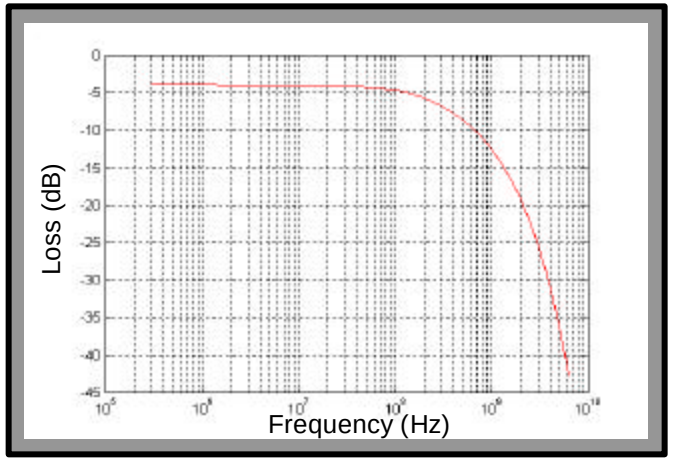
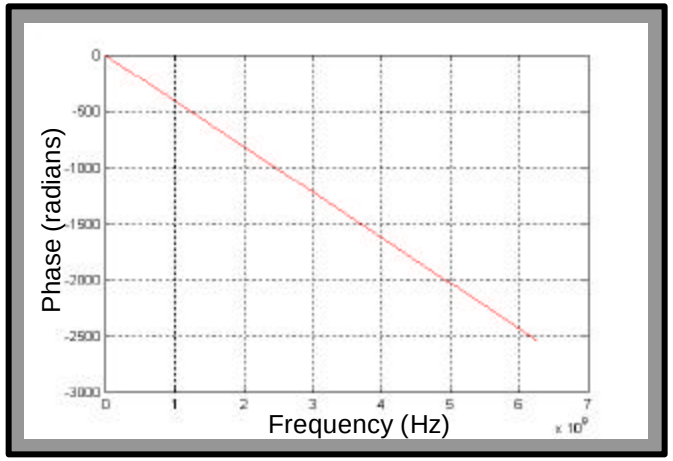
10GBASE-CX4 Link Analysis Outline

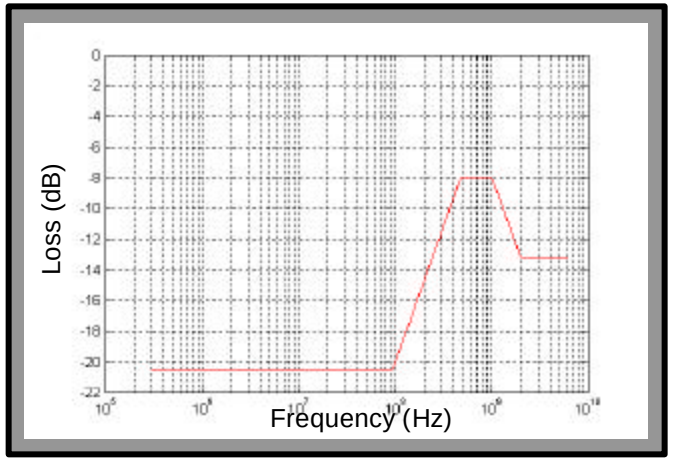
- Link Model Definition
- Cable Specifications v.s. Measurements
- Transceiver Specifications v.s. Measurements
- **Link Simulations**
- Summary / Recommendations

