Common Mode: Part 2, MM plots

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Purpose

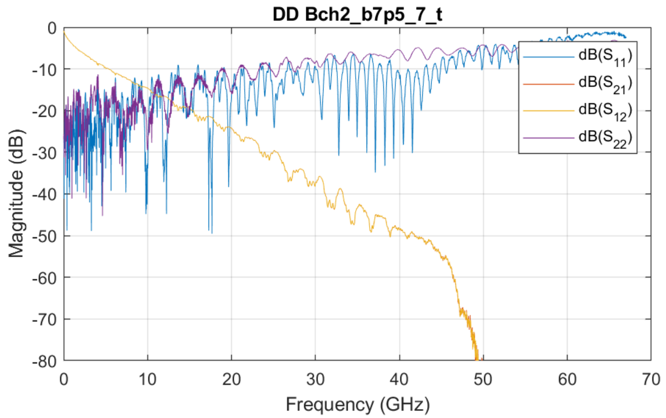
- Illustrate multi-mode s-parameter plots from mellitz_3ck_adhoc_01_061720
- Following data estimates change in referred SNR_Tx (delta) due to common mode to differential conversion

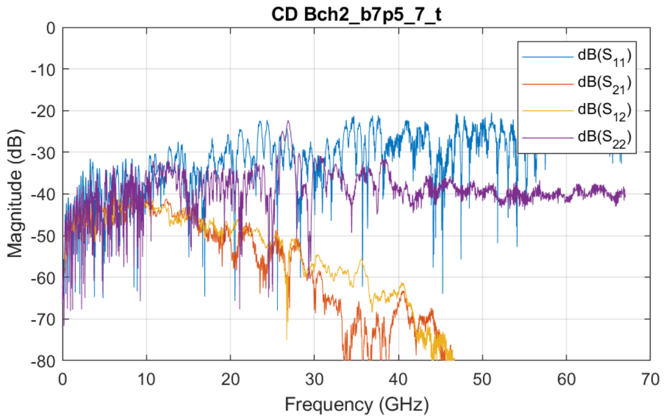
Gauging Study: Results with a Source of 30 mV, 10 mV, and 1 mV of AC CM

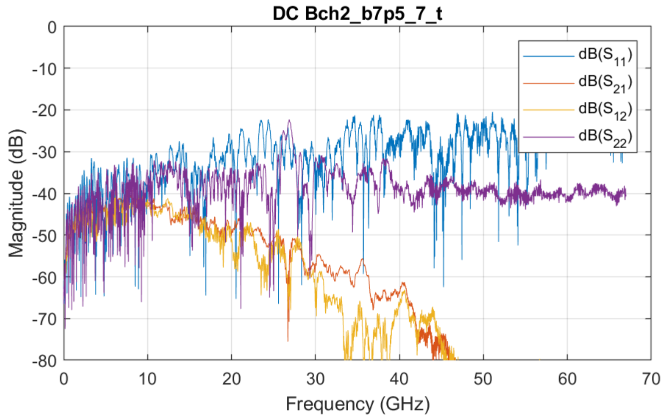
file	Old SNR_{Tx} (dB)	New SNR_{Tx} (dB) AC CM 30 mV	New SNR_{Tx} (dB) AC CM 10 mV	New SNR_{Tx} (dB) / AC CM 1 mV
Kateri/Bch2_b7p5_7_	32.5	32.0	32.4	32.5
Kateri/Bch2_b6_7_t	32.5	31.9	32.4	32.5
Kateri/CAch2_a2p5_t	32.5	30.4	32.2	32.5
Heck/.Cable_BKP_28dB_0p575m_more_isi_thru1	32.5	31.5	32.4	32.5
Mellitz/Via_Opt2_28dB_THRU	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

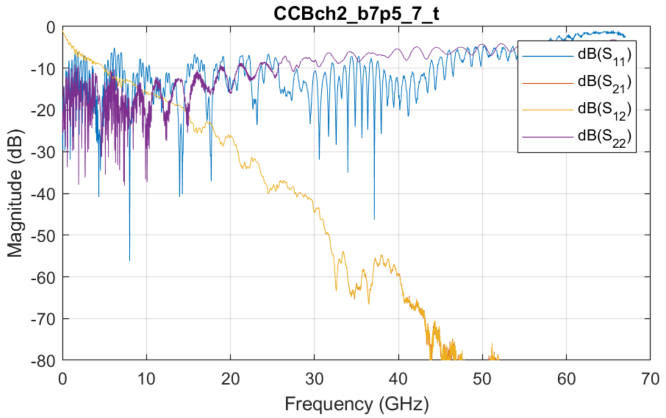
Assumption is an average common mode return loss at tp0 of 15 dB

