Subject: Re: 4Pi crossover study
Posted by Wayne Parham on Fri, 19 Jul 2013 17:12:45 GMT
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I think it is smart to tackle one issue at a time. The way you're going about it is good. It's just that I also think if you get the response right for the SEOS, it won't be right for the H290C and vice versa. The biggest difference is the ripple, but the rolloff slope is different too.

A horn with constant directivity will present the response of the driver, unmodified. So mass-rolloff is there. However, if the horn either increases directivity or increases efficiency as a function of frequency, then that will provide some acoustic equalization. Also, some drivers don't have as much mass-rolloff as others.

High-end rolloff is largely a diaphragm thing, not just mass but also flex modes. Sometimes you'll see mass-rolloff countered by damped breakup, and this can increase the top end. Where there isn't enough damping response is rough, but if the diaphragm has enough internal self-damping, response is smooth and it just looks like the driver has extended output. In any case, the top-end response of some drivers shows more rolloff than others.

output in the top two octaves. It also lets you set the amount of augmentation in the top two octaves.

that have a waveguide/horn use this same basic circuit topology.

Top-octave compensation is set mostly by the R1/C1 values, but it is also affected by voice coil inductance and the amount of damping from the Rs resistor, if used. Voice coil inductance tends to increase rising response. A shunt value in the Rs position tends to reduce rising response. And of course, the use of capacitor C1 increases rising response, and also sets where it begins.

The optional shunt value Rs is used for horn/driver impedance control. If the impedance peaks are all below crossover, then resistor Rs isn't needed. But if there are impedance peaks above crossover, then they will need to be snubbed by a resistor in position Rs. It's like a Zobel. The value is generally around 2x the DCR of the compression driver, which prevents the Zmax from rising too high. One could also use an inductor in series with Rs, and then use a lower value resistor. But I find the resistor by itself is sufficient.

The bottom octave shelf is created mostly by the value of R2. When it is high, the damping is reduced, boosting output near crossover. This is what creates the shelf. Where the shelf isn't needed, the R2 resistor should be set low, to provide more damping. Increased damping (using lower R2 value) can also be used to counter an impedance spike, similarly to Rs. But R2 is providing damping for the crossover, not the driver. So it acts differently than Rs, in that it isn't modifying the driver's impedance. Being ahead of R1/C1, resistor R2 is more effective at modifying the transfer function within the crossover region, whereas Rs is more effective at modifying the curve above the crossover region. Again, Rs is used just like a Zobel.

Balanced with all this, the R1/R2 ratio sets the overall attenuation. You have to set R1/R2 values that give the right attenuation for matching the tweeter output to the midwoofer, while simultanously setting R2 for the right bottom octave shelf, and R1 and C1 for the right top-octave augmentation.

This is the basic transfer function we are looking for. It may need a little more or less overall attenuation, or a little more or less top-octave augmentation. It may need more output in the bottom shelf, or maybe a little less. You may need to use impedance compensation, or you may not, depending on the horn and driver, whether or not it has impedance peaks above crossover. But in general, this is what we're looking for, which is appropriate for any constant directivity horn that doesn't have excessive ripple: