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EE273  
Demo 1  
Transmission Lines  
February 9, 2001

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# Schedule of Demonstrations

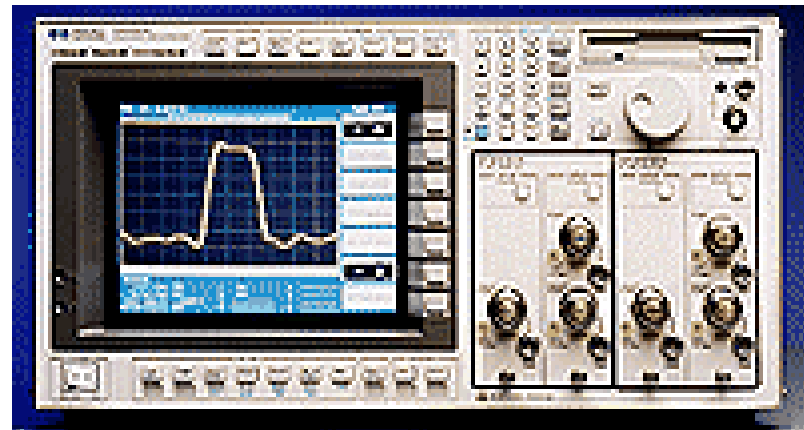
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- TDR of basic transmission line
  - open circuit, matched termination, short circuit, unterminated
- TDR of a line with slots in the ground plane
- TDR of a line with two vias
- Crosstalk demonstration
  - homogeneous medium
  - inhomogeneous medium
  - source terminated
  - perpendicular crosstalk
- Frequency dependent loss
  - TDT of line
  - response to data sequence

# The Sampling Scope/ Time-Domain Reflectometer

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- HP 54750A Sampling Scope
  - 54754A Differential TDR head
    - 45ps step generator
    - dual 18GHz sampling heads
  - 54751A Sampling head
    - dual 20GHz samplers
  - inputs +/- 2V Max!
  - 3.5mm/SMA connectors



# The Pulse Generator

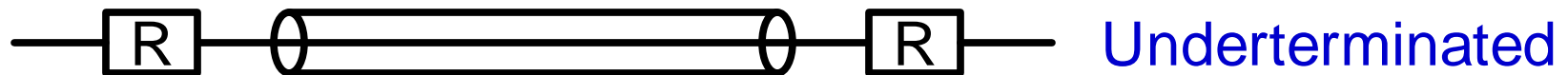
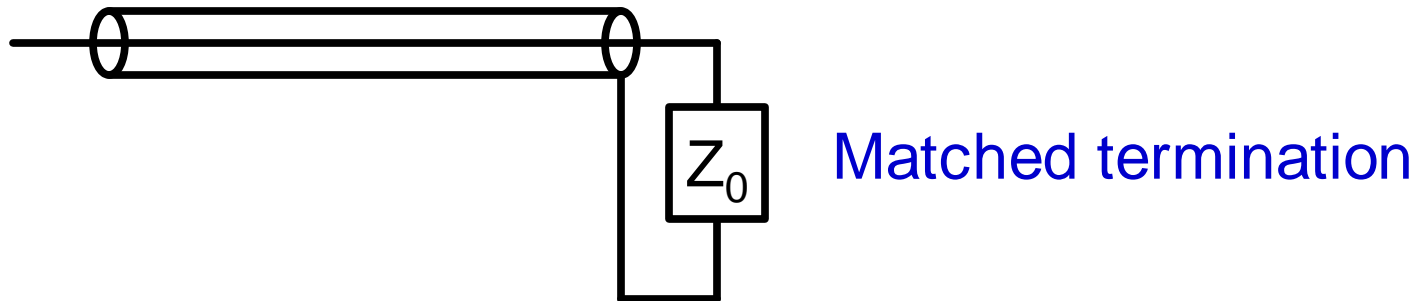
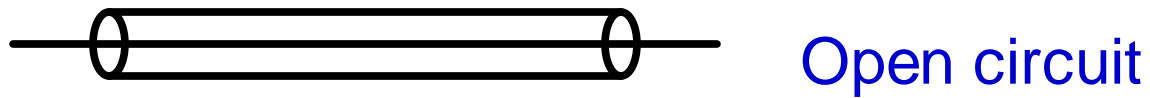
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- HP 8133A
  - 3GHz pulse generator
  - Square wave
  - Pulse
  - 32-bit sequence
  - PRBS sequence

