Subject: Help me make the leap
Posted by NEO Dan on Mon, 22 Feb 2010 06:13:09 GMT
View Forum Message <> Reply to Message

Hi All,
Over the last several years I've posted questions on and off. Now I've decided to commit and build my first arrays. The drivers I've chosen are the PE 299-250 Peerless SDS 6.5" buyout drivers and the JBL PT Waveguide AKA the EconoWave. The SDS are surface mount style frames. Big YEA for not having to countersink all those mid-woofers! I will be using a higher quality driver on the WG, the JBL 2408h. I'm told this driver has a BMS made diaphragm.

I've already had a good listen to the WG driver combo and the SQ gets a big thumbs up. No HARSH sound like the breakup in the D220Ti. For this I used the high efficiency version of the EconoWave crossover.

Here is the only crossover I've tried with the WG and driver so far:

Here is the JBL vs D220Ti, the JBL is the red trace.
note SPL is not at 1 watt

So far I've hashed out this much of the design:
9 SDS mid-woofers per line wired 3Sx3P for a 4 ohm nominal impedance.
The WG is to be @ 52.5" height, that's midway between my sitting/standing ear height.
The enclosure width is 15" with all drivers on 6.5" centers.
The enclosure will have 1.25" corner rounds on the vertical edges.

The primary use for these is as HT mains with a 80hz HPF, but I would like to allow for some flexibility in enclosure alignment.
Initally I have been thinking of going with 100 L tuned to ~70hz as this keeps excursion low and would work for HT use.
I had intended to do this by just cutting ~7" holes in the 3/4" MDF at near the top and bottom of the enclosure but I was told that the long tall aspect ratio of the enclosure was more suited to TL or MLTL alignments and that I would not likely get what I had intended. There was also talk that SQ would suffer so I kind of gave up on that for the moment.
Ideally I would like to be able to block a port to lower the tuning and extend the response for every day 2ch listening at lower levels.

My current train of thought has me at ~150 L with a couple 6"x6" plastic port tubes, this gives me -6 @ 80hz with the 80hz HPF. The tuning should be ~43hz with 2 ports and ~32hz with one.
Dimensions are 84"x15"x10.5 hwd.

My big questions are:
How do I measure this thing to get my crossover right?
Can I get a proper "forward lobe?" that goes straight out AND covers both the sitting and standing

listening positions?

The speakers will be toed-in for good imaging/phantom center. Will having the line of mid-woofers offset to the inside screw things up?

I am ready to build my test mule, but I wanted to ask if there is anything I should change to improve performance. Please point me in the right direction before it's too late.

TIA

Regards,
Dan

Subject: Re: Help me make the leap
Posted by Wayne Parham on Mon, 22 Feb 2010 15:42:53 GMT
View Forum Message <> Reply to Message

Here's the method I use to design this type of loudspeaker for uniform directivity and to set the position of the forward lobe:
Crossover optimization for DI-matched two-way speakersMore info on the subject:
DI-matched two-way loudspeakers

Subject: Re: Help me make the leap
Posted by NEO Dan on Mon, 22 Feb 2010 23:16:13 GMT
View Forum Message <> Reply to Message

Thanks Wayne!
That's a lot to digest but I have come away with a couple questions:
In my situation I will be crossing over much lower than the point at which the woofers directivity starts to narrow as I want to keep as much of the imaging cues coming from the point source as possible.

Knowing that only the WG will be approaching it's usable pattern cutoff, do you have any tips for getting things to come together properly. Is this situation a severe hurdle to good performance?

I know the WG+CD combo has a lower impedance peak at 1,126hz.

Subject: Re: Help me make the leap
Posted by Wayne Parham on Tue, 23 Feb 2010 01:48:09 GMT
View Forum Message <> Reply to Message

NEO Dan wrote on Mon, 22 February 2010 17:16In my situation I will be crossing over much lower than the point at which the woofers directivity starts to narrow as I want to keep as much of the imaging cues coming from the point source as possible.
Knowing that you want the imaging cues coming from a point source (as I do), why not use a point source for the midrange as well as the treble? I realize these comments are made in the array forum, but your comments beg the question.

NEO Dan wrote on Mon, 22 February 2010 17:16Knowing that only the WG will be approaching it's usable pattern cutoff, do you have any tips for getting things to come together properly. Is this situation a severe hurdle to good performance?
There are some deal-breakers where horns/waveguides are concerned. One is you don't want to send a signal to the driver below the point where excursion rises rapidly. That's a recipe for increased distortion and possibly driver failure. A deal breaker, if you asked me. Another problem is, if the horn is designed for constant directivity, you don't want to use the horn below the point where it loses directional control. That's a deal breaker too. Might as well not use a CD horn, if you're going to push it below the point where it's not CD anymore.

