.

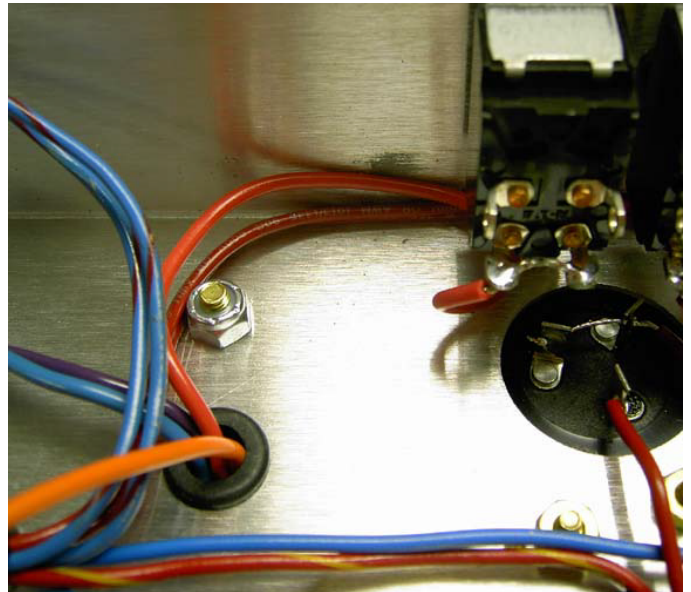
Step 10 cont.

- D.** One of the blue bias wires is already attached to a ground lug; route the other next to the red/yellow wire as shown. (You might use some masking tape to label this wire “Bias” to keep things organized if you like.)

TECH NOTE: MM MP100-460 transformer uses a white wire in place of this blue wire. Route the white bias wire as above and label “Bias.”

- E.** For those wiring for 120V operation take the red 120V wire from the PT primary and route it to the front of the chassis with the previous red wires as shown. Cut it long enough to strip back about 3/4” of insulation. Run the wire through BOTH bottom terminals of the power switch. Solder these connections, leaving a little space on the terminal that the wire goes to first; we will add another wire here soon.

TECH NOTE: MM MP100-460 transformer’s primary color code is the same as the MetroAmp 1203-80-MS transformer’s primary. Follow the instructions as written for wiring the primary of this PT.

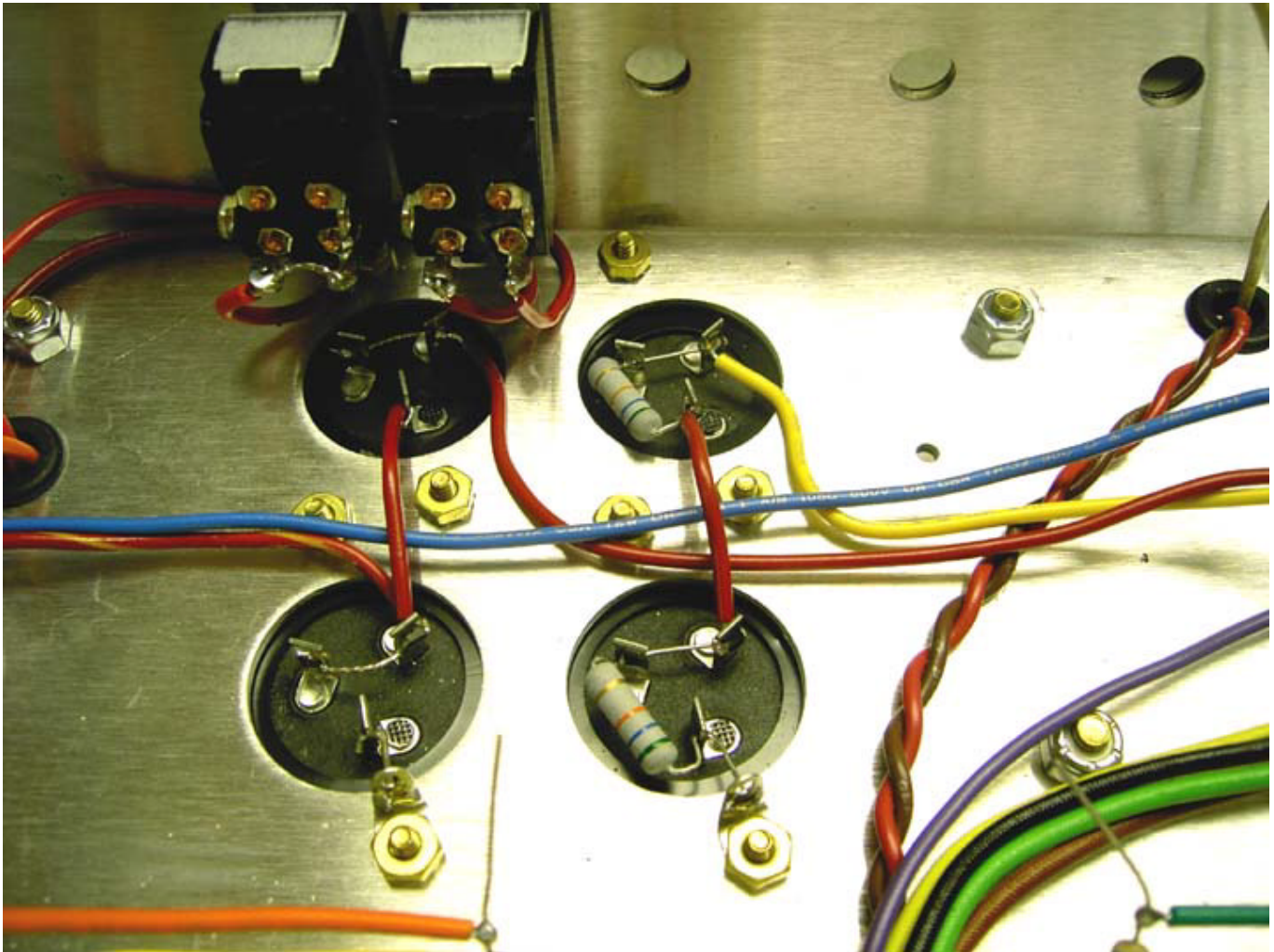


TECH NOTE: International builders may have to substitute either the blue (220V) tap wire OR the violet (240V) tap wire in the above instructions to operate the amplifier at the correct wall voltage.

Step 10 cont.

- F. Cut (2) 2" red wires, (1) 7" red wire and (1) 6" yellow wire. Strip 1/4" of insulation from each end of the 2" red wires; 3/4" of insulation from one end of the 7" red; and 1/4" of insulation from the 6" yellow wire.**

The first 2" red will jumper the black negative terminal of the F5 cap to the positive terminals of the F4 cap. The wire will be slightly up in the air in a hump when attached as shown below; other wires in the harness will route underneath them to keep things neat. The second 2" red will jumper from the black negative terminal of the F3 cap to the positive terminals of the F2 cap in the same fashion.

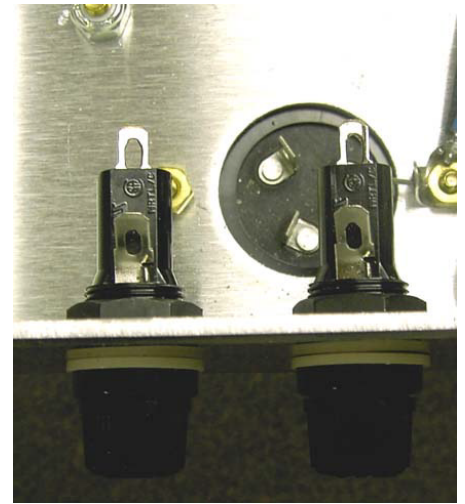


- G. The 7" red wire will connect to the positive terminals of the F5 cap; route it through one terminal and across to the other terminal. Solder these connections but leave some space in the outside terminal for another wire we will need to add. Label this wire "Rectifier" with tape if you like.**

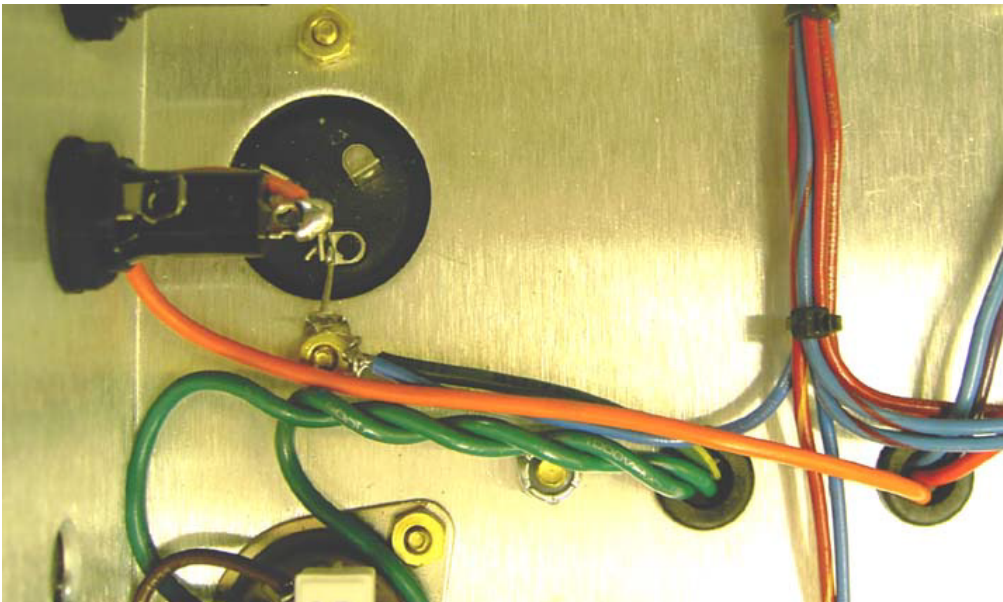
The 6" yellow will attach to the F3 cap's positive terminal as shown. Route these wires neatly towards the center of the chassis as shown (the red will route under one of the jumpers.)

Step 10 cont.

- H. Install the (2) fuse holder sin the back panel of the chassis. Bend the upper tabs gently upward to avoid burning the fuse holder casings when soldering.**

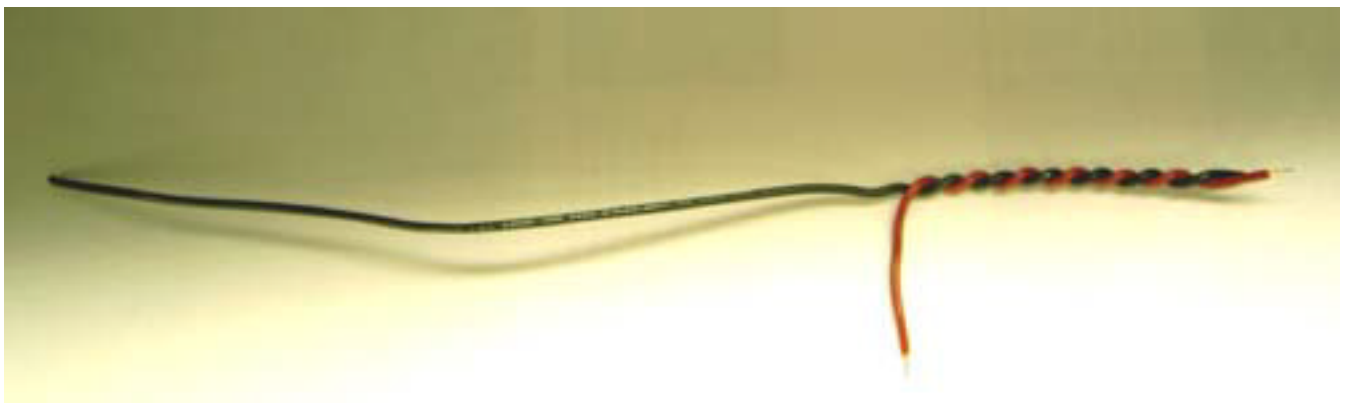


- I. Route the orange common wire from the PT primary to the end terminal of the mains fuse holder as shown below. Solder it in place but leave a little space for another wire to be attached later.**



TECH NOTE: MM
MP100-460 users,
your connection is
again the same.

- J. Cut a 6" red wire and a 13" black wire. Strip 1/8" of insulation from one end of each wire and twist together as shown below.**



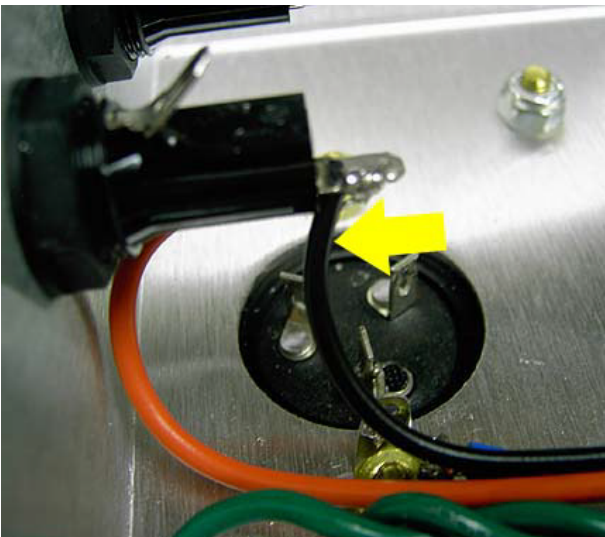
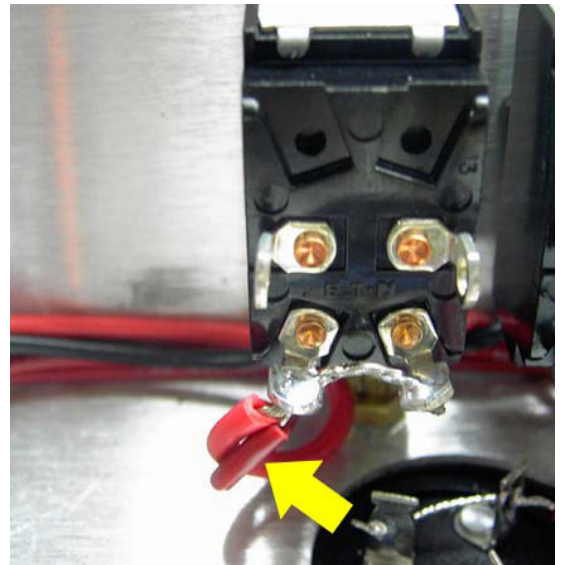
Step 10 cont.



- K. Mount the 120V indicator light in the chassis front panel. Take the red and black twisted wires and solder them to the light as shown at left. Route them up to the front of the chassis and under the switches.**

- L. The red wire from the indicator light will solder to the power switch as shown.**

TECH NOTE: International builders using the 220V or 240V taps to the power switch **DO NOT** make this connection. Instead the red wire must connect to the red 120V wire on your transformer for the light to operate correctly. Splice the two wires together with solder and shrink wrap. Reference the diagrams for international operation in the appendices.



