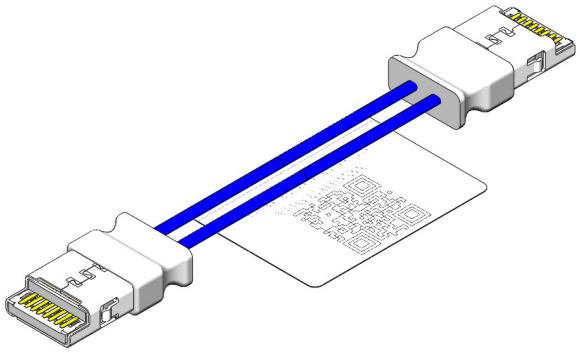
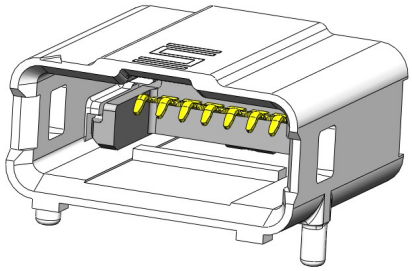
High Speed Characterization Report

ARM6-02-08.0-LU-LU-4-1



Mated with:

AMF6-02-S-RA-XX



Description:

0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

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Report Revision: 11/13/2023

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Cable Assembly Overview

The 0.635 mm (.025") pitch ARM6 Form Factor Cable Assembly is constructed with Eye Speed® 34 AWG, 92 Ω Thinax™ ultra performance twinax cable. The cable assembly is wired to facilitate either a Pin 1 to Pin 1 or a Pin 1 to Pin N mapping between the cable terminations. The ARM6 series cable assemblies are available with one or two differential pairs, come with AcceleRate® Mini (AMF6) connectors on both ends of the assembly, or with other Flyover® End 2 options for increased design flexibility.

The data in this report is applicable to the 2-pair option, 8-inch length cable, Pin 1 to Pin N wiring option, and mated to a right-angle AMF6 connector.

Length	Part Number	End 1	End 2
8 inches	ARM6-02-08.0-LU-LU-4-1	LU	LU

Table 1: Sample Description

Figure 1: Test Sample

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

Frequency Domain Data Summary

Bandwidth Figures – Differential Insertion Loss

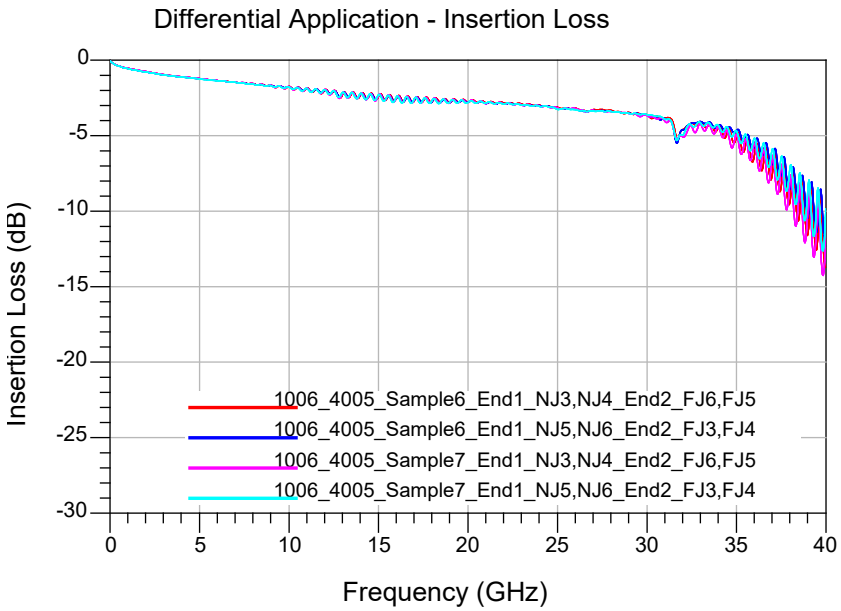

Figure 2

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

Time Domain Data Summary

Differential Application - Impedance

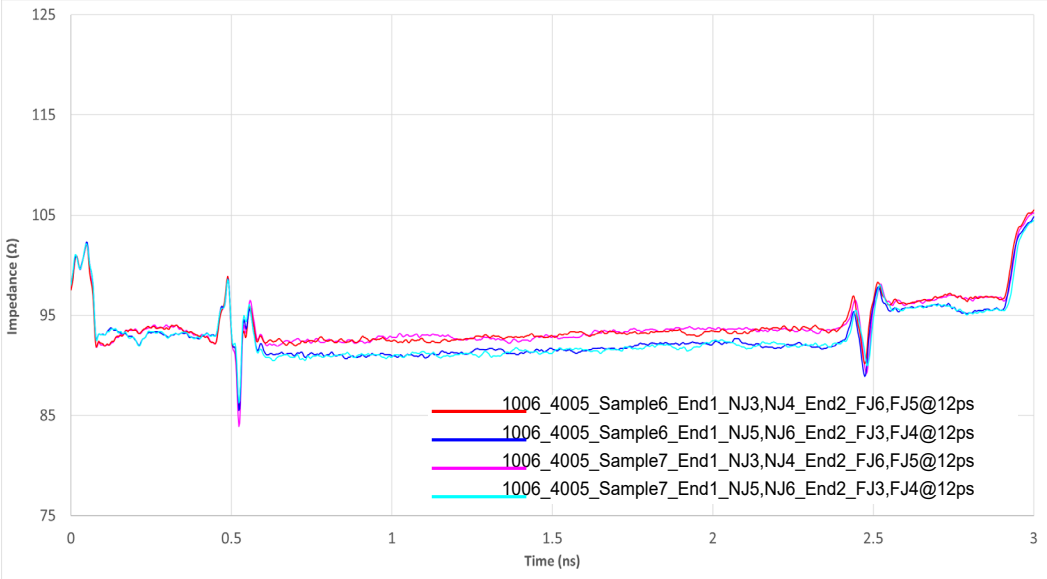

Figure 3

Differential Application – Propagation Delay

Driver	Receiver	8 inches
1006_4005_Sample6_End 1_N13,N14	1006_4005_Sample6_End 2_F16,F15	1.050 ns
1006_4005_Sample6_End 1_N15,N16	1006_4005_Sample6_End 2_F14,F13	1.050 ns
1006_4005_Sample7_End 1_N13,N14	1006_4005_Sample7_End 2_F16,F15	1.053 ns
1006_4005_Sample7_End 1_N15,N16	1006_4005_Sample7_End 2_F14,F13	1.054 ns

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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 "GSSG" differential drive configuration only.

