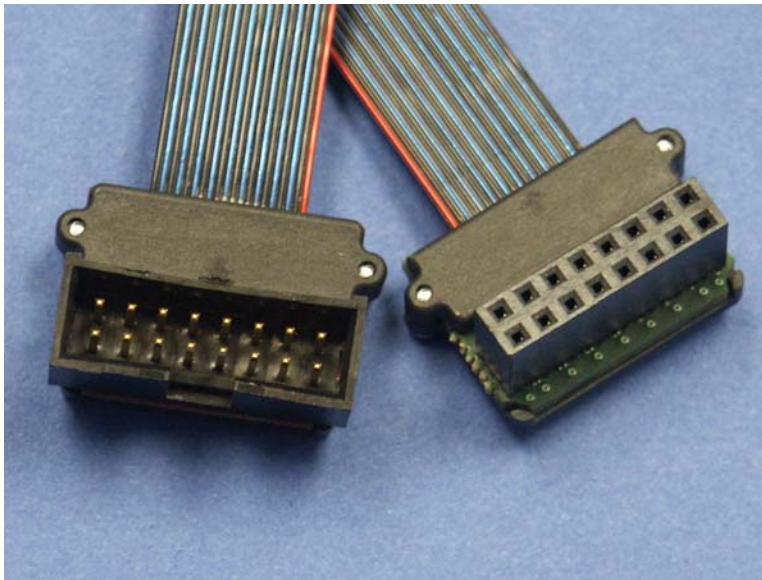




High Speed Characterization Report



HDR-108449-01-HHSC
HDR-108449-02-HHSC
HDR-108449-03-HHSC
HDR-108449-04-HHSC

FILE: HDR108449-01-04-HHSC.pdf

DATE: 03-29-04

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Introduction

This testing was performed to evaluate the electrical performance of the HHSC .001” series of high-data rate cable assemblies. Testing was performed in accordance to the High Performance Electrical Interconnect (HPEI) SFF-8416¹, 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) were measured. Frequency domain measurements were performed 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”). Only one line on each sample, using different ground configurations, was tested with the exception of propagation delay, where every line was tested.

Product Description

The sample consists of a length of Hitachi 38 AWG mini-coaxial ribbon cable. 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 HTSS shrouded header on one end (P/N: HTSS-32-01-01-S-DV) and a SSW surface mount socket (P/N: SSW-32-22-D-VS) on the other. The overall sample length is 10”.

Two types of transition boards exist. One type is a mirror image of the opposing transition PCB, whereas the other type is the same as the opposing connector only rotated (flipped) producing an opposite facing connector. Using these transitions boards produces the following connector positions; the HTSS terminal connector is up (TU) and down (TD) and the SSW socket is the upward position (SU). The rotated transition PCB is the traditional green color where the mirrored transition PCB is indicated by a red color. The board/cable termination area is then covered with plastic caps.

There are two different types of grounding configurations involved. One configuration uses lines two and three as grounds whereas the other uses lines nine and ten.

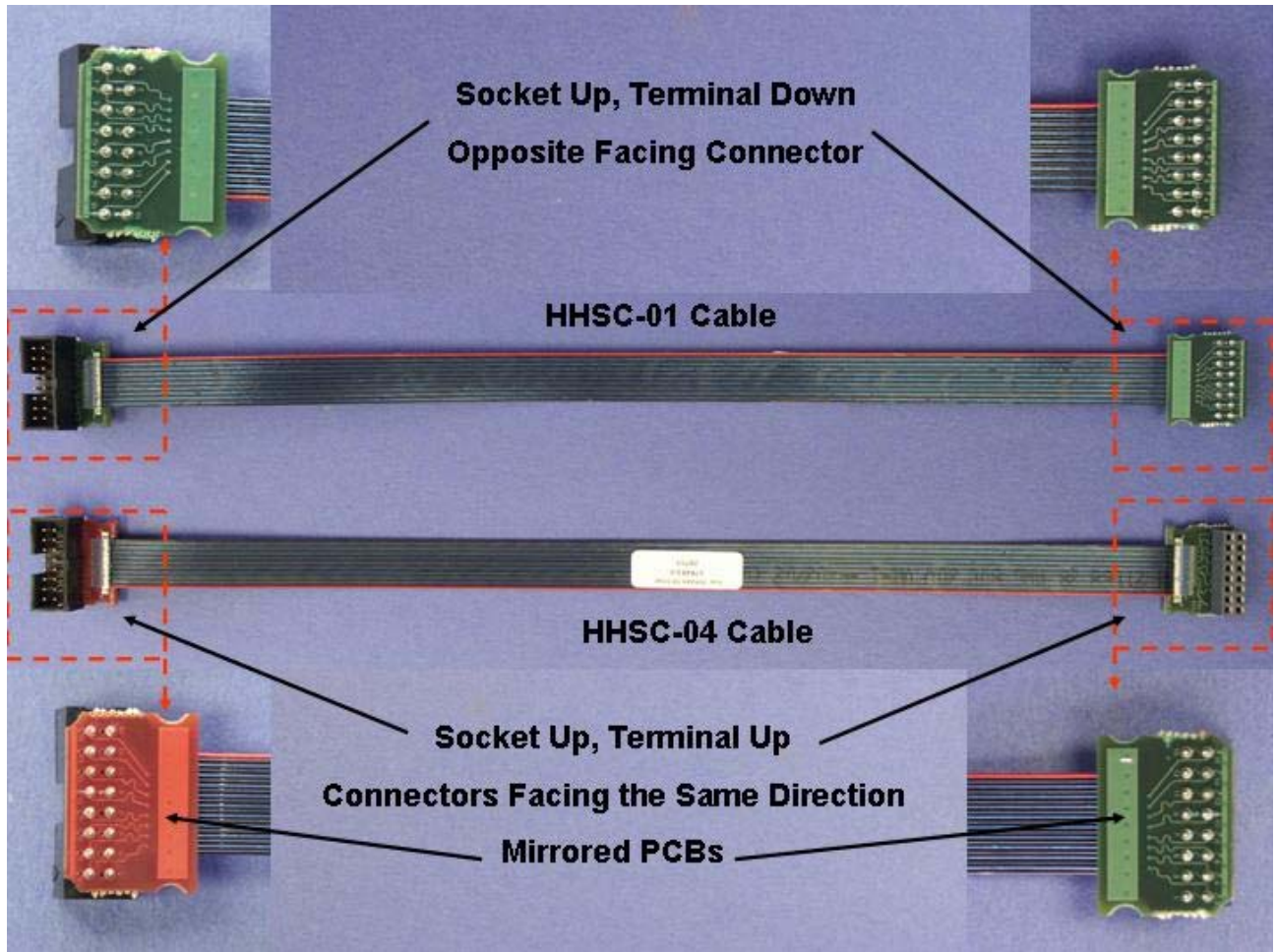
Four samples were tested, one of each assembly type. The actual sample numbers tested are shown in Table 1 below. Refer to Figure 1 on the next page for a picture of the sample.

Table 1: Sample Descriptions.

Assembly	Part Number	Grounds
HHSC-01	HHSC-108-10.00-SU-TD	Lines 2 & 3
HHSC-02	HHSC-108-10.00-SU-TD	Lines 9 & 10
HHSC-03	HHSC-108-10.00-SU-TU	Lines 2 & 3
HHSC-04	HHSC-108-10.00-SU-TU	Lines 9 & 10

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

Figure 1: 10.00" HHSC-01 and HHSC-04 Cable Assembly. Shown with caps off.
(PNs:) HHSC-108-10.00-SU-TU and HHSC-108-10.00-SU-TU.



Results Summary

Time Domain Data

Impedance

Impedance measurements were performed using an input risetime of 1.0ns. HTSS and SSW 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).

Table 2: Impedance Measurements (tr = 1ns).

Assembly	Connector		Cable	
	SSW	HTSS	SSW Side	HTST Side
HHSC-01	53.4	54.3	50.5	50.4
HHSC-02	57.9	58.3	52.1	52.3
HHSC-03	53.8	54.3	50.8	51.3
HHSC-04	58.7	59.0	54.8	54.8

Timing Measurements

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

Table 3: Timing Measurements.

Position	Propagation Delay (Seconds)			
	HHSC-01	HHSC-02	HHSC-03	HHSC-04
1	1.56E-9	1.59E-9	1.57E-9	1.59E-9
2	N/A	1.62E-9	N/A	1.64E-9
3	N/A	1.58E-9	N/A	1.58E-9
4	1.61E-9	1.63E-9	1.62E-9	1.62E-9
5	1.55E-9	1.57E-9	1.58E-9	1.58E-9
6	1.59E-9	1.61E-9	1.62E-9	1.61E-9
7	1.54E-9	1.55E-9	1.56E-9	1.55E-9
8	1.59E-9	1.60E-9	1.62E-9	1.61E-9
9	1.55E-9	N/A	1.56E-9	N/A
10	1.60E-9	N/A	1.62E-9	N/A
11	1.56E-9	1.56E-9	1.56E-9	1.56E-9
12	1.59E-9	1.61E-9	1.61E-9	1.60E-9
13	1.57E-9	1.59E-9	1.56E-9	1.57E-9
14	1.60E-9	1.62E-9	1.61E-9	1.60E-9
15	N/A	1.59E-9	N/A	1.58E-9
16	N/A	1.65E-9	N/A	1.63E-9
Min Delay	1.54E-9	1.55E-9	1.56E-9	1.55E-9
Max Delay	1.61E-9	1.65E-9	1.62E-9	1.64E-9
Skew (S)	70.0E-12	100.0E-12	60.0E-12	90.0E-12

NEXT

The near end crosstalk was measured in the time domain, as a voltage, and then converted to a percentage and reported below in Table 4.

Table 4: % NEXT

Assembly	NEXT (mV)	NEXT (%)
HHSC-01	11.4	4.6
HHSC-02	11.8	4.8
HHSC-03	11.4	4.6
HHSC-04	12.1	4.9

FEXT

The far end crosstalk was measured in the time domain, as a voltage, and then converted to a percentage and reported below in Table 5.

Table 5: % FEXT

Assembly	FEXT (mV)	FEXT (%)
HHSC-01	13.6	5.5
HHSC-02	13.7	5.5
HHSC-03	13.7	5.5
HHSC-04	14.1	5.7

Frequency Domain Data

Insertion Loss

HHSC-01

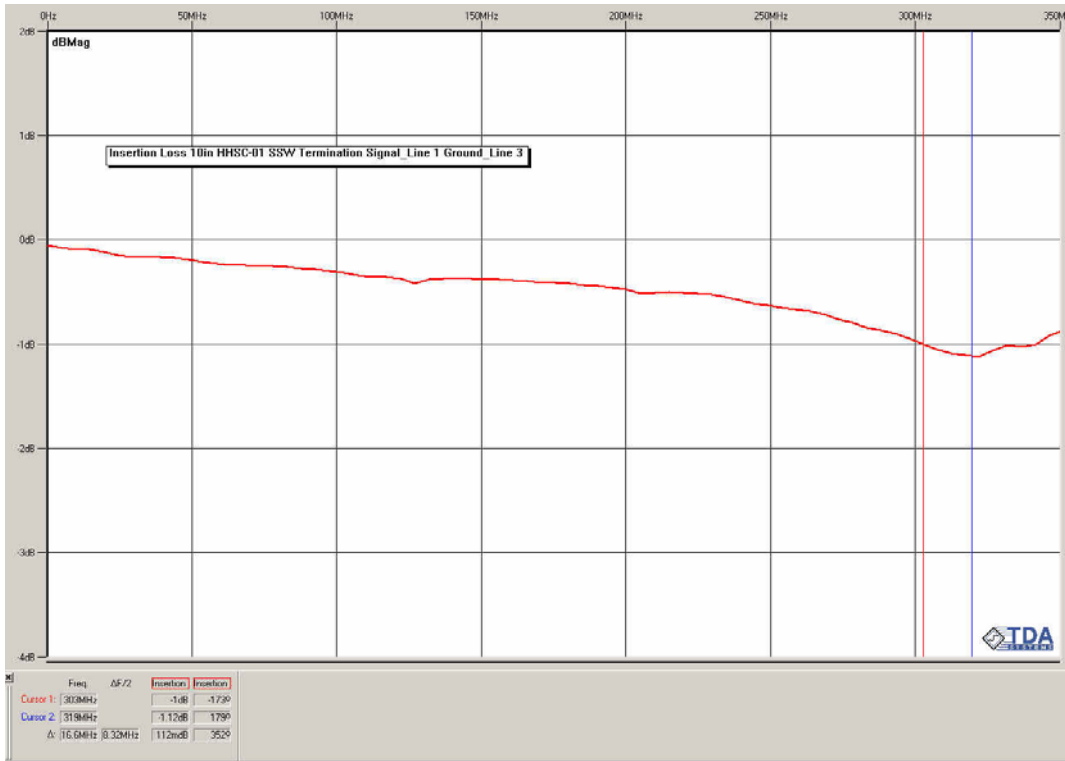


Figure 2: HHSC-108-10.00-SU-TD; Insertion Loss, Signal Line 1, Ground Line 3

HHSC-02

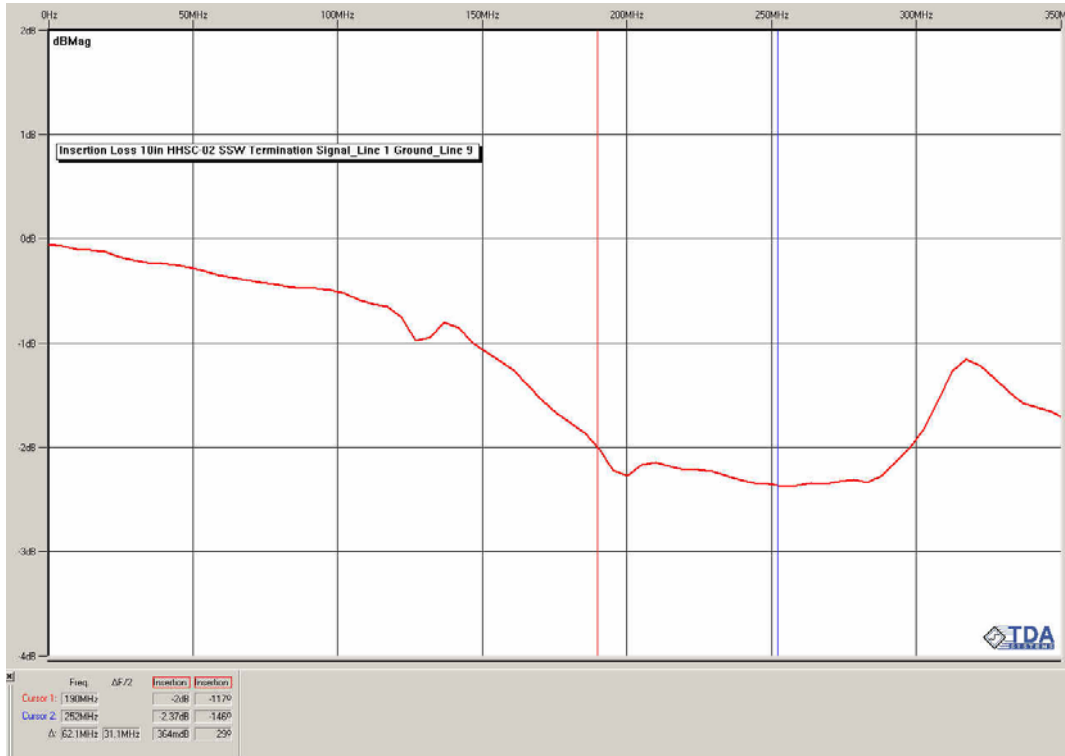


Figure 3: HHSC-108-10.00-SU-TD; Insertion Loss, Signal Line 1, Ground Line 9

HHSC-03

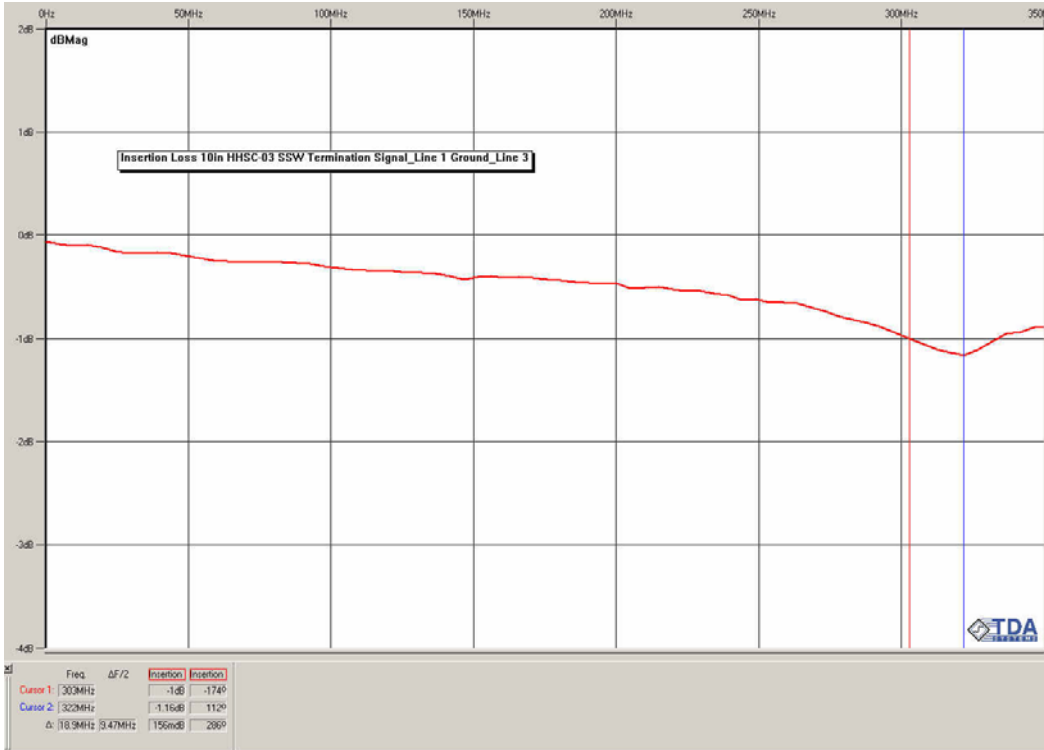


Figure 4: HHSC-108-10.00-SU-TU; Insertion Loss, Signal Line 1, Ground Line 3

HHSC-04

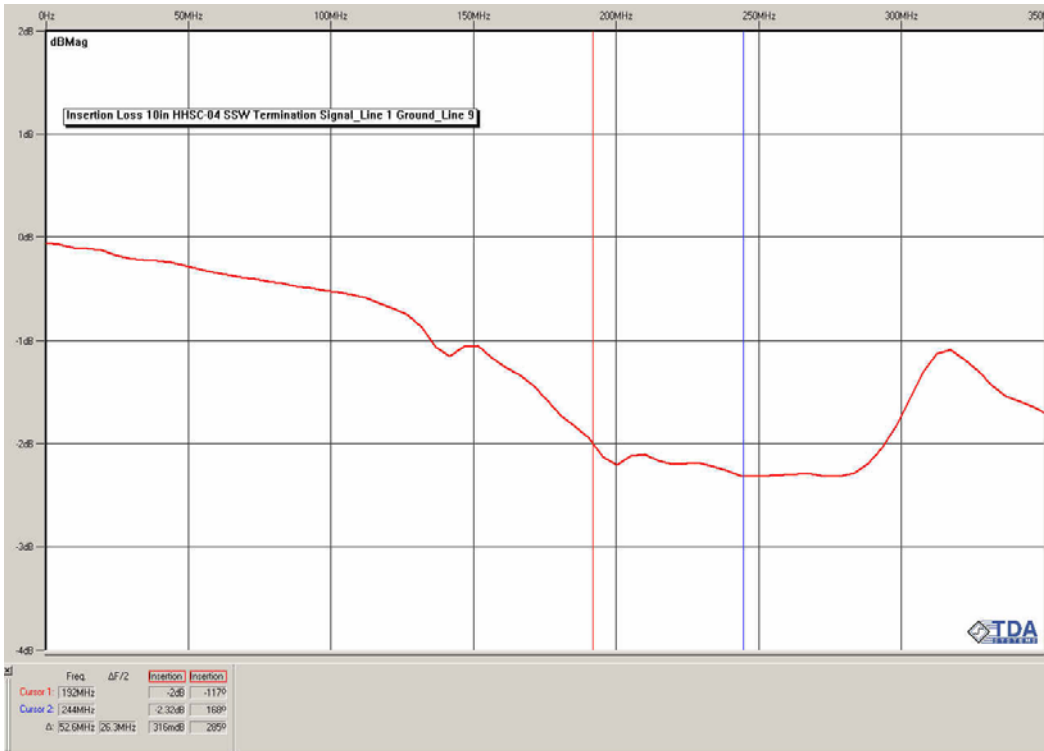


Figure 5: HHSC-108-10.00-SU-TU; Insertion Loss, Signal Line 1, Ground Line 9

Return Loss

HHSC-01



Figure 6: HHSC-108-10.00-SU-TD; Return Loss, Signal Line 1, Ground Line 3

HHSC-02

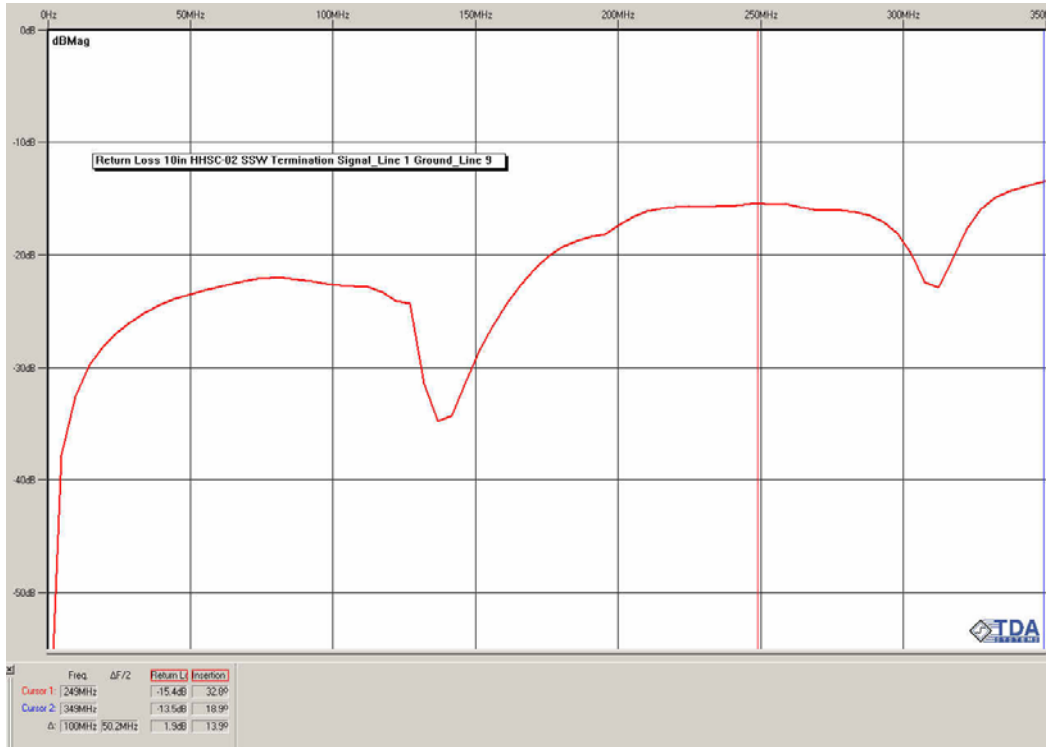


Figure 7: HHSC-108-10.00-SU-TD; Return Loss, Signal Line 1, Ground Line 9

HHSC-03

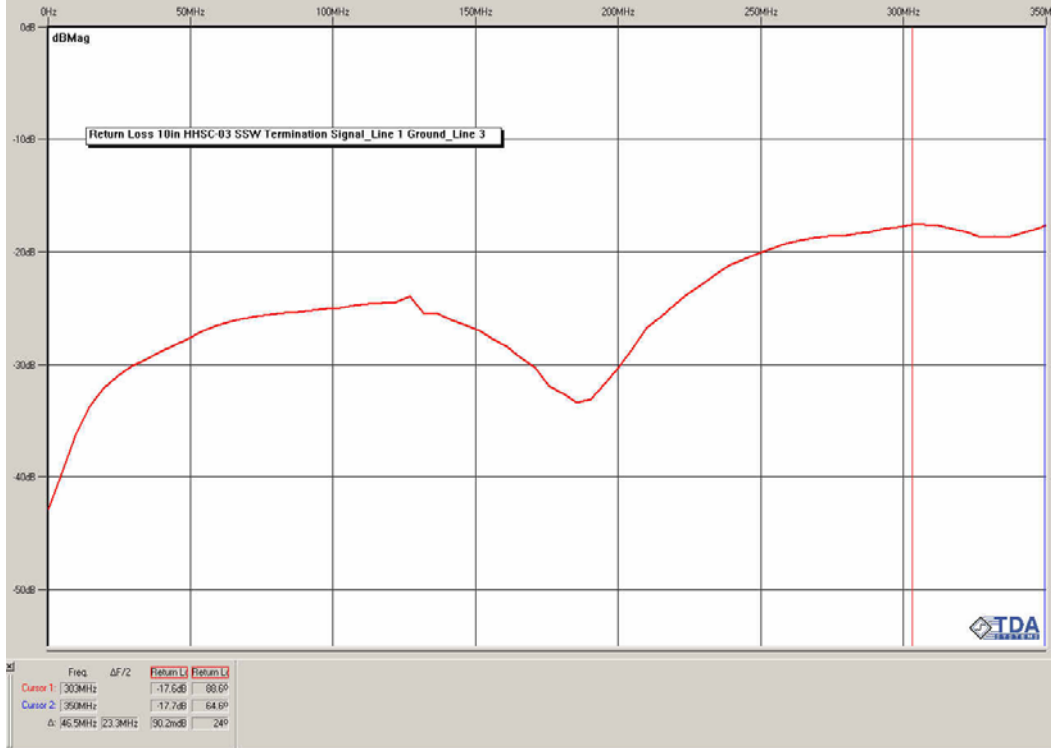


Figure 8: HHSC-108-10.00-SU-TU; Return Loss, Signal Line 1, Ground Line 3

HHSC-04

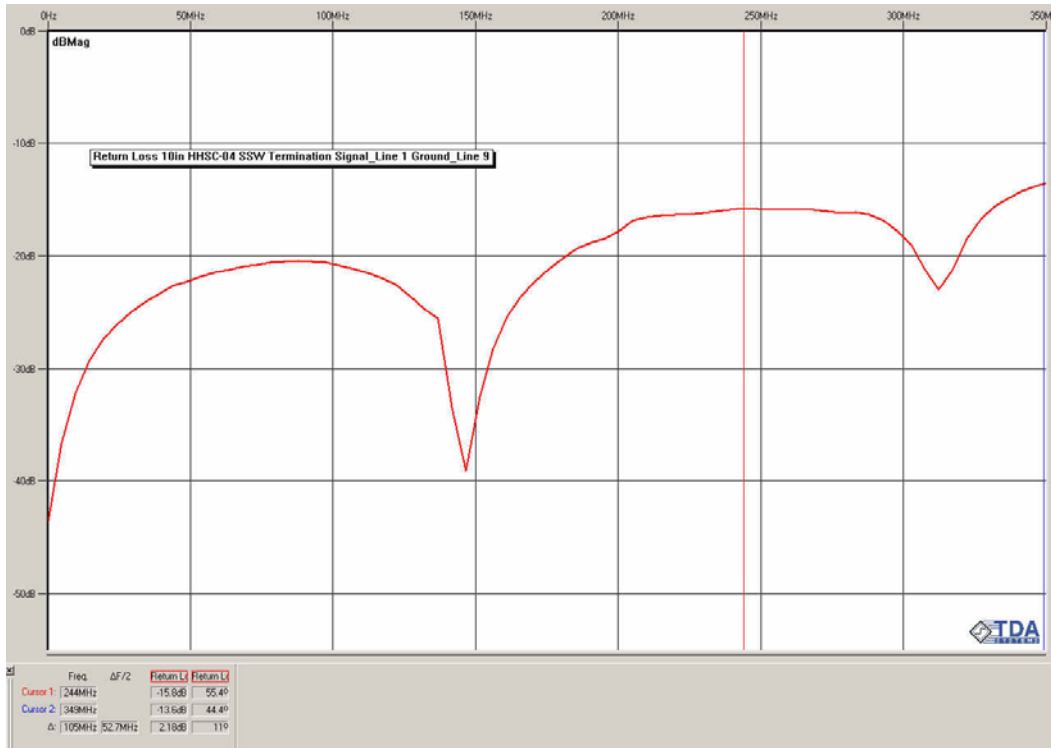


Figure 9: HHSC-108-10.00-SU-TU; Return Loss, Signal Line 1, Ground Line 9

Near End Crosstalk

HHSC-01

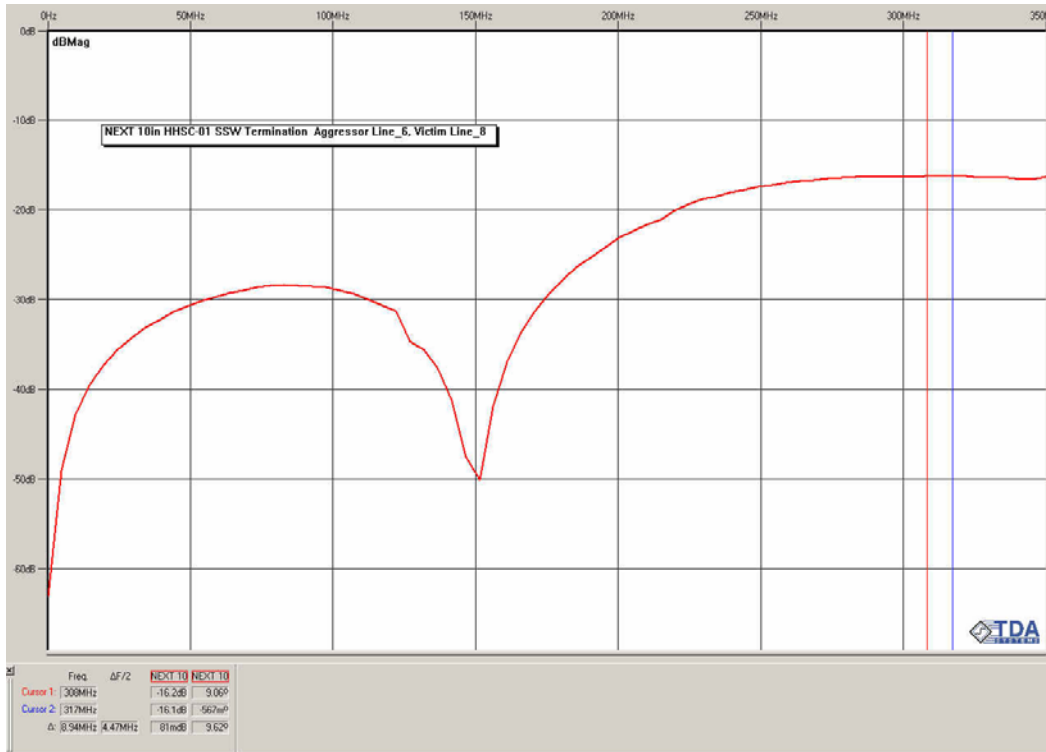


Figure 10: HHSC-108-10.00-SU-TD; NEXT, Aggressor; Line 6, Victim; Line 8

HHSC-02

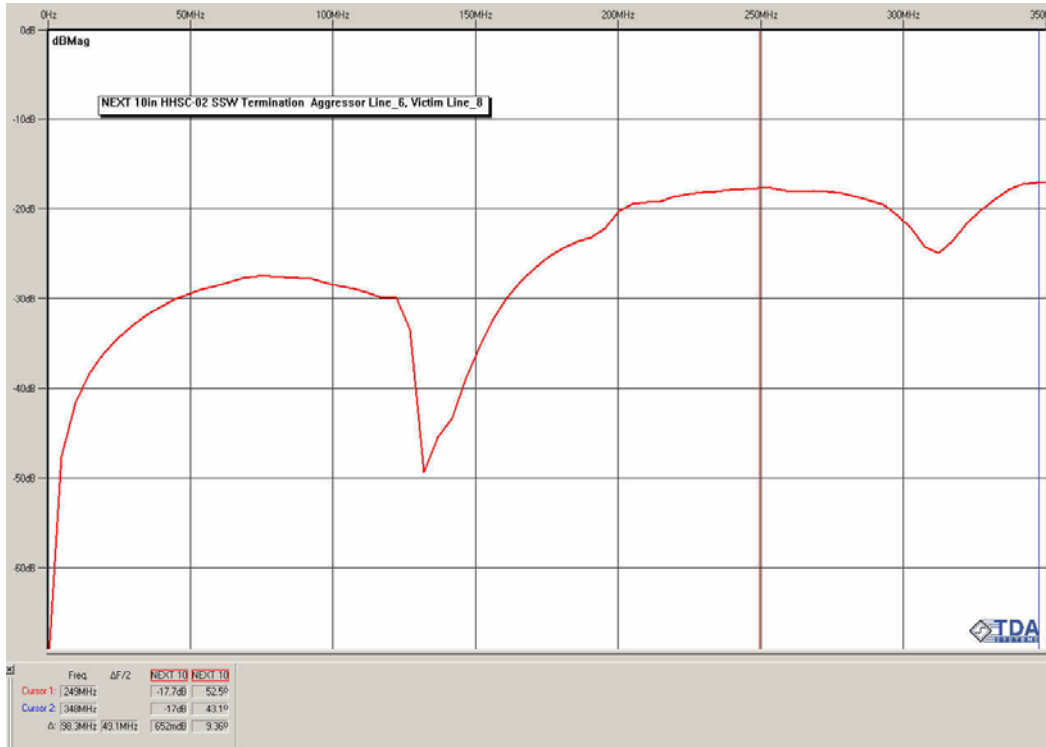


Figure 11: HHSC-108-10.00-SU-TD; NEXT, Aggressor; Line 6, Victim; Line 8

HHSC-03

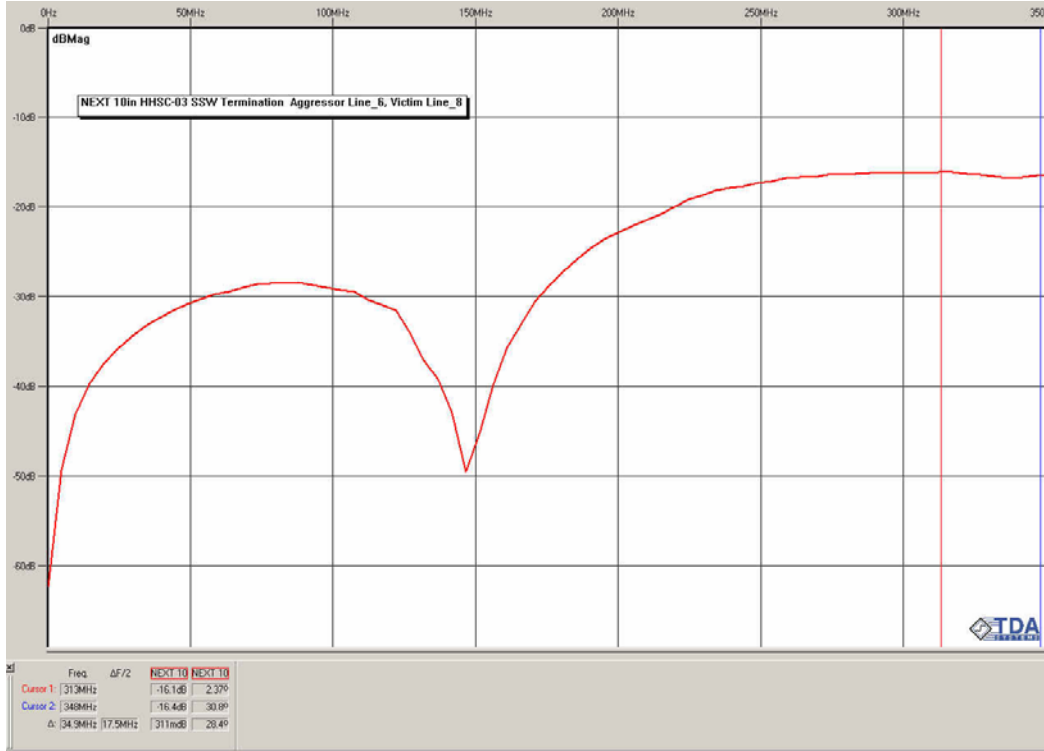


Figure 12: HHSC-108-10.00-SU-TU; NEXT, Aggressor; Line 6, Victim; Line 8

HHSC-04

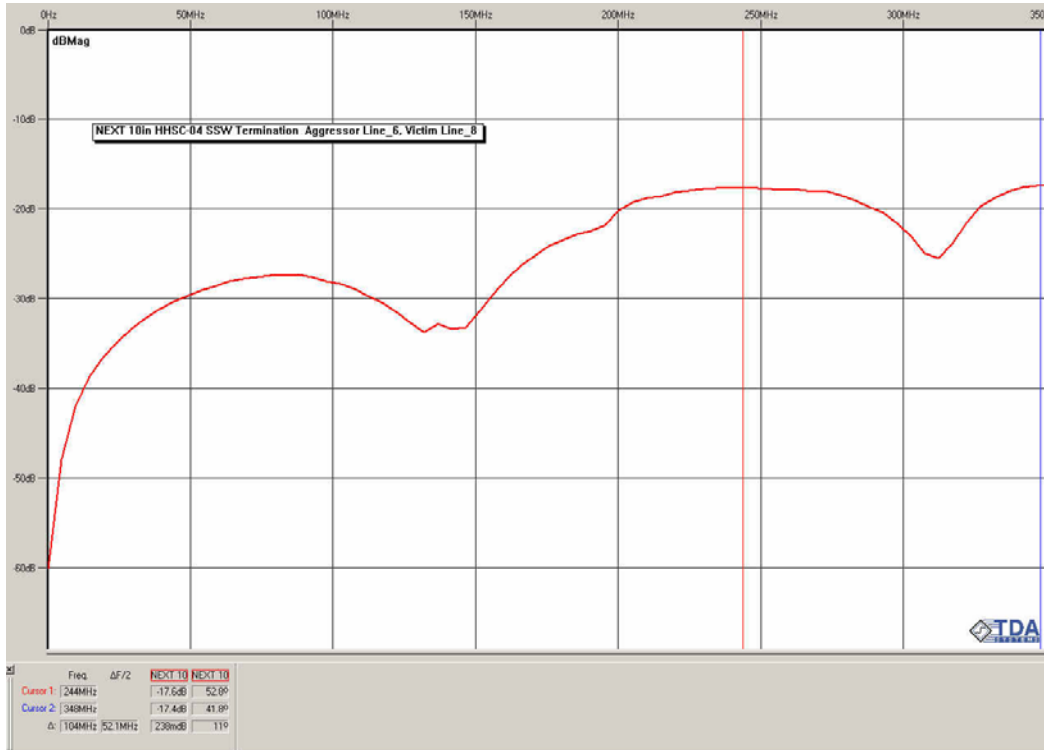


Figure 13: HHSC-108-10.00-SU-TU; NEXT, Aggressor; Line 6, Victim; Line 8

Far End Crosstalk

HHSC-01

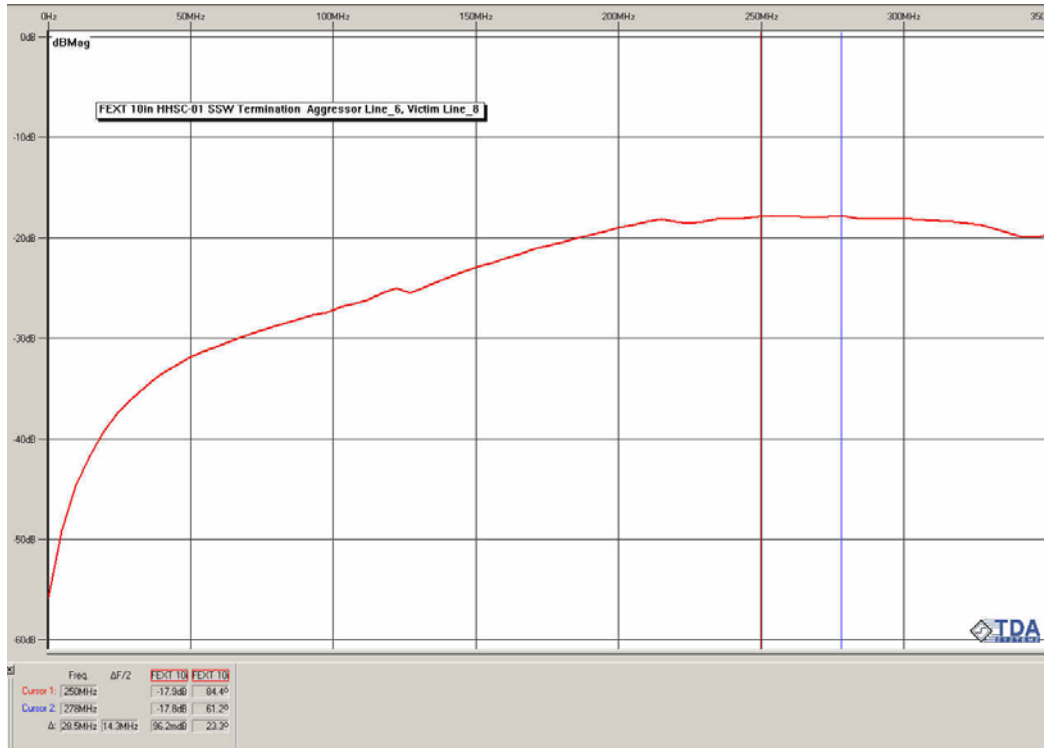


Figure 14: HHSC-108-10.00-SU-TD; FEXT, Aggressor; Line 6, Victim; Line 8

HHSC-02

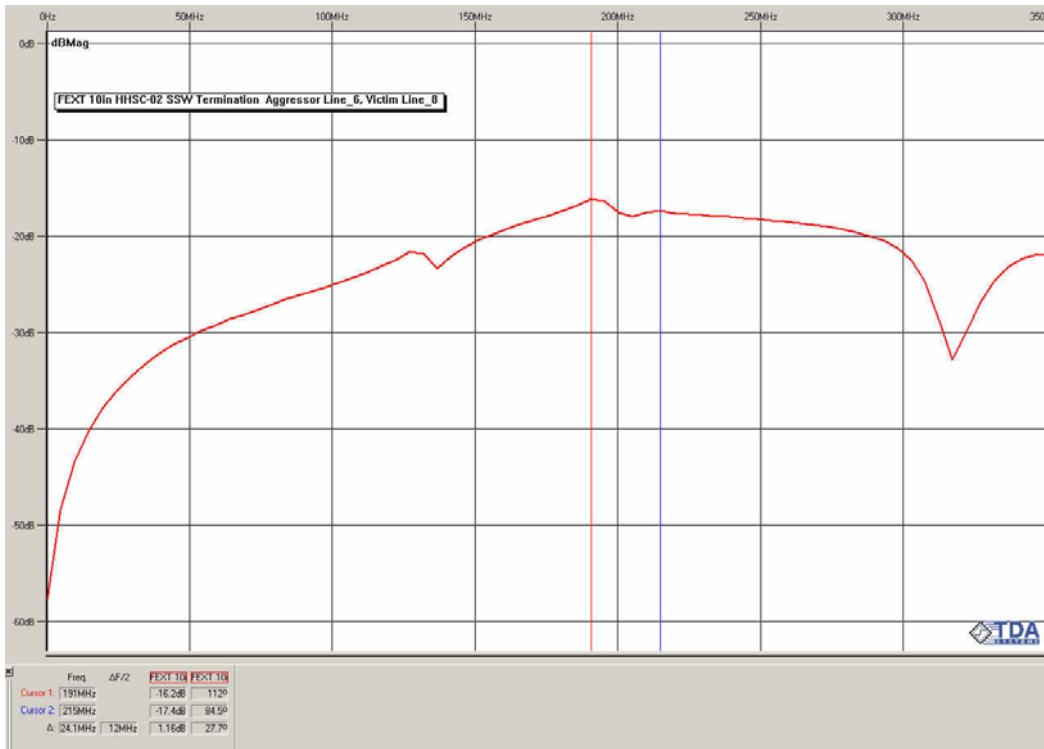


Figure 15: HHSC-108-10.00-SU-TD; FEXT, Aggressor; Line 6, Victim; Line 8

HHSC-03

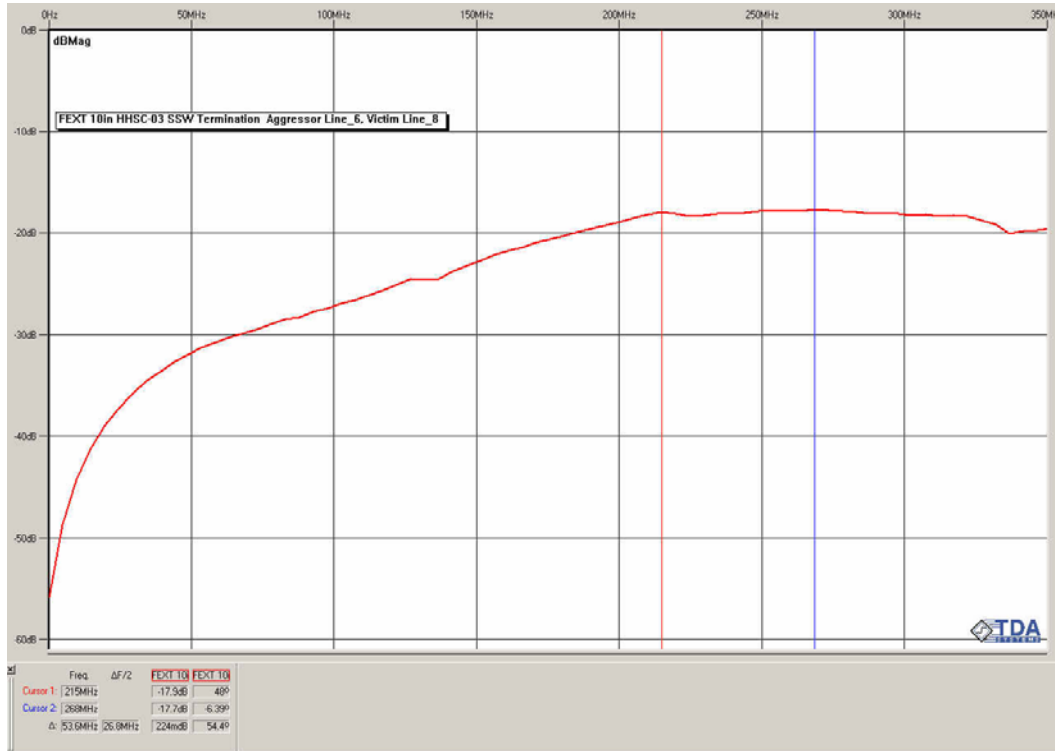


Figure 16: HHSC-108-10.00-SU-TU; FEXT, Aggressor; Line 6, Victim; Line 8

HHSC-04

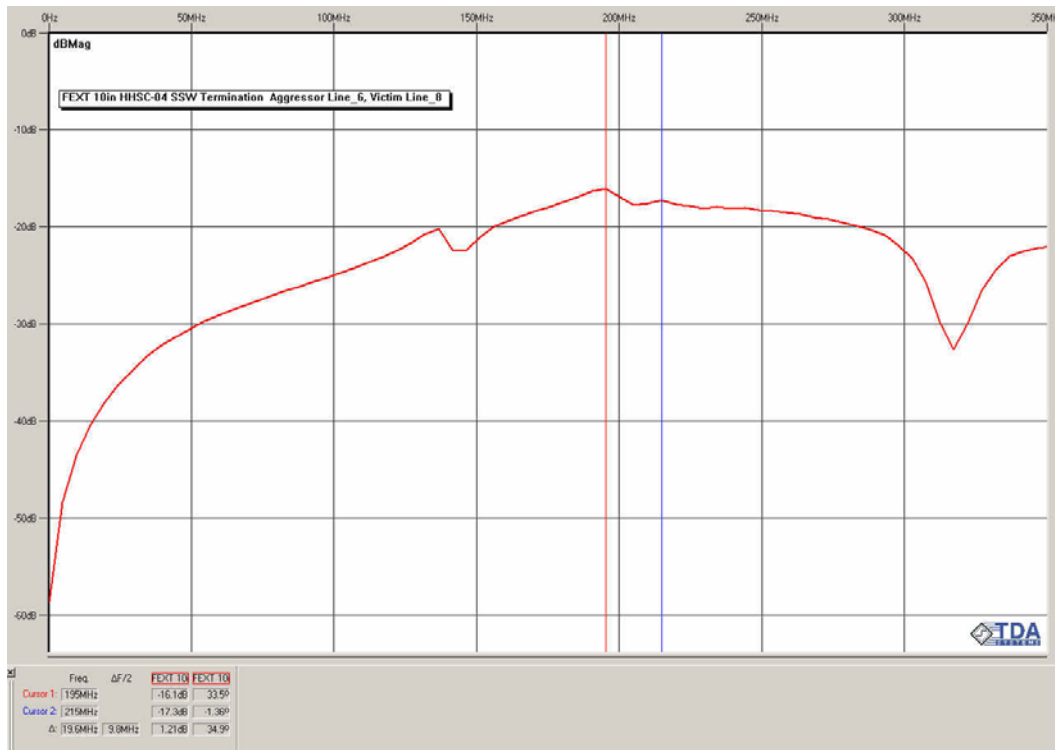


Figure 17: HHSC-108-10.00-SU-TU; FEXT, Aggressor; Line 6, Victim; Line 8

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 18. 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.

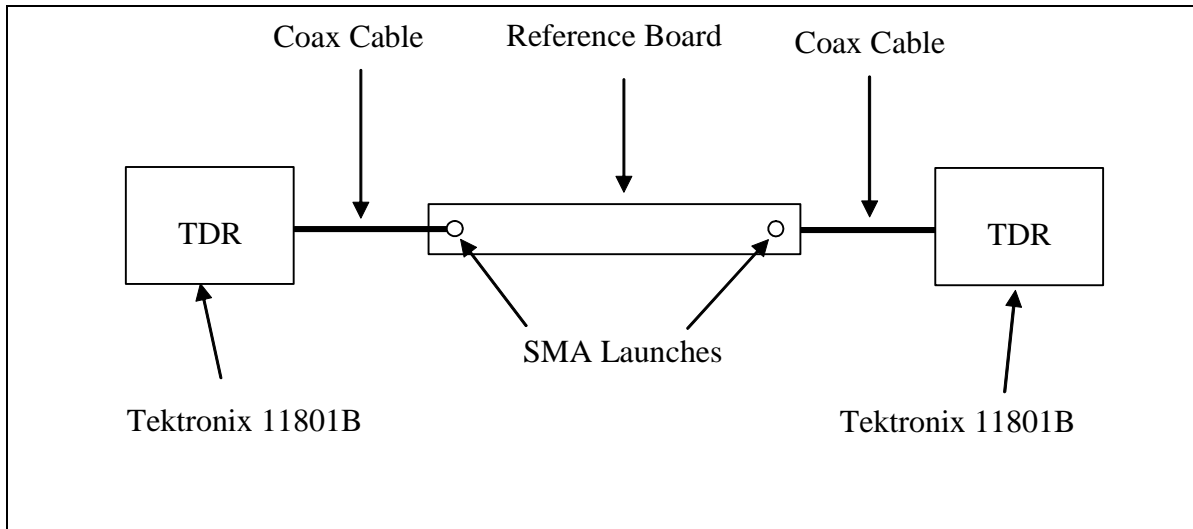


Figure 18: Setup for Measuring Reference Board.

Measurements were then performed using the test PCBs as shown in Figure 19. A picture of the PCB and HHSC is shown in Figure 20 on the following page.

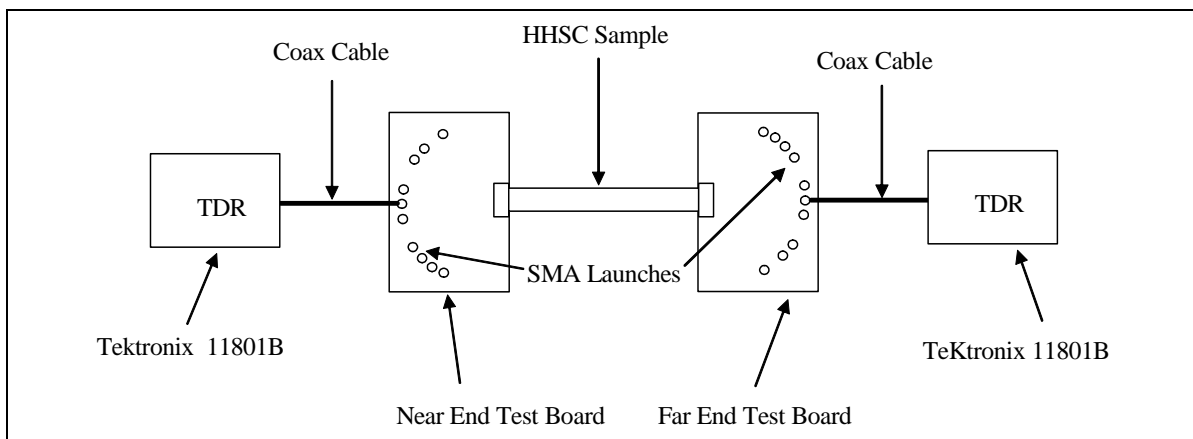


Figure 19: Z, PD, IL, & RL Measurement Configuration.

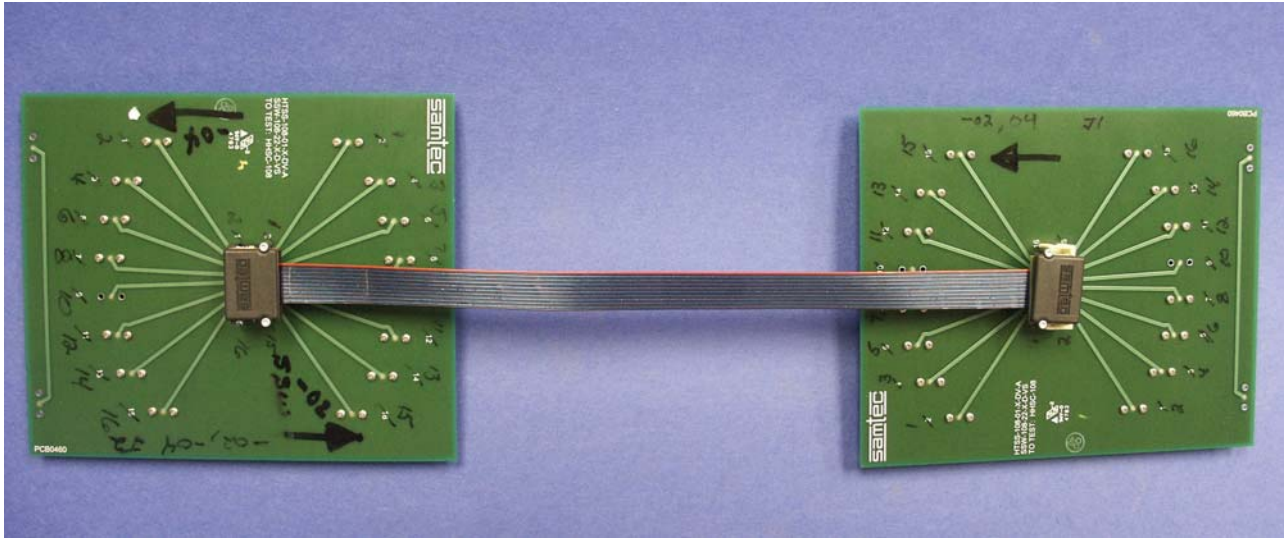


Figure 20: Test setup with Test PCBs and 10 inch HHSC-108-10.00-SU-TU with crossover.

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.

Table 6A: Grounding schemes and respective signal line number.

SSW	S	G	G	S	S	S	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
HTST	S	G	G	S	S	S	S	S	S	S	S	S	S	S	S	S

HHSC-01 and HHSC-03

Table 6B: Grounding schemes and respective signal line number

SSW	S	S	S	S	S	S	S	S	G	G	S	S	S	S	S	S
Line	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
HTST	S	S	S	S	S	S	S	S	G	G	S	S	S	S	S	S

HHSC-02 and HHSC-04

Time Domain Testing

Impedance:

The Tektronix 11801B 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 11801B 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 18 on page 13.

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. 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 21 and 22 on page 17.

Frequency Domain Testing

Attenuation:

Insertion Loss measurements were made using the Tektronix 11801B 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 18 on page 13).

The reference board was then replaced with the test PCBs and the sample (see Figure 19 on page 13). A thru measurement was taken and then post processed by using TDA Systems', IConnect software (Version 3.0). The result is the insertion loss of the cable assembly.

Return Loss:

Return Loss measurements were made using the Tektronix 11801B 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. A reference - open circuit - measurement was taken right at the start of the connector.

A matched reflection waveform of the cable assembly was acquired and then post processed by using TDA Systems', IConnect software (Version 3.0). The result is the return loss of the cable assembly.

Near and Far End Crosstalk:

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 compensate for the test setup losses (see Figure 18 on page 13) and an open circuit measurement was taken right at the start of the 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 21 on the next page). 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 Figure 22 on the next page.

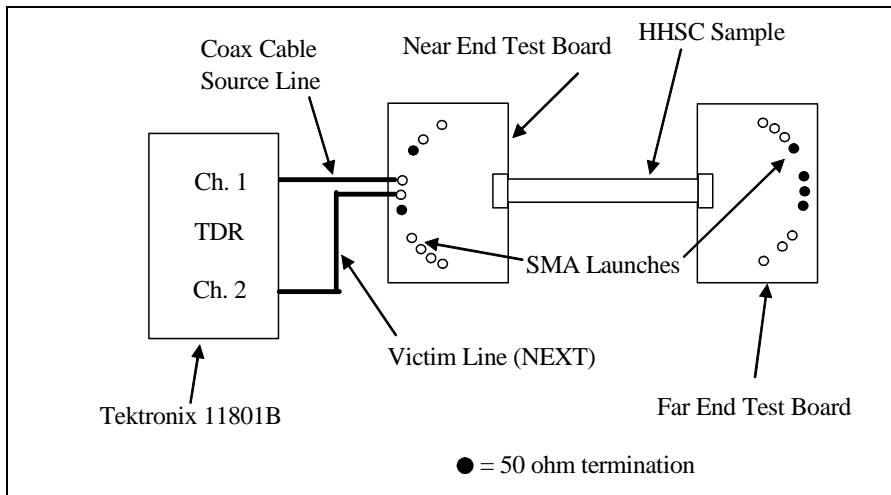


Figure 21: NEXT Measurement Setup.

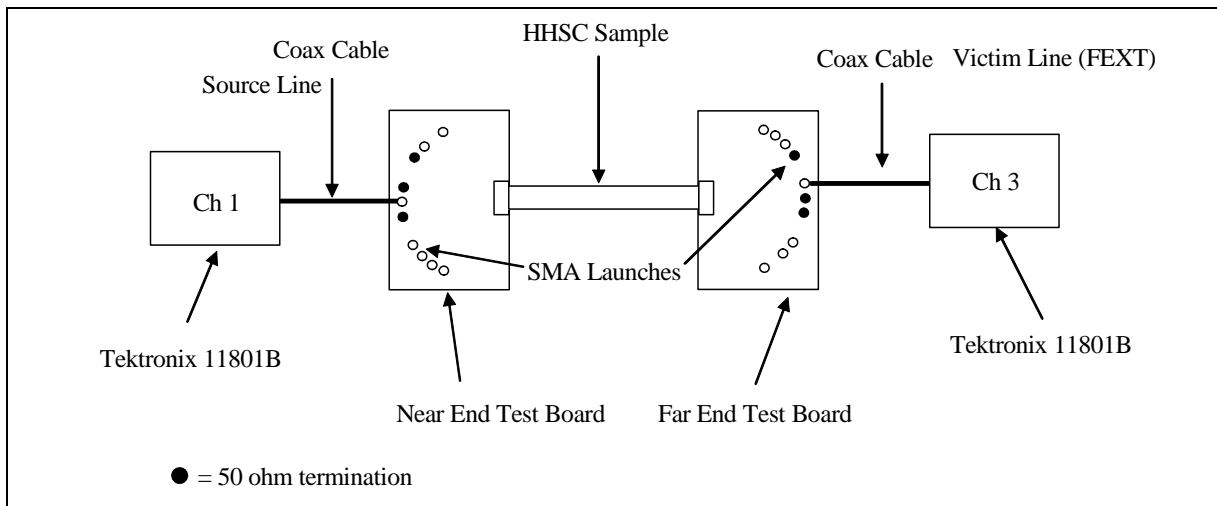


Figure 22: FEXT Measurement Setup.

Equipment

Time Domain Testing

Tektronix 11801B Oscilloscope
 Tektronix SD-24 TDR/Sampling Head
 Tektronix SD-24 TDR/Sampling Head
 TDA IConnect Ver 3.0.2 MX