Rockwell Automation

Multi-drop wake-up signalling challenges with MPoE

Wojciech Koczwara • Multi-drop wake-up signalling challenges with MPoE • 2023•09•08

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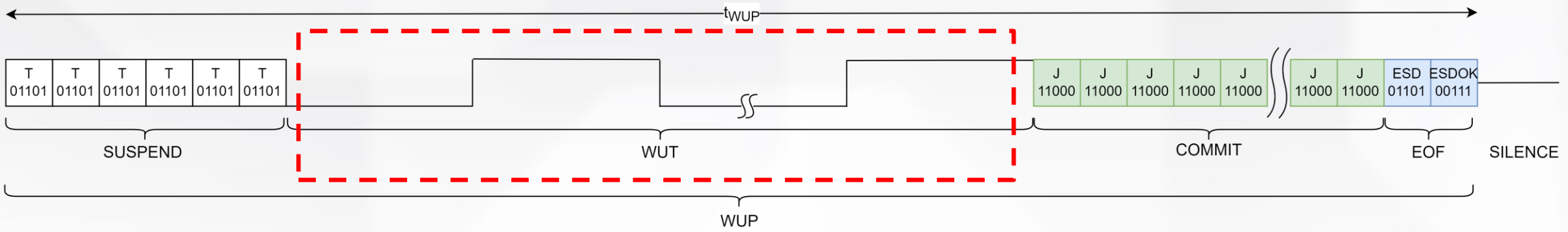
Wake-up (WUP) frame definition

- The main part is the Wake-Up Tone (WUT), a 625kHz square wave
- WUP is sent by regular transmitter front-end (usually 45+ Ohms source impedance)



Maximum MDI load by each node (802.3cg)

- C = 15pF, **L = 80uH (MPoE)**, R = 10kΩ

Table 147–4—MDI impedance limit parameters

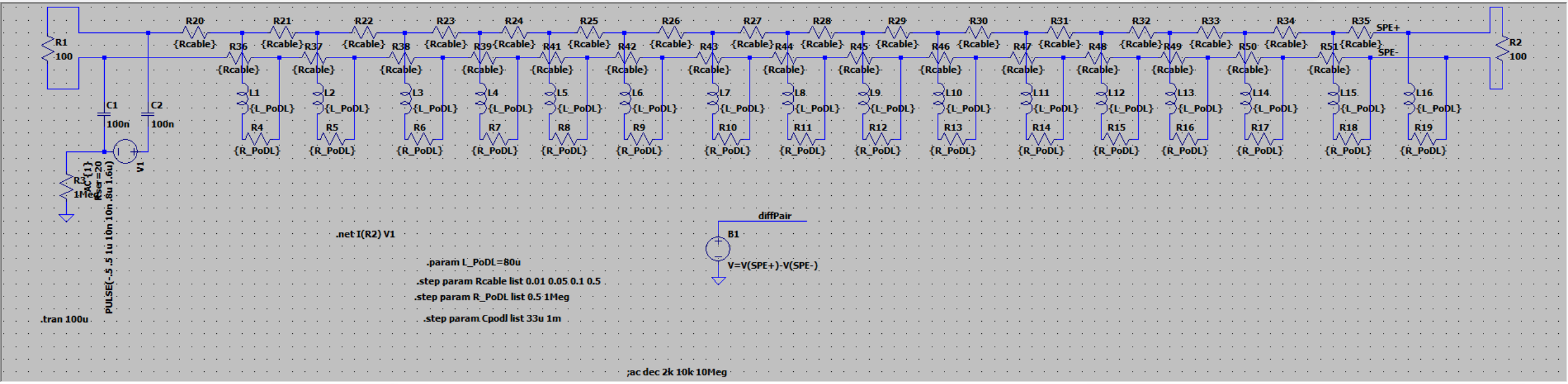
Parameter name	Unit of measure	Minimum value	Maximum value
R	kΩ	10	—
L	μH	80	—
C_{tot}	pF	—	180
C_{node}	pF	—	15

- This set of parameters supports 10BASE-T1S transmission band (2 – 40MHz)
- The parallelled inductance of 16+ nodes **can be detrimental to the WUP tone (625kHz)**

Simulation setup

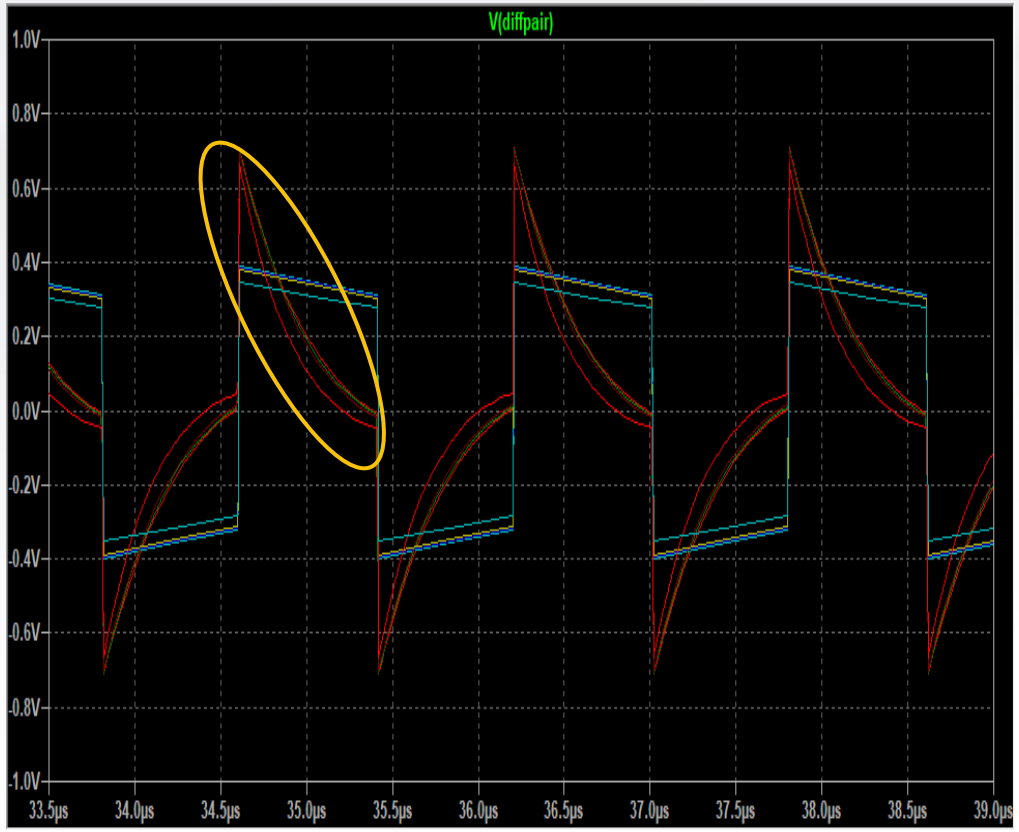
LTSpice simulation, only resistive cable loss

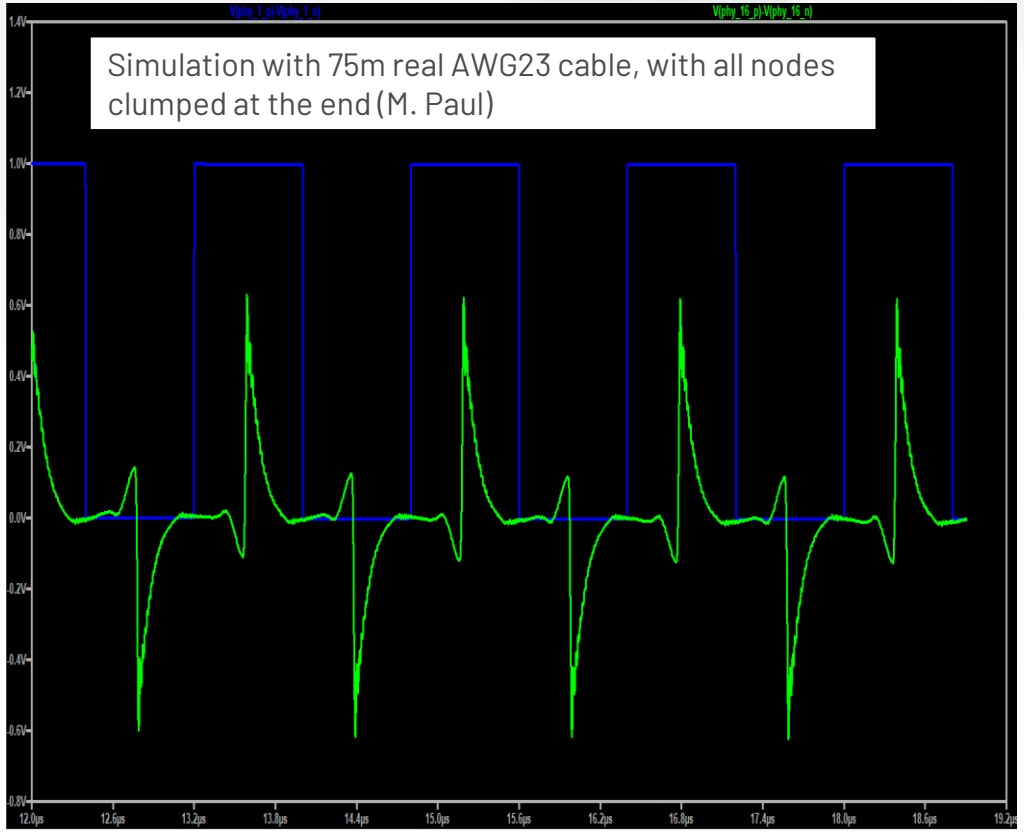
- 16 nodes of 80uH, cable resistance used only
- sweeping cable resistance between nodes
- 625kHz waveform
- 50R Transmitter at the left-hand side of link, receiver at right-hand terminator



