SPE Multidrop Enhancements Mixing Segment Considerations Update

July 2020

Chris DiMinico/MC Communications/PHY-SI LLC/Panduit
cdiminico@ieee.org
Bob Voss/Paul Wachtel/Panduit

Purpose

- Model development to consider the IEEE 802.3 10SPE Multidrop Enhancements mixing segment objective.

IEEE P802.3da Objectives

1. Define performance characteristics of a mixing segment for 10Mb/s multidrop single balanced pair networks supporting up to at least 16 nodes, for up to at least 50m reach.

- Update January 2020 Single Pair Multidrop Considerations

Contributors

- Piergiorgio Beruto – Canovatech
- Steffen Graber – Pepperl+Fuchs
- Paul Wachtel, Bob Voss, Ron Nordin – Panduit

SPMD Multidrop Topology

- **Use validated 802.3cg Multidrop Model as basis for SPMD-E Multidrop mixing segment characteristics**
  - 802.3cg Mixing segment
    - up to at least 8 nodes and 25 m in reach

.

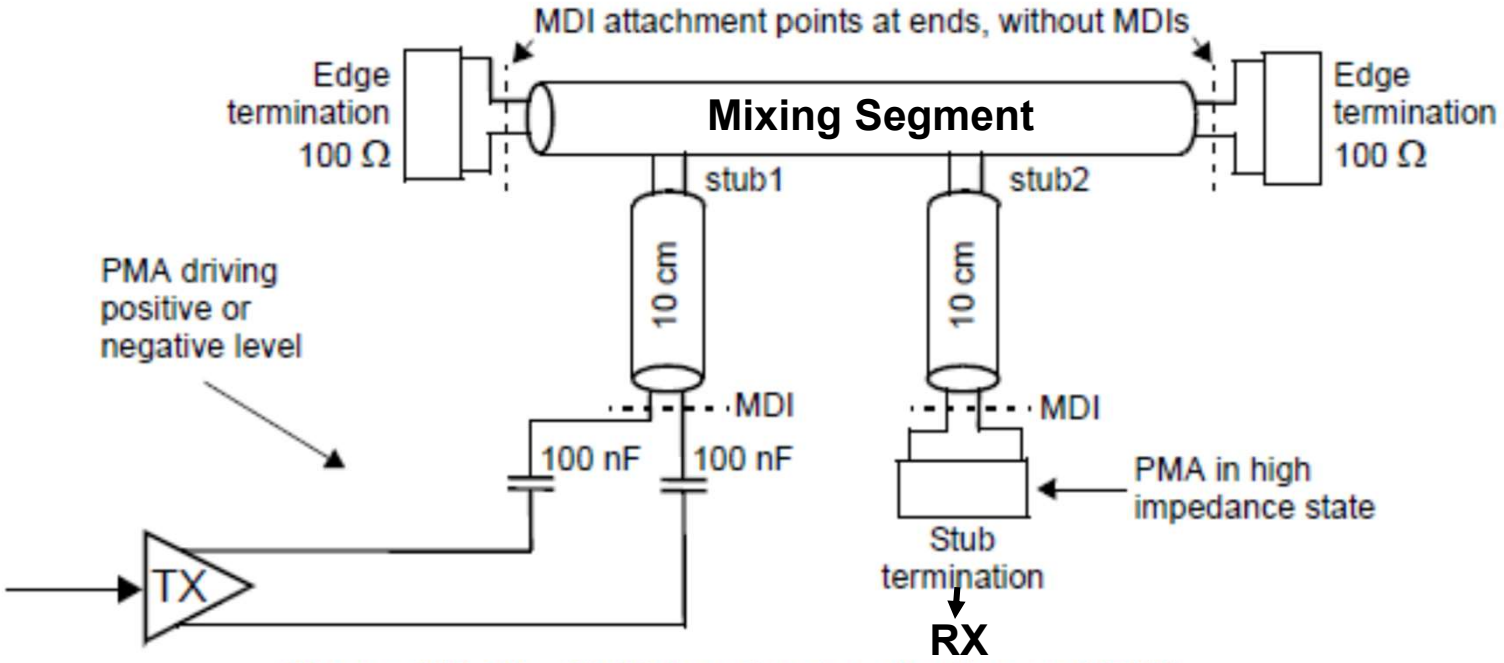


Figure 147–20—Multidrop line termination and PMA

147.9.2 MDI electrical specification – TX - PoDL

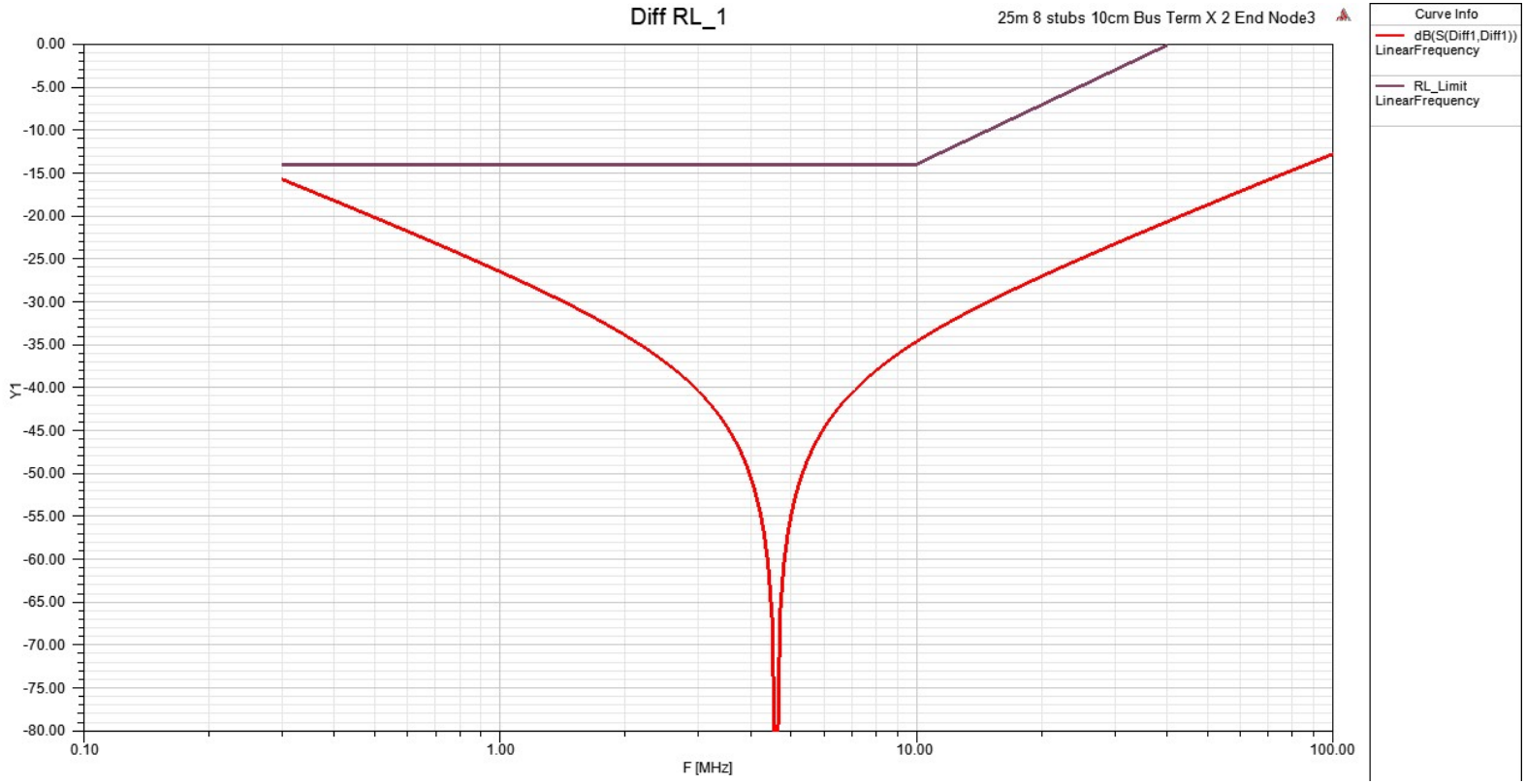
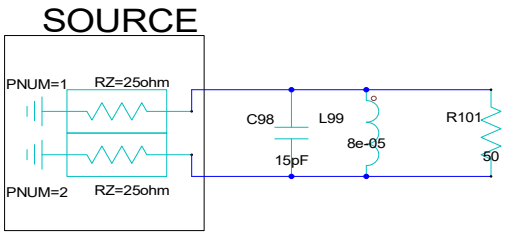


