High Speed Characterization Report

EBDM-6-12-2.0-S-RA-1

EBTF-6-12-2.0-S-RA-1

Description:
ExaMAX® 2.00 mm Direct Mate Orthogonal Header mating to Right-Angle Receptacle, 90 Degree Orientation

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Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

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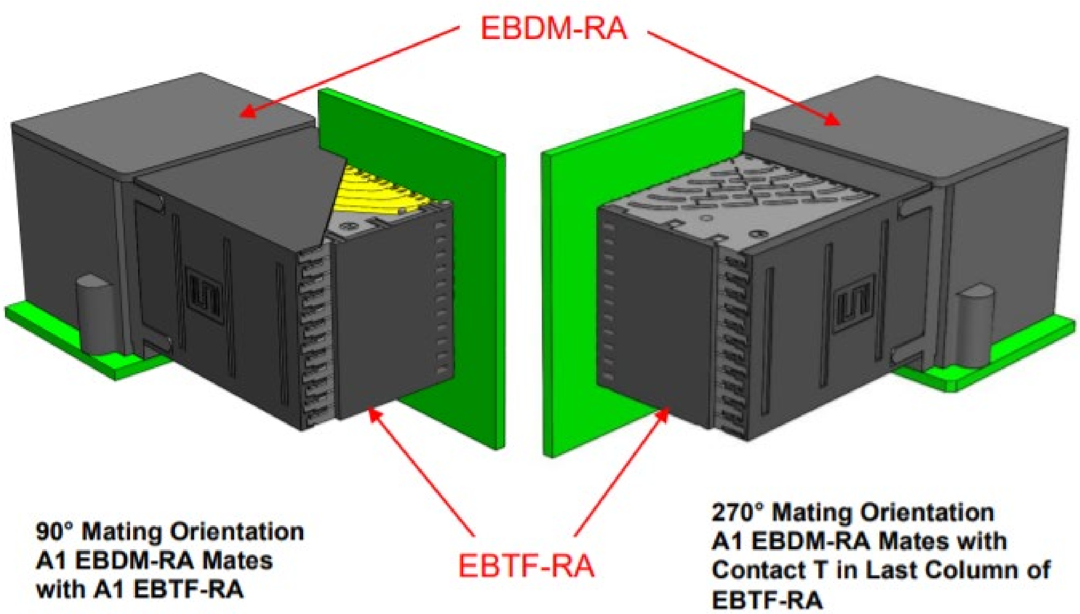
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

Connector Overview

The EBDM-RA/EBTF-RA series is ExaMAX® 2.00 mm Direct Mate Orthogonal Header mating to Right-Angle Receptacle. ExaMAX® EBDM-RA is able to mate with the ExaMAX® EBTF-RA in either a 90° mating orientation or a 270° mating orientation. The data in this report is applicable to the 6 pair, 12 column interconnect with 90 degree mating orientation.



Series: EBDM-RA / EBTF-RA
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Frequency Domain Data Summary

Bandwidth Chart – Differential Insertion Loss

EBDM-RA/EBTF-RA Connector Series

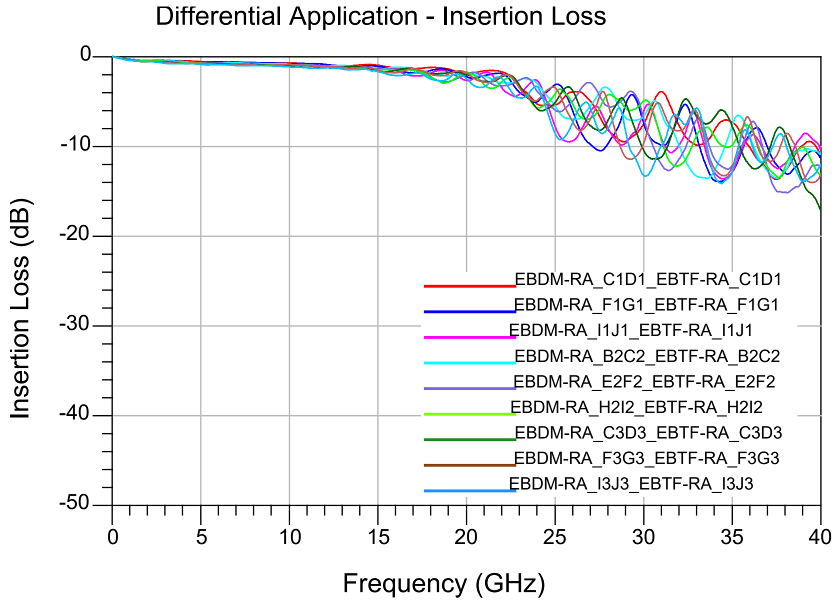

Figure 1

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

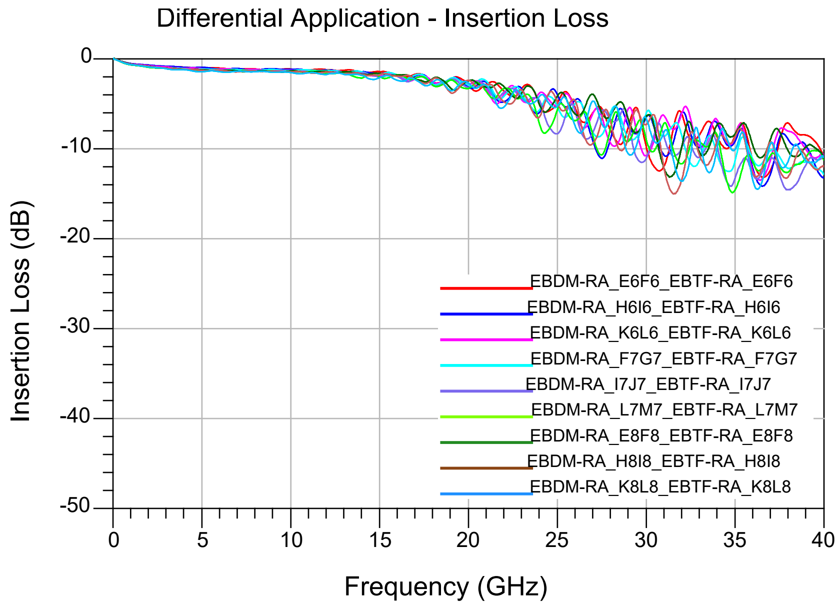

Figure 2

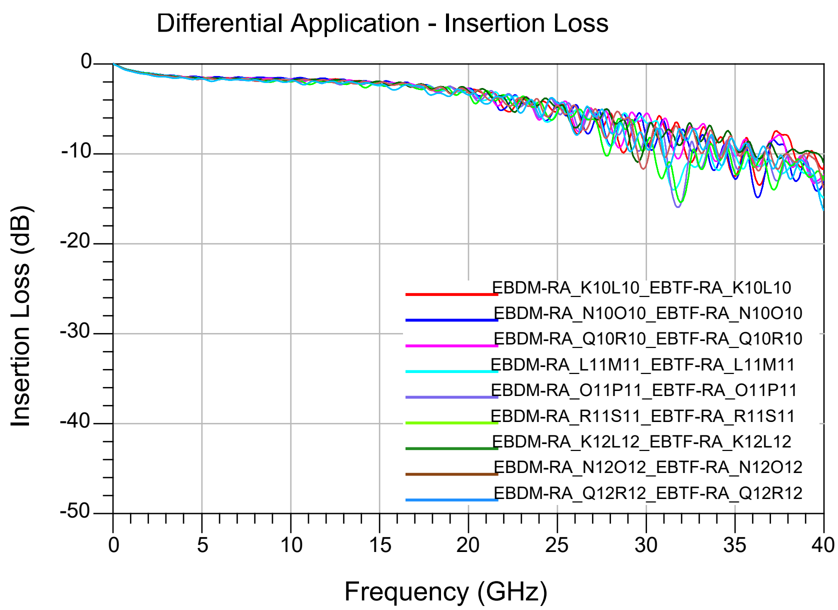

Figure 3

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

Time Domain Data Summary

Table 1 - Differential Impedance (Ω)

Driver	Signal Rise-time	30ps	50ps	100ps
EBDM-RA_C1D1	Maximum Impedance	101.7	101.6	101.3
	Minimum Impedance	85.1	85.6	86.6
EBDM-RA_F1G1	Maximum Impedance	102.0	101.9	101.6
	Minimum Impedance	84.9	85.5	87.1
EBDM-RA_I1J1	Maximum Impedance	102.1	102.1	101.8
	Minimum Impedance	84.4	85.3	86.9
EBDM-RA_B2C2	Maximum Impedance	101.8	101.6	101.3
	Minimum Impedance	85.3	86.2	87.6
EBDM-RA_E2F2	Maximum Impedance	102.0	101.9	101.7
	Minimum Impedance	85.6	86.3	87.6
EBDM-RA_H2I2	Maximum Impedance	102.3	102.1	101.9
	Minimum Impedance	85.7	86.5	87.6
EBDM-RA_C3D3	Maximum Impedance	102.0	101.8	101.6
	Minimum Impedance	84.2	85.3	87.1
EBDM-RA_F3G3	Maximum Impedance	102.3	102.2	101.9
	Minimum Impedance	84.3	85.4	87.3
EBDM-RA_I3J3	Maximum Impedance	102.3	102.3	102.1
	Minimum Impedance	84.2	85.3	87.0
EBDM-RA_E6F6	Maximum Impedance	103.2	103.1	102.8
	Minimum Impedance	84.9	85.8	87.5
EBDM-RA_H6I6	Maximum Impedance	103.9	103.6	103.2
	Minimum Impedance	86.7	87.5	89.2
EBDM-RA_K6L6	Maximum Impedance	103.3	103.2	103.1
	Minimum Impedance	86.0	86.9	88.7
EBDM-RA_F7G7	Maximum Impedance	103.1	103.0	102.9
	Minimum Impedance	85.3	86.3	88.0
EBDM-RA_I7J7	Maximum Impedance	103.3	103.3	103.0
	Minimum Impedance	85.4	86.2	87.7
EBDM-RA_L7M7	Maximum Impedance	103.2	103.2	103.1
	Minimum Impedance	85.5	86.6	88.6
EBDM-RA_E8F8	Maximum Impedance	103.5	103.5	103.3
	Minimum Impedance	87.8	88.5	90.0

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EBDM-RA_H8I8	Maximum Impedance	103.4	103.4	103.1
	Minimum Impedance	87.2	88.0	89.6
EBDM-RA_K8L8	Maximum Impedance	103.1	103.0	102.9
	Minimum Impedance	85.6	86.1	87.7
EBDM-RA_K10L10	Maximum Impedance	102.7	102.7	102.7
	Minimum Impedance	84.1	85.7	88.0
EBDM-RA_N10O10	Maximum Impedance	103.1	103.0	103.0
	Minimum Impedance	84.7	86.1	88.4
EBDM-RA_Q10R10	Maximum Impedance	103.1	103.0	103.0
	Minimum Impedance	84.4	85.9	88.2
EBDM-RA_L11M11	Maximum Impedance	102.9	102.8	102.8
	Minimum Impedance	84.4	85.8	88.2
EBDM-RA_O11P11	Maximum Impedance	103.0	103.0	103.0
	Minimum Impedance	84.0	85.3	88.0
EBDM-RA_R11S11	Maximum Impedance	103.2	103.1	103.1
	Minimum Impedance	84.1	85.3	87.2
EBDM-RA_K12L12	Maximum Impedance	103.3	103.2	103.2
	Minimum Impedance	84.9	87.3	89.7
EBDM-RA_N12O12	Maximum Impedance	103.3	103.3	103.3
	Minimum Impedance	84.5	87.0	89.8
EBDM-RA_Q12R12	Maximum Impedance	103.2	103.2	103.1
	Minimum Impedance	83.0	85.2	87.8

Series: EBDM-RA / EBTF-RA
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Table 2 - Differential Crosstalk (%)

Input(tr)	Driver	Receiver	30ps	50ps	100ps
NEXT	EBDM-RA_E2F2	EBDM-RA_C1D1	0.16	0.11	<0.1
	EBDM-RA_E2F2	EBDM-RA_F1G1	<0.1	<0.1	<0.1
	EBDM-RA_E2F2	EBDM-RA_I1J1	<0.1	<0.1	<0.1
	EBDM-RA_E2F2	EBDM-RA_B2C2	0.20	0.17	0.13
	EBDM-RA_E2F2	EBDM-RA_H2I2	0.19	0.13	0.10
	EBDM-RA_E2F2	EBDM-RA_C3D3	0.14	0.11	<0.1
	EBDM-RA_E2F2	EBDM-RA_F3G3	<0.1	<0.1	<0.1
	EBDM-RA_E2F2	EBDM-RA_I3J3	<0.1	<0.1	<0.1
	EBTF-RA_E2F2	EBTF-RA_C1D1	0.14	0.11	<0.1
	EBTF-RA_E2F2	EBTF-RA_F1G1	<0.1	<0.1	<0.1
	EBTF-RA_E2F2	EBTF-RA_I1J1	<0.1	<0.1	<0.1
	EBTF-RA_E2F2	EBTF-RA_B2C2	0.17	0.15	0.12
	EBTF-RA_E2F2	EBTF-RA_H2I2	0.17	0.12	0.10
	EBTF-RA_E2F2	EBTF-RA_C3D3	0.14	0.10	<0.1
	EBTF-RA_E2F2	EBTF-RA_F3G3	<0.1	<0.1	<0.1
	EBTF-RA_E2F2	EBTF-RA_I3J3	<0.1	<0.1	<0.1
	EBDM-RA_I7J7	EBDM-RA_E6F6	<0.1	<0.1	<0.1
	EBDM-RA_I7J7	EBDM-RA_H6I6	<0.1	<0.1	<0.1
	EBDM-RA_I7J7	EBDM-RA_K6L6	0.13	0.10	<0.1
	EBDM-RA_I7J7	EBDM-RA_F7G7	0.17	0.12	0.10
	EBDM-RA_I7J7	EBDM-RA_L7M7	0.17	0.12	0.10
	EBDM-RA_I7J7	EBDM-RA_E8F8	<0.1	<0.1	<0.1
	EBDM-RA_I7J7	EBDM-RA_H8I8	0.10	<0.1	<0.1
	EBDM-RA_I7J7	EBDM-RA_K8L8	0.14	0.11	<0.1
	EBTF-RA_I7J7	EBTF-RA_E6F6	<0.1	<0.1	<0.1
	EBTF-RA_I7J7	EBTF-RA_H6I6	<0.1	<0.1	<0.1
	EBTF-RA_I7J7	EBTF-RA_K6L6	0.14	0.10	<0.1
	EBTF-RA_I7J7	EBTF-RA_F7G7	0.15	0.13	0.10
	EBTF-RA_I7J7	EBTF-RA_L7M7	0.15	0.12	0.10
	EBTF-RA_I7J7	EBTF-RA_E8F8	<0.1	<0.1	<0.1
	EBTF-RA_I7J7	EBTF-RA_H8I8	<0.1	<0.1	<0.1
	EBTF-RA_I7J7	EBTF-RA_K8L8	0.15	0.11	<0.1
	EBDM-RA_O11P11	EBDM-RA_K10L10	<0.1	<0.1	<0.1
	EBDM-RA_O11P11	EBDM-RA_N10O10	<0.1	<0.1	<0.1
	EBDM-RA_O11P11	EBDM-RA_Q10R10	0.12	0.10	<0.1
	EBDM-RA_O11P11	EBDM-RA_L11M11	0.16	0.12	0.11
	EBDM-RA_O11P11	EBDM-RA_R11S11	0.15	0.13	0.12

Series: EBDM-RA / EBTF-RA
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NEXT	EBDM-RA_O11P11	EBDM-RA_K12L12	<0.1	<0.1	<0.1
	EBDM-RA_O11P11	EBDM-RA_N12O12	<0.1	<0.1	<0.1
	EBDM-RA_O11P11	EBDM-RA_Q12R12	0.12	0.10	<0.1
	EBTF-RA_O11P11	EBTF-RA_K10L10	<0.1	<0.1	<0.1
	EBTF-RA_O11P11	EBTF-RA_N10O10	<0.1	<0.1	<0.1
	EBTF-RA_O11P11	EBTF-RA_Q10R10	0.14	0.10	<0.1
	EBTF-RA_O11P11	EBTF-RA_L11M11	0.14	0.12	0.11
	EBTF-RA_O11P11	EBTF-RA_R11S11	0.14	0.13	0.12
	EBTF-RA_O11P11	EBTF-RA_K12L12	<0.1	<0.1	<0.1
	EBTF-RA_O11P11	EBTF-RA_N12O12	<0.1	<0.1	<0.1
	EBTF-RA_O11P11	EBTF-RA_Q12R12	0.12	0.10	<0.1
FEXT	EBDM-RA_E2F2	EBTF-RA_C1D1	<0.1	<0.1	<0.1
	EBDM-RA_E2F2	EBTF-RA_F1G1	0.13	<0.1	<0.1
	EBDM-RA_E2F2	EBTF-RA_I1J1	<0.1	<0.1	<0.1
	EBDM-RA_E2F2	EBTF-RA_B2C2	<0.1	<0.1	<0.1
	EBDM-RA_E2F2	EBTF-RA_H2I2	<0.1	<0.1	<0.1
	EBDM-RA_E2F2	EBTF-RA_C3D3	0.17	0.10	<0.1
	EBDM-RA_E2F2	EBTF-RA_F3G3	0.14	0.10	<0.1
	EBDM-RA_E2F2	EBTF-RA_I3J3	<0.1	<0.1	<0.1
	EBDM-RA_I7J7	EBTF-RA_E6F6	<0.1	<0.1	<0.1
	EBDM-RA_I7J7	EBTF-RA_H6I6	<0.1	<0.1	<0.1
	EBDM-RA_I7J7	EBTF-RA_K6L6	0.11	<0.1	<0.1
	EBDM-RA_I7J7	EBTF-RA_F7G7	<0.1	<0.1	<0.1
	EBDM-RA_I7J7	EBTF-RA_L7M7	0.14	<0.1	<0.1
	EBDM-RA_I7J7	EBTF-RA_E8F8	<0.1	<0.1	<0.1
	EBDM-RA_I7J7	EBTF-RA_H8I8	<0.1	<0.1	<0.1
	EBDM-RA_I7J7	EBTF-RA_K8L8	<0.1	<0.1	<0.1
	EBDM-RA_O11P11	EBTF-RA_K10L10	<0.1	<0.1	<0.1
	EBDM-RA_O11P11	EBTF-RA_N10O10	<0.1	<0.1	<0.1
	EBDM-RA_O11P11	EBTF-RA_Q10R10	0.12	<0.1	<0.1
	EBDM-RA_O11P11	EBTF-RA_L11M11	0.22	0.15	<0.1
	EBDM-RA_O11P11	EBTF-RA_R11S11	0.27	0.18	0.10
	EBDM-RA_O11P11	EBTF-RA_K12L12	<0.1	<0.1	<0.1
	EBDM-RA_O11P11	EBTF-RA_N12O12	<0.1	<0.1	<0.1
	EBDM-RA_O11P11	EBTF-RA_Q12R12	<0.1	<0.1	<0.1