Wake-Up Tone with MPoE / without MPoE – time domain

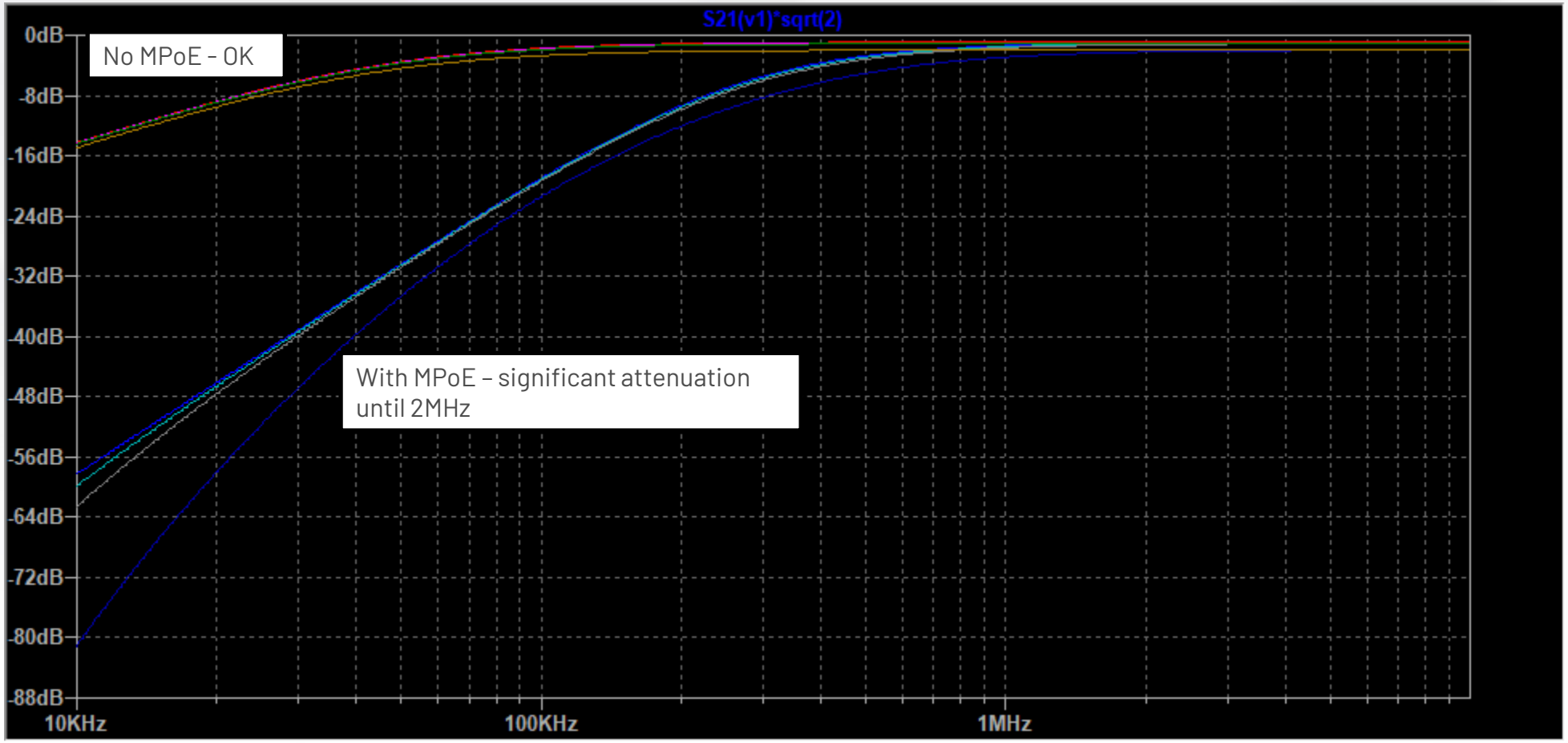
The droop from MPoE inductors deteriorates the 625kHz square Wake-Up Tone signal