Table 147–4—MDI impedance limit parameters

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



147.9.2 MDI electrical specification – RX - PoDL

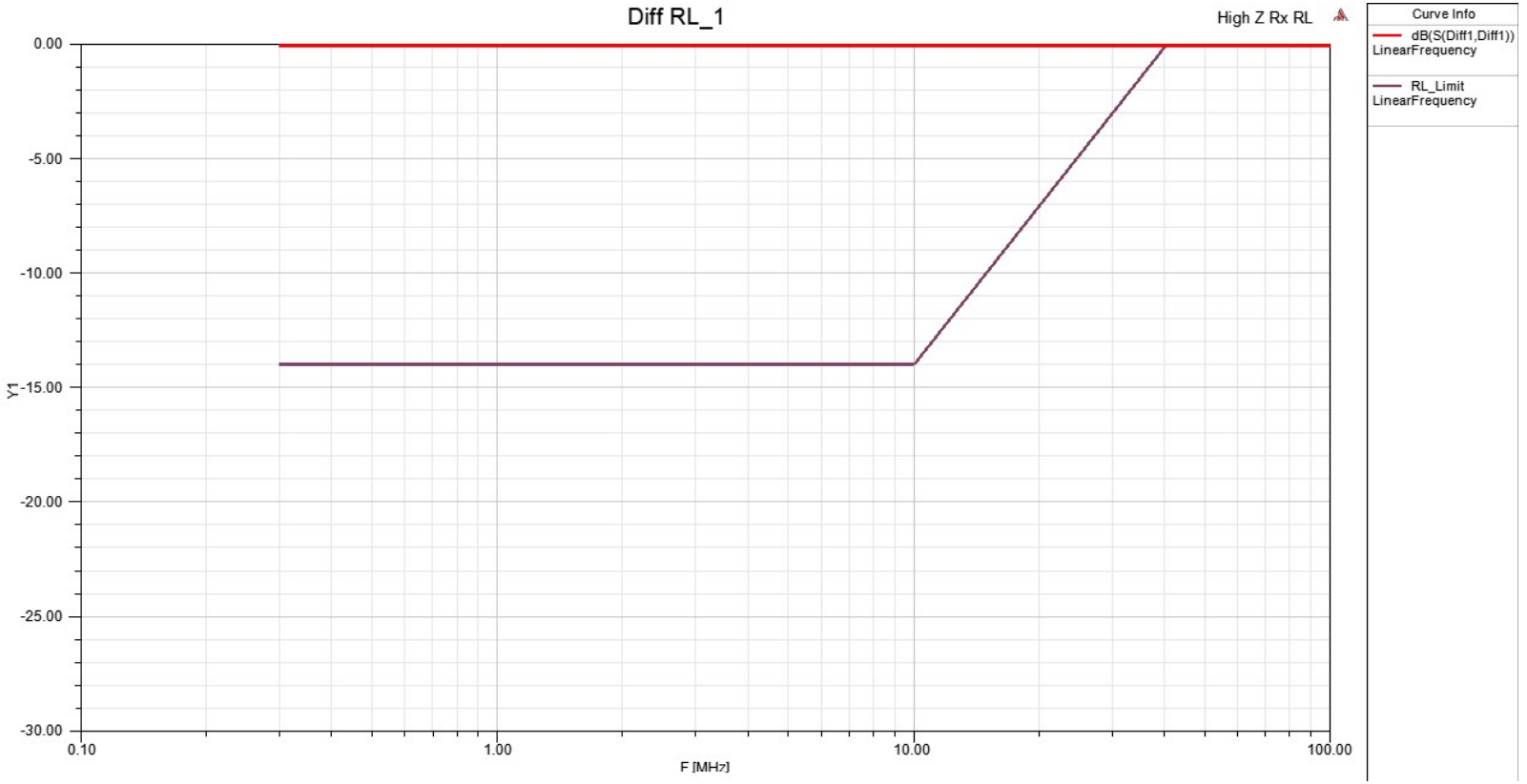
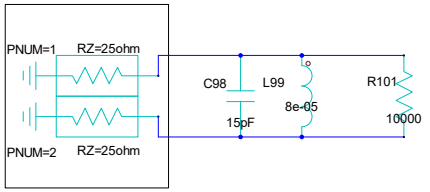


Table 147–4—MDI impedance limit parameters

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



147.8 Mixing segment characteristics

147.8.1 Insertion loss

The insertion loss of each 10BASE-T1S point-to-point link segment shall meet the values determined using Equation (147–3).

$$\text{Insertion loss}(f) < \begin{cases} 1.0 + \dfrac{1.6(f-1)}{9} & 0.3 \le f < 10 \\ 2.6 + \dfrac{2.3(f-10)}{23} & 10 \le f < 33 \\ 4.9 + \dfrac{2.3(f-33)}{33} & 33 \le f \le 40 \end{cases} \text{ dB} \qquad (147\text{–}3)$$

where

f is the frequency in MHz; $0.3 \le f \le 40$

147.8.2 Return loss

$$\text{Return loss}(f) > \begin{cases} 14 & 0.3 \le f < 10 \\ 14 - 10\log_{10}\left(\dfrac{f}{10}\right) & 10 \le f \le 40 \end{cases} \text{ dB} \qquad (147\text{–}4)$$

where

f is the frequency in MHz; $0.3 \le f \le 40$

147.8 Mixing segment characteristics

147.8.3 Mode conversion loss

The mode conversion loss of each 10BASE-T1S point-to-point link segment shall meet the values determined using Equation (147–5).

$$\text{Mode conversion loss}(f) > \begin{cases} 43 & 0.3 \le f < 20 \\ 43 - 20\log_{10}\left(\frac{f}{20}\right) & 20 \le f \le 200 \end{cases} \text{ dB} \qquad (147\text{–}5)$$

where

f is the frequency in MHz; $0.3 \le f \le 200$

147.8 Mixing segment characteristics

- Mixing segments engineered - 25 meters includes stubs – Example mixing segment 25 m - (2*.10 m)

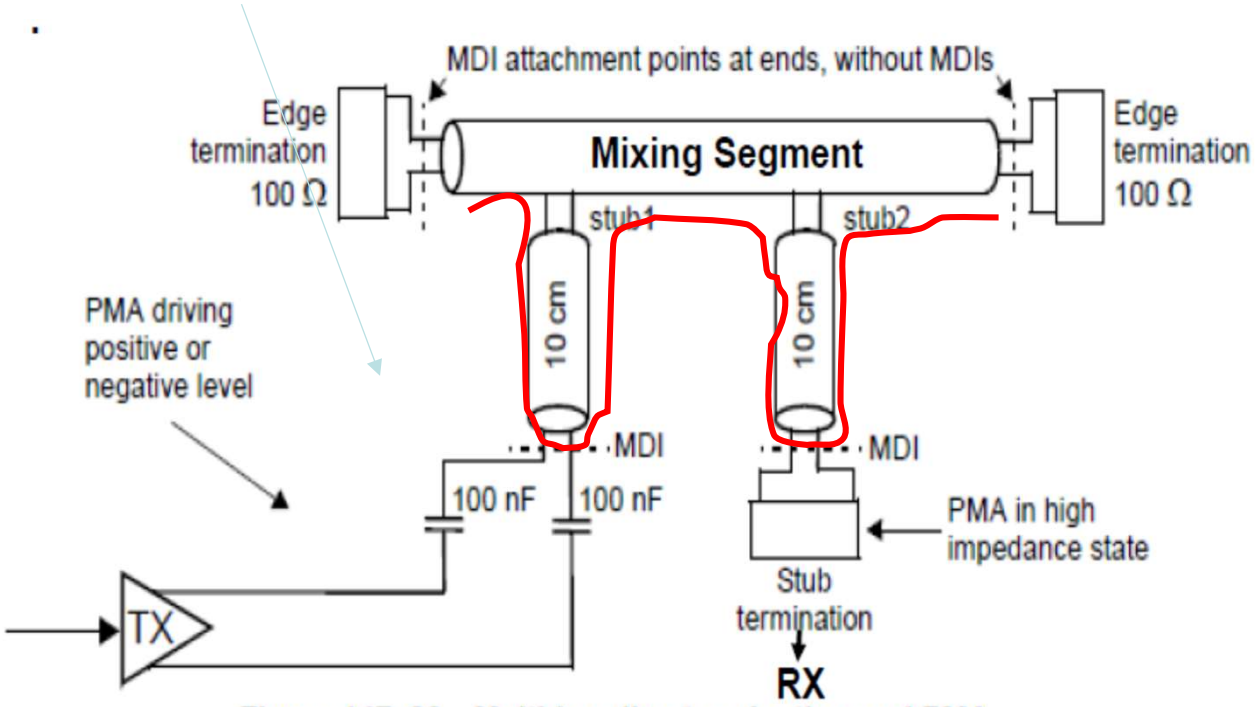
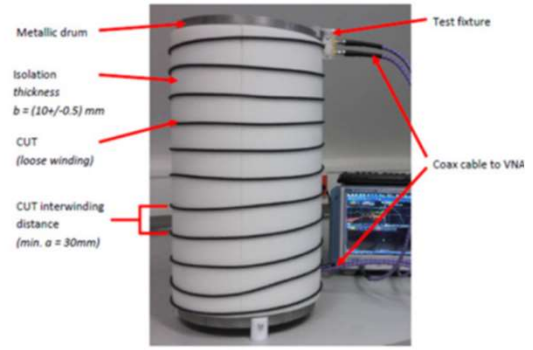


Figure 147–20—Multidrop line termination and PMA

Transmission Model

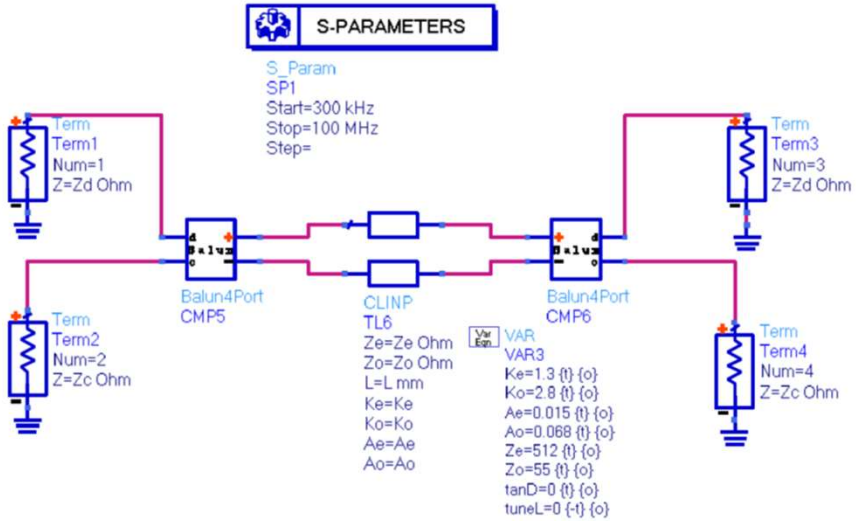
Cable modeling with ADS CLINP

- measurement of a „typical“ UTP cable (15m) at room temperature acc. to OPEN Alliance test specification (TC2)



- Fitting of CLINP parameters
  - Ae = 0,015dB/m@5MHz
  - Ao = 0.068dB/m@5MHz
  - Ze = 512Ω
  - Zo = 55Ω
  - Ke = 1,3
  - Ko = 2,8

  (Zd=100Ω, Zc=25Ω)



10SPE Study Group Automotive Channel for Multi-Drop Stefan Buntz, Daimler AG
http://www.ieee802.org/3/10SPE/public/adhoc/buntz_10SPE_03_1005.pdf

