ADVANCED INTERCONNECTIONS®

1.27mm Pitch
B2B® SMT Connector
6.00mm Mated Height

SIGNAL INTEGRITY SIMULATION AND MODELING

Rev. 1

www.advanced.com

ISO 9001

Advanced Interconnections Corp.
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Signal Integrity Data Reporting

At Advanced Interconnections Corporation, our Signal Integrity reporting method differs dramatically from the common industry practice of isolating the *aggressor* and *victim* terminals from each other by introducing dedicated ground terminals between them. We believe this method represents a theoretical, best-case, scenario that does not serve the needs of most systems engineers and circuit designers. An unrealistic number of connector terminals must be assigned to ground in order to achieve this scenario.

Our standard reporting practice is closely aligned with the decision-making processes of most systems engineers and circuit designers. The reported data addresses our customers I/O assignments (net-list) and helps them determine where to best run high-versus-low frequency signals through our connectors. As such, our reporting method represents a more practical net-list scenario. Utilizing our unbiased SPICE™ and IBIS™ files, system designers are able to create and/or debug their net-list quickly and accurately.

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ADVANCED INTERCONNECTIONS.

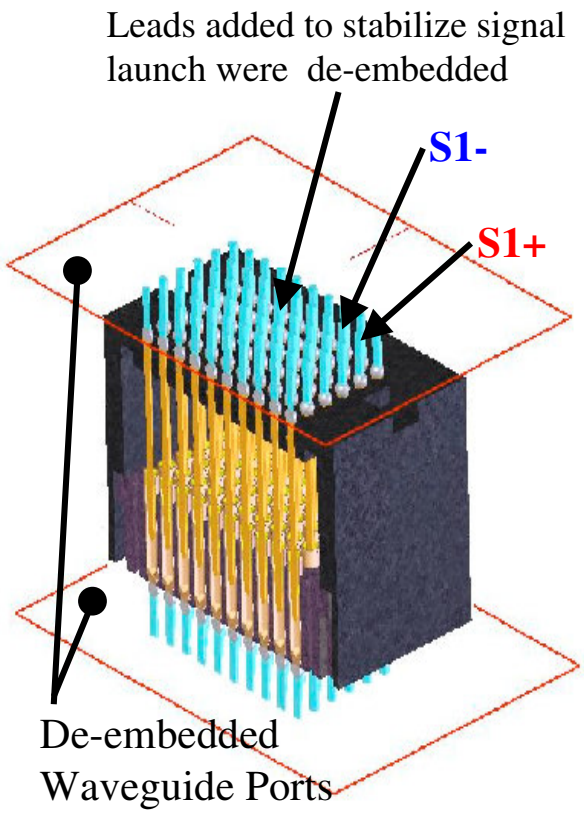
SI Modeling & Simulation Study

Simulation Setup

- The 1.27mm pitch, 6mm stack height was setup in a Agilent ADS Multi-Layer Library.
- A pin-out of 3 rows and 4 columns was assigned from a 4x4 array:

GND	GND	GND	GND
S1+	S1-	S2+	S2-
GND	GND	GND	GND

- A total of 12 sections were implemented, six for the female receptacle and six for the male pin.
  - Each section was implemented using 3 separate horizontal rows, which then were combined together into the 3x4 array using the ADS "combine 3 into 1" element.
  - The material properties of the plastic bodies were as follows:
    - Male: Er = 3.7, Loss Tan = 0.005; and Female: Er = 3.2, Loss Tan = 0.009.
    - Air was defined as Er = 1, Loss Tan = 0.
  - The Effective Er (composite value = plastic + air) of *Receptacle_plastic_2* was calculated to be Eff_Er = 2.75, Loss Tan = 0.005.



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SI Modeling & Simulation Study

Simulation Results

The test and measurement tasks were completed and the recommended Operational Bandwidth for the Socket Adapter System is as follows:

- Differential: DC to 1.7 GHz @ -15dB and ~1.1 to 1.8 Gbit/sec.
- Differential: DC to 3.3 GHz @ -10dB and ~2.1 to 3.5 Gbit/sec.
- Single-ended: DC to 2.7 GHz @ -15dB and ~1.7 to 2.9 Gbit/sec.
- Single-ended: DC to 5.9 GHz @ -10dB and ~3.8 to 6.3 Gbit/sec.

- At the above Bandwidths, Differential Impedance of this connector system is satisfactory and is attributed to the geometry of the female shell and the proximity of adjacent terminals. Single-ended Impedance is very favorable.

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SI Modeling & Simulation Study

Simulation Results– continued

- Differential Eye Diagrams were successfully formed at 5 Gbits/sec., with Jitter at 4psec and 8% eye closure.
  - ***The eye opening sustains a Data Mask with a voltage swing of ±175mV @ 100psec period.***

- Single-ended Eye Diagrams were successfully formed at 5 Gbits/sec., with Jitter at 6psec and 8% eye closure.
  - ***The eye opening sustains a Data Mask with a voltage swing of ±125mV @ 140psec period.***

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SI Modeling & Simulation Study

Simulation Results– continued

	Return Loss ($S_{\omega,\theta}$)	*Insertion Loss* ($S_{\phi,\beta}$)	*Zo @ 200 psec* (10-90%)
Differential *(Terminals S1+, S1-)*	*(S1,1) and (S2,2)* -15.0dB @ 1.7 GHz -10.0dB @ 3.3 GHz	*(S2,1)* -0.20dB @ 1.7 GHz -0.50dB @ 3.3 GHz	**83.5Ω**
Single-ended *(Terminals S1+)*	*(S1,1) and (S2,2)* *-15.0dB @ 4.1 GHz* *-10.0dB @ 7.4 GHz*	*(S2,1)* *-0.35dB @ 4.1 GHz* *-0.75dB @ 7.1 GHz*	**46.5Ω**
Single-ended *(Terminals S1-)*	*(S3,3) and (S4,4)* *-15.0dB @ 2.7 GHz* *-10.0dB @ 5.85 GHz*	*(S4,3)* *-0.35dB @ 2.7 GHz* *-1.00dB @ 5.85 GHz*	**45.0Ω**

- A *Return Loss* at -15dB (~18% *Reflection*) is the normally accepted industry standard. Most applications will tolerate data at -10 dB (~32% *Reflection*), however in this instance, performance safety margins may be increased by *de-rating* the connectors Operational Bandwidth and Data Rate.
- A *Insertion Loss* at -3dB (~50% of applied Power & ~71% of applied Voltage arrives at the Output Port) is the normally accepted industry standard.
- An Effective Impedance of 100Ω ±10Ω for Differential and 50Ω ±5Ω for Single-ended is the normally accepted industry guideline. De-rating the signal input risetime will improve the above Zo values.

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ADVANCED INTERCONNECTIONS.

SI Modeling & Simulation Study

Simulation Results– continued

	NeXT @ 200 psec (10-90%)	*FeXT @ 200 psec (10-90%)*	*Eye-Diagram @ 5 Gbit/sec*	*Eye-Diagram @ 5 Gbit/sec with 6 Gbit/sec Aggressor*
Differential ***(Terminals S1+, S1-)***	**1.7%**	**0.88%**	**Peak-to-Peak Jitter = 3 psec Eye-Closure = 6%**	**Peak-to-Peak Jitter = 4 psec Eye-Closure = 8%**
Single-ended ***(Terminals S1-)***	**4.25%**	**1.4%**	**Peak-to-Peak Jitter = 2 psec Eye-Closure = 3%**	**Peak-to-Peak Jitter = 6 psec Eye-Closure = 8%**

- **A *NeXT* at 5% maximum is the normally accepted industry standard. Shown above are worst case values for unshielded adjacent terminals. Under these conditions the NeXT differential results are very favorable and the single-ended NeXT results are favorable .**

- **A *FeXT* at 2% maximum is the normally accepted industry standard. Shown above are worst case values for unshielded adjacent terminals. Under these conditions differential FeXT results are very favorable and the single-ended FeXT results are favorable.**

- **A successful Eye-opening was created at 5 Gbit/sec and is *very favorable* as this data rate is well within the Operational Bandwidths recommended for this connector system. See note below.**

NOTE: The connector's transmit Data Mask can be defined to quantify the effective performance of the eye formation. For a Differential data mask, the total voltage equals 35% of the eye's applied *peak-to-peak* voltage, (1V in this report), and its period equals 50% of the Eye Interval, (200psec in this report). For a Single-ended data mask, the total voltage equals 50% of the eye's applied *peak-to-peak* voltage, (500mV in this report), and its period equals 70% of the Eye Interval, (200psec in this report). The Eye Interval = 1/Eye Data Rate = 1/5E9 = 200psec in this report. Normally, Maximum allowable Jitter = 5% and Maximum allowable Eye-Closure = 12%.

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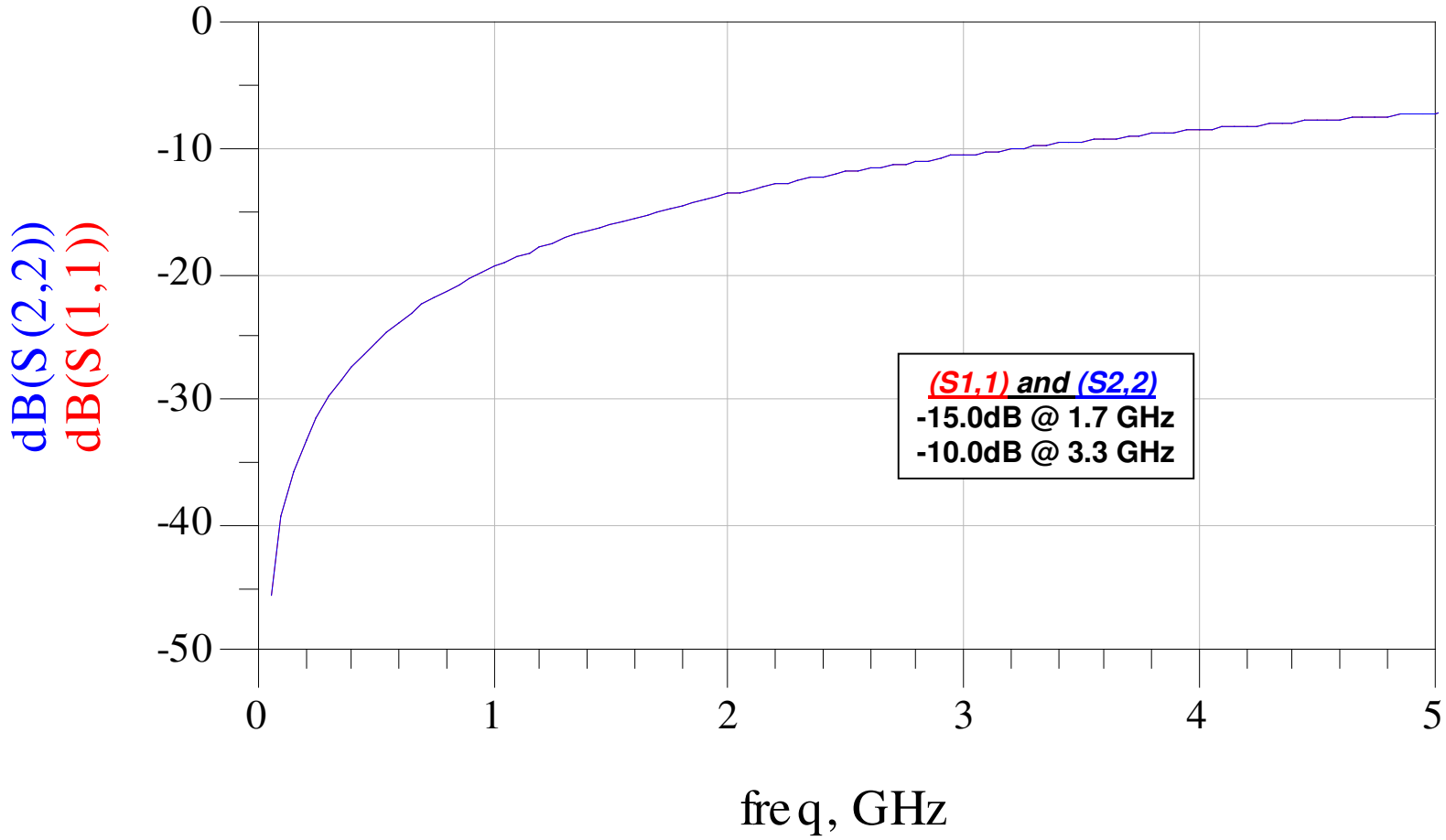
ADVANCED INTERCONNECTIONS.

