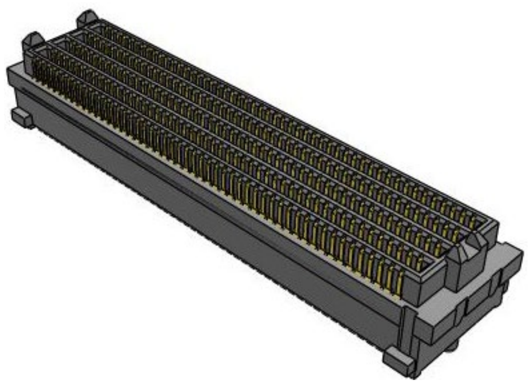
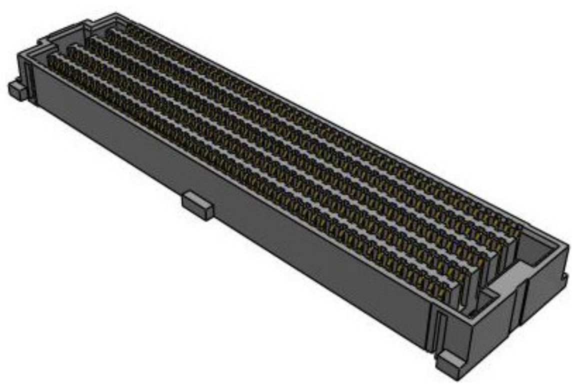
Analog Characterization Report

SEAM8-50-S05.0-S-10-3



mated with

SEAF8-50-S05.0-S-10-3



Description:

0.80 mm SEARAY™ High-Speed High-Density Open-Pin-Field Array, 10 mm Stack Height, Differential RF Analog Application

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Report Revision:5/20/2025

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Connector Overview

0.80 mm SEARAY™ is an open-pin-field array 0.0315" (0.80 mm) pitch connector. Available with up to 500 pins, SEARAY maximizes design and routing flexibility for single-ended or differential pair configurations. SEARAY uses the Rugged Edge Rate® contact system which is designed for applications requiring high-mating cycles. SEARAY™ is available in 4, 6, 8 and 10 row open pin field arrays. Pins per row selections are 10, 20, 30, 40, or 50. SEARAY™ parallel stack heights available for 7mm and 10mm. This report reflects the electrical characteristics specific to a mated SEAM8/SEAF8 10 mm stack height for Differential RF Analog solutions.

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 differential 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 isolation 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 and terminal pins.

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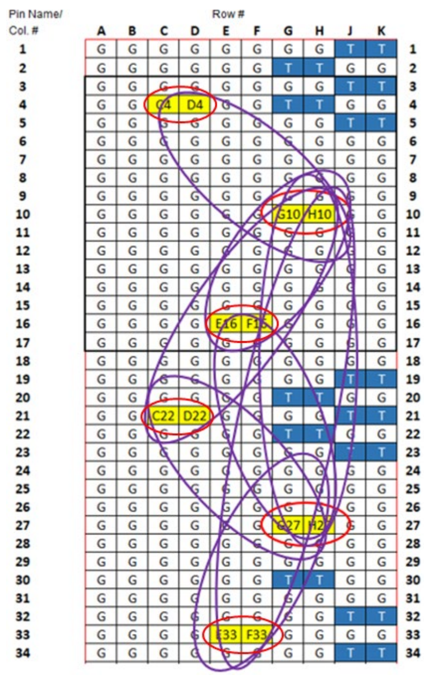
In general, the more pins dedicated to ground, the better electrical performance will be. But dedicating pins to ground reduces signal density of a connector. Therefore, care must be taken when choosing signal/ground ratios in cost or density-sensitive applications.

For this connector, the following configurations were evaluated:



Differential Impedance (denoted by red circles):

- GGSSGG (Ground*2- Signal- Signal- Ground*2)

Differential Crosstalk (denoted by purple 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.

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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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 Near-End and Far End Crosstalk, Power Sum Near- End Crosstalk, Power Sum Far- End Crosstalk, Insertion Loss, Return Loss, VSWR (Voltage Standing Wave Ratio). Other parameters or formats, from 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 D 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 1.43 mm of Differential PCB trace on both the SEAM8 and SEAF8 each. Delay is measured at 100 picoseconds signal risetime. Delay is calculated as the difference in time measured between the 50% amplitude levels of the input and output pulses.

Crosstalk or coupled noise data is provided for various signal configurations. All measurements are single disturber. Crosstalk is calculated as a ratio of the input line voltage to the coupled line voltage. The input line is sometimes described as the active or drive 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.

