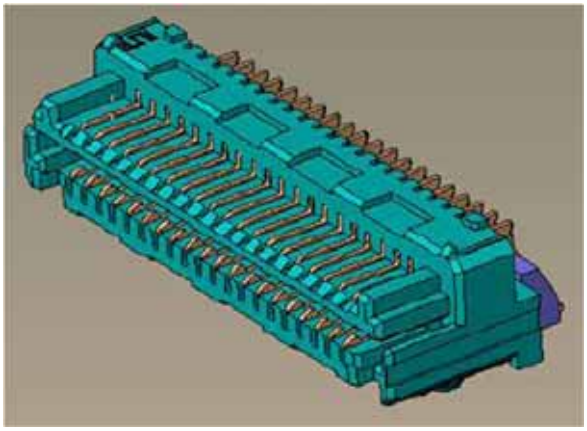
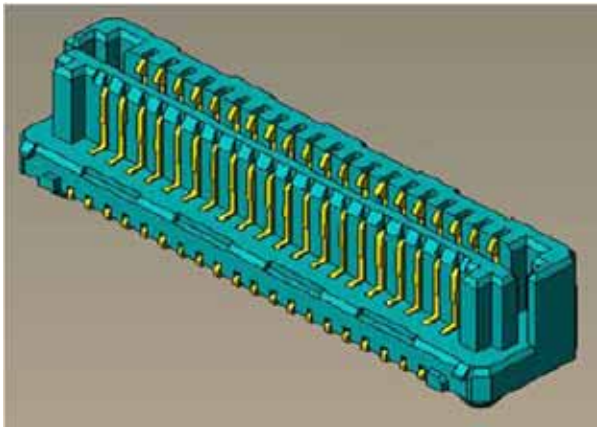
High Speed Characterization Report

LSEM-150-01-L-DH-A-N-TR



Mates with

LSEM-150-03.0-L-DV-A-N-TR



Description:

High Speed, Hermaphroditic Strip
Surface Mount, 0.8mm (.0315") Centerline
Right Angle to Vertical Orientation

Samtec Inc.
520 Park East Blvd.
New Albany IN 47151-1147 USA

WWW.SAMTEC.COM
1-800-SAMTEC-9 (US & Canada)
SIG@samtec.com
Phone: 812-944-6733
Fax: 812-948-5047
Report Revision: 3/16/2012

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Table of Contents

Connector Overview 1
Frequency Domain Data Summary 3
  Bandwidth Chart – Single-Ended & Differential Insertion Loss 5
Time Domain Data Summary 6
Characterization Details 10
  Differential and Single-Ended Data 10
  Connector Signal to Ground Ratio 10
  Frequency Domain Data 11
  Time Domain Data 12
Appendix A – Frequency Domain Response Graphs 13
  Single-Ended Application – Insertion Loss 13
  Single-Ended Application – Return Loss 13
  Single-Ended Application – NEXT Configurations 14
  Single-Ended Application – FEXT Configurations 15
  Differential Application – Insertion Loss 16
  Differential Application – Return Loss 16
  Differential Application – NEXT Configurations 17
  Differential Application – FEXT Configurations 18
Appendix B – Time Domain Response Graphs 19
  Single-Ended Application – Input Pulse 19
  Single-Ended Application – Impedance 20
  Single-Ended Application – Propagation Delay 21
  Single-Ended Application – NEXT, Worst Case Configuration 22
  Single-Ended Application – FEXT, Worst Case Configuration 23
  Single-Ended Application – NEXT, Best Case Configuration 24
  Single-Ended Application – FEXT, Best Case Configuration 25
  Single-Ended Application – NEXT, Across Row Configuration 26
  Single-Ended Application – FEXT, Across Row Configuration 27
  Differential Application – Input Pulse 28
  Differential Application – Impedance 29
  Differential Application – Propagation Delay 30
  Differential Application – NEXT, Worst Case Configuration 31
  Differential Application – FEXT, Worst Case Configuration 32
  Differential Application – NEXT, Best Case Configuration 33
  Differential Application – FEXT, Best Case Configuration 34
  Differential Application – NEXT, Across Row Case Configuration 35
  Differential Application – FEXT, Across Row Case Configuration 36
Appendix C – Product and Test System Descriptions 37

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Product Description 37
Test System Description 37
PCB-103257-TST-XX Test Fixture 37
PCB-103257-TST-XX PCB Layout Panel 38
PCB Fixtures 39
Calibration Board 43
Appendix D – Test and Measurement Setup 45
N5230C Measurement Setup 45
Test Instruments 45
Test Cables & Adapters 45
Appendix E - Frequency and Time Domain Measurements 46
Frequency (S-Parameter) Domain Procedures 46
Time Domain Procedures 46
Impedance (TDR) 46
Propagation Delay (TDT) 47
Near-End Crosstalk (TDT) & Far End Crosstalk (TDT) 47
Appendix F – Glossary of Terms 48

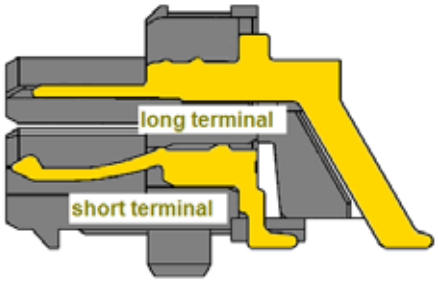
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Connector Overview

The LSEM series is a high-speed hermaphroditic design ideal for ruggedized applications. This interconnect features a slim row-to-row design and low cost blade & and beam contacts. LSEM is a double row contacts system available in 20, 30, 40, and 50 contacts per row. The data in this report is applicable only to the LSEM dual horizontal (right angle) row to vertical double row hermaphroditic interconnect system.
The device is a two terminal type right angle connector with terminals having different physical lengths and geometry. Dependent on that length and geometry performance characteristics will vary. The terminology used in this report to define which connector terminal is as follows:

*The short terminal of the connector is referred to as "Case 1"
*The long terminal of the connector is referred to as "Case 2"

This is illustrated in the following figure.



Connector System Speed Rating

LSEM-DH Hermaphroditic Series, Right Angle to Vertical Orientation Board-to-Board, 0.8mm Pitch

Case	Signaling	Speed Rating
1 (Short)	Single-Ended:	**9 GHz/ 18Gbps**
	Differential:	**10 GHz/ 20Gbps**
2 (Long)	Single-Ended:	**12 GHz/ 24Gbps**
	Differential:	**12.5 GHz/ 25Gbps**

The Speed Rating is based on the -3 dB insertion loss point of the connector system. The -3 dB point can be used to estimate usable system bandwidth in a typical, two-level

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

signaling environment. To calculate the Speed Rating, the measured -3 dB point is rounded-up to the nearest half-GHz level. The up rounding corrects for a portion of the test board's trace loss, since a short length of trace loss included in the loss data in this report. The resulting loss value is then doubled to determine the approximate maximum data rate in Gigabits per second (Gbps).

For example, a connector with a -3 dB point of 7.8 GHz would have a Speed Rating of 8 GHz/ 16 Gbps. A connector with a -3 dB point of 7.2 GHz would have a Speed Rating of 7.5 GHz/ 15 Gbps.

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315”) Pitch, Right Angle to Vertical Orientation

Frequency Domain Data Summary

Table 1 - Single-Ended Connector System Performance			
Case	**Test Parameter**	**Configuration**	
1 (Short)	**Insertion Loss**	GSG	3dB @ 9.050 GHz
	Return Loss	GSG	>10dB to 5.925 GHz
	Near-End Crosstalk	GAQG	< -20dB to 0.738 GHz
		GAGQG	< -20dB to 9.325 GHz
		Xrow, GAG to GQG	< -20dB to 9.113 GHz
	Far-End Crosstalk	GAQG	< -20dB to 2.938 GHz
		GAGQG	< -20dB to 8.575 GHz
		Xrow, GAG to GQG	< -20dB to 9.125 GHz
2 (Long)	**Insertion Loss**	GSG	3dB @ 11.938 GHz
	Return Loss	GSG	>10dB to 10.500 GHz
	Near-End Crosstalk	GAQG	< -20dB to 0.525 GHz
		GAGQG	< -20dB to 6.238 GHz
		Xrow, GAG to GQG	< -20dB to 9.113 GHz
	Far-End Crosstalk	GAQG	< -20dB to 5.988 GHz
		GAGQG	< -20dB to 6.213 GHz
		Xrow, GAG to GQG	< -20dB to 9.100 GHz

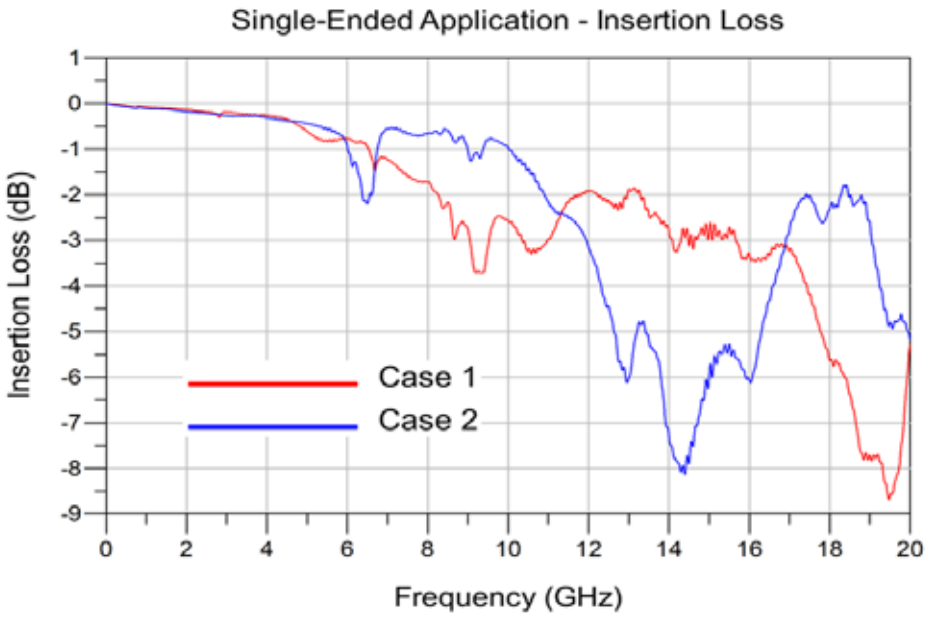
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315”) Pitch, Right Angle to Vertical Orientation

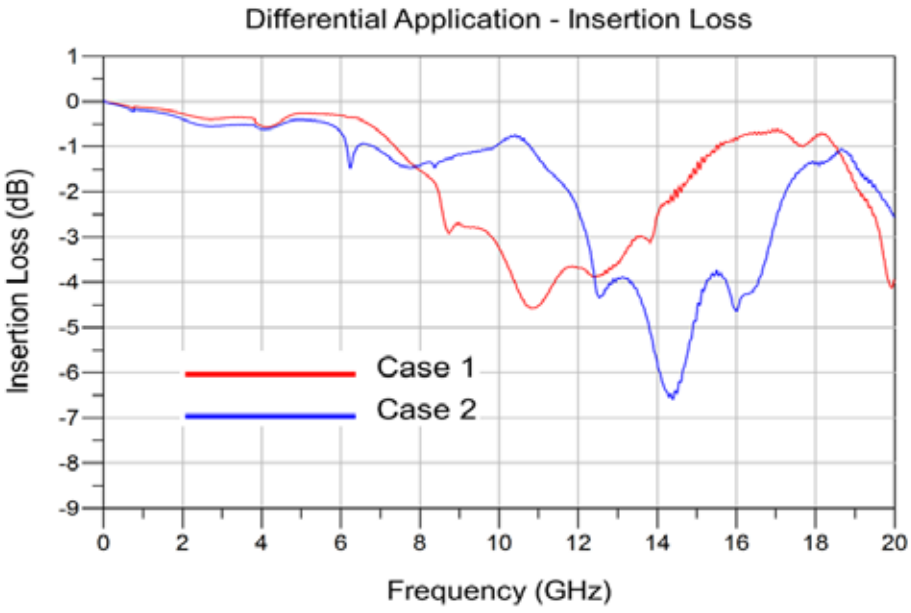
Table 2 - Differential Connector System Performance			
Case	**Test Parameter**	**Configuration**	
1 (Short)	**Insertion Loss**	GSSG	3dB @ 9.813 GHz
	Return Loss	GSSG	>10dB to 7.200 GHz
	Near-End Crosstalk	GAAQQG	< -20dB to 14.438
		GAAGQQG	< -20dB to 18.950
		Xrow, GAAG to GQQG	< -20dB to 20.000
	Far-End Crosstalk	GAAQQG	< -20dB to 14.325
		GAAGQQG	< -20dB to 17.913
		Xrow, GAAG to GQQG	< -20dB to 20.000
2 (Long)	**Insertion Loss**	GSSG	3dB @ 12.225 GHz
	Return Loss	GSSG	>10dB to 6.525 GHz
	Near-End Crosstalk	GAAQQG	< -20dB to 9.100 GHz
		GAAGQQG	< -20dB to 20.000
		Xrow, GAAG to GQQG	< -20dB to 20.000
	Far-End Crosstalk	GAAQQG	< -20dB to 20.000
		GAAGQQG	< -20dB to 20.000
		Xrow, GAAG to GQQG	< -20dB to 20.000

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Bandwidth Chart – Single-Ended & Differential Insertion Loss

LSEM Connector Series

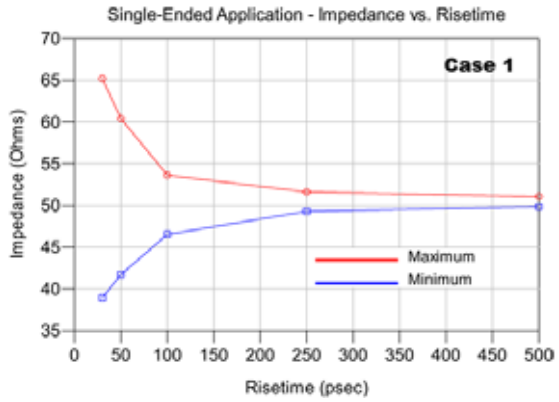


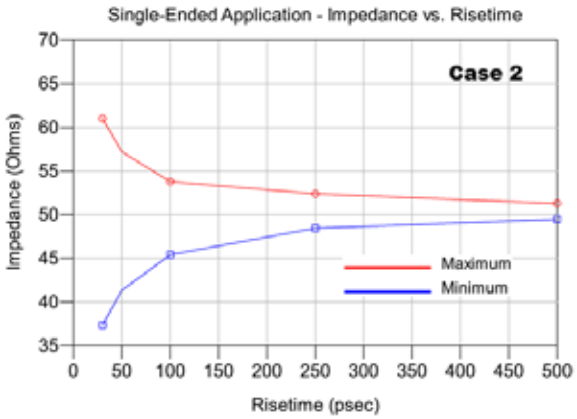


Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Time Domain Data Summary

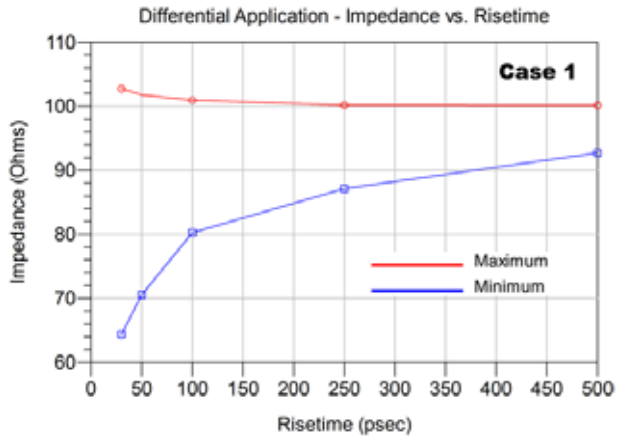
Table 3 – Single-End Impedance (Ω)						
Case	**Signal Risetime**	**30 ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
1	**Maximum Impedance**	65.2	60.4	53.6	51.6	51.1
	Minimum Impedance	39.0	41.7	46.5	49.3	49.9
2	**Maximum Impedance**	61.0	57.2	53.8	52.4	51.3
	Minimum Impedance	37.4	41.3	45.4	48.4	49.5

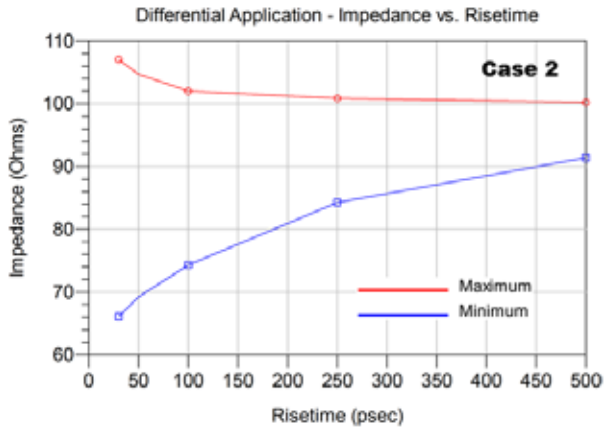




Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Table 4 - Differential Impedance (Ω)						
Case	**Signal Risetime**	**30 ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
1	**Maximum Impedance**	102.8	101.8	101.0	100.2	100.2
	Minimum Impedance	64.4	70.6	80.3	87.1	92.7
2	**Maximum Impedance**	107.1	104.7	102.0	100.9	100.2
	Minimum Impedance	66.1	69.2	74.3	84.3	91.4





Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Table 5 - Single-Ended Crosstalk (%)							
Case	**Input(tr)**		**30ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
1	NEXT	GAQG	19.5	17.0	14.5	7.9	4.3
		GAGQG	4.0	2.6	1.8	1.1	0.6
		Xrow	3.4	2.9	2.3	1.2	0.7
	FEXT	GAQG	9.6	6.1	3.6	1.6	0.8
		GAGQG	5.6	3.3	1.6	0.6	0.3
		Xrow	2.4	1.3	0.6	0.2	<0.1
2	NEXT	GAQG	22.0	20.3	17.6	10.9	6.0
		GAGQG	3.8	2.8	2.0	1.2	0.7
		Xrow	3.4	2.9	2.3	1.2	0.7
	FEXT	GAQG	7.1	5.8	3.5	1.8	1.0
		GAGQG	4.2	3.1	1.6	0.6	0.3
		Xrow	2.0	1.1	0.5	0.2	0.1

Table 6 - Differential Crosstalk (%)							
Case	**Input(tr)**		**30ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
1	NEXT	GAAQQG	5.7	4.8	3.9	2.0	1.1
		GAAGQQG	0.7	0.4	0.2	<0.1	<0.1
		Xrow	1.0	0.9	0.6	0.3	0.2
	FEXT	GAAQQG	1.7	1.0	0.7	0.3	0.2
		GAAGQQG	1.3	0.8	0.4	0.1	<0.1
		Xrow	0.4	0.3	0.1	<0.1	<0.1
2	NEXT	GAAQQG	6.5	6.2	5.3	3.3	1.9
		GAAGQQG	0.5	0.4	0.3	0.2	0.1
		Xrow	1.0	0.9	0.6	0.3	0.2
	FEXT	GAAQQG	1.5	1.2	1.0	0.6	0.3
		GAAGQQG	0.8	0.6	0.3	0.1	<0.1
		Xrow	0.3	0.2	0.1	<0.1	<0.1

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315”) Pitch, Right Angle to Vertical Orientation

Table 7 - Propagation Delay (Mated Connector)		
Case 1	**Single-Ended**	77 ps
	Differential	70 ps
Case 2	**Single-Ended**	92 ps
	Differential	93 ps

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Characterization Details

This report presents data that characterizes the signal integrity response of a connector pair in a controlled printed circuit board (PCB) environment. All efforts are made to reveal typical best-case responses inherent to the system under test (SUT).

In this report, the SUT includes the connector pair and footprint effects on a typical multi-layer PCB. PCB effects (trace loss) are de-embedded from test data. Board related effects, such as pad-to-ground capacitance, are included in the data presented in this report.

Additionally, intermediate test signal connections can mask the connector's true performance. Such connection effects are minimized by using high performance test cables and adapters. Where appropriate, calibration and de-embedding routines are also used to reduce residual effects.

Differential and Single-Ended Data

Most Samtec connectors can be used successfully in both differential and single-ended applications. However, electrical performance will differ depending on the signal drive type. In this report, data is presented for both differential and single-ended drive scenarios.

Connector Signal to Ground Ratio

Samtec connectors are most often designed for generic applications and can be implemented using various signal and ground pin assignments. In high-speed systems, provisions must be made in the interconnect for signal return currents. Such paths are often referred to as "ground". In some connectors, a ground plane or blade, or an outer shield, is used as the signal return, while in others, connector pins are used as signal returns. Various combinations of signal pins, ground blades, and shields can also be utilized. Electrical performance can vary significantly depending upon the number and location of ground pins.

In general, the more pins dedicated to ground, the better electrical performance will be. However, dedicating pins to ground reduces signal density of a connector. Therefore, care must be taken when choosing signal/ground ratios in cost or density-sensitive applications.

For this connector, the following array configurations are evaluated:

Single-Ended Impedance**:**
- GSG (ground-signal-ground)

Single-Ended Crosstalk**:**

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

- Electrical "worst case": GAQG (ground-active-quiet-ground)
- Electrical "best case": GAGQG (ground-active-ground-quiet-ground)
- Across row: "xrow case": GAG to GQG (from one row of terminals to the other row)

Differential Impedance**:**

- GSSG (Ground-positive signal-negative signal-ground)

Differential Crosstalk**:**

- Electrical "worst case": GAAQQG (ground-active-active-quiet-quiet-ground)
- Electrical "best case": GAAGQQG (ground-active-active-ground-quiet-quiet-ground)
- Across row: "xrow case": GAAG to GQQG (from one row of terminals to the other row)

Only one single-ended signal or differential pair was driven for crosstalk measurements.

Other configurations can be evaluated upon request. Please contact sig@samtec.com for more information.

In a real system environment, active signals might be located at the outer edges of the signal contacts of concern, as opposed to the ground signals utilized in laboratory testing. For example, in a single-ended system, a pin-out of "SSSS", or four adjacent single ended signals might be encountered as opposed to the "GSG" and "GSSG" configurations tested in the laboratory. Electrical characteristics in such applications could vary slightly from laboratory results. However, in most applications, performance can safely be considered equivalent.

Signal Edge Speed (Rise Time):
In pulse signaling applications, the perceived performance of the interconnect can vary significantly depending on the edge rate or rise time of the exciting signal. For this report, the fastest rise time used was 30 ps. Generally, this should demonstrate worst-case performance.

In many systems, the signal edge rate will be significantly slower at the connector than at the driver launch point. To estimate interconnect performance at other edge rates, data is provided for several rise times between 30ps and 500ps.

For this report, measured rise times were at 10%-90% signal levels.

Frequency Domain Data

Frequency Domain parameters are helpful in evaluating the connector system's signal loss and crosstalk characteristics across a range of sinusoidal frequencies. In this report, parameters presented in the Frequency Domain are Insertion Loss, Return Loss, and Near-End and Far-End Crosstalk. Other parameters or formats, such as VSWR or

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

S-Parameters, may be available upon request. Please contact our Signal Integrity Group at sig@samtec.com for more information.

Frequency performance characteristics for the SUT are generated directly from network analyzer measurements.

Time Domain Data
Time Domain parameters indicate Impedance mismatch versus length, signal propagation time, and crosstalk in a pulsed signal environment. The measured S-Parameters from the network analyzer are post-processed using Agilent Advanced Design System to obtain the time domain response. Time Domain procedure is provided in Appendix E of this report. Parameters or formats not included in this report may be available upon request. Please contact our Signal Integrity Group at sig@samtec.com for more information.

In this report, propagation delay is defined as the signal propagation time through the connector and connector footprint. It includes 100 mils of PCB trace on the LSEM-DH connector side and 100 mils of PCB trace on the LSEM-DV connector side. Delay is measured at 30 picoseconds signal rise-time. Delay is calculated as the difference in time measured between the 50% amplitude levels of the input and output pulses.

Crosstalk or coupled noise data is provided for various signal configurations. All measurements are single disturber. Crosstalk is calculated as a ratio of the input line voltage to the coupled line voltage. The input line is sometimes described as the active or drive line. The coupled line is sometimes described as the quiet or victim line. Crosstalk ratio is tabulated in this report as a percentage. Measurements are made at both the near-end and far-end of the SUT.

Data for other configurations may be available. Please contact our Signal Integrity Group at sig@samtec.com for further information.

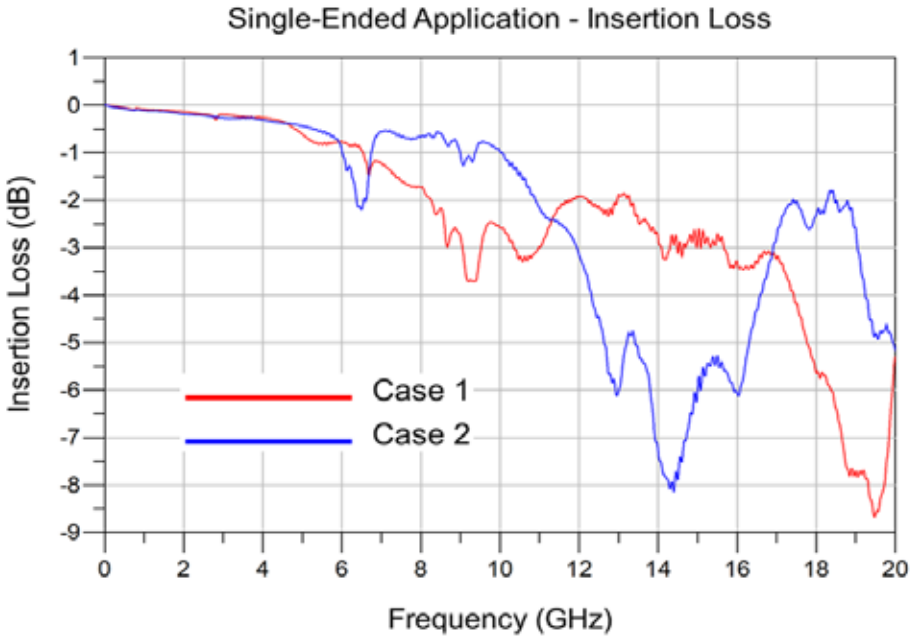
As a rule of thumb, 10% crosstalk levels are often used as a general first pass limit for determining acceptable interconnect performance. However, modern system crosstalk tolerance can vary greatly. For advice on connector suitability for specific applications, please contact our Signal Integrity Group at sig@samtec.com.

Additional information concerning test conditions and procedures is located in the appendices of this report. Further information may be obtained by contacting our Signal Integrity Group at sig@samtec.com.

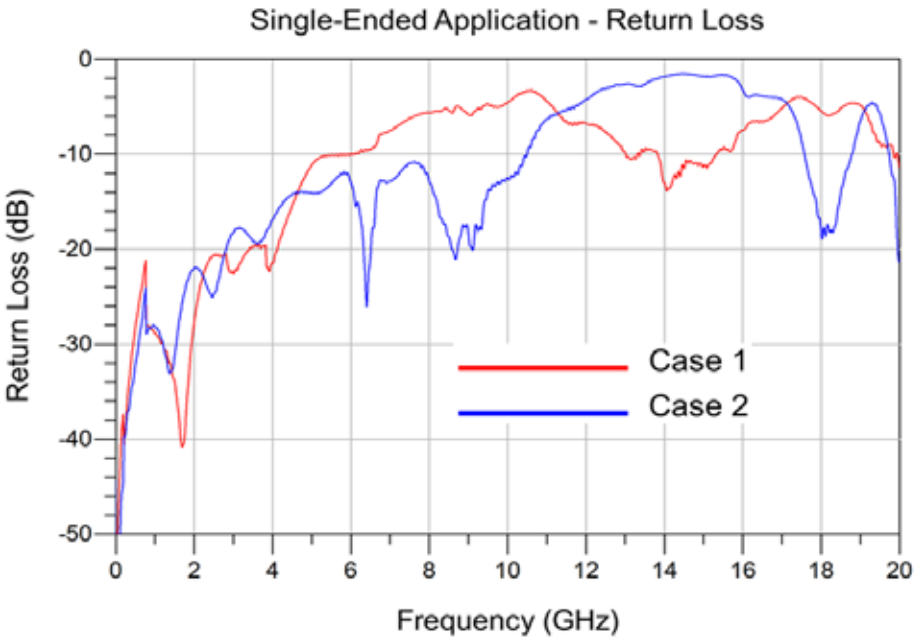
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Appendix A – Frequency Domain Response Graphs

Single-Ended Application – Insertion Loss



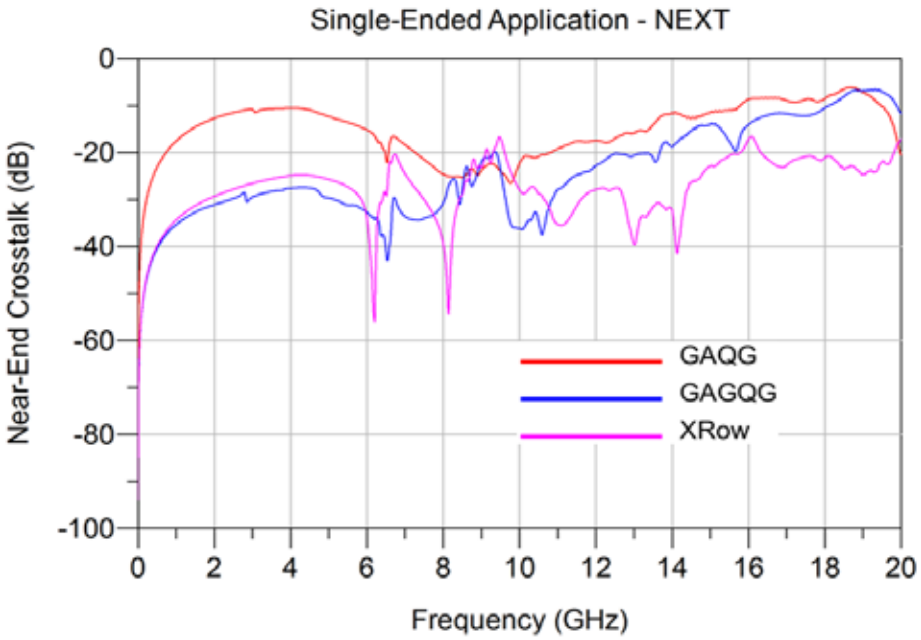
Single-Ended Application – Return Loss



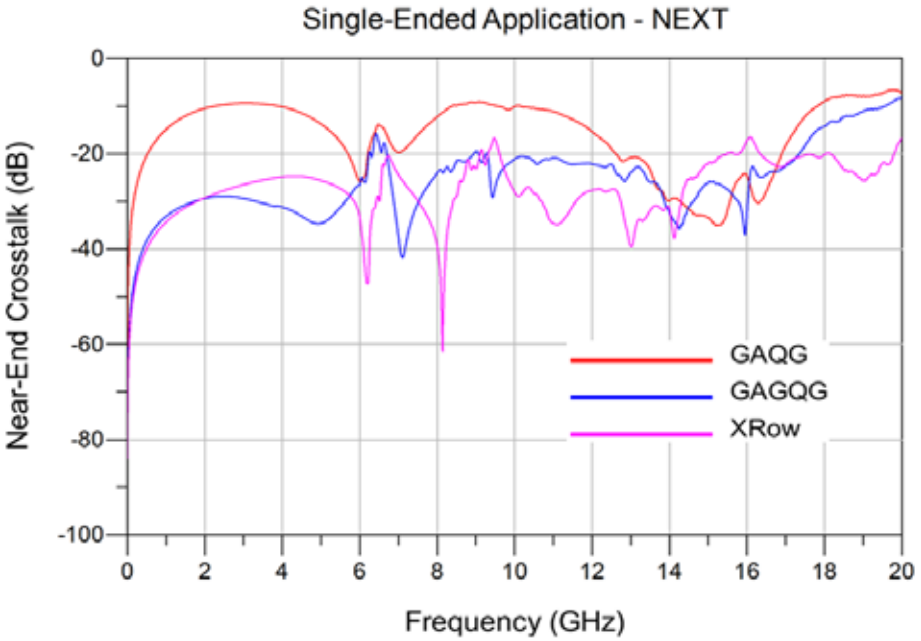
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Single-Ended Application – NEXT Configurations

Case 1



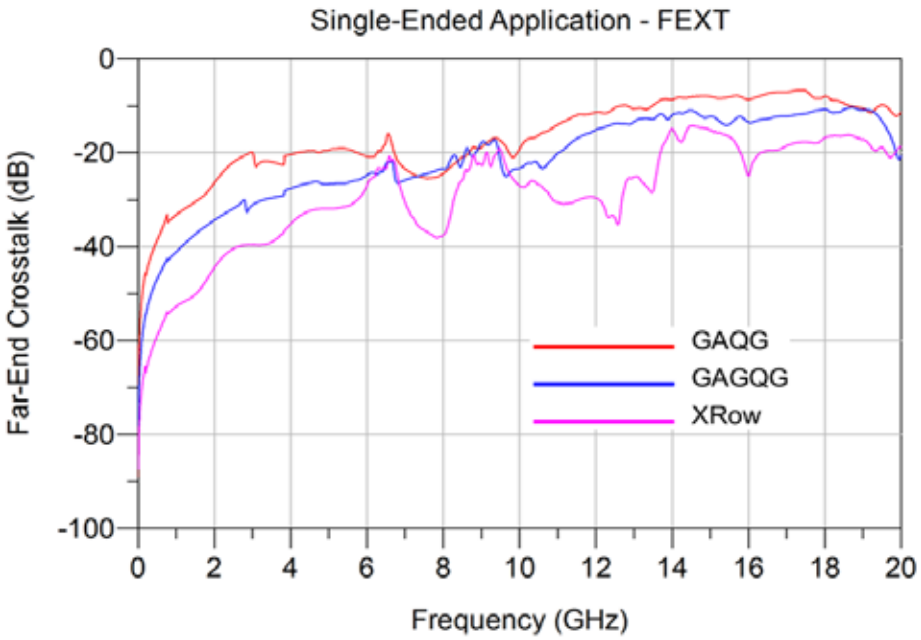
Case 2



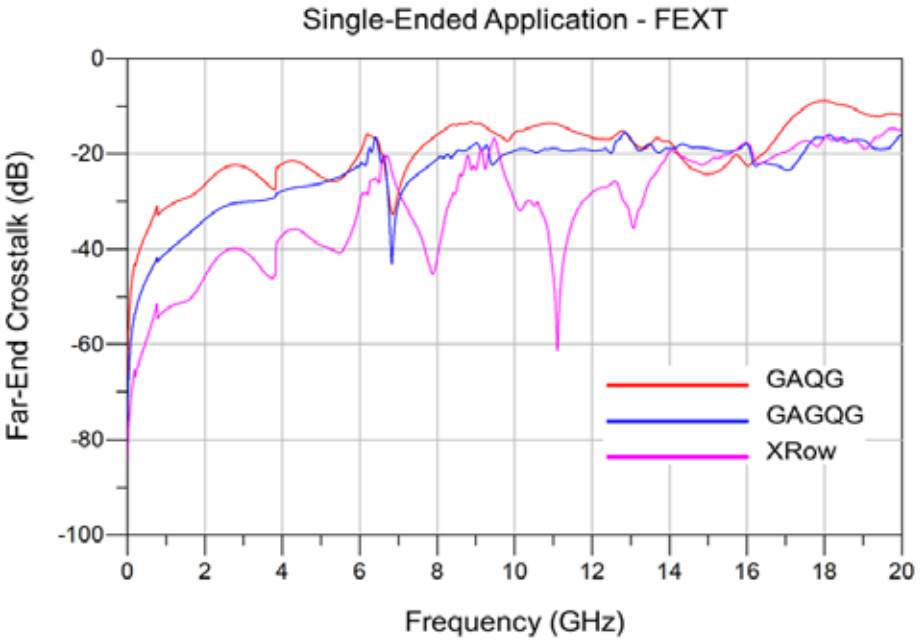
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Single-Ended Application – FEXT Configurations

Case 1

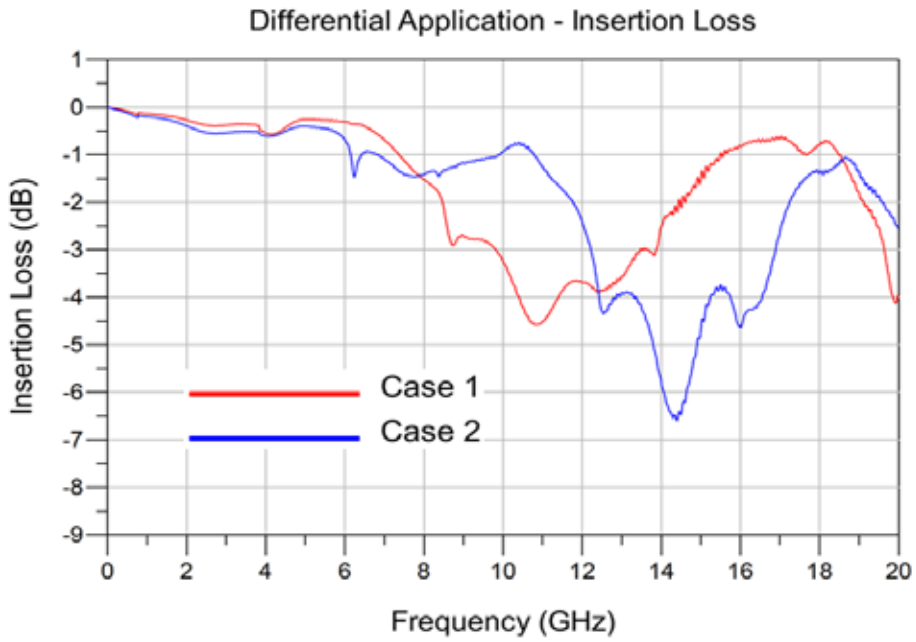


Case 2

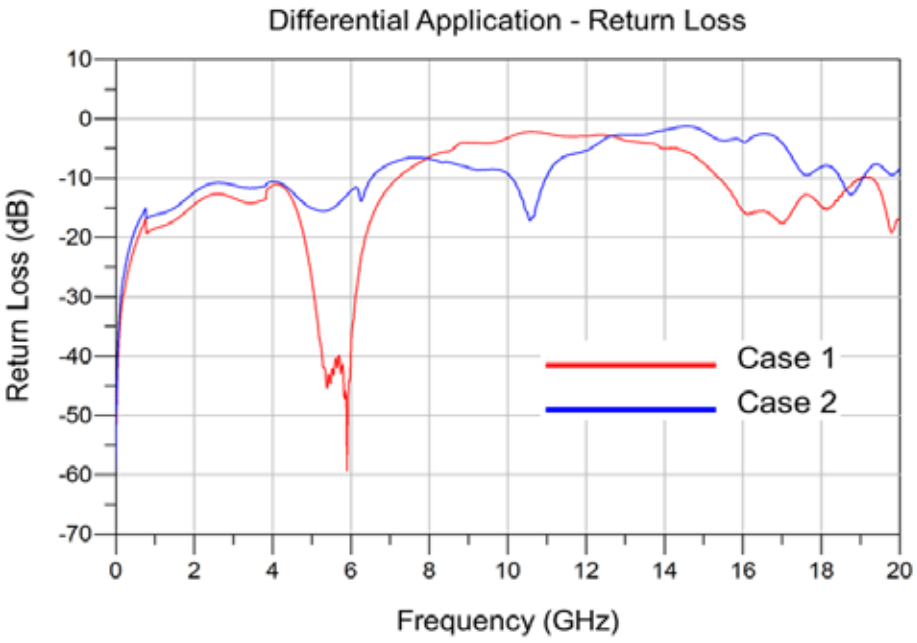


Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Differential Application – Insertion Loss



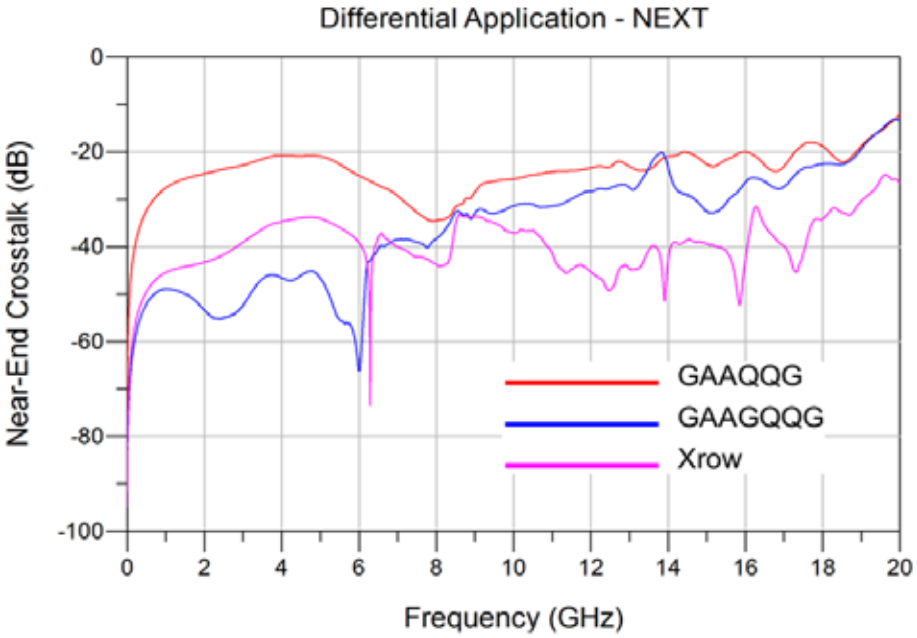
Differential Application – Return Loss



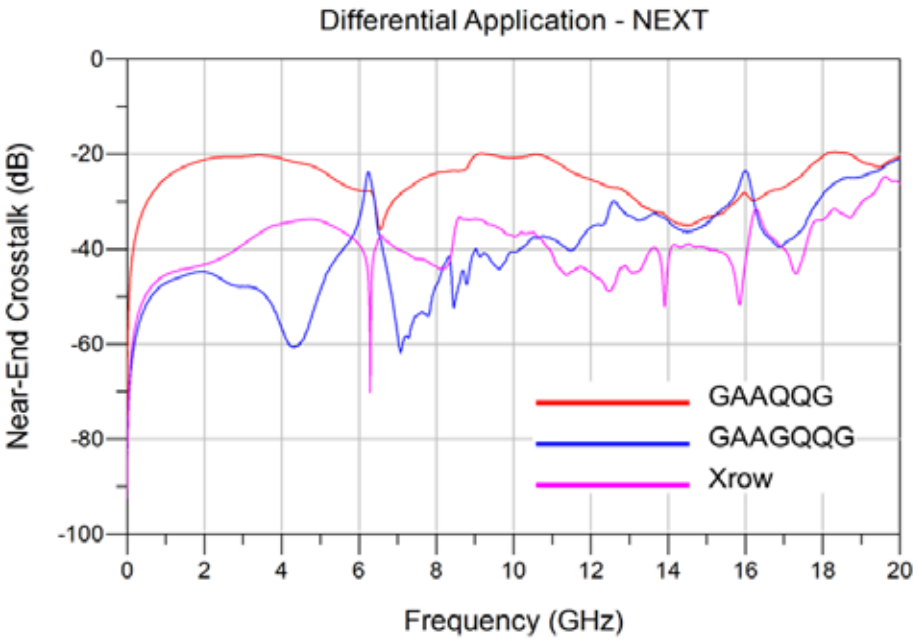
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Differential Application – NEXT Configurations

Case 1



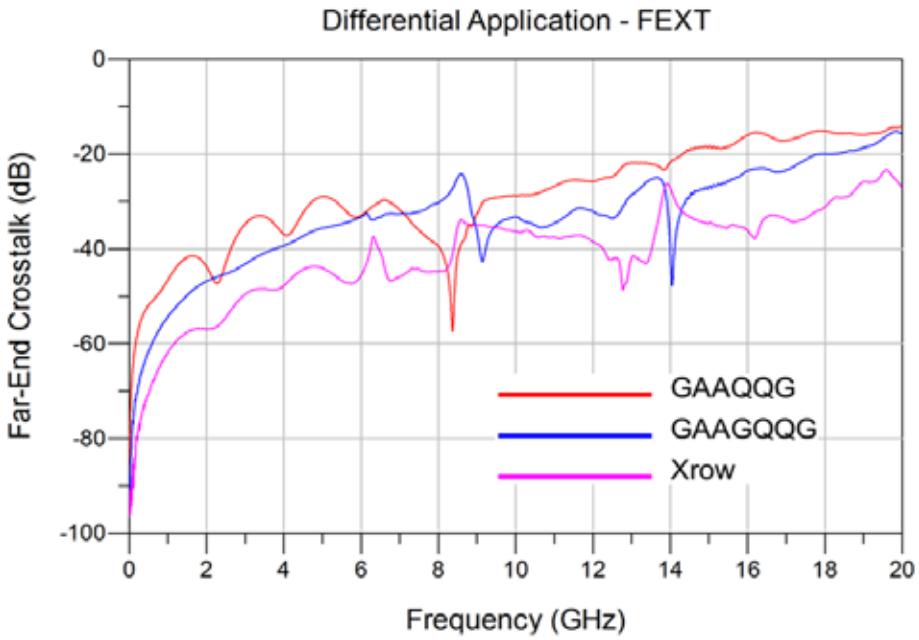
Case 2



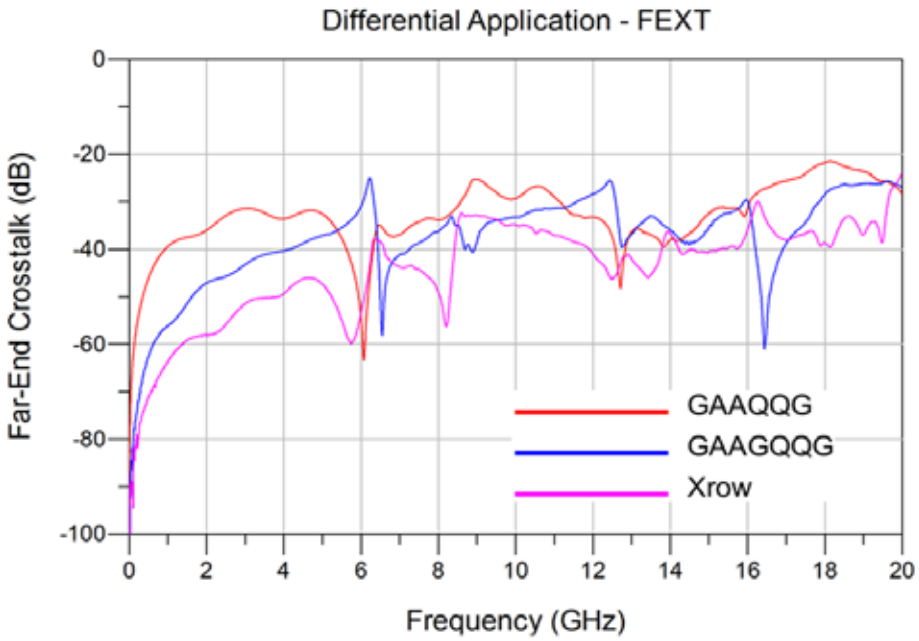
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Differential Application – FEXT Configurations

Case 1



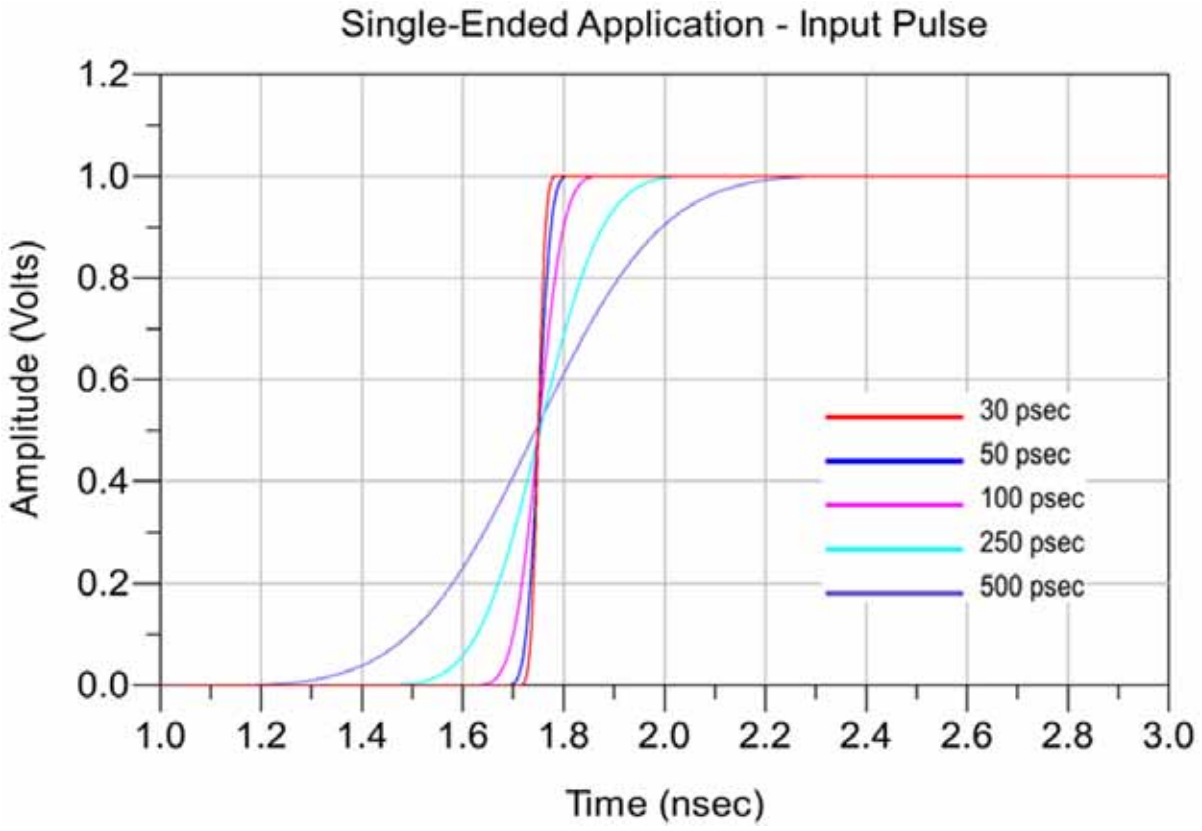
Case 2



Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Appendix B – Time Domain Response Graphs

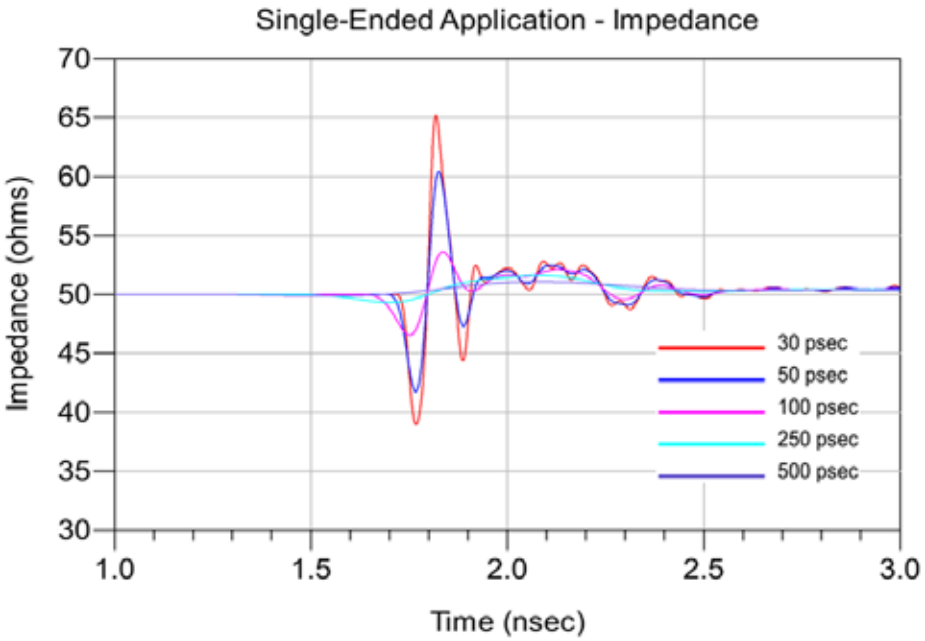
Single-Ended Application – Input Pulse



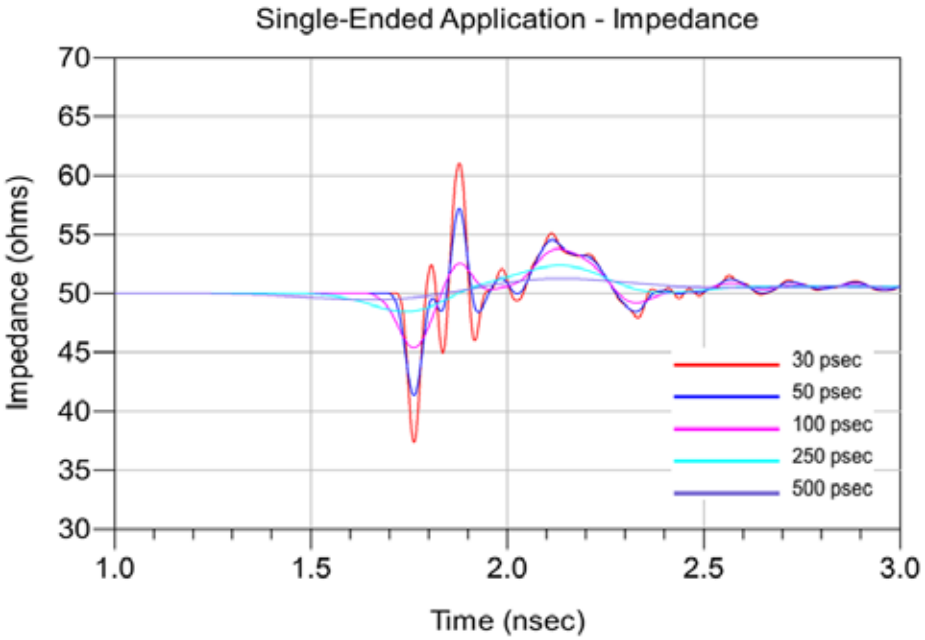
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Single-Ended Application – Impedance

