

# Addressing FECi TBDs

Addressing comments: 298, 304, 306, 307

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**IEEE 802.3dj Plenary Meeting**

**Vancouver, Canada**

**November 12, 2024**

# List of Supporters

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# Overview

## ❑ Background

- CD penalties
- FECi SER

## ❑ Addressing FECi related TBDs

- Comment 298 TDECQ/TECQ for 183.7.1
- Comment 304 OMA outer CL183.7.2
- Comment 306 TDECQ/TECQ for 182.7.1
- Comment 307 OMA outer CL183.7.2

## ❑ Summary.

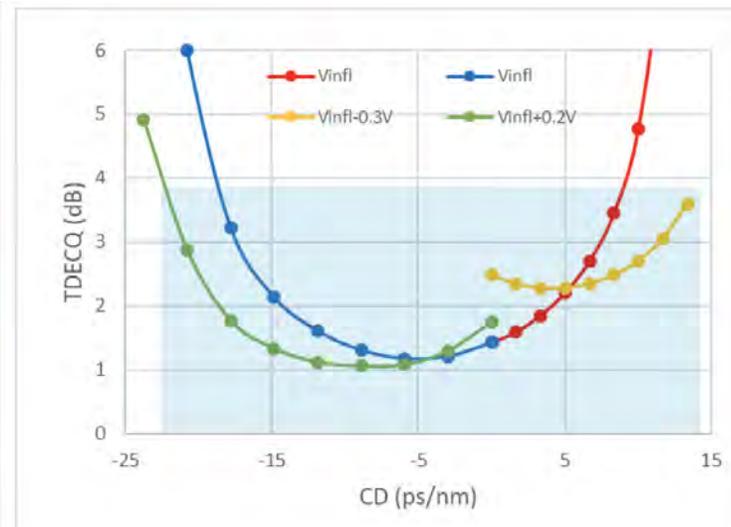
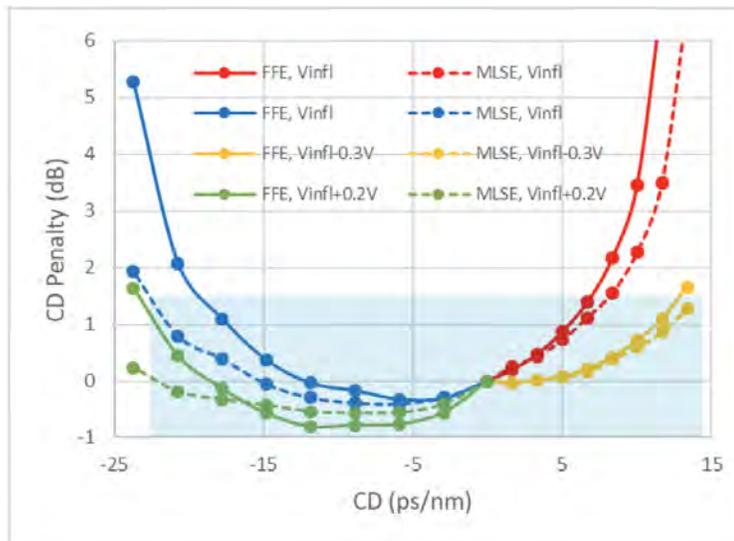
# Penalties for FR4 and LR4

