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Subject: 2 pi tower folding?

Posted by [grindstone](#) on Sun, 30 May 2010 18:39:59 GMT

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I was gifting some two pi's and a sort of homebrew el84 se thing to a friend as a little intro to tubeville and I read how much the decware guys seem to love the towers.

My buddy doesn't want the form factor of the towers so...I think I know the answer but have to ask anyway--has anybody successfully folded these things?

I mean, I know it's no longer Wayne's design so if it sucks it's my problem. Just trying to get a little more bass than the regular two pi and make a shorter speaker for his pref.

If not, I guess, please kindly count me in for a set of two pi tower plans please.

Thanks for the time.

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Subject: Re: 2 pi tower variants

Posted by [Wayne Parham](#) on Sun, 30 May 2010 20:13:13 GMT

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I'll send you the plans for the towers, some additional thoughts below.

tuning mechanism is Helmholtz, so the shape doesn't matter... with the following caveats.

I say it "doesn't matter" but in fact what I mean is the internal standing waves are attenuated rather than incorporated as a tuning mechanism like a horn or transmission line. But even that being the case, it is still important to consider internal standing wave behavior because it will be significant in a cabinet this size.

The only difference between a large bass-reflex cabinet and a large T-Line is that the fundamental standing wave mode in a transmission line is used whereas in a bass reflex, it isn't, or at least it shouldn't be. In a bass-reflex box, Helmholtz resonance is used instead. I suppose you could build a hybrid where both mechanisms were used.

In a transmission line, the port is physically placed where the fundamental node is in a pressure node. If you're building a bass-reflex box, the port should be placed somewhere else, where the fundamental standing wave node is not strong, but rather at a zero-crossing. That way, the only thing present at the port is Helmholtz resonance.

Whether the tuning mechanism is Helmholtz or standing waves, the harmonics should be attenuated with absorbent damping insulation. It also helps to position the port so that odd-harmonics fall on zero-crossings, like I mentioned above. This will also assist in attenuating

internal standing waves. If you have pressure modes that line up with the port, they'll show up as little blips in the response.

between about 1.5ft<sup>3</sup> and 5.5ft<sup>3</sup>, and tune the box to 40Hz. Smaller boxes will have higher cutoffs, larger boxes will go deeper. Put the woofer and tweeter on the baffle fairly close together. It's that simple, in theory. In practice, the larger boxes will start to have internal standing waves that line up in the lower midbass and bass range near where the port is tuned, too low for the insulation to absorb very well. So you'll want to position the woofer and port in the box where the port isn't in a pressure node, and you'll want to span the cross-section with insulation to help attenuate what's left.

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Subject: Re: 2 pi tower variants  
Posted by [grindstone](#) on Sun, 30 May 2010 21:07:26 GMT  
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Thank you for the incredibly detailed and fast reply.

It must take more time to write all this stuff than to do the work but thanks for outlining the considerations. I have too much respect for all the work that you do on your designs to loosely hack away but I will try to model something somehow to make my way. I may be back after I get started but for now thanks very much!

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Subject: Re: 2 pi tower variants  
Posted by [Wayne Parham](#) on Sun, 30 May 2010 21:20:11 GMT  
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When modeling, be sure to use something like Martin King's spreadsheets that will show you internal standing wave resonances, duct pipe modes, etc. Many box programs aren't capable of this, and only a few will even show the vent pipe resonance. We need to be able to see that and the influence of internal quarter-wave modes too. Otherwise, your model will look smooth but measurements may show some spikes in the lower midrange that your model didn't include.

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Subject: Re: 2 pi tower variants

Posted by [grindstone](#) on Mon, 31 May 2010 02:23:59 GMT

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Thanks again, Wayne. I know it's dicey to stray from the results of your hard work and that the pitfalls are many.

I switched to a non-MS OS long ago and have not been able to run the sheets (they were simpler and even then I needed hand-holding). I was poking at hornresp (runs in wine) to try to find some modes but I admit to not ever trying this kind of geometry in there so I need more work to even trust what I think I'm doing (let alone the validity). Fumbling in the dark.