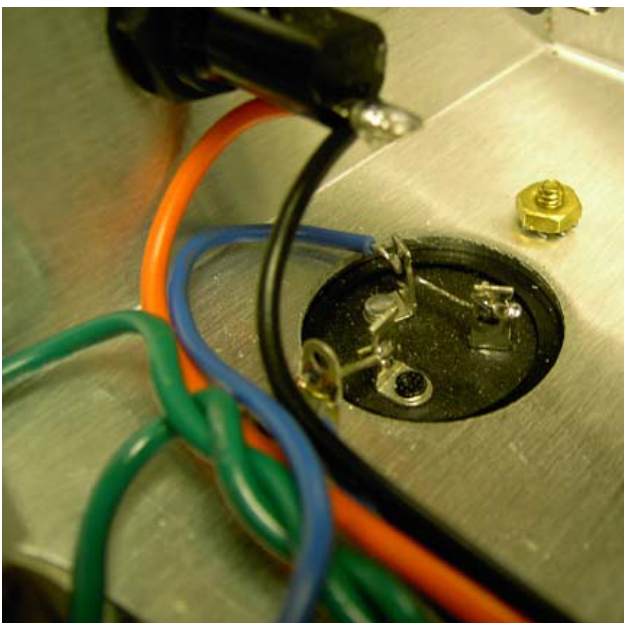
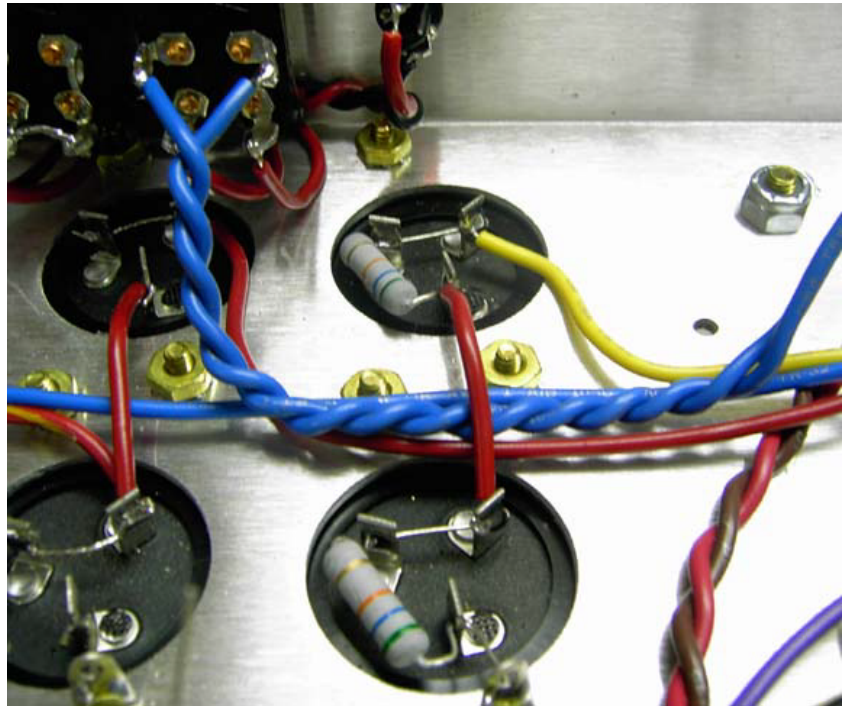
- M. The black wire will route to the mains fuse holder's end terminal with the orange common wire from the transformer as shown for 120V, 220V or 240V operation. Solder in place.**

Step 10 cont.

- N. Cut two 7" blue wires. Strip 1/4" off of one end of each wire, then twist them together tightly as shown below.**



- O. Solder one of the blue wires to each of the upper terminals on the standby switch. Route them under the F2/F3 red jumper towards the center of the chassis as shown at right. (Use some tape to label these wires "B+" if you like.)**

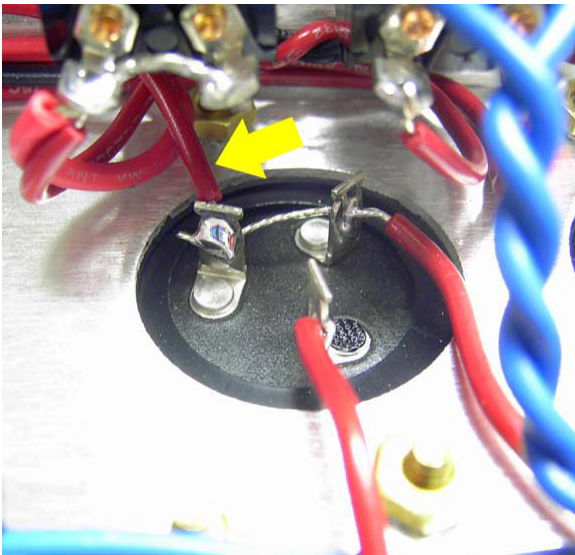
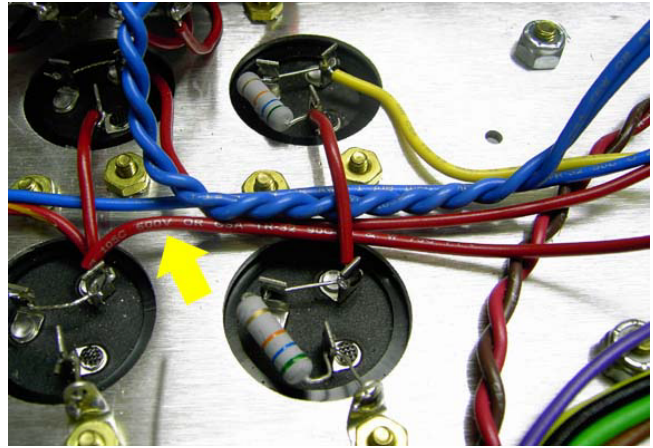


- P. Cut a 16" blue wire and strip 3/4" from one end. Run the stripped end through the two positive terminals on the F6 cap and solder these connections.**

Route this blue wire in front of the power tube sockets for now.

Step 10 cont.

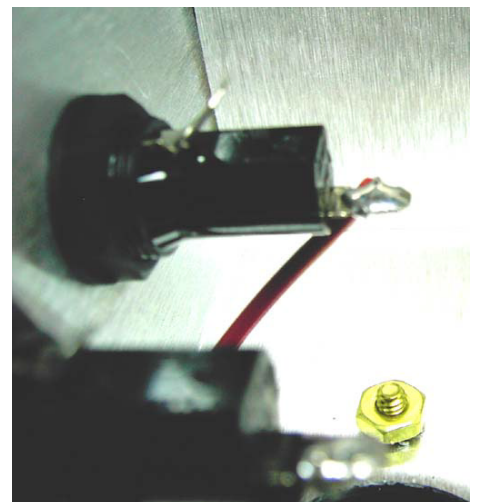
- Q.** Cut a 5" red wire and strip 1/4" from one end. Attach it to the F4 cap as shown. This is the last connection to this terminal; solder it completely. Route the wire towards the center of the chassis as shown at right. Label the wire "Snubbers" with tape if you like.



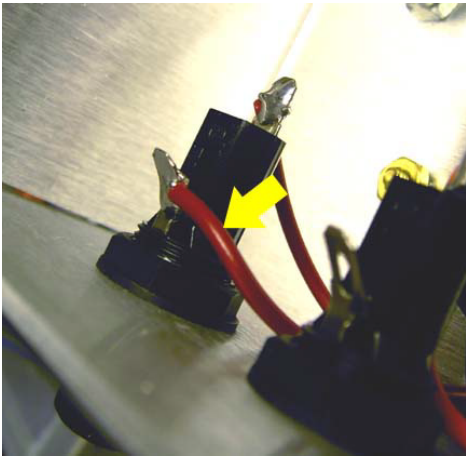
- R.** Cut a 12" red wire and strip 1/4" off of each end. Attach one end to the F5 cap as shown at left; solder this connection completely, with extra care not to burn any of the wires surrounding it. Route the wire to the back of the chassis as shown below.



- S.** The other end of this red wire solders to the HT fuseholder's end terminal as shown.



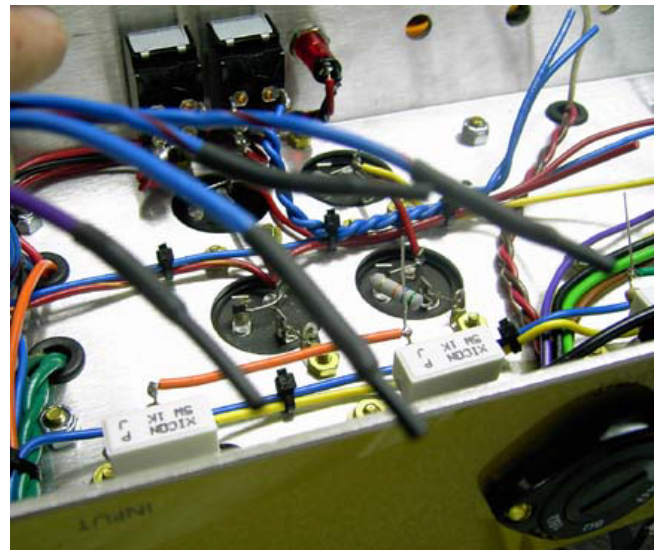
Step 10 cont.



- T. Cut a 14" red wire and strip 1/4" off of one end. Solder this wire to the upper terminal of the HT fuseholder as shown. Route it in front of the power tube sockets for now.**

- U. At this point we have made all the necessary connections. There should be two blue w/red stripe wires left, along with a blue and a violet from the PT primary voltage taps. (International builders will only have one voltage tap wire left, either the blue or the violet depending on the wall voltage needed in your locality.)**

Cut the ends of these remaining wires flush and shrink wrap them as shown.

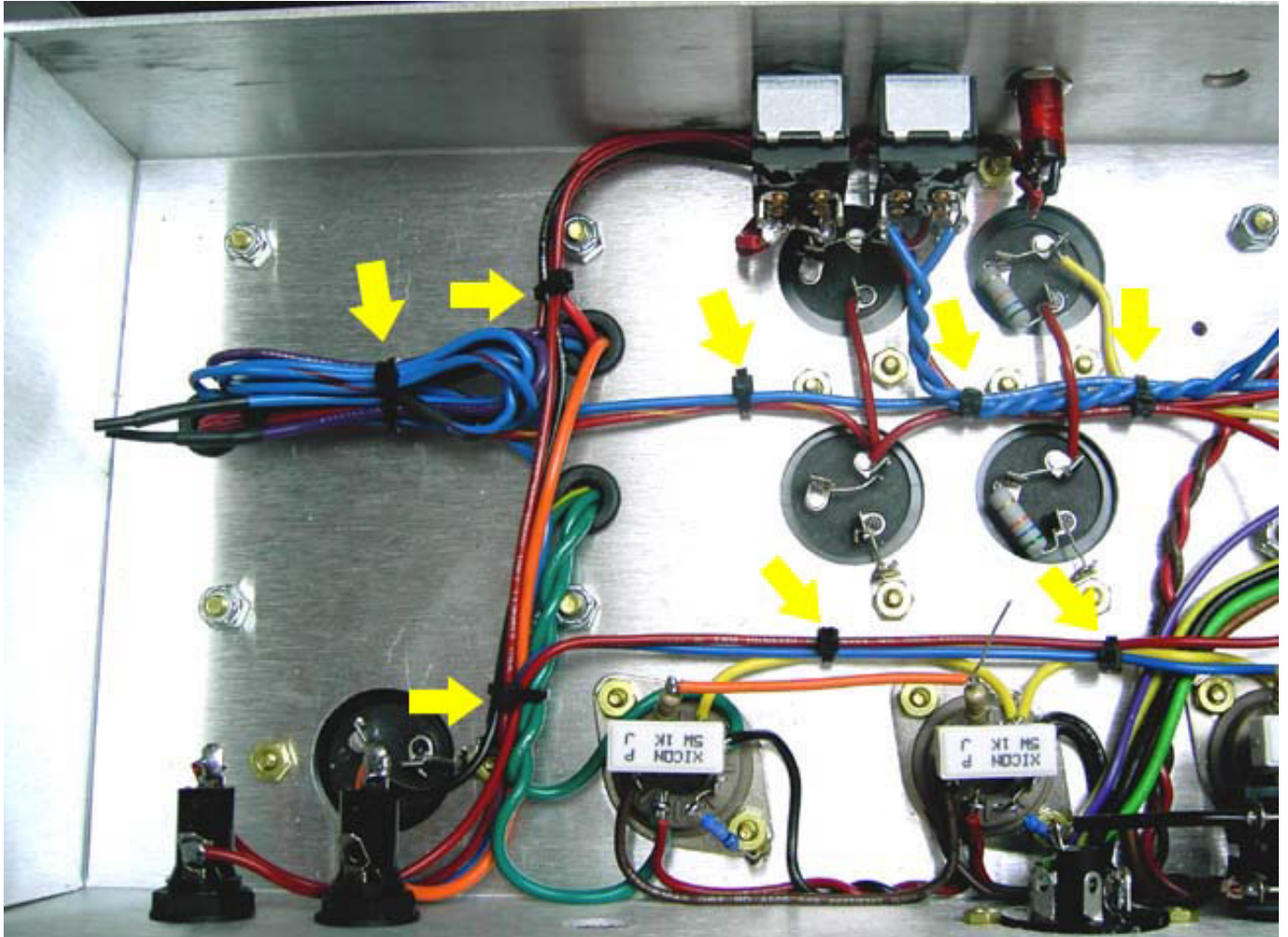


TECH NOTE: Only the MetroAmp 1203-80-MS PT will have the blue w/red stripe wires. These wires offer a high voltage output of about 80% of typical output and are not needed for this kit's construction; however, a modification kit can be ordered separately from Metropoulos Amplification to allow the selection of either high or low voltage operation.

MM MP100-460 transformer does not have this lower voltage option and hence does not have these two wires. Cut flush and shrink wrap any remaining primary voltage tap wires only.

Step 10 cont.

- V. Take (8) wire ties and tidy up your wiring harness as shown below. One tie will secure the extra PT wires safely out of the way. The rest will keep your wiring harnessing securely in place and neat.

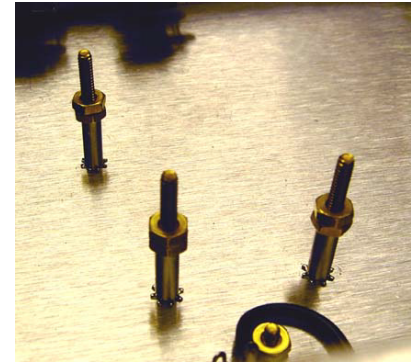


When finished clip the extra “tail” off the ties. If you’ve been patient and careful you will note how easy it is to find and follow each wire in the harness. Nice job!!

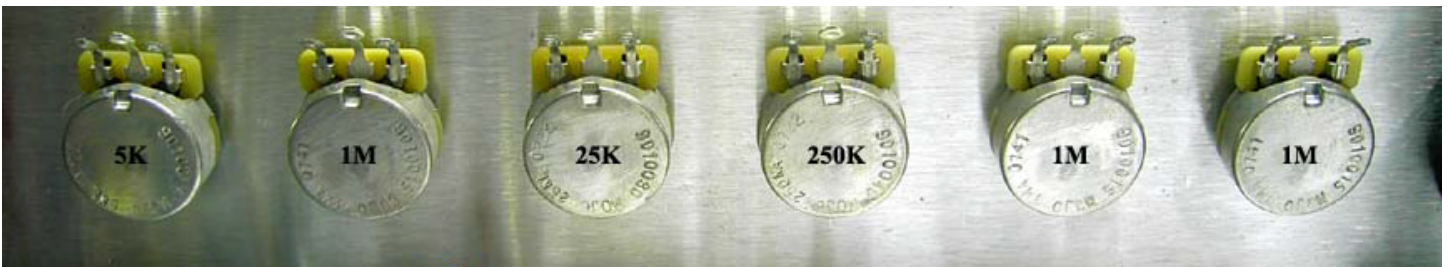
STEP 11: BOARD MOUNTS, CONTROLS AND INPUTS

- A. Install the (6) turret board mounting bolts as shown at right (not all are pictured.) The hardware sequence is:

BOLT - FLAT WASHER - CHASSIS - STAR WASHER - SPACER - NUT - NUT



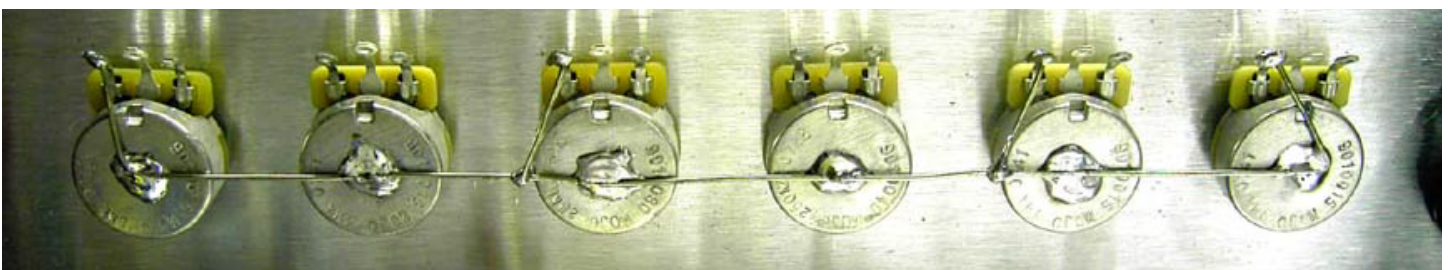
- B. Install the control potentiometers in the positions shown below: Presence 5K, Bass 1M, Middle 25K, Treble 250K, Volume I 1M, Volume II 1M. These values are typically stamped or printed on the potentiometer casing for identification.



