Subject: Distortion mechanisms
Posted by Wayne Parham on Wed, 23 Feb 2005 21:41:50 GMT
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Earl Geddes and I were discussing various distortion mechanisms, both on and off forum. I wanted to bring the discussion out in public I think most will find it interesting and because I'd like to hear other's opinions too. Some of you have done a lot of thinking on these matters, and some have done some work and models and measurements.One thing that comes to mind is Geddes opinion that second and third harmonic distortion from loudspeakers is not as objectionable as higher harmonics. I think he's probably right. I think measurements of second harmonics are still pretty good information, since they are easy to make and they indicate asymmetry. That will also introduce other even harmonics and the ones higher up in frequency may be the ones that are really noticeable, even if at lower amplitudes.Something else that comes to mind is the matter of nonlinear distortions verses linear distortions. That is something Geddes brings up a lot, and was also mentioned recently by Dave Williams. My thinking is that efficient, powerful speakers used at home hifi levels are probably used pretty much in the linear regions, at least where electro-mechanical properties like suspension stiffness and voice coil resistance and motor strength are concerned.I think the mathematical models are useful. I don't think it is wise to assume perfectly pistonic behavior of the diaphragm, perfectly resistive impedance of the voice coil or perfectly linear excursion of the motor. It is good to realize that isn't the case, and to take it into account when making a design. But the models that make those assumptions are useful tools.I also think that it is worthwhile to design systems that are very tolerant of parameter shifts because they're going to happen. And I think that doing things to reduce the things that cause nonlinear distortion is always good too. But first, you must define them and know what they are to begin dealing with them.There are many other distortion mechanisms too. There is throat distortion, caused by the nonlinearity of the air in extreme compression/rarefaction cycles. There are the high order modes that Geedes often focuses on. There is doppler distortion from moving diaphragms. There is intermodulation distortion. There is compression. Then there are other nonlinearities that don't have specific names. There is the modification of waveforms in some capacitors such as electrolytics and ceramics. There is the effect produced by a coil or transformer in magnetic saturation. There are the changes of a conductor when hot. Or of a semiconductor, like the carbon in resistors or the silicon in transistors. There is the non-uniformity of magnetic flux at the edges of travel in a loudspeaker, and the asymmetry produced by flux modulation.What do you guys think? Lots of things to consider here.