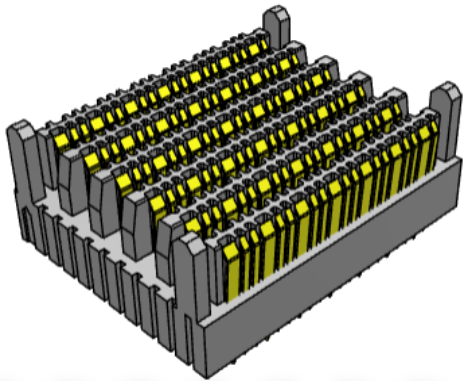
High Speed Characterization Report

EBTM-6-12-2.0-S-VT-1



Mates with

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

Description
ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs, Vertical Header mating to Right-Angle Receptacle (EBTM to EBTF-RA)

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Report Revision: 2/14/2022

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

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Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

Connector Overview

EBTM/EBTF-RA series is 2.0mm column pitch, include 4 or 6 pairs per column, with Press fit termination. The data in this report is applicable only to 6 pair per column EBTM vertical header mated to EBTF-RA receptacle.

Frequency Domain Data Summary

Bandwidth Chart – Differential Insertion Loss

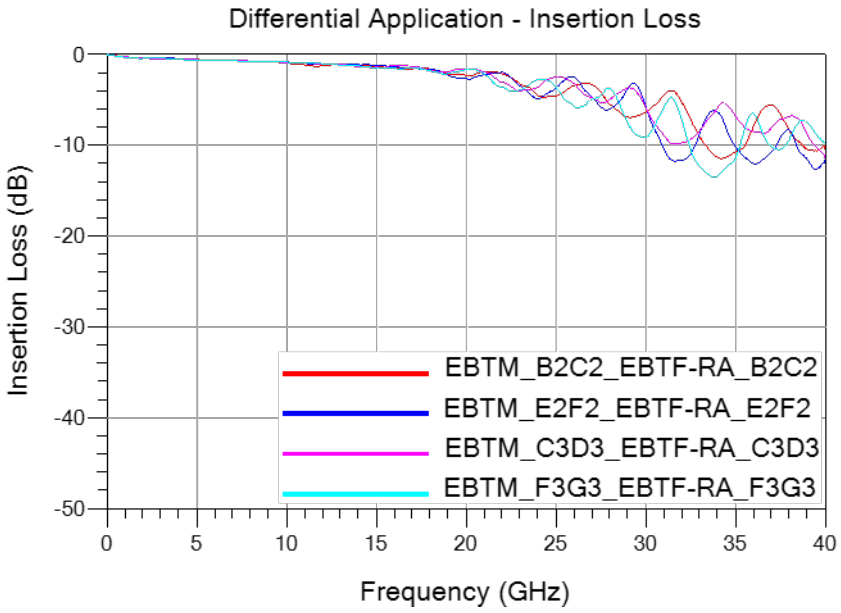

Figure 1

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

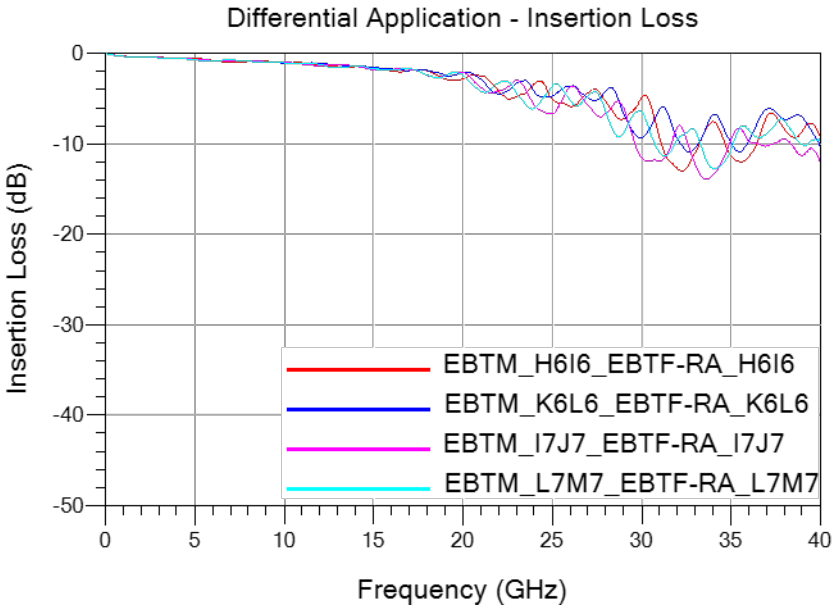

Figure 2

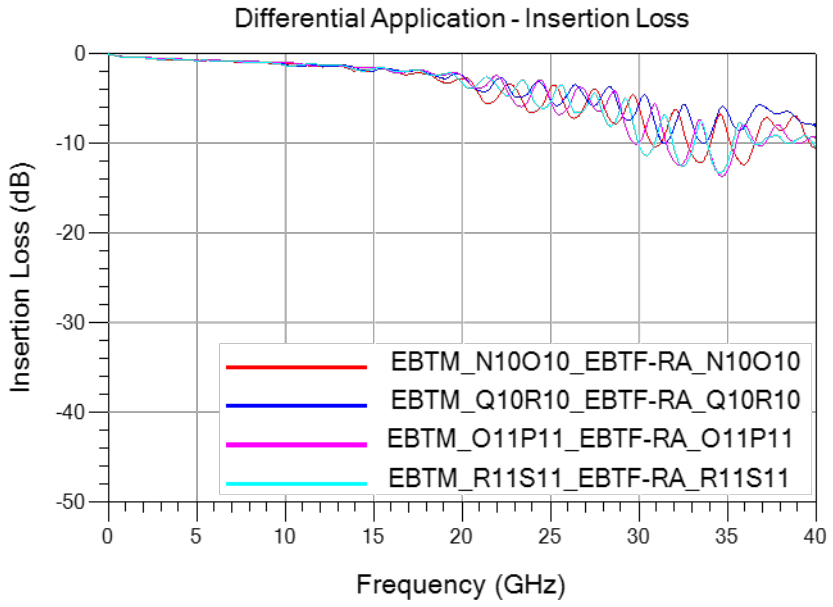

Figure 3

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

Time Domain Data Summary

Table 1 - Differential Impedance (Ω)				
Driver	**Signal Rise-time**	**30ps**	**50ps**	**100ps**
EBTM_B2C2	Maximum Impedance	101.6	101.5	101.3
	Minimum Impedance	83.7	85.0	86.8
EBTM_E2F2	Maximum Impedance	101.8	101.7	101.4
	Minimum Impedance	83.4	84.6	86.2
EBTM_C3D3	Maximum Impedance	101.7	101.5	101.4
	Minimum Impedance	84.6	85.9	86.8
EBTM_F3G3	Maximum Impedance	101.8	101.7	101.4
	Minimum Impedance	85.6	85.8	86.8
EBTM_H6I6	Maximum Impedance	102.2	102.2	101.8
	Minimum Impedance	85.8	87.0	88.9
EBTM_K6L6	Maximum Impedance	102.4	102.3	102.2
	Minimum Impedance	86.1	87.0	88.8
EBTM_I7J7	Maximum Impedance	102.1	102.0	101.8
	Minimum Impedance	86.1	87.0	88.1
EBTM_L7M7	Maximum Impedance	102.3	102.2	101.9
	Minimum Impedance	86.4	87.0	88.2
EBTM_N10O10	Maximum Impedance	102.8	102.6	102.4
	Minimum Impedance	85.2	85.6	86.8
EBTM_Q10R10	Maximum Impedance	102.7	102.6	102.6
	Minimum Impedance	86.1	86.7	87.7
EBTM_O11P11	Maximum Impedance	102.7	102.5	102.3
	Minimum Impedance	86.5	87.0	87.7
EBTM_R11S11	Maximum Impedance	102.8	102.7	102.5
	Minimum Impedance	86.0	86.6	87.4

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Table 2 - Differential Crosstalk (%)					
Input(tr)	**Driver**	**Receiver**	**30ps**	**50ps**	**100ps**
NEXT	EBTM_E2F2	EBTM_B2C2	0.20	0.17	0.13
	EBTM_E2F2	EBTM_H2I2	0.16	0.13	0.11
	EBTM_E2F2	EBTM_C3D3	0.15	0.11	<0.1
	EBTM_E2F2	EBTM_F3G3	<0.1	<0.1	<0.1
	EBTM_E2F2	EBTM_I3J3	<0.1	<0.1	<0.1
	EBTF-RA_E2F2	EBTF-RA_B2C2	0.17	0.15	0.13
	EBTF-RA_E2F2	EBTF-RA_H2I2	0.15	0.13	0.11
	EBTF-RA_E2F2	EBTF-RA_C3D3	0.13	0.11	<0.1
	EBTF-RA_E2F2	EBTF-RA_F3G3	0.11	<0.1	<0.1
	EBTF-RA_E2F2	EBTF-RA_I3J3	<0.1	<0.1	<0.1
	EBTM_H6I6	EBTM_E6F6	0.16	0.14	0.11
	EBTM_H6I6	EBTM_K6L6	0.15	0.12	0.11
	EBTM_H6I6	EBTM_F7G7	0.15	0.12	<0.1
	EBTM_H6I6	EBTM_I7J7	<0.1	<0.1	<0.1
	EBTM_H6I6	EBTM_L7M7	<0.1	<0.1	<0.1
	EBTF-RA_H6I6	EBTF-RA_E6F6	0.15	0.14	0.11
	EBTF-RA_H6I6	EBTF-RA_K6L6	0.16	0.13	0.11
	EBTF-RA_H6I6	EBTF-RA_F7G7	0.14	0.11	<0.1
	EBTF-RA_H6I6	EBTF-RA_I7J7	<0.1	<0.1	<0.1
	EBTF-RA_H6I6	EBTF-RA_L7M7	<0.1	<0.1	<0.1
	EBTM_O11P11	EBTM_L11M11	0.17	0.14	0.11
	EBTM_O11P11	EBTM_R11S11	0.15	0.13	0.12
	EBTM_O11P11	EBTM_K10L10	<0.1	<0.1	<0.1
	EBTM_O11P11	EBTM_N10O10	<0.1	<0.1	<0.1
	EBTM_O11P11	EBTM_Q10R10	0.16	0.11	<0.1
	EBTF-RA_O11P11	EBTF-RA_L11M11	0.14	0.13	0.11
	EBTF-RA_O11P11	EBTF-RA_R11S11	0.15	0.14	0.12
	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	0.12	0.10	<0.1

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Input(tr)	Driver	Receiver	30ps	50ps	100ps
FEXT	EBTM_E2F2	EBTF-RA_B2C2	<0.1	<0.1	<0.1
	EBTM_E2F2	EBTF-RA_H2I2	<0.1	<0.1	<0.1
	EBTM_E2F2	EBTF-RA_C3D3	0.14	<0.1	<0.1
	EBTM_E2F2	EBTF-RA_F3G3	0.17	0.10	<0.1
	EBTM_E2F2	EBTF-RA_I3J3	<0.1	<0.1	<0.1
	EBTM_H6I6	EBTF-RA_E6F6	<0.1	<0.1	<0.1
	EBTM_H6I6	EBTF-RA_K6L6	<0.1	<0.1	<0.1
	EBTM_H6I6	EBTF-RA_F7G7	0.14	<0.1	<0.1
	EBTM_H6I6	EBTF-RA_I7J7	<0.1	<0.1	<0.1
	EBTM_H6I6	EBTF-RA_L7M7	<0.1	<0.1	<0.1
	EBTM_O11P11	EBTF-RA_L11M11	0.14	<0.1	<0.1
	EBTM_O11P11	EBTF-RA_R11S11	0.19	0.12	<0.1
	EBTM_O11P11	EBTF-RA_K10L10	<0.1	<0.1	<0.1
	EBTM_O11P11	EBTF-RA_N10O10	<0.1	<0.1	<0.1
	EBTM_O11P11	EBTF-RA_Q10R10	0.12	<0.1	<0.1

Table 3 – Differential Propagation Delay (Mated Connector)	
EBTM_B2C2_ EBTF-RA_B2C2	137 ps
EBTM_E2F2_ EBTF-RA_E2F2	158 ps
EBTM_C3D3_ EBTF-RA_C3D3	144 ps
EBTM_F3G3_EBTF-RA_F3G3	166 ps
EBTM_H6I6_EBTF-RA_H6I6	191 ps
EBTM_K6L6_EBTF-RA_K6L6	219 ps
EBTM_I7J7_EBTF-RA_I7J7	200 ps
EBTM_L7M7_EBTF-RA_L7M7	226 ps
EBTM_N10O10_EBTF-RA_N10O10	250 ps
EBTM_Q10R10_EBTF-RA_Q10R10	274 ps
EBTM_O11P11_EBTF-RA_O11P11	256 ps
EBTM_R11S11_EBTF-RA_R11S11	285 ps

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

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 multilayer 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.