- C. Cut a piece of 18 gauge buss wire, about 9-1/2" long. Both ends will receive a bend roughly 7/8" in as shown below, which will go through the last terminal of the Volume II potentiometer and the last terminal of the Presence potentiometer.

Sand the backs of the potentiometer casings to help solder stick more easily. First solder the connections to the potentiometer terminals; this will keep the buss wire in place. Then solder the buss wire to the back of each potentiometer. Be patient and apply enough heat to let the solder flow easily, but no more; excessive heating could potentially damage the potentiometer.

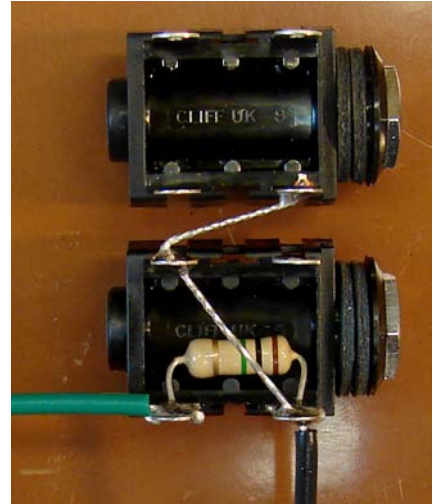
Cut two more small pieces of 18 gauge buss wire, and make a small hook in each end. Run one hooked piece through the last terminal of the Middle potentiometer, and the other through the last terminal of the Volume I potentiometer. Solder these connections. Then hook each piece around the buss wire, trimming any excess. Solder these connections to the buss wire as shown below.



Step 11 cont.

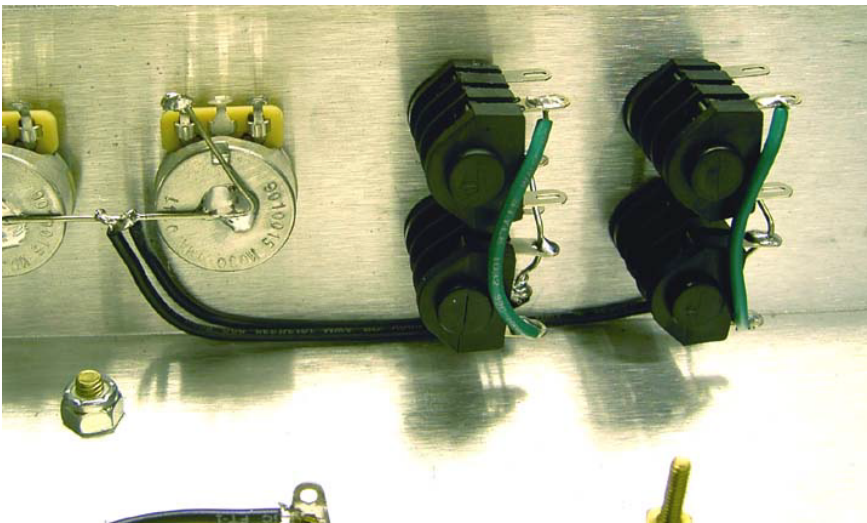
- D. Prep (2) pairs of Cliff Old-Style Jacks. Each pair of jacks will need (1) 1M, a 2" piece of buss wire, and a 2" piece of green wire. The pair of jacks for Input II's holes will need a 6" piece of black wire; the pair for Input I's holes will need a 4" piece of black wire. Strip 1/8" off one end of each black wire, and both ends of the green wires.**

Mount the 1M resistor as shown. A touch of solder to hold it is nice, but be sure not to fill the terminal holes yet. Run the buss wire from the top back terminal of the jack to the bottom front. Solder the top connection to hold it securely. Place the black wire in the bottom front terminal with the resistor lead and buss wire, and solder. Place the green wire in the bottom back terminal with the other resistor lead and solder.



Bend the buss wire forward and run it through the bottom front terminal of the second jack in the pair and solder. Trim any excess buss wire.

Repeat this procedure for the second pair of jacks.



- E. Install the jacks in the chassis holes (remember, the pair with the longer black wire goes in the Input II holes.)**

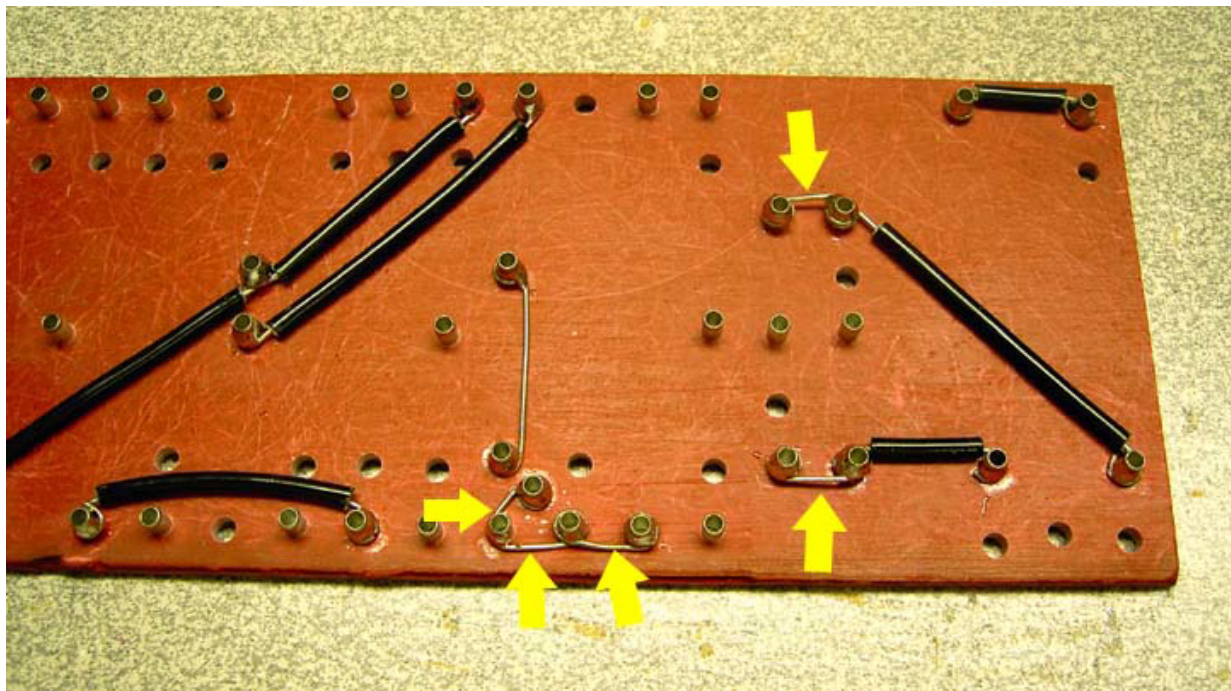
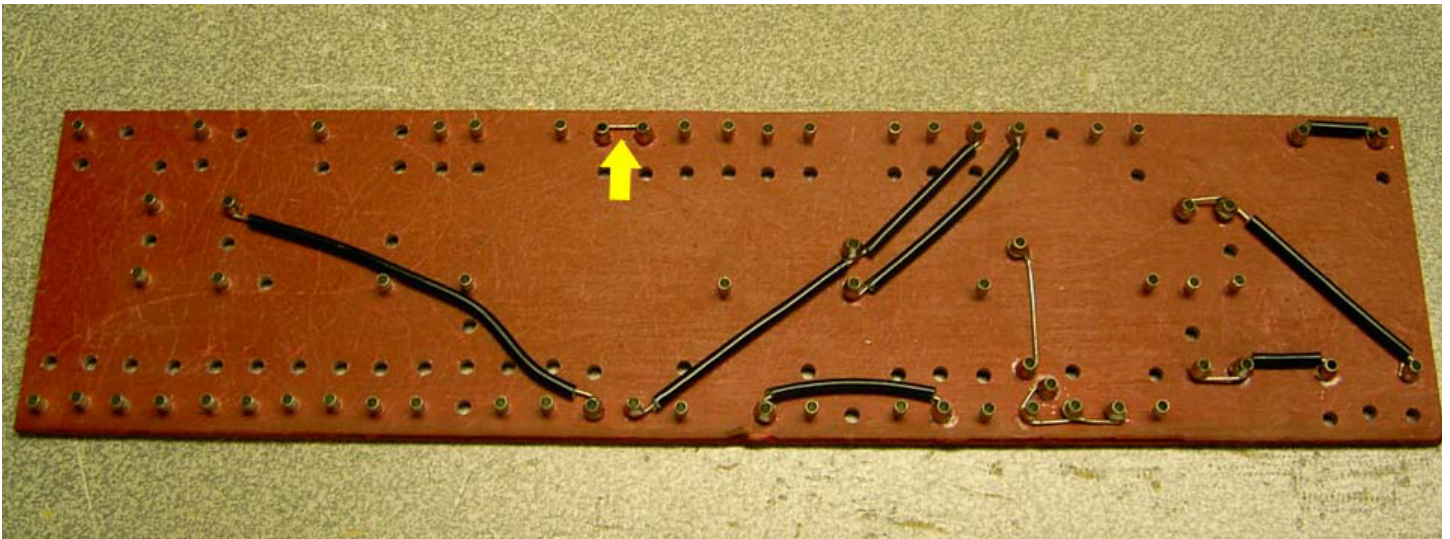
Route the black wires to the buss wire on the back of the potentiometers. Trim any excess and strip 1/8" from the end of each. Bend a small hook in each and

crimp the wires onto the buss wire with needlenose pliers. Solder these connections.

Strip 1/8" from the remaining end of each of the green wires and solder to the top back terminal of the upper jack as shown.

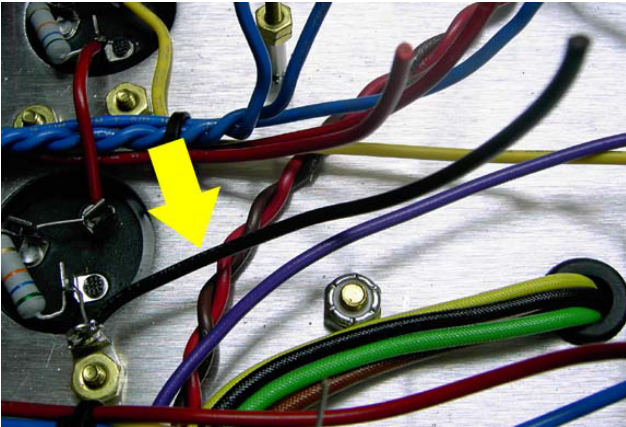
STEP 12: TURRET BOARD PREPARATIONS

- A. There are a number of connections that must be made on the turret board with 22 gauge buss wire and the black insulating tubing. Reference the pictures and diagrams for these connections. Check which terminals to connect very carefully before trimming the buss wire and tubing and soldering into place; a mistake here could be costly later. The connections are illustrated below, with some easy-to-miss connections highlighted with arrows:



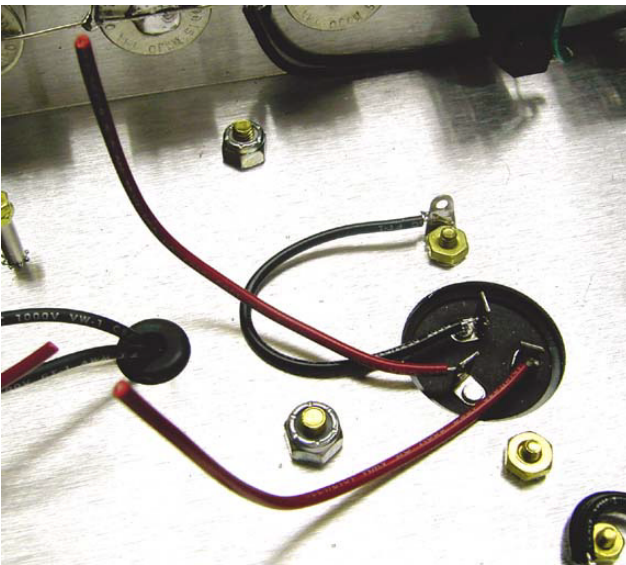
Allow enough extra buss wire at the end of each piece to wrap around the turrets for a solid connection before soldering. Some close connections work best with one longer piece of buss wire that wraps around each terminal, such as the area at the bottom of the picture above.

Step 12 cont.



- B. There are three more wires that must be added before the turret board can be installed in the chassis.**

Cut a 5" piece of black wire. Strip 1/4" off of one end and solder it into the hole we left empty on the F2 cap's ground lug.

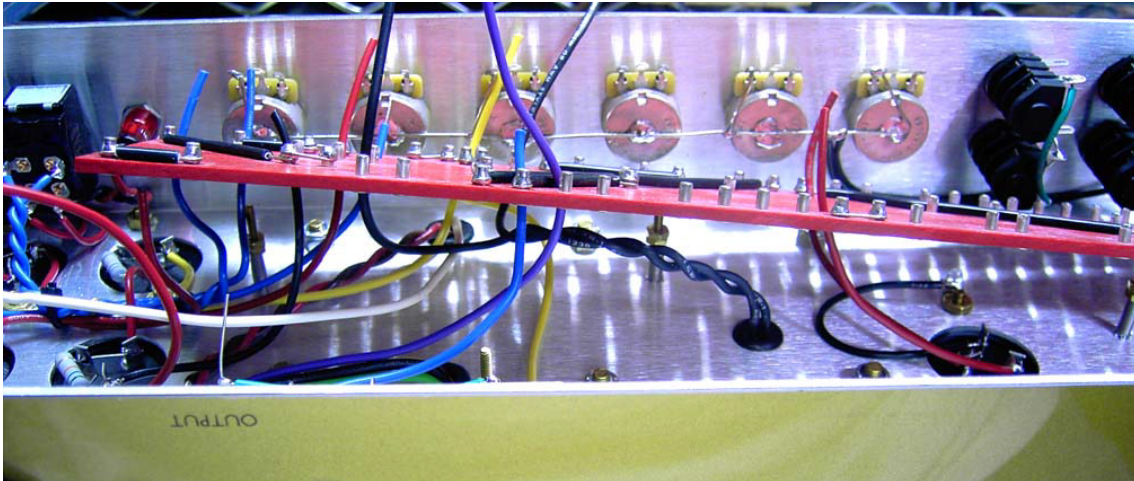


- C. Cut (2) 4" pieces of red wire. Strip 1/4" off one end of each wire. Solder one wire to each of the empty positive lugs of the F1 cap as shown at left.**

