Transmitter Functional Test Proposal

This document is a proposal for updating text relating to TFSEH including potential changes to the transmitter functional symbol error histogram (TFSEH) parameter and method.

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180.9.9 Transmitter functional test (TFT)

The transmitter functional test uses a functional receiver (FRx) defined in 180.9.9.1 to measure a transmitter functional symbol error histogram (TFSEH) defined in 180.9.9.2. A block diagram showing the functional receiver is shown in Figure 180–12. The transmitter under test is connected to the functional receiver by a test fiber which meets the requirements in 180.9.6.2. Full compliance with 180.9.6.2 requires the test fiber to provide back reflection with polarization state resulting in the greatest RIN. Other test fibers, including patch cords, may be used for additional tests.

The transmitter under test is configured with precoding set appropriately for the functional receiver being used in the test. The appropriate precoding state may be communicated via the ILT function or by other means.

The test block error histograms are measured using the method described in 174A.9.3.

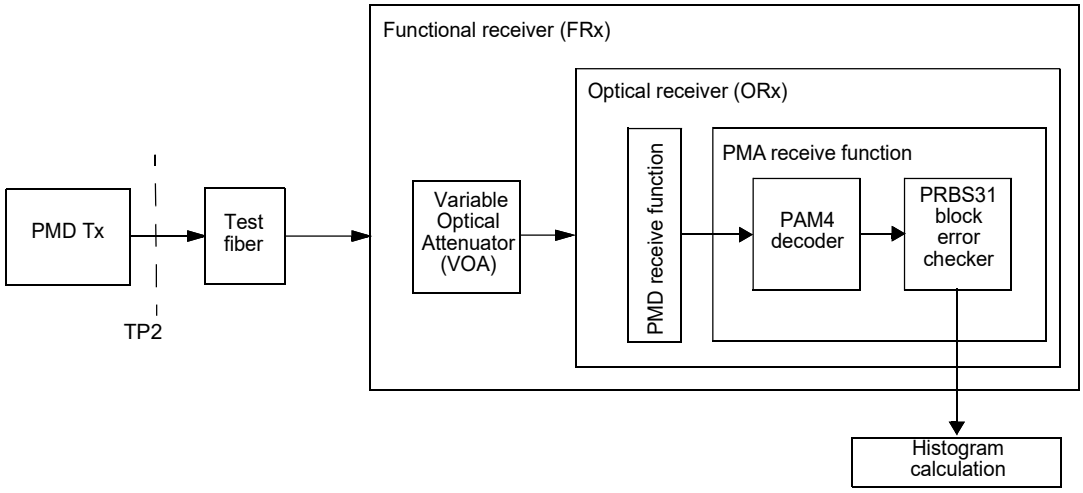

Figure 180–12—Transmitter functional test block diagram

180.9.9.1 Functional receiver (FRx) definition

The functional receiver (FRx) is a variable optical attenuator (VOA) followed by an optical receiver (ORx) that complies with the characteristics in Table 180–8. The VOA and test fiber approximate the compliance channel as given in Table 180–15. The VOA level is set to the value given by Equation (180–1), in which the first and second terms normalize differences in test fibers and optical receivers, respectively, so that symbol error counts are repeatable across different conditions.

$$VOA\_level = Test\_fiber\_correction + ORx\_TECQ\_correction - Test\_margin \quad (180–1)$$

where:

Test_fiber_correction is given by Equation (180–2), and is the difference between the power budget used to determine the transmitter under test OMAouter (min) and the best estimate of the test fiber power budget

ORx_TECQ_correction is the difference between receiver sensitivity (max) as given in Table 180–8 and ORx receiver sensitivity, both at transmitter under test TECQ, and is given by Equation (180–5)

Test_margin is additional *ORx_OMA,* to improve SNR of the transmitter functional test. It equals 1.5 dB, which decreases the required ORx operating BER to 2.4×10^{-5}

$$Test\_fiber\_correction = TX\_DUT\_power\_budget - Test\_fiber\_power\_budget \quad (180–2)$$

where:

TX_DUT_power_budget is the transmitter under test power budget for the specific test fiber as given in Table 180–9, except uses measured instead of max TDECQ value and is given by Equation (180–3)

Test_fiber_power_budget is the power budget of the test fiber using the best estimates of the test fiber channel insertion loss, MPI and DGD penalties, and TDECQ of the DUT and is given by Equation (180–4)

$$Tx\_DUT\_power\_budget = Channel\_insertion\_loss + MPI + DGD\_penalty\_allocation + max(DUT\_TECQ,DUT\_TEDCQ) \quad (180–3)$$

where:

Channel_insertion_loss is “Channel insertion loss” as given in Table 180–9

MPI + DGD_penalty_allocation is “MPI DGD penalty allocation” as given in Table 180–9

DUT_TECQ the TECQ measured for the transmitter under test

DUT_TDECQ the TDECQ measured for the transmitter under test

$$Test\_fiber\_power\_budget = Test\_fiber\_loss + Test\_fiber\_MPI+DGD\_penalty + Test\_fiber\_DUT\_TDECQ \quad (180–4)$$

where:

Test_fiber_loss is best estimate of the actual channel insertion loss of the test fiber

Test_fiber_MPI+DGD_penalty is best estimate of the actual MPI and DGD penalty of the test fiber

Test_fiber_DUT_TDECQ is best estimate of the transmitter under test actual TDECQ over the test fiber (equals *DUT_TECQ* + best estimate of the transmitter under test CD penalty over the test fiber)

$$ORx\_TECQ\_correction = RxS\_OMA@DUT\_TECQ - ORx\_RxS\_OMA@DUT\_TECQ \quad (180–5)$$

where:

RxS_OMA@DUT_TECQ is the receiver sensitivity OMA (max) spec at the TECQ measured for the transmitter under test

ORx_RxS_OMA@DUT_TECQ is the actual ORx receiver sensitivity OMA at the TECQ measured for the transmitter under test

180.9.9.2 Test functional symbol error histogram (TFSEH)

The transmitter functional symbol error histogram mask for each lane is given in Table 180–18 and is measured using the test pattern as given in Table 180–14.

The limit $H_{max}(k)$ is calculated using the method in 174A.9.5 using ORx operating BER = 2.4 × 10–5 and p = 1. This operating BER is *ORx_RxS* BER decreased by amount corresponding to *Test_margin* increase of *ORx_RxS_OMA*. This improves the measurement SNR of the transmitter functional test. ORx and *Test_margin* are defined in 180.9.9.1.

Minimum measurement time is 60 seconds.

A probable failure is indicated by exceeding the transmitter functional symbol error histogram mask defined in Table 180–18, or by one or more counts in test symbol errors *k* per test block with *k* greater than 8.

Table 180–18—Transmitter functional symbol error mask

Test symbol errors per test block, *k* (see 174A.9.5)	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}

181.9.9 Transmitter functional test

The transmitter functional symbol error histogram is measured using the method defined in 180.9.9 with the following exceptions:

— The transmitter under test is connected to the functional receiver by a test fiber which meets the requirements in 181.9.6.1. Full compliance with 181.9.6.1 requires the test fiber to provide back reflection with polarization state resulting in the greatest RIN. Other test fibers, including patch cords, may be used for additional tests.

where in 180.9.9.1

— The functional receiver (FRx) is a variable optical attenuator (VOA) followed by an optical receiver (ORx) that complies with characteristics as given in Table 181–6. VOA and the test fiber approximate the compliance channel as given in Table 181–13.

where in Equation (180–2)

— *Tx_DUT_power_budget* is the transmitter under test power budget for the specific test fiber as given in Table 181–7, except uses measured instead of max TDECQ value and is given by Equation (180–3).

where in Equation (180–3)

— *Channel_insertion_loss* is “Channel insertion loss” as given in Table 181–7.

— *MPI_DGD_penalty_allocation* is “MPI DGD penalty allocation” as given in Table 181–7.

where in 180.9.9.2

— The transmitter functional symbol error histogram mask per each lane is given in Table 180–18 and is measured using the test pattern as given in Table 181–12.

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182.9.9 Transmitter functional test

The transmitter functional symbol error histogram is measured using the method defined in 180.9.9 with the following exceptions:

— The transmitter under test is connected to the functional receiver by a test fiber which meets the requirements in 182.9.6.1. Full compliance with 182.9.6.1 requires the test fiber to provide back reflection with polarization state resulting in the greatest RIN. Other test fibers, including patch cords, may be used for additional tests.

where in 180.9.9.1

— The functional receiver (FRx) is a variable optical attenuator (VOA) followed by an optical receiver (ORx) that complies with characteristics as given in Table 182–8. VOA and the test fiber approximate the compliance channel as given in Table 182–15.

where in Equation (180–2)

— *Tx_DUT_power_budget* is the transmitter under test power budget for the specific fiber under test as given in Table 182–9, except uses measured instead of max TDECQ value and is given by Equation (180–3).

where in Equation (180–3)

— *Channel_insertion_loss* is “Channel insertion loss” as given in Table 182–9.

— *MPI_DGD_penalty_allocation* is “MPI DGD penalty allocation” as given in Table 182–9.

where in 180.9.9.2

— The transmitter functional symbol error histogram mask per each lane is given in Table 180–18 and is measured using the test pattern as given in Table 182–14.

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183.9.9 Transmitter functional test

The transmitter functional symbol error histogram is measured using the method defined in 180.9.9 with the following exceptions:

— The transmitter under test is connected to the functional receiver by a test fiber which meets the requirements in 183.9.6.1. Full compliance with 183.9.6.1 requires the test fiber to provide back reflection with polarization state resulting in the greatest RIN. Other test fibers, including patch cords, may be used for additional tests.

where in 180.9.9.1

— The functional receiver (FRx) is a variable optical attenuator (VOA) followed by an optical receiver (ORx) that complies with characteristics as given in Table 183–7. VOA and the test fiber approximate the compliance channel as given in Table 183–15.

where in Equation (180–2)

— *Tx_DUT_power_budget* is the transmitter under test power budget for the specific fiber under test as given in Table 183–8, except uses measured instead of max TDECQ value and is given by Equation (180–3).

where in Equation (180–3)

— *Channel_insertion_loss* is “Channel insertion loss” as given in Table 183–8.

— *MPI_DGD_penalty_allocation* is “MPI DGD penalty allocation” as given in Table 183–8.

where in 180.9.9.2

— The transmitter functional symbol error histogram mask per each lane is given in Table 180–18 and is measured using the test pattern as given in Table 183–14.

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