802.3da Cnode Compensation

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ANALOG DEVICES

AHEAD OF WHAT'S POSSIBLE™

Introduction

- Eye diagrams added to ADI model
  - Correlation with existing eye diagram models – Diminico, Wachtel, Voss
- Eyes are closed with certain configurations
- A new worst case system configuration
- A potential solution to keep the eyes open

Cnode

- 15pF Cnode is not realistic
  - Realistic Cnode is ~26pF typ.
  - Based on lab measurements
    - Presented on August 25, 2021 (Paul_da_082521.pdf)
    - Presented on March 12, 2021 (Paul_da_031221.pdf)
  - All simulation + modeling should be done with **30pF** Cnode as worst case

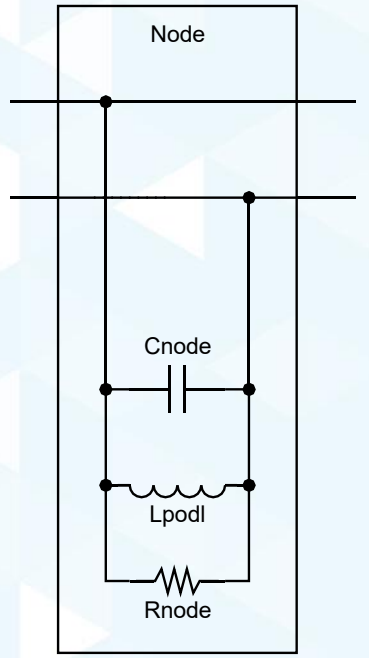


Table 147–4—MDI impedance limit parameters

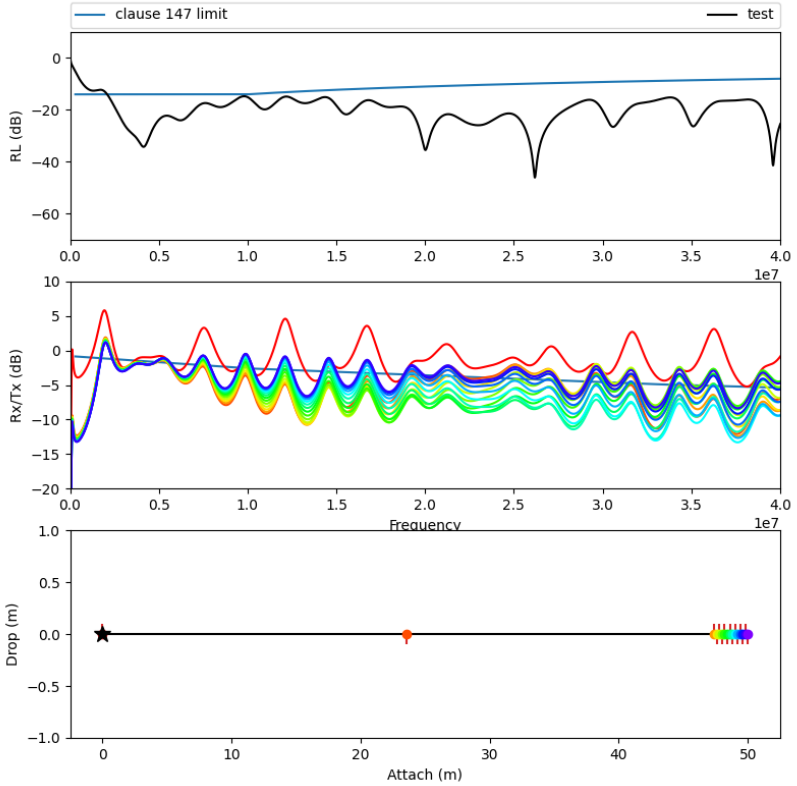
Parameter name	Unit of measure	Minimum value	Maximum value
R	kW	10	—
L	µH	80	—
C_{tot}	pF	—	180
C_{node}	pF	—	~~15~~

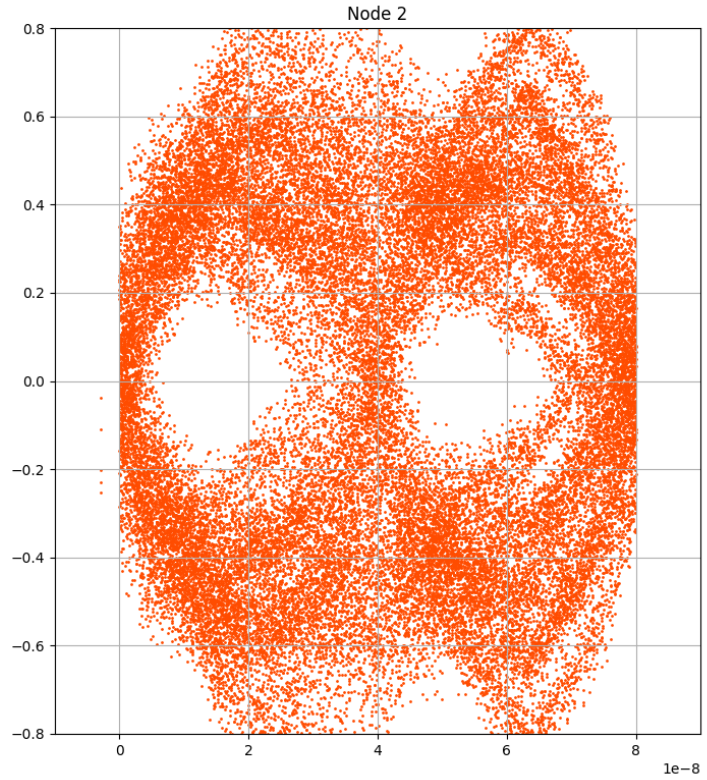
30pF

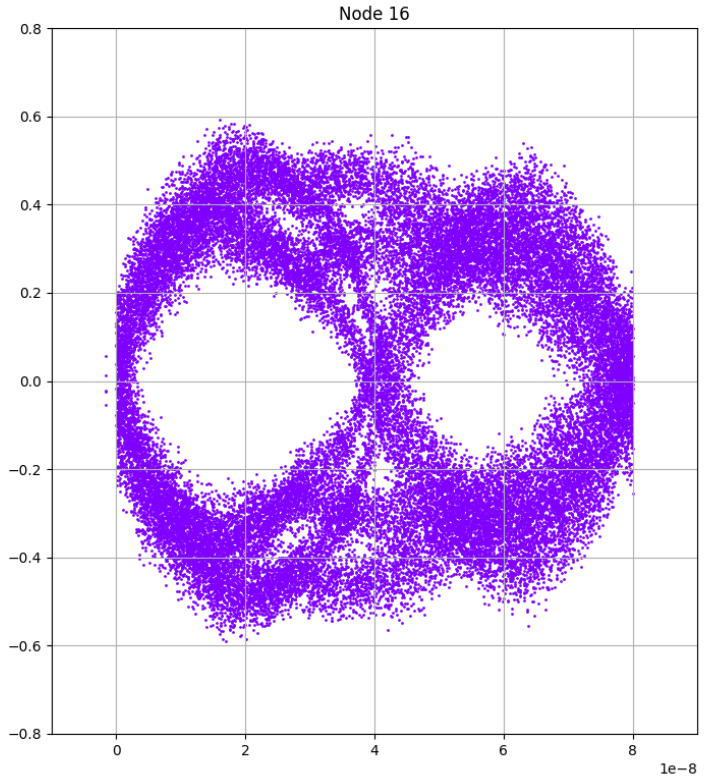
For the following simulations

Nodes	16
Drop Length	0.1m (10cm)
Mixing Segment Length	50m
Wire gauge	18 (Paul Wachtel's model)
Node Separation (14-nodes at end)	0.2m (20cm)

Cnode 15pF, Node 2 Centered





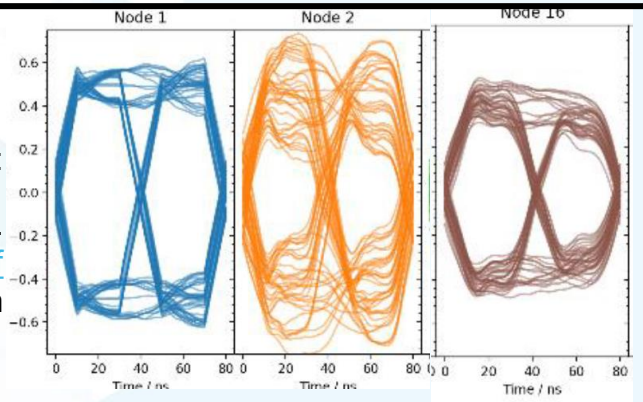


Eye diagrams from:

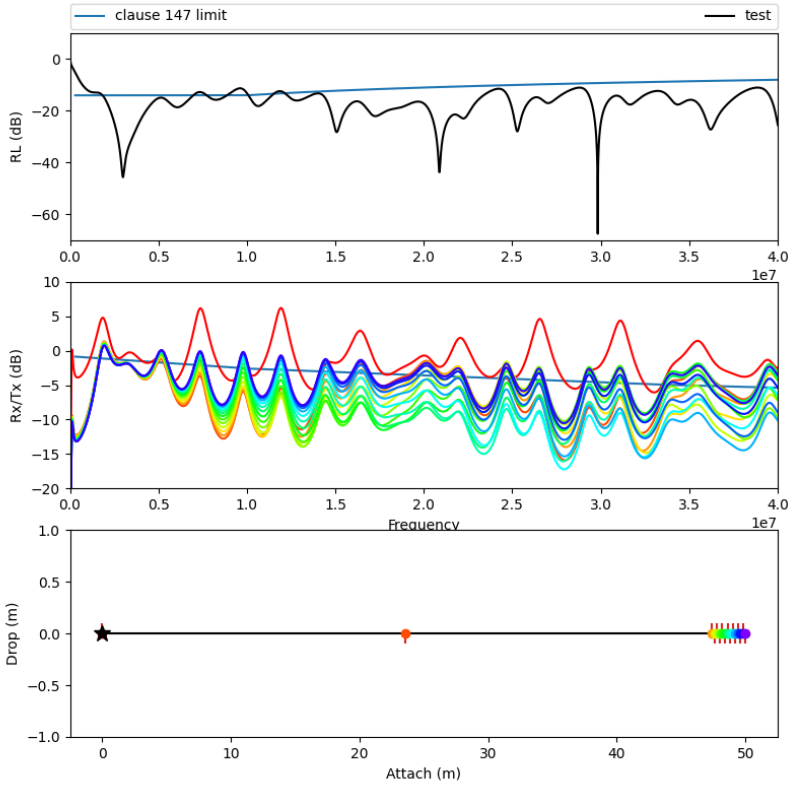
Diminico et.al.

