05-426r0  SAS-2 Cable Reach Objective and Crosstalk

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SAS-2 External Cable Reach Objective

- SAS-2 Proposal has requested a 10 meter reach objective
  - A reach of 10 meter would enable rack-to-rack interconnect (05-212r0)
  - Feasibility was illustrated in 05-341r1

- Connector technology has improved
  - Lower insertion loss
  - Lower crosstalk

- This presentation continues the investigation in 05-341r1 and evaluates crosstalk and the iPASS connector/cables
SDD21 compared to extended TCTF

- iPASS™ at 10m is comparable to Infiniband at 6m
Test Results iPASS™ Cable without De-Emphasis (6Gbps)

1m

6m

10m

15m
Test Results iPASS™ Cable with De-Emphasis (6Gbps)

1m

10m

6m

15m

iPASS™ and Tx De-Emphasis Enable 10m Operation
2 dB Power Penalty with Tx De-Emphasis and Finite length DFE

External Molex iPASS™ Cable Example at 6Gbps
- 10 meters for Rack to Rack interconnect will required equalization with SFF8088
- Open Rx eye @ 15m with Tx De-emphasis

iPASS™ Eyes 1->15 meter (Test Chip w/ De-Emphasis)

Rx Eye 1 m
Rx Eye 6 m
Rx Eye 10 m
Rx Eye 15 m

Sim DFE Out 1 m
Sim DFE Out 6 m
Sim DFE Out 10 m
Sim DFE Out 15 m

iPASS™ Sensitivity

Power Penalty 2 dB @ 1e-15

Un-Equalized

Equalized

SNR dB

BER

Theoretical:<blue> Unequalized:<cyan> Equalized:<magenta>
Molex Near End and Far End Cross Talk (05-398r0)

- 0.5, 1, 1.5 and 3m iPASS Cable
iPASS™ Crosstalk and Measurements

- Determined channel with highest coupling
  - Tx1 & Rx1
- Used 12G PG as the aggressor
  - 4000mV swing (approximate 4 aggressor)
  - PRBS-7 @ 6G + 20ppm
  - 22.5ps Tr/Tf
- Measured Rx Eyes w/ and w/o Crosstalk

<table>
<thead>
<tr>
<th>Aggressor</th>
<th>Xtalk</th>
<th>dB</th>
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<tbody>
<tr>
<td>0</td>
<td>20.2mV</td>
<td>-39.9</td>
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<tr>
<td>1</td>
<td>47.8mV</td>
<td>-32.4</td>
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<tr>
<td>2</td>
<td>19.4mV</td>
<td>-40.3</td>
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<tr>
<td>3</td>
<td>15.4mV</td>
<td>-42.3</td>
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</table>

Rx Eye w/ Cross Talk
iPASS™ Eyes without Crosstalk

6G Eyes De-Emphasis Enabled

1m (612mV)

10m (210mV)

6m (276mV)

15m (48mV)
6G Eyes w/ Crosstalk De-Emphasis Enabled

1m (598mV)

10m (138mV)

6m (241mV)

15m (?mV)
Robust 10m reach for SAS-2 is feasible with iPASS™ connectors, Tx De-Emphasis and Rx Equalization.

Using De-Emphasis and a DFE receiver the theoretical equalized power penalty is ~2dB.

Crosstalk with iPASS connector is not a significant issue at 10 meters.

SAS-2 Electrical Specification will need modifications for an External Cable Specification.

- Specify Tx Equalization (De-Emphasis)
- Crosstalk Specification
- Insertion loss / channel Specification
- Sensitivity / Eye Opening Specification