

200 Gb/s over OM4 & OMyy Baseline link proposals

IEEE P802.3ds 200 Gb/s per Wavelength MMF PHYs Task Force Interim Meeting

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Overview

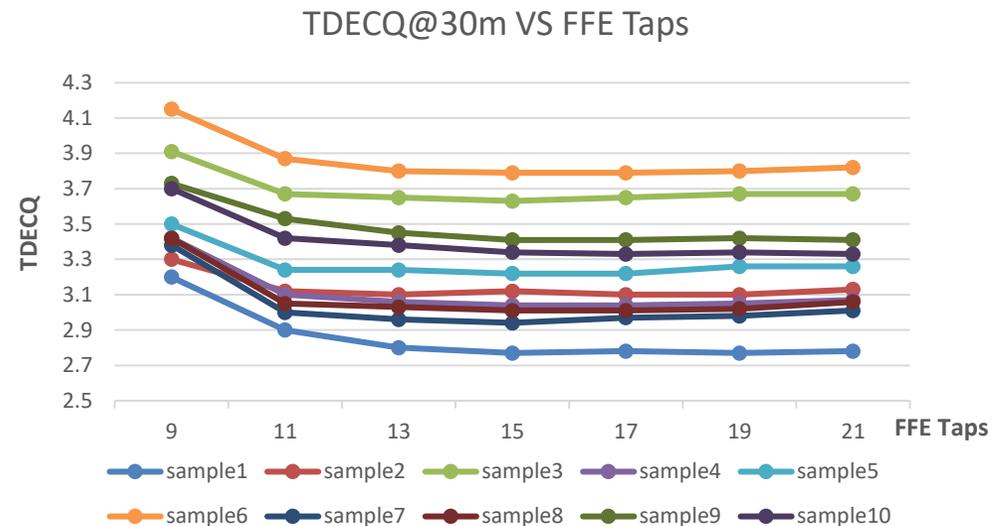
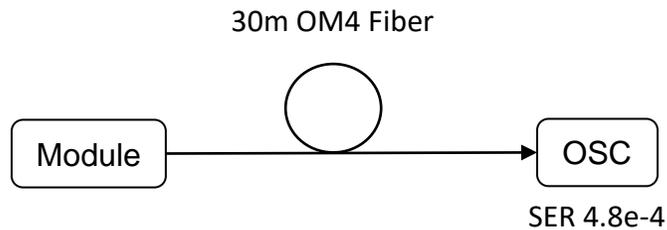
- 200 Gb/s operation over 30 m OM4 has been adopted as the objective
- Baseline proposal for 30 m link over OM4 was presented in Nov plenary meeting
 - [200 Gb/s over 30 m OM4 Objective: BER Floor Optimization and Baseline Link Update](#)
- In this presentation, We continue to provide an illustrative baseline preview for links with "OMyy" enhanced EMB (specs TBD) relative to standard OM4.
 - TDECQ Reference Receiver
 - TDECQ max

Proposed TDECQ Reference Receiver

- 9 Taps FFE was adopted as the reference receiver for 100G/Lane MMF
- For 200G/Lane MMF, more Taps are needed due to higher Baud rate
 - For 802.3dj, 15Taps FFE + 1Tap DFE was adopted as the reference receiver for 200G/Lane SMF
 - Recommend reusing the 200G/Lane SMF reference receiver model

TDECQ Reference Receiver Testing

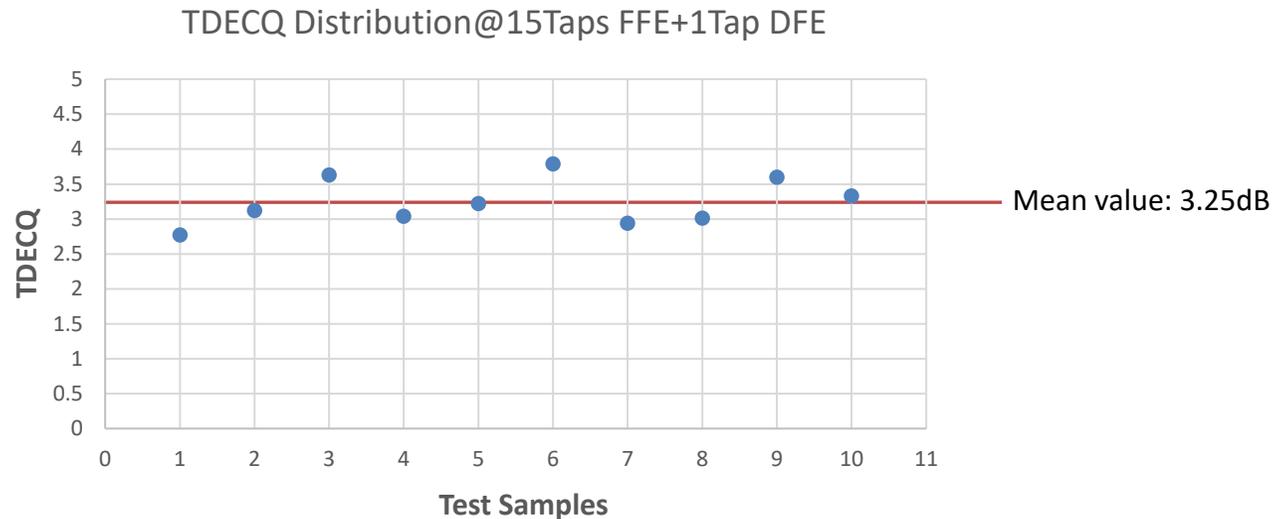
- Ten samples from two optical module manufacturers were tested
- Testing setup and result are as below
 - DFE is ON, test relationship between TDECQ and FFE taps number after transmission over 30m OM4 fiber



- 15Taps FFE + 1Tap DFE is a balanced choice

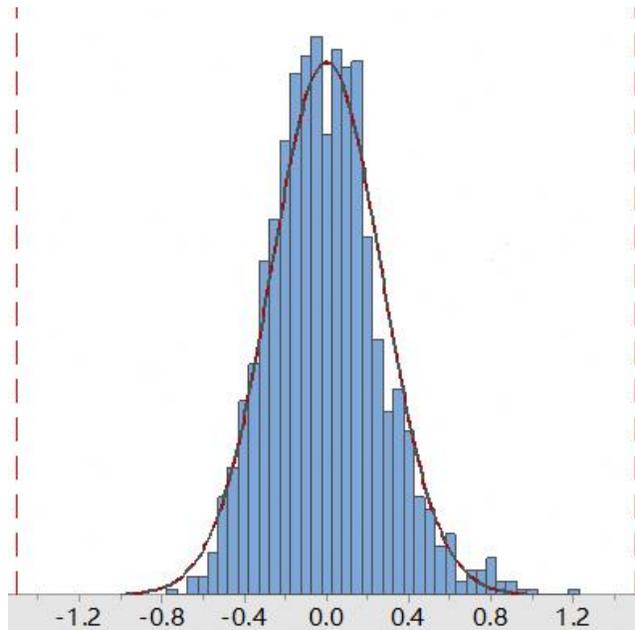
TDECQ max Test Data @30m

- Tested and collected TDECQ_{max} data of 200G MMF modules@30m Over OM4 fiber.
 - The value of TDECQ max @30m ranges between 2.77 dB and 3.79 dB.
 - Mean value: 3.25dB

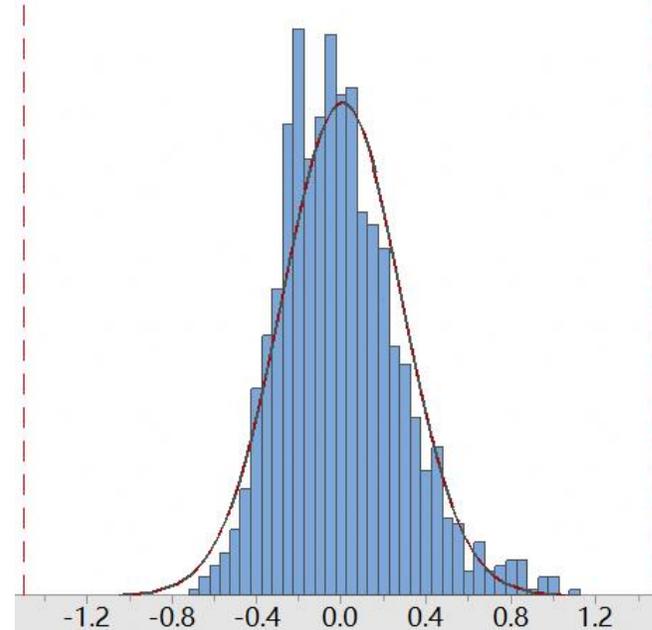


Trends

- For 50G/Lane and 100G/Lane MMF, TDECQ_{max} is 4.5 dB and 4.4 dB respectively.
- Collected and analyzed the TDECQ distribution of 50G and 100G MMF optical modules.
 - The distribution span of TDECQ for both 50G and 100G MMF optical modules is around 2.2 dB.



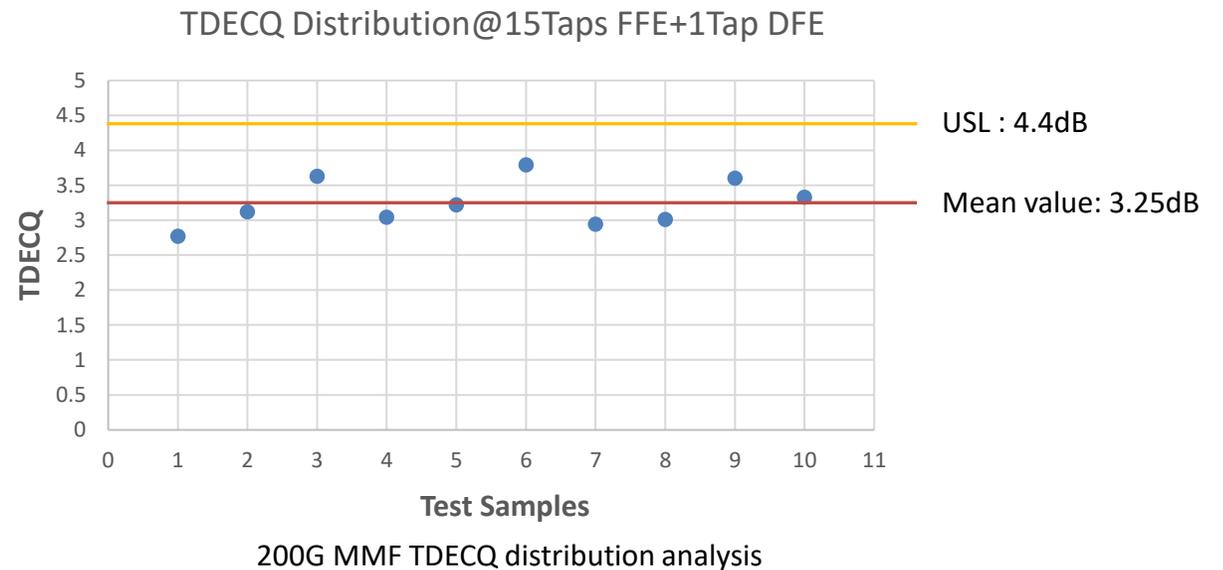
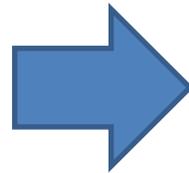
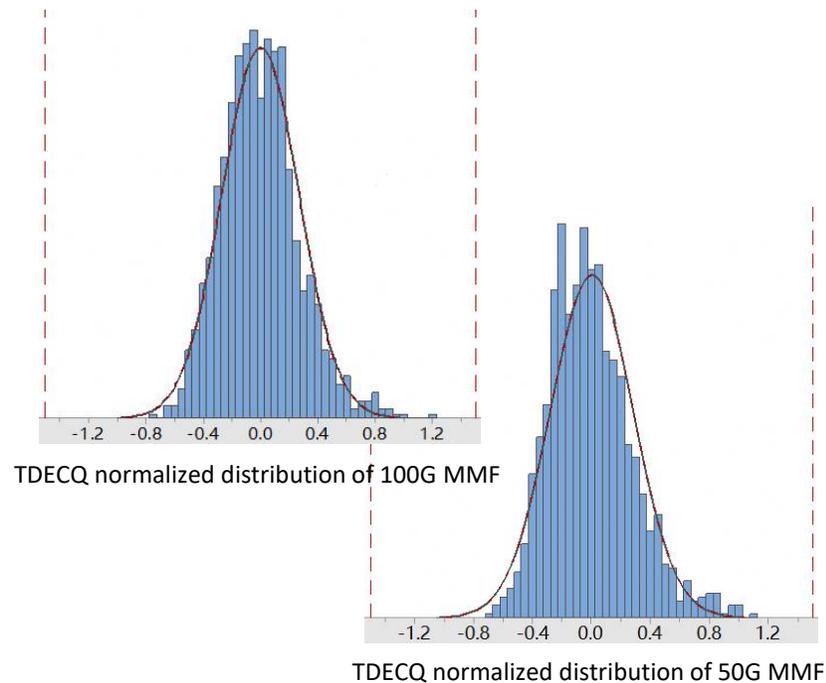
TDECQ normalized distribution of 100G MMF



TDECQ normalized distribution of 50G MMF

Proposed TDECQ_{max}

- The TDECQ distribution span for both 50G and 100G MMF optical modules is around 2.2 dB.
 - This distribution span provides significant reference value in defining 200G MMF TDECQ_{max}.
- Based on current 200G MMF TDECQ test data and historical experience, TDECQ_{max} 4.4dB is a acceptable which point to the validity of the earlier 4.6dB proposal.



Illustrative Baseline Preview

Illustrative Transmitter Specifications

Description	200GBASE-xx1 400GBASE-xx2 800GBASE-xx4 1.6TBASE-xx8	200GBASE-yy1 400GBASE-yy2 800GBASE-yy4 1.6TBASE-yy8	Unit
	TBD	TBD	
Signaling rate, each lane (range)	TBD	TBD	GBd
Modulation Format	PAM4	PAM4	
Lane wavelengths (range)	844~868	TBD	nm
RMS spectral width	TBD	TBD	nm
Average launch power, each lane (max)	TBD	TBD	dBm
Average launch power, each lane (min)	TBD	TBD	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(max)	TBD	TBD	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(min)	TBD	TBD	dBm
for TDECQ < 1.8 dB	TBD	TBD	dBm
for 1.8 dB ≤ TDECQ ≤ TDECQ (max)	TBD	TBD	dBm
Transmitter and dispersion eye closure (TDECQ), each lane (max)	4.6	4.6	dB
TECQ (max)	4.6	4.6	dB
Average launch power of OFF transmitter, each lane (max)	-30	-30	dBm
Transmitter power excursion, each lane (max)	TBD	TBD	dB
Extinction ratio, each lane, (min)	2	2	dB
Transmitter transition time (max)	8	8	ps
Transmitter over/under-shoot (max)	TBD	TBD	%
RIN _x OMA (max)	TBD	TBD	dB/Hz
Optical return loss tolerance (max)	TBD	TBD	dB
Encircled flux	≥86% at 19 um ≤30% at 4.5 um	≥86% at 19 um ≤30% at 4.5 um	dB

Illustrative Receiver Specifications

Description	200GBASE-xx1 400GBASE-xx2 800GBASE-xx4 1.6TBASE-xx8	200GBASE-yy1 400GBASE-yy2 800GBASE-yy4 1.6TBASE-yy8	Unit
	TBD	TBD	
Signaling rate, each lane (range)	TBD	TBD	GBd
Modulation Format	PAM4	PAM4	
Lane wavelengths (range)	844~868	TBD	nm
Damage threshold, each lane	TBD	TBD	dBm
Average receive power, each lane (max)	TBD	TBD	dBm
Average receive power, each lane (min)	TBD	TBD	dBm
Receive power, each lane (OMA_{outer}) (max)	TBD	TBD	dBm
Receiver reflectance (max)	TBD	TBD	dB
Receiver sensitivity (OMA_{outer}), each lane (max)			
for $TECQ < 1.8\text{dB}$	TBD	TBD	dBm
for $1.8\text{ dB} \leq TECQ \leq SECQ$	TBD	TBD	dBm
Stressed receiver sensitivity (OMA_{outer}), each lane (max)	TBD	TBD	dBm
Conditions of stressed receiver sensitivity test:			
SECQ	4.6	4.6	dB
OMA_{outer} of each aggressor lane ^c	3.5	3.5	dBm

Illustrative Link Budgets

Description	200GBASE-xx1 400GBASE-xx2 800GBASE-xx4 1.6TBASE-xx8	200GBASE-yy1 400GBASE-yy2 800GBASE-yy4 1.6TBASE-yy8	Unit
	OM4	OMyy	
Effective modal bandwidth at 850 nm	4700	TBD	MHz.km
Power budget (for max TDECQ)	TBD	TBD	dB
Operating distance	0.5 To 30	0.5 To 50	m
Channel insertion loss	1.6	1.7	dB
Maximum discrete reflectance	-20dB	-20dB	dB
Allocation for penalties (for max TDECQ)	TBD	TBD	dB
Additional insertion loss allowed	0.1	0.1	dB

The channel Insertion loss (30m)=0.1(fiber)+1.5(connector)=1.6dB

The channel Insertion loss (50m)=0.1(fiber)+1.6(connector)=1.7dB

The channel insertion loss is calculated using maximum distance and optical fiber attenuation of 3.0dB/km at 850nm plus an allocation for connection and splice loss

Summary

- 200G MMF Baseline Proposal further updated.
- 15 Taps FFE + 1 Tap DFE is a balanced reference receiver model for 200G MMF.
- Based on current 200G MMF TDECQ test data a value of 4.6dB is proposed.