P1-HO-P1eX Build Guide 05.10.15

By Cliff Chappell

Welcome to the P1-HO-P1eX Build Guide. The purpose of this guide is to offer the builder, particularly the first or second time builder, a little assistance in the construction of what, at times, can seem to be an overwhelming task. This guide is not intended as a step-by-step set of instructions.

Pre-planning Your Project

If you just want to build a 5W amp for your own use, you must choose between going with a noval (9 pin) or octal (8 pin) output tube. This choice will determine what else, if anything, that the amp can be later modified into. This choice will also determine what type of output tubes you can use in your amp.

If you go the noval route, you will be limited to using an EL84 (5W output), or 6N1P (1W output) for the power tube. Both are great sounding tubes, and you will be able to modify your P1 into an HO without any problems.

If you go the octal route, you will have a greater number of tubes to choose from for your power tube. You will be able to use 6V6's, EL34's, 6L6's, KT66's, etc. in your amp. You won't have any problems changing your P1 into an HO using these tubes either. If you think you are going to want to modify your amp into a P1 eXtreme later, a noble goal to be sure, then you will have to take this into your planning. Not only will you have to use an octal tube in your P1/HO, you will also need to use the P1 eXtreme transformer set and power supply capacitors (4 @ 47uF/450V instead of 4 @ 47uF/350V).

You can gather all of the parts from the BOM (bill of materials) yourself, or you can purchase a kit from Doberman Amps. If you purchase a kit, be sure to tell them what you plan on doing so that you can get the things you need. If you don't have a drill press, get the pre-punched chassis. It costs more, but without a drill press you probably won't be happy with the results. You should also get a turret/eyelet board from them. Look carefully at any of the option details for the amp on the detail sheet. Parts for these options are not included with the kit, or listed on the standard BOM, so you need to take that into account.

Other things that you will need that are not included with the kit include, but are not limited to:

- A soldering iron and solder.
- Wire. It's not supplied with the kit and it's not on the BOM. You can use 18 gauge wires for all of the wiring, or you can use a combination of 18 and 22 gauge wires. If you are going to vary the wire gauge, you need to understand where you can use the lighter gauge, and where you cannot.
- You are also going to need various fasteners to attach the transformers, turret/eyelet board, power socket, tube sockets, etc. to the chassis. Be prepared to make multiple trips to the auto, or home improvement stores for parts.

There are drill plans available for a chassis designed exclusively to fit this project. When drilled as shown, you will have all of the necessary holes to upgrade the amp at a later date. That means that there will always be un-used holes in you box. But once the amp is mounted in an enclosure with faceplates, you won't see the extra holes.

The last thing to consider is what you are going to hook the amp up to. If you don't already have a speaker you can connect it to, then you will have to plan for a speaker and its enclosure.

With all of that out of the way, let's get on with the show!

The Chassis

If your chassis is pre-punched, you can skip this section.

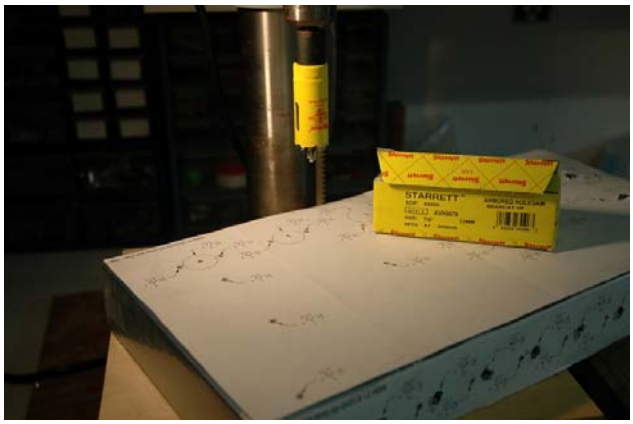
The first thing to do is to print out the drill plan on 11" x 17" paper. You MUST print it full size without any "Scaling" or "Fit to Page" stuff turned on. If you don't have access to a printer that can handle that size paper, go to your local Kinko's. Take a ruler and measure the output. The image for the chassis top should be 16" x 8", the same as the chassis. The images for the chassis front and back panels should be 16" x 2" just like the chassis. Note: When you go to Kinko's, print the chassis layout and turret/eyelet drawings discussed below.

Once you have the drill plan sheets lay them out next to your chassis like this:

Take note of where the labels are: they are all on the right. Also notice that the blue plastic that comes on the Hammond chassis is still there. Leave it on until you are ready to paint, or clear coat the chassis. If you don't, you will leave marks everywhere you touch it.

