CAUI-4 C2C Transmitter FFE Compliance

IEEE 802.3 bm

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Transmitter FFE Requirements

- CAUI-4 C2C transmitter only require modest amount of post and pre
  - Full KR4 transmit FFE is overkill when there is no back channel
- Result previously shown the CAUI-4 C2C links with TX FFE+ CTLE is rather insensitive to the transmit FFE setting
  - Transmit pre-cursor is nice too have but often may not even get optimized to the best level
- Assuming C2C channel loss is <=15 dB with 9-12 dB CTLE then transmit is sufficient to be
  - 6 dB post or 0.25 sufficient based on simulated results 4 to 8 setting is sufficient
  - 3 dB pre or 0.125 sufficient based on simulated results 3-4 setting is sufficient and the eye amplitude gain after CTLE is ~10%

Transmit FFE Definition

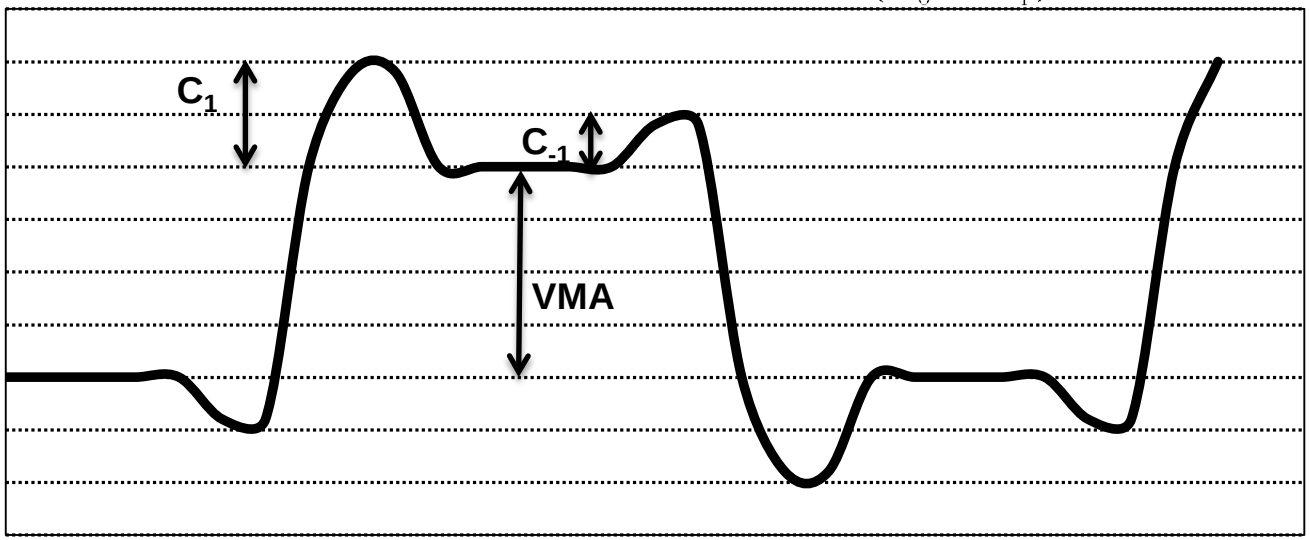
- Typical transmitter FFE waveform is shown below for 3 tap FFE with main tap designated as C_0, pre (C_{-1}), and post (C_1)

$$|C_{-1}|+|C_0|+|C_1|=1$$

$$VMA=\left(|C_0|-|C_{-1}|-|C_1|\right)\times Amplitude_{p-p}$$

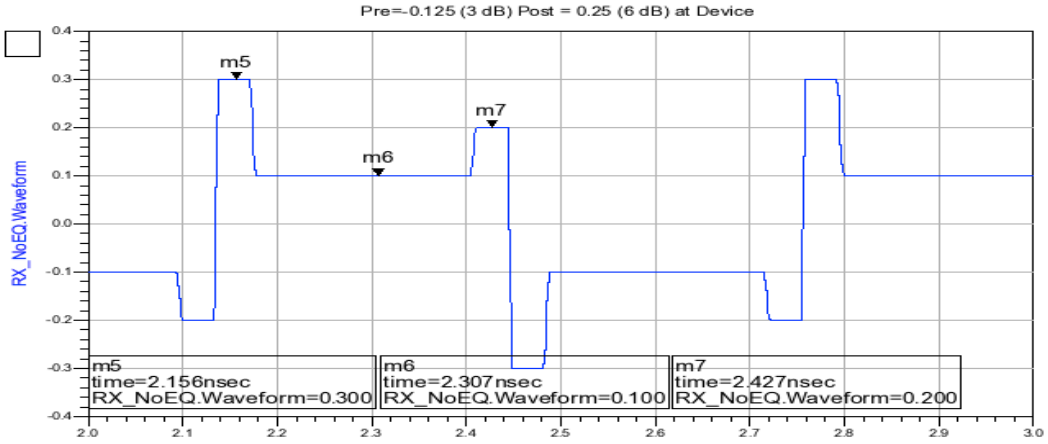
$$De-emphasis(C_1)=20*LOG10\left(\frac{1}{C_0-C_1}\right)$$

