Trying to Solve the Problem of Testing AC-Coupled, Differential Nets

Bill Eklow
Cisco Systems, Inc.
bebklow@cisco.com

The use of AC-coupled, differential signaling is becoming more and more prevalent in new high speed, gigabit designs. The presence of a coupling capacitor in the circuit presents significant challenges to traditional “static” test techniques such as IEEE 1149.1. In addition, testing of differential nets has also presented challenges to IEEE 1149.1. It appears likely that changes to IEEE 1149.1 will be required to accommodate the testing of AC-coupled, differential nets.

The drawing below (from www.acextest.org) shows an AC-coupled, differential net. In contrast to the “static” response from networks without the coupling capacitor, signals on the AC-coupled net decay over time. The transient nature of the response constrains the measurement at the receiver. The methodology for testing the AC-coupled network must now consider when and how the network is measured to make sure that the correct state is detected. The signal may also need to be “conditioned” on the driver side to ensure repeatable measurements.

The AC-coupled, differential network creates a new fault spectrum. Several of these new faults will be difficult to detect using “static” test methods. Opens on either leg of the differential path may be undetectable using static test techniques (this problem can exist with or without the AC coupling). In addition, shorts across the capacitor and to other nets (AC coupled net shorted to DC coupled net) may provoke different responses depending on the measurement technique.

Performance and real estate (chip and pin) must also be considered when evaluating test techniques. Performance of the transmitter could be affected by inserting test logic at the I/O pad. Due to the relatively simple nature of most of these high-speed components, gate and pin real estate must also be considered.

Testing of AC-coupled, differential nets requires a new fault model and a new test approach. Though the approach will likely be very similar to IEEE 1149.1, the dynamic test requirements will require a new test methodology. It will be difficult to describe this new, dynamic test methodology in the context of the existing IEEE 1149.1 standard.