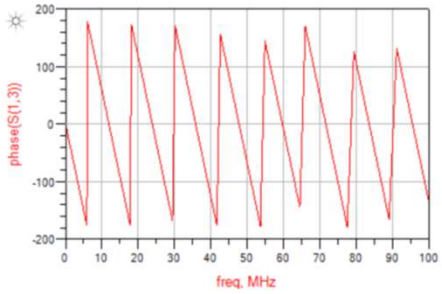
Cable Model

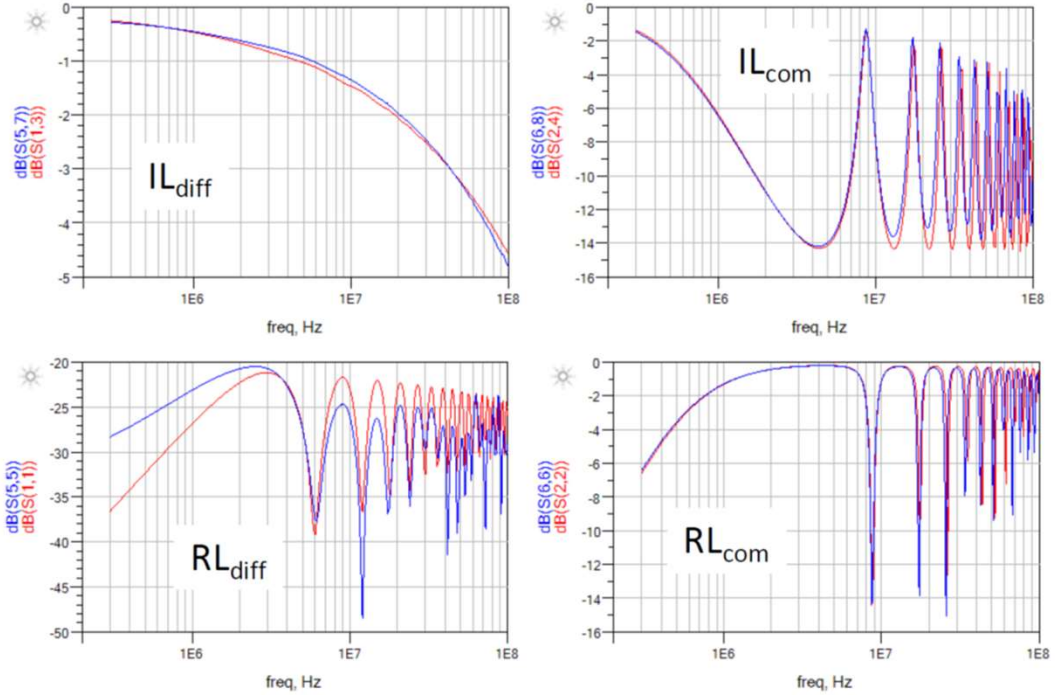
fitting results (=15m point-to-point channel)

Measurement

Simulation CLINP

- ~5dB attenuation at 100MHz for differential signal
- <20dB Return Loss
- Phase is constant:

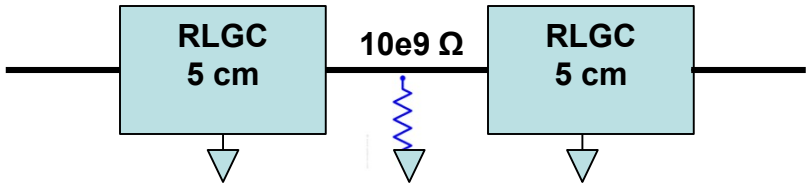




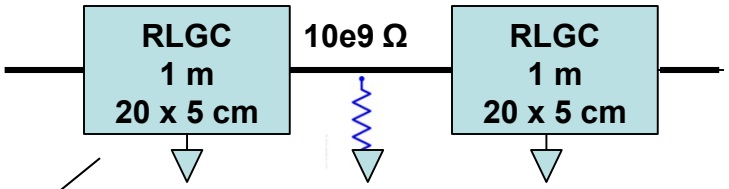
10SPE Study Group Automotive Channel for Multi-Drop Stefan Buntz, Daimler AG
http://www.ieee802.org/3/10SPE/public/adhoc/buntz_10SPE_03_1005.pdf

