Proposed Changes for Annex 69B

Howard Baumer, Magesh Valliappan

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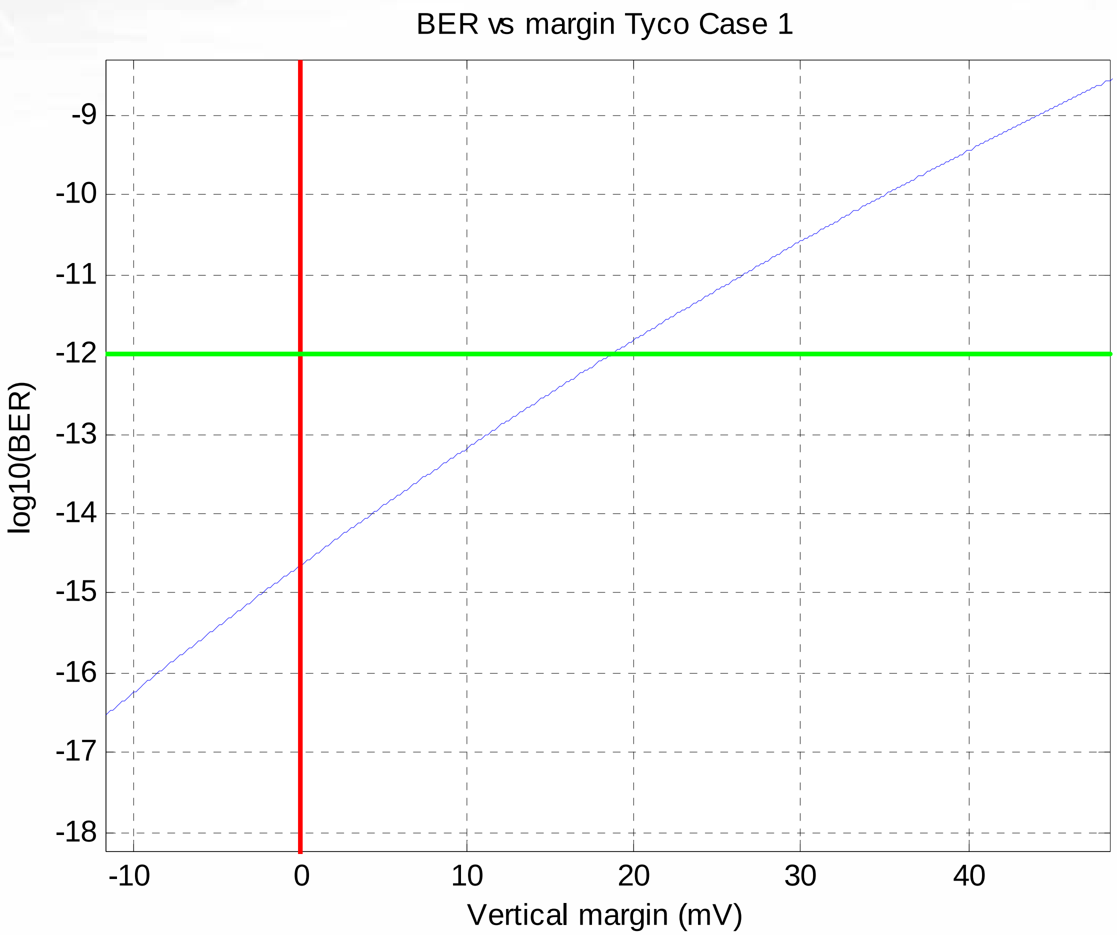
Simulation Conditions

- TX
  - Vpp 900mV
  - 40ps rise time
  - 55 ohm driver with Mellitz cap like package model (PAD+ESD cap = 0.63pF)
    - RL touches template near 4.5GHz, margin at other frequencies
  - Jitter : 0.1UIpp DJ, 0.05UI DCD, 0.15UI RJ
- XTLK
  - Same as transmitter, including FIR taps
- RX
  - Same package model as TX
  - 5 tap DFE, with quantization
  - +/- 5mV slicer ambiguity
  - Analytical model for CDR and RX jitter
  - 1.46mV RMS external noise
- Simulation Environment
  - Analytical model – Non-Gaussian, PDF based
  - Worst case alignment of XTLK, Reflections
  - Analog non-linearity not budgeted

Simulation Result Example



- Tyco Case 1, BER = 2e-15 [log10(BER) = -14.66]
- Tyco Case 1, Eye opening at 1e-12 = 19mV

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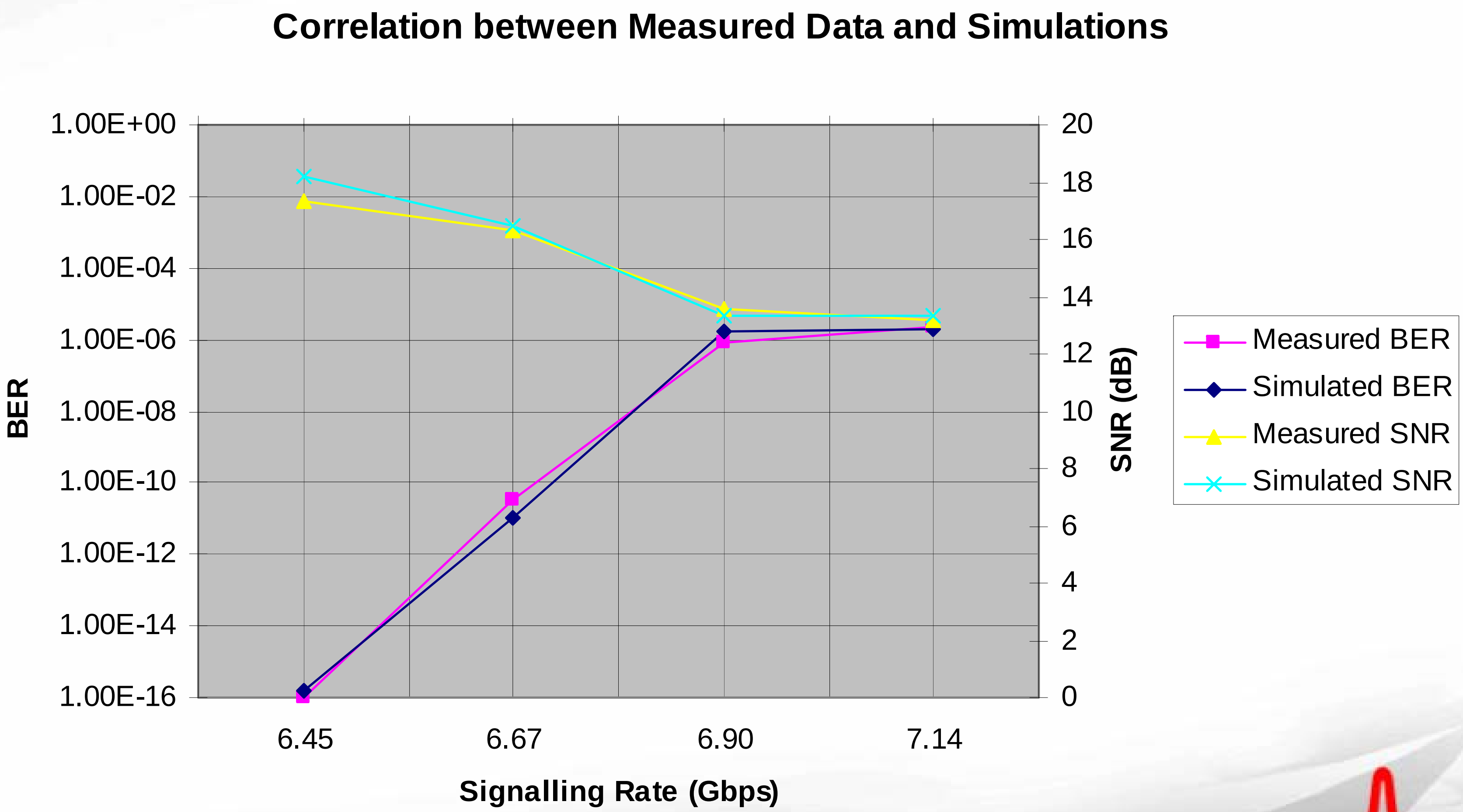
Correlation between Lab Measurements and Simulations



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Simulated Channels

- DAmbrosia_1T thru DAmbrosia_7T
- Molex_Inthru2-5 & Molex_Outthru2-5
- New Peters_B12,1,20,M1,20,T1,12,20
- Avago Ripple from Charles Moore
  - m_28_ripple_92 w/ Molex_Inthru2 crosstalk
  - m_40_ripple_29 w/ Molex_Inthru2 crosstalk
  - m_41_ripple_65 w/ Molex_Inthru2 crosstalk
  - m_42_ripple_92 w/ DAmbrosia_7T crosstalk
  - m_60_ripple_29 w/ DAmbrosia_7T crosstalk
  - m_60_ripple_55 w/ Molex_Inthru3 crosstalk
  - m_60_ripple_98 w/ Molex_Inthru3 crosstalk
  - m_81_ripple_46 w/ DAmbrosia_3T crosstalk
  - m_81_ripple_23 w/ Molex_Outthru4 crosstalk
  - m_82_ripple_90 w/ DAmbrosia_7T crosstalk
- Moore thru_worst

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Simulation vs D2.3 Annex 69B Limit Lines

Channel	Simulation		D2.3 Limits				
	BER	Veye	Amax	IL	ILD	RL	ICRf
Media/EoBP_DAmbrosia/DAmbrosia_1T	-14.66	19	X	-	-	-	-
Media/EoBP_DAmbrosia/DAmbrosia_2T	-13.38	10	X	-	-	-	-
Media/EoBP_DAmbrosia/DAmbrosia_3T	-11.28	-6	X	X	-	-	-
Media/EoBP_DAmbrosia/DAmbrosia_4T	-14.14	15	-	-	-	-	-
Media/EoBP_DAmbrosia/DAmbrosia_5T	-14.44	17	-	-	-	-	-
Media/EoBP_DAmbrosia/DAmbrosia_6T	-6.22	-69	-	X	X	-	-
Media/EoBP_DAmbrosia/DAmbrosia_7T	-11.96	0	-	-	-	-	-
Media/EoBP_Molex/Molex_Inthru2	-8.62	-32	X	-	-	-	X
Media/EoBP_Molex/Molex_Inthru3	-5.96	-70	X	-	-	-	X
Media/EoBP_Molex/Molex_Inthru4	-6.74	-63	X	-	-	-	X
Media/EoBP_Molex/Molex_Inthru5	-9.32	-24	X	-	-	-	X
Media/EoBP_Molex/Molex_Outthru2	-12.37	3	-	-	-	-	-
Media/EoBP_Molex/Molex_Outthru3	-8.8	-32	-	-	-	-	X
Media/EoBP_Molex/Molex_Outthru4	-9.07	-29	-	-	-	-	X
Media/EoBP_Molex/Molex_Outthru5	-13.18	9	-	-	-	-	-
Media/EoBP_PetersNew/peters_B12thru	-16.85	28	-	-	-	-	-
Media/EoBP_PetersNew/peters_B1thru	-16.45	27	-	-	X	-	-
Media/EoBP_PetersNew/peters_B20thru	-16.74	28	-	-	-	-	-
Media/EoBP_PetersNew/peters_M1thru	-14.88	18	-	-	X	-	-
Media/EoBP_PetersNew/peters_M20thru	-15.86	24	-	-	-	-	-
Media/EoBP_PetersNew/peters_T1thru	-4.45	-129	-	X	X	-	-
Media/EoBP_PetersNew/peters_T12thru	-0.31	-743	X	X	X	-	X
Media/EoBP_PetersNew/peters_T20thru	-4.11	-71	-	X	X	-	X
m_28_ripple_92	-16.56	25	-	-	-	X	-
m_40_ripple_29	-33.7546	71	-	-	-	-	-
m_41_ripple_65	-21.9388	44	-	-	-	-	-
m_42_ripple_92	-15.6958	21	-	-	-	-	-
m_60_ripple_29	-22.867	48	-	-	-	-	-
m_60_ripple_55	-13.3504	9	-	-	-	-	-
m_60_ripple_98	-9.7528	-19	-	-	-	-	-
m_81_ripple_46	-12.9881	7	-	-	-	-	-
m_82_ripple_23	-26.0196	30	-	-	-	-	-
m_82_ripple_90	-11.281	-5	X	-	-	-	-
Thru_worst			-	-	-	X	-
Media/EoBP_Peters/peters_B1thru			-	-	X	X	-
Media/EoBP_Peters/peters_B12thru			-	-	X	X	-
Media/EoBP_Peters/peters_B20thru			-	-	X	X	-
Media/EoBP_Peters/peters_B3thru			-	-	X	X	-
Media/EoBP_Peters/peters_B32thru			-	X	X	X	X
Media/EoBP_Peters/peters_B8thru			-	-	X	X	-
Media/EoBP_Peters/peters_M1thru			-	-	X	X	-
Media/EoBP_Peters/peters_M12thru			-	-	X	X	-
Media/EoBP_Peters/peters_M20thru			-	-	X	-	-
Media/EoBP_Peters/peters_M3thru			-	-	X	X	-
Media/EoBP_Peters/peters_M32thru			X	X	X	-	X
Media/EoBP_Peters/peters_M8thru			-	-	X	X	-
Media/EoBP_Peters/peters_T1thru			-	X	X	X	-
Media/EoBP_Peters/peters_T12thru			X	X	X	X	X
Media/EoBP_Peters/peters_T20thru			X	X	X	X	X
Media/EoBP_Peters/peters_T3thru			-	X	X	X	-
Media/EoBP_Peters/peters_T32thru			X	X	X	X	X
Media/EoBP_Peters/peters_T8thru			X	X	X	X	X

Simulation vs Proposed Annex 69B Changes

Channel	Simulation		Proposed Limits				
	BER	Veye	Amax	IL	ILD	RL	ICRf
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Media/EoBP_DAmbrosia/DAmbrosia_4T	-14.14	15	-	-	-	-	-
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Media/EoBP_PetersNew/peters_M20thru	-15.86	24	-	-	-	-	-
Media/EoBP_PetersNew/peters_T1thru	-4.45	-129	X	X	X	X	X
Media/EoBP_PetersNew/peters_T12thru	-0.31	-743	X	X	X	X	X
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m_82_ripple_90	-11.281	-5	X	-	X	-	X
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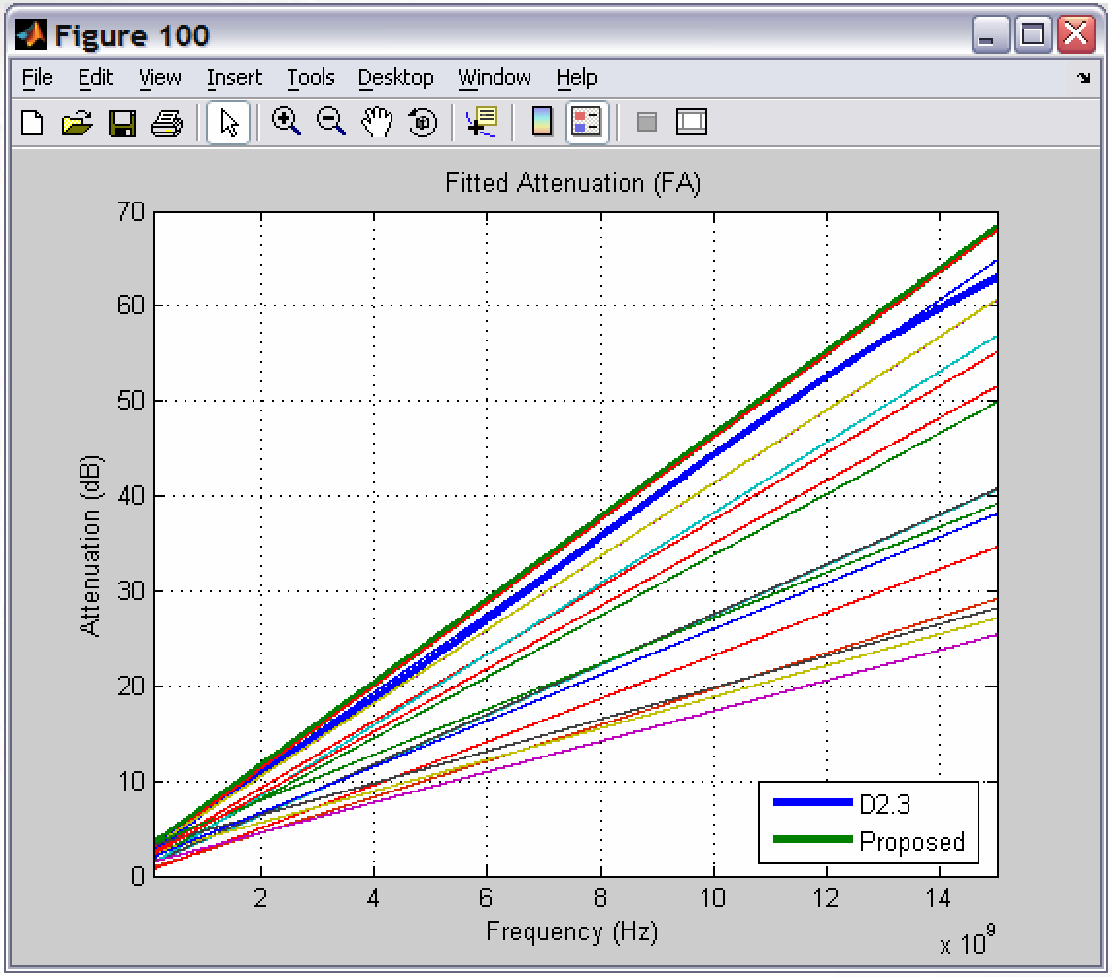
Media/EoBP_Peters/peters_B12thru			-	-	-	X	-
Media/EoBP_Peters/peters_B20thru			-	-	-	X	X
Media/EoBP_Peters/peters_B3thru			-	-	-	X	-
Media/EoBP_Peters/peters_B32thru			-	X	-	X	X
Media/EoBP_Peters/peters_B8thru			-	-	X	X	-
Media/EoBP_Peters/peters_M1thru			-	-	-	X	-
Media/EoBP_Peters/peters_M12thru			-	-	-	X	-
Media/EoBP_Peters/peters_M20thru			-	X	-	X	-
Media/EoBP_Peters/peters_M3thru			-	-	-	X	-
Media/EoBP_Peters/peters_M32thru			X	X	-	X	X
Media/EoBP_Peters/peters_M8thru			-	-	-	X	-
Media/EoBP_Peters/peters_T1thru			-	X	X	X	X
Media/EoBP_Peters/peters_T12thru			X	X	X	X	X
Media/EoBP_Peters/peters_T20thru			X	X	X	X	X
Media/EoBP_Peters/peters_T3thru			X	X	X	X	X
Media/EoBP_Peters/peters_T32thru			X	X	X	X	X
Media/EoBP_Peters/peters_T8thru			X	X	X	X	X

