Common Mode Comment Support

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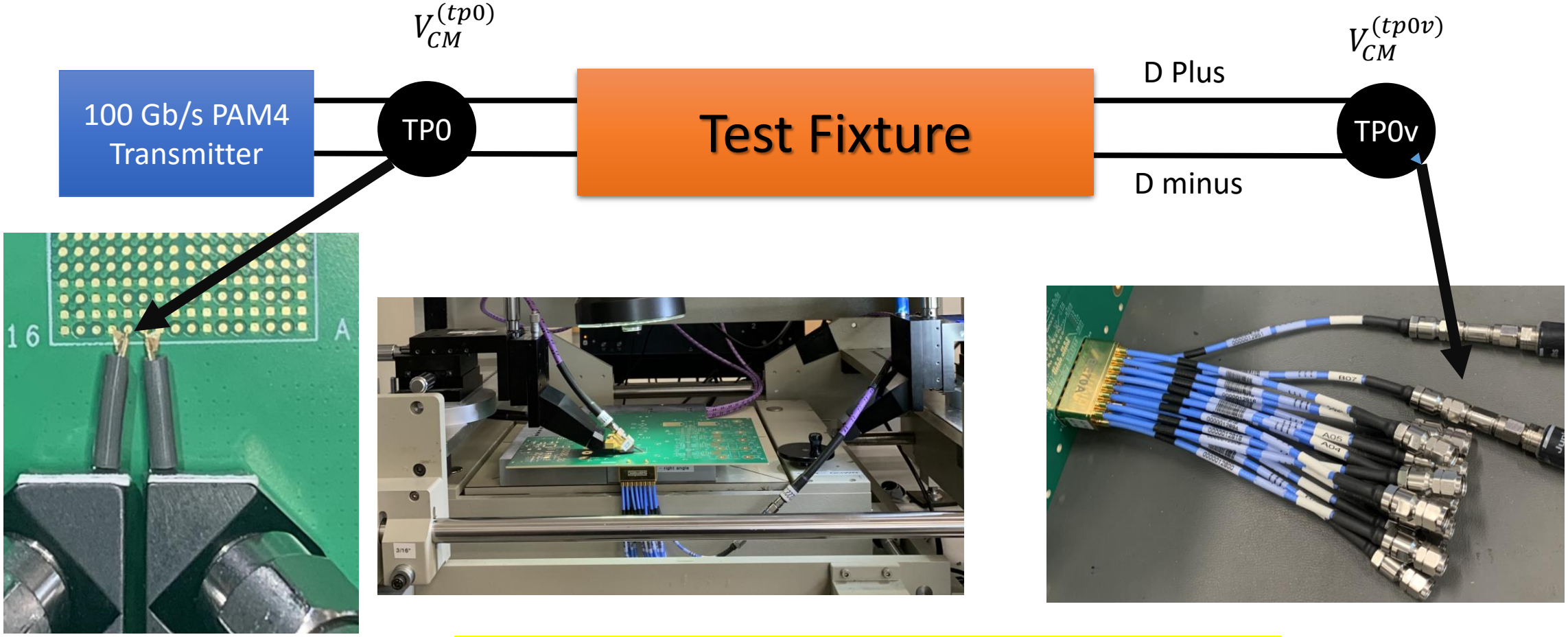
CL 163 and Annex 120F transmitter test setup example

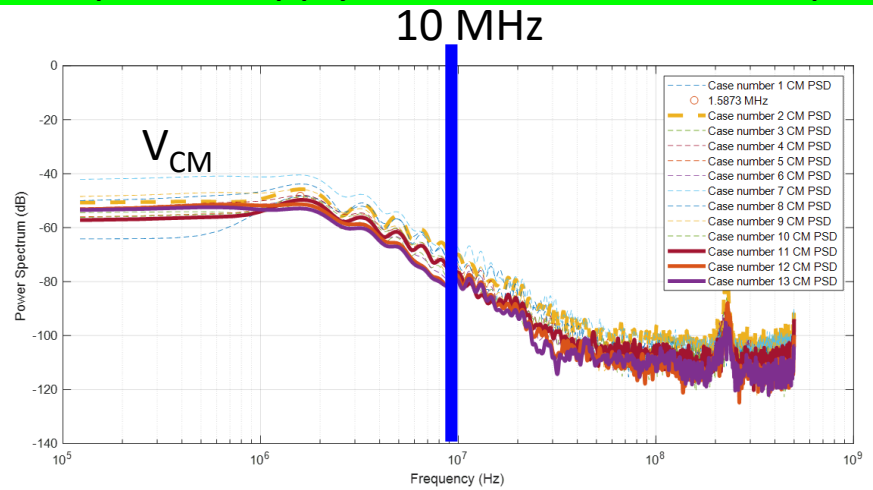


At some low enough frequency the common mode voltage at TP0 and TP0v are approximately the same.

