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My main focus for this week was going to be a look in converter design in digital equipment. The reason I chose this topic was because I was interested in discerning what types of qualities separate a good converter from a poorly designed one. We have all read John Watkinson's articles in which he reveals that a converter that is affected by digital cable quality is indeed a poor model. The question that naturally popped into my mind as a result of his argument against cable quality being a factor in a good converter was: How can the consumer tell if he/she is purchasing or using a unit with sloppy A/D or D/A converters? Not all digital product users have the luxury of connecting a multiple of cables and "A/B"ing the resultant sound quality. Are there specifications, such as a unit's signal-to-noise ratio or third harmonic distortion percentage, that will help to give a clue as to the quality craftsmanship of the digital converters?

The first place I turned for such answers was a year end overview of DAC's by Audio magazine. In their list of contemporary converters, they used rather generic categories on which to compare the products: sampling rates available, number of bits used in the conversion system, amount and type of digital inputs, etc. Nowhere, though, was there any indication of the quality comparison that could be made of the converters. Such a comparison seems necessary to me, for I imagine that a poorly designed 20-bit converter (while seeming highly developed and on the cutting-edge of digital fidelity) might not even meet the sound reproduction quality of a well designed 16-bit converter.

After my research into Audio magazine, I began to feel that a true ability to compare converters on the basis of quality rested on the basics of a thorough and fundamental knowledge of converters themselves. If one knows all the mechanisms of converter design, then one should be a little closer to knowing what a good converter is as compared to a bad one. Probably most students from DAP are familiar with the basics of converter design: on the A/D side are anti-alias filters followed by sampling and quantization; and on the D/A side is a decoding and reconstruction process followed by an anti-image filter.

In a more complicated view of converters, once oversampling and noise-shaping got thrown in, I began to become a little hazy. The concepts of these two processes seemed simple enough, but I felt I truly had not yet fully digested the reasons for and mechanisms of these two common digital converter traits. I knew that oversampling involved a higher sampling rate and lower bit rate, but how did it achieve PCM audio? I knew that noise shaping involved a feedback loop and an averaging process, but how does it shift noise into the higher frequency spectrum? To answer these questions, I turned to graphical explanations. I started drawing sine waves and lowering the bit rate while raising the frequency just to see what happened. Once I saw it on paper, it all began to make sense. The same held true for noise shaping. The little graphs I was drawing in my notebook (as sloppy as they may have been) were actually elucidating digital audio processes. The revelations provided by the graphs were not a huge leap into being able to compare converters on an electrical circuit level, but I was a step closer to seeing the reasons why certain pathways were developed for digital audio. I think for next week, I am going to try to create more accurate and detailed graphs (using either graph paper or mathematica) to help show the mechanisms of these processes to the class. Also, as a beginning step towards investigating converter design, I would like to run St. Croix's suggested test of digitally dubbing a DAT tape fifteen or twenty times and observing the end result.

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