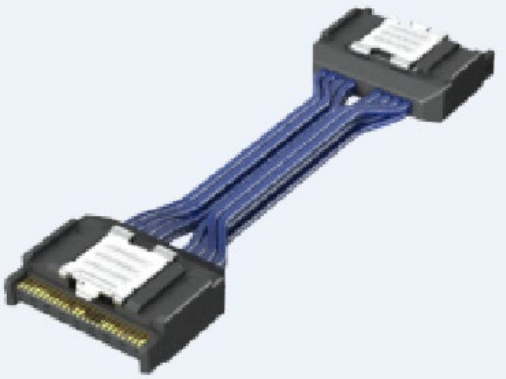
High Speed Characterization Report

AcceleRate™ ARX6 Cable System
In Situ USCAR2-6 Shock and Vibe

ARC6-16-XX.XX-LU-LD-2-1



Mated with:

ARF6-16-L-RA-TR

Description:
AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

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Report Revision: 2/8/2021

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

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Cable Assembly Overview

The 0.635 mm (.025") ARC6 Slim Body Cable Assembly is constructed using 34 AWG, 100 Ω Eye Speed® ultra-low skew twinax cable. The cable is terminated at both ends with connector on a printed circuit board. The cable assembly is wired to facilitate a Pin 1 to Pin 2 mapping between the cable terminations. The ARC6 series cable assemblies are available in 8 and 16 pairs per row. The data in this report is only applicable to 500 mm length cable assembly.

Each ARC6 cable assembly was tested by mating it to ARF6 socket at both ends. Mechanical Shock and Vibration should be done follow the steps shown in Figure 1. Five samples were tested, the actual part number is shown in Table 1, which also identifies End 1 and End 2 of each assembly. A relative sample picture is shown in Figure2.

Step	Description
1.	Visual Inspection *Note: Per USCAR-2 Section 5.1.8*
2.	Cycles Quantity = 10 Cycles
3.	Mechanical Shock (1) - Non Standard Shocks per Axis = 10 Wave Shape = Half Sine Direction = Positive Duration = 5-10 ms Acceleration = 35 g *Note: Shock and Vibe will be done back to back for each axis*
4.	Random Vibration (2) - Non Standard Frequency (Hz) = PSD (g^2/Hz) 5.0 = 0.00200 12.5 = 0.24800 77.5 = 0.00320 145.0 = 0.00200 200.0 = 0.01180 230.0 = 0.00032 1000.0 = 0.00002 Duration = 8 hrs/axis *Note: Shock and Vibe will be done back to back for each axis*
5.	Visual Inspection *Note: Per USCAR-2 Section 5.1.8*

Figure 1: Mechanical Shock and Vibration Description

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Length	Part Number	End 1	End 2
500 mm	ARC6-16-19.69-LU-LD-2-1	LU	LD

Table 1: Sample Description

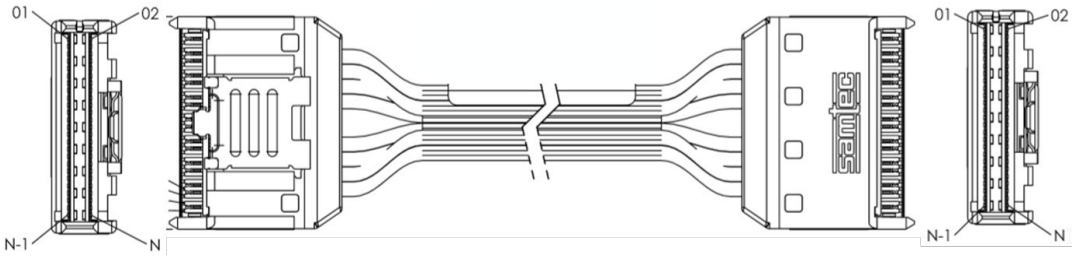

Figure 2: Test Sample

Frequency Domain Data Summary

Back-2-Back Pig-Tail cable reference measurements

- Pig-Tail cables properly tied up, leaving a short piece of loose cable before the DUT.
  - This will improve the variation of the DUT cable.
  - Length of free ranging pig-tail : X/Y ~ 7”, Z ~ 10” or 42% longer.
- Pig-Tail back-2-back expected variations as we started with the test, on the X/Y direction (please note the Z is different).
- Even with short loose pigtail we’ve seen an IL variation due to it. In order to understand it, the PIG_TAIL cables were connected back to back in a configuration very close to the DUT configuration and they were measured quiet and after approximately 6.5 hours while vibrating.
- The Differential IL variation of the pig-tail cable alone was computed as shown in the picture below.
- From there a fourth polynomial fitted curve was created to represent the approximate variation of the pig-tail over the course of each axis vibe test.
- Finally, we did a test to see how quickly the PIG-TAIL cable goes back to its initial state. We learned it comes back almost immediately.
- Insertion Loss Deviation (ILD) will be presented in two ways:
  - The unmodified version (as measured on the VNA)
  - Corrected. In this version we subtract the approximate effect of the PIG-TAIL cable based on the smooth fitted curve.

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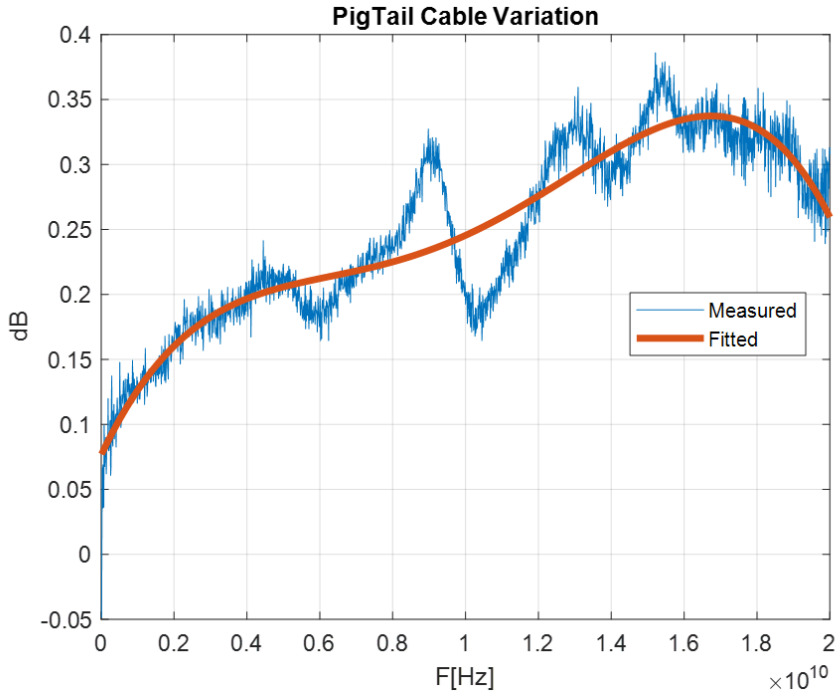

Figure 3

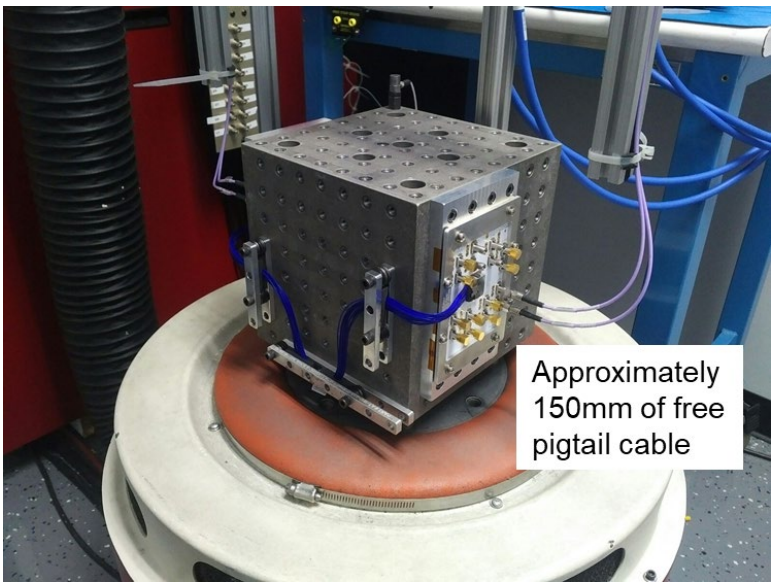

Figure 4

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Sample 1,2,3 measurement order: X axis → Y axis → Z axis
Sample 4,5 measurement order: Z axis → Y axis →X axis

Sample #1 (X-Axis)

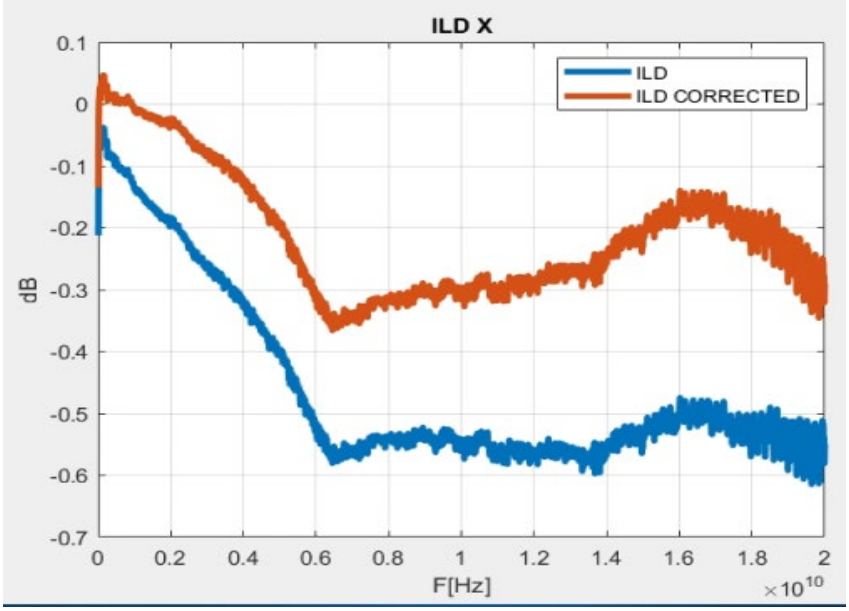
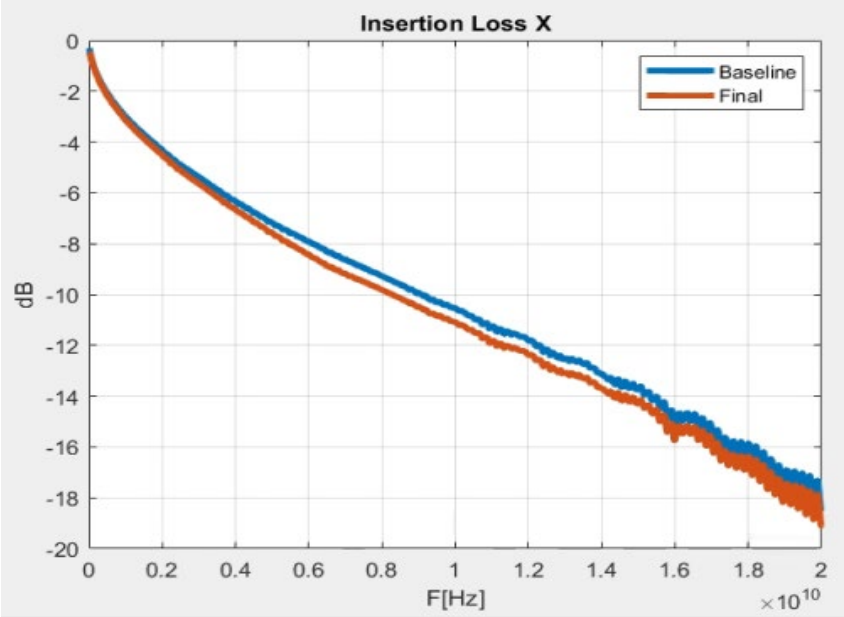


Figure 5



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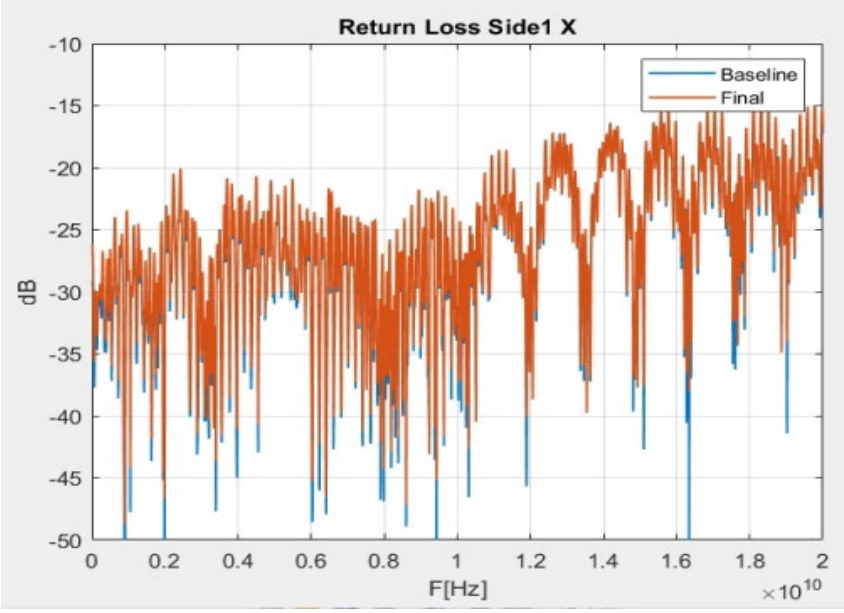

Figure 7

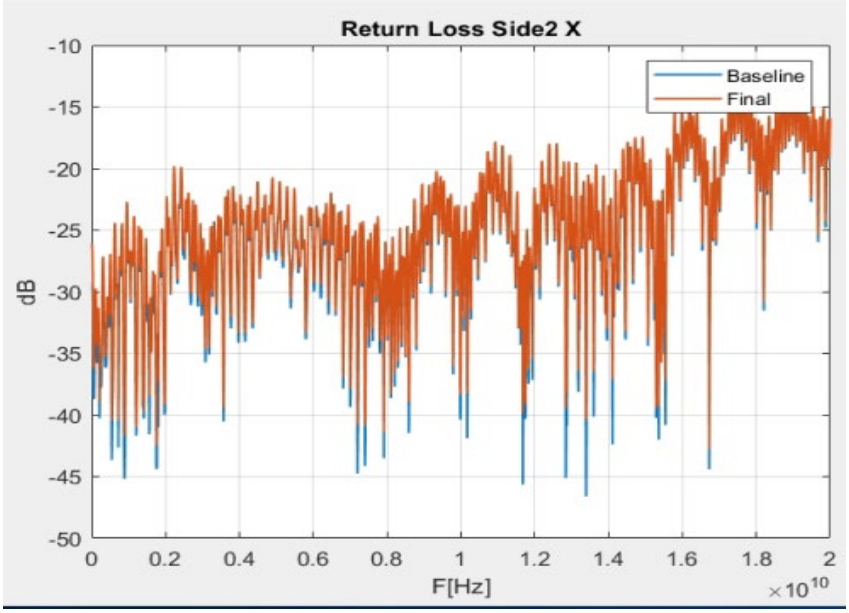

Figure 8

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Sample #1 (Y-Axis)

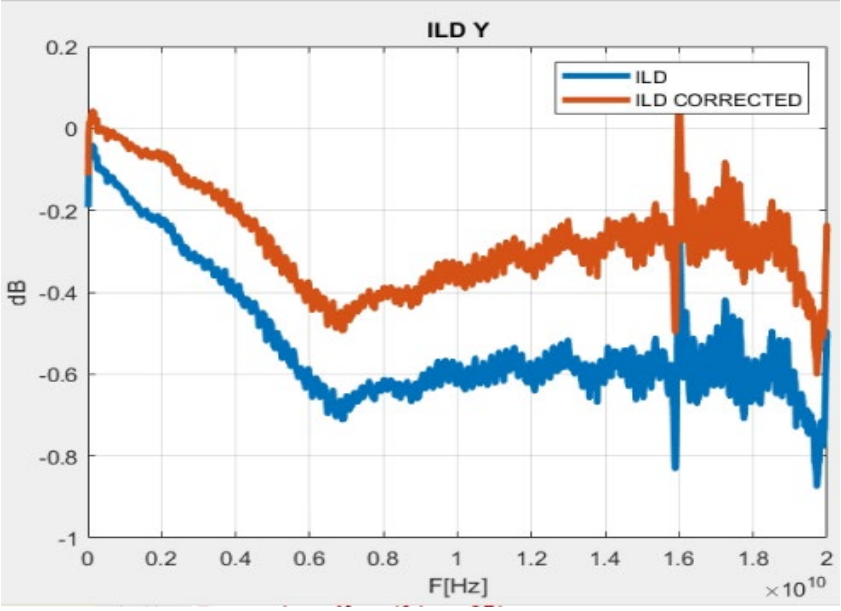
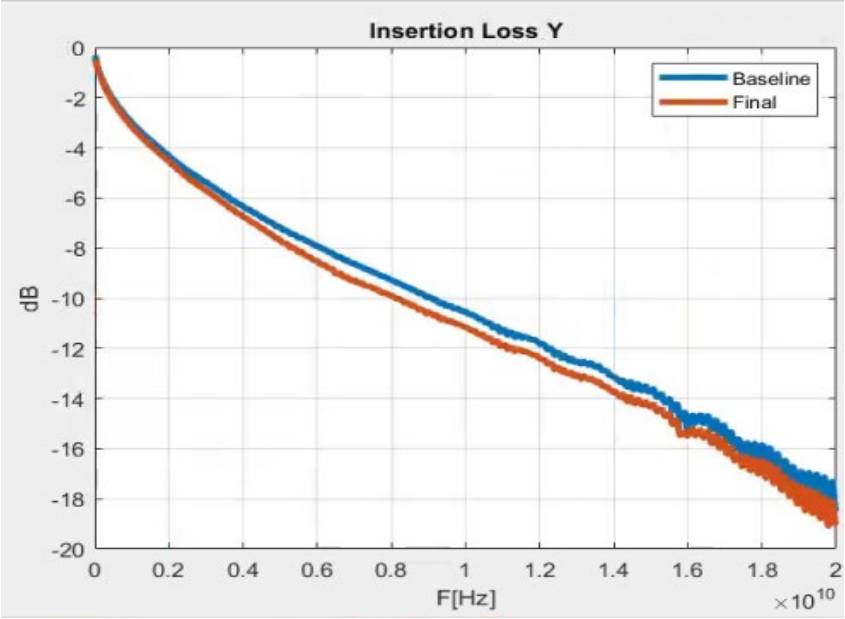


Figure 9



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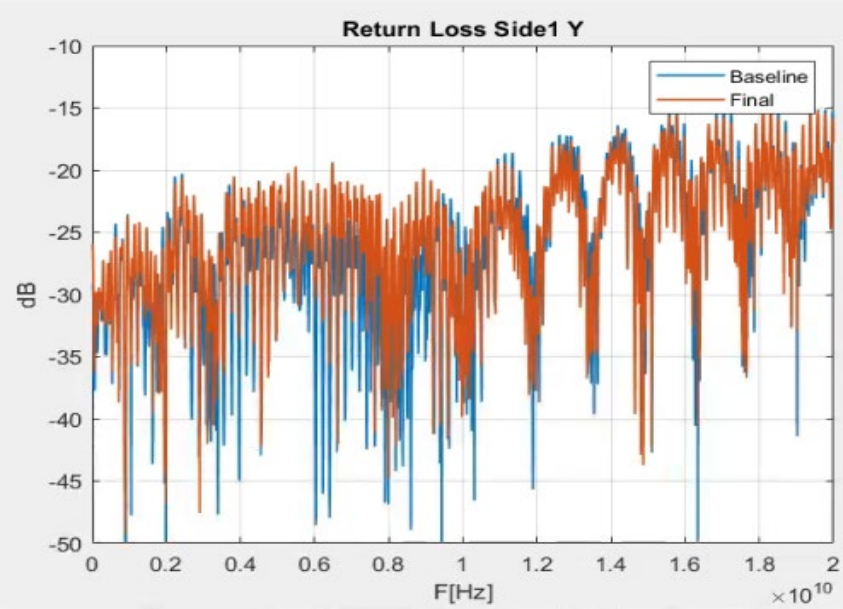

Figure 11

Figure 12

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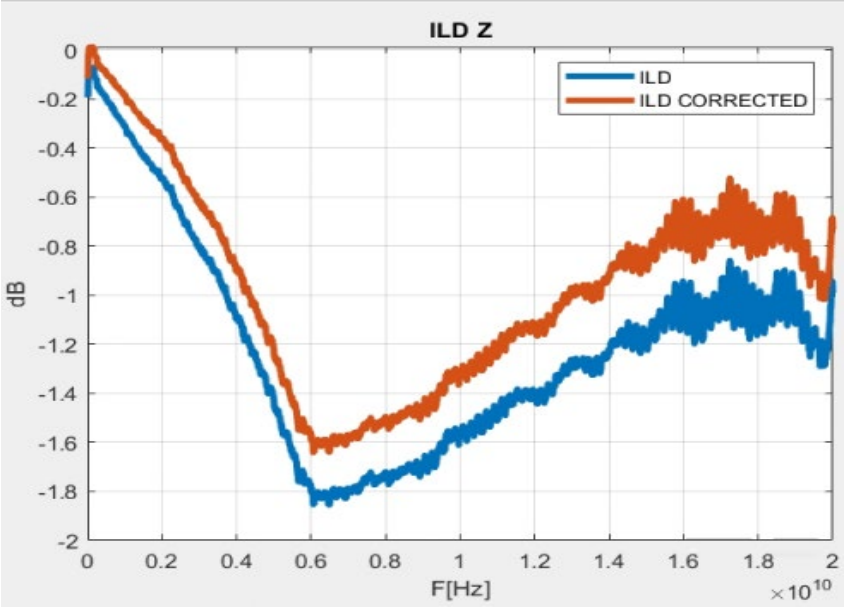
Sample #1 (Z-Axis)



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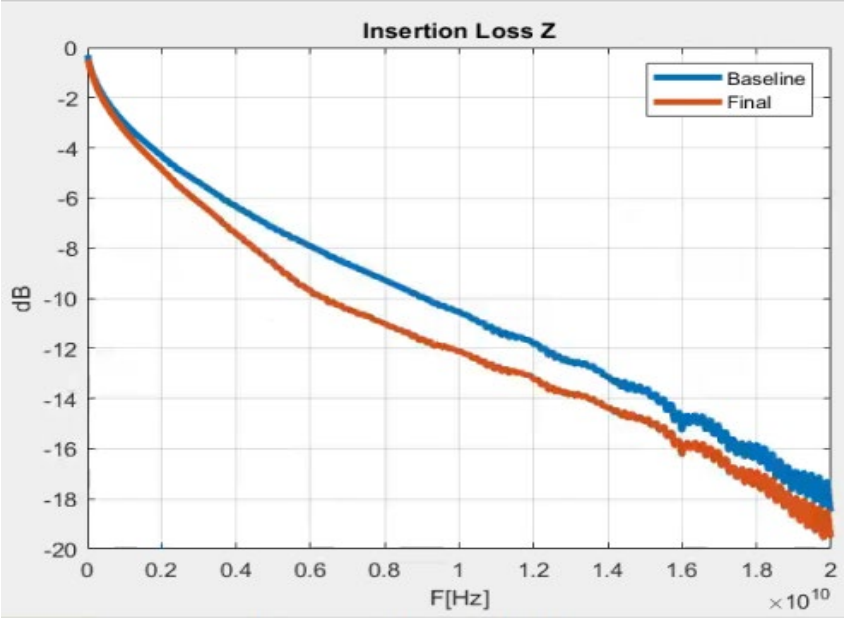

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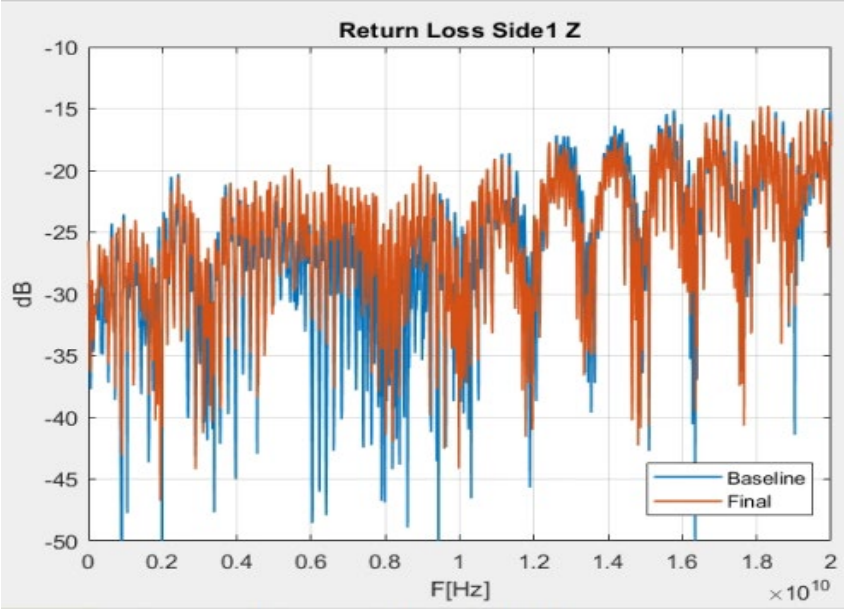

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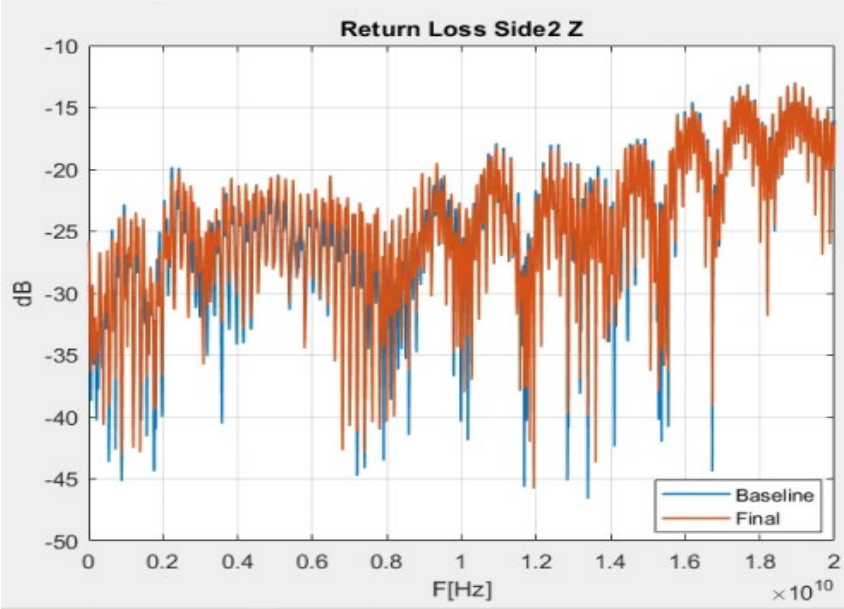

Figure 16

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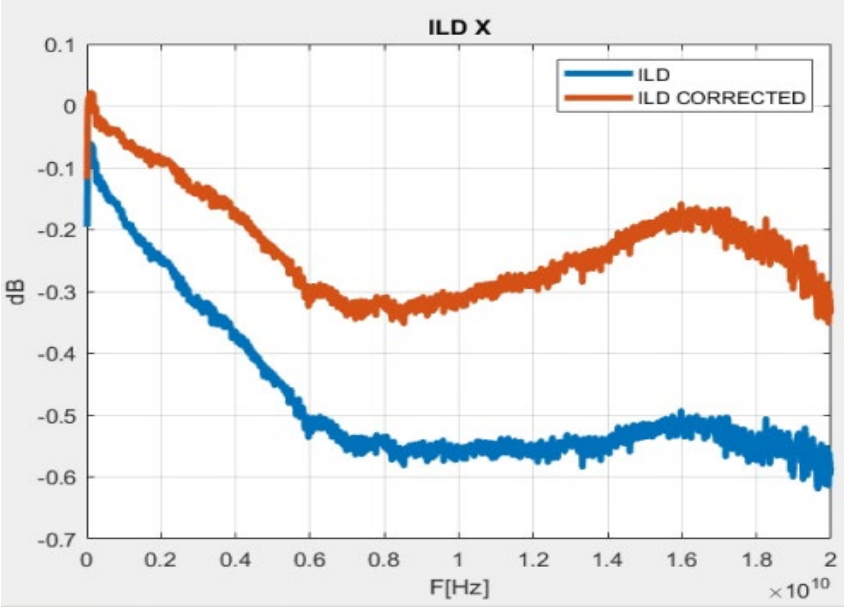
Sample #2 (X-Axis)



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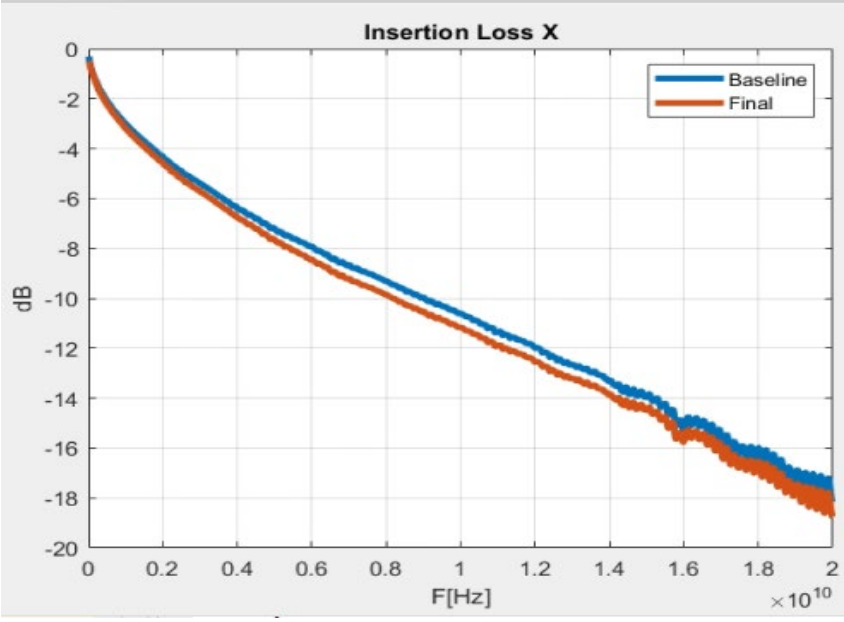

Figure 18

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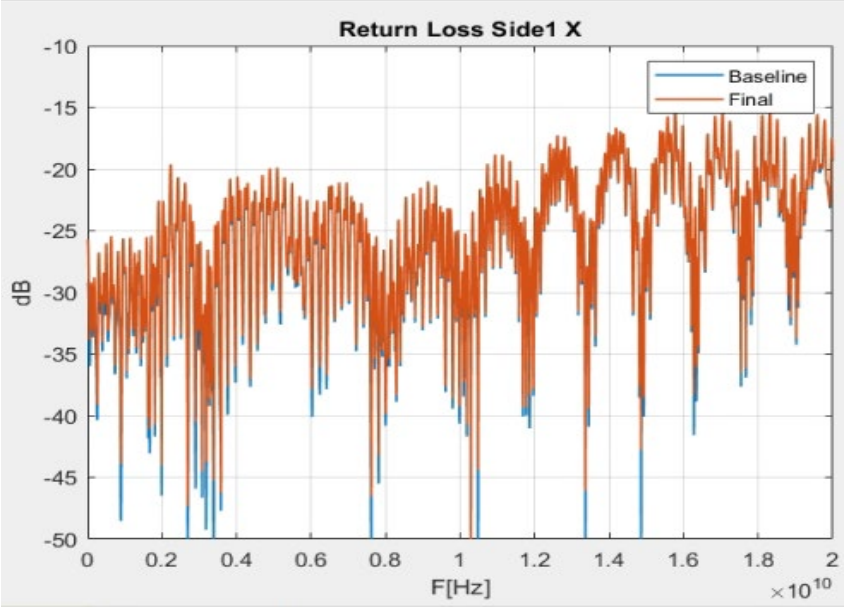

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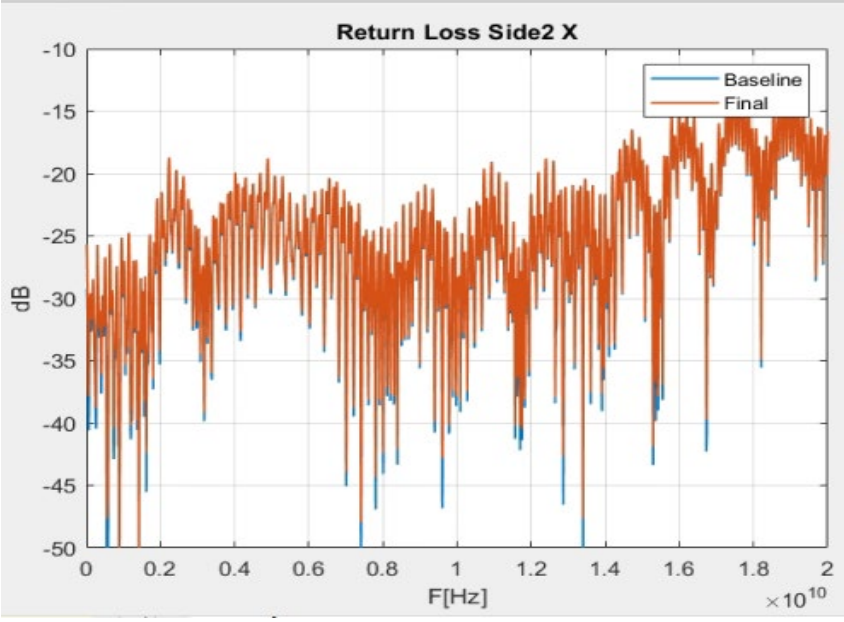

Figure 20

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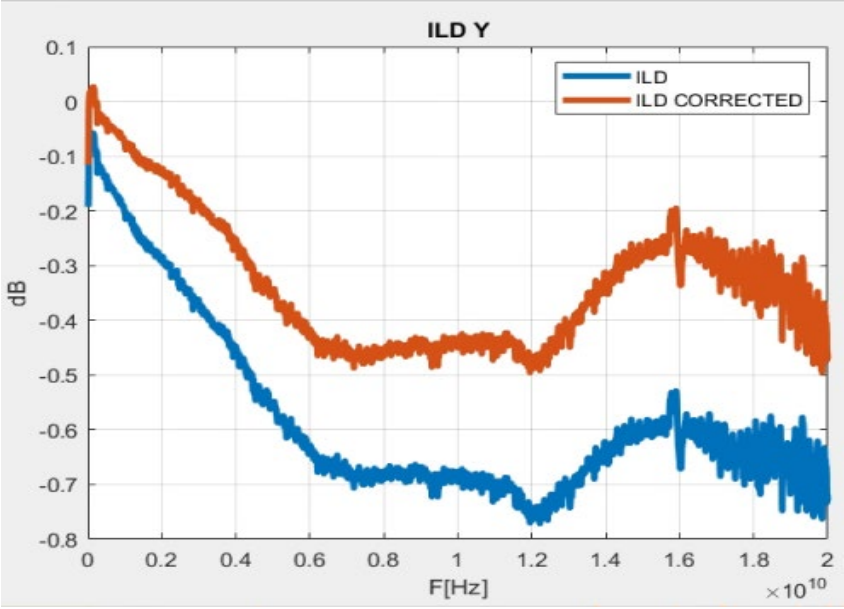
Sample #2 (Y-Axis)



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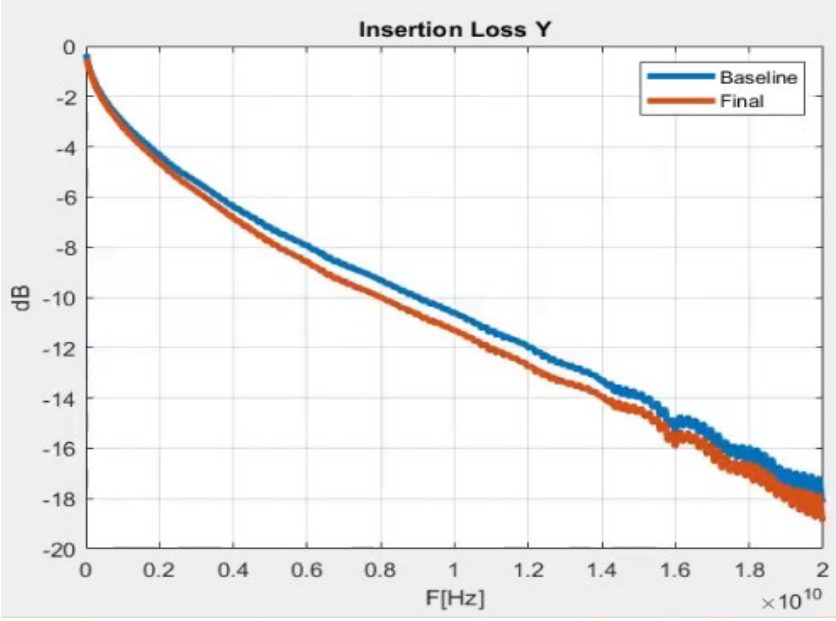

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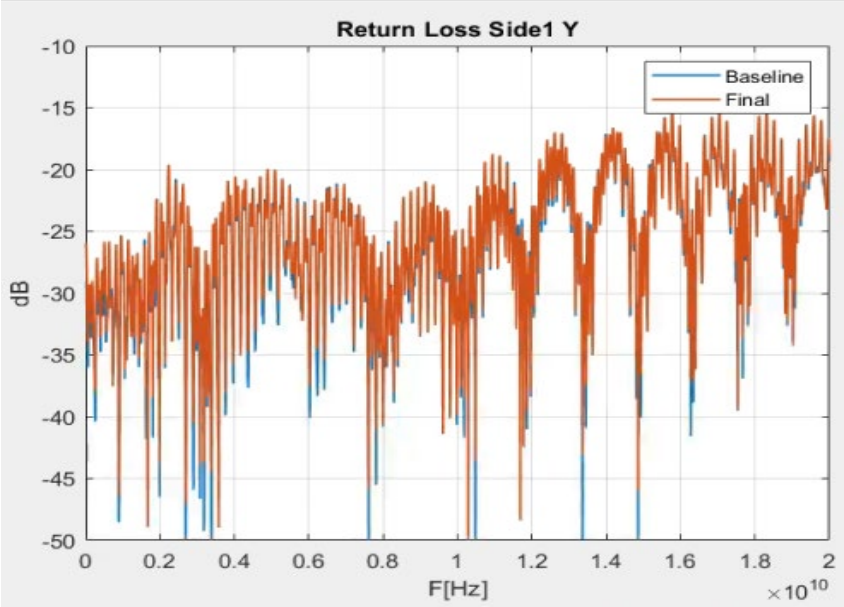

Figure 23

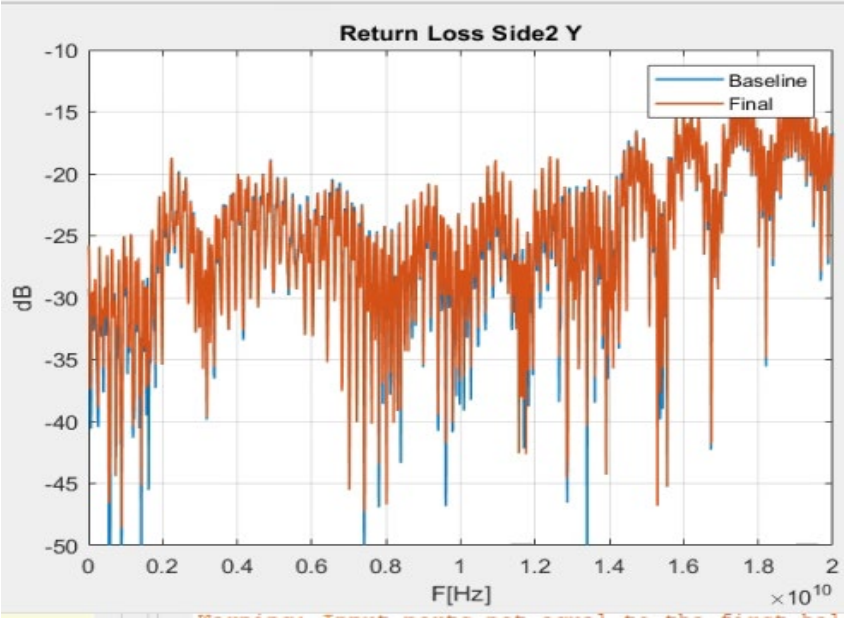

Figure 24

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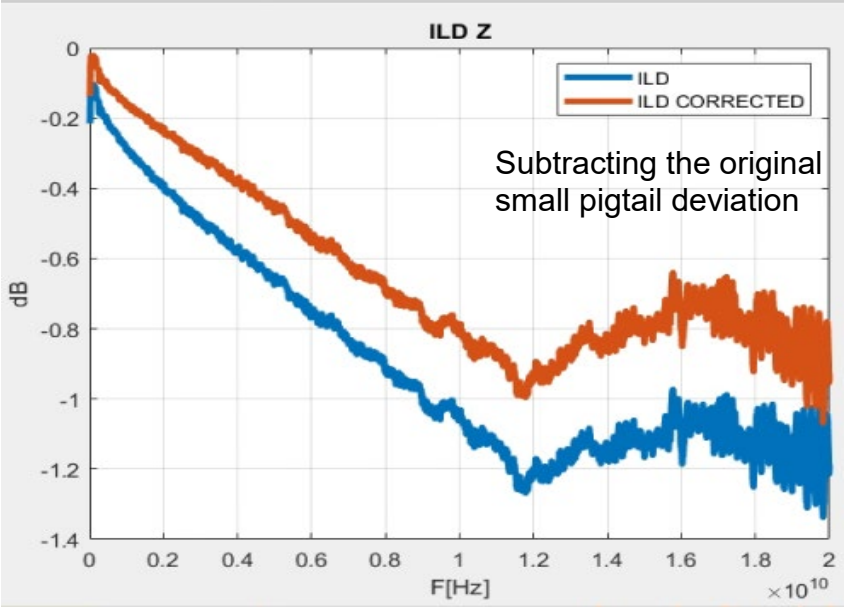
Sample #2 (Z-Axis)



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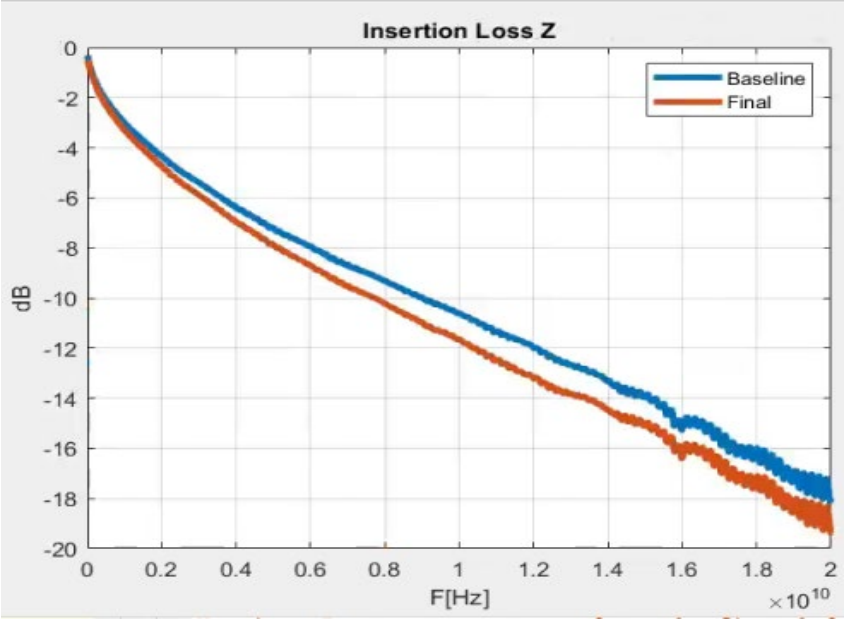

Figure 26

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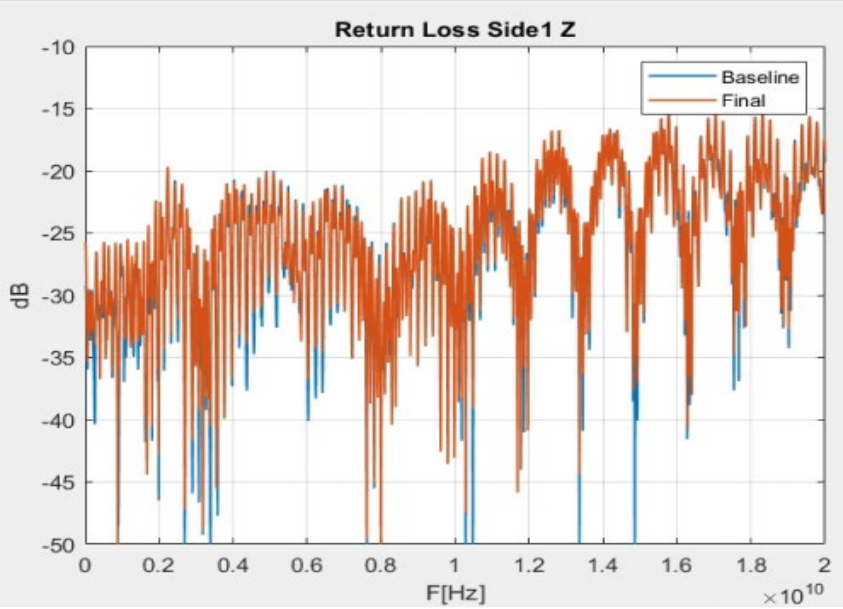

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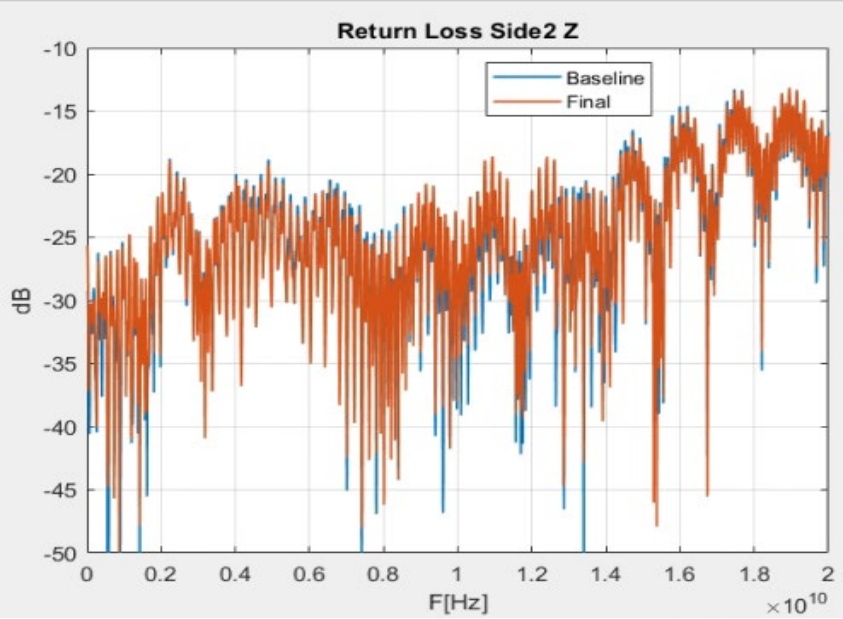

