Residual ISI Specification

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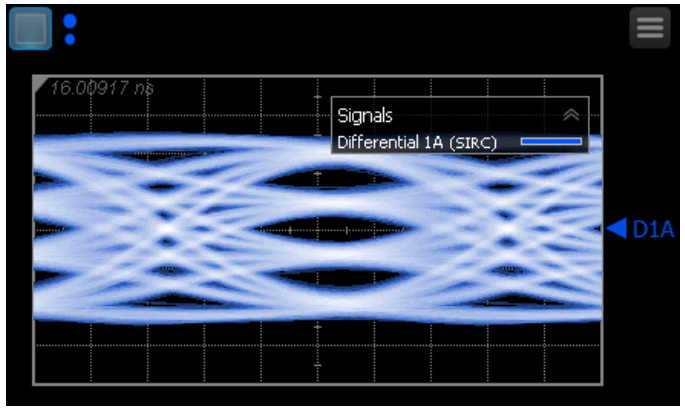
Introduction

- ISI_RES is specified with N_p=11, and therefore accounts for all error terms beyond post-cursor 6.
- With the transmitted signal measured at TP2, the ISI tail can extend beyond N_p=11.
- Currently proposed limit would cause commercial test equipment to fail at TP2.
- The ISI tail is expected to be mitigated by TX FFE, RX equalization or both.
- TX FFE was suggested in ran_3ck_adhoc_01_032322 and wu_3ck_adhoc_01_033022.
- RX CTLE mitigates the ISI tail more efficiently.
- Similar test methodology was adopted for SNR_ISI in 120.D.3.1.7.
- Relates to comments 18, 19, 20, 21, 22, 23, 28, 32 against D3.1

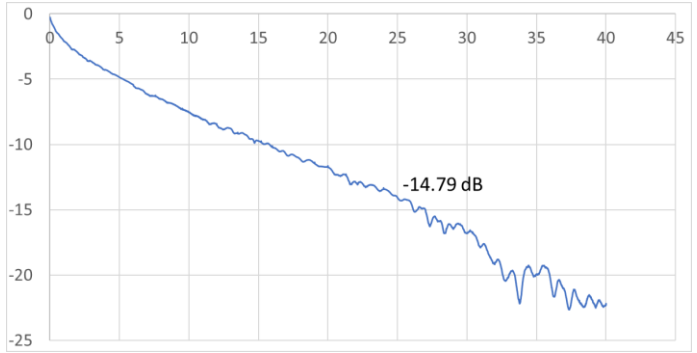
Test setup

BERT PPG → Physical Test Channel → Oscilloscope



PCB trace + OSFP connector + HCB

Total IL – 14.8dB @26.56 GHz
(3.9 dB for COM package +
10.975 dB for recommended loss
between TP0 and TP2)



