

A 1-day Intensive Workshop from
Bogatin Enterprises and beTheSignal.com

Controlling Transmission Line Loss Boot Camp

Opening your eyes to lossy effects

The cure for FUD (Fear, Uncertainty, Doubt):

In this practical, intensive training class, you will walk away with the understanding, skills, and tools needed to solve real problems.

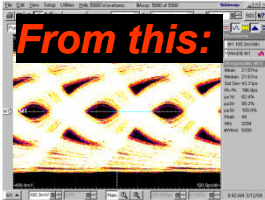


Figure 17: 42.5-Inch (Pre-Emphasis = 0)

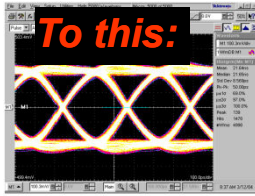


Figure 22: 42.5-Inch (Pre-Emphasis = 5)

If your circuit boards operate at 1 Gbps or above, just meeting a differential impedance spec for circuit boards is not enough. In current and next generation boards, it is critical to also meet a loss spec.

This one-day intensive training from the Signal Integrity Evangelist, Dr. Eric Bogatin will show you how you can characterize, control and improve the loss in circuit board transmission lines, by design and by fabrication. We eliminate the confusion over:

<ul style="list-style-type: none"> • Too many loss terms: attenuation, dissipation factor, skin depth, nepers/m, dB/GHz, dB/in 	<ul style="list-style-type: none"> • How does differential pair design affect loss?
<ul style="list-style-type: none"> • All the S-parameters, like S11, SDD21, SCD21, SCC11, S41, S21,... 	<ul style="list-style-type: none"> • What material properties affect loss?
<ul style="list-style-type: none"> • Time domain vs frequency domain- which is better? 	<ul style="list-style-type: none"> • What is a practical way to characterize loss?
<ul style="list-style-type: none"> • What copper foil features should I care about? 	<ul style="list-style-type: none"> • What can I do to control loss in my circuit boards?

At the end of this training program, you will be able to:

- Design a differential pair to control loss
- Optimize your stack up to control loss
- Select copper foils for lower loss
- Select laminate materials for lower loss
- Identify the first and second order factors that affect loss and control them
- Measure transmission line loss in the time or frequency domain
- Translate a loss spec into an action plan for circuit board design and fabrication

beTheSignal

Bogatin Enterprises LLC.

Ideal for Design and Fab Engineers!

**Admission fee Includes access to the online version: CEC-425
Transmission Line Loss Boot Camp**

Organized by :

Polar
Polar Instruments (AP) Pte Ltd
Simplified Solutions

How Do I Register?

Online at www.beTheSignal.com / www.polarinstruments.asia

Call 913-393-1305 / +65 6873 7470 or

email info@beTheSignal.com / training@polarinstruments.asia
for questions and group discounts.

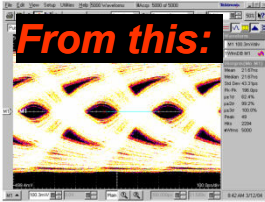


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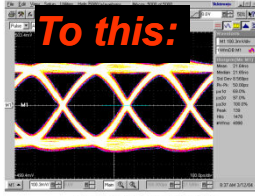


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Every attendee earns 0.6 CEUs for attendance and an additional 1.4 CEUs upon completion of the online continuing education curriculum: Controlling Transmission Line Loss Boot Camp at www.beTheSignal.com

Module 1 Why loss is important

- How loss affects digital signals: what we lose from a lossy interconnect
- End user applications where loss is important
- Frequency dependent attenuation of signals in transmission lines
- Describing loss in transmission lines with figures of merit
- Why optimizing and controlling for loss is important

Module 2: Root cause of loss

- Conductor and dielectric loss
- Impedance, resistance and conductance
- Current distributions, skin depth and RMS roughness
- Dielectric materials and conductance
- Frequency dependent loss from constant Dk, Df
- Dk, Df, geometry and loss

Module 3: Designing for lower loss

- Lower resistance by design: controlling current distributions
- Impact of surface treatments and selective surfaces
- Differential pair design tradeoffs and loss: cross section geometry and Dk
- Dielectric materials, frequency dependent factors and loss
- Mixed dielectrics, air and solder mask
- Limitations in the current state of predicting loss- why final measurement is critical

Module 4: Measuring and characterizing loss

- The ultimate approach: 4-port VNA
- Interpreting SDD21, SDD11 in terms of loss
- Time domain measurements with TDR/TDT and VNA measurements
- Alternative IPC standards
- The Intel SET2DIL method

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More info on : beTheSignal.com / polarinstruments.asia