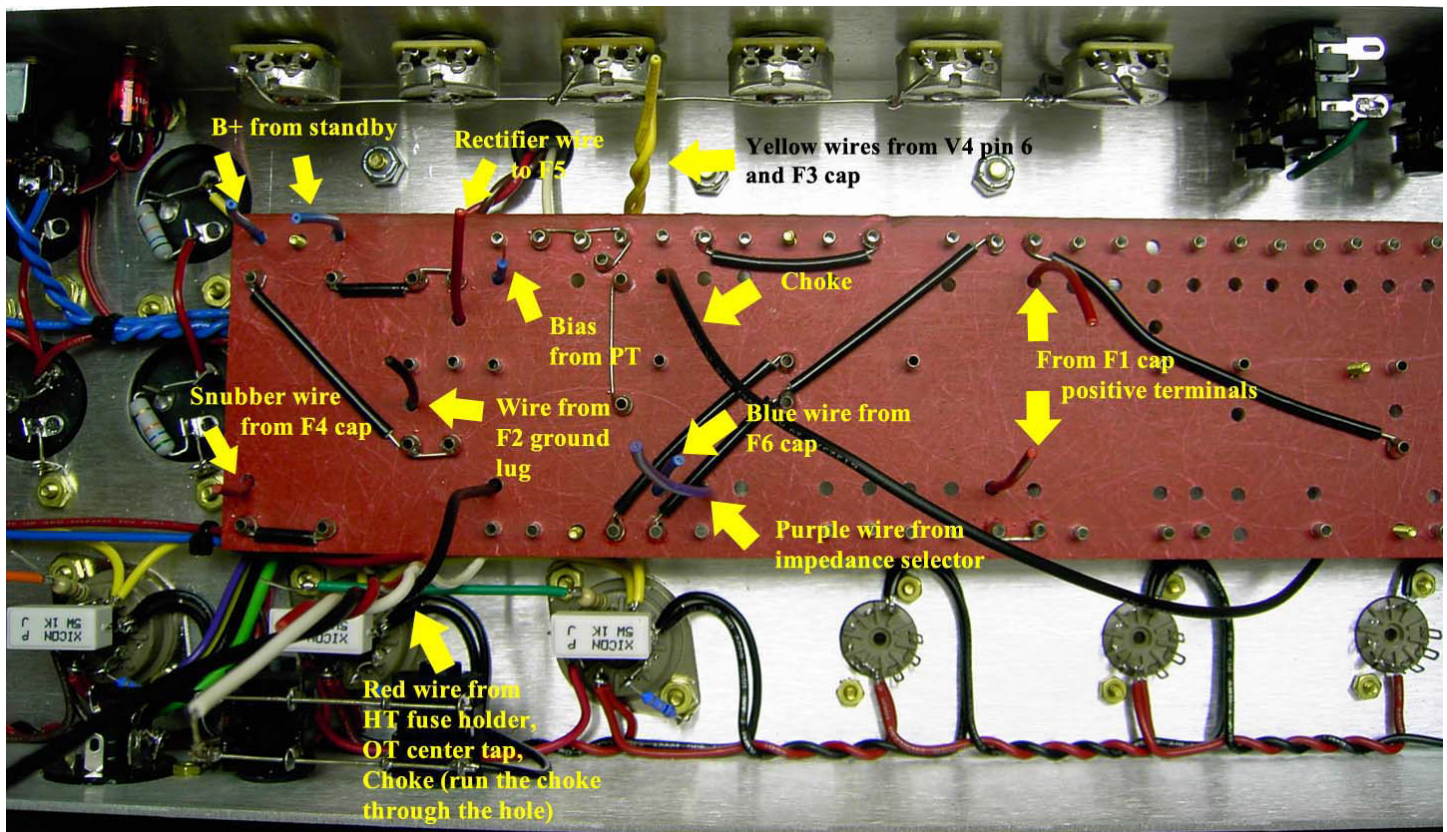
Close to the home stretch!!! Let's install that turret board.

STEP 13: INSTALLING THE TURRET BOARD

- A. Set the turret board into the chassis. Using the pictures below and the amp wiring diagrams in the appendices, route the loose wires in the chassis through the appropriate holes in the turret board. Be absolutely sure of where each wire is going before moving on, and reference the illustrations often; there's no room for confusion here! The wires come up from underneath as shown below.



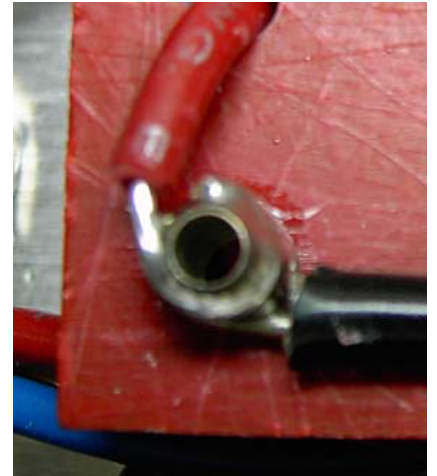
There are two turrets that act as junction points for three wires each, so some wires will come up around the edge of the turret board while others go through a hole in the board. This is illustrated below, and wires are labelled to help you stay clear on what is going where. Patience! If you've been labelling your wires this will be a snap.



Step 13 cont.

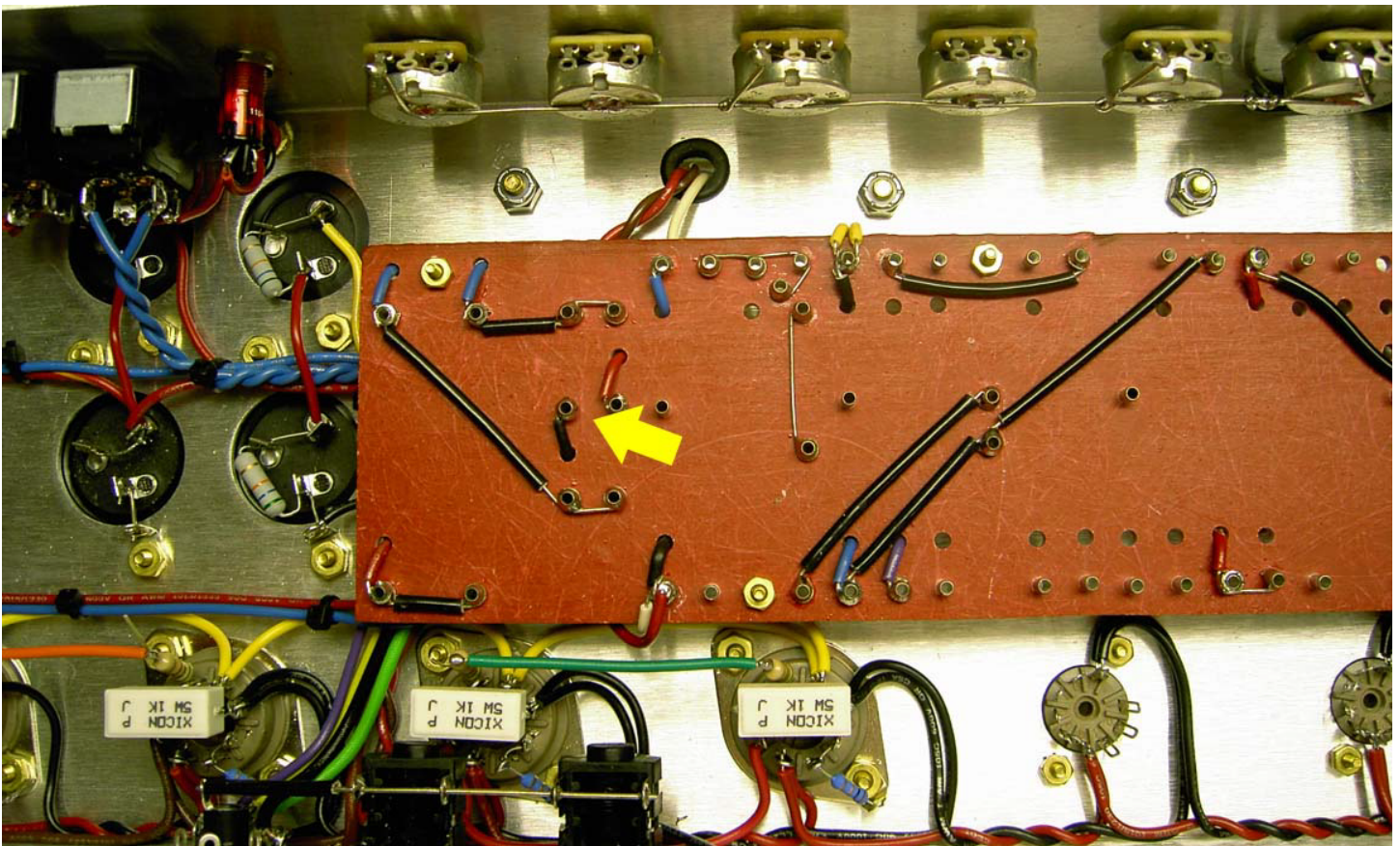
- B.** Once the wires are routed through their holes we can start connecting and soldering them to their respective turrets.

Here's a look at how the connections are made. Strip about 3/8" of insulation off of the wire. Twist the bare strands together and give them a touch of solder so that they hold together -- use just enough solder that you see it "suck" into the wire strands. Now we can wrap the bare wire around the turrets for a solid connection that will solder nicely to the turret.



Again, pay careful attention to the picture below and the wiring diagrams in the appendices to be sure of each connection. The wires will connect to the turret right next to the hole they came through.

Pay extra attention to the points marked with an arrow below; this is a common point for mistakes, which will result in blown fuses and wrong voltages if not correct!



Take a close look at the two turrets that act as junctions for three wires. These are tricky and will require an extra burst of patience. Wrap them tightly on the turret!

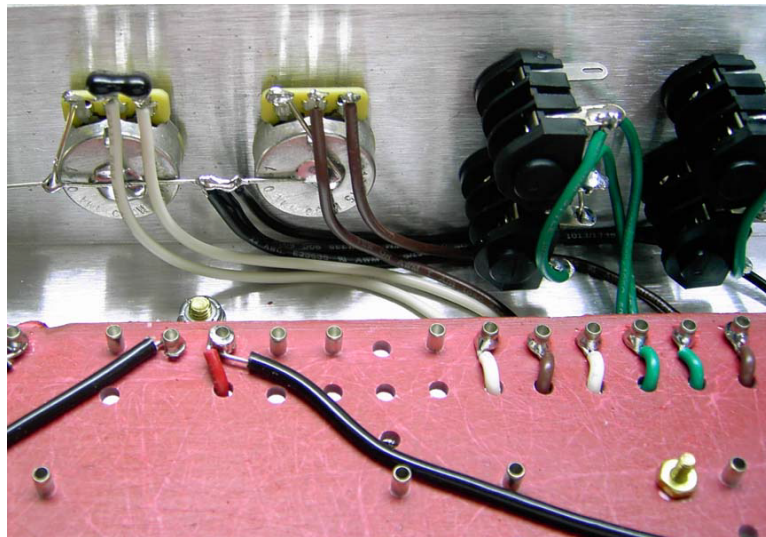
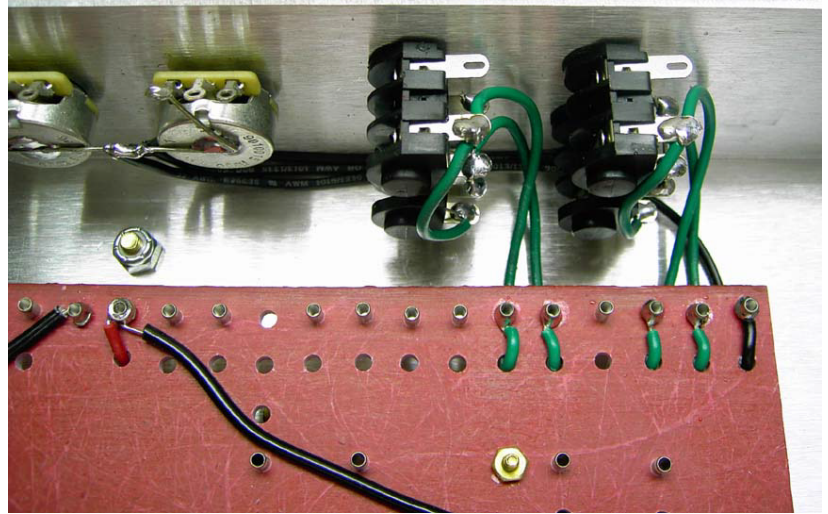
STEP 14: WIRING THE TURRET BOARD -- CONTROL PANEL SIDE

Let's start wiring the control panel side of the turret board. The procedure for attaching the wires to the turrets is the same -- strip 3/8" of insulation, run a little solder into the strands of wire to hold them together (called "tinning") and wrapping them around the turret to be soldered in place. In this case we'll attach the wire *first* however, and then run it through the hole in the turret board and on to its final connection.

Although there will be a picture of each section we wire, it is still recommended to reference the wiring diagram in the appendices often. Let's get started!

- A. Cut a 9" black wire and (4) 5" green wires. The black wire goes from the first turret at the far end of the board to the ground buss wire at the controls as shown -- connect it with the input grounds and tuck it neatly underneath.

The green wires will go from the turrets shown, to the input jacks. There are two pairs of green wires, a pair for each set of jacks. The right hand wire in each pair in the picture goes to the lower back terminal of the jack mounted at the bottom edge of the chassis; the left hand wire in each pair goes to the upper back terminal of the same jack as shown. (Don't get confused, since the chassis is upside down!)



- B. Next is the volume controls. Cut (2) brown wires, an 8" and a 6"; also cut two white wires, an 8" and a 7".

The 8" brown wire attaches to the turret between the two pairs of green wires, and the other end goes to the first lug of the Volume II pot. The 6" brown wire goes from the turret shown to the middle lug of the Volume II pot.

Step 14 cont.

The 8" white wire goes to the turret between the last green wire and the brown wire two turrets away; from there it attaches to the first lug of the Volume I pot. The 7" white wire goes from the lug on the other side of the last brown wire and on to the center lug of the Volume I pot.

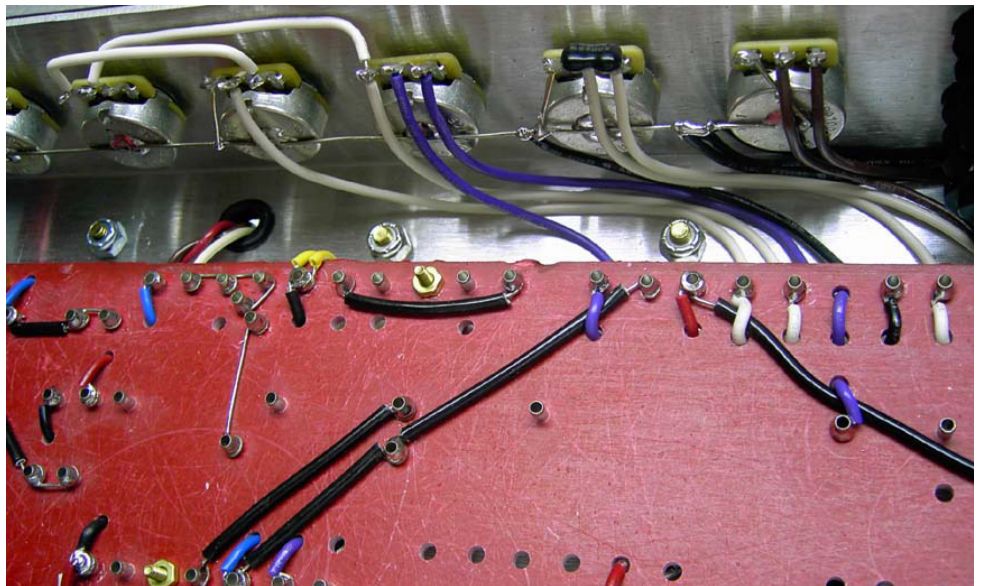
At this time Super Lead builders can add a 500pF capacitor across these same two lugs of the Volume I pot as shown. Super Bass amplifiers did not have this capacitor.

TECH NOTE: This capacitor is called a "bright cap" as its function is to allow some portion of high frequency signal to go around the volume pot altogether at lower settings, thus making the signal brighter. 500pF was a common value for late-60's amplifiers, but values from 100pF to 5000pF were used in different years and any of these values can be experimented with to tailor the tone of your amplifier after testing. As the value of the capacitor is increased, the range of frequencies being passed around the volume pot gets lower, going down into the midrange frequencies with the large 5000pF value. These large cap values are also the cause of later amplifiers having a large "jump" in volume early on in the volume control's range -- an undesirable effect in many players' eyes.

- C. Now we'll wire the tone controls section of the board. First cut a 6" black wire and attach it next to the last white wire from the previous step. The other end connects to the buss wire on the controls, between the Volume I and Treble pots.

Next cut (2) purple wires, one 8" and the other 5" long. The 8" wire goes from a turret towards the middle of the board to the first lug of the Treble pot as shown. After running the wire through the first hole and out past the board, bend a hook in it and feed it back up through the second hole and carefully pull it snug, and then down through the last hole and on to the Treble pot.