Differential Return Loss

Plot Range: DC to 5 GHz



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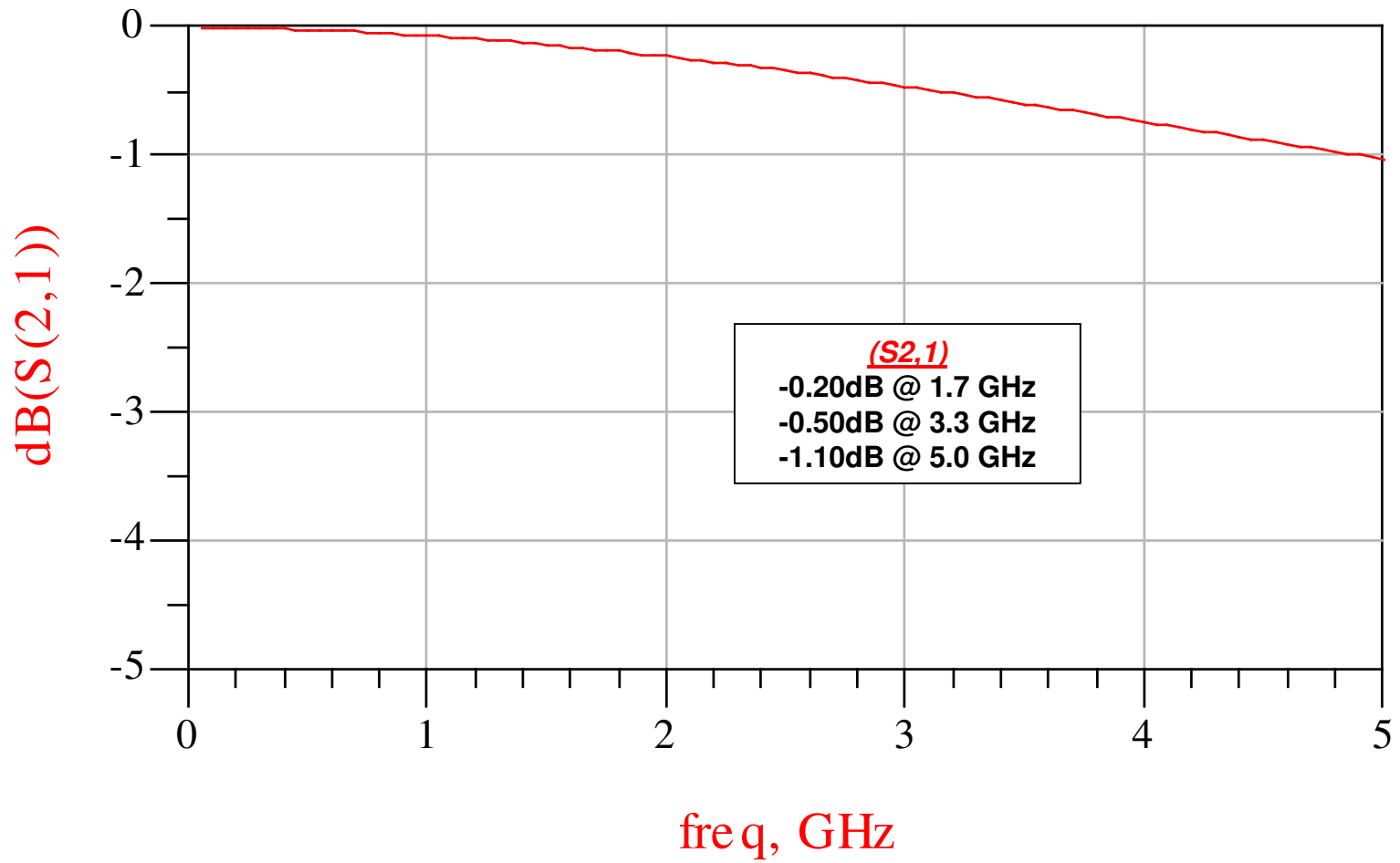
ADVANCED INTERCONNECTIONS.

Differential Insertion Loss

Plot Range: DC to 5 GHz



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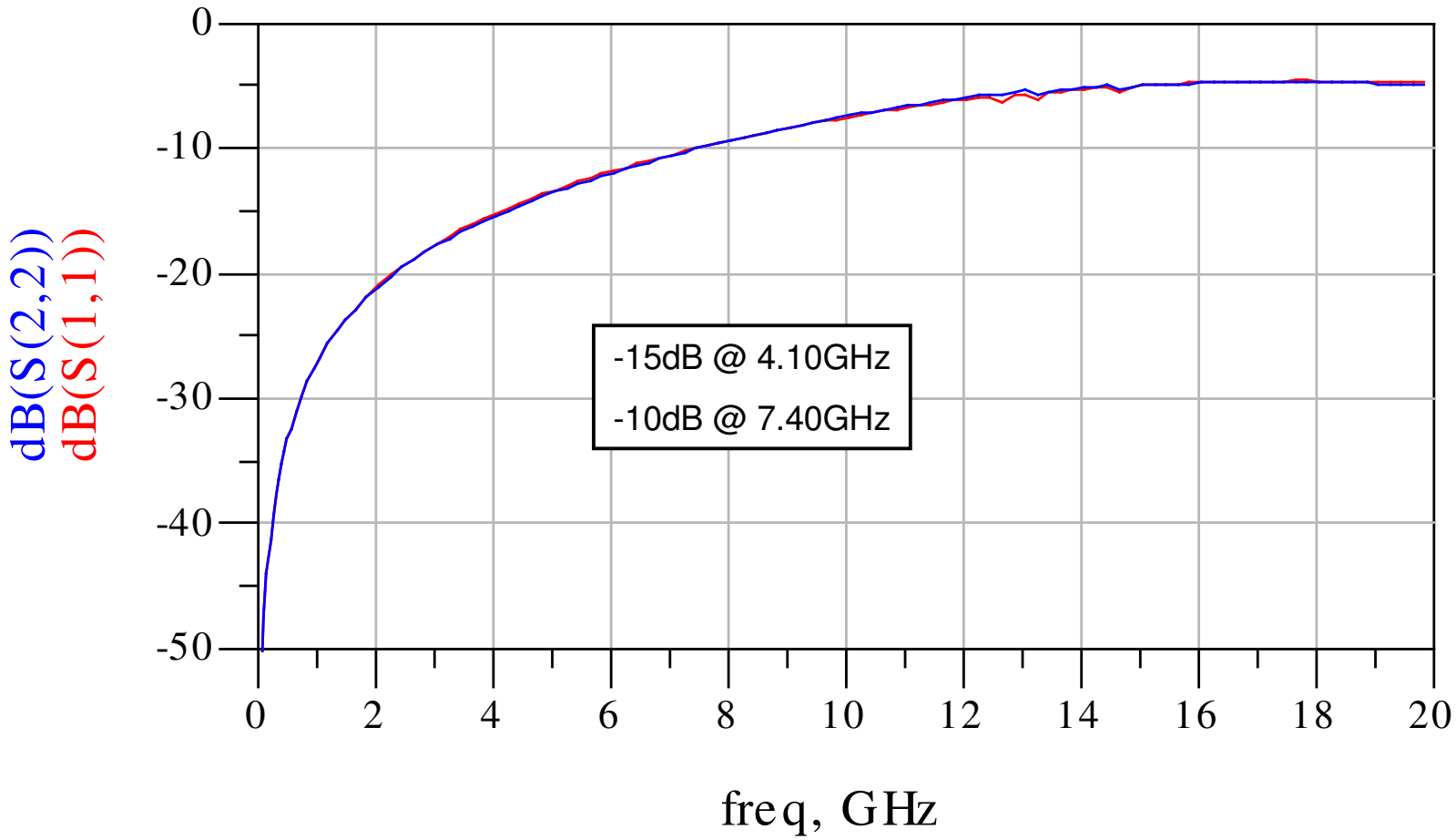
Single-ended Return Loss for S1+

Plot Range: DC to 20 GHz



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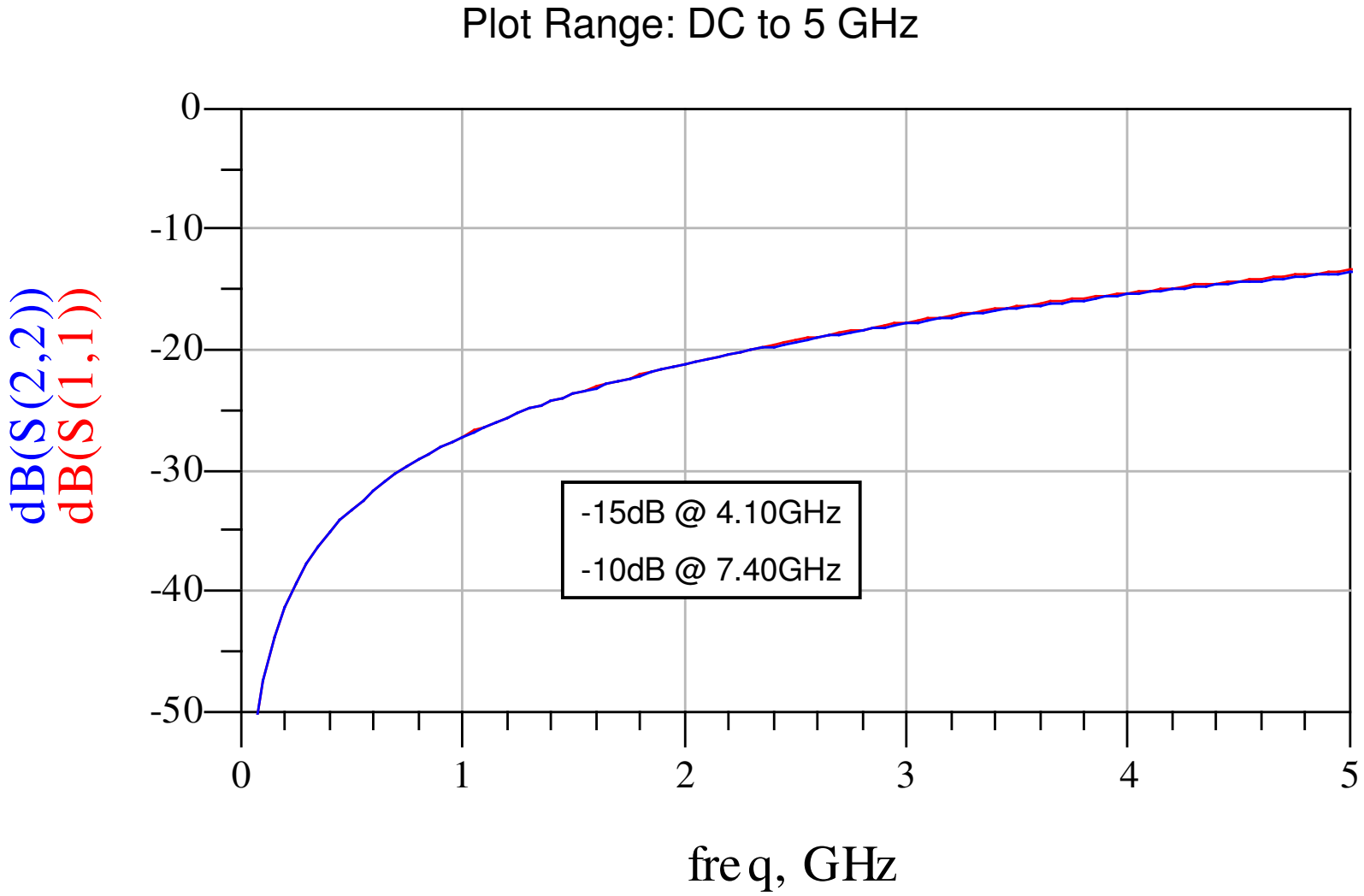
ADVANCED INTERCONNECTIONS.

Single-ended Return Loss for S1+



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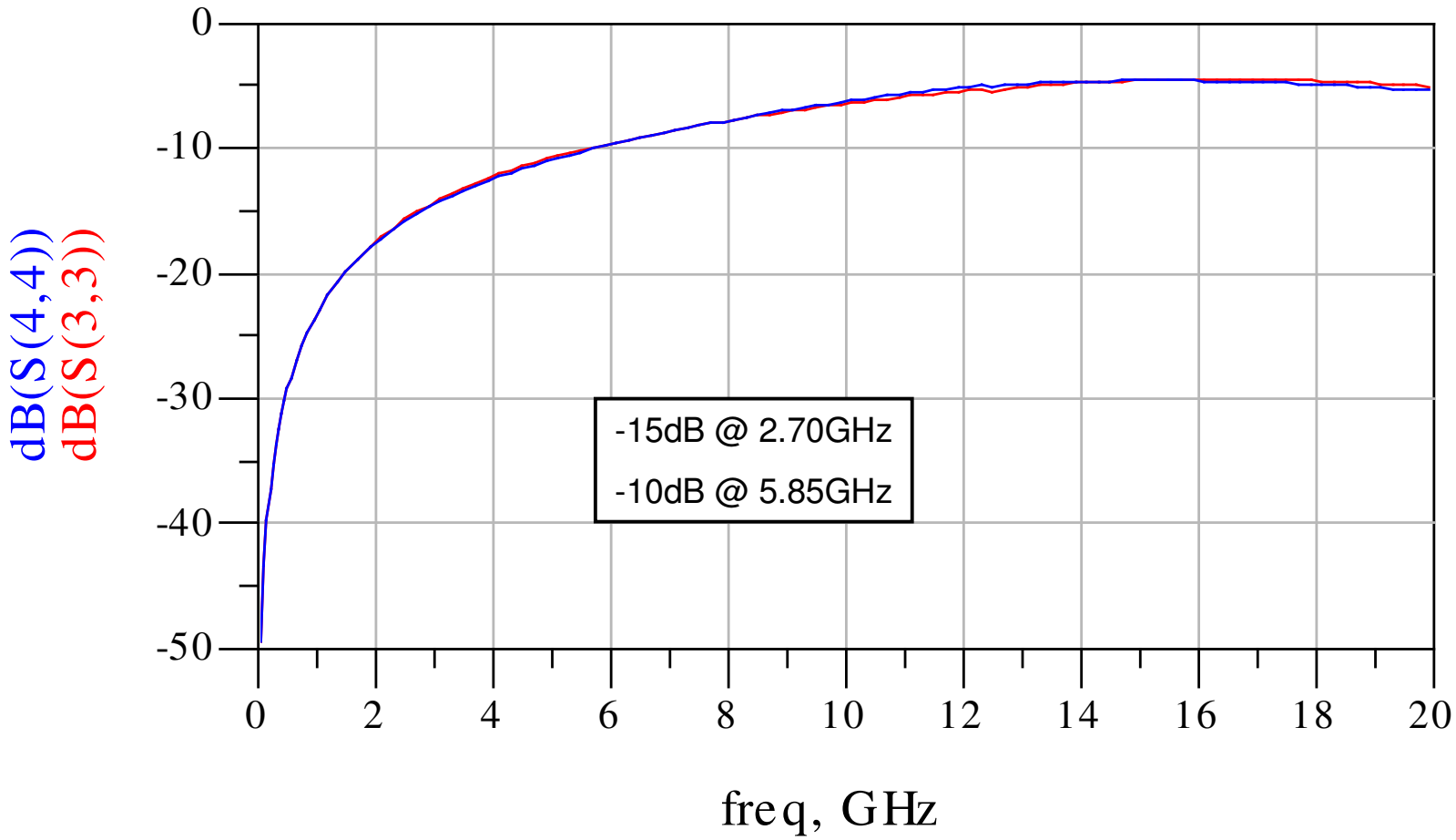
ADVANCED INTERCONNECTIONS.

Single-ended Return Loss for S1-

Plot Range: DC to 20 GHz



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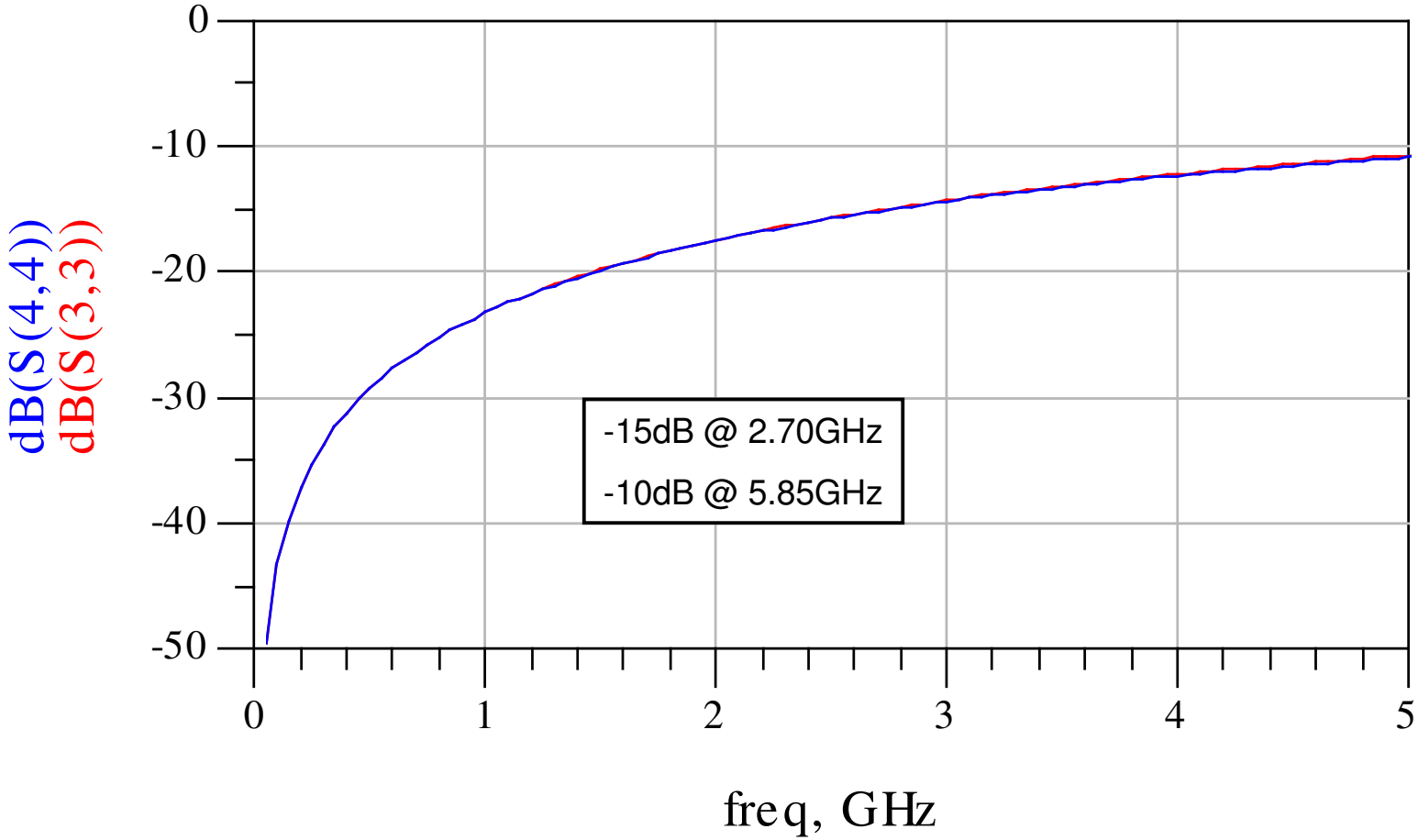
Single-ended Return Loss for S1-

Plot Range: DC to 5 GHz



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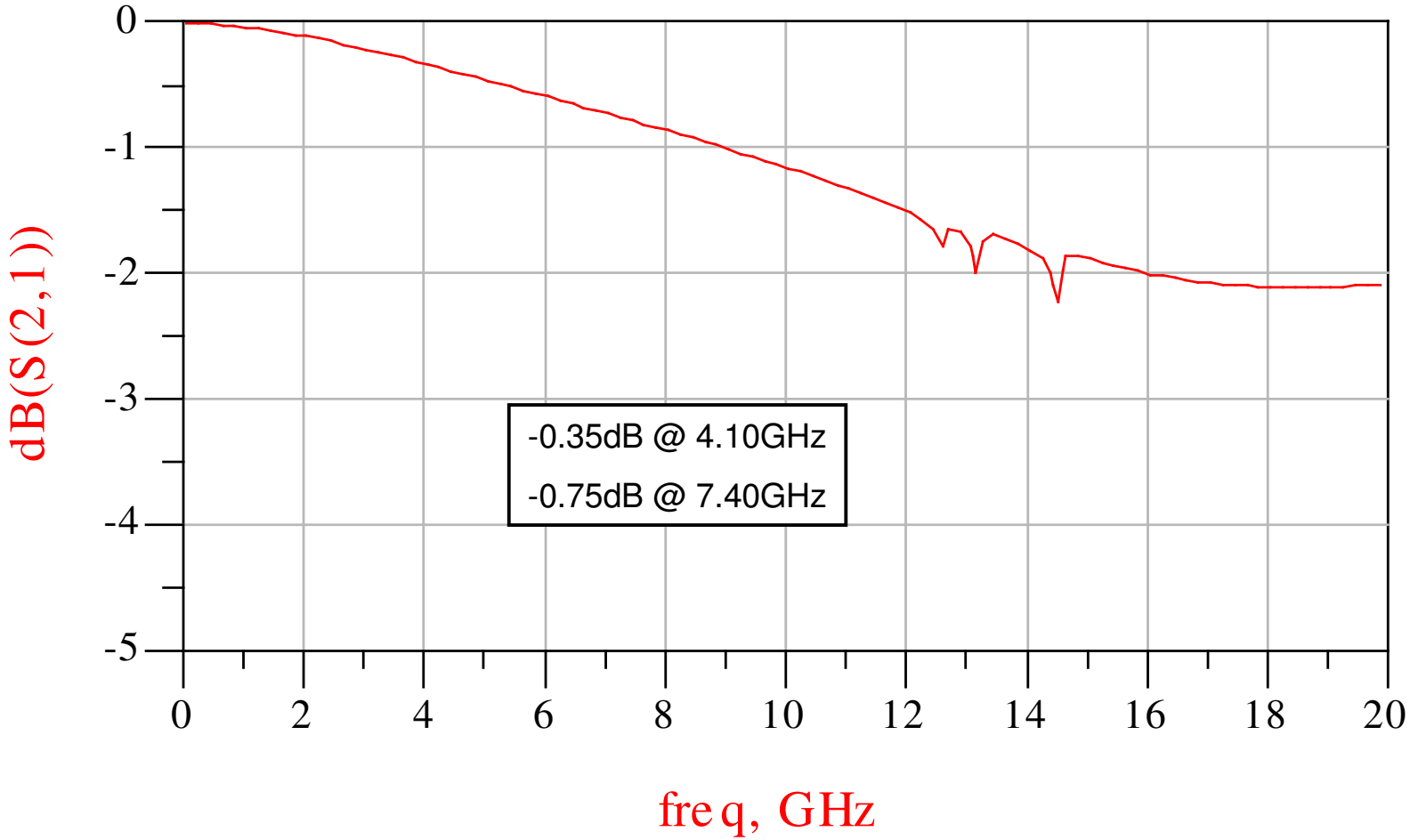
Single-ended Insertion Loss for S1+

Plot Range: DC to 20 GHz



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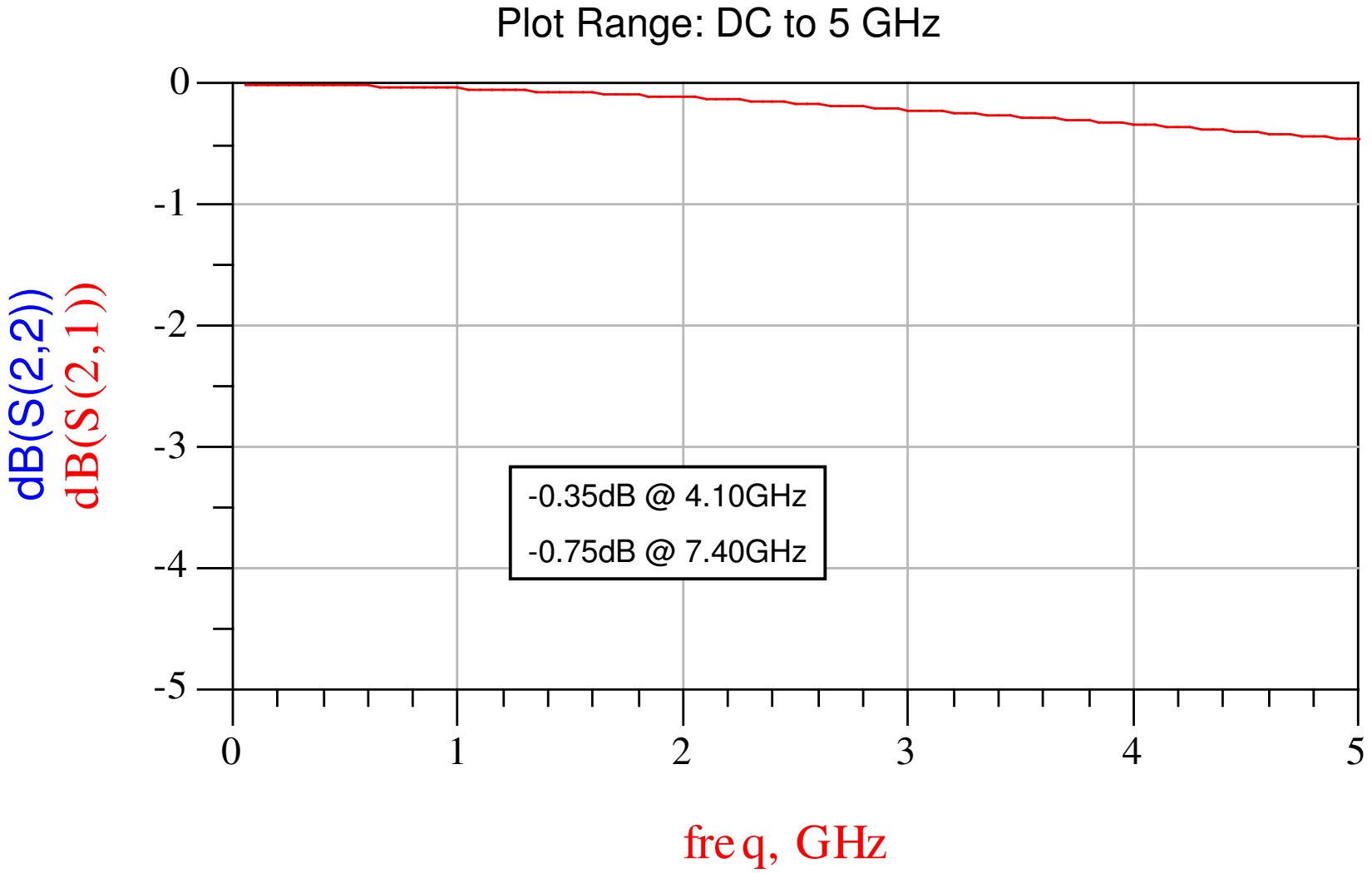
Single-ended Insertion Loss for S1+



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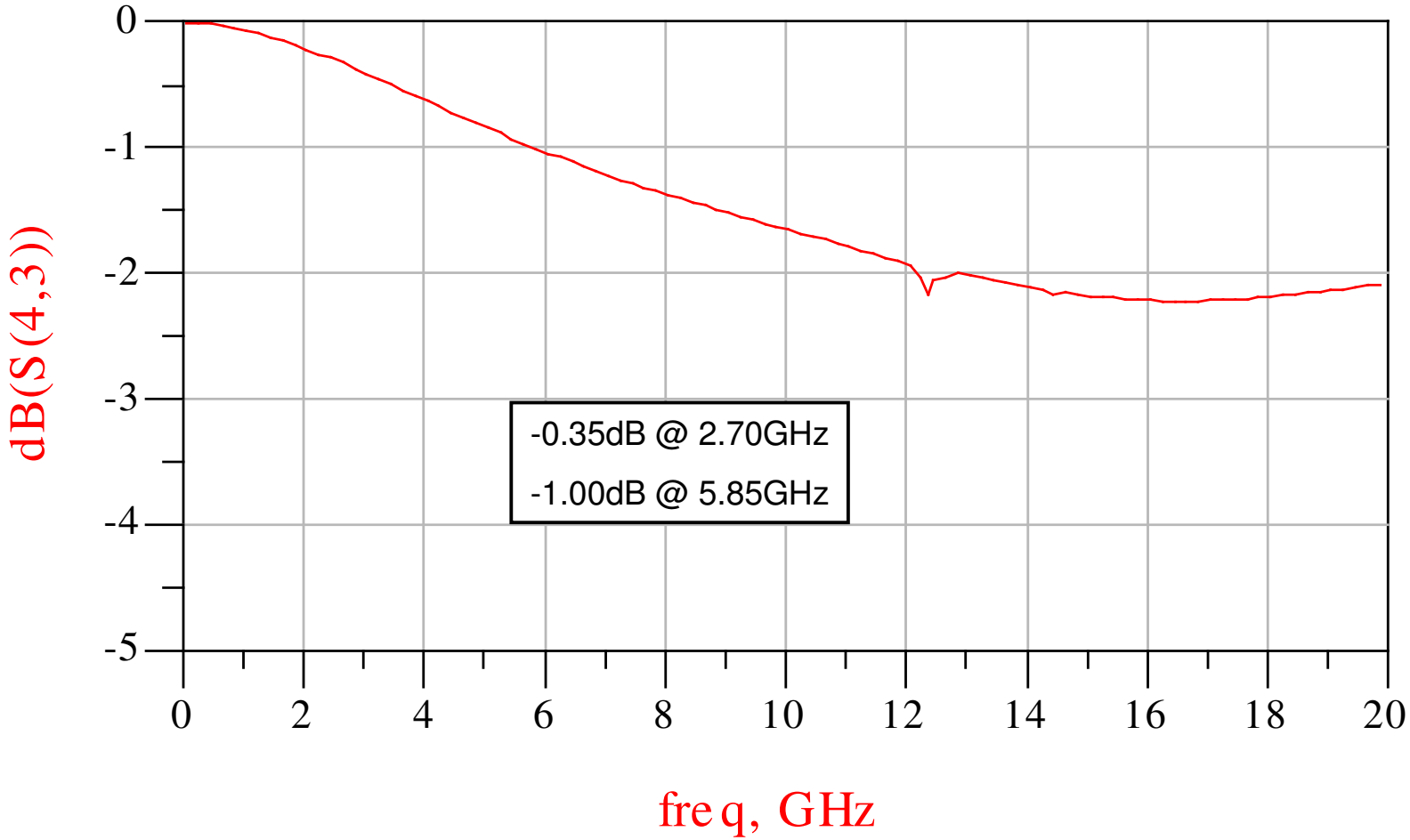
Single-ended Insertion Loss for S1-

Plot Range: DC to 20 GHz



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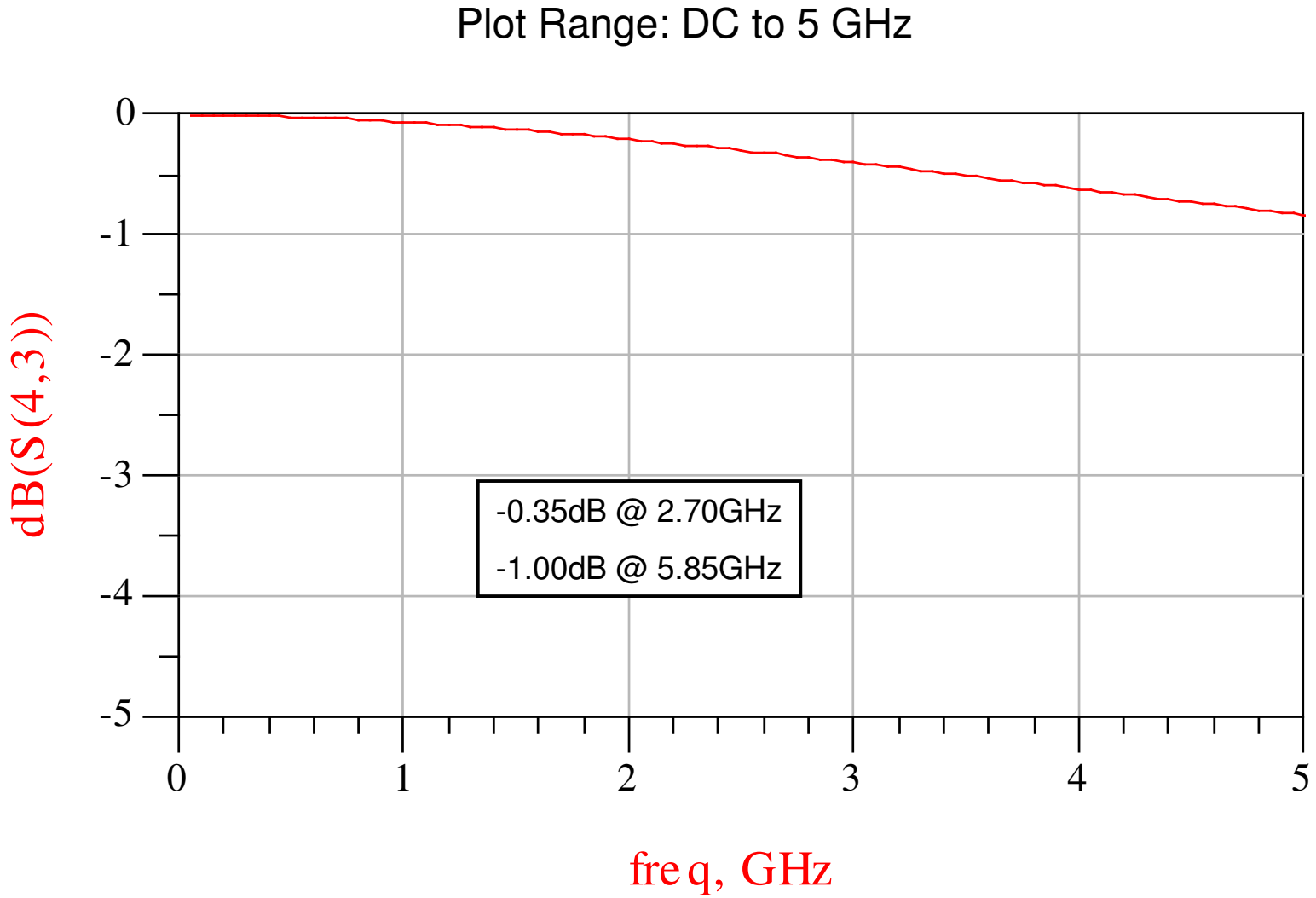
Single-ended Insertion Loss for S1-



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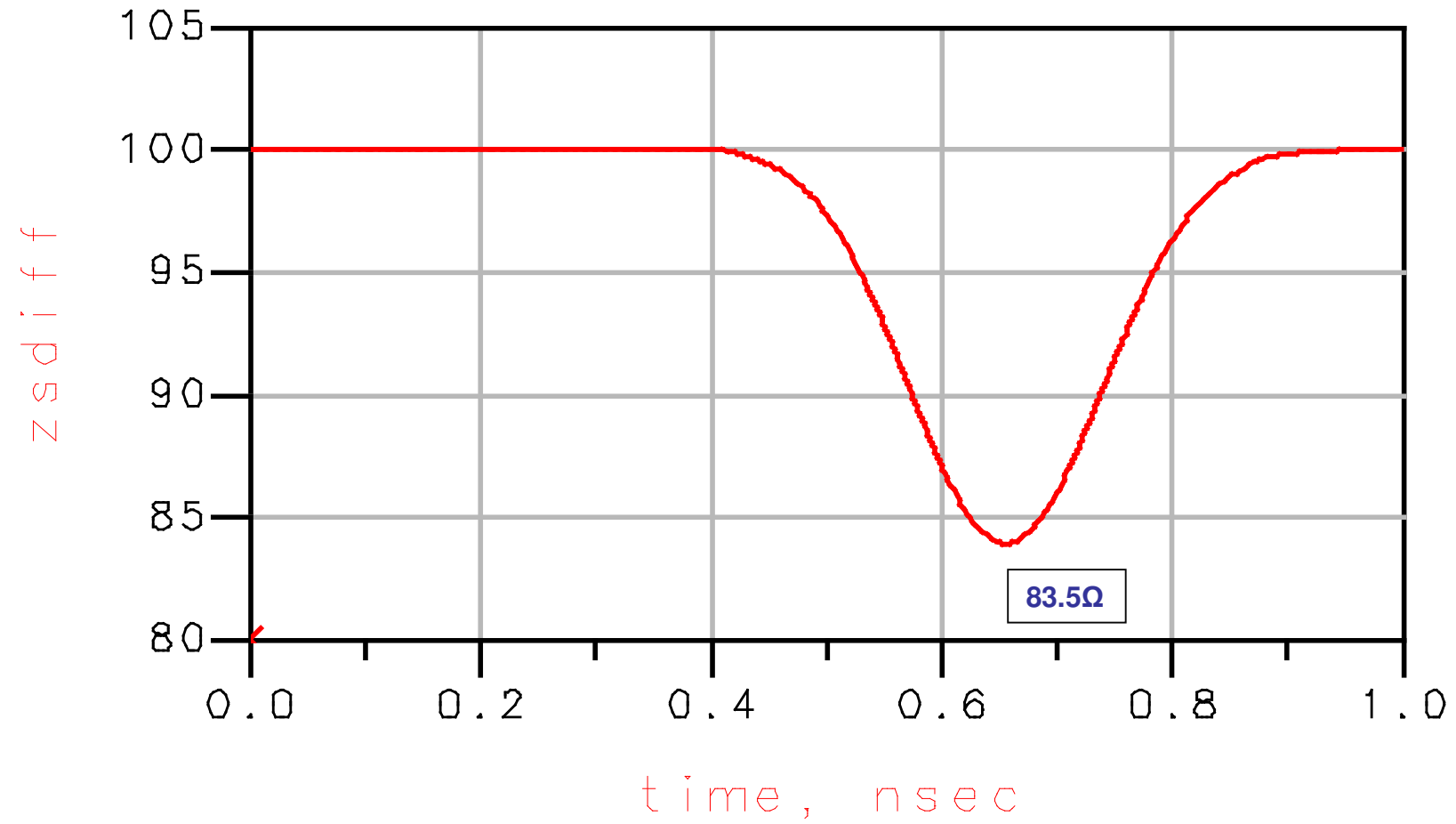
ADVANCED INTERCONNECTIONS.

Differential Impedance Profile

Simultaneous Plots at **200 psec** risetime (10-90%)



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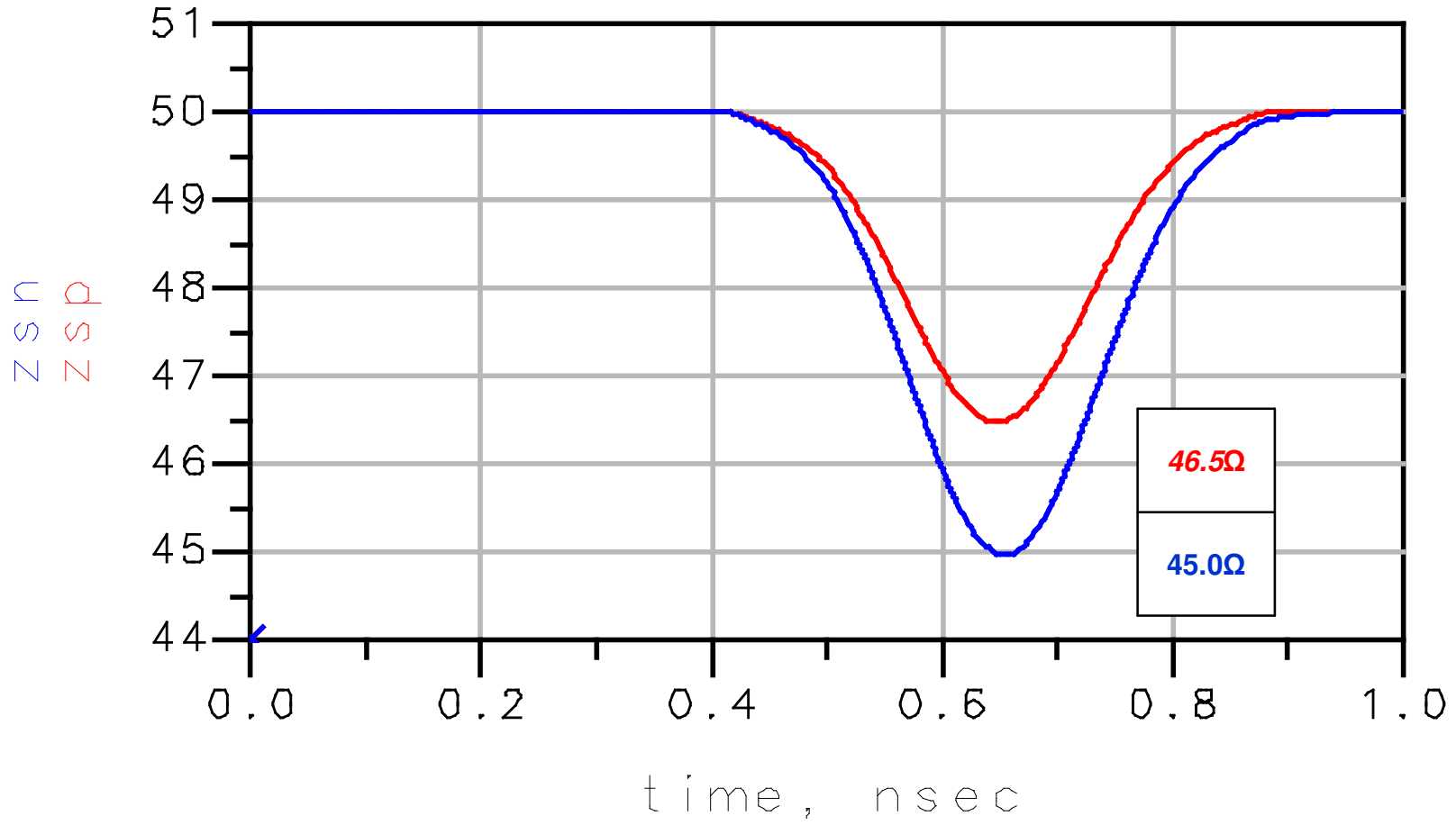
ADVANCED INTERCONNECTIONS.