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For this connector, the following configurations were evaluated:

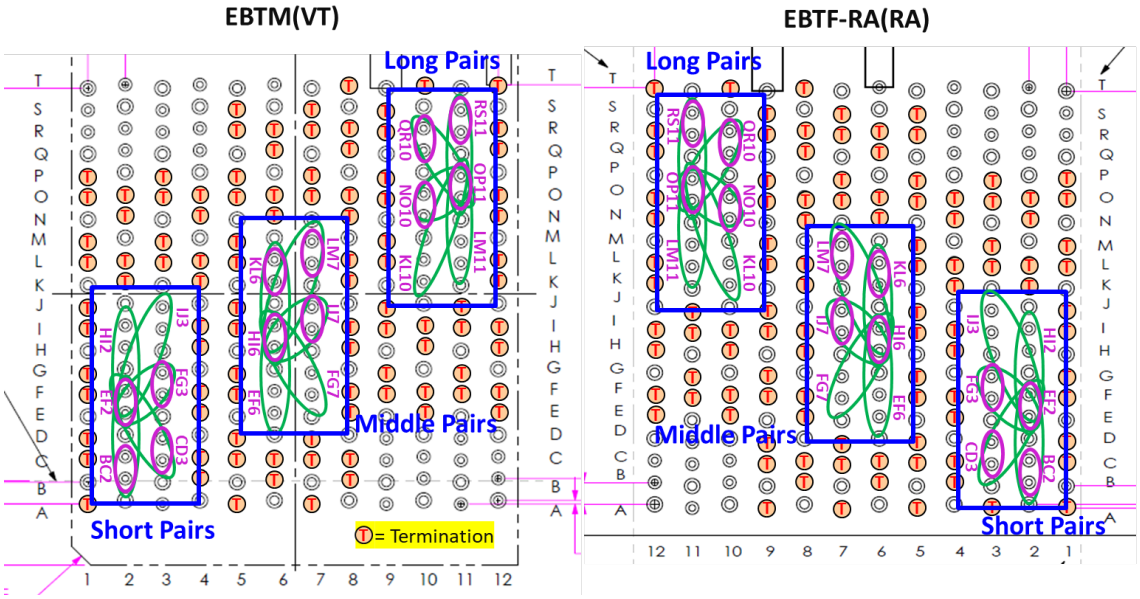

Figure 4

Differential Impedance (denoted by purple circles):

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

Differential Crosstalk (denoted by green 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.

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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 EBTM 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 Responses

Differential Application – Insertion Loss

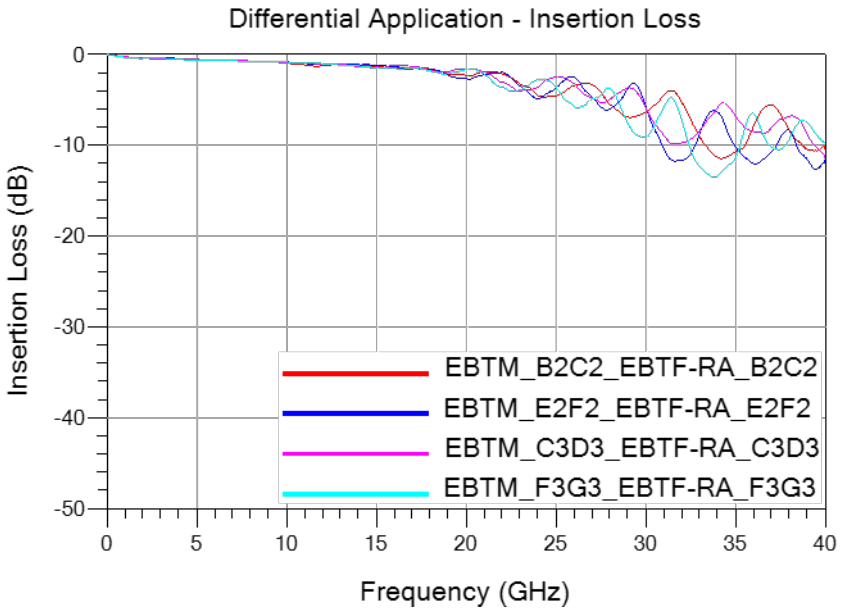

Figure 5

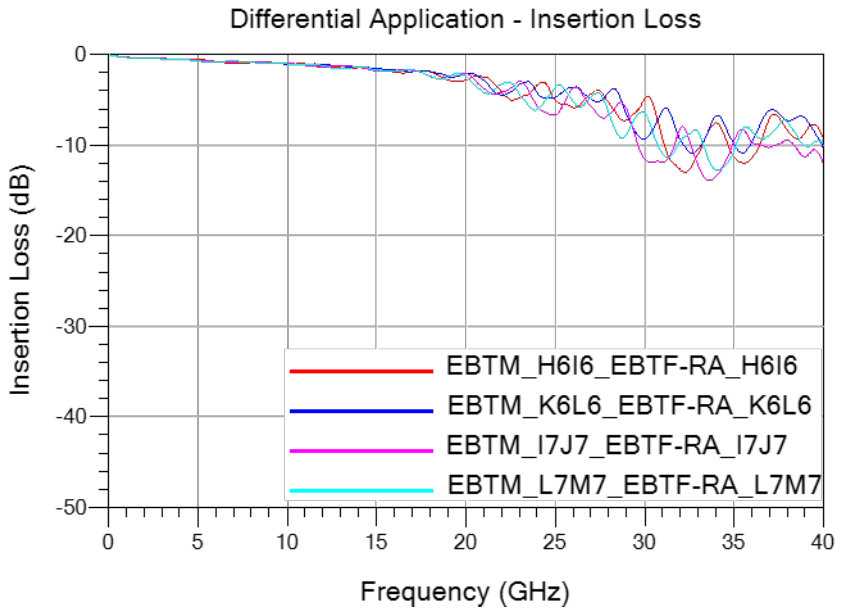

Figure 6

Series: EBTM / EBTF-RA
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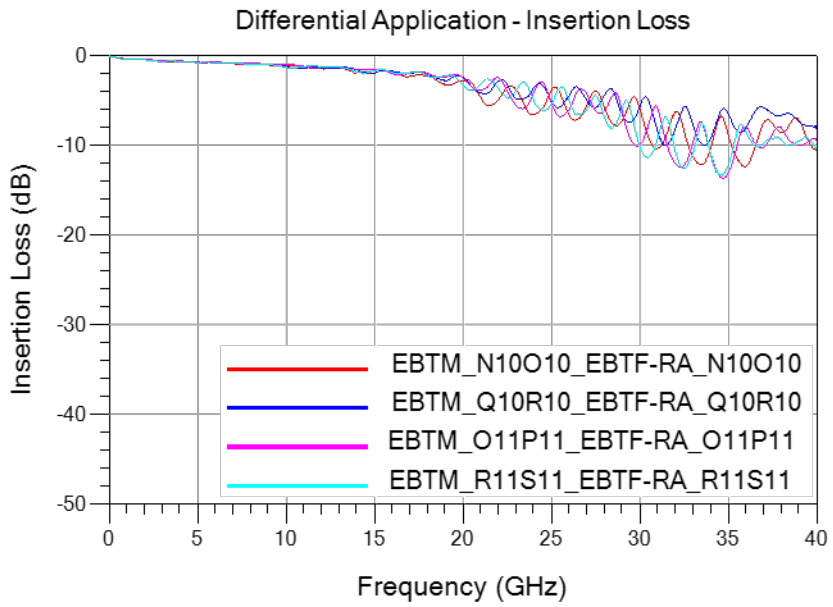