Kateri/Bch2_b7p5_7_ || Delta | -0.5 | -0.1 | 0

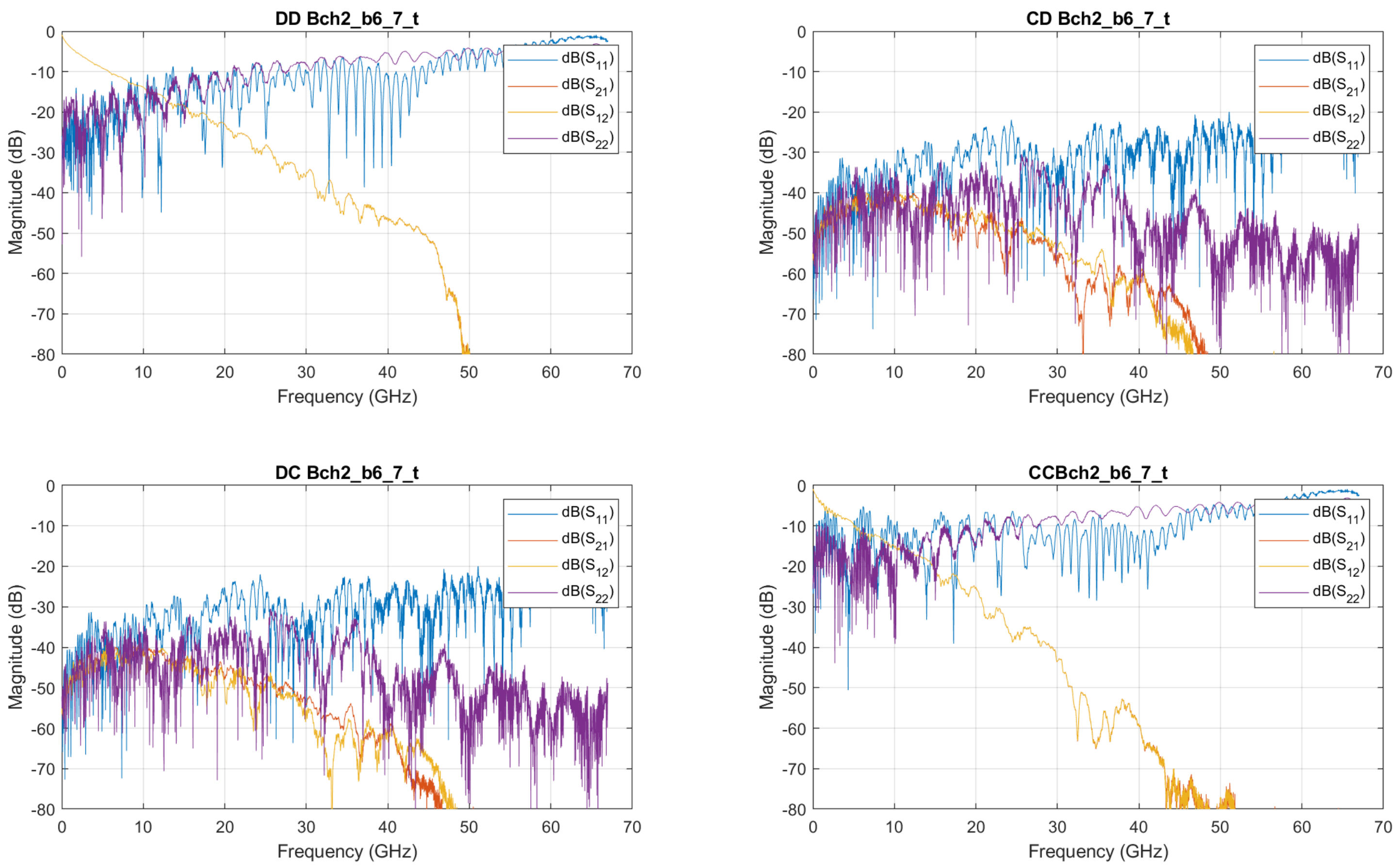




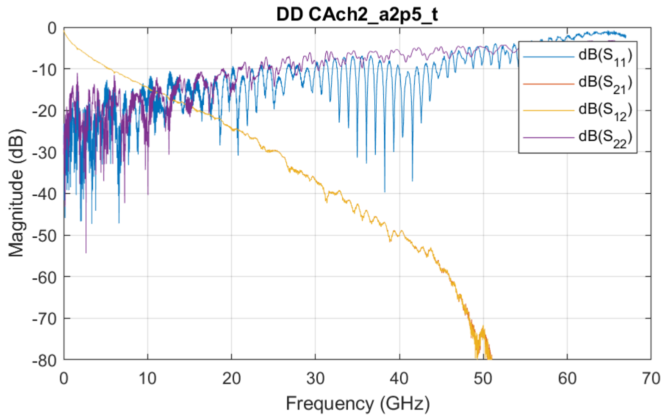


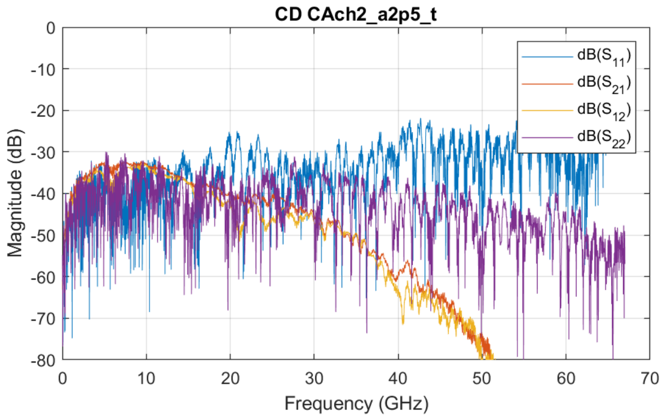


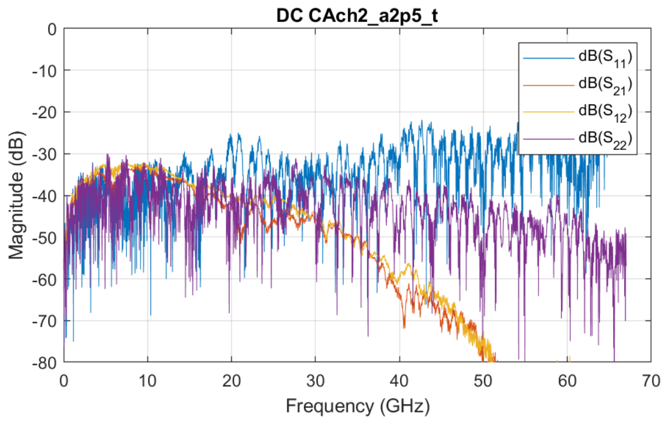
Kateri/Bch2_b6_7_t || Delta | -0.6 | -0.1 | 0

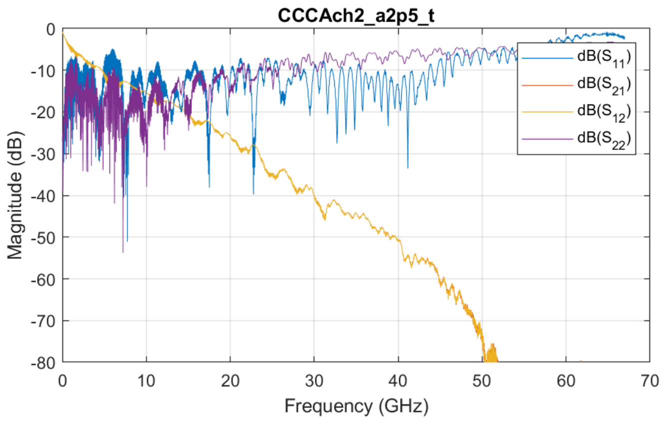


Kateri/CAch2_a2p5_t || Delta | -2.1 | -0.3 | 0

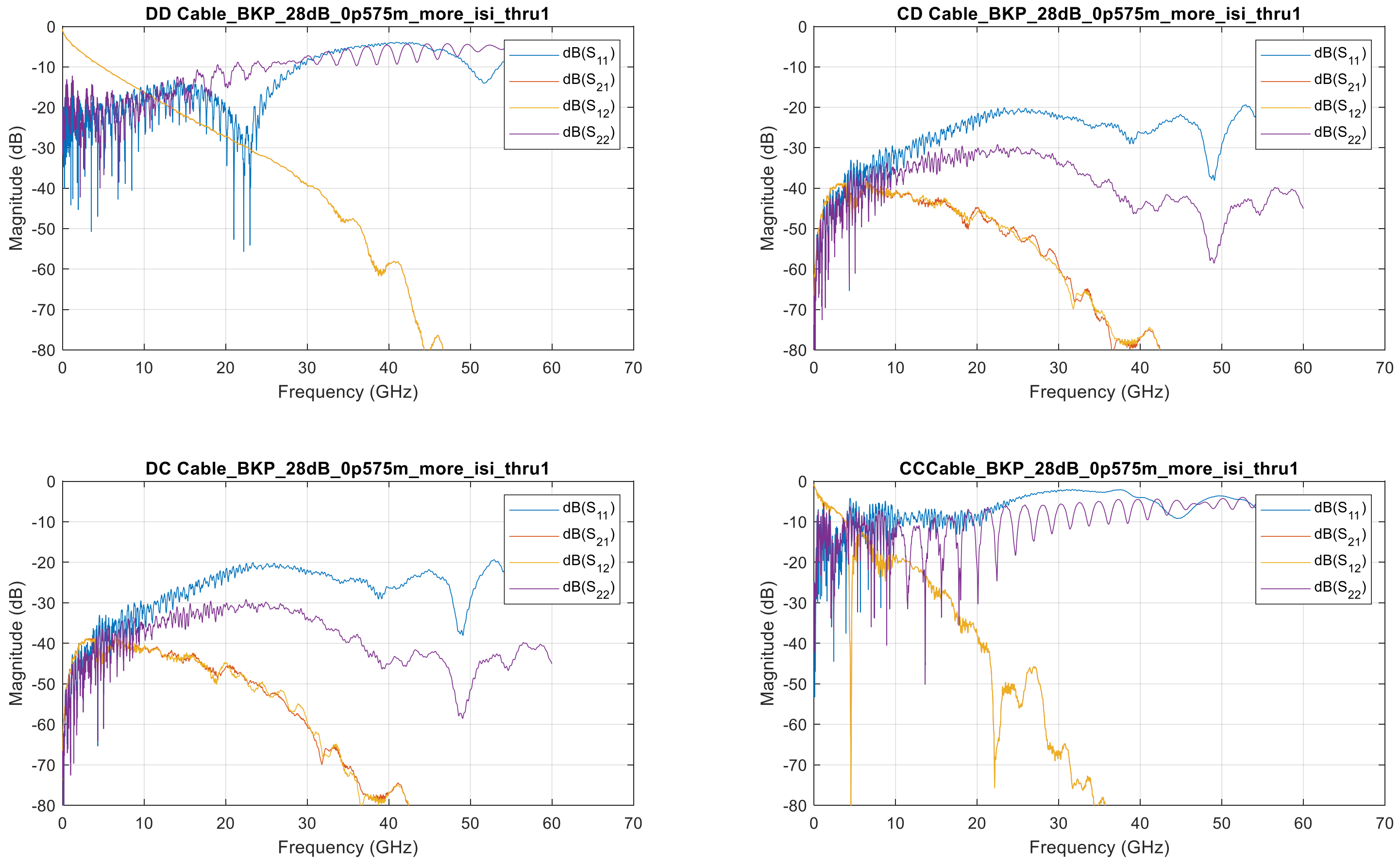




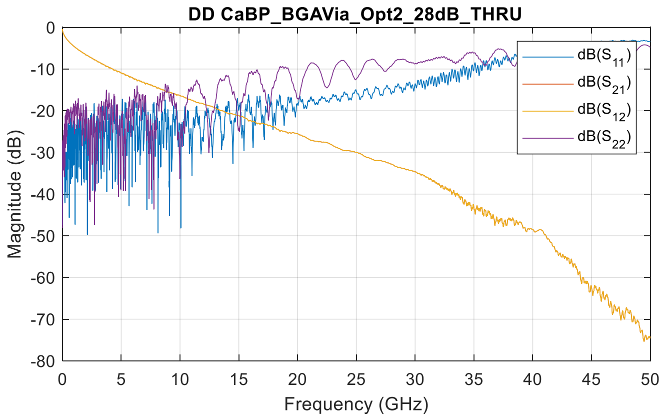


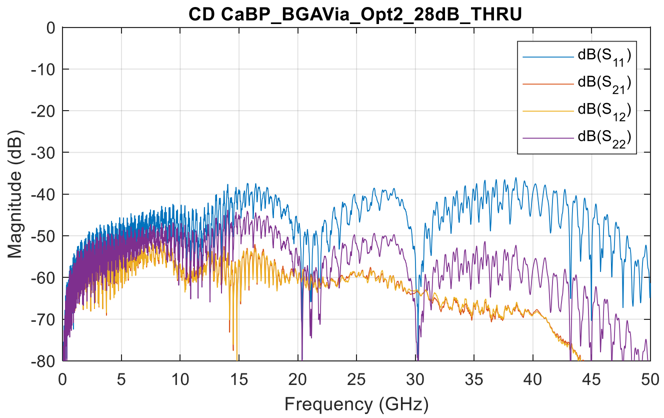


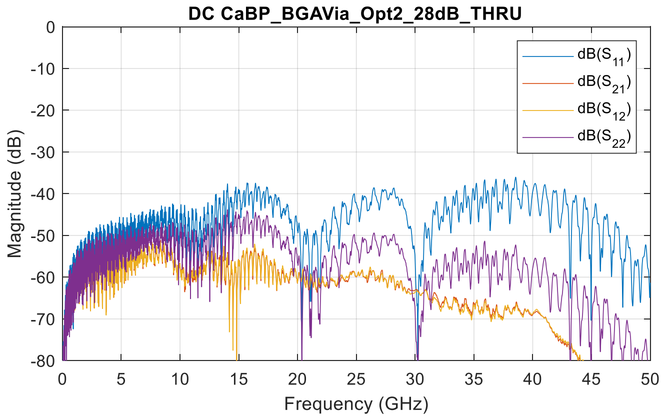
Heck/.Cable_BKP_28dB_0p575m_more_isi_thru1 || Delta | -1 | -0.1 | 0

