ECQ method

(comment R2-205 and others)

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Comment R2-205

- R2-205 SC 180.9.6.3 P 483 L 13 TR
- 802.3 is not a test specification (the 802.3 companion test specification was withdrawn). We are not supposed to be writing a model of a DSP. We are supposed to be defining TECQ and TDECQ, which are measured with a scope. Different. The scope does not do T-spaced sampling, for example. Previously, and for ECQ in other clauses, we had " One way of doing this, using estimated PAM4 symbol error ratio as the figure of merit for the equalized signal, is described below." and "Alternative optimization methods such as minimum mean squared error (MMSE) may be used to determine equalizer tap weights to reduce test time, and are expected to report equal or higher values of TDECQ. These alternative methods should not be used for receiver sensitivity and stressed receiver sensitivity calibration." So it was clear that the normative value is the best value (which does not take long to find, in spite of assertions that it must). We said that a short cut that reads high may be used, where reading high does not weaken the spec. Which would have been the case even if not stated.
  But this says: "For a given sampling phase phi0 and assumed RMS value sigmaG for Gaussian noise eta(t), determine the equalizer coefficients w and b(1), subject to the limits in Table 180–16, that result in the minimum mean squared error (MMSE) between yn and x(n). Alternative optimization methods may be used to determine equalizer tap weights if they report comparable values of TDECQ." This tries to make the inaccurate high-reading over-prescriptive method normative.
  There are other flaws in this but the whole concept is misguided; they should be removed when the damage in this draft is undone.
- What a mess. Replace the whole of 180.9.6 with the normal stable ECQ definition, following 168.7.5 (the latest sound version, I believe) with the few known relevant modifications for signalling rate and number FFE taps and the addition of the DFE.

Other comments

- R2-188, R2-206, R2-141, R2-205, R2-144, R2-15, R2-204, R2-194, R2-189, R2-16, R2-126, R2-17, R2-18 and R2-19 point out bugs in the draft 180.9.6, which can be avoided by referring back to Clause 121 as usual
- R1-284 and R1-287

Proposed text for 180.9.6

180.9.6 Transmitter and dispersion eye closure for PAM4 (TDECQ)

The TDECQ of each lane shall be within the limits given in Table 180–7 if measured using the test setup specified in 121.8.5.1, with the optical channel specified in 180.9.6.1, the measurement method in 121.8.5.3, and the reference equalizer in 180.9.6.2, with the following exceptions:

— The signaling rate of the test pattern generator is as given in Table 180–7.

— The test pattern is as specified for TDECQ in Table 180–14.

— The combination of O/E converter and the oscilloscope and the clock recovery unit are as defined for the reference receiver in 180.9.2. Compensation may be made for any deviation from an ideal fourth-order Bessel-Thomson response.

— OMAouter is defined by 180.9.5.

— The normalized noise power density spectrum, $N(f)$ in Equation (121–9) and Equation (121–10), is equivalent to white noise filtered by a fourth-order Bessel-Thomson response filter with a 3 dB bandwidth of 53.125 GHz.

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— If necessary, the calculation of $F(yi)$ and $CFL1(yi)$, $CFL2(yi)$, $CFL3(yi)$, $CFR1(yi)$, $CFR2(yi)$, and $CFR3(yi)$ in 121.8.5.3 is modified to allocate samples according to their positions in time in the test pattern rather than where they are found in the *y* dimension.

— The nominal threshold levels depend on the equalizer coefficients; they are $Pave - A/3$, $Pave$, and $Pave + A/3$, where A is the difference between the average of the equalized samples in both histograms derived from threes in the pattern and the average of the equalized samples in both histograms derived from zeros.

— $Pth1$, $Pth2$, and $Pth3$ are varied from their nominal values by up to ±2% of OMAouter in order to optimize TDECQ.

