



Return loss at TP2 for 100GBASE-CR4

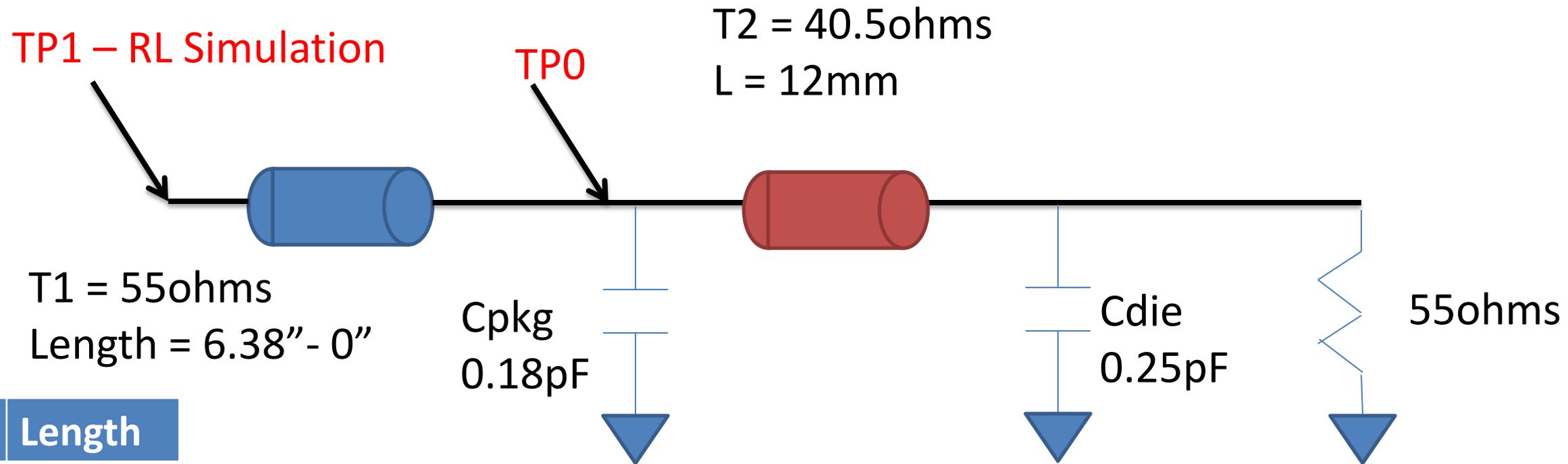
Mike Dudek QLogic

Nikhil Patel QLogic

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- **This presentation investigates the return loss specification at TP2 in 802.3bj draft 3.1 and compares it with the COM model. It is in support of comment r01-49**
- **The process is as follows.**
 1. A representation of the COM model was used for TP0. A representative PCB Tline model was used to get from TP0 to TP1. The length of the transmission line was varied to provide losses that varied from zero to the loss used for the COM Cable calculation. This is to represent hosts with trace lengths with the same loss as the MCB (same as the recommended min loss of the host within <0.1 dB at all frequencies) to the recommended max loss of the host.
 2. Analytical calculations (assuming worst case addition of reflections from the mated MCB/HCB and TP1) were used to generate the return loss at TP2, which are then compared with the clause 92 specification for the return loss at TP2. Note that this assumes that the host connector has a return loss no worse than the one used on the MCB.
 3. In addition S parameters from a measured MCB/HCB were concatenated to get from TP1 to TP2 and these were compared with the clause 92 specification for the return loss at TP2.

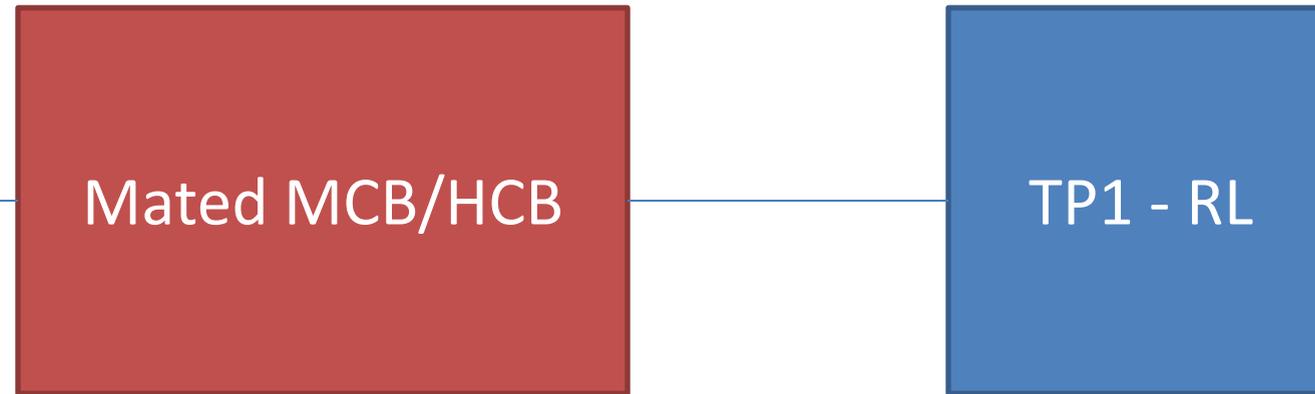
TP1 Simulation setup



T1 Loss	Length
6.26dB	6.38"
5dB	5.1"
4dB	4.08"
3dB	3.05"
2dB	2.04"
1dB	1.02"
0dB	No line

