

TFT Illustrations & Examples

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Outline

➤ Introduction

- DR Illustrations
- TFT Mask Examples
- Optional Tests
- LR Examples

802.3dv Intent

- The Author Team intends to propose TFT to 802.3dv, based on TFT in 802.3dj D3.3
- This presentation proposes **changes (in red)** to D3.3 to make explicit meaning of test fiber
 - Transmitter functional test (TFT) test fiber meaning definition in 802.3dj d3.3 180.9.8:
 1. The transmitter under test is connected to the FnRx by a test fiber, which meets the requirements in 180.9.6.2. (min & max dispersion in Table 180-15)
 2. Other test fibers, including patch cords, may be used for additional tests
 - Meaning of test fiber can be 1 or 2, depending on context, and is therefore implicit
 - [cole 3dj 01b 2609](#) correctly determines meaning of text fiber from context
 - All examples are correct so, there is no need for comments(s) against D3.3
- Separately, all aspects of TFT need revisiting from the ground up for 400G
 - 400G specifications can not be assumed to just scale from 200G
 - This applies to all 400G normative specifications, including:
 - LRS, SRS, OMA, AOP, ER, TECQ, TDECQ, transition time, overshoot

Transmitter Functional Test (TFT) Principle

- 802.3 single power-penalty optics spec methodology, capturing all impairments
 - Transmitter (Tx) optical power (Tx_OMA) is set proportional to Tx penalty
 - Receiver (Rx) sensitivity (RxS_OMA) is a function of Tx penalty, ideally proportional
 - Tx and Rx interoperate when $\text{Tx_OMA} - \text{RxS_OMA} \geq \text{Tx power budget at Tx penalty}$
- HW golden receiver, HW GnRx, directly measuring BER is the best normative Tx test
 - Test set-up: Tx DUT → Test fiber → GnRx → GnRx_BER
 - Fully specified, including noise density, signal bandwidth, and jitter-tracking bandwidth
 - Progressively more difficult to implement as rates increase, until infeasible
 - Replaced by sampling-scope-based SW GnRx indirectly estimating BER from noise
- HW functional receiver, HW FnRx, in place of GnRx, using 802.3 optics spec methodology
 - Test set-up: Tx DUT → Test fiber → FnRx (VOA → Optical Rx (ORx)) → FnRx_BER
 - For any Tx DUT, Test fiber, GnRx and ORx, there is a unique VOA_level resulting in:

$$\text{FnRx_BER} = \text{GnRx_BER}$$

(unique VOA_level maybe positive or negative)

Transmitter Functional Test (TFT) Summary

- BER spec is normative with other 802.3dj Tx characteristics (not standalone) including:
 - TECQ & TDECQ, OMA (min) & (max), ER (min), rise & fall time, over & undershoot (max)
- Uses HW functional receiver, **FnRx** (VOA → ORx) instead of HW golden receiver, **GnRx**
 - Principle based on 802.3 single power-penalty optics spec methodology
 - Referenced to LRS & SRS conformance test signal transmitters characterized by TECQ
 - TECQ measured using sampling-scope-based SW **GnRx**
- Addresses TECQ & TDECQ corner case problems, ex. [Tx Dispersion Penalty spec](#)
- Does not use individual impairment spec methodology, [ex. no separate jitter spec](#)
- First proposal, [7/25](#), Patch cord only, followed by updates:
 - [9/25](#), Test fiber added
 - [9/25](#), equations reorganized w/ full supporters list
 - [1/26](#), equations reorganized
 - [3/26](#), [5/26](#), [7/26](#), [9/26](#), variable names changed, functionally same as earlier proposals

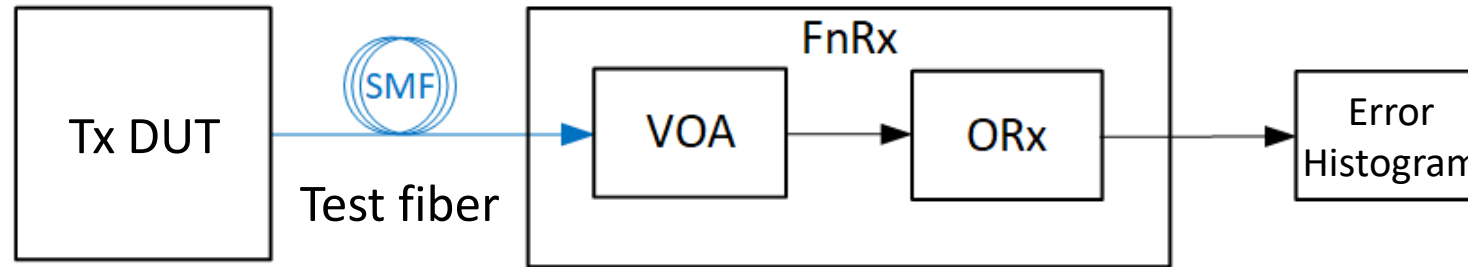
Outline

- Introduction

➤ DR Illustrations

- TFT Mask Examples
- Optional Tests
- LR Examples

VOA_level Equation



Functional receiver (**FnRx**) is defined in SC 180.9.8.1 as a variable optical attenuator (VOA) followed by an optical receiver (ORx) that complies with the characteristics in Table 180–8.

VOA calibrates differences in test fibers and optical receivers, respectively, to reduce variability across different test conditions.

$$\text{VOA_level} = \text{Test_fiber_correction} + \text{ORx_correction} \quad (180-16)$$

- **Test_fiber_correction** is the difference between the power budget used to determine the transmitter under test $\text{OMA}_{\text{outer}}$ (min) and the best estimate of the test fiber power budget.
- **ORx_correction** is the difference between receiver sensitivity (max) as given in Table 180-8, and the best estimate of the ORx receiver sensitivity at ORx operating BER target, both at transmitter under test TECQ

Test_fiber_correction Equation

$$\text{Test_fiber_correction} = \text{Tx_DUT_power_budget} - \text{Test_fiber_power_budget} \quad (180-17)$$

- Tx_DUT_power_budget is the transmitter under test power budget as specified in Table 180-9, except instead of the max TDECQ table value, uses max(DUT_TECQ, DUT_TDECQ) value with DUT_TDECQ measured over min and max dispersion fiber.
- Test_fiber_power_budget is the power budget using the best estimates of the test fiber Channel insertion loss, MPI and DGD penalties, and TDECQ of the transmitter under test over the test fiber

Table 180–9—Illustrative link power budget

Parameter	Value	Unit
Power budget (for max TDECQ)	6.7	dB
Operating distance	500	m
Channel insertion loss ^{a, b}	3	dB
Maximum discrete reflectance	–35	dB
Allocation for penalties ^c (for max TDECQ)	3.7	dB
Additional insertion loss allowed	0	dB

Test_fiber_correction Equation, cont

$$\text{Tx_DUT_power_budget} = \text{Channel_insertion_loss} + \text{MPI_DGD_penalties_allocation} + \max(\text{DUT_TECQ}, \text{DUT_TDECQ}) \quad (180-18)$$

- Channel_insertion_loss is the “Channel insertion loss” as given in Table 180–9
- MPI_DGD_penalties_allocation is the allocation for MPI and DGD penalties as given in Table 180–9
- DUT_TECQ is the measured TECQ for the transmitter under test
- DUT_TDECQ is the measured TDECQ for the transmitter under test over min and max dispersion fiber

$$\text{Test_fiber_power_budget} = \text{Test_fiber_loss} + \text{Test_fiber_MPI_DGD_penalties} + \text{Test_fiber_DUT_TDECQ} \quad (180-19)$$

- Test_fiber_loss is the best estimate of the actual channel insertion loss of the test fiber
- Test_fiber_MPI_DGD_penalties is the best estimate of the actual MPI and DGD penalties of the test fiber
- Test_fiber_DUT_TDECQ is the best estimate of the transmitter under test actual TDECQ value over the test fiber. Example estimates are the measured TDECQ value, or the measured TECQ value plus the best estimate of the CD penalty of the transmitter under test over the test fiber

Test_fiber_correction Examples

- $\text{Test_fiber_correction} = \text{Tx_DUT_power_budget} - \text{Test_fiber_power_budget}$
 - $\text{TFL} = \text{Test_fiber_loss (dB)} = \alpha \text{ Channel_insertion_loss } (0 \leq \alpha \leq 1)$
- Ex1. Patch cord (zero TFL ($\alpha = 0$) & zero penalties, TECQ test conditions)
 - $\text{Test_fiber_power_budget} = \text{DUT_TECQ}$
 - $\text{Test_fiber_correction} = \text{Tx_DUT_power_budget} - \text{DUT_TECQ}$
- Ex2. Test fiber (typical TFL ($0 < \alpha < 1$) & max penalties, TDECQ test conditions)
 - $\text{Test_fiber_power_budget} = \text{TFL} + \text{Test_fiber_MPI_DGD_penalties} + \text{Test_fiber_DUT_TDECQ}$
 - $\text{Test_fiber_correction} = (1 - \alpha) \text{ Channel_insertion_loss}$
- Ex3. Test fiber (max TFL ($\alpha = 1$) & max penalties)
 - $\text{Test_fiber_power_budget} = \text{Tx_DUT_power_budget}$
 - $\text{Test_fiber_correction} = 0$

(If ORx_correction is positive, then VOA_level is negative (gain), Ex.1 in LR TFT Examples table)

Test_fiber_correction Illustration

$$\text{Test_fiber_correction} = \text{Tx_DUT_power_budget} - \text{Test_fiber_power_budget}$$

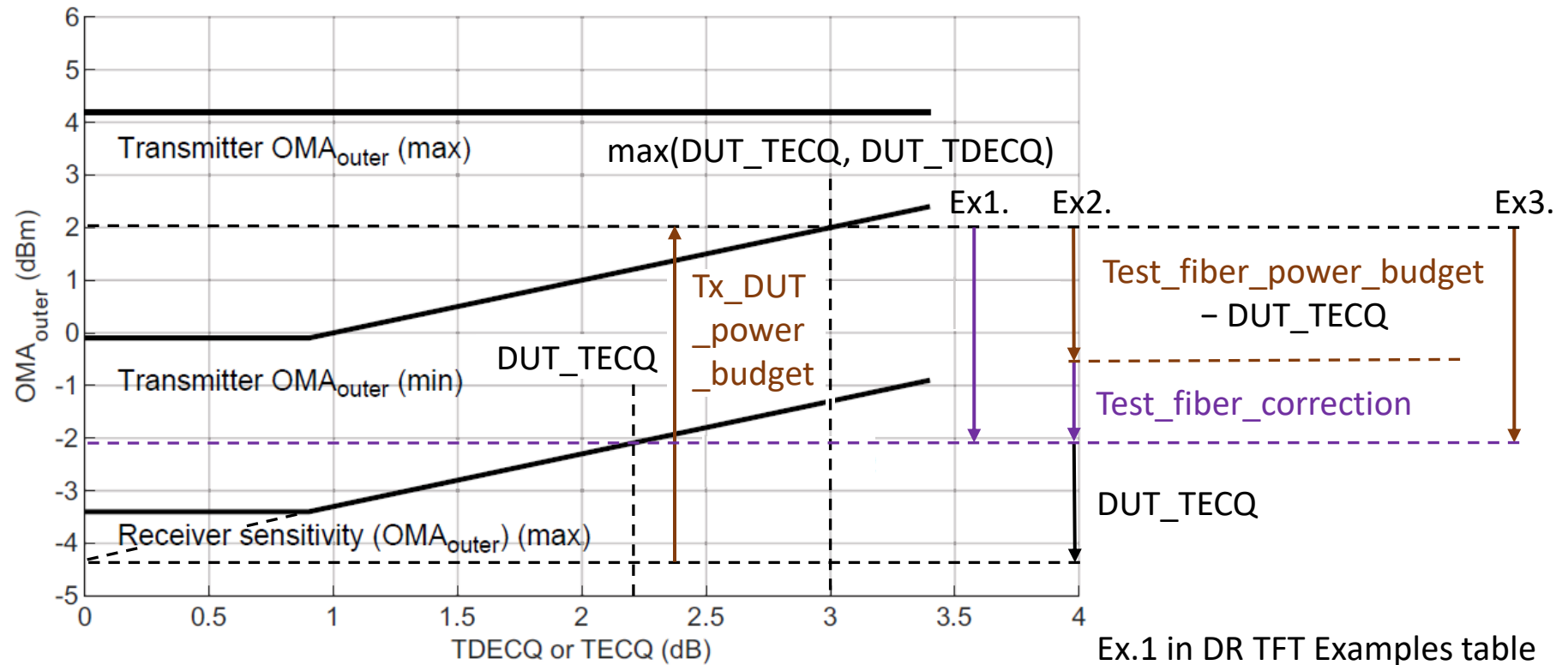


Figure 180-5—Transmitter OMA_{outer} each lane versus max(TECQ, TDECQ) and receiver sensitivity (OMA_{outer}) each lane versus TECQ

ORx_correction Equation

$$\text{ORx_correction} = \text{RxS_OMA_max_TFT} - \text{ORx_RxS_OMA_TFT} - \text{Test_margin} \quad (180-20)$$

- **RxS_OMA_max_TFT** is the receiver sensitivity $\text{OMA}_{\text{outer}}$ (max) spec at the measured TECQ of the transmitter under test
- **ORx_RxS_OMA_TFT** is the ORx receiver sensitivity $\text{OMA}_{\text{outer}}$ at the measured TECQ of the transmitter under test
- **Test_margin** is the additional **ORx_OMA** to improve SNR of the transmitter functional test. It is equal to 1.5 dB. The ORx operating BER target assuming random errors is changed to 2.4×10^{-5} . The transmitter functional symbol error **histogram** mask (see Table 180–17) is calculated using this BER target.

Test_margin Principle

- Model: Tx_DUT → Test fiber → ORx
 - $\text{SNR}_M \equiv \text{SNR of transmitter under test measurement}$
 - $\text{tfl} \equiv \text{test fiber loss (linear)} \geq 1$
- $\text{SNR}_M = (\text{Tx_DUT_Signal} / \text{tfl}) / ((\text{Tx_DUT_Noise} / \text{tfl}) + \text{ORx_Noise})$
 - SNR_M objective: $\text{SNR}_M \approx \text{Tx_DUT_Signal} / \text{Tx_DUT_Noise} \rightarrow (\text{Tx_DUT_Noise} / \text{tfl}) \gg \text{ORx_Noise}$
 - However, at receiver sensitivity: $(\text{Tx_DUT_Noise} / \text{tfl}) \sim \text{ORx_Noise}$
 - $\text{test_margin} \equiv \text{offset gain (linear)} \geq 1$, to counter tfl term
- $\text{SNR}_M = (\text{Tx_DUT_Signal} * \text{test_margin} / \text{tfl}) / (\text{Tx_DUT_Noise} * \text{test_margin} / \text{tfl}) + \text{ORx_Noise}$
- Transmitter test operating BER must be decreased from full link (PMD to PMD) $\text{BER} = 2.28 \times 10^{-4}$
- [Experimental validation](#)
- Example of common SNR_M improvement: after fiber eye measurement
 - Tx_DUT → Test fiber → Gain → DCA_Rx

ORx_correction Example

- $ORx_correction = \Delta RxS - Test_margin$
- $\Delta RxS = RxS_OMA_max_TFT - ORx_RxS_OMA_TFT$
 - $RxS_OMA_max_TFT = RxS_OMA_max_TECQ=0 + DUT_TECQ$
($Rx_OMA_min_TECQ=0$ is the extrapolation to zero TECQ of the receiver sensitivity OMA_{outer} (min) versus TECQ curve specified above the knee)
 - $ORx_RxS_OMA_TFT = ORx_RxS_OMA_TECQ=0 + ORx_RxS_slope * DUT_TECQ$
- $Test_margin = 1.5dB$

ORx_correction Illustration

$$\text{ORx_correction} = \Delta\text{RxS} - \text{Test_margin}$$

$$\Delta\text{RxS} = \text{RxS_OMA_max_TFT} - \text{ORx_RxS_OMA_TFT}$$

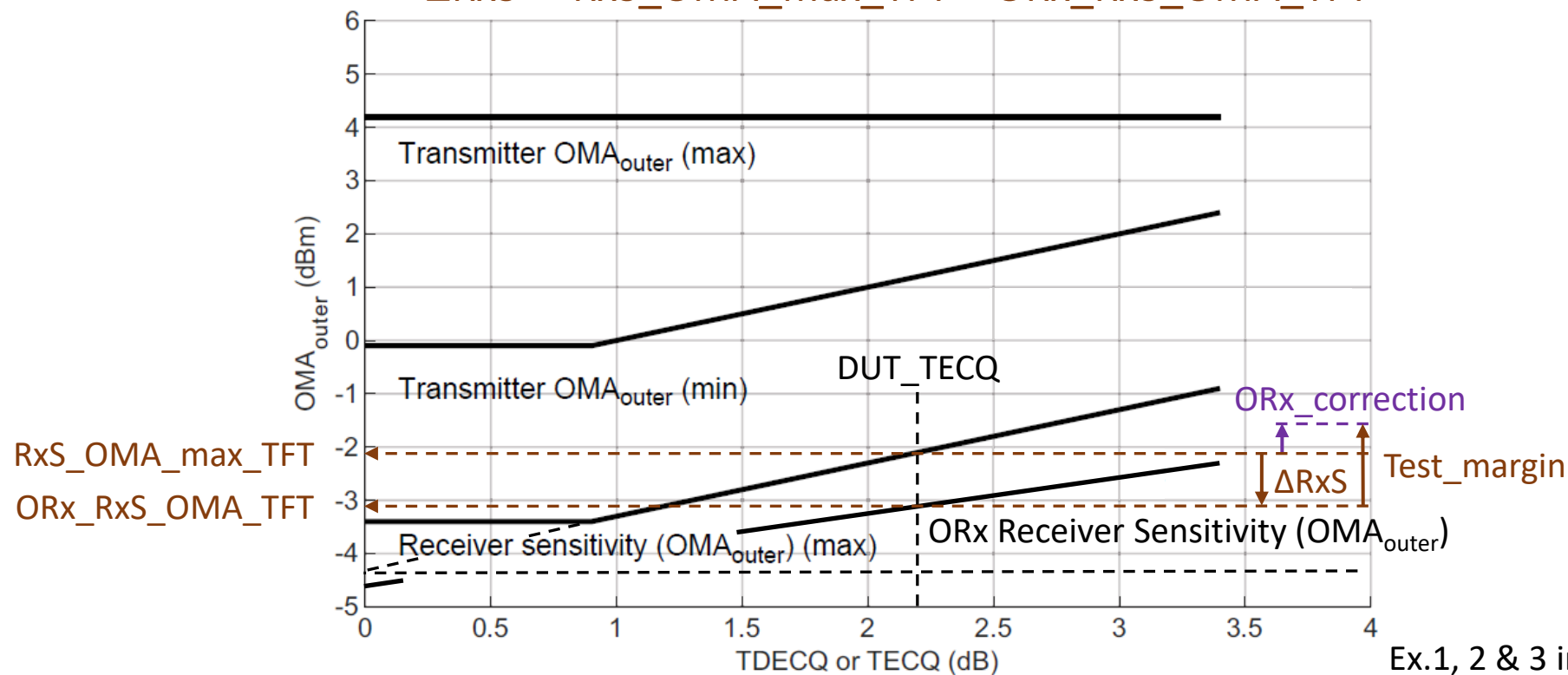


Figure 180–5—Transmitter OMA_{outer} each lane versus max(TECQ, TDECQ) and receiver sensitivity (OMA_{outer}) each lane versus TECQ

DR Test Fiber & Patch Cord TFT Examples

DRn	RxS_OMA(max) at TECQ=0: -4.3					Channel_insertion_loss: 3.0				MPI_DGD_penalties_allocation: 0.3				ORx_OMA_slope: 0.73		ORx_RxS_OMA at TECQ=0: -4.7		
` Ex.	Tx_DUT	Tx (min) -1.0		Tx_margin	var.	Test_fiber								FnRx		Test_margin		1.5
no.	actual	measured		max (TECQ, TDECQ)	OMA dBm	actual				estimated			Test_fiber_correction	ORx_correction	VOA_level	ORx_OMA_dBm	TFSEH Mask_margin	
	TECQ	TECQ /TP	TDECQ /TDP			TFL (loss)	MPI_DGD penalties	CD penalty	TDECQ	TFL (loss)	MPI_DGD penalties	TDECQ						
1	w/ no Tx_margin Tx_margin 0																	
	2.2	2.2	3.0	3.0	2.0	1.6	0.2	0.8	3.0	1.6	0.2	3.0	1.5	-0.5	1.0	-0.6	0.0	
2	w/ Tx_margin Tx_margin 1																	
	2.2	2.2	3.0	3.0	3.0	1.6	0.2	0.8	3.0	1.6	0.2	3.0	1.5	-0.5	1.0	0.4	0.0	
3	Neg CD penalty & Patch cord Tx_margin 0																	
	2.2	2.2	2.0	2.2	1.2	0.0	0.0	0.0	2.2	0.0	0.0	2.2	3.3	-0.5	2.8	-1.6	0.0	
4	Low TECQ & short Test fiber Tx_margin 0																	
	0.8	0.8	1.6	1.6	0.6	0.6	0.1	0.3	1.1	0.6	0.1	1.1	3.1	-0.9	2.2	-2.2	0.0	
Mask_margin = (ORx_OMA = Tx_DUT_OMA - actual_TFL - VOA_level) - (ORx_RxS_OMA at TECQ=0 + slope*actual_TECQ + actual_MPI_DGD_CD_penalties + Tx_margin + Test_margin)																		

Ex.1 VOA_level w/ no Tx_margin Illustration

$$\text{VOA_level} = \text{Test_fiber_correction} + \text{ORx_correction}$$

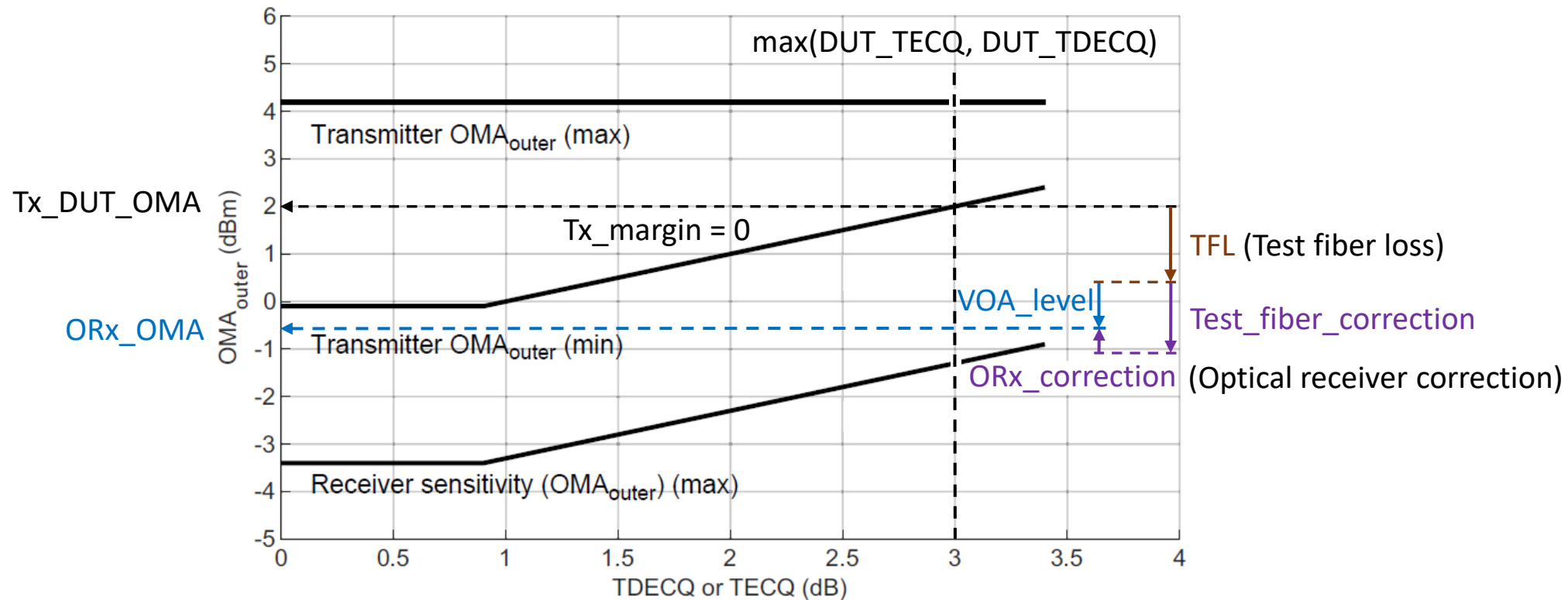


Figure 180–5—Transmitter OMA_{outer} each lane versus max(TECQ, TDECQ) and receiver sensitivity (OMA_{outer}) each lane versus TECQ

Ex.2 VOA_level w/ Tx_margin Illustration

$$\text{VOA_level} = \text{Test_fiber_correction} + \text{ORx_correction}$$

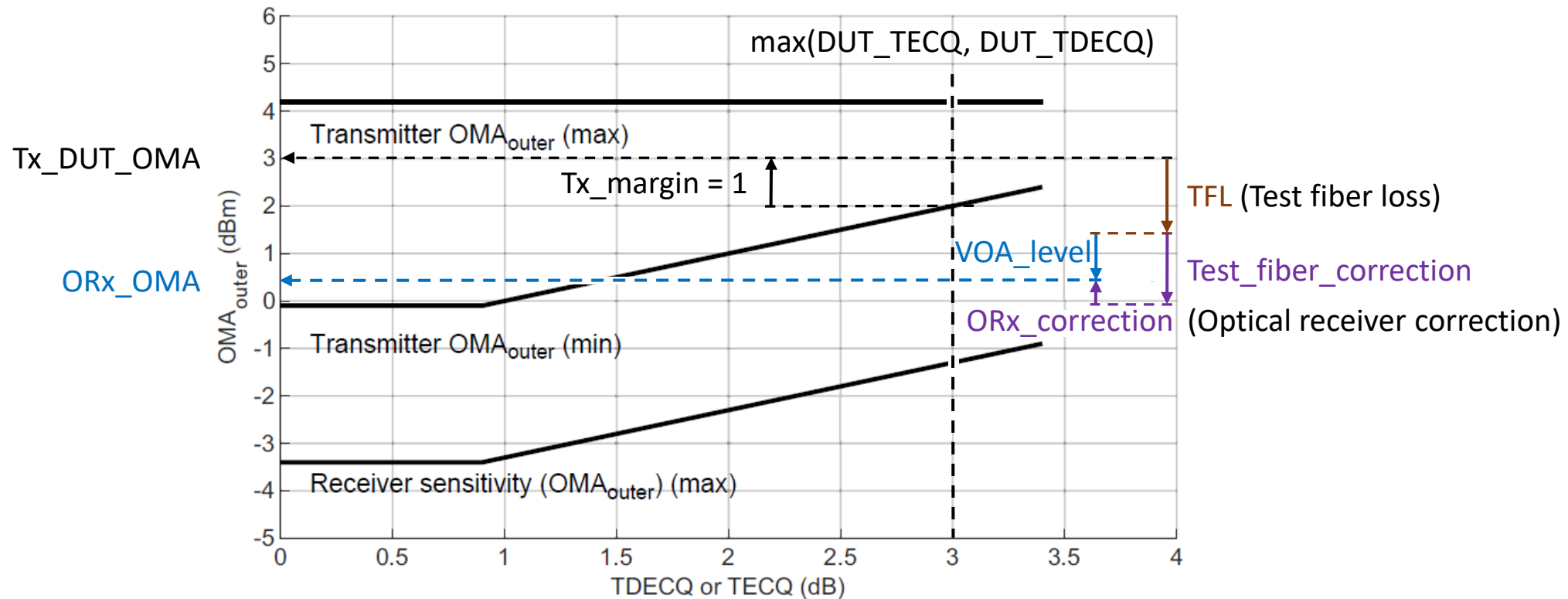


Figure 180–5—Transmitter $\text{OMA}_{\text{outer}}$ each lane versus max(TECQ, TDECQ) and receiver sensitivity ($\text{OMA}_{\text{outer}}$) each lane versus TECQ

Ex.3 VOA_level w/ Neg CD penalty & Patch Cord Illustration

$$\text{VOA_level} = \text{Test_fiber_correction} + \text{ORx_correction}$$

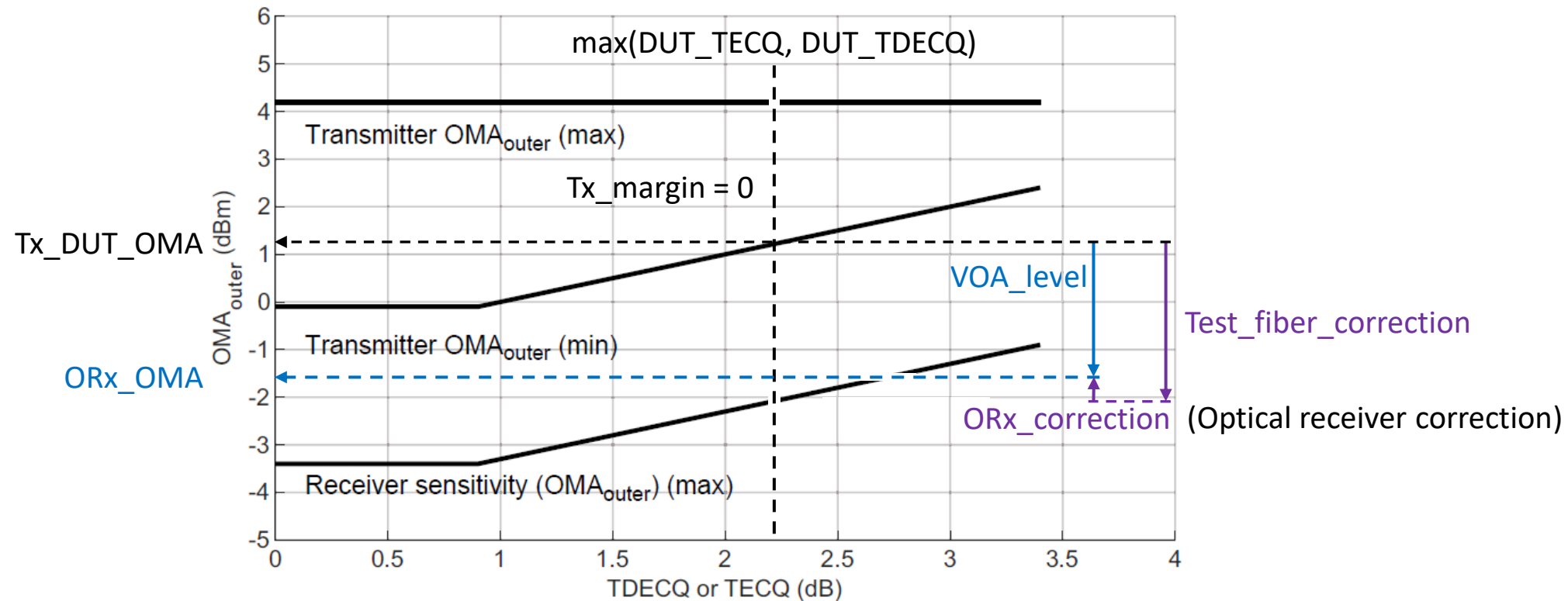


Figure 180–5—Transmitter $\text{OMA}_{\text{outer}}$ each lane versus max(TECQ, TDECQ) and receiver sensitivity ($\text{OMA}_{\text{outer}}$) each lane versus TECQ

Ex.4 VOA_level w/ low TECQ & Short Test Fiber Illustration

$$\text{VOA_level} = \text{Test_fiber_correction} + \text{ORx_correction}$$

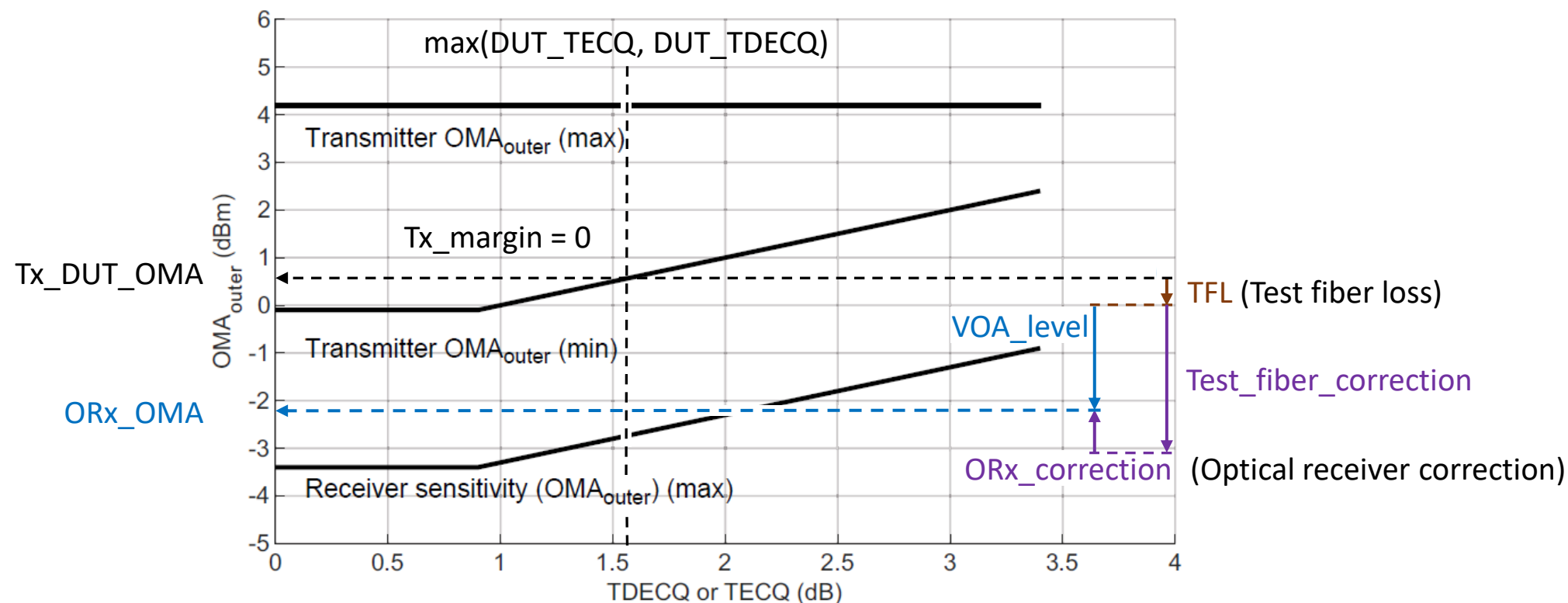


Figure 180–5—Transmitter OMA_{outer} each lane versus max(TECQ, TDECQ) and receiver sensitivity (OMA_{outer}) each lane versus TECQ

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- DR Illustrations
- **TFT Mask Examples**
- Optional Tests
- LR Examples

Optical Receiver Characterization Background

- Receiver sensitivity historically defined in 802.3 at two end points
 - Unstressed receiver sensitivity (URS) using a near-perfect test transmitter with nearly zero signal degradation and [URS_TECQ](#) (informative)
 - Stressed receiver sensitivity (SRS) using a worst-case test transmitter with noise, jitter, interferers and crosstalk for maximum signal degradation and [SECQ](#) (normative)
- Problem: URS used as a normative spec despite infeasibility of near-perfect test transmitter
 - [removed in 802.3cu](#)
 - normative RxS_OMA (max) curve specified as a function of TECQ
 - new 2nd test point not defined (*implicitly assumed DUT_RxS_OMA vs. TECQ slope = 1*)
- Low-stressed receiver sensitivity (LRS) defined in SC 180.9.14
 - restores second receiver sensitivity test point (*no assumption on slope*)
 - defines best possible transmitter with minimal feasible signal degradation and [LRS_TECQ](#)

Optical Receiver Characterization Definitions

- LRS $\equiv$ Low-stressed receiver sensitivity
- LRS_Tx $\equiv$ LRS conformance test signal transmitter
- LRS_TECQ $\equiv$ TECQ of LRS_Tx
- SRS $\equiv$ Stressed receiver sensitivity
- SRS_Tx $\equiv$ SRS conformance test signal transmitter
- SECQ $\equiv$ TECQ of SRS_Tx
- FnTx $\equiv$ Functional transmitter with worst case impairments
- FnTx_TECQ $\equiv$ TECQ of functional transmitter
- SRS_TECQ $\equiv$ SECQ or FnTx_TECQ, depending on which Tx is used for worst case test signal
- ORx_RxS_OMA $\equiv$ ORx receiver sensitivity OMA curve at TFT zero Mask margin based on LRS_TECQ and SRS_TECQ measurements, using LRS_Tx and SRS_Tx or FnTx, respectively

LRS Conformance Test Signal Characteristics

The Low-stressed Receiver Sensitivity (LRS) conformance test signal at TP3 meets the transmit characteristics given in Table 180-7 except for characteristics in Table 180-18.

Table 180-18-LRS conformance test signal exceptions to transmit characteristics

Parameter	Value	Unit
TECQ (max)	1.8	dB
TECQ (min)	1.4	dB
Overshoot and undershoot (max)	10	%
Extinction ratio (max)	5.5	dB
Extinction ratio (min)	4.5	dB
Transition time (max)	6.5	ps
Transition time (min)	4.5	ps
ORL tolerance (max)	15.5	dB
Average launch power of each aggressor lane (max)	-15	dBm

Supporting data in Christian Reimer, et al., [“Reference transmitter data in support of receiver sensitivity specification proposal”](#)

Optical Receiver Characterization Illustration

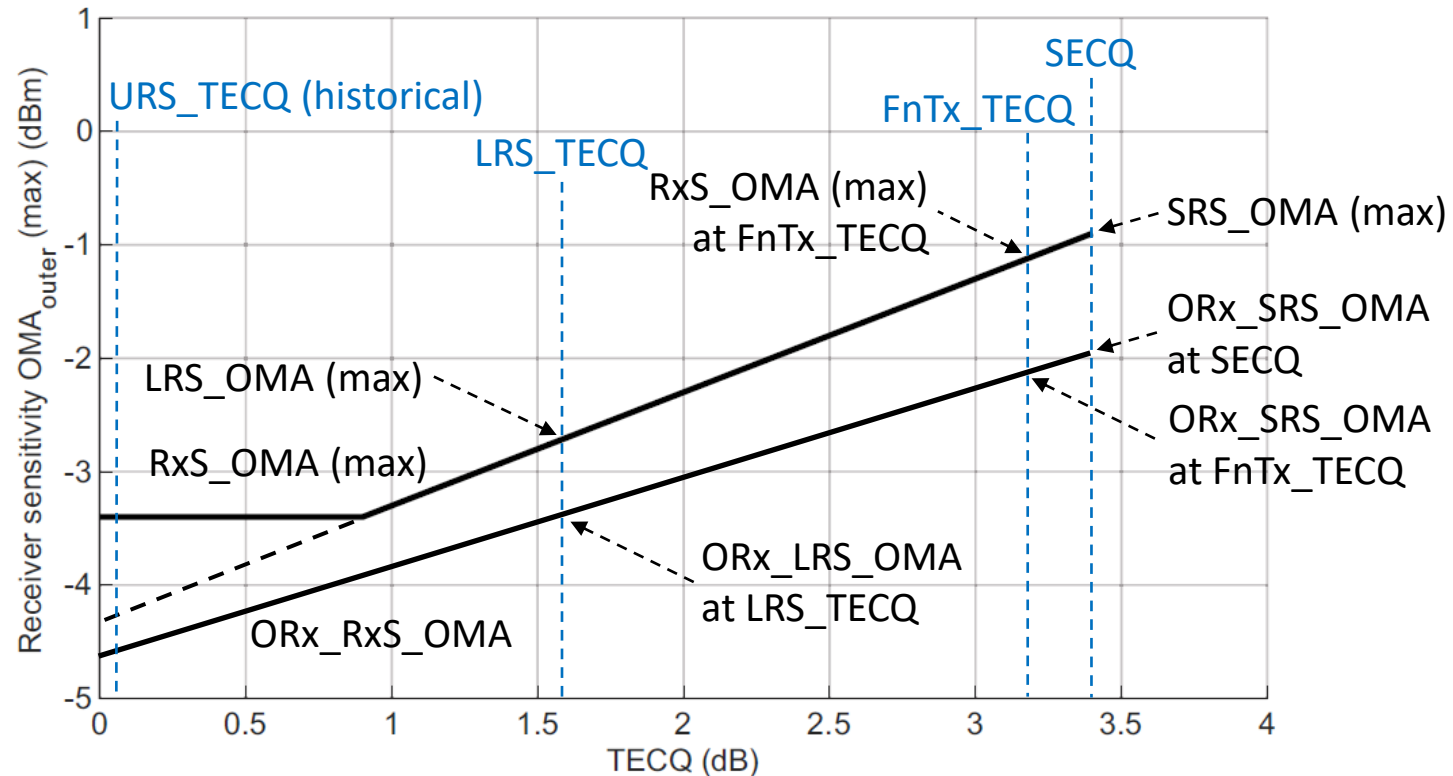


Figure 180–4—Receiver sensitivity ($\text{OMA}_{\text{outer}}$), each lane (max)

Transmitter Functional Test Definitions

- Tx_DUT $\equiv$ Device under test transmitter
- Tx_DUT_OMA $\equiv$ OMA at device under test transmitter output
- FnRx_OMA $\equiv$ OMA at functional receiver (FnRx) input
- VOA_level $\equiv$ Attenuation of variable optical attenuator (VOA)
- ORx_OMA $\equiv$ OMA at optical receiver (ORx) input
$$= \text{FnRx_OMA} - \text{VOA_level}$$
- ORx_OMA_ZM $\equiv$ ORx_OMA at TFT mask zero margin measured using Tx_DUT

TFT Mask

The transmitter functional symbol error histogram mask for each lane is given in Table180-17 and is measured using the test pattern as given in Table180-14. Minimum measurement time is 60 seconds.

A probable failure is indicated by exceeding the transmitter functional symbol error histogram mask defined in Table180-17, or by one or more counts in test symbol errors k per test block with $k > 8$.

Table 180–17—Transmitter functional symbol error **histogram mask**

Test symbol errors per test block, k	Probability $H_{\max}(k)$
1	1.15×10^{-1}
2	7.47×10^{-3}
3	3.24×10^{-4}
4	1.05×10^{-5}
5	2.73×10^{-7}
6	5.88×10^{-9}
7	1.08×10^{-10}
8	1.75×10^{-12}

TFT Mask Compliance Test

- Tx_DUT_OMA setting
 - Measure TECQ and TDECQ, w/ patch cord and min & max dispersion fibers, respectively
 - $\text{Tx_DUT_OMA} = \text{Tx_OMA_min_TECQ}=0 + \max(\text{DUT_TECQ}, \text{DUT_TDECQ}) + \text{Tx_margin}$
(Tx_OMA_min_TECQ=0 is the extrapolation to zero TDECQ or TECQ of the Transmitter OMA_{outer} (min) versus TDECQ or TECQ curve specified above the knee)
- TECQ (zero TFL ($\alpha = 0$) & zero penalties, Ex. 4 & 5 in LR TFT Examples table)
 - Tx_DUT → Patch cord → FnRx (VOA → ORx)
 - $\text{VOA_level} = \text{Test_fiber_correction} + \text{ORx_correction}$
 $= \text{Tx_DUT_OMA at Tx_margin}=0 - \text{ORx_OMA_ZM} - \text{Test_margin}$
- TDECQ (typical TFL ($0 < \alpha < 1$) & max penalties, Ex. 2 & 3 in LR TFT Examples table)
 - Tx_DUT → Test fiber → FnRx (VOA → ORx)
 - $\text{VOA_level} = (1 - \alpha) \text{Channel_insertion_loss} + \text{ORx_correction}$
- ORx TFT Histogram < Table 180-17 TFT Mask

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Pre-FEC Test BER Waterfall Compliance TFT

- Pre-FEC Test_BER < 2.28e-4 test condition examples:
 - 2.4e-5 (*TFT Mask Compliance Test*)
 - 1e-8 (*Error floor screen*)
- ORx Characterization at Pre-FEC Test_BER (*no Test_margin*)
 - $\text{ORx_correction} = \text{RxS_OMA_max_TFT} - \text{ORx_RxS_OMA_BER}$
 - $\text{RxS_OMA_max_TFT} \equiv \text{RxS_OMA (max) spec at Test_fiber_DUT_TDECQ (same as TFT Test)}$
 - $\text{ORx_RxS_OMA_BER} \equiv \text{ORx_OMA}$ at Test_BER measured using Tx_DUT (*different than TFT Test*)
- TECQ (zero TFL ($\alpha = 0$) & zero penalties)
 - Tx_DUT → Patch cord → FnRx (VOA → ORx)
 - $\text{VOA_level} = \text{Tx_DUT_OMA at Tx_margin=0} - \text{ORx_RxS_OMA_BER}$
- TDECQ (typical TFL ($0 < \alpha < 1$) & max penalties)
 - Tx_DUT → Test fiber → FnRx (VOA → ORx)
 - $\text{VOA_level} = (1 - \alpha) \text{Channel_insertion_loss} + \text{ORx_correction}$
- ORx Pre-FEC BER < Test_BER

TP & TDP Functional Test Definitions

- $\text{ORx_LRS_OMA} \equiv \text{ORx_OMA}$ at zero TFT Mask Margin (*or at pre-FEC Test_BER*)
measured using LRS_Tx
- $\text{ORx_SRS_OMA} \equiv \text{ORx_OMA}$ at zero TFT Mask Margin (*or at pre-FEC Test_BER*)
measured using SRS_Tx or FnTx
- **TP** $\equiv$ DUT Transmitter Penalty
measured using patch cord
- **TDP** $\equiv$ DUT Transmitter & Dispersion Penalty
measured using Test fiber
- $\text{ORx_OMA_ZM} \equiv \text{ORx_OMA}$ at TFT mask zero margin (*or at pre-FEC Test_BER*)
measured using Tx_DUT

TP & TDP Functional Test

- TP or TDP (see Calculations Ex. 4 & 5 or 2 & 3, respectively)
 - Tx_DUT → Patch cord or Test fiber → FnRx (VOA → ORx)
 - TP or TDP =
$$\text{LRS_TECQ} + \frac{(\text{SRS_TECQ} - \text{LRS_TECQ}) * (\text{ORx_OMA_ZM} - \text{ORx_LRS_OMA})}{(\text{ORx_SRS_OMA} - \text{ORx_LRS_OMA})}$$
- Tx_DUT_OMA = Tx_OMA_min_TECQ=0 + max(TP, TDP) + Tx_margin

