

# Rarely Asked Questions—Issue 121

## Unfiltered Analog

By David Buchanan



### Question:

Why is my signal so distorted when I'm doing everything right (I think)?

### Answer:

High speed converters have made many performance gains over the years, particularly in linearity, and therefore distortion. But to realize the performance, you need clean signal

sources. Every once in a while I get an inquiry about having a clean setup, but still not meeting the distortion specifications. Recently one designer told me he was evaluating the AD9680 at 1 GSPS, and was trying to correlate to our specified distortion at 765 MHz. Therefore he was expecting to see better than 80 dB of dynamic range in the output spectrum. So he was more than a little surprised to see a second harmonic only 45 dB down from the fundamental. I asked him to tell me about his test setup. Having attended an ADI presentation in which we gave some recommendations on evaluating our high speed converter products, he was confident that he had a clean setup. The AD9680 ADC features user configurable options to optimize performance over different Nyquist zones, and he had double checked that he had the correct SPI writes for this frequency band. He was using our evaluation tools, which meant he had clean on-board supplies. He remembered accurately that one of our recommendations is the Rohde & Schwarz SMA100 as a signal source; they had those available in their lab, and he was using two of them for his clock and analog sources in his ADC evaluation. Sounded like he had done his homework. What could it be?

I asked him to take a look at Figure 1 in application note AN-835 so we could try to identify the problem.