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 configurations are evaluated:

J1	1	NJ3	NJ4	4	5	NJ5	NJ6	8
NAME	GND	PAIR		GND	GND	PAIR		GND
J2	8	FJ6	FJ5	5	4	FJ4	FJ3	1

NEXT

J1	1	NJ3	NJ4	4	5	NJ5	NJ6	8
NAME	GND	PAIR		GND	GND	PAIR		GND
J2	8	FJ6	FJ5	5	4	FJ4	FJ3	1

FEXT

Respective signal line numbers show both End1 and End2

Differential Impedance (denoted by green circles)**:**

- GSSG (Ground-positive signal-negative signal-Ground)

Differential Crosstalk (denoted by red circles)**:**

- Both configurations shown are in row: the terminals to the other terminals are on the same row.

See Appendix C – Product and Test System Descriptions for details

Other configurations can be evaluated upon request. Please contact sig@samtec.com for more information.

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 12 ps. Generally, this should demonstrate worst-case performance.

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 12 ps and 100 ps.

For this report, measured rise times were at 20%-80% signal levels.

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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.

Time Domain Data

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

Impedance mismatch versus length is measured by DCA-X86100D 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 B of this report.

The measured S-Parameters from the network analyzer are post-processed using Keysight ADS to obtain the time domain response for signal propagation time. The Time Domain procedure is provided in Appendix D of this report. Parameters or formats not included in this report may be available upon request. Please contact our Signal Integrity Group at sig@samtec.com for more information.

In this report, propagation delay is defined as the signal propagation time through the cable assembly, mating connectors, and connector footprint. It also includes 2.545mm of PCB trace on each connector side. Delay is measured at 100 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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Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

