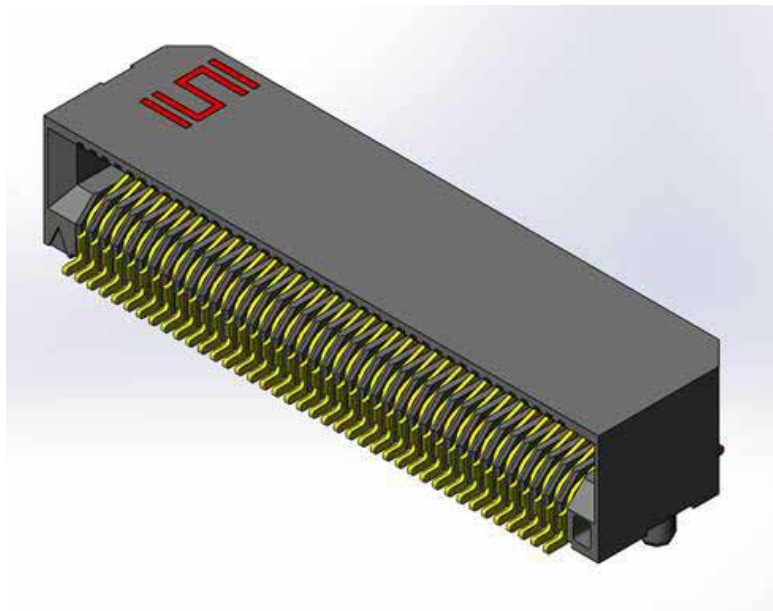




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## High Speed Characterization Report

MEC6-1XX-02-X-D-RA1



**Description:**  
**Mini Edge-Card Socket, Right Angle, Surface Mount,**  
**0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card**

**Series:** MEC6-RA**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

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**Series:** MEC6-RA

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## Connector Overview

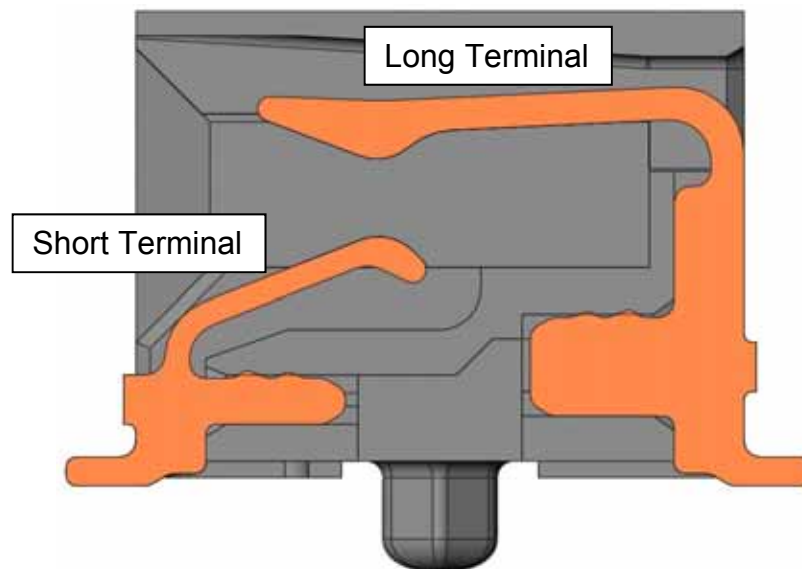
The MEC6-RA series is a double row, mini edge-card socket connector on a 0.635mm (0.0250") pitch and available up to 100 pins. The data in this report is applicable only to MEC6 right angle socket connector mated to a 1.6mm thick card.

MEC6-RA possesses two terminal types, with each terminal type having different performance. The signal integrity performance of these two terminal types is documented in this report. The terminology used in this report to define which connector terminal is as follows:

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

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

This is illustrated in the following figure.



**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Connector System Speed Rating

MEC6-RA Mini Edge-Card Series, 0.635mm Pitch, mates to 1.6mm thick card

<u>Case</u>	<u>Signaling</u>	<u>Speed Rating</u>
1 (Short Row)	Single-Ended:	<b>10 GHz/ 20 Gbps</b>
	Differential:	<b>11 GHz/ 22 Gbps</b>
2 (Long Row)	Single-Ended:	<b>7.5 GHz/ 15 Gbps</b>
	Differential:	<b>7.5 GHz/ 15 Gbps</b>

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.

Series: MEC6-RA

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## Frequency Domain Data Summary

Table 1 - Single-Ended Connector System Performance					
Case 1 = Short Row; Case 2 = Long Row					
Case	Test Parameter	Configuration	Driver	Receiver	
1	Insertion Loss	GSG	Edge_Card_15	MEC6-RA_15	3dB@ 10 GHz
	Return Loss	GSG	Edge_Card_15	Edge_Card_15	>10dB to 9.5 GHz
		GAQG	Edge_Card_57	Edge_Card_59	<-20dB to 1.2 GHz
	Near-End Crosstalk	GAGQG	Edge_Card_15	Edge_Card_19	<-20dB to 20 GHz
		Xrow, GAG to GQG	Edge_Card_57	Edge_Card_58	<-20dB to 20 GHz
		GAQG	Edge_Card_57	MEC6-RA_59	<-20dB to 6.4 GHz
	Far-End Crosstalk	GAGQG	Edge_Card_15	MEC6-RA_19	<-20dB to 7.3 GHz
Xrow, GAG to GQG		Edge_Card_58	MEC6-RA_57	<-20dB to 20 GHz	
GSG		Edge_Card_16	MEC6-RA_16	3dB@ 7.4 GHz	
2	Return Loss	GSG	Edge_Card_16	Edge_Card_16	>10dB to 5.4 GHz
	Near-End Crosstalk	GAQG	Edge_Card_58	Edge_Card_60	<-20dB to 0.6 GHz
		GAGQG	Edge_Card_16	Edge_Card_20	<-20dB to 20 GHz
	Far-End Crosstalk	GAQG	Edge_Card_58	MEC6-RA_60	<-20dB to 9.2 GHz
		GAGQG	Edge_Card_16	MEC6-RA_20	<-20dB to 11.4 GHz

Table 2 - Differential Connector System Performance					
Case 1 = Short Row; Case 2 = Long Row					
Case	Test Parameter	Configuration	Driver	Receiver	
1	Insertion Loss	GSSG	Edge_Card_39,41	MEC6-RA_39,41	3dB@ 10.6 GHz
	Return Loss	GSSG	Edge_Card_39,41	Edge_Card_39,41	>10dB to 1.9 GHz
		GAAQQG	Edge_Card_39,41	Edge_Card_43,45	<-20dB to 13.1 GHz
	Near-End Crosstalk	GAAGQQG	Edge_Card_39,41	Edge_Card_45,47	<-20dB to 13.2 GHz
		Xrow, GAAG to GQQG	Edge_Card_57,59	Edge_Card_58,60	<-20dB to 20 GHz
		GAAQQG	Edge_Card_39,41	MEC6-RA_43,45	<-20dB to 20 GHz
	Far-End Crosstalk	GAAGQQG	Edge_Card_39,41	MEC6-RA_45,47	<-20dB to 20 GHz
Xrow, GAAG to GQQG		Edge_Card_57,59	MEC6-RA_58,60	<-20dB to 20 GHz	
GSSG		Edge_Card_40,42	MEC6-RA_40,42	3dB@ 7.5 GHz	
2	Return Loss	GSSG	Edge_Card_40,42	Edge_Card_40,42	>10dB to 1.5 GHz
	Near-End Crosstalk	GAAQQG	Edge_Card_40,42	Edge_Card_44,46	<-20dB to 17 GHz
		GAAGQQG	Edge_Card_40,42	Edge_Card_46,48	<-20dB to 20 GHz
	Far-End Crosstalk	GAAQQG	Edge_Card_40,42	MEC6-RA_44,46	<-20dB to 19.4 GHz
		GAAGQQG	Edge_Card_40,42	MEC6-RA_46,48	<-20dB to 20 GHz

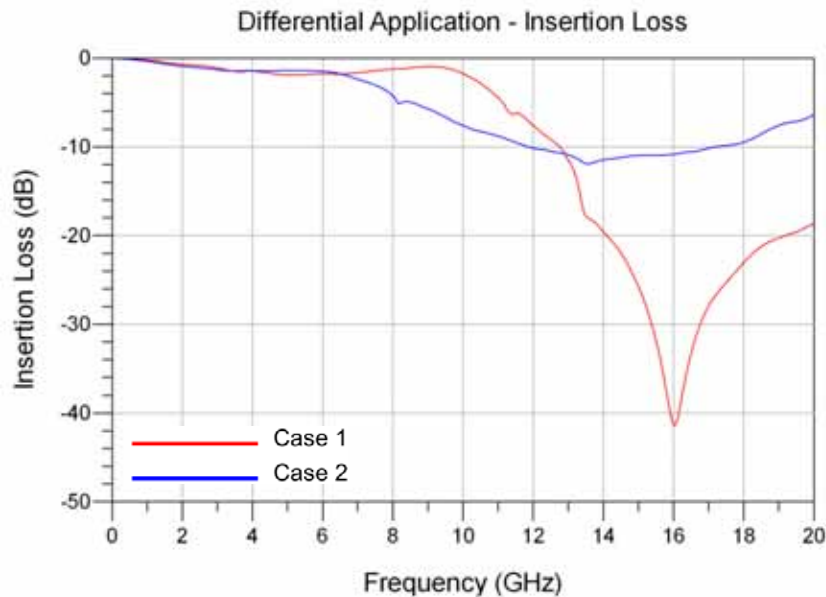
**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
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## Bandwidth Chart – Single-Ended & Differential Insertion Loss

Case 1 = Short Row; Case 2 = Long Row

MEC6-RA Connector Series



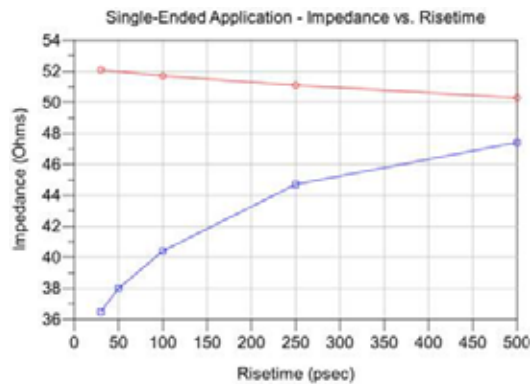
**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
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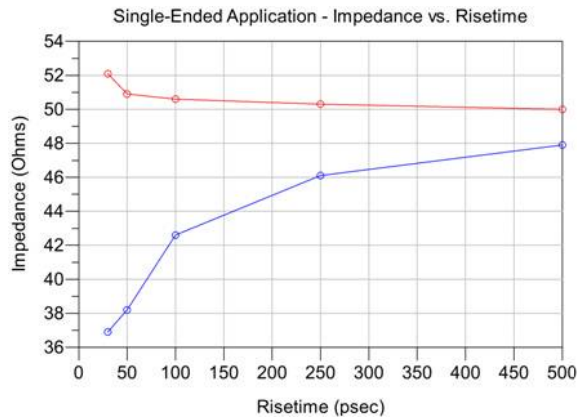
## Time Domain Data Summary

Table 3 - Single-Ended Impedance ( $\Omega$ )						
Case 1 = Short Row; Case 2 = Long Row						
Case	Signal Rise-time	30ps	50ps	100ps	250ps	500ps
1	Maximum Impedance	52.1	52.0	51.7	51.1	50.3
	Minimum Impedance	36.5	38.0	40.4	44.7	47.4
2	Maximum Impedance	52.1	50.9	50.6	50.3	50.0
	Minimum Impedance	36.9	38.2	42.6	46.1	47.9

### Single-Ended Impedance - Case 1, Short Row



### Single-Ended Impedance - Case 2, Long Row

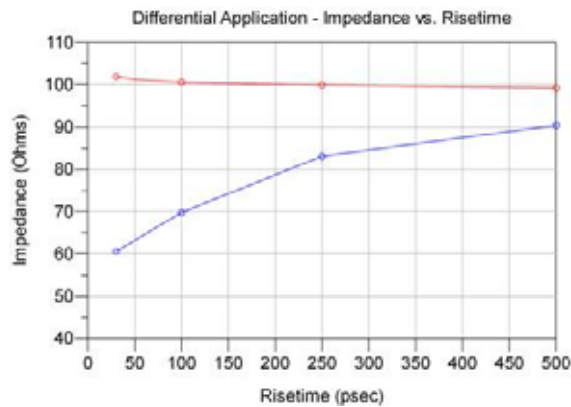


**Series:** MEC6-RA

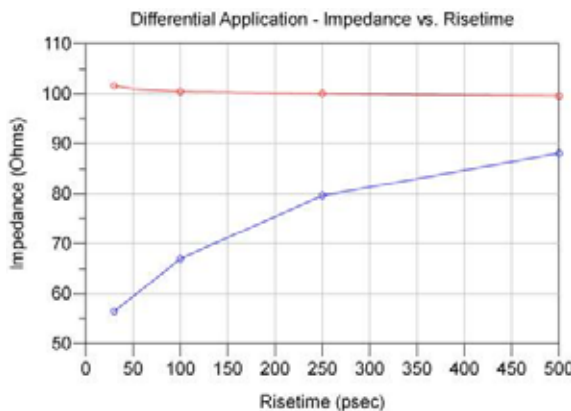
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
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<b>Table 4 - Differential Impedance (<math>\Omega</math>)</b>						
Case 1 = Short Row; Case 2 = Long Row						
Case	Signal Rise-time	30ps	50ps	100ps	250ps	500ps
1	Maximum Impedance	101.9	101.2	100.5	99.9	99.2
	Minimum Impedance	60.6	63.2	69.8	83.1	90.4
2	Maximum Impedance	101.6	100.9	100.4	100.0	99.5
	Minimum Impedance	56.5	59.4	67.0	79.6	88.1

### Differential Impedance - Case 1, Short Row



### Differential Impedance - Case 2, Long Row





Series: MEC6-RA

Description: Mini Edge-Card Socket, Right Angle, Surface Mount,  
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**Table 5 - Single-Ended Crosstalk (%)**  
Case 1 = Short Row; Case 2 = Long Row

Case	Input(tr)	Configuration	Driver	Receiver	30ps	50ps	100ps	250ps	500ps
1	NEXT	GAQG	Edge_Card_57	Edge_Card_59	17.08	15.04	12.16	5.52	2.89
		GAGQG	Edge_Card_15	Edge_Card_19	2.89	2.49	1.67	0.74	0.39
		Xrow	Edge_Card_57	Edge_Card_58	1.53	1.42	0.95	0.42	0.18
	FEXT	GAQG	Edge_Card_57	MEC6-RA_59	4.77	3.78	2.38	1.06	0.62
		GAGQG	Edge_Card_15	MEC6-RA_19	2.75	2.19	1.18	0.45	0.26
		Xrow	Edge_Card_58	MEC6-RA_57	0.91	0.67	0.33	0.10	<0.1
2	NEXT	GAQG	Edge_Card_58	Edge_Card_60	20.69	19.69	17.64	9.84	5.43
		GAGQG	Edge_Card_16	Edge_Card_20	2.55	2.38	1.92	1.00	0.58
	FEXT	GAQG	Edge_Card_58	MEC6-RA_60	2.75	2.19	1.18	0.45	0.26
		GAGQG	Edge_Card_16	MEC6-RA_20	2.67	1.92	1.00	0.37	0.10

**Table 6 - Differential Crosstalk (%)**  
Case 1 = Short Row; Case 2 = Long Row

Case	Input(tr)	Configuration	Driver	Receiver	30ps	50ps	100ps	250ps	500ps
1	NEXT	GAAQQG	Edge_Card_39,41	Edge_Card_43,45	5.21	4.22	3.16	1.77	0.88
		GAAGQQG	Edge_Card_39,41	Edge_Card_45,47	0.39	0.26	0.16	<0.1	<0.1
		Xrow	Edge_Card_57,59	Edge_Card_58,60	0.23	0.19	0.13	<0.1	<0.1
	FEXT	GAAQQG	Edge_Card_39,41	MEC6-RA_43,45	2.53	2.27	1.74	0.94	0.51
		GAAGQQG	Edge_Card_39,41	MEC6-RA_45,47	0.36	0.26	0.10	<0.1	<0.1
		Xrow	Edge_Card_57,59	MEC6-RA_58,60	0.24	0.17	<0.1	<0.1	<0.1
2	NEXT	GAAQQG	Edge_Card_40,42	Edge_Card_44,46	6.23	5.81	5.10	3.13	1.78
		GAAGQQG	Edge_Card_40,42	Edge_Card_46,48	0.50	0.41	0.28	0.15	<0.1
	FEXT	GAAQQG	Edge_Card_40,42	MEC6-RA_44,46	2.14	1.86	1.68	1.02	0.58
		GAAGQQG	Edge_Card_40,42	MEC6-RA_46,48	0.43	0.29	0.18	<0.1	<0.1

**Table 7 - Propagation Delay (Mated Connector)**

Case 1 = Short Row; Case 2 = Long Row

Case 1	Single-Ended	40 ps
	Differential	32 ps
Case 2	Single-Ended	73 ps
	Differential	66 ps

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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 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. However, dedicating pins to ground reduces signal density of a connector. Therefore, care must be taken when choosing signal/ground ratios in cost or density-sensitive applications.

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For this connector, the following configurations were evaluated:

Single-Ended Impedance:

- GSG (Ground-Signal-Ground)

Single-Ended Crosstalk:

- Electrical "worst case": GAQG (Ground-Active-Quiet-Ground)
- Electrical "best case": GAGQG (Ground-Active-Ground-Quiet-Ground)
- Across row: "xrow case": GAG to GQG (from one row of terminals to the other row)

Differential Impedance:

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

Differential Crosstalk:

- Electrical "worst case": GAAQQG (Ground-Active-Active-Quiet-Quiet-Ground)
- Electrical "best case": GAAGQQG (Ground-Active-Active-Ground-Quiet-Quiet-Ground)
- Across row: "xrow case": GAAG to GQQG (from one row of terminals to the other row)

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

Other configurations can be evaluated upon request. Please contact [sig@samtec.com](mailto: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.

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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](mailto: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.

Impedance mismatch versus length is measured by DSA8200 Digital Serial Analyzer. Board related effects, such as pad-to-ground capacitance and trace loss, are included in the data presented in this report. The impedance data is provided in [Appendix E](#) of this report.

The measured S-Parameters from the network analyzer are post-processed using Agilent Advanced Design System to obtain the time domain response for signal propagation time and crosstalk. The 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](mailto: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 MEC6-RA connector and the edge-card side each. 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

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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](mailto: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](mailto: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](mailto:sig@samtec.com).

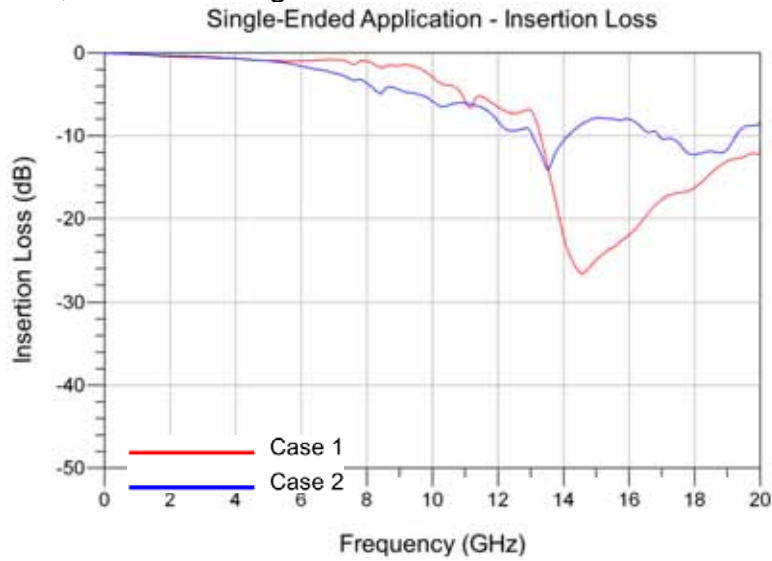
Series: MEC6-RA

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## Appendix A – Frequency Domain Response Graphs

### Single-Ended Application – Insertion Loss

Case 1 = Short Row; Case 2 = Long Row



### Single-Ended Application – Return Loss

Case 1 = Short Row; Case 2 = Long Row

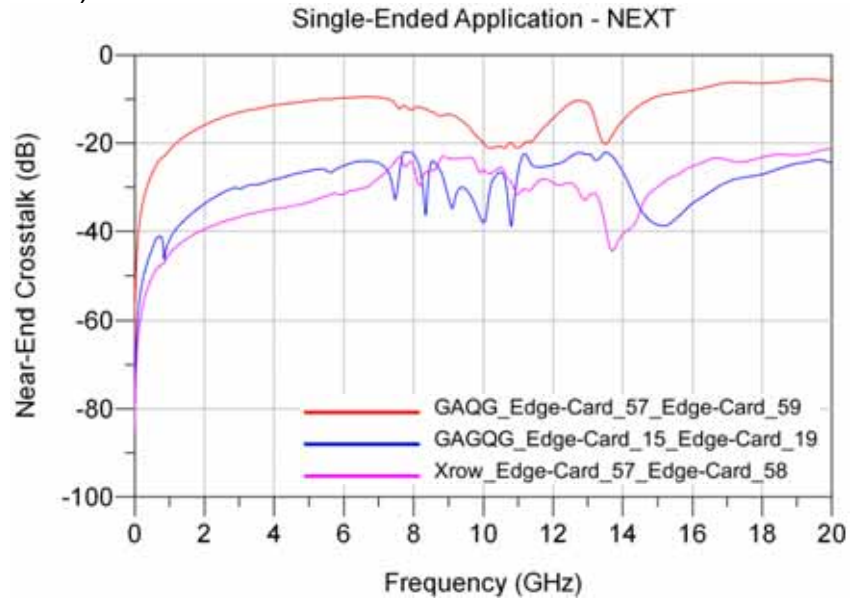


**Series:** MEC6-RA

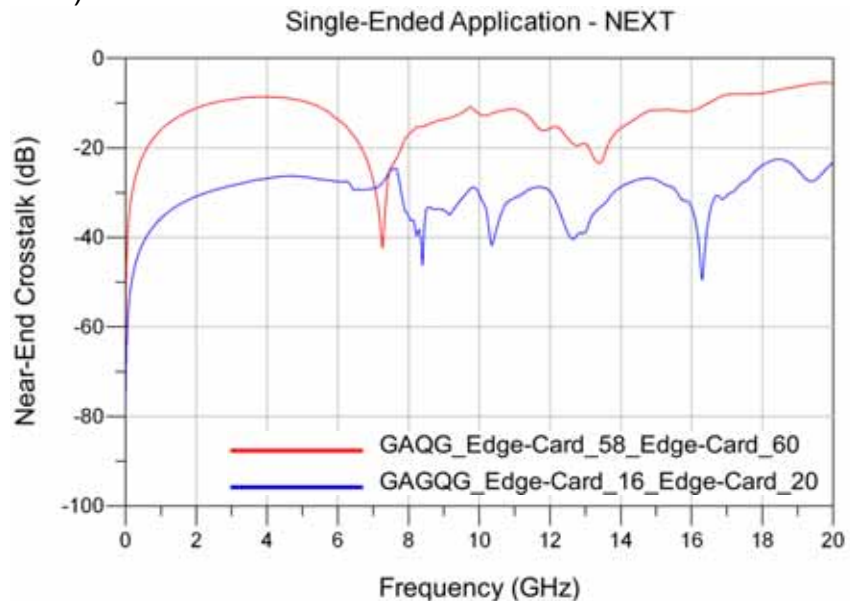
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
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## Single-Ended Application – NEXT Configurations

### Case 1 (Short Row)



### Case 2 (Long Row)

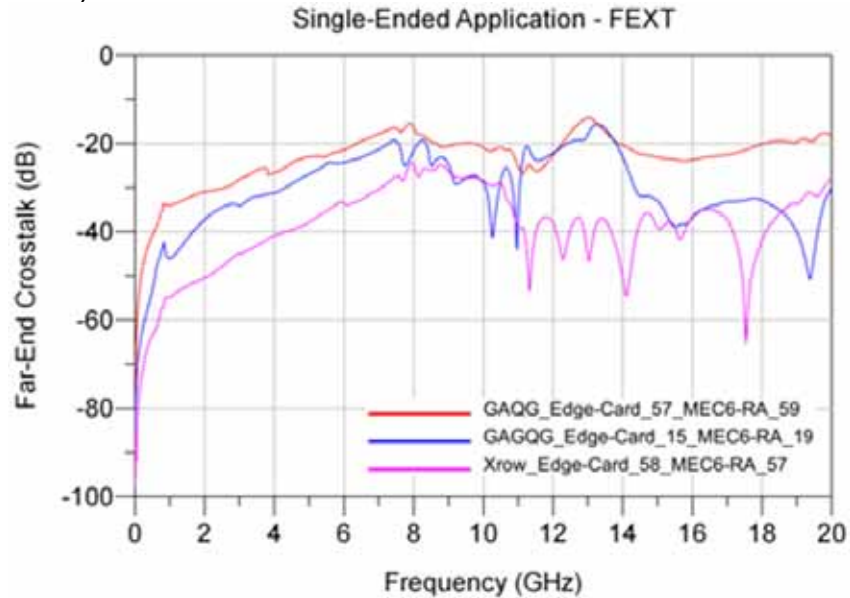


**Series:** MEC6-RA

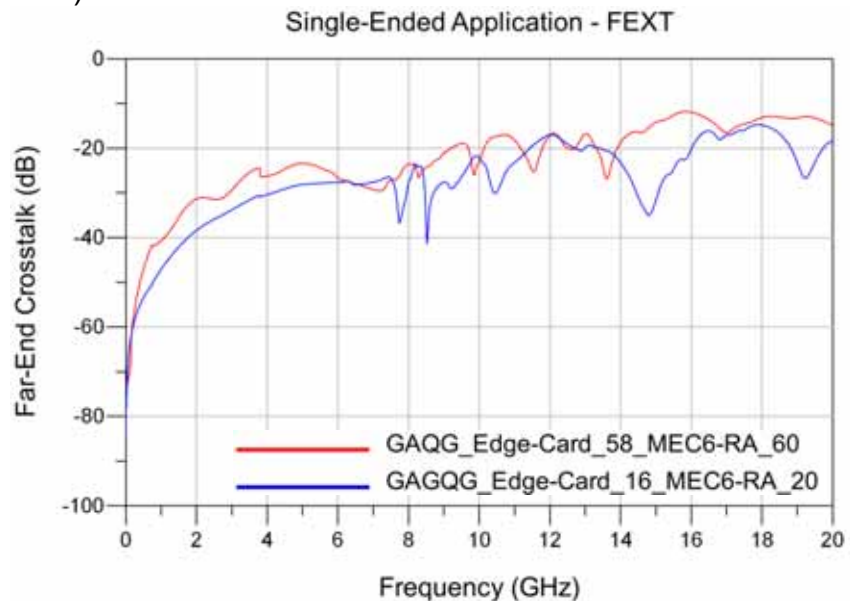
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
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## Single-Ended Application – FEXT Configurations

Case 1 (Short Row)



Case 2 (Long Row)

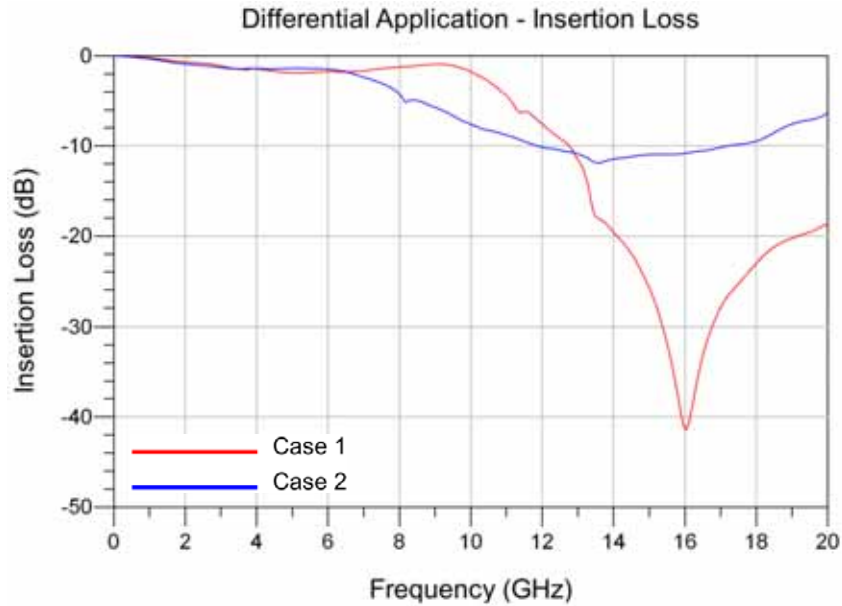


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**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
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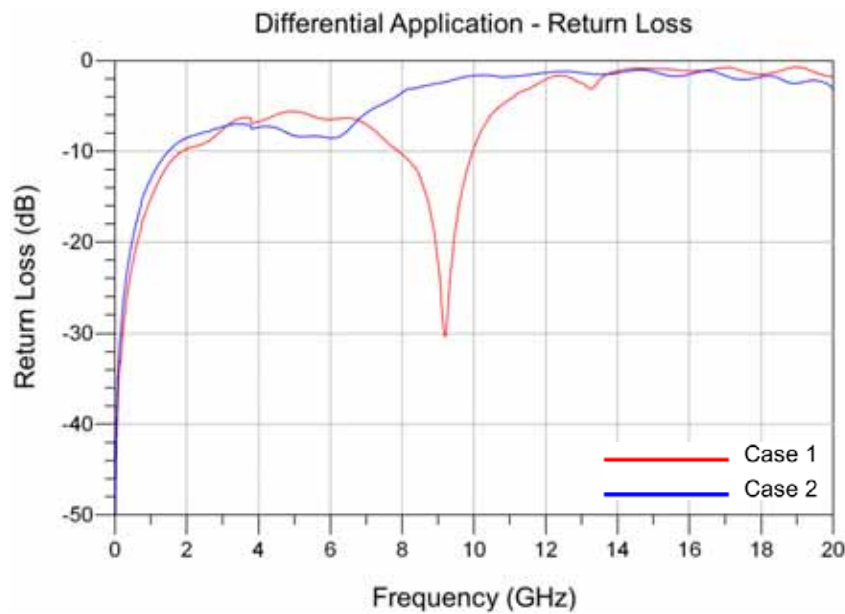
## Differential Application – Insertion Loss

Case 1 = Short Row; Case 2 = Long Row



## Differential Application – Return Loss

Case 1 = Short Row; Case 2 = Long Row

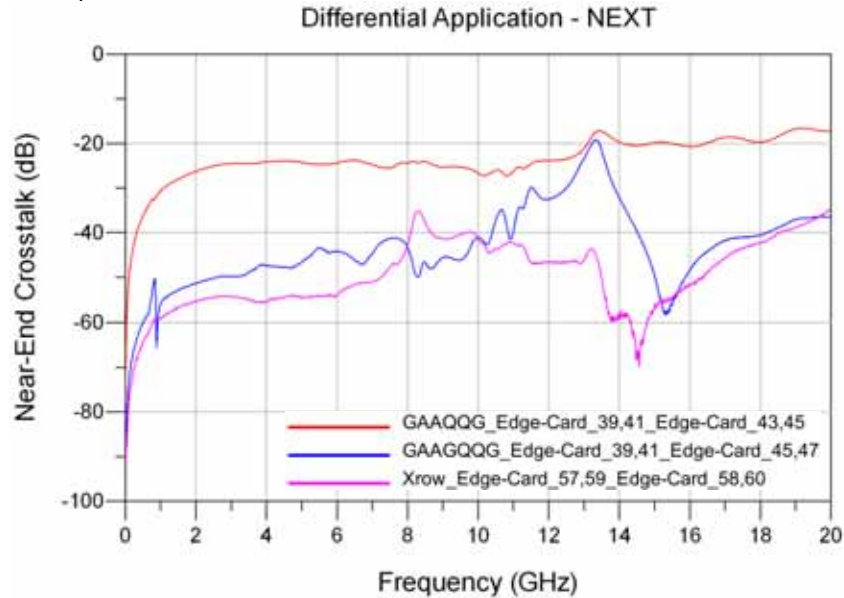


**Series:** MEC6-RA

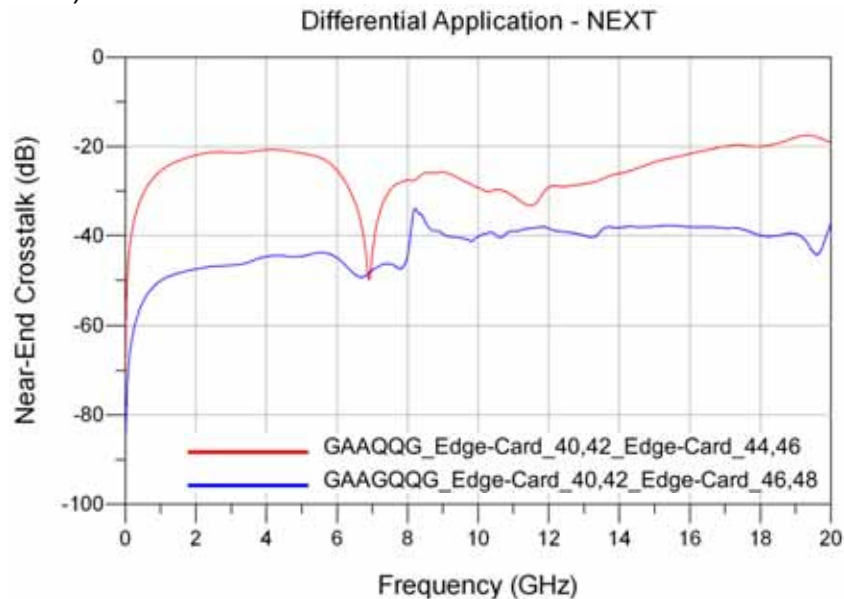
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Differential Application – NEXT Configurations

Case 1 (Short Row)



Case 2 (Long Row)

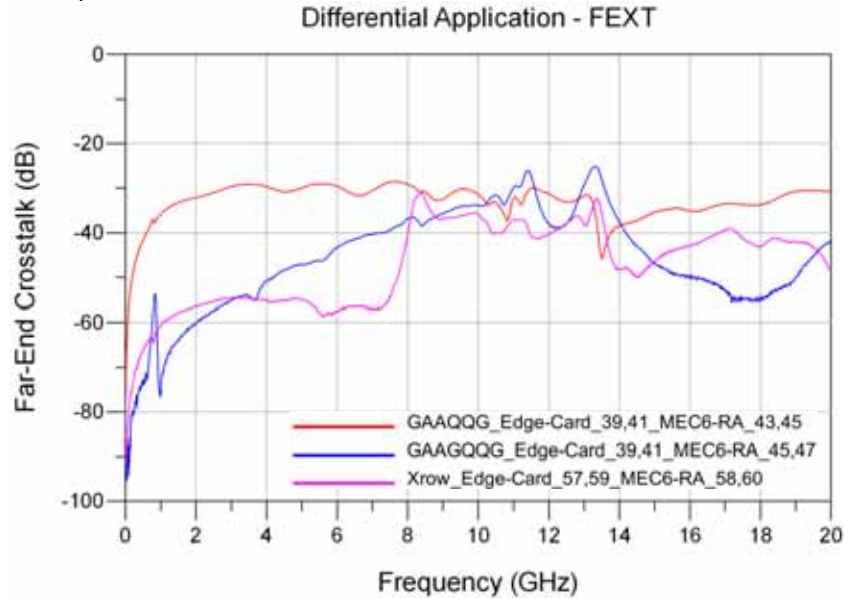


**Series:** MEC6-RA

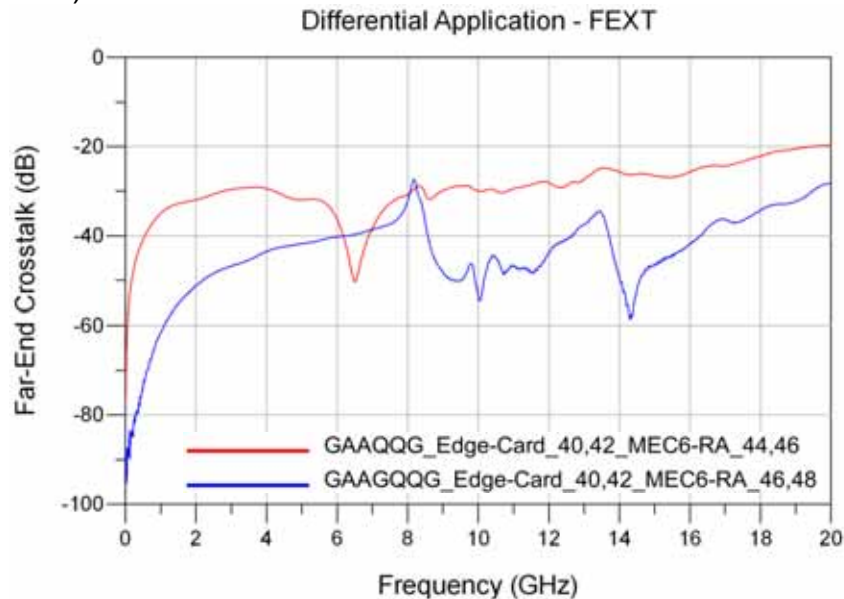
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Differential Application – FEXT Configurations

### Case 1 (Short Row)



### Case 2 (Long Row)

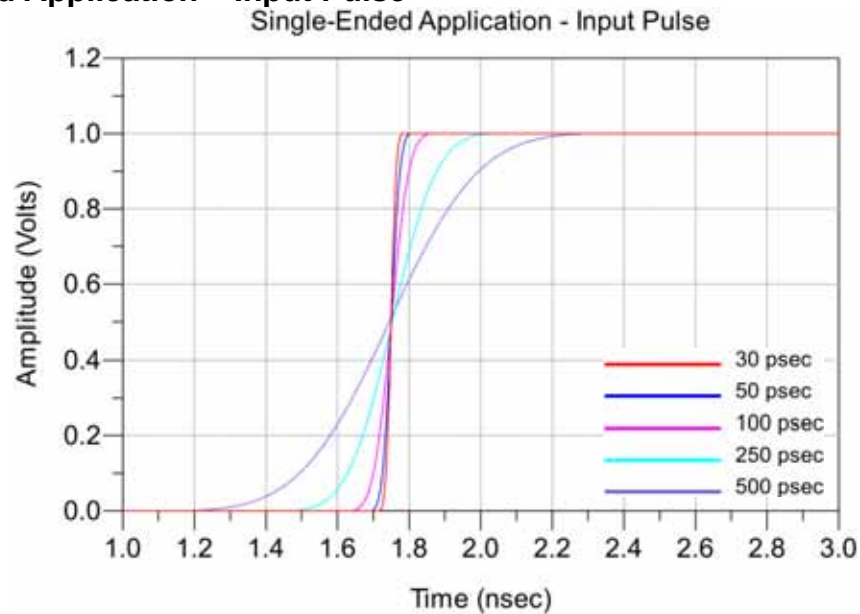


**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Appendix B – Time Domain Response Graphs

### Single-Ended Application – Input Pulse

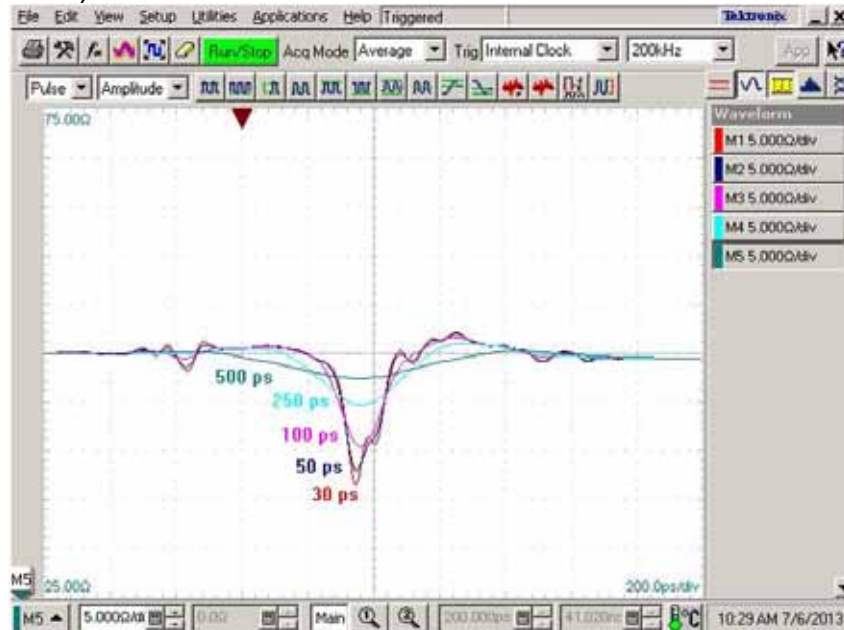


**Series:** MEC6-RA

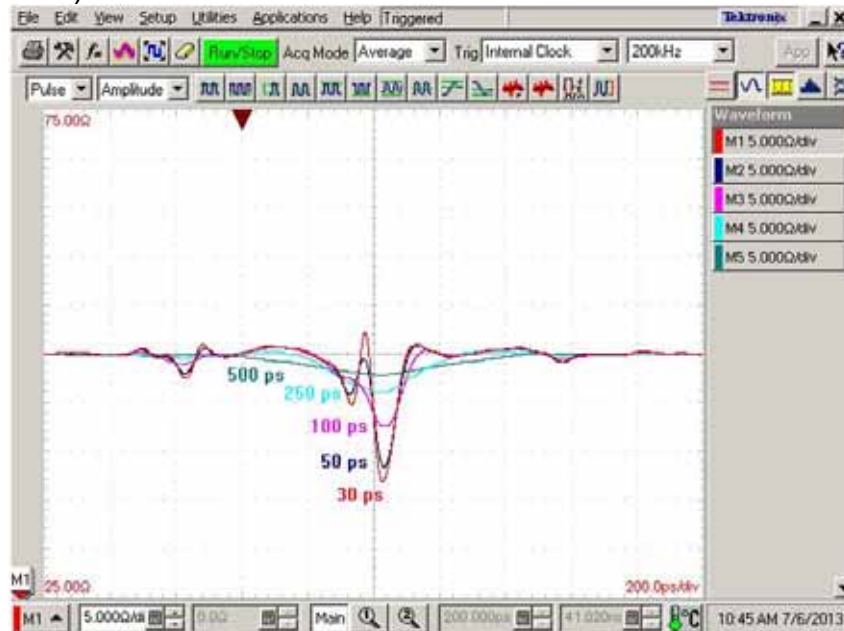
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