Case 1



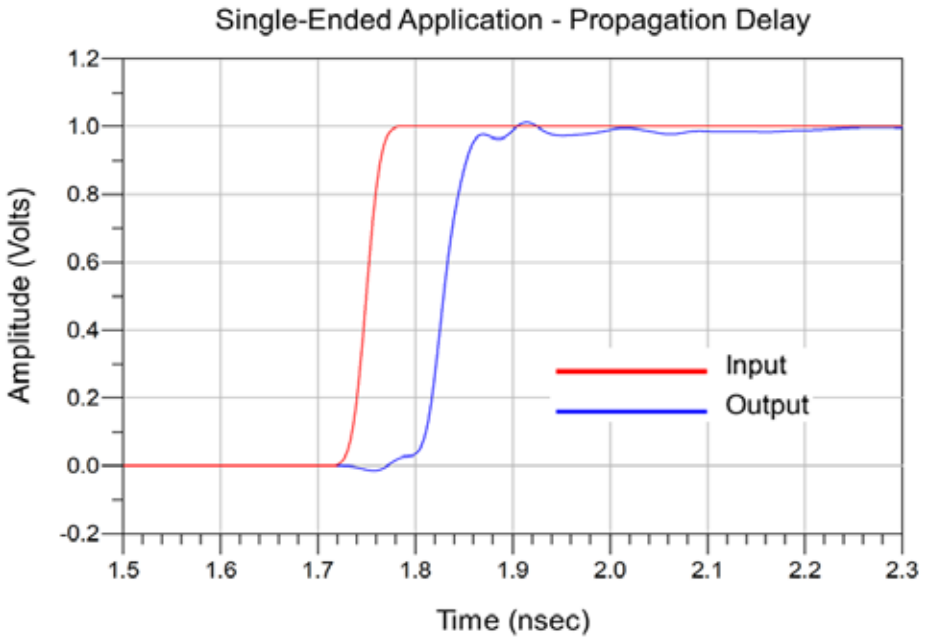
Case 2



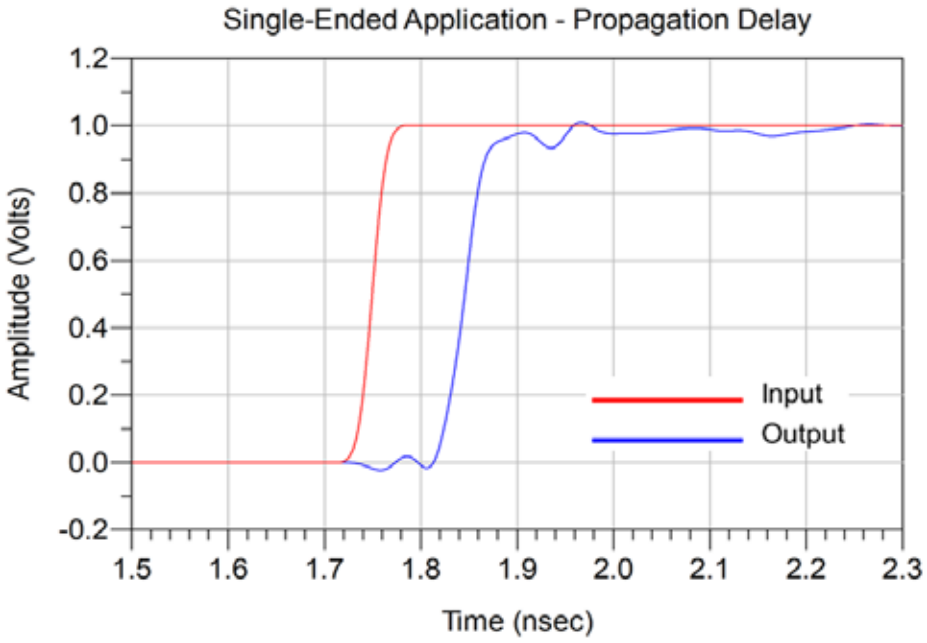
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Single-Ended Application – Propagation Delay

Case 1



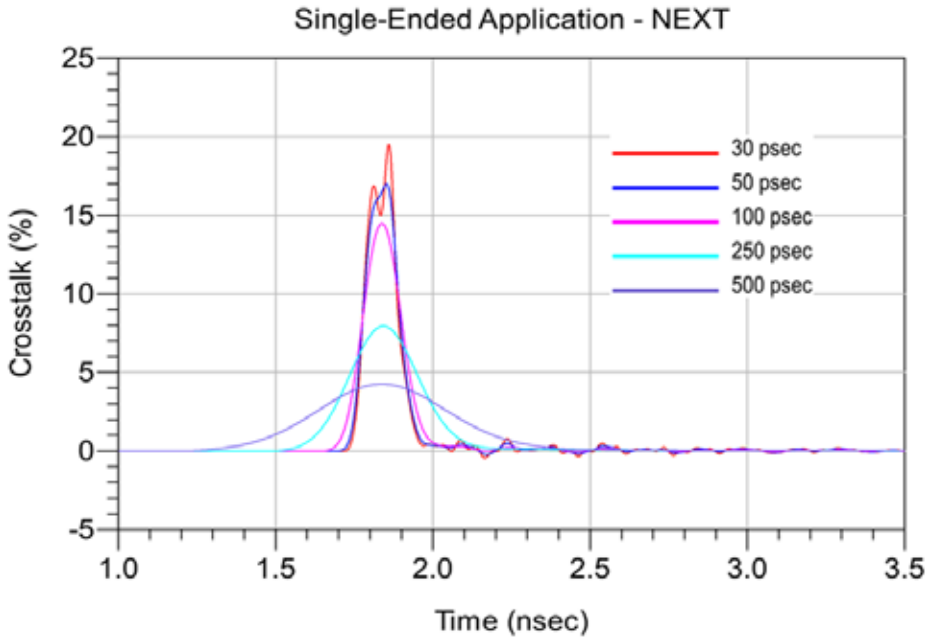
Case 2



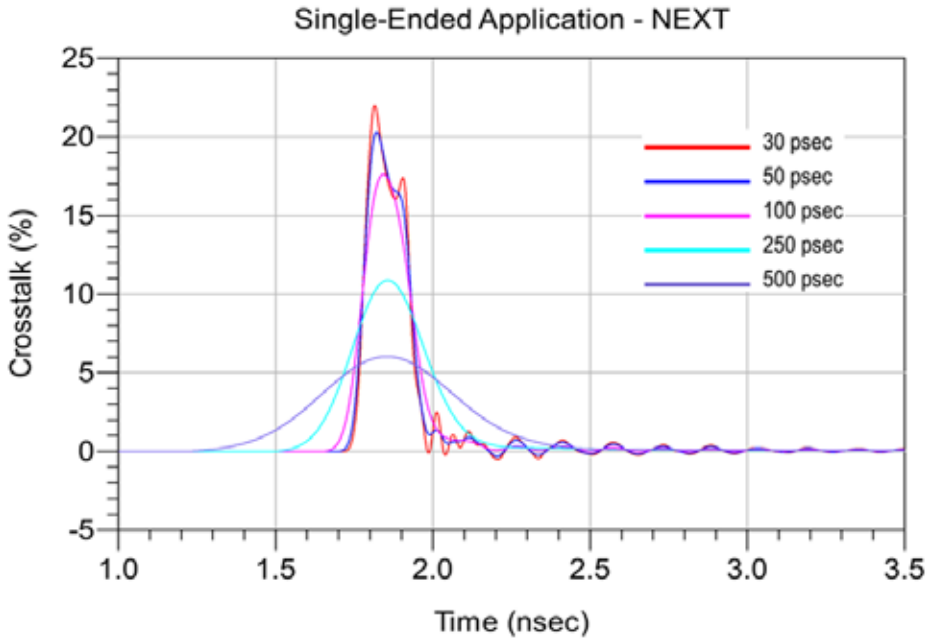
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Single-Ended Application – NEXT, Worst Case Configuration

Case 1



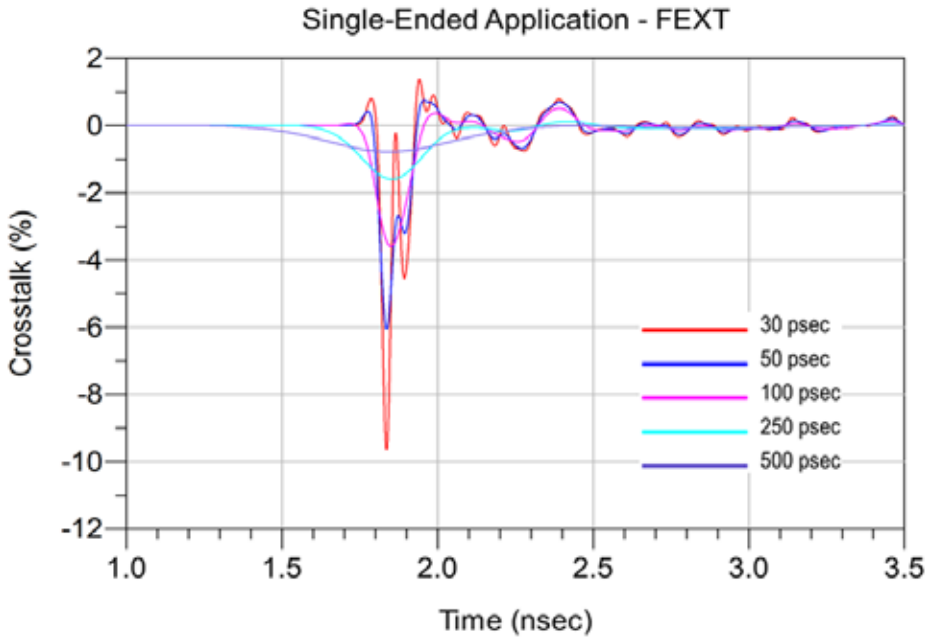
Case 2



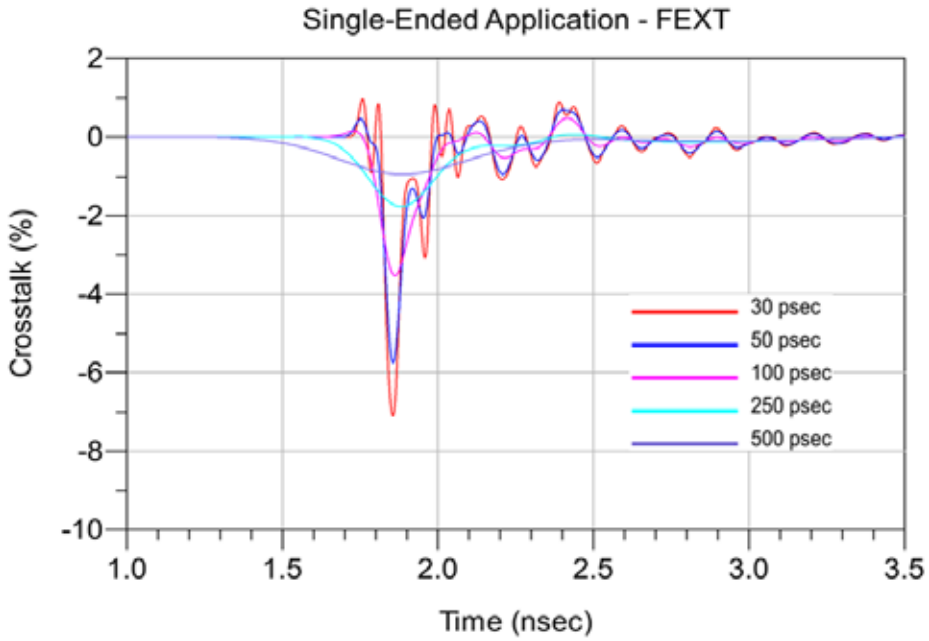
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Single-Ended Application – FEXT, Worst Case Configuration

Case 1



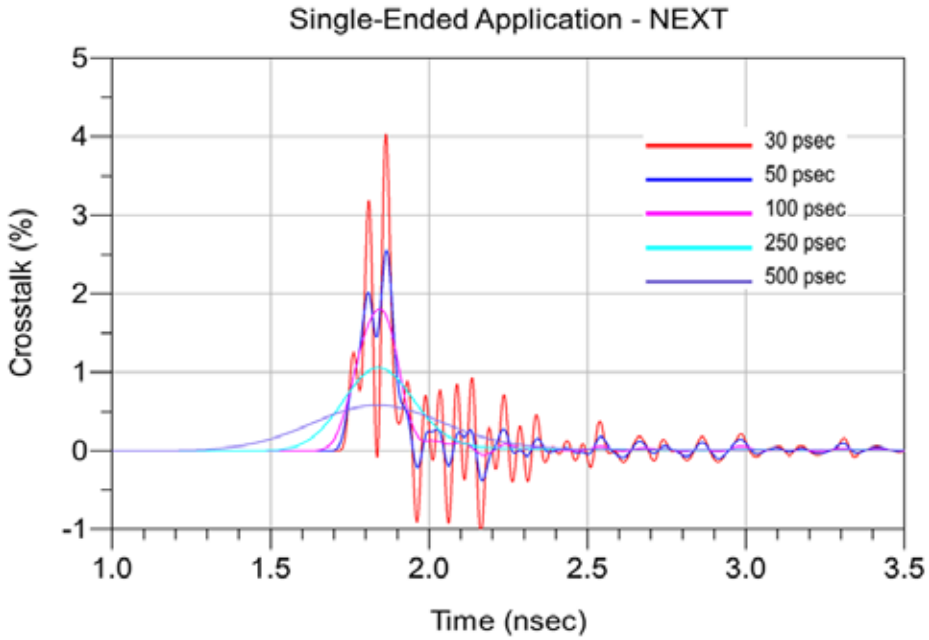
Case 2



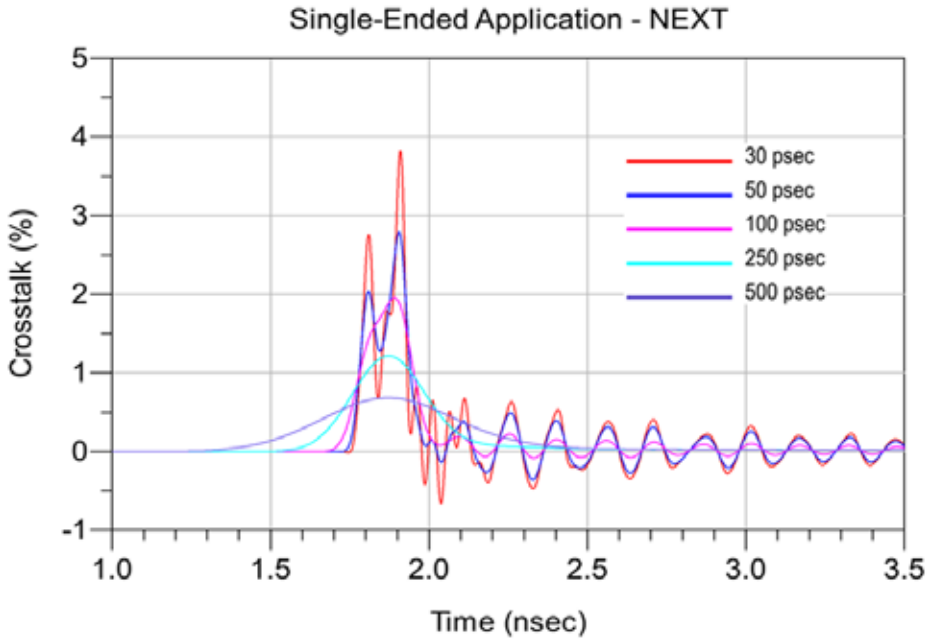
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Single-Ended Application – NEXT, Best Case Configuration

Case 1



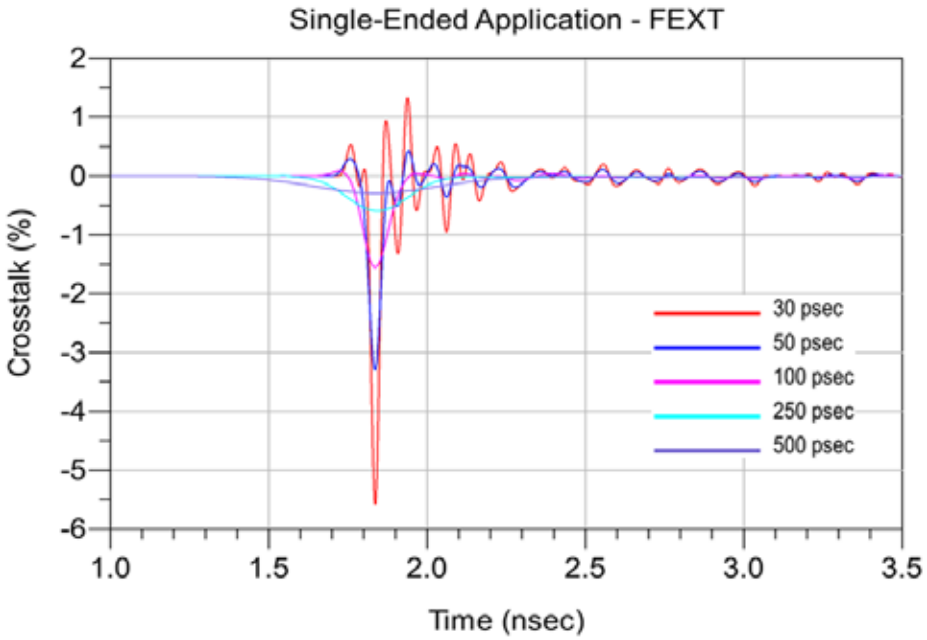
Case 2



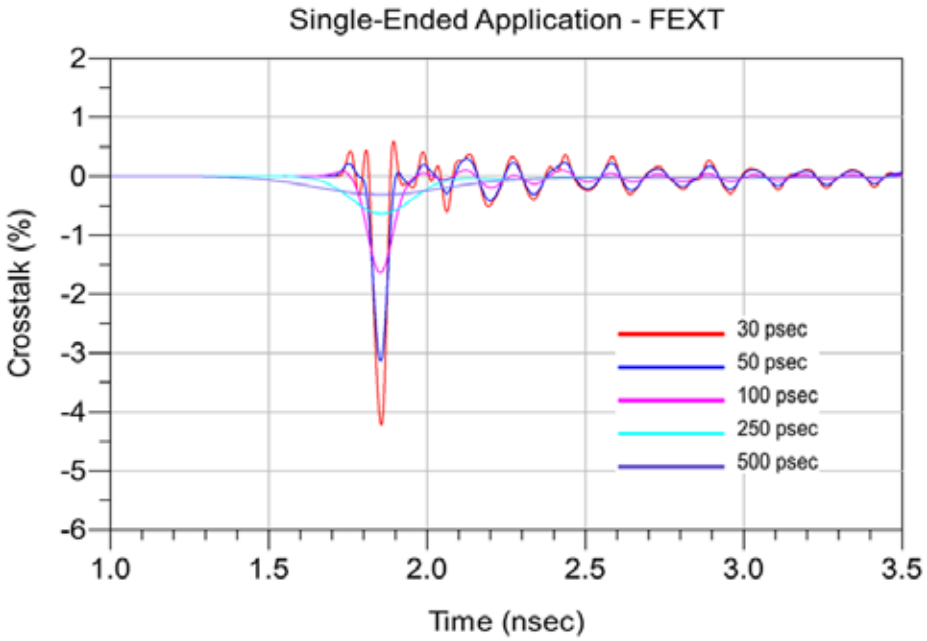
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Single-Ended Application – FEXT, Best Case Configuration

