Return loss at TP2 for CAUI-4 Chip to Module

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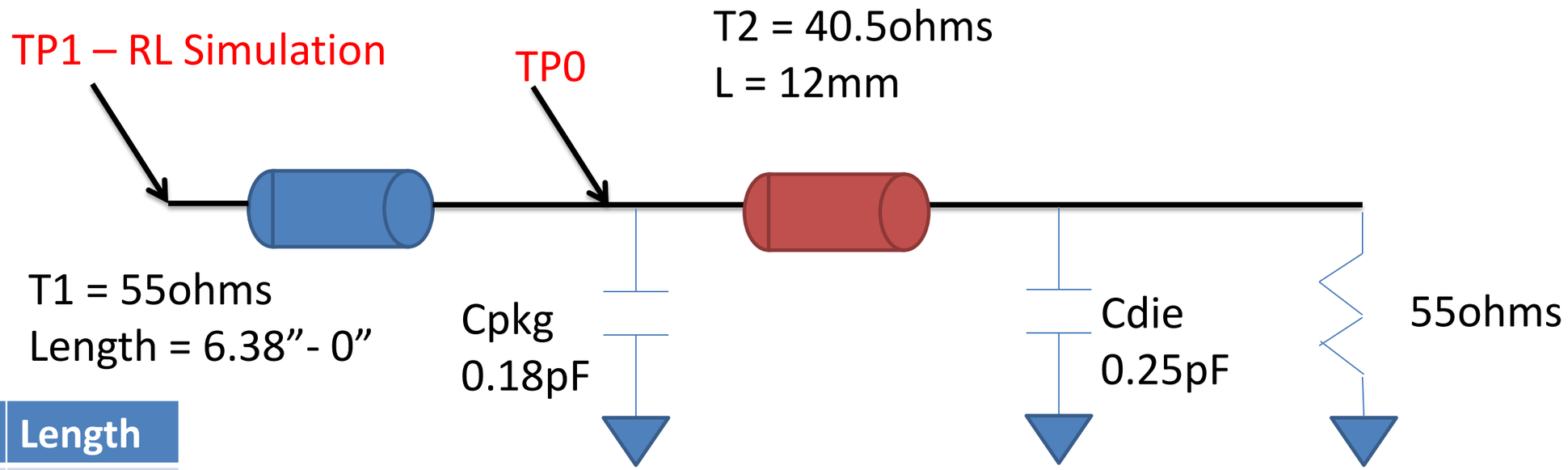
Outline

- **This presentation investigates the return loss specification at TP2 in 802.3bm draft 2.1 and compares it with the assumed ASIC and host specifications. It is in support of comment 48. A similar comment r01-49 was made against 802.3bj.**
- **The process is as follows.**
  1. A representation of the Clause 93 ASIC model (used in COM calculations) 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 cable calculation in COM. 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 <0.1dB 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 83E specification for the host return loss at TP2 (Equation 83E-2). 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 83E specification for the host return loss at TP2.

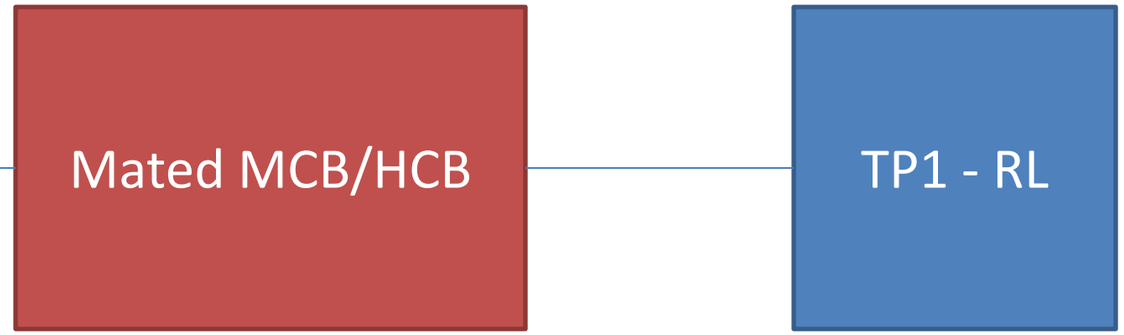
TP1 Simulation setup



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



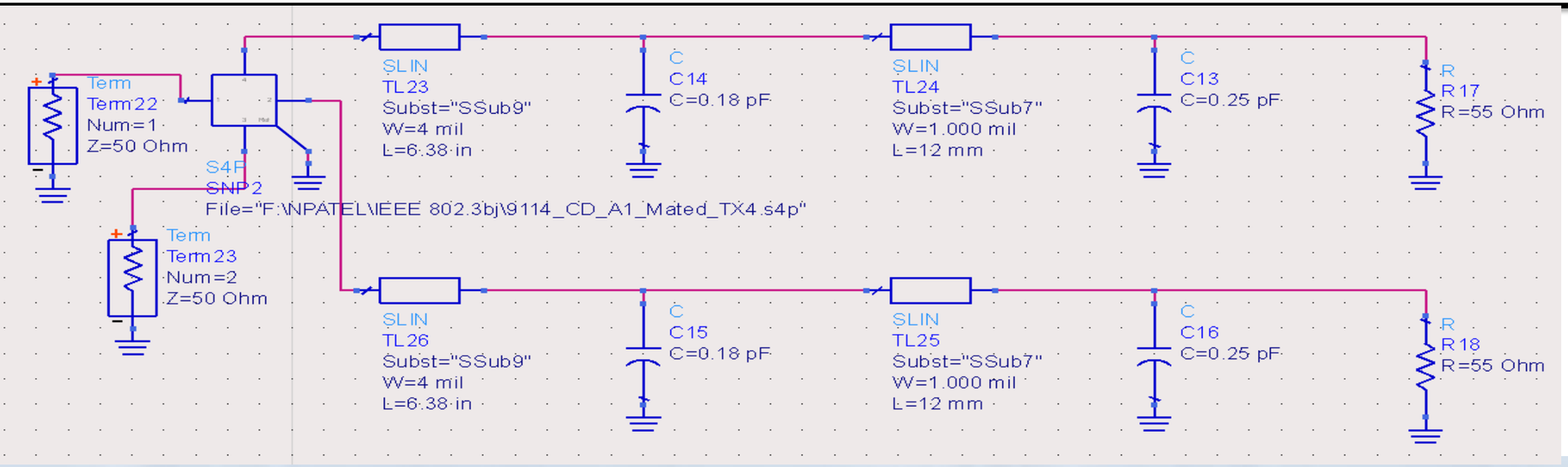
Analytic method

TP2 RL Equation

TP2 RL = -20*log10(10^(-(MCB_HCB_RL/20) + 10^(TP1_RL+2*MCB_HCB_IL) /20)

