AC common mode and SDC21 limits

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Supporters

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Background – Common Mode

- In order to mitigate the performance impact due to the following two effects
  - P/N skew mismatch from channel → common-mode to differential conversion loss (SDC21) shall be constrained
  - Smaller AC common-mode (CM) noise could mitigate the effects
- Two of the solutions
  - Put SDC21 spec limit
  - Modify AC COM spec
- How to balance the specs among these two?

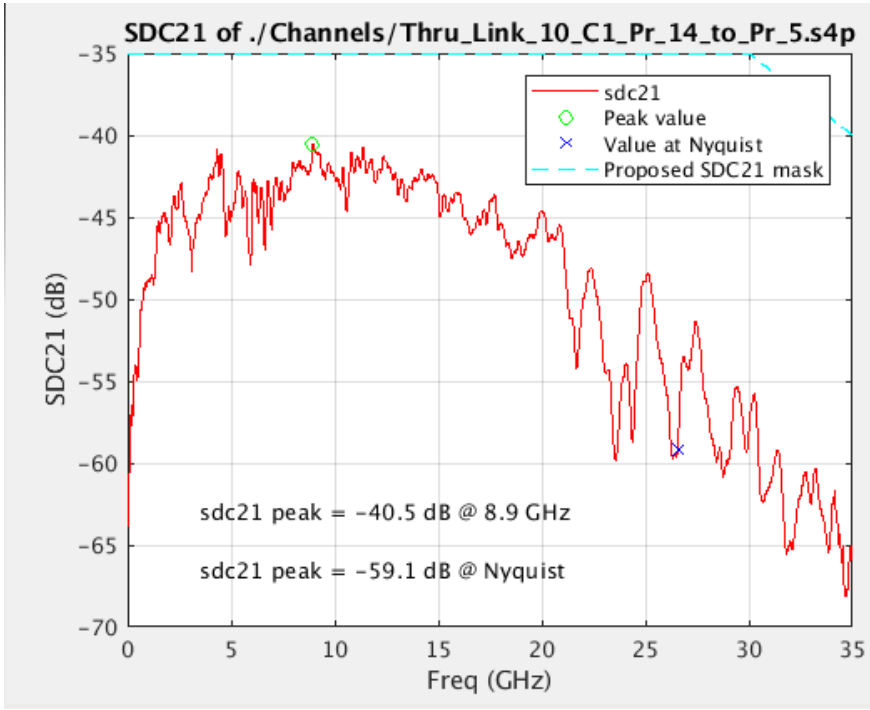
SNT TX analysis – from Rich

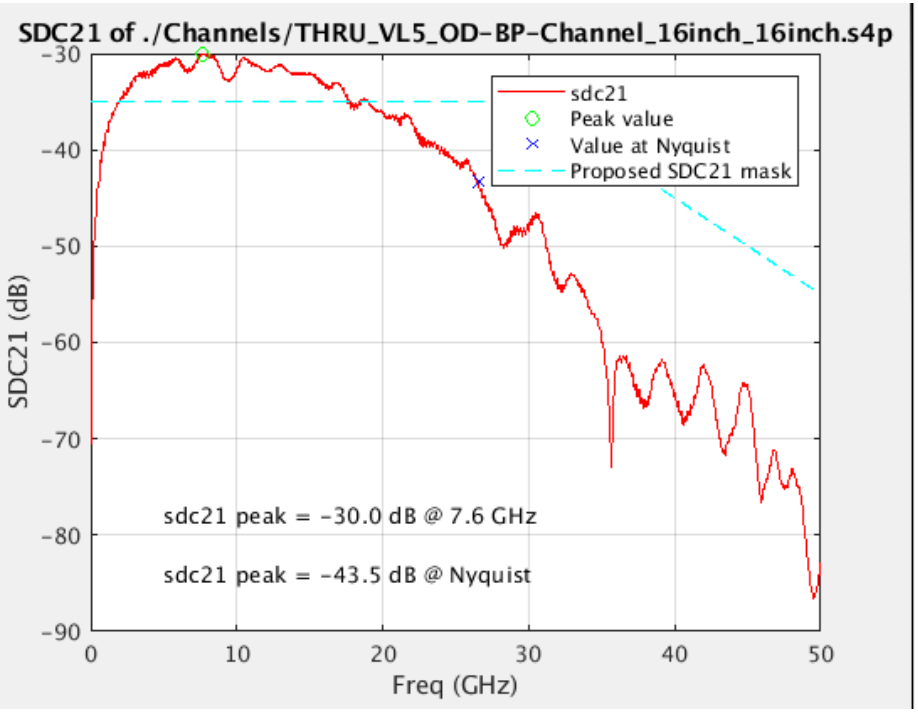
- Leverage the matlab code from Rich to further analysis [mellitz_3ck_adhoc_01_062420.pdf]
  - On more AC CM values

