High Speed Characterization Report

FFTP-10-D-8.77-01-N

Mated with:
EHF-110-01-XX-D

Description:
.050 x .050 C/L Twisted Pair Female IDC Assembly
Table of Contents

Introduction ......................................................................................................... 4
Product Description .............................................................................................. 4
Results Summary ................................................................................................ 6
  Time Domain Data ............................................................................................. 6
    Impedance ....................................................................................................... 6
    Timing Measurements ....................................................................................... 6
    NEXT .................................................................................................................. 7
    FEXT ................................................................................................................... 7
  Frequency Domain Data ...................................................................................... 8
    Insertion Loss .................................................................................................... 8
    Return Loss ....................................................................................................... 9
    Near End Crosstalk ......................................................................................... 10
Test Procedures .................................................................................................... 12
  Fixturing: ........................................................................................................... 12
  Time Domain Testing ......................................................................................... 14
    Impedance: ..................................................................................................... 14
    Propagation Delay: .......................................................................................... 14
    Skew: ............................................................................................................... 14
    NEXT and FEXT: ............................................................................................... 14
  Frequency Domain Testing ................................................................................ 15
Equipment ............................................................................................................. 17
  Time Domain Testing ......................................................................................... 17
**Introduction**

This testing was performed to evaluate the electrical performance of the FFTP series of .050 x .050 C/L Twisted Pair Female IDC Assemblies. Testing was performed in accordance to the High Performance Electrical Interconnect (HPEI) SFF-8416, Level 1\(^1\) 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-100748-TST-11 and PCB-100748-TST-12. Calibration boards were also utilized (PCB-100748-TST-99).

**Product Description**

The test sample consists of ten twisted pairs of #30 AWG wire with PVC insulation. The wires are terminated to FFSD socket strip connectors at each end. The connector terminals are on 50-mil centers. Each connector has a polarization key. Assembly length is 8.77 inches.

The FFTP assembly was tested by mating it at each end to an EHF-110-01-XX-D connector (ejector header). One sample was tested. The actual part number that was tested is shown in Table 1, which also identifies End 1 and End 2 of the assembly; a relative sample picture is shown in Figure 1. Two pairs, an inner pair and an outer pair, of the sample were tested.

<table>
<thead>
<tr>
<th>Length</th>
<th>Part Number</th>
<th>End 1</th>
<th>End 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.77 in.</td>
<td>FFTP-10-D-8.77-01-N</td>
<td>EHF</td>
<td>EHF</td>
</tr>
</tbody>
</table>

Table 1: Sample Description

“End 1” of the assembly has the polarization key facing toward the wires of the assembly.

---

\(^1\) Measurement and Performance Requirements for HPEI Bulk Cable, Rev 15, June 27, 2005
Series: FFTP
Description: .050 x .050 C/L Twisted Pair Female IDC Assembly

Figure 1: Test Sample Configuration
Results Summary

Time Domain Data

Impedance
Impedance measurements were performed using a filtered risetime of 500 pS. Note that all measurements were performed with the assembly mated to the respective connector/test board. Data was measured at the cable connector. Cable impedance was not uniform so a nominal value was reported. It is one half the sum of 100 ohms plus the maximum impedance along the cable.

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Path</th>
<th>End Option</th>
<th>Cable End 1</th>
<th>End Option</th>
<th>Cable End 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>End 1</td>
<td>Z (Ω)</td>
<td>Z Nom (Ω)</td>
<td>Z (Ω)</td>
</tr>
<tr>
<td>FFTP-10-D-8.77-01-N</td>
<td>Outer</td>
<td></td>
<td>97.6</td>
<td>127.5</td>
<td>97.8</td>
</tr>
<tr>
<td></td>
<td>Inner</td>
<td></td>
<td>98.7</td>
<td>128.4</td>
<td>99.0</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Path</th>
<th>Propagation Delay (nS)</th>
<th>Skew (nS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFTP-10-D-8.77-01-N</td>
<td>Outer</td>
<td>1.210</td>
<td>0.014</td>
</tr>
<tr>
<td></td>
<td>Inner</td>
<td>1.196</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Timing Measurements
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 490 mV. The acquired data was measured using a filtered rise time of 500 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.

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Path</th>
<th>End 1 NEXT (mV)</th>
<th>NEXT (%)</th>
<th>End 2 NEXT (mV)</th>
<th>NEXT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFTP-10-D-8.77-01-N</td>
<td>Outer</td>
<td>10.4</td>
<td>2.1</td>
<td>10.0</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Inner</td>
<td>12.4</td>
<td>2.5</td>
<td>10.8</td>
<td>2.2</td>
</tr>
</tbody>
</table>

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 490 mV. The acquired data was measured using a filtered rise time of 500 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.

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Path</th>
<th>End 1 FEXT (mV)</th>
<th>FEXT (%)</th>
<th>End 2 FEXT (mV)</th>
<th>FEXT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFTP-10-D-8.77-01-N</td>
<td>Outer</td>
<td>7.2</td>
<td>1.5</td>
<td>11.6</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>Inner</td>
<td>11.2</td>
<td>2.3</td>
<td>12.4</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Table 5: % FEXT
**Frequency Domain Data**

**Insertion Loss**

![Insertion Loss Graph](image)

**Figure 2: FFTP-10-D-8.77-01-N Insertion Loss**
Return Loss

Figure 3: FFTP-10-D-8.77-01-N Return Loss
Near End Crosstalk

Figure 4: FFTP-10-D-8.77-01-N NEXT
Far End Crosstalk

Figure 5: FFTP-10-D-8.77-01-N FEXT
Test Procedures

Fixturing:
All measurements were performed using the test boards. The test boards have trace lengths of 1.500 inches and provide for the interconnection to the FFTP assembly by use of replaceable SMA connectors. The calibration boards provide a THRU reference trace pair. Figure 6 below shows how the THRU reference traces were utilized to compensate for the losses due to the coaxial test cables, SMA launches, and the test board traces during testing.

![Diagram of Test Setup]

Figure 6: Test setup for Thru Reference Acquisition

Measurements were then performed using the test boards as shown in Figure 7. A picture of the test board and cable is shown in Figure 8.
The twisted pair assembly terminations had a particular signal line configuration. The respective signal line numbers are shown in Table 6 below. There are a total of 10 positions per row. Not all positions were made available at SMA connectors on the test boards. All adjacent line pairs are terminated where applicable.

<table>
<thead>
<tr>
<th>3</th>
<th>5</th>
<th>7</th>
<th>9</th>
<th>11</th>
<th>13</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 6: Respective signal line numbers.

Table 7 below shows the signal line numbers corresponding to the inner and outer paths for the different configurations tested. The test board jack numbers corresponding to the lines are listed.

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFTP-10-D-8.77-01-N</td>
<td>J9/J10</td>
</tr>
<tr>
<td></td>
<td>J3/J4</td>
</tr>
</tbody>
</table>

Table 7: Inner Path and Outer Path Signal Line Numbers
**Time Domain Testing**

**Impedance:**
The Tektronix 11801B oscilloscope was set up in TDR (time domain reflectometry) mode using a 500-pS filtered risetime and 16 averages. The horizontal setup of the TDR used 512 point record length and a horizontal scale of 500 pS/div to allow the near end connector and the entire length of the assembly to be displayed. All connector impedance measurements were made at the near-end connector. Cable impedance was not uniform so a nominal value was reported as one half the sum of 100 ohms plus the maximum impedance along the cable.

**Propagation Delay:**
The propagation delay was measured and skew calculated by first acquiring a thru reference pulse of the reference trace 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 6).

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 9). 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 10). All adjacent lines were terminated, at both ends, with 50Ω SMA loads; refer to Figures 9 and 10.
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 10 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 9 and 10.

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 6). 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 flex assembly.

Return Loss:

An open circuit reference measurement was taken using a signal trace pair on the calibration boards. A matched reflection waveform of the flex assembly, i.e. with the flex 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 flex 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 6).

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 9). NEXT was then post processed using Tektronix’s IConnect® software to generate the NEXT of the flex 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 10). FEXT was then post processed using Tektronix’s IConnect® software to generate the FEXT of the flex assembly in the frequency domain.
Figure 9: NEXT Measurement Setup.

Figure 10: FEXT Measurement Setup.
Series: FFTP  
Description: .050 x .050 C/L Twisted Pair Female IDC Assembly

Equipment

*Time Domain Testing*
Tektronix 11801B Oscilloscope  
Tektronix SD24 TDR/Sampling Head  
Tektronix SD26 Sampling Head