I can do pieces, but not the whole thing with proper driver and port locations. Haven't been able to nail the Z humps you posted elsewhere, either. Pretty sure I might be misapplying this model, too (but I'm having a sort of "fun"

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### File Attachments

1) [schem.jpg](#), downloaded 7271 times

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**Subject: Re: 2 pi tower variants**

Posted by [Wayne Parham](#) on Mon, 31 May 2010 02:32:09 GMT

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It looks cool, that's for sure. You just gotta test it to see where those peaks fall, either with computer models and sims or cut-and-try physical models and measurements, or both.

What OS are you running now? I run all flavors of MS stuff, (almost literally) from Win98 to Vista. Really do, still have an old copy of Win98 running on one box because of its smaller footprint. I'm also running Ubuntu v10 (just upgraded from v9) and use OpenOffice on it. It has an Excel clone that runs spreadsheets pretty well, even has a VBA implementation that runs most of the macros. If you do file I/O in macros, some VBA rewrites are in order but basically, spreadsheets just work in most cases.

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**Subject: Re: 2 pi tower variants**

Posted by [grindstone](#) on Mon, 31 May 2010 03:03:17 GMT

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Well, at my skill level, I'm counting the first two honks and not going high-order.

I mean, to state the obvious, making the volume into anything other than what you designed makes it something else so the question is what makes sense (no answer here, yet). I don't pretend to be making the same thing but more trying to save the most of a good thing while still

fitting something into the guy's house.

The Helmholtz is cool, and to radically paraphrase you, a tall skinny box is gonna have modes and they'll need attention...and damping...and care locating port and driver.

Re OS, yeah linux here (slackware). Some \*buntu's on other boxes. Probably should have kept a box running the other stuff but it was a partially religious conversion that was strongly motivated at the time

The macro things are always extra work and the older I get the more I respect people that just use whatever tool they need to do their tasks. Life's too short for everything to be a hobby. Convert your files a few times and it's tough to be excited about the world requiring another switch to new formats...which gets back to the OT zealotry thing

hornresp doesn't run crash-free in wine but it runs and always seems to even with all the changes so it's another thing in the world to be really grateful for (like pi speakers, this board, and all the time & energy you spend educating). You must not sleep at all.

I'm probably gonna need to post over on the hornresp thread to figure out how far afield i've already strayed.

As long as I'm here, thanks for making such great things available at such economical prices as the 2 pi stuff. I might not have any idea what I'll end up with yet, but I know that it'd be quite a few dB down if it weren't for your stuff. It makes my whole little gift plan even possible and that's just plain cool.

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Subject: Re: 2 pi tower variants  
Posted by [Matts](#) on Mon, 31 May 2010 17:44:49 GMT  
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It's quite nice of you to introduce a friend to good tube sounds with excellent dynamic speakers! My reaction, for whatever it's worth, is try to build a pair of the Pi 2 Towers according to spec, as an experiment, if nothing else. Very ez to do and inexpensive for what you get. Ask your friend to try them out- if they truly value the sound, the size will not seem quite as important. If they don't care about deeper bass, the std Pi 2 is wonderful and has enough bass for good listening. Can't deny the laws of physics...

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Subject: Re: 2 pi tower variants  
Posted by [Norris Wilson](#) on Mon, 31 May 2010 21:14:36 GMT  
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What is the required enclosure volume to load the 10" woofer in the standard 2 Pi?

Thanks

Norris

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Subject: Re: 2 pi tower variants  
Posted by [grindstone](#) on Tue, 01 Jun 2010 00:32:11 GMT  
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Hi Norris

Very rough, std 2pi is around 1.8ft3 / 50 L, tower 4.5 ft3 / 128 L

And Matts I like the trojan horse plan. We slip the tower in there as a gateway drug and once the monkey is on his back I'm all set! Problem is, his gatekeeper kaboshed it getting in the door. Good thinking, though. Gotta scheme more...maybe I build the towers to spec and lug them somewhere so he can hear them and then it's his problem to get them in his door.

And it's not like I'm any philanthropist--I broke my leg and couldn't drive (clutch foot) and he bummed me an auto-trans truck so I owe him.

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Subject: Re: 2 pi tower folding?  
Posted by [grindstone](#) on Sun, 06 Jun 2010 05:51:27 GMT  
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A sort of interim pretend/virtual update. Awaiting approval on size. Figured that since it's gonna honk anyway, might as well make it a pipe. Couldn't resolve issues with any pipe and still have driver height right with driver around 1/3 down the pipe, etc.

