PoDL Noise Limit

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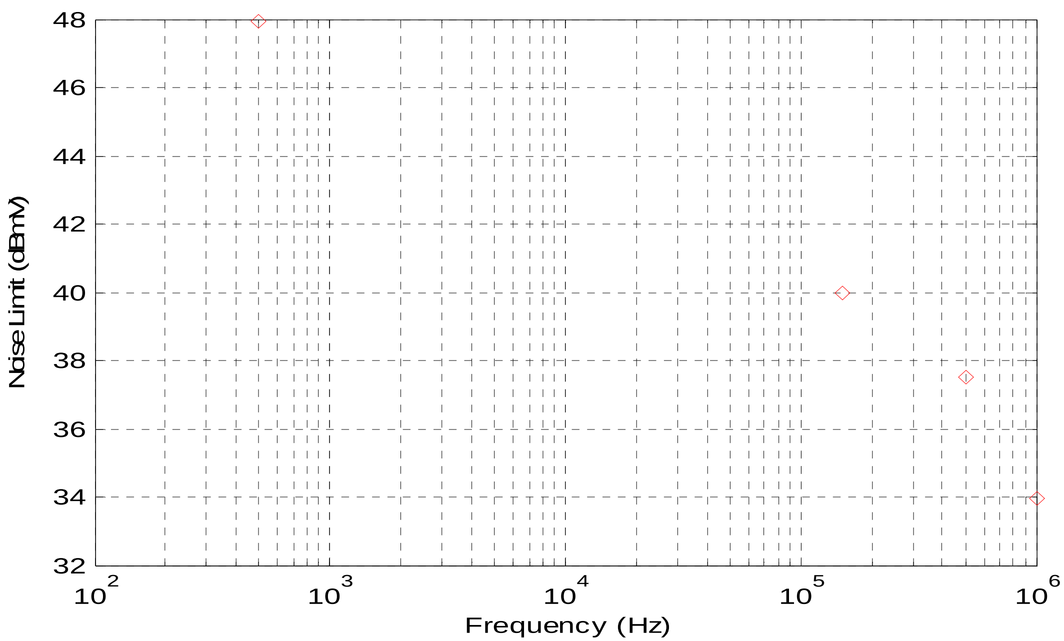
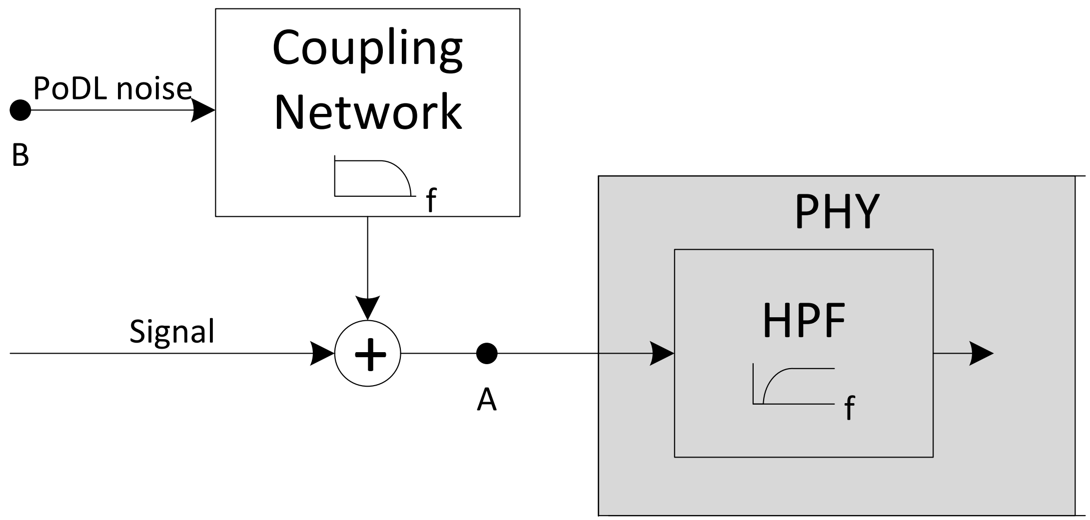
Preliminaries

- PoDL noise level below 1MHz according to Clause 33 and as shown below with assumption PAR =1.
- Coupling network may be able to provide up to 30dB attenuation at 1MHz but implementation margin is desirable.
- Without a HPF at the receiver, the PoDL noise will be large and cause significant performance degradation.



Approach To Finding PoDL Noise Limit



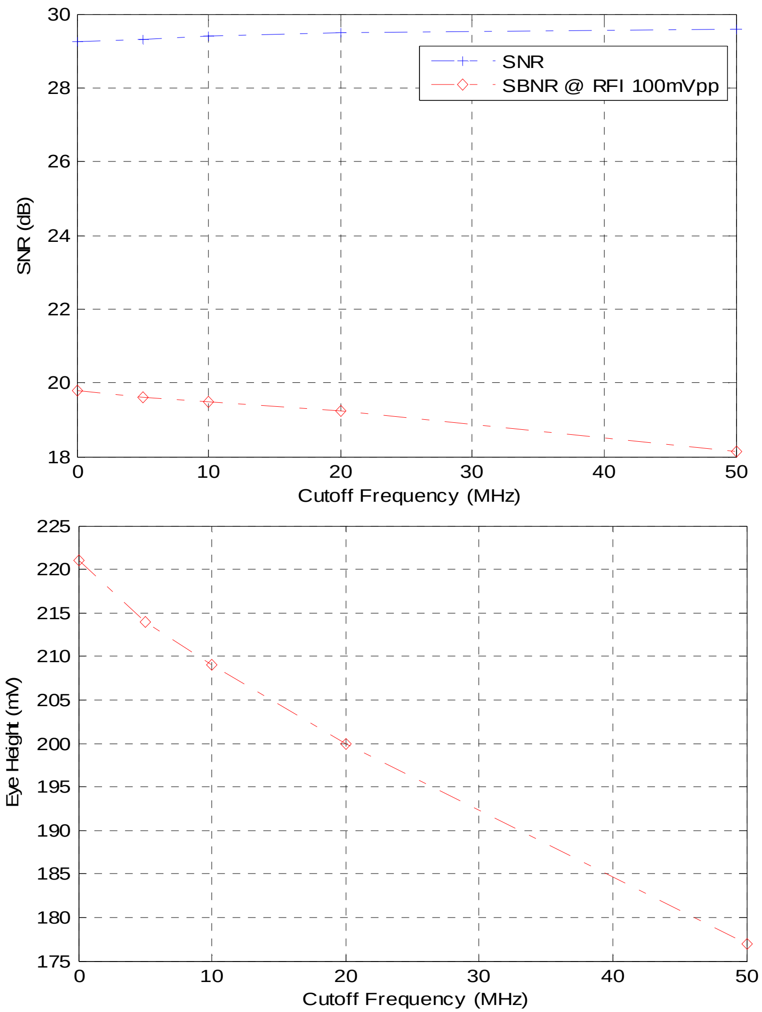
- To find the PoDL noise limit at the input of coupling network, i.e., point B as in Clause 33, three steps will be taken:
    1. Find the appropriate cutoff frequency of HPF.
    2. Find the single-tone limit line at point A assuming maximal 1 dB loss of SBNR and the found cutoff frequency of HPF.
    3. Find the multi-band envelope limit for point B using the single-tone limit line and a baseline coupling network model.

