38.x.x Signal at TP3 for Comformance Testing

Comformance testing of receivers shall use a signal at TP3 conforming to the requirements described below. The signal used for conformance testing is conditioned by applying deterministic jitter (DJ) and intersymbol interference (ISI). The conditioned signal schematically is shown on Figure 1. The horizontal eye closure (reduction of pulse width) caused by DJ shall be no less than the amount listed in Table 1. The vertical eye closure shall be reduced by no less than the amount listed in Table 1.Note: The DJ cannot be added with a simple phase modulation.

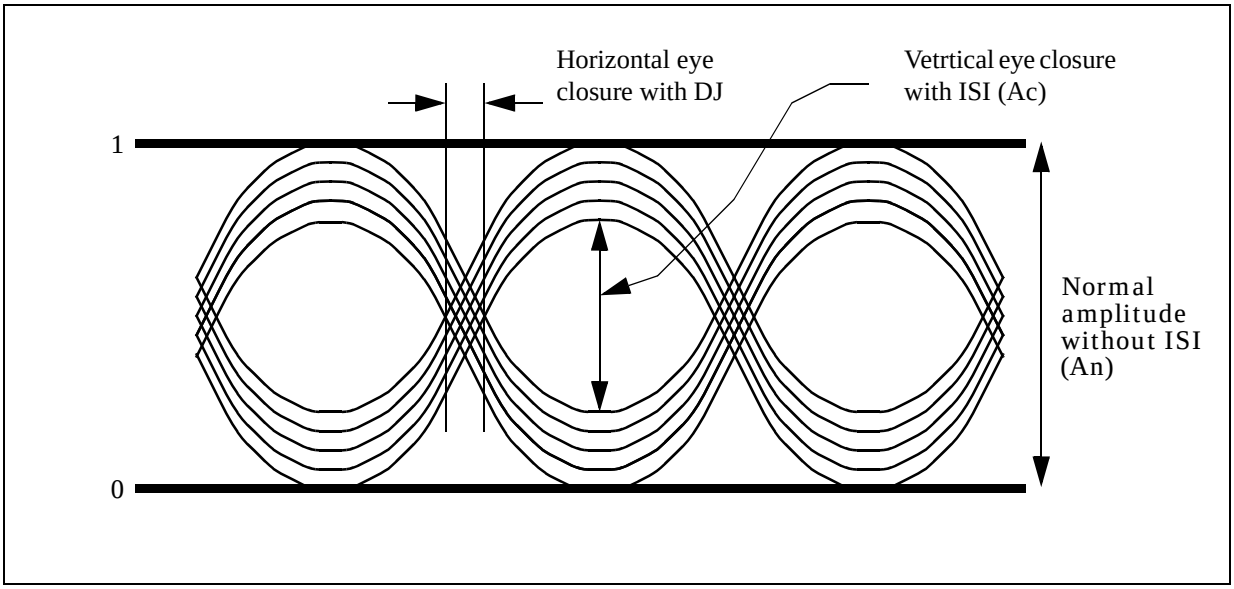

Figure 1 Required characteristics of the conformance test signal at TP3

TABLE 1. Required vertical and horizontal eye closures for the conformance test signal at TP3

fiber type	vertical eye closure [dB]	horizontal eye closure [ps]
SX-62.5 μm MMF	3.5±0.2	140
LX-62.5 μm MMF	3.6±0.2	140

The vertical eye closure is given by:

$$\text{Vertical eye closure [db]} = 10 \times \log \frac{Ac}{An}$$

where, Ac is the amplitude of the closed eye and An is the normal amplitude without ISI.

Figure 2 shows the recomended test set up for producing the conformance test signal at TP3. The coaxial cable is adjusted in length to produce the correct DJ. Since the coaxial cable can produce the incorrect ISI, a limiting amplifier is used to restore fast rise and fall times. A Bessel-Thompson filter is selected to produce the minimum ISI induced eye closure as specified in Table 1. This conditioned signal is used to drive a high bandwidth linearly modulated laser source.

The vertical and horizontal eye closures to be used for receiver conformance testing are verified using a fast photodetector and amplifier. The bandwidth of the photodetector must be at least 2.5 GHz. A 1875 MHz fourth order Bessel Thompson filter shall be used at the oscilloscope input. Special care needs to be taken to ensure that all the light from the fiber is collected by the fast photodetector and that there is no mode selective loss.

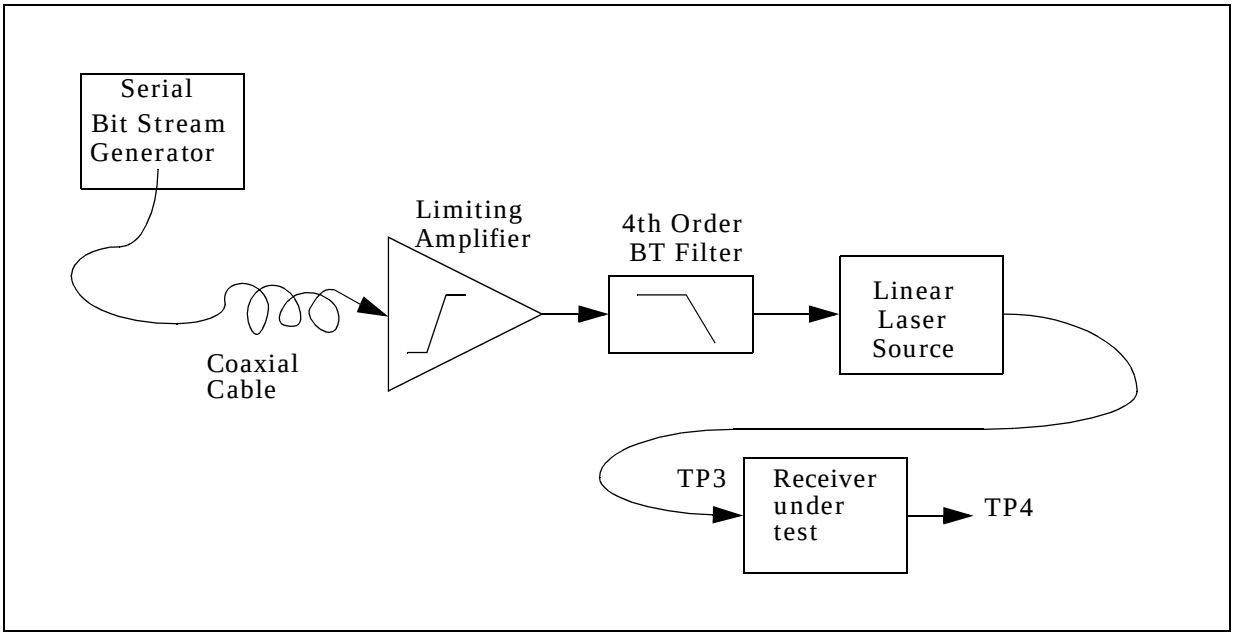

Figure 2 Proposed apparatus for generating conformance test signal at TP3

38.6.7 Stressed Receiver Sensitivity Measurements

Add the following paragraph to page 38.12 at line 23.

"The stressed receiver sensitivity shall be measured using the conformance test signal at TP3, as specified in 38.x.x. After correcting for extinction ratio of the source, the stressed receiver sensitivity shall meet the conditions specified in table 38-4 for 1000BASE-SX and in Table 38-8 for 1000BASE-LX."

Add the first row from the table below to Table 38-4, and second line to Table 38-8:

fiber type	stress sensitivity [dBm][a,b]
SX-62.5	-12.8
LX-62.5	-14.5

a. Measured with TP3 conformance test signal defined in 38.x.x for BER = 10^{-12} at eye center.

b. Measured with transmitter signal that has 9 dB extinction ratio. If other extinction ratio is used, the receiver sensitivity is corrected for the extinction ratio penalty, as shown in Annex X.

Appendix X: Calculation of the Required Stressed Receiver Sensitivity

The receiver sensitivity $RX_{stressed\ sens}$ measured with the conformance test signal satisfies the following equation:

$$RX_{stressed\ sens} < RX_{spec} + ISI_{total} + ER \quad \text{(EQ 1)}$$

where, RX_{spec} is the receiver sensitivity specified in Tables 38-4 and 38-8. ISI_{total} is the total ISI penalty at the analog output of the receiver. This is a sum of the ISI at TP3 and the budgeted receiver degradation. ER is the extinction ratio

penalty. This stressed receiver sensitivity is measured at the eye center. The receiver average receive power (min) sensitivity specifications of -17 dBm for SX and -19 dBm for LX are not changed. Since in this case the stressed receiver sensitivity is measured with a conformance test signal, the ISI penalty present in the signal (including that added by the receiver) will appear as a penalty for the stressed receiver sensitivity. The eye opening is measured at the minimum possible power level present at the receiver using a 62.5 µm fiber (62.5 µm fiber is used because it stresses the receiver with both ISI and DJ). For 1000BASE-SX transceivers, this level is -12.8 dBm. The eye width will be minimum of 0.3 UI with a penalty of 0.5 dB at the end points relative to the center.

38.y.y Measurement of the Receiver 3 dB Electrical Bandwidth

The measurement of the receiver 3 dB electrical bandwidth shall be performed using the following procedure:

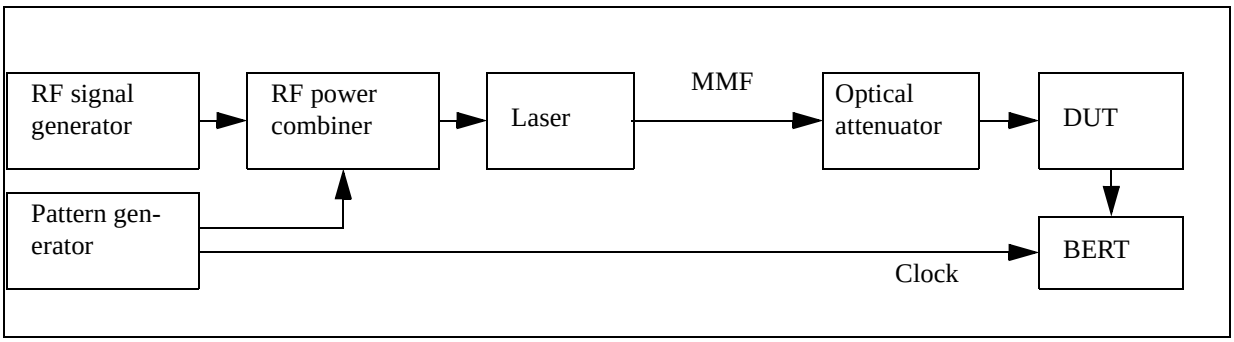

Figure 3 Experimental setup for receiver bandwidth measurement

An RF signal is added asynchronously to the data stream used to modulate the laser. The laser and modulator frequency responce must be calibrated to assure that an accurate measurement can be made. The steps for measuring the 3 dB bandwidth are:

1. Connect the laser output to the receiver under test through an optical attenuator and set the optical power to -12.5 dBm for SX and -13.9 for LX when no rf power is applied. This power level needs to be corrected for any difference from the minimum extinction ratio.

2. Find eye center with the error detector. Turn on the RF power while maintaining the same average optical power.

3. At every frequency being tested, measure the necessary RF signal amplitude (in dBm) required to achieve a constant BER (e.g. 10^{-6}).

4. The receiver bandwidth is calculated by adding the laser's calibrated frequency response from the measured data.

5. The receiver 3dB electrical bandwith is the frequency where the corrected RF amplitude increases by 3 dB (electrical). Care should be taken to convert to electrical dB and to correctly compensate for the laser's frequency response.

38.6.8 Conformance Total Jitter Measurement with Conformance Test Signal

Add the following text to page 38.12 on line 26 following the words "Total jitter". Add "at TP2".

On page 38.12, line 29, put period after K28.5 and delete the remainder of the sentence.

Add the following paragraph to page 38.12 at line 31.

"Total jitter at TP4 shall be measured using the conformance test signal at TP3, as specified in 38.x.x. The optical power shall be set at -12.5 dBm for SX and -13.9 dBm for LX. This power level shall be corrected for any difference

from the minimum extinction ratio. The total jitter shall be measured according to the method in ANSI X3.230-1994 FC-PH Annex A, subclause A.4.2, *Active output interface eye opening measurement* (reproduced here as Annex 38A). Measurements shall be taken directly at TP4 without any additional Bessel-Thompson filters beyond that described in 38.x.x".

The receiver contributed jitter when measured with conformance test signal shall be less than TBD