TP2 Return loss derivation

TP2 – RL Calculation



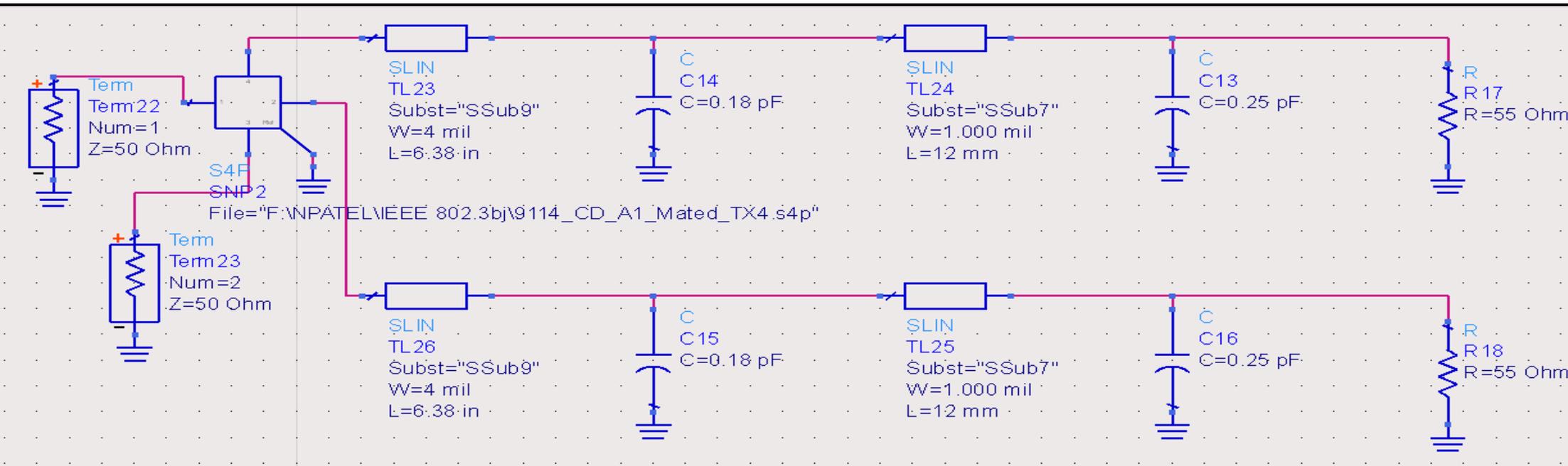
Analytic method

TP2 RL Equation

$$TP2\ RL = -20 * \log_{10}(10^{-(MCB_HCB_RL/20)} + 10^{(TP1_RL + 2 * MCB_HCB_IL) / 20})$$

RL – Return Loss

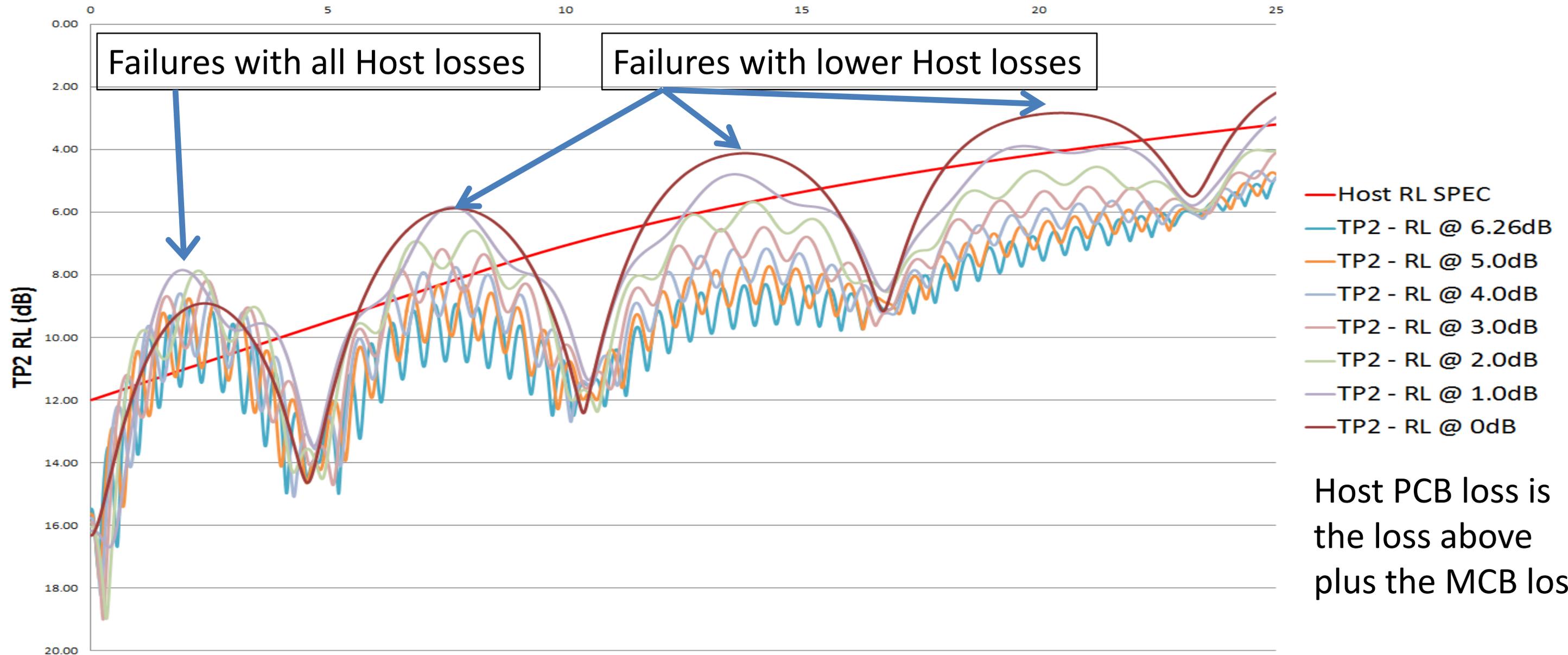
IL - Insertion Loss



Method 2
Simulation using mated
MCB/HCB measured S
Parameters

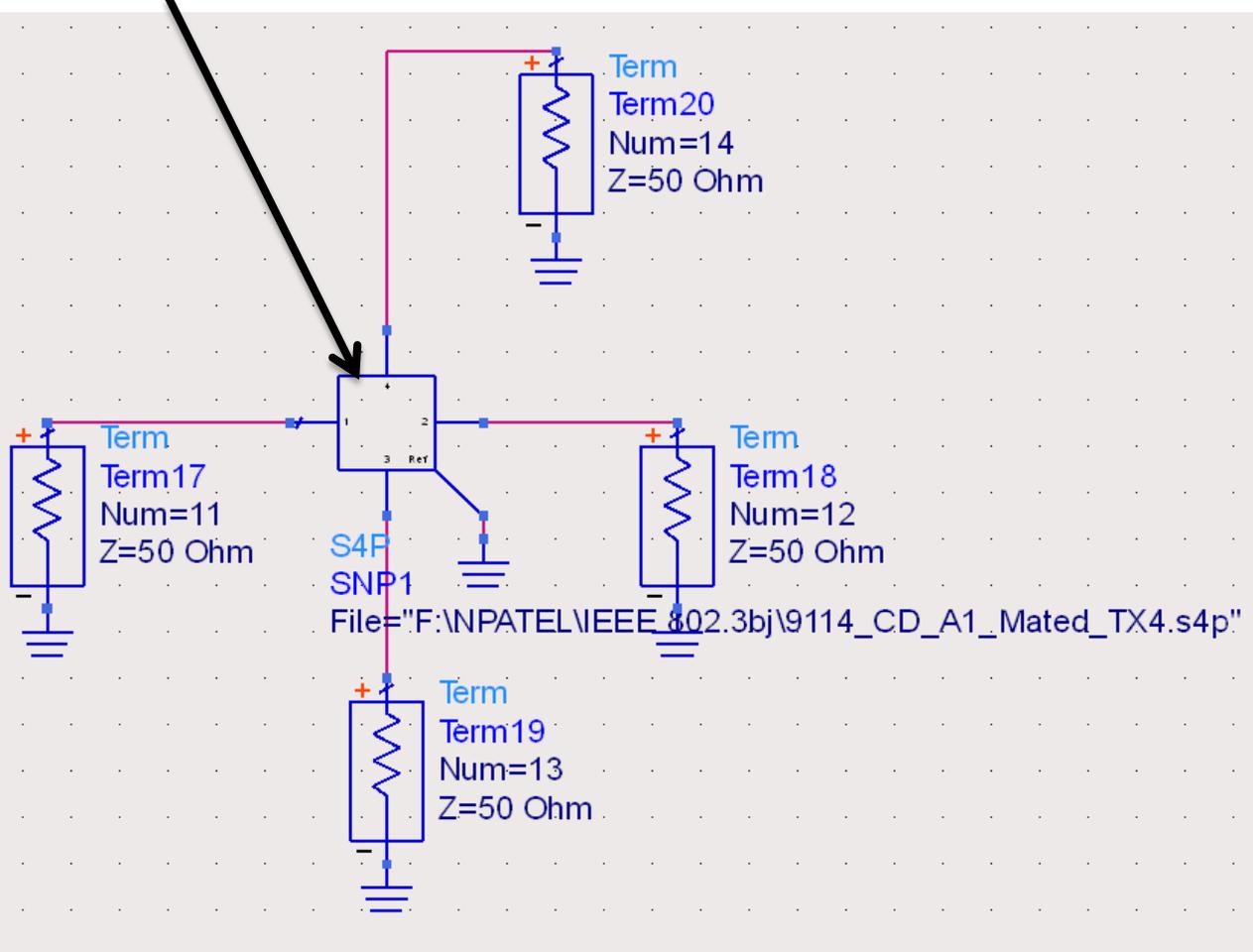
TP2 Return Loss – Analytic Method

TP 2 RL at various TP1 losses
Frequency (Ghz)



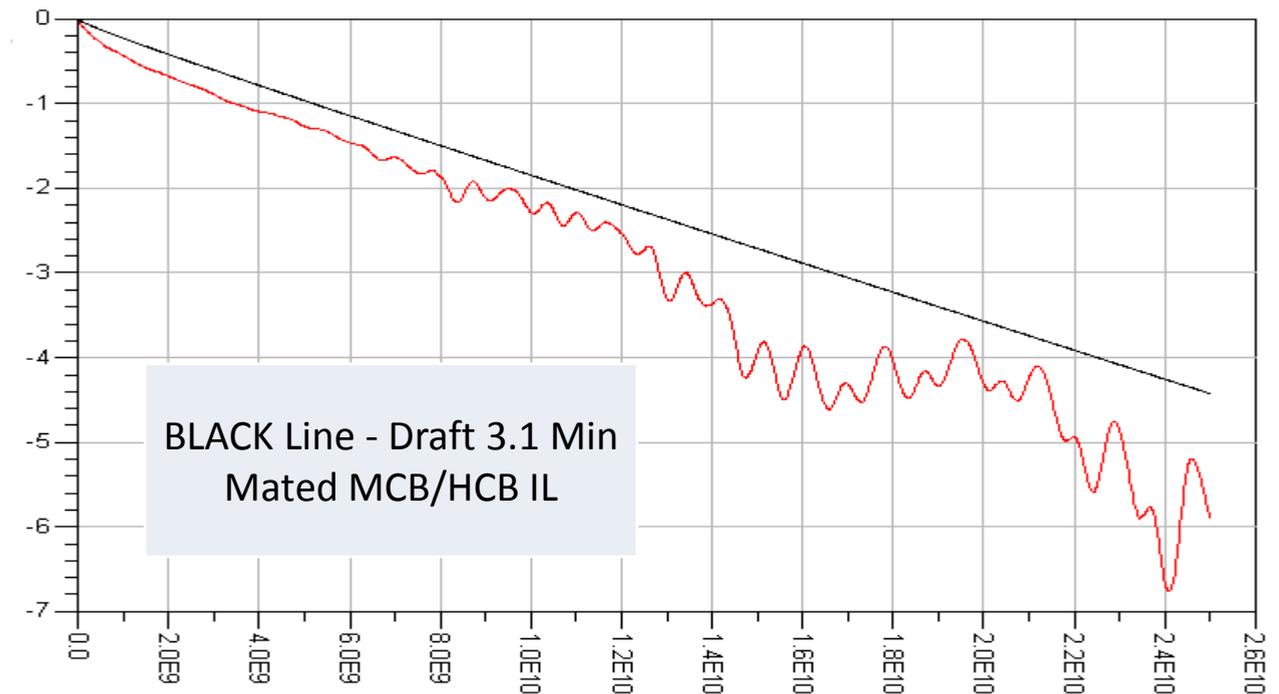
Mated MCB/HCB S-parameter file

Mated MCB/HCB S-parameter file from C. Diminico. Note that it is expected that the out of spec return loss will be corrected with changes to the MCB