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

Table 3- Propagation Delay (Mated Connector)	
EBDM-RA_C1D1_EBTF-RA_C1D1	153 ps
EBDM-RA_F1G1_EBTF-RA_F1G1	179 ps
EBDM-RA_I1J1_EBTF-RA_I1J1	208 ps
EBDM-RA_B2C2_EBTF-RA_B2C2	168 ps
EBDM-RA_E2F2_EBTF-RA_E2F2	193 ps
EBDM-RA_H2I2_EBTF-RA_H2I2	222 ps
EBDM-RA_C3D3_EBTF-RA_C3D3	199 ps
EBDM-RA_F3G3_EBTF-RA_F3G3	223 ps
EBDM-RA_I3J3_EBTF-RA_I3J3	251 ps
EBDM-RA_E6F6_EBTF-RA_E6F6	280 ps
EBDM-RA_H6I6_EBTF-RA_H6I6	308 ps
EBDM-RA_K6L6_EBTF-RA_K6L6	337 ps
EBDM-RA_F7G7_EBTF-RA_F7G7	310 ps
EBDM-RA_I7J7_EBTF-RA_I7J7	337 ps
EBDM-RA_L7M7_EBTF-RA_L7M7	364 ps
EBDM-RA_E8F8_EBTF-RA_E8F8	325 ps
EBDM-RA_H8I8_EBTF-RA_H8I8	351 ps
EBDM-RA_K8L8_EBTF-RA_K8L8	378 ps
EBDM-RA_K10L10_EBTF-RA_K10L10	421 ps
EBDM-RA_N10O10_EBTF-RA_N10O10	448 ps
EBDM-RA_Q10R10_EBTF-RA_Q10R10	477 ps
EBDM-RA_L11M11_EBTF-RA_L11M11	448 ps
EBDM-RA_O11P11_EBTF-RA_O11P11	476 ps
EBDM-RA_R11S11_EBTF-RA_R11S11	504 ps
EBDM-RA_K12L12_EBTF-RA_K12L12	462 ps
EBDM-RA_N12O12_EBTF-RA_N12O12	488 ps
EBDM-RA_Q12R12_EBTF-RA_Q12R12	516 ps

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

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 differentially 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.

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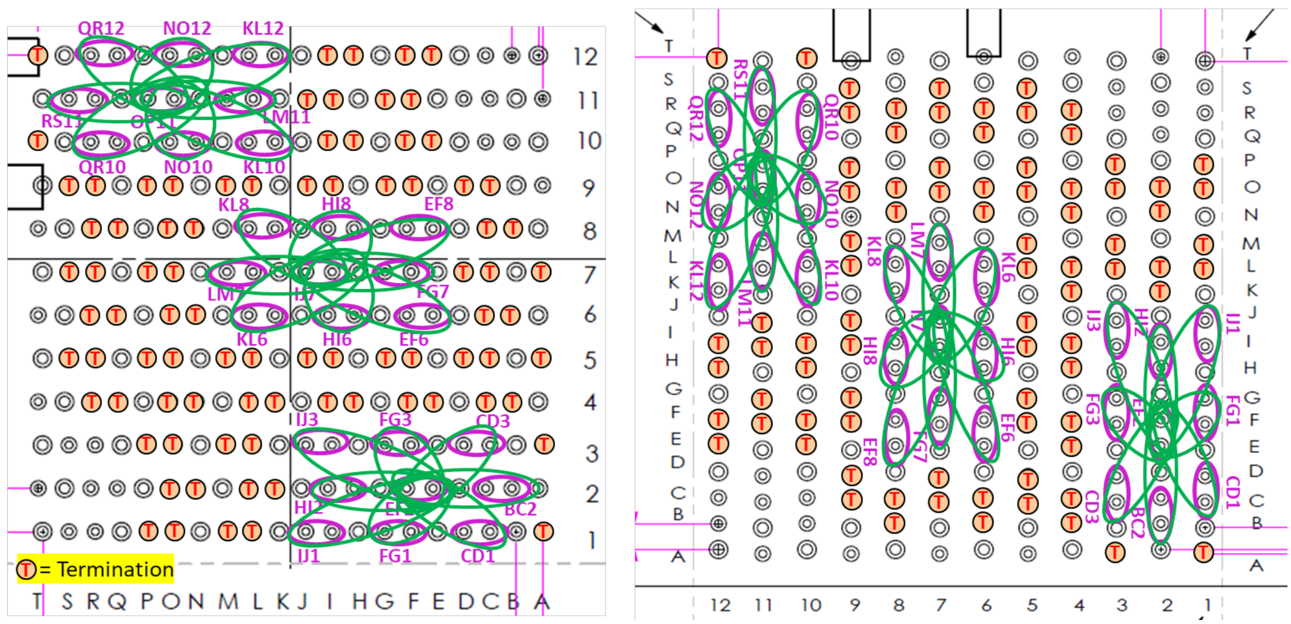
For this connector, the following array configurations were evaluated:

EBDM-RA EBTF-RA



<u>Differential Impedance (denoted by purple circles)</u>**:**

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

<u>Differential Crosstalk (denoted by green circles)</u>**:**

- 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.

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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 2.30 mm of PCB trace on both the EBDM-RA and EBTF-RA 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.

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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.

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Appendix A – Frequency Domain Response Graphs

