IEEE 802.3da SPMD TF: Multidrop Low-Power Status Update

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Previously on “Multidrop Energy Saving”

- **September 2023 – Campinas**
  - Provides details of proposed wake-up signaling
  - Concerns in detection of 625kHz tone due to MPoE inductive loading
  - Do not specify “low power” – implementation dependent
    - Device can still conform even if it isn’t supported
  - Currently, this is really “turn off” / “turn on”
    - “Turn off” is an upper layer feature (out of scope)
    - Defining a mechanism to “turn on” the full segment

- **Today we look at the concerns of MPoE inductive loading and detection of 625 kHz signaling**

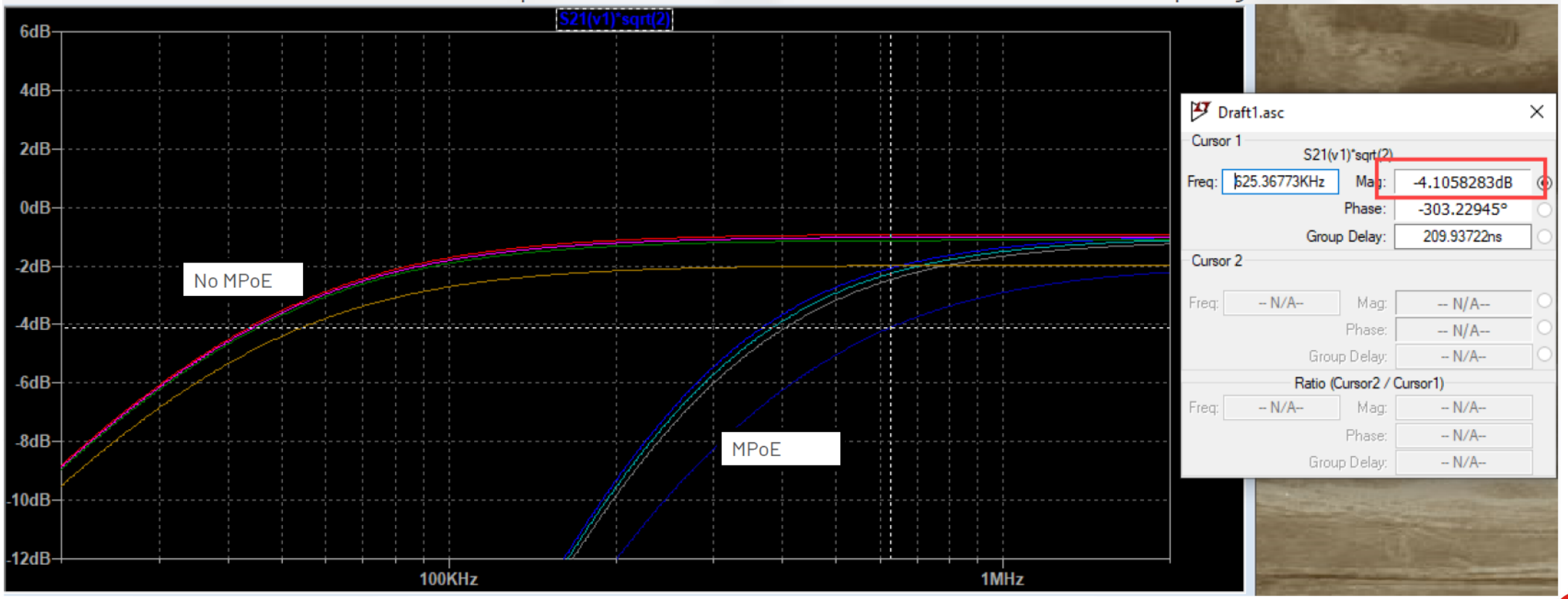
Why 625 kHz?

