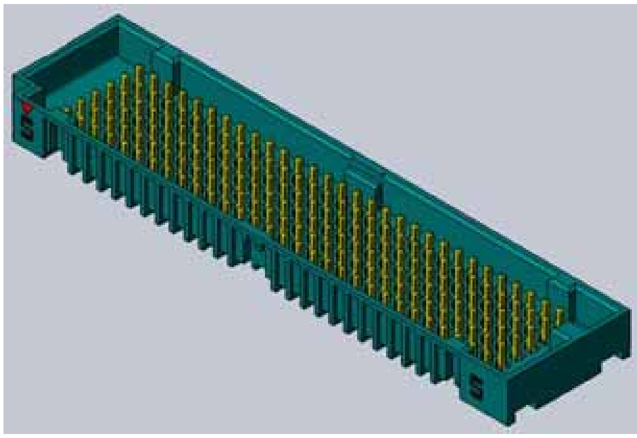
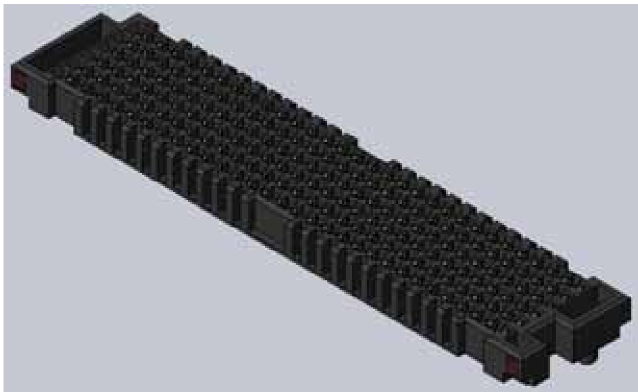
High Speed Characterization Report

LPAM-XX-01.0-L-XX-2



Mates with

LPAF-XX-03.0-L-XX-2



Description:
Low Profile, Open Pin Field Array,
1.27mm x 1.27mm Pitch, 4mm Stack Height

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Report Revision: 8/10/2012

Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Table of Contents

Series: LPAM/LPAF
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Connector Overview

LPAM/LPAF is a low profile, 1.27mm x 1.27mm pitch array interconnect system for high-speed board-to-board applications. The open pin field design allows for dual signaling and is suitable for Fiber Channel, Rapid I/O, PCIe, SATA and Infiniband data rates.

The LPAM/LPAF Series has been designed in 4, 6, 8 ad 10 rows arrays. Positions per row options designed include 10, 20, 30, 40 or 50. This report presents the high-speed electrical characteristics specific to LPAM-1mm/LPAF-3mm 4mm mated stack height test system.

Connector System Speed Rating

LPAM/LPAF Series, 1.27mm x 1.27mm (.050” x .050”) pitch interconnect, 4mm Stack Height.

Signaling	Speed Rating
Single-Ended: 1:1 S/G	**16.5 GHz/ 33Gbps**
Single-Ended: 2:1 S/G	**17.0 GHz/ 34Gbps**
Differential: Optimal Horizontal	**18.5 GHz/ 37Gbps**
Differential: Optimal Vertical	**17.5 GHz/ 35Gbps**
Differential: High Density Vertical	**17.5 GHz/ 35Gbps**

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 is 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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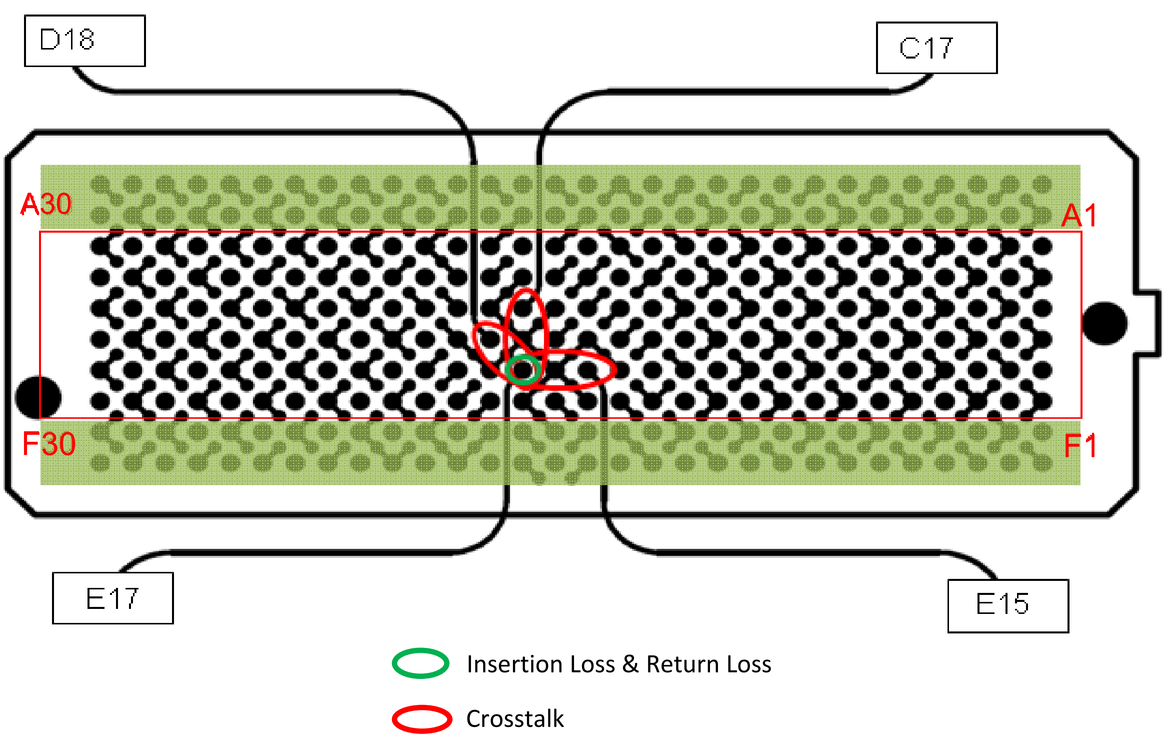
Frequency Domain Data Summary

Table 1 - Single-Ended 1:1 S/G Pattern Performance			
Test Parameter	**Driver**	**Receiver**	
Insertion Loss	LPAM_E17	LPAF_E17	3dB@ 16.4 GHz
Return Loss	LPAM_E17	LPAM_E17	>10dB to 11.1 GHz
Near-End Crosstalk	LPAM_E17	LPAM_C17	<-20dB to 20.0 GHz
	LPAM_E17	LPAM_D18	<-20dB to 20.0 GHz
	LPAM_E17	LPAM_E15	<-20dB to 20.0 GHz
Far-End Crosstalk	LPAM_E17	LPAF_C17	<-20dB to 20.0 GHz
	LPAM_E17	LPAF_D18	<-20dB to 20.0 GHz
	LPAM_E17	LPAF_E15	<-20dB to 20.0 GHz

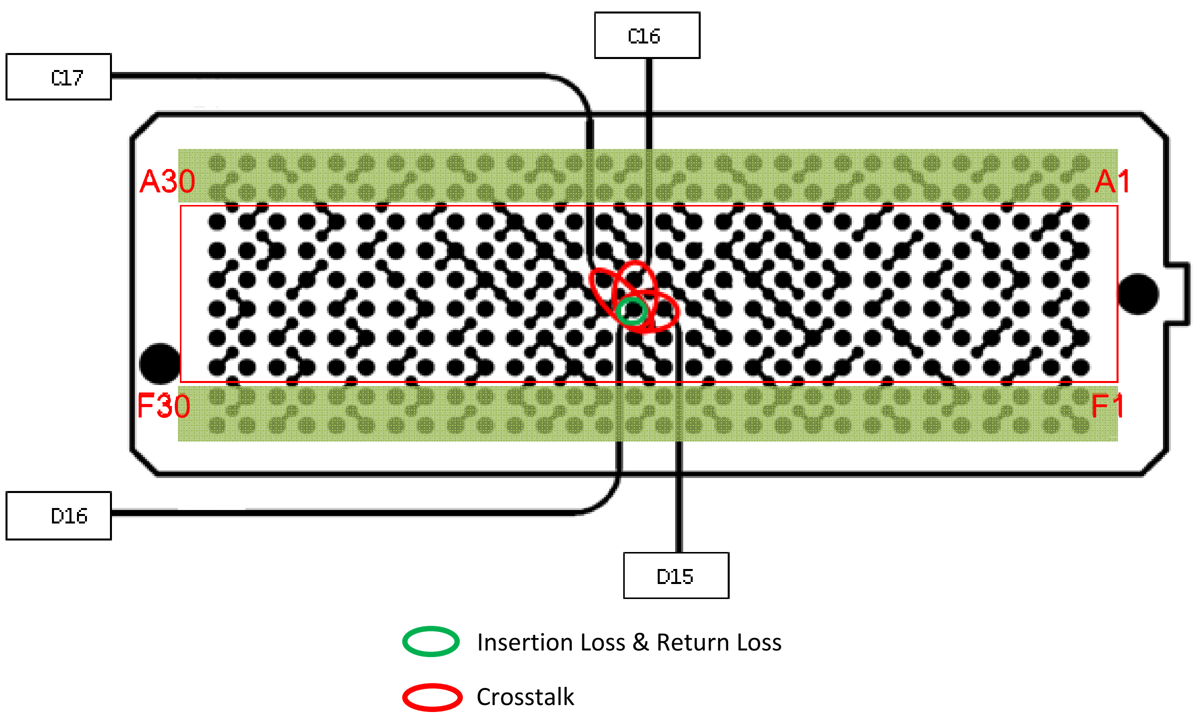
Single-Ended 1:1 S/G Pattern Pin Map



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Table 2 - Single-Ended 2:1 S/G Pattern Performance			
Test Parameter	**Driver**	**Receiver**	
Insertion Loss	LPAM_D16	LPAF_D16	3dB@ 17.0 GHz
Return Loss	LPAM_D16	LPAM_D16	>10dB to 10.8 GHz
Near-End Crosstalk	LPAM_D16	LPAM_C16	<-20dB to 4.3 GHz
	LPAM_D16	LPAM_C17	<-20dB to 20.0 GHz
	LPAM_D16	LPAM_D15	<-20dB to 3.4 GHz
Far-End Crosstalk	LPAM_D16	LPAF_C16	<-20dB to 7.9 GHz
	LPAM_D16	LPAF_C17	<-20dB to 20.0 GHz
	LPAM_D16	LPAF_D15	<-20dB to 8.1 GHz

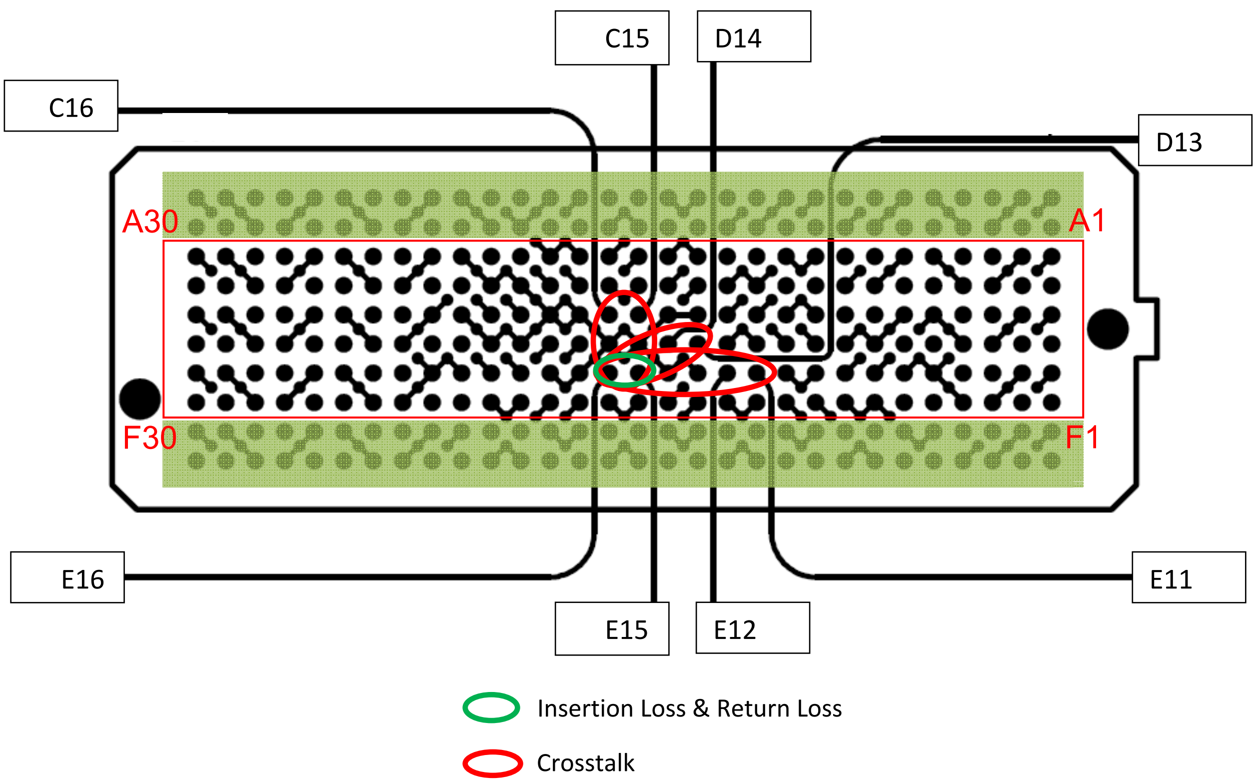
Single-Ended 2:1 S/G Pattern Pin Map



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Table 3 - Differential Optimal Horizontal Performance			
Test Parameter	**Driver**	**Receiver**	
Insertion Loss	LPAM_E15,E16	LPAF_E15,E16	3dB@ 18.4 GHz
Return Loss	LPAM_E15,E16	LPAM_E15,E16	>10dB to 13.45 GHz
Near-End Crosstalk	LPAM_E15,E16	LPAM_C15,C16	<-20dB to 20.0 GHz
	LPAM_E15,E16	LPAM_D13,D14	<-20dB to 20.0 GHz
	LPAM_E15,E16	LPAM_E11,E12	<-20dB to 20.0 GHz
Far-End Crosstalk	LPAM_E15,E16	LPAF_C15,C16	<-20dB to 20.0 GHz
	LPAM_E15,E16	LPAF_D13,D14	<-20dB to 20.0 GHz
	LPAM_E15,E16	LPAF_E11,E12	<-20dB to 20.0 GHz

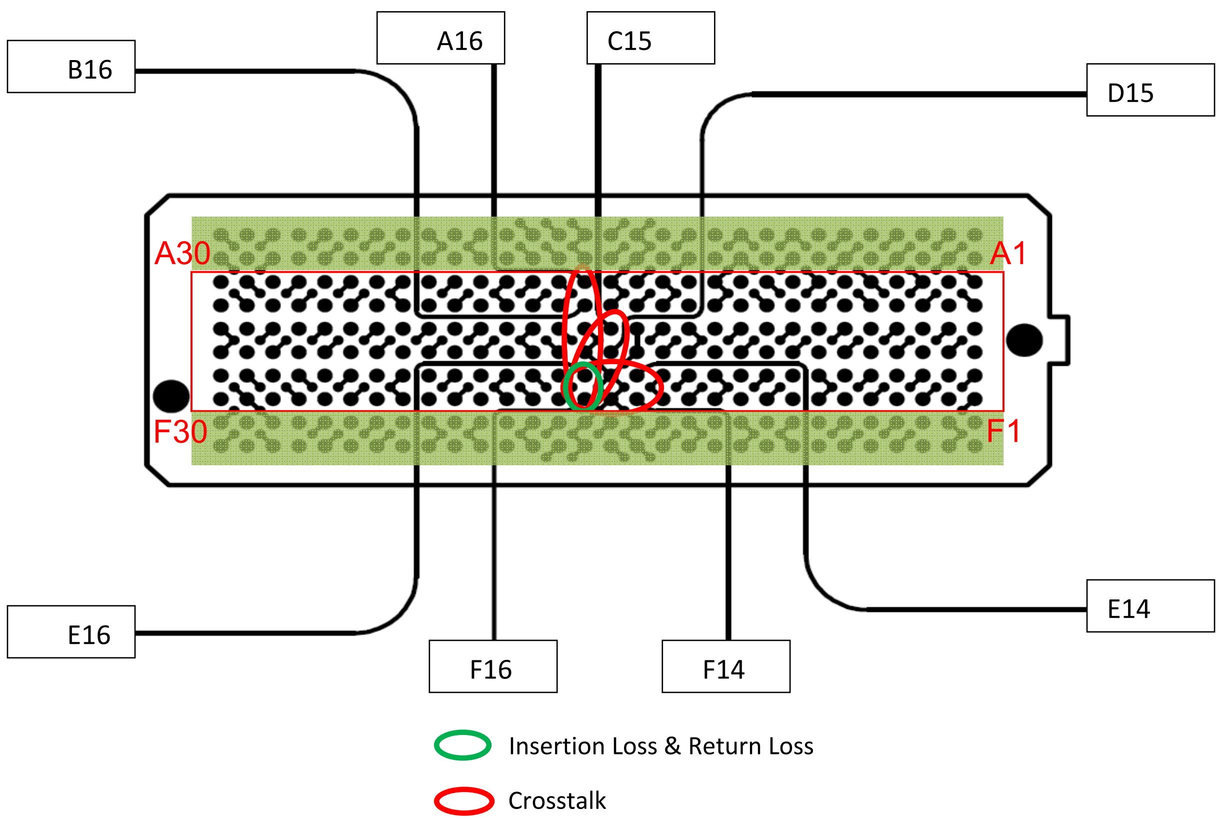
Differential Optimal Horizontal Pin Map



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Table 4 - Differential Optimal Vertical Performance			
Test Parameter	**Driver**	**Receiver**	
Insertion Loss	LPAM_E16,F16	LPAF_E16,F16	3dB@ 17.2 GHz
Return Loss	LPAM_E16,F16	LPAM_E16,F16	>10dB to 14.7 GHz
Near-End Crosstalk	LPAM_E16,F16	LPAM_A16,B16	<-20dB to 20.0 GHz
	LPAM_E16,F16	LPAM_C15,D15	<-20dB to 20.0 GHz
	LPAM_E16,F16	LPAM_E14,F14	<-20dB to 20.0 GHz
Far-End Crosstalk	LPAM_E16,F16	LPAF_A16,B16	<-20dB to 20.0 GHz
	LPAM_E16,F16	LPAF_C15,D15	<-20dB to 20.0 GHz
	LPAM_E16,F16	LPAF_E14,F14	<-20dB to 20.0 GHz

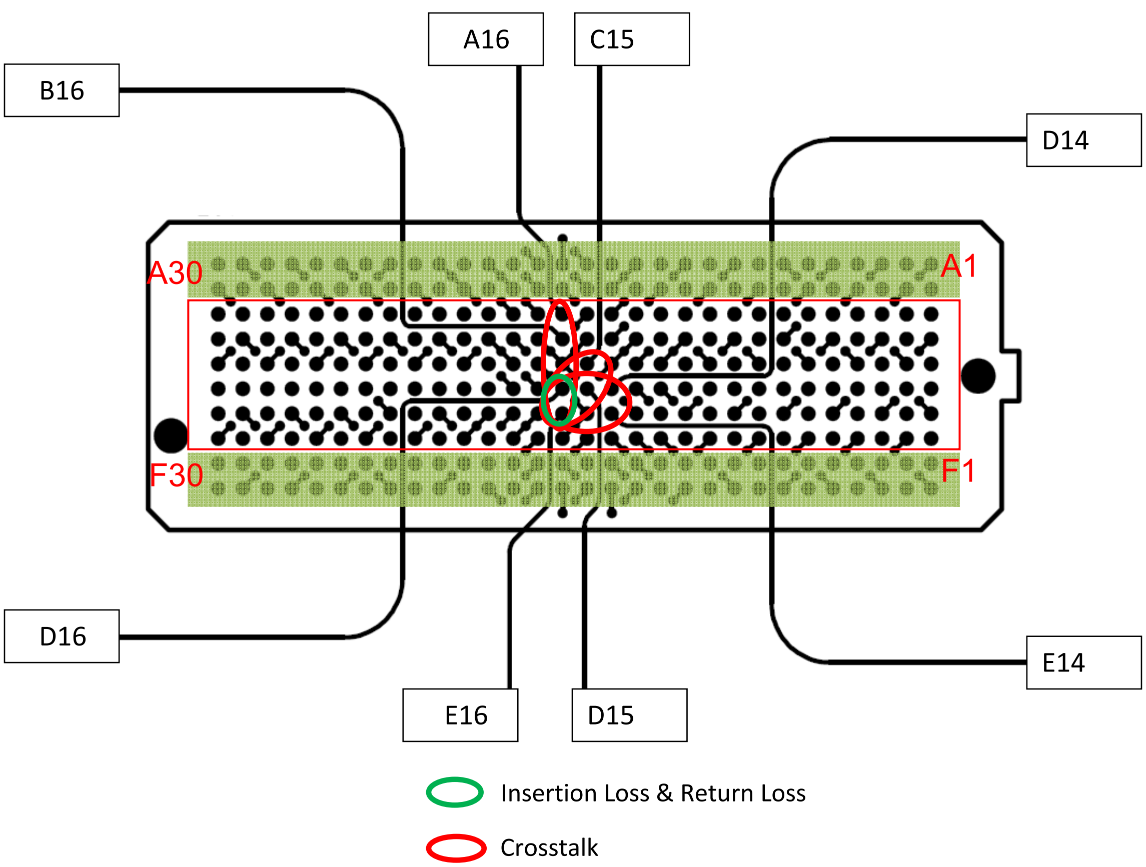
Differential Optimal Vertical Pin Map



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Table 5 - Differential High Density Vertical Performance			
Test Parameter	**Driver**	**Receiver**	
Insertion Loss	LPAM_D16,E16	LPAF_D16,E16	3dB@ 17.1 GHz
Return Loss	LPAM_D16,E16	LPAM_D16,E16	>10dB to 13.1 GHz
Near-End Crosstalk	LPAM_D16,E16	LPAM_A16,B16	<-20dB to 20.0 GHz
	LPAM_D16,E16	LPAM_C15,D15	<-20dB to 20.0 GHz
	LPAM_D16,E16	LPAM_D14,E14	<-20dB to 20.0 GHz
Far-End Crosstalk	LPAM_D16,E16	LPAF_A16,B16	<-20dB to 20.0 GHz
	LPAM_D16,E16	LPAF_C15,D15	<-20dB to 20.0 GHz
	LPAM_D16,E16	LPAF_D14,E14	<-20dB to 20.0 GHz

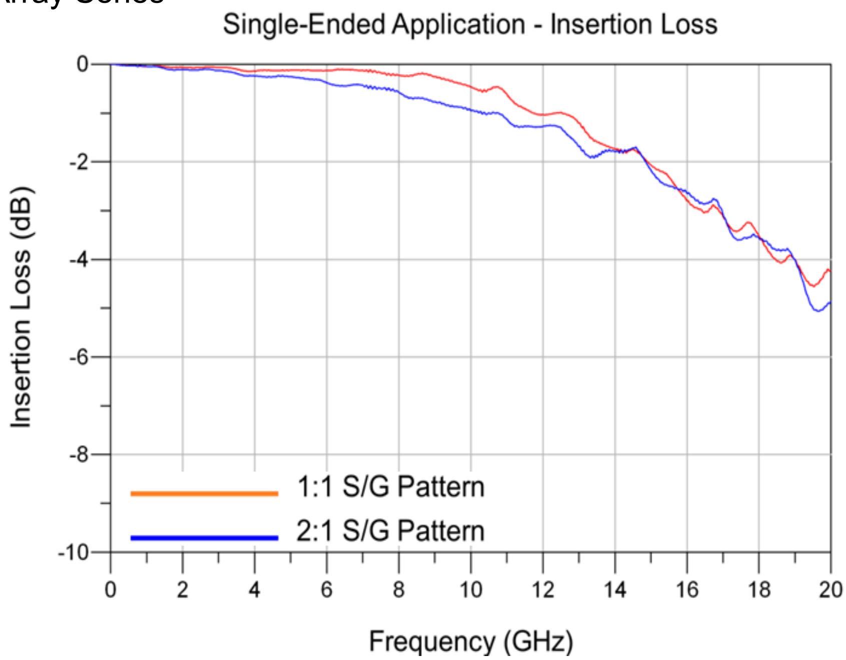
Differential High Density Vertical Pin Map

