High Speed Characterization Report

FCF8-20-01-L-XX.XX-S

Mated with:
FCS8-20-01-L-S-A

Description:

High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

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Cable Assembly Overview

Samtec's FCF8/FCS8 is a cost-effective, micro discrete wire coax interconnect solution for high speed applications. The coax cable assembly (FCF8 Series) and board level connector (FCS8 Series) create a high performance system with a compact design and rugged features suitable for applications that require a space-saving, economical solution for high-speed transmission of data in micro-industrial, medical/military instrumentation, and many cable-to-board high speed signaling applications. The data in this report is applicable to 0.25m and 1m cable assembly lengths.

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 FCF8 cable assemblies tested.

Assembly	Configuration	-7 dB Frequency	Speed Rating
FCF8-20-01-L-09.84-S (0.25m)	Single Ended	6.5GHz	13Gbps
	Differential	7.5GHz	15Gbps
FCF8-20-01-L-39.37-S (1m)	Single Ended	1.5GHz	3Gbps
	Differential	2.5GHz	5Gbps

Table 1: Cable Assembly Speed Ratings

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.

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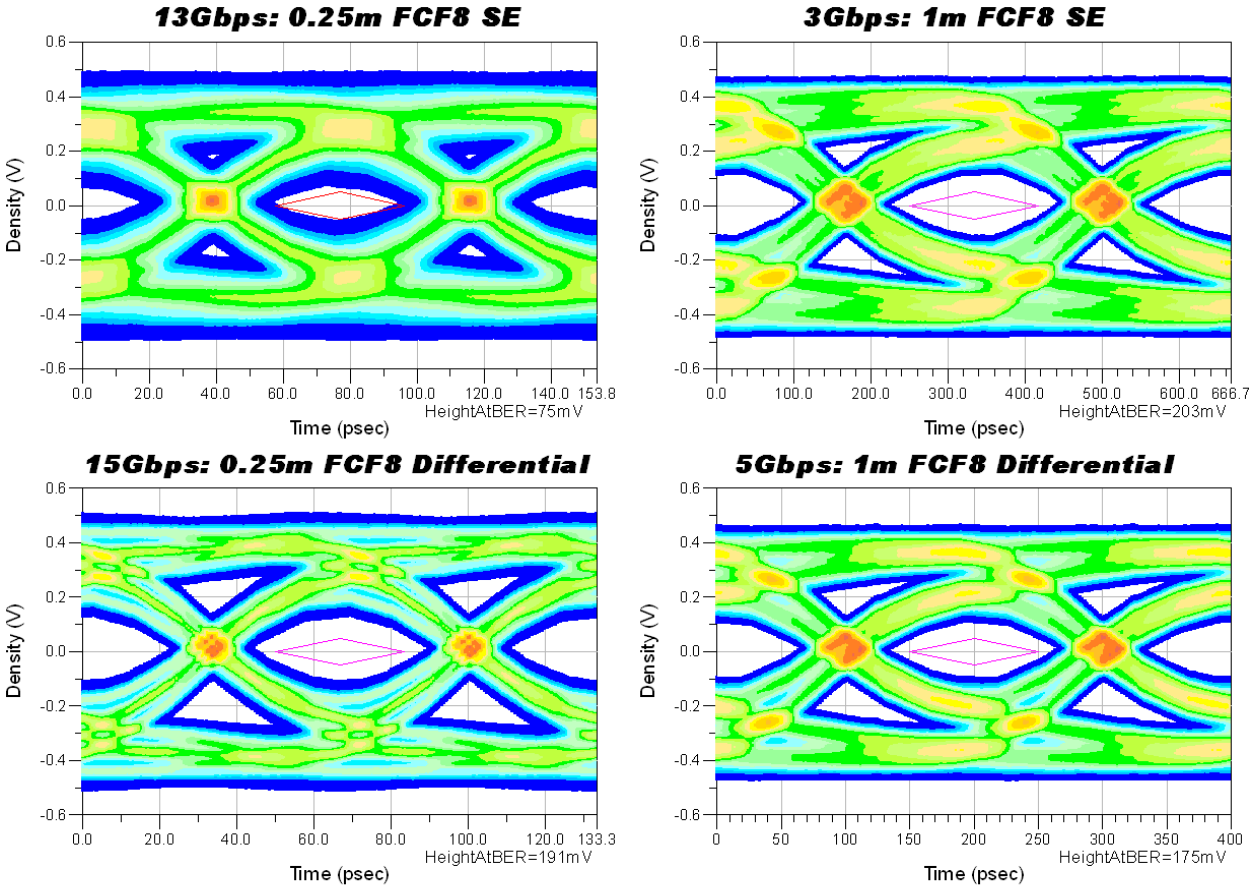
Eye Pattern Summary



No De-Emphasis

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Frequency Domain Data Summary

Table 2 - Cable assembly System Performance

Test Parameter	Configuration		0.25m Threshold Limits	1m Threshold Limits
Insertion Loss	Single Ended	Edge Case	-7dB @ 5.3 GHz	-7dB @ 1.7 GHz
		Middle Case	-7dB @ 6.4 GHz	-7dB @ 1.5 GHz
	Differential	Edge Case	-7dB @ 7.7 GHz	-7dB @ 2.9 GHz
		Middle Case	-7dB @ 7.2 GHz	-7dB @ 2.4 GHz
Return Loss	Single Ended	Edge Case	<-10dB to 0.8 GHz	<-10dB to 0.9 GHz
		Middle Case	<-10dB to 1.2 GHz	<-10dB to 1.1 GHz
	Differential	Edge Case	<-10dB to 3.1 GHz	<-10dB to 6.4 GHz
		Middle Case	<-10dB to 2.6 GHz	<-10dB to 6.2 GHz
Near-End Crosstalk	Single Ended	Edge Case	<-20dB to 0.3 GHz	<-20dB to 0.3 GHz
		Middle Case	<-20dB to 0.3 GHz	<-20dB to 0.2 GHz
	Differential	Edge Case	<-20dB to 1.2 GHz	<-20dB to 1.5 GHz
		Middle Case	<-20dB to 1.2 GHz	<-20dB to 1.6 GHz
Far-End Crosstalk	Single Ended	Edge Case	<-20dB to 0.6 GHz	<-20dB to 0.2 GHz
		Middle Case	<-20dB to 0.6 GHz	<-20dB to 0.5 GHz
	Differential	Edge Case	<-20dB to 13.6 GHz	<-20dB to 20.0 GHz
		Middle Case	<-20dB to 13.7 GHz	<-20dB to 20.0 GHz

See Appendix D for details on test setup

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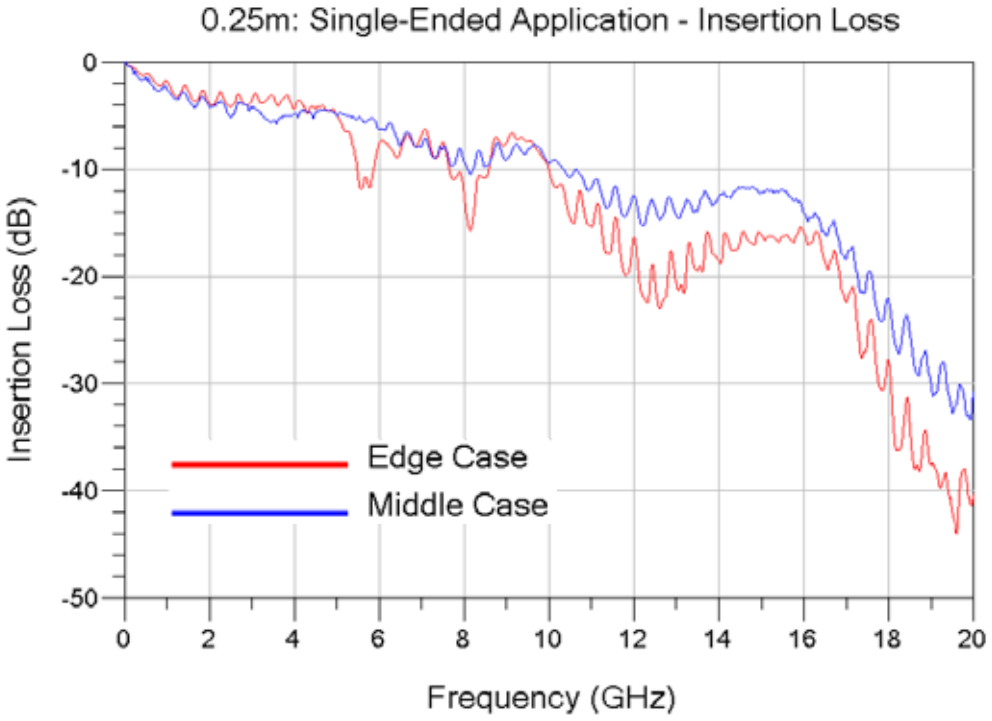
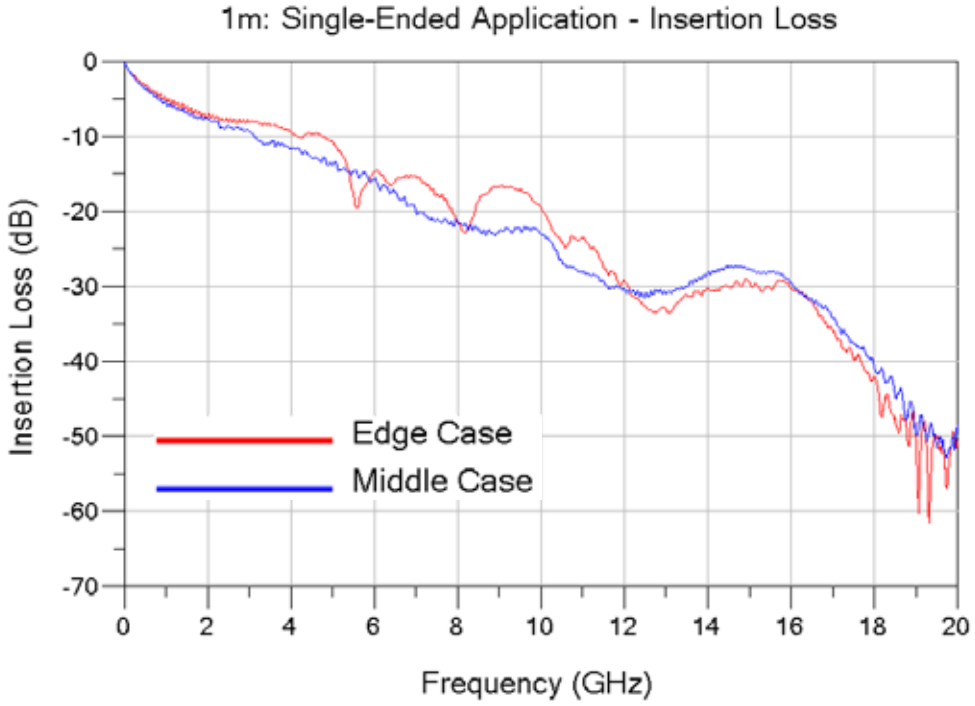
Bandwidth Chart – Single Ended Insertion Loss





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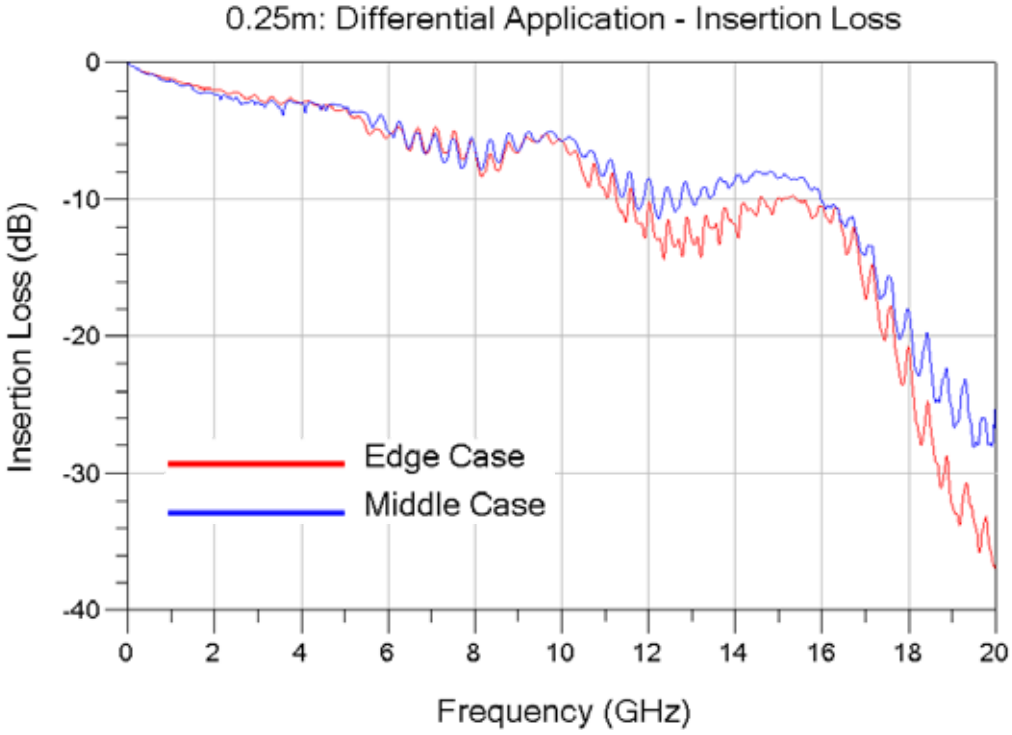
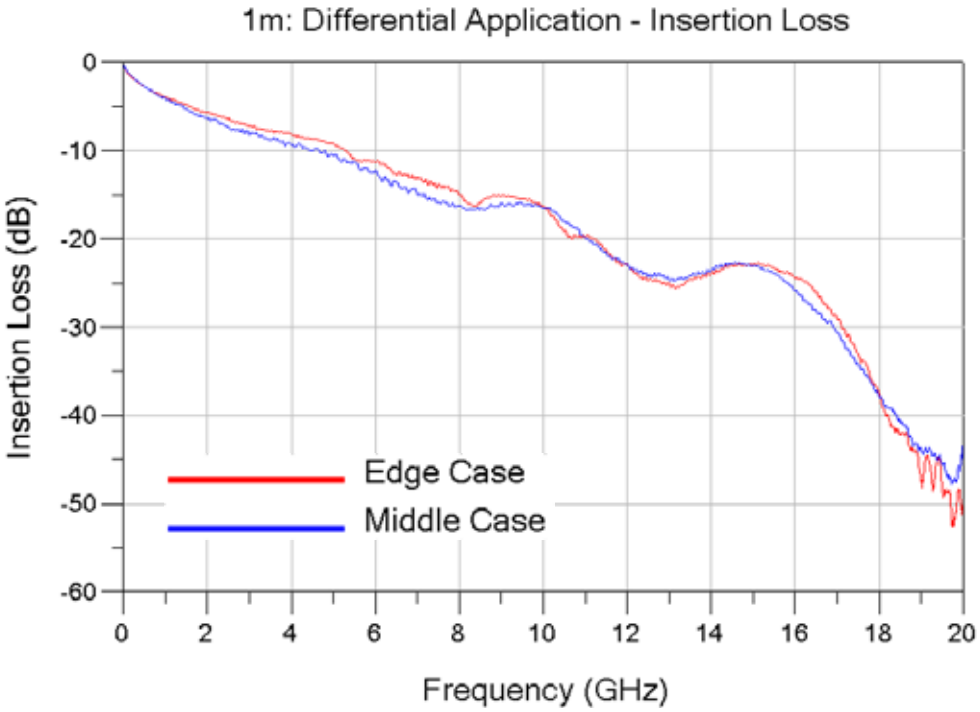
Bandwidth Chart – Differential Insertion Loss