Gauging Study: Results with a Source of 30 mV, 10 mV, and 1 mV of AC CM

file	Old SNR_{Tx} (dB)	New SNR_{Tx} (dB) AC CM 30 mV	New SNR_{Tx} (dB) AC CM 10 mV	New SNR_{Tx} (dB) / AC CM 1 mV
Kateri/Bch2_b7p5_7_	32.5	32.0	32.4	32.5
Kateri/Bch2_b6_7_t	32.5	31.9	32.4	32.5
Kateri/CAch2_a2p5_t	32.5	30.4	32.2	32.5
Heck/.Cable_BKP_28dB_0p575m_more_isi_thru1	32.5	31.5	32.4	32.5
Mellitz/Via_Opt2_28dB_THRU	32.5	32.4	32.5	32.5
Zambell/Thru_Link_9_C1_Pr_14_to_Pr_5	32.5	31.7	32.4	32.5
Gore/C2C_PCB_SYSVIA_20dB_thru	32.5	31.3	32.4	32.5
Palkert/THRU_VL5_OD-BP-Channel_16inch_16inch	32.5	25.7	31.0	32.5
Rabinovich/Channel_Thru_P1_to_P2_01.s4p	32.5	30.4	32.2	32.4

Analysis of SDC21 of Channels – Peak SDC21





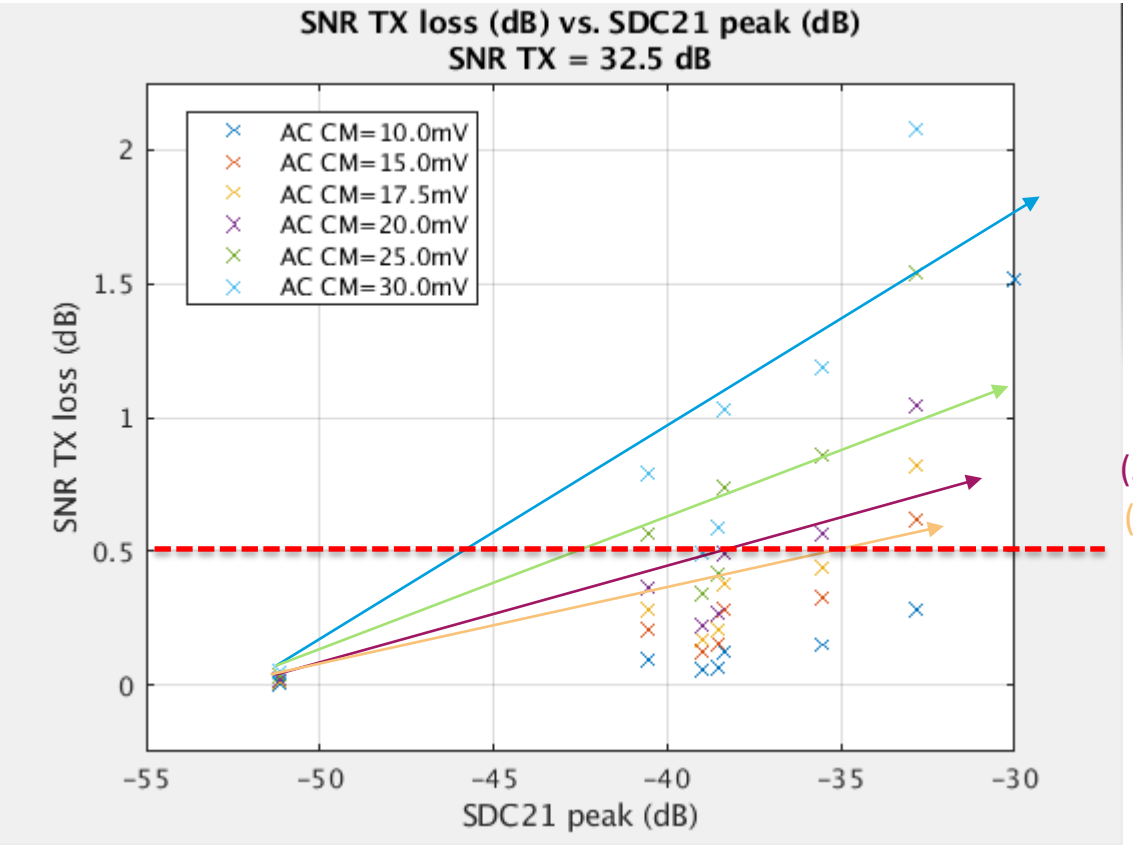
- Analysis of the peak value of SDC21 responses
  - Channel-by-channel variation is large, in the range of -30 ~ -50 dB
  - Most of the channels are in the range of -30 ~ -40 dB
- Analysis SNR_{Tx} loss vs. SDC21 peak value
  - Try to find good balance among them

Peak SDC21 of Channels

File	AC CM (mV)	New SNR_{Tx} (dB) 30	17.5	15	10	1	sdc21_Peak (dB)
Kateri/Bch2_b7p5_7_		32.0	32.3	32.4	32.4	32.5	-38.9931
Kateri/Bch2_b6_7_t		31.9	32.3	32.3	32.4	32.5	-38.5647
Kateri/CAch2_a2p5_t		30.4	31.7	31.9	32.2	32.5	-32.8423
Heck/Cable_BKP_28dB_0p575m_more_isi_thru1		31.5	32.1	32.2	32.5	32.5	-38.3842
Mellitz/CaBP_BGAVia_Opt2_28dB_THRU		32.4	32.5	32.5	32.5	32.5	-51.1657
Zambell/Thru_Link_~~9~~10_C1_Pr_14_to_Pr_5		31.7	32.2	32.3	32.4	32.5	-40.547
Gore/C2C_PCB/SYSVIA_20dB_thru		31.3	32.1	32.2	32.4	32.5	-35.5721
Palkert/THRU_VL5_OD-BP-Channel_16inch_16inch		25.7	28.9	29.6	31.0	32.5	-30.0389

- Old SNR_{Tx} is 32.5 dB

How to constraint impact from common-mode noise? SDC21 & AC CM



(30mV, -45 dB)

(25mV, -42.5 dB)

(20mV, -38 dB)

(17.5mV, -35 dB)

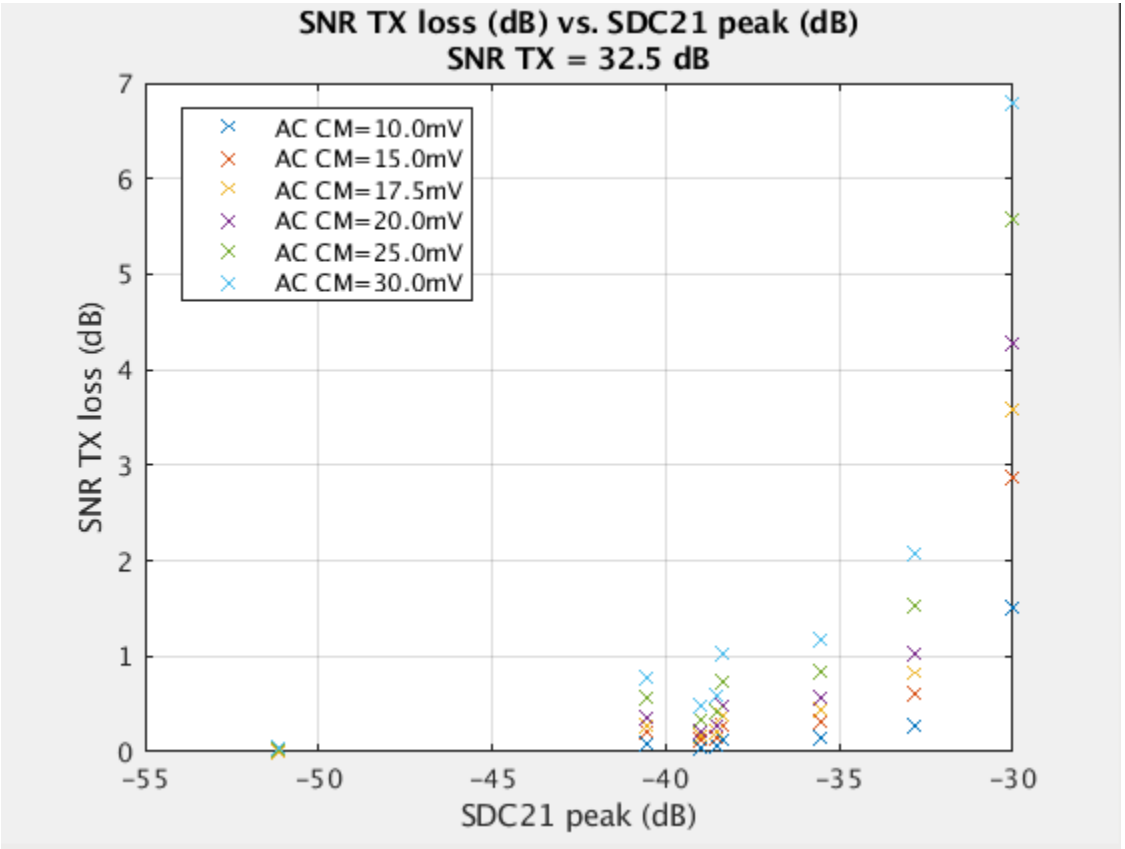
- If take SNR TX loss <= 0.5 dB as criterion
  - Consider part of common-mode noise is correlated to TX signal and therefore could be reduced by RX equalization
- Higher AC CM (such as 30 mV), more limits on SDC21 (-45 dB for example)
  - Maybe AC CM <= 17.5 mV & SDC21 <= -35 dB is good selection

Summary

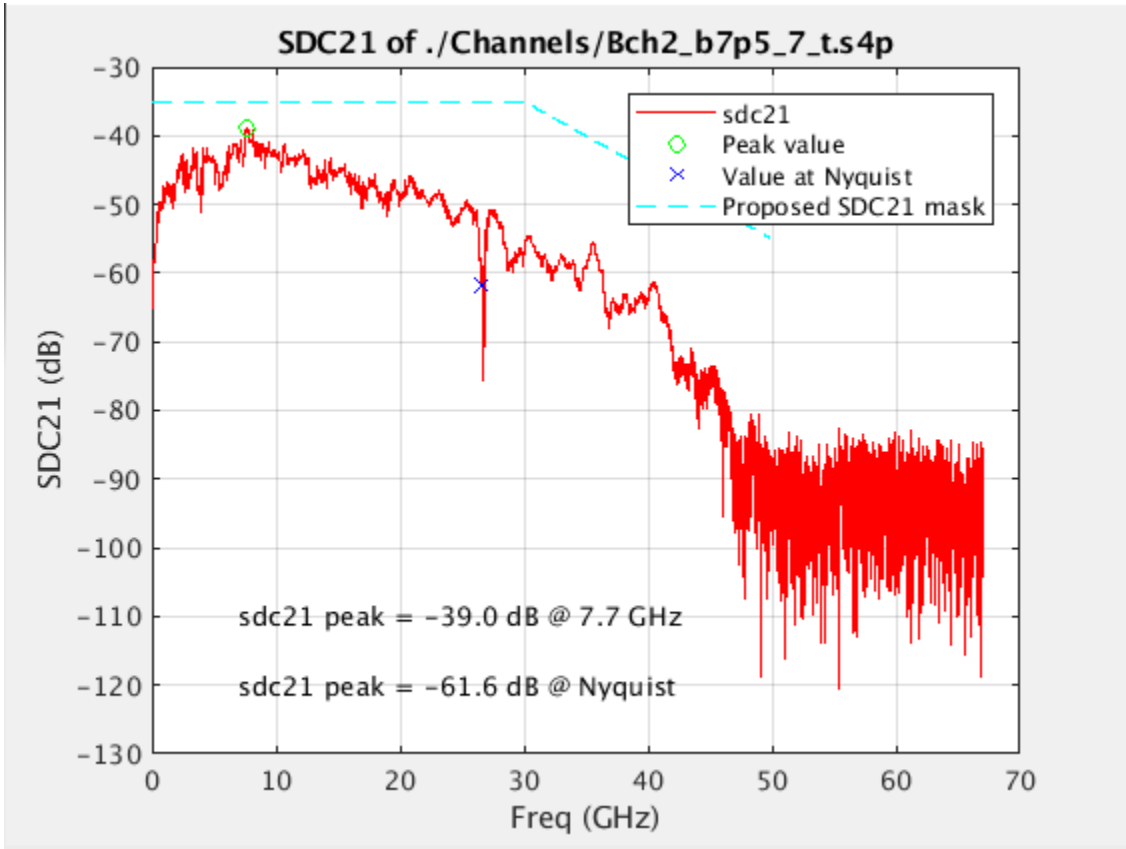
- We may consider both of the following proposals to mitigate impact from P/N skew
  - Adopt SDC21 spec limit as
  - $\mathrm{SDC21}_{\mathrm{lim}}(f) = \begin{cases} -35 & 0.01 \le f \le 30 \\ -35 - (f - 30) & 30 < f \le 50 \end{cases}$
    - Where
    - ***SDC21$_{lim}$(f)*** is the common-mode to differential conversion loss limit in dB at frequency ***f***
    - ***f*** is the frequency in GHz
    - PS: two channels will fail SDC21 limit spec
  - Modify AC common-mode noise from 30 mV to 17.5 mV
    - For KR (C163)