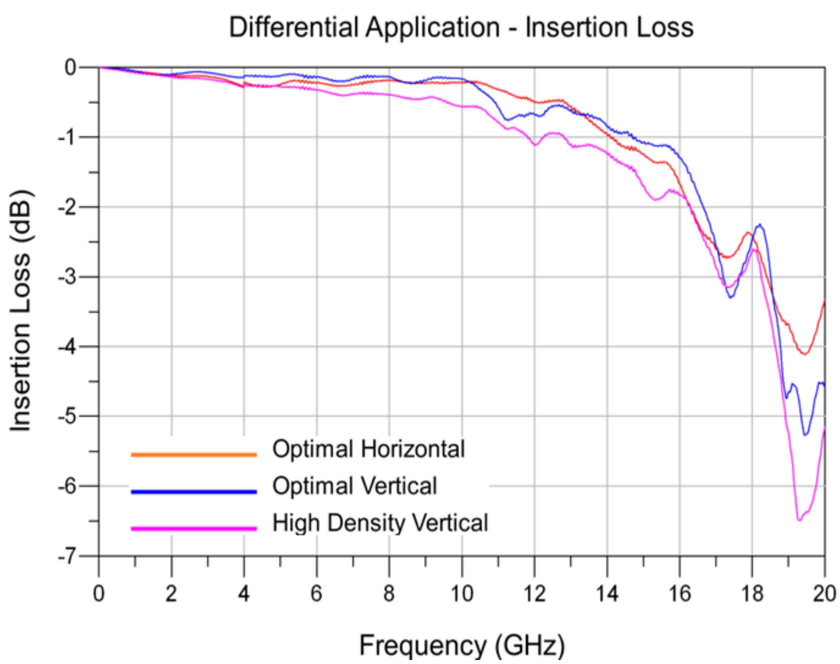


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Bandwidth Charts – Single-Ended & Differential Insertion Loss

LPAM/LPAF Array Series





Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Time Domain Data Summary

Table 6 – Single-End Impedance (Ω) – 1:1 S/G Pattern					
Signal Risetime	**30 ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
Maximum Impedance	58.6	53.8	53.6	52.8	51.8
Minimum Impedance	43.5	46.8	49.2	49.7	50.0

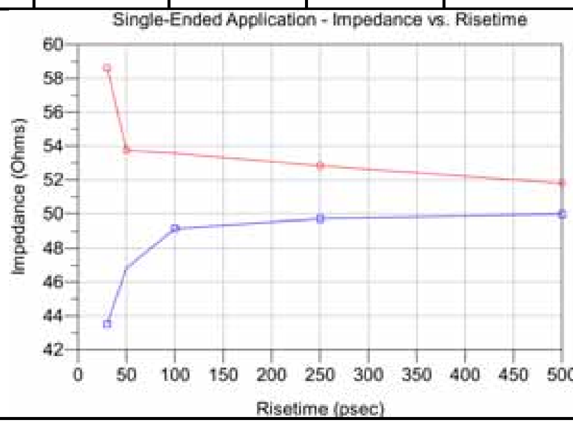
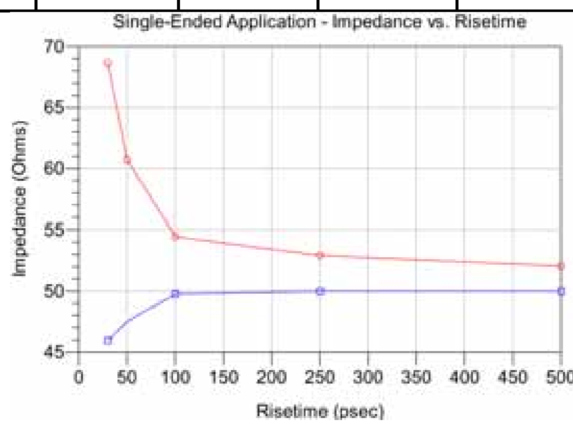


Table 7 – Single-End Impedance (Ω) – 2:1 S/G Pattern					
Signal Risetime	**30 ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
Maximum Impedance	68.7	60.7	54.5	52.9	52.1
Minimum Impedance	46.0	47.5	49.8	50	50



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Table 8 – Differential Impedance (Ω) – Optimal Horizontal

Signal Risetime	30 ps	50 ps	100 ps	250 ps	500 ps
Maximum Impedance	108.1	103.5	103.3	102.6	101.4
Minimum Impedance	84.8	88.5	94.3	98.1	99.4

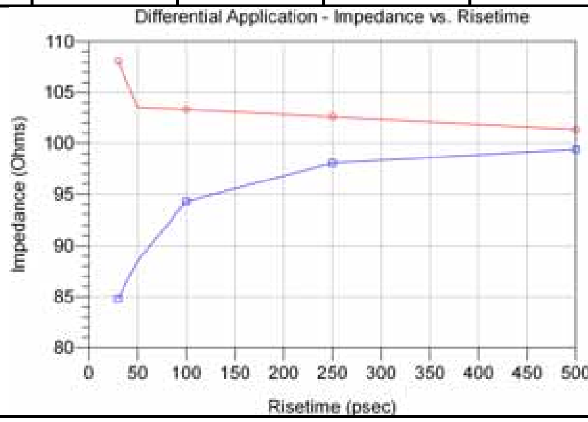
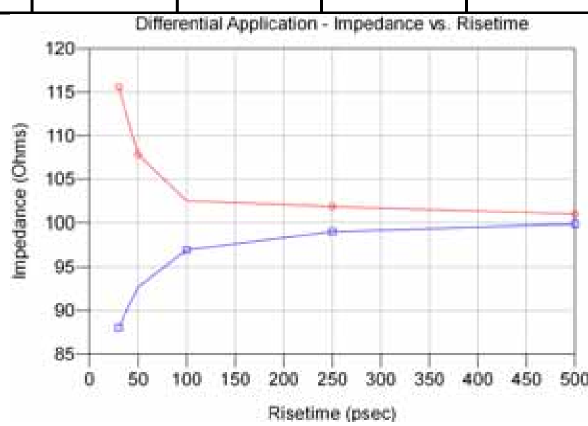


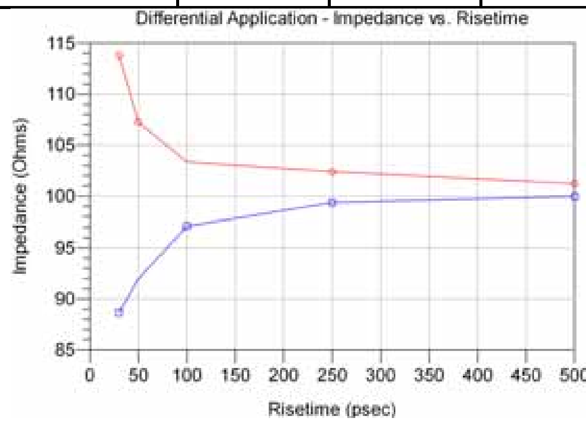
Table 9 – Differential Impedance (Ω) – Optimal Vertical

Signal Risetime	30 ps	50 ps	100 ps	250 ps	500 ps
Maximum Impedance	115.6	107.8	102.5	101.8	101
Minimum Impedance	88.1	92.7	97.0	99.1	100



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

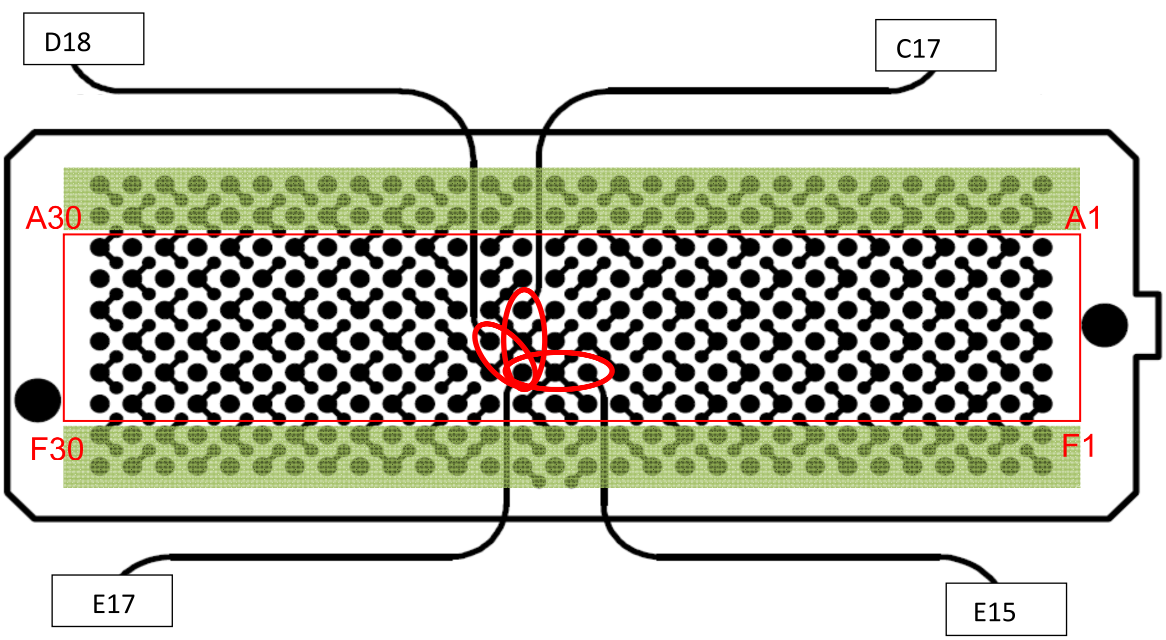
Table 10 – Differential Impedance (Ω) – High Density Vertical					
Signal Risetime	**30 ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
Maximum Impedance	113.8	107.3	103.4	102.4	101.2
Minimum Impedance	88.6	92	97.1	99.4	100



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Table 11 - Single-Ended Crosstalk (%) – 1:1 S/G Pattern							
Input(tr)	**Driver**	**Receiver**	**30 ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
NEXT	LPAM_E17	LPAM_C17	0.23	0.20	0.11	<0.1	<0.1
	LPAM_E17	LPAM_D18	2.21	1.80	1.03	0.43	0.22
	LPAM_E17	LPAM_E15	0.41	0.27	0.15	<0.1	<0.1
FEXT	LPAM_E17	LPAF_C17	0.20	0.14	<0.1	<0.1	<0.1
	LPAM_E17	LPAF_D18	0.89	0.56	0.25	<0.1	<0.1
	LPAM_E17	LPAF_E15	0.51	0.31	0.13	<0.1	<0.1

Single-Ended 1:1 S/G Pattern Crosstalk Pin Map

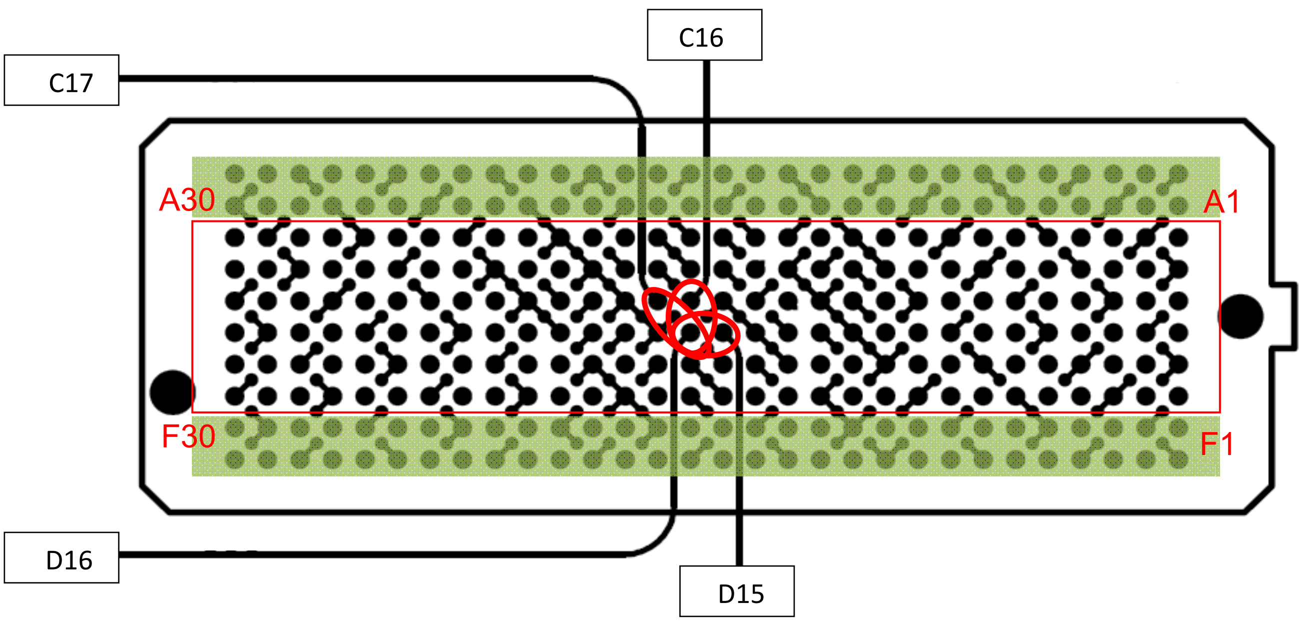


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Table 12 - Single-Ended Crosstalk (%) – 2:1 S/G Pattern

Input(tr)	Driver	Receiver	30 ps	50 ps	100 ps	250 ps	500 ps
NEXT	LPAM_D16	LPAM_C16	8.52	6.93	4.04	1.68	0.85
	LPAM_D16	LPAM_C17	3.32	2.79	1.71	0.73	0.37
	LPAM_D16	LPAM_D15	9.94	8.08	4.75	2.01	1.02
FEXT	LPAM_D16	LPAF_C16	4.80	3.49	1.88	0.74	0.38
	LPAM_D16	LPAF_C17	2.36	1.72	0.96	0.39	0.20
	LPAM_D16	LPAF_D15	4.31	3.02	1.57	0.60	0.30

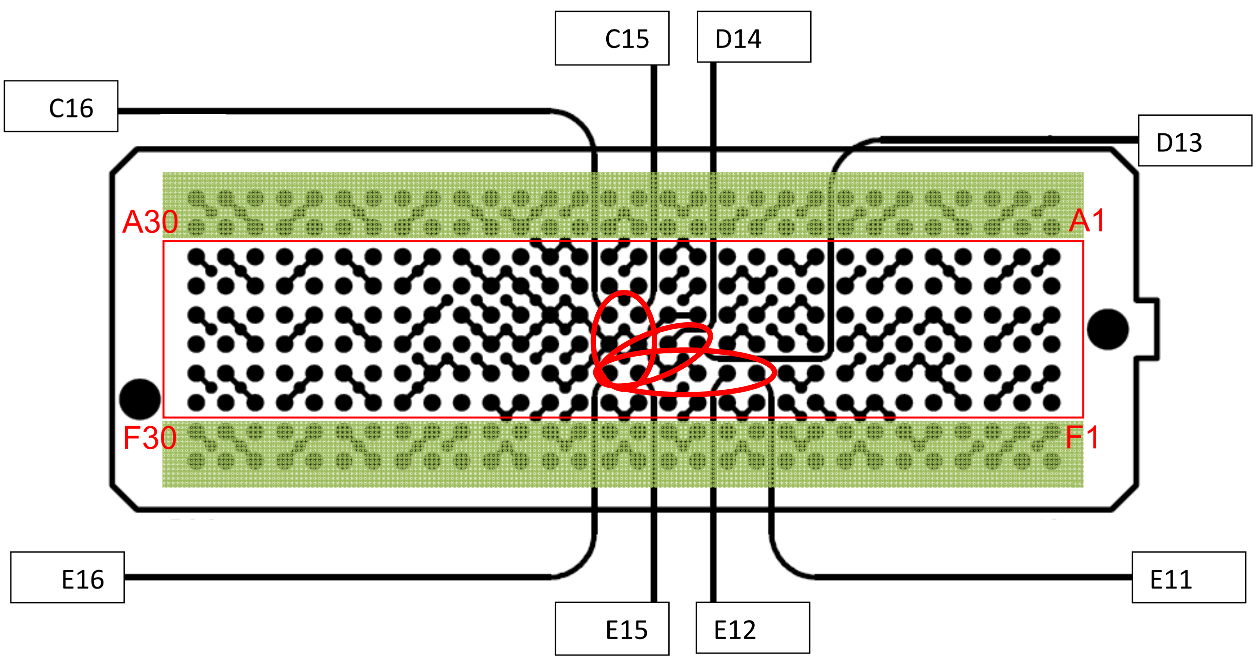
Single-Ended 2:1 S/G Pattern Crosstalk Pin Map



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Table 13 - Differential Crosstalk (%) – Optimal Horizontal							
Input(tr)	**Driver**	**Receiver**	**30 ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
NEXT	LPAM_E15,E16	LPAM_C15,C16	0.10	<0.1	<0.1	<0.1	<0.1
	LPAM_E15,E16	LPAM_D13,D14	0.79	0.64	0.36	0.15	<0.1
	LPAM_E15,E16	LPAM_E11,E12	0.43	0.26	0.14	<0.1	<0.1
FEXT	LPAM_E15,E16	LPAF_C15,C16	<0.1	<0.1	<0.1	<0.1	<0.1
	LPAM_E15,E16	LPAF_D13,D14	0.19	0.11	<0.1	<0.1	<0.1
	LPAM_E15,E16	LPAF_E11,E12	1.32	0.79	0.45	0.19	0.10

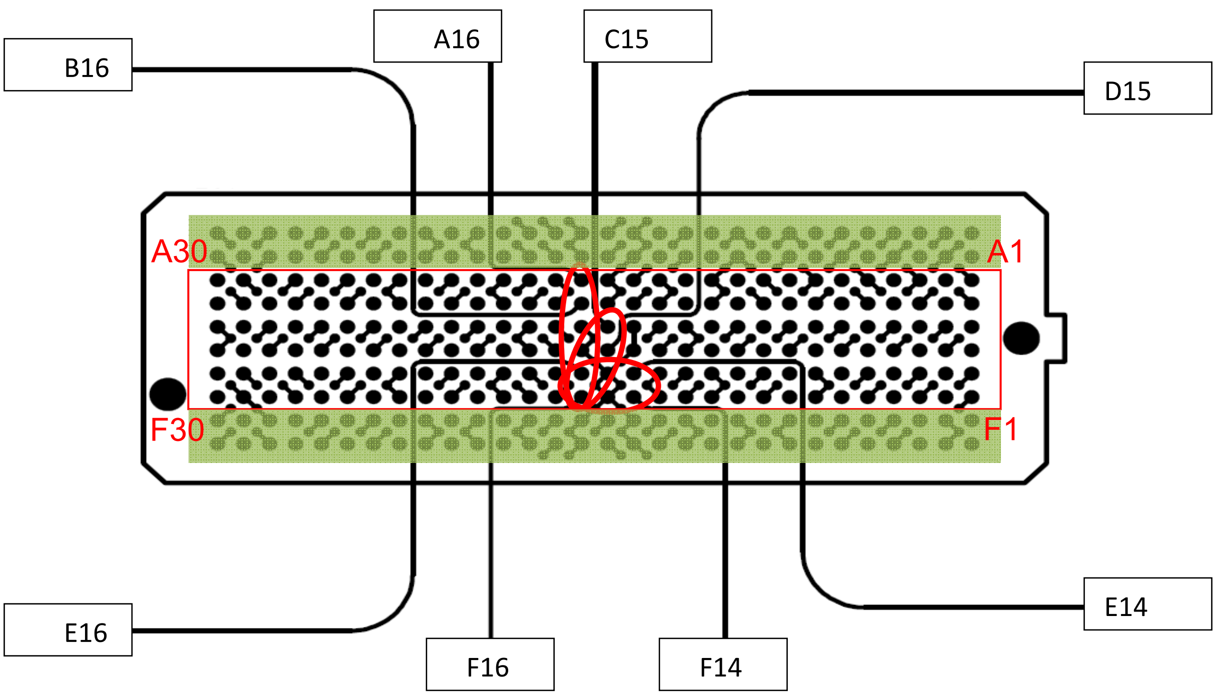
Differential Optimal Horizontal Crosstalk Pin Map



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Table 14 - Differential Crosstalk (%) – Optimal Vertical							
Input(tr)	**Driver**	**Receiver**	**30 ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
NEXT	LPAM_E16,F16	LPAM_A16,B16	0.21	0.15	<0.1	<0.1	<0.1
	LPAM_E16,F16	LPAM_C15,D15	0.86	0.67	0.37	0.15	<0.1
	LPAM_E16,F16	LPAM_E14,F14	0.55	0.41	0.22	<0.1	<0.1
FEXT	LPAM_E16,F16	LPAF_A16,B16	0.34	0.26	0.14	<0.1	<0.1
	LPAM_E16,F16	LPAF_C15,D15	0.14	0.10	<0.1	<0.1	<0.1
	LPAM_E16,F16	LPAF_E14,F14	0.40	0.26	0.13	<0.1	<0.1

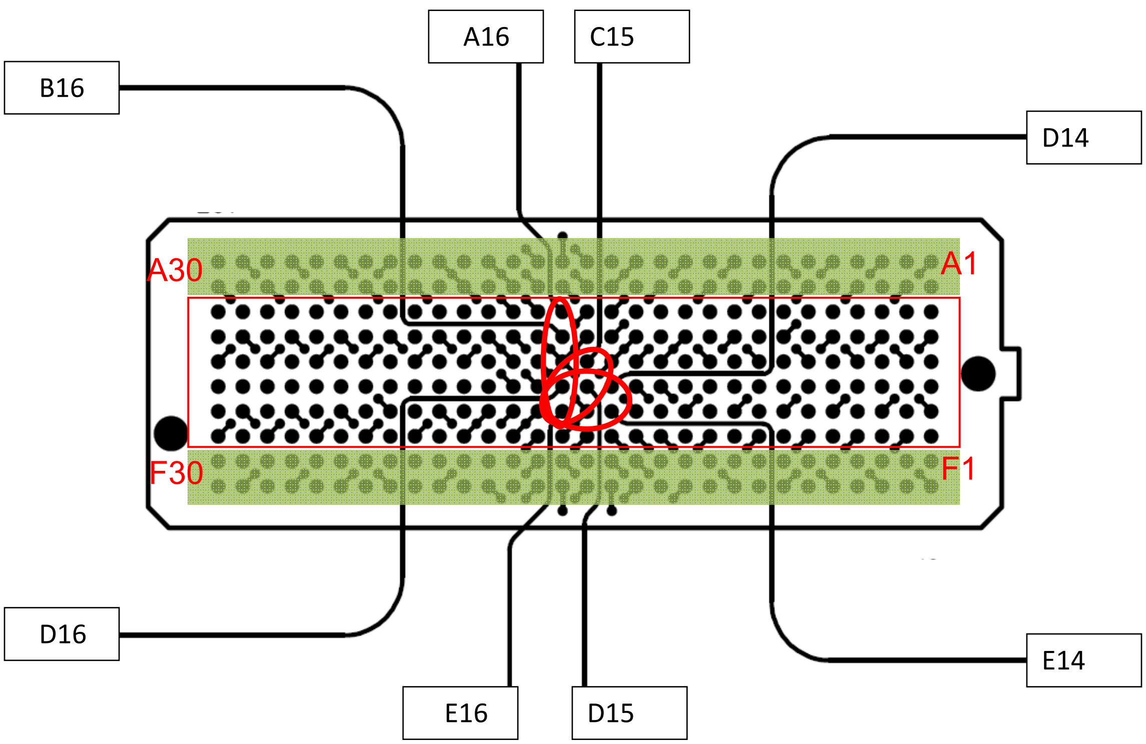
Differential Optimal Vertical Crosstalk Pin Map



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Table 15 - Differential Crosstalk (%) – High Density Vertical							
Input(tr)	**Driver**	**Receiver**	**30 ps**	**50 ps**	**100 ps**	**250 ps**	**500 ps**
NEXT	LPAM_D16,E16	LPAM_A16,B16	0.11	<0.1	<0.1	<0.1	<0.1
	LPAM_D16,E16	LPAM_C15,D15	2.53	2.08	1.27	0.55	0.27
	LPAM_D16,E16	LPAM_D14,E14	0.43	0.37	0.24	0.11	<0.1
FEXT	LPAM_D16,E16	LPAF_A16,B16	0.18	0.15	<0.1	<0.1	<0.1
	LPAM_D16,E16	LPAF_C15,D15	0.60	0.38	0.19	<0.1	<0.1
	LPAM_D16,E16	LPAF_D14,E14	0.50	0.37	0.18	<0.1	<0.1

Differential High Density Vertical Crosstalk Pin Map



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Table 16 - Propagation Delay (Mated Connector)	
Single-Ended: 1:1 S/G	28 ps
Single-Ended: 2:1 S/G	26 ps
Differential: Optimal Horizontal	28 ps
Differential: Optimal Vertical	25 ps
Differential: High Density Vertical	29 ps

Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

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.