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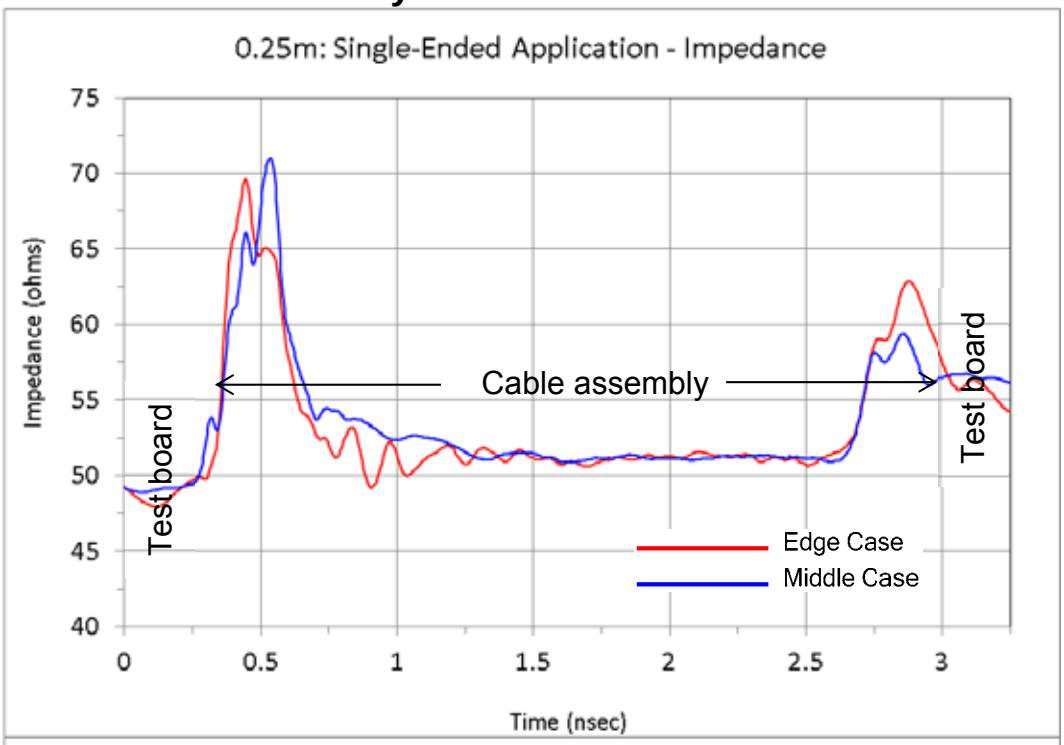
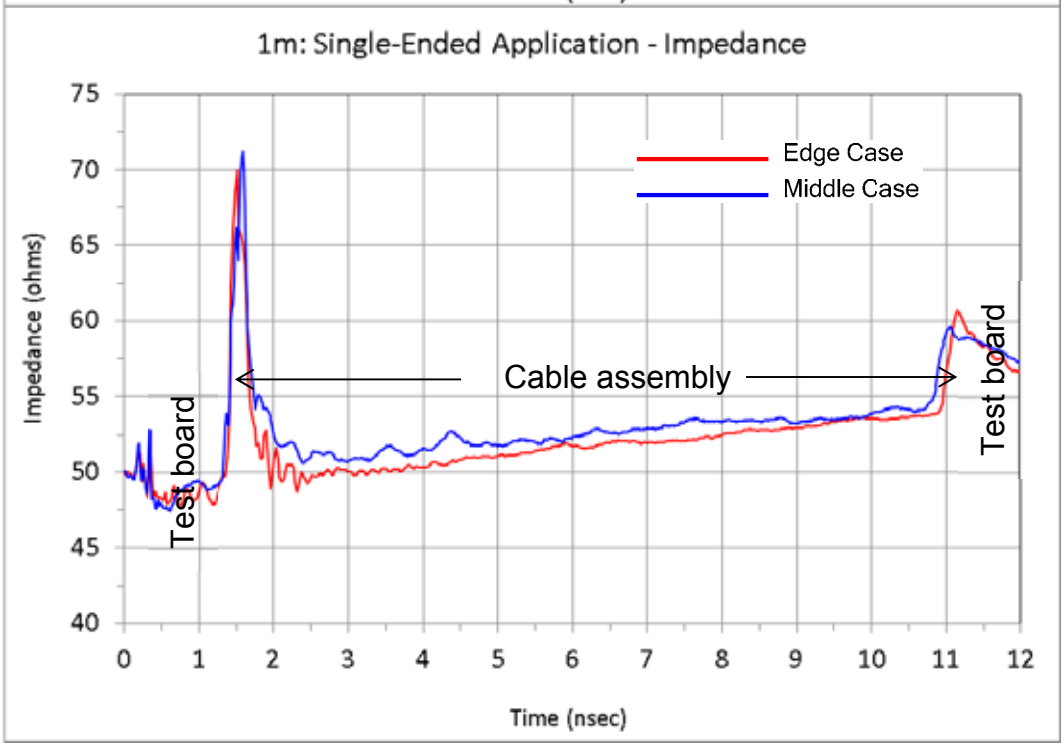
Time Domain Data Summary





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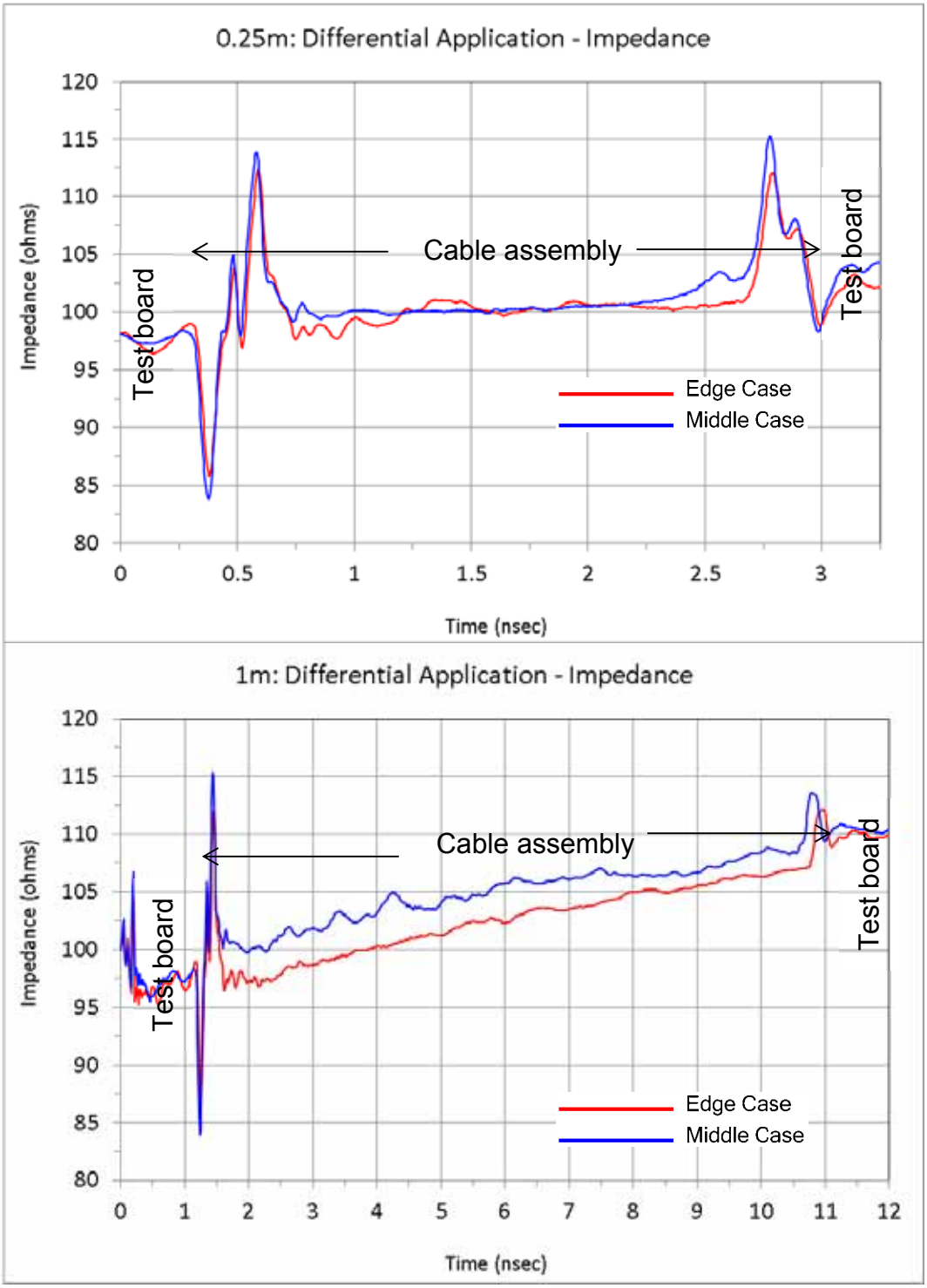

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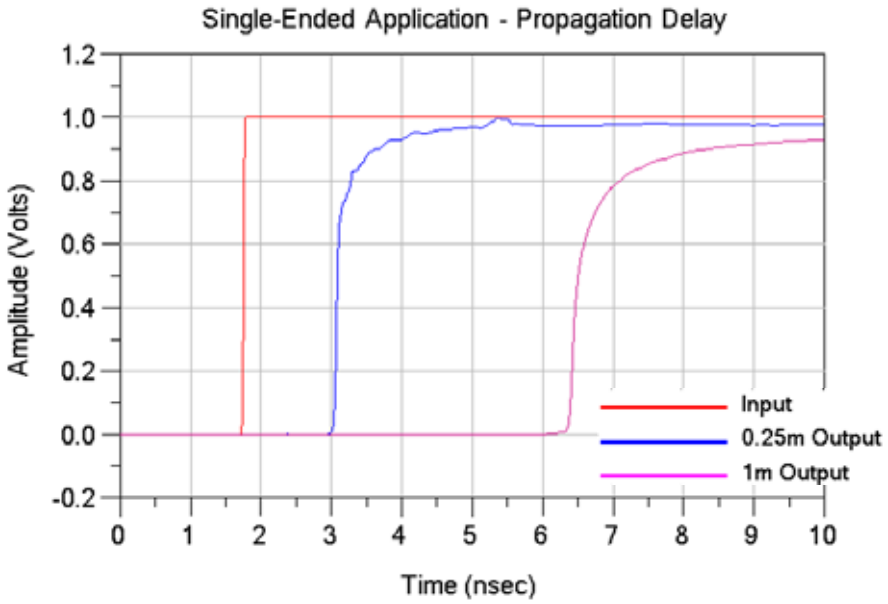
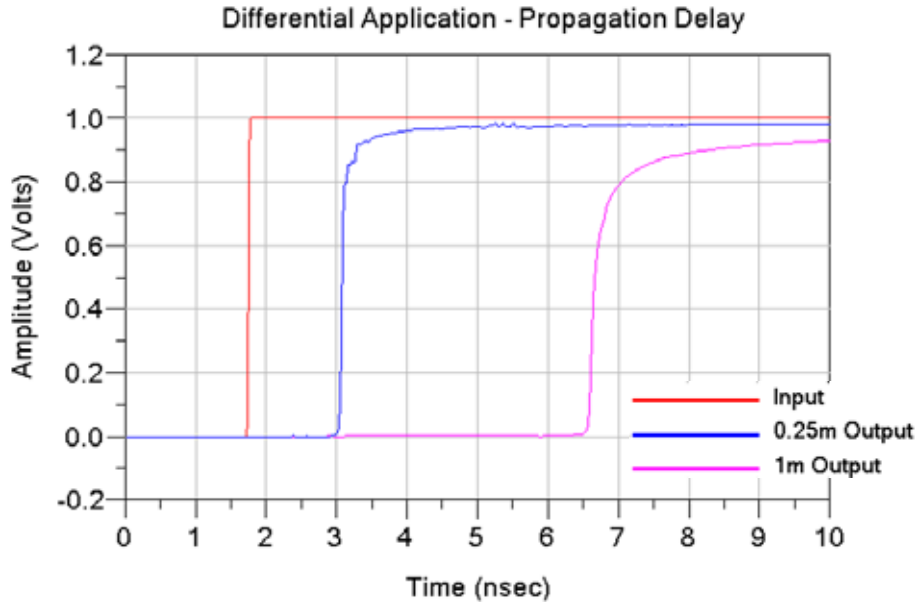
Table 3 - Propagation Delay (Cable Assembly)		
Cable length	Single Ended	Differential
0.25m	1.3ns	1.3ns
1m	5.0ns	4.9ns





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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.