Figure 7

Differential Application – Return Loss

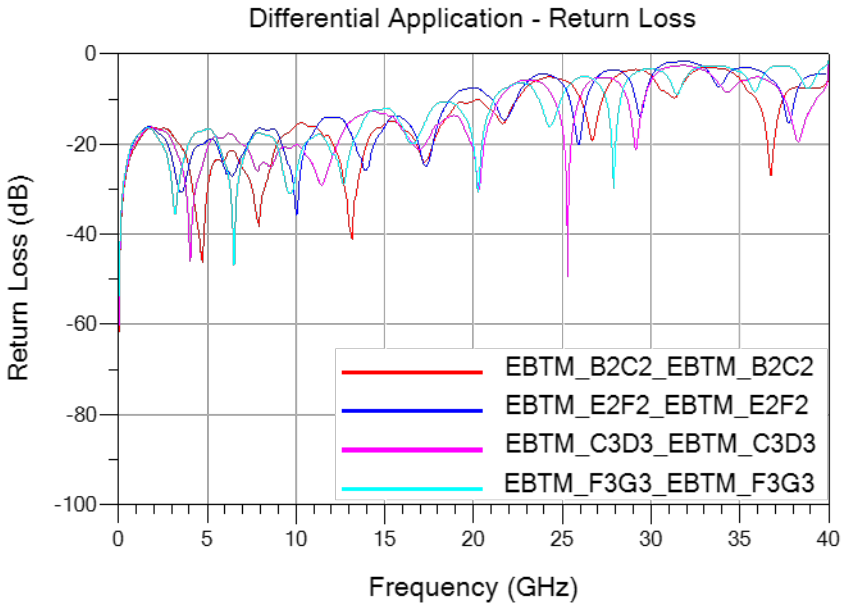

Figure 8

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

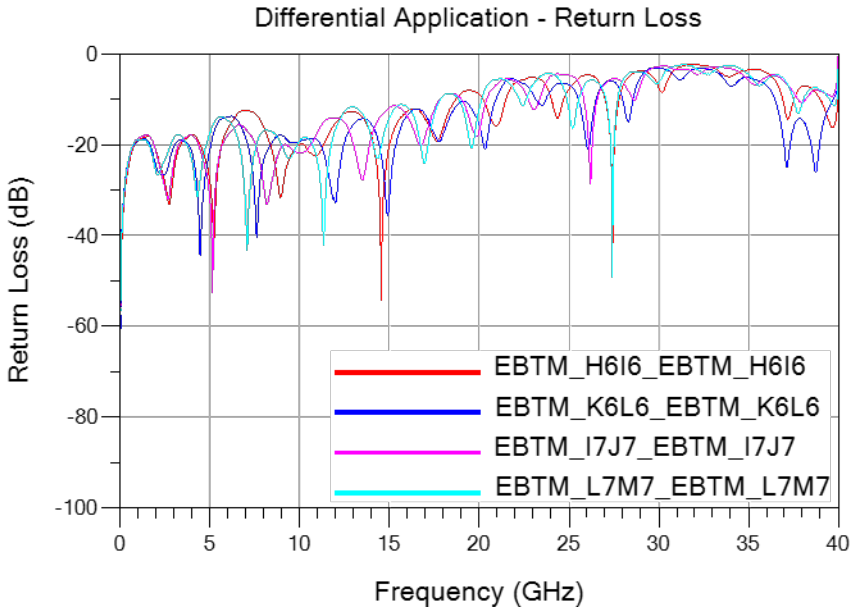

Figure 9

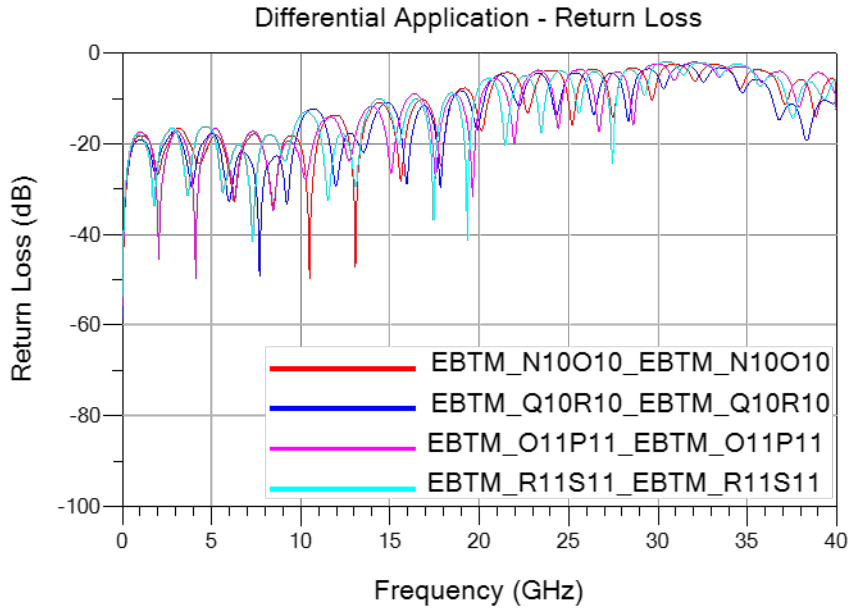

Figure 10

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

Differential Application – NEXT Configurations

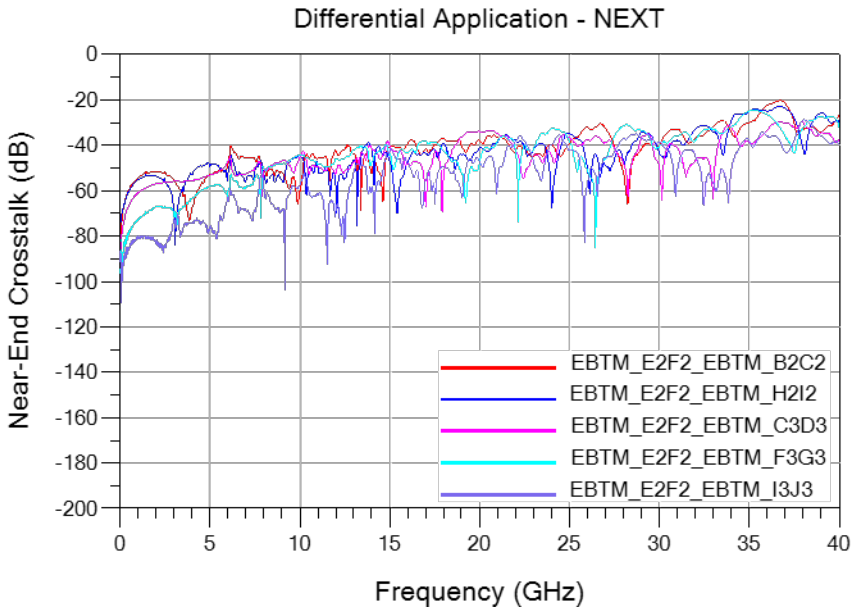

Figure 11

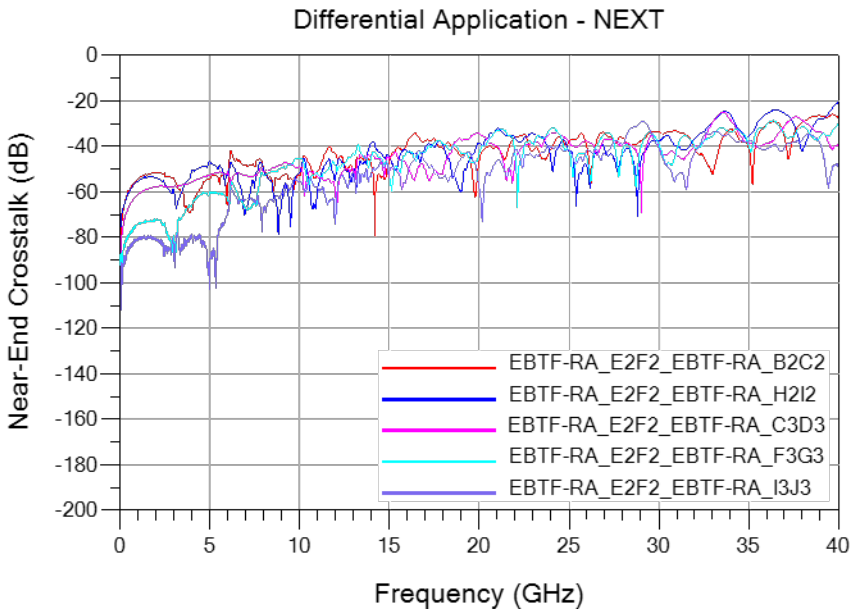

Figure 12

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

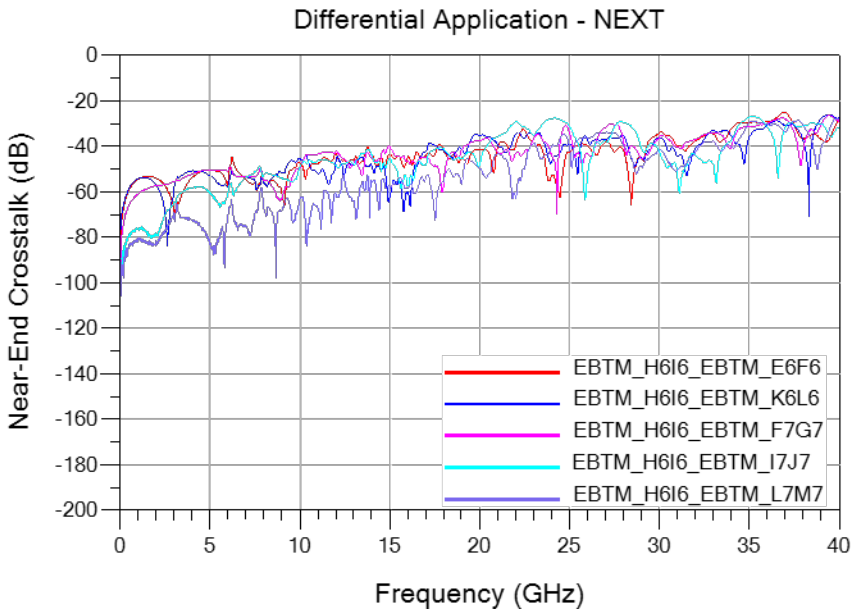

