Replace 85.8.3.2 with the following:

85.8.3.2 Transmitted output waveform

The 40GBASE-CR4 and 100GBASE-CR10 transmit function includes programmable equalization to compensate for the frequency-dependent loss of the channel and facilitate data recovery at the receiver. The functional model for the transmit equalizer is the three tap transversal filter shown in Figure 85–3.

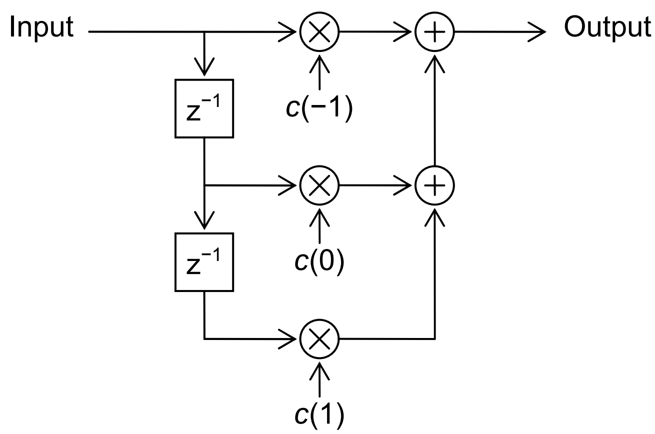

Figure 85–3 – Transmit equalizer functional model

The state of the transmit equalizer and hence the transmitted output waveform may be manipulated via the PMD control function defined in 85.7.12 or via the management interface. The transmit function responds to a set of commands issued by the link partner's receive function and conveyed by a back-channel communications path. This command set includes instructions to a) increment coefficient $c(n)$, b) decrement coefficient $c(n)$, c) hold coefficient $c(n)$ at its current value, or d) set the coefficients to a pre-defined value (preset or initialize). In response, the transmit function relays status information to the link partner's receive function. The status messages indicate that a) the requested update to coefficient $c(n)$ has completed (updated), b) coefficient $c(n)$ is at its minimum value, c) coefficient $c(n)$ is at its maximum value, or d) coefficient $c(k)$ is ready for the next update request (not_updated).

The requirements for the 40GBASE-CR4 and 100GBASE-CR10 transmit equalizer are intended to be similar to the requirements for 10GBASE-KR (refer to 72.7.1.10). However, the signal path from the transmit function to TP2 introduces frequency dependent loss and phase shift that distorts the signal and makes it difficult to accurately characterize equalizer performance at TP2 using the methodology specified for 10GBASE-KR. Instead the following process is defined for the verification of transmit equalizer performance at TP2.

1. The transmitter under test is preset per 72.6.10.2.3.1 such that $c(-1)$ and $c(1)$ are zero and $c(0)$ is its maximum value.

2. Capture at least one complete cycle of the test pattern PRBS9 (refer to 83.5.10) at TP2 per 85.8.3.2.3.
3. Compute the linear fit to the captured waveform per 85.8.3.2.4.
4. Define t_x to be the time where the rising edge of the linear fit pulse, *p*, from step 3 crosses 50% of its peak amplitude.
5. Sample the linear fit pulse, *p*, at symbol-spaced intervals relative to the time $t_0 = t_x + 0.5$ UI, interpolating as necessary to yield the sampled pulse p_i.
6. Use p_i to compute the vector of coefficients, *w*, of a N_w-tap symbol-spaced transversal filter that equalizes for the transfer function from the transmit function to TP2 per 85.8.3.2.5.

The parameters of the pulse fit and the equalizing filter are given in Table 85-5.

The peak value of the linear fit pulse from step 3, *p*, shall be greater than 240 mV. The RMS value of the error between the linear fit from step 3 and the measured waveform, *e*, normalized the peak value of the pulse, *p*, must be no greater than 0.037.