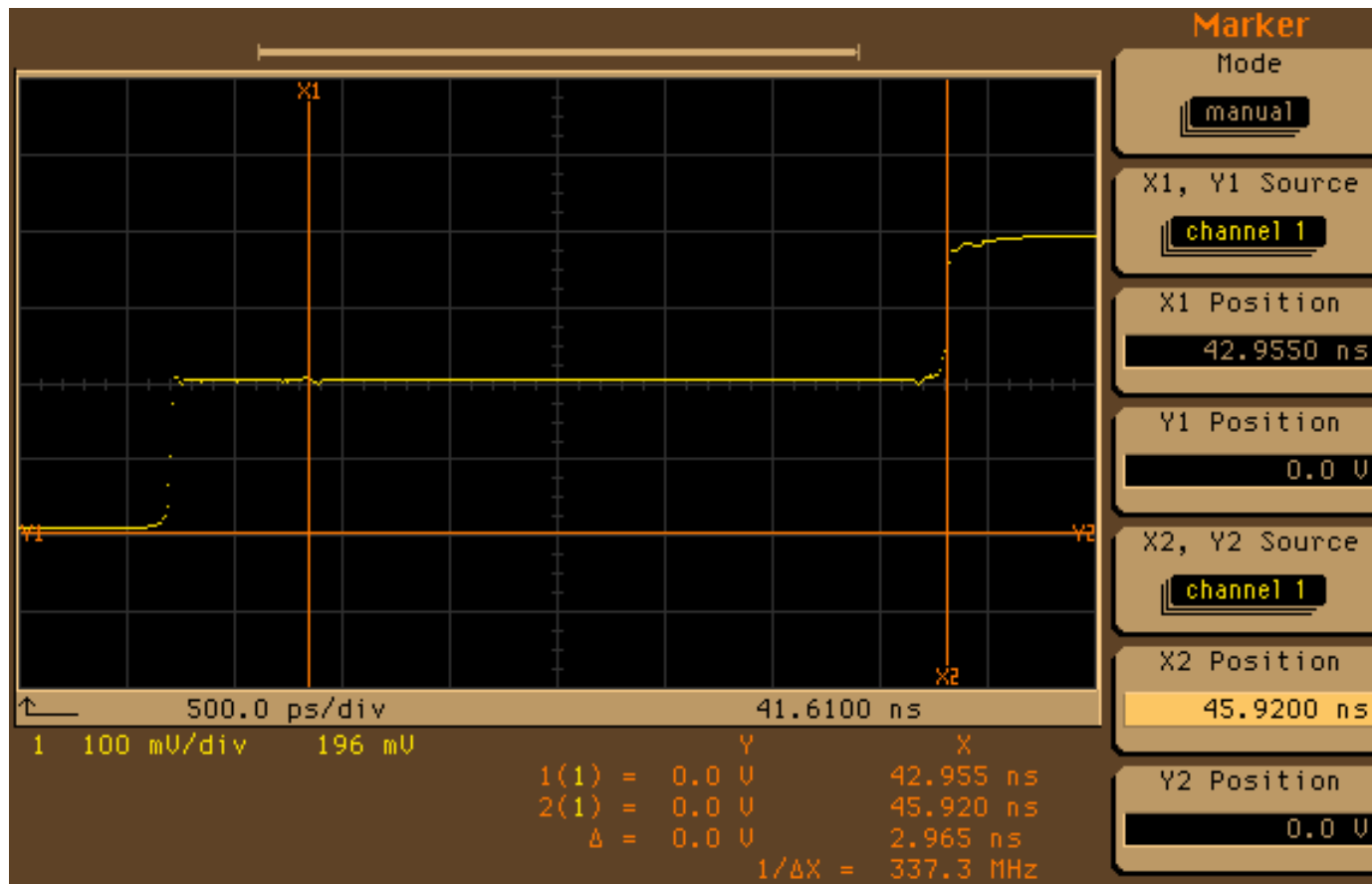


# TDR of Basic Line

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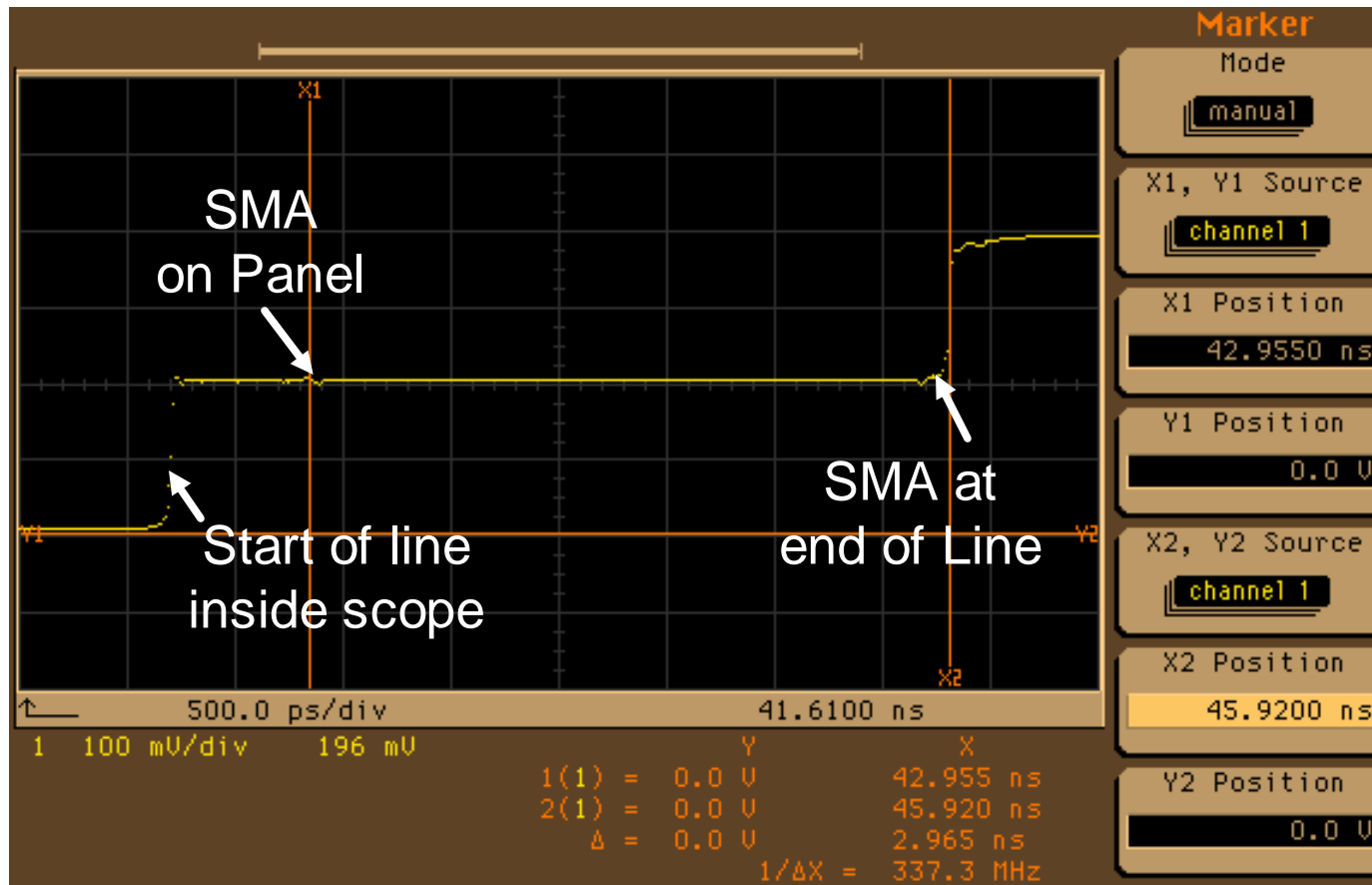
# Open Line



3.0 ns from start of line to reflection implies line is \_\_\_\_ ns long

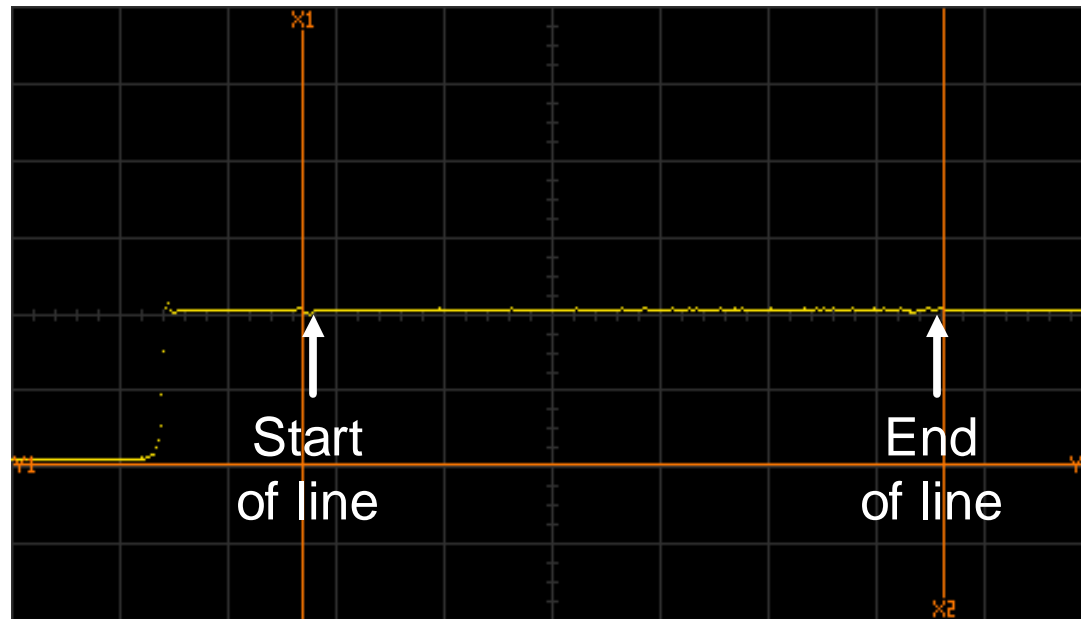
# Open Line

Compare slope of edge at start of line with slope after two round trips.



# Matched Termination

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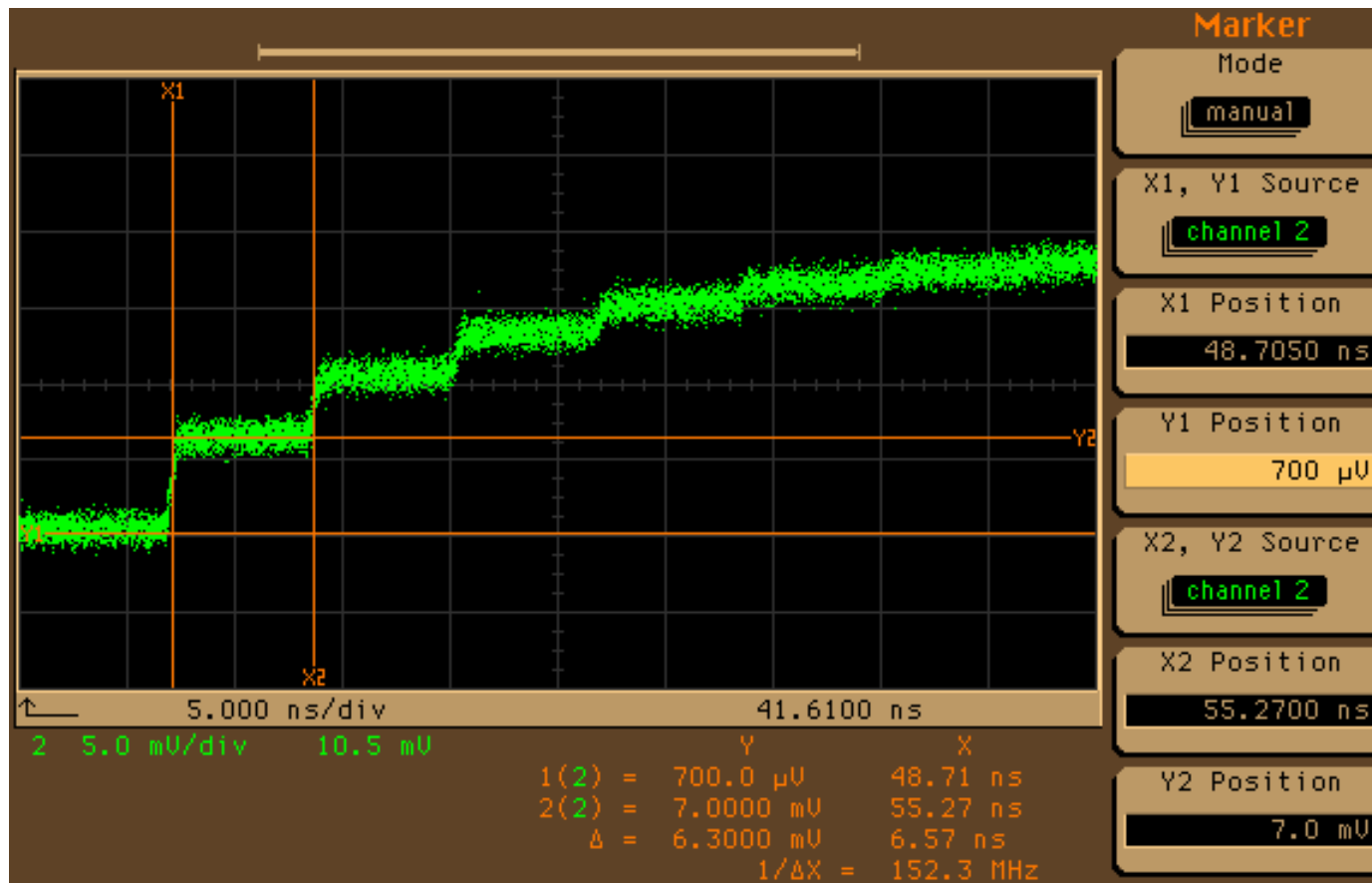


