Mated Board and Host Specifications

IEEE 802.3bj Task Force

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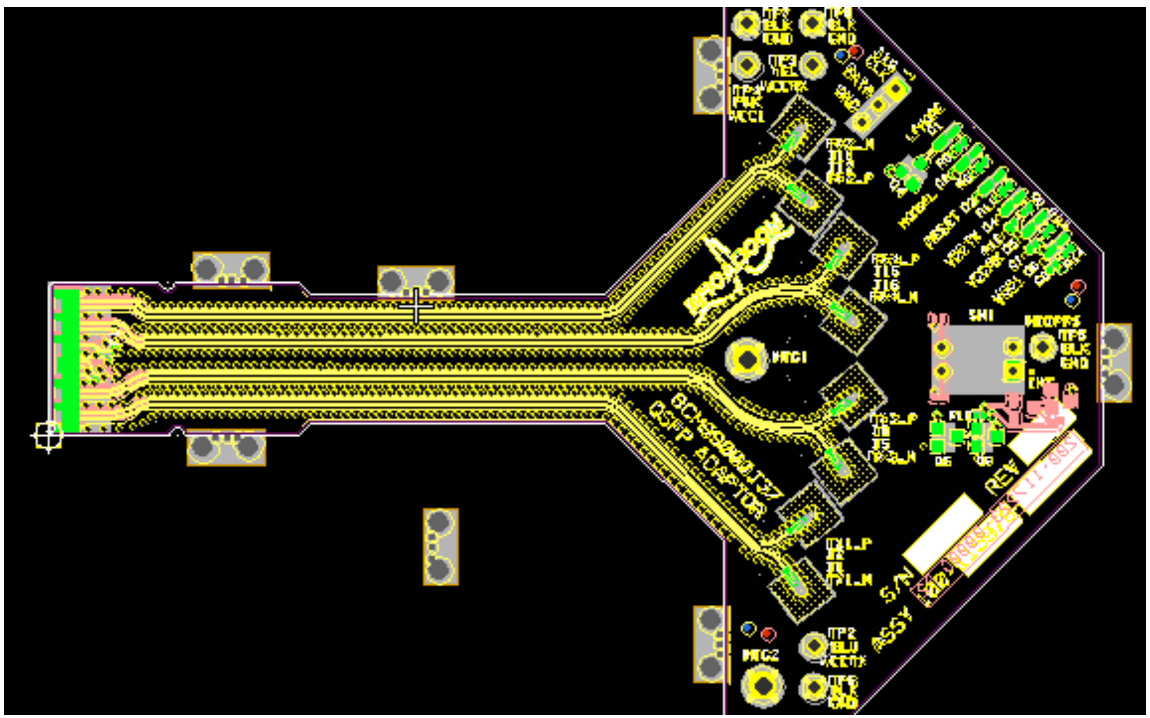
Overview

- Addressing following comments
  - 308/311 – Transmitter/Host RL
  - 309 – Channel Loss
  - 316 – MCB loss
  - 317 – HCB loss
  - 319 – MCB-HCB mated RL

QSFP+ HCB Microstrip Construction

- Based on 12-12-12 mils differential microstrip with 20 mils ground shield separation with loss of 5.6 dB@14 GHz
  - Substrate material Rogers 4350B
  - Signals are routed on top and bottom
  - Trace length 3.4”
  - To meet target loss of 1.75 dB, RO3003 with rolled Cu will be needed instead of RO4350B with ED

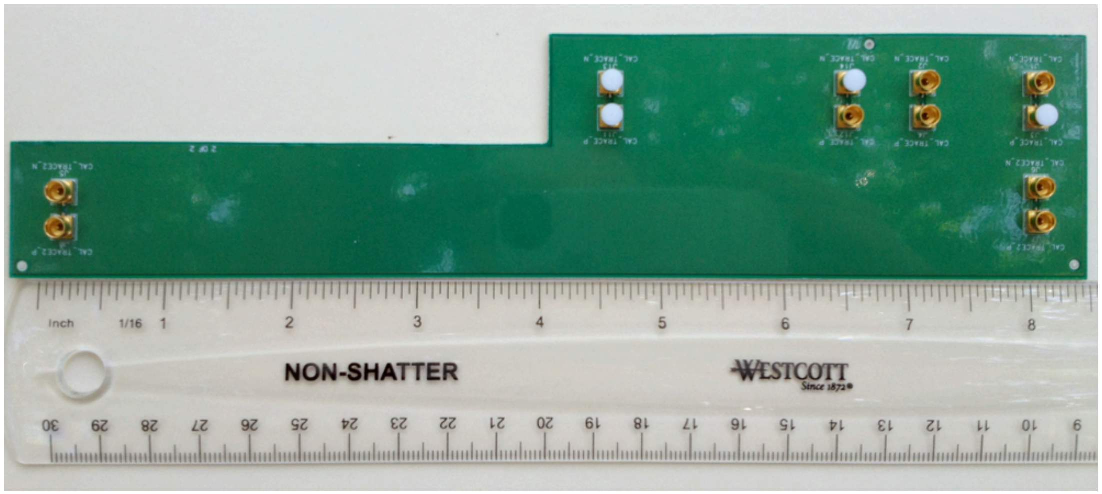


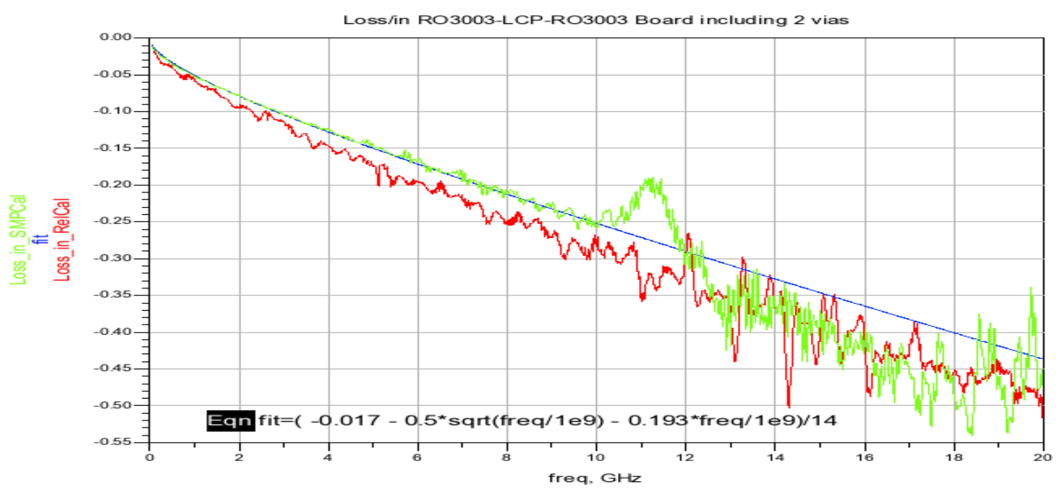
Strip-line HCB Construction

- CFP HCB traces are 7.5” long with max loss of 2.1 dB at 5.5 GHz
- To minimize losses
  - Used Rogers 3003
  - Stripline construction of 12-13-12 mils was used
  - Roger 3003 laminates were bonded with Roger 3850 LCP material (does require high temperature press)
  - To keep the surface roughness losses low rolled Cu was used
- Based on the above construction one may build a HCB meeting max loss of 1.75 dB at 14 GHz with stripline
  - In the case of QSFP28, max PCB thickness of 1mm (0.040”), a single routing layer or embedded microstrip would need to be used
- Alternatively we could increase HCB loss to 2 dB giving little more implementation flexibility but small enough not requiring open other parameters.

RO3003 Stripline Losses

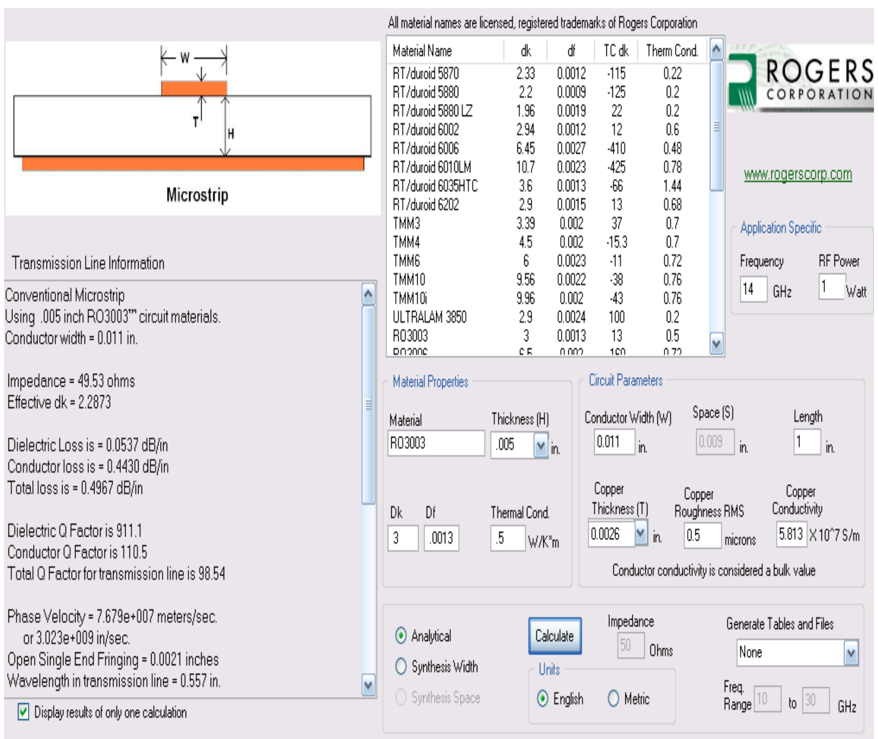
- Loss per inch calculated two different method
  - Some of the noise is due to SMP connector and the cal kit

