Subject: Re: Constant directivity tweeter horns and waveguides
Posted by Wayne Parham on Mon, 07 Apr 2008 22:51:50 GMT
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I think the thing most often perceived as "horn honk" is uneven amplitude response, particularly an exagerated midrange. It is usually when there is a midrange resonance that boosts a narrow region and then falls off at higher frequency. The horns that are usually considered to be colored are the ones that have some kind of midrange peak that isn't equalized. Said another way, if a horn is made such that there is a peak in sound output that isn't equalized, then that will definitely sound "honky", especially if it's in the midrange, where our ears are most sensitive.When there's an abrupt change in flare rate in a horn, the discontinuity causes an acoustic reflection back towards the throat. This can be seen as an impedance spike at a frequency depending on the position in the horn. The mouth termination is one source of discontinuity, and it results in an impedance peak at the lower frequency end of the scale. If there are other transitions, they can be seen at higher frequencies.The backwave reflection causes a resonant condition that results in an impedance increase, and usually an increase in sound output as well. The reflected wave combines with the source wave and produces pipe mode resonances. The frequency, shape and size of the resonances depends on the distance between source and termination, and also on other factors such as resistance and bandwidth, damping and Q.Most compression tweeter horns have mouth terminations that cause this condition to exist somewhere between 500Hz and 2kHz, depending on the size of the horn. Sometimes a horn isn't well-behaved at the lower end of its range and if it is used too low, it generates a pretty big peak. One should use caution to ensure the crossover point chosen is high enough to avoid this.Another thing to consider is the power response of the compression driver itself. They're very efficient for a couple of octaves, three at most. Above that, they begin to rolloff. At 2kHz, efficiency of a good 1" compression horn is 40% or so but by 10kHz it is only around 5%. So for example, a 1" compression driver is usually pretty strong from about 1kHz to 4kHz but then response falls 6dB/octave because of diaphragm mass. Output is generally 12dB down in the top octave.If a horn provides constant directivity, then it will need electrical equalization to compensate for falling power response. Some horns begin to beam at higher frequencies which provides on axis EQ, but off axis falls off very rapidly at high frequencies. Such a horn may sound good directly on axis in an anechoic environment, but most people don't listen in anechoic conditions. Indoors, the reverberent field tracks the power response. So without EQ, the total sound energy in the room is much louder below 4kHz. This condition may contribute to what some identify as horn coloration.As for diffraction, my experience is that it isn't high on the list of audio annoyances. The one exception is where arrays are used, diffraction slots in the throats of CD horns cause the apparent apex to be different along the horizontal axis than the vertical. I am not at all sure that diffraction is a qualitative problem that adversely affects performance in any other way.A long time ago, I used to round all the edges of my loudspeakers to prevent edge diffraction. My thinking was it was easy enough to do, so even if the benefits were marginal it was worth doing. But it was only easy to do on painted cabinets. Bending veneers around the corners gave my cabinet makers fits, because sometimes the veener would break as it was applied. So we built cabinets both ways, with rounded edges and without and listened for differences. I listened, the guys building them listened, and we had others listen too. Not a single person could hear a difference. This makes me tend to believe that to focus on edge diffraction as a potential problem might be exaggerated.