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 – NEXT Configurations

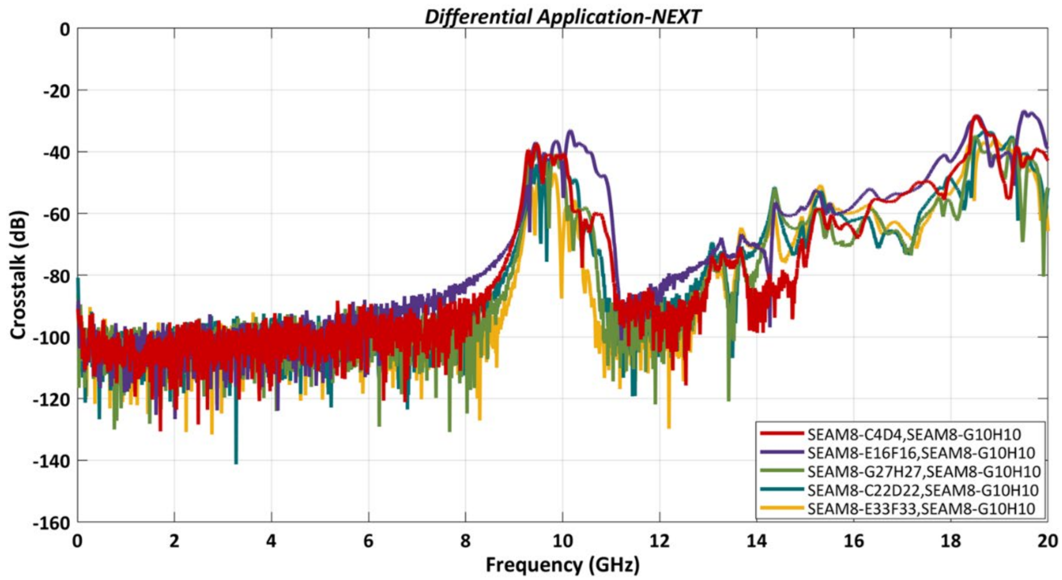

Figure 1

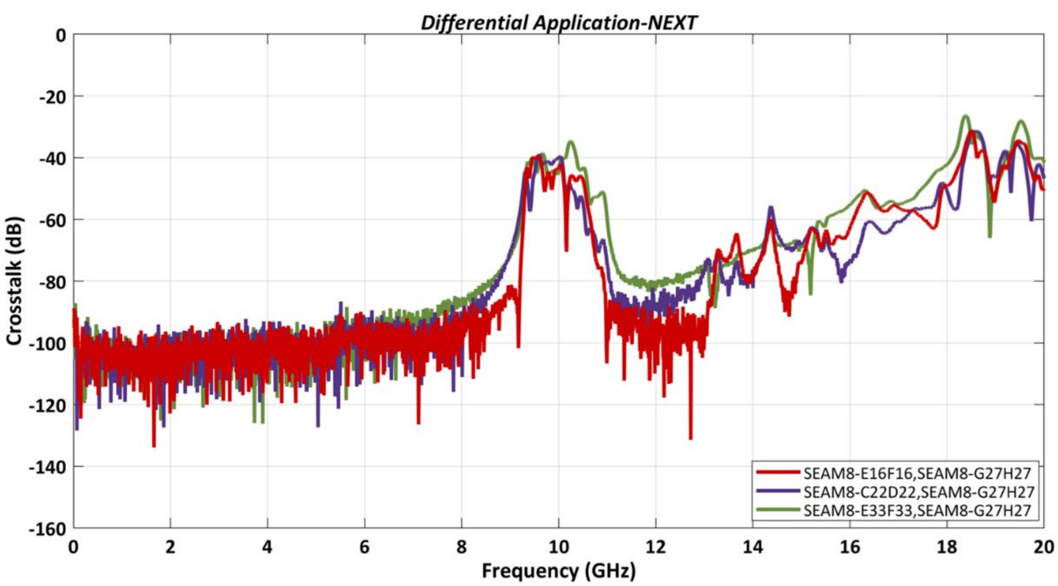

Figure 2

Series: SEAM8/SEAF8
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Differential Application – FEXT Configurations