## Associated CD penalty and TDECQ for FR4 and LR4 based on

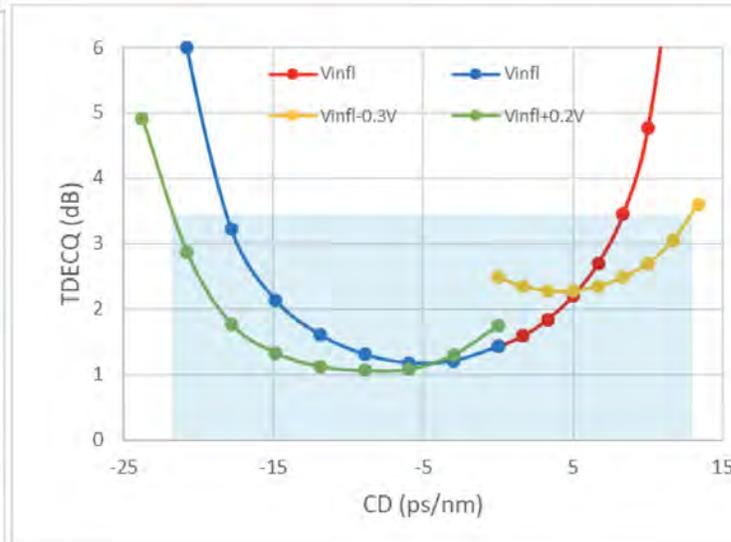
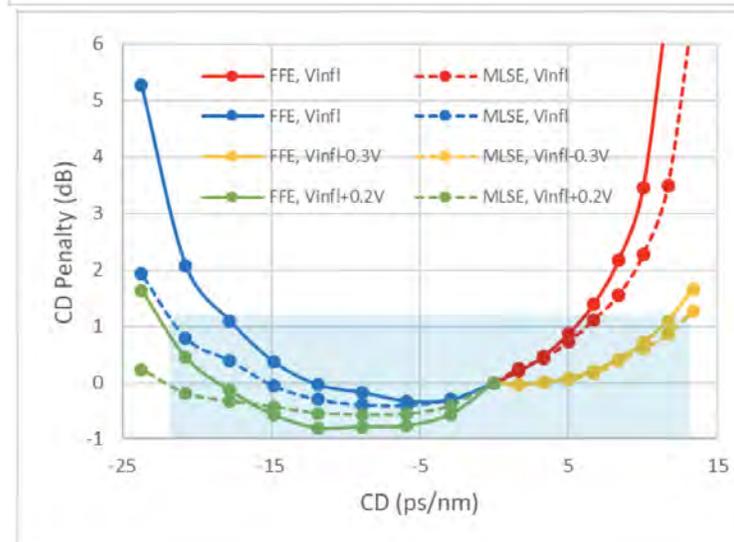
[johnson 3df 01a 221011](#)

- LR4 CD range -22.2 to 14.3 ps/nm result in CD penalty of 1.5 dB and TDECQ of 3.9 dB, the current 800GBASE-LR4 has TDECQ of 3.9 dB
- CWDM CD range of -21.5 to 12.8 ps/nm result in CD penalty of 1.2 dB and TDECQ of 3.9 dB, it is reasonable to propose TDECQ of 3.4 dB for 800GBASE-FR4.

