

Return Loss and ERL Limits for C2M and CR

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IEEE 802.3ck Task Force

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Overview

- ❑ **Contribution in support of following C2M comments**
 - TP4 SCC22 comment
 - TP1a SCC22 comment
 - TP1 SCD11 comment
 - TP4a SCD11 comment
- ❑ **This contribution with additional supporting material also addresses questions raised during March telephonic conference calls.**

Background Material

□ The basic methodology came from SFF-8431 SFP+ then carried into IEEE nPPI

- Transmitters
 - Limits SDD22 and SCC22
 - AC VCM generated with value of 12 mV RMS defined
- Channel/far end
 - AC VCM out defined with value of 15 mV RMS
- Receiver
 - Max AC VCM tolerance with value of 15 mV RMS
 - Limits on SDD11 and SCD11 (differential to common mode)
 - SDC11 (common mode to differential) was not defined given that VCM was only 15 mV and only 3-5% of the differential signal that travel back gets reflected by the channel
 - SCD11 coverts 100's mV of p-p signal at the receiver

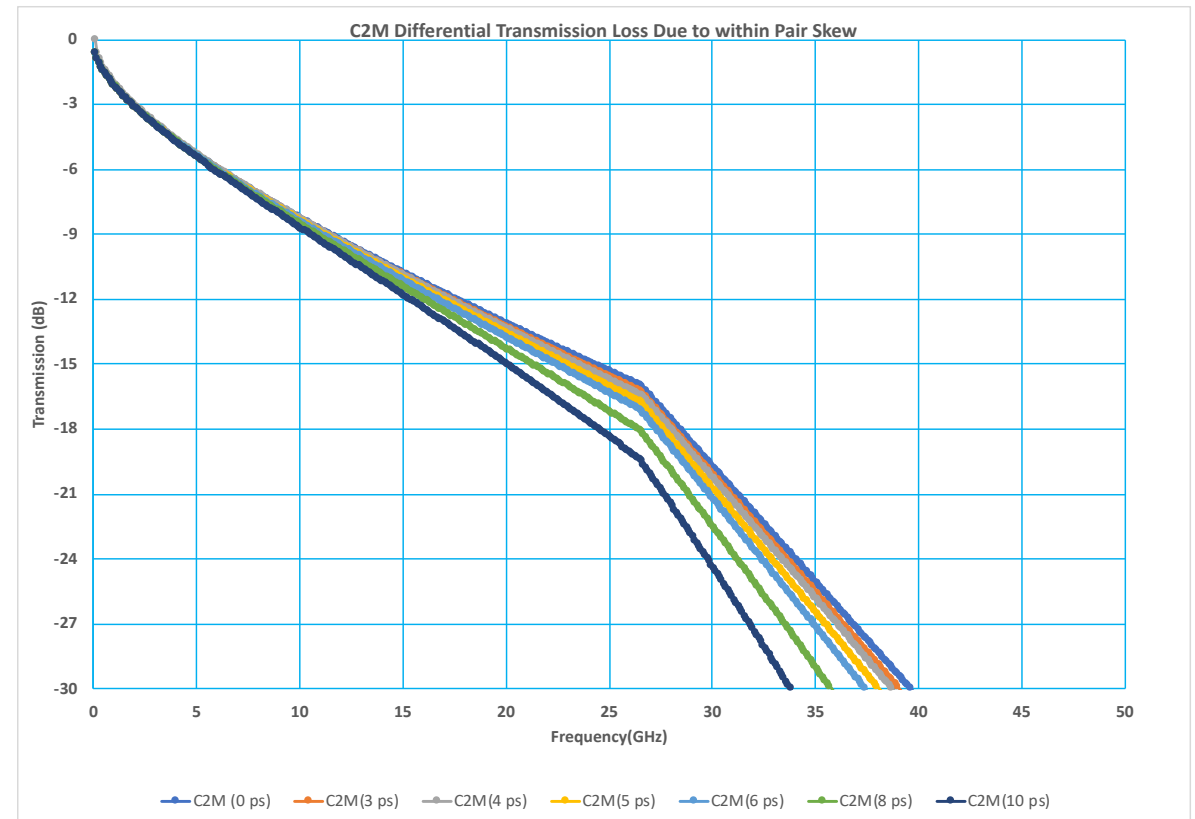
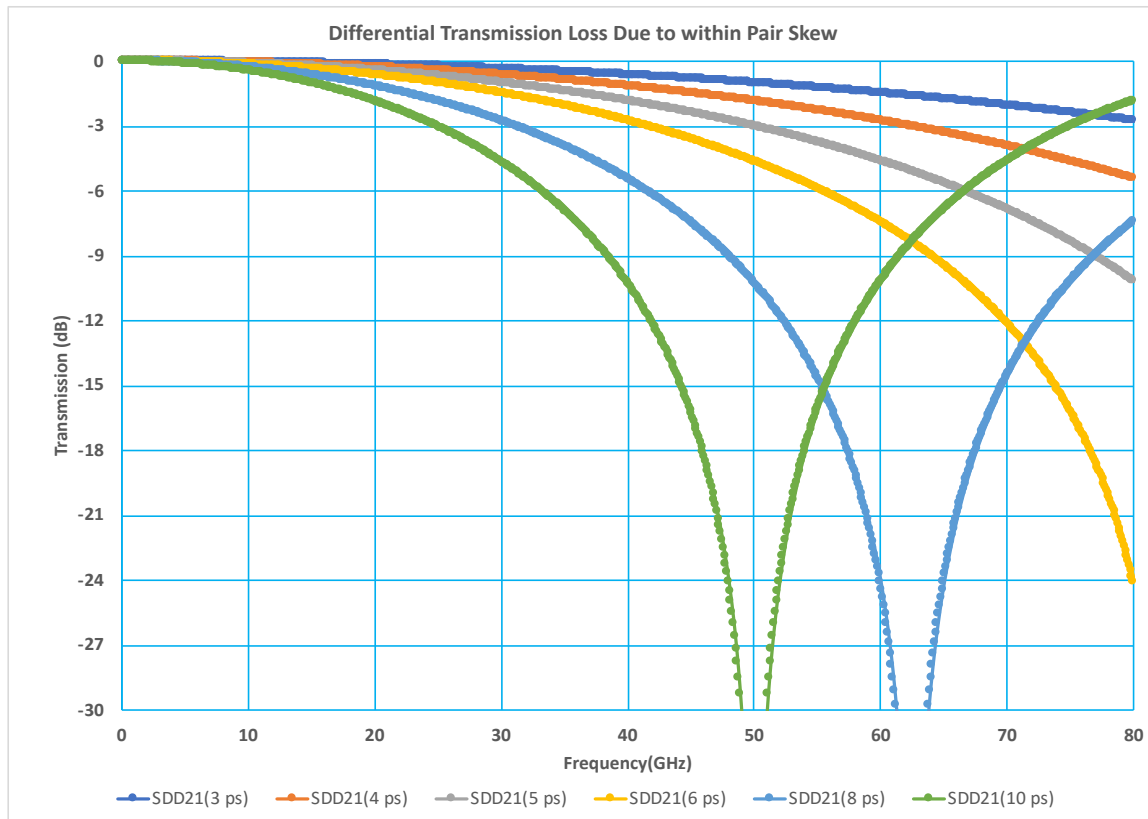
□ In the 25G AUI 802.3bm we made following changes

