Subject: 4 Pi Build in San Luis Obispo - Flush Mounting and Bracing
Posted by alexg on Sun, 24 Jan 2021 18:19:49 GMT
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Hello from San Luis Obispo, CA!

After more than a year of pestering Wayne via email and scouring the forum I have started my 4 Pi build. My goal is to share my progress along the way but have a few questions to get started.

1) I want to flush mount the horn/waveguide. Does anyone have any pointers to share? My thought was to make the first cut with a jig saw and some kind of cutting guide and then go back over the opening with a router and rabbet bit. One thing is for sure, I am definitely going to mess this part up once or twice so I had several extra pieces cut so that I can just do it over if necessary.

2) Is wood glue sufficient for securing the bracing on the inside of the enclosure? I am thinking about using wood glue and shorter brad nails, nailed from the exterior of the enclosure. Good idea or not necessary?

Speakers will go in the Great Room (Kitchen/Dining Room/Living Room). Due to the layout and size of this space my plan is to build 3 speakers. Speakers will be set up in an L shaped formation so that I will have 2 listening areas (See diagram below). 2 of the speakers will flank the fireplace for critical listening, home theater (tv is mounted above fireplace), or if I just want to relax on the sofa and listen. For this configuration, speakers will be set up approx 8-10' apart with flanking subs. Listening position will be 8-10 feet away. The third speaker will be used in conjunction with the speaker to the right of the fireplace. Third speaker will be positioned approx 20' from the other speaker. Together this configuration will be used for daily listening and background music while we are in the kitchen and/or sitting at the island where we spend most of our time while in this space. I will use a toggle switch to toggle back and forth between the configurations. As far as my diagram goes, I am not an artist and definitely not an engineer.

Room Diagram

To build 3 speakers I used 2 full sheets of MDF. This gives me all of the pieces I will need with enough material left over for extra "parts," primarily the baffles. As I mentioned above, in case I mess something up I can just start over. I do own a table saw (portable, contractor grade) but in order to ensure accuracy and consistency I had the local lumber yard cut the pieces for me. I am not talking about Home Depot! The local lumber yard has been around for decades. In addition to supplying lumber and hardware, they specialize in hardwoods, trim, and molding. They have an old school professional grade table saw that is dead accurate and offer a cutting service. For $20 they made my cuts using a cut sheet that I provided. For anyone planning to go the DIY route and not use Wayne's Kit (which is a great value and would have made my life infinitely easier) I highly recommend this approach if you do not have a cabinet style table saw.

A few construction pics.

File Attachments
1) 4 Pi - Room Diagram.jpg, downloaded 1675 times
2) 4 Pi - Gluing up enclosures.jpg, downloaded 1759 times
3) 4 Pi - 2 Enclosures.jpg, downloaded 1793 times
4) 4 Pi - Ports.jpg, downloaded 1815 times

Subject: Re: 4 Pi Build in San Luis Obispo - Flush Mounting and Bracing
Posted by Wayne Parham on Sun, 24 Jan 2021 21:31:48 GMT
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Looks like you're off to a really great start!

The braces can be installed with white glue only - no screws or tacking nails necessary. Make the braces a tiny bit long - like about a 32nd of an inch - so they fit snug. This preloads the panels being braced, which is what we want. Just put some white glue on each end of the braces and press 'em in.

I'll defer to the cabinetmakers to tell you how to route the baffle for the waveguides. I think they use a follower of some sort that indexes off the through-hole, but I'm not sure. I know that when it's done on a CNC machine, no sort of follower is necessary - the dimension is programmed in. But I do think you can do it by hand with a follower.

Subject: Re: 4 Pi Build in San Luis Obispo - Parts Arrived, Got a Router Jig
Posted by alexg on Thu, 25 Mar 2021 17:12:01 GMT
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It has been a few weeks since my original post. Somehow, when I do projects, audio and otherwise I seem to forget just how difficult it is to find time to work on stuff. In the planning phase I envision myself working away, continuously until the project is complete. Or, actually getting an entire Saturday to myself to focus on a project and make significant progress. Fat chance! The reality is that my projects are filled with late night and early morning sessions spread over several months. And of course, just when I find an opening to hunker down and get stuff done one of my kids will start crying or call out for a "milky" or get up ridiculously early on the very same day that I decide to get up early and want to be read to.

Anyway, Wayne, thanks responding to my last post.

The parts arrived at the end of February. Everything was in good order and well packed. Crossovers are top notch. Good quality boards, nice lay-out, and clean solder joints. I went with

standard capacitors and resistors but opted to upgrade the inductors to the 15awg version. As far as upgrades go, Wayne has an article in the FAQ section of the forum called "Upgrades." As the title suggests, it talks about the available upgrades and their benefits including which make the greatest impact. It sounds like upgrading the inductors delivers the most noticeable improvement as far as the crossovers components go. For the drivers I will be using the B&C DEC250 for the compression driver and the JBL 2226H for the woofer. Based on what I have read on the various forums, available product reviews, and on this forum, the driver upgrades are a "no brainer."

I mentioned previously that my goal is to recess the drivers and horns but that I wasn't sure how to go about handling the horns. For the JBL 2226H I will use my Jasper circle jig. For the horns, my neighbor had a really great solution for me. As it turns out, he is slightly more than obsessed with extruded aluminum framing. His entire garage, shop, and work van are filled with furniture and components made from extruded aluminum not to mention the entertainment center in his living room and the desk, printer stand, and bookshelves in his home office. He lent me a router jig that he made using the same.

The jig is comprised of 4 lengths of 2060 extruded v-slot aluminum framing and a handful of the L-brackets that are designed to work with this material. At the end of the day you get a jig that is adjustable but sturdy.

I made a couple of practice runs and the jig works great. I do need to figure out how to handle the corners because the finished radius that you get with this jig is slightly smaller/tighter than the radius of the corners on the horn. Unless someone has a suggestion I may just use some kind of wood filler to fill in the difference and sand it down. My plan is to use veneer so I should be able to cover it up nicely. There is a product that my cabinet guy introduced me to a few years back that is similar to Bondo. I have used it on several occasions but can't quite remember the name. It comes in a black can with bright orange writing and is available at Home Depot, Lowes, etc.... I will include the name in my next post.

Got a couple of questions.

1) Is there any additional benefit to adding dampening to the horns? Based on what I could find in the forum, there is not and the "care guide" that comes with the horns states that the abs material provides excellent dampening. However, I do see that some people do it anyway and swear by it.

2) For the flanking subs I am will be using 2, 15" Dayton Drivers from Parts Express and 2 of the Denovo 3.0 Cubic/Ft Sub enclosures. I plan to port the enclosures. My question is, as far as flanking subs go, if the driver is facing forward and I do not have room for a port in front, is it better to position the ports in the back or have them firing down to the floor? If the back is the way to go is it better to mount them high or low? Since I am adding the ports myself, I can add them

wherever is best.

3) I am thinking to finish the speakers in a Walnut veneer. Does anyone have recommendations for wood veneer? Brands that have worked well? Where to buy? Retailers and/or brands to avoid? Your input would be much appreciated.

4) What size screws would you recommend for the JBL Drivers?

Thanks in advance!

File Attachments

1) 4Pi Parts.jpg, downloaded 1570 times
2) Extrude.jpg, downloaded 1585 times
3) Router Jig.jpg, downloaded 1626 times
4) bracing.jpg, downloaded 1557 times

Subject: Re: 4 Pi Build in San Luis Obispo - Parts Arrived, Got a Router Jig
Posted by Wayne Parham on Thu, 25 Mar 2021 21:25:29 GMT
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Nice work so far. And man, I hear you about the "things get in the way" issue when doing projects. I always have several projects underway, and like you, I have several disruptors. But I always try to remember that a mountain is climbed one step at a time and that it pays off to sometimes take detours and rest breaks. I sometimes have to tell myself this because my nature is to get stressed and try to conquer the mountain in one day. Never any good in that. So I know to always enjoy the disrupters rather than to endure the disruptors. In fact, even my terminology is wrong, in that I should change from calling them "disruptors" to maybe "detours" or even think of them as "fun distractions."