# Short Circuit

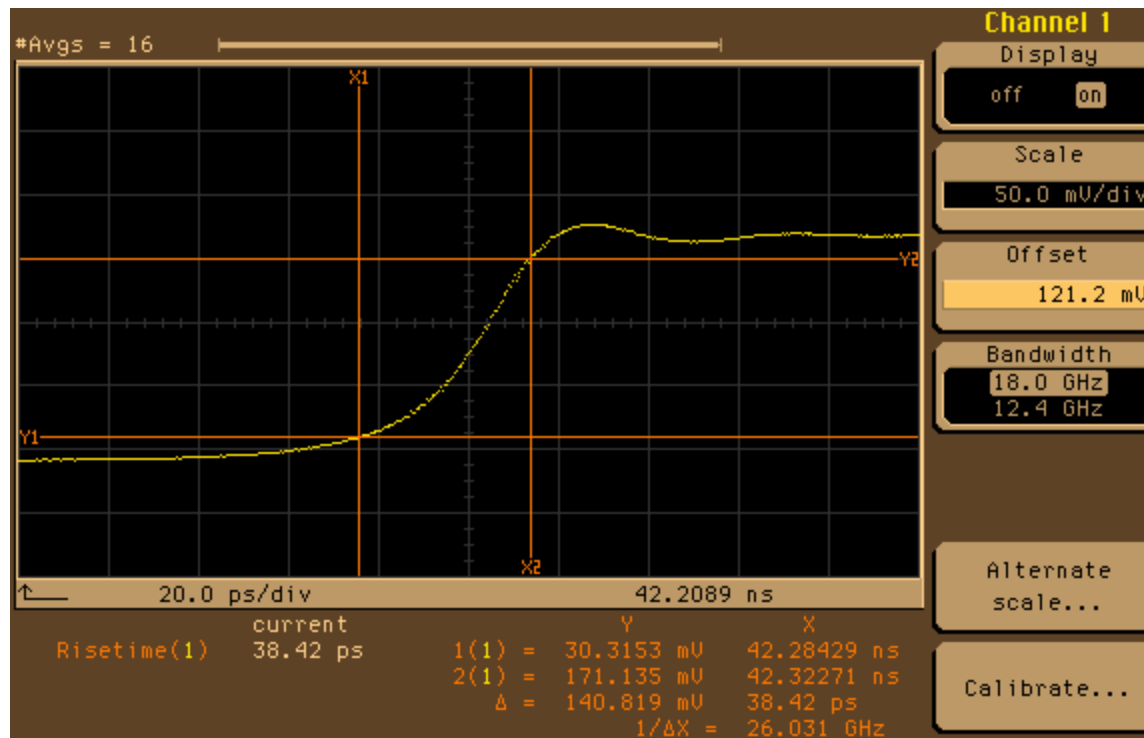
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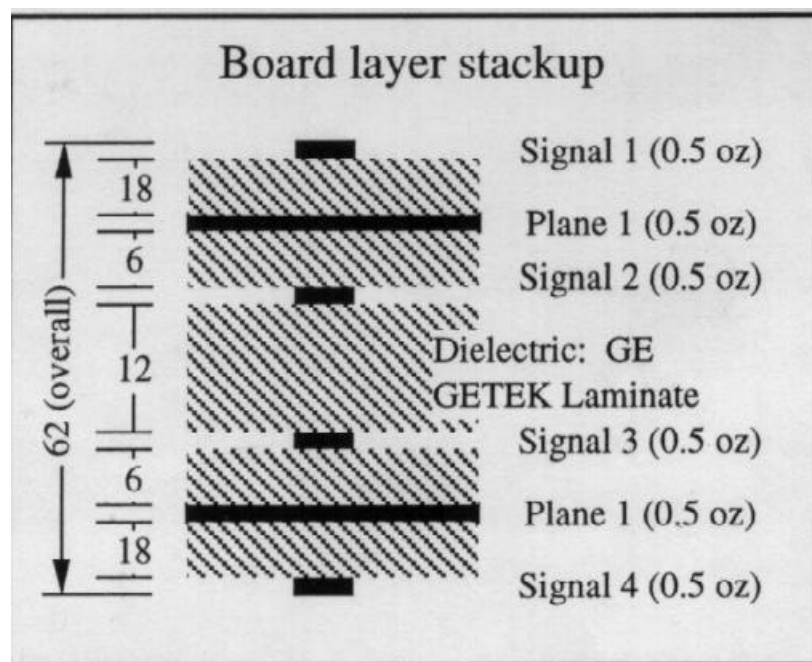
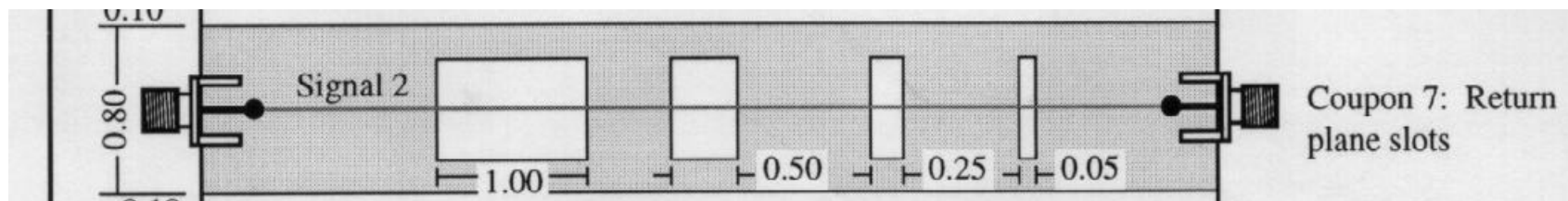
# “Ring-Up” of Underterminated Line



# Close-up of TDR Rise-Time

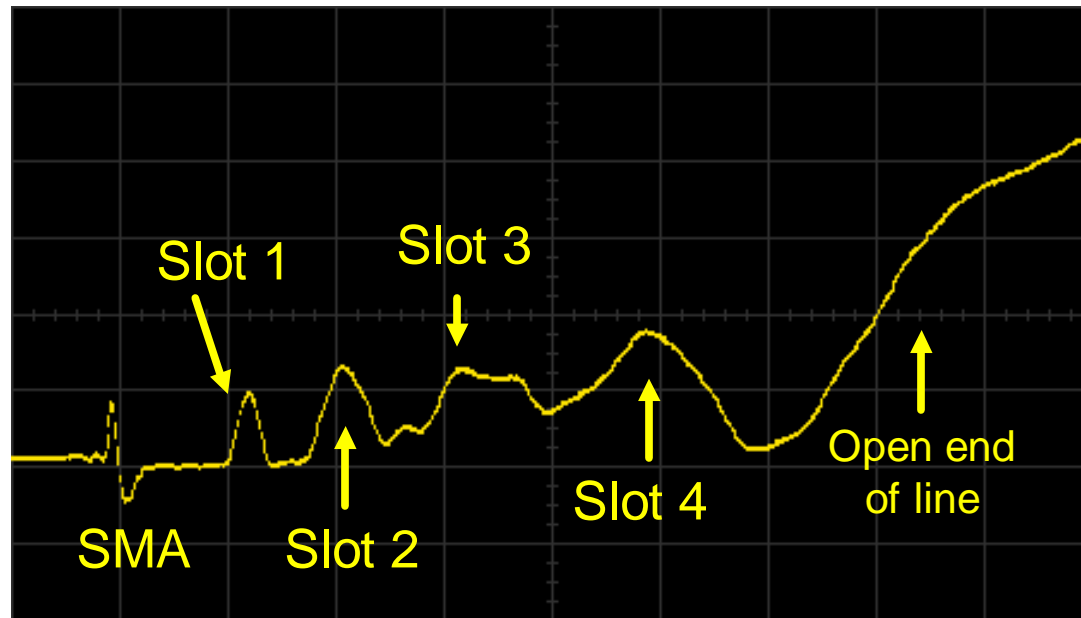


# TDR of Line with Slots in Ground Plane



# From Side with Narrow Slot

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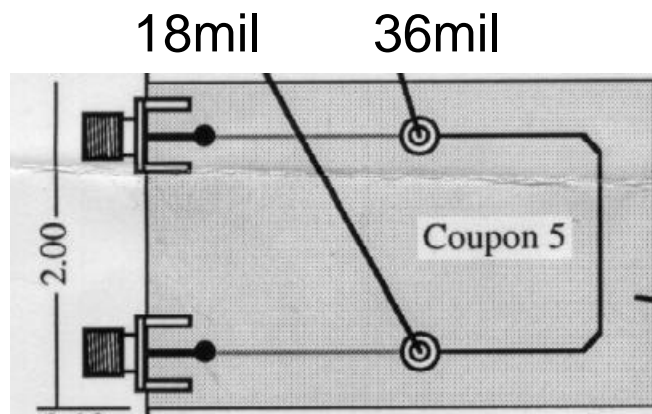