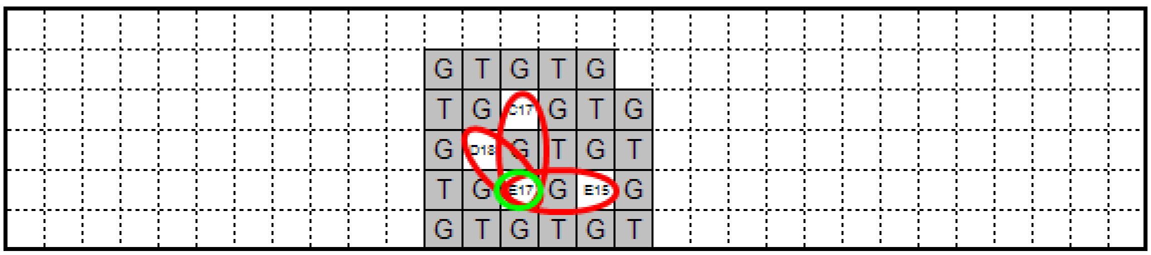
In general, the more pins dedicated to ground, the better electrical performance will be. But dedicating pins to ground reduces signal density of a connector. Therefore, care must be taken when choosing signal/ground ratios in cost or density-sensitive applications.

Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

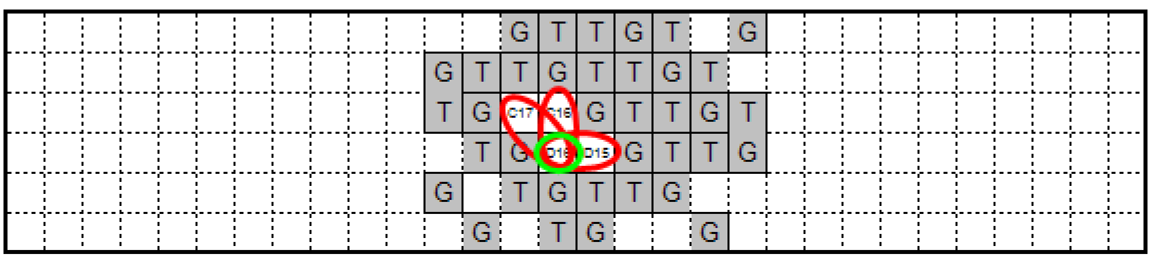
For this connector, the following array configurations are evaluated:

☐	Open pin field	G	Grounded pin field
☐	Signal pin field	T	50 ohm termination field

Single-Ended 1:1



Single-Ended 2:1

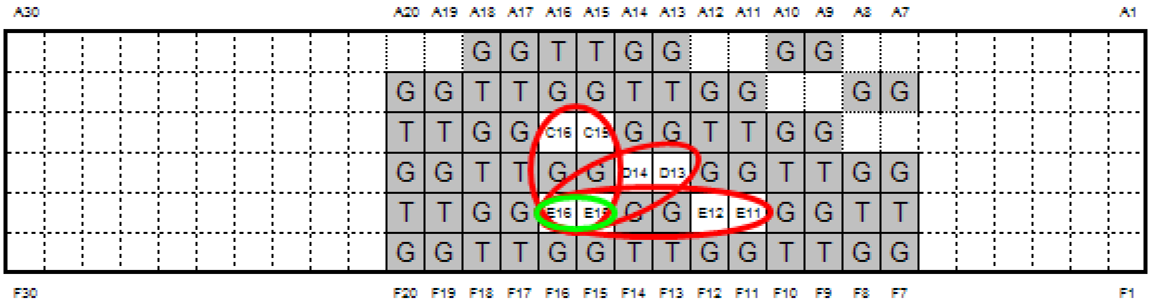


<u>Single-Ended Impedance (denoted by green circles):</u>
- 1:1 S/G ratio
- 2:1 S/G ratio

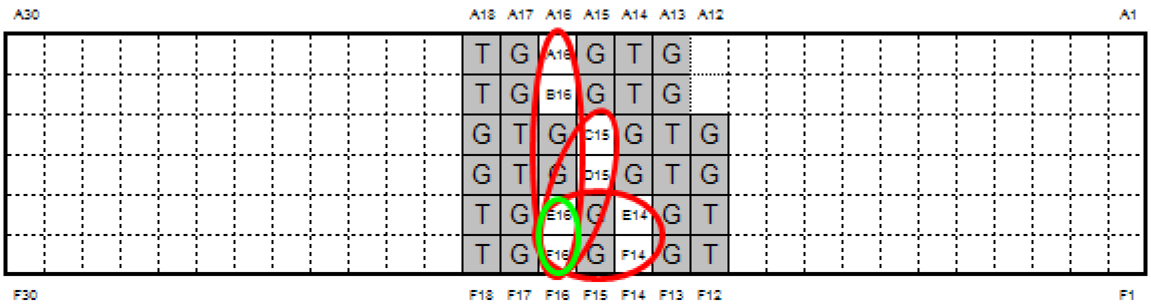
<u>Single-Ended Crosstalk (denoted by red circles):</u>
- 1:1 S/G ratio
- 2:1 S/G ratio

Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

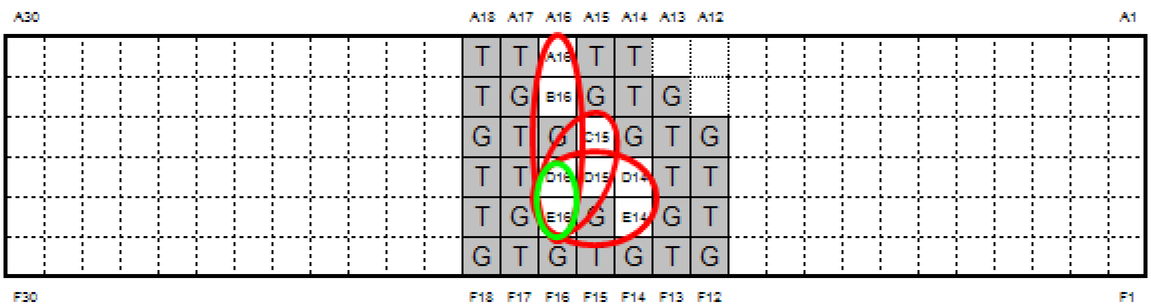
Optimal Horizontal



Optimal Vertical



Vertical High Density



Differential Impedance (denoted by green circles):

- Optimal Horizontal
- Optimal Vertical
- High Density Vertical

Differential Crosstalk (denoted by red circles):

- Optimal Horizontal
- Optimal Vertical
- High Density Vertical

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

Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

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. But 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 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.

Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

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 each end of the connector. Delay is measured at 100 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.

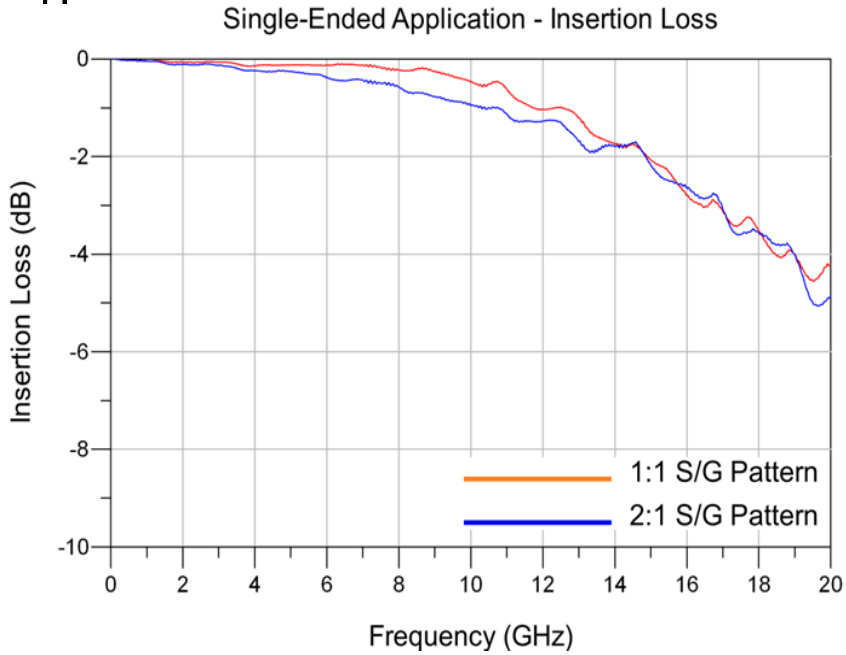
As a rule of thumb, 10% crosstalk levels are often used as a general first pass limit for determining acceptable interconnect performance. But modern system crosstalk tolerance can vary greatly. For advice on connector suitability for specific applications, please contact our Signal Integrity Group at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

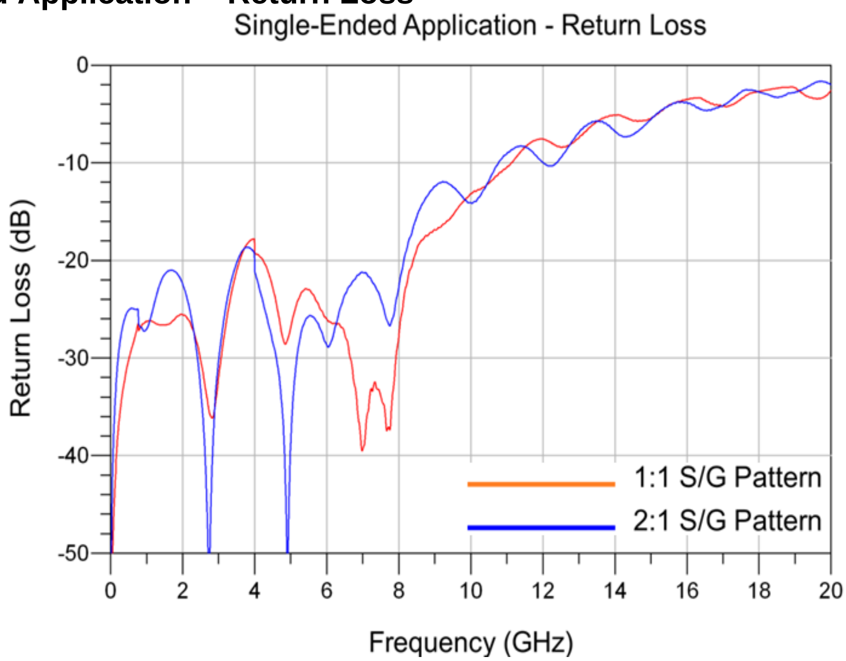
Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Appendix A – Frequency Domain Response Graphs

Single-Ended Application – Insertion Loss

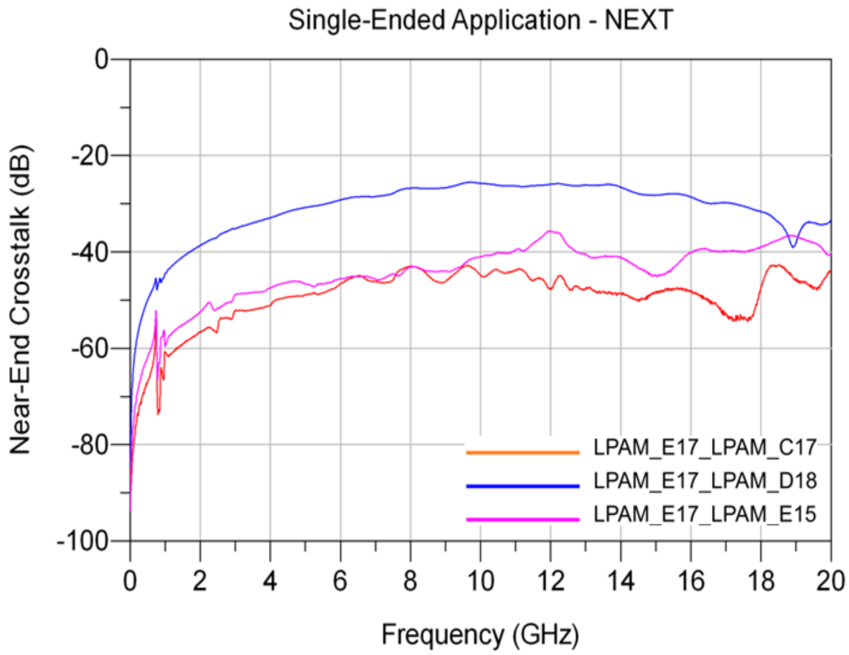


Single-Ended Application – Return Loss

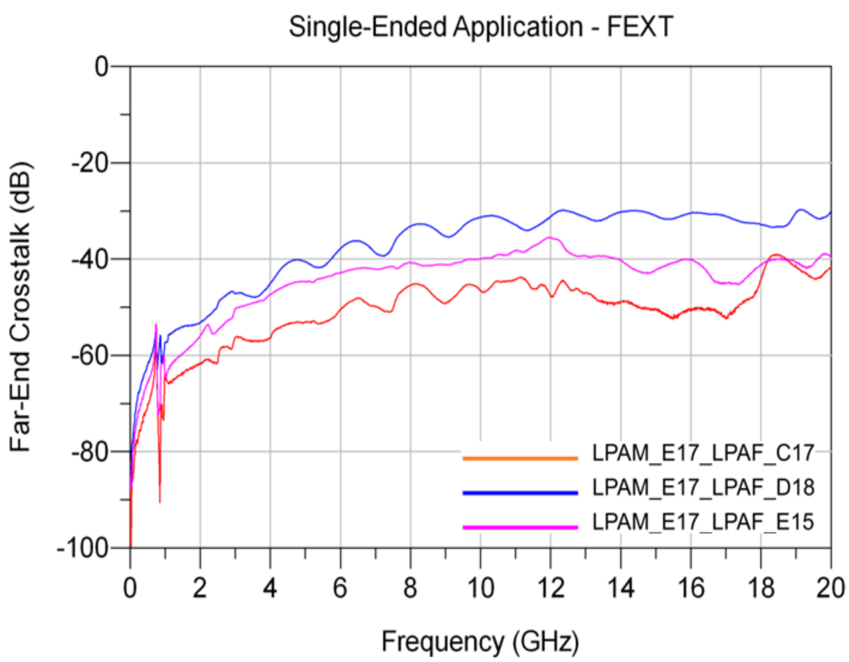


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Single-Ended 1:1 S/G Pattern Application – NEXT

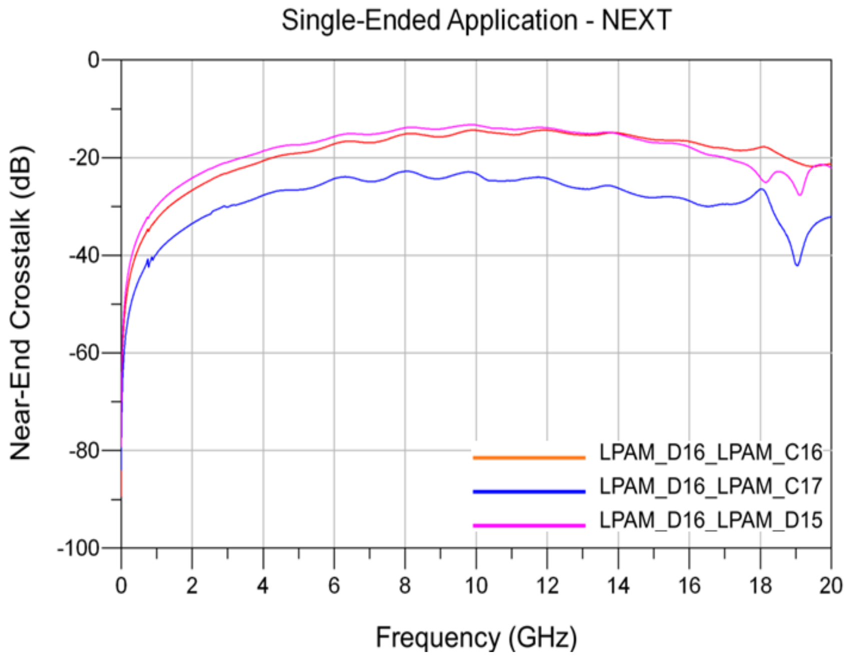


Single-Ended 1:1 S/G Pattern Application – FEXT

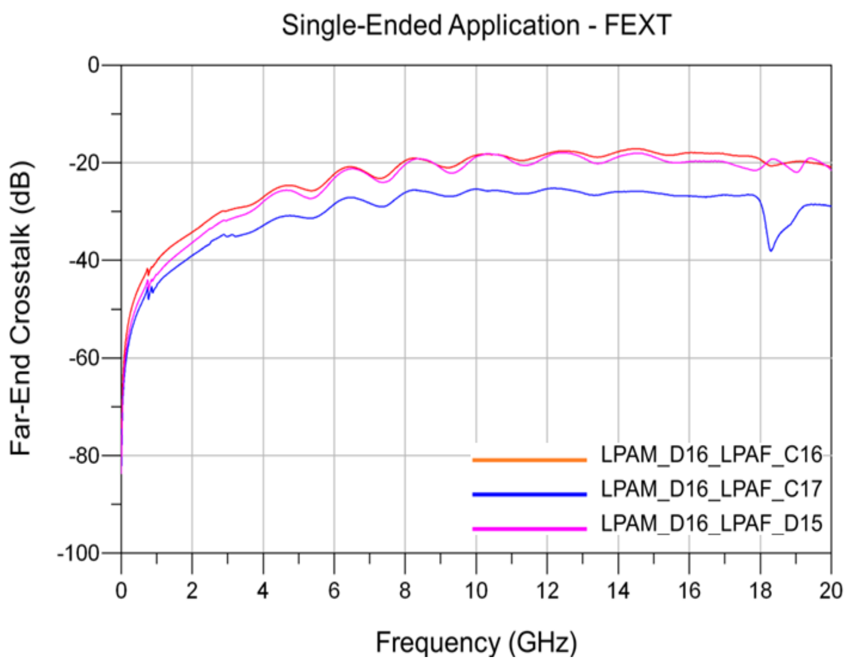


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Single-Ended 2:1 S/G Pattern Application – NEXT

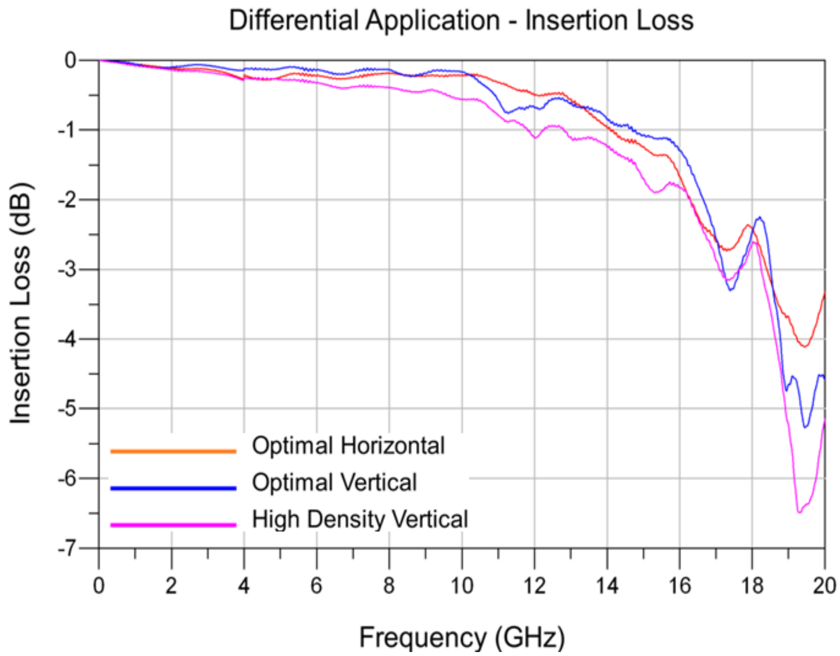


Single-Ended 2:1 S/G Pattern Application – FEXT

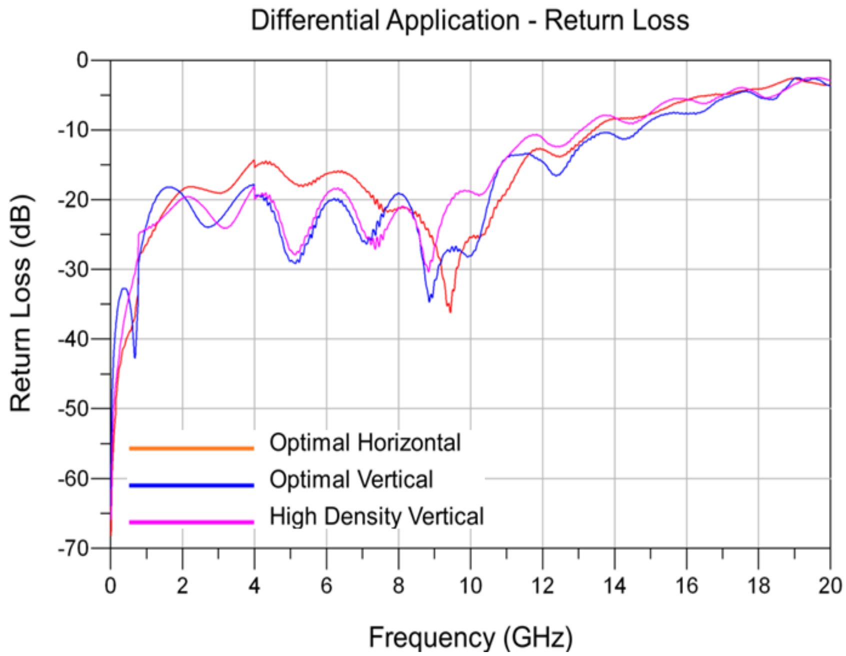


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Differential Application – Insertion Loss

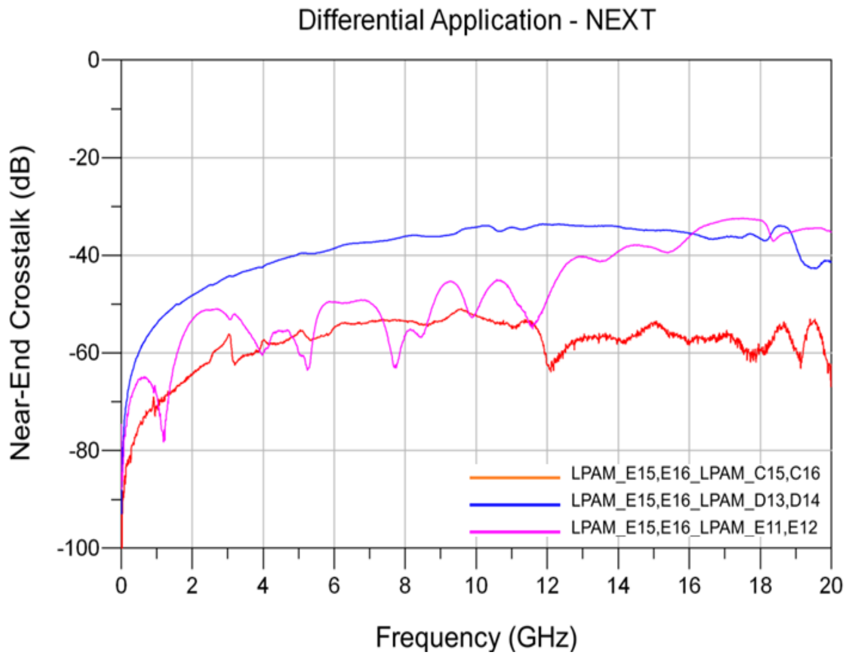


Differential Application – Return Loss

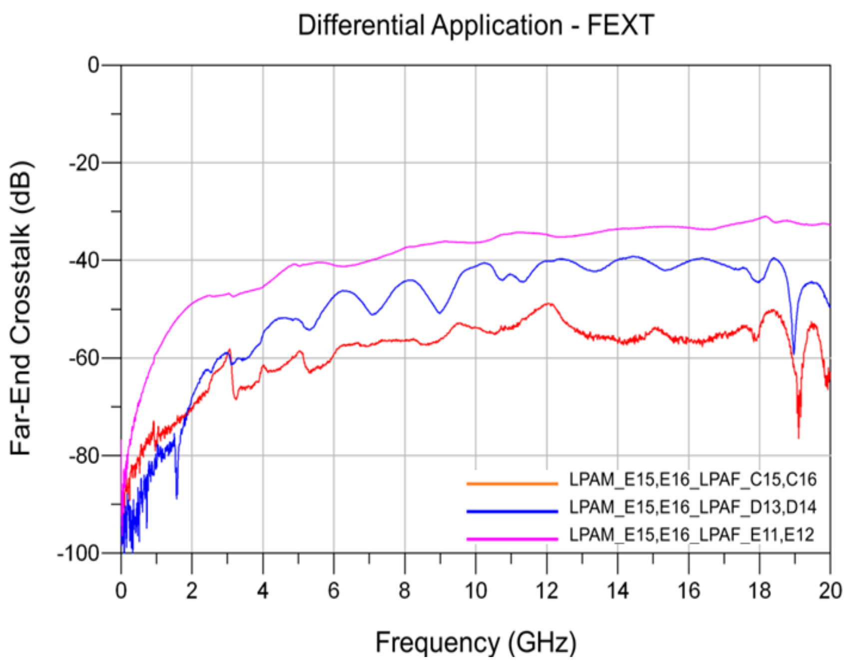


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Differential Optimal Horizontal Application – NEXT

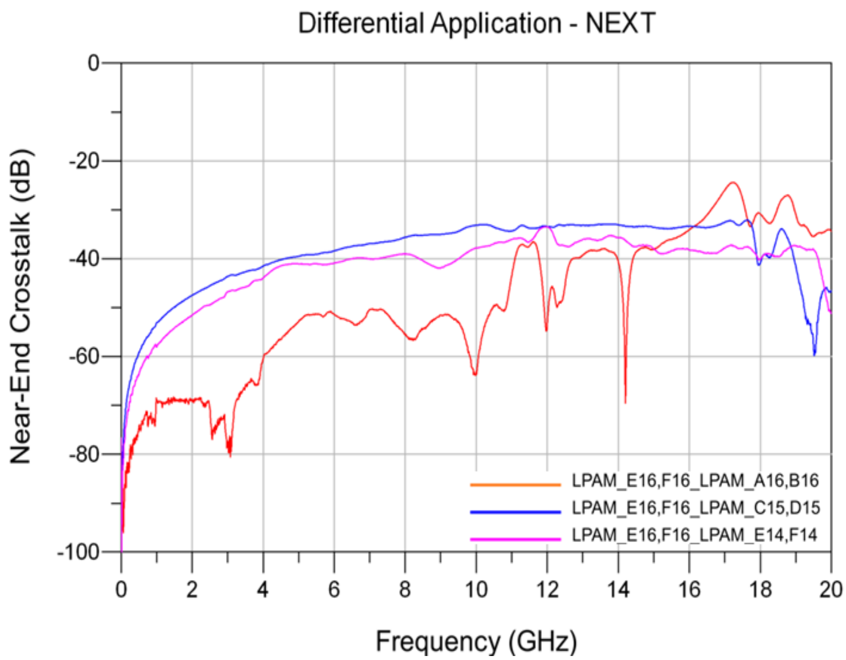


Differential Optimal Horizontal Application – FEXT

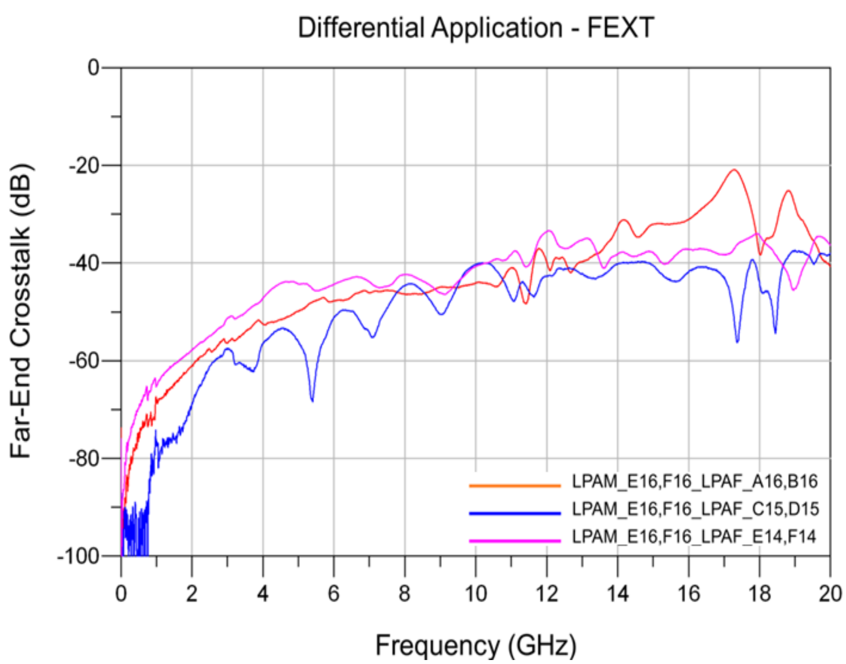


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Differential Optimal Vertical Application – NEXT

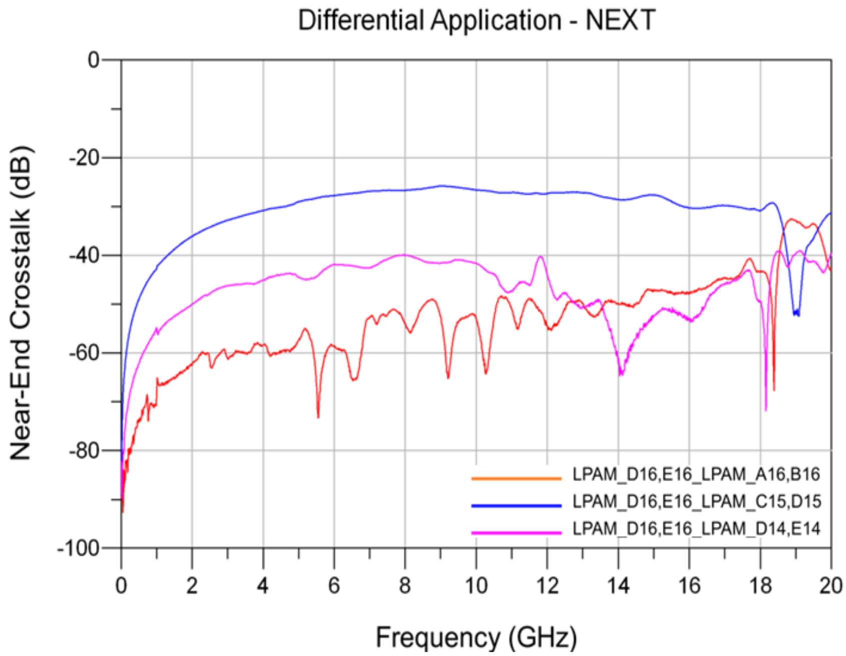


Differential Optimal Vertical Application – FEXT

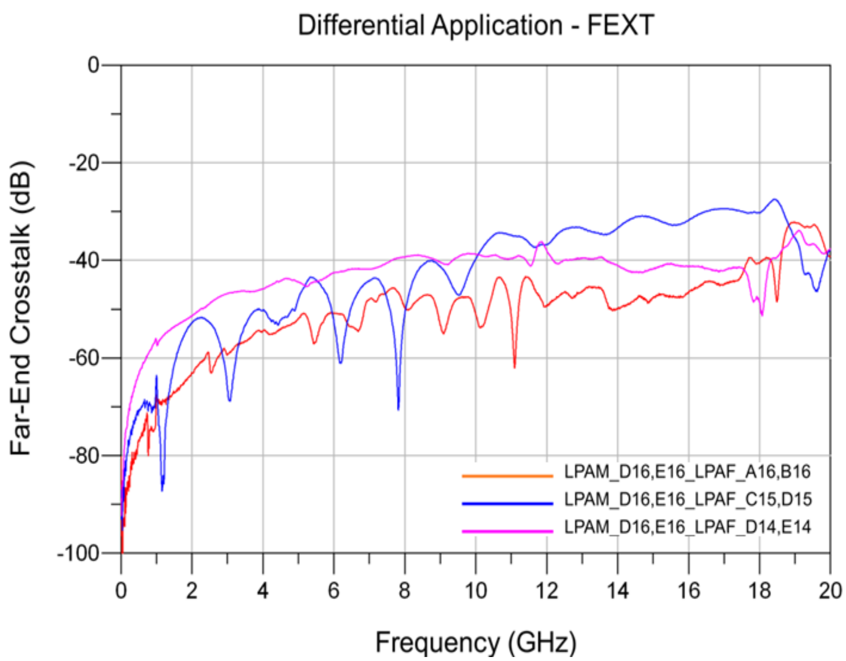


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Differential High Density Vertical Application – NEXT



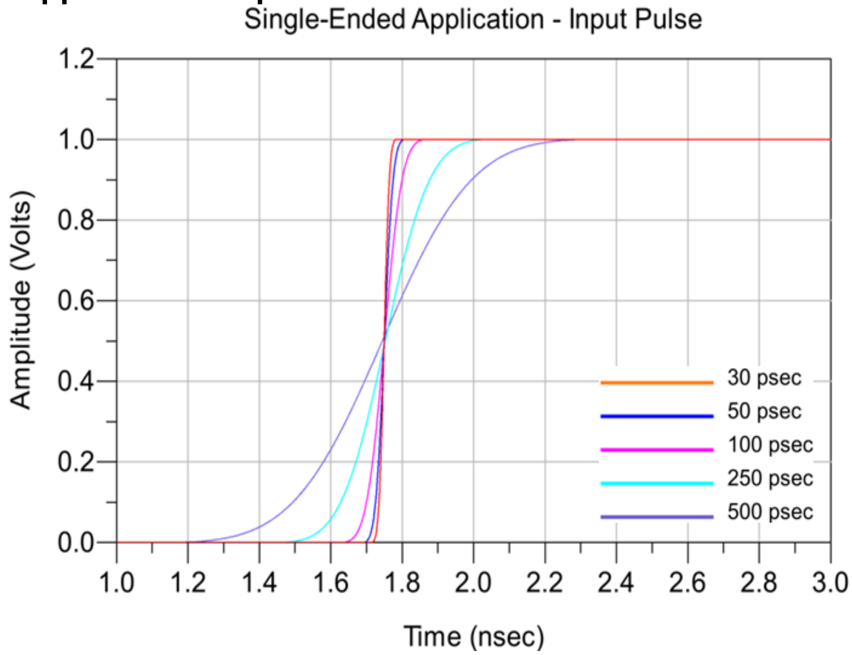
Differential High Density Vertical Application – FEXT



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

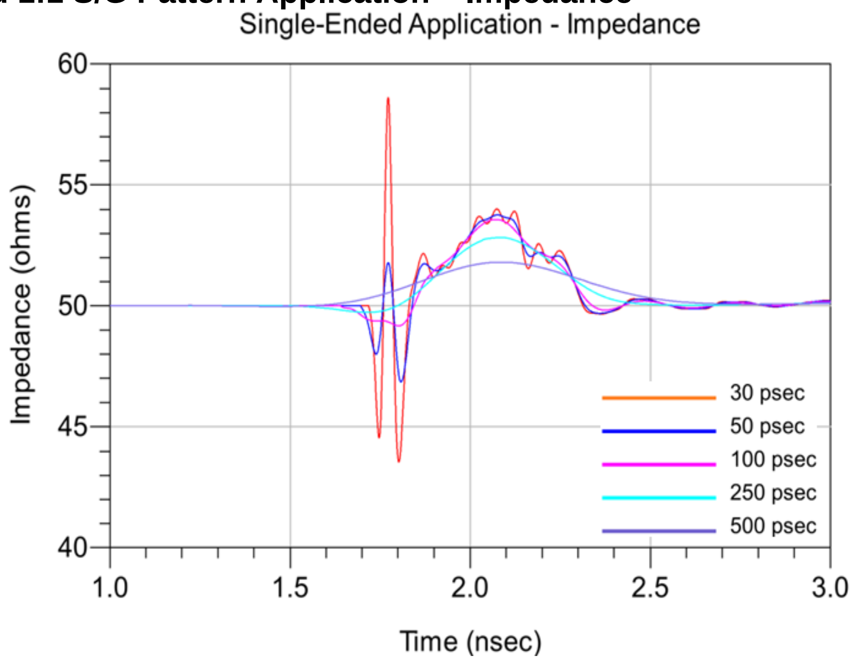
Appendix B – Time Domain Response Graphs

Single-Ended Application – Input Pulse

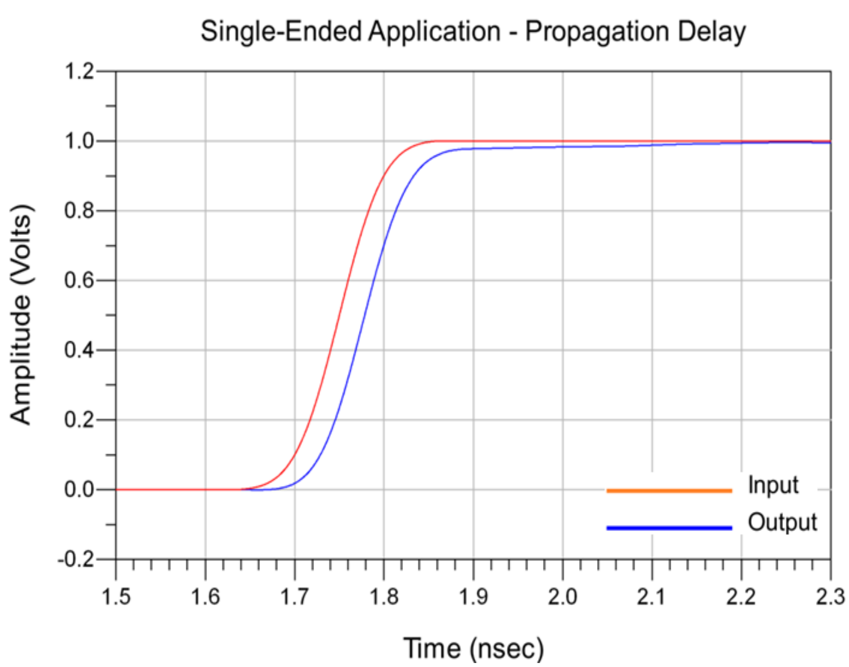


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Single-Ended 1:1 S/G Pattern Application – Impedance

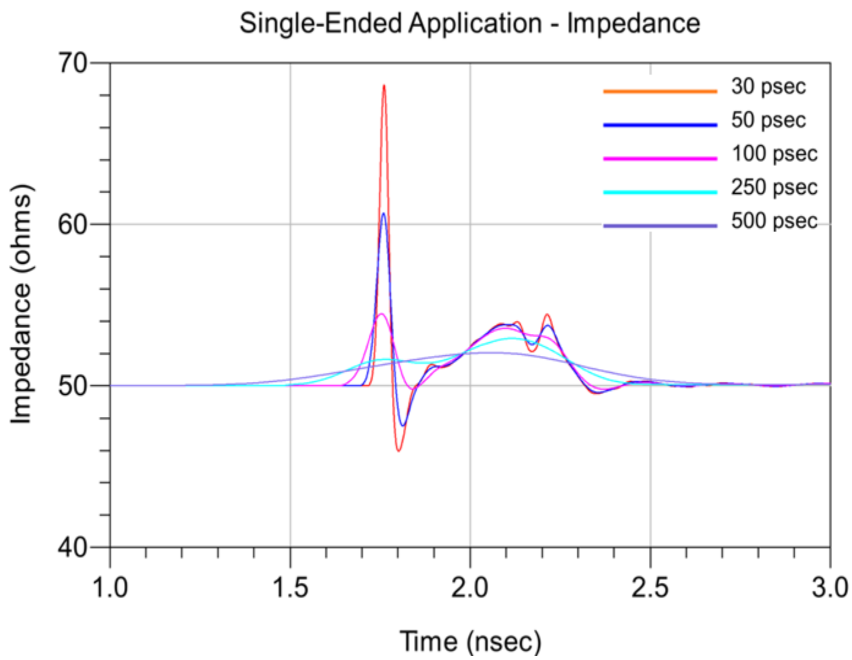


Single-Ended 1:1 S/G Pattern Application – Propagation Delay

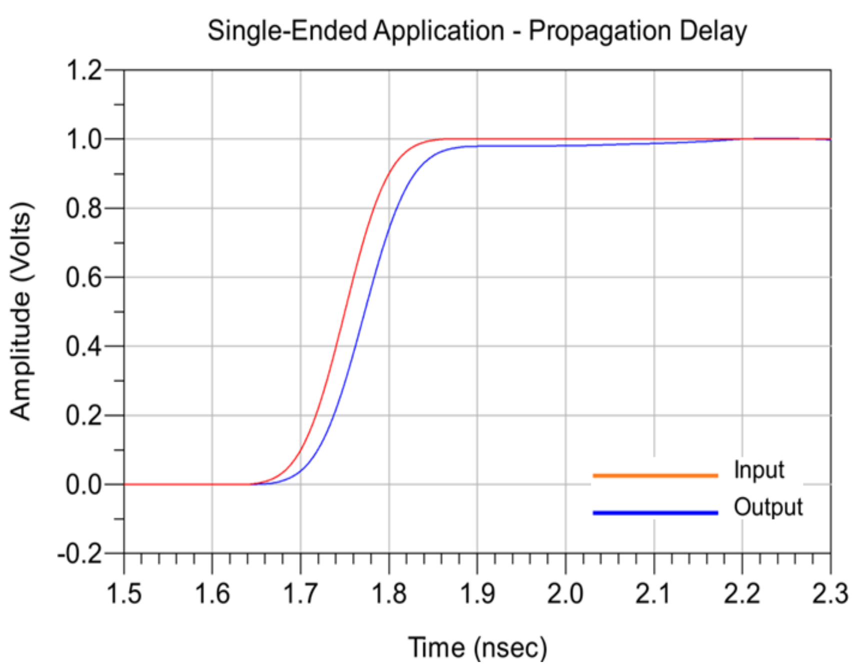


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Single-Ended 2:1 S/G Pattern Application – Impedance

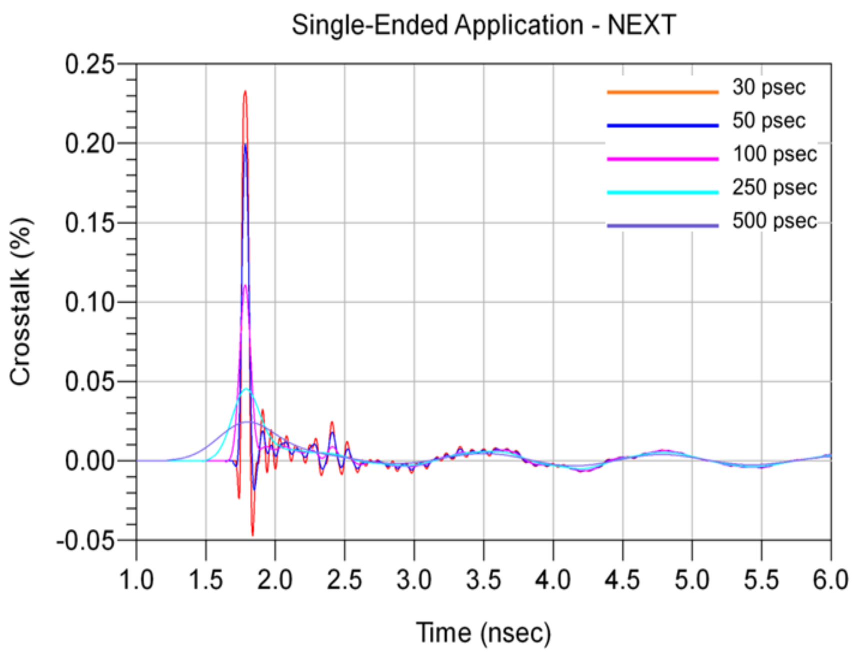


Single-Ended 2:1 S/G Pattern Application – Propagation Delay

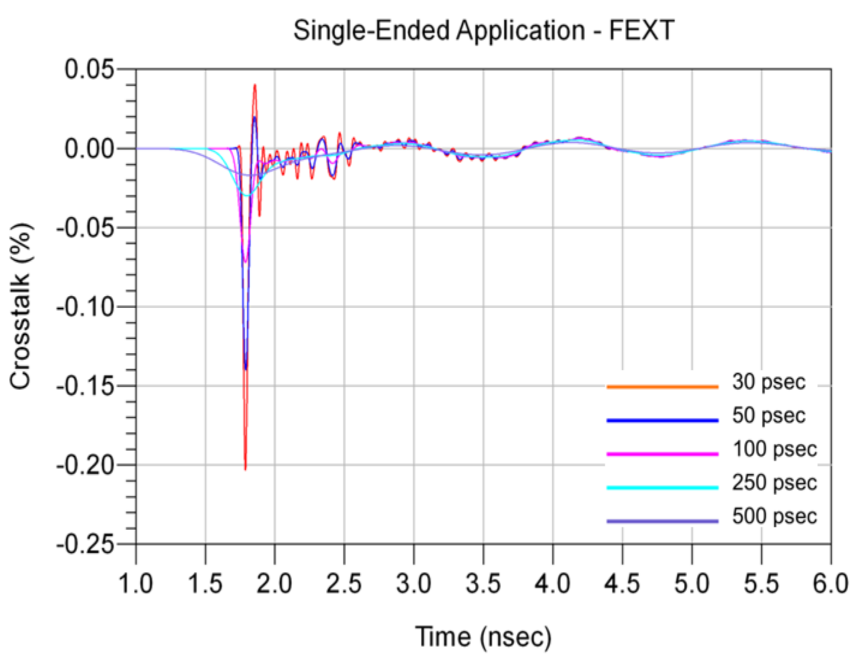


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Single-Ended 1:1 S/G Pattern Application – NEXT, LPAM_E17_LPAM_C17

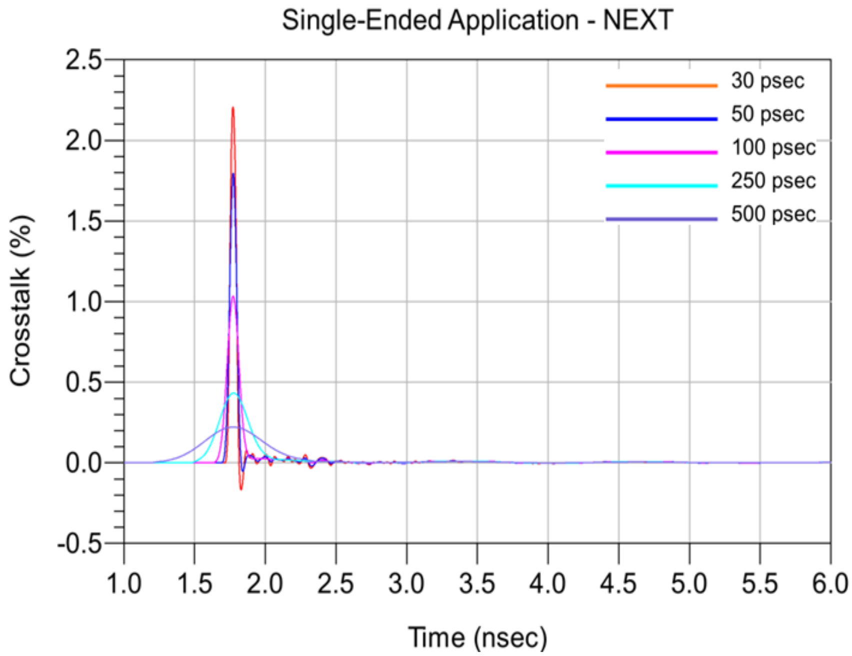


Single-Ended 1:1 S/G Pattern Application – FEXT, LPAM_E17_LPAF_C17

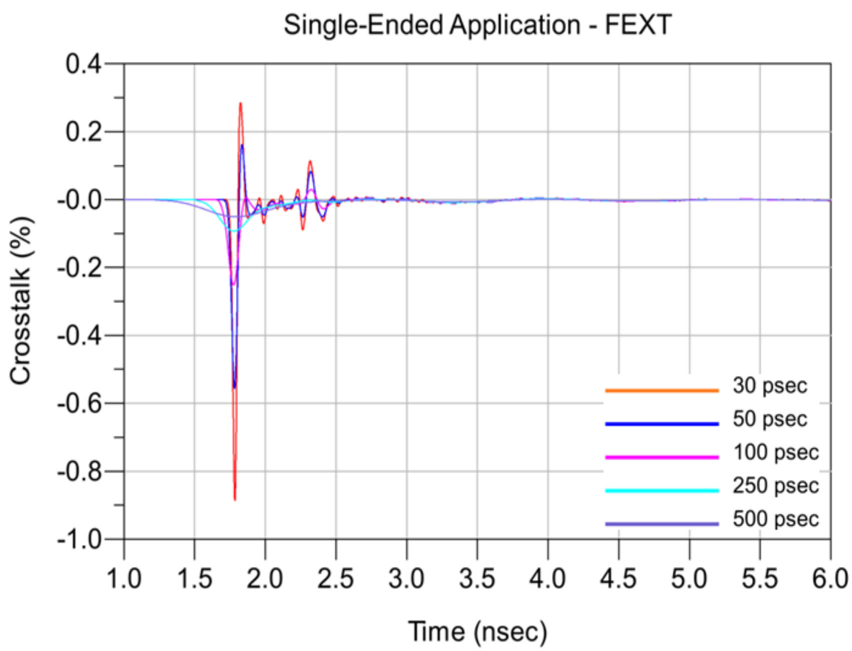


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Single-Ended 1:1 S/G Pattern Application – NEXT, LPAM_E17_LPAM_D18

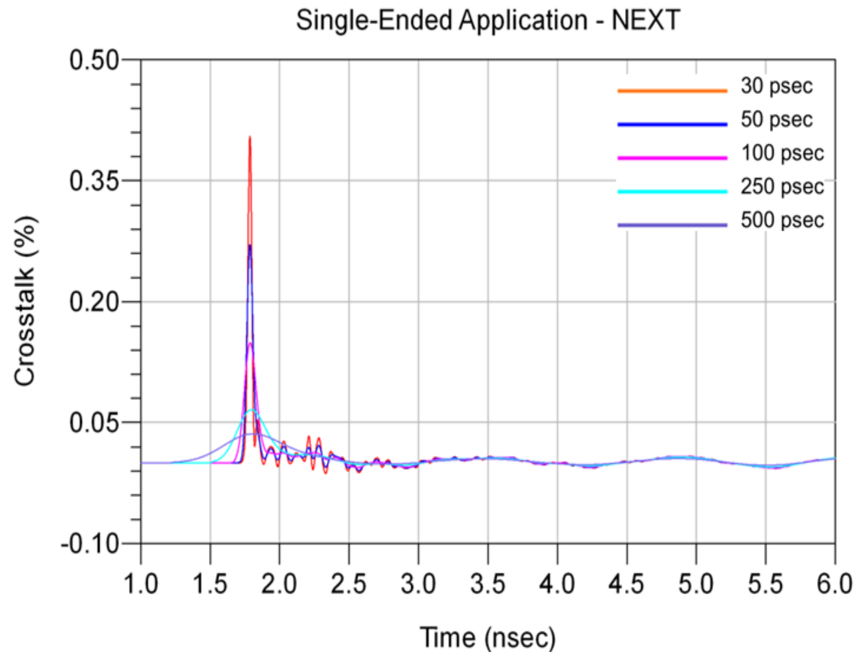


Single-Ended 1:1 S/G Pattern Application – FEXT, LPAM_E17_LPAF_D18

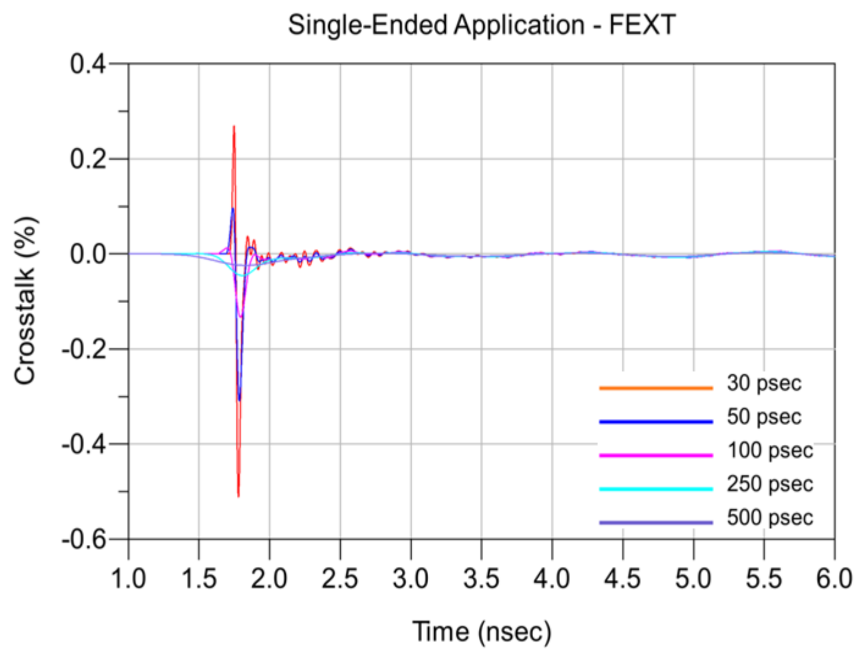


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Single-Ended 1:1 S/G Pattern Application – NEXT, LPAM_E17_LPAM_E15

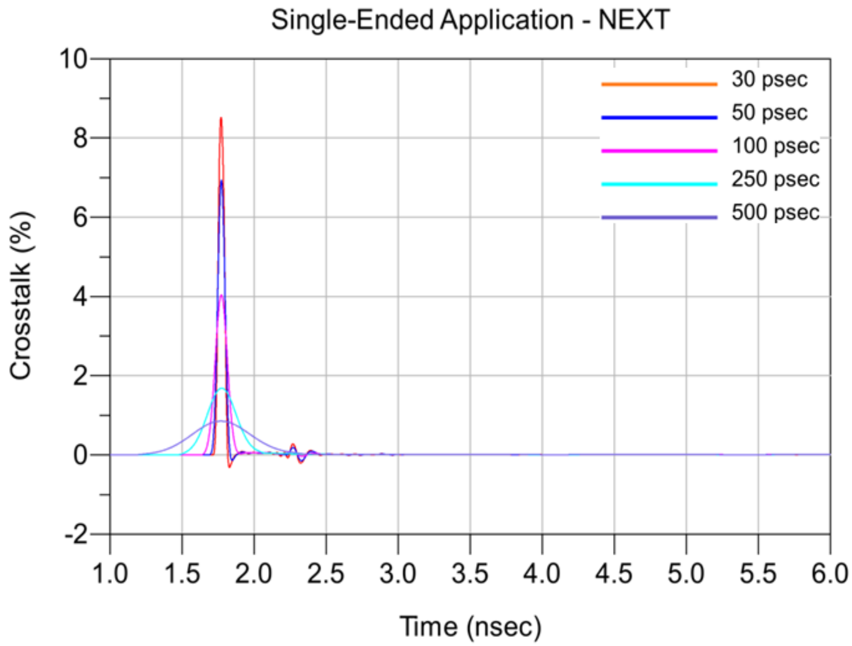


Single-Ended 1:1 S/G Pattern Application – FEXT, LPAM_E17_LPAF_E15

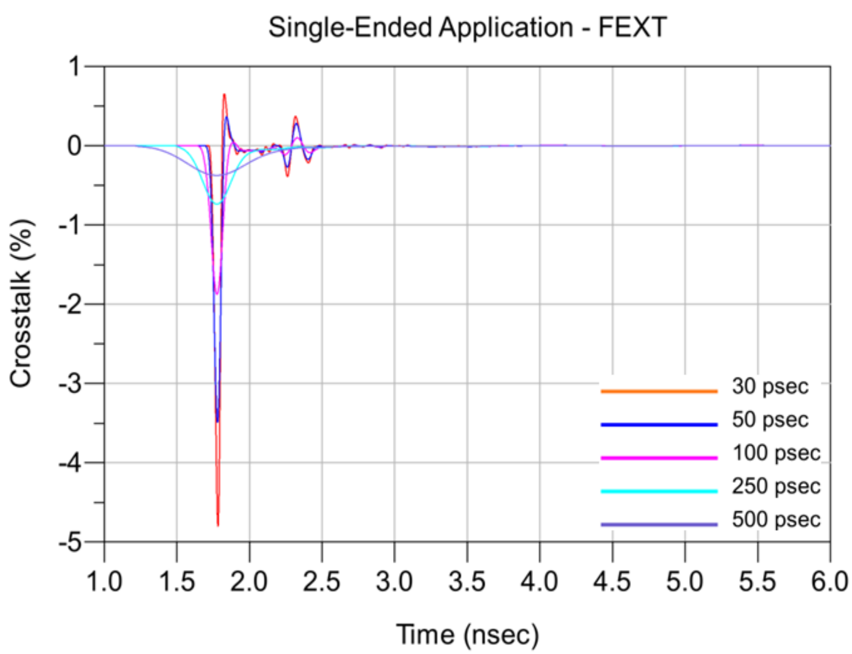


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Single-Ended 2:1 S/G Pattern Application – NEXT, LPAM_D16_LPAM_C16

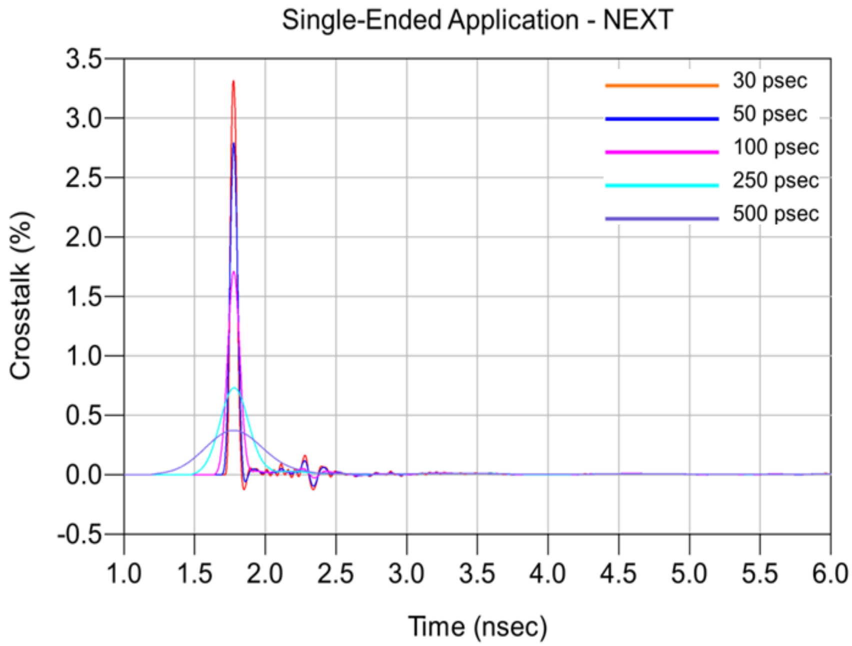


Single-Ended 2:1 S/G Pattern Application – FEXT, LPAM_D16_LPAF_C16

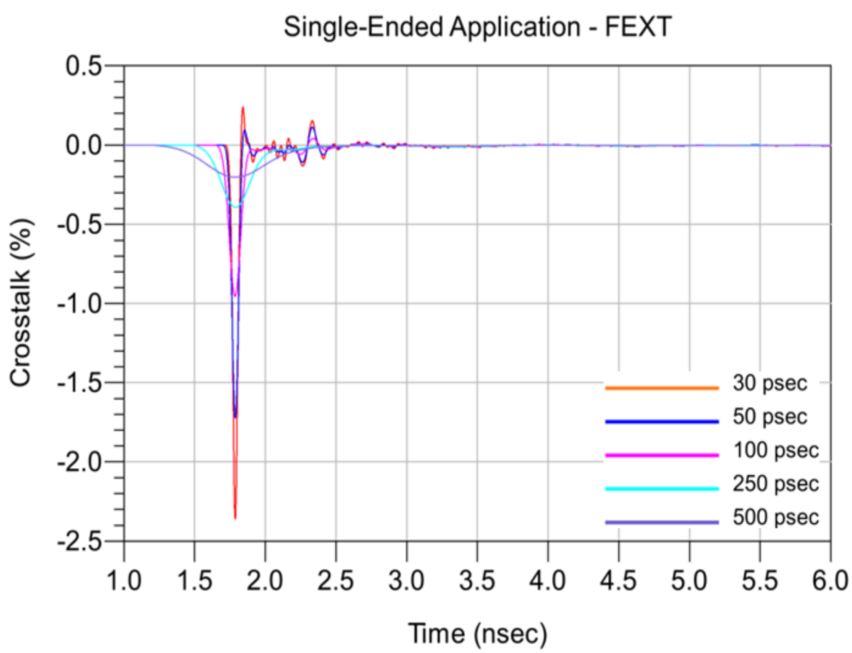


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Single-Ended 2:1 S/G Pattern Application – NEXT, LPAM_D16_LPAM_C17

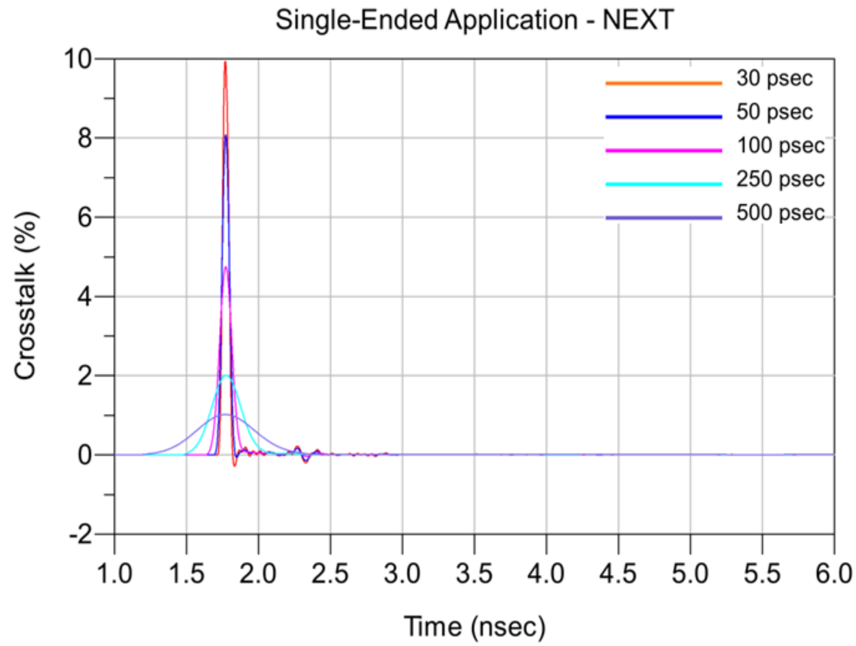


Single-Ended 2:1 S/G Pattern Application – FEXT, LPAM_D16_LPAF_C17

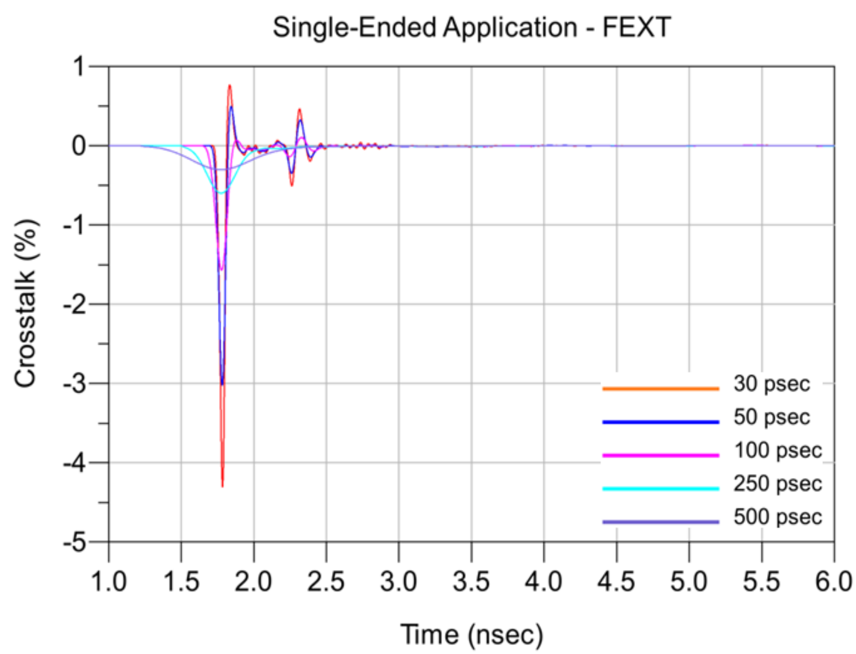


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Single-Ended 2:1 S/G Pattern Application – NEXT, LPAM_D16_LPAM_D15



Single-Ended 2:1 S/G Pattern Application – FEXT, LPAM_D16_LPAF_D15



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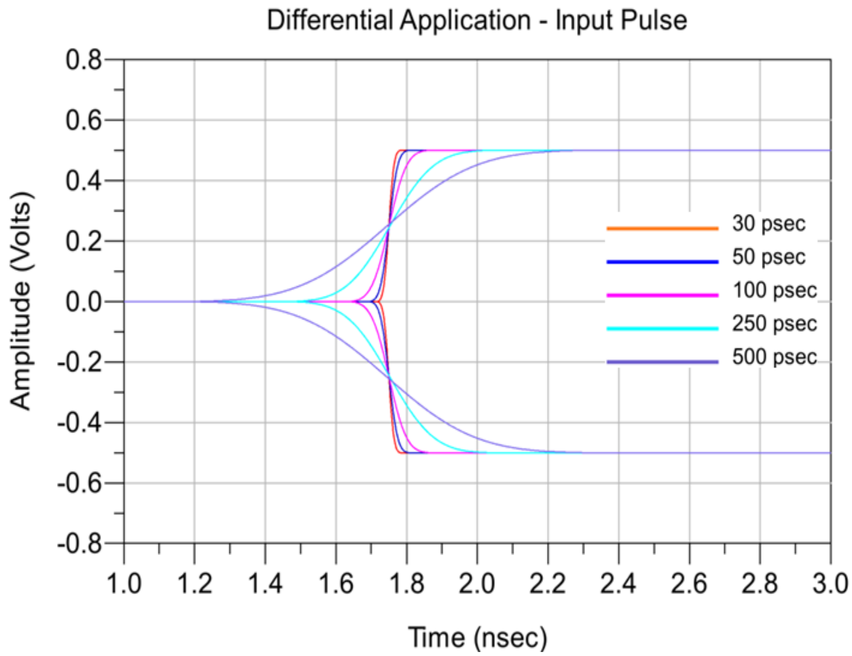
Report Revision: 8/10/2012

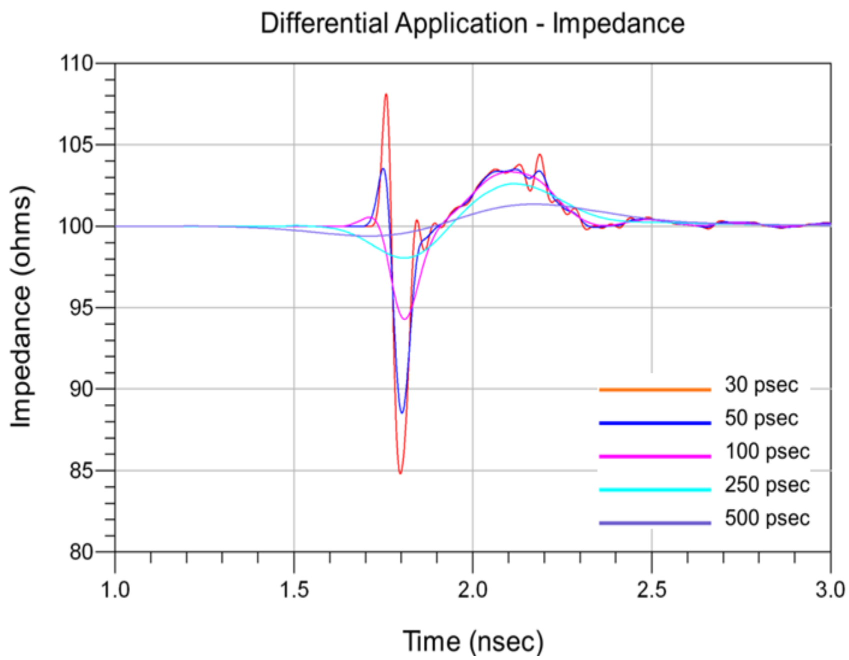
Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Differential Application – Input Pulse

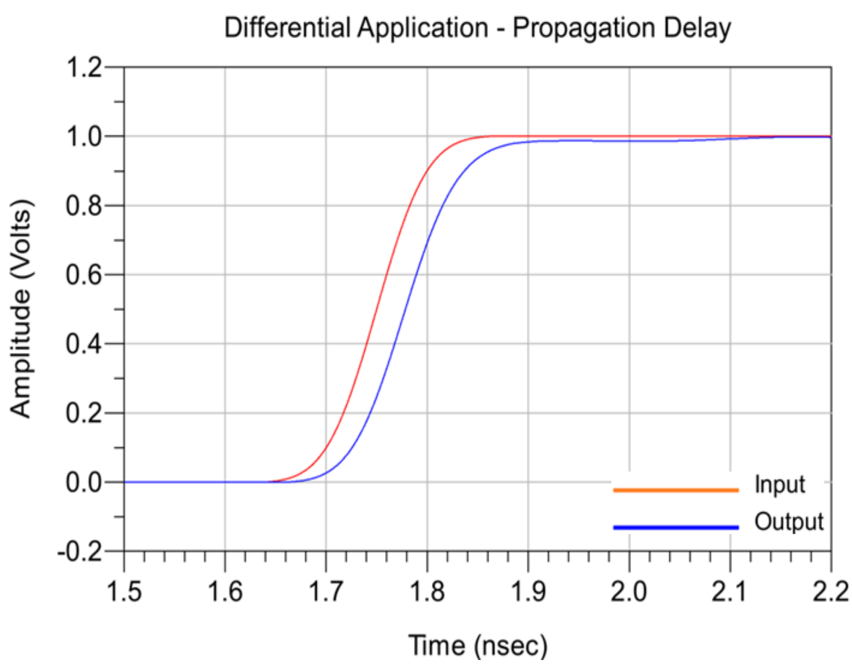


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Differential Optimal Horizontal Application – Impedance

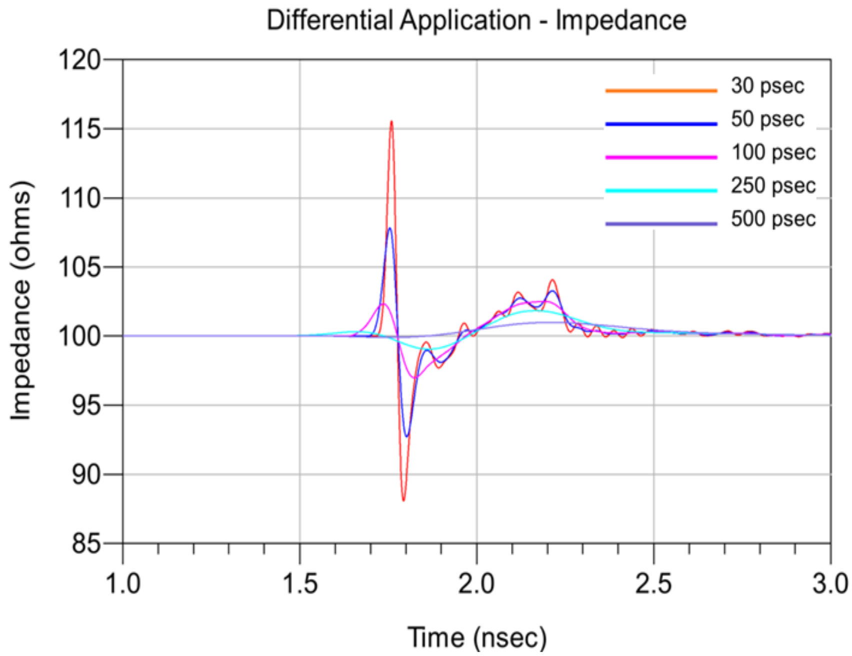


Differential Optimal Horizontal Application – Propagation Delay

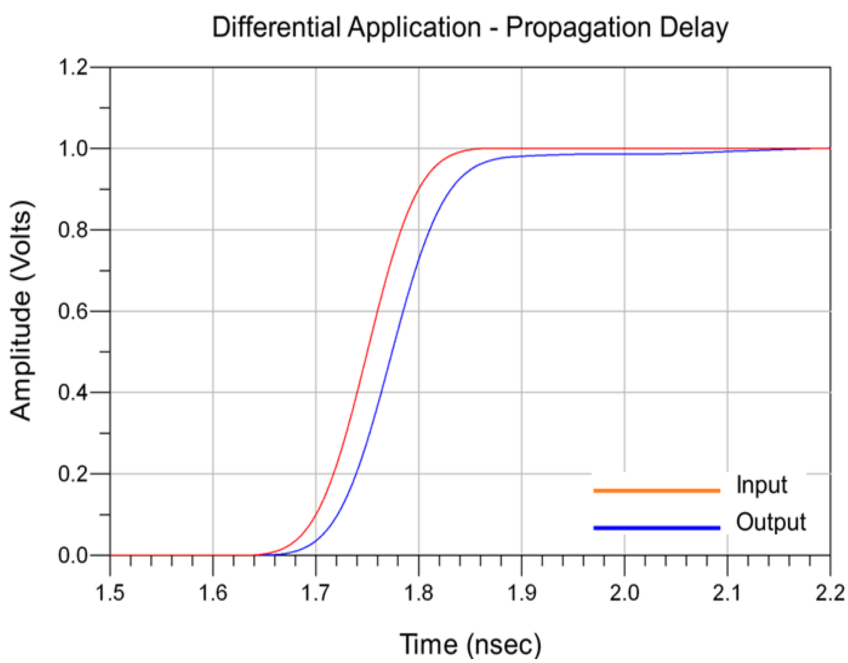


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Differential Optimal Vertical Application – Impedance

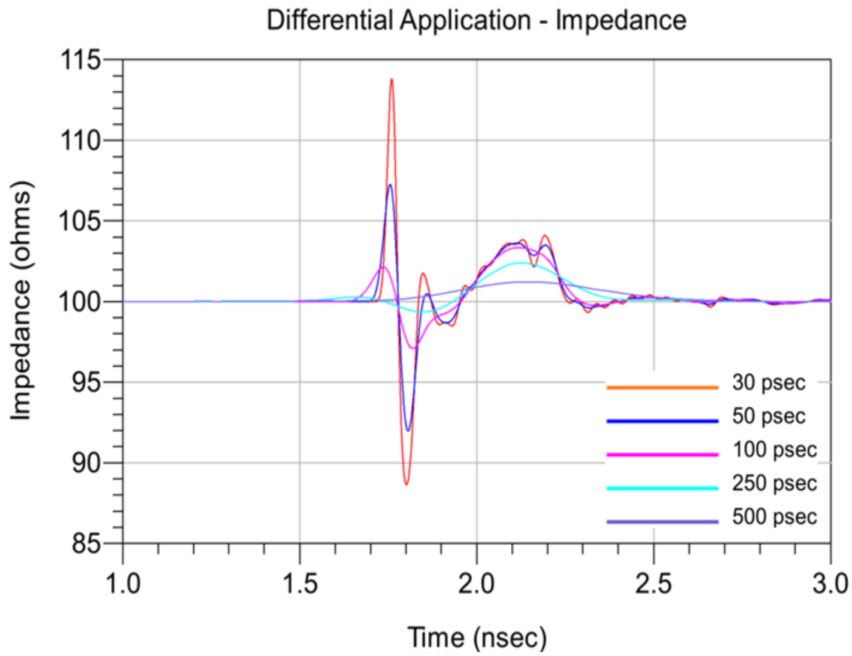


Differential Optimal Vertical Application – Propagation Delay

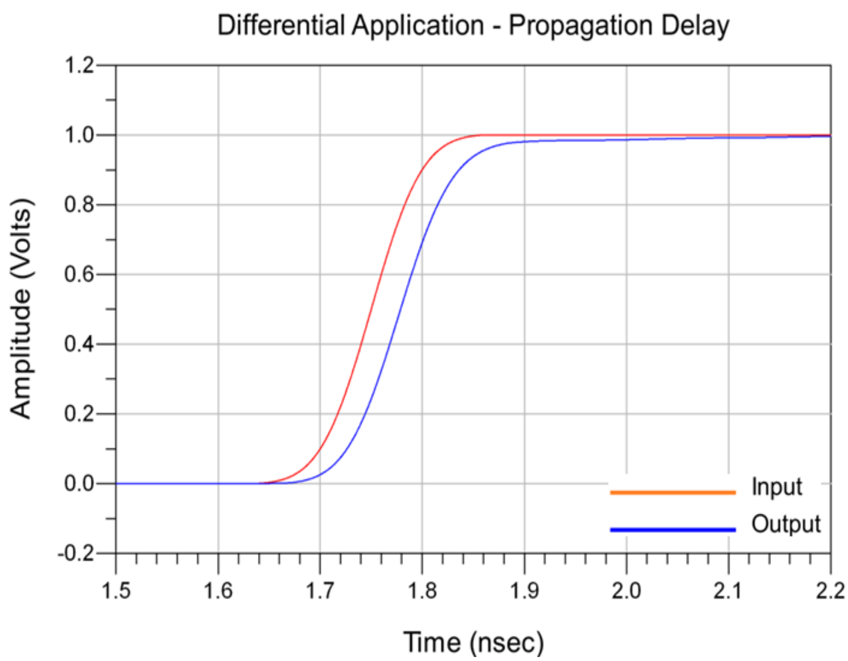


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Differential High Density Vertical Application – Impedance

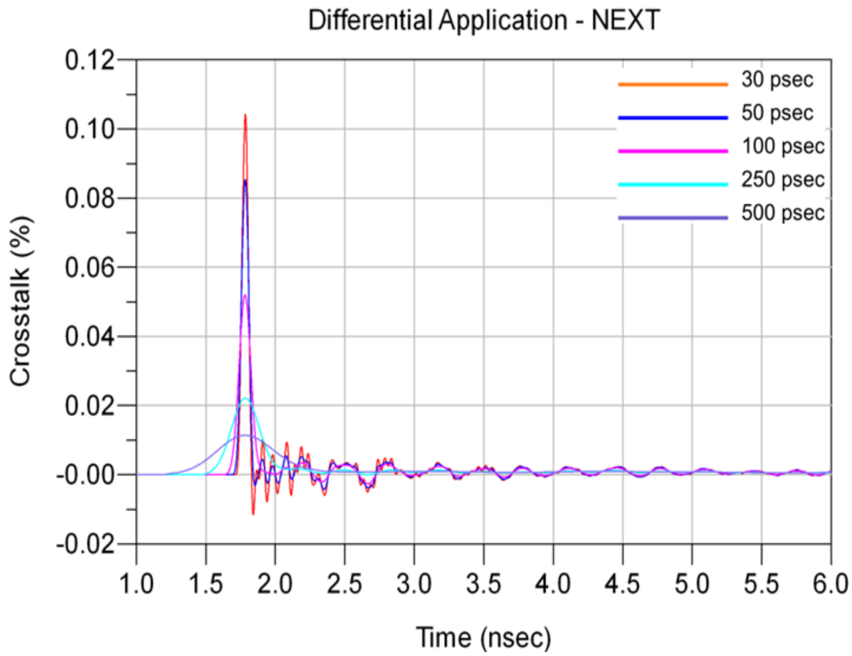


Differential High Density Vertical Application – Propagation Delay

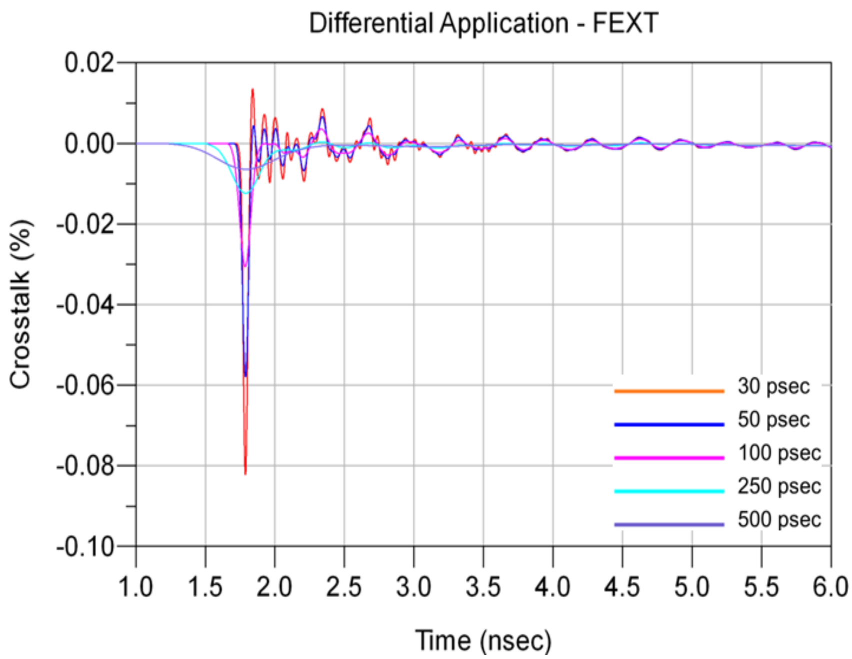


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Diff Optimal Horizontal Application – NEXT, LPAM_E15,E16_LPAM_C15,C16

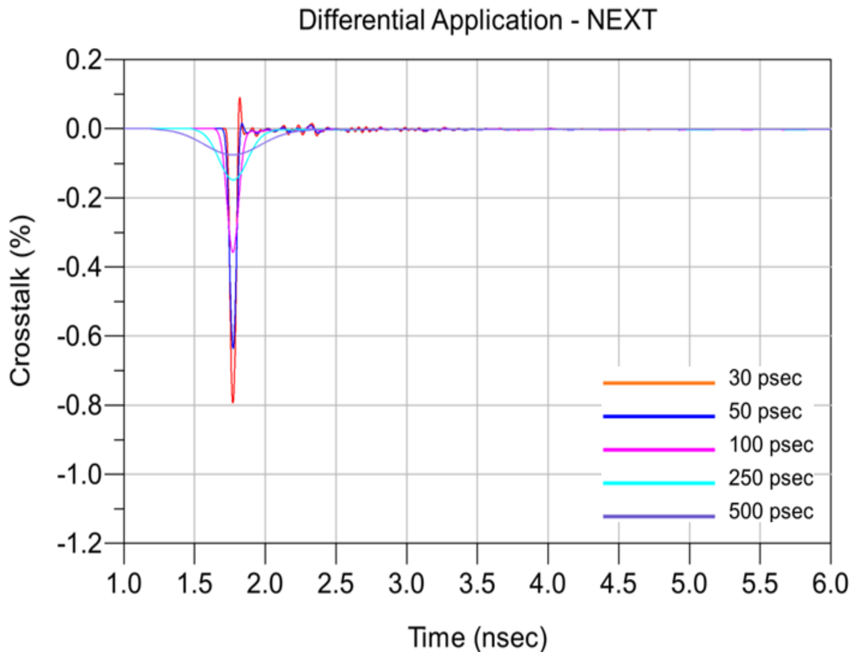


Diff Optimal Horizontal Application – FEXT, LPAM_E15,E16_LPAF_C15,C16

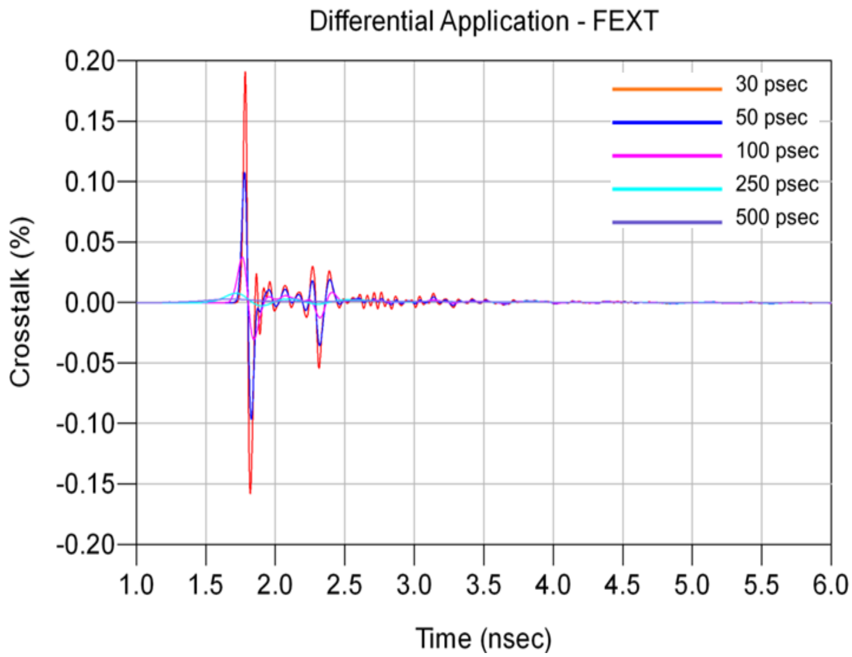


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Diff Optimal Horizontal Application – NEXT, LPAM_E15,E16_LPAM_D13,D14

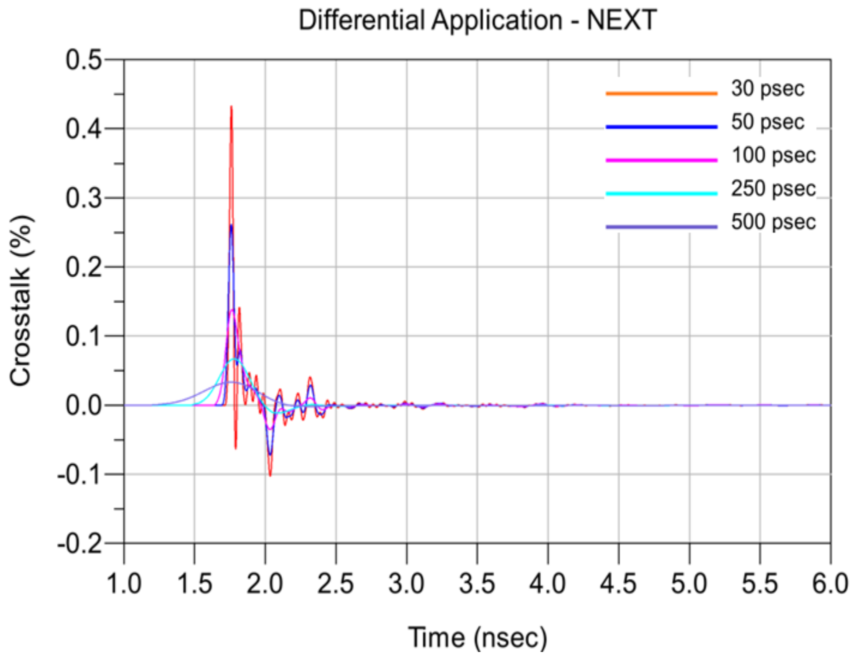


Diff Optimal Horizontal Application – FEXT, LPAM_E15,E16_LPAF_D13,D14

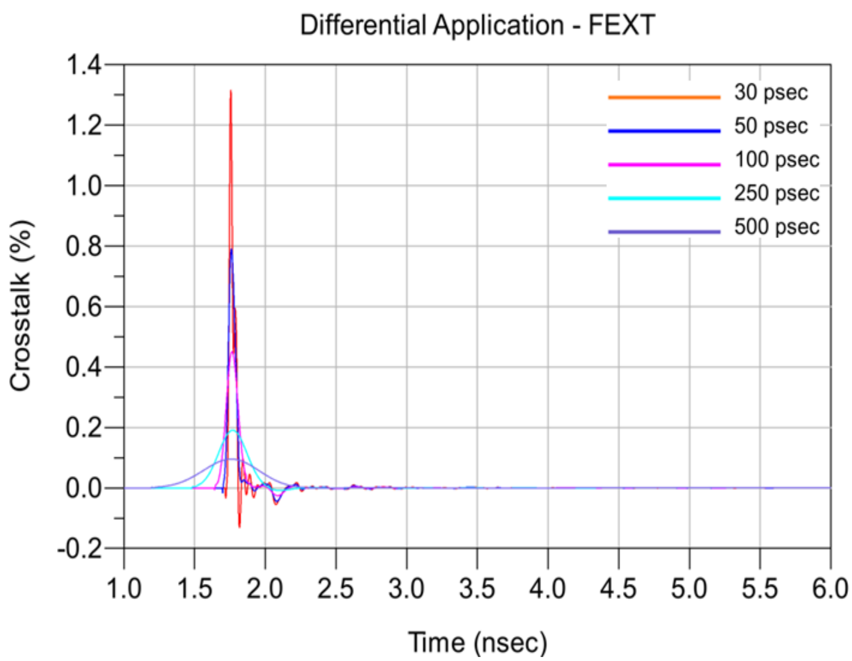


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Diff Optimal Horizontal Application – NEXT, LPAM_E15,E16_LPAM_E11,E12

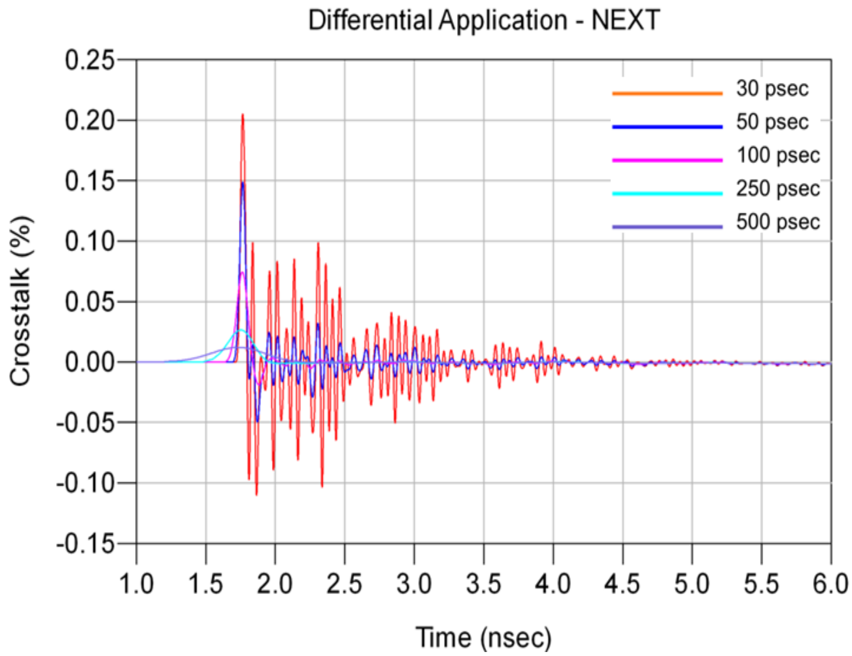


Diff Optimal Horizontal Application – FEXT, LPAM_E15,E16_LPAF_E11,E12

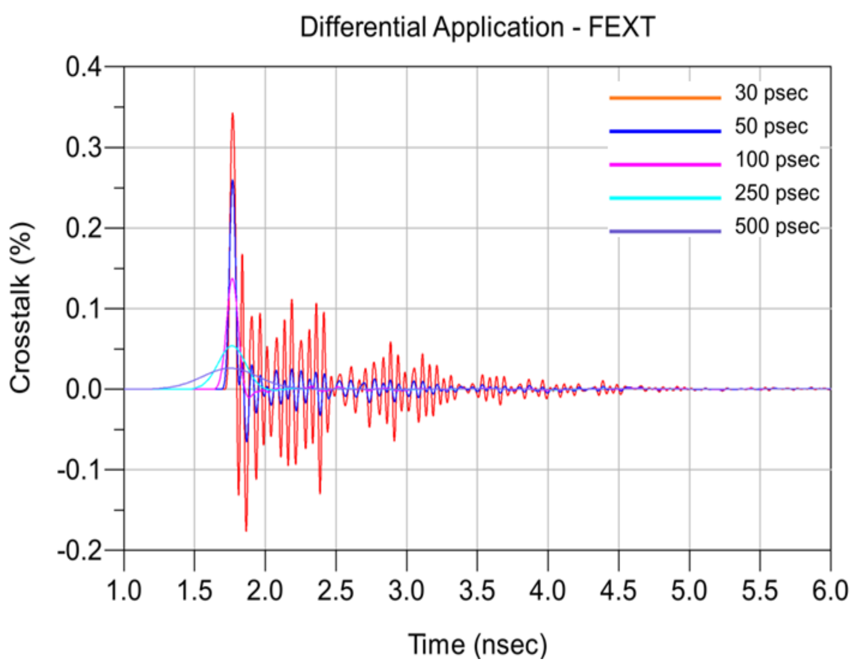


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Diff Optimal Vertical Application – NEXT, LPAM_E16,F16_LPAM_A16,B16

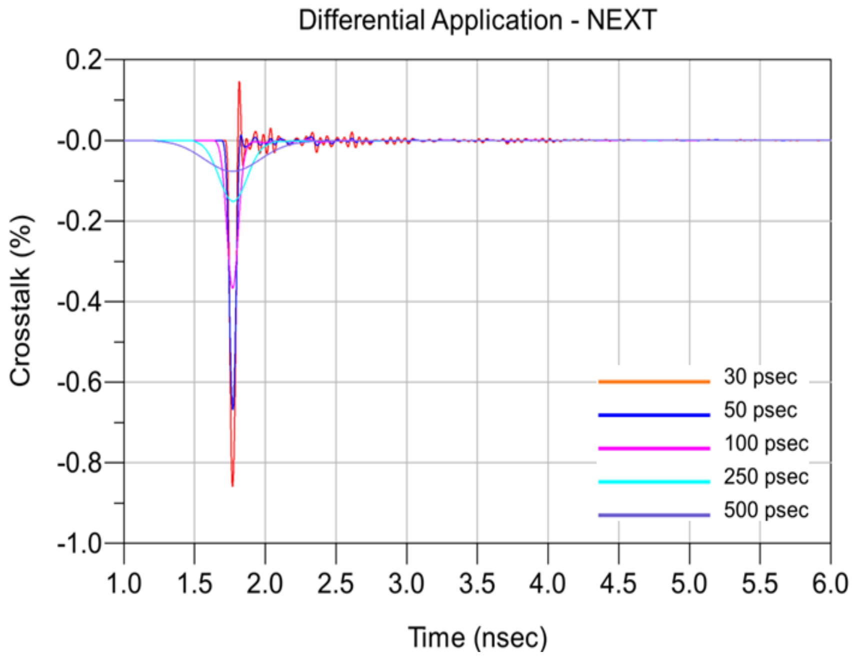


Diff Optimal Vertical Application – FEXT, LPAM_E16,F16_LPAF_A16,B16

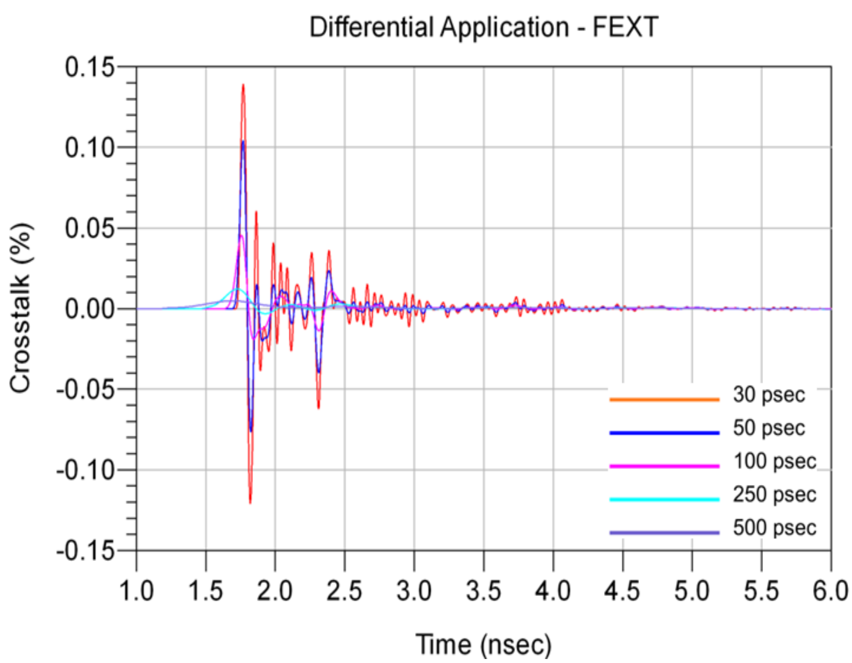


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Diff Optimal Vertical Application – NEXT, LPAM_E16,F16_LPAM_C15,D15

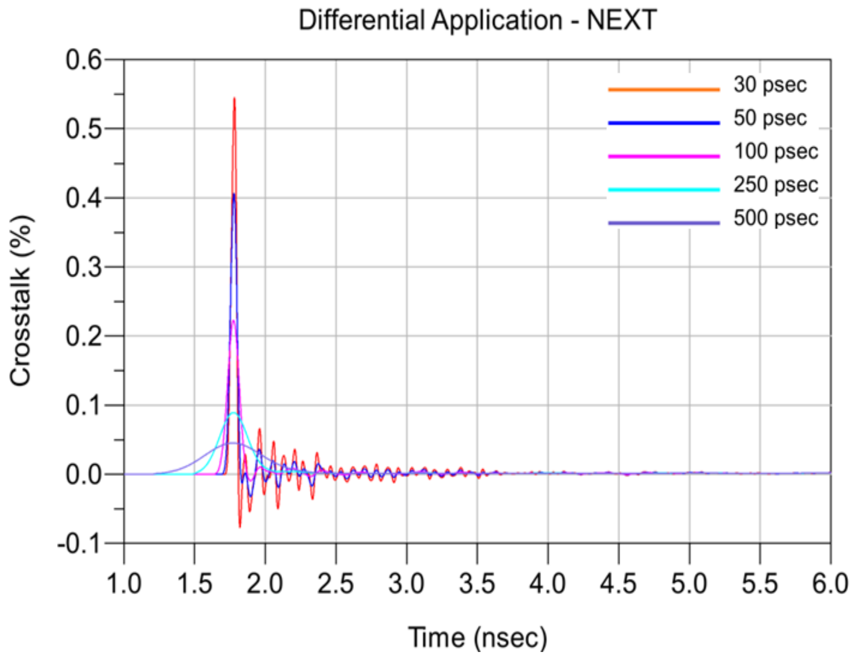


Diff Optimal Vertical Application – FEXT, LPAM_E16,F16_LPAF_C15,D15

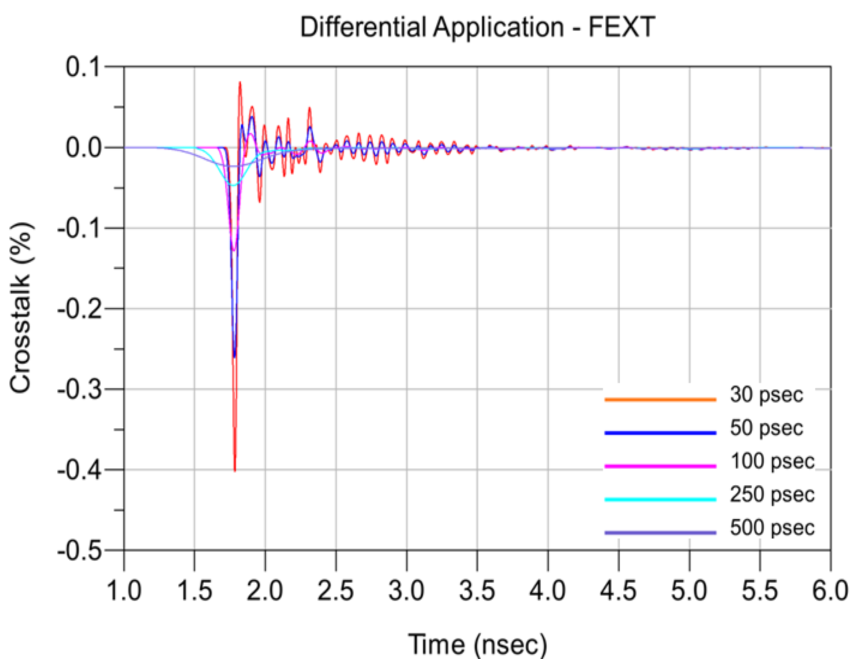


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Diff Optimal Vertical Application – NEXT, LPAM_E16,F16_LPAM_E14,F14

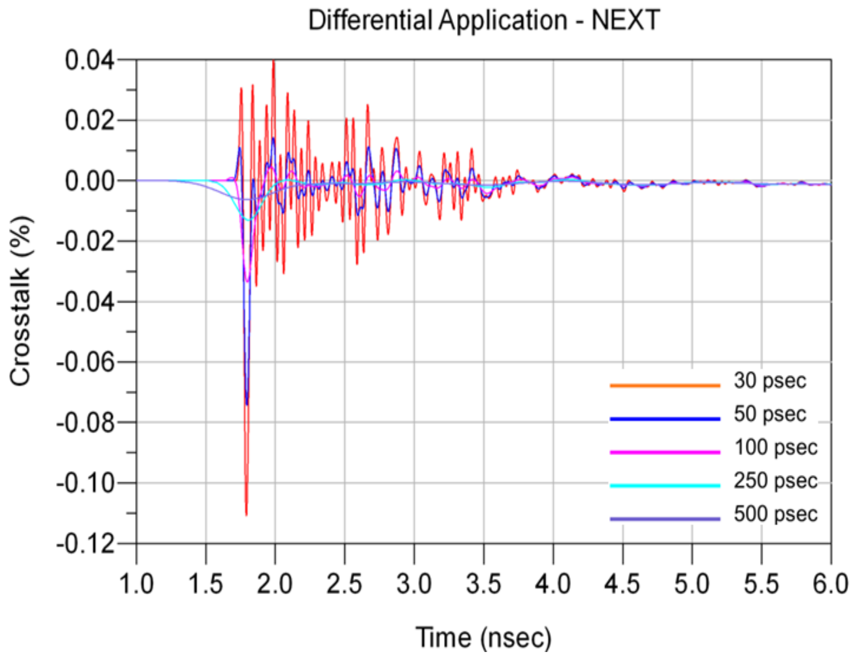


Diff Optimal Vertical Application – FEXT, LPAM_E16,F16_LPAF_E14,F14

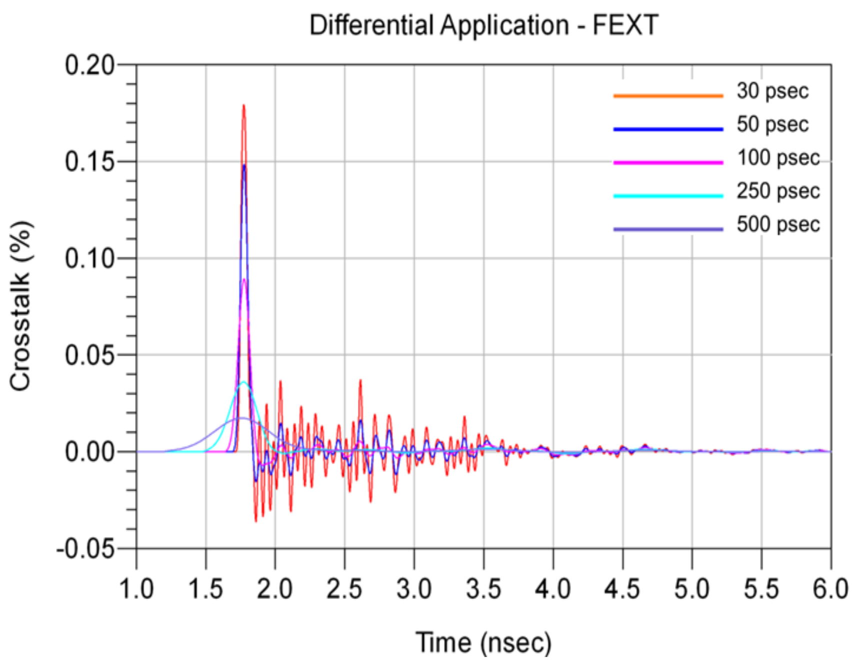


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Diff High Density Vertical Application – NEXT, LPAM_D16,E16_LPAM_A16,B16

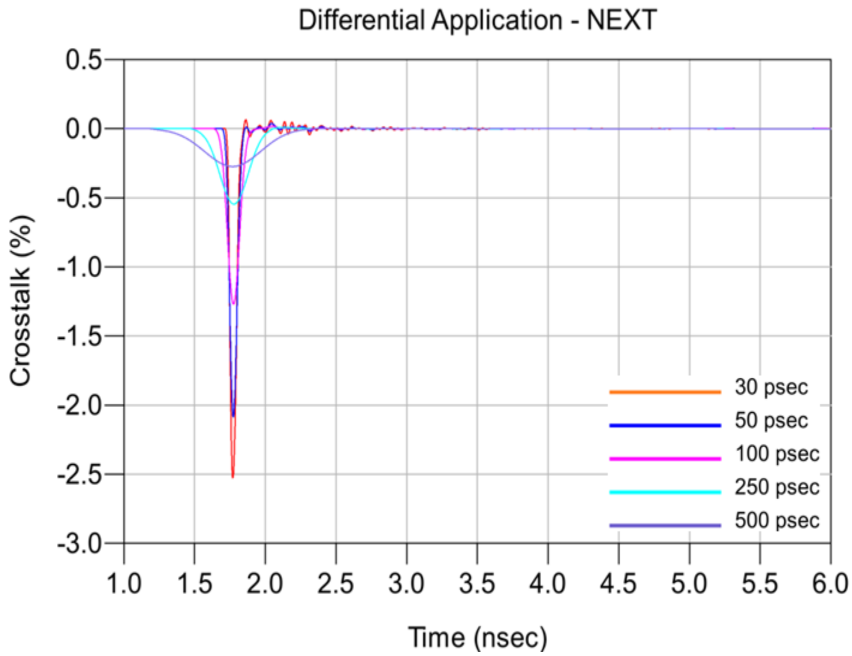


Diff High Density Vertical Application – FEXT, LPAM_D16,E16_LPAF_A16,B16

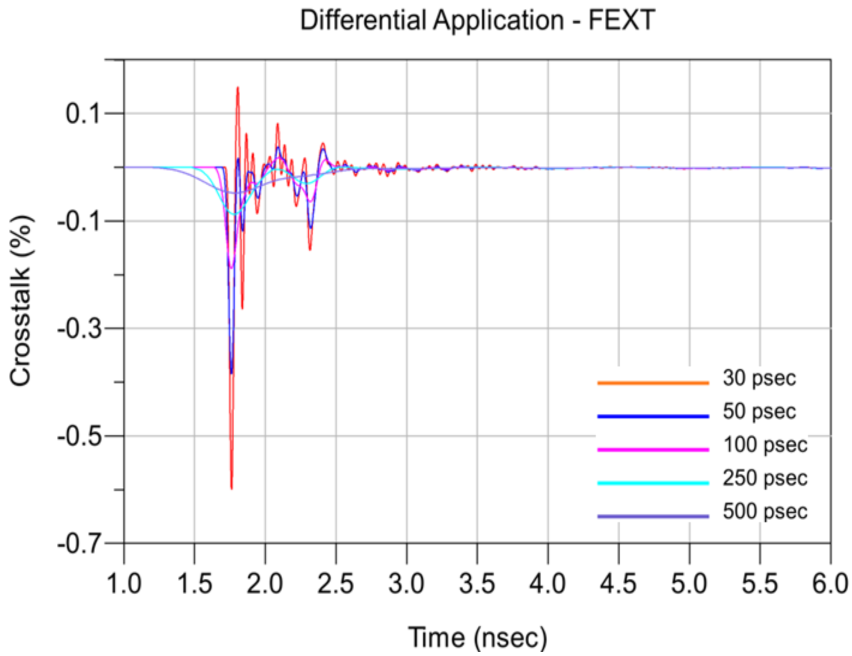


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Diff High Density Vertical Application – NEXT, LPAM_D16,E16_LPAM_C15,D15

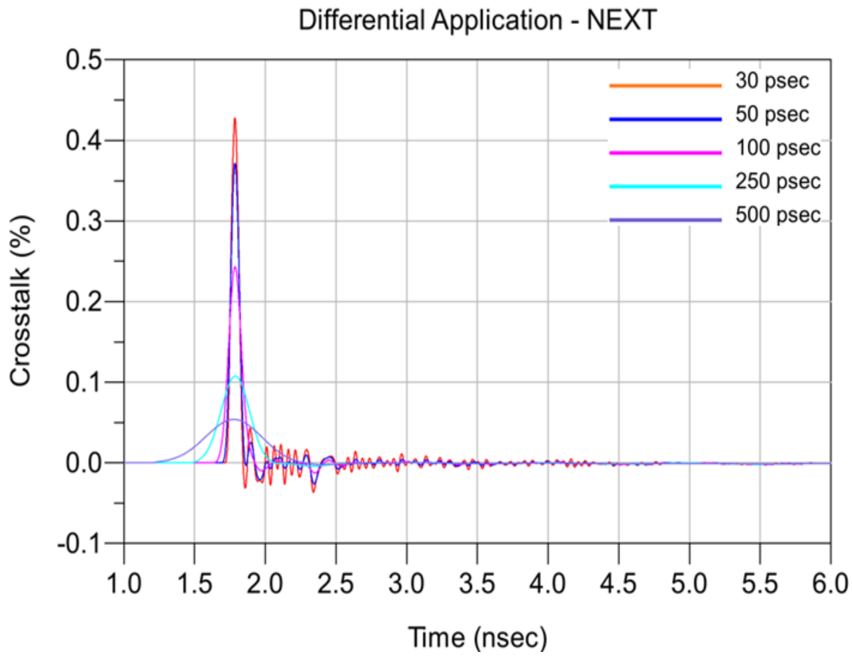


Diff High Density Vertical Application – FEXT, LPAM_D16,E16_LPAF_C15,D15

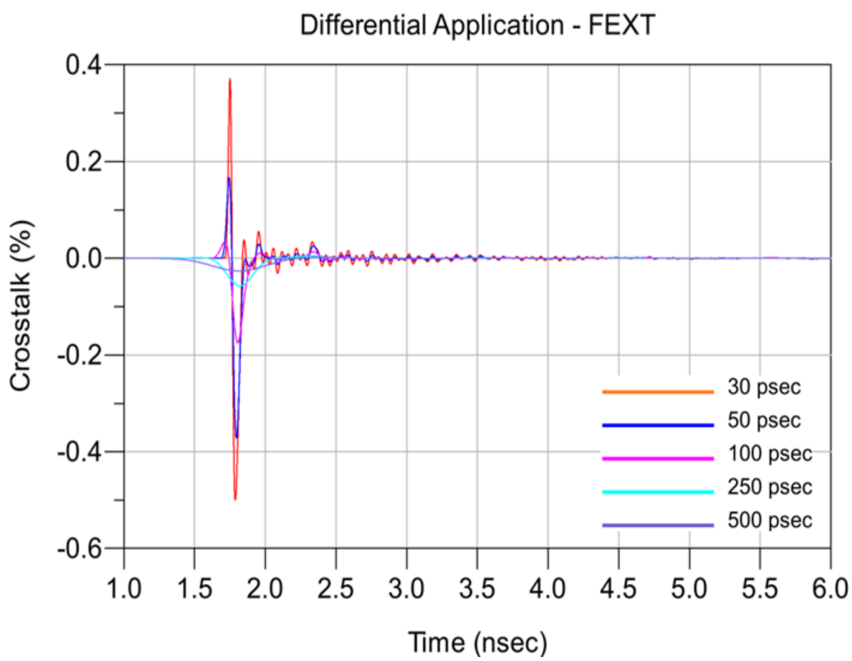


Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Diff High Density Vertical Application – NEXT, LPAM_D16,E16_LPAM_D14,E14



Diff High Density Vertical Application – FEXT, LPAM_D16,E16_LPAF_D14,E14



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Appendix C – Product and Test System Descriptions

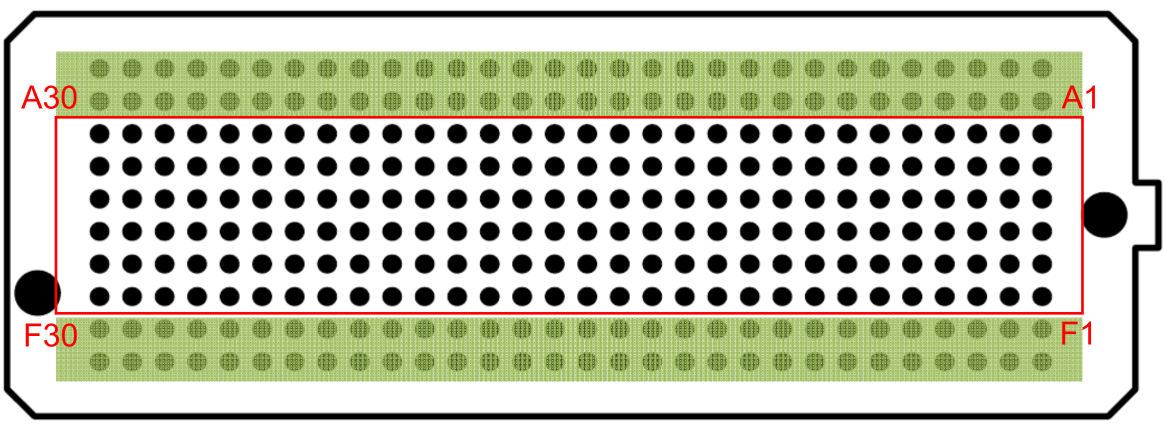
Product Description

Product test samples are 4mm (0.157") stack height LPAM/LPAF Series connectors. The part numbers are LPAM-30-01.0-L-06-2-A-K-TR and LPAF-30-03.0-L-06-2-A-K-TR. The LPAM/LPAF Series is a low profile, open pin field connector designed for single-ended signals with various options for differential signaling configurations. The open pin field array is 6 row providing 30 signal pins per row. 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. Optimization of the SMA launch was performed using full wave simulation tools to minimize reflections. Ten test fixtures are specific to the SEAM/ SEAF Series connector set and identified by part numbers PCB-103314-TST-01-A and B to PCB-103314-TST-05 A and B. Calibration standards specific to the SEAM/ SEAF Series are located on the calibration boards PCB-103314-TST-06 and PCB-103314-TST-07. To keep trace lengths short, five different test board sets were required to access the necessary signal pins.

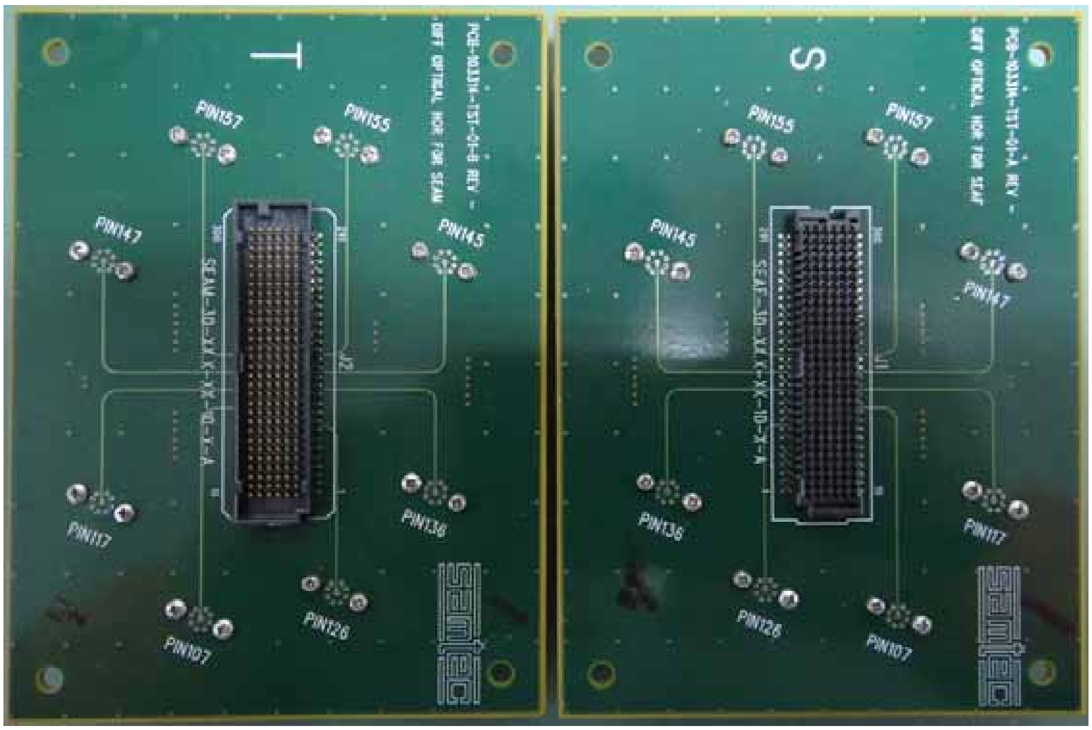
Because LPAM/LPAF series connectors have the same footprint with SEAM/SEAF series connectors, the SEAM/SEAF test boards (PCB103314) can be used for LPAM/LPAF connector measurement. LPAM/LPAF connectors were soldered onto the middle of the soldering pad inside the red square area as shown below.