Anyway, I digress.

To answer your questions:

1. Horn damping. It doesn't hurt, that's for sure. Some people swear by it. I personally don't find it useful because the H290C is so thick and heavy. It's well-damped, as dead as a rock. Its bell mode is over an octave below the passband, at around 420Hz. So the sound passing through it cannot energize it and the sound on the outside of the horn is damped by the insulation within the cabinet. Still, you won't hurt anything by adding rope calk or any other sort of damping goo on the outside.

H290C (unmounted) Bell Mode

2. Port location for flanking subs is unimportant because the sound emanating from the port is

almost purely the Helmholtz region, certainly very little up high. I do think it's useful to have the woofer cone forward-facing, since the lower-mids emanate from there.

3. Sorry that I'm not as much help here as the woodworkers. Usually the cabinetmakers I've worked with show me samples that I choose from. But I do know you can buy online and many of the online sellers will also show grain images.

I've shopped at "Woodcraft Supply" - which is both online and has "brick and mortar" stores - and found excellent veneers there. They also have nice "chunks" of wood which were great when I was making CNC wood horn/waveguides. The link below shows some of the veneer products they have available online and/or in the stores.
Woodcraft Veneers
4. I like to use 10/32 thread button head screws with black oxide coating. They're attractive and fit nicely. Use T-Nuts or threaded inserts. The length depends on whether you surface-mount or flush-mount, because the depth of the baffle and any additional backing you might provide for strength behind a router groove sets the length needed. But I tend to find that 1-1/4" seems to always work.

Subject: Re: 4 Pi Build in San Luis Obispo - Parts Arrived, Got a Router Jig
Posted by alexg on Fri, 26 Mar 2021 18:47:38 GMT
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Wayne,

Thanks for the quick response. I am glad that I am not the only person that struggles to get stuff done.

For the subs, if I position ports on the bottom of the subs (facing down to the floor) is there a minimum distance that I should maintain between the bottom of the subs and the floor?

As far as dampening the horn, you had me at "I personally don't find it useful." ha! ha! If the designer doesn't think it is necessary then that is all that I need to know.

Subject: Re: 4 Pi Build in San Luis Obispo - Parts Arrived, Got a Router Jig
Posted by Wayne Parham on Fri, 26 Mar 2021 19:17:01 GMT
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I've often used a rule-of-thumb to make the minimum spacing between a port and a nearby boundary to be equal to the port diameter.

But I've also found many times where this wasn't needed.

The Helmholtz resonance isn't affected much by having boundaries nearby, and that's what matters most. Beyond that, you have a whole different matter - Turbulence that causes audible chuffing. This doesn't change port tuning, but it does create audible artifacts. And that's what's really an issue when we're talking about the distance to a boundary. It's an issue of airspeed and the potential for turbulence.

So basically, if you don't hear something off, you're good. It'll keep the dust from collecting under the port, that's for sure. :lol:

Subject: Re: 4 Pi Build in San Luis Obispo - Parts Arrived, Got a Router Jig
Posted by OutOfSpace on Sat, 27 Mar 2021 15:30:45 GMT
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Alex,

re; the radius for your horn cut-outs, are you using a guide bushing on your router or just running the base within the jig? I guess in either case, if you use a bigger pattern bit the corners will have a bigger radius, hopefully matching the horn.
No surprise there. Nice jig, too!
Chris

Subject: Re: 4 Pi Build in San Luis Obispo - Parts Arrived, Got a Router Jig
Posted by alexg on Sat, 27 Mar 2021 16:23:08 GMT
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Hi Chris,

I am using a Template Router Bit with a flush trim bearing. The bit is 3/4" wide x 1/4" deep. In my practice runs I was sinking the bit and running the bearing along the inside of the jig. I will look into bushing guides. Thanks for your input.

Alex

Subject: Re: 4 Pi Build in San Luis Obispo - Flush Mounting and Bracing
Posted by Jensen on Mon, 05 Apr 2021 11:56:21 GMT
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https://www.veneersupplies.com/

I've used these guys a few times, including for my 4pi project (my first foray into veneering). Great lot consistency and a wide selection so you can spend as much or as little as you want.
You can probably search under my name to find my 4pi project. Be warned, veneering such large sides isn't a trivial task...