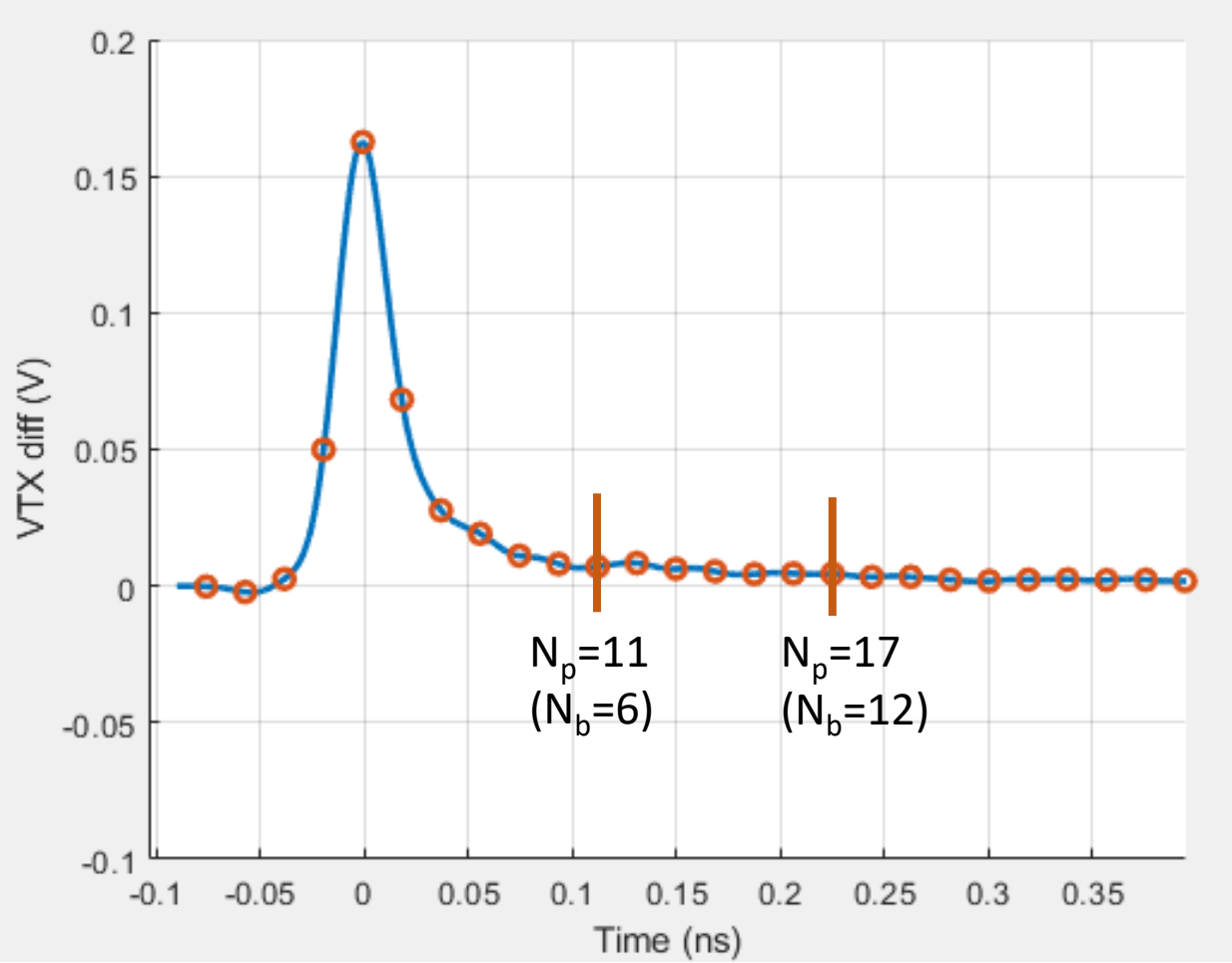
V_f = 0.407665

R_{peak}/V_f = 0.398652

SNDR = 34.487477

R_{LM} = 0.975340

Case 1 – No TX FFE, no RX CTLE



N_p=11 (6 post cursors)