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For this cable assembly, the following array configurations are evaluated:

Single-Ended Impedance**:**
- Edge Case (terminals on the end)
- Middle Case (terminals in the middle)

Single-Ended Crosstalk**:**
- Edge Case (adjacent terminals on the end)
- Middle Case (adjacent terminals in the middle)

Differential Impedance**:**
- Edge Case (one terminal on the end)
- Middle Case (bottom terminals in the middle)

Differential Crosstalk**:**
- Edge Case (adjacent terminals, one terminal on the end)
- Middle Case (adjacent terminals, all in the middle)

See Appendix D – Product and Test System Descriptions for details

Only one 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 rise time of the exciting signal. For this report, the fastest rise time used was 30 ps. Generally, this should demonstrate worst-case performance.

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

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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.

De-emphasis is a means of "cleaning up" the eye diagram, at the expense of overall signal level. The high-frequency component of the signal degrades more so than the low-frequency content – left unchecked, the result is risetime degradation and closing of the eye. De-emphasis combats this by attenuating the low-frequency content of the signal in the transmitter, thereby accentuating the high-frequency content and keeping the eye open. However, this attenuation causes a lower signal level at the receiver.

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 directly from network analyzer measurements.

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Time Domain Data

Time Domain parameters indicate Impedance mismatch versus length, and signal propagation time in a pulsed signal environment. The measured S-Parameters from the network analyzer are post-processed using Agilent ADS to obtain the time domain response. 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. It also includes 40 mils of PCB trace on each connector side. 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.

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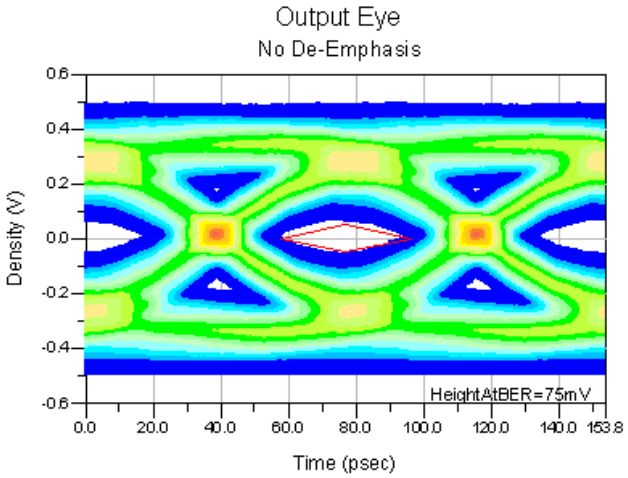
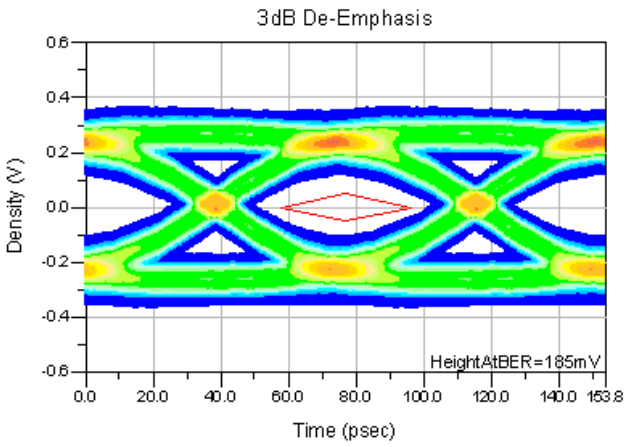
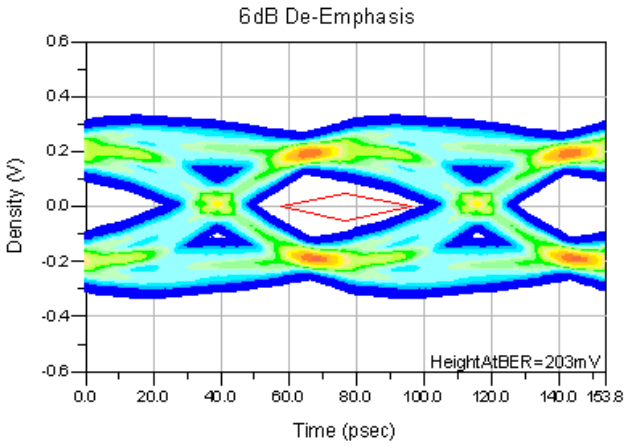
Appendix A – Eye Diagrams

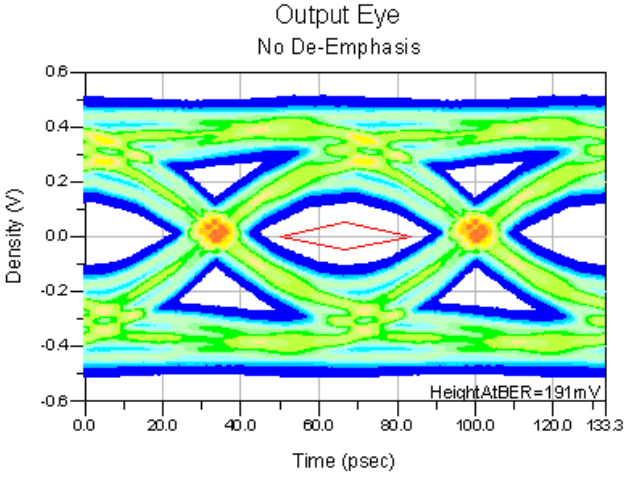
13Gbps: 0.25m FCF8 SE

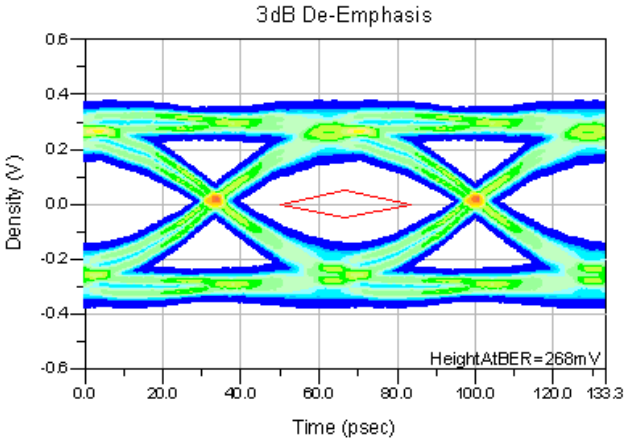


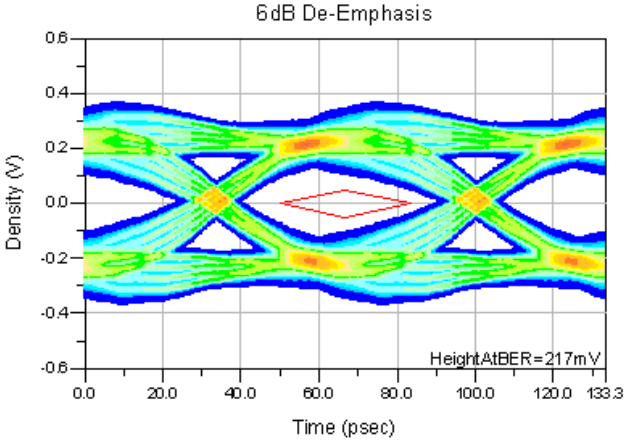




15Gbps: 0.25m FCF8 Differential







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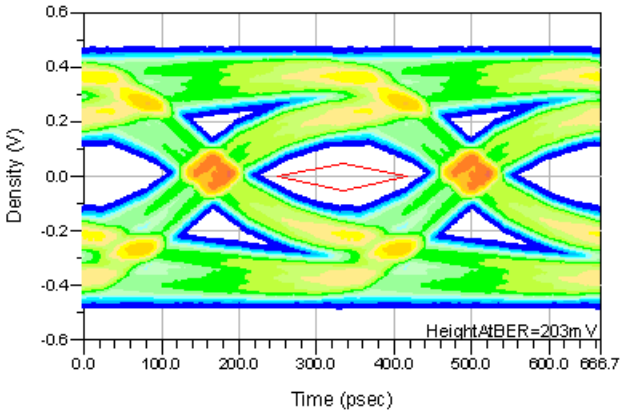
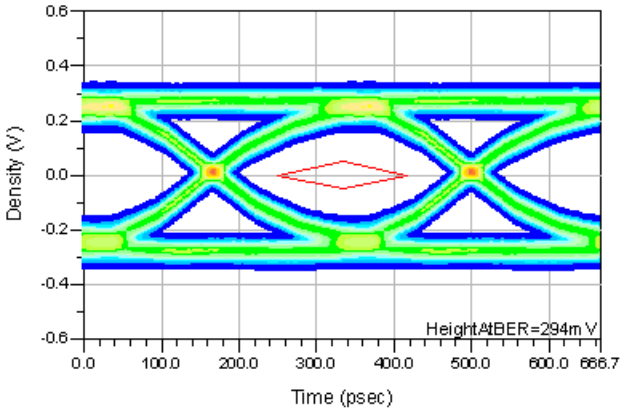
3Gbps: 1m FCF8 SE