Next, tape the guides to the outside of the chassis. Make sure you have all of the labels on the right side of the chassis. Use plenty of tape because the drill bits and hole-saws will want to pull and twist the paper somewhat. The result should look something like this (well, you probably will only be building one amp at a time ;-). WARNING: All of the holes shown on the drill plans are

accurately sized for the components used in the prototype amps. These are commonly available parts and they are listed on my parts list. It is up to you to verify that the parts you are using require the hole sizes shown. If your parts require a different size hole you will still use the marked center point for the hole, your hole will just be a different size.



Now, it's off to the drill press. First, a word about producing those larger holes: Most drill bit sets include bits up to ½". That's fine for most of the holes in the chassis. If you are using Switchcraft ¼" Phone Jacks as I do, then you will need a 7/16" bit which is not supplied with most drill bit sets. The jack itself only requires a 3/8" hole when used by itself, but if you use the isolation shoulder washers (and you should), you will need a 7/16" hole to accommodate the shoulder of the washer. For holes larger than 1/2" I use holesaws. These can easily handle thin aluminum like that used in Hammond chassis; just make sure to follow the manufacturer's drill speed recommendations. I use STARRETT Bearcat VP holesaws. They hold up well and STARRETT produces one that's the PERFECT size for octal sockets. Here is the catalog numbers for the three that I use, along with what they are for:

AVH1016	Size 11/16" (17MM)	Hole for the lamp assembly
AVH0078	Size 7/8" (22MM)	Holes for noval (9 pin) sockets
AVH0116	Size: 1-1/16" (27MM)	Holes for octal (8 pin) sockets

Before you drill the holes, you will need to center punch them. For that you will need a center punch. The best ones are spring loaded. By using one you will be less likely to hit the punch too hard and bend the chassis. The goal here is just to put a SMALL ding in the chassis for the drill bit to start in. This is to prevent the bit wandering around before deciding where your hole will be 8-). So, grab your punch, hammer, and chassis and get started. We'll be waiting here at the drill press until you're done.

Finished tapping? Good. Now you need to drill the holes. Notice that the hole sizes shown on the drill plan is the radius of the hole. You'll have to double that number to tell what size bit to use. Start with the 1/8" bit as it is the smallest hole called out on the drill plan and it's also the perfect size for a pilot hole for all of the other holes. When you are done with that drill bit every hole on the drill plan will have a 1/8" D. hole in the center of it. Let us know when you're done, and DON'T FORGET to wear eye

protection and gloves while you are doing this. Those aluminum shavings are SHARP and HOT!

All done? OK, the next part is quite tedious, but important. The first thing is to remove the paper drill plan from the chassis, but leave the protective blue film in place. Next, using a small file, clean up the ragged edges of your holes. Be careful not to remove too much material from the edges or your parts will be loose in their mounting holes. Now dry fit each and every part into its respective hole.

What? You have four round holes instead of one square hole in the chassis where the IEC power connector goes? Well, use a jigsaw to connect the outside edges of those four holes. Don't worry about squaring off the four corners; they are not square on the connector either. If you don't have access to a jigsaw, an inexpensive alternative to consider is a Radio Shack "Nibbler". I've never used one myself, but many others do and report positive results. You should be able to locate it on Radio Shack's web site using the following part number is: *64-2960.

Once you have dry fit all of the parts that will mount to the chassis (you checked the trannies too, right?), it's time to paint the chassis. Even if you decide to leave it silver you still need to clear coat it. If you don't, the oil (and the enzymes in it) from your hands will leave marks on the chassis that will not come off. Even if you paint it, add a couple of layers of clear over the paint for durability. It'll look better too!

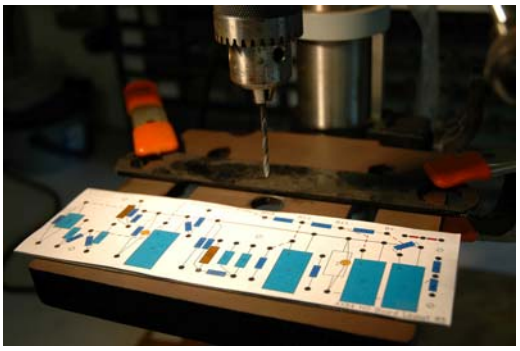
I decided to go with gold chassis for the prototypes.

The Turret/eyelet board

This section of the document will cover the amps turret/eyelet board. The board plans will work if you use eyelets, however I use turrets. It's up to you to decide whether to use eyelets or turrets.