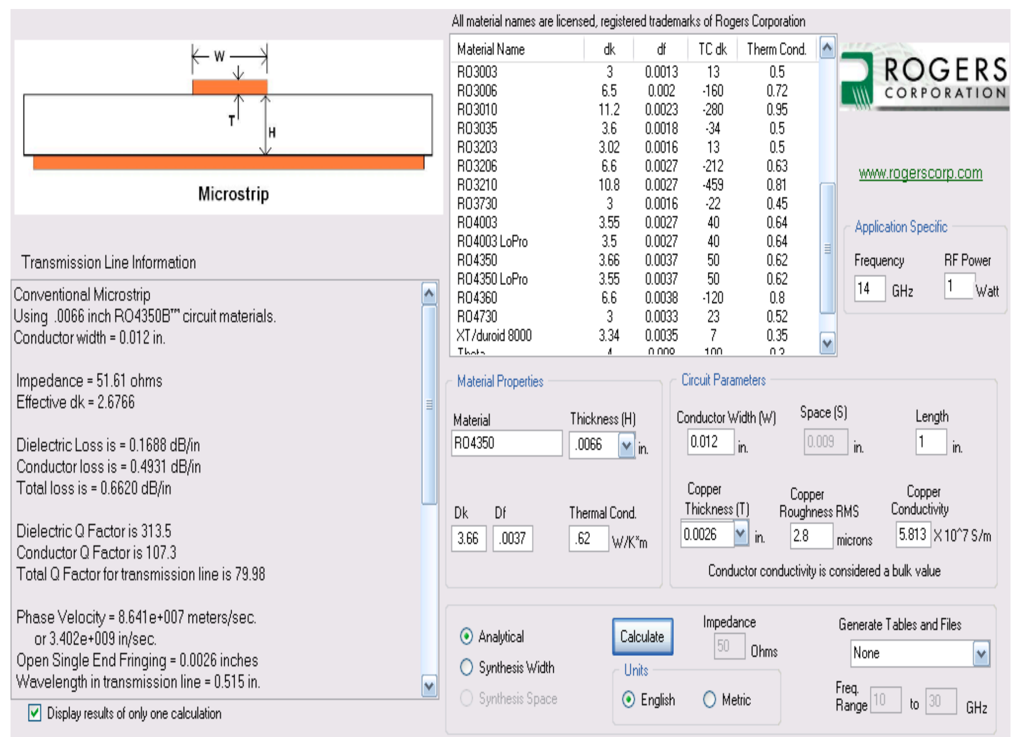




HCB loss Moving from RO4350B to RO30003

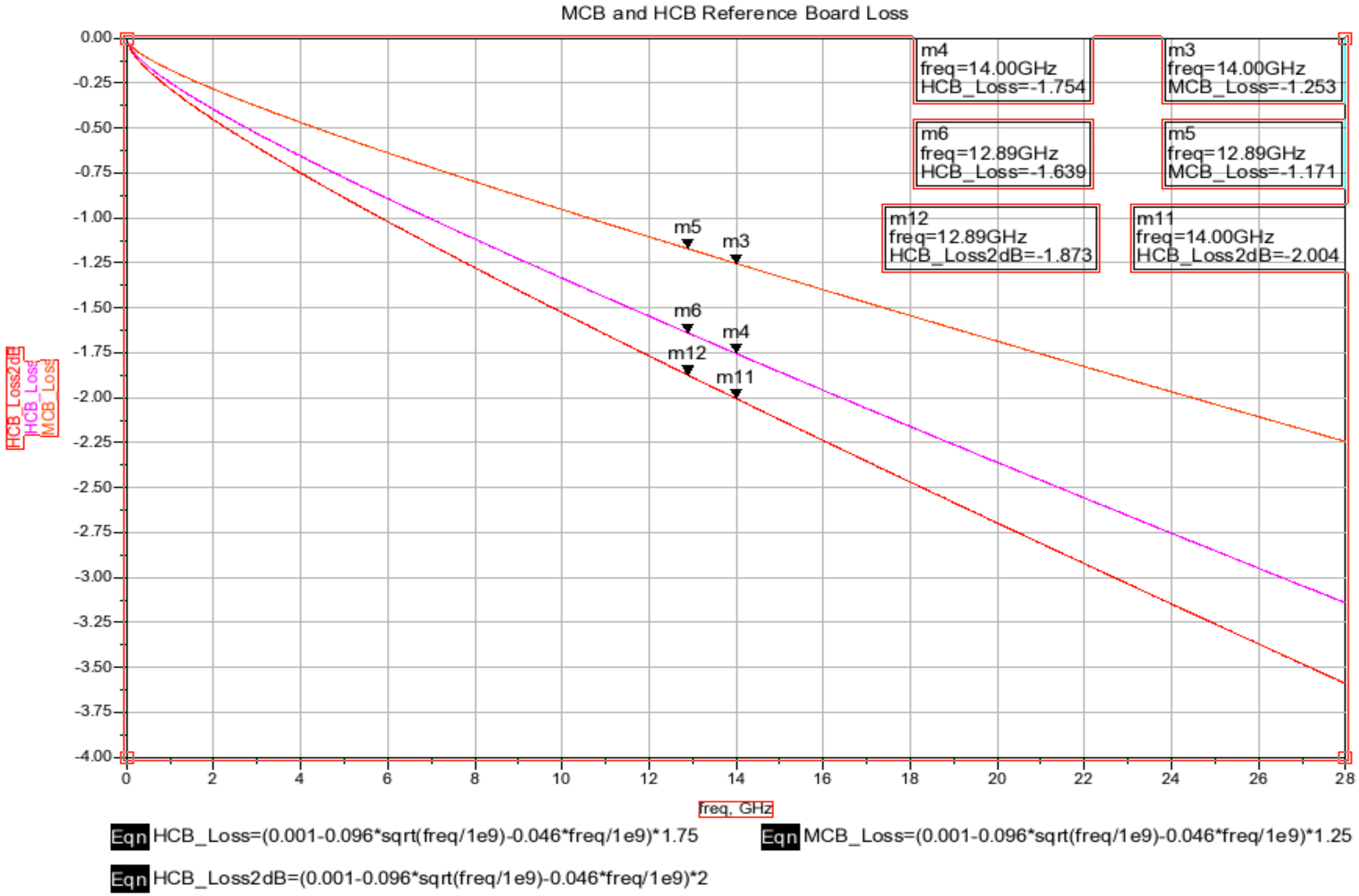
- Loss for 12 mil single-ended trace
  - Using Rogers Corp calculator (free download but require registration) https://www.rogerscorp.com/acm/technology/index.aspx