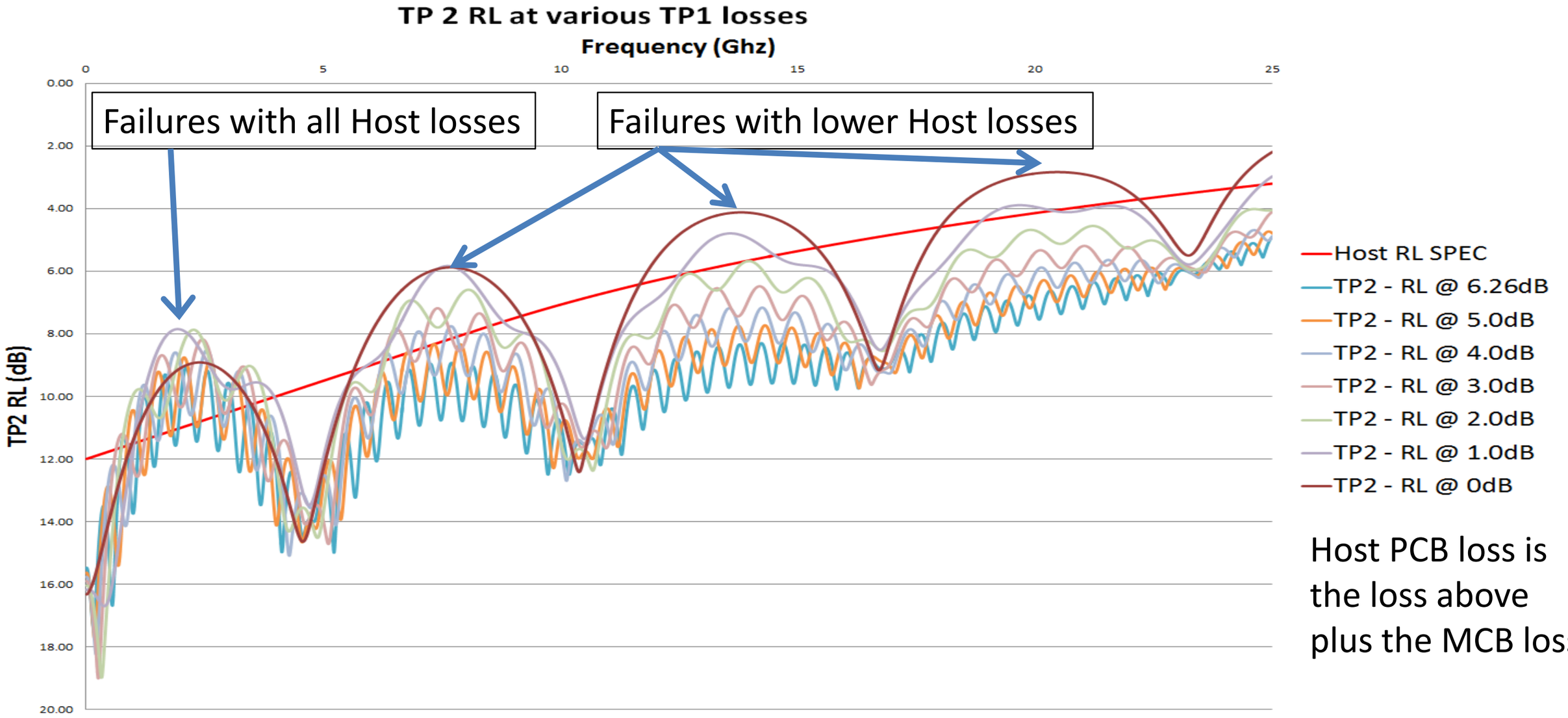
RL – Return Loss

IL - Insertion Loss



Method 2
Simulation using mated MCB/HCB measured S Parameters

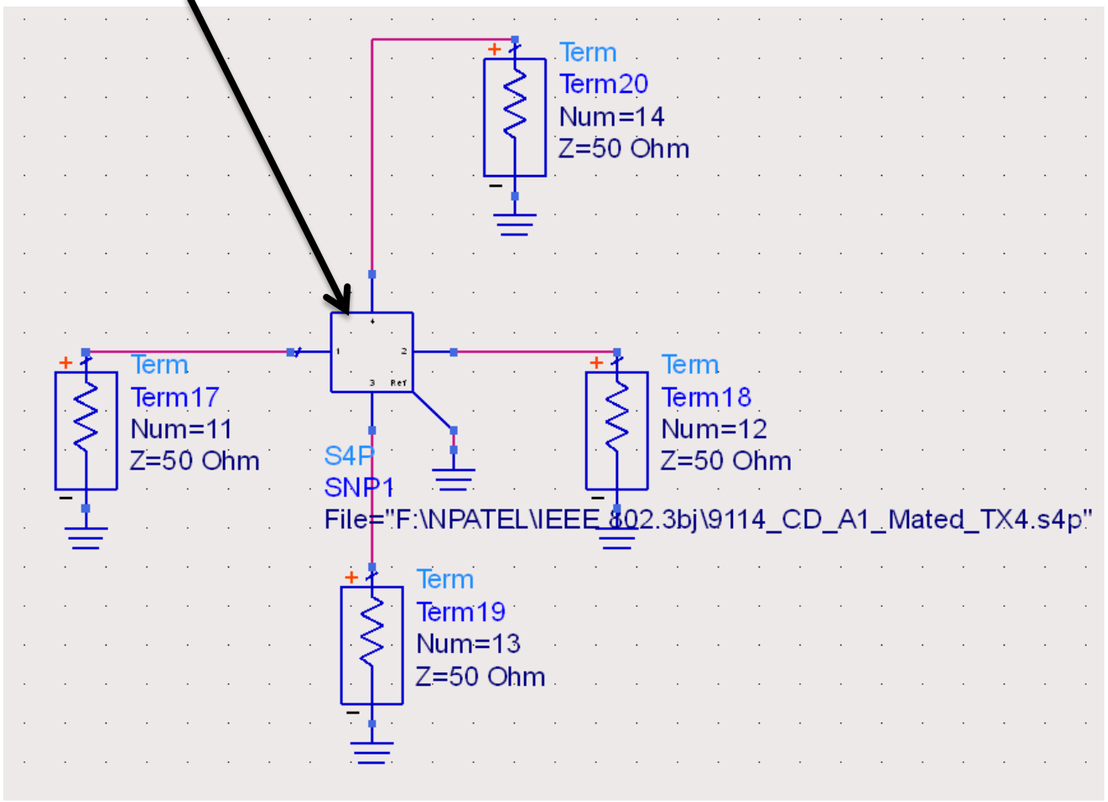
TP2 Return Loss – Analytic Method



Host PCB loss is the loss above plus the MCB loss

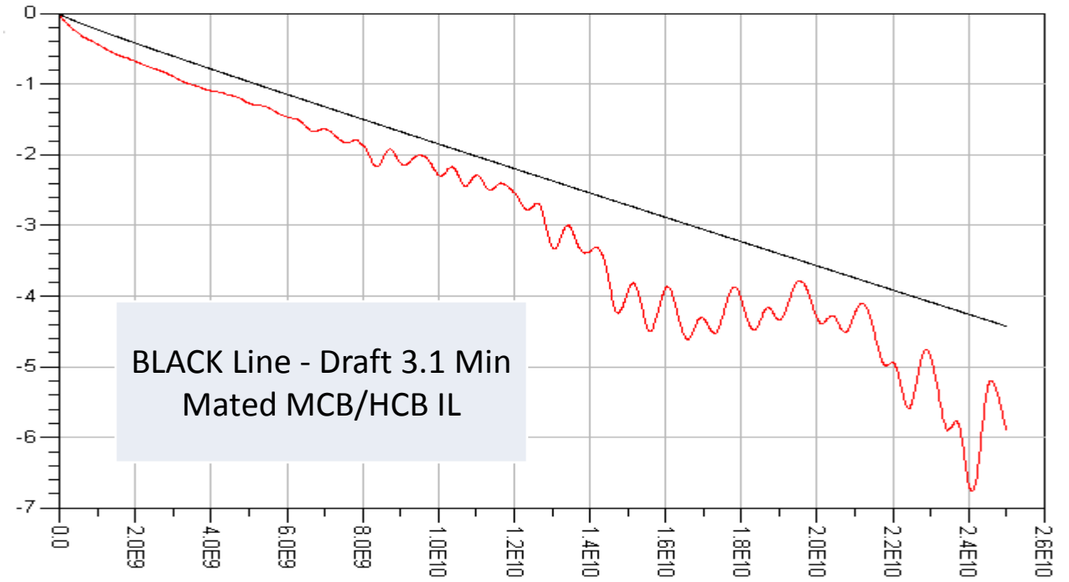
Mated MCB/HCB S-parameter file

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



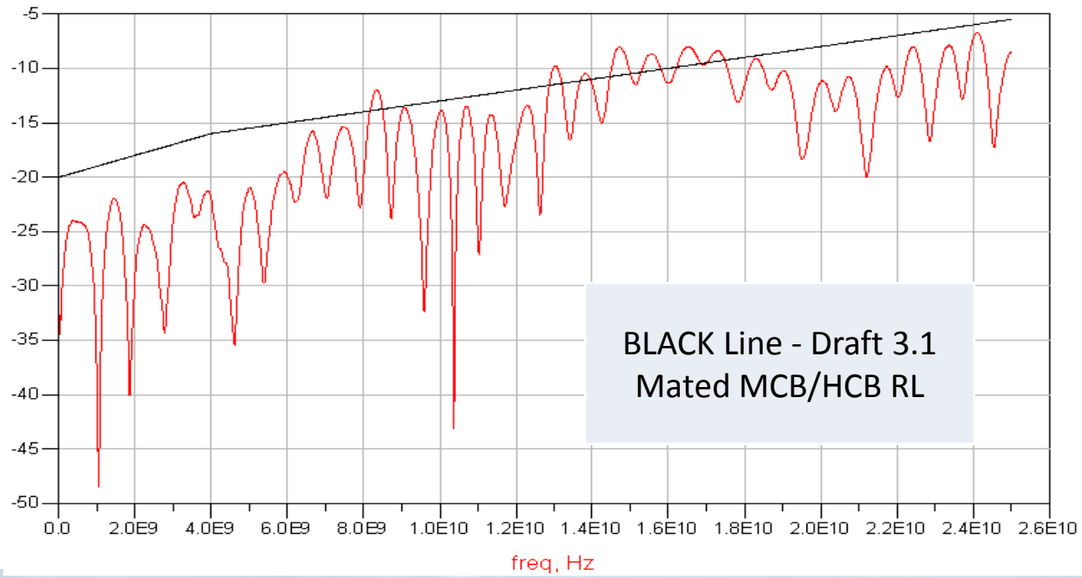
Insertion Loss

dB



Return Loss

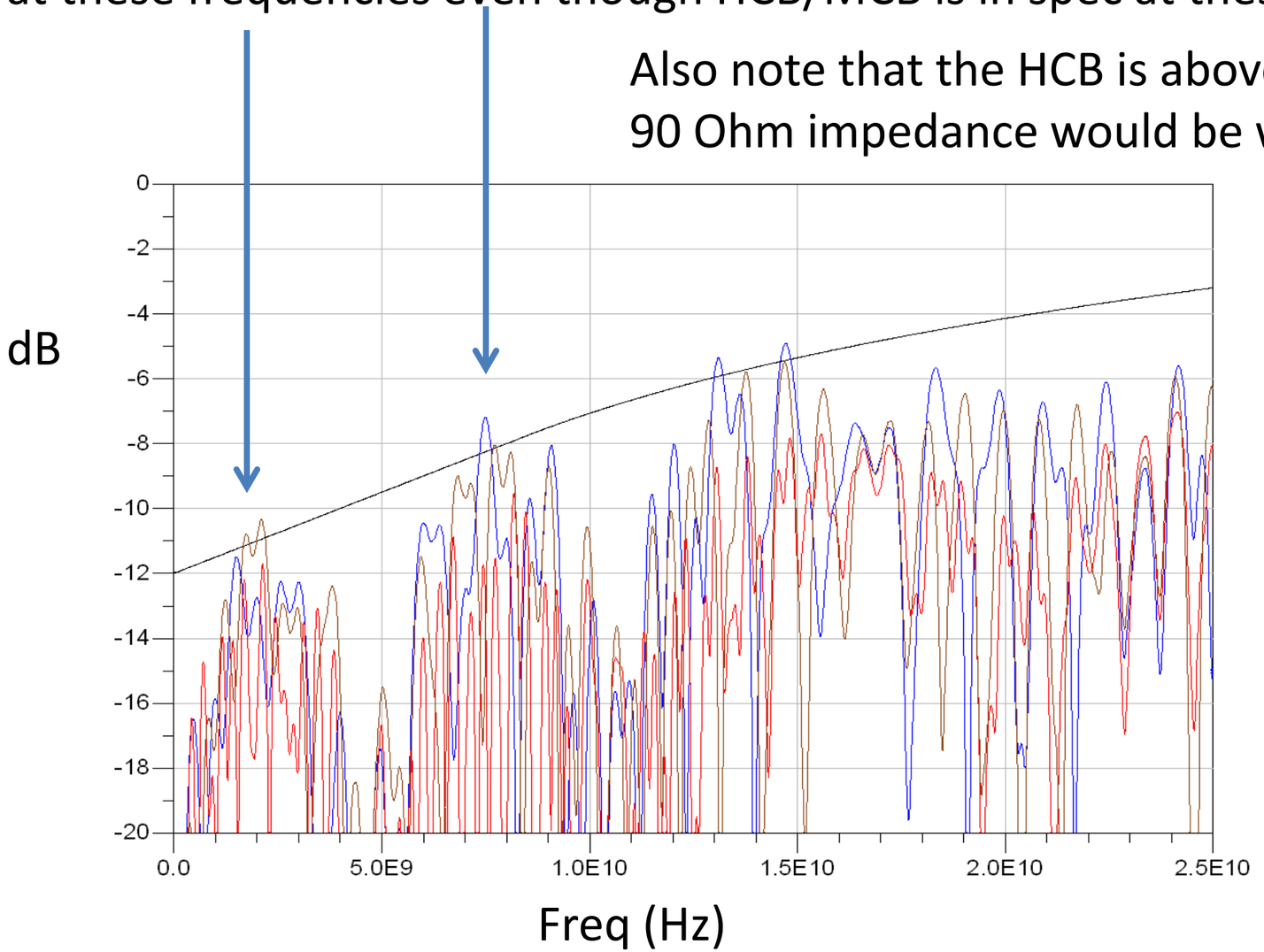
dB



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

Conclusions and Proposal

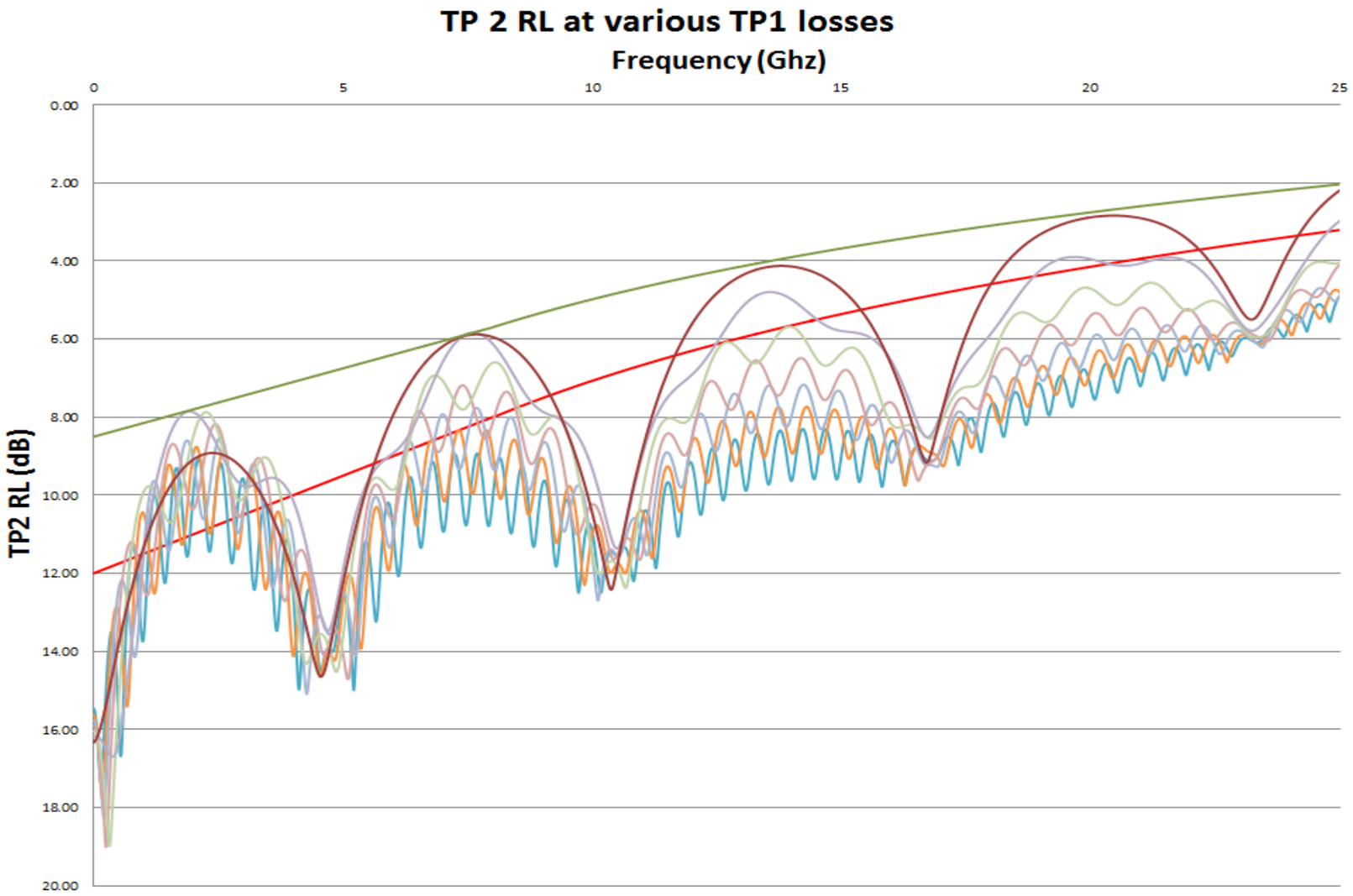
- **There is an issue with a worst case Clause 93 IC and assumed host traces. The specification for the return loss at TP2 is not met with compliance boards that just meet their specification**
- **Proposal**
  1. As proposed in comment 48 the Host TP2 and TP3 (identical specification in equation 83E-5) should be relaxed to

