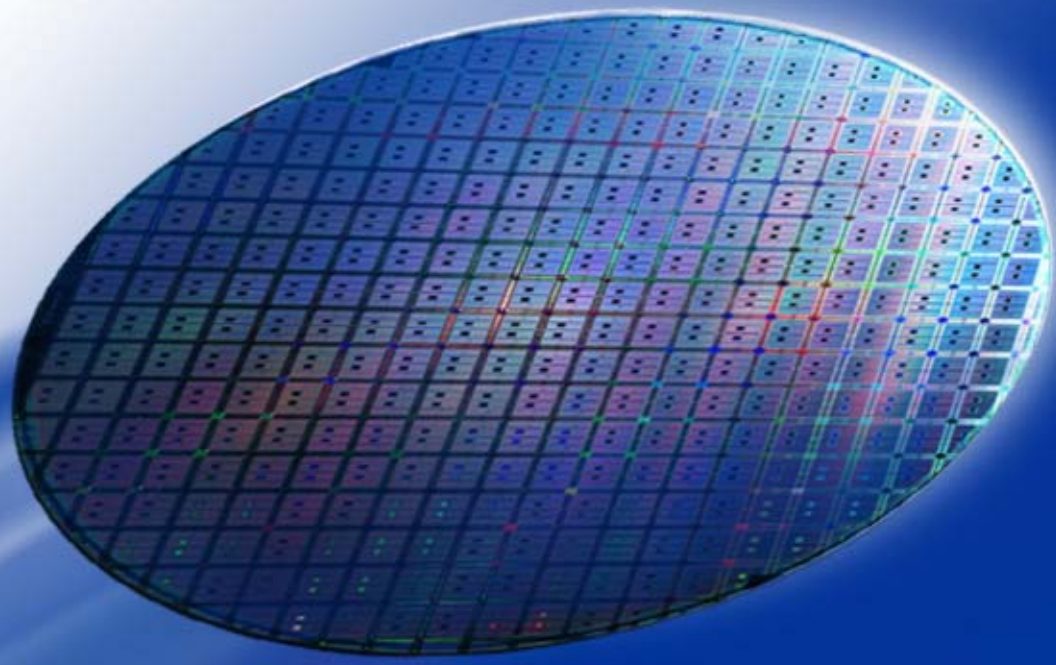


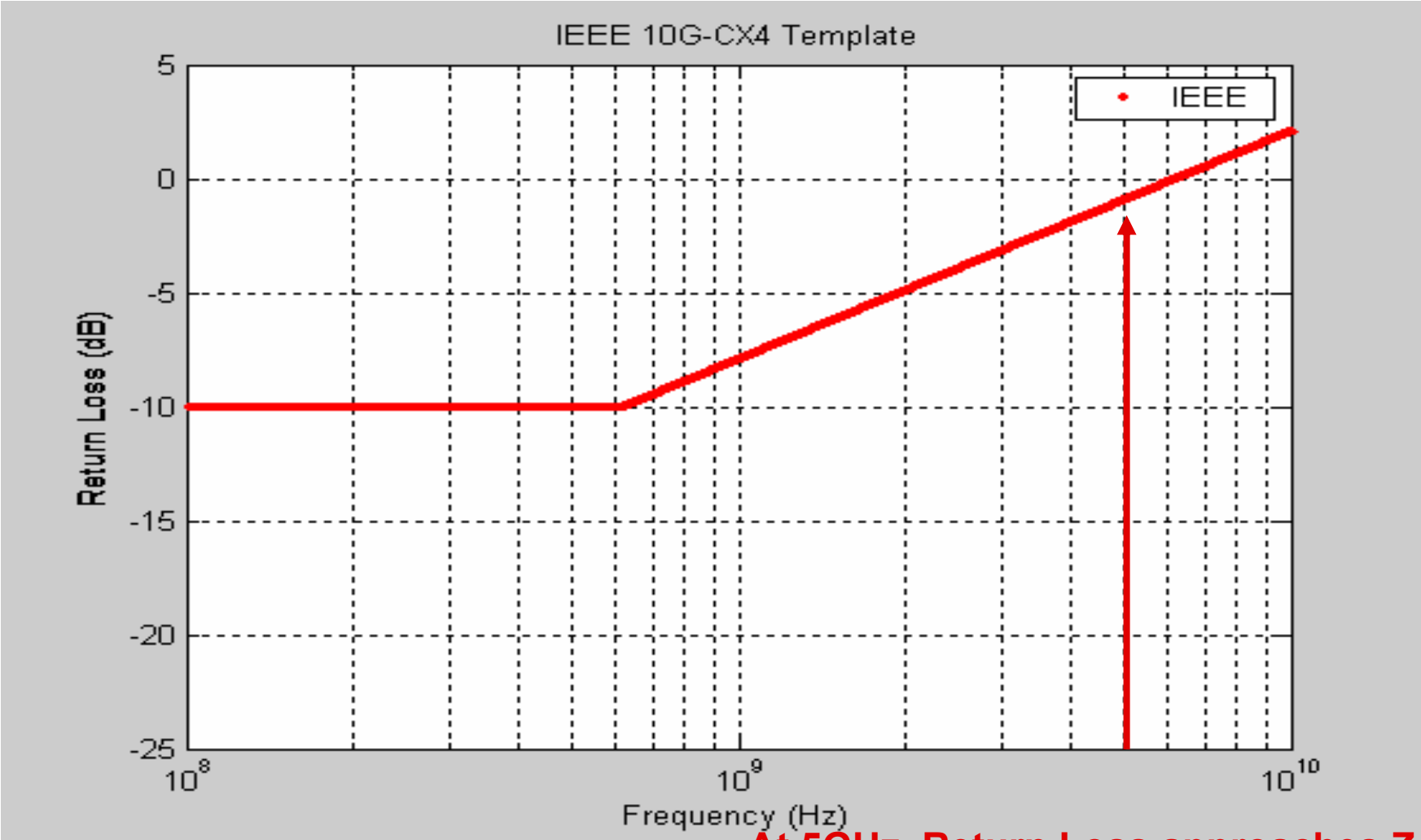
TX & RX Return Loss Templates IEEE 802.3ap

Zhi Wong

May 2004

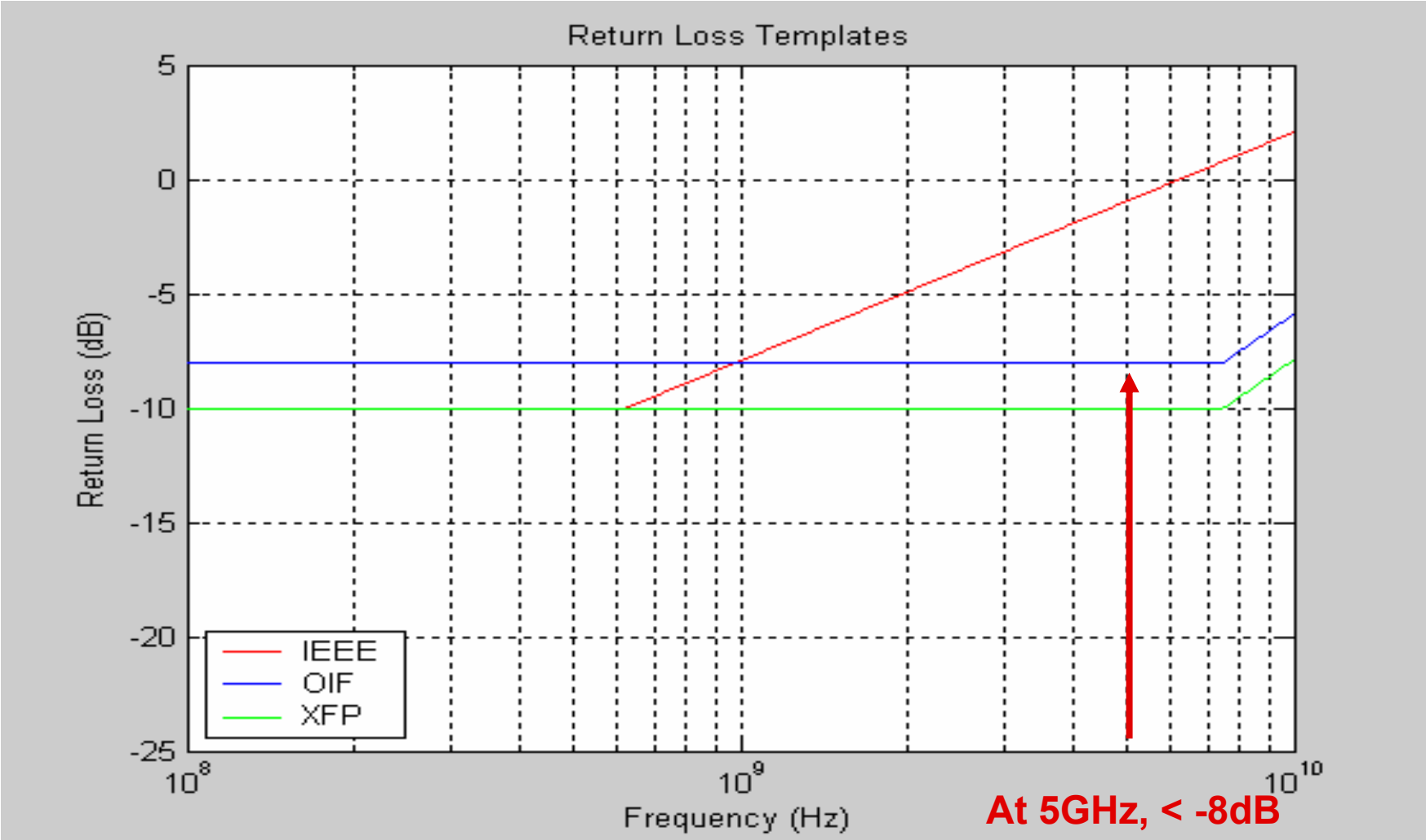
Long Beach, CA

Statement of the Problem

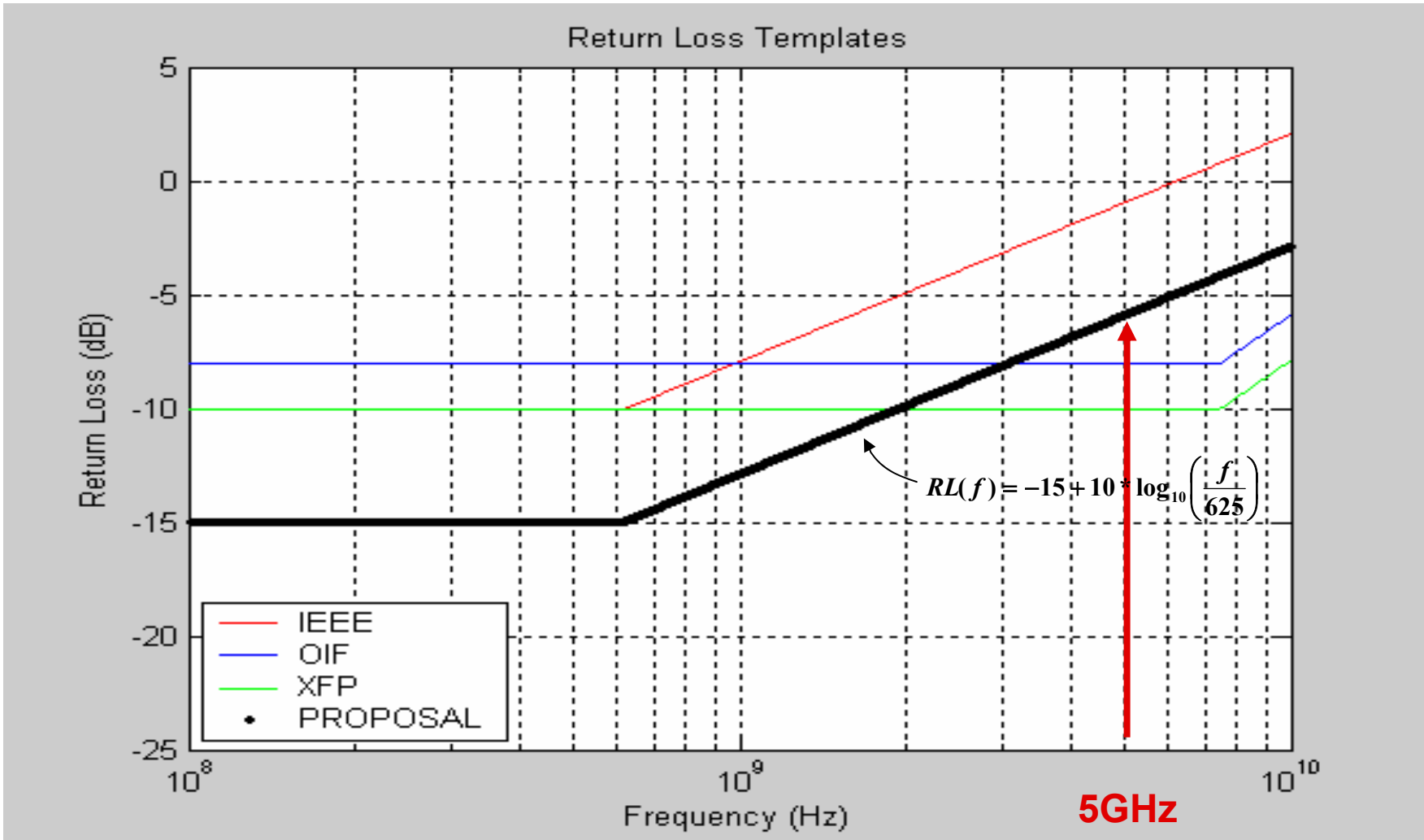


At 5GHz, Return Loss approaches Zero

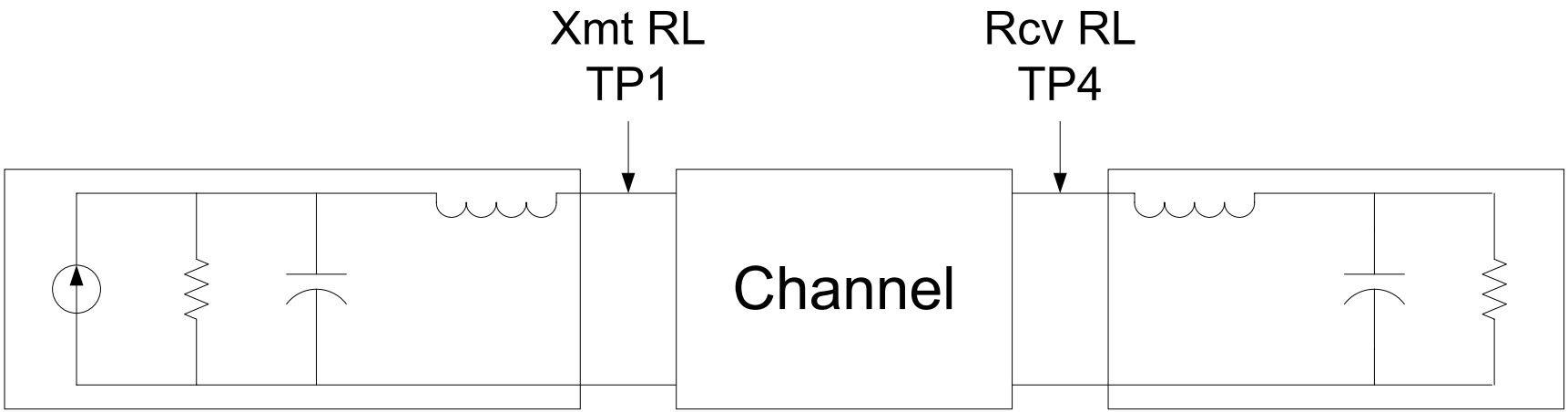
Return Loss Templates



