Transmitter Functional Symbol Error Mask Test Proposal Update

IEEE P802.3dj Task Force Joint Electrical, Logic & Optics Ad Hoc

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Supporters

- Not requested
- Update status only

Outline

- Introduction
- Equation 180-1 Changes
- Starting-point Parameters
- FR4 & LR4 Over-fiber Test

Introduction

- IEEE 802.3dj TF adopted additional test of 200G/lane Ethernet transmit optics.
- FRx was initially defined as just the optical hardware receiver, but this definition was changed at the August meeting, therefore equation left-hand side requires changing.
- The adopted *Tx_test_margin*, Operating BER and Symbol Error Mask require updating based on further measurements.
  - Starting-point parameter values in this presentation are based on measurements presented by Roberto Rodes.
  - Consensus parameter values will be in the final version of the proposal.
- A discussion of over-fiber test, primarily for chromatic dispersion (CD) limit compliance, was started by the Author Team prior to the August meeting.

Equation 180-1 Changes: Names

- During the August Plenary meeting the definition of Functional Receiver (FRx) was changed from compliant Optical Receiver (ORx) to compliant ORx preceded by a VOA
- FRx_OMA name now means input to the VOA, whereas the equation defines the output of the VOA, therefore, proposed left-hand equation side change:
  - From: *FRx_OMA* To: *ORx_OMA*
- Tx_TECQ, Tx_TDECQ are repetitive, therefore, proposed name change:
  - From: *Tx_TECQ* To: *DUT_TECQ*
  - From: *Tx_TDECQ* To: *DUT_TDECQ*
- *VOA_setting* and *Test_SMF_correction* added for clarity (no functional change)
- Final names and format deferred to the Editors

Equation 180-1 Changes

- ORx_OMA:
  - Tx DUT connected to FRx by short Test SMF (patch cord):

    ORx_OMA = FRx_OMA - VOA_setting

    FRx_OMA = Tx_DUT_OMA

    VOA_setting = Test_SMF_correction + RxS_TECQ_correction - Tx_test_margin
- where (abbreviated):
  - Tx_DUT_OMA complies with Table 180-7 or 182-7
  - Test_SMF_correction is for difference from optical channel chars. in 180.8 or 182.8:

    Test_SMF_correction = Channel_insertion_loss + MPI+DGD_penalty_allocation
    + max(DUT_TDECQ - DUT_TECQ, 0)
  - RxS_TECQ_correction is for ORx_RxS deviation from Figure 180-4 or 182-4:

    RxS_TECQ_correction = RxS_OMA(max) - ORx_RxS (@DUT_TECQ)
  - Tx_test_margin increases ORx_OMA away from noise limit

Starting-point Parameters

- Tx_test_margin = 1.5dB
- Operating BER = 2.40E-5

Test symbol errors per test block, *k* (see 174A.8.5)	Probability *Hmax*(*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
9	3.50 x 10-13
10	3.50 x 10-13
11	3.50 x 10-13
12	3.50 x 10-13
13	3.50 x 10-13
14	3.50 x 10-13
15	3.50 x 10-13
16	3.50 x 10-13

FR4 & LR4 Over-fiber Test Mainly for CD Limit Compliance

- The over-fiber test is same as currently specified Transmitter functional symbol error histogram test in 181.9.7 or 183.9.7, including:
  - *RxS_TECQ_correction*
  - Tx_test_margin
  - Operating BER
  - Symbol Error Mask
- Two differences:
  - Longer Test SMF, or emulator mainly of CD, connects Tx DUT to FRx input
  - FRx VOA setting (see proposed equation 181-1 on next page)
- If Test SMF is short (FRx_OMA = Tx_DUT_OMA), proposed eq. 181-1 = eq. 180-1
- Author Team is discussing the details of the over-fiber test.

FR4 & LR4 Over-fiber Test, Proposed Equation 181-1

- ORx_OMA:
  - Tx DUT connected to FRx by Test SMF (or emulator)

    ORx_OMA = FRx_OMA - VOA_setting

    VOA_setting = Test_SMF_correction + RxS_TECQ_correction - Tx_test_margin
- where (abbreviated):
  - *Test_SMF_correction* is for difference from optical channel chars. in 181.8 or 183.8:

    Test_SMF_correction = Channel_insertion_loss - Test_SMF_loss

    + MPI+DGD_penalty_allocation - Test_SMF_MPI+DGD_penalty

    + max(DUT_TDECQ - DUT_TECQ, 0) - Test_SMF_DUT_D
  - Simplified *Test_SMF_correction* for only max positive dispersion penalty Test SMF:

    Test_SMF_correction = Channel_insertion_loss - Test_SMF_loss

    + MPI+DGD_penalty_allocation - Test_SMF_MPI+DGD_penalty

FR4-500 (Clause 181) Over-fiber Test, ORx_OMA Examples

RxS_OMA@TECQ=0 -4.1	Channel_insertion_loss 3.5	MPI+DGD_penalty_allocation 0.6	Tx_OMA@TECQ=0 0.0	RxS_TECQ_correction 0

Case		Tx_DUT						Test_SMF						FRx			
RxS_OMA@TECQ=0	Alph.	TECQ	TDECQ	max(TECQ, TDECQ)	max(TDECQ - TECQ, 0)	margin	OMA	actual			estimated			Tx_test_margin	VOA_setting	ORx_OMA	ORx_Err
								loss	MPI+DGD	DUT D	loss	MPI+DGD	DUT D				
1	A	2	3	3	1	1	4.0	3.5	0.6	1.0	3.5	0.6	1.0	1.5	-1.5	2.0	0.0
	B	2	3	3	1	0	3.0	3.5	0.6	1.0	3.5	0.6	1.0	1.5	-1.5	1.0	0.0
	C	2	3	3	1	0	3.0	2.0	0.3	1.0	2.0	0.3	1.0	1.5	0.3	0.7	0.0
2 (= eq. 180-1)	A	2	3	3	1	0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	3.6	-0.6	0.0
	B	2	2	2	0	1	3.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2.6	0.4	0.0
	C	3	2	3	0	0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2.6	0.4	0.0
3	A	3	2	3	0	0	3.0	2.0	0.3	-0.8	2.0	0.3	-0.8	1.5	1.1	-0.1	0.0
	B	3	2	3	0	0	3.0	3.5	0.6	-1.0	3.5	0.6	-1.0	1.5	-0.5	0.0	0.0
	C	3	2	3	0	1	4.0	3.5	0.6	-1.0	3.5	0.6	-1.0	1.5	-0.5	1.0	0.0

ORx_OMA = Tx_DUT_OMA - actual_Test_SMF_loss - VOA_setting	ORx_Err = ORx_OMA - (RxS_OMA@TECQ=0 + TECQ + Tx_margin + actual_MPI+DGD+DUT_D_penalty + Tx_test_margin)

LR4 (Clause 183) Over-fiber Test, ORx_OMA Examples

RxS_OMA@TECQ=0 -6.9	Channel_insertion_loss: 6.3	MPI+DGD_penalty_allocation: 1.1	Tx_OMA@TECQ=0: 0.5	RxS_TECQ_correction: 0

Case		Tx_DUT						Test_SMF						FRx			
								actual			estimated						
No.	Alph.	TECQ	TDECQ	max(TECQ, TDECQ)	max(TDECQ - TECQ, 0)	margin	OMA	loss	MPI+DGD	DUT D	loss	MPI+DGD	DUT D	Tx_test _margin	VOA _setting	ORx _OMA	ORx _Err
1	A	2	3.5	3.5	1.5	1	5.0	6.3	1.1	1.5	6.3	1.1	1.5	1.5	-1.5	0.2	0.0
	B	2	3.5	3.5	1.5	0	4.0	6.3	1.1	1.5	6.3	1.1	1.5	1.5	-1.5	-0.8	0.0
2	A	2	4.5	4.5	2.5	0	5.0	6.3	1.1	1.5	6.3	1.1	2.5	1.5	-1.5	0.2	**1.0**
	B	2	4.5	4.5	2.5	**-1**	4.0	6.3	1.1	1.5	6.3	1.1	**1.5**	1.5	-0.5	-1.8	**0.0**
3	A	2	3.5	3.5	1.5	0	4.0	5.3	0.6	1.5	5.3	0.6	1.5	1.5	0.0	-1.3	0.0
	B	2	4.5	4.5	2.5	**-1**	4.0	5.3	0.6	1.5	5.3	0.6	**1.5**	1.5	1.0	-2.3	**0.0**
	C	3	4.5	4.5	1.5	**-1**	4.0	5.3	0.6	1.5	5.3	0.6	1.5	1.5	0.0	-1.3	**0.0**
4 (= eq. 180-1)	A	2	3.5	3.5	1.5	0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	7.4	-3.4	0.0
	B	3.5	2	3.5	0	0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	5.9	-1.9	0.0

ORx_OMA = Tx_DUT_OMA - actual_Test_SMF_loss - VOA_setting	ORx_Err = ORx_OMA - (RxS_OMA@TECQ=0 + TECQ + Tx_margin + actual_MPI+DGD+DUT_D_penalty + Tx_test_margin)

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Thank you