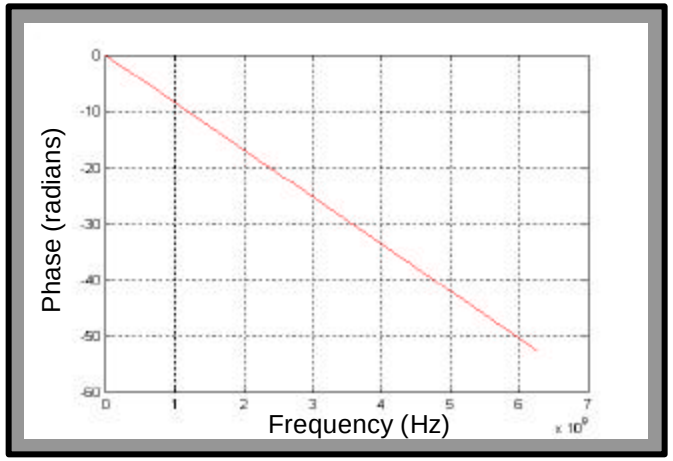
S-parameters to Pulse Response





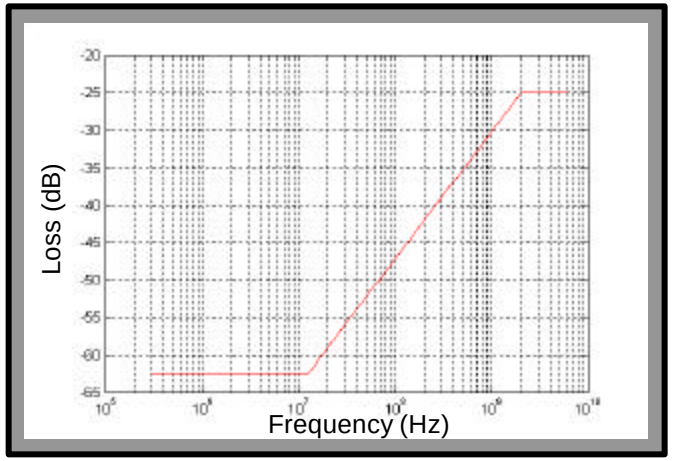
Insertion Loss

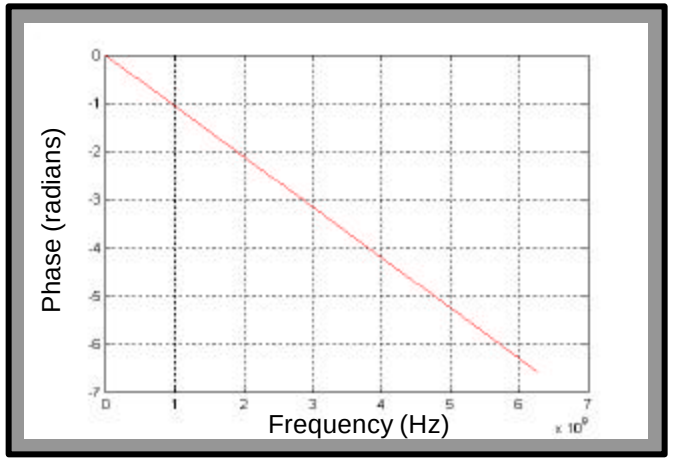




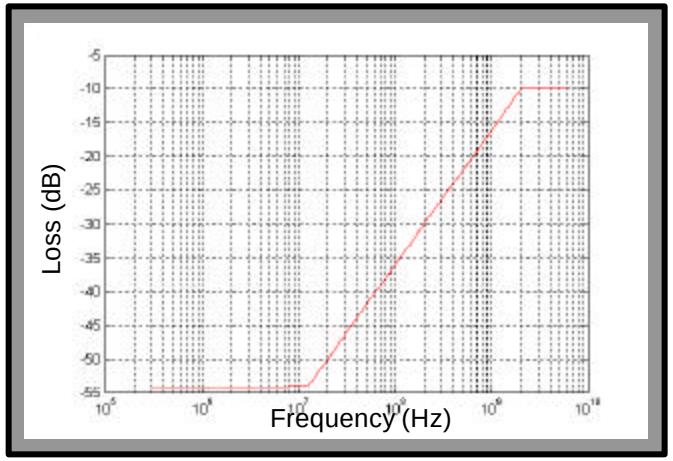
Return Loss

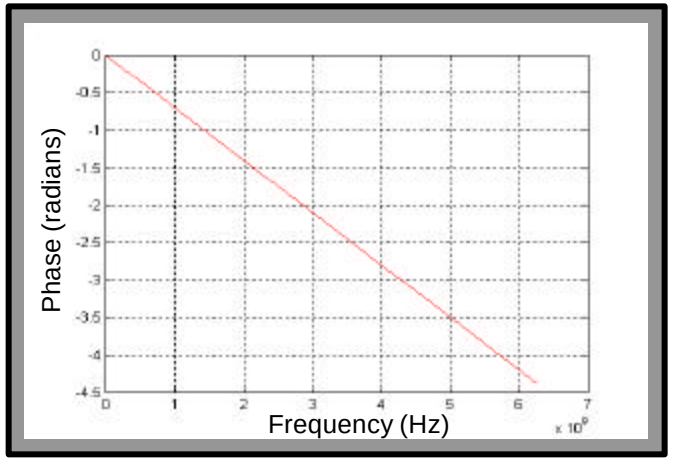
S-parameters to Pulse Response





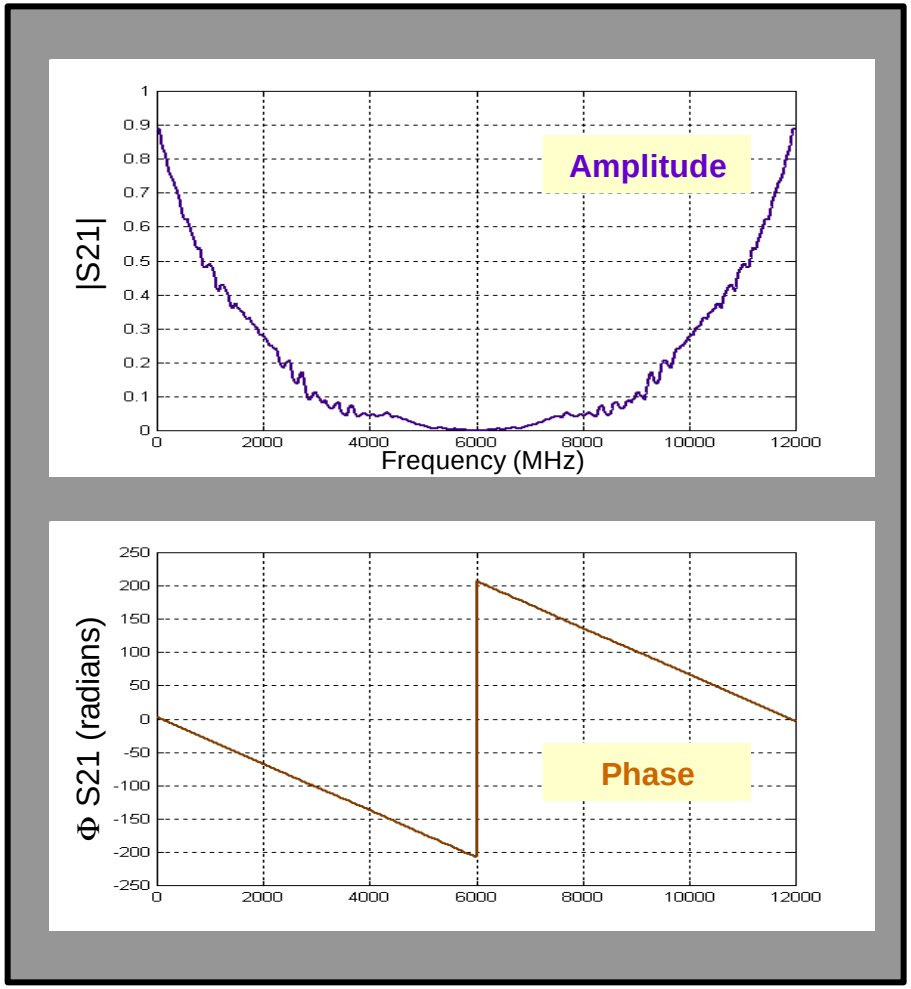