everyday genius

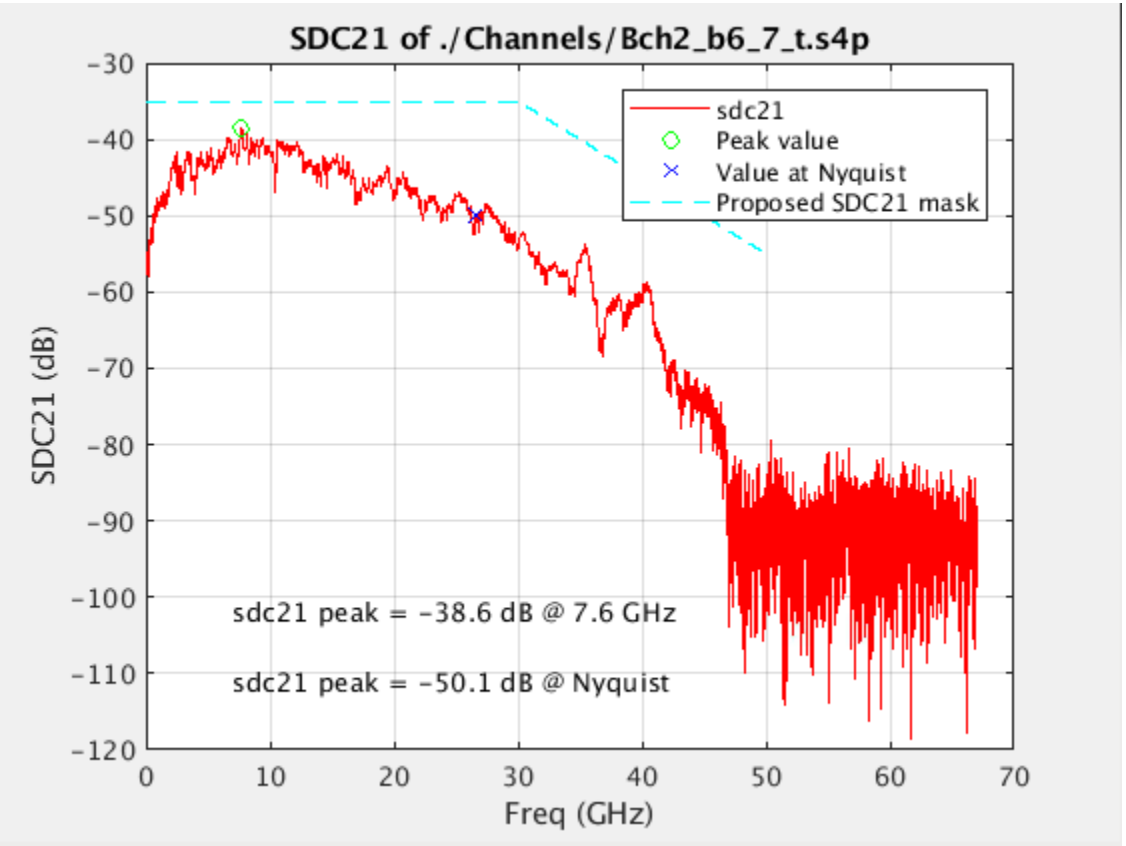
Detailed Plot of SNR TX loss vs. SDC21 Peak



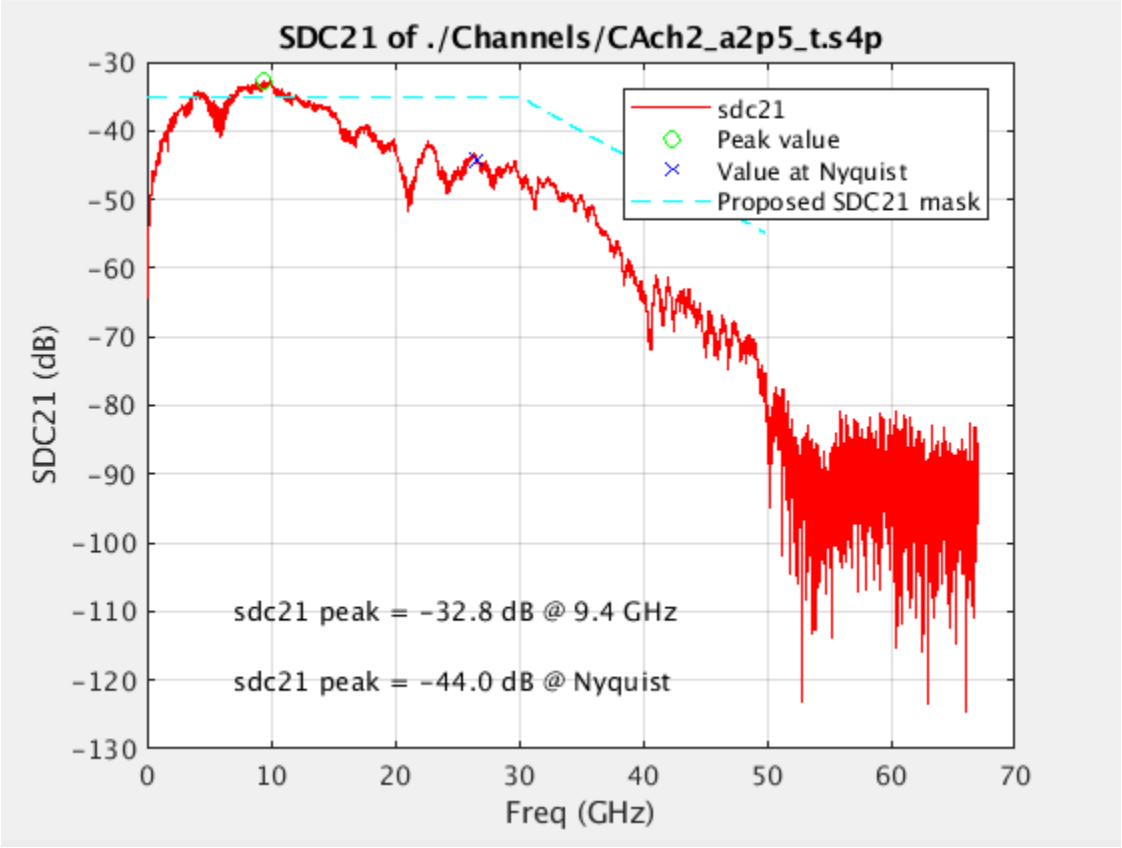
Kateri/Bch2_b7p5_7_



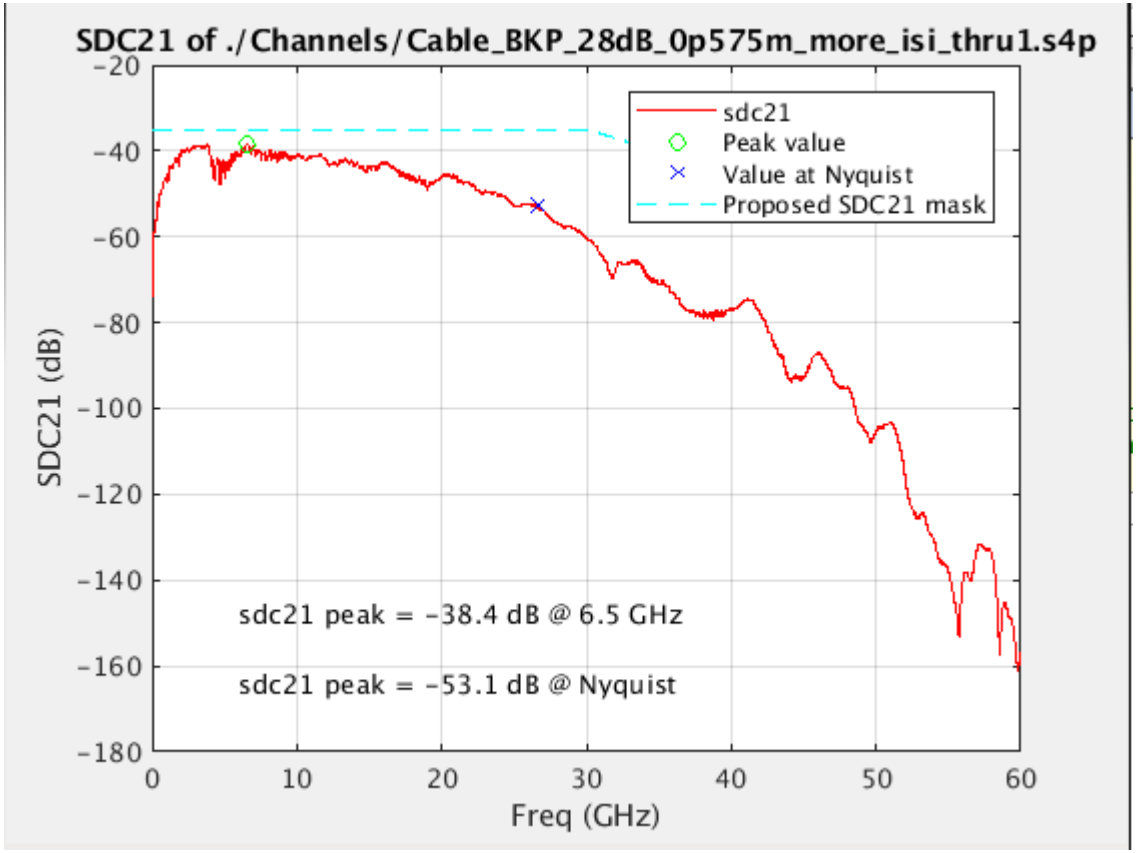
Kateri/Bch2_b6_7_t