Differential Application – Insertion Loss

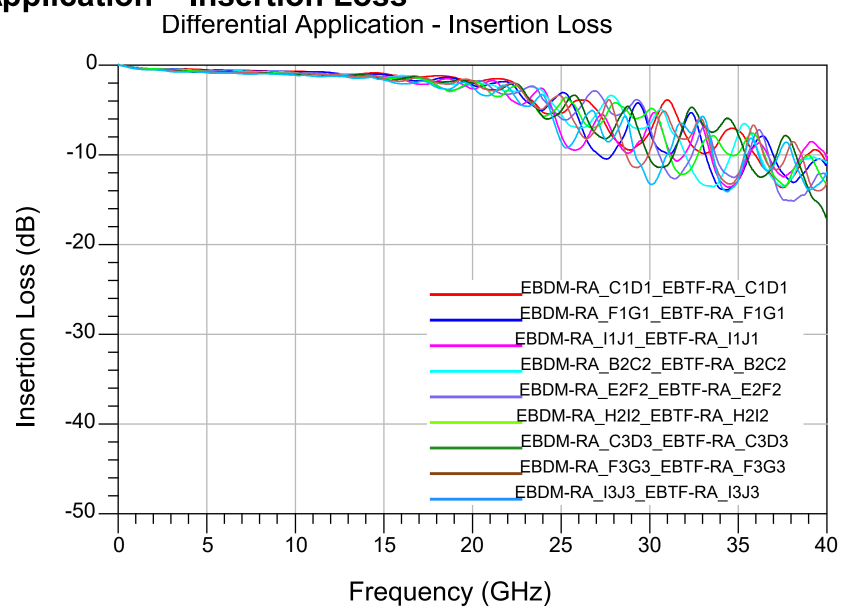

Figure 4

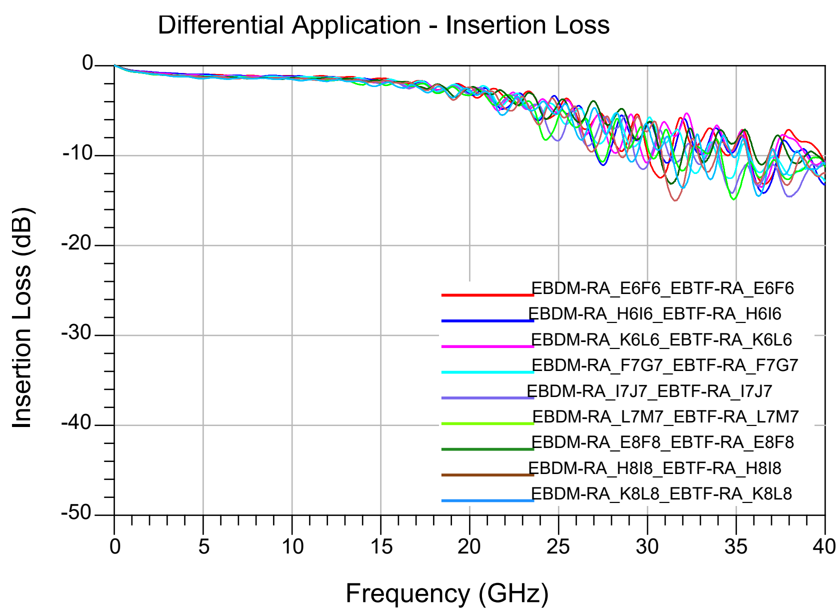

Figure 5

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

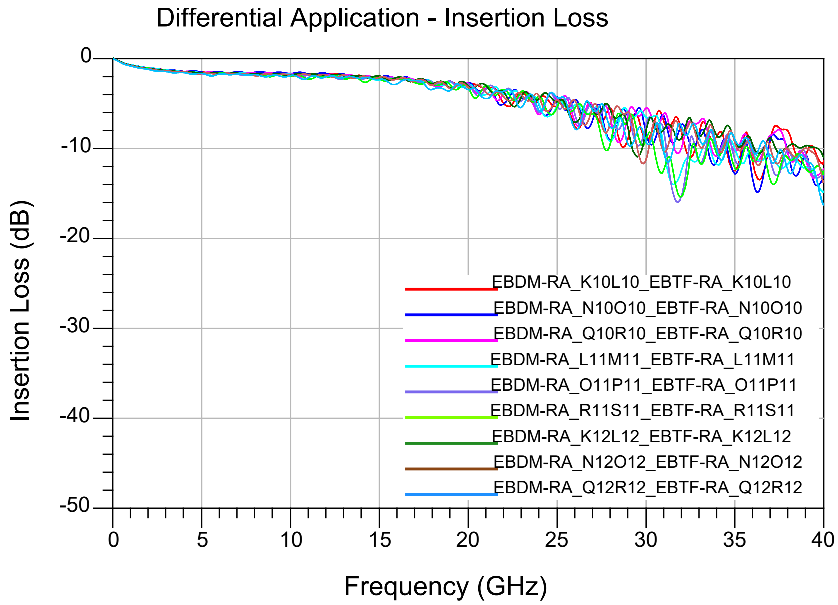

Figure 6

Differential Application – Return Loss

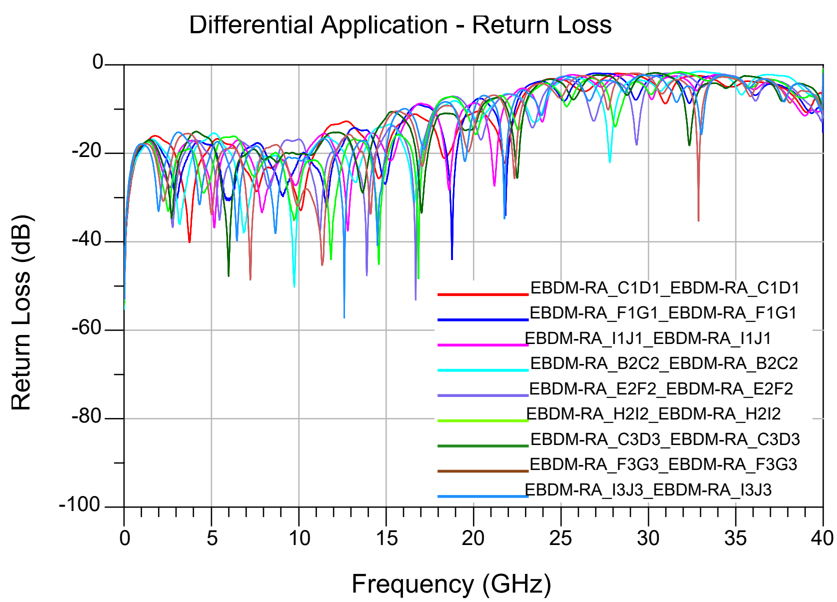

Figure 7

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

Differential Application - Return Loss

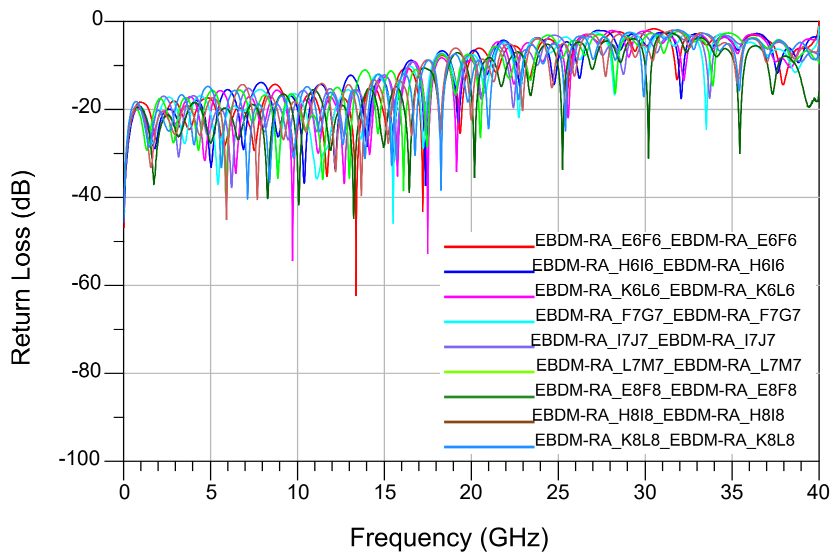

Figure 8

Differential Application - Return Loss

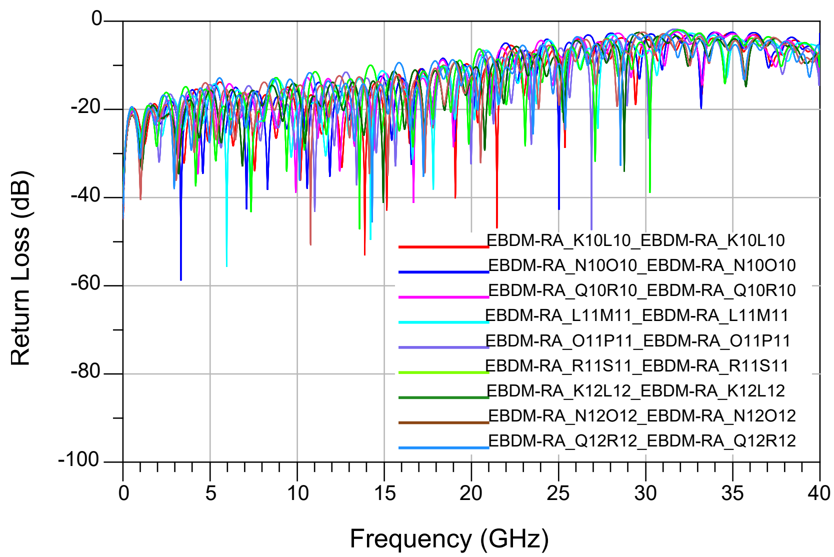

Figure 9

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

Differential Application – NEXT Configurations

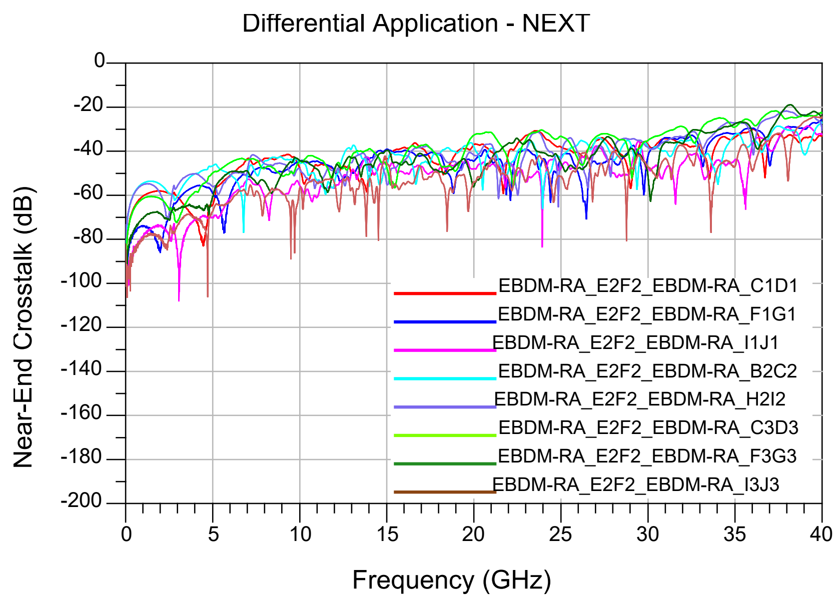

Figure 10

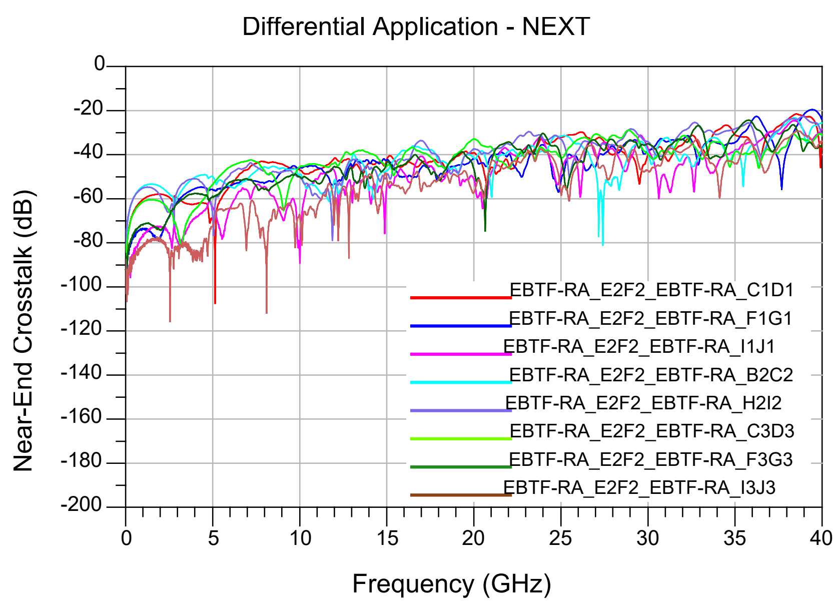

Figure 11

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

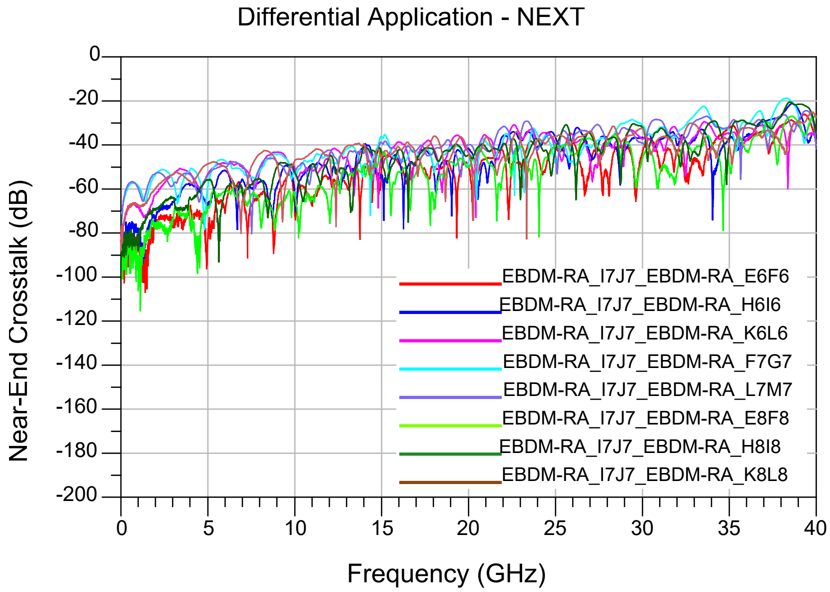

Figure 12

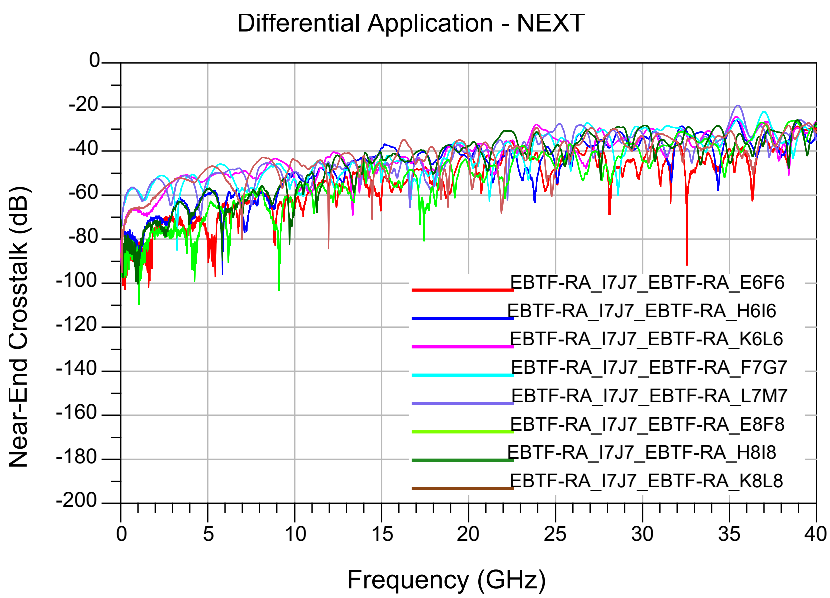

Figure 13

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

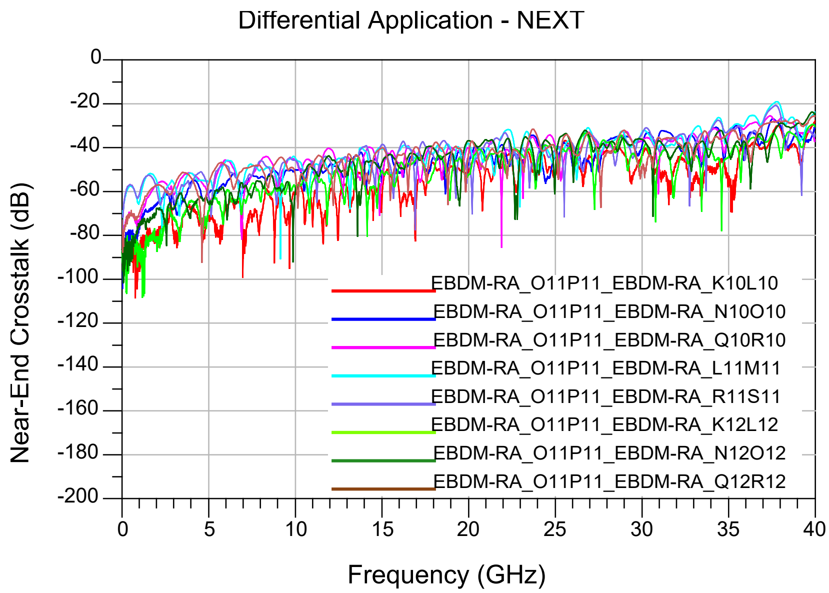

Figure 14

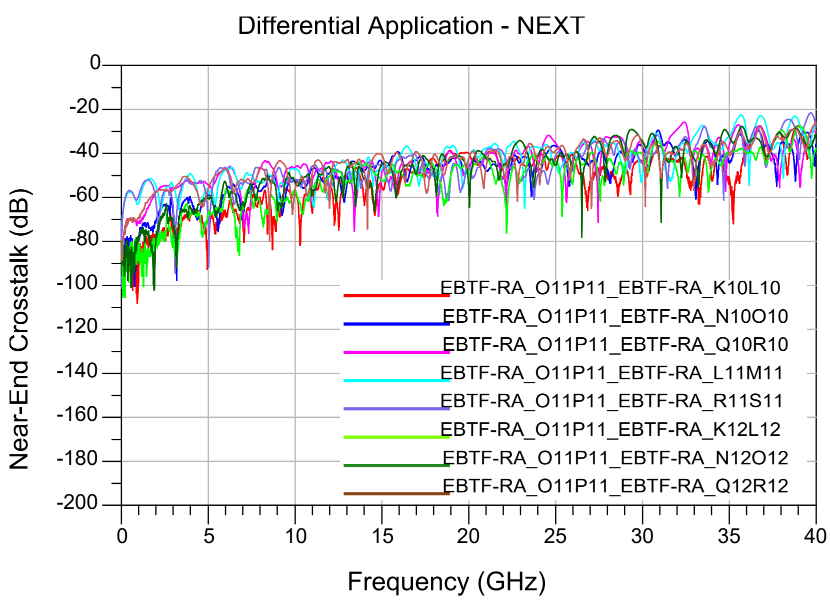

Figure 15

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

Differential Application – FEXT Configurations

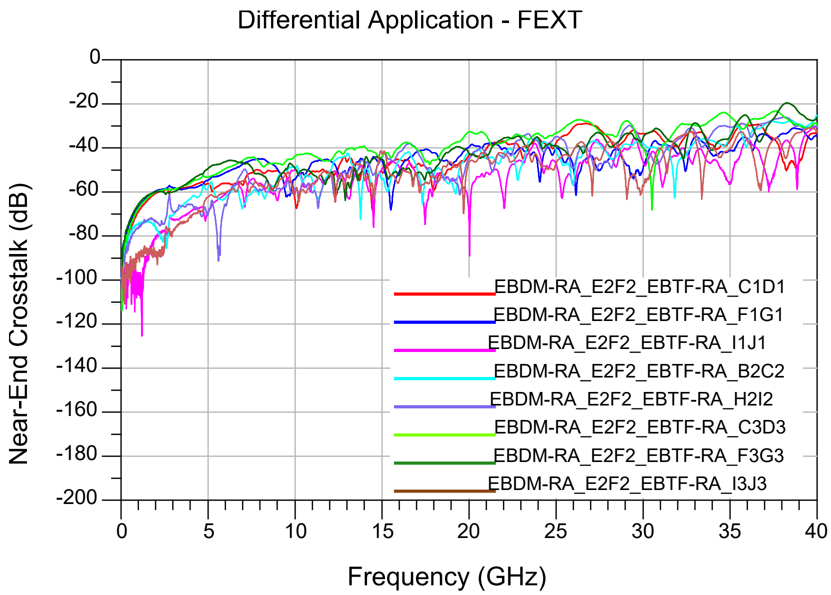

Figure 16

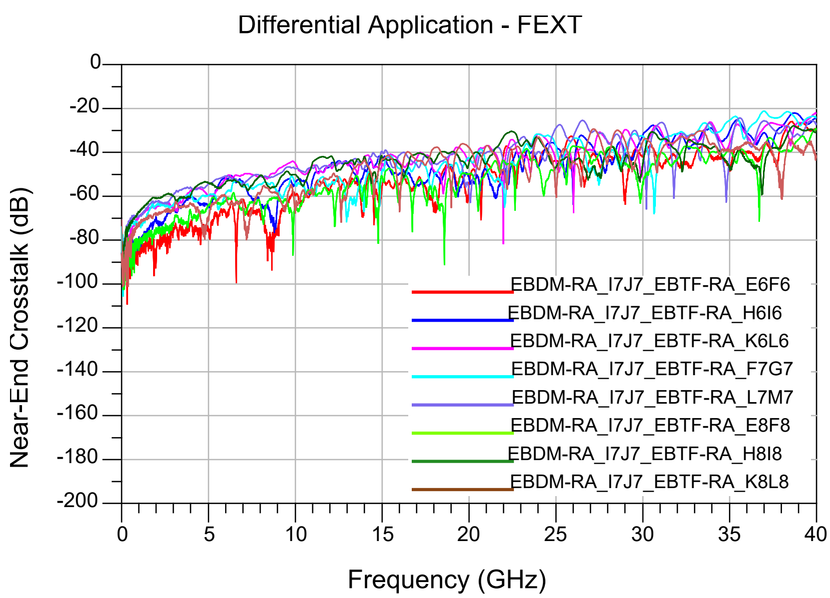

Figure 17

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

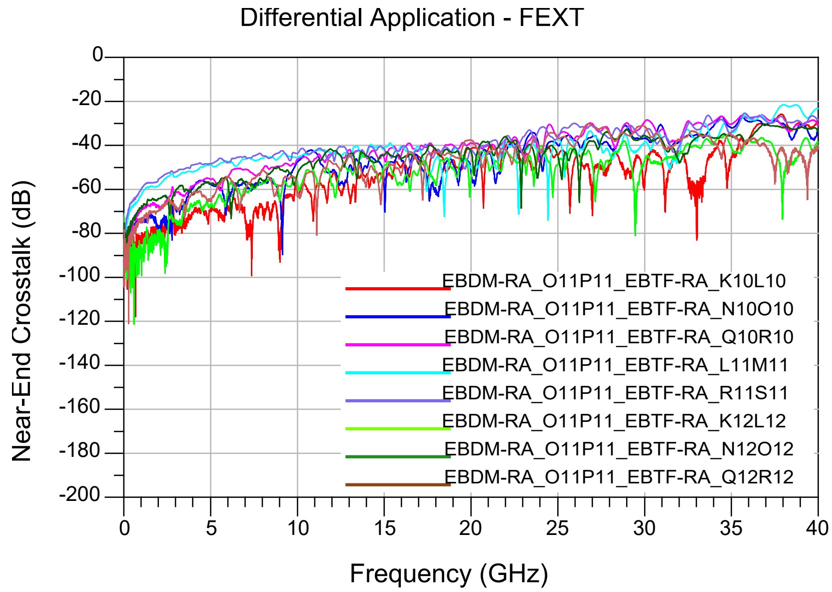

Figure 18

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

Appendix B – Time Domain Responses

Differential Application – Impedance

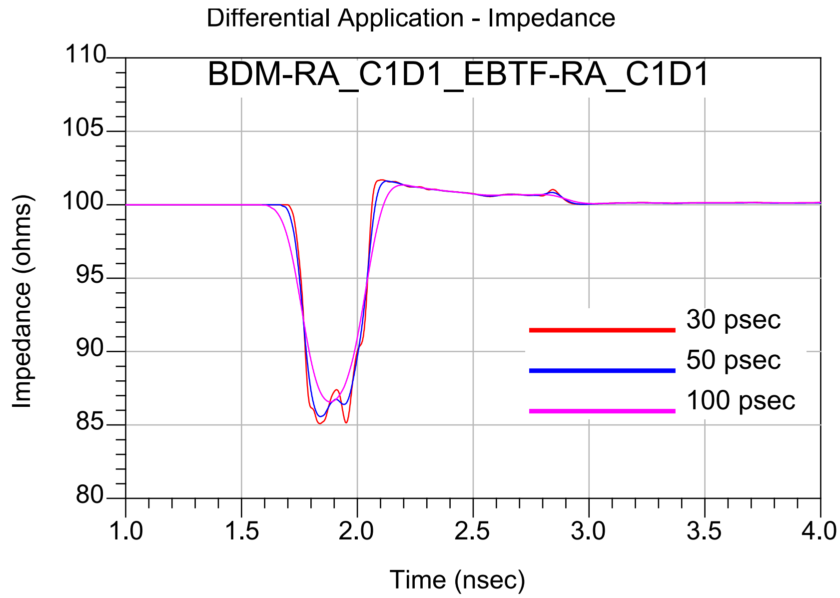

Figure 19

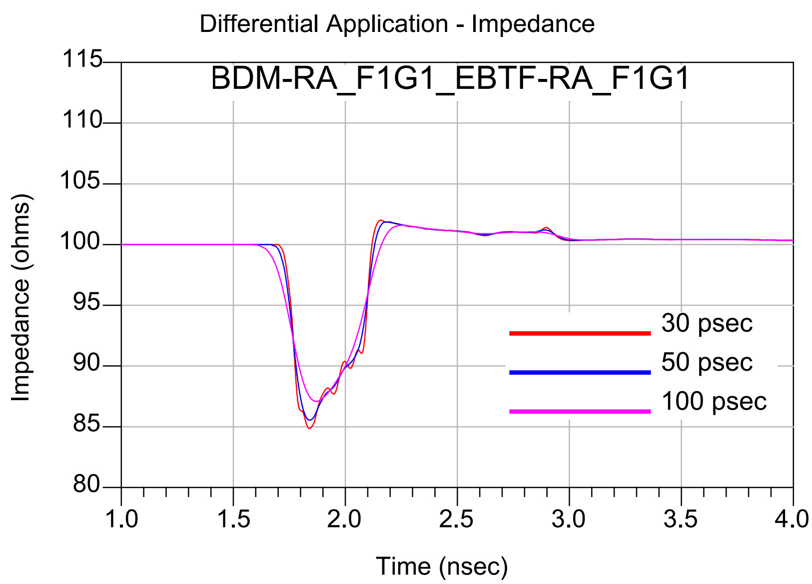

