A 212.5 Gbps-PAM4 Chip-to-Module Channel for “Universal Port” and Its Characteristics: Design C

Mike Li, Jenny Jiang, Hsinho Wu, Masashi Shimanouchi, Ilia Radashkevich, Itamar Levin, Ariel Cohen (Intel)
Karan Jumani, Sina Bardikalaie, Vivek Shah, Scott Sommers (Molex)

Sept., 2023
Background and Introduction (I)

• An important and common Chip-to-Module (C2M) Channel is the so-called “Universal Port” C2M, as shown in the following diagram.

Host C2M

“Universal Port”

Host CR

• The loss of the C2M channel (TP0-TP1A) budget is determined/bounded by the bump-to-bump, ref PKG, and DAC loss budget, which are trending <=40 dB, ~6 dB (IL optimized), ~16 dB, for 212.5 Gbps-PAM4 signaling.
Background and Introduction (II)

• We leveraged our established/validated C2M channel design tool-flow-methodology (TFM) (e.g., [1], [2]) to create this C2M channel design to support 212.5 Gbps-PAM4 “Universal Port”.
C2M Channel Design C for “Universal Port”

### Design C

<table>
<thead>
<tr>
<th>Component</th>
<th>Insertion Loss TP0-TP1a (dB) @ 53.125GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host PCB via</td>
<td>0.75 dB</td>
</tr>
<tr>
<td>Host PCB Trace</td>
<td>5.0 inch (1.27 dB/inch)</td>
</tr>
<tr>
<td>Connector</td>
<td>1.03 dB</td>
</tr>
<tr>
<td>HCB</td>
<td>3.42 dB</td>
</tr>
<tr>
<td>Total</td>
<td>11.55 dB</td>
</tr>
</tbody>
</table>

To Host IC

- TP0-TP1a
- Host PCB (92.5Ω)
- Connector (92.5Ω)
- HCB (92.5Ω)

To Module

- To Host IC
- .s12p
- To Module

- p6
- p5
- p4
- p3
- p2
- p1
- p12
- p11
- p10
- p9
- p8
- TX7

- RX6
- RX8

- PCB-via
- Host PCB Trace
- PCB-via
- Connector
- HCB

- Aggressor 1
- Victim CH
- Aggressor 2
C2M Channel Design C Characteristics (I)

TP0-TP1a Characteristics (DC-53.125GHz)

- **IL**: 11.55dB @ 53.125GHz
- **RL** ~ 13.4dB (<53.125GHz)
- **FEXT** < 41.1dB (<53.125GHz)
- **NEXT** < 47.6dB (<53.125GHz)
C2M Channel Design C Characteristics (II)

- ILD < +- 1 dB (<53.125 GHz)
- ICR > 26 dB (<53.125 GHz)
C2M Channel Design C Characteristics (III)

[S] parameter BW DC-120GHz
Summary

• We have created a C2M channel Design C supporting “Universal Port” at 212.5 Gbps-PAM4
• This C2M channel includes PCB-Via, PCB, connector, and HCB
• This C2M channel has:
  – An IL (TP0-TP1A) of ~11.55 dB at 53.125 GHz
  – RL <~ 13.4dB at <= 53.125 GHz
  – FEXT < 41.1dB, NEXT < 47.6dB, at <= 53.125 GHz
  – PCB IL of ~6.35 dB/reach of 5 inch (with 1.27 dB/inch) at 53.125 GHz
References