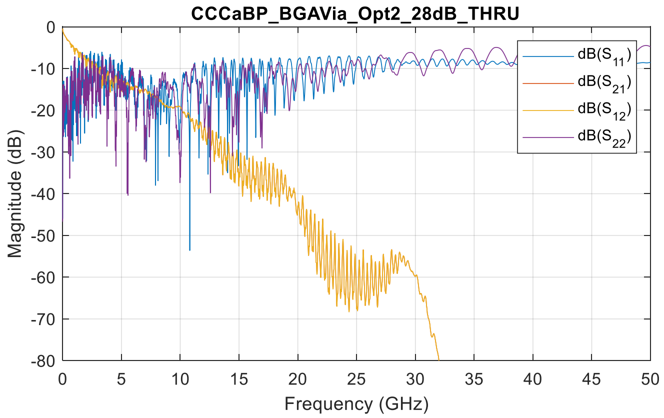


Mellitz/Via_Opt2_28dB_THRU || Delta | -0.1 | 0 | 0

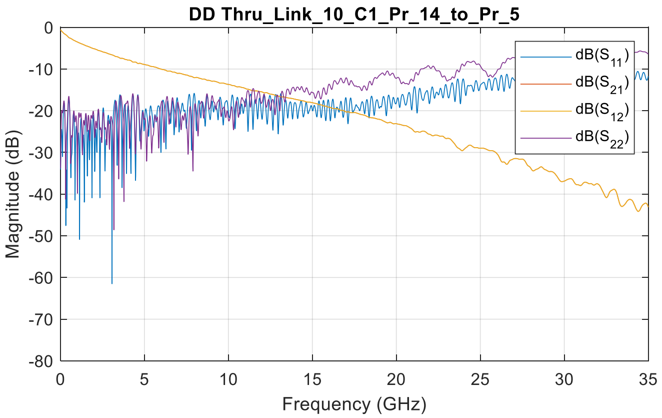


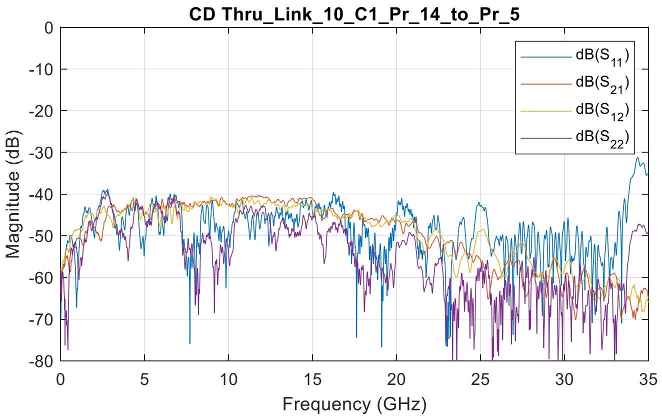


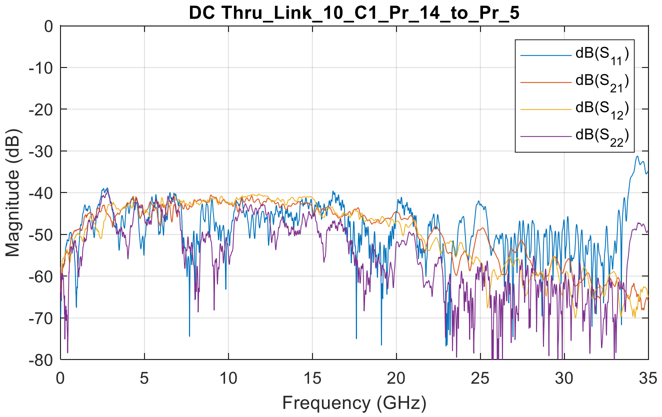


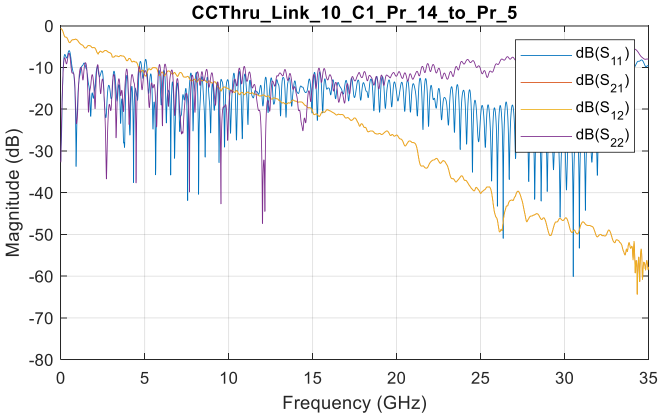


Zambell/Thru_Link_9_C1_Pr_14_to_Pr_5 || Delta | -0.8 | -0.1 | 0

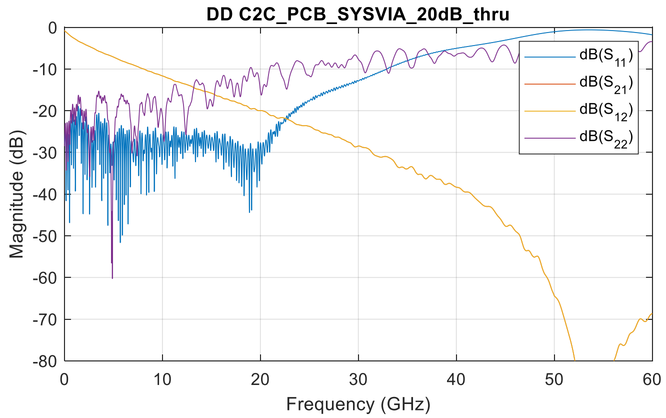


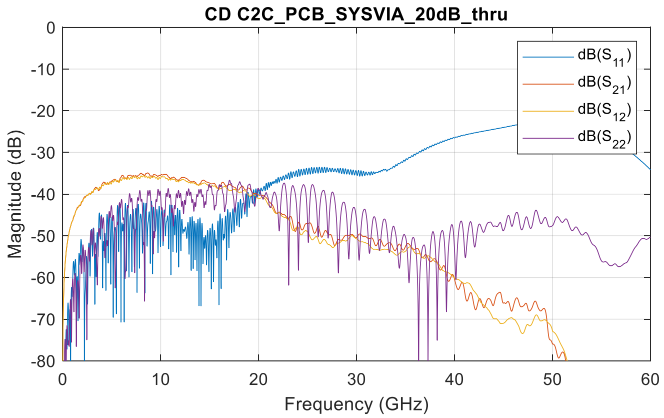


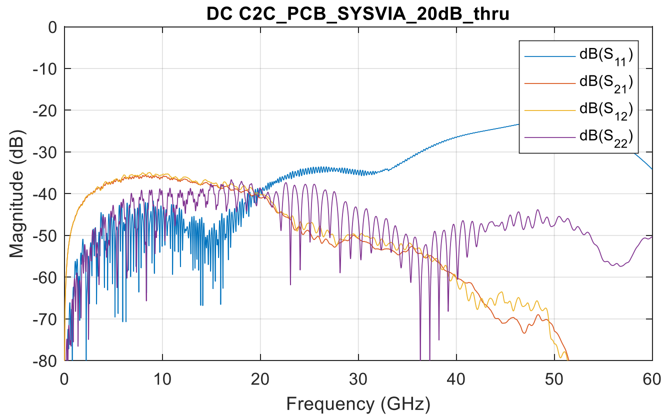


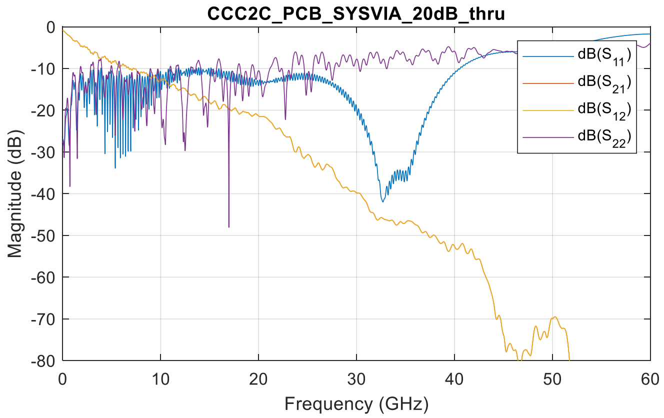


Gore/C2C_PCB_SYSVIA_20dB_thru || Delta | -1.2 | -0.1 | 0

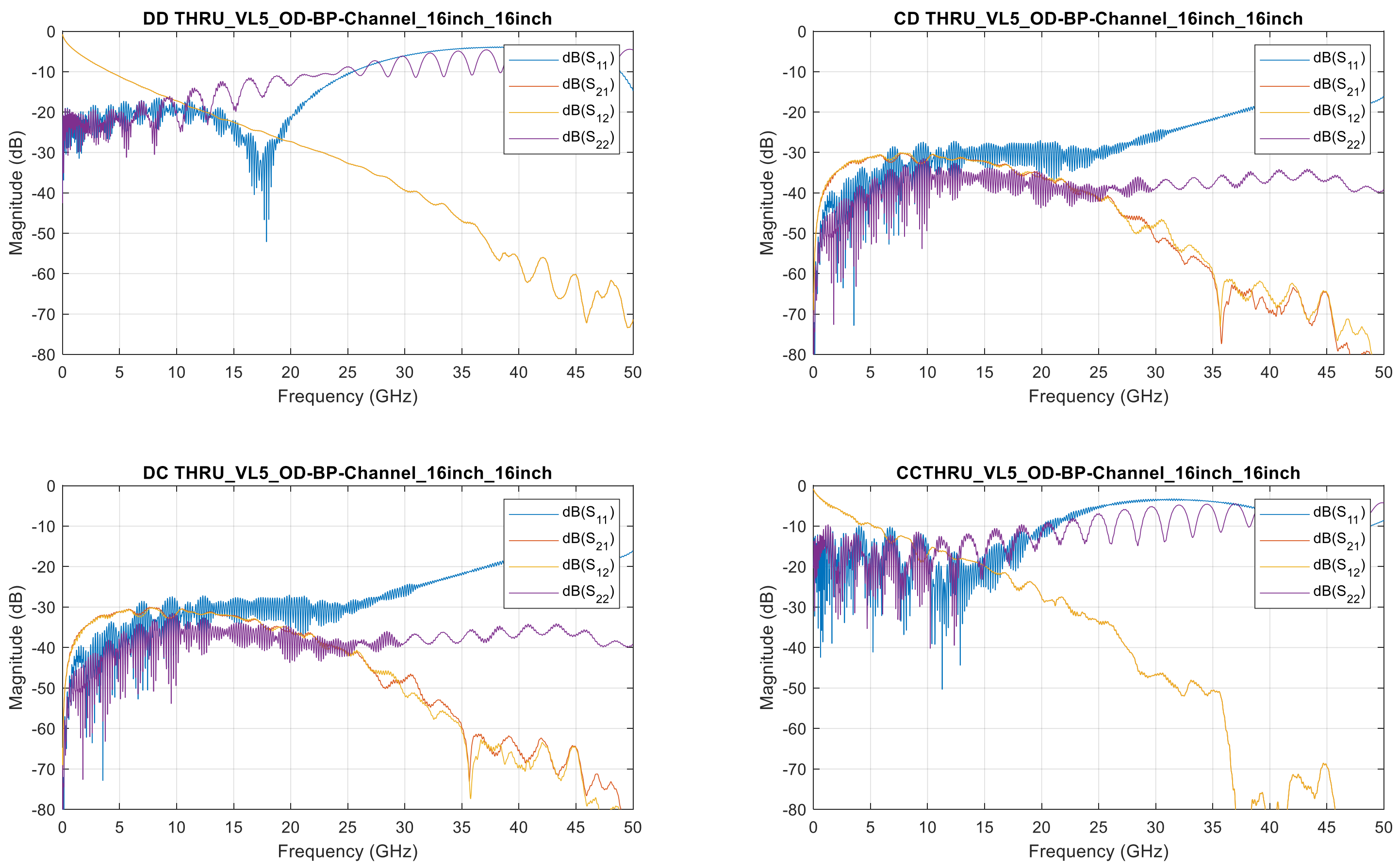




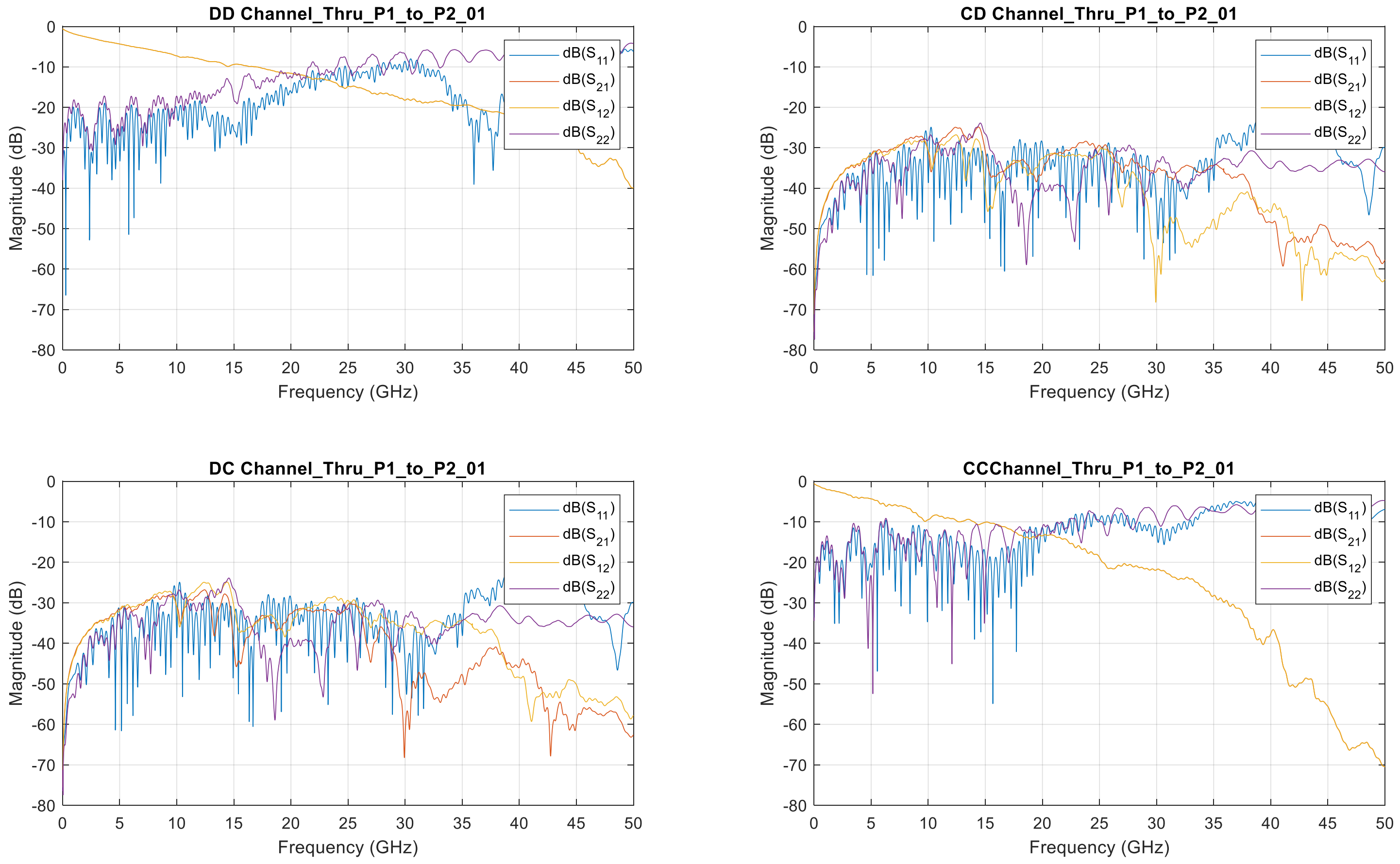




Palkert/THRU_VL5_OD-BP-Channel_16inch_16inch || Delta | -6.8 | -1.5 | 0



Rabinovich/Channel_Thru_P1_to_P2_01.s4p || Delta | -2.1 | -0.3 | -0.1



Data from mellitz_3ck_adhoc_01_061720

Background

- ❑ Common mode noise may introduce differential noise at the receiver.
- ❑ Utilize a SNR_Tx with Rx referred noise added
- ❑ Task force has much experience with what happens when SNR_Tx parameter goes up and down
  - Rather than modifying COM at this point
- ❑ First step is “do we have a problem”
  - Start with the 30 mV AC CM specification an comprehend for KR first