Appendix A – Frequency Domain Responses

Differential Application – Insertion Loss

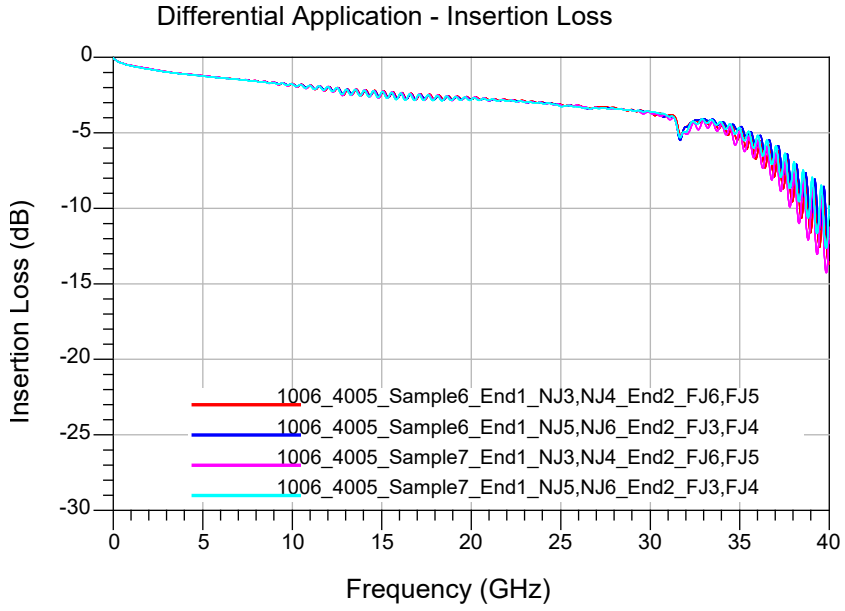

Figure 4

Differential Application – Return Loss

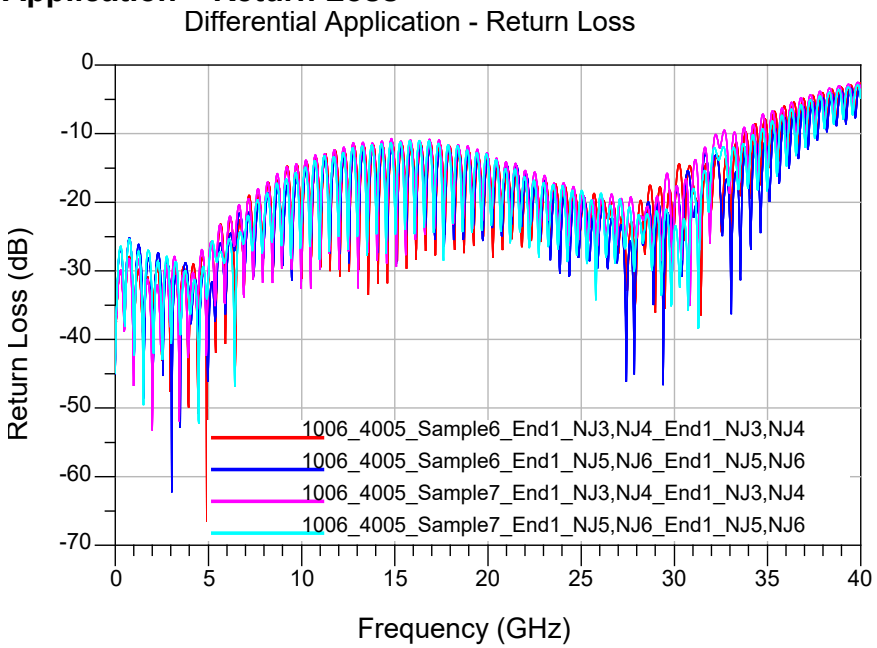

Figure 5

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

Differential Application – NEXT Configurations

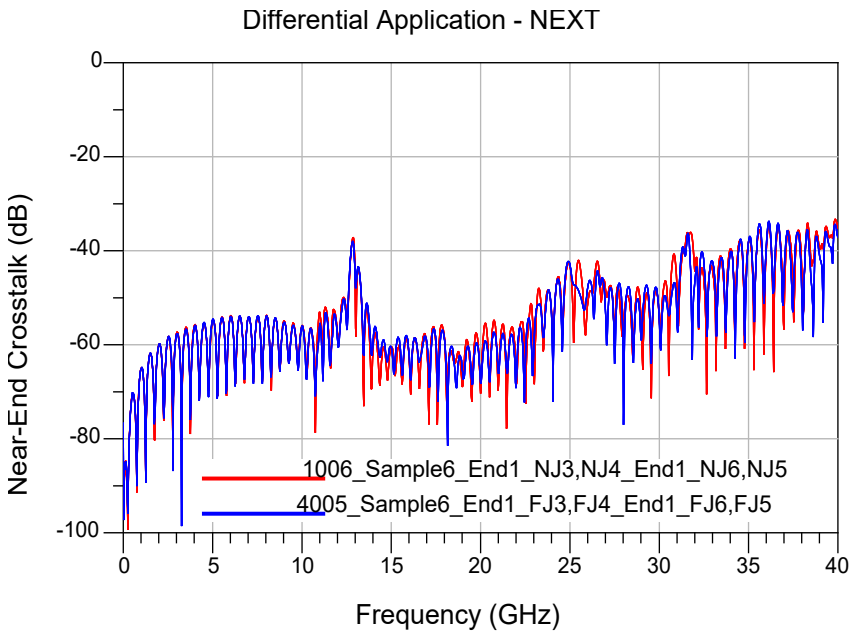

Figure 6

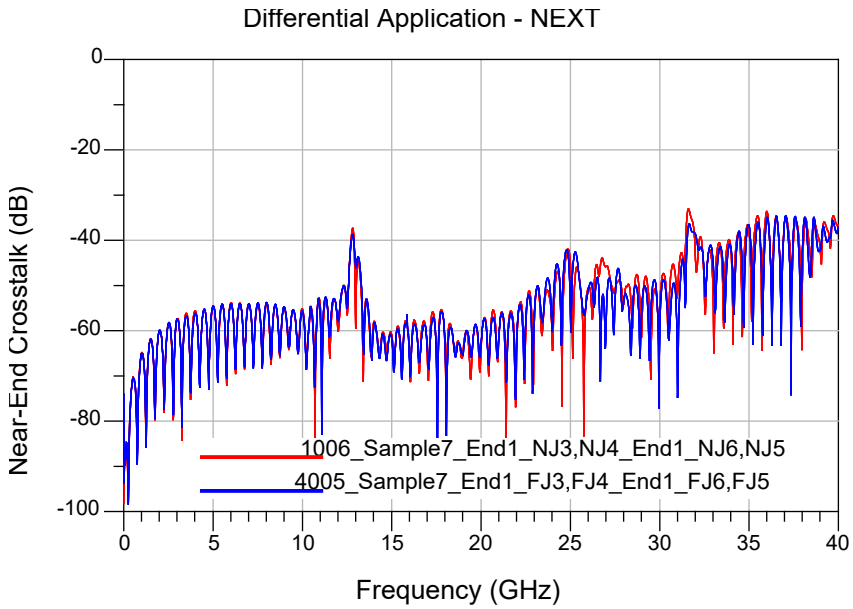

Figure 7

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

Differential Application – FEXT Configurations

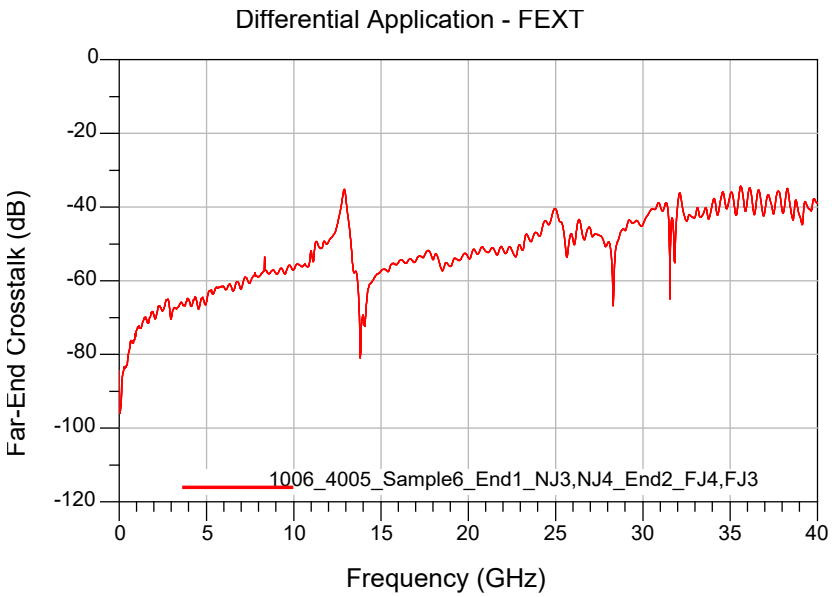

Figure 8

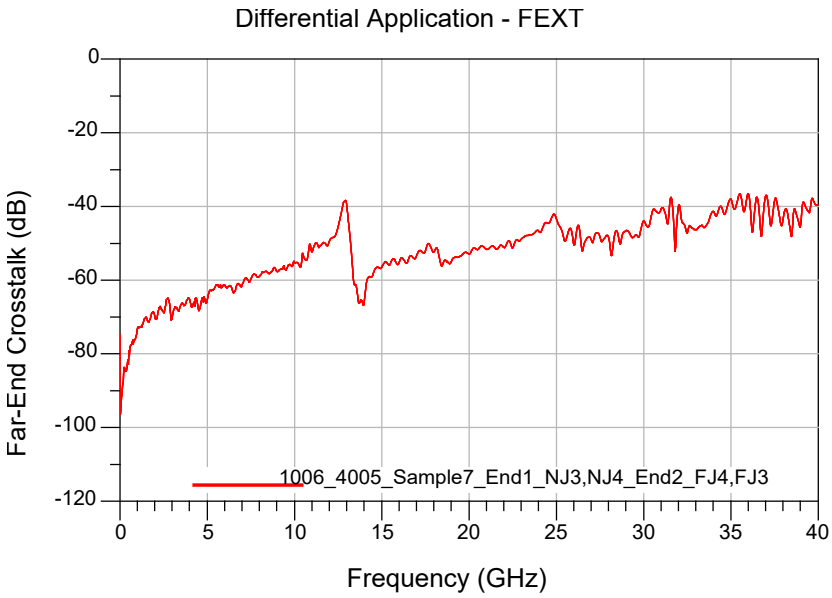

Figure 9

