Common Mode: Fact or Fiction

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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

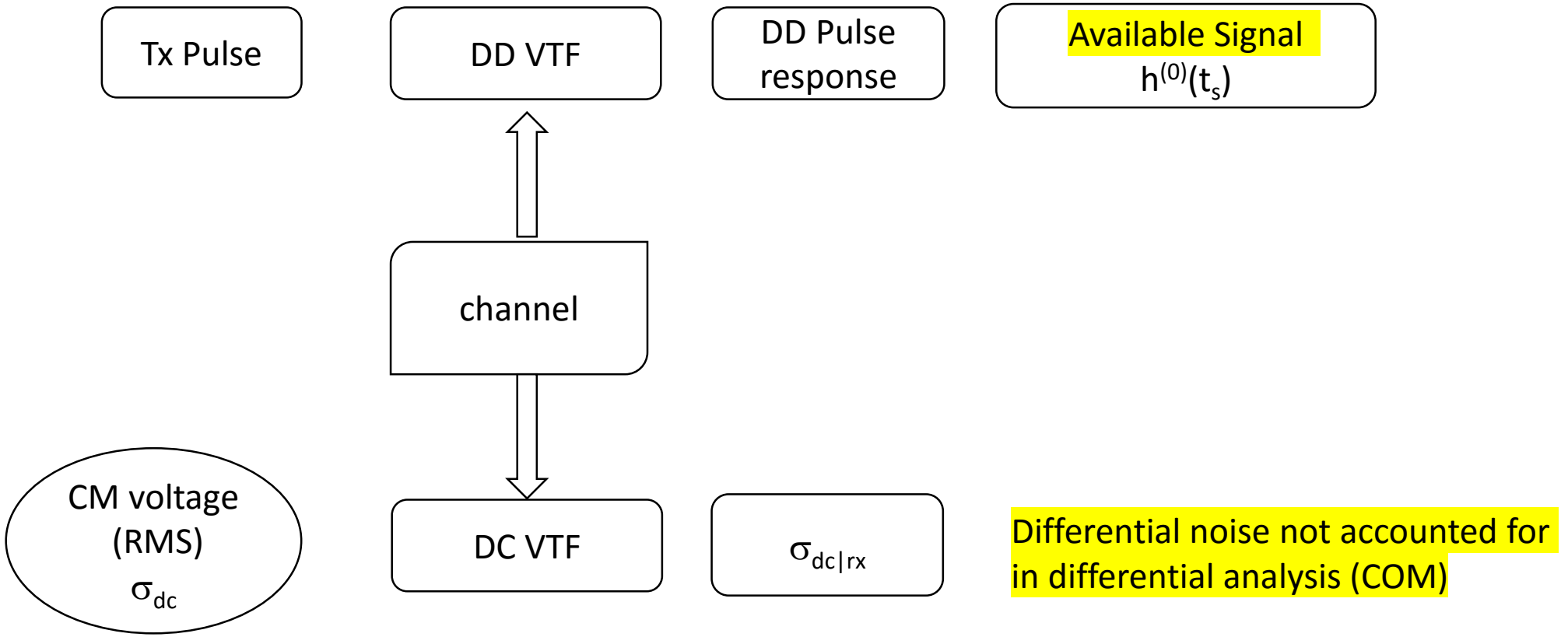
SNR_Tx Receiver Referred CM Noise

- 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



Details or Estimate for AC CM voltage at Rx

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

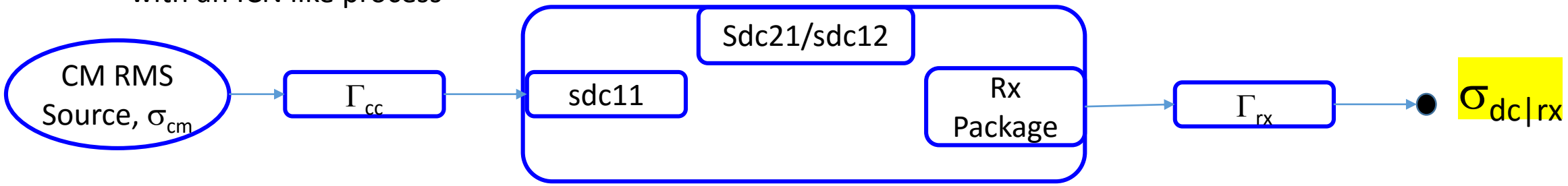
$$\Delta S_{cm}(f) = sdc_{11}(f)sdc_{22}(f) - sdc_{12}(f)sdc_{21}(f)$$

- 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

Common mode RL spec for package converted to dB with an ICN like process

Common mode Voltage transfer function



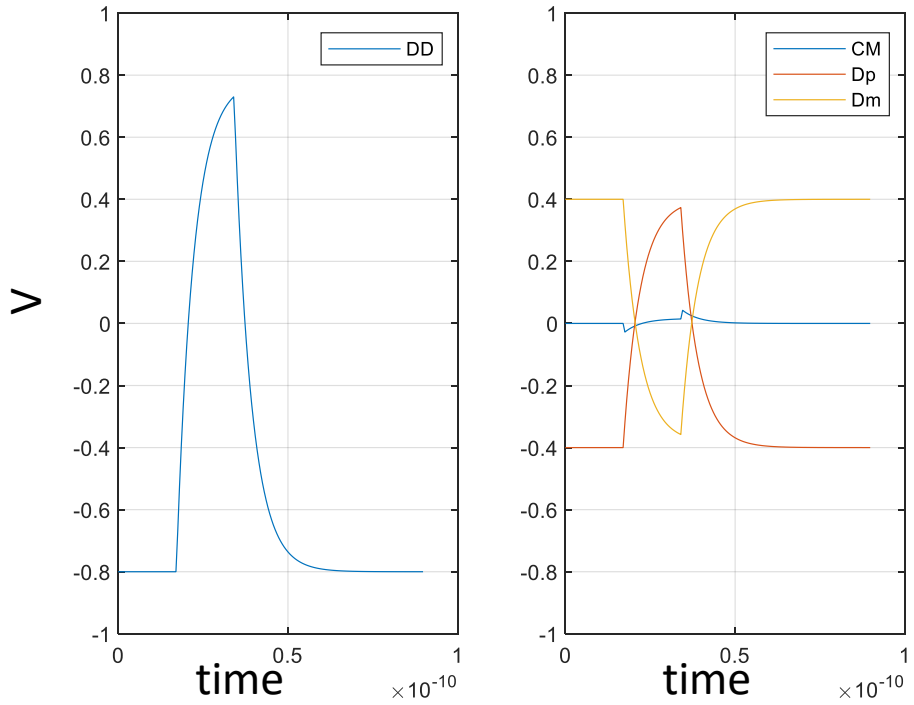
Package added at a 4 port file

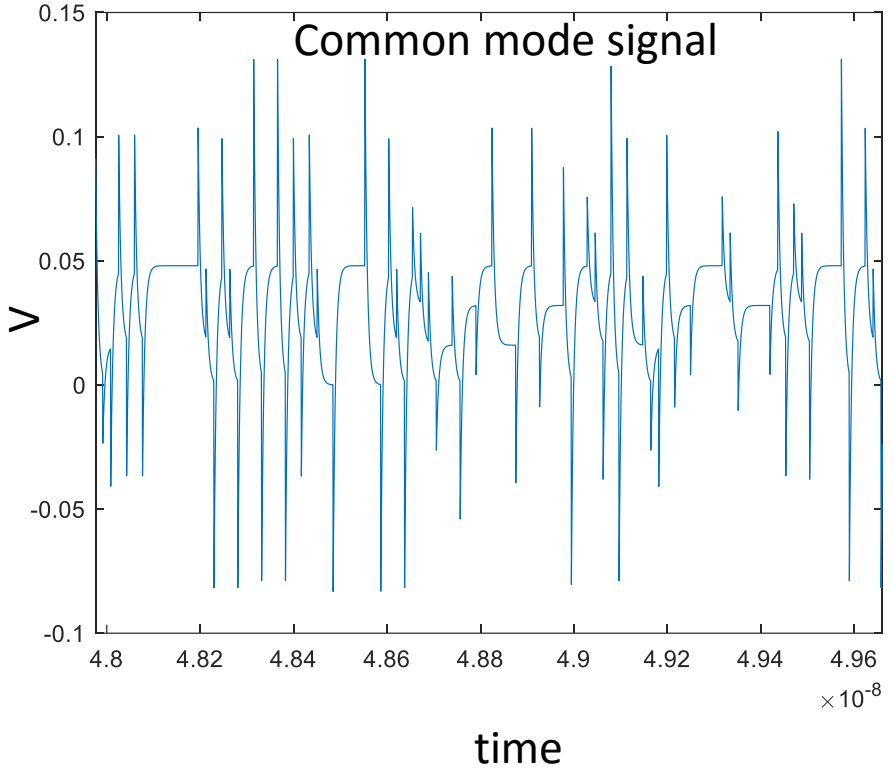
Gauging Study: Results with a Source of 30 mV, 10 mV, and 1 mV of AC CM

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	32.1	32.5	32.5
Kateri/Bch2_b6_7_t	32.5	32.0	32.4	32.5
Kateri/CAch2_a2p5_t	32.5	30.7	32.3	32.5
Heck/.Cable_BKP_28dB_0p575m_more_isi_thru1	32.5	31.6	32.4	32.5
Mellitz/Via_Opt2_28dB_THRU	32.5	32.5	32.5	32.5
Zambell/Thru_Link_9_C1_Pr_14_to_Pr_5	32.5	31.8	32.4	32.5
Gore/C2C_PCB_SYSVIA_20dB_thru	32.5	31.5	32.4	32.5
Palkert/THRU_VL5_OD-BP-Channel_16inch_16inch	32.5	26.4	31.2	32.5
Rabinovich/Channel_Thru_P1_to_P2_01.s4p	32.5	30.7	32.3	32.4

What might a common signal look like

- ❑ 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