MDNext



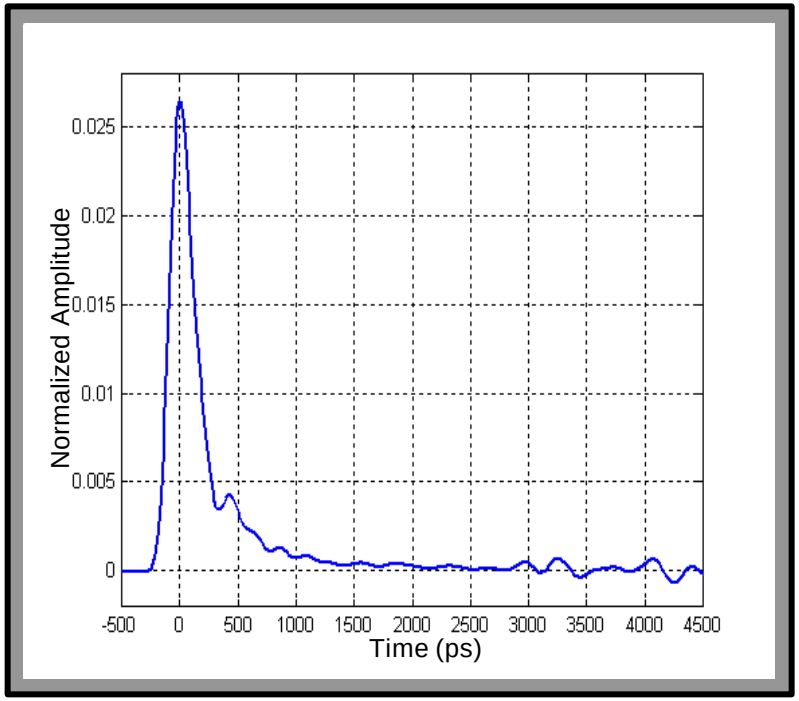


MDELFext

Inverse DFT to Obtain Impulse Response



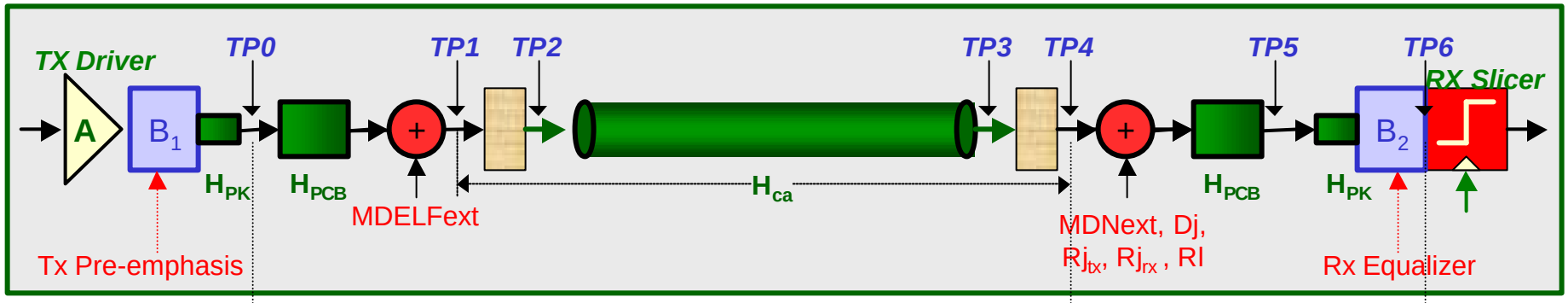
MATLAB Inverse Fourier Transform

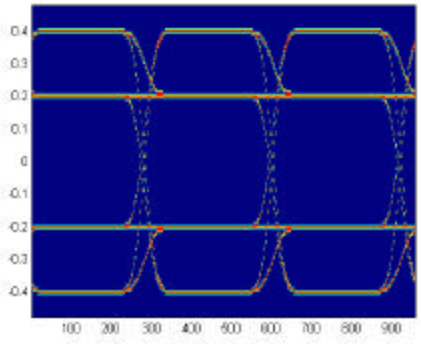


Impulse Response: IFFT

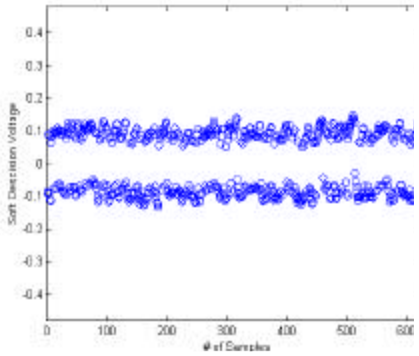
Frequency Response for DFT with Fs=12.5-GHz

