



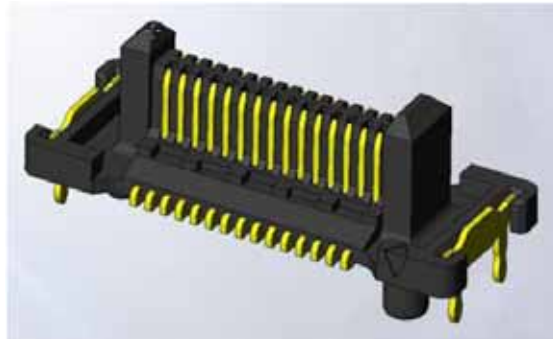
High Speed Characterization Report

FS5-30-04.0-L-DV-TH



Mates with

FT5-30-01.0-L-DV-TH



Description:

**High Speed Floating Contact Socket and Terminal Strip
Board-to-Board, 0.5mm Pitch, 5mm Stack Height**

Series: FS5/FT5**Description:** High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

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Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Connector Overview

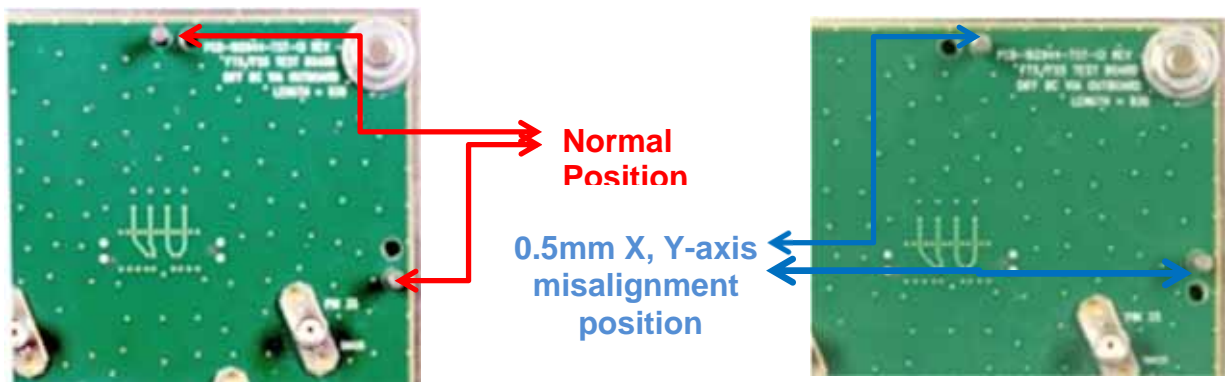
Samtec' s FS5/FT5 Interconnect System contacts float 0.5mm on the X and Y axis. The system minimizes misalignment and is ideal for multiple connector board-to-board applications. The connector system features either 15 or 30 contacts per row and is available in 5mm and 7mm stack heights. The data in this report is applicable only to the 5mm stack height.

Since the contact system floats, there is a potential for variance in the electrical performance. To track the possible changes in electrical performance, tests are performed in a normal mating position and again after the system is floated to the maximum .5mm X and .5mm Y misalignment position.

*The normal mating position of the connector is referred to as "Case 1"

*The maximum 0.5mm X and Y misalignment positions are referred to as "Case 2"

The normal and misalignment positions are illustrated in the following figures.



Connector System Speed Rating

FS5/FT5 Floating Contact Strip, 5mm Stack Height Board-to-Board, 0.5mm Pitch,

<u>Case</u>	<u>Signaling</u>	<u>Speed Rating</u>
1	Single-Ended:	6 GHz/ 12Gbps
	Differential:	6 GHz/ 12Gbps
2	Single-Ended:	6 GHz/ 12Gbps
	Differential:	6 GHz/ 12Gbps

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

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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.

Frequency Domain Data Summary

Table 1 - Single-Ended Connector System Performance			
Case	Test Parameter	Configuration	
1	Insertion Loss	GSG	3dB @ 5.8 GHz
	Return Loss	GSG	> 10dB to 3.9 GHz
	Near-End Crosstalk	GAQG	< -20dB to 0.5 GHz
		GAGQG	< -20dB to 10.4 GHz
		Xrow, GAG to QQG	< -20dB to 20.0 GHz
	Far-End Crosstalk	GAQG	< -20dB to 4.3 GHz
		GAGQG	< -20dB to 5.8 GHz
		Xrow, GAG to QQG	< -20dB to 15.9 GHz
	2	Insertion Loss	GSG
Return Loss		GSG	> 10dB to 4.0 GHz
Near-End Crosstalk		GAQG	< -20dB to 0.5 GHz
		GAGQG	< -20dB to 10.4 GHz
		Xrow, GAG to QQG	< -20dB to 20.0 GHz
Far-End Crosstalk		GAQG	< -20dB to 11.7 GHz
		GAGQG	< -20dB to 5.6 GHz
		Xrow, GAG to QQG	< -20dB to 20.0 GHz

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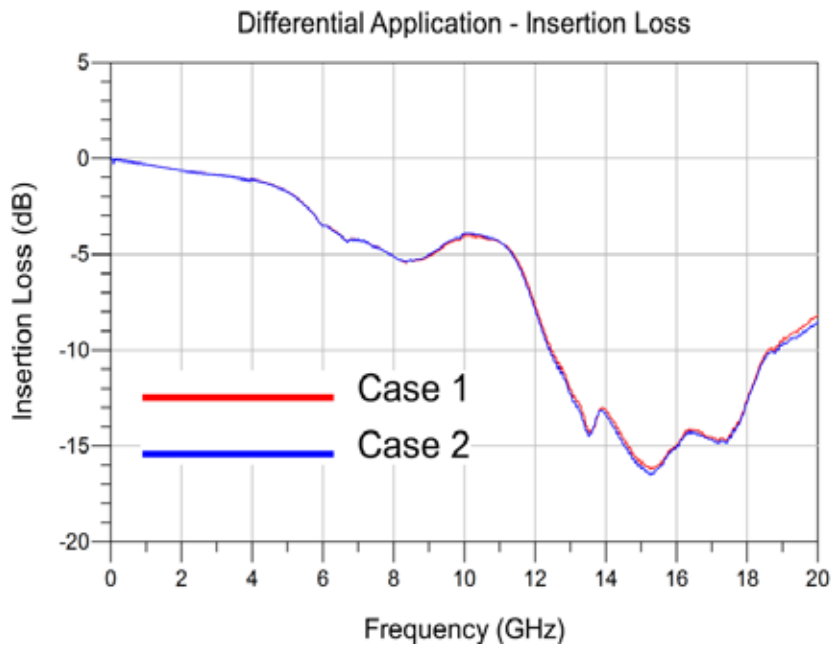
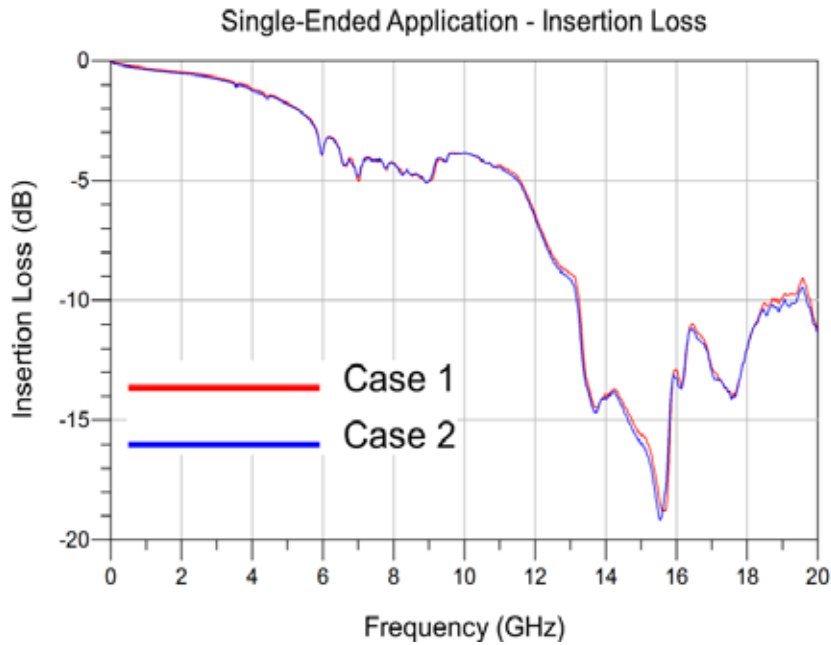
Table 2 - Differential Connector System Performance			
Case	Test Parameter	Configuration	
1	Insertion Loss	GSSG	3dB @ 5.8 GHz
	Return Loss	GSSG	> 10dB to 4.4 GHz
	Near-End Crosstalk	GAAQQG	< -20dB to 20.0 GHz
		GAAGQQG	< -20dB to 20.0 GHz
		Xrow, GAAG to GQQG	< -20dB to 20.0 GHz
	Far-End Crosstalk	GAAQQG	< -20dB to 20.0 GHz
		GAAGQQG	< -20dB to 20.0 GHz
		Xrow, GAAG to GQQG	< -20dB to 20.0 GHz
2	Insertion Loss	GSSG	3dB @ 5.8 GHz
	Return Loss	GSSG	> 10dB to 4.0 GHz
	Near-End Crosstalk	GAAQQG	< -20dB to 20.0 GHz
		GAAGQQG	< -20dB to 20.0 GHz
		Xrow, GAAG to GQQG	< -20dB to 20.0 GHz
	Far-End Crosstalk	GAAQQG	< -20dB to 20.0 GHz
		GAAGQQG	< -20dB to 20.0 GHz
		Xrow, GAAG to GQQG	< -20dB to 20.0 GHz

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Bandwidth Chart – Single-Ended & Differential Insertion Loss

FS5/FT5 Connector Series

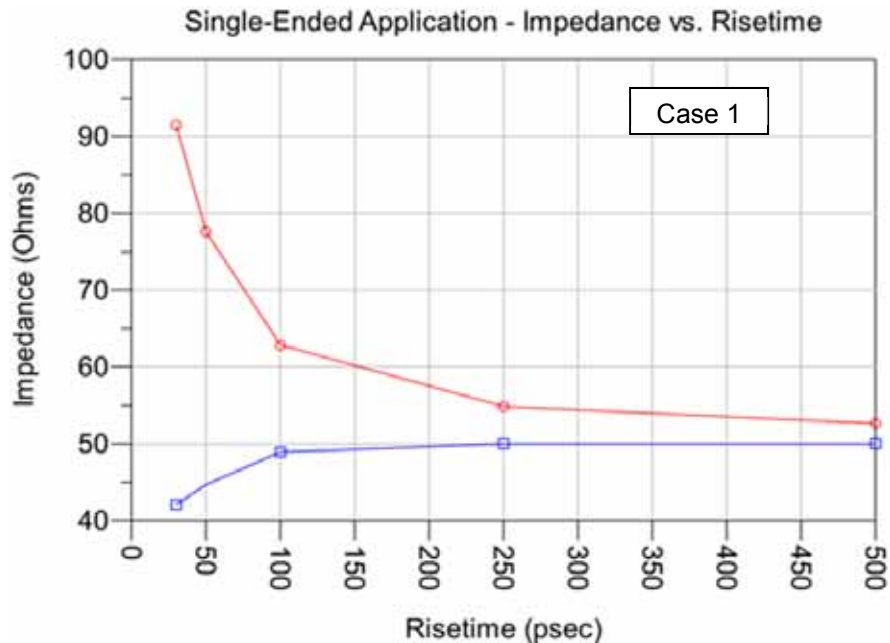


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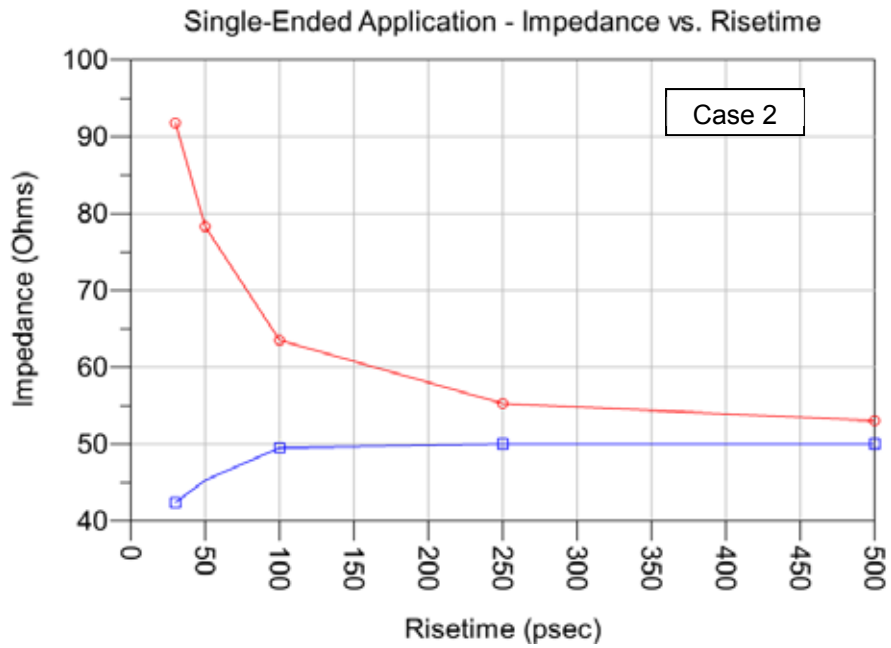
Time Domain Data Summary

Table 3 – Single-End Impedance (Ω)						
Case	Signal Risetime	30 ps	50 ps	100 ps	250 ps	500 ps
1	Maximum Impedance	91.4	77.6	62.9	54.8	52.6
	Minimum Impedance	42.1	44.7	48.9	50.0	50.0
2	Maximum Impedance	91.7	78.3	63.5	55.3	53.0
	Minimum Impedance	42.4	45.3	49.5	50.0	50.0



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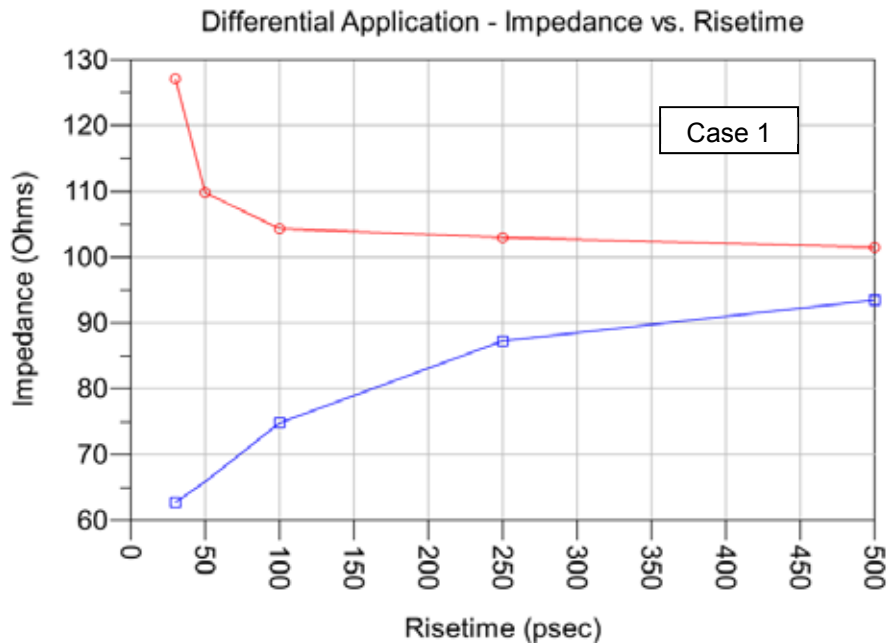
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,



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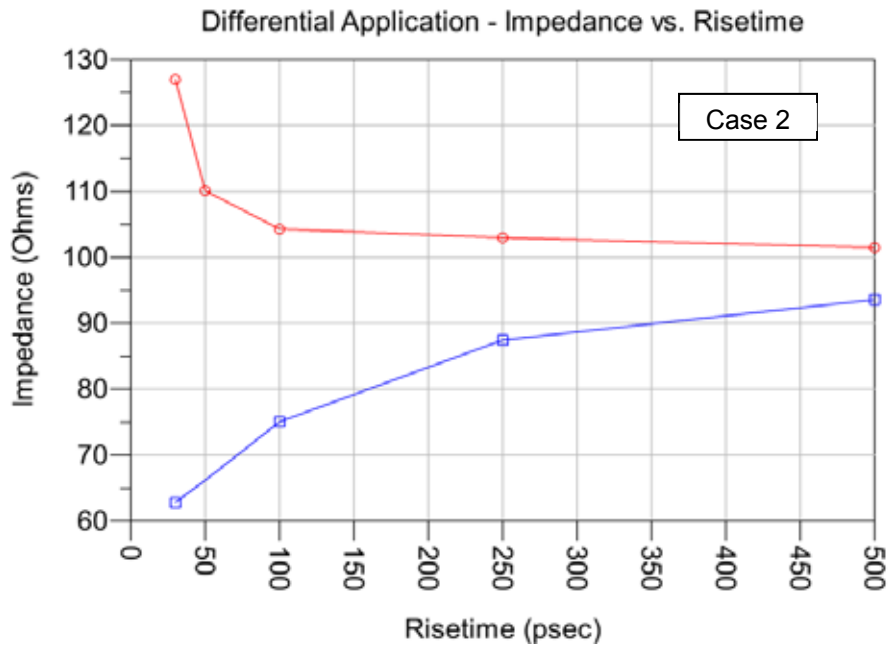
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Table 4 - Differential Impedance (Ω)						
Case	Signal Risetime	30 ps	50 ps	100 ps	250 ps	500 ps
1	Maximum Impedance	127.1	109.8	104.3	103.0	101.5
	Minimum Impedance	62.7	65.9	74.8	87.3	93.5
2	Maximum Impedance	127.0	110.1	104.3	103.0	101.5
	Minimum Impedance	62.8	66.2	75.0	87.4	93.6



