RAQ's

Rarely Asked Questions

Strange stories from the call logs of Analog Devices

Taming A/D Converter Power Supplies

Q. Will a switching power supply (dc-to-dc converter) really degrade the A/D converter's performance?

A. Engineers commonly feel that a switching power supply can degrade the performance of an A/D converter, leading them to choose a low dropout (LDO) linear regulator over a switcher, but this perception isn't entirely true. LDOs have lower ripple and noise specifications, but recent studies show that efficient switchers can be employed in some converter designs provided the designer understands the topology, applies some practical know how, and takes the required precautions.

First choose the converter and then choose the right switcher. Not just any switcher will do. From the datasheet, check the switcher's noise and ripple specifications, as well as its switching frequency. A typical switcher might have 10 µV rms noise over a 100-kHz bandwidth. Assuming the noise is white, this is equivalent to a noise density of 31.6 nVrms/rt-Hz over the band of interest.

Next, check the converter's power supply rejection (PSR) specification to get an understanding of where the converter's performance will degrade due to noise on the supply. 60 dB (1 mV/V) is typical for most high-speed converters over the first Nyquist zone.

Using a 16-bit ADC with 2-Vpp full-scale input range, 78-dB SNR, and 125-MSPS sampling rate, the noise floor is 11.26 n V rms. The noise from any source must be kept below this in order to prevent it from being seen by the converter. In the first Nyquist zone, fs/2, the converter noise will be 89.02 µV rms (11.26 nVrms/

rt-Hz) × sqrt(125 MHz/2). Although the switcher's noise (31.6 nv/rt-Hz) is more than twice that of the converter, remember to account for the converter's 60-dB PSRR, which will suppress the switcher's noise to 31.6 pV/rt-Hz (31.6 nV/rt-Hz × 1 mV/V). This noise is much smaller than the converter's noise floor, so the switcher's noise will not degrade the converter's performance.

Supply filtering, grounding, and layout is important too. Adding 0.1 µF capacitors to the ADC power supply pins will reduce the noise even lower than that calculated above. A simple LC filter on the power supply output may work, but a cascaded filter will suppress the switcher's noise even more. Remember that approximately 20 dB/decade is gained for each additional stage. Tightly stacked power and ground planes (≤4 mil spacing) can add inherent high-frequency decoupling to the PCB design. Lastly, good physical partitioning is key; keep sensitive analog circuits away from switching circuits. For further design assistance with power supplies and converters, contact your local ADI FAE.

To Learn More About How to Power Converters
http://designnews.hotims.com/27739-100

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Have a question involving a perplexing or unusual analog problem? Submit your question to: raq@reedbusiness.com

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