This thing is maybe 20x19x33 or so to make one simple fold (my goal). Tough to fit and not sure this succeeds (page 2 of pdf shows how hatched "design" model fails to fold right). It's not as much of a plan as it is a general direction.

OTOH, can put that divider board about anywhere and not be any farther off...never did really understand mean path length at centerline vs. shortest distance type path lengths...upshot is not really sure how it models and seems pointless to pretend it conforms to any sim outta me.

Plus, if this thing gets rejected too, it's at least starting high to leave room for negotiation back to the real 2pi tower

Last, got a couple numbers off the drivers, too, fwiw. No claims/everything disclaimed and any deviations are me or my measurement methods or both, blah, etc.

So basically everything in this post is worthless and an update is unnecessary. Call it just a

neighborly hello then...

## File Attachments

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- 1) [weirdline.pdf](#), downloaded 442 times
  - 2) [alpha10\\_ballpark.jpg](#), downloaded 453 times
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Subject: Re: 2 pi tower folding?

Posted by [Wayne Parham](#) on Sun, 06 Jun 2010 14:19:56 GMT

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That's pretty cool. I wonder how it will measure. Keep us posted!

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Subject: Re: 2 pi tower folding?

Posted by [grindstone](#) on Tue, 10 May 2011 05:32:01 GMT

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I've burned this whole night messing with stuffing and lining and my head hurts. There's basic voicing stuff either in addition to or resultant from all that internal reflection beeswax, too.

The closest I can get these 2pi tower-ish jobs to sound like pianos and acoustic guitars is completely empty but I can't make that trade for the clarity either.

If I overstuff, man the bass control is even more sweet and it just wants all the watts I can give it...but when returning volume to late-night levels with small/simple/sparse stuff, the "wood harmonics" are too far down and it's not right for guitar bodies and pianos; gets too "closed in".

I keep feeling like it's not even the standing waves but just what reflects back through the cone locally there...but maybe both for all I know. That's next when I step away from this keyboard.

I do feel like I prefer having some lining there closer to the alpha10 but it's all so much more sensitive than I'd have guessed. This driver Really needs space to breathe right (even with about a 15x10 cross section). The tuning doesn't really move but about 3Hz no matter what but the voicing of the thing is night and day.

As always, probably should have just done what Wayne said and might get there yet

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Subject: Never did fold them in the end

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Posted by [grindstone](#) on Sun, 14 Apr 2013 20:16:12 GMT

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Meant to cap this old thread long-ago but it never happened. I see the trend going the wrong way, too, so here's a quick dump while I have an opening.

The upshot is that I didn't build the tower as-designed due to height limits--as such, all warts are mine. I simmed a zillion things in Martin's sheets and worked hard to try for a couple more Hz on the bottom. Put the port on the front for the extra couple dB wherever that was...I think I was aiming for max amplitude at ~42Hz or something. Overcooked it a little bit and ended-up throttling the port a little with three layers of fabric from the surplus store stretched over a hunk of gutter guard (aka mammal and grandkid filter) and more fiberglass internally. If I were a proud man, I'd say aperiodicity was a goal and that I Meant to do that. Fact is, the thing lit-up some rooms here and taught me a lot about my house (one placement got my foyer to resonate, somehow, for one, which was wild). It was aligned higher-Q too-low for my place, but better for where it was headed. (And, since the port location will come-up, yup, I did look at about the first 5 box harmonics when choosing that spot).

Because it's a kit, all the heavy-lifting is done, but I still used it to investigate what could be had from going nuts on whatever else was left. I learned a lot. Worked so hard and learned so much building something for a friend that I'll never do it again

I glued 5-sides early and then clamped/unclamped the baffle during all manner of wanking with bracing and lining. Ran them maybe 8-9 months that way, in and out of the system as thoughts of rebuilding different boxes or trying different drivers danced in my head. Ran them side-by-side with 8 other pairs of speakers from OB to tiny monitors to...everything in the place.

First, I used 1/2 (walls) and 5/8 (baffle) particle board as a nod to weight considerations and sought to brace for what was traded in wall thickness. I did diy an accelerometer and a little preamp to mess with that stuff, but honestly, once I figured out how to really listen for pboard walls, the knuckle system worked reliably and I didn't have to wonder about any data. Where I arrived is pretty-much ~6" max unbraced span. Anything else even the knuckle-test reveals. Spent a lot of time comparing to plywood and, if I had to do it over again, I'd go all-plywood if I could swing nice plywood. Still and all, best boxes I've built.

