RF Interconnection Technologies for 40G Serial

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- Hidenori Takahashi, KDDI Labs

System Supplier
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- Satoshi Obara, Fujitsu
- Shinji Nishimura, Hitachi Ltd
- Hidehiro Toyoda, Hitachi Ltd
- Satomi Shioiri, NEC

Transceiver Supplier
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- Beck Mason, JDSU
- Mike Dudek, JDSU
- Atsushi Takai, Opnext
- Kiyohisa Hiramoto, Opnext
- Matt Traverso, Opnext
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- Hao Feng, Eudyna
- Tetsuya Kinoshita, Kyocera
- Keith Nellis, Inphi Corp
- David McCormick, Picometrix
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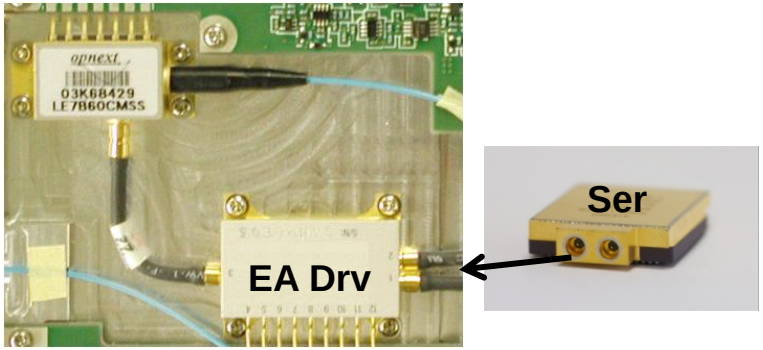
- Padraig O'Mathuna, Gigoptix

Outline

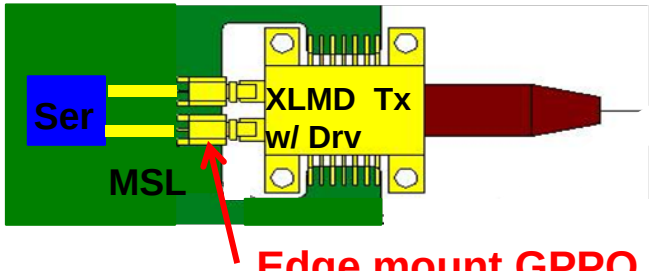
- Purpose of this presentation
  - RF interconnection technology to reduce 40GE Serial cost is proposed.
  - These technologies are available now and also enable to reduce optical module size in near future
- Effective cost reduction method for 40G Serial
  - Integration EML and EA Driver into one PKG
  - Removing GPPO from Serdes ICs and optical devices
- Two-types of RF interconnection method to remove GPPO
  - Edge mount GPPO method
  - FPC interconnection method
- Optical module size estimation by using proposed RF interconnection method
  - Comparison between Serial vs CWDM