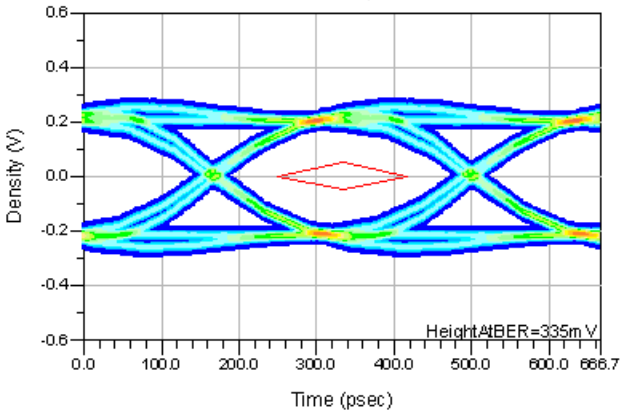
Output Eye
No De-Emphasis



3dB De-Emphasis

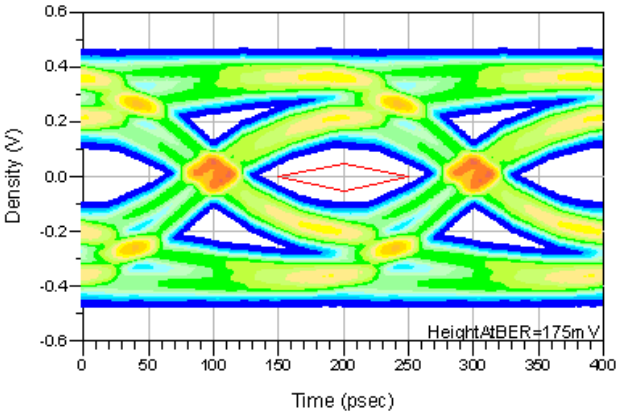


6dB De-Emphasis

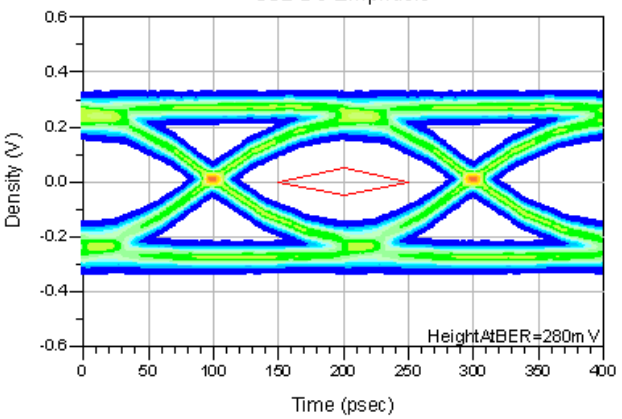


5Gbps: 1m FCF8 Differential

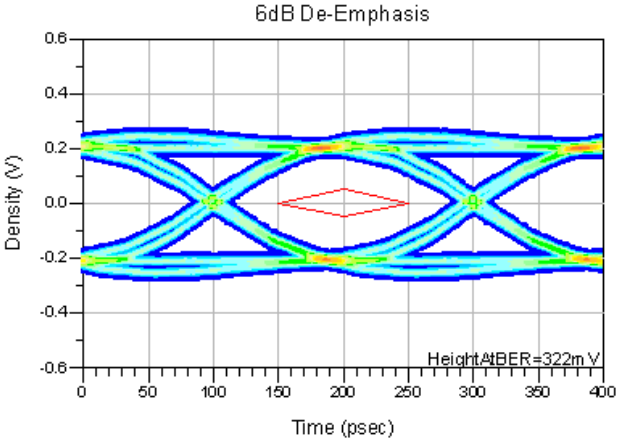
Output Eye
No De-Emphasis



3dB De-Emphasis



6dB De-Emphasis



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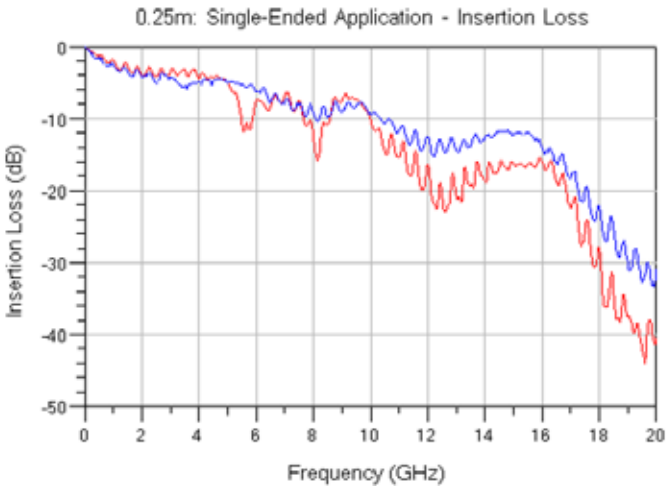
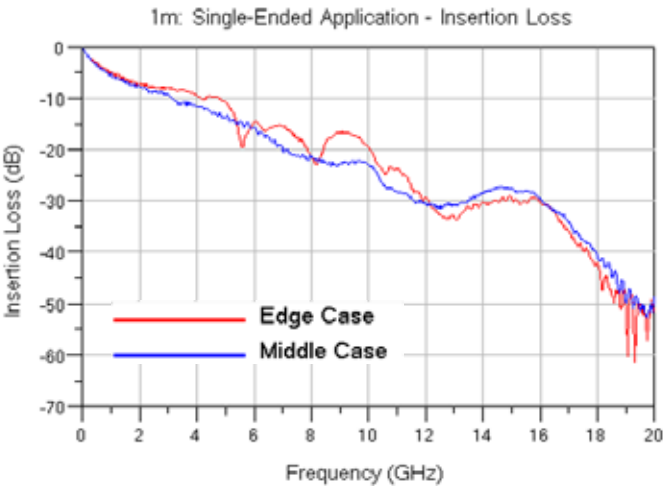
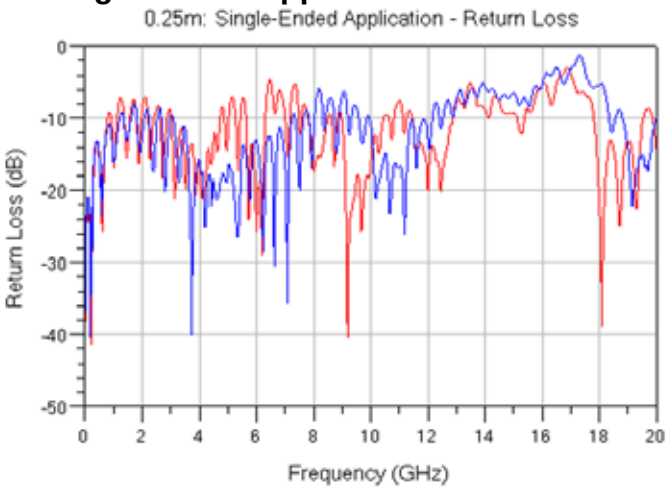
Appendix B – Frequency Domain Response Graphs

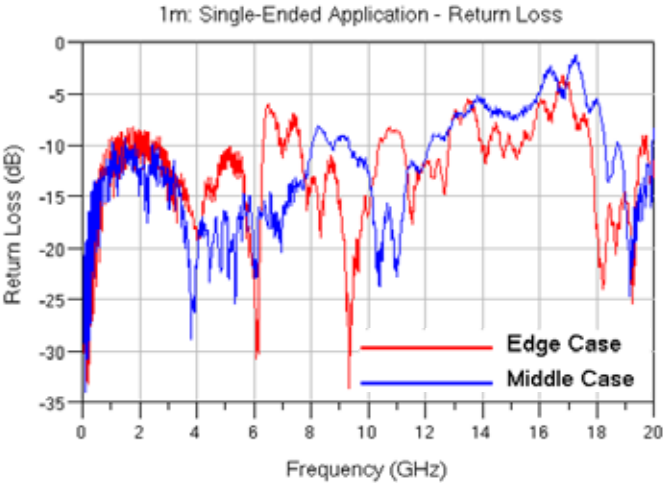
Single-Ended Application – Insertion Loss





Single-Ended Application – Return Loss





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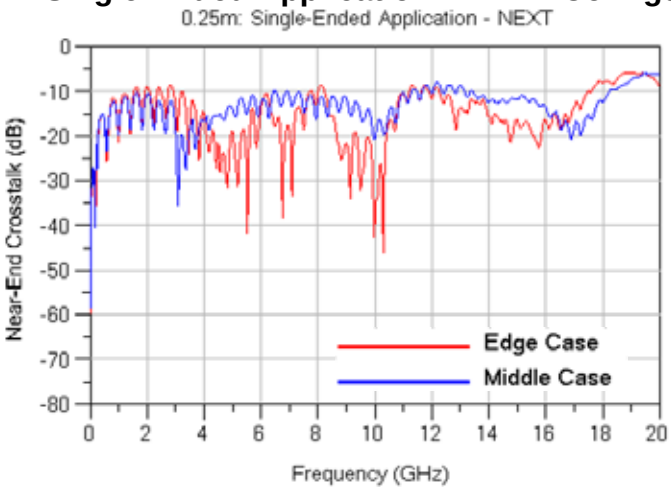
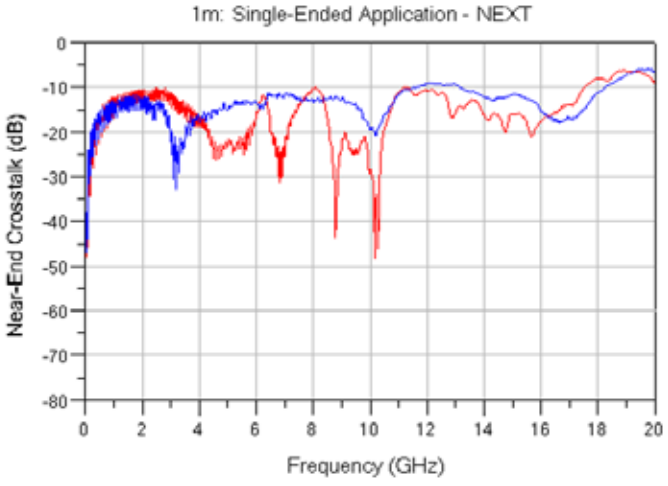
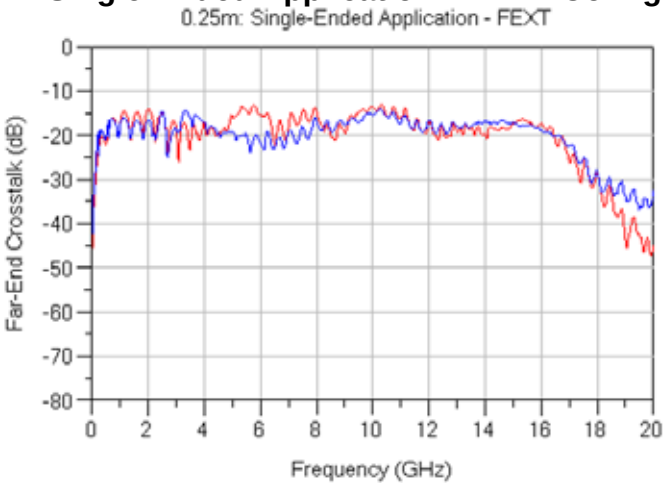
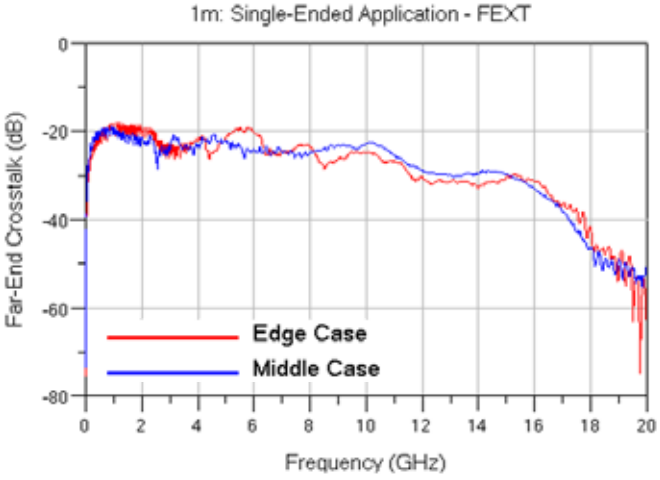
Single-Ended Application – NEXT Configurations





Single-Ended Application – FEXT Configurations





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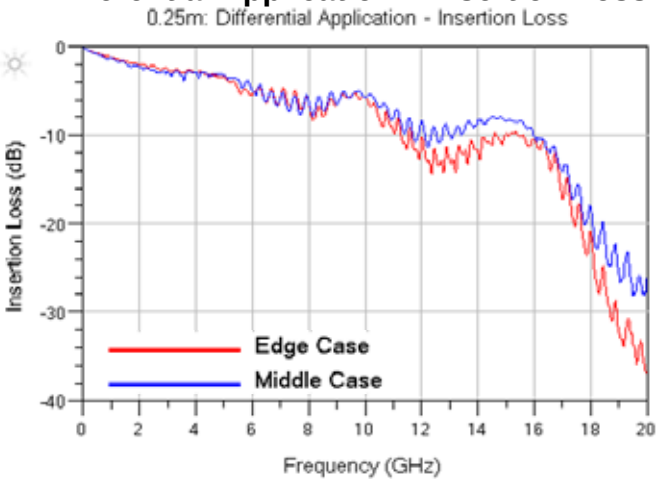
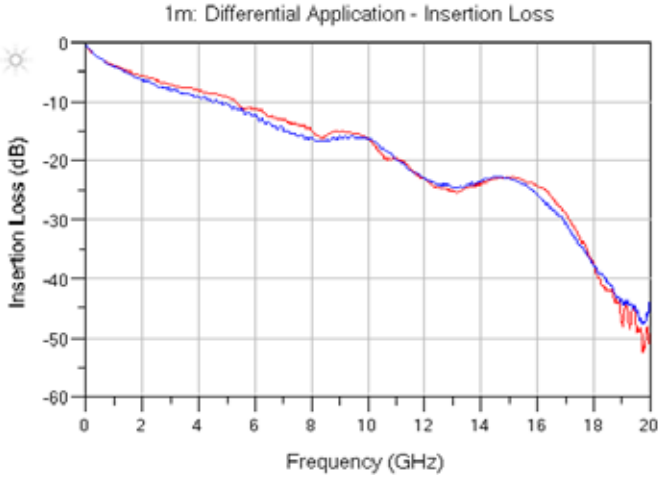
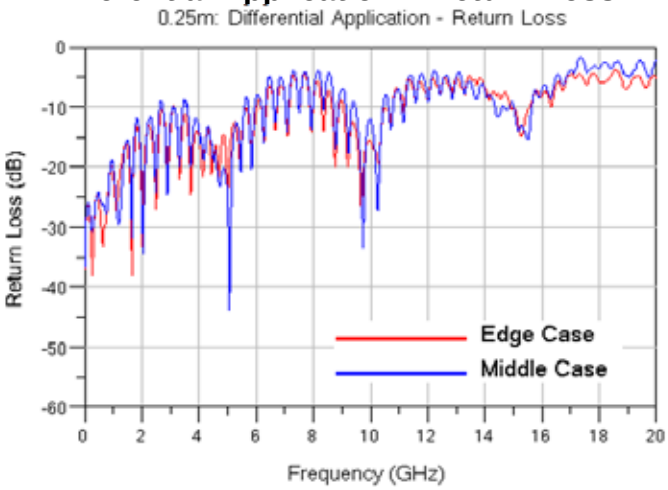
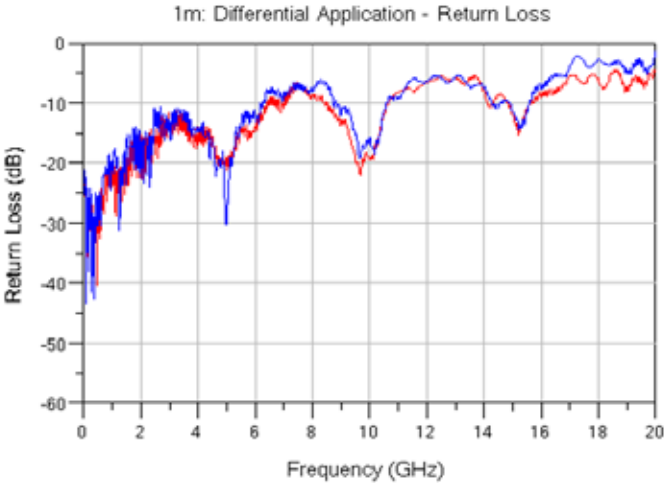
Differential Application – Insertion Loss





