Draft changes to clause 95 including TxVEC – rev2
(post June 5th ad hoc)

MMF ad hoc working document

Jonathan King

Table 95-6, Tx Characteristics

Optical Modulation Amplitude (OMA), each lane (min)[b]	−7.1	dBm
Launch power in OMA minus TxVEC (min)	−8	dBm
Transmitter vertical eye closure (TxVEC), each lane (max)	5	dB
Average launch power of OFF transmitter, each lane (max)	−30	dBm
Extinction ratio (min)	2	dB
Optical return loss tolerance (max)	12	dB
Encircled flux[c]	≥ 86% at 19 μm ≤ 30% at 4.5 μm	
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.3, 0.38, 0.45, 0.35, 0.41, 0.5}	

[a]RMS spectral width is the standard deviation of the spectrum.
[b]Even if the TxVEC < 0.9 dB, the OMA (min) must exceed this value.
[c]If measured into type A1a.2 or type A1a.3 50 μm fiber in accordance with IEC 61280-1-4.

Table 95-8, link budget

Table 95–8—100GBASE-SR4 illustrative link power budget

Parameter	OM3	OM4	Unit
Effective modal bandwidth at 850 nm[a]	2000	4700	MHz.km
Power budget (for max TxVEC)	8.2		dB
Operating distance	0.5 to 70	0.5 to 100	m
Channel insertion loss[b]	1.8	1.9	dB
Allocation for penalties[c] (for max TxVEC)	6.3		dB
Additional insertion loss allowed	0.1	0	dB

[a]per IEC 60793-2-10.
[b]The channel insertion loss is calculated using the maximum distance specified in Table 95–5 and cabled optical fiber attenuation of 3.5 dB/km at 850 nm plus an allocation for connection and splice loss given in 95.11.2.1.
[c]Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested.

Table 95-10, test patterns

Optical modulation amplitude (OMA)	Square wave or 4	95.8.4
Transmitter vertical eye closure (TxVEC)	3 or 5	95.8.5
Extinction ratio	3, 5 or valid 100GBASE-SR4 signal	95.8.6

95.8.5 TxVEC (was TDP)

95.8.5 Transmitter vertical eye closure (TxVEC)

TxVEC of each lane shall be within the limits given in Table 95–6 if measured using the methods specified in 95.8.5.1 and 95.8.5.2.

TxVEC is a measure of each optical transmitter's vertical eye closure; it is based upon vertical histogram data from eye-diagrams measured through an optical to electrical converter (O/E) with a bandwidth equivalent to a combined reference receiver and worst case optical channel. Table 95–10 specifies the test patterns to be used for measurement of TxVEC.

- 2 more sub-sections describe the measurement set up and method….

New section 95.8.5.1 test set up

95.8.5.1 TxVEC conformance test set-up

A block diagram for the TxVEC conformance test is shown in Figure 95–3. Other measurement

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┌──────────────┐       ┌──────────────┐   ┌──────────────┐        ┌──────────────────┐
│   PMD (Tx)   │◄──────┤   Optical    ├──►│ O/E for lane │ ─────► │ Signal in        │
│              │       │   splitter   │   │ under test   │        │                  │
└──────────────┘ Patch └──────┬───────┘   └──────┬───────┘        │     Oscilloscope │
                 cord         │                  │                │                  │
                        Patch │                  ▼                │                  │
                        cord  │            ┌─────────┐            │                  │
                              ▼            │   CRU   ├──► Trigger  │                  │
                        ┌──────────────┐   └─────────┘            └──────────────────┘
                        │   Variable   │
                        │   Reflector  │
                        └──────────────┘
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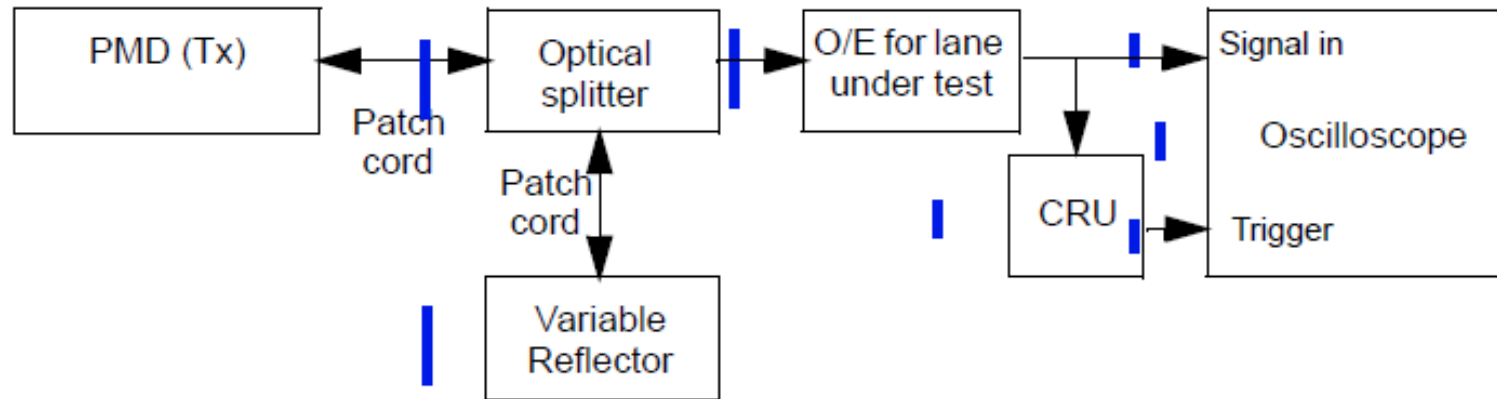
Figure 95–3—TxVEC conformance test block diagram

