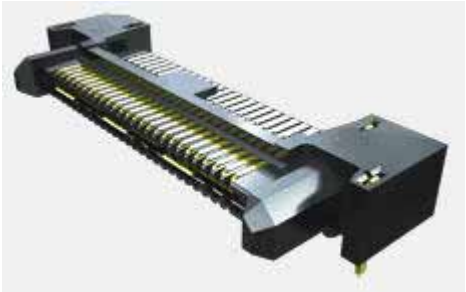
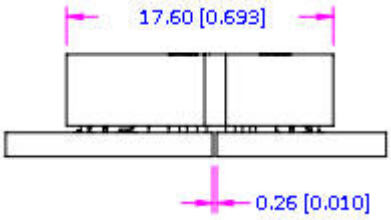
High Speed Characterization Report

QRM8-052-01-S-RA-GP





Mates with

QRF8-052-01-S-RA-GP

Description:

Q Rate® Slim Body Integral Ground Plane
0.8mm (.0315”) Pitch Rugged Edge Rate Contacts
Right Angle to Right Angle

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Report Revision: 5/12/2014

Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

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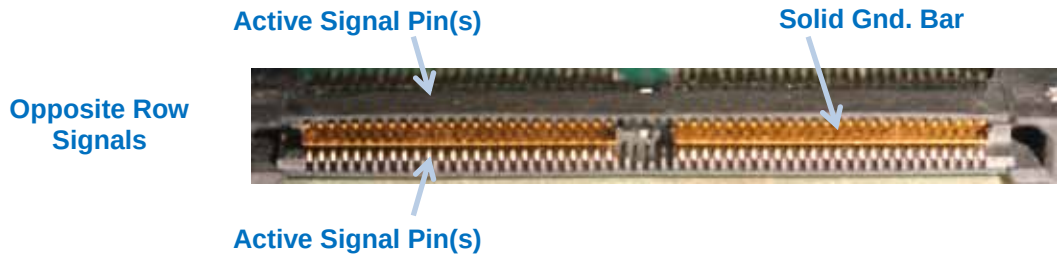
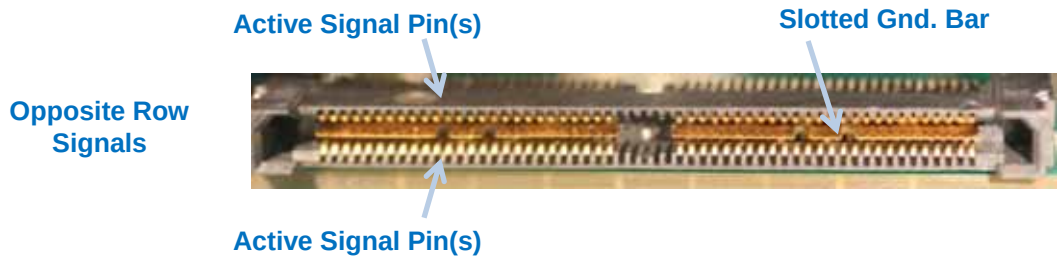
Disclaimer Statement

Below are two pictures of the Samtec part number QRF8-052-01-L-RA-GP. Picture "A" is of a connector containing a solid type ground/power bar. In the second picture "B" of the same connector, the solid ground bar was replaced with a ground bar that contains two slotted cutouts. It was felt that if these slots were located between two active and opposite row signals, crosstalk between the contact pins could be negatively affected. Therefore, two full SI characterization tests were performed in order to determine if electrical integrity is affected by the insertion of slotted ground/power bar in place of a standard solid ground/power bar. Characterization results from two tests indicate negligible crosstalk change. Data within this report are the results from the slotted ground/power bar and identified as cases 3 and 4. Not contained within this report are the solid ground/power bar results. These are identified as cases 1 and 2 in a like report. Please contact our Signal Integrity Group at sig@samtec.com for further information.

"A" Solid Ground/Power Bar



"B" Slotted Ground/Power Bar



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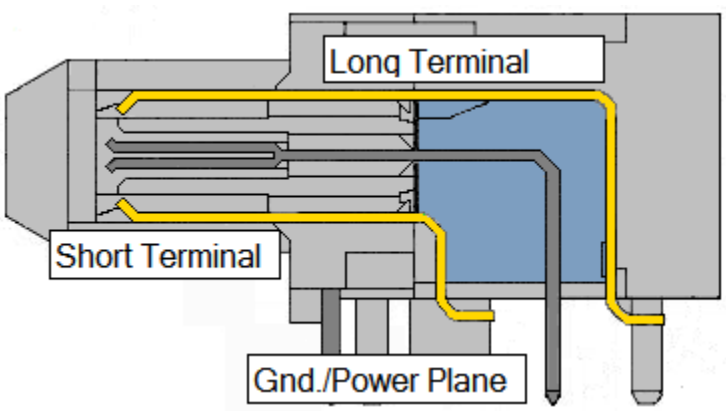
Connector Overview

Samtec's QRM8-RA/QRF8-RA Q Rate® Slim Body Low Profile connectors are designed for high-speed applications where signal integrity is essential. The connectors employ Rugged Edge Rate™ contacts with an integrated ground/power plane between the two rows of signals contacts for improved electrical performance. QRM8-RA/QRF8-RA is available with up to 156 I/O's contacts.

Data presented in this report is applicable only to a mated QRM8-RA to QRF8-RA connector system. The right angle connectors consist of two terminal paths, but unlike most Samtec design's, these paths are not symmetric. Therefore, performance characteristics between the two signal path lengths will differ. Short terminal characteristics are defined as Case 3. Long terminal characteristics are defined as Case 4.

The illustration below defines the performance paths:



Connector System Speed Rating

QRM8-RA/QRF8-RA, Q Rate® Slim Body, 0.8mm Pitch, Right Angle to Right Angle

Case		Signaling	Speed Rating
3	(Short Terminal)	Single-Ended:	**14.5 GHz/ 29Gbps**
		Differential:	**16.0 GHz/ 32Gbps**
4	(Long Terminal)	Single-Ended:	**9.0 GHz/ 18Gbps**
		Differential:	**13.0 GHz/ 26Gbps**

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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 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.

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Frequency Domain Data Summary

Table 1 - Single-Ended Connector System Performance Case 3 = Short Row; Case 4 = Long Row			
Case	**Test Parameter**	**Configuration**	
3	**Insertion Loss**	GSG	3dB @ 14.1 GHz
	Return Loss	GSG	>10dB to 5.8 GHz
	Near-End Crosstalk	GAQG	< -20dB to 0.725 GHz
		GAGQG	< -20dB to 20.0 GHz
	Far-End Crosstalk	GAQG	< -20dB to 5.6 GHz
		GAGQG	< -20dB to 5.5 GHz
4	**Insertion Loss**	GSG	3dB @ 9.0 GHz
	Return Loss	GSG	>10dB to 9.0 GHz
	Near-End Crosstalk	GAQG	< -20dB to 0.388 GHz
		GAGQG	< -20dB to 8.9 GHz
		Xrow, GAG to GQG	< -20dB to 20.0 GHz
	Far-End Crosstalk	GAQG	< -20dB to 5.6 GHz
		GAGQG	< -20dB to 8.9 GHz
		Xrow, GAG to GQG	< -20dB to 20.0 GHz

Table 2 - Differential Connector System Performance Case 3 = Short Row; Case 4 = Long Row			
Case	**Test Parameter**	**Configuration**	
3	**Insertion Loss**	GSSG	3dB @ 16.0 GHz
	Return Loss	GSSG	>10dB to 7.9 GHz
	Near-End Crosstalk	GAAQQG	< -20dB to 6.6 GHz
		GAAGQQG	< -20dB to 20.0 GHz
	Far-End Crosstalk	GAAQQG	< -20dB to 13.4 GHz
		GAAGQQG	< -20dB to 20.0 GHz
4	**Insertion Loss**	GSSG	3dB @ 12.7 GHz
	Return Loss	GSSG	>10dB to 11.0 GHz
	Near-End Crosstalk	GAAQQG	< -20dB to 15.0 GHz
		GAAGQQG	< -20dB to 20.0 GHz
		Xrow, GAAG to GQQG	< -20dB to 20.0 GHz
	Far-End Crosstalk	GAAQQG	< -20dB to 15.1 GHz
		GAAGQQG	< -20dB to 20.0 GHz
		Xrow, GAAG to GQQG	< -20dB to 20.0 GHz

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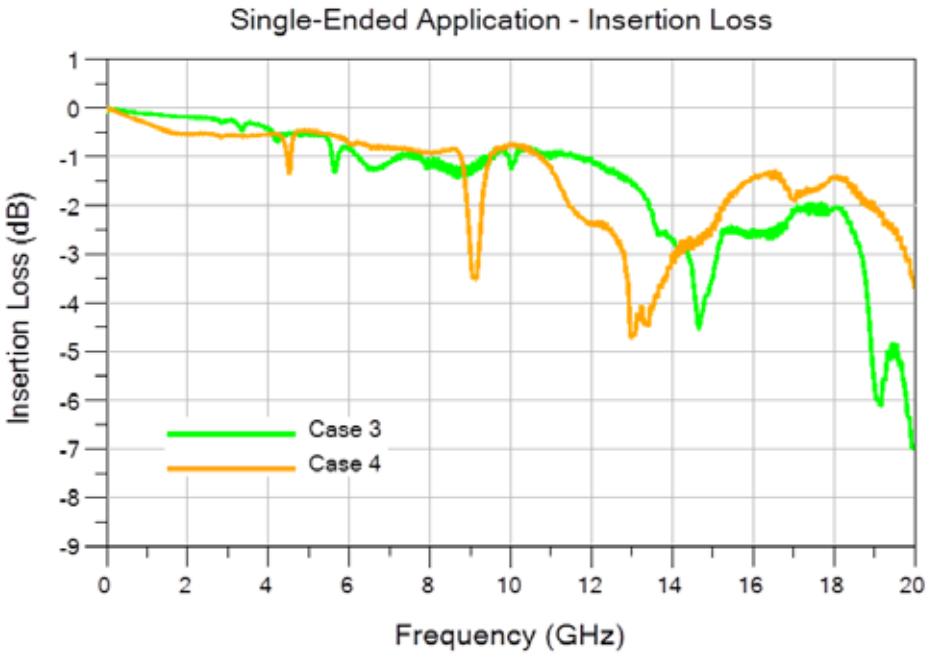
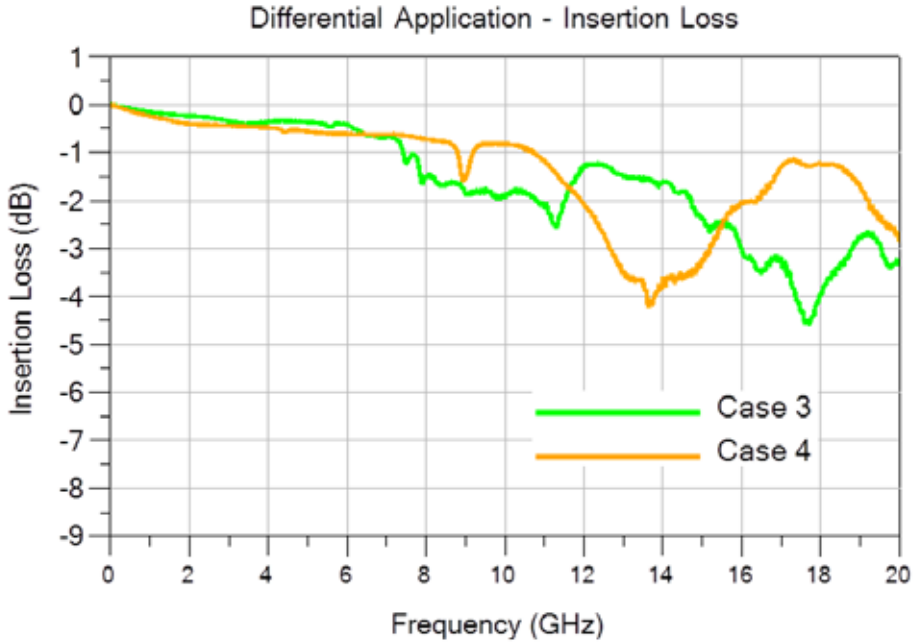
Bandwidth Chart – Single-Ended & Differential Insertion Loss

Case 3 = Short Row Case 4 = Long Row

QRM8-RA/QRF8-RA, Q Rate® Slim Body Series





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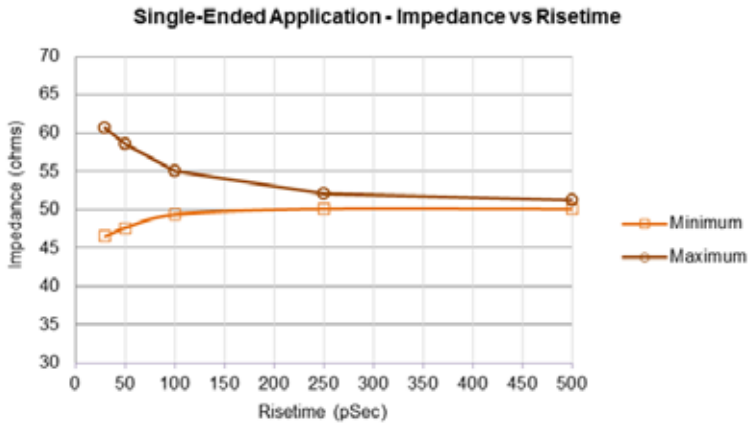
Time Domain Data Summary