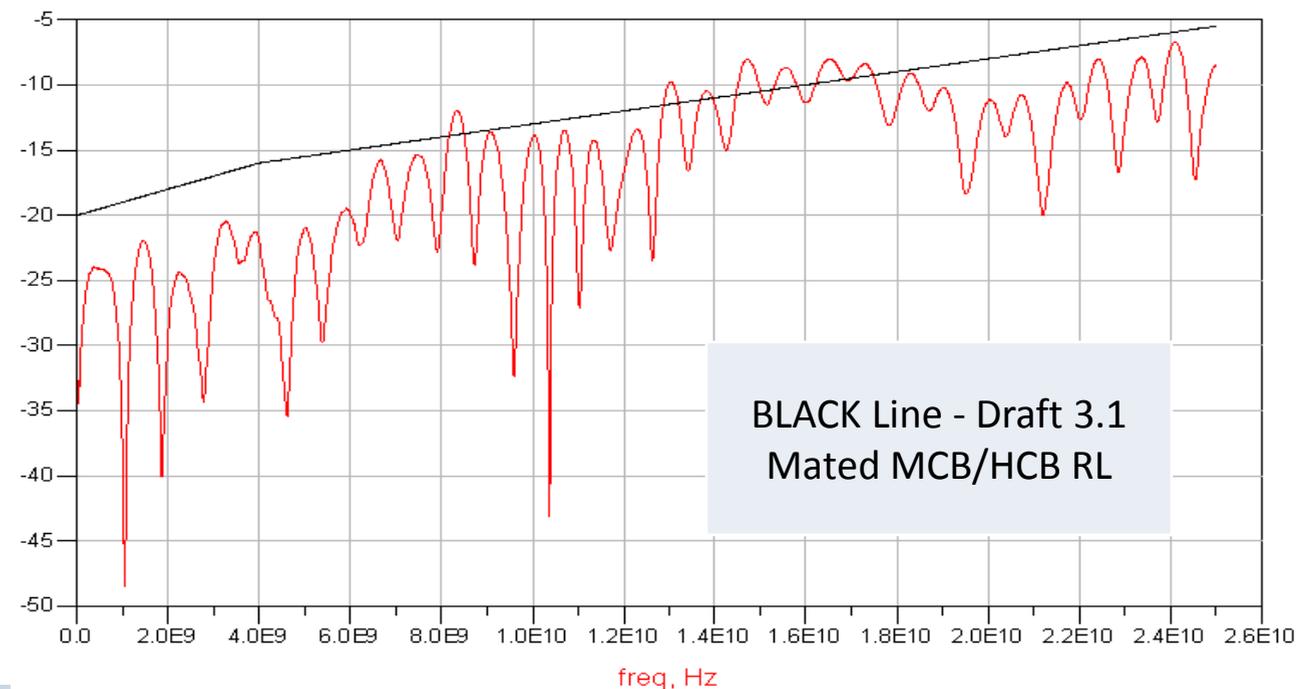
Insertion Loss

dB



Return Loss

dB

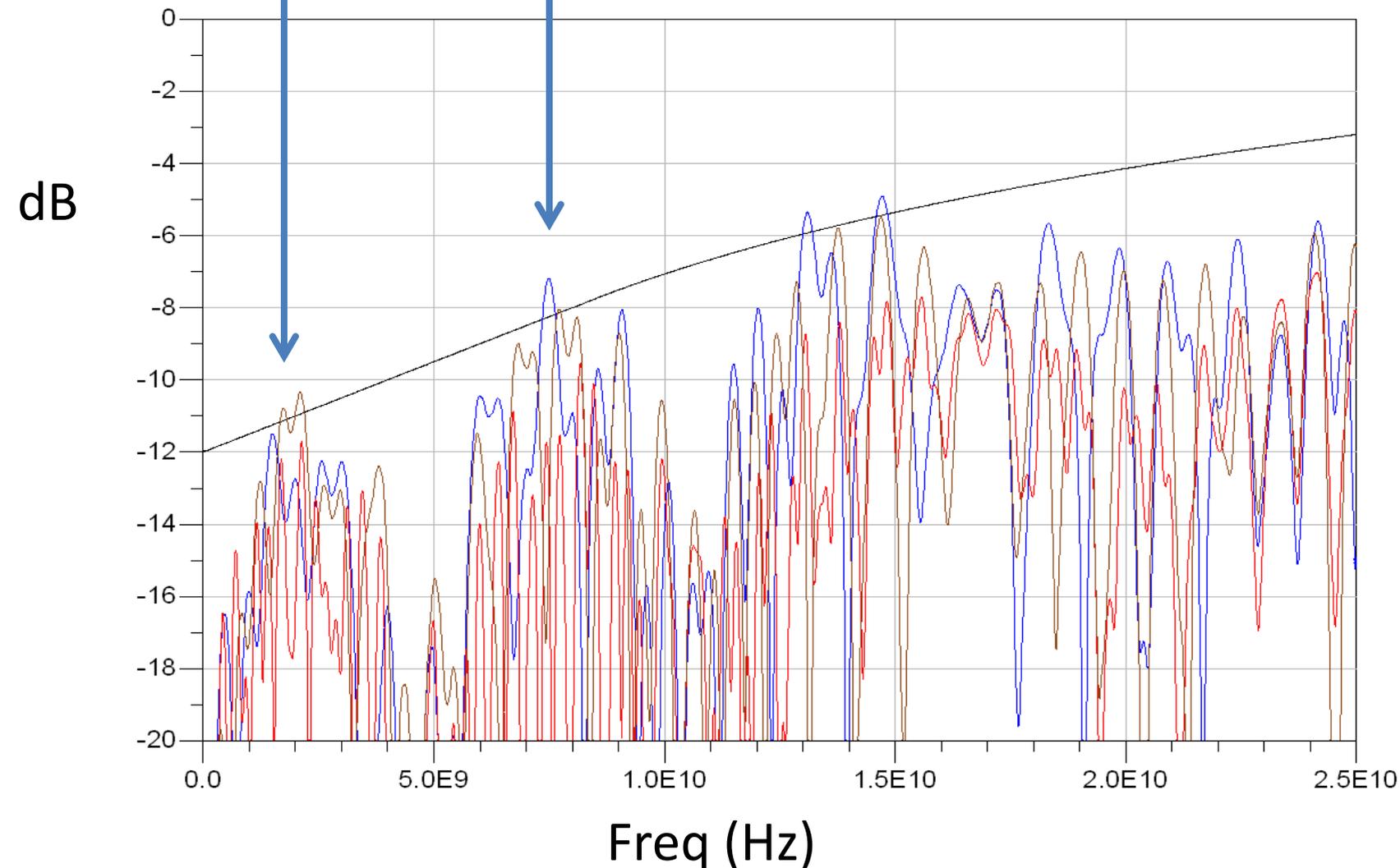


TP2 Return Loss – Method 2 (measured MCB/HCB)



Fails spec at these frequencies even though HCB/MCB is in spec at these frequencies

Also note that the HCB is above 100 Ohm impedance whereas 90 Ohm impedance would be worst case.



Black – Host RL Spec
Red – TP2 RL @ 6.26dB
Brown – TP2 RL @ 1dB
Blue – TP2 RL @ 0dB

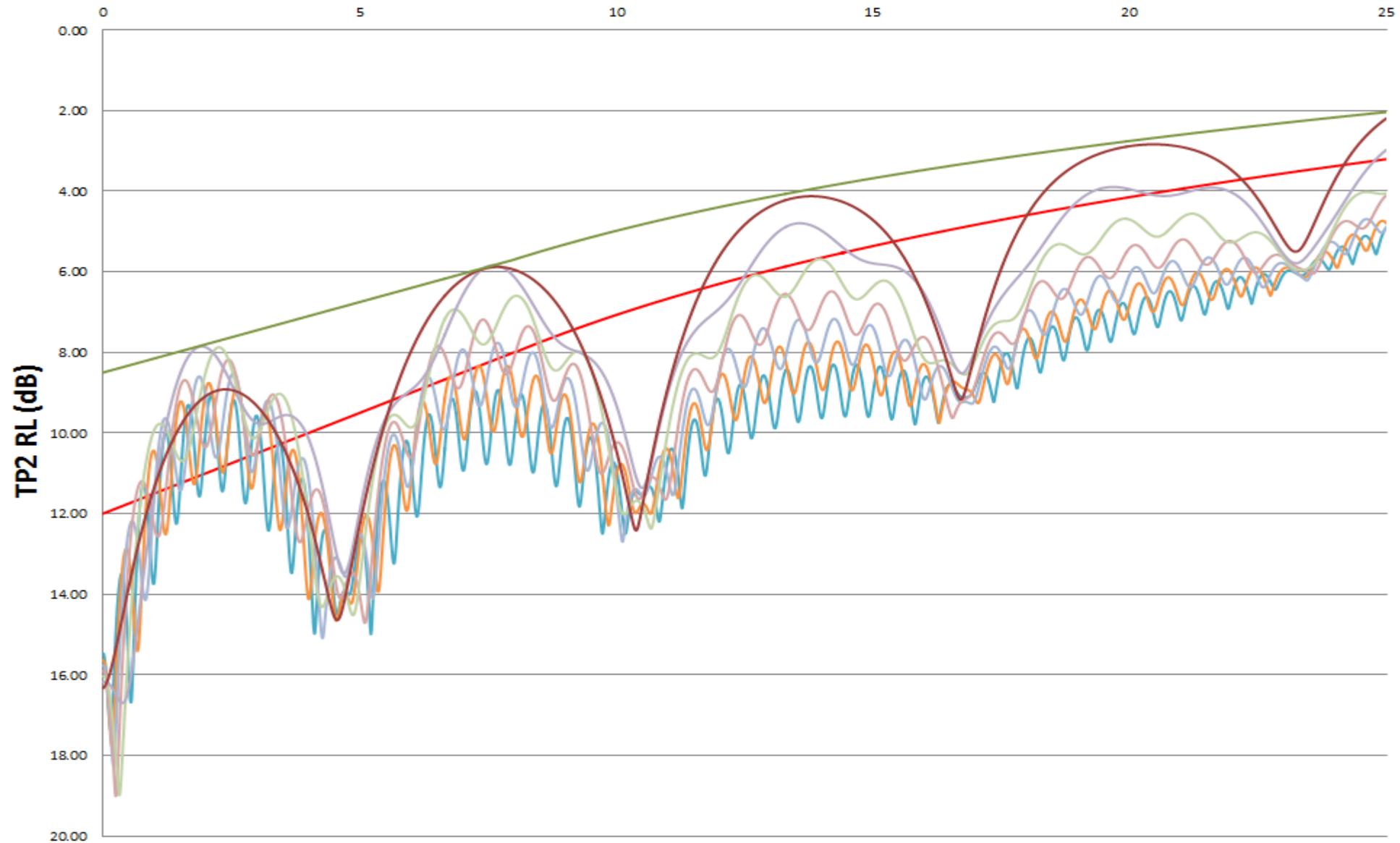
Host PCB loss is the loss above plus the MCB loss