Figure 20

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

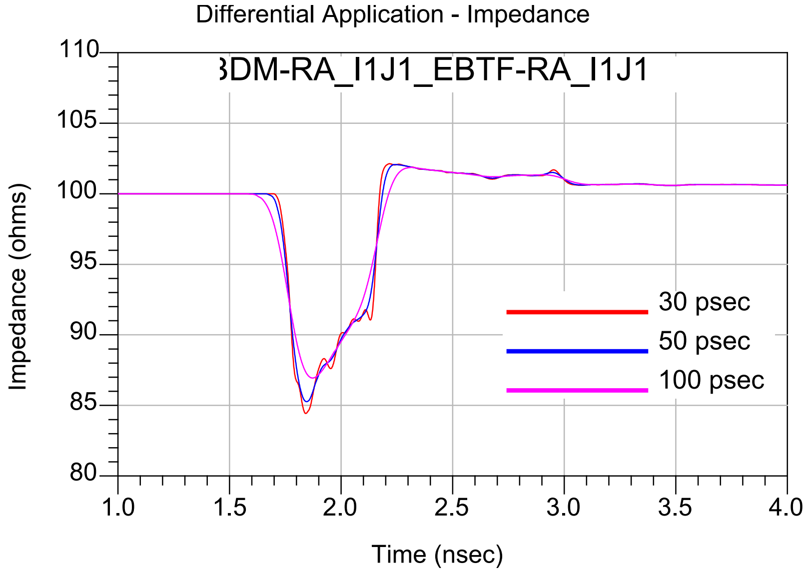

Figure 21

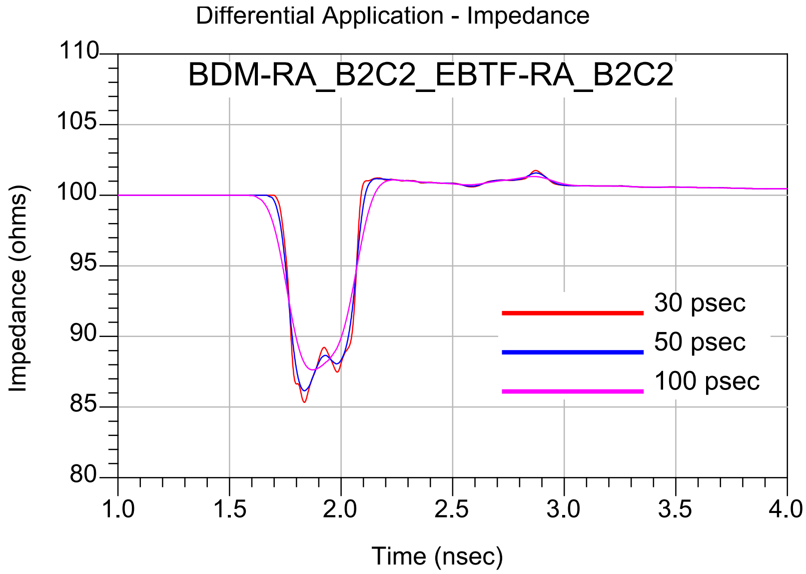

Figure 22

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

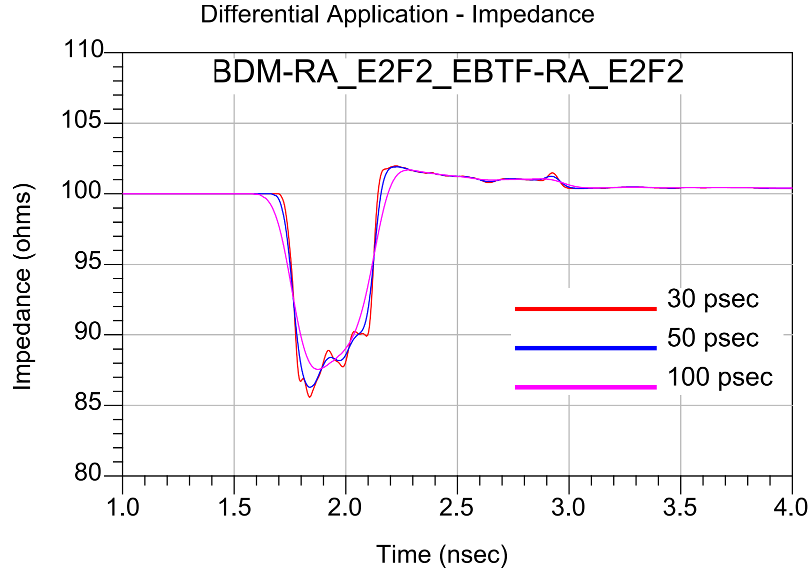

Figure 23

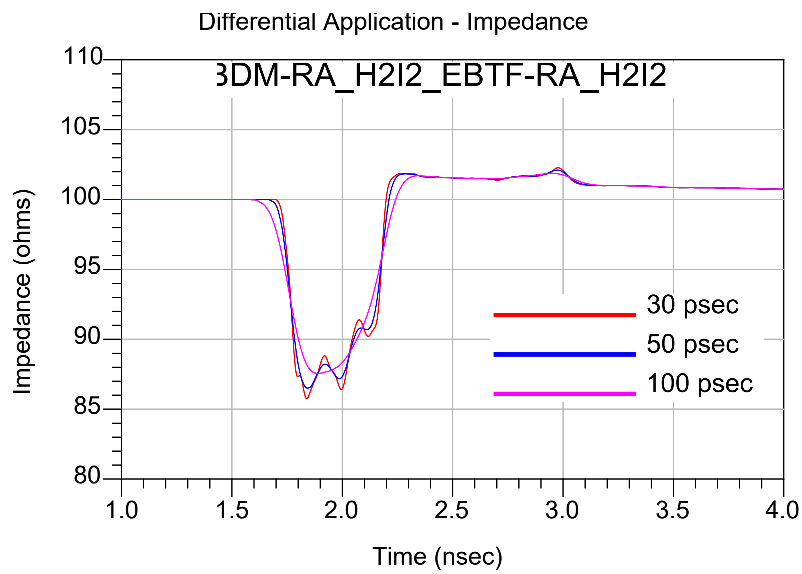

Figure 24

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

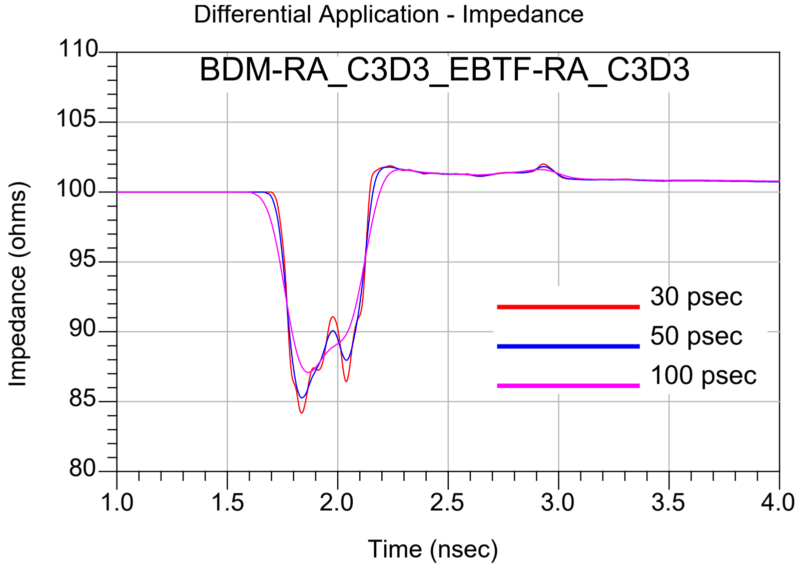

Figure 25

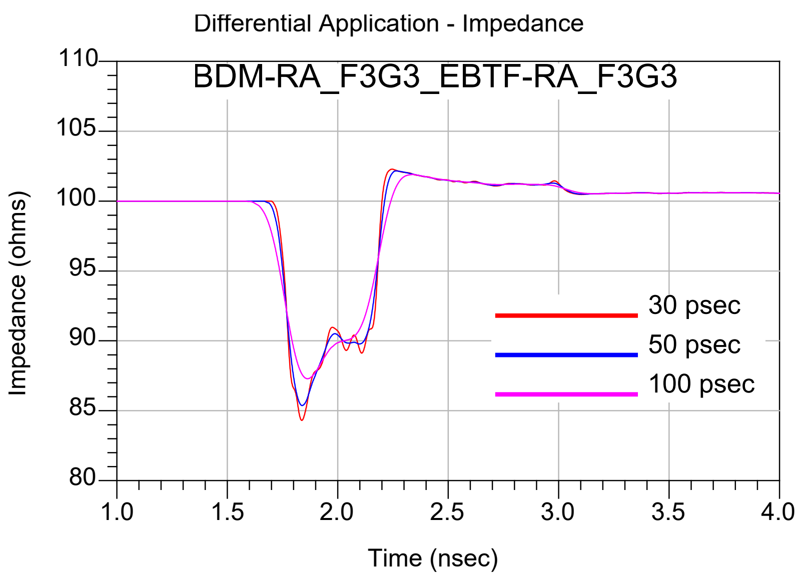

Figure 26

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

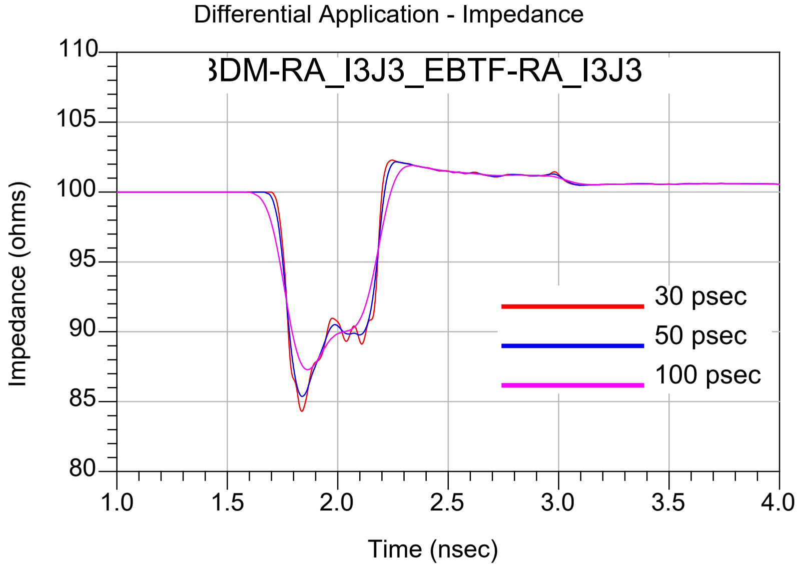

Figure 27

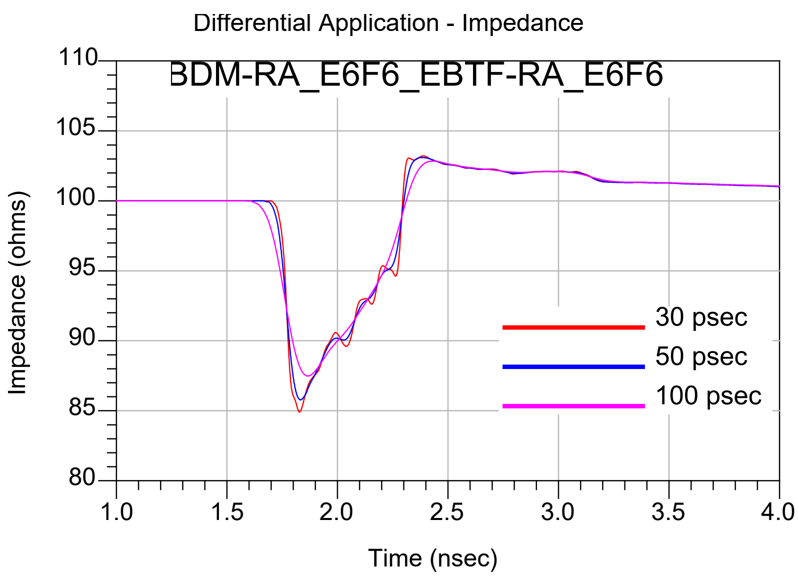

Figure 28

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

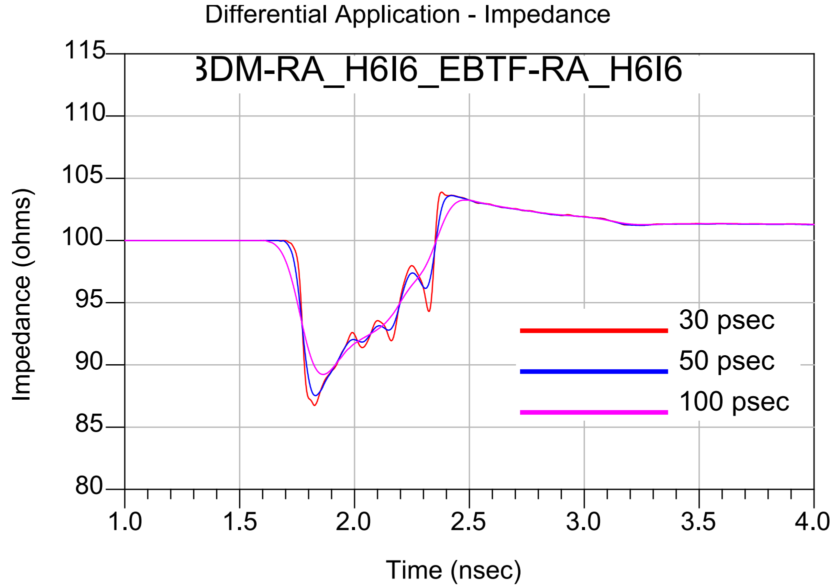

Figure 29

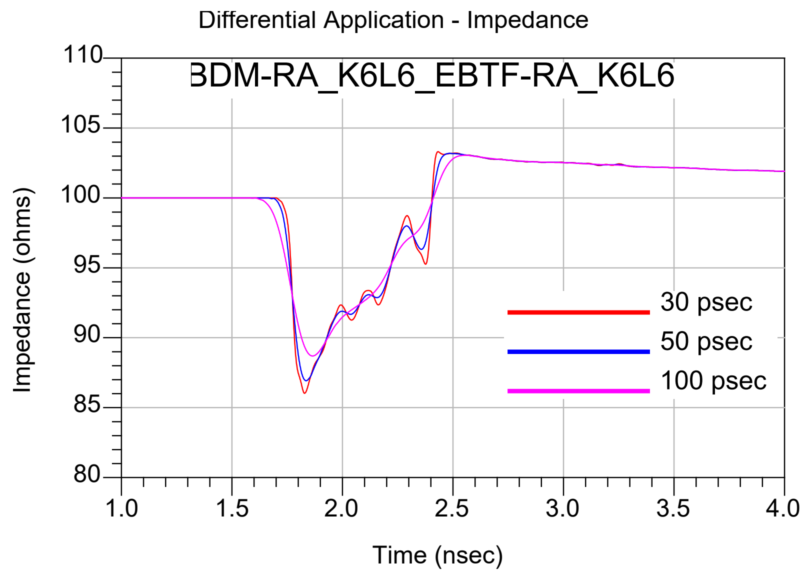

Figure 30

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

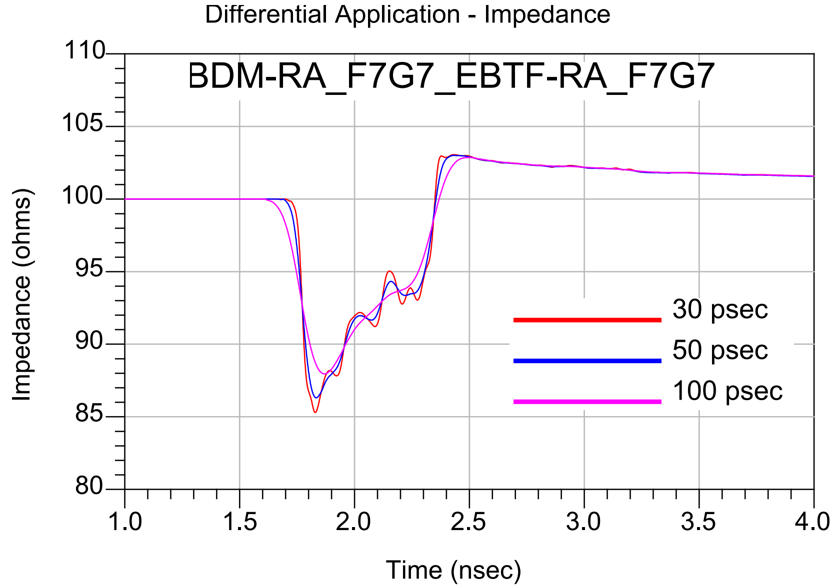

Figure 31

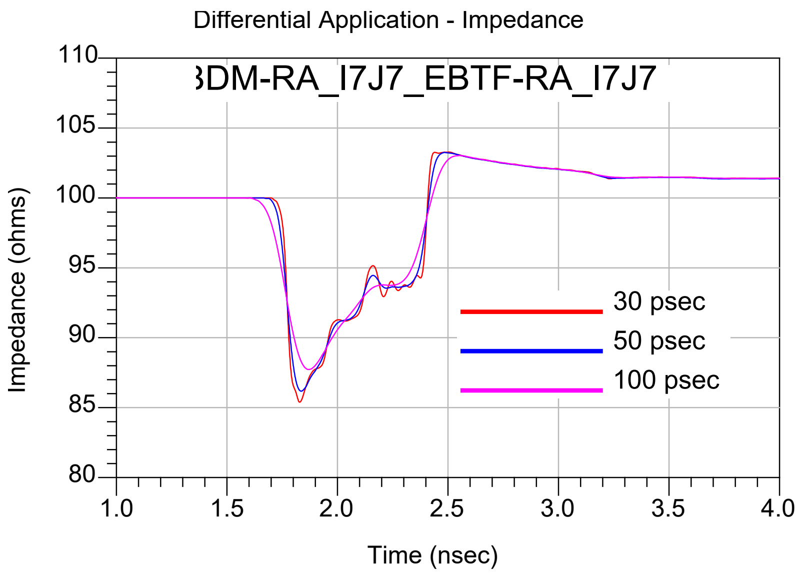

Figure 32

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

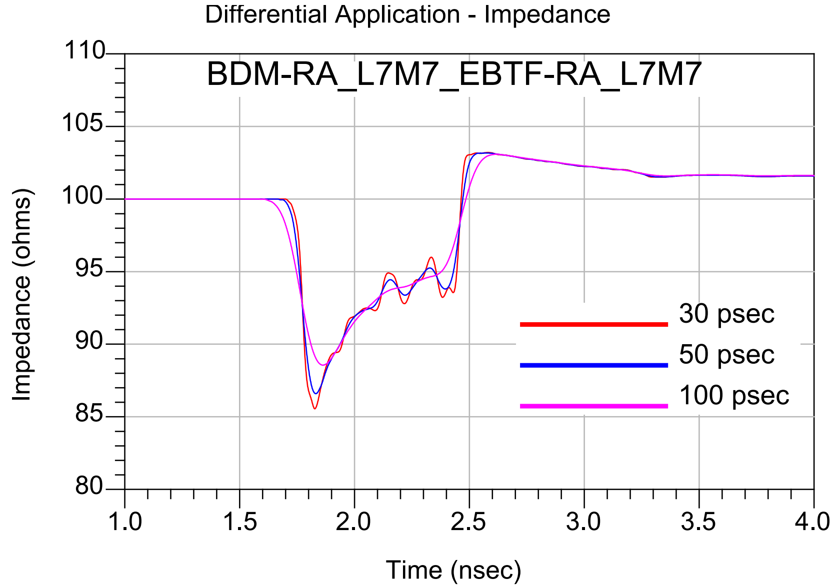

Figure 33

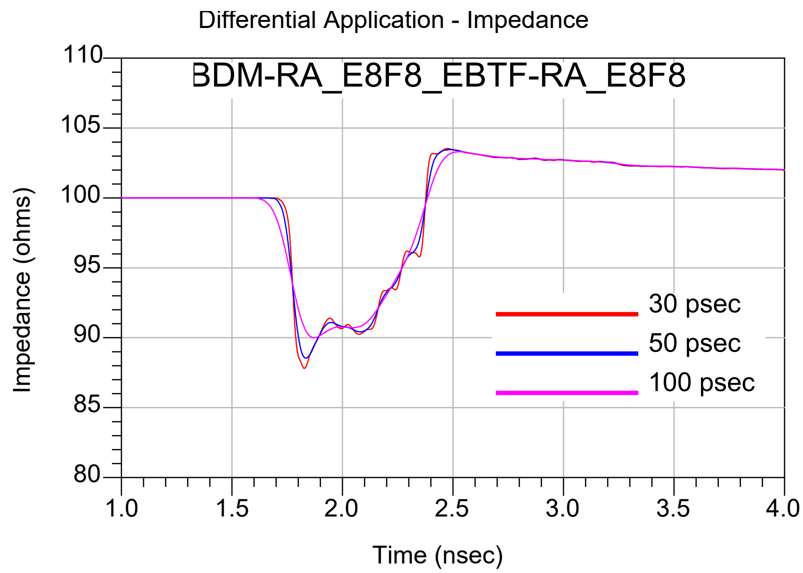

Figure 34

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

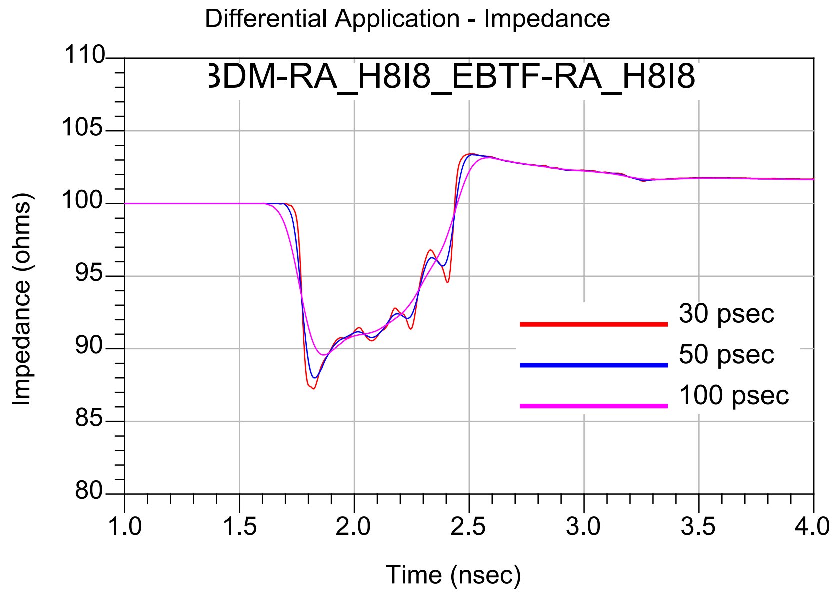

Figure 35

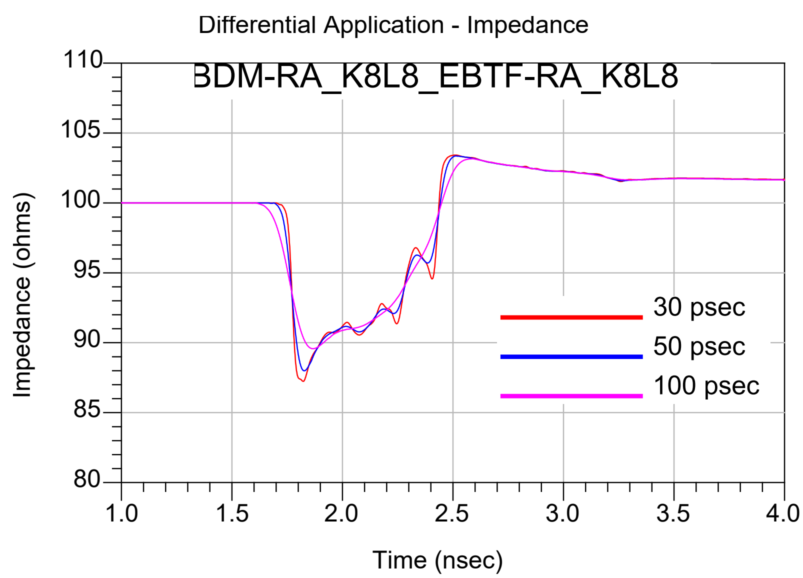

Figure 36

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

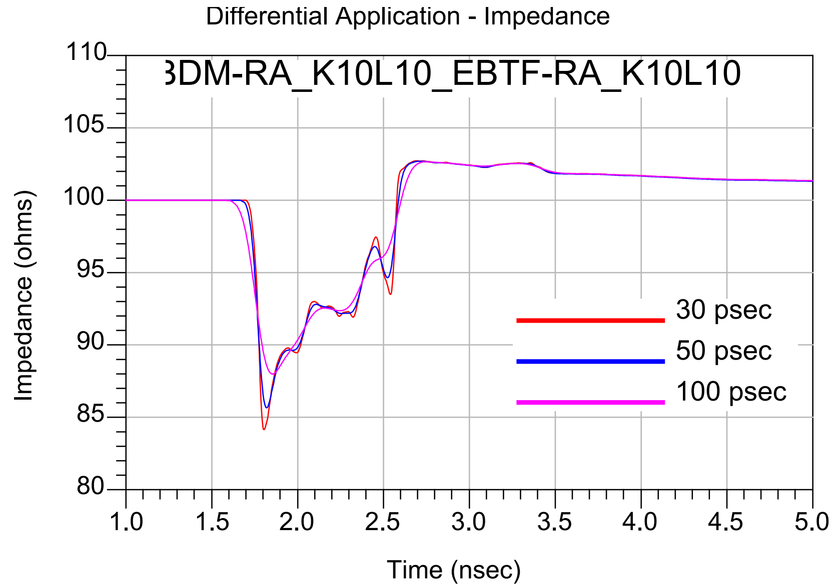

Figure 37

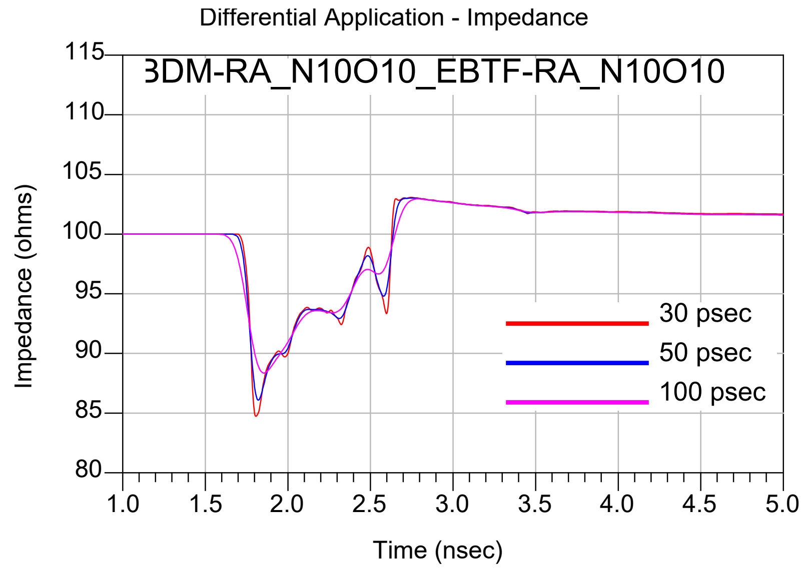

Figure 38

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

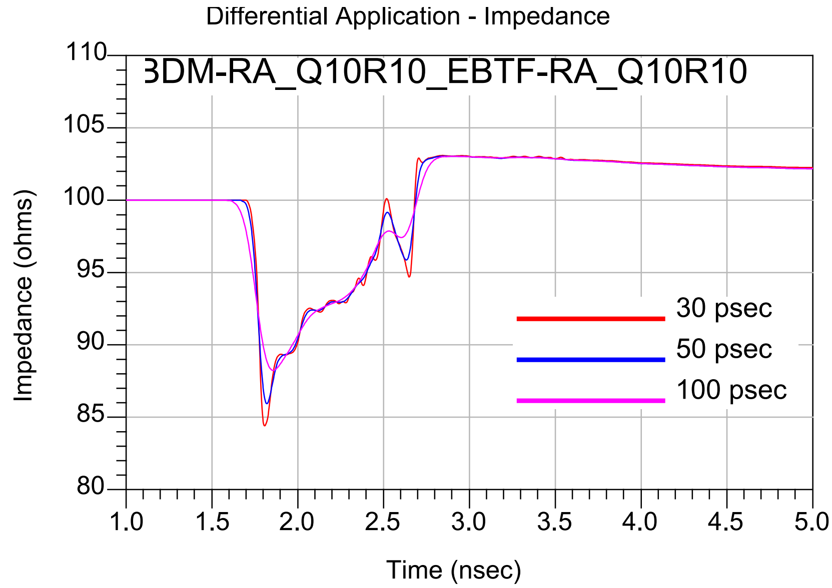

Figure 39

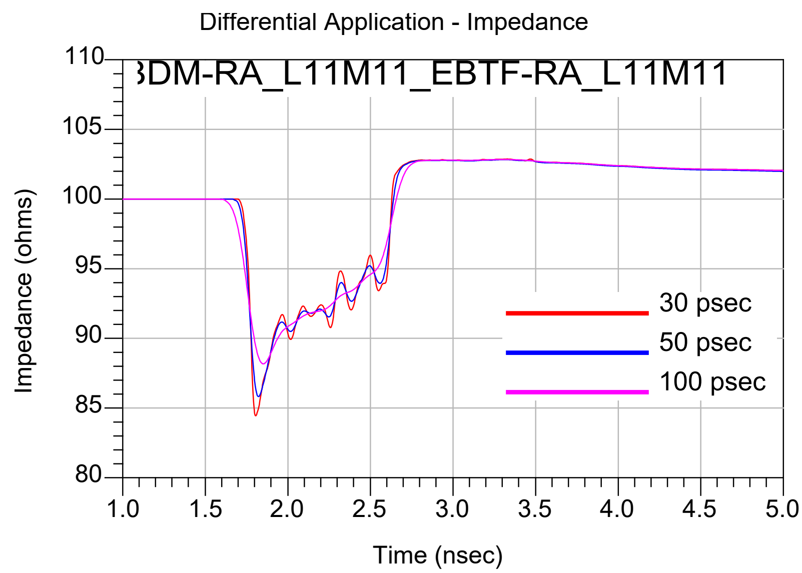

Figure 40