Locate the turret shown for the second purple wire; connect it and then run it to the center lug of the Treble pot. Again, keep using the diagrams and pictures to avoid any mistakes.



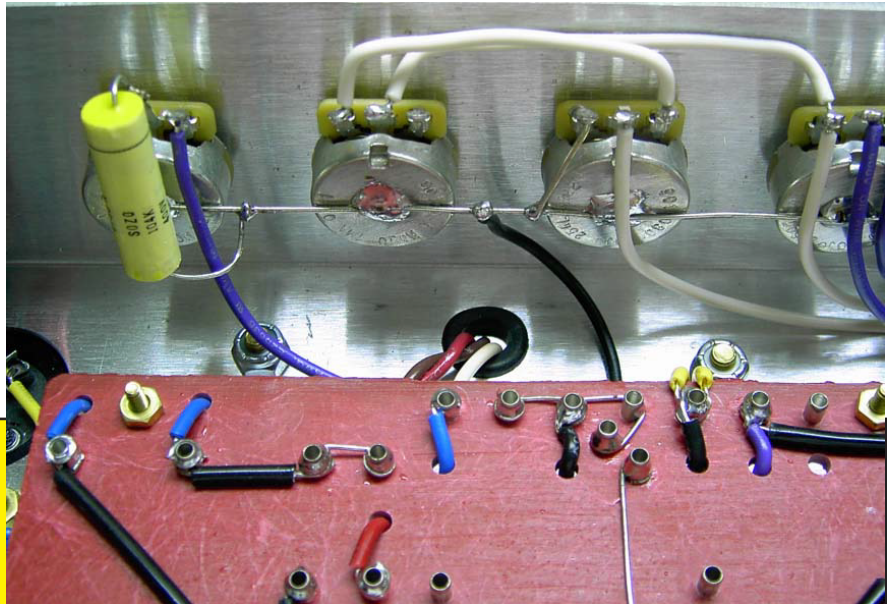
Step 14 cont.

For the Middle and Bass controls cut (2) 7" white wires, a 4" white wire and a 3" white wire. The first 7" white wire connects to the turret next to the purple treble wire; the other end will actually connect to the last lug on the Treble pot, with one end of the 4" white wire. Solder this connection on the Treble pot's lug and then route the other end of the 4" white wire to the center lug on the Bass pot as shown.

Connect the other 7" white wire to the remaining lug between the two purple wires and on to the center lug of the Middle pot. Now use the 3" white wire to connect the first lug of the Middle pot to the last lug on the Bass pot as shown.

- D. The Presence control only requires one purple wire, 8" in length. Connect it to the lug shown at right, then tuck it under the edge of the turret board and connect it to the first lug of the Presence pot.

TECH NOTE: Routing the wire to the Presence control too close to the other tone control pots and wires can result in squealing at higher volumes; tucking it under the turret board edge away from the other tone control wiring is usually all that is required to control these issues.



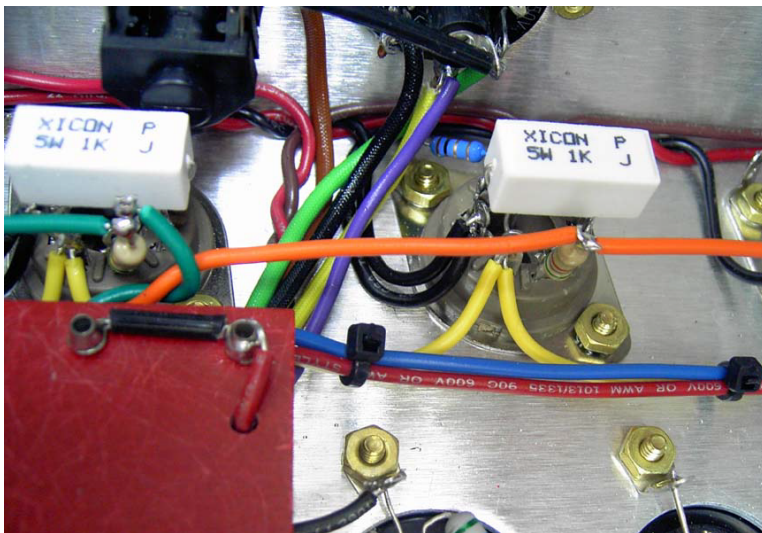
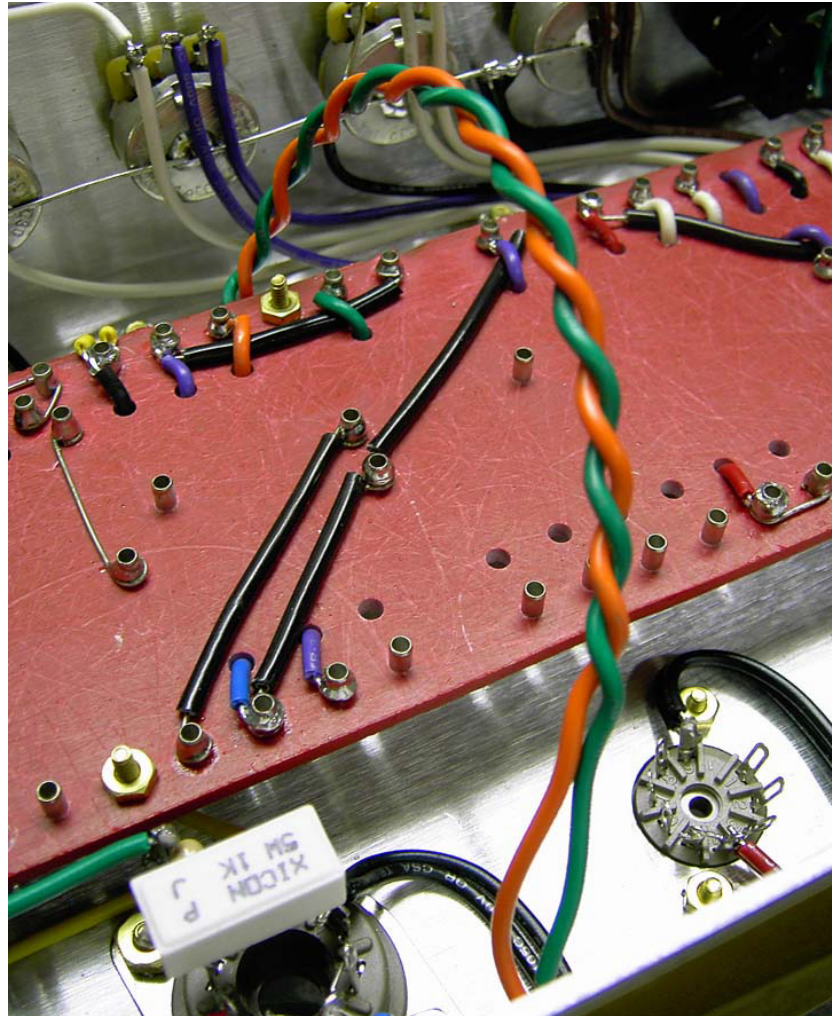
- E. Find (1) .1uF capacitor to install on the Presence control. One end connects to the center lug as shown; the other end grounds to the buss wire on the control pots, between the Presence and Bass controls. A detail photo is at left.
- F. Cut a 5" piece of black wire. Note the group of four lugs in the above picture that are connected together with buss wire; this piece of black wire will connect to the center lug on the edge of the board as shown, and then attach to the buss wire on the control pots between the Bass and Middle controls. (This is the ground for the amplifier's bias circuit.)

Step 14 cont.

- G.** There are two more wires that need to connect to this side of the turret board. Cut a 10" green and a 10" orange wire. Attach them to the empty turrets shown in the picture below and in the diagrams, and route them through their holes. Once they are routed through, you will need to twist them as tightly and evenly as possible as shown.

Now comes the tricky part: this twisted pair of wires must route carefully under the turret board and come out on the other side of the chassis, between the V5 and V6 tube sockets. Gently lifting the turret board up can help you to see where they should go and get them pulled through successfully.

When they are routed in place, they will connect to the extra leads of the 5.6K resistors mounted to pin 5 of the V5 and V6 tube sockets. Cut the wires to length with as little slack as you can, with just a little extra to strip back about 1/4" of insulation. Tin the wires and make a small hook in each.



Make a similar hook in the leads on the two 5.6K resistors, so that you can connect the green wire to the 5.6K on V5, and the orange wire to the 5.6K on V6. Crimp these connections down with needlenose pliers, and solder them. Reference the picture at left. Make sure the resistors are positioned away from anything they might accidentally contact as shown.

Now you may tighten the nuts down that hold the board in place.

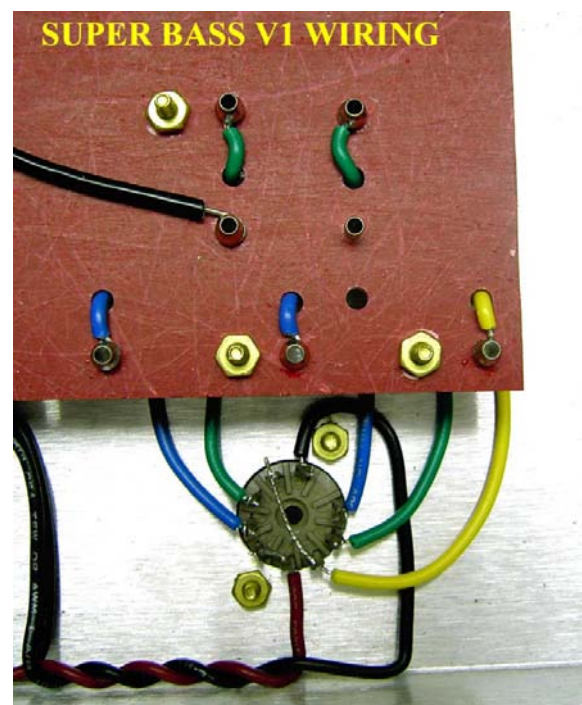
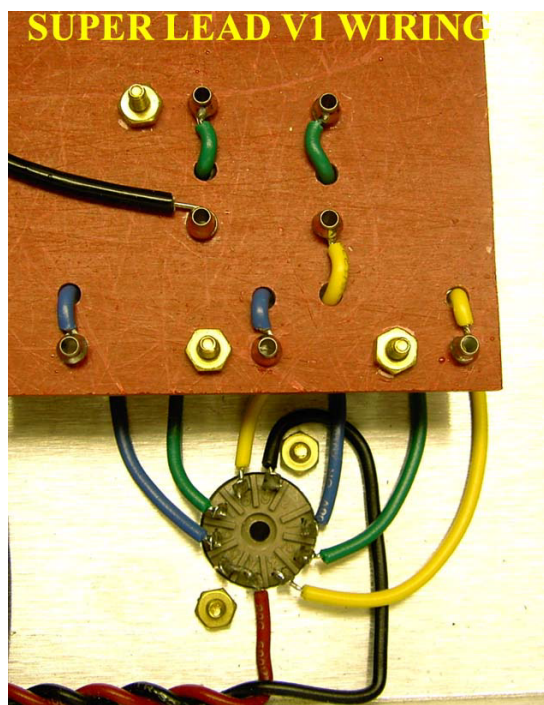
STEP 15: WIRING THE TURRET BOARD -- TUBE SOCKET SIDE

Now let's wire the tube socket side of the turret board. Start with 4" lengths of all wires we will be using, but be aware that this is a generous length to insure that you have plenty for all the connections we will make. Most of these connections do not need the full 4" length and should be cut down to make the wires as short and direct as possible before soldering to the tube socket pins.

Also note that certain colors of wire represent what they are carrying: in particular we are concerned with the blue wires (carrying high plate voltages to the preamp tubes) and the green wires (carrying sensitive input signals to the preamp tubes.) These two sets of wires often don't really play well together and must be handled carefully to keep your amplifier as quiet as possible. Mimic the pictures to try and keep them separated as much as you can. If they must cross each other, shift them around after soldering both ends and try to get them crossing at right angles to minimize any noise that will get picked up. Let's go!!

- A. We'll start off wiring V1, the first preamp stage for both channels of the amp. For a Super Lead amplifier, you'll need two blue wires, two yellow wires, and two green wires. Reference the picture below as well as the wiring diagrams in the appendices and install these wires as shown.

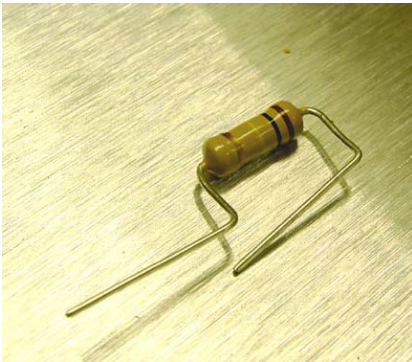
If you're building a Super Bass, you'll only need one yellow wire. Instead of a separate wire going to pin 3 and pin 8 of the V1 tube, you'll need to leave enough extra length of the yellow wire to strip back about 3/4" of insulation. Run this bare wire through pin 3 and across to pin 8 as shown, solder, and trim any excess that may be extending past the socket pins. One turret will be empty on the board.



Step 15 cont.

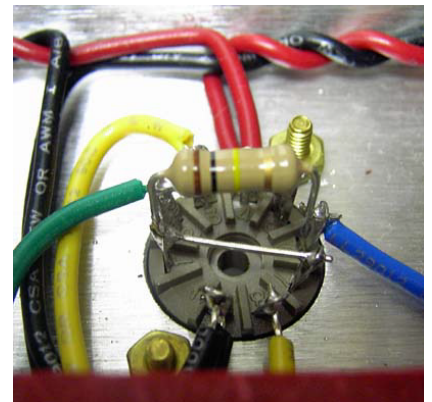
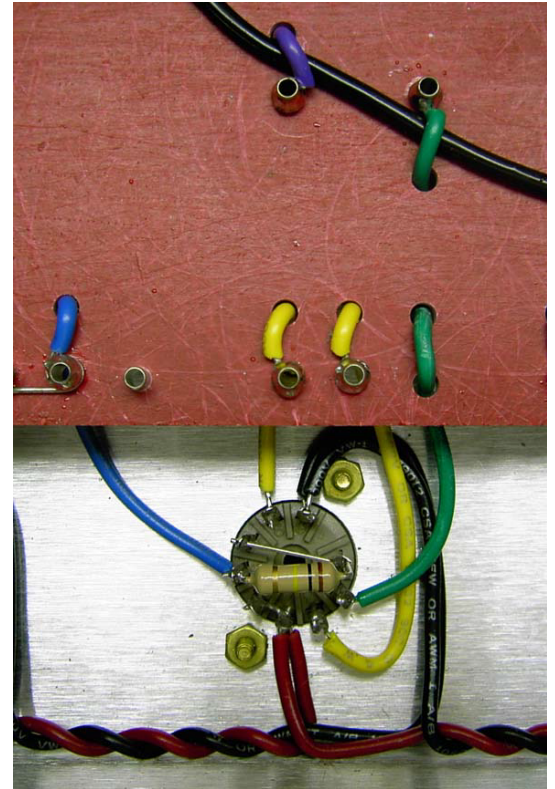
- B.** The V2 tube is where the two channels come together, and the tone controls are driven. You'll need one green wire, two yellow wires and one blue wire, as well as (1) 100K resistor. Solder the wires to the turret board, and go ahead and solder the yellow and green wires onto the V2 sockets (yellows at pins 3 and 8, green at pin 2.)

To attach the blue wire, you may want to make a small hook to hold it to pin 6 of V2 while we get the 100K resistor ready to attach.



Here's a detail picture of how to bend the resistor to get it in place on the tube socket. Notice that the "tails" are at a slight angle from each other.

