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# DISTORTION AND THE EAR

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After reading D. Self's article, "Advanced preamplifier design" in your November issue, I feel obliged to comment on the general attitude to audio amplifier design taken by the majority of WW contributors. At the core of this approach is the assumption that any loss of realism, originating from amplification within the reproducing train, is a direct function of t.h.d. Consequently with each new design appears detailed analysis of t.h.d. performance but, from the user's point of view, the lack of any comparative listening test is painfully obvious.

A striking example of the ear's dissimilarity to a t.h.d. meter would be the attempted measurement of distortion from an audibly inferior preamplifier of a sinewave signal recorded on disc. Wow and tracing distortion combine to swamp the amplifier's contribution by orders of magnitude, but the amplifier's imperfections are all too obvious through the reproduction of voice or music from the same source.

If an accurate model of the human audio processing path existed, it would be possible to design with confidence circuits that introduced the theoretical minimum of audible colouration. Unfortunately, this model does not exist and any major advancement in amplifier quality can only be achieved through extensive, practical listening comparisons of all types of active devices and circuit configurations.

After experimenting for several years in this direction and through the careful analysis of designs proved to be audibly superior, the one common factor to emerge is an appreciation of the ear's uncanny ability

to detect high order distortion products under heavy masking by low order products and noise. In essence, the ear will react favourably to 1st order distortion products in the order of one per cent, provided all higher order products are virtually non-existent. Although it has been long accepted that the ear does favour colouration derived from low order products, the relative weighting ratio (for a given degree of colouration) has never been established and I believe has been consistently under-estimated.

If one applies this theory to high quality amplifiers, the design rules are radically altered. Bipolar transistors become virtually useless in low level stages because of the complex exponential transfer characteristic. Negative feedback (even locally applied) tends to be a disadvantage because innocuous low order distortion products are converted to lower level, but audibly more apparent, higher order ones (Ref. Scroggie) and the output impedance of devices becomes a significant source of distortion. Space allows no further elaboration but a simple example of this alternative approach is given in the form of a unity gain buffer stage. Anyone interested in conducting a comparative listening test (on a high quality stereo system) between this circuit and the standard emitter-follower may find the lack of correlation between measured t.h.d. and audible colouration interesting.

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