Single-ended Impedance Profile for S1+ & S1-

Simultaneous Plots at **200 psec** risetime (10-90%)
S1+ (Zsp Edge Terminals) *vs.* S1- (Zsn Interior Terminals)



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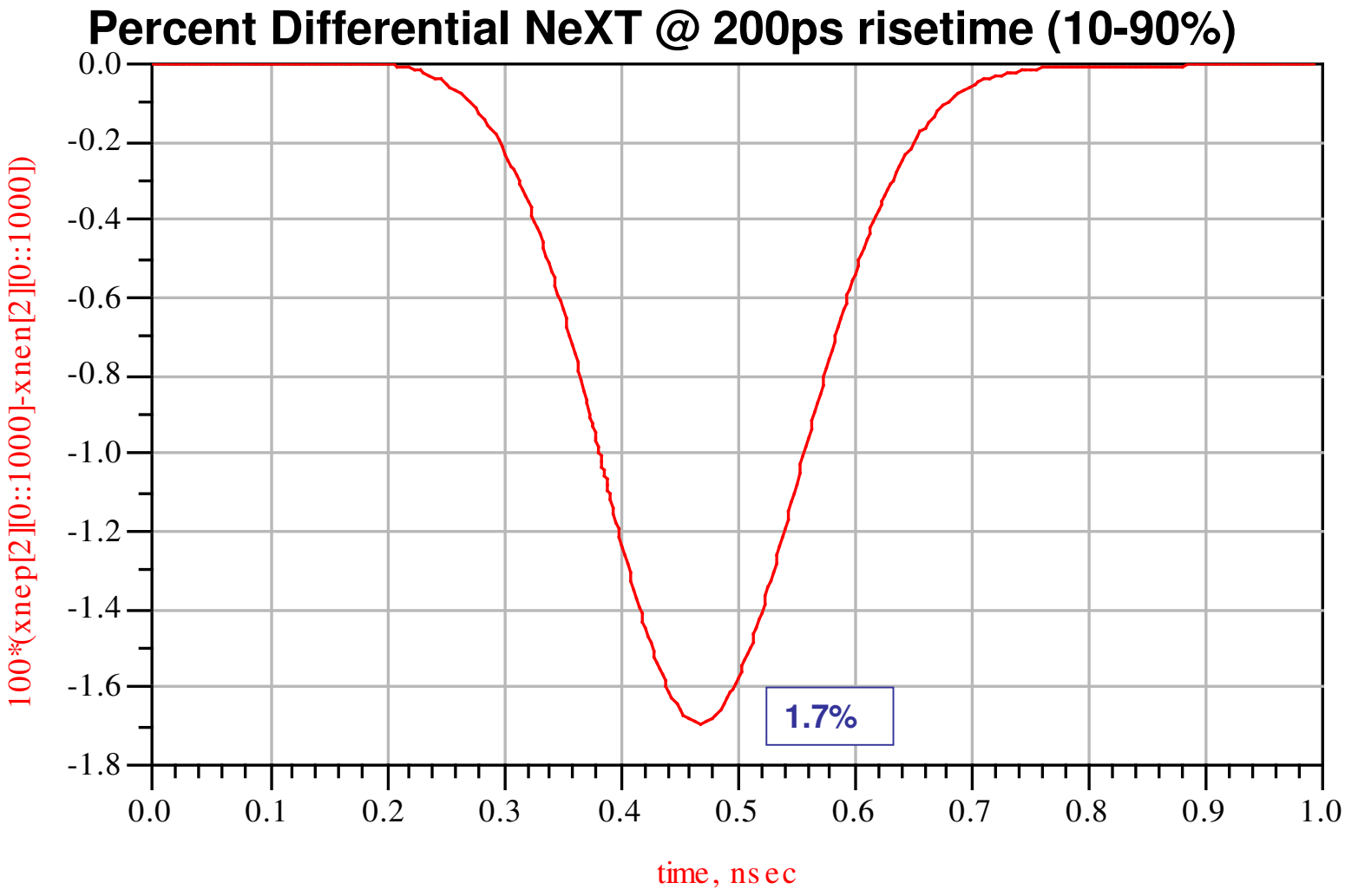
Differential Near-end Crosstalk (NeXT)



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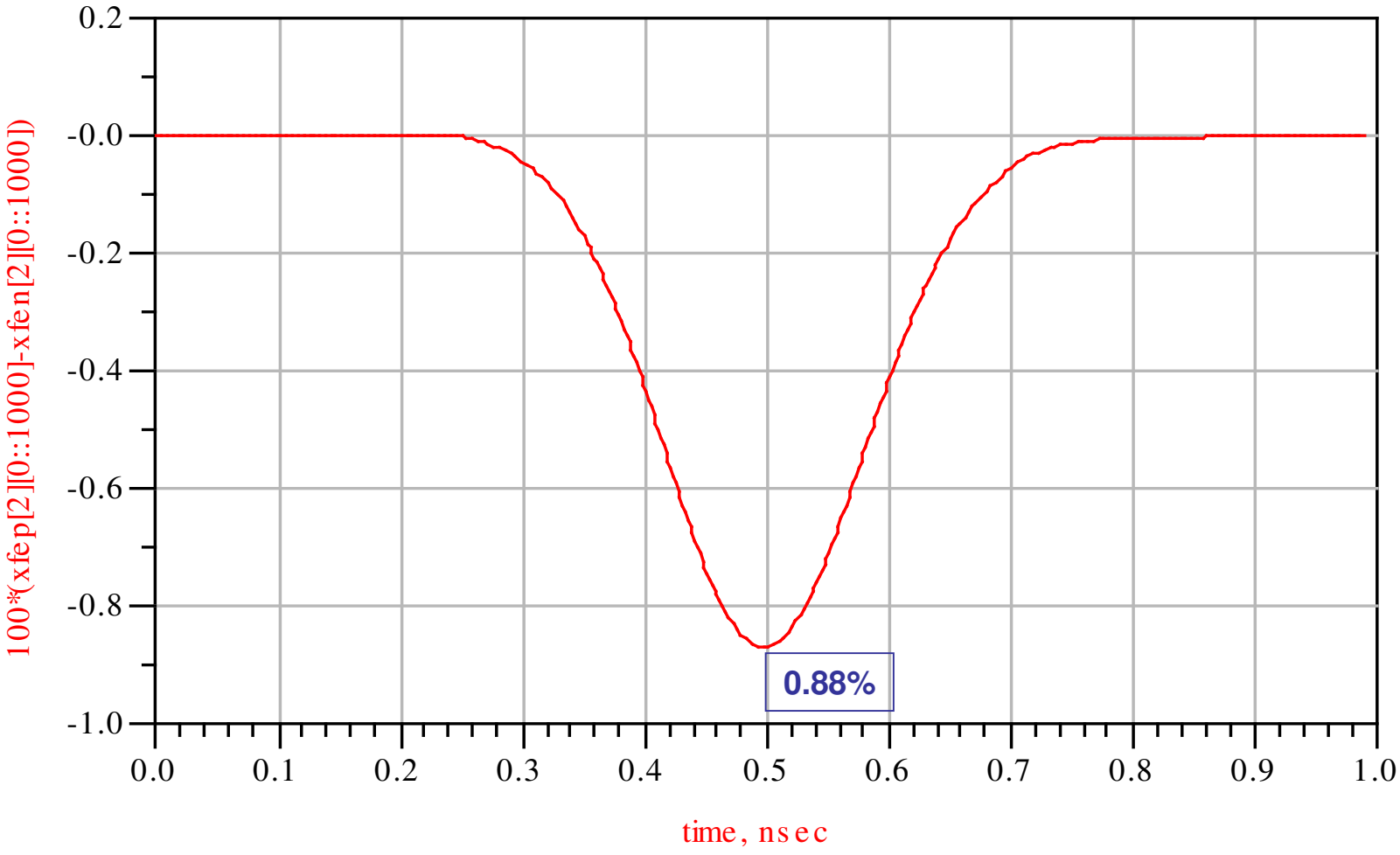
Differential Far-end Crosstalk (FeXT)

Percent Differential FeXT @ 200ps risetime (10-90%)



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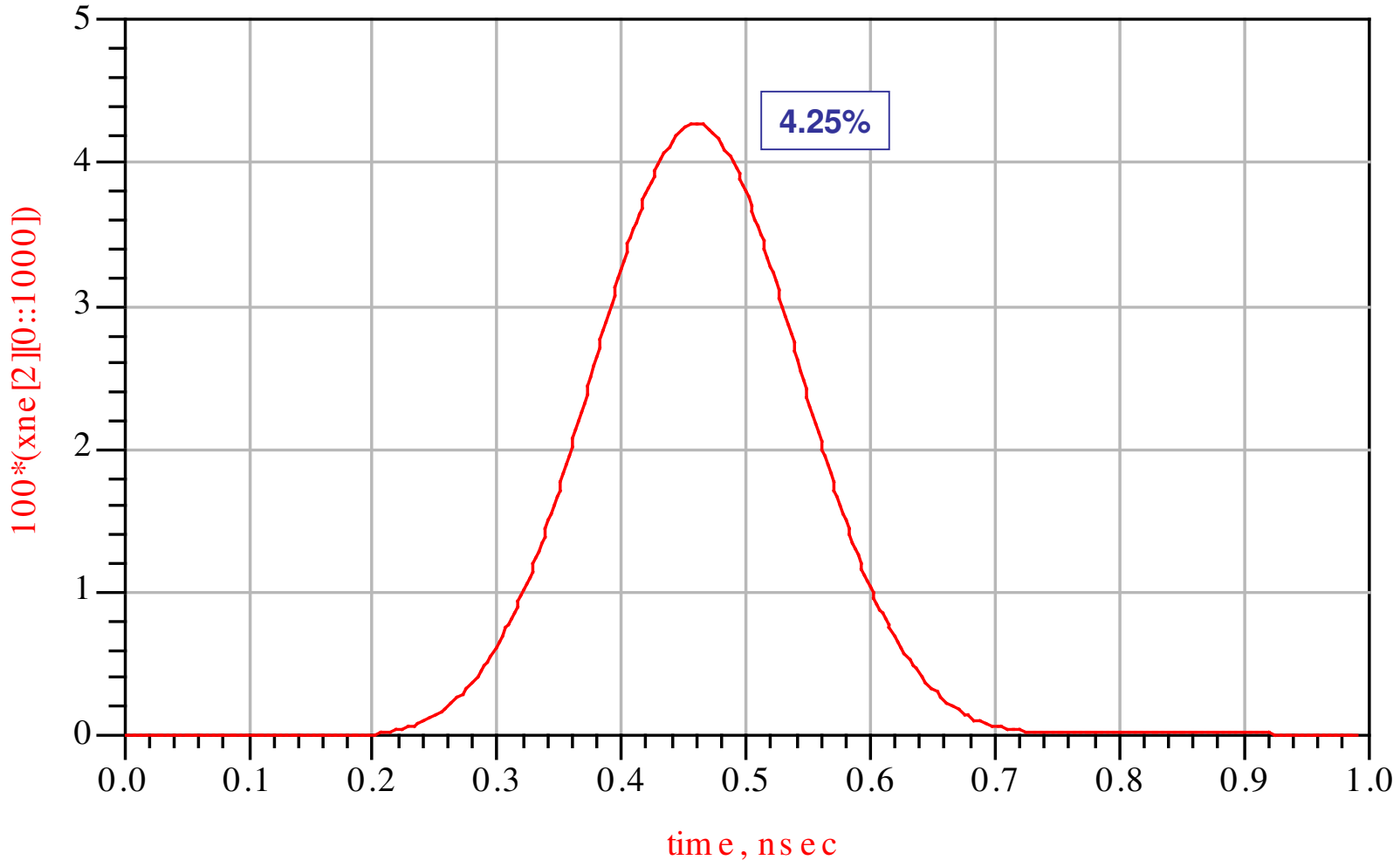
Single-ended Near-end Crosstalk (NeXT)