# From Side with Wide Slot

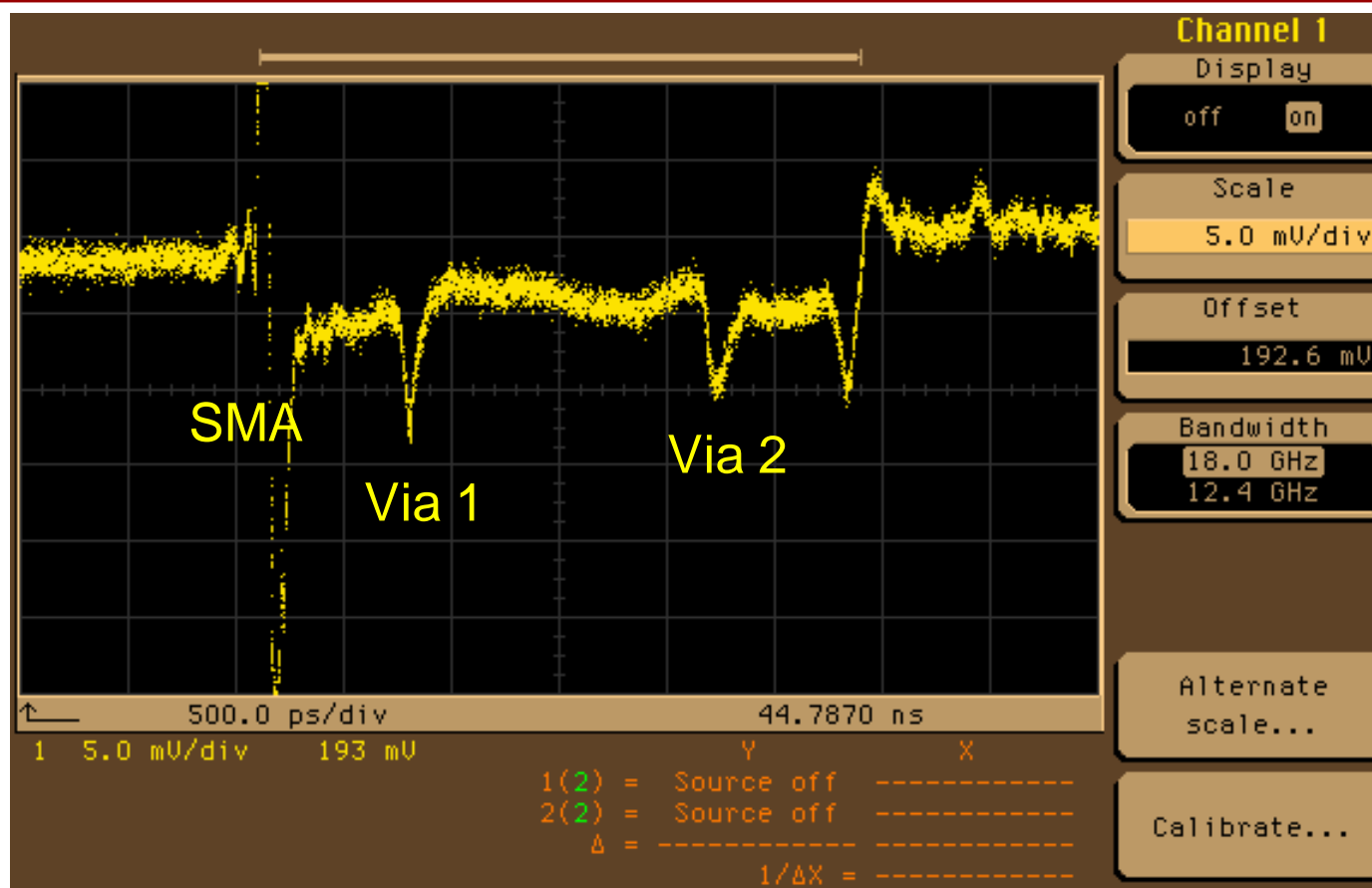


# Line with Two Vias

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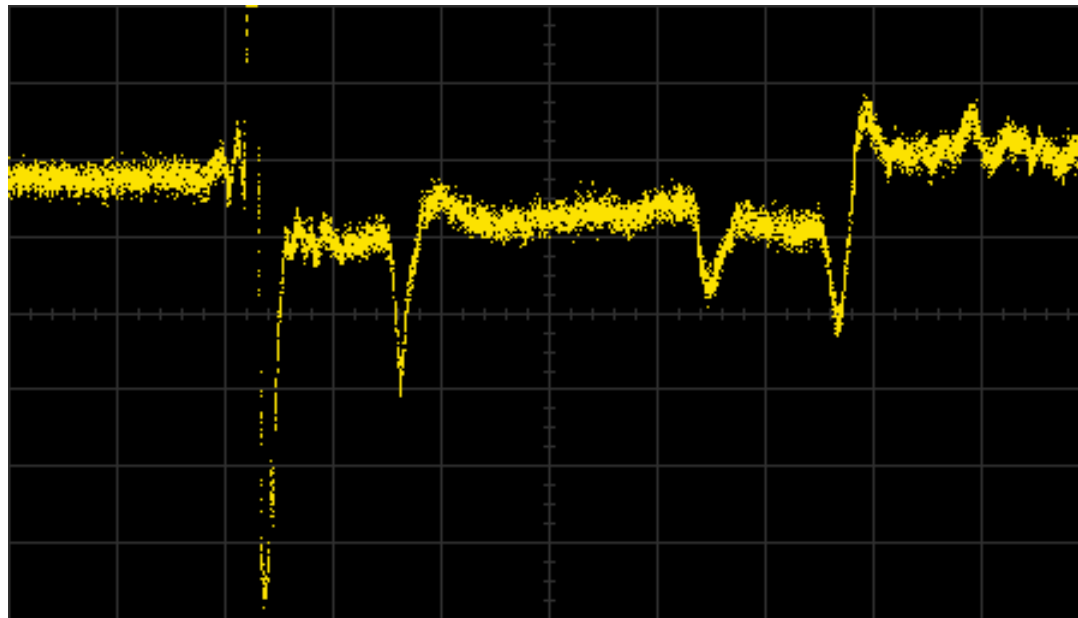


# Vias from the 18mil side

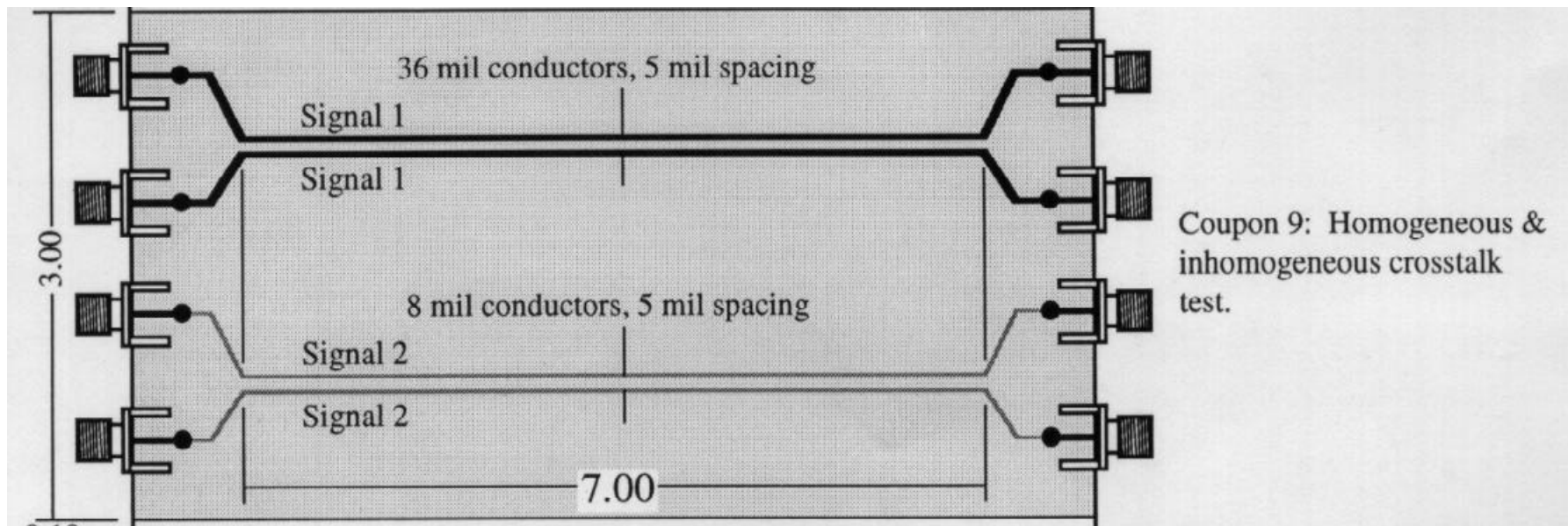


# Vias from the 36mil side

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# Setup for Crosstalk Demonstration