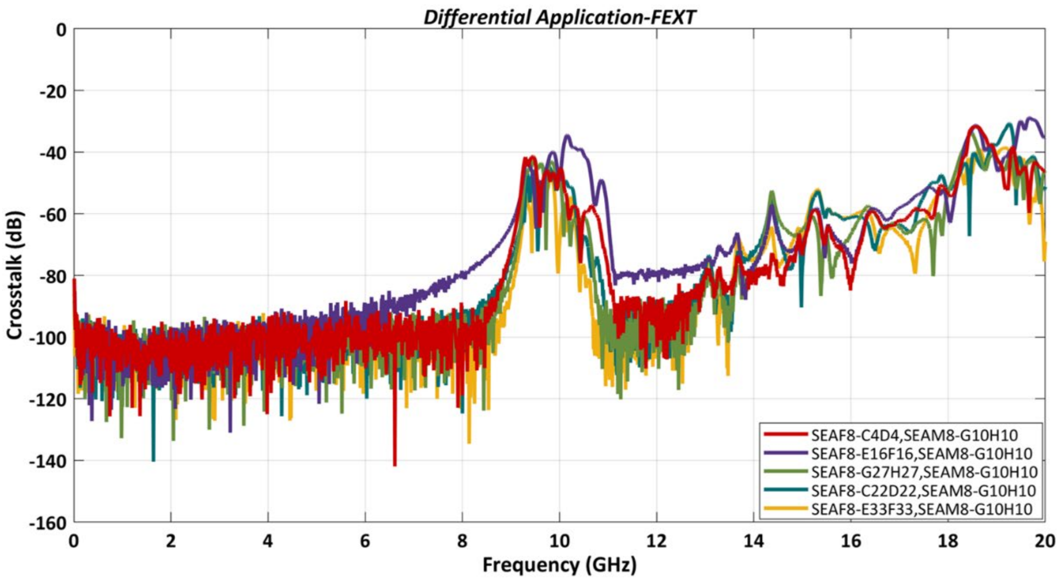

Figure 3

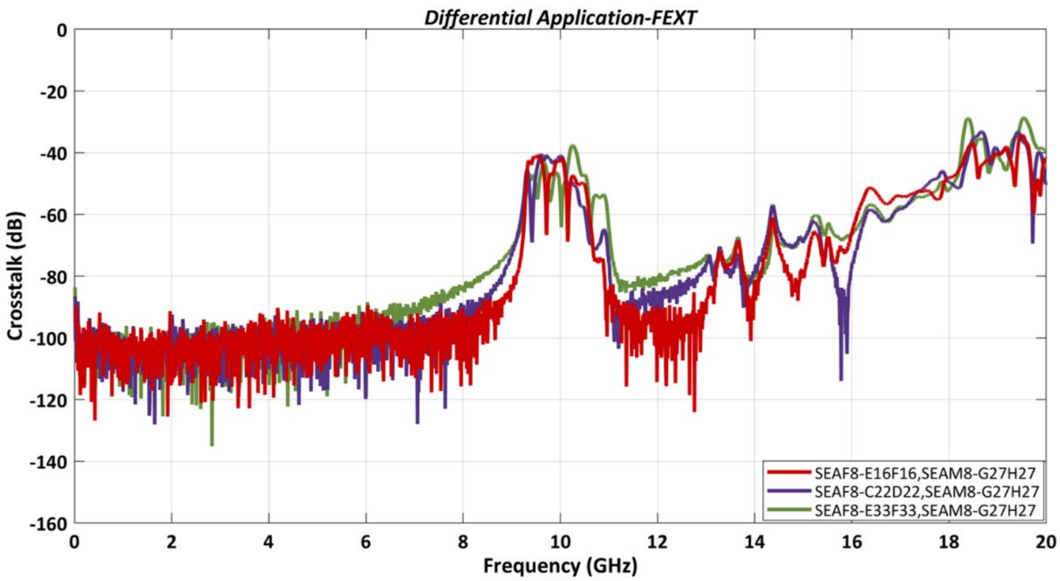

Figure 4

Series: SEAM8/SEAF8
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Differential Application – PS NEXT Configurations

