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Consideration of 50G NRZ optical components for 400GbE PMD

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Introduction

- 50Gb/s NRZ is the best option for 400GbE PMD because of the advantage in the link budget below.

Delta of link budget from100GBASE LR4 (Preliminary)

	100GBASE LR4	8x50G NRZ	8x50G PAM4	4x100G PAM4	4x100G DMT
MUX/DEMUX[(a)]	-	2.0	2.0	0	0
Coding[(a)]	-	0	5.0	5.0	9+α
Non-linearity[(b)]	-	0	1.0	1.0	0
MPI[(b)]	-	0	1.2	1.2	0
Quantization[(a)]	-	0	0.5	0.5	0.5
BW penalty[(a)]	-	1.5	0	1.5	-α

(a) cole_02_0814_smf.pdf (b) xu_3bs_01_0714.pdf

- Clear 50-56Gb/s NRZ eyes were demonstrated.
  - qian_3bs_01_0714.pdf (electrical)
  - shirao_3bs_01a_0714.pdf (optical)
- 56Gb/s NRZ was demonstrated over SMF 10km-equivalent (@1.3μm) link.
  - wen_3bs_01_0914.pdf

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Introduction

- This presentation provides information supporting optical components for 50Gb/s NRZ.

  -EML output power and extinction ratio trade-off

  -FPC interface possibility for 50Gb/s optical devices

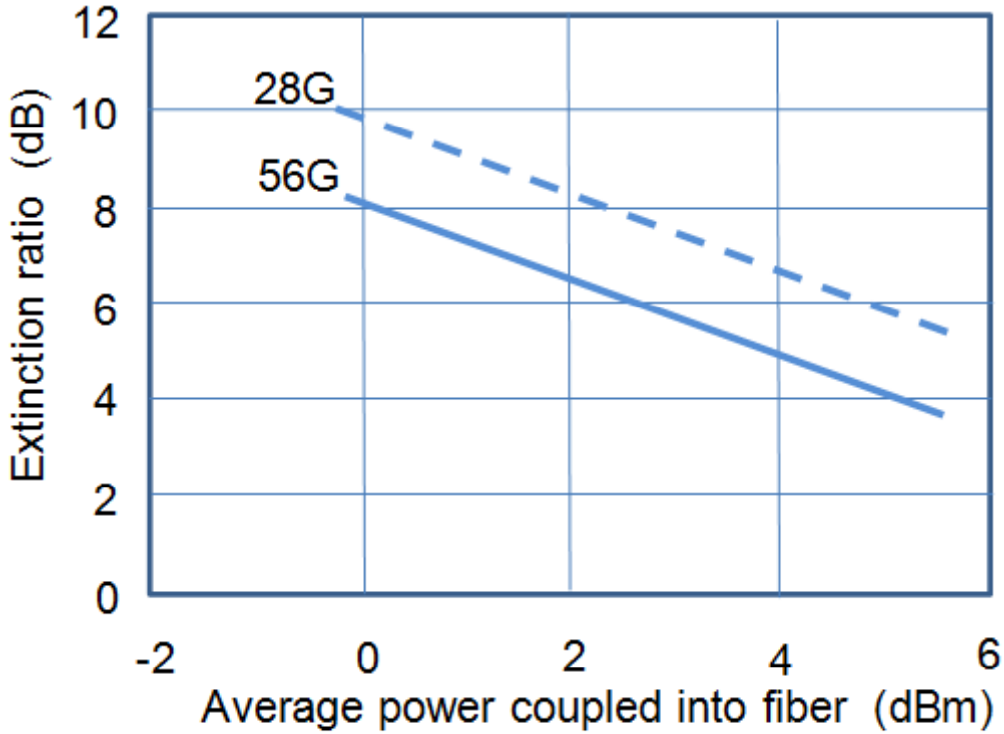
EML output power estimation

EML output power estimation

- Trade-off of EML output power was roughly calculated for 56G NRZ.
- Designing parameters such as energy gap of EA modulator were considered in the trade-off curve. In particular, 56G EMLs with ER of 4dB, 6dB and 8dB are different structure.