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Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,



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Table 5 - Single-Ended Crosstalk (%)							
Case	Input(tr)		30ps	50 ps	100 ps	250 ps	500 ps
1	NEXT	GAQG	17.3	16.8	16.2	11.1	6.3
		GAGQG	3.0	2.8	2.1	1.2	.7
		Xrow	1.9	1.8	1.3	.7	.4
	FEXT	GAQG	3.1	2.9	2.3	1.0	.5
		GAGQG	2.9	2.4	1.4	.6	.3
		Xrow	.4	.3	.2	.1	<0.1
2	NEXT	GAQG	17.5	17.0	16.4	11.1	6.3
		GAGQG	3.0	2.7	2.4	1.2	.7
		Xrow	2.0	1.8	1.3	.7	.4
	FEXT	GAQG	3.1	3.0	2.4	1.0	.5
		GAGQG	2.8	2.3	1.4	.6	.3
		Xrow	.4	.3	.2	.1	<0.1

Table 6 - Differential Crosstalk (%)							
Case	Input(tr)		30ps	50 ps	100 ps	250 ps	500 ps
1	NEXT	GAAQQG	5.3	5.1	4.8	3.6	2.1
		GAAGQQG	.5	.5	.3	.2	.1
		Xrow	.5	.5	.4	.2	.1
	FEXT	GAAQQG	2.4	2.1	1.5	.9	.5
		GAAGQQG	.5	.4	.2	.1	<0.1
		Xrow	.4	.3	.2	.1	.1
2	NEXT	GAAQQG	5.3	5.2	4.9	3.6	2.1
		GAAGQQG	.6	.5	.3	.2	.1
		Xrow	.5	.5	.4	.2	.1
	FEXT	GAAQQG	2.3	2.0	1.4	.9	.5
		GAAGQQG	1.7	1.3	.6	.2	.1
		Xrow	.4	.3	.2	.1	.1

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Table 7 - Propagation Delay (Mated Connector)		
Case 1	Single-Ended	134 ps
	Differential	133 ps
Case 2	Single-Ended	135 ps
	Differential	133 ps

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Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

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.

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Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

For this connector, the following array configurations are evaluated:

Single-Ended Impedance:

- GSG (ground-signal-ground)

Single-Ended Crosstalk:

- 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.

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Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

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 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 80 mils of PCB trace on the TEM-DH connector side and 77.5 mils of PCB trace on the SEM 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.



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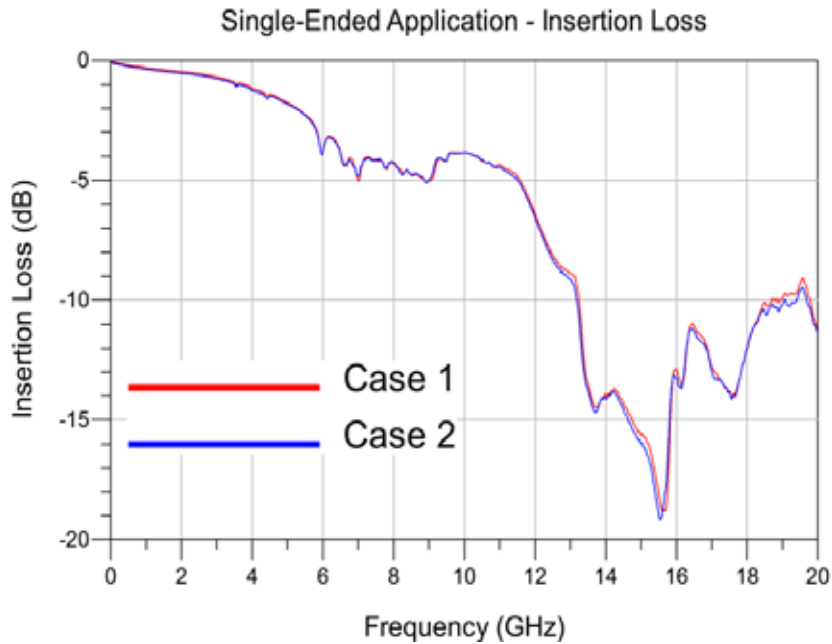
Additional information concerning test conditions and procedures is located in the appendices of this report. Further information may be obtained by contacting our Signal Integrity Group at sig@samtec.com.

Series: FS5/FT5

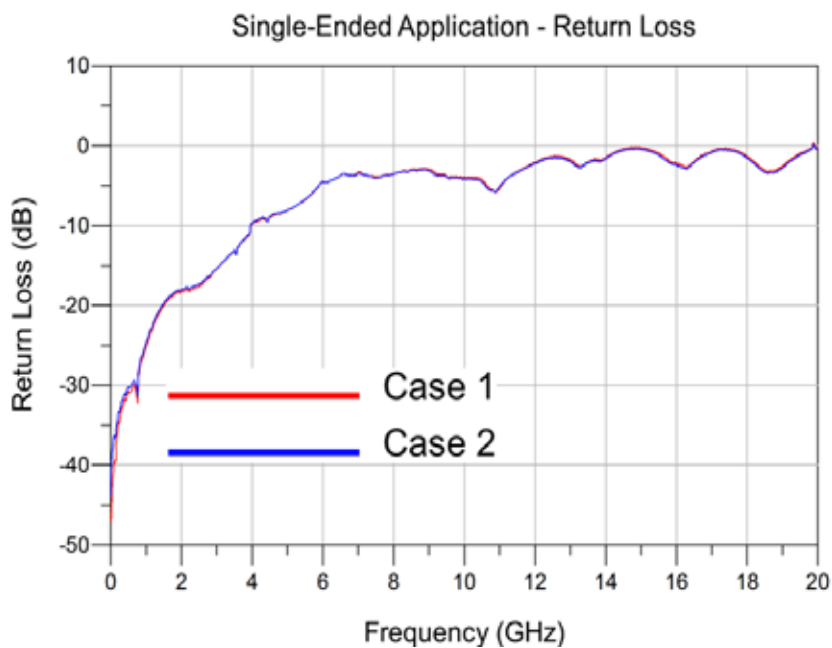
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Appendix A – Frequency Domain Response Graphs

Single-Ended Application – Insertion Loss



Single-Ended Application – Return Loss

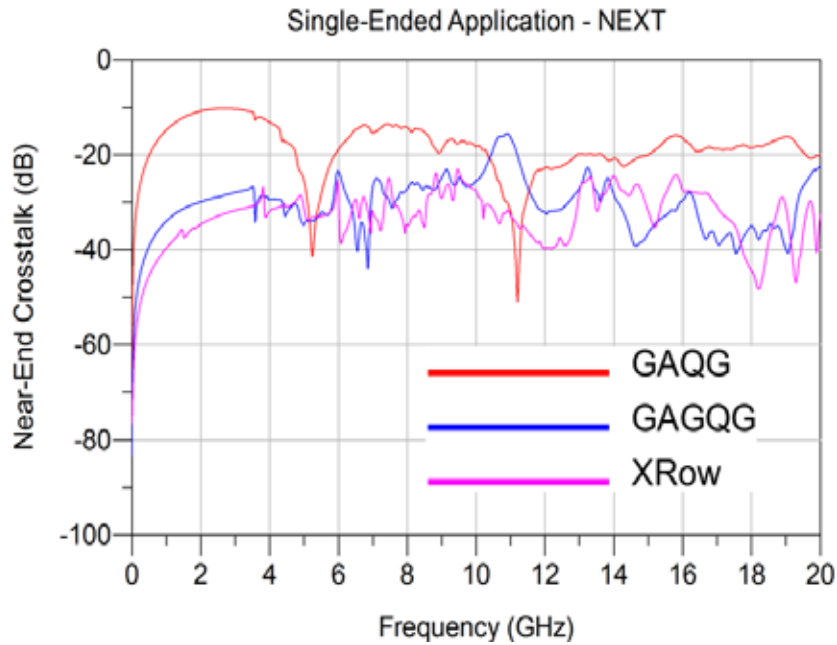


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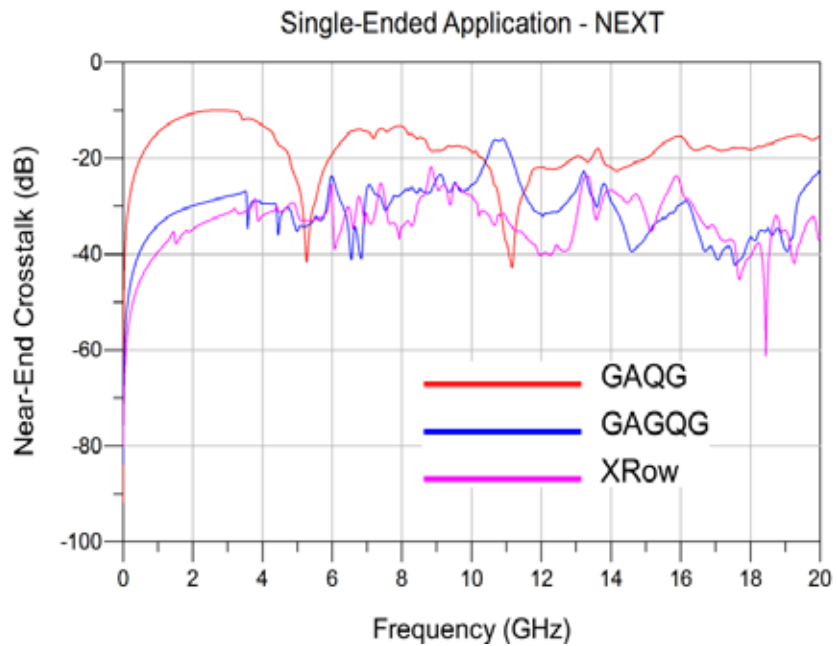
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Single-Ended Application – NEXT Configurations

Case 1



Case 2

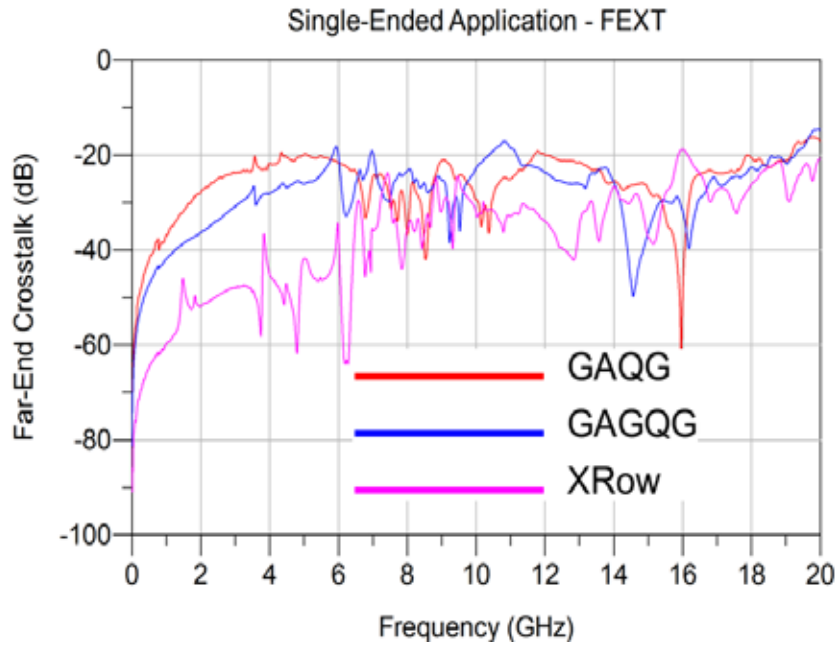


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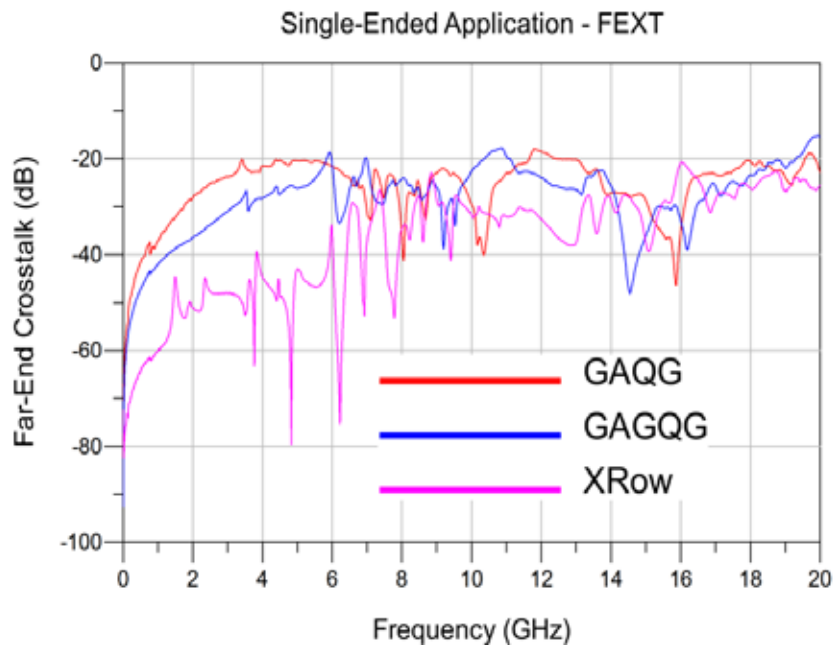
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Single-Ended Application – FEXT Configurations

Case 1



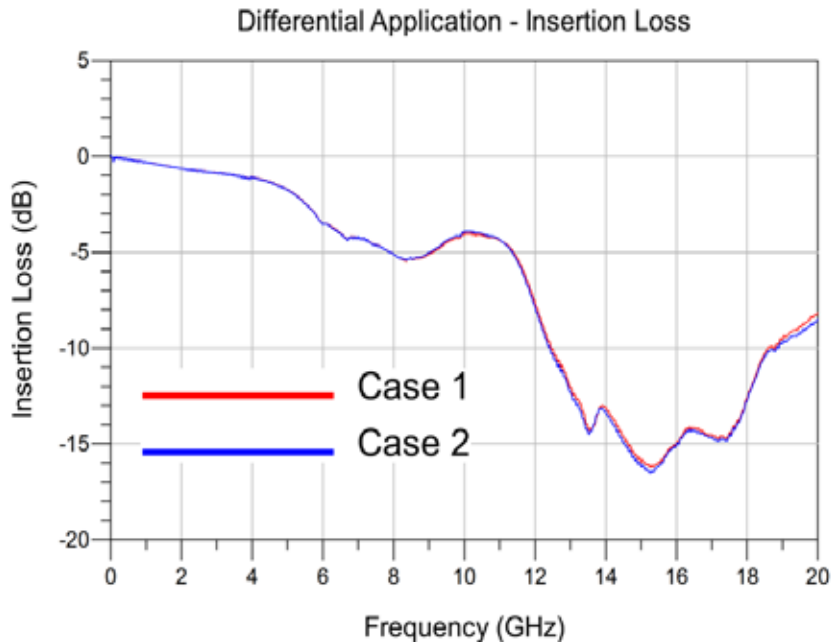
Case 2



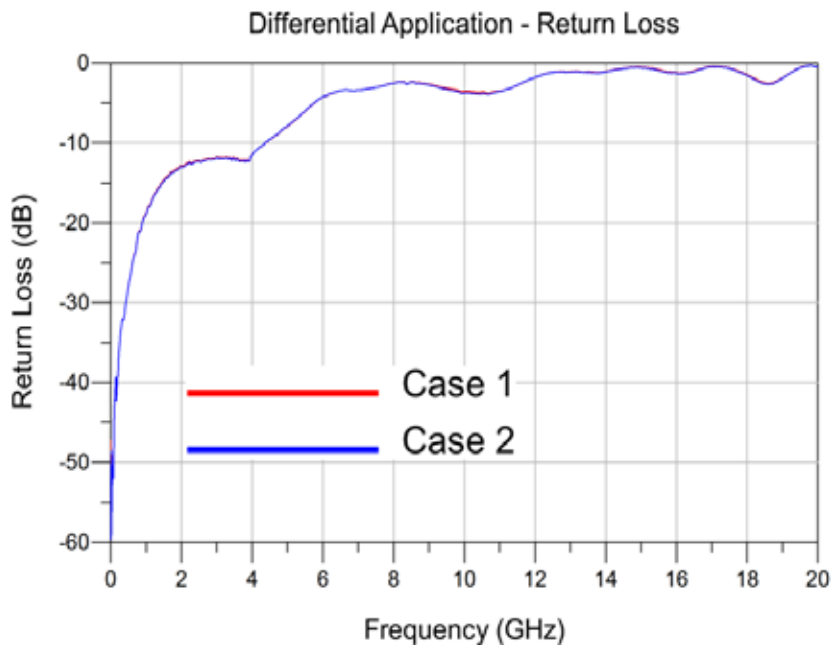
Series: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Differential Application – Insertion Loss