The first thing you will have to do is to cut the 1/16" Garolite down to the correct size for the turret/eyelet board. Use a table saw and a small tooth carbide blade for this. If you don't have a table saw, you may want to consider buying a pre-cut and/or pre-punched board. Some folks will sell them already loaded with turrets or eyelets.

After you have sized the turret/eyelet board material, tape the printout of the board to it. Next get something thin with a known straight edge that you can clamp down the table on your drill press as an alignment guide. The guide allows you to slide the turret/eyelet board along it as you drill holes that are in a line. It just makes things faster. Here is a picture of my setup. I simply used a blade tightening bar from my table saw and a couple of quick clamps.

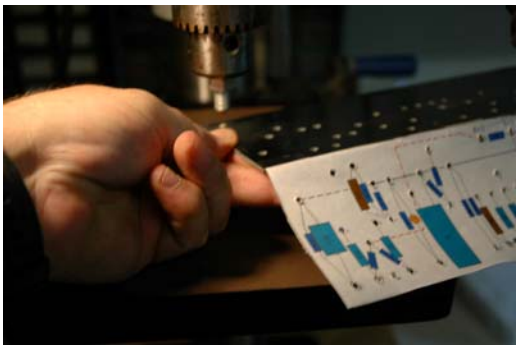


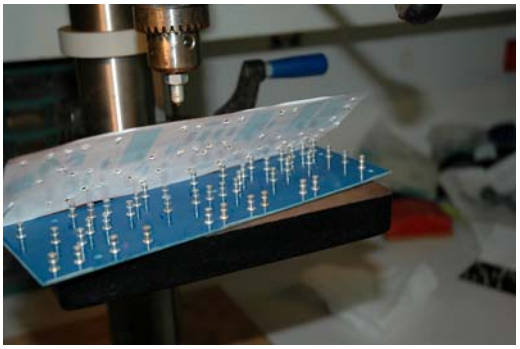
It's always a good idea to use a scrap piece of board to drill some test holes. You want a nice snug fit when you insert the turret into it. The size of some turrets will vary so do not assume that you need to drill a specific size hole.

Once you have all the holes drilled in the board you are ready to stake the turrets. You will need a turret staking tool that is available from several sources on the internet. It mounts in your drill press and allows you to easily press and flare a turret into your board. This is what the one I have looks like.

Basically, you insert the turret upside down. Next, lower the turret/eyelet board (top side down) onto the bottom of the turret. Then you lower the piece mounted in the chuck down into the center of the turret and apply enough pressure to flare the bottom of the turret. Make sure that the top piece is centered above the bottom half of the staking tool so that you get a nice even flare of the turret.

One of the most common errors is to stake the turrets to the wrong side of the board. In this project you want the turrets rising up from the side of the board that has the drill plan on it. So, just free one side of the paper drill plan, flip the board upside down and lower the board onto the bottom of the turret in the staking tool (Sorry, this isn't the best of photos but it's the only one I have that illustrates the point).



