

# Update on TDECQ CER evaluation

Addressing comments #247, #248, #249 and #250 against IEEE 802.3dj D2.2

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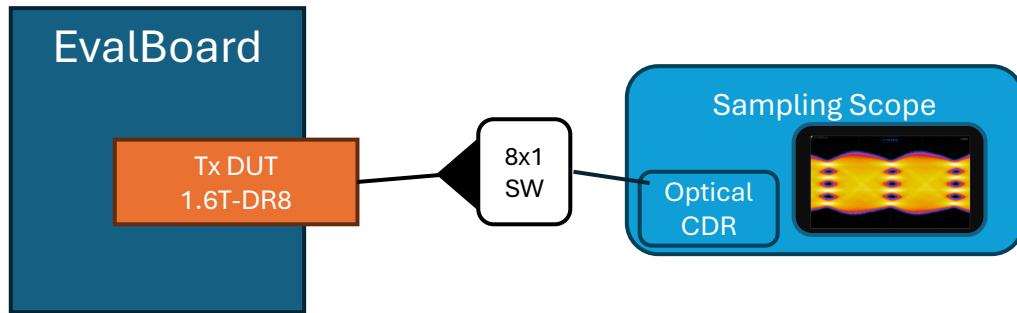
# Introduction

- In September Interim [rodes\\_3dj\\_02\\_2509](#) show some initial evaluation of the proposed TDECQ CER
- The results showed significant measurement variation, up to 1dB in some cases
- Despite these findings, the Task Force decided to include this specification as normative in the standard
- Since then, individuals associated with Keysight have acknowledged the consistency issues and released a new beta version of the test software
- The specification still needs to demonstrate **consistency**, **usefulness**, and **minimal harm** (i.e., avoiding false positives)
- Unfortunately, this presentation will show that some measurement issues remain in the current implementation.
- This presentation does not address its usefulness
- This presentation will show the potential harm with currently limits
- Due to time constraints, the data presented here covers only **TDECQ\_CER for outer FEC**.

# Test setups

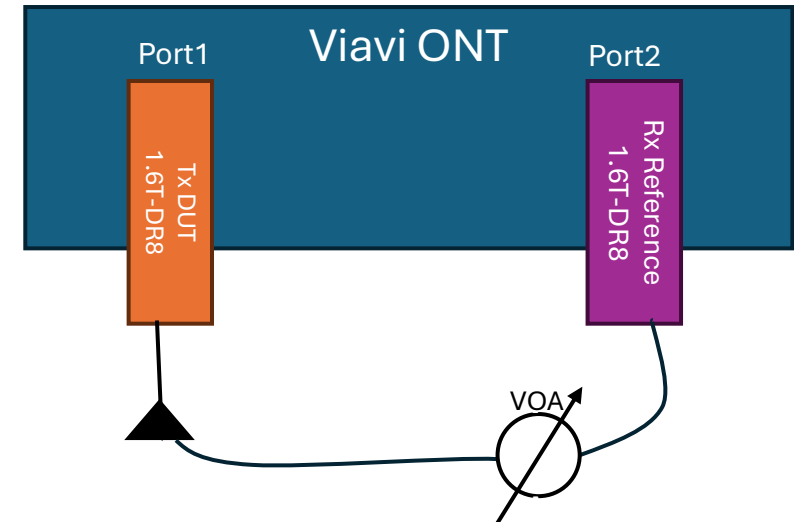
Measuring TDECQ, TDECQ\_CER and codeword error histograms on the same Transmitter DUTs

## Setup for TDECQ and TDECQ\_CER



- SSPRQ pattern (~65k PAM4 symbols)
- ~64 samples/UI
- Acquire data for up to 5 calculations for each Tx


## Setup for Functional Rx Testing





- VOA values: 0 dB and from 5 to 8dB on 0.25dB steps
- 10 sec test time for each power

# TDECQ Results

Tx1

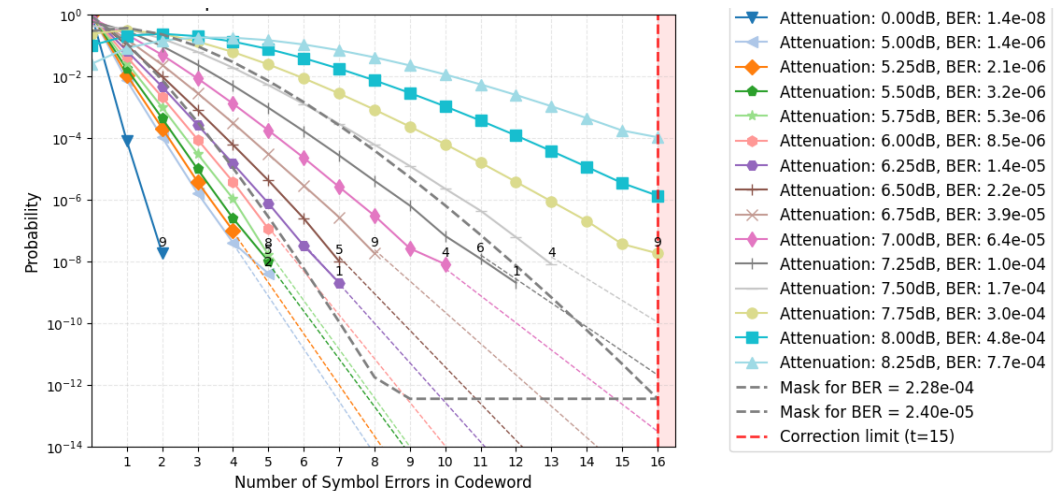
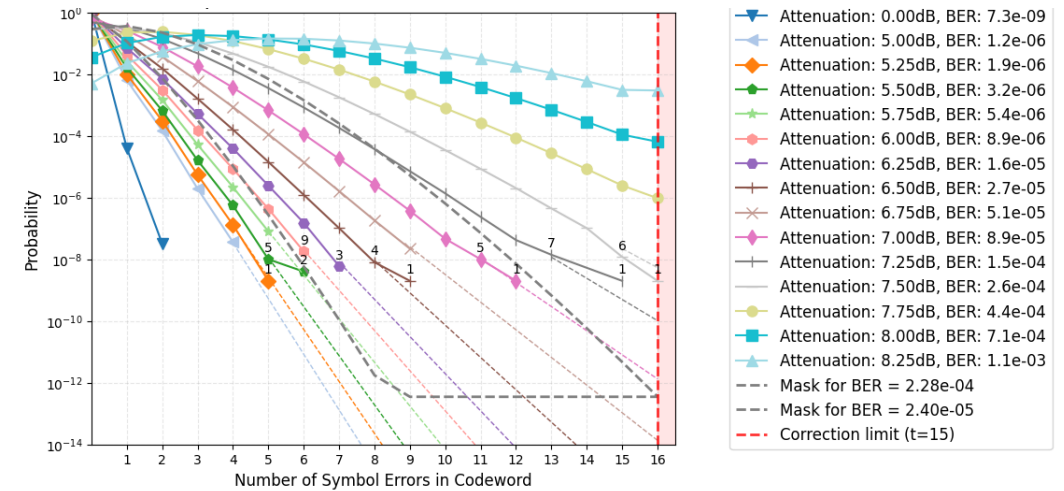
Results 

Measurement		Current	Minimum	Maximum	Count
CER TDECQ		3.66 dB	3.25 dB	3.66 dB	5
TDECQ		2.68 dB	2.63 dB	2.68 dB	5

Tx2


Results					
Measurement		Current	Minimum	Maximum	Count
CER TDECQ	F1	3.25 dB	3.07 dB	3.63 dB	5
TDECQ	F1	2.70 dB	2.70 dB	2.76 dB	5



# Codeword error rate Results



# TDECQ Results

Tx3

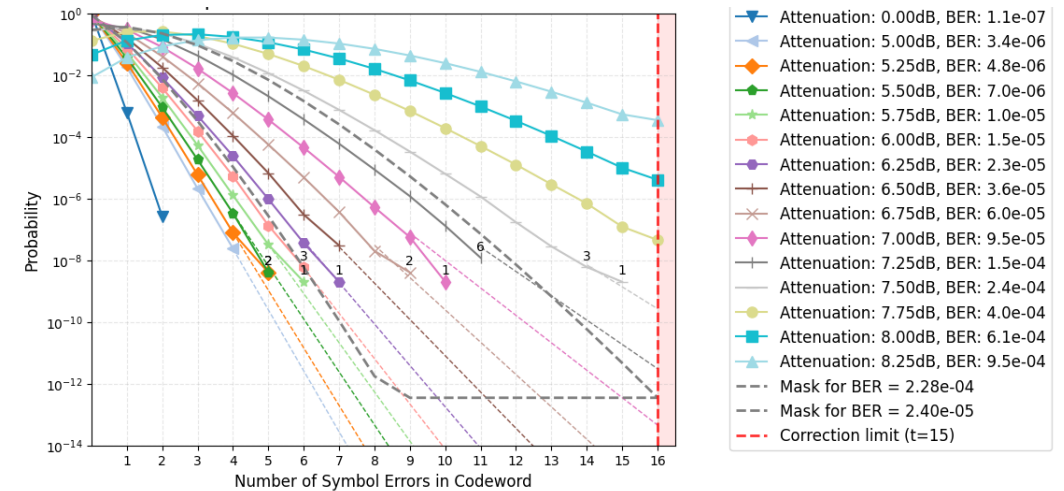
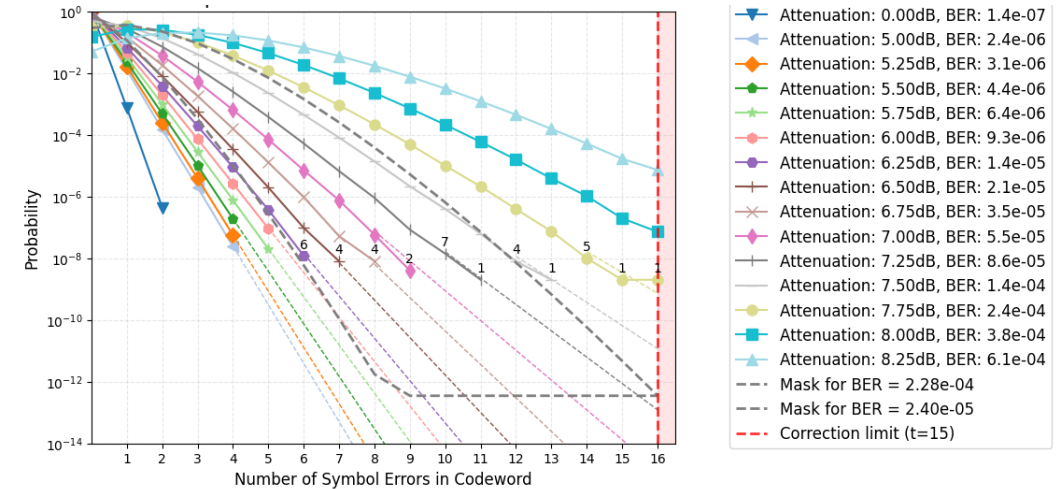
Results 

Measurement		Current	Minimum	Maximum	Count
CER TDECQ		3.74 dB	3.50 dB	3.80 dB	5
TDECQ		2.90 dB	2.84 dB	2.91 dB	5

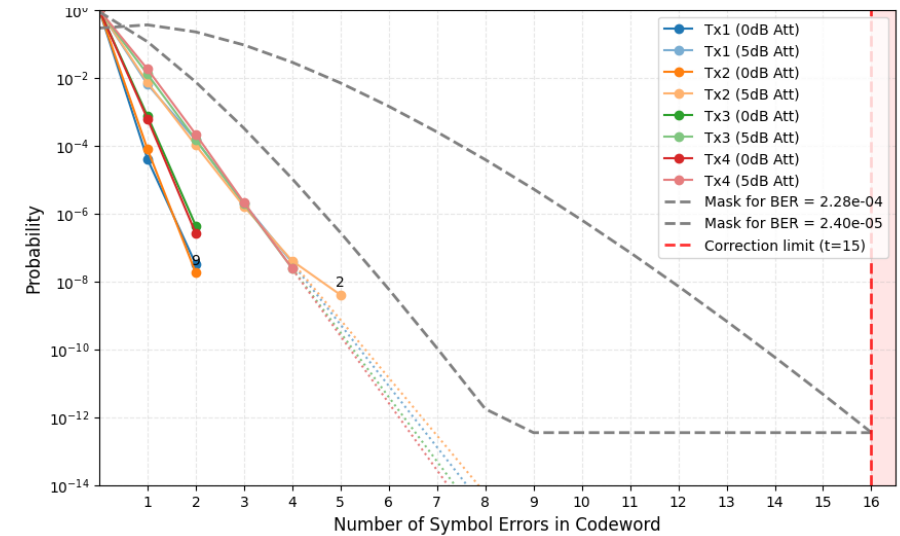
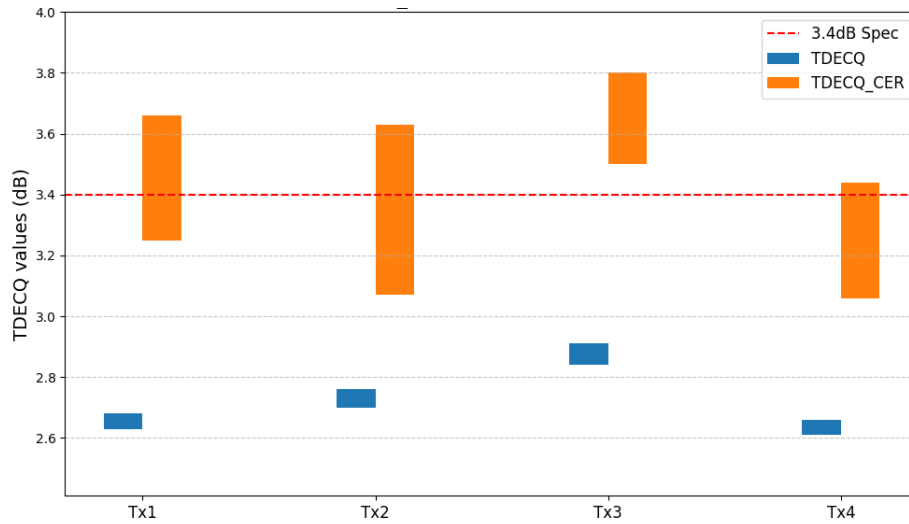
Tx4

Results					
Measurement		Current	Minimum	Maximum	Count
CER TDECQ	F1	SER?	3.06 dB	3.44 dB	4
TDECQ	F1	2.66 dB	2.61 dB	2.66 dB	6

# Codeword error rate Results



# Results Summary



The TDECQ\_CER variation is approximately 10× higher than the TDECQ.

All transmitters show plenty of margin in the link. Even with a 5 dB loss (compared to the 3 dB maximum DR4 channel loss), all Txs maintain large margins in both OMA and codeword error ratio, easily covering any potential Rx-to-Rx variation.

However, TDECQ\_CER is generating false positives, disqualifying transmitters that perform without issue in the link.

## Proposed actions:

- Remove the TDECQ\_CER specification, or
- Increase the limit to 4.4 dB, or
- ~~Make the specification informative rather than normative.~~

# Conclusion

- TDECQ\_CER is not ready to be a normative spec in the standard
- It has not shown enough merit yet:
  - 50% chance that identifies a Tx with FEC bin count 7 in [chayeb\\_3dj\\_01b\\_2509](#)

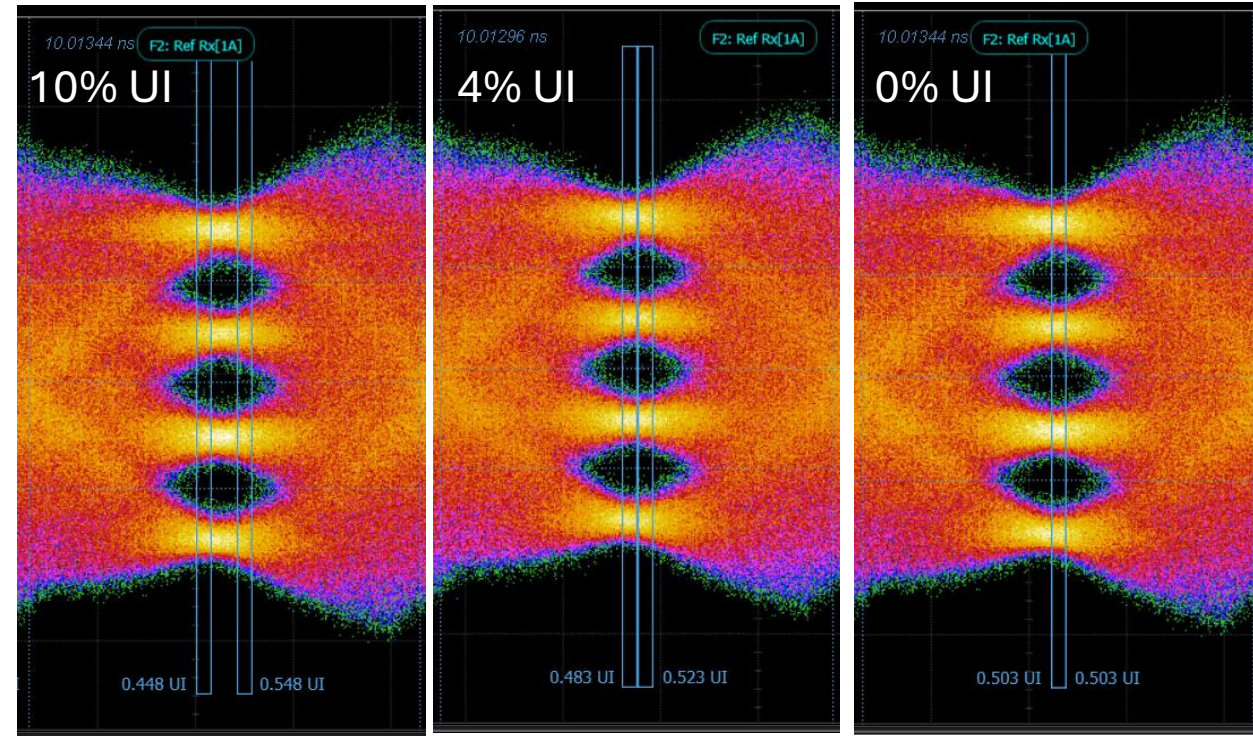
It has shown in this presentation:

- There are still measurement consistency issues
  - It produce high yield hit with false positives
- Recommend to:
  - Remove the TDECQ\_CER specification, or
  - Increase the limit to 4.4 dB



# Appendix: TDECQ target SER vs histogram spacing

		Histogram Spacing (UI%)					
		0	2	4	6	8	10
Target SER	4.56E-04	1.64	1.68	1.77	1.94	2.18	2.5
	2.00E-04	1.86	1.89	2	2.19	2.44	2.89
	1.00E-04	2.07	2.12	2.26	2.48	2.72	3.19
	5.00E-05	2.25	2.3	2.43	2.73	2.92	?
	2.00E-05	2.4	2.46	2.7	2.97	3.08	?
	1.00E-05	2.52	2.59	2.8	?	?	?



There has been discussion about exploring a lower target SER, as achieving the target CER has been shown to require a lower allocated average BER. To maintain comparable TDECQ performance under these conditions, reducing the histogram spacing becomes necessary.

Reducing the histogram spacing to **2% UI** enables approximately a twofold reduction in the target SER while maintaining similar TDECQ results.

**Proposal:** Investigate lowering the target SER to **5e-5** and reducing the histogram spacing to **4% UI**.