Cable Model

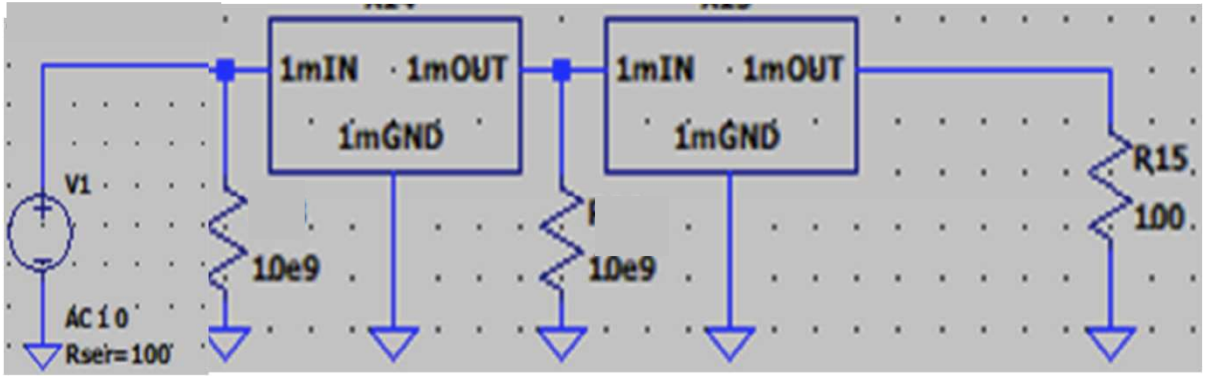
- 5 cm RLCG



- Concatenate 20*5 cm RLCG - 1 m

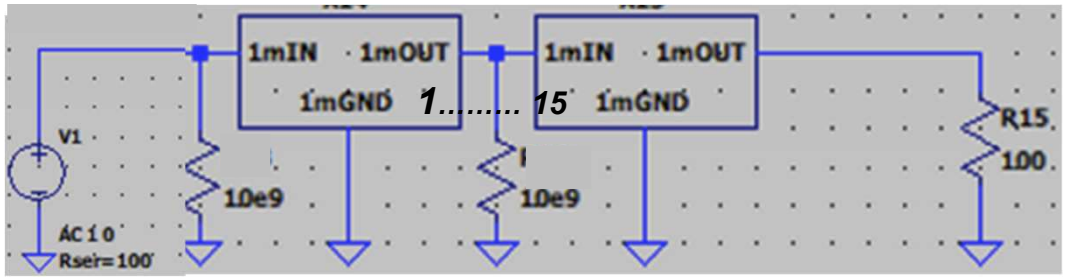


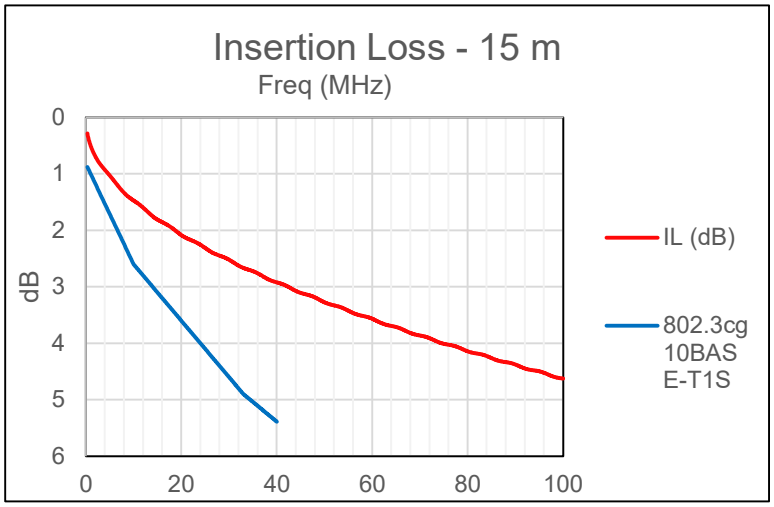
- Spice model 1 m cable sections

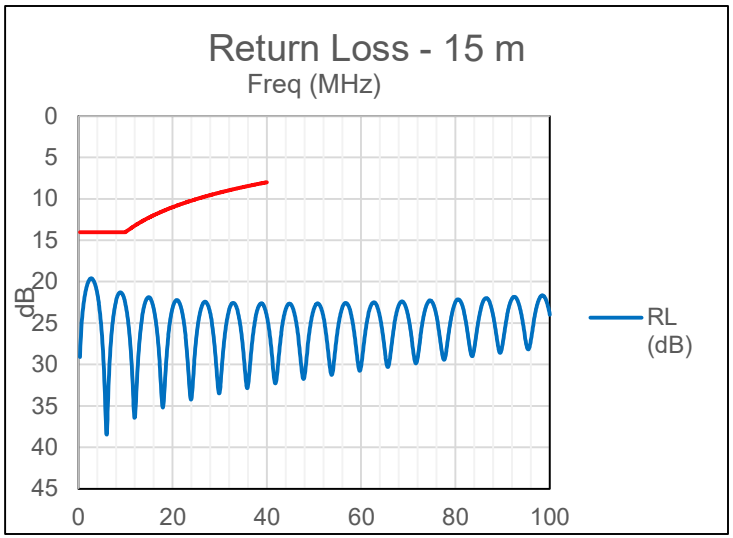


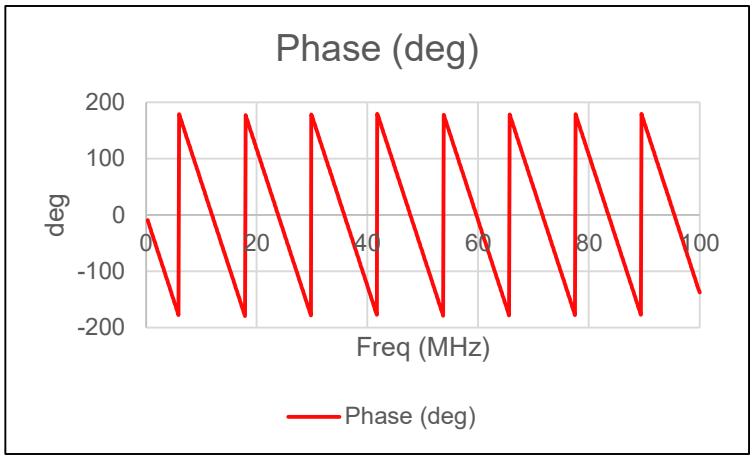
Cable model – 15 meters

- 1 m - 15 sections





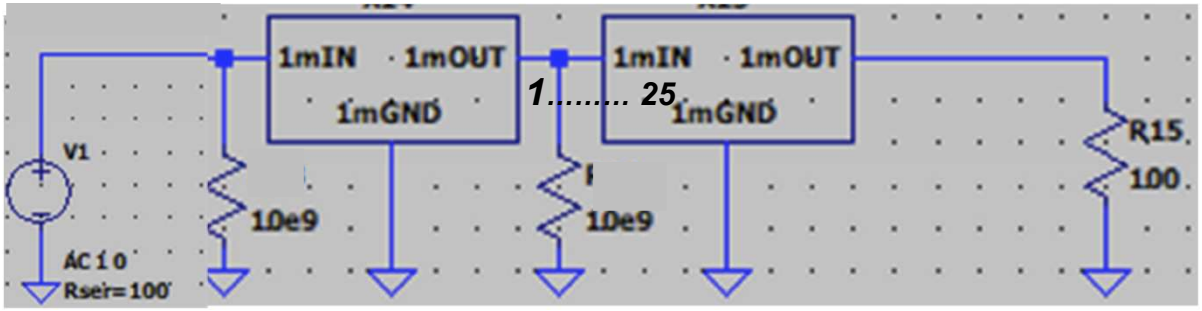


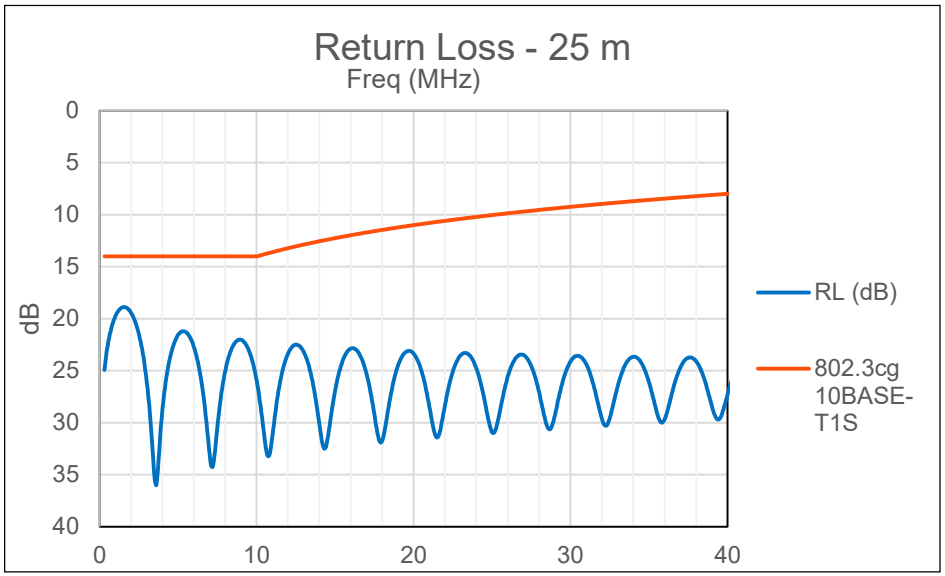


Consistent with >>10SPE Study Group Automotive Channel for Multi-Drop Stefan Buntz, Daimler AG http://www.ieee802.org/3/10SPE/public/adhoc/buntz_10SPE_03_1005.pdf

