Corrections Needed in Clause 180.9.6

Norman Swenson

Affiliated with Nokia, Point2

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Revision a

Addresses Comments: R2-188, R2-189, R2-16, R2-17, R2-18

Supporters

- Marek Hajduczenia
- Roberto Rodes
- Eric Maniloff
- Ali Ghiasi
- Chris Cole
- Matt Brown

Introduction

- With the changes introduced in 3.2, there are a few things that need cleaning up in clause 180.9.6
- The DFE is based on a:
  - Mean zero input signal
  - Balanced and scaled alphabet, {-1, -1/3, 1/3, 1}

  for the transmitted sequence
- SSPRQ is specified as a sequence from the unbalanced alphabet {0, 1, 2, 3}
- The signal out of the reference receiver is not mean zero
  - It is referred to as “optical power” in the clause, which cannot be negative

Comments: R2-188

The equalizer is modeled as shown in Figure 180–10, where

- $r(t)$ is the output of the reference receiver defined in 180.9.2, with the mean value subtracted from the signal
- $\eta(t)$ is colored Gaussian noise, generated from additive white Gaussian noise (AWGN) filtered by a Bessel-Thomson (BT) filter as defined in 180.9.2
- $z(t)$ is the input signal given by Equation (180–1)
- z_n is the sampled response of input signal $z(t)$, given by Equation (180–2)
- y_n is the equalizer output corresponding to x_n
- X_n is the nth symbol in the test pattern sequence, $X_n \in \{0, 1, 2, 3\}$, and x_n is given by Equation (180-3)
- $\boldsymbol{w}$ is the set of feed-forward tap coefficients, given by Equation (180- 4)
- $b(1)$ is the feedback tap coefficient
- the feedback is modeled as correct, i.e., x_n is the pattern used to generate the input $r(t)$
- the received signal $r(t)$ is aligned with the test pattern such that $r(nT)$ corresponds to x_n

$$z(t) = r(t) + \eta(t) \qquad (180\text{–}1)$$

$$z_n = z(nT + \phi)\text{, where } 0 < \phi < T \qquad (180\text{–}2)$$

$$\boxed{x_n = 2/3\,X_n - 1, \qquad x_n \in \{-1, -1/3, 1/3, 1\} \qquad (180\text{-}3)}$$

$$\boldsymbol{w} = \{w(a), w(a+1), \ldots, w(a+14)\} \qquad (180\text{- }4)$$

Comments: R2-188

Parameter	Symbol	Value	
		Minimum	Maximum
Number of feed-forward taps	N_w	15	
Number of pre-cursor feed-forward taps	—	0	3
Main tap coefficient limit	$w(0)$	$0.9 - b(1)$	2.5
Normalized feed-forward tap coefficient limits:	$w(i)/w(0)$		
$i = -3$		–0.15	0.1
$i = -2$		–0.1	0.25
$i = -1$		–0.5	0.1
$i = 1$		–0.6	0.2
$i = 2$		–0.2	0.3
$i = 3$		–0.15	0.15
$i = 4$		–0.15	0.15
$i = 5$		–0.15	0.15
$i = 6$		–0.15	0.15
$i \geq 7$		–0.1	0.1
Pre-post-cursor tap coefficient difference limit: $\lvert w(1)/w(0) - b(1) - w(-1)/w(0) \rvert$	—	—	0.25
Feed-forward tap DC gain[a]	—	1	
Number of feedback taps	N_b	1	
Feedback tap coefficient limit[b]	$b(1)$	0	0.33

[a] The sum of all 15 feed-forward tap coefficients, $w(i)$.
[b] The feedback tap coefficient $b(1)$ is referenced to $OMA_{TDECQ}/2$ (see 180.9.6.4 for definition of OMA_{TDECQ}).

The new definition of x_n is now consistent with footnote b.