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

Differential Application – Differential to Common Mode Conversion

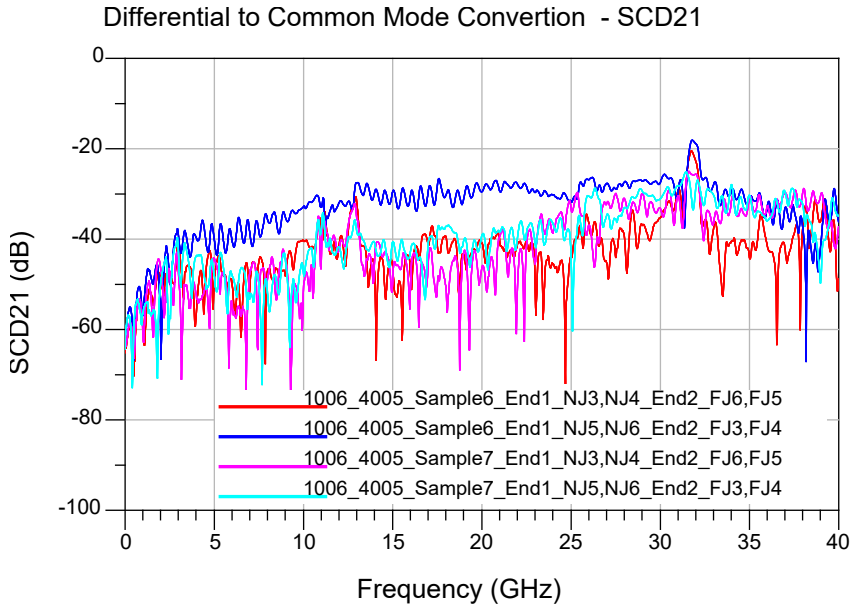

Figure 10

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

Appendix B – Time Domain Responses

Differential Application – Input Pulse

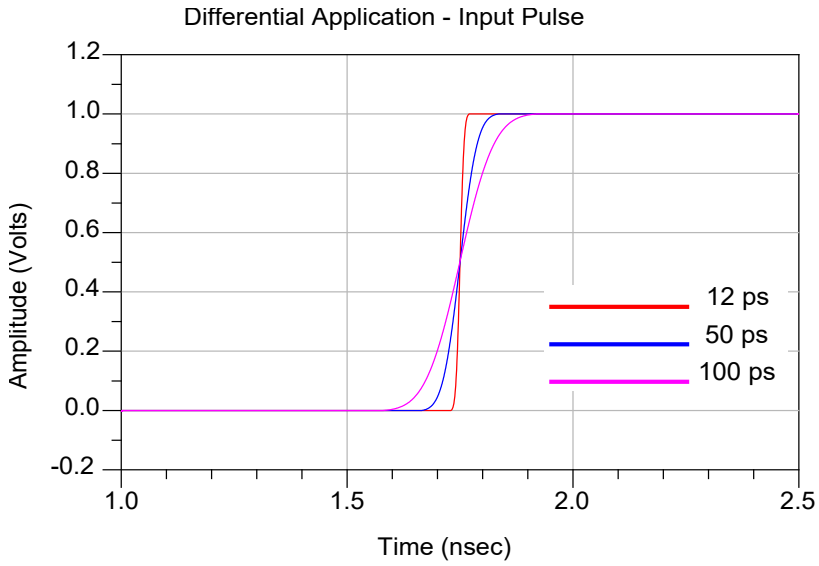

Figure 11

Differential Application – Cable assembly Impedance

ARM6-02-08.0-LU-LU-4-1

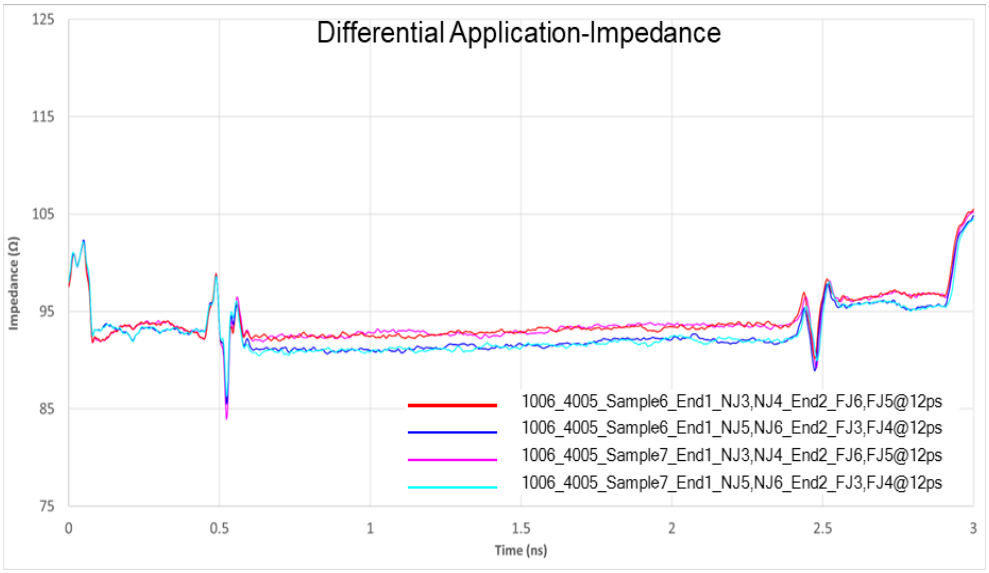

Figure 12

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

Differential Application – Cable assembly Impedance

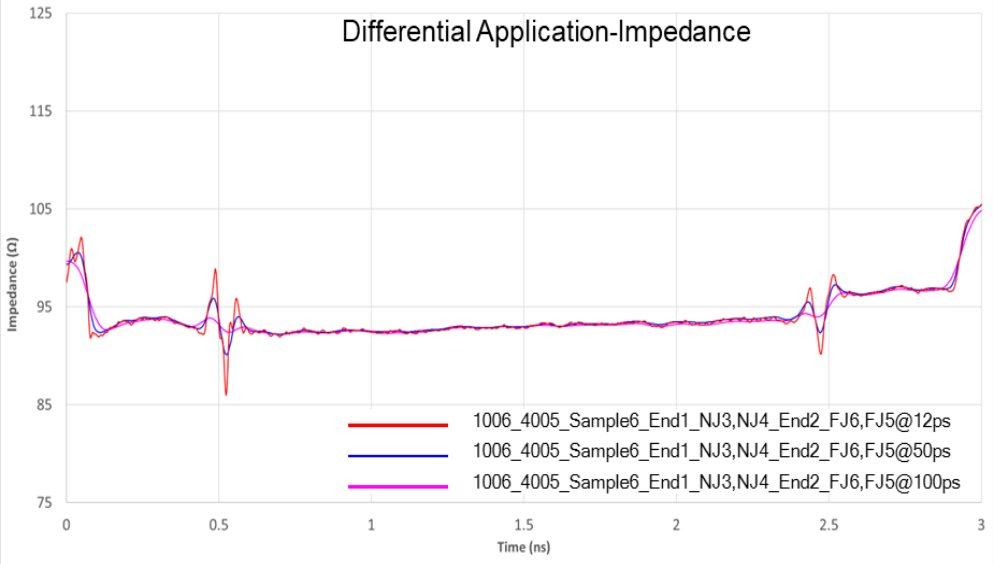

