In support of comments #63, #64, #65, #66, and #67

Peter Stassar, Huawei

IEEE P802.3cp Task Force, Teleconference, 23 September 2020

Comment #65

Cl **158** *SC* **158.10** *P* **73** *L* # 65

Stassar, Peter Huawei

Comment Type **ER** *Comment Status* **D**

The readability of Tables 158-13 (and 159-12) if a format similar to Table 88-14 is used.

SuggestedRemedy

Reformat Table 158-13 (and 159-12) to a format similar to Table 88-14. A detailed proposal will be made in a presentation to the relevant TF meeting

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.

A presentation will be submitted with detailed proposal.

Proposal
Table 158-13 - Fiber optic cabling (channel) characteristics

Description	10GBASE-BR10	10GBASE-BR20	10GBASE-BR40	Unit
Operating distance (max)	10	20	40	km
Channel insertion loss[a],[b](max)	6.2	15	18	dB
Channel insertion loss (min)	0	0	10	dB
Positive dispersion[b] (max)	35	70	141	ps/nm
Negative dispersion[b] (min)	–64	–127	–254	ps/nm
DGD_max[c]	10	10	10	ps
Optical return loss (min)	21	21	21	dB

[a] These channel insertion loss values include cable, connectors, and splices.
[b] Over the wavelength range 1260 nm to 1340 nm.
[c] Differential Group Delay (DGD) is the time difference at reception between the fractions of a pulse that were transmitted in the two principal states of polarization of an optical signal. DGD_max is the maximum differential group delay that the system must tolerate.

Proposal
Table 159-12 - Fiber optic cabling (channel) characteristics

Description	25GBASE-BR10	25GBASE-BR20	25GBASE-BR40	Unit
Operating distance (max)	10	20	40	km
Channel insertion loss[a],[b](max)	6.2	15	18	dB
Channel insertion loss (min)	0	0	10	dB
Positive dispersion[b] (max)	35	38.5	79	ps/nm
Negative dispersion[b] (min)	–64	–83	–166	ps/nm
DGD_max[c]	8	10.3	10.3	ps
Optical return loss (min)	21	21	21	dB

[a] These channel insertion loss values include cable, connectors, and splices.
[b] Over the wavelength range 1260 nm to 1340 nm for 25GBASE-BR10 and 1281 nm to 1322 nm for 25GBASE-BR20 and 25GBASE-BR40.

Comment #64

Cl **158** *SC* **158.10** *P* **73** *L* **12** # 64

Stassar, Peter Huawei

Comment Type **TR** *Comment Status* **D**

The maximum dispersion level for the 1270 nm part is not -19/-38/-75 ps/nm but zero in all 3 cases. This applies for zero km distances

SuggestedRemedy

In Table 158-13 modify the maximum chromatic dispersion from -19/-38/-75 to 0/0/0 ps/nm

Proposed Response *Response Status* **W**

PROPOSED ACCEPT.

The maximum chromatic dispersion at the 1270 nm channel “disappears” in the dispersion characteristics of the whole channel over the complete wavelength range as shown in proposed Table 158-13 on slide 3.

Comment #66

Cl **159** *SC* **159.9** *P* **94** *L* # 66

Stassar, Peter Huawei

Comment Type **TR** *Comment Status* **D**

The maximum dispersion level for the first 3 columns is not -19/-6/-11 ps/nm but 0/0/0 ps/nm. This applies for zero km distances. Furthermore in some cases the rounding of the dispersion has been downwards instead of upwards, e.g. 39.5 to 39 instead of 40.

SuggestedRemedy

In Table 159-12 modify the chromatic dispersion from -19/-6/-11 to 0/0/0 ps/nm. Also modify 39 to either 39.5 or 40 ps/nm. This will also be taken into account in the detailed proposal that will be put into a presentation.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT.

The maximum chromatic dispersion at the 1270 nm and 1289 nm channels "disappear" in the dispersion characteristics of the whole channel over the complete wavelength range as shown in proposed Table 159-12 on slide 4.

Comment #63

Cl **160** *SC* **160.9** *P* **119** *L* # 63

Stassar, Peter Huawei

Comment Type **TR** *Comment Status* **D**

It would make the readability significantly better if 160.9 would have its own local copy of Table 159-12

SuggestedRemedy

Create local copy of Table 159-12 in clause 160.9

Proposed Response *Response Status* **W**

PROPOSED ACCEPT.

Proposal

Table 160-xx - Fiber optic cabling (channel) characteristics

Description	50GBASE-BR10	50GBASE-BR20	50GBASE-BR40	Unit
Operating distance (max)	10	20	40	km
Channel insertion loss[a],[b](max)	6.2	15	18	dB
Channel insertion loss (min)	0	0	10	dB
Positive dispersion[b] (max)	35	38.5	79	ps/nm
Negative dispersion[b] (min)	–64	–83	–166	ps/nm
DGD_max[c]	8	10.3	10.3	ps
Optical return loss (min)	21	21	21	dB

[a] These channel insertion loss values include cable, connectors, and splices.

[b] Over the wavelength range 1260 nm to 1340 nm for 50GBASE-BR10 and 1281 nm to 1322 nm for 50GBASE-BR20 and 50GBASE-BR40.

[c] Differential Group Delay (DGD) is the time difference at reception between the fractions of a pulse that were transmitted in the two principal states of polarization of an optical signal. DGD_max is the maximum differential group delay that the system must tolerate.

Comment #67

Cl **160** *SC* **160.6** *P* **108** *L* # 67

Stassar, Peter Huawei

Comment Type **TR** *Comment Status* **D**

This comment is a repeat of comment #185 to D2.0, proposing to align the PAM4 specification methodology with the one used in P802.3cu D2.2.

SuggestedRemedy

A detailed presentation will be submitted with specific proposals for modification

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.

A presentation will be submitted with detailed proposal.

Changes on PAM4 specification methodology in P802.3cu D3.0

The changes that were introduced in P802.3cu are visible in Subclause 140.6, where for 100GBASE-DR the old methodology is used and for 100GBASE-FR/LR the new methodology is shown.

Modification of 100GBASE-DR was not open in the cu project.

On the following pages, both specification methods are shown and highlighted.

Separate proposals will be made on subsequent pages.

PAM4 transmitter specification in P802.3cu D3.0

Description	~~Value~~ 100GBASE-DR	100GBASE-FR1	100GBASE-LR1	Unit
Signaling rate (range)	53.125 ± 100 ppm			GBd
Modulation format	PAM4			—
Wavelength (range)	1304.5 to 1317.5			nm
Side-mode suppression ratio (SMSR), (min)	30			dB
Average launch power (max)	4	4	4.8	dBm
Average launch power[a] (min)	–2.9	–3.1	–1.9	dBm
Outer Optical Modulation Amplitude (OMA_{outer}) (max)	4.2	4.2	5	dBm
Outer Optical Modulation Amplitude (OMA_{outer}) (min)[b] for TDECQ <1.4 dB for 1.4 dB ≤ TDECQ ≤ 3.4 dB	–0.8 — —	— –0.1 –1.5 + TDECQ	— 1.1 –0.3 + TDECQ	dBm dBm dBm
Launch power in OMA_{outer} minus TDECQ (min): for extinction ratio ≥ 5 dB for extinction ratio < 5 dB	 –2.2 –1.9	 — —	 — —	 dBm dBm
Transmitter and dispersion eye closure for PAM4 (TDECQ) (max)	3.4	3.4	3.4	dB
TDECQ – $10\log_{10}(C_{eq})$ (max) [c]	3.4	—	—	dB

PAM4 transmitter specification pt2 in P802.3cu D3.0

Description	~~Value~~ 100GBASE-DR	100GBASE-FR1	100GBASE-LR1	Unit
TECQ (max)	—	3.4	3.4	dB
| TDECQ - TECQ | (max)	—	2.5	2.5	dB
Average launch power of OFF transmitter (max)	–15	–15	–15	dBm
Extinction ratio (min)	3.5	3.5	3.5	dB
Transmitter transition time (max)	17	17	17	ps
Transmitter over/under-shoot (max)	—	22	22	%
Transmitter peak-to-peak power (max)	—	5	5.5	dBm
~~$RIN_{15.5}$OMA (max)~~ RIN_xOMA (max), where x is the optical return loss tolerance (max)	–136	–136	–136	dB/Hz
Optical return loss tolerance (max)	15.5	17.1	15.6	dB
Transmitter reflectance[d] (max)	–26	–26	–26	dB

[a]Average launch power (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
[b]For 100GBASE-DR, ~~E~~even if the TDECQ < 1.4 dB for an extinction ratio of ≥ 5 dB or TDECQ < 1.1 dB for an extinction ratio of < 5 dB, the OMA_{outer} (min) must exceed this value.
[c]C_{eq} is a coefficient defined in 121.8.5.3, which accounts for the reference equalizer noise enhancement.
[d]Transmitter reflectance is defined looking into the transmitter.

PAM4 receiver specification in P802.3cu D3.0

Description	~~Value~~ 100GBASE-DR	100GBASE-FR1	100GBASE-LR1	Unit
Signaling rate (range)	53.125 ± 100 ppm			GBd
Modulation format	PAM4			—
Wavelength~~s~~ (range)	1304.5 to 1317.5			nm
Damage threshold[a]	5	5	5.8	dBm
Average receive power (max)	4	4	4.8	dBm
Average receive power[b] (min)	–5.9	–7.1	–8.2	dBm
Receive power (OMA_{outer}) (max)	4.2	4.2	5	dBm
Receiver reflectance (max)	–26	–26	–26	dB
Receiver sensitivity (OMA_{outer})[e] (max) for TECQ < 1.4 dB for 1.4 dB ≤ TECQ ≤ 3.4 dB	Equation (140–1)[c] — —	— –4.5 –5.9 + TECQ	— –6.1 –7.5 + TECQ	dBm dBm dBm
Stressed receiver sensitivity (OMA_{outer})[d] (max)	–1.9	–2.5	–4.1	dBm
Conditions of stressed receiver sensitivity test:[e]				
Stressed eye closure for PAM4 (SECQ)	3.4	3.4	3.4	dB
SECQ – $10\log_{10}(C_{eq})$[f] (max)	3.4	—	—	dB

[a]The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level. The receiver does not have to operate correctly at this input power.
[b]Average receive power (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
[c]Receiver sensitivity (OMA_{outer}) (max) for 100GBASE-DR is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB.
[d]Measured with conformance test signal at TP3 (see 140.7.10) for the BER specified in 140.1.1.
[e]These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.
[f]C_{eq} is a coefficient defined in 121.8.5.3, which accounts for the reference equalizer noise enhancement.

Changes in PAM4 specification methodology in P802.3cu D3.0

- The 1st technical change is with respect to the Tx parameter "TDECQ – $10\log_{10}(C_{eq})$ (max)", which has been deleted from P802.3cu for a variety of reasons.
- Some background is provided in cole_3cu_01b_0120
- Instead new parameters "TECQ" and "|TDECQ – TECQ|" have been introduced.
- TECQ: TDECQ without using a test fiber (so back to back).
- |TDECQ – TECQ|: conventional dispersion penalty

Proposals:

- Remove Tx parameter "TDECQ – 10log10(Ceq) (max)"
- Add Tx parameter "TECQ" with max value 3.2 dB (same as max TDECQ)
- Add Tx parameter "|TDECQ – TECQ|" with max value 2.5 dB (not critical)

Changes in PAM4 specification methodology in P802.3cu D3.0

- The 2nd technical change is the addition of Tx parameters “Transmitter over/under-shoot (max)” and “Transmitter peak-to-peak power (max)”
- Further input from component vendors is necessary to determine how important those are for 50G PAM4 and which values would be appropriate.

- For this round, preparing for D2.2, it is not proposed to add this.

Receiver:

- Receiver sensitivity has become normative (no longer informative)
- Associated technical change in Rx specification is the removal of condition “SECQ – $10\log_{10}(C_{eq})$ (max)” from the specification for “Stressed receiver sensitivity test”.
- It is proposed to implement this also in the cp D2.2.

Further changes in PAM4 specification methodology

- The further changes in P802.3cu D3.0 are purely how certain parameters are represented and additionally removing dependency on extinction ratio
- Launch power in "OMA_{outer} minus TDECQ", with a fixed limit, is rewritten as "OMA_{outer}" as "value + TDECQ".

Outer Optical Modulation Amplitude (OMA_{outer}) (min)[b]	–0.8	=	=	dBm
for TDECQ <1.4 dB	=	–0.1	1.1	dBm
for 1.4 dB ≤ TDECQ ≤ 3.4 dB	=	–1.5 + TDECQ	–0.3 + TDECQ	dBm

- With this new representation, it is more clear that below TDECQ the minimum output power is flat, whereas for above TDECQ it goes up linearly with TDECQ. Furthermore simplification without ER.
- Additionally a clarifying Figure has been added (see following page)
- It is proposed to add such a clarifying figure.

Clarifying Transmitter output power requirements

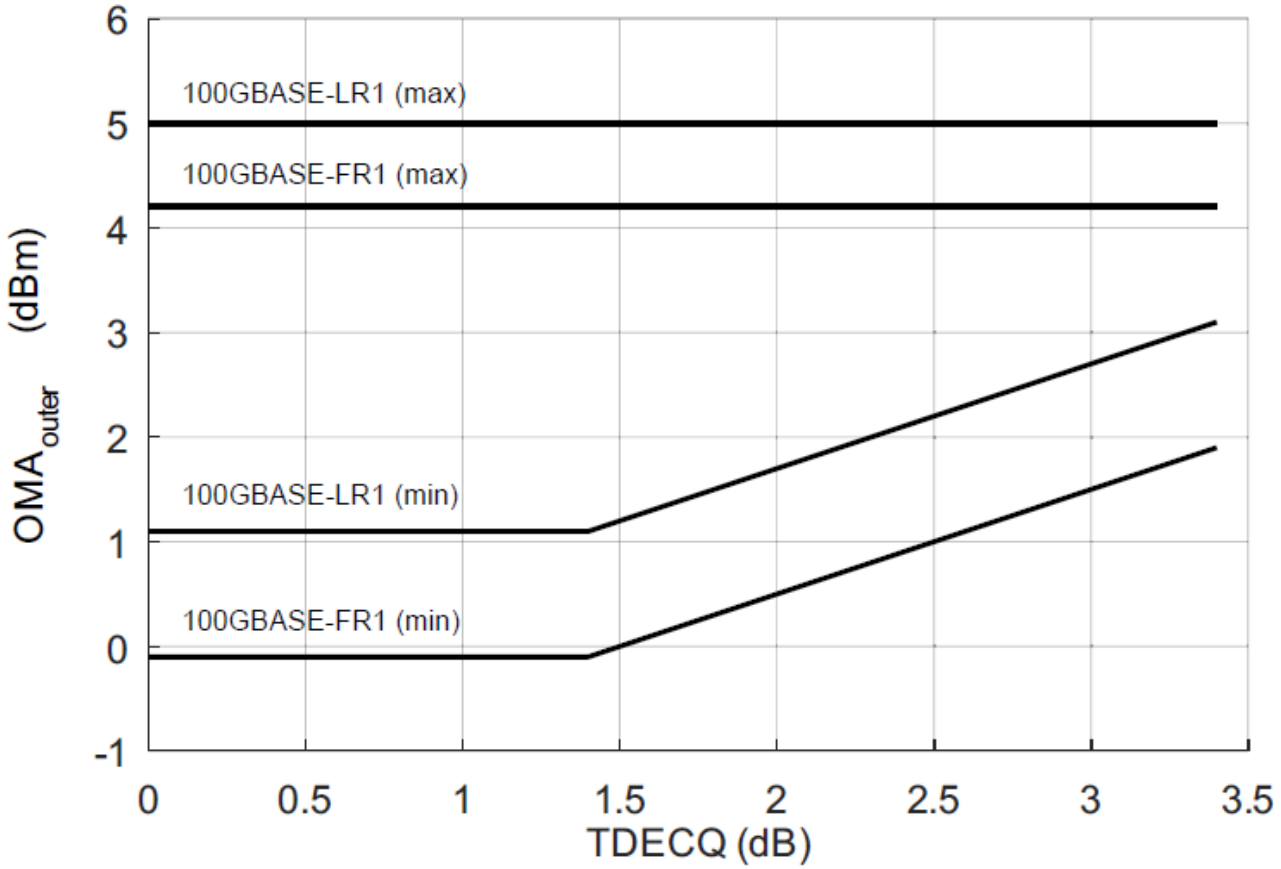

Figure 140–2a—OMAouter (max) and OMAouter (min) versus TDECQ for 100GBASE-FR1 and 100GBASE-LR1

Further changes in PAM4 specification methodology

- In a similar way, the receiver sensitivity has been expressed differently.

Receiver sensitivity (OMA_{outer})[e] (max)	Equation (140–1)[c]	—	—	dBm
for TECQ < 1.4 dB	—	–4.5	–6.1	dBm
for 1.4 dB ≤ TECQ ≤ 3.4 dB	—	–5.9 + TECQ	–7.5 + TECQ	dBm

- Instead of referring to Equations, values are shown in relation to TECQ.
- With this new representation, it is more clear that below TECQ the requirement for Rx sensitivity is flat, whereas for above TECQ it goes up linearly with TECQ.
- Additionally a clarifying Figure has been added (see following page)
- It is proposed to add such a clarifying figure.

Clarifying Receiver sensitivity requirements

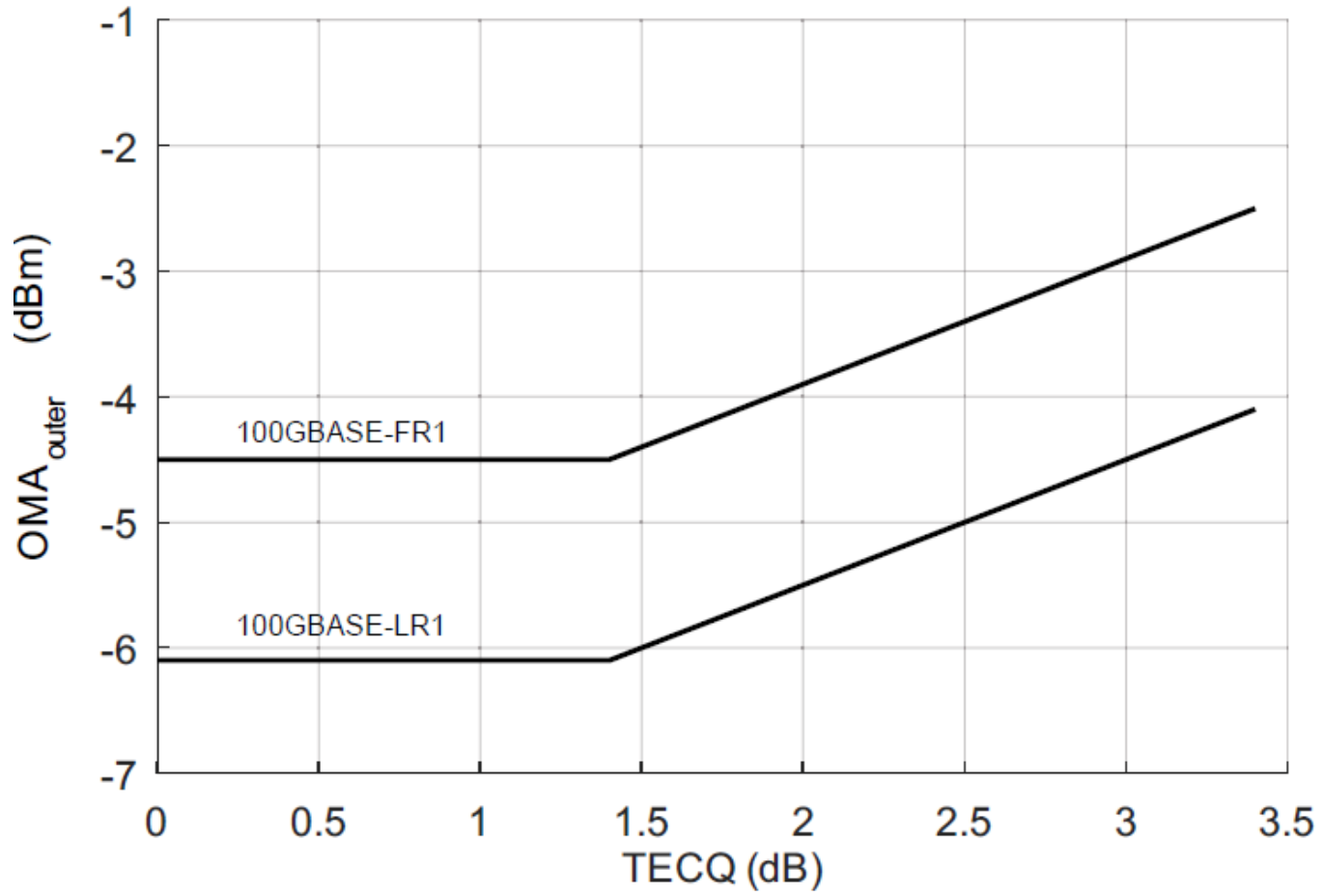

Figure 140–2b—Receiver sensitivity (OMA$_{outer}$) (max) for 100GBASE-FR1 and 100GBASE-LR1