$$8.5 - 0.35 \times f \qquad 0.01 \le f \le 8$$

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

- **It is not proposed to change the module return loss specifications as it is expected that the module IC will be a smaller chip that can more easily meet the return loss specifications.**

TP2 Return Loss – Analytic Method

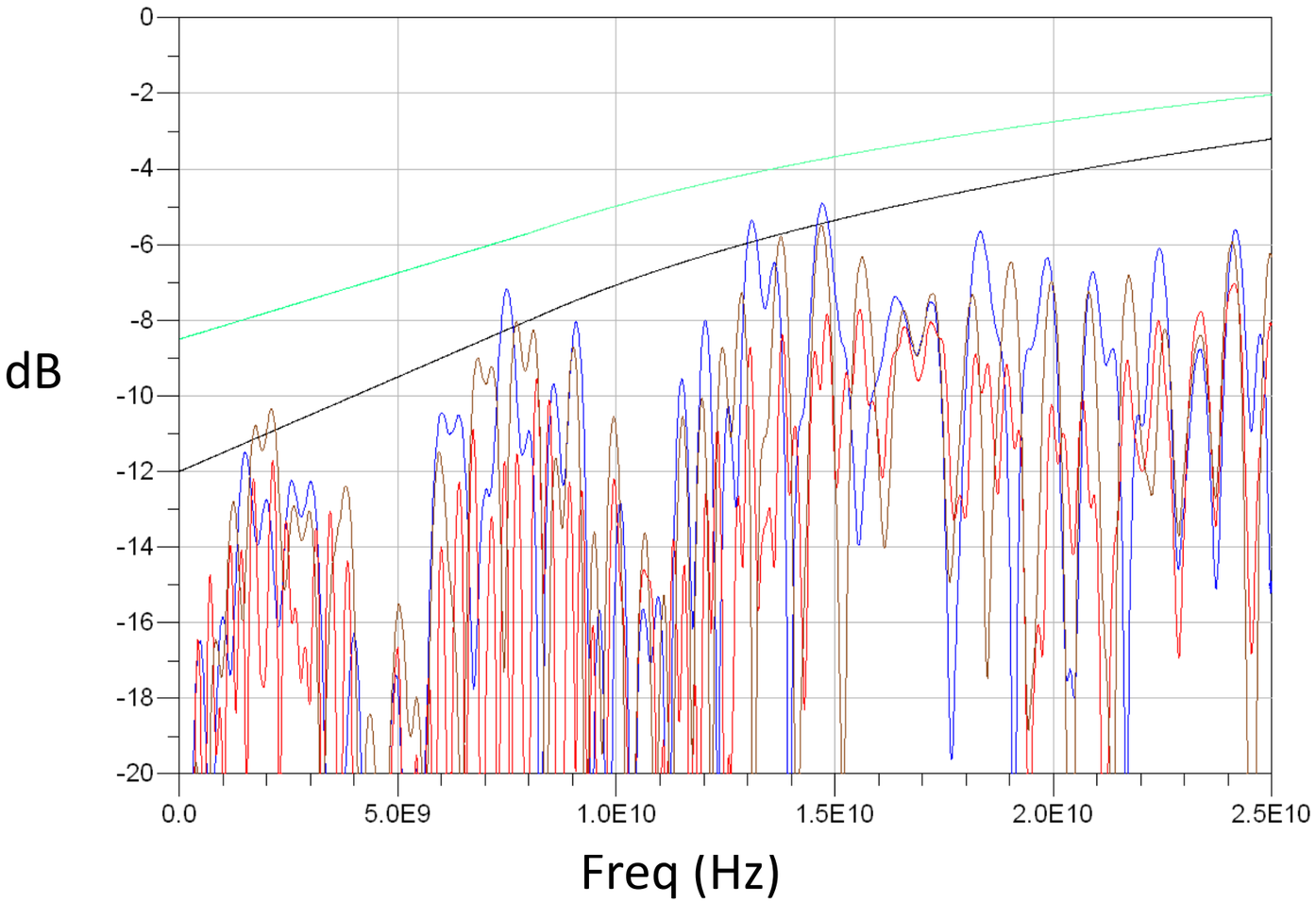


Host PCB loss is this loss plus the MCB loss

$8.5 - 0.35 \times f \qquad 0.01 \le f \le 8$

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

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

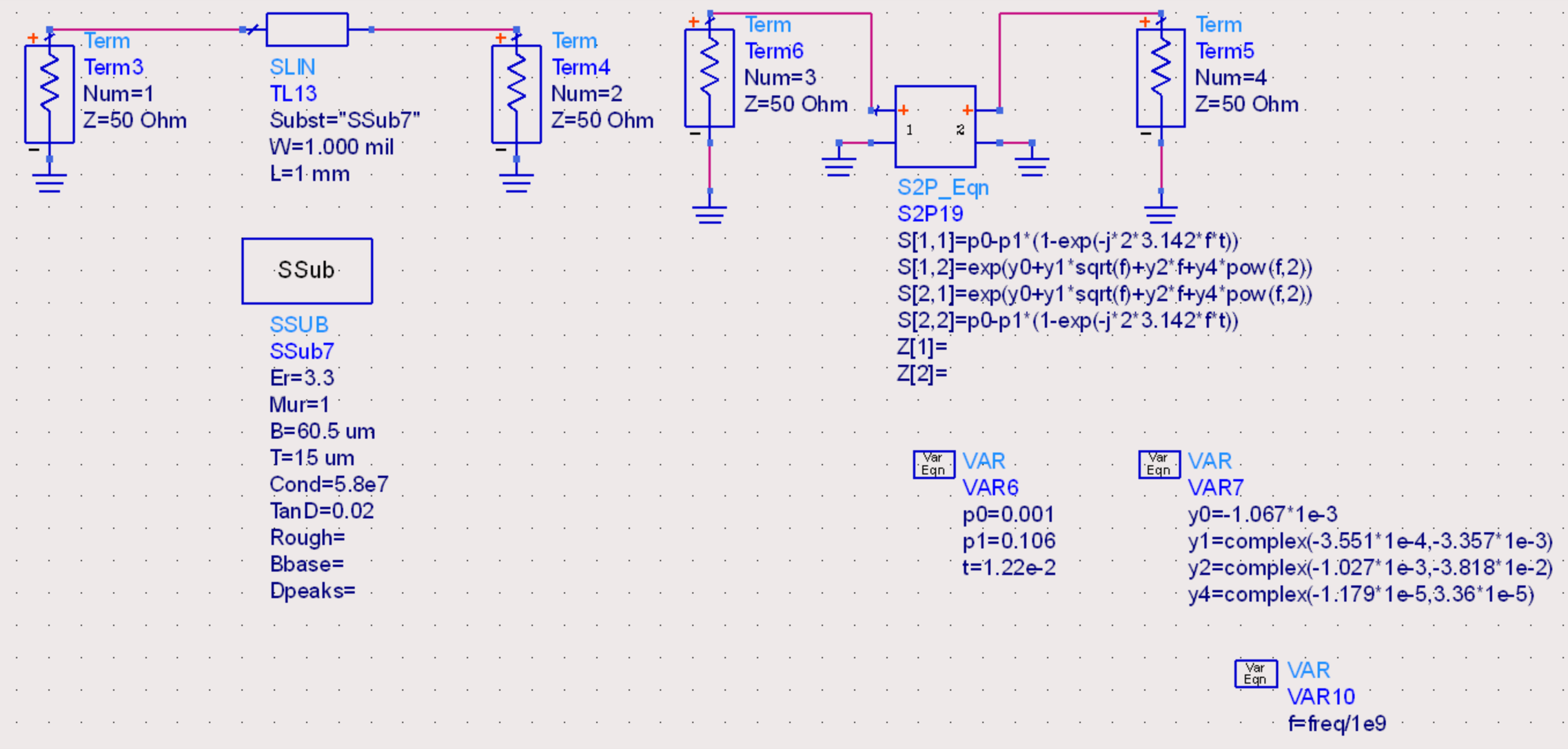
Green – Proposed RL Spec

$8.5 - 0.35 \times f \qquad 0.01 \le f \le 8$

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

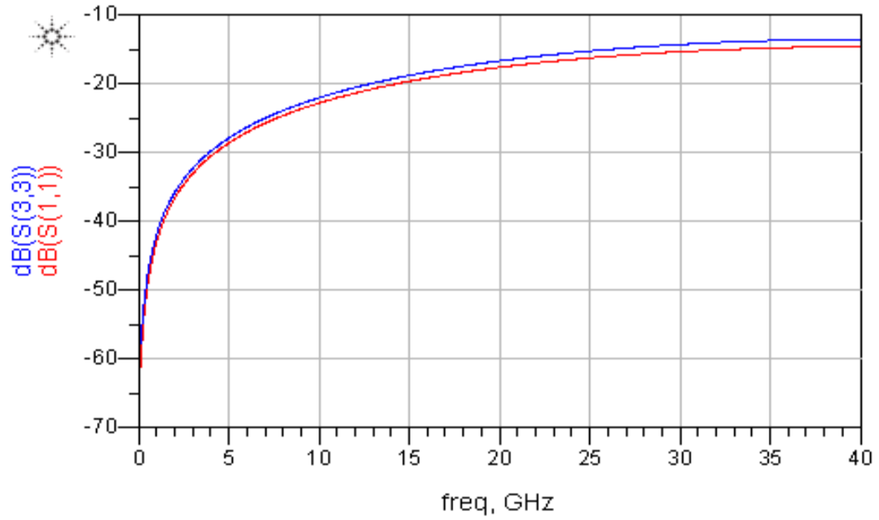
Backup.

Comparing zp Tline vs S-param equations

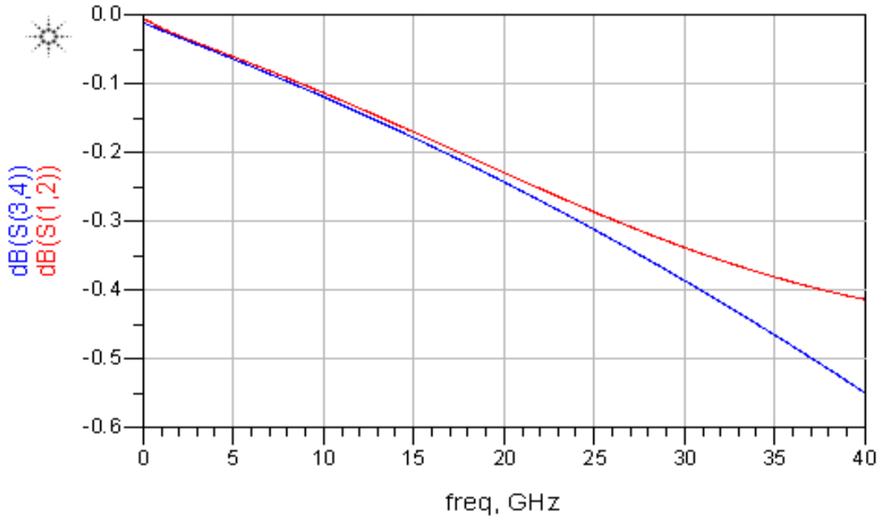


Comparing zp Tline vs S-param equations

Return Loss
L= 1mm
Red – Tline
Blue – S parameter equation

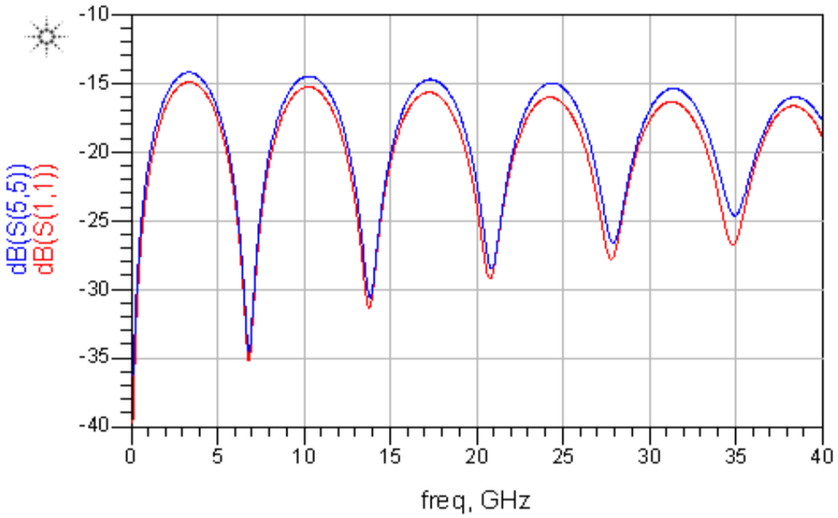


Insertion Loss
L= 1mm
Red – Tline
Blue – S parameter equation

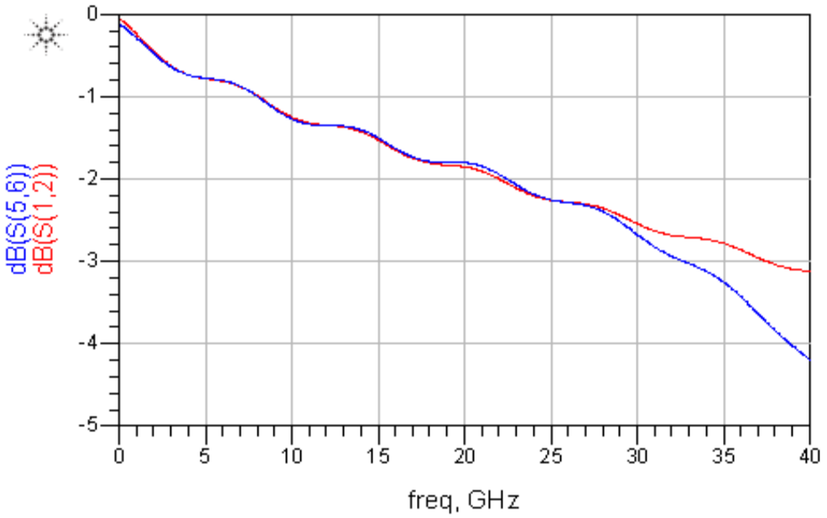


Comparing zp Tline vs S-param equations

Return Loss
L= 12mm
Red – Tline
Blue – S parameter equation



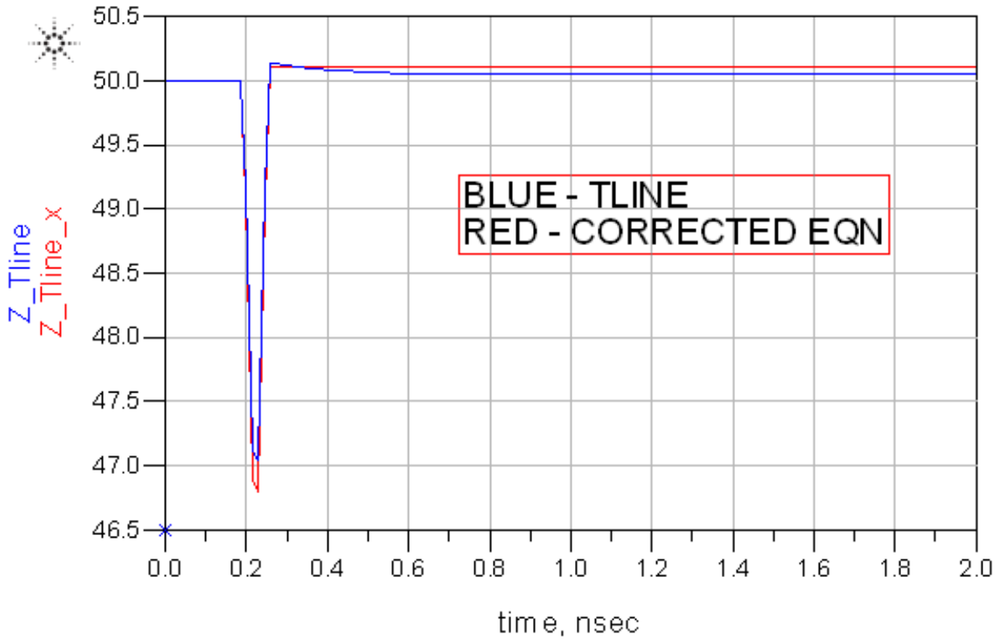
Insertion Loss
L= 12mm
Red – Tline
Blue – S parameter equation