LR4

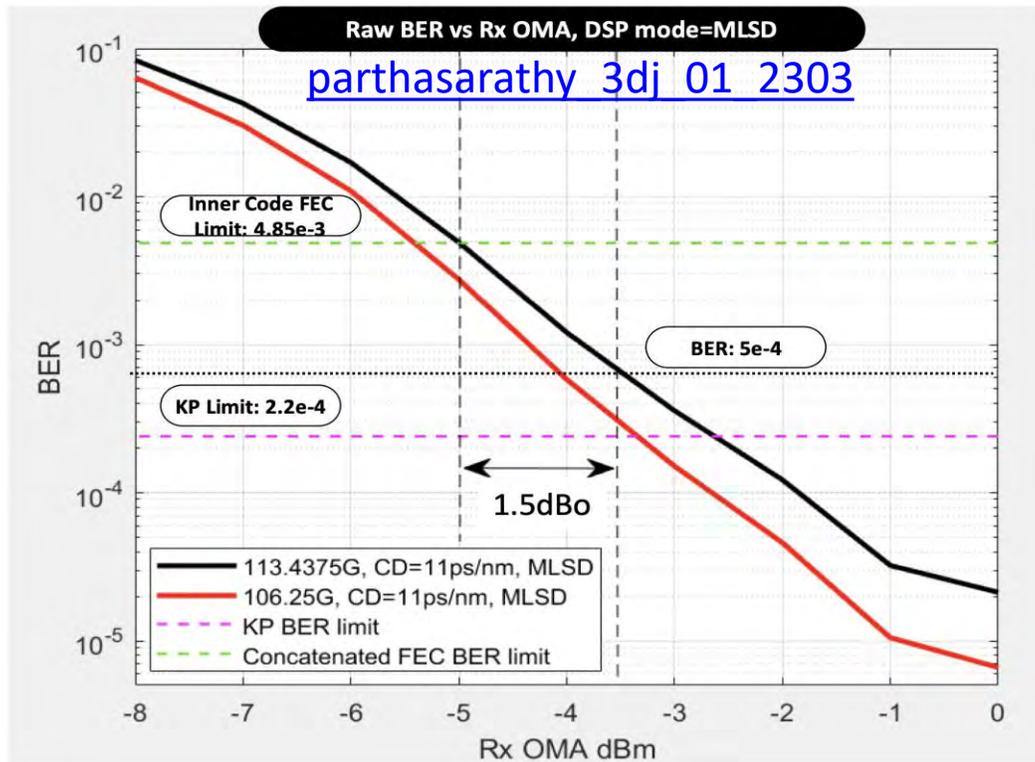


CWDM4



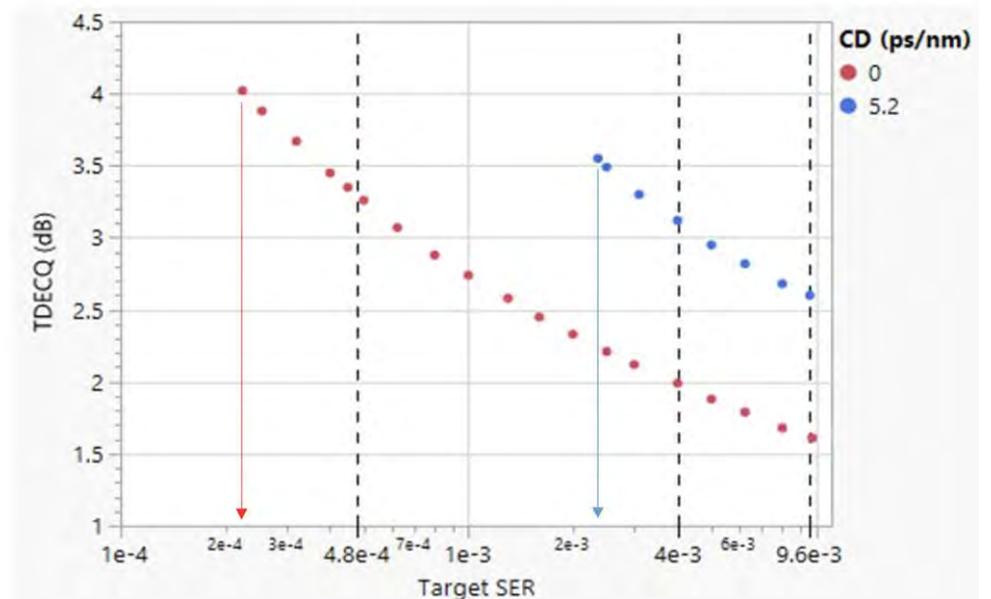
# FECi SER

- ❑ FECi BER input OMA is close to linear in the region of interest and follows FECo response with addition of 1.5 dBo gain as shown in [parthasarathy 3dj 01 2303](#)
- ❑ [johnson 3dj optx 01 241031](#) raises concern about compression of TDECQ with higher SER, but this in line with expectation as was reported by [lecheminant 3dj 01b 2309](#)
- ❑ Based on what we know today the adopted SER 9.6E-3 is technically sound and we should not adjust SER for FECo or FECi till we have a solid proposal how to account for transmitter block errors.



## Channel 1331 TDECQ

[johnson 3dj optx 01 241031](#)



# Comment 298

□ [johnson\\_3df\\_01a\\_221011](#) show TDECQ of 3.9 dB for LR4 given slightly higher CD penalty and the same presentation show TDECQ of 3.4 dB for FR4

- Propose to adopt the following parameters for FR4
  - TDECQ of 3.4 dB for FR4
  - TECQ=3.0 dB
  - |TDECQ-TECQ|<sub>max</sub>=2.5 dB
- Adopting propose value are reasonable and inline with johnson\_3df\_01a\_221011
- This allow us to make progress and during working group both FEC<sub>o</sub> and FEC<sub>i</sub> parameters will require further confirmation.

Table 183–6—800GBASE-FR4 and 800GBASE-LR4 transmit characteristics

Description	800GBASE-FR4	800GBASE-LR4	Unit
Signaling rate, each lane (range)	113.4375 ± 50 ppm		GBd
Modulation format	PAM4		—
Lane wavelengths (range)	1264.5 to 1277.5 1284.5 to 1297.5 1304.5 to 1317.5 1324.5 to 1337.5	1294.53 to 1296.59 1299.02 to 1301.09 1303.54 to 1305.63 1308.09 to 1310.19	nm
Side-mode suppression ratio (SMSR), (min)	30		dB
Total average launch power (max)	10.9	11.5	dBm
Average launch power, each lane (max)	4.9	5.5	dBm
Average launch power, each lane <sup>a</sup> (min)	-2.2 <sup>b</sup>	-1.1 <sup>c</sup>	dBm
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ), each lane (max)	4.8	5.7	dBm
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ), each lane (min)	0.8	—	dBm
for max(TECQ, TDECQ) < 0.9 dB	3.4 dB	—	dBm
for 0.9 dB ≤ max(TECQ, TDECQ) ≤ TBD dB	Equation (183-1)	—	dBm
for max(TECQ, TDECQ) < 1.4 dB	—	1.9	dBm
for 1.4 dB ≤ max(TECQ, TDECQ) ≤ 3.9 dB	—	Equation (183-2)	dBm
Difference in launch power between any two lanes (OMA <sub>outer</sub> ) (max)	4	3	dB
Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane (max)	TBD 3.4 dB	3.9	dB
Transmitter eye closure for PAM4 (TECQ), each lane (max)	3.0 dB TBD	3.2	dB
TDECQ - TECQ  (max)	2.5 dB TBD	2.5	dB

# Comment 306

□ [johnson\\_3df\\_01a\\_221011](#) show TDECQ of 3.9 dB for LR4 and the difference between LR4 and DR-2 is the CD for DR-2 is ~1/5 of LR4

- Propose to adopt the following parameters for FR4
  - TDECQ of 3.4 dB for FR4
  - TECQ=3.0 dB
  - |TDECQ-TECQ|max=2.5 dB
- Adopting propose value are reasonable and inline with johnson\_3df\_01a\_221011
- This allow us to make progress and during working group both FECo and FECi parameters will require further confirmation.

Table 182-7—200GBASE-DR1-2, 400GBASE-DR2-2, 800GBASE-DR4-2, and 1.6TBASE-DR8-2 transmit characteristics

Description	200GBASE-DR1-2	400GBASE-DR2-2 800GBASE-DR4-2 1.6TBASE-DR8-2	Unit
Signaling rate, each lane (range)	113.4375 ± 50 ppm		GBd
Modulation format	PAM4		—
Lane wavelength (range)	1304.5 to 1317.5		nm
Side-mode suppression ratio (SMSR), (min)	30		dB
Average launch power, each lane (max)	4		dBm
Average launch power, each lane <sup>a</sup> (min)	-2.6 <sup>b</sup>		dBm
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ), each lane (max)	4.2		dBm
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ), each lane (min)	0.4 -0.5 + max(TECQ, TDECQ)		dBm
Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane (max)	3.4 dB	TBD	dB
TECQ (max)	3.0 dB	TBD	dB
TDECQ - TECQ  (max)	2.5 dB	TBD	dB

# Comment 304

- With the  $|TDECQ-TECQ|_{max}=2.5$  dB and TDECQ 3.4 dB then following parameters are arrived:
  - Stress receiver sensitivity  $= -3.7 + 2.5 = -1.2$  dBm
  - Stress eye closure for PAM4 (SECQ)  $= 3.4$  dB.