Figure 13

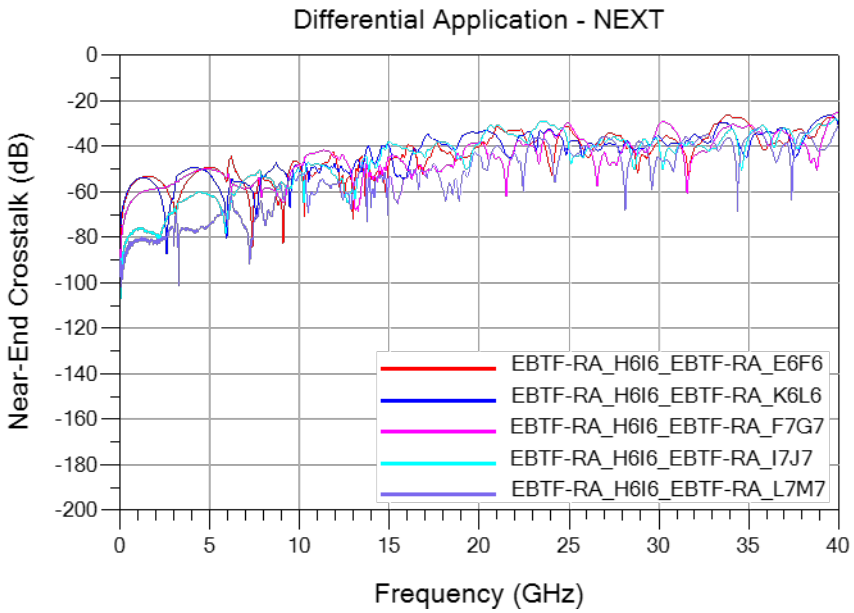

Figure 14

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

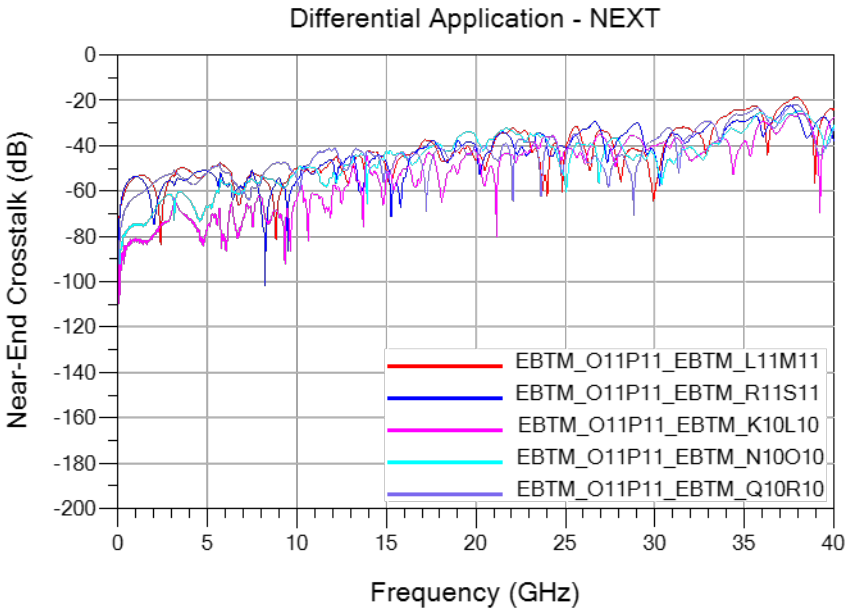

Figure 15

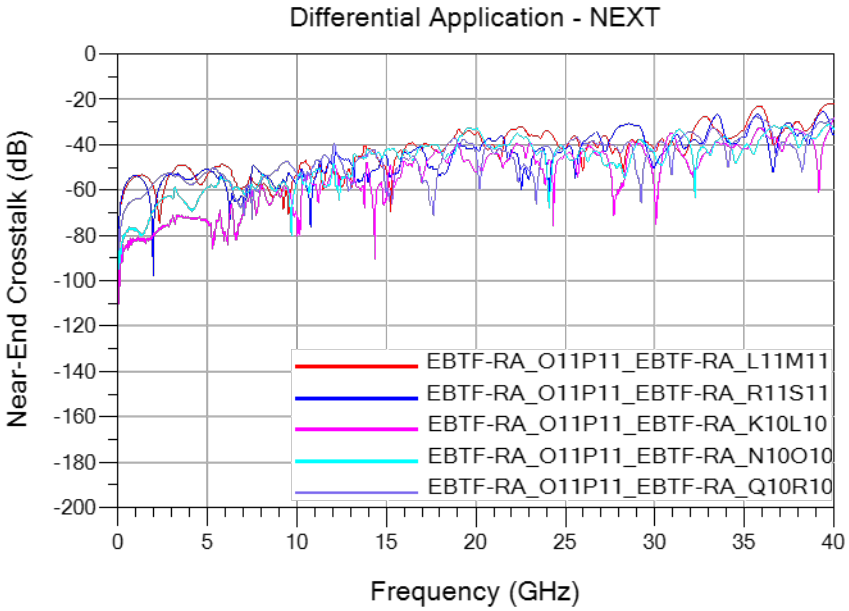

Figure 16

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

Differential Application – FEXT Configurations

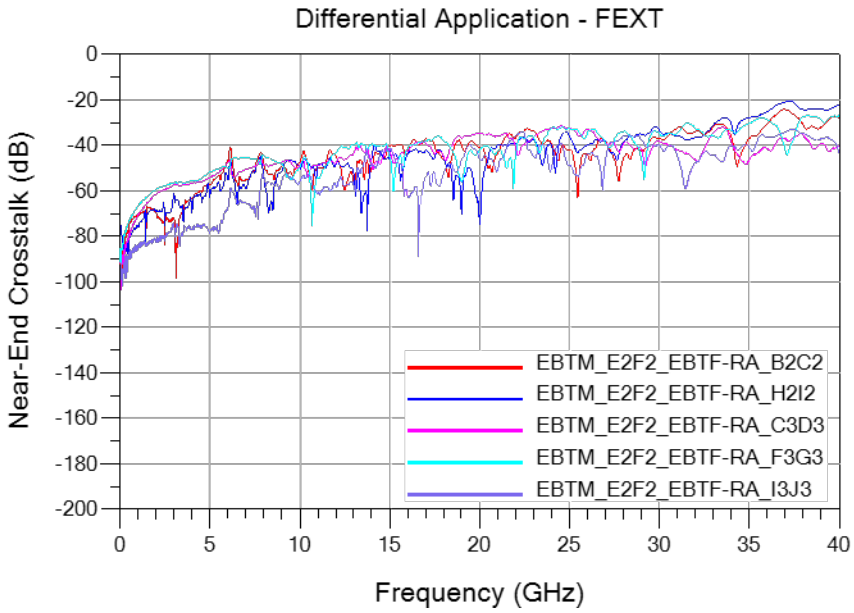

Figure 17

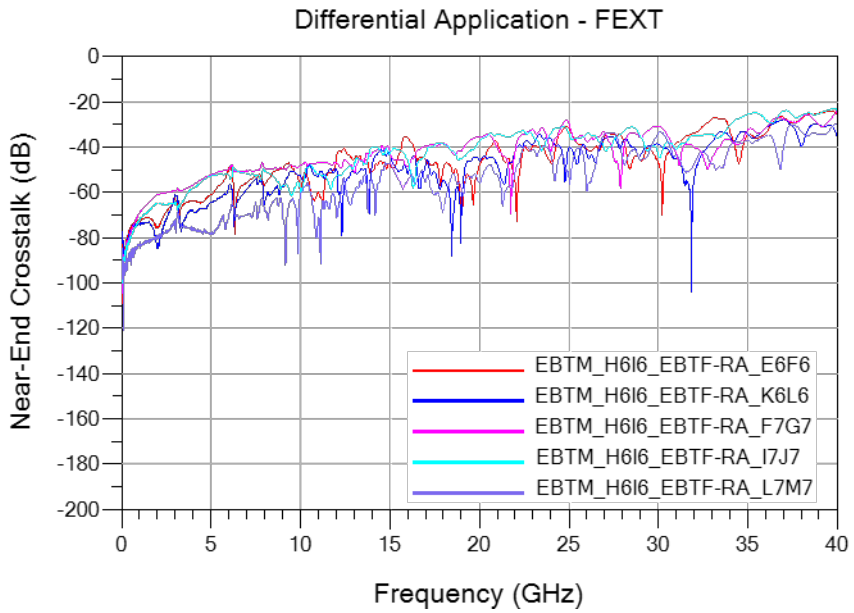

Figure 18

Series: EBTM / EBTF-RA
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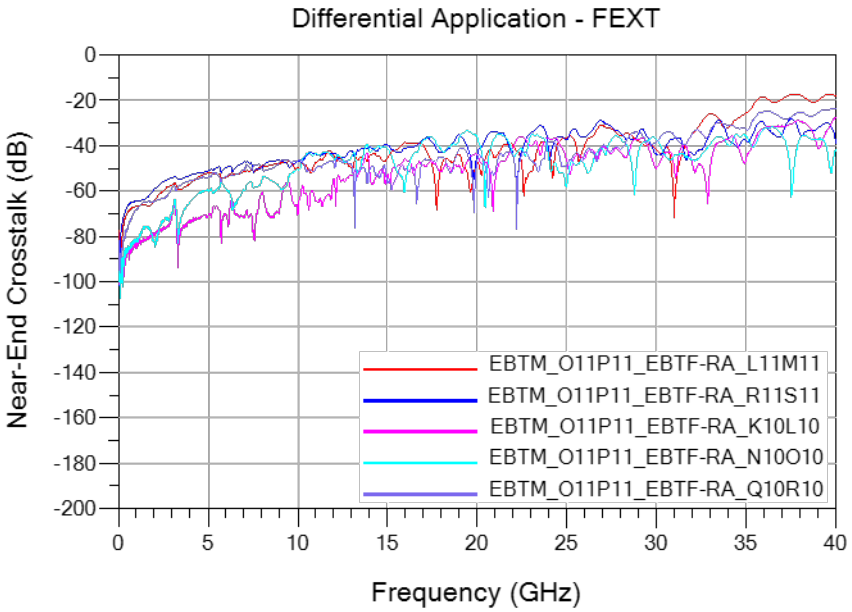