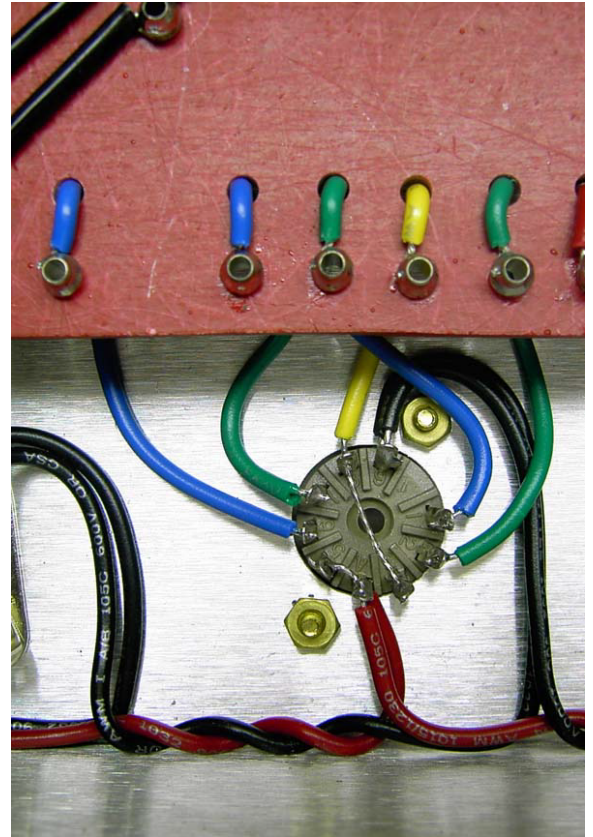
Now slide the resistor into place. The body of the resistor itself will go between pins 6 and 1. The tail under the resistor will go from pin 1 to pin 7. Now solder these connections (along with the blue wire at pin 6) and trim any excess resistor lead as shown.



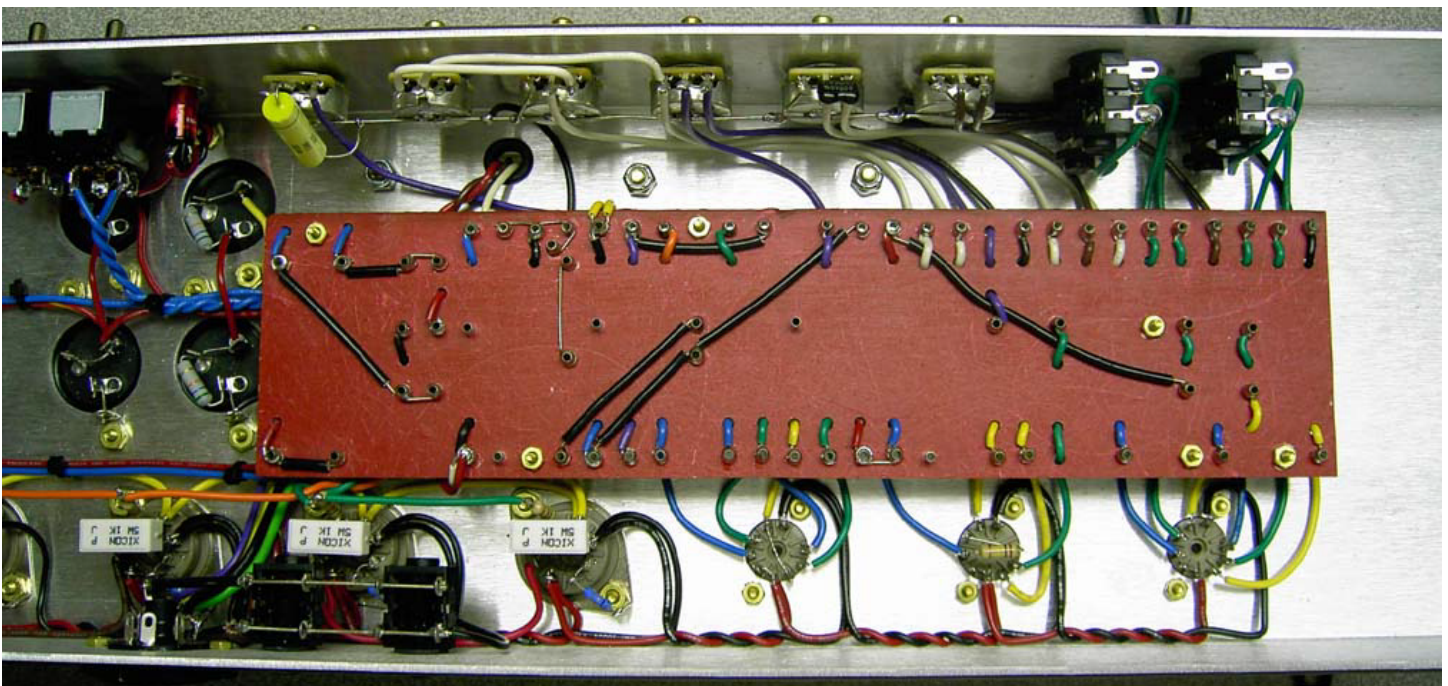
Step 15 cont.

C. The V3 tube is the “phase inverter” or “phase splitter” in the amplifier. Its network of components divide the incoming signal to drive the power amplifier section in two halves -- V4 and V5 will be “pushing” while V6 and V7 cool down, and vice versa, giving better amplifier efficiency and higher power.

You’ll need two blue wires, two green wires and one yellow wire. Attach them to the turret board, route them through the holes and solder to the tube socket as shown in the pictures and diagrams (blue wires at pins 1 and 6, greens at pins 2 and 7, and the yellow bridging across the socket to connect pins 3 and 8.) Getting the yellow wire to go to pin 8 first can be a tight squeeze; if necessary you may run the yellow wire to pin 3 first and then across to pin 8.



The chassis should now look like the picture below (a Super Lead is illustrated.) Take a few moments to double check all wiring connections before moving on to install the board components; corrections will be much harder to make with the components mounted in place.



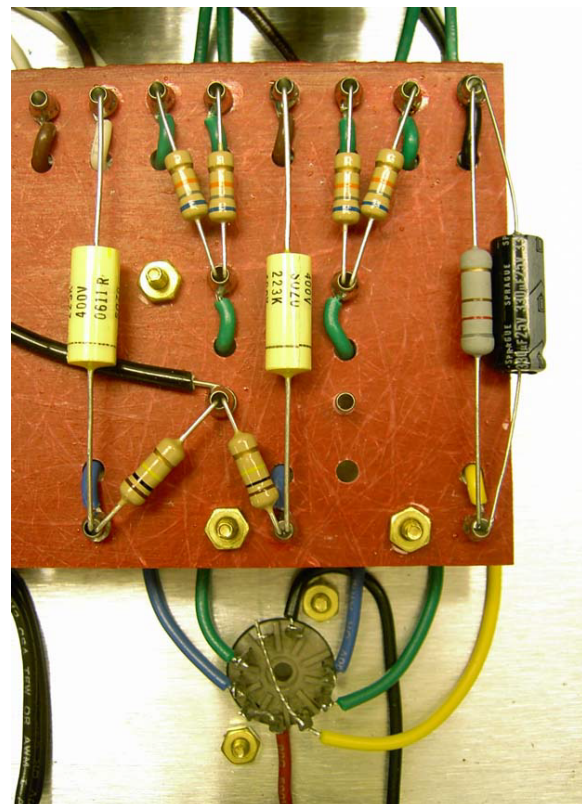
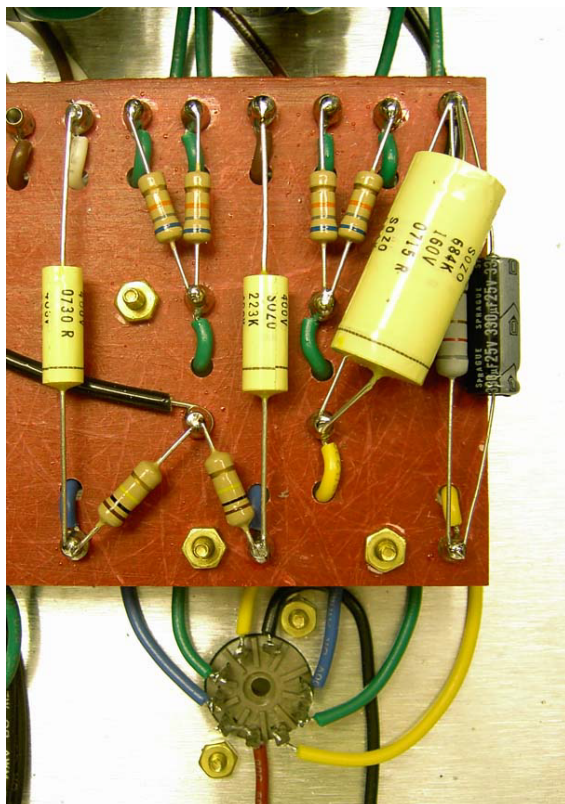
STEP 16: INSTALLING BOARD COMPONENTS

It's now time to install all the components on the turret board. Lay each component across the turrets it will connect to, and bend sharp right angles at the points where the component leads will go down into the turret (you may find it helpful to mark these points with a fine tip marker before lifting the component up to bend the ends.) Trim any excess lead off after bending; you only need about 1/8"-1/4" of lead going into the turrets, no more. Don't solder components into place until all components that may share a turret are laying in place. Heat the turret and component leads thoroughly to insure that the solder flows into the joints for a solid connection.

Pay careful attention to the components layout, as there are small differences between the Super Lead and the Super Bass. There is a color code chart included in the appendices as well, to help you identify the proper resistor values.

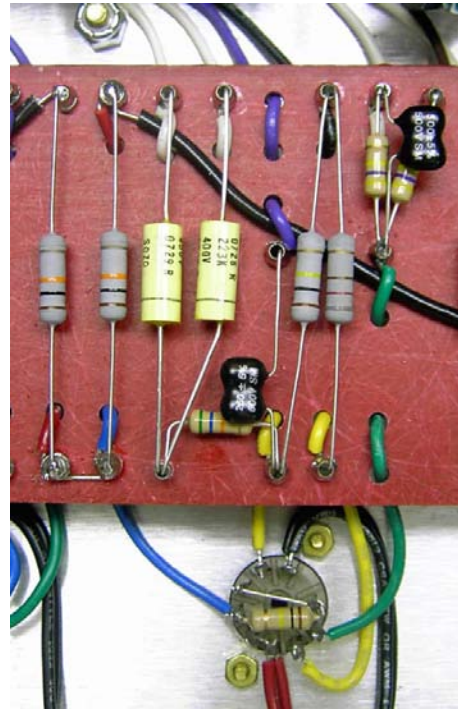
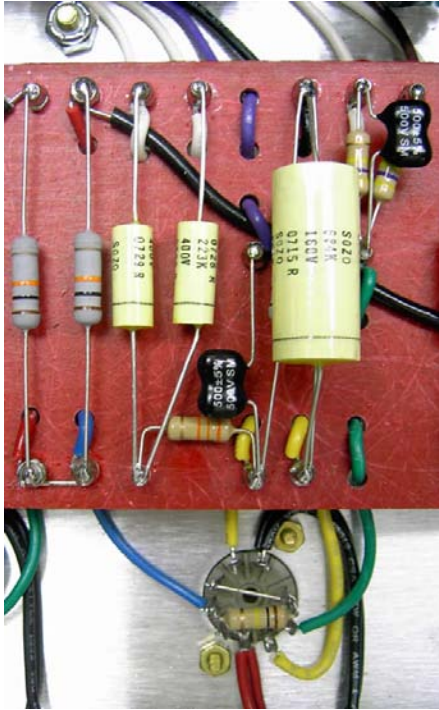
- A. Lay out the components for the V1 stages of the amplifier and get the ends bent and ready to solder. Note the differences between the Super Lead layout on the left and the Super Bass layout on the right. Two components are omitted in the Super Bass, and the capacitor on the far left of the picture is a different value.

Also pay close attention to the direction of the capacitor at far right in the pictures below; this part must be installed in the correct direction to function properly. The end with the dimpled ring is the positive end, and must be installed towards the tube socket side of the board.

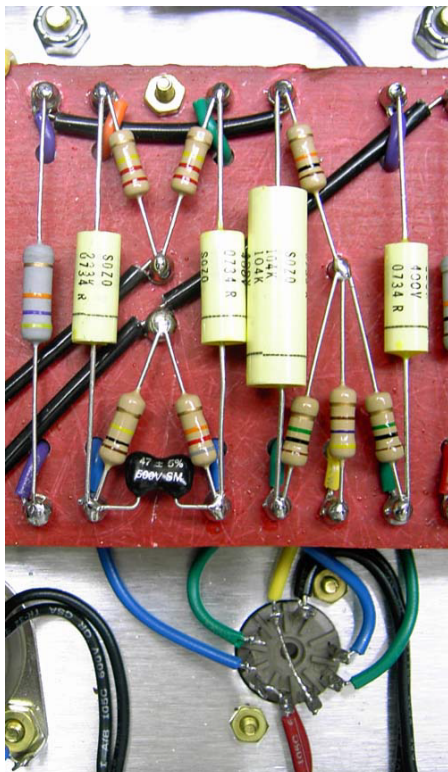


Step 16 cont.

- B.** Below are pictured the component layouts for the V2 section of the turret board. As with the first section of the board, there are slight differences between the Super Lead on the left and the Super Bass on the right; reference the component diagram for the amplifier you're building.

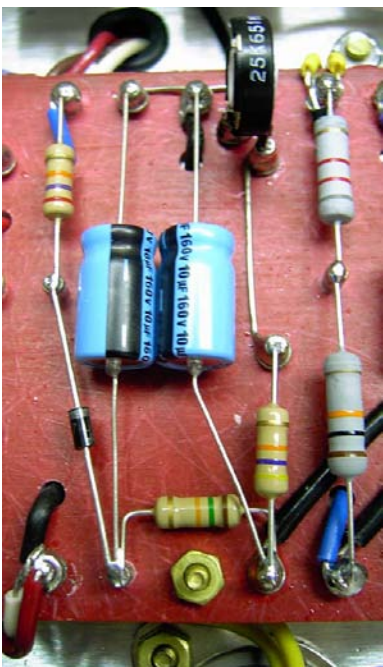


- C.** Here's the V3 section of the turret board, again with some small differences between the Super Lead at left and the Super Bass at right.



TECH NOTE: Whether you're building the Super Lead or Super Bass, pay special attention to the resistor marked at right. It's a 470 ohm resistor; a common mistake is to use a 470K resistor by accident, which results in high voltage readings on the V3 tube and very low output volume.

Double check the color code on the resistor or measure with your multimeter before installing.

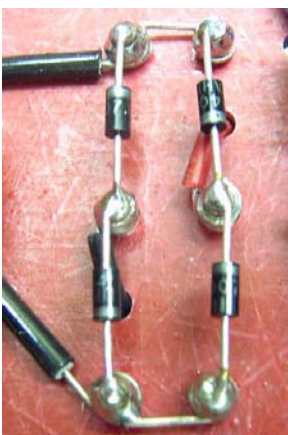


- D. Here's the bias circuit's section of the turret board, along with two resistors that help drop the voltages down for the preamp section of the amp. Again, pay close attention to the direction of the capacitors in this circuit; the dimpled positive end points to the control panel side of the turret board here. Make sure to place the diode (lower left in the pic) in the correct direction, with the silver band facing the control panel side of the amp.

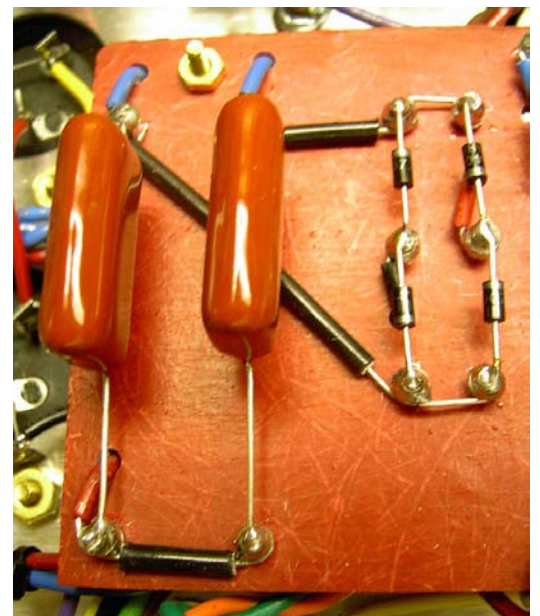
Use the upright bias pot from your components kit, with one leg installing in each turret. Solder carefully -- it's a tight fit!