RF Interconnection Methods

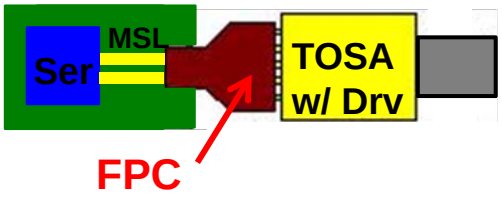
Current OC768

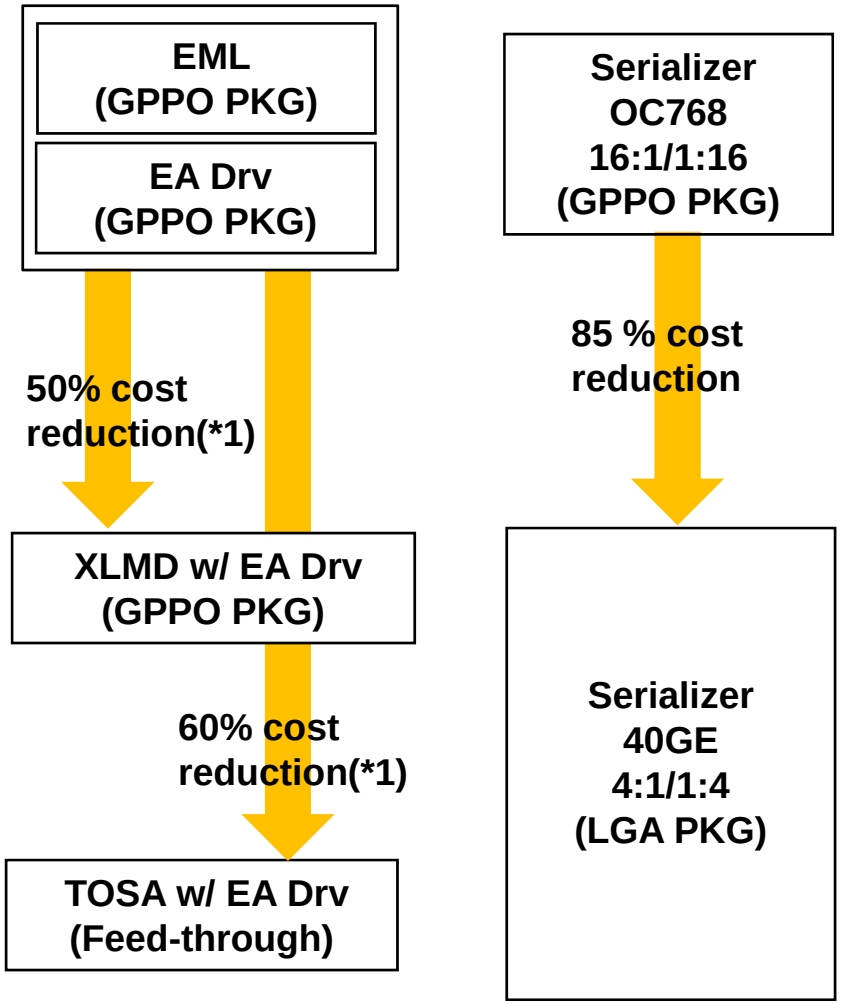


GPPO edge mount connectors



FPC interconnection

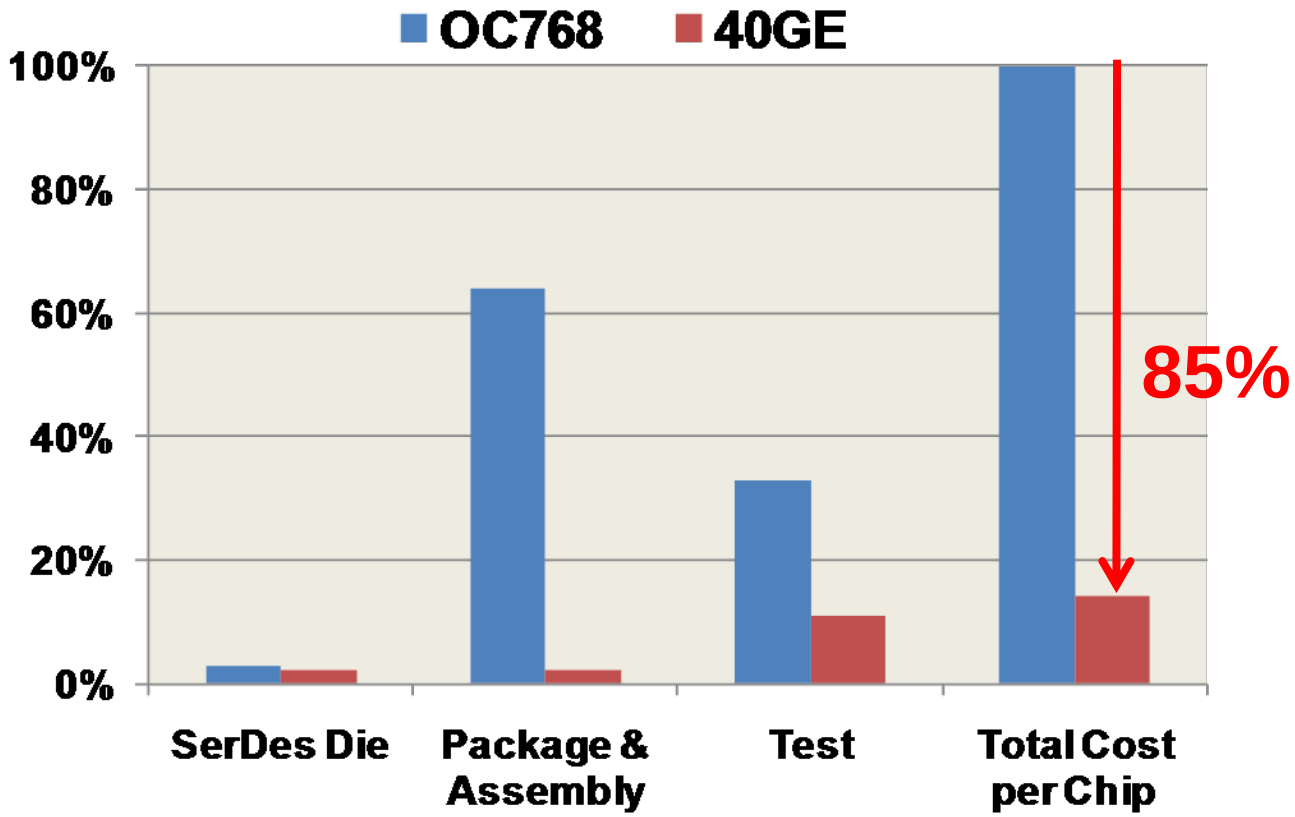


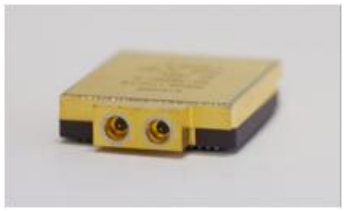