Good luck and enjoy the process.

Subject: Re: 4 Pi Build in San Luis Obispo - Settings for Flanking Subs
Posted by alexg on Tue, 20 Jul 2021 02:36:49 GMT
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Finally, finished my flanking subs. I am using 2, 15" Drivers from Parts Express in ported enclosures.

For flanking subs, you said "just set it for low-pass 100Hz BW 12dB/Oct." For this I am going to use a miniDSP that I have from a previous project (LXmini from Siegfried Linkwitz). It will be super easy to set the recommended low pass filter in the DSP. Should I set a high pass filter as well?

File Attachments
1) Sub 11.jpg, downloaded 1166 times
2) Sub 6.jpg, downloaded 1186 times

Subject: Re: 4 Pi Build in San Luis Obispo - Settings for Flanking Subs
Posted by Wayne Parham on Tue, 20 Jul 2021 15:52:09 GMT
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It never hurts to use a high-pass filter for vented subs set at or just below the Helmholtz frequency. So if your sub cabinets are tuned to 20Hz, set a fourth-order high-pass at 15-20Hz.

Subject: Re: 4 Pi Build in San Luis Obispo - Progress
Posted by alexg on Tue, 03 May 2022 17:08:15 GMT
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Finally starting to make some progress..... I was hoping to post as I go but I tend to work in fits and spurts when doing these kinds of projects and although I found time to work on the speakers I fell behind on my posts and updates.

In order to recess the wave guides, I ended up using the same template strategy that "Roger S" used. Thanks "Roger S!" At first I tried to use my jig to cut the shape of the wave guide directly into the baffle but really struggled to get the corners right. The jig was great for cutting the general shape of the wave guide but didn't allow me to effectively address the rounded corners. So, I ended up making the template per Roger S using my jig and router and then routed the corners by hand. It took me a several tries to get it right but after a few attempts I finally got one that I was happy with. From there I used the template to cut the baffle. Worked like a charm.

For the woofers, I beefed up the back side of the baffle with an additional piece of wood per Wayne's recommendation in order to give them a little more "meat" to attach to. Using my jasper circle jig I cut a round disc approximately 16.25" in diameter using some ¾" cabinet grade plywood that I had lying around and glued it to the back of the baffle. I then cut the recess and hole for the woofer.

From there I attached the baffles and vents using clamps and kettle bells.

For the most part I am pleased with my results thus far however I would like to point out a few issues.

#1 - Even though I had the local lumber yard cut my sheet of MDF to spec, after gluing up the box and then attaching the baffle my speaker was not perfectly square with some parts slightly hanging out over other parts. I ended up using a trim router to clean things up.

#2 - I pre-cut the hole for my vent with the intention of using a trim router to clean things up and make the opening flush and square however I got little too aggressive with the jig saw and over cut the opening in a few spots and then allowed the trim router to get away from me a few times so I now have to go back and fix the problem areas with some kind of wood filler. You can see it in the photo below and in some of the other photos in this post.

File Attachments

1) Inside and Front.jpg, downloaded 600 times

2) #3 - Jig #5.jpg, downloaded 582 times
3) Recessed baffle after jig saw.jpg, downloaded 584 times
4) Baffle with round disc JBL BAcker.jpg, downloaded 475 times
5) Router cutting JBL hole.jpg, downloaded 118 times
6) Woofer Ring Back.jpg, downloaded 596 times
7) Router cutting woofer hole.jpg, downloaded 578 times
8) Baffle clamps.jpg, downloaded 567 times
9) Kettle Bell Vent.jpg, downloaded 568 times
10) Vent Issues.jpg, downloaded 572 times

Subject: Re: 4 Pi Build in San Luis Obispo - Questions for Wayne
Posted by alexg on Tue, 03 May 2022 19:43:34 GMT
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Some questions for Wayne.

1) Ok to use foam or wax strips for gaskets? I have a bunch from other projects.