Figure 19

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

Appendix B – Time Domain Responses

Differential Application – Impedance

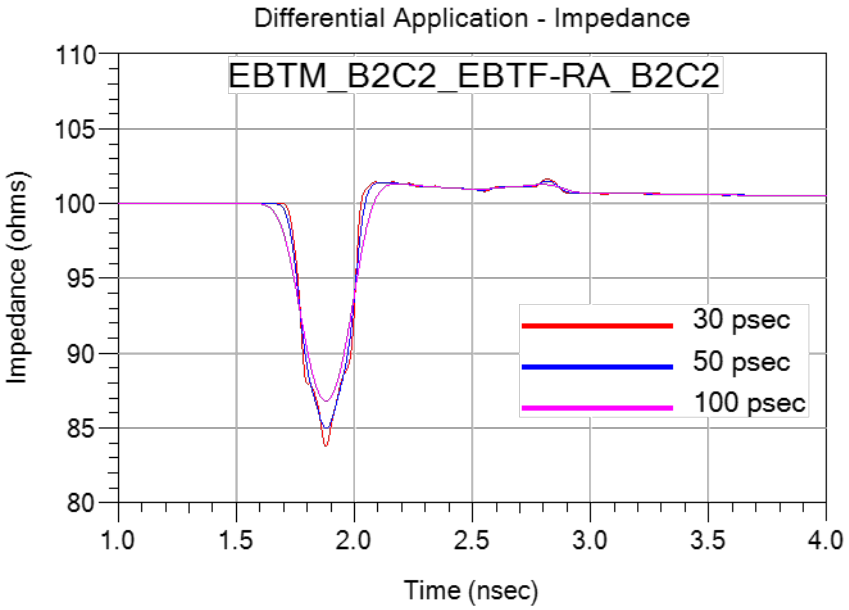

Figure 20

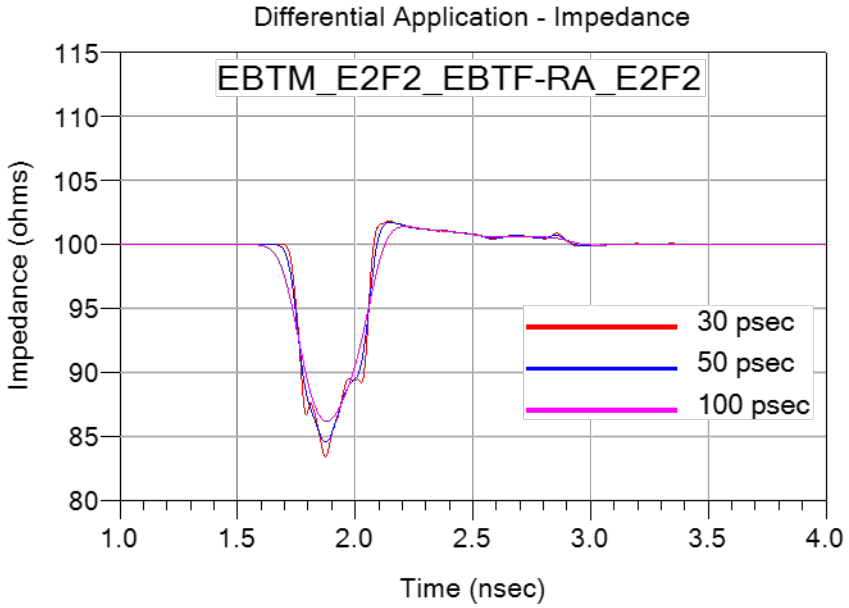

Figure 21

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

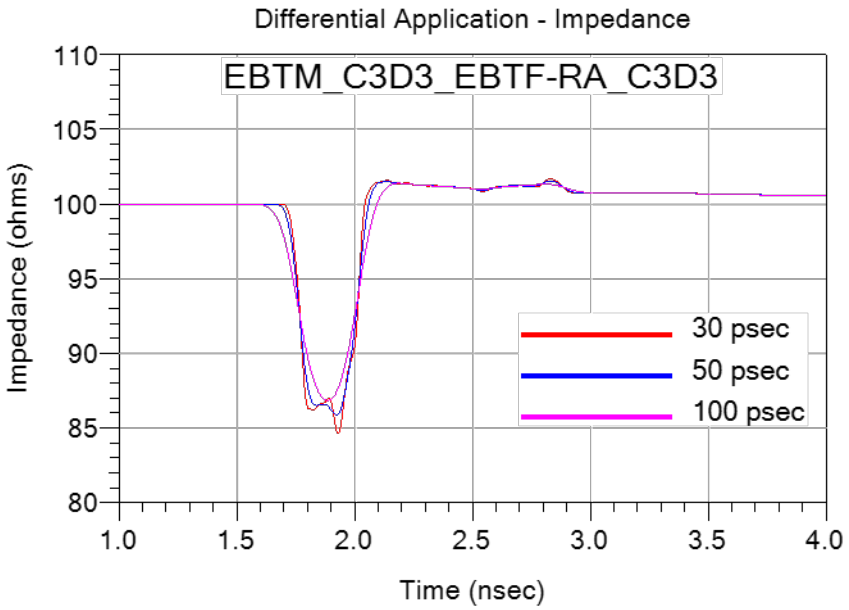

Figure 22

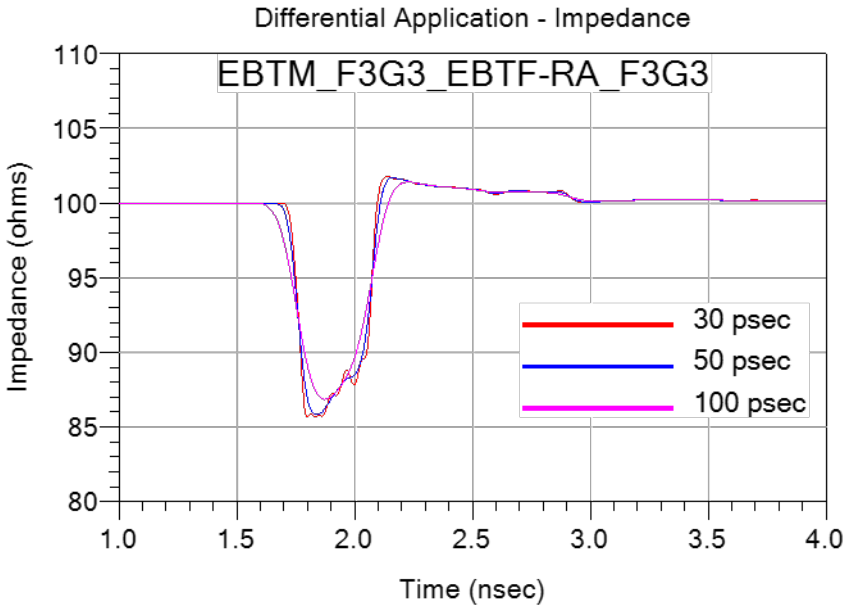

Figure 23

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

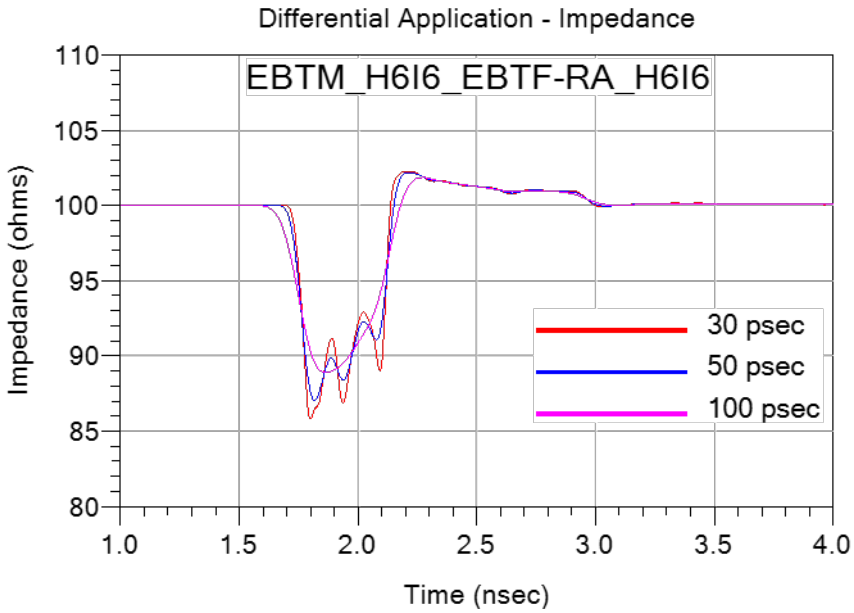

Figure 24

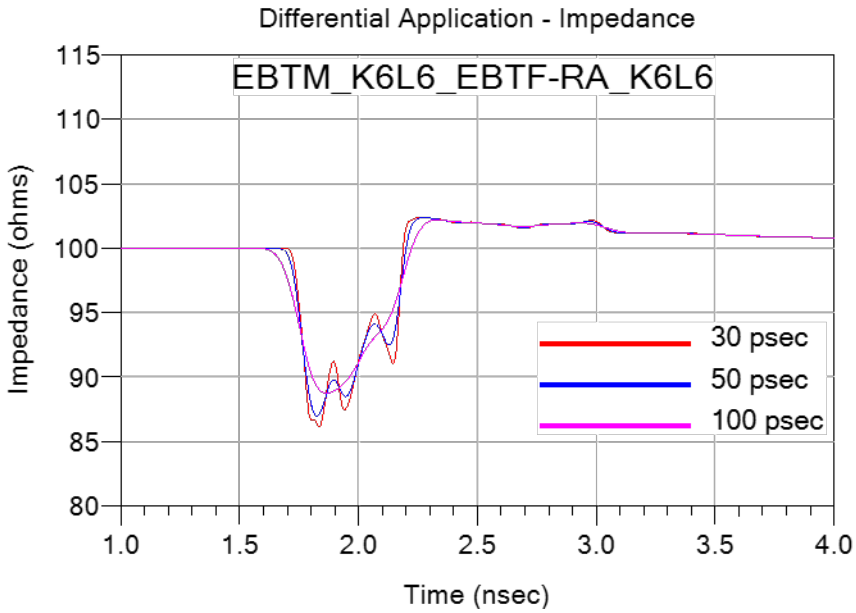

Figure 25

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

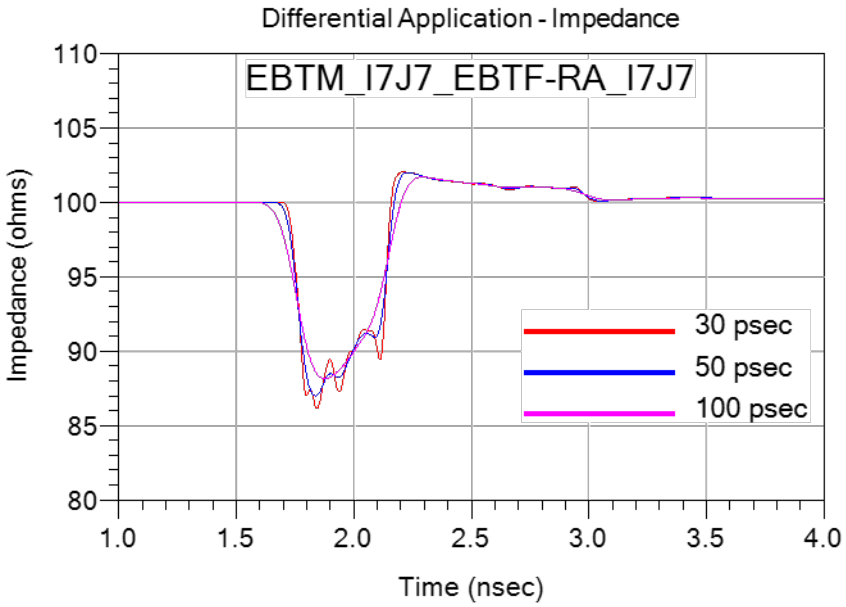

Figure 26

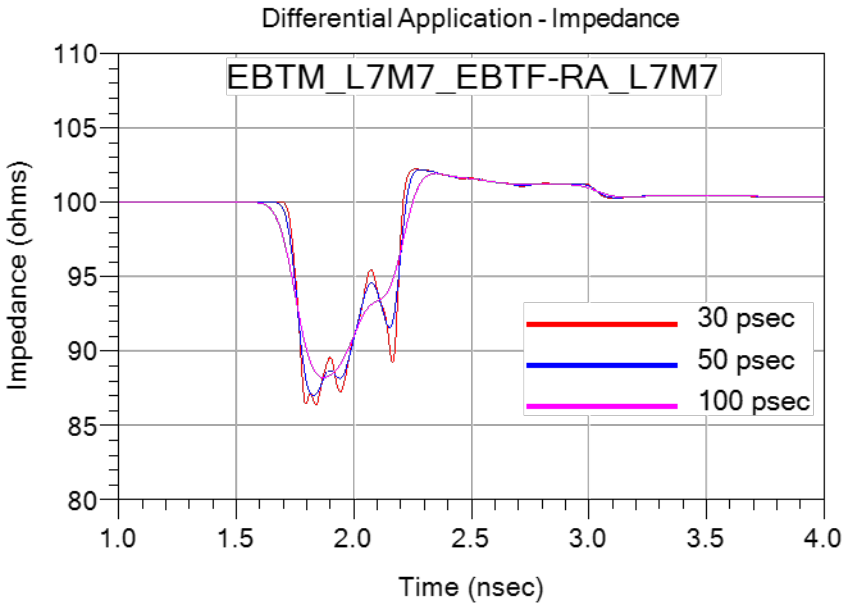

Figure 27

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

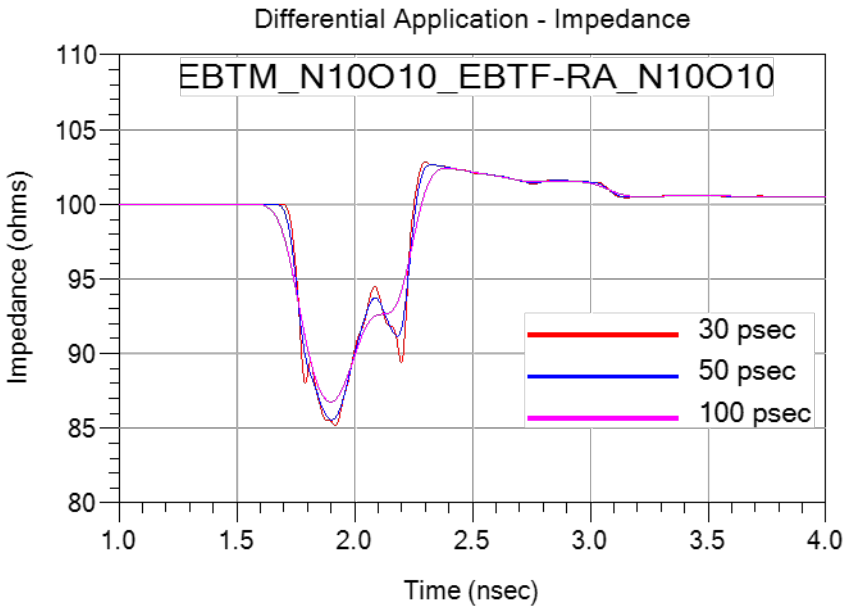

