TDECQ Reference Receiver Main Tap Location Constraint

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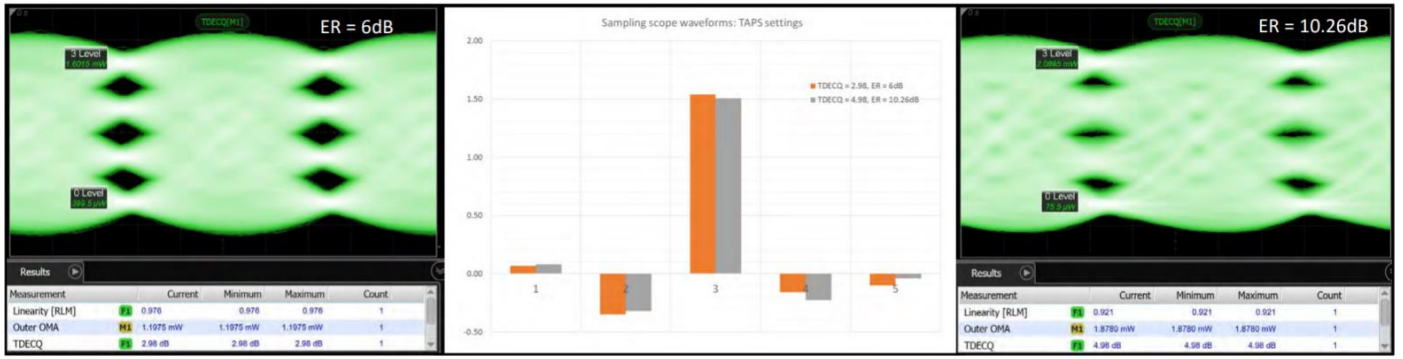
Introduction

- Current spec allows TDECQ reference FFE have up to two precursors.
- Precursors are costly for real receivers. Supporting multiple precursors forces real receivers to choose high power solutions and results in high module power.
- Threshold adjustment is recently added for reference receiver and more "pressure" is transferred from TX to RX.
- This presentation proposes to limit the number of precursors to balance TX/RX pressure for equalization, enable low power modules, and ensure interoperability.

TDECQ Measurement Results

- Historically in IEEE 802.3bs project, TDECQ reference receiver was changed from 5-tap T/2 FFE to 5-tap T-spaced FFE to increase transmitter yield on TDECQ test. Considering post-cursors are usually important for channel loss and reflections, the maximum range of precursors is increased from about 1 UI to 2 UI.
- Reported TDECQ measurements show 5-tap T-spaced plus threshold adjustment effectively improves transmitter yield. Meanwhile precursor 2 is usually small.
- For example, mazzini_3bs_01_0917.pdf shows main tap is optimized to tap 3 (2 precursors) for good transmitters. Precursor 2 is relatively small.

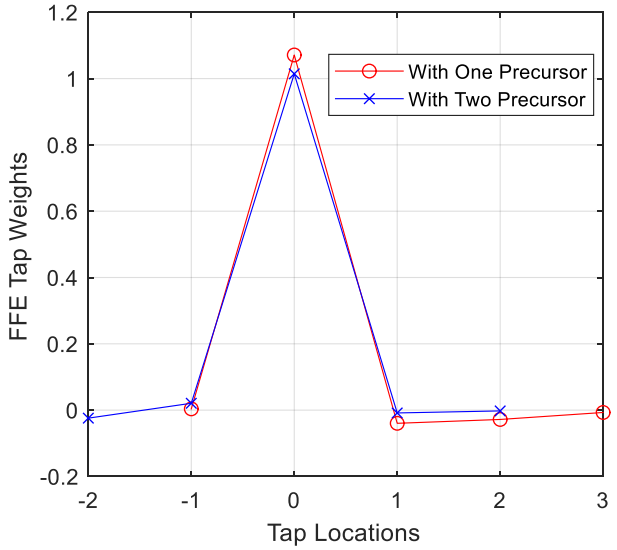
Transmitter results over two reference settings: PRBS20.



TDECQ Measurement Results

- We compared 100GBASE-DR TDECQ results for different number of FFE precursors.
- If without any TX FIR, TDECQ is very bad.
- If playing with TX FIR, reference FFE with one or two precursors give similar TDECQ.

Number of reference FFE precursors	One	two
TDECQ (dB)	1.73	1.69



Cost of Precursors

- In general there will be hardware and power cost to support more precursors.
- For some architectures, pre-cursors are more costly than post-cursors and may bring extra distortion. For those SERDES taking advantage of fractional (e.g. T/2) spaced FFE, more precursors are usually difficult.
- Optimizing main tap location is possible on real receiver, but at significant cost of extra hardware and power.

Proposed Changes for 50GBASE-FR and 50GBASE-LR

139.7.5.4 TDECQ reference equalizer

The reference equalizer for 50GBASE-FR and 50GBASE-LR is a 5 tap, T spaced, feed-forward equalizer (FFE), where T is the symbol period. A functional model of the reference equalizer is shown in Figure 139–5. The sum of the equalizer tap coefficients is equal to 1. Tap 1, tap 2, or tap 3, has the largest magnitude tap coefficient.

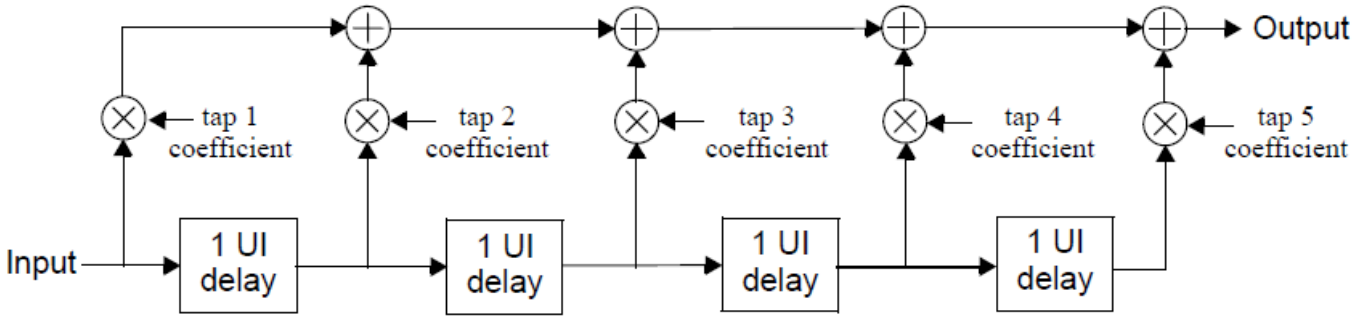


Figure 139–5—TDECQ reference equalizer functional model

- Changes:

  Tap 1 or tap 2, has the largest magnitude tap coefficient.

Proposed Changes for 100GBASE-DR

140.7.5.1 TDECQ reference equalizer

The reference equalizer for 100GBASE-DR is a 5 tap, T spaced, feed-forward equalizer (FFE), where T is the symbol period. A functional model of the reference equalizer is shown in Figure 140–4. The sum of the equalizer tap coefficients is equal to 1. Tap 1, tap 2, or tap 3, has the largest magnitude tap coefficient.

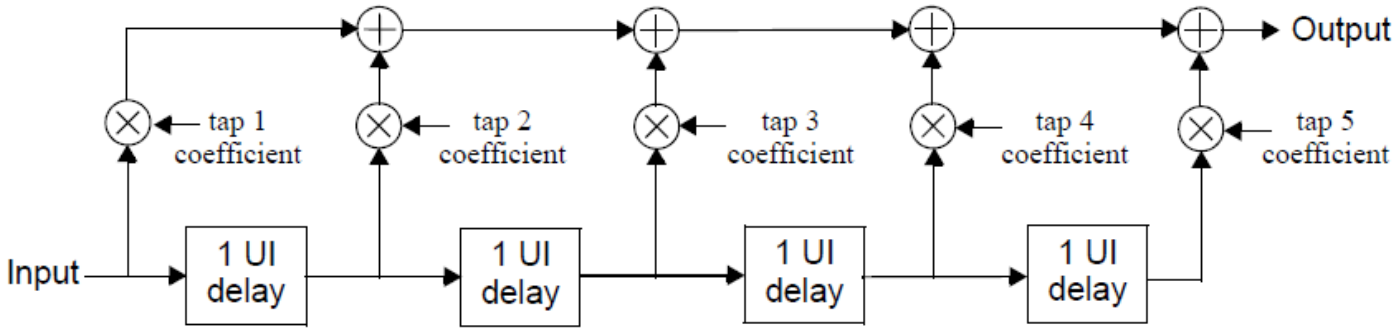


Figure 140–4—TDECQ reference equalizer functional model

- Changes:

  Tap 1 or tap 2, has the largest magnitude tap coefficient.

Conclusions

- FFE precursor 2 in TDECQ test is usually small, and precursor equalization can be done on TX.
- Devices will improve, but allowing reference receiver have multiple precursors forces real receivers to implement two or more precursors to ensure interoperability, therefore causes module power to stay high.
- To enable low power modules and ensure interoperability, propose to limit the number of precursors to **one**.

Thanks!