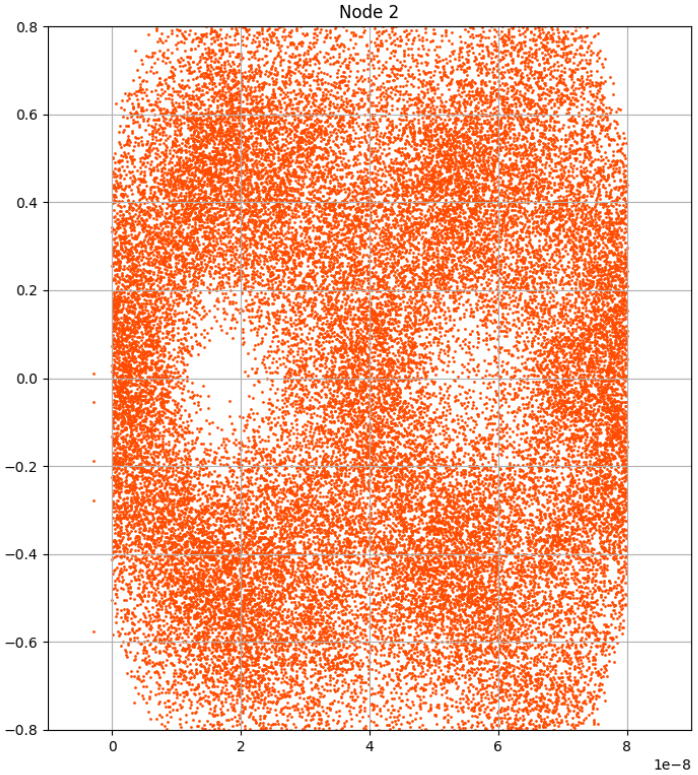
https://www.ieee802.org/3/da/public/100621/diminico_SPMD_01b_100621.pdf