Fitted Attenuation (Amax)



Passing Channels

$100\text{MHz} \le f \le 380\text{MHz}$

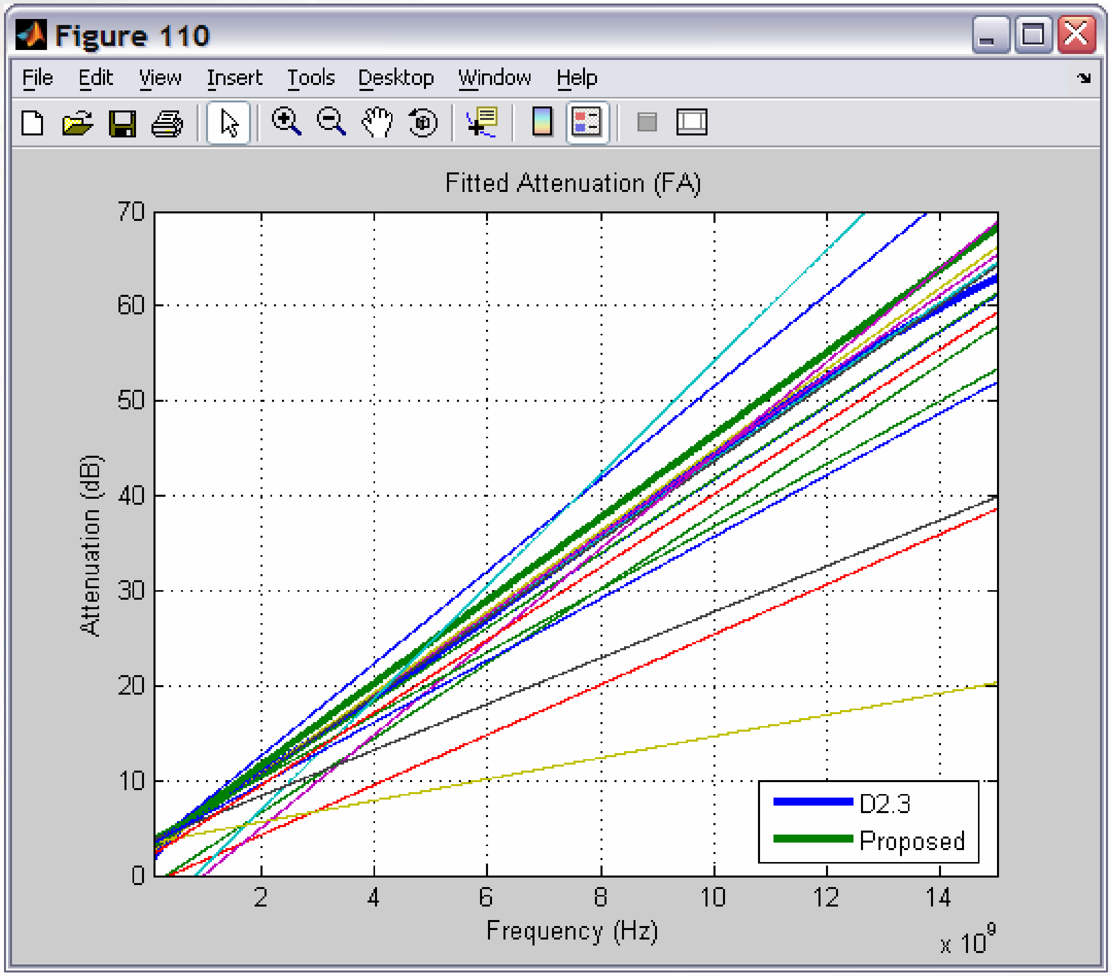
$$A(f) \ge A_{max} = 3.18 + 3.21 \cdot 10^{-9} \cdot f$$

$380\text{MHz} < f \le 15\text{GHz}$

$$A(f) \ge A_{max} = 2.74 + 4.36 \cdot 10^{-9} \cdot f$$

Fit calculated 100MHz - 9GHz

Fitted Attenuation (Amax)



Failing Channels

$100MHz \le f \le 380MHz$

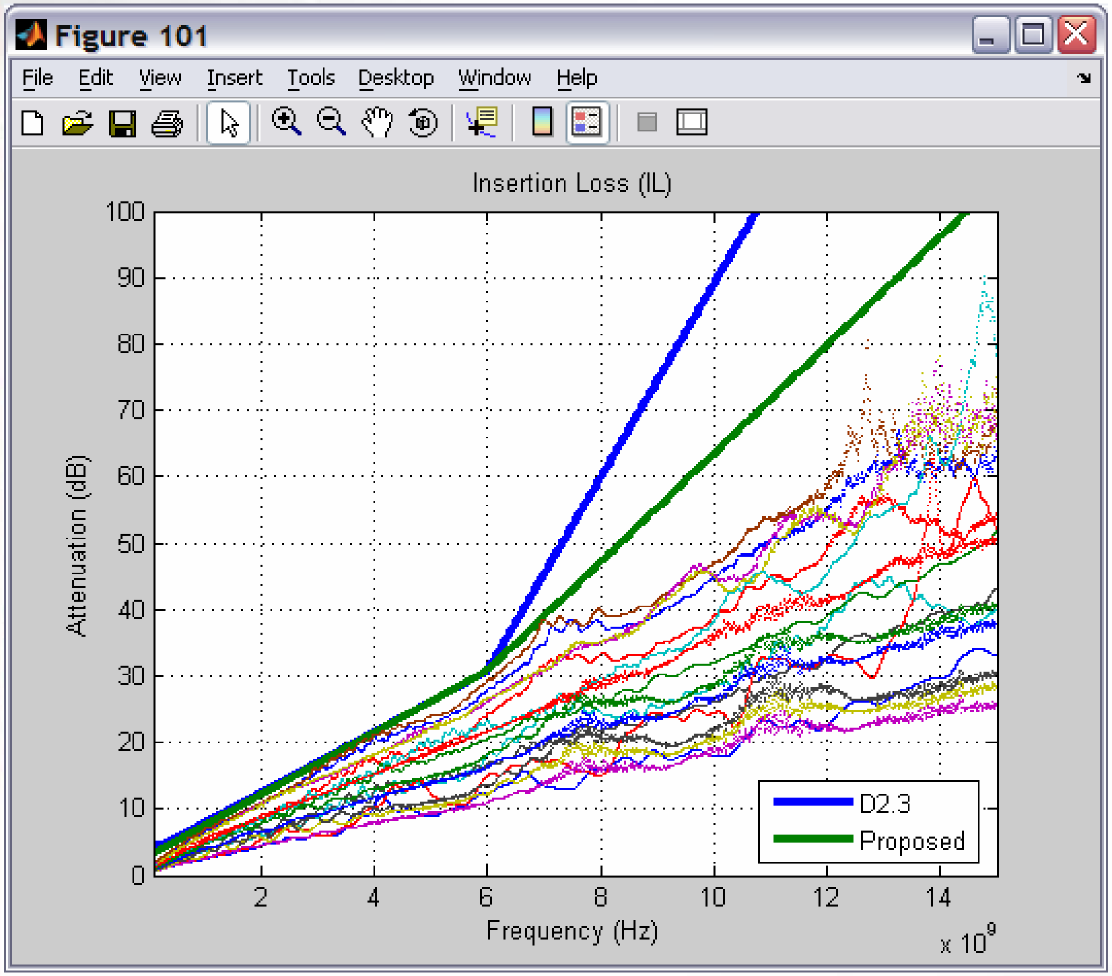
$A(f) \ge A_{max} = 3.18 + 3.21 \cdot 10^{-9} \cdot f$

$380MHz < f \le 15GHz$

$A(f) \ge A_{max} = 2.74 + 4.36 \cdot 10^{-9} \cdot f$

Fit calculated 100MHz - 9GHz

Insertion Loss (IL)



Passing Channels

$$50\text{MHz} \le f \le 6\text{GHz}$$

$$IL(f) \le A_{max} + 0.8 + 2.65 \cdot 10^{-10} \cdot f$$

$$6\text{GHz} < f \le 15\text{GHz}$$

$$IL(f) \le A_{max} + 0.8 + 2.65 \cdot 10^{-10} \cdot f + 3.5 \cdot 10^{-9} \cdot (f - 6\text{GHz})$$

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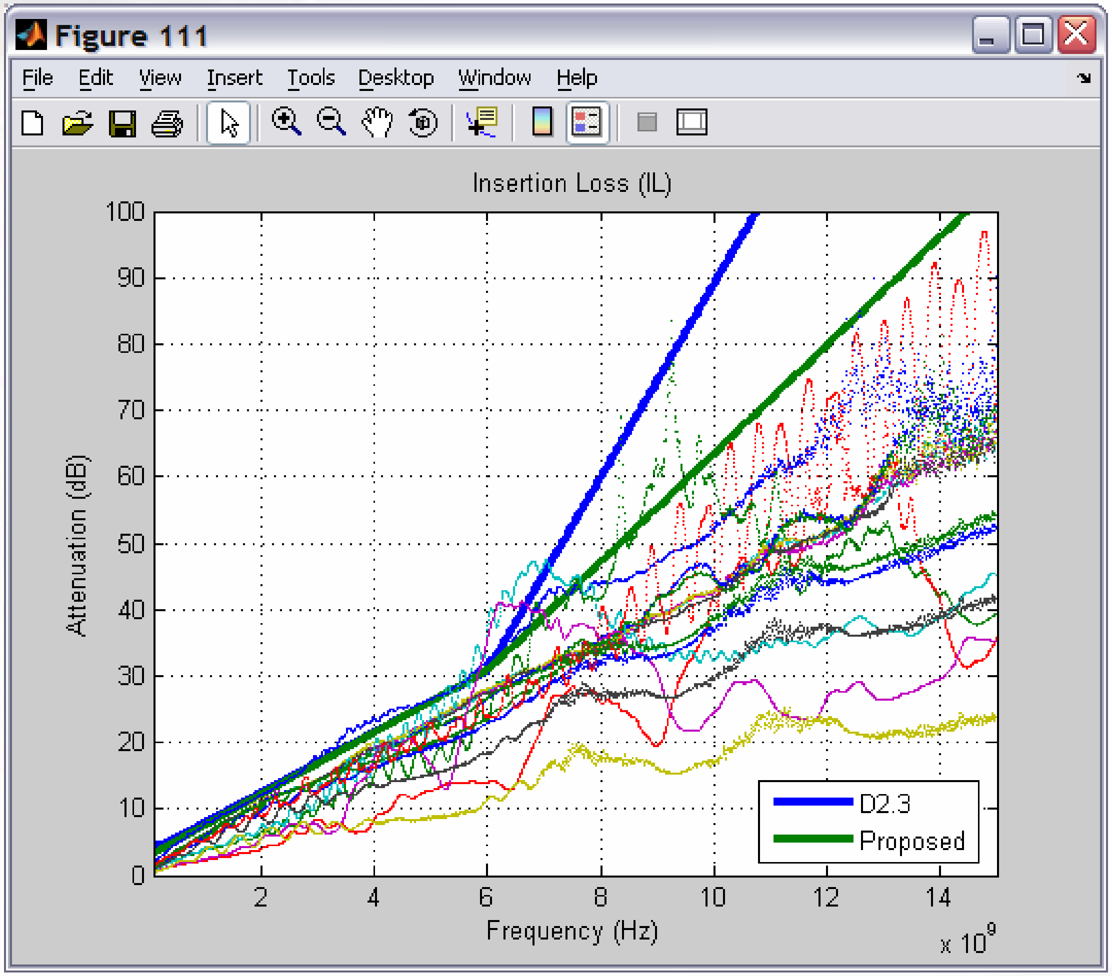
Insertion Loss (IL)



Failing Channels

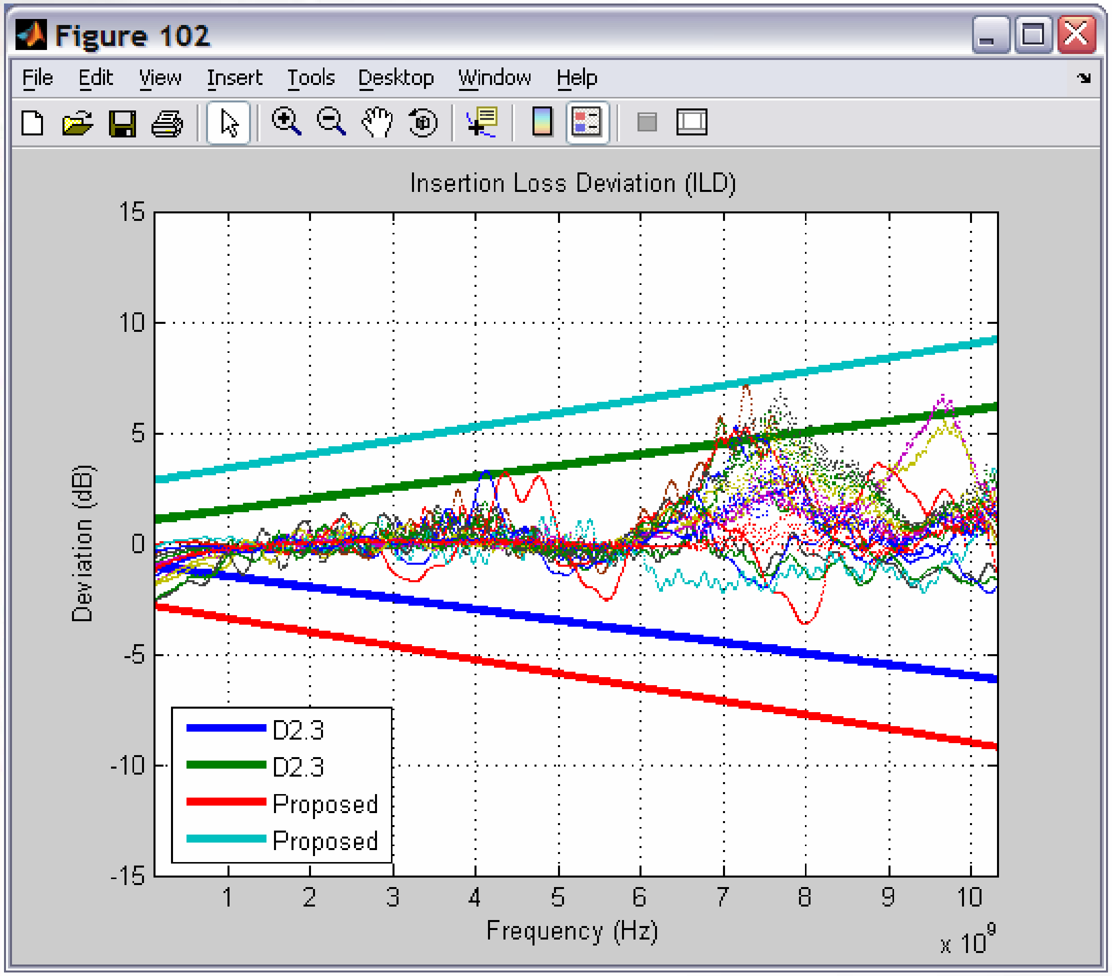
$$50\text{MHz} \le f \le 6\text{GHz}$$

$$IL(f) \le A_{max} + 0.8 + 2.65 \cdot 10^{-10} \cdot f$$

$$6\text{GHz} < f \le 15\text{GHz}$$

$$IL(f) \le A_{max} + 0.8 + 2.65 \cdot 10^{-10} \cdot f + 3.5 \cdot 10^{-9} \cdot (f - 6\text{GHz})$$

Insertion Loss Deviation (ILD)



Passing Channels

$$100\text{MHz} \le f \le 10.3125\text{GHz}$$

$$-2.77 - 4.36 \cdot 10^{-10} \cdot f \le \text{ILD}(f)$$

$$\text{ILD}(f) \le 2.77 + 4.36 \cdot 10^{-10} \cdot f$$

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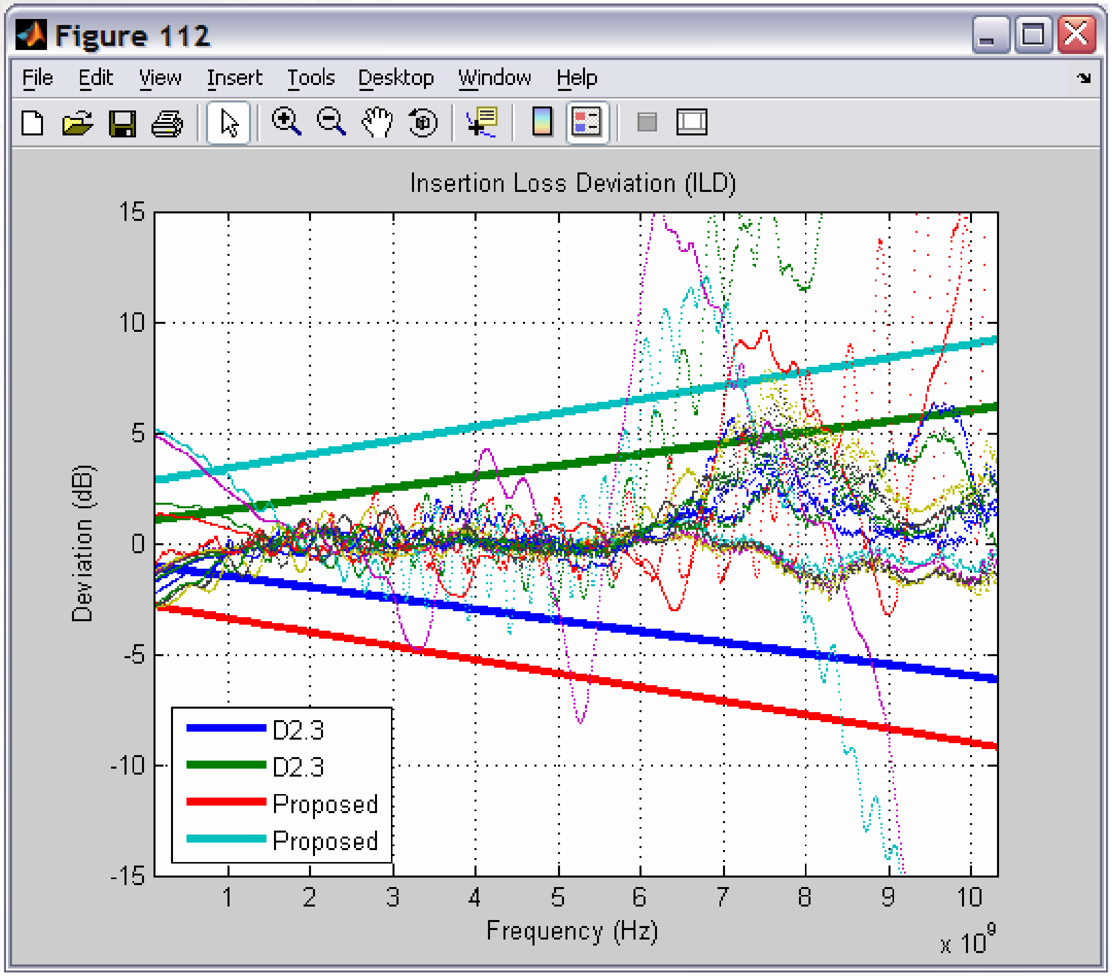
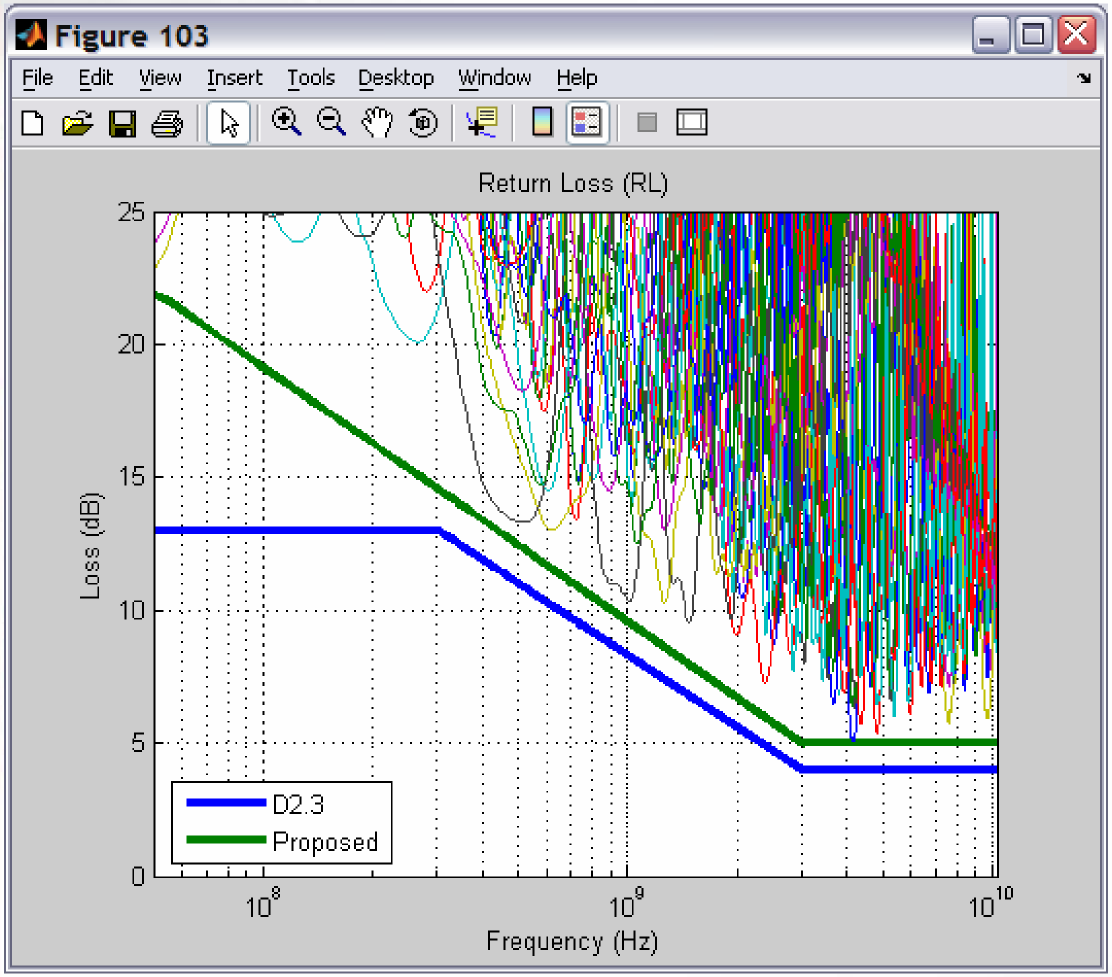
Insertion Loss Deviation (ILD)



Failing Channels

$$100\text{MHz} \le f \le 10.3125\text{GHz}$$
$$-2.77 - 4.36 \cdot 10^{-10} \cdot f \le \text{ILD}(f)$$
$$\text{ILD}(f) \le 2.77 + 4.36 \cdot 10^{-10} \cdot f$$

Return Loss (RL)