100nF coupling caps provide minimal attenuation above ~250kHz

As shown by Wojciech Koczwara – 08 Sept 2023 - Campinas

S21 (transmitter to right-hand terminator) – Zoom In

At 625kHz, around **4dB** loss can be expected (needs confirmation with real cable and topologies)



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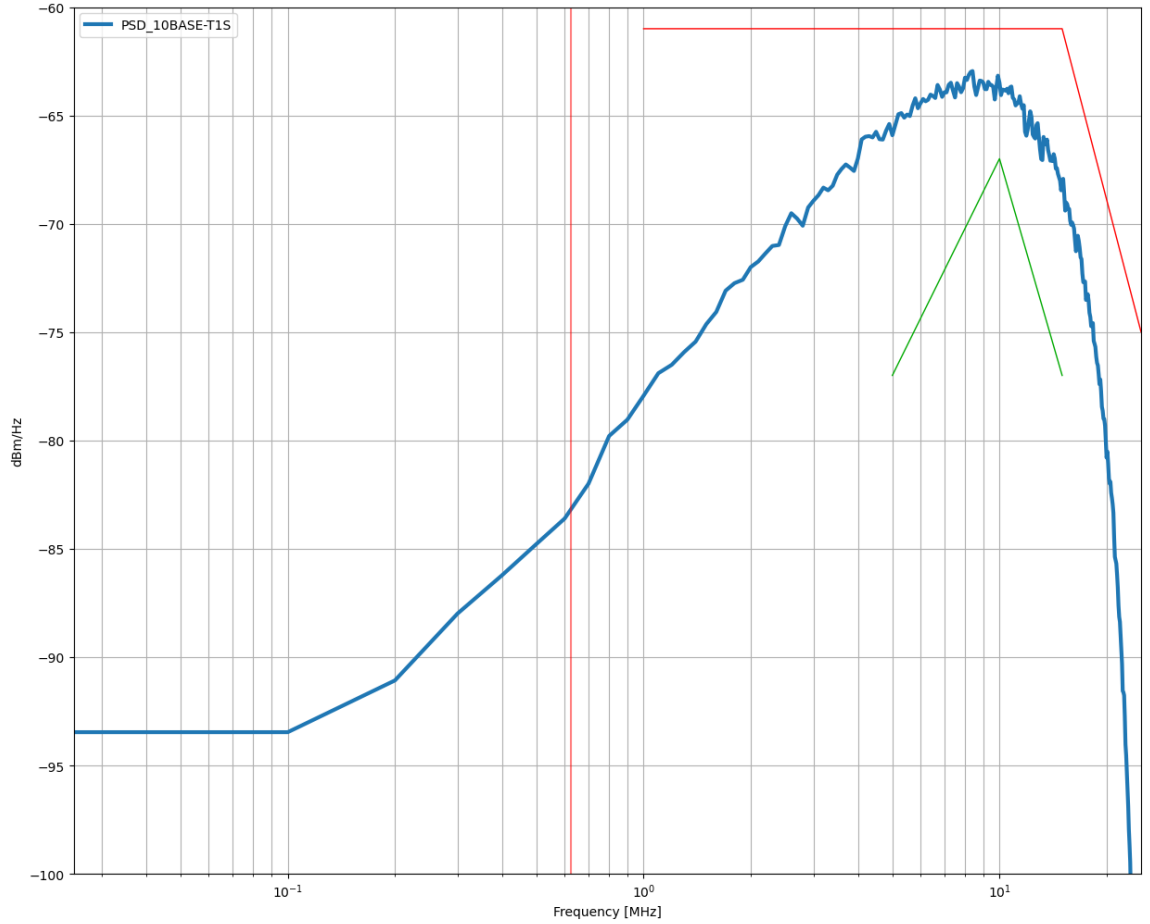
Why 625 kHz?