Case 1



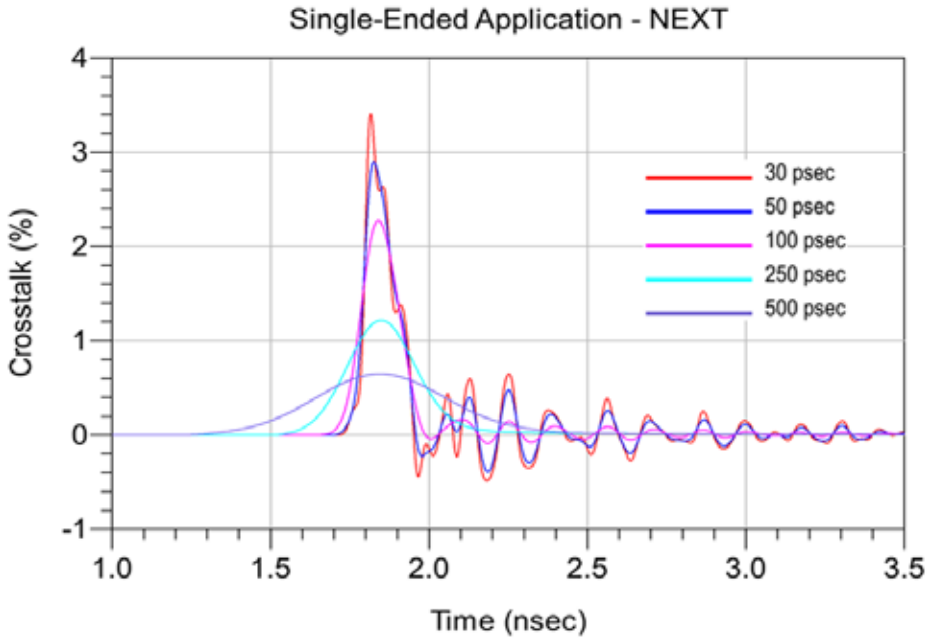
Case2



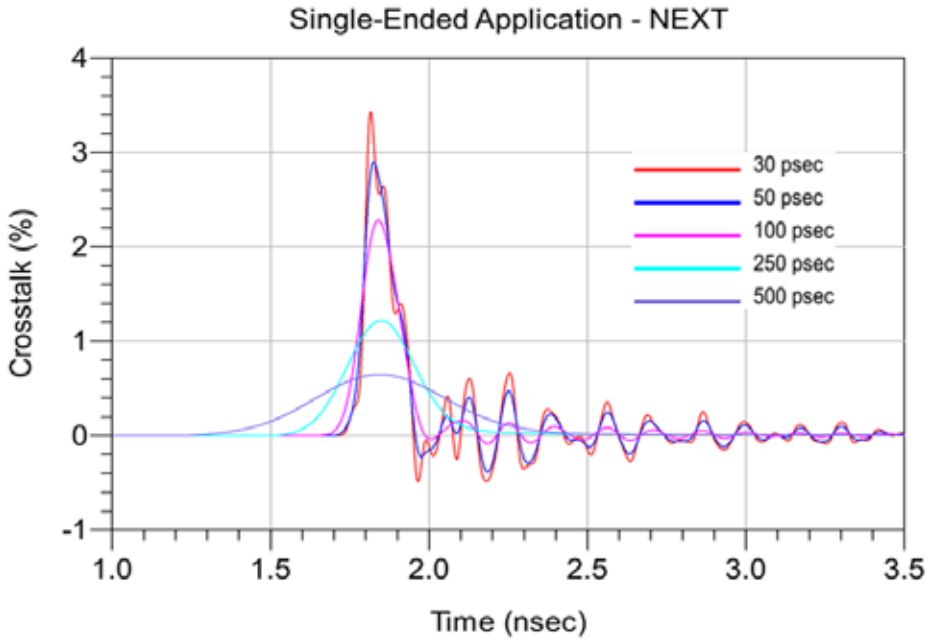
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Single-Ended Application – NEXT, Across Row Configuration

Case 1



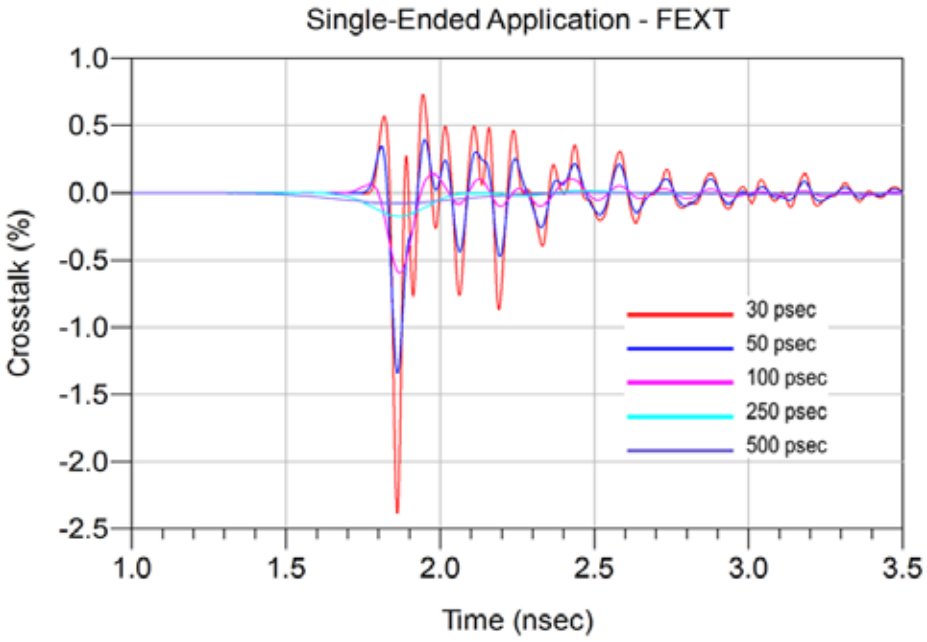
Case 2



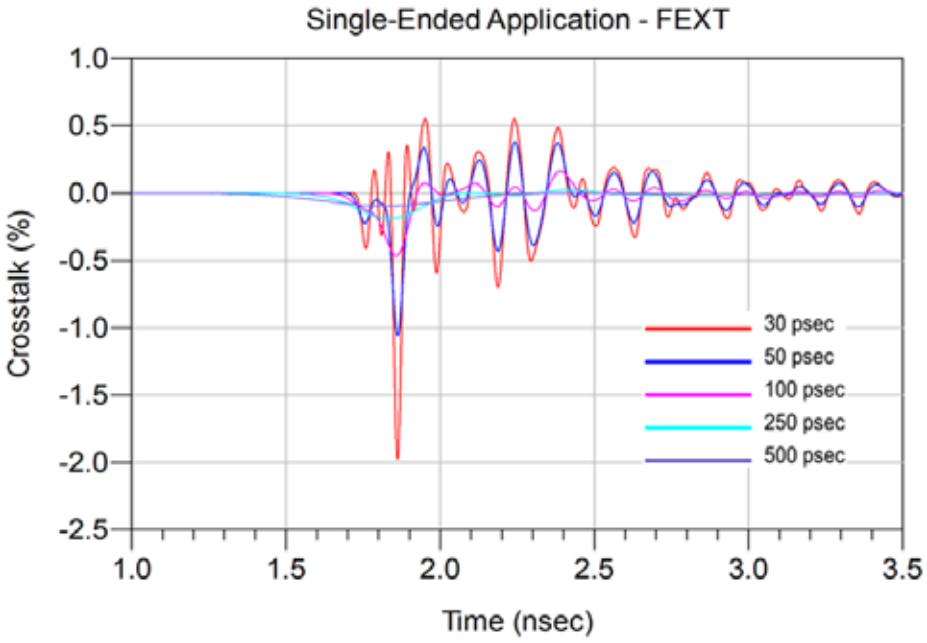
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Single-Ended Application – FEXT, Across Row Configuration

Case 1

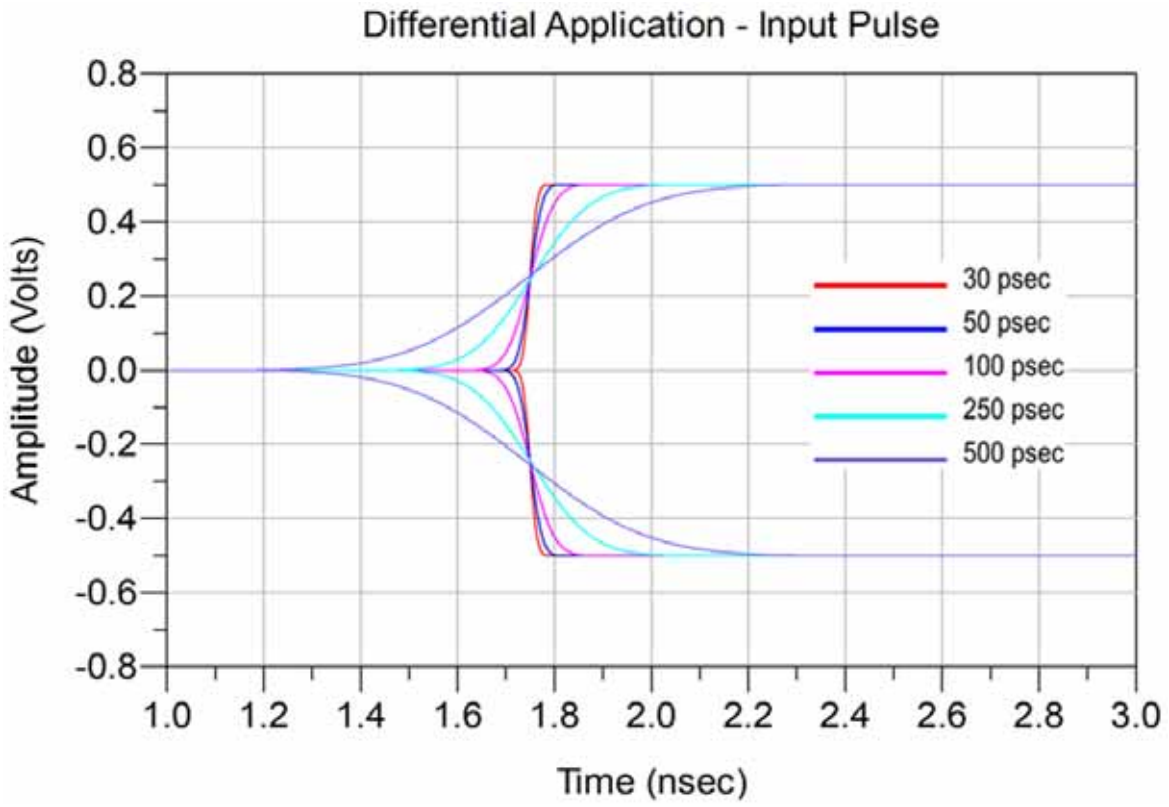


Case 2



Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

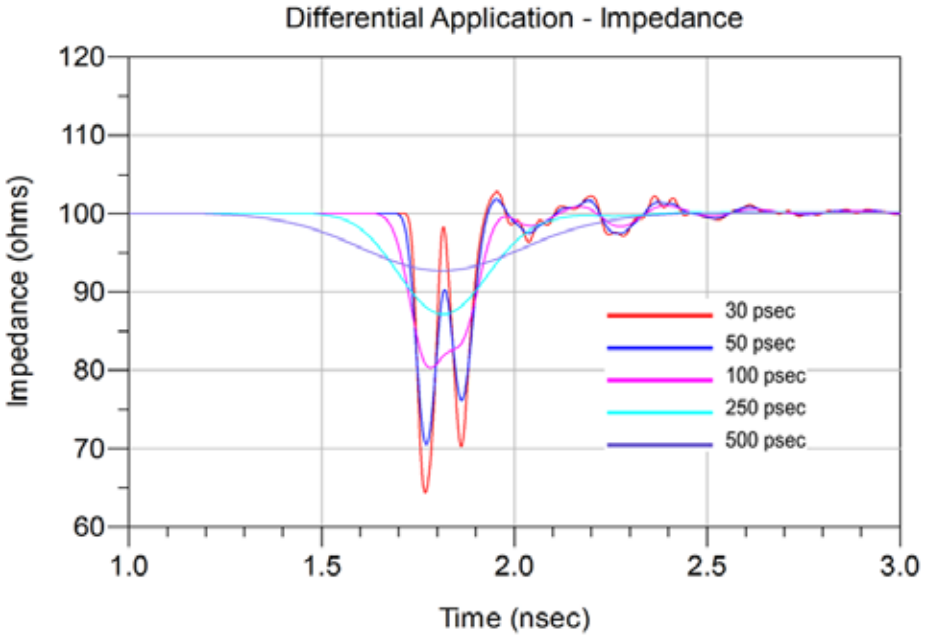
Differential Application – Input Pulse



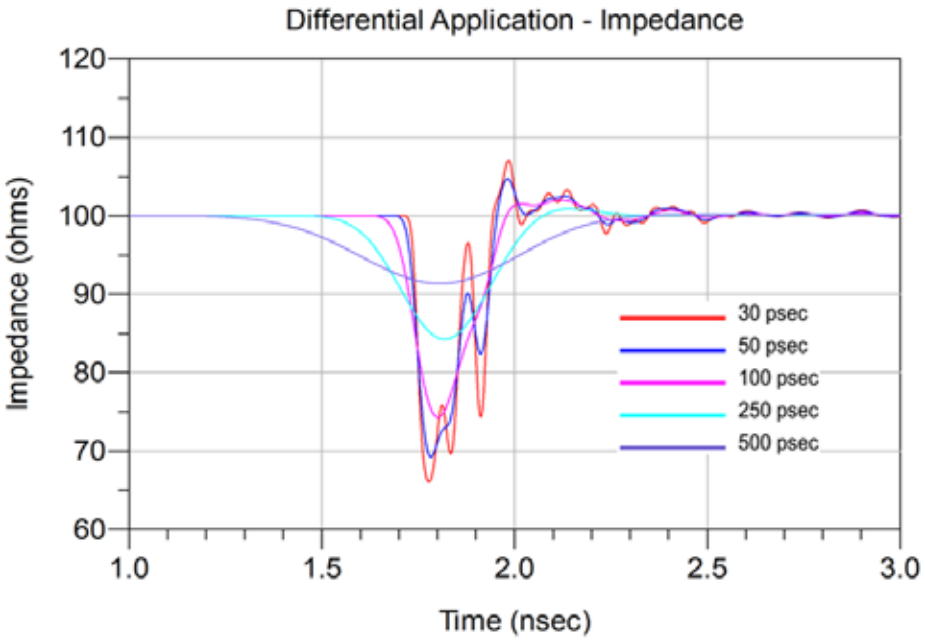
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Differential Application – Impedance

Case 1



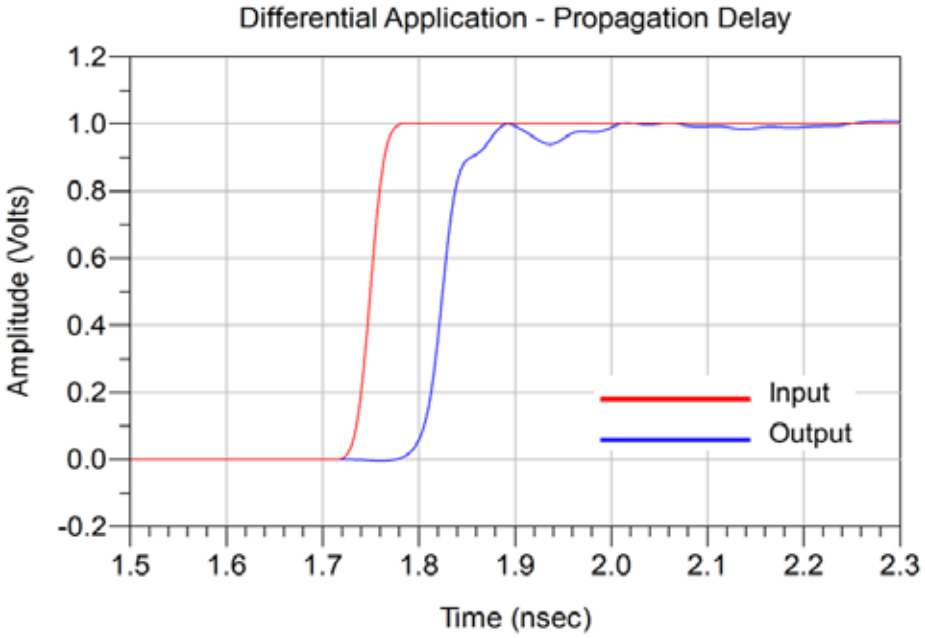
Case 2



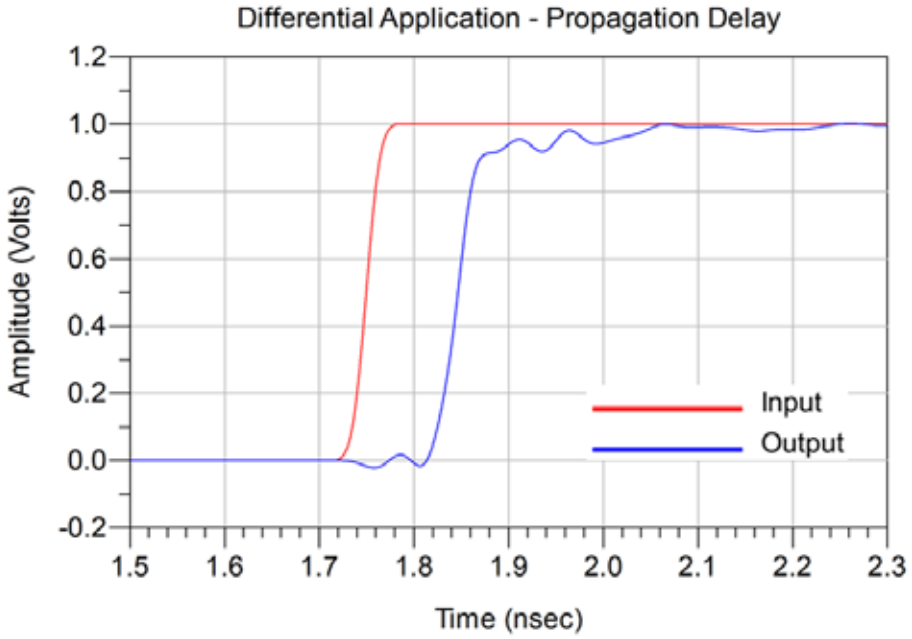
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Differential Application – Propagation Delay