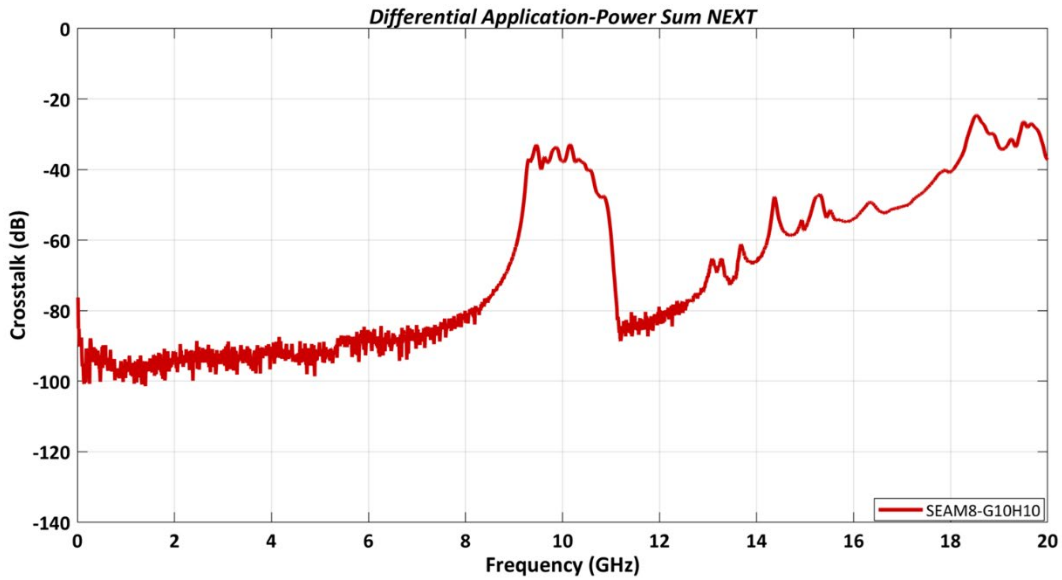

Figure 5

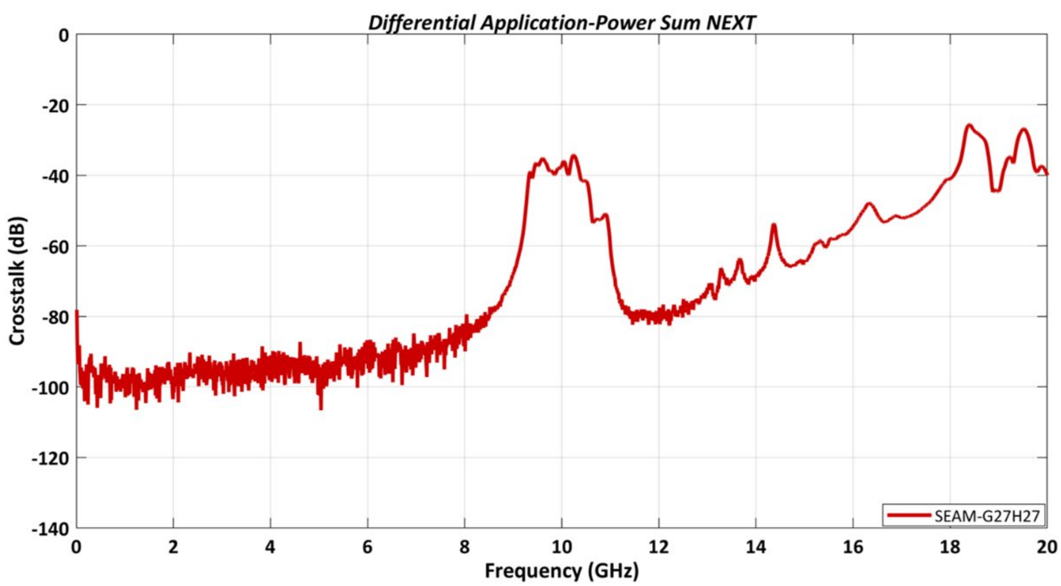

Figure 6

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Differential Application – PS FEXT Configurations

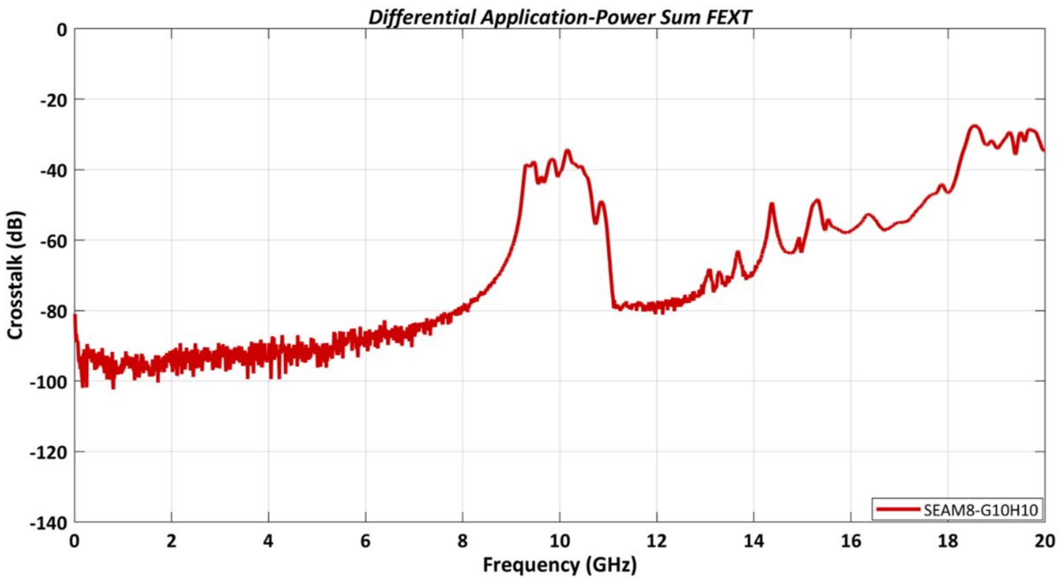

Figure 7

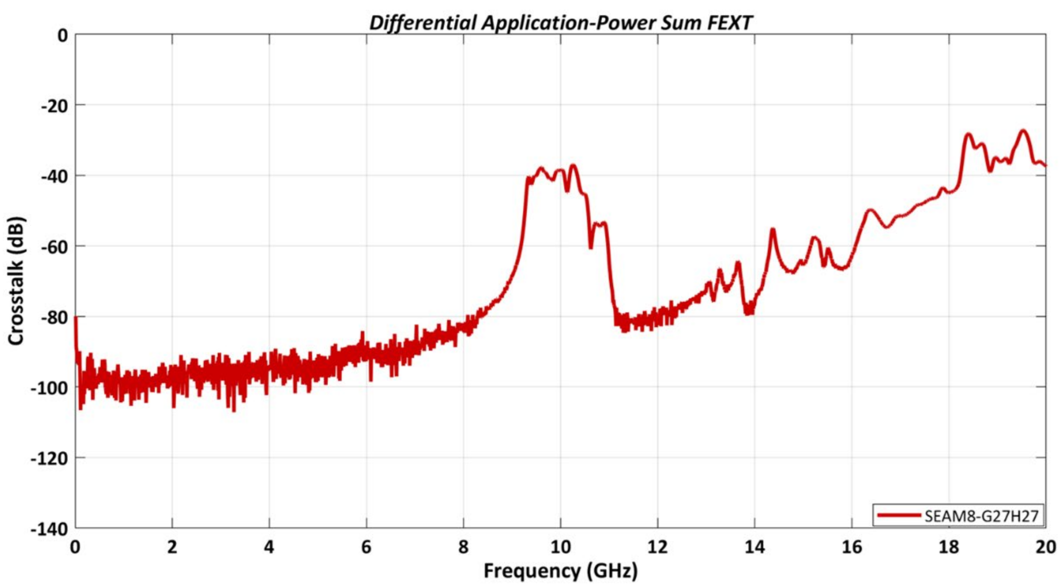

Figure 8

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Table 1 - Differential Crosstalk (dB)

Input(tr)	Driver	Receiver	4GHz	8GHz
NEXT	SEAM8_C4D4	SEAM8_G10H10	-116.10	-91.54
	SEAM8_E16F16	SEAM8_G10H10	-96.58	-83.64
	SEAM8_G27H27	SEAM8_G10H10	-105.90	-94.25
	SEAM8_C22D22	SEAM8_G10H10	-94.06	-101.10
	SEAM8_E33F33	SEAM8_G10H10	-102.20	-94.43
	SEAM8_E16F16	SEAM8_G27H27	-95.92	-101.60
	SEAM8_C22D22	SEAM8_G27H27	-107.60	-90.90
	SEAM8_E33F33	SEAM8_G27H27	-113.40	-88.16
FEXT	SEAF8_C4D4	SEAM8_G10H10	-97.54	-119.0
	SEAF8_E16F16	SEAM8_G10H10	-97.88	-80.19
	SEAF8_G27H27	SEAM8_G10H10	-99.31	-98.18
	SEAF8_C22D22	SEAM8_G10H10	-115.50	-124.80
	SEAF8_E33F33	SEAM8_G10H10	-105.50	-100.30
	SEAF8_E16F16	SEAM8_G27H27	-97.91	-107.70
	SEAF8_C22D22	SEAM8_G27H27	-110.20	-94.00
	SEAF8_E33F33	SEAM8_G27H27	-102.90	-83.65

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Differential Application – Return Loss

