DesignCon 2010 TF-MA5 Tutorial

February 1st, 9am

"Quality of High Frequency Measurements: Practical Examples, Theoretical Foundations, and Successful Techniques that Work Past the 40GHz Realm"

Hosted by Heidi Barnes of Verigy, and Al Neves of Teraspeed Consulting, LLC

Summary:

The presenters below have been invited to help fill a growing need that exists in the "Signal Integrity" world of high speed electrical interconnects. The ability to take high quality measurements that capture the variety of high frequency effects for correlation with simulations is not a trivial task as one tries to run digital signals at microwave frequencies. Assumptions that work well for narrow band microwave applications can be misleading when applied to wide bandwidth PRBS digital data patterns. The purpose of this tutorial is to provide the attendees with practical examples and a toolbox of techniques for measuring and modeling the Signal Integrity of high speed interconnects. It may seem only a small step from 3 Gbps to 10Gbps but in terms of measurement quality and simulations this is where the real work begins and it is no longer just a few that face this challenge. Mainstream PCIE and HyperTransport interfaces are moving beyond 5Gbps, DDR memory is pushing past 3Gbps, and XDR is pushing 10 Gbps. The tutorial will focus on bringing together connector design examples along with the basics in theory and methodology to provide a solid understanding of the quality of measurements and simulations at high speeds.

Tutorial Outline:

Part 1: Interconnect Measurement Example to Demonstrate High Frequency Challenges

Presented by:

Jim Nadolny, Samtec Signal Integrity Specialist
Tom Dagostino, Teraspeed Consulting, LLC, VP of Device Modeling Division

- *Practical measurements on interconnect systems and the challenges faced by Samtec SI engineers when making very high frequency measurements.*
- *TRL calibration examples for material extraction.*

Part 2: Understanding the Frequency Domain and Time Domain Relations of High Speed, Wide Bandwidth Interconnect Systems: Stability, Causality and Passivity

Presented by:
Yuriy Shlepnev, Ph.D., President of Simberian Inc.

- *Primer of matrix math to understand multiport theory*
- *Impedance, admittance and multiport scattering parameters*
- *Reciprocity, passivity and geometrical symmetry properties and quality metrics for S-parameters*
- *Time-domain characterization of multiport systems: causality, stability, and passivity*
- *Building causal, stable, and passive macro-models for time and frequency-domain analysis of multiport systems*
- *Global S-parameters quality metrics in frequency domain*
- *Practical examples of multiport parameters quality estimation and improvement*

Part 3: S-parameters for Model Extraction to 50GHZ: Problems, pitfalls, and lessons learned….

Presented by:
Scott McMorrow President of Teraspeed Consulting, LLC

- *How much bandwidth do you need for 15 Gbps models?*
- *The problems and pitfalls of transforming between frequency and time domains.*
- *Sharing "Black Magic" of getting 3D-EM solvers to agree with measurements.*

Biographies:

Jim Nadolny is an engineer with Samtec where he leads a team of Signal Integrity specialists dedicated to providing models, data and simulation services for customers. Jim received a BSEE from the University of Connecticut in 1984 and an MSEE from the University of New Mexico in 1992. Jim is active within technical community having served as chairman of TC-10, a technical committee dedicated to signal integrity in the IEEE EMC Society and is a track chairman for DesignCon. Jim has published more than 20 papers related to signal integrity and electromagnetic interference and received best paper awards from DesignCon in 2004 and 2008.

Tom Dagostino is Vice President of Teraspeed Consulting Group. Tom Dagostino currently manages and models in the Teraspeed Consulting Group LLC's Device Characterization Division. Mr. Dagostino has over 14 years experience in Signal Integrity modeling, previously with Zeelan Technologies and Mentor Graphics. Prior assignments have included over 18 years with Tektronix program managing, designing and performing market research on Digital Storage Oscilloscopes, real time oscilloscopes, probes and technology. Mr. Dagostino holds 10 Patents relating to DSO technologies and product features.

Yuriy Shlepnev is the president and founder of Simberian Inc., were he develops electromagnetic software for advanced analysis of interconnects. He received M.S. degree in radio engineering from Novosibirsk State Technical University in 1983, and the Ph.D. degree in computational electromagnetics from Siberian State University of Telecommunications and Informatics in 1990. He was principal developer of a planar 3D electromagnetic simulator for Eagleware Corporation. From 2000 to 2006 he was a principal engineer at Mentor Graphics Corporation, where he was leading the development of electromagnetic software for simulation of high-speed digital circuits. The results of his research are published in multiple papers and conference proceedings.

Scott McMorrow is President and Founder of Teraspeed Consulting Group**.** Mr. McMorrow is an experienced technologist with over 20 years of broad background in complex system design, interconnect & Signal Integrity engineering, modeling & measurement methodology, engineering team building and professional training. Mr. McMorrow has a consistent history of delivering and managing technical consultation that enables clients to manufacture systems with state-of-the-art performance, enhanced design margins, lower cost, and reduced risk. Mr. McMorrow is an expert in high-performance design and signal integrity engineering, and has been a consultant and trainer to engineering organizations world-wide.