Power-over-Coax Related High Pass Filter Parameters for IEEE 802.3dm

Sujan Pandey

Velinktech

Minneapolis, September 15, 2025

Supporters

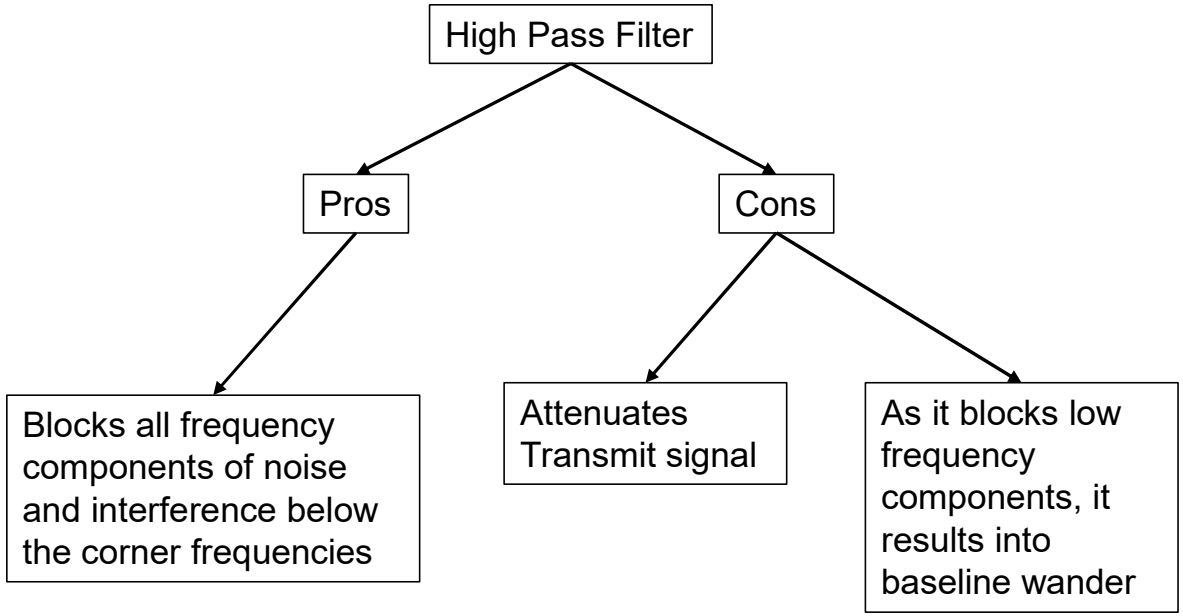
- Thomas Hogenmueller, Bosch
- Heiko Strohmeier, Bosch
- Alireza Razavi, Infineon

Motivation

- Earlier contributions [1,2] have expressed some concerns on feasibility of using smaller size PoC inductors 1uH [1] and 0,68uH [2] for ACT based PHYs
- ACT based downstream receiver complexity is explored in [3,4] and the analysis used 10MHz and 45MHz corner frequencies respectively for the high pass filter (HPF) related to PoC
- Many discussions [1,2,3,4] were around different corner frequencies of high pass filter related to PoC that ranges from 8MHz to 45MHz
- IEEE 802.3 spec neither specify HPF filter parameter nor the value of PoC inductor. It rather gives the guidelines
- The contribution explores trade-off between PoC values and SNR degradation

