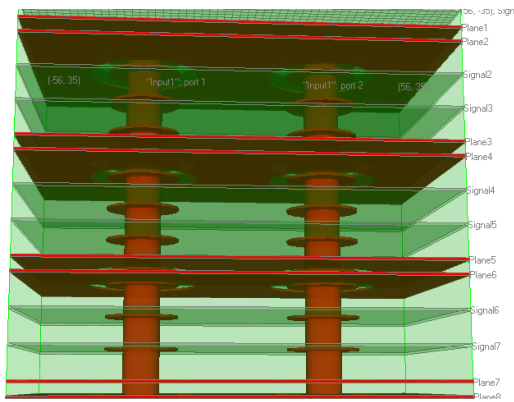


TVD: Transparent Via Design

Making all discontinuities disappear

Now with hands on labs!



To minimize signal quality problems all interconnects should be designed as controlled impedance transmission lines. But, discontinuities at transitions are unavoidable. As rise times drop below 1 nsec, these discontinuities are not transparent and are often the reason systems do not work. Learn how to make these discontinuities transparent and enable system operation into the 10 Gbps regime and higher in this class.

A process is introduced to analyze all discontinuities and evaluate the problem they might cause, singly and in combination. We show, using rules of thumb, approximations and numerical simulation tools, how to translate physical structures into a circuit model to enable simulation to give insight into their impact. When they are identified as a problem we show three general techniques to optimize the design to make the structures more transparent. This method can be applied to all discontinuities, such as:

• Single ended vias	• Solder balls
• Differential vias	• Connectors
• Corners, bends and serpentes	• Terminating resistors
• Neck downs in BGA fields	• DC blocking capacitors

Now with hands on labs!

Since every design is custom, one set of rules can't work with all designs. That's why many important design tradeoff questions can only be answered with "it depends." And the way we answer it depends questions is by putting in the numbers. Unique to this class, we will introduce a simple, easy to use simulation tool that will empower you to answer many "it depends" questions, specific to your next design.

We supply a copy of QUCS and all the example files. You supply your lap top, running a Windows operating system. The software and example files are fully functional and yours to take back with you.

No previous simulation experience is necessary. Even if you have never done any simulation before, you will find this an incredibly easy to use tool. To participate in the hands on labs, you must bring your own lap top to the class.

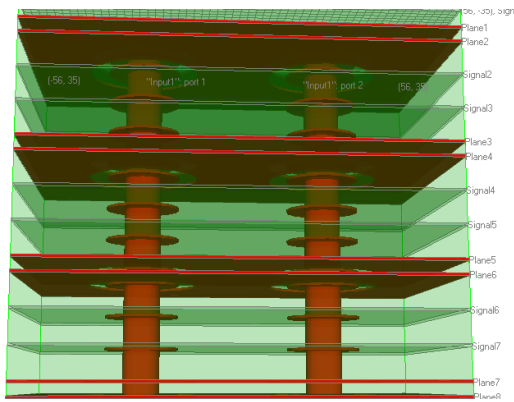


How Do I Register?

Online at www.beTheSignal.com, call 913-393-1305 or email info@beTheSignal.com for questions and group discounts.

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Outline

• **Module 1 A general approach to evaluate discontinuities**

- 3D modeling tools
- Transmission line approximations and the bandwidth of the model
- Time and frequency domain simulation: single and multiple discontinuities
- Role of stubs
- HOLs: series discontinuities in the time and frequency domains and terminations

Module 2: Designing transparent single-ended vias

- Interpreting S-parameter models
- At what bandwidth are vias a problem
- Impact from design features: stubs, clearance holes, NFPs, pitch, length
- Exploring design space to make single-ended vias transparent
- HOLs: analyzing via S-parameter models, impact from thru and stub sections

Module 3: Designing transparent differential vias

- Interpreting S-parameter models
- Impact from design features: stubs, clearance holes, NFPs, pitch, length
- An analytical model for a differential via
- Mode conversion
- Exploring design space to make differential vias transparent
- HOLs: analyzing via S-parameter models, modeling thru and stub differential vias

Module 4: Discontinuities in the signal path

- Three techniques to make discontinuities disappear
- Evaluating measured S-parameter files of discontinuities
- Analyzing connectors
- Analyzing traces through via hole fields
- Analyzing DC blocking capacitors
- HOLs: building models from S-parameter files, compensation in time and frequency domains