High Data Rate Characterization Report

EPLSP-019-3000

Mated with:
ERI8-019-S-D-RA and ERI8-019-S-D-RA

Description:
High Speed I/O Cable Assembly, 0.8mm Pitch
Table of Contents

Introduction ................................................................................................................... 3
Product Description .......................................................................................................3
Results Summary ...........................................................................................................5
   Time Domain Data .................................................................................................. 5
      Impedance .......................................................................................................... 5
      Timing Measurements ......................................................................................... 5
      NEXT ................................................................................................................. 6
      FEXT ................................................................................................................. 6
   Frequency Domain Data .......................................................................................... 7
      Insertion Loss ..................................................................................................... 7
      Return Loss ....................................................................................................... 8
      Near End Crosstalk ............................................................................................ 9
      Far End Crosstalk ..............................................................................................10
Test Procedures ..........................................................................................................11
   Fixturing: .............................................................................................................. 11
   Time Domain Testing ............................................................................................. 13
      Impedance: ....................................................................................................... 13
      Propagation Delay: ............................................................................................ 13
      Skew: ................................................................................................................ 13
      NEXT and FEXT: ............................................................................................... 13
   Frequency Domain Testing .................................................................................... 14
Test Equipment .......................................................................................................... 15
Introduction
This testing was performed to evaluate the electrical performance of the EPLSP series of high speed IO cable assemblies.

Time domain and frequency domain measurements were made. In the time domain impedance, propagation delay, skew, near-end crosstalk and far-end crosstalk (NEXT and FEXT, respectively) were measured. The frequency domain measurements include insertion loss, return loss, NEXT and FEXT. The insertion loss and return loss responses were extracted from the time domain by using Tektronix IConnect® and MeasurementXtractor™ software; the frequency domain crosstalk was measured using an Agilent N5230A 4 port Phase Network Analyzer.

All measurements were made utilizing printed circuit boards specifically designed to test this product, referred to in this report as “test boards”.

Product Description
The test sample consists of two shielded #32 AWG twinax cables, which together provide for 8 differential signal pairs plus clock and power lines. The cable is terminated at each end to a printed circuit transition board and an EPLSP plug connector; the connector’s contacts are on 0.8 mm centers. The transition boards are wired to facilitate a Pin 1 to Pin 1 mapping between the cable terminations.

The EPLSP assembly was tested by mating it at each end to an ERI8 socket (PN: ER18-019-S-D-RA). One 3.0 meter sample was tested; the actual part number is shown in Table I, and identifies End 1 and End 2 of the assembly. A picture of the termination, the pin mapping and the End 1 identifier are shown in Figure 1.

<table>
<thead>
<tr>
<th>Length</th>
<th>Part Number</th>
<th>End 1</th>
<th>End 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000 mm</td>
<td>EPLSP-019-3000</td>
<td>EPLSP</td>
<td>EPLSP</td>
</tr>
</tbody>
</table>

Table 1: Sample Description

Two lines from the sample were tested, a long path and a short path. The short path is identified as Pair 1 and the long path is identified as Pair 6.
Series: EPLSP
Description: High Speed I/O Cable Assembly, 0.8-mm Pitch

Figure 1: EPLSP Test Sample Pin-Out Configuration and Termination
Results Summary

**Time Domain Data**

**Impedance**

Impedance measurements were performed using a native risetime of 35 ps. Note that all measurements were performed with the assembly mated to the respective connector/test board. Data was measured at the mated connector and at 200 pS into the cable itself.

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Connector End 1</th>
<th>Connector End 2</th>
<th>Cable TX32100</th>
<th>Cable TX32100</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPLSP P1</td>
<td>80 Ω</td>
<td>115 Ω</td>
<td>106 Ω</td>
<td>114 Ω</td>
</tr>
<tr>
<td>EPLSP P6</td>
<td>80 Ω</td>
<td>115 Ω</td>
<td>104 Ω</td>
<td>112 Ω</td>
</tr>
</tbody>
</table>

Table 2: Impedance Measurements

**Timing Measurements**

Skew was calculated as the difference between the propagation delays of the longest and the shortest electrical paths. Pair 1 is the short path and Pair 6 is the long path.

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>EPLSP-019-3000</td>
<td>Long</td>
<td>14.498</td>
<td>0.112</td>
</tr>
<tr>
<td></td>
<td>Short</td>
<td>14.385</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 differential incident pulse amplitude from the TDR was 500 mV. The acquired data was measured using the native risetime of 35 ps. The End 1 heading in Table IV 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>Config.</th>
<th>END1</th>
<th>END2</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPLSP-019-3000</td>
<td>Typ.</td>
<td>Adjacent</td>
<td>2.5</td>
<td>2.0</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 differential incident pulse amplitude from the TDR was 500 mV. The acquired data was measured using the native risetime of 35 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>Config.</th>
<th>END1</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPLSP-019-3000</td>
<td>Typ.</td>
<td>Adjacent</td>
<td>2.0</td>
</tr>
</tbody>
</table>

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

**Insertion Loss**

**EPLSP Insertion Loss**

![Graph showing insertion loss for EPLSP](image)

**Figure 2: Insertion Loss, P1 & P2, -3 dB @ 380.0MHz**
Return Loss

Figure 3: Return Loss, P1 & P6, -26 dB @ 380 MHz
Near End Crosstalk

**Figure 4:** NEXT, -45 dB NEXT @ 380.0 MHz
Far End Crosstalk

P6 to P7 FEXT

Figure 5: FEXT, -57.5 Db FEXT @ 380.0 MHz
Test Procedures

**Fixturing:**
All measurements were made using test boards specifically designed for this product, identified as PCB-101685-TST-01. The test boards contain traces that are 2 inches in length and provide for the interconnection to the test equipment by use of a Samtec’s Bull’s Eye™ Test Point System. A picture of a test board mated to the EPSP sample is shown in Figure 6.

For measurements that required reference measurements (insertion loss, return loss, NEXT, FEXT and propagation delay) the test boards contain a 2X calibration trace. The reference board was used to compensate for the losses due to the coaxial test cables and the test board traces during the measurement process, Figure 7.

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**Figure 2: Test Board with EPLSP Sample, Test Board Layout**

**Figure 3: 2X Calibration Trace**
Measurements were then performed using the test configuration as shown in Figure 8.

![Test Configuration Diagram]

The test boards are configured across the connector row in a ground – signal – signal – ground scheme that maps to the EPLSP-01-3000-32 sample. The connector mapping and the respective signal line numbers are shown in Figure 9.

![Test Board Connector Mapping Table]
High Speed Characterization Report

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Time Domain Testing

Impedance:
The Tektronix DSA8200 oscilloscope was set up in TDR (time domain reflectometry) mode using an unfiltered rise time and 64 averages. The horizontal setup of the TDR used a 4000 point record length and a horizontal scale of 1 nS/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. 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 DSA8200 oscilloscope. A thru reference of the coaxial test cables, and the 2X calibration trace was performed to determine the pulse amplitude of the TDR generator (see Figure 7).

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 10). 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 11). All adjacent lines were terminated, at both ends, with 50Ω loads; refer to Figures 10 and 11.
Frequency Domain Testing

Insertion loss and return loss measurements were made using the Tektronix DSA8000 oscilloscope in conjunction with Tektronix’s Iconnect software. Testing was performed using a rise time of 35 pS. The horizontal scale was set to 5 nS/div, the record length was set to 4000 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 loads.

Insertion Loss:
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 (see Figure 12). 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 signal traces on the test boards including the test board connector. A matched reflection waveform of the cable assembly, i.e. with the assembly terminated in 50-Ω 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 frequency domain using the N5230A network analyzer. A calibration plane was established at the ends of the test cables by performing a SOLT calibration using an 85052D 3.5 mm calibration kit.

To acquire NEXT a differential pair was driven using the network analyzer and NEXT was measured on an adjacent trace in frequency domain (see Figure 10). No other normalization or de-embedding techniques were performed.

To acquire FEXT a differential pair was driven using the network analyzer and FEXT was measured on an adjacent differential pair at the far end in frequency domain (see Figure 11). No other normalization or de-embedding techniques were performed.
Test Equipment
Tektronix DSA8200
Tektronix 80E04 Sampling Module
Tektronix 80E04 Sampling Module
Tektronix IConnect® Measurement XTractor™
Agilent N5230A PNA Network Analyzer