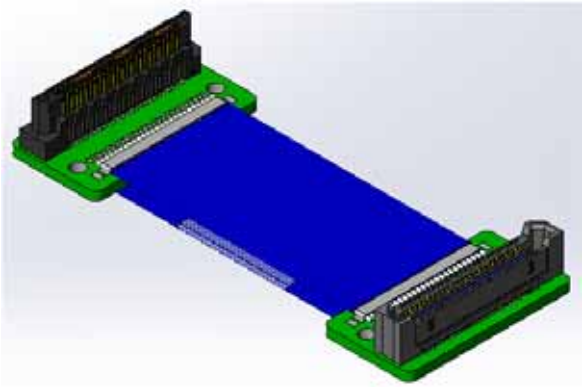
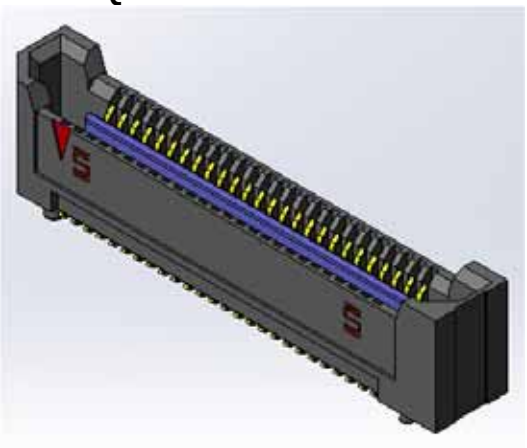
High Speed Characterization Report

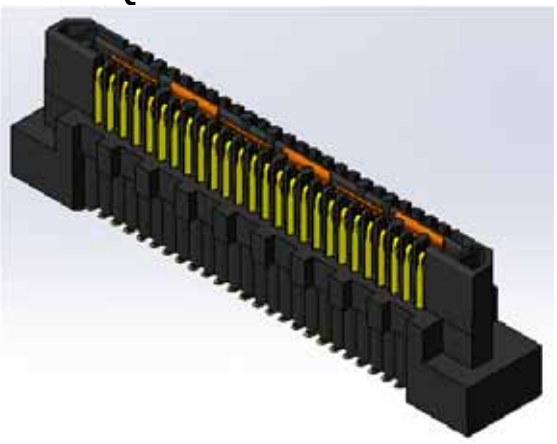
EQRD-XXX-XX.XX-TTR-STL-1



Mated with:

QRF8-XXX-05.0-L-D-A and QRM8-XXX-05.0-L-D-A





Description:

0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

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Report Revision: 6/25/2015

Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

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Cable Assembly Overview

The 0.8 mm (.0315") EQRD Cable Assembly is constructed using 34 AWG micro ribbon coax cable with double row structure. The cable assembly connectors are of the vertical mount type (DV). The EQRD series cable assemblies are available in 26, 52 and 78 positions per row and 43.69 mm (1.72") length minimum. The data in this report is only applicable to 250 mm and 1000 mm length cable assembly.

The test sample consists of two micro coaxial ribbon cables that contain 26 lines each. At each end of the cable there is a connector that is terminated to a small transition PCB. Each connector is soldered to its respective PCB. The connector terminals are on 0.8 mm centers. The cable assembly is wired to facilitate a Pin 1 to Pin 1 mapping between the cable terminations.

The EQRD cable assemblies were tested by mating to a QRF8 Socket at End 1 and to a QRM8 header at End 2. One sample of each length assembly was tested. The actual part numbers that were tested are shown in Table 1, which also identifies End 1 and End 2 of each assembly. A relative sample picture is shown in Figure1. Two single-ended lines and two differential pairs, a Long Path and a Short Path each, of each assembly type were tested.

Length	Part Number	End 1	End 2
250 mm	EQRD-026-09.80-TTR-STL-1	TTR	STL
1000 mm	EQRD-026-39.37-TTR-STL-1	TTR	STL

Table 1: Sample Description

Figure 1: Test Sample

Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Cable Assembly Speed Rating

The cable assembly Speed Rating is based on the -7 dB insertion loss point of the mated cable assembly. The -7 dB point can be used to estimate usable system bandwidth in a typical two-level signaling environment.

To calculate the Speed Rating, the measured -7 dB point is rounded up to the nearest half-GHz level. The up-rounding corrects for any loss from the test board traces. The resulting loss value is then doubled to determine the approximate maximum data rate in Gigabits per second (Gbps). The following table summarizes the Cable Assembly Speed Ratings for the EQRD cable assemblies tested.

Assembly			-7 dB Frequency	Speed Rating
EQRD-026-09.80-TTR-STL-1	Single-Ended	Long Row	4.5 GHz	9 Gbps
		Short Row	4.0 GHz	8 Gbps
	Differential	Long Row	6.5 GHz	13 Gbps
		Short Row	6.0 GHz	12 Gbps
EQRD-026-39.37-TTR-STL-1	Single-Ended	Long Row	3.0 GHz	6 Gbps
		Short Row	2.5 GHz	5 Gbps
	Differential	Long Row	5.5 GHz	11 Gbps
		Short Row	5.0 GHz	10 Gbps

Table 2: Cable Assembly Speed Rating

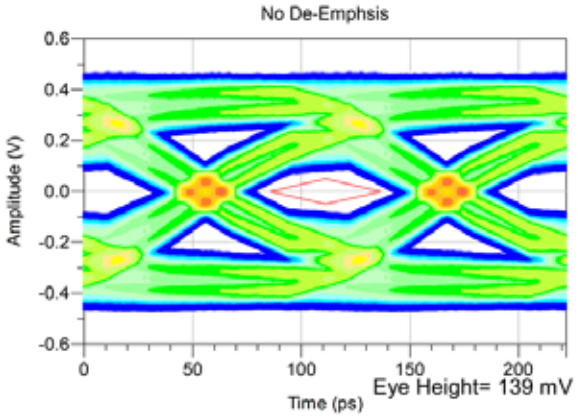
The Samtec Speed Rating is best considered a figure of merit for comparing relative performance between cable assemblies. The Speed Rating becomes less meaningful in systems using multi-level signaling or where crosstalk or impedance mismatch are more critical parameters. Modern high-speed digital transceivers can accommodate roughly 9 dB of loss and still operate reliably. The -7 dB rating is a conservative number that allocates 2 dB of system budget for other channel components such as short PCB traces and IC packaging effects.

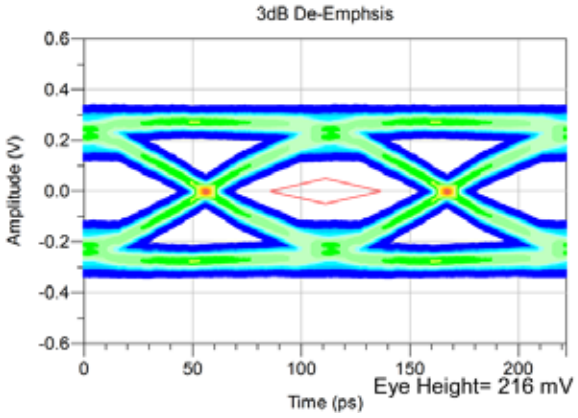
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

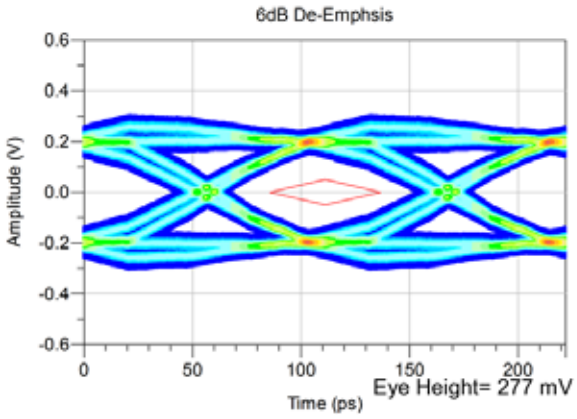
Eye Pattern Summary

EQRD-026-09.80-TTR-STL-1
Single-Ended

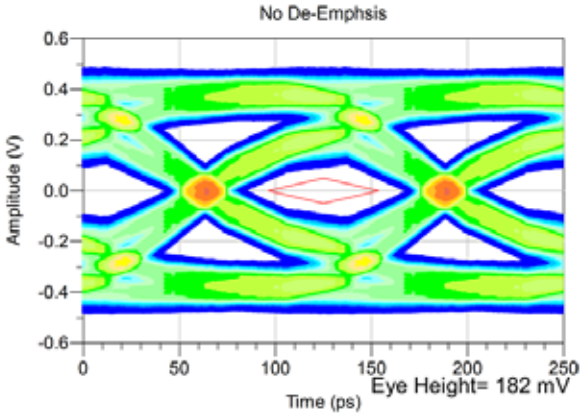
Long Row Output Eye: 9 Gbps

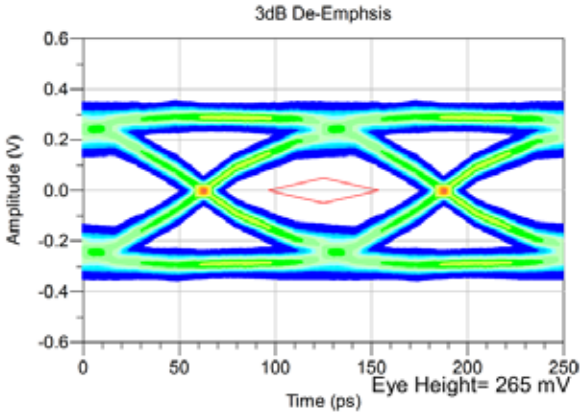


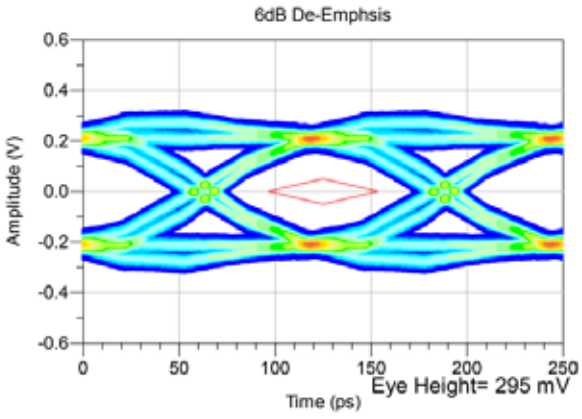




Short Row Output Eye: 8 Gbps







Series: EQRD
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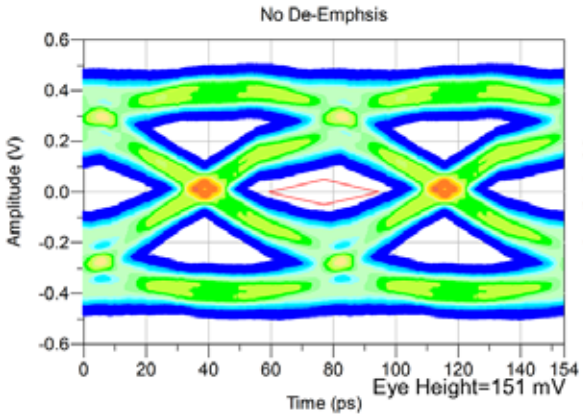
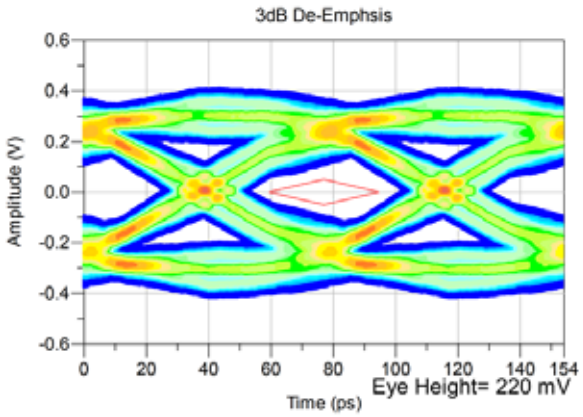
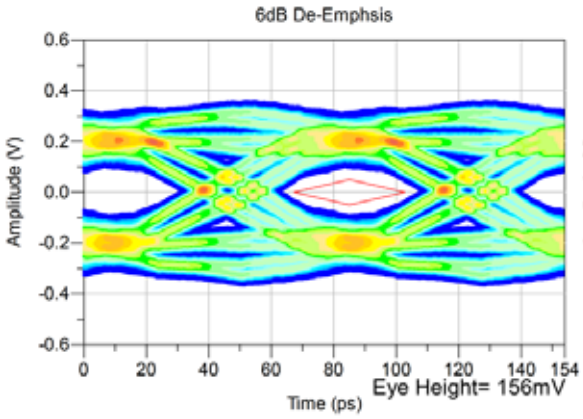
EQRD-026-09.80-TTR-STL-1
Differential

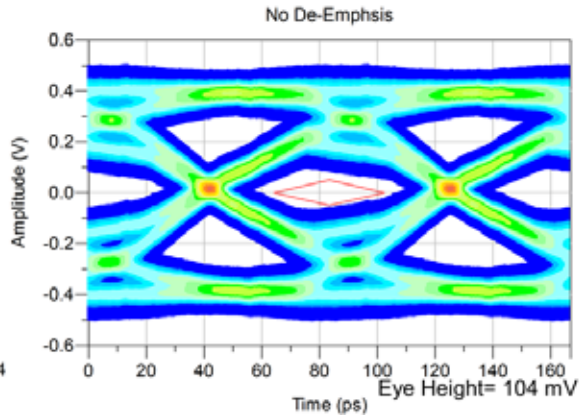
Long Row Output Eye: 13 Gbps

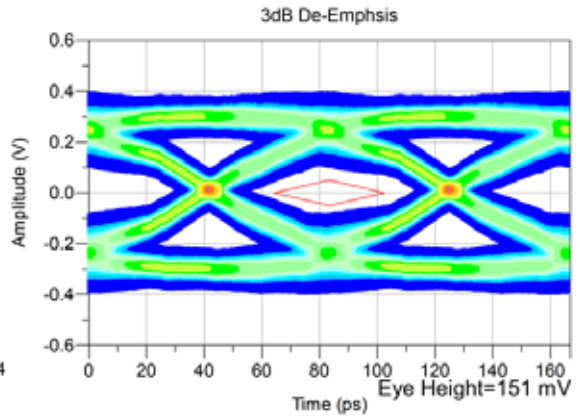


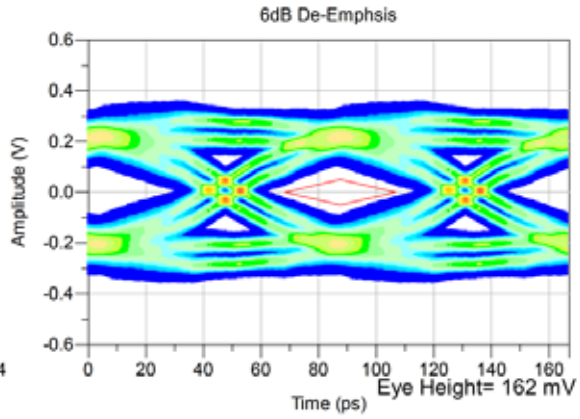




Short Row Output Eye: 12 Gbps



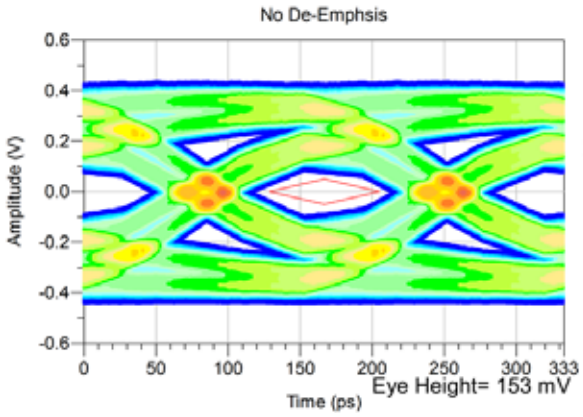


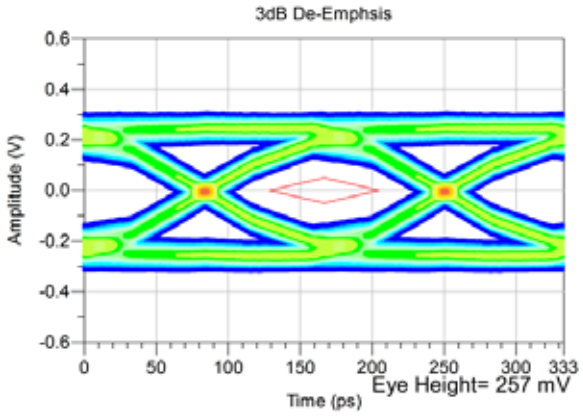


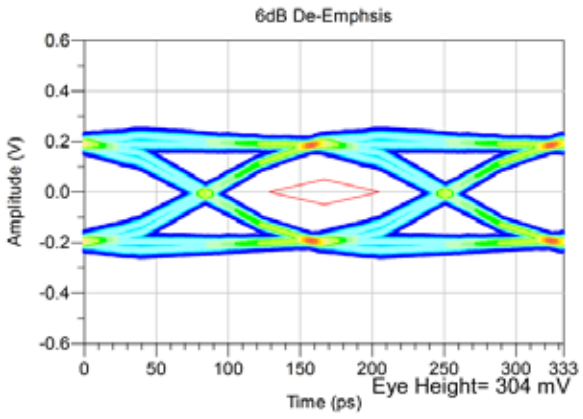
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

EQRD-026-39.37-TTR-STL-1
Single-Ended

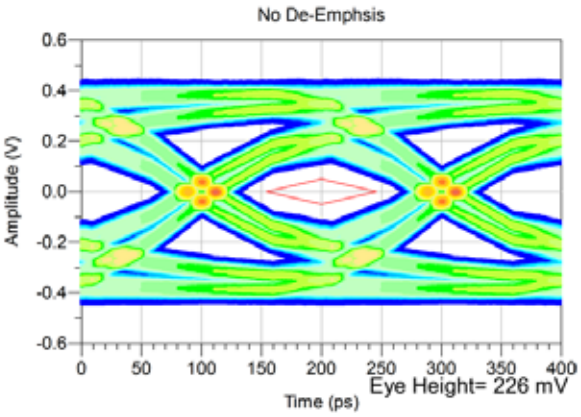
Long Row Output Eye: 6 Gbps

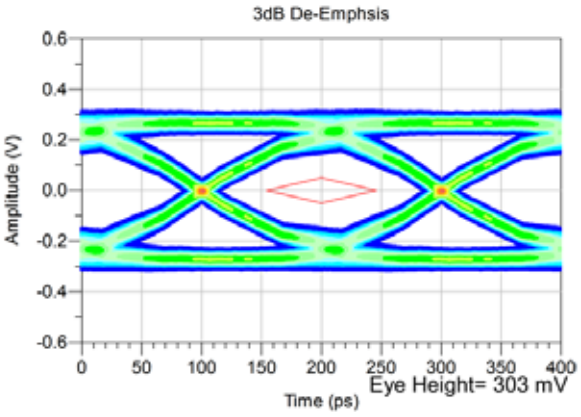


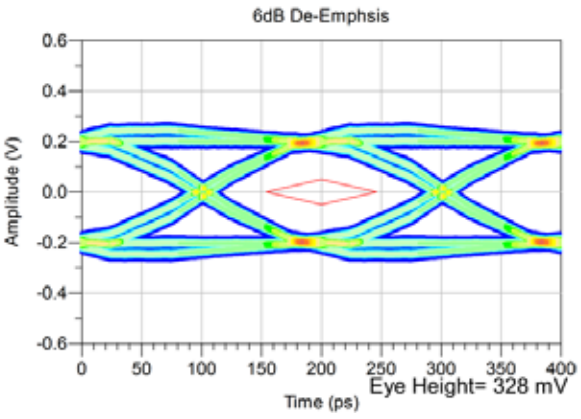




Short Row Output Eye: 5 Gbps







Series: EQRD
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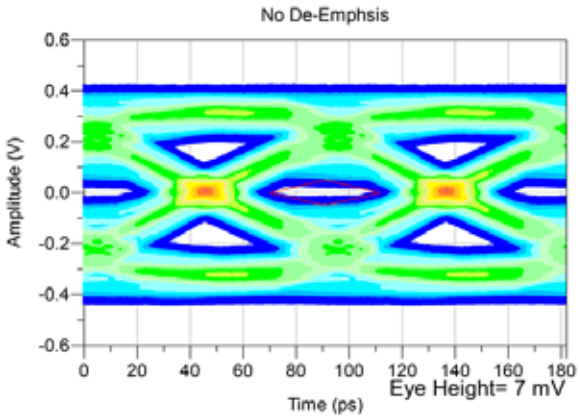
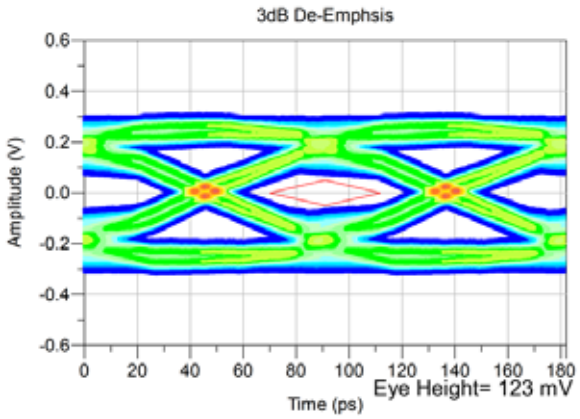
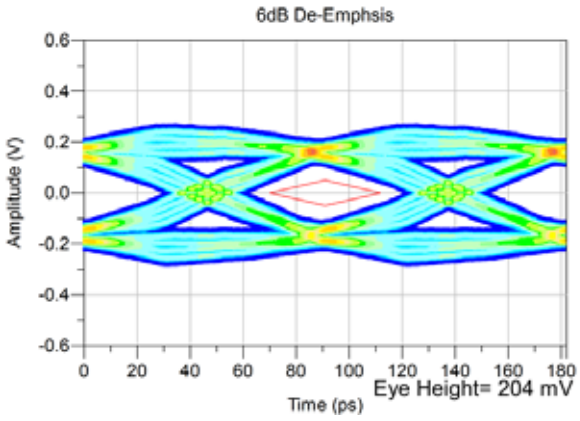
EQRD-026-39.37-TTR-STL-1
Differential

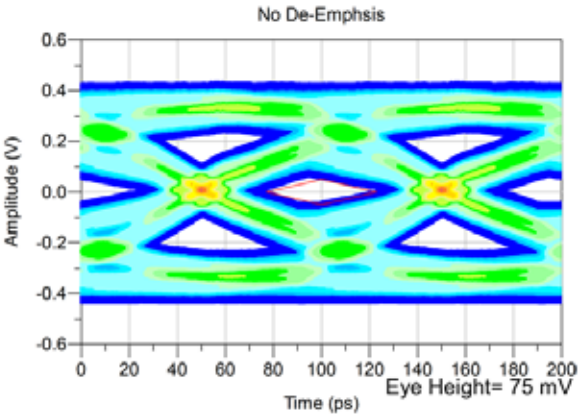
Long Row Output Eye: 11 Gbps

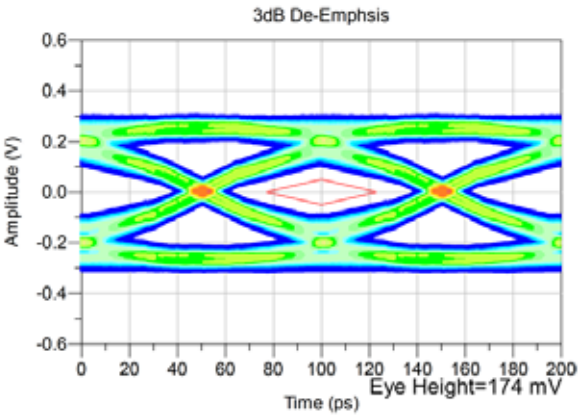


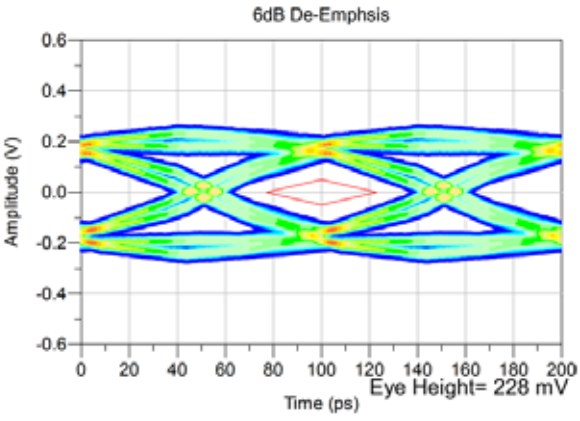




Short Row Output Eye: 10 Gbps







Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Frequency Domain Data Summary

Table 3 – Single-Ended Cable System Performance

Test Parameter	Configuration	Driver	Receiver	0.25m	1m
Insertion Loss	Long Row	TTR_26	STL_26	7dB@ 4.31 GHz	7dB@ 2.54 GHz
	Short Row	TTR_1	STL_1	7dB@ 3.73 GHz	7dB@ 2.25 GHz
Return Loss	Long Row	TTR_26	TTR_26	>10dB to 4.33 GHz	>10dB to 4.99 GHz
	Short Row	TTR_1	TTR_1	>10dB to 1.63 GHz	>10dB to 1.6 GHz
Near-End Crosstalk	In Row: Long Row	TTR_26	TTR_28	<-20dB to 0.3 GHz	<-20dB to 0.23 GHz
	Across Row	TTR_26	TTR_25	<-20dB to 16.2 GHz	<-20dB to 16.21 GHz
	In Row: Short Row	TTR_1	TTR_3	<-20dB to 0.31 GHz	<-20dB to 0.31 GHz
	Across Row	TTR_1	TTR_2	<-20dB to 8.51 GHz	<-20dB to 8.5 GHz
Far-End Crosstalk	In Row: Long Row	TTR_26	STL_28	<-20dB to 0.51 GHz	<-20dB to 0.49 GHz
	Across Row	TTR_26	STL_25	<-20dB to 20 GHz	<-20dB to 20 GHz
	In Row: Short Row	TTR_1	STL_3	<-20dB to 0.54 GHz	<-20dB to 0.5 GHz
	Across Row	TTR_1	STL_2	<-20dB to 11.33 GHz	<-20dB to 20 GHz

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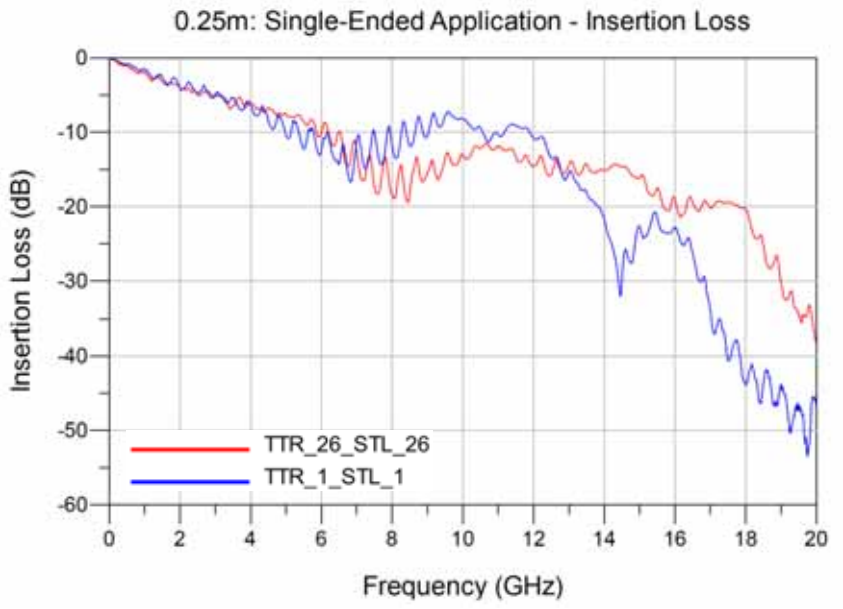
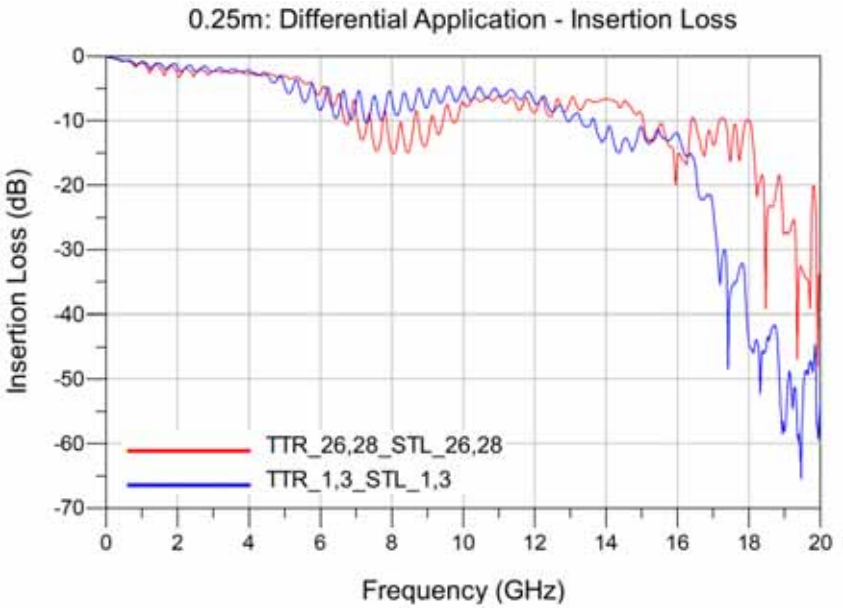
Table 4 – Differential Cable System Performance

Test Parameter	Configuration	Driver	Receiver	0.25m	1m
Insertion Loss	Long Row	TTR_26,28	STL_26,28	7dB@ 6.25 GHz	7dB@ 5.19 GHz
	Short Row	TTR_1,3	STL_1,3	7dB@ 5.53 GHz	7dB@ 4.58 GHz
Return Loss	Long Row	TTR_26,28	TTR_26,28	>10dB to 1.15 GHz	>10dB to 1.48 GHz
	Short Row	TTR_1,3	TTR_1,3	>10dB to 1.18 GHz	>10dB to 2.16 GHz
Near-End Crosstalk	In Row: Long Row	TTR_26,28	TTR_30,32	<-20dB to 1.64 GHz	<-20dB to 2.95 GHz
	Across Row	TTR_26,28	TTR_25,27	<-20dB to 18.8 GHz	<-20dB to 18.8 GHz
	In Row: Short Row	TTR_1,3	TTR_5,7	<-20dB to 2.1 GHz	<-20dB to 2.2 GHz
	Across Row	TTR_1,3	TTR_2,4	<-20dB to 19.85 GHz	<-20dB to 19.85 GHz
Far-End Crosstalk	In Row: Long Row	TTR_26,28	STL_30,32	<-20dB to 9.46 GHz	<-20dB to 20 GHz
	Across Row	TTR_26,28	STL_25,27	<-20dB to 20 GHz	<-20dB to 20 GHz
	In Row: Short Row	TTR_1,3	STL_5,7	<-20dB to 4.49 GHz	<-20dB to 20 GHz
	Across Row	TTR_1,3	STL_2,4	<-20dB to 20 GHz	<-20dB to 20 GHz

Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Bandwidth Chart – Single-Ended & Differential Insertion Loss





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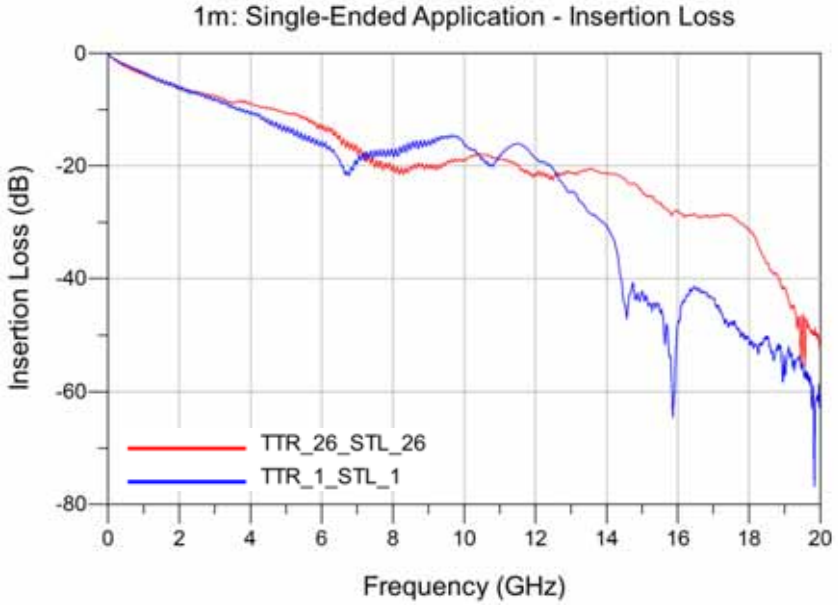

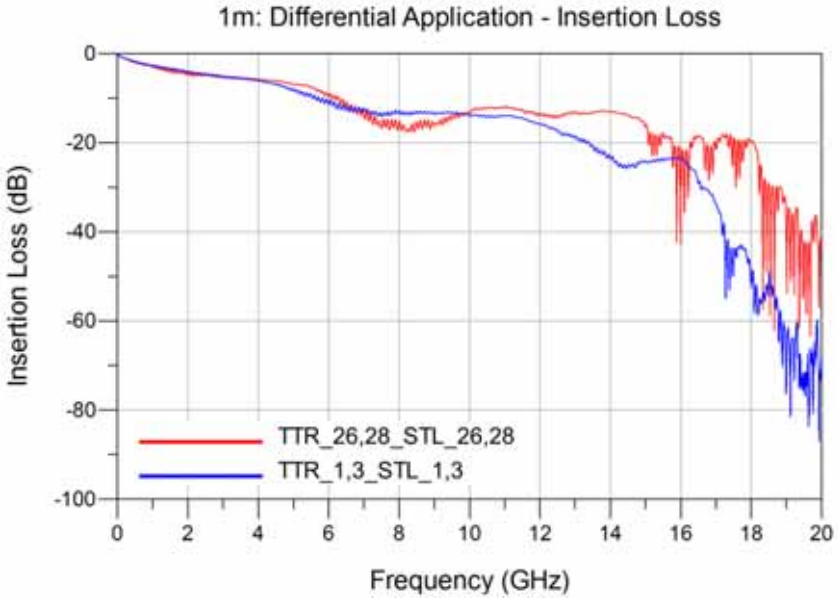

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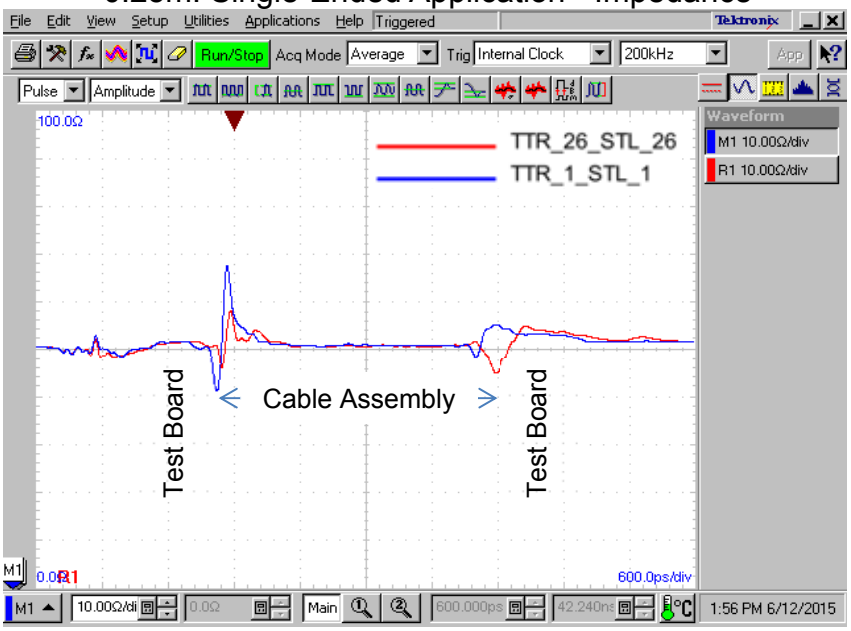
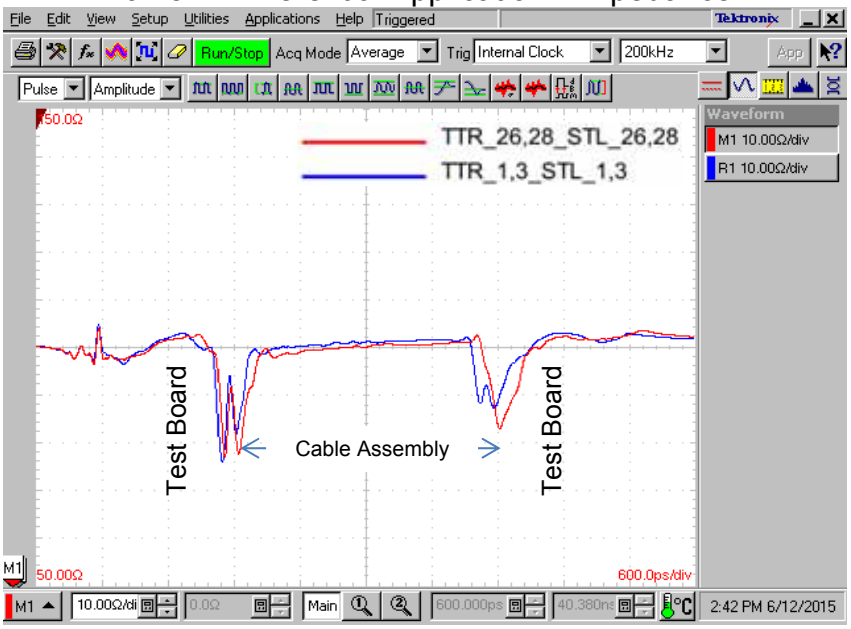
Time Domain Data Summary

0.25m: Single-Ended Application - Impedance



0.25m: Differential Application - Impedance



Series: EQRD
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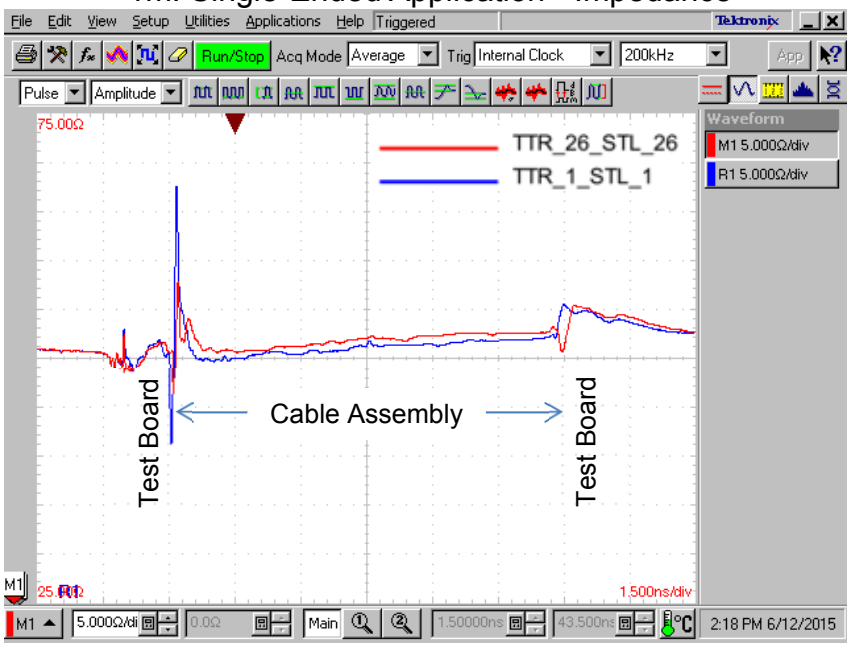
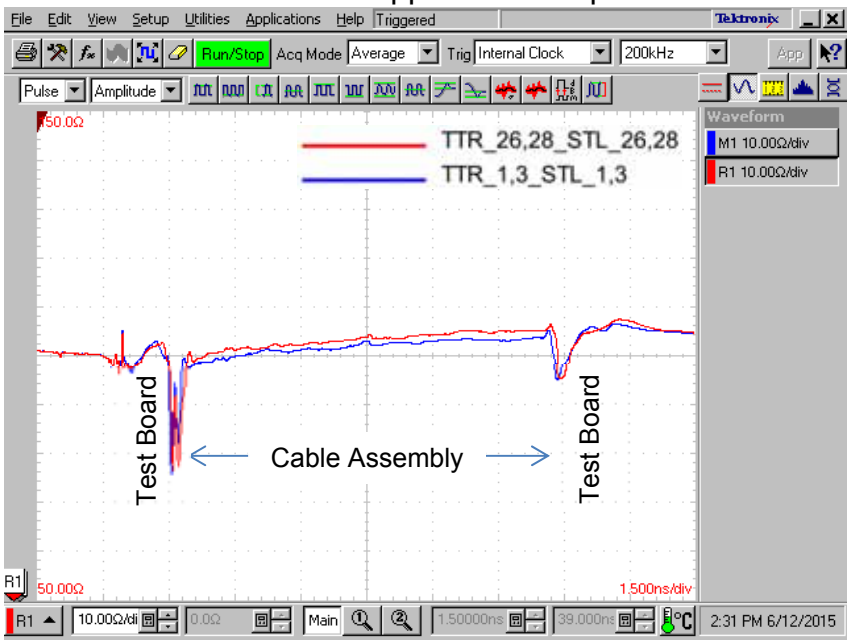
1m: Single-Ended Application - Impedance



1m: Differential Application - Impedance



Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Table 5 - Propagation Delay (Cable Assembly)				
Cable length	**Driver/ Receiver**	**Driver/ Receiver**	**Driver/ Receiver**	**Driver/ Receiver**
	TTR_26/ STL_26	TTR_1/ STL_1	TTR_26,28/ STL_26,28	TTR_1,3/ STL_1,3
0.25m	1.359ns	1.249ns	1.324ns	1.224ns
1m	4.539ns	4.471ns	4.499ns	4.414ns

Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Characterization Details

This report presents data that characterizes the signal integrity response of a cable assembly 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 mating connectors, cable assembly, 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 cable assembly'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 cable assemblies 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 "S" single-ended and "SS" differential drive configurations.