Table 3 – Single-End Impedance (Ω) Case 3 = Short Row, Case 4 = Long Row						
Case	**Signal Risetime**	**30 ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
3	**Maximum Impedance**	60.7	58.6	55.0	52.1	51.3
	Minimum Impedance	46.5	47.6	49.4	50.1	50.1
4	**Maximum Impedance**	64.7	63.6	62.2	58.1	54.9
	Minimum Impedance	49.0	49.3	49.5	50.0	50.0

Single-Ended Impedance – Case 3, Short Row



Single-Ended Impedance – Case 4, Long Row

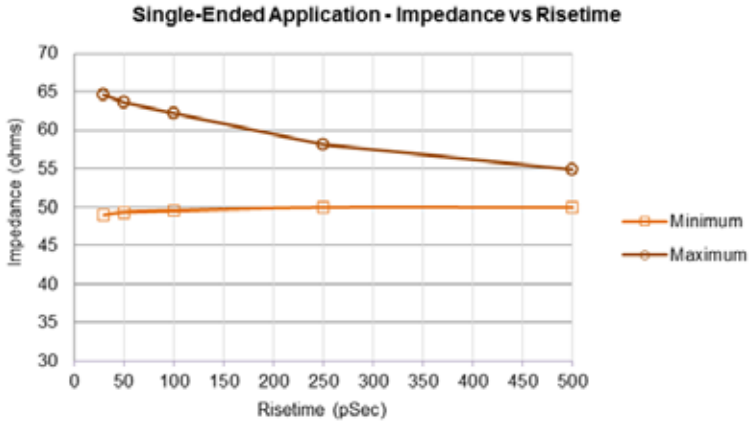


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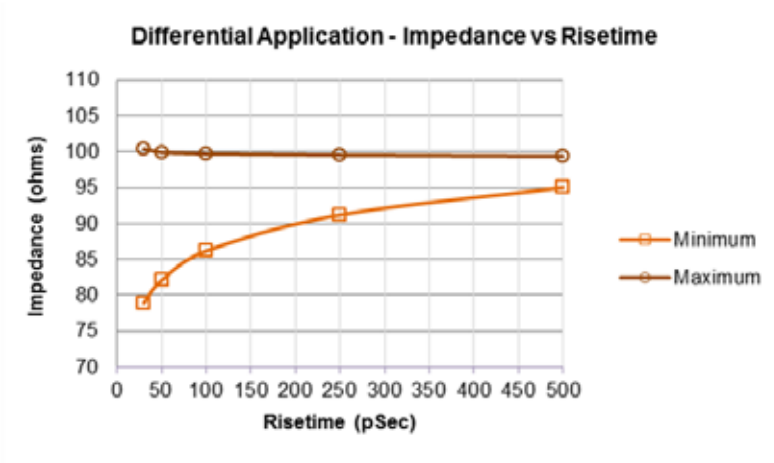
Table 4 – Differential Impedance (Ω) Case 3 = Short Row, Case 4 = Long Row						
Case	**Signal Risetime**	**30 ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
3	**Maximum Impedance**	100.3	99.9	99.8	99.6	99.4
	Minimum Impedance	78.9	82.1	86.2	91.2	95.0
4	**Maximum Impedance**	104.2	103.6	103.1	101.2	100.5
	Minimum Impedance	84.5	88.2	90.8	94.2	97.6

Differential Impedance – Case 3, Short Row



Differential Impedance – Case 4, Long Row

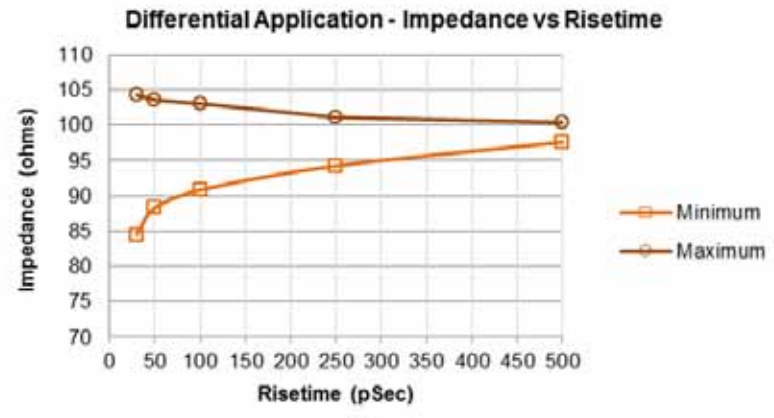


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Table 5 - Single-Ended Crosstalk (%)
Case 3 = Short Row; Case 4 = Long Row

Input(tr)			30ps	50 ps	100 ps	250 ps	500 ps
3	NEXT	GAQG	19.5	17.2	15.2	8.5	4.5
		GAGQG	2.6	2.0	1.5	0.8	0.4
	FEXT	GAQG	5.1	3.7	3.0	1.5	0.8
		GAGQG	2.7	2.0	1.4	0.9	0.5
4	NEXT	GAQG	19.1	18.4	17.3	12.8	7.6
		GAGQG	2.1	1.8	1.6	1.2	0.7
		Xrow	<0.1	<0.1	<0.1	<0.1	<0.1
	FEXT	GAQG	6.9	5.2	4.1	3.3	2.2
		GAGQG	1.9	1.3	0.8	0.5	0.3
		Xrow	<0.1	<0.1	<0.1	<0.1	<0.1

Table 6 - Differential Crosstalk (%)
Case 3 = Short Row; Case 4 = Long Row

Input(tr)			30ps	50 ps	100 ps	250 ps	500 ps
3	NEXT	GAAQQG	6.4	5.6	4.9	2.8	1.5
		GAAGQQG	0.7	0.4	0.3	0.2	0.1
	FEXT	GAAQQG	2.1	1.2	0.4	0.1	<0.1
		GAAGQQG	1.3	0.9	0.5	0.2	0.1
4	NEXT	GAAQQG	6.1	5.9	5.5	4.1	2.4
		GAAGQQG	0.5	0.4	0.3	0.2	0.1
		Xrow	<0.1	<0.1	<0.1	<0.1	<0.1
	FEXT	GAAQQG	1.4	0.8	0.3	0.2	0.1
		GAAGQQG	0.5	0.3	0.2	0.1	<0.1
		Xrow	<0.1	<0.1	<0.1	<0.1	<0.1

Table 7 - Propagation Delay (Mated Connector)
Case 3 = Short Row; Case 4 = Long Row

Case 3	Single-Ended	72ps
	Differential	69ps
Case 4	Single-Ended	120ps
	Differential	115ps

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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 within 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**:**

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- 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,

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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 10 mils of PCB trace on the QRM8 connector side and 10 mils of PCB trace on the QRF8 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.

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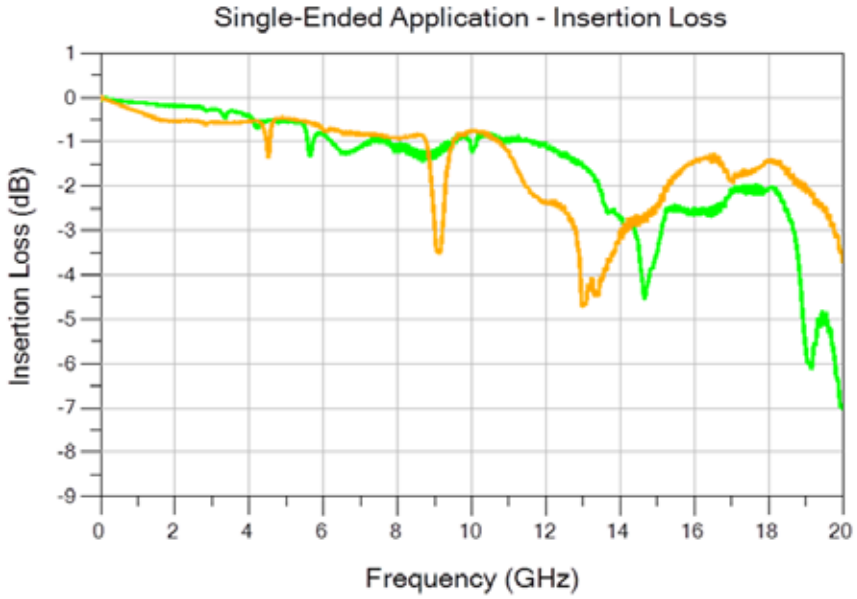
Appendix A – Frequency Domain Response Graphs

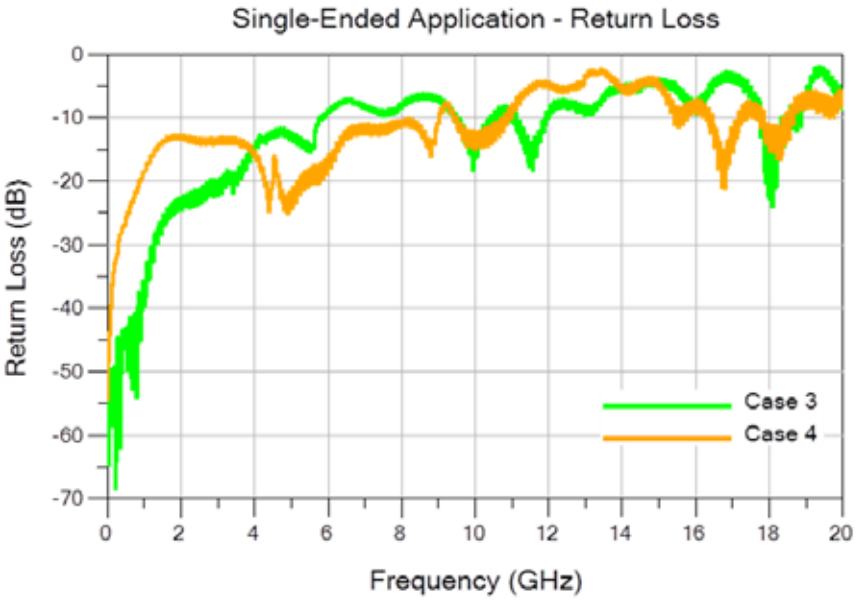
Single-Ended Application – Insertion Loss

Case 3 = Short Row; Case 4 = Long Row



Single-Ended Application – Return Loss

Case 3 = Short Row; Case 4 = Long Row



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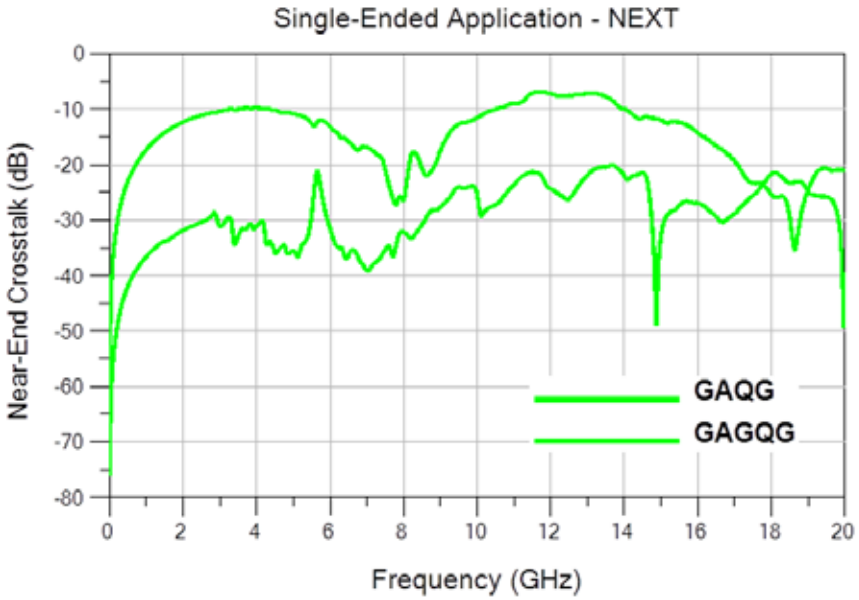
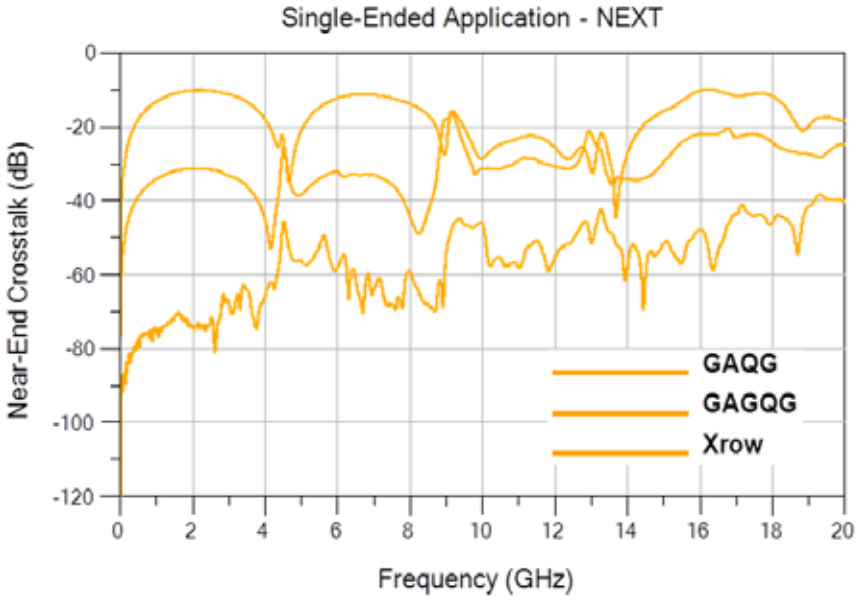
Single-Ended Application – NEXT Configurations, Case 3

