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Subject: Constant directivity, compression drivers and crossovers

Posted by [Wayne Parham](#) on Mon, 27 Jul 2009 02:54:48 GMT

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There are a few things that may conspire to create a ~3kHz peak in a CD horn with a 1" exit driver. One is that's just below where compression driver mass rolloff starts. Another is the possibility of a pipe mode, some horns have one at the bottom of their passband and sometimes another about an octave up. A third reason is the horn may be gaining directivity control in one or both axes, which causes an increase in on-axis amplitude (and anywhere within the pattern). In fact, most CD horns have some or all of these attributes, causing them to look like they have a peak in the first octave, with drooping response above that. It's so common in horns like these that 10 or 12 years ago, my Mantra about CD horns was "peak at cutoff, with a negative slope" to describe their response curve on various internet discussion boards. They all seem to have an initial pipe mode, followed by mass rolloff, creating a diagonal line of falling response.

About the crossover, I'm not sure if you remember my Crossover Document, but in that paper I examine and describe first, second and third-order filters with various compensation networks. What I found is that second and third-order filters act pretty similarly in terms of how the R1/R2/C1 network can be used to provide specific damping to make the appropriate transfer function, conjugating power response.

I developed that network specifically for CD horns, and it is designed not only to provide SPL matching and top-octave compensation, but also to provide specific damping of the core splitter high-pass filter in order to set the level of the region below mass rolloff as well. In essence, you balance R1/R2 to cause the reactive components in the core splitter filter to double as a peaking coil or notch filter, whichever is needed.

Since R1/R2 sets the damping of the core splitter filter, you can set whatever amount of peaking you want. It can be set for slightly overdamped or slightly underdamped, whatever is needed. That was always the whole intent of the R1/R2/C1 network - to provide these three things: 1. SPL matching between woofer and tweeter, 2. Top octave conjugate compensation for mass rolloff and 3. Specific damping for the core splitter to set the response in the region below mass rolloff, basically the octave between crossover and mass rolloff. Usually, the circuit is slightly underdamped, but if there is a pipe mode and/or diaphragm resonance in this region then it may need to be set for more damping.

About the slope of the core splitter section of the tweeter circuit, the biggest difference in second-order and third-order is the width of the overlap band and the phase relationship with the adjacent driver. The R1/R2/C1 network interacts the same with second-order filters as it does with third-order (and higher) slopes, so you can use this topology on any of them.

The choice of core splitter slopes and frequencies for the woofer and tweeter circuits should be determined by finding the ones that put the vertical nulls in the right place. That's largely dependent on the physical relationship between drivers and their characteristics. You should choose second, third or even fourth order filters and their frequencies solely based on performance in the vertical plane.

Crossover optimization for DI-matched two-way speakers

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