Differential Application – Return Loss

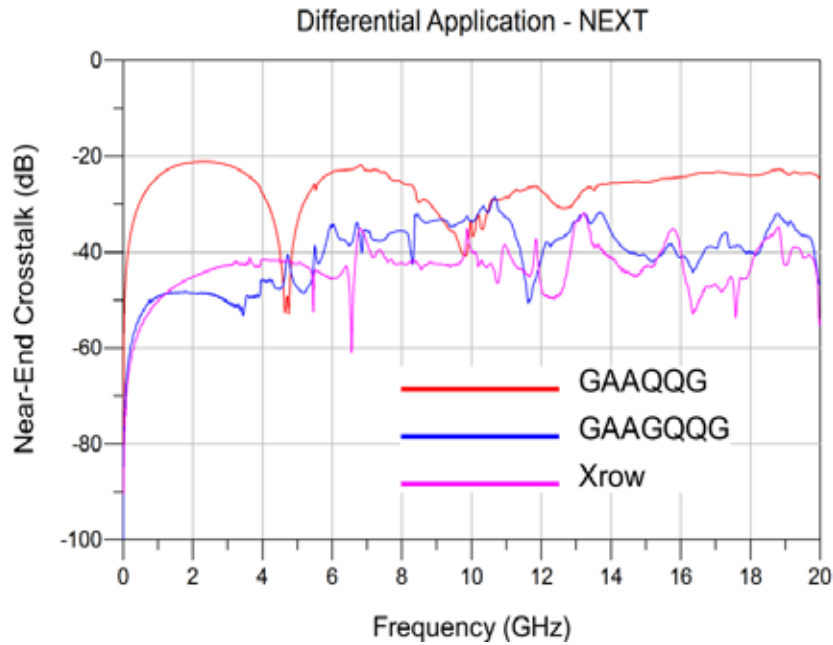


Series: FS5/FT5

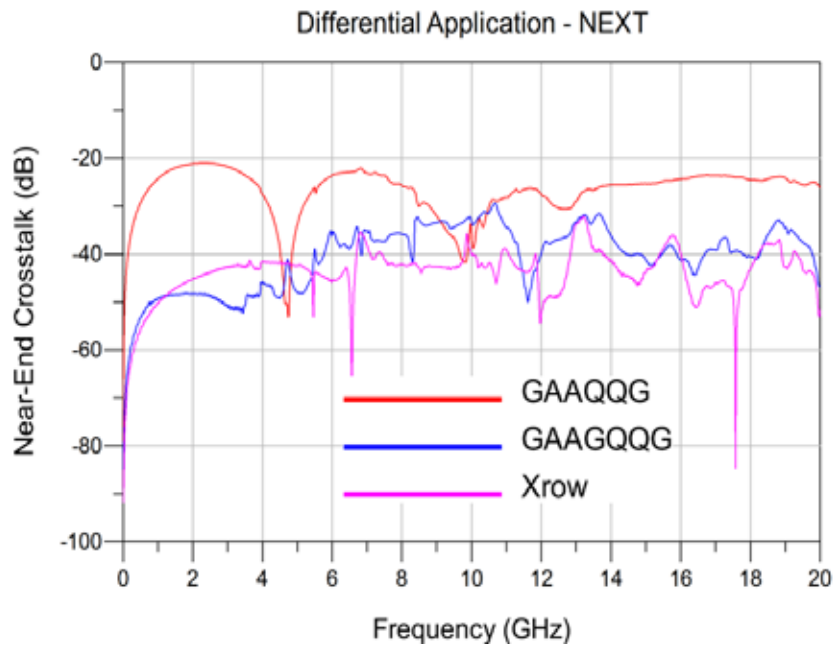
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Differential Application – NEXT Configurations

Case 1



Case 2

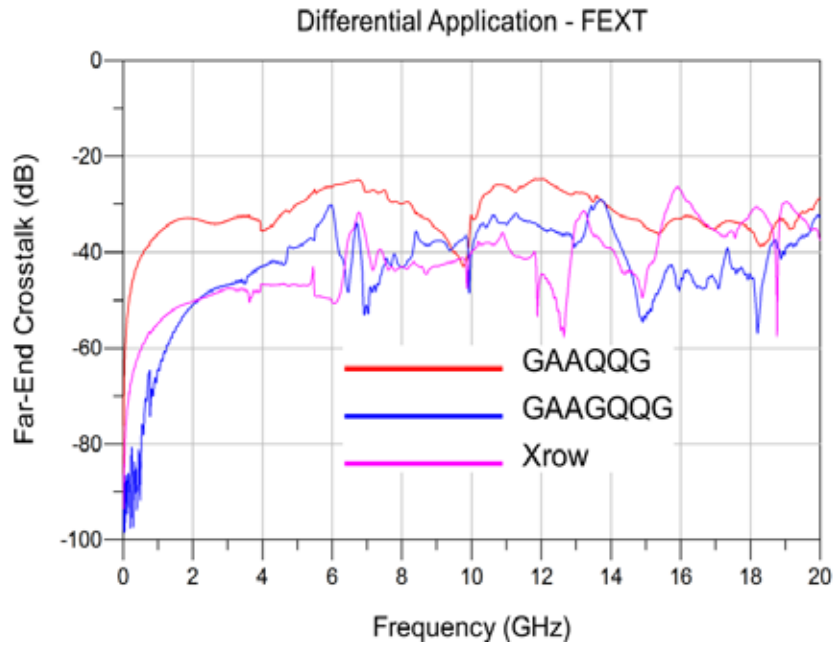


Series: FS5/FT5

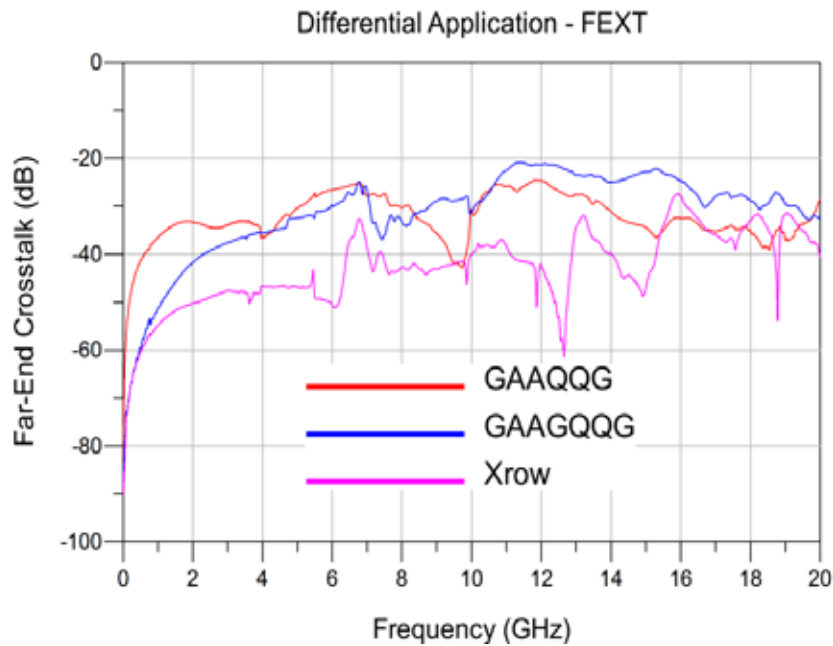
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Differential Application – FEXT Configurations

Case 1



Case 2

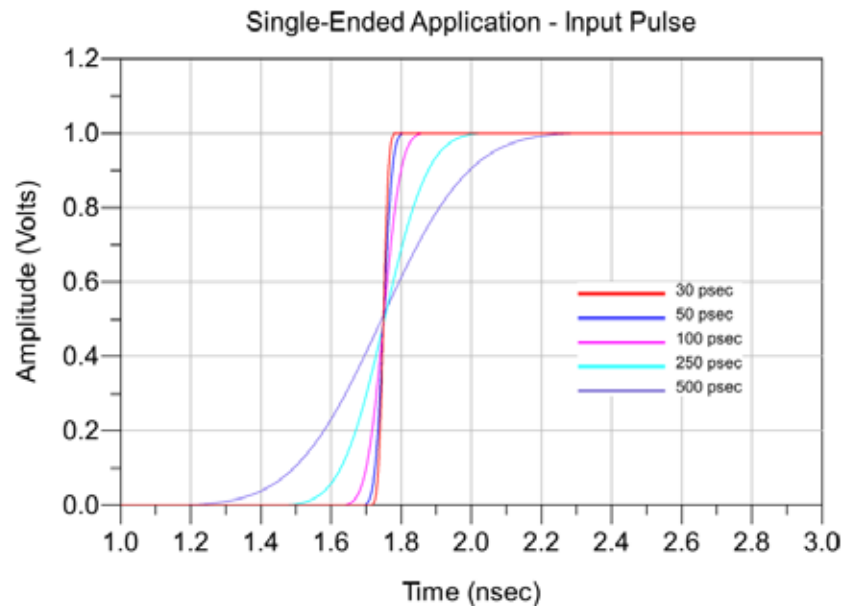


Series: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Appendix B – Time Domain Response Graphs

Single-Ended Application – Input Pulse

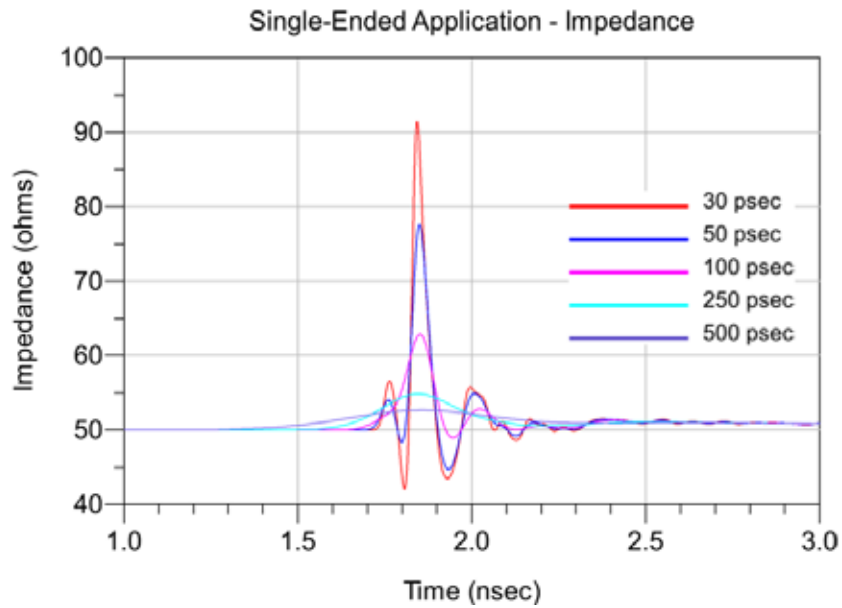


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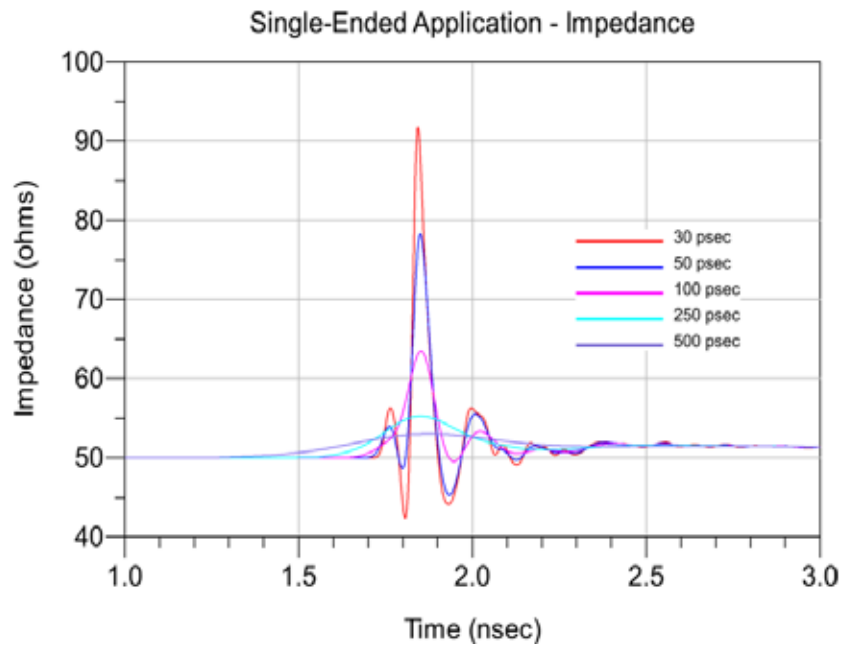
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Single-Ended Application – Impedance

Case 1



Case 2

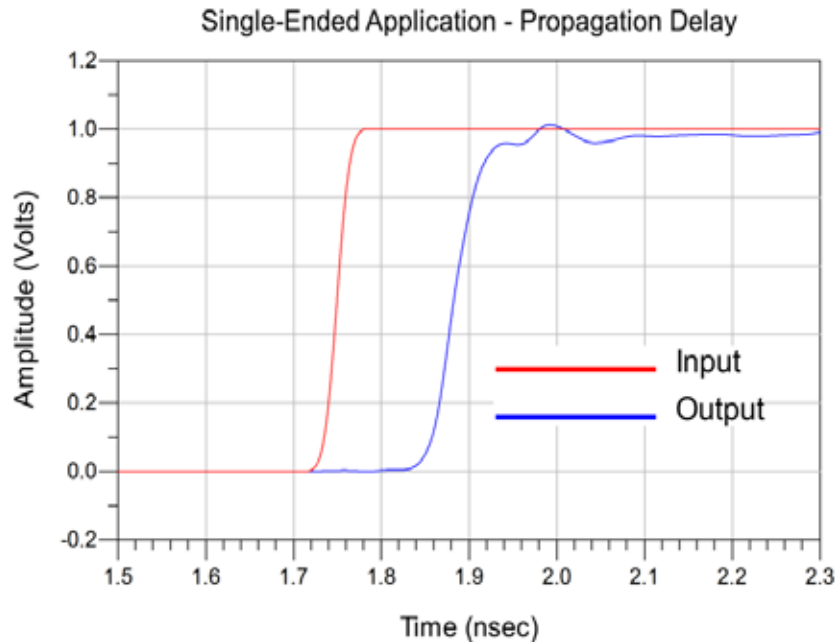


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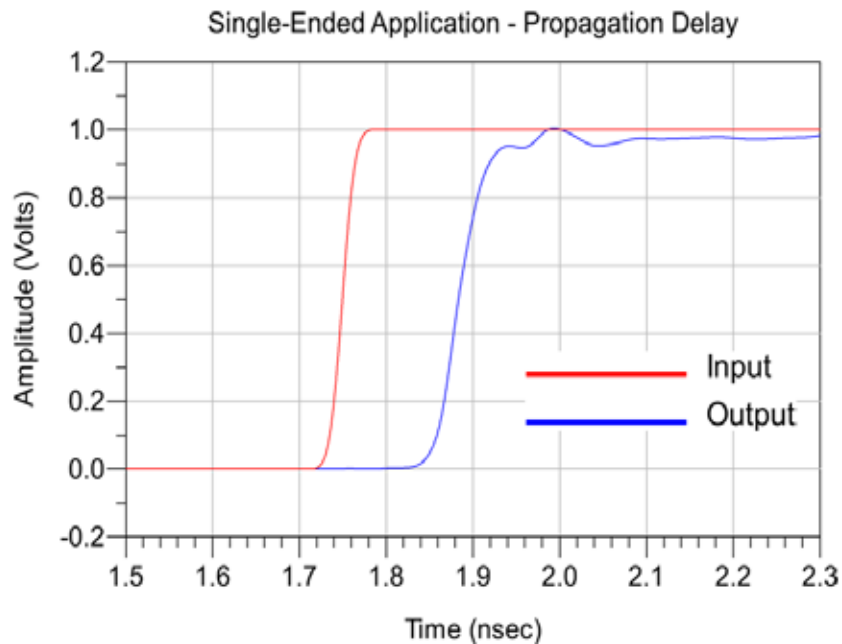
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Single-Ended Application – Propagation Delay