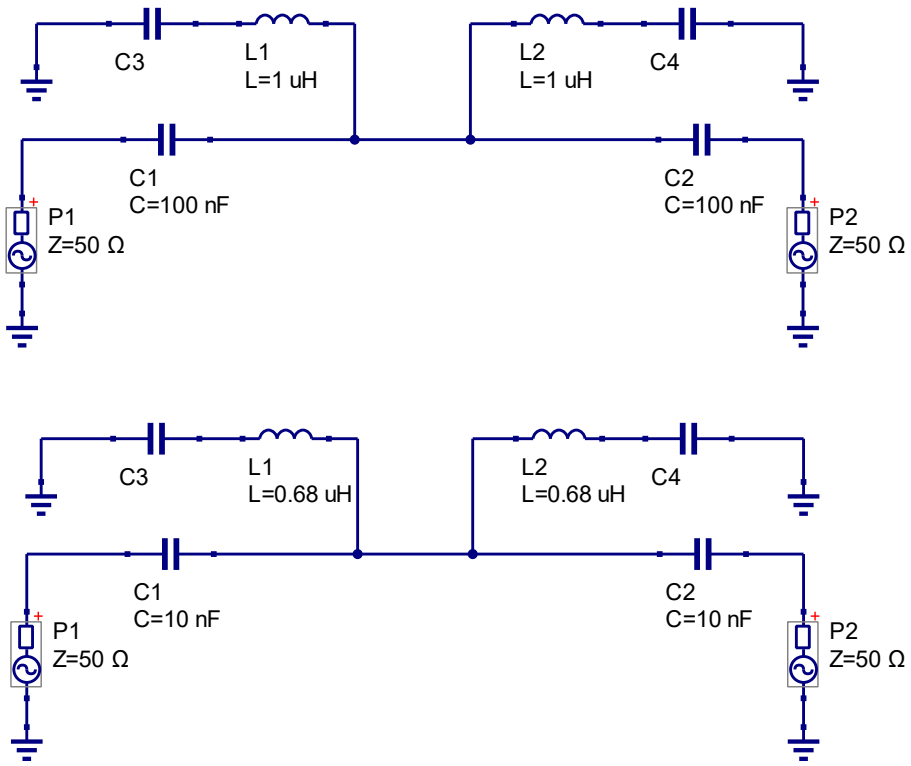
High Pass Filter

- Since most of the signal power of Differential Manchester Encoding (DME) is concentrated around fundamental frequency, the effect of received signal attenuation and baseline wander effects will be less compared to baseband signal starts from close to DC



PoC Filter Parameters

- PoC inductor value with 1uH gives ~8MHz corner frequency of high pass filter
- PoC inductor value with 0.68uH gives ~12MHz corner frequency of high pass filter
- To have 45MHz high pass filter corner frequency we need about 175nH PoC inductor
- Is there a practical use case for 175nH PoC inductor?



Maximum Output Droop

- If we were to adopt IEEE 802.3ch output droop [5]

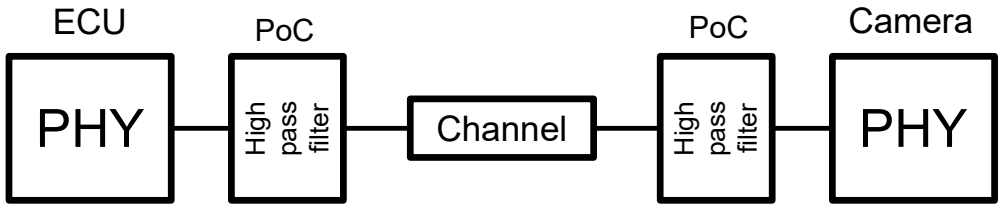
149.5.2.1 Maximum output droop

With the transmitter in test mode 6 and using the transmitter test fixture 1 shown in Figure 149–35, the magnitude of both the positive and negative droop shall be less than 15%, measured with respect to an initial value at 4 ns after the zero crossing and a final value at 16 ns after the zero crossing (12 ns period).

- PoC inductor value shall be > 3.7uH to maintain output droop of .3ch
- To enable PoC inductor with value 1uH or less, output droop specification must be changed
  - Ultimately, this means pushing high pass filter corner frequency further away from what is agreed for IEEE 802.3ch