- There is an issue that with a worst case IC and host as used in the COM model for testing cables. The specification for the return loss at TP2 is not met with compliance boards that just meet their specification.
- As the cable COM is already calculated with these parameters there is little risk in relaxing it for hosts with long traces. It is expected that hosts with shorter traces will perform better and therefore that should not be an issue. However if there are concerns with this then a cable COM test case could be created to create maximum reflections by using the short package without the TP0 to TP1 transmission line. This new test case would either be in addition to the existing two cases (short and long package with 6.2dB TP0 to TP1 loss) or could replace the existing short package test case.
- **Proposal**
 1. As proposed in comment r01-49 the TP2 and TP3 (identical specification) should be relaxed to

$$\begin{array}{ll} 8.5 - 0.35 \times f & 0.01 \leq f \leq 8 \\ 3.9 - 7.4 \times \log_{10}(f/14) & 8 < f \leq 19 \end{array}$$

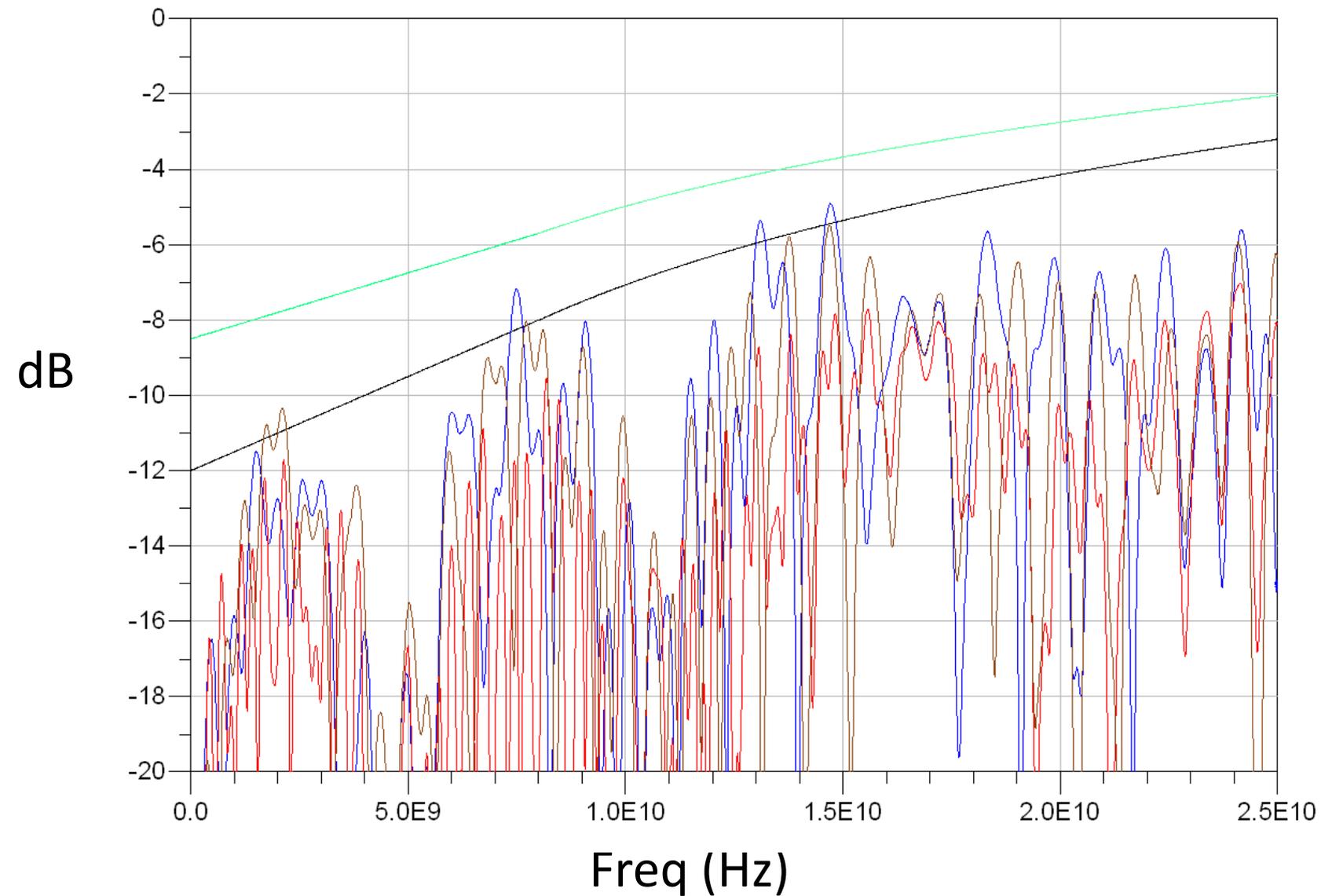
TP2 Return Loss – Analytic Method

TP 2 RL at various TP1 losses
Frequency (Ghz)



- Host RL SPEC
 - TP2 - RL @ 6.26dB
 - TP2 - RL @ 5.0dB
 - TP2 - RL @ 4.0dB
 - TP2 - RL @ 3.0dB
 - TP2 - RL @ 2.0dB
 - TP2 - RL @ 1.0dB
 - TP2 - RL @ 0dB
 - Proposed Host RL SPEC
- Host PCB loss is this loss plus the MCB loss
- $$8.5 - 0.35 \times f \quad 0.01 \leq f \leq 8$$
- $$3.9 - 7.4 \times \log_{10}(f/14) \quad 8 < f \leq 19$$

TP2 Return Loss – Method 2



Black – Host RL Spec

Red – TP2 RL @ 6.26dB + MCB

Brown – TP2 RL @ 1dB + MCB

Blue – TP2 RL @ 0dB + MCB

Green – Proposed RL Spec

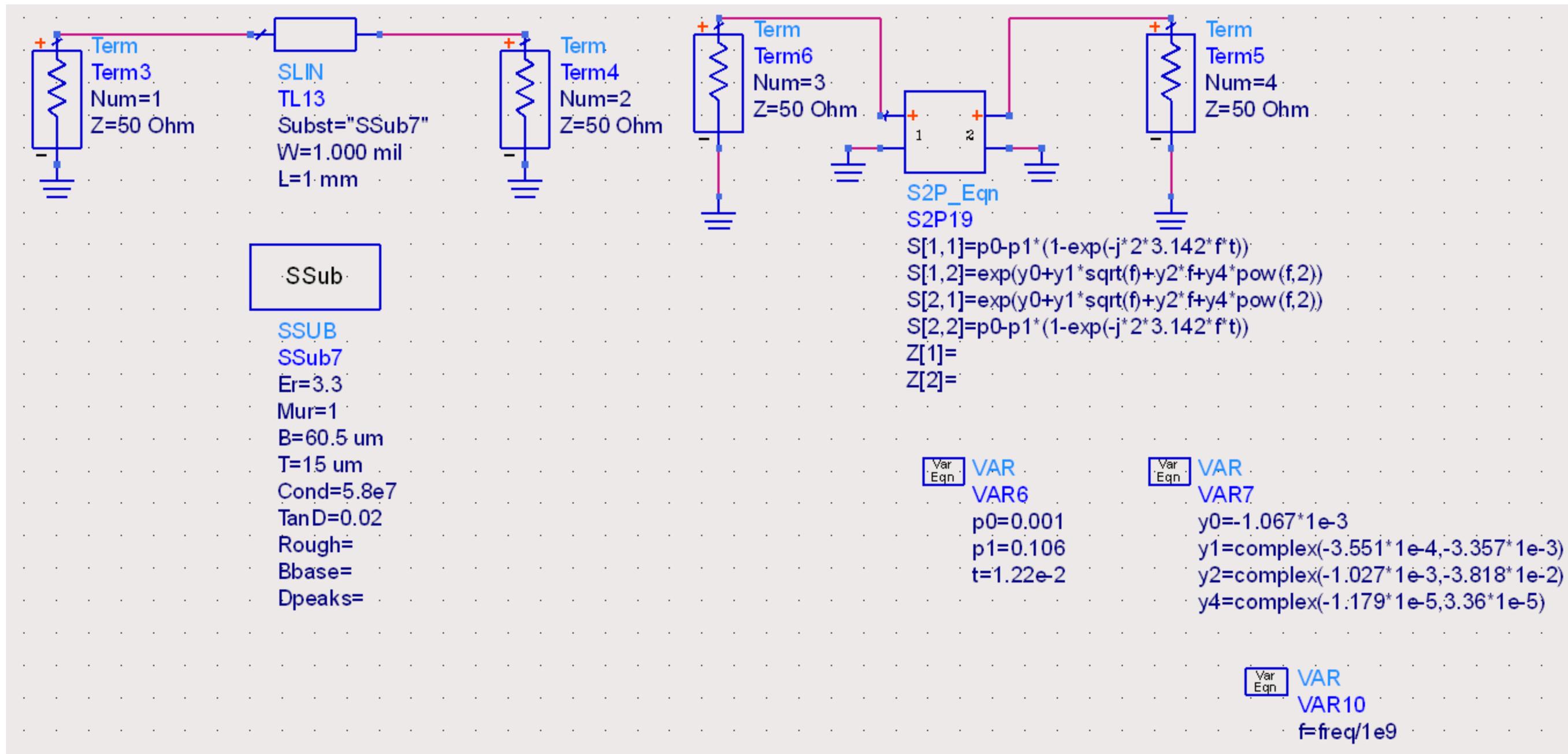
$$8.5 - 0.35 \times f \quad 0.01 \leq f \leq 8$$

$$3.9 - 7.4 \times \log_{10}(f/14) \quad 8 < f \leq 19$$



Backup.