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

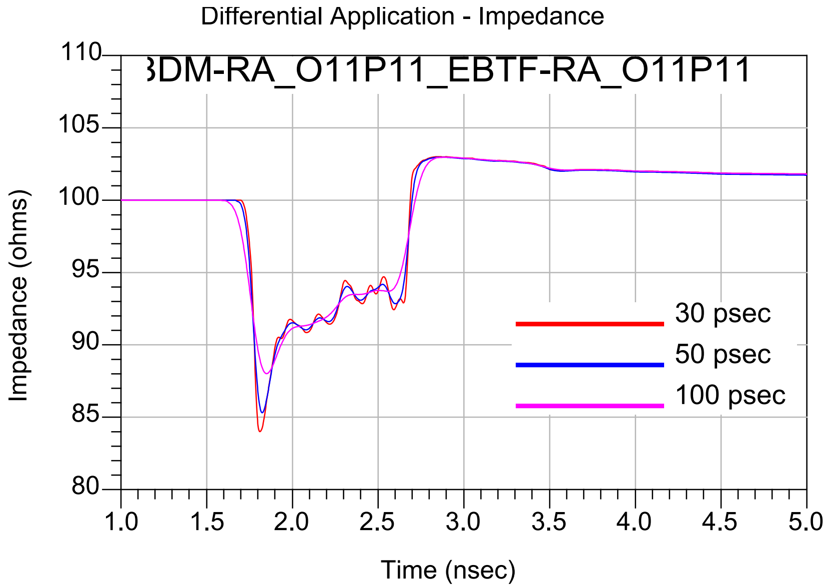

Figure 41

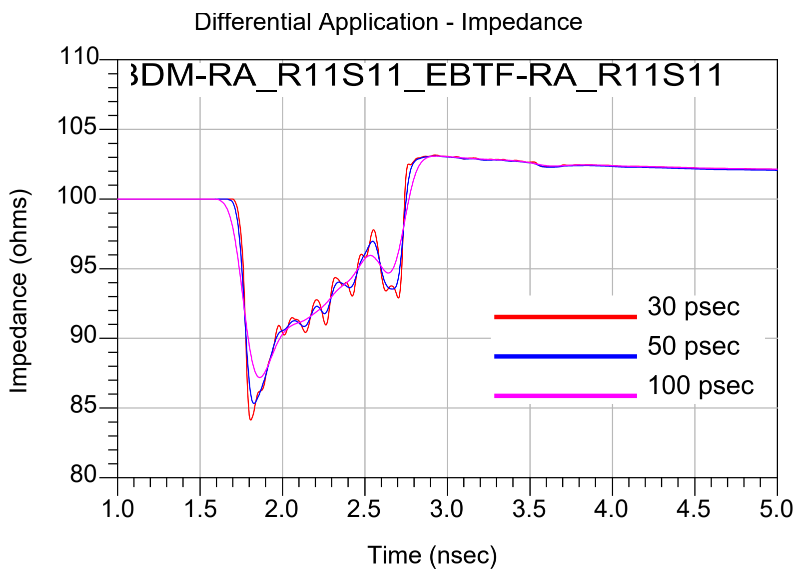

Figure 42

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

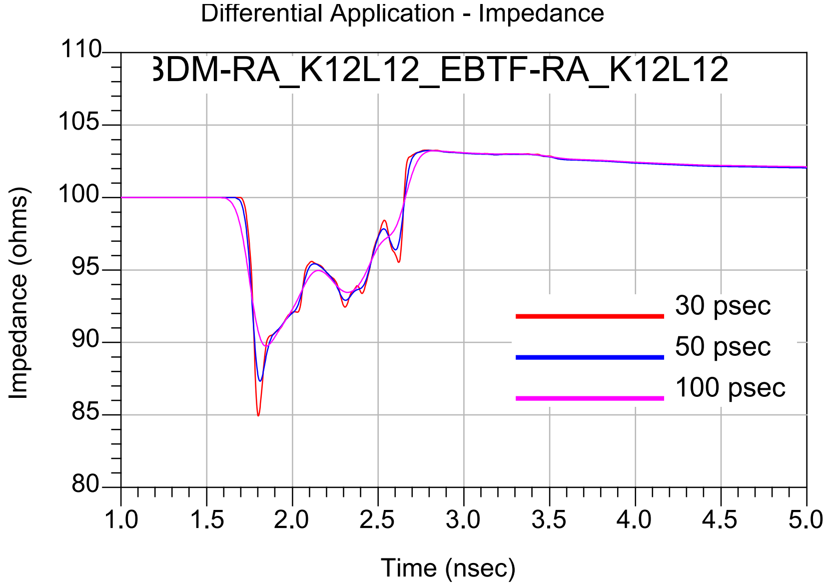

Figure 43

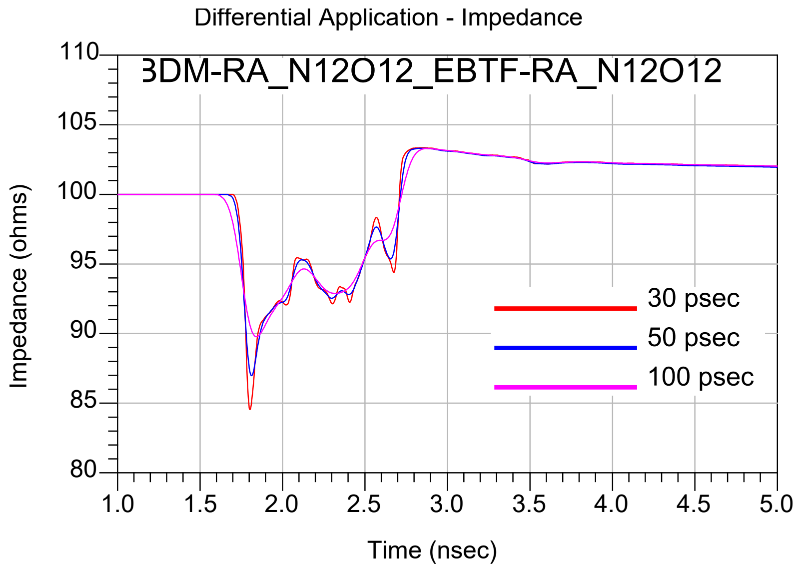

Figure 44

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

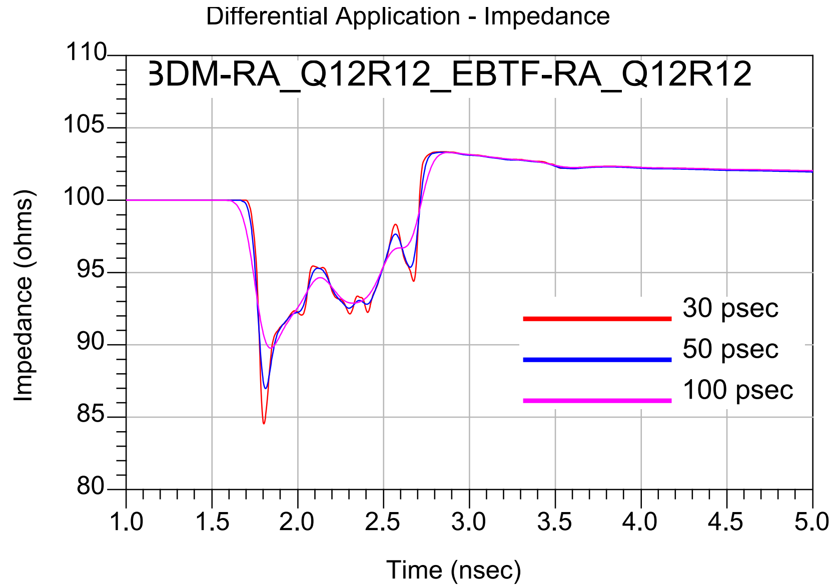

Figure 45

Differential Application – Propagation Delay

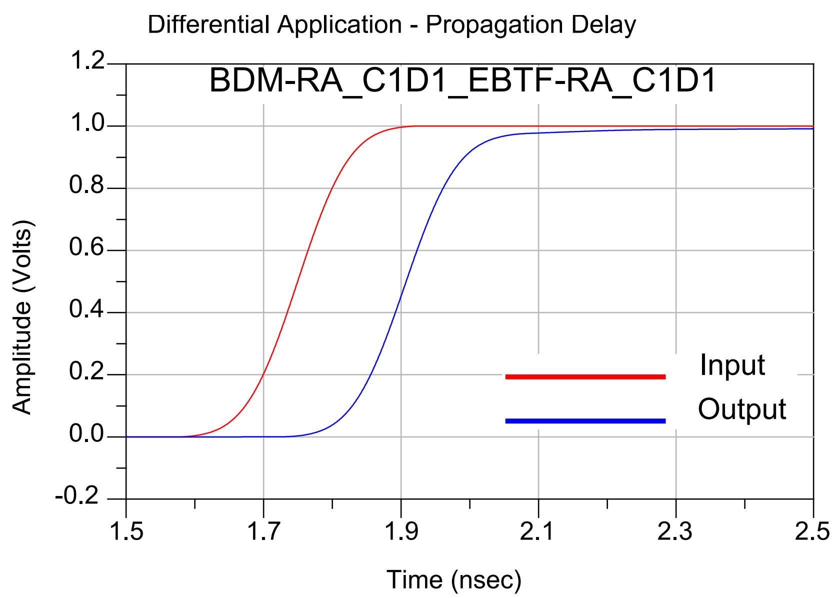

Figure 46

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

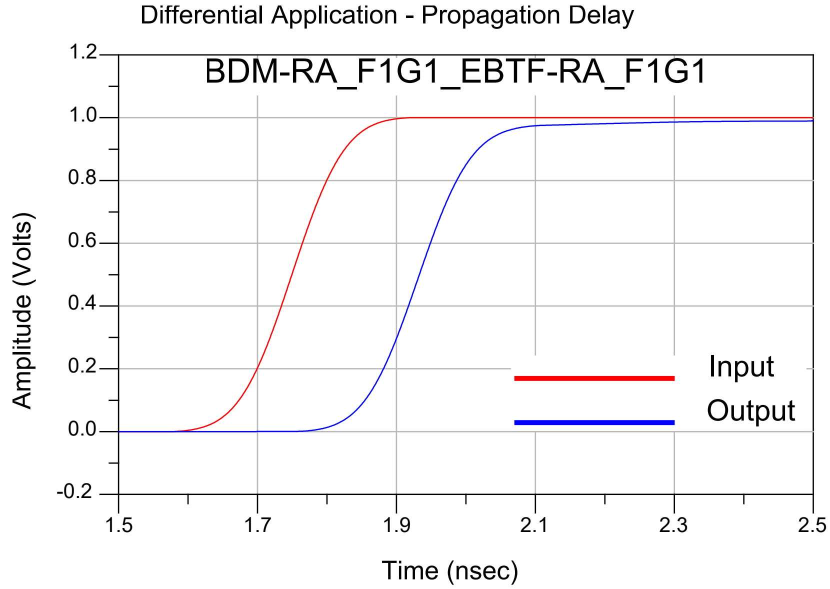

Figure 47

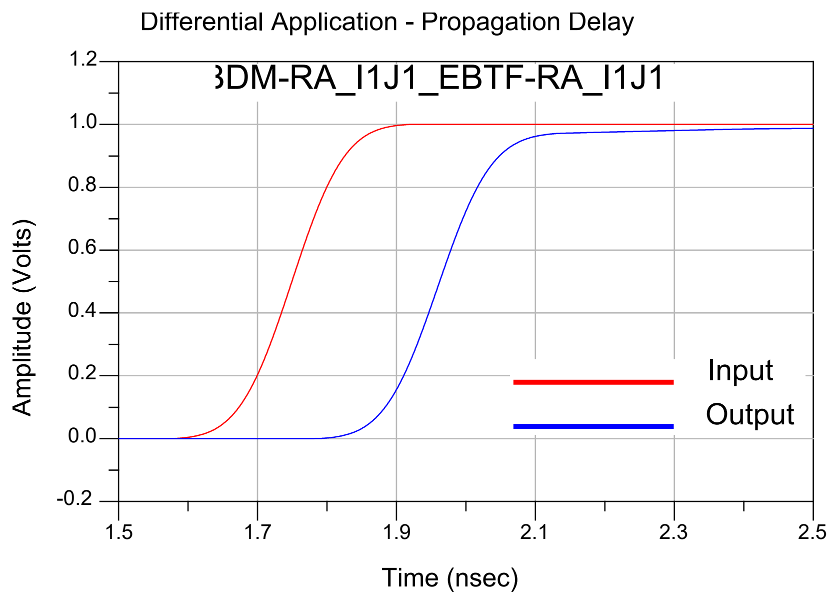

Figure 48

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

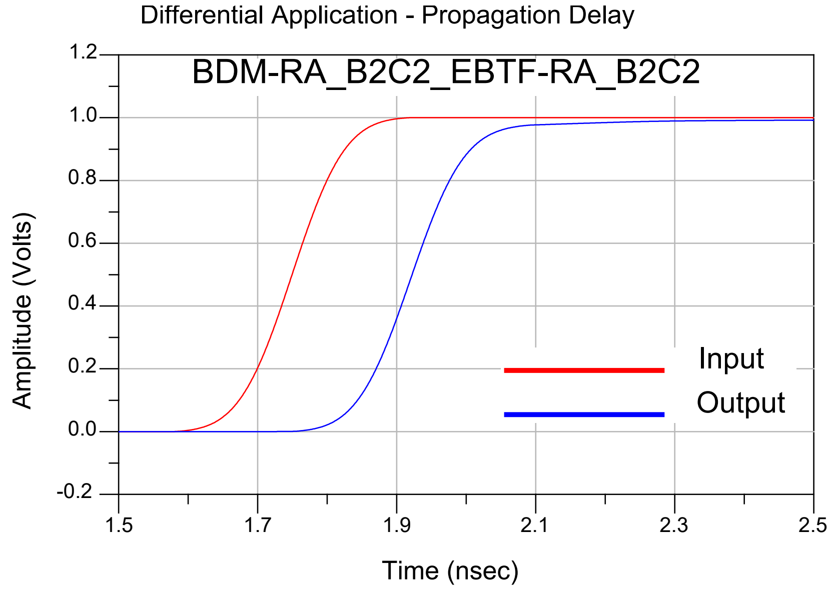

Figure 49

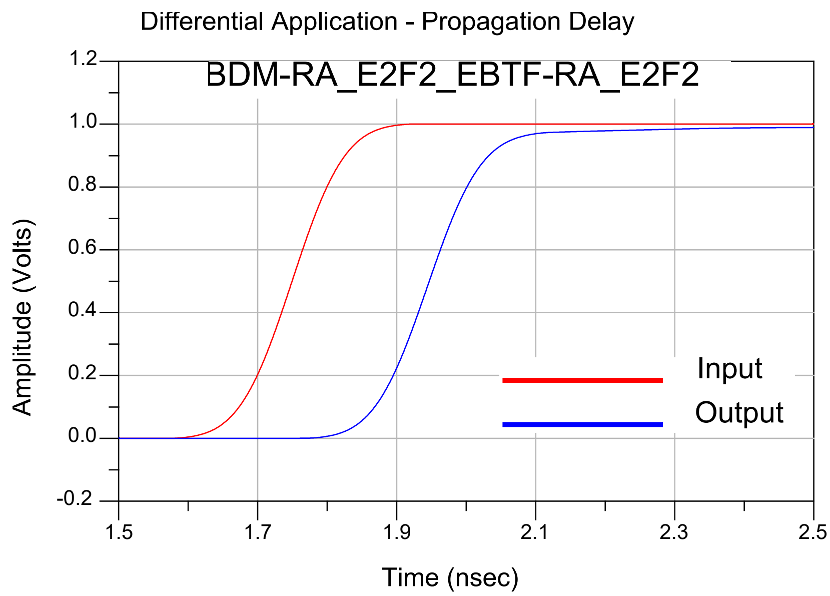

Figure 50

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

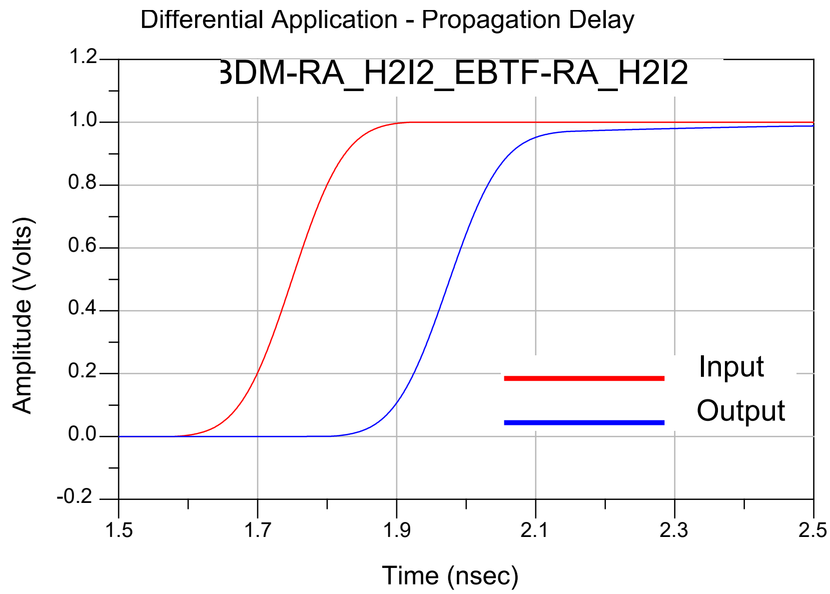

Figure 51

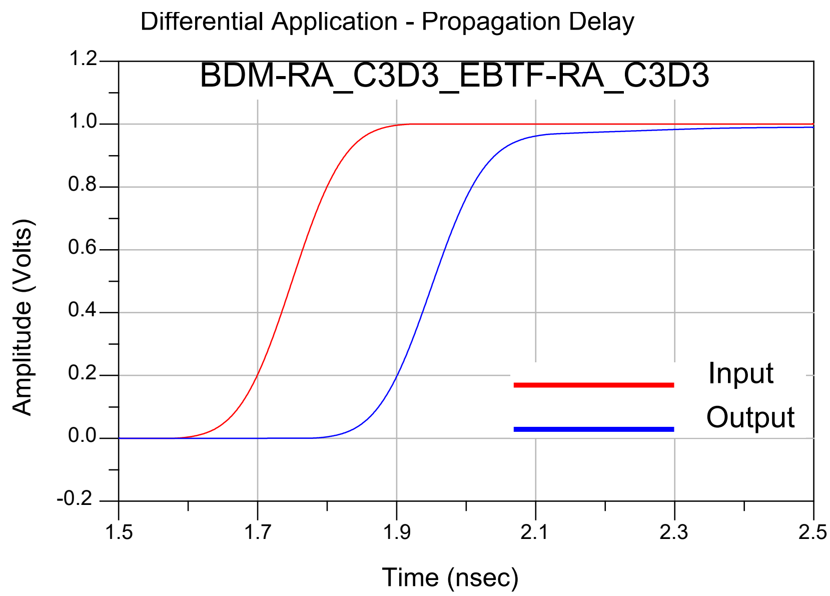

Figure 52

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

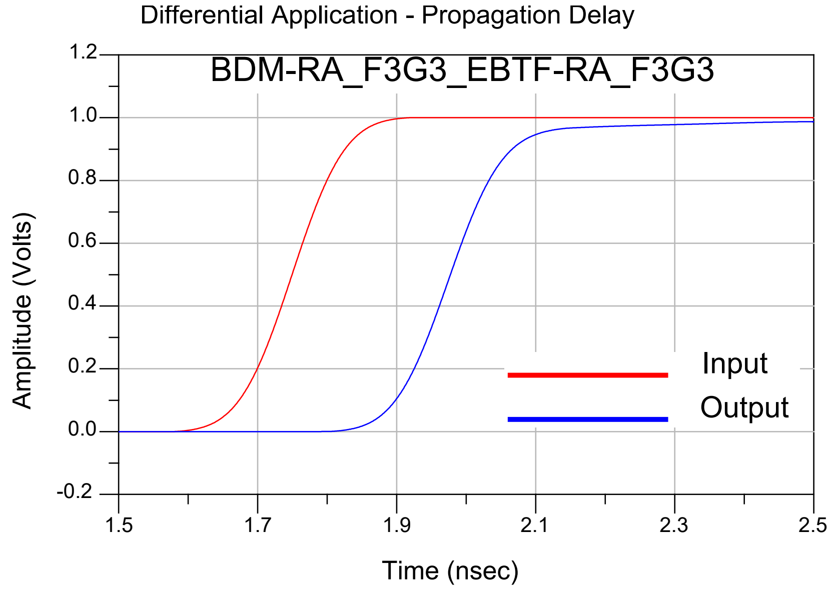

Figure 53

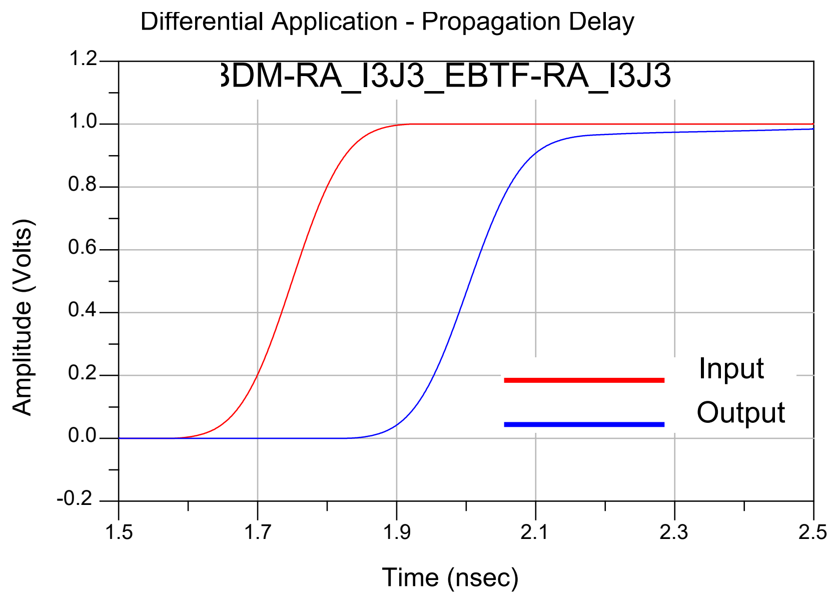

Figure 54

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

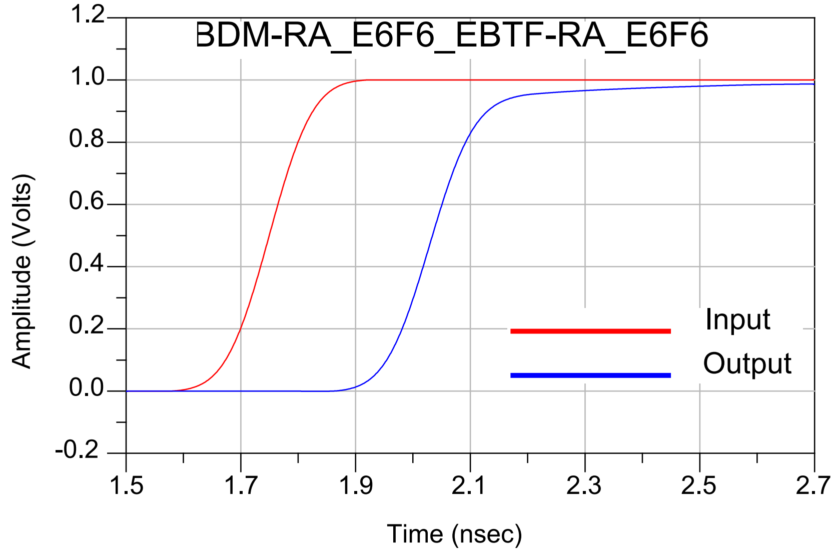

Figure 55

Differential Application - Propagation Delay

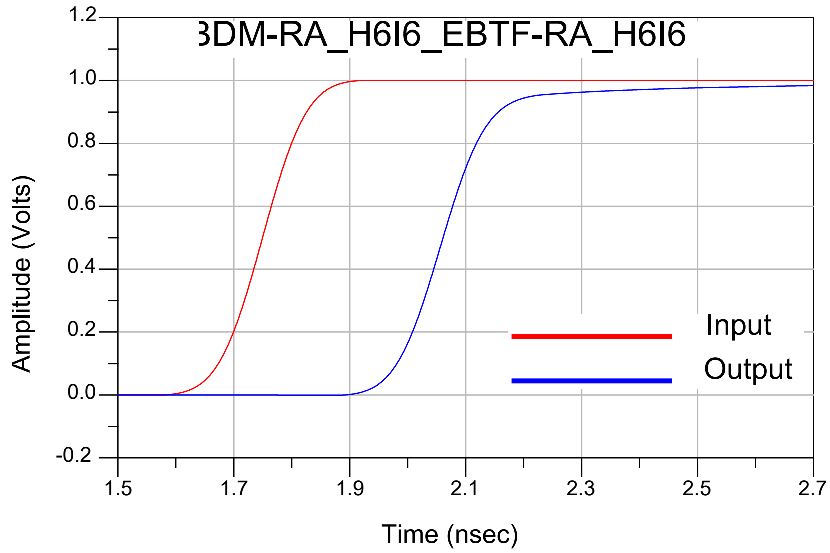

Figure 56

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

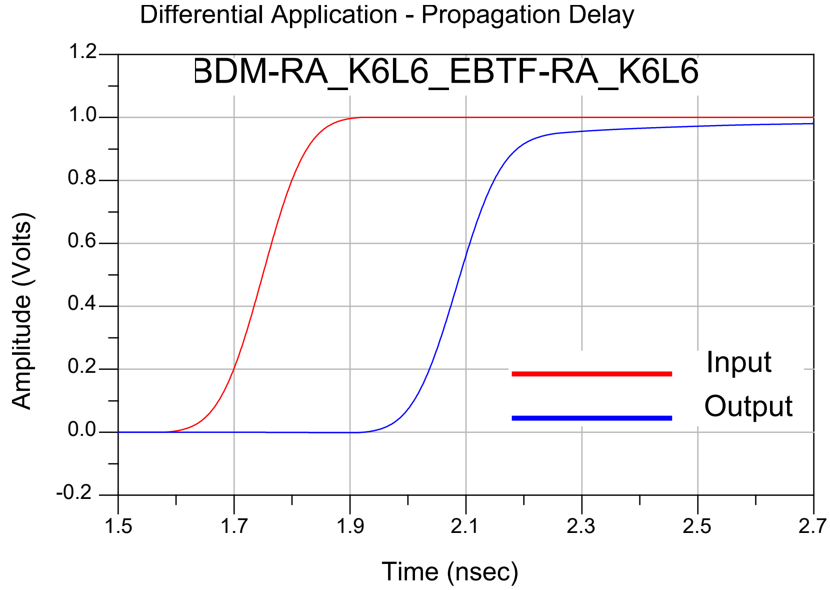

Figure 57

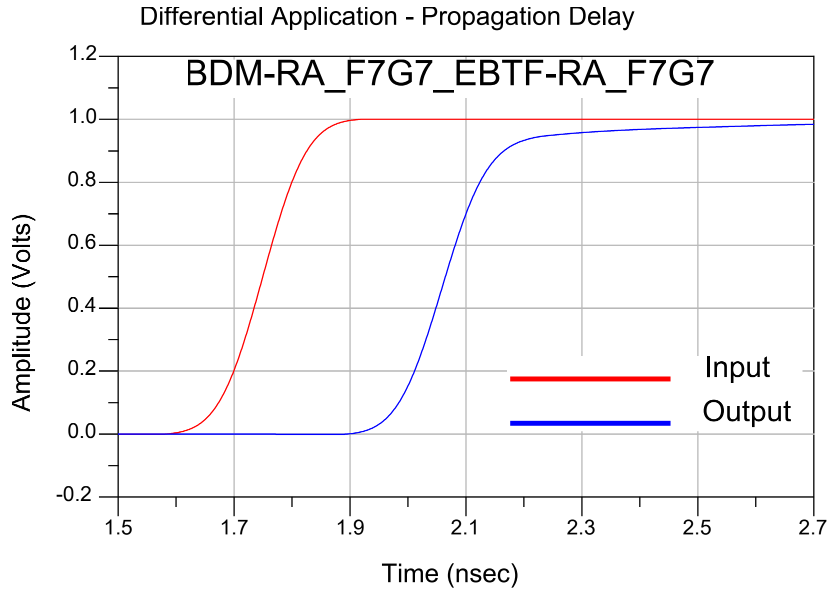

Figure 58

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

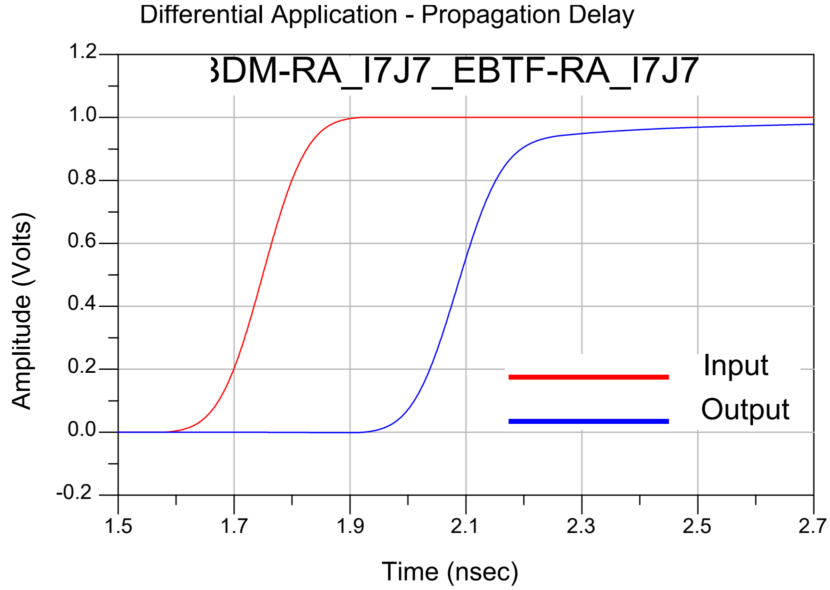

Figure 59

