Metal-Working for Dummies, part 1. Bottom Panel

Wall of Sound.ca DIY all tube phono preamp project

Note: Please don't be intimidated by the size of this and subsequent attachments. I've gone into excruciating detail so novice metalworkers can see and follow every step of the process. There are plenty of pictures, which makes for a seemingly large document. It will likely take less time to actually perform most the steps than read the instructions.

Tools required:

Tool Sources:

Local hardware stores and the big box home reno stores can be a source for tools. However, they mostly sell tool bits for wood working. The centre punch(es), centre drills and counter sinks used on this project need to be metal-working capable.

In Canada, Busy Bee Tools sells reasonably priced metal working tools. In the USA, Harbour Freight might be a source for tools. Local industrial tool suppliers might have what's needed too.

Electric drill, two speeds and variable speed. I like the DeWalt rechargeable.

The following drill bits:

1/8” or 3.2mm

5/32” or 4mm

13/64” or 5.1mm

1/4” or 6.4mm

23/64” or 9mm

3/8” or 9.5mm

A centre punch like the one shown below.

I’ve seen inexpensive sets containing three sizes of centre punch, one of which be just the right size for the stand-off holes in the circuit boards.

An automatic (spring loaded) centre punch can be useful. The one shown below (stock no, 597) is from Busy Bee tools in Canada.

Centre drills like the ones shown below. One about 3/16” (4-5mm) in diameter and the other about 3/8” (9-10mm).

Metal cutting counter sinks like the ones shown below. One about 1/4” (6mm) in diameter and the other about 1/2” (12mm) or slightly larger. 3 flute countersinks are preferable but the 4 flute variety work OK.

A set of inexpensive transfer punches. Not essential but makes layout of the PCB spacer holes on the bottom panel easier especially if you don't have an automatic punch or a conventional punch that is close to the size of the holes in the board. But don't buy a set just for this project.

If you don't want to buy a variety of punches a fine tipped marker and one centre punch will work well. That's what I used for this project. It's a bit more work but with patience and care the holes in the bottom plate lined up with the standoff holes in the circuit board without any filing needed.

A selection of screw drivers and pliers.

QuickGrip-style clamps.

Red and black Sharpie markers.

Fine point black marker

Painters masking tape ¾" or 1" wide.

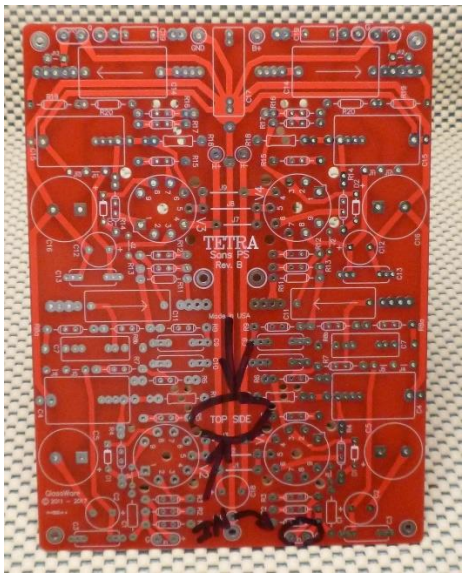
Layout:

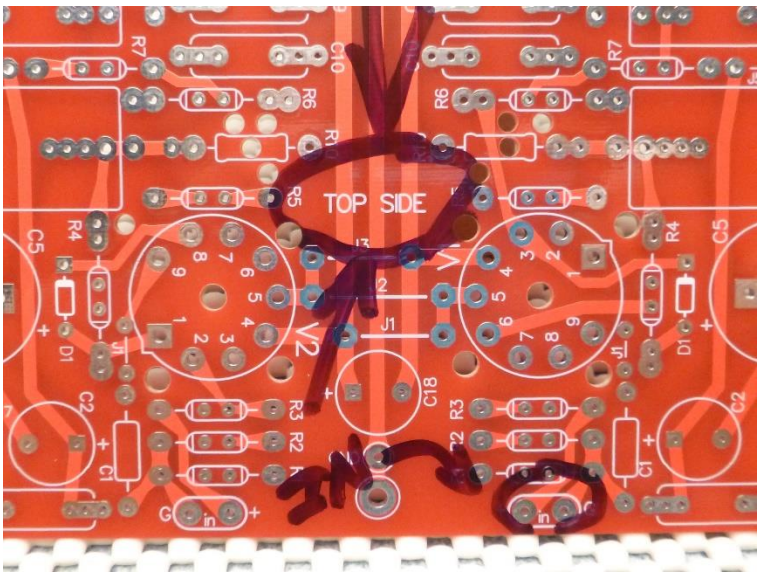
Note: The chassis shown here is the one recommended in **Parts List No. 1**, available for download in the first installment in this series. If you wish to use a different chassis feel free to do so. **However**, it should not be any smaller than the one in the parts list. I wouldn't advise using two chassis, one for the power supply and one for the amp board, as it would involve a 300 volt cable linking the two. The one-chassis version built here does not suffer from the power supply interfering with the amplifier section. If you use a different chassis than the one shown below you will need to adjust the measuring and positioning of some of the holes.

The amplifier board will be placed on the left side of the chassis as viewed from the front over the previously marked "AMP" position.

Find the circuit board for the amplifier. Don't mix up the sets of parts from the amplifier and power supply kits.

With a black marker circle the top side of the circuit board as shown below. Circle one of the inputs to avoid confusion when orienting the board. If you happen to get the board upside down or backwards you'll hate yourself later.