The lining and tuning, as mentioned-above, are interdependent, but I went through several extended sessions running them on their backs and quickly iterating lining configurations. For kicks, I took some Z curves when doing that to see what might've been happening with tuning. The tuning shifts were minimal compared to the voicing of the boxes. I can't recommend the exercise more strongly. Over the course of maybe a year, I did probably four 3-4 hour sessions cycling the same snippets of the same material. (In case anyone wonders, dry bead of RTV was on one box, and I went with rope caulk on the other. Packing tape and clamps for the rest. After having to scrape and 40-grit the RTV out prior to gluing, note-to-self--Never use RTV for that again. I tried weatherstripping once, too, which is fine for short clamp-ups, but has the same problems as the RTV if you leave it mashed into the edges of the box for days).

All I'll say is the exercise is worth the pain and that I have no recommendations; what I can say is that I'm 100% positive I achieved the best compromise between transient performance and openness. I'm also 100% positive that I got the most out of these boxes and that it will be different

for any other box. As long as I'm opining so strongly, I should state that I really believe most big boxes are sorely underbraced and that it's audible and it matters. The problem is that, in a sort of Zen way, you (one) have to hear lack-of-box to hear box. People who run OB or maybe panels or big ribbons get that (but there's so much more going on with dipole vs. omni that it's a bad comparison, maybe). Anyway, I didn't until I heard it. The experience was the same with the lining. I'll never again treat lining so lightly and large effort is worth it. A cross-batt is a good start and the driver placement at somewhere 1/3 or 1/2 helps those modes, but it really is a balance of compromises. I'm not trumpeting my method, my intent is just to be a vocal data point that the effort in bracing and lining is rewarded (even for something so lowly (sic) as a "pro" driver). Get something that's percussion-heavy and something sparse and ambient that has large soundbodies like piano or cello and try to find the happy spot with the lining for both.

In the end, I listened to them the most alongside Cornwalls and tuned to approximate them. They get closer than I'd have thought possible, though in-fairness, it's clear that a 10 inch driver is not a 15 inch driver (mostly in scale of presentation, not amplitude/FR so much). I worked really hard to make piano and cello sound the same Size on these as on the Cornwalls. The large box really helps (and there's no substitute), but lining is part of that as well. The size illusion came-off really-well.

Ended-up bracing the basket legs with aluminum JB-welded-on (and no, I didn't do the A/B vs. the unbraced baskets). In addition, I wrapped each basket leg in a couple-three layers of craft felt (as allowed by clearance). I have done that on other widerange drivers and I threw the works at this thing. Basically, the drivers are economical stamped baskets and I wanted to move the leg resonances higher if I could. I also sought to absorb whatever rearside reflections that could be had. All wank, no data as Zilch might say

Among the many process-related things I learned are that 36-grit really does remove as much as you remember and that Minwax High Performance Wood Filler is stronger than...everything. Much work was done in the garage in the winter and I gained invaluable knowledge about shear strength of frozen yellow glue vs. unfrozen yellow glue. I also learned to not be preoccupied when tightening socketheads in a driver basket as they will summarily punch new holes w/o notice. (I am proud, however, at handling drivers soooo many times over so long a period and not trashing them--some sort of record). I learned that people look at you like you're from the Moon when you ask for "shower pan gasket" despite having a printout of their company offering complete with SKU number in-hand. (I used that red hard rubber and will never do that again, either, btw--my 2c is to just do a nice bead of RTV and let it set-up). That venerable Vifa tweeter is still pretty nice for a dome and I still hate those tiny terminals (early-on, I soldered pigtailed on them and had to due to box size vs. cup location). I also learned that 2-yr-old-proofing-heavy grille costs about 5dB past 1kHz (ramping up from no atten at maybe 500Hz). Somewhere in there, I made some switch + pot thing to ping on the driver on the scope to twiddle for source resistance that best-damped the thing, too. This was fun and instructive, but it's another thing I'll not repeat. An SE 2a3 into 5k came pretty-close to right for source Z, but I fudged the tuning looser/boomier for a better compromise on a sand amp. For the first time, I used a heavy roller to put some texture on the thing in anticipation of using the truck-bed black. That worked really well to hide the imperfections. The grille then, had to be a sort of intermediate gray that would work with whichever way he went (to date, he's not decided). I learned a lot about the sympathetic excitation of whatever other speaker was near these things when running LF tones (that stuff happens and I can't swear if it was aiding or acting as bass trap). Lastly, I learned that it's almost



universal that most (non-audio) people expect big speakers to be LOUD and to flap their pants and thump their chests. Perception is a funny thing and that might be an issue for some. I don't know where I read/heard it, but I've since stolen someone's line that you don't have big speakers to make big sounds but rather to make the little sounds.