Cable assembly Signal to Ground Ratio

Samtec cable assemblies 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 cable assemblies, a ground plane or blade, or an outer shield, is used as the signal return, while in others, cable assembly 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 cable assembly. Therefore, care must be taken when choosing signal/ground ratios in cost or density-sensitive applications.

Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable
For this cable assembly, the following array configurations are evaluated:

Single-Ended Impedance**:**

- Long Row (upper terminals, furthest from test fixture)
- Short Row (bottom terminals, closest to test fixture)

Single-Ended Crosstalk**:**

- In Row: Long Row (adjacent terminals in the long row)
- In Row: Short Row (adjacent terminals in the short row)
- Across Row: “Xrow”: (from one row of terminals to the other row)

Differential Impedance**:**

- Long Row (upper terminals, furthest from test fixture)
- Short Row (bottom terminals, closest to test fixture)

Differential Crosstalk**:**

- In Row: Long Row (adjacent terminals in the long row)
- In Row: Short Row (adjacent terminals in the short row)
- Across Row: “Xrow”: (from one row of terminals to the other row)

See Appendix D – Product and Test System Descriptions for details

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 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.

Signal Edge Speed (Rise Time)
In pulse signaling applications, the perceived performance of the interconnect can vary significantly depending on the edge rate or the rise time of the exciting signal. For this report, the fastest rise time used was 30 ps. Generally, this should demonstrate the worst-case performance.

Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable
In many systems, the signal edge rate will be significantly slower at the cable assembly 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.

Unless otherwise stated, measured rise times were at 10%-90% signal levels.

Eye Diagram Data

Eye patterns are a time domain characterization of system level performance. Eye patterns are generated by sending continuous streams of data from a transmitter to a receiver, and overlaying the received signals upon one another. Over time, the received data builds to resemble an eye. Negative SI effects in the transmission path can cause the signal to distort, which over time, will cause the eye to "close". Specifications, such as an eyemask template, can be placed on the amount of open area required in the eye to ensure a functional system.

An eyemask template is a representation of the receiver's sensitivity and is often used as a metric of performance. While there are lot-to-lot and vendor-to-vendor variations in receiver sensitivity, some general guidelines can be developed. After reviewing several major industry standards (PCIe, Gigabit Ethernet), we find similar eyemask requirements and we will use these as the basis for a generic template in this report. For this report, we will assume a receiver amplitude sensitivity of 50 mVpp and a jitter margin of 0.5 UI. This results in a diamond shape eyemask template that is 50 mV high and 0.5 UI wide.

Please contact our Signal Integrity Group at sig@samtec.com for more information.

Frequency Domain Data

Frequency Domain parameters are helpful in evaluating the cable assembly 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, Near-End and Far-End Crosstalk, and Mode Conversion. 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 from network analyzer measurements.

Time Domain Data

Time Domain parameters indicate Impedance mismatch versus length and signal propagation time in a pulsed signal environment.

Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable
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 C of this report.

The measured S-Parameters from the network analyzer are post-processed using Agilent ADS to obtain the time domain response for signal propagation time. The Time Domain procedure is provided in Appendix F 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 cable assembly, mating connectors, and connector footprint. Delay is measured at 30 picoseconds signal rise-time. Delay is calculated as the difference in time measured between the 50% amplitude levels of the input and output pulses.

Data for other configurations may be available. Please contact our Signal Integrity Group at sig@samtec.com for further information.

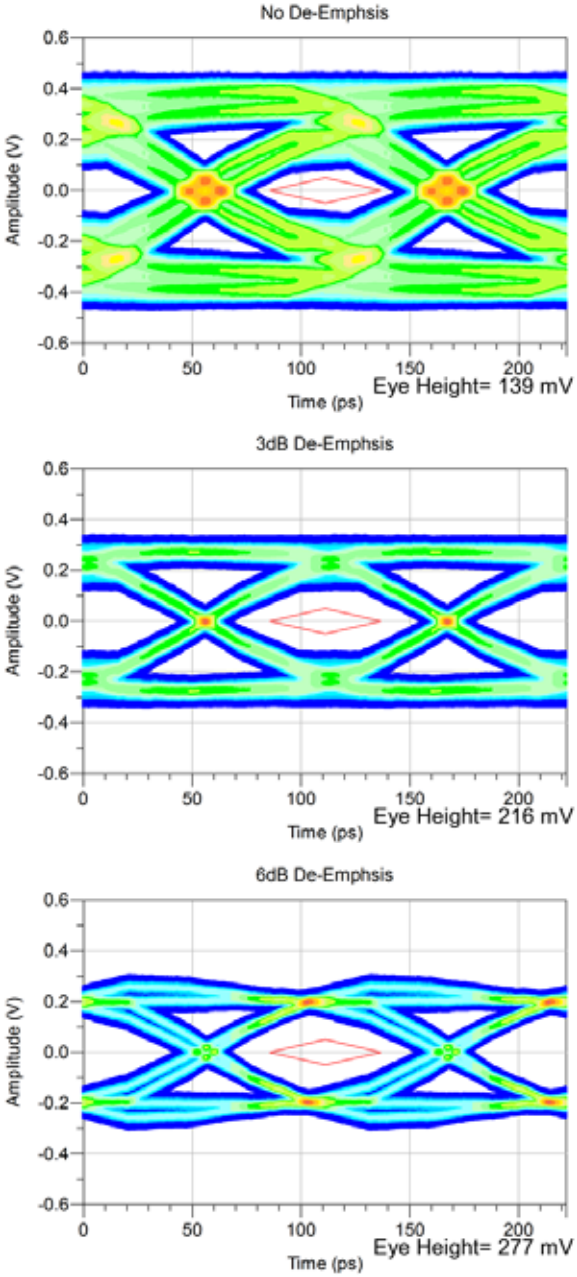
Additional information concerning test conditions and procedures is located in the appendices of this report. Further information may be obtained by contacting our Signal Integrity Group at sig@samtec.com.

Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Appendix A – Eye Diagrams

EQRD-026-09.80-TTR-STL-1
Single-Ended

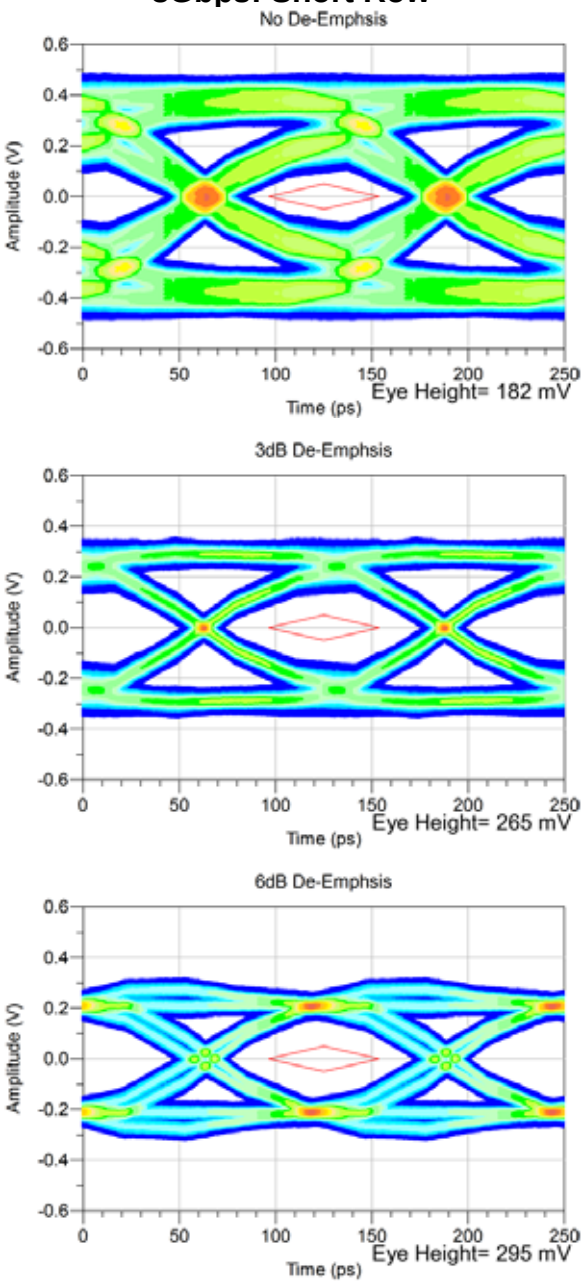
9Gbps: Long Row



Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Single-Ended

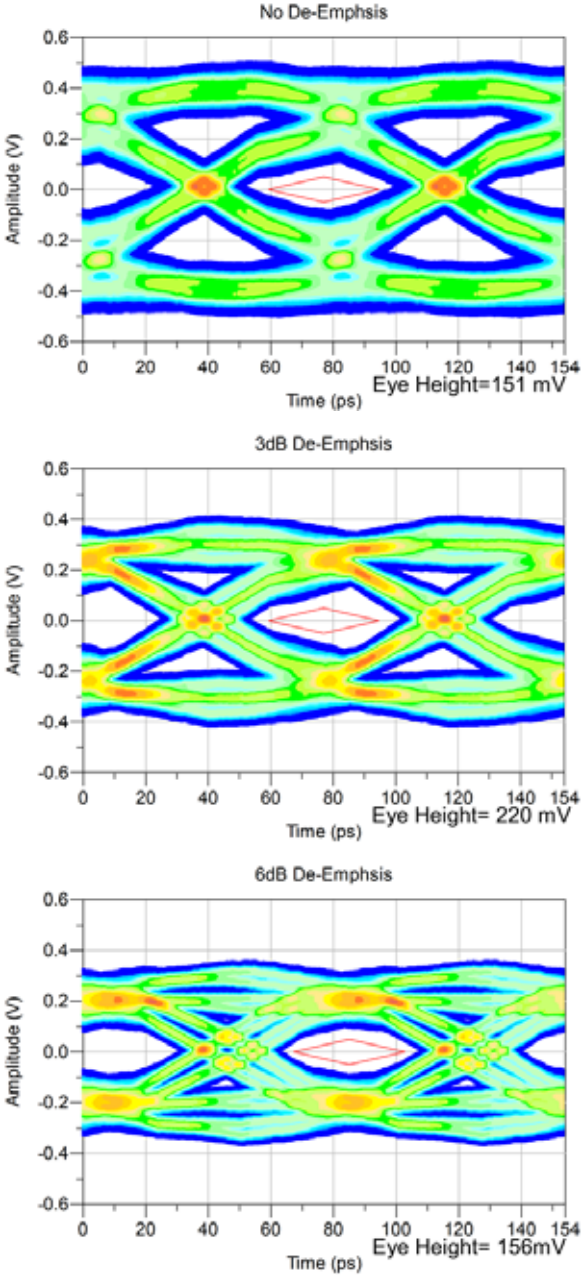
8Gbps: Short Row



Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Differential

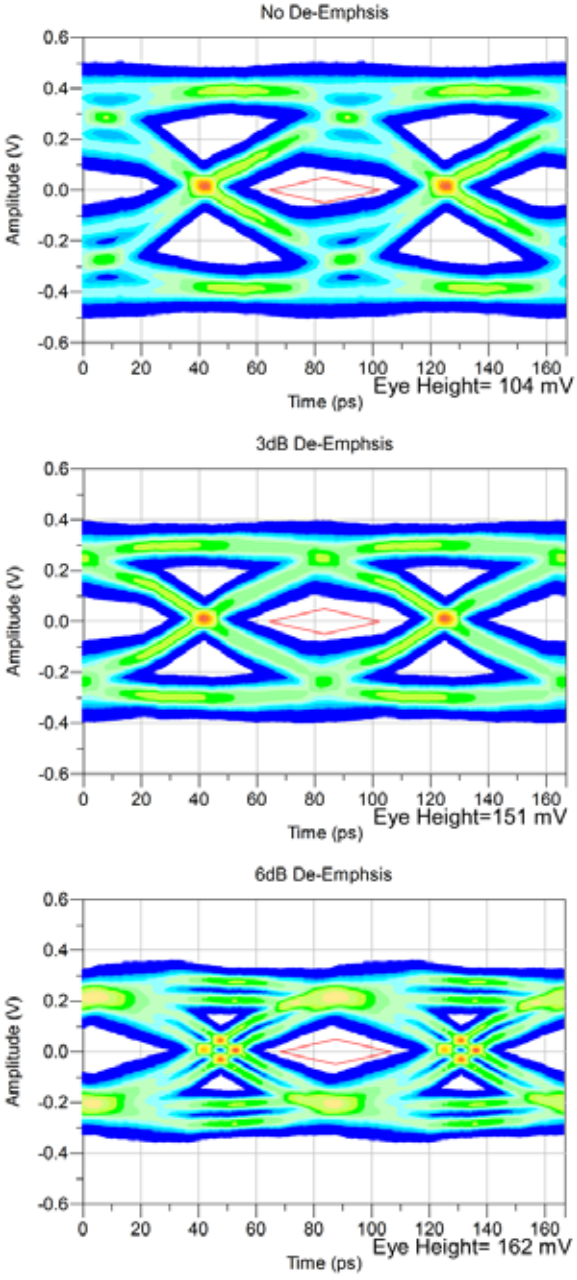
13Gbps: Long Row



Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Differential

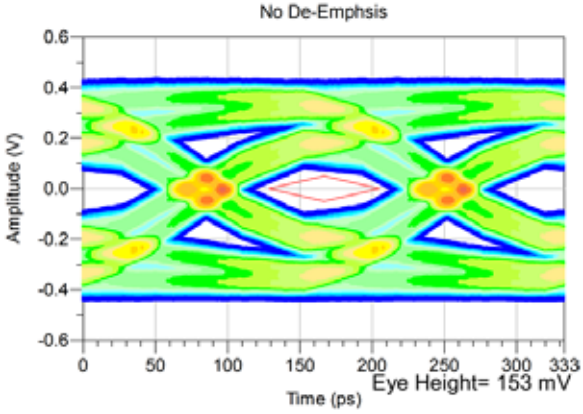
12Gbps: Short Row

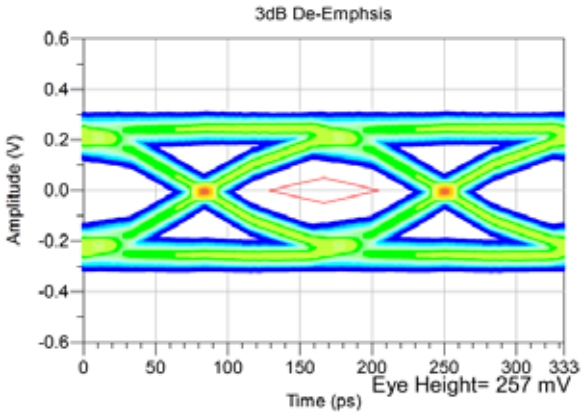


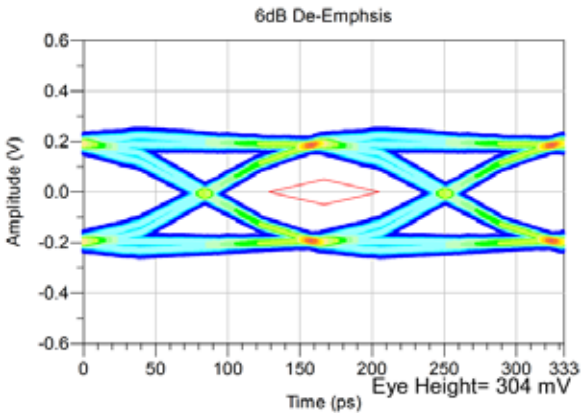
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