Comments: R2-188, R2-18

Use X_n instead of x_n

y_n is implicitly a function of x_n (or X_n)

$$P(y_{n,\mathrm{L}}, \sigma_\mathrm{G}) = \frac{1}{2}\begin{cases} \mathrm{erfc}\left(\dfrac{P_{\mathrm{th1}} - y_{n,\mathrm{L}}}{\sqrt{2}C_{\mathrm{eq}}\sigma_\mathrm{G}}\right) & X_n = 0 \\ \mathrm{erfc}\left(\dfrac{y_{n,\mathrm{L}} - P_{\mathrm{th1}}}{\sqrt{2}C_{\mathrm{eq}}\sigma_\mathrm{G}}\right) + \mathrm{erfc}\left(\dfrac{P_{\mathrm{th2}} - y_{n,\mathrm{L}}}{\sqrt{2}C_{\mathrm{eq}}\sigma_\mathrm{G}}\right) & X_n = 1 \\ \mathrm{erfc}\left(\dfrac{y_{n,\mathrm{L}} - P_{\mathrm{th2}}}{\sqrt{2}C_{\mathrm{eq}}\sigma_\mathrm{G}}\right) + \mathrm{erfc}\left(\dfrac{P_{\mathrm{th3}} - y_{n,\mathrm{L}}}{\sqrt{2}C_{\mathrm{eq}}\sigma_\mathrm{G}}\right) & X_n = 2 \\ \mathrm{erfc}\left(\dfrac{y_{n,\mathrm{L}} - P_{\mathrm{th3}}}{\sqrt{2}C_{\mathrm{eq}}\sigma_\mathrm{G}}\right) & X_n = 3 \end{cases} \quad (180\text{–}7)$$

One or the other! Not both!

Alternatively, change values to {-1, -1/3, 1/3, 1}

where

C_{eq} is a coefficient which accounts for the reference equalizer noise enhancement

$P_{th1}, P_{th2}, P_{th3}$ are thresholds adjusted from $P_{0,th1}, P_{0,th2}, P_{0,th3}$ within limits described below

Addresses Hajduczenia Comment R2-18.

Comments: R2-189, R2-16, R2-17 (background)

The nominal threshold levels $P_{0,\text{th1}}$, $P_{0,\text{th2}}$, and $P_{0,\text{th3}}$, are determined from the OMA_TDECQ and the average optical power P_ave as defined in Equation (180–4), Equation (180–5), and Equation (180–6), and illustrated in Figure 180–11.

$$P_{0,\,th1} = \text{P}_\text{ave} - \frac{\text{OMA}_\text{TDECQ}}{3} \qquad (180\text{–}4)$$

$$P_{0,\,\text{th2}} = \text{P}_\text{ave} \qquad (180\text{–}5)$$

$$P_{0,\,\text{th3}} = \text{P}_\text{ave} + \frac{\text{OMA}_\text{TDECQ}}{3} \qquad (180\text{–}6)$$

where OMA_TDECQ is measured on the equalized captured waveform y_n using the method defined in 180.9.5.

r(t) is no longer a power, as the mean has been subtracted off, and y_n is a discrete-time signal, not a continuous-time signal. The method defined in 180.9.5 is for a continuous-time signal with runs of threes and runs of zeros. I suggest introducing a continuous-time signal when we introduce the eye diagram, then use that to define OMA_TDECQ.

Comments: R2-189, R2-16, R2-17

Original:

An eye diagram to help illustrate TDECQ is shown in Figure 180–11. The eye diagram corresponds to the optimized equalizer setting at sampling phase ϕ_0. The feedback symbol x_n changes at phase $\phi = \phi_0 - T/2$.

I suggest:

An eye diagram to help illustrate TDECQ is shown in Figure 180–11. The eye diagram corresponds to the optimized equalizer setting at sampling phase ϕ_0. The feedback symbol ~~x_n changes at phase $\phi = \phi_0 - T/2$.~~ x_{n-1} changes value to x_n at time $t = nT + \phi_0 + T/2$.

The eye diagram reflects a continuous-time waveform $y(t)$ corresponding to y_n, where $y(t)$ would be the output of a continuous-time equalizer obtained by removing the sampler in Figure 180-10.

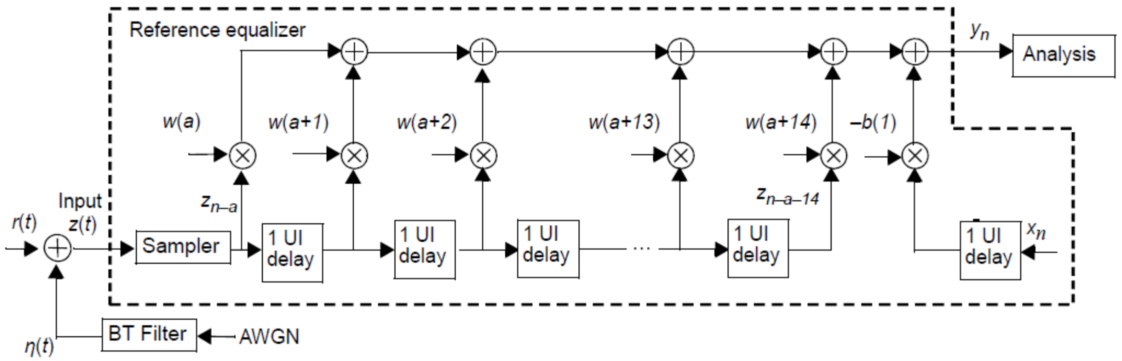

Figure 180–10—TDECQ reference equalizer functional model

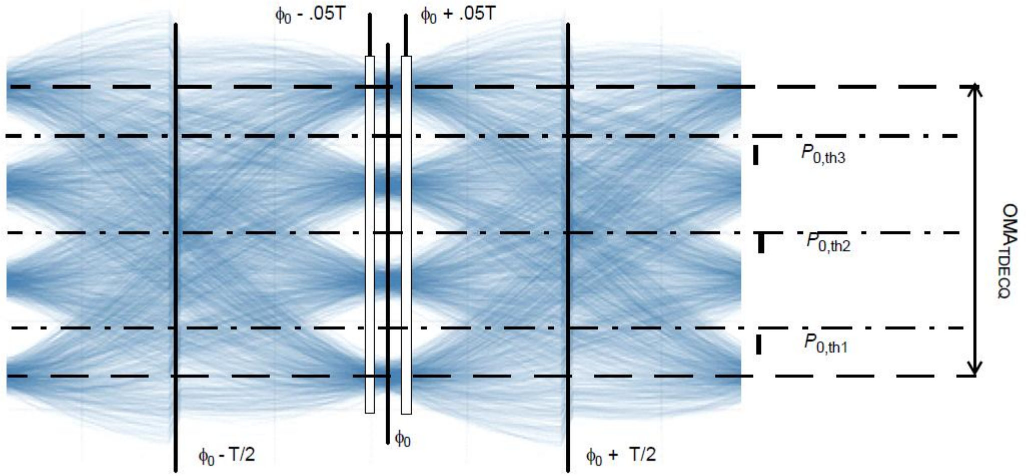

Figure 180–11—Illustration of the TDECQ measurement

Comments: R2-189, R2-16, R2-17

The nominal threshold levels $P_{0,\text{th1}}$, $P_{0,\text{th2}}$, and $P_{0,\text{th3}}$, are ~~determined from the $\text{OMA}_{\text{TDECQ}}$ and the average optical power P_{ave} as~~ defined in Equation (180–4), Equation (180–5), and Equation (180–6), and illustrated in Figure 180–11.

$$P_{0,\,th1} = \cancel{P_{\text{ave}}} - \frac{\text{OMA}_{\text{TDECQ}}}{3} \quad (180\text{–}4)$$

$$P_{0,\,\text{th2}} = \cancel{P_{\text{ave}}}\ 0 \quad (180\text{–}5)$$

$$P_{0,\,\text{th3}} = \cancel{P_{\text{ave}}} + \frac{\text{OMA}_{\text{TDECQ}}}{3} \quad (180\text{–}6)$$

where $\text{OMA}_{\text{TDECQ}}$ is measured on the equalized captured waveform $\cancel{y_k}$ $y(t)$, using the method defined in 180.9.5 ,
and where $y(t)$ is the continuous time waveform corresponding to the eye diagram shown in Figure 180-11.

Thank you