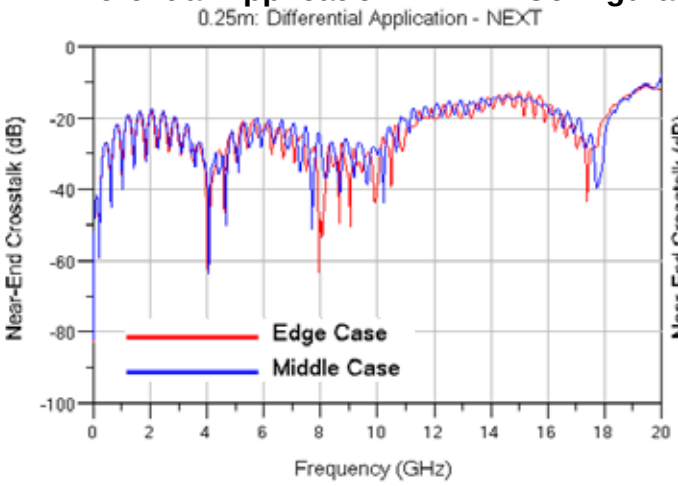
Differential Application – Return Loss

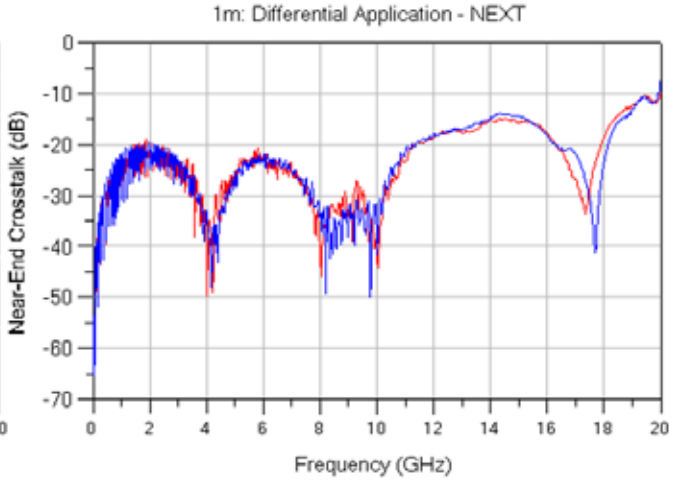




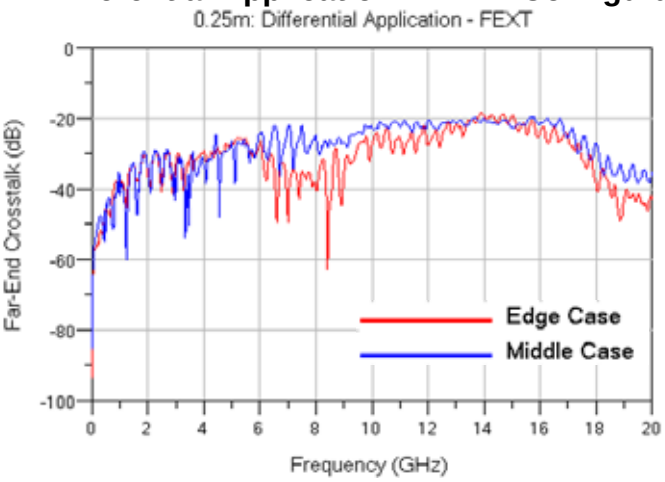
Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

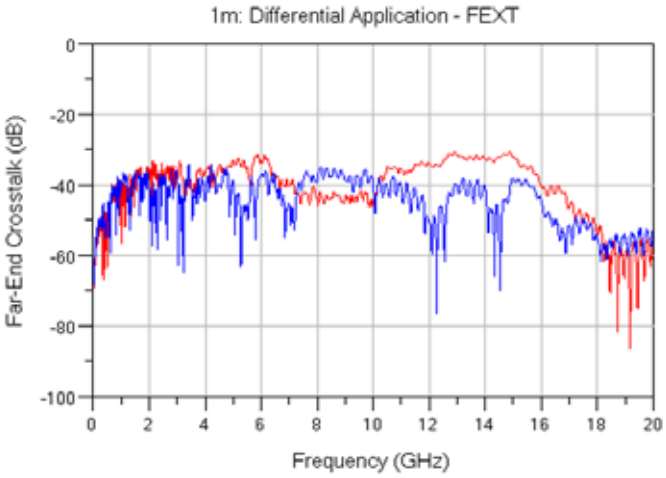
Differential Application – NEXT Configurations



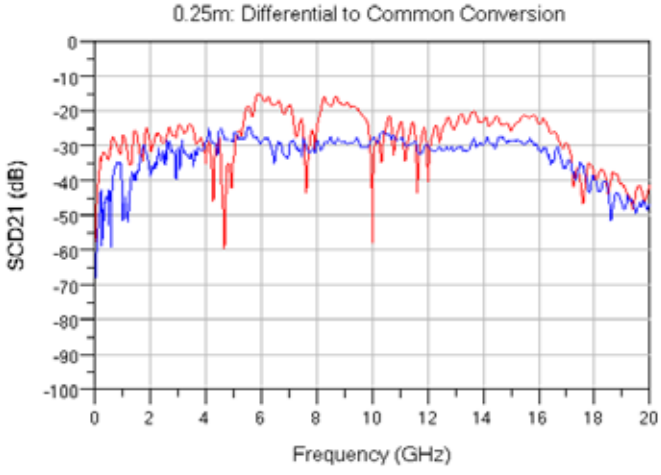


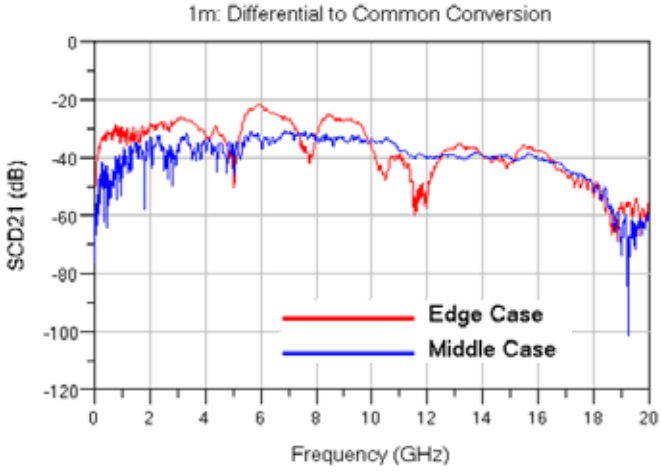
Differential Application – FEXT Configurations





Differential Application – Differential to Common Mode Conversion

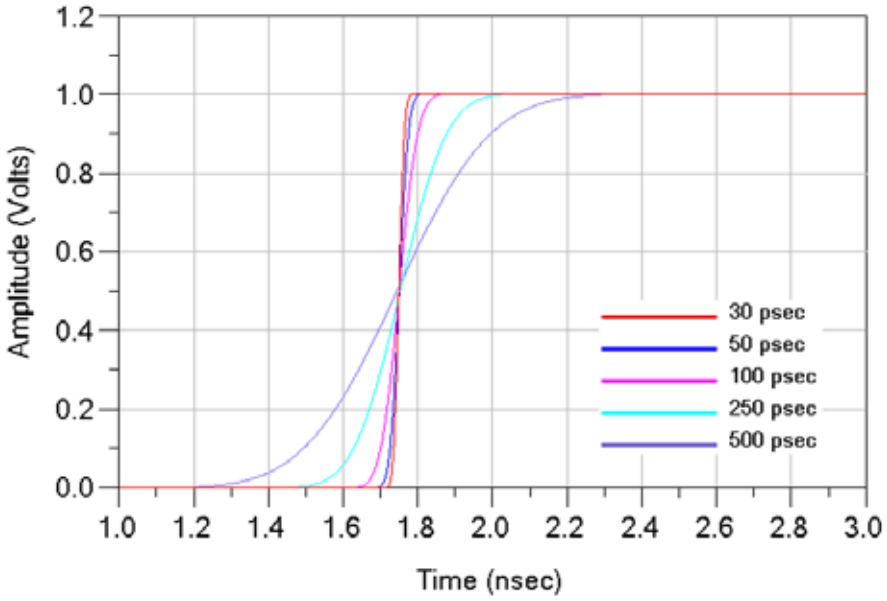




Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

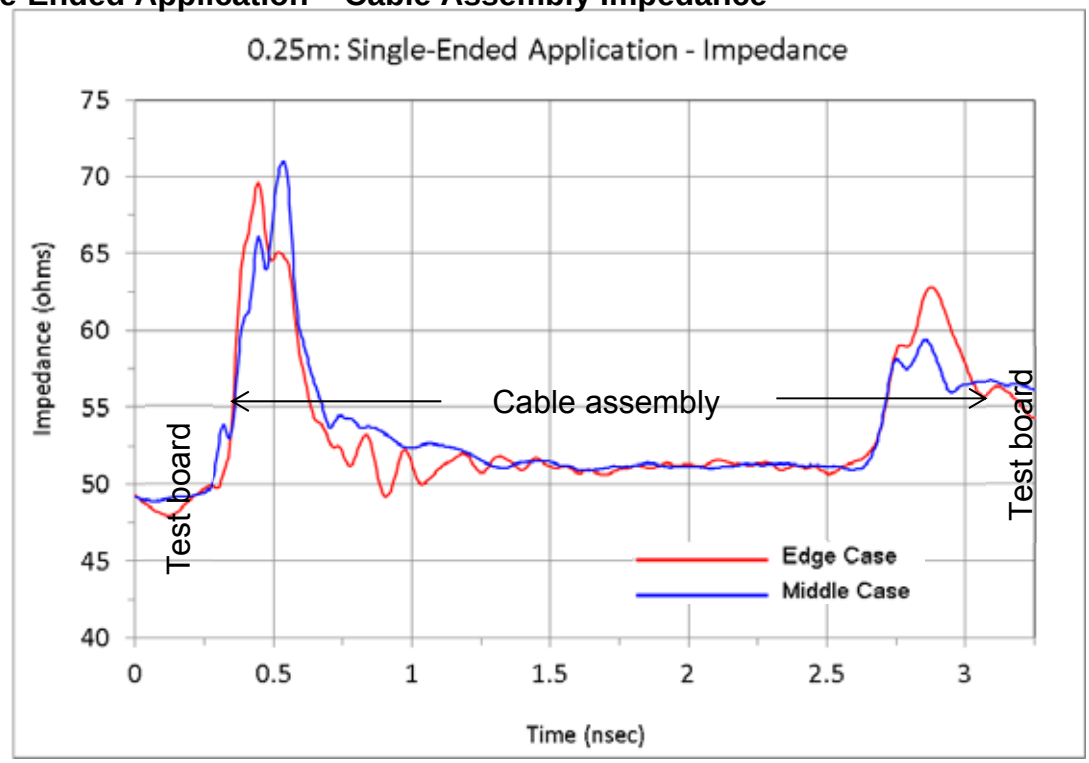
Appendix C – Time Domain Response Graphs