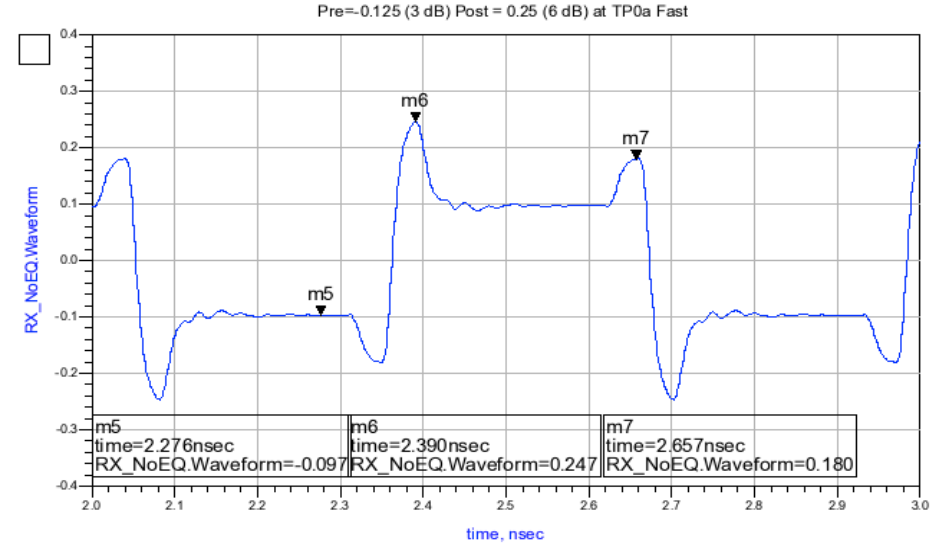
$$De-emphasis(C_0)=20*LOG10\left(\frac{1}{C_0-C_{-1}}\right)$$