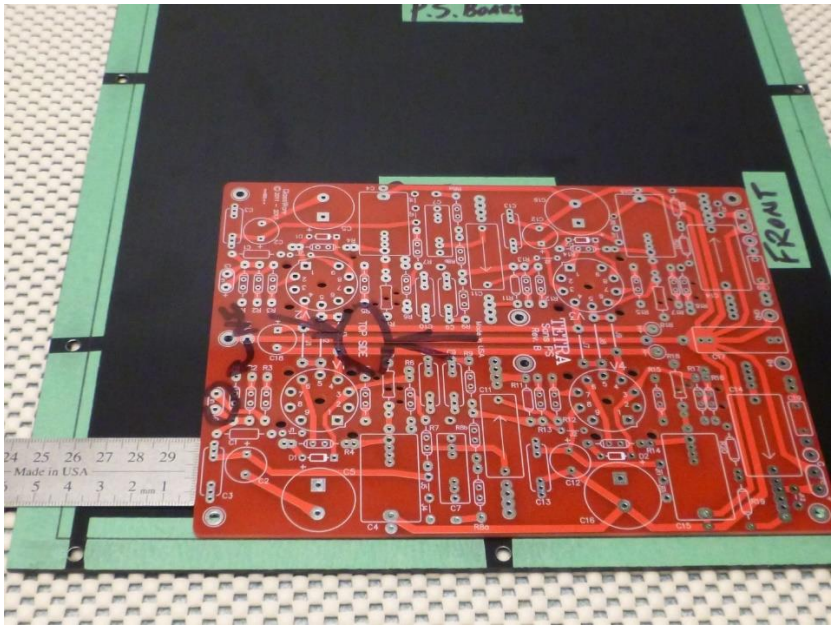




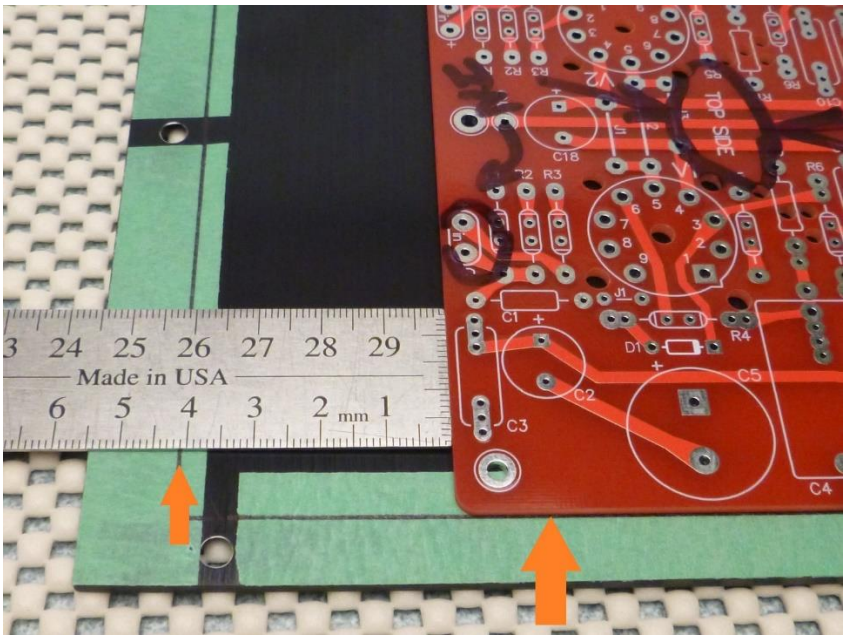
IMPORTANT:

Don't rush the hole marking and drilling process. If you get a hole slightly off you will spend a lot more time filing holes to get them to line up with the board. In the following steps always use a centre punch to mark the hole positions and a centre drill to start the hole. Failure to do so will result in the drill used to make the finished hole wandering away from the desired position.

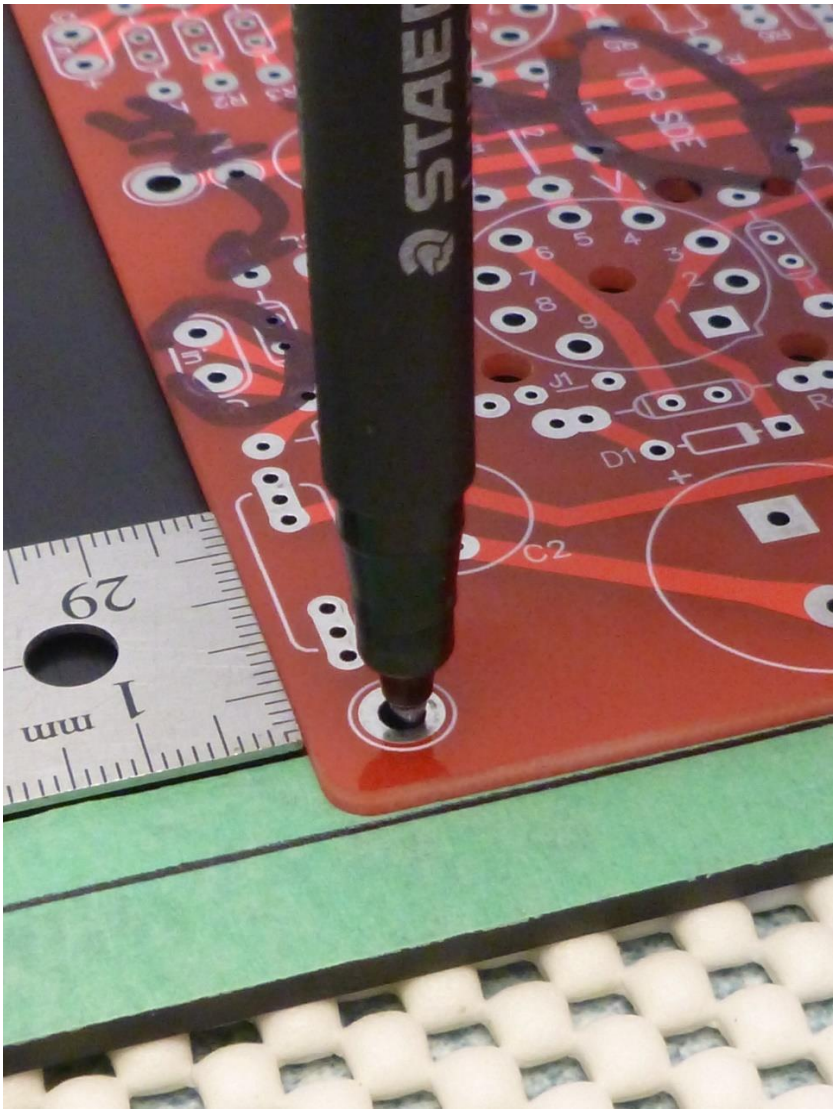
Locate the input end of the board. Place it on the bottom plate with the input end about 1⅝" (41mm) from the line on the tape at the rear edge of the panel.