EQRD-026-39.37-TTR-STL-1
Single-Ended

6Gbps: Long Row



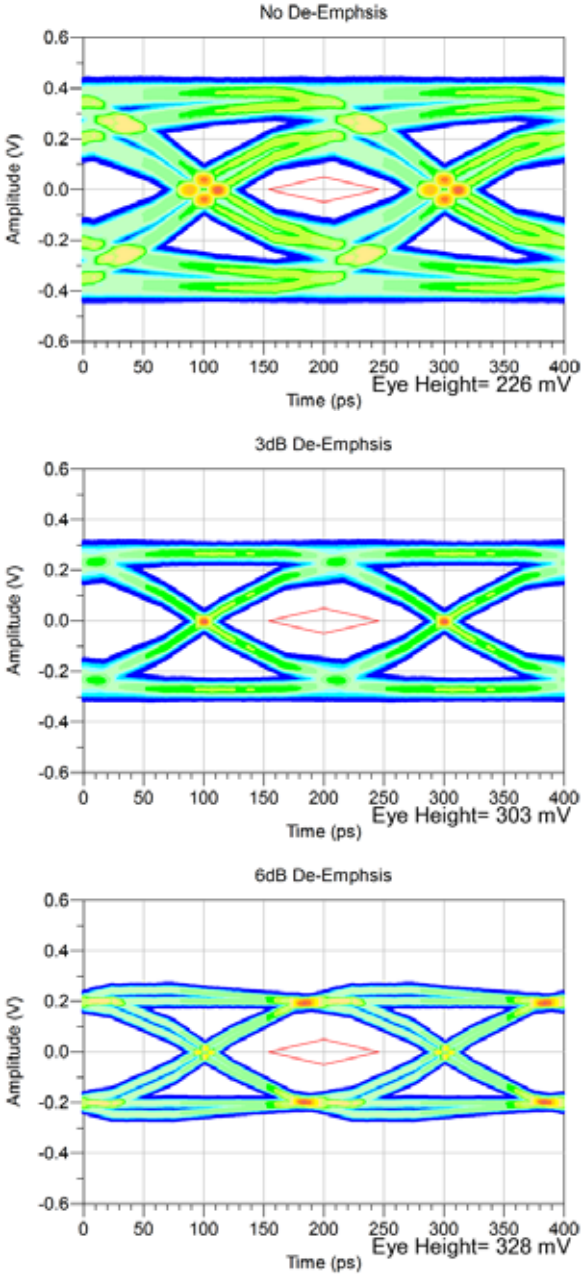




Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Single-Ended

5Gbps: Short Row

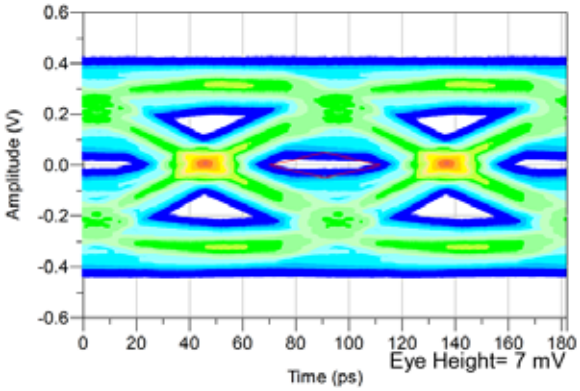


Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

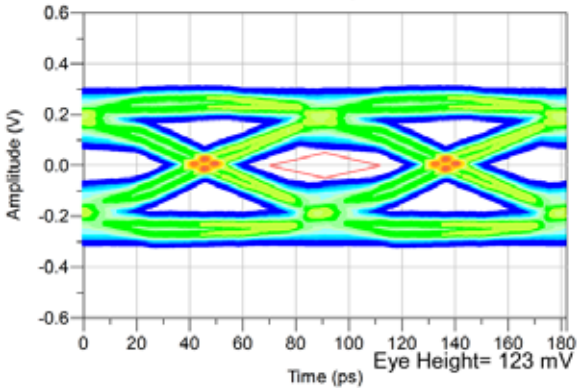
Differential

11Gbps: Long Row

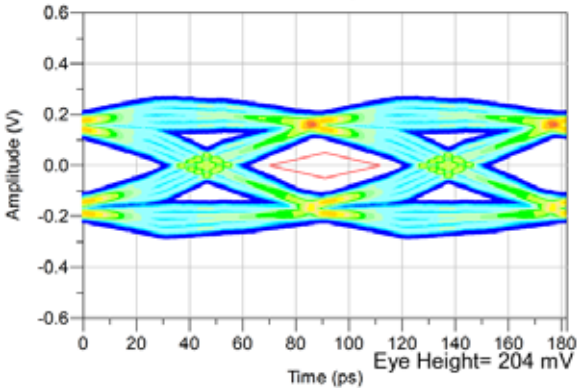
No De-Emphsis



3dB De-Emphsis



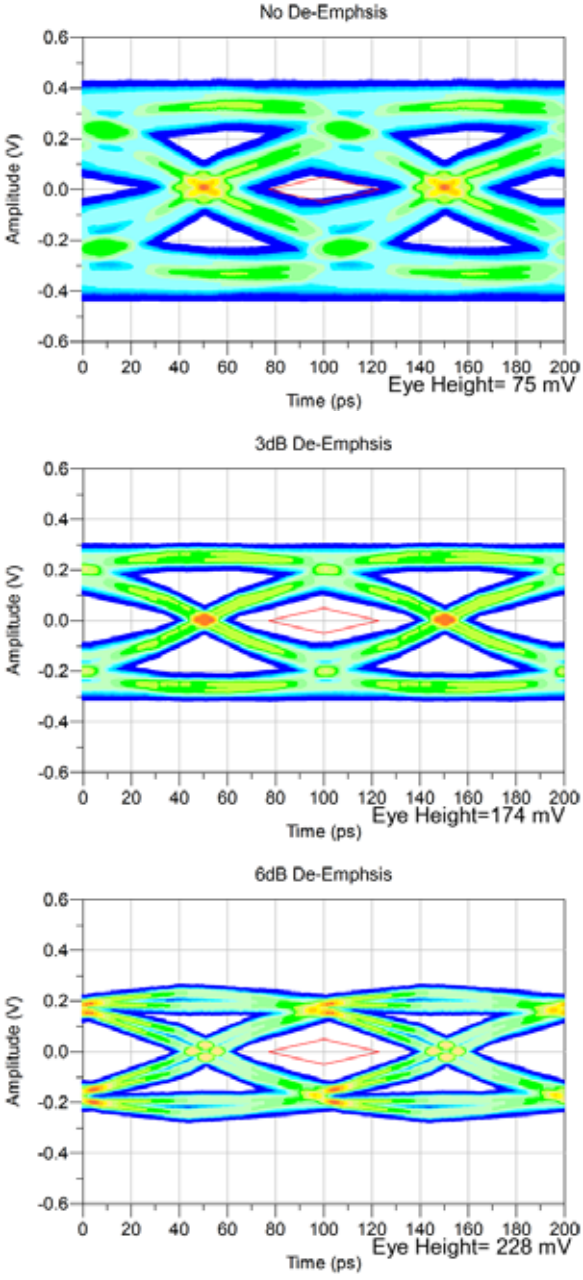
6dB De-Emphsis



Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Differential

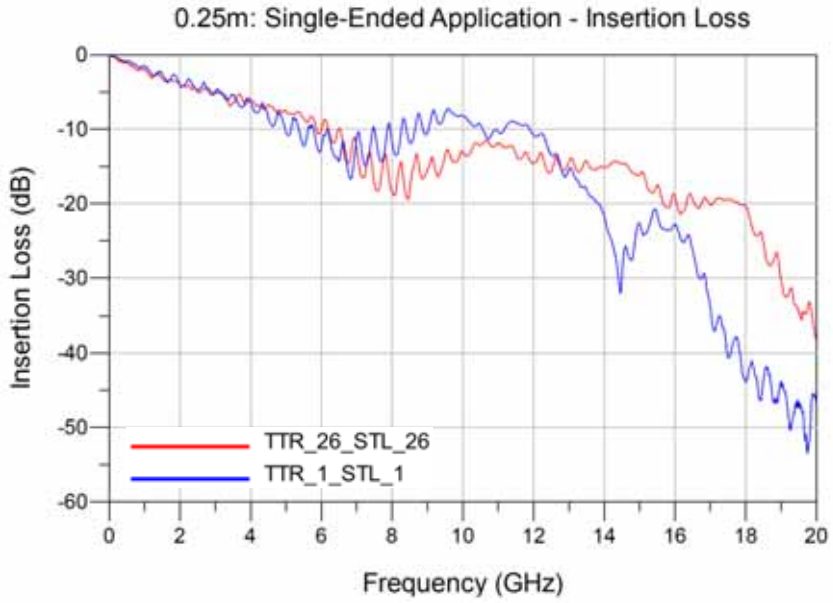
10Gbps: Short Row

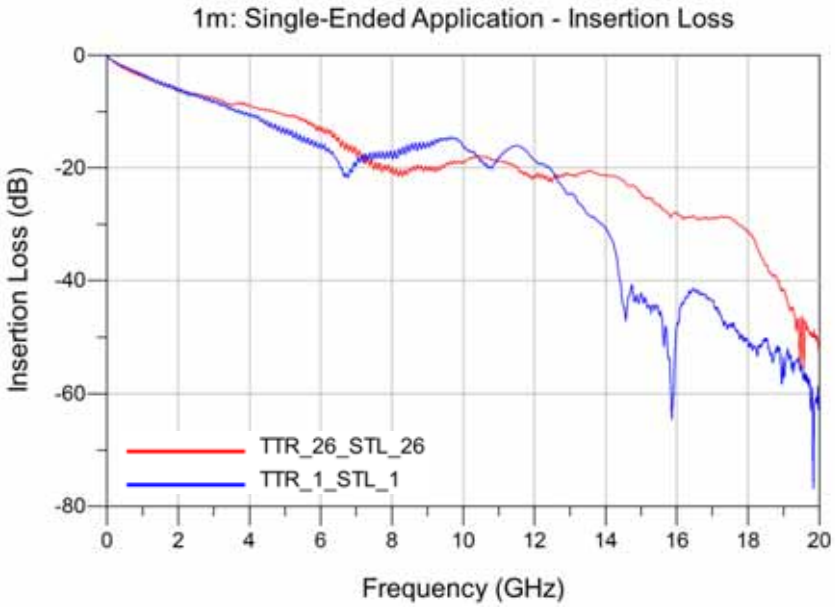


Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Appendix B – Frequency Domain Response Graphs

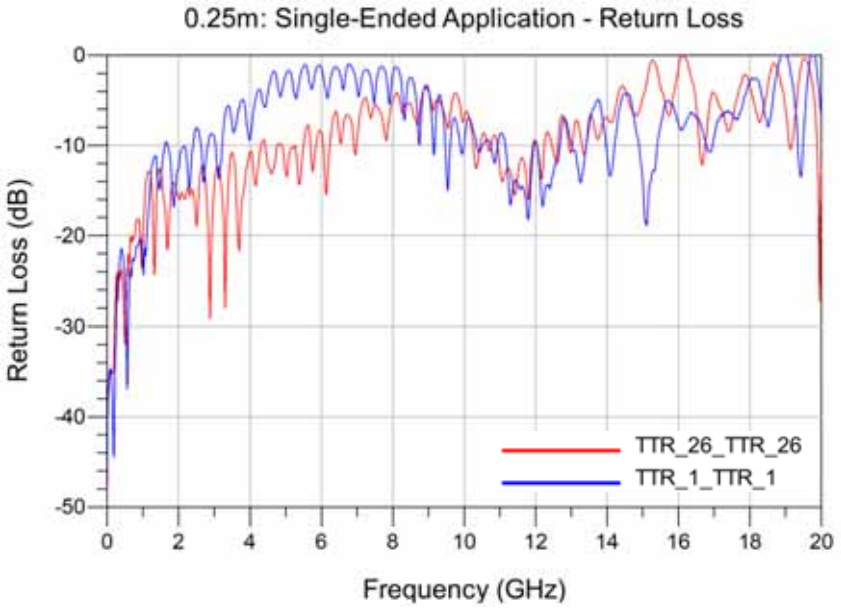
Single-Ended Application – Insertion Loss

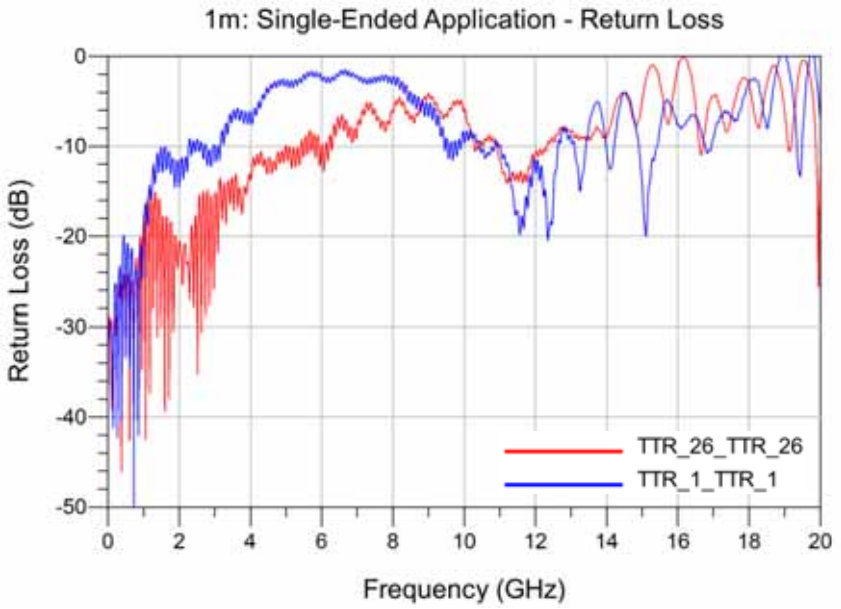




Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

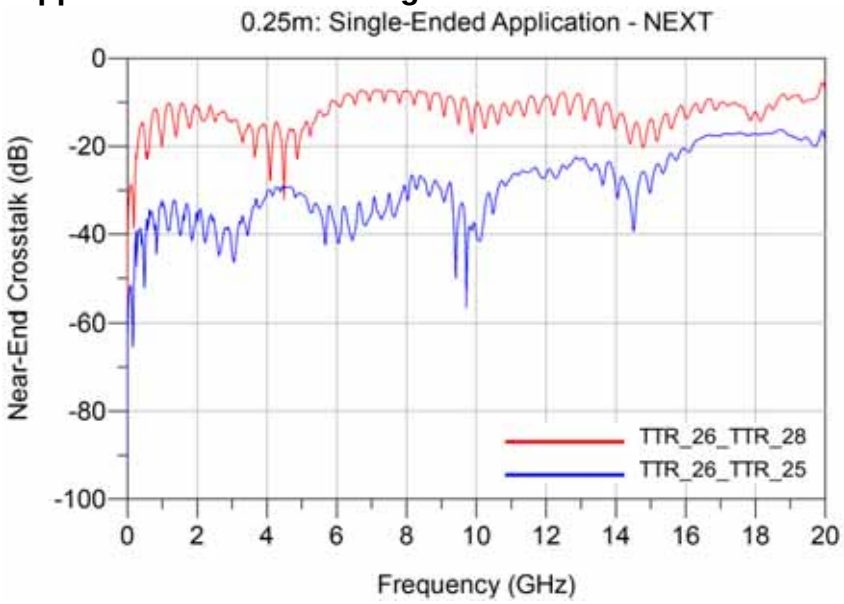
Single-Ended Application – Return Loss

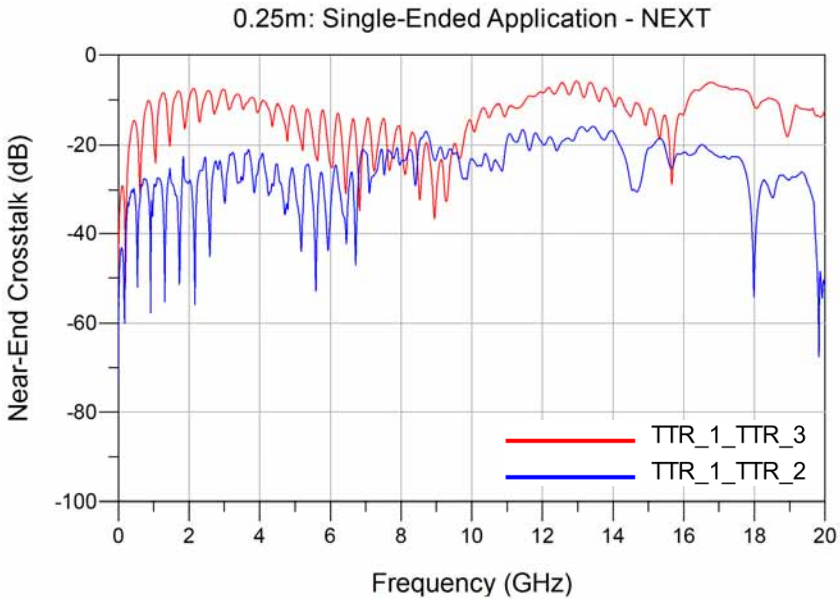




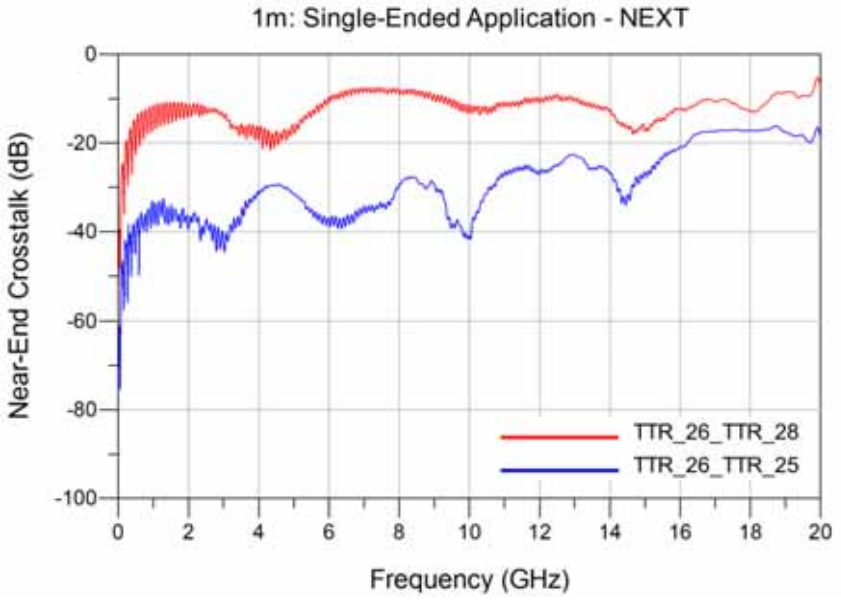
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

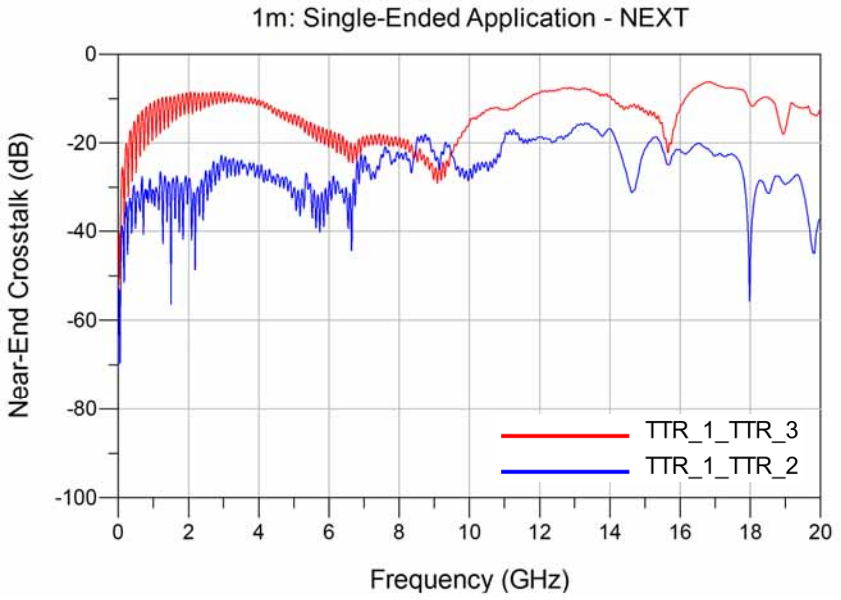
Single-Ended Application – NEXT Configurations





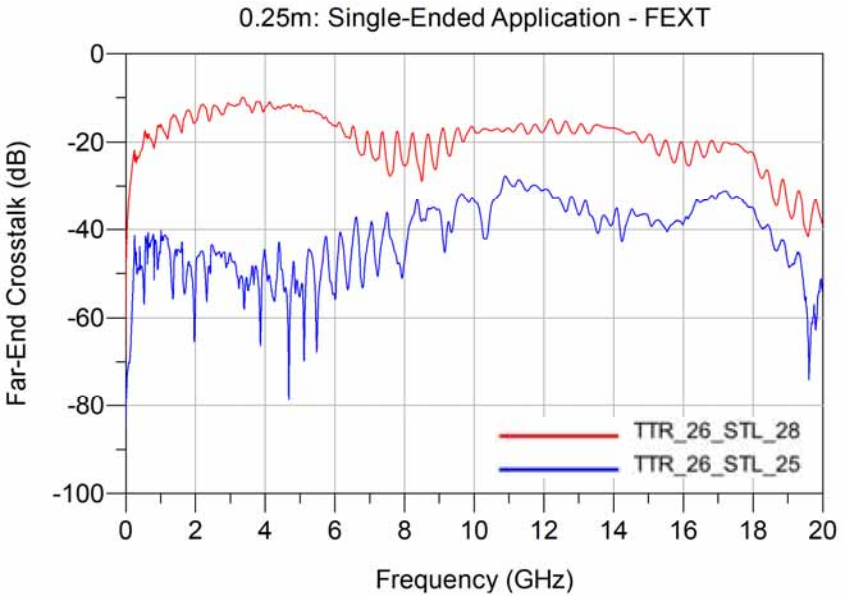
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