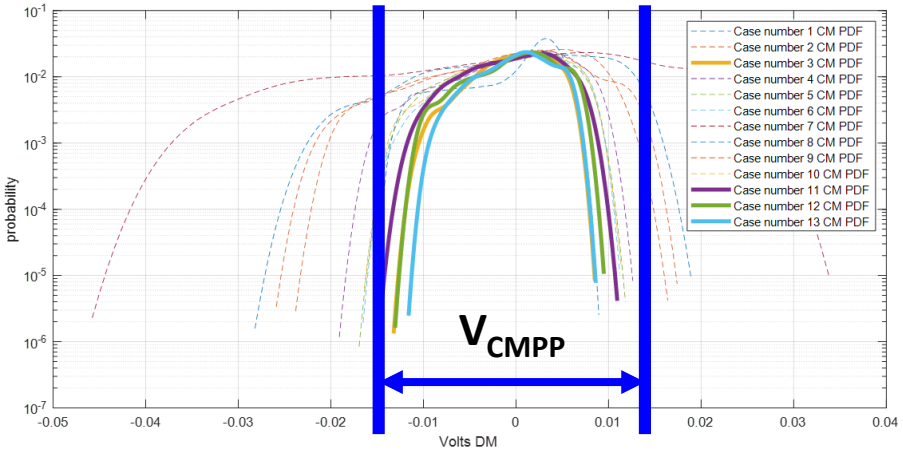
Low Frequency CM noise is not fixture dependent

- Given:
  - $V_{CM}^{(tp0)} \cong V_{CM}^{(tp0v)}$
- The TP0v CM specifications is:
  - $SCMR = 20\ log_{10}\left(\frac{p_{max}}{V_{CMPP}}\right)$
  - The parameter p_{max} is intended to adjust for high frequency fixture loss and **not relevant for low frequency signals**
- **Recommend: Use V_{CMPP} only for a low frequency CM specifications.**