Set the edge of the amp board along the line on the tape as shown below. Don't be concerned that the board is too close to the edge. When it is mounted on the board spacers it will clear the side.

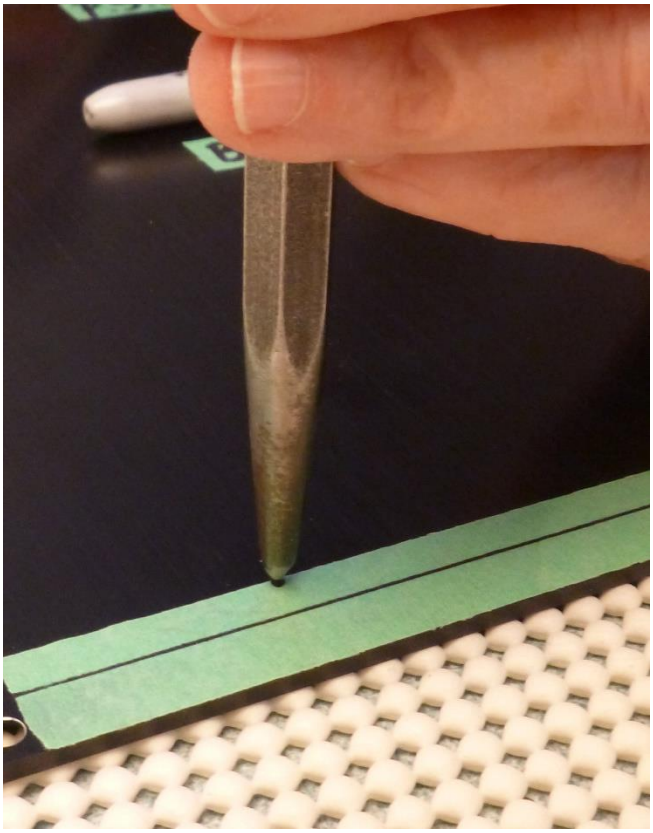


If you don’t have a centre punch that fits the standoff holes in the board precisely use a fine tipped marker to mark the hole.

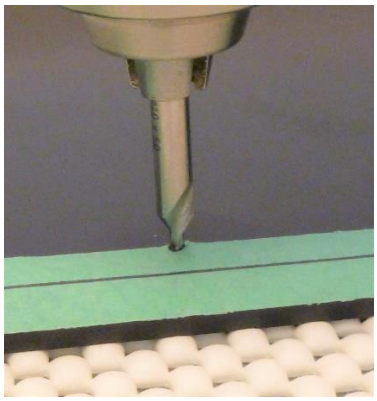


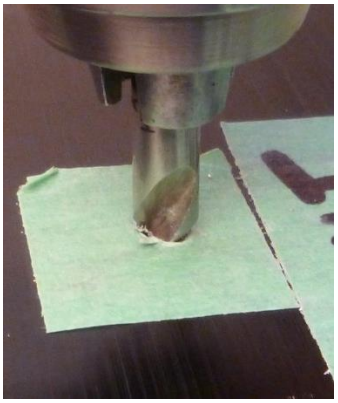
Alternatively, use a centre punch, automatic punch or transfer punch of appropriate size to mark the position of **one** corner hole as shown. Note: Transfer punches are for making light indentations only. Just tap them lightly then use a centre punch to make a deeper indentation.

After marking the position, either with a marker or punch, remove the board and make a deeper mark with a centre punch.