- Increased TP1a AC VCM to 17.5 mV to account for 25.78 GBd channels
- For some reason receiver SCD11 was swapped with SDC11, given that in most cases SCD11~SDC11 there probably not a material impact
- Given that both SCD11 and SDC11 play important roll to covert differential/common mode signal back to spurious differential signal recommend to define both SCD11/SDC11 for the receivers

Sources of Common Mode

□ Driver P/N asymmetry and interconnect P/N mismatch are the two sources of common mode generation

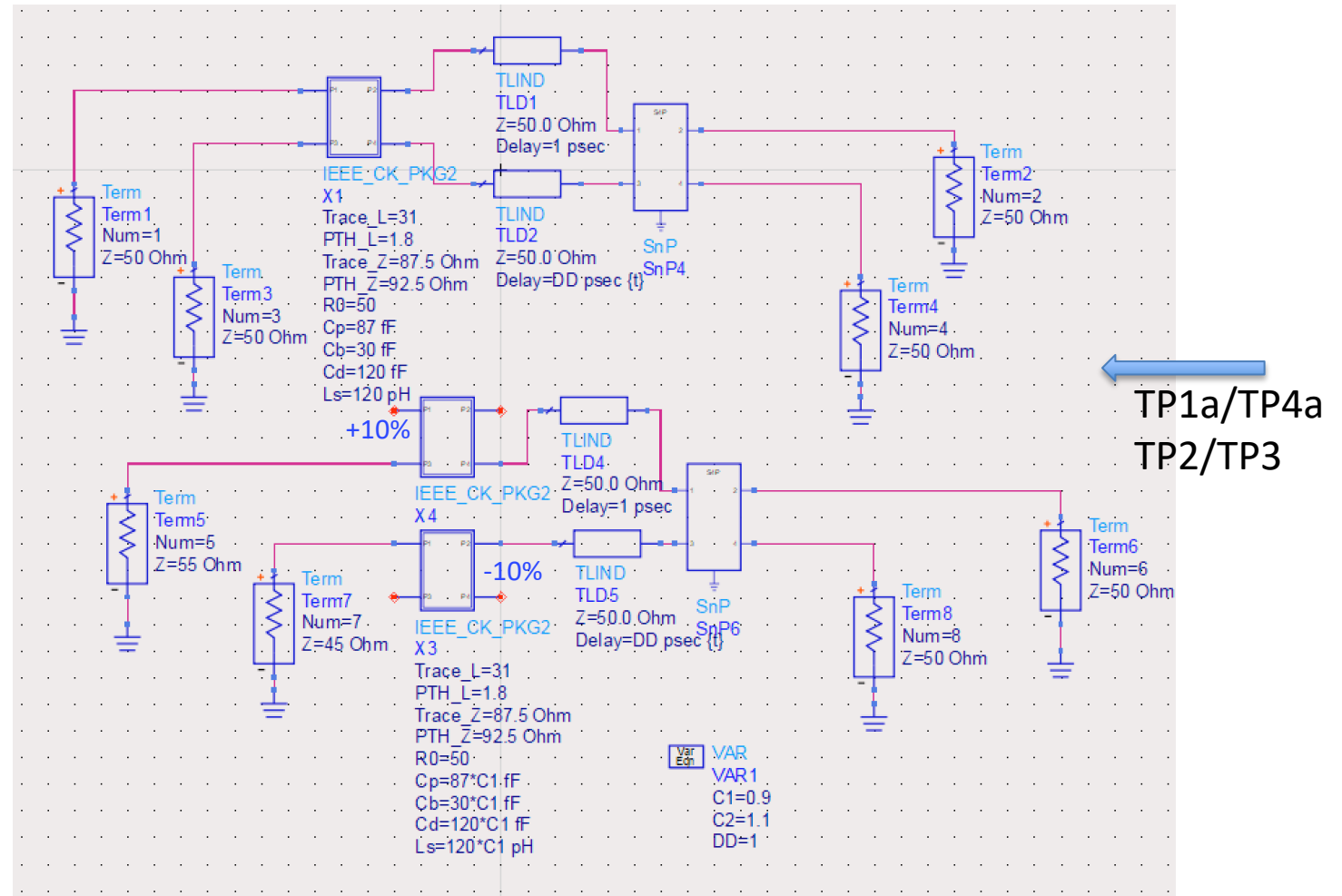
- Graph show the theoretical impact of 3-10 ps of skew on C2M IL where the penalty increases with the Baudrate increase , D. Nozadze, IEEE EPEPS, 2017
- The CK channels already include effects of P/N mismatch but currently COM reference model and package don't excite the common modes and obviously the impact is overlooked at the receiver.



Host Circuit

Host circuit for SCC, SCD:

- Yamaichi MCB/HCB
- $\pm 10\%$ term mismatch for 2nd CKT
- IEEE PKG $\pm 10\%$ C/L for 2nd CKT
- Delay mismatch up to 11 ps.

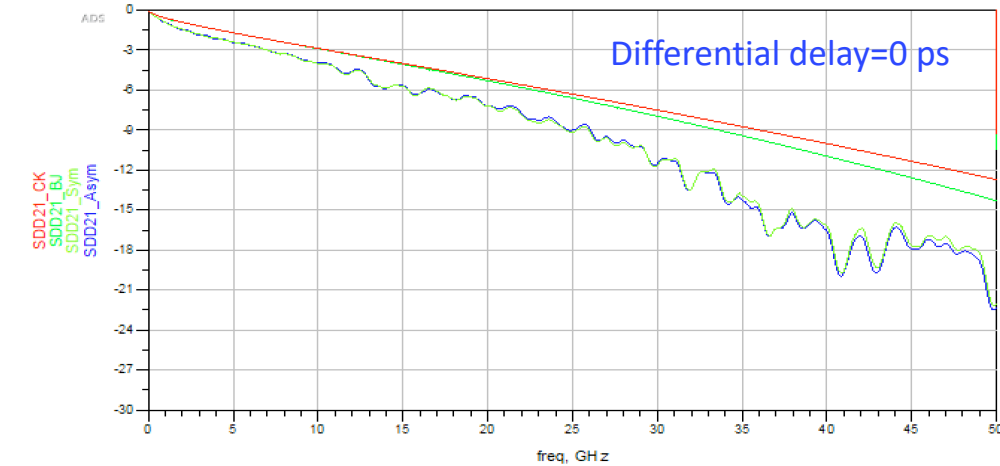


Host Transfer Response for Package Asymmetry and Differential Delay

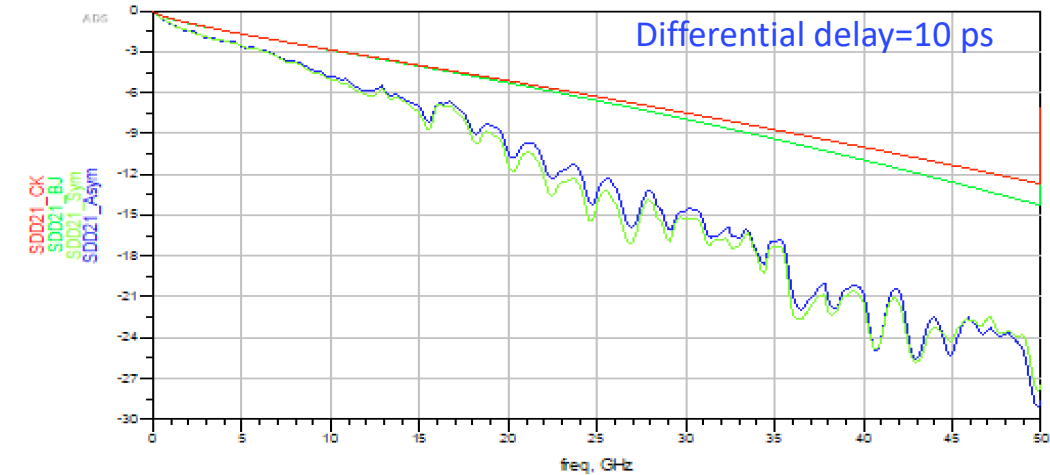
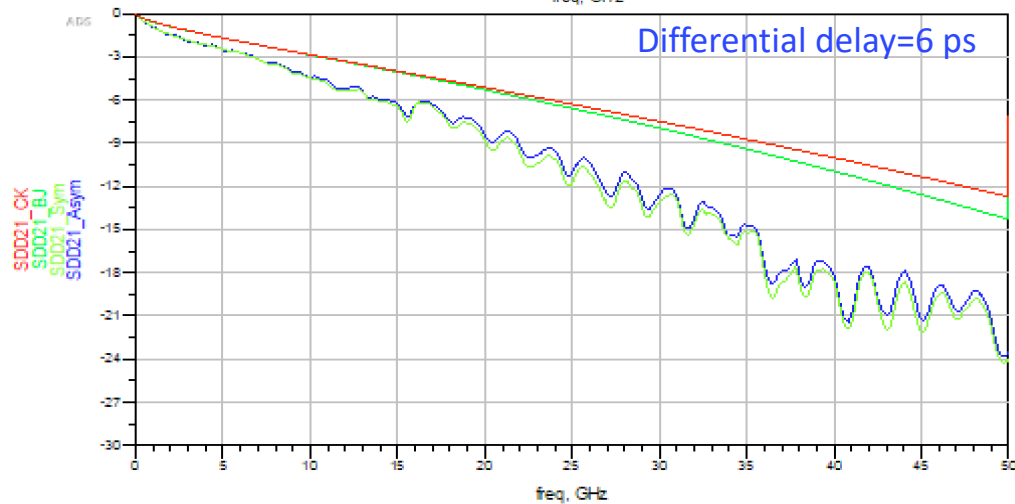
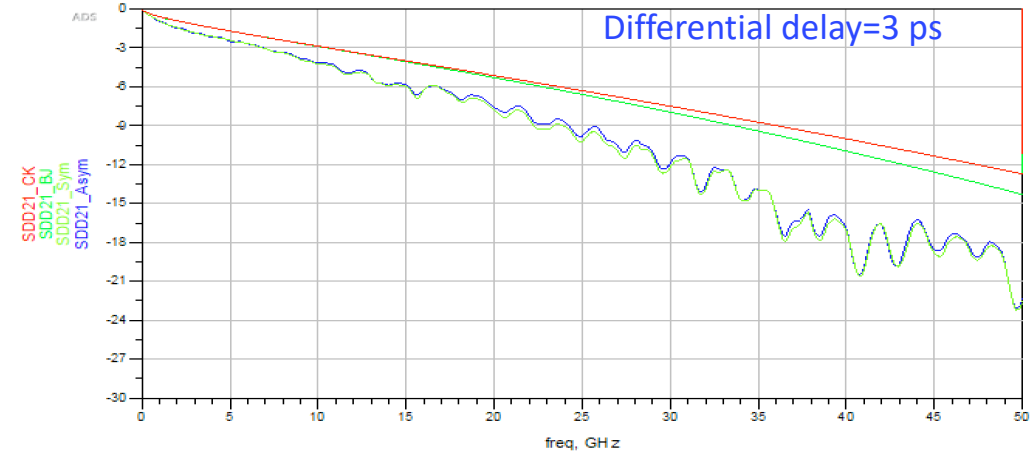
□ A well design host expected to meet 3 ps of differential delay