-3dB coupling loss between EML chip and fiber were taken into account

-Output power in OMA of 3.3dBm was expected at commonly discussed ER value of 6dB, which satisfied the 10km link budget (*wen_3bs_01_0914.pdf*)



ER	Ave. power [dBm]	OMA [dBm]
4dB	5.0	**4.4**
6dB	2.5	**3.3**
8dB	0	**1.6**

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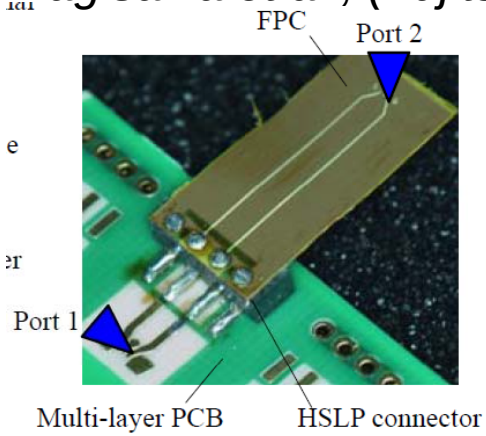
FPC interface for 50Gb/s optical devices

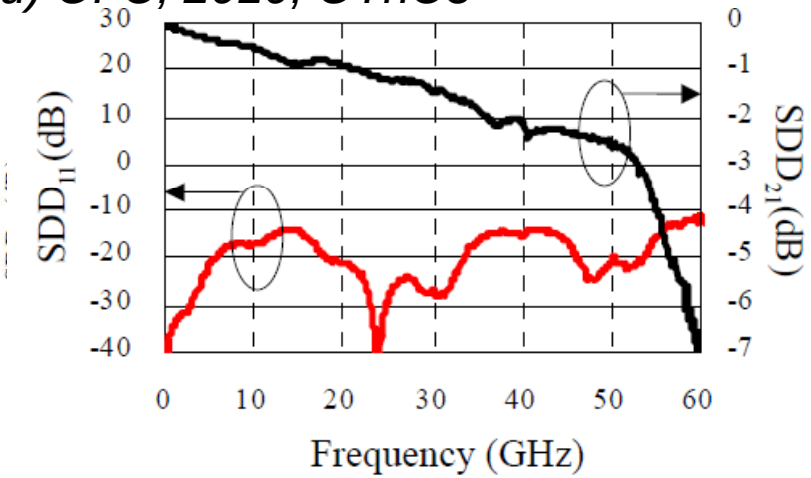
Performance of FPC interface

■FPC interface is a possible candidate for 400GbE Tx/Rx device.

- High speed FPC connector (>50GHz) has been reported.

T. Yagisawa et al., (Fujitsu) OFC, 2010, OThC3

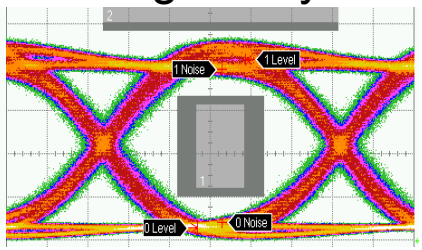




-Commercially available EML TOSA with FPC interface performed good eye waveform at 43Gb/s, which is compliant to XLMD2-MSA.

M. Shirao et al., OFC, 2013, OTh4H.6

http://www.xlmdmsa.org/



43Gb/s eye waveform

<u>The FPC technology of 10Gb/s XMD-MSA or 40Gb/s XLMD2 MSA will be reusable for 50Gb/s NRZ</u>

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Summary

Consideration of 50Gb/s NRZ optical components for 400GbE PMD

-Trade-off of EML

- Output power and extinction ratio are feasible for 50Gb/s NRZ

-FPC interface possibility for 50Gb/s optical devices

- FPC technology of XMD MSA or XLMD2 MSA is reusable for 50Gb/s NRZ

50Gb/s NRZ is feasible and clearly a strong candidate for 400GbE PMD