### Single-Ended Application – Impedance

#### Case 1 (Short Row)



#### Case 2 (Long Row)

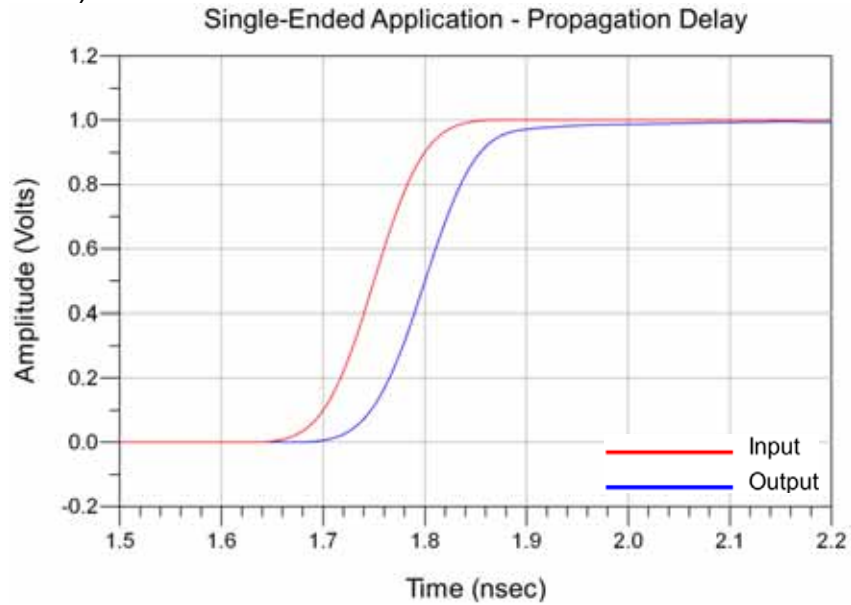


**Series:** MEC6-RA

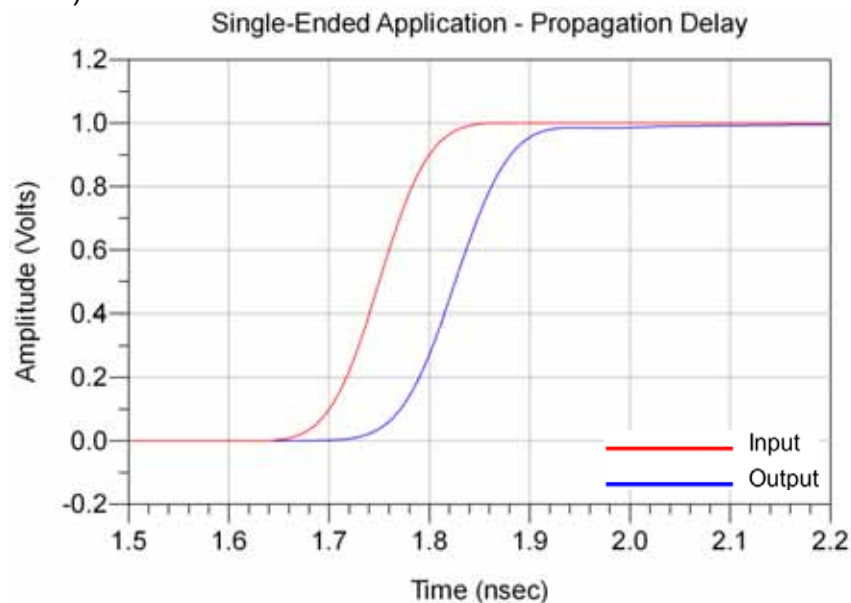
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

### Single-Ended Application – Propagation Delay

Case 1 (Short Row)



Case 2 (Long Row)

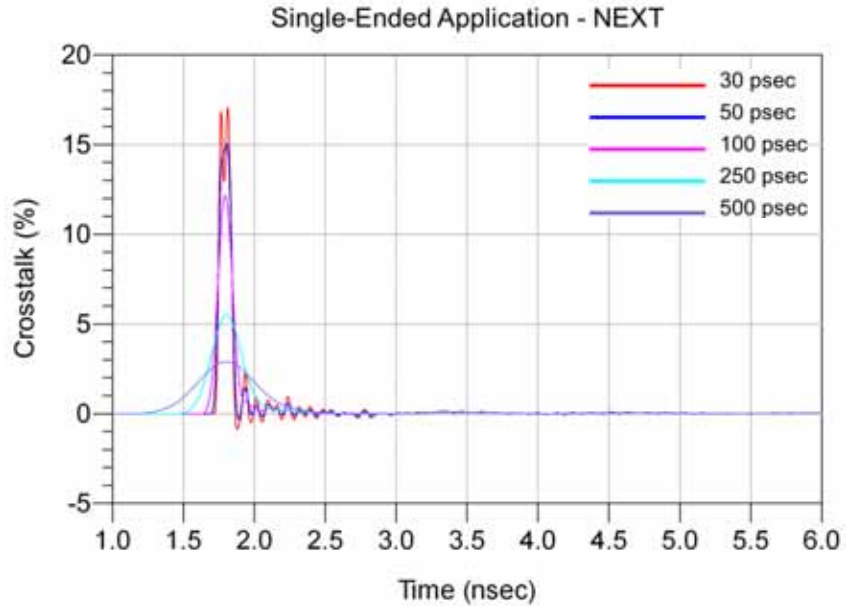


**Series:** MEC6-RA

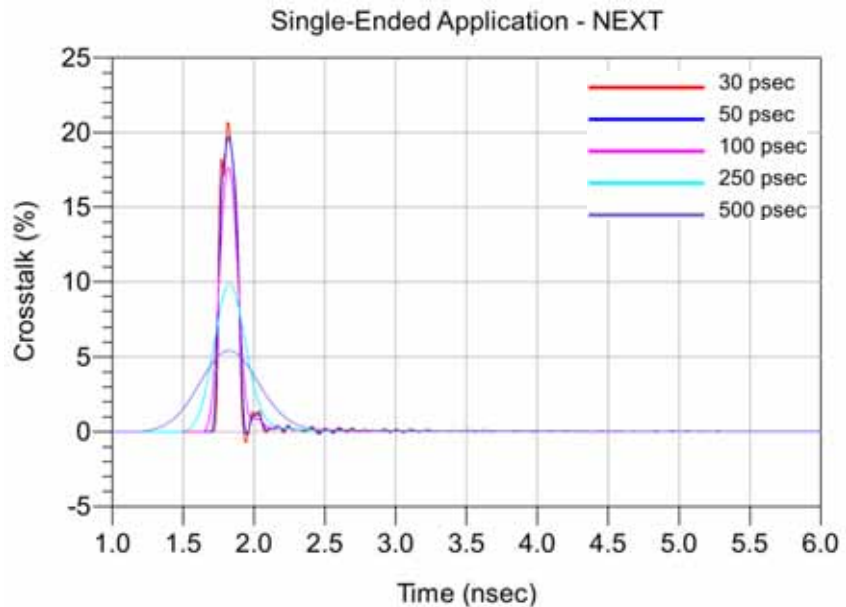
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Single-Ended Application – NEXT, Worst Case Configuration

Case 1 (Short Row) - Edge-Card\_57\_Edge-Card\_59



Case 2 (Long Row) - Edge-Card\_58\_Edge-Card\_60

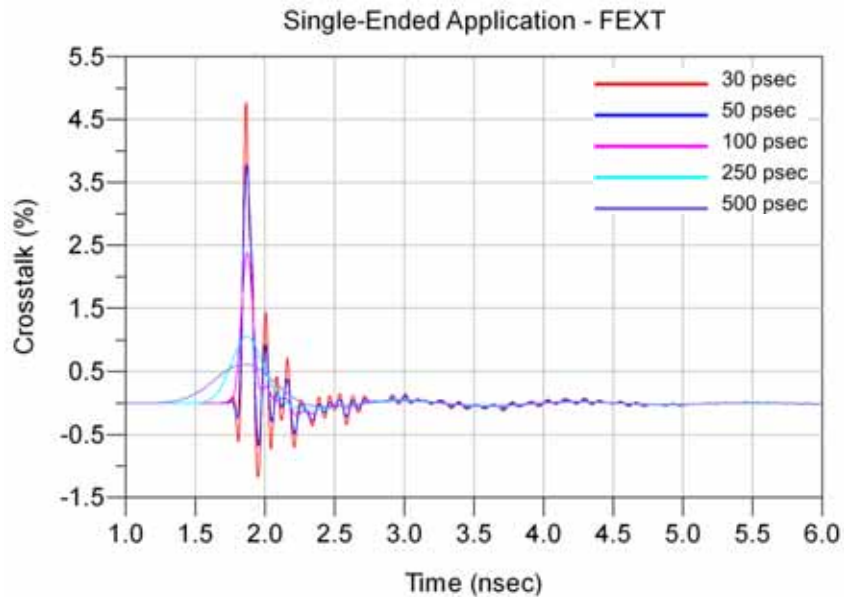


**Series:** MEC6-RA

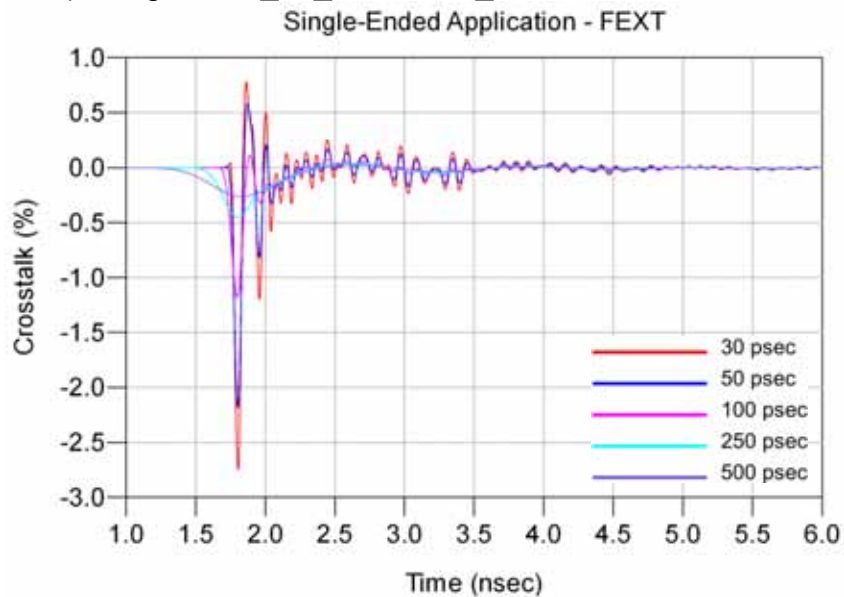
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Single-Ended Application – FEXT, Worst Case Configuration