Comparing zp Tline vs S-param equations



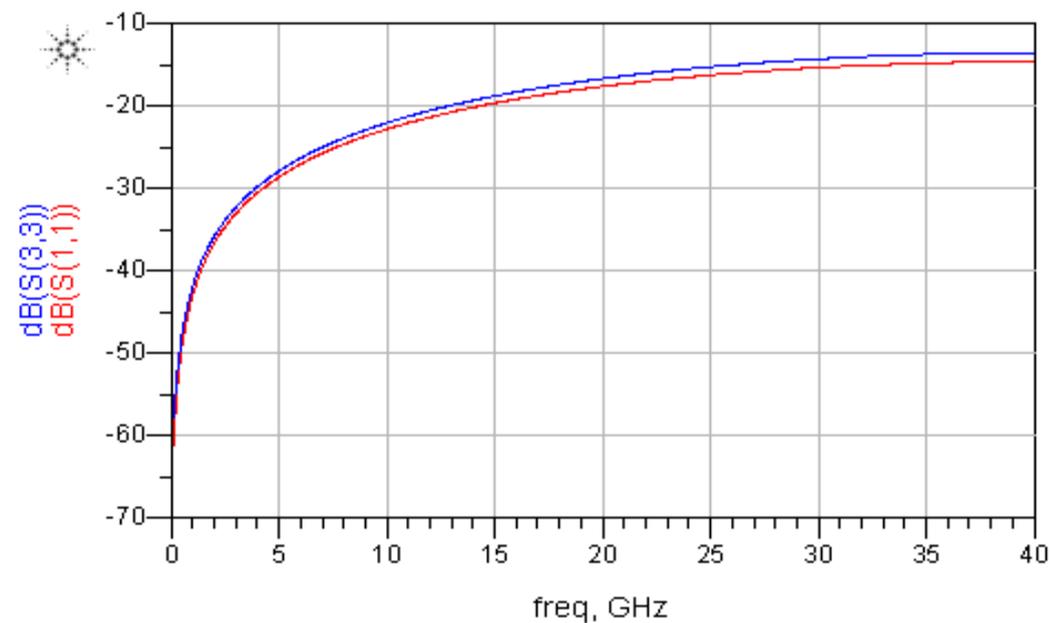
Comparing zp Tline vs S-param equations

Return Loss

L= 1mm

Red – Tline

Blue – S parameter equation

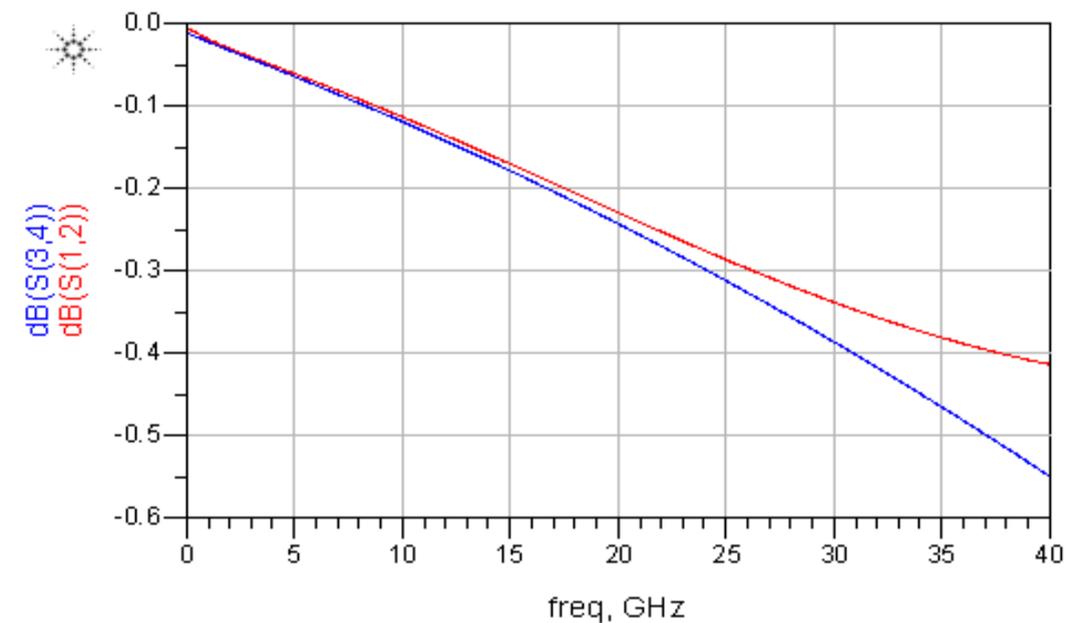


Insertion Loss

L= 1mm

Red – Tline

Blue – S parameter equation



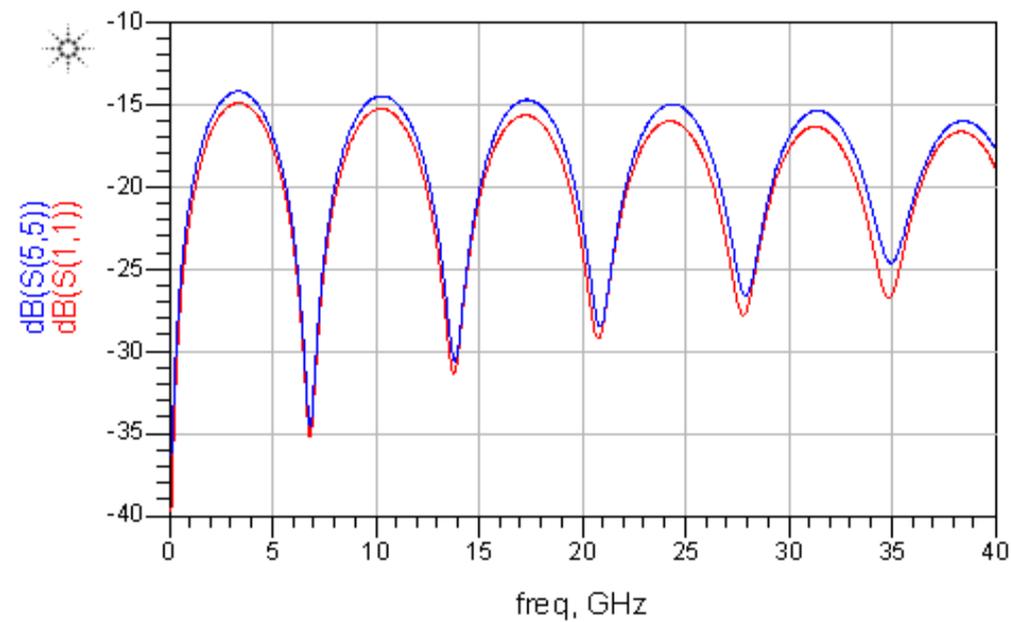