(*1) TOSA(w/ driver)+ROSA cost, not include volume effect
From traverso_01_0909

Cost reduction of SerDes for 40GE Serial

Cost Comparison:
OC768 and 40GE SerDes, YR2008 technology





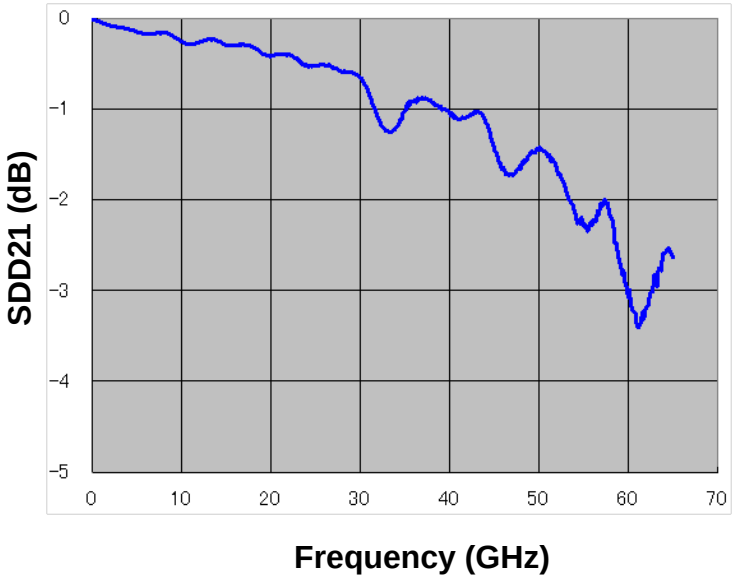
OC768 16:1/1:16
(GPPO PKG)

40GE 4:1/1:4
(LGA PKG)

Edge Mount GPPO Method

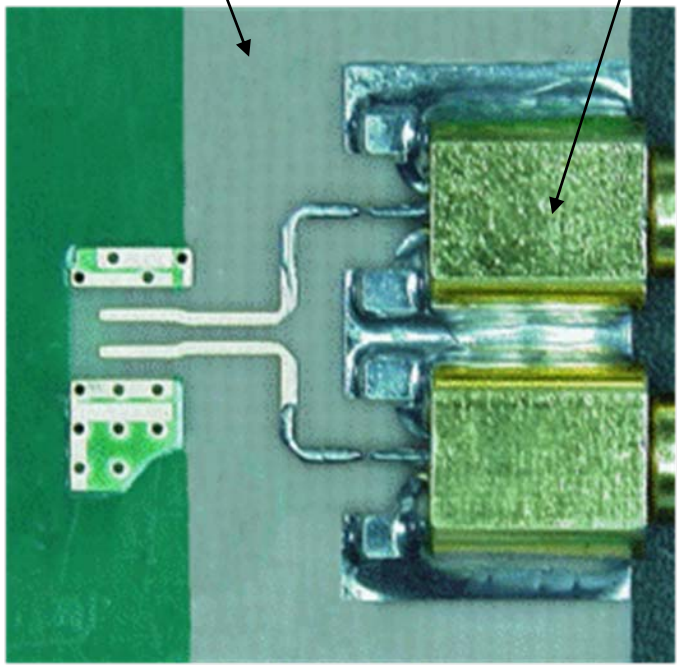
Transmission loss = 1.0dB@40GHz

f_{-3dB} bandwidth = 60GHz

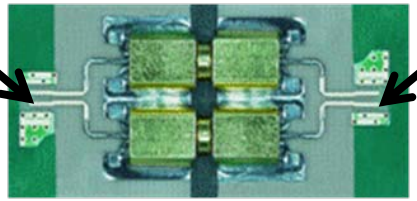


GPPO Edge Mount

Multi-layer PCB(FR-4)



Probe



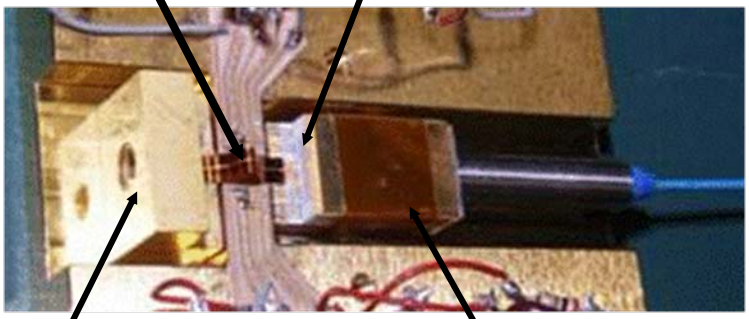
Probe

Available Today

FPC Interconnection Method

FPC film
(10mm, R=0.75, 90deg bend)

Ceramic feed-through



GPPO connector

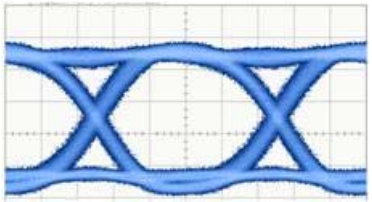
Driver IC integrated EML module

(*OECC 2008, WeC-1)

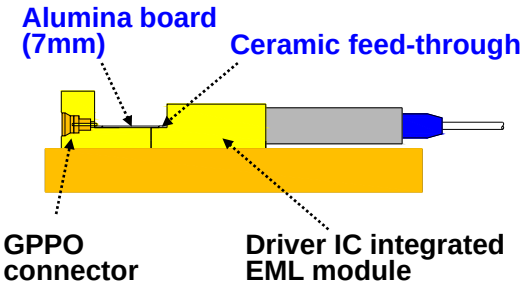
Bit rate : 39.8Gb/s
Data pattern : PRBS31

X-point	50.1 %
Jitter p-p	4.01 ps
Jitter rms	0.64 ps
Eye amp.	1.2 V
Tr	7.11 ps
Tf	7.44 ps

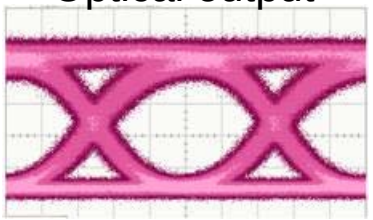
Input waveform



1. Alumina board connection(Reference)

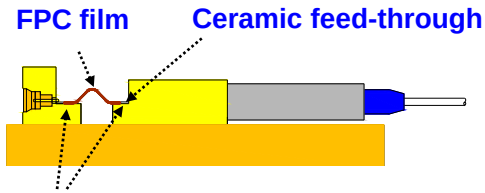


Optical output



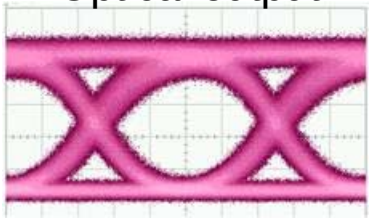
X-point	50.0 %
Ext. ratio	10.5 dB
Jitter p-p	7.56 ps
Jitter rms	1.13 ps

2. FPC film connection



Solder Joint

Optical output



X-point	50.3 %
Ext. ratio	10.8 dB
Jitter p-p	7.56 ps
Jitter rms	1.09 ps

Available in 2009

FPC Measurement Conditions

- FPC Material: Polyimide (t=50um)
- Signal Line: Micro strip line/ Grounded coplanar line (L=10mm)
- Measurement Conditions

  FPC Temperature: 25, 50, 85°C

  (a) Bent (90°, 120°, 180°, R=0.75mm)

  (b) Twisted

  (c) Folded

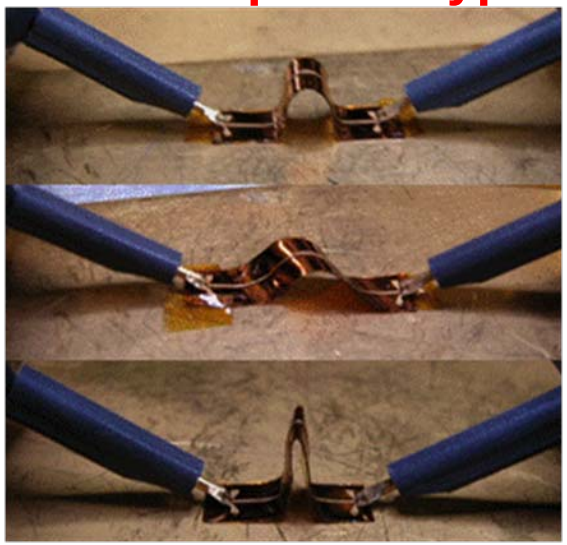
Micro Strip Line Type

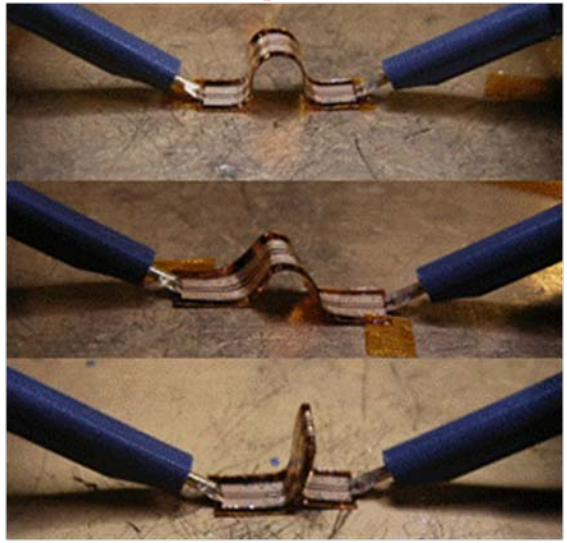
Grounded Coplanar Line Type

(a)

(b)

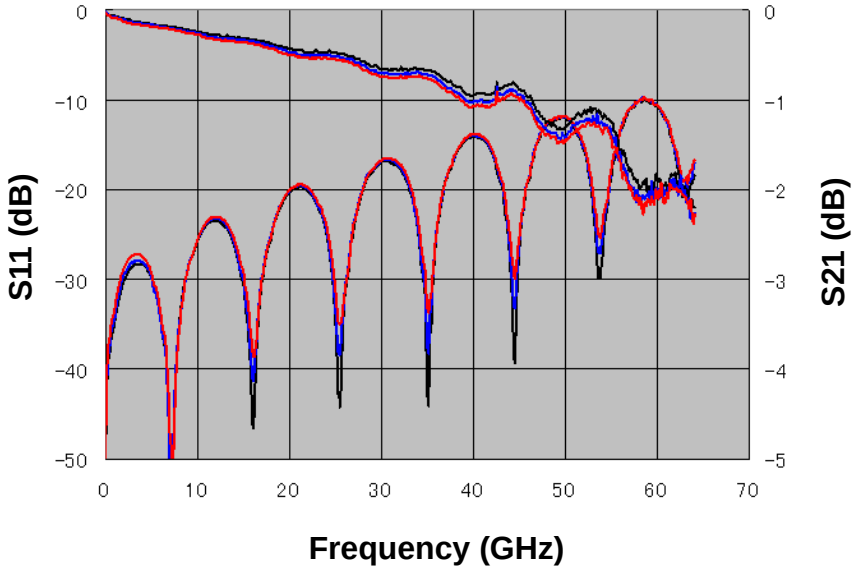
(c)



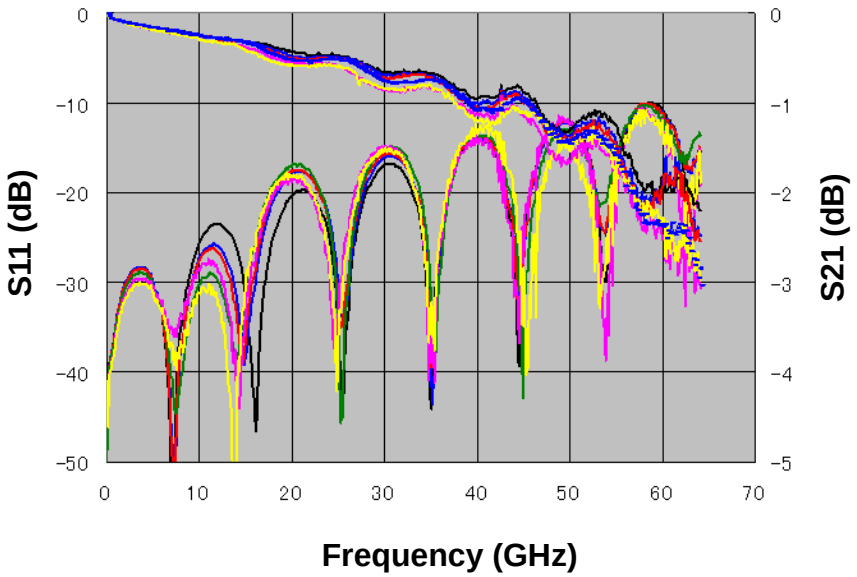


MSL Type FPC Performance

➢Micro Strip Line Type



25ºC
50ºC
85ºC

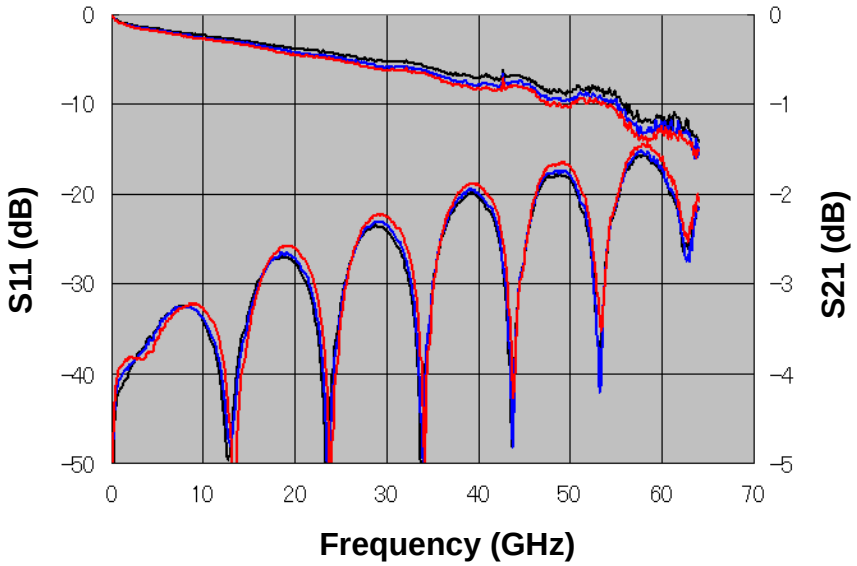


Straight
Bent 90º
Bent 120º
Bent 180º
Twisted
Folded

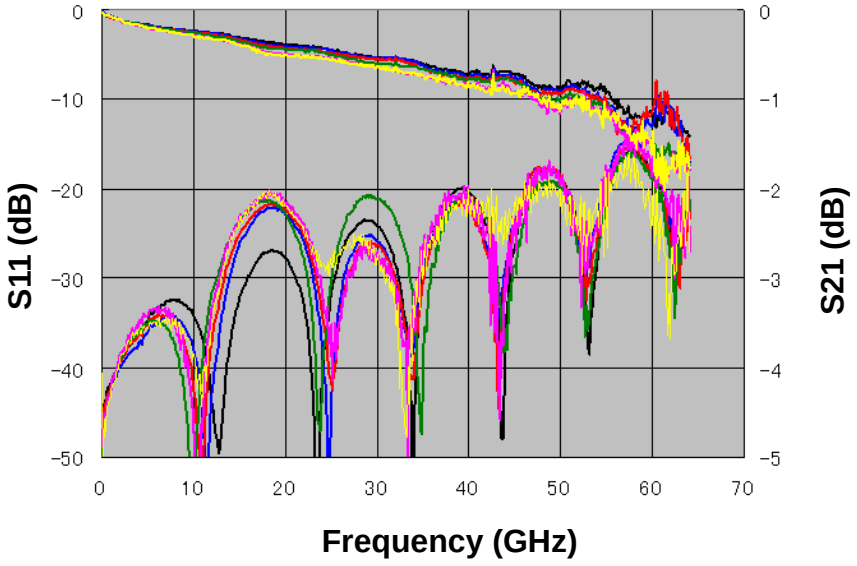
No degradation

Grounded CPL Type FPC Performance

➢Grounded Coplanar Line Type



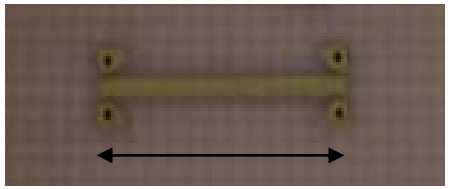
25°C
50°C
85°C



Straight
