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APPLICATION BULLETIN

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A CLARIFICATION OF USE HIGH-SPEED S/H TO IMPROVE SAMPLING ADC PERFORMANCE

by ??, (602) 746-7???

You know it's going to be one of those days when you see the printed version of an article you wrote and realize that you have made an error in the presentation of your ideas. This is what happened to me as I read *Use High Speed S/H to Improve Sampling ADC Performance (Design Update*, Vol. 1, No. 1). This article will rectify the situation and further illuminate some important performance aspects of the ADS7800.

After having spent three weeks staring at the display of an Audio Precision distortion analyzer and trying to track down the jitter sources in a digital audio reconstruction board, I did the experiments with the ADS7800 and SHC804. In the former project, I could not distinguish between harmonic distortion and other spurious frequency components, due to the nature of the measurement. In the latter, all we did measure was harmonic distortion (aside from SNR). And this is where I made my mistake; so let me set the record straight and tell you: **In all but the most contrived cases, jitter does NOT cause HARMONIC distortion!**

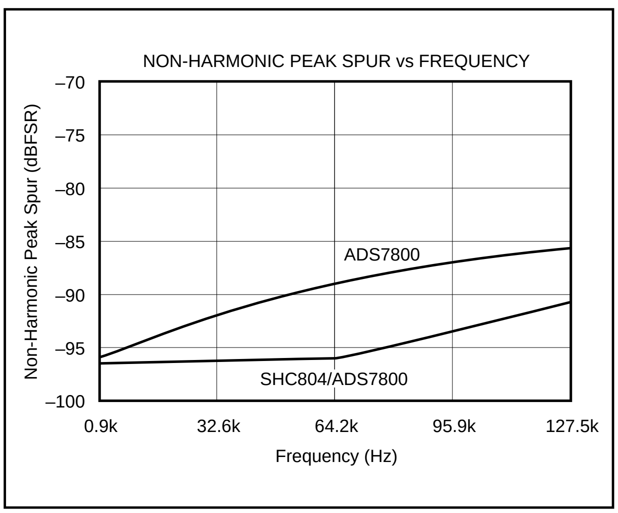

FIGURE 1. The Level of Non-Harmonic Spurious Signal Components is Improved by Using the Lower-Jitter Sampling Mechanism of the SHC804. Note that even without the SHC804, non-harmonic spurs are below –85dB up to the Nyquist frequency.

Jitter causes spurious frequency components, and the level of the spurs is dependent upon the rms value of the jitter, and the frequency of the signal being digitized, as explained in the article in Vol. 1, No. 1. This will cause a degradation in SNR.

Therefore, the graph from *Design Update*, Vol. 1, No. 1 showing the improvement in THD with the SHC804 preceding the ADS7800 really does not illustrate the results of reducing jitter. The correct results can be seen in Figure 1. The level of spurious frequencies is improved significantly by using the lower-jitter sampling mechanism of the SHC804.

So why does the THD improve by adding the SHC804 if harmonic distortion is not caused by jitter? The cause of the harmonic distortion in this case is a function of the sample/hold in the ADS7800. The on-resistance of the sampling switch changes with input signal amplitude, causing a changing phase lag in the sampling mechanism. This results in even-order harmonic distortion. A close look at Figure 2 will reveal the largest spur is the second harmonic of the input signal. (A complete explanation of this phenomenon, as well as other information on using the ADS7800 for dynamic applications, will be the subject of a forthcoming Application Note).

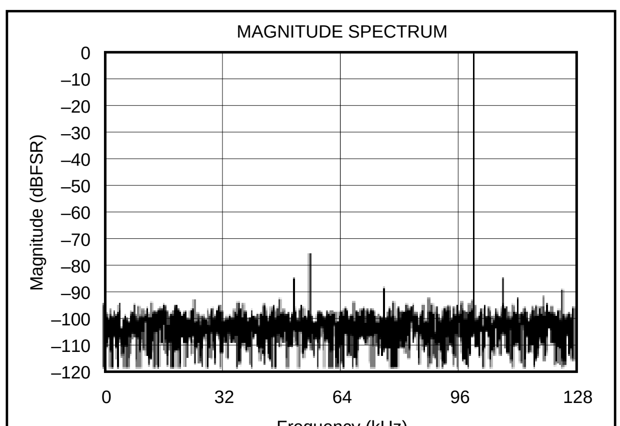

FIGURE 2. Spectral Performance of ADS7800 Digitizing a Full-Scale 100kHz Sine Wave at a 256kHz Sampling Rate. The largest frequency component (aside from the fundamental) is the second harmonic at –76dB.

This phenomenon is present in **all** monolithic sampling ADCs—not just the ADS7800. In fact, we spent considerable time and effort here at Burr-Brown creating a design that minimized this distortion. A monolithic sampling 12-bit converter yielding spectral results such as those in Figure 2 is remarkable! (To add insult to injury, the FFTs originally published were performed on an early version of the ADS7800, which gave a much larger second harmonic. I was quickly informed that we had improved the ADS7800 since then, and had **never** shipped ADS7800s like the one I had used for my experiments.)

With the SHC804 in front of the ADS7800, the ADS7800's input sample/hold sees essentially DC, reducing harmonic distortion. (Request PDS-1018 for ADS7800 and PDS-512 for SHC804.)