Comparing zp Tline vs S-param equations

Return Loss

L= 12mm

Red – Tline

Blue – S parameter equation

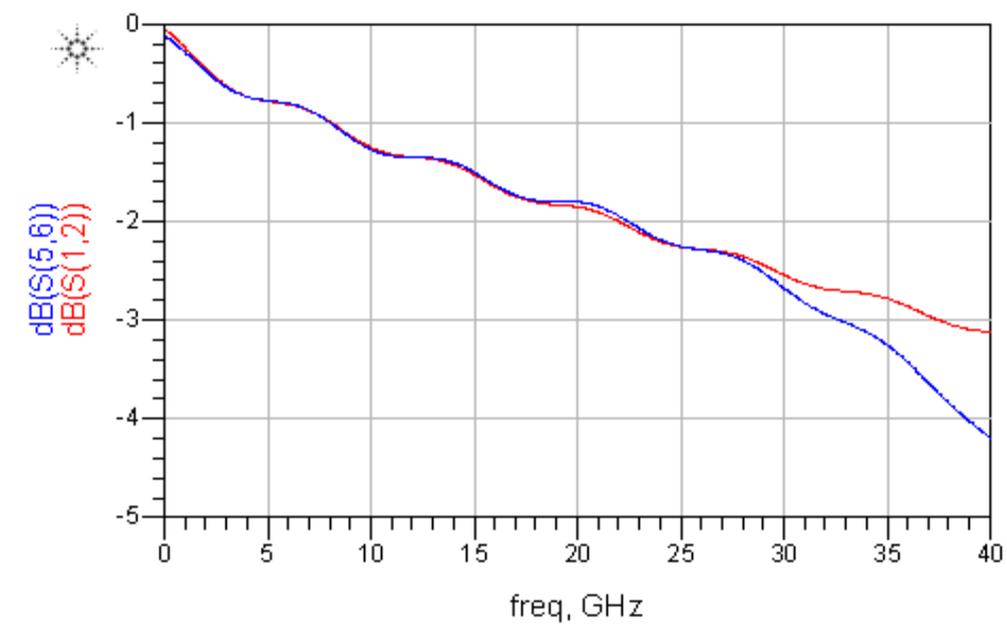


Insertion Loss

L= 12mm

Red – Tline

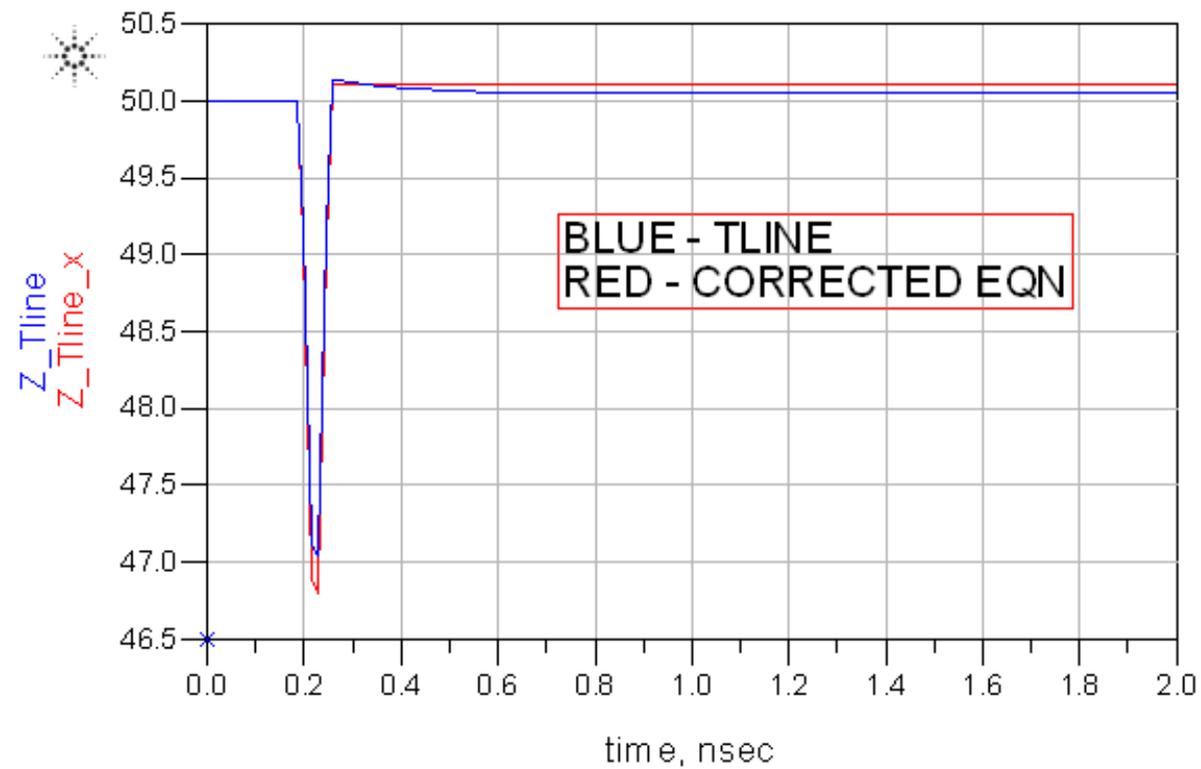
Blue – S parameter equation



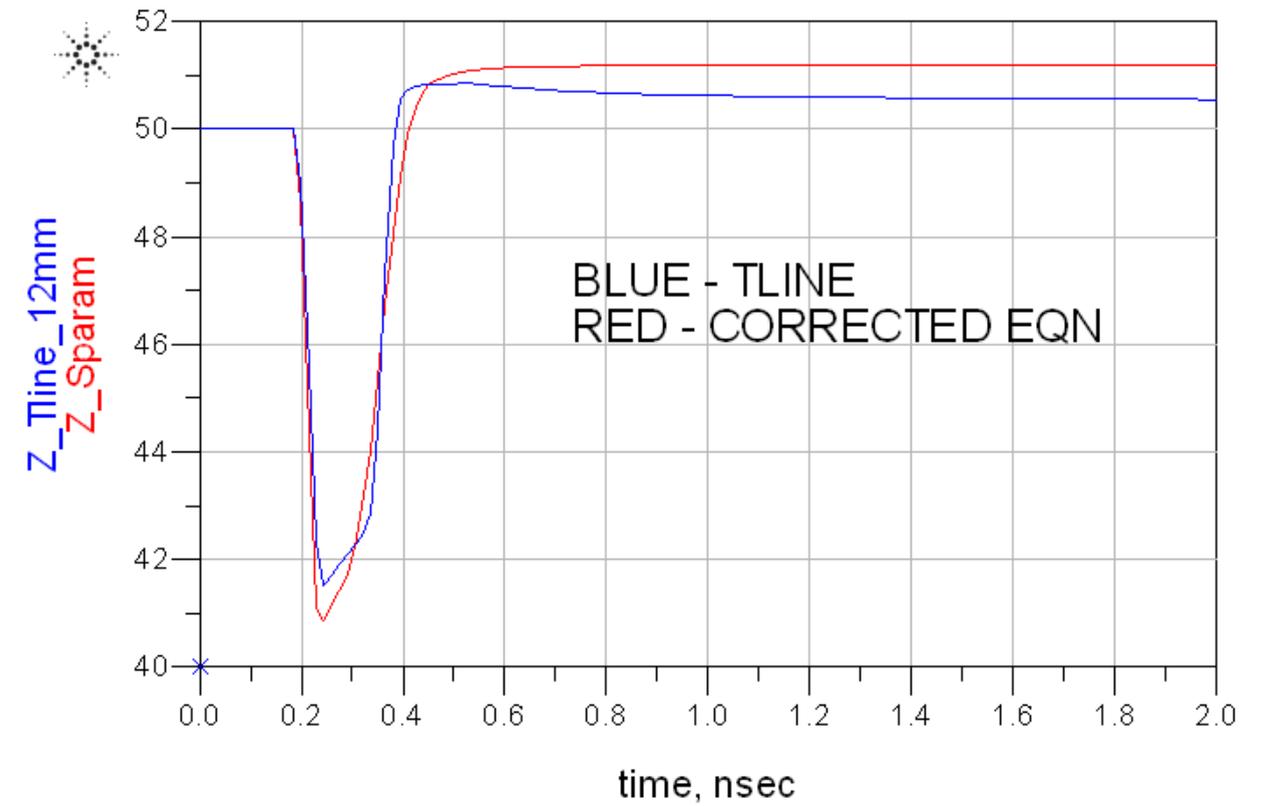
TDR Tline vs. S-param

30ps rise time