- E. Lastly, here's the rectifier section of the turret board. It converts the AC voltages from your power transformer to the DC voltages that the amp requires to function.



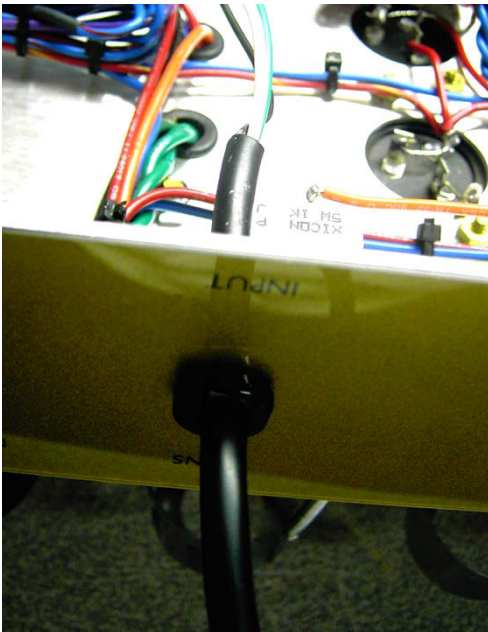
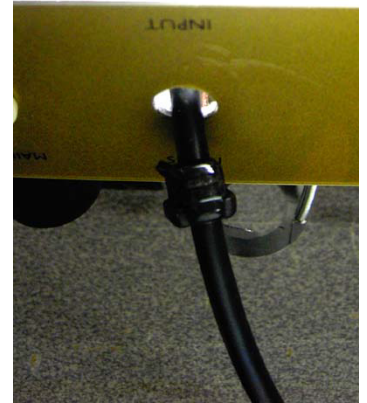
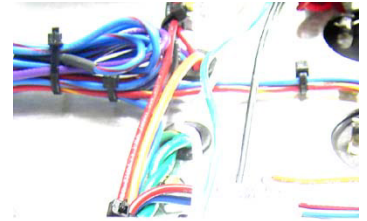
Give special attention to the direction of the silver bands on the diodes once again; if they are placed wrong your amp will be blowing fuses.



STEP 17: FINAL CHASSIS ASSEMBLY -- AC CORD AND KNOBS

- A. Find the AC cord that came with the kit. Cut off the female IEC receptacle if it came furnished with one. Carefully strip back 8" of insulation from the cord -- you don't want to nick the AC wires inside the insulating sheath.

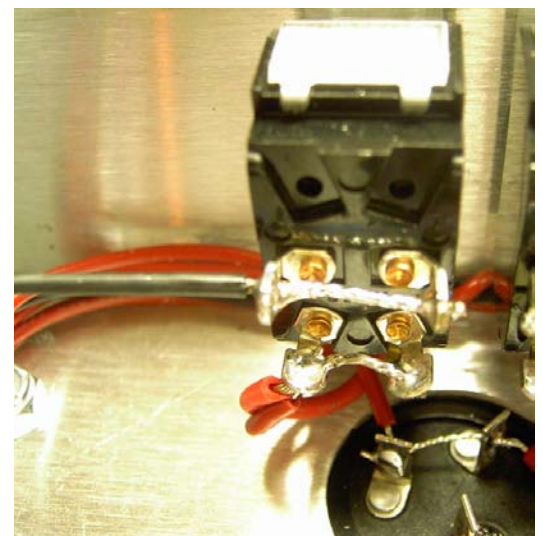
Find the black plastic strain relief. Place it around the cord, leaving about 1" of insulated cord to the inside as shown.



Now the tricky part -- using your needlenose pliers squeeze the strain relief onto the cord while gently working it through the Mains Input hole in the chassis.

You may wish to use masking tape to protect the plexi panel on the amp -- it's very easy to slip up and scratch the panel. Patiently work the strain relief through until the back pops through the chassis completely. Gently tug the cord to be sure it's seated all the way.

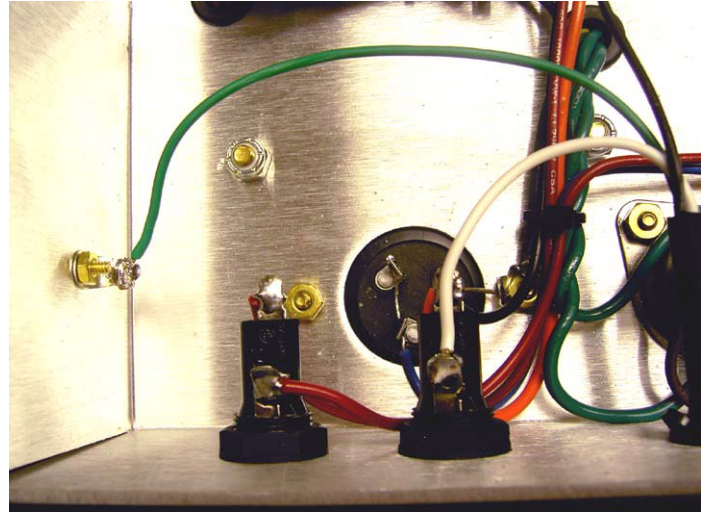
- B. Route the black wire from the AC cord to the power switch. Strip about 3/4" of insulation from it and run it through both of the empty terminals on the switch as shown. Solder in place.



Step 17 cont.

- C.** The white wire from the AC cord goes to the empty top terminal of the Mains fuse holder -- trim and solder it in place.

The green wire is the earth ground. To truly be to electrical code this wire should have its own lug on a separate bolt from other grounds, as shown at right. You will have to drill a hole to install a bolt and nut there.



If you do not have a drill available, install a ground lug on the F6 cap mounting bolt closest to the chassis wall, right under the HT fuse holder. Trim the green wire to length and solder in place.

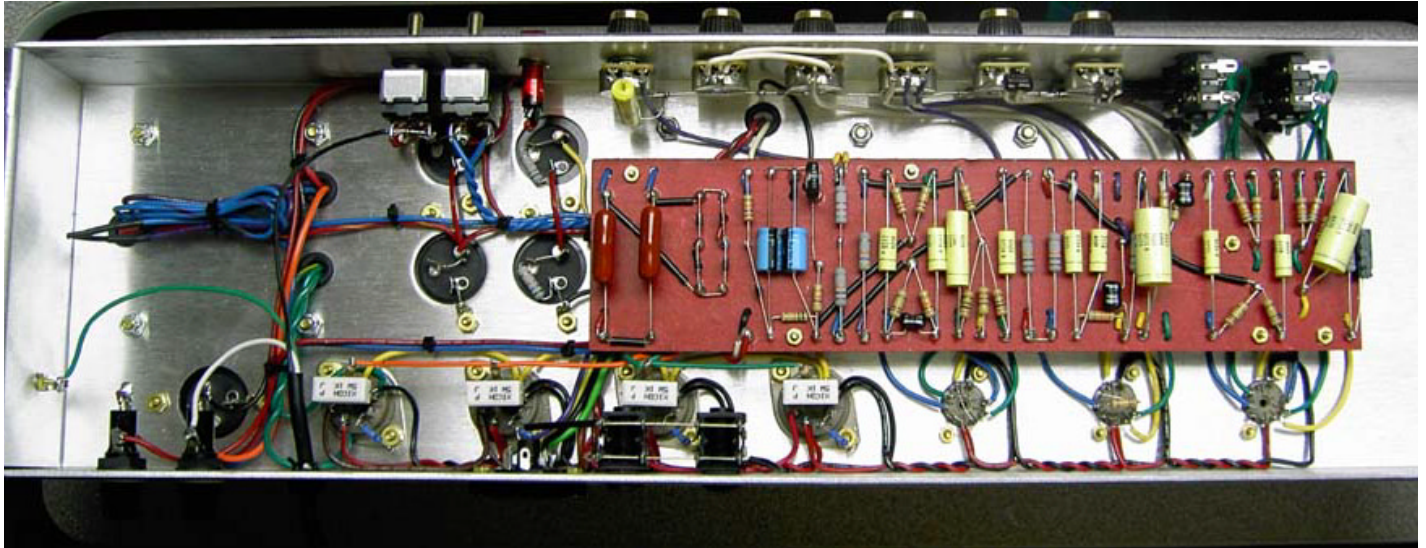
- D.** Install the (6) Marshall Set Screw Knobs on the control pot shafts using a 5/64" Allen wrench. (A 2mm works well in metric countries.)

The knobs often have excess material inside that must be cleared away before they will fit the pot shafts. Don't force them, or you could ruin the pot -- instead use a 1/4" drill bit or small round file to enlarge the hole in the knob.



Step 17 cont.

Your amplifier chassis is now complete and ready for testing. If you are unsure of any of the connections or components that you have installed, take one more chance to ensure that your work is accurate. When you're positive that everything is in order, we'll begin testing the amplifier!



STEP 18: VOLTAGE READINGS AND TESTING

HIGH VOLTAGE WARNING!!!!

THIS AMPLIFIER OPERATES AT UP TO 500VDC!!!! IT CAN CAUSE SERIOUS INJURY OR DEATH IF PROPER SAFETY PROCEDURES ARE NOT STRICTLY MAINTAINED!!

PLEASE USE EXTREME CAUTION WHILE TESTING, BIASING, OR PERFORMING ANY WORK ON YOUR AMPLIFIER.

A GOOD RULE TO FOLLOW IS TO HAVE ONLY *ONE* HAND INSIDE THE CHASSIS AT ANY TIME. (PUT THE OTHER HAND IN YOUR POCKET.)

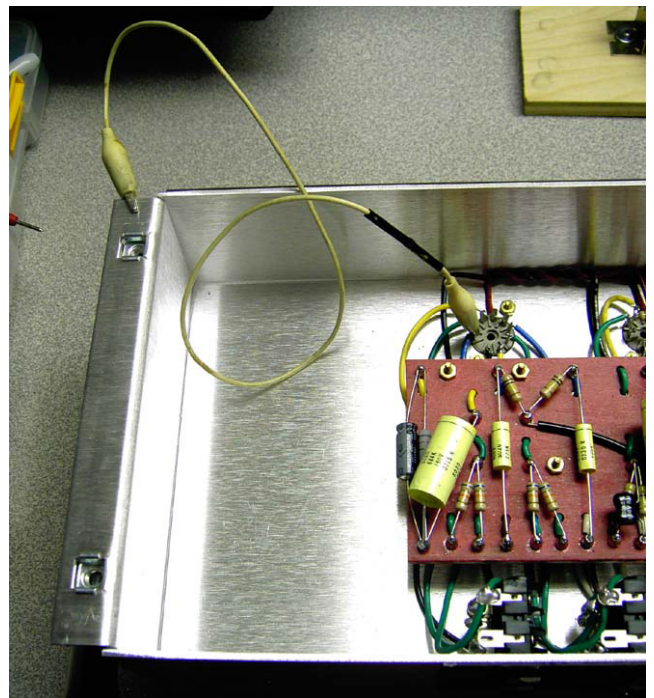
BE SURE TO UNPLUG THE POWER CORD AND DRAIN THE FILTER CAPACITORS BEFORE DOING ANY WORK INSIDE THE CHASSIS.

First, it is essential to know how to drain your filter capacitors correctly. These capacitors can store hundreds of volts of energy under some circumstances.

All you need is a wire with alligator clips at each end. (Although the wire pictured has an extra resistor inserted in it, this is not necessary for this kit -- the resistors in the high voltage supply will be more than adequate to keep the capacitors from draining too quickly.)

Simply clip one end of the wire to the bare chassis and the other end to pin 1 of the V1 tube. Wait a few minutes to allow the caps to drain, and check them with your meter to be sure they are

completely drained. (Set your meter to a DC voltage range of at least 600VDC. Place the black lead in a chassis mounting hole, and place the red lead on the positive terminals of each capacitor.) You can leave the wire in place while you work to ensure that the caps do not regain any charge -- just don't forget to remove it before powering up the amplifier again.



- A. Insert a 4A fuse in the Mains fuse holder and a 1A fuse in the HT fuse holder. (The fuse ratings are stamped on the metal ends.)
- B. Gently insert the (3) 12AX7/ECC83 preamp tubes in their sockets. Note the gap between pins 1 and 9 in the tube and the sockets -- be sure they align. Use a gentle, circular rocking motion when seating the tubes all the way down. **DO NOT** install the (4) EL34 power tubes at this time.

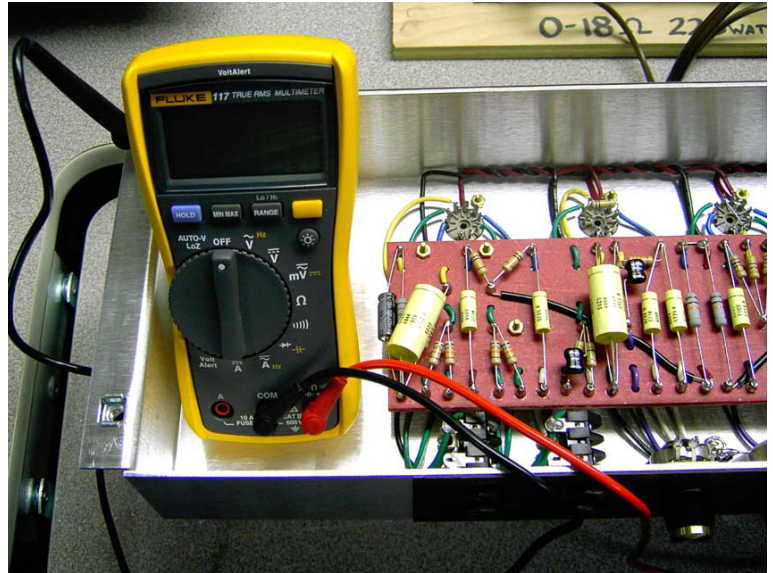
Step 18 cont.

- C.** Before turning on any power get your meter ready to use. The end of the chassis has plenty of room for most meters to sit.

Place the black ground lead in one of the chassis mounting holes as



shown -- it's a great place to ground the meter so you have only one hand in the chassis while you work.



- D.** With your meter set to AC volts (the 100 Volt range is plenty) go ahead and plug the amplifier in and flip the **ONLY** the Mains Power switch to the “on” position. Do not flip the standby switch at this point.

The amplifier's indicator light should come on continuously at this point. If you look under the chassis at the preamp tubes their filaments should be lit as well.

If the light goes out at this point, flip the power switch back off, unplug the amp and check the mains fuse. If the fuse has blown you have a short fairly early in the power supply. Check the following:

- ensure that you have no visible shorts in the black and red heater wiring such as stray wires between pins or to the chassis.
- double check the direction of the four diodes that make up the rectifier on the turret board, and the placement of the wires to the diodes.
- go through the wiring from the mains transformer with the wiring diagram and ensure that it is correct.

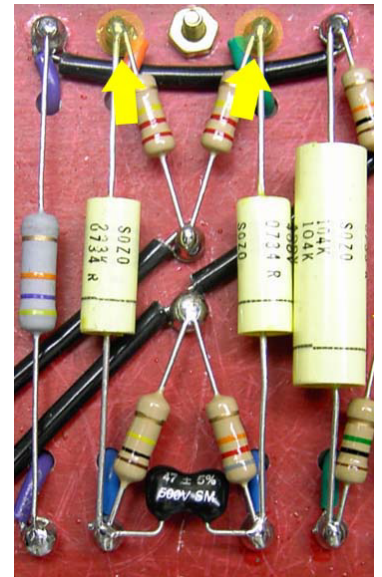
If all is well take the red lead of your meter and carefully place it on pin 2 of the V7 power tube socket. You should read about 3.15VAC. Move the lead carefully to pin 7 and you should get the same results. Verify this reading on pin 2 and 7 of V6, V5, and V4 as well. The preamp tube sockets should give the same results when measured at pin 4/5 (which are joined together) and then at pin 9.

Step 18 cont.

- E. Now set your meter to DC volts, again in the 100V range. Place the red lead at the 5.6K resistor on pin 5 of V5, and then the 5.6K resistor at pin 5 of V6. These readings are the bias voltage and will read negative on your meter.