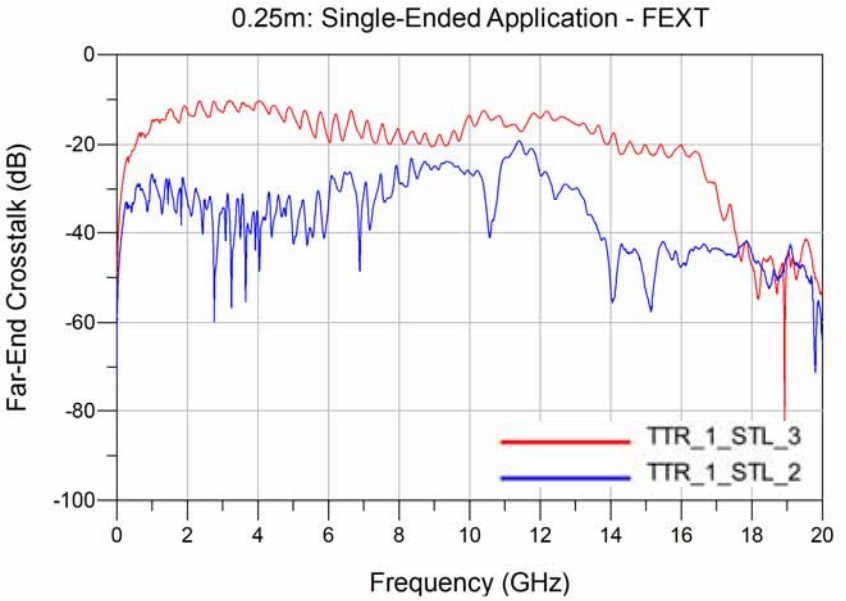




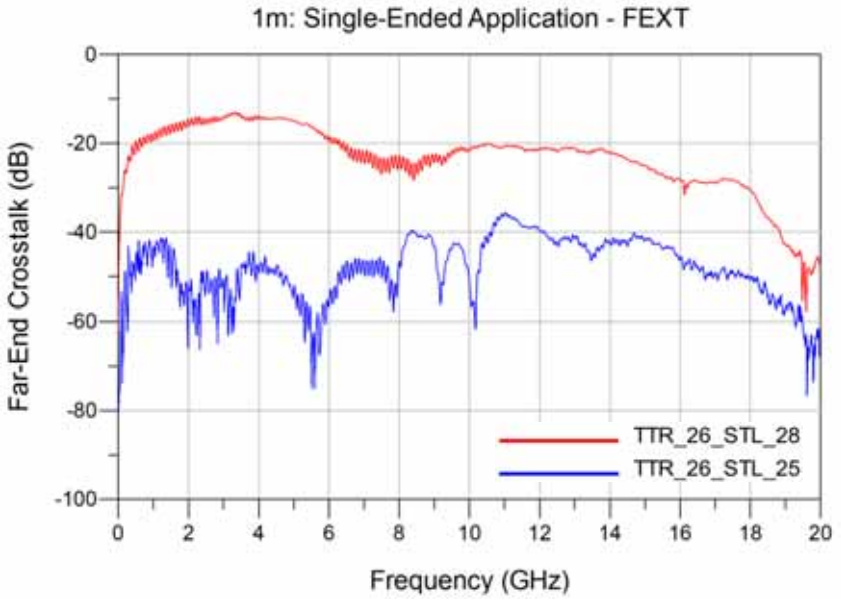
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

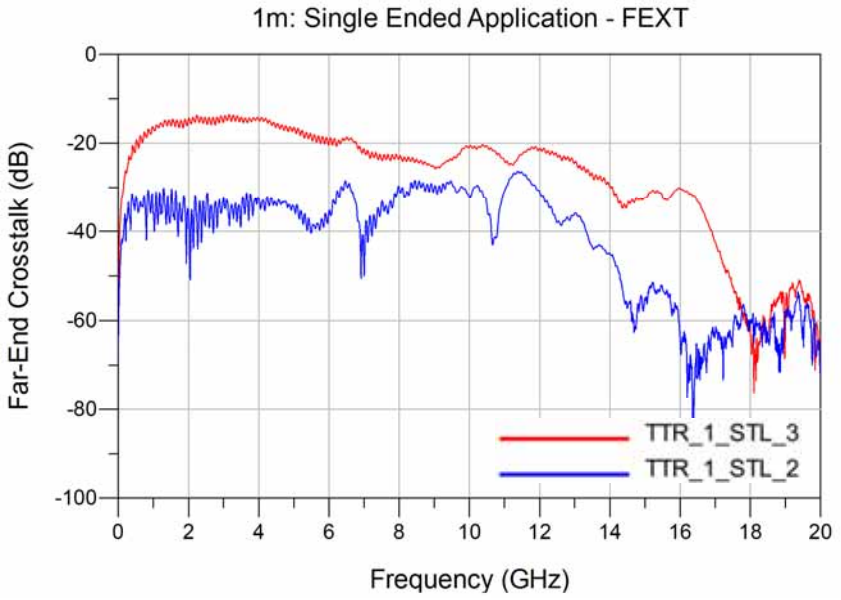
Single-Ended Application – FEXT Configurations





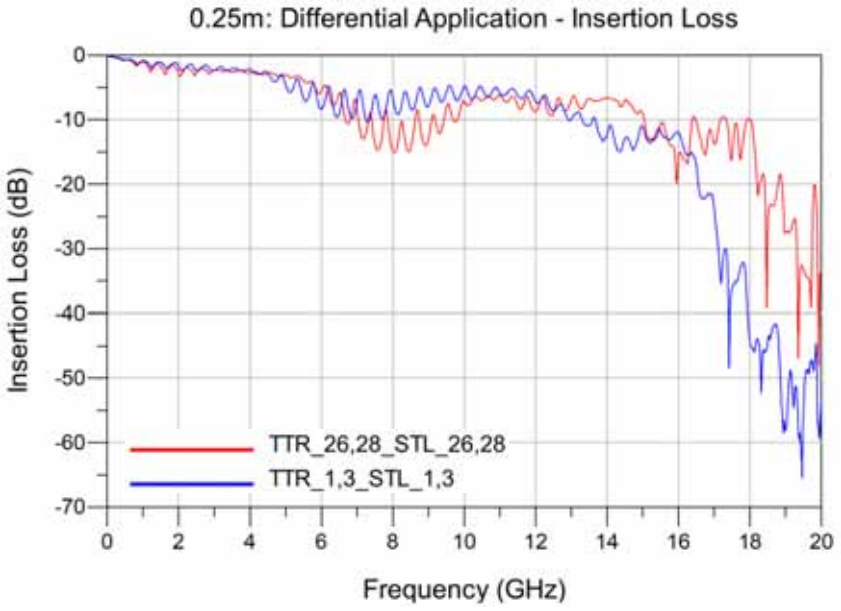
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

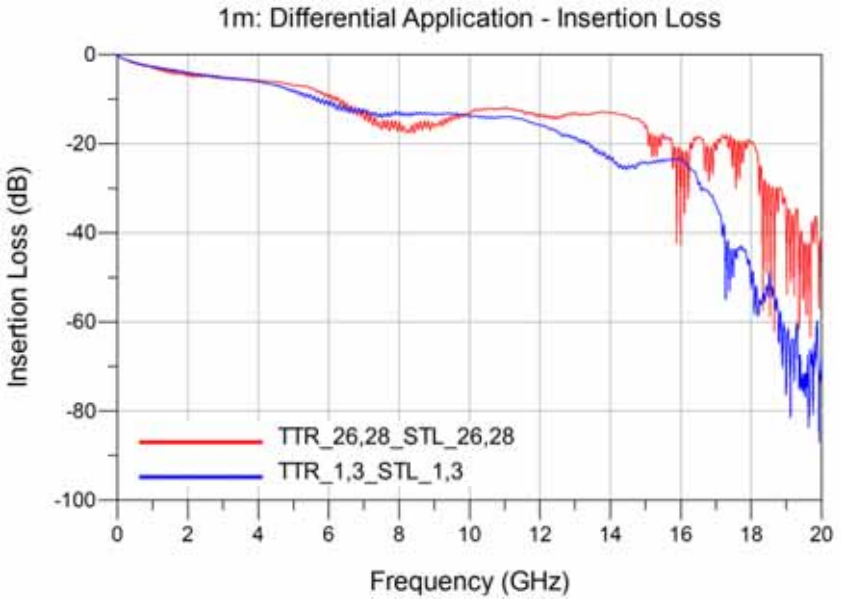




Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

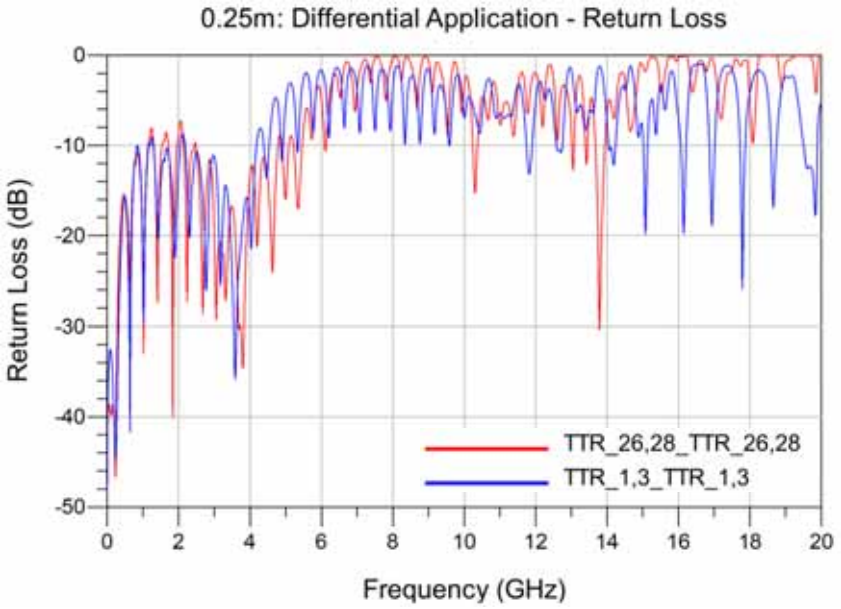
Differential Application – Insertion Loss

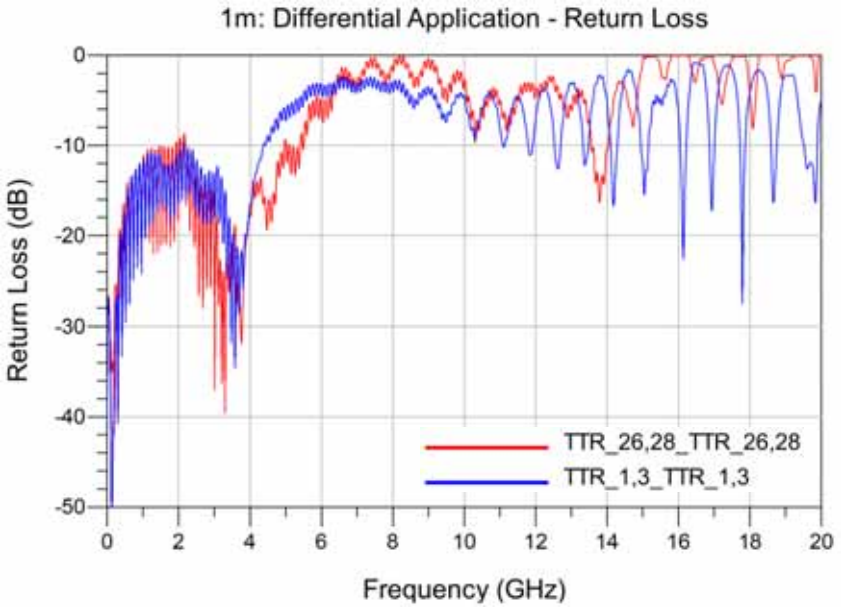




Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

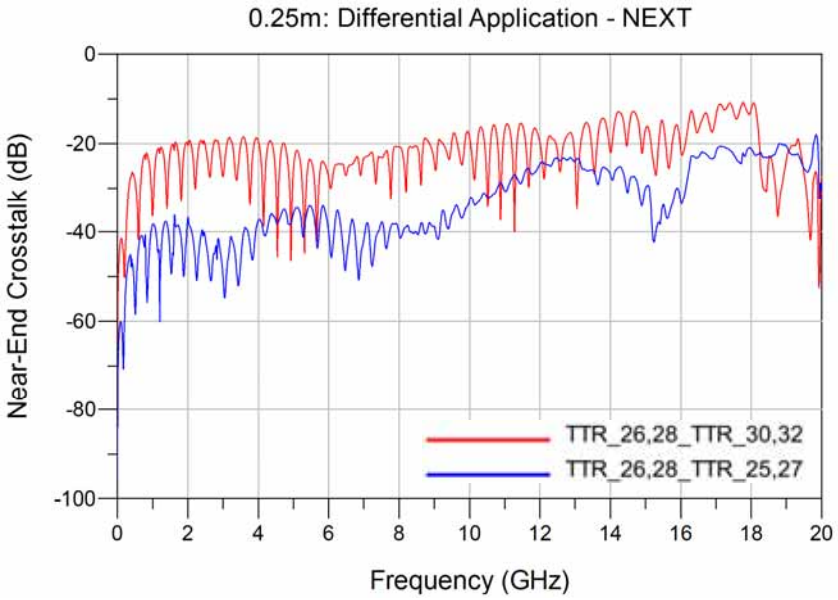
Differential Application – Return Loss

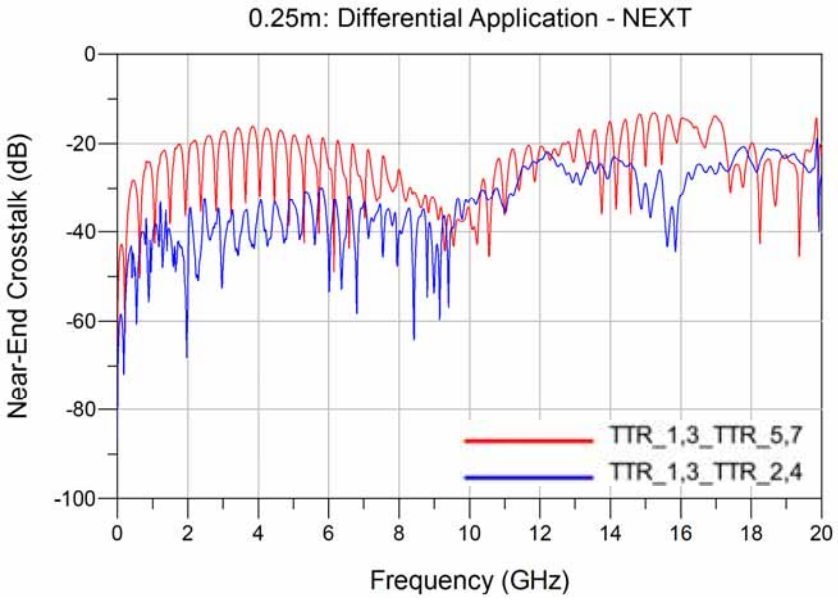




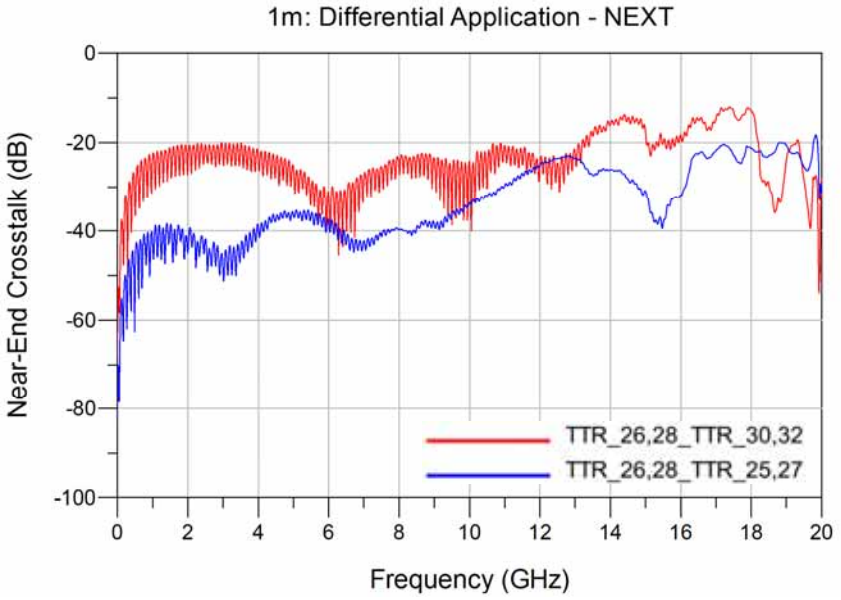
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

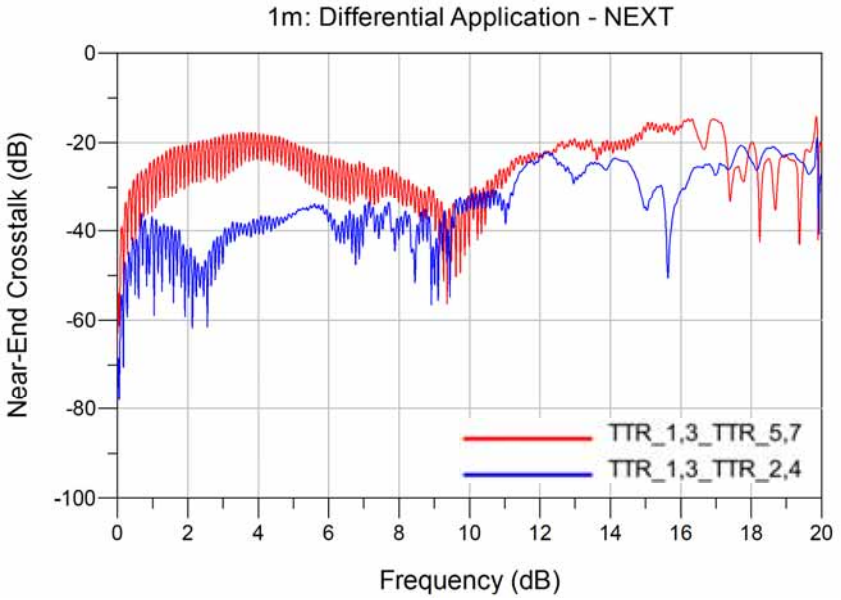
Differential Application – NEXT Configurations





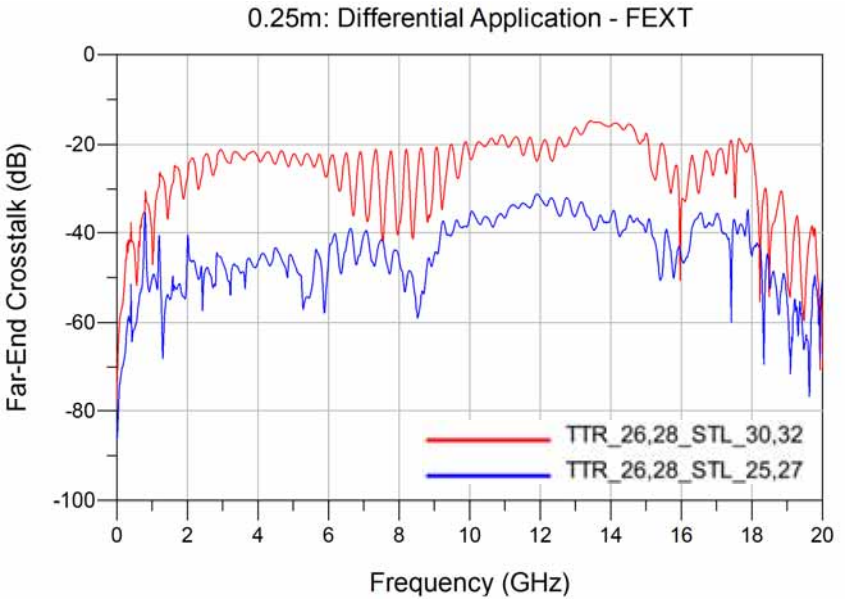
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

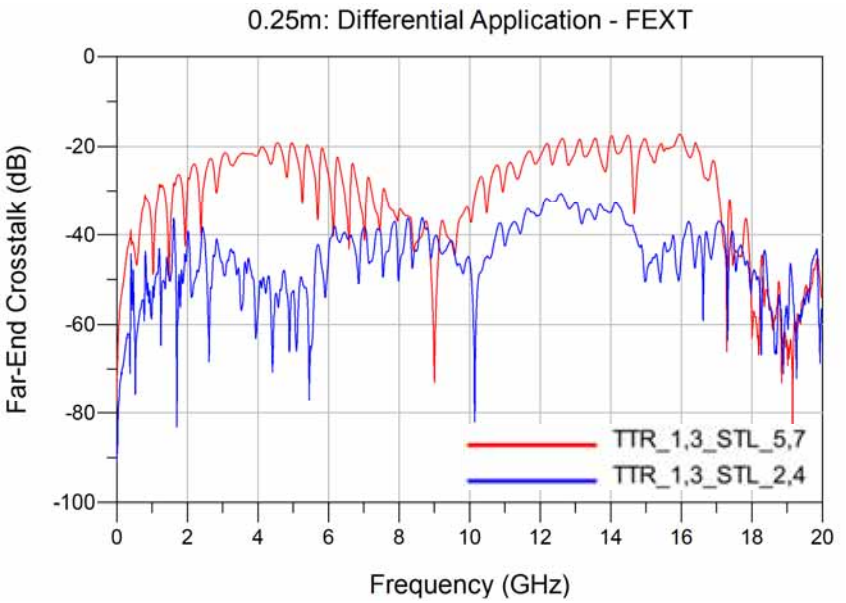




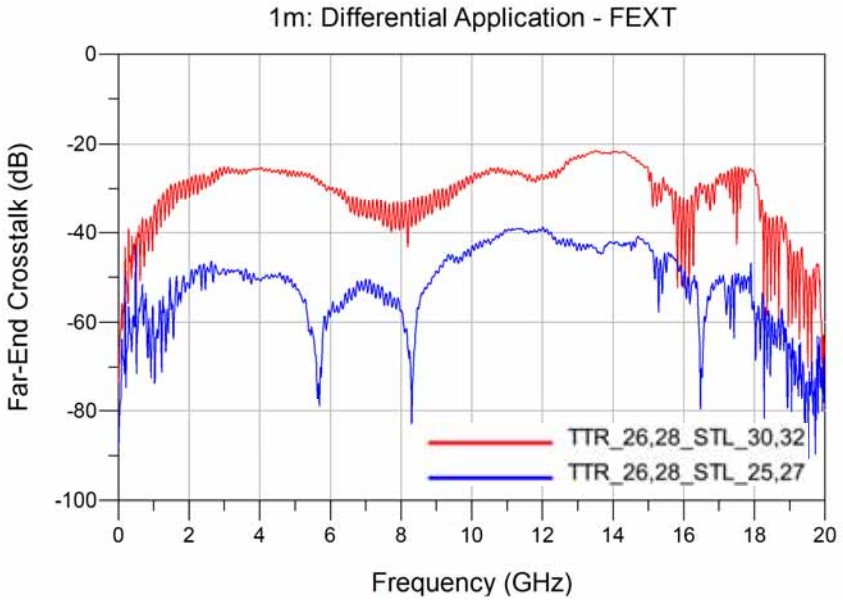
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

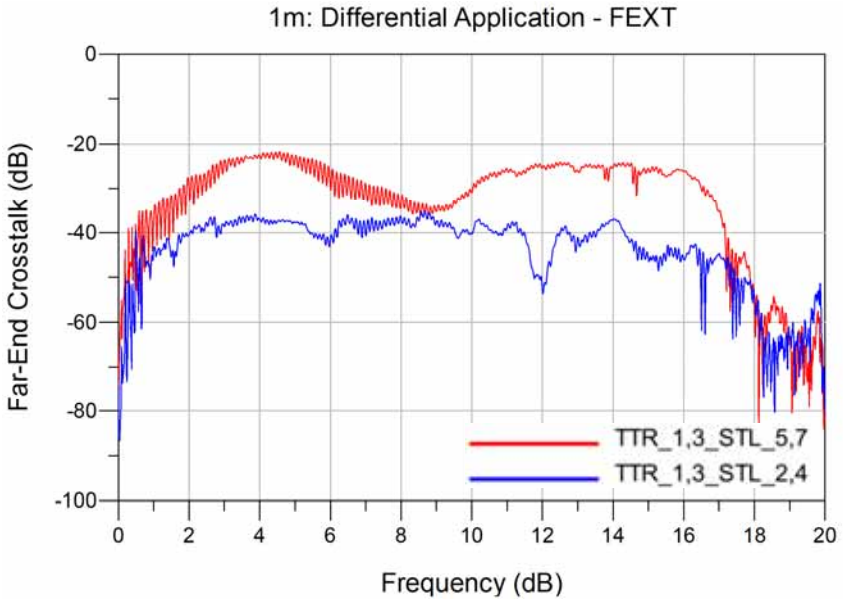
Differential Application – FEXT Configurations





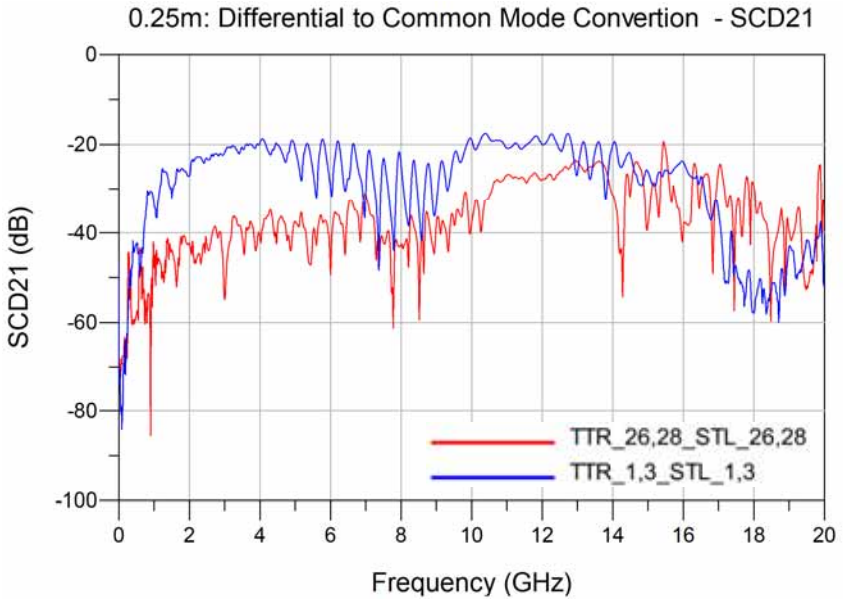
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

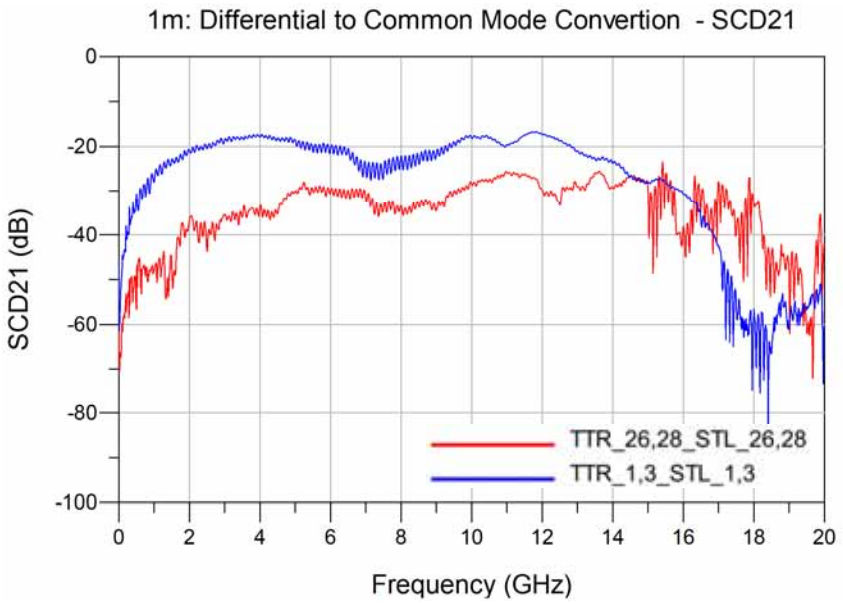




Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Differential Application – Differential to Common Mode Conversion

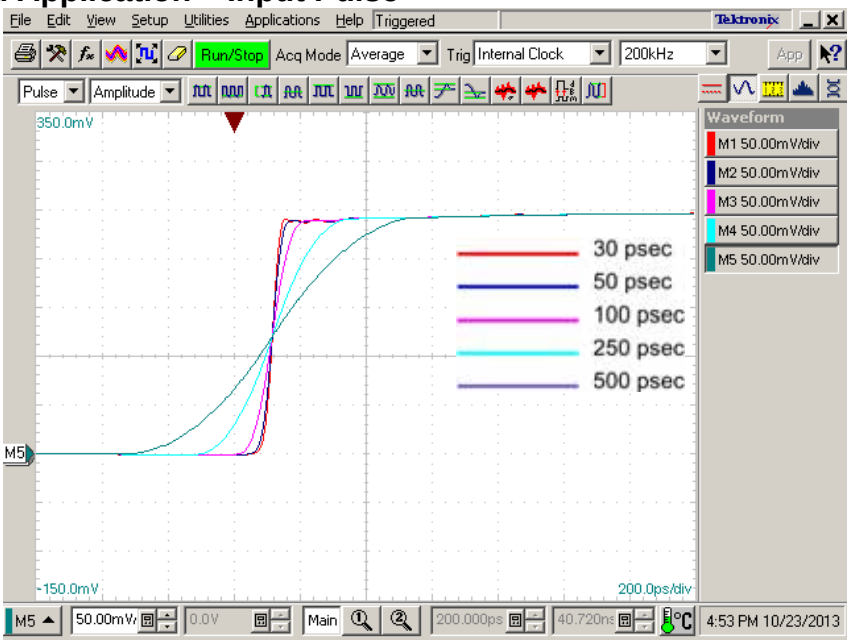




Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

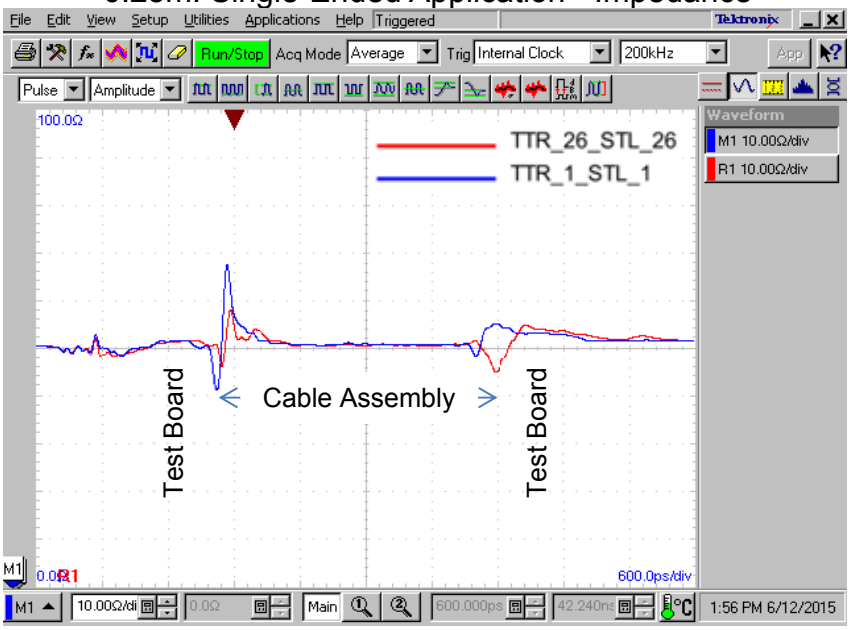
Appendix C – Time Domain Response Graphs

Single-Ended Application – Input Pulse



Single-Ended Application – Cable Assembly Impedance

0.25m: Single-Ended Application - Impedance

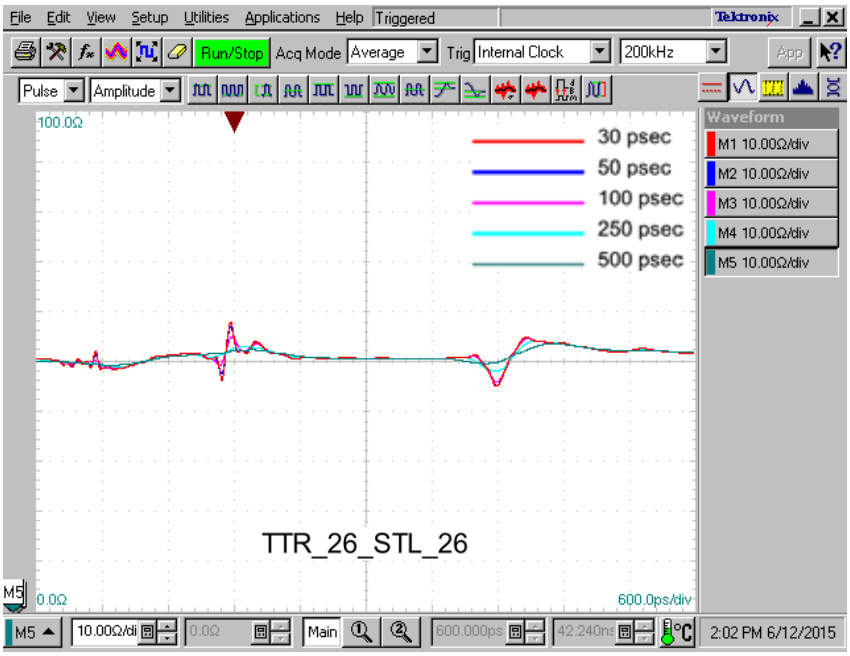


Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

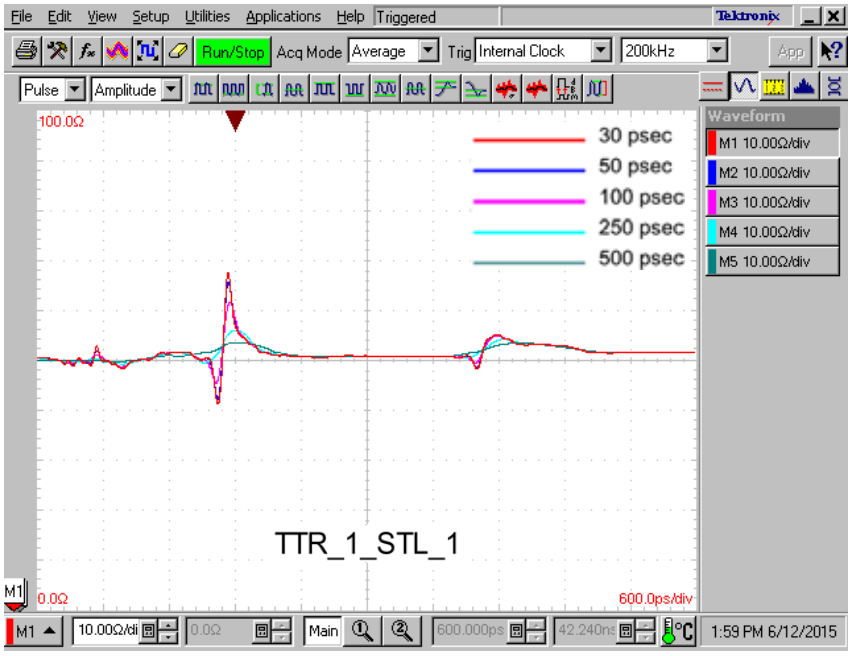
1m: Single-Ended Application - Impedance

Single-Ended Application – Cable assembly Impedance

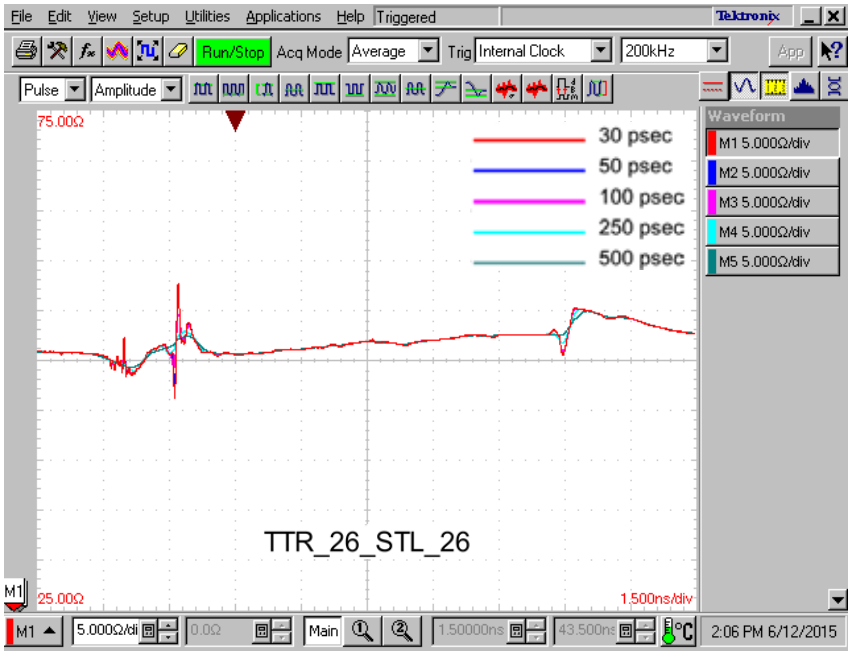
EQRD-026-09.80-TTR-STL-1



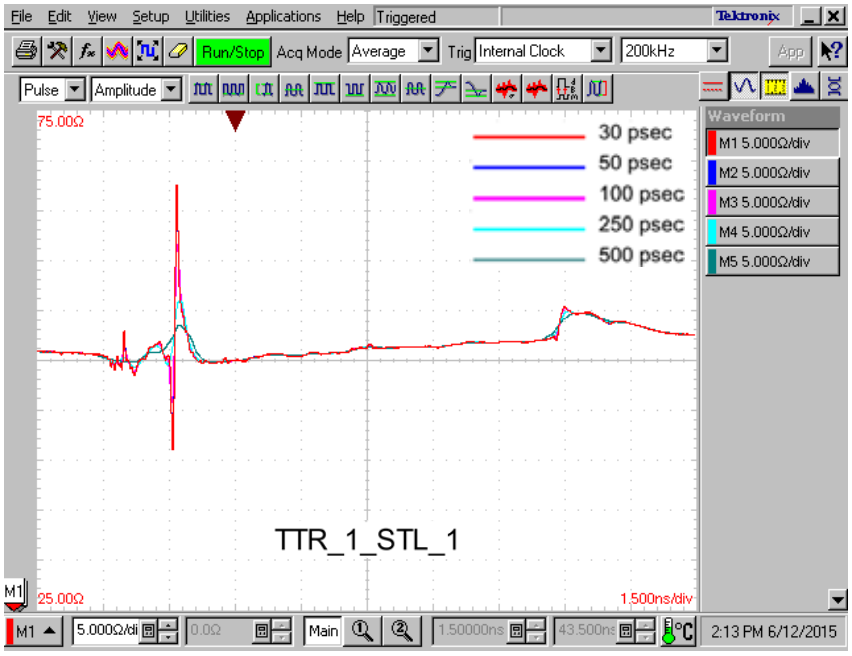
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable



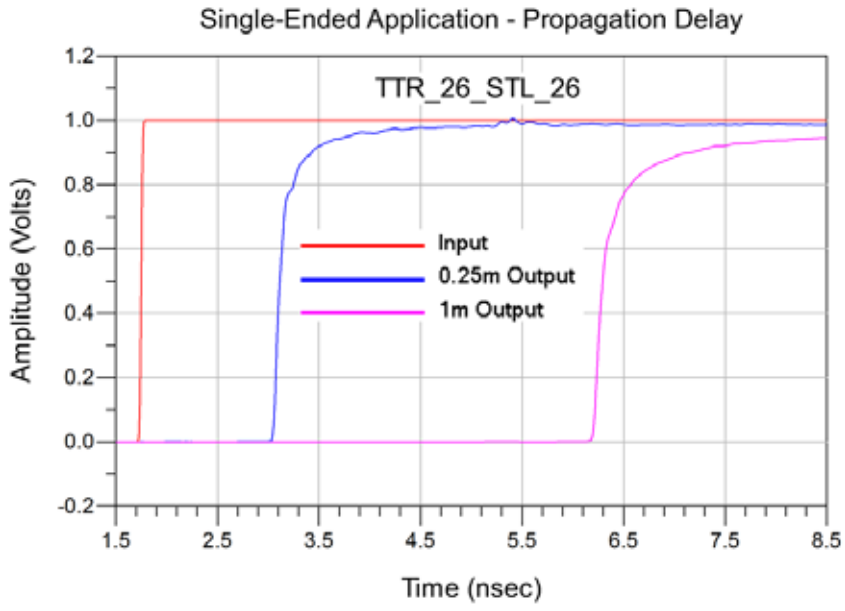
EQRD-026-39.37-TTR-STL-1



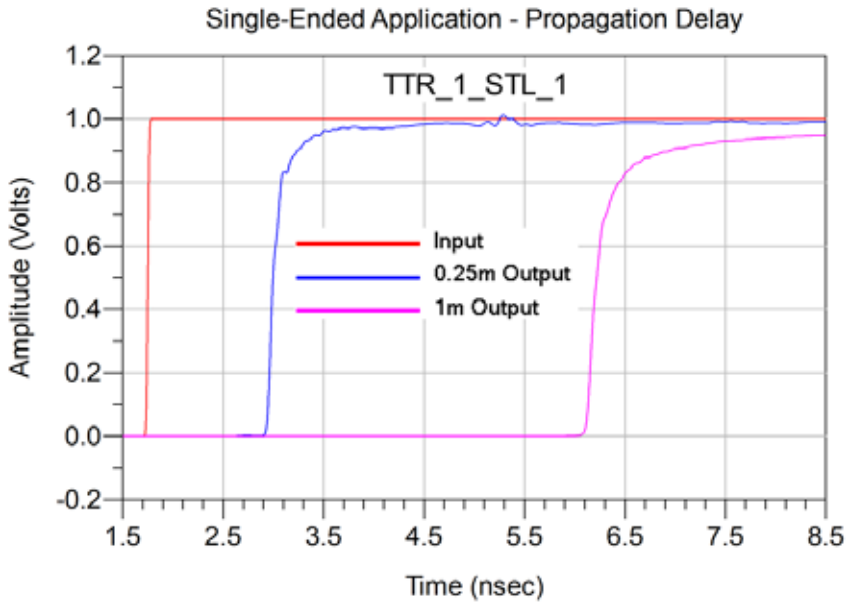
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable



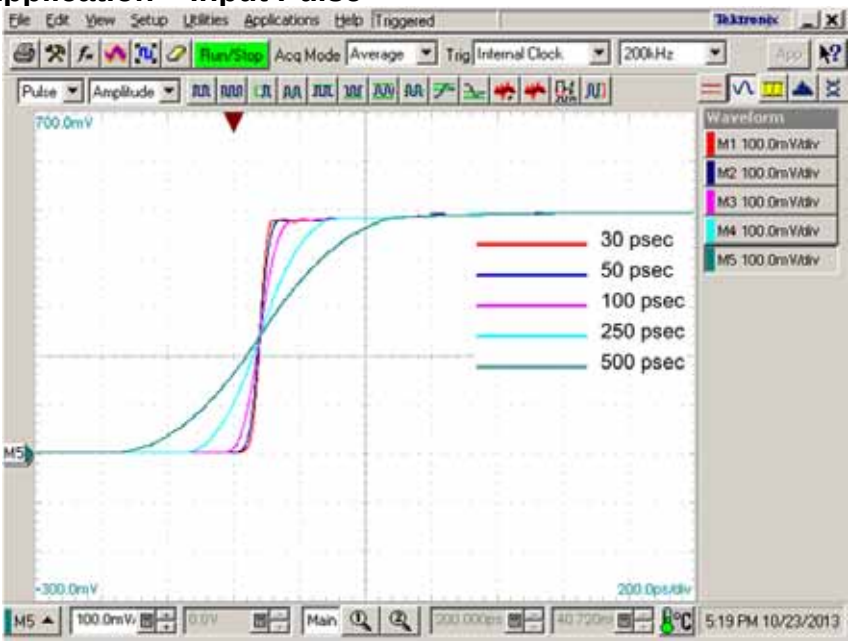
Single-Ended Application – Propagation Delay



Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable



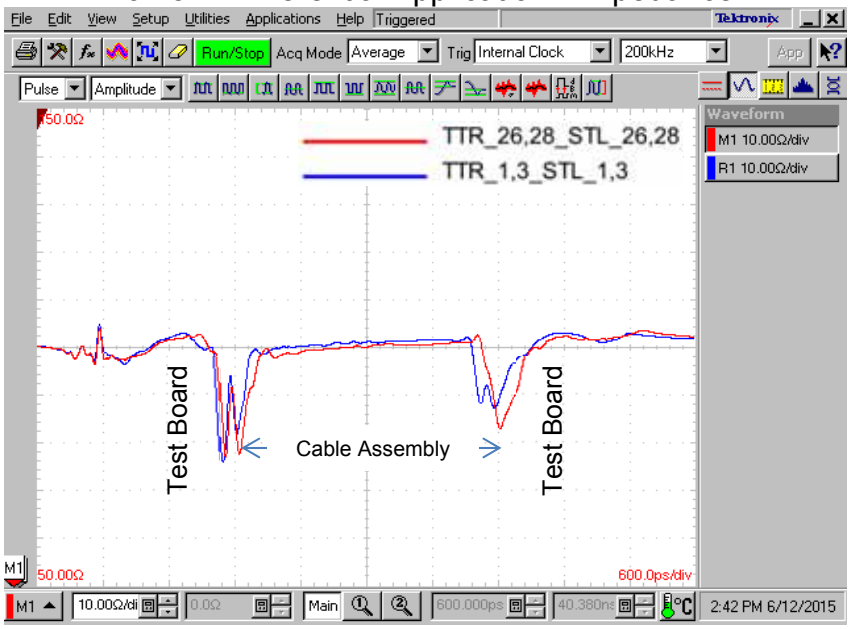
Differential Application – Input Pulse



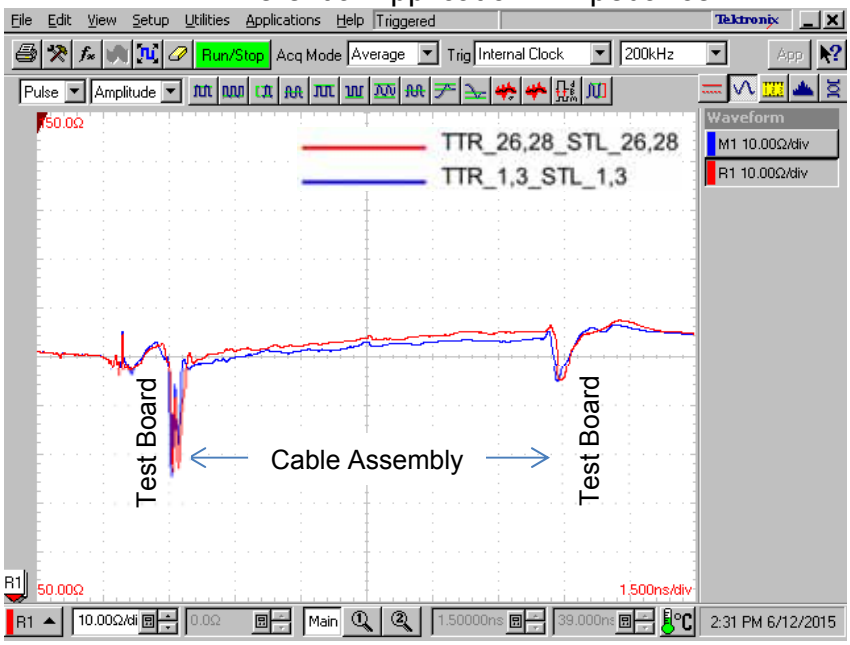
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Differential Application – Cable Assembly Impedance

0.25m: Differential Application - Impedance

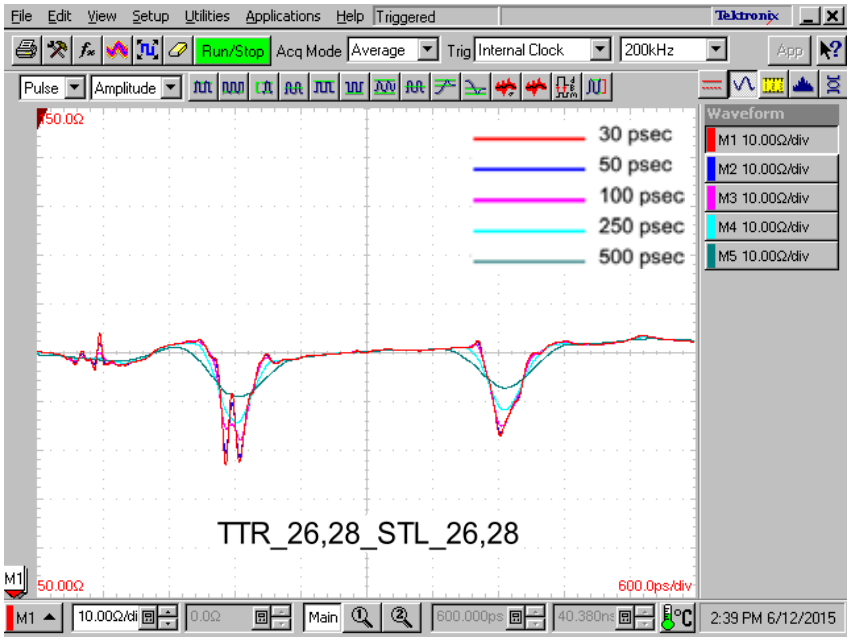


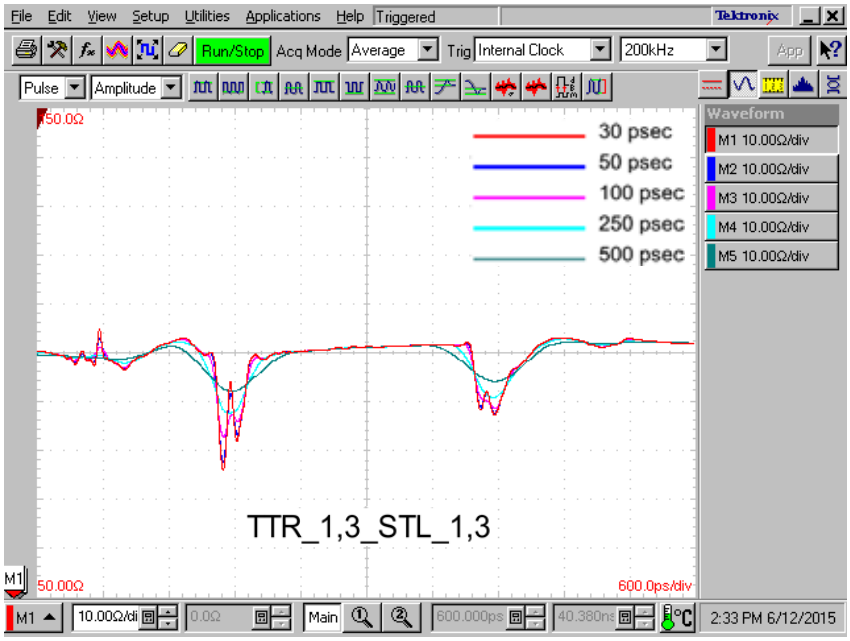
1m: Differential Application - Impedance



Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable
Differential Application – Cable assembly Impedance

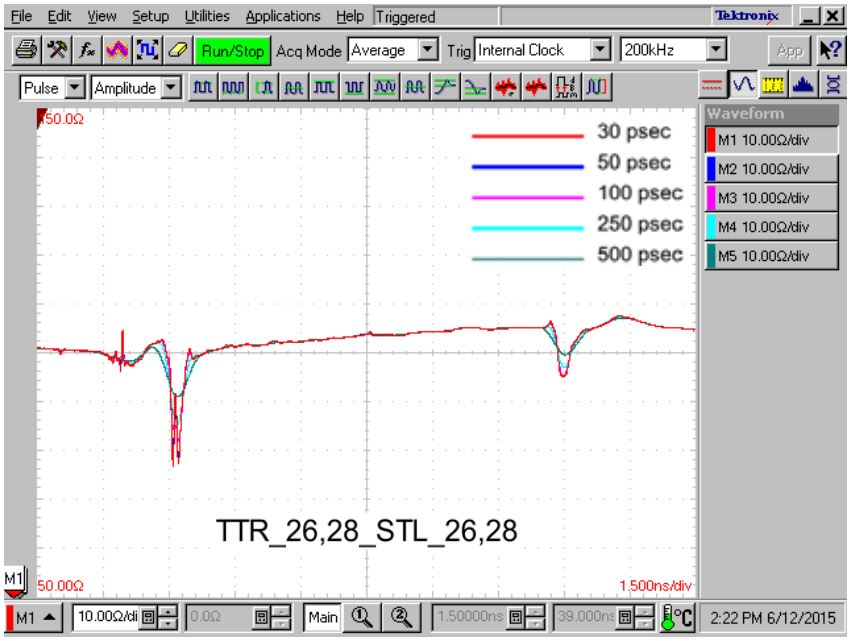
EQRD-026-09.80-TTR-STL-1

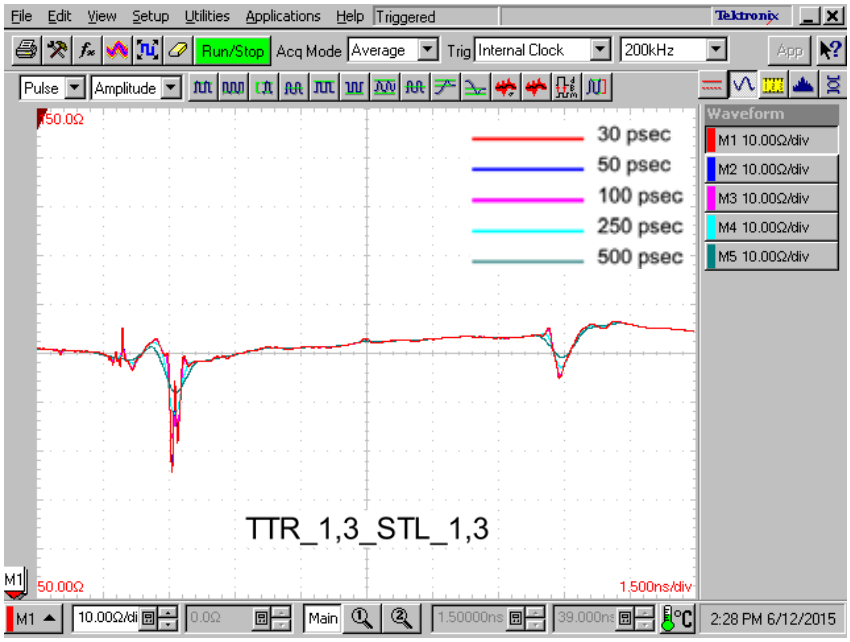




Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

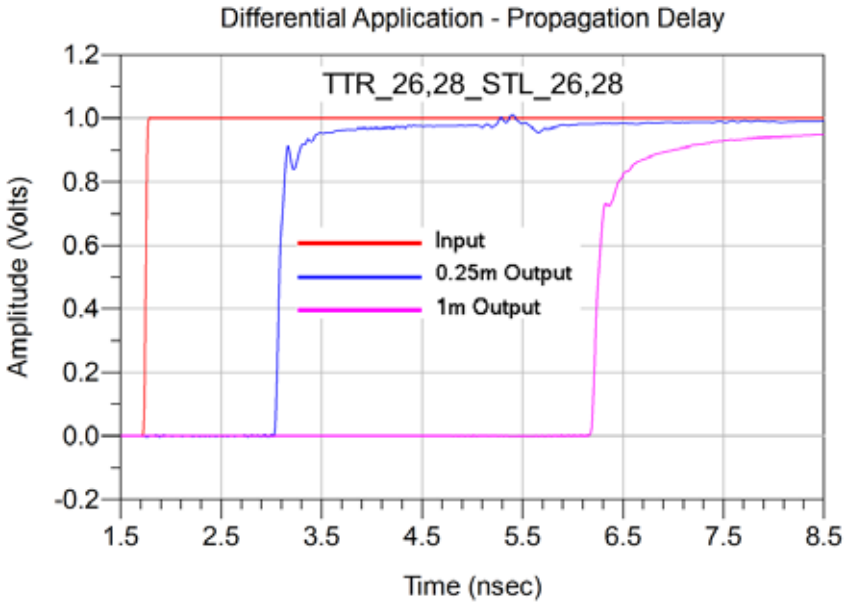
EQRD-026-39.37-TTR-STL-1

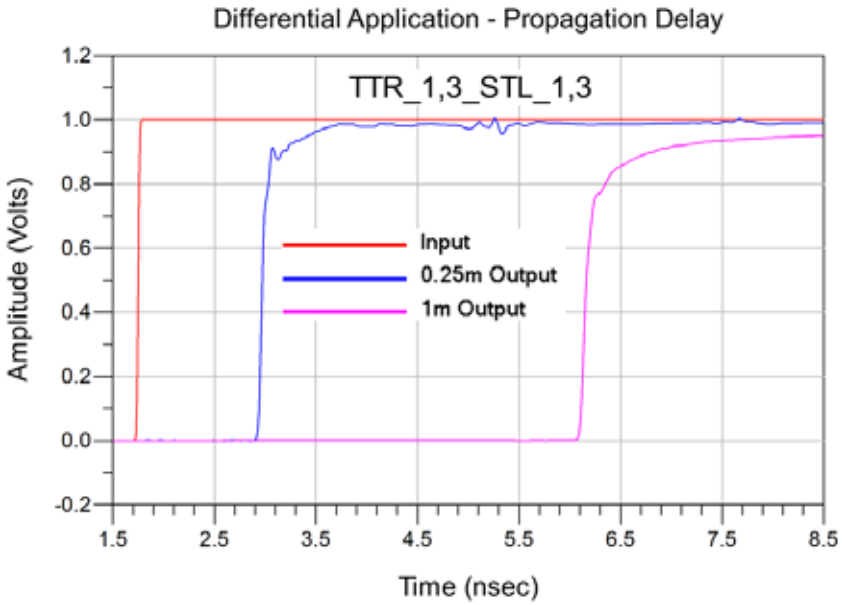




Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Differential Application – Propagation Delay





Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Appendix D – Product and Test System Descriptions

Product Description

Product test samples are 0.8 mm Q Rate® High Speed Coax Cable Assemblies. The part numbers are EQRD-026-09.80-TTR-STL-1 and EQRD-026-39.37-TTR-STL-1. They mate with QRF8-XXX-05.0-L-D-A and QRM8-XXX-05.0-L-D-A. A photo of the mated test article mounted to SI test boards is shown below.

The cable assembly terminations had a particular signal line configuration. The respective signal line numbers are shown in Table 6 below. There are a total of 26 positions per row. Not all positions are shown. SMA jack numbers on the test boards correspond to the assembly line numbers. All adjacent lines are terminated where applicable.