D4.0 Link Simulation Results

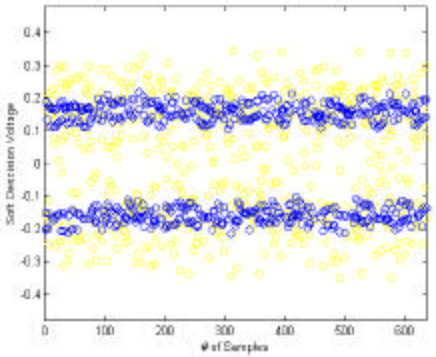




Eye = 400mVpp
Margin = 400mVpp



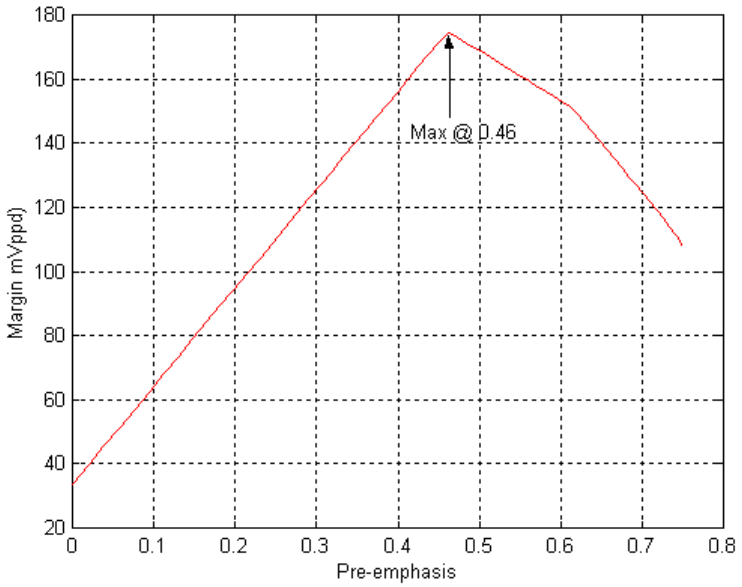
Eye = 81mVpp
Margin = 39mVpp



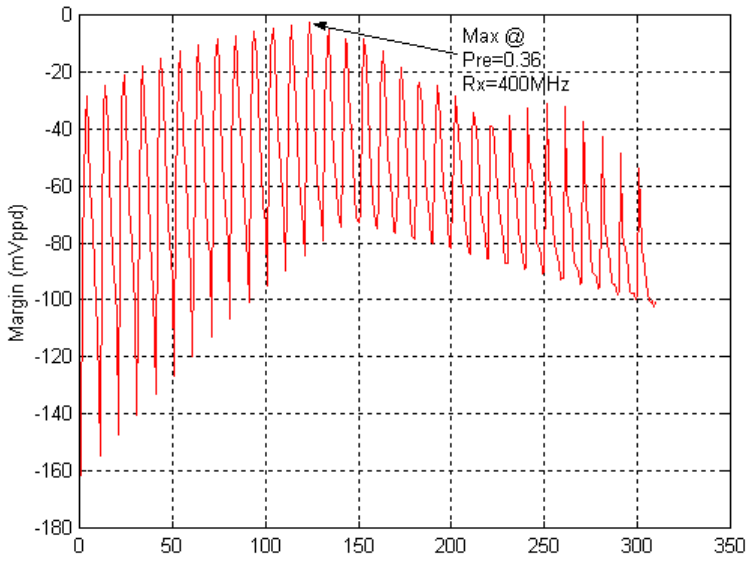
Eye = 0mVpp
Margin = -258mVpp

• Typical Eye Diagrams for Nominal Pre-emphasis = 50%

Equalization Optimization

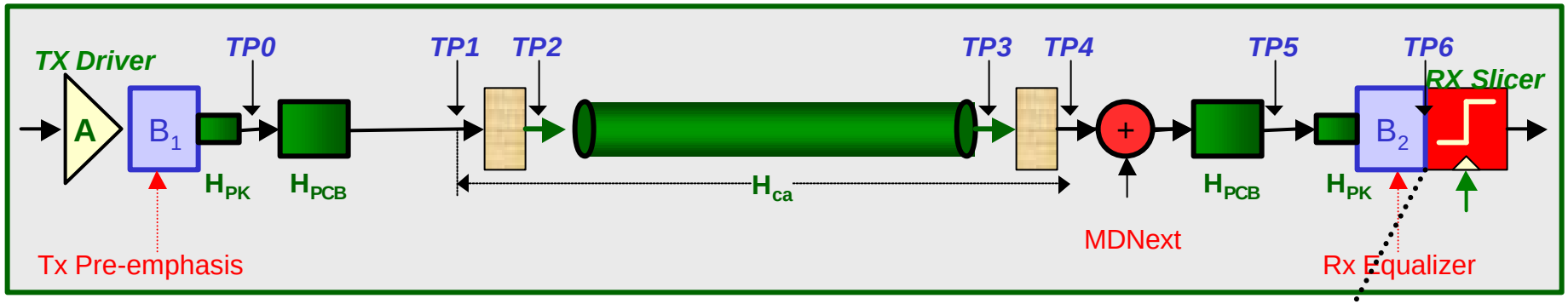


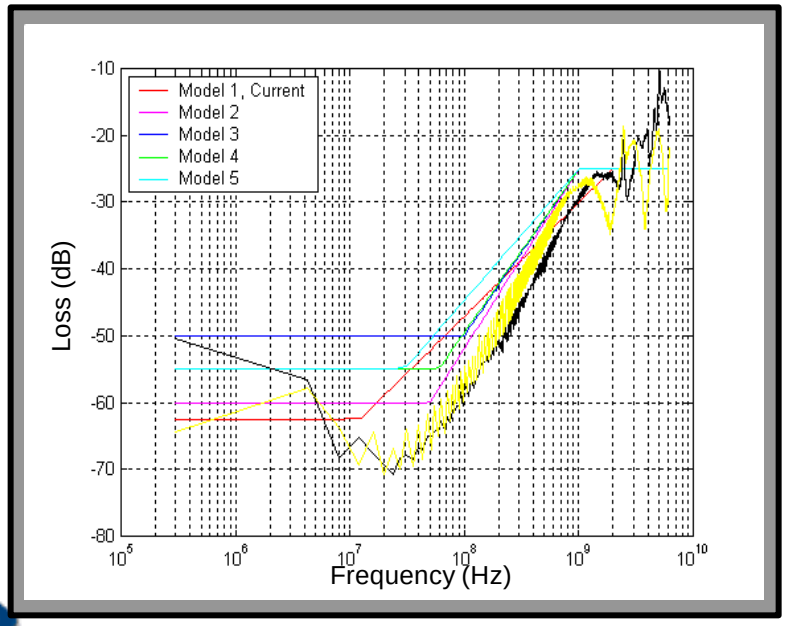
2/3 Worst Case Insertion Loss



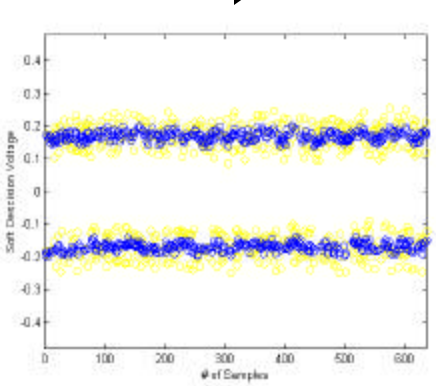
Margin vs Pre-emp vs Rx Eq.
Worst Case Insertion Loss

