High Data Rate Characterization Report

FHSC-110-10.00-TTL-STR-1
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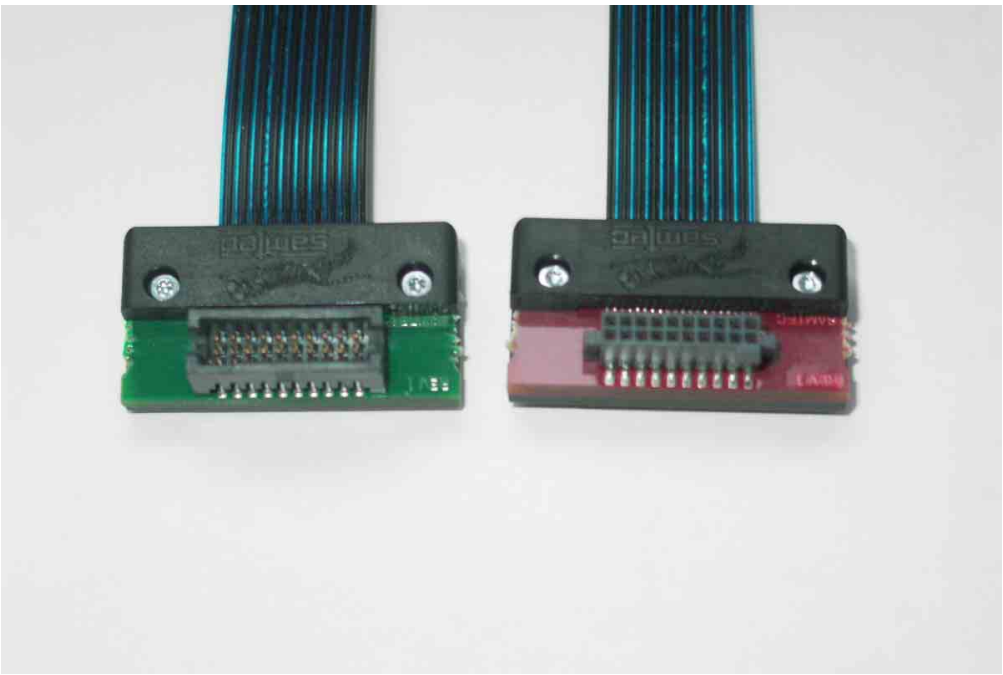

Mated with:
SFM-110-X-X-D-A
TFM-110-X-X-D-A

Description:
Cable Assembly, Standard Data Rate, 0.050” Pitch

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Report Revision: 3/1/2005

Series: FHSC Mated with TFM and SFM
Description: Cable Assembly, Standard Data Rate, 0.050" Pitch

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Introduction

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

Time domain and frequency domain measurements were made. In the time domain impedance, propagation delay, skew, near end and far end crosstalk (NEXT and FEXT, respectively) was measured. Frequency domain measurements were preformed using TDA's IConnect software and include insertion loss (IL), return loss (RL), NEXT and FEXT. All measurements were made utilizing printed circuit boards specifically designed to test this product (referred to in this report as "test PCBs"). One line on each sample, using different ground configurations, was tested.

Product Description

The sample consists of one 10 inch length of Hitachi 38 AWG micro ribbon coaxial cable with 20 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 (refer to Figure 1 on the following page). All cable assemblies are terminated with a TFM shrouded header on one end (P/N: TFM-110-02-S-D-A) and a SFM surface mount socket (P/N: SFM-110-L2-S-D-A) on the other. The overall sample length is 10.60 inches.

There are two types of grounding configurations relative to each individual cable assembly. Configuration FHSC -01, uses positions 2, 3, 15 and 16 as grounds the other, FHCS -02, uses positions 9 and 10 as grounds.

Two samples were tested, one of each assembly type. Testing for impedance, propagation delay, insertion and return loss was preformed on position 1 and testing for NEXT and FEXT was preformed using position 6 as the aggressor and position 8 as the victim.

The actual sample numbers tested are shown in Table 1. Refer to Figure 1 for a picture of the sample.

[1] Measurement and Performance Requirements for HPEI Bulk Cable, Rev 9.0, March 18, 2004

Series: FHSC Mated with TFM and SFM
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Assembly	Part Number	Grounds
FHSC-01	FHSC-110-10.00-TTL-STR-1	2, 3, 15, 16
FHSC-02	FHSC-110-10.00-TTL-STR-1	9 & 10