Percent Single-ended NeXT @ 200ps risetime (10-90%)



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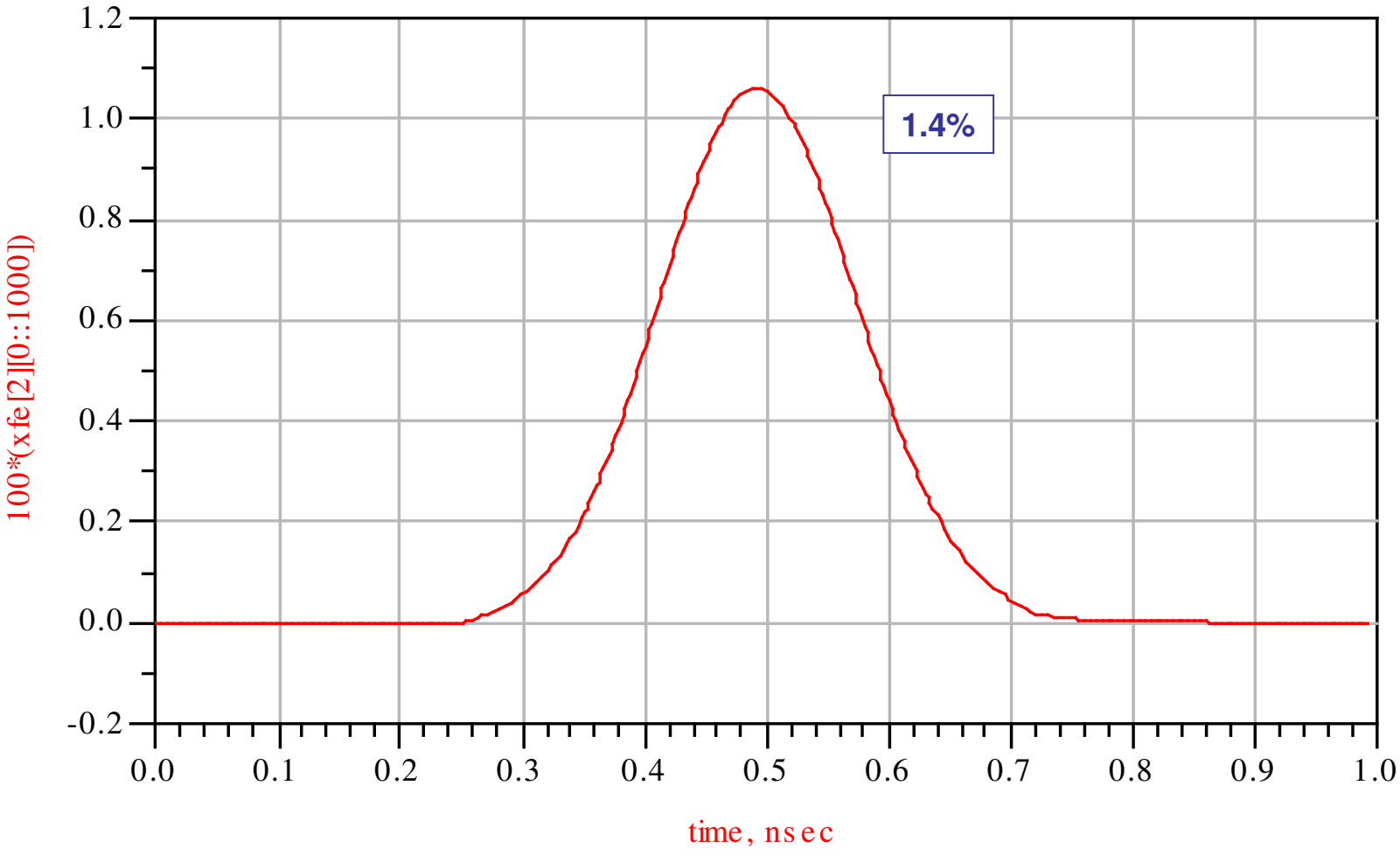
Single-ended Far-end Crosstalk (FeXT)

Percent Single-ended FeXT @ 200ps risetime (10-90%)



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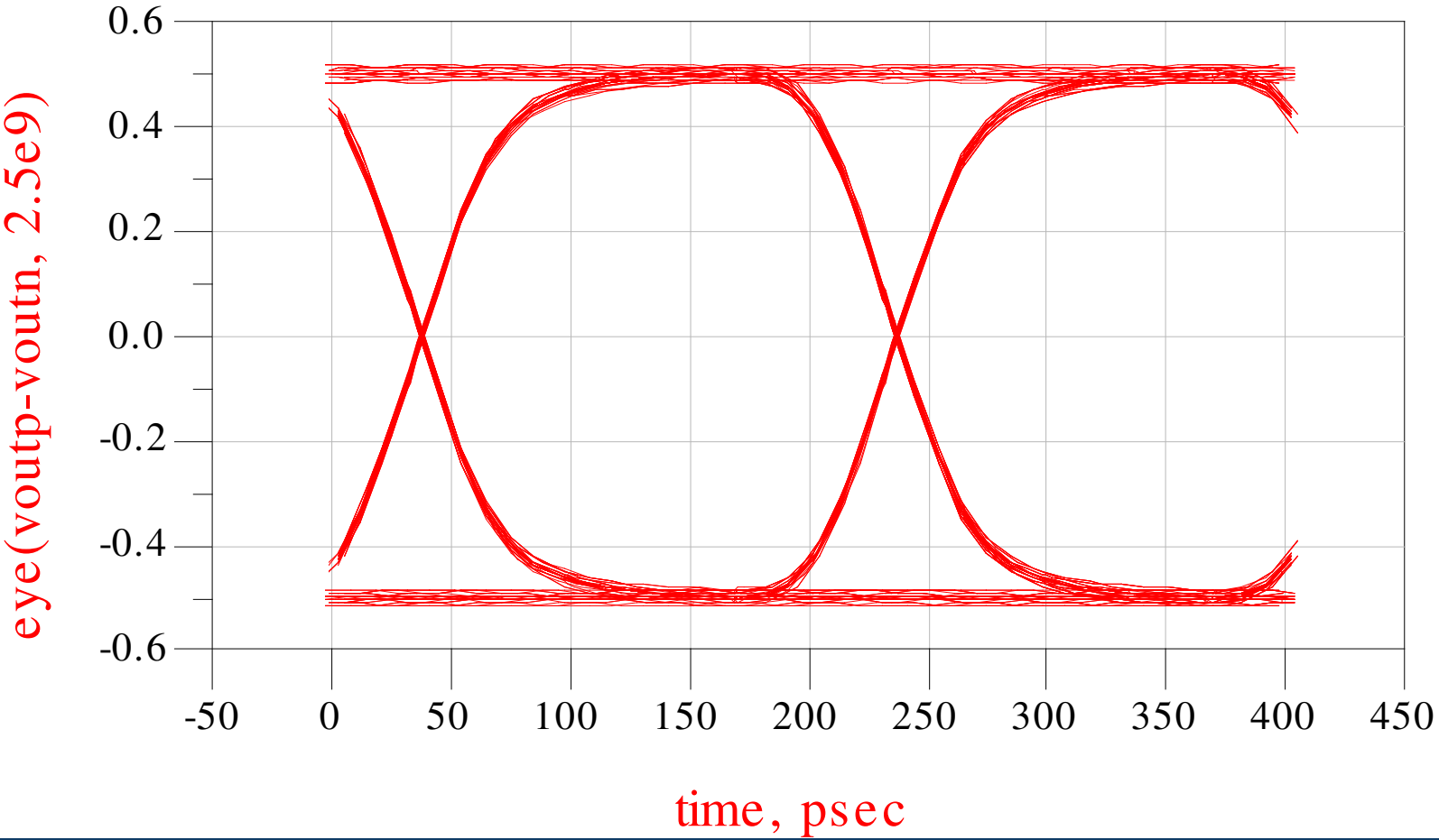
ADVANCED INTERCONNECTIONS.

Differential Eye-Diagram

Eye Opening @ 5 Gbit/sec.