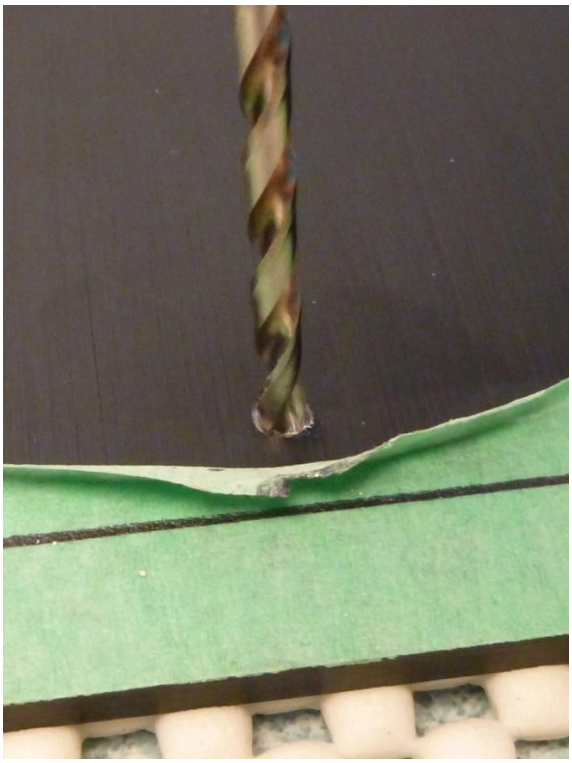


Set the power drill on the lowest speed and put the small centre drill in the chuck. Place the centre drill in the indentation then slowly start it turning. The aim to have the tapered part of the center drill start to engage the metal of the bottom panel. But once the tapered part contacts the metal panel it can be "sucked" into the panel too far if you're not careful.

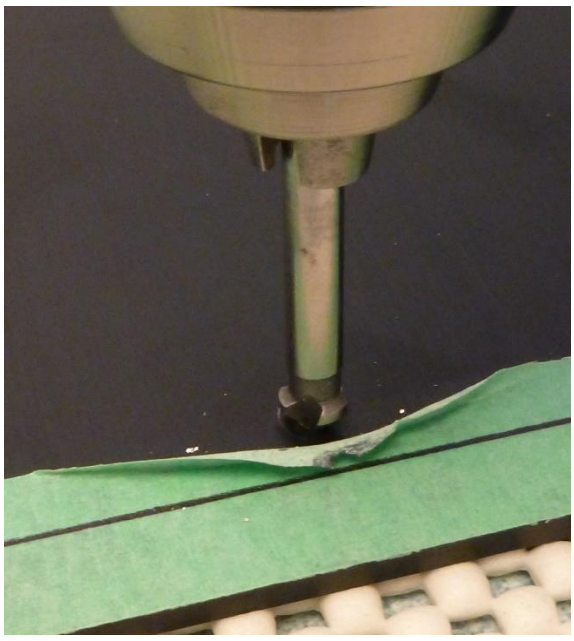




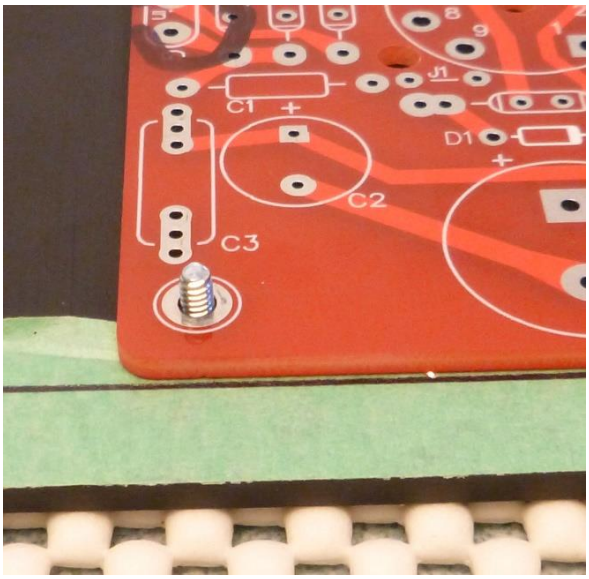
Using a 1/8” (3.2 mm) drill bit, (start slow then increase speed) drill a hole at the centre drilled location. When drilling aluminum a few drops of alcohol (methyl hydrate) on the drill bit will help keep it cool and cutting better.

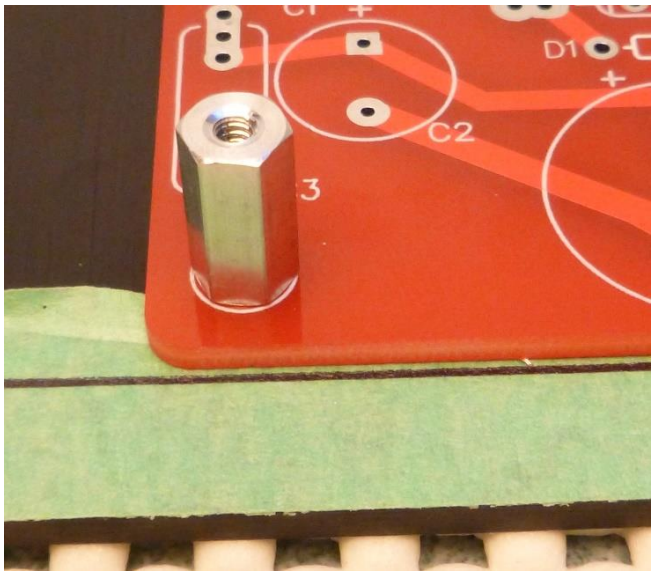


After the hole has been drilled deburr both sides with the small countersink turning at a very slow speed in your power drill.