(TX_OMA_min_TECQ=0 is the extrapolation to zero TDECQ or TECQ of the Transmitter OMA_{outer} (min) versus TDECQ or TECQ curve specified above the knee)

TP & TDP Functional Test Illustration

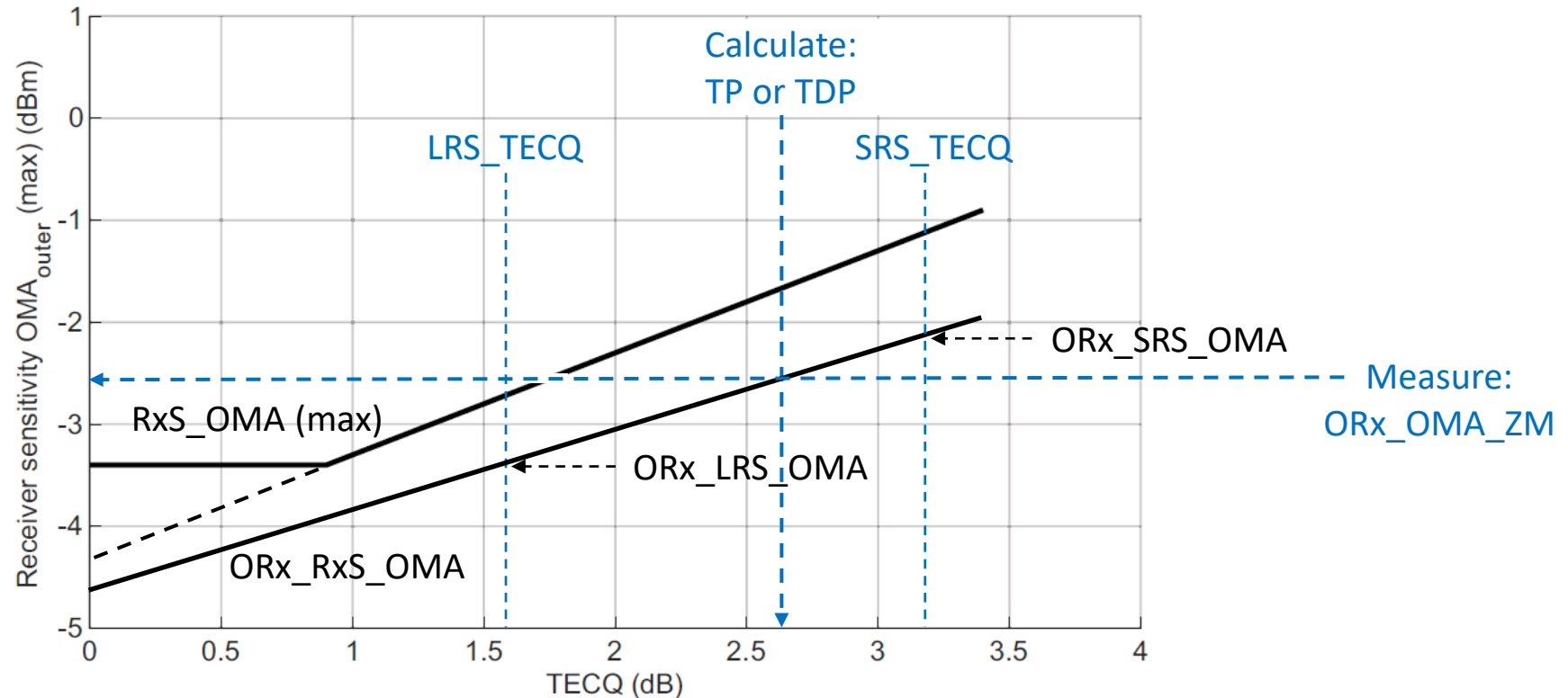


Figure 180–4—Receiver sensitivity ($\text{OMA}_{\text{outer}}$), each lane (max)

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LR Test fiber & Patch Cord TFT Examples

LR4	RxS_OMA(max) at TECQ=0: -6.9					Channel_insertion_loss: 6.3		MPI_DGD_penalties_allocation: 1.1		ORx_RxS_OMA at TECQ=0: -7.9							
Ex.	Tx_DUT	Tx (min)	0.5	Tx_margin	1.0	Test_fiber								FnRx	Test_margin	1.5	
no.	actual	measured		max (TECQ, TDECQ)	OMA	actual				estimated			Test_fiber_correction	ORx_correction	VOA_level	ORx_OMA dBm	TFT Mask_margin
	TECQ	TECQ /TP	TDECQ /TDP	/(TP, TDP)	dBm	TFL (loss)	MPI_DGD penalties	CD penalty	TDECQ	TFL (loss)	MPI_DGD penalties	TDECQ					
1	2.0	2.0	3.5	3.5	5.0	6.3	1.1	1.5	3.5	6.3	1.1	3.5	0.0	-0.5	-0.5	-0.8	0.0
	2.0	2.0	3.5	3.5	5.0	5.3	0.5	1.5	3.5	5.3	0.5	3.5	1.6	-0.5	1.1	-1.4	0.0
2	2.0	2.0	2.5	2.5	4.0	5.3	0.5	1.5	3.5	5.3	0.5	2.5	1.6	-0.5	1.1	-2.4	-1.0
	2.0	2.0	3.5	3.5	5.0	5.3	0.5	1.5	3.5	5.3	0.5	3.5	1.6	-0.5	1.1	-1.4	0.0
3	2.0	2.0	5.5	5.5	7.0	5.3	0.5	1.5	3.5	5.3	0.5	5.5	1.6	-0.5	1.1	0.6	2.0
	2.0	2.0	3.5	3.5	5.0	5.3	0.5	1.5	3.5	5.3	0.5	3.5	1.6	-0.5	1.1	-1.4	0.0
4	2.0	1.5	3.5	3.5	5.0	0.0	0.0	0.0	2.0	0.0	0.0	1.5	9.4	-0.5	8.9	-3.9	-0.5
	2.0	2.0	3.5	3.5	5.0	0.0	0.0	0.0	2.0	0.0	0.0	2.0	8.9	-0.5	8.4	-3.4	0.0
5	2.0	3.0	2.5	3.0	4.5	0.0	0.0	0.0	2.0	0.0	0.0	3.0	7.4	-0.5	6.9	-2.4	1.0
	2.0	2.0	2.5	2.5	4.0	0.0	0.0	0.0	2.0	0.0	0.0	2.0	7.9	-0.5	7.4	-3.4	0.0
Mask_margin = (ORx_OMA = Tx_DUT_OMA - actual_TFL - VOA_level) - (ORx_RxS_OMA at TECQ=0 + actual_TECQ + actual_MPI_DGD_CD_penalties + Tx_margin + Test_margin)																	

TFT Illustrations & Examples

Thank you