  - Loss/in at 14 GHz will improve from 0.66dB/in to 0.50 dB/in
  - Current HCB





MCB and HCB Loss Profile

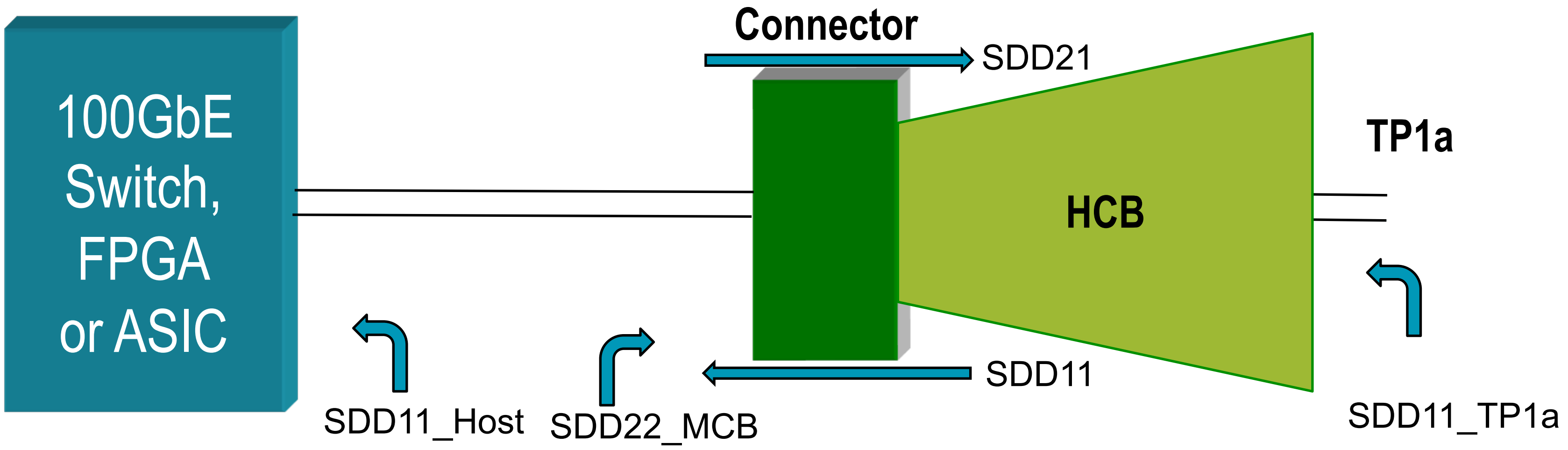
- Addressing comment 316/317
  - 2 dB HCB loss will make it more manufacturable