MDNext Sensitivity



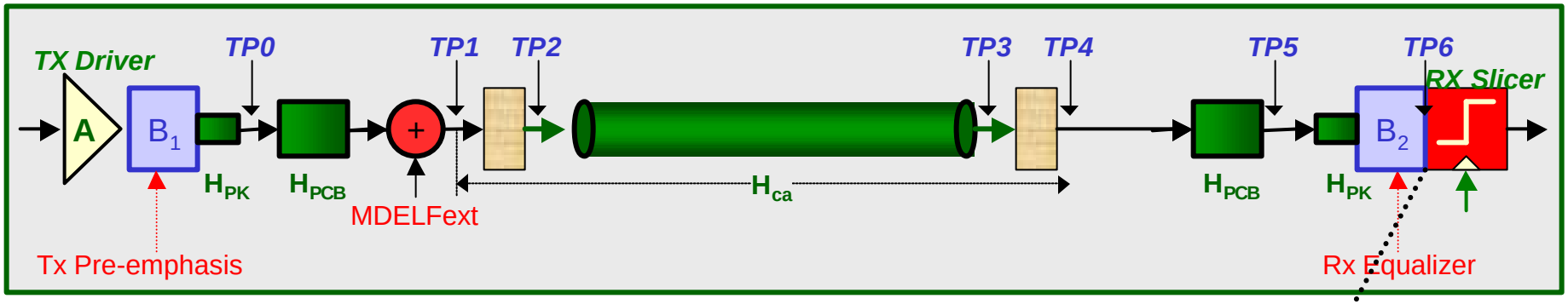


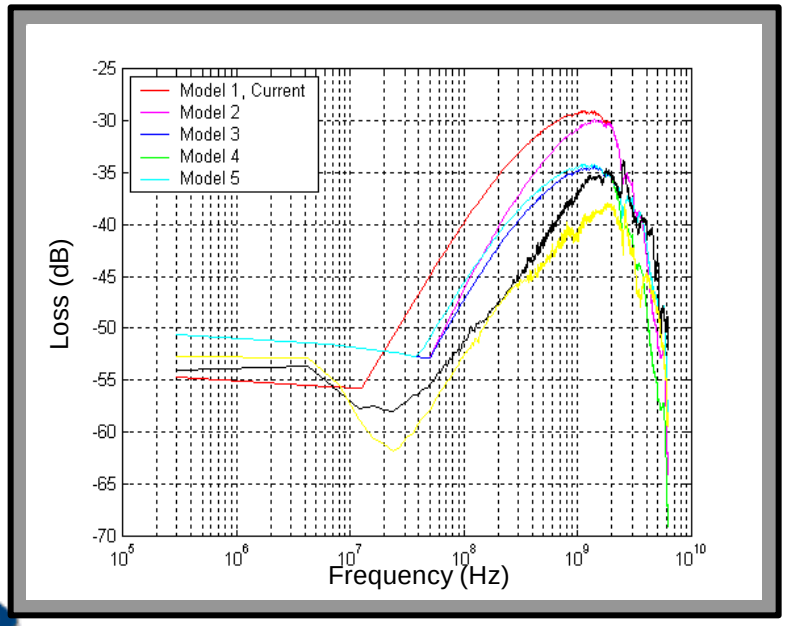
Model	Eye	Margin
1	178	127
2	157	106
3	158	105
4	157	105
5	156	105



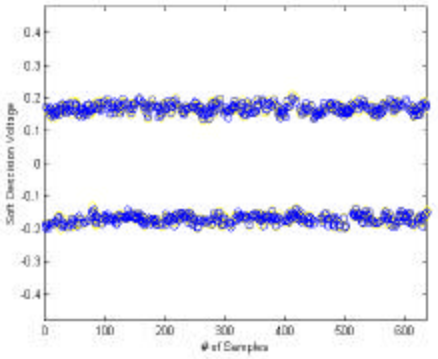
Current Model 1
Eye = 178mVpp
Margin = 127mVpp

MDELFext / MDFext Sensitivity



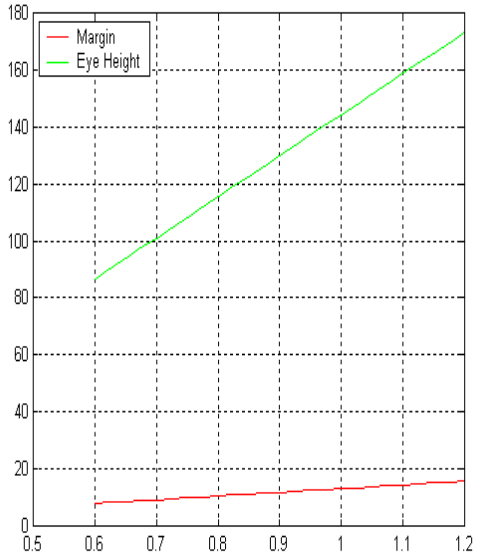


Model	Eye	Margin
1	242	264
2	247	172
3	262	202
4	262	200
5	262	194

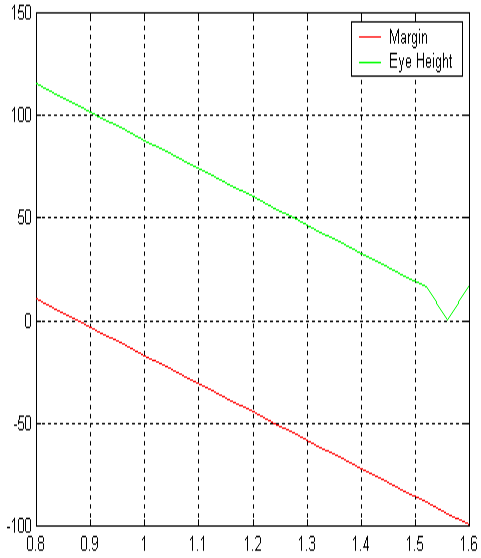


Model 3
Eye = 262mVpp
Margin = 202mVpp

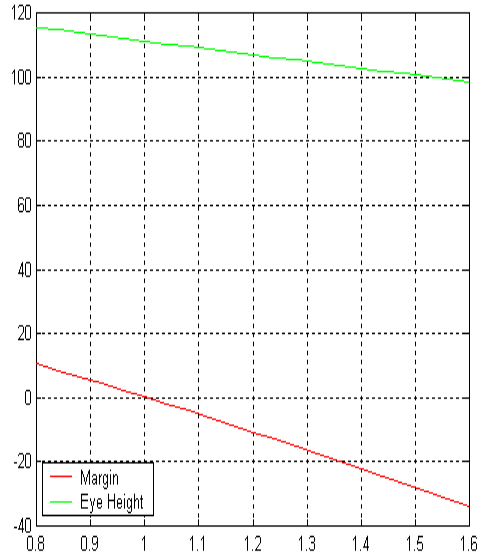
Amplitude Sensitivities



Tx Amplitude vs Margin

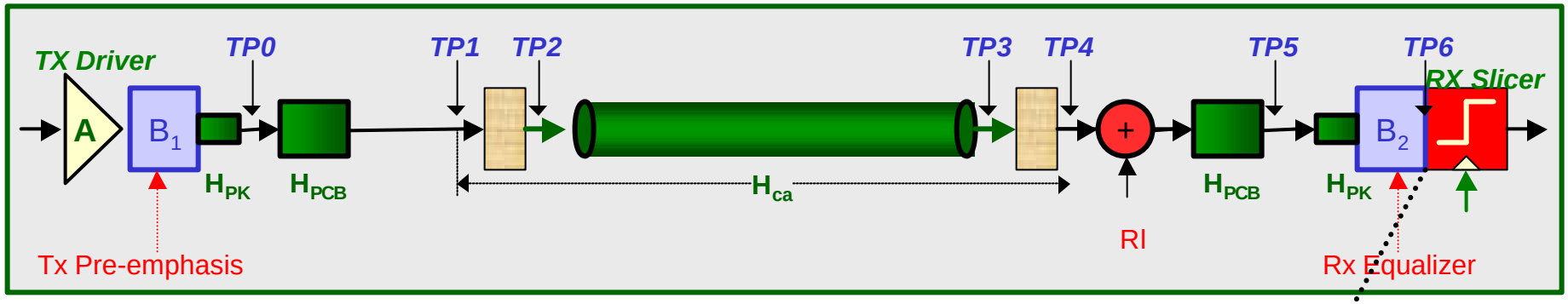


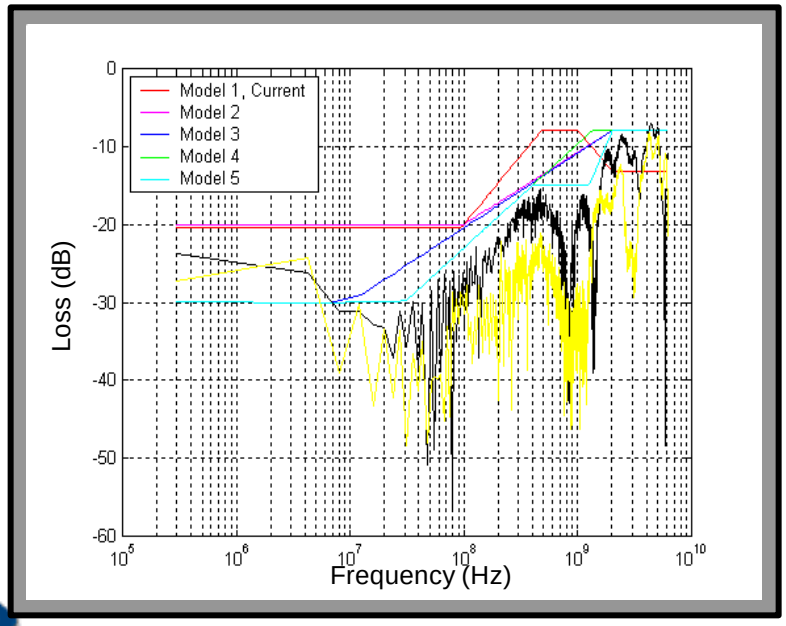
MDNext Amplitude vs Margin



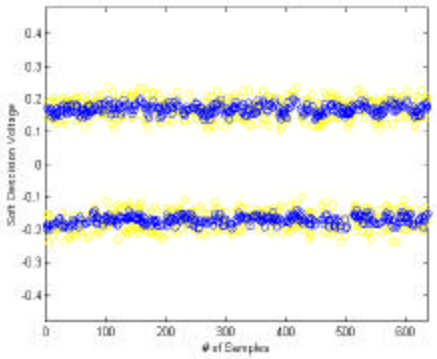
MDFext Amplitude vs Margin

Cable Assembly Return Loss Sensitivity



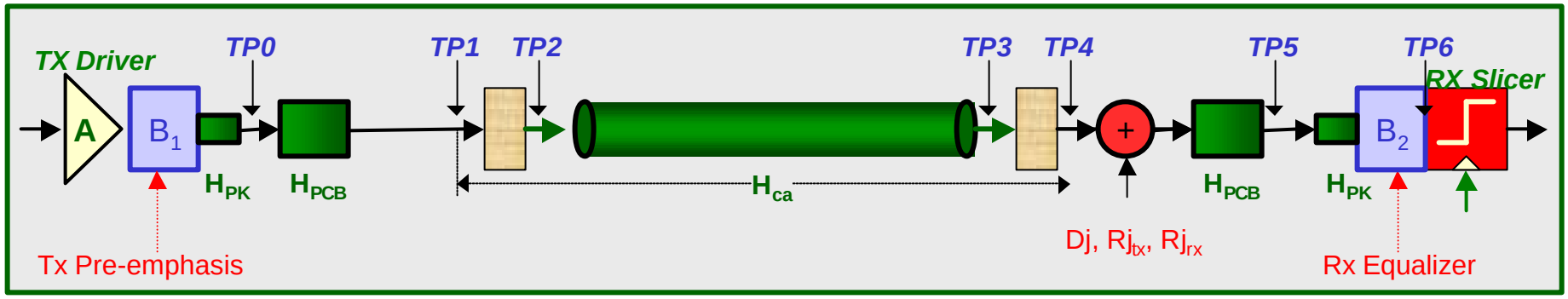


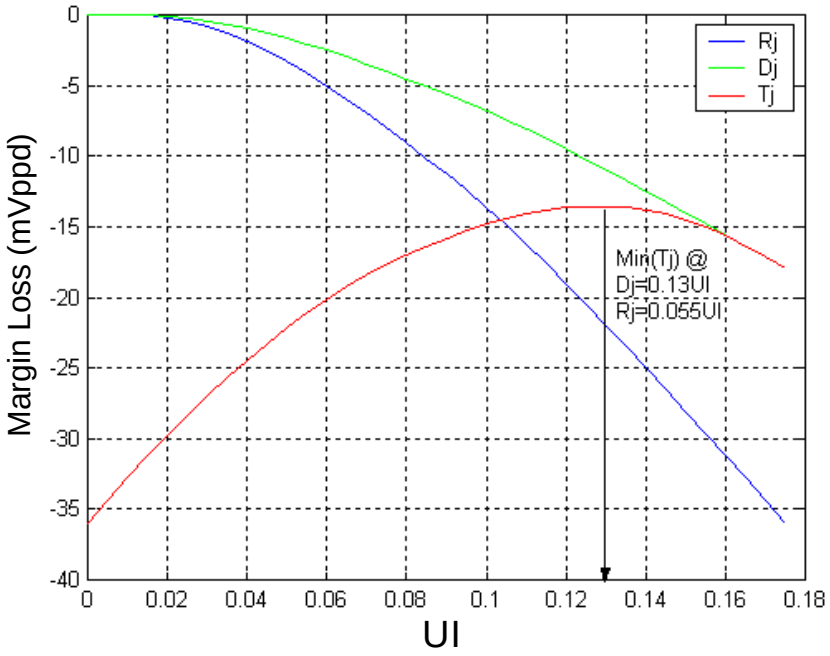
Model	Eye	Margin
1	171	96
2	176	117
3	175	115
4	161	100
5	205	243