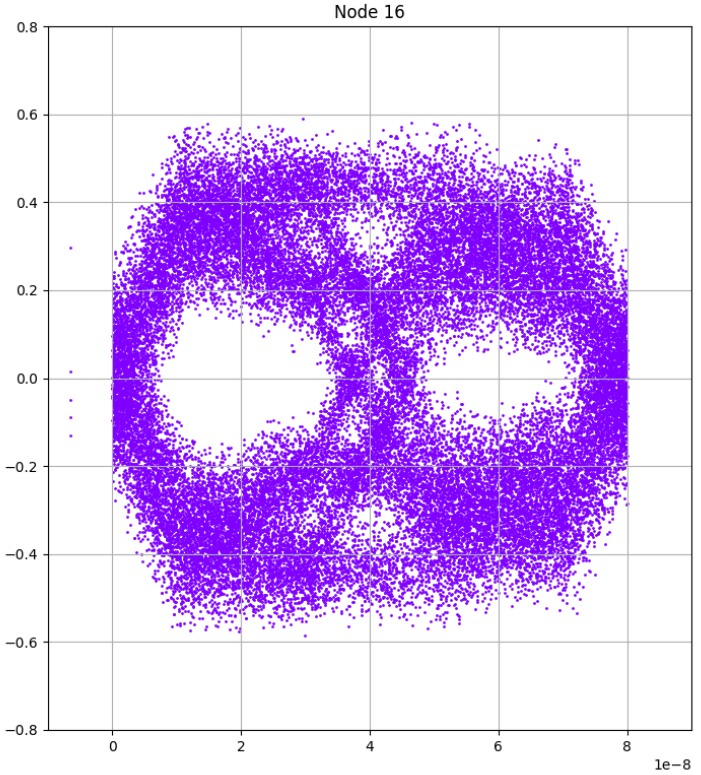
Slide 12 (PoDL), for correlation



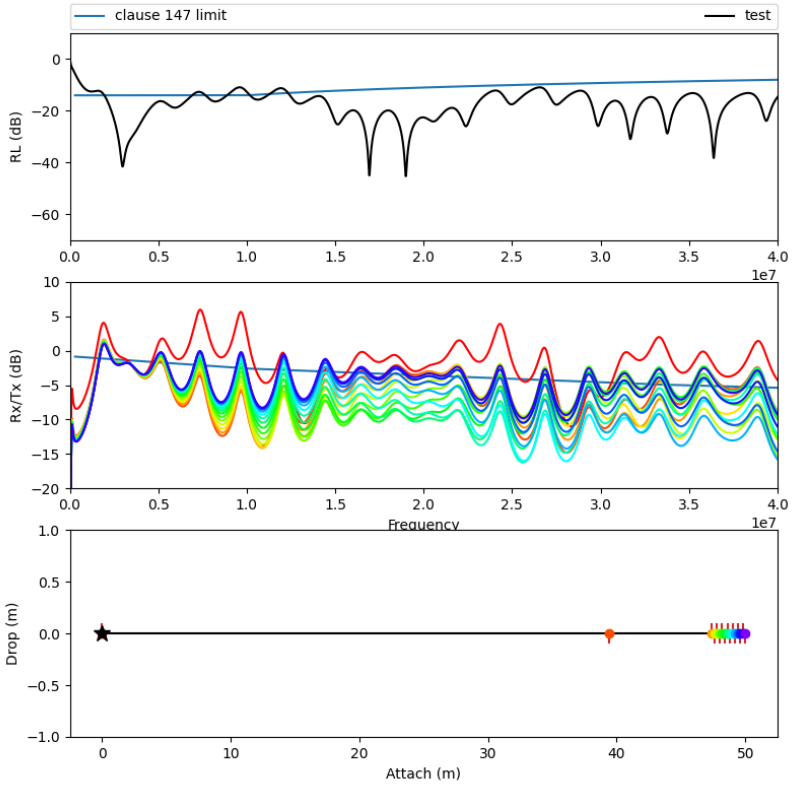
Cnode 30pF, Node 2 Centered

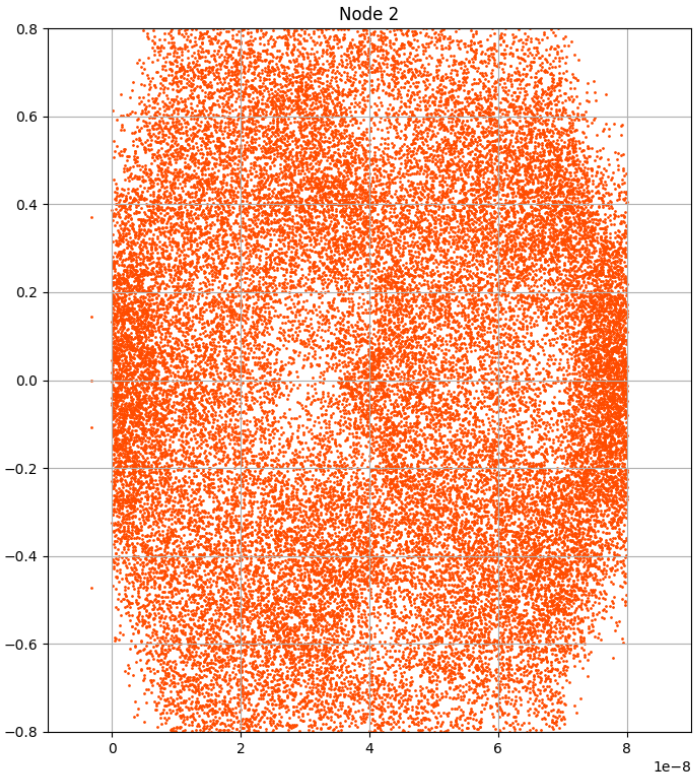


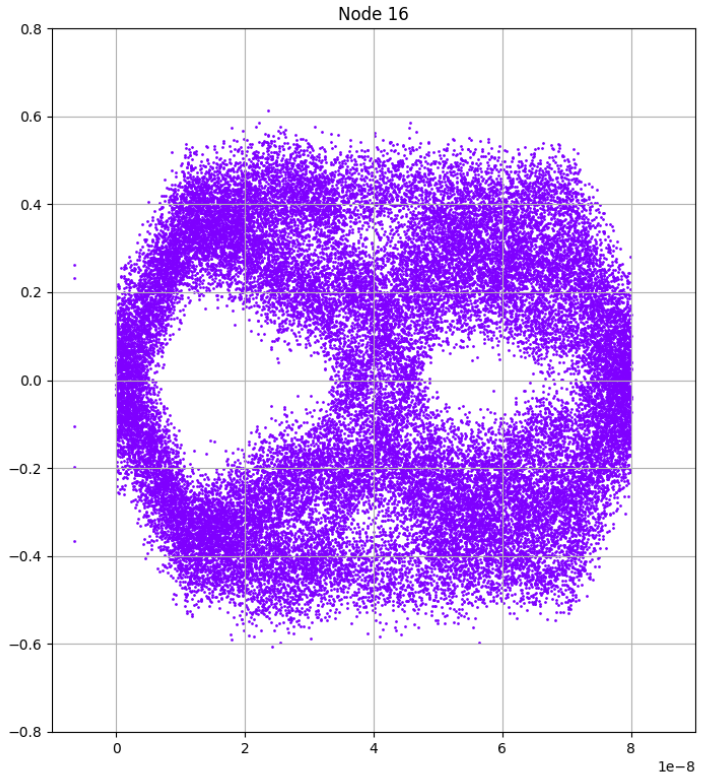




Cnode 30pF, Node 2 8m From Clump