ISI_RES = -22.8694 dB

σ_e = 0.0117 V

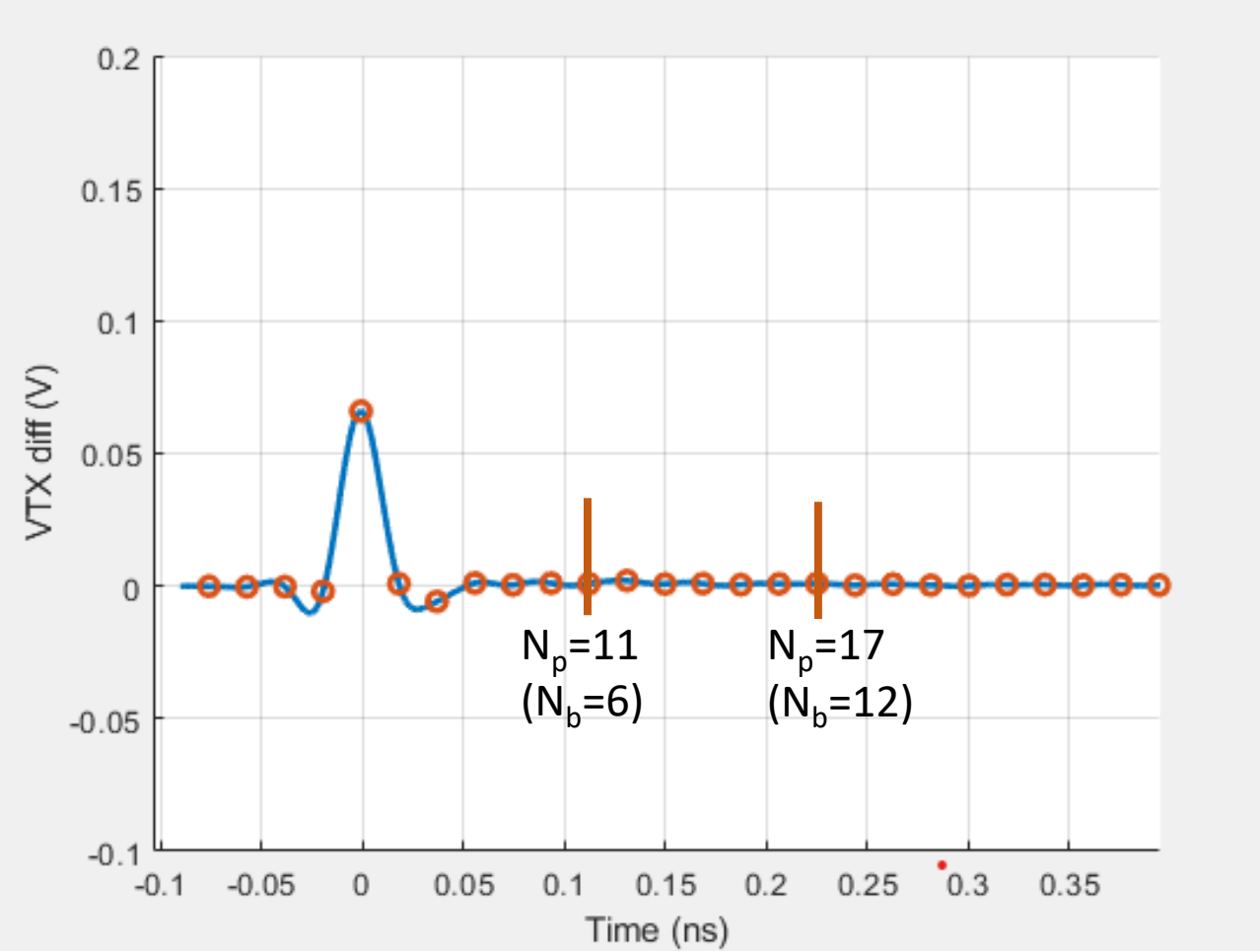
N_p=17 (12 post cursors)

ISI_RES = - 27.1311 dB

σ_e = 0.0071 V

Current specification – ISI_RES < -30 dB with N_p=11

Case 2 – Optimized TX FFE, no RX CTLE



*TX FFE taps – [0, 0.0294, -0.179, 0.585, -0.2]

N_p=11 (6 post cursors)

ISI_RES = -27.8027 dB

σ_e = 0.0027 V

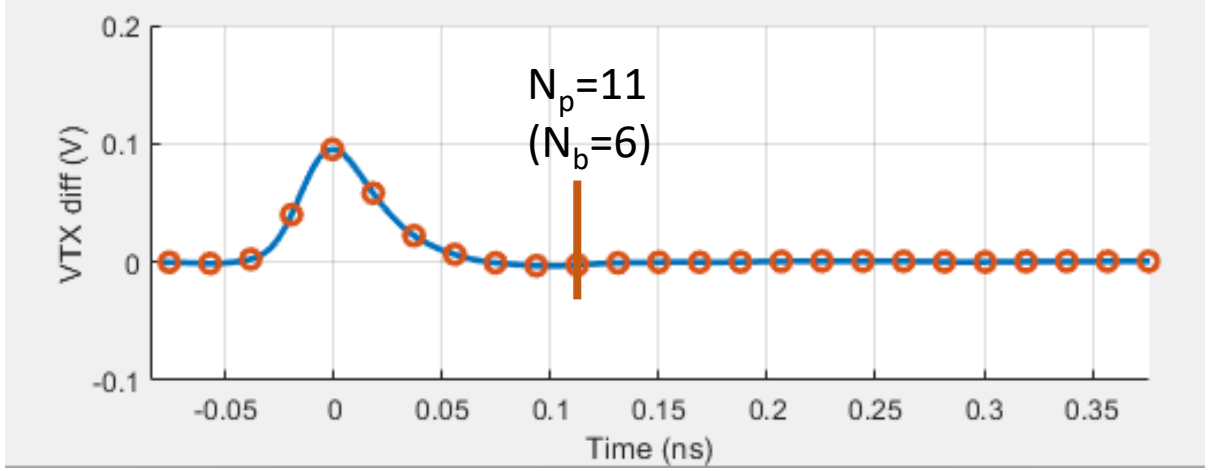
N_p=17 (12 post cursors)

