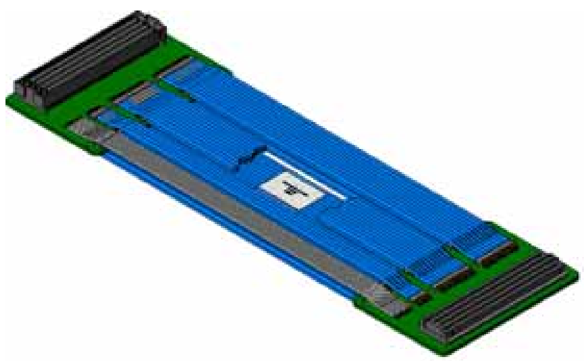
High Speed Characterization Report

HDR-153514-01
HDR-153514-02



Mated with:
ASP-134488-01 & ASP-134486-01

Description:
Vita 57 (FMC) High Pin Count (HPC) Cable Assembly

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Report Revision: 1/17/2013

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Introduction

This testing was performed to evaluate the electrical performance of the VITA 57 FMC (Field Programmable Mezzanine Card) HDR High Pin Count Cable Assemblies. Time domain and frequency domain measurements were made.

Time domain measurements included impedance, propagation delay, crosstalk and skew. Frequency domain measurements were performed using Tektronix's IConnect® and Measurement XTractor™ software (Version 3.6.0) and included insertion loss (IL), return loss (RL), near end crosstalk (NEXT) and far end crosstalk (FEXT).

All measurements were made utilizing two sets of test boards specifically designed for this project and are referred to as "test board" in this report. One set of test boards, used for Short Path testing, was PCB-103977-TST-01 and PCB-103977-TST-02. The second set, used for Long Path testing, was PCB-103977-TST-05 and PCB-103977-TST-06. A pair of calibration boards (PCB-103977-TST-99) was also used.

Product Description

The Vita 57 FMC High Pin Count Cable Assembly is constructed using 32 AWG, 100 Ω twinax cable. The cable is terminated at the first end with a SEAF High Speed High Density Open pin field Array Socket (Part Number: ASP-134486-01) and at the second end a SEAM High Speed High Density Open pin field Array Terminal (Part Number: ASP-134488-01). Overall assembly length is either 300-mm or 550-mm. Both assemblies are wired to facilitate a Pin 1 to Pin1 mapping between the cable ends.

Each Vita 57 FMC HDR High Pin Count Cable Assembly was tested by mating it to an ASP-134488-01 .050" Pitch Socket Array Assembly at one end and to an ASP-134486-01 .050" Pitch Terminal Array Assembly at the other end. One sample of each assembly was tested. The actual part numbers that were tested are shown in Table 1, which also identifies End 1 and End 2 of each assembly. A product drawing of the HDR-153514-XX is shown in Figure 1. Two differential pairs, a Long Path and a Short Path, of each assembly type were tested.

Length	Part Number	End 1 (SEAF)	End 2 (SEAM)
300 mm	HDR-153514-01	ASP-134486-01	ASP-134488-01
550 mm	HDR-153514-02	ASP-134486-01	ASP-134488-01

Table 1: Sample Description

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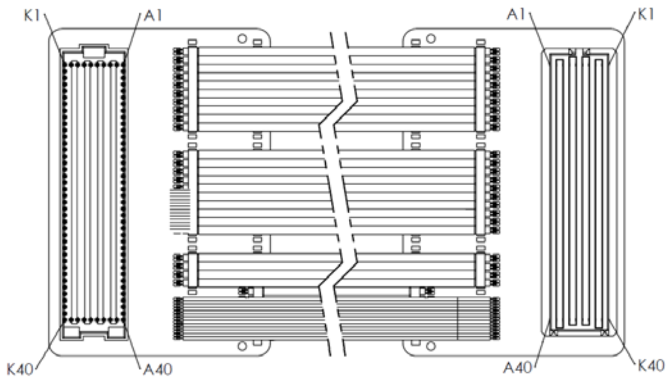

Figure 1: HDR-153514-XX Product Drawing

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 Vita 57 FMC High Pin Count cable assemblies tested.

Assembly	-7 dB Frequency	Speed Rating
HDR-153514-01	7500 MHz	15 Gbps
HDR-153514-02	7500 MHz	15 Gbps

Table 2: 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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Results Summary

Time Domain Data

Impedance

Impedance measurements were made using a filtered rise time of 100 pS.
The data presented in Table 3 is the impedance of the fully mated cable assembly and the cable impedance measured 200 pS into the cable.

Assembly	Path	End Option				Cable	
		End 1		End 2		End 1	End 2
		Z_{Min} (Ω)	Z_{Max} (Ω)	Z_{Min} (Ω)	Z_{Max} (Ω)	Z_{max} (Ω)	Z_{max} (Ω)
HDR-153514-01	Long	88.6	107.9	87.3	109.4	100.4	100.4
	Short	94.2	103.8	92.6	104.1	98.8	98.6
HDR-153514-02	Long	88.3	111.4	90.2	118.1	100.2	100.8
	Short	91.7	103.8	92.0	104.0	98.5	98.5

Table 3: Impedance Measurements

Timing Measurements

Skew was calculated as the difference between the propagation delays of the longest and the shortest electrical paths. End 1 of the assembly was the source end for these measurements.

Assembly	Path	Propagation Delay (nS)	Skew (nS)
HDR-153514-01	Long	1.786	0.354
	Short	1.432	
HDR-153514-02	Long	2.985	0.362
	Short	2.623	

Table 4: Timing Measurements

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NEXT

The near end crosstalk was measured in the time domain and converted to a percentage and reported below in Table 5. The incident pulse amplitude from the TDR was 470 mV. The acquired data was measured using a filtered rise time of 100 pS. The End 1 heading in Table 5 represents the near-end of the assembly, i.e. the source end. All NEXT measurements were performed with the assembly mated to the respective connector/test board. Since most of the crosstalk occurs in the connectors, the values in Table 5 represent the crosstalk that occurs in the near-end mated assembly and the test board connectors.

Assembly	Path	END1		END 2	
		NEXT (mV)	NEXT (%)	NEXT (mV)	NEXT (%)
HDR-153514-01	Long	2.8	<1.0	2.6	<1.0
	Short	3.1	<1.0	3.1	<1.0
HDR-153514-02	Long	3.0	<1.0	3.0	<1.0
	Short	3.1	<1.0	3.0	<1.0

Table 5: % NEXT

FEXT

The far end crosstalk was measured in the time domain and converted to a percentage and reported below in Table 6. The incident pulse amplitude from the TDR was 470 mV. The acquired data was measured using a filtered rise time of 100 pS. The End 1 heading in Table 6 represents the near-end cable assembly connector, i.e. the source end. All FEXT measurements were performed with the cable assembly mated to the respective connector/test board. The values in Table 6 represent the crosstalk measured at the far end of the assembly.

Assembly	Path	END1		END 2	
		FEXT (mV)	FEXT (%)	FEXT (mV)	FEXT (%)
HDR-153514-01	Long	1.4	<1.0	1.3	<1.0
	Short	1.0	<1.0	1.0	<1.0
HDR-153514-02	Long	1.2	<1.0	1.1	<1.0
	Short	1.0	<1.0	1.0	<1.0

Table 6: % FEXT

Series: HDR-153514-XX
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Frequency Domain Data

Insertion Loss

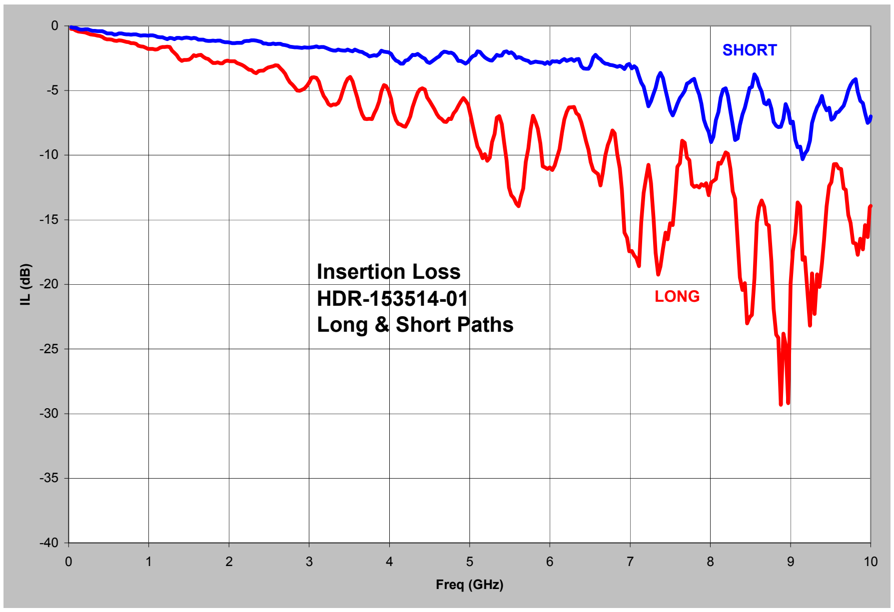

Figure 2: HDR-153514-01 Insertion Loss

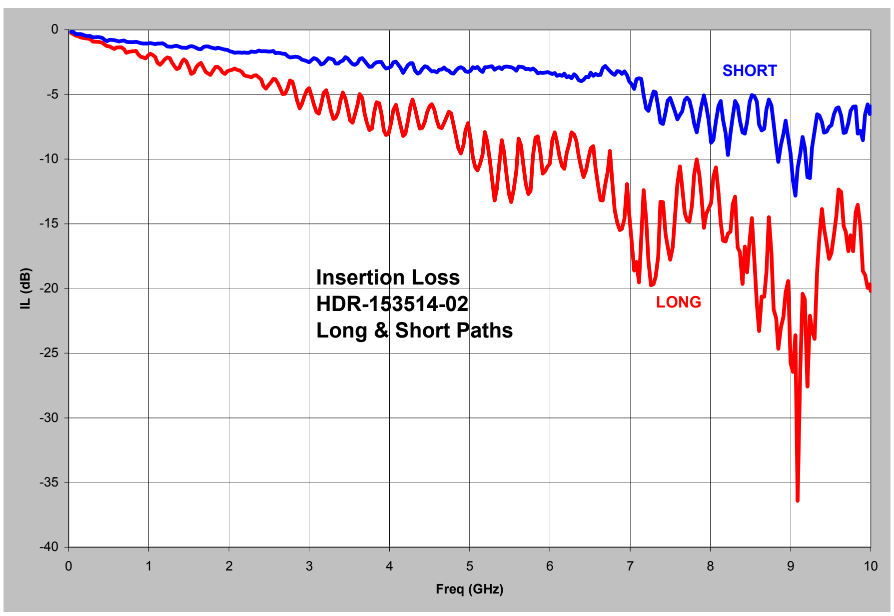

Figure 3: HDR-153514-02 Insertion Loss

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Return Loss

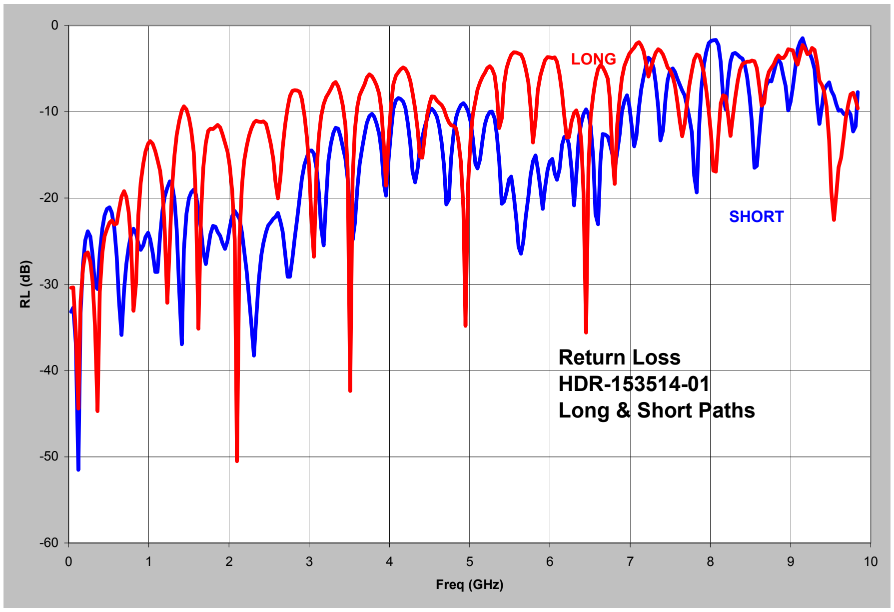

Figure 4: HDR-153514-01 Return Loss

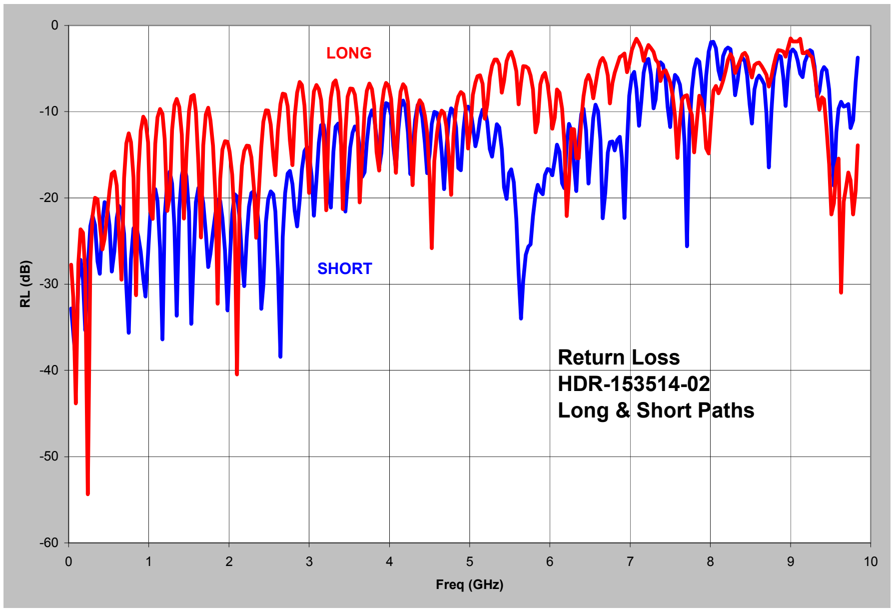

Figure 5: HDR-153514-02 Return Loss

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Near End Crosstalk

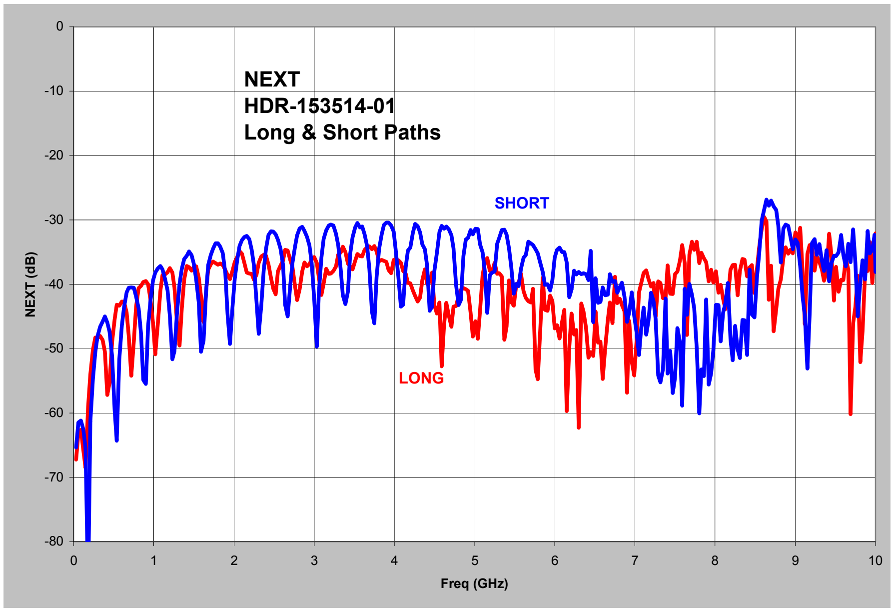

Figure 6: HDR-153514-01 NEXT

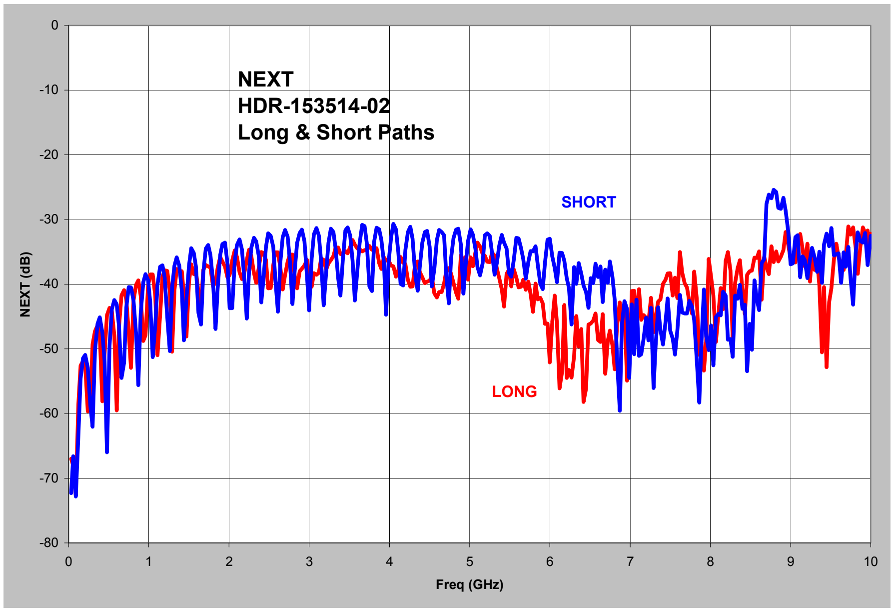

Figure 7: HDR-153514-02 NEXT

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Far End Crosstalk

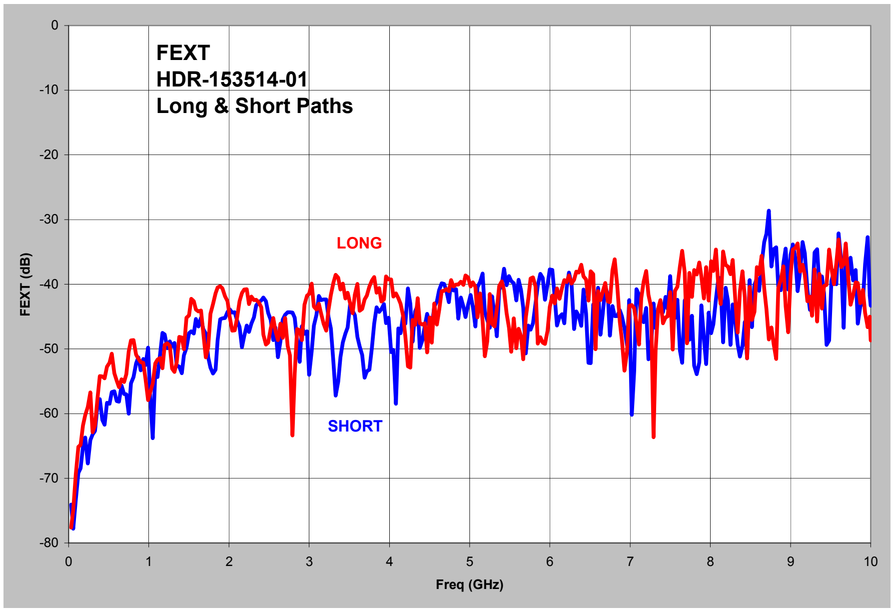

Figure 8: HDR-153514-01 FEXT

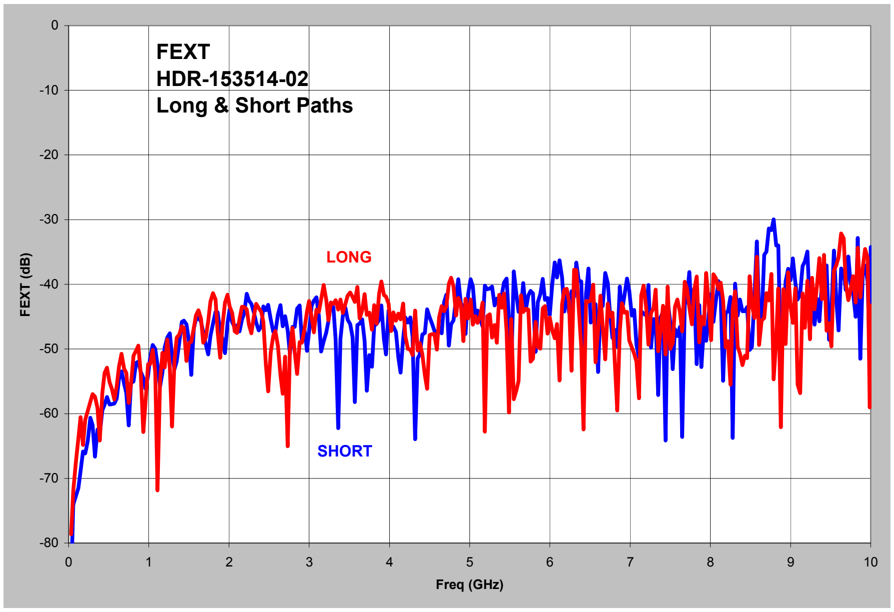

Figure 9: HDR-153514-02 FEXT

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Test Procedures

Fixturing:

PCB-103977-TST-XX:

All measurements were performed using test boards identified as PCB-103977-TST-01, PCB-103977-TST-02, PCB-103977-TST-05 and PCB-103977-TST-06. PCB-103977-TST-XX have signal traces with a nominal length of 3.124 inches that provide for the interconnection to the Vita 57 FMC High Pin Count cable assemblies by use of field replaceable SMA connectors. The CAL Board identified as PCB-103977-TST-99 provides THRU and Open reference traces; the artwork of PCB-103977-TST-0X is shown below in Figure 10.

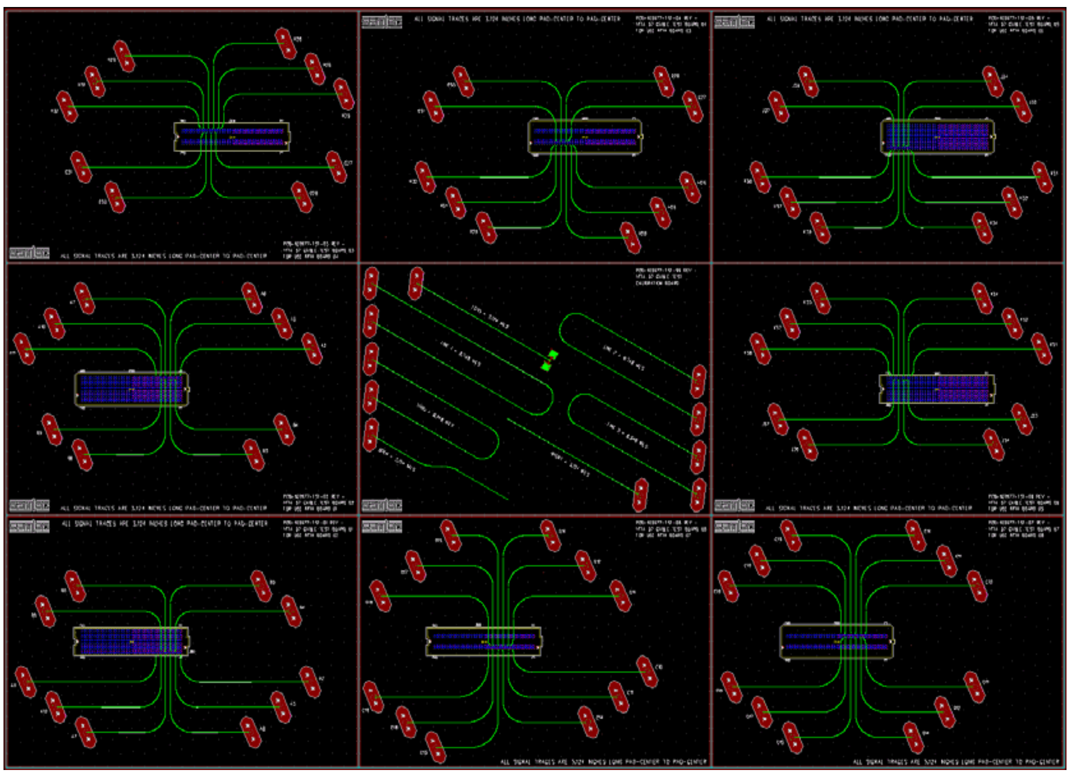

Figure 10: PCB-103977-TST-XX and PCB-103977-TST-99 Artwork

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Figure 11 below shows how the THRU reference traces were utilized to compensate for the losses due to the coaxial test cables, SMA launches, and the test board traces during testing.

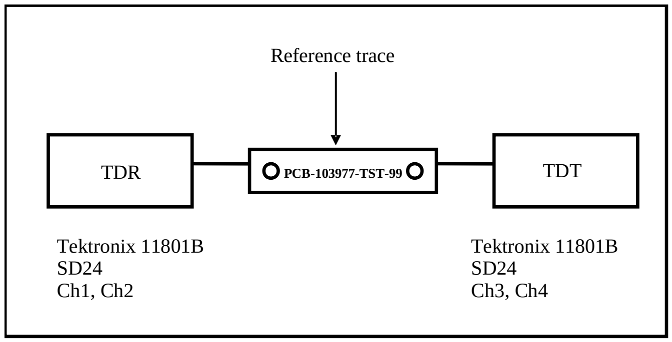

Figure 11: Test setup for Thru Reference Acquisition

Measurements were then performed using the test boards as shown in Figure 12.

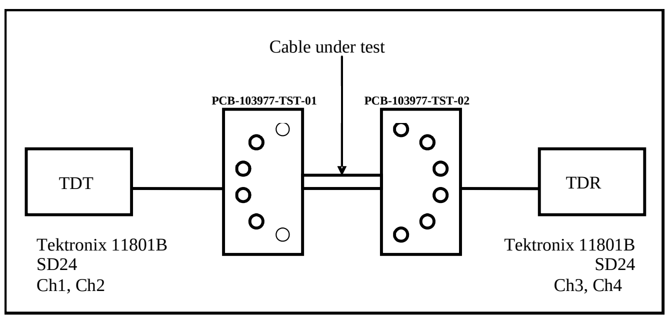

Figure 12: PCB-103977-TST-01 and PCB-103977-TST-02

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The cable assembly terminations had a particular signal line configuration. The respective signal line numbers that were made available as test ports and that were used during the testing are shown in Table 7 below. All adjacent lines are terminated where applicable. Not all positions are shown.

											K32	G	K34	K35	G	**K37**	**K38**	G
											G	J33	J34	G	J36	J37	G	
	G	G	B4	B5	G	G	B8	B9	G									
G	**A2**	**A3**	G	G	A6	A7	G	G	A10									

Table 7: Respective signal line numbers as viewed from End 1

Table 8 below shows the signal line numbers corresponding to the Inner and Outer paths for the different configurations tested. The test board jack numbers correspond to the assembly line numbers.

Assembly	**Path**	
	Long	**Short**
HDR-153514-01	K37/K38	A2/A3
HDR-153514-02	K37/K38	A2/A3

Table 8: Long and Short Path Signal Line Numbers

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Time Domain Testing

Impedance:

The Tektronix 11801B oscilloscope was set up in TDR (time domain reflectometry) mode using a 100-pS filtered risetime and 16 averages. The horizontal setup of the TDR used a 512 point record length and a horizontal scale of 200 pS/div to allow the near end connector and a portion of the cable to be displayed. All connector impedance measurements were made at the near-end of the mated cable system. Cable impedance was measured 200 pS into the cable after the connector.

Propagation Delay:

The propagation delay was measured and skew calculated by first acquiring a thru reference pulse of the reference line. Using the delay function of the TDR, set at 50% amplitude of the reference pulse, the sample was inserted and the sample delay was measured. The TDR delay function calculates the sample delay by subtracting the delay measurement of the reference pulse from the delay measurement of the sample plus the test board traces.

Skew

Skew is defined as the difference between of the propagation delays of the longest (maximum delay) and the shortest (minimum delay) electrical paths.

NEXT and FEXT

Near end crosstalk (NEXT) and far end crosstalk (FEXT) measurements were made using the Tektronix 11801B oscilloscope. A thru reference of the coaxial test cables, SMAs, and reference board was performed to determine the pulse amplitude of the TDR generator.

To acquire NEXT, a signal was applied using the oscilloscope pulse generator. NEXT was measured on an adjacent signal line at the near end (see Figure 13). To acquire FEXT, a line was driven with the oscilloscope pulse generator. FEXT was measured on an adjacent line at the far end. All adjacent lines were terminated, at both ends, with 50Ω SMA loads.

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Frequency Domain Testing

All frequency domain measurements were made using the Tektronix 11801B oscilloscope. Testing was performed using a risetime of 35 pS. The horizontal scale was set to 5 nS/div, the record length was set to 5120 points and the number of averages was set to 128. These values were selected to ensure the ratio between the number of points and the window length was long enough to capture the highest frequencies and still yield a small enough frequency step to gain adequate resolution. End 1 of the assembly was the source end for all frequency domain measurements. All adjacent lines were terminated at both ends with 50Ω SMA loads.

Attenuation

Insertion Loss test setup losses were compensated for by acquiring a thru measurement (reference output pulse) of the coaxial test cables, SMAs, and the reference lines (see Figure 10). A thru measurement of an assembly was taken and then post processed by using Tektronix IConnect® software. The result is the insertion loss of the cable assembly.

Return Loss

An open circuit reference measurement was taken using OPEN reference traces from a pair of CAL boards. A matched reflection waveform of the cable assembly, i.e. with the assembly terminated in 50-Ω SMA loads on the far end test board, was acquired and then post processed by using Tektronix IConnect® software. The result is the return loss of the cable assembly.

Near and Far End Crosstalk

NEXT and FEXT were measured in the time domain using the oscilloscope and then converted to frequency domain data using Tektronix IConnect® software. Initially a thru reference measurement of the coaxial test cables, SMAs, and reference line was performed to compensate for the test setup losses.

To acquire NEXT a line was driven using the oscilloscope pulse generator. NEXT was measured, in the time domain, on an adjacent line, Figure 13. NEXT was then post processed using Tektronix's IConnect® software to generate the NEXT of the cable assembly in the frequency domain.

To acquire FEXT a line was driven using the oscilloscope pulse generator. FEXT was measured in the time domain on an adjacent line at the far end, Figure 14. FEXT was then post processed using Tektronix's IConnect® software to generate the FEXT of the cable assembly in the frequency domain.

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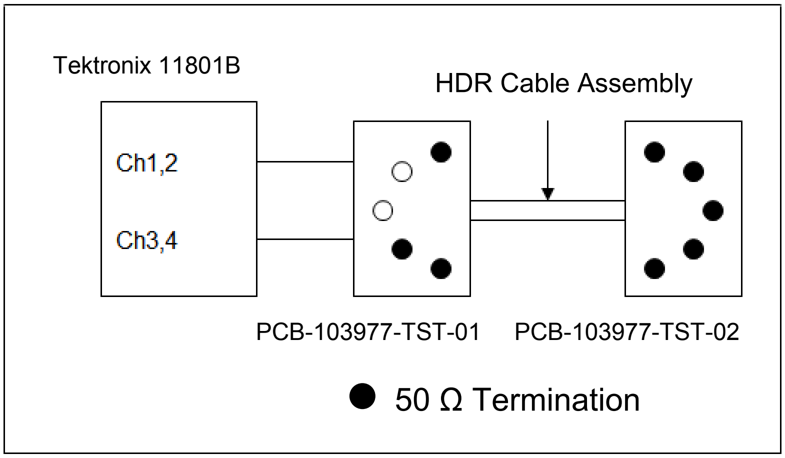

Figure 13: NEXT Measurement Setup.

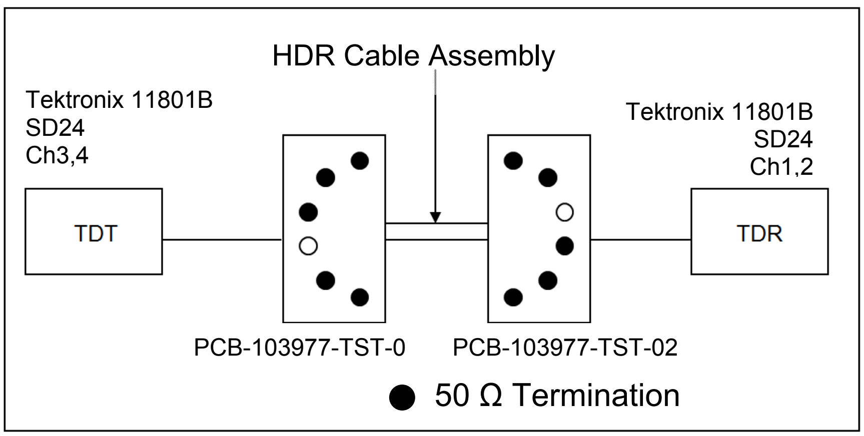

Figure 14: FEXT Measurement Setup

Equipment

Time Domain Testing

Tektronix 11801B Oscilloscope
Tektronix SD24 TDR/Sampling Head (X2)

Software

Tektronix IConnect® MeasureXtrator™ 3.6.0

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