Subject: Re: Crossover optimization for DI-matched two-way speakers
Posted by Wayne Parham on Mon, 28 Jan 2013 19:36:02 GMT
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One thing I've noticed is people that use really short waveguides seem to prefer using small midwoofers. This isn't always the case, of course, but I do think it's a general trend. As an example, think of all the commercially available mini-monitor sized speakers with small midwoofers and short "baffle-dimple" waveguides. Those seem to be a natural fit.

Longer waveguides generally work better for larger midwoofers. This seems to be another natural combination. There are a myriad reasons for this, acoustic loading, resistance/reactance, excursion, etc. but I suspect one of the most fundamental reasons is a long device has an acoustic center that is somewhat further back, and tends to match better with the acoustic center of a larger midwoofer. Another part of this is the smaller woofer needs higher crossover for directivity matching, and shallow waveguides have higher-frequency impedance peaks, so they aren't resistive until relatively high frequency. Both things tend to favor a higher crossover region.

You can adjust these parameters somewhat in the crossover, but you can't go too far with it. One of the conditions that is required of the crossover is to match the phase of the midwoofer with the tweeter, but there are several other simultaneous conditions that must also be met, some with competing priorities. So while the crossover can (and necessarily will) modify phase, and so some tailoring is possible, it shouldn't be done at the expense of something else that is equally important. An example would be to use a low-order high-pass filter in the tweeter circuit which allowed excessive compression driver excursion. Compression drivers have close tolerance between diaphragm and phase plug, and so are particularly sensitive to out-of-band energy.

Whichever way you go, small and short or large and deep, pay attention to the phase between woofer and tweeter when designing the crossover. Whether measuring the forward lobe using the top/bottom process I described in the video clip above, or by doing the reverse connection method to find its center, be careful to find whether the two sound sources are truly on the same cycle, and not shifted by a full cycle or even a multi-cycle shift. You can estimate the acoustic centers and then calculate the phase between drivers through the crossover, but it is a meticulous process. An easier (and more accurate) method is to measure acoustic phase.

The goal is to have acoustic phase within 90° through the audio band. If you see phase shift rapidly in the crossover region, yet the reverse-connection method still shows a null on the baffle normal (straight-forward) axis, then there is a full cycle or a multi-cycle shift. This will usually show up as poor off-axis response, but will not show up in on-axis response.

This is an example of what you are looking for: