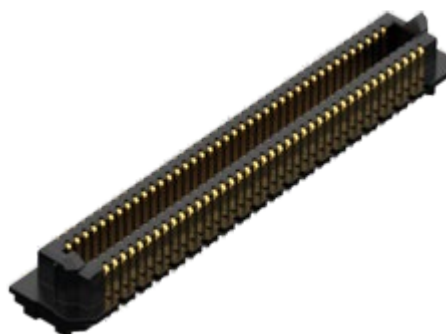


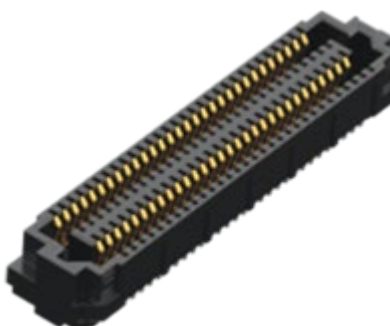


High Speed Characterization Report

ADM6-XX-01.5-XXX-4-A



ADF6-XX-03.5-XXX-4-A



Description:
0.635 mm AcceleRate® HD High-Density Interconnect,
5mm Mated Stack Height

Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Table of Contents

Connector Overview	1
Frequency Domain Data Summary	1
Bandwidth Chart – Differential Insertion Loss	1
Time Domain Data Summary	2
Table 1 - Differential Impedance (Ω)	2
Table 2 - Differential Crosstalk (%)	2
Table 3 - Propagation Delay (Mated Connector)	3
Characterization Details	4
Differential and Single-Ended Data	4
Connector Signal to Ground Ratio	4
Frequency Domain Data	6
Time Domain Data	6
Appendix A – Frequency Domain Responses	8
Differential Application – Insertion Loss	8
Differential Application – Return Loss	8
Differential Application – NEXT Configurations	9
Differential Application – FEXT Configurations	10
Appendix B – Time Domain Responses	11
Differential Application – Impedance	11
Differential Application – Propagation Delay	13
Differential Application – NEXT, ADM6_A19A20_ADM6_A15A16	15
Differential Application – NEXT, ADM6_B13B14_ADM6_A15A16	15
Differential Application – NEXT, ADM6_B17B18_ADM6_A15A16	16
Differential Application – NEXT, ADM6_C15C16_ADM6_A15A16	16
Differential Application – NEXT, ADM6_C19C20_ADM6_A15A16	17
Differential Application – NEXT, ADM6_D13D14_ADM6_A15A16	17
Differential Application – NEXT, ADM6_D17D18_ADM6_A15A16	18
Differential Application – NEXT, ADM6_A15A16_ADM6_B13B14	18
Differential Application – NEXT, ADM6_A19A20_ADM6_B13B14	19
Differential Application – NEXT, ADM6_B17B18_ADM6_B13B14	19
Differential Application – NEXT, ADM6_C15C16_ADM6_B13B14	20
Differential Application – NEXT, ADM6_C19C20_ADM6_B13B14	20
Differential Application – NEXT, ADM6_D13D14_ADM6_B13B14	21
Differential Application – NEXT, ADM6_D17D18_ADM6_B13B14	21
Differential Application – FEXT, ADF6_A19A20_ADM6_A15A16	22
Differential Application – FEXT, ADF6_B13B14_ADM6_A15A16	22
Differential Application – FEXT, ADF6_B17B18_ADM6_A15A16	23
Differential Application – FEXT, ADF6_C15C16_ADM6_A15A16	23
Differential Application – FEXT, ADF6_C19C20_ADM6_A15A16	24

Series: ADM6 / ADF6**Description:** 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – FEXT, ADF6_D13D14_ADM6_A15A16	24
Differential Application – FEXT, ADF6_D17D18_ADM6_A15A16	25
Differential Application – FEXT, ADF6_A15A16_ADM6_B13B14	25
Differential Application – FEXT, ADF6_A19A20_ADM6_B13B14	26
Differential Application – FEXT, ADF6_B17B18_ADM6_B13B14	26
Differential Application – FEXT, ADF6_C15C16_ADM6_B13B14	27
Differential Application – FEXT, ADF6_C19C20_ADM6_B13B14	27
Differential Application – FEXT, ADF6_D13D14_ADM6_B13B14	28
Differential Application – FEXT, ADF6_D17D18_ADM6_B13B14	28
Appendix C – Product and Test System Descriptions	29
Product Description	29
Test System Description	29
PCB-ADx6-109153-SIG-01 Test Fixtures	29
PCB Fixtures	30
Appendix D – Test and Measurement Setup	32
N5225B Measurement Setup	32
Test Instruments	32
Test Cables & Adapters	32
Appendix E - Frequency and Time Domain Measurements	33
Frequency (S-Parameter) Domain Procedures	33
Time Domain Procedures	33
Impedance (TDR).....	33
Propagation Delay (TDT)	33
Appendix F – Glossary of Terms	34

Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

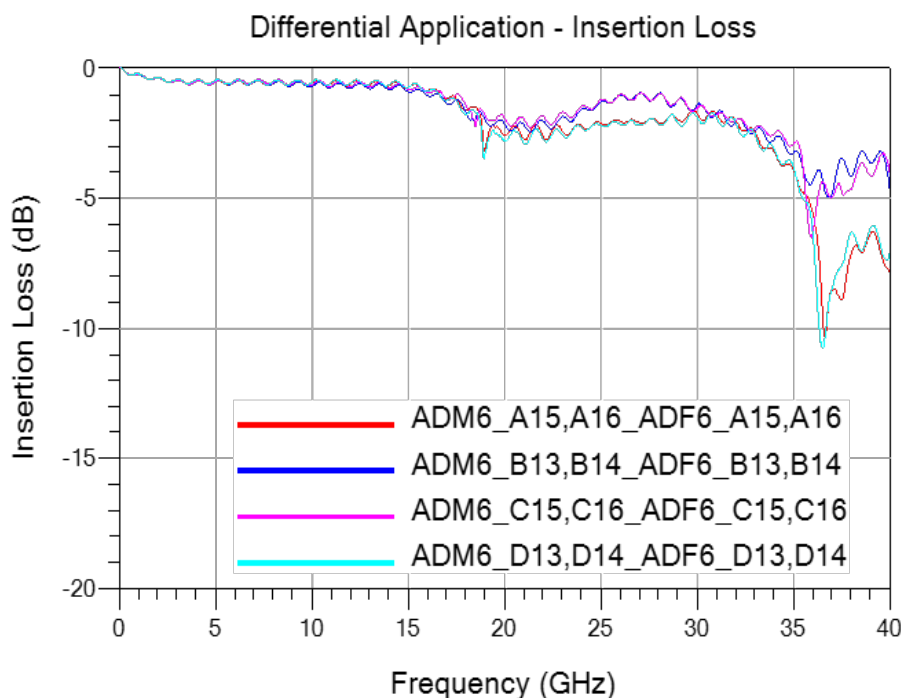
Connector Overview

The AcceleRate® HD High-Density interconnect includes an ADM6 series header mating to an ADF6 series socket. The ADM6/ADF6 series is a 4-row design, 10-60 positions per row, incredibly dense design with up to 240 total I/Os. It is low profile 5 mm stack height and slim 5 mm width and utilizes Samtec's Edge Rate® contact system which is optimized for signal integrity performance. Additional stack heights and higher pin counts are in development.

Frequency Domain Data Summary

Bandwidth Chart – Differential Insertion Loss

ADM6/ADF6 Connector Series



Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Time Domain Data Summary

Table 1 - Differential Impedance (Ω)				
Driver	Signal Rise-time	30ps	50ps	100ps
ADM6_A15,A16	Maximum Impedance	101.8	101.7	101.6
	Minimum Impedance	88.6	90.7	93.0
ADM6_B13,B14	Maximum Impedance	101.7	101.6	101.6
	Minimum Impedance	85.8	88.5	91.1
ADM6_C15,C16	Maximum Impedance	101.6	101.5	101.5
	Minimum Impedance	84.8	87.3	90.4
ADM6_D13,D14	Maximum Impedance	101.7	101.6	101.6
	Minimum Impedance	85.8	88.5	91.1

Table 2 - Differential Crosstalk (%)					
Input(tr)	Driver	Receiver	30ps	50ps	100ps
NEXT	ADM6_A19,A20	ADM6_A15,A16	<0.1	<0.1	<0.1
	ADM6_B13,B14	ADM6_A15,A16	0.36	0.26	0.14
	ADM6_B17,B18	ADM6_A15,A16	0.37	0.26	0.14
	ADM6_C15,C16	ADM6_A15,A16	<0.1	<0.1	<0.1
	ADM6_C19,C20	ADM6_A15,A16	<0.1	<0.1	<0.1
	ADM6_D13,D14	ADM6_A15,A16	<0.1	<0.1	<0.1
	ADM6_D17,D18	ADM6_A15,A16	<0.1	<0.1	<0.1
	ADM6_A15,A16	ADM6_B13,B14	0.36	0.25	0.14
	ADM6_A19,A20	ADM6_B13,B14	<0.1	<0.1	<0.1
	ADM6_B17,B18	ADM6_B13,B14	<0.1	<0.1	<0.1
	ADM6_C15,C16	ADM6_B13,B14	0.15	<0.1	<0.1
	ADM6_C19,C20	ADM6_B13,B14	<0.1	<0.1	<0.1
	ADM6_D13,D14	ADM6_B13,B14	<0.1	<0.1	<0.1
	ADM6_D17,D18	ADM6_B13,B14	<0.1	<0.1	<0.1

Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Crosstalk (%)					
FEXT	ADF6_A19,A20	ADM6_A15,A16	<0.1	<0.1	<0.1
	ADF6_B13,B14	ADM6_A15,A16	<0.1	<0.1	<0.1
	ADF6_B17,B18	ADM6_A15,A16	<0.1	<0.1	<0.1
	ADF6_C15,C16	ADM6_A15,A16	<0.1	<0.1	<0.1
	ADF6_C19,C20	ADM6_A15,A16	<0.1	<0.1	<0.1
	ADF6_D13,D14	ADM6_A15,A16	<0.1	<0.1	<0.1
	ADF6_D17,D18	ADM6_A15,A16	<0.1	<0.1	<0.1
	ADF6_A15,A16	ADM6_B13,B14	<0.1	<0.1	<0.1
	ADF6_A19,A20	ADM6_B13,B14	<0.1	<0.1	<0.1
	ADF6_B17,B18	ADM6_B13,B14	<0.1	<0.1	<0.1
	ADF6_C15,C16	ADM6_B13,B14	<0.1	<0.1	<0.1
	ADF6_C19,C20	ADM6_B13,B14	<0.1	<0.1	<0.1
	ADF6_D13,D14	ADM6_B13,B14	<0.1	<0.1	<0.1
	ADF6_D17,D18	ADM6_B13,B14	<0.1	<0.1	<0.1

Table 3 - Propagation Delay (Mated Connector)	
ADM6_A15,A16_ADF6_A15,A16	88 ps
ADM6_B13,B14_ADF6_B13,B14	81 ps
ADM6_C15,C16_ADF6_C15,C16	80 ps
ADM6_D13,D14_ADF6_D13,D14	88 ps

Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm 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 differentially and single-ended driven 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: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

For this interconnect, the following configurations were evaluated:

A	B	C	D	A	B	C	D
A30	B30	C30	D30	A30	B30	C30	D30
A29	B29	C29	D29	A29	B29	C29	D29
A28	B28	C28	D28	A28	B28	C28	D28
A27	B27	C27	D27	A27	B27	C27	D27
A26	B26	C26	D26	A26	B26	C26	D26
A25	B25	C25	D25	A25	B25	C25	D25
A24	B24	C24	D24	A24	B24	C24	D24
A23	B23	C23	D23	A23	B23	C23	D23
A22	B22	C22	D22	A22	B22	C22	D22
A21	B21	C21	D21	A21	B21	C21	D21
A20	B20	C20	D20	A20	B20	C20	D20
A19	B19	C19	D19	A19	B19	C19	D19
A18	B18	C18	D18	A18	B18	C18	D18
A17	B17	C17	D17	A17	B17	C17	D17
A16	B16	C16	D16	A16	B16	C16	D16
A15	B15	C15	D15	A15	B15	C15	D15
A14	B14	C14	D14	A14	B14	C14	D14
A13	B13	C13	D13	A13	B13	C13	D13
A12	B12	C12	D12	A12	B12	C12	D12
A11	B11	C11	D11	A11	B11	C11	D11
A10	B10	C10	D10	A10	B10	C10	D10
A9	B9	C9	D9	A9	B9	C9	D9
A8	B8	C8	D8	A8	B8	C8	D8
A7	B7	C7	D7	A7	B7	C7	D7
A6	B6	C6	D6	A6	B6	C6	D6
A5	B5	C5	D5	A5	B5	C5	D5
A4	B4	C4	D4	A4	B4	C4	D4
A3	B3	C3	D3	A3	B3	C3	D3
A2	B2	C2	D2	A2	B2	C2	D2
A1	B1	C1	D1	A1	B1	C1	D1

Differential Impedance (denoted by blue circles):

- GSSG (Ground-positive Signal-negative Signal-Ground)

Differential Crosstalk (denoted by red circles):

- In row: from the terminals to the other terminals on the same row.
- Across row: from one row of terminals to the other row of terminals.

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.

Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

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 30 ps and 100 ps.

For this report, measured rise times were at 20%-80% 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 Keysight 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 4.151 mm of PCB trace on both the ADM6 and ADF6 each. Delay is measured at 100 picoseconds signal risetime. 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

Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

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.

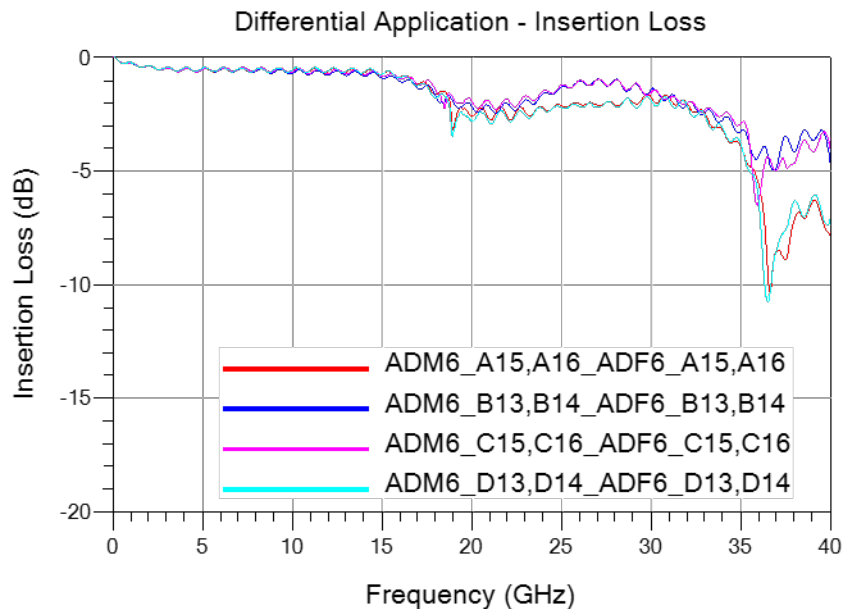
Additional information concerning test conditions and procedures is in the appendices of this report. Further information may be obtained by contacting our Signal Integrity Group at sig@samtec.com.

Series: ADM6 / ADF6

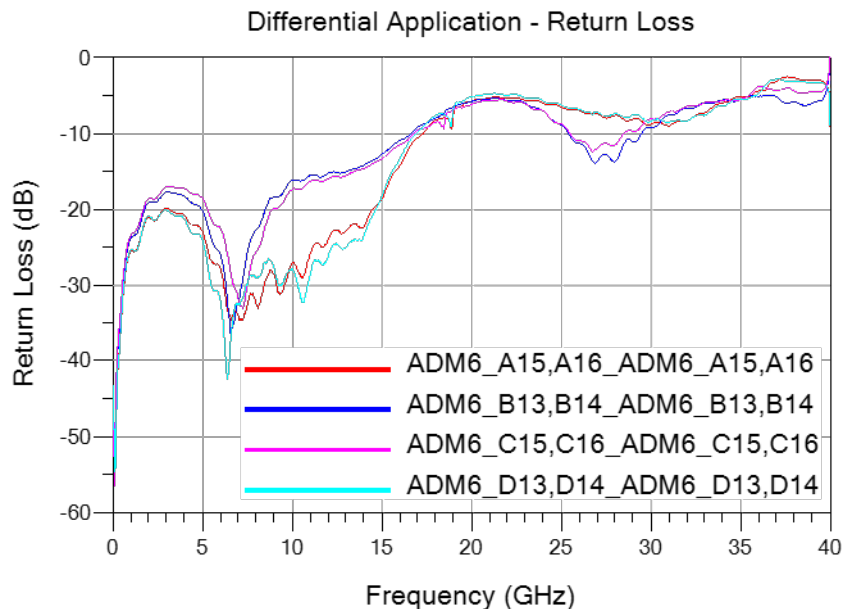
Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Appendix A – Frequency Domain Responses

Differential Application – Insertion Loss



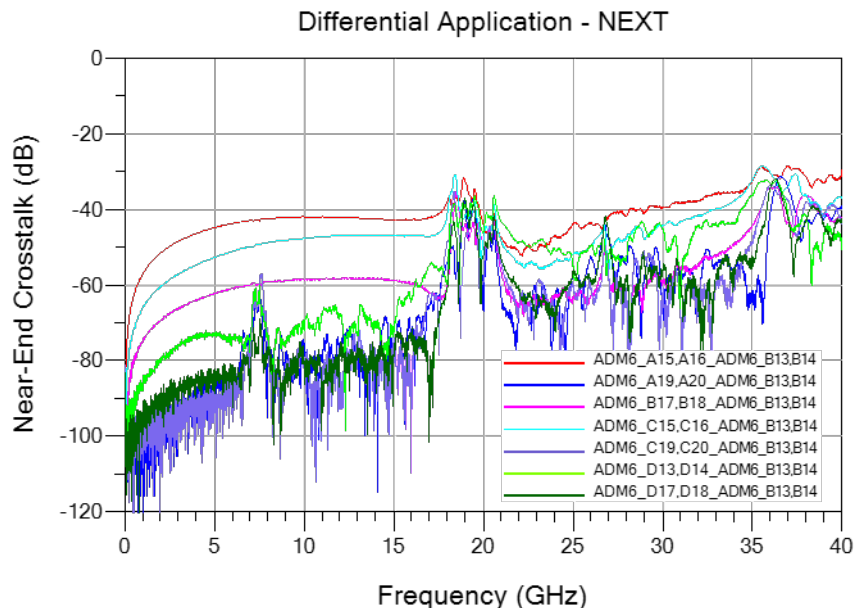
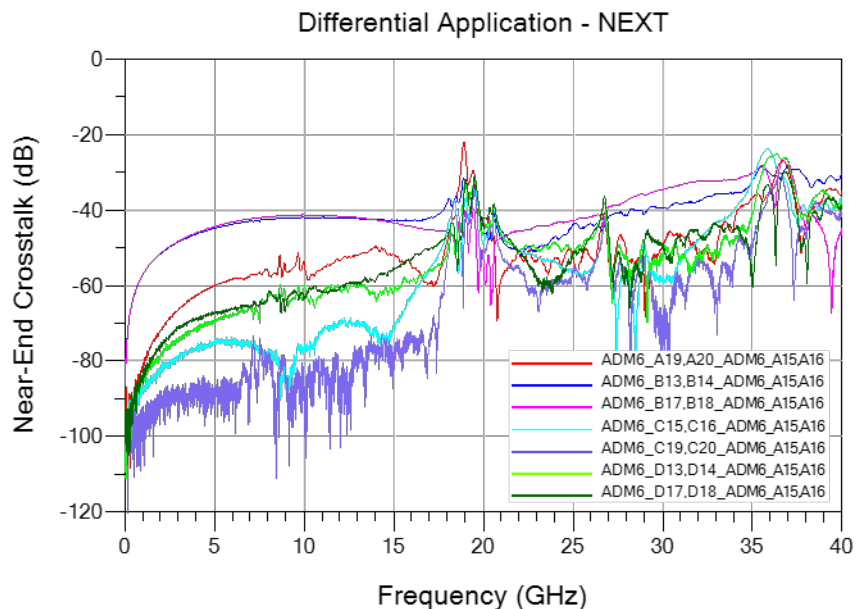
Differential Application – Return Loss



Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

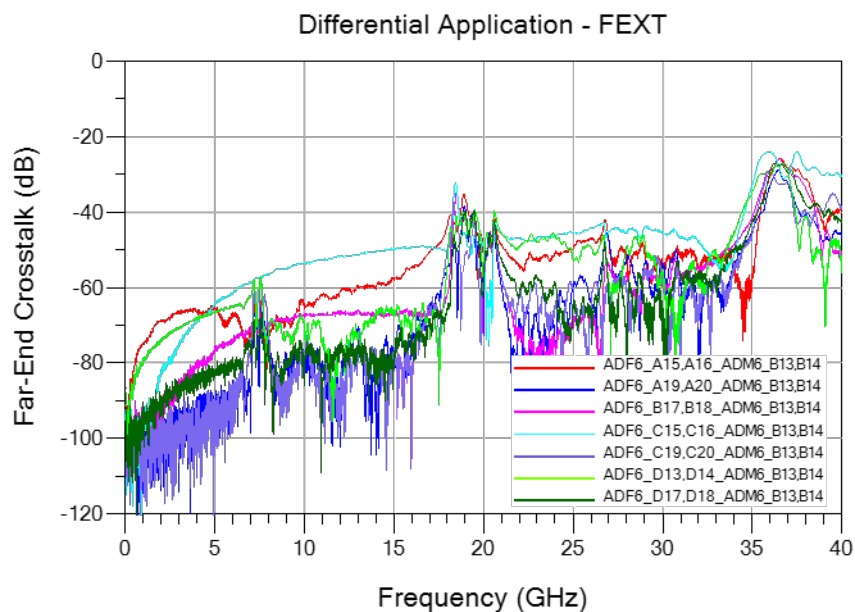
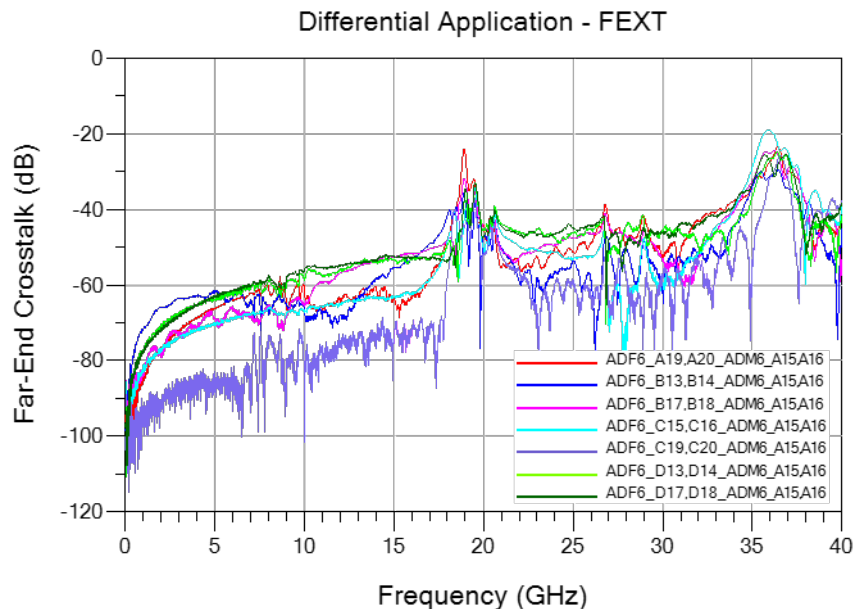
Differential Application – NEXT Configurations



Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – FEXT Configurations



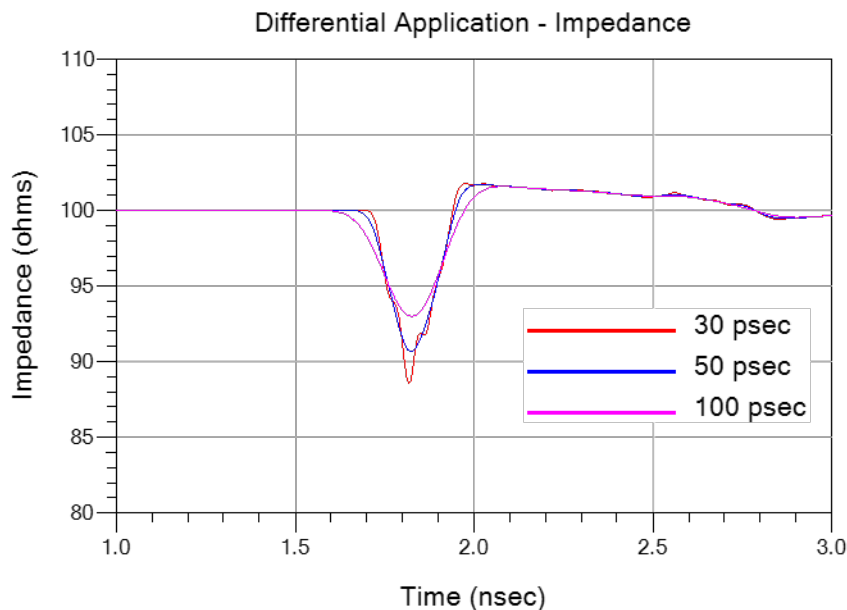
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

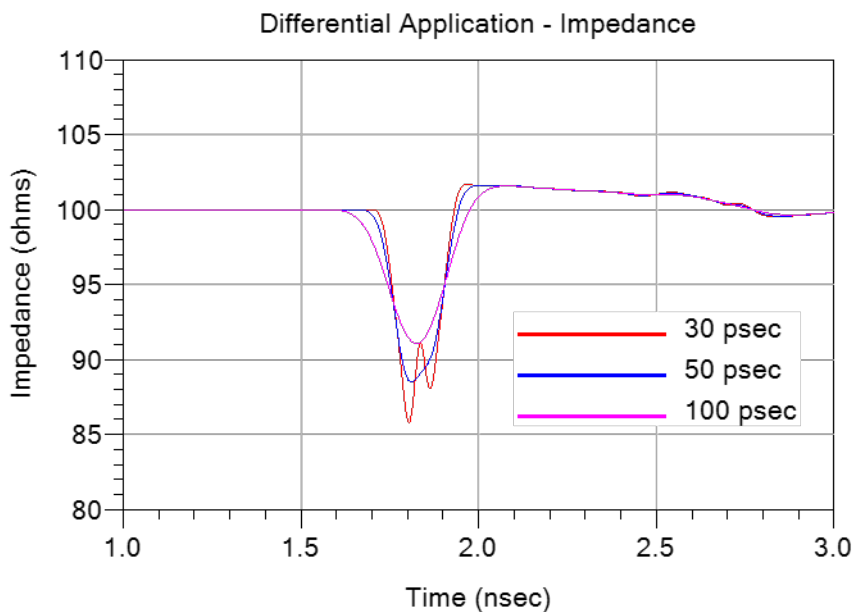
Appendix B – Time Domain Responses

Differential Application – Impedance

ADM6_A15,A16-ADF6_A15,A16

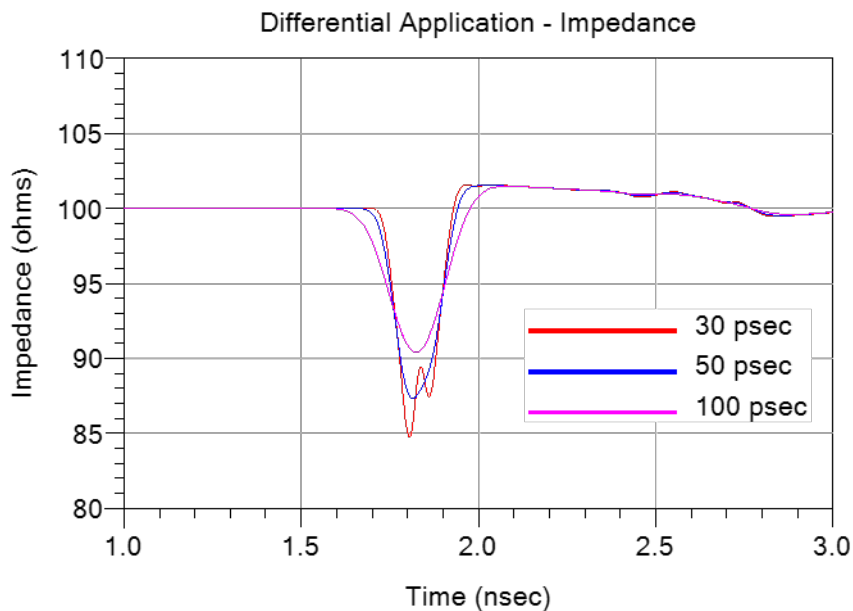


ADM6_B13,B14-ADF6_B13,B14

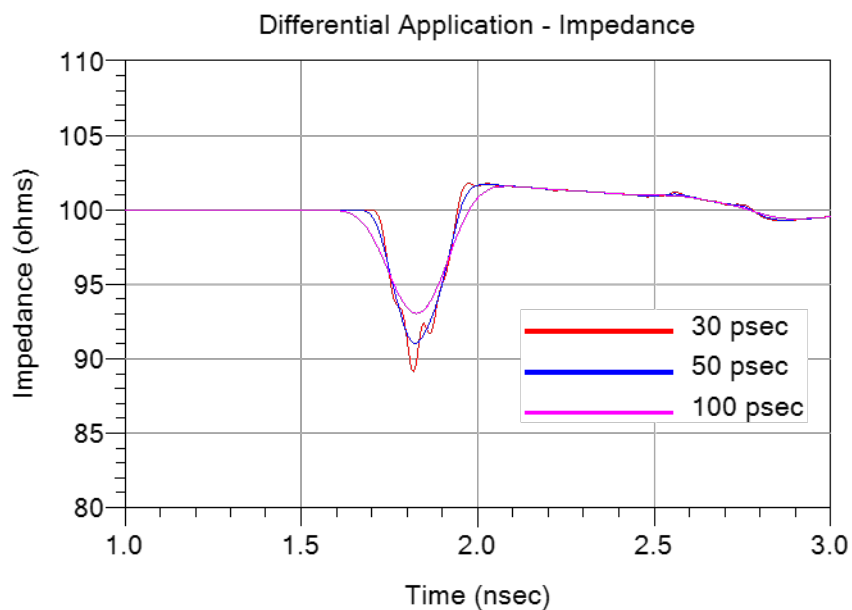


Series: ADM6 / ADF6**Description:** 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

ADM6_C15,C16-ADF6_C15,C16



ADM6_D13,D14-ADF6_D13,D14

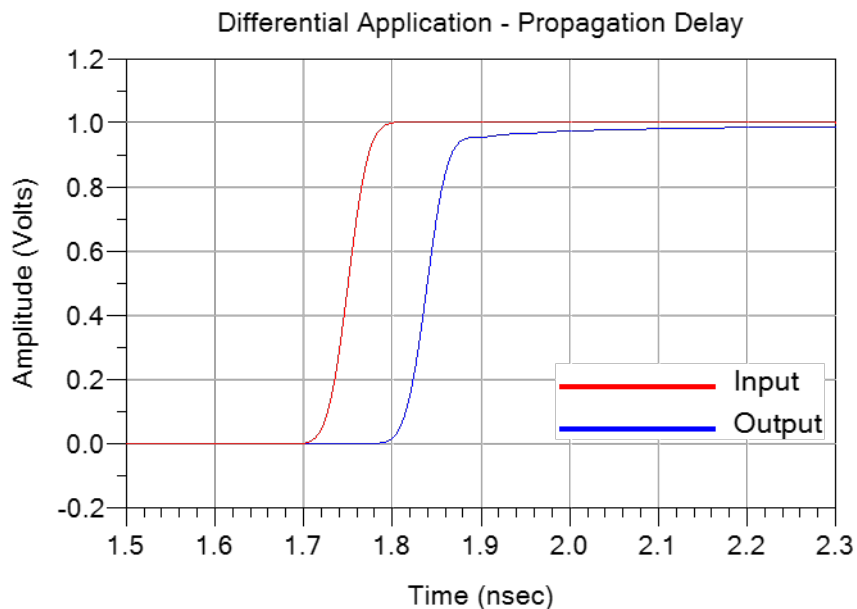


Series: ADM6 / ADF6

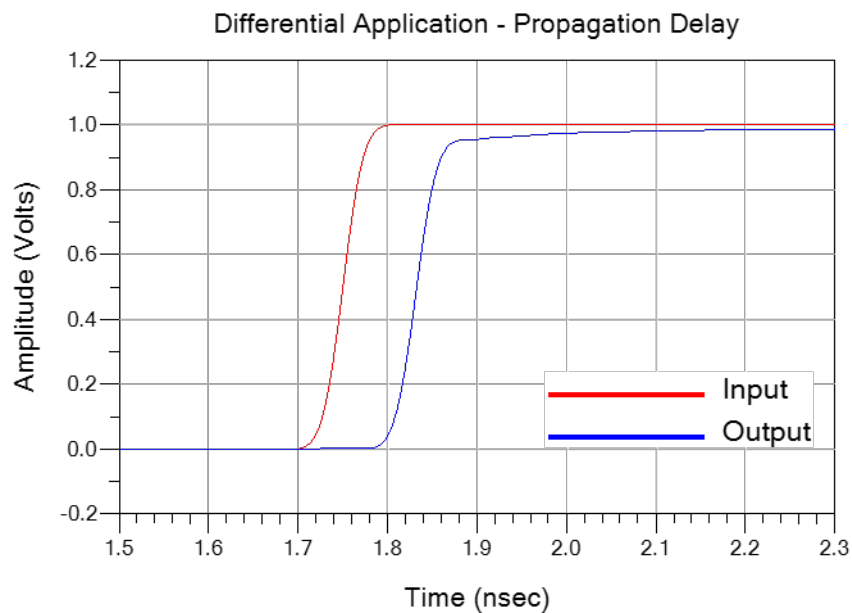
Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – Propagation Delay

ADM6_A15,A16-ADF6_A15,A16



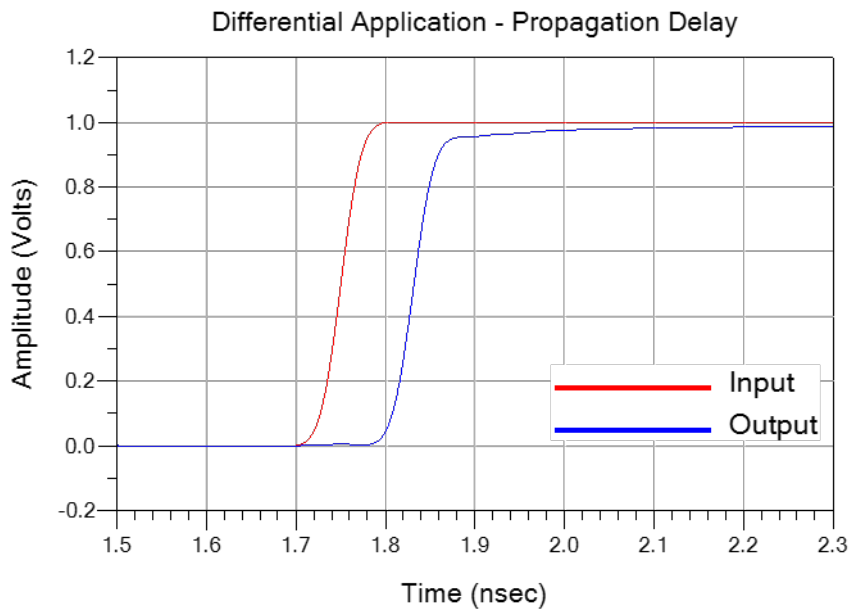
ADM6_B13,B14-ADF6_B13,B14



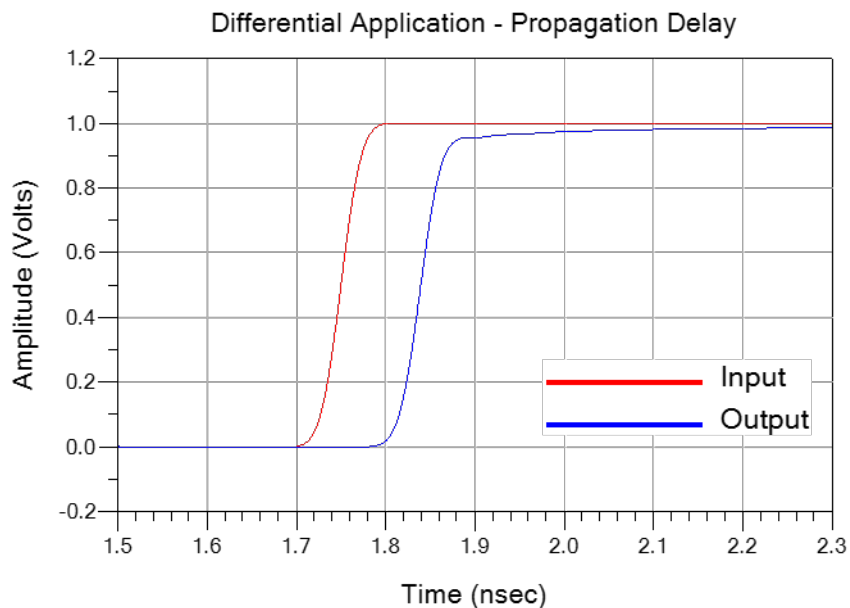
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

ADM6_C15,C16-ADF6_C15,C16



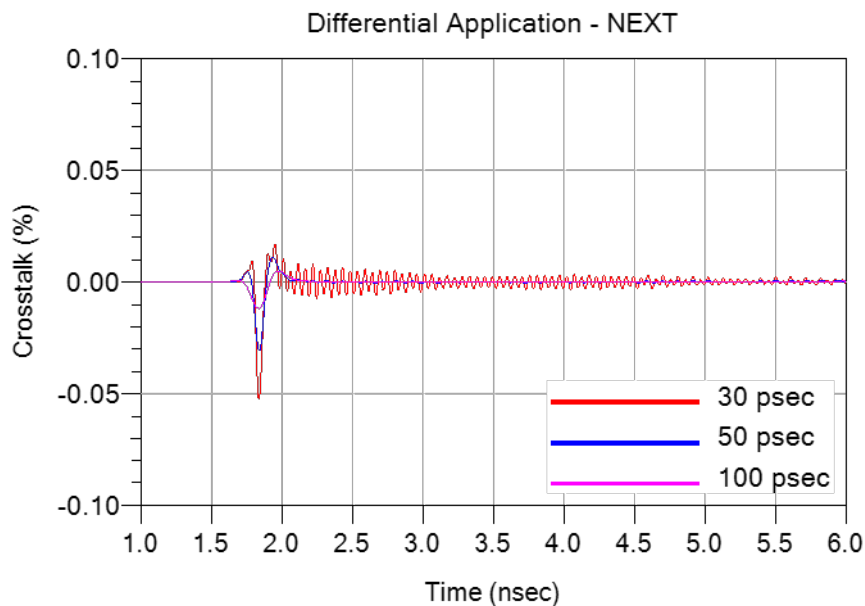
ADM6_D13,D14-ADF6_D13,D14



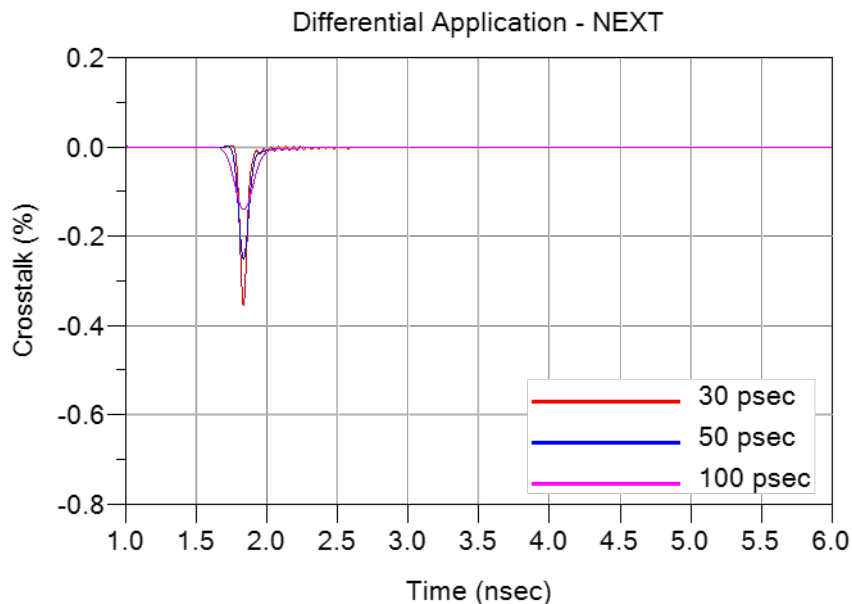
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – NEXT, ADM6_A19A20_ADM6_A15A16



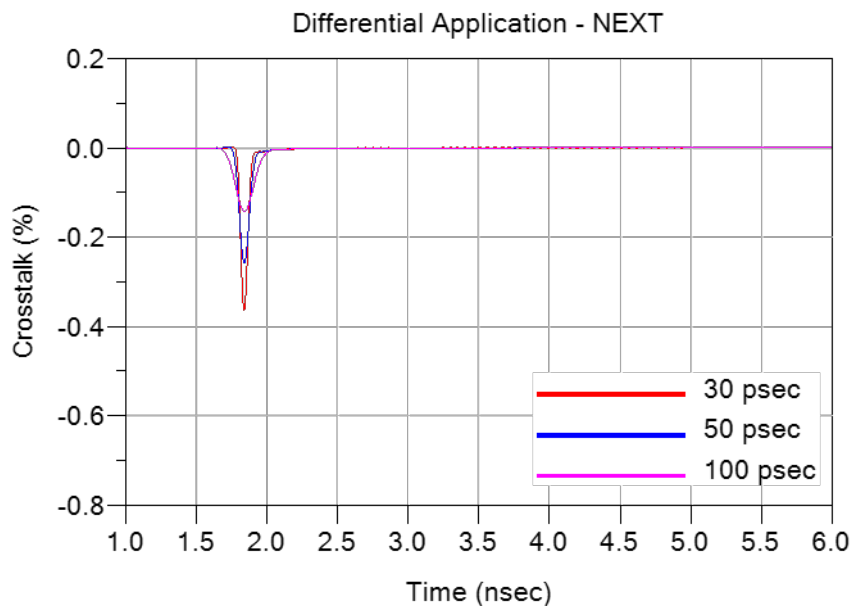
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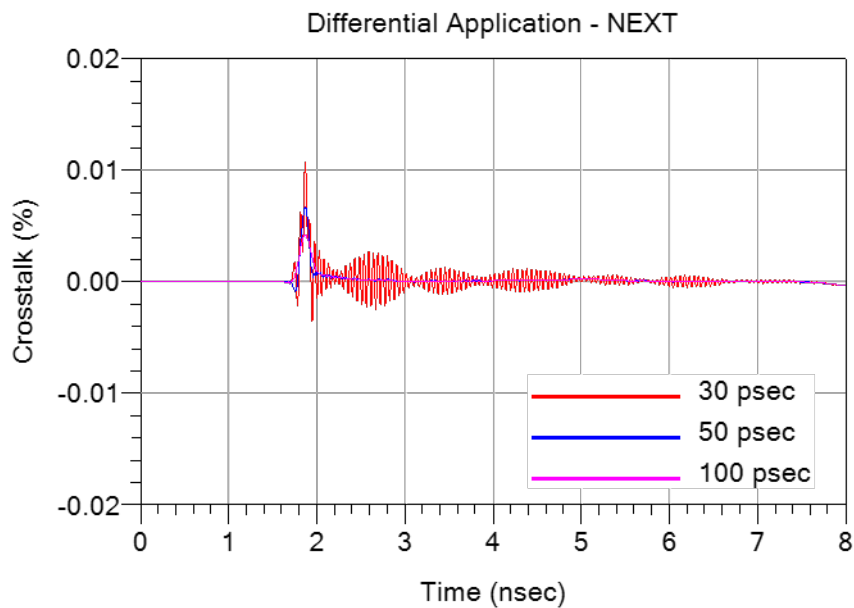
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – NEXT, ADM6_B17B18_ADM6_A15A16



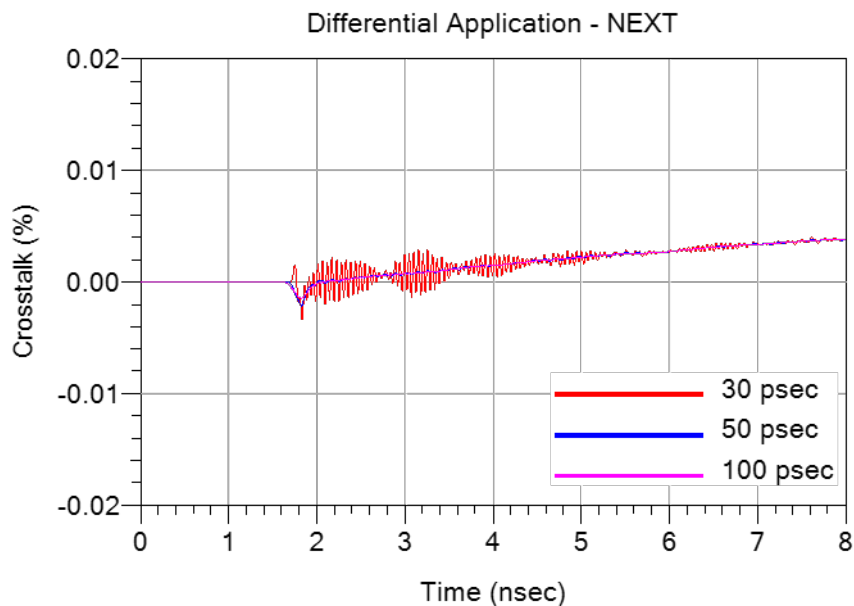
Differential Application – NEXT, ADM6_C15C16_ADM6_A15A16



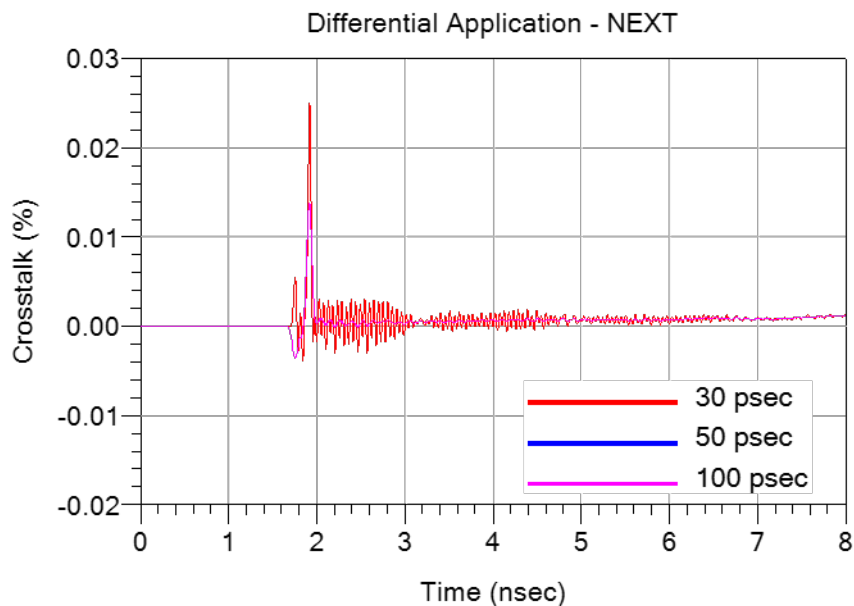
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – NEXT, ADM6_C19C20_ADM6_A15A16



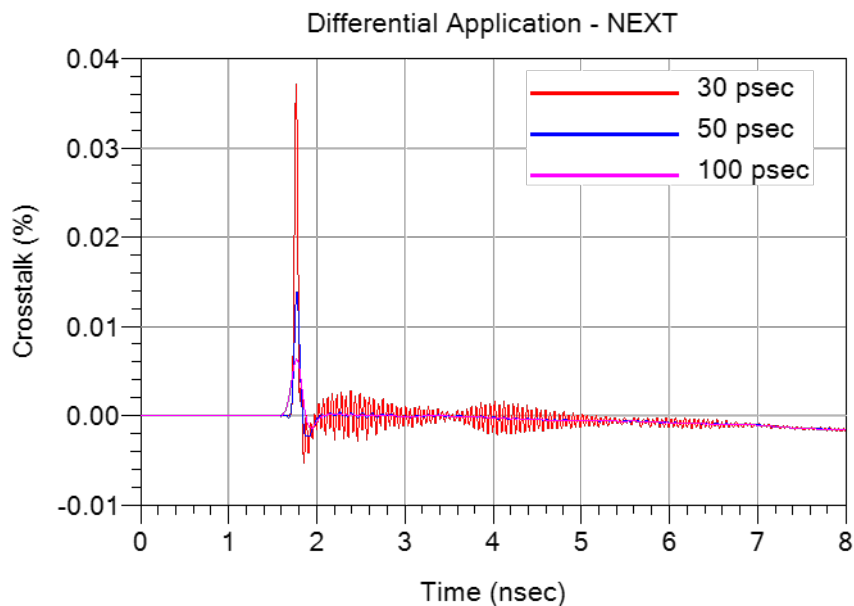
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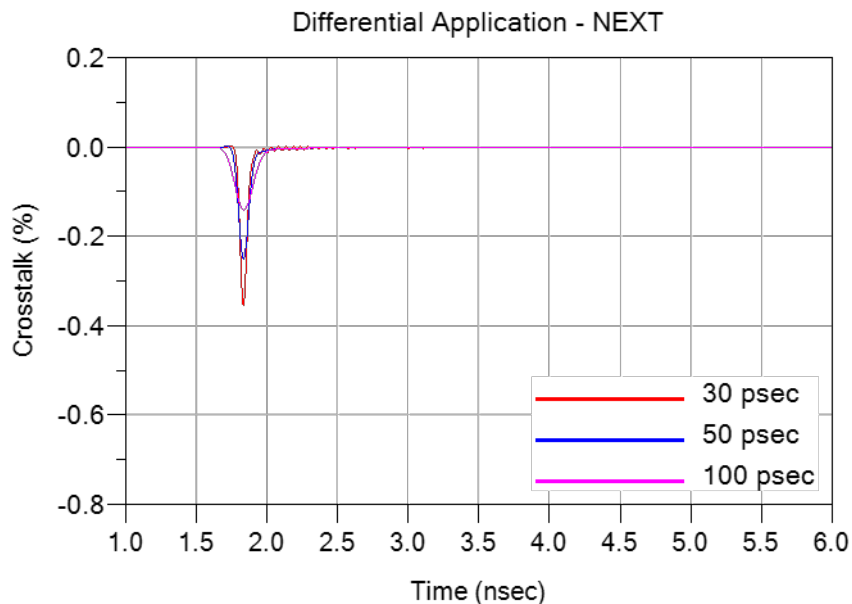
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – NEXT, ADM6_D17D18_ADM6_A15A16



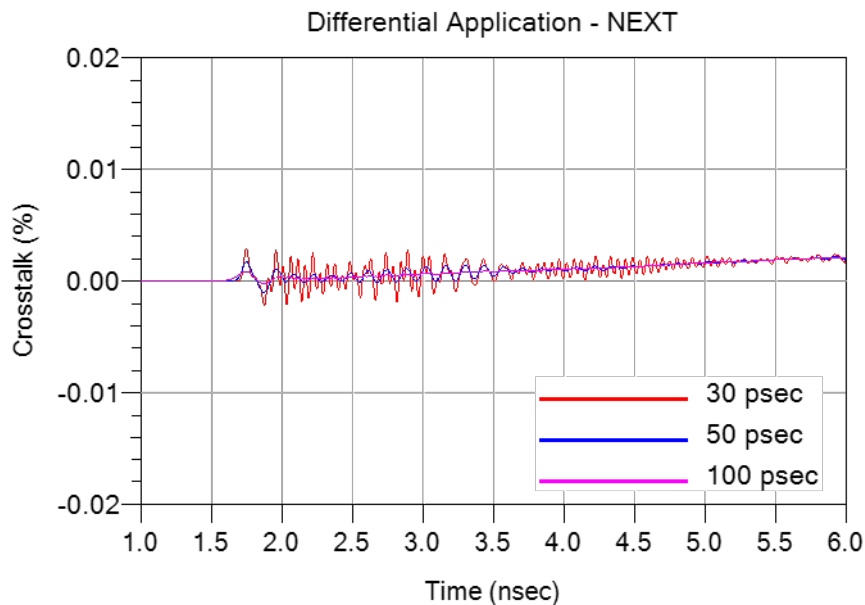
Differential Application – NEXT, ADM6_A15A16_ADM6_B13B14



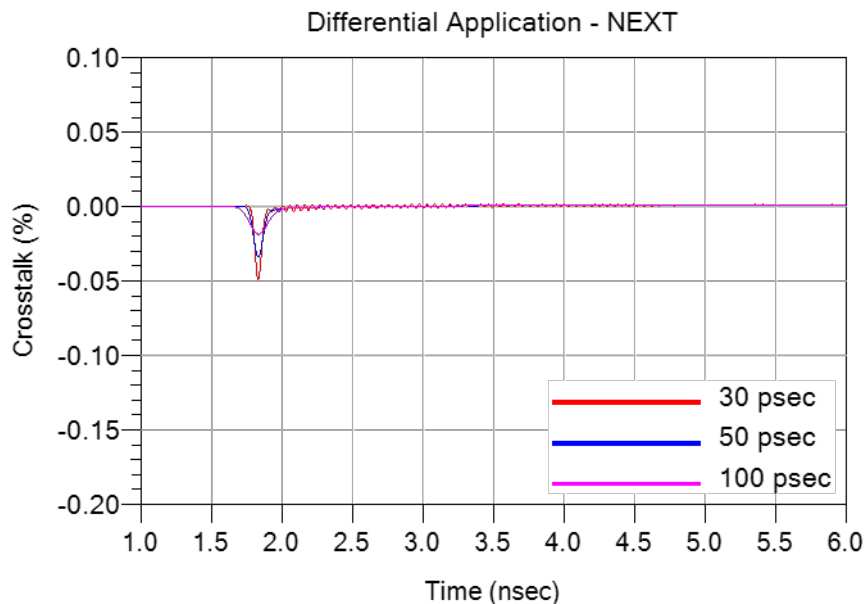
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – NEXT, ADM6_A19A20_ADM6_B13B14



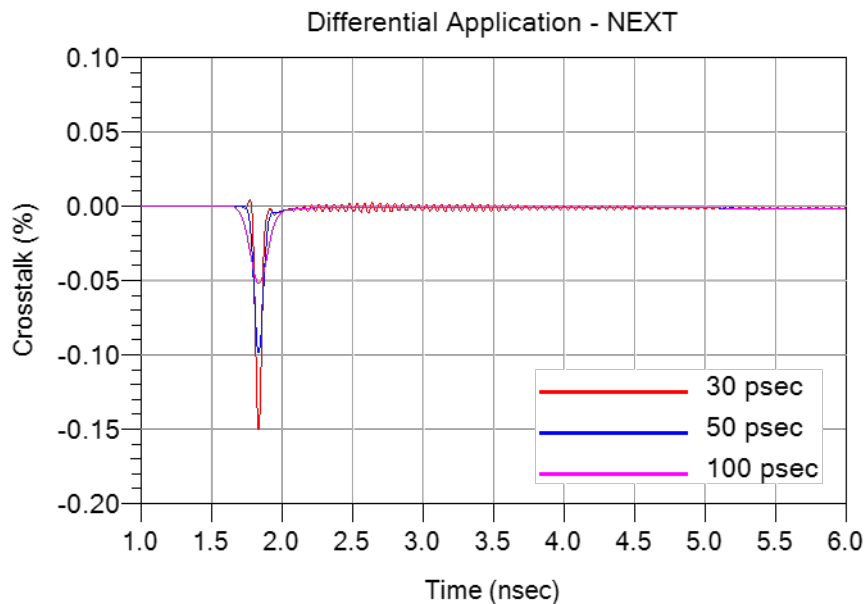
Differential Application – NEXT, ADM6_B17B18_ADM6_B13B14



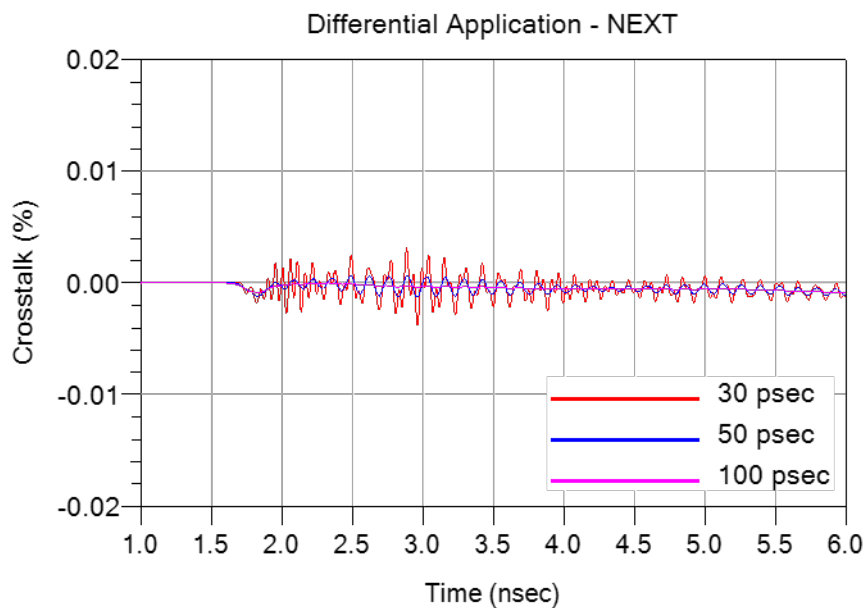
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – NEXT, ADM6_C15C16_ADM6_B13B14



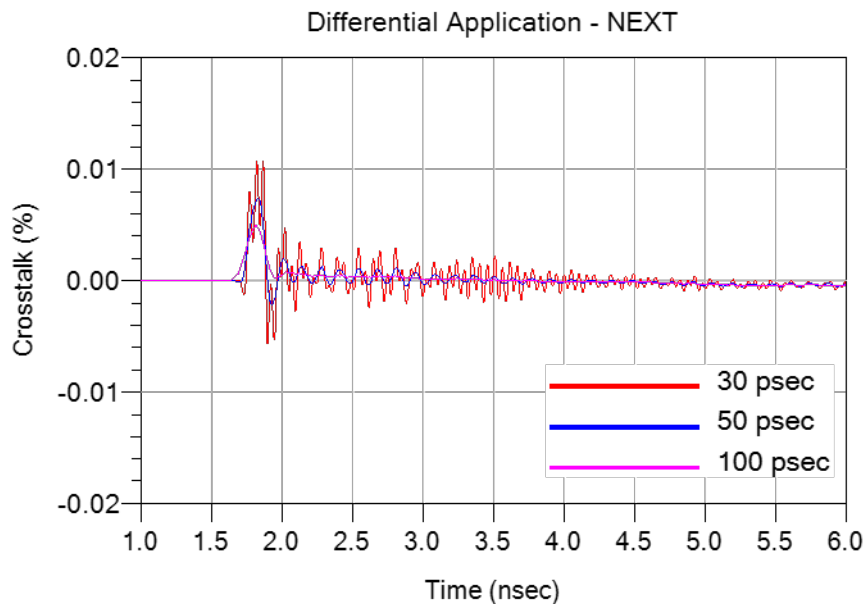
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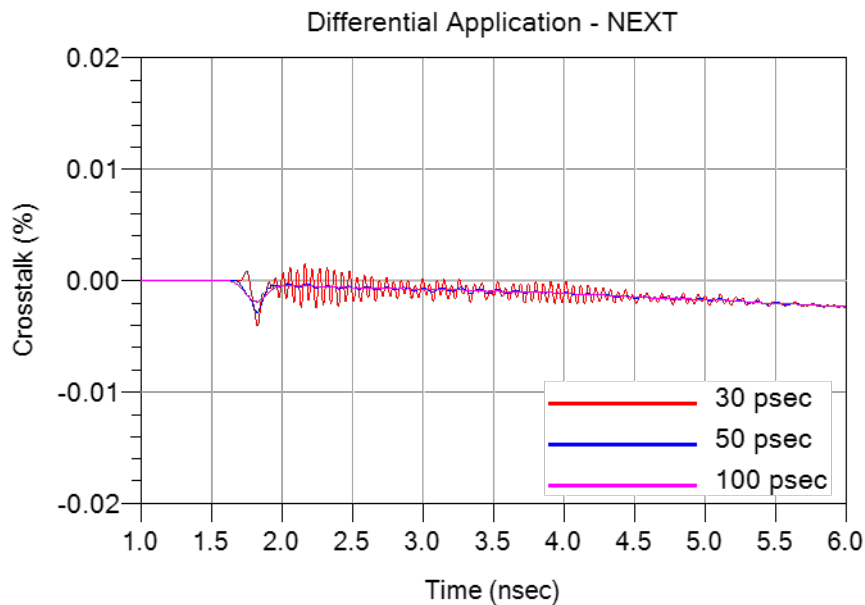
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – NEXT, ADM6_D13D14_ADM6_B13B14



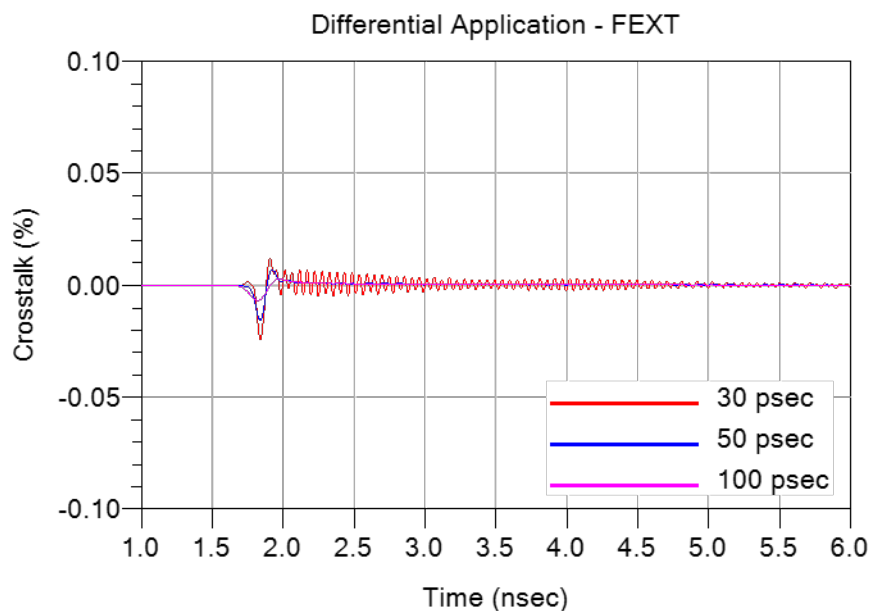
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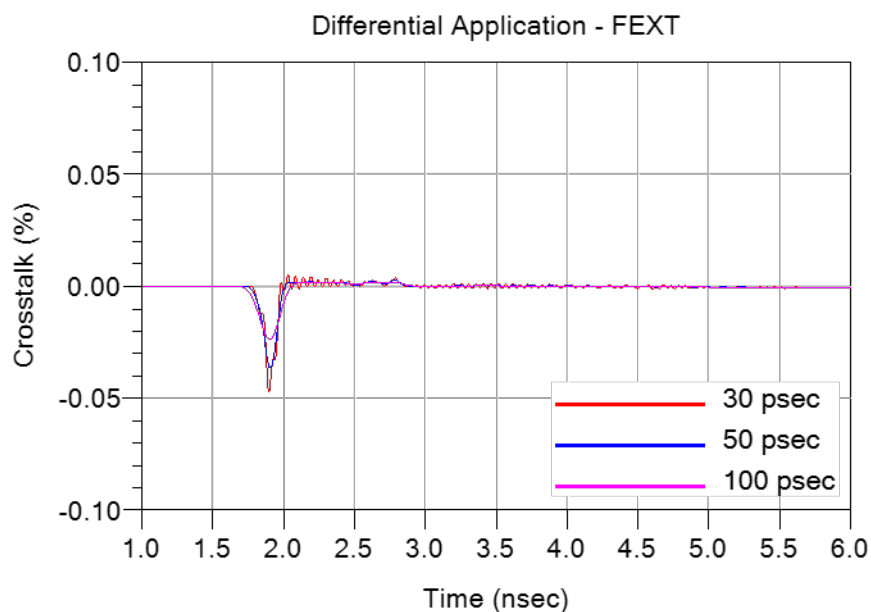
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Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – FEXT, ADF6_A19A20_ADM6_A15A16



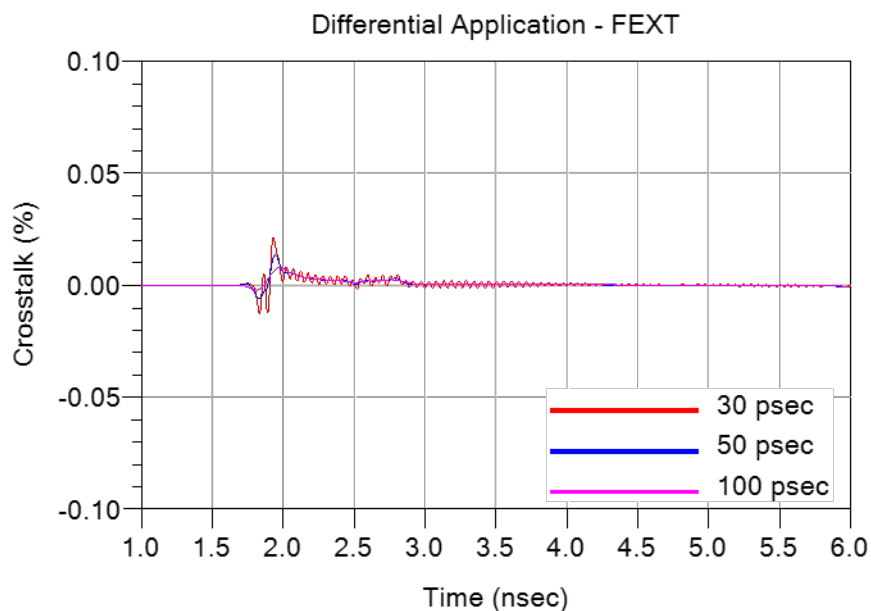
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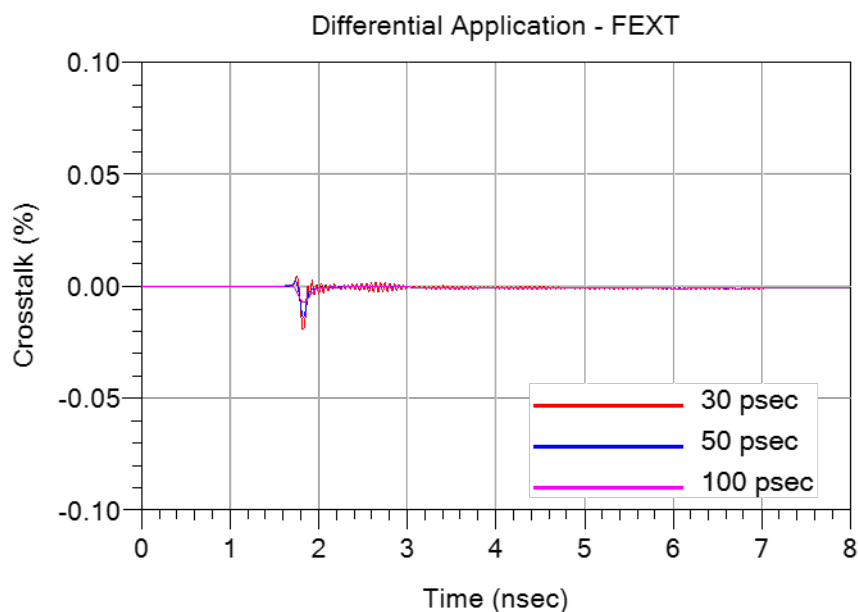
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – FEXT, ADF6_B17B18_ADM6_A15A16



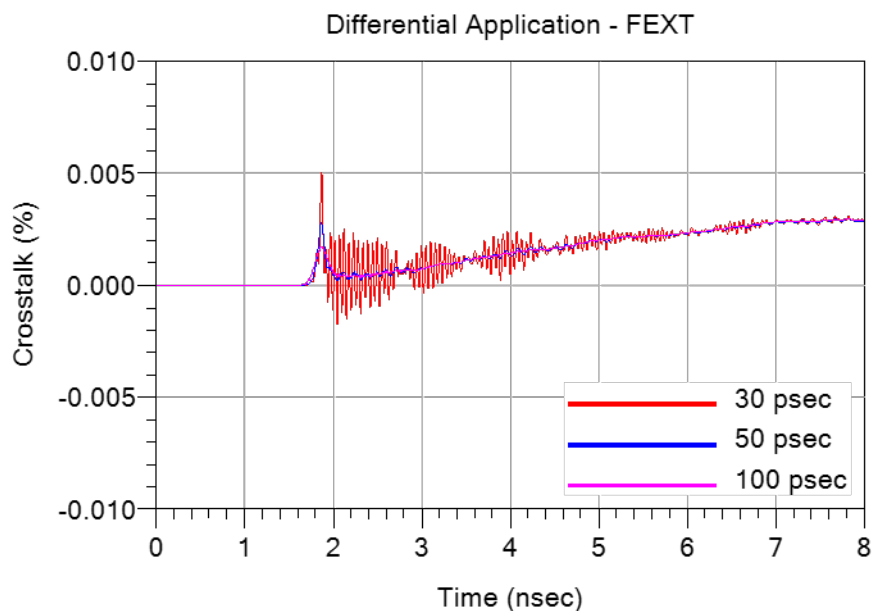
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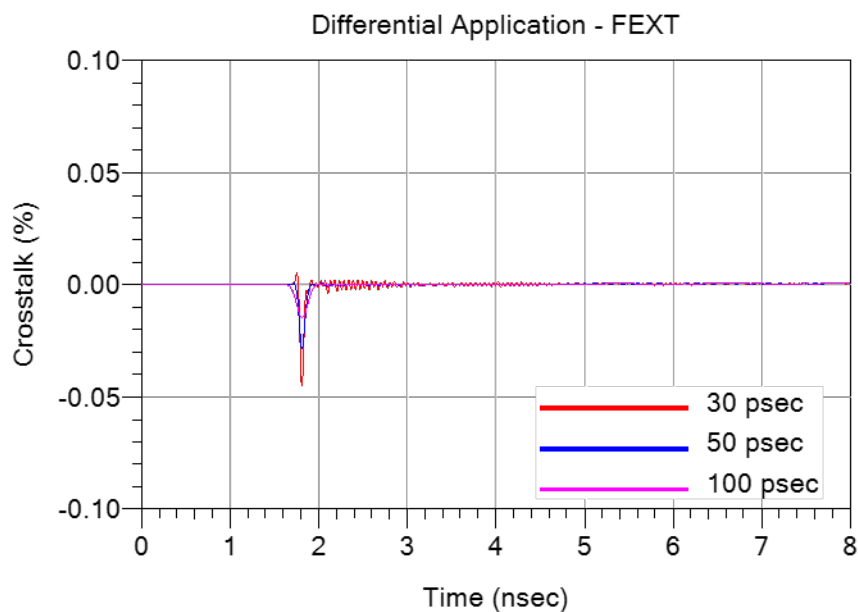
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – FEXT, ADF6_C19C20_ADM6_A15A16



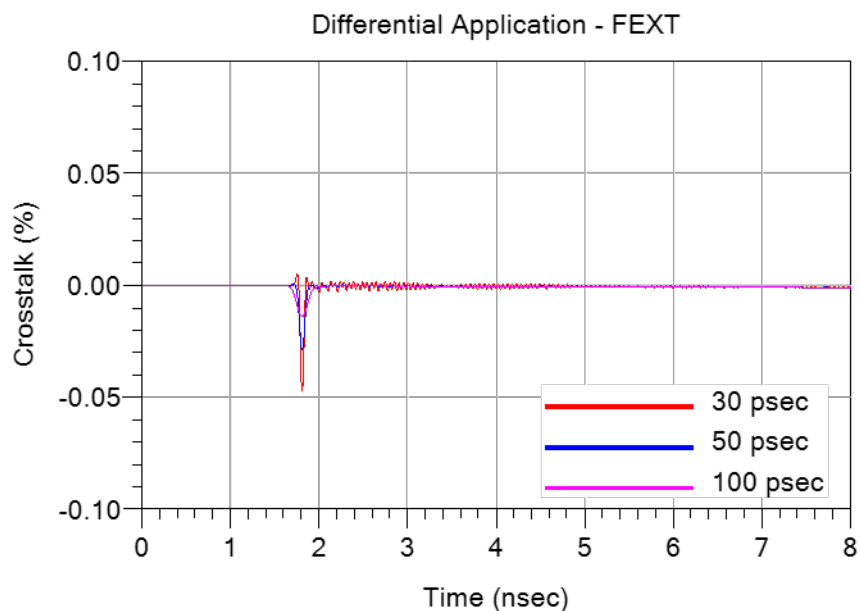
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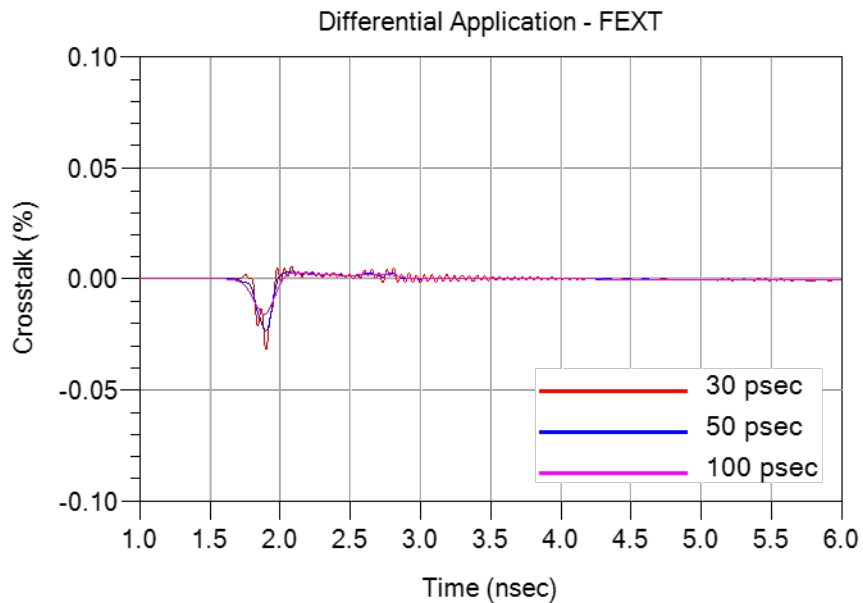
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – FEXT, ADF6_D17D18_ADM6_A15A16



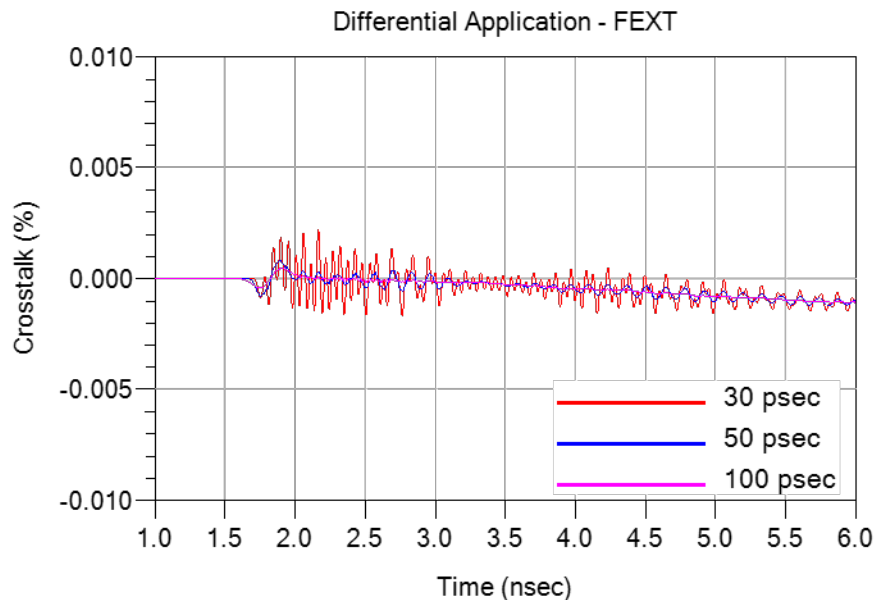
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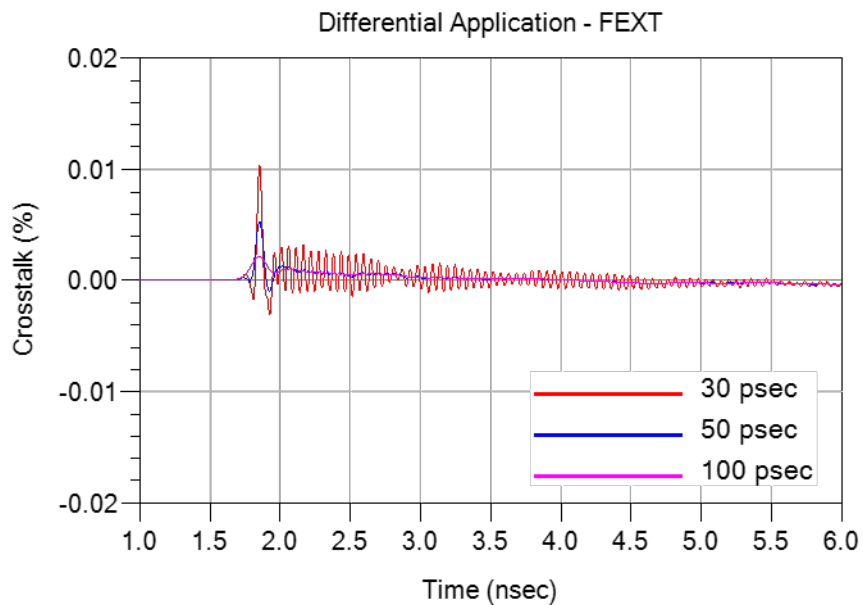
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – FEXT, ADF6_A19A20_ADM6_B13B14



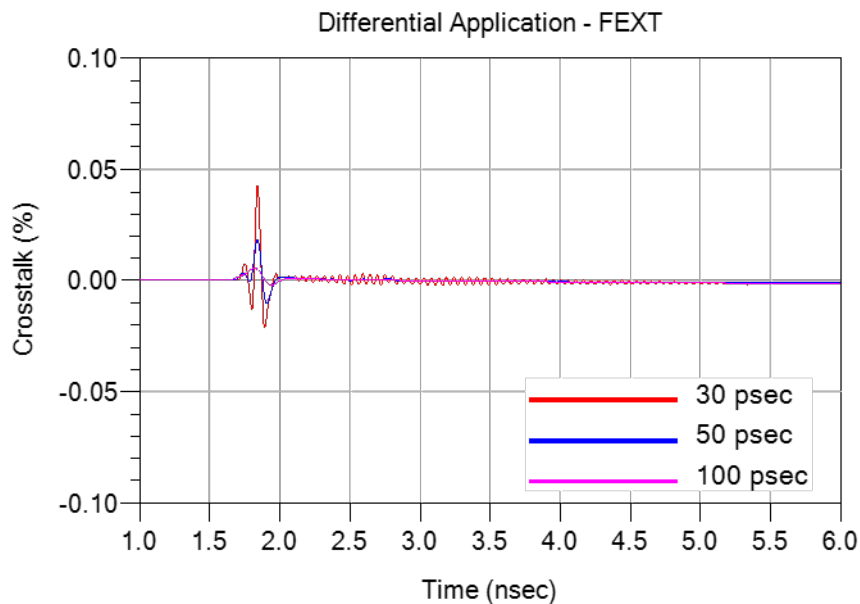
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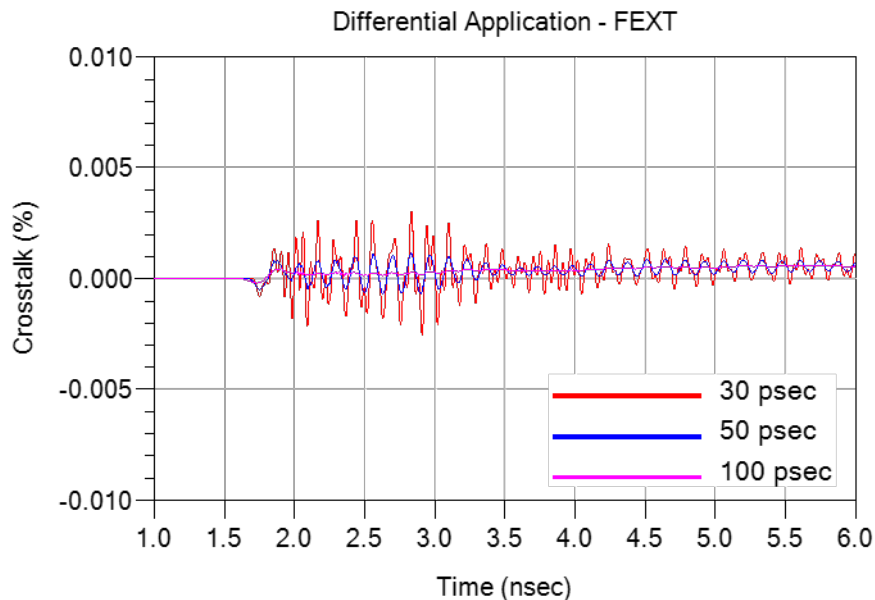
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – FEXT, ADF6_C15C16_ADM6_B13B14



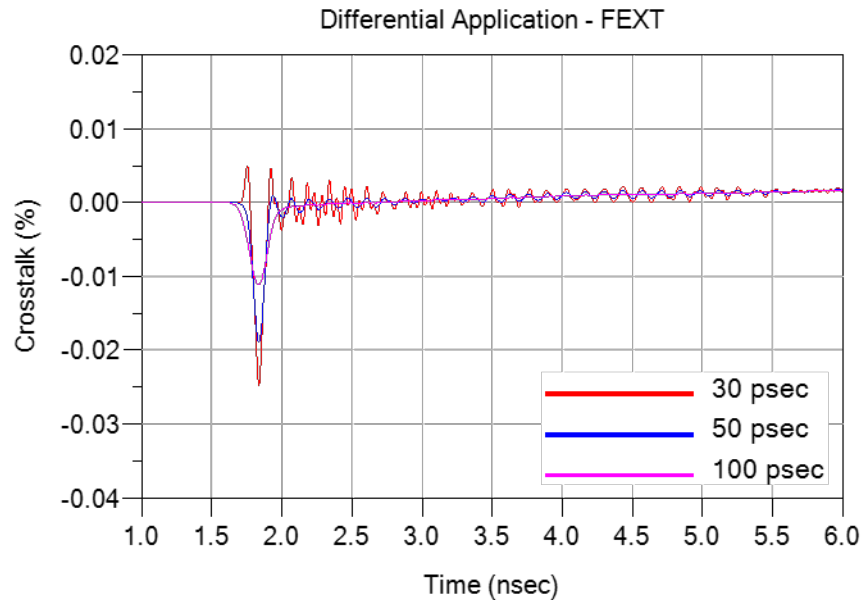
Differential Application – FEXT, ADF6_C19C20_ADM6_B13B14



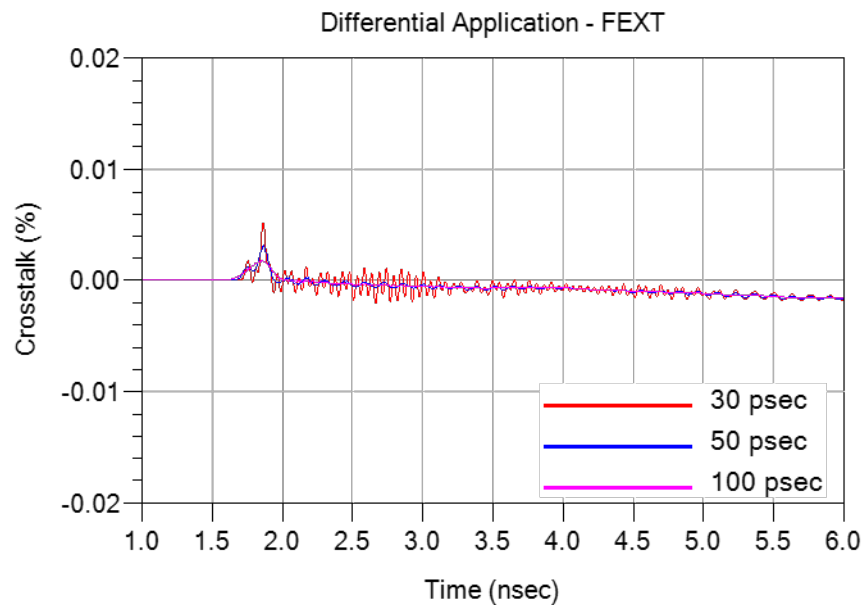
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Differential Application – FEXT, ADF6_D13D14_ADM6_B13B14



Differential Application – FEXT, ADF6_D17D18_ADM6_B13B14



Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Appendix C – Product and Test System Descriptions

Product Description

Product test samples are High-Density ADx6 Series connectors. The part number is ADM6-30-01.5-XXX-4-A and ADF6-30-03.5-XXX-4-A. A photo of the test articles mounted to SI test boards is shown below.

Test System Description

The test fixtures are composed of eight-layer ITERA MT40 material with 50Ω signal trace and pad configurations designed for the electrical characterization of Samtec high speed connector products. A PCB mount 2.4mm connector is used to interface the PNA test cables to the test fixtures. Optimization of the 2.4mm launch was performed using full wave simulation tools to minimize reflections. The test fixtures and calibration kit are specific to the ADx6 series connector set and identified by part number PCB-ADx6-109153-SIG-01.

PCB-ADx6-109153-SIG-01 Test Fixtures

Shown below is a photograph of the one of the three test board sets.

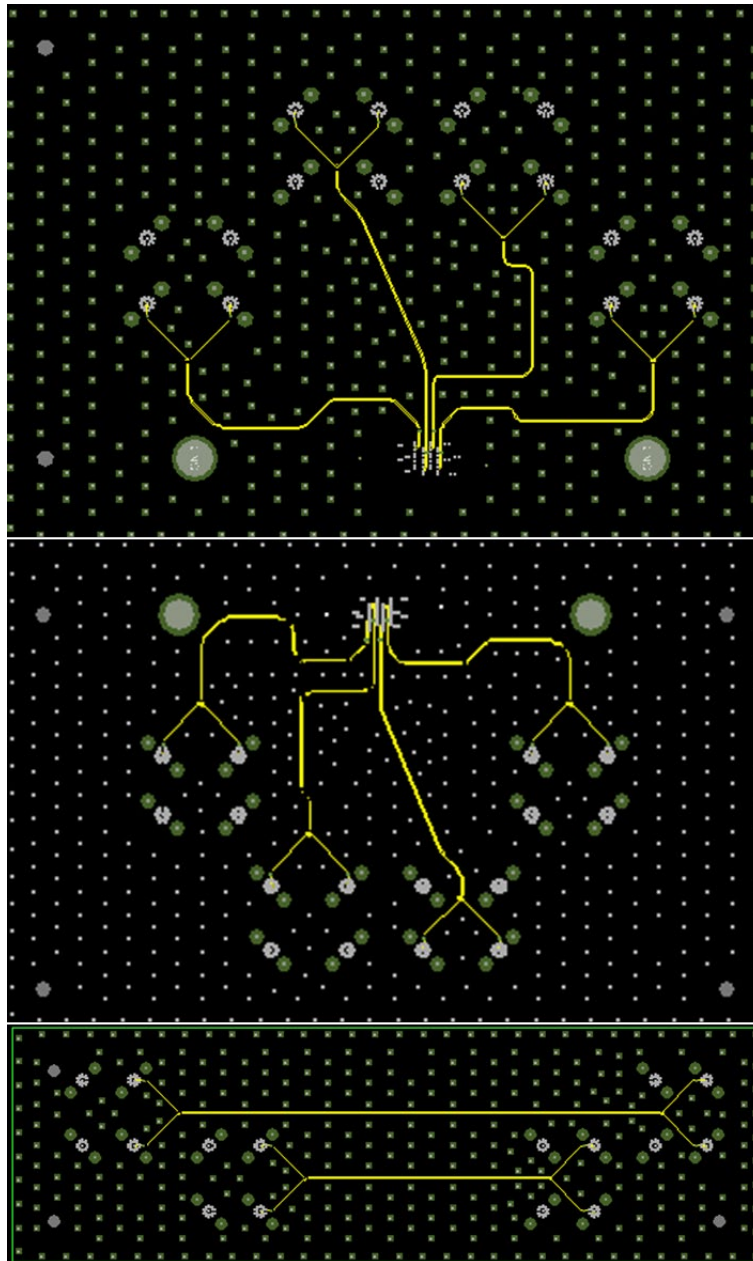


Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

PCB Fixtures

The test fixtures used are as follows:



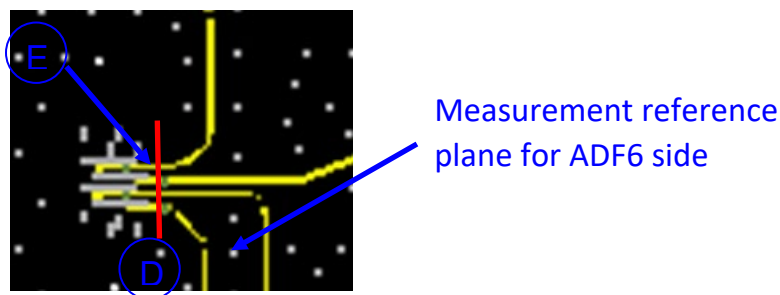
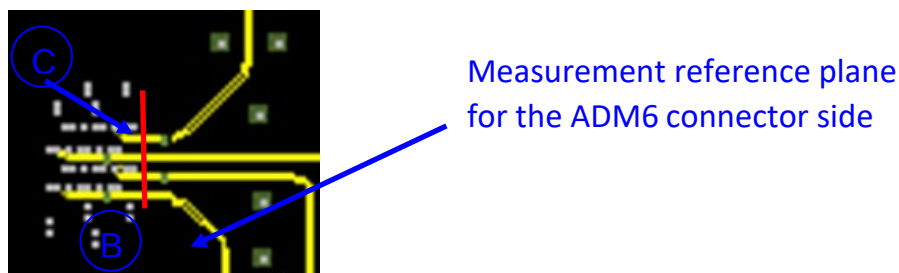
Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

All traces on the test boards are length matched to 68.086 mm measured from the edge of the pad to the 2.4mm connector. The AFR calibration effectively removes 63.935 mm of test board trace effects. This means that 4.151 mm of test board trace length effects are included in the both sides of test boards in the measurement. The S-Parameter measurement includes:

- A- The ADx6 Series connector set
- B- Test board vias, pads (footprint effects) for the ADM6 connector side.
- C- 4.151 mm of 0.12 mm wide microstrip trace.
- D- Test board vias, pads (footprint effects) for the ADF6 side.
- E- 4.151 mm of 0.12 mm wide microstrip trace.

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



Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Appendix D – Test and Measurement Setup

For frequency domain measurements, the test instrument is the Keysight N5225B PNA-L network analyzer. Frequency domain data are obtained directly from the instrument and figures are generated by Keysight ADS. The network analyzer is configured as follows:

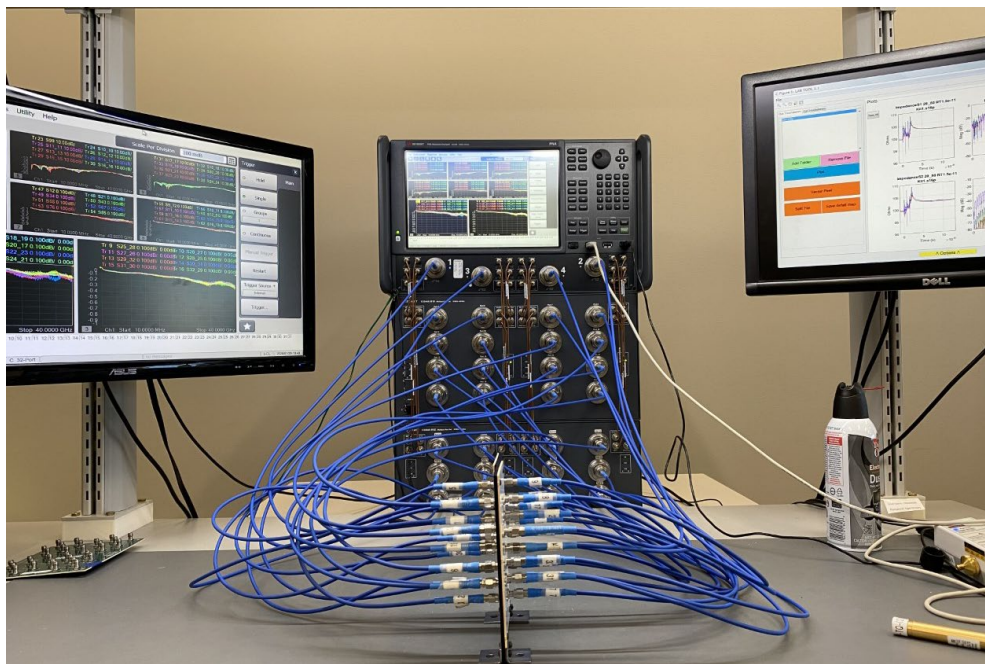
Start Frequency – 10 MHz

Stop Frequency – 40 GHz

Number of points – 4000

IFBW – 1 KHz

N5225B Measurement Setup



Test Instruments

<u>QTY</u>	<u>Description</u>
1	Keysight N5225B PNA-L Network Analyzer (10 MHz to 40 GHz)
1	Keysight N4694-60003 ECAL Module (10 MHz to 40 GHz)

Test Cables & Adapters

<u>QTY</u>	<u>Description</u>
4	Junkosha 2.4mm male to female cables

Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm 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 through calibration standards, the SI test boards, and the selection of the PCB vendor.

A coaxial SOLT calibration is performed using a N4694-60003 ECAL module. Then DUT measurements are performed under SOLT calibration. The measurements include the effect of test fixture. The measurements of the 2X THRU line standards are required to remove the test fixture effect.

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 Keysight ADS 2017. 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.

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

Series: ADM6 / ADF6

Description: 0.635 mm AcceleRate® HD High-Density Interconnect, 5mm Stack Height

Appendix F – Glossary of Terms

ADS – Advanced Design Systems

FD – Frequency domain

FEXT – Far-End Crosstalk

GSG – Ground–Signal–Ground; geometric configuration

GSSG - Ground–Signal–Signal–Ground; geometric configuration

NEXT – Near-End Crosstalk

PCB – Printed Circuit Board

SE – Single-Ended

SI – Signal Integrity

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

Z – Impedance (expressed in ohms)