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Subject: Cabinet design, port placement and internal standing waves

Posted by [Wayne Parham](#) on Fri, 31 Aug 2012 23:28:13 GMT

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There are three things that come into play with the cabinet geometry and the arrangement of the woofer and port(s).

First is the Helmholtz frequency, which is something pretty much all DIYers think about. When you run a T/S simulation, this is primarily what it is showing. Cabinet volume and Helmholtz frequency set the response in the bottom octave or two, and most hobbyists are aware of that part.

Second is the port airspeed, which is not an issue below 50MPH, and probably not even at 100MPH. It's only an issue at extreme excursion levels, meaning it's being played very loudly (or is being pushed too low, below its passband).

Truly, we don't want the excursion anyway, since it increases intermodulation distortion. So if extreme SPL is needed, high-pass the speaker to limit the signals sent to the speaker below the Helmholtz frequency.

I only say this because I think port airspeed is sometimes over-analyzed by DIYers. We don't want the ports to be too small, but they don't have to be huge either, especially in a speaker like this. The midwoofer in a matched-directivity two-way is really a midrange driver that digs deep, and it shouldn't be pressed hard in the subwoofer range, because that will increase IMD and make vocals less pure. These should really be seen as three-way speakers with detached woofers in the form of flanking subs.

The third thing is the frequency and position of standing wave modes that line up inside the cabinet. This is what most DIYers overlook. But it is a very important consideration in speakers like these, as it directly influences sound quality, particularly in the midrange.

When people complain about the "box sound", it's usually this anomaly that causes it. In fact, I'd go so far as to say the only reason open-baffle speakers are ever considered is the fact that so many speakers suffer from midrange anomalies caused by standing waves. But with careful cabinet layout, they can be perfectly mitigated.

If we were making subs, it almost wouldn't matter what size and shape the box was or where the woofer and port were. The wavelengths presented to the box would be very long compared to box dimensions, so standing waves would not form. Don't even need acoustic damping material inside a subwoofer.

Similarly, when the cabinet is small, standing waves aren't too bad because even though they will line up in the passband, the frequency range where they do is high enough that the stuffing damps the standing wave modes very effectively.

But larger cabinets used for mains can be kind of tricky, because the standing waves often line up in the lower midrange. This is a tough frequency range to deal with because acoustic insulation

lining the walls doesn't do anything at all. There is no absorption at midrange frequencies, so any standing waves inside will cause response ripple, and sometimes it can be pretty bad.

The best thing you can do is to put the midwoofer and port(s) in positions where standing waves don't develop a high-pressure node. It also helps to put a sheet of insulation in the middle of the cabinet, spanning the cross-section. The insulation can attenuate midrange if spaced away from the walls. That's why we put a sheet on the brace between woofer and tweeter, in addition to the sheets that line the walls. It sort of breaks the cabinet into two sections, and traps the midrange while allowing the bass to pass right through.

So this brings me to the point. It's best to make acoustic measurements to verify response when contemplating cabinet dimension modifications, and/or port or midwoofer position changes. There are very few software modeling tools that will show the response anomalies caused by standing waves, so it has to be measured.

My suggestion would be to either stick with my plans or with the mod described in this thread. These are configurations that have been tested. You can center the tweeter, provided the distance between woofer and tweeter remain the same, but don't deviate from the box dimensions or the placement and size of the port and midwoofer.

Or if you have measurement equipment, by all means, you can find other configurations that work well. But you definitely don't want to just pick a port with a box modeling program and call it good. That isn't good enough for speakers like these.