Passing Channels

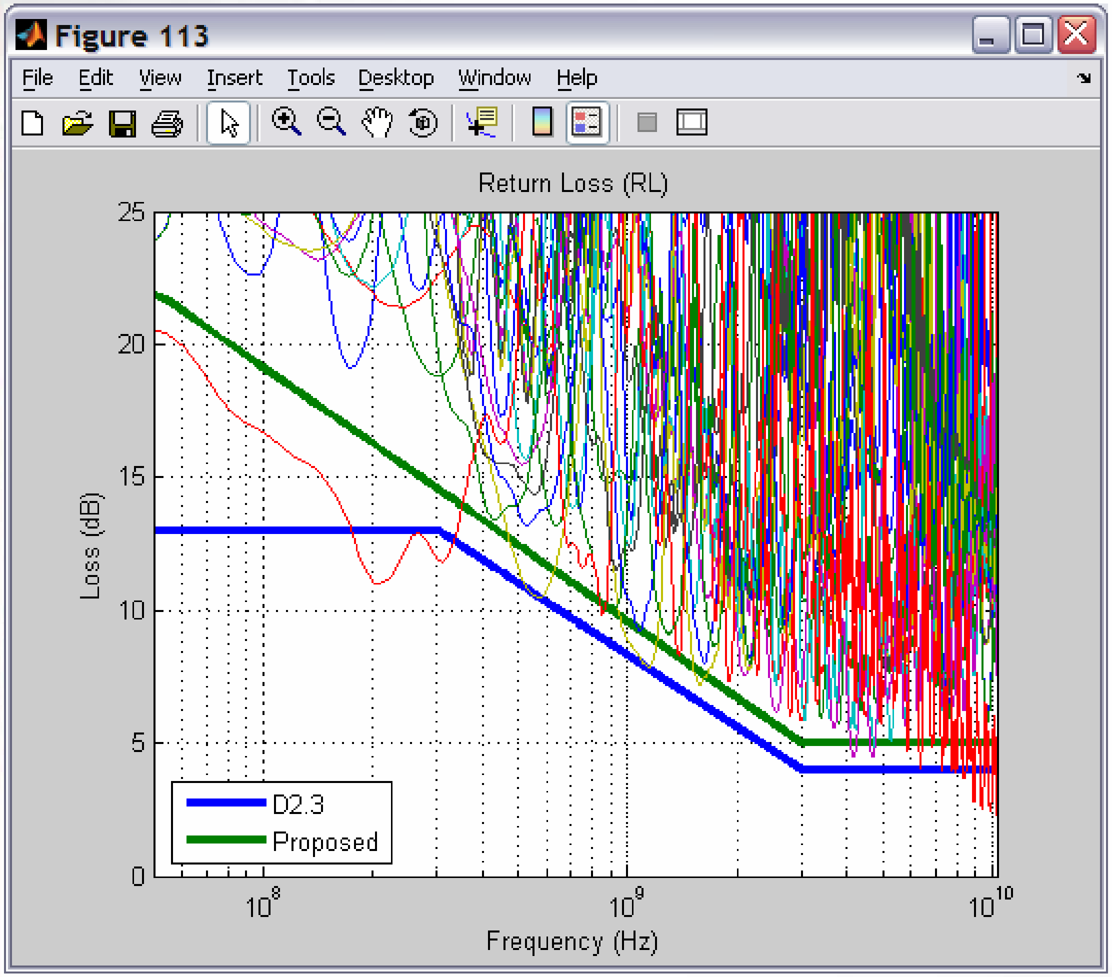
$50\text{MHz} \le f < 3\text{GHz}$

$$RL(f) \ge 22 + 9.56 \cdot \log_{10}\left(\frac{f}{50\text{MHz}}\right)$$

$3\text{GHz} \le f \le 10.3125\text{GHz}$

$$RL(f) \ge 5$$

Return Loss (RL)



Failing Channels

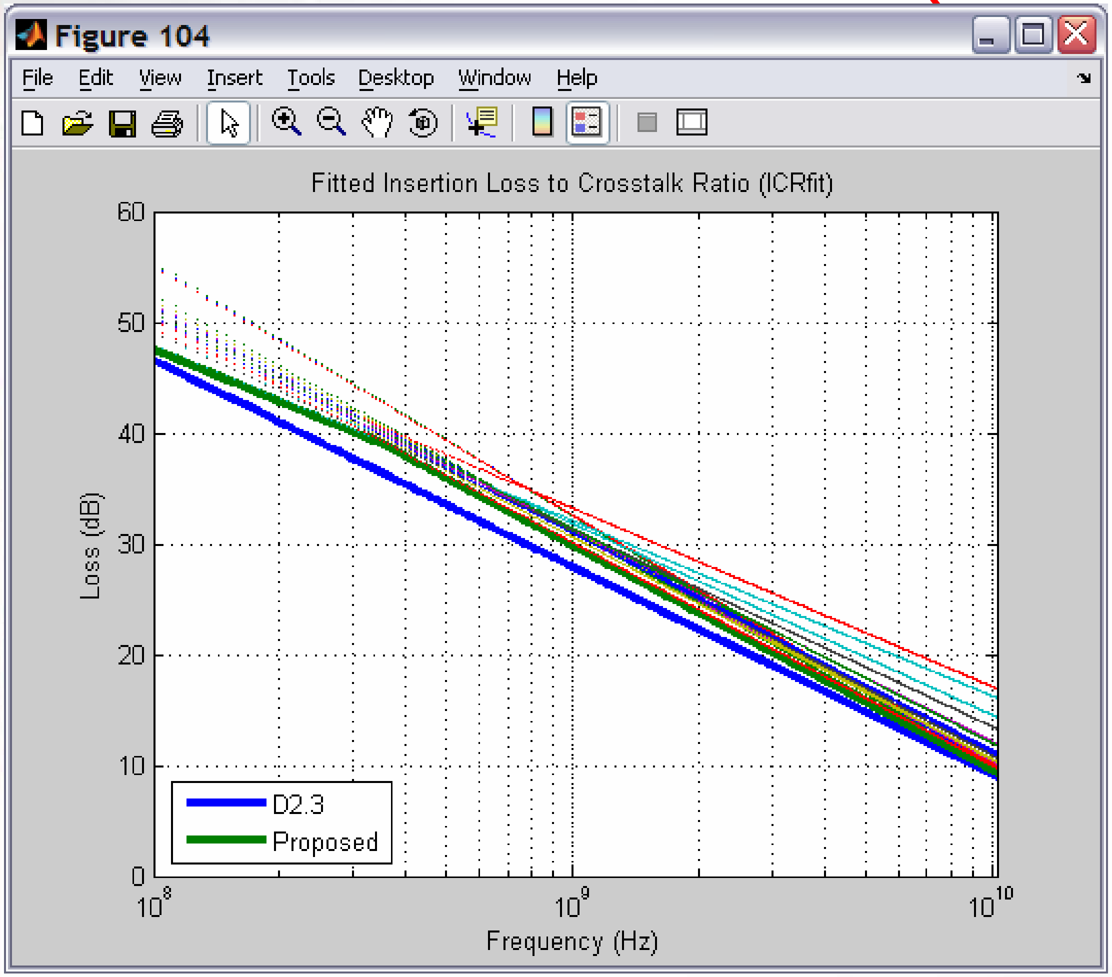
$$50\text{MHz} \le f < 3\text{GHz}$$

$$RL(f) \ge 22 + 9.56 \cdot \log_{10}\left(\frac{f}{50\text{MHz}}\right)$$

$$3\text{GHz} \le f \le 10.3125\text{GHz}$$

$$RL(f) \ge 5$$

Fitted Insertion Loss to Crosstalk Ratio (ICR_{fit})