— Package/device asymmetry of ± 10 has negligible impact on ILD.

```
Eqn SDD21_BJ=if (freq/1e9<50) then -(0.471*sqrt(freq/1e9)+0.1194*freq/1e9+0.002*(freq/1e9)**2) else 0
Eqn SDD21_CK=if (freq/1e9<50) then -0.9503*(0.471*sqrt(freq/1e9)+0.141*freq/1e9+0.0012*(freq/1e9)**2) else 0
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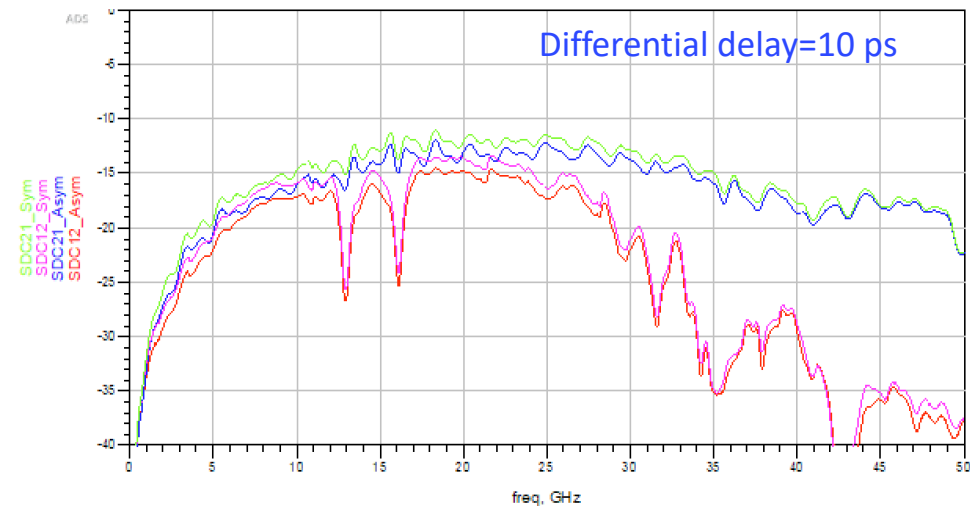
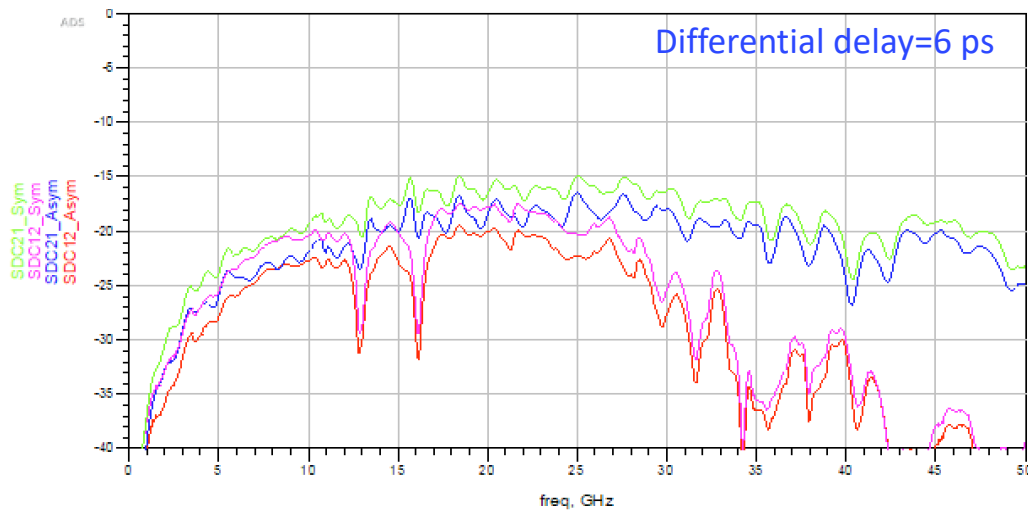
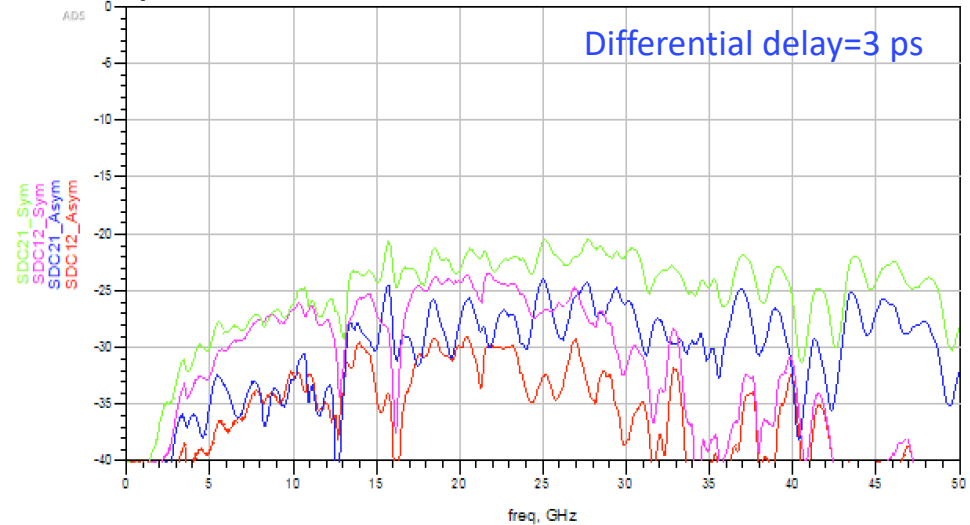
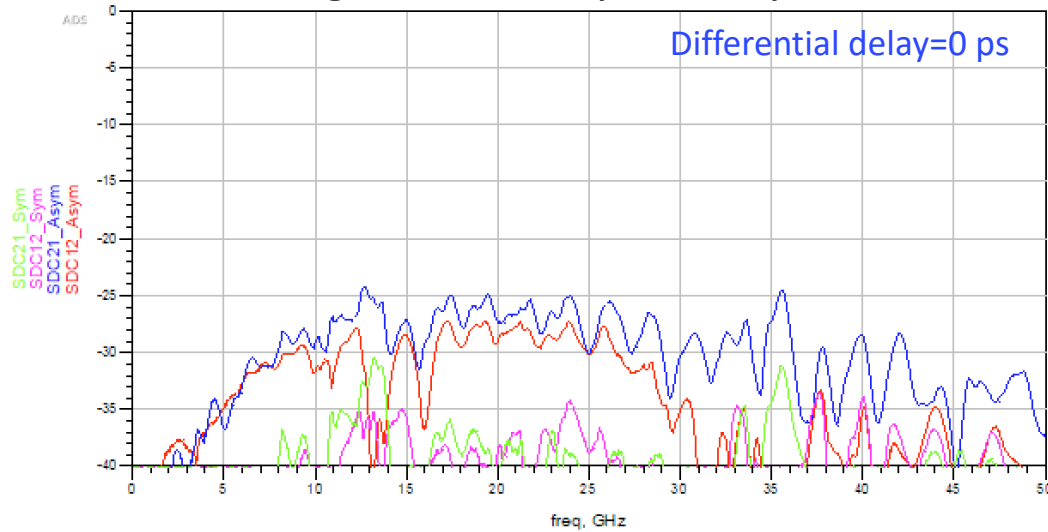


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```



MCB-HCB Differential to Common Mode Transfer Response with Package Asymmetry and Differential Delay

- A well design host with 3 ps of differential delay has negligible conversion penalty