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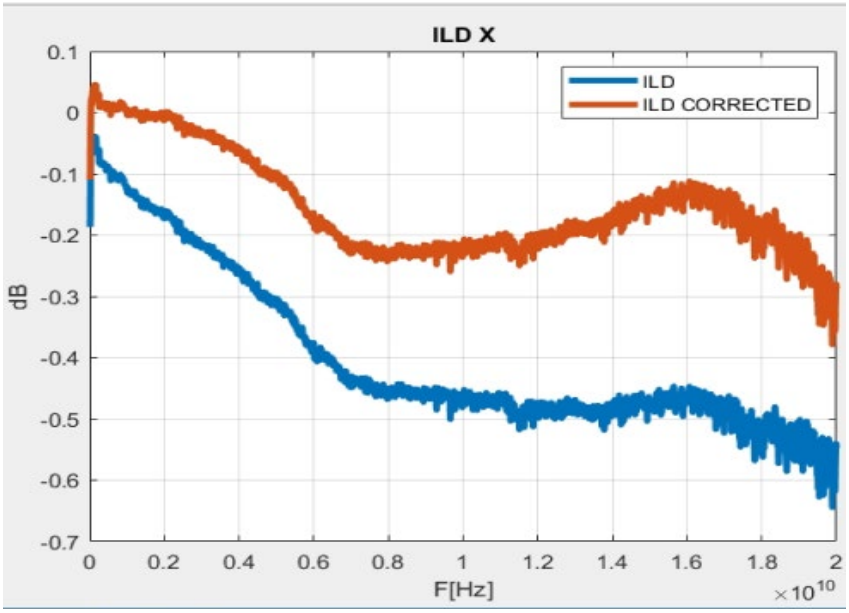
Sample #3 (X-Axis)



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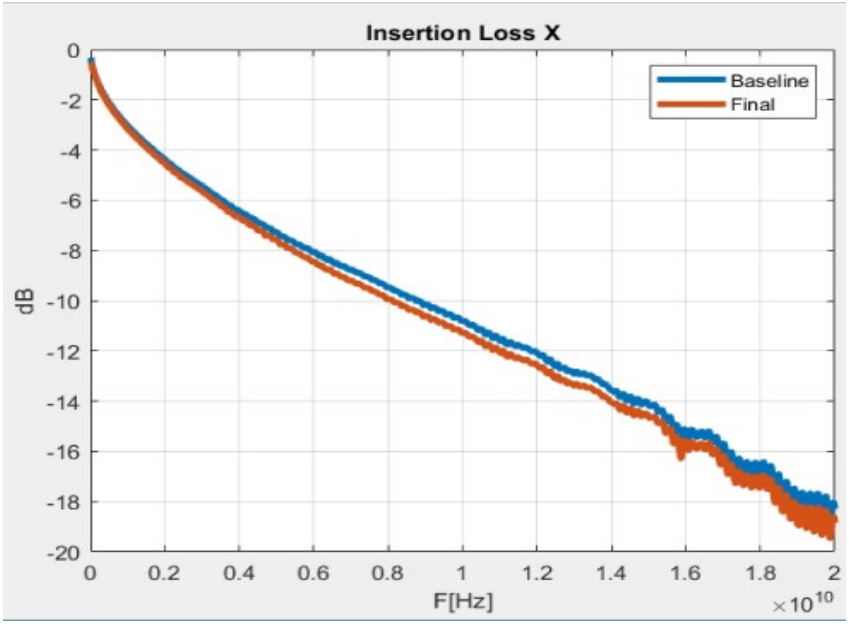

Figure 30

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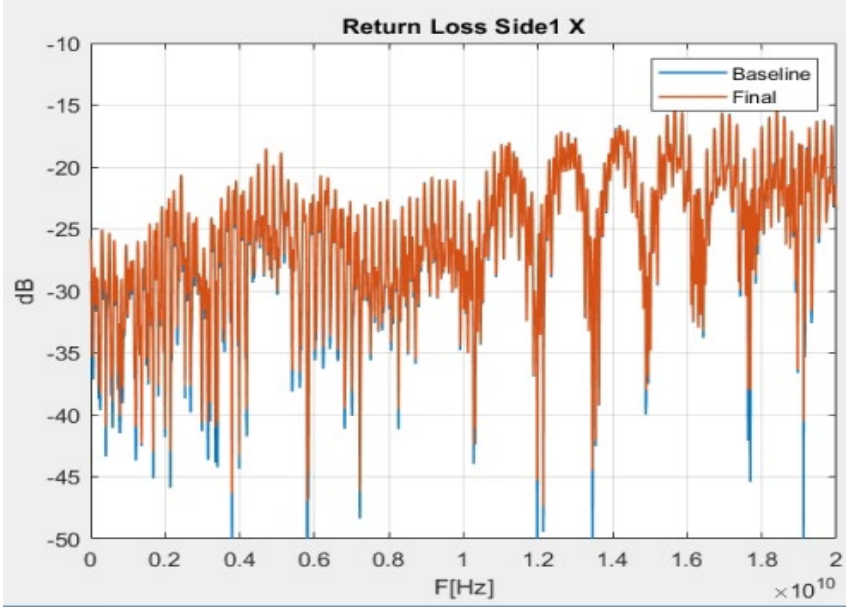

Figure 31

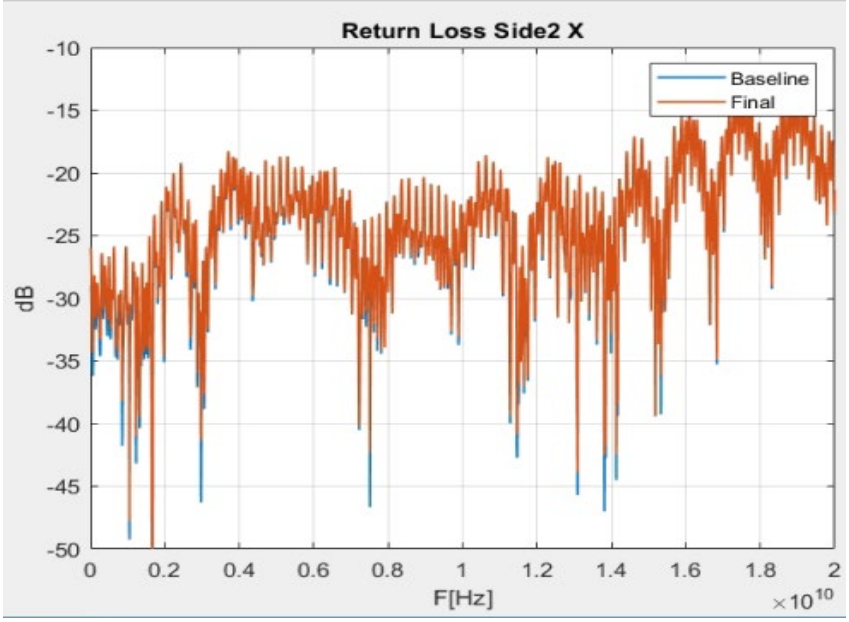

Figure 32

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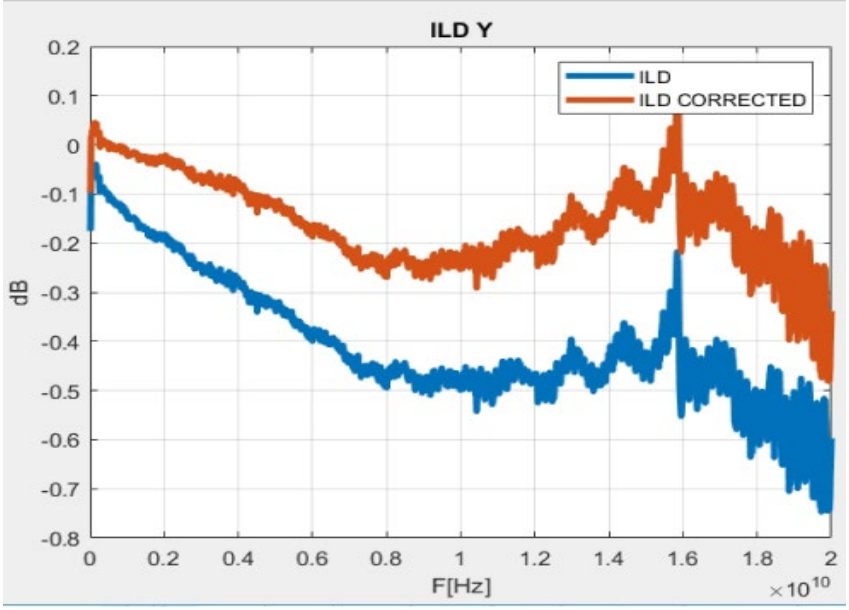
Sample #3 (Y-Axis)



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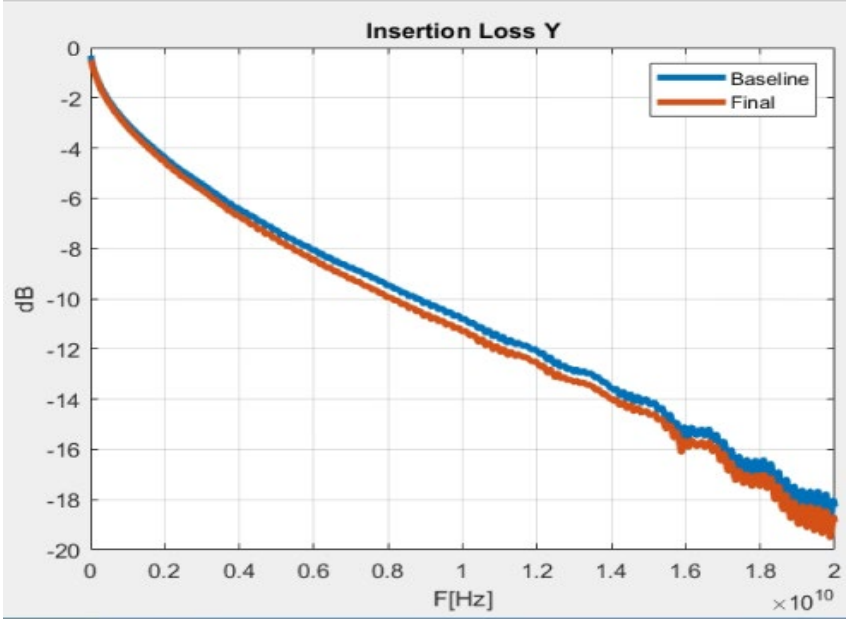

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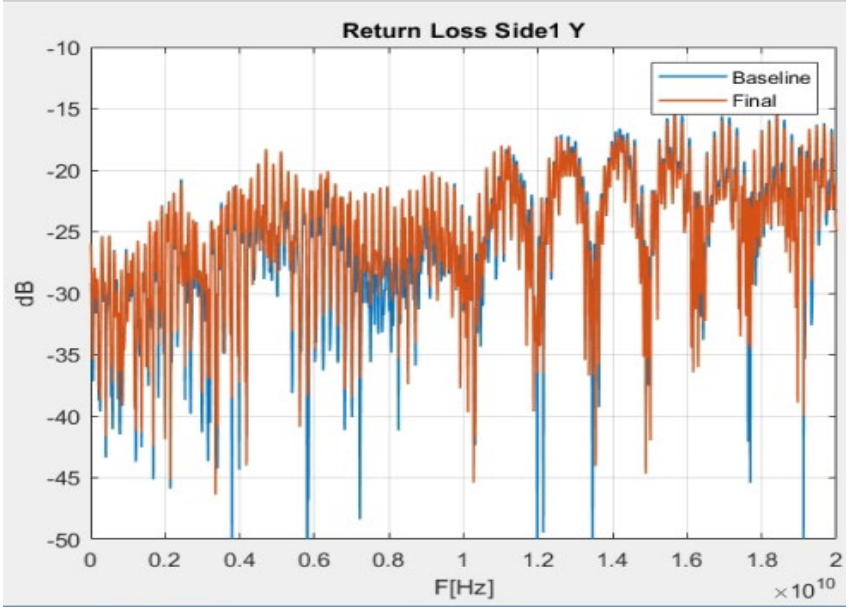

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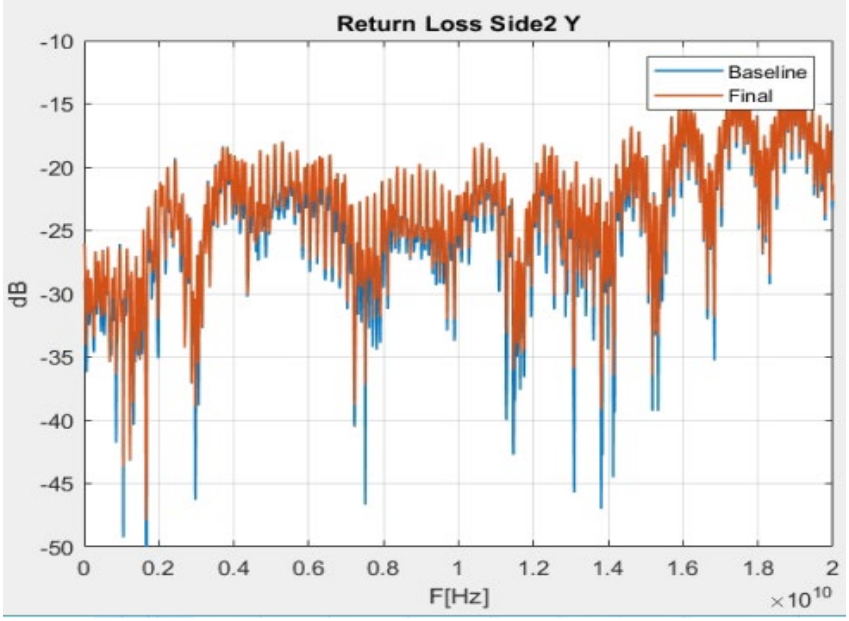

Figure 36

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Sample #3 (Z-Axis)

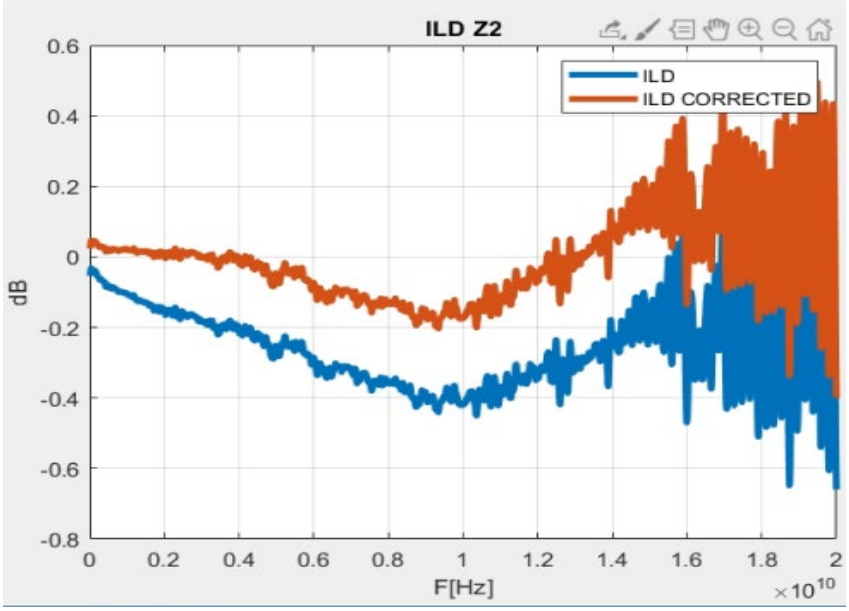
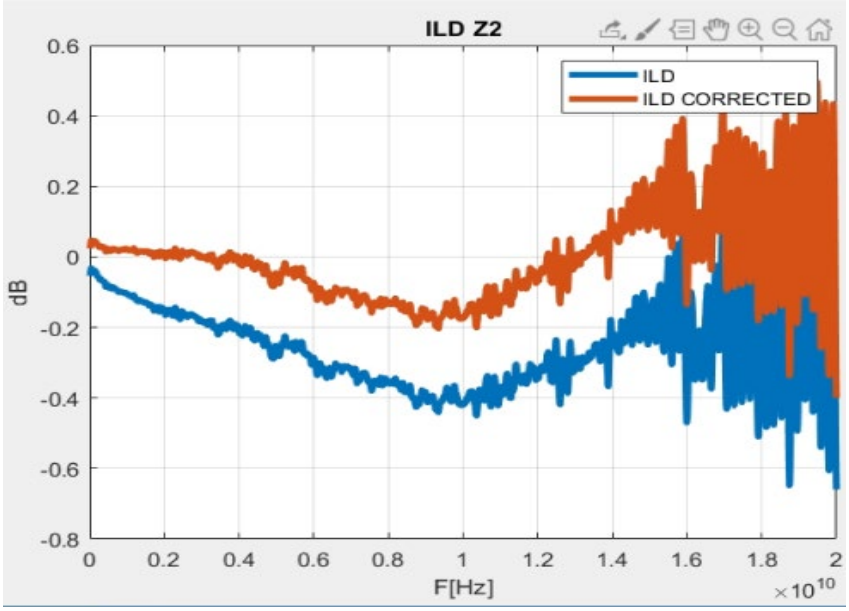


Figure 37



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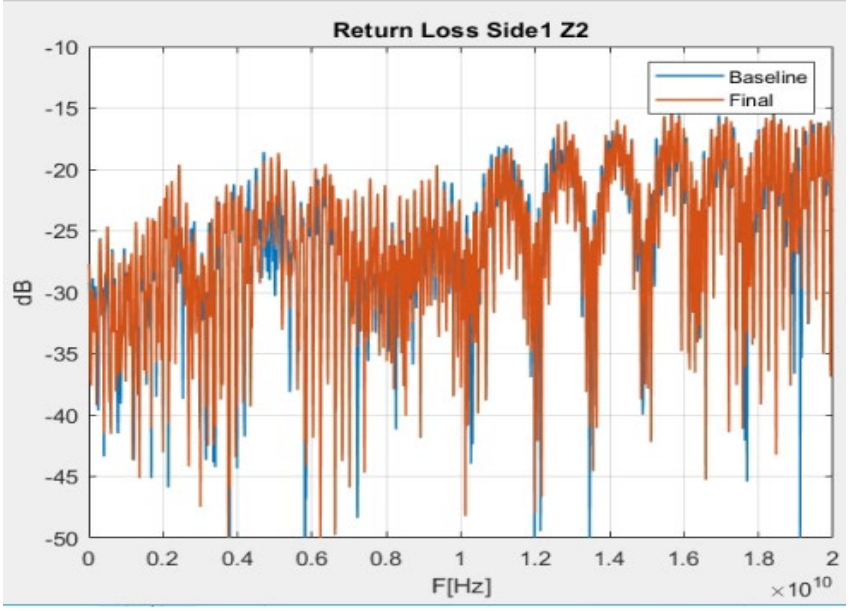

Figure 39

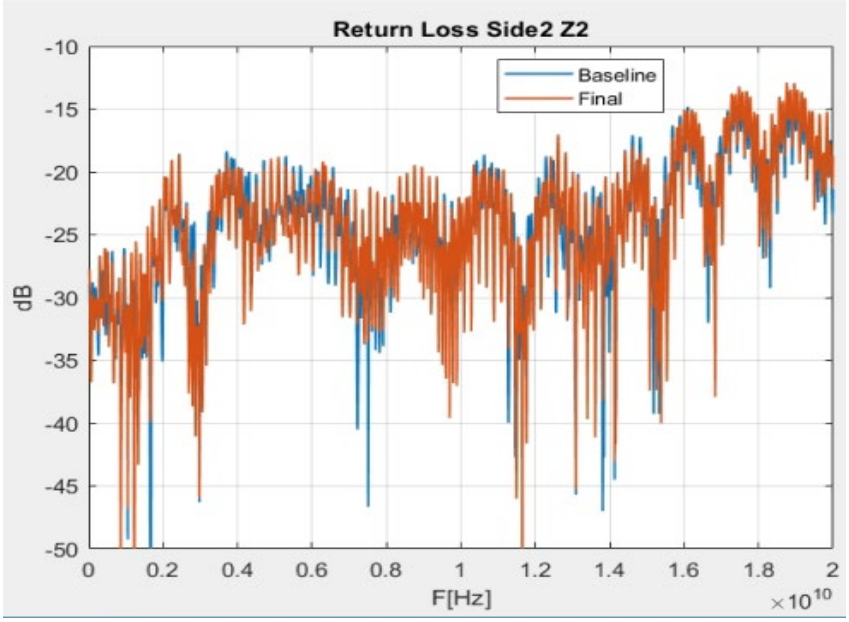

Figure 40

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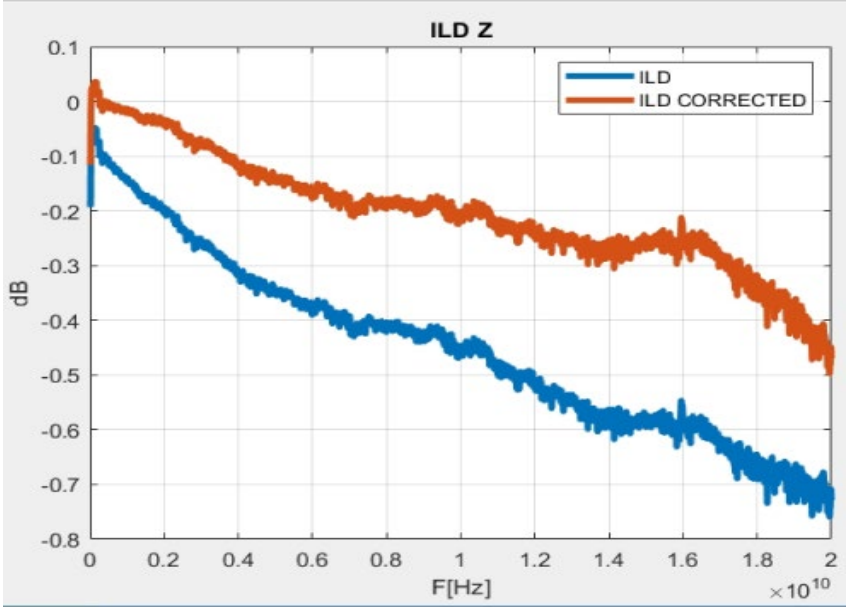
Sample #4 (Z-Axis)



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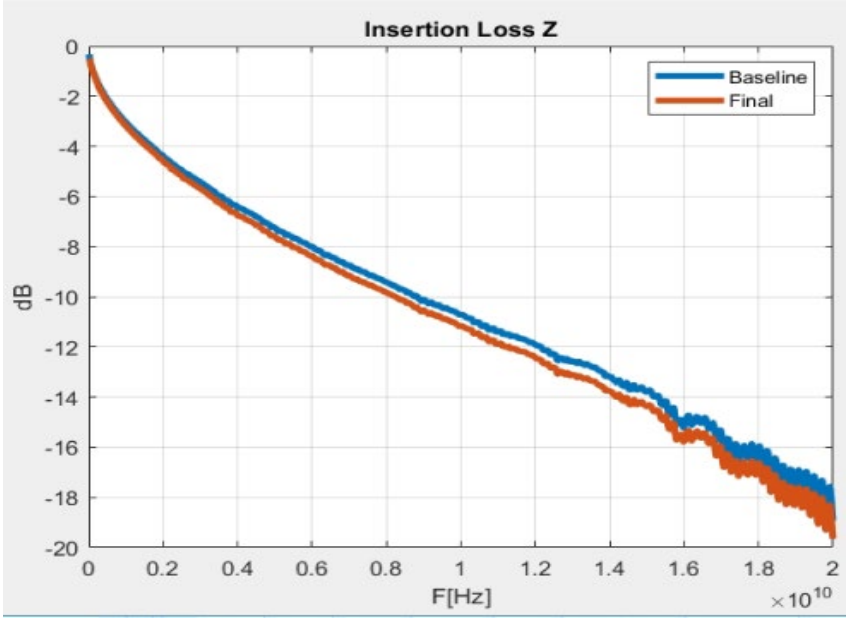