Case 1 (Short Row) - Edge-Card\_57\_MEC6-RA\_59



Case 2 (Long Row) - Edge-Card\_58\_MEC6-RA\_60

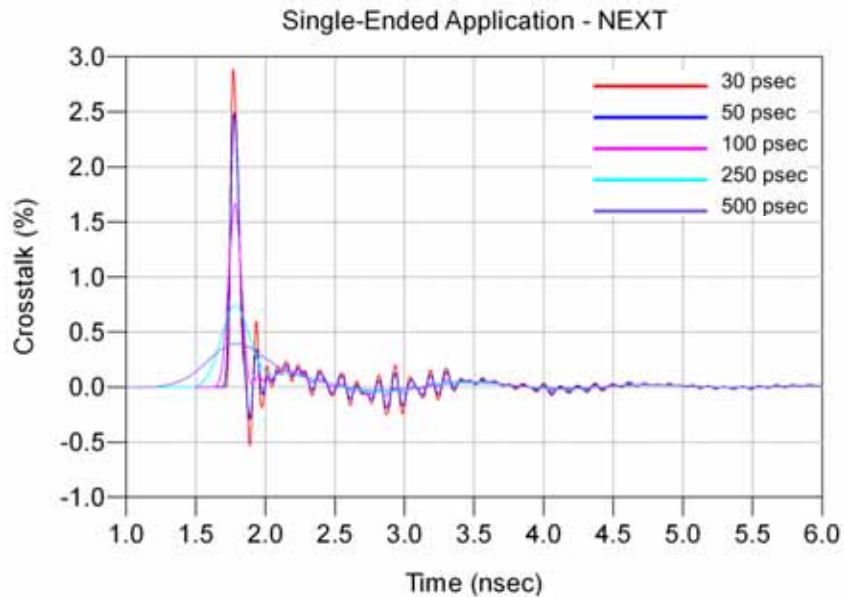


**Series:** MEC6-RA

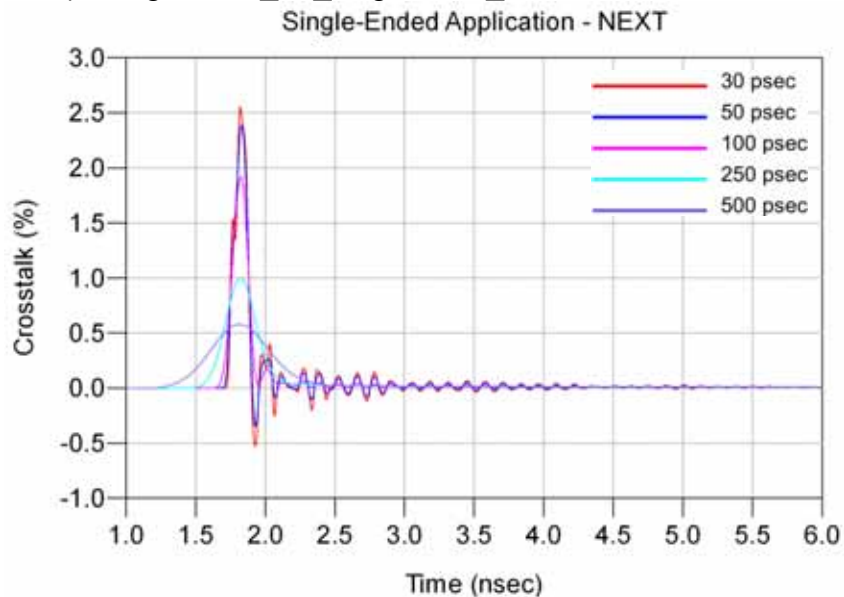
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Single-Ended Application – NEXT, Best Case Configuration

Case 1 (Short Row) - Edge-Card\_15\_Edge-Card\_19



Case 2 (Long Row) - Edge-Card\_16\_Edge-Card\_20

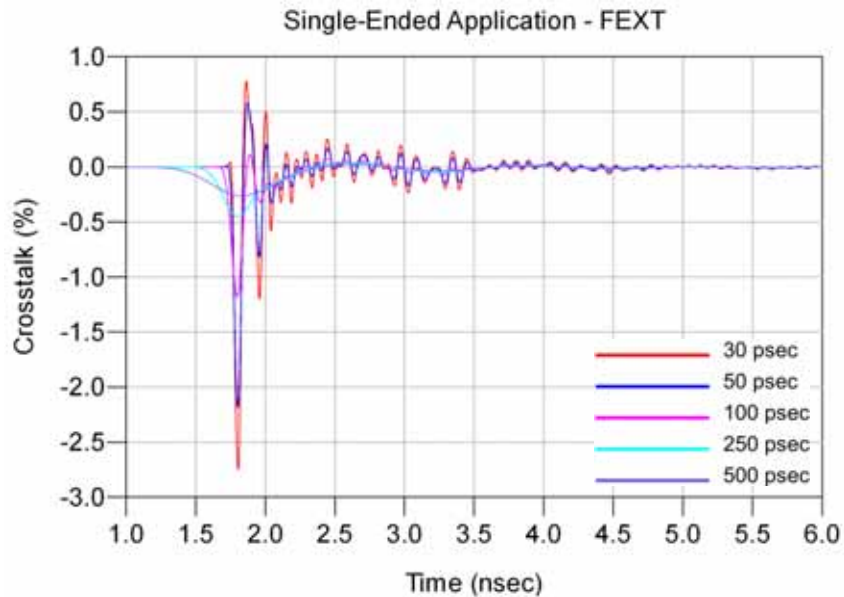


**Series:** MEC6-RA

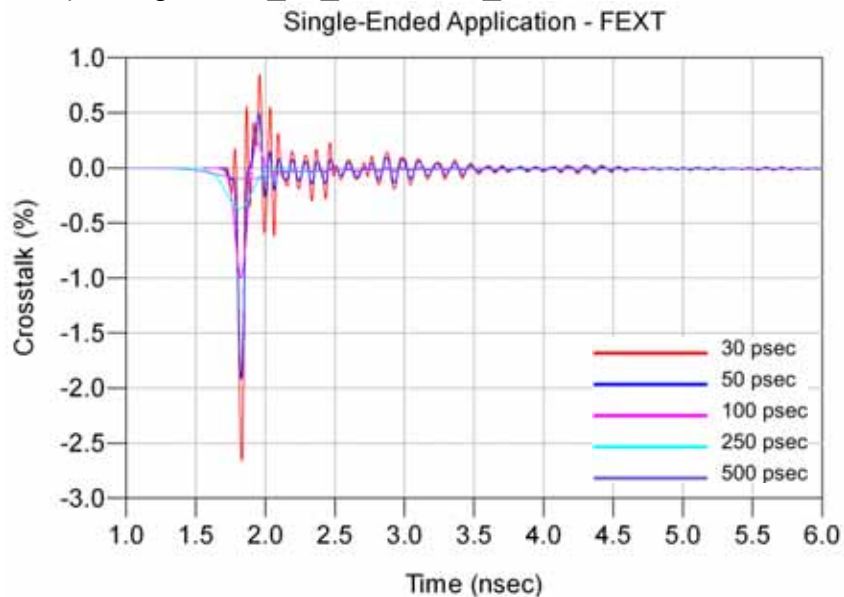
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Single-Ended Application – FEXT, Best Case Configuration

Case 1 (Short Row) – Edge-Card\_15\_MEC6-RA\_19



Case 2 (Long Row) – Edge-Card\_16\_MEC6-RA\_20

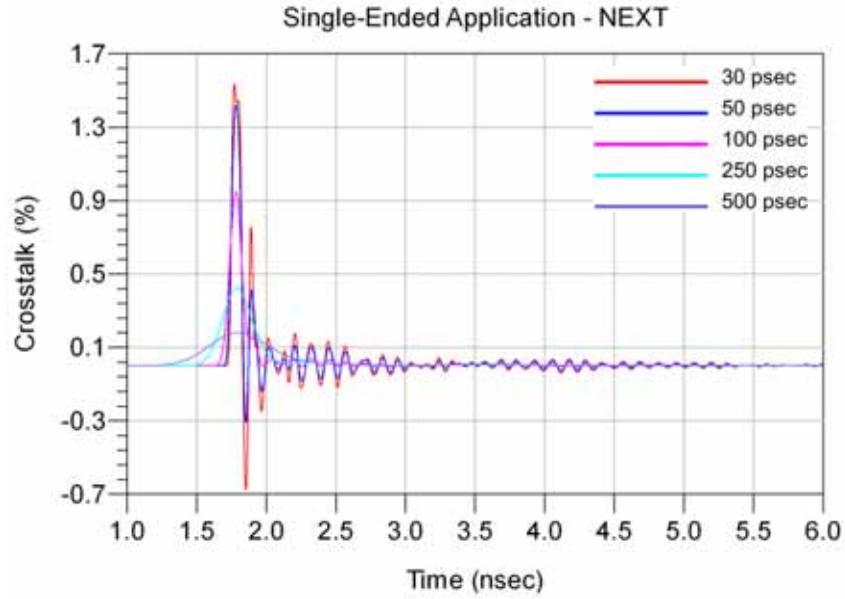


**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

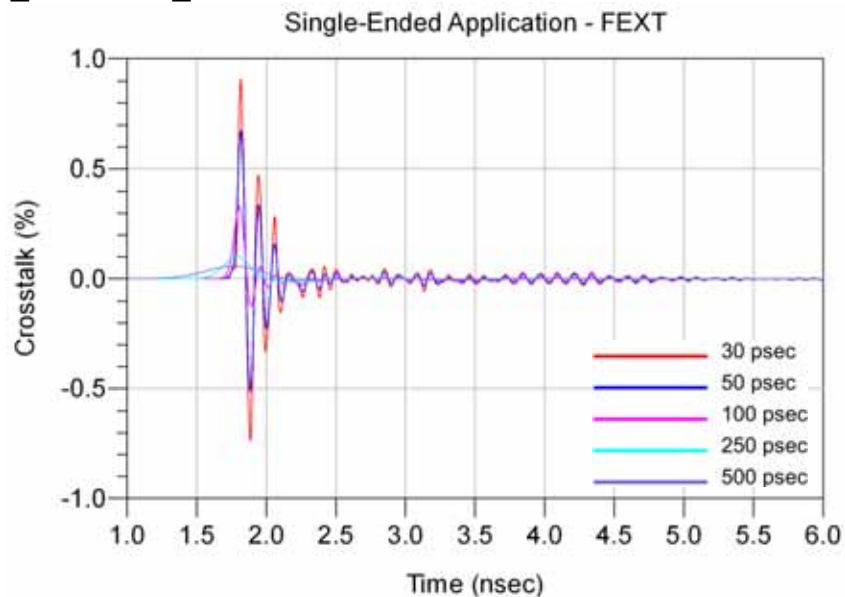
## Single-Ended Application – NEXT, Across Row Configuration

Edge-Card\_57\_Edge-Card\_58



## Single-Ended Application – FEXT, Across Row Configuration

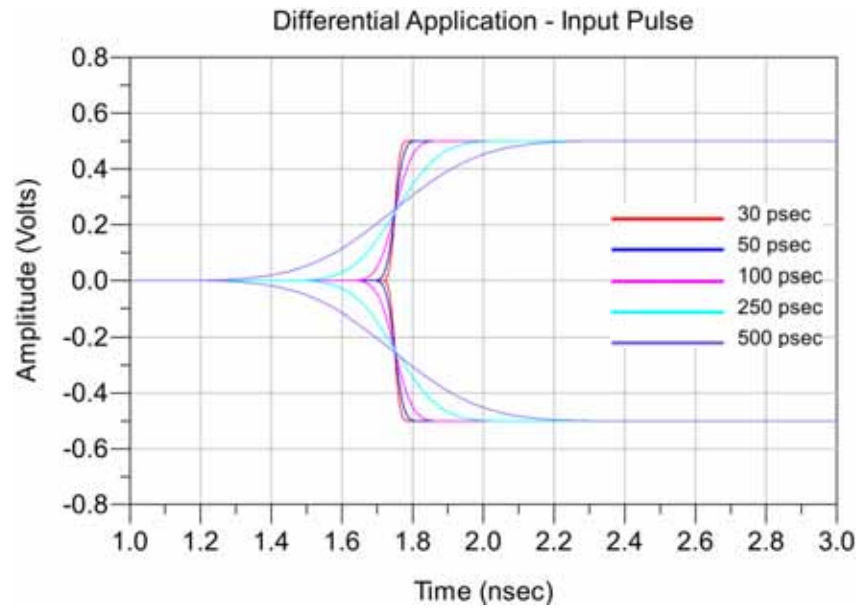
Edge-Card\_58\_MEC6-RA\_57



**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

### Differential Application – Input Pulse

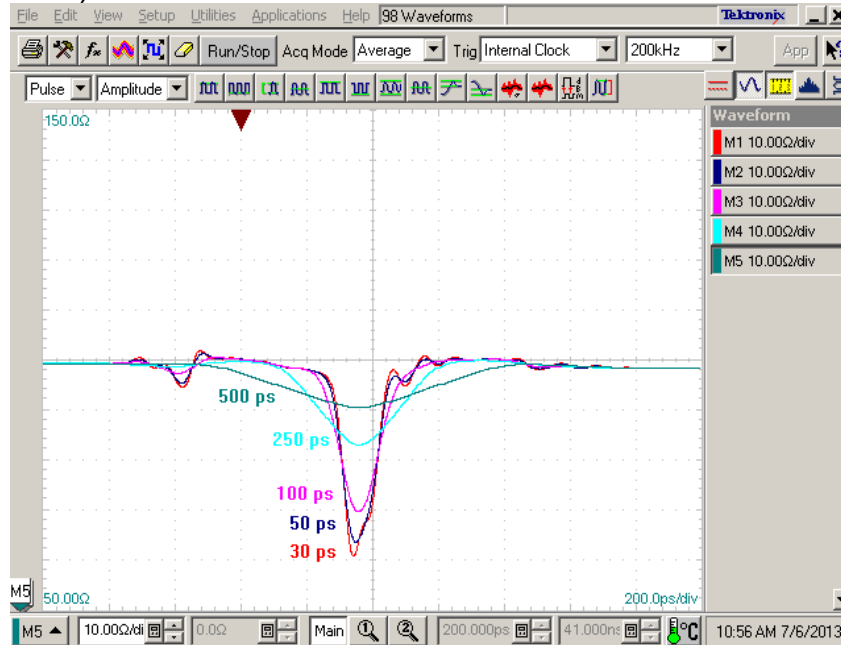


**Series:** MEC6-RA

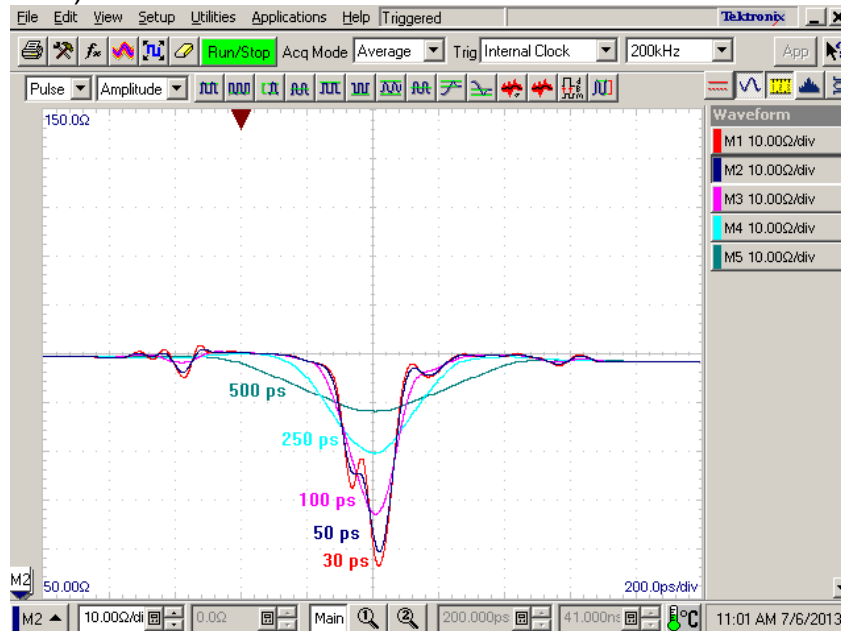
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