Host Aggregate Return Loss

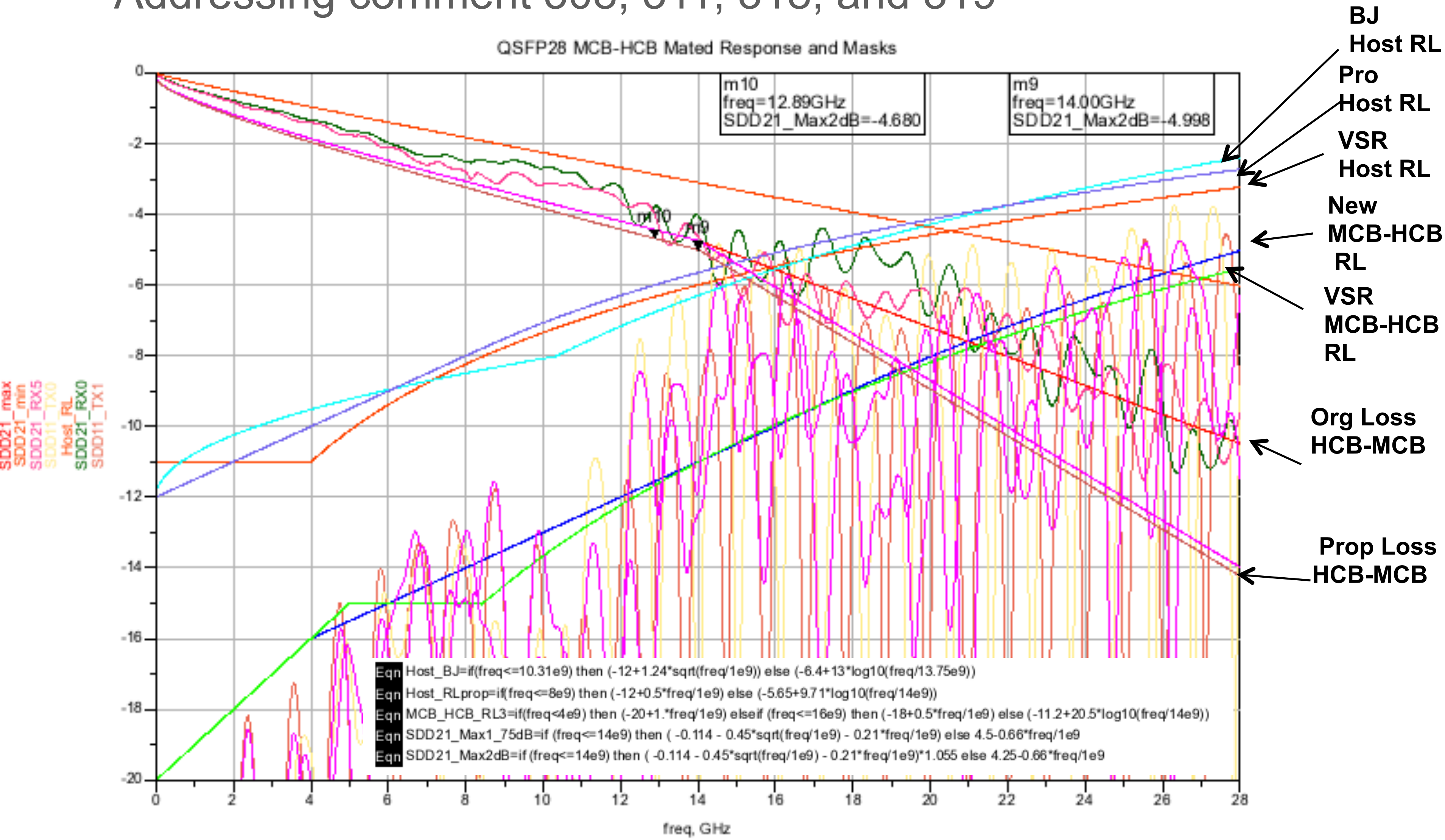
- Host aggregate return loss can be written as
  - SDD21/SDD12 is the through loss
  - When the host PCB loss is the identical to MCB loss then one may approximate SDD21/SDD12 to unity