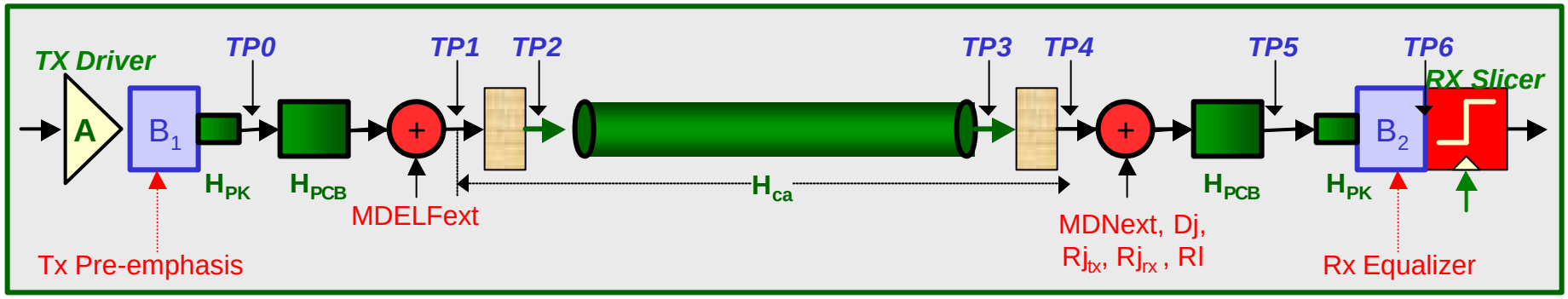
Model 5
Eye = 262mVpp
Margin = 202mVpp

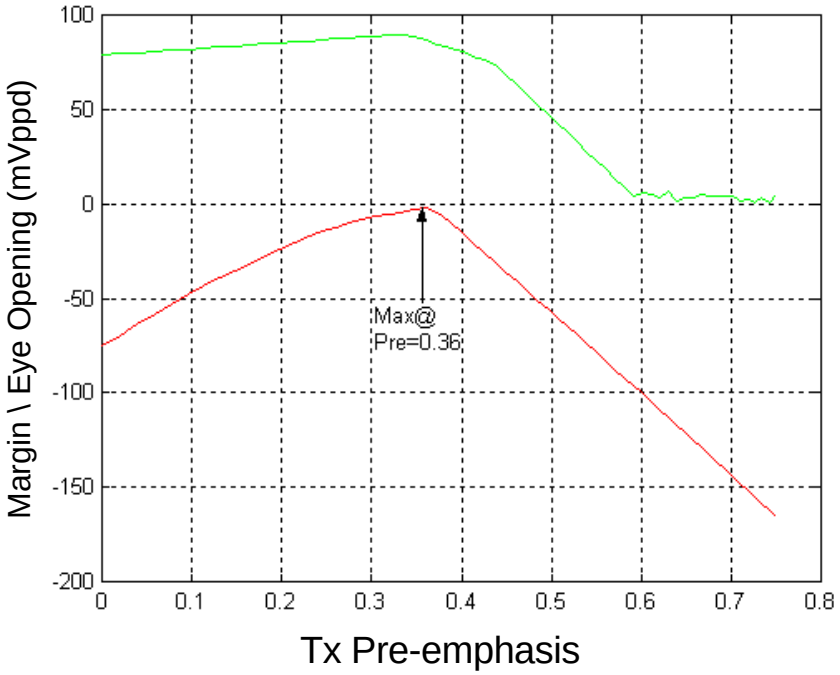
Jitter Sensitivity





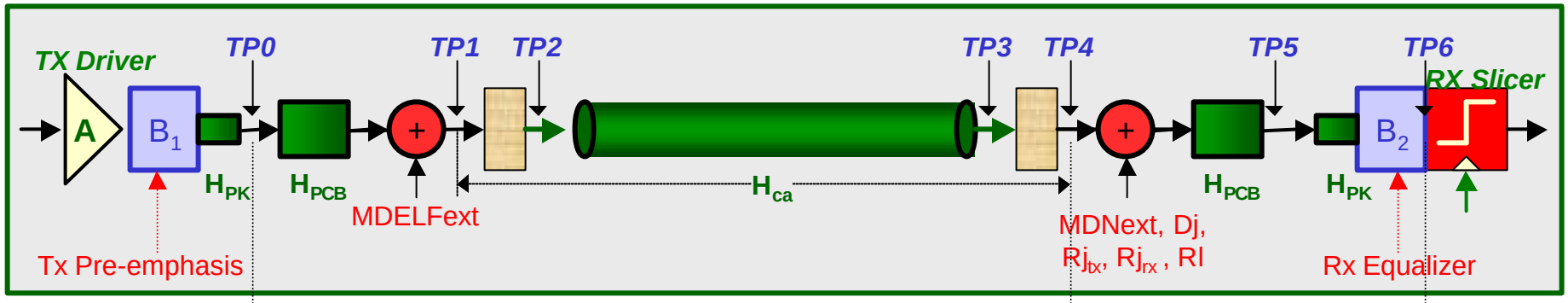
Worst Case Simulation

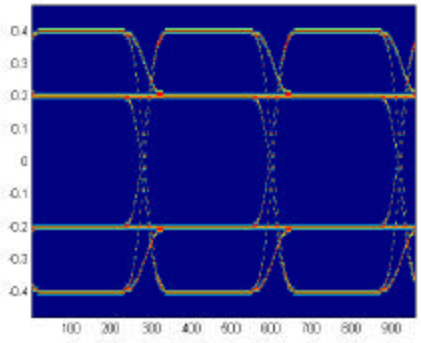




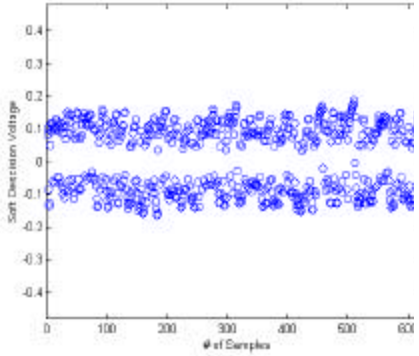
IL = Current Spec
RL = Model #5
MDFext = Model #3
MDNext = Current Spec
Trf = 130ps
V(fext) = 1.2Vppd
V(next) = 1.0Vppd
V(tx) = 800mVppd
Dj = 0.085Ui
Rj = 4.2ps rms
Rx Pole = 400MHz

D4.1 Cable Assembly Model?