Single-Ended Application – Input Pulse

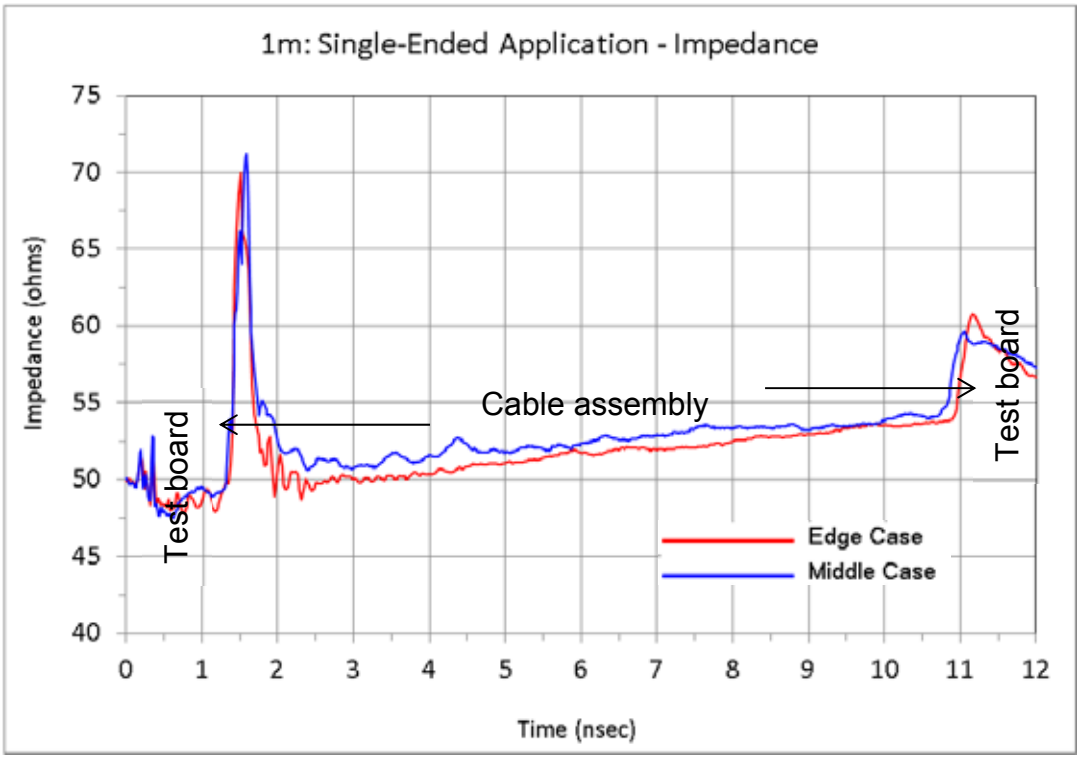


Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

Single-Ended Application – Cable Assembly Impedance

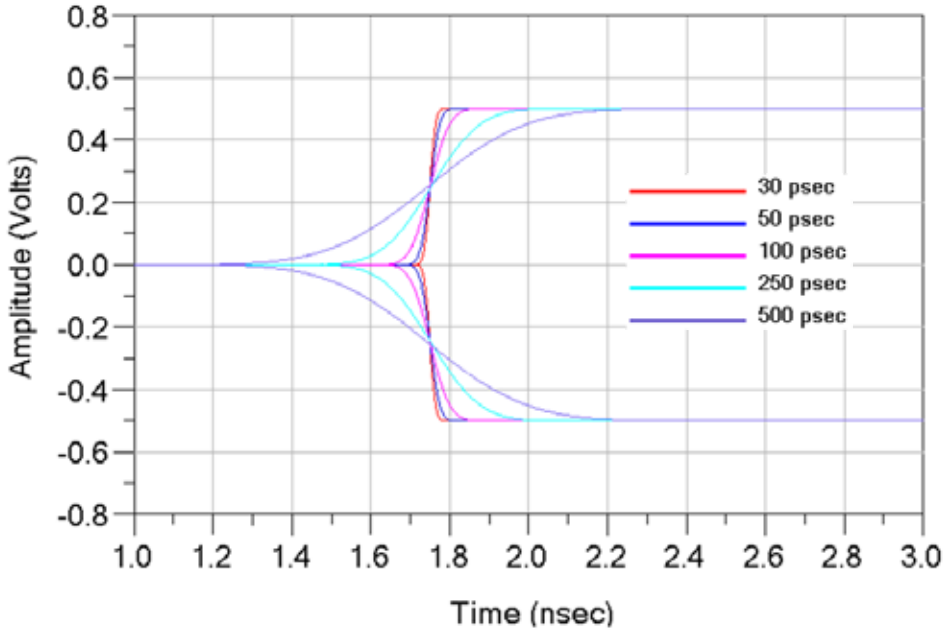


Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths



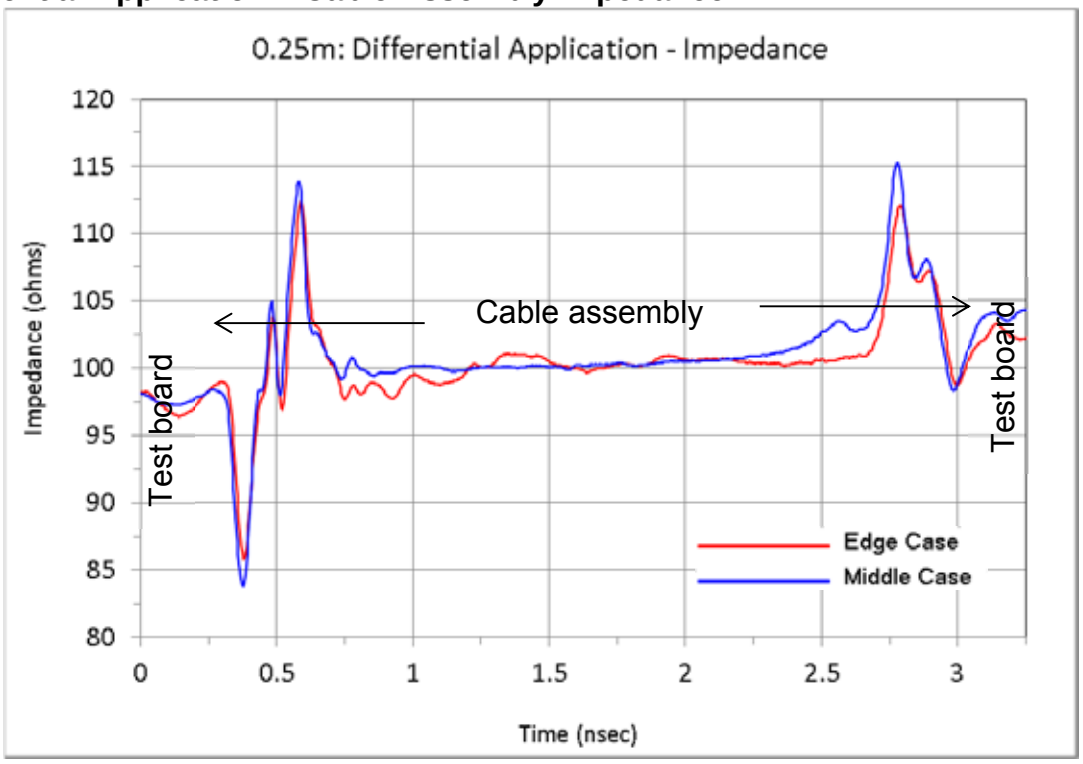
Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

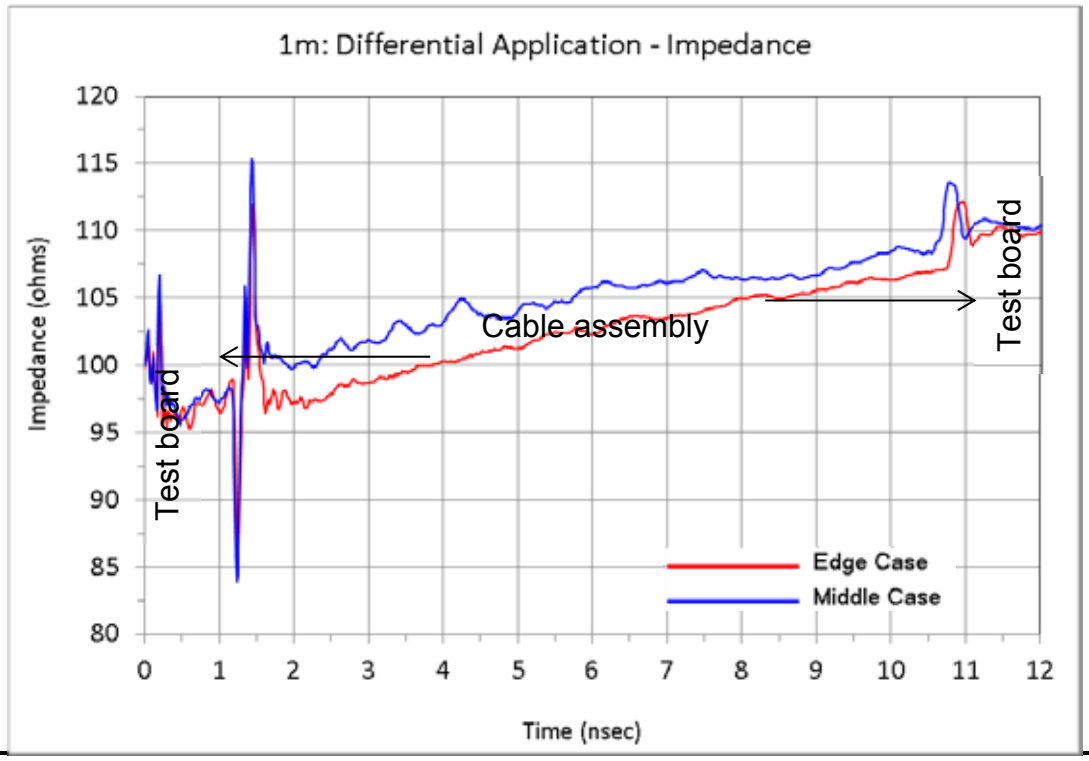
Differential Application – Input Pulse



Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

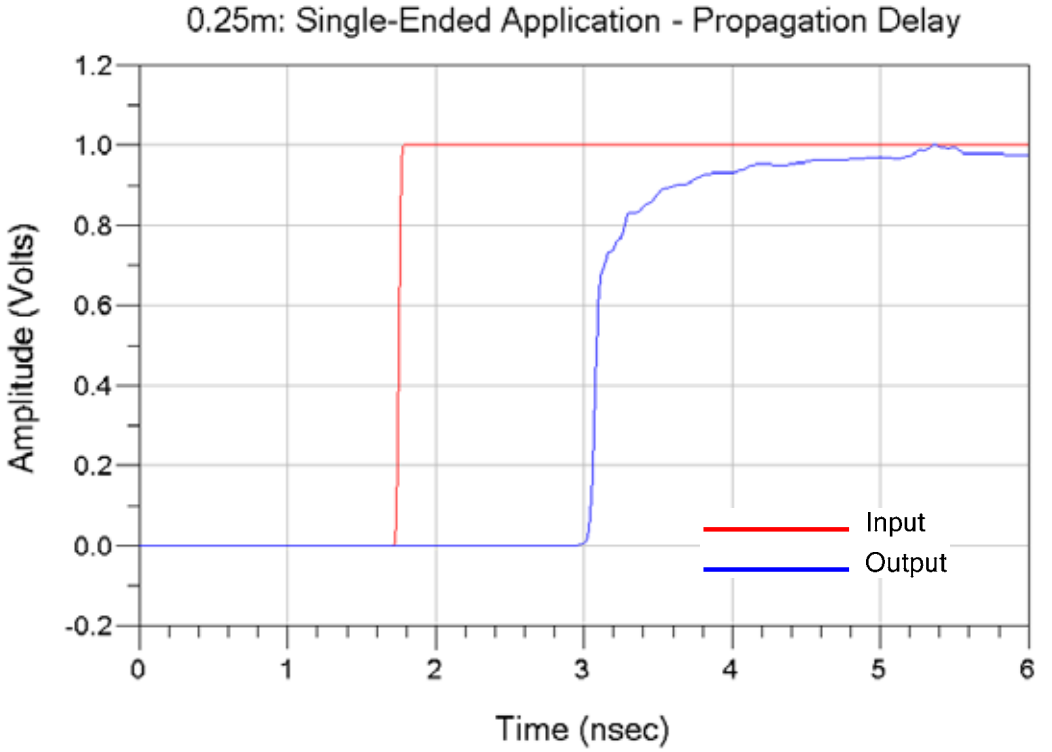
Differential Application – Cable Assembly Impedance

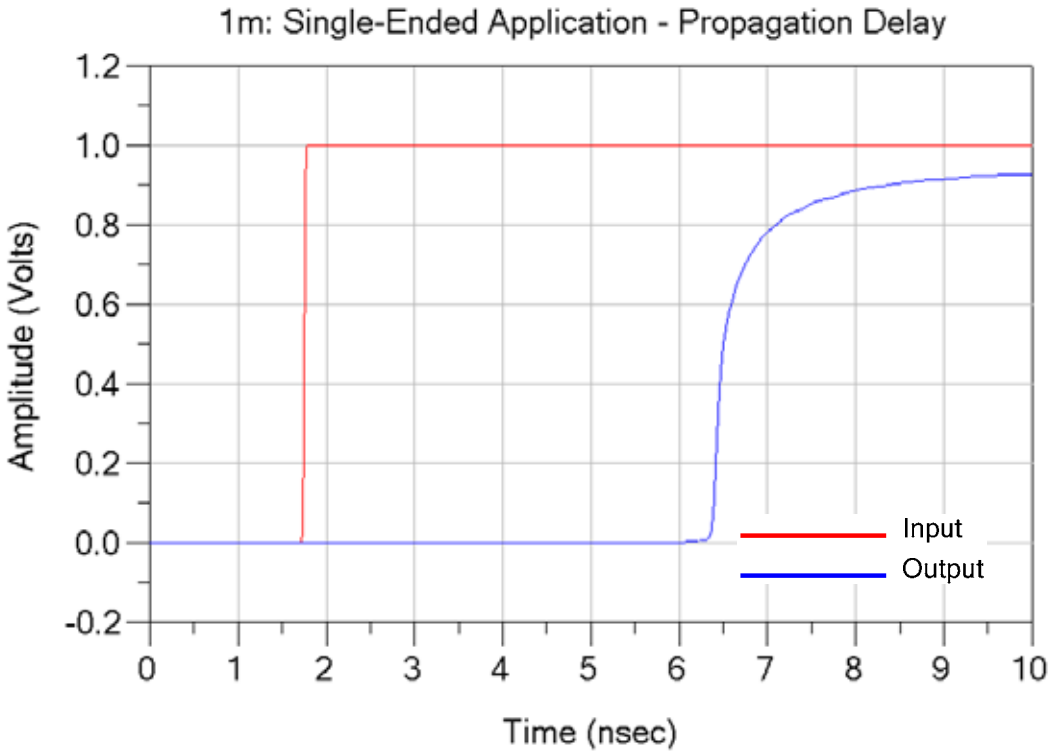




Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

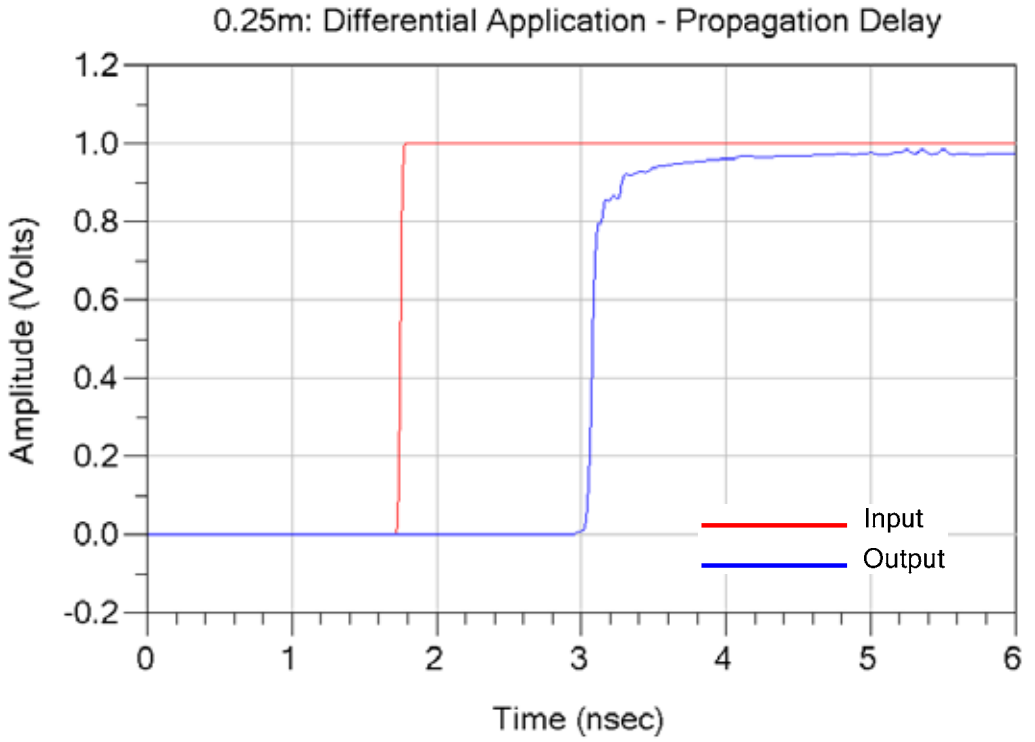
Single-Ended Application – Propagation Delay