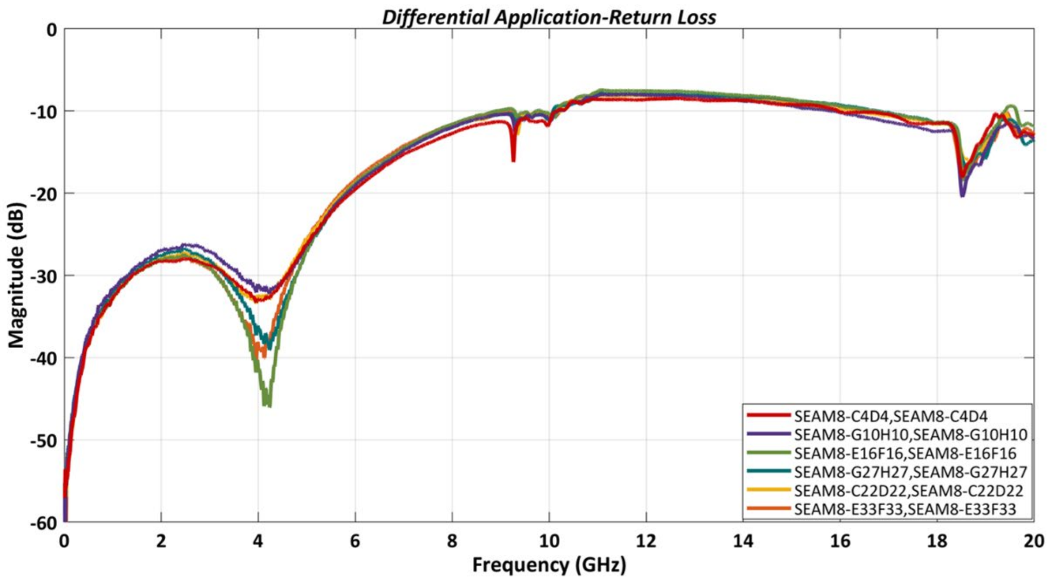

Figure 9

Differential Application – VSWR

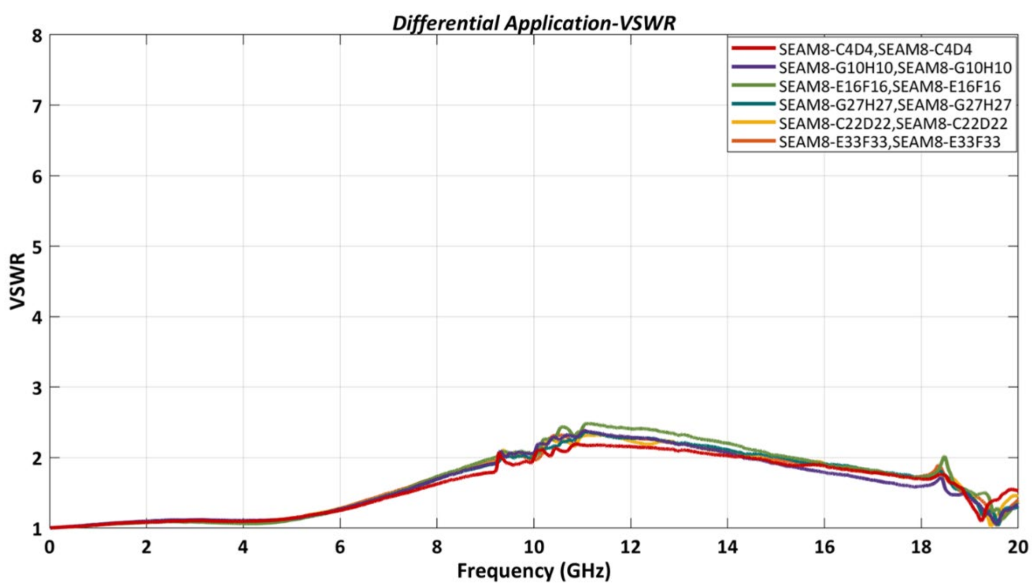

Figure 10

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Differential Application – Insertion Loss

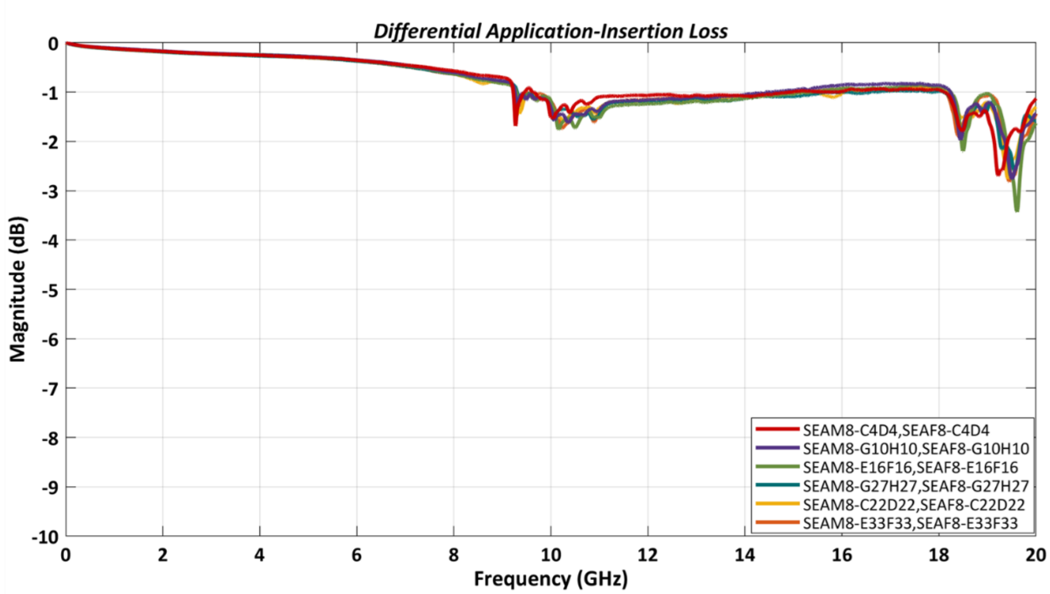

Figure 11

Table 2 –Differential Propagation Delay (Mated Connector)	
C4D4	91 ps
G10H10	90 ps
E16F16	91 ps
G27H27	92 ps
C22D22	92 ps
E33F33	91 ps

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Appendix B – Product and Test System Descriptions

Product Description

Product test samples are SEAM8/SEAF8 series connectors. The part number is SEAM8-50-S05.0-S-10-3 and SEAF8-50-S05.0-S-10-3. A photo of the test articles mounted to SI test boards is shown below.