Clarifying Illustrative power budget

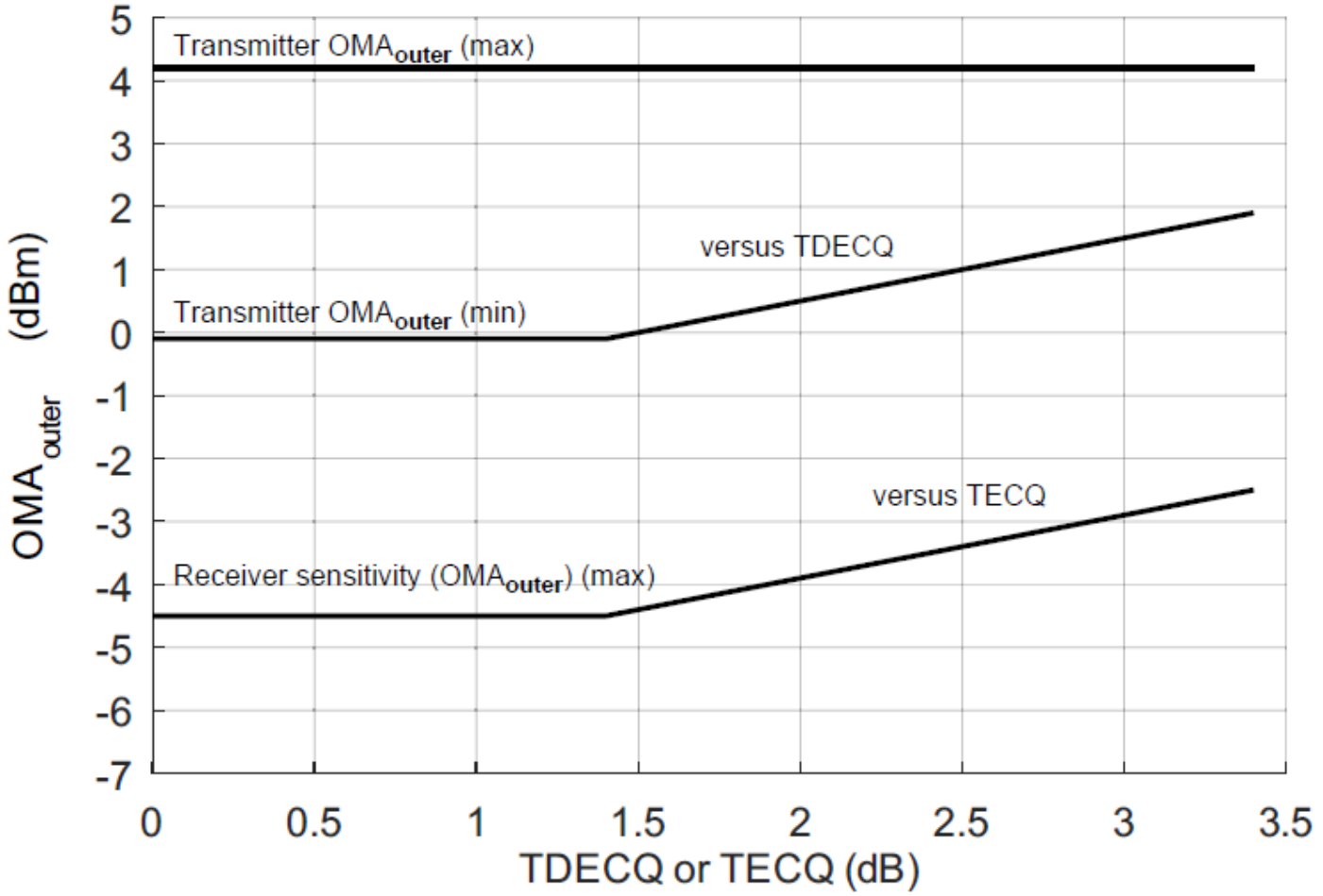

Figure 140–2c—Transmitter OMA$_{outer}$ versus TDECQ and receiver sensitivity (OMA$_{outer}$) versus TECQ for 100GBASE-FR1

Specific proposals for 50GBASE-BR10/BR20/BR40

Parameter	50GBASE-BR10	50GBASE-BR20	50GBASE-BR40	Unit
Transmitter Table 160-6				
Outer Optical Modulation Amplitude (OMA_{outer}) (min): for TDECQ <1.4 dB for 1.4 dB ≤ TDECQ ≤ 3.2 dB	 –1.5 –2.9 + TDECQ	 0.4 –1 + TDECQ	 3.4 2 + TDECQ	dBm
TECQ (max)	3.2	3.2	3.2	dB
| TDECQ - TECQ | (max)	2.5	2.5	2.5	dB
Receiver Table 160-7				
Receiver sensitivity (OMA_{outer})(max) for TECQ < 1.4 dB for 1.4 dB ≤ TECQ ≤ 3.2 dB	 –8.4 –9.8 + TECQ	 –15.1 –16.5 + TECQ		dBm

Thanks!