- **Below the DME data power spectrum**
  - Higher and we must contend with noise from data
  - Separation allows for filtering
- **Below immunity requirements**
  - Would have issues >1Mhz
- **Detectable using low-power analog methods**



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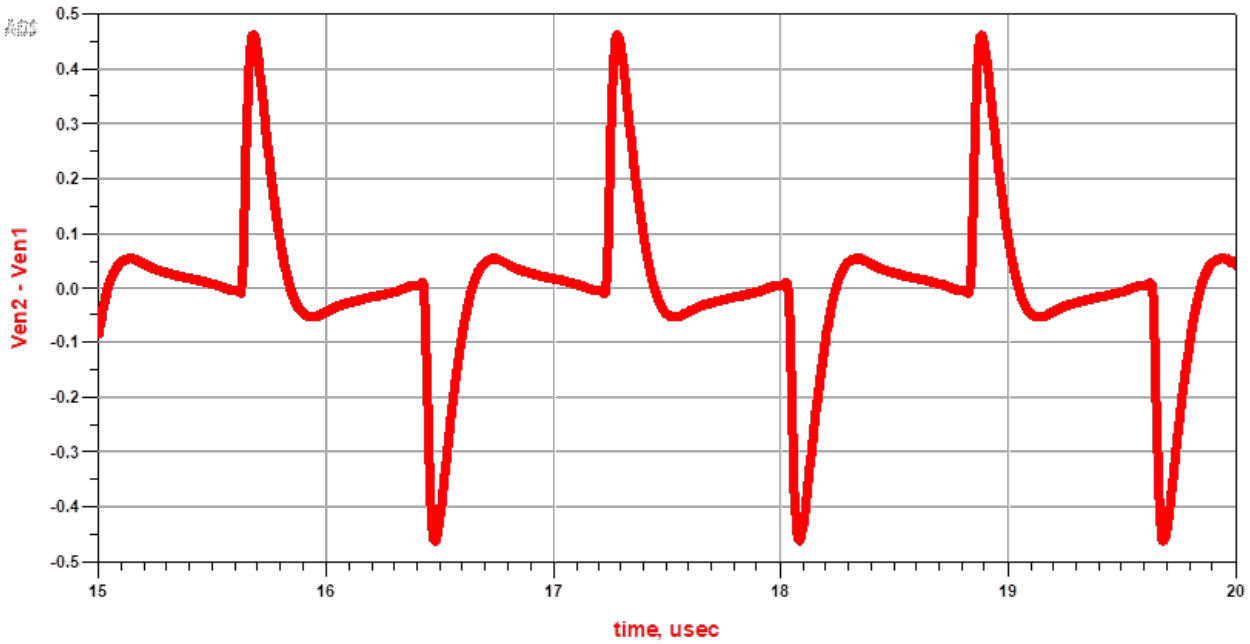
Effects of MPOE on 625kHz signaling