Test System Description

The test fixtures are composed of six-layer I-TERA 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 SEAM8/SEAF8 series connector set and identified by part number PCB-113402-SIG-XX.

PCB-113402-SIG-XX Test Fixtures

Shown below is a photograph of the test board set.

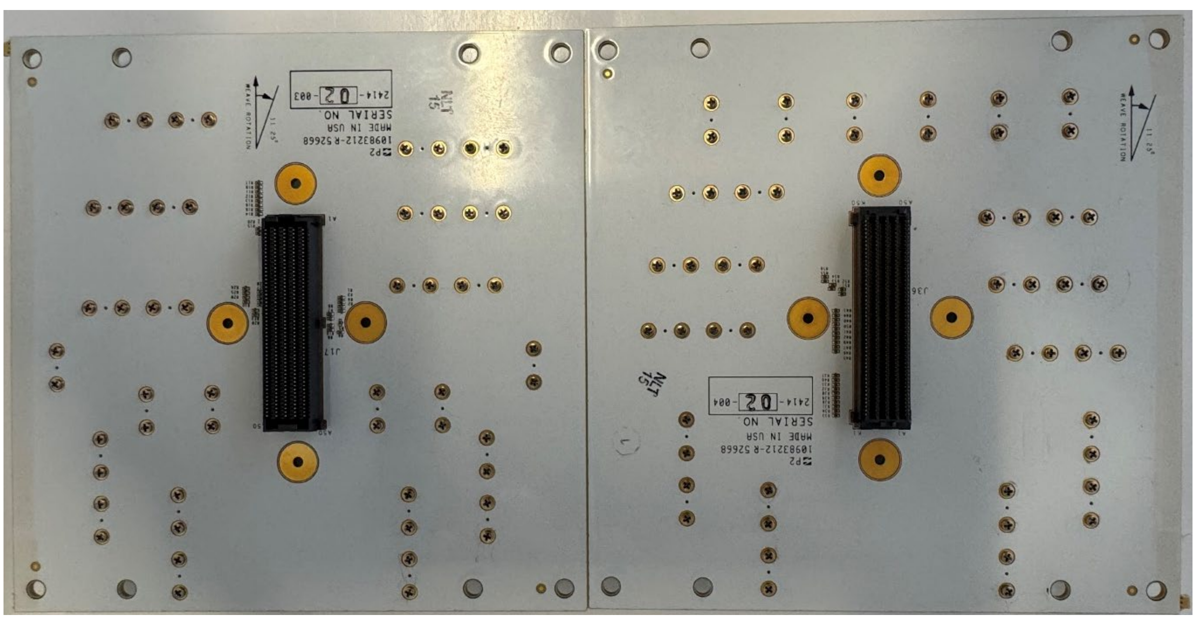

Figure 12

PCB Fixtures

The test fixtures used are as follows:

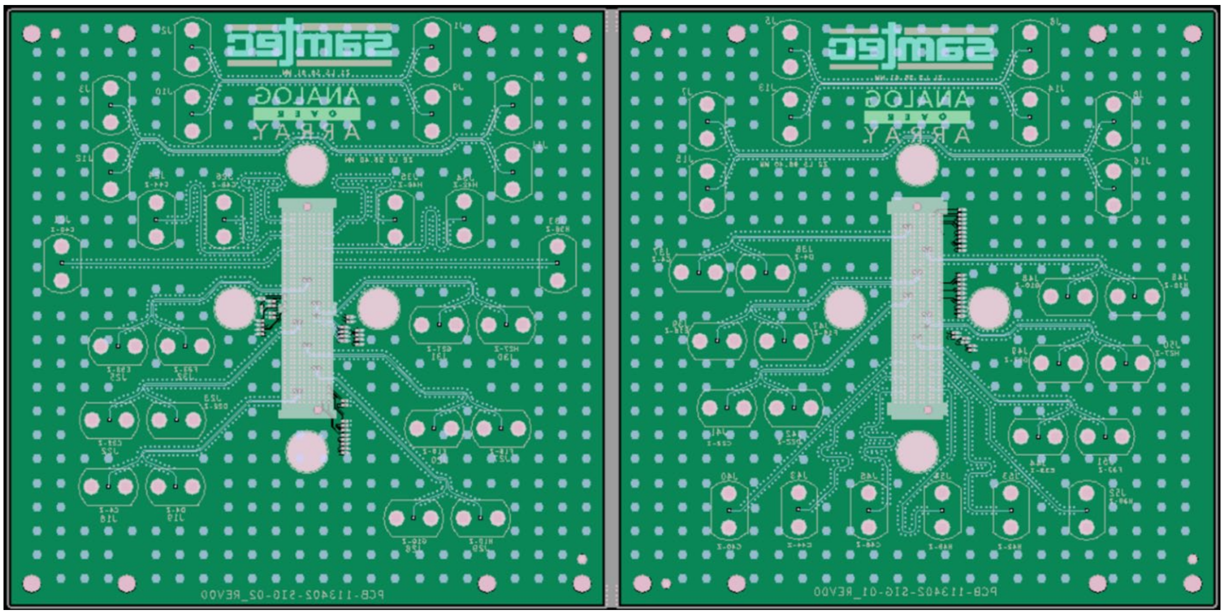

Figure 13

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All traces on the test boards are length matched to 49.63 mm measured from the edge of the pad to the 2.4mm connector. The AFR calibration effectively removes 48.2 mm of test board trace effects. This means that 1.43 mm of test board trace length effects are included in both sides of test boards in the measurement. The S-Parameter measurement includes:

A- The SEAM8/SEAF8 Series connector set
B- Test board vias, pads (footprint effects) for the SEAM8 connector side.
C- 1.43 mm of 0.142 mm wide stripline trace.
D- Test board vias, pads (footprint effects) for the SEAF8 connector side.
E- 1.43 mm of 0.142 mm wide stripline trace.

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

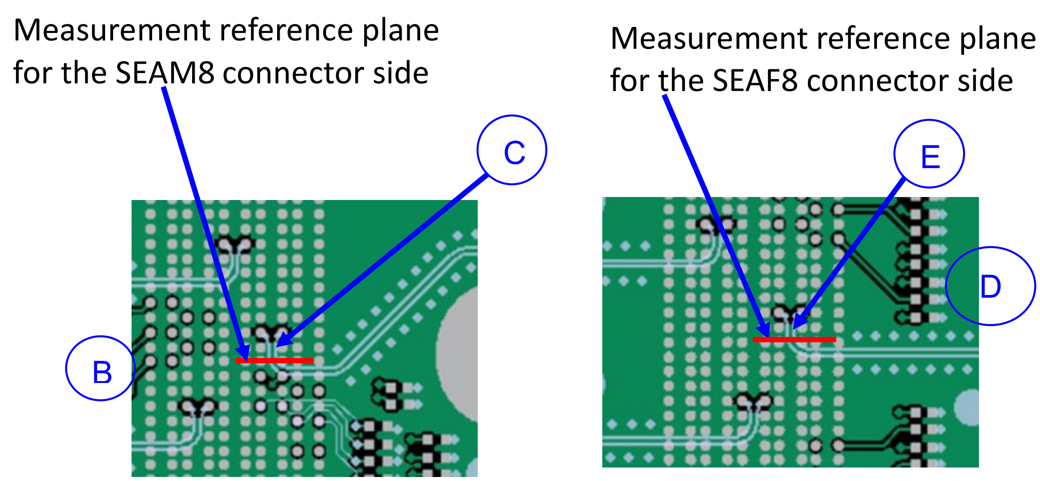

Figure 14

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Appendix C – 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

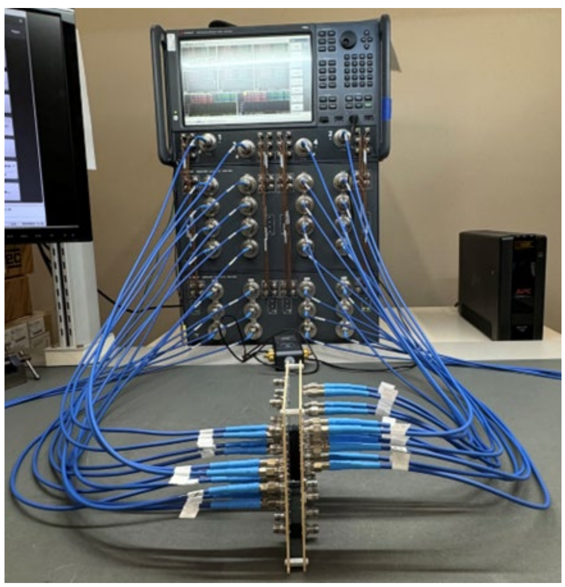

Figure 15

Test Instruments

QTY	Description
1	Keysight N5225B PNA Network Analyzer (10 MHz to 40 GHz)
1	Keysight N4694-60003 Ecal (10 MHz to 40 GHz)

Test Cables & Adapters

QTY	Description
24	1m Junkosha 2.4mm male to female cables

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Appendix D - 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.

Appendix E – 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
PS FEXT – Power Sum Far- End Crosstalk
PS NEXT - Power Sum Near- End Crosstalk
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
VSWR – Voltage Standing Wave Ratio
Z – Impedance (expressed in ohms)