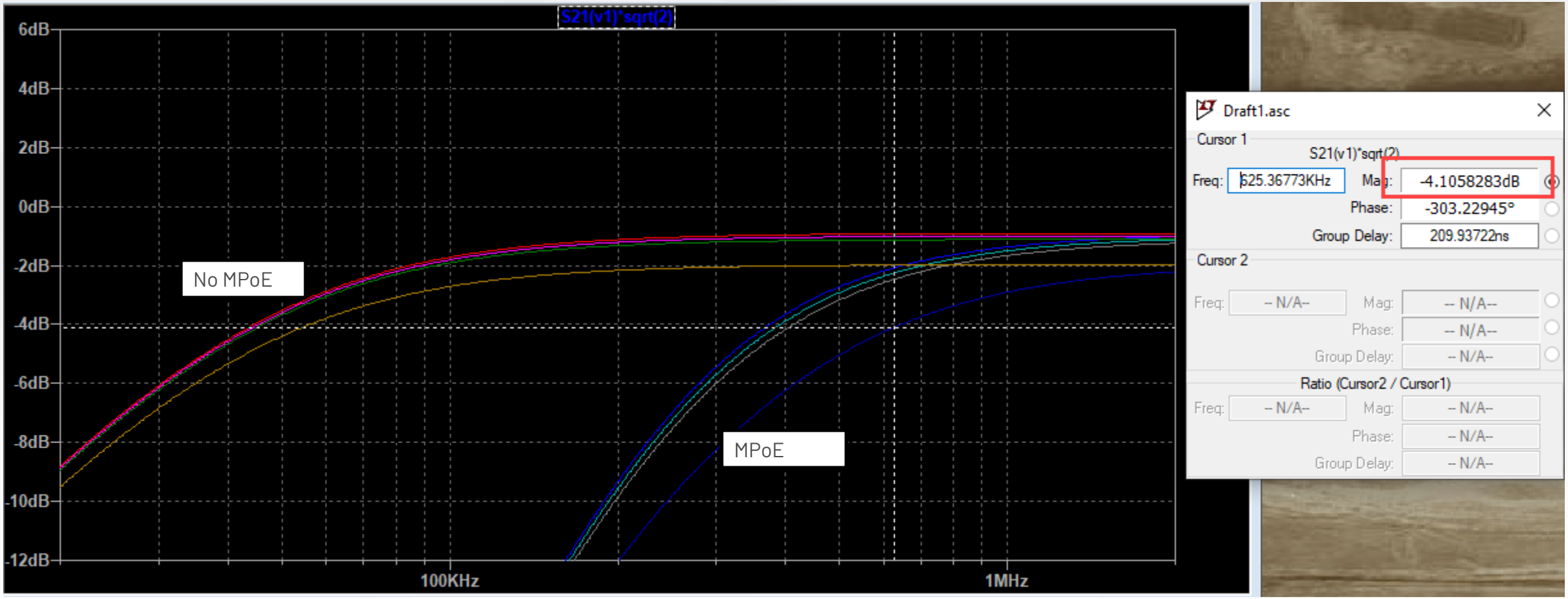
Attenuation (S21) from the transmitter to right-hand terminator