Figure 28

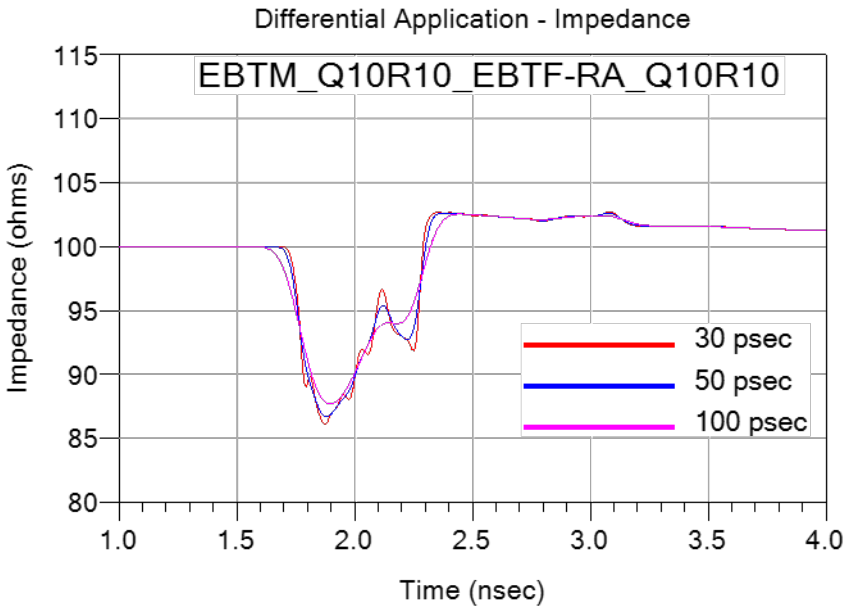

Figure 29

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

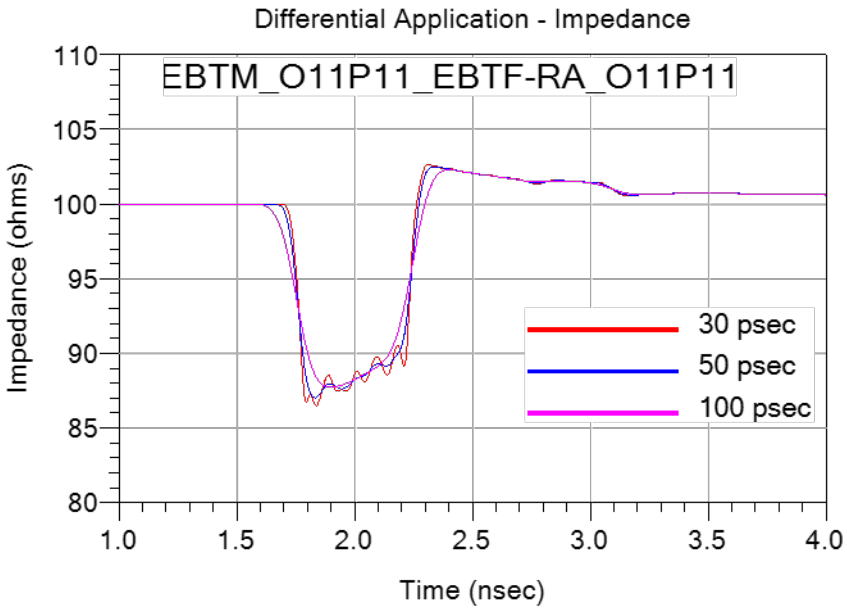

Figure 30

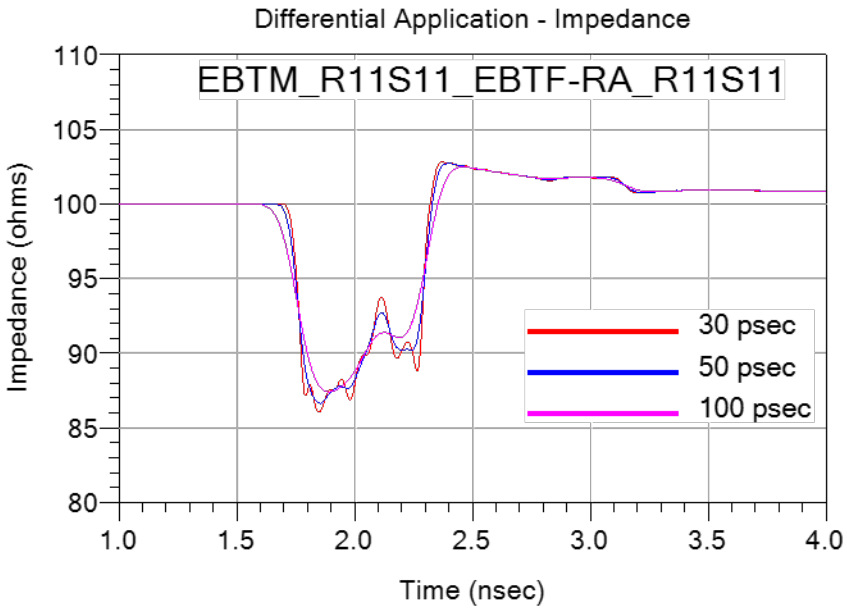

Figure 31

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

Differential Application – Propagation Delay

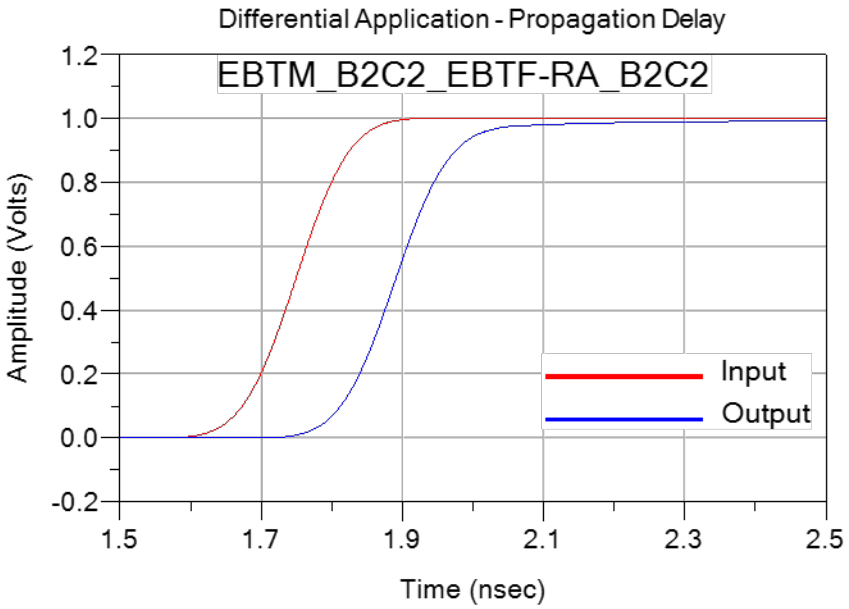

Figure 32

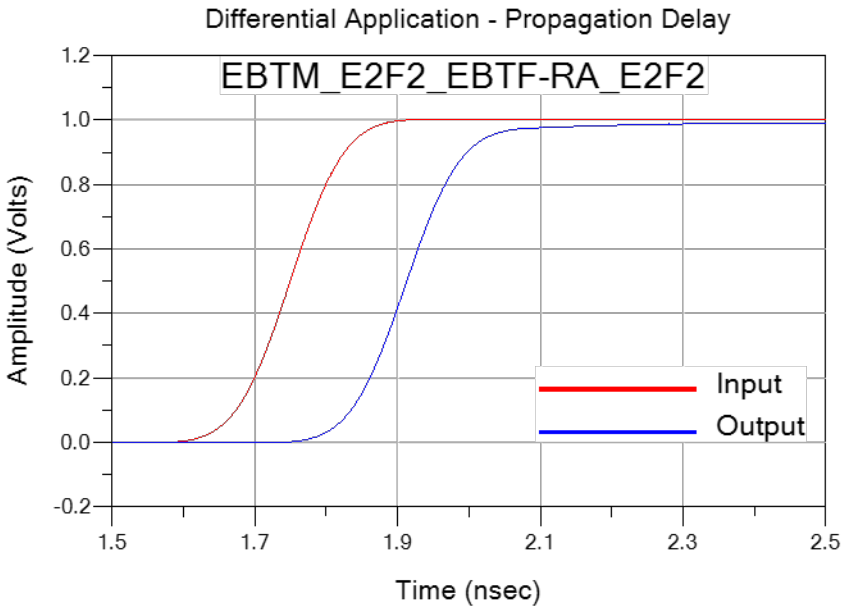

Figure 33

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

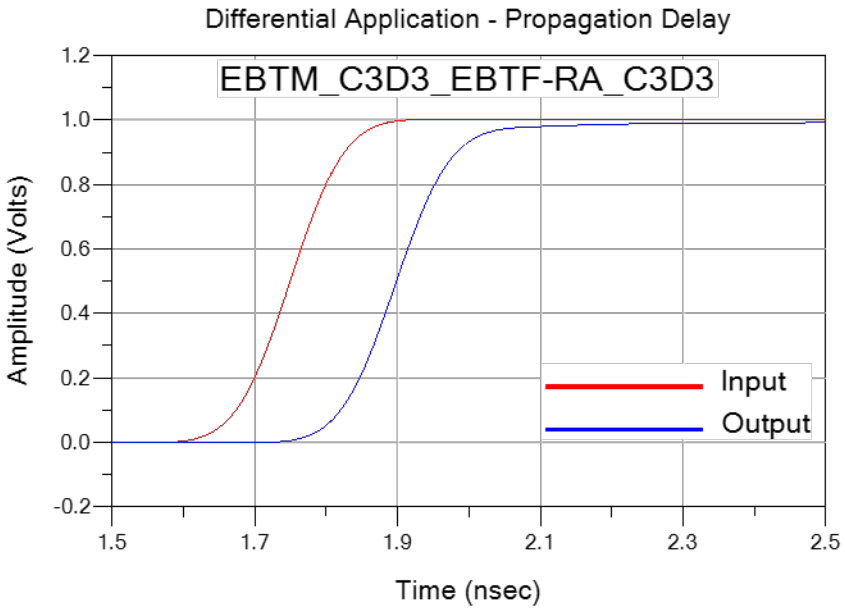

Figure 34

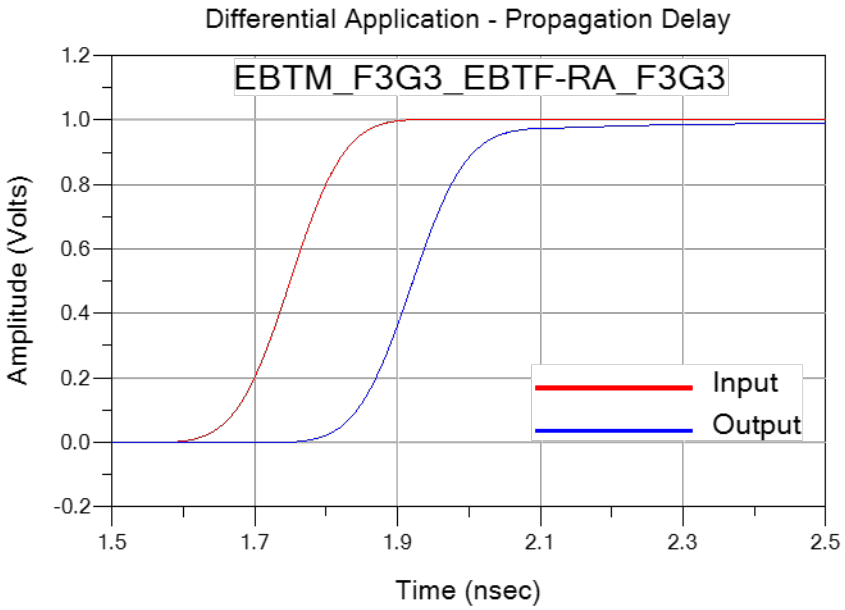

Figure 35

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

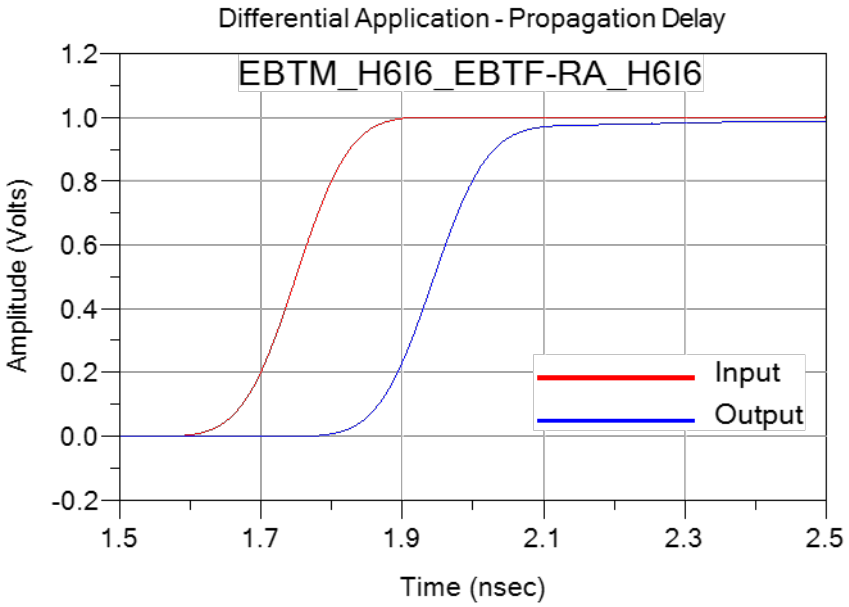

Figure 36

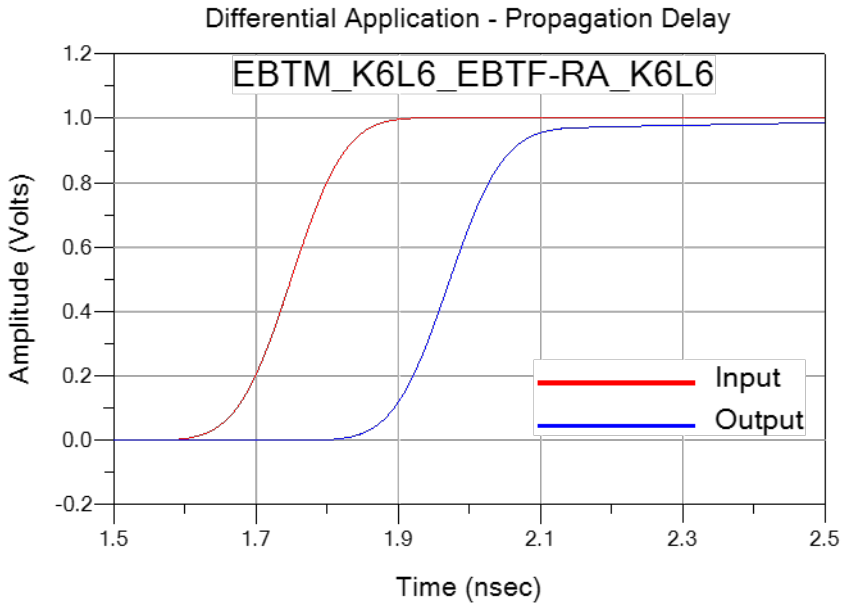

Figure 37

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