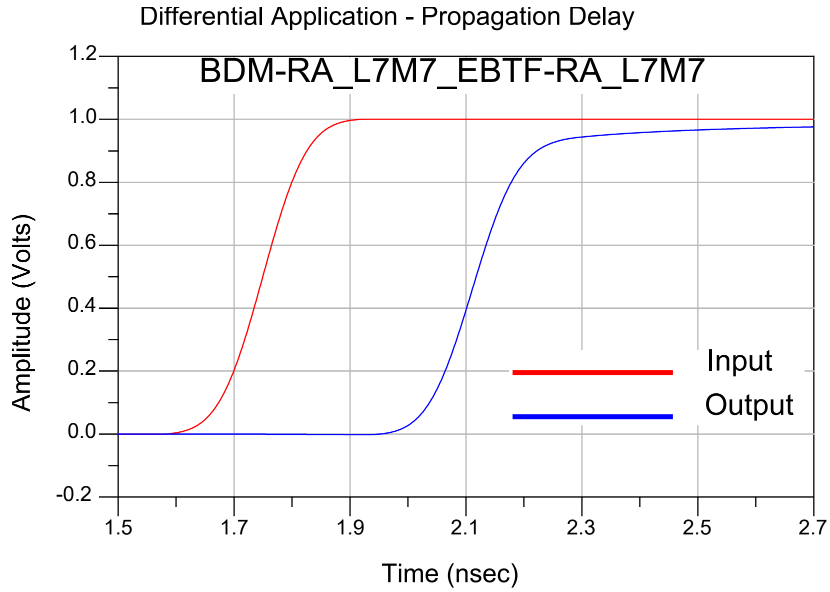

Figure 60

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

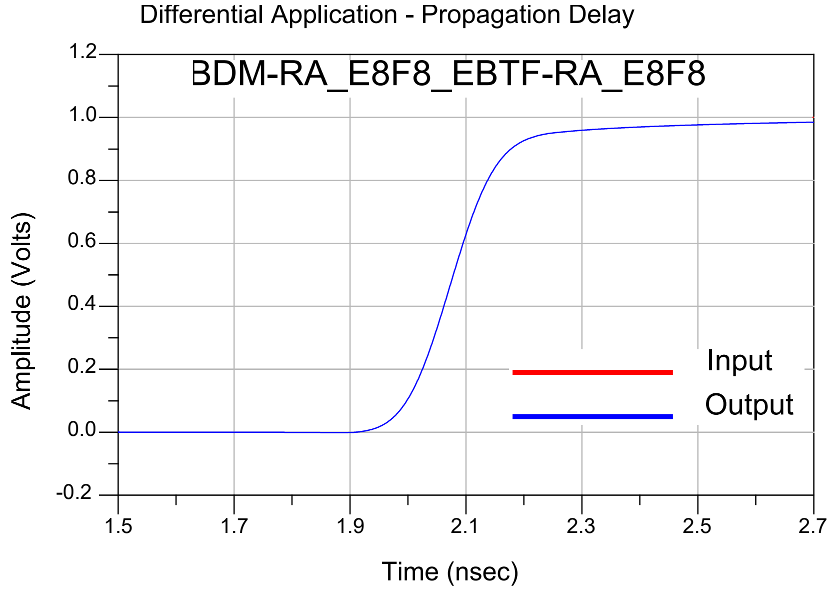

Figure 61

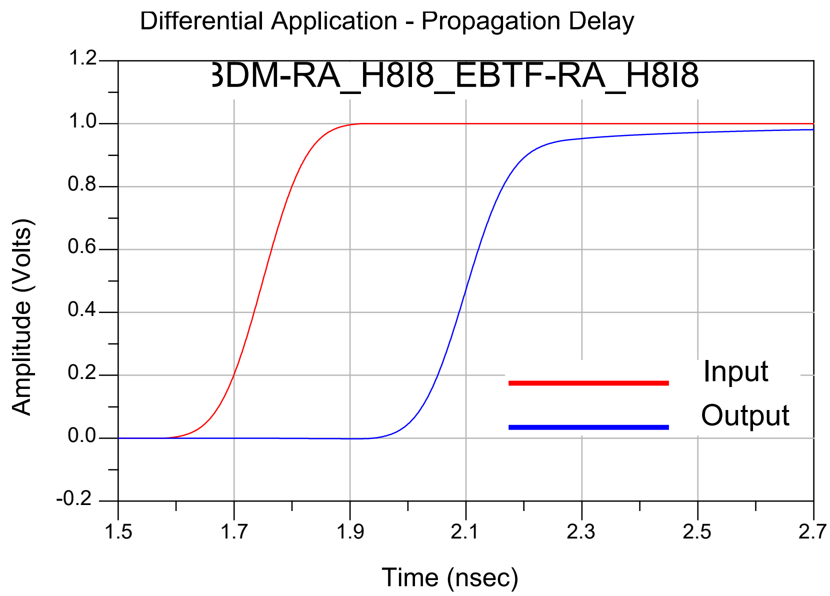

Figure 62

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

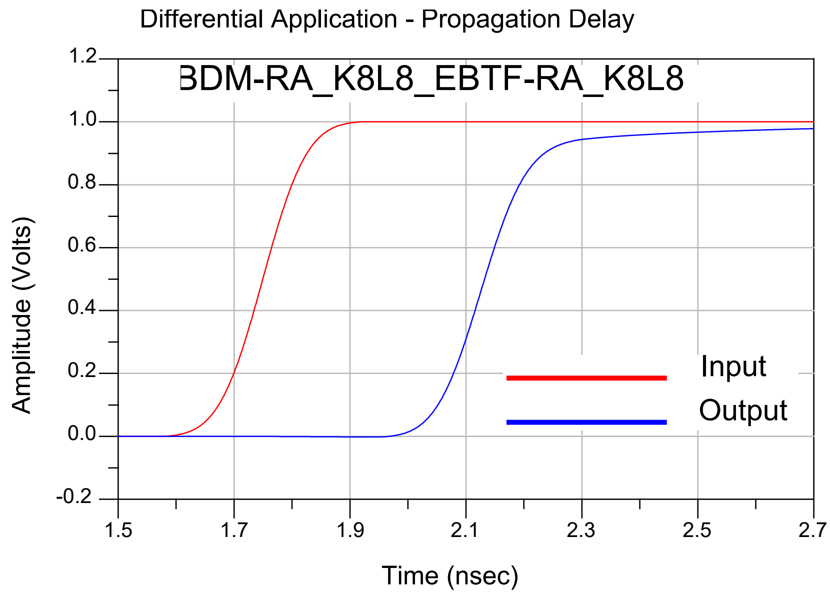

Figure 63

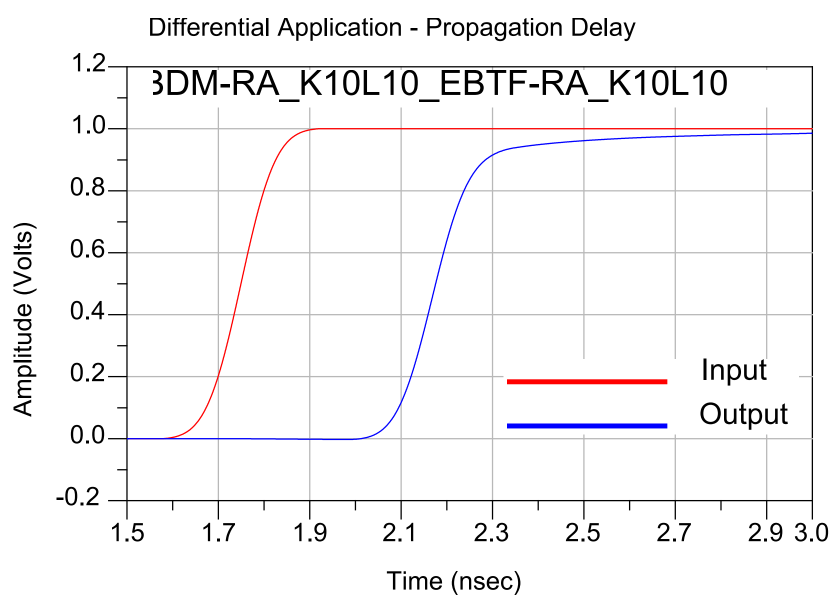

Figure 64

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

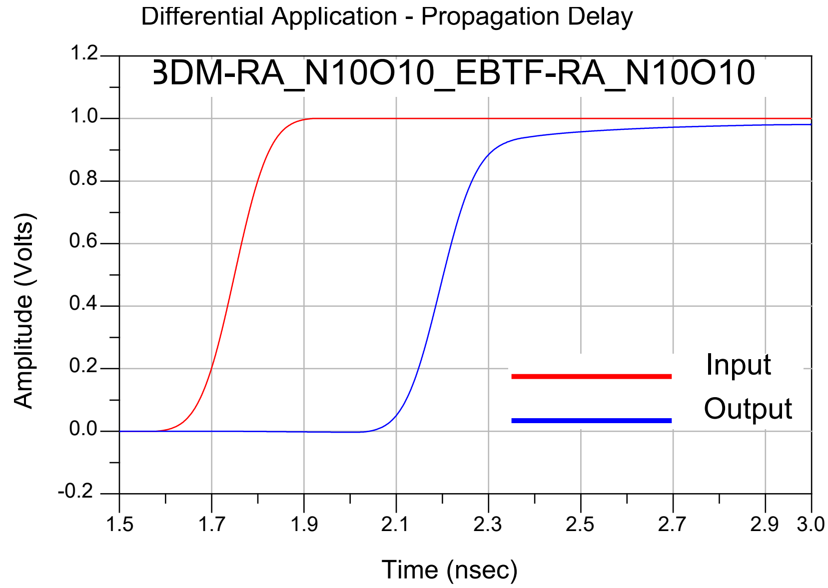

Figure 65

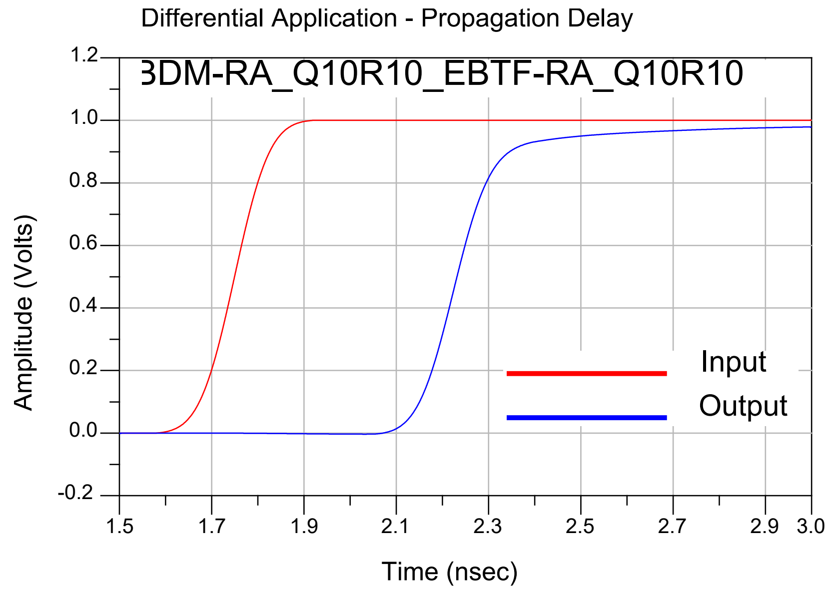

Figure 66

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

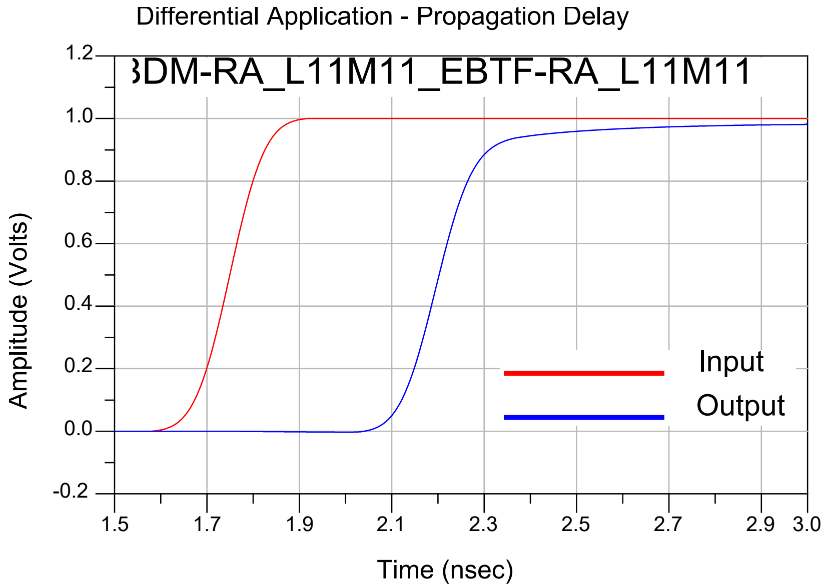

Figure 67

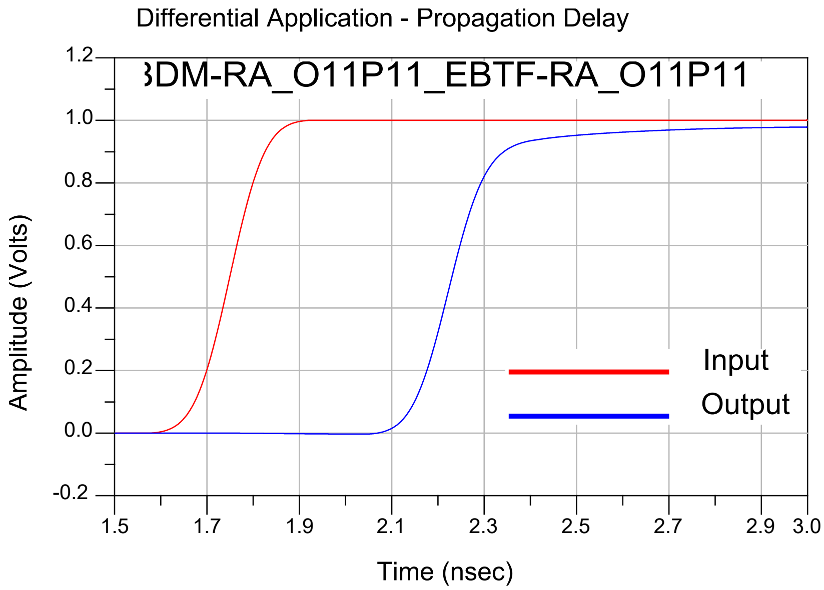

Figure 68

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

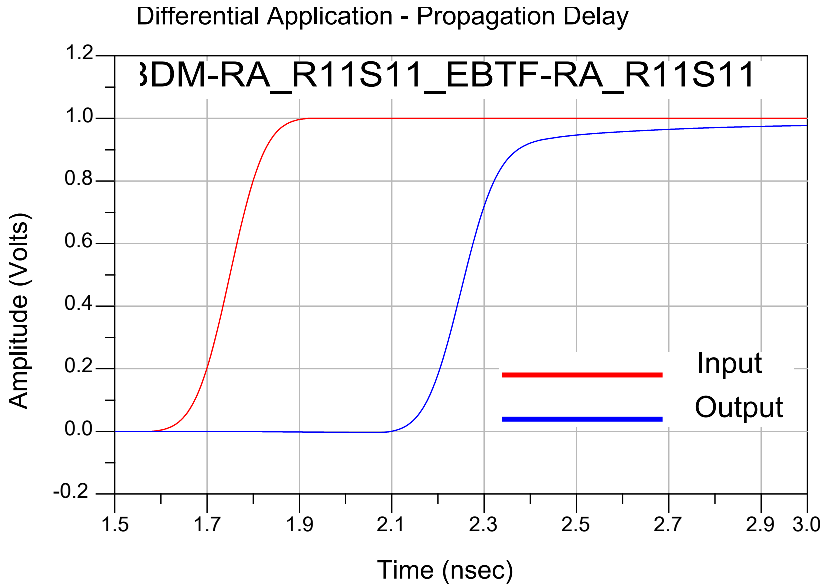

Figure 69

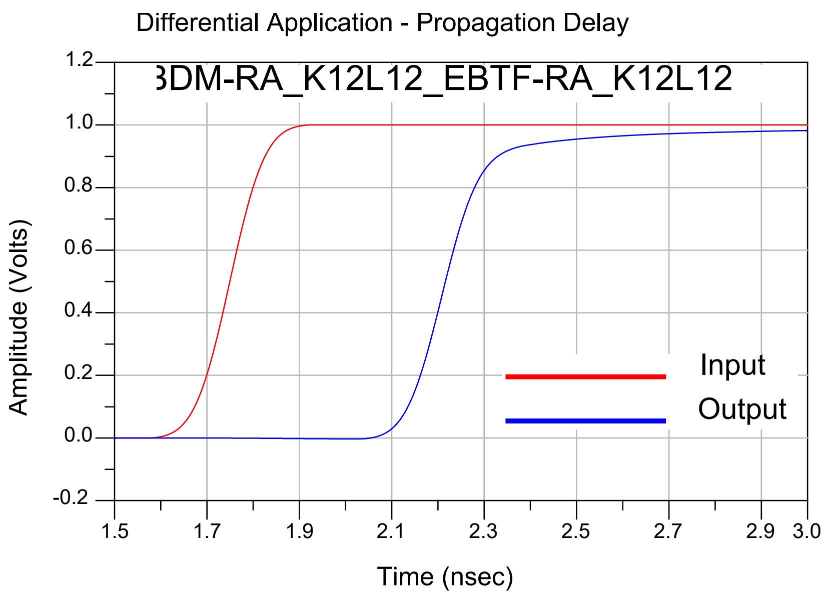

Figure 70

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

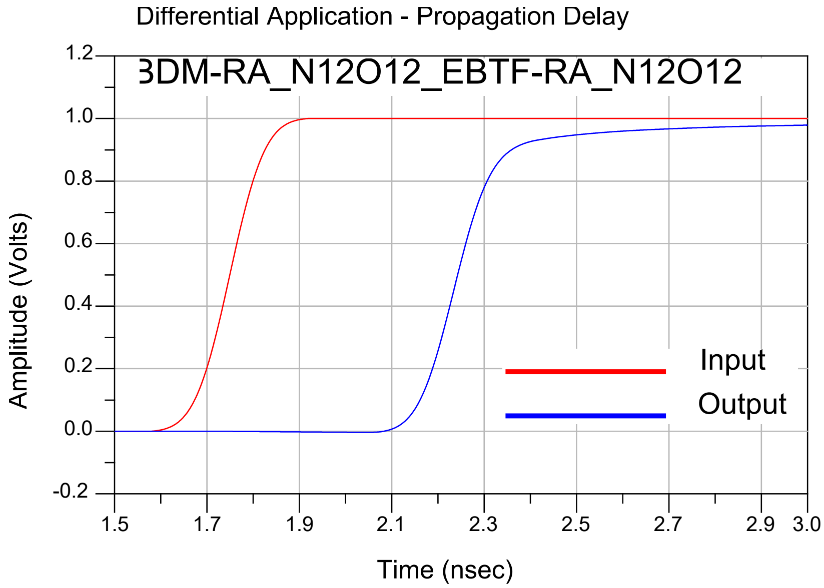

Figure 71

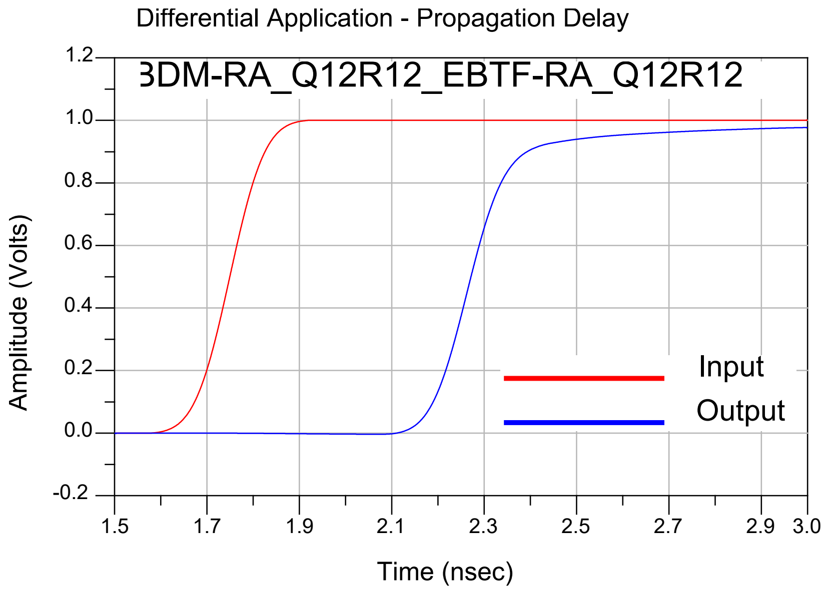

Figure 72

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Report Revision: 10/14/2021

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Appendix C – Product and Test System Descriptions

Product Description

Product test samples are EBDM-RA/EBTF-RA Series connectors. The part number is EBDM-6-12-2.0-S-RA-1-G-S and EBTF-6-12-2.0-S-RA-1-L. A photo of the test articles mounted to SI test boards is shown below.

Test System Description