Passing Channels

$100MHz \le f < 350MHz$

$$ICR_{fit}(f) \ge 47 - 15.62 \cdot \log_{10}\left(\frac{f}{100MHz}\right)$$

$350MHz \le f \le 10.3125GHz$

$$ICR_{fit}(f) \ge 39 - 20.21 \cdot \log_{10}\left(\frac{f}{350MHz}\right)$$

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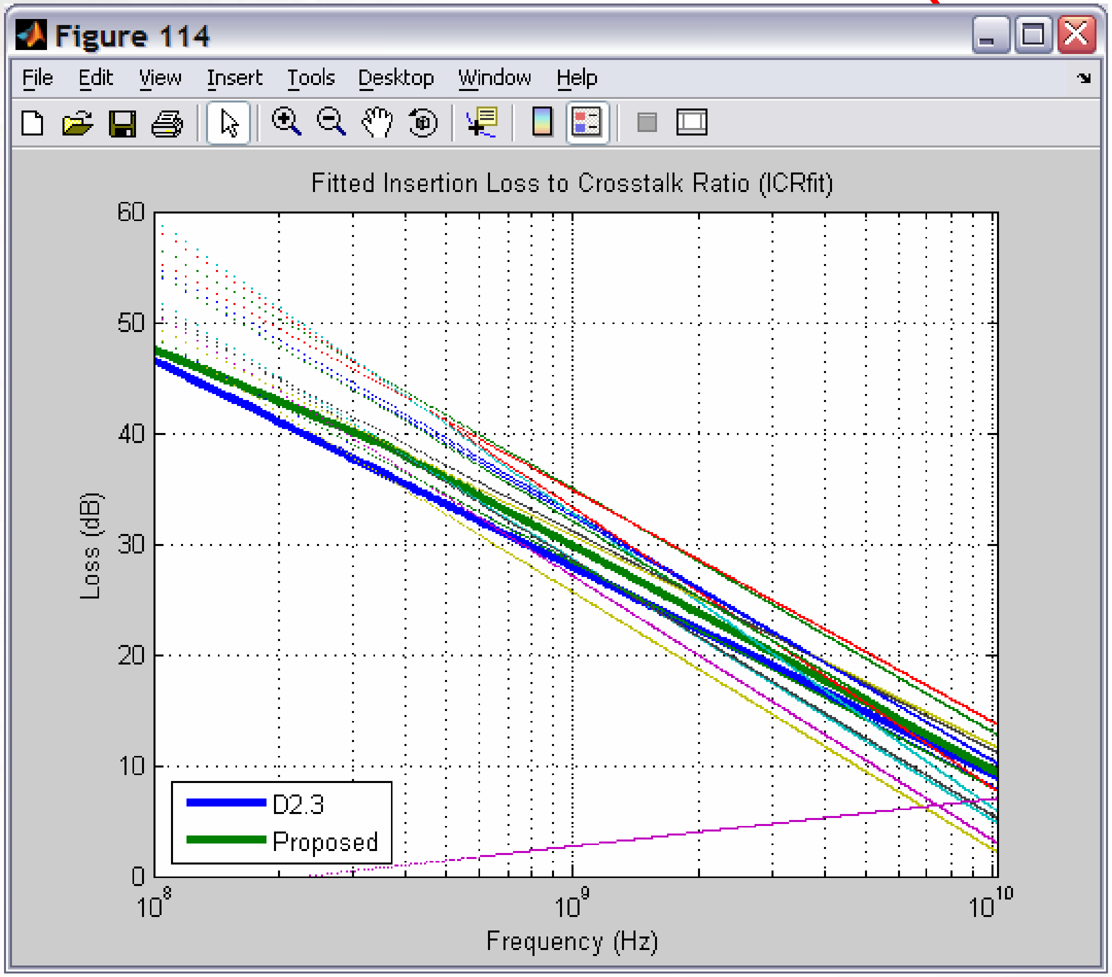
Fitted Insertion Loss to Crosstalk Ratio (ICR_{fit})



Failing Channels

$100MHz \le f < 350MHz$

$$ICR_{fit}(f) \ge 47 - 15.62 \cdot \log_{10}\left(\frac{f}{100MHz}\right)$$

$350MHz \le f \le 10.3125GHz$

$$ICR_{fit}(f) \ge 39 - 20.21 \cdot \log_{10}\left(\frac{f}{350MHz}\right)$$

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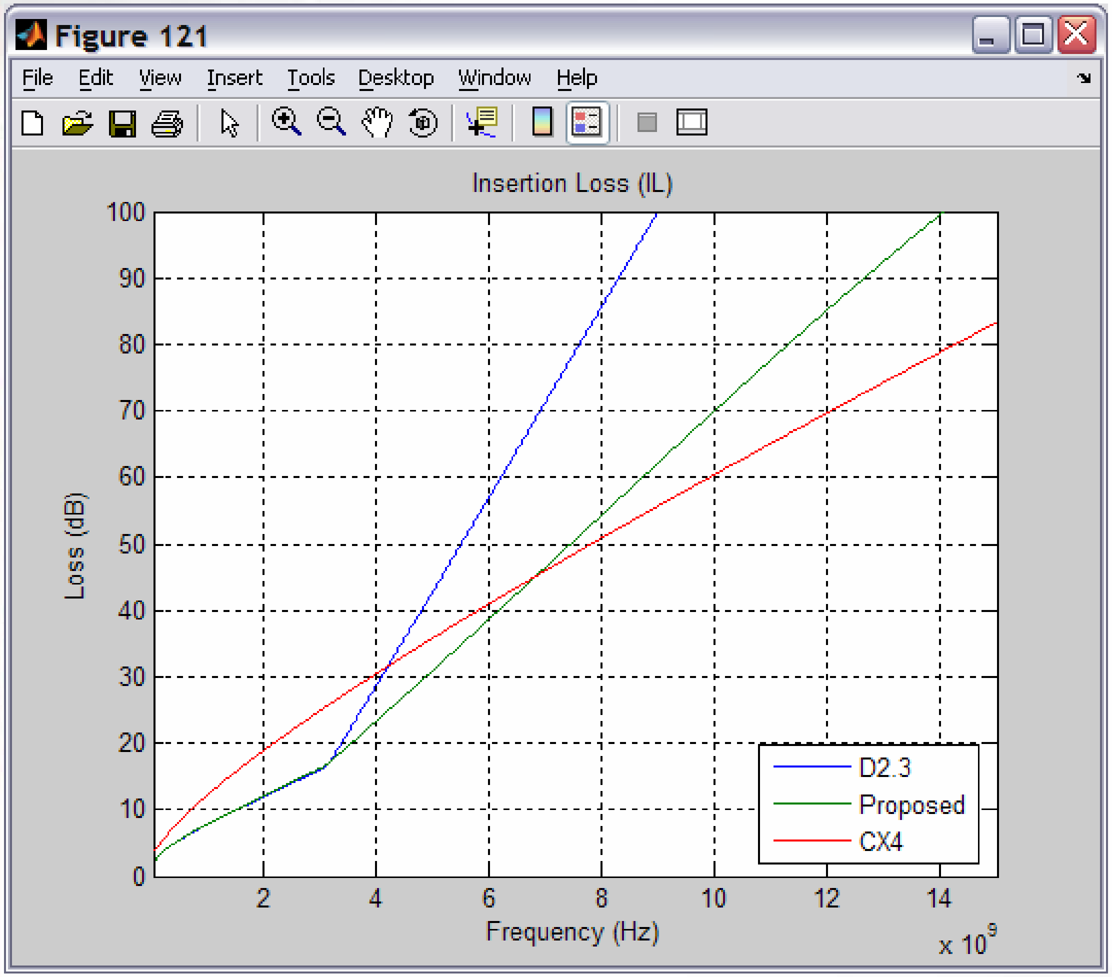
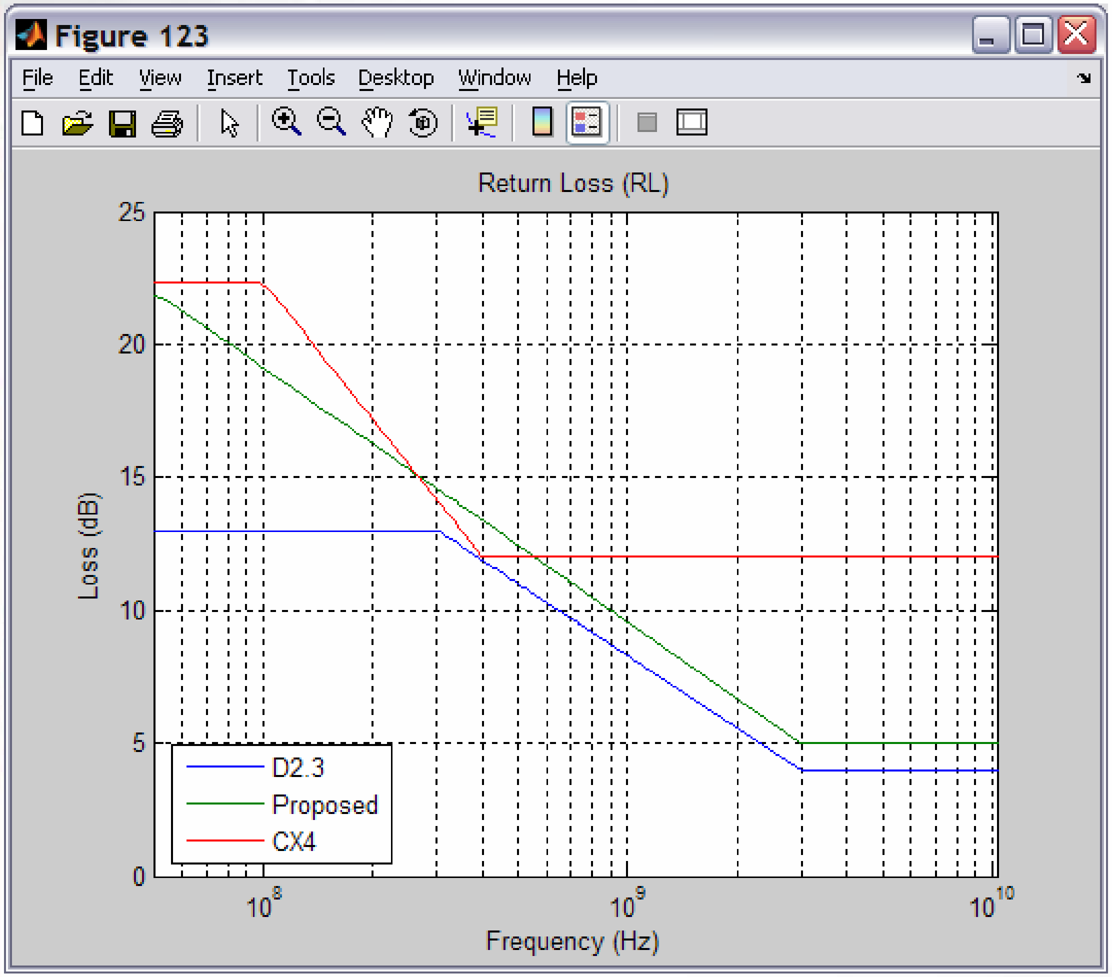
KX4 vs. CX4 (IL)