ISI_RES = - 29.6271 dB

σ_e = 0.0022

Current specification – ISI_RES < -30 dB with N_p=11

Case 3 – No TX FFE, with RX CTLE

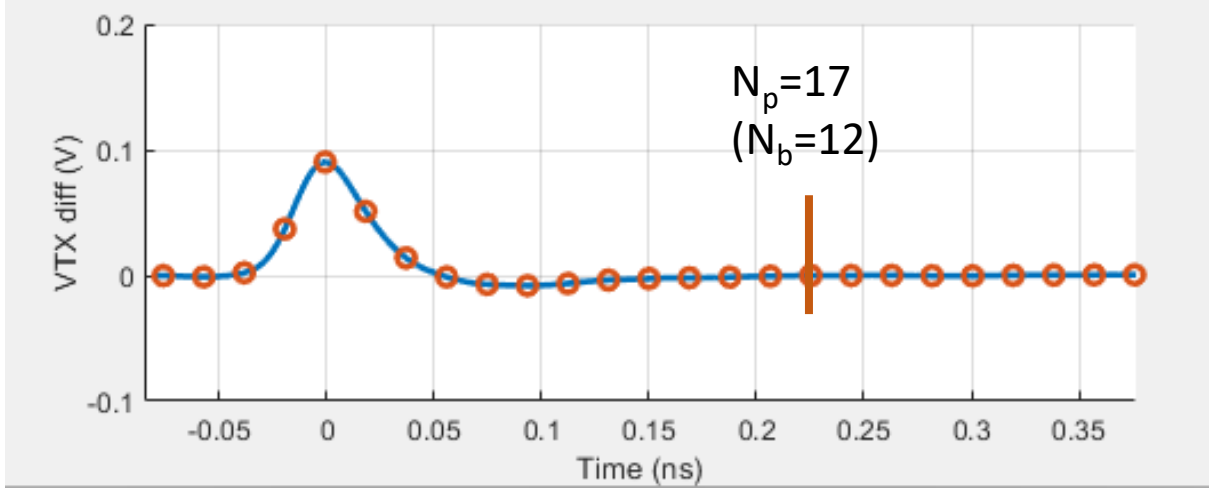


N_p=11 (6 post cursors)

ISI_RES = -31.3379 dB

σ_e = 0.0026 V

g_DC = -5
g_DC2 = -2



N_p=17 (12 post cursors)

ISI_RES = - 33.4291 dB

σ_e = 0.0019

g_DC = -8
g_DC2 = -1

Current specification – ISI_RES < -30 dB with N_p=11

Conclusions

- Currently proposed limit for ISI_RES at TP2 is borderline even for test equipment with optimized TX FFE.
- When measured at TP2, ISI_RES is dominated by the ISI tail, which is expected to be mitigated by RX equalization.
- Current definition does not account for the expected RX capabilities – 12 tap DFE and a CTLE.

Proposed Changes

- Define ISI_RES measurement with the COM reference receiver:
  - In 163.9.2.6 change