Bent 90°
Bent 120°
Bent 180°
Twisted
Folded

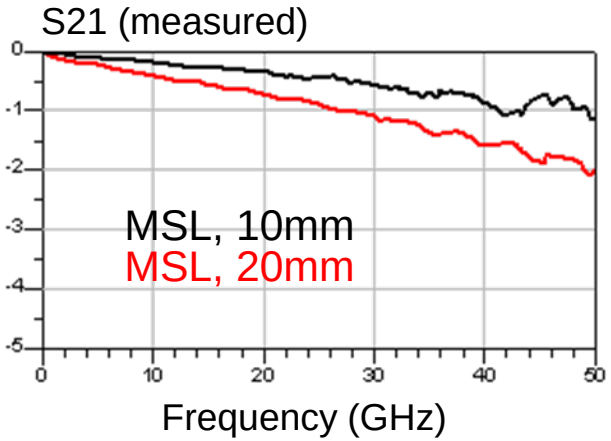
No degradation

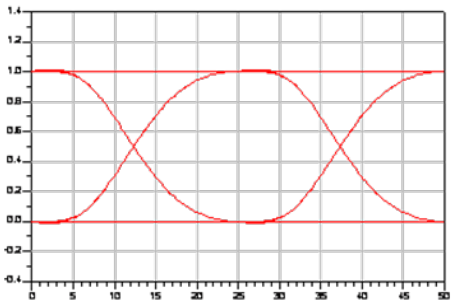
40G Signal Transmission on FR4



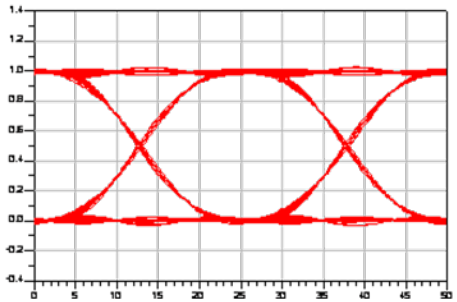
MSL 10mm

Material ：CCL-EL230 type T
Dielectric Constant：3.8 (@1GHz)
Dielectric Tangent：0.005 (@1GHz)
Thickness ：200um

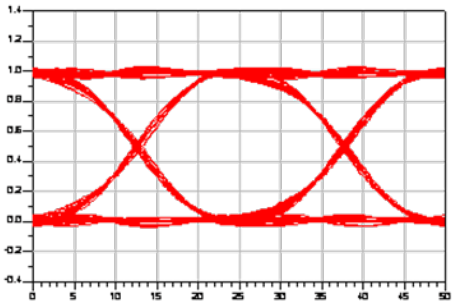




Input waveform (40Gb/s)