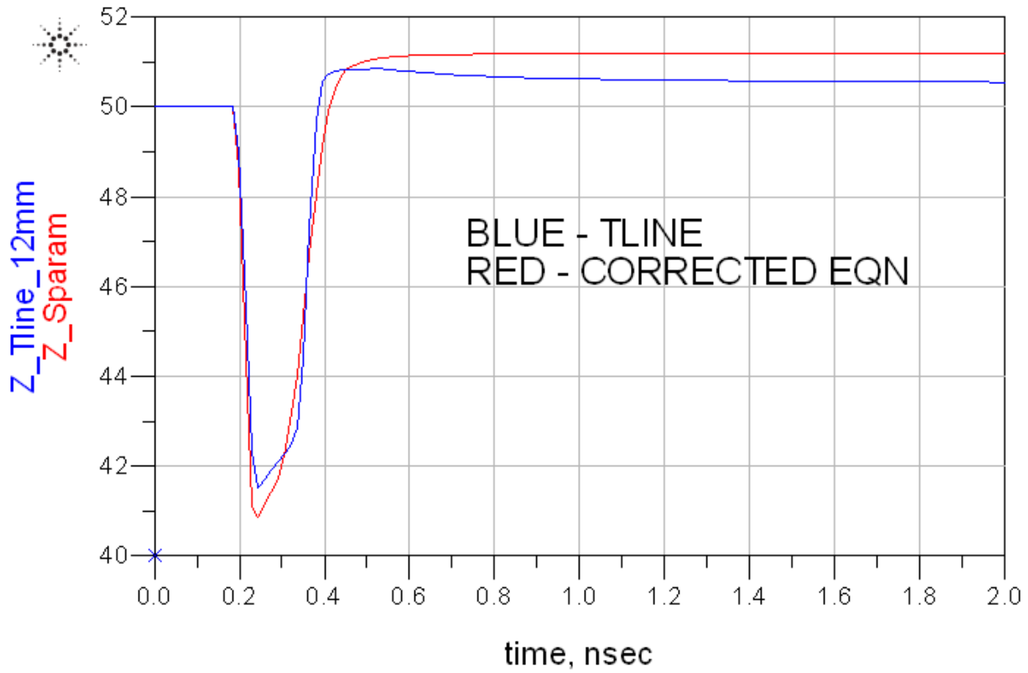
TDR Tline vs. S-param

30ps rise time

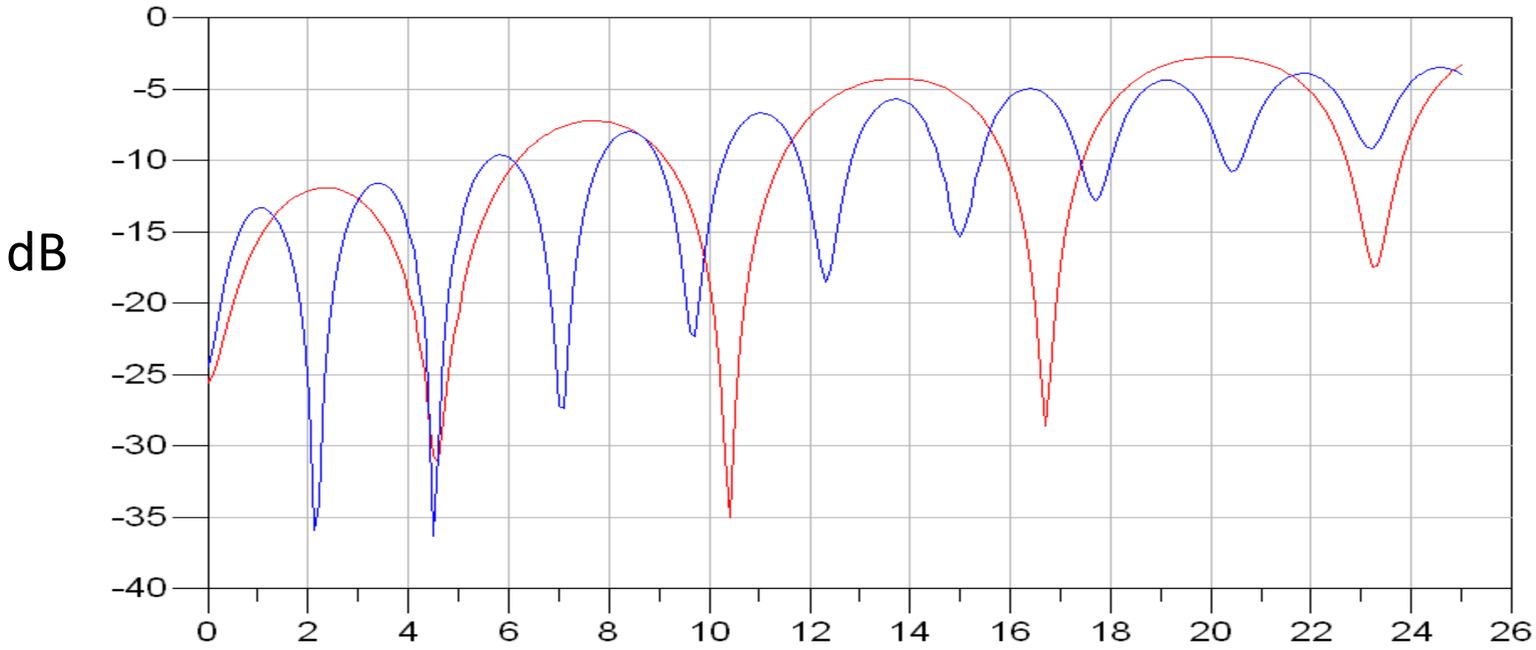
1mm



12mm

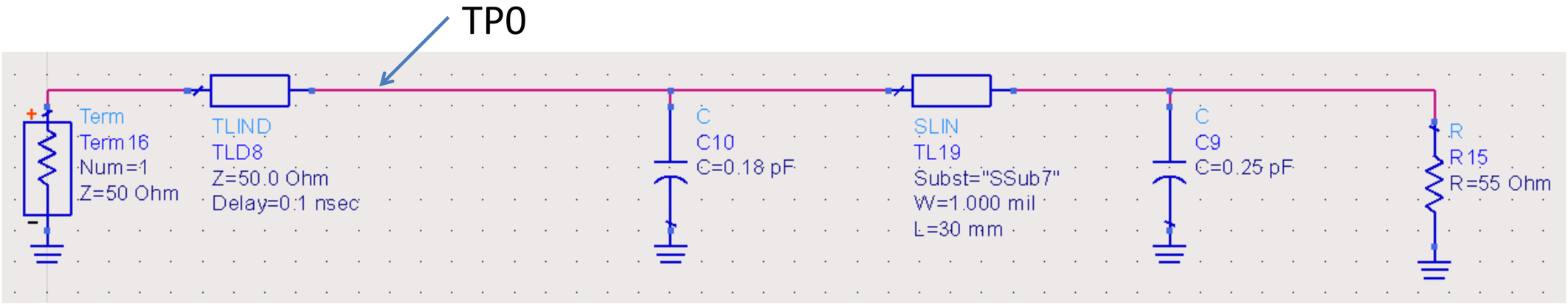


S11 – TP0 – Return loss

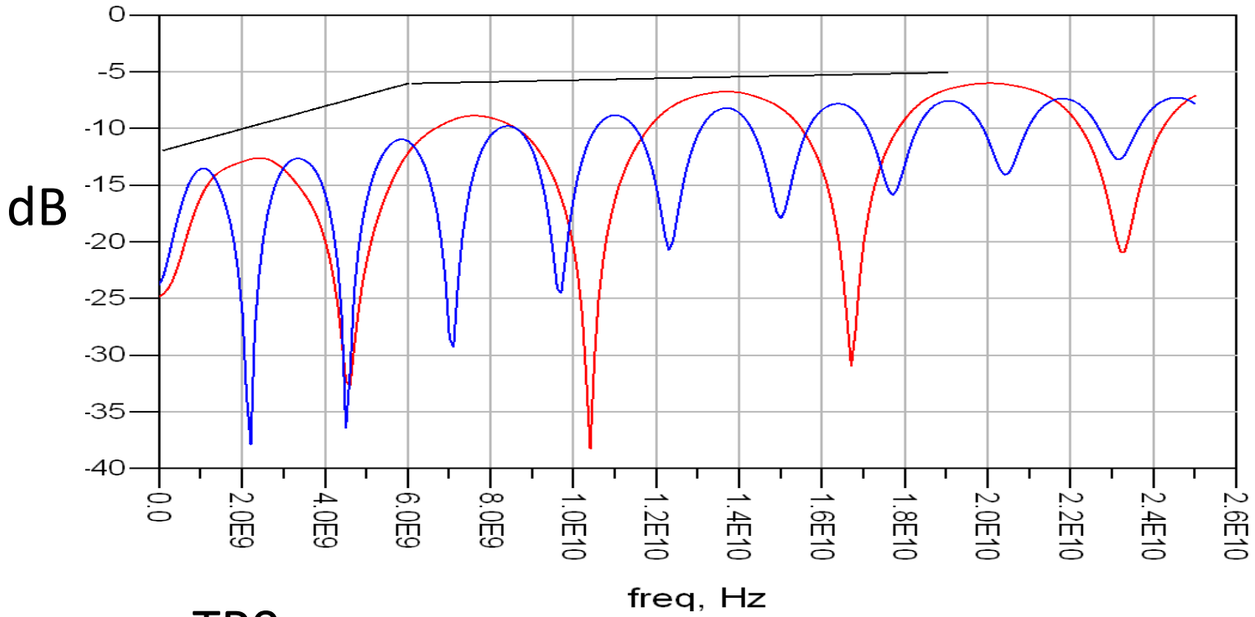


Red line – Return loss for 12mm