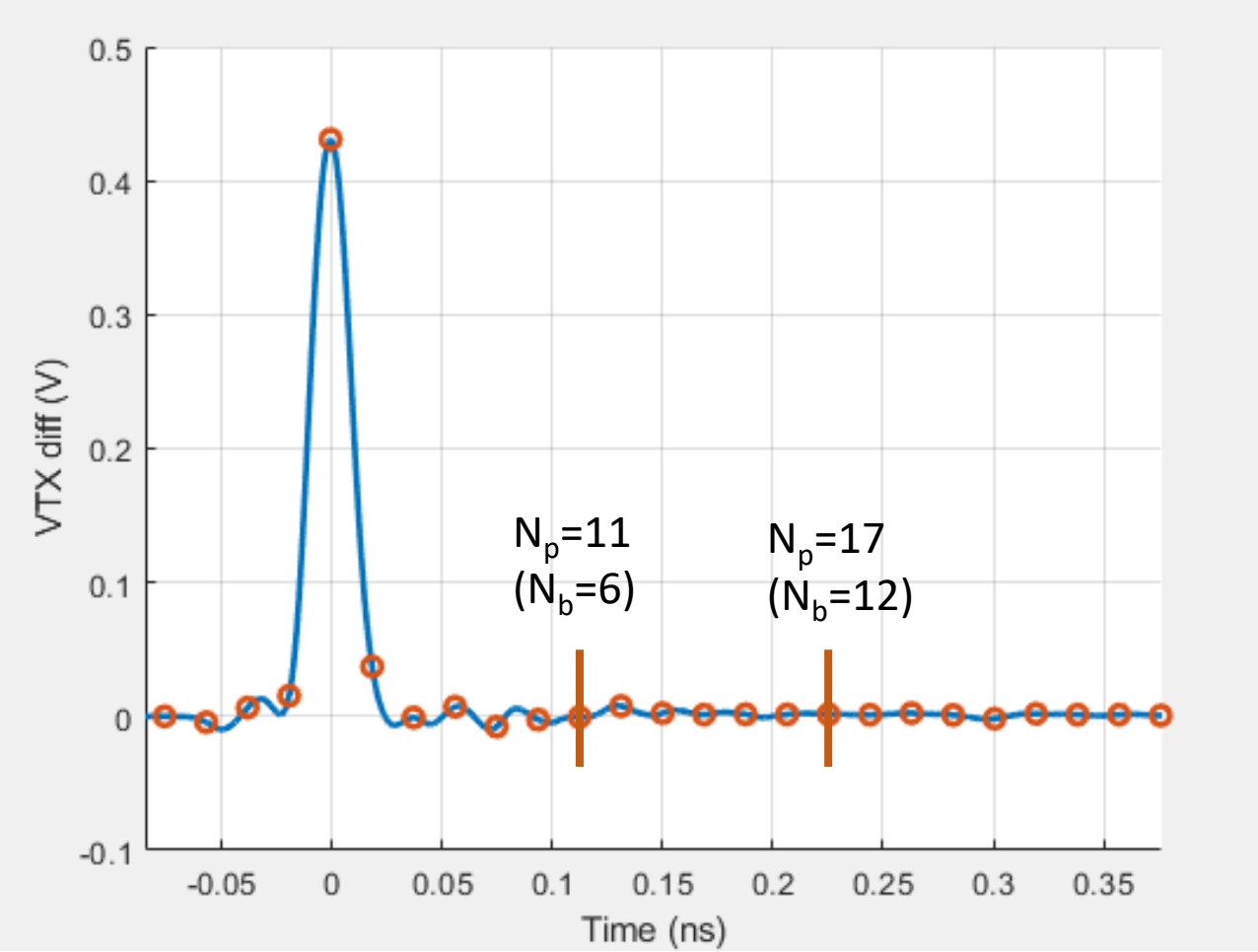
    “Residual intersymbol interference ISI_RES is determined using Equation (163–1). The linear fit pulse response p(k) and error e(k) are determined using the linear fit procedure in 162.9.4.1.1 with the exception that Np = 11.”

    to:

    “Residual intersymbol interference ISI_RES is determined using Equation (163–1). The linear fit pulse response p(k) and error e(k) are determined using the linear fit procedure in 162.9.4.1.1, after these have been recalculated with the continuous time filter described in 93A.1.4.3 using the parameters in Table 163-11 applied and optimized for minimum ISI_RES, with the exception that Np=12+Dp+1.”

Backup

For reference – Signal at TP0



N_p=11 (6 post cursors)

ISI_RES = -33.0463 dB

σ_e = 0.0096 V

With CTLE

g_DC = -2

g_DC2 = -1

ISI_RES = -35.5156 dB

N_p=17 (12 post cursors)

ISI_RES = - 34.7756 dB

σ_e = 0.0079

g_DC = -7

g_DC2 = 0

ISI_RES = -36.0719 dB