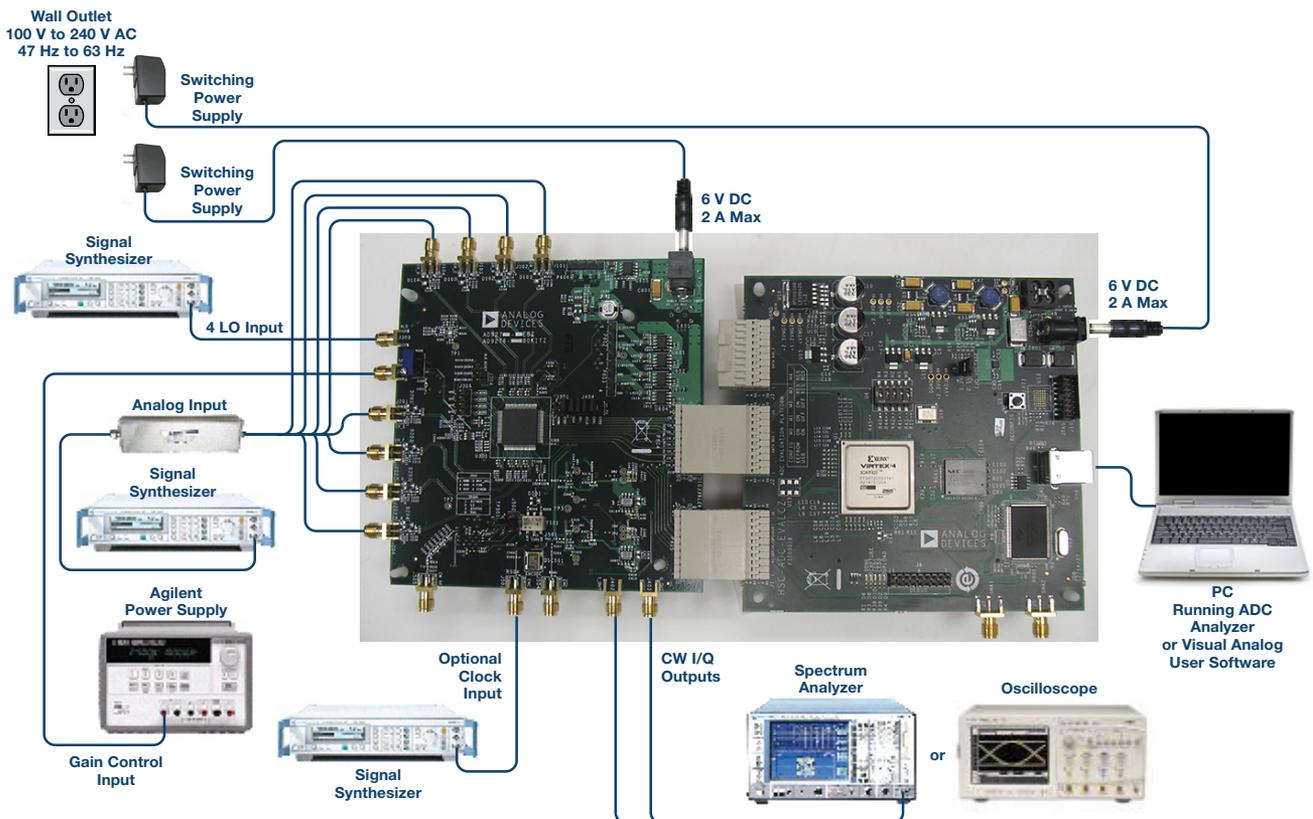


Figure 1.

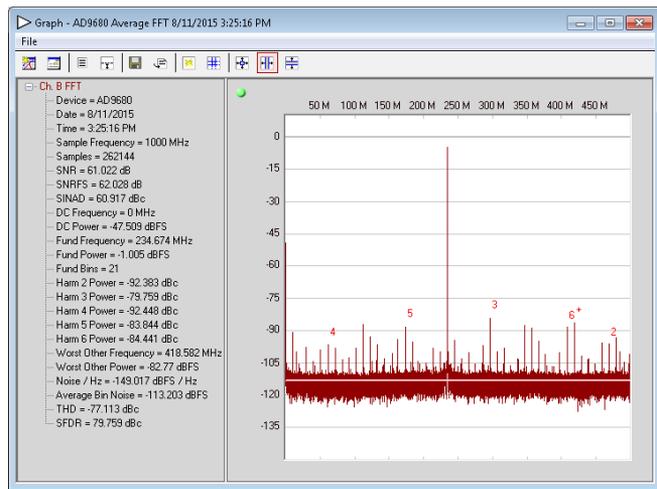
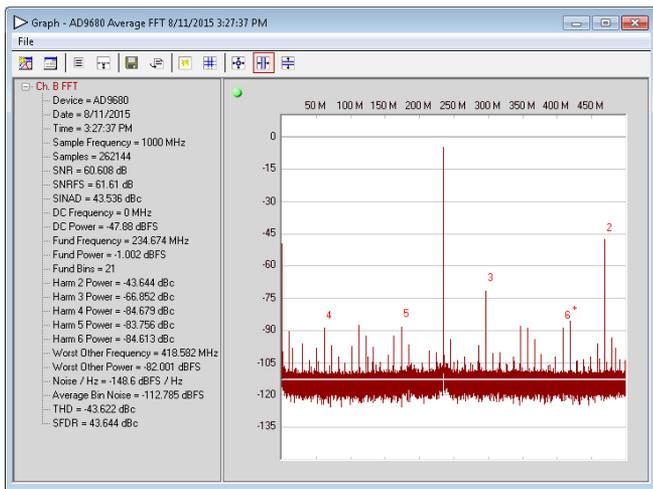


Figure 2. AD9680 output frequency spectrum, 1 GSPS, 765 MHz at -1 dBFS, without filtering analog input (left), and with filtering (right).

It didn't take long—he had not been filtering the analog input. While our friends at Rohde & Schwarz make an excellent signal source, you will still need to filter out the harmonics. You can see from the spectral plots above that I was quickly able to provide correlation that without filtering out the harmonics you will be measuring the distortion of the source and not the ADC. He asked me why the SNR result improved slightly as well with a filter. I reminded him that just as the higher order harmonics

are folding back into the output spectrum, the wideband noise of the signal source will also alias. In this case the effect is subtle, as this generator's noise is very low. Fortunately that was his only problem, and he was back on his evaluation project.



David Buchanan [david.buchanan@analog.com] received a B.S.E.E. from the University of Virginia in 1987. Employed in marketing and applications engineering roles by Analog Devices, Adaptec, and STMicroelectronics, he has experience with a variety of high performance analog semiconductor products. He is currently a senior applications engineer with ADI's High Speed Converters product line in Greensboro, North Carolina.



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