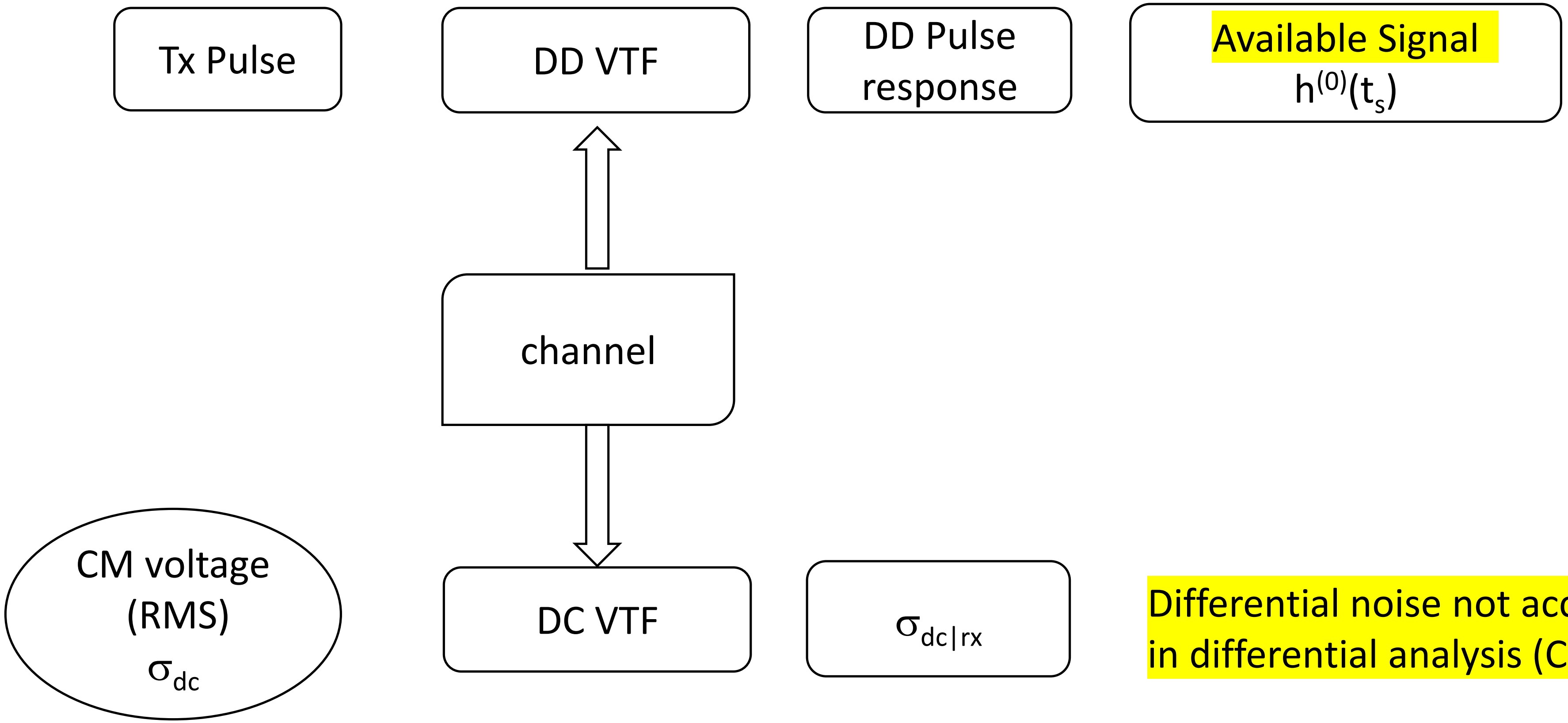
SNR_Tx Receiver Referred CM Noise

- ❑ Rx CM noise referred to SNR_Tx

$$SNR_{Tx|Rx} = -10 \ * log10\left(\frac{\sigma^2_{dc|rx} + h^{(0)}(ts)2\,10^{-\frac{SNR_{Tx}}{10}}}{h^{(0)}(ts)^2}\right)$$

- $\sigma_{dc|rx}$ differential noise at the Rx created from AC CM noise at the Tx
- The available signal at the receiver is $h^{(0)}(ts)$

Simple First Estimate



Differential noise not accounted for in differential analysis (COM)

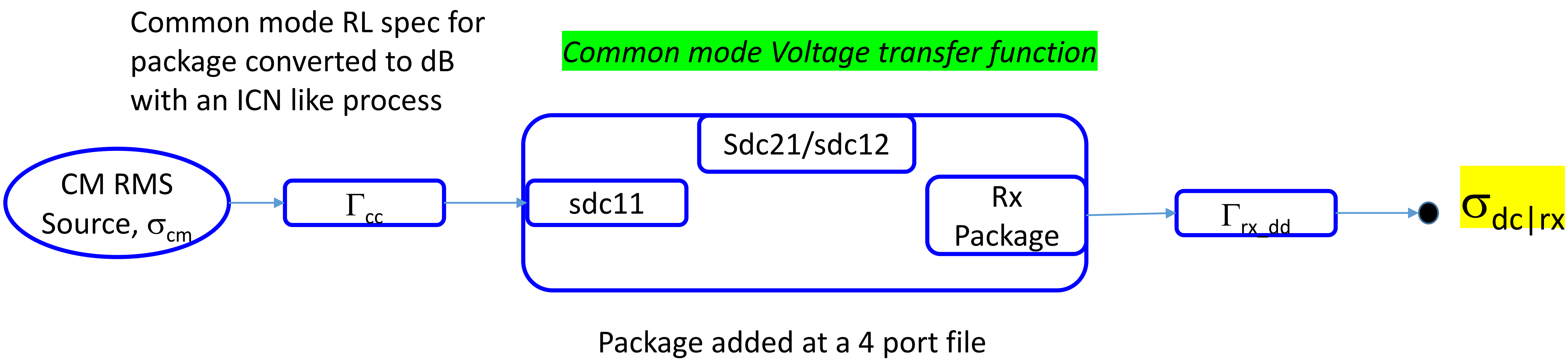
Details or Estimate for AC CM voltage at Rx

- AC CM VTF (voltage transfer function)
  - $$H_{21}^{dc}(f) = \frac{sdc_{21}(f)\,(1-\Gamma_{dd_{tx}})(1+\Gamma_{cc_{rx}})}{1-sdc_{11}(f)\Gamma_{cc_{tx}}-sdc_{22}(f)\Gamma_{dd_{rx}}-\Gamma_{cc_{tx}}\Gamma_{dd}\Delta S_{cm}(f)}$$

$$\Delta S_{cm}(f) = sdc_{11}(f)sdc_{22}(f) - sdc_{12}(f)sdc_{21}(f)$$

- AC CM voltage estimate
  - $$\sigma_{dc|rx} = \sqrt{2\,\sigma_{cm}{}^{2} \int H_{21}^{dc}(f)^{2} W(f)\,df}$$
  - $W(f)$ is the spectral power weight function used for ICN

Estimate of common mode voltage translated to differential voltage at the Rx



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

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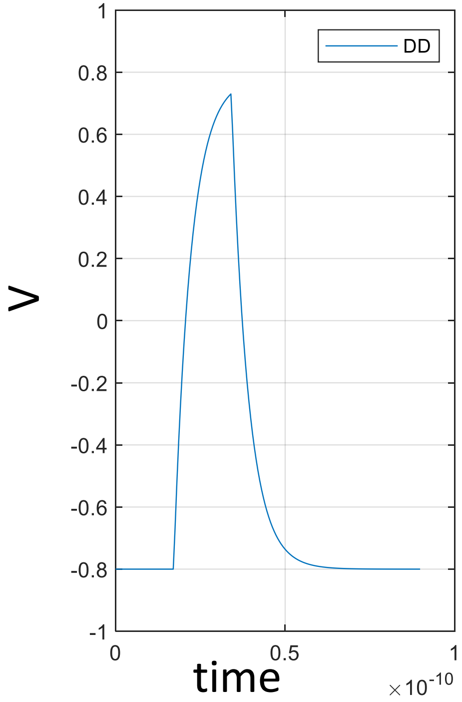
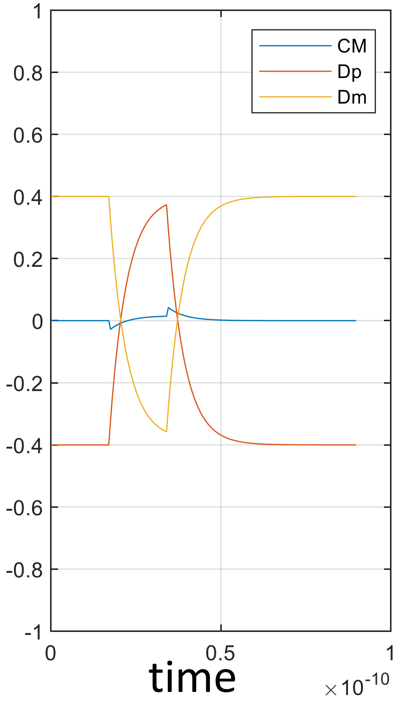
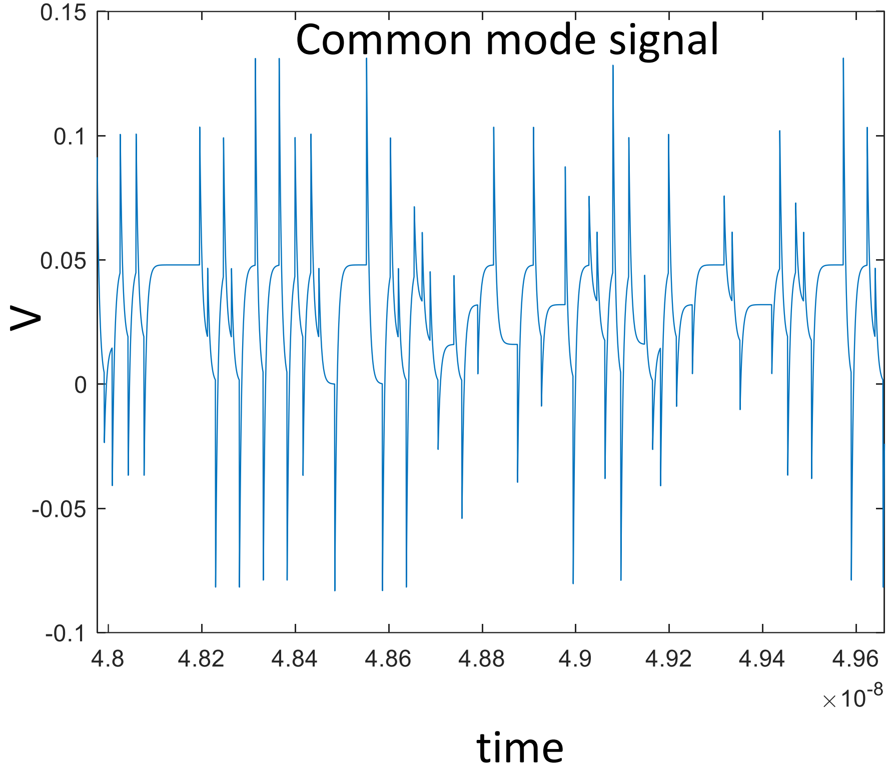
Assumption is an average common mode return loss at tp0 of 15 dB

What might a common signal look like at tp0

- ❑ Intrapair Voltage Imbalance
- ❑ Intrapair Skew
- ❑ CM crosstalk







Should spec be an RMS and crest factor?

What to do about CM

- ❑ OPTION 1 include in COM, no need for channel CM spec's
  - See backup
- ❑ OPTION 2 drastically reduce a AC CM voltage to a few mV
- ❑ Call for action. What does a AC CM really look like
- ❑ Once we determine how much AC CM is allowed then next step is address the CM RL specifications

Extra Backup data

How would we could put in COM (93A)

- Add equation $\sigma_{DC}{}^2 = 2\,\sigma_{cm}{}^2 \int H_{21}^{dc}(f)^2 W(f)df$
- Modify
  - Equation 93A-36 $FOM = 10 * log10\left(\frac{A_s^2}{\sigma_{TX}^2+\sigma_{ISI}^2+\sigma_j^2+\sigma_{XT}^2+\sigma_N^2+\sigma_{DC}^2}\right)$
  - Add term, $\sigma_{cm}{}^2$ to Equation 93A-41
- Add convolution term $P_{dd\_cm}(y)$ to equation 93A-43
  - Where P_{dd_cm} is computed from the procedure in 93A.1.7.1