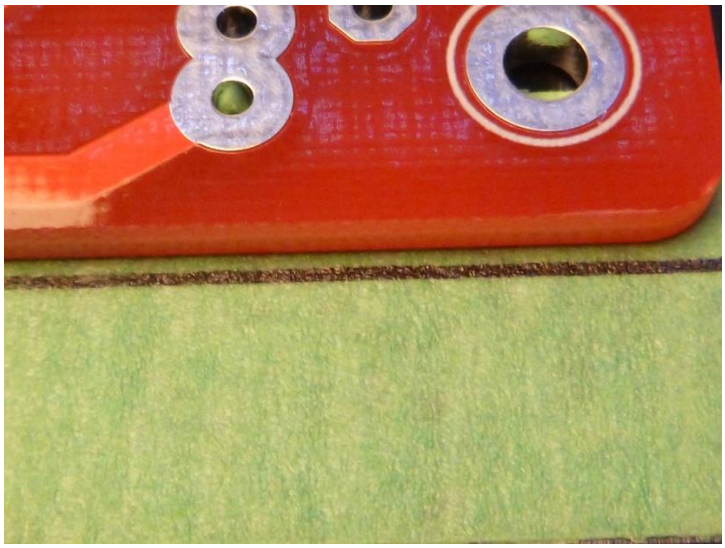


Insert one of the 4-40 screws, included with the board kit, up through the just-drilled hole in the bottom. Place the board over this screw, top side up with the input at the rear, and thread one of the 4-40 spacers over it.

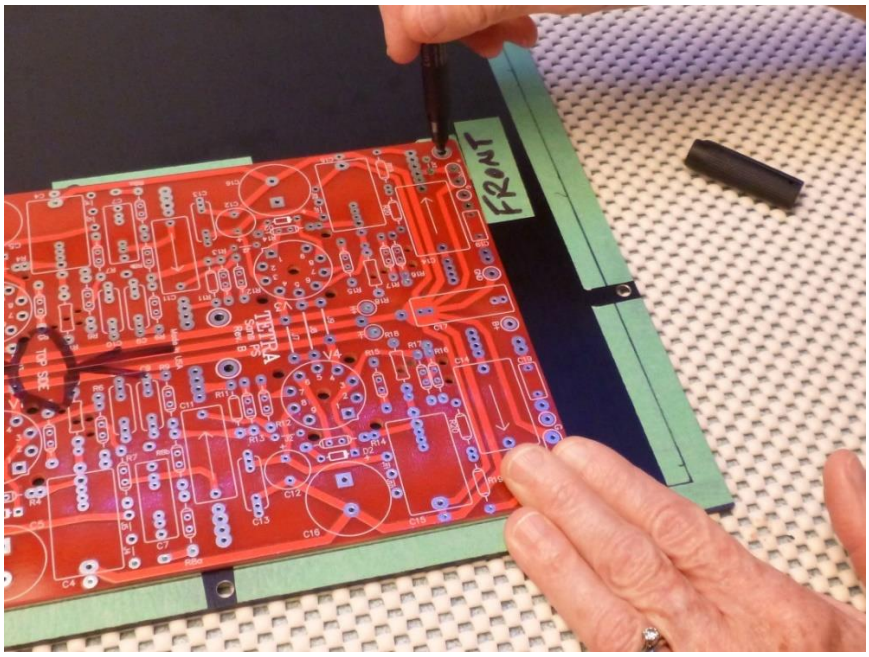




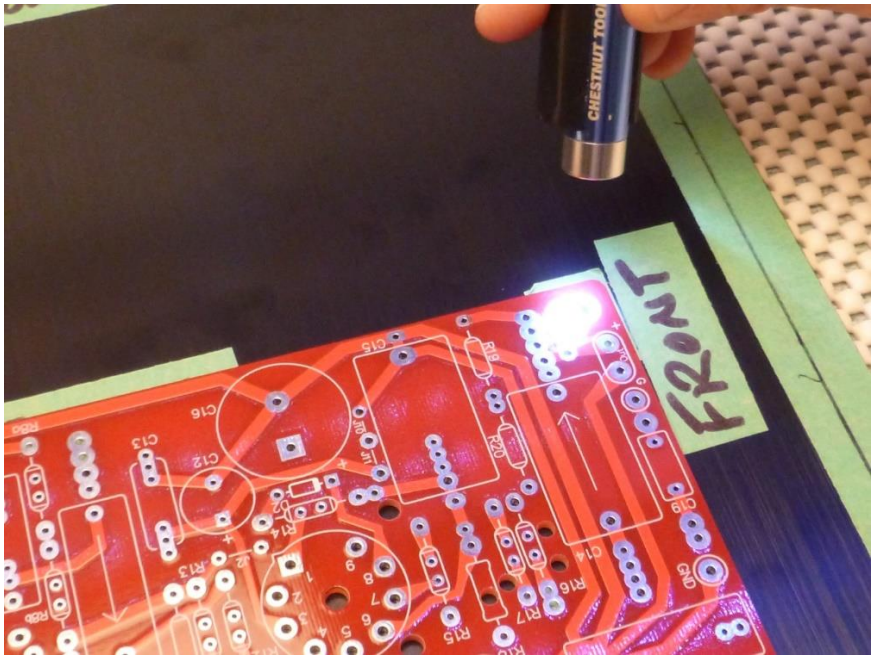
Align the opposite end of the board with the line drawn on the tape or align it so that it's a consistent distance from the line over the length of the board. If you have a scared-up work bench like mine a recess can usually be found (or made) for the head of the 4-40 screw protruding below the bottom panel.



On a hole in the opposite corner of the board centre punch, transfer punch or if your punches are too big to fit through the hole, mark its position with a felt tipped pen. Use a piece of tape underneath if it helps you see the hole location.



Use a light and check the hole location on the bottom panel relative to the hole on the board.



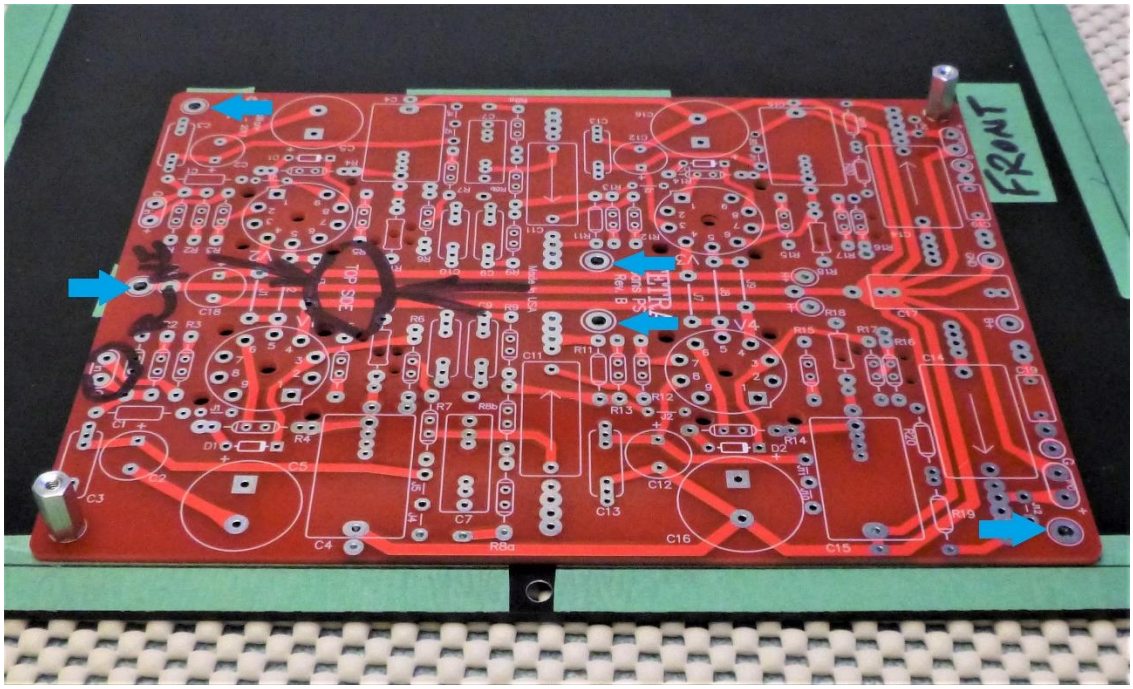
If the position is not precisely centered in the hole see procedure below.

See below for a demo that will "fix" a hole centre punched slightly off of the desired location.

If you happen to put a centre mark slightly off of the desired position it can be "pushed" back to the proper location by angling the centre punch and tapping it again. The pictures below demonstrate on a bare piece of aluminum so it's more easily seen. Don't feel frustrated if you have to "push" your centre marks around, I have to do it all the time. It's worthwhile taking a few seconds to "push" them to the proper location. It will save many minutes filing the holes later.

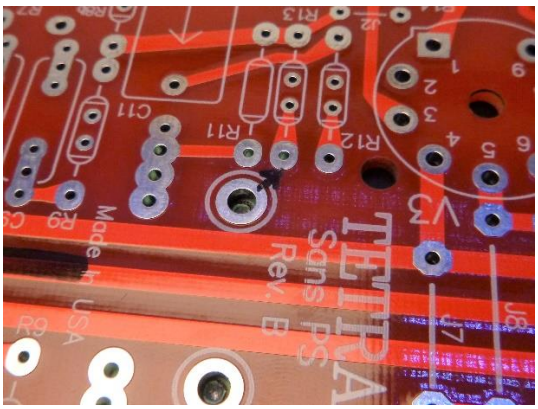
Once you think you have the centre punched hole in the correct location put the board back on the bottom and check as before. As above, remove the board, centre drill, then drill a 1/8” (or 3.2mm) hole and deburr.

Attach the amp board to the bottom plate with 2 screws and hex spacers as shown below.



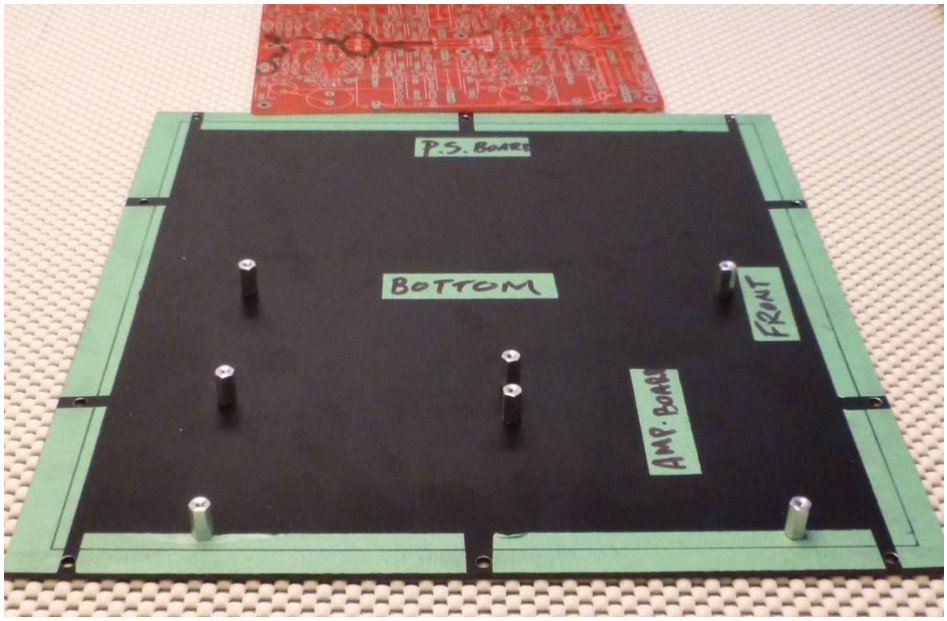
Mark the positions for the remaining 5 holes as shown above. Remove the board. Centre punch, then put the board back on the two holes already drilled. If any centre punch marks need to be “moved” as described earlier, do this before drilling. This is a pain but it’s a lot easier than filing holes that are slightly displaced from the ideal position.