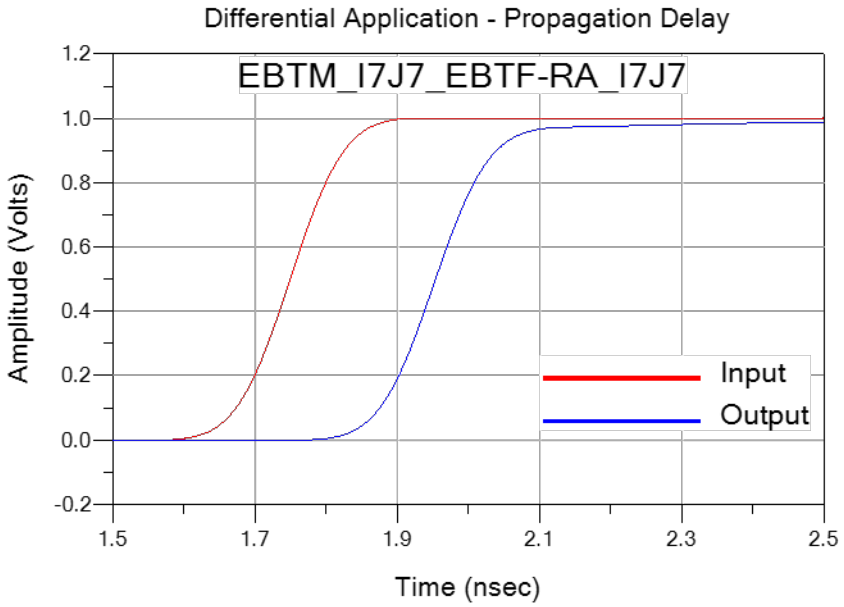

Figure 38

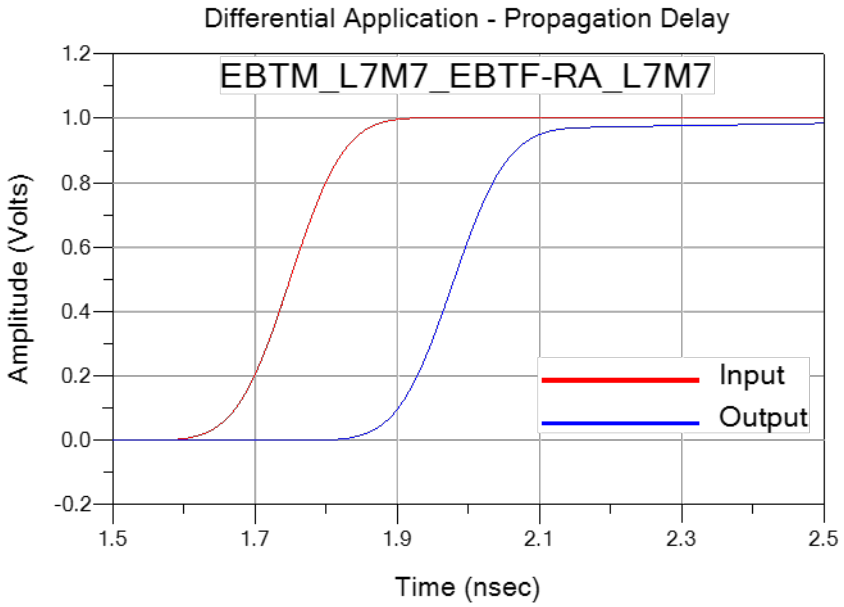

Figure 39

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

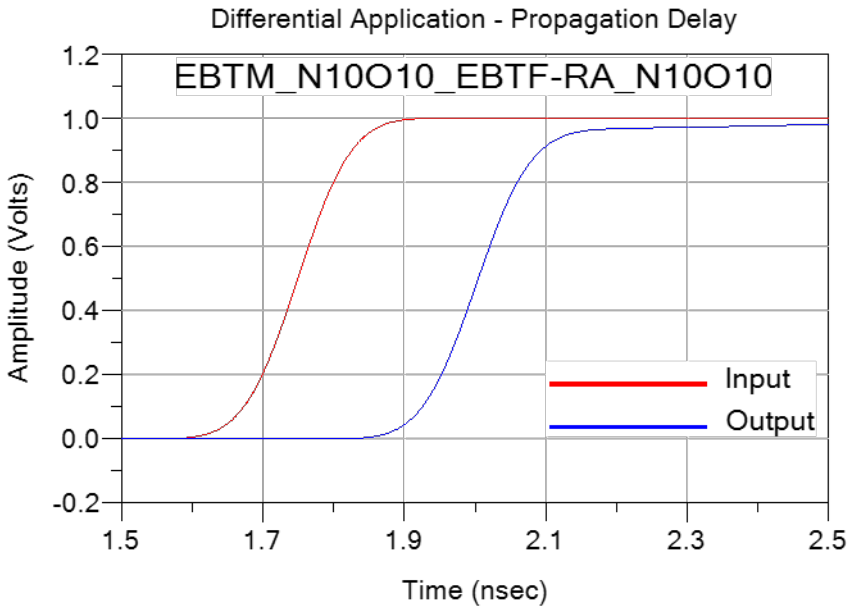

Figure 40

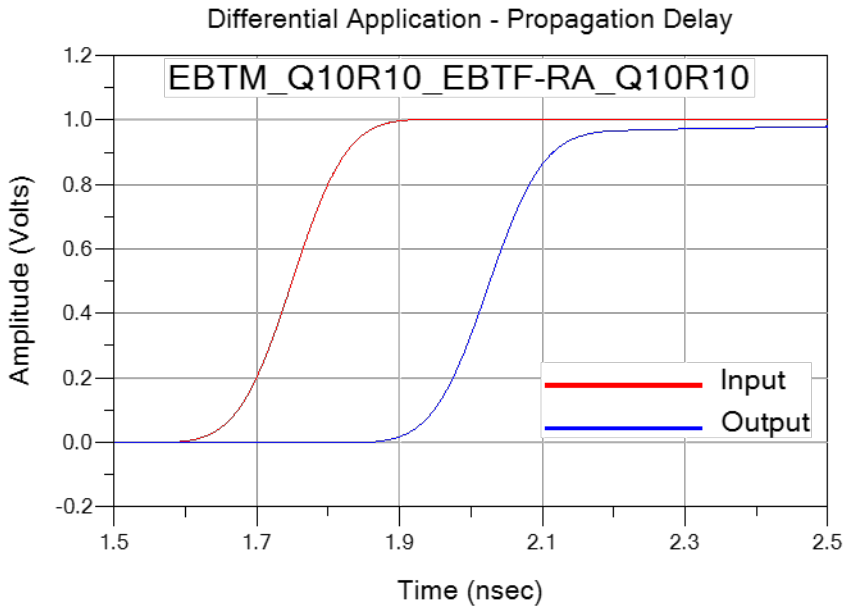

Figure 41

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

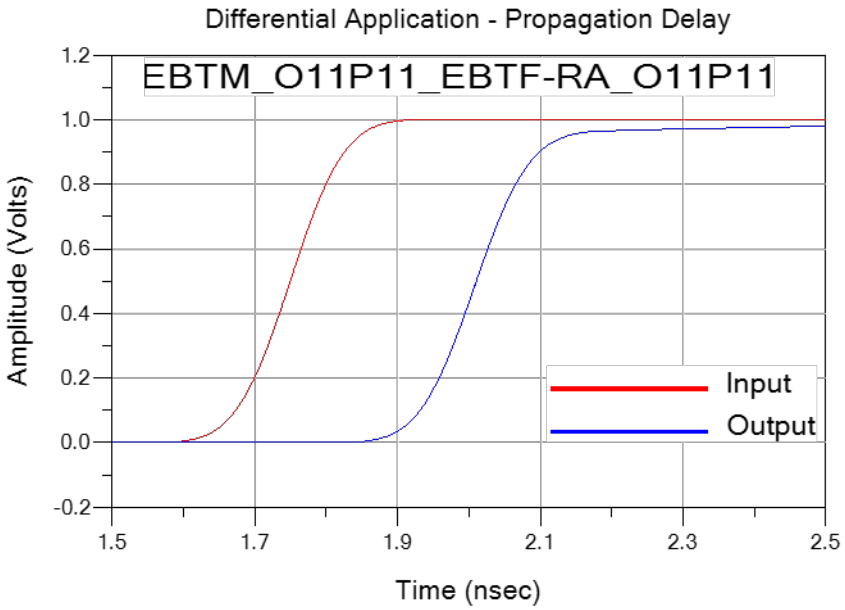

Figure 42

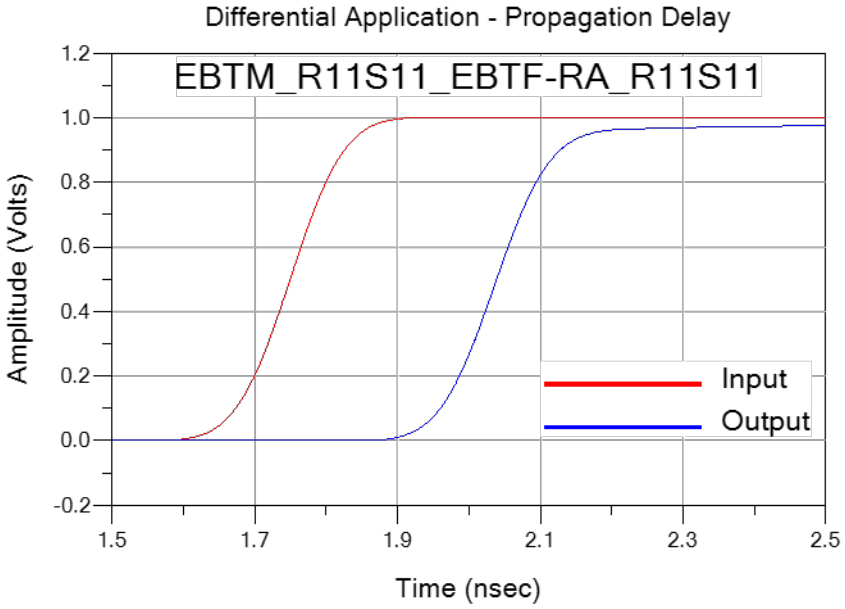

Figure 43

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

Appendix C – Product and Test System Descriptions

Product Description

Product test samples are EBTM/EBTF-RA Series connectors. The part number is EBTM-6-12-2.0-S-VT-1 and EBTF-6-12-2.0-S-RA-1. A photo of the test samples mounted to SI test boards is shown below. The boards were populated with 2.4 mm connectors to reliable out to 50 GHz.