2) Waveguide is recessed. Does it require "more meat" (backing) like the woofer)?

3) Can I install a larger piece for bracing?
- I was thinking of installing a more substantial piece of bracing that would touch all 4 interior walls, add more support, and give me something to attach the insulation to.

4) I have added some backing behind the woofer. I may add backing behind the waveguide. I would also like to potentially add the bracing that I described above. At what point should I be concerned about having a material impact on the internal volume.

5) I did see your article about how to properly install T-Nuts however I am wondering if it is ok to simply use larger wood screws in place of t-nuts especially because I used plywood as the backing for my woofers?

Subject: Re: 4 Pi Build in San Luis Obispo
Posted by Wayne Parham on Tue, 03 May 2022 20:15:10 GMT
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Your build is lookin' great!

I like the ring you've used to add "meat" behind the woofer for mounting screws. We do the exact same thing. It adds thickness where it's needed and eliminates the need for a double baffle. These speakers are heavy enough.

We do the same thing around the waveguide, which I think answers your question about that.

You could use wood screws to mount the drivers, sure. But I wouldn't. It isn't much more trouble to use T-Nuts and they provide much more clamping force without stripping. Not that you need much clamping force - 10 foot/pounds per screw is plenty - but still, the metal threads are much stronger and long-lasting.

You can add bracing if you want, but it's really only needed between the baffle and back. The rest of the panels are small enough to shift panel resonance way out of the passband. We tie the sides together at the same place - between woofer and tweeter - which is overkill but serves to provide a "perch" for the insulation that spans the cabinet interior. That's what is really important, to span the cross-section with insulation separating the midwoofer and the port. It prevents midrange from entering the port, but bass passes right through. That's its function.

As for gasket material, you could probably use your wax strips. I don't know - never used them - but the gaskets in vented loudspeakers aren't stressed so most anything that makes a decent gasket will work in this application. Almost any flat non-corrugated cardboard material is fine for a gasket. I like 40 mil PVC material, commonly used for making shower pans.

Subject: Re: 4 Pi Build in San Luis Obispo - Progress
Posted by frederf69 on Sat, 04 Nov 2023 21:39:48 GMT
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Hello,
how did you get all this from the plans; which don't feature the recess or the hoop to support woofer. + will there be enough room for proper bracing?

Subject: Re: 4 Pi Build in San Luis Obispo - Progress
Posted by Wayne Parham on Sun, 05 Nov 2023 15:38:23 GMT
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The cabinet is pretty simple - it's a rectangular box - so cabinetmakers don't need anything more to be able to cut and build from these plans. They're not like the 12Pi hornsubs, which really is a complicated build, and needs more detail in the drawing. But you're right that the simple plans do leave some stuff out. Most of my plans don't even show the amplifier connection panel - largely because some use Cardas binding posts but others use a different kind of panel - so but I usually just tell people to center them on the back panel, three inches up.

Same thing with the cross-brace. I just tell people to place a cross-brace between the woofer and tweeter. I suggest a pair of sticks make from the panel material, one spanning front to back and the other spanning side to side. Most people do that, but some make a panel brace. Either method works just fine.

The stuff that's important acoustically is shown in the plans though. The crossover schematic, the

cabinet dimensions and the placement of the drivers, the port and the fiberglass insulation damping material. Those are important because they determine things like internal standing waves and the shape of the forward lobe and positions of the vertical nulls.

Stylistic details are left to the cabinet builder. Some make a plain box with drivers mounted on the surface of the baffle. Others cut a groove in the front with a baffle with a router so they can recess the drivers and mount them flush. When doing so, the baffle becomes thin so more support is needed. Most cut a round or square panel, glue it to the back of the baffle and cut through it. That effectively doubles the baffle thickness in the area it is needed. Some people paint their cabinets, others veneer them. Some people make grilles, and others don't.

To tell the truth, I've seen some really nice cabinetry displayed here. There are some really talented cabinet makers that have posted pics of their work here. I asked to borrow one of 'em, and hade a cabinet built just like theirs. It's now offered as an option on the three Pi model.