Upon inspection I found that 2 centre punch marks need to be “moved”. See below for markings on boards that serve as a guide to help correct the location before drilling.

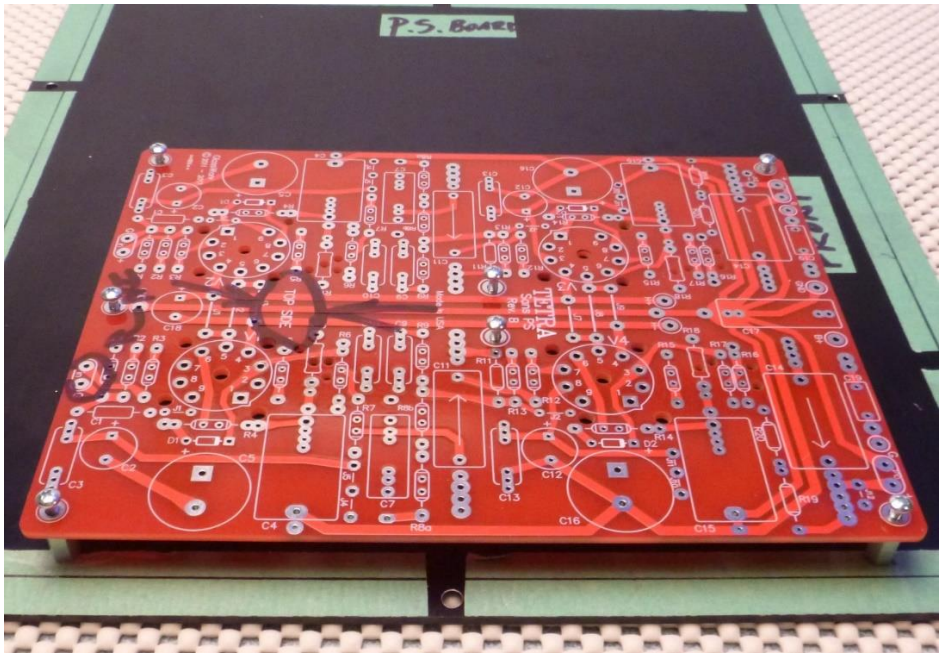


When happy with the centre punch locations, centre drill, then drill the remaining holes with a 1/8” (or 3.2 mm) drill. Deburr the holes.

Attach the hex spacers included with the kit finger tight to all 7 locations on the bottom panel.



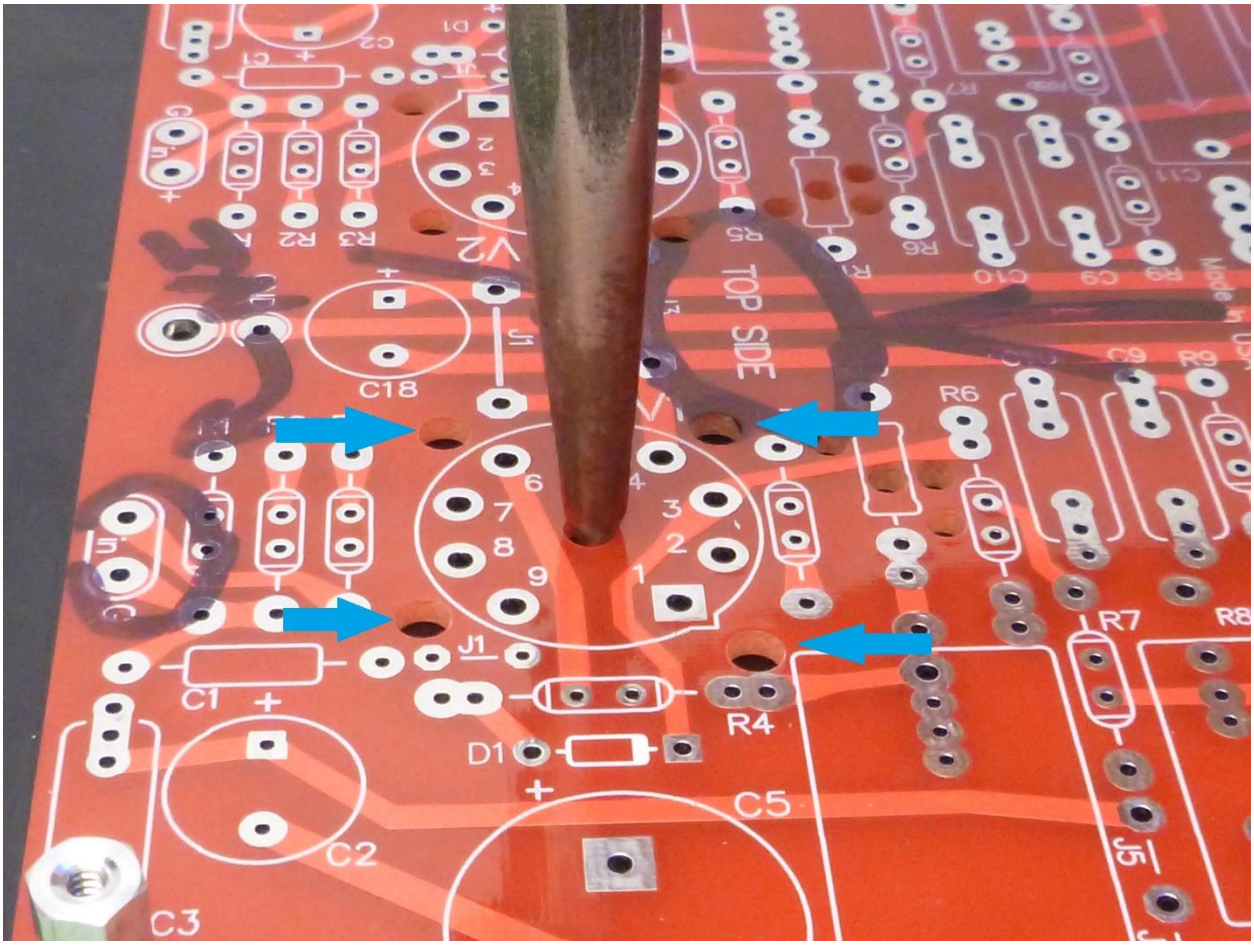
Place the board, top side up, input to the rear, over the spacers then thread seven 4-40 screws through the holes in the board into the spacers to check that they all fit. If you've been careful in your layout and drilling you won't have to file any holes in the bottom plate. Don't file the holes in the circuit board.