The test fixtures are composed of ten-layer 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 VNA test cables to the test fixtures. Optimization of the 2.4mm connector launch was performed using full wave simulation tools to minimize reflections. The test fixtures and calibration kit are specific to the EBDM-RA/EBTF-RA series connector set and identified by part number PCB-EBDMRS-110443-SIG-0, PCB-EBDMRM-110443-SIG-0, PCB-EBDMRL-110443-SIG-0 and PCB-EBTFRS-110445-SIG-0, PCB-EBTFRM-110445-SIG-0, PCB-EBTFRL-110445-SIG-0 and PCB-EBDMRC-110443-SIG-0.

EBDMRx-110443-SIG-0 and PCB-EBTFRx-110445-SIG-0 Test Fixtures

Shown below is one photograph of the test board sets.

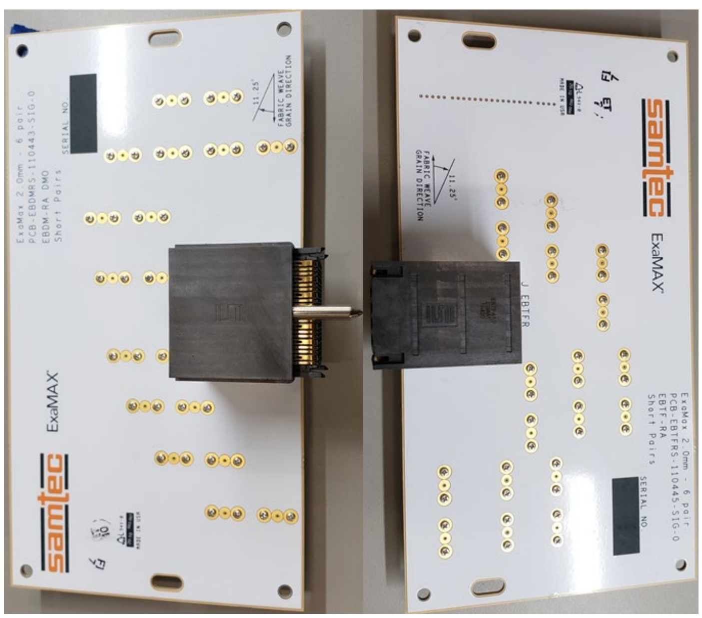

Figure 73

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

PCB Fixtures

The test fixtures used are as follows:

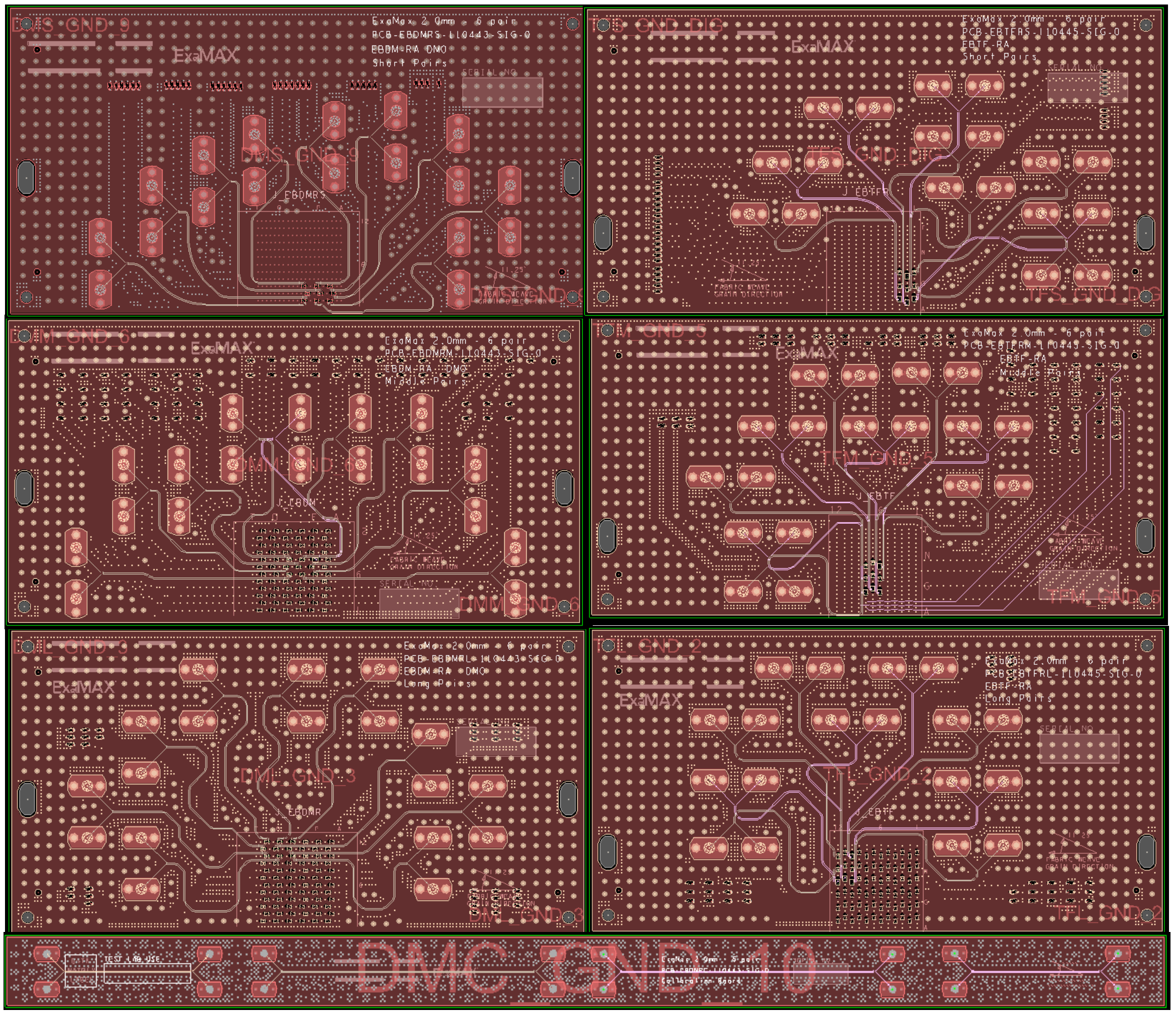

Figure 74

Series: EBDM-RA / EBTF-RA
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All traces on the test boards are length matched to 63.65 mm measured from the edge of the pad to the 2.4mm connector. The AFR calibration effectively removes 61.35 mm of test board trace effects. This means that 2.30 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 EBDM-RA/EBTF-RA Series connector set
B- Test board vias, pads (footprint effects) for the EBDM-RA connector side.
C- 2.30 mm of 0.142 mm wide microstrip trace.
D- Test board vias, pads (footprint effects) for the EBTF-RA side.
E- 2.30 mm of 0.142 mm wide microstrip trace.

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

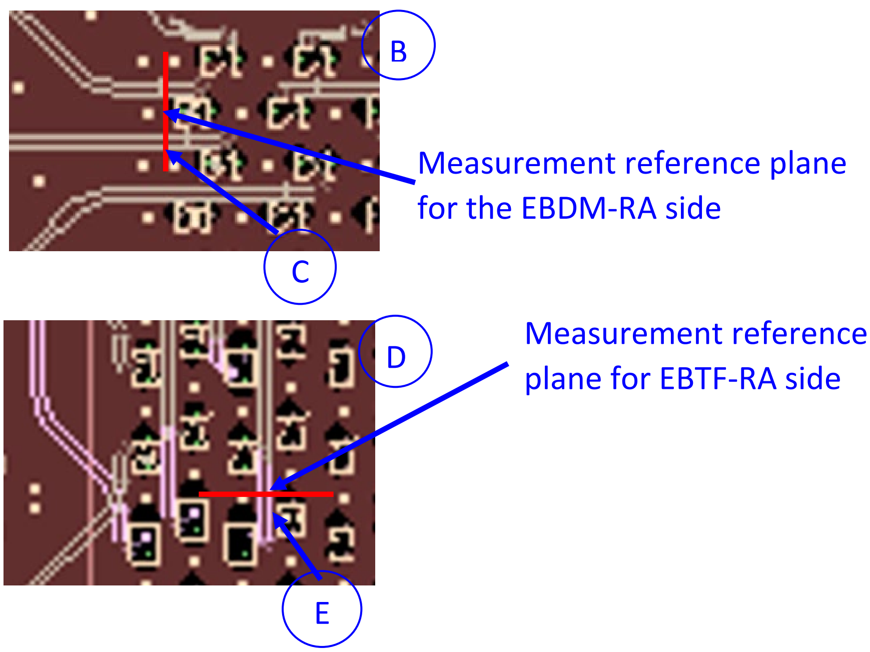

Figure 75

Series: EBDM-RA / EBTF-RA
Description: ExaMAX® 2.00 mm(.0787") Pitch, DMO, 90 Degree Orientation

Appendix D – Test and Measurement Setup