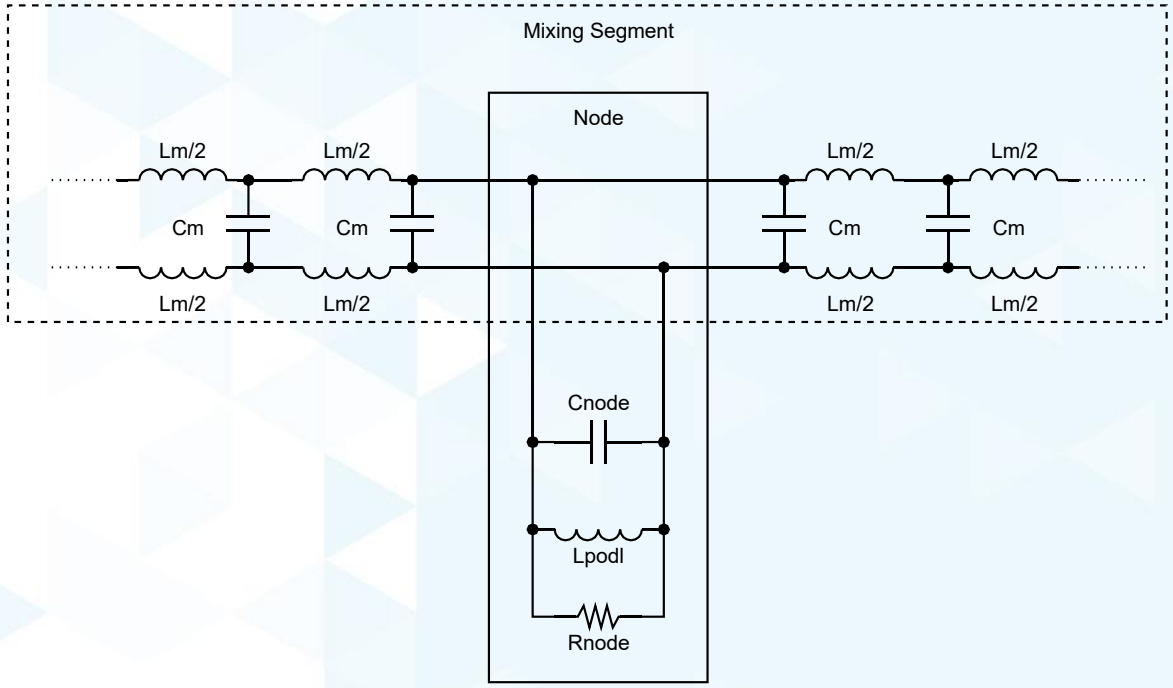




Compensated Nodes

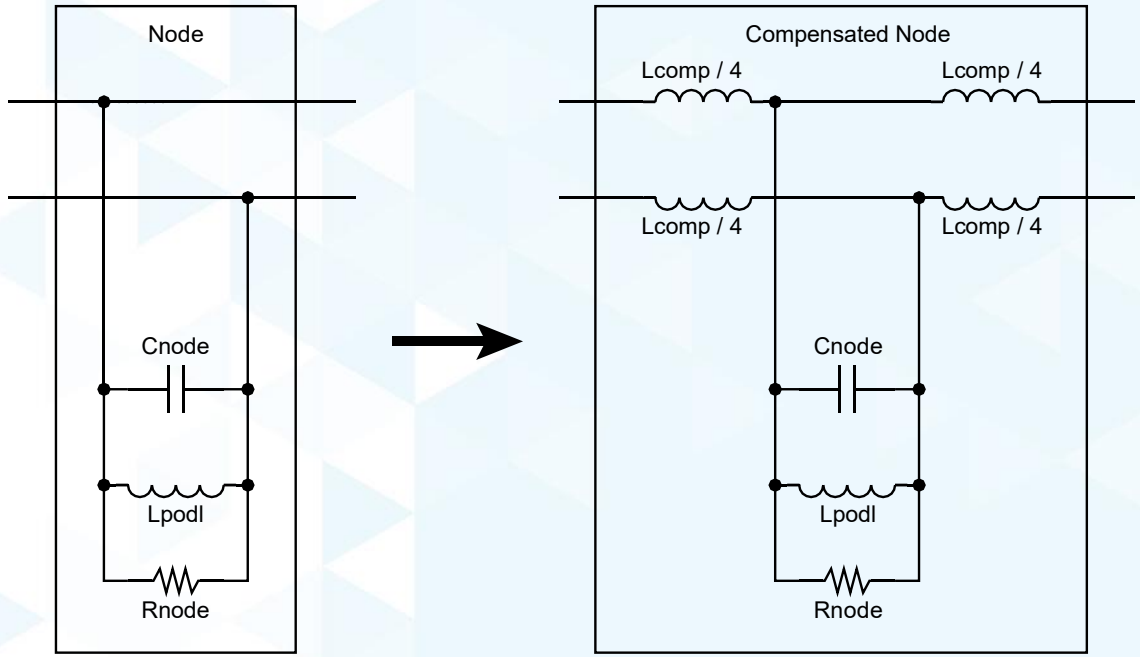
TX Line Impedance

- Tx line impedance: Zo = $\sqrt{Lm/Cm}$
- Nodes change Zo
  - Nodes not matched to Zo
  - Cause reflections
  - Reflections close the TX eyes