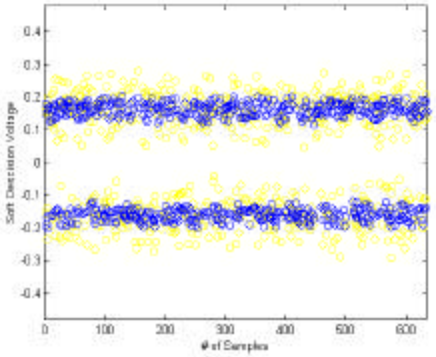




Eye = 400mVpp
Margin = 400mVpp



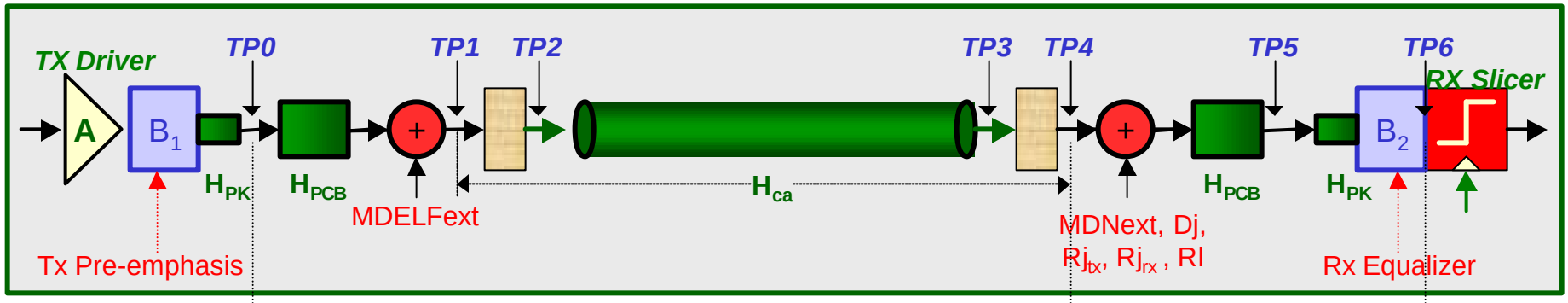
Eye = 38mVpp
Margin = -17mVpp

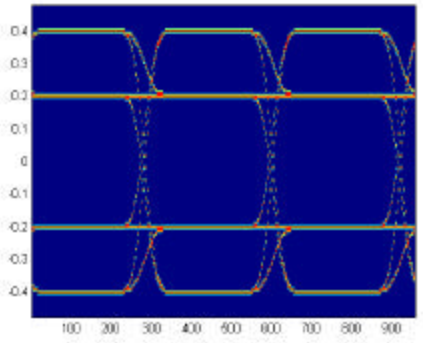


Eye = 86mVpp
Margin = -3mVpp

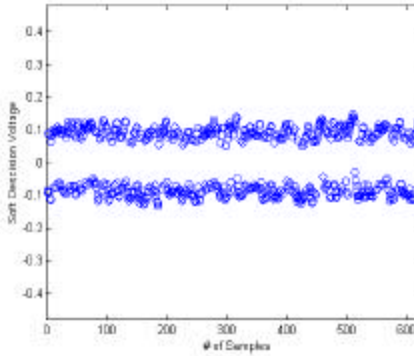
• Typical Eye Diagrams for Nominal Pre-emphasis = 36%

D4.0 Link Simulation Results

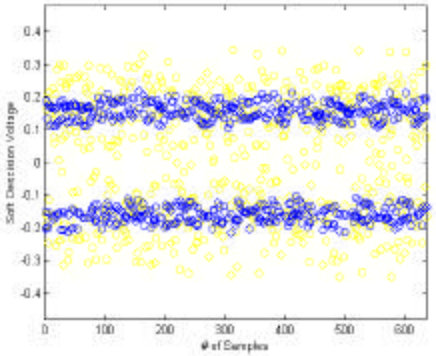




Eye = 400mVpp
Margin = 400mVpp



Eye = 81mVpp
Margin = 39mVpp



Eye = 0mVpp
Margin = -258mVpp

• Typical Eye Diagrams for Nominal Pre-emphasis = 50%

10GBASE-CX4 Link Analysis Outline

- Link Model Definition
- Cable Specifications v.s. Measurements
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- Link Simulations
- **Summary / Recommendations**

Cable Assembly Summary / Recommendations

- MDELFext is to large and doesn't match measured cable assemblies, change to:
  - MDELFext >= 15 - 21.85 x log10(Freq/50) for 50MHz < Freq <= 2000MHz
  - ELFext >= 17 - 21.85 x log10(Freq/50) for 50MHz < Freq <= 2000MHz
- Return Loss is to large and doesn't match measured cable assemblies, change to:
  - Return Loss >= 30 - 13.33 x log10(Freq/30) for 10MHz < Freq <= 400MHz
  - Return Loss >= 15 for 400MHz < Freq <= 1250Mz
  - Return Loss >= 15 - 34.3 x log10(Freq/1250) for 1250MHz < Freq <= 2000MHz

Transmitter Summary / Recommendations

- Transmit amplitude range is to large allowing for the creation of excessive Next, adopt the following specification:
  - Differential peak amplitude lane to lane difference shall be less then 200mVpp.
- Transmit amplitude range is to large allowing for the creation of excessive Fext, make the following change:
  - Differential peak amplitude, maximum, section 54.7.3.4, shall be less than 1200mVpp.
- Adopt the transmit template submitted by Ze'ev Roth and scaled for 36% pre-emphasis

END