Case 1



Case 2

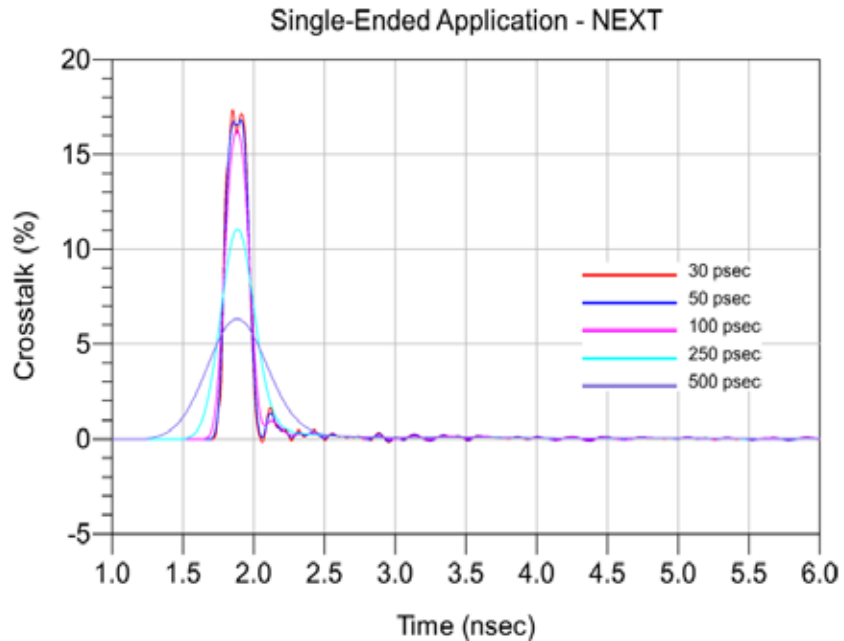


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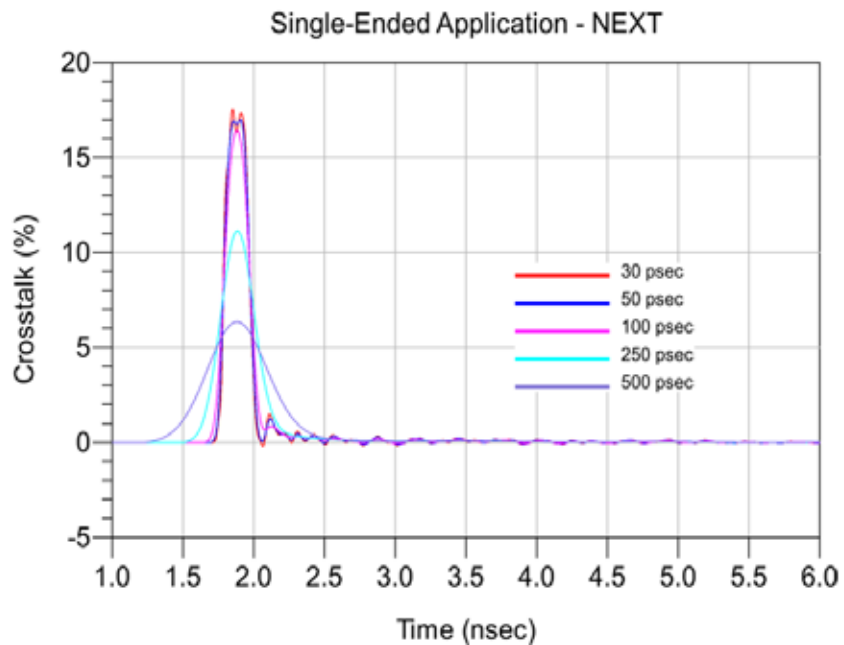
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Single-Ended Application – NEXT, Worst Case Configuration

Case 1



Case 2

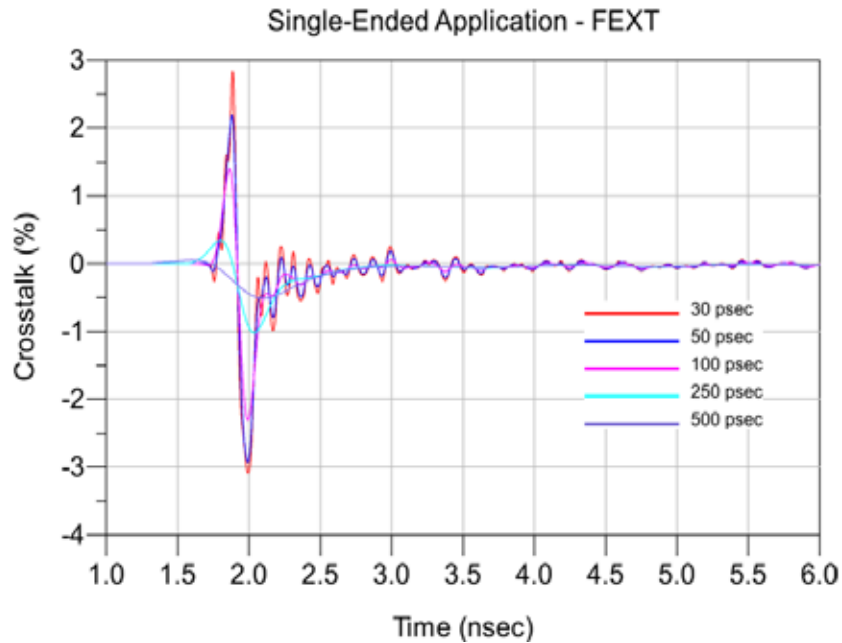


Series: FS5/FT5

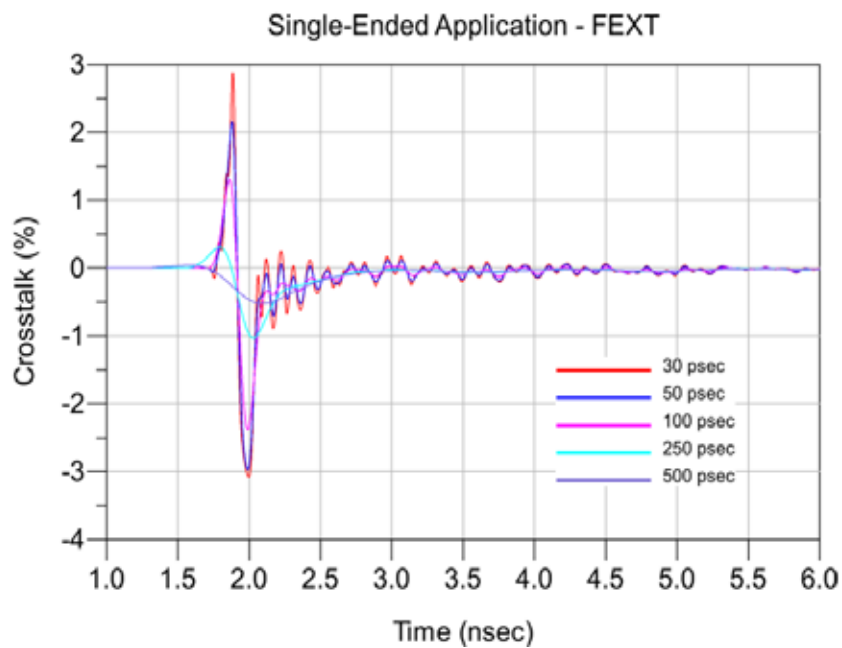
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Single-Ended Application – FEXT, Worst Case Configuration

Case 1



Case 2

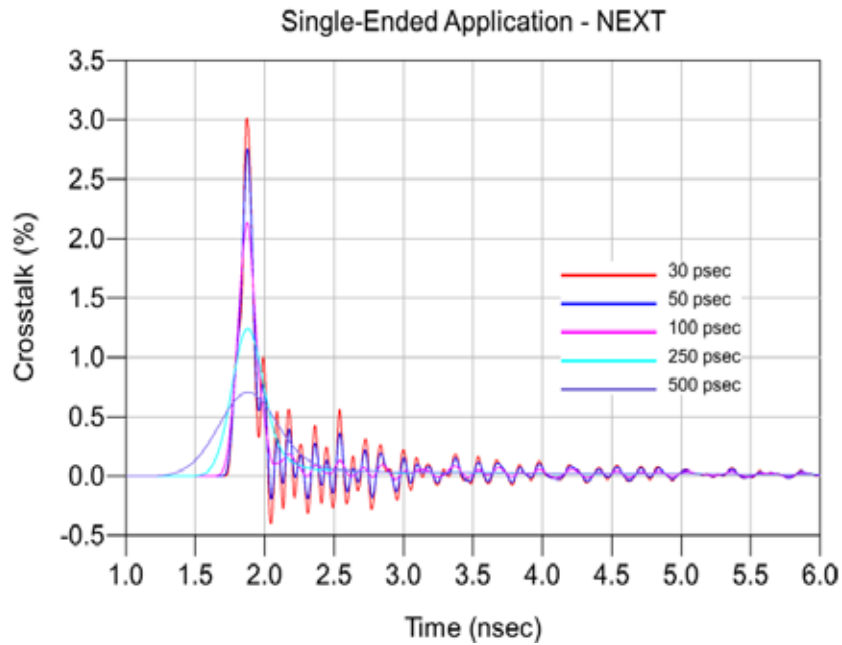


Series: FS5/FT5

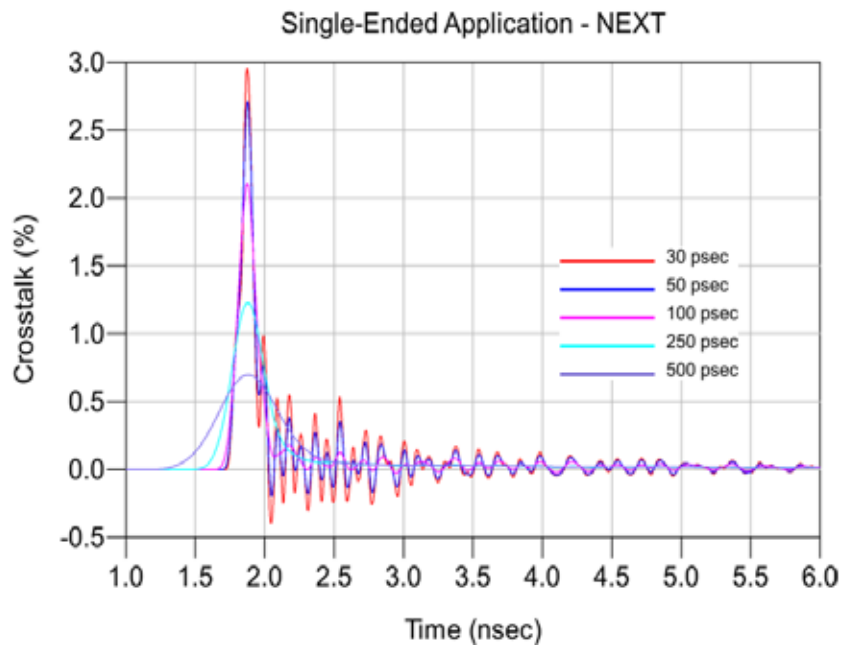
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Single-Ended Application – NEXT, Best Case Configuration

Case 1



Case 2

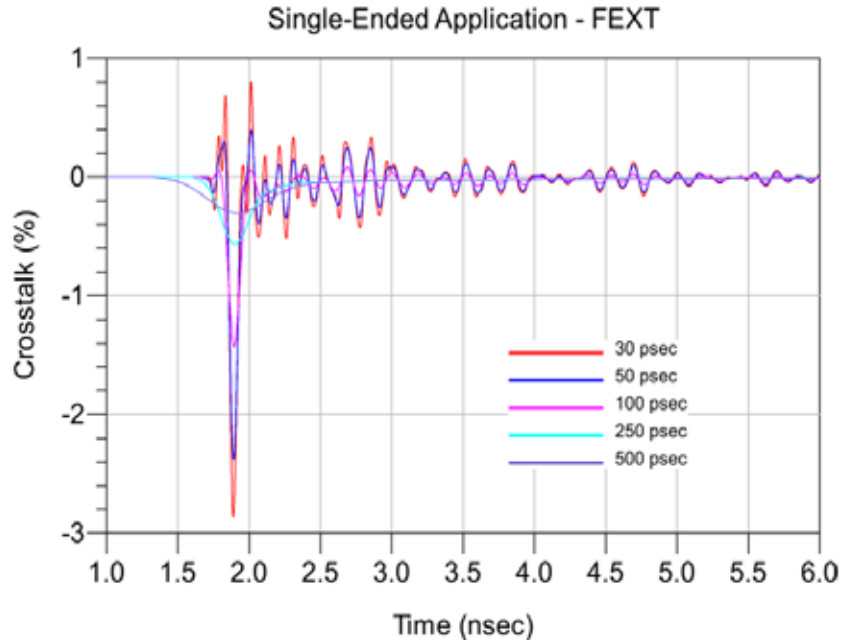


Series: FS5/FT5

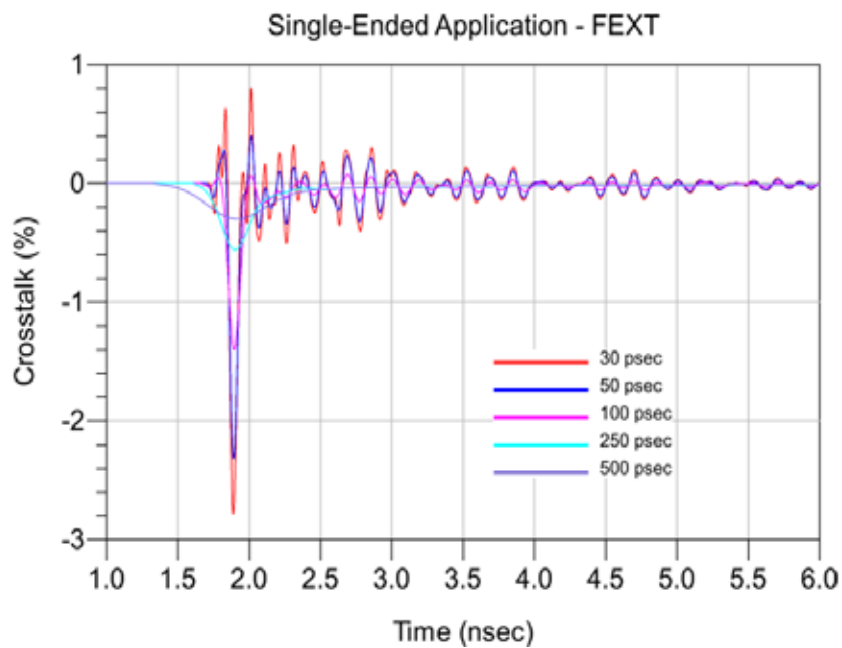
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Single-Ended Application – FEXT, Best Case Configuration

Case 1



Case2

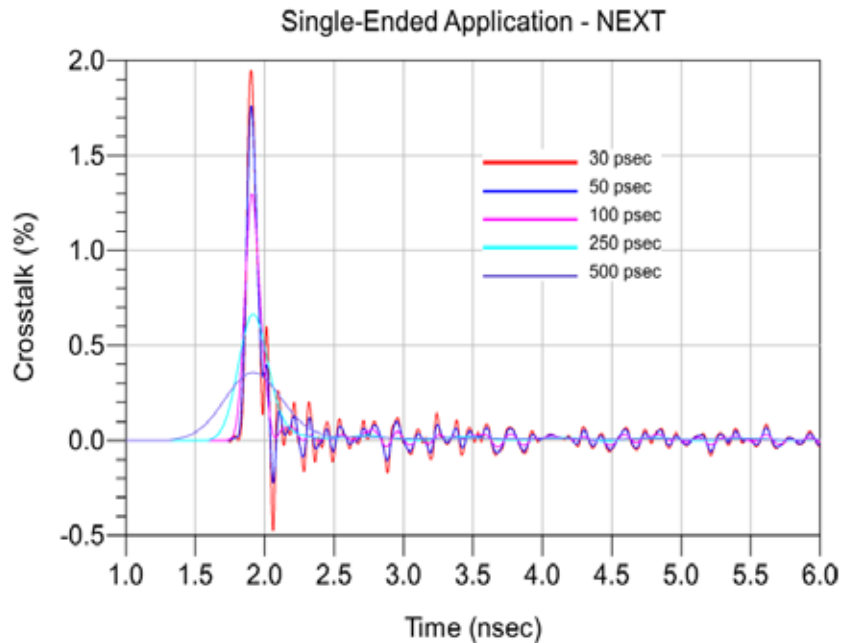


Series: FS5/FT5

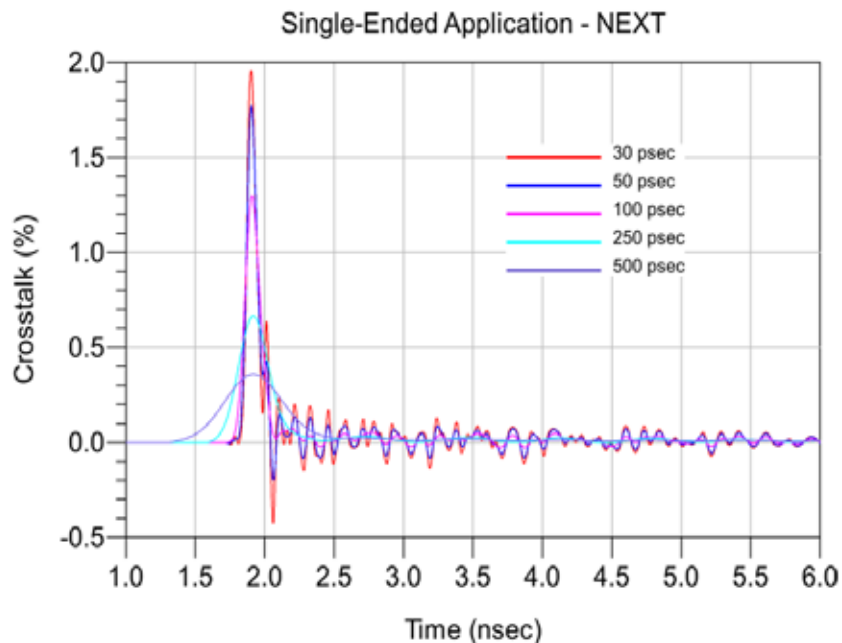
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Single-Ended Application – NEXT, Across Row Configuration

Case 1



Case 2

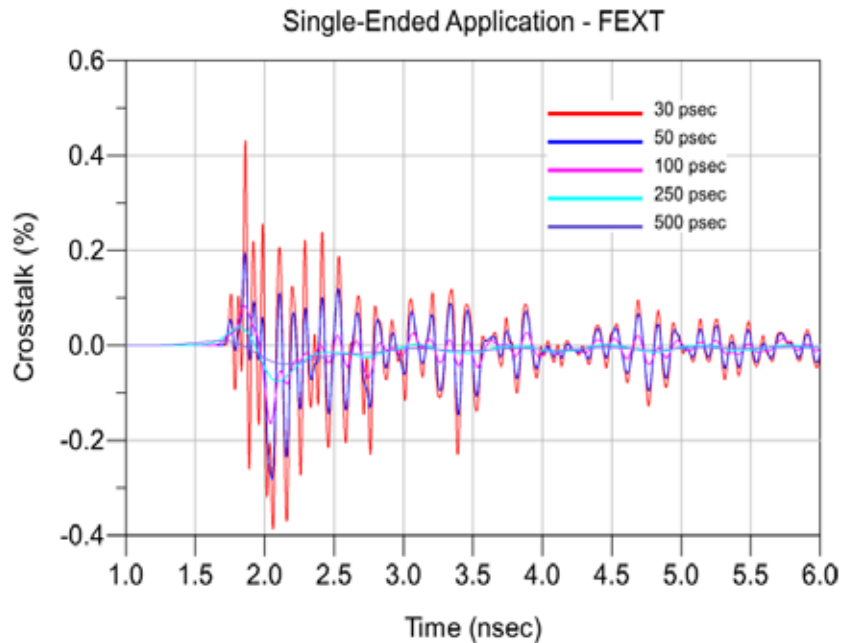


Series: FS5/FT5

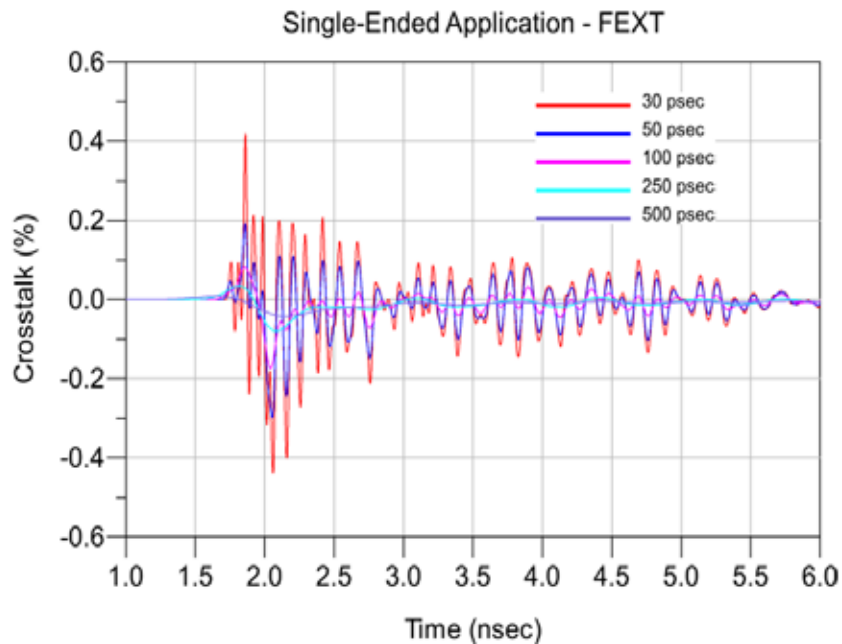
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Single-Ended Application – FEXT, Across Row Configuration

Case 1



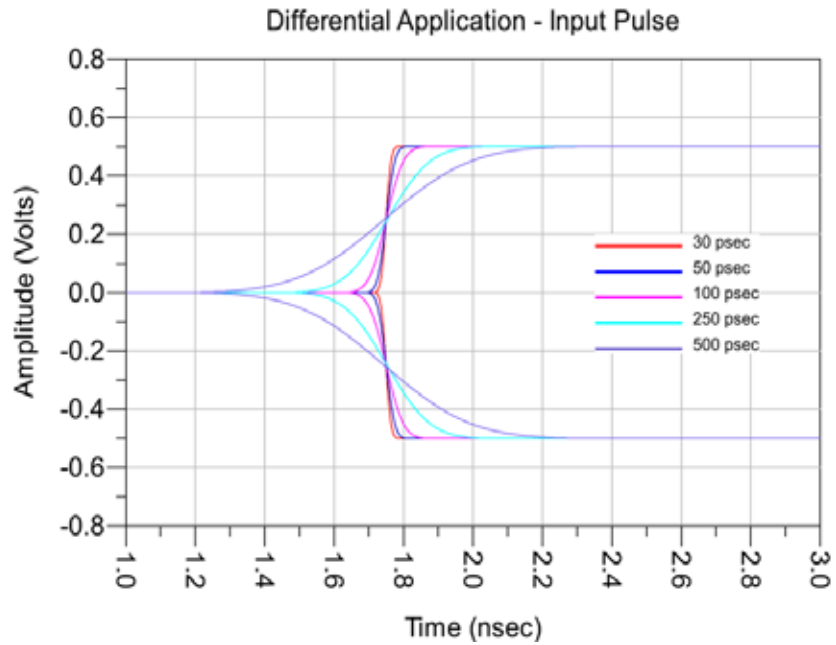
Case 2



Series: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Differential Application – Input Pulse

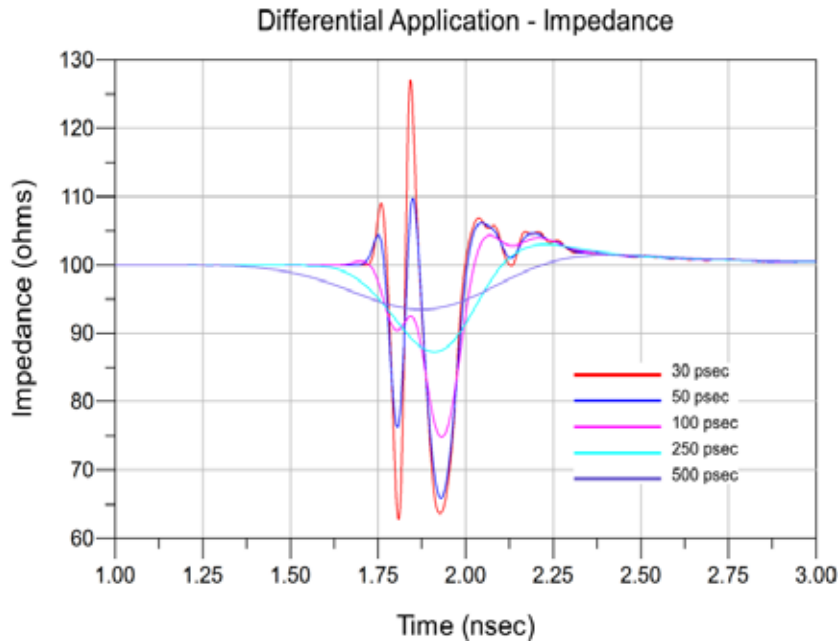


Series: FS5/FT5

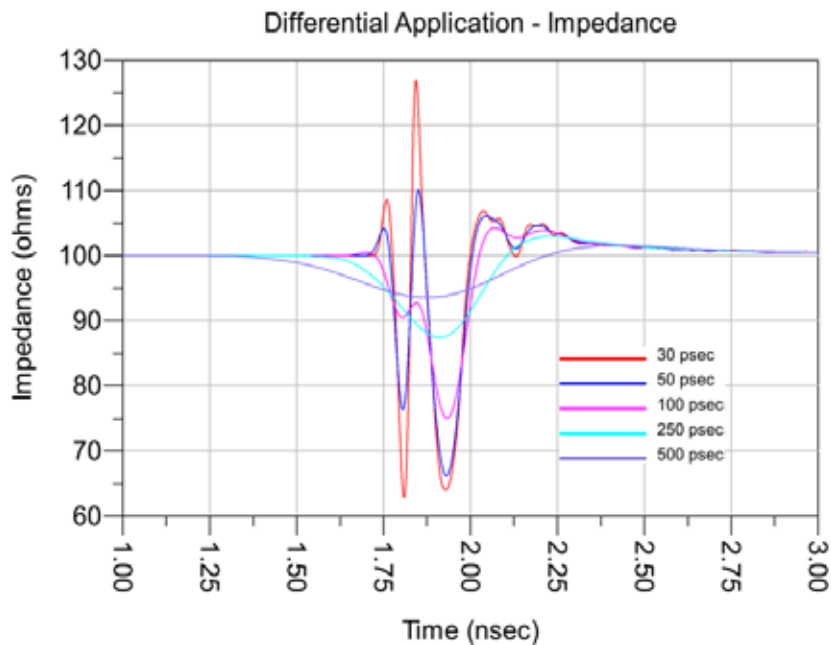
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Differential Application – Impedance

Case 1



Case 2

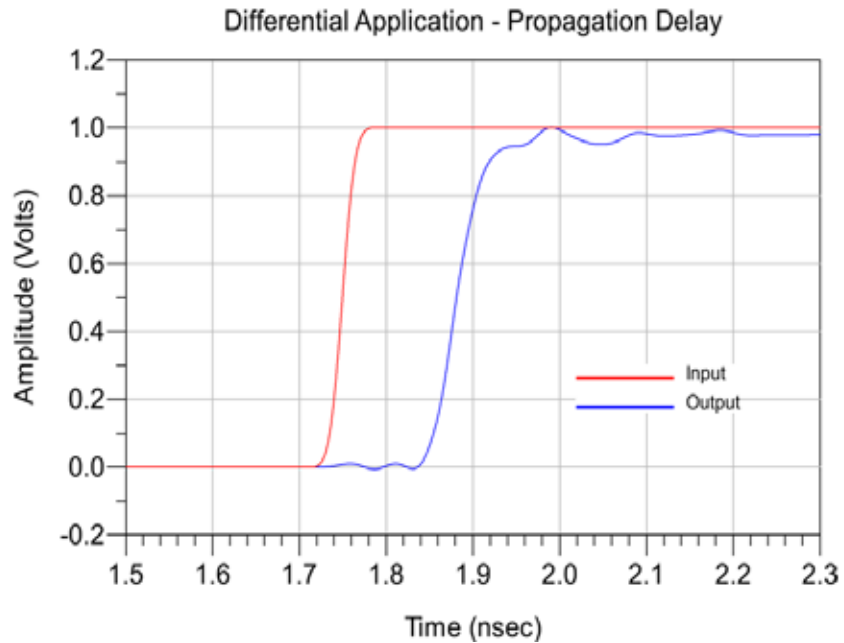


Series: FS5/FT5

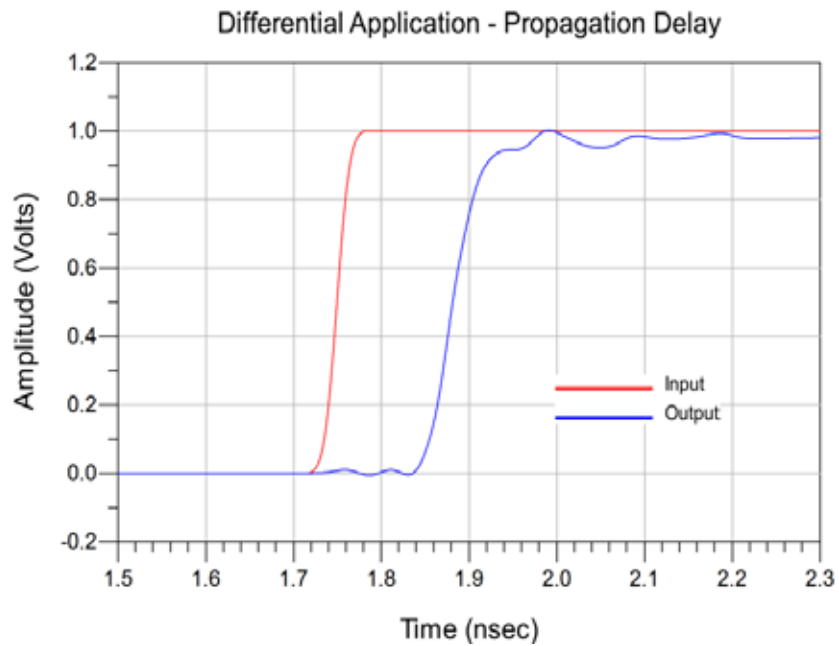
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Differential Application – Propagation Delay

Case 1



Case 2

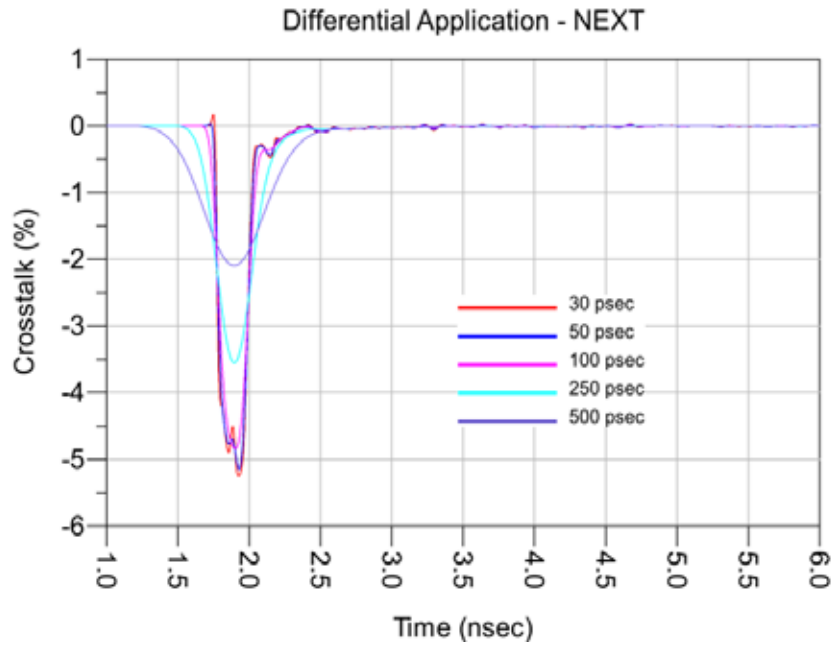


Series: FS5/FT5

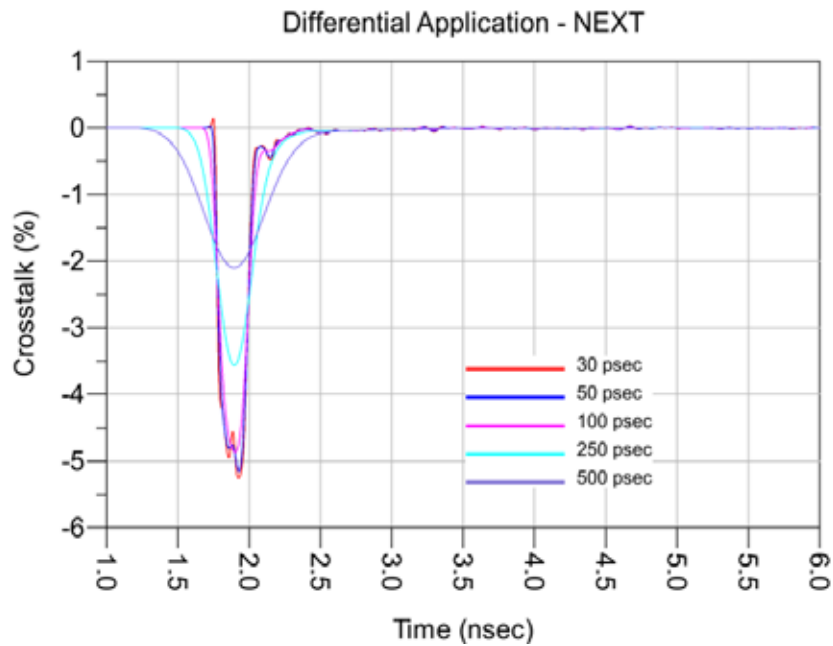
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Differential Application – NEXT, Worst Case Configuration