When you are happy with the fit of the board on the spacers, remove the screws, board and spacers.

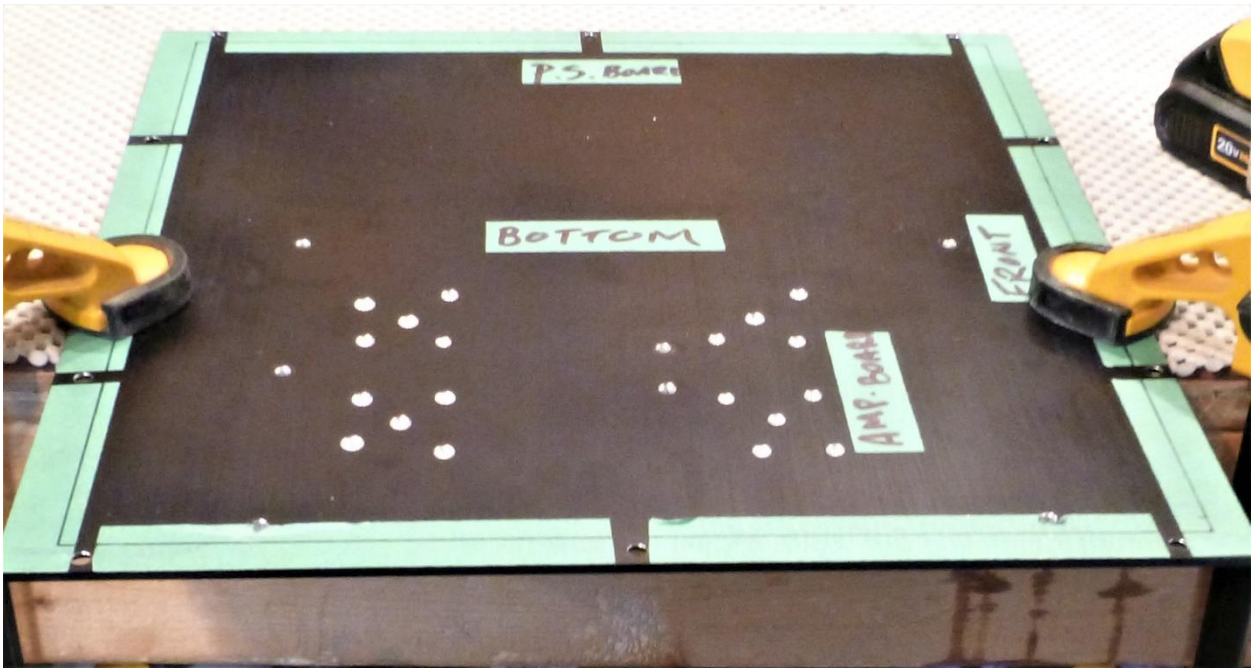
Once more, attach the board only (no spacers), top side up, input to the rear, to the chassis bottom with two screws.

In the centre of each tube position, marked V1 through V4, and in 3 or 4 positions around each, you will see holes in the circuit board. Mark these with a felt pen or centre punch them directly. Their position is <u>not</u> critical as these are for ventilation.



Remove the board and put it with the rest of the board parts.

At each marked location centre drill, using the larger centre drill, and drill using a 13/64” or 5.1mm bit. It’s a good idea to clamp the panel to your work bench as the larger drills tend to “grab” when drilling. Deburr the holes using the large countersink.



Proceed to, **Metal-Working for Dummies, part 2.** This will detail locating and making the holes for the power supply board and transformers.