BLUE line – Return loss for 30mm



S11 – TP0a – Tline test fixture – 50ohms

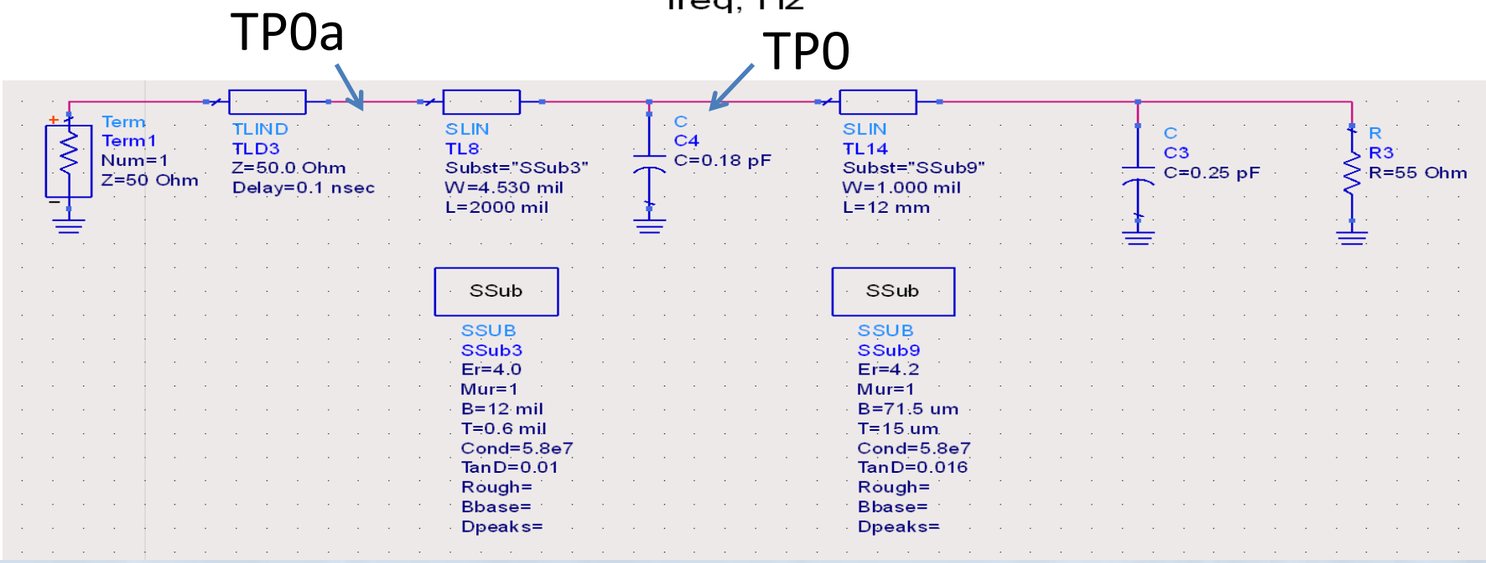


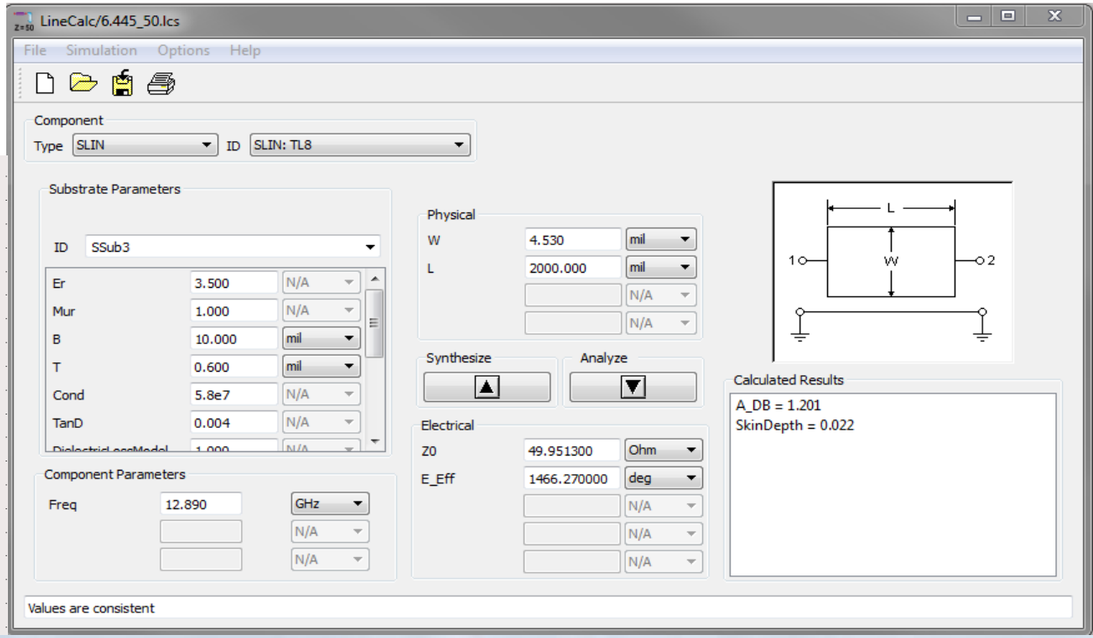
Black line - $$RL_d(f) \geq \begin{cases} 12.05 - f & 0.05 \leq f \leq 6 \\ 6.5 - 0.075f & 6 < f \leq 19 \end{cases} \text{ dB} \qquad (93\text{–}3)$$

Red line – Return loss for 12mm

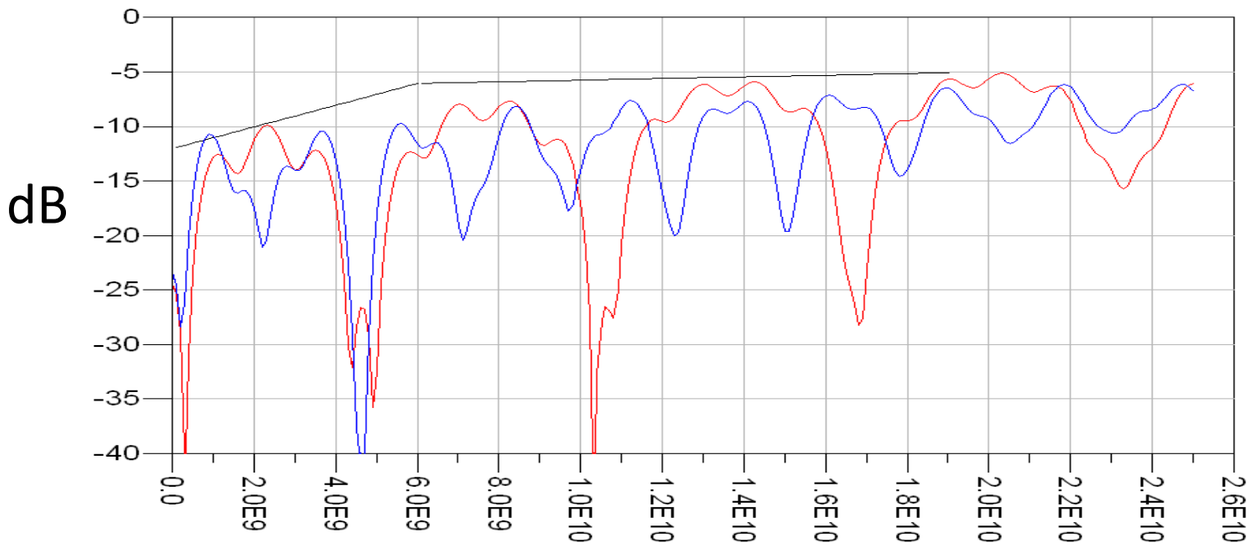
BLUE line – Return loss for 30mm

1.2dB loss at 12.89 Ghz for 2” Tline





S11 – TP0a – Tline test fixture – 55ohms



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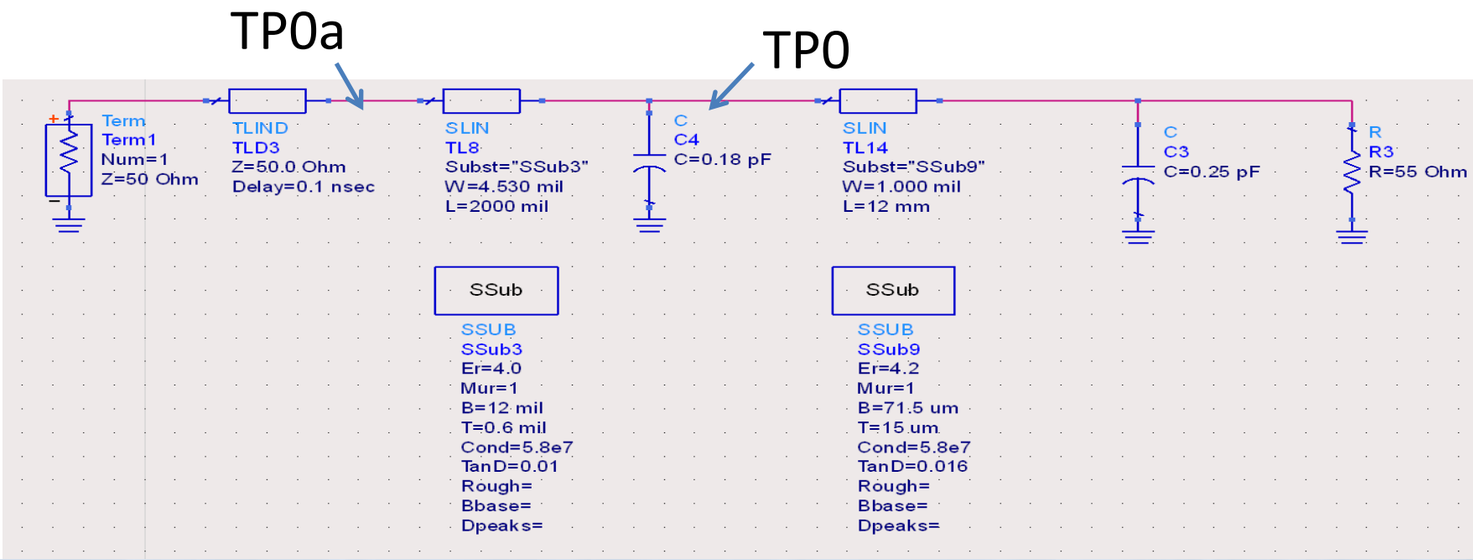
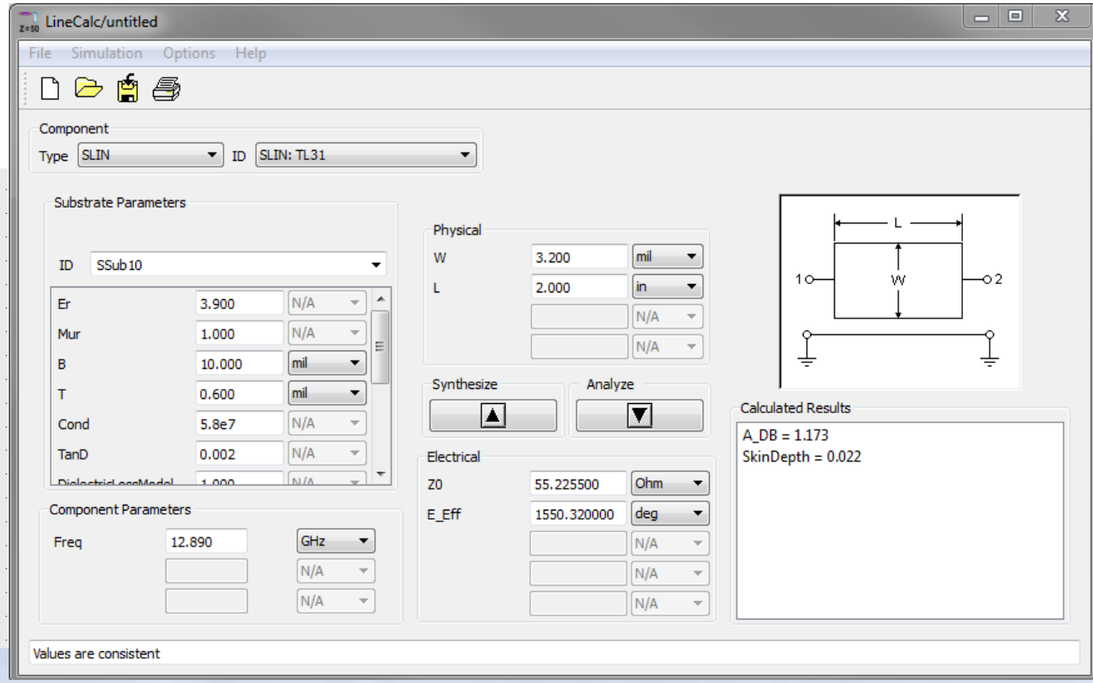
Red line – Return loss for 12mm

BLUE line – Return loss for 30mm

1.2dB loss at 12.89 Ghz for 2” Tline





TP1 Return Loss