The Last Byte

Test at Gbps: Megaproblem or micromanagement?

Rob Aitken
Artisan Components

TEST AT gigabits-per-second (Gbps) regimes: On the one hand, it sounds complicated and expensive—the sort of thing that requires racks of equipment with fancy names and exciting functions. Digitizing oscilloscopes, bit-error rate testers, and high-precision frequency sources: These are the types of boxes that impress relatives when you show them what you do for a living—far more impressive than demonstrating various ways of enumerating the stuck-at faults on a textual netlist. On the other hand, how hard can it really be? High-frequency signals are everywhere, lurking inside MP3 players, laptops, cell phones, and all the other ubiquitous gadgets you carry with you to stay in touch with work at all times, whether you're wireless or just plain wired. So which is it—easy or hard? Or is it both?

One reason why Gbps test is so difficult is that we test people make it difficult. High-speed signals are usually differential. But we don't like differential signals. Concepts like VOH and VOL (voltage output high and voltage output low) don't translate well to differential signals, especially when the lowest high is well below the highest low. It's just confusing.

We once thought we could measure voltages as analog values, try to get a baseline, and work from there. This involved lots of reprogramming on expensive machines that were never designed for the task. Did that work? Not really—so we bought or built special differential receiver channels. The signals came with their own clocks embedded in the signal. But that's not the way we do things in test, so we had to try to generate new clocks at higher levels of precision than those that drove designers to embed them in the first place; racks of instruments again. Did that work? Not really, so we went back to extracting the clocks that were already there. The signals are meant to travel short distances—across short, shielded board lines—to another chip, an antenna, or a special cable. So what do we do about that? Put the chip in a socket, on a load board, connected through pogo pins to a test head, run some cables from there to the instruments, and look at the signal. Does that work? Eventually—if you have patience, a good design, a 3D field solver, and some good help with the equipment.

Why do we do these things? We want to check the eye diagrams, the specs, and the bit error rate. We make test and characterization measurements, and measurements decreed by the standards. All in all, we're approaching the high-speed signal test problem in a strange way. The signals we test are designed to be robust, noise tolerant, and inexpensive. Our inclination is to test them in ways that are error prone, noise calibrated, and expensive. Is this the best way? For proving that a part meets all specs and adheres to standards, perhaps. But to verify that it works? This is much less clear.

Rob Aitken is senior architect of product technology at Artisan Components. Contact him at aitken@artisan.com.

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