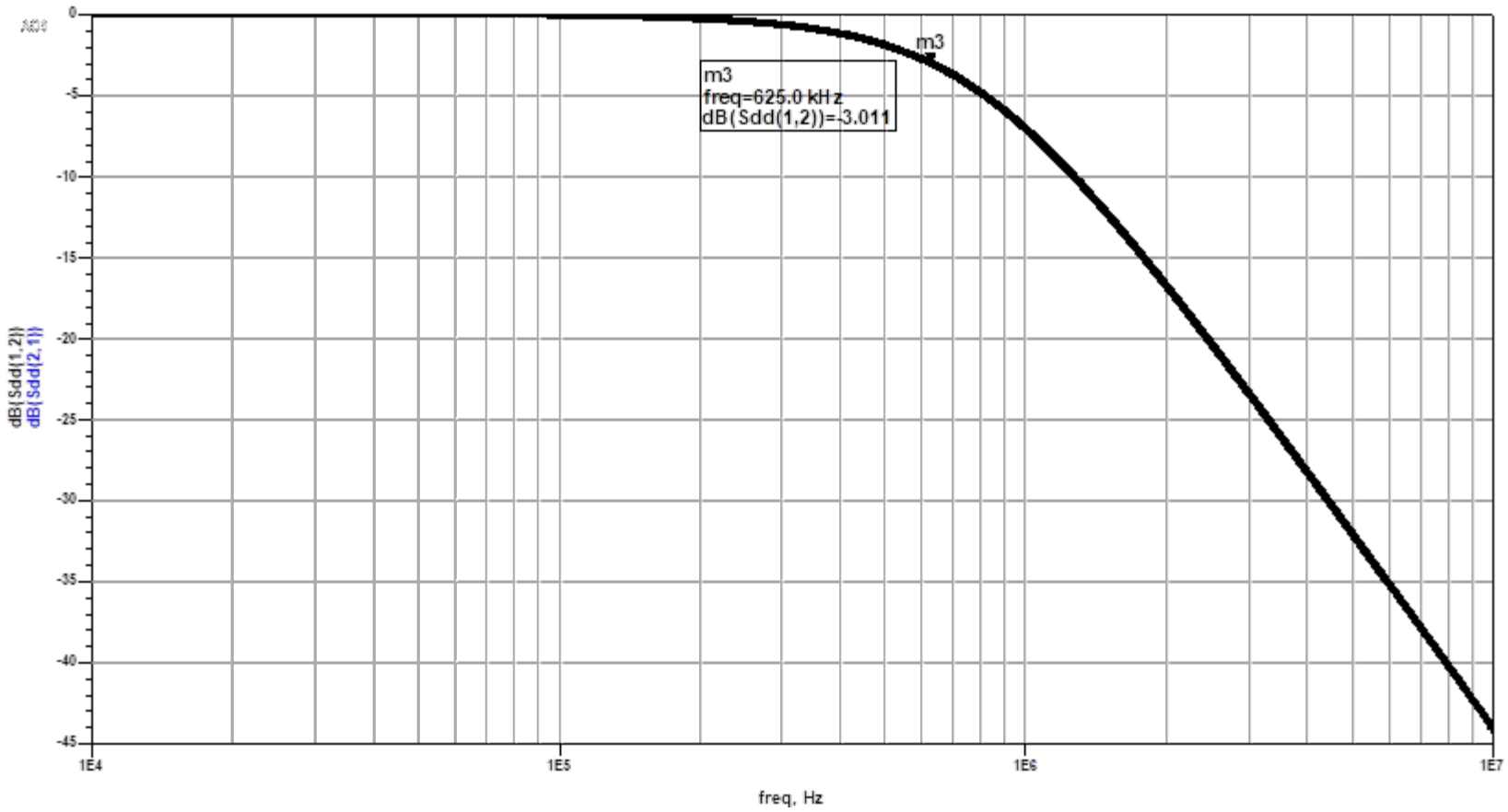
- **Inductance yields distortion of the received 625kHz square wave**
  - Our model results compare to those of M. Paul and W. Koczwara



- **But there is still energy at 625kHz**
  - Is it enough?

Model Implementation

- **Typical detectors would likely implement an input filter**
  - Second order low-pass, cutoff at 625kHz – filter out DME and noise
  - Creates a band-pass filter when combined with high-pass of 100nF caps