Proposed Return Loss Template



Simulated Return Loss using Single-Ended Lumped Model

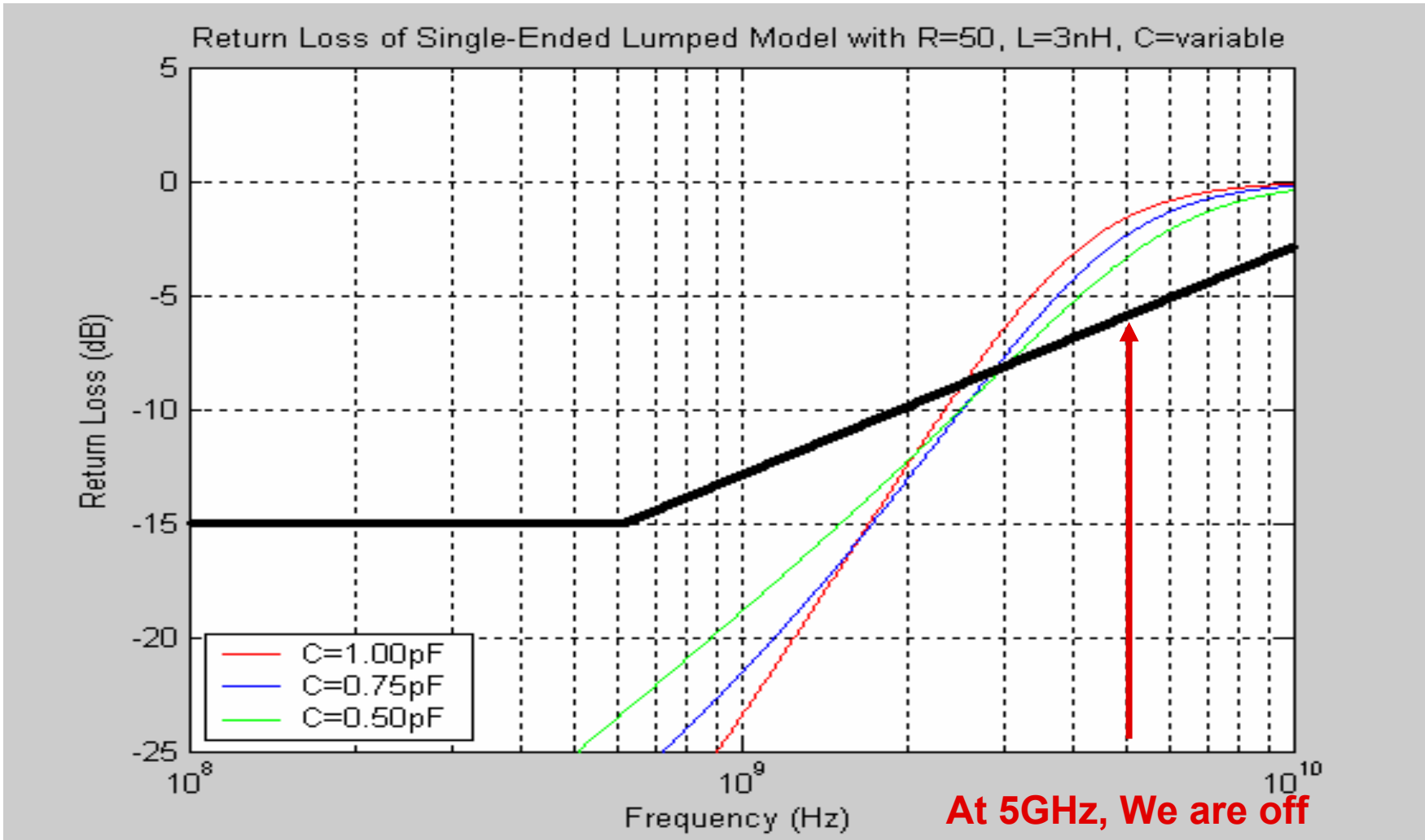


R = 50 Ohms
L = 3nH
C = 1pF or less

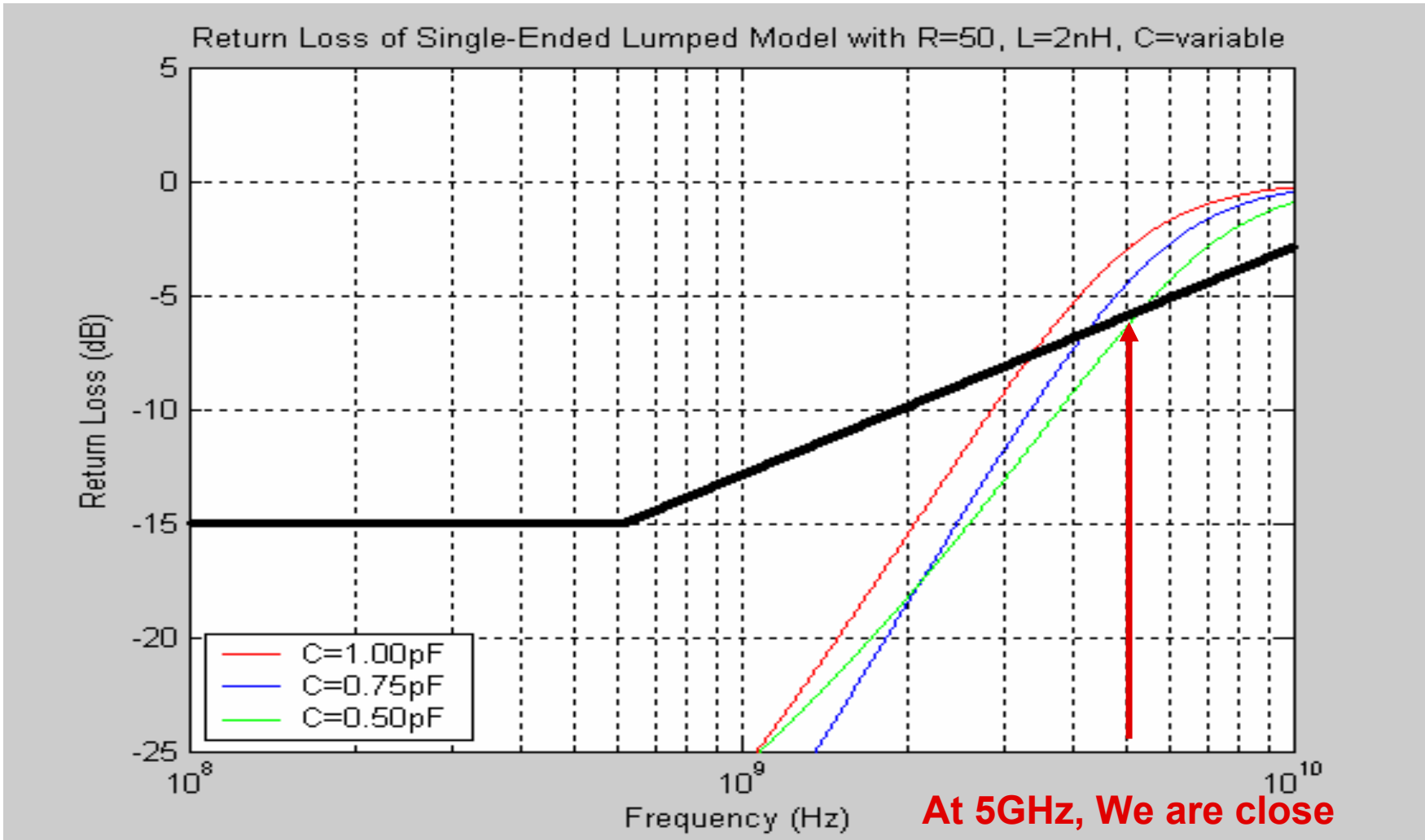
Zo = 50 Ohms

R = 50 Ohms
L = 3nH
C = 1pF or less

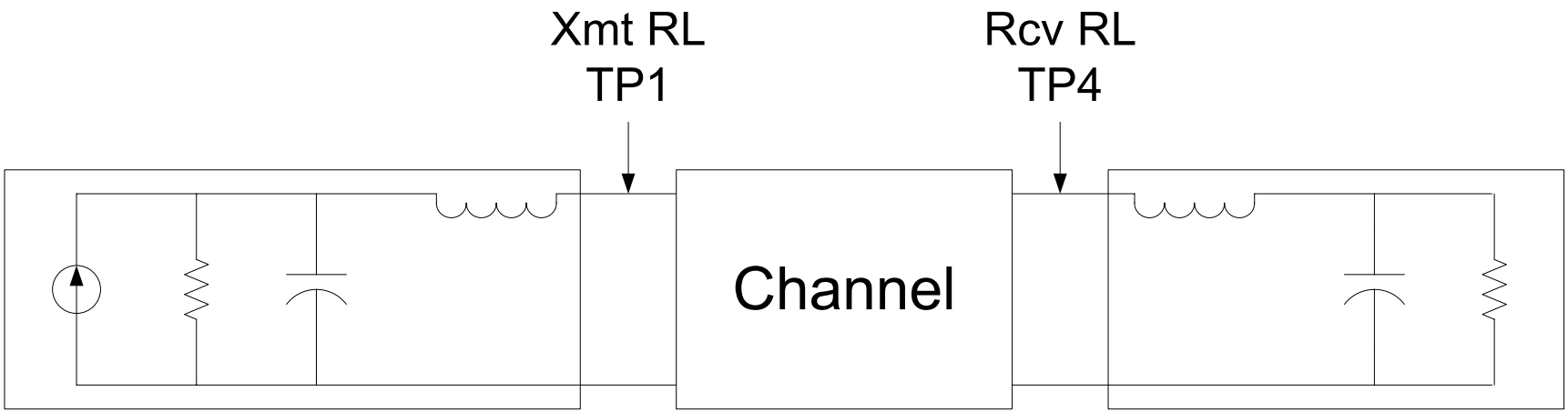
R = 50, L = 3nH, C = variable



R = 50, L = 2nH, C = variable



Simulated Return Loss using Single-Ended Lumped Model

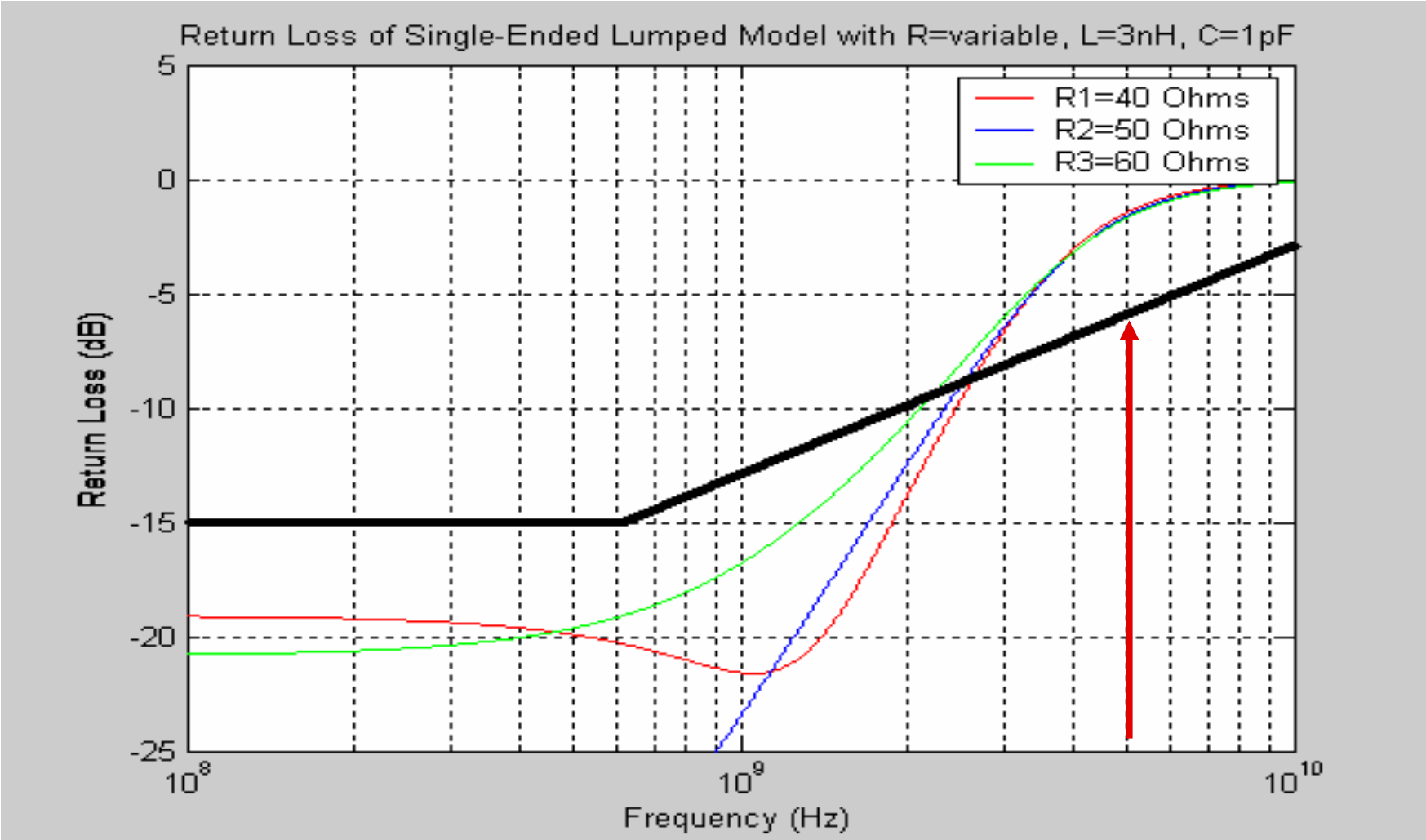


R = 50 Ohms +/- 20%
L = 3nH or less
C = 1pF or less