The 80uH inductors introduce significant loss under 2MHz



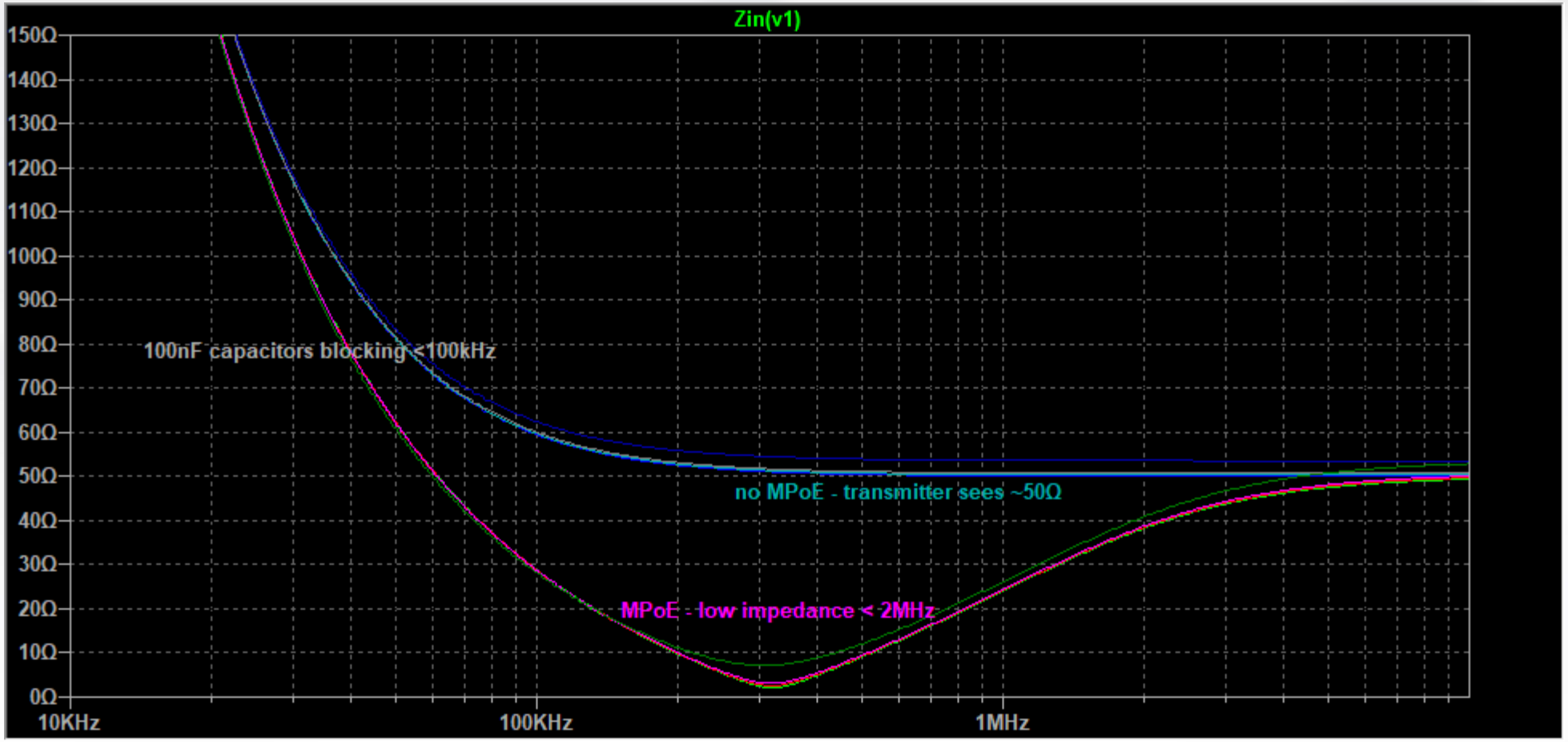
S21 (transmitter to right-hand terminator) – Zoom In

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



Impedance seen by the 50Ω transmitter

There is **little room for the Wake-Up Tone under 2MHz** without introducing significant loss



Ideas for improvement

- Improve detection to work with the deteriorated signal (e.g. use band-pass filtering @ 625kHz)
- Move the Wake-Up Tone to higher frequencies (preferably above 2-4MHz)
- Increase the required MPoE inductance (likely to 320uH, or more)

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