### Differential Application – Impedance

#### Case 1 (Short Row)



#### Case 2 (Long Row)

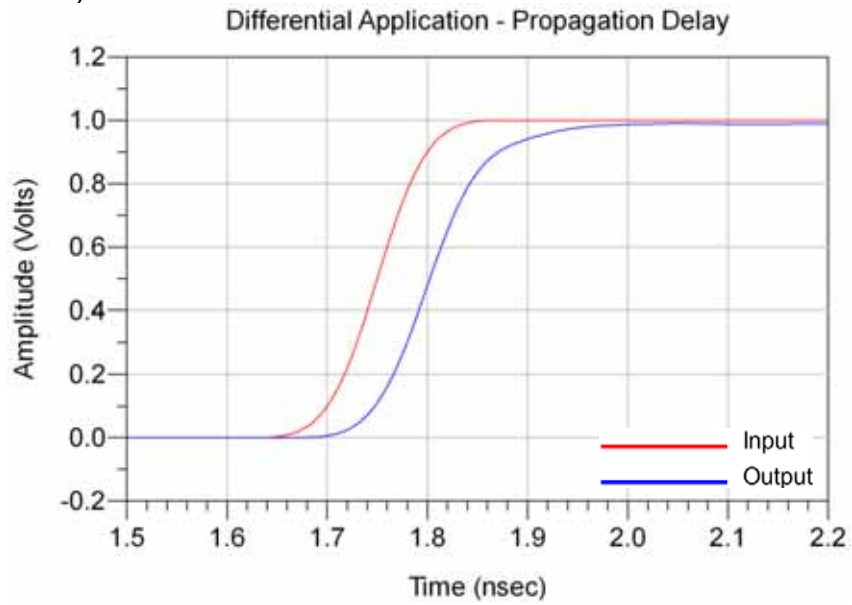


**Series:** MEC6-RA

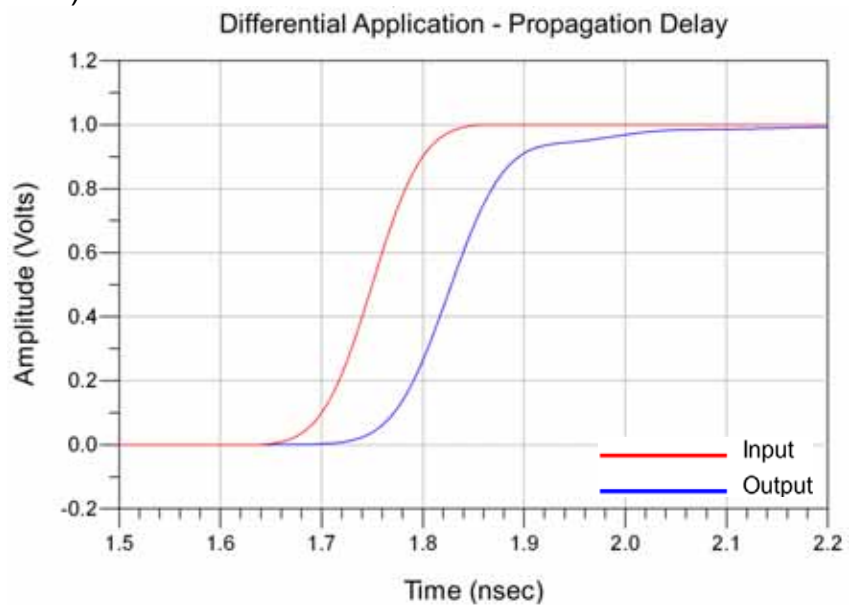
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

### Differential Application – Propagation Delay

Case 1 (Short Row)



Case 2 (Long Row)

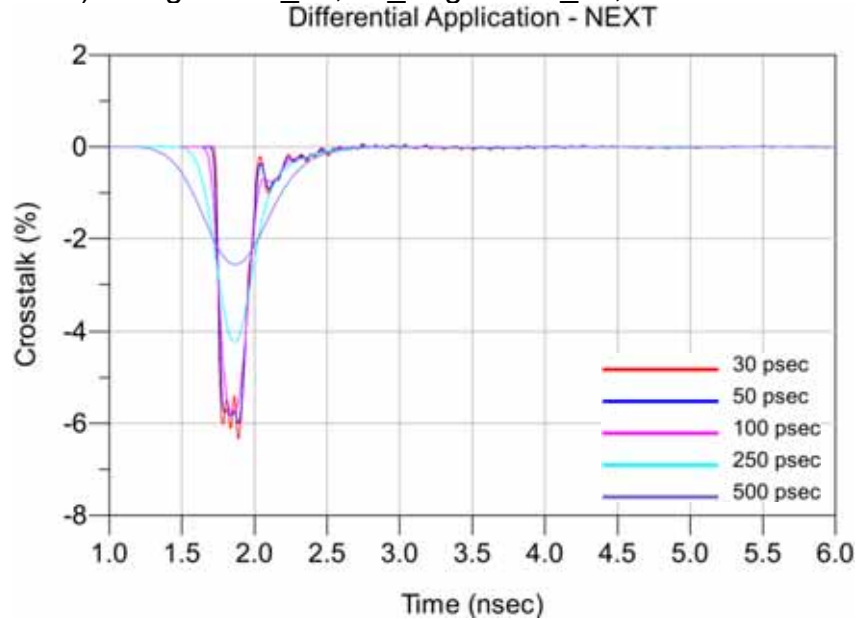


**Series:** MEC6-RA

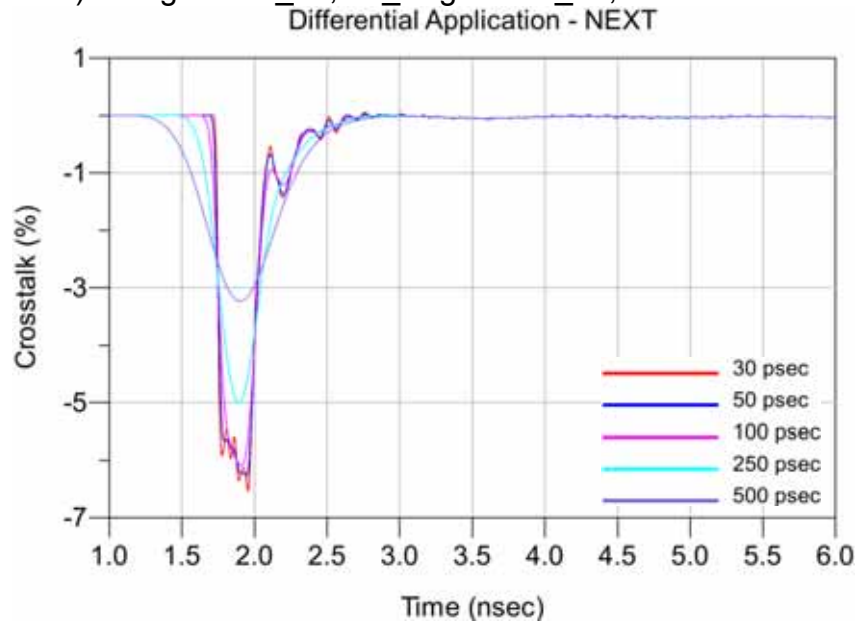
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Differential Application – NEXT, Worst Case Configuration

Case 1 (Short Row) – Edge-Card\_39, 41\_Edge-Card\_43, 45



Case 2 (Long Row) – Edge-Card\_40, 42\_Edge-Card\_44, 46

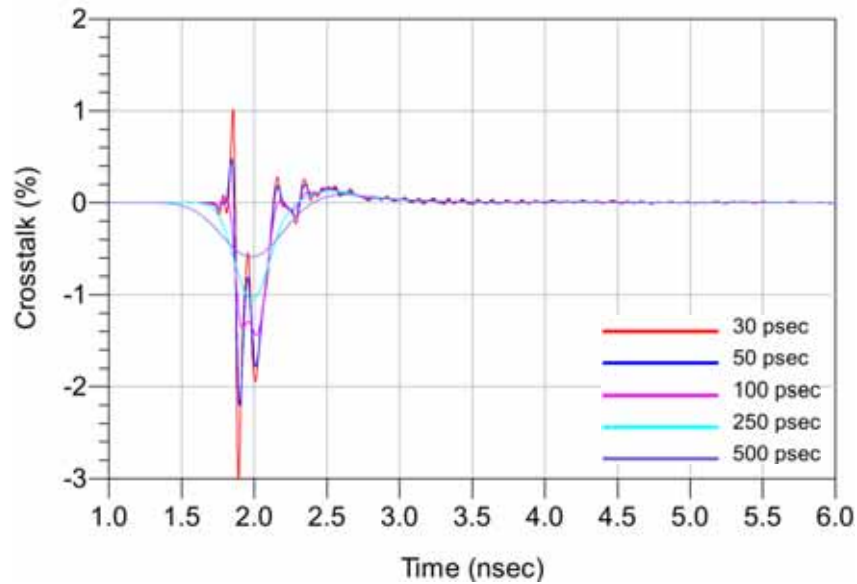


**Series:** MEC6-RA

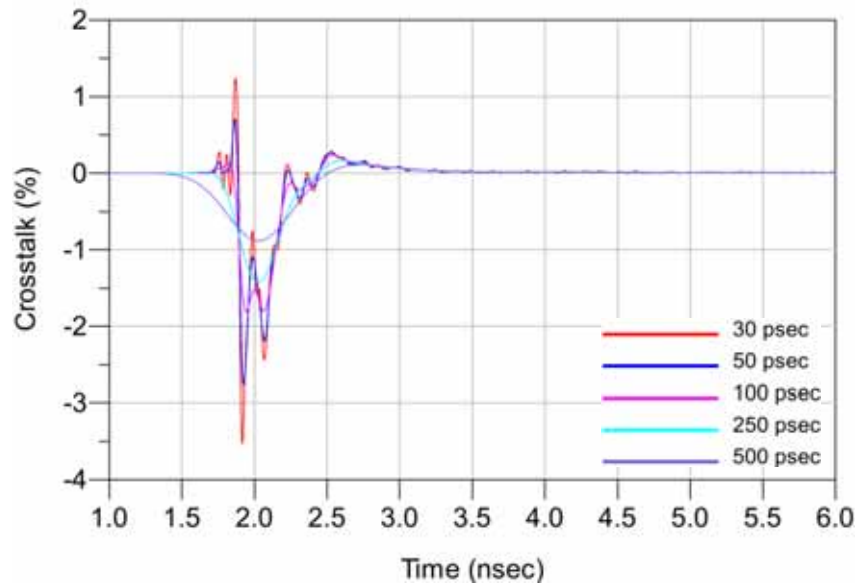
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Differential Application – FEXT, Worst Case Configuration

Case 1 (Short Row) – Edge-Card\_39, 41\_MEC6-RA\_43, 45  
Differential Application - FEXT



Case 2 (Long Row) – Edge-Card\_40, 42\_MEC6-RA\_44, 46  
Differential Application - FEXT

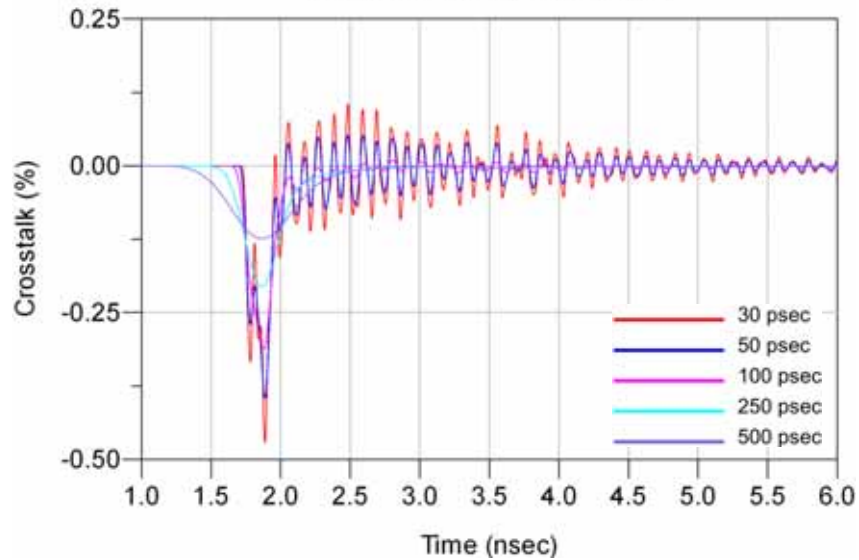


**Series:** MEC6-RA

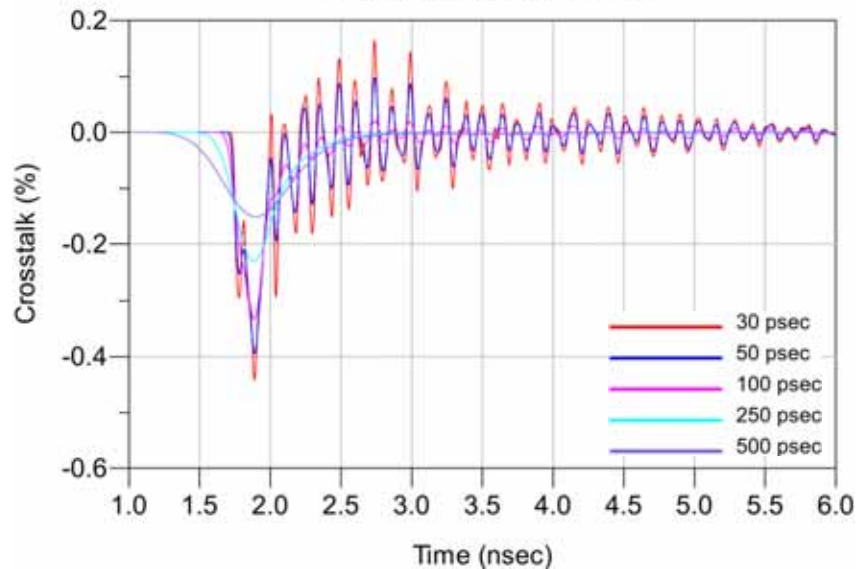
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Differential Application – NEXT, Best Case Configuration

Case 1 (Short Row) – Edge-Card\_39, 41\_Edge-Card\_45, 47  
Differential Application - NEXT



Case 2 (Long Row) – Edge-Card\_40, 42\_Edge-Card\_46, 48  
Differential Application - NEXT

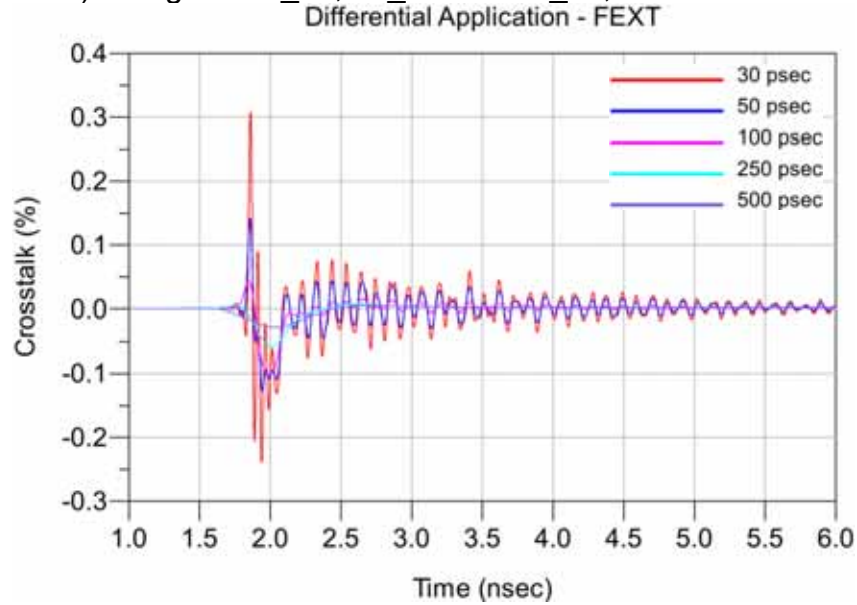


**Series:** MEC6-RA

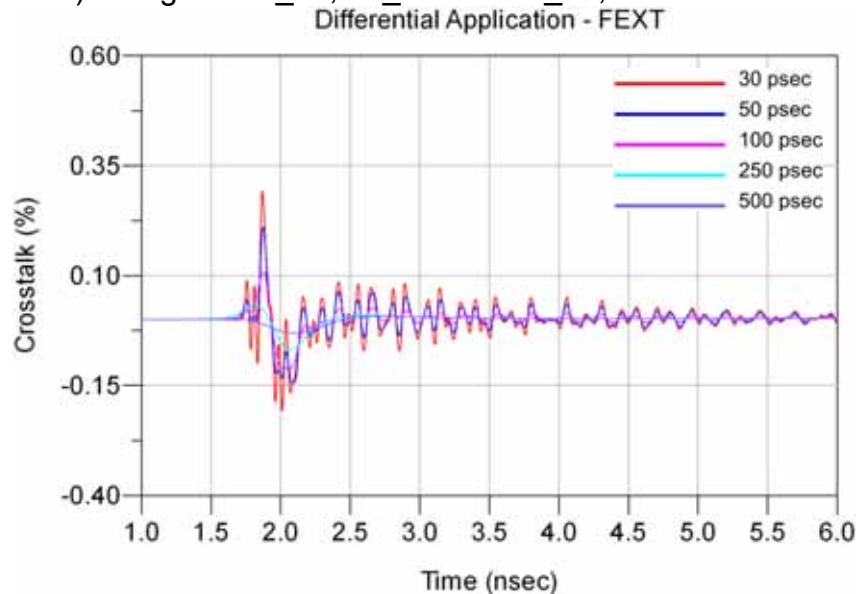
**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Differential Application – FEXT, Best Case Configuration

Case 1 (Short Row) – Edge-Card\_39, 41\_MEC6-RA\_45, 47



Case 2 (Long Row) – Edge-Card\_40, 42\_MEC6-RA\_46, 48

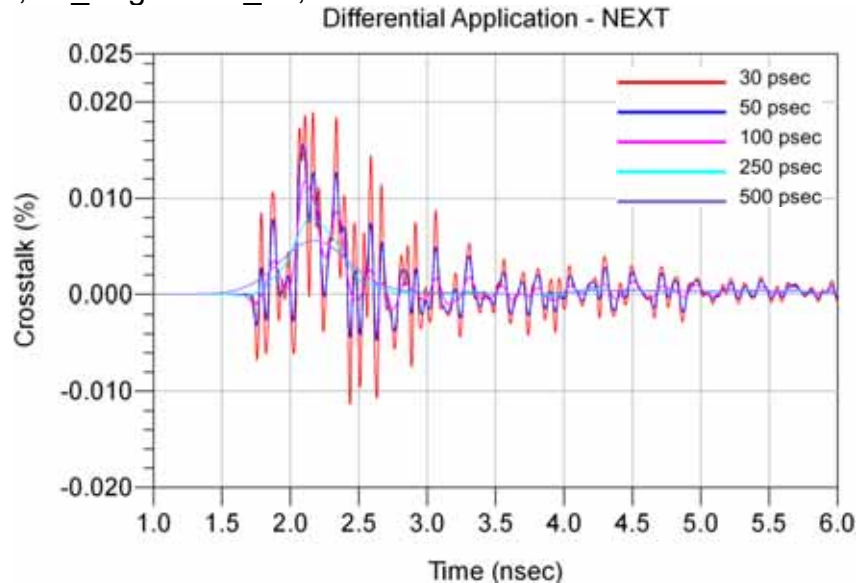


**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

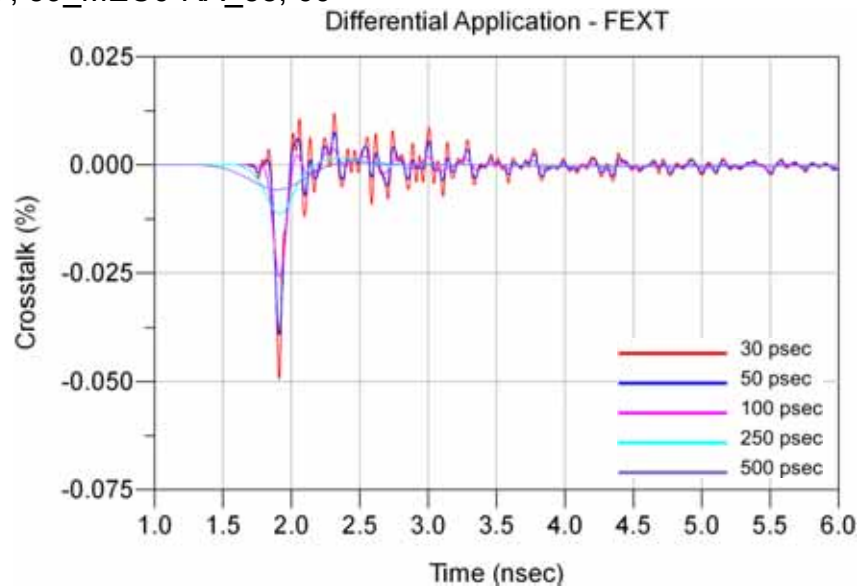
## Differential Application – NEXT, Across Row Case Configuration

Edge-Card\_57, 59\_Edge-Card\_58, 60



## Differential Application – FEXT, Across Row Case Configuration

Edge-Card\_57, 59\_MEC6-RA\_58, 60



**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Appendix C – Product and Test System Descriptions

### Product Description

Product test samples are MEC6-RA series connectors. The part number is MEC6-140-02-L-D-RA1. The MEC6-RA Series is a right angle and PCB surface mount product. Each connector has two rows of contacts evenly spaced on a 0.635mm (0.0250") pitch. The right angle design forces the top row terminals to have a longer electrical length than those of the bottom row; hence, the electrical characteristics between the short row and long row will differentiate. When mated the connector and the edge-card locate on a parallel. 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 test cables to test fixtures. Optimization of the SMA launch was performed using full wave simulation tools to minimize reflections. Six test fixtures are specific to the MEC6-RA series connector set and identified by part numbers PCB-104299-TST-01-A and B through PCB-104299-TST-03-A and B. Calibration standards specific to the MEC6-RA series are located on the calibration boards PCB-104299-TST-10. To keep trace lengths short, three different test board sets were required to access the necessary signal pins.

### PCB-104299-TST-XX Test Fixtures

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

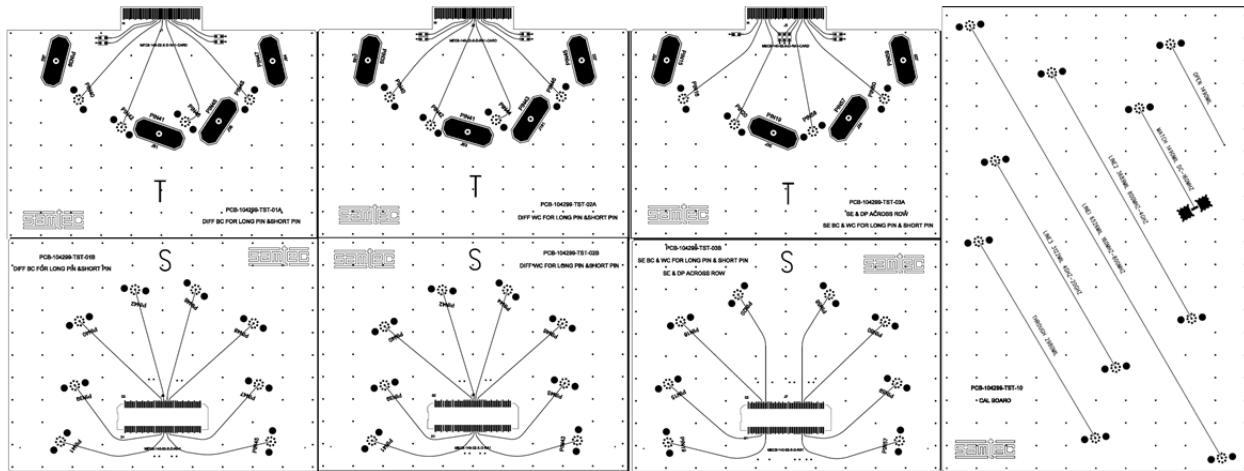


**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

### PCB-104299-TST-XX PCB Layout Panel

Artwork of the PCB design is shown below.



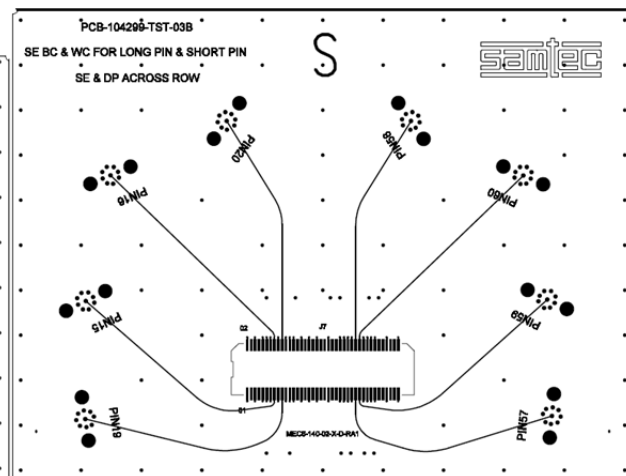
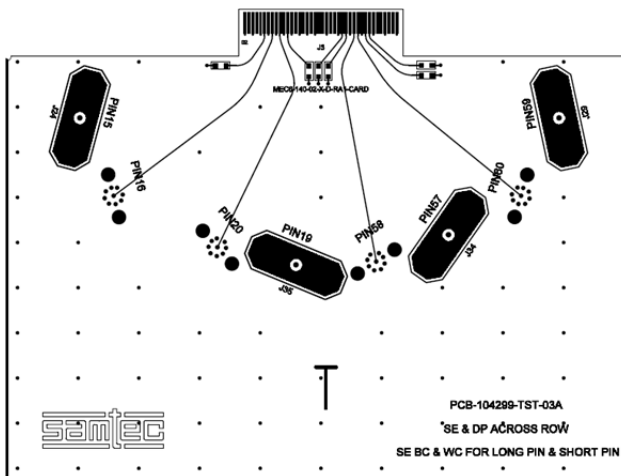
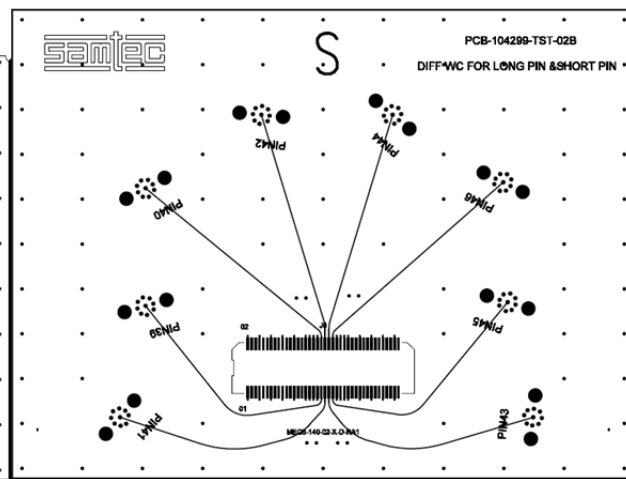
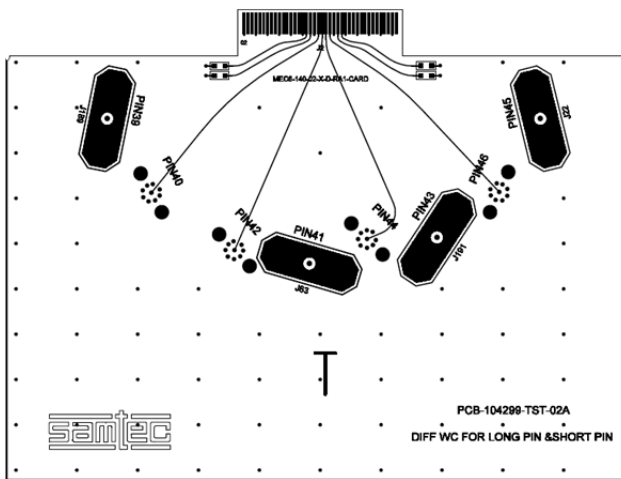
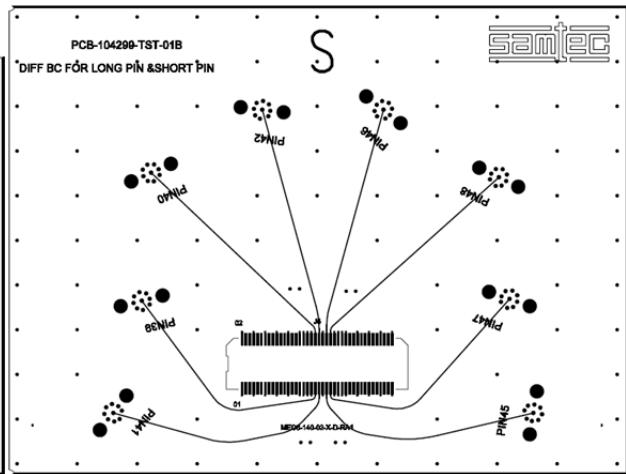
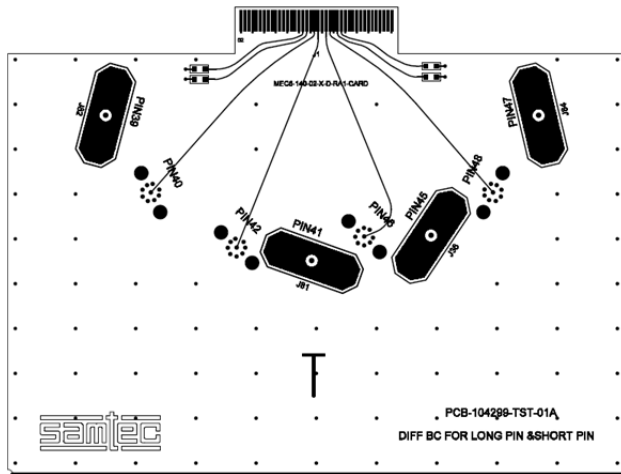
### PCB Fixtures

The test fixtures used are as follows:

- PCB-104299-TST-01A – Edge-Card for differential best case for long pin and short pin
- PCB-104299-TST-01B – MEC6-RA Series Test Board for differential best case for long pin and short pin
- PCB-104299-TST-02A – Edge-Card for differential worst-case for long pin and short pin
- PCB-104299-TST-02B – MEC6-RA Series Test Board for differential worst-case for long pin and short pin
- PCB-104299-TST-03A – Edge-Card for single-ended best-case and worst-case for long pin and short pin, single-ended and differential across-row
- PCB-104299-TST-03B – MEC6-RA Series Test Board for single-ended best-case and worst-case for long pin and short pin, single-ended and differential across-row

Series: MEC6-RA

Description: Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

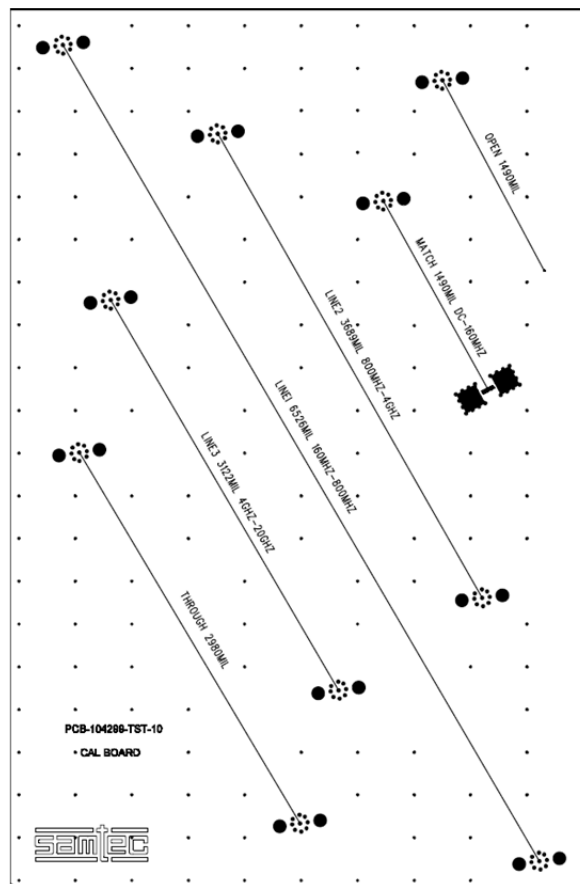


**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## 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 calibration 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 – 6526 mils
- Line 2 – 3689 mils
- Line 3 – 3122 mils
- Match – 1490 mils

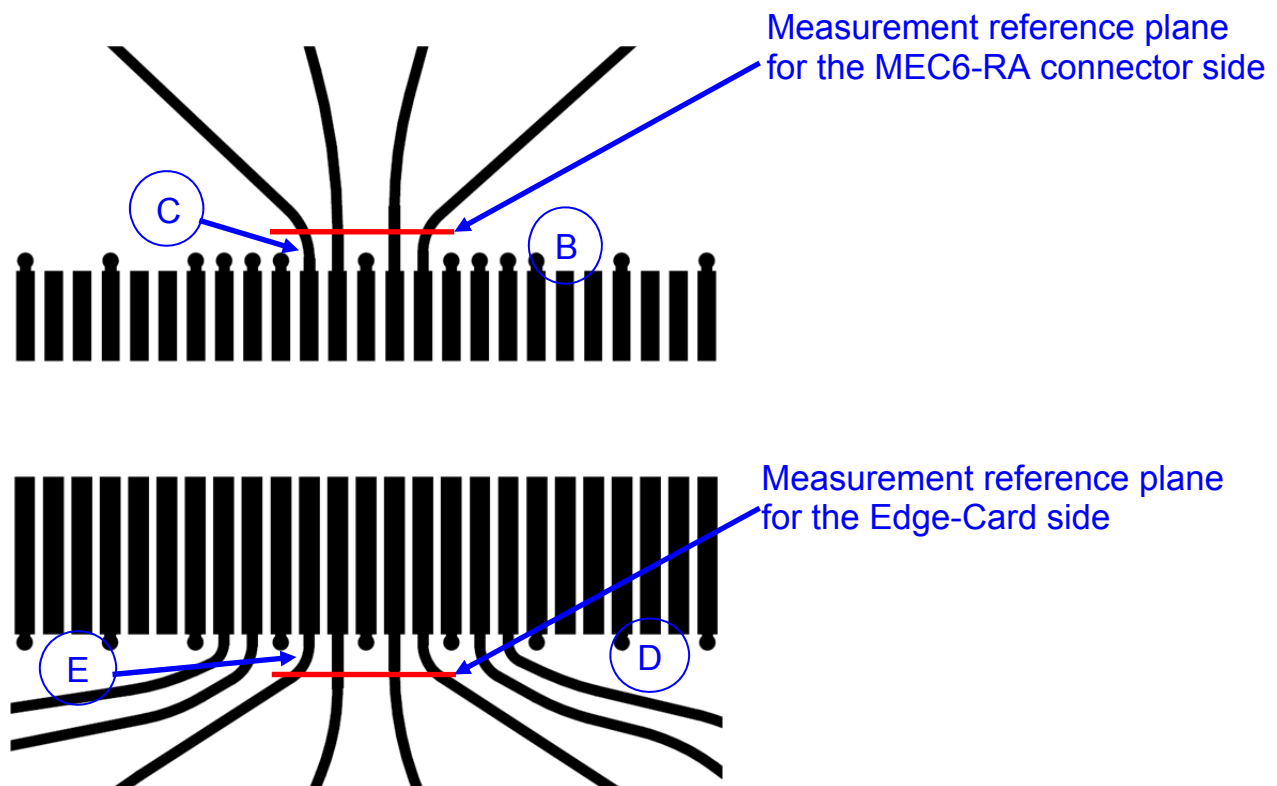
**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

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 1.49" of test board trace effects. This means that 10 mils 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 MEC6-RA Series connector set
- B- Test board vias, pads (footprint effects) for the MEC6-RA connector side.
- C- 10 mils of 9.5 mil wide microstrip trace.
- D- Test board vias, pads (footprint effects) for the Edge-Card side.
- E- 10 mils of 9.5 mil wide microstrip trace.

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



**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## Appendix D – Test and Measurement Setup

For frequency domain measurements, 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

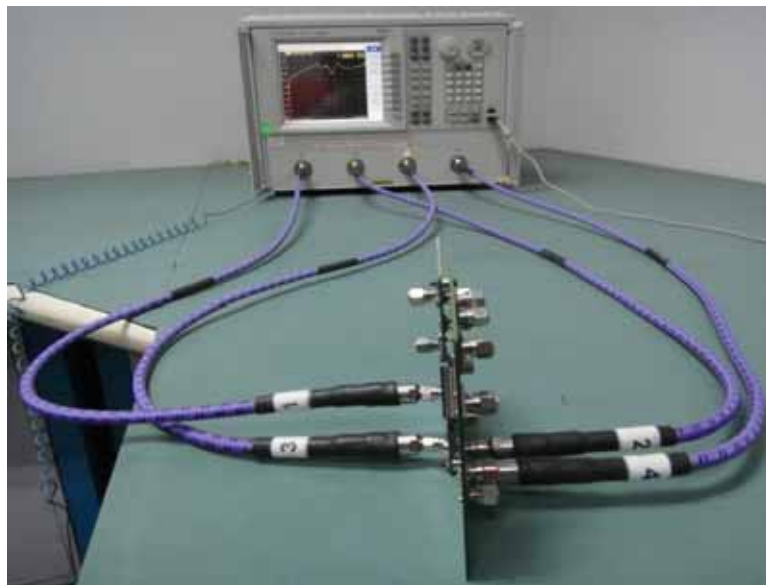
Stop Frequency – 20 GHz

Number of points -1601

IFBW – 1 KHz

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

### N5230C Measurement Setup



### Test Instruments

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

<u>QTY</u>	<u>Description</u>
4	Gore OWD01D02039-4 (DC-50 GHz)

**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

For impedance measurements, the test instrument is the Tektronix DSA8200 Digital Serial Analyzer mainframe and 80E04 sampling module. The impedance data and profiles are obtained directly from the instrument. The Digital Analyzer is configured as follows:

	Single-Ended Signal	Differential Signal
Vertical Scale:	5 ohm / Div:	10 ohm/ Div:
Offset:	Default / Scroll	Default / Scroll
Horizontal Scale:	200ps/ Div	200ps/ Div
Record Length:	4000	4000
Averages:	≥ 16	≥ 16

### DSA8200 Measurement Setup



### Test Instruments

<u>QTY</u>	<u>Description</u>
1	Tektronix DSA8200 Digital Serial Analyzer
2	Tektronix 80E04 Dual Channel 20 GHz TDR Sampling Module

### Test Cables & Adapters

<u>QTY</u>	<u>Description</u>
2	Samtec RF405-01SP1-01SP1-0305 (DC-20 GHz)

**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## **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 MEC6-RA 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](http://www.samtec.com/Technical_Library/reference/articles/pdfs/tech-note_using-PLTS-for-time-domain-data_web.pdf)

### **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:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

### 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.

### Impedance (TDR)

Measurements involving digital pulses are performed using either Time Domain Reflectometer (TDR) or Time Domain Transmission (TDT) methods. The TDR method is used for the impedance measurements in this report.

The signal line(s) of the SUT's is energized with a TDR pulse and the far-end of the energized signal line is terminated in the test systems characteristic impedance (e.g.; 50Ω or 100Ω terminations). By terminating the adjacent signal lines in the test systems characteristic impedance, the effects on the resultant impedance shape of the waveform is limited. The "best case" signal mapping was tested and is presented in this report.

**Series:** MEC6-RA

**Description:** Mini Edge-Card Socket, Right Angle, Surface Mount,  
0.635mm (0.025") Pitch, Mated with 1.60mm (0.062") thick load card

## **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)