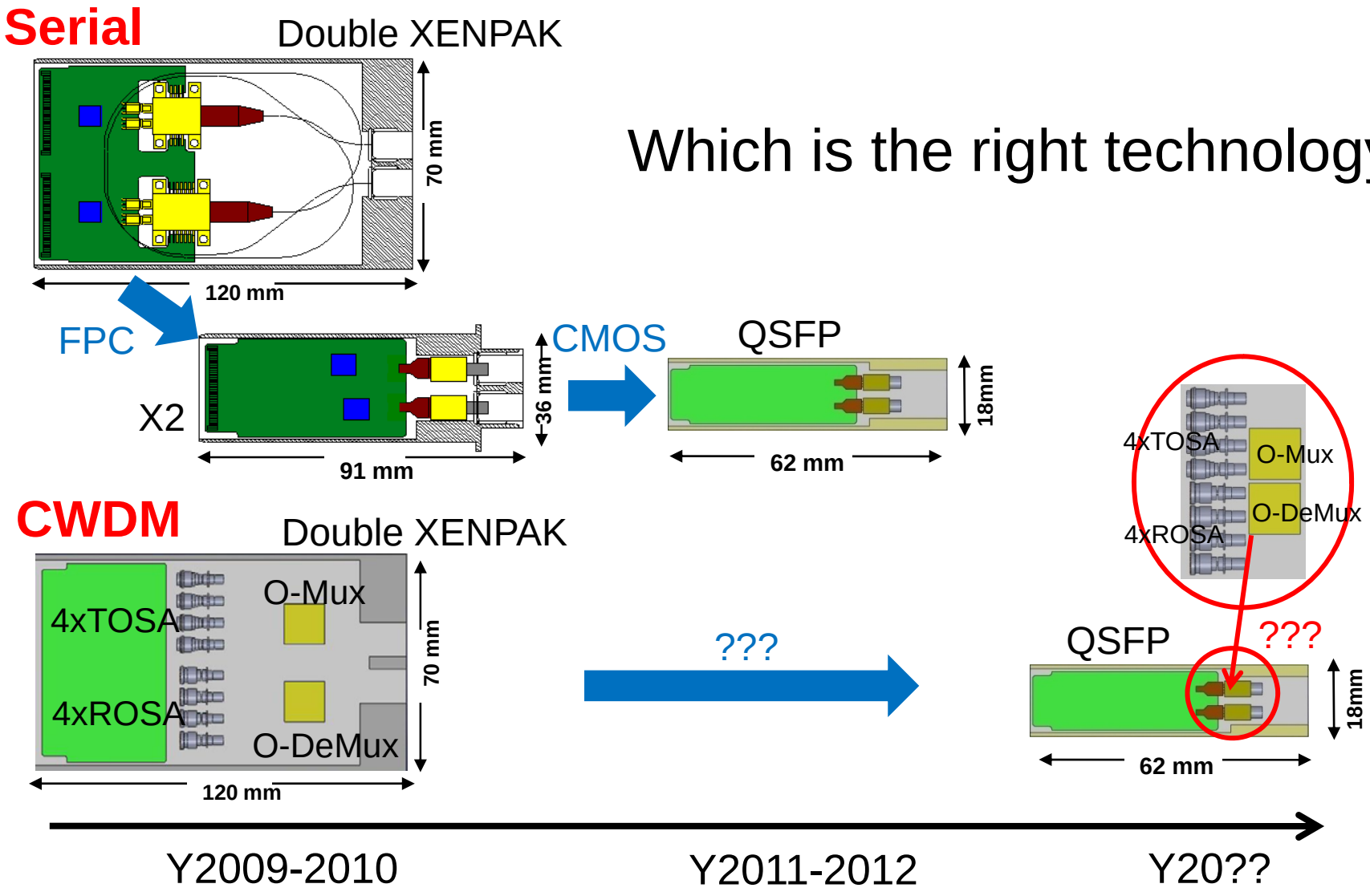


After 10mm transmission



After 20mm transmission

Optical Module Size



Summary

- Recommend the 802.3ba task force to adopt 40GbE Serial PMD for 10Km SMF:
  - Two-types of RF interconnection method are proposed and confirmed that RF characteristics are acceptable for 40G Serial
    - GPPO edge mount method – Available today
    - FPC interconnect method – Available in 2009
  - These technologies enable to reduce optical module cost and size for 40G Serial
  - Optical module size
    - X2 by adopting FPC interconnection method
    - QSFP by adopting low power CMOS
  - Serial is the right technology for 40GbE 10km SMF application