

PAM-4 Link Simulations with a Chip-to-Chip (c2c) Channel

For IEEE 802.3bs

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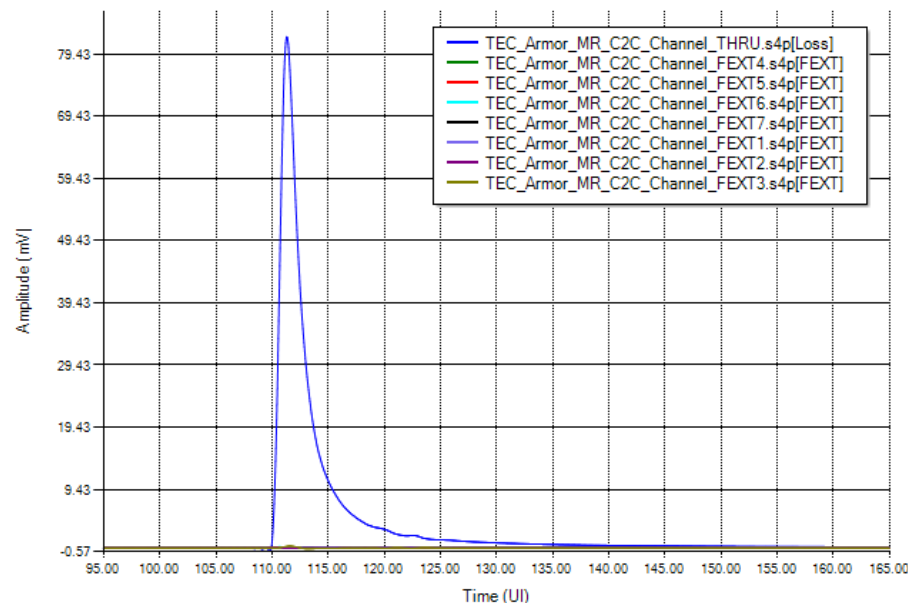
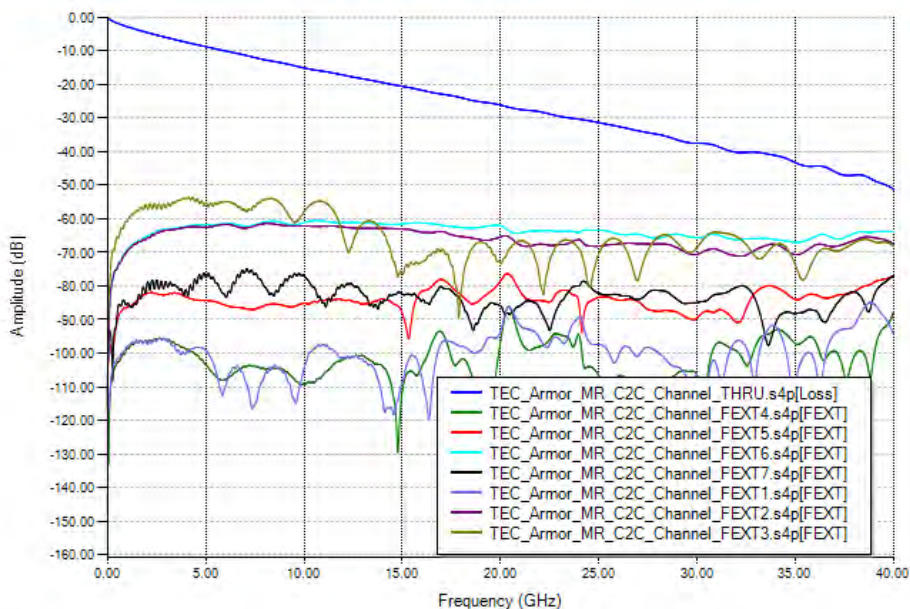
Channel Characteristics

TEC_Armor_MR_C2C_Channel_THRU/FEXTn.s4p

(<http://www.ieee802.org/3/bs/public/channel/index.shtml>)