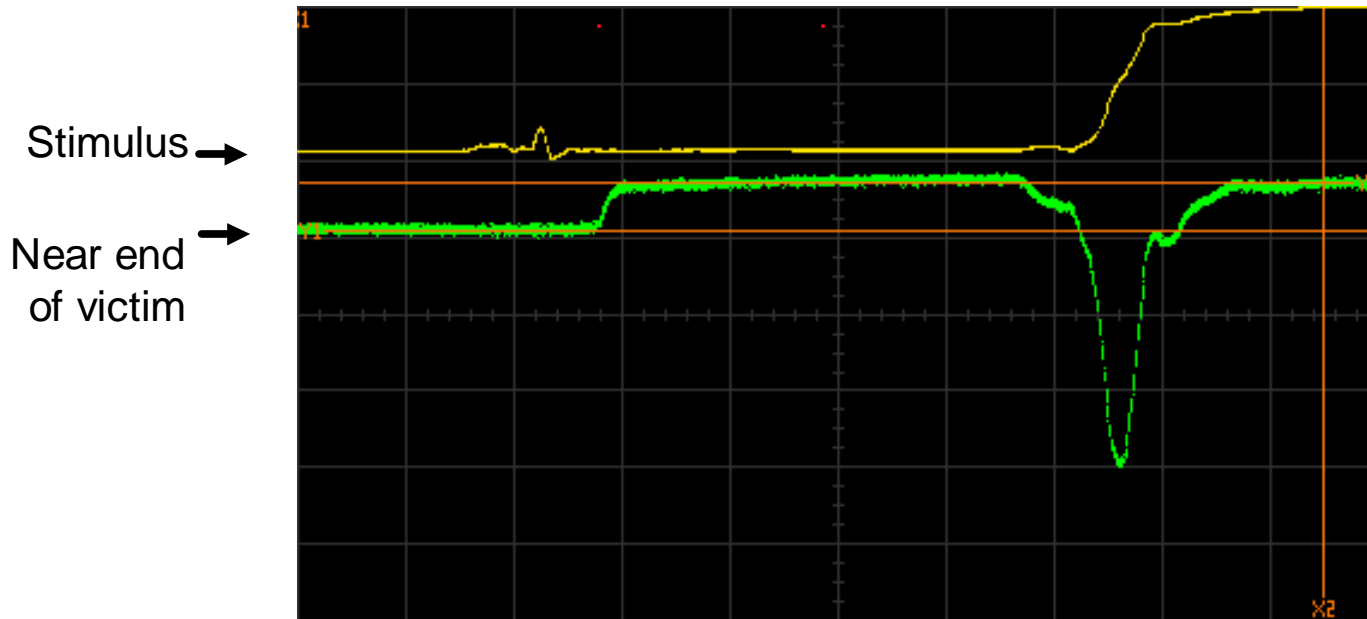


# Crosstalk Between Surface Traces

SMA

## Source end of two open lines

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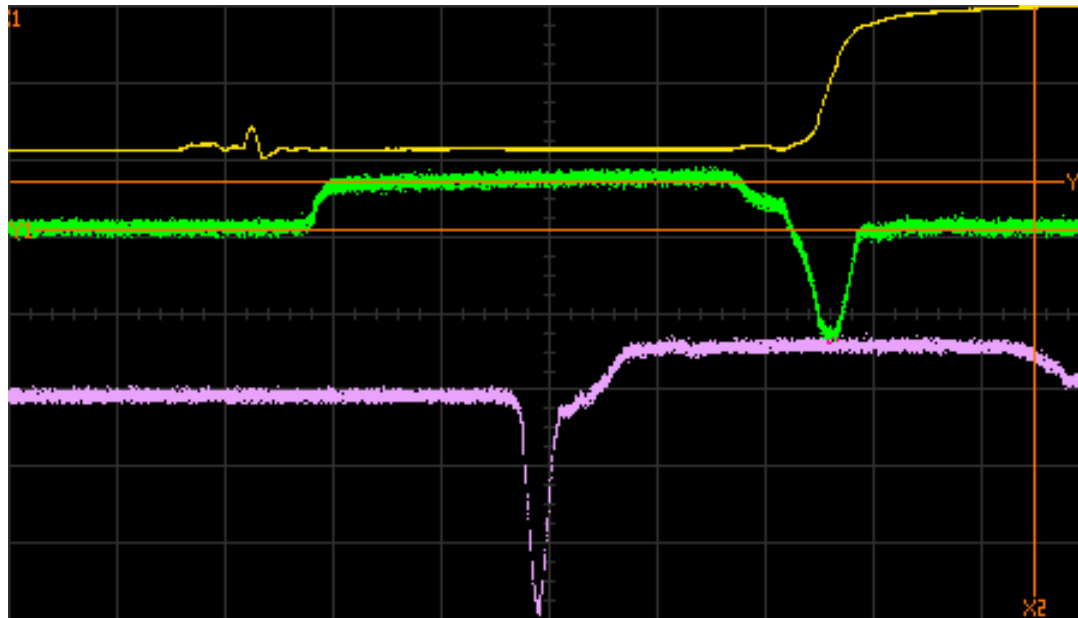
Edge on stimulus occurs  
inside scope far off left  
edge of screen



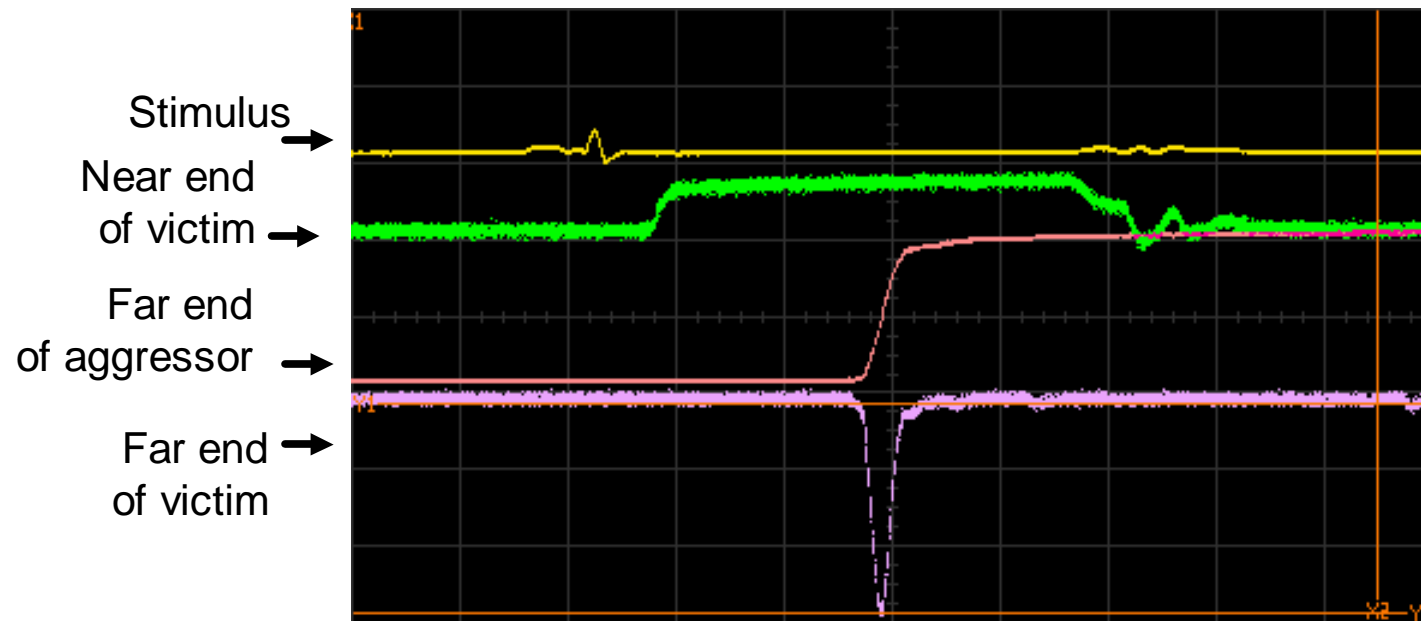
Length of coupled segment

# Terminate far end of victim

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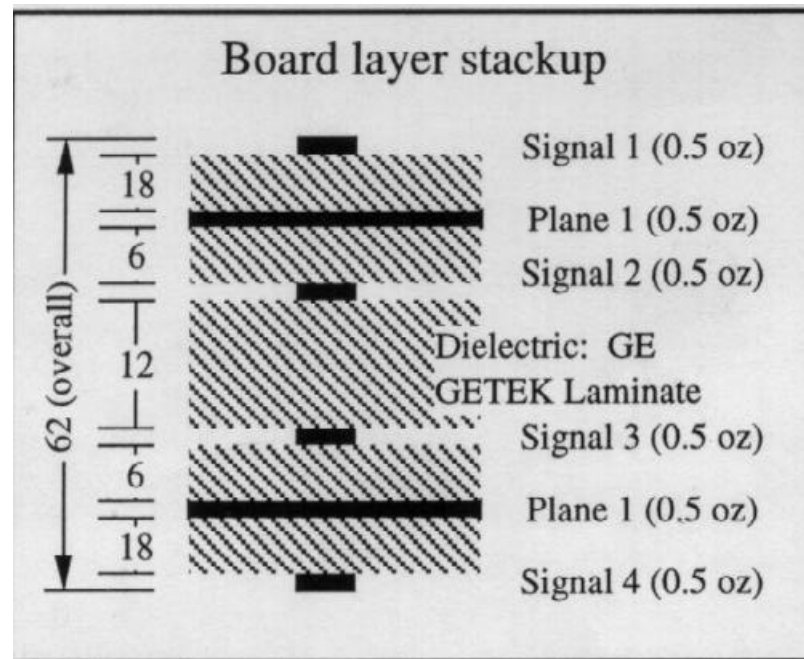