Short Row



Single-Ended Application – NEXT Configurations, Case 4

Long Row



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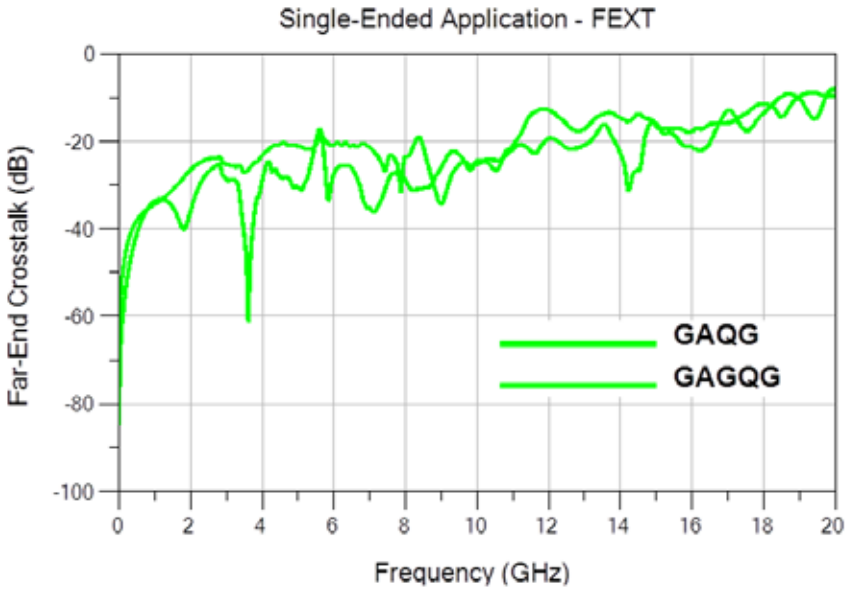
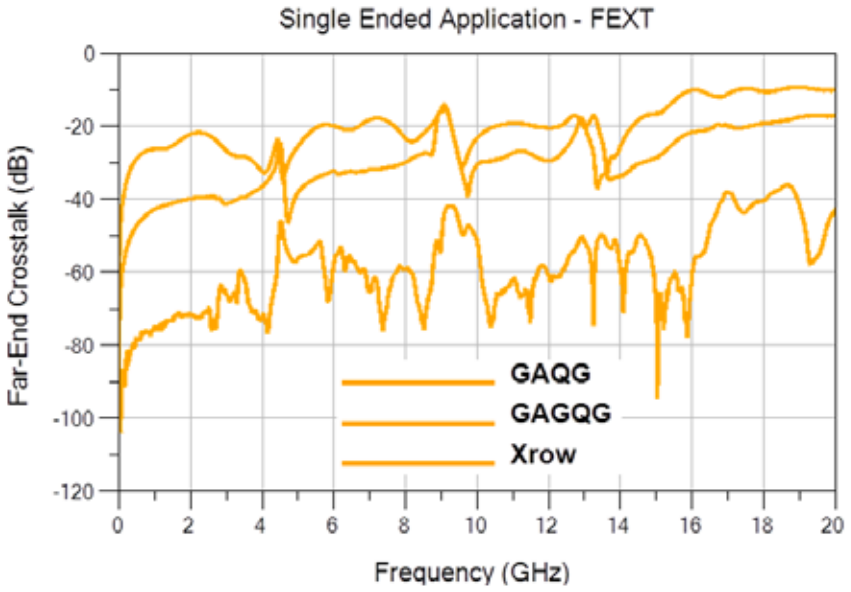
Single-Ended Application – FEXT Configurations, Case 3

Short Row



Single-Ended Application – FEXT Configurations, Case 4

Long Row



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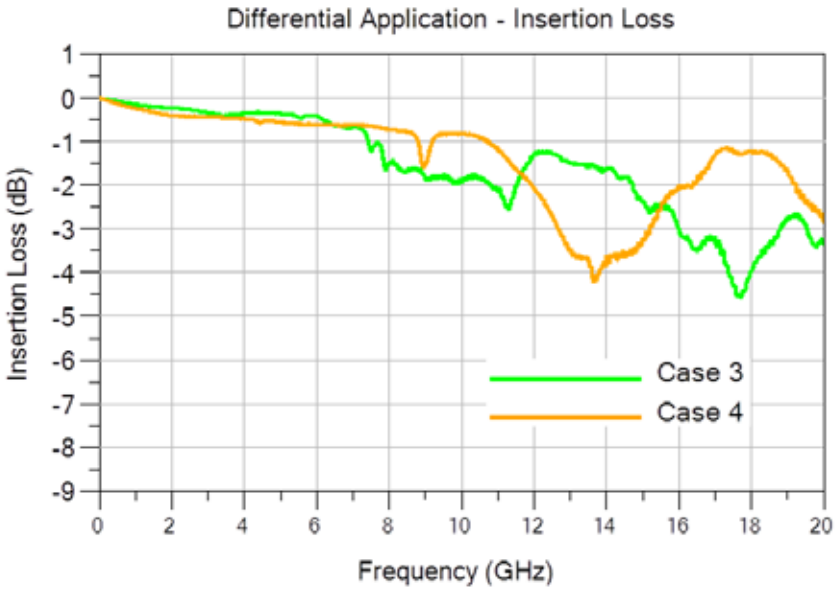
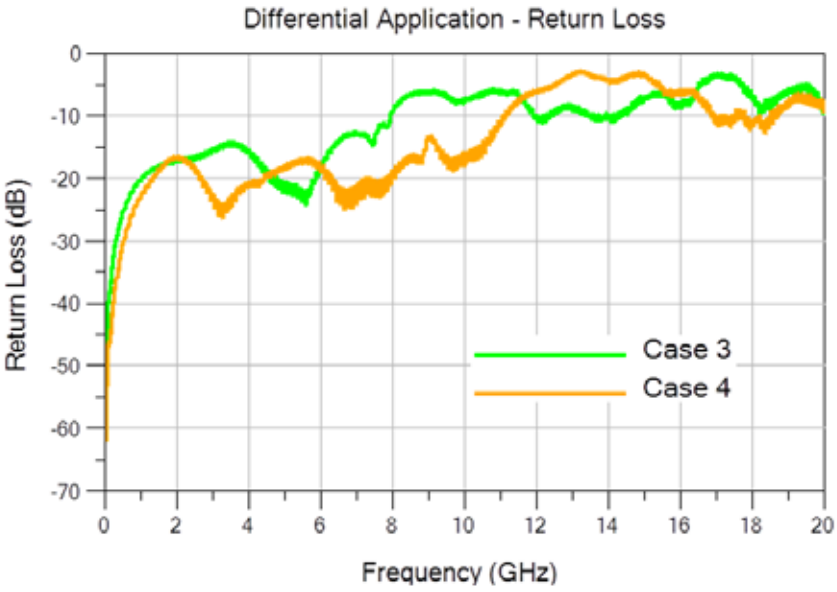
Differential Application – Insertion Loss

Case 3 = Short Row; Case 4 = Long Row



Differential Application – Return Loss

Case 3 = Short Row; Case 4 = Long Row



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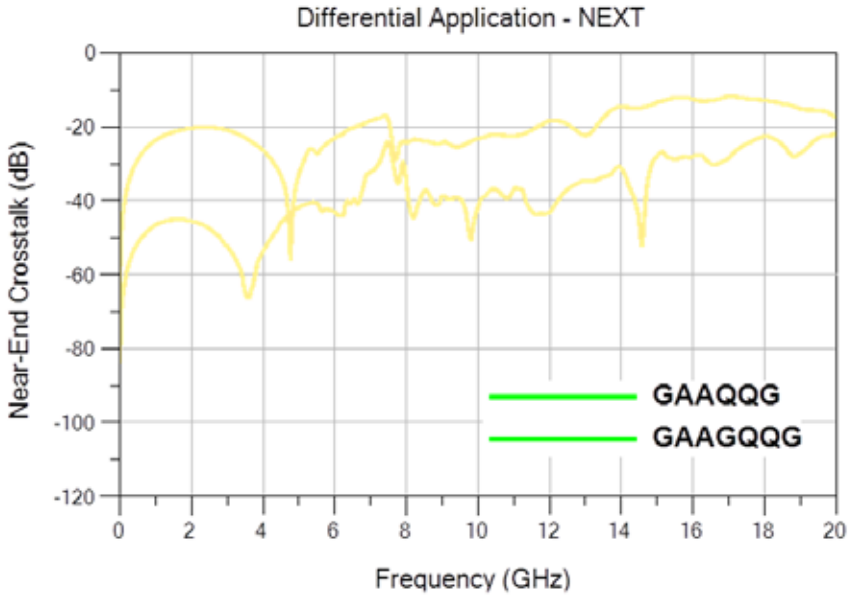
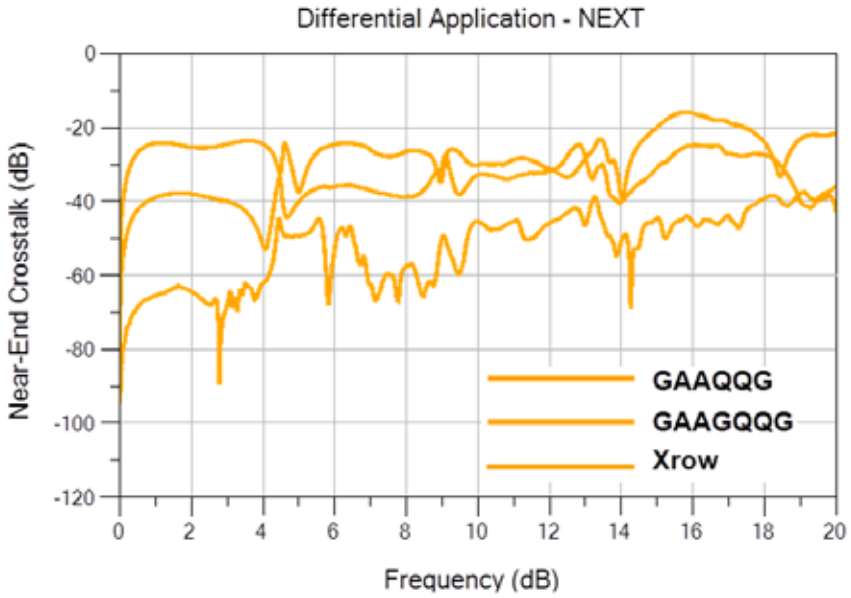
Differential Application – NEXT Configurations, Case 3

Short Row



Differential Application – NEXT Configurations, Case 4

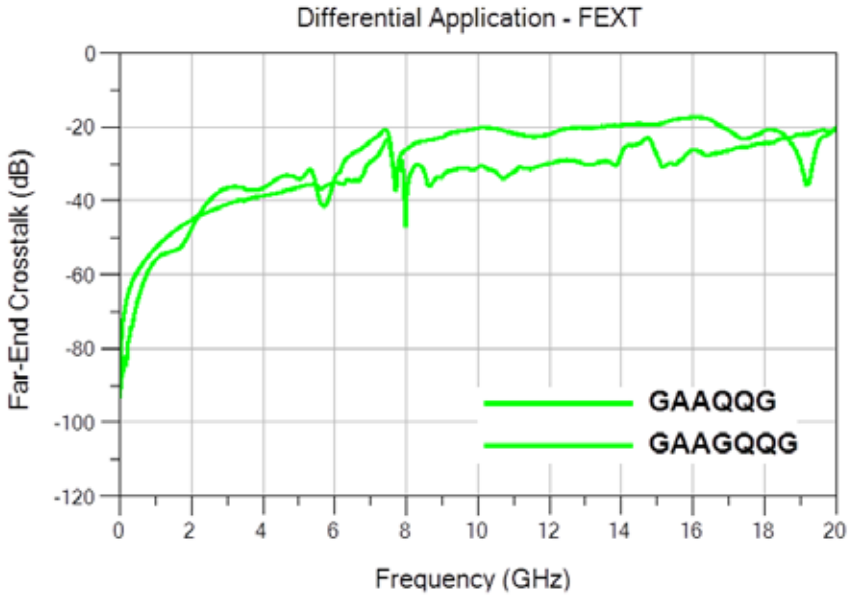
Long Row



Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

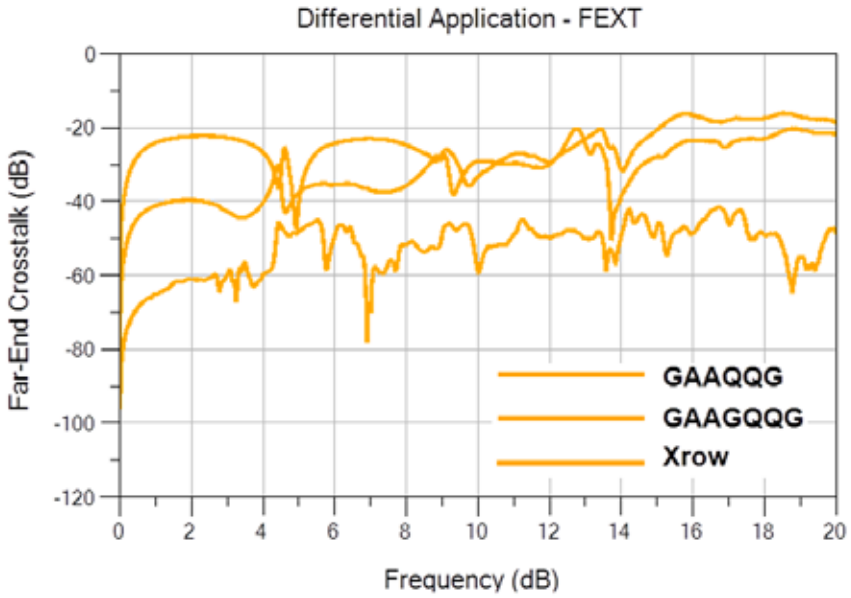
Differential Application – FEXT Configurations, Case 3