Figure 13

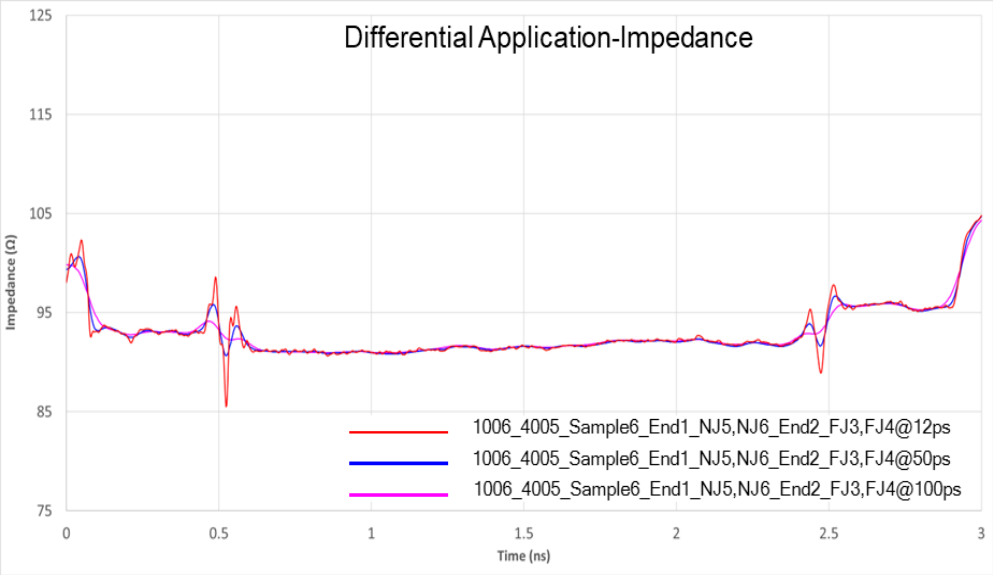

Figure 14

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

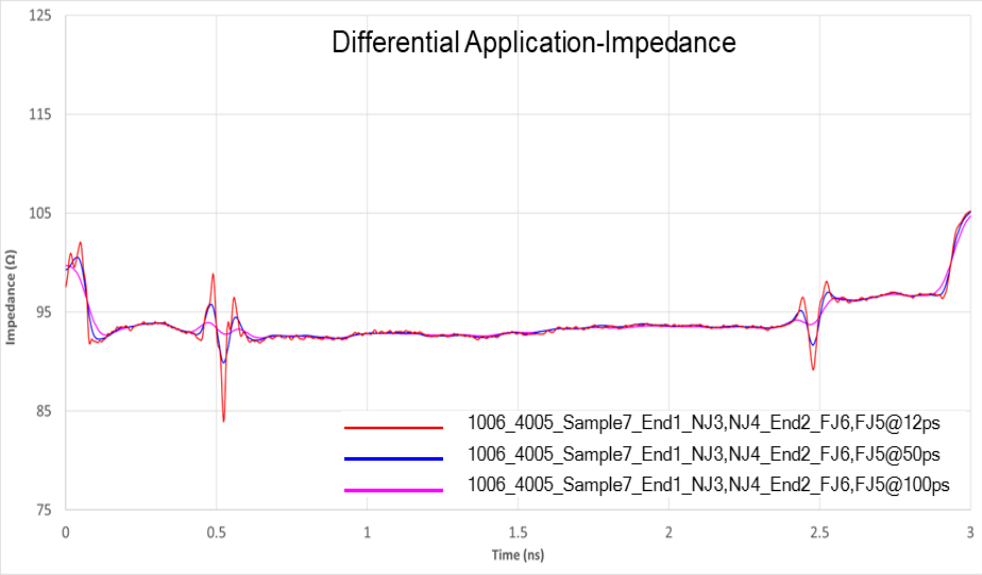

Figure 15

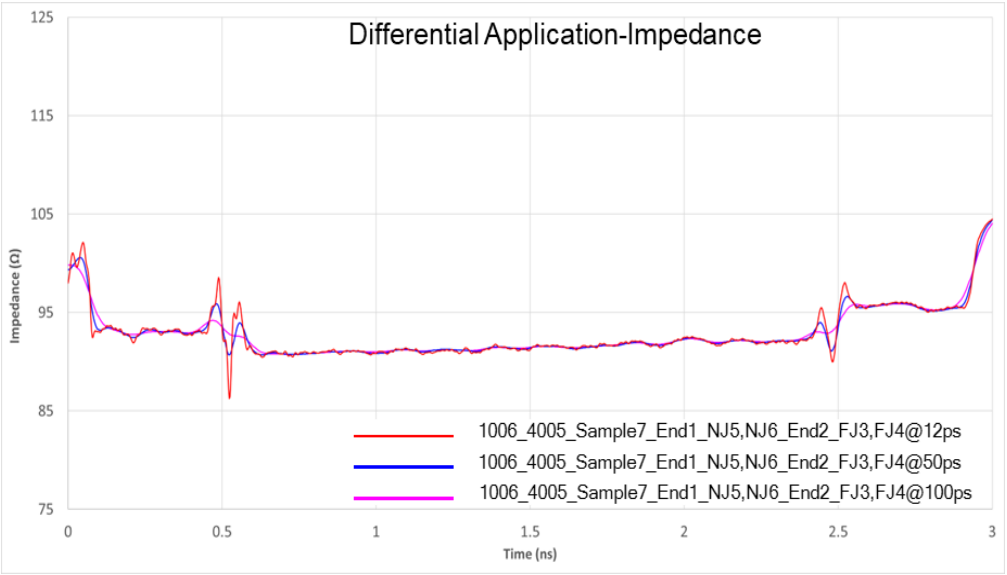

Figure 16

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

Differential Application – Propagation Delay

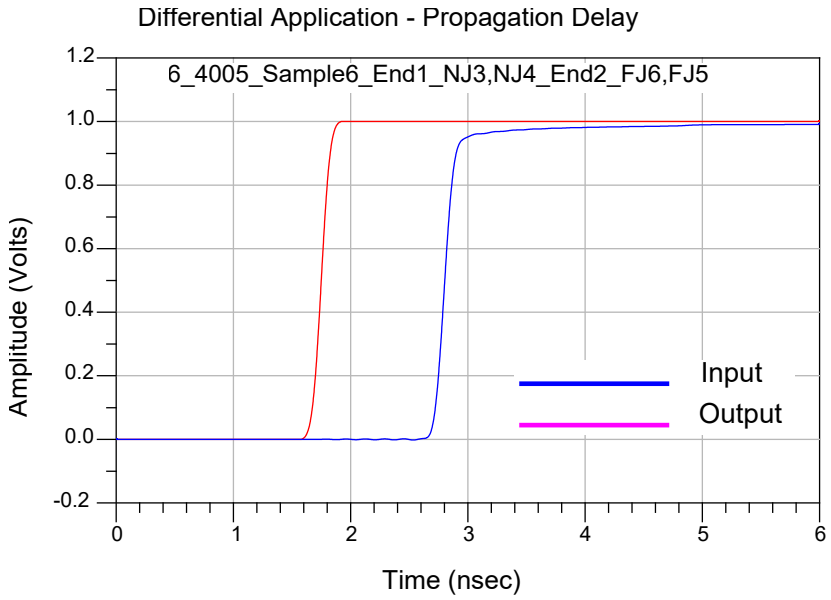

Figure 17

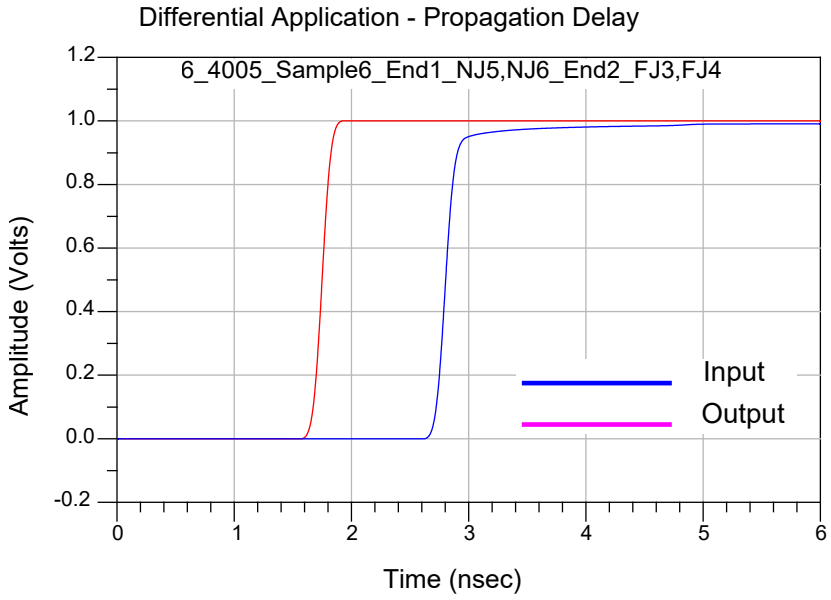

Figure 18

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

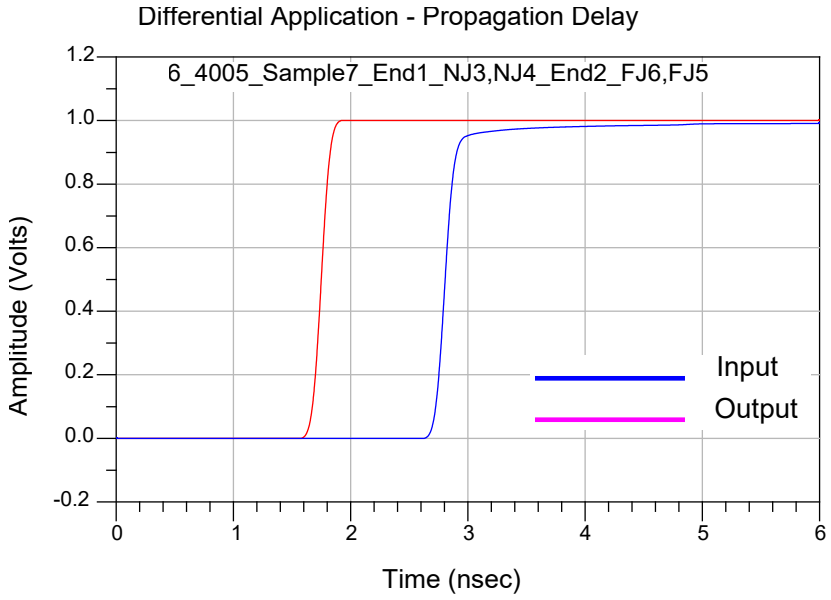

Figure 19

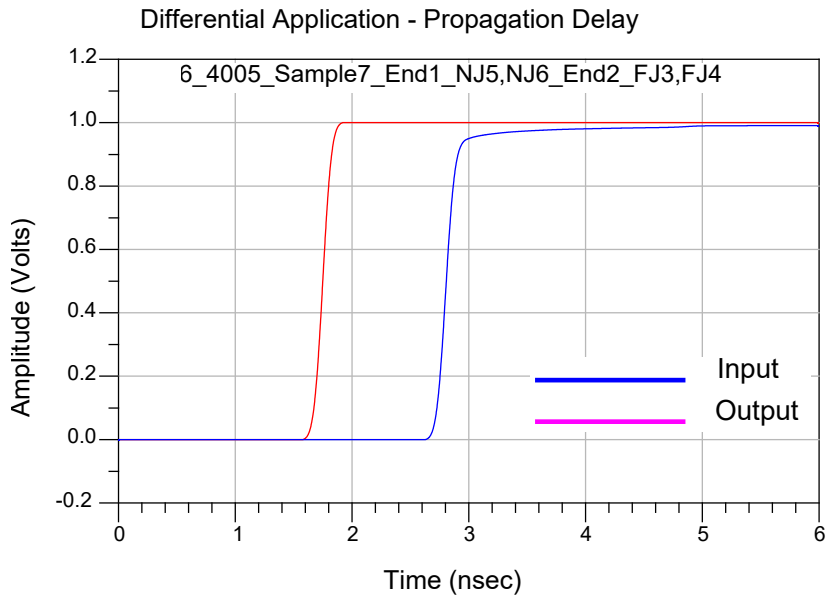

Figure 20

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