Table 85-6 – Normalized transmit pulse template

Parameter	Value, UI
Linear fit pulse length, N_p	7
Linear fit pulse delay, D_p	1
Equalizer length, N_w	7
Equalizer delay, D_w	1

The peak value of linear fit pulse from step 3, p, shall be greater than 240 mV.

For each configuration of the transmit equalizer:

7. Configure the transmitter under test as required by the test.
8. Capture at least one complete cycle of the test pattern PRBS9 (refer to 83.5.10) at TP2 per 85.8.3.2.3.
9. Compute the linear fit to the captured waveform per 85.8.3.2.4.
10. Define t_x to be the time where the rising edge of the linear fit pulse, *p*, from step 9 crosses 50% of its peak amplitude.
11. Sample the linear fit pulse, *p*, at symbol-spaced intervals relative to the time $t_0 = t_x + 0.5$ UI, interpolating as necessary to yield the sampled pulse p_i.
12. Equalize the sampled pulse p_i using the coefficient vector, *w*, computed in step 6 per 85.8.3.2.5 to yield the equalized pulse q_i.

The RMS value of the error between the linear fit from step 9 and the measured waveform, *e*, normalized the peak value of the pulse, *p*, must be no greater than 0.037.

The normalized amplitude of coefficient $c(-1)$ is the value of q_i at time $t_0 + (D_w - 1)$ UI. The normalized amplitude of coefficient $c(0)$ is the value of q_i at time $t_0 + D_w$ UI. The normalized amplitude of coefficient $c(1)$ is the value of q_i at time $t_0 + (D_w + 1)$ UI.

85.8.3.2.1 Coefficient step size

The change in the normalized amplitude of coefficient $c(n)$ corresponding to a request to "increment" that coefficient shall be between 0.0083 and 0.050. The change in the normalized amplitude of coefficient $c(n)$ corresponding to a request to "decrement" that coefficient shall be between –0.050 and –0.0083.

The change in the normalized amplitude of the coefficient is defined to be difference in the value measured to prior to the assertion of the "increment" or "decrement" request (e.g. the coefficient update request for all coefficients is "hold") and the value upon the assertion of a coefficient status report of "updated" for that coefficient.

85.8.3.2.2 Coefficient range

When sufficient "increment" or "decrement" requests have been received for a given coefficient, the coefficient will reach a lower or upper bound based on the coefficient range or restrictions placed on the minimum steady state differential output voltage or the maximum peak-to-peak differential output voltage.

With $c(-1)$ set to zero and both $c(0)$ and $c(1)$ having received sufficient "decrement" requests so that they are at their respective minimum values, the ratio $(c(0) - c(1))/(c(0) + c(1))$ shall be greater then or equal to 4.

With $c(1)$ set to zero and both $c(-1)$ and $c(0)$ having received sufficient "decrement" requests so that they are at their respective minimum values, the ratio $(c(0) - c(-1))/(c(0) + c(-1))$ shall be greater then or equal to 1.54.

Note that a coefficient may be set to zero by first asserting a coefficient preset request and then manipulating the other coefficients as required by the test.

85.8.3.2.3 Waveform acquisition

The transmitter under test repetitively transmits the specified test pattern. The waveform shall be captured with an effective sample rate that is M times the signaling rate of the transmitter under test. The value of M shall be an integer not less than 7. Averaging multiple waveform captures is recommended.

The captured waveform shall represent an integer number of repetitions of the test pattern totaling N bits. Hence the length of the captured waveform should be MN samples. The waveform should be aligned such that the first M samples of waveform correspond to the first bit of the test pattern, the second M samples to the second bit, and so on.