Short Row



Differential Application – FEXT Configurations, Case 4

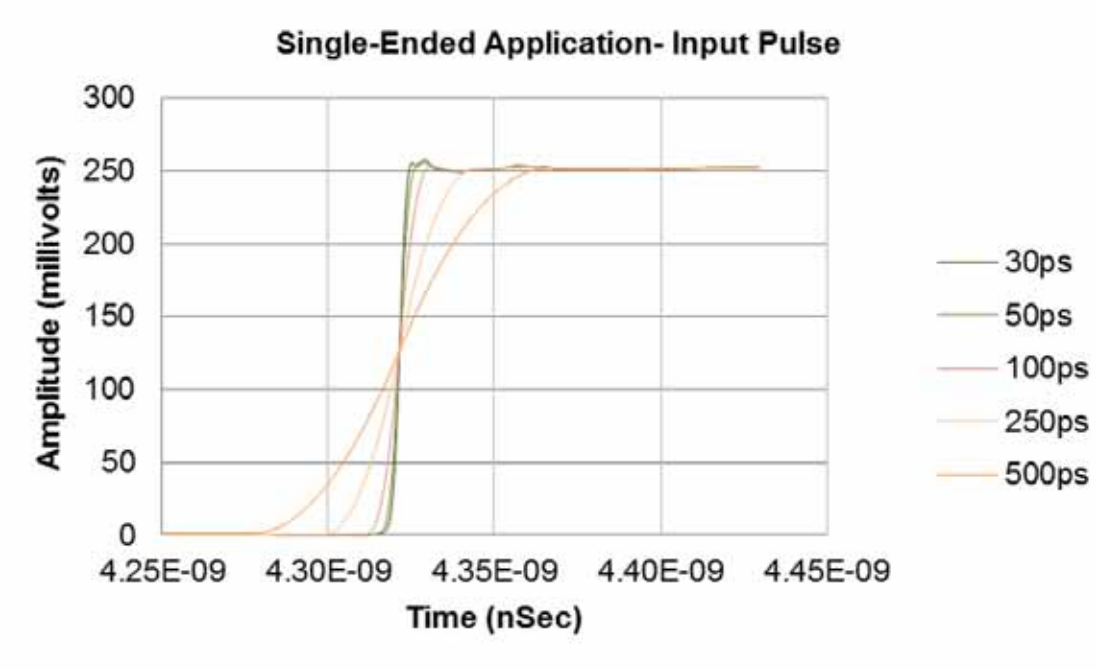
Long Row



Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Appendix B – Time Domain Response Graphs

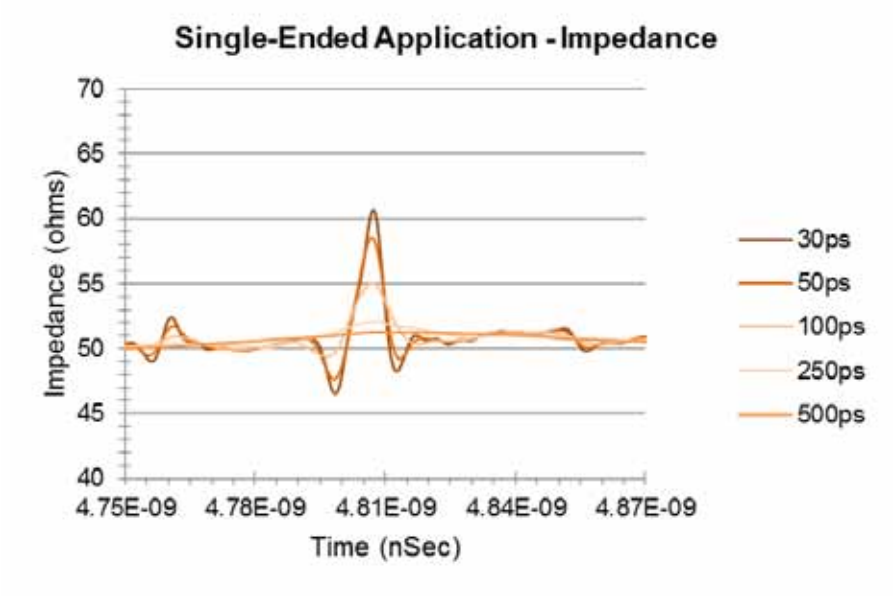
Single-Ended Application – Input Pulse



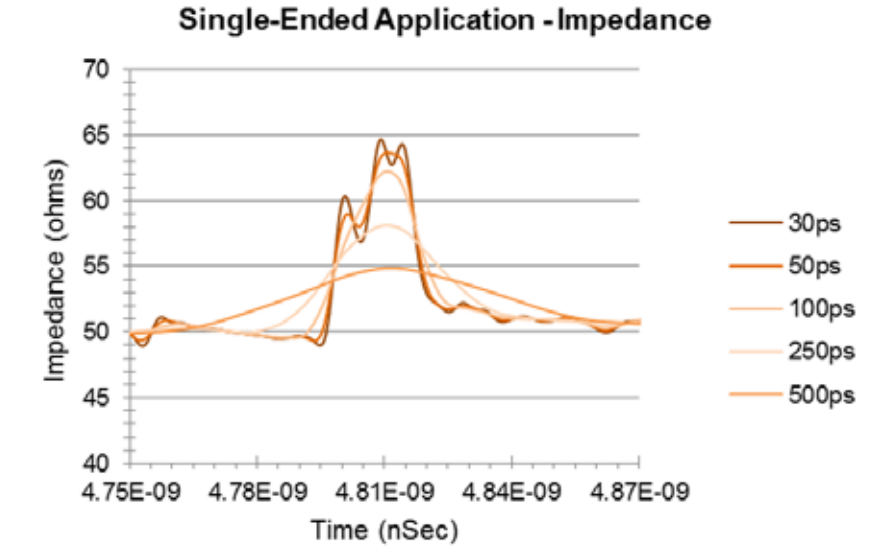
Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Single-Ended Application – Impedance

Case 3 (Short Row)



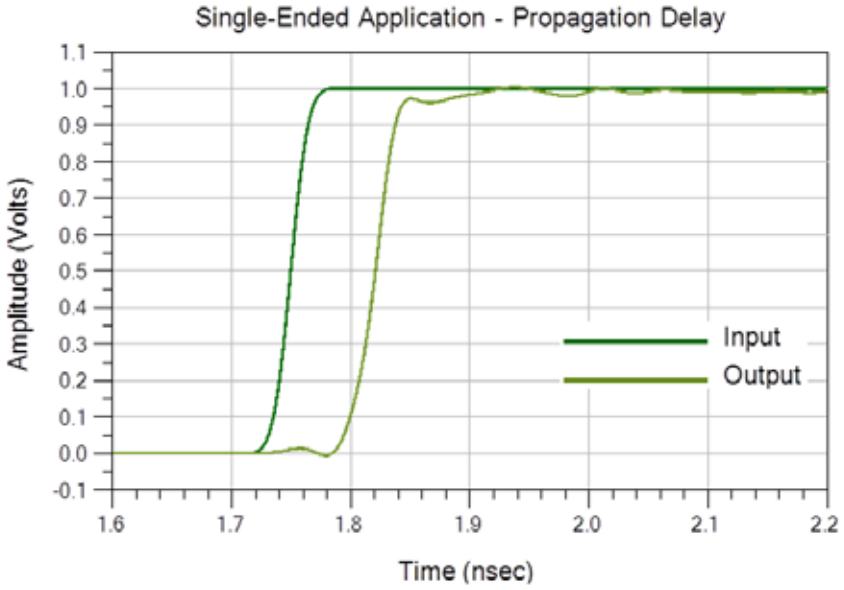
Case 4 (Long Row)



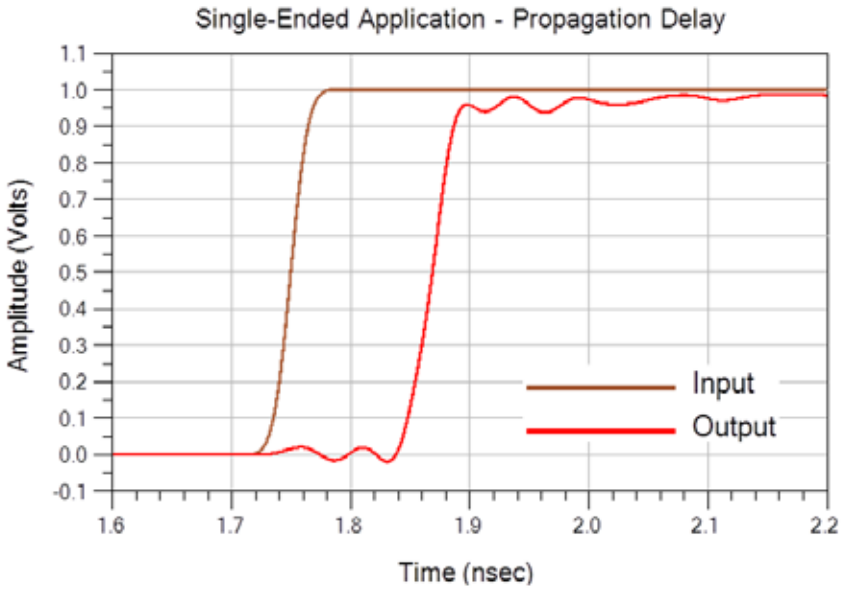
Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Single-Ended Application – Propagation Delay

Case 3 (Short Row)



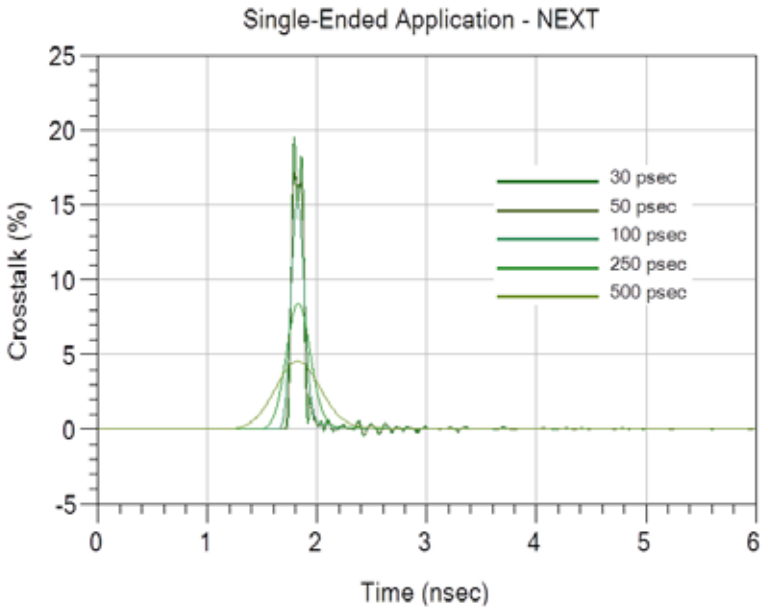
Case 4 (Long Row)



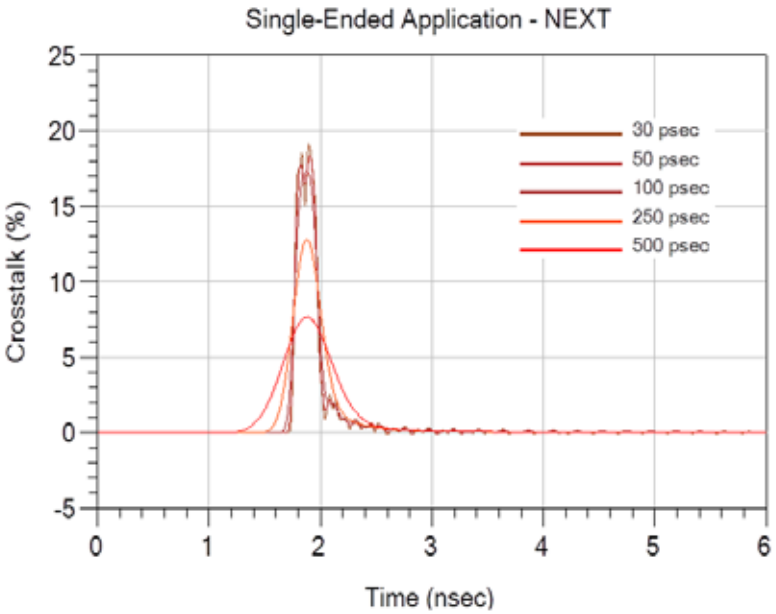
Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Single-Ended Application – NEXT, Worst Case Configuration

Case 3 (Short Row)