Sound: Very fun all-weather speaker. Fun is the word I keep coming back-to. For the money on the kit (don't forget soldered XO's are included), it's a ridiculously good speaker if you build a good box and work on the lining. Kudos to Wayne for brewing this. If asked to name a fault, I'd say that the Eminence isn't a res-king, but you have to spend a Lot more to get that w/o losing what this does. Further, some of that is on me for reaching lower as well (i.e., if drivers are relieved of LF-duty, clarity will benefit).

I would say that anyone that can tolerate the size of box that does justice to these things shouldn't hesitate. I ran these all day for a long time and they put a lot of smiles on me. It's possible to get higher-quality bass from this thing than I'd have guessed and I stand educated. Like many Eminence drivers, these things will take a bunch of power, too, and they seem to like a little bit of power. Recommended, and again nice-work, Wayne! My only regret was that I found these after the horn-supply dried-up for the earlier models (seems I have horn-itis and I fear it's quite permanent).

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### File Attachments

- 1) [empty\\_w\\_most\\_braces.jpg](#), downloaded 341 times
  - 2) [thick\\_roller.jpg](#), downloaded 347 times
  - 3) [mammal\\_filter.jpg](#), downloaded 331 times
  - 4) [grille\\_frames.jpg](#), downloaded 306 times
  - 5) [delivery\\_civic.jpg](#), downloaded 352 times
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Subject: Re: 2 pi tower folding?

Posted by [grindstone](#) on Sun, 14 Apr 2013 20:58:38 GMT

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Couple more files while I'm here (and yes the CW are almost exactly 1-bicycle tall). Thanks for all the bandwidth.

PS Wayne, thanks to your business for letting us enjoy your hobby in such an accessible way

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### File Attachments

- 1) [size\\_ref\\_CW\\_and\\_packing\\_tape\\_vertical\\_test\\_eg.jpg](#),

downloaded 353 times

2) [Z\\_ref.jpg](#), downloaded 347 times

3) [learned\\_I\\_suck\\_at\\_upholstery.jpg](#), downloaded 305 times

4)

[innocent\\_start\\_ignore\\_notes\\_except\\_weights\\_35x20x16\\_as\\_built.pdf](#), downloaded 318 times

5) [blue\\_grille\\_red\\_no\\_grille\\_in\\_room\\_1\\_6th\\_ignore\\_level.jpg](#), downloaded 341 times

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Subject: Re: 2 pi tower folding?

Posted by [Wayne Parham](#) on Mon, 15 Apr 2013 05:45:07 GMT

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Looks like a great cabinet, and the (no grille) measurement results look pretty similar to what I get from the towers, so I think you've kept the internal standing waves at bay. Nice job!

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Subject: Re: 2 pi tower folding?

Posted by [grindstone](#) on Mon, 15 Apr 2013 06:11:04 GMT

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Thanks, but I'm sure my quick in-room is heavy on the room and I hesitated to post-it. I literally only had about 20 minutes to cobble a rig and take whatever data I could when it came time to ship them out.

Thanks again for all you do, Wayne.

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#### File Attachments

1) [gated\\_right.jpg](#), downloaded 334 times

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Subject: Re: 2 pi tower folding?

Posted by [Wayne Parham](#) on Mon, 15 Apr 2013 06:34:40 GMT

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That's true, of course, but the HF range looks pretty much untainted by the room. The LF response is going to be dominated by the room, but it looks clean above 100Hz. And the 100-300Hz range is what I was most concerned with anyway. That's where the internal standing

waves would have presented themselves, and even smoothing wouldn't hide them. But response is clean there, so I'd say your port, driver and stuffing layout is good. There's something going on at 200Hz, but I'm betting that's self-interference from a boundary outside the box.

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