Case 1



Case 2

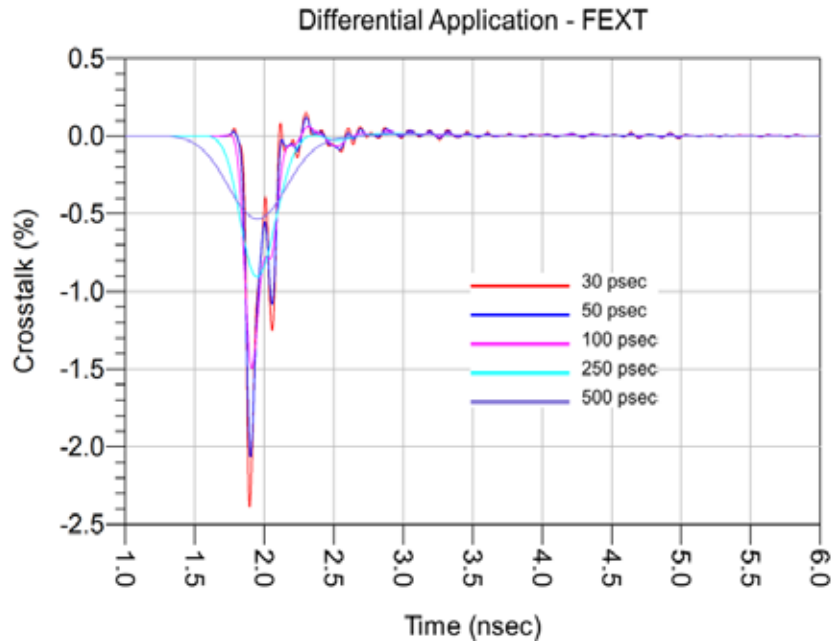


Series: FS5/FT5

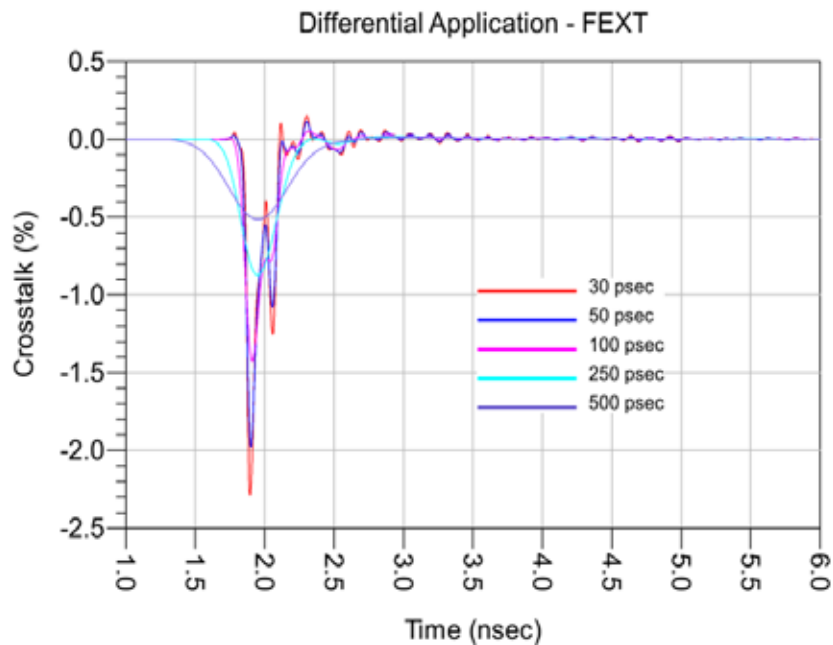
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Differential Application – FEXT, Worst Case Configuration

Case 1



Case 2

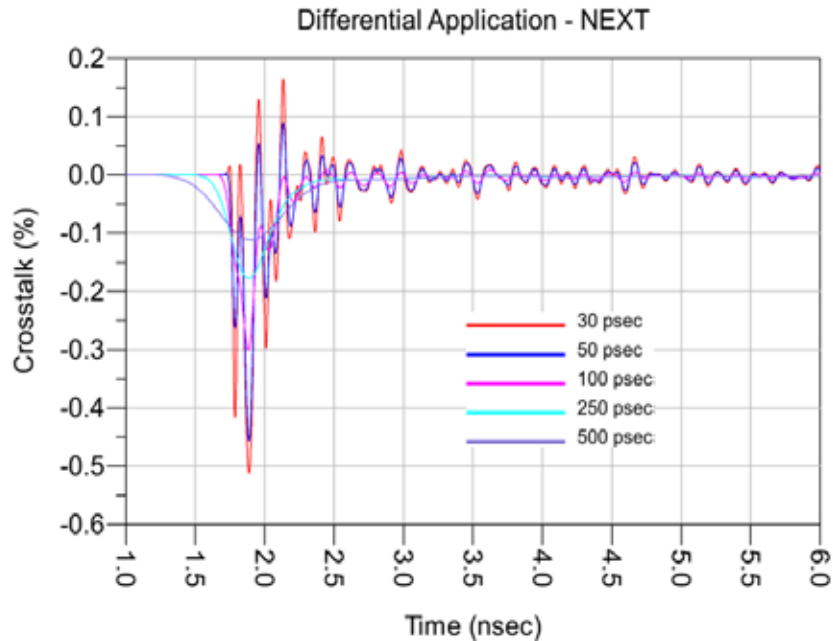


Series: FS5/FT5

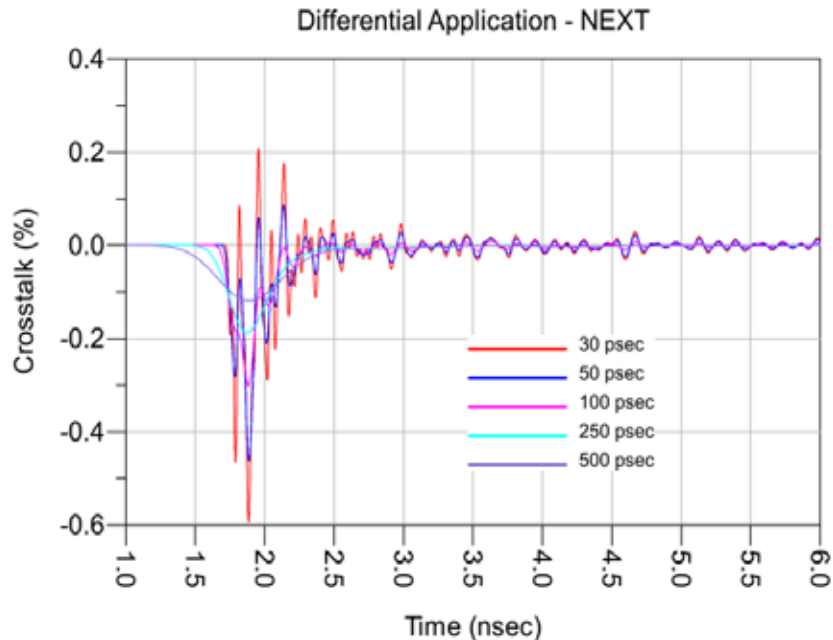
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Differential Application – NEXT, Best Case Configuration

Case 1



Case 2

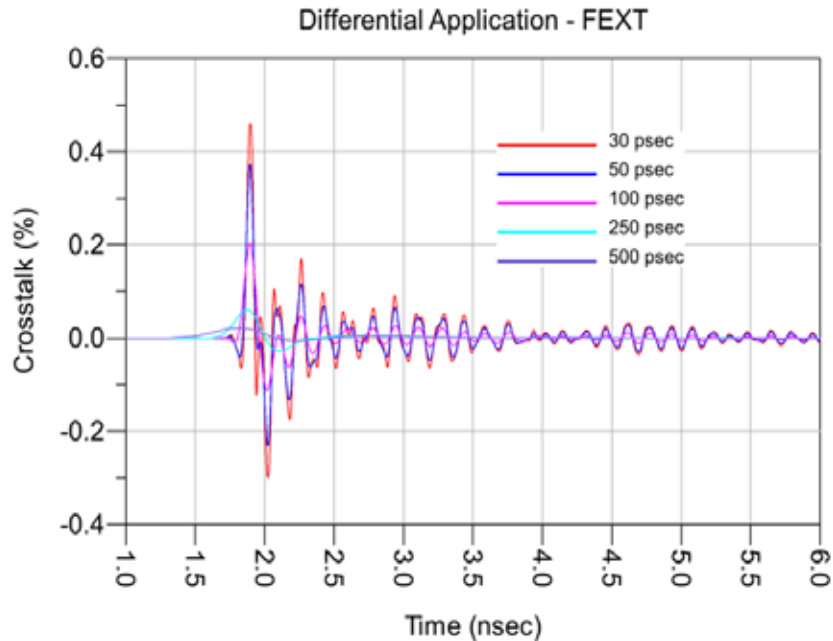


Series: FS5/FT5

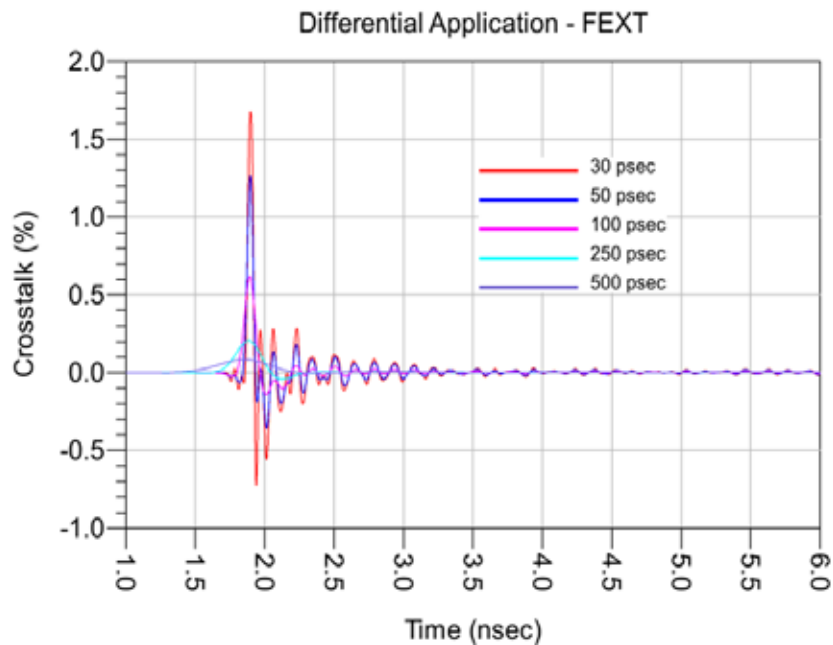
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Differential Application – FEXT, Best Case Configuration

Case 1



Case 2

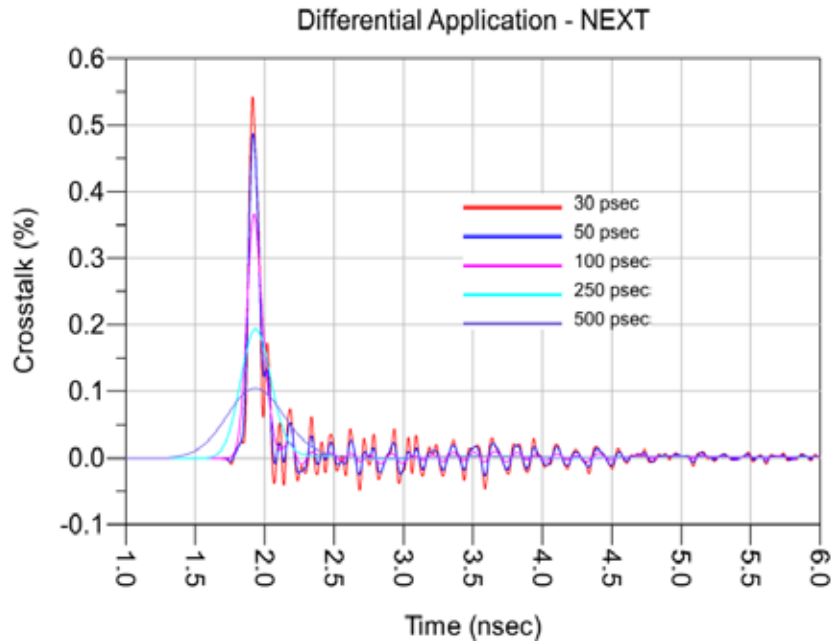


Series: FS5/FT5

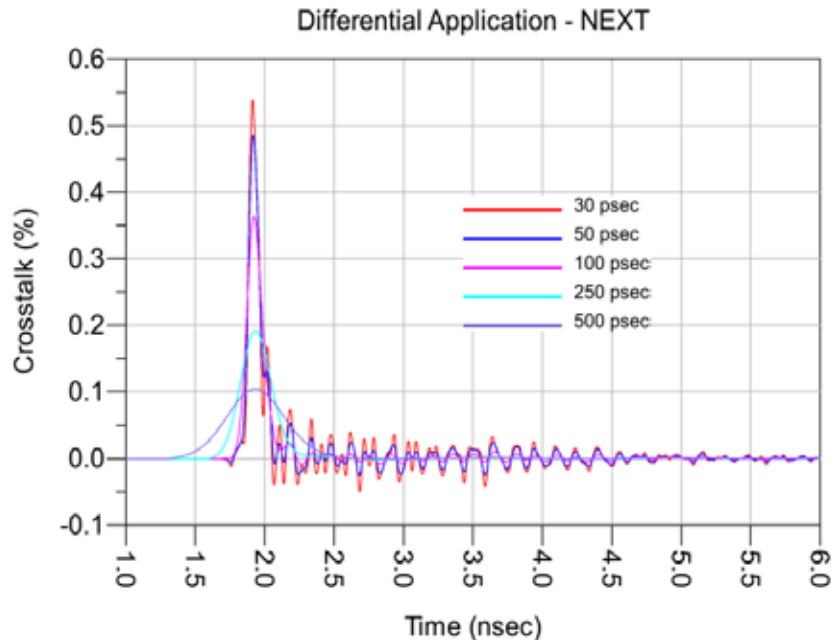
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Differential Application – NEXT, Across Row Case Configuration