JNEye Channel Viewer: [1] FR: Sdd21

JNEye Channel Viewer: [2] SBR: Sdd21



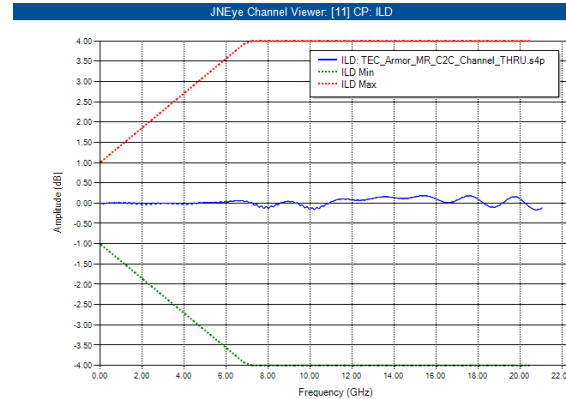
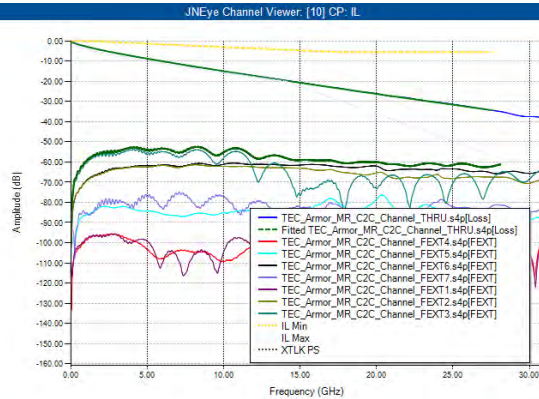
Note:

- IL at 13 GHz = -18.3 dB, PSXT = -56.9 dB at 13 GHz
- Shown good TEC channel characteristics in frequency and time domain.
 - ◀ Thru channel: shown slight causality violation

Channel Characteristics (cont.)

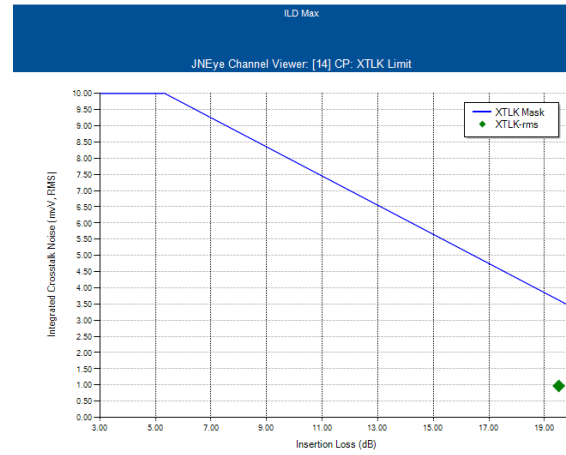
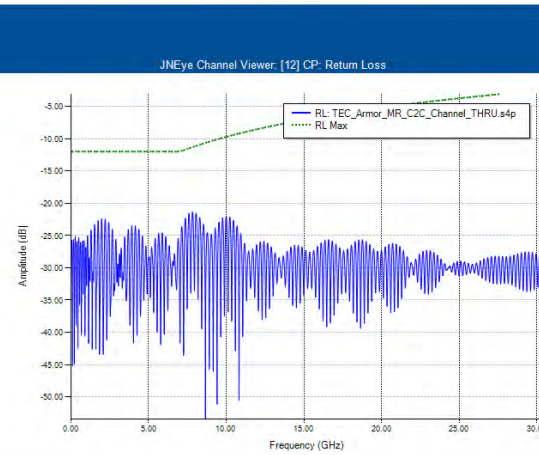
TEC_Armor_MR_C2C_Channel_THRU/FEXTn.s4p

Insertion Loss



ILD

Return Loss



ICN

OIF-CEI-28G-MR Channel Compliance Check

— Pass all checks

IL at 13 GHz = 18.3 dB, ILD <= +/- 0.19 dB, ICN = 0.97 mV rms



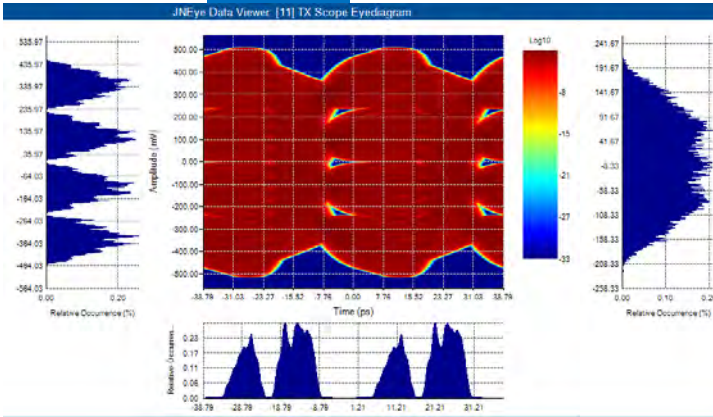
Link Configuration and Parameter Settings