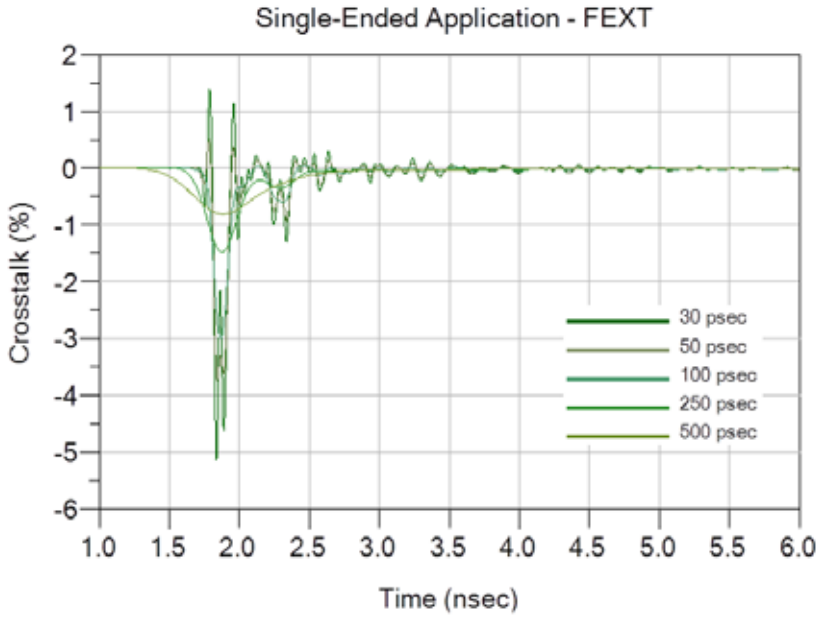
Case 4 (Long Row)



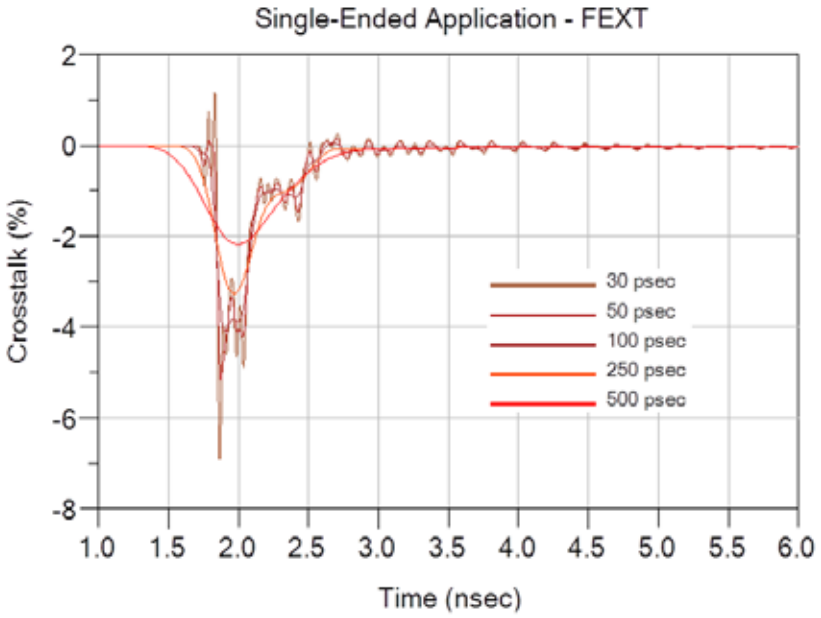
Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Single-Ended Application – FEXT, Worst Case Configuration

Case 3 (Short Row)



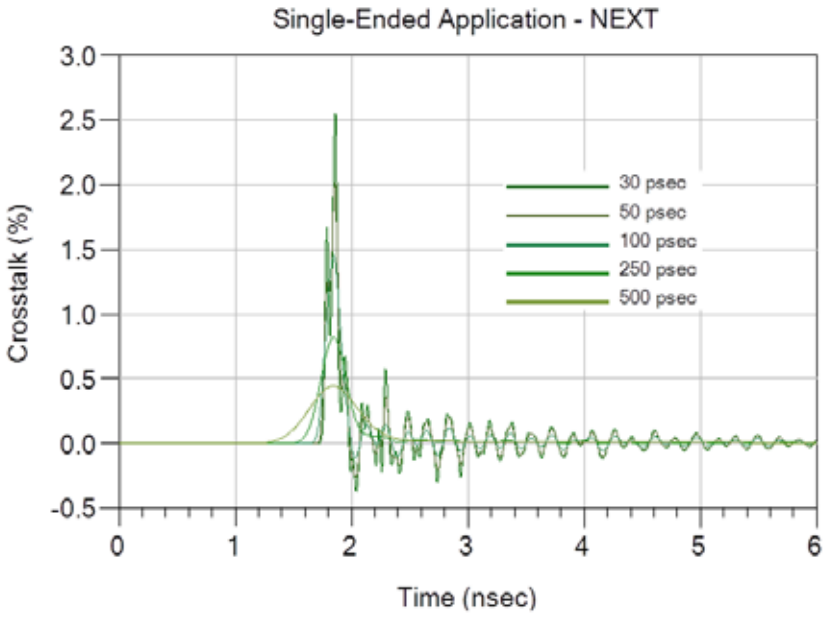
Case 4 (Long Row)



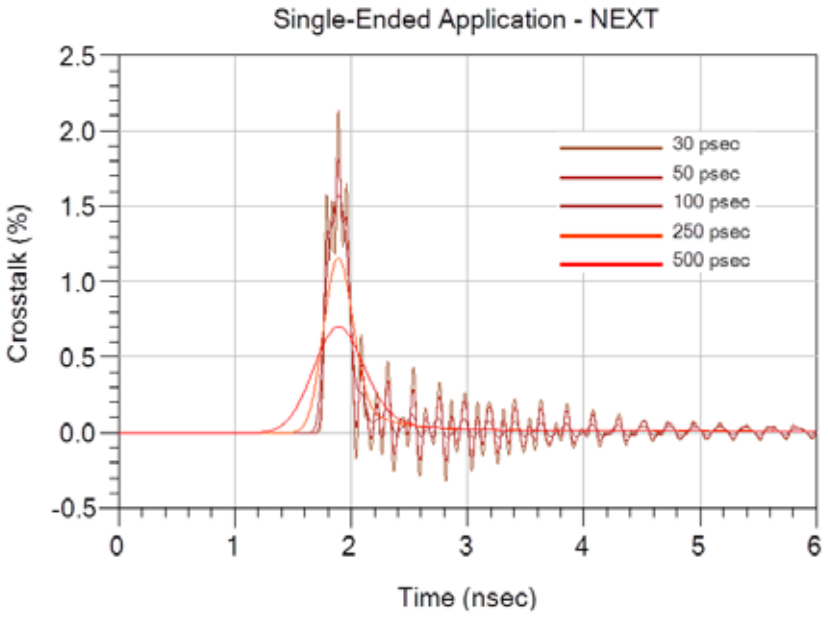
Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Single-Ended Application – NEXT, Best Case Configuration

Case 3 (Short Row)



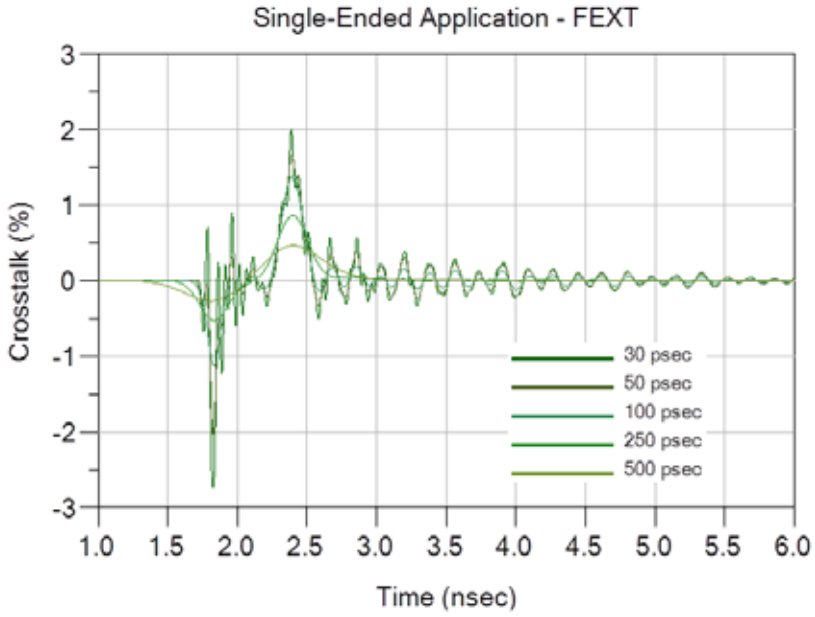
Case 4 (Long Row)



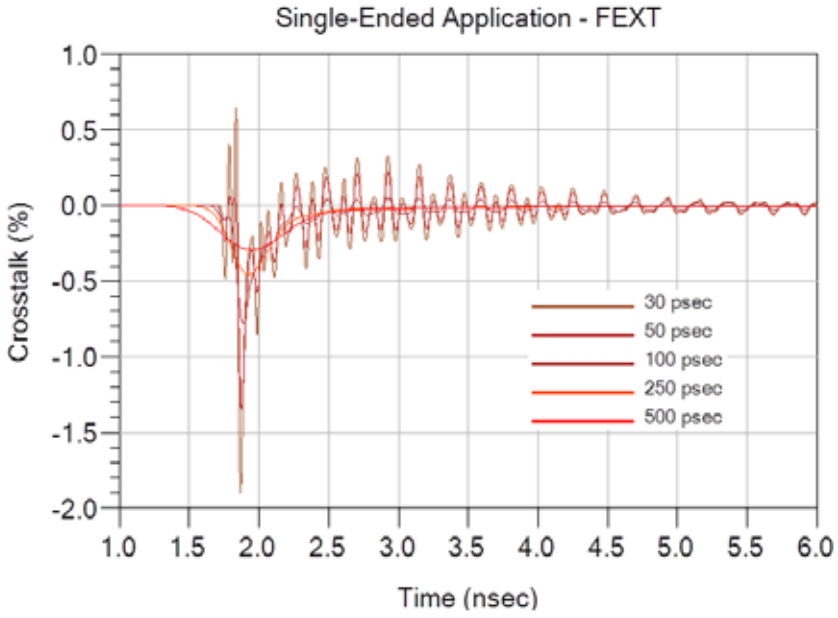
Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Single-Ended Application – FEXT, Best Case Configuration

Case 3 (Short Row)

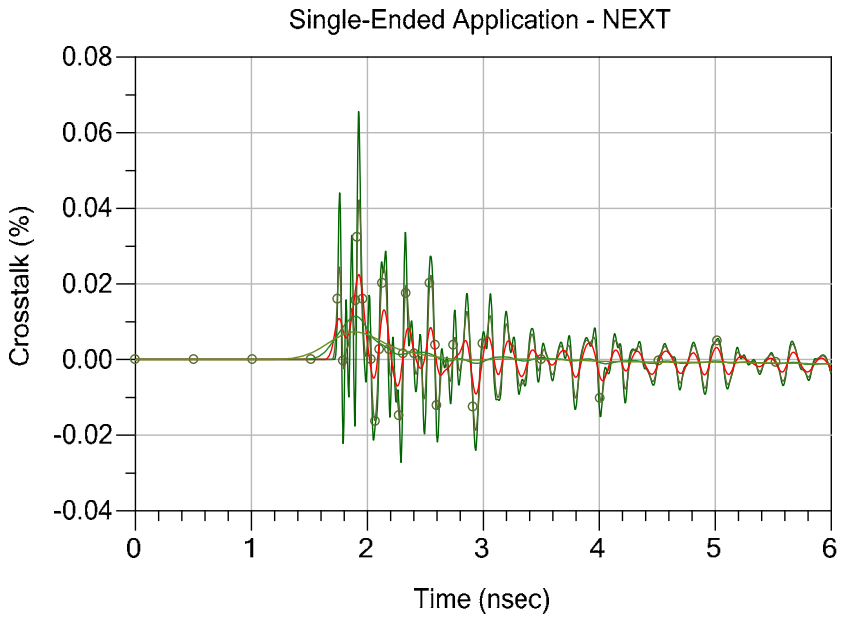


Case 4 (Long Row)

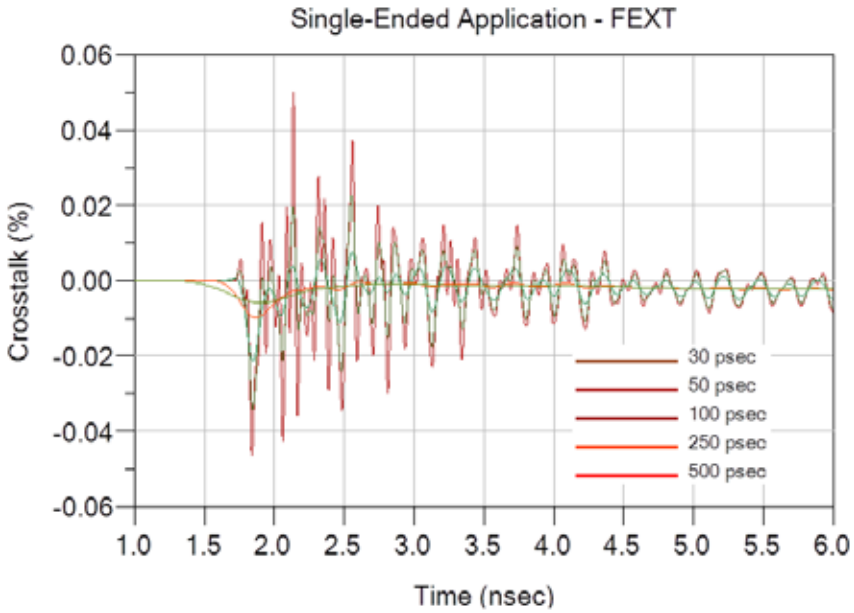


Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Single-Ended Application – NEXT, Across Row Configuration