 - Package/device asymmetry of ± 10 has negligible impact on conversion.



Host SCC11/22

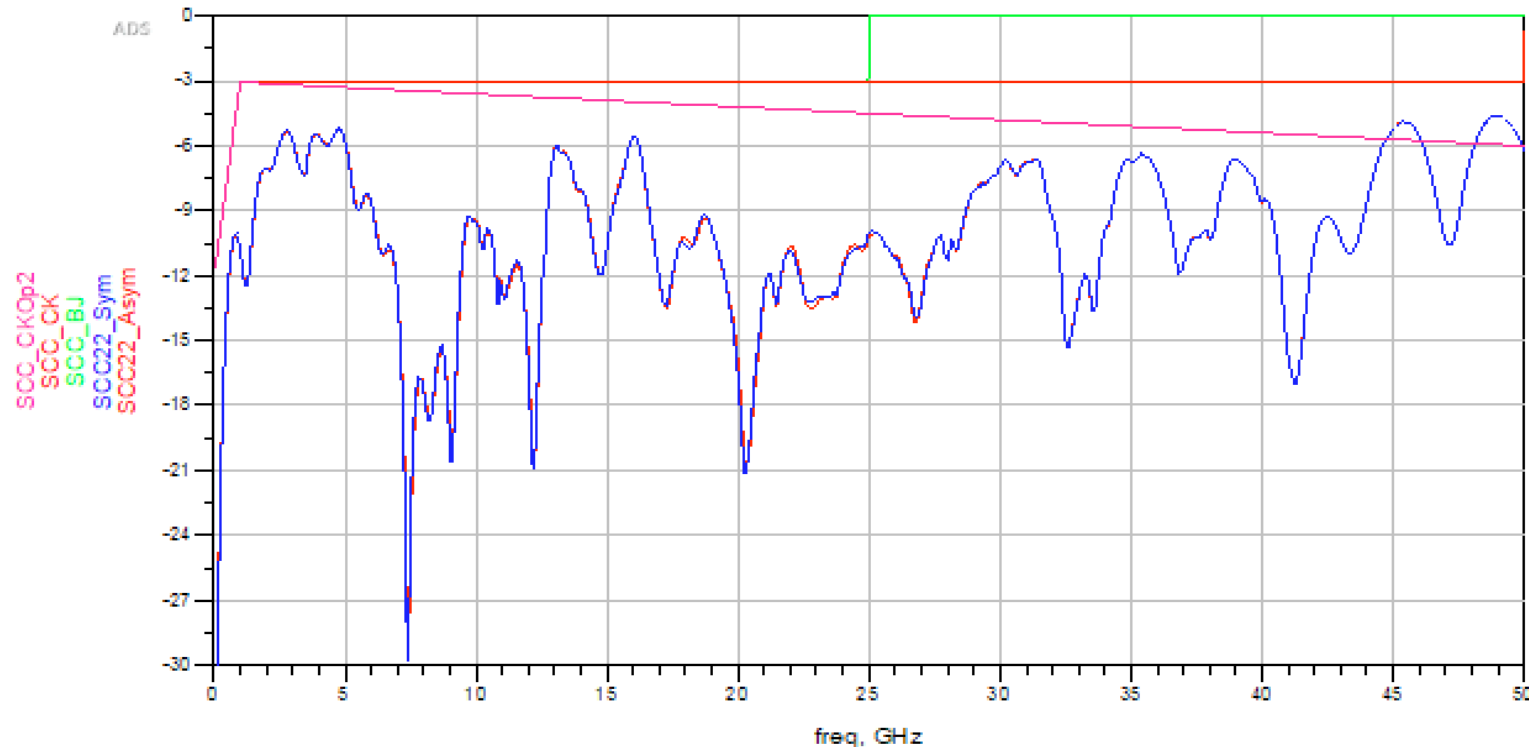
□ Graph are in reflectance but IEEE 802.3ck specifies return loss

- Two SCCxx limited are presented but on the host side but option 2 will -6 dB limit.

Eqn SCC_BJ=if (freq/1e9<1) then -12+9*freq/1e9 elseif (freq/1e9<25) then -3 else 0

Eqn SCC_CK=if (freq/1e9<1) then -12+9*freq/1e9 elseif (freq/1e9<50) then -3 else 0

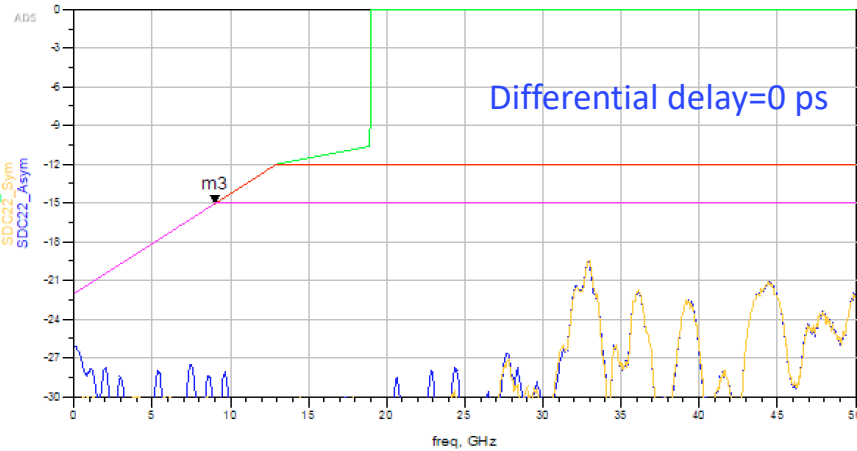
Eqn SCC_CKOp2=if (freq/1e9<1) then -12+9*freq/1e9 elseif (freq/1e9<50) then -3-1.55*freq/25.78/1e9 else -6



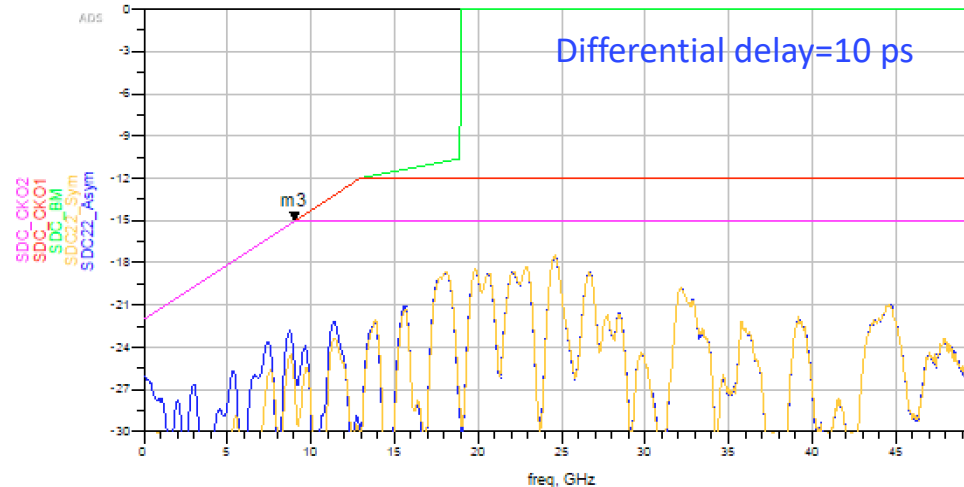
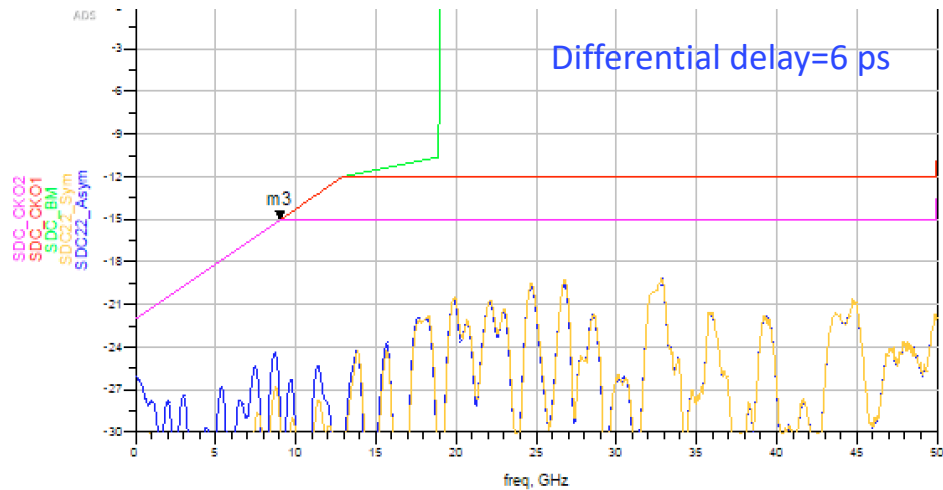
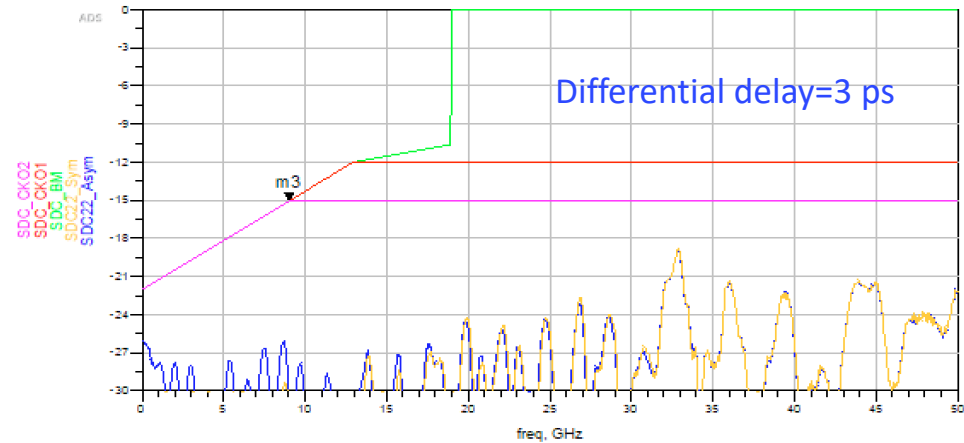
Host Input SDC22/SCD22

802.3bm SDC22 graph and two proposed limit for CK

```
Eqn SDC_BM =if (freq/1e9<12.89) then -22+20*freq/1e9/25.78 elseif (freq/1e9<19) then -15+6*freq/25.78/1e9 else 0
Eqn SDC_CKO1 =if (freq/1e9<12.89) then -22+20*freq/1e9/25.78 elseif (freq/1e9<50) then -12 else 0
Eqn SDC_CKO2 =if (freq/1e9<9) then -22+20*freq/1e9/25.78 elseif (freq/1e9<50) then -15 else 0
```



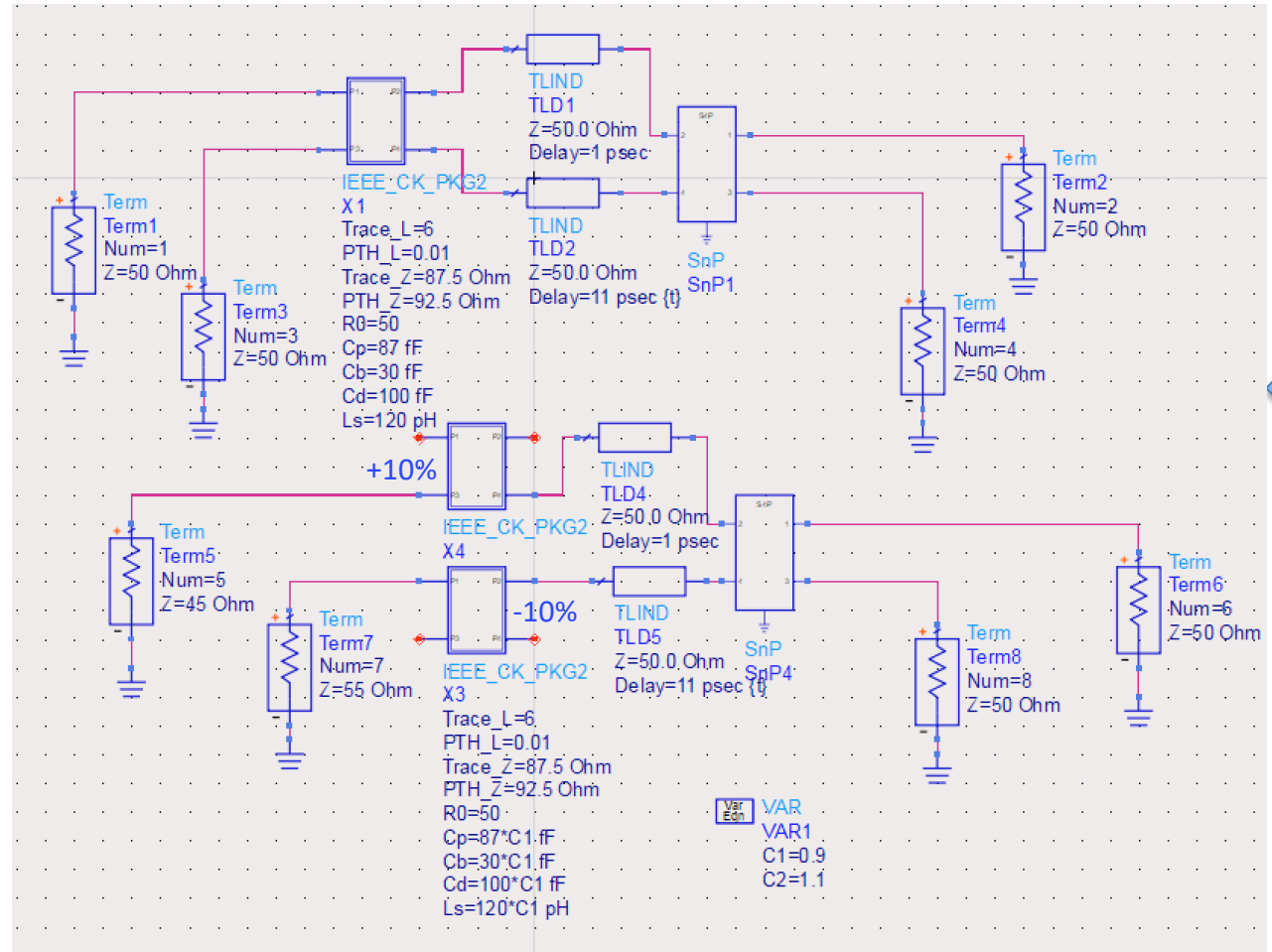
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Module Circuit

Module circuit for SCC, SCD:

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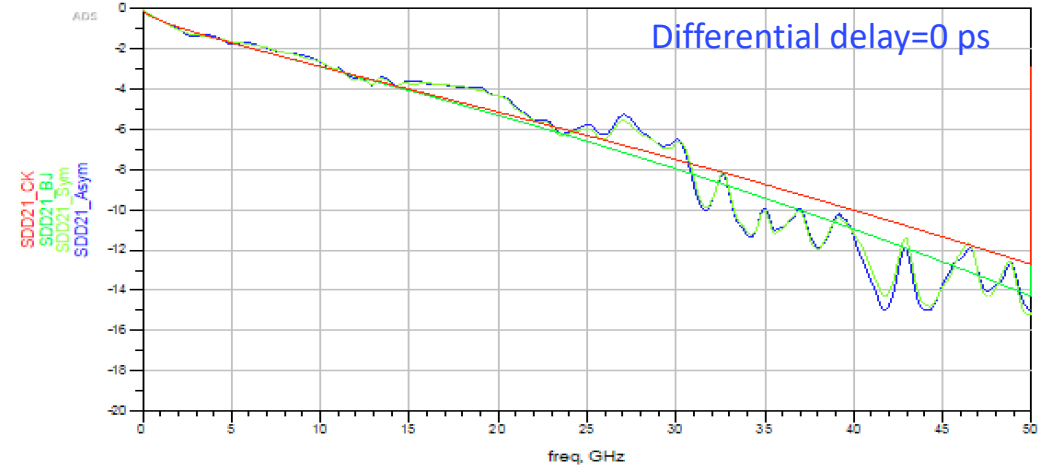
← TP1/TP4

Module Transfer Response for Package Asymmetry and Differential Delay

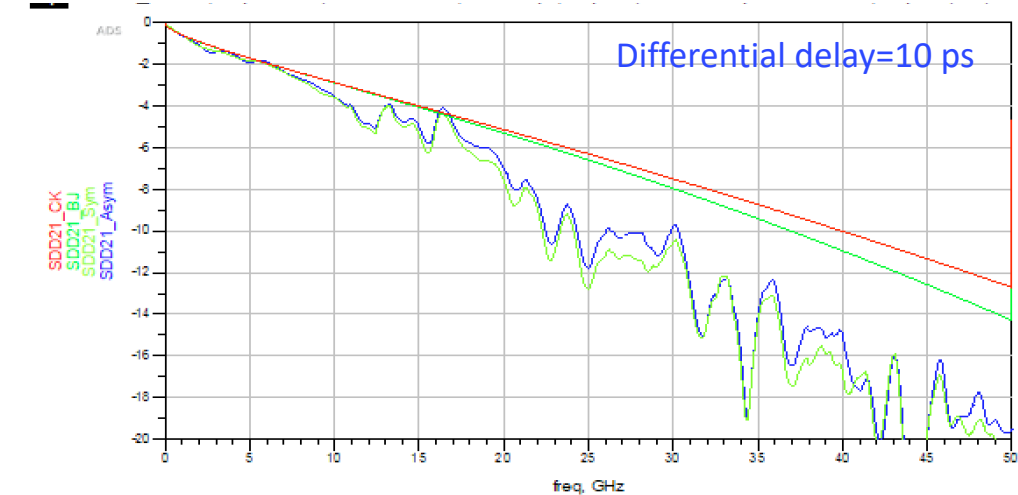
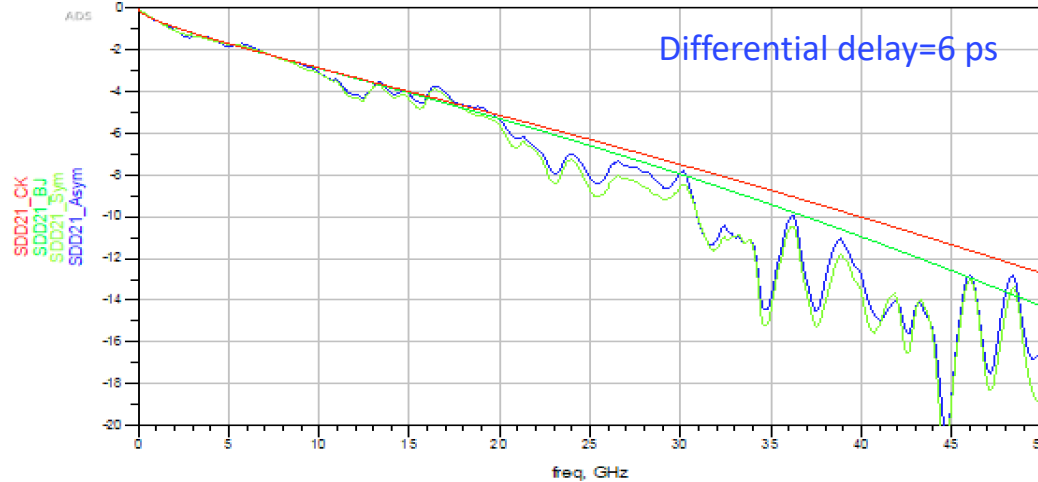
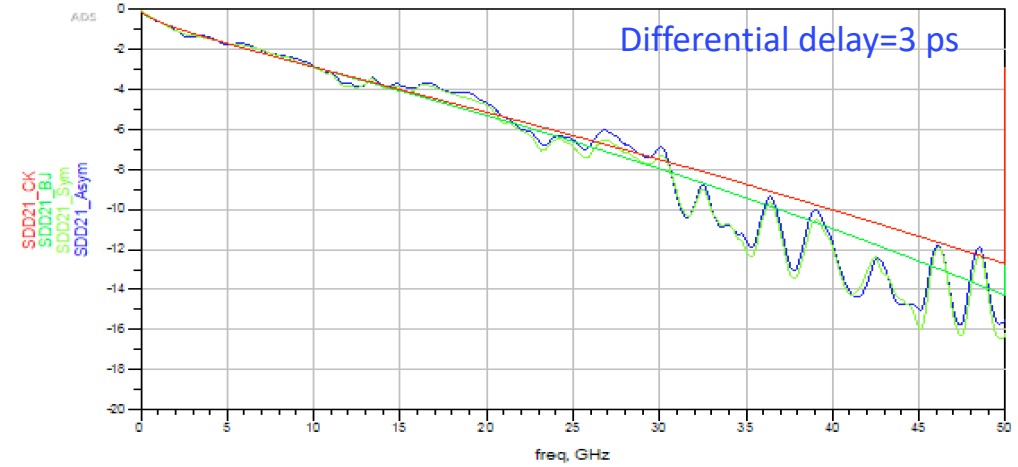
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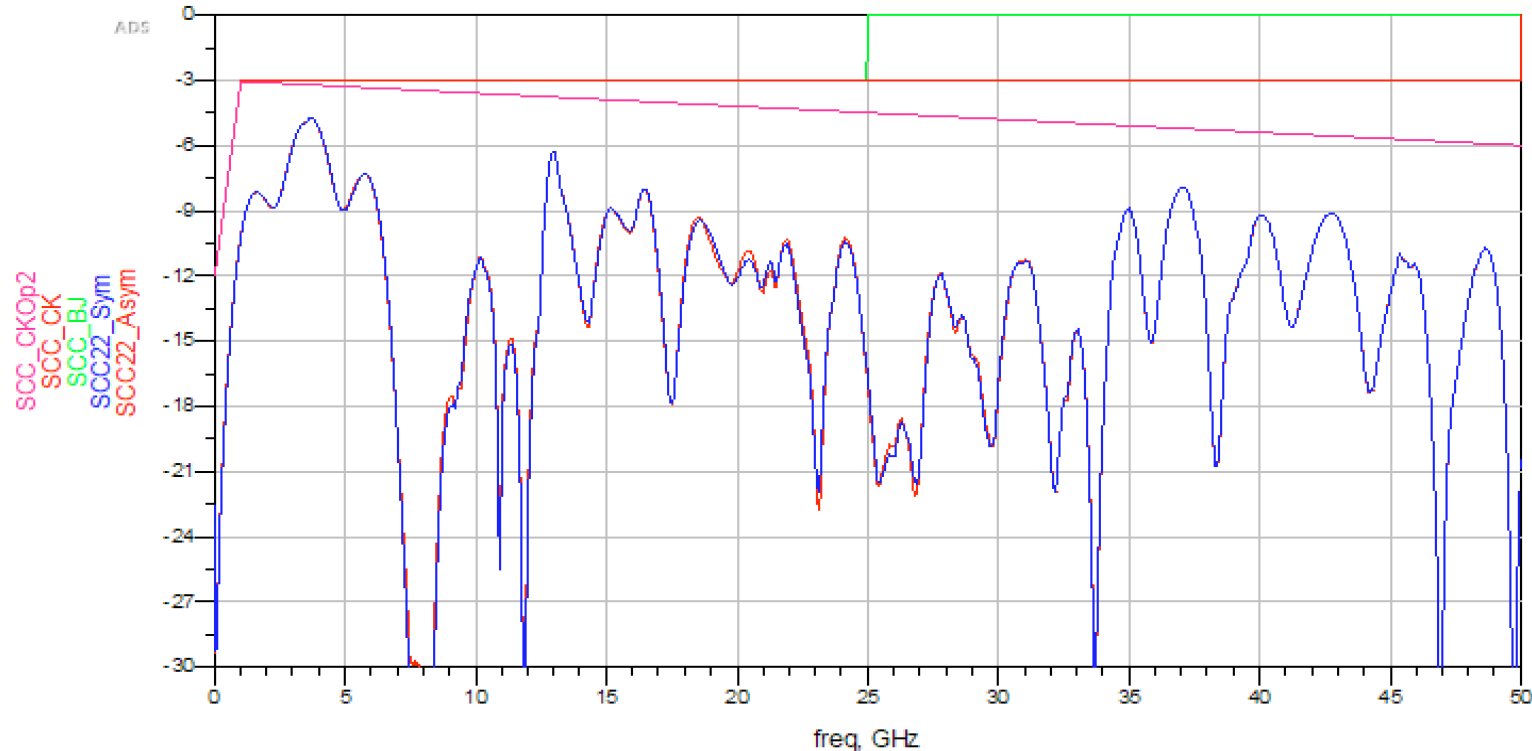
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Module Output SCC22 Limits

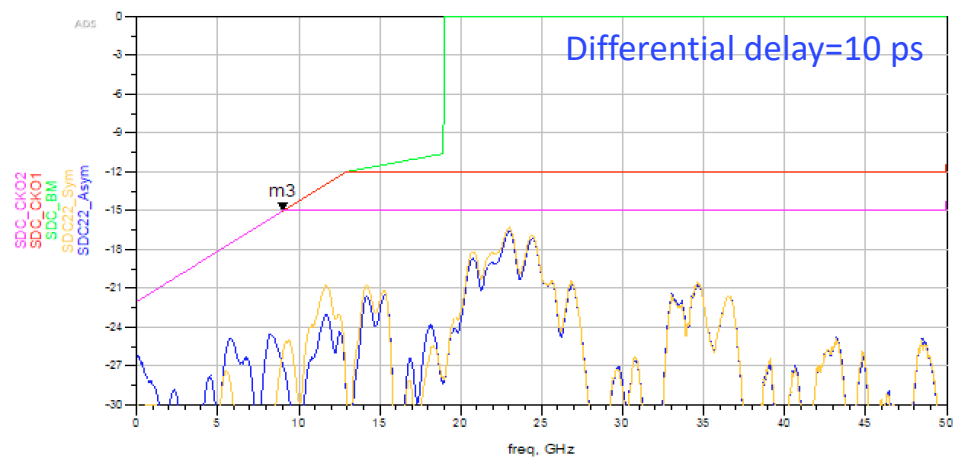
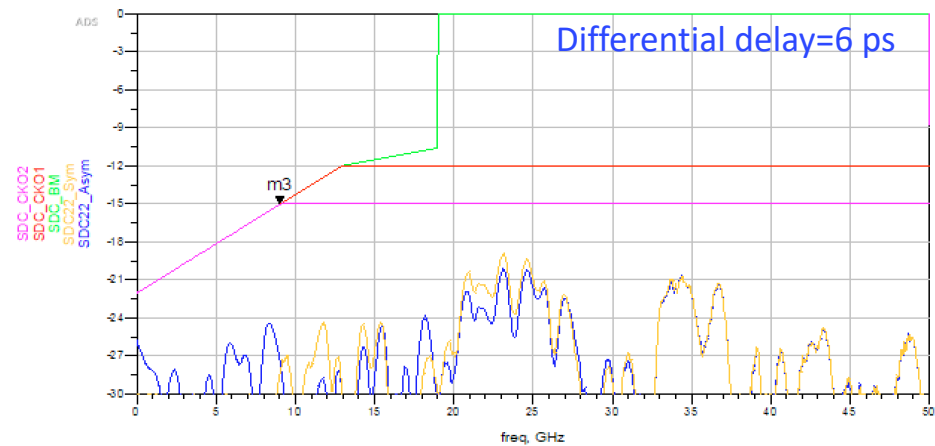
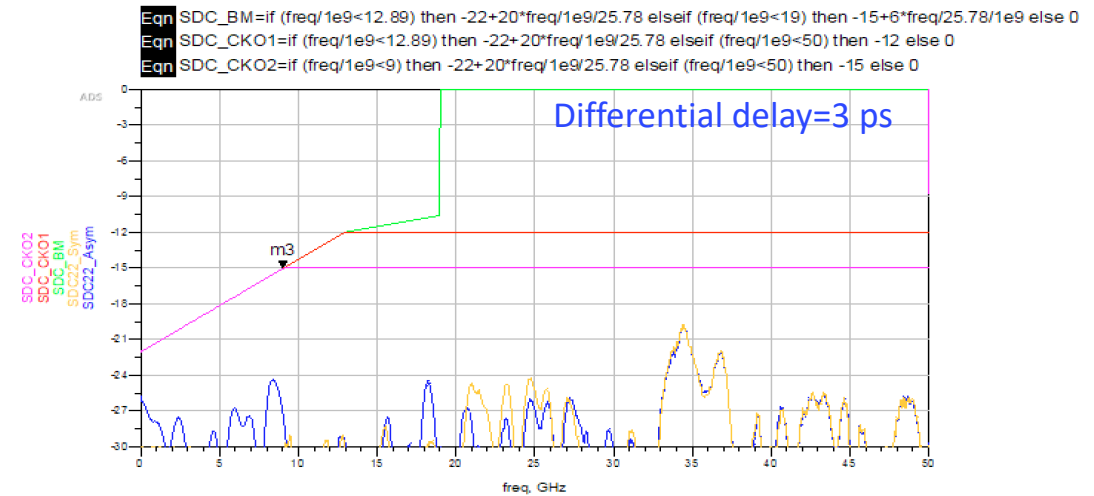
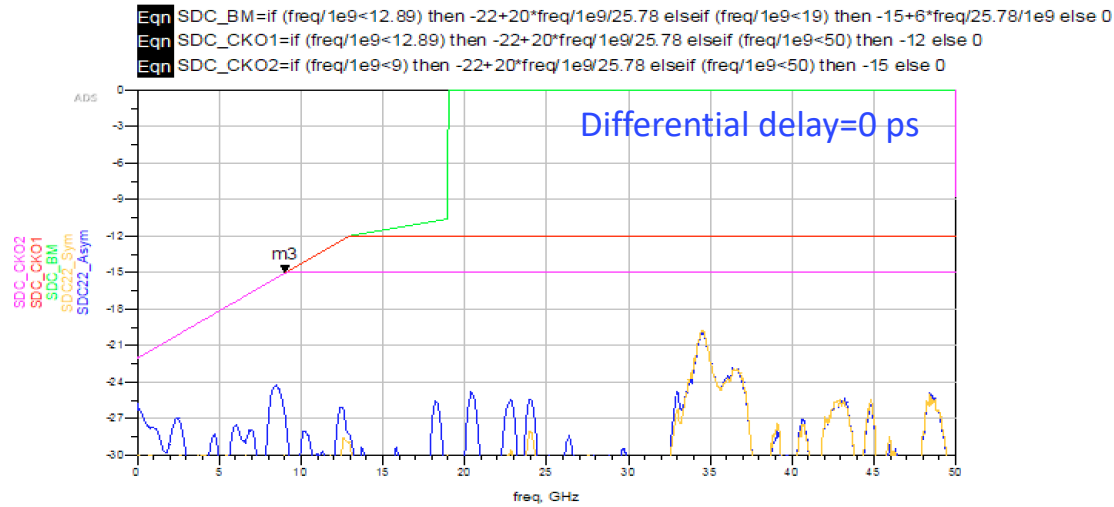
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```



Module Input SDC11/SCD11

802.3bm SDC11 graph and two proposed limit for CK



Summary

- **The need for common mode return loss and conversion return losses have been questions:**
 - The source common mode SCC22 serves to partially absorb the converted differential to common mode and reflected common mode
 - Receiver SDC11/SCD11 help absorb, reduce common-mode-differential and differential-common-mode conversion that with secondary reflection can result in spurious differential signal
 - In SFP+/IEEE nPPI SDC11 were defined for the receiver and has larger spurious contribution
 - But in CL83E SDC11 was swapped with SCD11
 - SDC11 and SCD11 are identical for passive networks both should be defined in the 802.3ck
- **COM analysis in [mellitz_3ck_adhoc_01_061720](#) indicate common mode converted spurious differential signal may have several dB of SNR penalty**
 - The limits proposed for common mode return loss and receiver SDC11/SCD11 will mitigate spurious differential signals.