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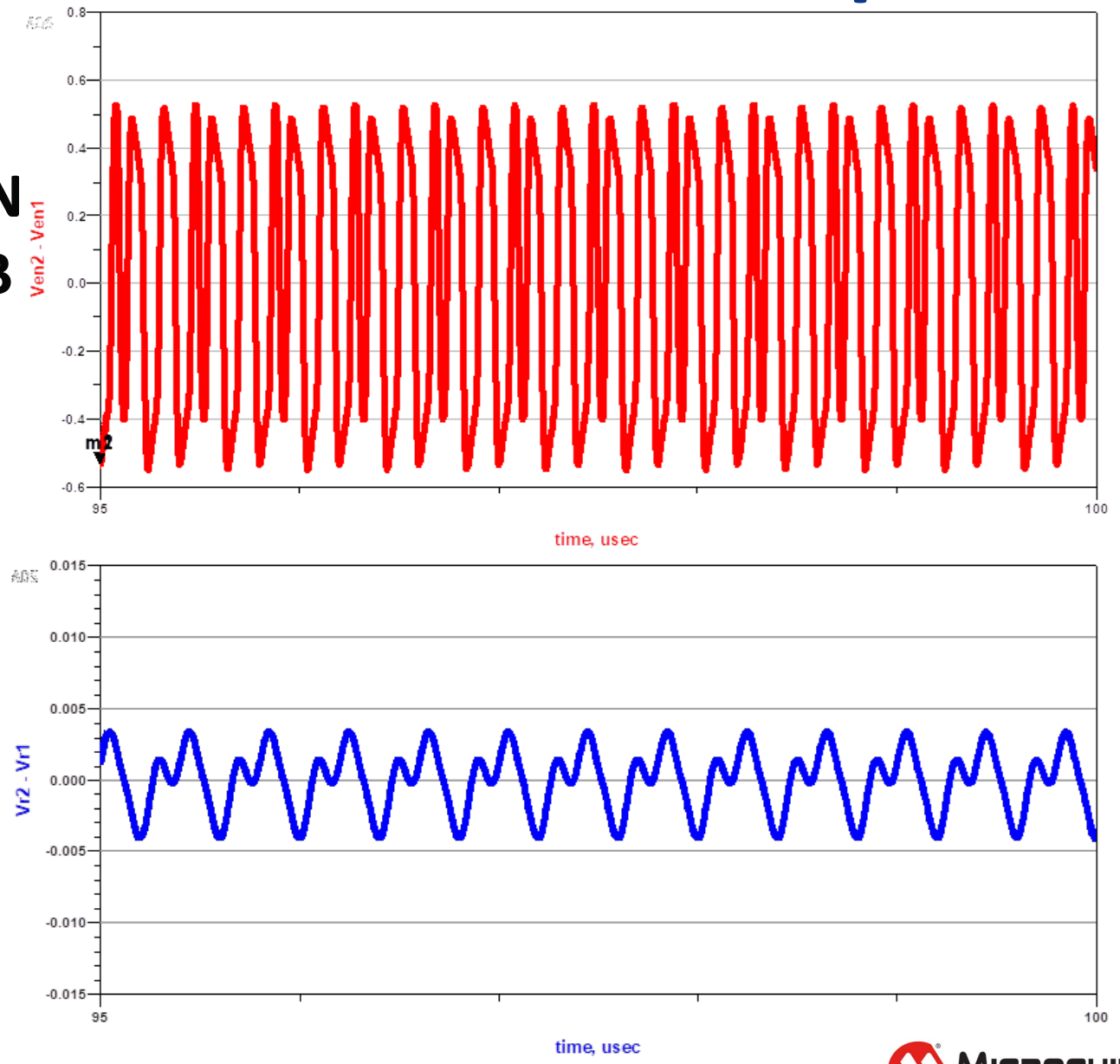
Effect of low-pass filter at wake detector input

DME Data

- **Low pass filter attenuates BEACON DME signaling amplitude by -40dB**
  - Red – filter input $1.1V_{pp}$
  - Blue – filter output $8mV_{pp}$