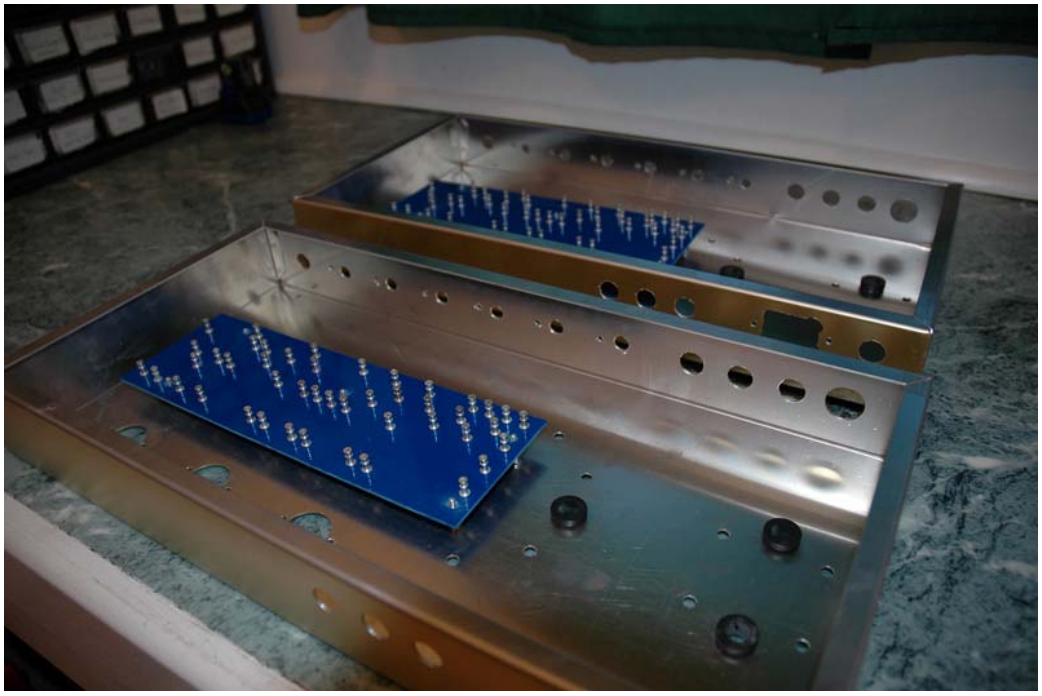


Be careful about which holes to install turrets in. Remember, there are five mounting holes in the board which will not get turrets. If you accidentally install a turret in one of the mounting holes you can remove it by drilling out the flared part on the back side. Just be careful not to drill all the way through the board. Once you are done, hopefully, your new turret/eyelet board looks like this.

Now then, are your ready to finally heat up the soldering iron? No, you're not, not yet anyway. We have one more thing to check before we can begin actually assembling the amp. Remember that tedious dry-fitting step we went through before? Well, we still have to dry-fit the turret/eyelet board and it's much easier to do this without any components on it. Since all of our parts are handmade, you will find that things like the turret/eyelet board mounting holes may not line up perfectly with those in the chassis. You need to install rubber grommets in the holes that the transformer wires pass through. They are usually found in the electrical department of home improvement stores. Get them to fit a ½" hole.

You're going to need some stand-offs to attach the turret/eyelet board to the chassis. These are little hexagonal or round shaped posts. One end has a threaded hole in it; the other has a threaded post on it. Get the ones with the 4-40 threads that are at least 1/2" long. You also need some 4-40 x 1/4" screws, #4 flat washers, and #4 lock washers to secure the standoffs to the chassis. The lock washer goes between the screw head and the flat washer. The screw shaft goes through the chassis with the standoff attaching to it inside of the chassis. It also isn't a bad idea to place a drop of blue Locktite on the screw threads prior to connecting the standoff.

Once you have the standoffs installed you can dry-fit the turret/eyelet boards. If the standoffs and the holes in the board don't line up you can use a drill bit to adjust the size/alignment of the problem areas.



Alright, everything fit OK now? Let's move on to installing components on the turret/eyelet board.

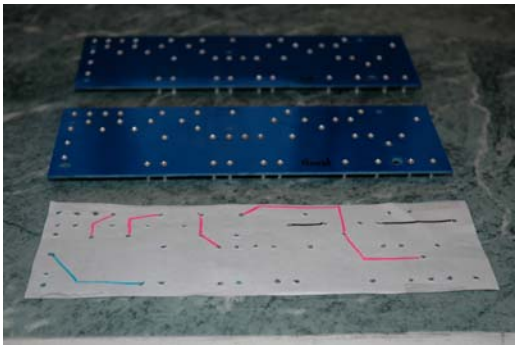
The turret/eyelet board for these amps is designed with a few wires on the bottom of it. We want to solder them in first. Flip your drill guide over and use a pen or highlighter to mark the dashed lines. Those dashed lines on the drill guide are the wires on the bottom of the board. Now solder some wires in connecting the turrets. Don't insert too much wire into the bottom of the turret: 1/16" of wire is enough.

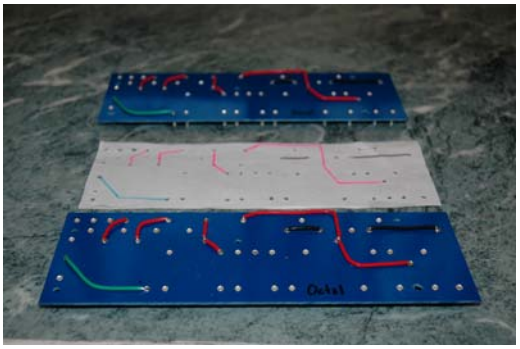
I use 16ga wire that fits VERY tightly into the bottom of the turret to insure that the wire does not get loose and fall out when I solder things to the top of the turret. Additionally, I put a dab of clear silicon in the middle of each of these wires to affix them to the bottom of the board as added insurance.