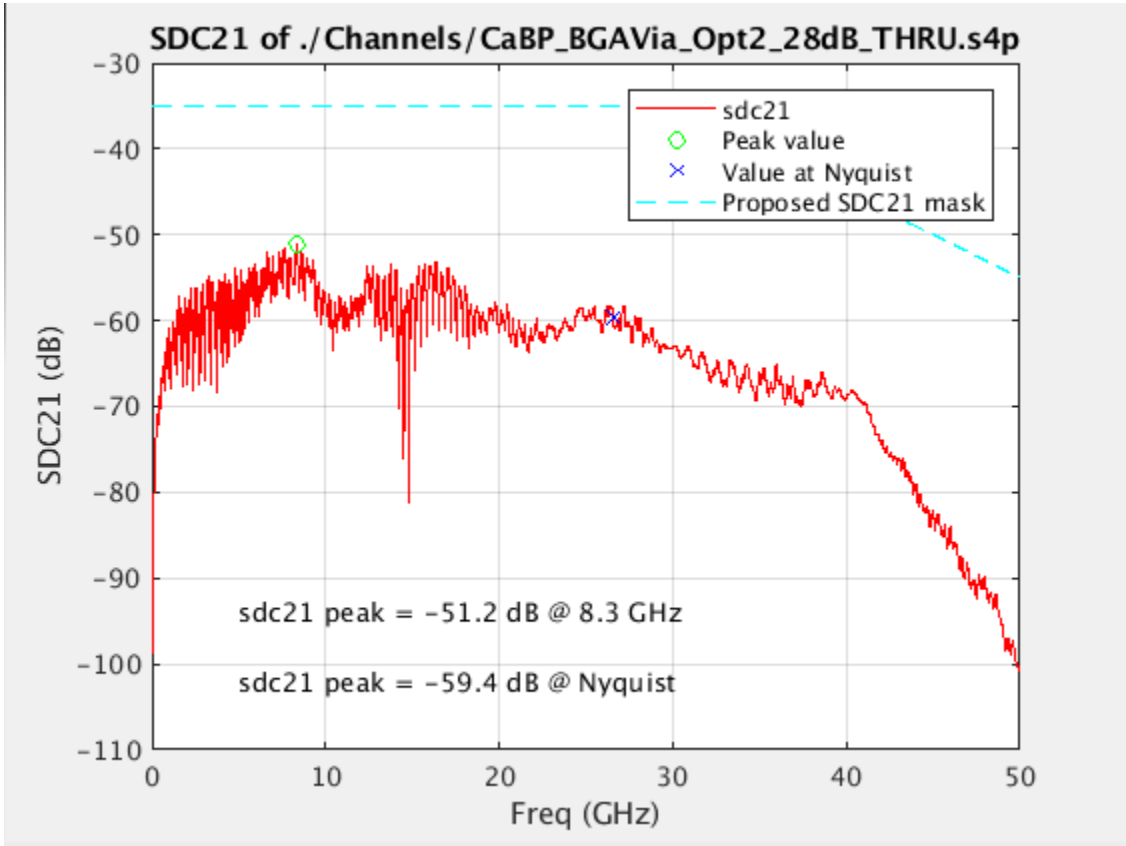
Kateri/CAch2_a2p5_t



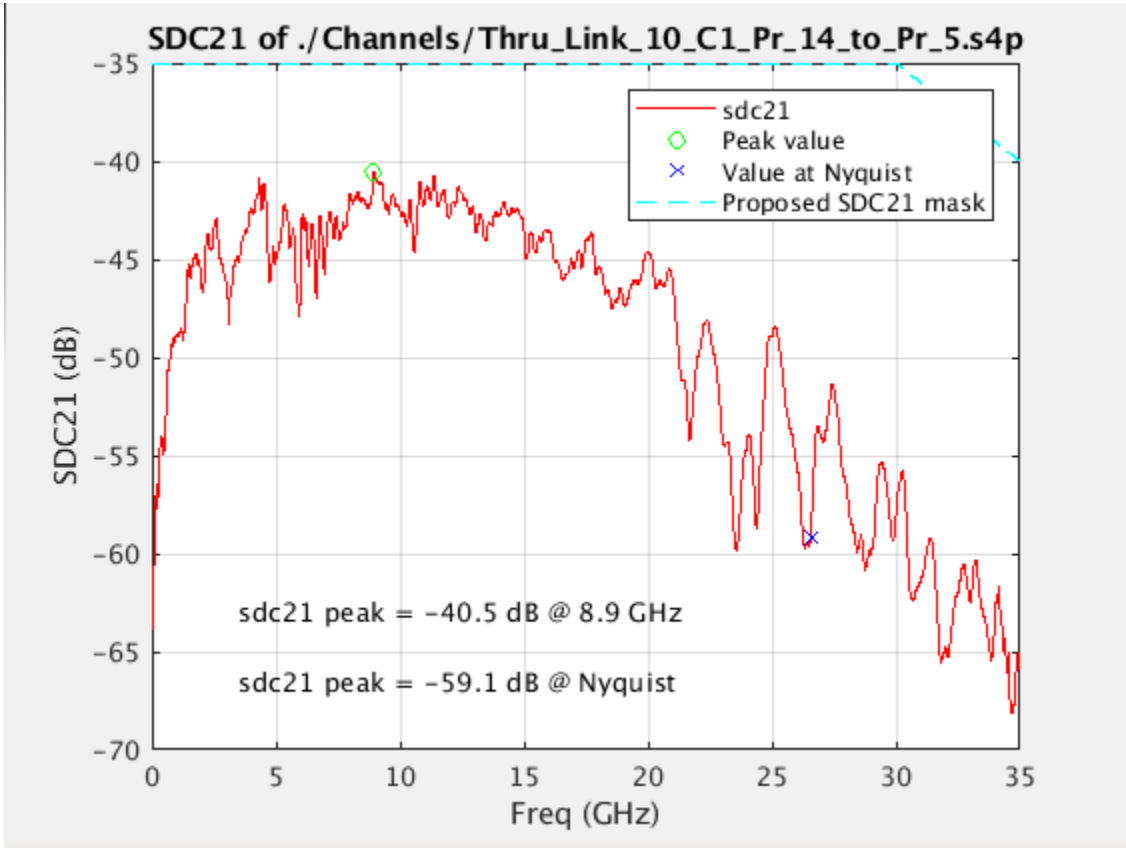
Heck/Cable_BKP_28dB_0p575m_more_isi_thru1



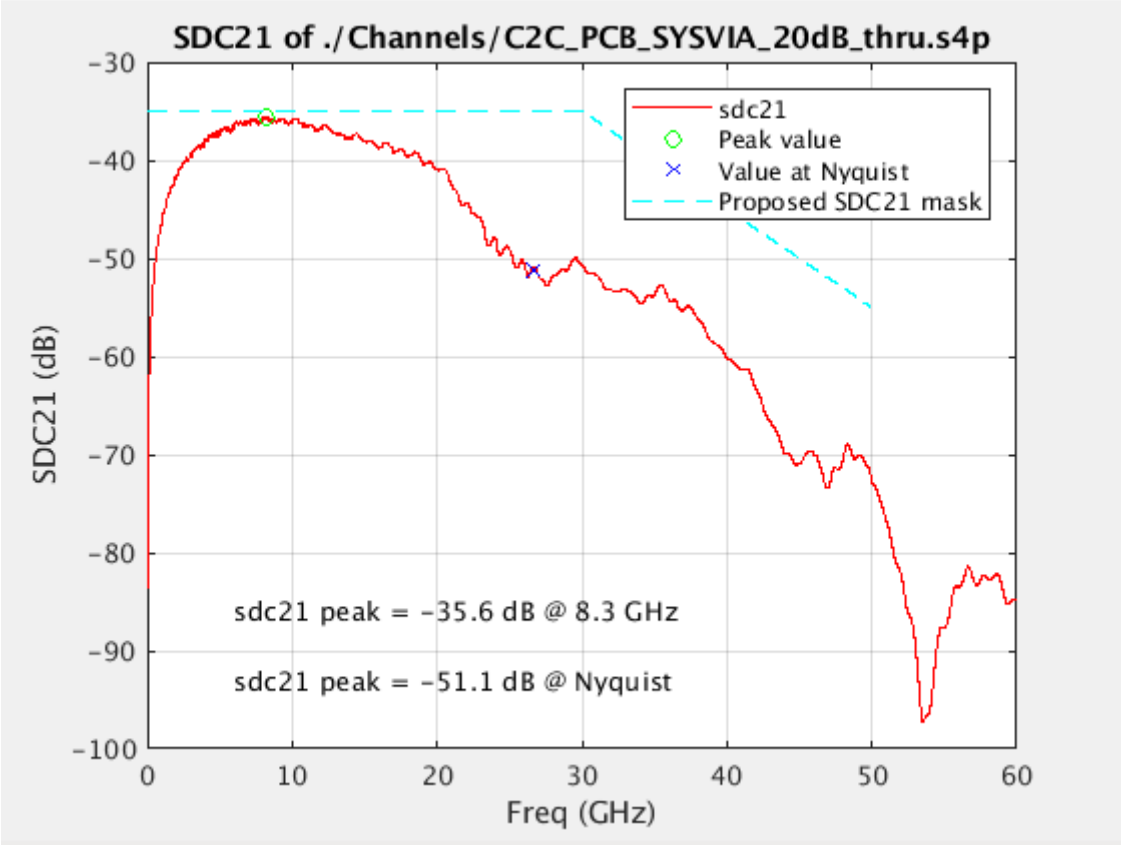
Mellitz/CaBP_BGAVia_Opt2_28dB_THRU



Zambell/Thru_Link_10_C1_Pr_14_to_Pr_5



Gore/C2C_PCB/SYSVIA_20dB_thru



Palkert/THRU_VL5_OD-BP-Channel_16inch_16inch