High Data Rate Characterization Report

VPSTP-016-1000-01

Mated with:
VRDPC-50-01-M-RA and VRDPC-50-01-M-RA

Description:
Plug Shielded Twisted Pair Cable Assembly, 0.8mm Pitch

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Introduction

This testing was performed to evaluate the electrical performance of the VPSTP series of high-speed cable systems. Testing was performed in accordance to the High Performance Electrical Interconnect (HPEI) SFF-8416, Level 1[1] testing standards when applicable.

Time domain and frequency domain measurements were made. Time domain measurements included impedance, propagation delay, crosstalk and skew. Frequency domain measurements were preformed 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 test boards specifically designed for this project and are referred to as "test board" in this report. The test boards were identified as "PCB-100473-TST-01".

Product Description

Each sample consists of a 1-meter long, #30 AWG shielded twisted pair cable. The cable is terminated by soldering a small transition PCB (termination board) at each end. Each termination board has a connector soldered to it. The cable assembly is terminated with a DS high-speed plug at each end.

One wiring configuration was tested, Connector Option -01, which connects the First End Pin #1 to the Second End Pin # 1. The VPSTP cable assembly was tested by mating it to a VRDPC test board connector. One sample was tested. The actual part number that was tested is shown in Table 1, which also identifies End 1 and End 2 of the assembly; a relative sample picture of the terminating connectors is shown in Figure 1. End 1 is on the left when the cable jacket markings are read in normal fashion with the assembly stretched out left to right. Two lines, the longest and the shortest electrical paths, of the sample were tested.

Length	Part Number	Termination	End 1	End 2
1000 mm	VPSTP-016-1000-01		DS1	DS1

Table 1: Sample Descriptions

[1] Measurement and Performance Requirements for HPEI Bulk Cable**,** Rev 15, June 27, 2005

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Figure 1: Test Sample Terminations

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Results Summary

Time Domain Data

Impedance

Impedance measurements were performed using a filtered risetime of 100 pS. Note that all measurements were performed with the cable assembly mated to the respective connector/test board. Data was measured at the cable connector and 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_{nom} (Ω)	Z_{nom} (Ω)
DS1-DS1-01	Long	75.4	104.5	75.6	133.2	95.6	92.9
	Short	78.4	129.8	78.0	115.6	96.0	94.3

Table 2: Impedance Measurements

Timing Measurements

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

The results are tabulated below.

Assembly	Path	Propagation Delay (nS)	Skew (nS)
DS1-DS1-01	Long	4.751	.015
	Short	4.766	

Table 3: 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 4. The incident pulse amplitude from the TDR was 478 mV. The acquired data was measured using a filtered rise time of 100 pS. The End 1 and End 2 headings in Table 4 represents the near-end cable assembly connector, i.e. the source end. All NEXT measurements were performed with the cable assembly mated to the respective connector/test board. Since most of the crosstalk occurs in the connectors, the values in Table 4 represent the crosstalk that occurs in the near-end mated cable assembly and the test board connectors.

Assembly	Path	End 1		End 2	
		NEXT (mV)	NEXT (%)	NEXT (mV)	NEXT (%)
DS1-DS1-01	Long	7.0	1.46	35.2	7.36
	Short	12.2	2.55	7.6	1.59

Table 4: % NEXT

FEXT

The far 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 478 mV. The acquired data was measured using a filtered rise time of 100 pS. The End 1 and End 2 headings in Table 5 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 5 represent the crosstalk measured at the far end of the assembly.

Assembly	Path	End 1		End 2	
		FEXT (mV)	FEXT (%)	FEXT (mV)	FEXT (%)
DS1-DS1-01	Long	5.76	1.21	15.8	3.31
	Short	13.4	2.80	13.2	2.76

Table 5: % FEXT

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Frequency Domain Data

Insertion Loss

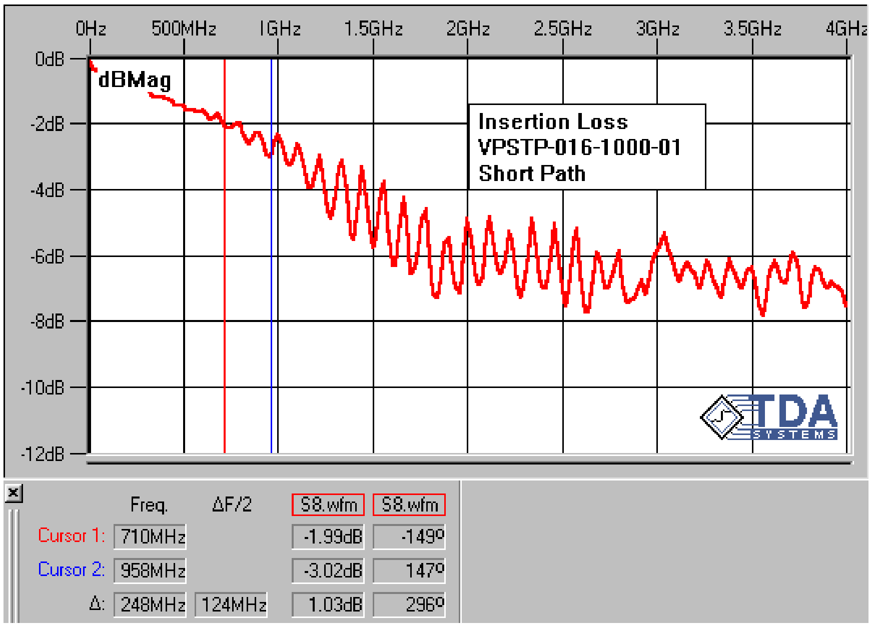

Figure 2: VPSTP-016-1000-01 Insertion Loss Short Path

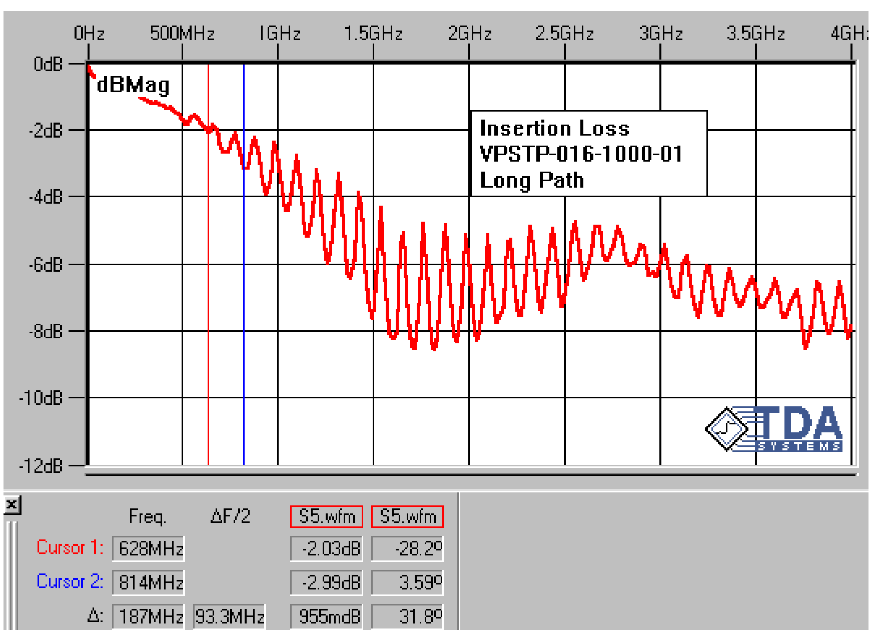

Figure 3: VPSTP-016-1000-01 Insertion Loss Long Path

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Return Loss

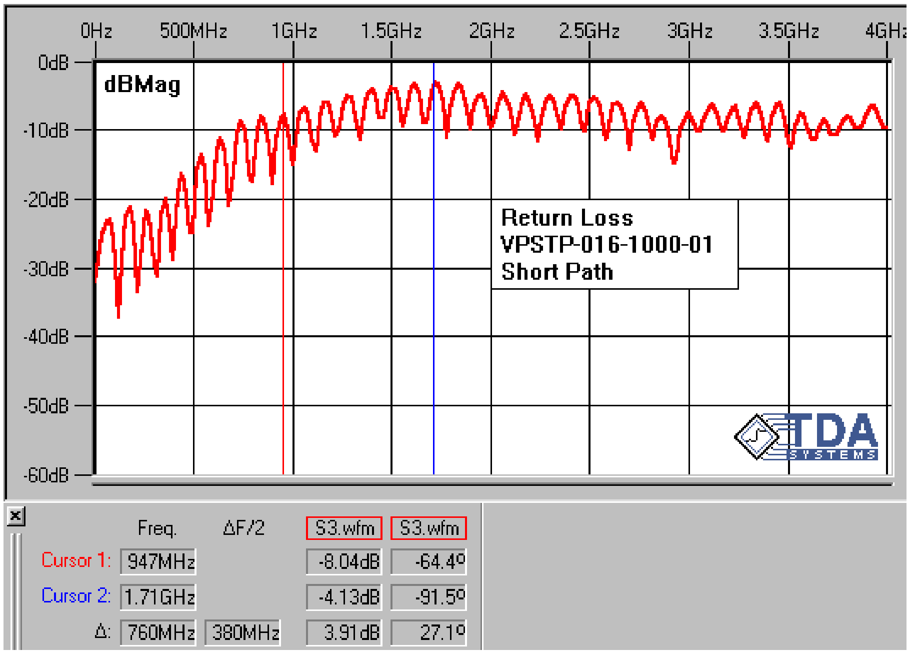

Figure 4: VPSTP-016-1000-01 Return Loss Short Path

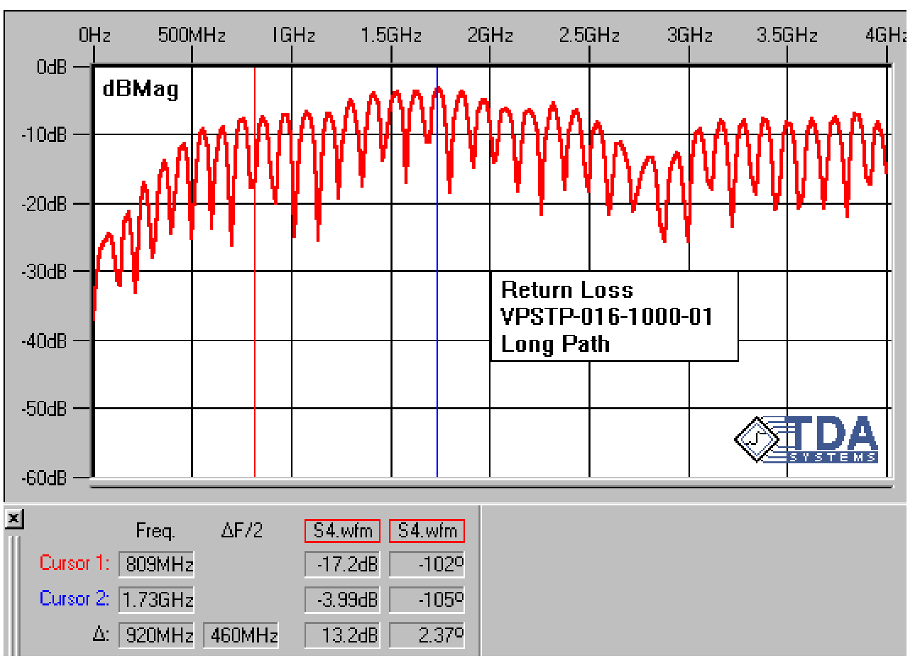

Figure 5: VPSTP-016-1000-01 Return Loss Long Path

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Near End Crosstalk

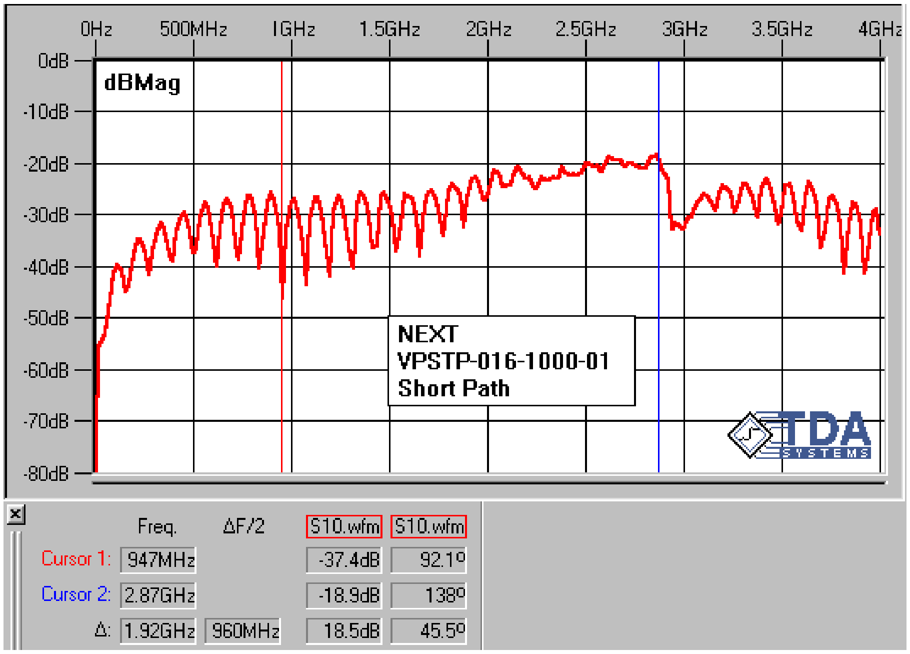

Figure 6: VPSTP-016-1000-01 NEXT Short Path

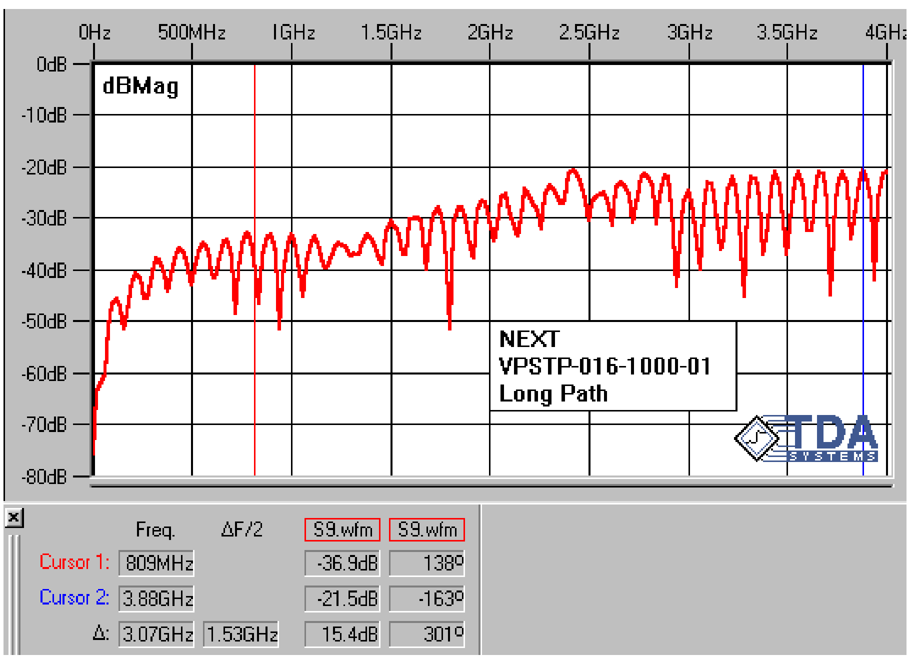

Figure 7: VPSTP-016-1000-01 NEXT Long Path

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Far End Crosstalk

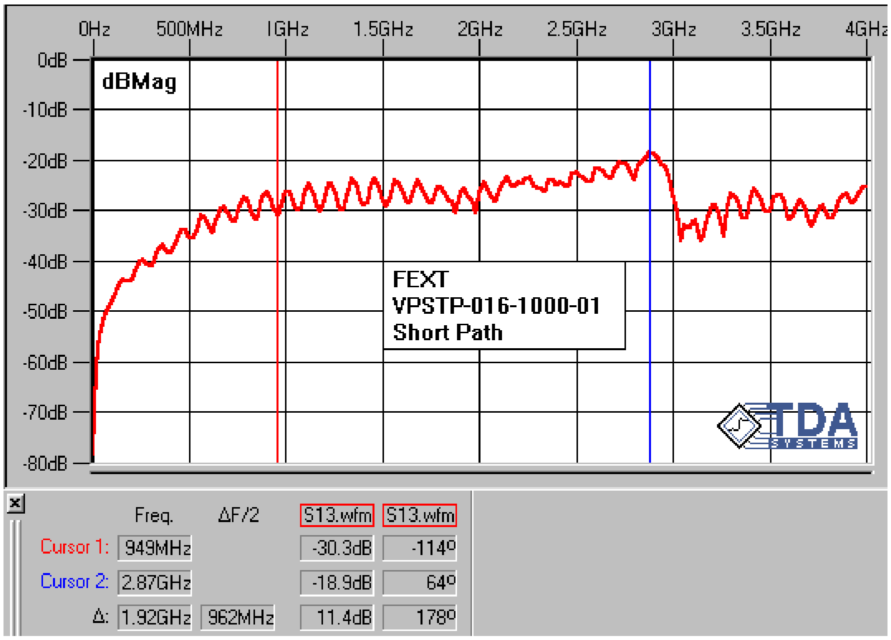

Figure 8: VPSTP-016-1000-01 FEXT Short Path

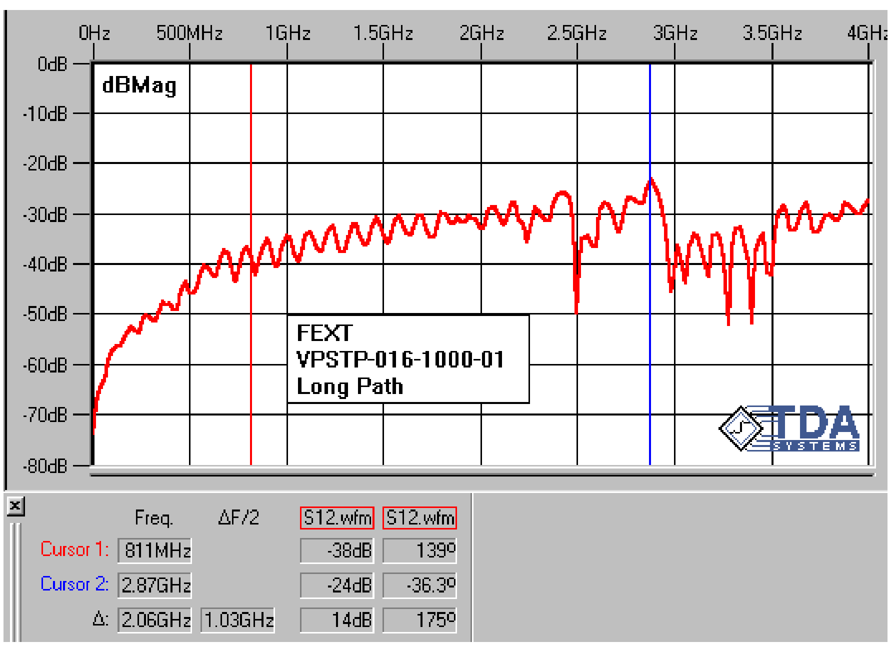

Figure 9: VPSTP-016-1000-01 FEXT Long Path

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Test Procedures

Fixturing:

All measurements were performed using the test boards. The test boards have trace lengths of 3.000 inches and provide for the interconnection to the VPSTP cable by use of replaceable SMA connectors. Each test board had a pair of THRU reference traces. Figure 10 below shows how the THRU reference trace pair was utilized to compensate for the losses due to the coaxial test cables, SMA launches, and the test board traces during testing.

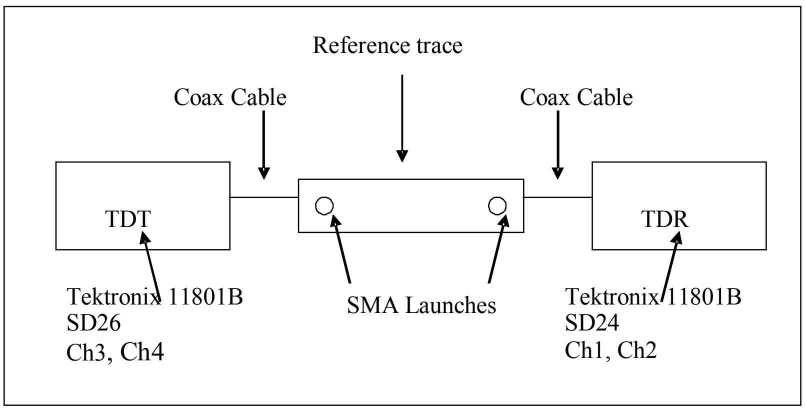

Figure 10: Test setup for Thru Reference Acquisition

Measurements were then performed using the test boards as shown in Figure 11. A picture of the test board and cable is shown in Figure 12.

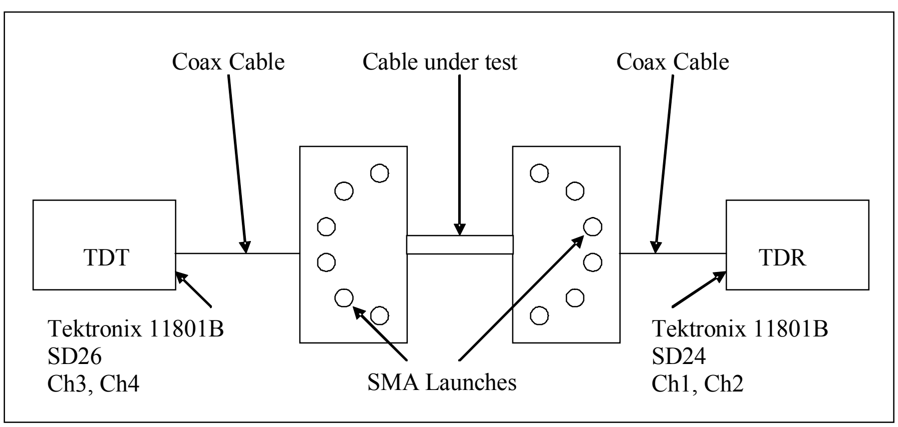

Figure 11: Characterization test setup

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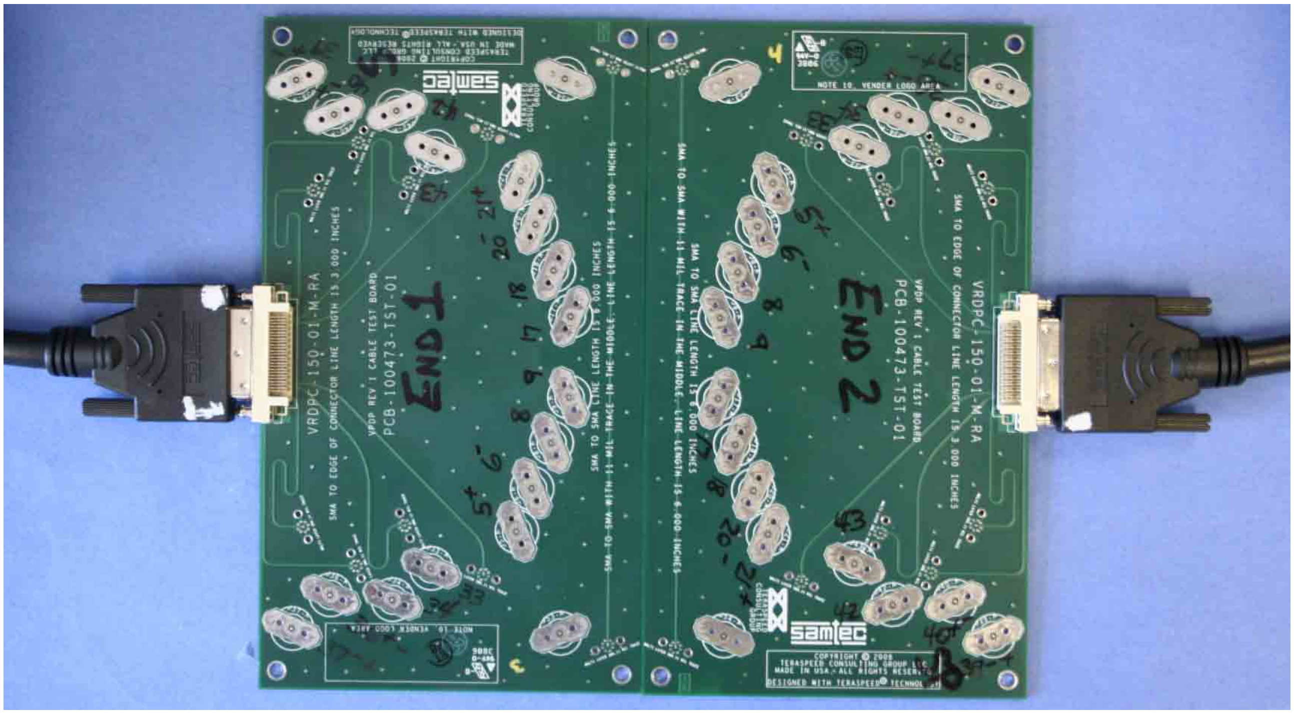

Figure 12: Test setup with Test PCBs and EQDP cable.

The cable terminations had a particular S & G configuration. The respective signal line numbers are shown in Table 6 below (there are a total of 25 positions per row). All adjacent line pairs are terminated where applicable.

G	2	3	G	5	6	G	8	9	G	G	G	G	G	G	G	17	18	G	20	21	G	23	24	G
G	G	G	G	30	31	G	33	34	G	36	37	G	39	40	G	42	43	G	45	46	G	G	G	G

Table 6: Grounding scheme and respective signal line numbers

Table 7 below shows the signal line numbers corresponding to the short and long paths for the different configurations tested.

Assembly	Path	
	Long	Short
DS1-DS1-01	J2-J3 → J24-J23	J36-J37 → J40-J39

Table 7: Long Path 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 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 impedance measurements were made at the near-end connector and 200 pS into the cable.

Propagation Delay:

The propagation delay was measured and skew calculated by first acquiring a thru reference pulse of the reference trace pair. 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 (see Figure 10).

To acquire NEXT, a signal was applied using the oscilloscope pulse generator. NEXT was measured on an adjacent signal line pair at the near end (see Figure 13). To acquire FEXT, a trace pair was driven with the oscilloscope pulse generator. FEXT was measured on an adjacent trace pair at the far end (see Figure 14). All adjacent line pairs were terminated, at both ends, with 50Ω SMA loads; refer to Figures 13 and 14.

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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 the frequency domain measurements. All adjacent line pairs were terminated at both ends with 50Ω SMA loads; refer to Figures 13 and 14.

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 trace pair (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 a signal trace on a test fixture board without mating connector to the cable assembly. A matched reflection waveform of the cable assembly, i.e. with the cable 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 board trace pair was performed to compensate for the test setup losses (see Figure 10).

To acquire NEXT a trace pair was driven using the oscilloscope pulse generator. NEXT was measured, in the time domain, on an adjacent trace pair (see 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 trace pair was driven using the oscilloscope pulse generator. FEXT was measured in the time domain on an adjacent trace pair at the far end (see 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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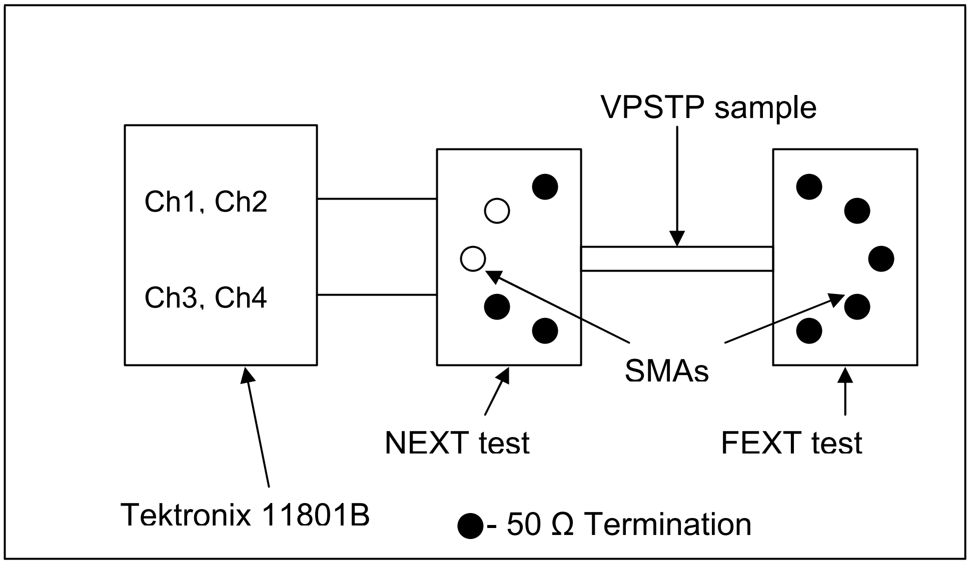

Figure 13: NEXT Measurement Setup.

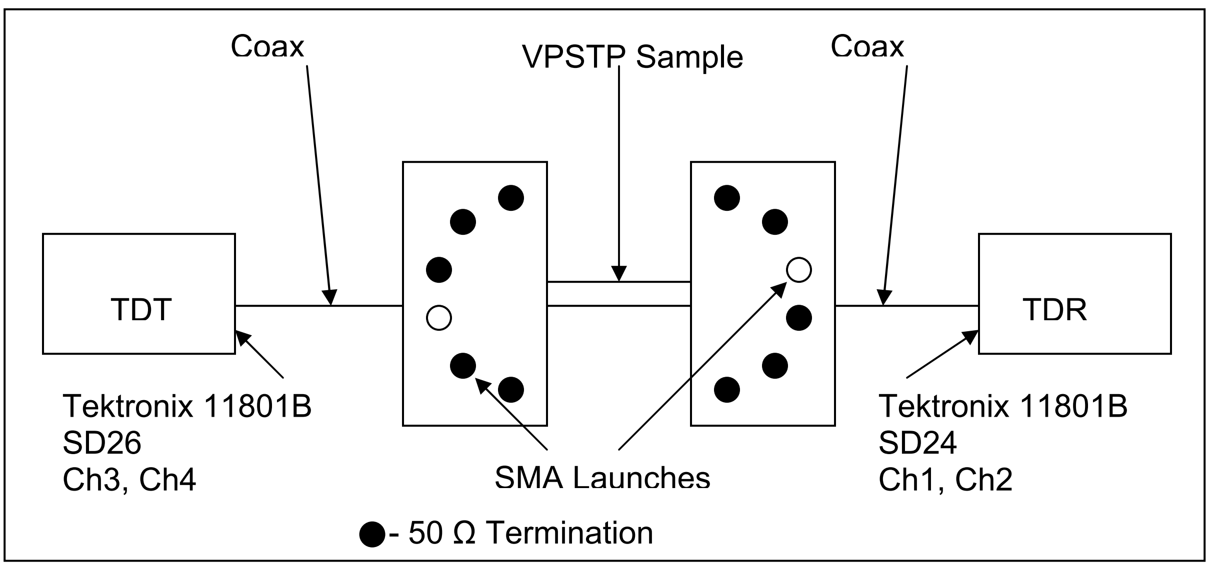

Figure 14: FEXT Measurement Setup

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Equipment

Time Domain Testing

Tektronix 11801B Oscilloscope
Tektronix SD24 TDR/Sampling Head
Tektronix SD26 Sampling Head