- ◀ Data Rate: 51.56 Gbps
- ◀ Signaling: PAM-4
- ◀ Test pattern: PRBS-31 + PAM-4
- ◀ BER: 10^{-6} and 10^{-15}
- ◀ Channel: TE C2C channels
 - with 7 FEXT
- ◀ TX:
 - Vdiff: 1.15V
 - Tf: 14.7 ps
 - Noise: 0.5 mV-rms
 - Jitter:
 - ◀ DCD 0.014 UI, BUJ: 0.033 UI, RJ: 0.211 ps-rms
- ◀ RX:
 - CTLE, 5- and 10-Tap DFE

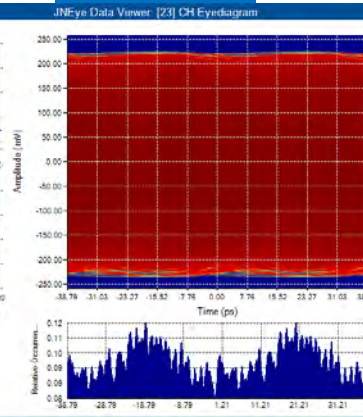
Link Simulation Results

Data Rate: 51.56 Gbps / PAM-4 / TX (3-Tap FIR) / RX (10-Tap and 5-Tap DFE)

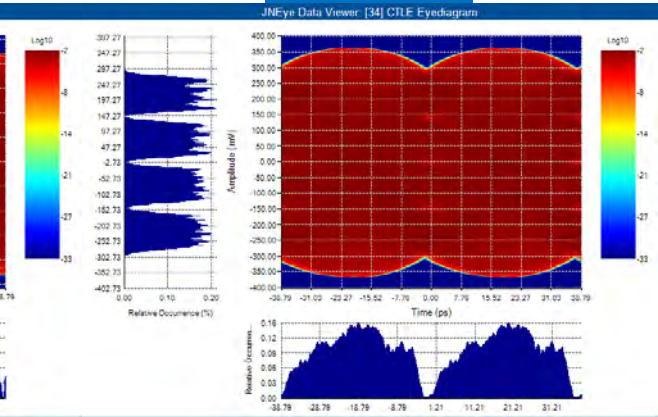
TX Output



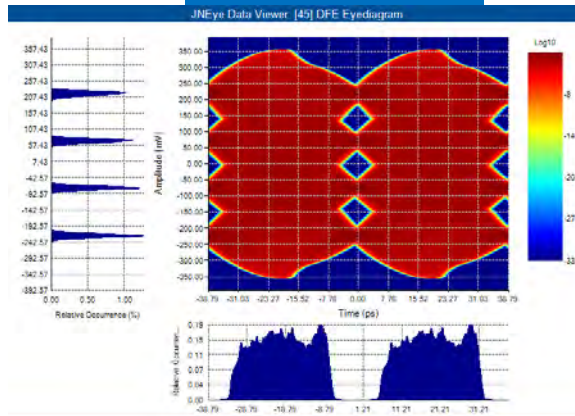
Channel Output



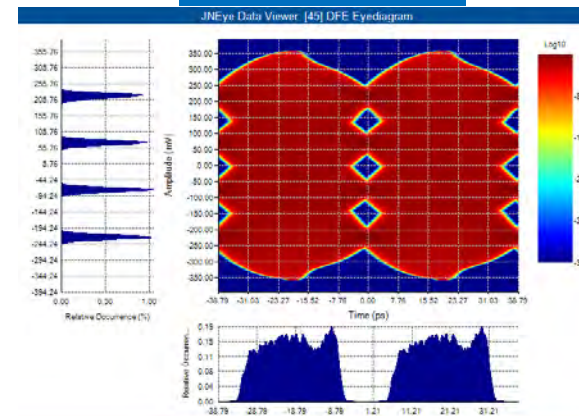
RX CTLE Output



RX w/ 10-Tap DFE Output



RX w/ 5-Tap DFE Output



DFE (10-Tap) Output
 BER 1e-15: EW = 0.17 UI (6.47 ps), EH = 76.6 mV
 BER 1e-6: EW = 0.23 UI (8.83 ps), EH = 90.1 mV

DFE (5-Tap) Output
 BER 1e-15: EW = 0.16 UI (6.06 ps), EH = 70.8 mV
 BER 1e-6: EW = 0.22 UI (8.41 ps), EH = 81.1 mV

Summary and Conclusion

- ◀ This PAM-4 simulation results with TE C2C link channels suggest:
 - SERDES with a 3-tap FIR, CTLE, 5-tap DFE, and KP4 FEC can provide solution with link BER < 1e-15

References

- [1] <http://www.ieee802.org/3/bs/public/channel/index.shtml>
(TE channel data)