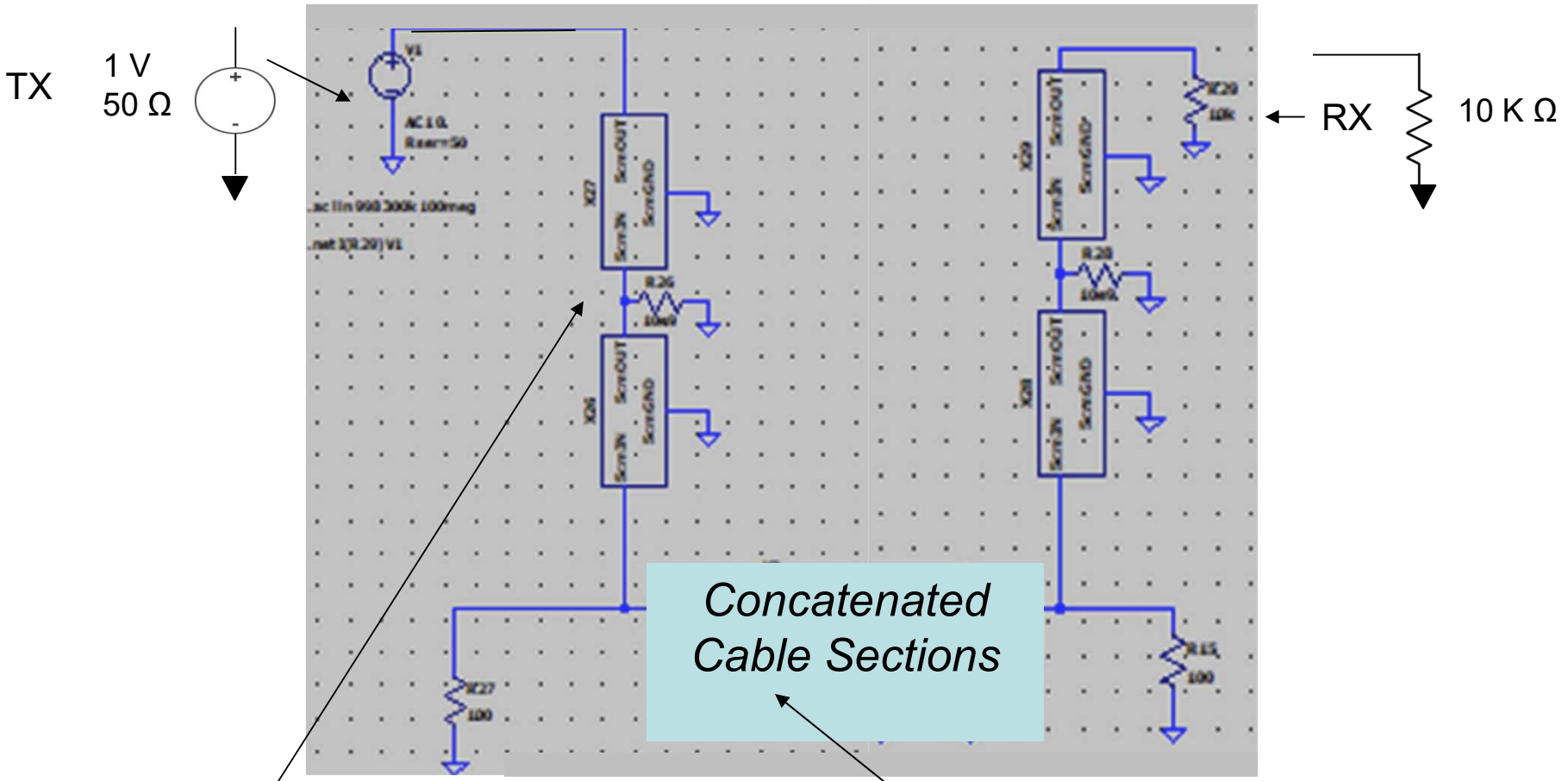
Cable model – 25 meters

- 1 m – 25 sections

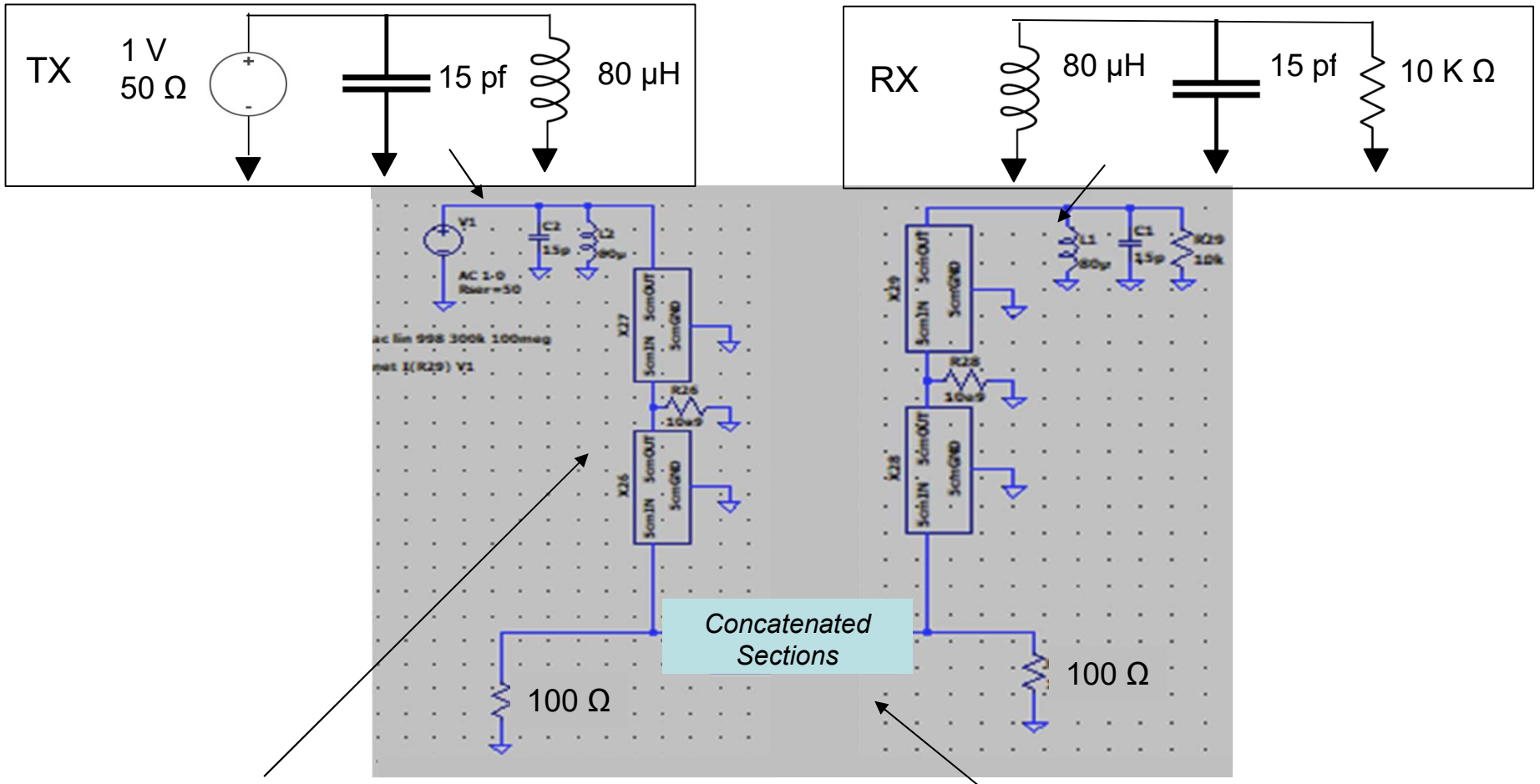




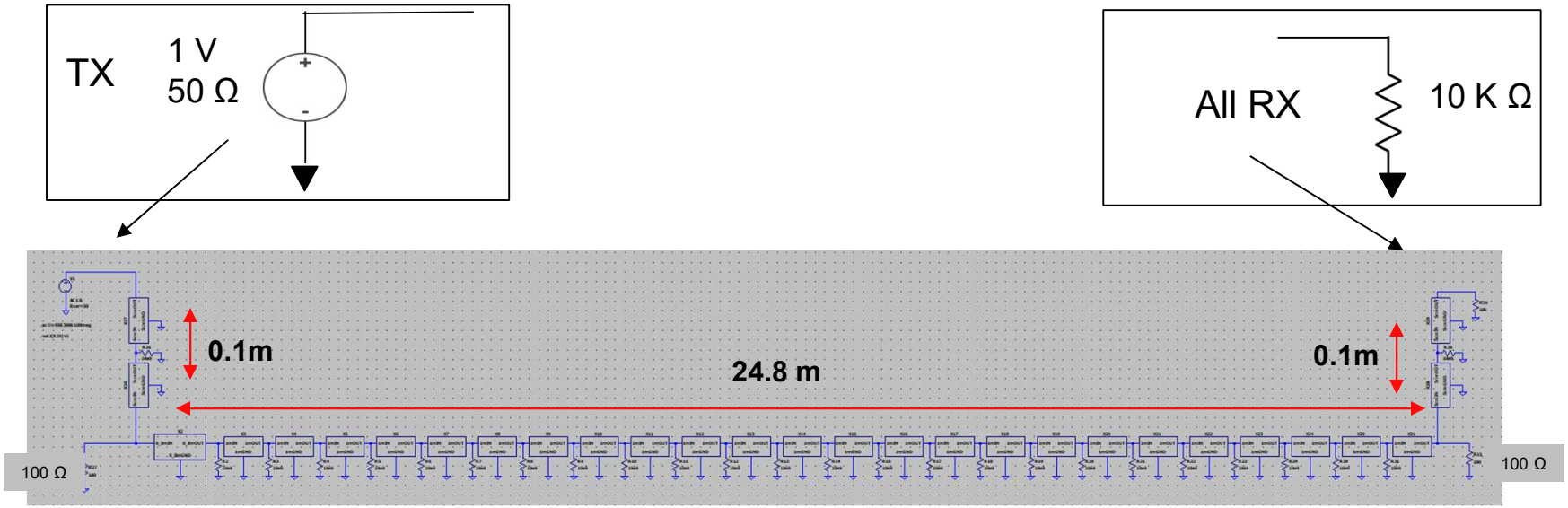
Source and Load without PoDL



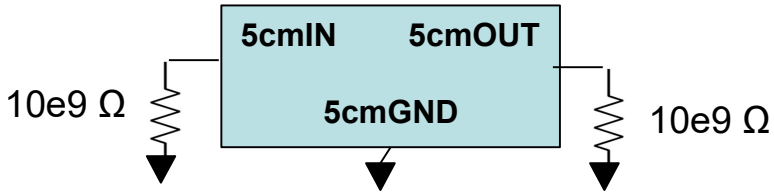
Source and Load with PoDL



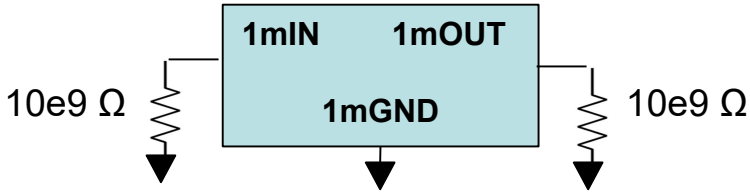
25 m – 2 taps – no PoDL



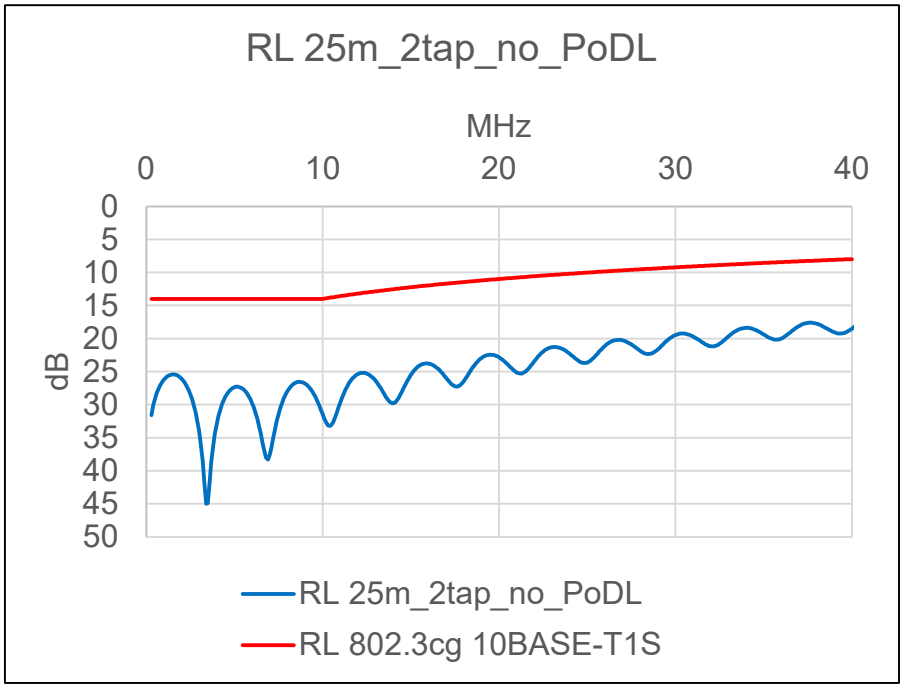
All taps consist of 2*5cm segments

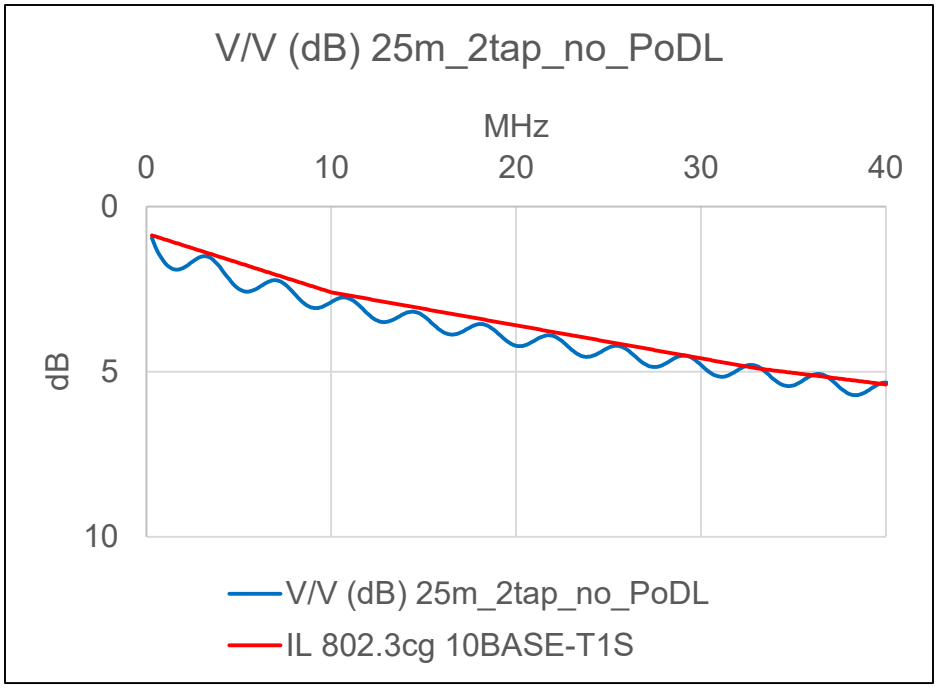