Other builders have made the following suggestions:

- Drill a small hole NEXT to the connecting turret and route the wire to connect to the turret above board. You keep the under-board neatness but can actually SEE the connection to verify its integrity.
- When I use through turrets with under-mounted wires I strip enough insulation to let a 1/8" or so extend beyond the top of the turret. Then I bend it over (just as you'd do with an eyelet board). It's not quite as neat, but they don't fall when soldering from the top.

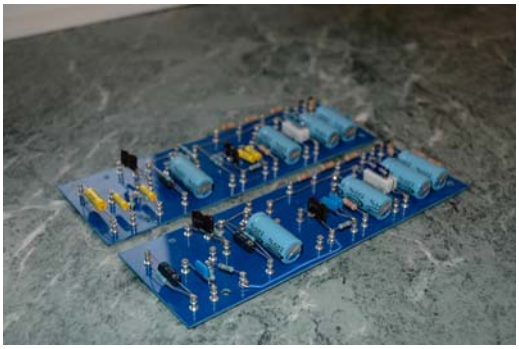
IMPORTANT NOTE: As you install **each** wire and/or component on the board, use a highlighter pen to highlight that part of the circuit on the schematic. Highlight each thing on the schematic as you do it, don't do several things, and then highlight them at one time. This is how you are going to check your work. When you are finished, the entire schematic will be highlighted. If some part is not, then you probably didn't do it.





Now you can flip the boards over and solder all of the components to them. I'll assume you know how to do that, and that you know what goes where. Double-check those resistors before you solder them in. If you get the wrong value installed somewhere you'll cause yourself a lot of problems later on.

OK, hopefully your turret/eyelet board looks something like these. It is also a good idea to put a small dab of clear, non-hardening silicon between the power supply caps (those are the four 47uF/350V capacitors), and the board at the top edge of the capacitor. That will help dampen and stabilize the capacitor. It also allows the capacitor to be removed at a later date.



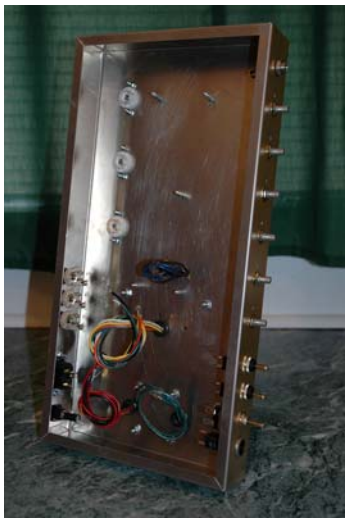
Next, we'll install everything in the chassis.

The Chassis

The first thing to do is install all of the components that mount in the front and rear panels of the chassis. Be sure to remember isolate those phone jacks with shoulder washers.

IMPORTANT NOTE: Here it is again. As you install **each** component in the chassis, use a highlighter pen to highlight that part of the circuit on the schematic. Highlight each thing on the schematic as you do it, don't do several things, and then highlight them at one time. This is how you are going to check your work. When you are finished, the entire schematic will be highlighted. If some part is not, then you probably didn't do it.

After you have the components in the front and rear panels you can mount the tube sockets. Be sure that you orient the sockets as shown on the chassis layout drawing. The last components attached to the chassis are the transformers. You'll need some 6-32 x 1/2" screws, #6 flat and lock washers and nuts. It won't hurt to put a little of that blue Locktite on the transformer mounting screws either.



Once you have all of the components mounted in the front, rear, and top panels of the amp, but BEFORE you install the turret/eyelet board we need to do a little wire

routing and twisting. The best way to twist the transformer leads, and any other wire that you are going to install and needs to be twisted, is with a hand drill. You'll get nice tight, even twists that will stay twisted (well, except for the transformer leads. They will want to unwind some). Be sure and stick a pencil between the wires down next to the rubber grommet. That keeps the wire from twisting up into the transformer and pulling loose. Don't try and make them too tight, you will pull something loose and cause a short!

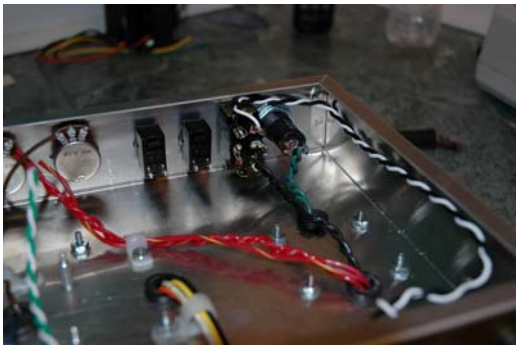
The wires that need to be twisted together are (colors are for Hammond products):

- The two green 6.3V filament wires.
- The two yellow 5V filament wires (if your transformer has them).
- The two red PT secondary high voltage leads.
- The two black PT primary low voltage leads.