For frequency domain measurements, the test instrument is the Keysight N5227A 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 Keysight ADS. The network analyzer is configured as follows:

Start Frequency – 10 MHz
Stop Frequency – 40 GHz
Number of points – 4000
IFBW – 700 Hz

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

N5227A Measurement Setup

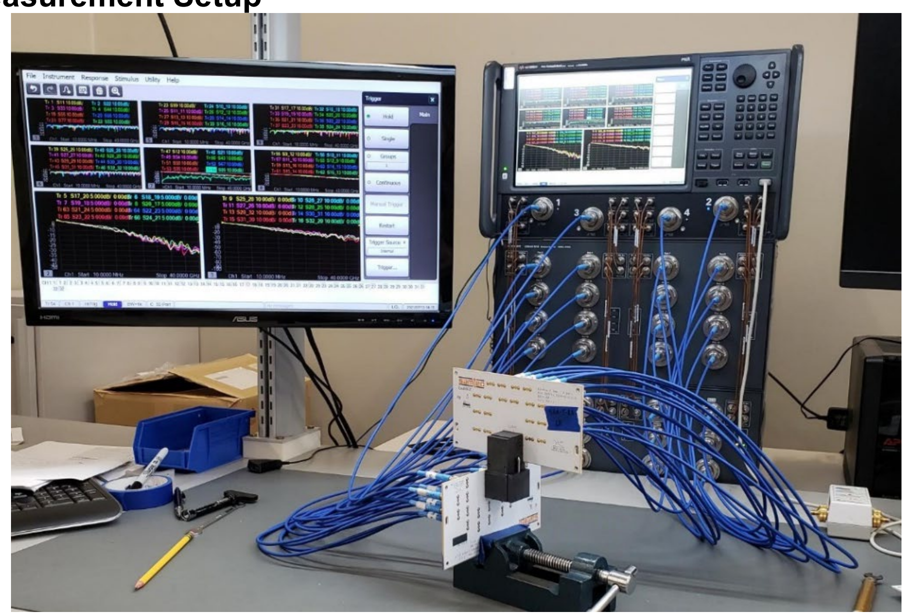

Figure 76

Test Instruments

QTY	Description
1	Keysight N5227A PNA-L Network Analyzer (10 MHz to 67 GHz)
1	Keysight N4694-60003 ECAL Module (10 MHz to 67 GHz)

Test Cables & Adapters

QTY	Description
32	1 m Junkosha 2.4mm male to female cables

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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 2016. 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

Propagation Delay (TDT)
The Propagation Delay is a measure of the Time Domain delay through the connector and footprint. A step pulse is applied to the touchstone model of the connector and the transmitted voltage is monitored. The same pulse is also applied to a reference channel with zero loss, and the Time Domain pulses are plotted on the same graph. The difference in time, measured at the 50% point of the step voltage is the propagation delay.

Near-End Crosstalk (TDT) & Far End Crosstalk (TDT)
A step pulse is applied to the touchstone model of the connector and the coupled voltage is monitored. The amplitude of the peak-coupled voltage is recorded and reported as a percentage of the input pulse.

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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.

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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)