

Optical Module TDECQ



Overview

Understanding TDECQ: Key PAM4 Transmitter Quality Metric for TDECQ stands for Transmitter and Dispersion Eye Closure Quaternary. It is a standardized measu.

Key Takeaways

TDECQ stands for Transmitter and Dispersion Eye Closure Quaternary, a key metric that quantifies the optical quality of a PAM4 transmitter. Definition and Purpose

TDECQ is a standardized measurement used to evaluate the performance of PAM4 optical transmitters by comparing a real transmitter to an ideal reference transmitter under the same conditions . It expresses the extra optical power (in dB) required for a real transmitter to achieve the same vertical eye opening as an ideal transmitter, accounting for impairments such as noise, inter-symbol interference (ISI), and dispersion . A lower TDECQ value indicates better signal quality and typically correlates with lower bit error rates .

Why TDECQ is Important

With the shift from NRZ (two-level) to PAM4 (four-level) modulation, traditional metrics like extinction ratio and eye-mask margin became insufficient because PAM4 compresses the eye diagram into three sub-eyes. TDECQ provides a robust, repeatable metric for evaluating transmitter performance in high-speed links (50G, 100G, 200G, 400G, and beyond) and ensures link reliability and compliance with IEEE standards .

Measurement Methodology

TDECQ measurement involves several steps:

- **Signal Capture:** The transmitter output is captured using a reference optical-to-electrical converter and a sampling oscilloscope .
- **Reference Filtering:** A 4th-order Bessel-Thomson filter simulates the bandwidth limitations of a real receiver .
- **Equalization:** A reference feed-forward equalizer (FFE) reopens the closed PAM4 eyes caused by the test setup, allowing accurate measurement of vertical eye closure .
- **Calculation:** Algorithms compute the TDECQ penalty by quantifying the vertical eye closure across all three PAM4 sub-eyes, reflecting the combined effects of noise, ISI, and dispersion .

Practical Interpretation

- **0 dB TDECQ:** Perfect transmitter, identical to the ideal reference .
- **IEEE Ceiling (e.g., 3.4 dB for 400G PAM4):** Maximum allowable penalty for compliance .
- **Lower TDECQ:** Indicates better transmitter quality and more margin for real-world impairments like connector loss or temperature variations . TDECQ is critical for manufacturers and network operators because it directly correlates with symbol error rate (SER) and bit error rate (BER), ensuring that optical links operate reliably over their expected lifetime .

Summary

TDECQ is a key optical transmitter quality metric for PAM4 systems, measuring how much a real transmitter deviates from an ideal one in terms of vertical eye closure. It accounts for noise, ISI, and dispersion, and is essential for high-speed optical module compliance, link reliability, and performance evaluation in modern data center and telecom networks .

Article Content

TDECQ: Understanding the Theory Behind the Key Metric for

“TDECQ (Transmitter Dispersion Eye Closure Quaternary) Replaces Historic Eye-mask and TDP Test for 400 Gb/s PAM4 Optical

TDEC for PAM4 ("TDECQ")

The test pattern specified for TDECQ (see Table 123-11) is transmitted repetitively by the optical lane under test and the oscilloscope

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Development trend of optical

Development trend of optical interconnect technology in intelligent computing centers Summary 6 High rate :Intelligent computing

How to Optimize 800G Optical Transceiver Manufacturing Tests

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TDEC for PAM4 ("TDECQ")

TDECQ is a measure of each optical transmitter"s vertical eye closure when transmitted through a worst case optical channel

106 Gb/s PAM4 TDECQ Measurement

Motivation While TDECQ has been introduced for PAM4 based optical links, no actual measurement has been reported to validate

Further thoughts onTECQ/TDECQ

A complexity comes from the BERadded, some further discussion needed. The BER is at the output of an optical module. For FECi

:MEASure:EYE:TDEQ

The TDECQ measurement: Measures the quality of an optical transmitter with its optical link. Describes the optical power penalty of

Improving TDECQ Test Definition

Counter-propagating asynchronous optical signal (crosstalk) at maximum OMA applied to the module under test TP3. The crosstalk

TDECQ: Understanding the Theory Behind the Key Metric for

TDECQ: Understanding the Theory Behind the Key Metric for PAM4 Optical Transmitters When decisions were made to change from

TDECQ Part II Manufacturing Test Recommendations | Keysight

TDECQ (Transmitter Dispersion and Eye Closure Quaternary) is the primary metric defining the performance of an optical transmitter

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This document is for preliminary research. Verify specifications against current standards, product documentation and project requirements.