# Terminate far end of aggressor



# Surface Traces vs Internal Traces

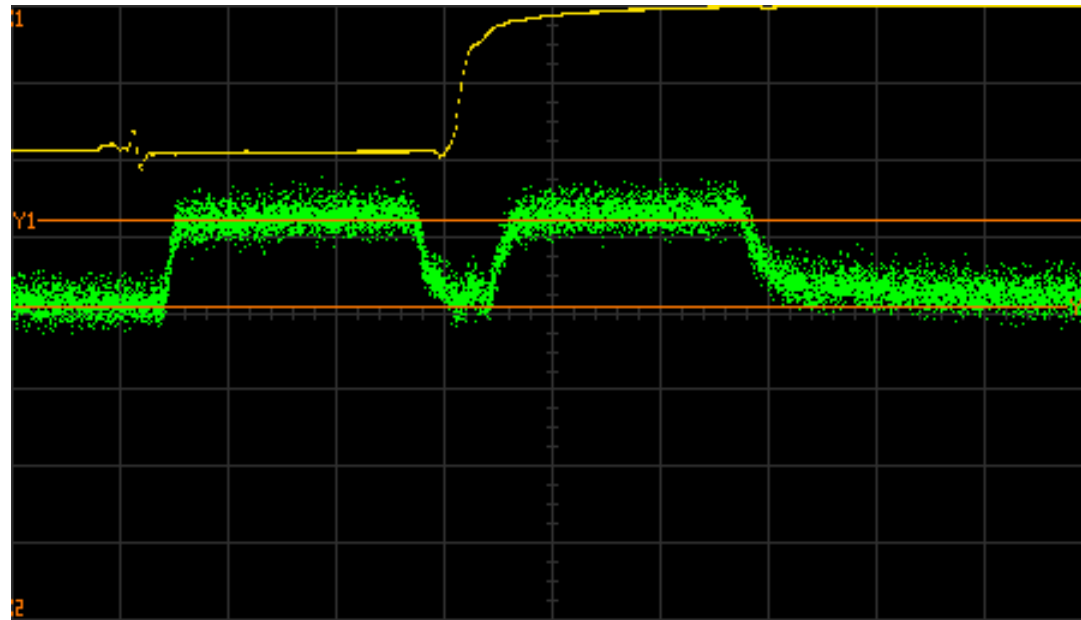
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# Crosstalk in Homogeneous Medium

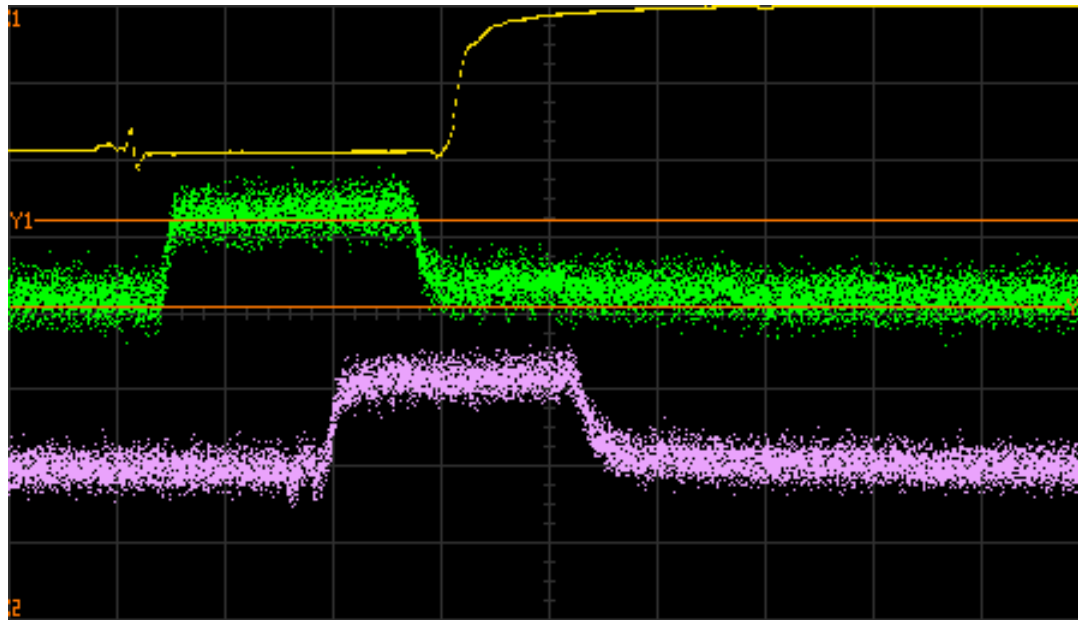
## Source end of source terminated lines

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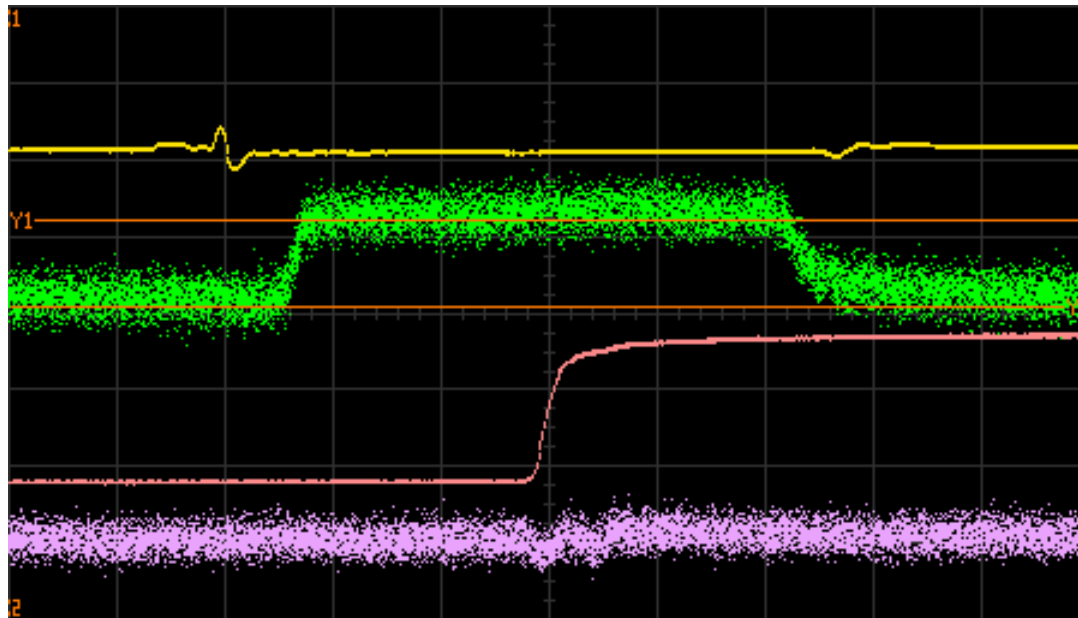
# Terminate far end of victim

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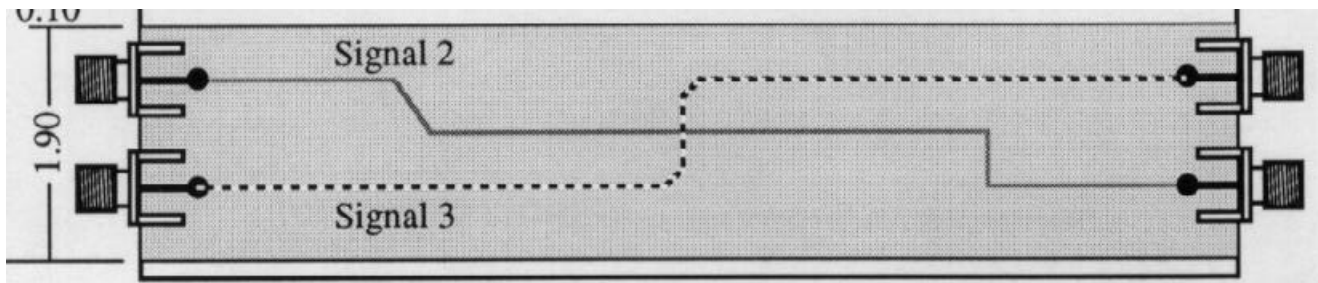
# Terminate far end of aggressor