85.8.3.2.4 Linear fit to the waveform measured at TP2

Given the captured waveform $y(k)$ and corresponding aligned symbols $x(n)$ derived from the procedure defined in 85.7.3.2.3, define the M-by-N waveform matrix Y as shown in (85-1).

$$Y = \begin{bmatrix} y(1) & y(M+1) & \cdots & y(M(N-1)+1) \\ y(2) & y(M+2) & \cdots & y(M(N-1)+2) \\ \vdots & \vdots & \cdots & \vdots \\ y(M) & y(2M) & \cdots & y(MN) \end{bmatrix} \qquad (85\text{-}1)$$

Rotate the symbols vector x by the specified pulse delay D_p to yield x_r.

$$x_r = \left[x(D_p+1) \quad x(D_p+2) \quad \cdots \quad x(N) \quad x(1) \quad \cdots \quad x(N-D_p) \right] \qquad (85\text{-}2)$$

Define the matrix X to be an N-by-N matrix derived from x_r as shown in (85-3).

$$X = \begin{bmatrix} x_r(1) & x_r(2) & \cdots & x_r(N) \\ x_r(N) & x_r(1) & \cdots & x_r(N-1) \\ \vdots & \vdots & \cdots & \vdots \\ x_r(2) & x_r(3) & \cdots & x_r(1) \end{bmatrix} \qquad (85\text{-}3)$$

Define the matrix X_1 to be the first N_p rows of X concatenated with a row vector of 1's of length N. The M-by-(N_p + 1) coefficient matrix, P, corresponding to the linear fit is then defined by (85-4).

$$P = YX_1^{\mathrm{T}}(X_1X_1^{\mathrm{T}})^{-1} \qquad (85\text{-}4)$$

In (85-4) the superscript "T" denotes the matrix transpose operator.

$$E = PX - Y = \begin{bmatrix} e(1) & e(M+1) & \cdots & e(M(N-1)+1) \\ e(2) & e(M+2) & \cdots & e(M(N-1)+2) \\ \vdots & \vdots & \cdots & \vdots \\ e(M) & e(2M) & \cdots & e(MN) \end{bmatrix} \qquad (85\text{-}5)$$

The error waveform, $e(k)$, is then read column-wise from the elements of E. Define P_1 to be a matrix consisting of the first N_p columns of the matrix P as shown in 85-6.

$$P_1 = \begin{bmatrix} p(1) & p(M+1) & \cdots & p(M(N_p-1)+1) \\ p(2) & p(M+2) & \cdots & p(M(N_p-1)+2) \\ \vdots & \vdots & \cdots & \vdots \\ p(M) & p(2M) & \cdots & p(MN_p) \end{bmatrix} \qquad (85\text{-}6)$$

The linear fit pulse response, $p(k)$, is then read column-wise from the elements of P_1.

85.8.3.2.5 Removal of the transfer function between the transmit function and TP2

Rotate sampled pulse response p_i by the specified equalizer delay D_w to yield p_r as shown in (85-7).

$$p_r = \left[p_i(D_w + 1) \quad p_i(D_p + 2) \quad \cdots \quad p_i(N_p) \quad p_i(1) \quad \cdots \quad p_i(N_p - D_w) \right] \tag{85-7}$$

Define the matrix P_2 to be an N_p-by-N_p matrix derived from p_r as shown in (85-8).

$$P_2 = \begin{bmatrix} p_r(1) & p_r(2) & \cdots & p_r(N_w) \\ p_r(N_w) & p_r(1) & \cdots & p_r(N_w - 1) \\ \vdots & \vdots & \cdots & \vdots \\ p_r(2) & p_r(3) & \cdots & p_r(1) \end{bmatrix} \tag{85-8}$$

Define the matrix P_3 to be the first N_w rows of P_2. Define a unit pulse column vector x_p of length N_p. The value of element $x_p(D_p + 1)$ is 1 and all other elements have a value of 0. The vector of filter coefficients w that equalizes p_i is then defined by (85-9).

$$w = (P_3^{\mathrm{T}} P_3)^{-1} P_3^{\mathrm{T}} x_p \tag{85-9}$$

Given the column vector of equalizer coefficients, w, the equalized pulse response q_i is determined by (85-10).

$$q_i = P_3 w \tag{85-10}$$