Cables consist of 1 m segments

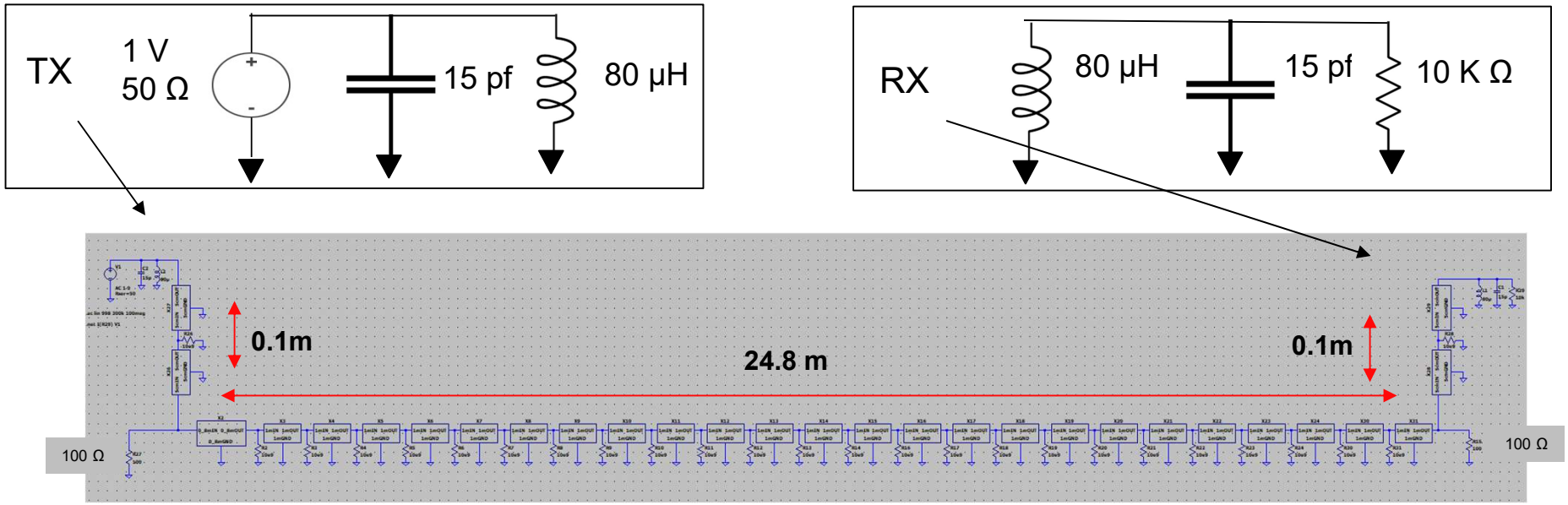


25 m – 2 taps – no PoDL

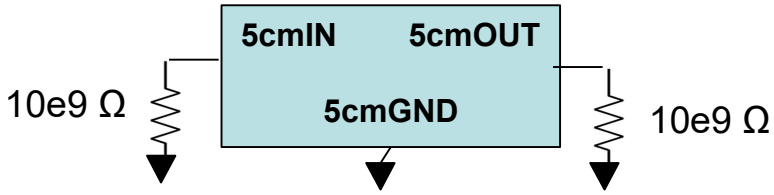




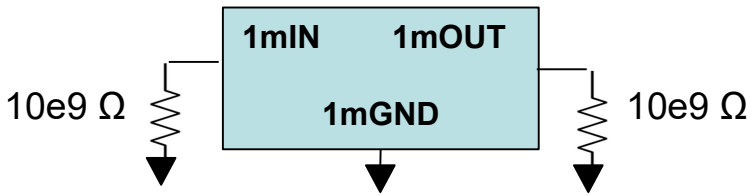
25 m – 2 taps – PoDL



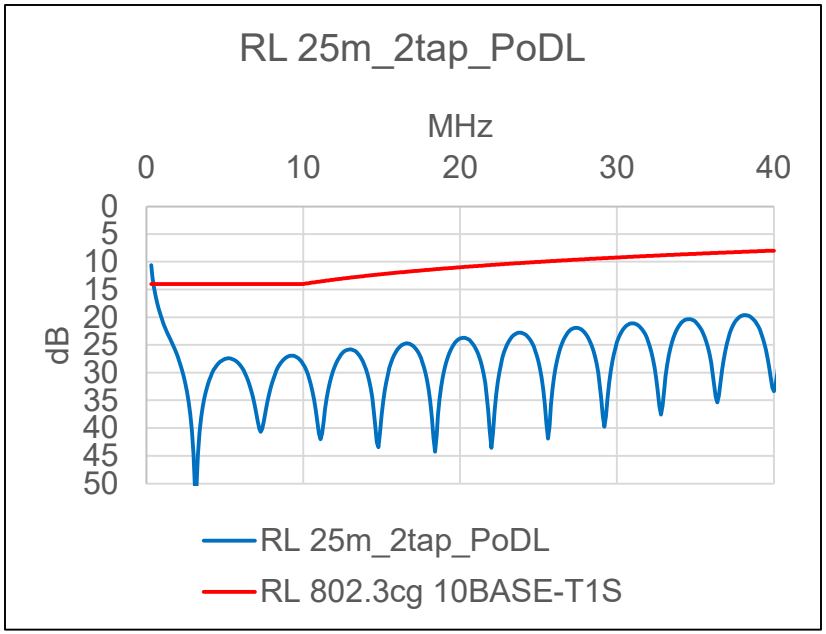
All taps consist of 2*5cm segments

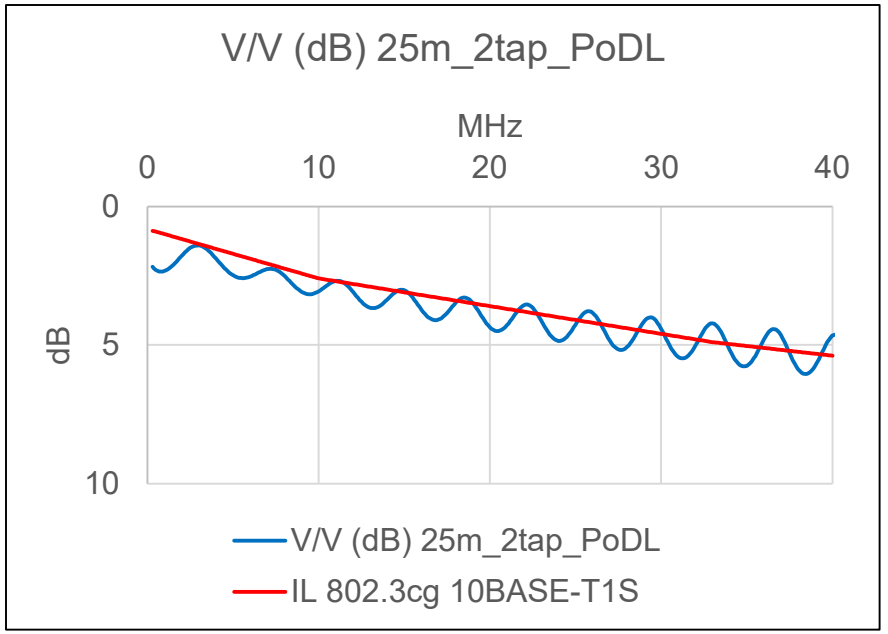


Cables consist of 1 m segments

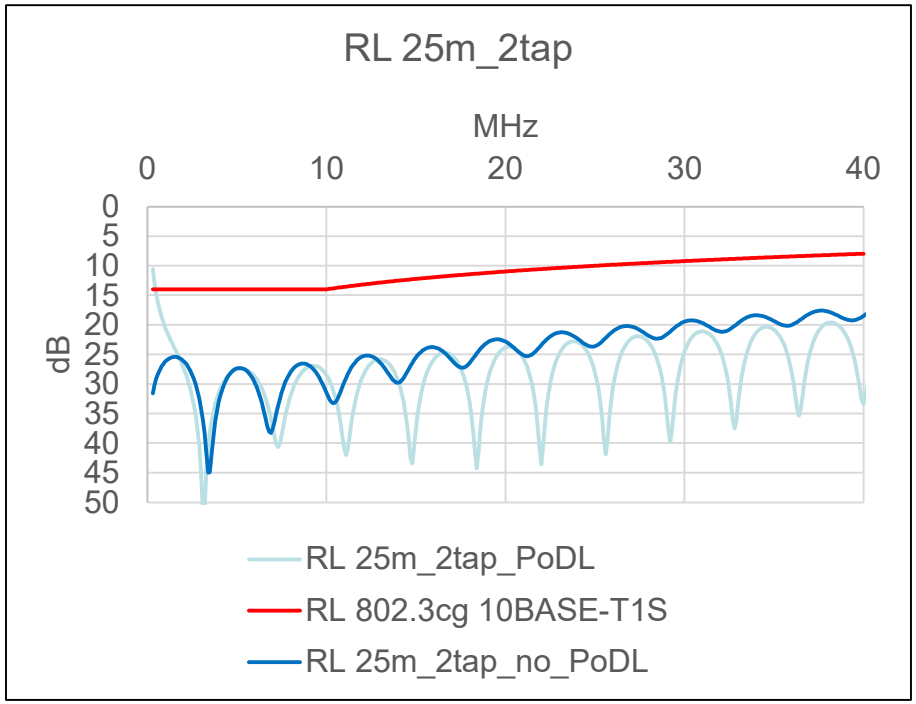


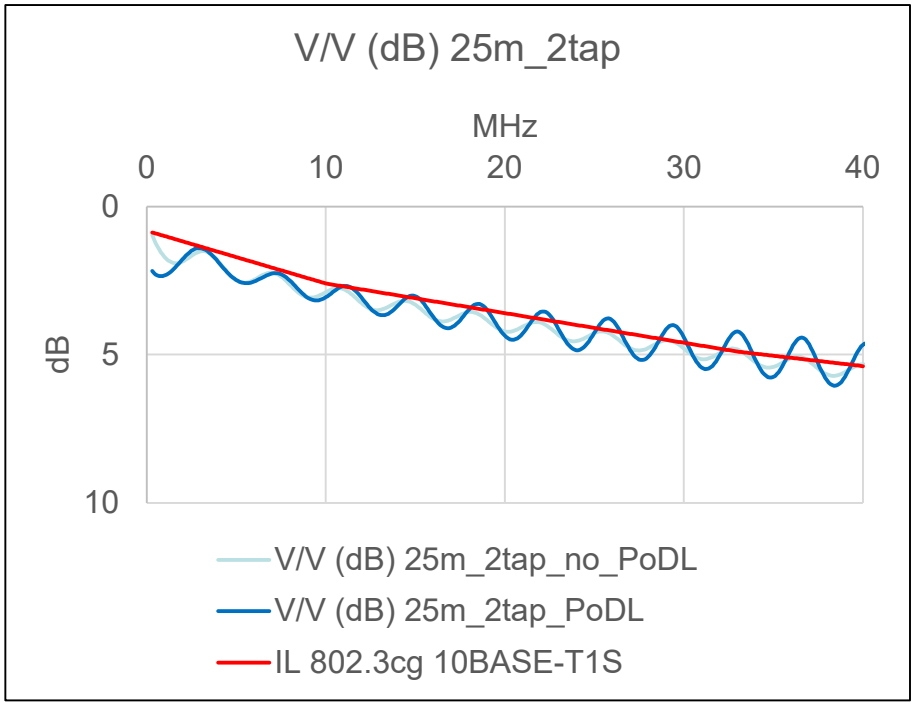