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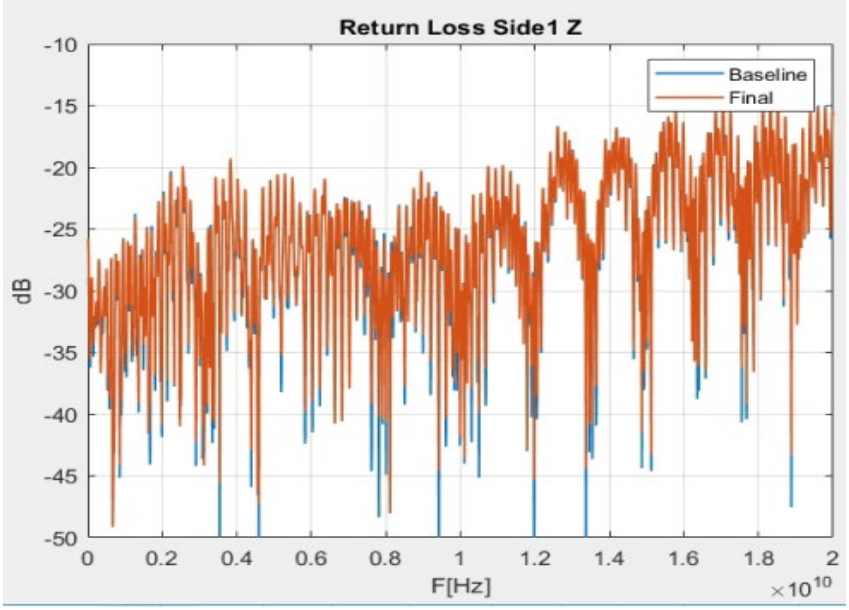

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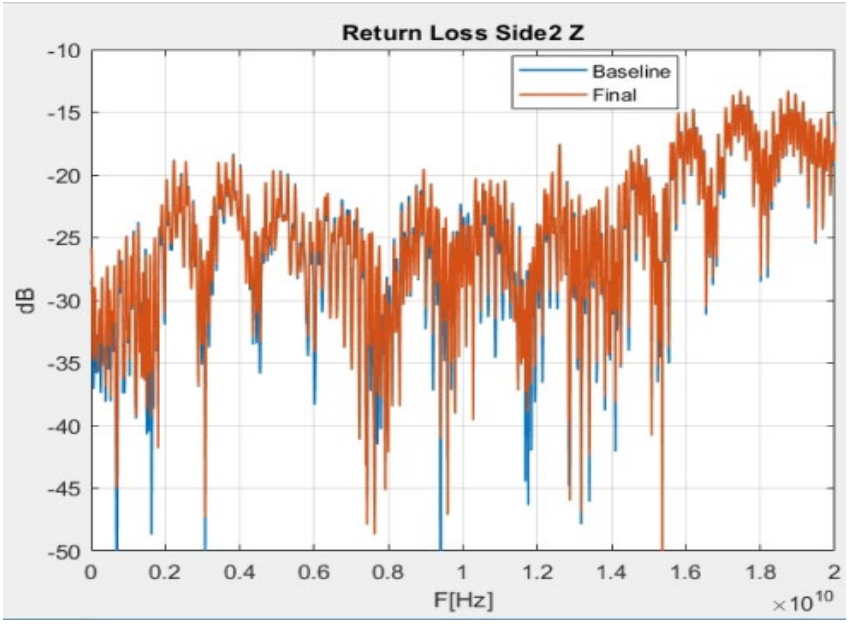

Figure 44

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Sample #4 (Y-Axis)

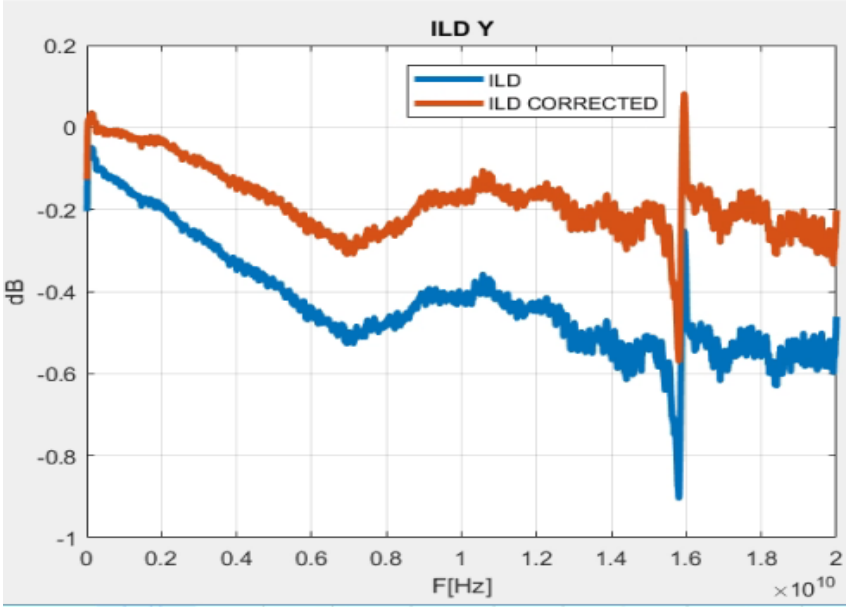

Figure 45

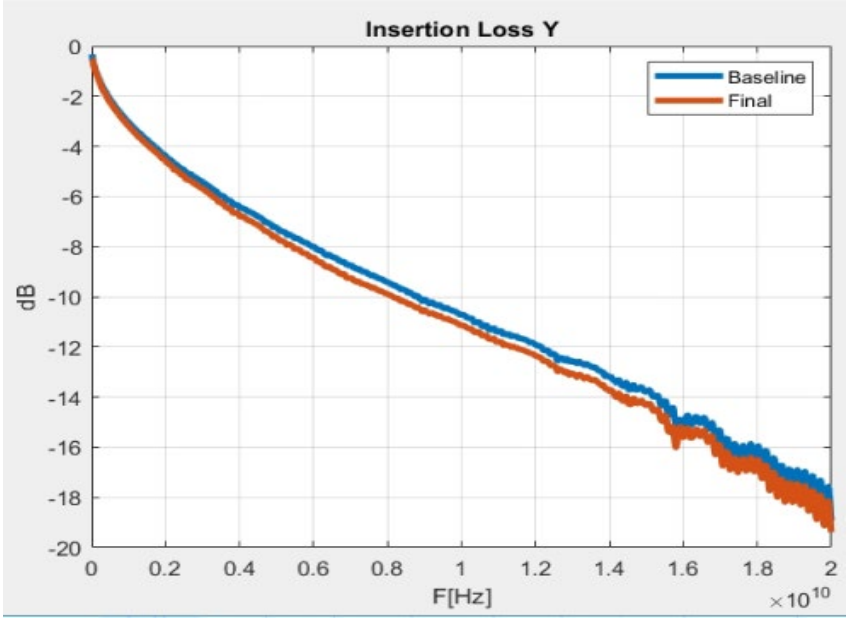

Figure 46

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

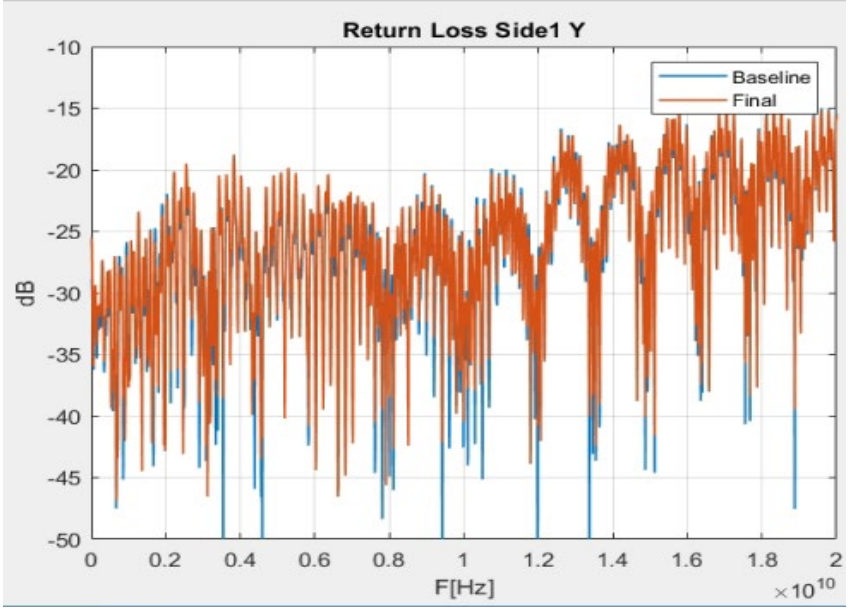

Figure 47

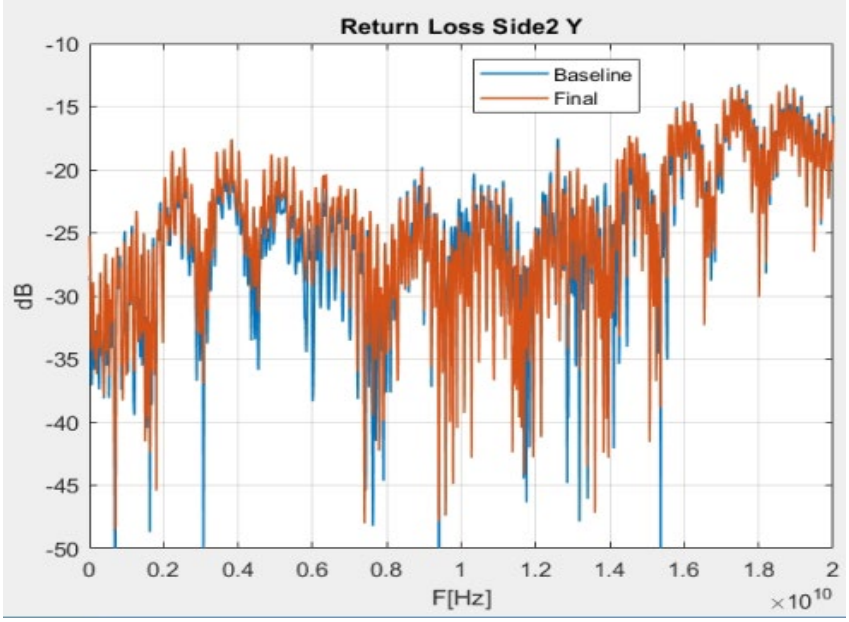

Figure 48

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample #4 (X-Axis)

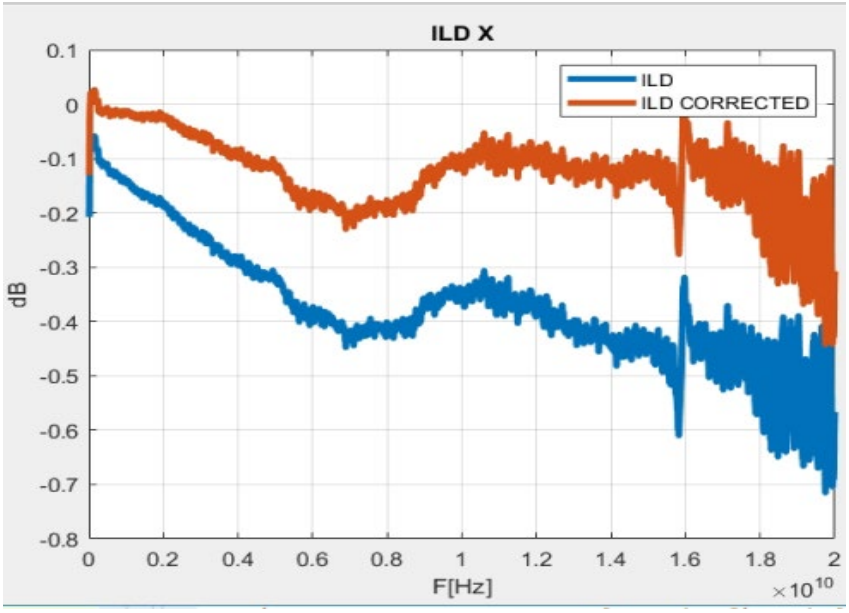

Figure 49

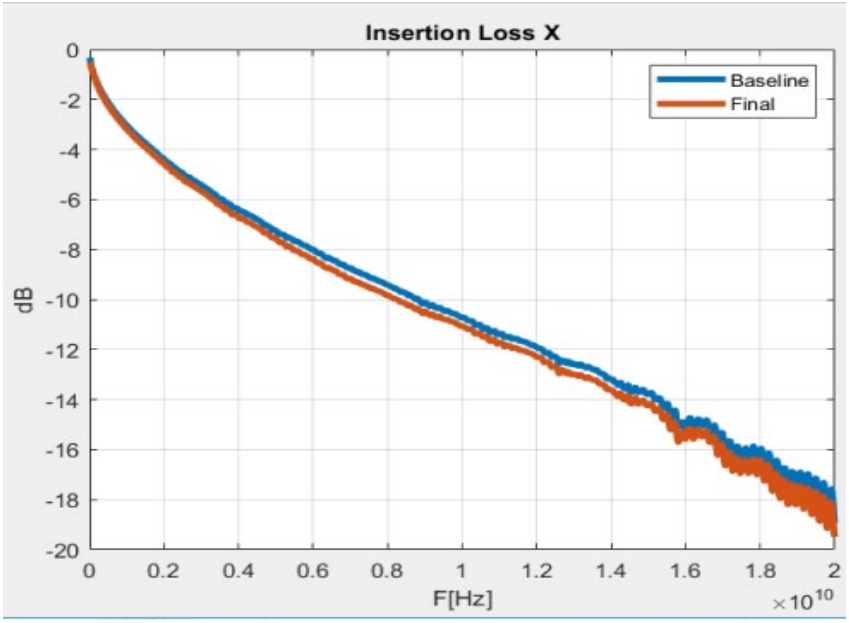

Figure 50

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

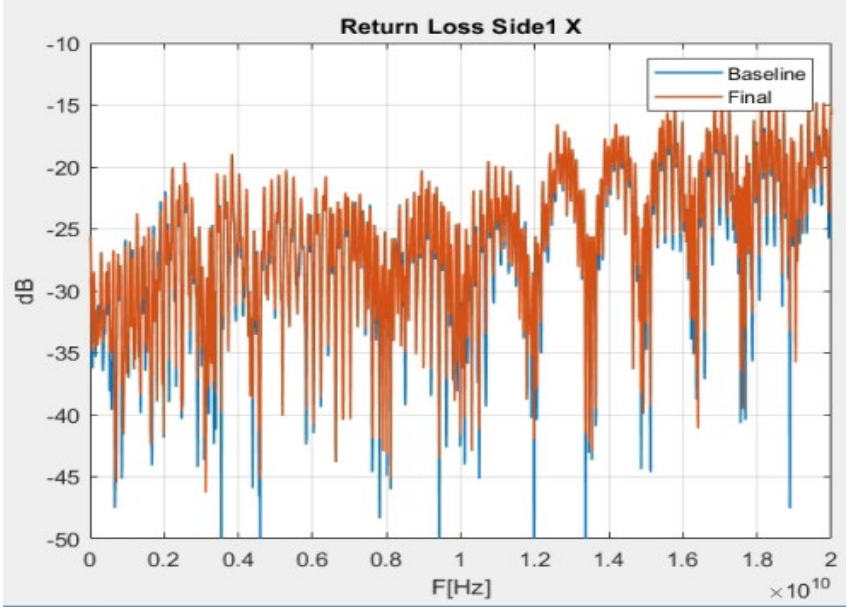

Figure 51

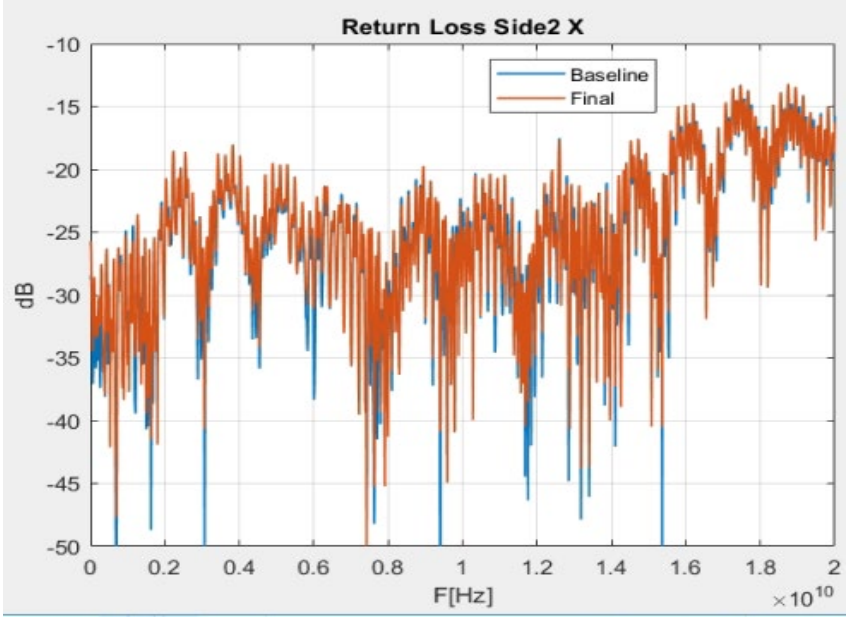

Figure 52

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample #5 (Z-Axis)

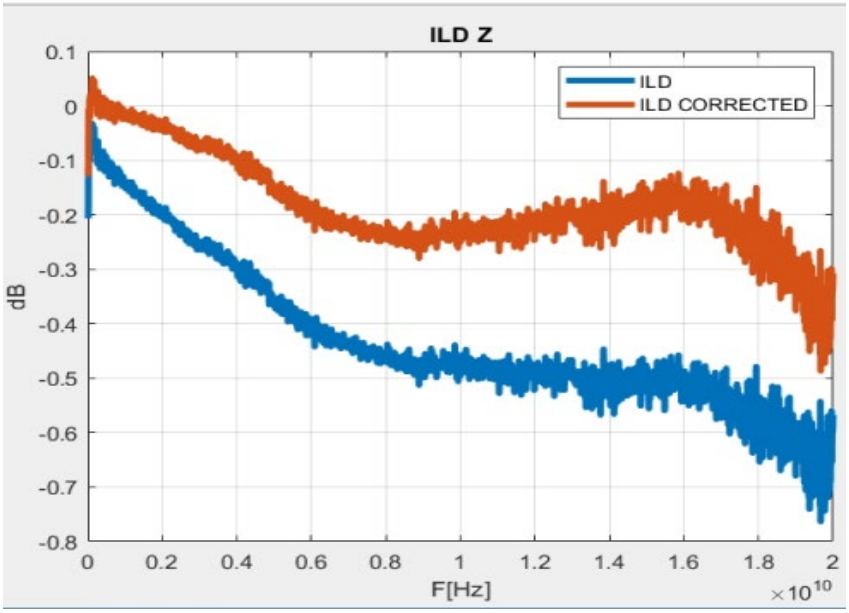

Figure 53

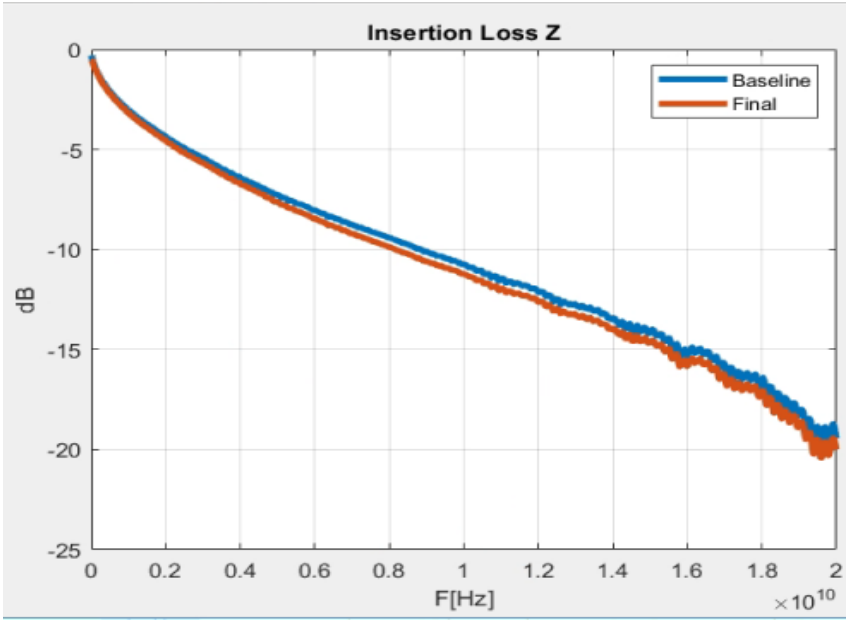

Figure 54

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

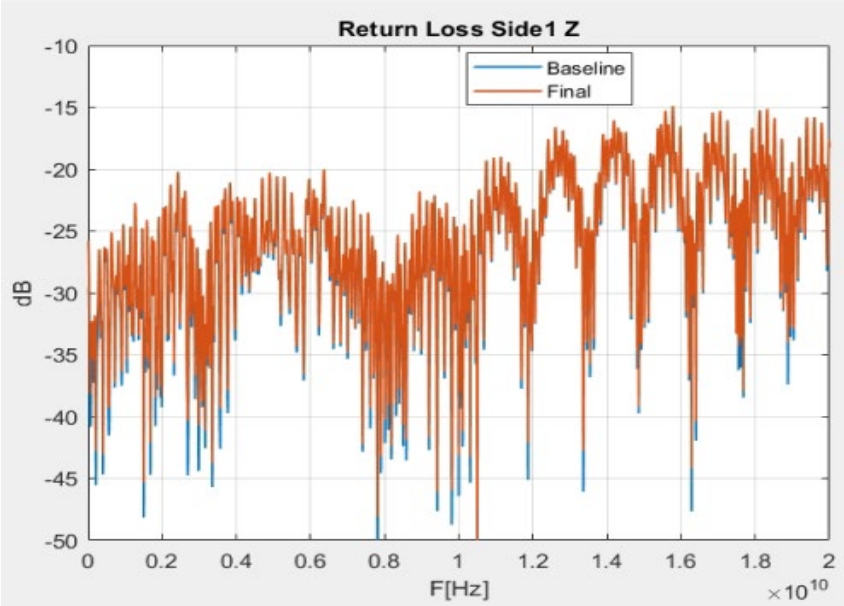

Figure 55

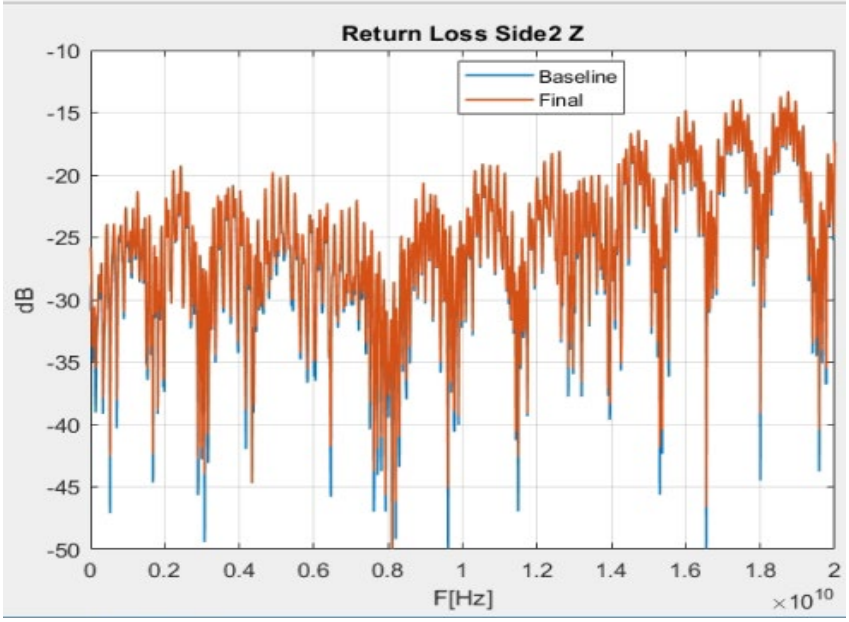

Figure 56

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample #5 (Y-Axis)