Table 1: Sample Descriptions

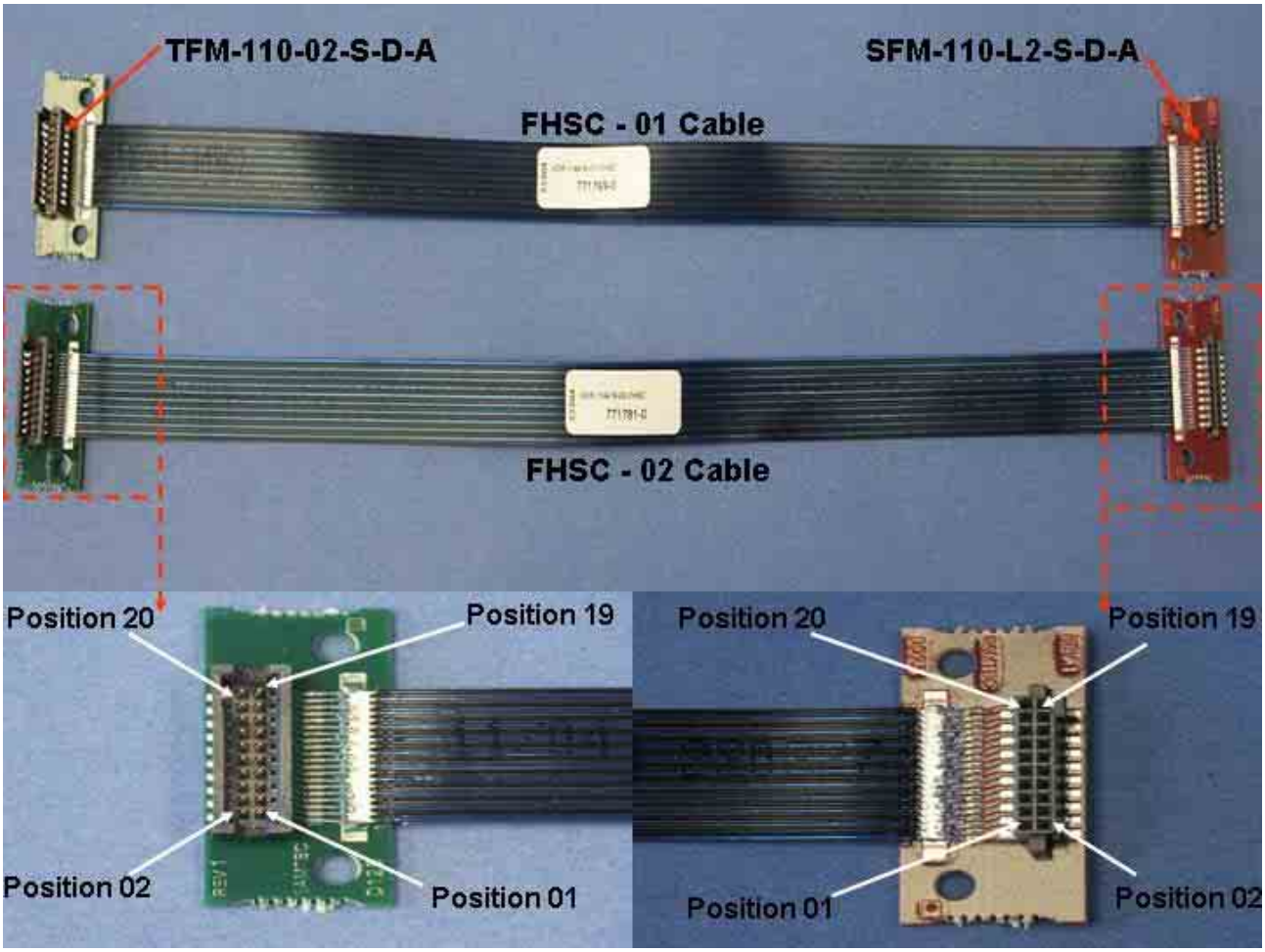

Figure 1: 10.00" FHSC-01 and FHSC-02 Cable Assembly. Shown with caps off.
(P\Ns:) FHSC-110-10.00-TTL-STR-1

Series: FHSC Mated with TFM and SFM
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Results Summary

Time Domain Data

Impedance

Impedance measurements were performed using a filtered risetime of 1.0ns. TFM and SFM designations in Table 2 represent the near-end cable assembly connector. Note that all measurements were performed with the cable assembly mated to the respective connector/test PCB. Data was taken at the respective mated connector and 200ps into the cable (refer to Figure 1).

Assembly	Connector		Cable	
	TFM	SFM	TFM Side	SFM Side
FHSC-01	49.8	49.9	50.2	49.3
FHSC-02	49.7	50.3	51.1	50.9

Table 2: Impedance Measurements (tr = 1nsec)

Timing Measurements

The propagation delay was measured and is recorded in Table 3. Skew was calculated as the difference between the maximum (an outer row line) and minimum (an inner row) propagation delays of each sample.

Position	Propagation Delay (Seconds)	
	FHSC-01	FHSC-02
1	1.40 nsec	1.388 nsec
4	1.44 nsec	1.434 nsec
Skew	40 psec	46 psec

Table 3: Timing Measurements

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NEXT

The near end crosstalk was measured in the time domain as a voltage, using a filtered risetime of 1.0ns, and then converted to a percentage and reported below in Table 4. 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	TFM		SFM	
	NEXT (mV)	NEXT (%)	NEXT (mV)	NEXT (%)
FHSC-01	7.4	2.9	8.0	3.2
FHSC-02	7.3	2.9	7.0	2.8

Table 4: % NEXT

FEXT

The far end crosstalk was measured in the time domain as a voltage, using a filtered risetime of 1.0ns, and then converted to a percentage and reported below in Table 5. Since most of the crosstalk occurs in the connectors the values in Table 5 represent the crosstalk that occurs in the far end mated cable assembly, the test board connectors and the cable itself.

Assembly	TFM		SFM	
	FEXT (mV)	FEXT (%)	FEXT (mV)	FEXT (%)
FHSC-01	8.9	3.6	8.9	3.6
FHSC-02	6.6	2.6	6.7	2.7

Table 5: % FEXT

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Frequency Domain Data

Insertion Loss

FHSC-01

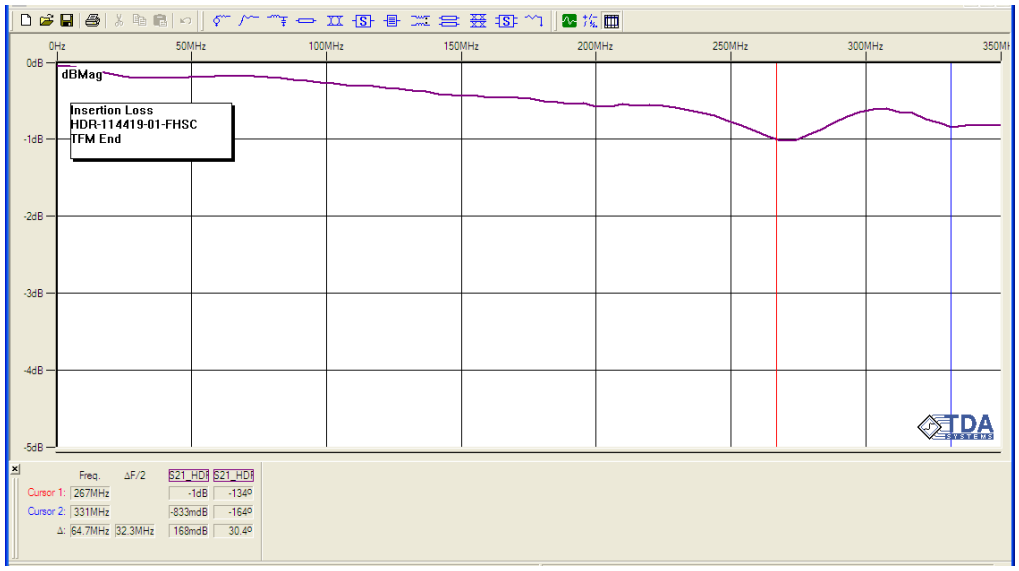

Figure 2: FHSC (01)-110-10.00-TTL-STR-1; Insertion Loss, Signal Line 1, Ground Lines 2, 3, 15 & 16

FHSC-02

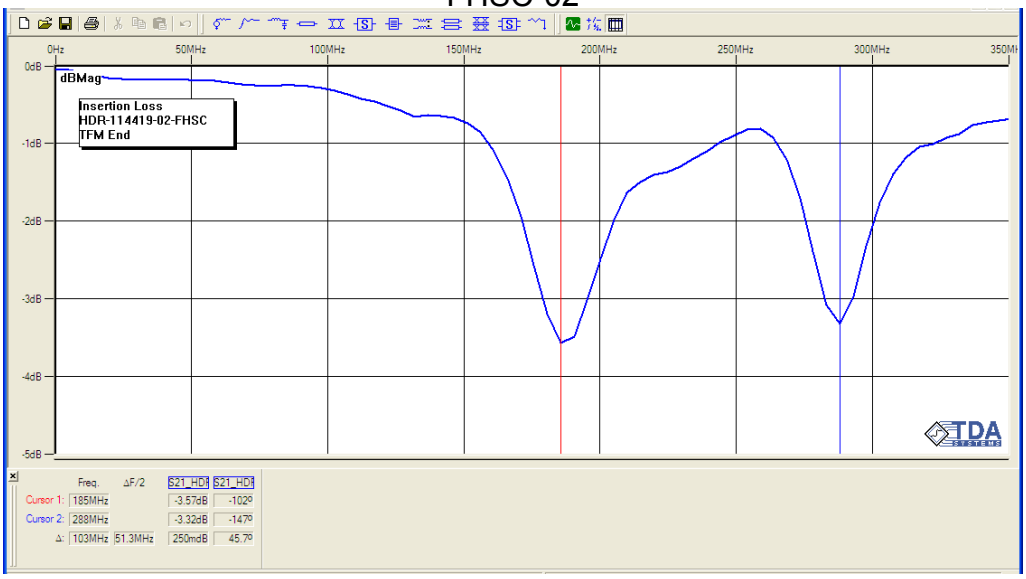

Figure 3: FHSC (02)-110-10.00-TTL-STR-1; Insertion Loss, Signal Line 1, Ground Lines 9 & 10

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Return Loss

FHSC-01

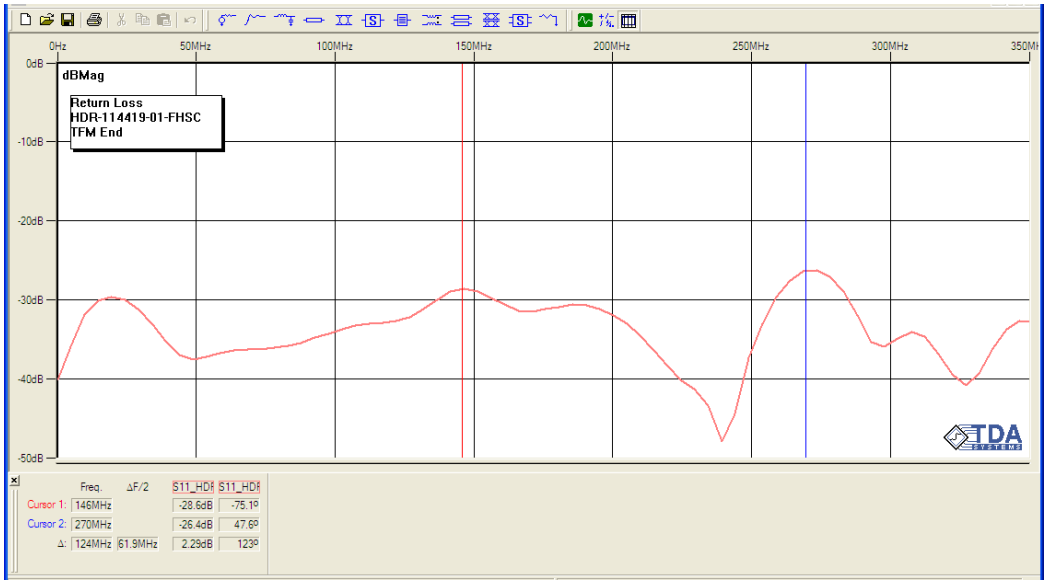

Figure 4: FHSC (01)-110-10.00-TTL-STR-1; Return Loss, Signal Line 1, Ground Lines 2, 3, 15 & 16

FHSC-02

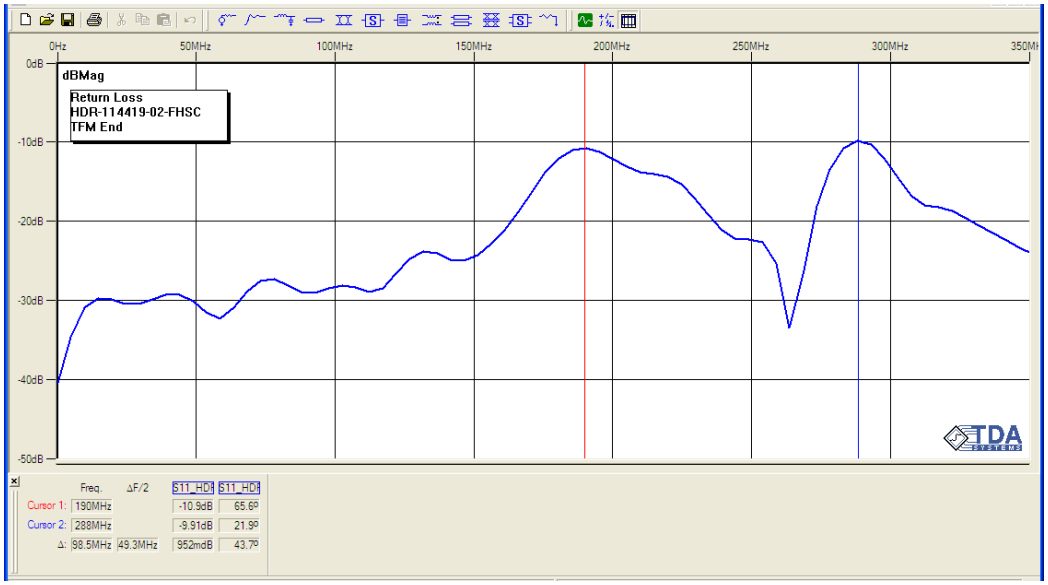

Figure 5: FHSC (02)-110-10.00-TTL-STR-1; Return Loss, Signal Line 1, Ground Lines 9 & 10

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Near End Crosstalk

FHSC-01

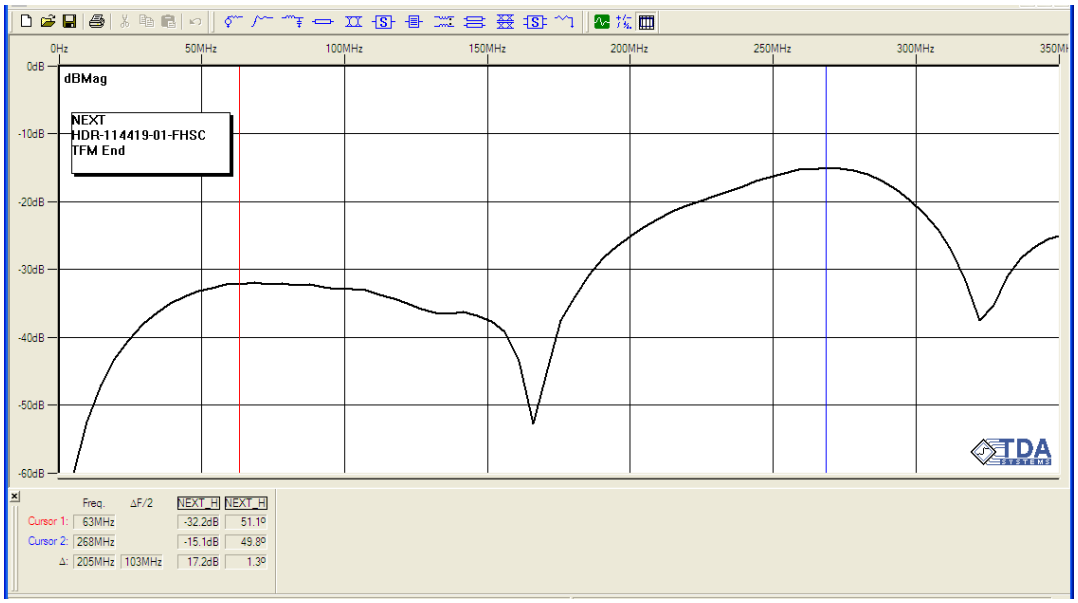

Figure 6: FHSC (01)-110-10.00-TTL-STR-1; NEXT, Aggressor Line 6, Victim Line 8, Ground Lines 2, 3, 15 & 16

FHSC-02

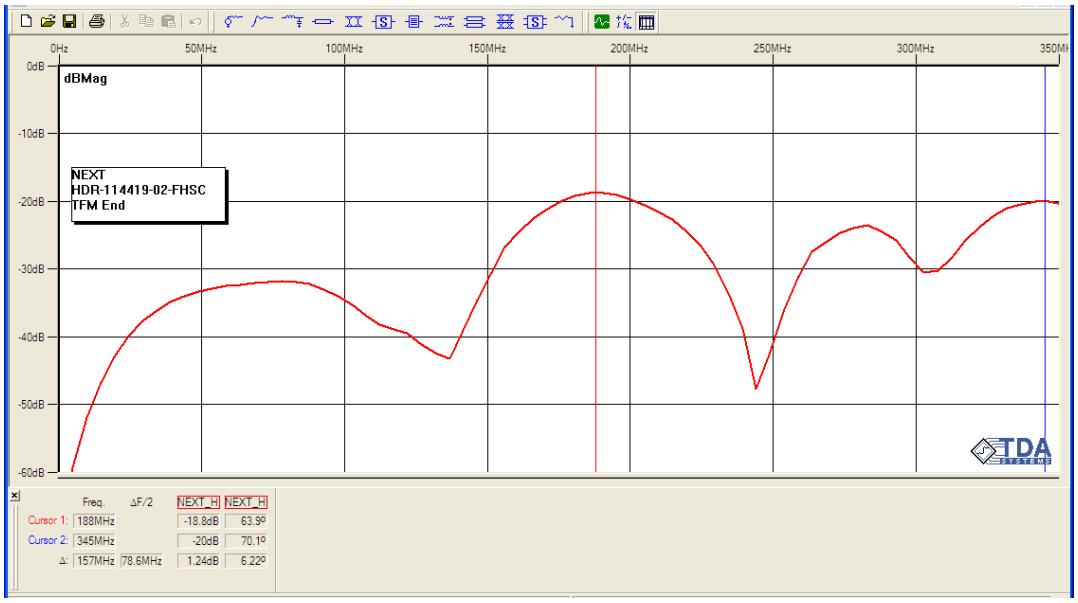

Figure 7: FHSC (02)-110-10.00-TTL-STR-1; NEXT, Aggressor Line 6, Victim Line 8, Ground Lines 9&10

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Far End Crosstalk

FHSC-01

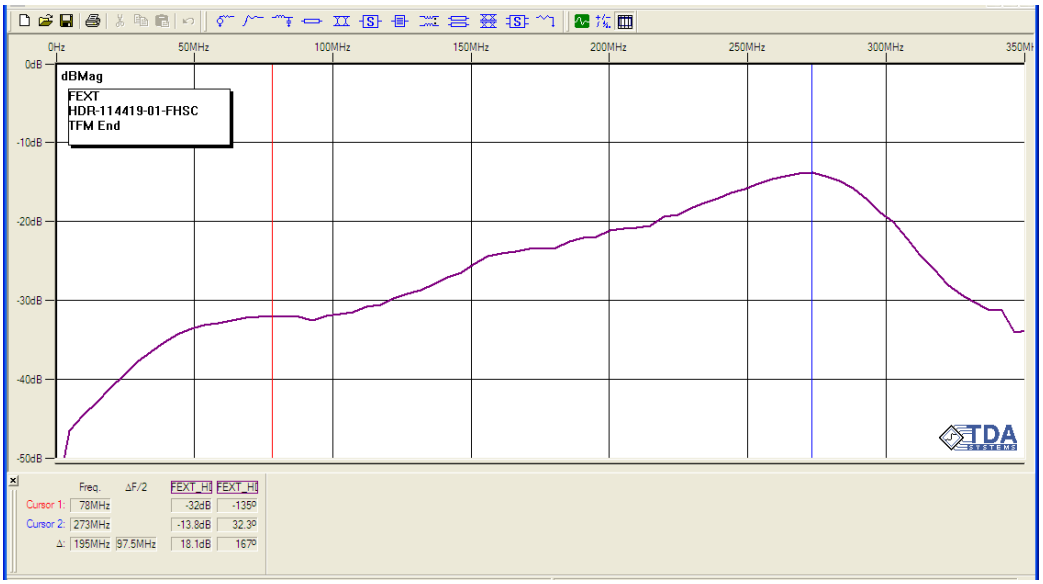

Figure 8: FHSC (01)-110-10.00-TTL-STR-1; FEXT, Aggressor Line 6, Victim Line 8, Ground Lines 2, 3, 15 & 16

FHSC-02

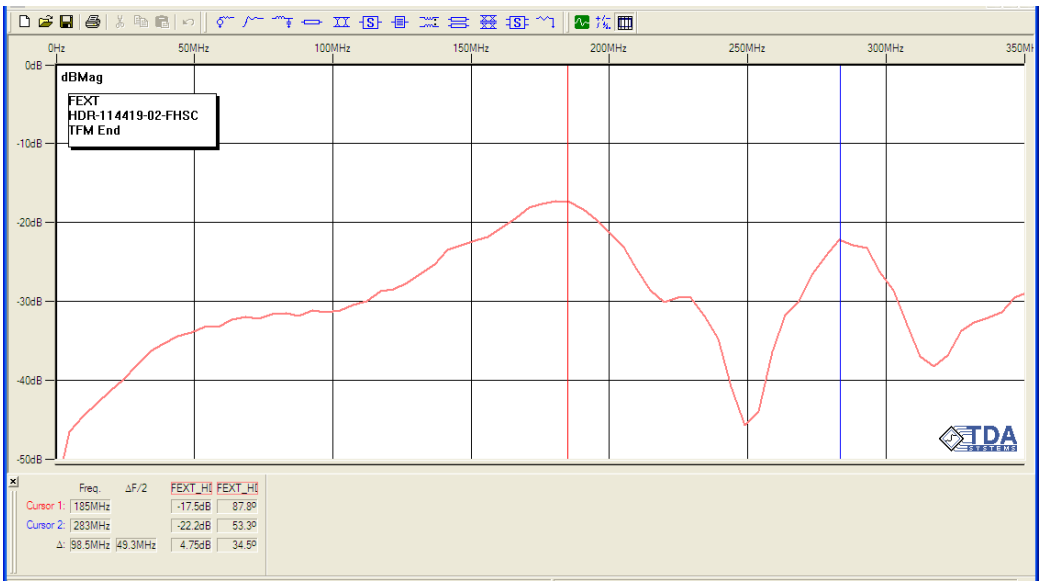

Figure 9: FHSC (02)-110-10.00-TTL-STR-1; FEXT, Aggressor Line 6, Victim Line 8, Ground Lines 9 & 10

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Test Procedures

Fixturing:

All measurements were performed using test PCBs specifically designed for the product under test. For measurements that required reference measurements (insertion loss, return loss, NEXT, FEXT and propagation delay) a reference, or calibration, board was utilized as shown in Figure 10. The reference board was used to compensate for the losses due to the coaxial test cables, SMA launches and the test PCB traces during the measurement process.

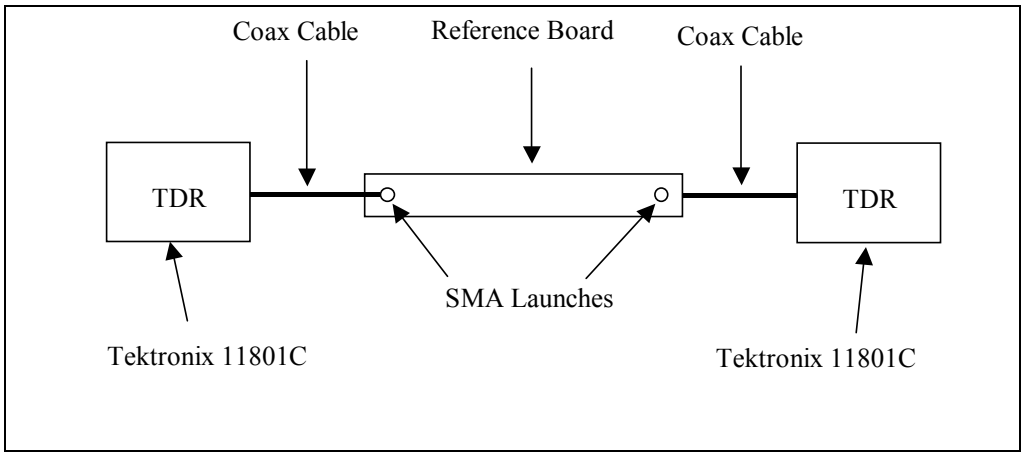

Figure 10: Setup for Measuring Reference Board.

Measurements were then performed using the test PCBs as shown in Figure 11. A picture of the PCB and FHSC is shown in Figure 12 on the following page.

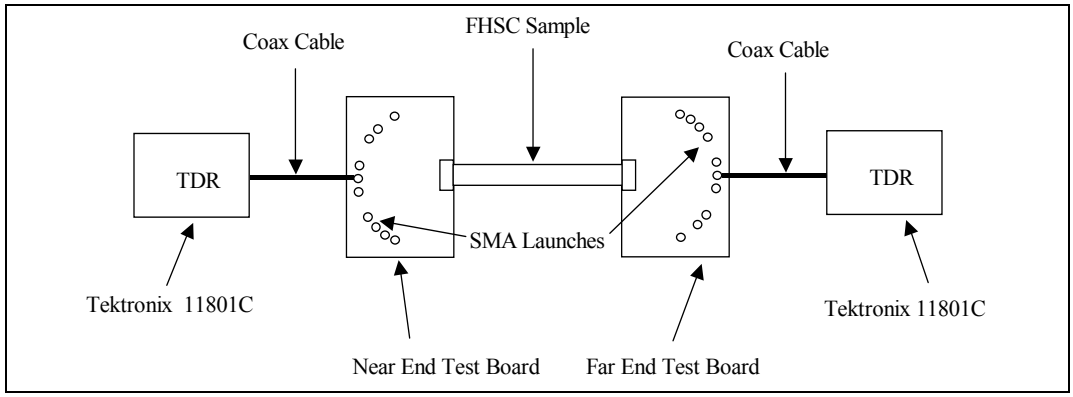

Figure 11: Z, PD, IL, & RL Measurement Configuration.

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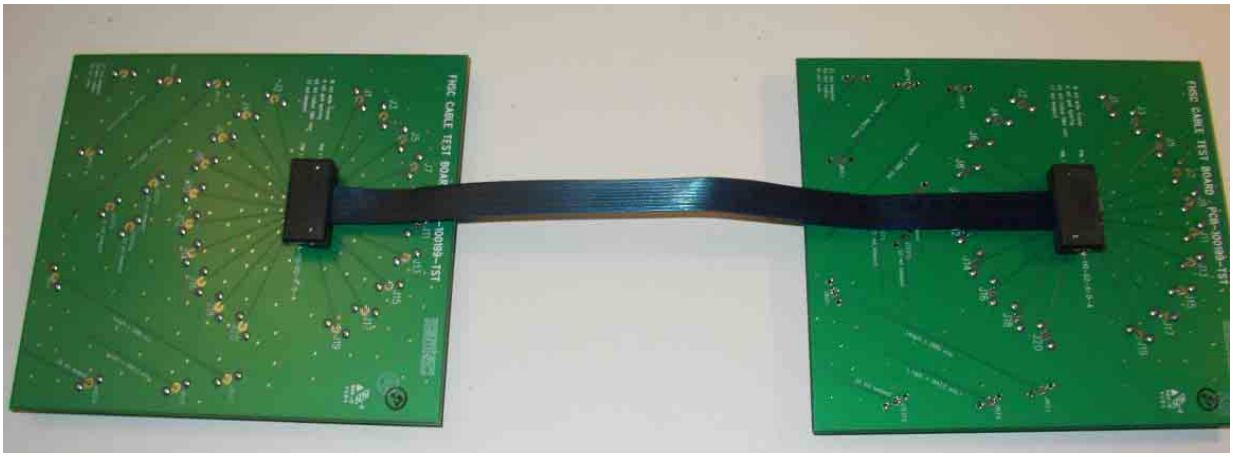

Figure 12: Test setup with Test PCBs and 10 inch FHSC cable assembly.

The test PCBs have designated grounding schemes. This influences, almost exclusively, the connector portion of the cable assembly while having minimal affects on the actual cable. The ground schemes and respective signal line numbers are shown in Tables 6A and 6B below. All adjacent lines are terminated where applicable.

TFM	S	G	G	S	S	S	S	S	S	S	S	S	S	S	G	G	S	S	S	S
Line	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
SFM	S	G	G	S	S	S	S	S	S	S	S	S	S	S	G	G	S	S	S	S

Table 6A: FHSC-01 Grounding schemes and Respective Signal Line Number

TFM	S	S	S	S	S	S	S	S	G	G	S	S	S	S	S	S	S	S	S	S
Line	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
SFM	S	S	S	S	S	S	S	S	G	G	S	S	S	S	S	S	S	S	S	S

Table 6B: FHSC-02 Grounding schemes and Respective Signal Line Number

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Time Domain Testing

Impedance:

The Tektronix 11801C oscilloscope was set up in TDR (time domain reflectometry) mode using 128 averages and a 500-point record length. The horizontal scale was set to 500ps/div to allow the near end connector and a portion of the cable to be displayed. The filtering function was set to 1.0ns. Measurements were made at the near end of each sample. The impedance measurements included the mated cable connector and 200ps into the cable.

Propagation Delay:

The time domain transmission capabilities (TDT) of the oscilloscope were used to measure the propagation delay. The delay of the test cables, SMA connectors, and a reference PCB were measured collectively and stored as an input reference.

The sample and the test PCBs replaced the reference PCB and the pulse at the output of the sample was measured. The propagation delay was determined by using the propagation delay measurement function of the oscilloscope. This function measures the difference in time, at 50% the level, between the output pulse and the input pulse.

Skew:

The skew was calculated by taking the difference of the propagation delay measurements. Calculations were performed between the inner (minimum delay) and outer (maximum delay) connector rows.

NEXT and FEXT:

Near end crosstalk (NEXT) and far end crosstalk (FEXT) measurements were made using the Tektronix 11801C oscilloscope. A thru reference of the coaxial test cables, SMAs and reference board was performed to compensate for the test setup losses. Refer to Figure 10.

To acquire the NEXT, a near end line was driven using the oscilloscope. NEXT was measured on an adjacent line, using a filtered risetime of 1.0ns, at the near end as matched reflection waveform. Acquiring FEXT, a near end line was driven with the oscilloscope. FEXT was measured on an adjacent line at the far end. 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

Attenuation:
Insertion Loss measurements were made using the Tektronix 11801C oscilloscope. Testing was performed using a risetime of 35ps. The horizontal scale was set to 20ns/div, the record length was set to 5120 points and the number of averages was set to 128. These values are used to ensure the ratio between the number of points and the window length is long enough to capture the highest frequencies. Test setup losses were compensated for by acquiring a thru measurement (reference output pulse) of the coaxial test cables, SMAs and reference board (see Figure 10).

The reference board was then replaced with the test PCBs and the sample (see Figure 11). A thru measurement was taken and then post processed by using TDA Systems', IConnect software (Version 3.1). The result is the insertion loss of the cable assembly post processed to 350 MHz.

Return Loss:
Return Loss measurements were made using the Tektronix 11801C oscilloscope. The horizontal scale was set to 20ns/div, the record length was set to 5120 points and the number of averages was set to 128. These values are used to ensure that the ratio between the number of points and the window length is long enough to capture the highest frequencies. An open circuit reference measurement was taken right at the start of the near end connector.

A matched reflection waveform of the cable assembly was acquired and then post processed by using TDA Systems', IConnect software (Version 3.1). The result is the return loss of the cable assembly post processed to 350 MHz.

Near and Far End Crosstalk:
Near end crosstalk (NEXT) and far end crosstalk (FEXT) measurements were made using the Tektronix 11801C oscilloscope. A thru reference of the coaxial test cables, SMAs and reference board was performed to compensate for the test setup losses (see Figure 10) and an open circuit measurement was taken right at the start of the near end connector.

To acquire the NEXT, a near end line was driven using the oscilloscope. NEXT was measured on an adjacent line at the near end as matched reflection waveform (see Figure 13) then post processed by using TDA Systems', IConnect software (Version 3.1). The result is the NEXT of the cable assembly post processed to 350 MHz. Acquiring FEXT, a near end line was driven with the oscilloscope. FEXT was measured on an adjacent line at the far end then post processed by using TDA Systems', IConnect software (Version 3.1). The result is the return loss of the cable

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assembly post processed to 350 MHz. All adjacent lines were terminated, at both ends, with 50Ω SMA loads; Refer to Figures 13 and 14.

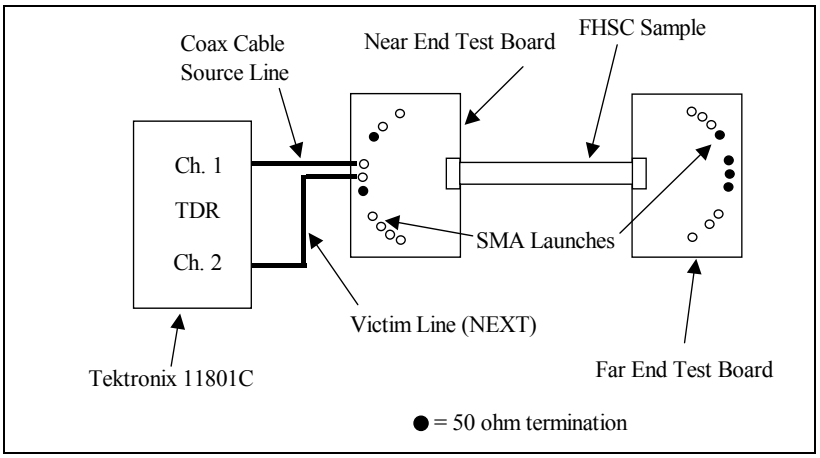

Figure 13: NEXT Measurement Setup.

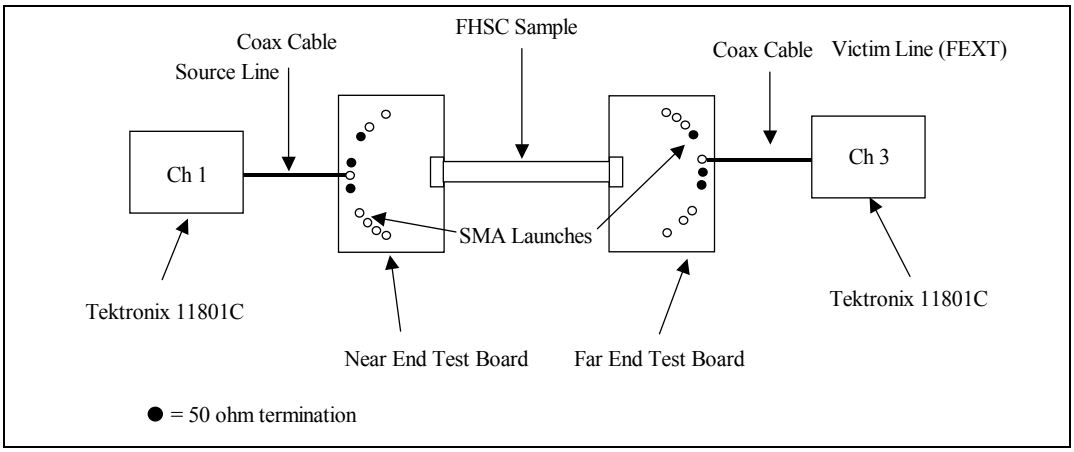

Figure 14: FEXT Measurement Setup.

Equipment

Time Domain Testing

Tektronix 11801C Oscilloscope
Tektronix SD-24 TDR/Sampling Head
Tektronix SD-26 Sampling Head
TDA IConnect Version 3.1.0 MX