Table 183–7—800GBASE-FR4 and 800GBASE-LR4 receive characteristics

Description	800GBASE-FR4	800GBASE-LR4	Unit
Signaling rate, each lane (range)	113.4375 ± 50 ppm		GBd
Modulation format	PAM4		—
Lane wavelengths (range)	1264.5 to 1277.5 1284.5 to 1297.5 1304.5 to 1317.5 1324.5 to 1337.5	1294.53 to 1296.59 1299.02 to 1301.09 1303.54 to 1305.63 1308.09 to 1310.19	nm
Damage threshold <sup>a</sup> , each lane	5.9	6.5	dBm
Average receive power, each lane (max)	4.9	5.5	dBm
Average receive power, each lane <sup>b</sup> (min)	-6.2	-7.4	dBm
Receive power (OMA <sub>outer</sub> ), each lane (max)	4.8	5.7	dBm
Difference in receive power between any two lanes (OMA <sub>outer</sub> ) (max)	4.1	3.3	dB
Receiver reflectance (max)	-26		dB
Receiver sensitivity (OMA <sub>outer</sub> ), each lane <sup>c</sup> (max)			
for TECQ < 0.9 dB	-3.7	-	dBm
for 0.9 dB ≤ TECQ ≤ SECQ	-4.6 + TECQ	-	dBm
for TECQ < 1.4 dB	-	-5.5	dBm
for 1.4 dB ≤ TECQ ≤ SECQ	-	-6.9 + TECQ	dBm
Stressed receiver sensitivity (OMA <sub>outer</sub> ), each lane <sup>c</sup> (max)	<b>TBD</b> 1.2 dB	-3	dBm
Conditions of stressed receiver sensitivity test: <sup>d</sup>			
Stressed eye closure for PAM4 (SECQ), lane under test	<b>TBD</b> 3.4 dB	3.9	dB
OMA <sub>outer</sub> of each aggressor lane	0.8	0.3	dBm

# Comment 307

- ❑ DRx-2 loss budget need to be +0.75 dB higher compared to DRx application to support 2000 m.
- ❑ The illustrative link budget for DRx-2 then becomes:
  - Power budget for max TDECQ= 7.8
  - Allocation for penalties=3.8 dB
    - TDECQ=3.4 dB
    - MPI/DGD=0.4 dB.

Table 182–9—Illustrative link power budget

Parameter	Value	Unit
Power budget (for max TDECQ)	7.8 dB TBD	dB
Operating distance	2000	m
Channel insertion loss <sup>a</sup>	4	dB
Maximum discrete reflectance	–35	dB
Allocation for penalties <sup>b</sup> (for max TDECQ)	3.8 dB TBD	dB
Additional insertion loss allowed	0	dB

<sup>a</sup> The channel insertion loss is calculated using the maximum distance specified in Table 182–6 and cabled optical fiber attenuation of 0.5 dB/km at 1304.5 nm plus an allocation for connection and splice loss given in 182.8.2.1.

<sup>b</sup> Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested. This value includes an allocation of 0.4 dB for MPI and DGD penalties.

# Summary

- ❑ **Draft D1.2 already include SER, TDECQ, SECQ, and stress receiver sensitivity for 800GBase-LR4**
- ❑ **By leveraging 800GBASE-LR4 specifications and [johnson\\_3df\\_01a\\_221011](#) following TBDs for DR-X-2 and FR4 can be be addressed**
  - TDECQ, TECQ, |TDECQ-TECQ| max, SECQ, power budget, allocation for penalties, and stress receiver sensitivity
- ❑ **By adopting the proposed parameters for the TBDs in Cause 182 and 183 we will make progress**
  - Proposed FECi TDECQ/TECQ values are just a starting point and encouraging additional data
  - There is ample opportunity during D2.x and D3.x to refine any parameter in the draft!