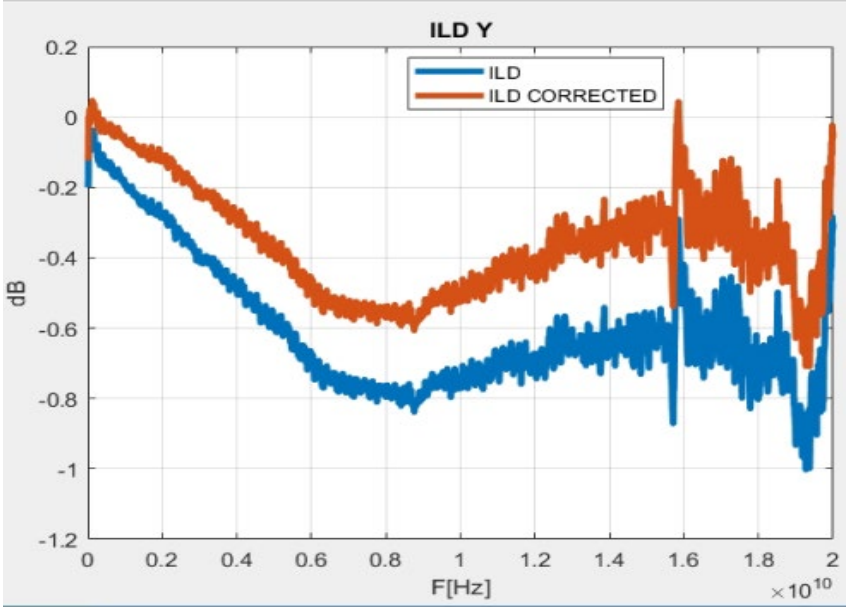

Figure 57

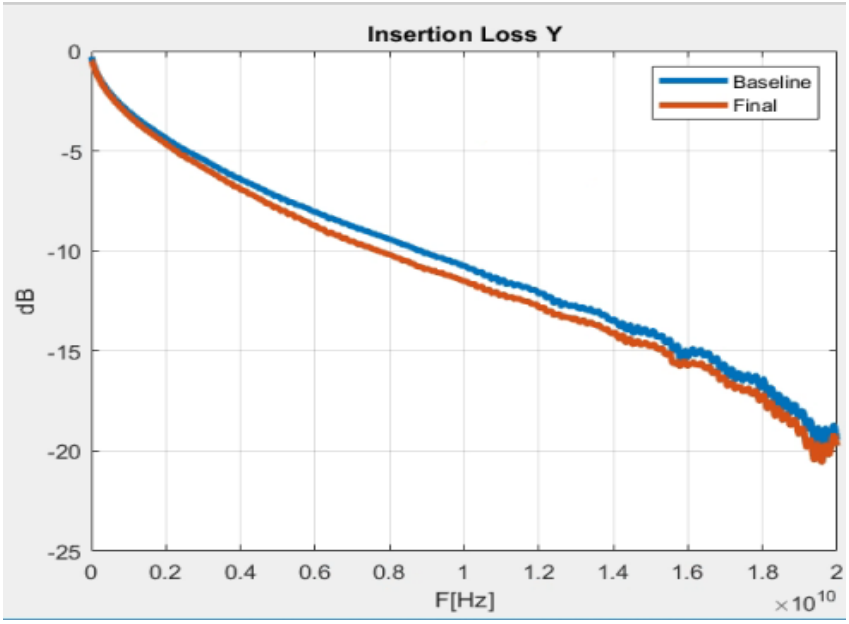

Figure 58

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

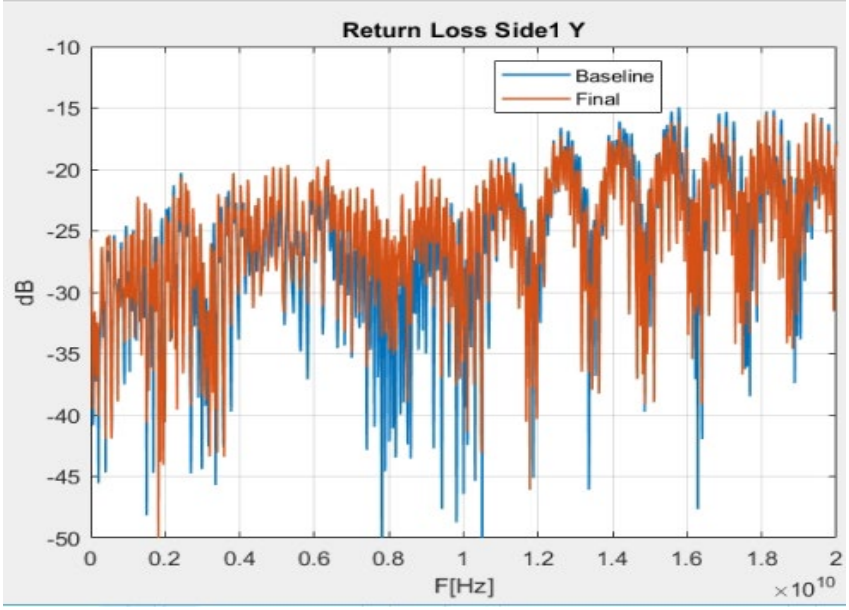

Figure 59

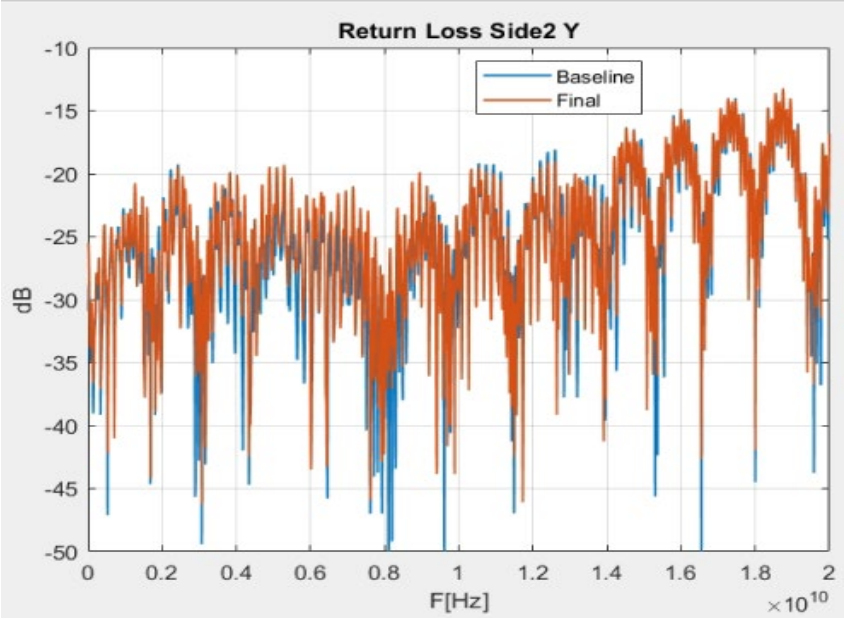

Figure 60

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample #5 (X-Axis)

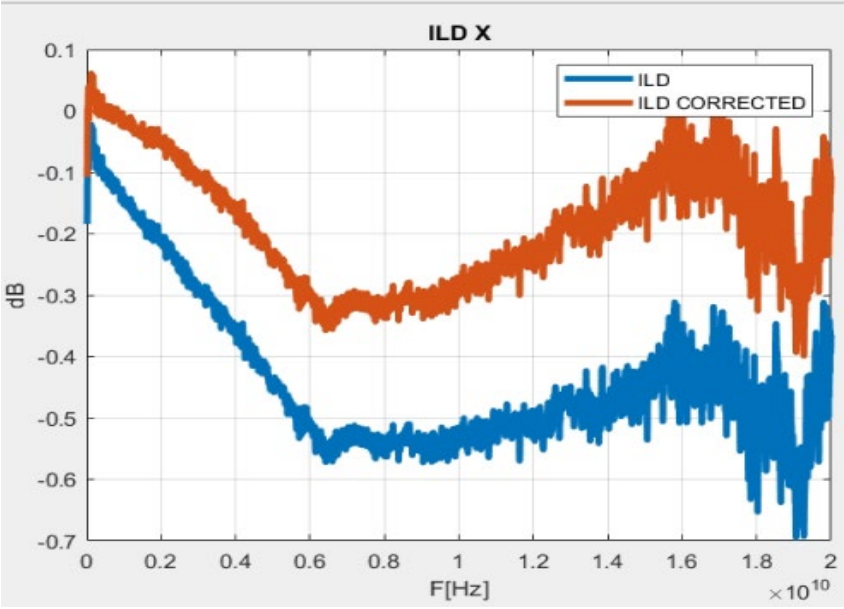

Figure 61

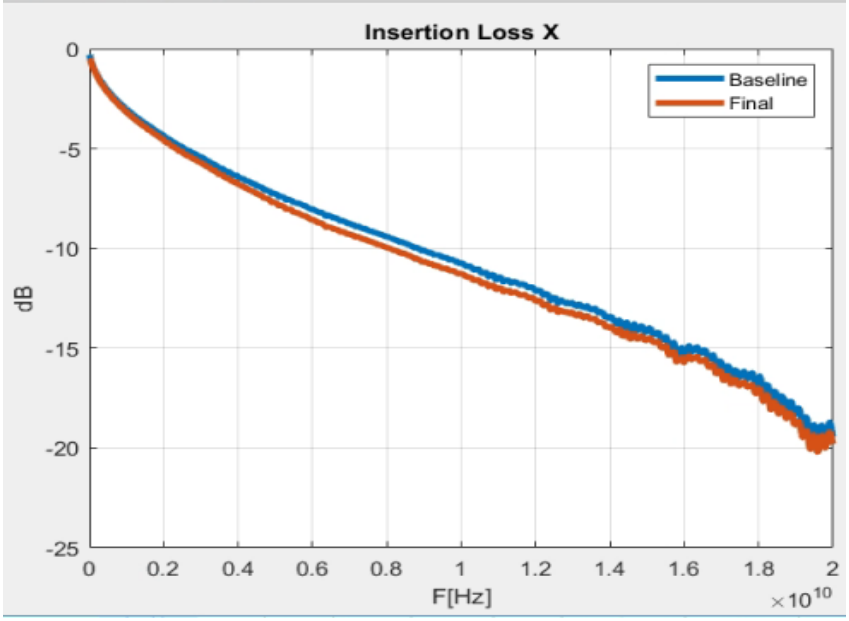

Figure 62

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

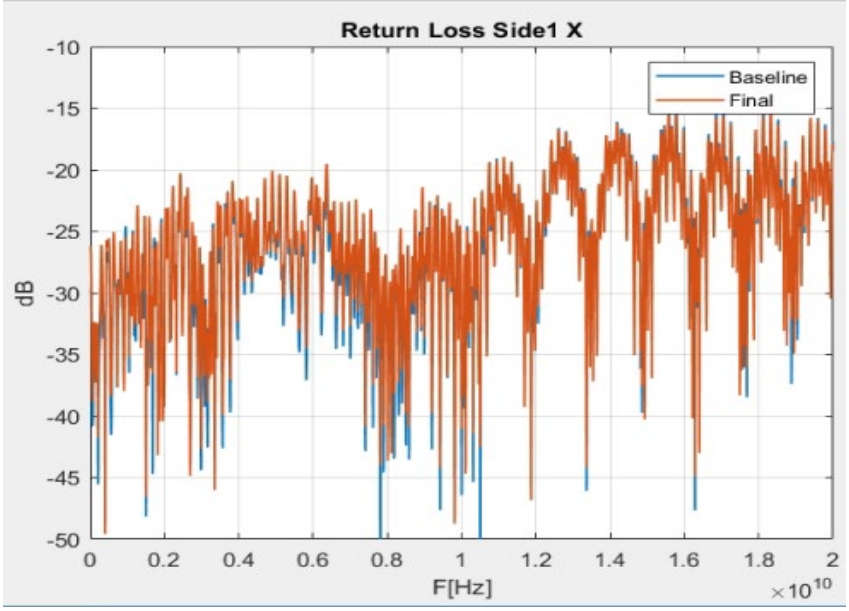

Figure 63

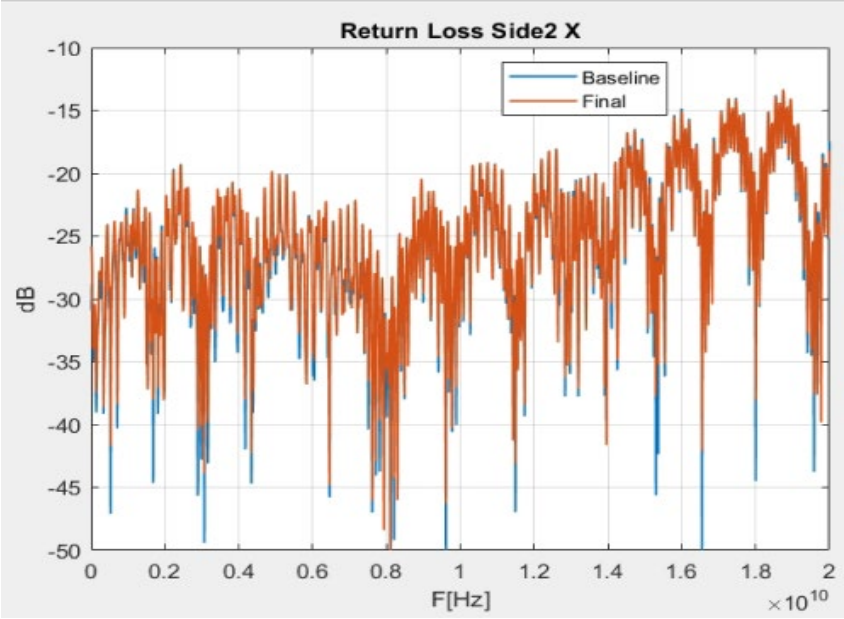

Figure 64

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Pictures of the ARF6-RA and the ARC6 plug contacts before and after testing.

Sample 1 – Cable end 1A

Pre-test

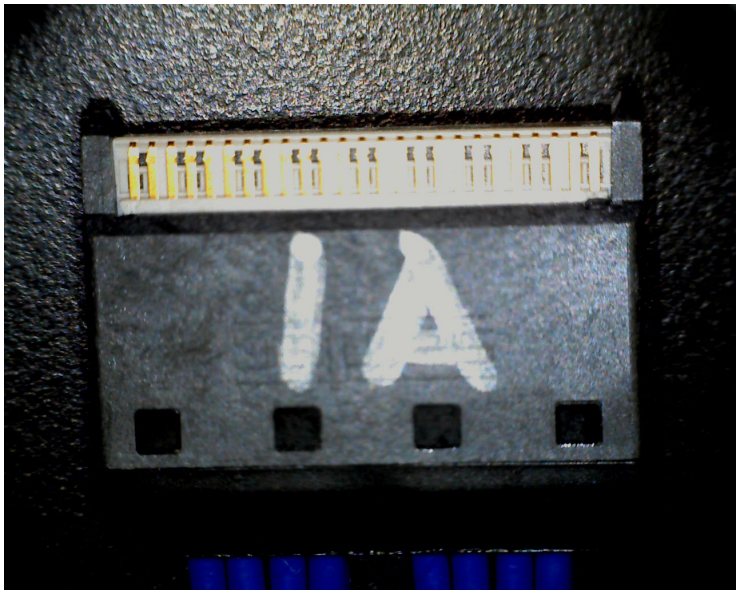

Figure 65

Post-test

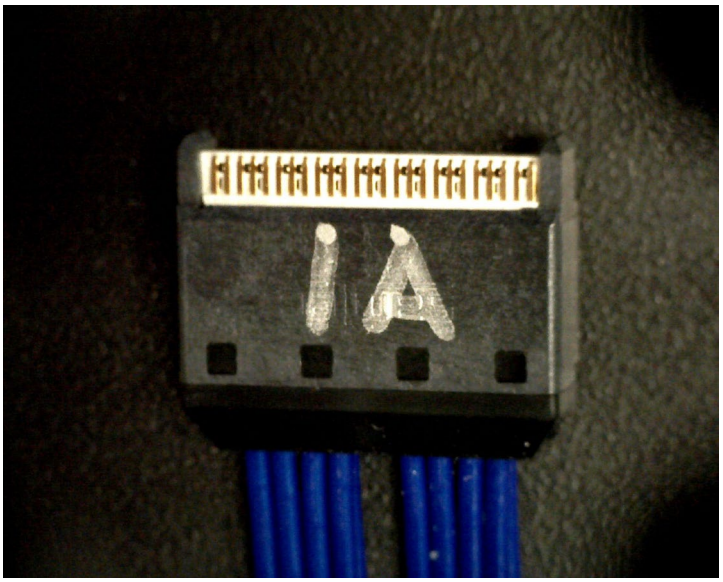

Figure 66

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 1 – Cable end 1B

Pre-test

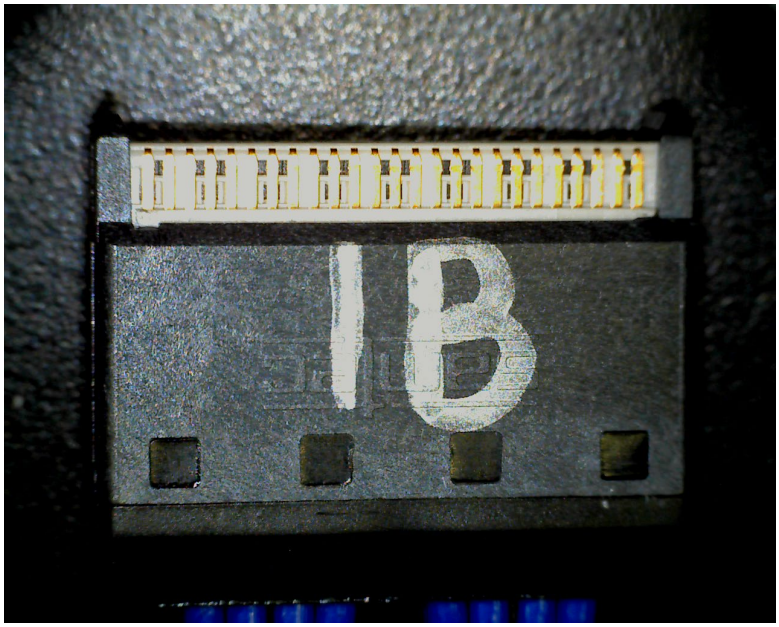

Figure 67

Post-test

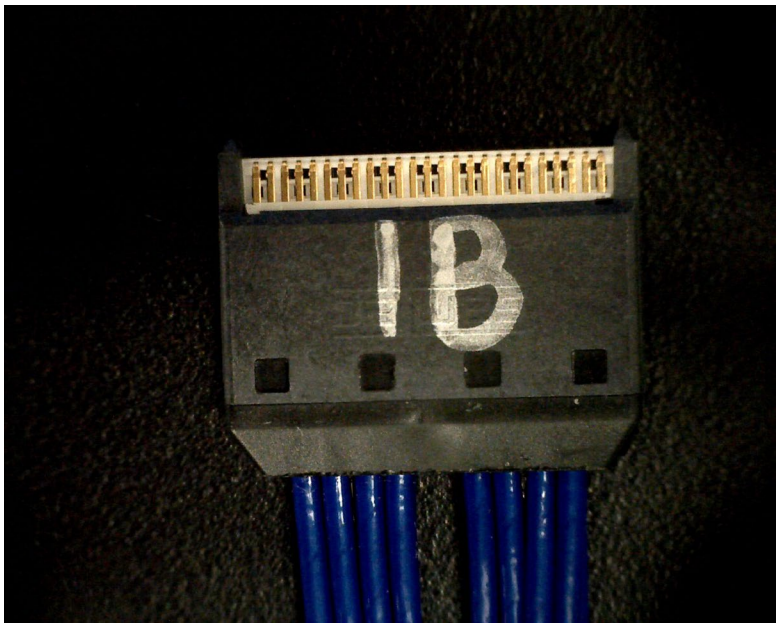

Figure 68

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 1 – PCB Connector 1A

Pre-test

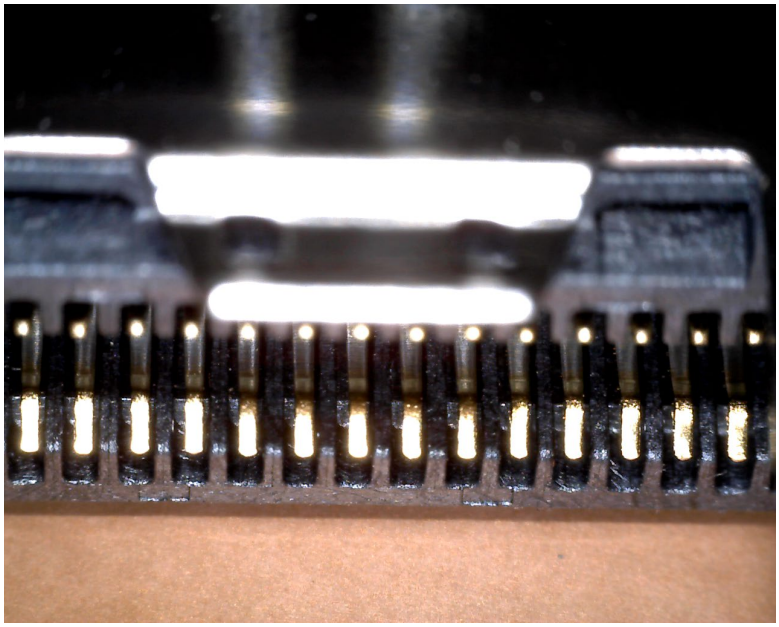

Figure 69

Post-test

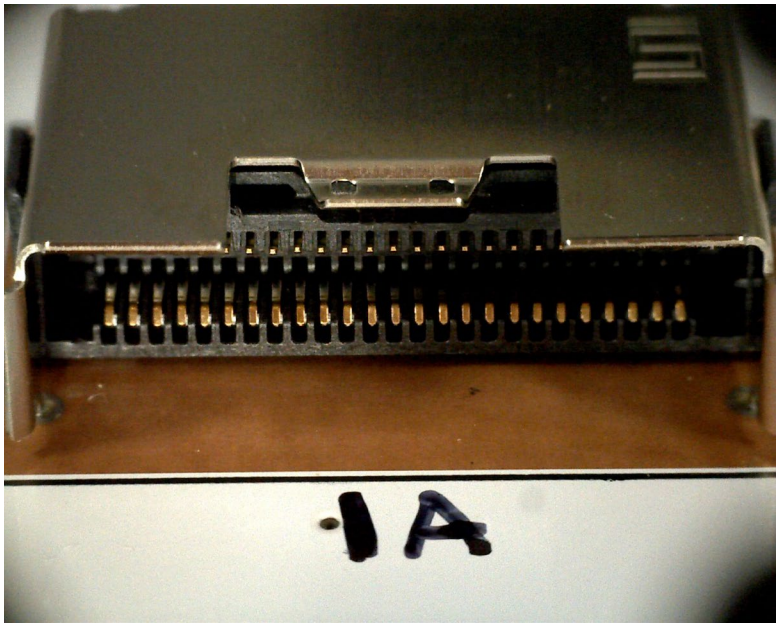

Figure 70

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 1 – PCB Connector 1B

Pre-test

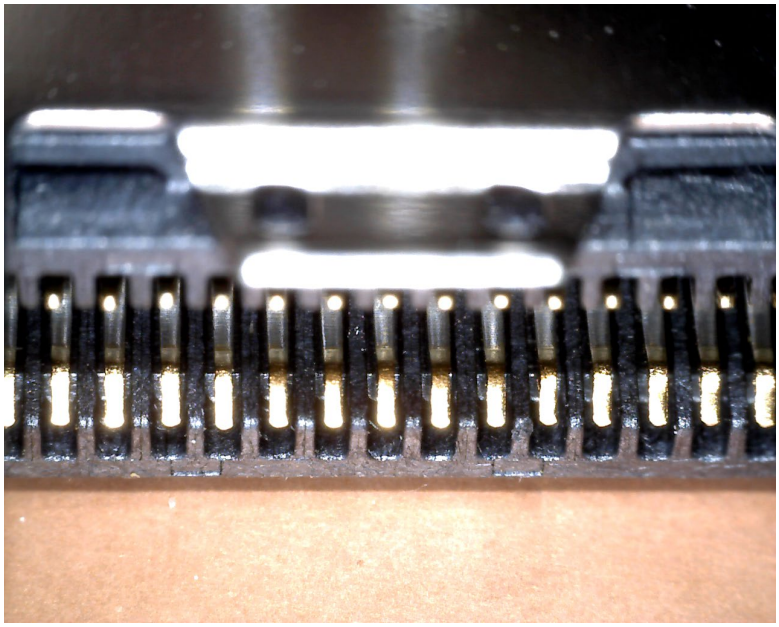

Figure 71

Post-test

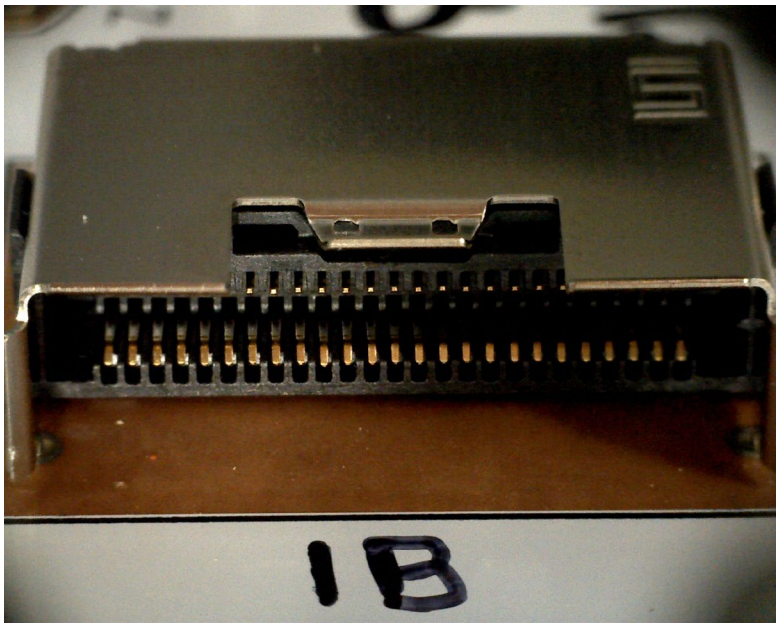

Figure 72

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 2 – Cable end 2A

Pre-test

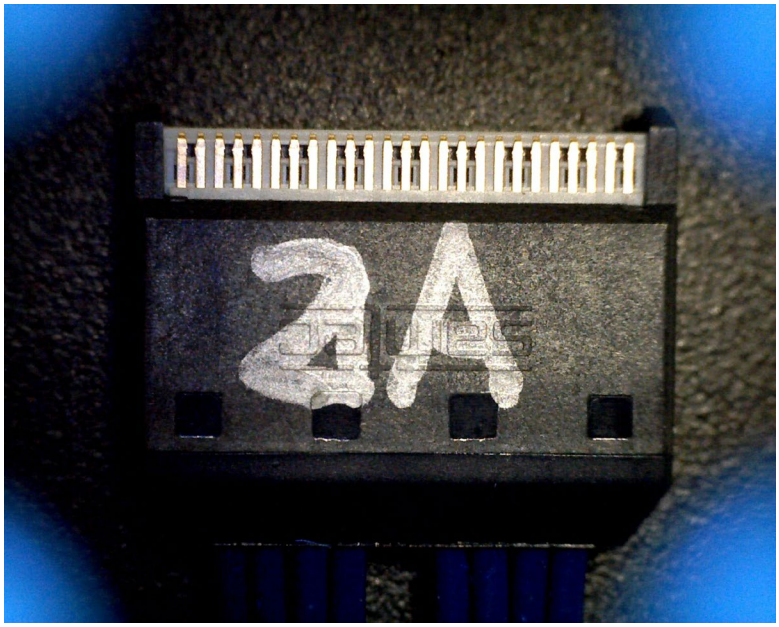

Figure 73

Post-test

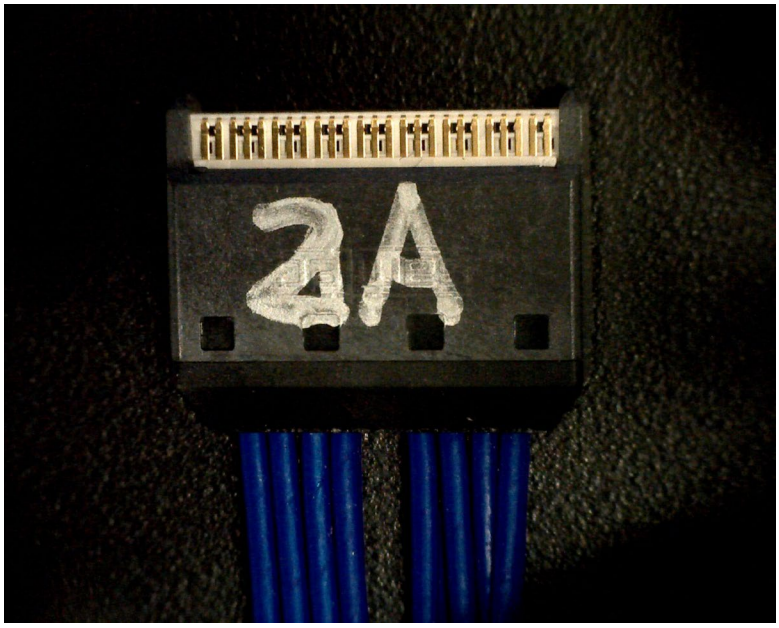

Figure 74

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 2 – Cable end 2B

Pre-test

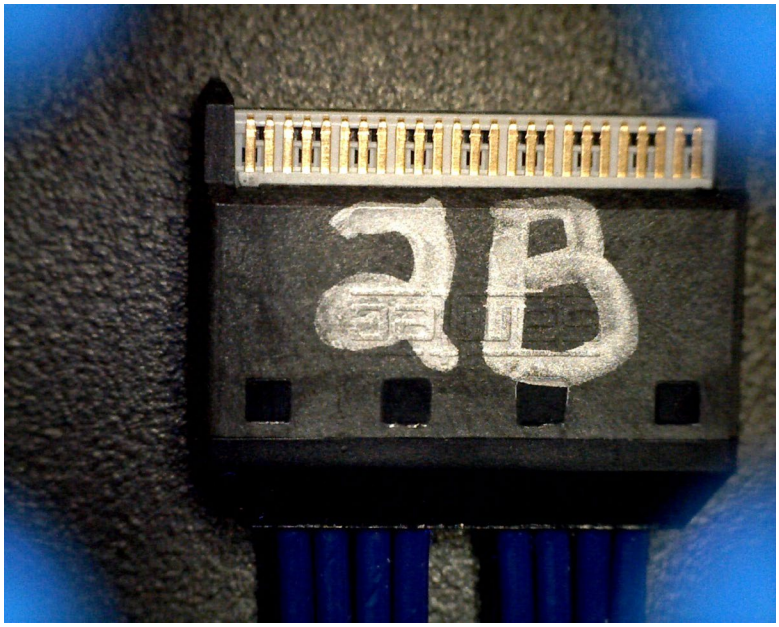

Figure 75

Post-test

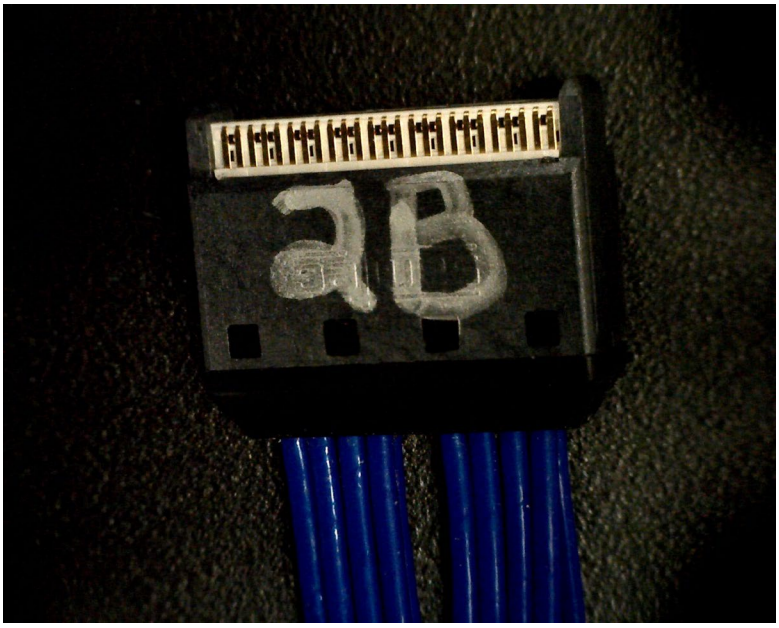

Figure 76

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 2 – PCB Connector 2A

Pre-test

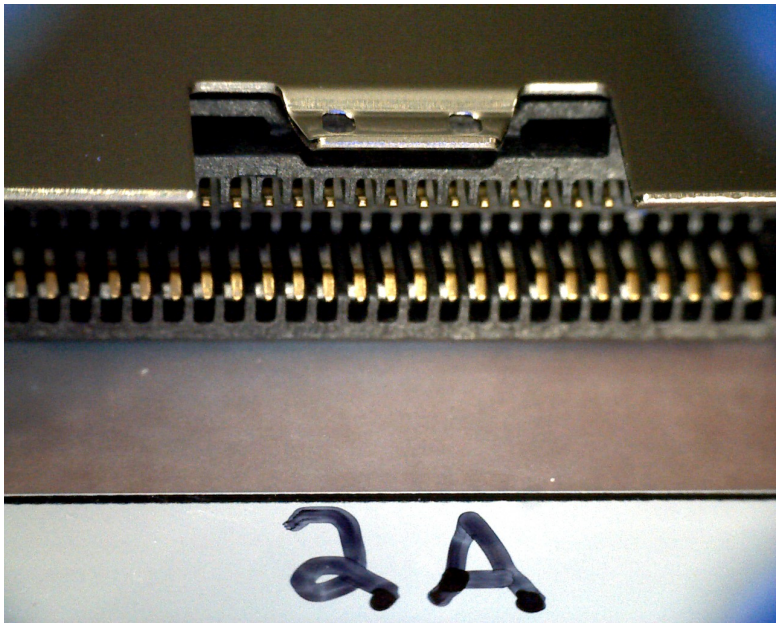

Figure 77

Post-test

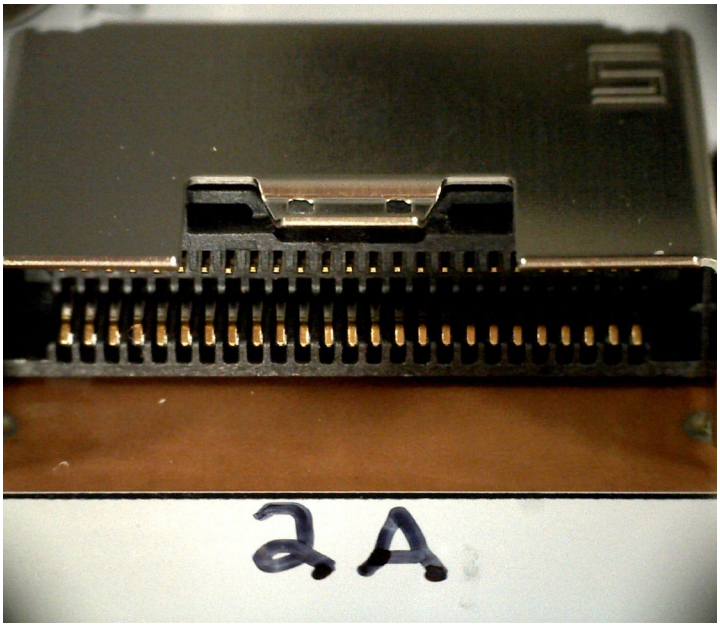

Figure 78

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 2 – PCB Connector 2B

Pre-test

Figure 79

Post-test

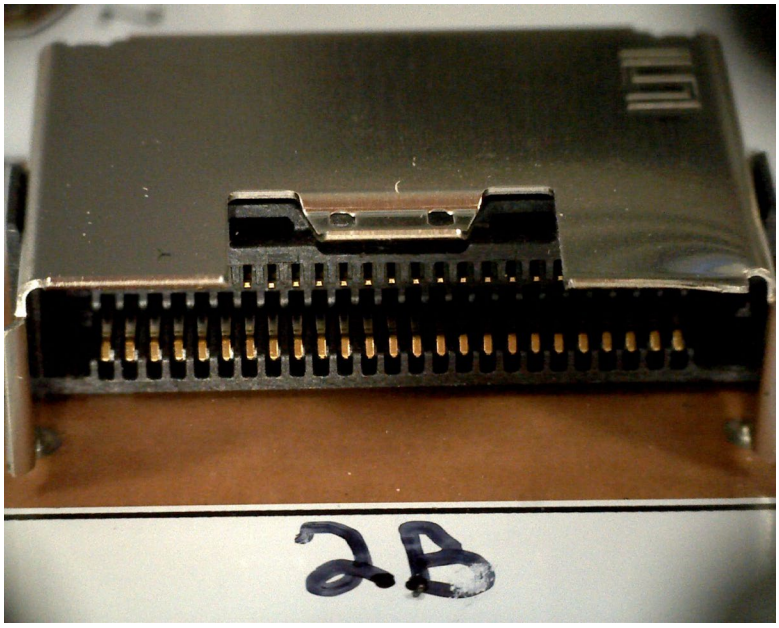

Figure 80

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 3 – Cable end 3A

Pre-test

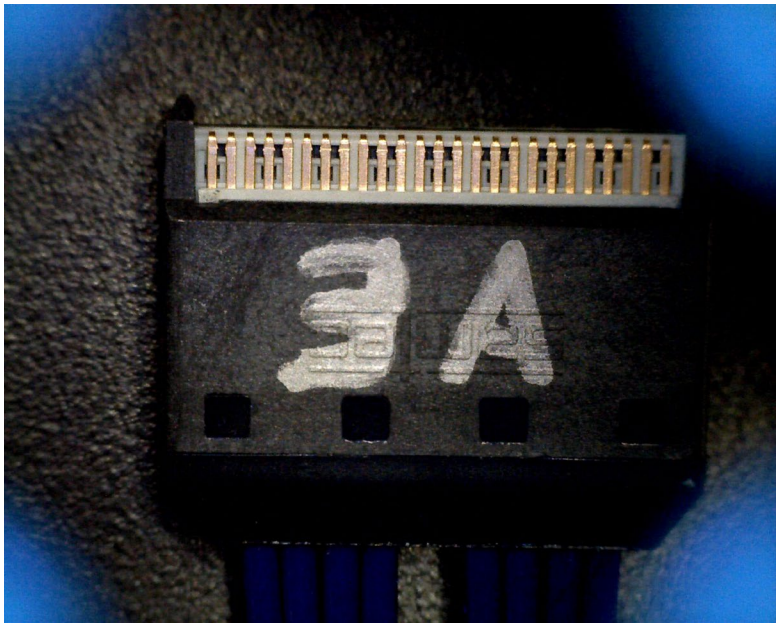

Figure 81

Post-test

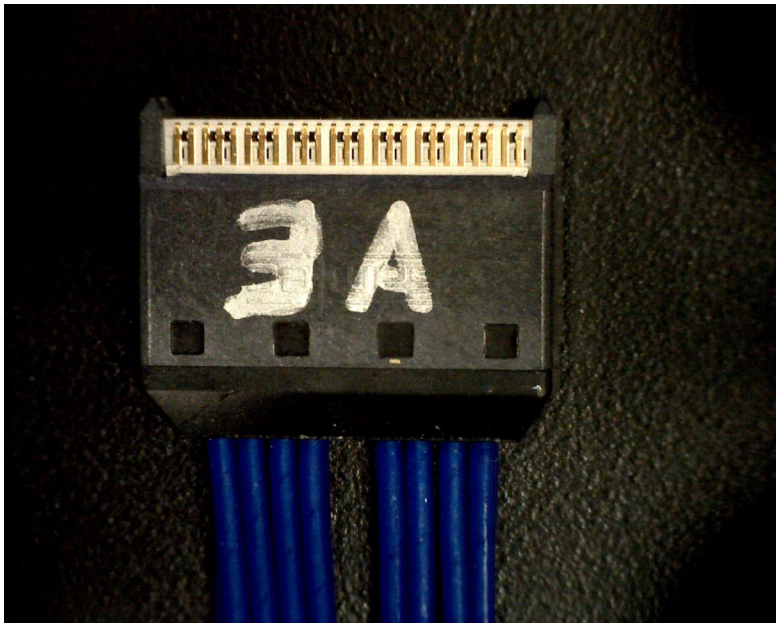

Figure 82

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 3 – Cable end 3B

Pre-test

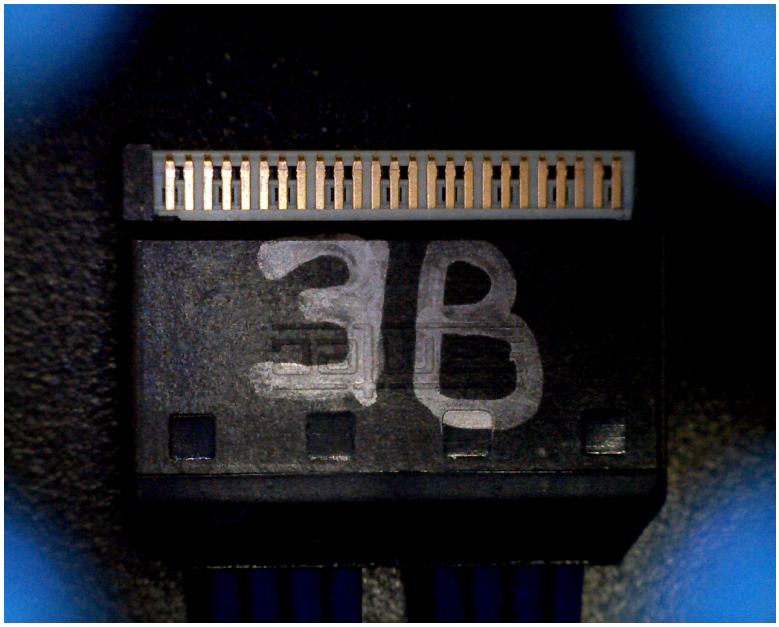

Figure 83

Post-test

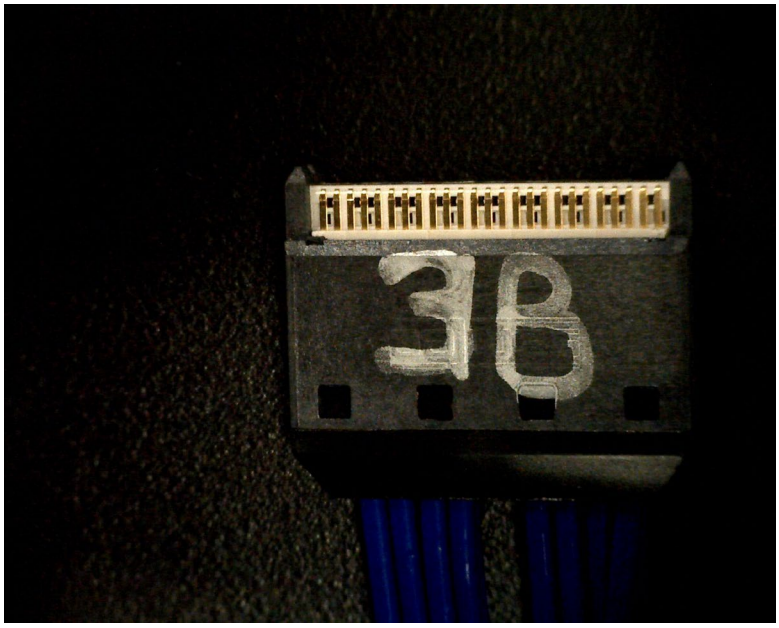

Figure 84

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 3 – PCB Connector 3A