Now, using a small standard screwdriver, turn the bias trim pot and watch the voltage vary. It should vary in a range of roughly -30 to -50 VDC. Set the trim pot to the largest negative voltage that you can at this point, i.e. -50 VDC is preferable to -30 VDC. This will ensure your power tubes are running as “cool” as possible when they are first installed. Be sure you see this negative voltage at each of the resistors mounted to pin 5 on V4 through V7. DO NOT proceed to insert the power tubes until you have verified that this voltage is present!

TECH NOTE: If you find it difficult to keep the meter lead steady on the resistors while turning the bias pot try placing the meter lead in the points highlighted at right. This may keep your lead from slipping -- a big concern, since we have to break our “only one hand in the chassis” rule for this measurement.



If you do not have any bias voltage present, check the following:

- with your meter set to the 500 V AC range, check for about 90 VAC at the point marked with the arrow at left, where the PT's bias winding hooks to the board. (Use the larger range, just in case the voltage is somewhat higher.)
- double check the direction of the diode highlighted in yellow at left. The silver band must face as shown for the circuit to work.
- double check the direction of the bias capacitors. Positive must go to ground in the bias circuit as shown at left.

- F. Now (still with no EL34 power tubes installed) check your amplifier's voltages against the following chart. Be aware that with no power tubes installed the voltages will read higher than shown by 5-10%. (Differences in your local wall voltage and component tolerances also may factor in if the readings differ, but the “trends” in voltages from pin to pin should remain fairly constant.) Probe very carefully.

Step 18 cont.

100 WATT VOLTAGE CHART

	PIN NUMBER								
	1	2	3	4	5	6	7	8	9
V1 12AX7	156	0	2	3.15	3.15	213	0	3	3.15
V2 12AX7	168	0	2	3.15	3.15	303	168	169	3.15
V3 12AX7	230	26	42	3.15	3.15	229	27	42	3.15
V4 EL34	GND	3.15	498	493	-45	496	3.15	GND	
V5 EL34	GND	3.15	498	493	-45	496	3.15	GND	
V6 EL34	GND	3.15	498	493	-45	496	3.15	GND	
V7 EL34	GND	3.15	498	493	-45	496	3.15	GND	

GND = GROUND

- G. If the voltages follow the chart above fairly closely, power down the amplifier and unplug the mains cord. Install the (4) EL34 power tubes. Now let's look at setting the bias on the power tubes.

Extremely important and often misunderstood, biasing is simply setting the operating parameters for a tube. In our case, we will adjust the current flow through the power tubes at idle by adjusting a fixed bias voltage. For this amplifier, this is the negative voltage that is applied to pin 5 of the V4-V7 tube sockets.

To determine where to set the bias, we use a simple formula. This formula is:
70%(maximum plate dissipation) divided by (B+ voltage) equals (cathode current)

Here, maximum plate dissipation is how much heat the EL34 tube's internal structure can safely handle as it operates -- it has nothing to do with output power in the amplifier. An EL34 can dissipate 25 watts of heat; 70% of this is 17.5 watts. The B+ voltage is the high voltage DC you've measured at pin 3 of the V4-V7 output tube sockets.

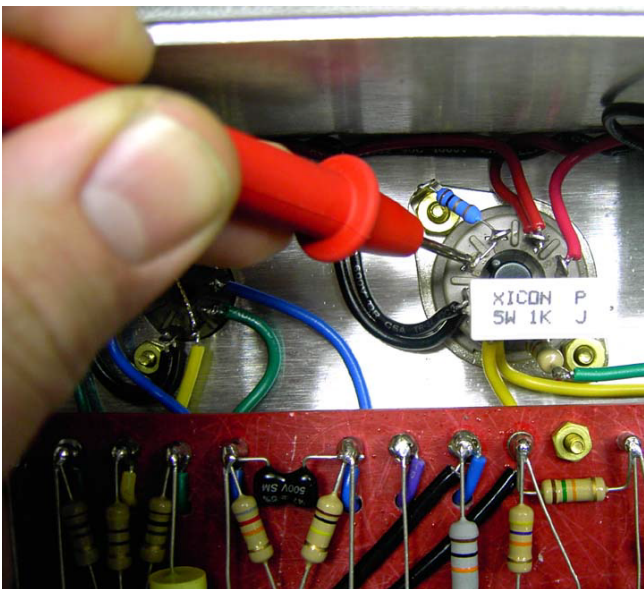
Let's try plugging the numbers from the voltage chart into the formula to see how it works.

(17.5 watts dissipation) divided by (498 VDC) = 0.035 amps cathode current or 35 milliamps (mA) of cathode current. This is the maximum amount of current we want to see across any of the EL34 tubes.

You'll remember we placed a 1 ohm resistor between pins 1 and 8 of the V4-V7 tube sockets and ground after installing the tube sockets. Although we don't need to get into another formula here, thanks to *Ohm's Law* if we read the voltage across these resistors in millivolts (mV) it will be the same as the current in milliamps.

TECH NOTE: As you work through adjusting the bias voltage to achieve the current value figured by the formula, notice that as you bring the bias voltage down from -50VDC (which increases the current flow through the EL34 tubes) the B+ voltage on pin 3 of each tube goes down slightly -- the higher the idle current, the lower the B+ voltage. Although the difference may be small, for this reason it is wise to use the formula again once or twice as you adjust the current flow upwards for accuracy.

Now it's time to perform the procedure on your own amplifier. Start with the exact B+ at pin 3 of V4-V7 in your amplifier and figure your maximum cathode current. Set your meter for DC millivolts. With the black ground lead of your meter still in a chassis mounting hole, very carefully place the red lead of your meter at the open hole of pin 8 of V4. Using a small standard screwdriver adjust the bias trim pot and watch as the millivolt reading on your meter comes up. Go no further than the maximum you figured using the above formula. Now check the mV readings on pin 8 of V5-V7.



As even a "matched" set of tubes do not draw the exact same amount of current, it is not unusual for the measurements to vary. Find the tube with the largest mV reading at pin 8 -- this is your "hottest" tube and will be the tube to set at the value you figured in the formula. (The other tubes will be at less current, so that no tube exceeds this current figure.) Set your meter back up to at least the 600 VDC range and re-check your B+ at pin 3 of the "hottest" tube. Refigure the formula with this value, and setting your meter back to DC mV, double-check the adjustment at pin 8 of the "hottest" tube to match your figure from the formula.

TECH NOTE: It's all about tone, and some people like a slightly different bias setting than others. You may set your bias lower than the maximum value we figured with the formula above, up to a certain point -- typically a range of between 60% to 70% of the plate dissipation rating is acceptable. For the test amplifier that the chart was made from, a range of 30-35mA is a guideline operating range.
As always, be extremely careful in the chassis if you choose to experiment further with biasing.

As your power tubes break in with some use, expect the bias to drift a little bit. Plan on having to recheck and possibly readjust the bias setting after a few hours of use.

- H. If you have been using a dummy load of some type for testing, power down your amp and plug in a speaker cabinet, then power back up. Turn the treble, middle, bass and presence knobs about halfway up now. Then bring up the Volume I knob gradually -- you should hear a hiss as the volume comes up. Turn Volume I back down and bring Volume II up, again listening for a hiss.

If you hear a loud hum or any crackling:

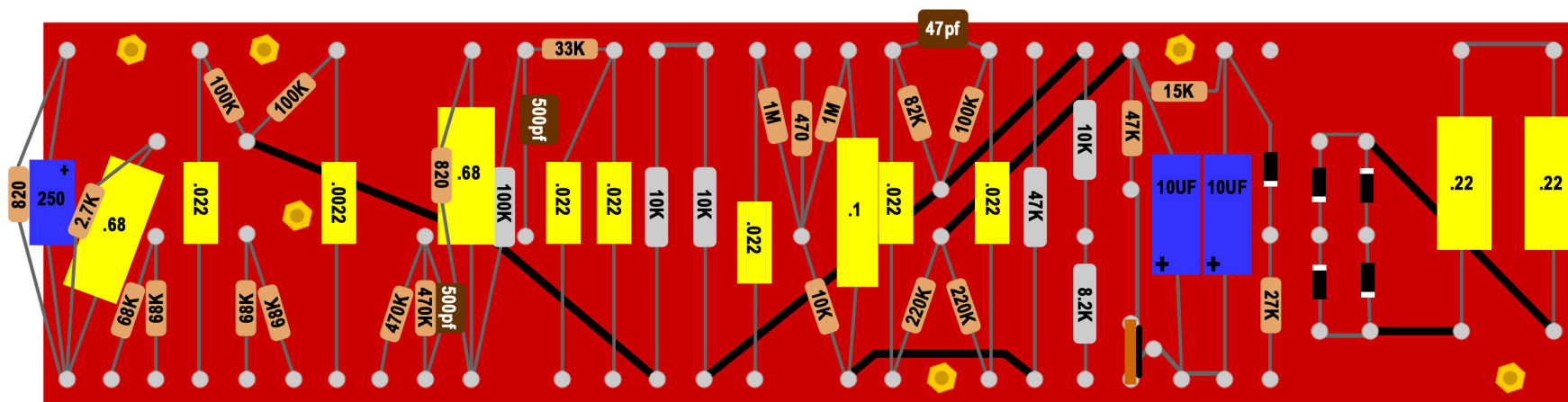
- try swapping the 12AX7 preamp tube locations. (Power down while swapping tubes!) Try to determine if one particular tube causes more problems than the others.
- if you can't hear any differences by swapping tubes, then try powering up with no tube in the V1 position. If the noise ceases, examine your wiring and grounding in the V1 portion of the circuit. When you're certain that the wiring is correct and grounding is solid, try the amp with the V1 tube in place again. If the noise is still present, you may have a bad 12AX7 tube.
- if the noise is still present with V1 pulled, power down and reinsert V1; then pull the V2 12AX7. Power back up -- if the noise is gone, examine the wiring in the V2 portion of the circuit. If all looks good the V2 tube may be bad.

One or two spare 12AX7 tubes on hand is a great aid to troubleshooting -- your local music center should have some available.

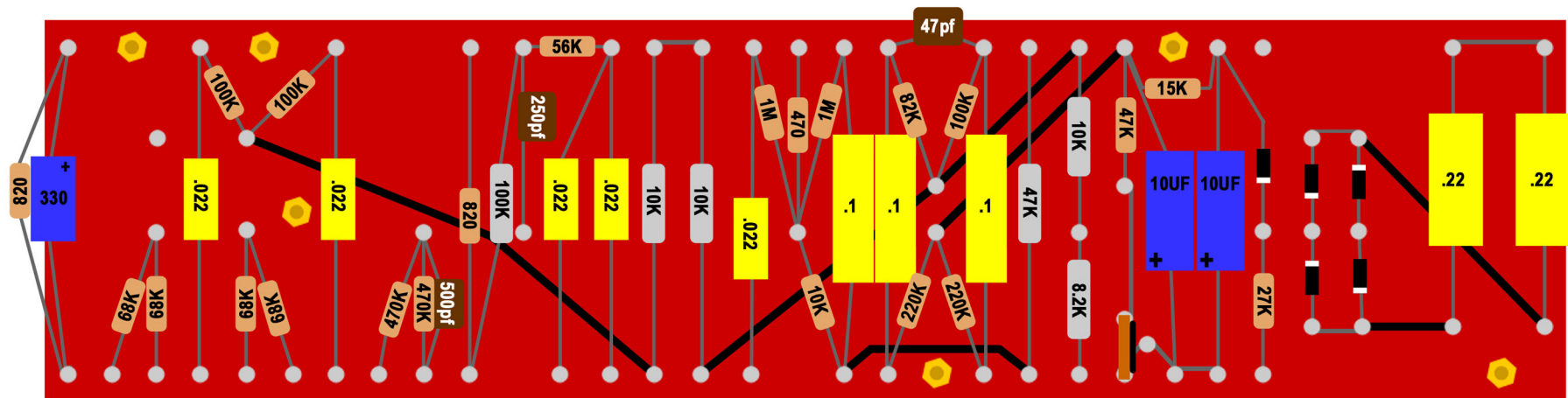
Be aware that with the chassis sitting on the bench, it is likely that if you crank the presence and volume knobs up all the way you will hear a high pitched whine or squeal. Once the chassis is bolted into the shielded head case the squeal should go away.

If no unusual noises are present go ahead and plug a guitar into the amp and experiment with the volume and tone settings -- ensure that all the knobs seem to function as they should. (Before you turn the amp off, it would be a great time to double check the bias setting with all controls set back to zero.)

100 WATT SUPERLEAD '69-MID '73



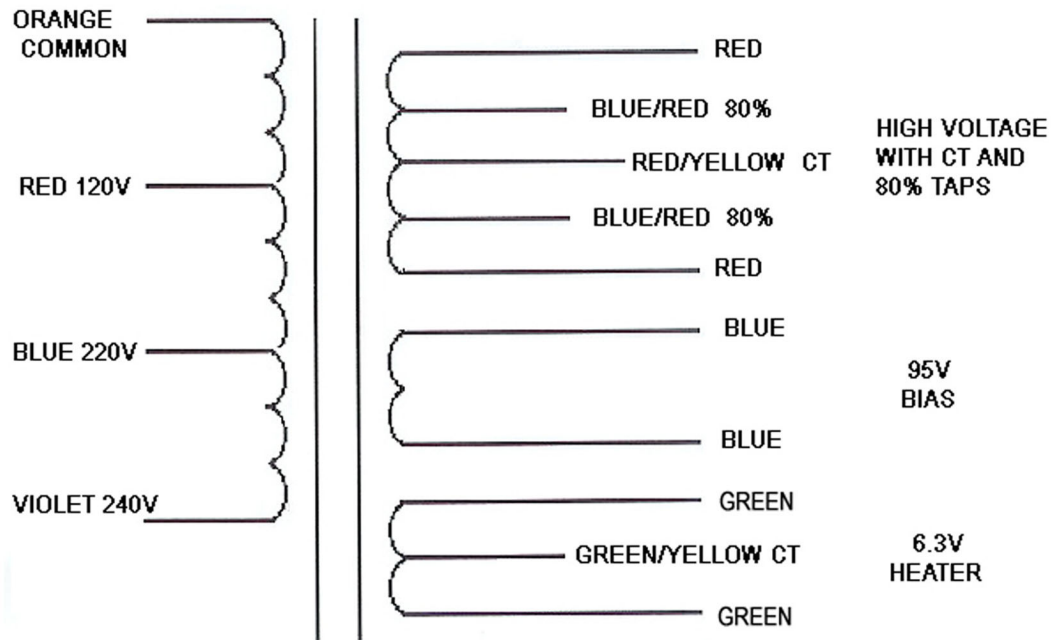
100 WATT SUPERBASS '69-MID '73



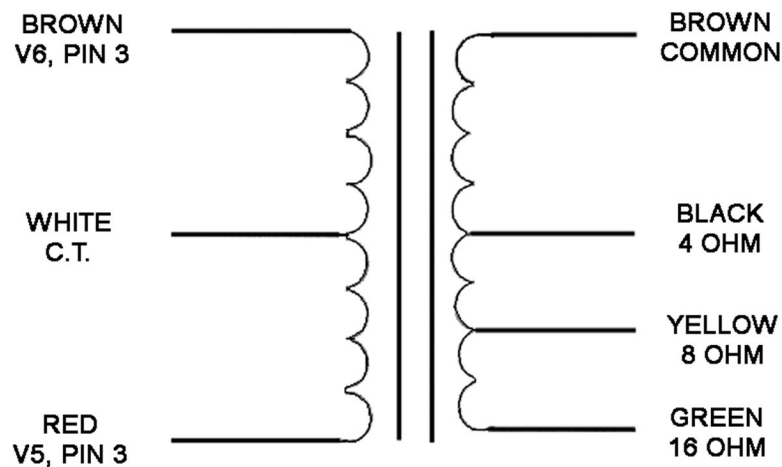
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METROAMP 100 WATT POWER LAYDOWN MOUNT WITH LOW VOLTAGE OPTION

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NOTE:
ENAMEL MUST BE REMOVED FROM
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