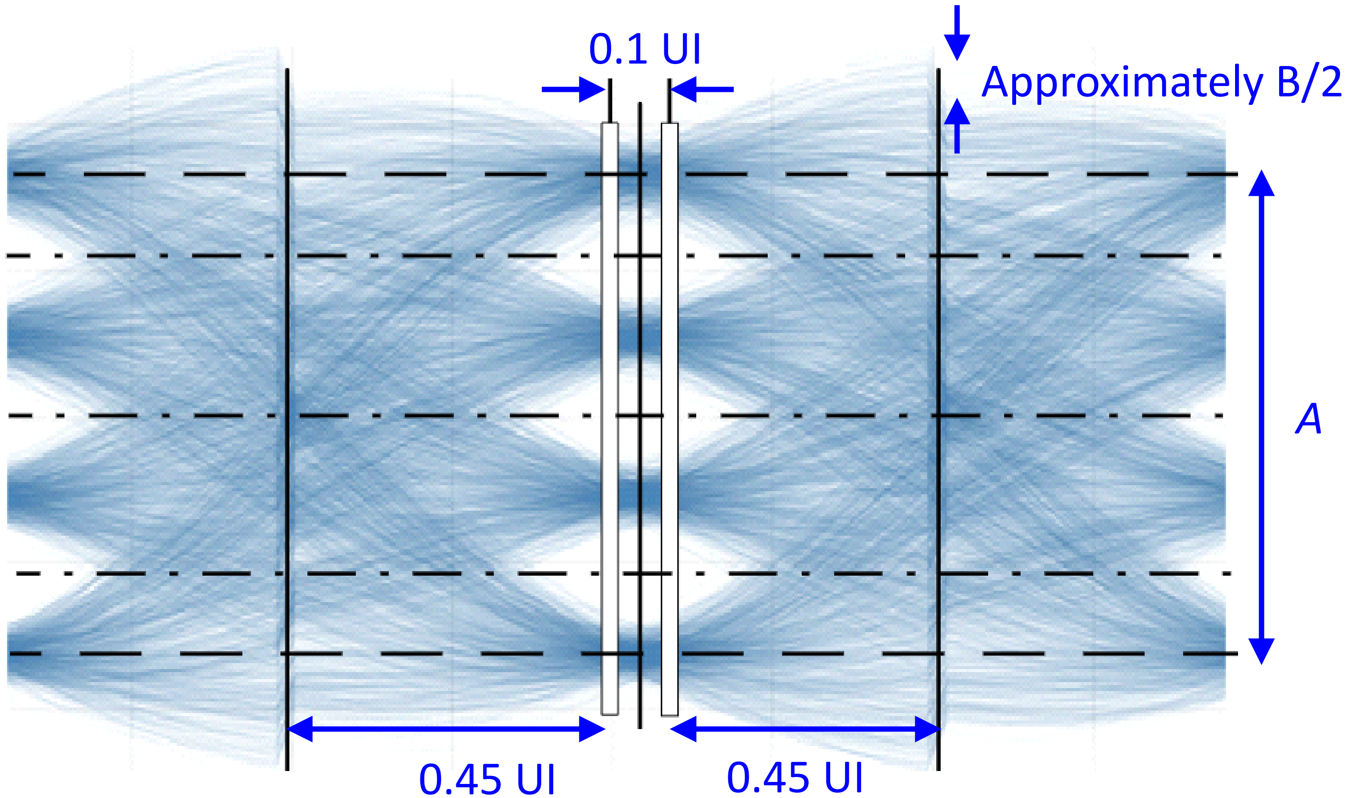
A block diagram for the TDECQ conformance test is shown in Figure 180–9. Other equivalent measurement implementations may be used with suitable calibration.

[Figure 180–9, TDECQ conformance test block diagram, as in D3.2]

An example of an equalized eye diagram is shown in Figure 180–10.

The note about allocating samples is probably unnecessary for 180 and 181, but it could improve accuracy in 182 and 183 where Qt is lower

Figure 180–10—Illustration of the TDECQ measurement



- If available, replace the graphic with one with the correct histogram window widths, transparent histogram windows, without the three vertical lines, and with the feedback transitions at 180° from the histograms
- No need to label the horizontal lines, which could be left out too

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180.9.6.1 Channel requirements

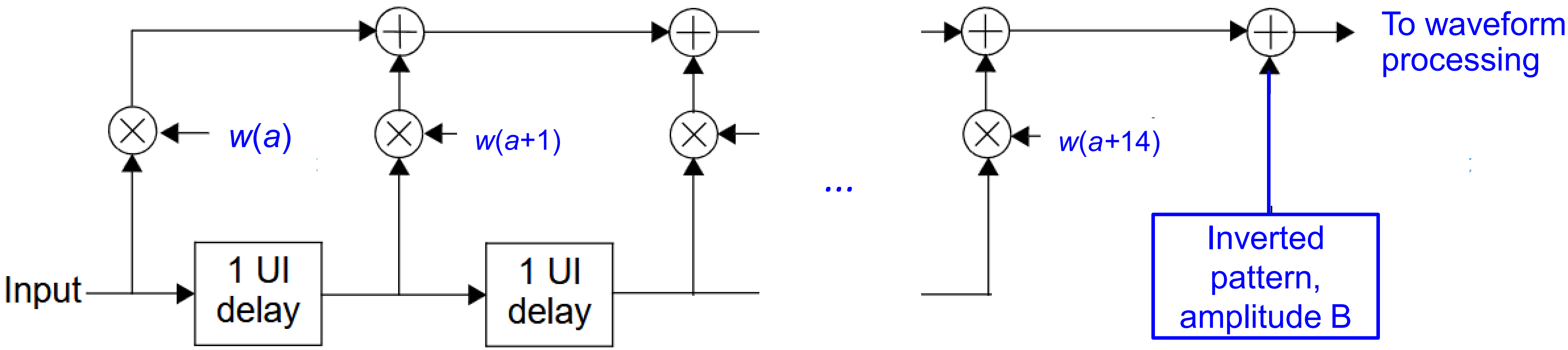
[as in D3.2 but renumbered]

180.9.6.2 TDECQ reference equalizer

The reference equalizer has 15 T-spaced feed-forward taps, where T is the symbol period, and a pattern generator representing a single decision feedback tap. This feedback pattern is an inverted and level-shifted copy of the test pattern, with timing representing feedback from the previous unit interval. It is added as a high bandwidth signal with levels $-B/2$, $-B/6$, $B/6$, and $B/2$, changing value 0.5 UI after the mean timing of the histogram windows, as shown in Figure 180–10. The peak-to-peak amplitude B is to be optimised along with other tap coefficients, the three thresholds, and the timing of the pair of histogram windows, subject to the limit for $b(1)$, where $b(1) = B/(A+B)$. A functional model of the reference equalizer is shown in Figure 180–11; the reference equalizer tap coefficients are specified in Table 180–16.

[Table 180–16 as in D3.2]

Figure 180–11—TDECQ reference equalizer functional model



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