Pre-test

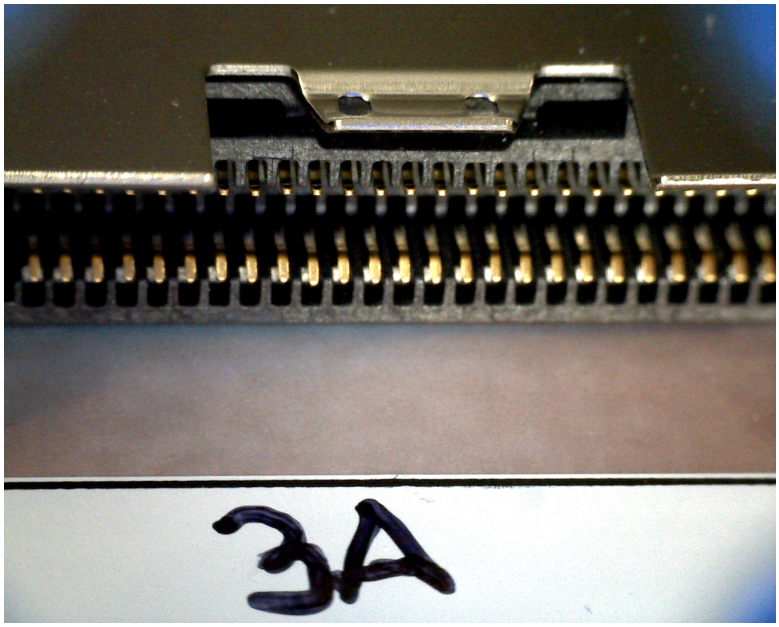

Figure 85

Post-test

Figure 86

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 3 – PCB Connector 3B

Pre-test

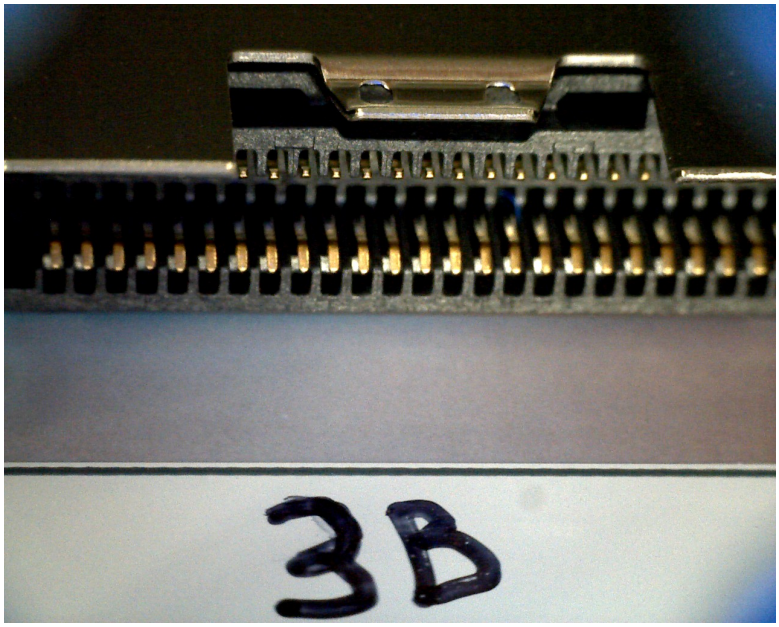

Figure 87

Post-test

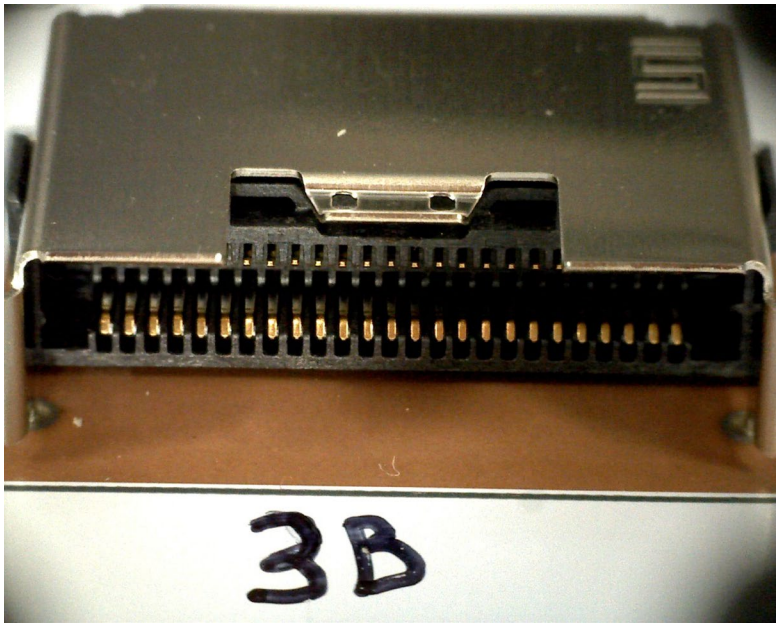

Figure 88

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 4 – Cable end 4A

Pre-test

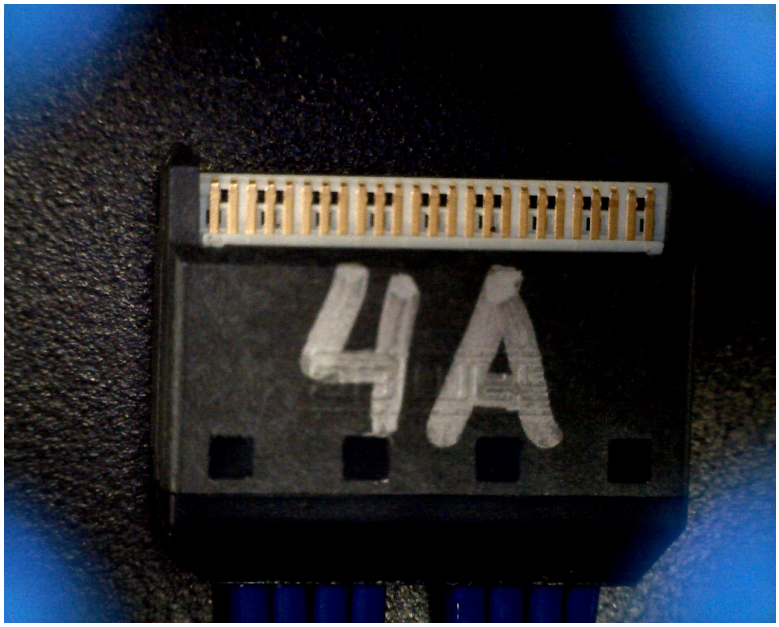

Figure 89

Post-test

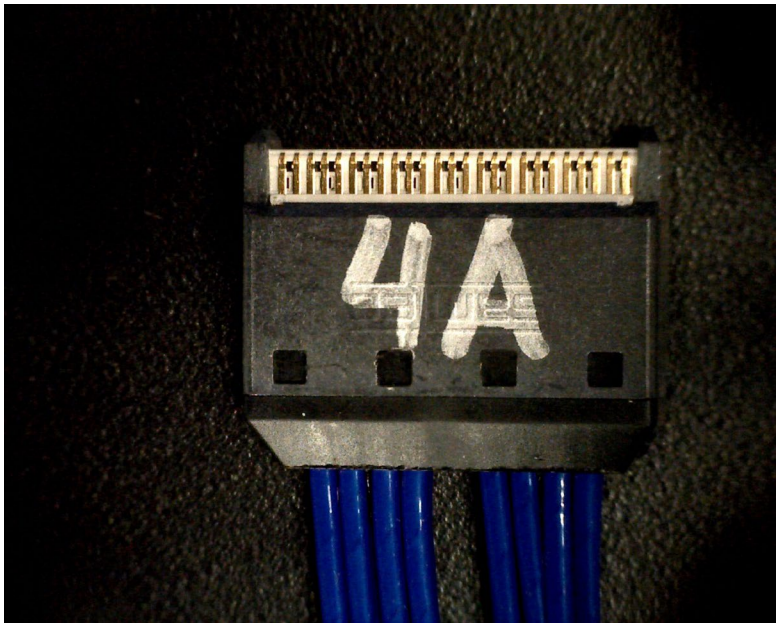

Figure 90

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 4 – Cable end 4B

Pre-test

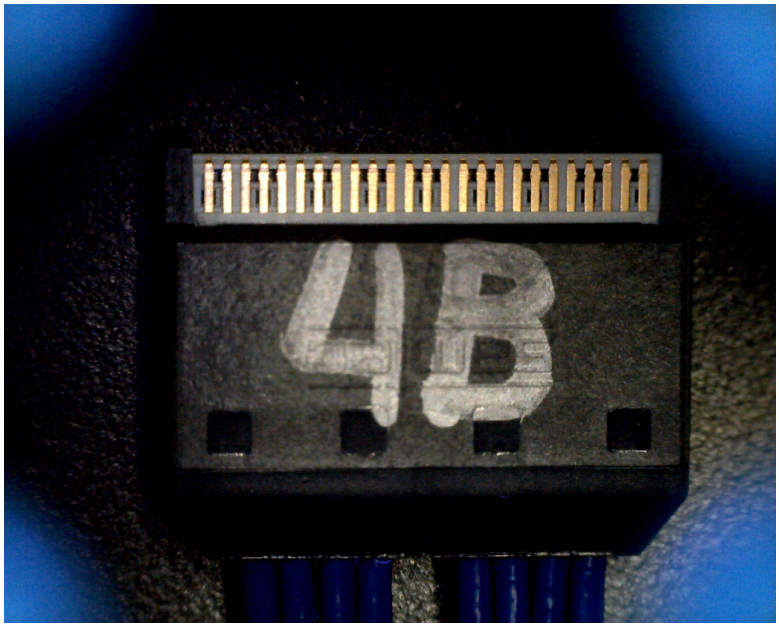

Figure 91

Post-test

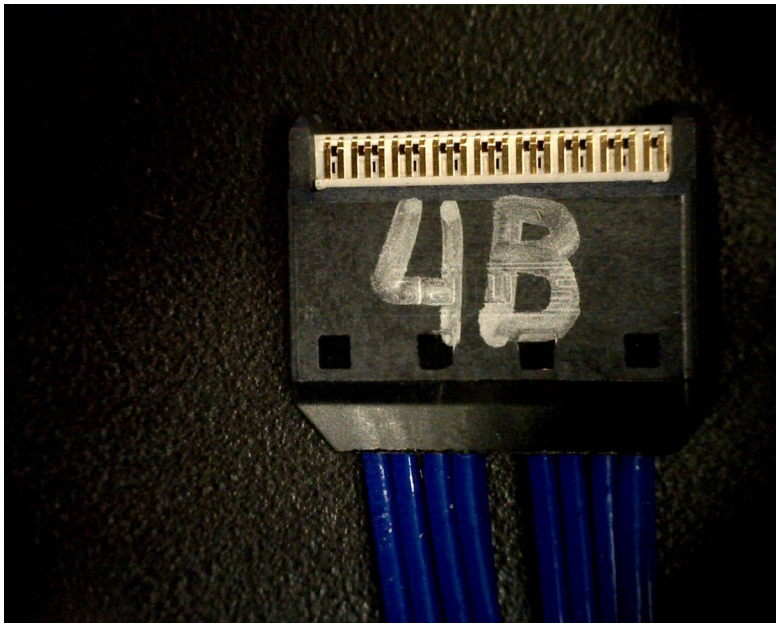

Figure 92

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 4 – PCB Connector 4A

Pre-test

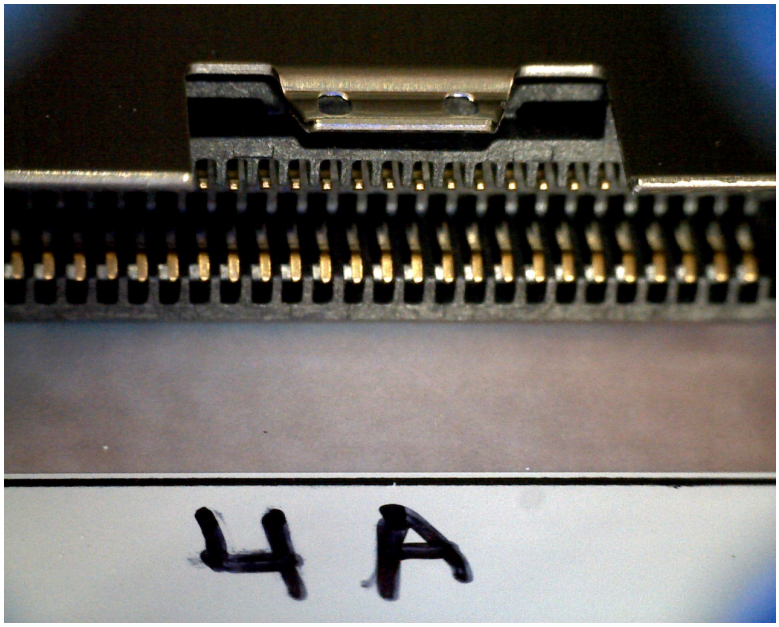

Figure 93

Post-test

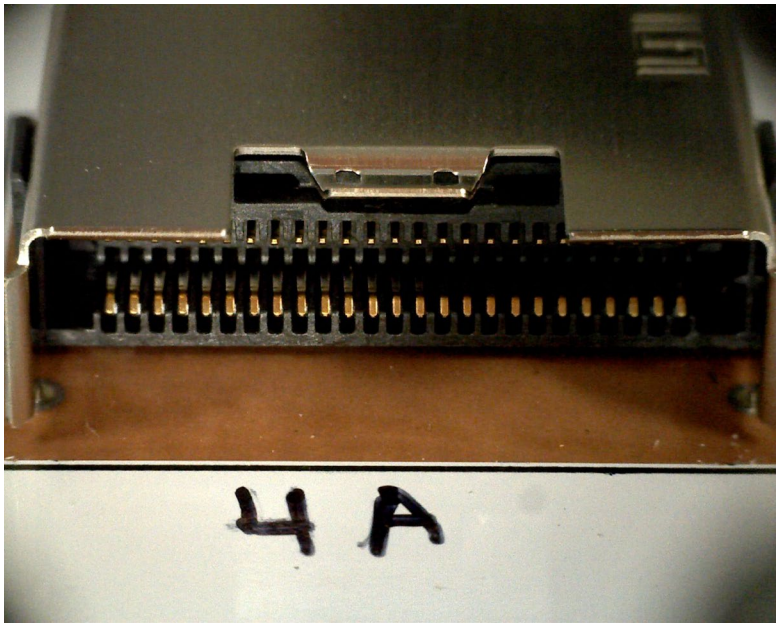

Figure 94

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 4 – PCB Connector 4B

Pre-test

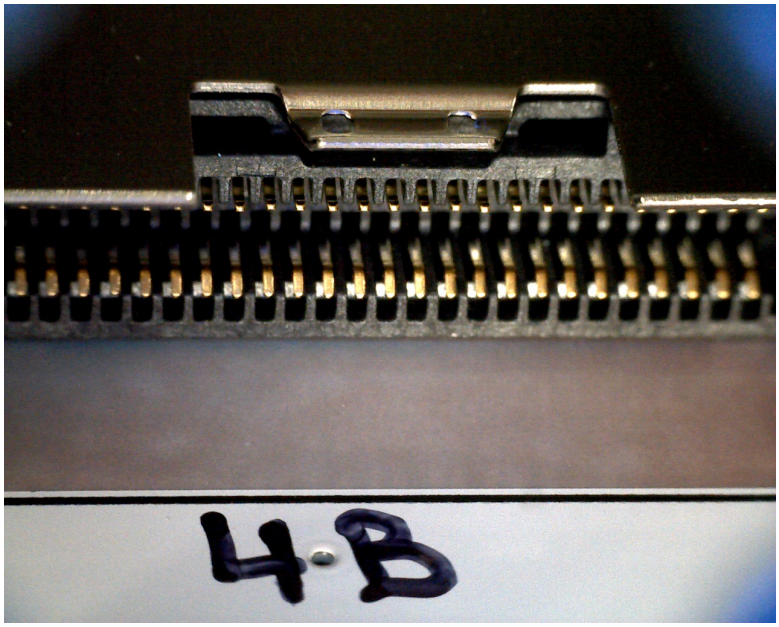

Figure 95

Post-test

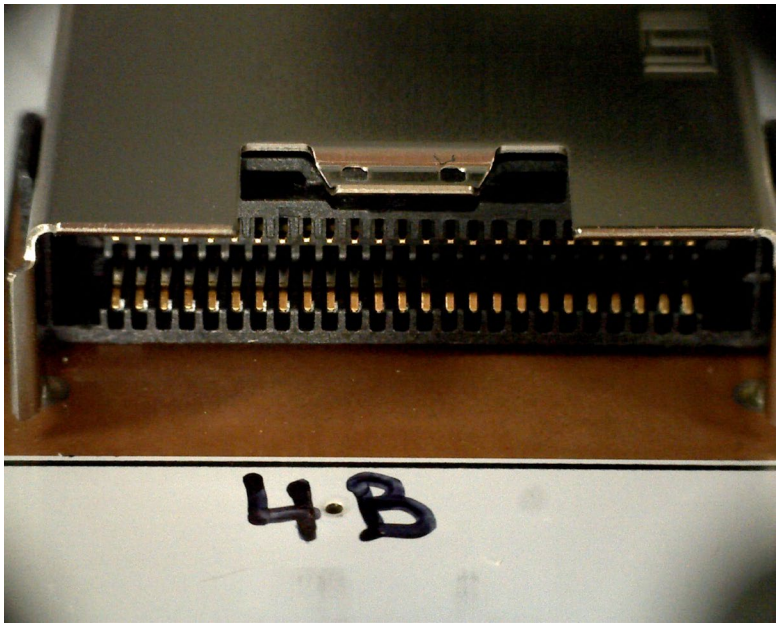

Figure 96

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 5 – Cable end 5A

Pre-test

Figure 97

Post-test

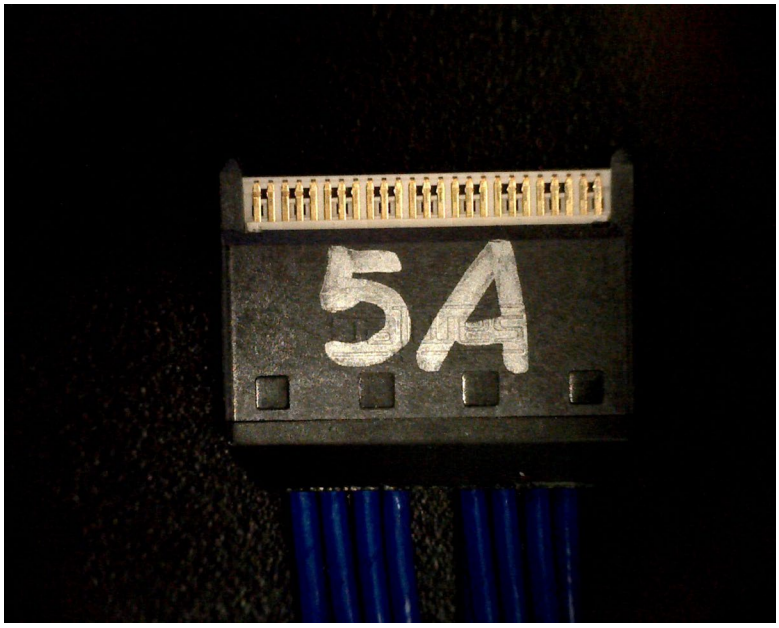

Figure 98

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 5 – Cable end 5B

Pre-test

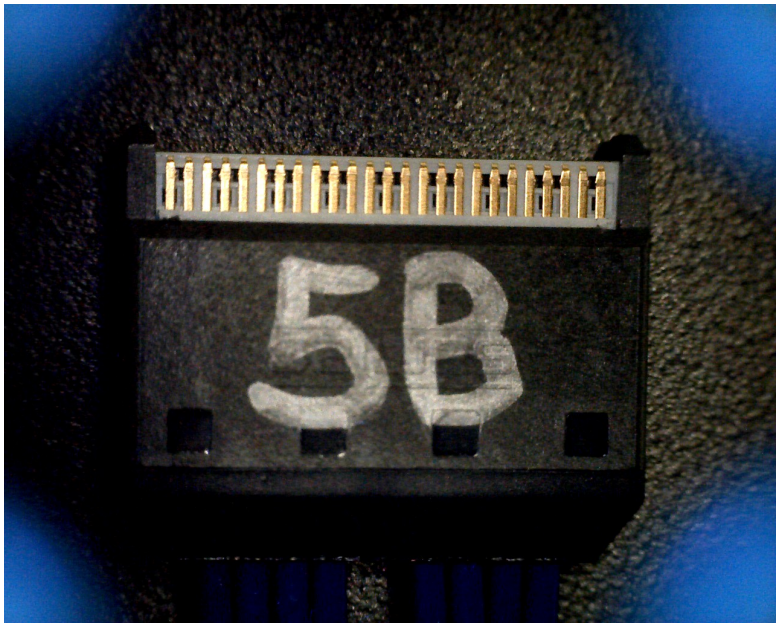

Figure 99

Post-test

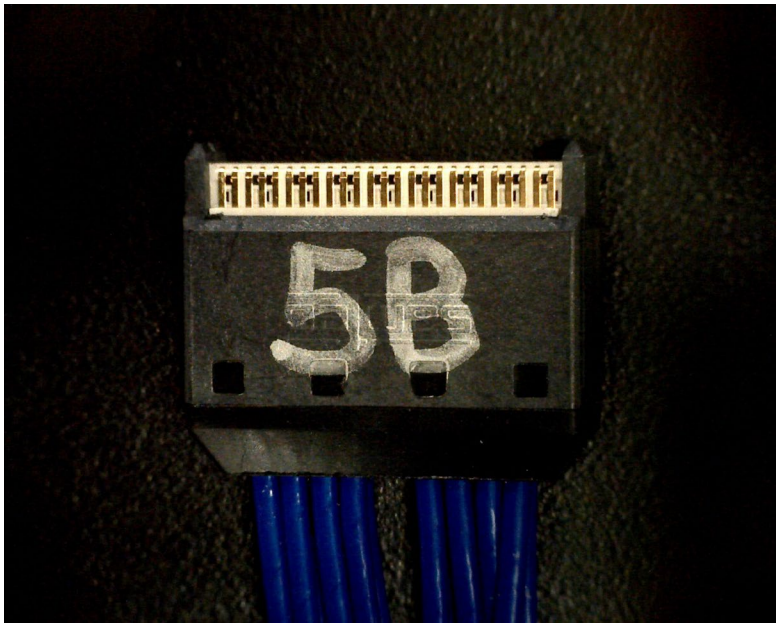

Figure 100

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 5 – PCB Connector 5A

Pre-test

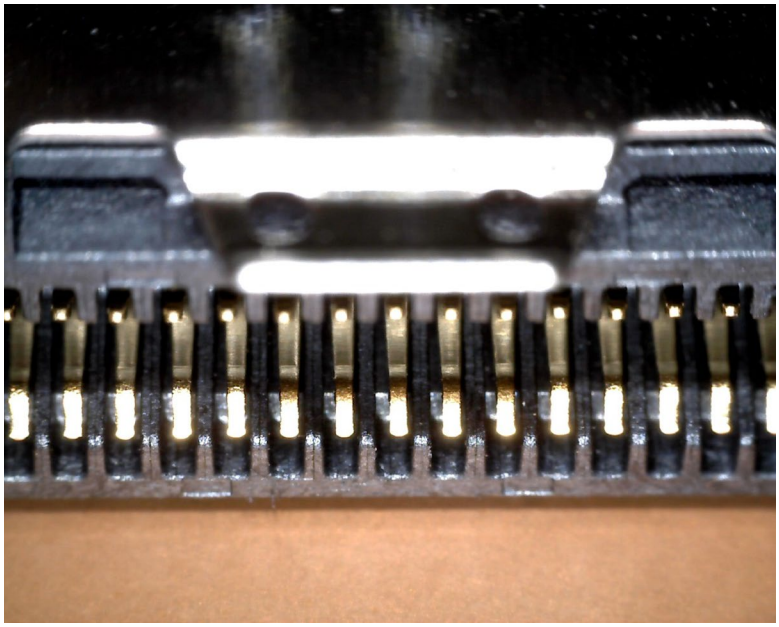

Figure 101

Post-test

Figure 102

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Sample 5 – PCB Connector 5B

Pre-test

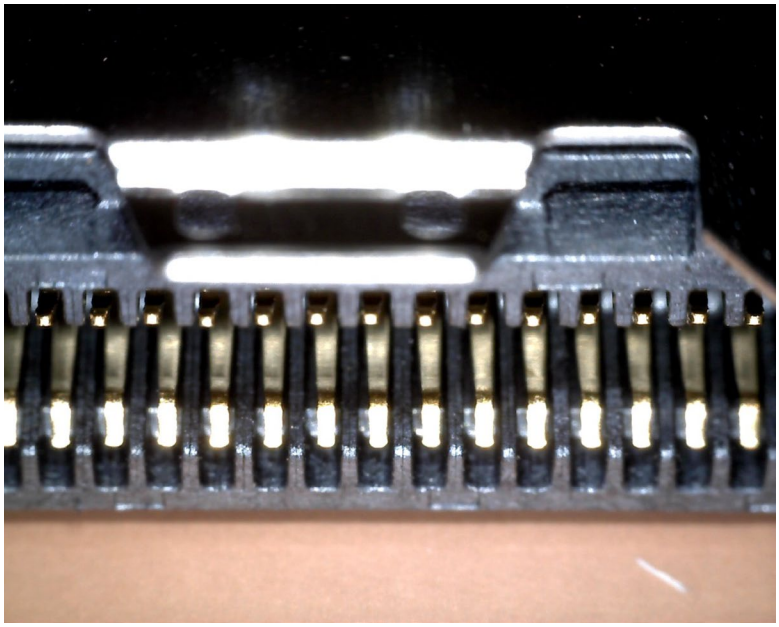

Figure 103

Post-test

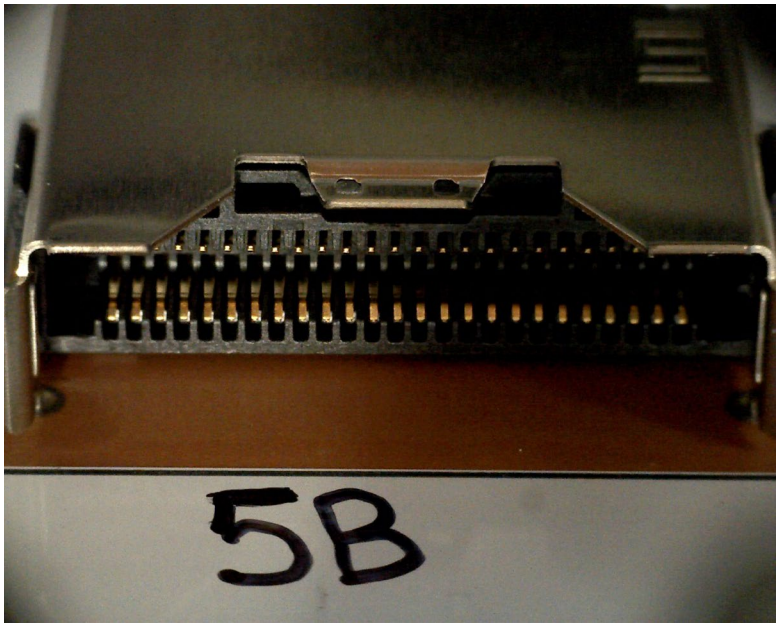

Figure 104

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Insertion Loss before and after mechanical shock and vibration