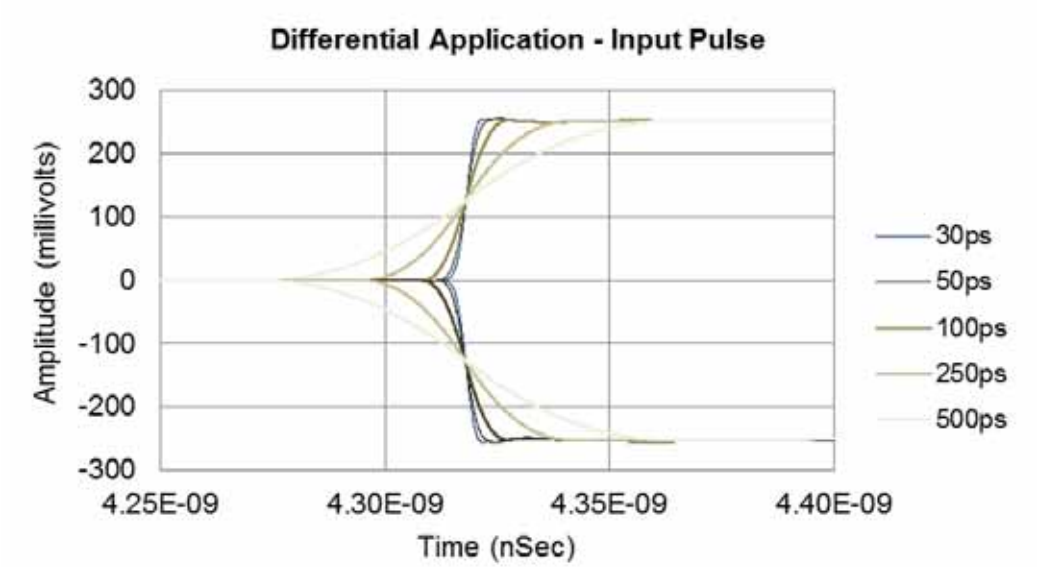


Single-Ended Application – FEXT, Across Row Configuration



Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

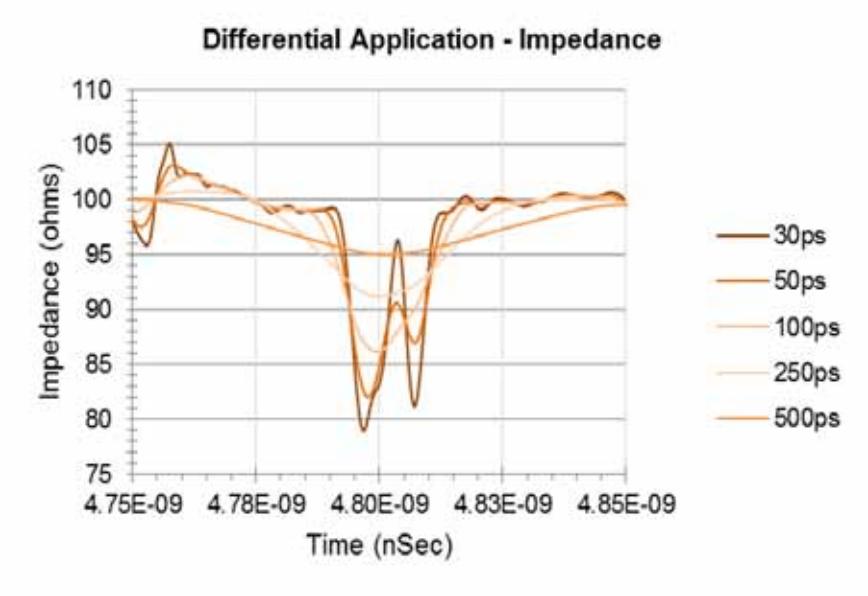
Differential Application – Input Pulse



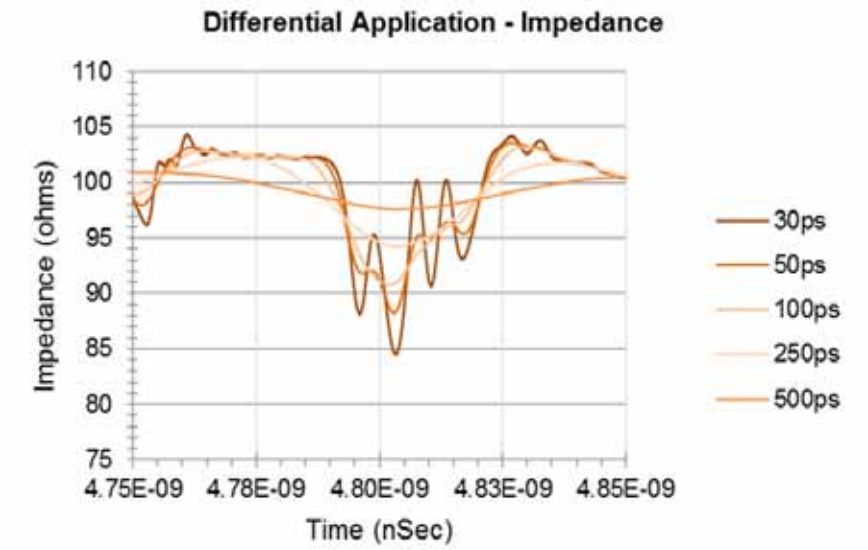
Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Differential Application – Impedance

Case 3 (Short Row)



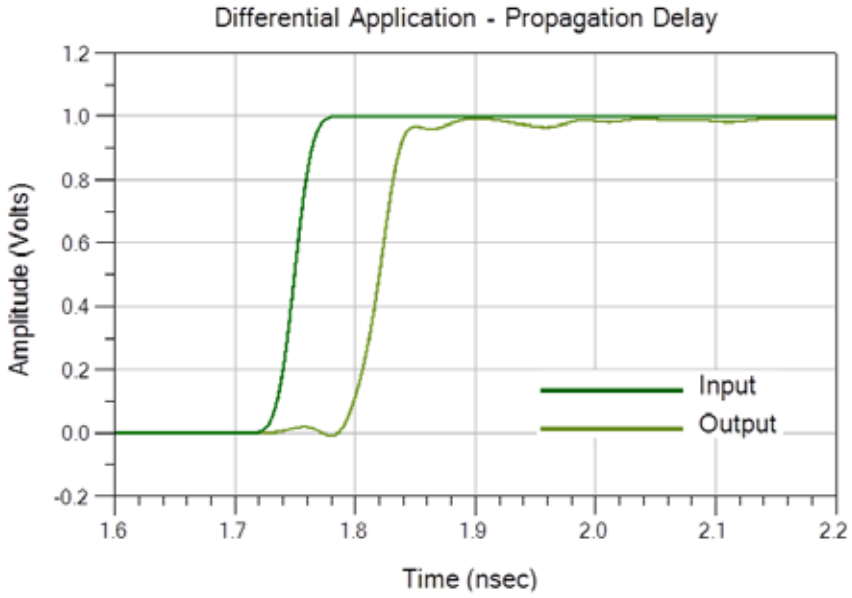
Case4 (Long Row)



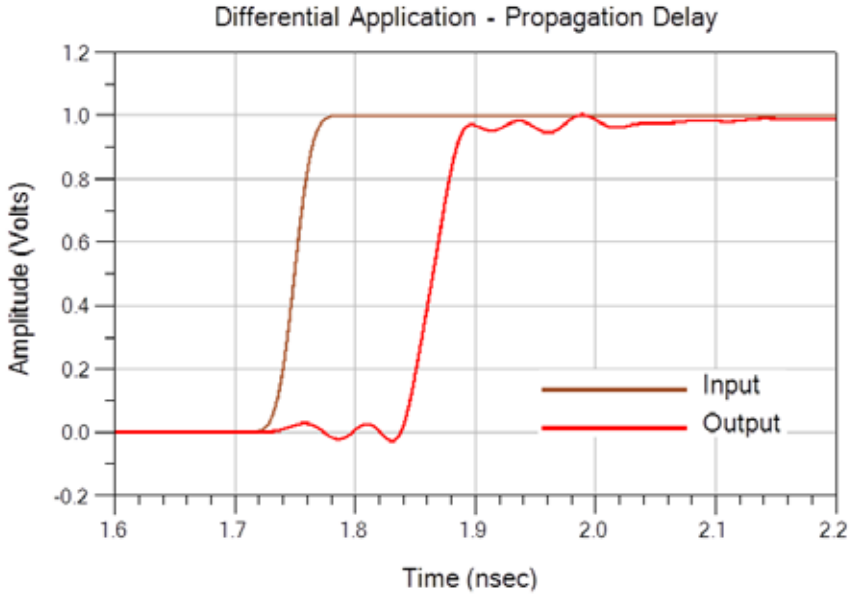
Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Differential Application – Propagation Delay

Case 3 (Short Row)



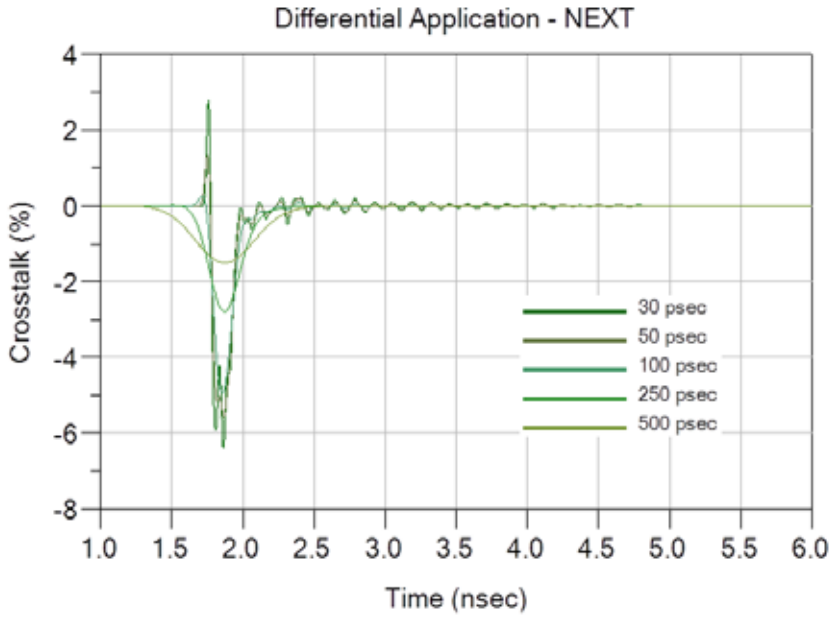
Case4 (Long Row)



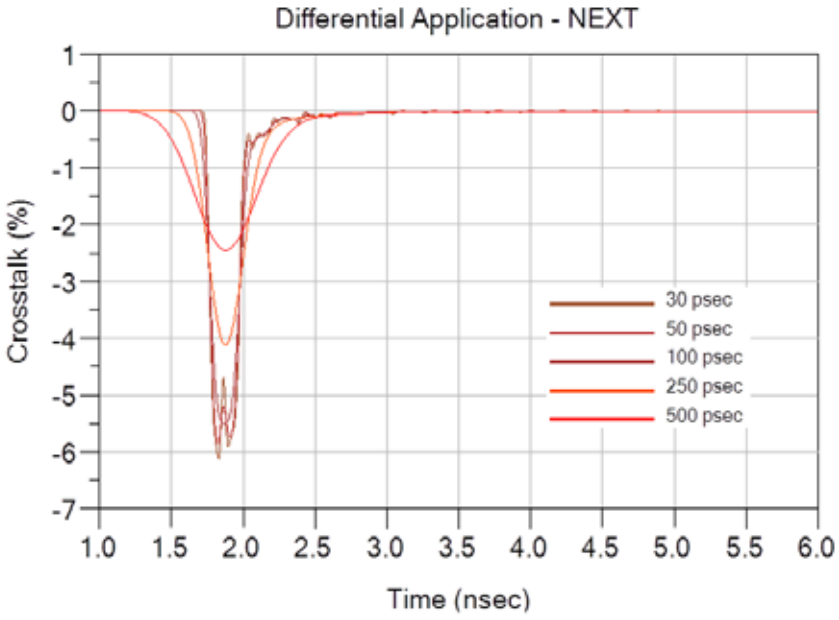
Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Differential Application – NEXT, Worst Case Configuration

Case 3 (Short Row)



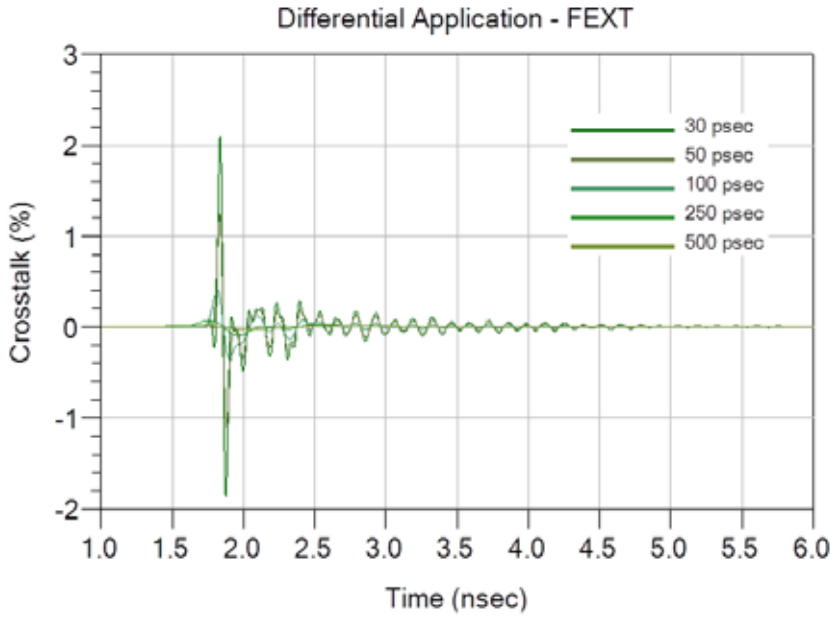
Case4 (Long Row)