$$SDD11\_TP1a = SDD11\_Host + SDD21 \bullet SDD12 \bullet \left(\frac{SDD11\_Host}{1 - SDD22\_MCB \bullet SDD11\_Host} \right)$$



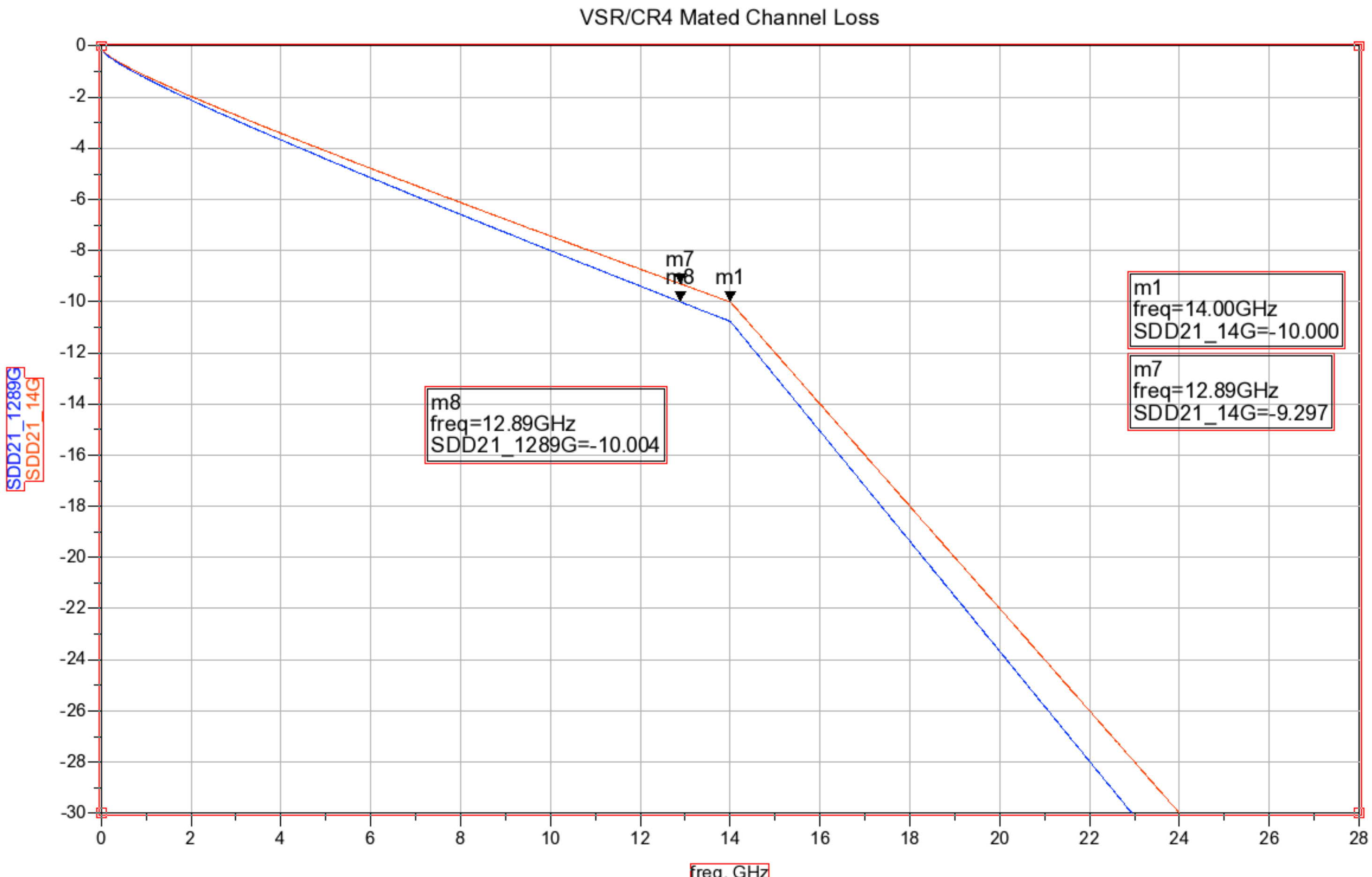
Mated Board and Host Return Loss and Return Loss at TP1a

- Addressing comment 308, 311, 318, and 319



CR4 Host Mated Channel Loss

- Comment 309, equation shown is for SDD21 not loss

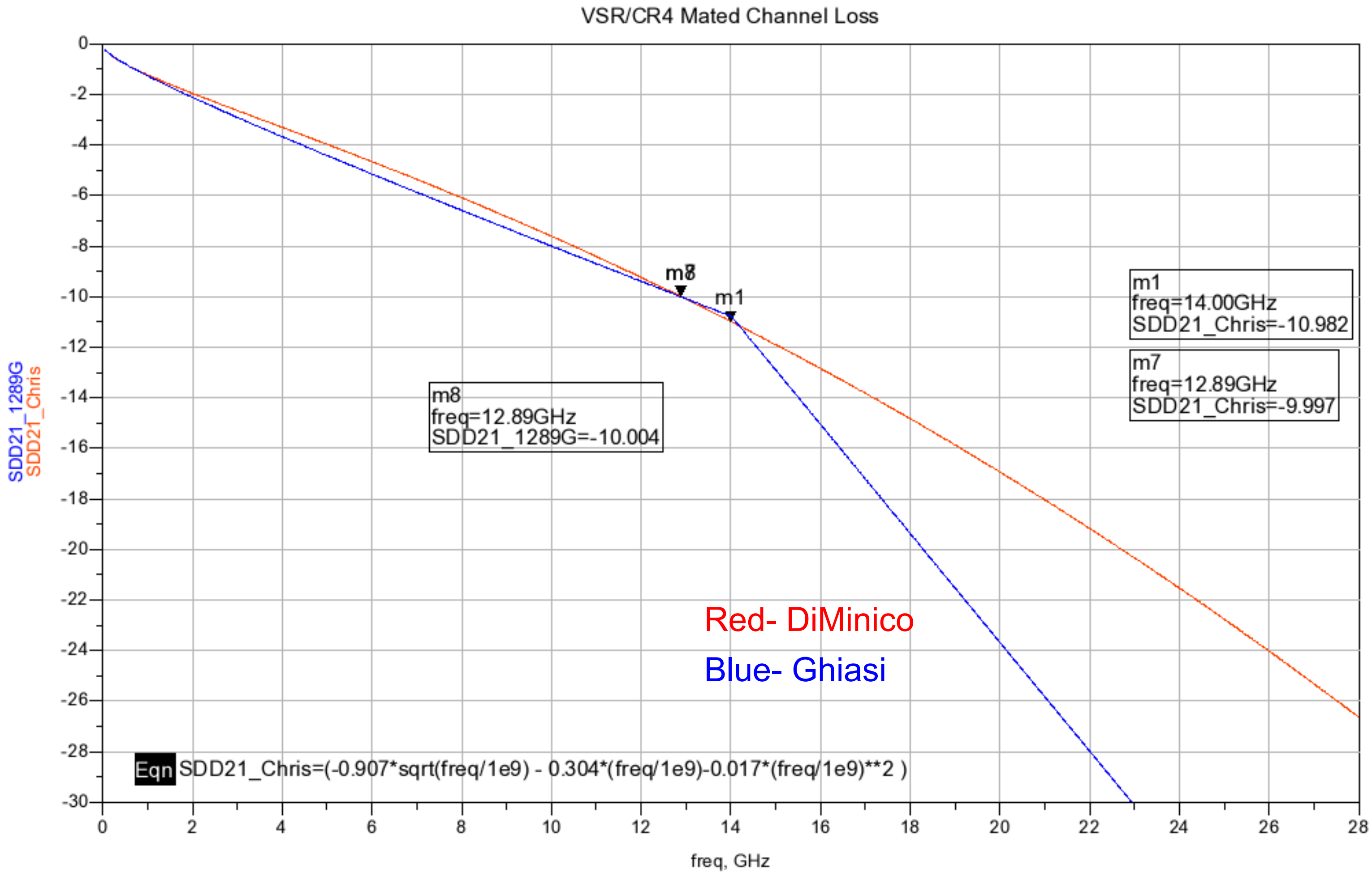


Eqn SDD21_14G=if (freq< 14e9) then (-0.075 - 0.566*freq/1e9 - 0.537*sqrt(freq/1e9)) else 18-2*freq/1e9

Eqn SDD21_1289G=(if (freq< 14e9) then (-0.075 - 0.566*freq/1e9 - 0.537*sqrt(freq/1e9)) else 18-2*freq/1e9)*1.076

Proposed Ghiasi and DiMinico Loss Overlaid

- Comment 309, equation shown is for SDD21 not loss



Eqn SDD21_1289G=(if (freq< 14e9) then (-0.075 - 0.566*freq/1e9 - 0.537*sqrt(freq/1e9)) else 18-2*freq/1e9)*1.076

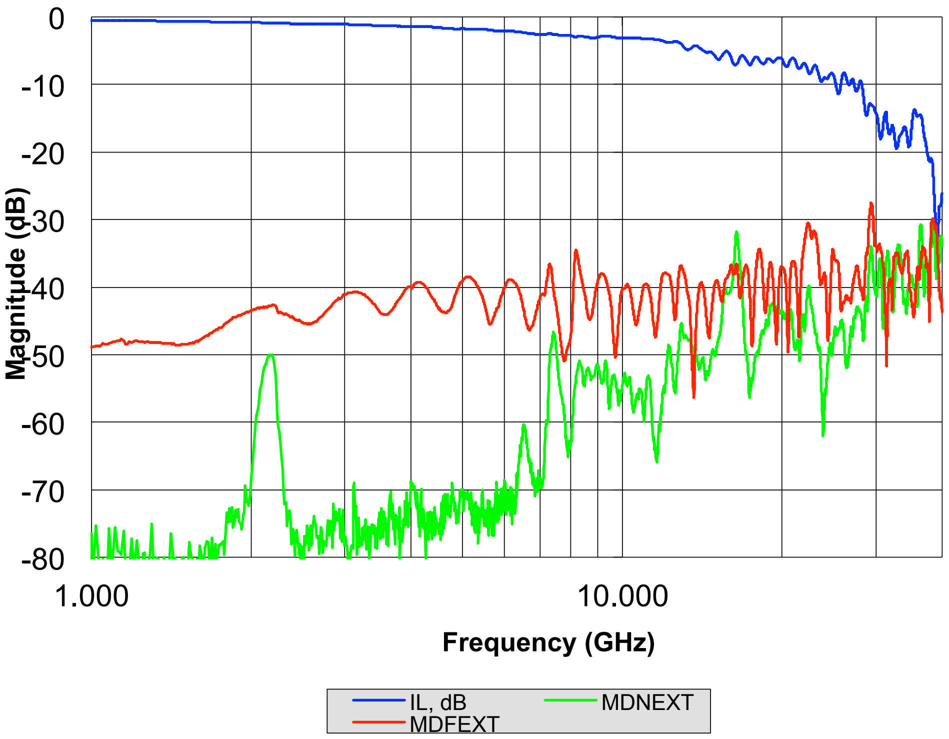
Issue of Relaxing Mated Board Return loss

- As the frequency has increased and board loss reduced any board or connector imperfection shows up as insertion loss and ILD
  - Increasing MCB/HCB loss is the best way to hide a problem than can exist in real system where IC are placed 0.5” from the connector
- If we relax the mated board return loss without relaxing the host then realistic host will not meet the RL
- If we relax the mated board and host then there will be some signal integrity penalty
- We should relax the return loss at last resort and while understanding the implications.

QSFP28 MCB-HCB Crosstalk

- Include 4 NEXTs and 3 FEXTs
  - As the board loss has gone down crosstalk has increased

MCB-HCB Crosstalk	10.3125 GBd ICN (mV)	25.78 GBd ICN (mV)	28.0 GBd ICN (mV)
Rise Time 20-80% (ps)	24.000	9.600	8.840
MDNEXT	0.323	1.390	1.612
MDFEXT	3.593	4.562	4.673
ICN	3.607	4.769	4.943



Summary

- Current HCB loss of 1.75 dB at 14 GHz can be met if superior material and construction is used
  - To facilitate more flexible implementation HCB loss could relaxed to 2 dB without material impacting or need to adjust other specifications
- If the HCB board loss is increased to 3.75 dB one may be able to correct for signal at TP1a with software CTLE having 2 dB additional but no longer host return loss can be measured
  - When HCB has loss of 3.75 dB even a short at connector just due to the board loss could read RL of -7.5 dB!
- Mated board return loss shown here are based on early boards with SMA on MCB and SMP on the HCB impacting the RL and require further upgrade for 25G operation
- HCB and MCB are functional instrument for signal measurements and host return loss measurement requiring very carful construction otherwise the whole concept is useless!

Thank You