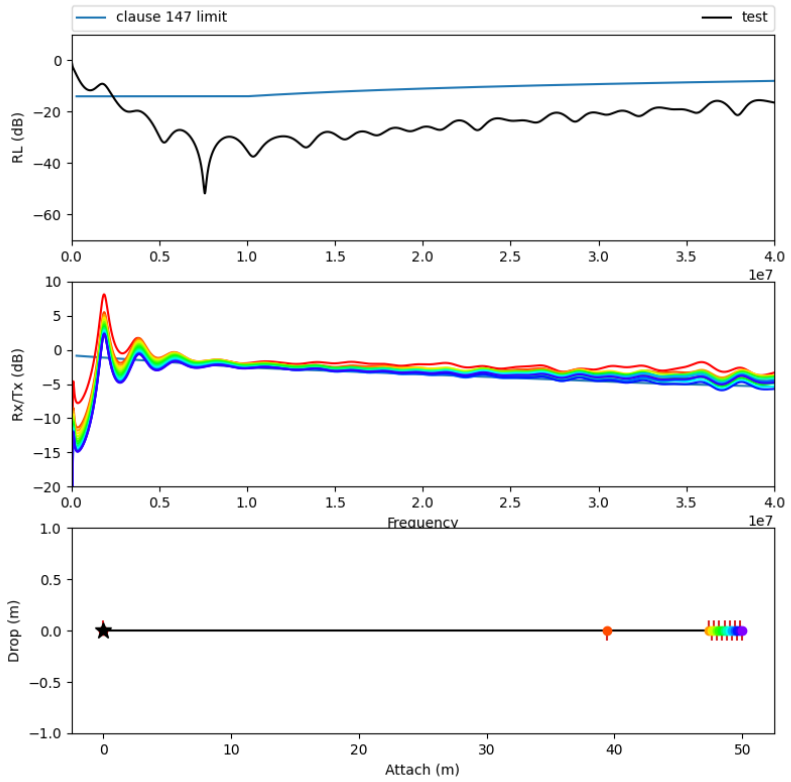
Compensated Node

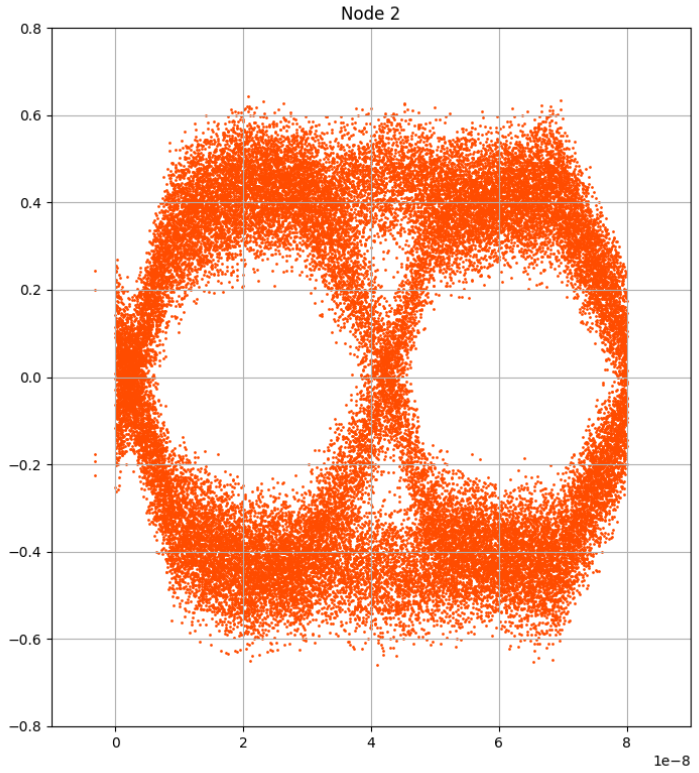
- For Node compensation
  - Treat the node like another Lump in the TX line
  - Add inductors to compensate Cnode
  - Lcomp = Zo^2 * Cnode

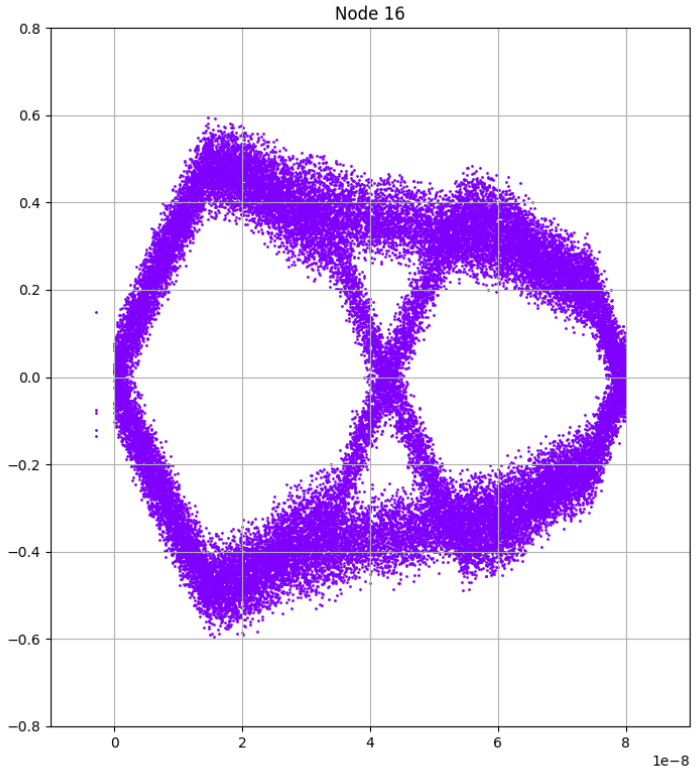


New Node Model

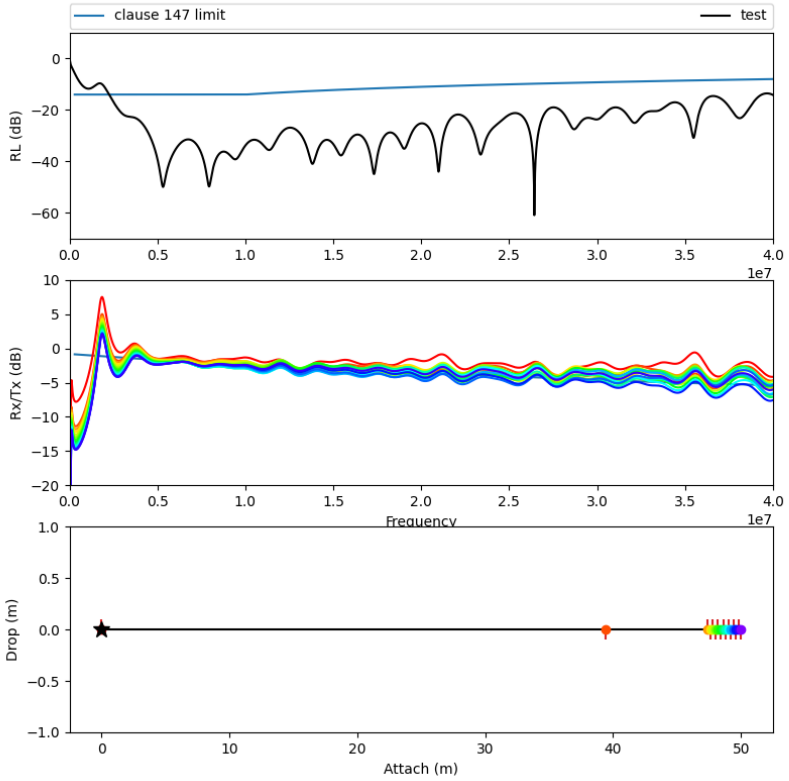
30pF, Node 2 8m from Clump Compensated (Cnode error =0%, Lcomp error=0%)