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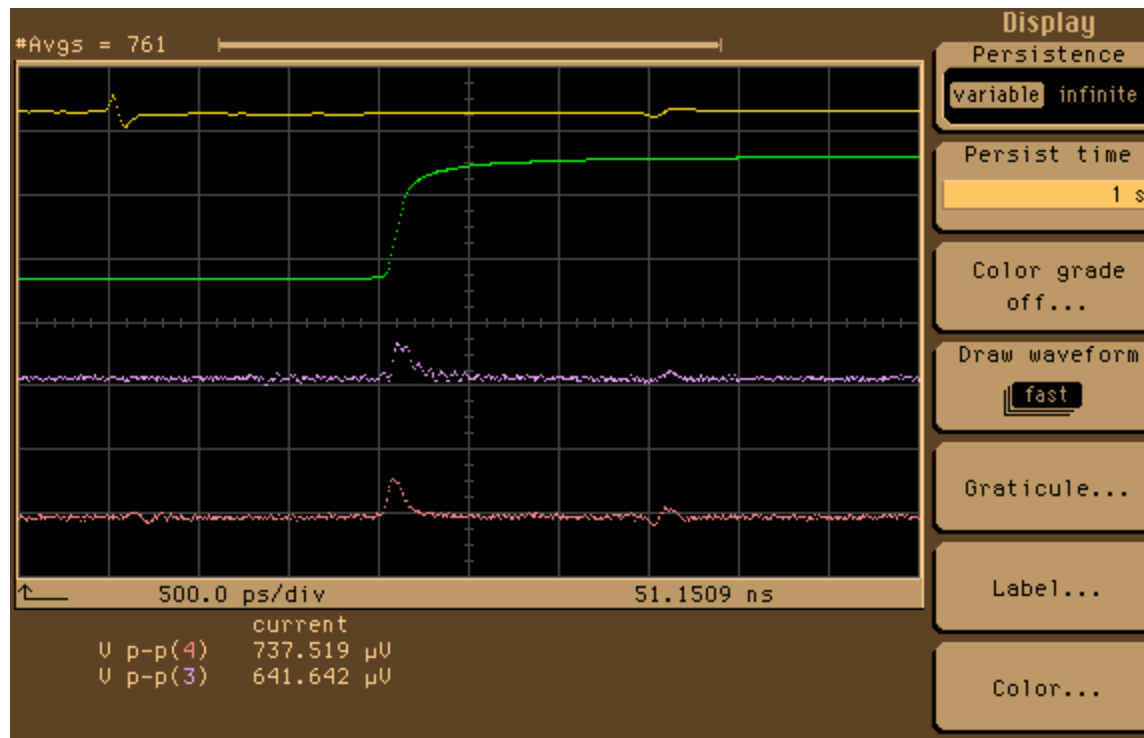


# Perpendicular Crosstalk Demonstration

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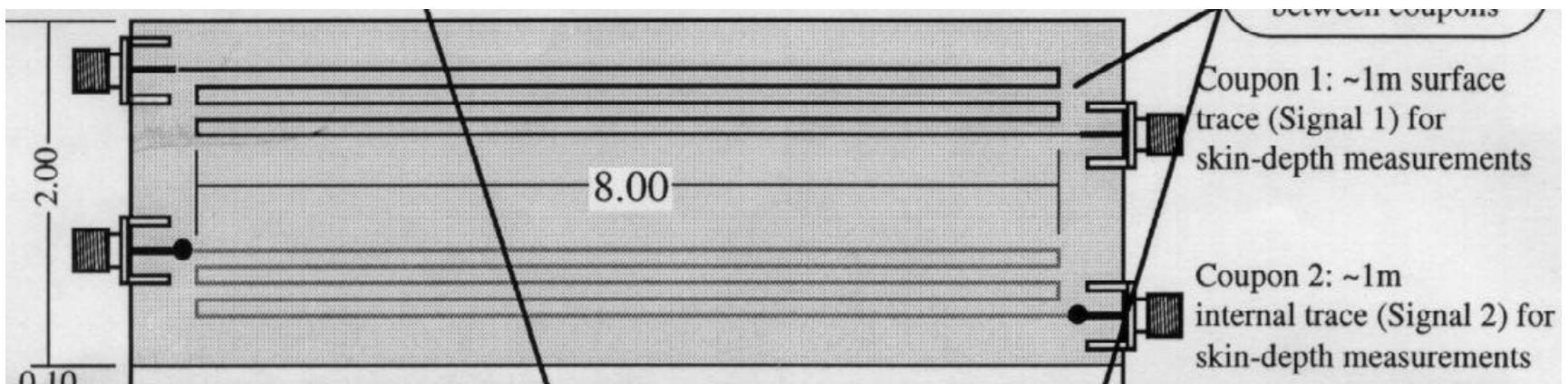


# Perpendicular Crosstalk



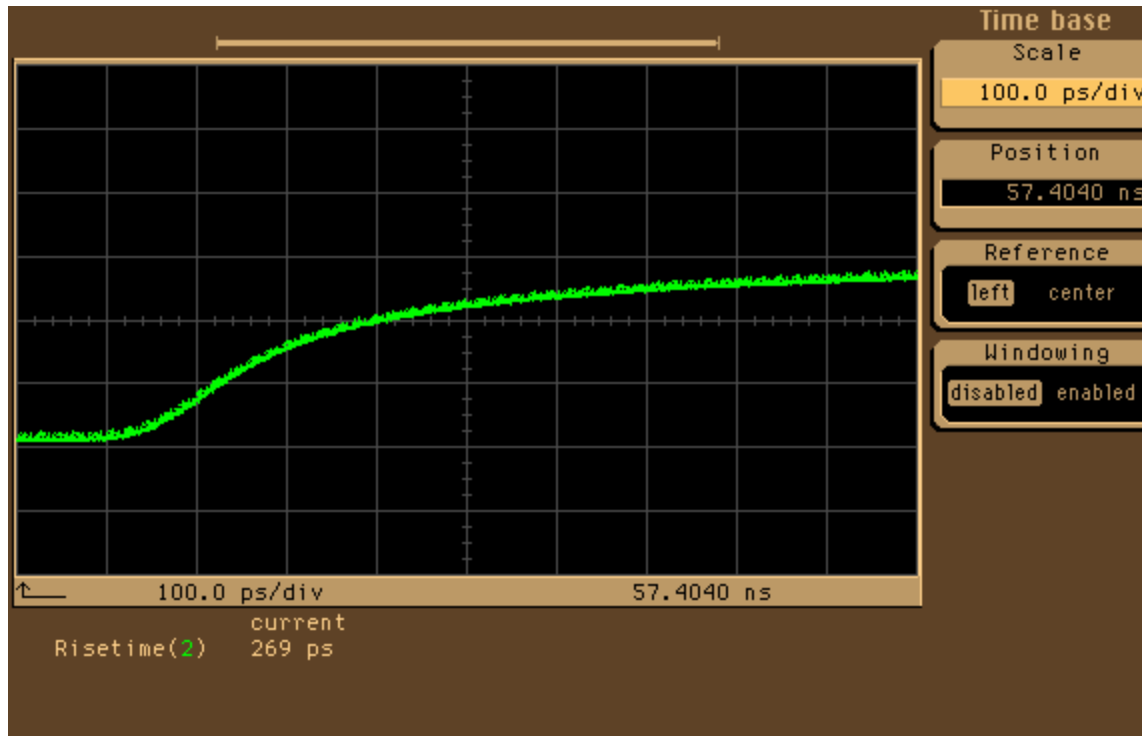
# Setup for Frequency-Dependent Loss Demonstration

