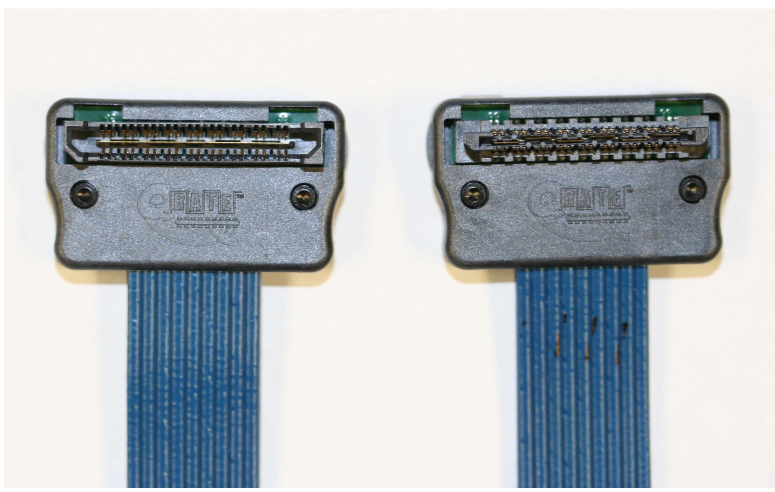
High Speed Characterization Report

EQRP-018-39.37-TTR-STL-1
EQRP-018-39.37-TTR-STL-2



Mated with:
QRF8-018-05.0-L-D-DP-A and QRM8-018-05.0-L-D-DP-A

Description:
0.8mm Q-Rate Cable Assembly, 32 AWG Ribbon Twinax

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Introduction

This testing was performed to evaluate the electrical performance of the EQRP series of 0.8-mm Q-Rate Twinax Cable Assemblies.

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-102285-TST-01 REV A and PCB-102285-TST-02 REV A. A calibration board was also utilized (PCB-102285-TST-98 REV A).

Product Description

Each test sample consists of two micro-twinax ribbon cables that contain 9 twinaxes each. At each end of the cable there is a connector that is terminated to a small transition PCB. Each connector is soldered to its respective PCB. The connector terminals are on 0.8-mm centers. Assembly length is 39.37 inches. The cable assembly connectors are of the vertical mount type (DV).

The transition PCBs are of two types and allow for two different wiring options. The –1 wiring option provides a Pin 1 to Pin 1 mapping between the cable ends. The –2 wiring option provides a Pin 1 to Pin 2 mapping between cable ends. This results in a crossover so that the inner row of connector terminals at one end is mapped to the outer row of connector terminals at the opposite end, and vice versa.

The EQRP assemblies were tested by mating to a QRF8-DP socket at End 1 and to a QRM8-DP header at End 2. One sample of each assembly type was tested. The actual part numbers that were tested are shown in Table 1, which also identifies End 1 and End 2 of the assemblies; a relative sample picture is shown in Figure 1. Two lines, a long path (LP) and a short path (SP), of each sample were tested.

Length	Part Number	Termination	End 1	End 2
39.37 in.	EQRP-018-39.37-TTR-STL-1	DV – DV	TTR	STL
39.37 in.	EQRP-018-39.37-TTR-STL-2	DV – DV	TTR	STL

Table 1: Sample Description

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Figure 1: Test Sample Configuration

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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 assembly mated to the respective connector/test board. Data was measured at the cable connector and at 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)
TTR-STL-1	Long	87.8	96.5	87.9	98.8	100.3	101.1
	Short	85.7	101.2	84.4	99.8	102.0	101.5
TTR-STL-2	Long	87.1	96.7	82.3	98.9	102.2	101.5
	Short	85.7	99.5	82.3	100.7	100.9	100.7

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)
EQRP-018-39.37-TTR-STL-1	Long	5.194	0.124
	Short	5.070	
EQRP-018-39.37-TTR-STL-2	Long	5.186	0.038
	Short	5.148	

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 450 mV. The acquired data was measured using a filtered rise time of 100 pS. The End 1 heading in Table 4 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 4 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 (%)
TTR-STL-1	Long	4.24	0.94	4.08	0.91
	Short	4.32	0.96	4.48	1.00
TTR-STL-2	Long	4.16	0.92	4.08	0.91
	Short	4.56	1.01	5.28	1.17

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 450 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 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	END1		END 2	
		FEXT (mV)	FEXT (%)	FEXT (mV)	FEXT (%)
TTR-STL-1	Long	2.00	0.44	1.84	0.41
	Short	2.56	0.57	2.48	0.55
TTR-STL-2	Long	1.68	0.37	1.60	0.36
	Short	2.56	0.57	2.64	0.59

Table 5: % FEXT

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Frequency Domain Data

Insertion Loss

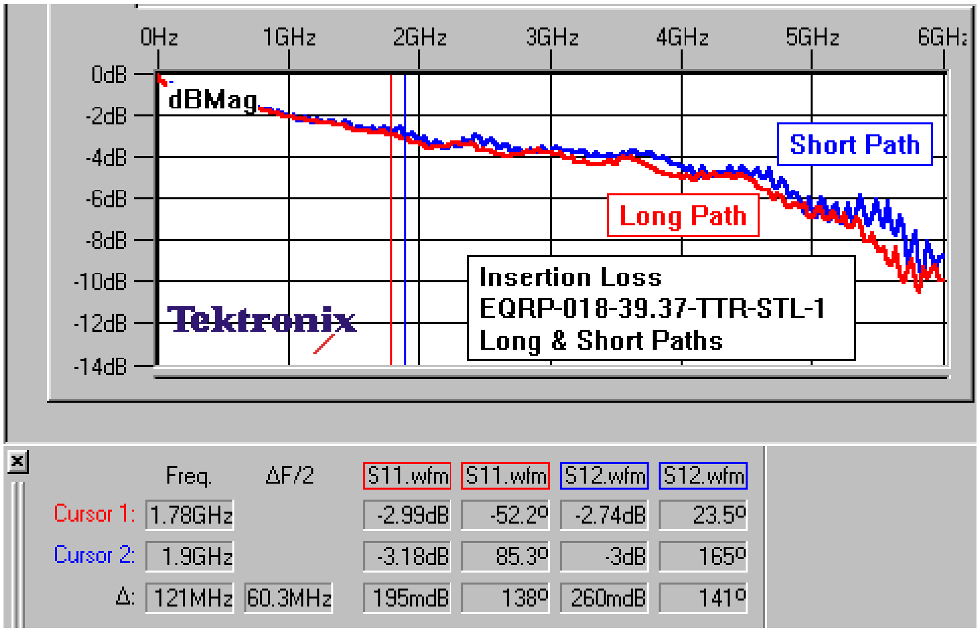

Figure 2: EQRP-018-39.37-TTR-STL-1 Insertion Loss

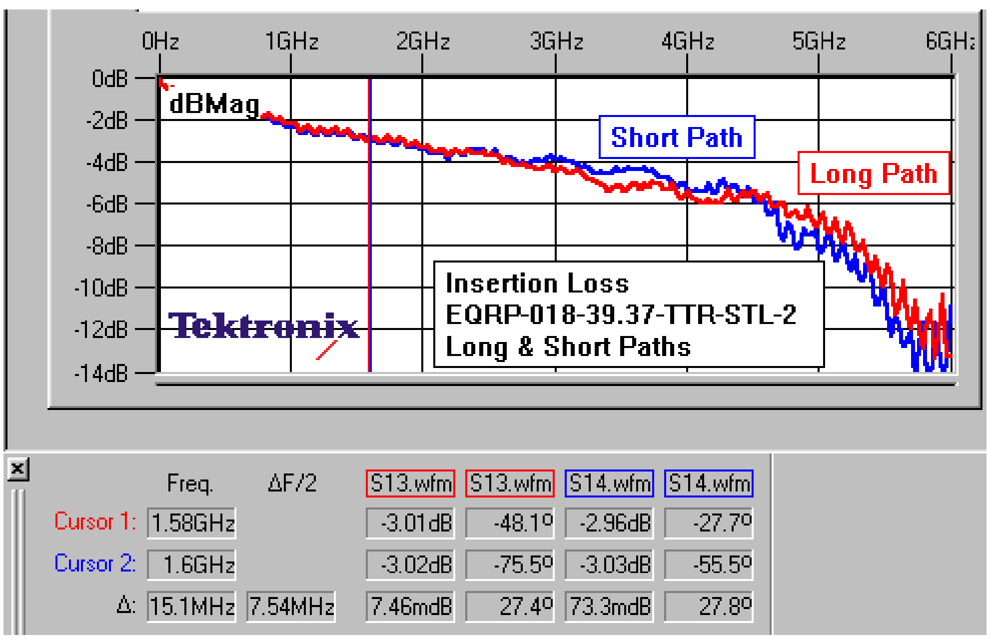

Figure 3: EQRP-018-39.37-TTR-STL-2 Insertion Loss

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Return Loss

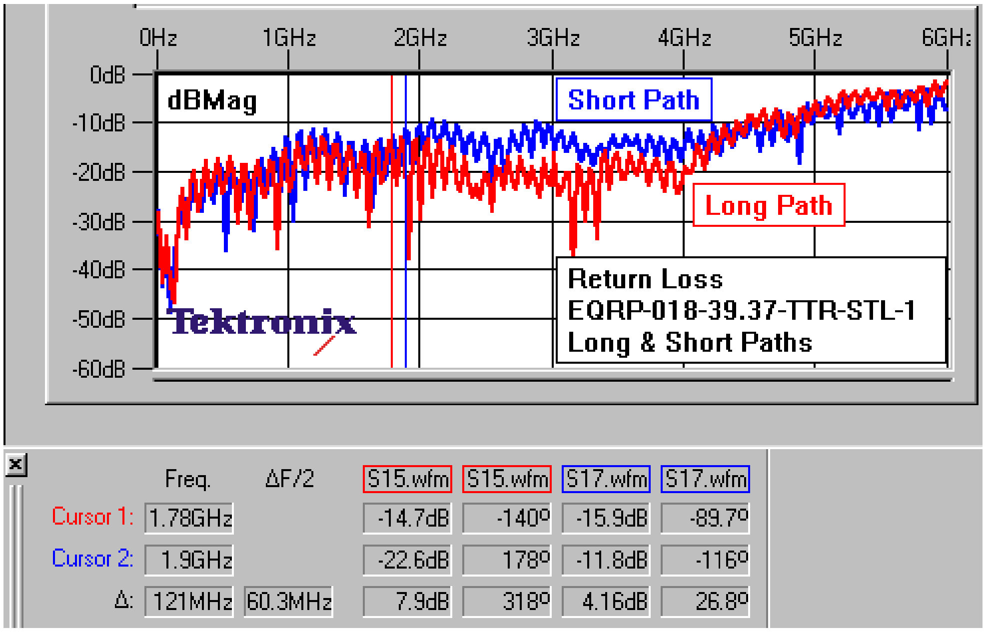

Figure 4: EQRP-018-39.37-TTR-STL-1 Return Loss

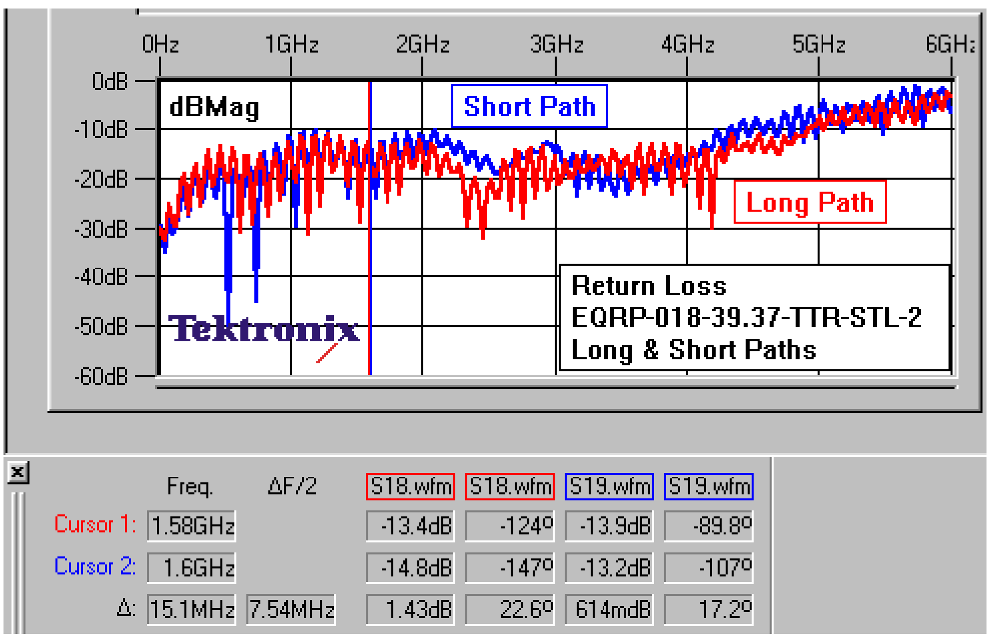

Figure 5: EQRP-018-39.37-TTR-STL-2 Return Loss

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Near End Crosstalk

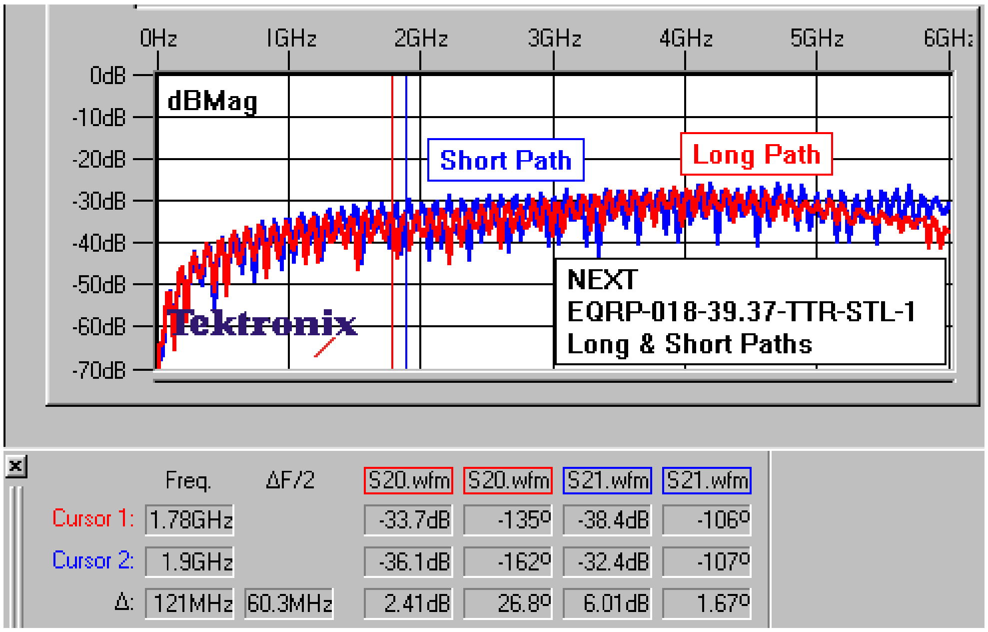

Figure 6: EQRP-018-39.37-TTR-STL-1 NEXT

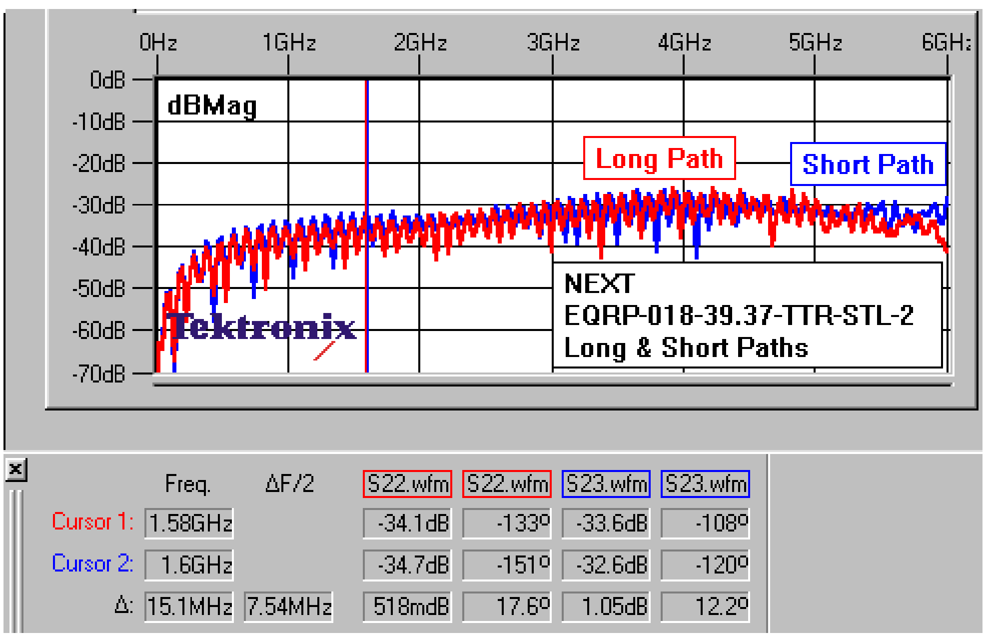

Figure 7: EQRP-018-39.37-TTR-STL-2 NEXT

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Far End Crosstalk

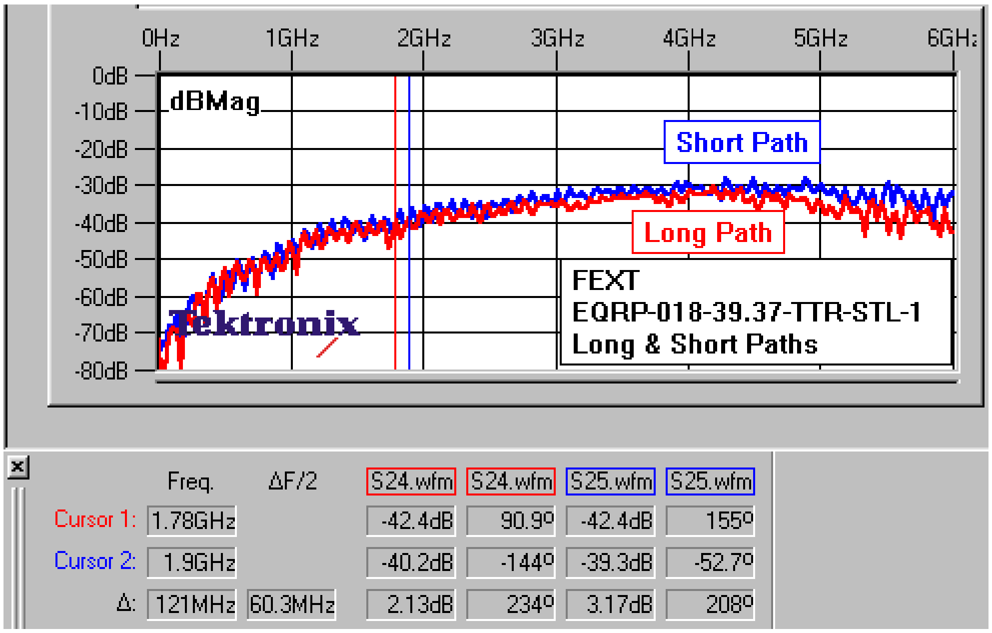

Figure 8: EQRP-018-39.37-TTR-STL-1 FEXT

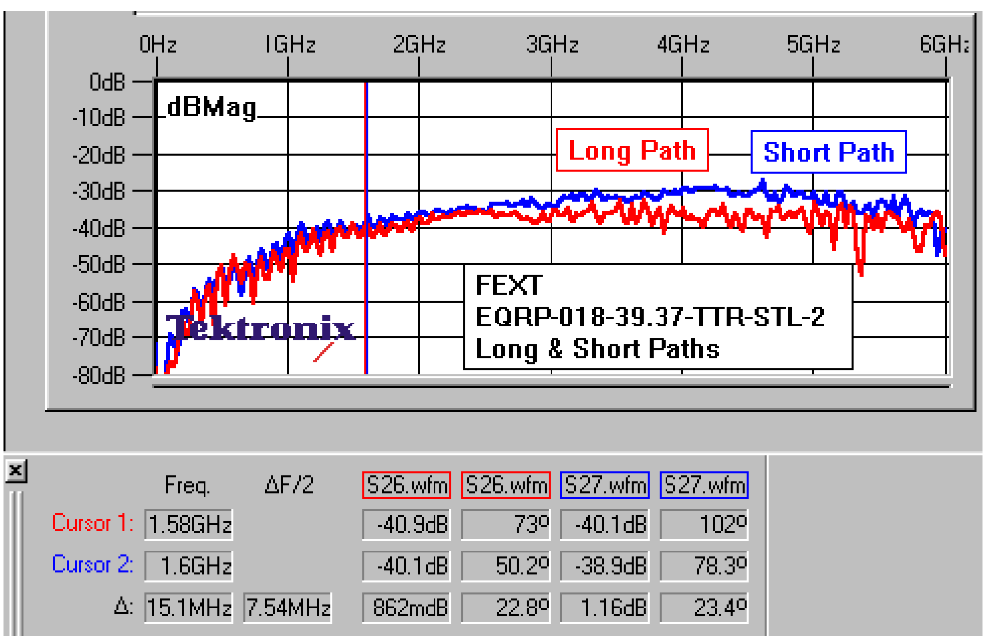

Figure 9: EQRP-018-39.37-TTR-STL-2 FEXT

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Test Procedures

Fixturing:

All measurements were performed using the test boards. The test boards have trace lengths of 3.30 inches and provide for the interconnection to the EQRP assembly by use of field replaceable SMA connectors. The calibration board provides a THRU reference trace pair. 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.

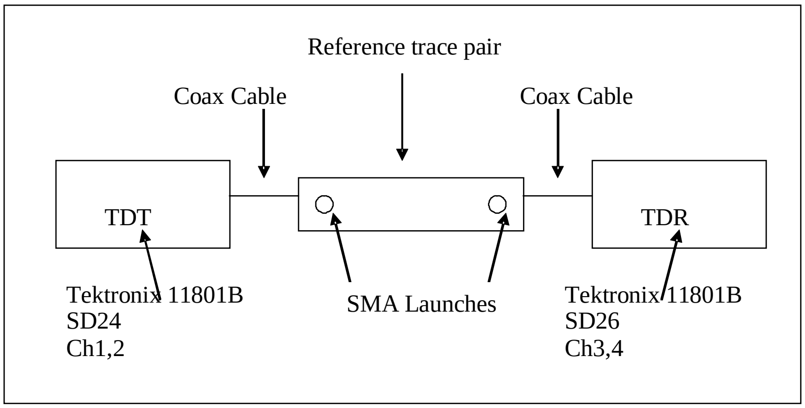

Figure 10: Test setup for Thru Reference Acquisition

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.

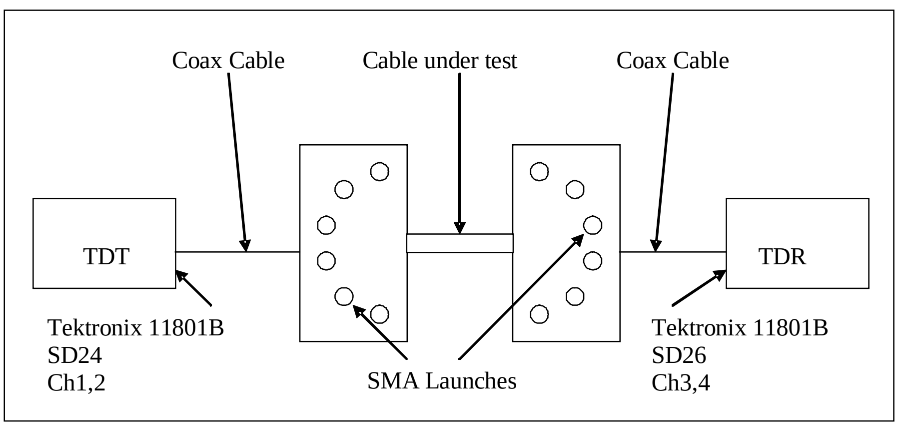

Figure 11: Characterization test setup

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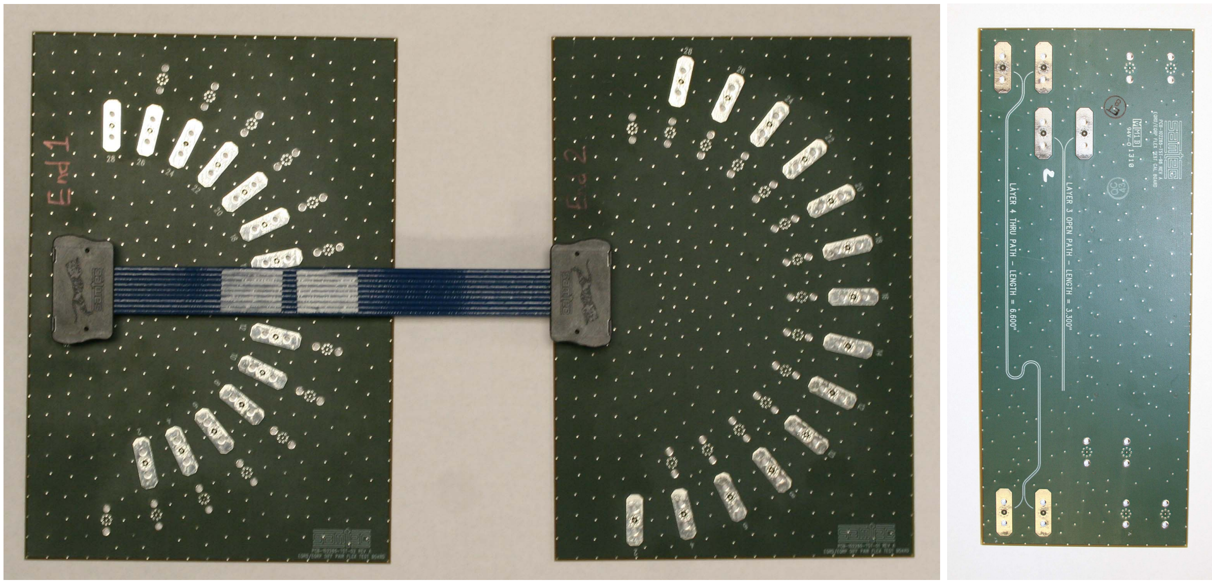

Figure 12: Test setup with Test PCBs, calibration board and EQRP coax cable assembly.

The twinax cable assembly terminations had a particular signal line configuration. The respective signal line numbers are shown in Table 6 below. There are a total of 26 positions per row. Not all positions are shown. SMA jack numbers on the test boards correspond to the assembly line numbers. All adjacent lines are terminated where applicable. Lines that are not brought out to an SMA jack are grounded on the test boards.

2	4		6	8		10	12		14	16		18	20		22	24		26	28		G
1	3		5	7		9	11		13	15		17	19		21	23		25	27		G

Table 6: Respective signal line numbers.

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

Assembly	Path	
	Long	Short
EQRP-018-39.37-TTR-STL-1	J2-J4	J17-J19
EQRP-018-39.37-TTR-STL-2	J2-J4 → J1-J3	J17-J19 → J18-J20

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 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 connector. 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 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 lines 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 frequency domain measurements. All adjacent lines 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 the signal trace pair on the calibration board. 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 calibration 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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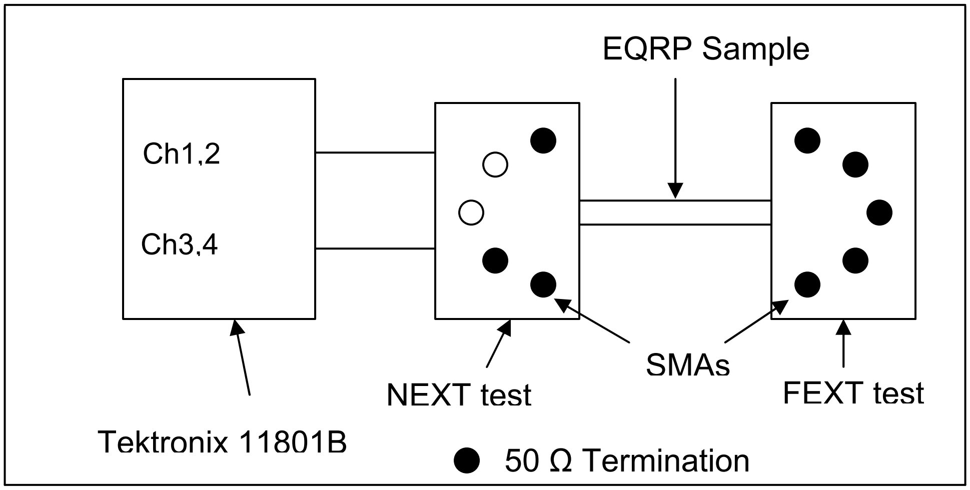

Figure 13: NEXT Measurement Setup.

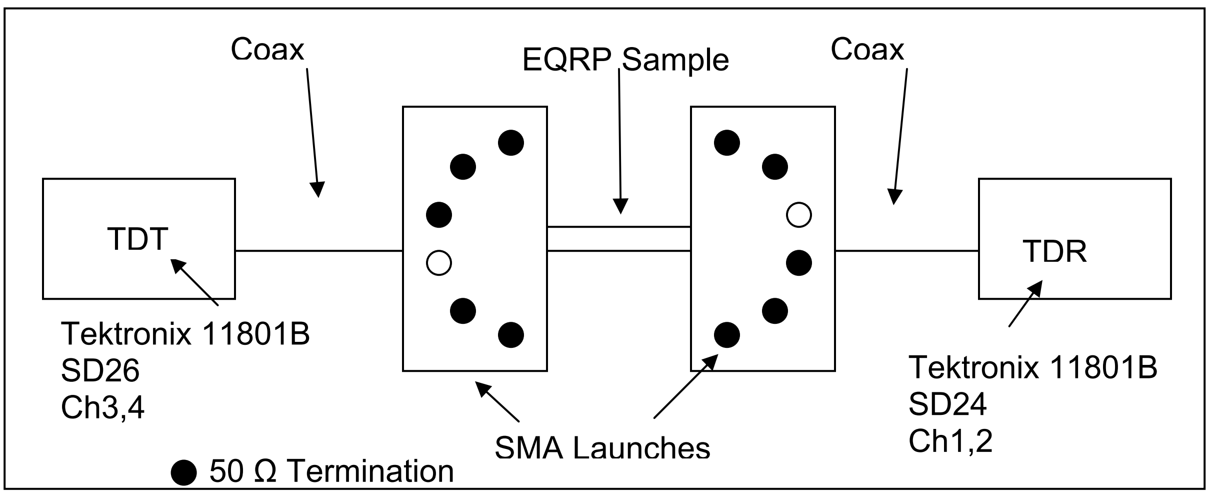

Figure 14: FEXT Measurement Setup

Equipment

Time Domain Testing

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