

Conspiracy theory



My company was developing a system to drive a CCD (charge-coupled device) at the end of a long cable. This device required 12 separate clocks, swinging between approximately 5 and -10V , of various frequencies, phases, and duty cycles. We soon found that the ringing of these clocks on the far end of the cable was intolerable, so we added a resistive terminator to each line. We “barnacled”

these terminators on the back of the prototype, and everything worked beautifully—at least enough for us to tweak the rest of the circuit.

Finally, it was time to re-spin the board, incorporating all the changes we had added to the prototype. Because the clock signals were fairly large, we used through-hole resistors for the terminators. When we powered up the system with the new revision of the board, the results were horrible. We couldn’t get an image on the CCD at all, and the whole thing was “worse than dead.” But it was a complicated system and a

finicky CCD. My boss spent a couple of days fussing with the wave-generating and image-capturing software before concluding that the problem might be in the new board, and the problem landed back in my lap.

The first things to look at were the clocks. To get an accurate picture on the scope, I carefully attached the probe ground to the ground side of each terminating resistor before probing the hot side. Every clock was perfect, so I began to look elsewhere for the problem. I finally got a bit lazy with my scope, and, instead of grounding the

probe at the optimal place for each signal, I just chose a central ground point and left it there.

The first clock worked beautifully, as did the second and the third. Sigh. But when I looked at the fourth one—whoa, Nelly! It was ringing so badly you couldn’t tell where the rising edge was supposed to be. Continuing in this manner, I found that half of the clocks were good, but the others were lousy. I figured I’d better get a closer look and went back to my old method of grounding the probe on the resistor, and the ringing stopped. Eureka! The probe was providing the ground for the terminators but only one at a time—the one I was looking at. That action alone was not enough to change the symptoms of a badly behaving circuit. After I used a bit of wire and solder, the whole system was working like a charm.

I next had to find out why those six resistors weren’t grounded. I had certainly designed them to be grounded. My CAD program showed that they connected to the internal ground plane in exactly the same way as the other six were. Then, I decided to look at the Gerber files with a third-party viewer. According to the Gerber files and in direct contradiction of the design, those six resistors were actually *not* connected to the ground plane. But one thing they had in common was that they were rotated from the default orientation.

Looking further, I found that my CAD program had an option to either draw or flash the pads. On this design I had somehow inadvertently selected the “flash” option. This program turned out to have a little bug that won’t flash plane connections properly on a rotated pad. I had never previously thought much about flash versus draw, but it’s now part of my checklist. One more thing to worry about: Your computer lies to you, and your oscilloscope covers up for it. **EDN**

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