Note: scale change

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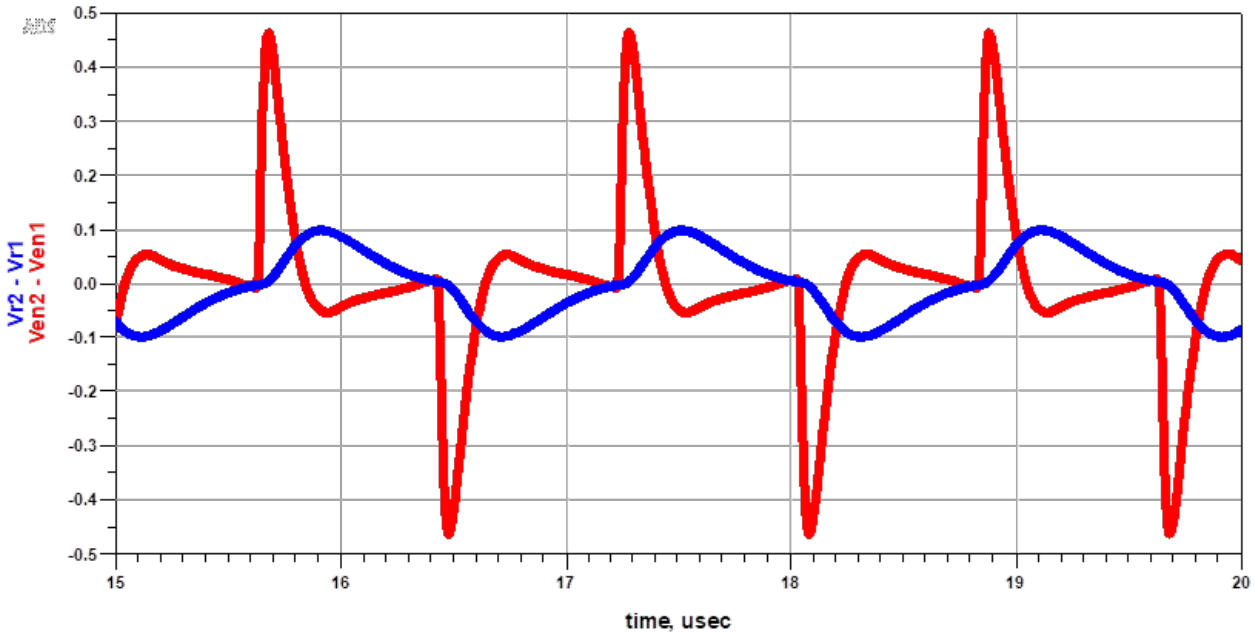
Effect of low-pass filter at wake detector input

MPoE Received 625kHz signal

- **Received input to the LPF in red**
- **Filtered input to the detector in blue**
  - Still 200mV$_{pp}$



- **This is easily detectable, but what about noise tolerance?**

Next steps

- **Continue work on model implementations**
- **Will this meet noise tolerance requirements?**
  - What are the requirements?
    - What noise may be added due to MPoE and other sources?
  - Higher order low-pass filter?
  - High Q bandpass filter?
- **Transmit 625kHz at higher amplitude? (pre-emphasis)**
- **Do we really need 320µH?**
  - Might be able to do with less and still get reliable detection.
    - Needs work testing!

Paths Forward

- **Restrict to only non-MPoE Clause 147 10BASE-T1S**
- **Make it work with MPOE**
  - Appears feasible, still performing work
- **Create a new in-band wake**
  - ”not so low” power (mA)
- **Others?**

Conclusions

- **Continue exploring the 625kHz tone feasibility for 10BASE-T1M MPoE applications**
- **Don’t block reaching Draft 1.0 working group ballot**

Thank You!

Acknowledgements

- **The technical analysis in this presentation was performed by**
  - Fatma Fruehling (Caliskan) and
  - Galin Ivanov

References

- **10BASE-T1S multidrop EEE proposal**

  10BASE-T1S multidrop EEE proposal (Baggett, 12/7/2023)

- **10BASE-T1S multidrop Low-Power Wake Proposal**

  10BASE-T1S multidrop Low-Power Wake Proposal (Baggett, 12/9/2023)

- **Multi-drop wake-up signaling challenges with MPoE**

  Multi-drop wake-up signaling challenges with MPoE (Koczwara, 12/9/2023)