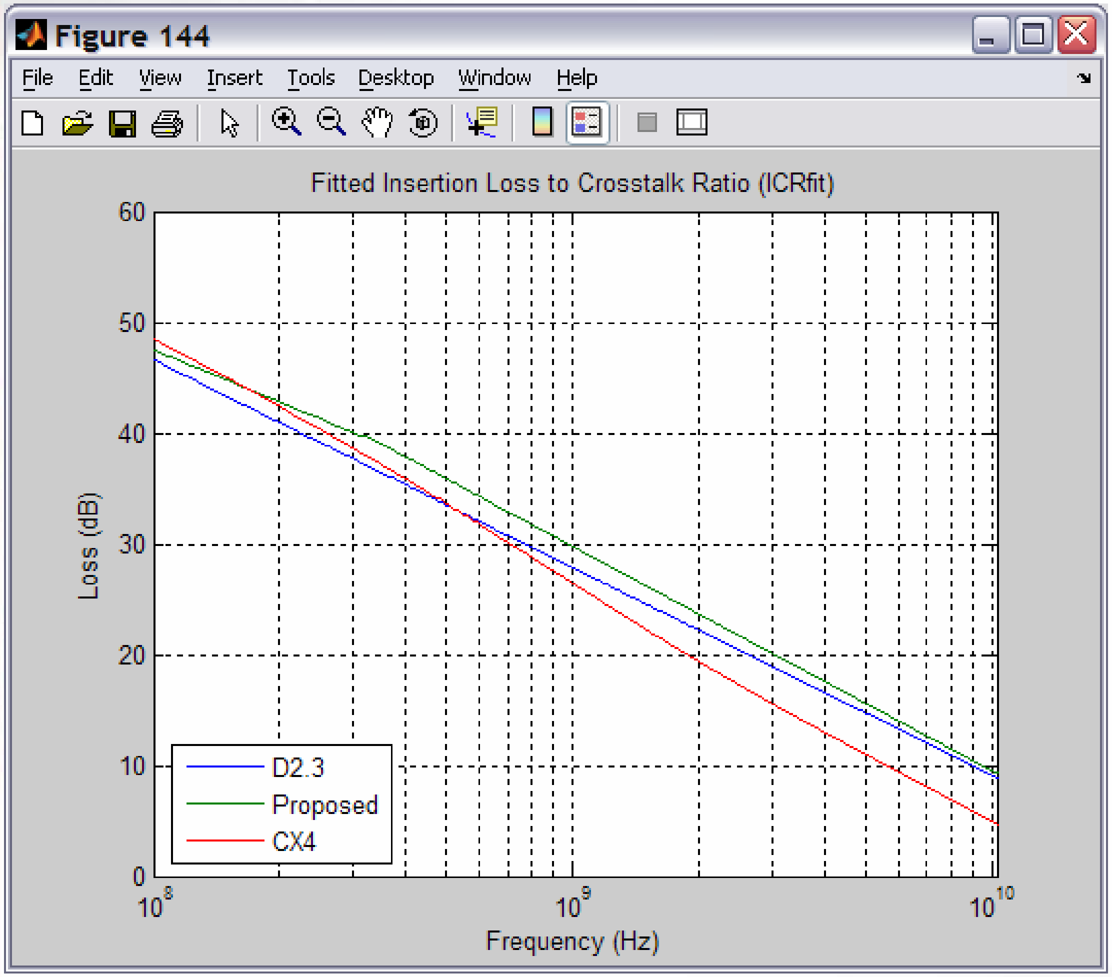
- 10GBASE-CX4 IL more than proposed 10GBASE-KX4 IL in frequency band of interest, 100MHz – 2000MHz

KX4 vs. CX4 (RL)



- 10GBASE-CX4 RL less than proposed 10GBASE-KX4 RL in frequency band of interest, 100MHz – 2000MHz

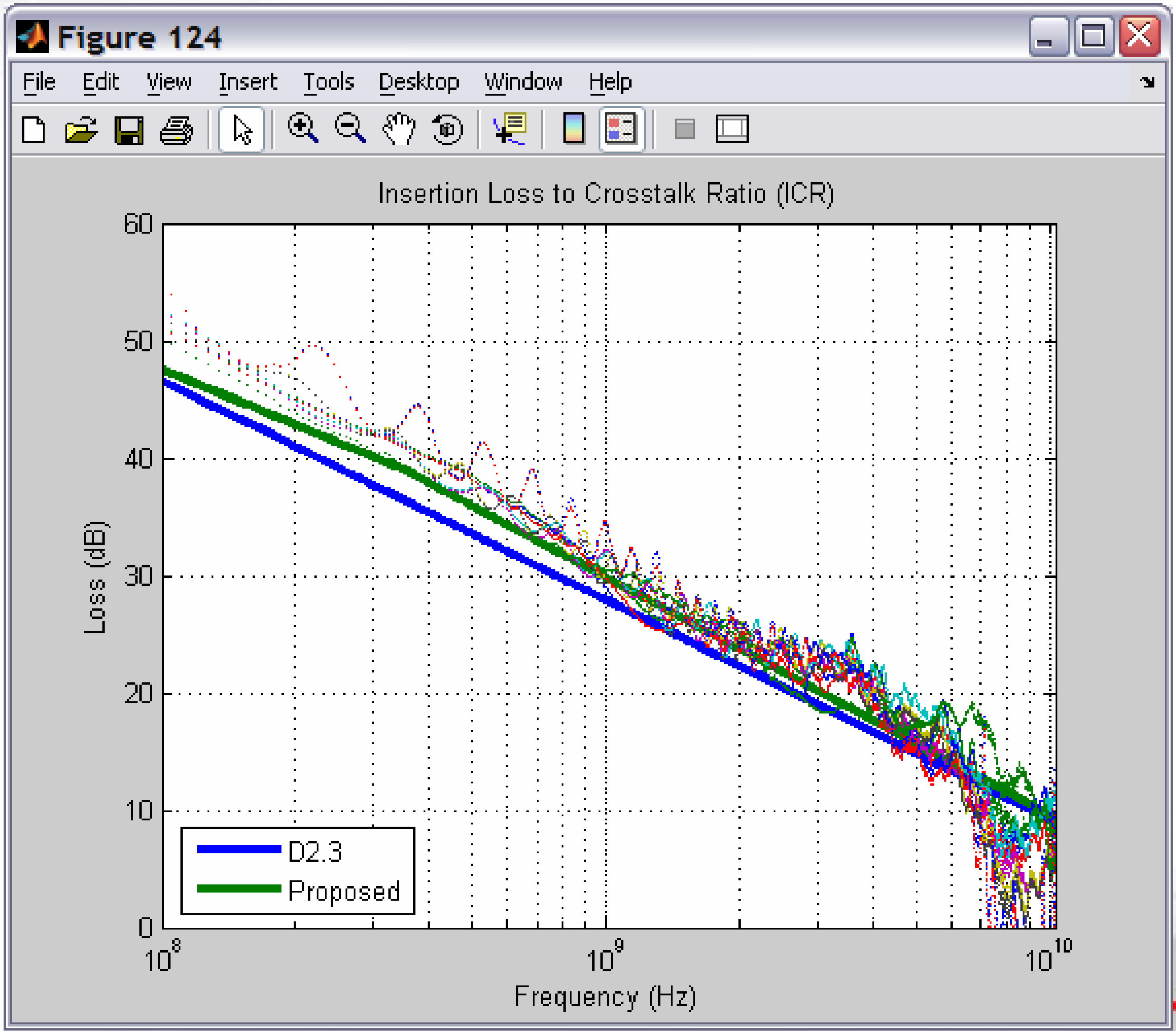
KX4 vs. CX4 (ICRfit)



- ICRfit = IL – MDX
- 10GBASE-CX4 ICRfit more stringent than proposed 10GBASE-KX4 ICRfit in frequency band of interest, 100MHz – 2000MHz

Backup Slides

Ripple Channel ICR



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Ripple Channel ICR_{fit}