Appendix C – Product and Test System Descriptions

Product Description

Product test samples are 0.635 mm (.025") ARM6 AcceleRate® Mini Form Factor Cable Assemblies. The part number tested is ARM6-02-08.0-LU-LU-4-1. This mates with AMF6-02-S-RA. 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. There are a total of 2 pairs per row, the signal line numbers are shown in Table 2.

J1	1	2	3	4	5	6	7	8
NAME	GND	PAIR		GND	GND	PAIR		GND
J2	8	7	6	5	4	3	2	1

Table 2：Signal line numbers

Test System Description

The test fixtures are composed of Fourteen-layer TACHYON 100G material with 92.5Ω differential signal trace and pad configurations designed for the electrical characterization of Samtec high speed cable assembly products. A PCB mount 1.85mm connector is used to interface the PNA test cables to the test fixtures. Optimization of the 1.85mm launch was performed using full wave simulation tools to minimize reflections. The test fixtures and calibration kit are specific to the ARM6 series connector set and identified by part number PCB-112543-SIG-01_REV01.

PCB-112543-SIG-01_REV01Test Fixtures

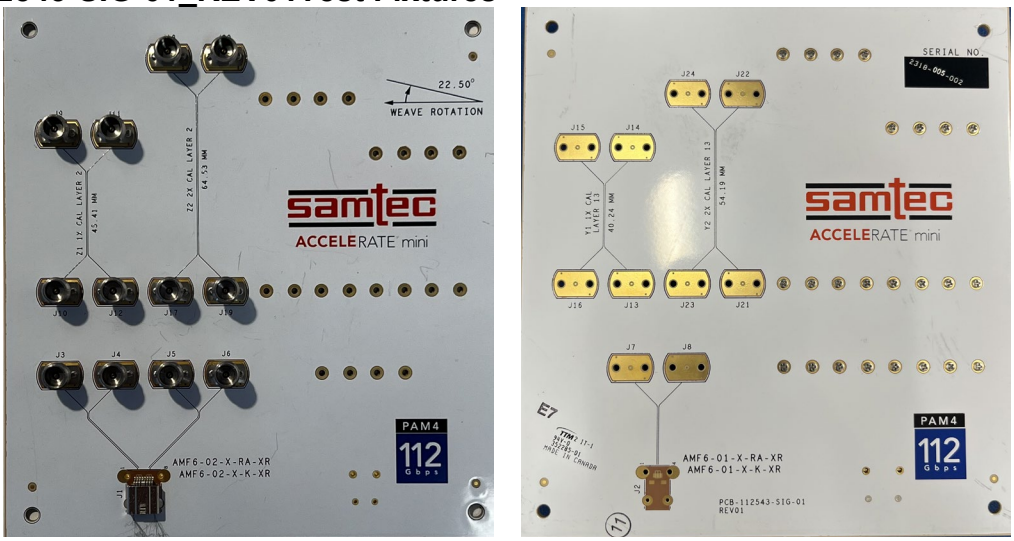

Figure 21

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

PCB Fixtures

The test fixtures used are as follows:

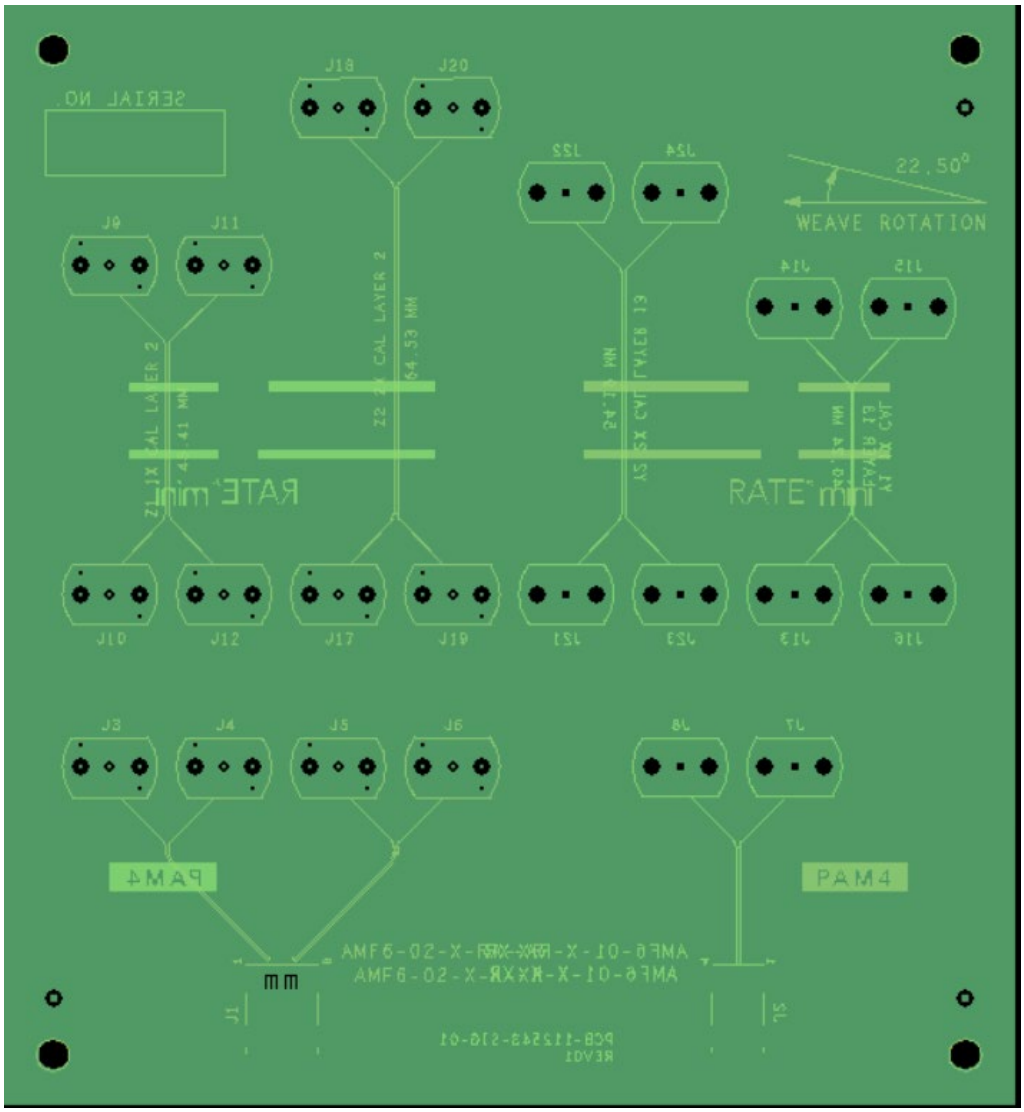

Figure 22

PCB-112543-SIG-01_REV01 – ARM6 Cable Test Board

Series: ARM6
Description: 0.635 mm AcceleRate® Mini Form Factor Cable Assembly, 2 Differential Pairs, 8-inch Length, Mated with Right-Angle AMF6

Appendix D – Test and Measurement Setup

For frequency domain measurements, the test instrument is the Agilent N5227B PNA-L network analyzer. Frequency domain data and graphs are extracted from the instrument by AFR application. The network analyzer is configured as follows:

Start Frequency – 10 MHz
Stop Frequency – 67 GHz
IFBW – 1 KHz

N5227B Measurement Setup

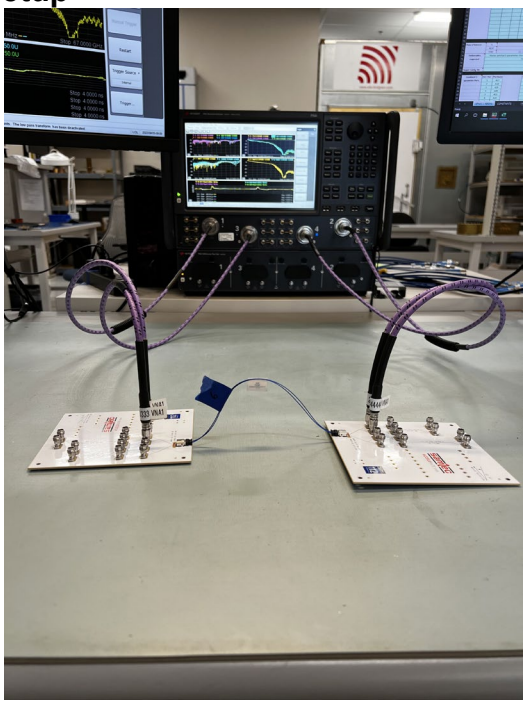

Figure 23

Test Instruments

QTY	Description
1	Agilent N5227B PNA-L Network Analyzer (10 MHz to 67 GHz)
1	Agilent 1.85mm 85058B

Test Cables & Adapters

QTY	Description
4	1 m Gore 1.85mm male to female cables

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For impedance measurements, the test instrument is the Keysight DCA-X86100D Wide-Bandwidth Oscilloscope Mainframe. The impedance data and profiles are obtained directly from the instrument. The Digital Analyzer is configured as follows:

Vertical Scale: 5 ohm / Div
Horizontal Resolution: 2.5ps
Averages: 128

DCA-X86100D Measurement Setup

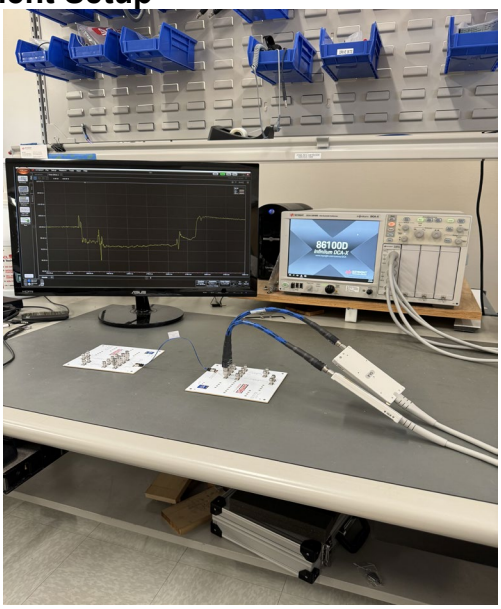

Figure 24

Test Instruments

QTY	Description
1	Keysight DCA-X86100D Wide-Bandwidth Oscilloscope Mainframe

Test Cables & Adapters

QTY	Description
4	Junkosha J12J104376-00

Series: ARM6
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Appendix E - Frequency and Time Domain Measurements

Frequency (S-Parameter) Domain Procedures

The quality of any data taken with a network analyzer is directly related to the quality of the calibration standards and the use of proper test procedures. For this reason, extreme care is taken in the design of the calibration standards, the SI test boards, and the selection of the PCB vendor.

A coaxial SOLT calibration is performed using Agilent 1.85mm 85058B. Then DUT measurements are performed under SOLT calibration. The measurements include the effect of test fixture. The measurements of the 2X THRU line standards are required to remove the test fixture effect.

Time Domain Procedures

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

The Time Domain responses were generated using Keysight ADS 2022 update 1. 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://suddendocs.samtec.com/notesandwhitepapers/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 figure.
The difference in time, measured at the 50% point of the step voltage is the propagation delay.

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Impedance (TDR)

Measurements involving digital pulses are performed using either Time Domain Reflectometer (TDR) or Time Domain Transmission (TDT) methods. The TDR method is used for the impedance measurements in this report.

The signal line(s) of the SUT's is energized with a TDR pulse and the far-end of the energized signal line is terminated in the test systems characteristic impedance (e.g., 50Ω or 100Ω terminations). By terminating the adjacent signal lines in the test systems characteristic impedance, the effects on the resultant impedance shape of the waveform are limited.

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Appendix F – Glossary of Terms

ADS – Keysight Advanced Design System
AFR – Automatic Fixture Removal
PCB – Printed Circuit Board
SUT – System Under Test
SOLT – acronym used to define Short, Open, Load & Thru Calibration Standards
TDR – Time Domain Reflectometry
TDT – Time Domain Transmission