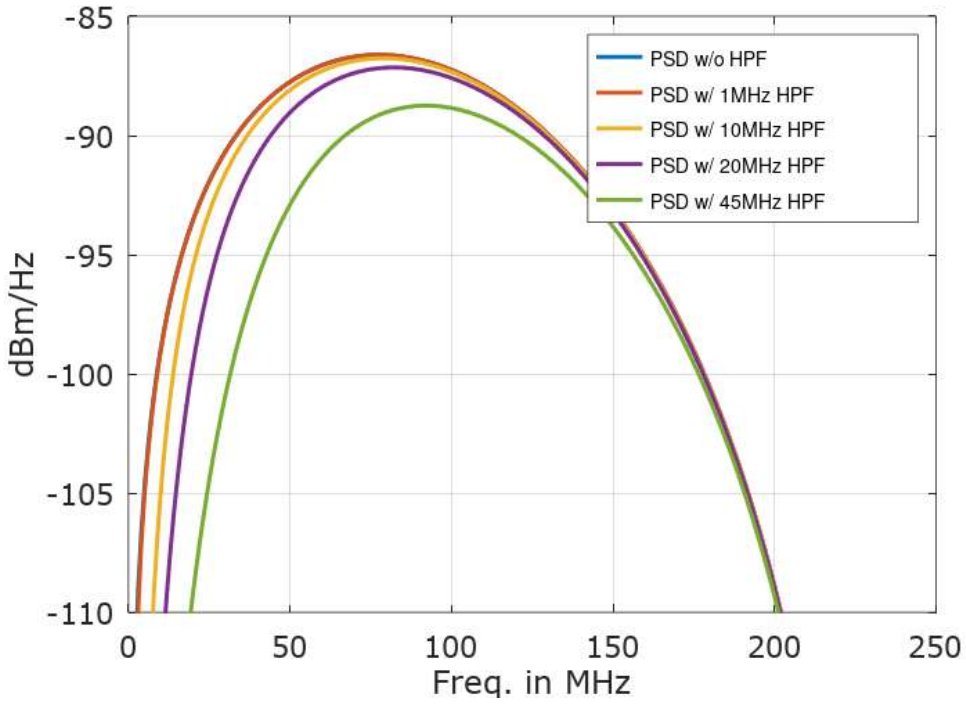
High Pass Filter Effects

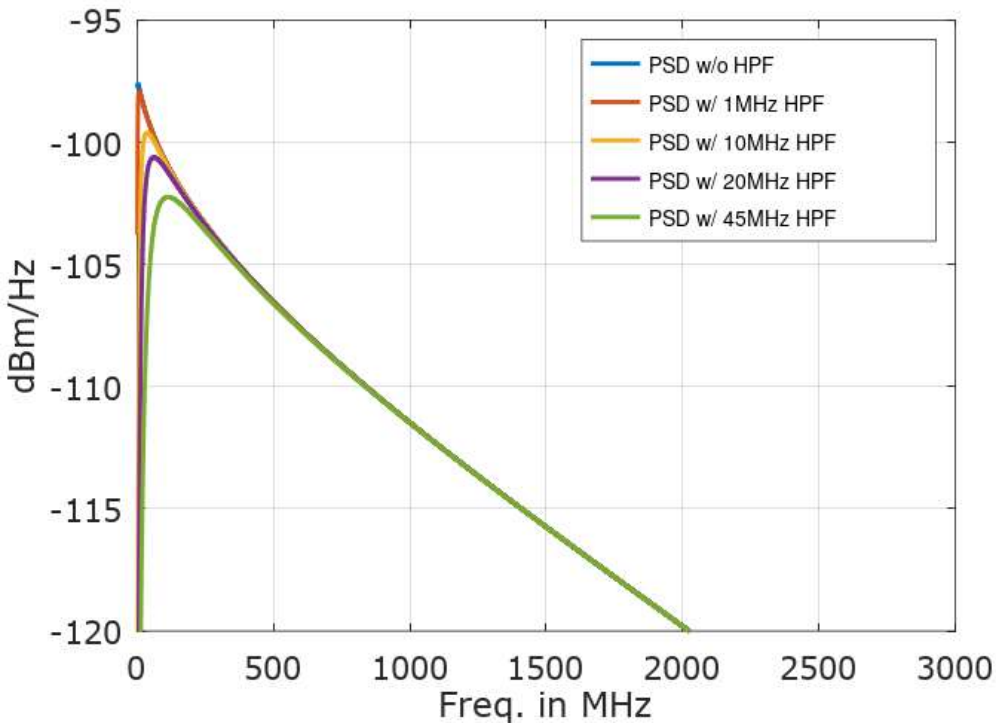
- Downstream transmitter
  - PSD is spread over a wide band
  - Small portion of TX signal gets attenuate at PoC filter
  - Big loss of TX signal will be on channel
- Upstream transmitter
  - PSD is spread over a narrow band
  - Relatively big portion of TX signal gets attenuate at PoC filter
  - Very small loss of signal on the channel



High Pass Filter Effects

- Upstream and Downstream transmitted PSDs





High Pass Filter Effects on SNR

	Inductor value	Upstream SNR Degradation	Downstream SNR Degradation
No PoC	None	0 dB	0 dB
1 MHz	8uH	0 dB	0 dB
10 MHz	800nH	0.2 dB	0.3 dB
20 MHz	400nH	0.7 dB	0.7 dB
45 MHz	175nH	2.6 dB	1.4 dB

Conclusion

- IEEE 802.3 spec does not specify the value of PoC inductor
- Output droop gives a guideline for the minimum value of inductor for PoC
- Current IEEE 802.3ch output droop does not seem to meet the PoC inductor values that are being discussed within task force
- As a group we need to agree on a minimum PoC value that is practically feasible for automotive use cases
- SNR degradation perspective, having PoC inductor of ~500nH is equivalent to losing about 0.5dB SNR margin, which is can be handled, if it is needed
- Question: is there any killer application for smaller inductor value (<500nH)?

References

- [1] Power-Over-Coax Complexity and System Impact, Conrad Zerna.
- [2] Power over Coaxial Cable Optimization and Signaling Trade-off, Ahmad Chini and Mehmet Tazebay.
- [3] LDR Receiver in ACT Equalization and Echo Cancellation, Hossein Sedarat.
- [4] Uplink and Downlink PHYs Complexity Analysis Based on IEEE 802.ch Channel Parameters, Sujan Pandey.
- [5] Test Modes in ACT Downstream Direction, Hossein Sedarat.

Thank You!