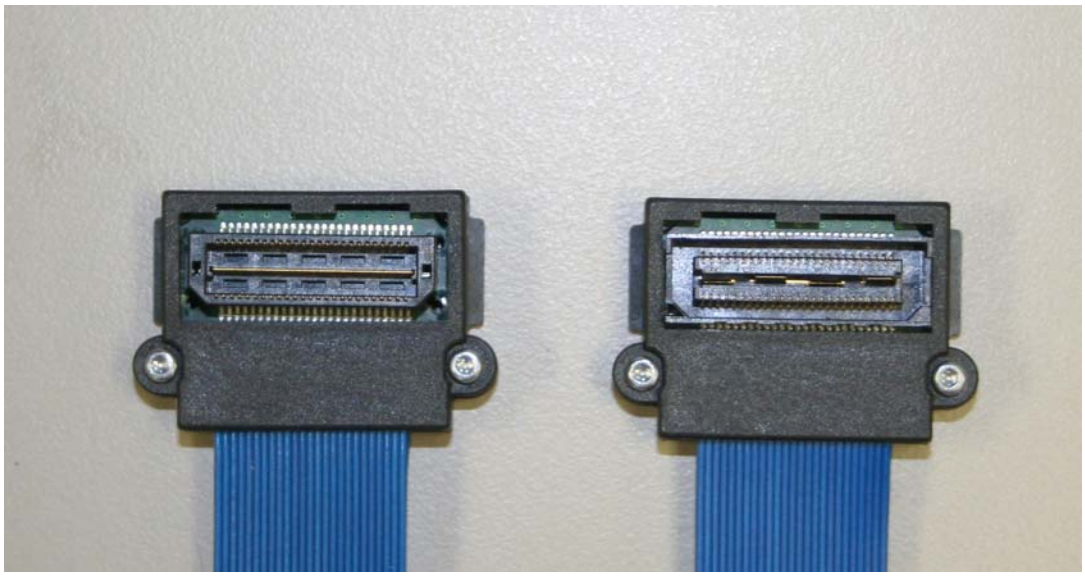
High Data Rate Characterization Report

SQCD-050-39.37-SEU-TEU-1
SQCD-050-39.37-STR-TEU-1
SQCD-050-39.37-STR-TTL-1
SQCD-050-39.37-SEU-TEU-2
SQCD-050-39.37-STR-TEU-2
SQCD-050-39.37-STR-TTL-2



Mated with:
QSS-025-01-X-D-A and QTS-025-01-X-D-A

Description:
Cable Assembly, High Data Rate, 0.635mm Pitch

Samtec Inc.
520 Park East Blvd.
New Albany IN 47151-1147 USA

WWW.SAMTEC.COM
1-800-SAMTEC-9 (US & Canada)
SIG@samtec.com
Phone: 812-944-6733
Fax: 812-948-5047
Report Revision: 6/16/2006

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

Table of Contents

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

Introduction

This testing was performed to evaluate the electrical performance of the SQCD series of high-speed cable systems. Testing was performed in accordance to the High Performance Electrical Interconnect (HPEI) SFF-8416 , Level 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-100463-TST-03" and "PCB-100463-TST-04".

Product Description

Each sample consists of two 39.37 inch (1m), 38 AWG micro-coaxial cables that contain 25 single lines. At each end of the cable there is a connector that is terminated to a small transition PCB. The respective connector is soldered to the PCB. All cable assemblies are terminated with a QTS high speed header at one end and a QSS high speed socket at the other end. There are two types of QTS and QSS connectors that can be terminated; edge-mount (EM) or vertical mount (DV). The cable connectors contain 25 pins per row.

The connectors are soldered to the transition PCBs. The green transition boards are a straight through type that connects the outer connector row of one connector to the outer row of the opposite connector, and the inner connector row is connected to the inner row on the other connector. The red transition boards are crossover type boards and are used to connect the inner row to the outer connector row and vice versa. The crossover boards are used to achieve a position 1 to position 1 mapping because the second end terminations are turned down for the edge mount and turned left for the vertical mount. Figure 1 on the preceding page is a picture of a termination configuration of one of the test samples. The board/cable termination areas are covered with plastic caps.

Six samples, one of each type of termination configuration, were tested. The actual sample part numbers tested are shown in below in Table 1, which also identifies End 1 and End 2 of each assembly. Two lines, the longest and the shortest electrical paths, from each sample were tested.

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

Length	Part Number	Termination	End 1	End 2
39.37in	SQCD-050-39.37-SEU-TEU-1	EM-EM	SEU	TEU
39.37in	SQCD-050-39.37-STR-TEU-1	DV-EM	STR	TEU
39.37in	SQCD-050-39.37-STR-TTL-1	DV-DV	STR	TTL
39.37in	SQCD-050-39.37-SEU-TEU-2	EM-EM	SEU	TEU
39.37in	SQCD-050-39.37-STR-TEU-2	DV-EM	STR	TEU
39.37in	SQCD-050-39.37-STR-TTL-2	DV-DV	STR	TTL

Table 1: Sample Descriptions

Figure 1: Test Sample Configuration

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

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 termination 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_{max} (Ω)	Z_{max} (Ω)
SEU-TEU-1	Long	50.8	63.0	49.9	60.2	48.0	47.8
	Short	48.9	56.0	48.5	55.9	49.5	49.6
STR-TEU-1	Long	50.3	57.7	49.9	60.4	48.0	46.7
	Short	49.1	55.3	47.7	54.7	49.5	49.5
STR-TTL-1	Long	50.0	58.3	50.0	57.9	47.7	47.3
	Short	49.1	53.8	47.7	54.3	49.6	49.5
SEU-TEU-2	Long	49.2	56.4	47.9	58.9	49.5	49.5
	Short	50.0	63.1	50.1	61.6	47.9	48.0
STR-TEU-2	Long	49.2	53.8	48.1	59.3	48.6	49.5
	Short	50.3	57.8	50.1	61.0	48.0	48.1
STR-TTL-2	Long	49.2	53.9	47.7	53.5	47.4	49.4
	Short	50.3	58.2	50.0	58.6	47.9	48.2

Table 2: Impedance Measurements

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

Timing Measurements

Skew was calculated as the difference between the propagation delay of the longest (outer row) and the shortest (inner Row) electrical paths. End 1 of each assembly was the source end for these measurements.

The results are tabulated below.

Assembly	Path	Propagation Delay (nS)	Skew (nS)
SEU-TEU-1	Long	5.059	.035
	Short	5.024	
STR-TEU-1	Long	5.129	.129
	Short	5.000	
STR-TTL-1	Long	5.161	.168
	Short	4.993	
SEU-TEU-2	Long	5.060	.034
	Short	5.094	
STR-TEU-2	Long	5.057	.084
	Short	5.141	
STR-TTL-2	Long	5.185	.011
	Short	5.196	

Table 3: Timing Measurements

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

NEXT

The near end crosstalk was measured in the time domain and converted to a percentage and reported below in Table 3. The incident pulse amplitude from the TDR was 238 mV. The acquired data was measured using a filtered rise time of 100 pS. The End 1 and End 2 headings in Table 4 represent 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 3 represent the crosstalk that occurs in the near-end mated cable assembly and the test board connectors.

Assembly	Path	END1		END 2	
		NEXT (mV)	NEXT (%)	NEXT (mV)	NEXT (%)
SEU-TEU-1	Long	38.4	16.1	40.0	16.8
	Short	33.6	14.1	35.2	14.8
STR-TEU-1	Long	39.2	16.5	41.2	17.3
	Short	31.2	13.1	34.8	14.6
STR-TTL-1	Long	38.8	16.3	39.2	16.5
	Short	30.8	12.9	31.6	13.3
SEU-TEU-2	Long	33.2	13.9	38.0	16.0
	Short	38.4	16.1	40.0	16.8
STR-TEU-2	Long	31.2	13.1	36.0	15.1
	Short	38.8	16.3	41.6	17.5
STR-TTL-2	Long	31.2	13.1	34.0	14.3
	Short	39.2	16.5	39.6	16.6

Table 4: % NEXT

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

FEXT

The far 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 238 mV. The acquired data was measured using a filtered rise time of 100 pS. The End 1 and End 2 headings in Table 4 represent 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 4 represent the crosstalk measured at the far end of the assembly.

Assembly	Path	END 1		END 2	
		FEXT (mV)	FEXT (%)	FEXT (mV)	FEXT (%)
SEU-TEU-1	Long	13.6	5.7	13.6	5.7
	Short	9.2	3.9	9.6	4.0
STR-TEU-1	Long	14.0	5.9	13.2	5.5
	Short	8.4	3.5	8.8	3.7
STR-TTL-1	Long	13.6	5.7	13.6	5.7
	Short	8.4	3.5	8.0	3.4
SEU-TEU-2	Long	11.6	4.9	11.2	4.7
	Short	14.8	6.2	14.4	6.1
STR-TEU-2	Long	10.0	4.2	11.2	4.7
	Short	14.0	5.9	13.2	5.5
STR-TTL-2	Long	11.2	4.7	12.8	5.4
	Short	15.6	6.6	12.8	5.4

Table 5: % FEXT

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

Frequency Domain Data

Insertion Loss

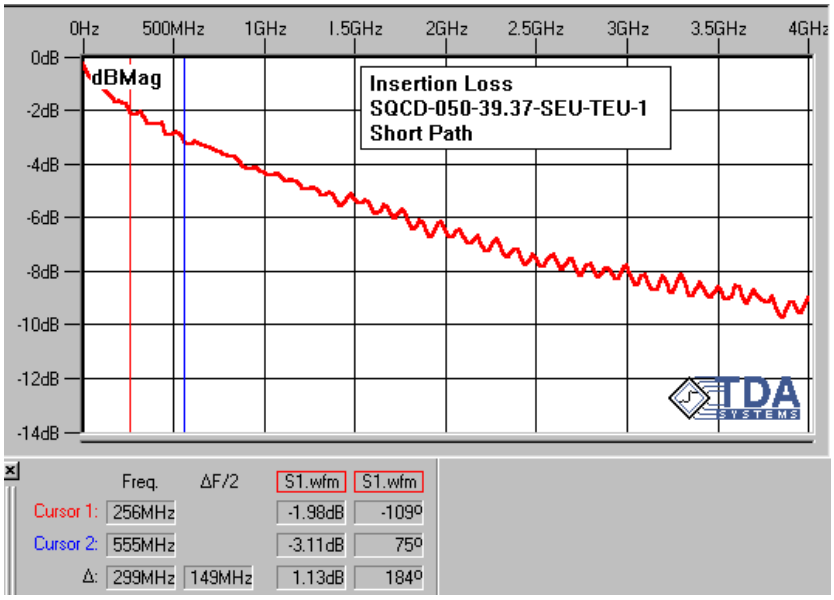


Figure 2: SQCD-050-39.37-SEU-TEU-1 Insertion Loss Short Path

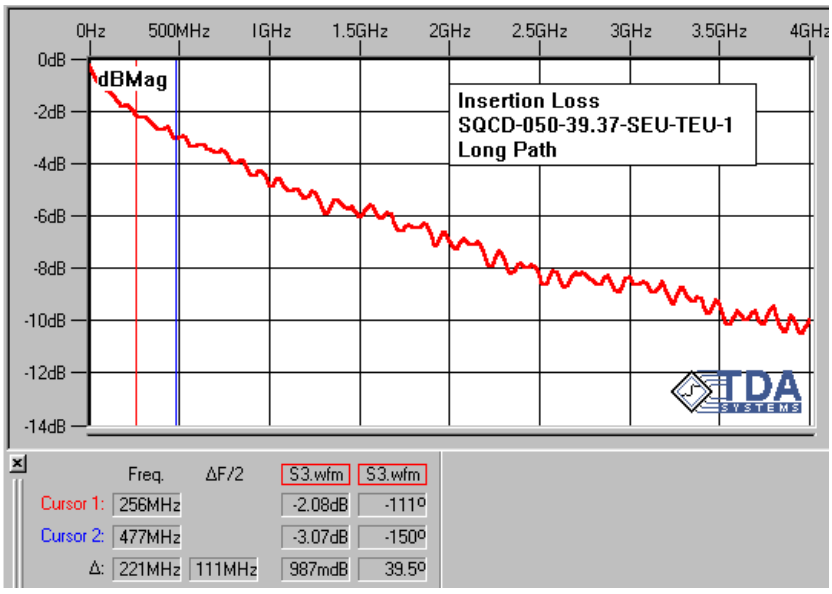


Figure 3: SQCD-050-39.37-SEU-TEU-1 Insertion Loss Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

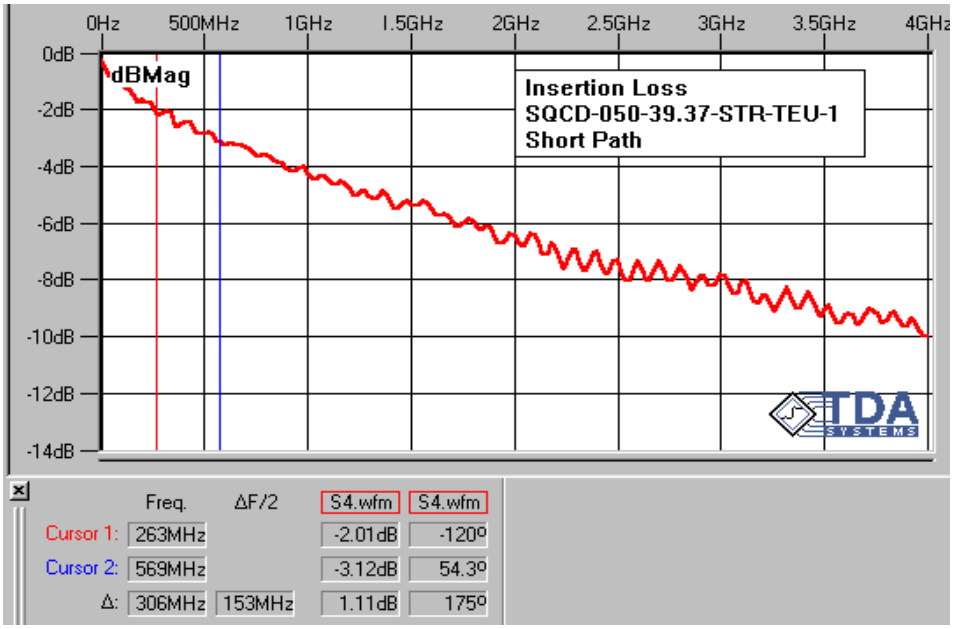


Figure 4: SQCD-050-39.37-STR-TEU-1 Insertion Loss Short Path

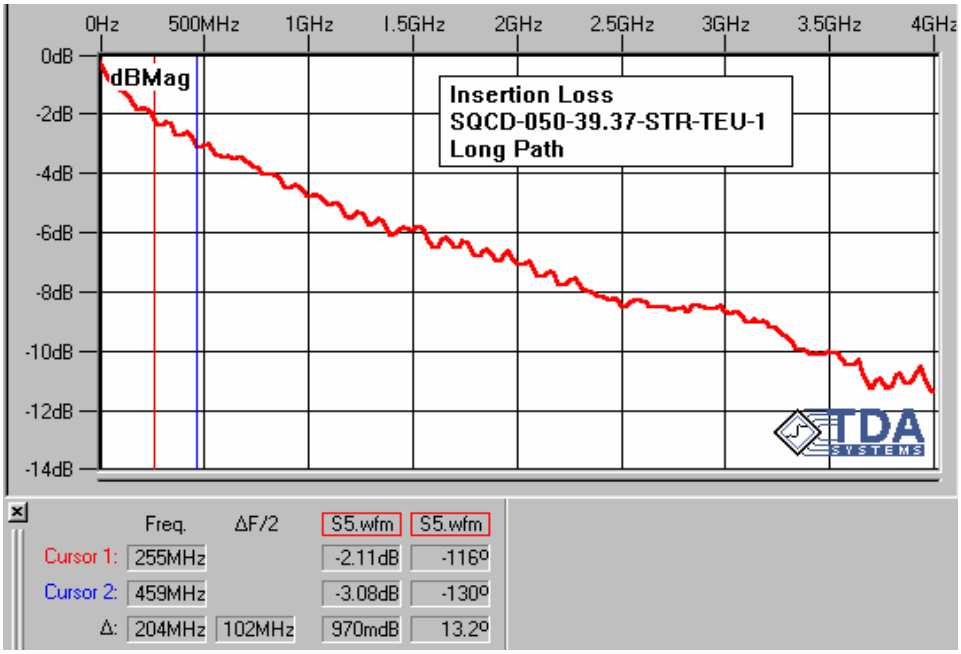


Figure 5: **SQCD-050-39.37-STR-TEU-1 Insertion Loss Long Path**

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

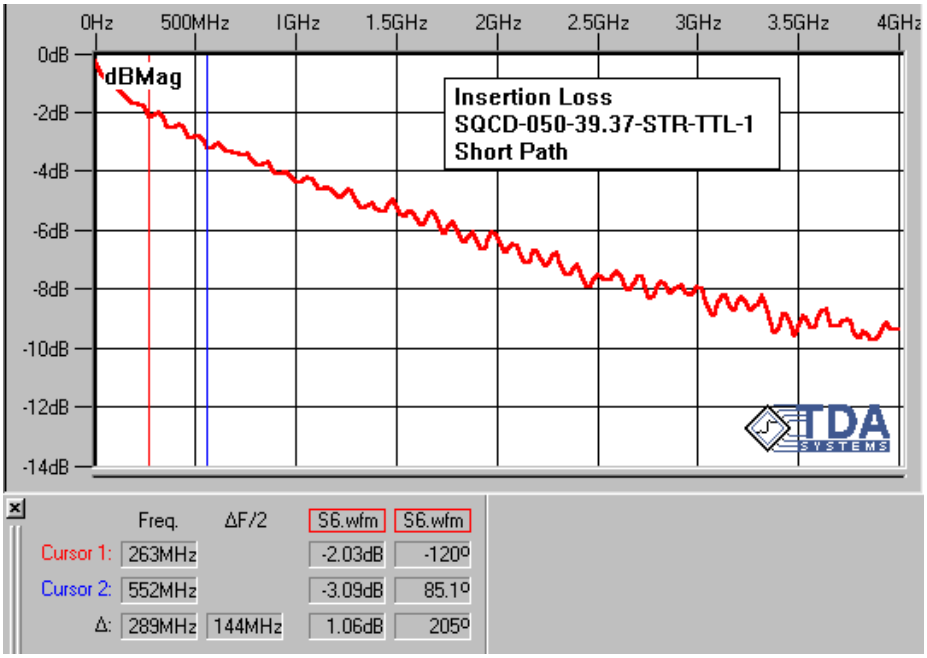


Figure 6: **SQCD-050-39.37-STR-TTL-1 Insertion Loss Short Path**

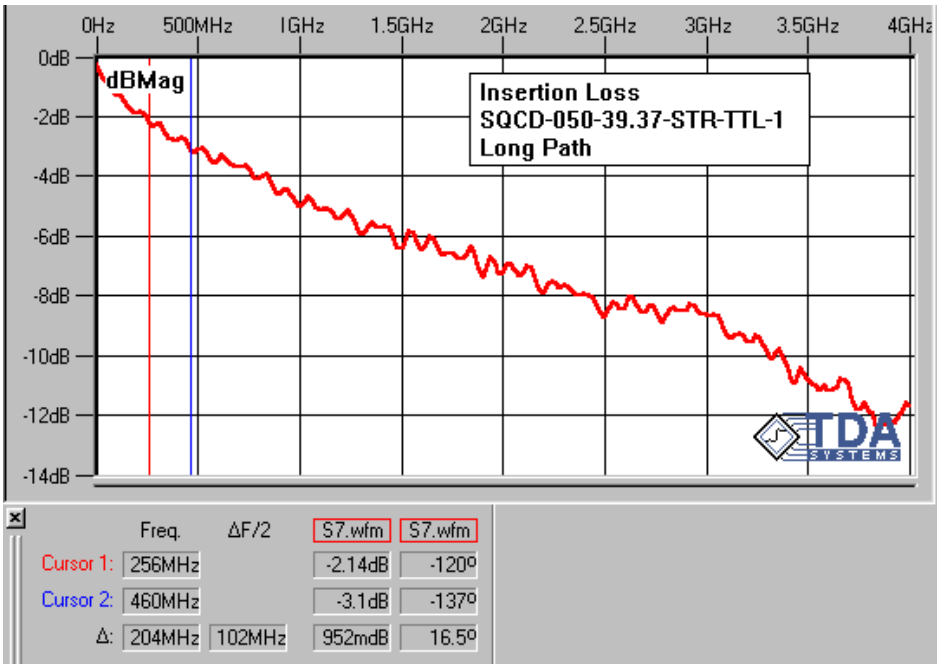


Figure 7: **SQCD-050-39.37-STR-TTL-1 Insertion Loss Long Path**

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

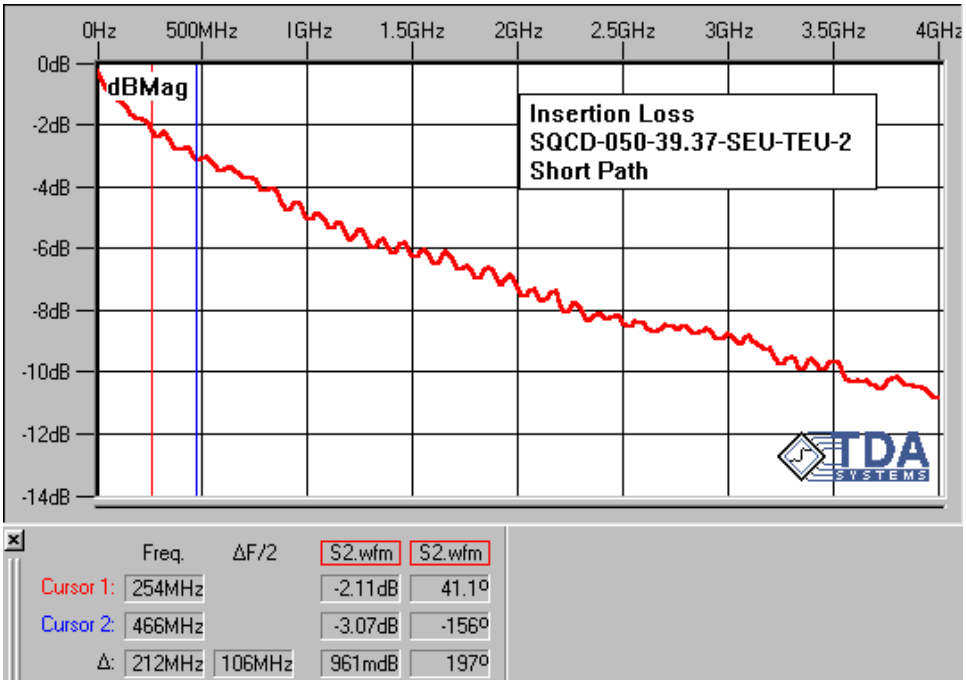


Figure 8: SQCD-050-39.37-SEU-TEU-2 Insertion Loss Short Path

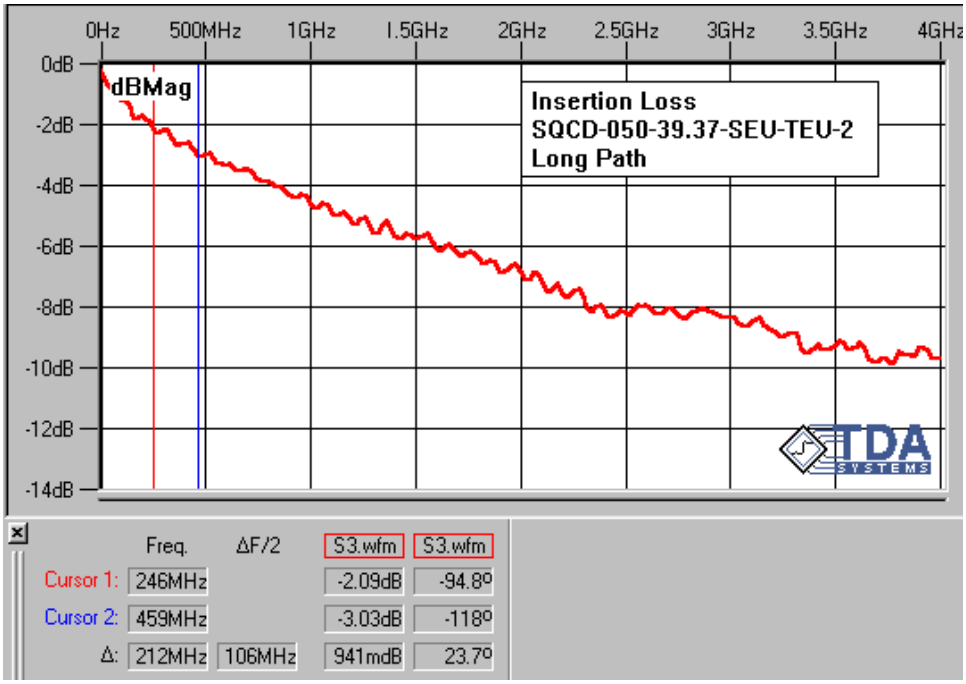


Figure 9: SQCD-050-39.37-SEU-TEU-2 Insertion Loss Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

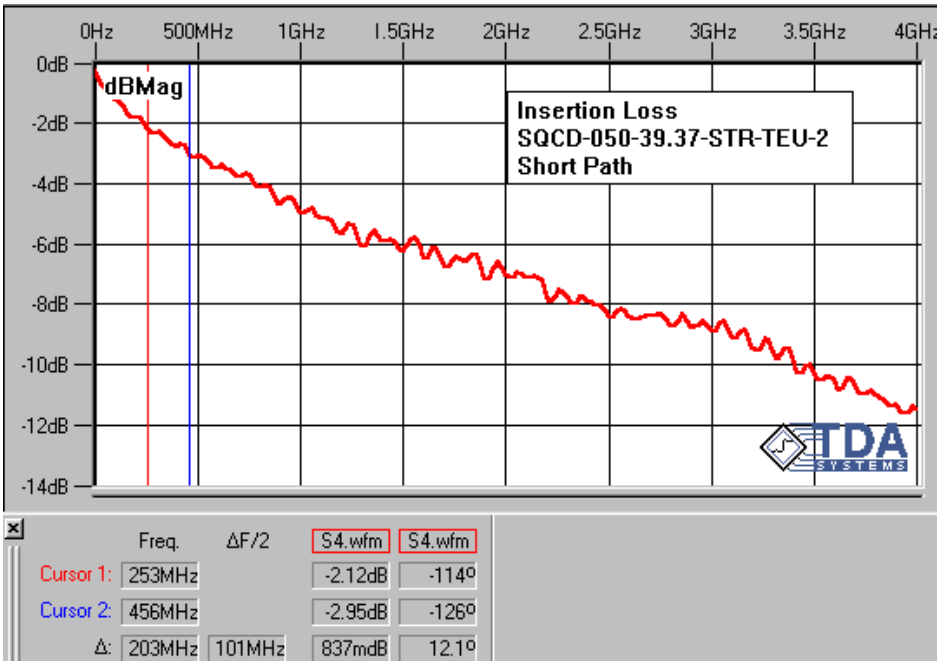


Figure 10: SQCD-050-39.37-STR-TEU-2 Insertion Loss Short Path

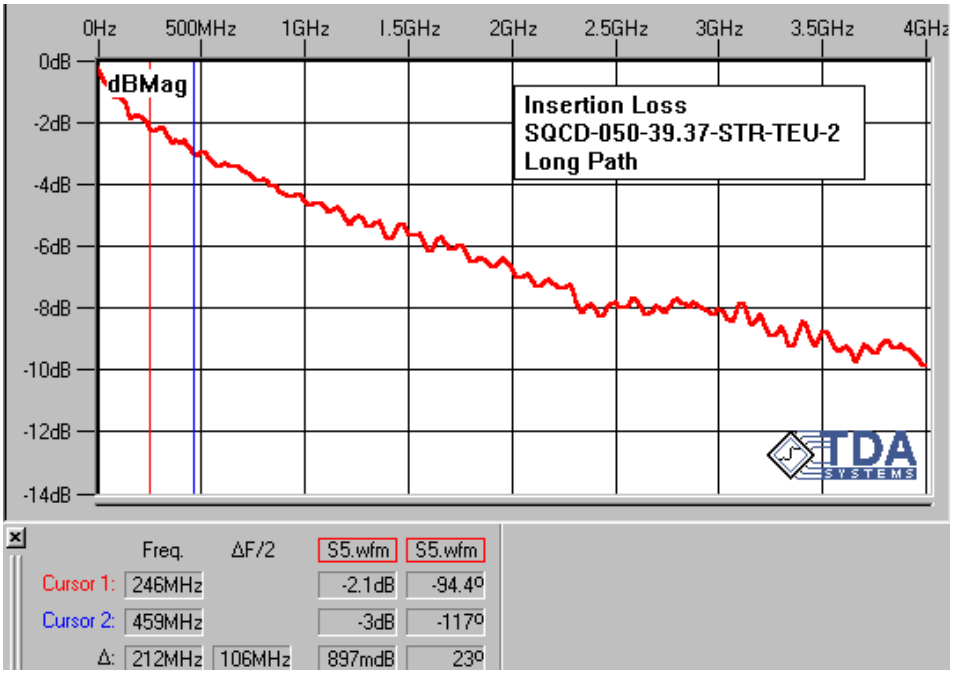


Figure 11: SQCD-050-39.37-STR-TEU-2 Insertion Loss Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

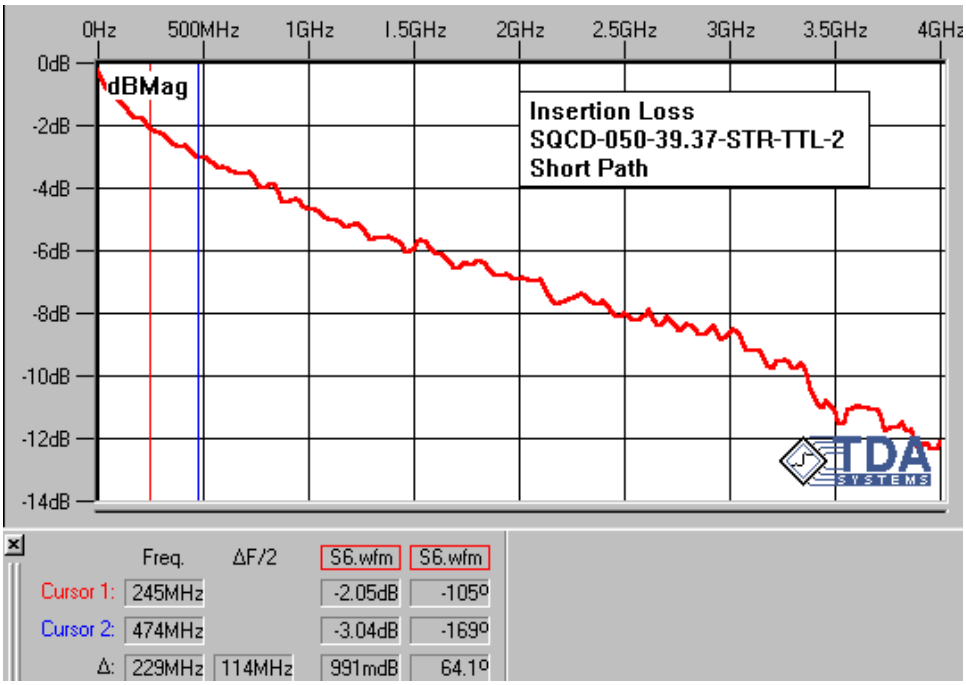


Figure 12: SQCD-050-39.37-STR-TTL-2 Insertion Loss Short Path

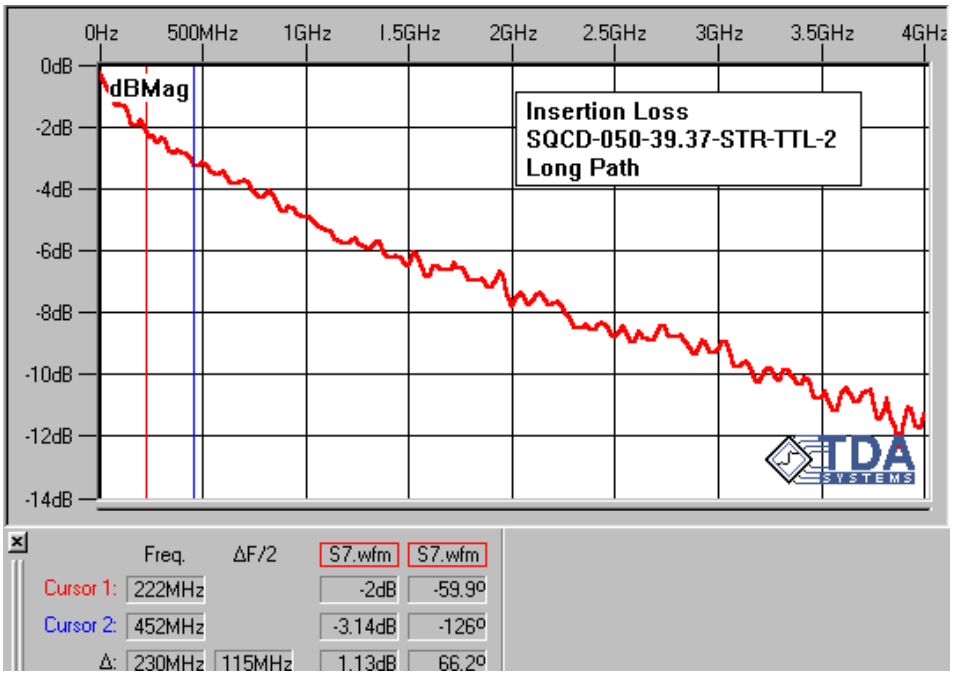


Figure 13: SQCD-050-39.37-STR-TTL-2 Insertion Loss Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

Return Loss

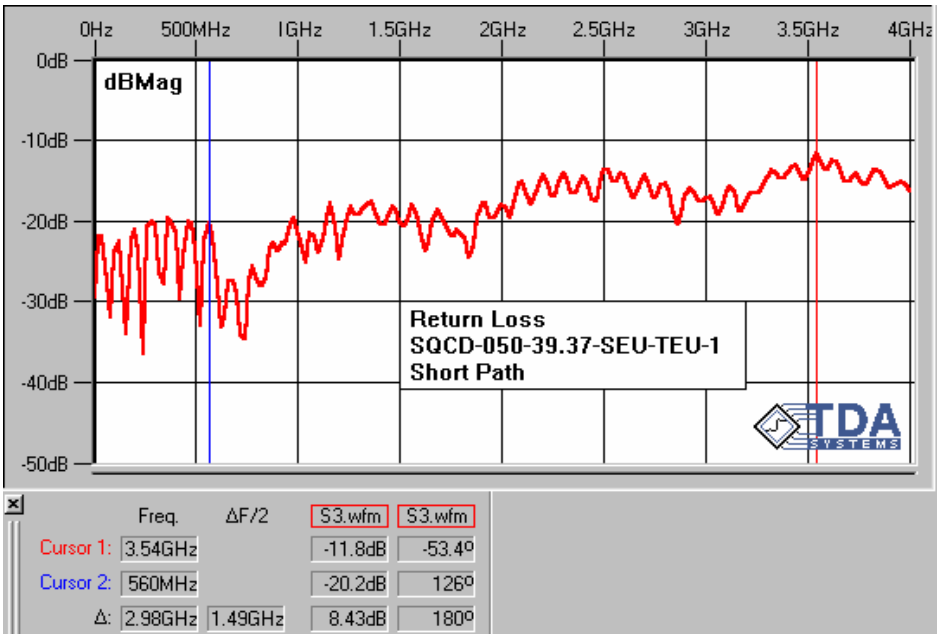


Figure 14: SQCD-050-39.37-SEU-TEU-1 Return Loss Short Path

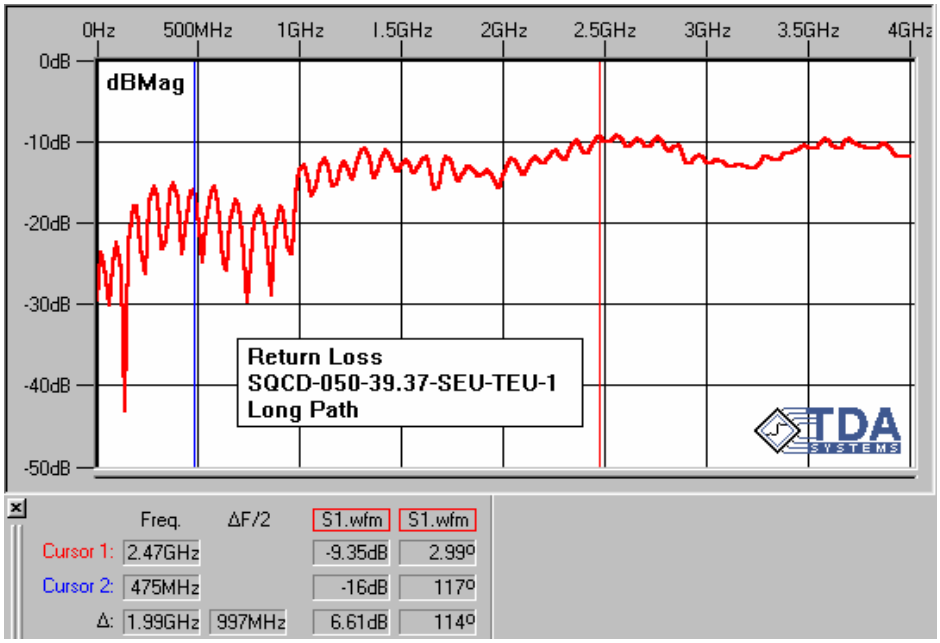


Figure 15: SQCD-050-39.37-SEU-TEU-1 Return Loss Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

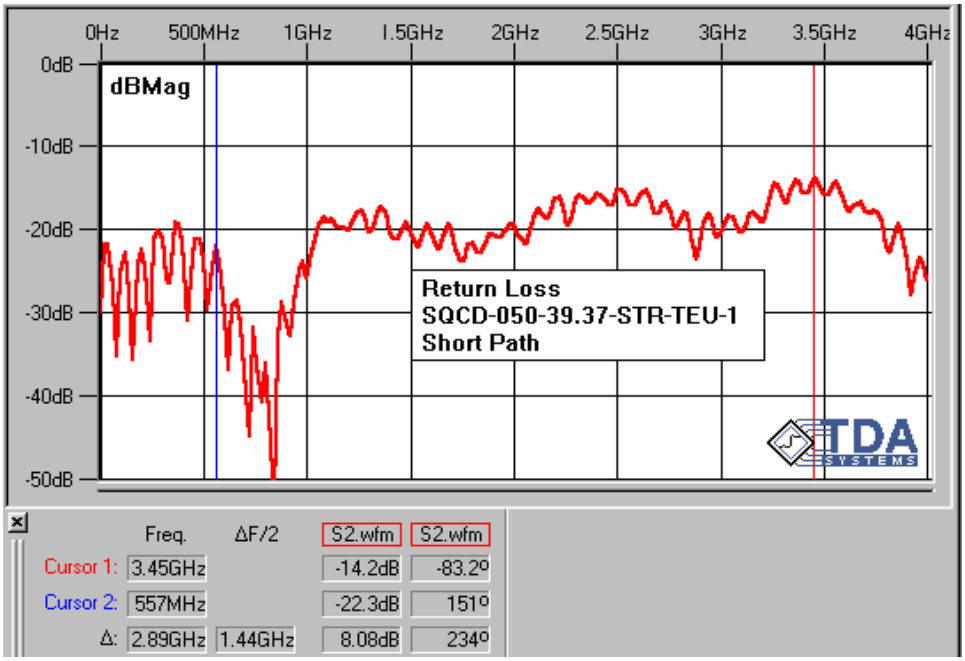


Figure 16: SQCD-050-39.37-STR-TEU-1 Return Loss Short Path

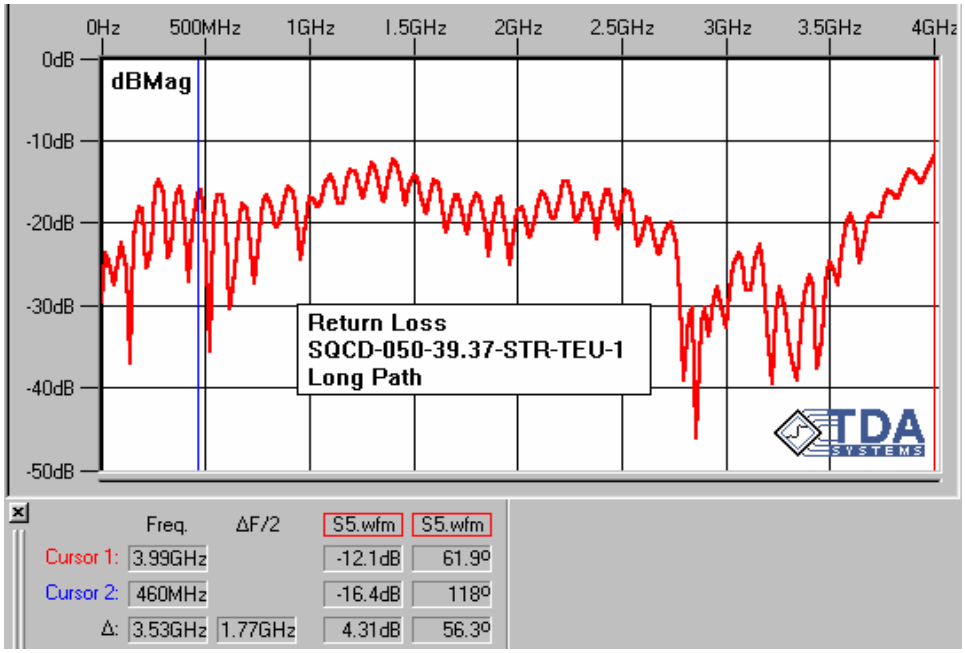


Figure 17: SQCD-050-39.37-STR-TEU-1 Return Loss Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

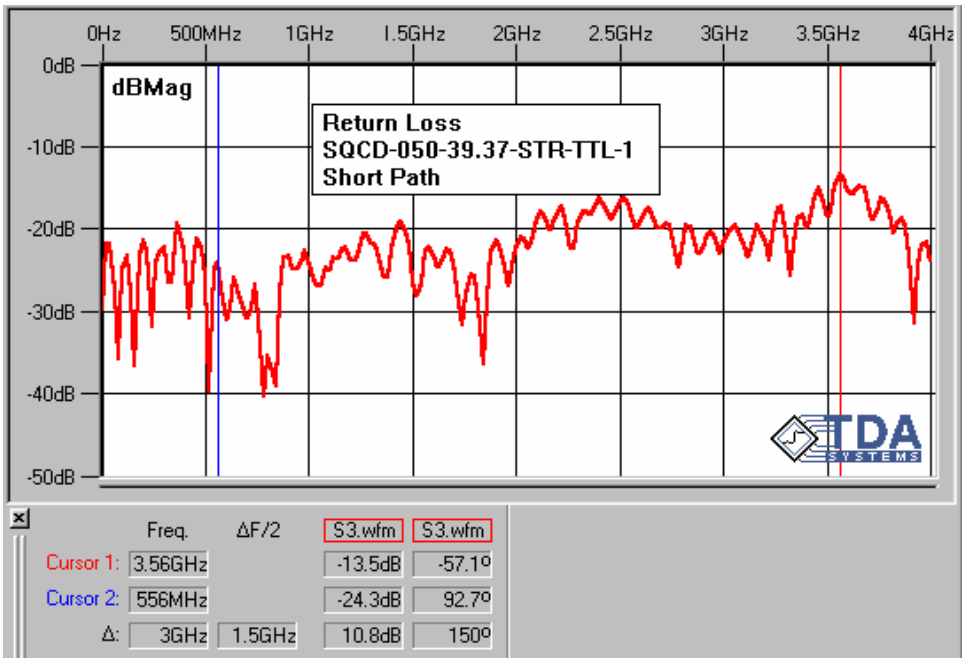


Figure 18: SQCD-050-39.37-STR-TTL-1 Return Loss Short Path

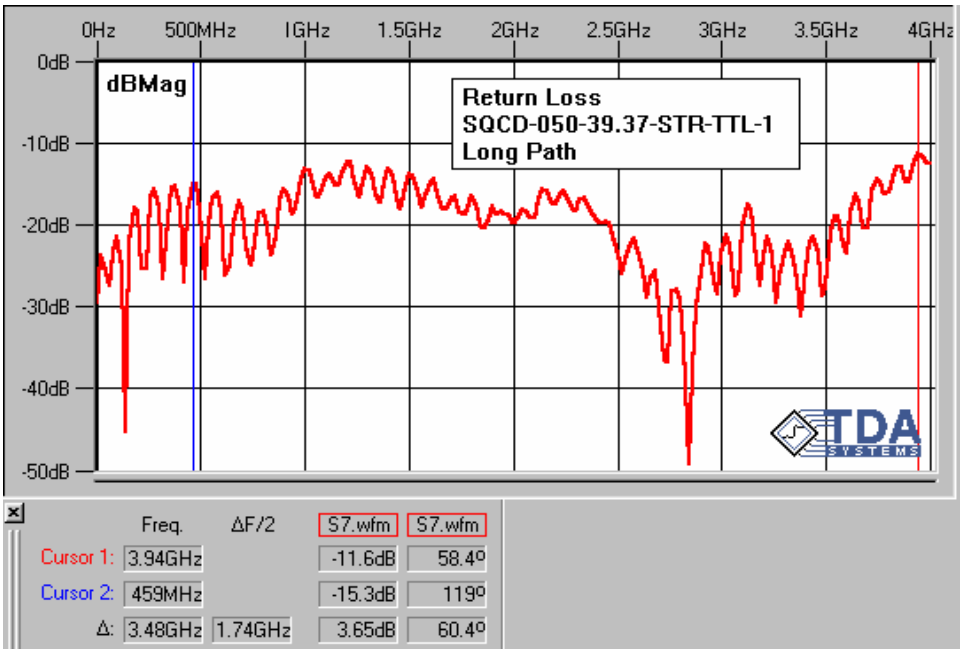


Figure 19: SQCD-050-39.37-STR-TTL-1 Return Loss Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

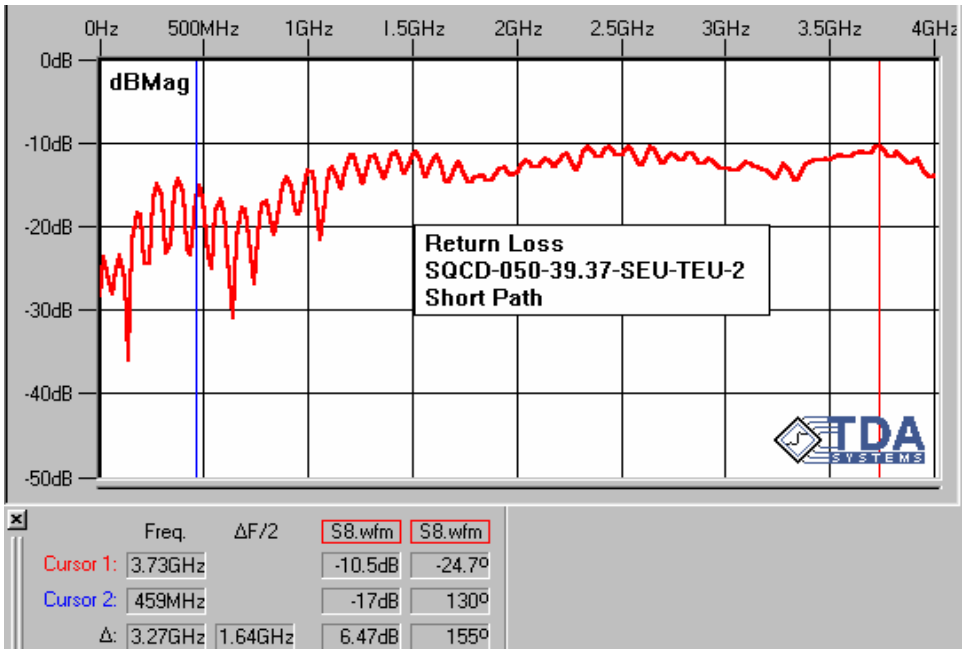


Figure 20: SQCD-050-39.37-SEU-TEU-2 Return Loss Short Path

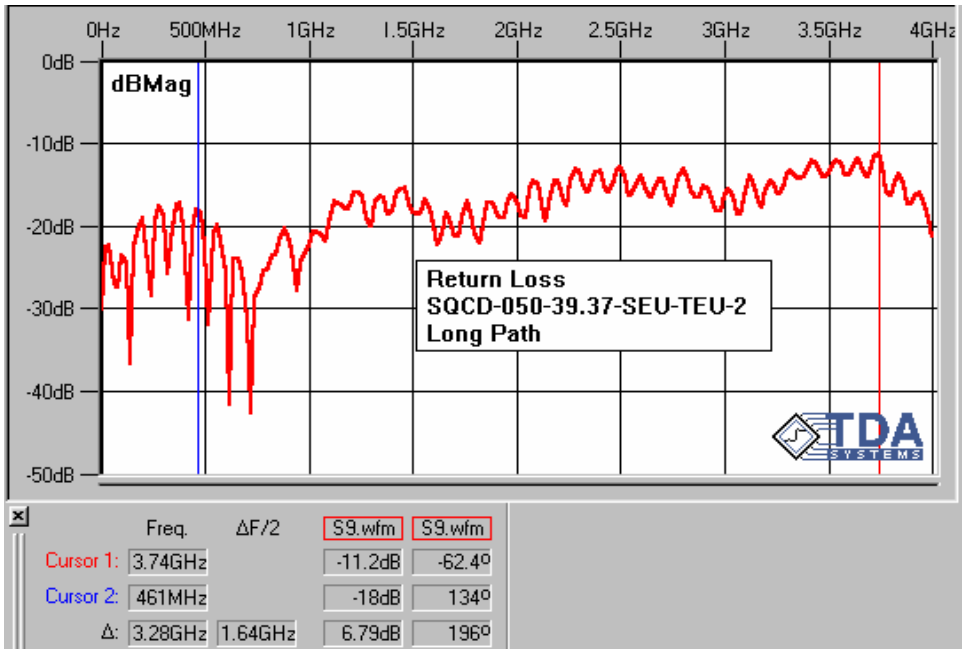


Figure 21: SQCD-050-39.37-SEU-TEU-2 Return Loss Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

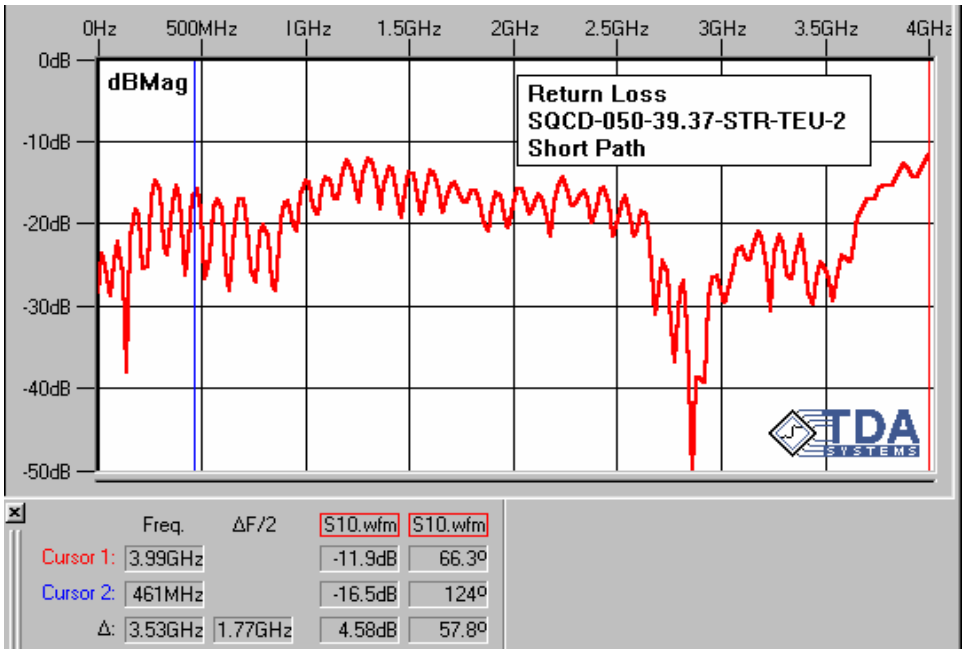


Figure 22: SQCD-050-39.37-STR-TEU-2 Return Loss Short Path

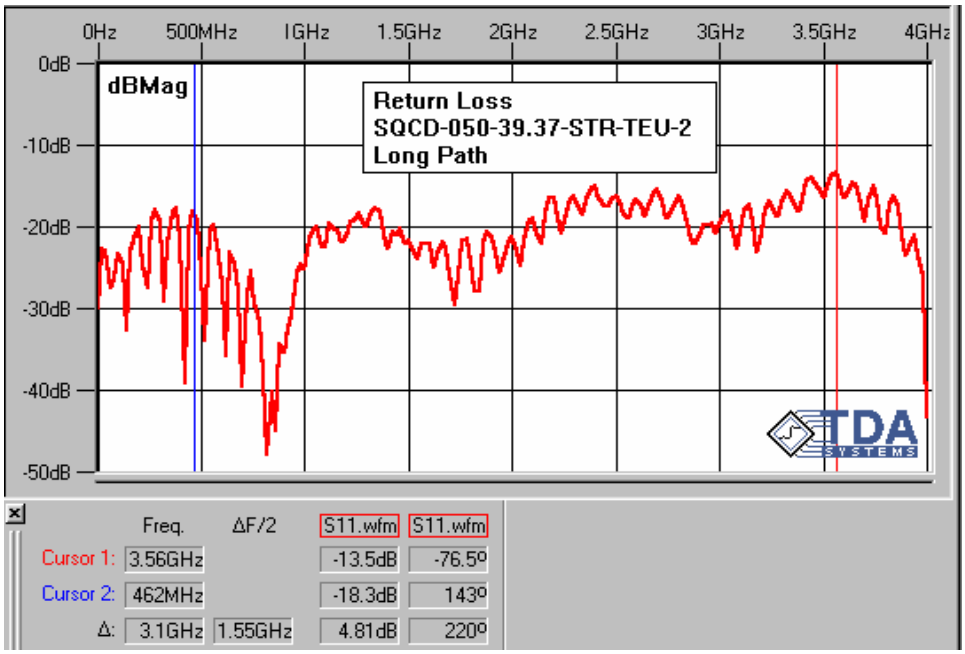


Figure 23: SQCD-050-39.37-STR-TEU-2 Return Loss Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

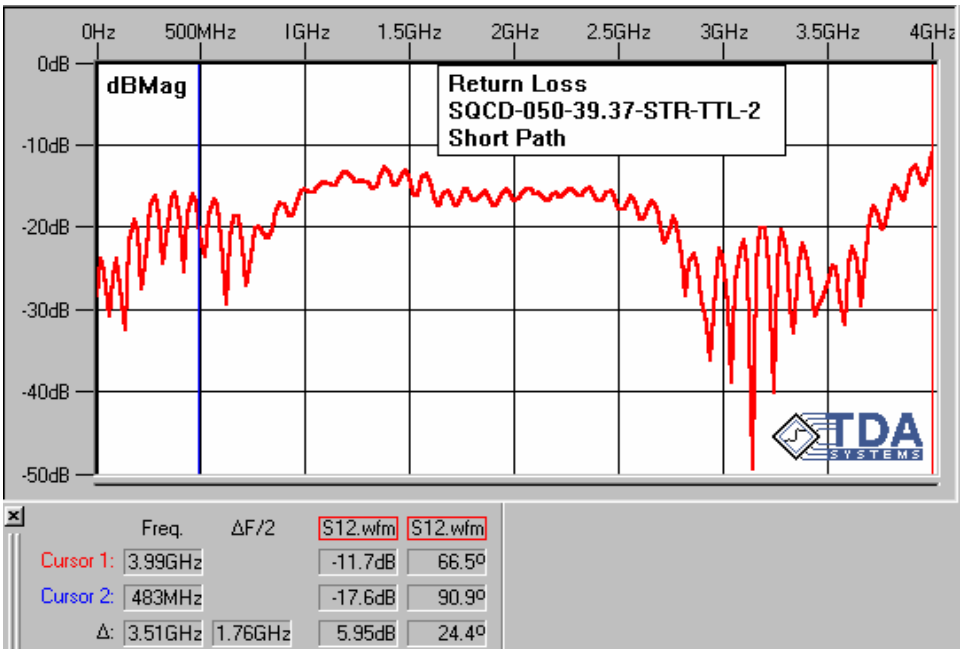


Figure 24: SQCD-050-39.37-STR-TTL-2 Return Loss Short Path

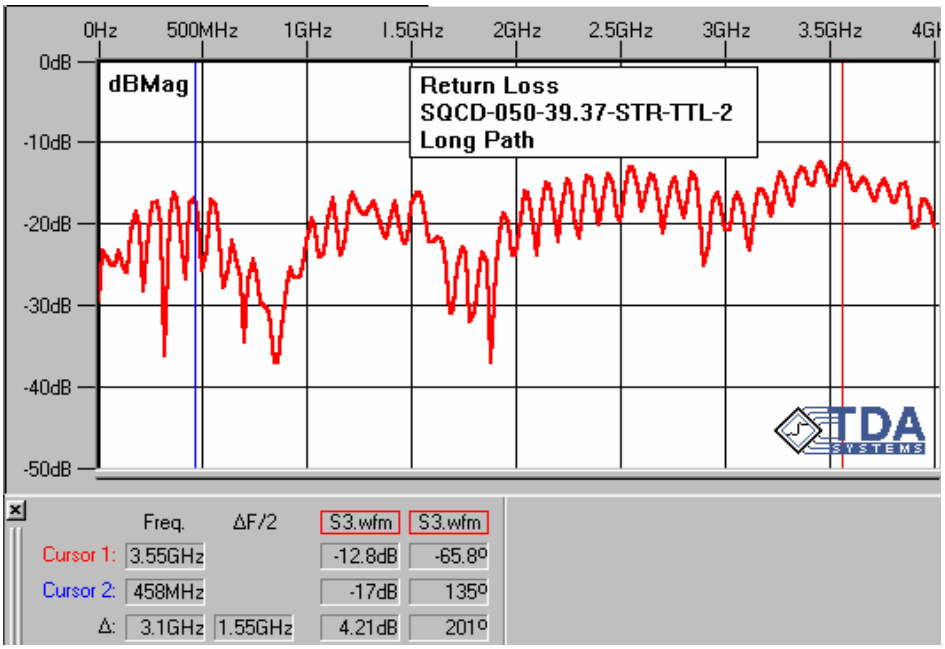


Figure 25: SQCD-050-39.37-STR-TTL-2 Return Loss Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

Near End Crosstalk

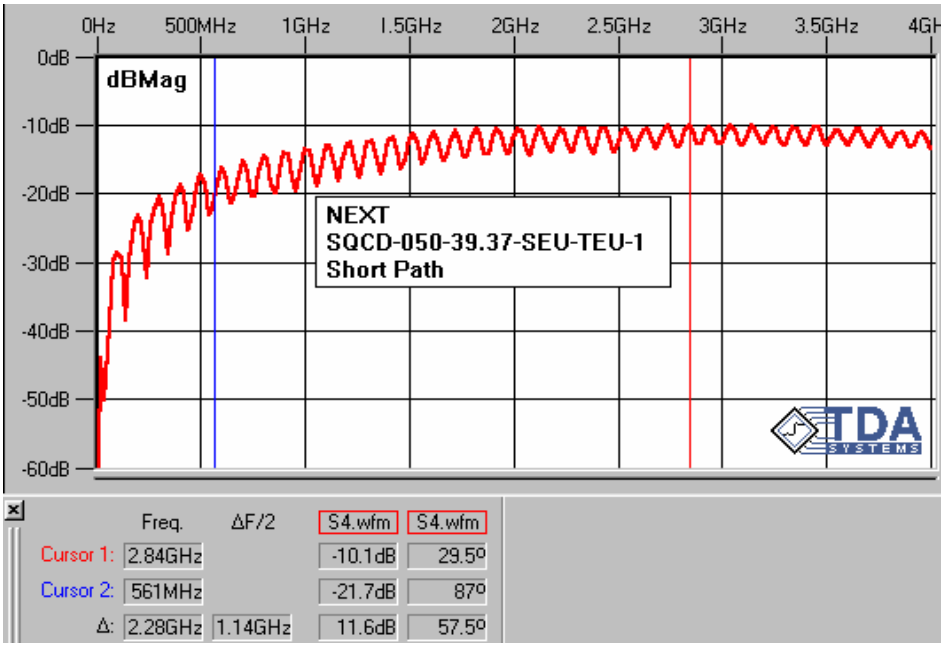


Figure 26: SQCD-050-39.37-SEU-TEU-1 NEXT Short Path

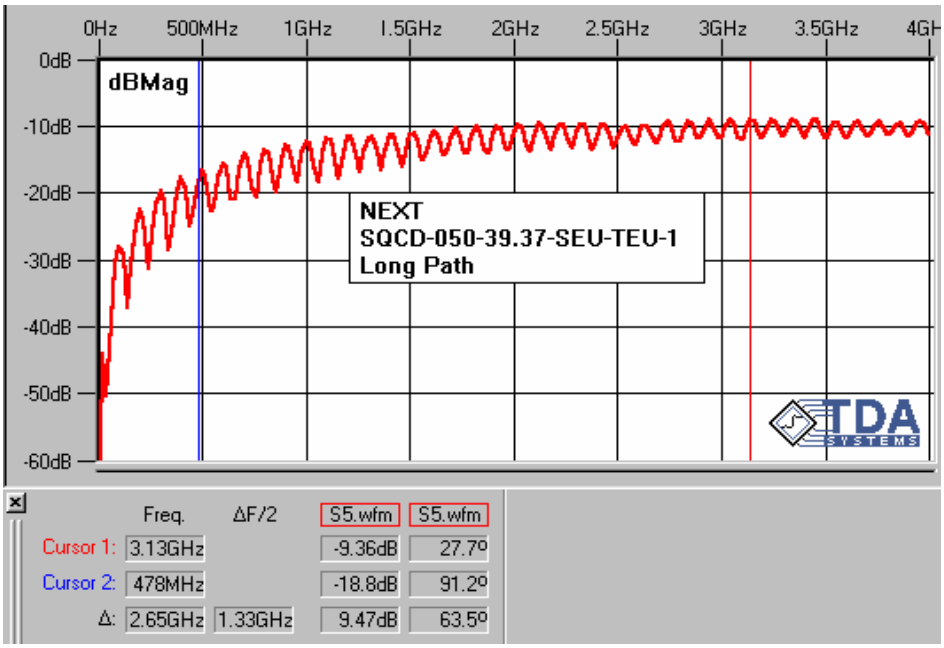


Figure 27: SQCD-050-39.37-SEU-TEU-1 NEXT Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

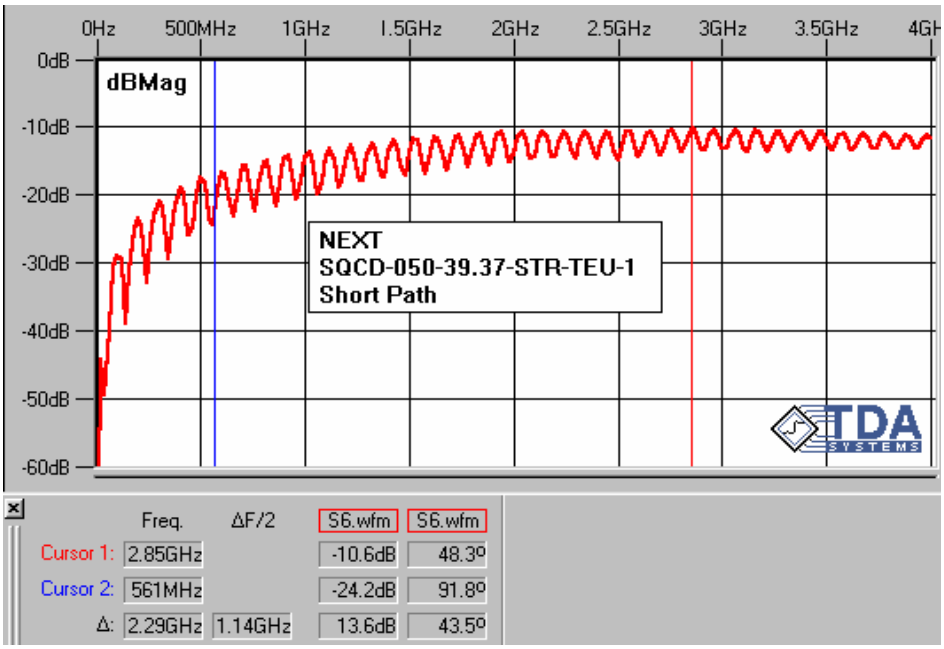


Figure 28: SQCD-050-39.37-STR-TEU-1 NEXT Short Path

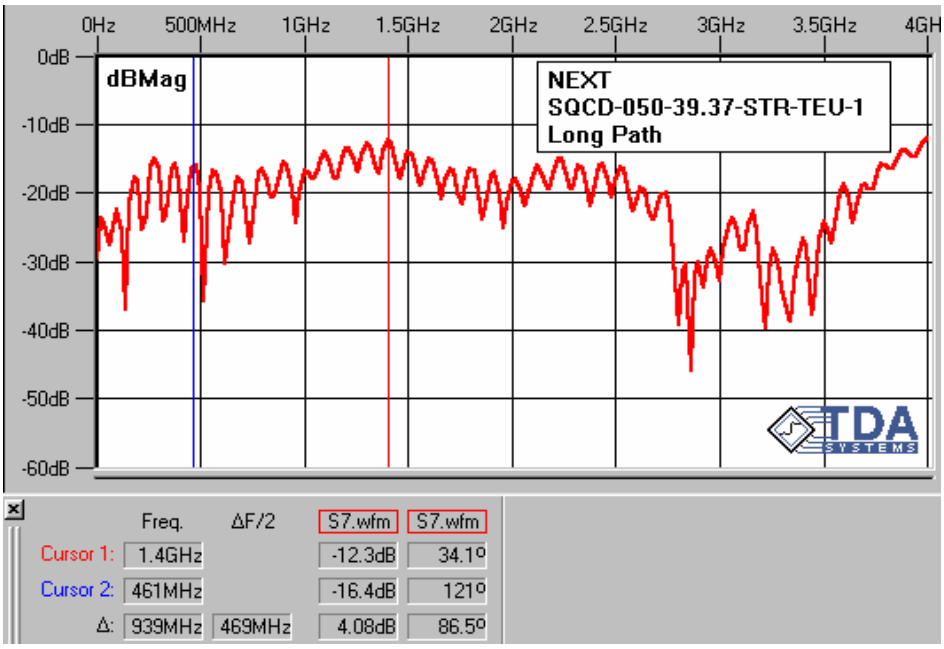


Figure 29: SQCD-050-39.37-STR-TEU-1 NEXT Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

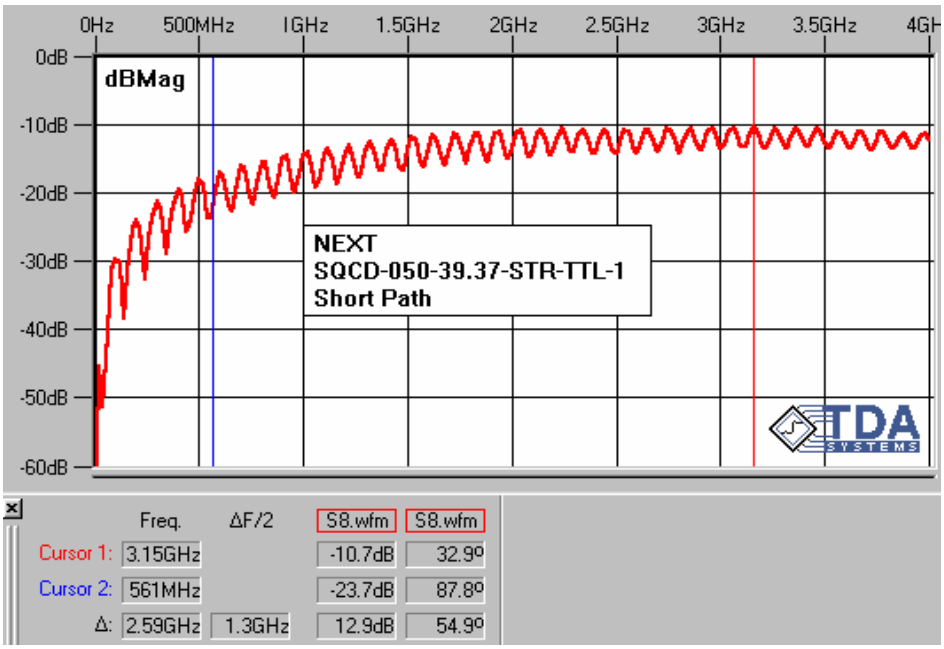


Figure 30: SQCD-050-39.37-STR-TTL-1 NEXT Short Path

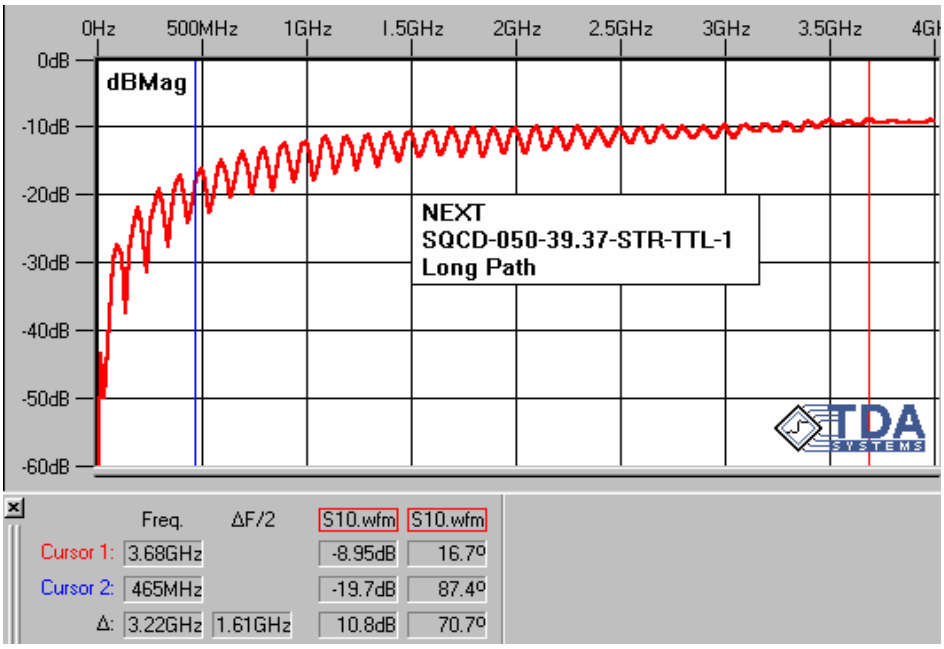


Figure 31: SQCD-050-39.37-STR-TTL-1 NEXT Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

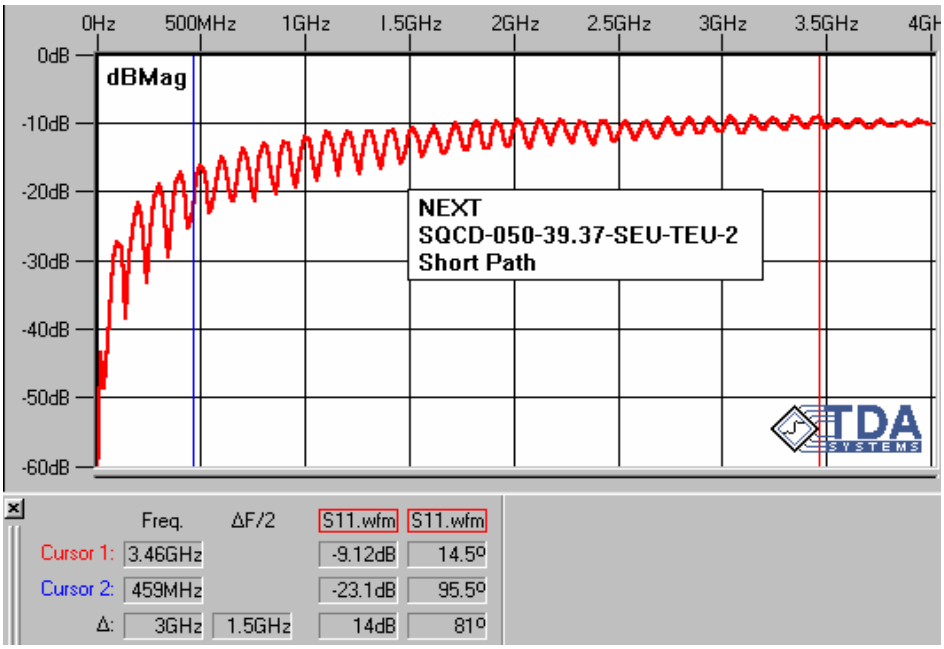


Figure 32: SQCD-050-39.37-SEU-TEU-2 NEXT Short Path

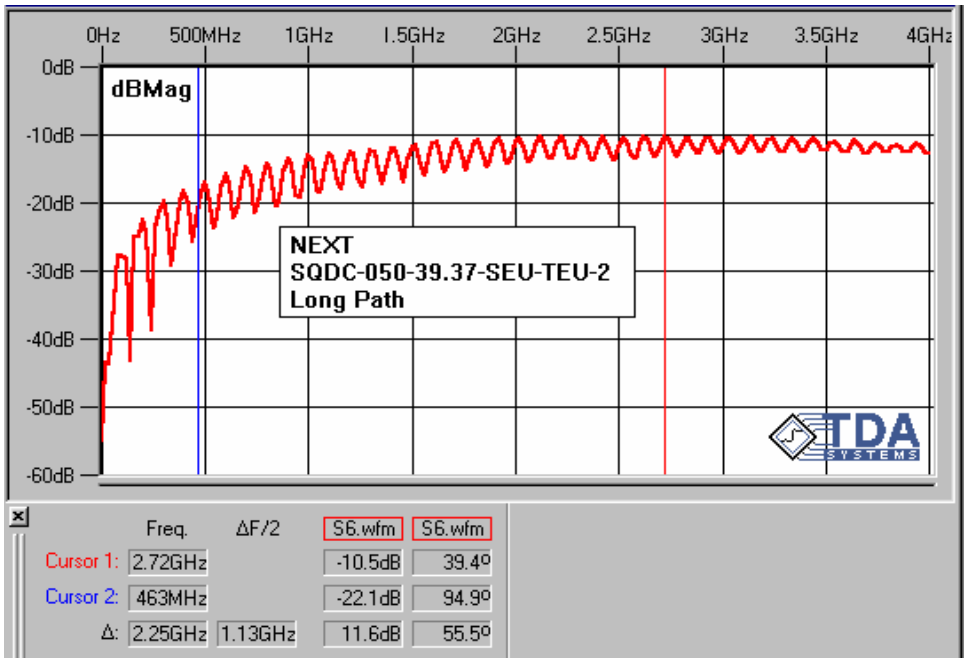


Figure 33: SQCD-050-39.37-SEU-TEU-2 NEXT Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

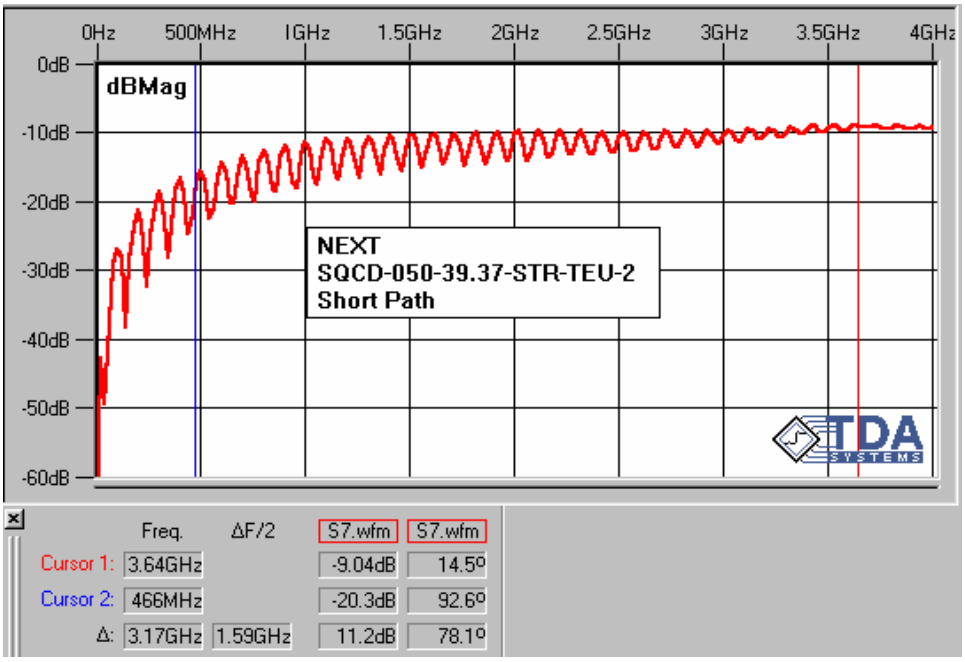


Figure 34: SQCD-050-39.37-STR-TEU-2 NEXT Short Path

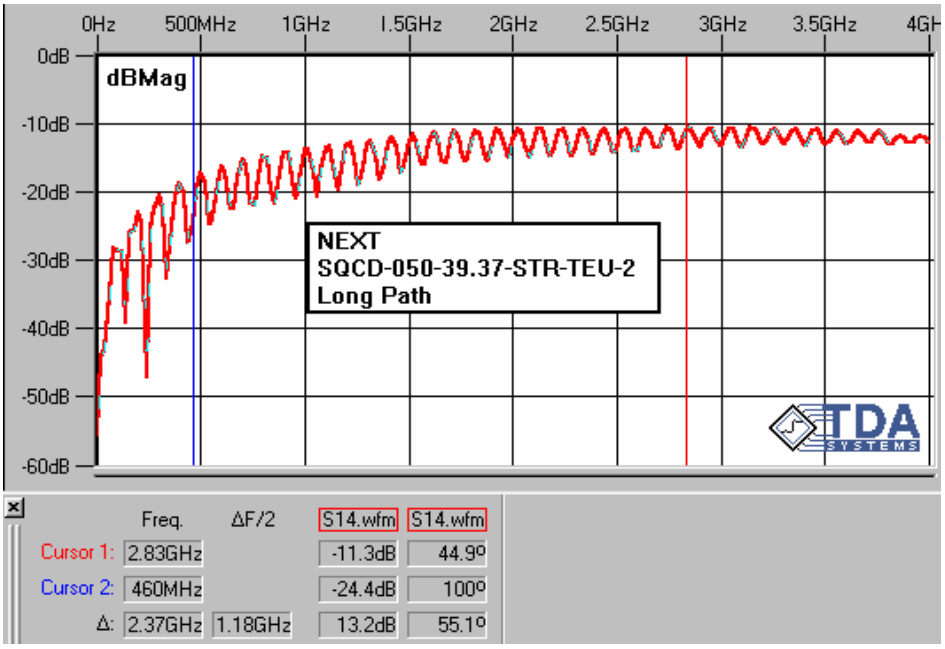


Figure 35: SQCD-050-39.37-STR-TEU-2 NEXT Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

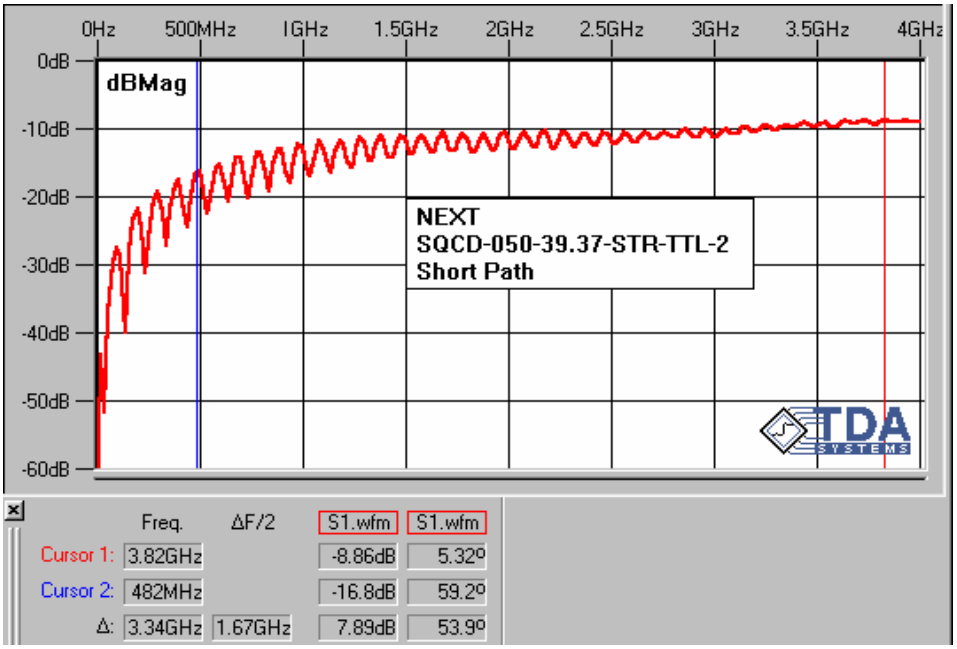


Figure 36: SQCD-050-39.37-STR-TTL-2 NEXT Short Path

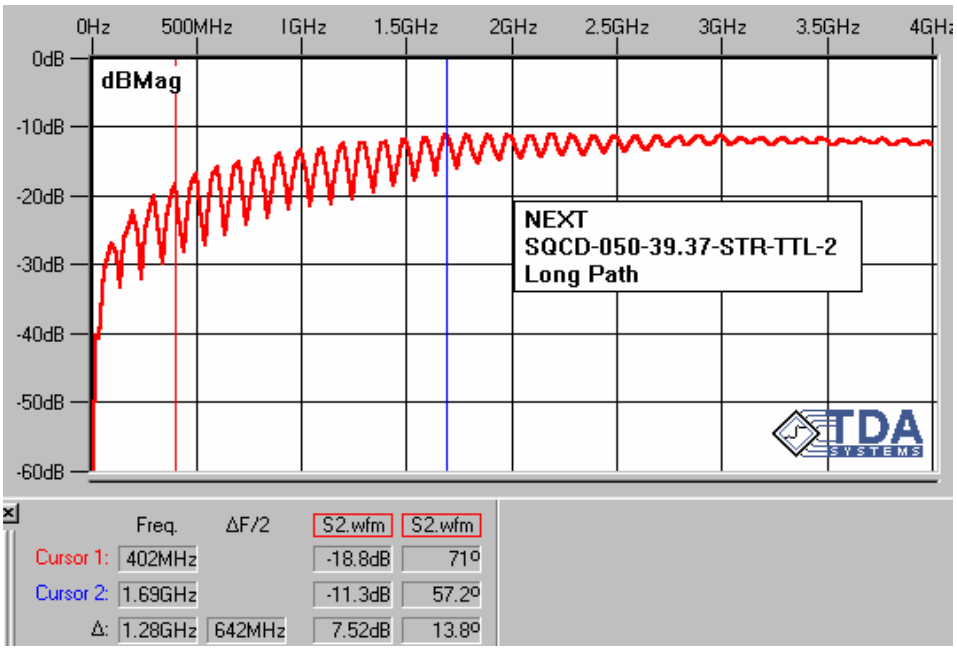


Figure 37: SQCD-050-39.37-STR-TTL-2 NEXT Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

Far End Crosstalk

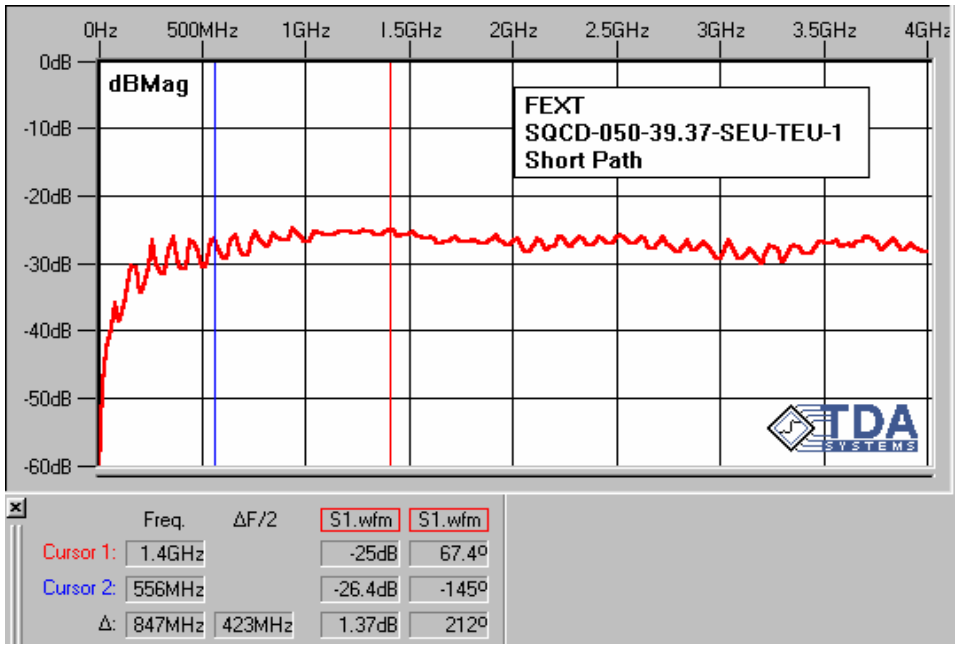


Figure 38: SQCD-050-39.37-SEU-TEU-1 FEXT Short Path

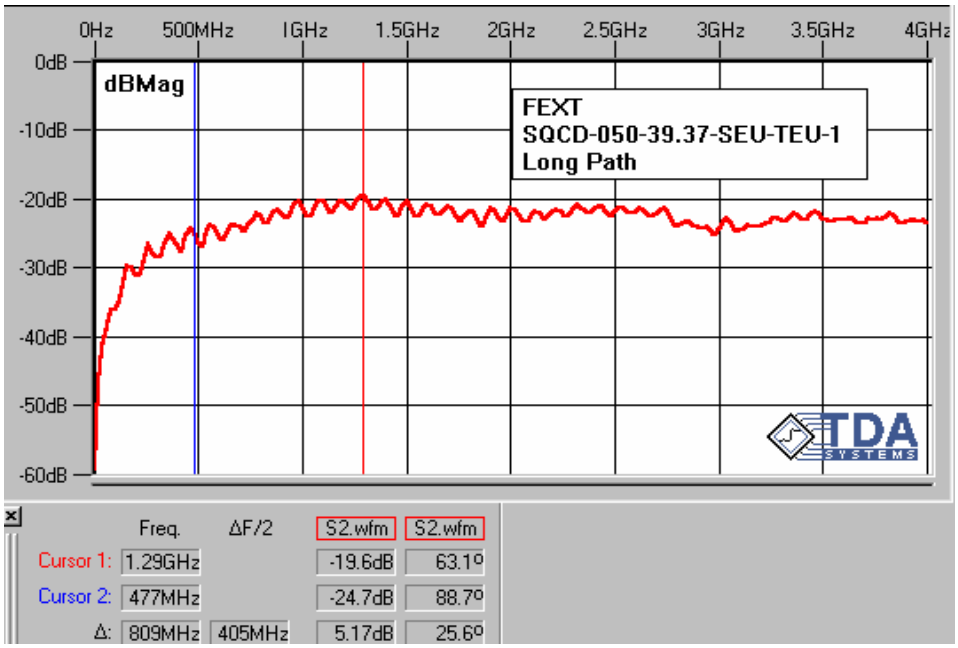


Figure 39: SQCD-050-39.37-SEU-TEU-1 FEXT Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

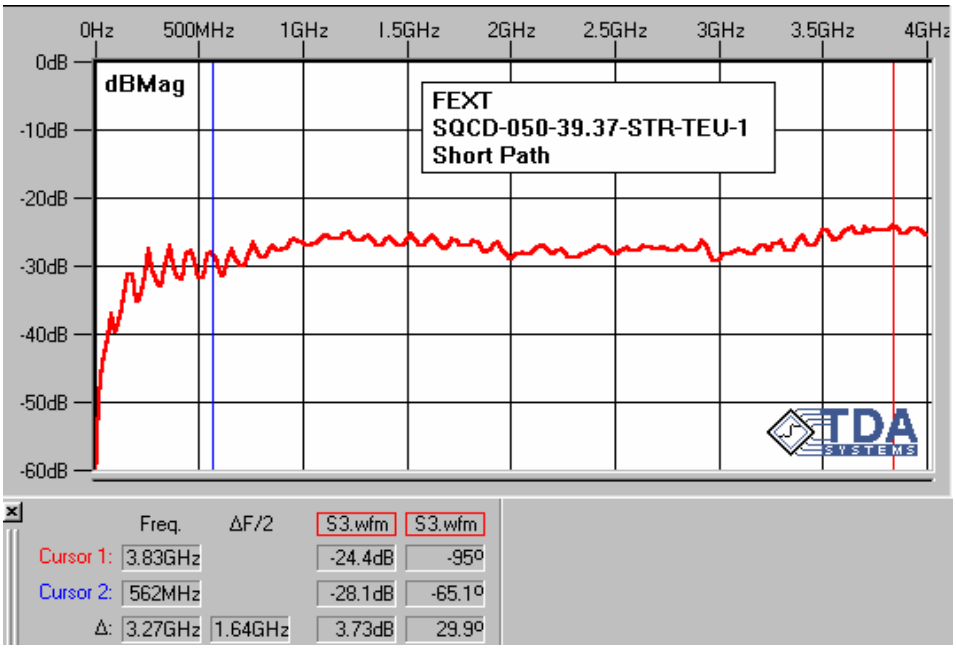


Figure 40: SQCD-050-39.37-STR-TEU-1 FEXT Short Path

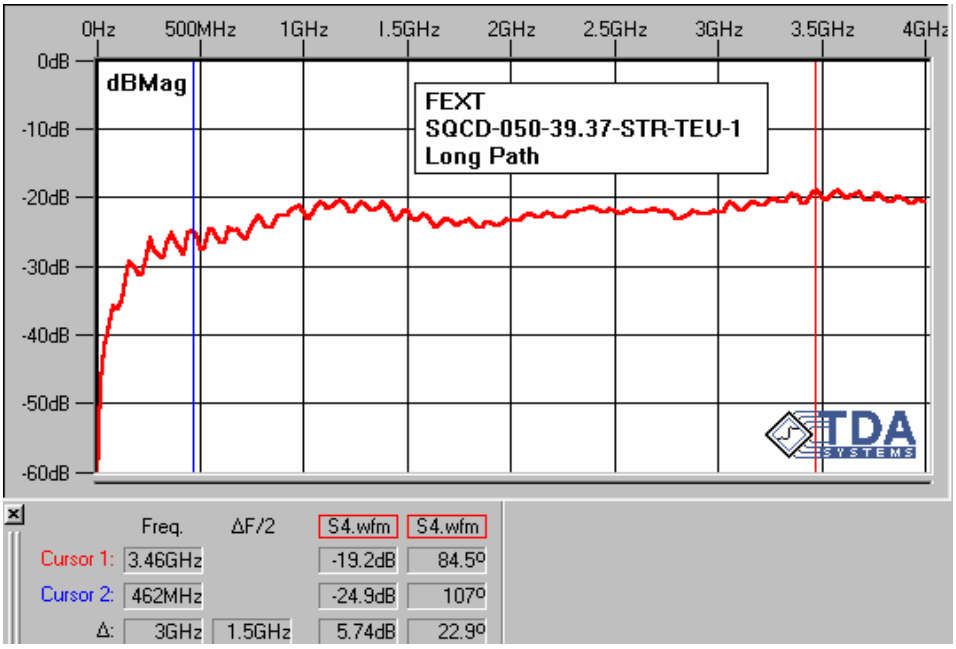


Figure 41: SQCD-050-39.37-STR-TEU-1 FEXT Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

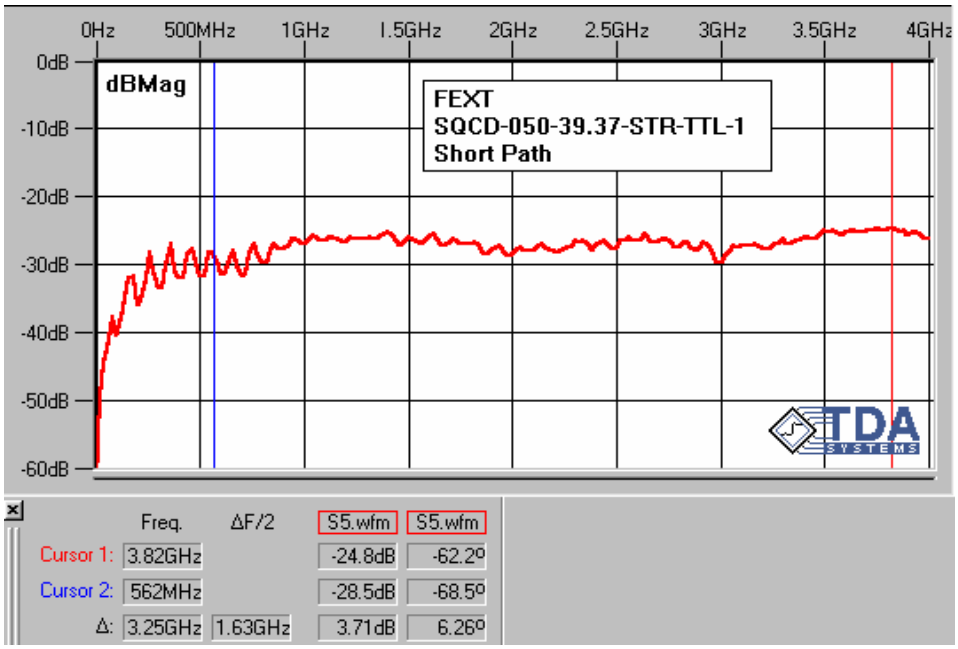


Figure 42: SQCD-050-39.37-STR-TTL-1 FEXT Short Path

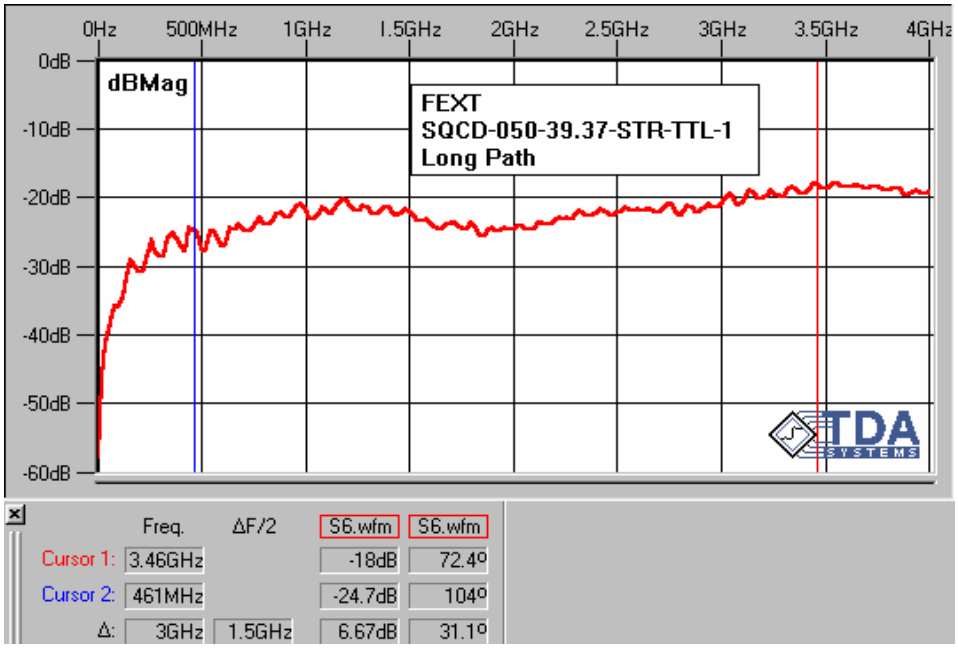


Figure 43: SQCD-050-39.37-STR-TTL-1 FEXT Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

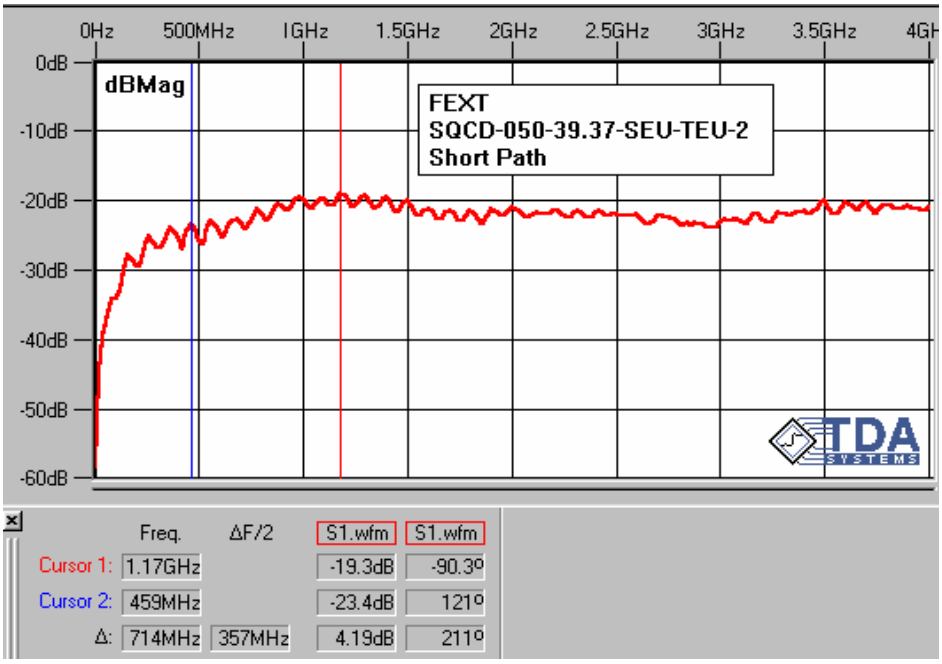


Figure 44: SQCD-050-39.37-SEU-TEU-2 FEXT Short Path

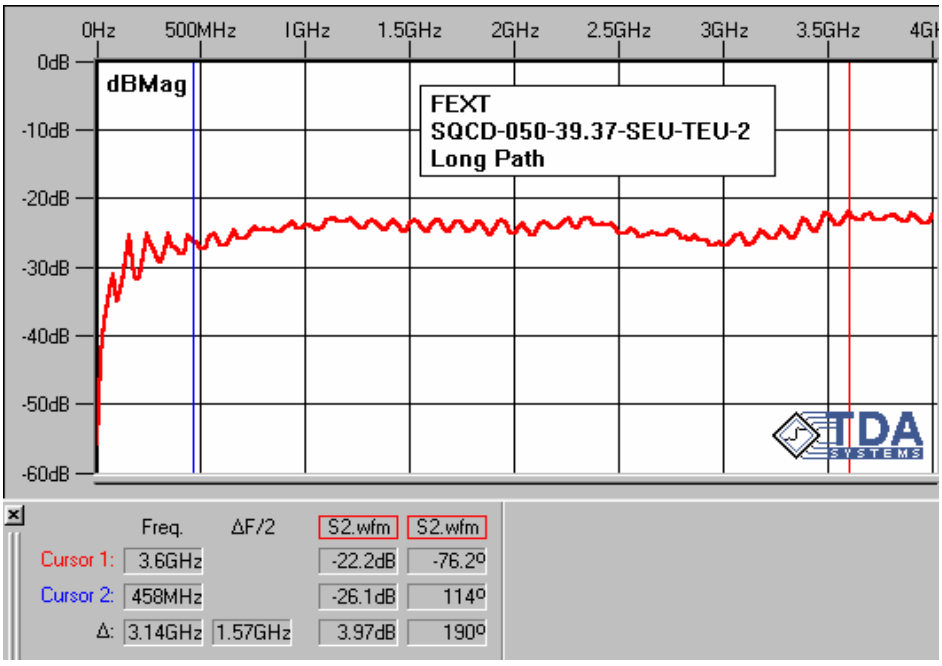


Figure 45: SQCD-050-39.37-SEU-TEU-2 FEXT Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

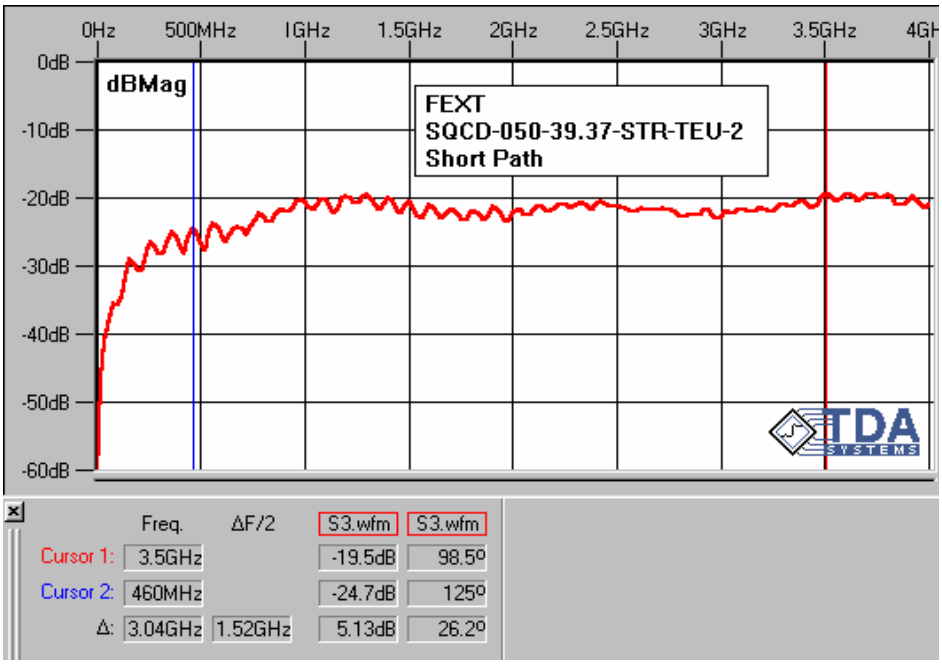


Figure 46: SQCD-050-39.37-STR-TEU-2 FEXT Short Path

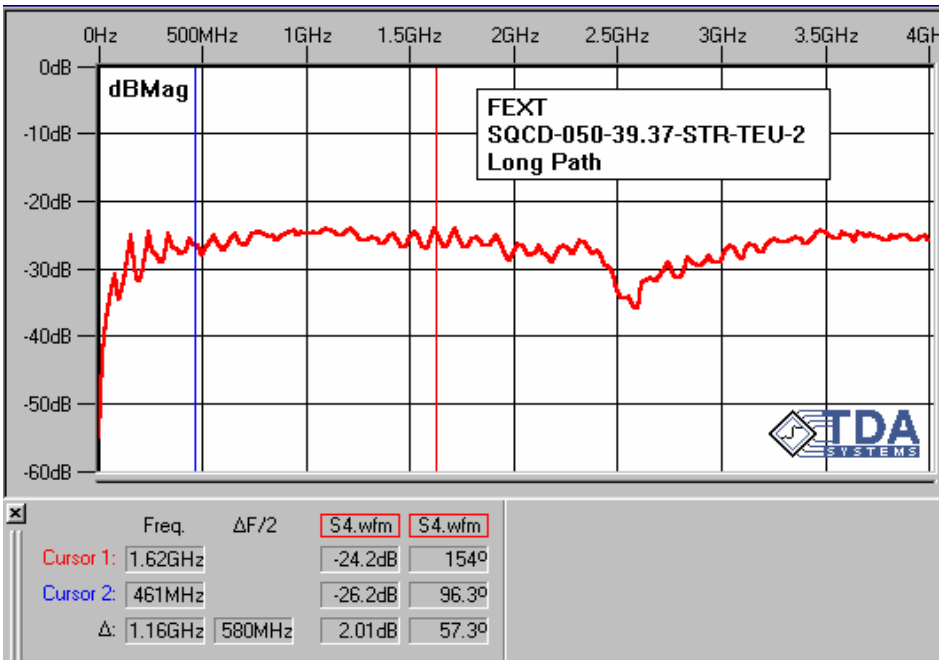


Figure 47: SQCD-050-39.37-STR-TEU-2 FEXT Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

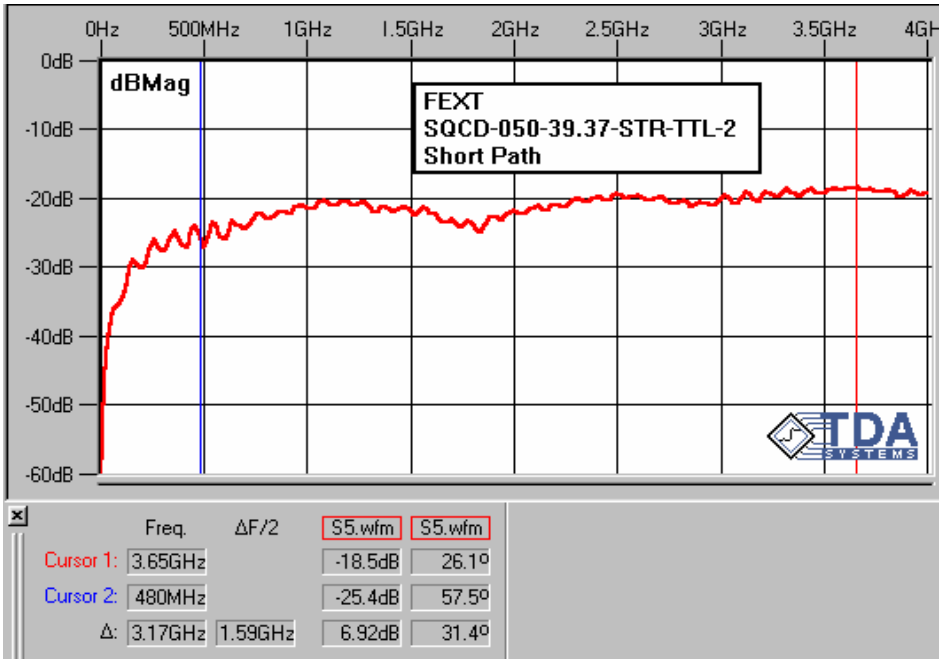


Figure 48: SQCD-050-39.37-STR-TTL-2 FEXT Short Path

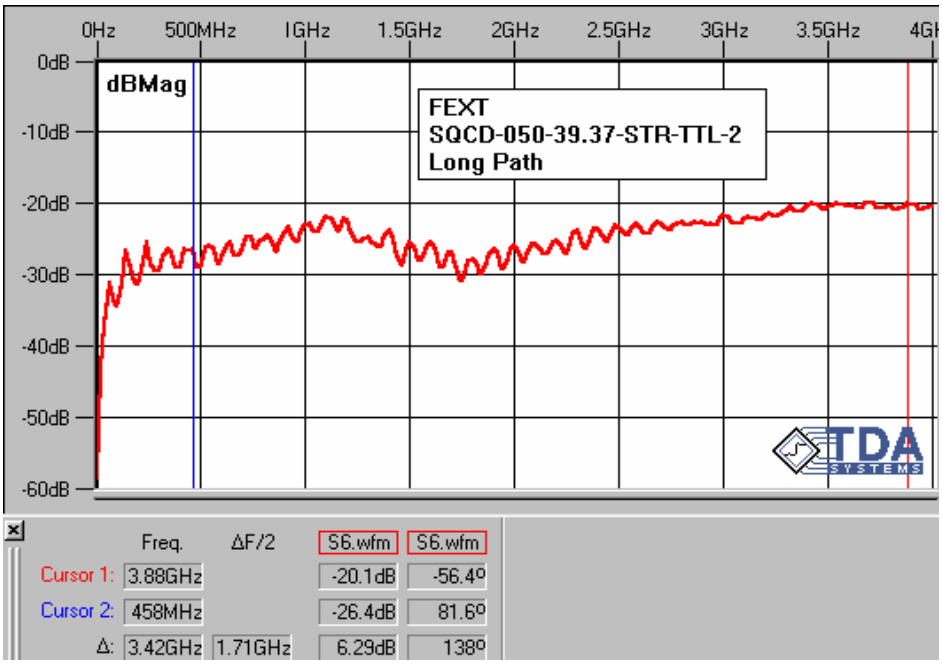


Figure 49: SQCD-050-39.37-STR-TTL-2 FEXT Long Path

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

Test Procedures

Fixturing:

All measurements were performed using the test boards specifically designed for this project. The test boards have trace lengths of 2.500 inches and provide for the interconnection to the SQCD cable by use of replaceable SMA connectors. Each test board has a THRU reference trace. Figure 50 below shows how the THRU reference trace was utilized to compensate for the losses due to the coaxial test cables, SMA launches, and the test board traces during testing.

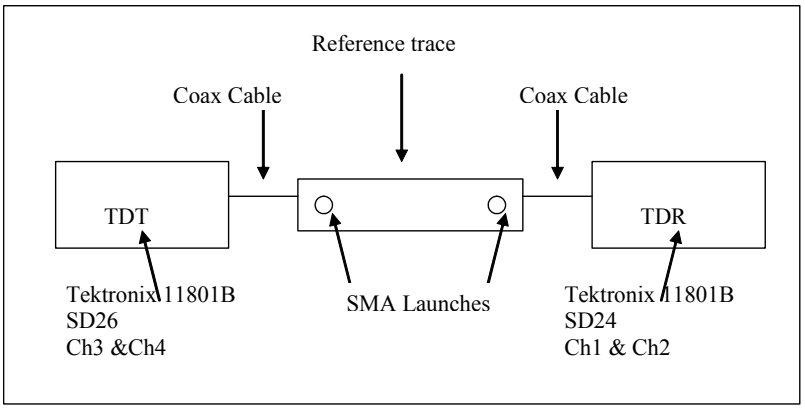


Figure 50: Test setup for Thru Reference Acquisition

Measurements were then performed using the test boards as shown in Figure 51. A picture of the test board and cable is shown in Figure 52.

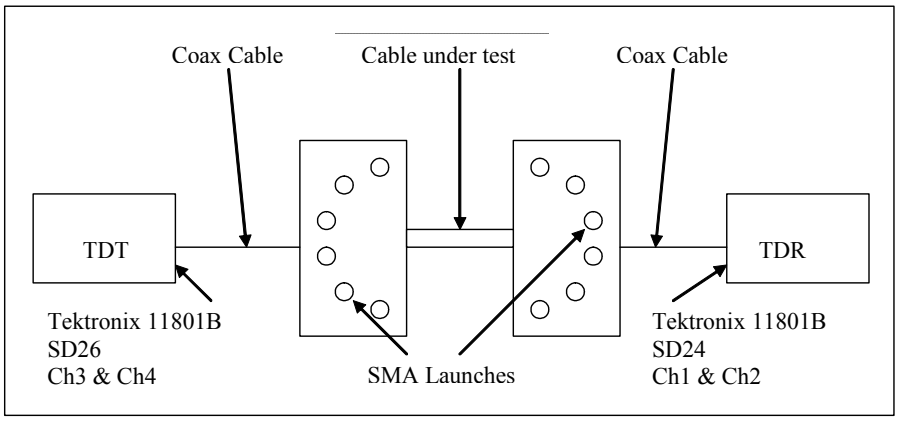


Figure 51: Characterization test setup

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

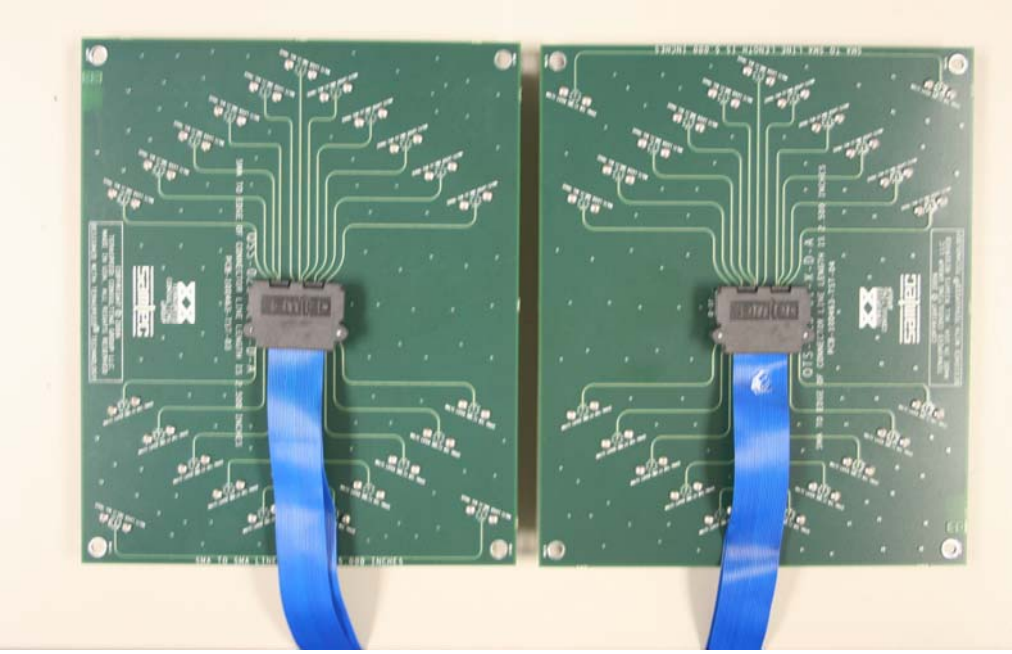


Figure 52: Test setup with Test PCBs and SQCD cable.

The cable termination uses a S, G, S, G … configuration. The respective signal line numbers are shown in Table 6 below (first 25 positions shown; there are a total of 50 positions per row). All adjacent lines are terminated where applicable.

G	*3*	*G*	*G*	*9*	*11*	*G*	*G*	*G*	*G*	*21*	*23*	*25*	*27*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*43*	*45*	*47*	*49*
G	*4*	*G*	*G*	*10*	*12*	*G*	*G*	*G*	*G*	*22*	*24*	*26*	*28*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*44*	*46*	*48*	*50*

Table 6: Grounding scheme and respective signal line number

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

EM → EM Assembly	Path		DV → EM Assembly	Path		DV → DV Assembly	Path	
	Long	Short		Long	Short		Long	Short
SEU-TEU-1	50	25	STR-TEU-1	49	26	STR-TTL-1	49	26
SEU-TEU-2	26	49	STR-TEU-2	26	49	STR-TTL-2	26	49

Table 7: Long Path and Short Path Signal Line Numbers

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

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 termination 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 board. 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 50).

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 53). To acquire FEXT, a trace was driven with the oscilloscope pulse generator. FEXT was measured on an adjacent trace at the far end (see Figure 54). All adjacent lines were terminated, at both ends, with 50Ω SMA loads; refer to Figures 53 and 54.

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

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 each assembly was the source end for all frequency domain measurements. All adjacent lines were terminated, at both ends, with 50Ω SMA loads; refer to Figures 53 and 54.

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 board (see Figure 50 on page 31). A thru measurement of an assembly was taken and then post processed by using Tektronix's IConnect® software (Version 3.6.0). 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 assemblies. A matched reflection waveform of the cable assembly, i.e. with the cable assembly terminated in a 50-Ω SMA load on the far end test board, was acquired and then post processed by using Tektronix's IConnect® software (Version 3.0). 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's IConnect® software (Version 3.6.0). Initially a thru reference measurement of the coaxial test cables, SMAs, and reference board was performed to compensate for the test setup losses (see Figure 50 on page 31).

To acquire NEXT a trace was driven using the oscilloscope pulse generator. NEXT was measured, in the time domain, on an adjacent trace (see Figure 53, page 35). 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 was driven using the oscilloscope pulse generator. FEXT was measured, in the time domain, on an adjacent trace at the far end (see Figure 54, page

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

35). FEXT was then post processed using Tektronix's IConnect® software to generate the FEXT of the cable assembly in the frequency domain.

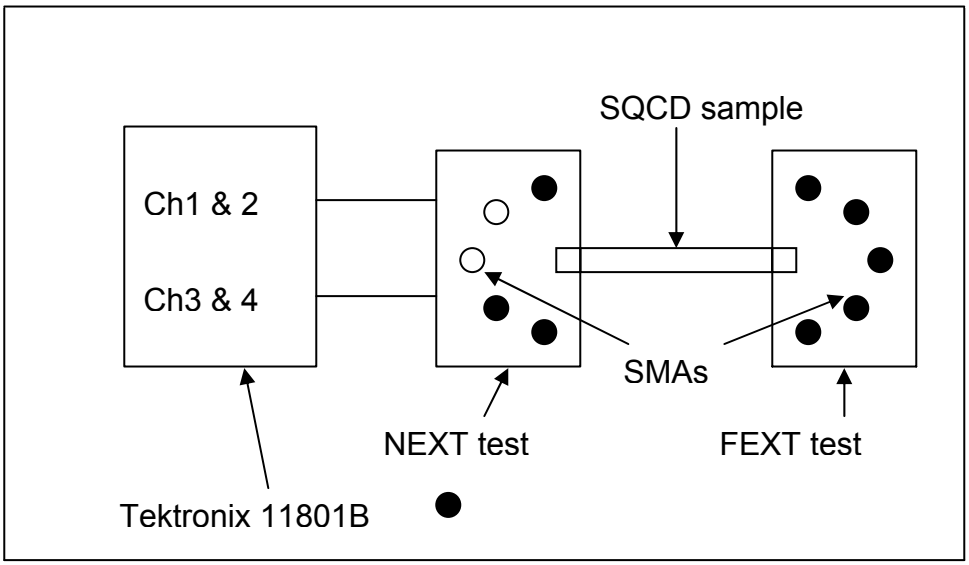


Figure 53: NEXT Measurement Setup.

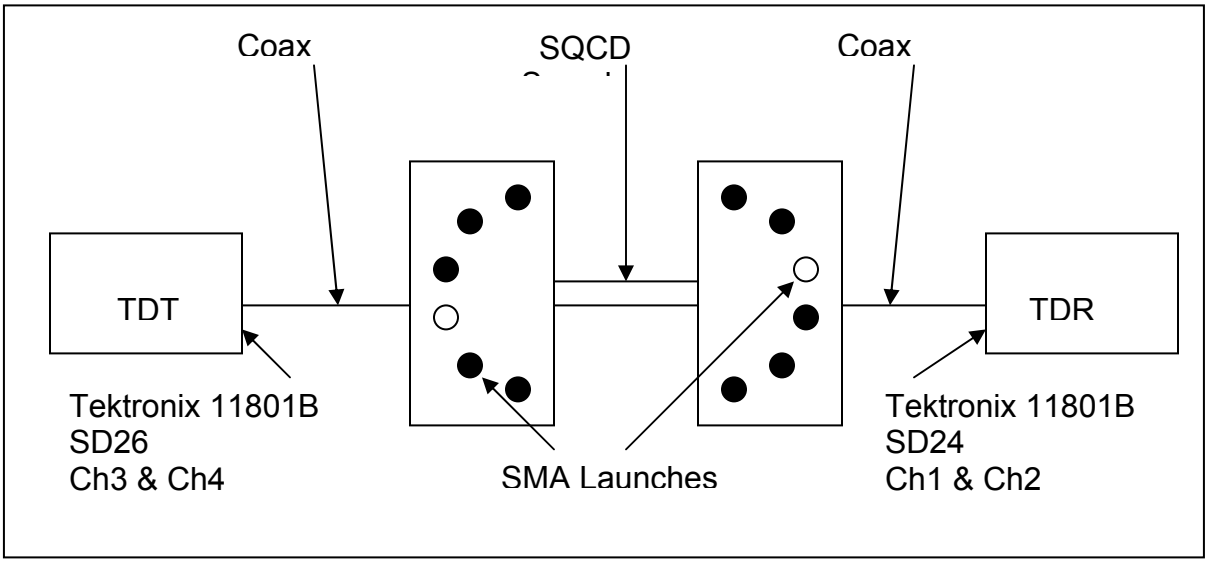


Figure 54: FEXT Measurement Setup

Series: SQCD
Description: Cable Assembly, High Data Rate, 0.635mm Pitch

Equipment

Time Domain Testing

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