25 m – 2 taps – PoDL



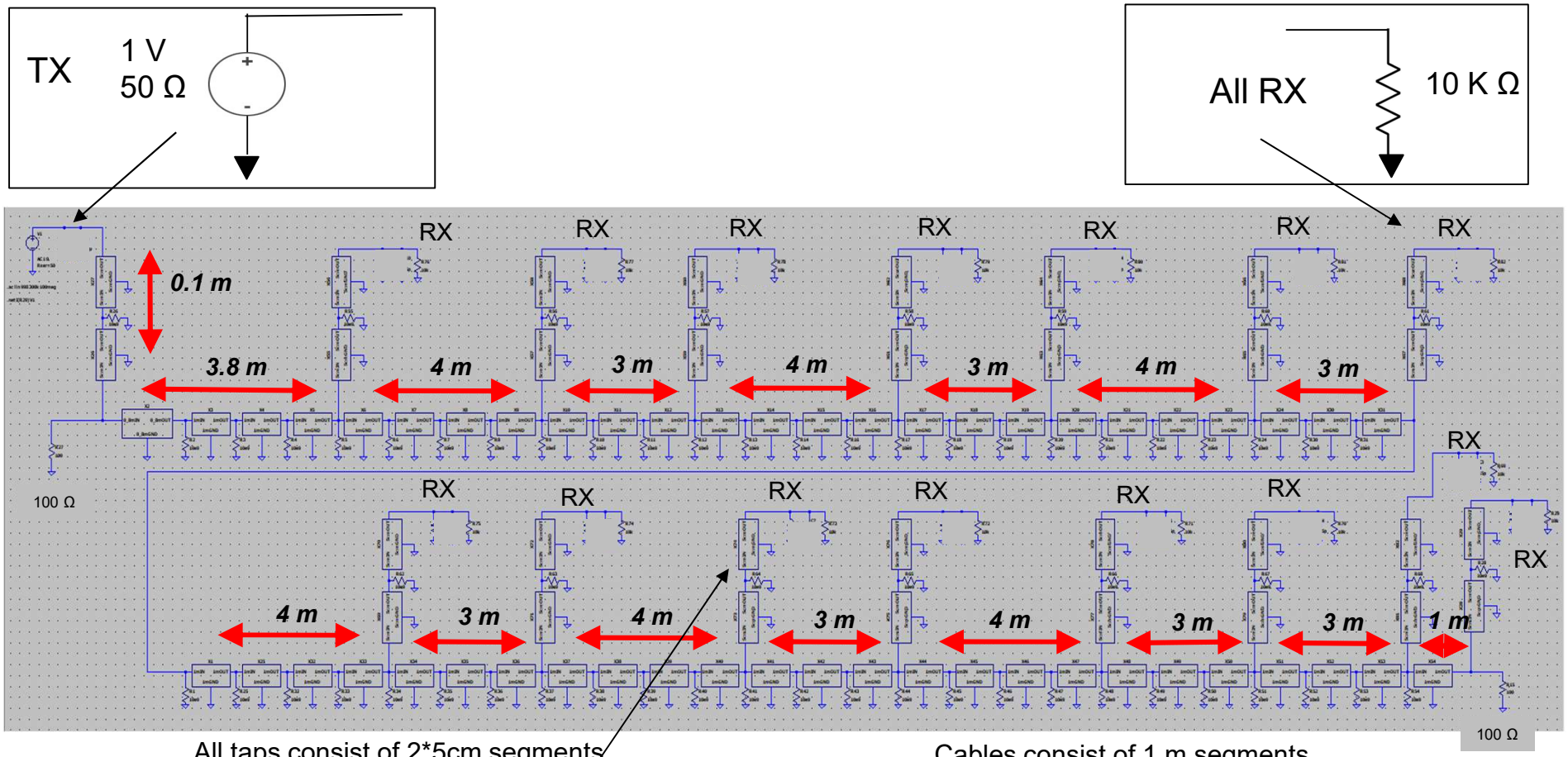


25 m – 2 taps – Compare

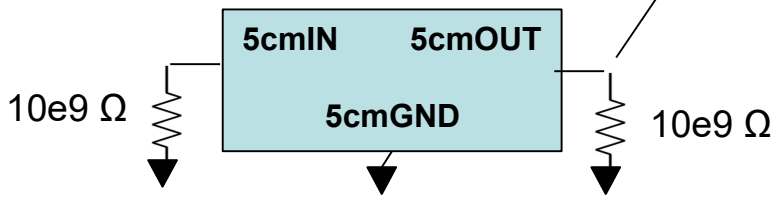




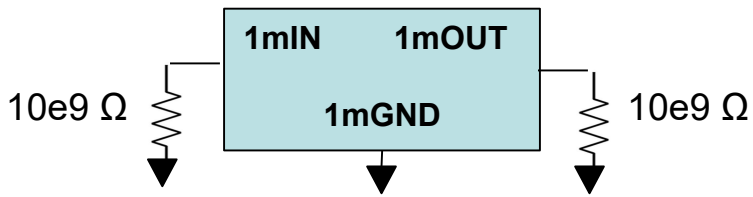
50 m –16 tap – no PoDL



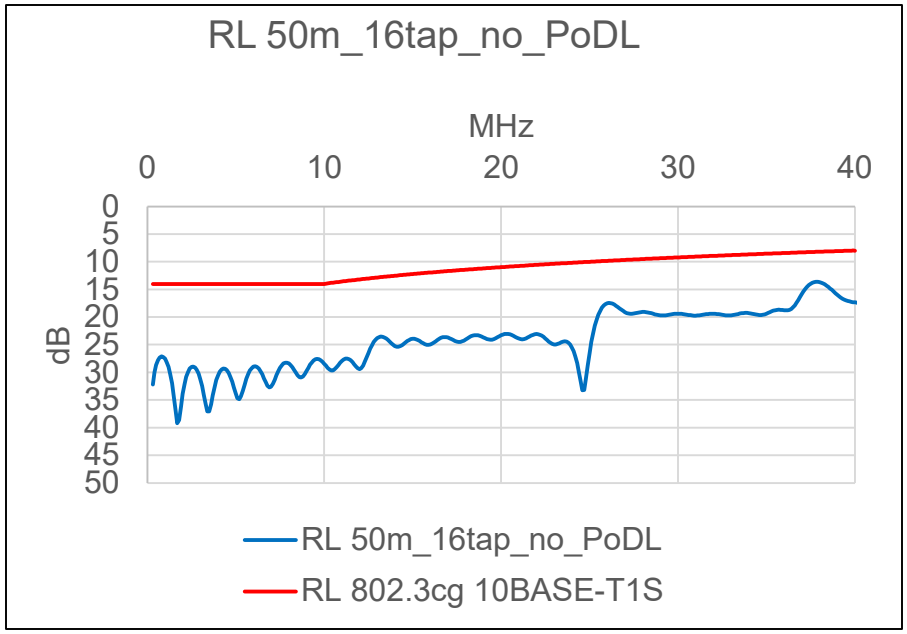
All taps consist of 2*5cm segments

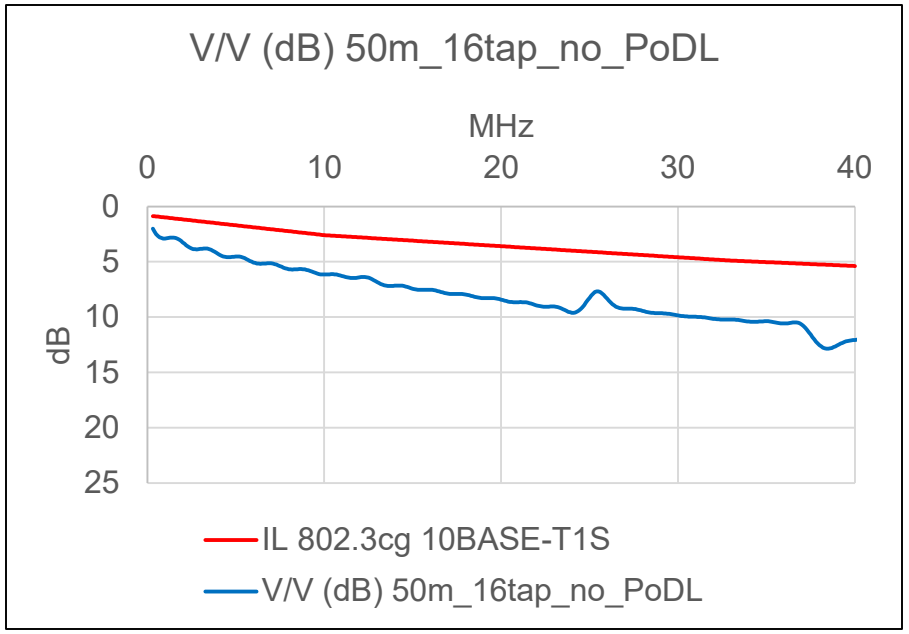


Cables consist of 1 m segments

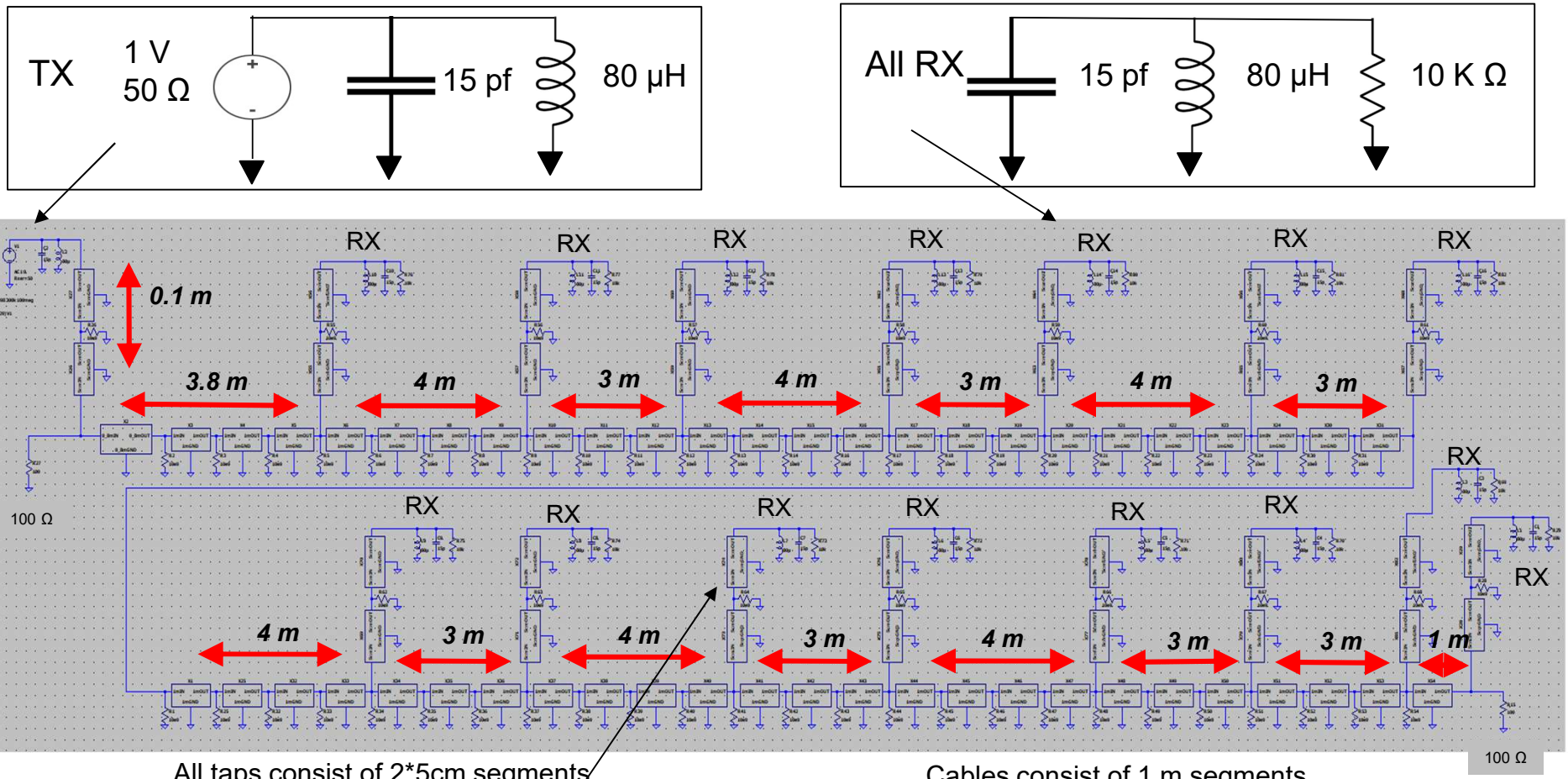


50 m –16 tap – no PoDL

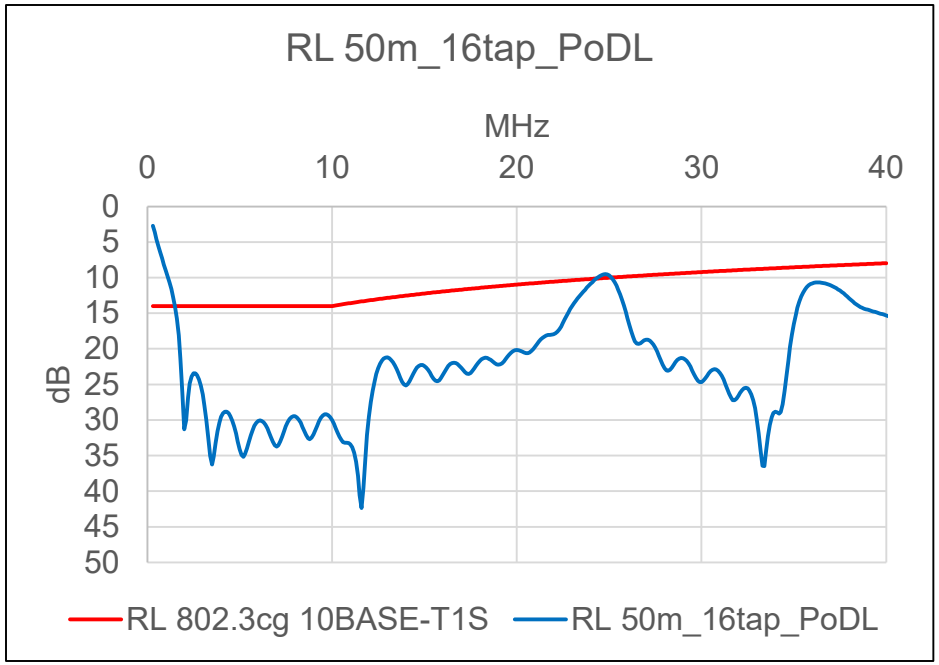