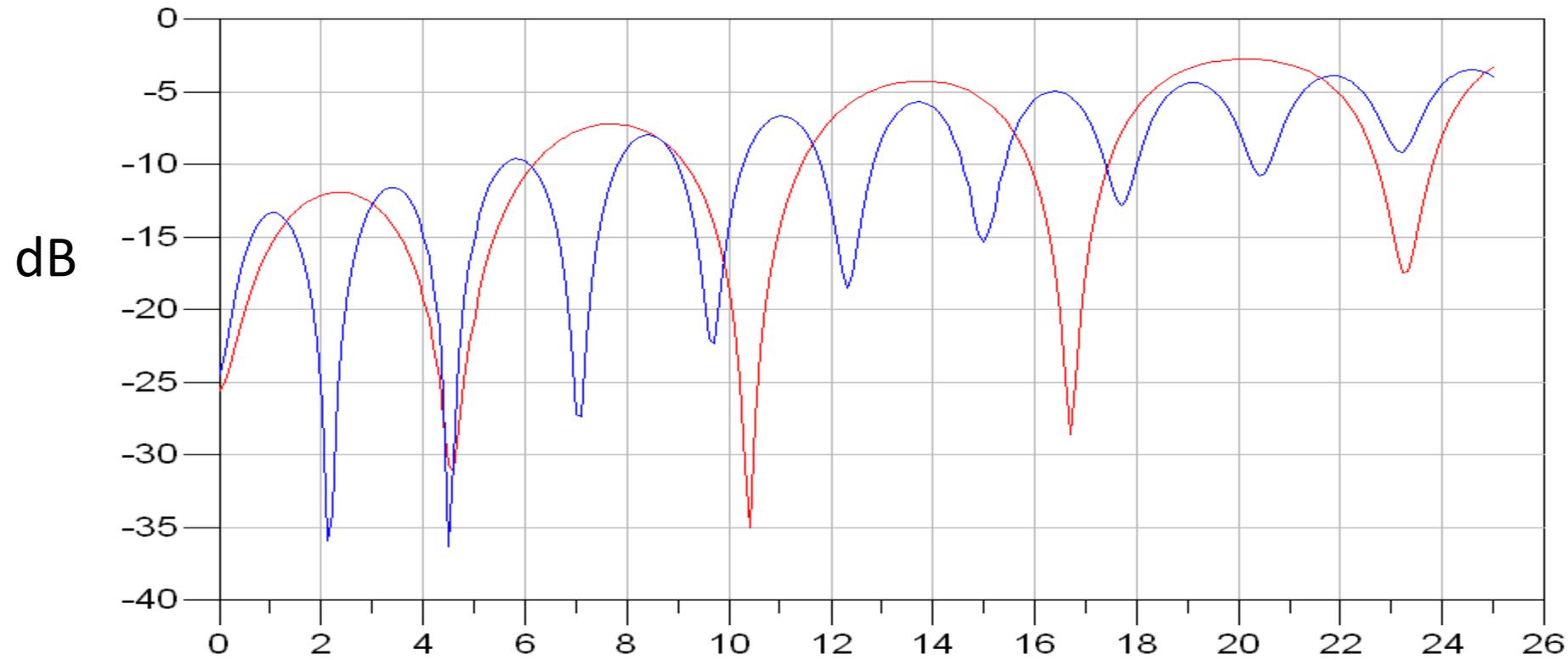
1mm



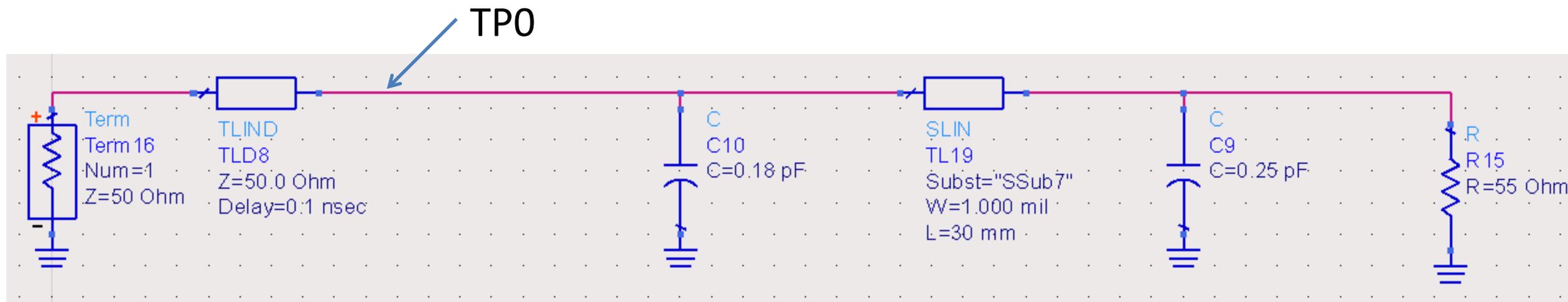
12mm



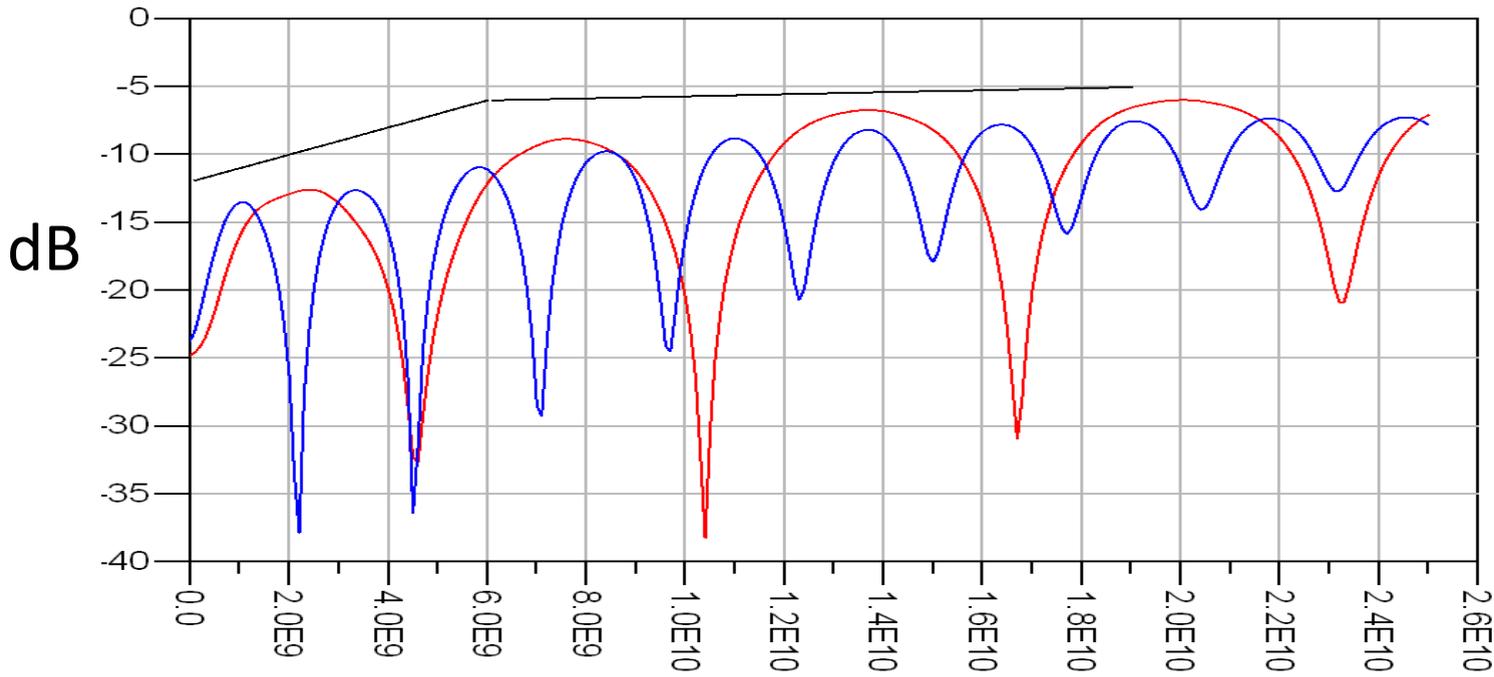
S11 – TP0 – Return loss



Red line – Return loss for 12mm
BLUE line – Return loss for 30mm



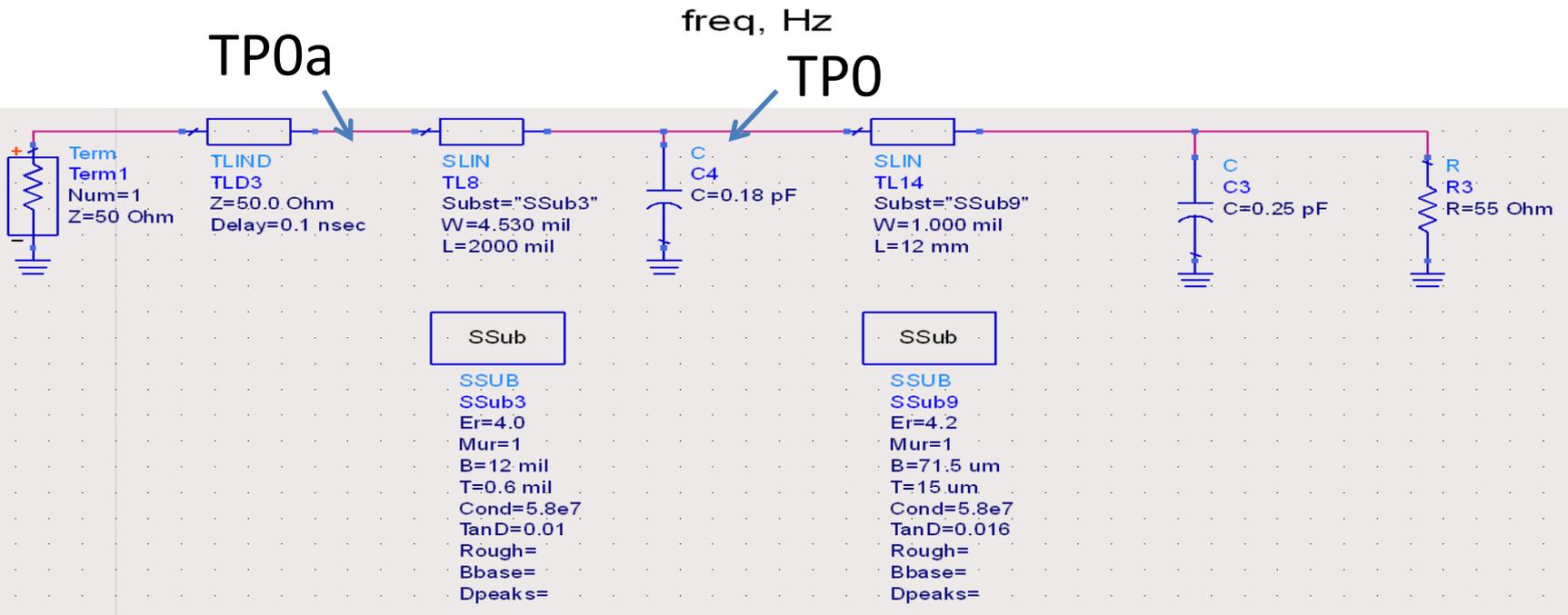
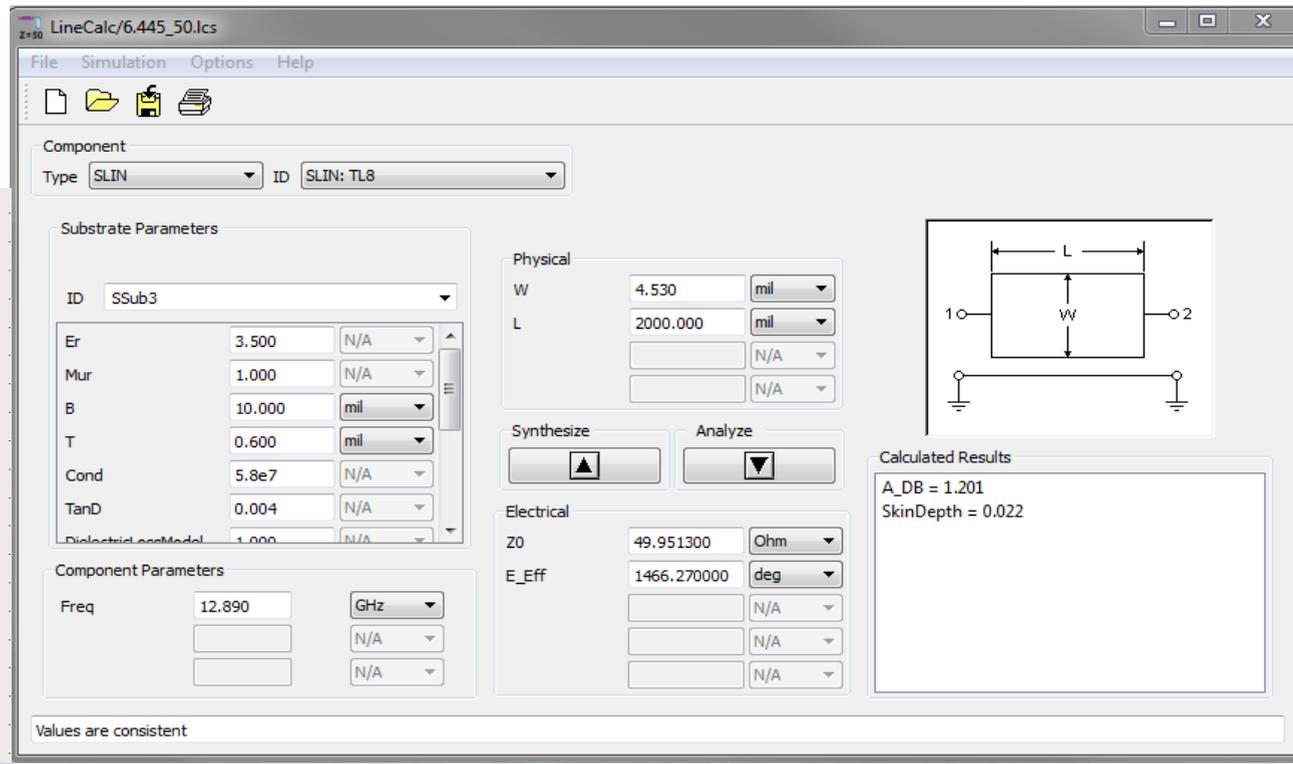
S11 – TP0a – Tline test fixture – 50ohms