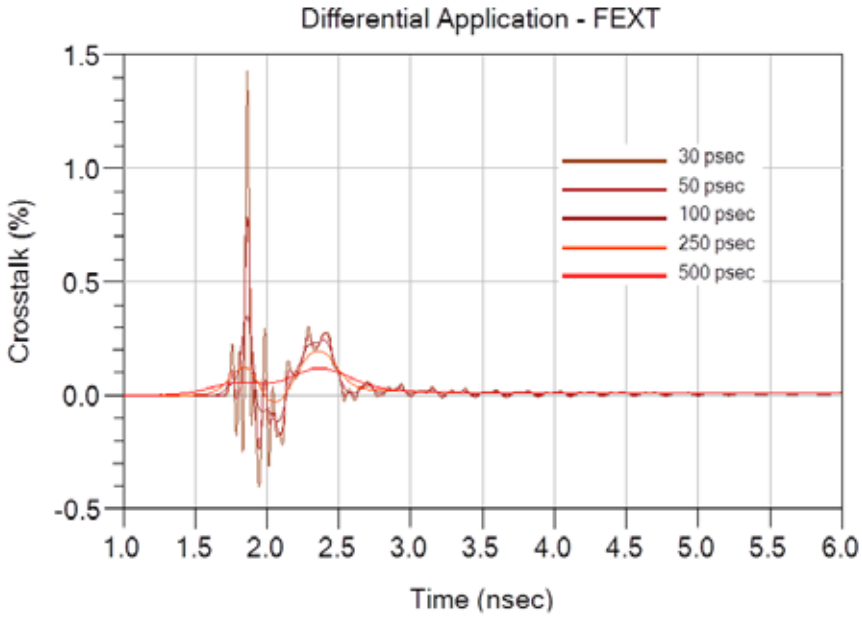
Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Differential Application – FEXT, Worst Case Configuration

Case 3 (Short Row)



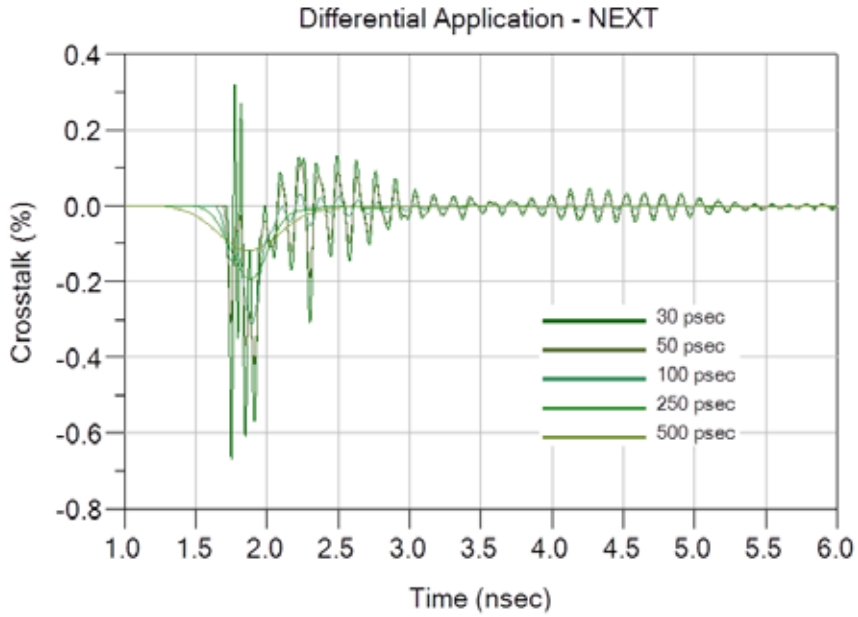
Case4 (Long Row)



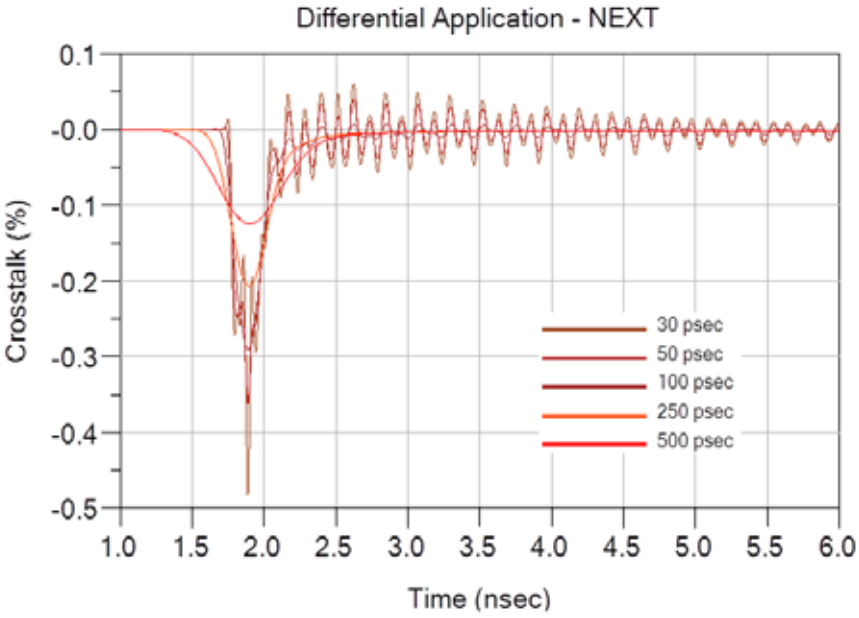
Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Differential Application – NEXT, Best Case Configuration

Case 3 (Short Row)



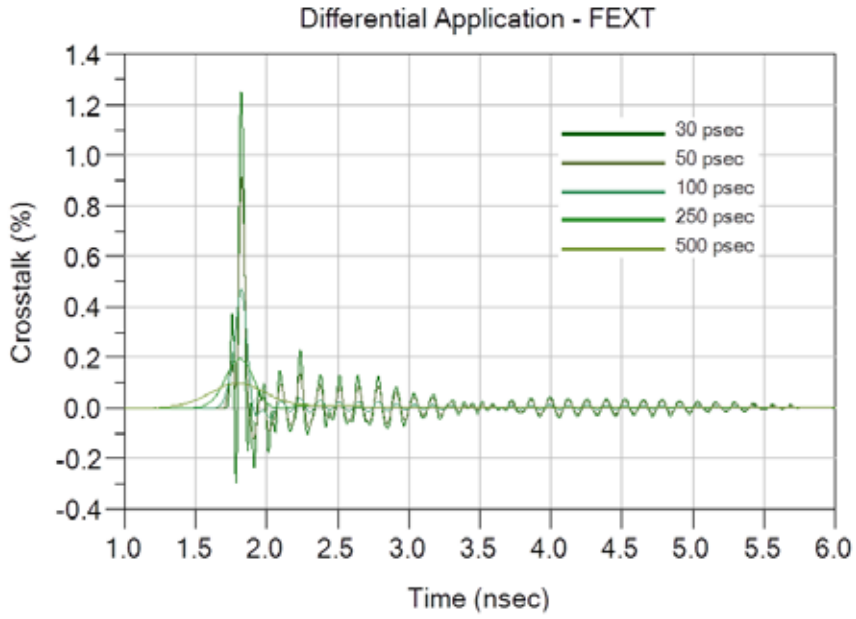
Case4 (Long Row)



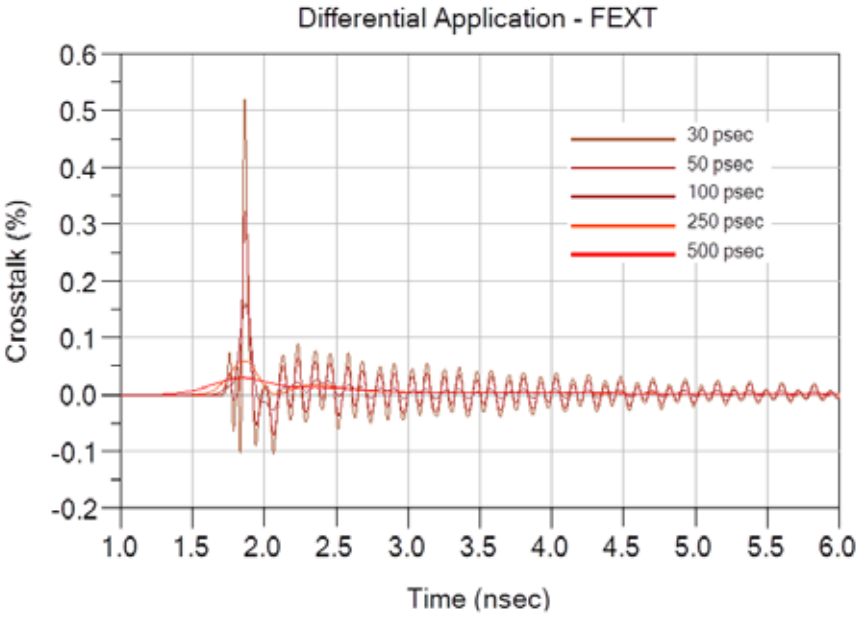
Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Differential Application – FEXT, Best Case Configuration

Case 3 (Short Row)

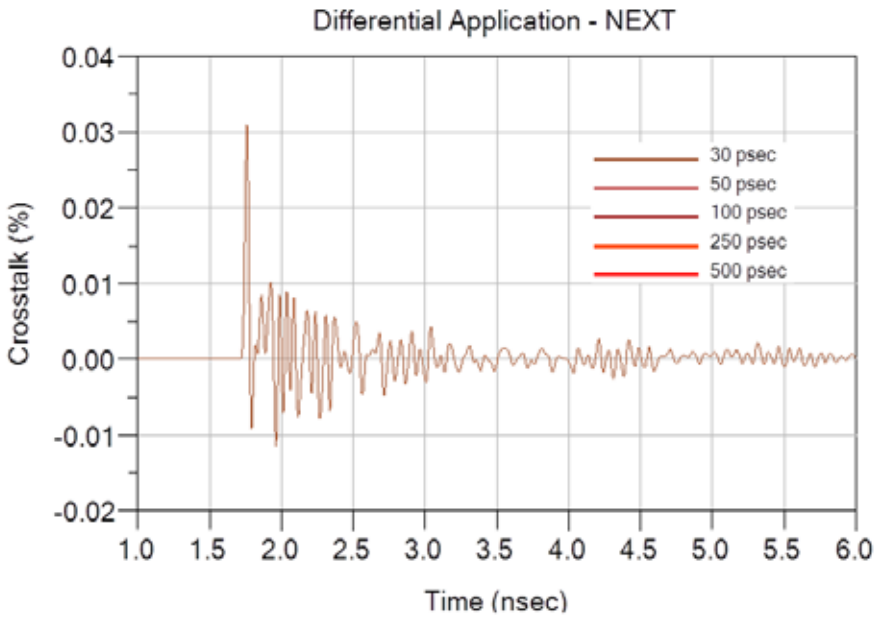


Case4 (Long Row)

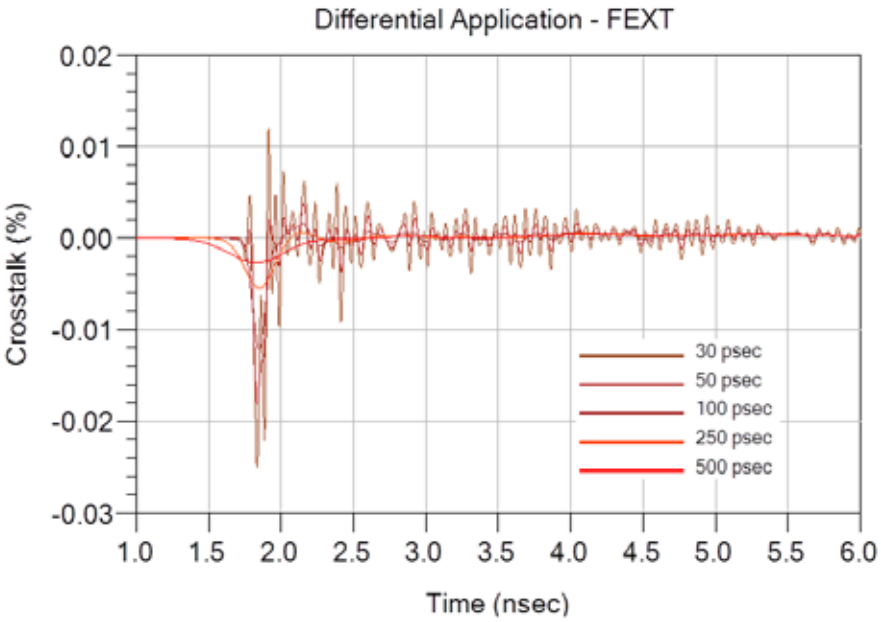


Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Differential Application – NEXT, Across Row Case Configuration



Differential Application – FEXT, Across Row Case Configuration



Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Appendix C – Product and Test System Descriptions

Product Description

Product test samples are QRM8-RA/QRF8-RA Q Rate® Slim Body Low Profile Right Angle connectors. The terminal part number is QRM8-052-01-L-RA-GP and it mates to QRF8-052-01-L-RA-GP. The connector has two rows of 26 contacts evenly spaced on a 0.8 mm (0.0315") pitch. Depictions of a terminal and socket right angle connector mounted to a mated PCB fixture appear below.

