Impact of TDECQ CER Settings on Measurement Consistency

Associated with comments 51 and 54 against IEEE 802.3dj D2.3

Roberto Rodes, Coherent

Related Comments

Cl **180** *SC* **180.9.7.1** *P* **486** *L* **41** # 51

Rodes, Roberto Coherent

Comment Type **TR** *Comment Status* **D** *TDECQCER (CO)*

TDECQCER has significant variation, narrow histogram window and higher number of samples per UI improves the variability

SuggestedRemedy

specify >63 sample/UI and 0.02 UI width histograms. Replace "The waveform should be acquired with greater than 25 samples/UI. This provides at least one sample falling within both the left and the right 0.04 UI width histograms for each symbol." with "The waveform should be acquired with greater than 63 samples/UI and 0.02 UI width histogram. This provides at least one sample falling within both the left and the right 0.02 UI width histograms for each symbol."

Cl **180** *SC* **180.7.1** *P* **470** *L* **34** # 54

Rodes, Roberto Coherent

Comment Type **TR** *Comment Status* **D** *TDECQCER (CO)*

If TDECQCER better correlates with Rx Sensitivity, it should replace TDECQ for calculating link budget and OMA specs. However, TDECQCER does not combine samples of all 65k PAM4 symbols to create distribution but creates distributions for each PAM4 sample. This drastically reduces the number of samples available to create stable statistics. Oscilloscope testing is better suited for traditional TDECQ and new TDECQCER. Traditional TDECQ has shown good correlation for most cases.

SuggestedRemedy

Remove TDECQ CER from the spec. Do the same for CL 181, 182 and 183

CER TDECQ Test Variability vs. SPUI (Same Tx)

Measurement Setup

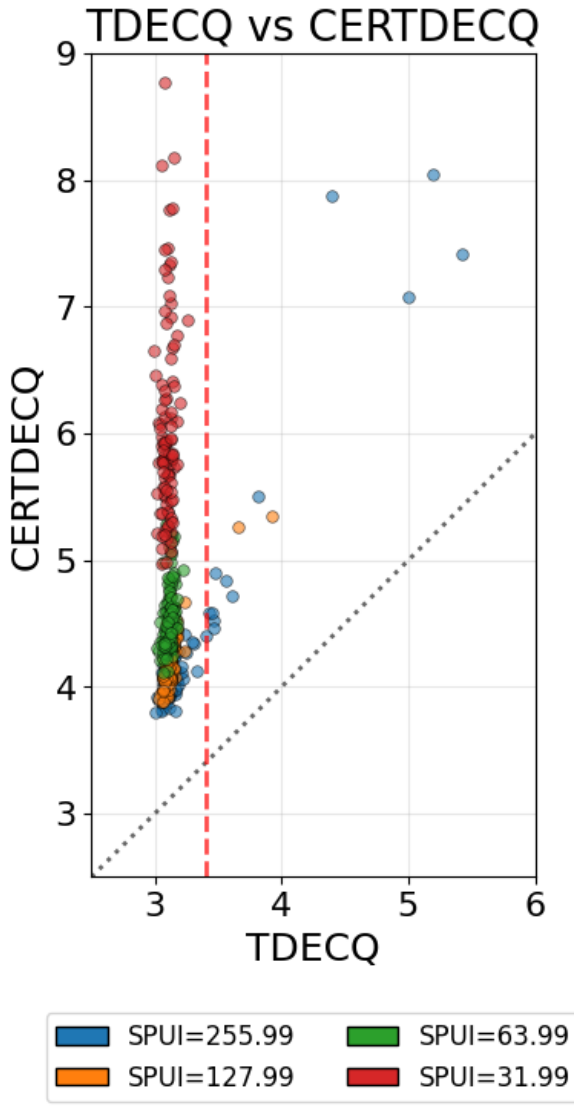
- One 200 Gb/s lane
- 400 consecutive re-tests of TDECQ and CER TDECQ
- Four samples-per-UI (SPUI) settings compliant with the current draft (>25 sa/UI)

Results

- CER TDECQ distributions narrow as sa/UI increases.
- Test variability and error are strongly dependent on SPUI.
- SPUI values >127 show convergence issues and significantly increase test time.

Recommendation

Specify the test with a fixed SPUI value of **63.99** to reduce test variability.



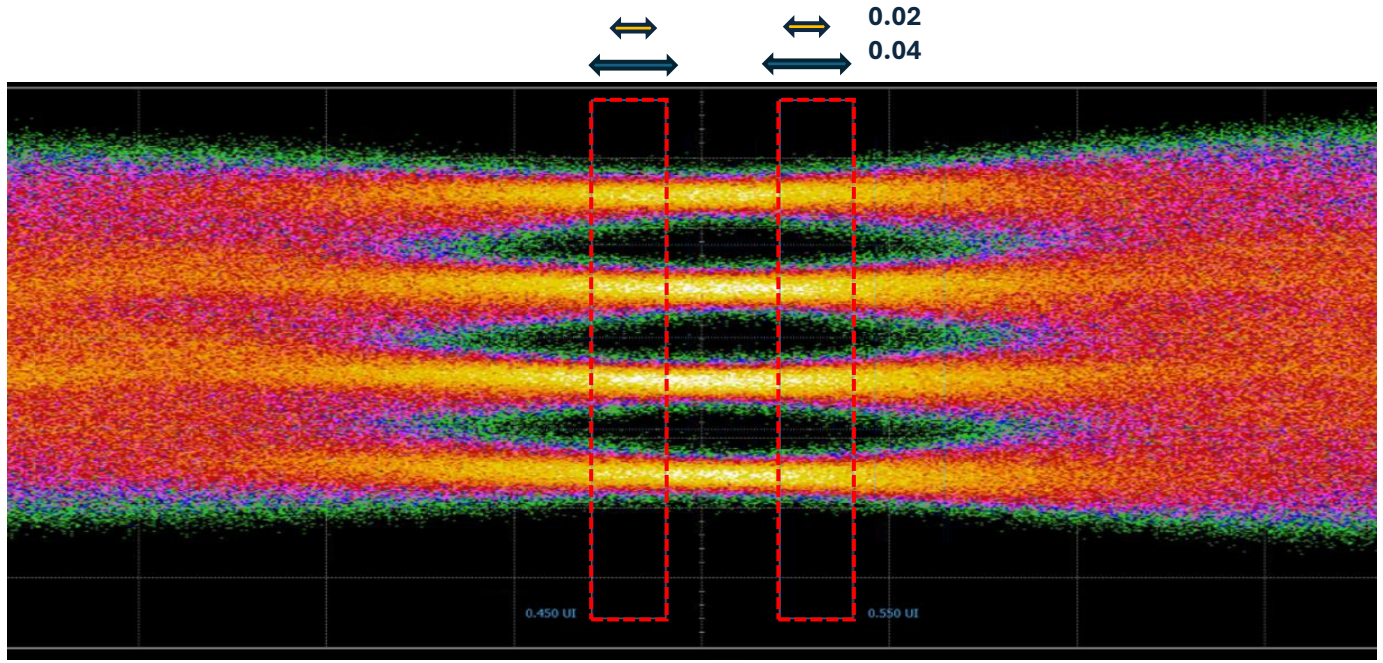
Effect of Histogram Width

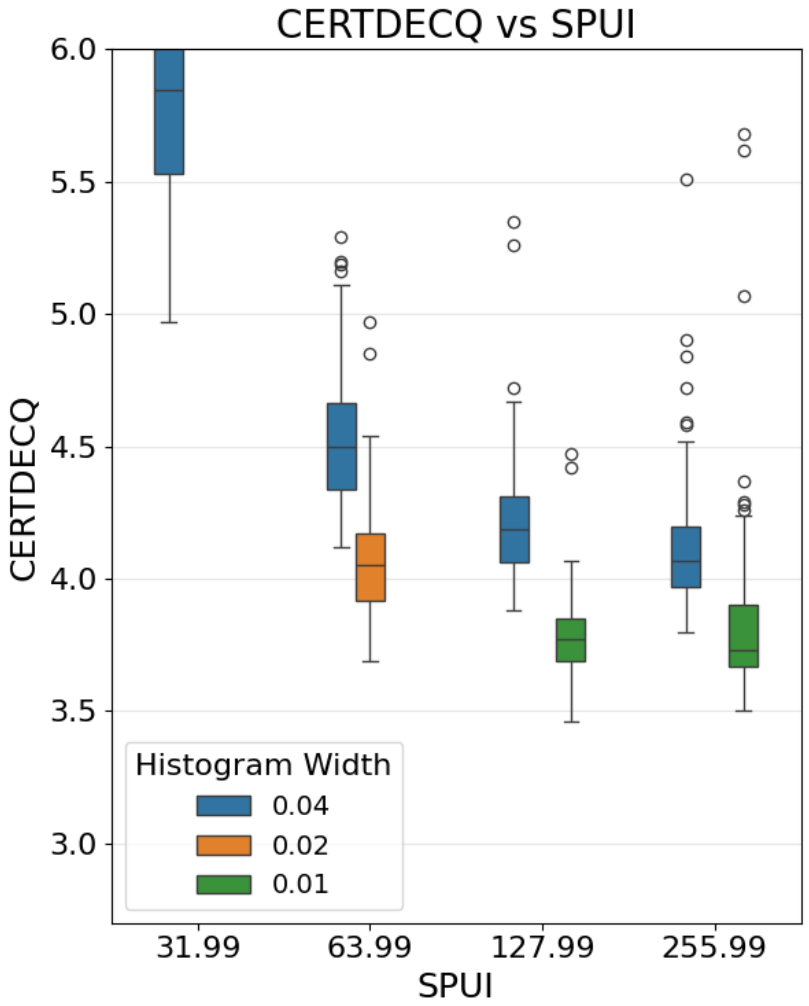
Sampling Considerations

Higher sampling rates allow a narrower sampling window, reducing sampling variability while still ensuring at least one sample per symbol.

Results

Reducing histogram width from **0.04 UI to 0.02 UI** lowers CER TDECQ values and slightly reduces test variability.





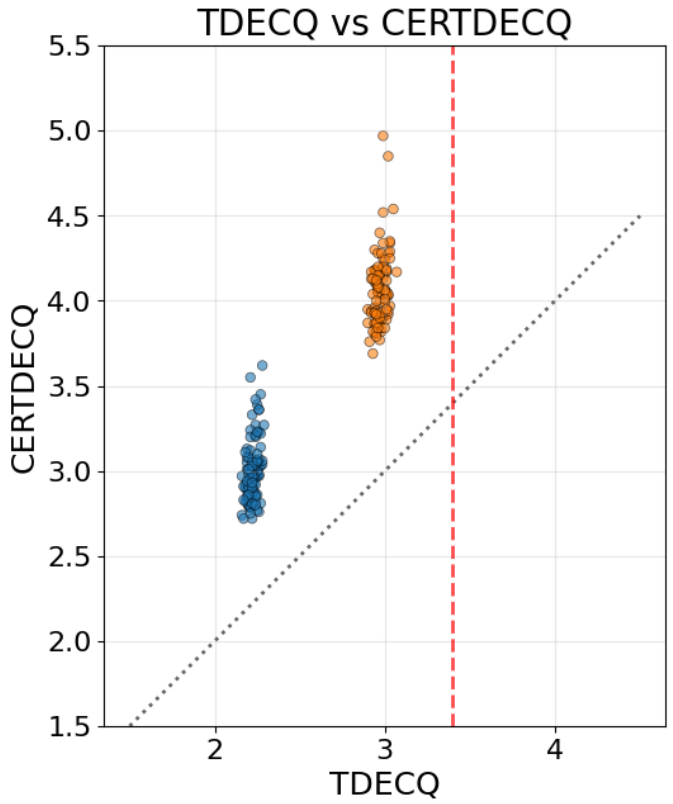
CER TDECQ Excursion Relative to TDECQ

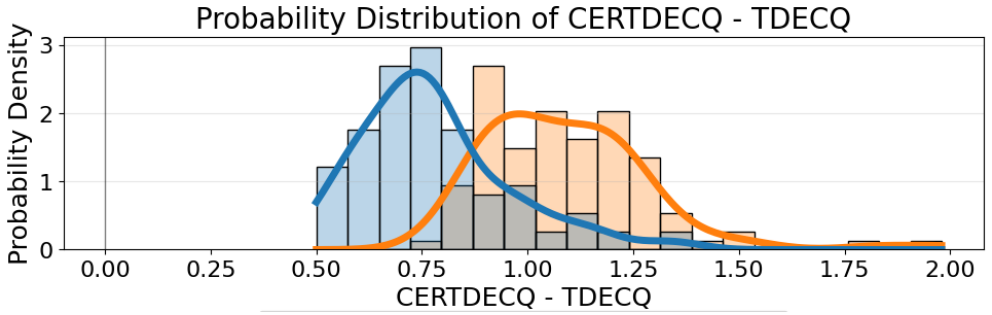
Measurement Setup

- Two different transmitters
- 100 consecutive re-tests of TDECQ and CER TDECQ
- SPUI = 63.99
- Histogram width = 0.02 UI

Results

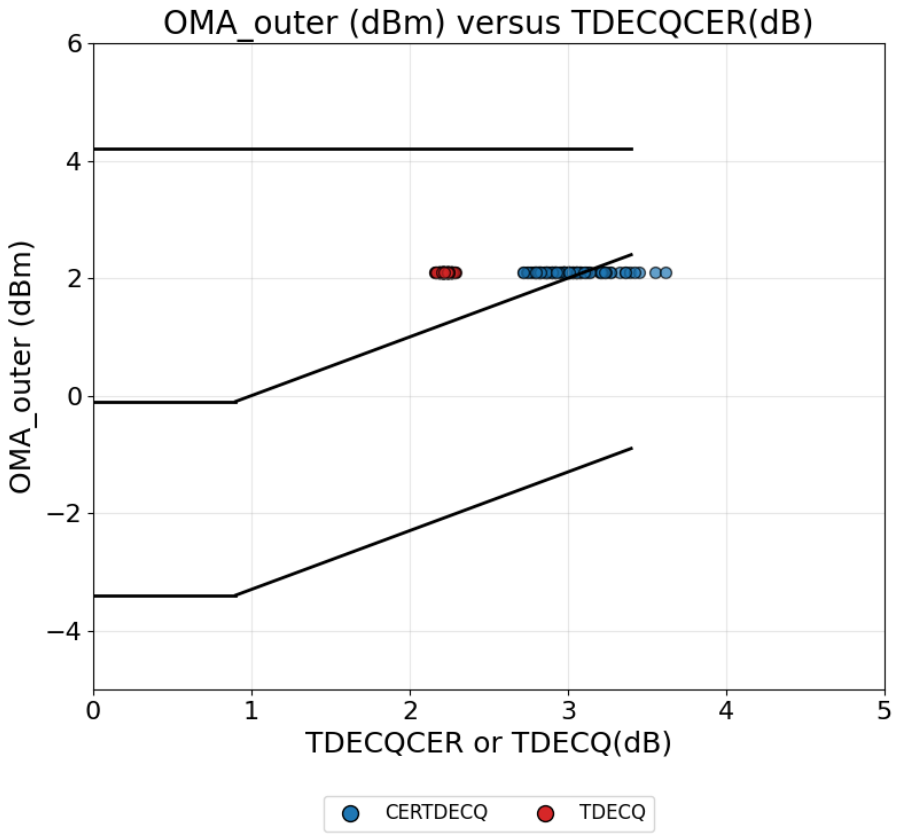
- Lower-TDECQ Tx: excursion from **0.5 to 1.3 dB**
- Higher-TDECQ Tx: excursion from **0.7 to 2.0 dB**
- Observed excursion exceeds the **1 dB margin** currently added in the draft.

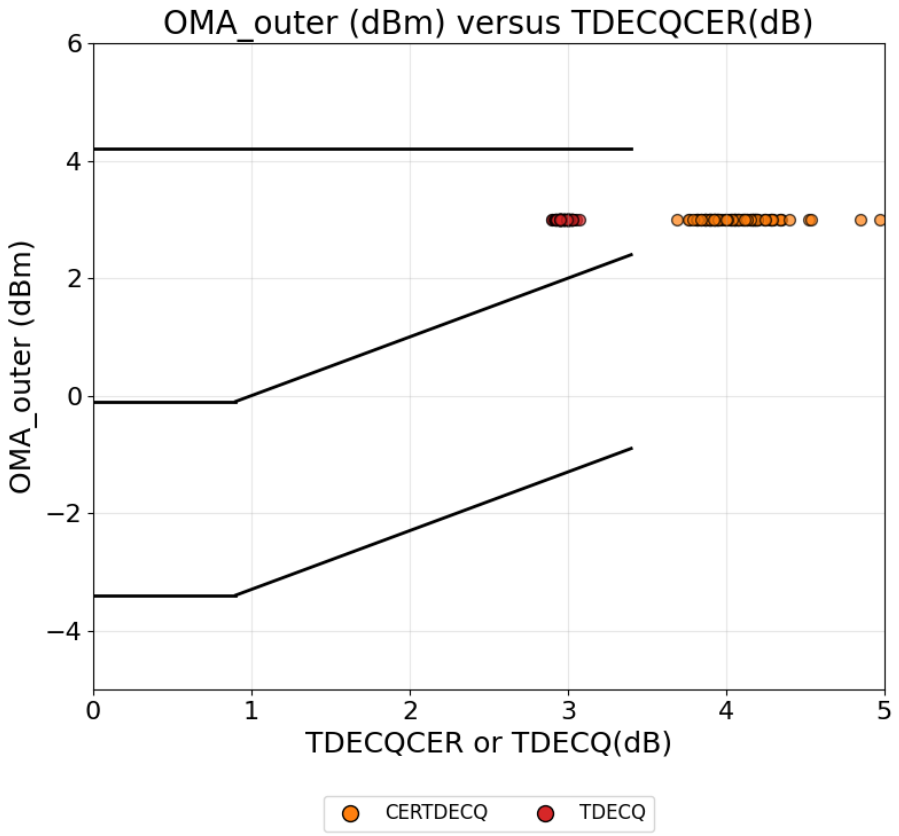




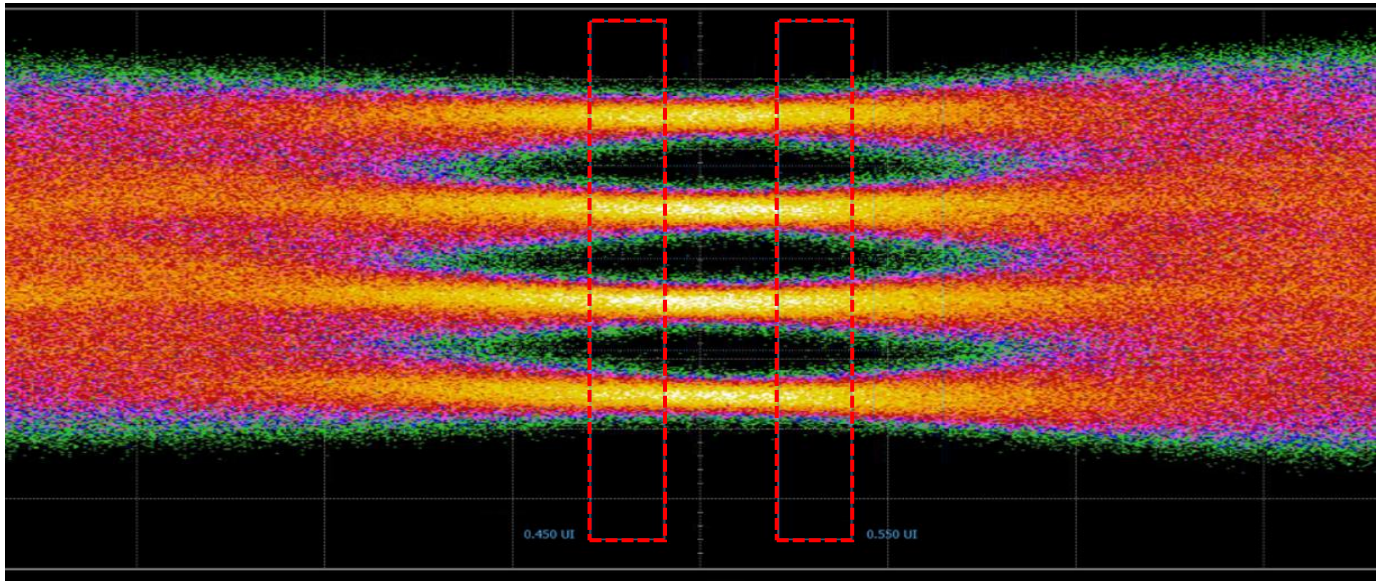
Why Test Variability Is a Concern

- CER TDECQ is intended as an enhanced TDECQ with improved correlation to BLER performance penalty.
- However, the current level of CER TDECQ test variability would make Tx OMA allocation for link budgeting extremely challenging.





TDECQ vs. CER TDECQ



TDECQ builds a single distribution from samples across all symbols of the entire SSPRQ pattern, making it a consistent distribution that is largely insensitive to the scope random sampling phase and noise of a particular measurement instance.

CER TDECQ forms 65,535 per-symbol distributions, often with as little as one data point, making them more sensitive to random scope sampling phase and noise of a particular measurement instance

Conclusions

- Constraining the CER TDECQ test to **63.99 SPUI** and a **0.02 UI histogram width** reduces test variability.
- Even with these constraints, the remaining test variability remain excessive.
- The Task Force is encouraged to further refine the test methodology or to consider removing the CER TDECQ test altogether.