Case 1



Case 2

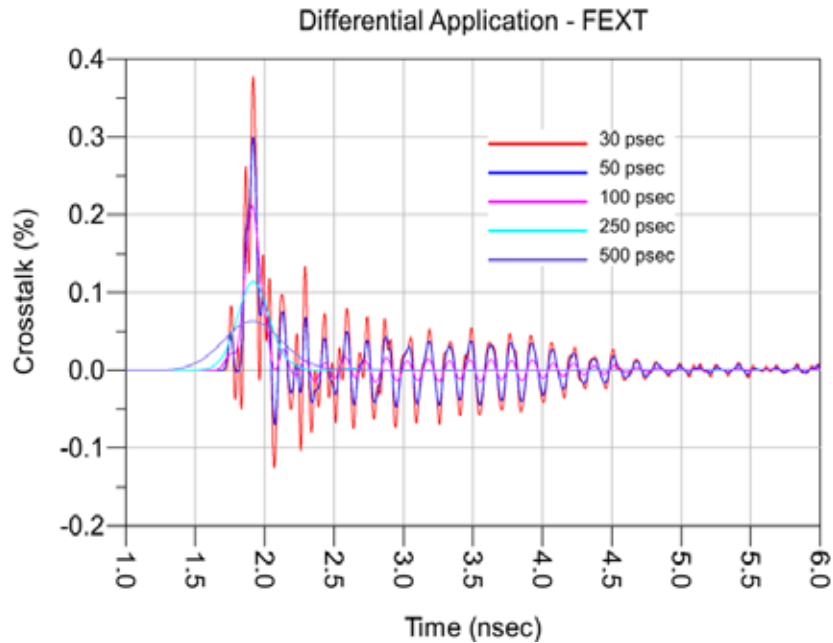


Series: FS5/FT5

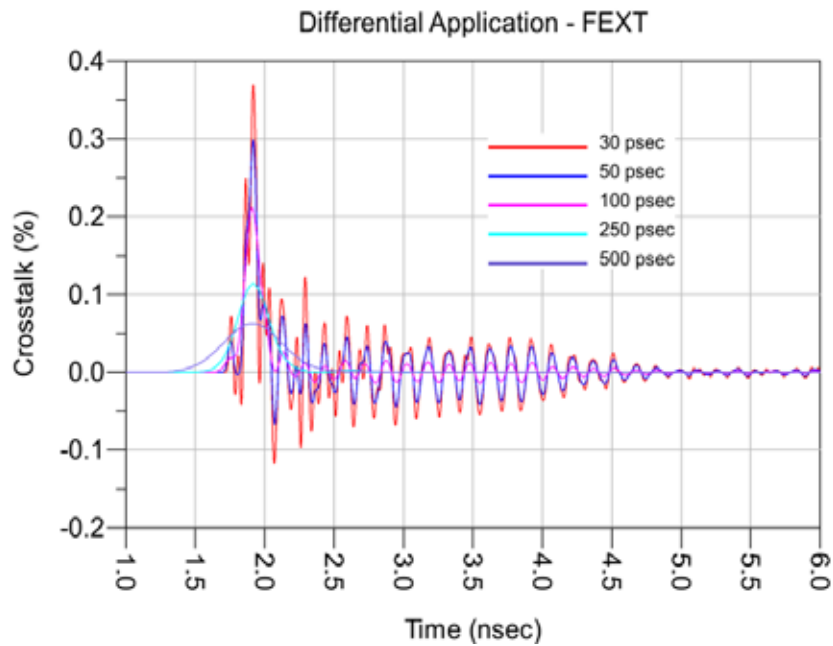
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Differential Application – FEXT, Across Row Case Configuration

Case 1



Case 2



Series: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

Appendix C – Product and Test System Descriptions

Product Description

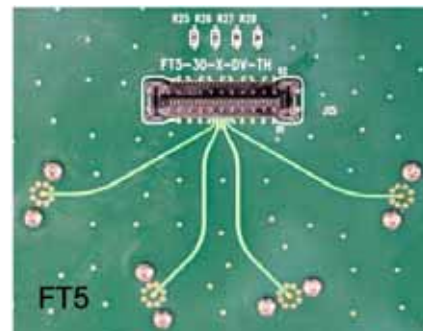
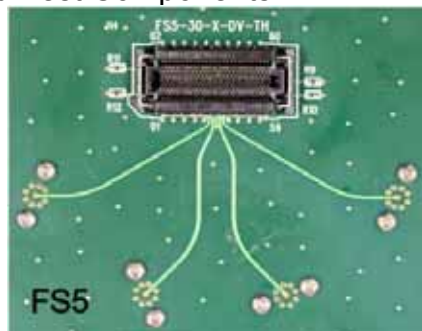
Product test samples are High Speed Floating Contact FS5/FT5 Series connectors. The part numbers are FS5-30-04.0-L-DV-TH and FT5-30-01.0-L-DV-TH. Each connector has two rows of 30 contacts evenly spaced on a 0.5 mm (0.0195”) pitch. The floating contact system provides 0.5mm of float in the X and Y directions. A photo of the test articles mounted to SI test boards is shown below.

Test System Description

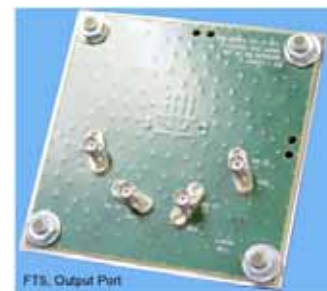
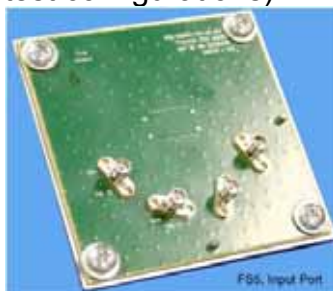
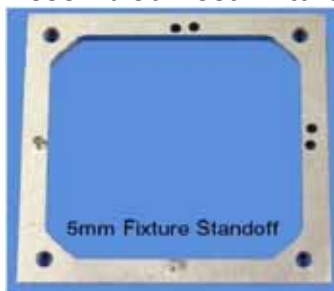
The test fixtures are composed of four-layer FR-4 material with 50Ω signal trace and pad configurations designed for the electrical characterization of Samtec high speed connector products. A PCB mount SMA connector is used to interface the VNA test cables to the test fixtures. SMA launch optimization is attained using full wave simulation tools to minimize reflections. There are 16 test fixtures specific to the FS5/FT5 series connector set. Fourteen of the 16 fixtures mate comprising a full hi-speed characterization utilizing 12 test configurations of two signal types. Two of the remaining boards contain the SMA/LRM calibration structures designed specifically for the FS5/FT5 series. Displayed on the following pages is information for SMA/LRM calibration structures and directives for mating FS5/FT5 fixtures.

PCB-102944-TST-XX Test Fixture

Populated Test Components



Assembled Test Fixture (1 of 7 test configurations)

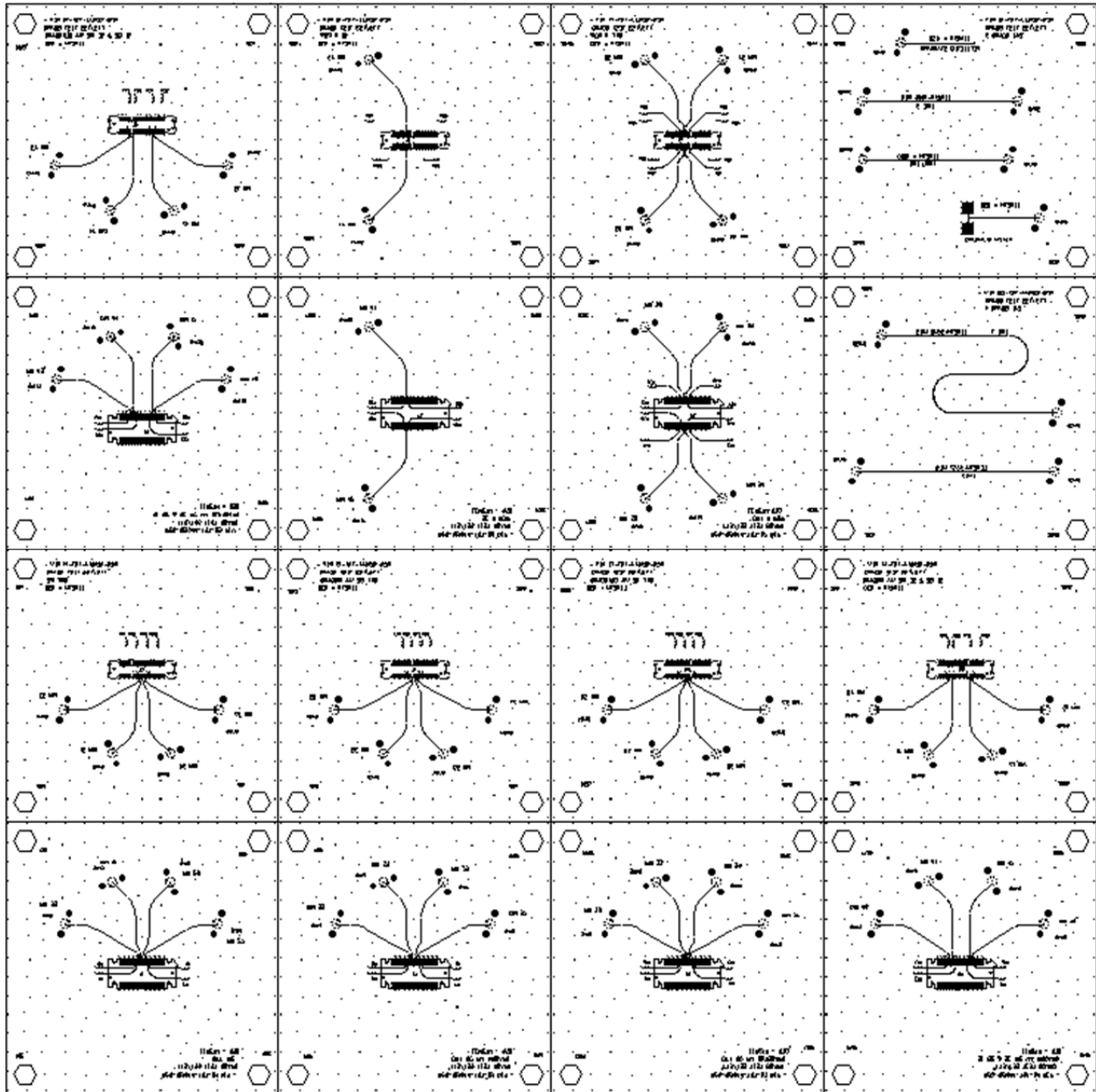


Series: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

PCB-102944-TST-XX PCB Layout Panel

PCB design artwork shown below.



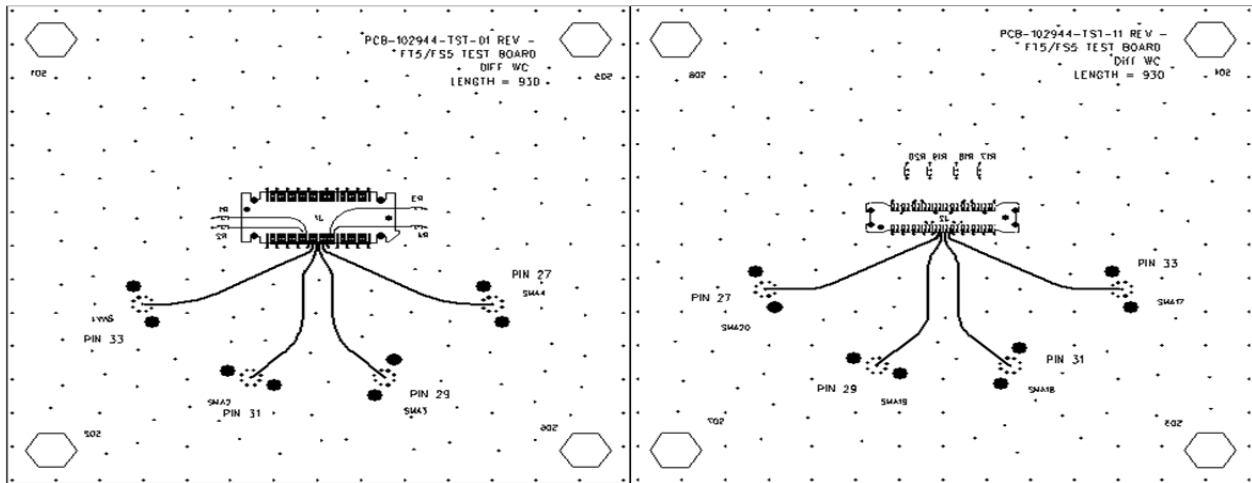
Series: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

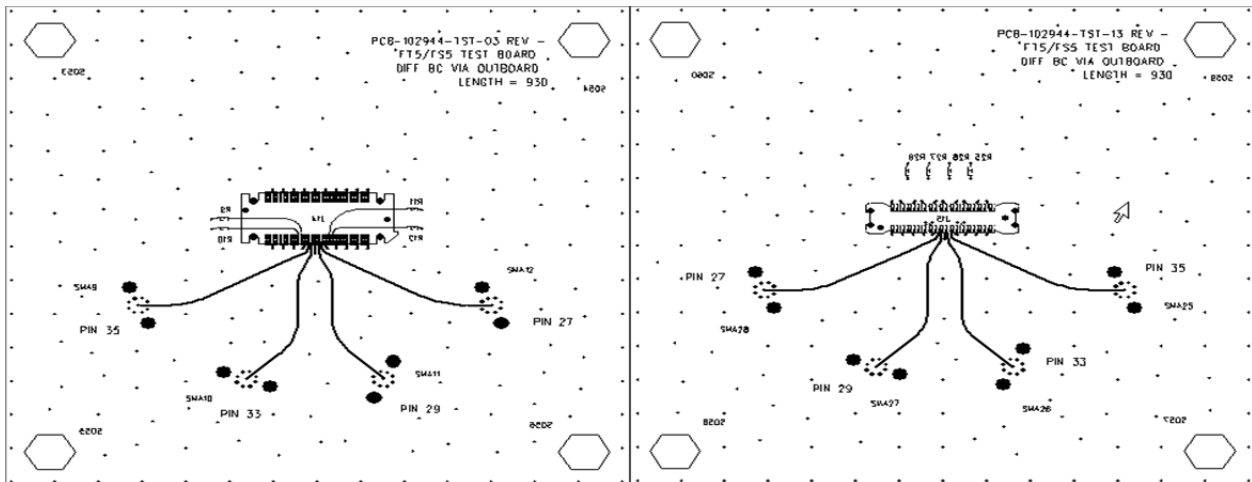
PCB Fixtures

The test fixtures used are as follows:

PCB-102944 -TST-01 Rev, FS5 Floating Socket *mates with* PCB-102944 -TST-11, Rev, FT5 Terminal, Differential Worst Case Configuration, Crosstalk Parameters



PCB-102944 -TST-03 Rev, FS5 Floating Socket *mates with* PCB-102944 -TST-13, Rev, FT5 Terminal, Differential Best Case Configuration, Transmission/Reflection Parameters, Crosstalk Parameters, Via Location: Outboard

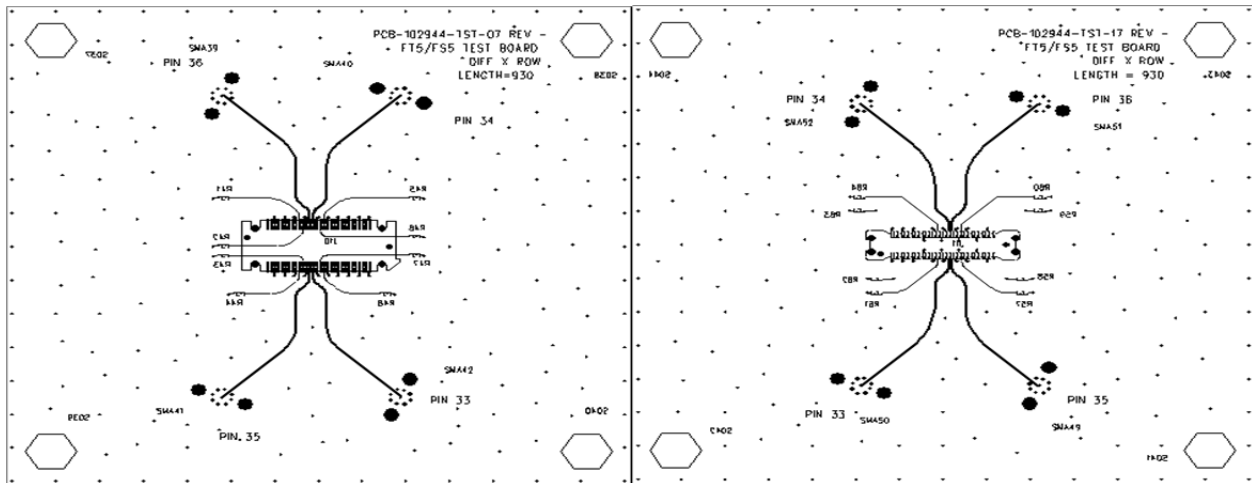


Series: FS5/FT5

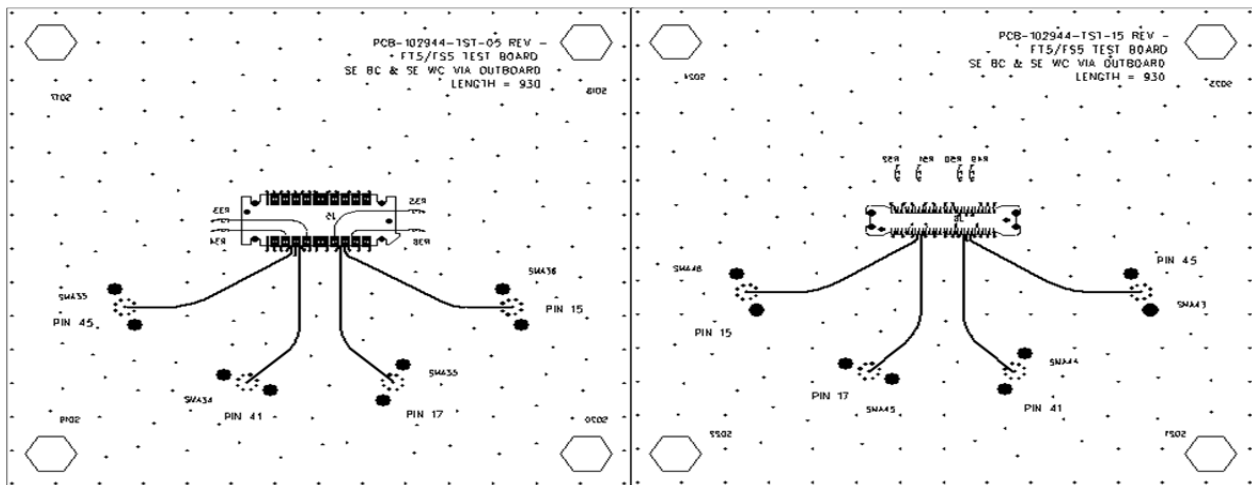
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

PCB Fixtures (Cont.)