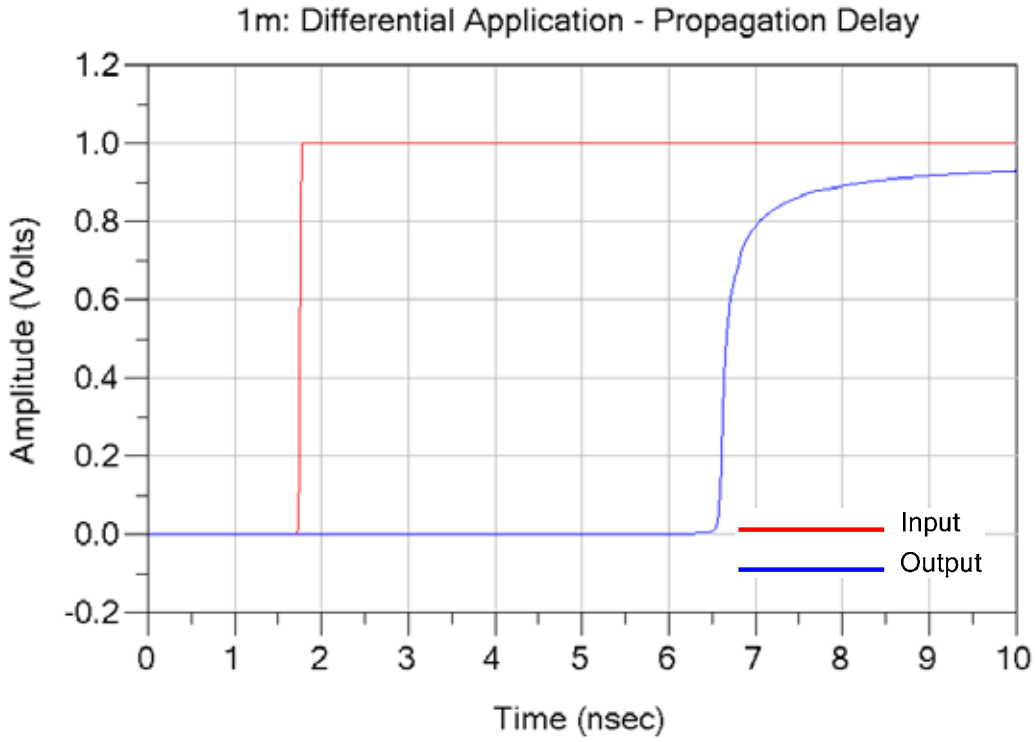




Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

Differential Application – Propagation Delay



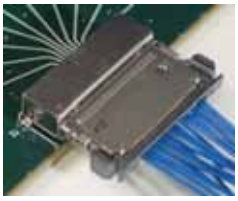


Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

Appendix D – Product and Test System Descriptions

Product Description

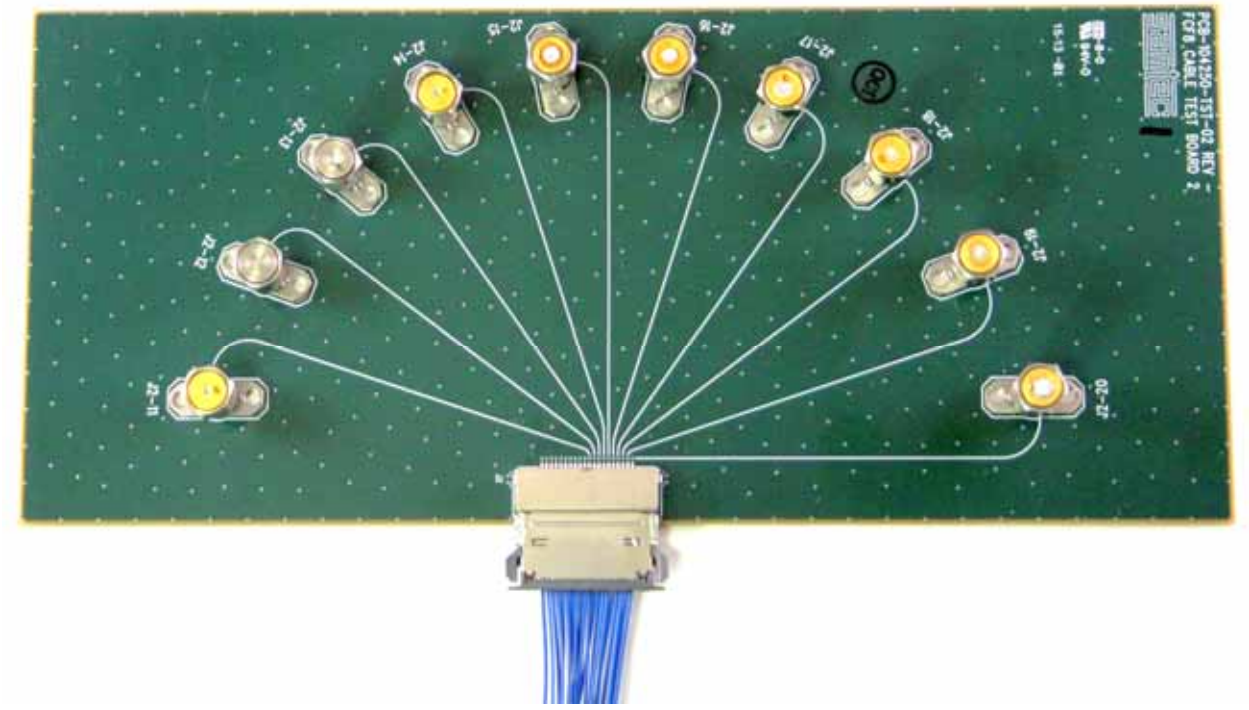
Product test samples are FCF8 cable assemblies. The part number is FCF8-20-01-L-XX.XX-S and it mates to FCS8-20-01-L-S-A. The cable assembly has one row of 20 contacts evenly spaced on a 0.8 mm (0.0315") pitch, in a SSSS configuration. A representative image of the mated test article mounted to SI test boards is shown at right.



Test System Description

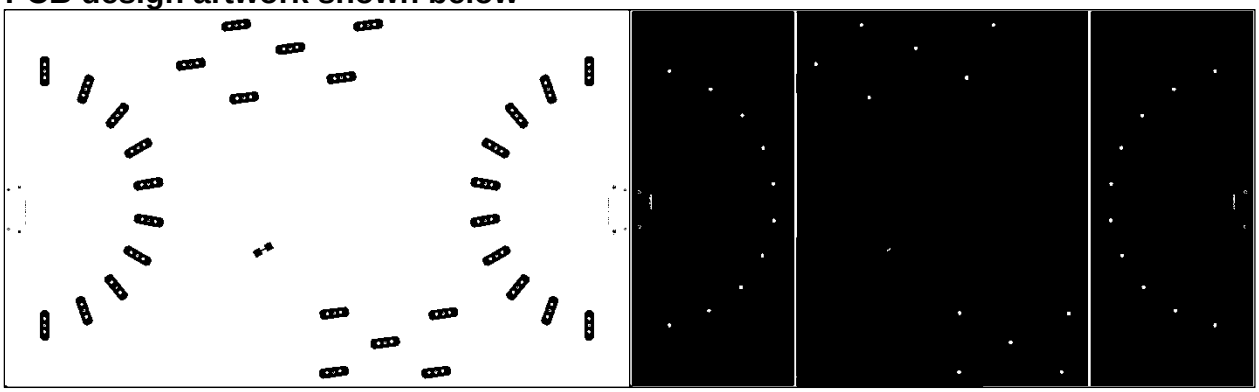
The test fixtures are composed of six layer FR-406 material with 50Ω signal trace and pad configurations designed for the electrical characterization of Samtec high speed cable assembly products. A PCB mount SMA connector is used to interface the VNA test cables to the test fixtures. SMA launch optimization is attained using full wave simulation tools to minimize reflections. There is one test fixture specific to the FCF8 series cable assembly set. The Auto Fixture Removal (AFR) calibration structures designed specifically for the FCF8 series are on a separate test fixture. Displayed on the following pages is information for the SMA/AFR calibration structure and directives for mating FCF8 fixtures.

PCB-104250-TST-XX Test Fixtures

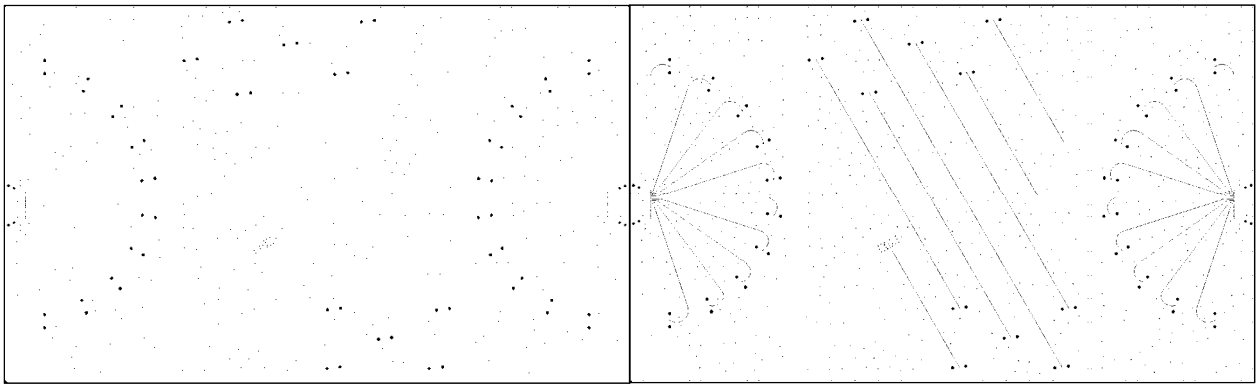


Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

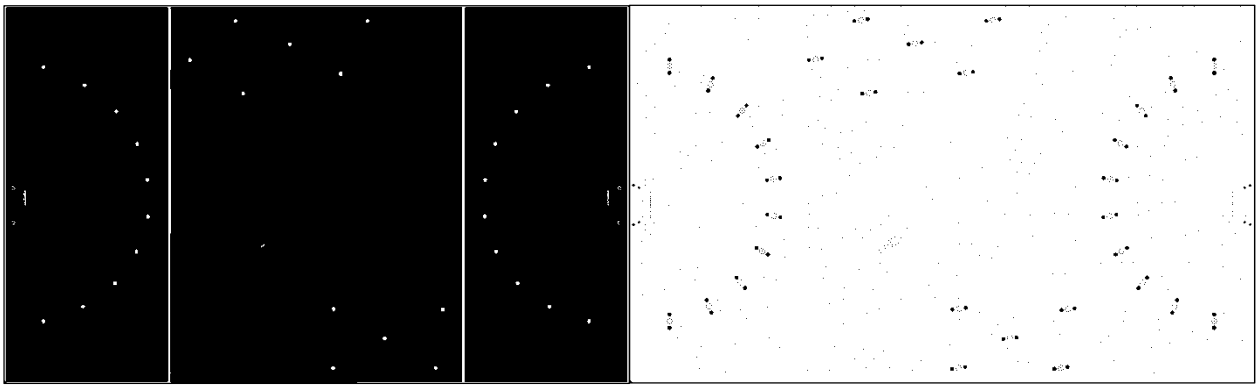
PCB design artwork shown below



Layer 1 Layer 2



Layer 3 Layer 4



Layer 5 Layer 6

Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

PCB Fixtures

The test fixtures used are as follows:

INSERTION LOSS: Edge Case

	NEAR END	FAR END	
1	1	20	2
3	2	19	4
	3	18	
	4	17	
	5	16	
	6	15	
	7	14	
	8	13	
	9	12	
	10	11	
	11	10	
	12	9	
	13	8	
	14	7	
	15	6	
	16	5	
	17	4	
	18	3	
	19	2	
	20	1	

INSERTION LOSS: Middle Case

	NEAR END	FAR END	
	1	20	
	2	19	
	3	18	
	4	17	
1	5	16	2
3	6	15	4
	7	14	
	8	13	
	9	12	
	10	11	
	11	10	
	12	9	
	13	8	
	14	7	
	15	6	
	16	5	
	17	4	
	18	3	
	19	2	
	20	1	

All adjacent unused pairs terminated in 50 ohms

Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

PCB Fixtures (Cont.)

NEXT: Edge Case

	NEAR END	FAR END
1	1	20
3	2	19
2	3	18
4	4	17
	5	16
	6	15
	7	14
	8	13
	9	12
	10	11
	11	10
	12	9
	13	8
	14	7
	15	6
	16	5
	17	4
	18	3
	19	2
	20	1

NEXT: Middle Case

	NEAR END	FAR END
	1	20
	2	19
2	3	18
4	4	17
1	5	16
3	6	15
	7	14
	8	13
	9	12
	10	11
	11	10
	12	9
	13	8
	14	7
	15	6
	16	5
	17	4
	18	3
	19	2
	20	1

All adjacent unused pairs terminated in 50 ohms

Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

PCB Fixtures (Cont.)

FEXT: Edge Case

	NEAR END	FAR END	
1	1	20	
3	2	19	
	3	18	2
	4	17	4
	5	16	
	6	15	
	7	14	
	8	13	
	9	12	
	10	11	
	11	10	
	12	9	
	13	8	
	14	7	
	15	6	
	16	5	
	17	4	
	18	3	
	19	2	
	20	1	

FEXT: Middle Case

	NEAR END	FAR END	
	1	20	
	2	19	
	3	18	2
	4	17	4
1	5	16	
3	6	15	
	7	14	
	8	13	
	9	12	
	10	11	
	11	10	
	12	9	
	13	8	
	14	7	
	15	6	
	16	5	
	17	4	
	18	3	
	19	2	
	20	1	

All adjacent unused pairs terminated in 50 ohms

Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

Appendix E – Test and Measurement Setup

The frequency domain test instrument is the Agilent N5230C PNA-L network analyzer. Frequency domain data and graphs are obtained directly from the instrument. Post-processed time domain data and graphs are generated using convolution algorithms within Agilent ADS. The network analyzer is configured as follows:

Start Frequency – 300 KHz	Number of points -1601
Stop Frequency – 20 GHz	IFBW – 1 KHz

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

The time domain test instrument is the Tektronix DSA8200 Digital Serial Analyzer. TDR plots are generated directly on the instrument.