The general idea here is to secure the PT, OT, filament, and signal wires in such a way as to control their location. The easiest and cheapest way is to use nylon wire holders. These tabbed loops allow you to run the wire(s) through them, and then secure the loop via holes in the tabs with a screw, or bolt. In our case, since there are many bolts and holes available, bolts are what we will use. Get small (~1/4" ID), and medium sizes. The small ones **must** fit under the turret/eyelet board.

The first wires to secure are the OT secondary leads (the brown and blue wires). You need to keep them nice and close to the chassis and away from the bottom of the turret/eyelet board. The next to secure are the OT primary leads. Secure them so that they make a straight run from where they enter the chassis to the output jacks. This photo shows the OT primaries and the blue secondary in their location.

Next, secure the PT primary and secondary wires. Don't solder anything in yet. Remember, we are just arranging wires right now. Refer to the chassis drawings for the wire locations. Use the transformer mounting bolts when they are in the right place, and use an existing empty hole if there isn't a properly located bolt. Here are some photos of the other wires secured and in place.



Once you have all the transformer wires held in place by the wire holders, you can trim all of the wires to fit their runs to the components they will be soldered to. Make them a little bit longer than necessary; you can do any final length adjusting just prior to soldering them in. If you are careless and trim a wire too short, NO WHINING! The old carpenter's rule applies to amps as well as wood: "Measure twice, cut once". Don't solder ANY of the OT or PT wires in yet. That will happen after you go through the first part of Paul Ruby's "First Power Up" document.

IMPORTANT NOTE: As you install **each** wire and/or component in the amp, use a highlighter pen to highlight that part of the circuit on the schematic. Highlight each thing on the schematic as you do it, don't do several things, and then highlight them at one time. This is how you are going to check your work. When you are finished, the entire schematic will be highlighted. If some part is not, then you probably didn't do it.

After the transformer leads are trimmed you can wire up the filaments. I would recommend that you install, and wire the filaments of a second preamp tube socket. Even if you are building an HO or P1eX, you should put it in. It's only going to cost a couple of bucks, and if you ever decide to use it, you'll be very glad that socket, and those filaments are already installed and wired.

Connect the shielded wire from the input jack to the terminal strip as shown below. Make sure that you leave the lead that will connect the turret/eyelet board to the ground lug long enough to reach the board.

The last thing to do prior to installing the turret/eyelet board is to wire up the IEC connector, the fuse holder, the power switch, and the standby switch. Refer to the chassis layout drawing for wire routing. Be sure to make the twisted wires that connect the standby switch to the turret/eyelet board long enough. Same for the twisted filament wires from the pilot lamp and from the power tube socket.

Installing the Board in the Chassis

There isn't much to this section unless you didn't dry fit the board in the chassis earlier. If you didn't, you will find out why it was a good idea to do it BEFORE the components were on the board. Once you have the board in the chassis, put a drop of blue Locktite on the standoff threads. It will keep the nuts from coming loose without using lock washers. Your amp should be starting to look more like an amp now.

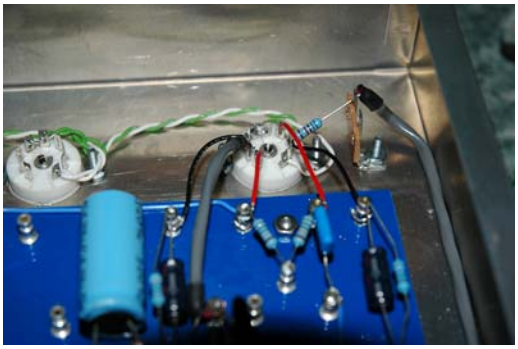
Wiring Up the Rest of the Amp

IMPORTANT NOTE: As you install **each** wire and/or component in the amp, use a highlighter pen to highlight that part of the circuit on the schematic. Highlight each thing on the schematic as you do it, don't do several things, and then highlight them at one time. This is how you are going to check your work. When you are finished, the entire schematic will be highlighted. If some part is not, then you probably didn't do it.