PCB-102944 -TST-07 Rev, FS5 Floating Socket *mates with* PCB-102944 -TST-17, Rev, FT5 Terminal, Differential Across Row Configuration, Crosstalk Parameters



PCB-102944 -TST-05 Rev, FS5 Floating Socket *mates with* PCB-102944 -TST-15, Rev, FT5 Terminal, Single-Ended Across Row Configuration, Crosstalk Parameters

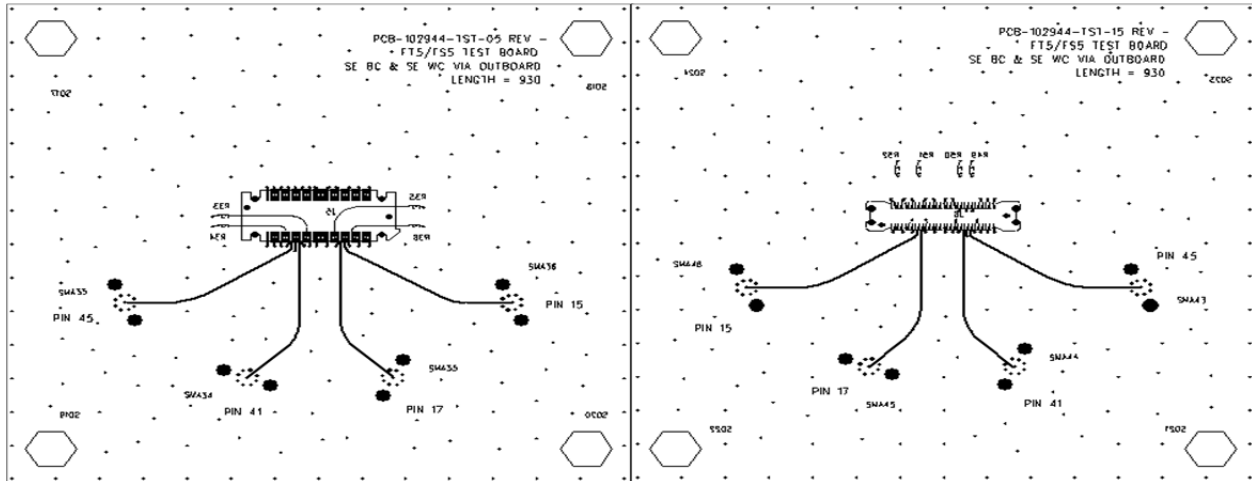


Series: FS5/FT5

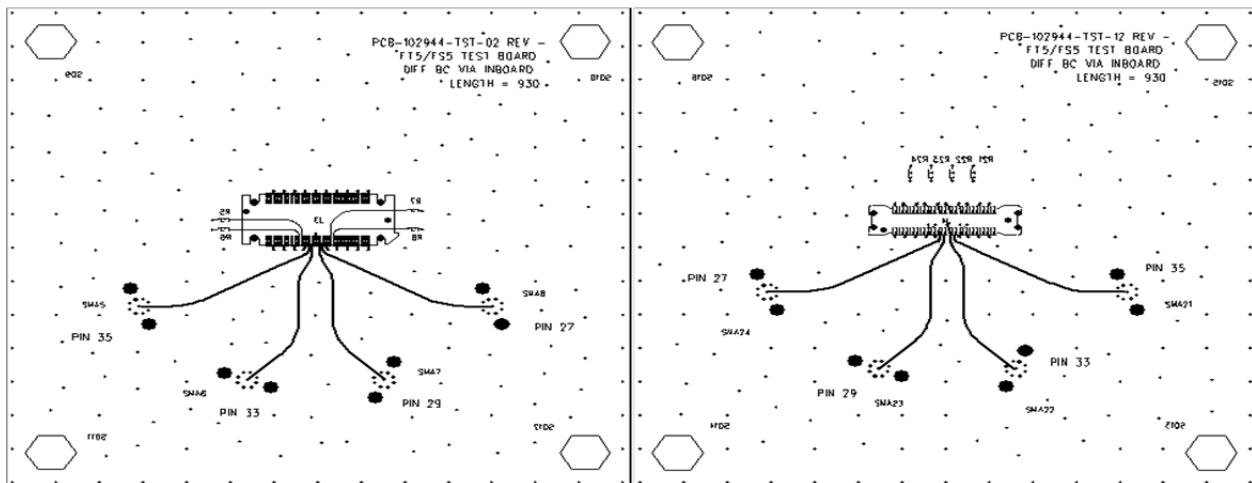
Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

PCB Fixtures (Cont.)

PCB-102944 -TST-06 Rev, FS5 Floating Socket *mates with* PCB-102944 -TST-16, Rev, FT5 Terminal, Single-Ended Best & Worst Case Configurations, Transmission/ Reflection Parameters, Crosstalk Parameters, Via Location: Outboard



PCB-102944 -TST-02 Rev, FS5 Floating Socket *mates with* PCB-102944 -TST-12, Rev, FT5 Terminal, Single-Ended Best & Worst Case Configurations, Transmission/ Reflection Parameters, Crosstalk Parameters, Via Location: Inboard

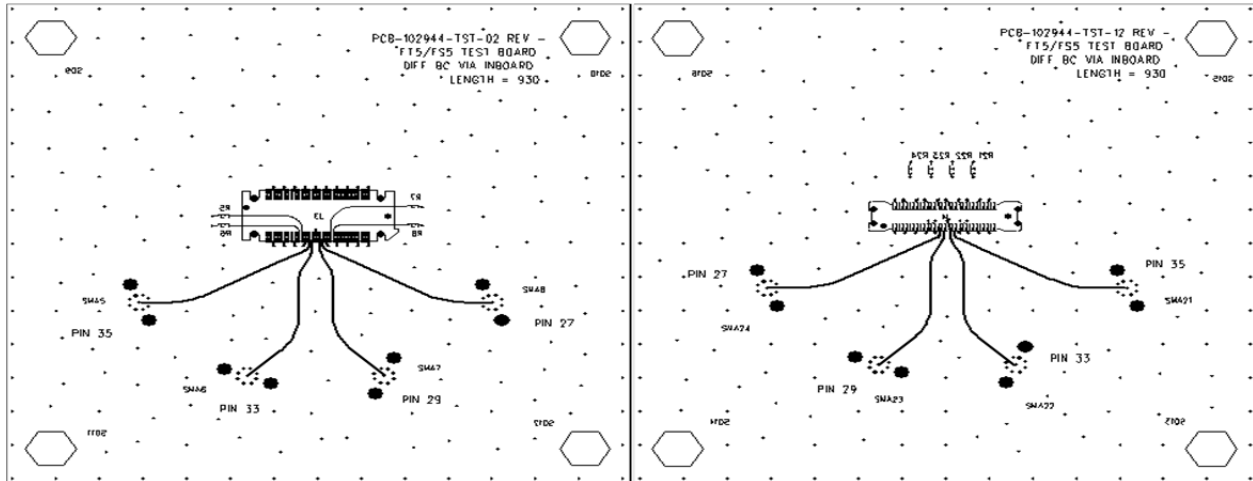


Series: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

PCB Fixtures (Cont.)

PCB-102944 -TST-03 Rev, FS5 Floating Socket *mates with* PCB-102944 -TST-13, Rev, FT5 Terminal, Differential Best Case Configuration, Transmission/Reflection Parameters, Crosstalk Parameters, Via Location: Inboard

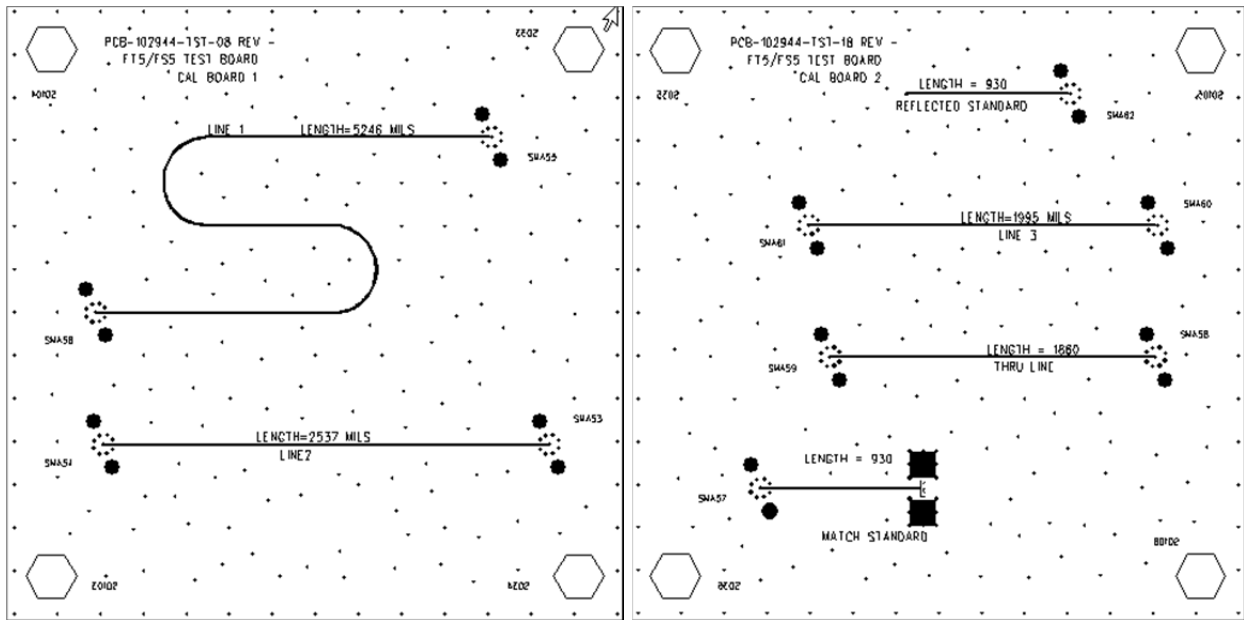


Series: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

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-102944-TST-08

Line 1 - Length = 5246 mils

Line 2 - Length = 2537 mils

PCB-102944-TST-18

Reflect Standard - Length = 930 mils

Line 3 - Length = 1995 mils

Thru Line (2X) = 1860 mils

Match Standard - Length = 930 mils

Cal Kit Name: 2011-10-31_FS5_FT5_PCB102944-TST_CER

Kit Identification: #29, PCB_TRL_2X_3LINE

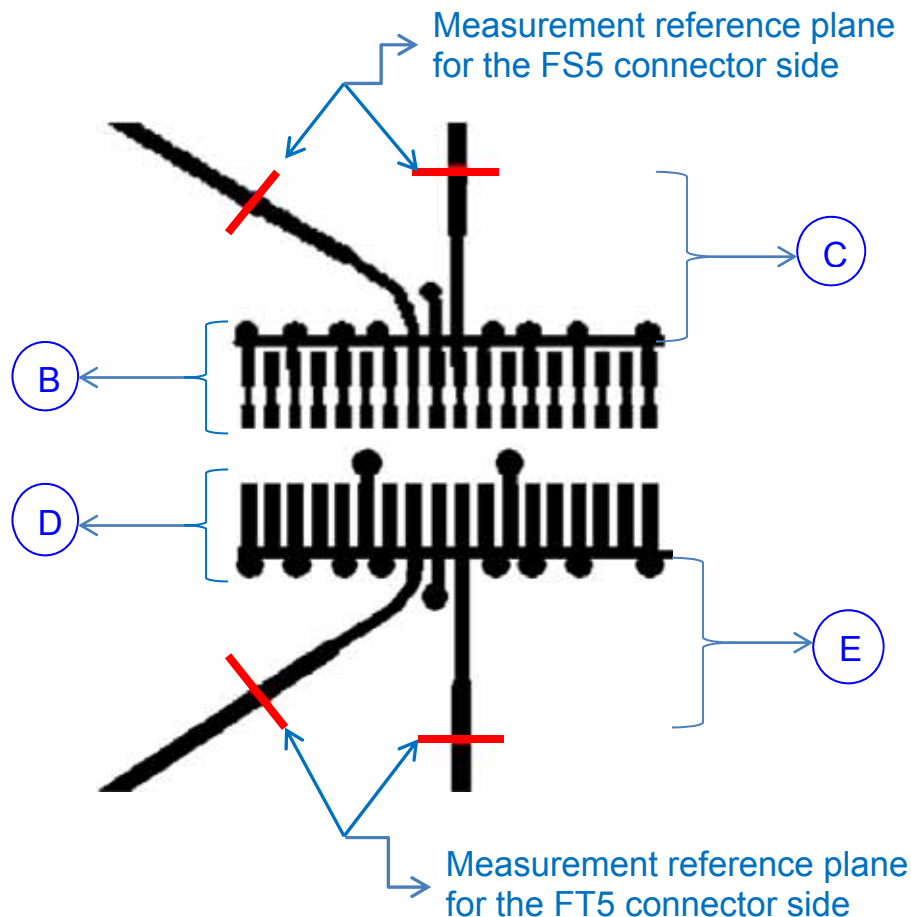
Series: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

All traces on the test boards are length matched to 1130 mils measured from the center of the pad to the SMA. The TRL calibration effectively removes 930 mils of test board trace effects. Since the pad sizes for the FS5 and FT5 connectors are of different geometry and size, the reference plane location is slightly different on each test board. This means that 200 mils of test board trace length effects for the FS5 connector side and 198 mils for the FT5 connector side are included in the measurement. The S-Parameter measurements include:

- A- The FS5/FT5 Series connector set
- B- Test board vias, pads (footprint effects) for the FS5 connector side.
- C- 200 mils of tapered signal trace 16 to 11.7 mil wide microstrip.
- D- Test board vias, pads (footprint effects) for the FT5 connector side.
- E- 198 mils of tapered signal trace 16 to 11.7 mil wide microstrip.

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



Series: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

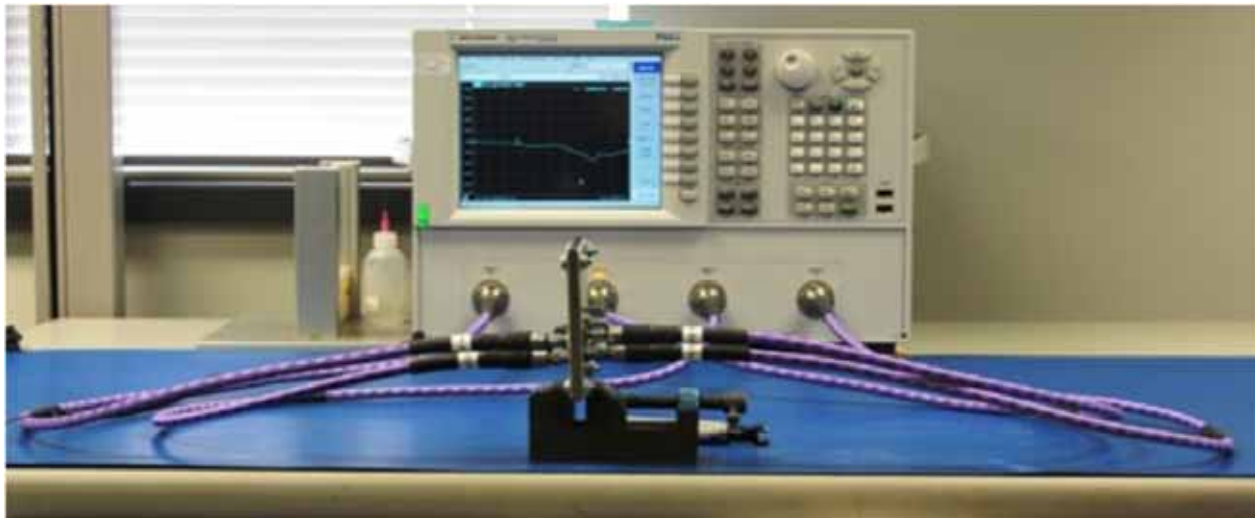
Appendix D – Test and Measurement Setup

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

<u>QTY</u>	<u>Description</u>
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

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

Series: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

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 a 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 FS5/FT5 Series test boards, the bandwidth is 19.55 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 2009 update 1. 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](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: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

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: FS5/FT5

Description: High Speed Floating Contact, Board-to-Board, 5mm Stack Height, 0.5mm Pitch,

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)