Black line - $RL_d(f) \geq \left\{ \begin{array}{ll} 12.05 - f & 0.05 \leq f \leq 6 \\ 6.5 - 0.075f & 6 < f \leq 19 \end{array} \right\} \text{ dB} \quad (93-3)$

Red line – Return loss for 12mm
 BLUE line – Return loss for 30mm

1.2dB loss at 12.89 Ghz for 2" Tline

LineCalc/6.445_50.lcs

Component: SLIN ID: SLIN: TL8

Substrate Parameters (SSub3): Er=3.500, Mur=1.000, B=10.000 mil, T=0.600 mil, Cond=5.8e7, TanD=0.004

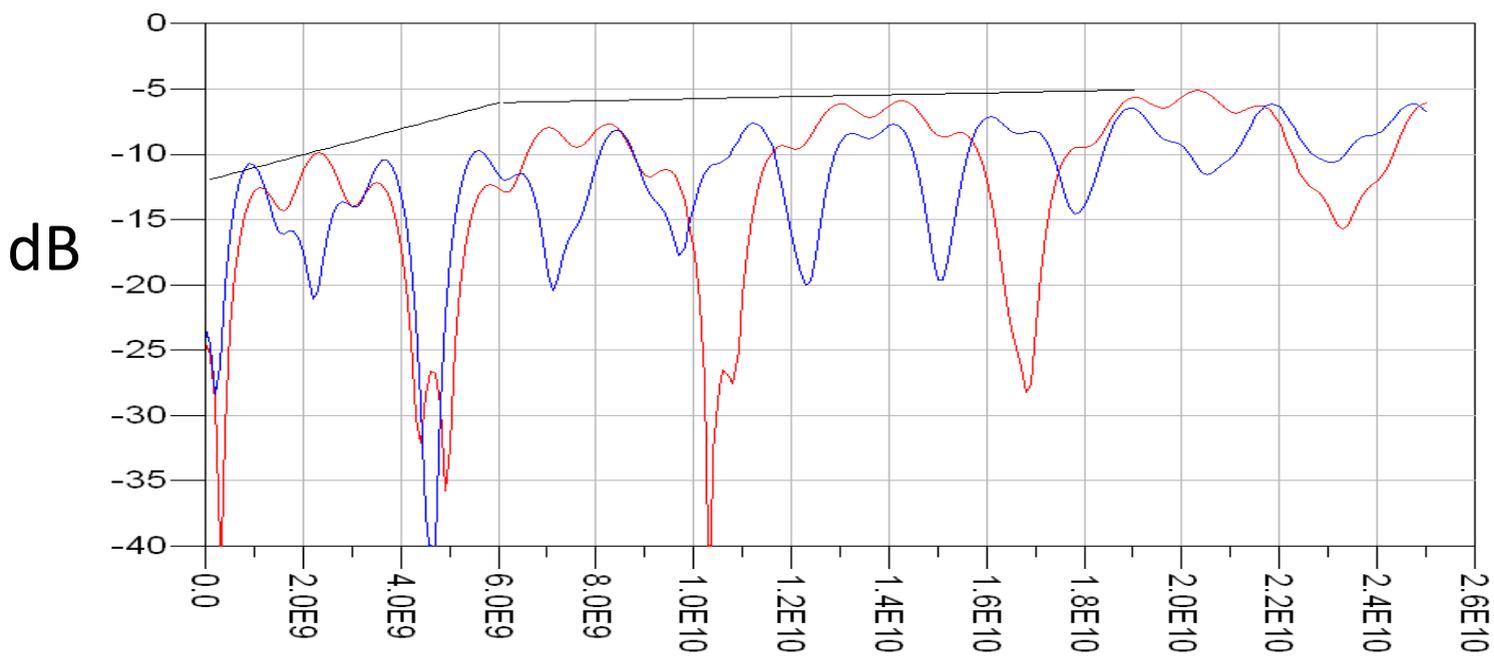
Physical: W=4.530 mil, L=2000.000 mil

Frequency: 12.890 GHz

Calculated Results:

- A_DB = 1.201
- SkinDepth = 0.022

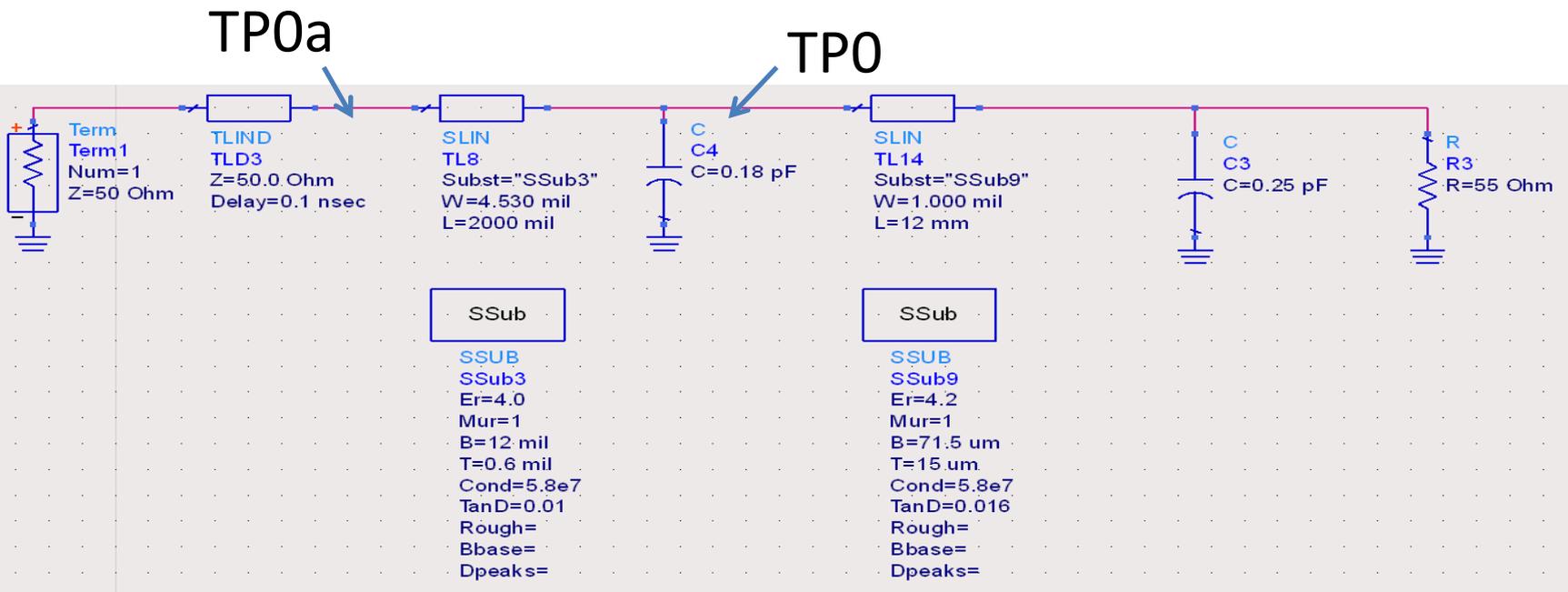
S11 – TP0a – Tline test fixture – 55ohms



Black line - $RL_d(f) \geq \left\{ \begin{array}{ll} 12.05 - f & 0.05 \leq f \leq 6 \\ 6.5 - 0.075f & 6 < f \leq 19 \end{array} \right\} \text{ dB} \quad (93-3)$

Red line – Return loss for 12mm
 BLUE line – Return loss for 30mm

1.2dB loss at 12.89 Ghz for 2” Tline



Substrate Parameters		
ID	SSub10	
Er	3.900	N/A
Mur	1.000	N/A
B	10.000	mil
T	0.600	mil
Cond	5.8e7	N/A
TanD	0.002	N/A
DielectricLossModel	1.000	N/A

Physical	
W	3.200 mil
L	2.000 in

Electrical	
Z0	55.225500 Ohm
E_Eff	1550.320000 deg

Calculated Results

A_DB = 1.173
 SkinDepth = 0.022

TP1 Return Loss

TP 1 RL at various Lengths