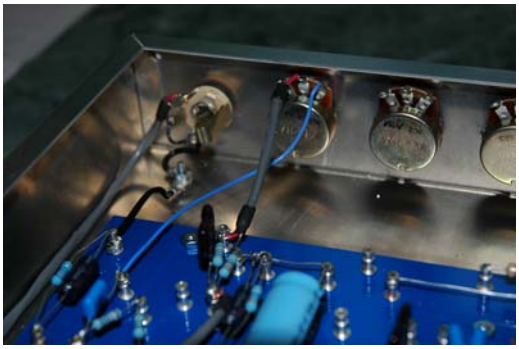
You're probably getting tired of reading that, but it IS IMPORTANT. If there is a problem when you get finished with this amp, you will most likely find that you didn't wire up something (likely), or that you highlighted something that you didn't do (more likely), or that you highlighted something that you did wrong (most likely). Sorry, but that's the truth. I have built four of these amps while creating this project and none of them had a problem as a result of the docs. Every problem was caused by my not doing something, or doing something incorrectly on the first two amps. The second two had no problems AT ALL. I had however, become quite anal about highlighters by that time 8-).

So, this last part is easy. Just follow the schematic and the chassis layout drawing. Remember: Don't solder in the transformer leads yet, you'll do that during the First Power Up procedure. Here are some P1 photos of parts of the amp so that you can see how I wired up various components.

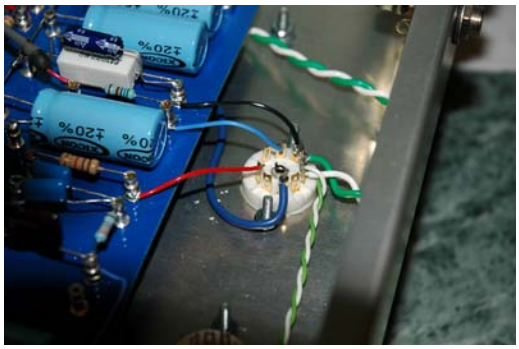
The first preamp tube socket:



The first gain pot:

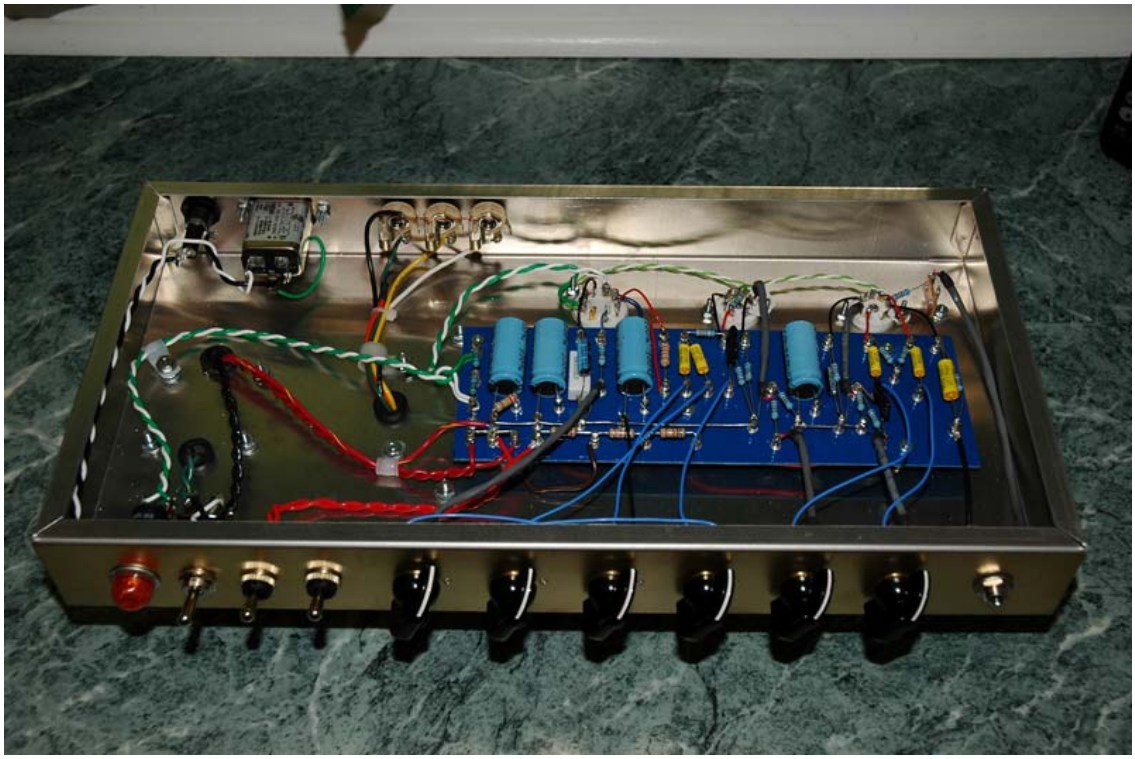


The power tube socket:

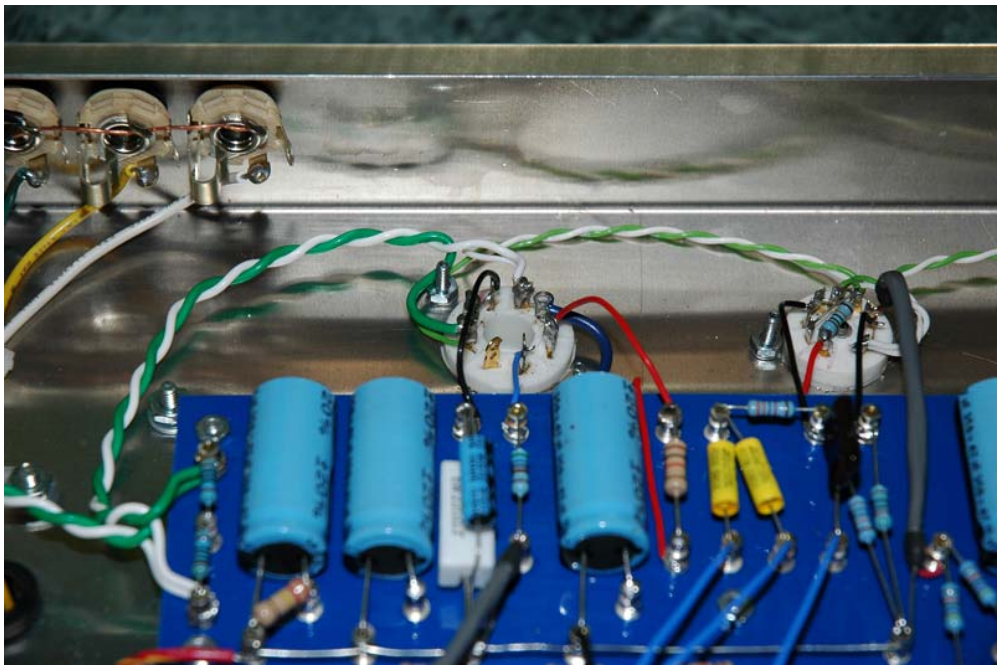


The optional mute switch:

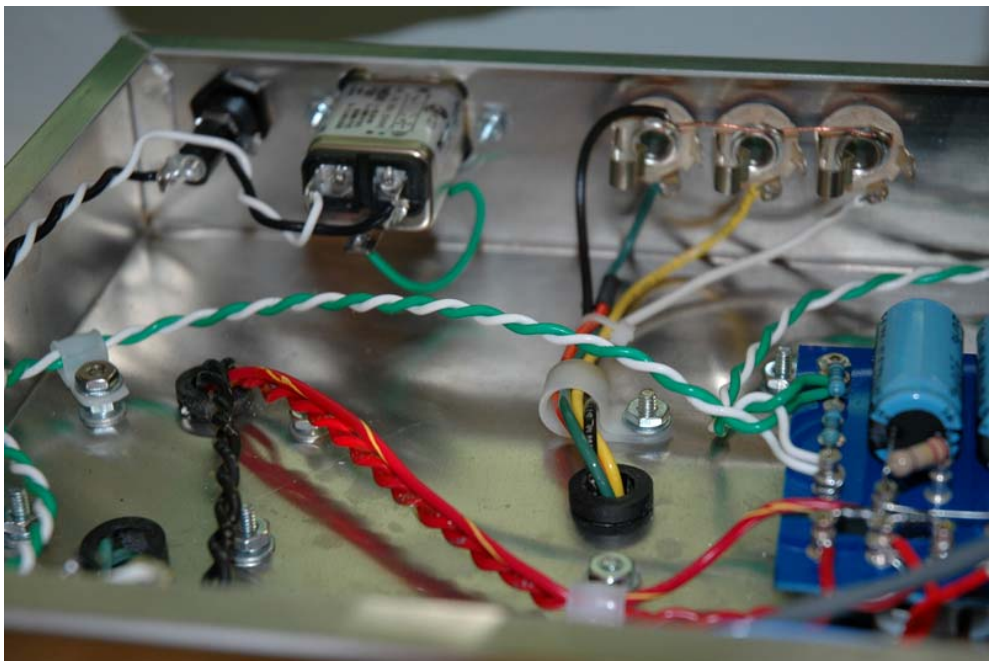
And here are some High Octane build pictures.



The High Octane's second preamp tube and power tube socket:



Here is the power end of the amp (note the use of wire holders):



And finally, a shot of the outside: