

# Rarely Asked Questions

Strange stories from the call logs of Analog Devices

## Considerations on High-Speed Converter PCB Design, Part 4: Plane Coupling

**Q.** What are some important PCB layout rules when using a high-speed converter?

**A.** Part 1 of this series discussed why splitting AGND and DGND is not necessary unless circumstances within the design force you to make that choice. Part 2 discussed the design of the power delivery system (PDS), and how squeezing the power and ground planes together provide added capacitance. Part 3 discussed how wise design of the E-Pad gets the best performance and most heat out of your signal chain design. Part 4 will make light of cross coupling between layers and planes within the PCB.

It is inevitable that some high-speed converter layouts will have a circuit plane overlapping another within the PCB design. In some cases, a sensitive analog plane (power, ground, or signal) might be directly above a noisy digital plane. Most designers wouldn't think that this would matter, as the planes are on different layers. So, here's a simple test:

Choose one of the adjacent layers and inject a signal on that plane. Next, connect the cross-coupled layer to a spectrum analyzer. Can you see how much signal is coupling through to the adjacent layer? Even though they might be separated by 40 mils, adjacent layers still form a capacitor in some sense, and will therefore still couple signal from one plane to another at some frequency.

Let's say a noisy digital plane on one layer has a 1-V signal that switches at a high speed. With 60-dB isolation between the



layers, the non-driven layer will "see" 1 mV of coupling from the driven layer. To a 12-bit analog-to-digital converter (ADC) with a 2-V p-p full-scale swing, this is 2 LSBs (least significant bits) of coupling. This may be fine for your particular system, but keep in mind that as you increase the resolution from 12 bits to 14 bits, the sensitivity quadruples, so the error increases to 8 LSBs.

Ignoring cross-plane/cross-layer coupling will probably neither make the system fail nor cripple the design, but be aware, because more coupling exists between two planes than what might be imagined.

Keep this in mind when noise spurs are seen coupling in the frequency spectrum of interest. Sometimes layouts dictate that unintended signals or planes be cross-coupled to a different layer. Remember this when debugging your sensitive systems: the issue may lie one layer below.



**Contributing Writer**  
Rob Reeder is a senior converter applications engineer working in Analog Devices high-speed converter group in Greensboro, NC since 1998. Rob received his MSEE and BSEE from Northern Illinois University in DeKalb, IL in 1998 and 1996 respectively. In his spare time he enjoys mixing music, art, and playing basketball with his two boys.

**Have a question involving a perplexing or unusual analog problem? Submit your question to:**  
[www.analog.com/askrob](http://www.analog.com/askrob)

For Analog Devices' Technical Support, Call 800-AnalogD

SPONSORED BY



**To Learn More About High-Speed Layout**

<http://dn.hotims.com/40993-100>