Sometimes a horn really only has control in one plane (usually the horizontal) at the bottom of its passband, and vertical control comes in (hopefully smoothly) within the first octave or so. That's workable, particularly since driver-to-driver interactions set the vertical pattern anyway. But what isn't a good idea, in my opinion, is to use a horn designed for constant directivity below the frequency where it is able to set the pattern in the horizontal plane.

At high frequency, the horn sets the pattern and the acoustic load is primarily resistive. These are the benefits of horn loading. At low frequency, the horn is acoustically invisible. It's like it isn't even there. And since the driver is designed with an assumption that it will be presented an acoustic load that limits its excursion, it is ill-equipped to handle low-frequency content. Distortion rises and the excessive excursion may cause damage, sending the diaphragm into the phase plug. One can always derate the device, allowing only low-power, and that may prevent damage but I still question the wisdom of using a horn at too low a frequency. It isn't providing any benefit.

Then there is a transition region, where the horn begins to provide acoustic loading and directivity control. The trouble is, this sometimes isn't a smooth transition. It is a range where the acoustic loading often swings largely from reactive to resistive, which in turn causes rapid phase movement that is hard to design (the crossover) around.

The take away from all this for me is, unless there are compelling reasons why I need to run a horn lower than it is really designed for, I usually don't.

NEO Dan wrote on Mon, 22 February 2010 17:16
I know the WG+CD combo has a lower impedance peak at 1,126hz.
This is probably the first quarter-wave mode (resonance), and it generally marks the beginning of the transition region. Sometimes, you can use a horn right down to that frequency with good results, at least as far as acoustic loading (and crossover phase) are concerned. It may not be able to control directivity very effectively yet at that low frequency though, and in this case, there will be evident some response steps and/or ripples at frequencies where directivity changes, where it goes from a wide (uncontrolled) pattern to a more narrow beam set by the horn.

Honestly, your impedance chart looks pretty good, and I think this horn/driver combination will be very well behaved from 1.2kHz up. I often see two quarter-wave mode resonances, sometimes three, towards the lower end of the range, and there are sometimes diaphragm breakup resonances up high. I'm guessing the horn probably has pretty good pattern control; At least horizontal control down to the quarter-wave mode and it probably gains vertical control in the next octave or so. If so, that's pretty good, as good as it gets, really. I think if you crossover anywhere in the 1kHz to 2kHz range - wherever directivity matches and the forward lobe is positioned properly - it will sound nice and give a good, uniform pattern.

The thing is, getting back to the point source, the use of a controlled directivity tweeter, and matching to the midwoofer or midwoofers, I think the whole point of using a CD horn / waveguide is uniform directivity. That's why we use them. If that isn't the goal or at least one of them, there probably is little reason to use a CD horn. You could use a different kind of horn; It becomes almost arbitrary.

One possibility that occurs to me is to configure the array so that it comes online in stages. Maybe allow only the midwoofer driver(s) nearest the waveguide to run all the way up to match the tweeter, and crossover where their directivities match.

This could be done in the form of an MTM configuration, perhaps. The main thing is, the tweeter horn and midwoofer(s) should be crossed over roughly where horizontal directivity matches, within about an octave. You have some wiggle room there, but don't go too far or the horizontal pattern suffers. At the same time, the C-T-C spacing should be such that the vertical nulls are about where the tweeter pattern falls off at HF. These are the two things to balance.

Then maybe you could bring in the rest of the midwoofers a little lower, in the range where they sum well. I guess this would be a sort of staged transition from array to point source, something I think you'd have to work out if you were going to try and mate an array with a waveguide.

One link I failed to provide in my last reply was my crossover document. It shows a lot of configurations that may be useful for you, from first-order to third-order, all with CD compensation for the top-octave. I used Spice to model the circuits, and the schematics and transfer functions are shown. I've also found a few more posts in the archives that may shed some light on the matter for you. My approach may not directly relate to your array, as they are very different things. But as for crossover circuits, CD horn / waveguides and matching directivity, these links will probably be useful for you. At the very least, they'll give you a baseline, something known to work, and provide some food for thought.

Crossover Document
Crossover Electronics 101 Seminar Handout
Tweeter circuits for constant directivity horns and waveguides
Constant directivity, compression drivers and crossovers