Effects of HPF

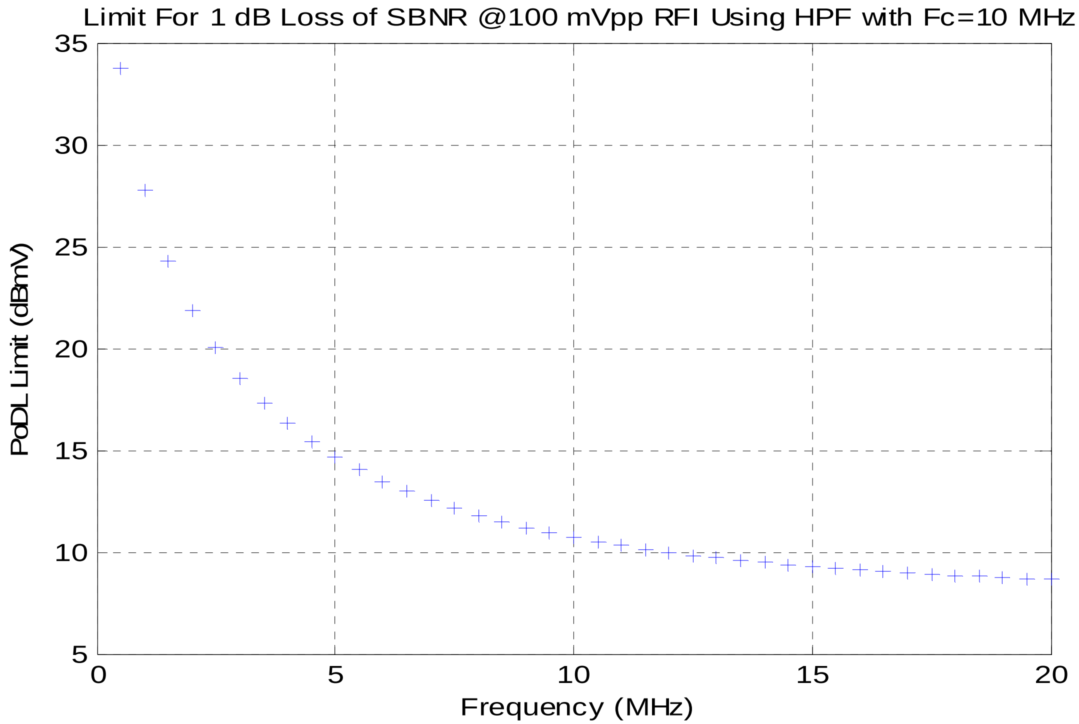
- HPF reduces eye opening and immunity to RFI.
- Reduction of eye opening and SNR due to HPF is more significant for longer channels.
- HPF reduces transient noise amplitude [Chini_Tazebay_3bp_01a_0114.pdf].

HPF Cutoff Frequency vs Performance of Ideal DFE

- 15m channel at room temperature.
- PAM3 with TX PSD -80.5dBm/Hz @ DC.
- 32.8 dB SQNR.
- First-order Butterworth filter.
- Cutoff frequency =0 indicates no HPF.
- Eye opening decreases roughly linearly with cutoff frequency.
- Fc=10MHz seems to be a reasonable choice.
  - Raw eye height decreases by about 5% and SBNR @100mVpp RFI by 0.3dB.
  - It provides 20 dB attenuation at 1MHz.



Single-Tone Noise Limit



- Above limit assumes maximal 1dB loss of SBNR @ 100 mVpp RFI due to single-tone noise and use of HPF with fc=10MHz.

Multi-Band Envelop Limit

- The limit line assuming single-tone disturbance Ls(f) needs to be translated into envelope limits defined in frequency bands as in Clause 33.
- Assume a baseline coupling network with cutoff frequency at 100 kHz, i.e., N(f)=1/(1+jf/100e3).
- Define the envelop limit of a frequency band as the minimum of 20*log10[Ls(f)/N(f)]-10 with f in the band of concern and subtraction of 10 due to 5 frequency regions and a 3 dB margin. The actual margin is larger since the minimum is taken in the region and PAR=1 is assumed.

Frequency (Hz)	Clause 33 Limit mVpp	Calculated Limit mVpp
<500	500	30702
500 to 150 k	200	184
150k to 500 k	150	156
500k to 1 M	100	155
1M to 10M	n/a	155

Proposed Extension to Claus 33

- If the assumed baseline coupling network is feasible, i.e., magnitude response when f>500 Hz is below that of a first-order lowpass filter with fc=100 kHz, add a frequency region from 1 to 10MHz with limit 100 mVpp.

Frequency (Hz)	Proposed Limit (mVpp)
<500	500
500 to 150 k	200
150 k to 500 k	150
500 k to 1 M	100
1M to 10 M	100

Discussion & Conclusions

- A first-order HPF with cutoff frequency at 10MHz achieves a good tradeoff between PoDL noise and immunity to RFI.
- If the coupling network can provide more than 20 dB attenuation at 1MHz, it is proposed to extend clause 33 by using the same limit of the region from 0.5 to 1 MHz for frequency beyond 1 MHz.
- Otherwise, the single-tone limit line at the input of PHY can be used to derive PoDL noise limit.