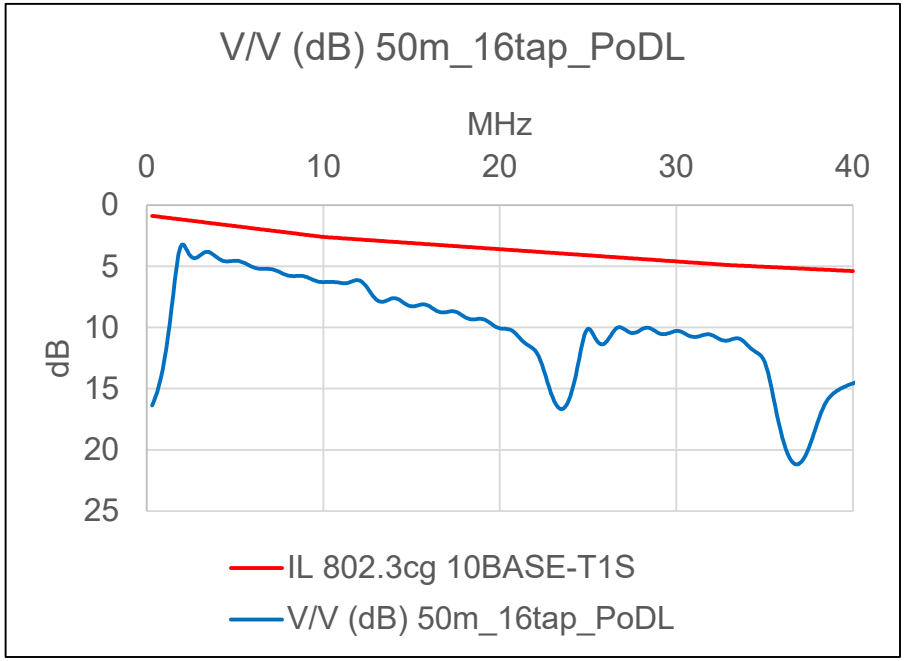


50 m –16 tap – PoDL

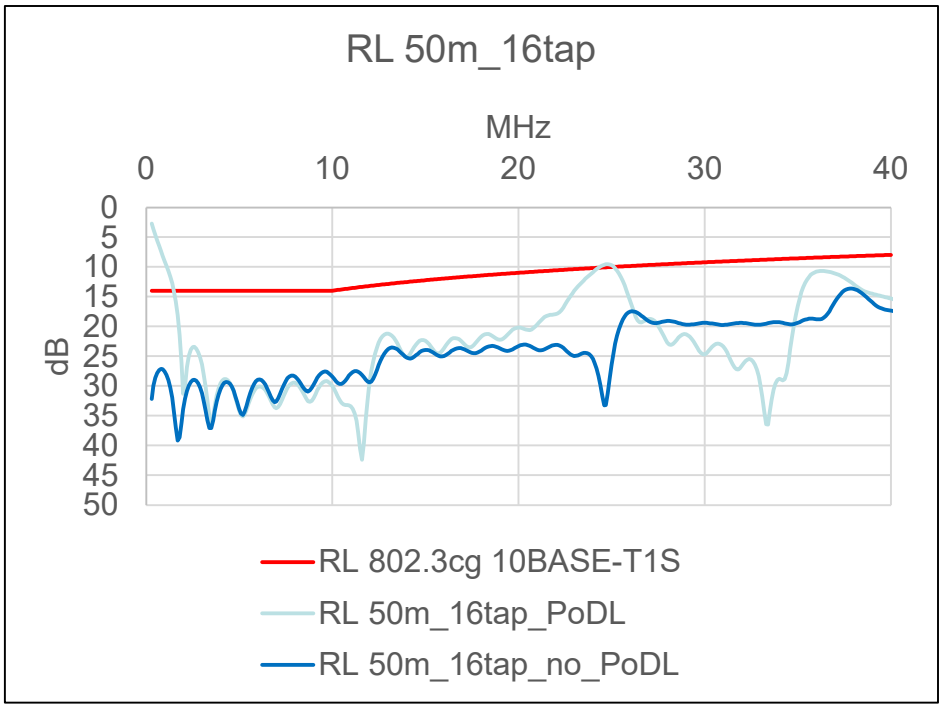


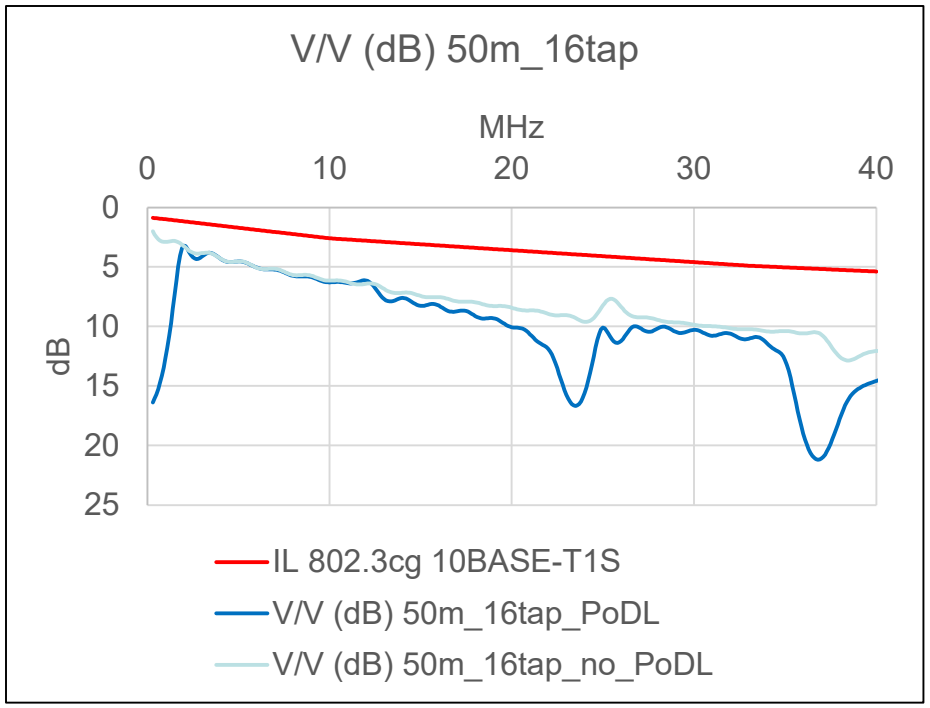
50 m –16 tap – PoDL





50 m –16 tap – Compare





Summary

- Model development to consider the IEEE 802.3 10SPE Multidrop Enhancements mixing segment objective.

- Update January 2020 Single Pair Multidrop Considerations

- Further work (suggestions welcome):
  - 18 AWG cable model