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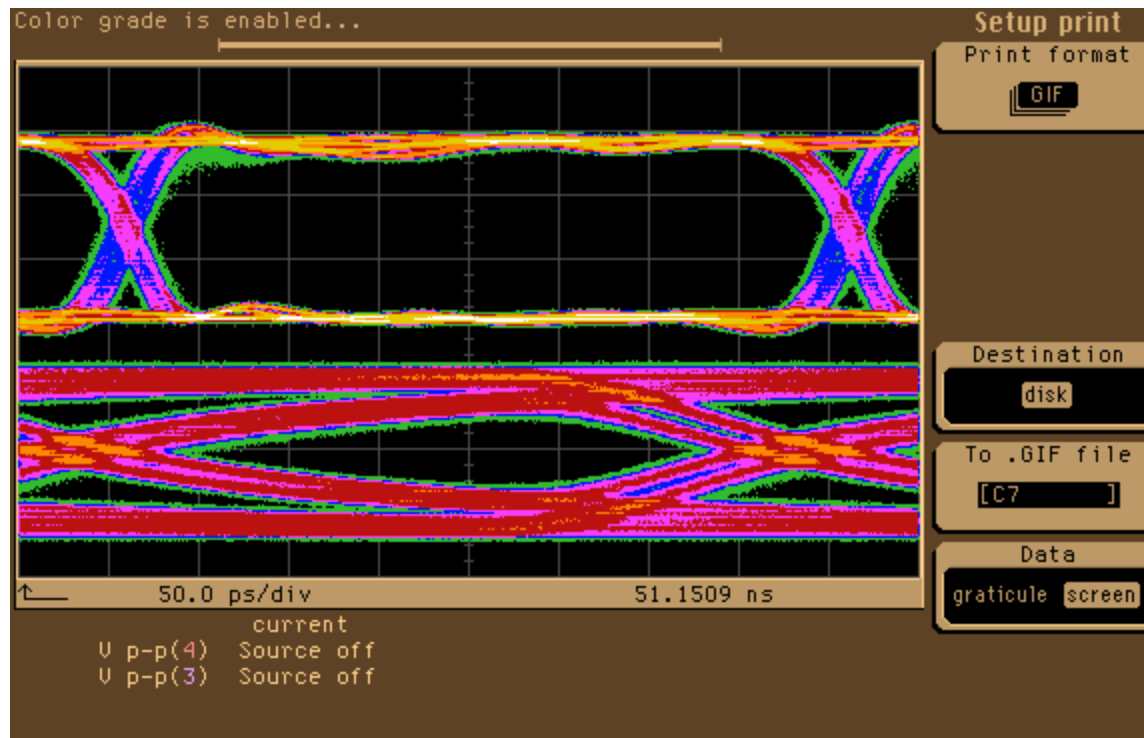


# Frequency Dependent Attenuation Step Response

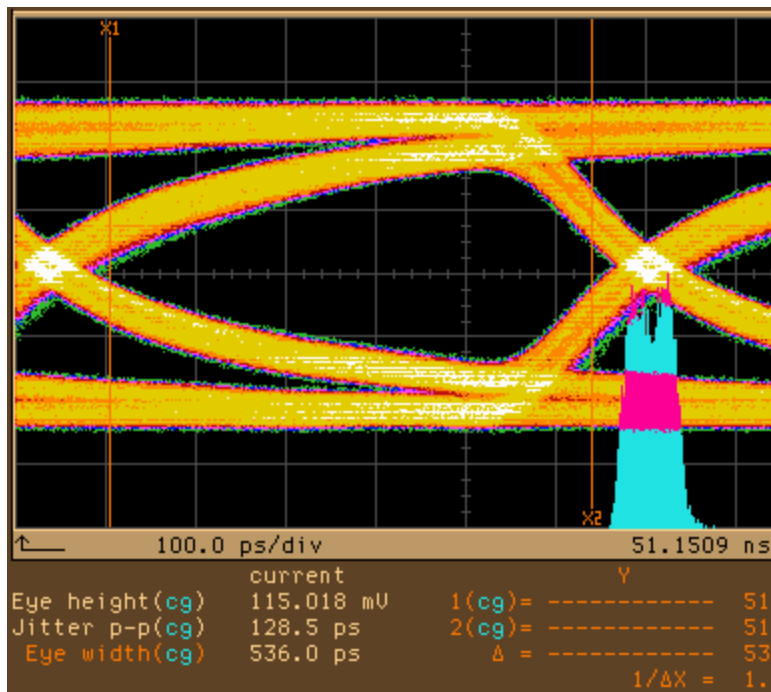
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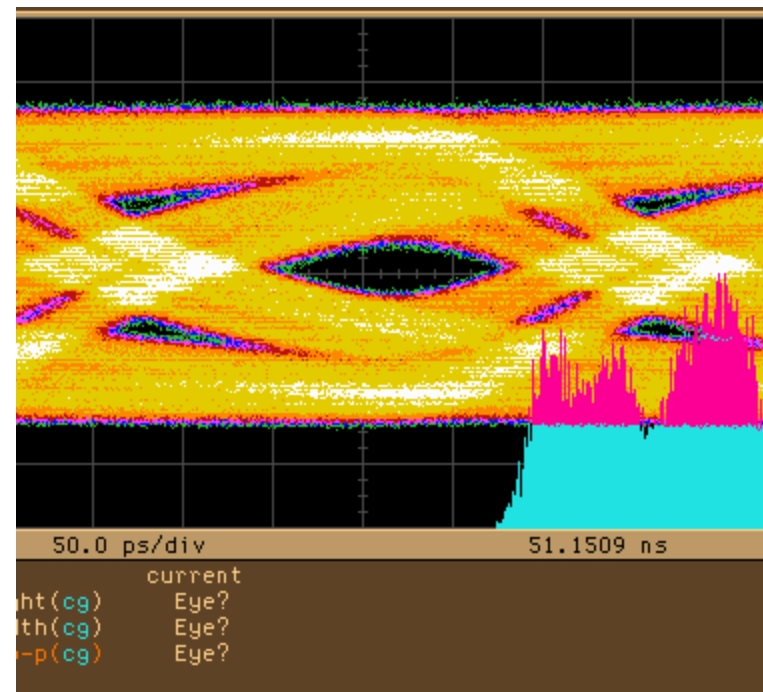
# Frequency-Dependent Attenuation Eye Diagram



# Frequency-Dependent Nature of Attenuation



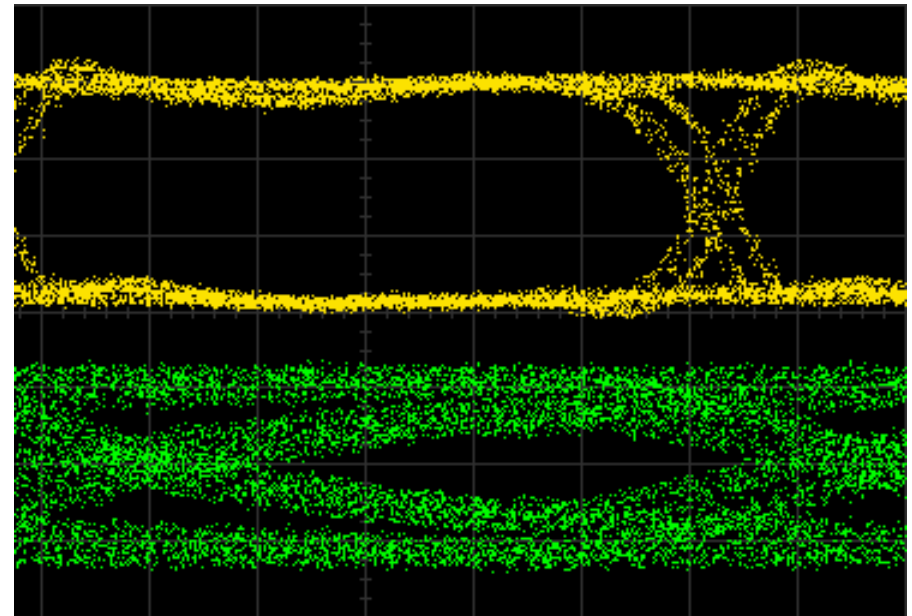
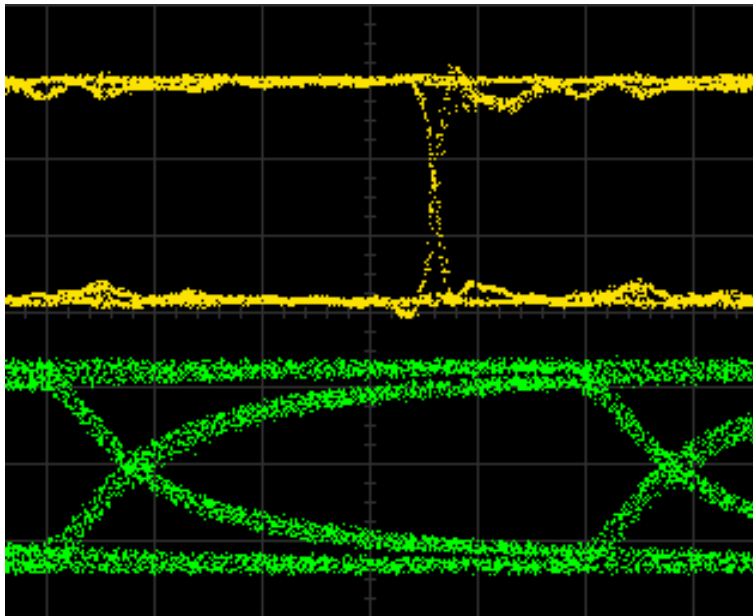
1.5GB/s



3.5GB/s

# 1Gb/s vs 3Gb/s

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# 1m vs 2m