implementations may be used with suitable calibration.

Each optical lane is tested individually with all other lanes in operation. The optical splitter and variable reflector are adjusted so that each transmitter is tested with an optical return loss of 12 dB.

The combination of the O/E and the oscilloscope used to measure the optical waveform has a fourth-order Bessel-Thomson filter response with a bandwidth of 12.6 GHz. Compensation may be made for any deviation from an ideal fourth-order Bessel-Thomson response.

The clock recovery unit (CRU) has a corner frequency of 10 MHz and a slope of 20 dB/decade.

New section 95.8.5.2, test method – part 1

95.8.5.2 TxVEC measurement method

The oscilloscope is set up to accumulate samples for the optical eye-diagram of the transmitter under test, as illustrated in Figure 95–4.

OMA is measured according to 95.8.4. The power of the optical zeros (P0) and the power of the optical ones (P1) are recorded.

The average optical power and the crossing points of the eye-diagram, and the four vertical histograms used to calculate TxVEC, are measured using Pattern 3 or Pattern 5.

The 0 UI and 1 UI crossing points are determined by the time average of the eye crossing points, as measured at the average optical power level, as illustrated in Figure 95–4.

Four vertical histograms are measured through the eye, centered at 0.4 UI and 0.6 UI, and above and below the average optical power of the eye-diagram, as illustrated in Figure 95–4.

Each histogram has a width of 0.04 UI. Each histogram window has one height boundary set close to average power level of the eye-diagram, and the other height boundary is set beyond the outer-most samples of the eye, so that no further eye samples would be captured by increasing the outer boundary of the histogram. Starting from the boundary of the histogram closest to the average optical power level, the optical power at which the cumulative distribution of each histogram equals the 0.005th percentile of the total number of samples for each histogram is recorded (these are the powers A, B, C, and D illustrated in Figure 95–4).

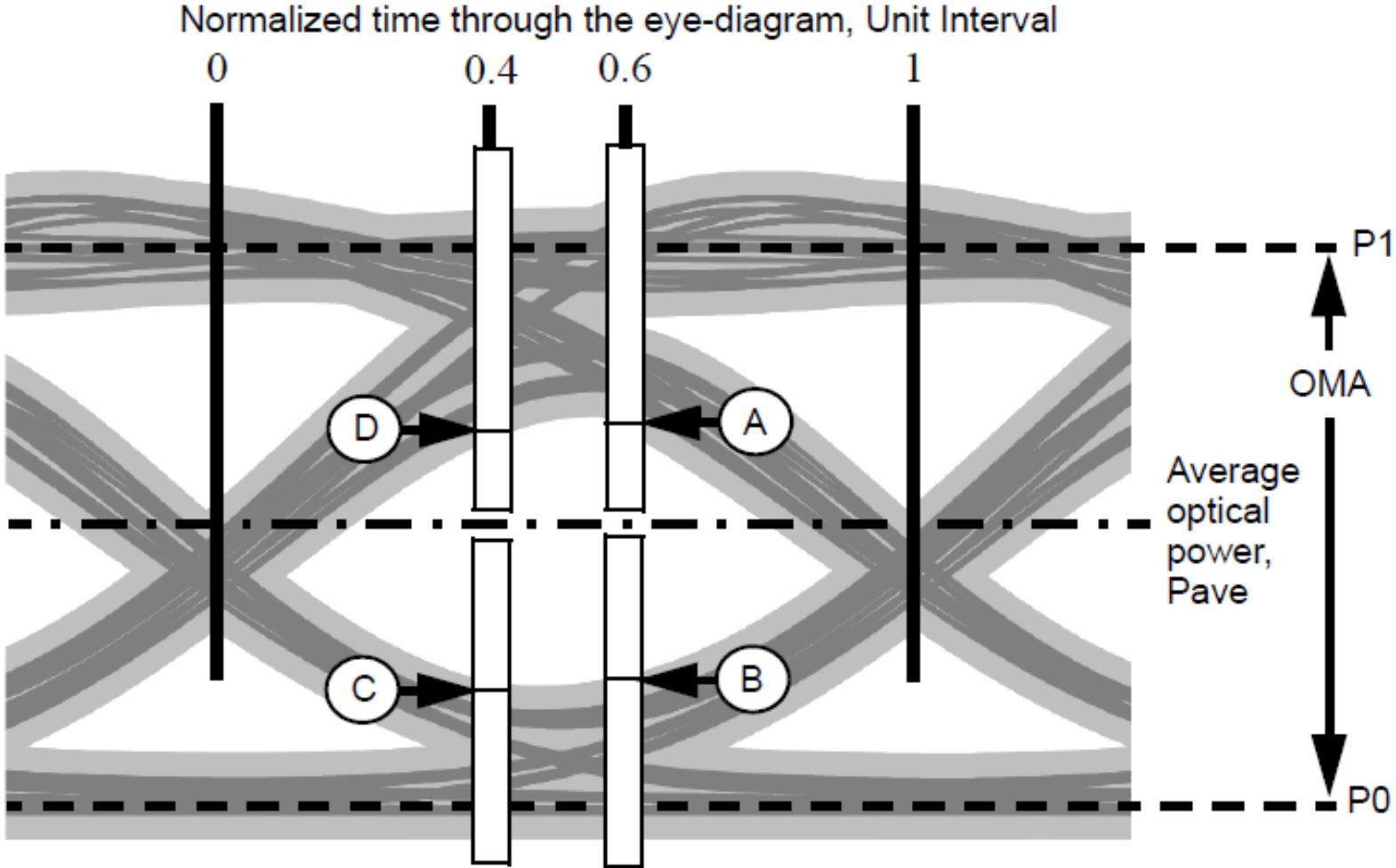# New section 95.8.5.2, test method – part 2

Figure 95–4—Illustration of the TxVEC measurement

New section 95.8.5.2, test method – part 3

TxVEC is defined as the largest of the four quantities given by Equation (95–1) to Equation (95–4):

$$TxVEC(A) = 10\log_{10}\left(\frac{P1 - Pave}{A - Pave}\right) \quad\quad (95–1)$$

$$TxVEC(B) = 10\log_{10}\left(\frac{Pave - P0}{Pave - B}\right) \qu\quad (95–2)$$

$$TxVEC(C) = 10\log_{10}\left(\frac{Pave - P0}{Pave - C}\right) \qu\quad (95–3)$$

$$TxVEC(D) = 10\log_{10}\left(\frac{P1 - Pave}{D - Pave}\right) \qu\quad (95–4)$$

where

Pave	is the average optical power of the eye-diagram
P0, P1	are the optical one and optical zero levels of the eye-diagram
A, B, C, D	are the 0.005th percentile optical power levels of the four vertical histograms described in 95.8.5.2.

The method described in 95.8.5.2 is the reference measurement method. Other (equivalent) measurement methods may be used with suitable calibration.

PICS

95.12.4.4 Optical measurement methods

Item	Feature	Subclause	Value/Comment	Status	Support
COM1	Measurement cable	95.8	2 m to 5 m in length	M	Yes [ ]
COM2	Center wavelength and spectral width	95.8.2	Per TIA/EIA-455-127-A or IEC 61280-1-3 under modulated conditions	M	Yes [ ]
COM3	Average optical power	95.8.3	Per IEC 61280-1-1	M	Yes [ ]
COM4	OMA measurements	95.8.4	Each lane	M	Yes [ ]
COM5	Transmitter vertical eye closure (TxVEC)	95.8.5	Each lane	M	Yes [ ]
COM6	Extinction ratio	95.8.6	Per IEC 61280-2-2	M	Yes [ ]
COM7	Transmit eye	95.8.7	Each lane	M	Yes [ ]