SEARAY Flex Assembly

High-Speed Electrical Performance

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I. Test Fixture

Test Boards

The test fixture consisted of two test boards – one with a male connector and the other with a female connector. The test boards were constructed with NELCO-12 dielectric and utilized a strip line construction with length matched traces. Calibration traces from the same panel as the test board was used to calibrate out some of the test fixture error.

Figure 1: Male Test Board

Figure 2: Female Test Board & Calibration Traces

Test Equipment

Tektronix TDS8000 Digital Sampling Oscilloscope
Agilent 8722ES S-Parameter Network Analyzer

Device Under Test

The DUTs six flex assemblies with a male SEARAY connector on one end and a female SEARAY connector on the other end. Three of these assemblies were approximately three inches long and the other three were approximately 15 inches long. Construction details are listed below.

MATERIAL	POLYIMIDE
CONSTRUCTION	STRIPLINE
TRACE LENGTH	2.8" AND 14.8"

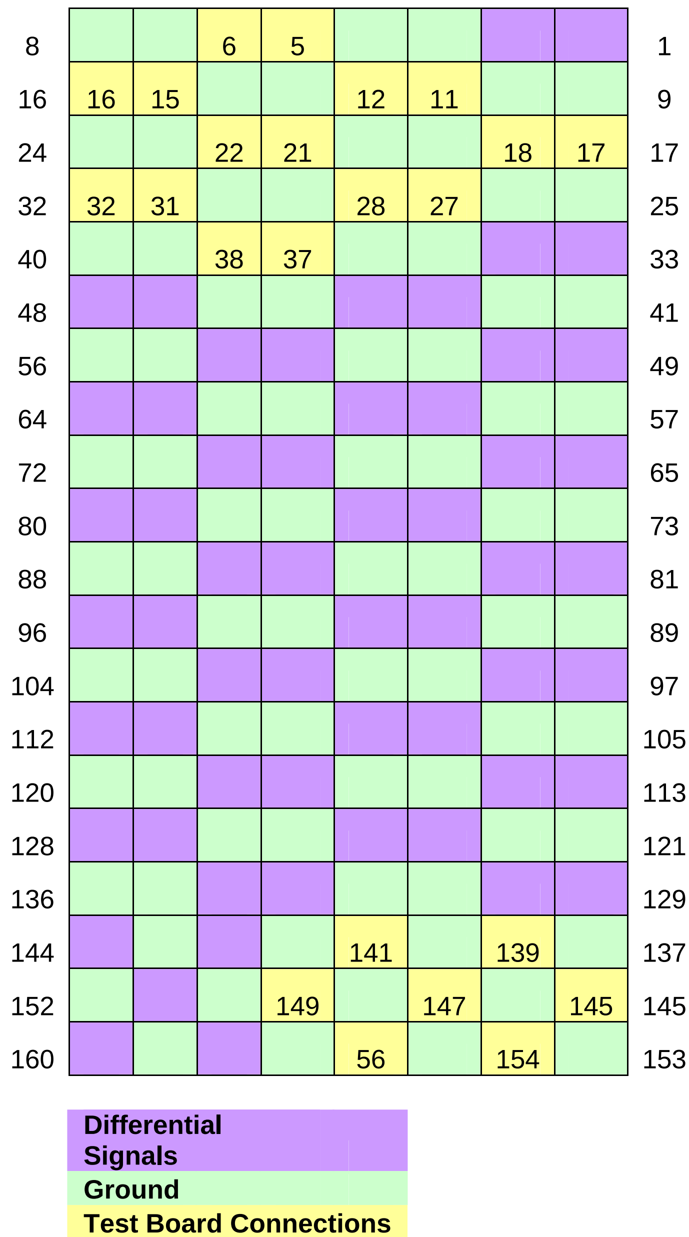

Figure 3: Test Board Pinout

II. Time Domain Analysis

TDR Impedance Data

The following graphs show the impedance profile of the assembly launch. They include the test boards and connectors. Only the near end is shown. The rise time used was 40ps 10% to 90%. The impedance profile below is typical. Most profiles have peaks within 2 ohms of the values below.

Figure 4: Differential Impedance

Near End Cross Talk

In these measurements the victim and the aggressor are on the same test board. The test board at the far end is terminated to 100 ohms differential. The aggressor was 500mVpp.

Figure 5: Cross Talk Configurationshows a portion of the connector pinout configuration. The yellow pair was the victim for the measurements. Each red pair was an aggressor. Only one aggressor pair was active at a time.

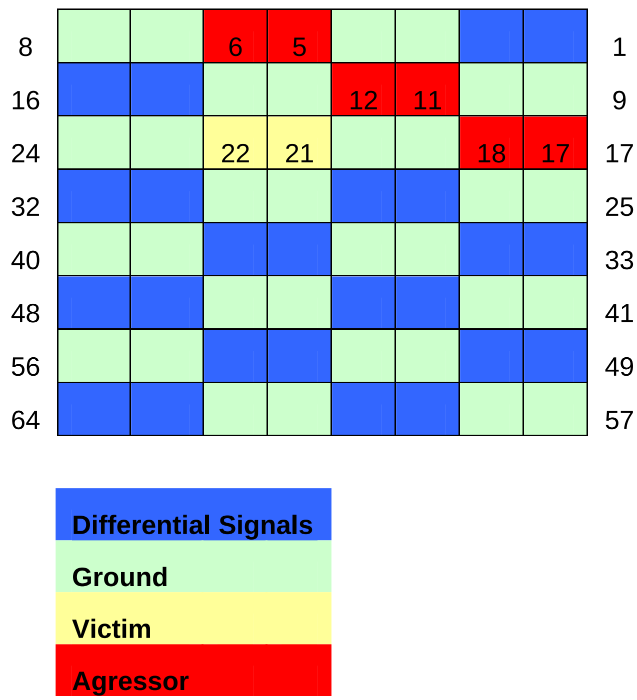

Figure 5: Cross Talk Configuration

Near End Cross Talk (continued)

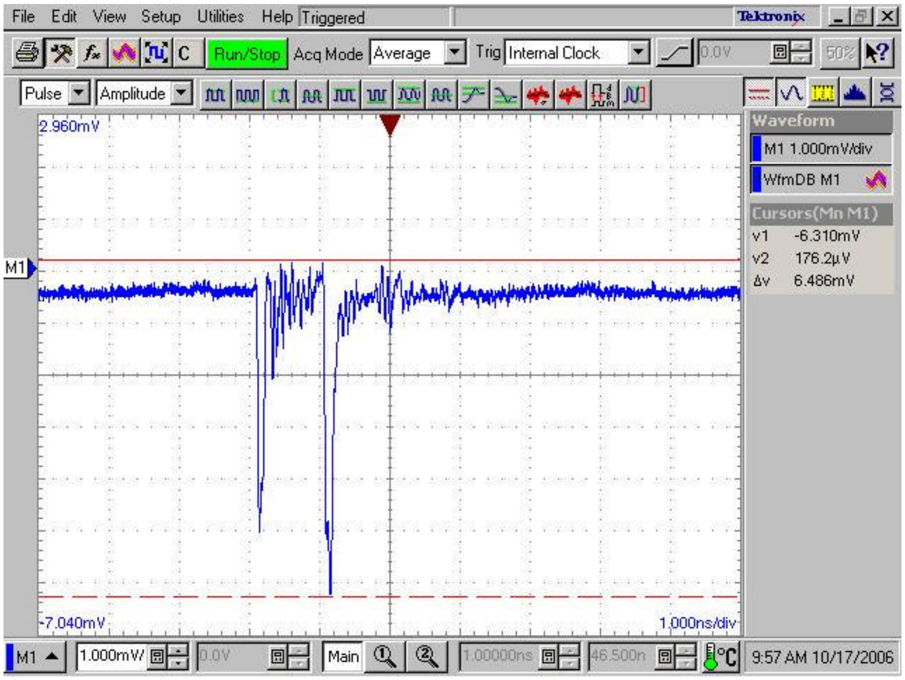

Figure 6: Worse Case 2.8" Trace NEXT

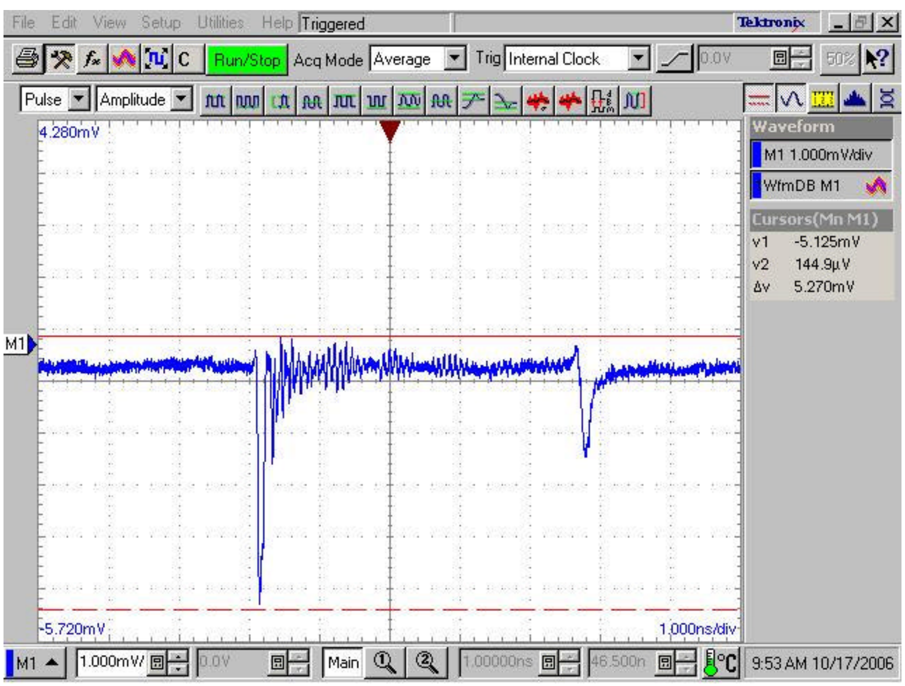

Figure 7: Worse Case 14.8" Trace NEXT

Far End Cross Talk

In these measurements the victim and the aggressor are on opposite test boards. The other ends are terminated to 100 ohms differential. The aggressor was 500mVpp.

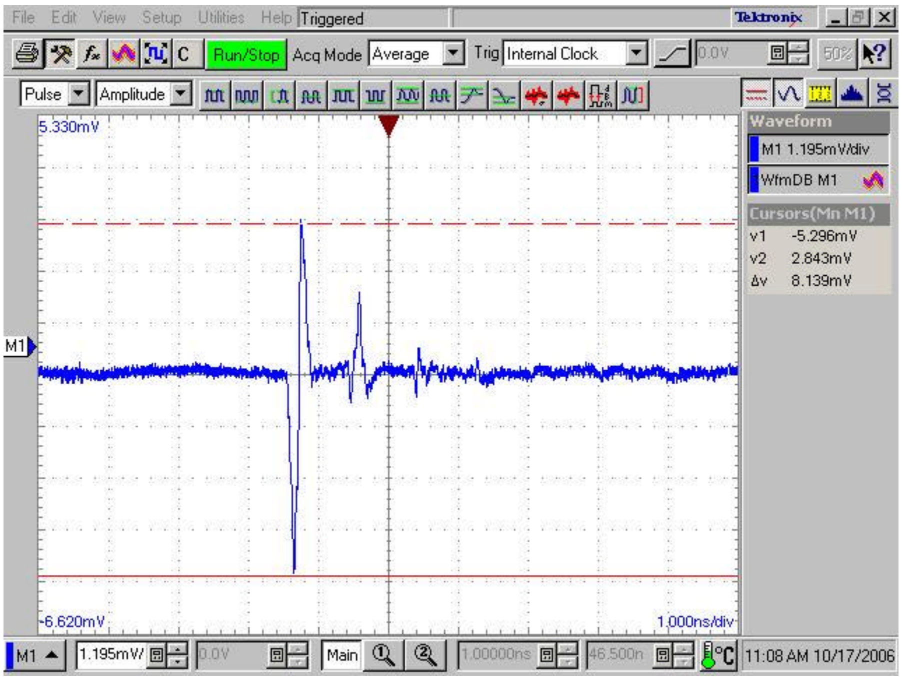

Figure 8: Worse Case 2.8" Trace FEXT

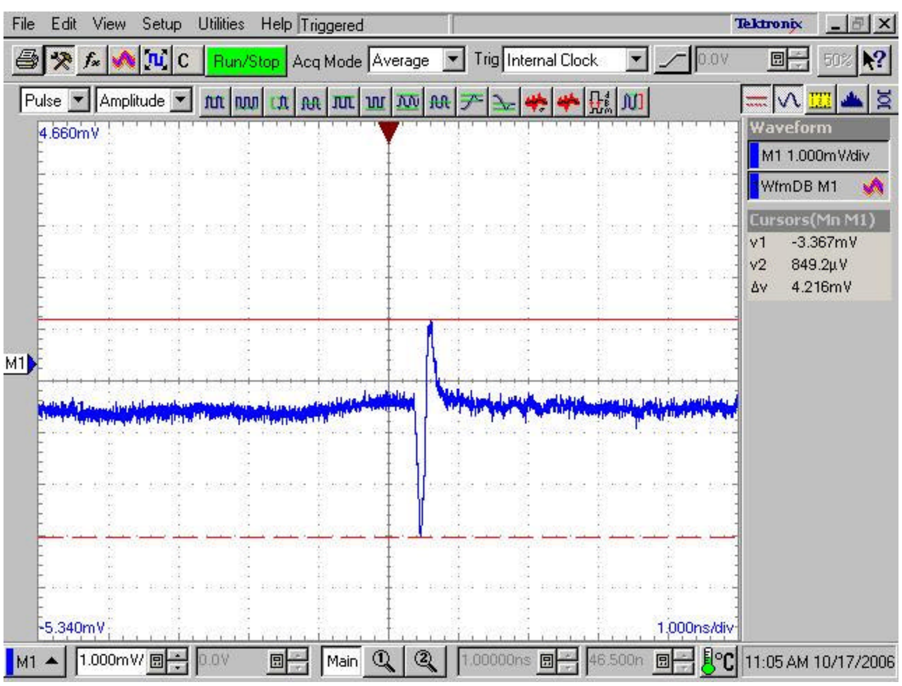

Figure 9: Worse Case 14.8" Trace FEXT

Eye Diagrams

Below are typical eye diagrams from a short and long flex. The eye diagrams were derived from the frequency data (see **Frequency Domain Analysis**).

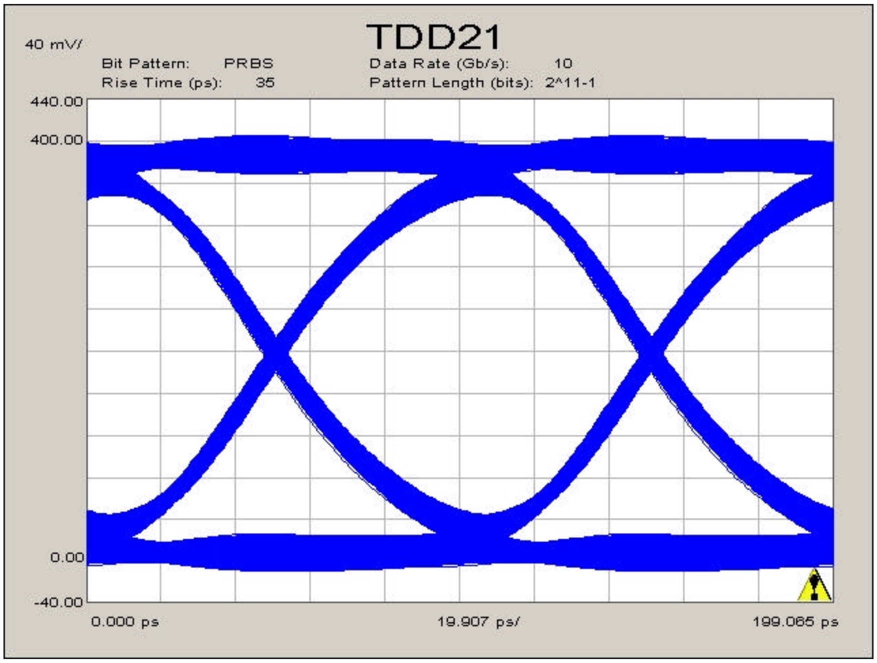

Figure 10: 10Gbps PRBS Pattern through 2.8" Trace

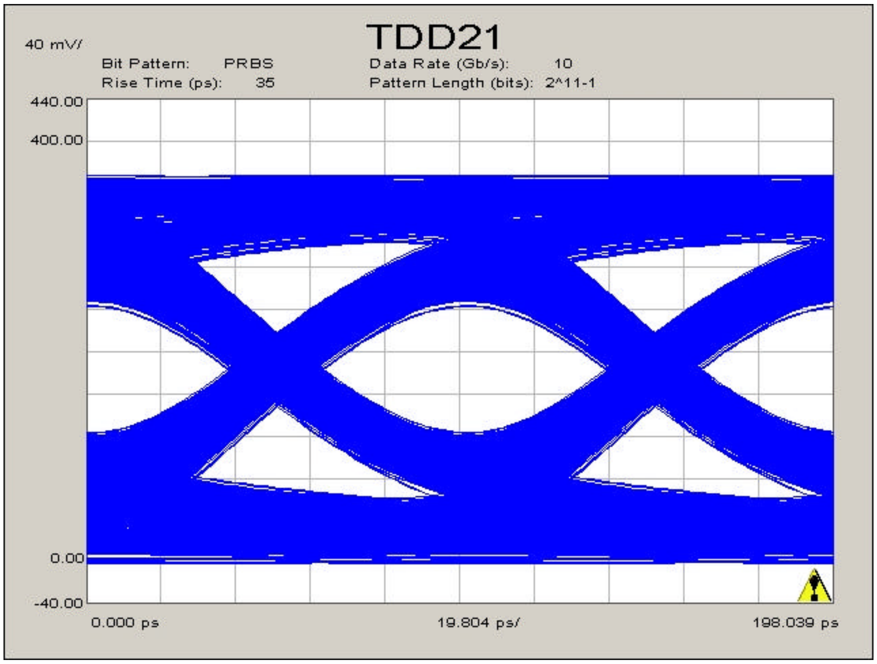

Figure 11: 10Gbps PRBS Pattern through 14.8" Trace

III. Frequency Domain Analysis

A TLR type calibration was performed before the frequency measurements were taken. The test board SMA connector and some of the test board trace are compensated for through the calibration. The calibration plane is one inch from the SEARAY connector.

Insertion Loss

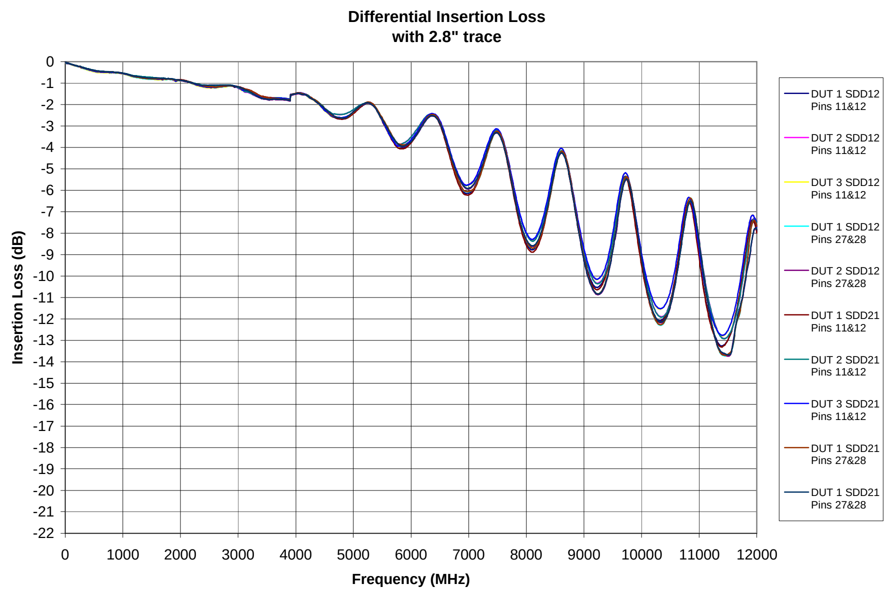

Figure 12: Differential Insertion Loss with 2.8" Trace

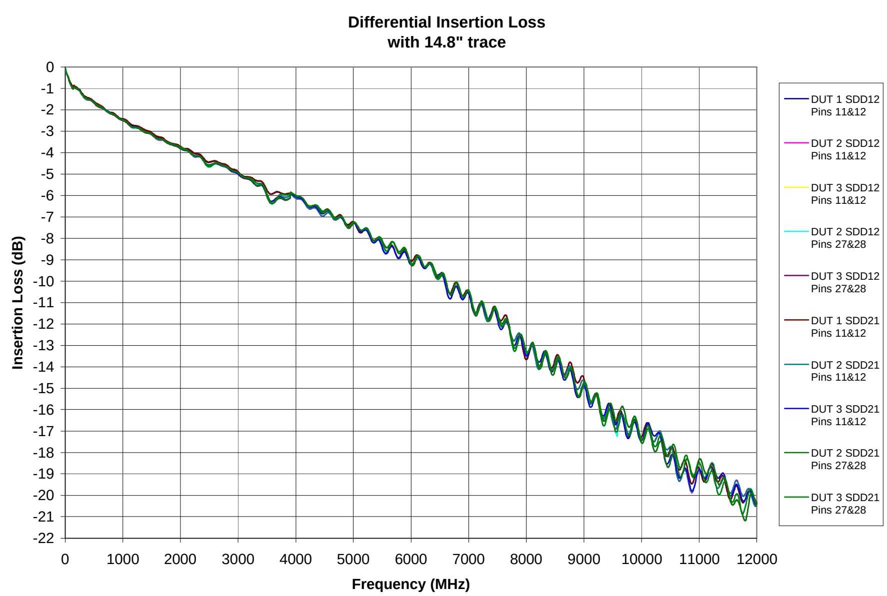

Figure 13: Differential Insertion Loss with 14.8" Trace

Return Loss

Return loss measurements are shown up to 12GHz.

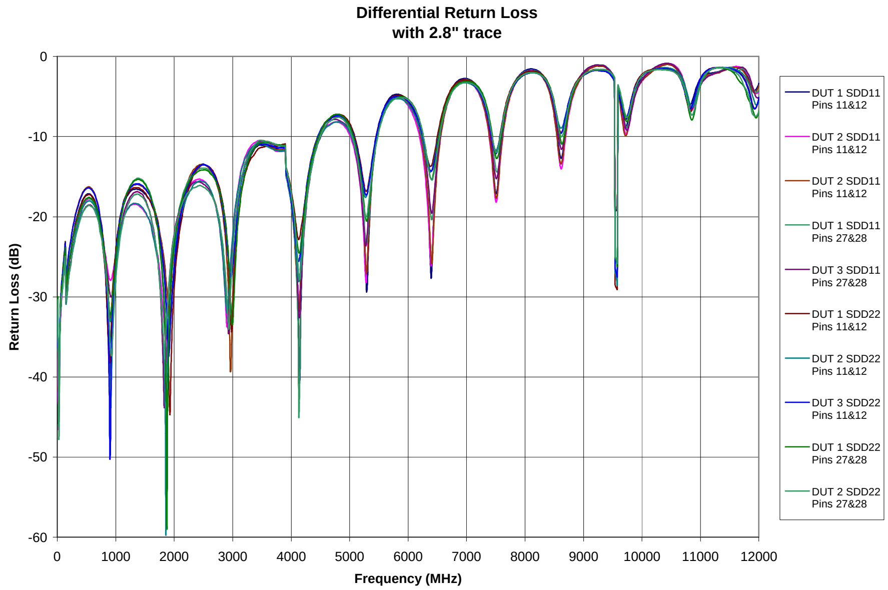

Figure 8: Differential Return Loss with 2.8" Trace

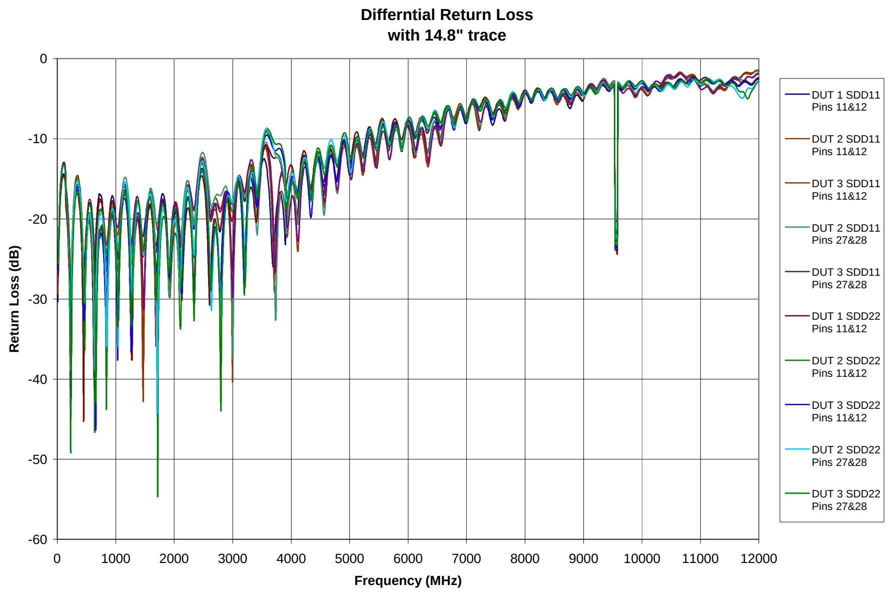

Figure 9: Differential Return Loss with 14.8" Trace

IV. Discussion

As can be seen from the data, the SEARAY flex assembly can be a very effective high speed solution. The short flex has a 3dB bandwidth of approximately 5GHz (fundamental frequency of 10Gbps data). At 5GHz, the 15" assembly has only 7.5dB of attenuation. Modern transceivers such as those found in high-end FPGAs employ pre-emphasis and/or equalization to realize receiver sensitivities far greater than 7.5dB.

Assuming there is a linear increase in loss with an increase in the flex length, the data from the two different trace lengths can be interpolated to provide a good estimate of attenuation for a given length at a given frequency.

For example at 5GHz, we know at 2.8" there is 3dB of loss and 7.5dB at 14.8". Below, two equations with two unknowns are simultaneously solved to yield an estimate of loss pre linear trace length at 5GHz.

$x + 2.8y = 3$ ***where** x is the fixed loss (interconnect)*
$x + 14.8y = 7.5$ ***y is the loss per length***

$y = 0.375$
$x = 1.95$

To solve for loss of any length at 5GHz the equation becomes:

$a = 1.95 + 0.375b$ ***where a is the insertion loss in dB***
b is the length of the differential pair in inches

To solve for maximum length at 5GHz for a given loss budget the equation becomes:

$b = (a - 1.95) / 0.375$ ***where a is the insertion loss in dB***
b is the length of the differential pair in inches

Data was also taken for single ended traces, but not presented here. The single ended performance was similar to the differential. Since most single ended data is transmitted at much lower speeds, the high performance of this flex is only valuable in that there is the potential to run a very long trace or in cases where the loss budget is prohibitively low.