Example of power supply common mode noise spectrum

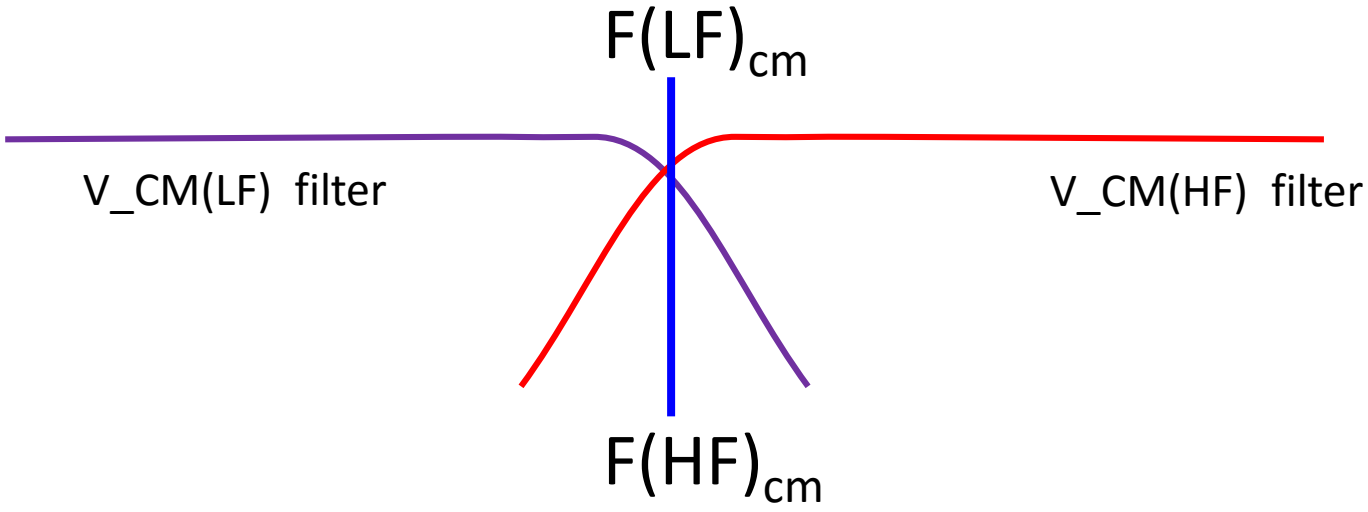


Example of power supply common mode noise histogram



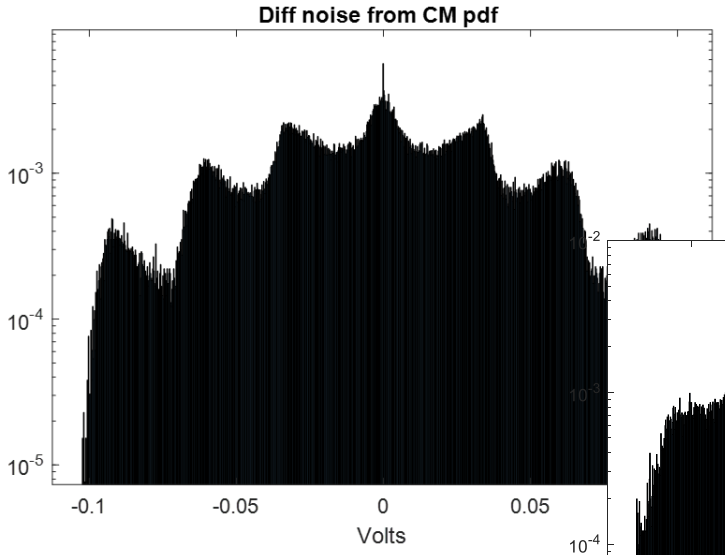
Proposal 1: Separate CM voltage specification by frequency

- V_CM(LF) is V_CM filtered by a low pass 4th order Bessel Thomson filter with 3 dB point a $f(LF)_{cm}$
- V_CM(HF) is V_CM filtered by a high pass 4th order Bessel Thomson filter with 3 dB point a $f(HF)_{cm}$
- OPTION 1
  - $F(LF)_{cm}$=$F(LF)_{cm}$=10 MHz
- OPTION 2
  - $F(LF)_{cm}$=$F(LF)_{cm}$=100 MHz
- Recommend option 1

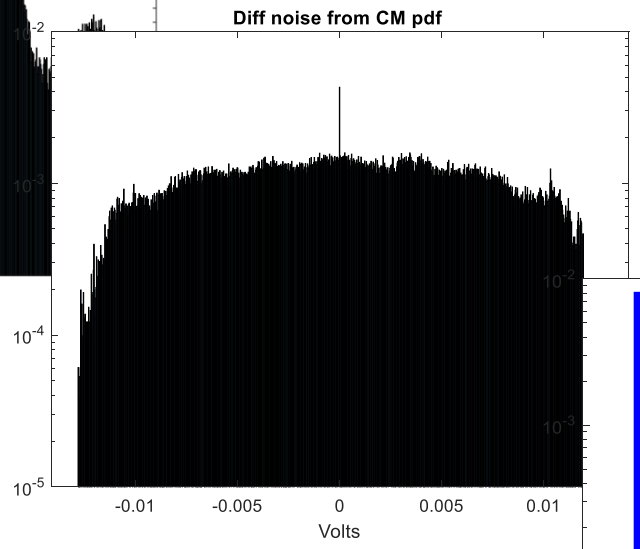


High Frequency CM noise is fixture dependent and can have wide variety of distributions