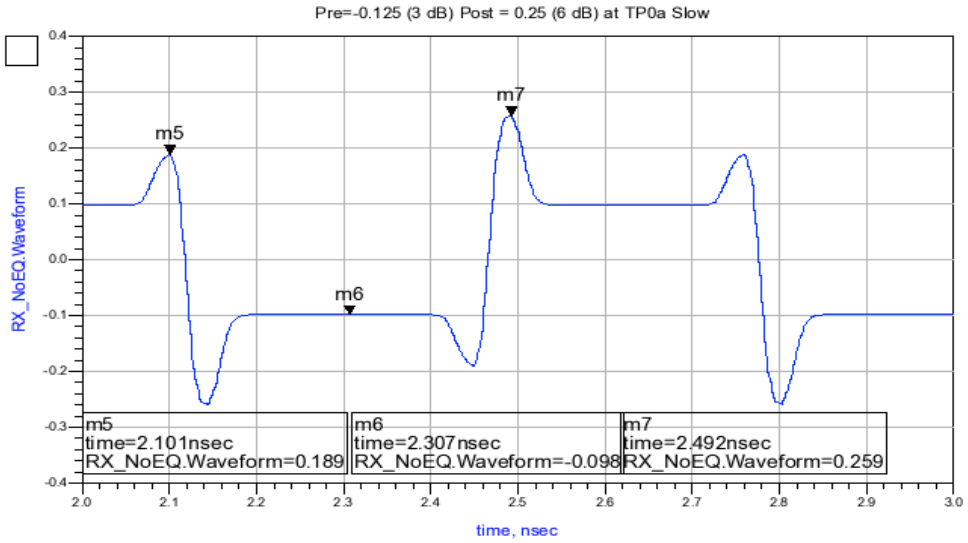


Transmitter Waveform

- At device output assuming 800 mV and at TP0a
  - For fast and slow driver



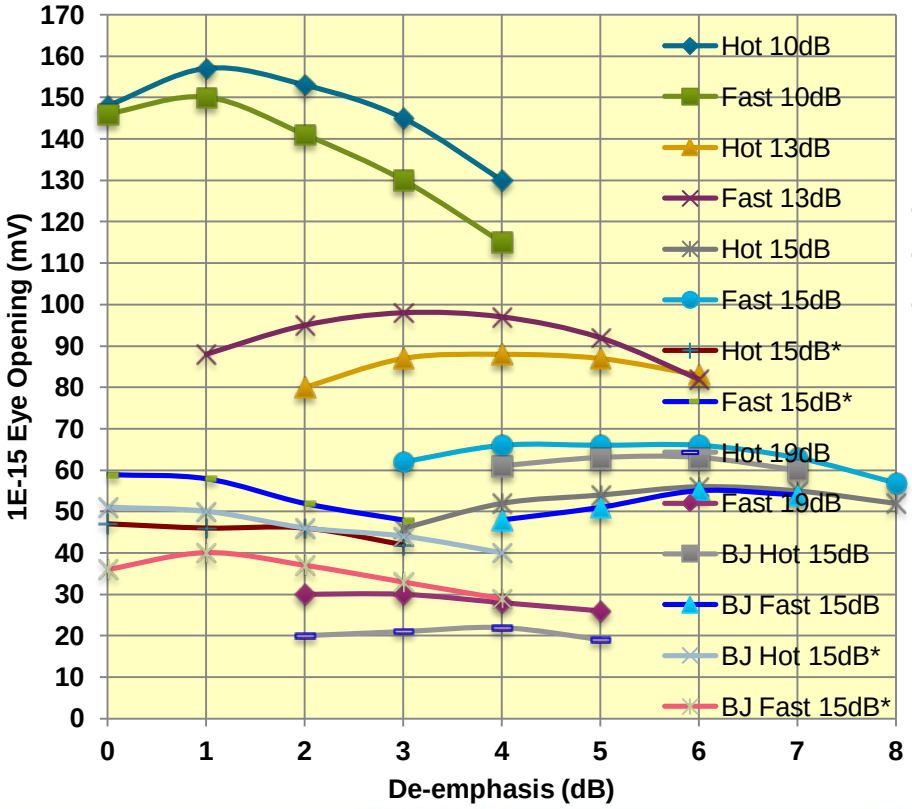




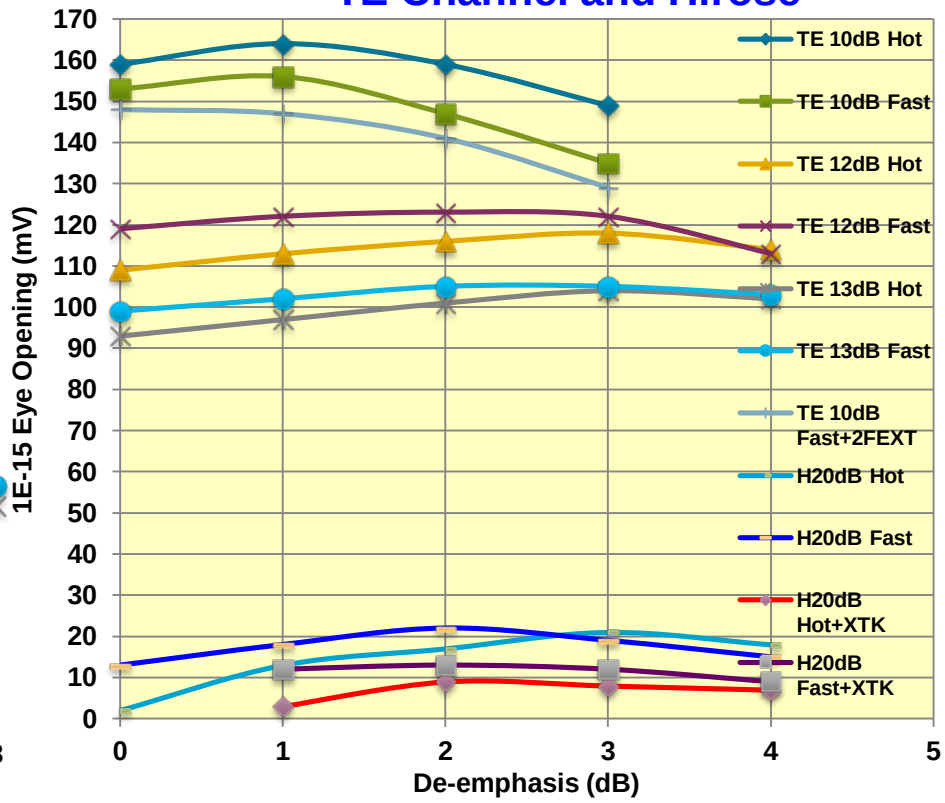
Summary of Eye Opening

- Fast driver performs better for higher loss channel
  - For full simulation details see http://www.ieee802.org/3/bm/public/mar13/ghiasi_01_0313_optx.pdf
  - Increasing CTLE peaking did not improve far end eye opening just reduced TX FFE
  - Optimizing TX FFE pre-cursor improves results below by ~10%
  - 19-20 dB channel results in only ~10 mV signal at TP5
  - All results are with 9 dB CTLE with exception of result with * based on 14 dB CTLE

FR4 Channel



TE Channel and Hirose



Simplified Method to Measure Transmit FFE

- This simplified procedure is sufficient to verify transmit FFE in CAUI-4 C2C applications
  - A KR4 transmitter more than sufficient to meet this application
- Transmitter FFE setting can be verified with following simplified procedure
  - Set pattern to 8 1's 8 0' repeating pattern or PRBS9 pattern
  - At TP0a measure VMA
  - Measure minimum post and pre level
  - Measure post/main and pre/main
    - Verify Post has at least 5 setting with one setting as zero de-emphasis
    - Verify Pre has at least 3 setting with one setting as off

Thank You !