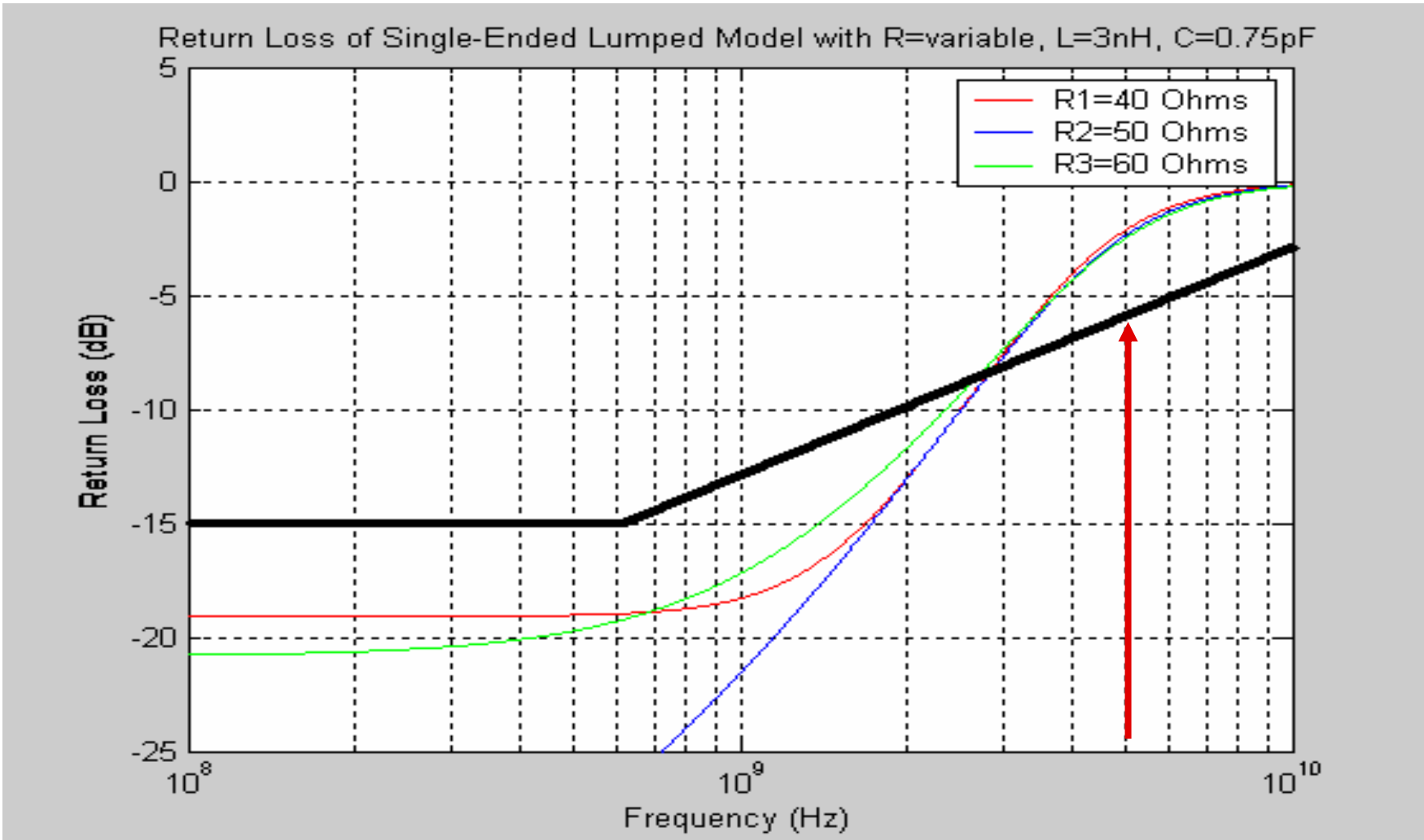
Zo = 50 Ohms

R = 50 Ohms +/-20%
L = 3nH or less
C = 1pF or less

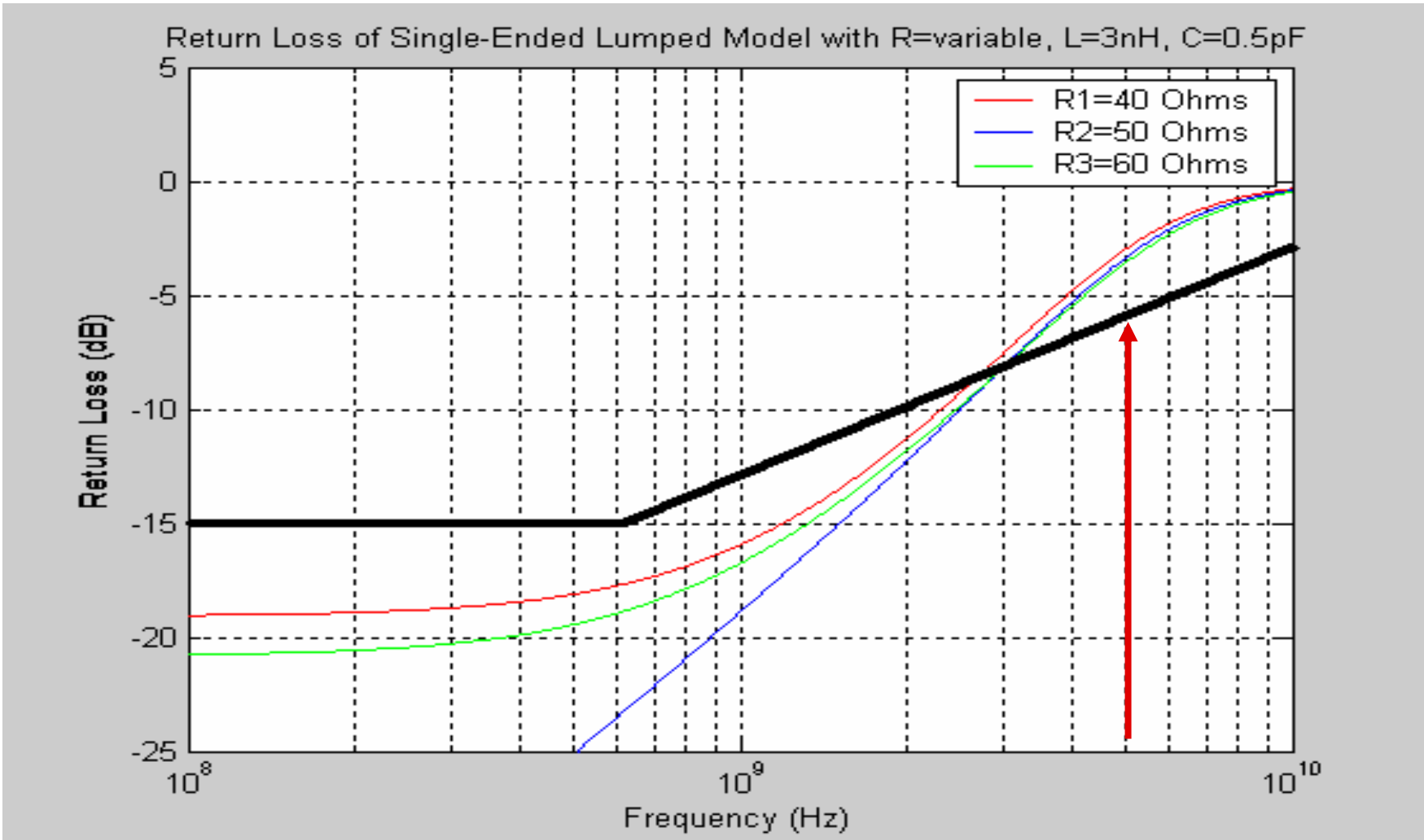
L = 3nH, C = 1.00pF, R = variable



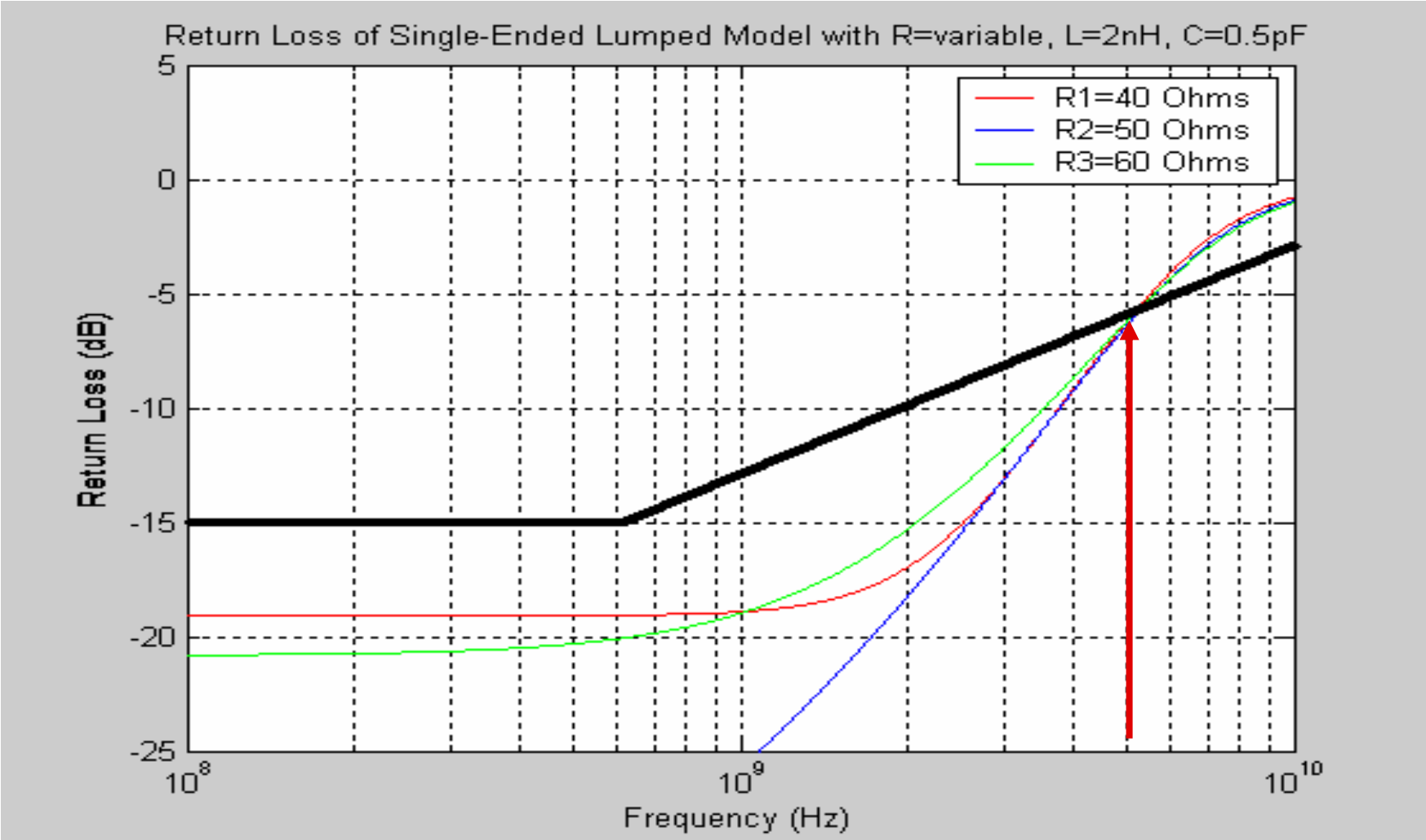
L = 3nH, C = 0.75pF, R = variable