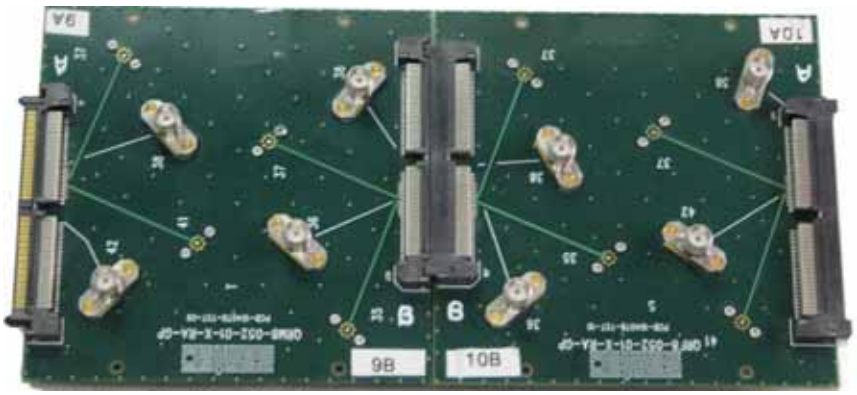
Test System Description

The test fixtures are composed of four-layer FR-406 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 7 test fixtures specific to the QRM8/QRF8 series connector set. Six of the 7 fixtures mate to comprise a full hi-speed characterization test. The remaining board contains the SMA/LRM calibration structures designed specifically for the QRM8-RA/QRF8-RA series. Displayed on the following pages is information for the SMA/LRM calibration structure and directives for mating QRM8-RA/QRF8-RA fixtures.

PCB Fixtures

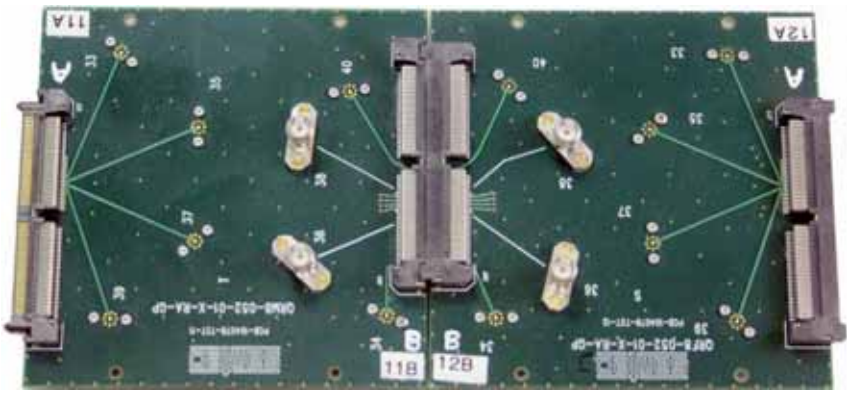
The test fixtures used are as follows:

PCB-104078 -TST-09A Rev - QRM8-RA Terminal Test Board *mates with* PCB-104078 -TST-10A Rev -QRF8-RA Socket Test Board. Measurable configurations available from the 9A-10A connector mating are single-ended long & short row insertion loss/return loss, best-case long row, short row & cross row near-end/far-end crosstalk. Mating 9B to 10B yields a differential cross row near-end and far-end crosstalk signal measurement.

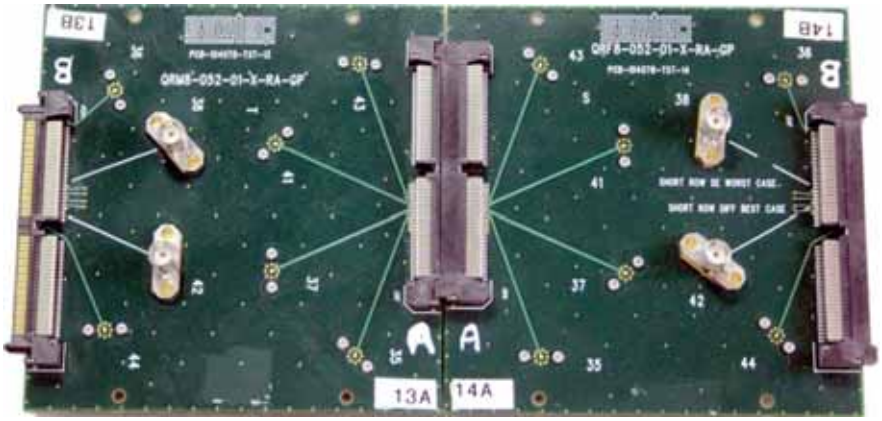


Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

PCB-104078 -TST-11A Rev - QRM8-RA Terminal Test Board *mates with* PCB-104078 -TST-12A Rev -QRF8-RA Socket Test Board. Measurable configurations available from an 11A-12A connector mating are differential worst-case long row near-end and far-end crosstalk. Mating 11B to 12B yields differential worst-case short row near-end and far-end crosstalk.



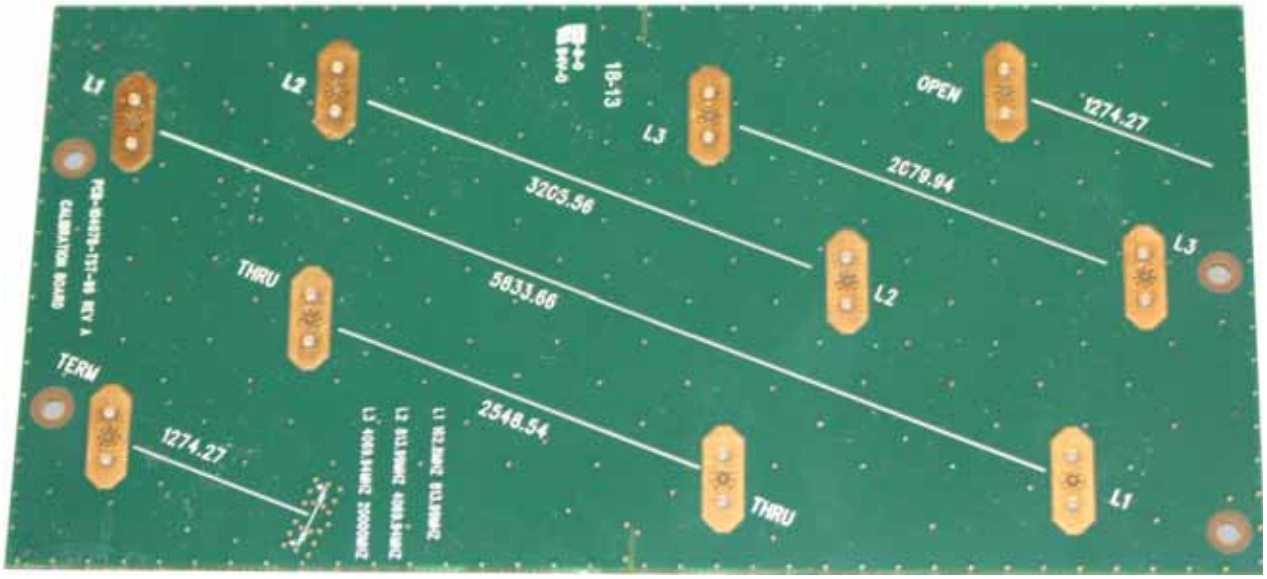
PCB-104078 -TST-13A Rev - QRM8-RA Terminal Test Board *mates with* PCB-104078 -TST-14A Rev -QRF8-RA Socket Test Board. Measurable configurations available from the 13A-14A connector mating are differential long row insertion loss/return loss, differential best-case long row near-end and far-end crosstalk, and single-ended worst-case long row near-end and far-end crosstalk. Mating 13B to 14B yields differential short row insertion loss/return loss, differential best-case short row near-end and far-end crosstalk, and single-ended worst-case short row near-end and far-end crosstalk.



Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") 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.



Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

Line - Reflect - Match (LRM) Calibration Standards

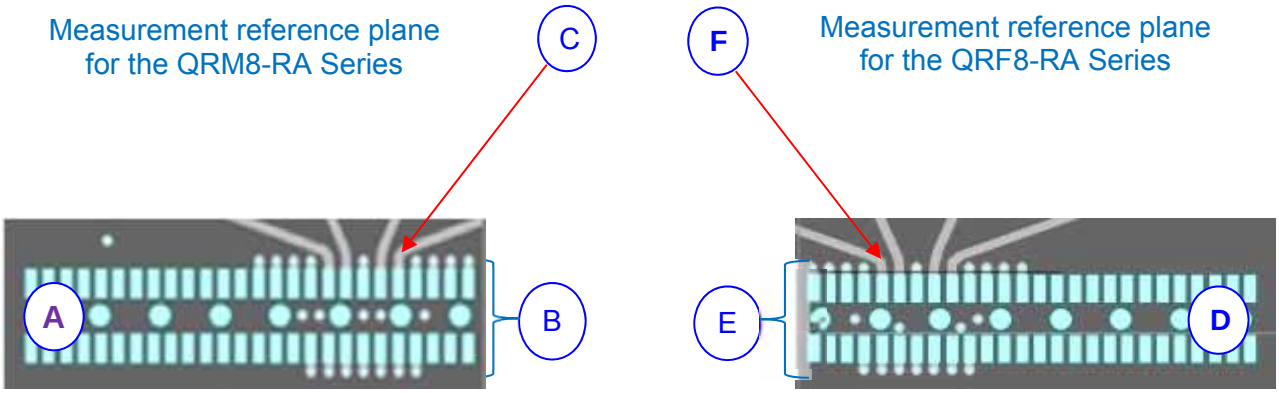
PCB-104078-TST-98, PCB-104078-TST-99

Reflect Standard - Open = 1274.27 mils	Line 3 Length = 2079.94 mils
Line 1 Length = 5833.66 mils	Line 2 Length = 3205.56 mils
Match Standard - Term = 1274.27 mils	Thru Line (2X) = 2548.54 mils

All traces on the QRM8-RA test boards are length matched to 1274.27 mils measured from the SMA center contact pad to the edge of a signal pad at the connector's footprint. All traces on the QRF8-RA test boards are length matched to 1274.27 mils measured from the SMA center contact pad to the edge of a signal pad at the connector's footprint. The LRM calibration effectively removes 5833.66 mils of PCB signal trace effects. The calibrated reference plane is located 10 mils from the connector pad on each side. The S-Parameter measurements include:

A. The QRM-RA Series connector
B. Test board vias, pads (footprint effects) for the QRM8 connector side.
C. 10 mils of 9.5 mil wide microstrip signal trace
D. The QRF_RA8 Series connector
E. Test board vias, pads (footprint effects) for the QRF8 connector side.
F. 10 mils of 9.5 mil wide microstrip signal trace

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



Series: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") Pitch

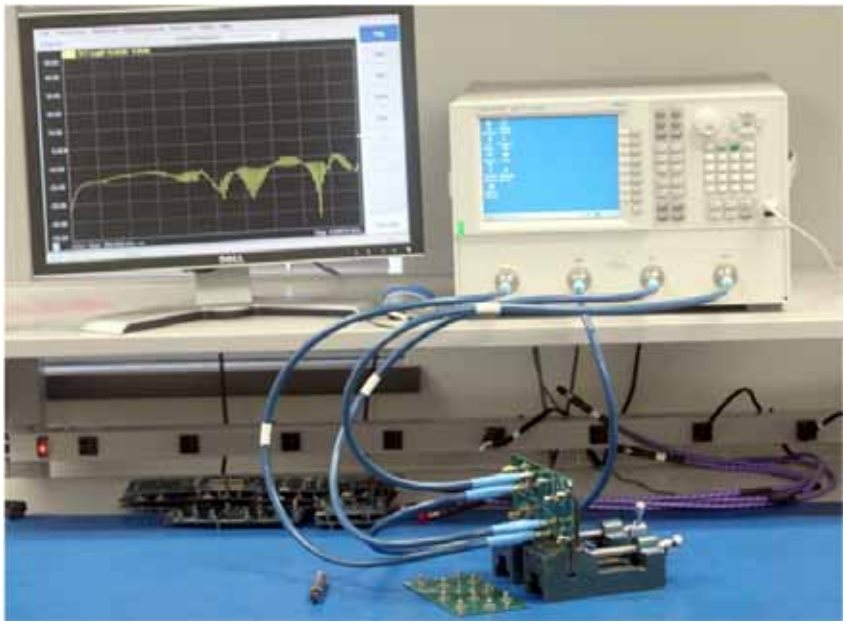
Appendix D – Test and Measurement Setup

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

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: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") 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 an N4433A E-cal 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 QRM8/QRF8 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 update 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: QRM8-RA/QRF8-RA Q Rate® Slim Body Integral Ground Plane
Description: Right Angle-to-Right Angle, 0.8mm (.0315") 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.

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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
LRM – Line Reflect Match calibration
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)