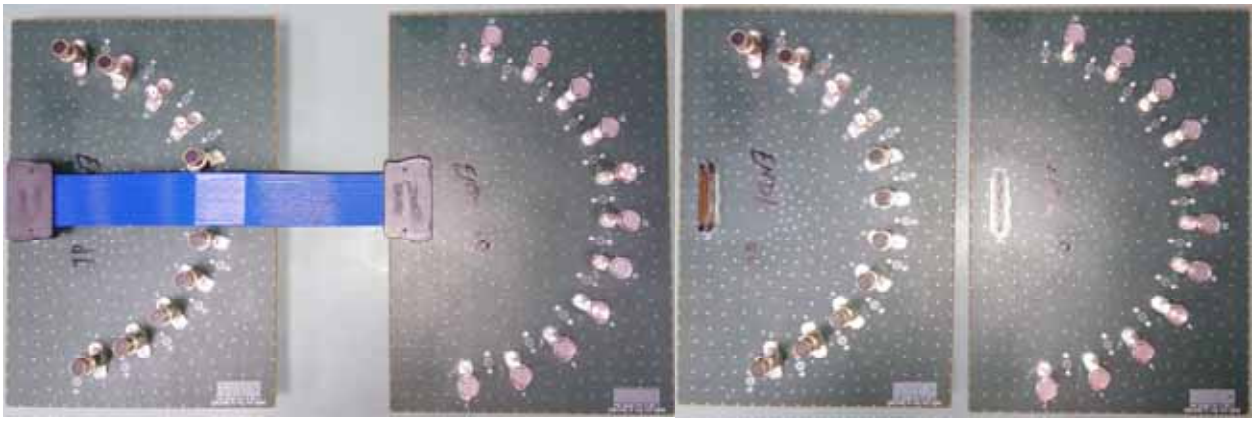
2	4	6	8	10	G	G	G	G	G	22	24	26	28	30	32	G
1	3	5	7	9	G	G	G	G	G	21	23	25	27	29	31	G

Table 6: Respective signal line numbers as viewed from End 1

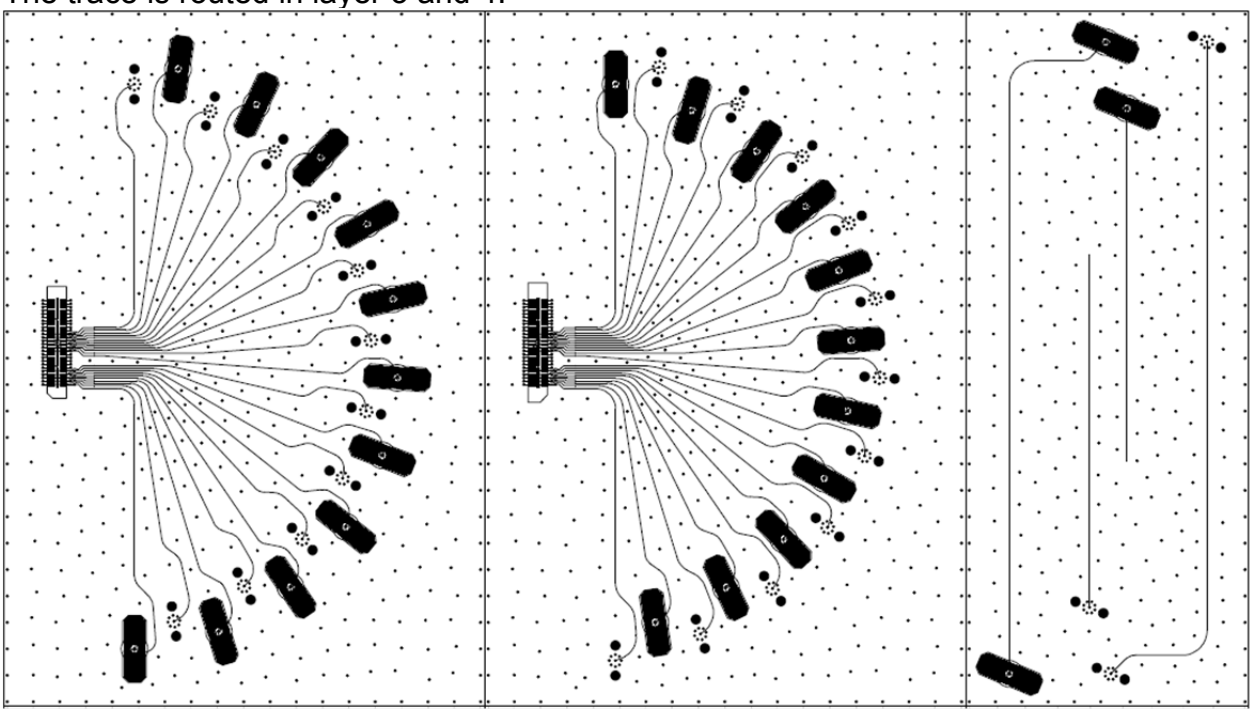
Test System Description

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 cable assembly products. A PCB mount SMA connector is used to interface the VNA test cables to the test fixtures. Optimization of the SMA launch was performed using full wave simulation tools to minimize reflections. Two test fixtures are specific to EQRD series cable assemblies and identified by part numbers PCB-102285-TST-11 and 12. The Auto Fixture Removal (AFR) calibration structures designed specifically for the EQRD series are located on PCB-102285-TST-99. Displayed on the following pages is the information for the EQRD and AFR calibration structure and directives for the mating EQRD fixtures.

PCB-102285-TST-XX Test Fixtures



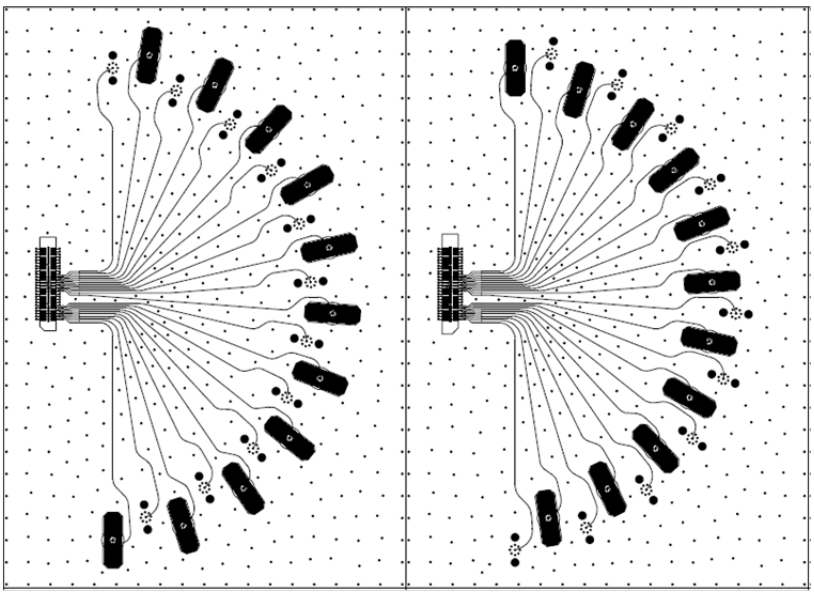
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable
Artwork of the PCB design is shown below.
The trace is routed in layer 3 and 4.



Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

PCB Fixtures

The test fixtures used are as follows:



PCB-102285-TST-11 – EQRD Cable Test Board 1
PCB-102285-TST-12 – EQRD Cable Test Board 2

Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

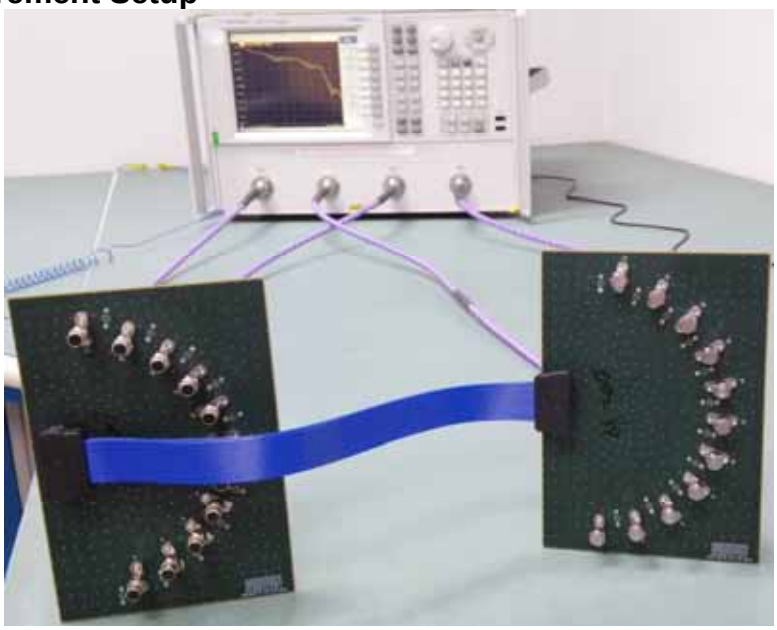
Appendix E – Test and Measurement Setup

For frequency domain measurements, the test instrument is the Agilent N5230C PNA-L network analyzer. Frequency domain data and graphs are extracted from the instrument by AFR application. 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	Number of points -1601
Stop Frequency – 20 GHz	IFBW – 1 KHz

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

N5230C Measurement Setup



Test Instruments

QTY	Description
1	Agilent N5230C PNA-L Network Analyzer (300 KHz to 20 GHz)
1	Agilent N4433A ECAL Module (300 KHz to 20 GHz)

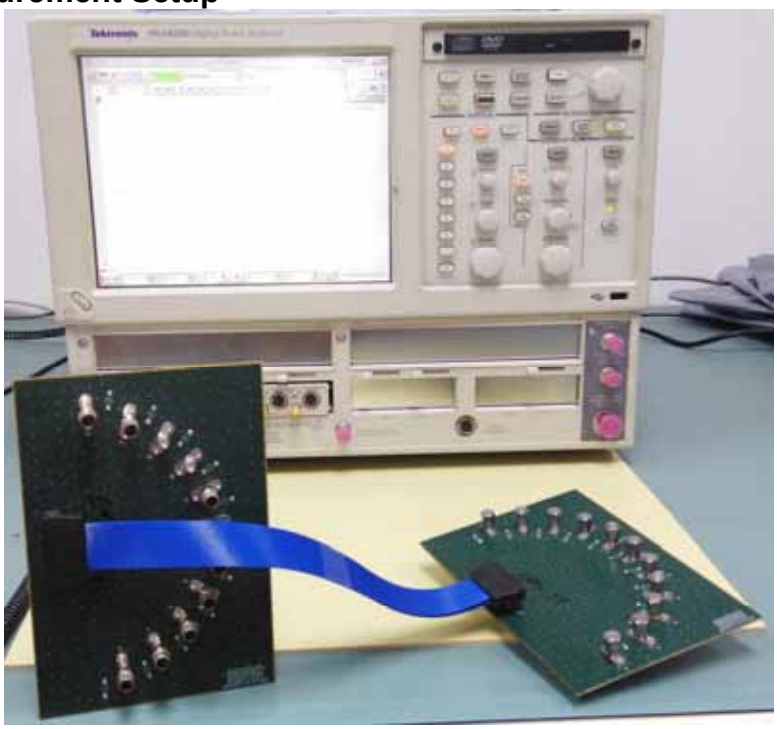
Test Cables & Adapters

QTY	Description
4	Gore OWD01D02039-4 (DC-26.5 GHz)

Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable
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:

Vertical Scale: 10 ohm / Div:
Offset: Default / Scroll
Horizontal Scale: 600ps/ Div or 1.5ns/ Div
Record Length: 4000
Averages: ≥ 16

DSA8200 Measurement Setup



Test Instruments

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

Test Cables & Adapters

QTY	Description
2	Samtec RF405-01SP1-01SP1-0305 (DC-20 GHz)

Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Appendix F - Frequency and Time Domain Measurements

Eye Diagram Procedures

Eye Diagrams and statistical eye diagram metrics such as eye height can be generated by post-processing Frequency Domain measurements using Agilent ADS. Simulated data is sent over a touchstone model and the bits are overlain into an eye pattern.

Currently, no CEI specification is available for 7Gbps, so *CEI-28-VSR Working Clause Proposal, CEI Implementation agreement Draft 7.0*, dated May 14, 2012 was used for this report.

The simulation circuit is modeled as:
Agilent's Advanced Design System Tx and Rx modules that are configured to the *CEI-28-VSR Working Clause Proposal, CEI Implementation agreement Draft 7.0*, dated May 14, 2012.

- Tx parameters are specified in Section 1.3.3, *Module-to-Host Specifications*, Table 1-4, Page 7.
- Rx parameters defined in Section 1.3.2 *Host-to-Module Electrical Specifications*, Table 1-1, Page 5.
- A 3.3 inch length of Tx interconnect trace segment at the transmitter.
- SUT Cable Assembly S-Parameter measurements
  - Test board vias, pads (footprint effects) for the QRF8 connector
  - The QRF8 series connector
  - The EQRD-026-XX.XX-TTR-STL-1 cable assembly
  - The QRM8 series connector
  - Test board vias, pads (footprint effects) for the QRM8 connector
- A 3.3 inch length of Rx interconnect trace segment at the receiver.

All traces were modeled as microstrip on FR4 with the following parameters:

- The FR4 parameters are modeled using:
  - Er = 4.2 @ 1 GHz
  - Loss Tangent = 0.02 @ 1 GHz

- Copper is modeled as:
  - Conductivity = 4.5E+7 S-m
  - Surface roughness = 0.6 micron

- Traces are microstrip and stripline with the following geometry:
  - Trace width: 5.5 mil for stripline and 7.5 mil for microstrip
  - Trace copper thickness: 1.4 mil for stripline and 2.1 mil for microstrip

Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

- FR4 dielectric thickness:
  - 4.7 mil between layer 1 & 2 and between 5 & 6
  - 4 mil between layer 2 & 3 and between 4 & 5
  - 33.8 mil between layer 3 & 4

Eye Mask

The eye mask is set for 50mVpp, with a jitter margin of 0.5 UI.

Rise Time

The 10-90 risetime of the 9Gbps signal was determined to be 78psec, using the following formula:

Risetime = 0.35/Bandwidth

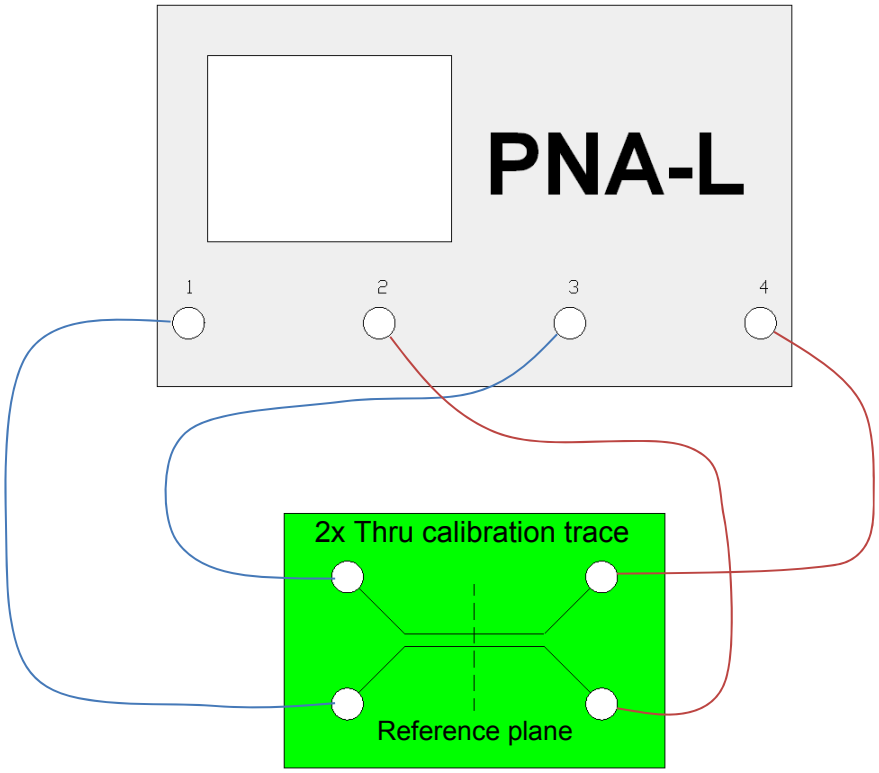
Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

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 AFR calibration standards, the SI test boards and the selection of the PCB vendor.

The measurement process begins with a measurement of the AFR calibration standards. A coaxial SOLT calibration is performed using an N4433A E-CAL module. This measurement is required in order to obtain precise values of the line standard offset delay and frequency bandwidths. Measurements of the 2x through line standard can be used to determine the maximum frequency for which the calibration standards are valid. For the EQRD test boards, this is greater than 20 GHz.

The figure below shows how the THRU reference traces are utilized to compensate for the losses due to the coaxial test cables and the test fixture during testing. The calibration board is characterized to obtain parameters required to define the 2x Thru.

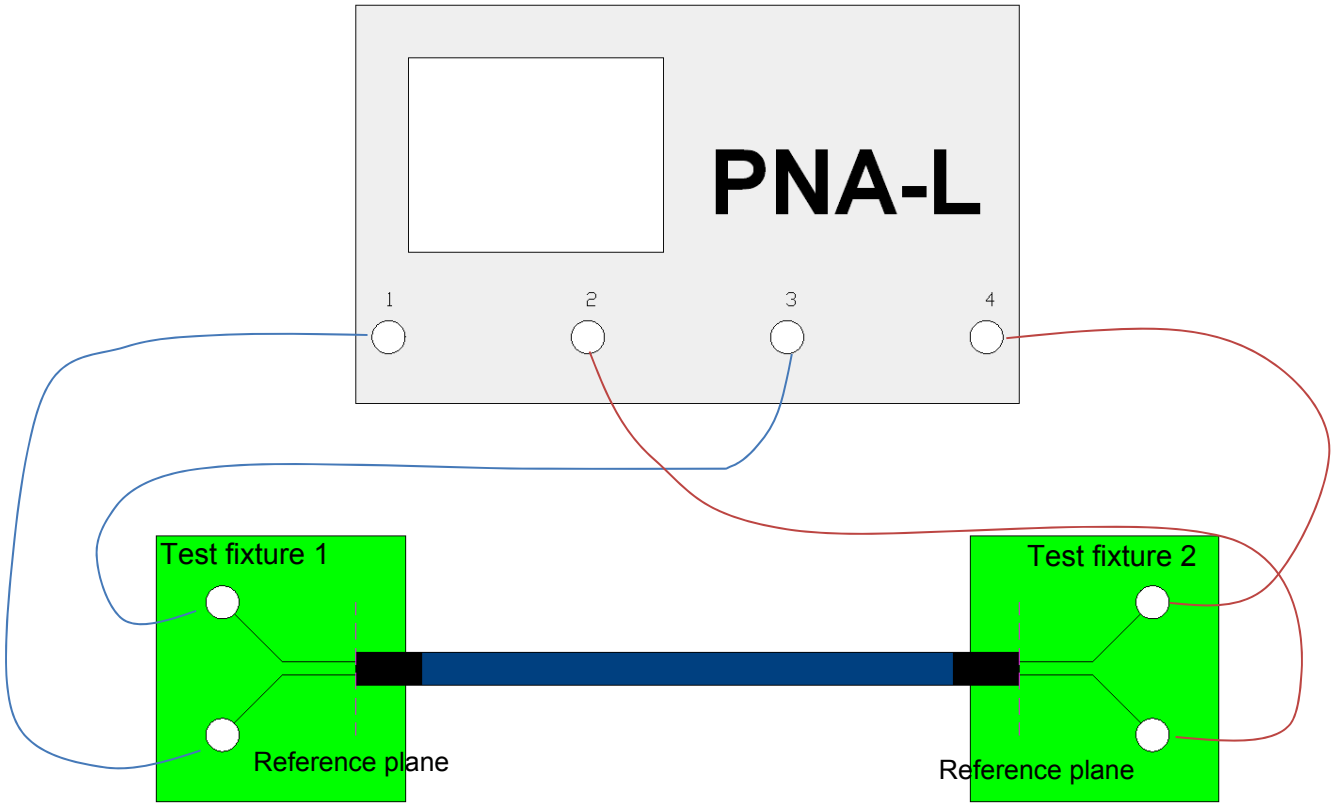


Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Measurements are then performed using the test boards as shown below. The test board effects are removed in post-processing via AFR in Agilent PLTS. The calibrated reference plane is located at the middle of the connector footprint on each side. The S-Parameter measurements include:

A. Test board vias, pads (footprint effects) for the QRF8 connector
B. The QRF8 series connector
C. The EQRD-026-XX.XX-TTR-STL-1 test cable
D. The QRM8 series connector
E. Test board vias, pads (footprint effects) for the QRM8 connector

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



Series: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

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 band-width-limited data, such as measured with modern network analyzer.

The Time Domain responses were generated using Agilent ADS 2011 update 10. 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/Documents/WebFiles/Technical_Library/Reference/Articles/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 cable assembly and footprint. A step pulse is applied to the touchstone model of the cable assembly 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.

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: EQRD
Description: 0.8 mm Q Rate® High Speed Coax Cable Assembly, 34 AWG Micro Ribbon Coax Cable

Appendix G – Glossary of Terms

ADS – Agilent Advanced Design System
AFR – Automatic Fixture Removal
CTLE – Continuous Time Linear Analyzer
CuFireFly™ - Copper FireFly™ assembly
DUT – Device under test
FD – Frequency domain
FEXT – Far-End Crosstalk
HDV – High Density Vertical
NEXT – Near-End Crosstalk
OV – Optimal Vertical
OH – Optimal Horizontal
PCB – Printed Circuit Board
PLTS – Agilent Physical Layer Design System
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
UI – Unit Interval
XROW – Across Row
Z – Impedance (expressed in ohms)