Case 1



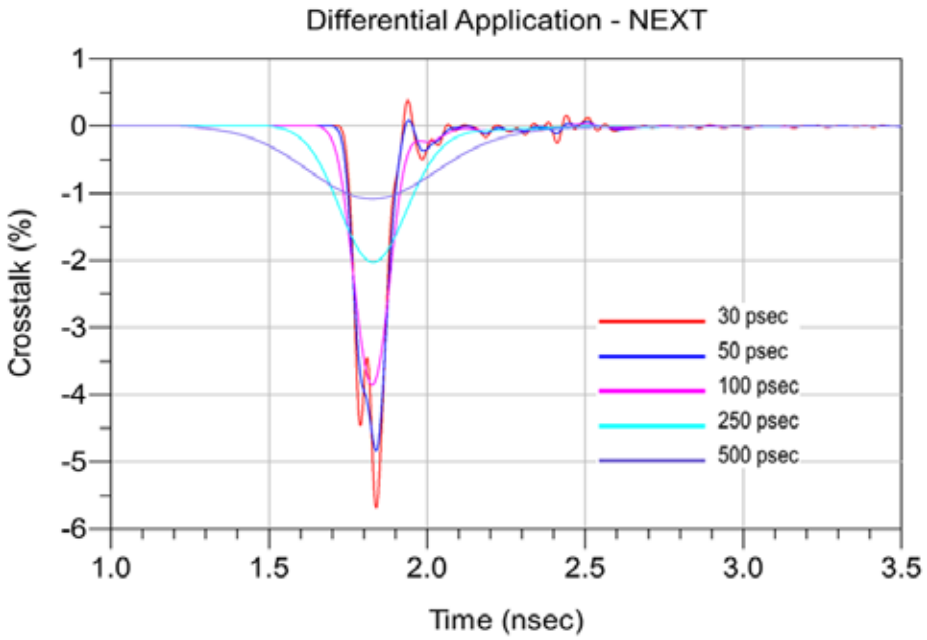
Case 2



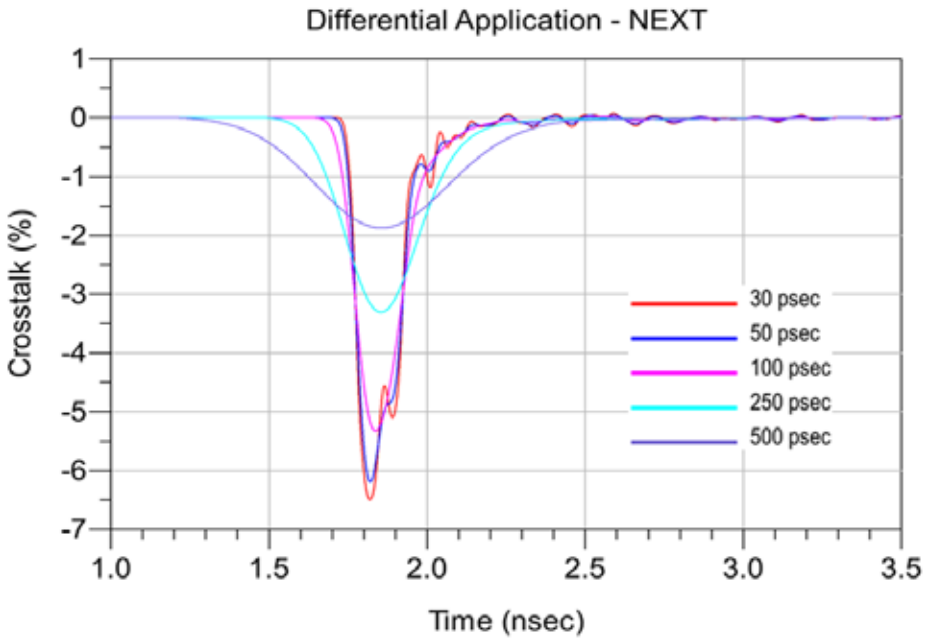
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Differential Application – NEXT, Worst Case Configuration

Case 1



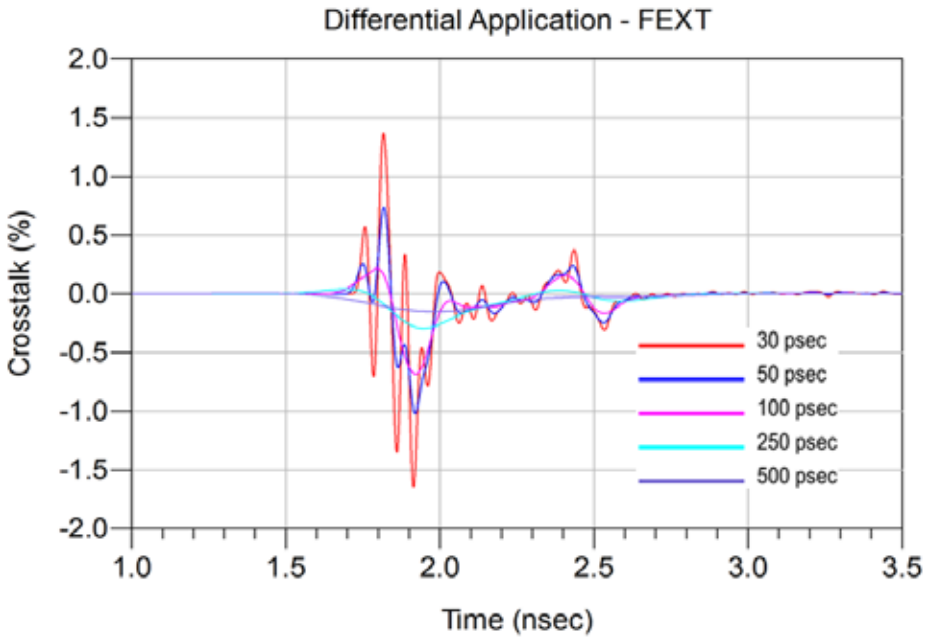
Case 2



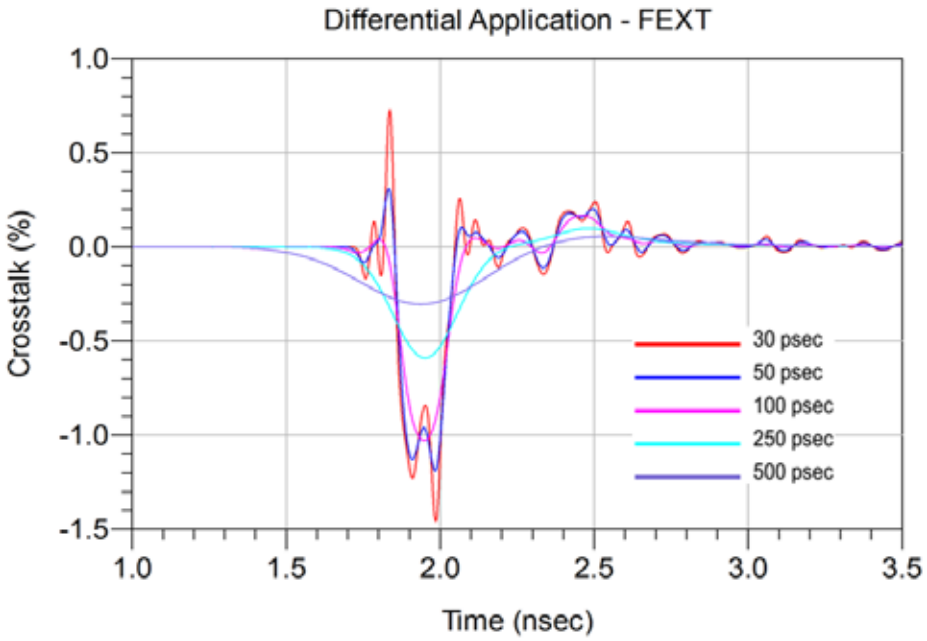
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Differential Application – FEXT, Worst Case Configuration

Case 1



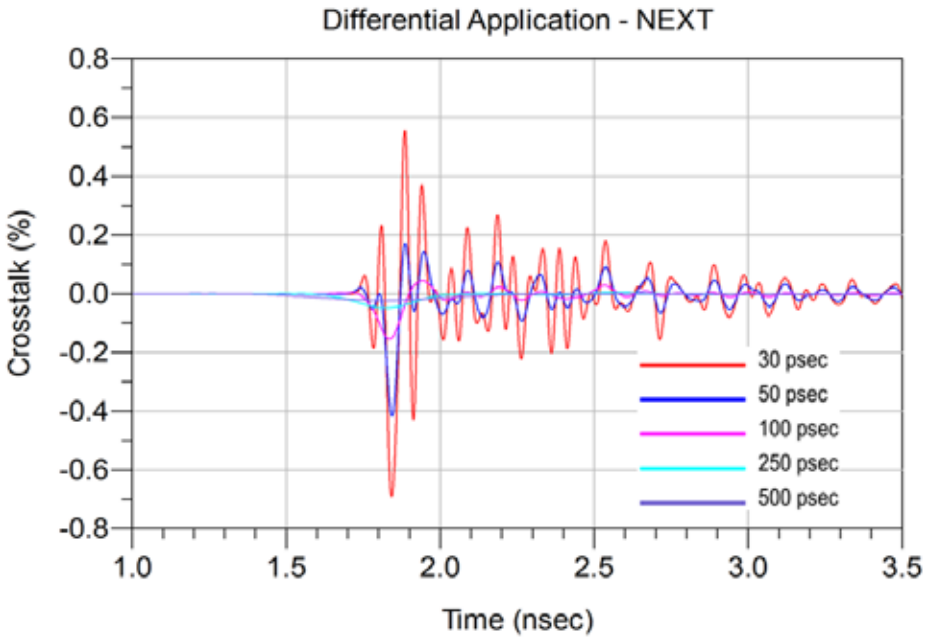
Case 2



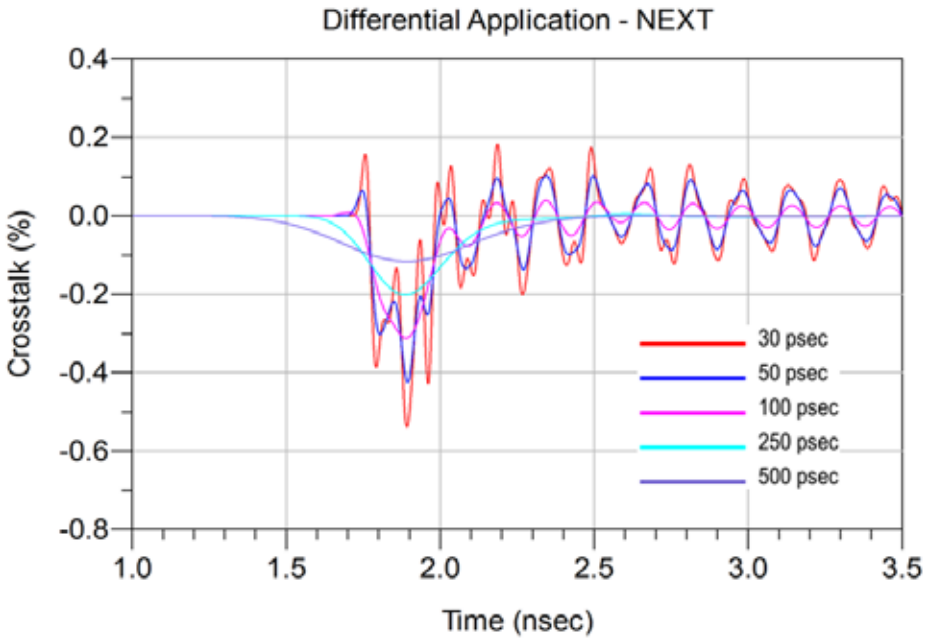
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Differential Application – NEXT, Best Case Configuration

Case 1



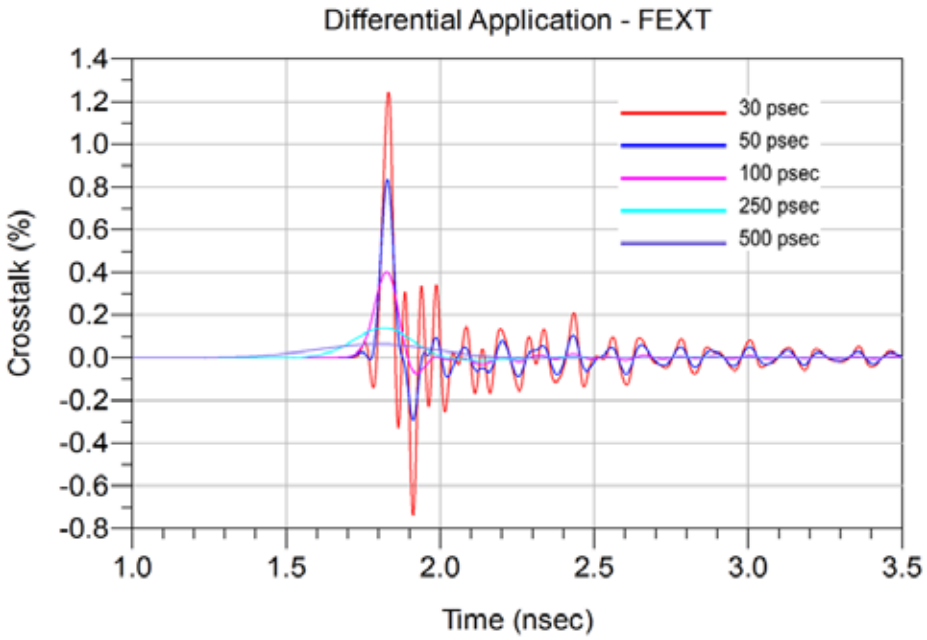
Case 2



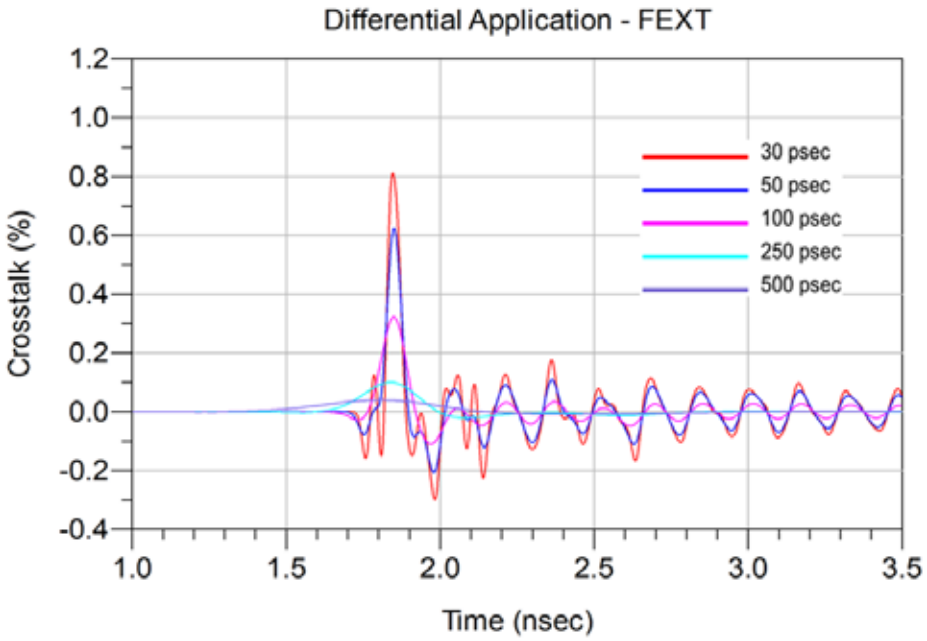
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Differential Application – FEXT, Best Case Configuration

Case 1



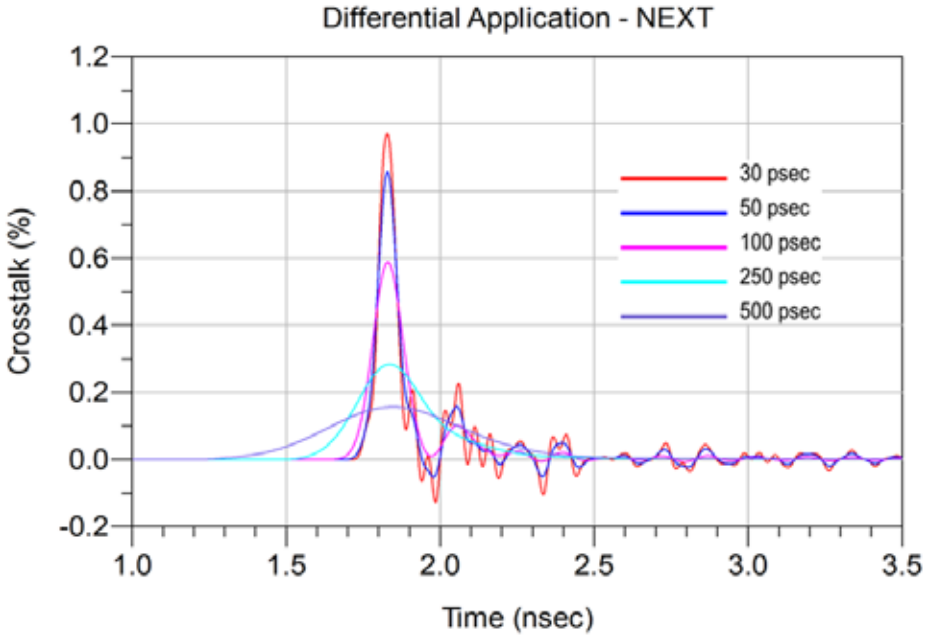
Case 2



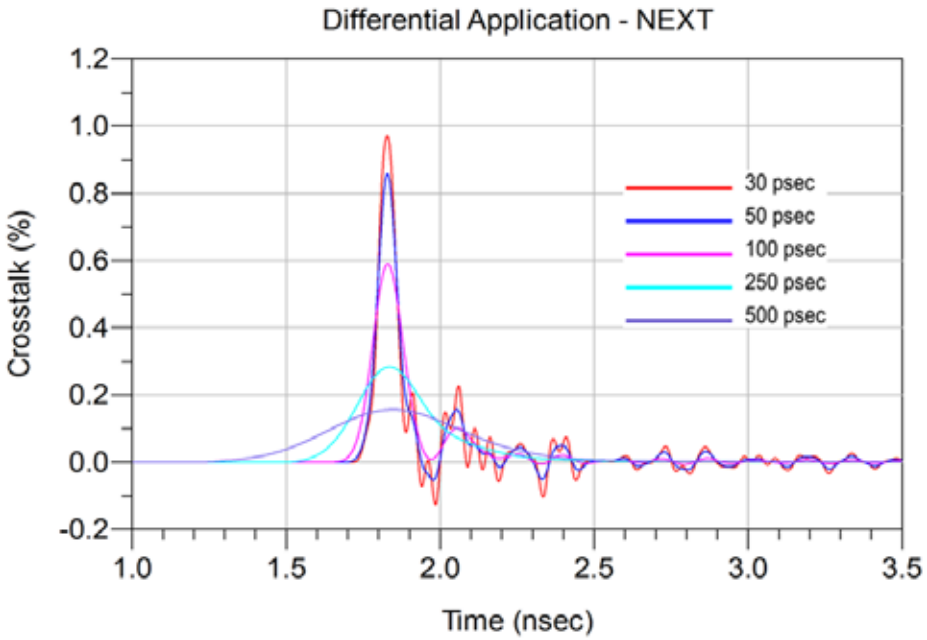
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Differential Application – NEXT, Across Row Case Configuration

