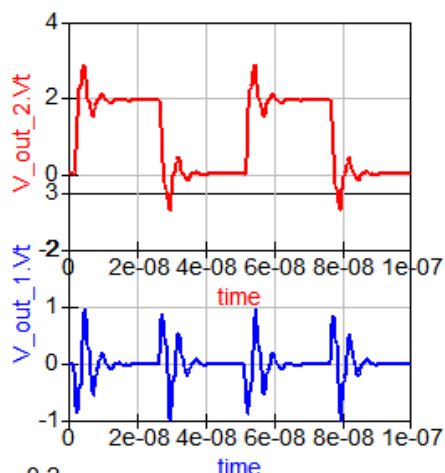


*A 2-day advanced training class with  
Dr. Eric Bogatin, Signal Integrity Evangelist*



## **CRNX: Controlling Reflection Noise and Cross Talk**

*Eliminate signal integrity noise in your next product*

***Now with hands on labs!***

***There are two kinds of engineers, those who have signal integrity problems and those that will.*** Keeping your fingers crossed and hoping your product will work is not an effective design strategy: as speed goes up, luck goes down.

This 2-day advanced signal integrity training class thoroughly reviews the design process and principles to reduce reflection noise and cross talk to acceptable levels. The design principles in this class are most suitable for single-ended and differential designs under 2 Gbps. If your designs are over 2 Gbps, the Advanced GigaBit Channel Design (AGCD) class is for you.

How do you establish design rules for a robust design? Which routing topology and termination strategy gives the highest data rate? What small details can make the difference between acceptable BER at 1.25 Gbps or failing at 1.1 Gbps? How do you answer these sorts of questions and establish confidence in a design before you build it? After this class, you will never be afraid of ground bounce again.

If you are a new designer or an experienced hardware engineer, you will pick up new analysis tools and design tricks to add to your tool box. A complete list of topics is included in the course outline.

### ***Now with hands on labs!***

The most common answer to all signal integrity questions is “it depends”. The way we answer it depends questions is by putting in the numbers. While this class introduces many rules of thumb and approximations, sometimes, to get a good answer requires a simulation. This is why numerical simulation tools are essential.

By special arrangement, we give you access to Mentor Graphics HyperLynx to run hands on labs we created specifically for this class. These labs illustrate the design principles and allow you to explore design space with virtual prototypes, on your own, after the class.

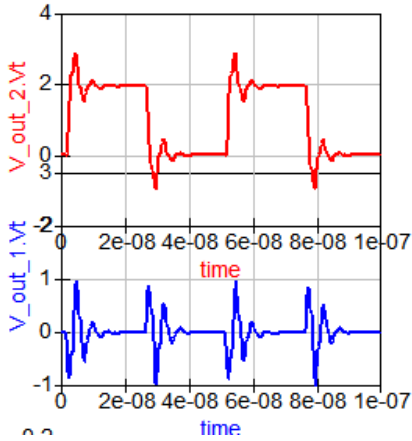
No previous simulation experience is necessary. Even if you have never done any simulation before, you will find the labs we have created easy to use and help you immediately apply the principles you learn in class to your next design.



### **How Do I Register?**

Online at [www.beTheSignal.com](http://www.beTheSignal.com),  
[info@beTheSignal.com](mailto:info@beTheSignal.com) for questions and group discounts.  
Schedule is online at [www.beTheSignal.com](http://www.beTheSignal.com)

*A 2-day advanced training class with  
Dr. Eric Bogatin, Signal Integrity Evangelist*



# **CNRX: Controlling Noise from Reflections and Cross Talk**

*Eliminate signal integrity noise in your next product*

## **Class Outline**

Day 1

Day 2

<p><b>01 Transmission Lines</b></p> <ul style="list-style-type: none"> <li>• Single-ended and differential signals</li> <li>• Ringing as root cause of ISI and eye collapse</li> <li>• Why clock signals don't tell the whole story</li> <li>• The root cause of ringing and eliminating it</li> <li>• Highest data rate and routing topology features</li> </ul>	<p><b>05 Features of NEXT and FEXT</b></p> <ul style="list-style-type: none"> <li>• Controlling fringe fields</li> <li>• Capacitive and inductive coupling</li> <li>• Why NEXT is different from FEXT</li> <li>• How much is too much? Impact on eyes</li> <li>• Spacing and cross talk</li> </ul>
<p><b>02 Termination Strategies</b></p> <ul style="list-style-type: none"> <li>• Noise margins and timing</li> <li>• Four simulation types</li> <li>• Six different approaches and signal quality</li> <li>• Power dissipation</li> <li>• Terminating bi-directional busses</li> </ul>	<p><b>06 Reducing NEXT and FEXT</b></p> <ul style="list-style-type: none"> <li>• Impedance, coupling, cross talk, terminations</li> <li>• Coupling length, rise time, NEXT, FEXT</li> <li>• Guard traces: how, when, where, why?</li> <li>• Eliminating FEXT with stripline</li> <li>• Diff cross talk and coupling</li> </ul>
<p><b>03 Routing Topologies</b></p> <ul style="list-style-type: none"> <li>• Branches, ISI and the limit to data rates</li> <li>• Terminating clustered loads, trees</li> <li>• Terminating linear busses</li> <li>• Three tricks to achieve higher data rates</li> <li>• Bi-directional busses</li> </ul>	<p><b>07 Origin of Ground Bounce</b></p> <ul style="list-style-type: none"> <li>• Ground bounce and total inductance of RP</li> <li>• RPDs- where ground bounce can occur</li> <li>• Estimating ground bounce</li> <li>• Connectors and packages</li> <li>• Terminations, diff pairs and current control</li> </ul>
<p><b>04 Discontinuities</b></p> <ul style="list-style-type: none"> <li>• Two topologies and simulations</li> <li>• Using S-parameter models of connectors</li> <li>• Vias and changing return planes</li> <li>• Stub length and highest data rate</li> <li>• Multiple discontinuities and location</li> </ul>	<p><b>08 Eliminating Ground Bounce</b></p> <ul style="list-style-type: none"> <li>• Safely crossing gaps in return paths</li> <li>• Optimized via design</li> <li>• Safely referencing to Vdd or Vss or Vtt</li> <li>• Reducing plane cavity noise</li> <li>• Never be afraid again</li> </ul>

Visit [www.beTheSignal.com](http://www.beTheSignal.com)