Test Instruments

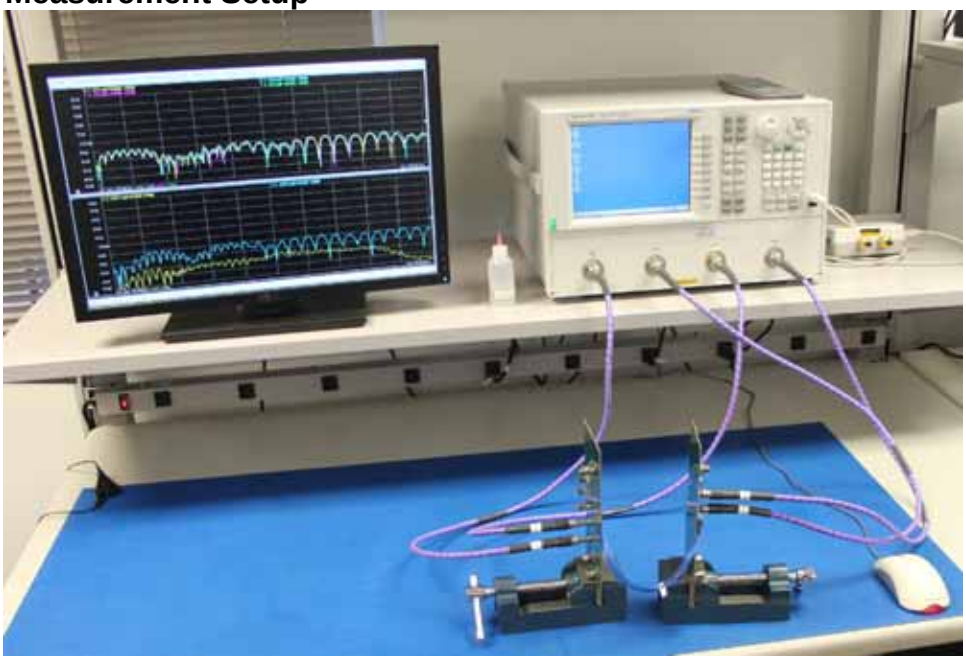
QTY	Description
1	Agilent N5230C PNA-L 4-Port Network Analyzer (300 KHz to 20 GHz)
1	Agilent N4433A Ecal module (300 KHz to 20 GHz)
1	Tektronix DSA8200 Digital Serial Analyzer
1	Tektronix 80E04 Sampling Module

Test Cables & Adapters

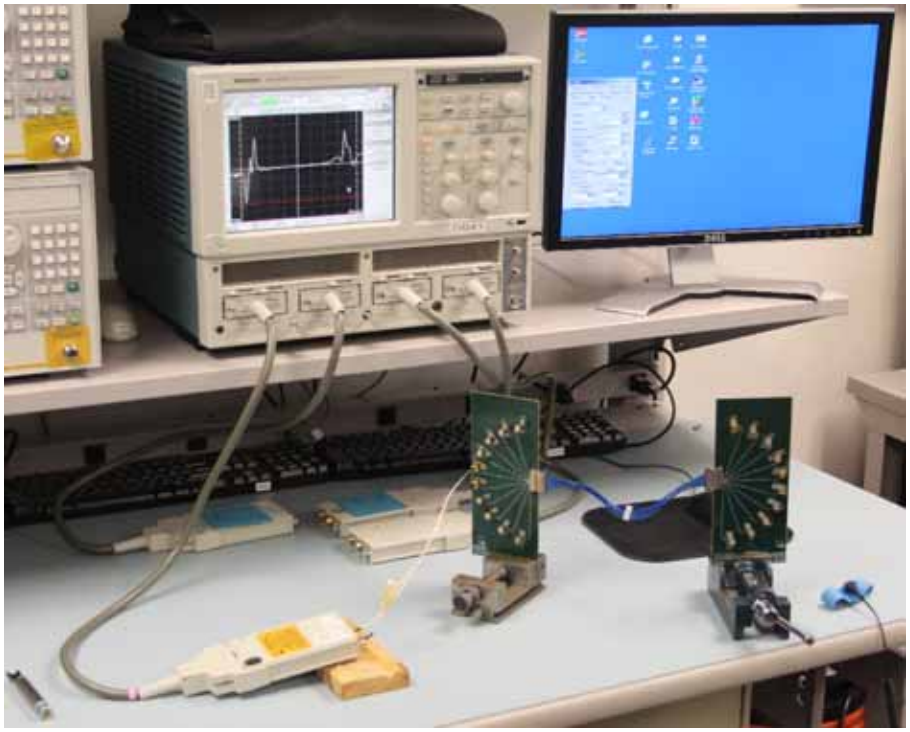
QTY	Description
4	WL Gore –Z0CJ0CK0360 3.5 mm(f) to 3.5mm(m) Test Port Cables (PNAL-L)
2	Samtec RF405-01SP1-01SP1-0305 SMA (m) to SMA (m) RF Cables (TDR)

Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

N5230C Measurement Setup



DSA8200 Measurement Setup



Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

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. The bit rate is determined by the -7dB point from Table 1.

The simulation circuit is modeled as:
Agilent's Advanced Design System Tx and Rx modules that are configured as below

- Tx parameters
  - Bite Rate for each test defined as the -7dB point. See Table 1 on page 1
  - Vhigh = 1V
  - Vlow = -1V
  - Tx Mode: Maximal Length LFSR
  - Register Length: 9
- Rx parameter
  - No Rx equalization
  - No jitter
  - Bit Error Rate Contour: 1e-12
- A 1.0 inch length of Tx interconnect trace segment at the transmitter.
- SUT Cable Assembly S-Parameter measurements
  - 40 mils of 5 mil wide differential stripline signal trace
  - Test board vias, pads (footprint effects) for the FCS8 connector
  - The FCS8 series connector J1
  - The FCF8 cable assembly
  - The FCS8 series connector J2
  - Test board vias, pads (footprint effects) for the FCS8 connector
  - 40 mils of 5 mil wide differential stripline signal trace
- A 1.0 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

Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

- Traces are differential microstrip with the following geometry:
  - 100 ohm differential impedance
  - 4.25 mil trace width
  - 2 mil trace copper thickness
  - 5.75 mil center-to-center spacing
  - 4.4 mil FR4 dielectric thickness
    No differential coupling to neighboring differential channels

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 14Gbps signal was determined to be 25 psec, using the following formula:

Risetime = 0.35/Bandwidth

De-Emphasis
Simulations are run with no de-emphasis, then with the de-emphasis filter set for -3dB and then -6dB respectively.

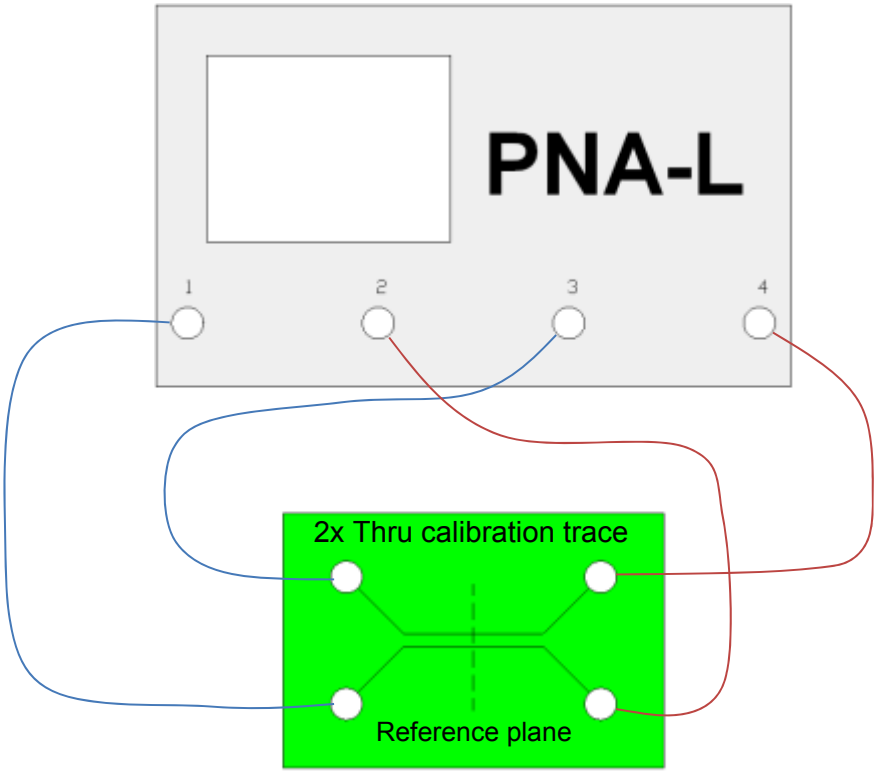
Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

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 FCF8 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.

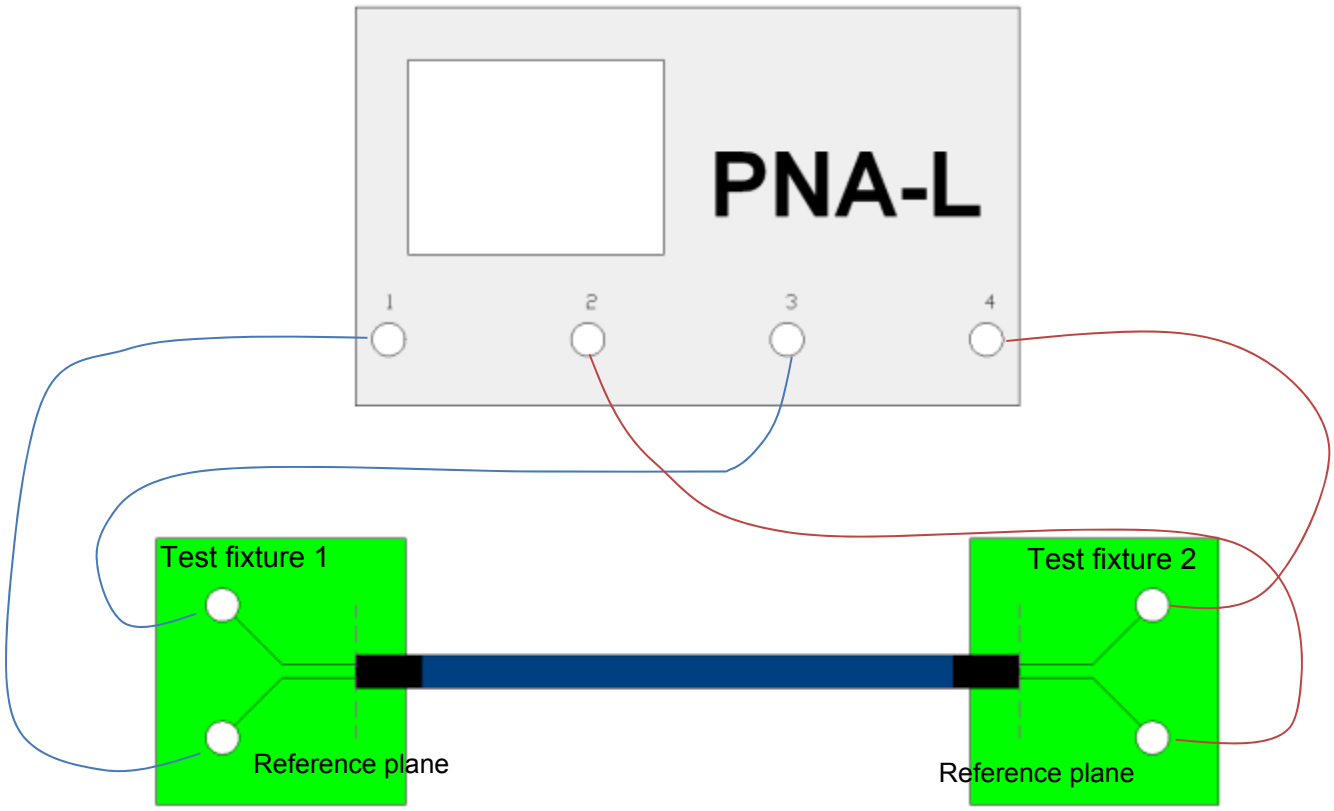


Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

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 10 mils from the connector footprint on each side. The S-Parameter measurements include:

A. Test board vias, pads (footprint effects) for the FCS8 connector
B. The FCS8 series connector J1
C. The FCF8 test cable
D. The FCS8 series connector J2
E. Test board vias, pads (footprint effects) for the FCS8 connector

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



Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

Time Domain Procedures

Impedance measurements of the cable assembly were taken with a Tektronix DSA8200 oscilloscope utilizing a 80E04 sampling module. It was set up in TDR (Time Domain Reflectometry) mode using 128 averages. The horizontal scale was set to allow the FCS8 jacks, FCF8 cable assembly, and a portion of the PCB to be displayed. The rise time was 30ns.

Propagation Delay measurements were mathematically transformed from the Frequency Domain response. Perfect transformation requires Frequency Domain data from DC to infinity Hz. Fortunately, a very accurate Time Domain response can be obtained with bandwidth-limited data, such as measured with modern network analyzer.

The Time Domain responses were generated using Agilent ADS 2013 update 6. 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

Impedance (TDR)
A step pulse is applied to the cable assembly and the reflected voltage is monitored. The reflected voltage is transformed into an impedance profile. All ports of the cable are terminated in 50 ohms.

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.

Series: FCF8
Description: High Speed Cost-Effective Micro Coax Assembly, 0.8mm Pitch, 38 AWG Micro Coax Cable, 0.25m and 1m Cable Lengths

Appendix G – Glossary of Terms

ADS – Agilent Advanced Design System
AFR – Automatic Fixture Removal
CTLE – Continuous Time Linear Analyzer
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 Test System
PNA – Programmable Network Analyzer
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
Z – Impedance (expressed in ohms)