Case 1



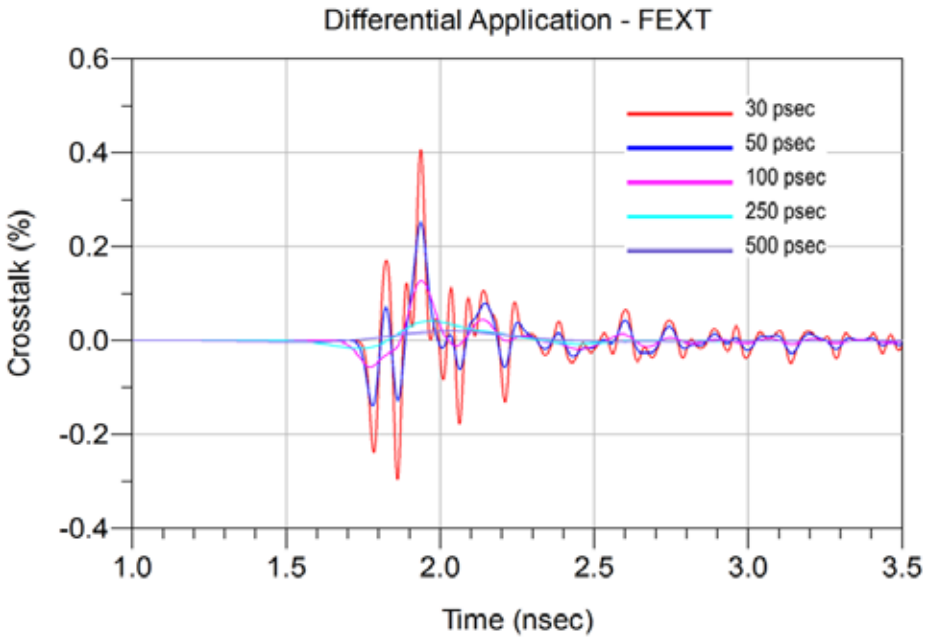
Case 2



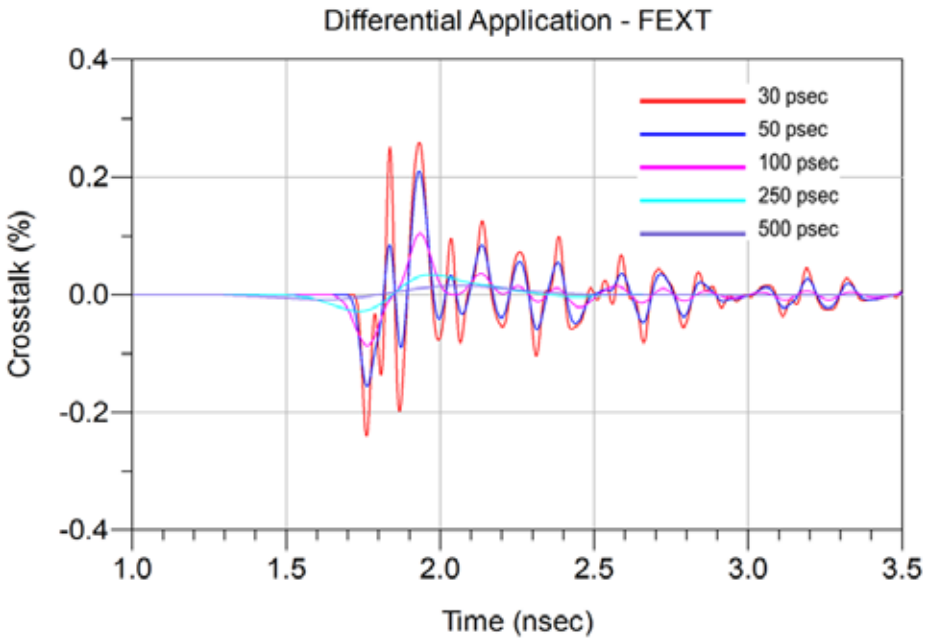
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Differential Application – FEXT, Across Row Case Configuration

Case 1



Case 2



Series: LSEM
Description: Board-to-Board, 0.8mm (.0315”) Pitch, Right Angle to Vertical Orientation

Appendix C – Product and Test System Descriptions

Product Description

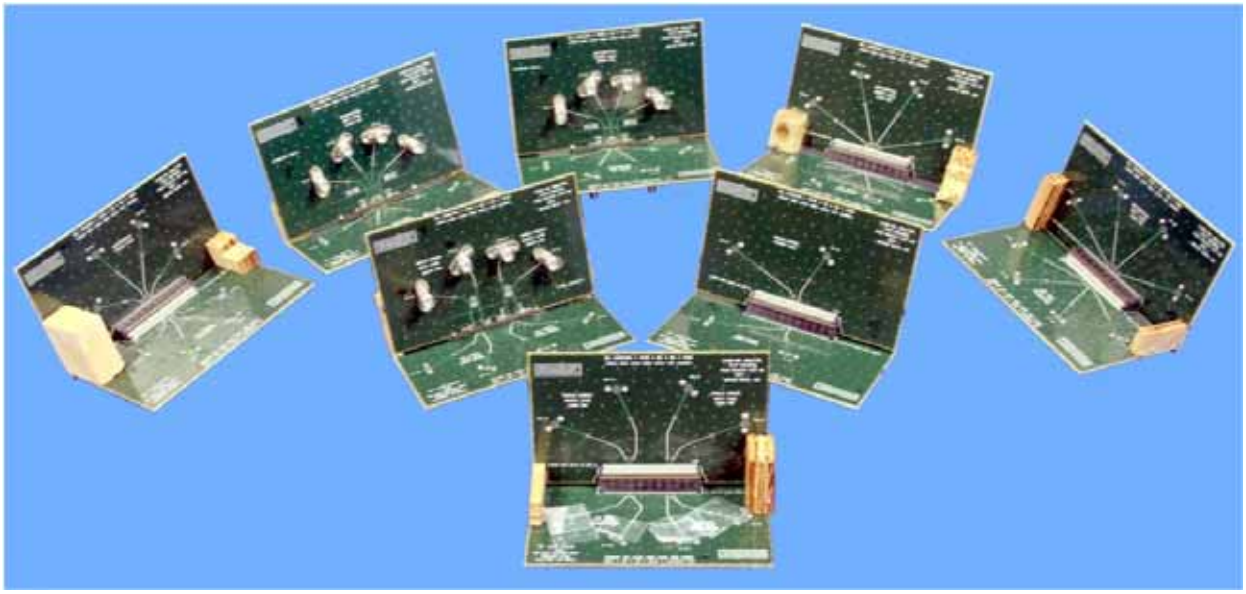
Product test samples are from the hermaphroditic high-speed LSEM connector series. Part numbers are LSEM-150-01-L-DH-A-N-TR and LSEM-150-03.0-L-DV-A-N-TR. Each connector has two rows of 30 contacts evenly spaced on a 0.8 mm (0.0314”) pitch. A photo of the test articles mounted to SI test boards is shown below.

Test System Description

The test fixtures are composed of four-layer FR-4 material with 50Ω signal trace and pad configurations designed for the electrical characterization of Samtec high speed connector products. A PCB mount SMA connector is used to interface the VNA test cables to the test fixtures. SMA launch optimization is attained using full wave simulation tools to minimize reflections. There are 17 test fixtures specific to the LSEM-DH series connector set. Sixteen of the 17 fixtures mate comprising a full hi-speed characterization utilizing 12 test configurations of two signal types. The remaining board contains the SMA/LRM calibration structures designed specifically for the LSEM-DH series. Displayed on the following pages is information for SMA/LRM calibration structures and directives for mating LSEM series fixtures.

PCB-103257-TST-XX Test Fixture

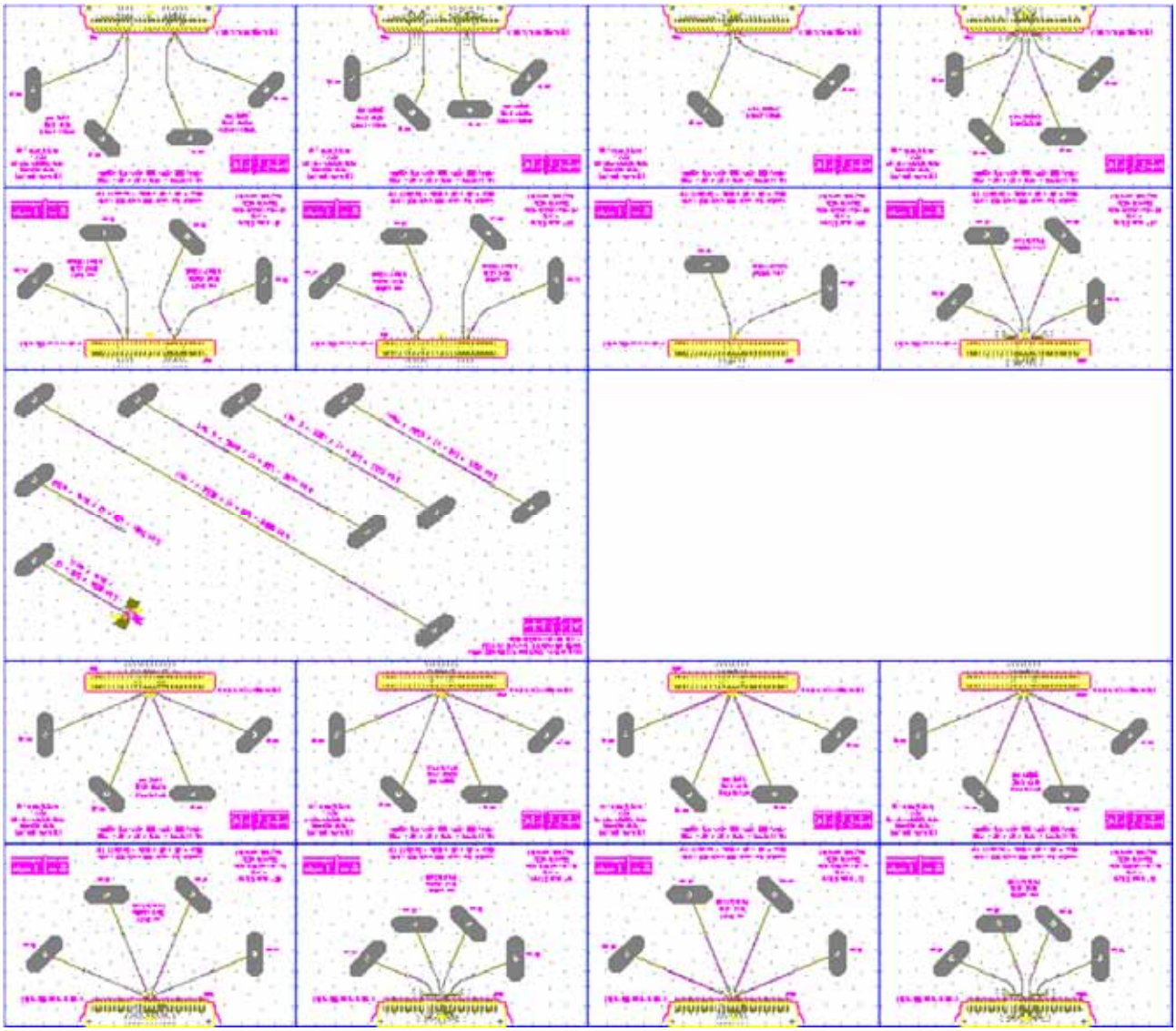
Populated Test Components



Series: LSEM
Description: Board-to-Board, 0.8mm (.0315”) Pitch, Right Angle to Vertical Orientation

PCB-103257-TST-XX PCB Layout Panel

PCB design artwork shown below.

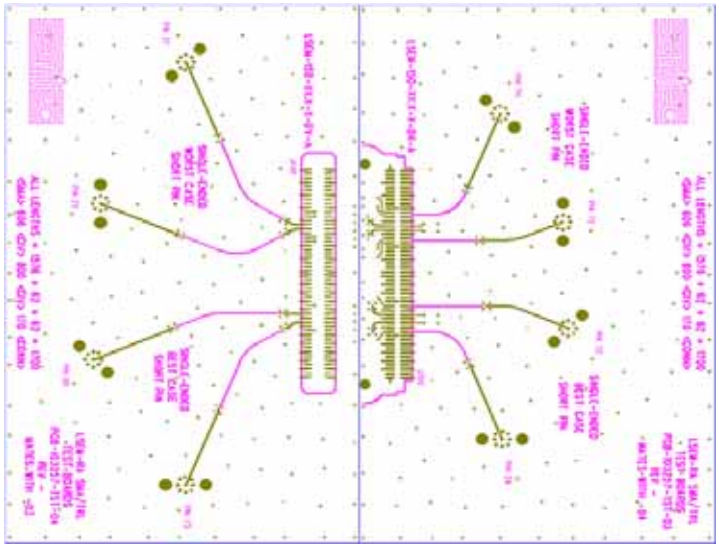


Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

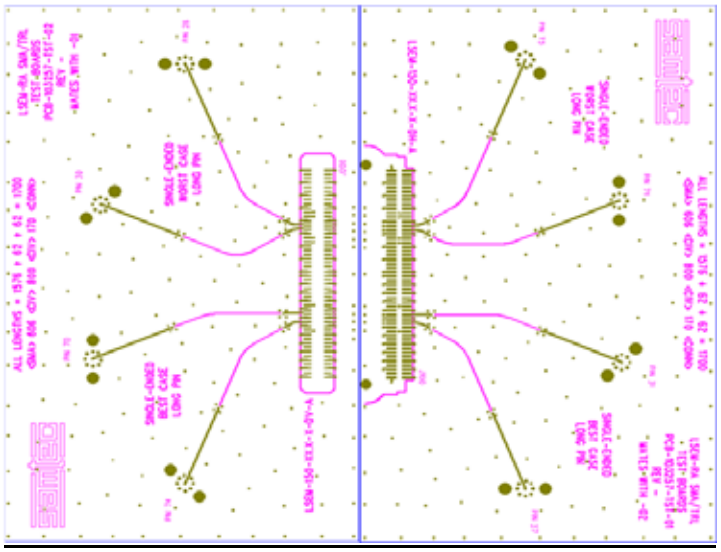
PCB Fixtures

The test fixtures used are as follows:

PCB-103257-TST-01 Rev, LSEM-DH *mates with* PCB-103257-TST-02 Rev, LSEM-DV
Case 1, Single-Ended Best & Worst Case Configurations, Transmission/ Reflection Parameters, Crosstalk Parameters



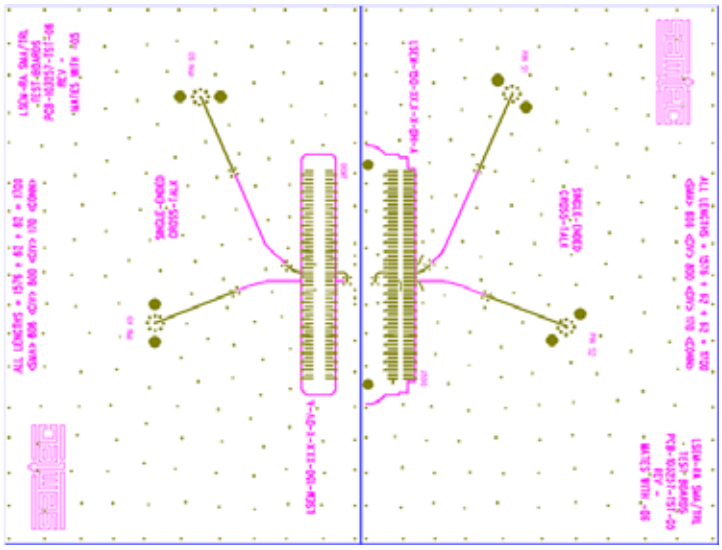
PCB-103257-TST-03 Rev, LSEM-DH *mates with* PCB-103257-TST-04 Rev, LSEM-DV
Case 2, Single-Ended Best & Worst Case Configurations, Transmission/ Reflection Parameters, Crosstalk Parameters



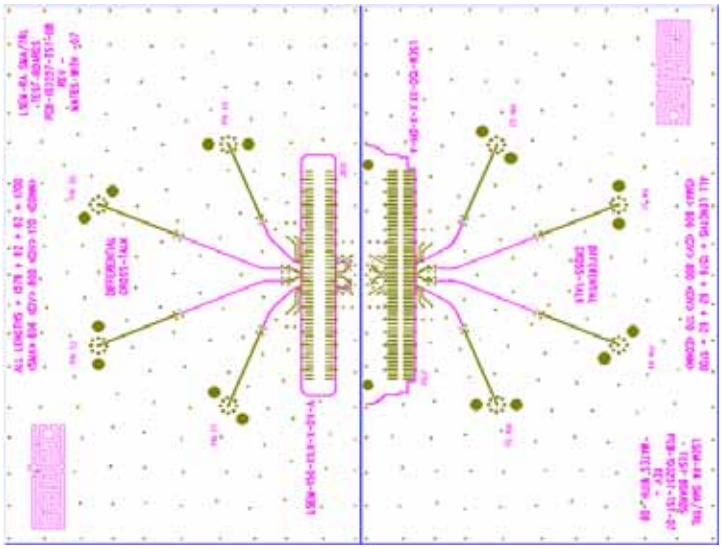
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

PCB Fixtures (Cont.)