Peak-to-peak jitter is 3 psec and Eye-Closure is 6%



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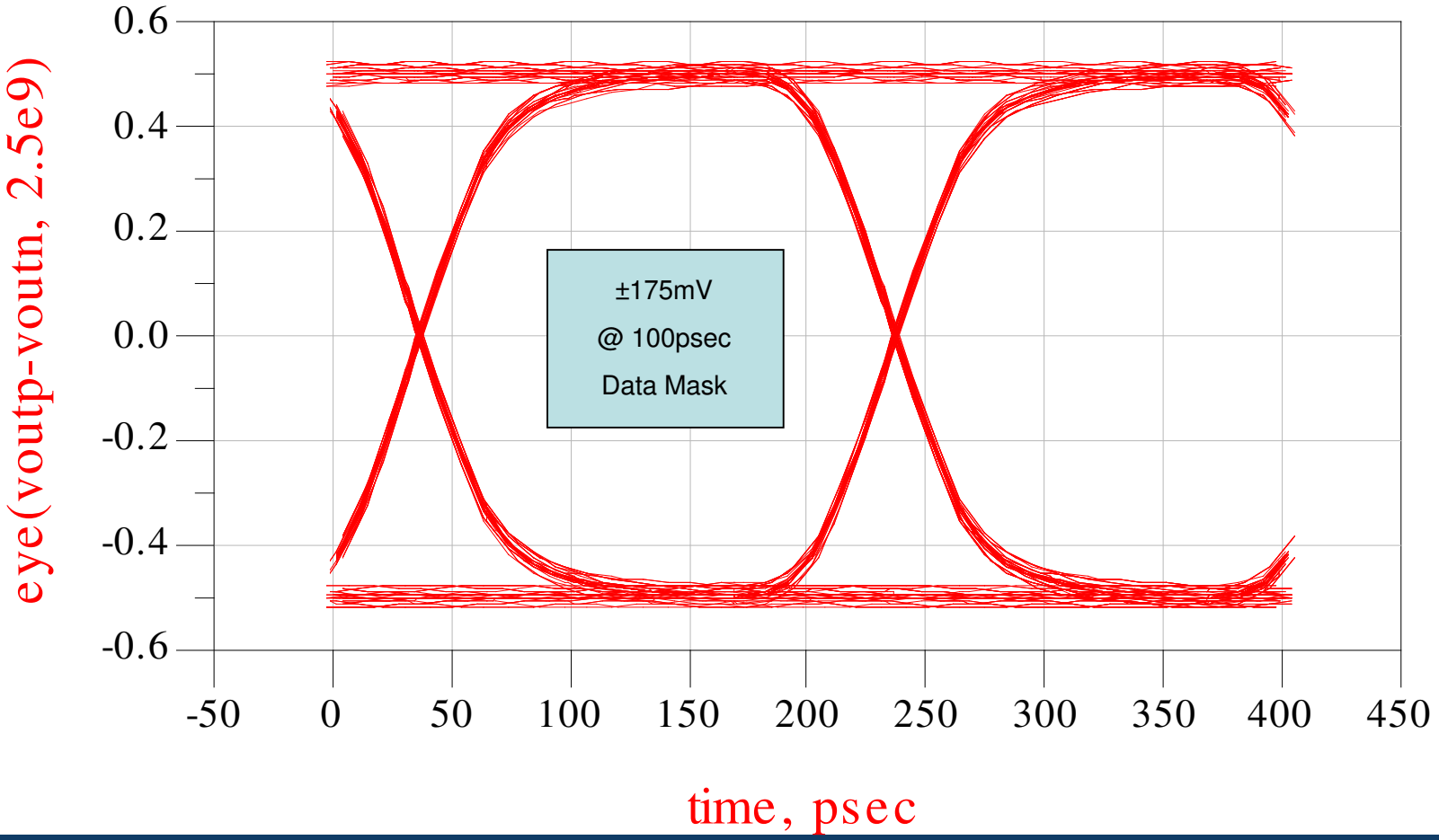
Differential Eye-Diagram w/Aggressor

Eye Opening @ 5 Gbit/sec with a 6 Gbit/sec Aggressor

Peak-to-peak jitter is 4 psec and Eye-Closure is 8%



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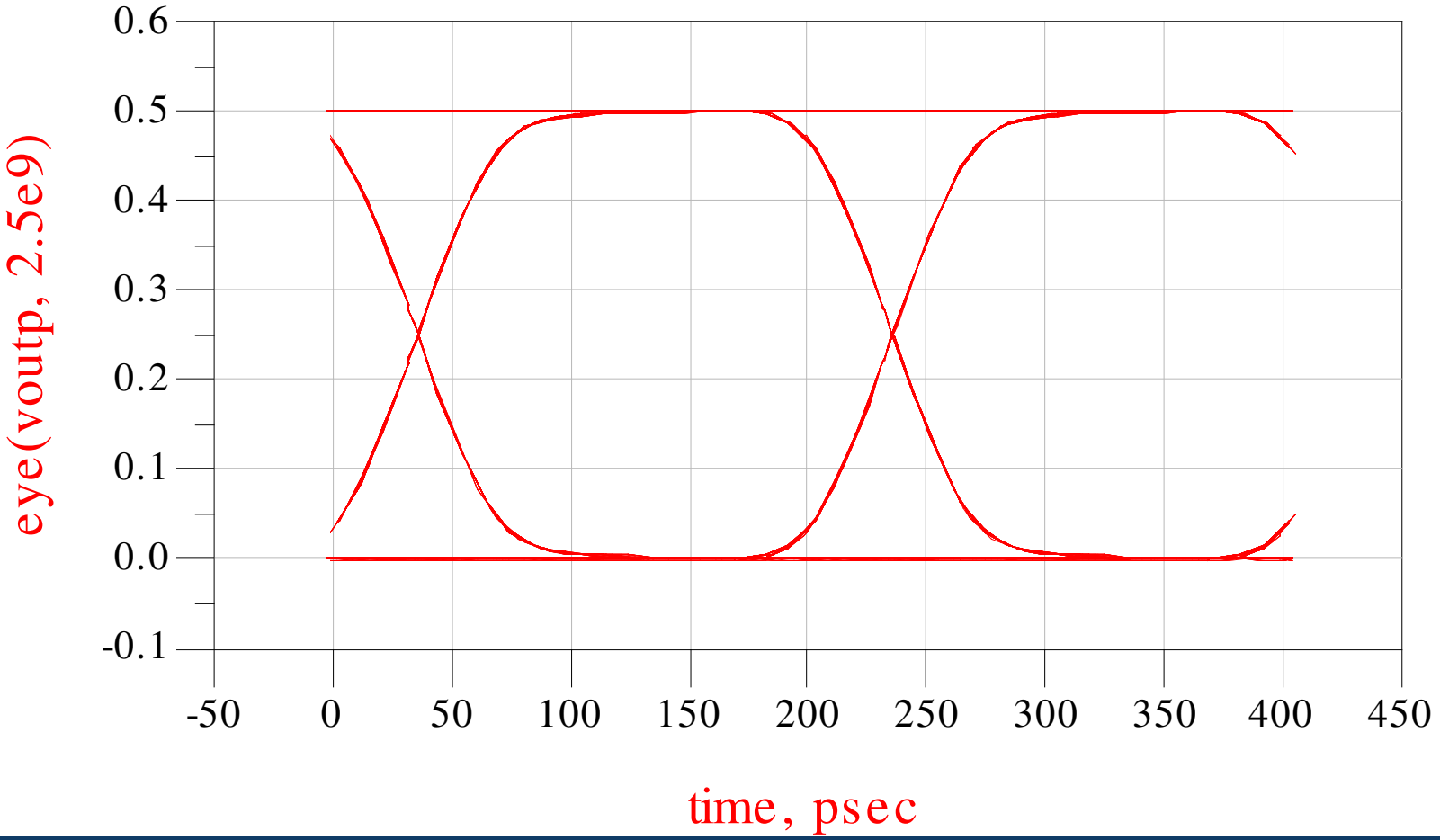
Single-ended Eye-Diagram

Eye Opening @ 5 Gbit/sec.

Peak-to-peak jitter is 2 psec and Eye-Closure is 3%



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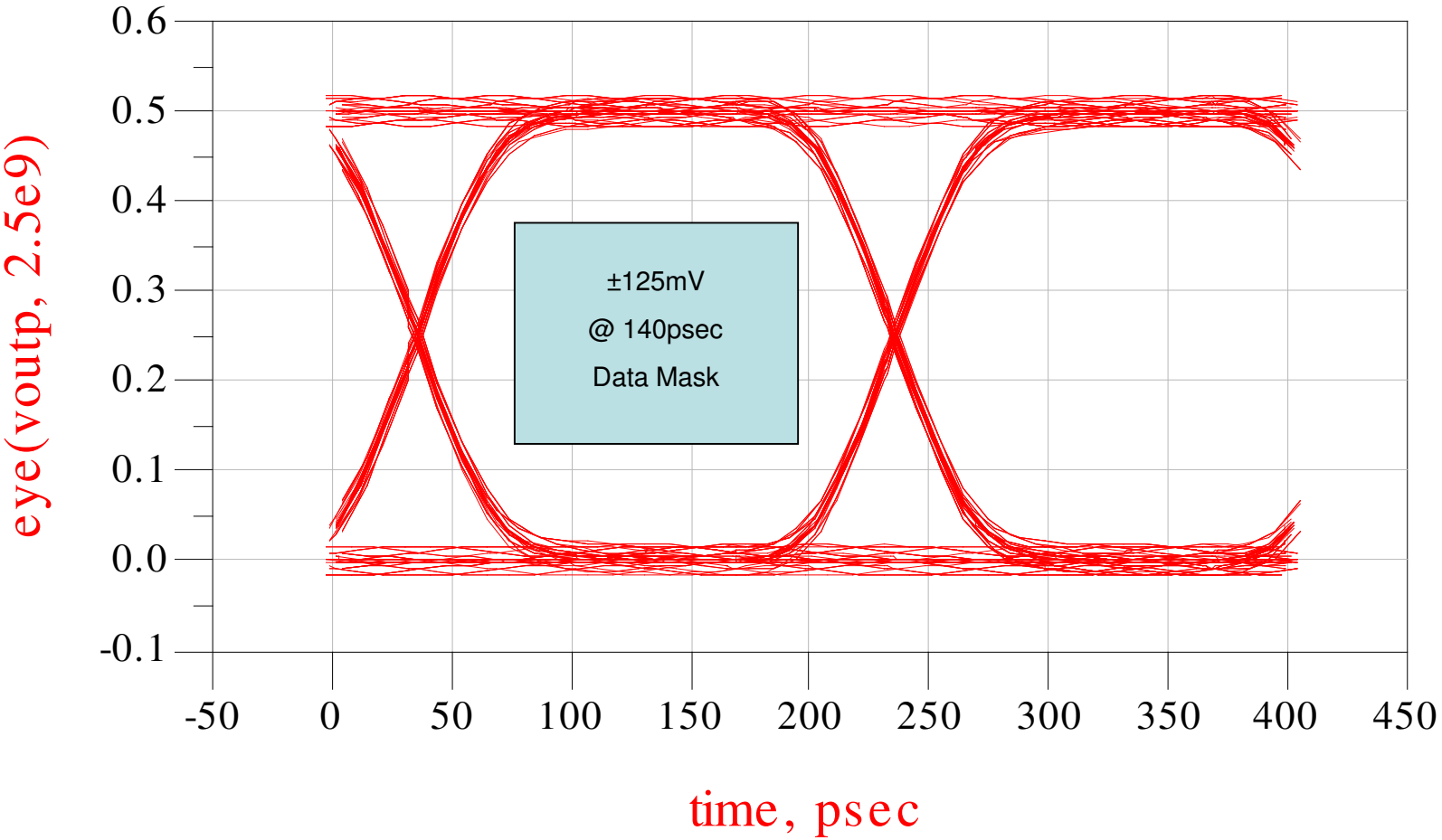
Single-ended Eye-Diagram w/Aggressor

Eye Opening @ 5 Gbit/sec with a 6 Gbit/sec Aggressor

Peak-to-peak jitter is 6 psec and Eye-Closure is 8%



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