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

PCB-103314-TST-XX Test Fixtures

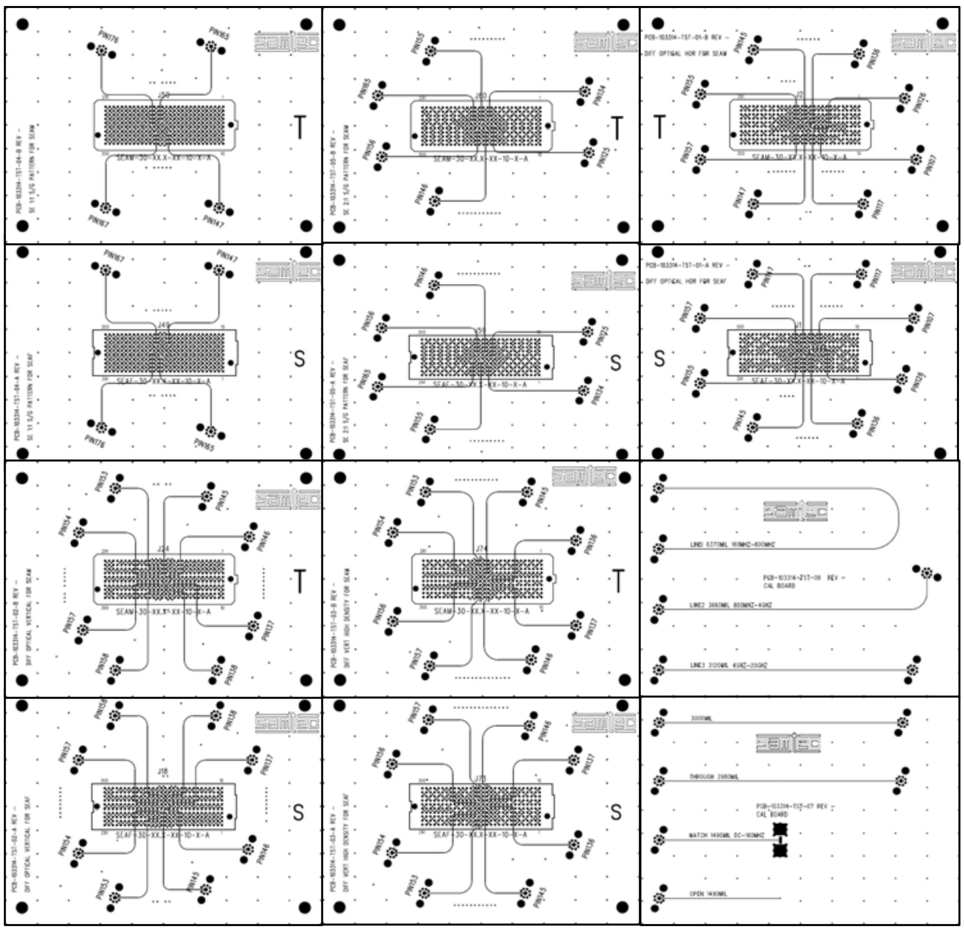
Shown below is a photograph of one of the five test board sets. The LPAM/LPAF connectors were soldered in the middle of the solder paste area.



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

PCB-103314-TST-XX PCB Layout Panel

Artwork of the PCB design is shown below.



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

PCB Fixtures

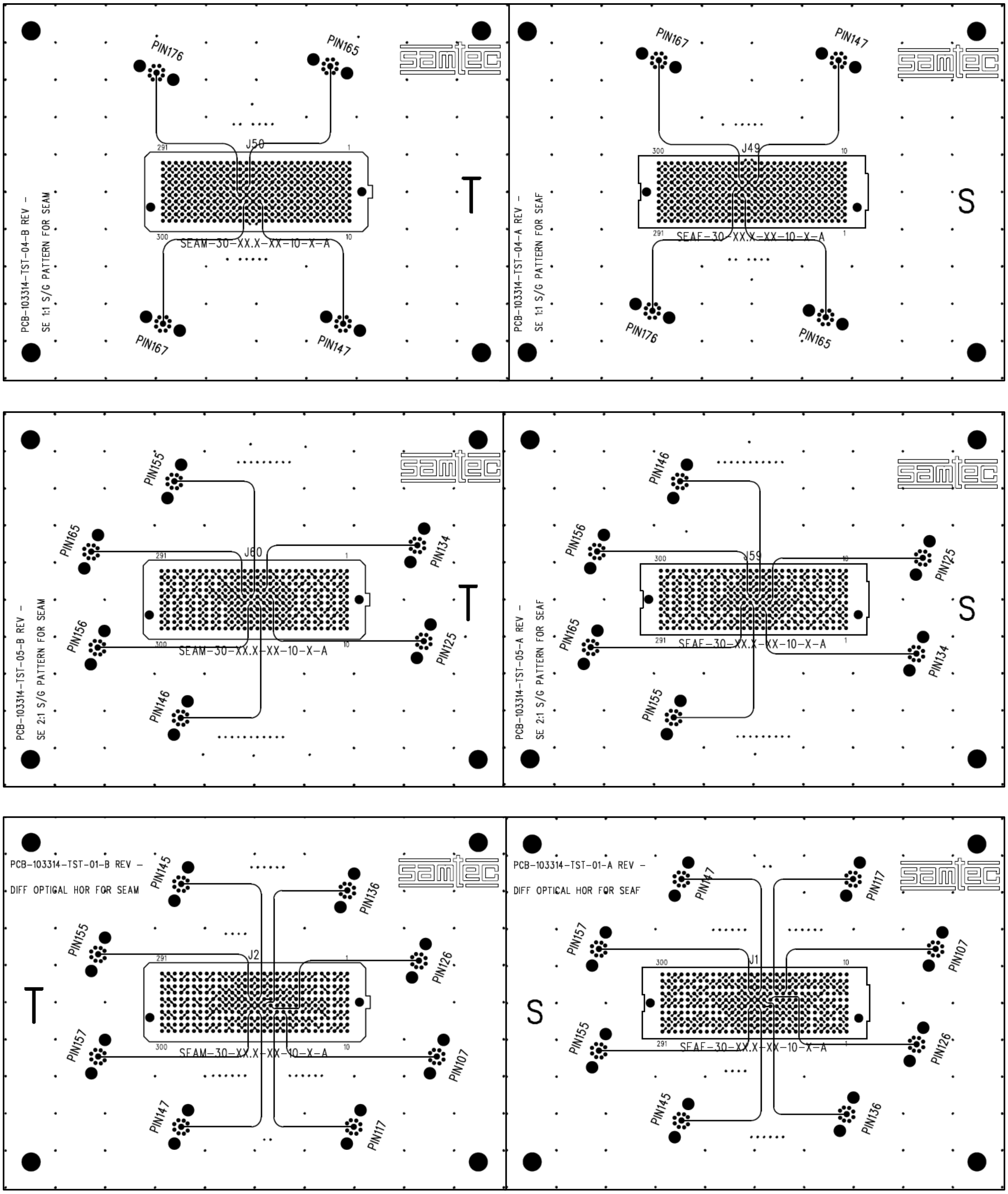
The test fixtures used are as follows:

PCB-103314 -TST-04-B Rev – LPAM Series Test Board for SE 1:1 S/G Pattern
PCB-103314 -TST-04-A Rev – LPAF Series Test Board for SE 1:1 S/G Pattern
PCB-103314 -TST-05-B Rev – LPAM Series Test Board for SE 2:1 S/G Pattern
PCB-103314 -TST-05-A Rev – LPAF Series Test Board for SE 2:1 S/G Pattern
PCB-103314 -TST-01-B Rev – LPAM Series Test Board for Differential Optimal Horizontal
PCB-103314 -TST-01-A Rev – LPAF Series Test Board for Differential Optimal Horizontal
PCB-103314 -TST-02-B Rev – LPAM Series Test Board for Differential Optimal Vertical
PCB-103314 -TST-02-A Rev – LPAF Series Test Board for Differential Optimal Vertical
PCB-103314 -TST-03-B Rev – LPAM Series Test Board for Differential High Density Vertical
PCB-103314 -TST-03-A Rev – LPAF Series Test Board for Differential High Density Vertical

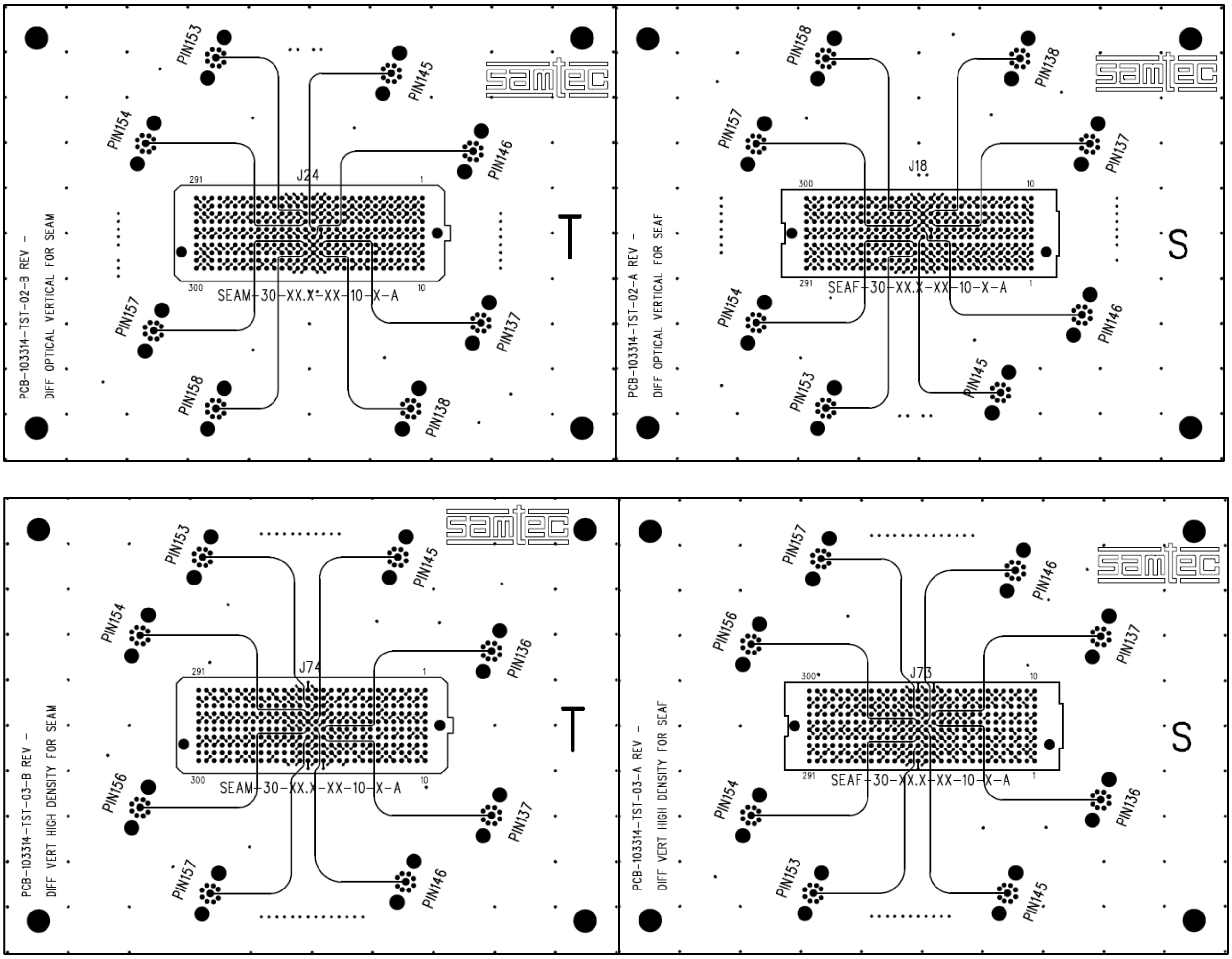
The pin numbers in the PCB layout are for SEAM/SEAF series connectors. The corresponding pin numbers for LPAM/LPAF connectors are listed below.

	SEAM/SEAF	LPAM/LPAF
Single-Ended 1:1	PIN167	PIN_E17
	PIN165	PIN_C17
	PIN176	PIN_D18
	PIN147	PIN_E15
Single-Ended 2:1	PIN156	PIN_D16
	PIN155	PIN_C16
	PIN165	PIN_C17
	PIN146	PIN_D15
Optimal Horizontal	PIN147,157	PIN_E15,E16
	PIN145,155	PIN_C15,C16
	PIN126,136	PIN_D13,D14
	PIN107,117	PIN_E11,E12
Optimal Vertical	PIN157,158	PIN_E16,F16
	PIN153,154	PIN_A16,B16
	PIN145,146	PIN_C15,D15
	PIN137,138	PIN_E14,F14
Vertical High Density	PIN156,157	PIN_D16,E16
	PIN153,154	PIN_A16,B16
	PIN145,146	PIN_C15,D15
	PIN136,137	PIN_D14,E14

Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height



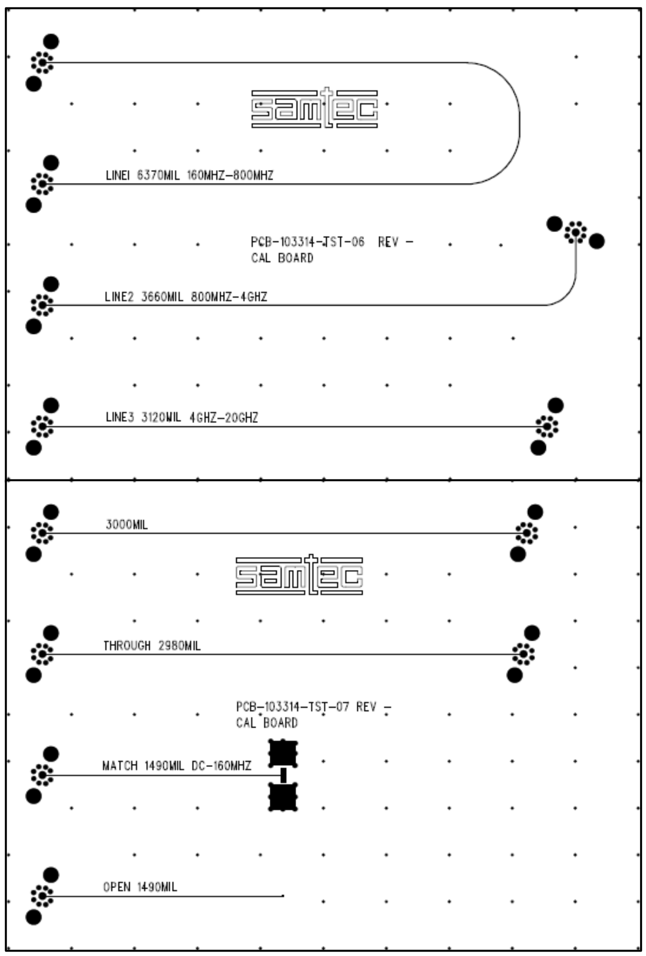
Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Calibration Board

Test fixture losses and test point reflections were removed from the data by use of TRL calibration. The calibration board is 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.



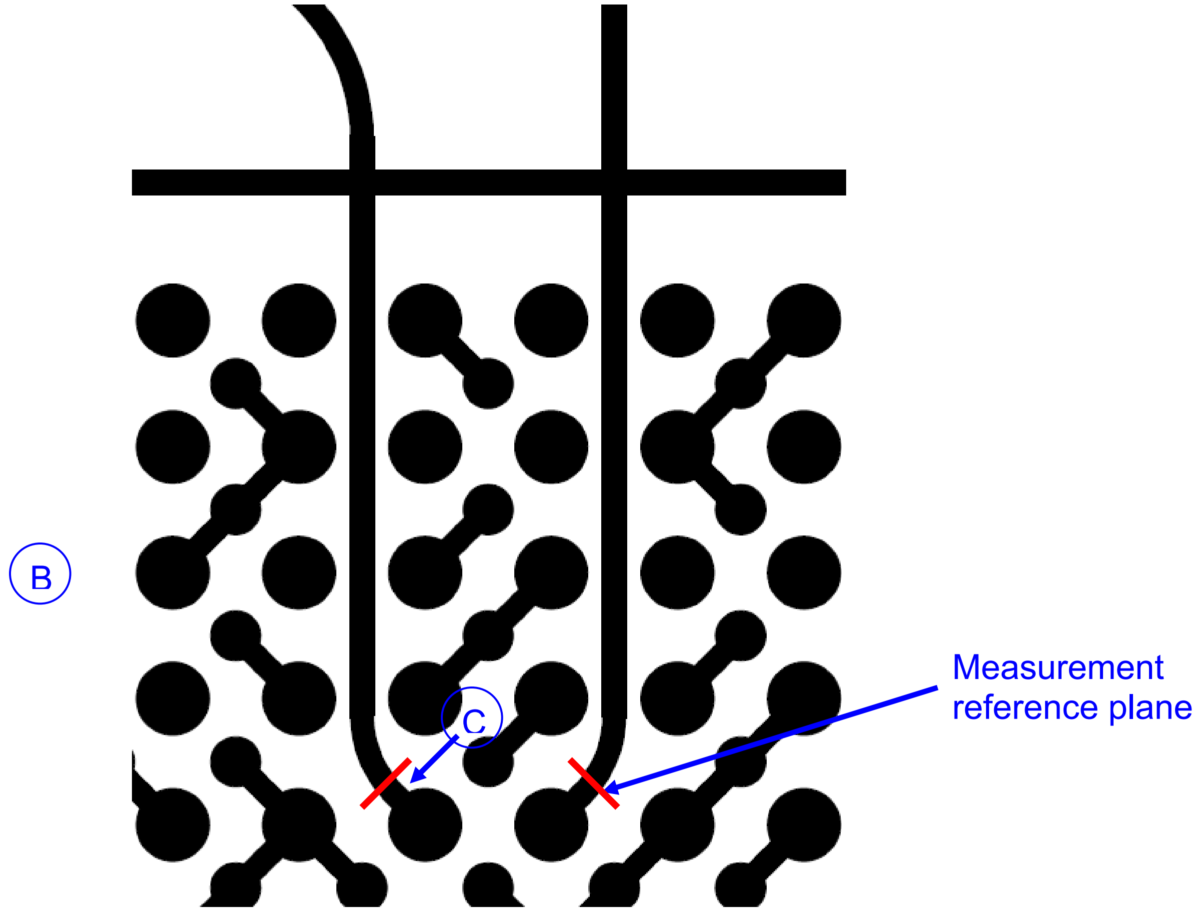
Thru line – 2980 mils
Open Reflect – 1490 mils
Line 1 – 6370 mils
Line 2 – 3660 mils
Line 3 – 3120 mils
Match – 1490 mils

Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

All traces on the test boards are length matched to 1.5” measured from the edge of the pad to the SMA. The TRL calibration effectively removes 1.490” of test board trace effects. This means that 10 mils of test board trace length effects are included in the measurement. The S-Parameter measurement includes:

A- The LPAM/LPAF Series connector set
B- Test board vias and pads (footprint effects)
C- 10 mils of 9.5 mil wide microstrip trace

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



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

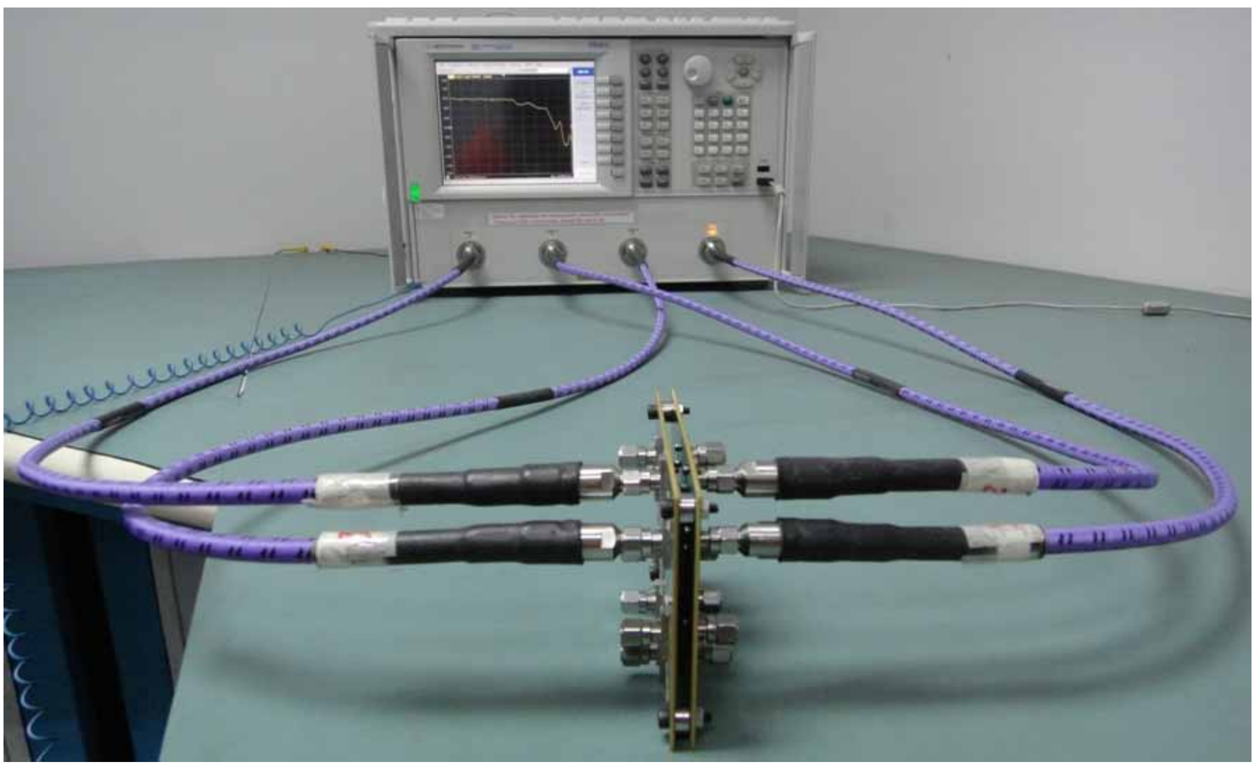
Appendix D – Test and Measurement Setup

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

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

N5230C Measurement Setup



Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

Test Instruments

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

Test Cables & Adapters

QTY	Description
4	Gore OWD01D02039-4 (DC-50 GHz)

Series: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

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 LPAM/LPAF 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 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

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: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

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: LPAM/LPAF
Description: Low Profile, Open Pin Field Array, 1.27mm x 1.27mm Pitch, 4mm Stack Height

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)