PCB-103257-TST-05 Rev, LSEM-DH *mates with* PCB-103257-TST-06 Rev, LSEM-DV
Case 1, Single-Ended Across Row Configuration, Crosstalk Parameters



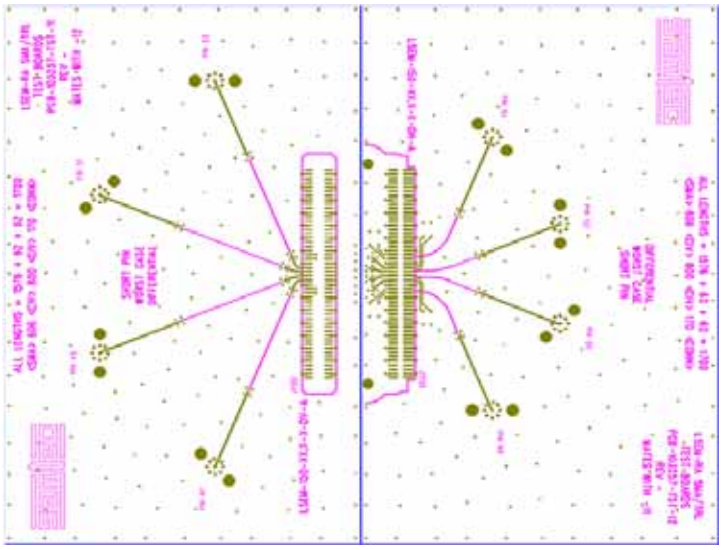
PCB-103257-TST-07 Rev, LSEM-DH *mates with* PCB-103257-TST-08 Rev, LSEM-DV
Case 1, Differential Across Row Configuration, Crosstalk Parameters



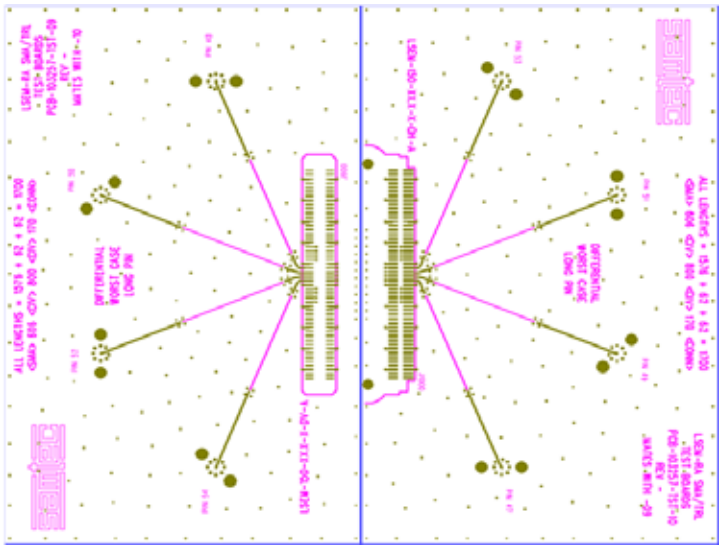
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

PCB Fixtures (Cont.)

PCB-103257-TST-12 Rev, LSEM-DH *mates with* PCB-103257-TST-11 Rev, LSEM-DV
Case 1, Differential Worst Case Configuration, Crosstalk Parameters



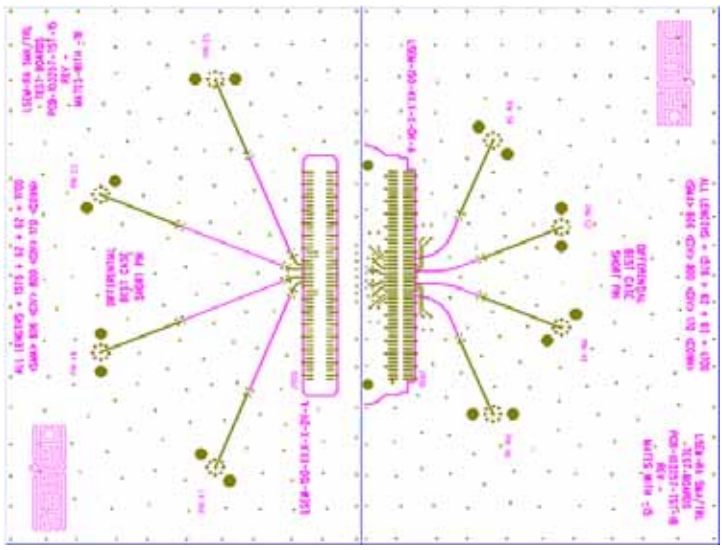
PCB-103257-TST-10 Rev, LSEM-DH *mates with* PCB-103257-TST-09 Rev, LSEM-DV
Case 2, Differential Worst Case Configuration, Crosstalk Parameters



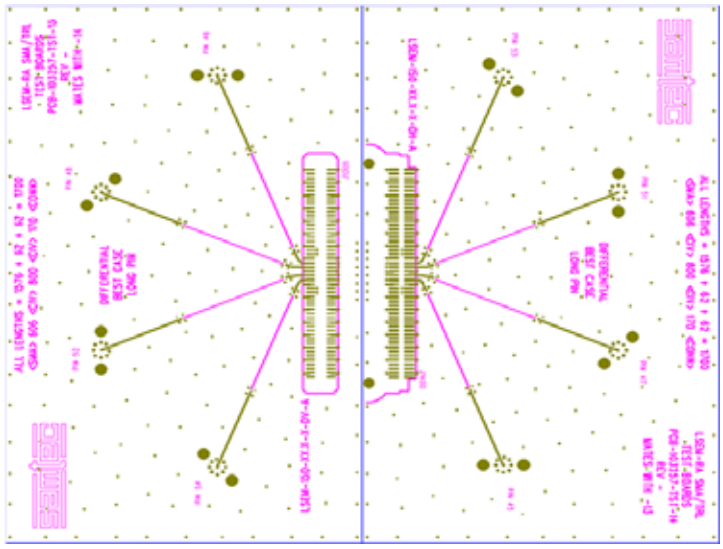
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

PCB Fixtures (Cont.)

PCB-103257-TST-16 Rev, LSEM-DH *mates with* PCB-103257-TST-15 Rev, LSEM-DV
Case 1, Differential Best Case Configuration, Transmission/ Reflection Parameters, Crosstalk Parameters



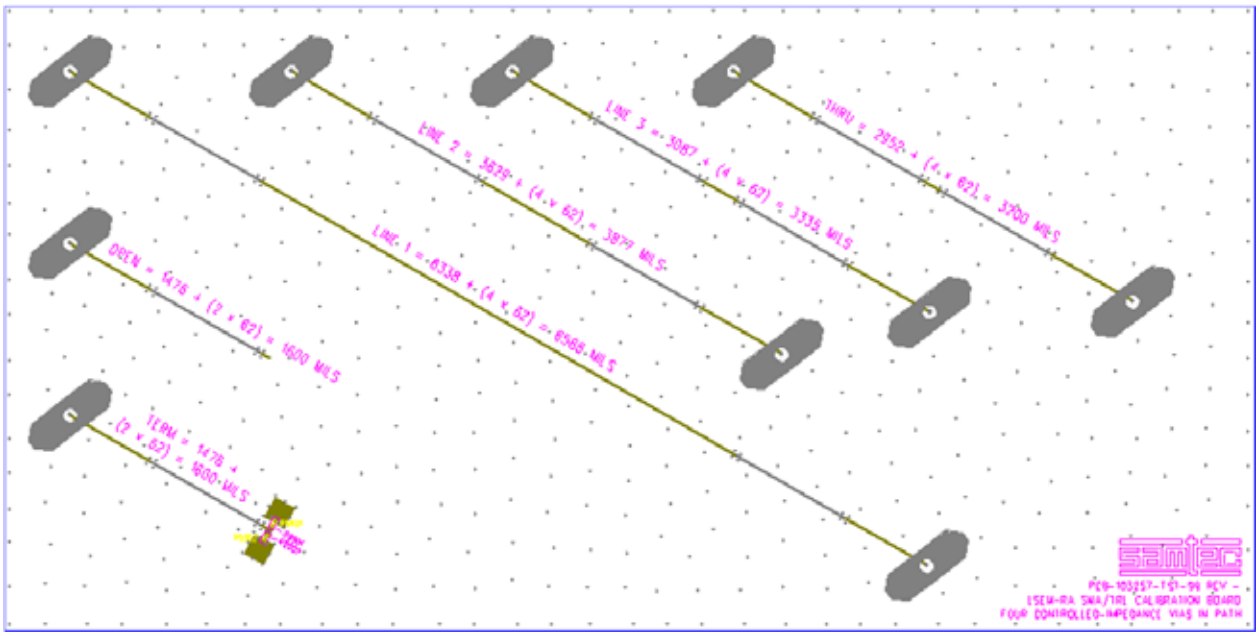
PCB-103257-TST-14 Rev, LSEM-DH *mates with* PCB-103257-TST-13 Rev, LSEM-DV
Case 2, Differential Best Case Configuration, Transmission/ Reflection Parameters, Crosstalk Parameters



Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Calibration Board

Test fixture losses and test point reflections were removed from the data by use of LRM calibration. The calibration boards are shown below. Prior to making any measurements, the calibration board is characterized to obtain parameters required to define the calibration kit. Once a cal kit is defined, calibration using the standards on the calibration board can be performed. Finally, the device can be measured and the test board effects are automatically removed.



Line - Reflect - Match (LRM) Calibration Standards

PCB-103257-TST-99

Reflect Standard - Length = 1600 mils
Match Standard – Length = 1600 mils
Line 1 - Length = 6586 mils
Line 2 - Length = 3877 mils
Line 3 - Length = 3335 mils
Thru Line (2X) = 3200 mils

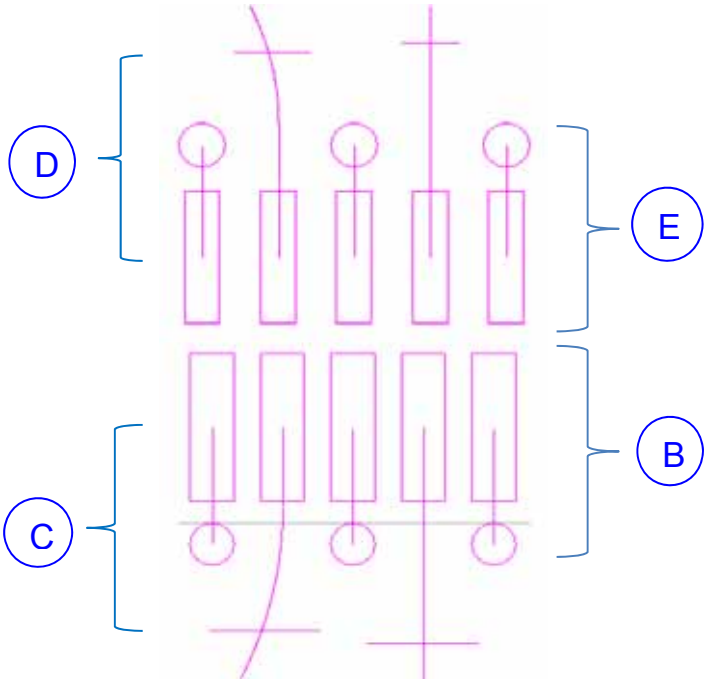
Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

All traces on the test boards are length matched to 1700 mils measured from the center of the pad to the SMA. The TRL calibration effectively removes 1600 mils of trace effects from each test board. The reference plane location is effectively 100 mils from the center of each signal pad. This means 200 mils of PCB signal trace length are included in the measurement. The S-Parameter measurements include:

A- The LSEM-DH/LSEM-DV-03.0 mated connector
B- Via and footprint effects for LSEM-DH
C- 100 mils of 16 mil wide microstrip
D- Via and footprint effects for LSEM-DV
E- 100 mils of 16 mil wide microstrip

The figure below shows the location of the measurement reference plane.

Measurement reference plane
for the LSEM-DV connector



Measurement reference plane
for the LSEM-DH connector

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

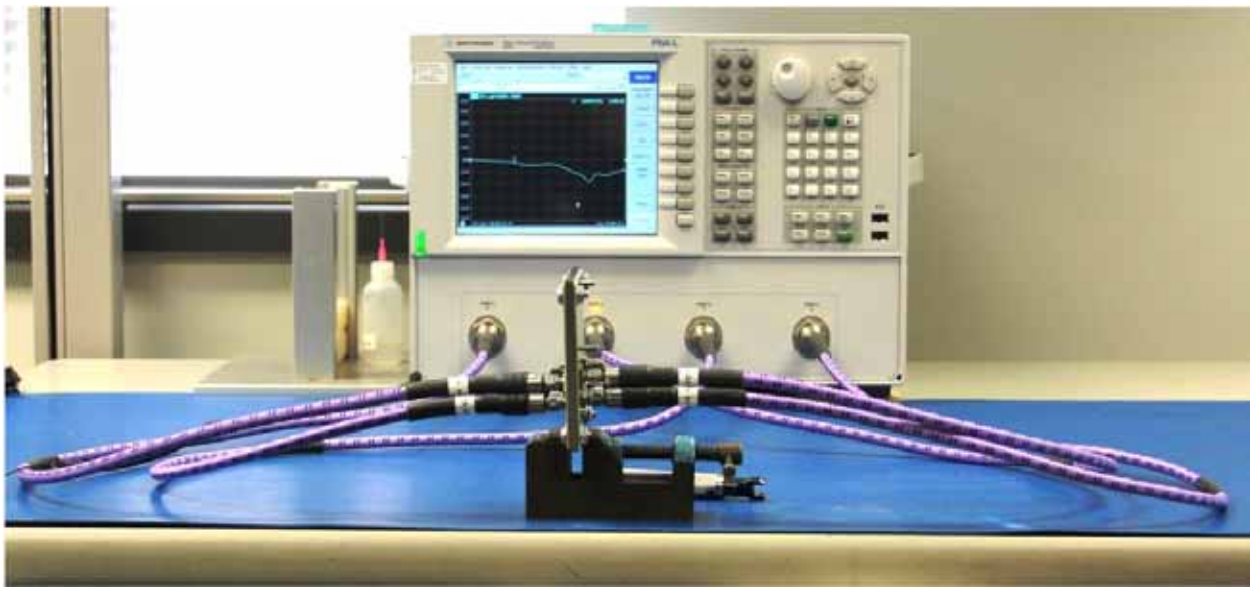
Appendix D – Test and Measurement Setup

The test instrument is the Agilent N5230C PNA-L network analyzer. Frequency domain data and graphs are obtained directly from the instrument. Post-processed time domain data and graphs are generated using convolution algorithms within Agilent ADS. The network analyzer is configured as follows:

Start Frequency – 300 KHz Number of points -1601
Stop Frequency – 20 GHz IFBW – 1 KHz

With these settings, the measurement time is approximately 20 seconds.

N5230C Measurement Setup



Test Instruments

QTY	Description
1	Agilent N5230C PNA-L 4-Port Network Analyzer (300 KHz to 20 GHz)
1	Agilent N4433A Ecal module (300 KHz to 20 GHz)

Test Cables & Adapters

QTY	Description
4	WL Gore –Z0CJ0CK0360 3.5 mm(f) to 3.5mm(m) Test Port Cables

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Appendix E - Frequency and Time Domain Measurements

Frequency (S-Parameter) Domain Procedures

The quality of any data taken with a network analyzer is directly related to the quality of the calibration standards and the use of proper test procedures. For this reason, extreme care is taken in the design of the LRM calibration standards, the SI test boards, and the selection of the PCB vendor.

The measurement process begins with a measurement of the LRM calibration standards. A coaxial SOLT calibration is performed using an N4433A ecal module. This measurement is required in order to obtain precise values of the line standard offset delay and frequency bandwidths. Measurements of the reflect and 2x through line standard can be used to determine the maximum frequency for which the calibration standards are valid. For the LSEM_DH/LSEM_DV Series test boards, this is greater than 20 GHz.

From the LRM calibration standard measurements, a user defined calibration kit is developed and stored in the network analyzer. Calibration is then performed on all 4 ports following the calibration wizard within the Agilent N5230C. This calibration is saved and can be recalled at any time. Calibration takes roughly 30 minutes to perform.

Time Domain Procedures

Mathematically, Frequency Domain data can be transformed to obtain a Time Domain response. Perfect transformation requires Frequency Domain data from DC to infinity Hz. Fortunately, a very accurate Time Domain response can be obtained with bandwidth-limited data, such as measured with modern network analyzer.

The Time Domain responses were generated using Agilent ADS 2011.10. This tool has a transient convolution simulator, which can generate a Time Domain response directly from measured S-Parameters. An example of a similar methodology is provided in the Samtec Technical Note on domain transformation.
http://www.samtec.com/Technical_Library/reference/articles/pdfs/tech-note_using-PLTS-for-time-domain-data_web.pdf

Impedance (TDR)
A step pulse is applied to the touchstone model of the connector and the reflected voltage is monitored. The reflected voltage is converted to a reflection coefficient and then transformed into an impedance profile. All ports of the Touchstone model are terminated in 50 ohms.

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Propagation Delay (TDT)

The Propagation Delay is a measure of the Time Domain delay through the connector and footprint. A step pulse is applied to the touchstone model of the connector and the transmitted voltage is monitored. The same pulse is also applied to a reference channel with zero loss, and the Time Domain pulses are plotted on the same graph. The difference in time, measured at the 50% point of the step voltage is the propagation delay.

Near-End Crosstalk (TDT) & Far End Crosstalk (TDT)

A step pulse is applied to the touchstone model of the connector and the coupled voltage is monitored. The amplitude of the peak-coupled voltage is recorded and reported as a percentage of the input pulse.

Series: LSEM
Description: Board-to-Board, 0.8mm (.0315") Pitch, Right Angle to Vertical Orientation

Appendix F – Glossary of Terms

ADS – Advanced Design Systems
BC – Best Case crosstalk configuration
DUT – Device under test, term used for TDA IConnect & Propagation Delay waveforms
FD – Frequency domain
FEXT – Far-End Crosstalk
GSG – Ground–Signal-Ground; geometric configuration
GSSG - Ground–Signal-Signal-Ground; geometric configuration
HDV – High Density Vertical
NEXT – Near-End Crosstalk
OV – Optimal Vertical
OH – Optimal Horizontal
PCB – Printed Circuit Board
PPO – Pin Population Option
SE – Single-Ended
SI – Signal Integrity
SUT – System Under Test
S – Static (independent of PCB ground)
SOLT – acronym used to define Short, Open, Load & Thru Calibration Standards
TD – Time Domain
TDA – Time Domain Analysis
TDR – Time Domain Reflectometry
TDT – Time Domain Transmission
WC – Worst Case crosstalk configuration
Z – Impedance (expressed in ohms)