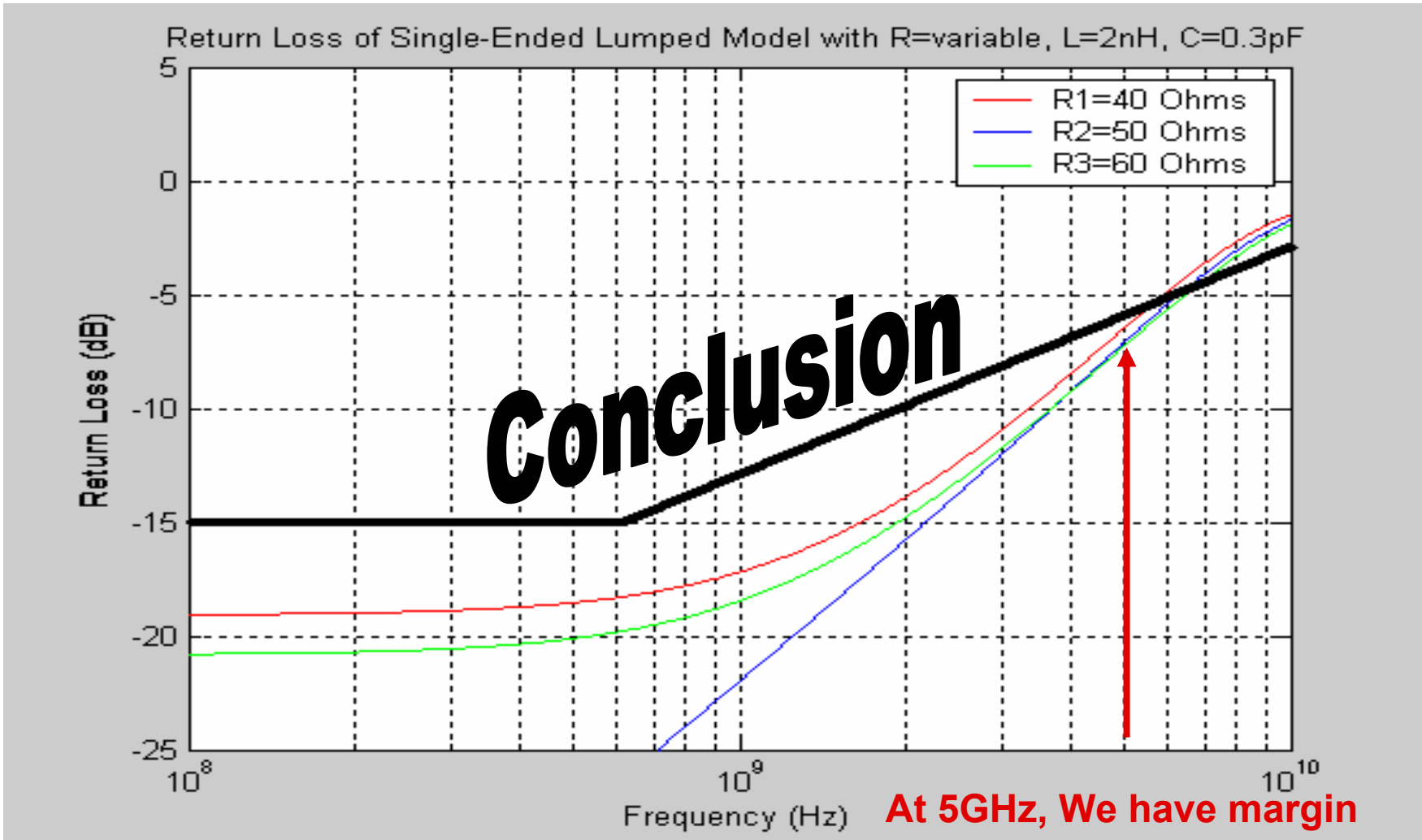
L = 3nH, C = 0.50pF, R = variable



L = 2nH, C = 0.50pF, R = variable

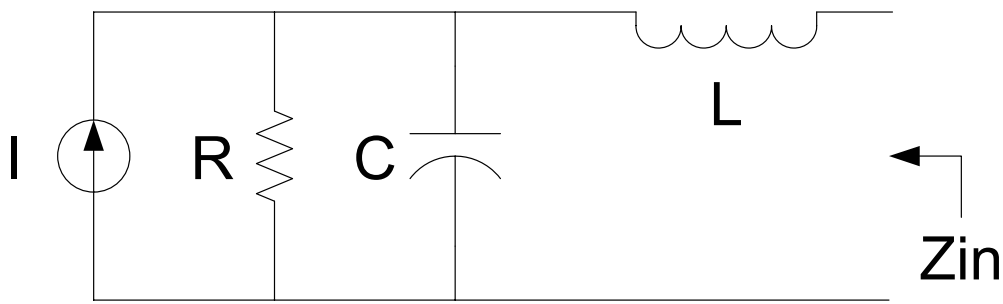


L = 2nH, C = 0.30pF, R = variable



Additional Slides

Single-Ended Lumped Model



C = Lumped Capacitance of Pad, ESD structures and input devices

L = Lumped Inductance of package trace and bondwire

Return Loss Equivalent Function

$$RL(f) = \frac{\Gamma_0 + s\left[\tau_1\left(1-\Gamma_0\right) - \tau_2\left(1+\Gamma_0\right)\right] + 2s^2\tau_1\tau_2\left(1+\Gamma_0\right)}{1 + s\left[\tau_1\left(1-\Gamma_0\right) + \tau_2\left(1+\Gamma_0\right)\right] + 2s^2\tau_1\tau_2\left(1+\Gamma_0\right)}$$

$$\Gamma_0 = \frac{R_L - R}{R_L + R} \qquad \tau 1 = \frac{L}{2R} \qquad \tau 2 = \frac{RC}{2}$$

IEEE 802.3ak (10G-CX4) Template