Test System Description

The test fixtures are composed of six-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 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 EBTx series connector set and identified by part number PCB-EBTMRS-110444-SIG-0; PCB-EBTMRM-110444-SIG-0; PCB-EBTMRL-110444-SIG-0; PCB-EBTFRS-110445-SIG-0; PCB-EBTFRM-110445-SIG-0 and PCB-EBTFRL-110445-SIG-0.

PCB-EBTMRX-110444-SIG-0 and PCB-EBTFRX-110445-SIG-0 Test Fixtures

Shown below is a photograph of the test board set.

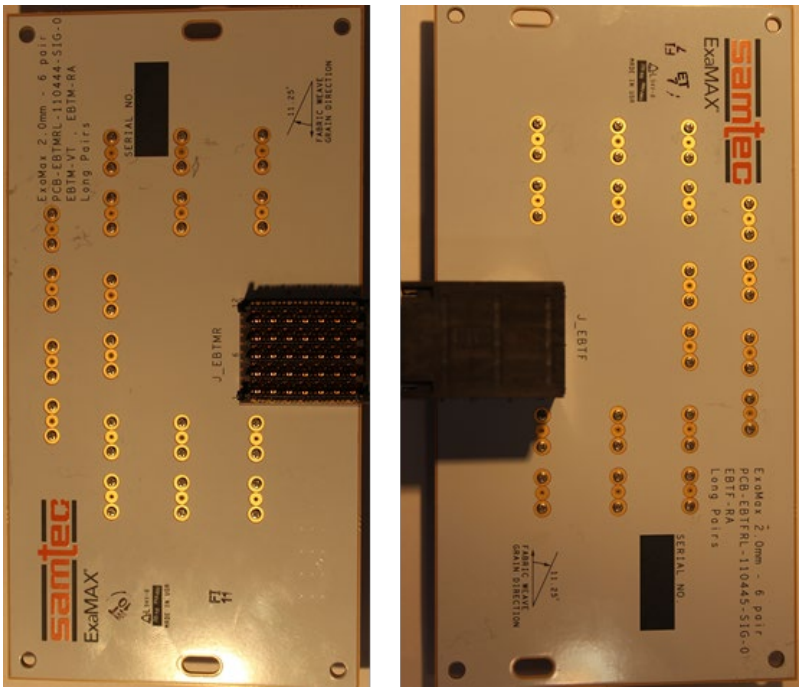

Figure 44

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

PCB Fixtures

The test fixtures used are as follows:

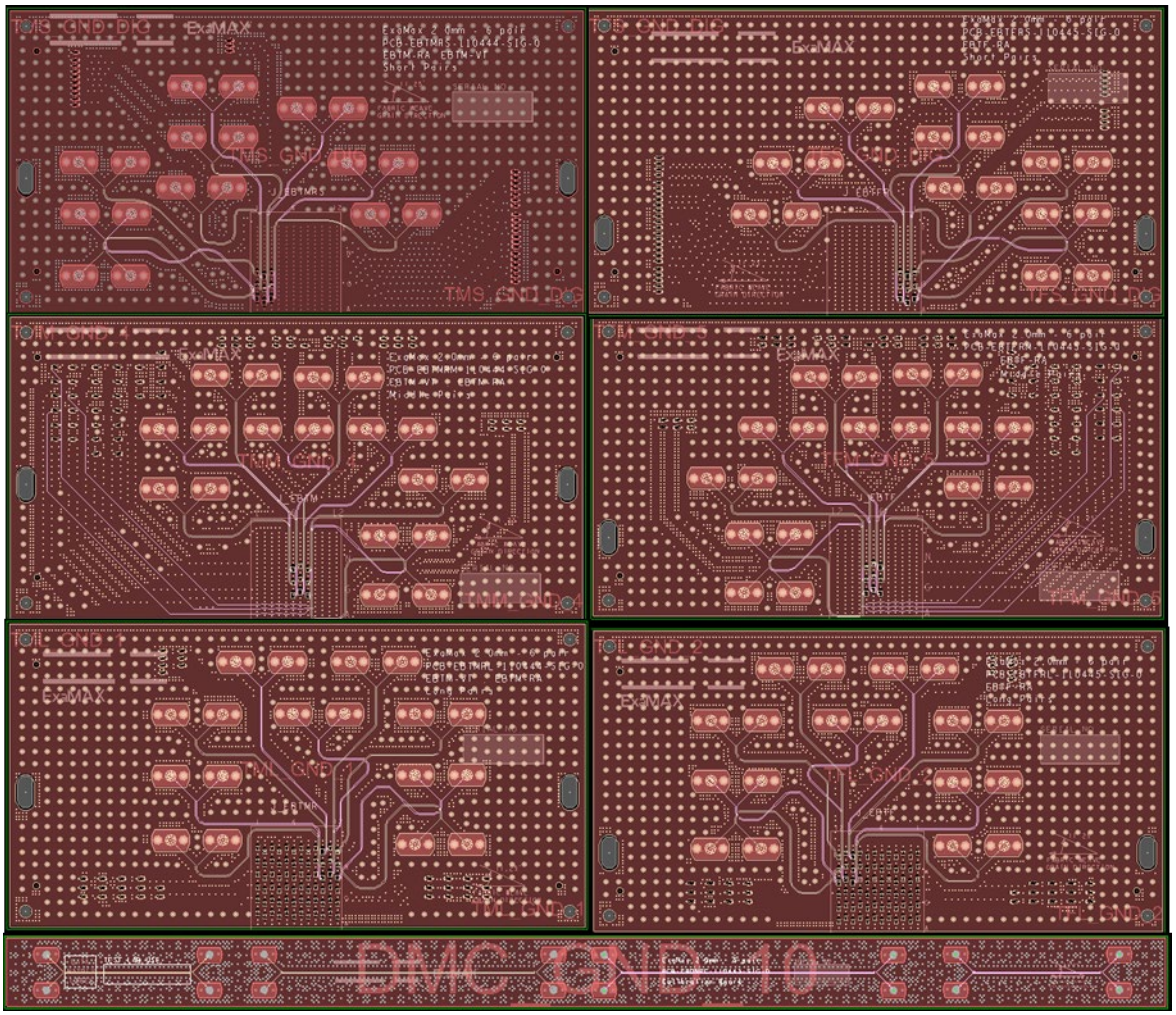

Figure 45

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

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 EBTM/EBTF-RA Series connector set
B- Test board vias, pads (footprint effects) for the EBTM 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.

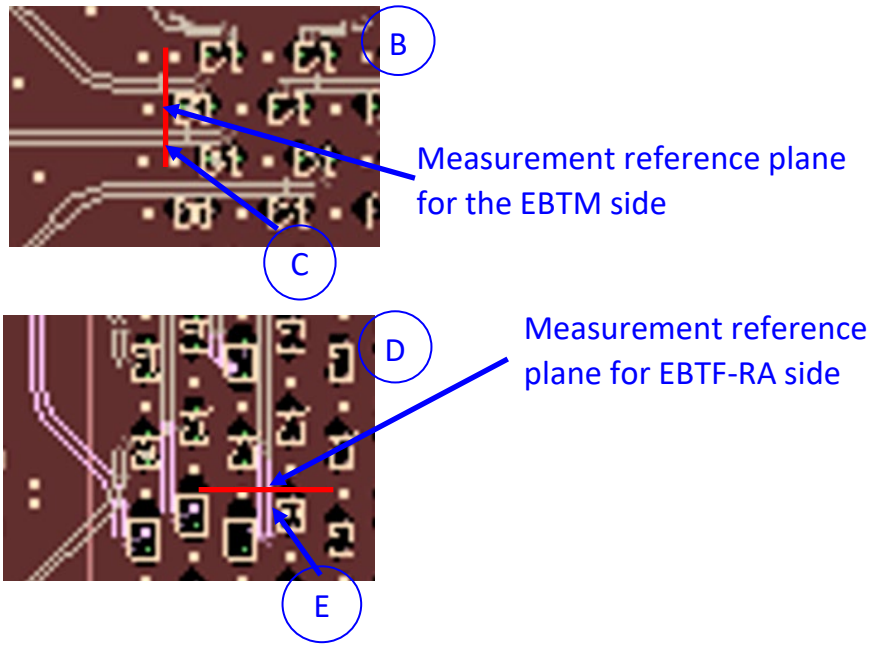

Figure 46

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

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

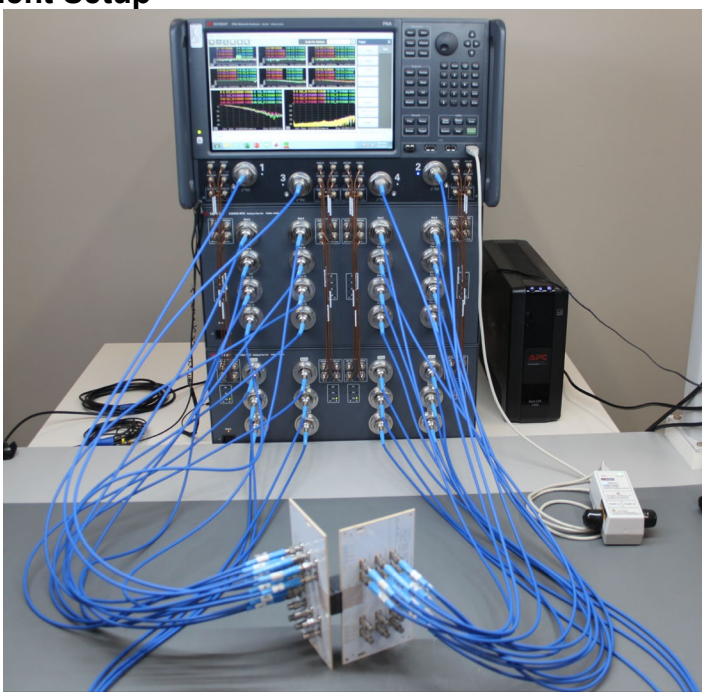

Figure 47

Test Instruments

QTY	Description
1	Keysight N5225B PNA Network Analyzer
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

Series: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

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 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: EBTM / EBTF-RA
Description: ExaMAX® 2.00 mm High-Speed Backplane, 6 Pairs,
Vertical Header mating to Right-Angle Receptacle

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)