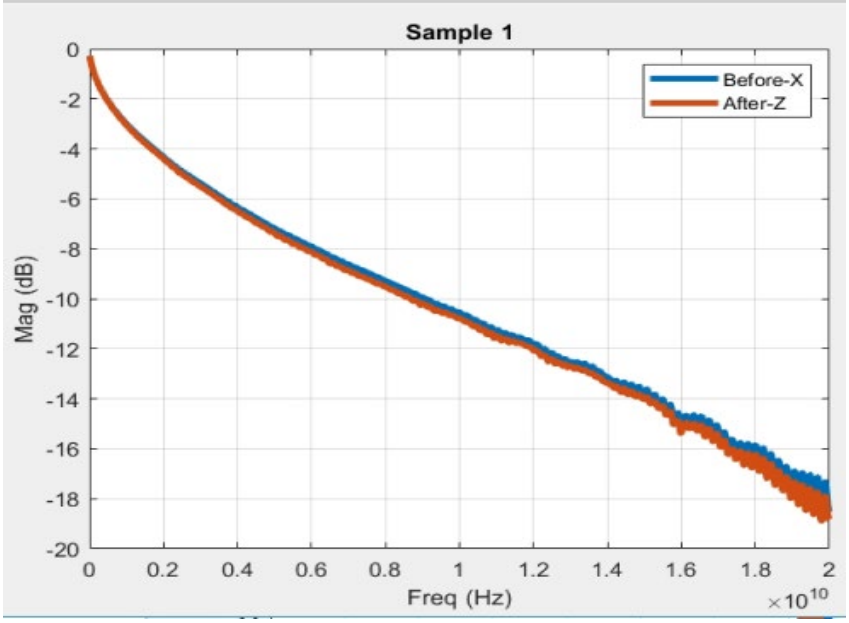

Figure 105

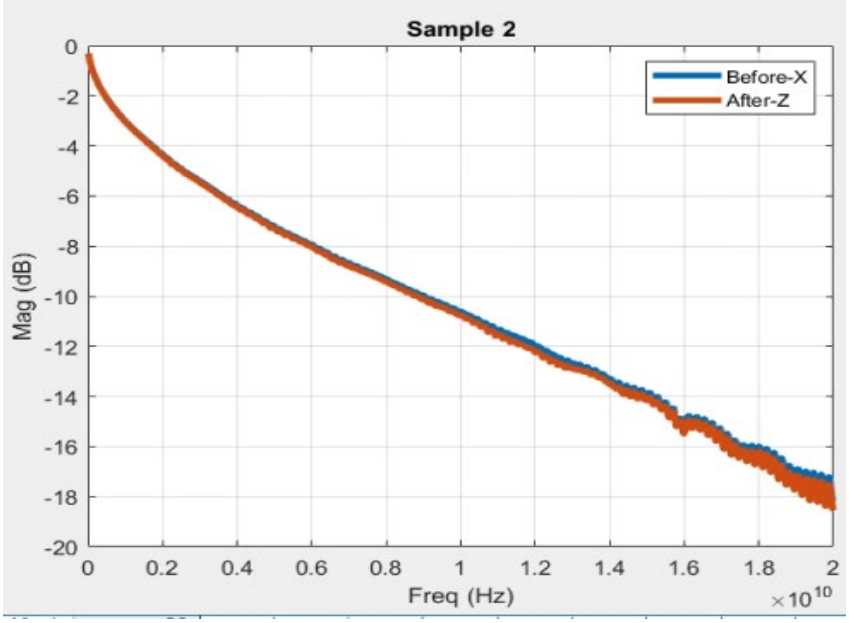

Figure 106

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

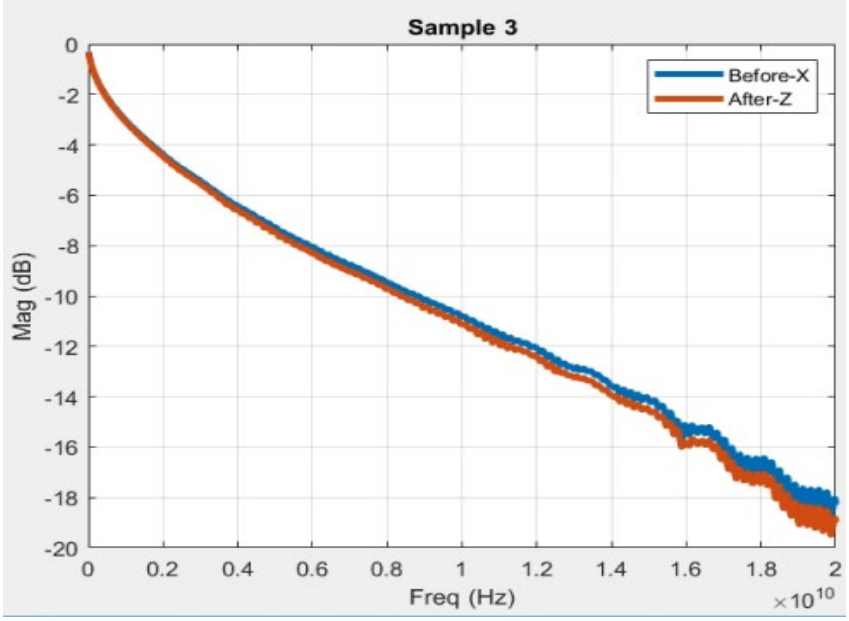

Figure 107

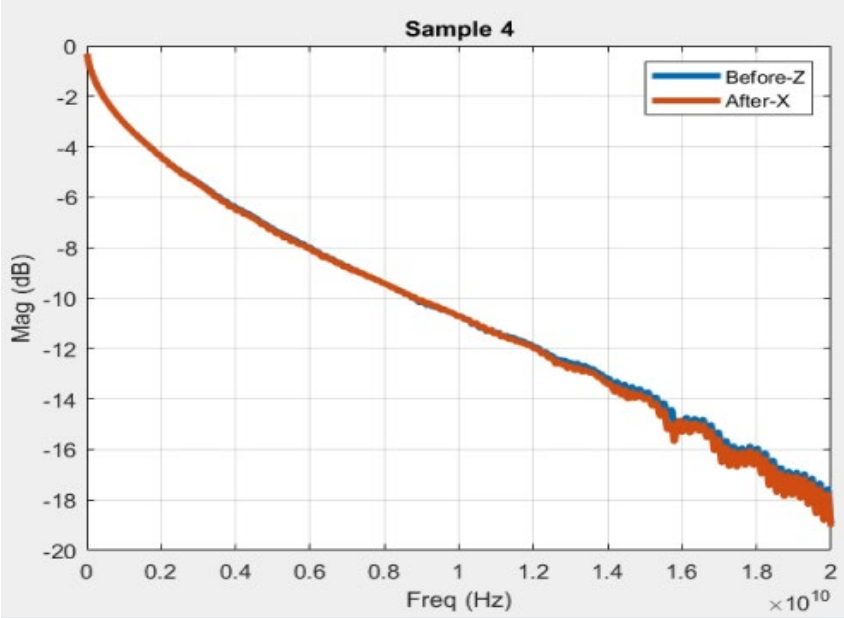

Figure 108

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

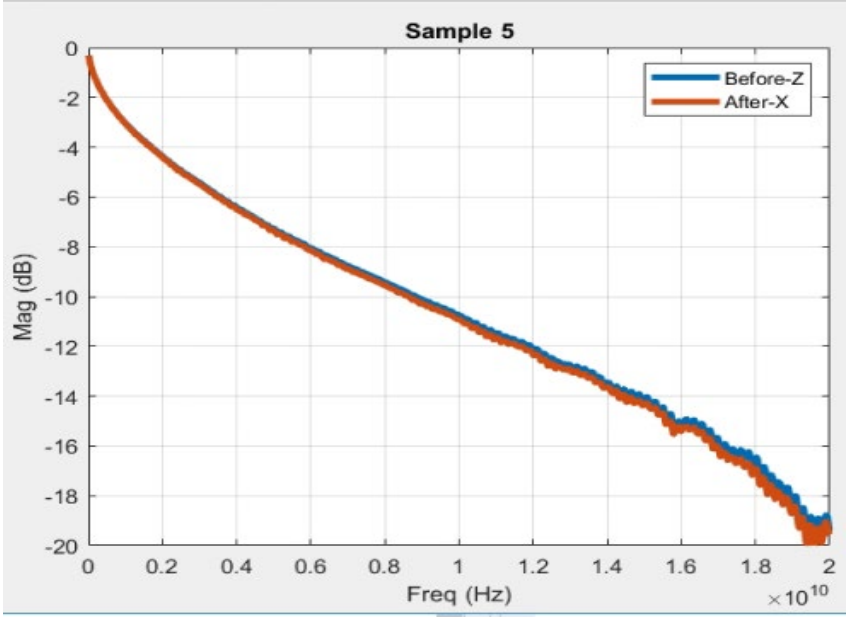

Figure 109

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax 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. Board related effects, such as pad-to-ground capacitance, are included in the data presented in this report.

All measurements should be done during Mechanical Shock and Vibration, please do not disturb the measurements (do not move cables, DUT, etc.) until test is over.

Frequency Domain Data

Frequency Domain parameters are helpful in evaluating the cable assembly system's signal loss characteristics across a range of sinusoidal frequencies. In this report, parameters presented in the Frequency Domain are Insertion Loss and Return Loss. 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.

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Appendix A – Product and Test System Descriptions

Product Description

Product test samples are 0.635 mm (.025") ARC6 Slim Body Cable Assemblies. The part number is ARC6-16-19.69-LU-LD-2-1. They mate with ARF6-16-L-RA-TR. 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 total of 16 pairs per row, the signal line numbers are shown in Table 2.

J1	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49
NAME	GND1	PAIR		GND1	PAIR		GND1	PAIR		GND1	PAIR		GND1	PAIR		GND1	PAIR		GND1	PAIR		GND1	PAIR		GND1
J2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
J1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
NAME	GND2	PAIR		GND2	PAIR		GND2	PAIR		GND2	PAIR		GND2	PAIR		GND2	PAIR		GND2	PAIR		GND2	PAIR		GND2
J2	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49

Table 2：Signal line numbers

Test System Description

The test fixtures are composed of six-layer Itera MT40 material with 100Ω differential signal trace and pad configurations designed for the electrical characterization of Samtec high speed cable assembly products. A PCB mount 2.4mm connector is used to interface the PNA test cables to the test fixtures. Optimization of the 2.4mm launch was performed using full wave simulation tools to minimize reflections. The test fixtures and calibration kit are specific to the ARx6 series connector set and identified by part number PCB-109926-SIG01.

PCB-109926-SIG01 Test Fixtures

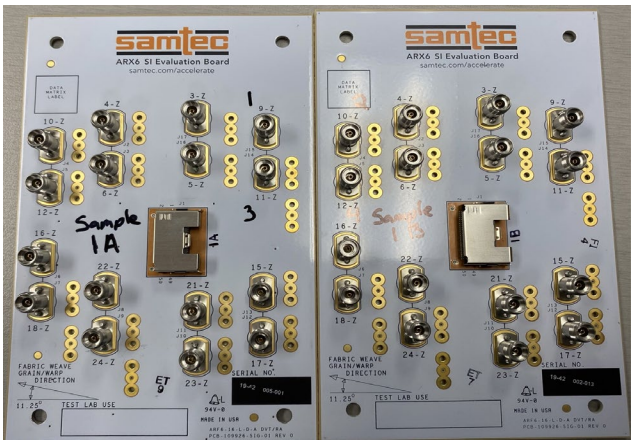

Figure 110

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Artwork of the PCB design is shown below.

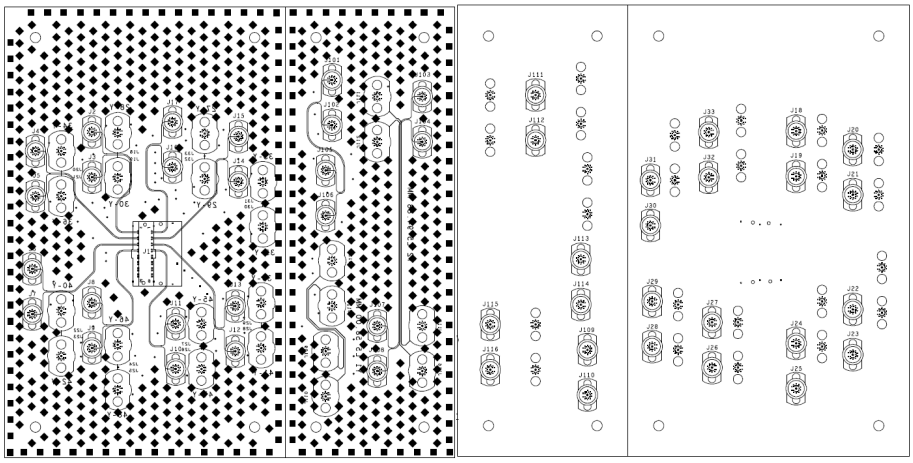

Figure 111

PCB Fixtures

The test fixtures used are as follows:

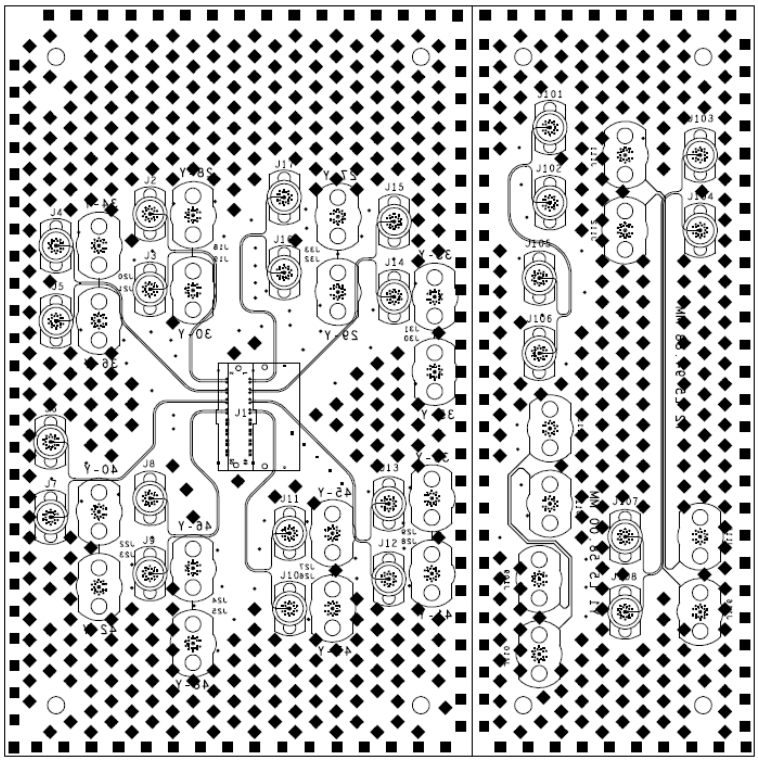

Figure 112

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

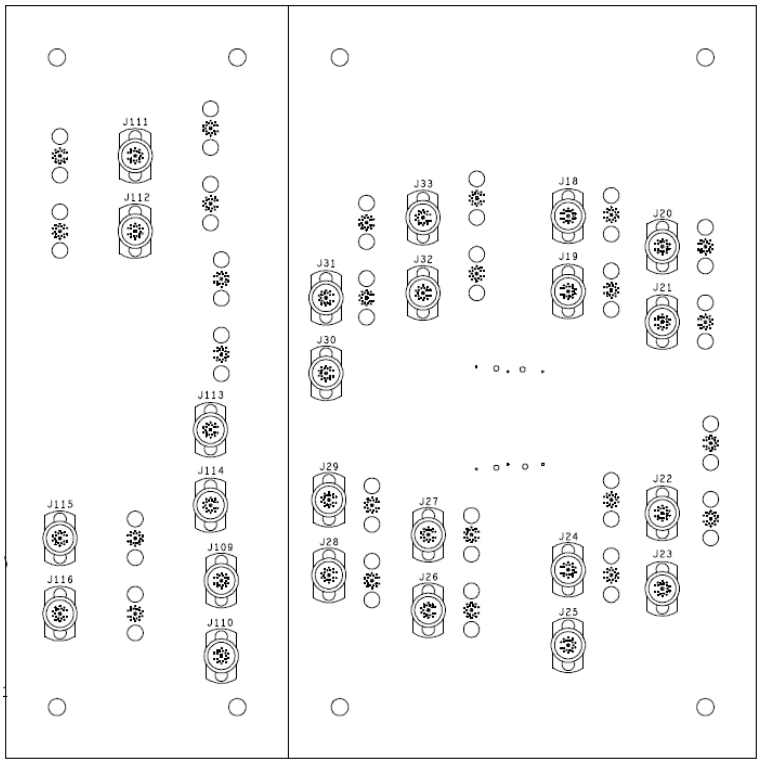

Figure 113

PCB-109926-SIG01 – ARC6 Cable Test Board

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Appendix B – Test and Measurement Setup

For frequency domain measurements, the test instrument is the Agilent N5224B PNA-L network analyzer. Frequency domain data and graphs are extracted from the instrument. The network analyzer is configured as follows:

Start Frequency – 10 MHz
Stop Frequency – 20 GHz
IFBW – 1 kHz

N5224B Measurement Setup

- High level visuals of the Vibe Cube and the Pig-Tail setup and DUT cable assembly.
- Pig-Tail back-2-back expected variations as we started with the test, on the X/Y direction (please note the Z is different).
- The measurement will be presented in the order they were measured.
  - Sample 1,2,3: X → Y → Z
  - Sample 4,5: Z → Y →X

X-axis set up

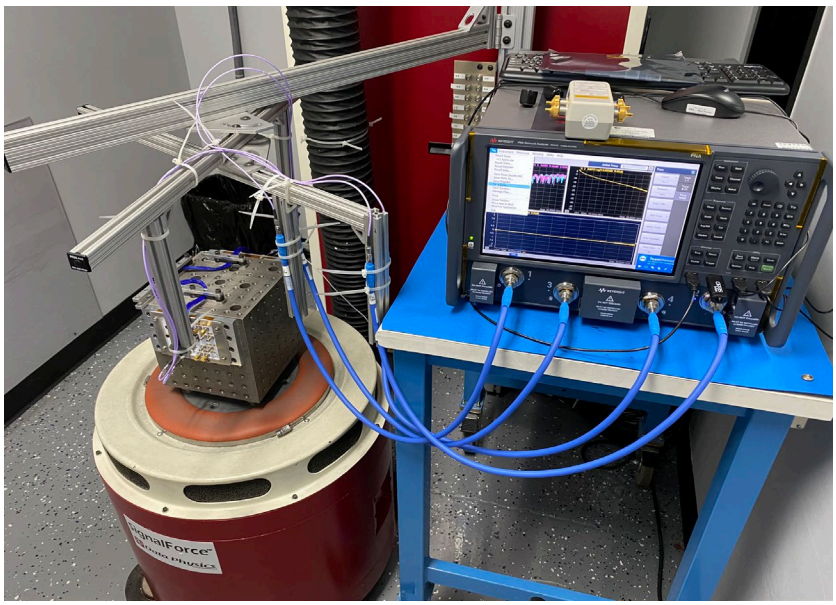

Figure 114

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

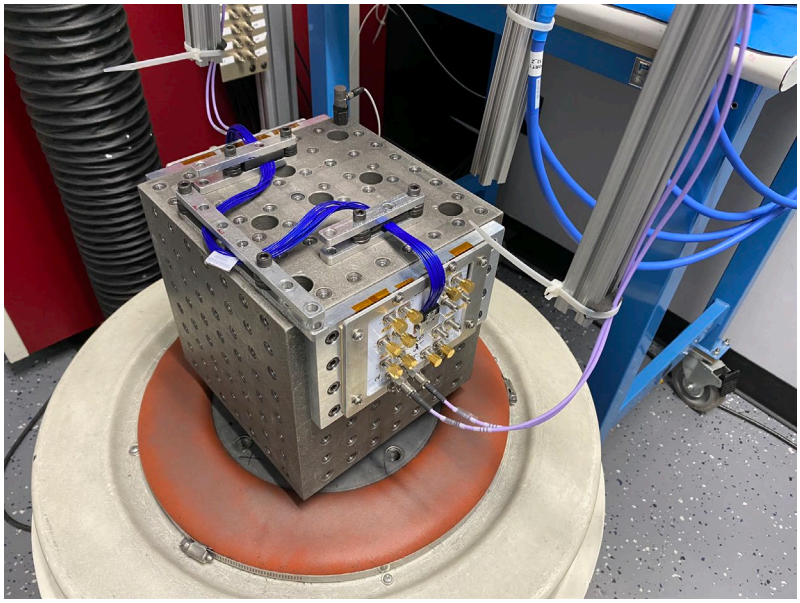

Figure 115

Y-axis set up

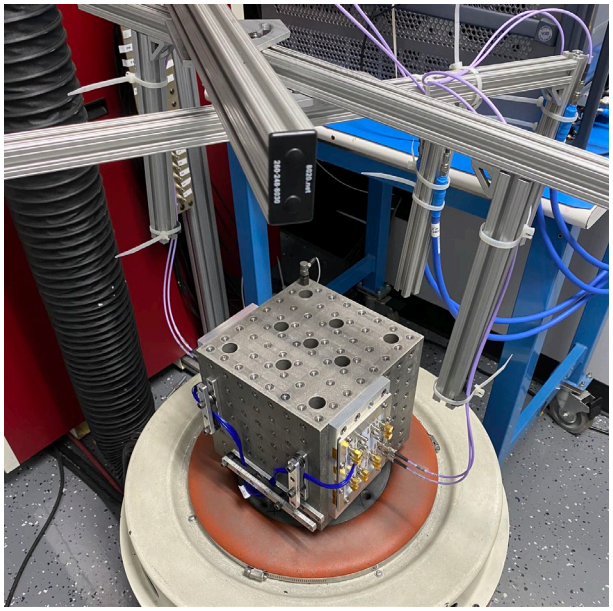

Figure 116

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

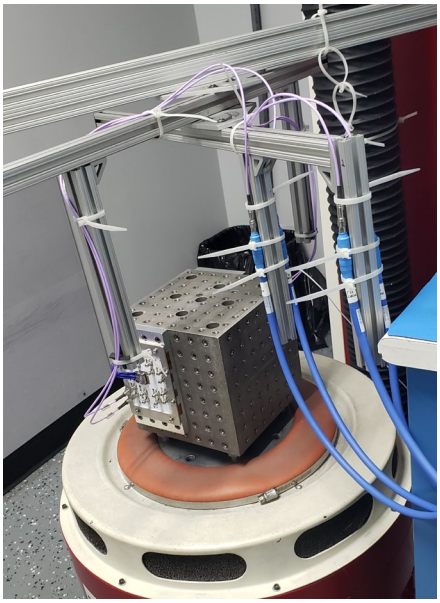

Figure 117

Z-axis set up

Figure 118

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

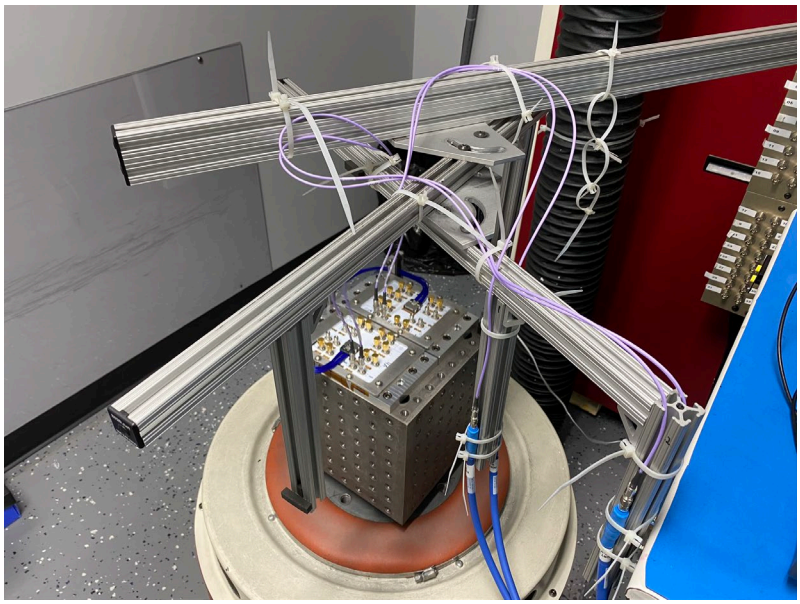

Figure 119

Test Instruments

QTY	Description
1	Keysight N5224B PNA-L Network Analyzer (10 MHz to 43.5 GHz)
1	Keysight N4694-60003 ECAL Module (10 MHz to 67 GHz)

Test Cables & Adapters

QTY	Description
4	Junkosha MWX241 (DC to 20 GHz)
4	Pigtail Cable (RF23C-92SP-92SJ-1000)

Series: ARC6
Description: AcceleRate® Slim Cable Assembly, 0.635 mm Pitch, 34 AWG, 100 Ω Eye Speed® Ultra-Low Skew Twinax Cable

Appendix C - Frequency 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 a N4694-60003 ECAL module. Then DUT measurements are performed under SOLT calibration. The measurements include the effect of test fixture. The measurements of the 2X THRU line standards are required to remove the test fixture effect.

Appendix D – Glossary of Terms

PCB – Printed Circuit Board
SUT – System Under Test
SOLT – acronym used to define Short, Open, Load & Thru Calibration Standards