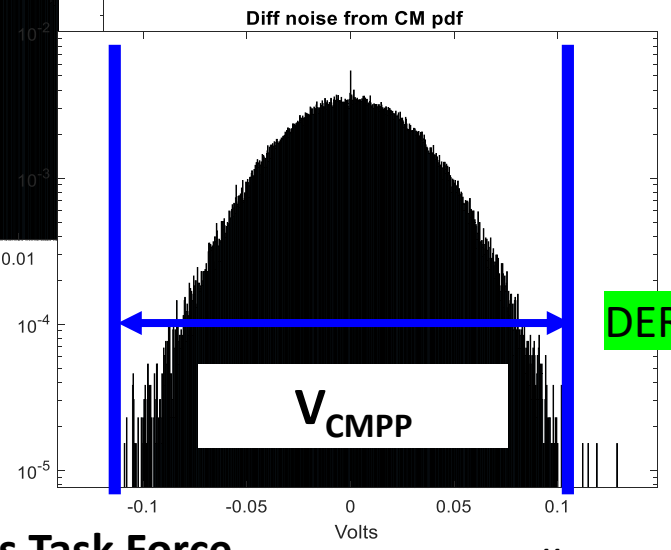
5 ps Skew



10 % imbalance



CM AWGN



Peak to peak (p-p) seems more relevant than RMS

DER_0

- Extremes of CM possibilities
- Illustration of a peak to peak parameter

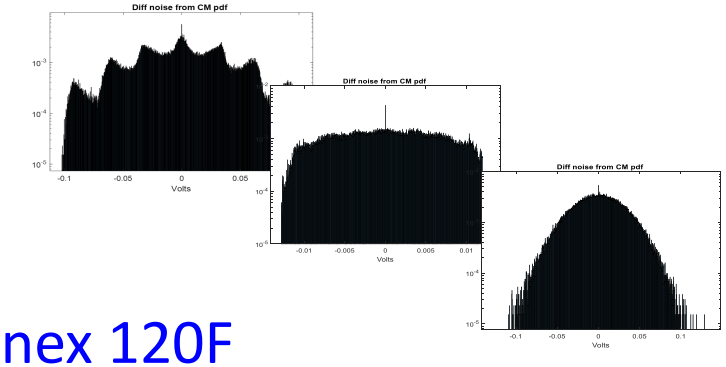
High Frequency common mode calculations

- SCMR(min) for 11.8 dB (table 163-5) and 10.7 dB (table 120F-1)
- Since low frequency common mode is accounted for elsewhere use 15 mV RMS at a baseline at TP0.
- COM Reference Package data
  - Package 1: 12 mm p_{max}=275 mV
  - Package 2: 31 mm p_{max}=213 mV
- Option 1: AWGN assumption
  - SCMR(min)= 20*log10(p_{max}/(15*2*qfunctinv(1e-4)) = 11.8 dB (table 163-5)
  - SCMR(min)= 20*log10(p_{max}/(15*2*qfunctinv(1e-5)) = 10.7 dB (table 120F-1)
- Option 2: sine wave assumption
  - SCMR(min)= db(p_{max}/(15*2*sqrt(2))) = 14.7 dB (both tables)
- Recommend option 1

Proposal 2: for CL 163 and Annex 120F

- Separate CM with filtering
  - V_CM(LF) is V_CM filtered by a low pass 4th order Bessel Thomson filter with 3 dB point a 10 MHz
  - V_CM(HF) is V_CM filtered by a high pass 4th order Bessel Thomson filter with 3 dB point a 10 MHz
- V_{CMPP} (max) → 30 mV (new line in tables)
  - Used for low frequency
- SCMR(min) → 11.8 dB (table 163-5) and 10.7 dB (table 120F-1)
  - Used for high frequency

CM for CL 162 and Annex 120G



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- RMS does not seem to be as comprehensive as a peak to peak specification like V_{CMPP}
  - Aligning measurement method with Clause 163 and Annex 120F
- Option 1: AWGN assumption
  - V_{CMPP} = 30*2*qfunctinv(1e-4) = 233 mV (table 162-10)
  - V_{CMPP} = 25*2*qfunctinv(1e-5) = 213 mV (table 120G-1 and table 120G-3)
- Option 2: sine wave assumption
  - V_{CMPP} = 30*2*sqrt(2)= 70.7 mV (table 162-10)
  - V_{CMPP} = 25*2*sqrt(2)= 84.5 mV (table 120G-1 and table 120G-3)
- Recommend option 1

Proposal 3: replace CMS RMS with V_{CMPP}

- V_{CMPP} = 233 mV (table 162-10)
- V_{CMPP} = 213 mV (table 120G-1 and table 120G-3)

Thank You!