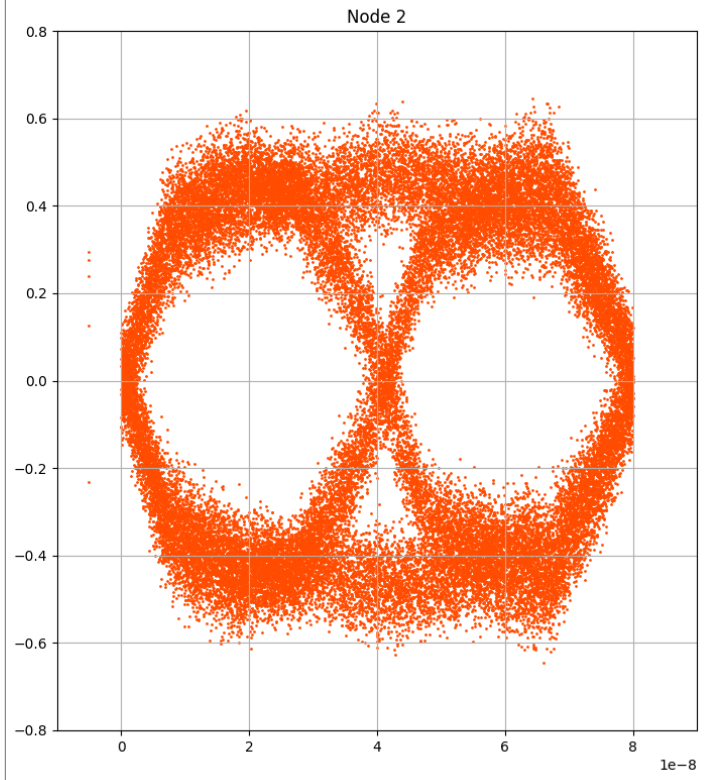


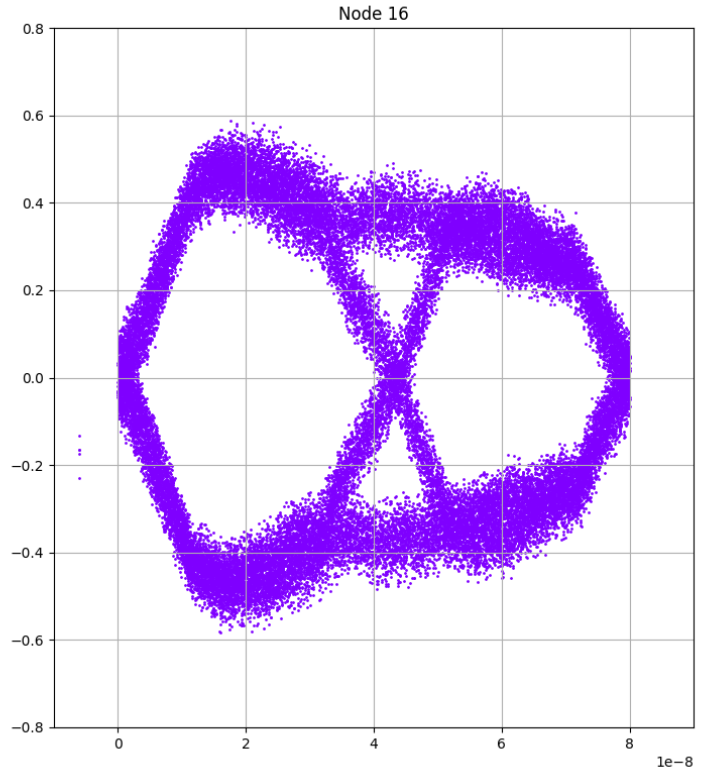




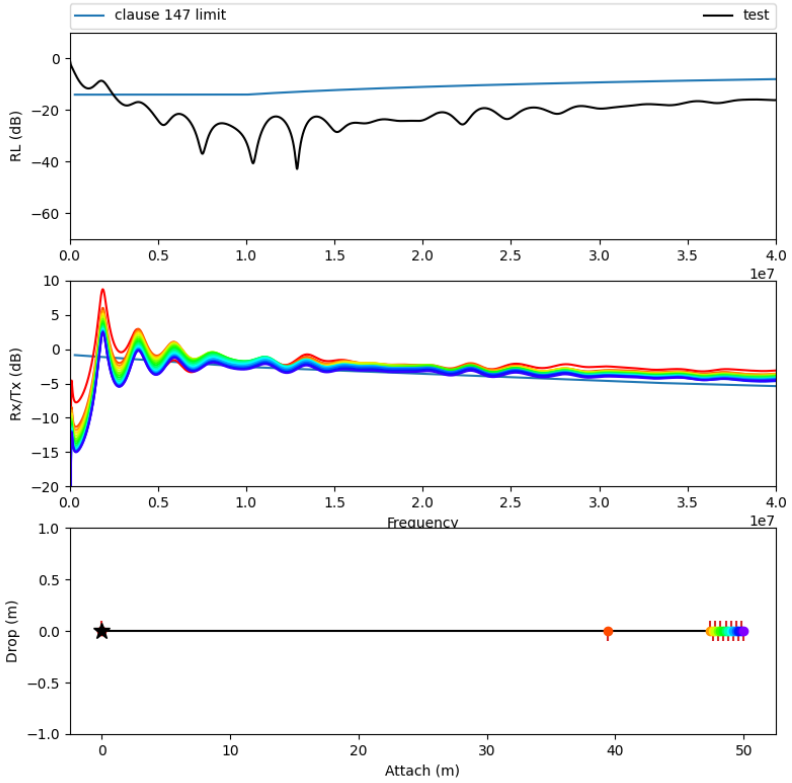
36pF, Node 2 8m from Clump Compensated (Cnode +20%, Lcomp -5%)

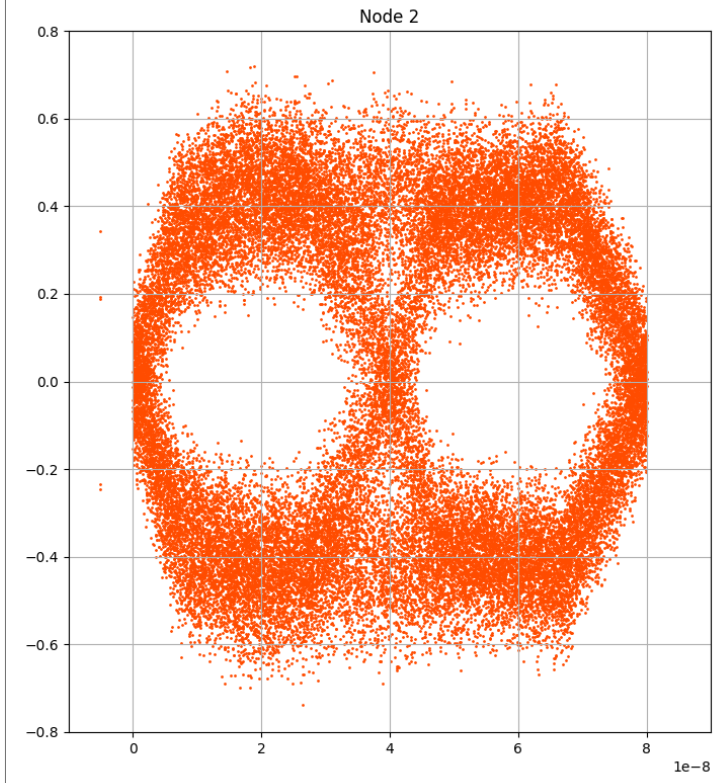


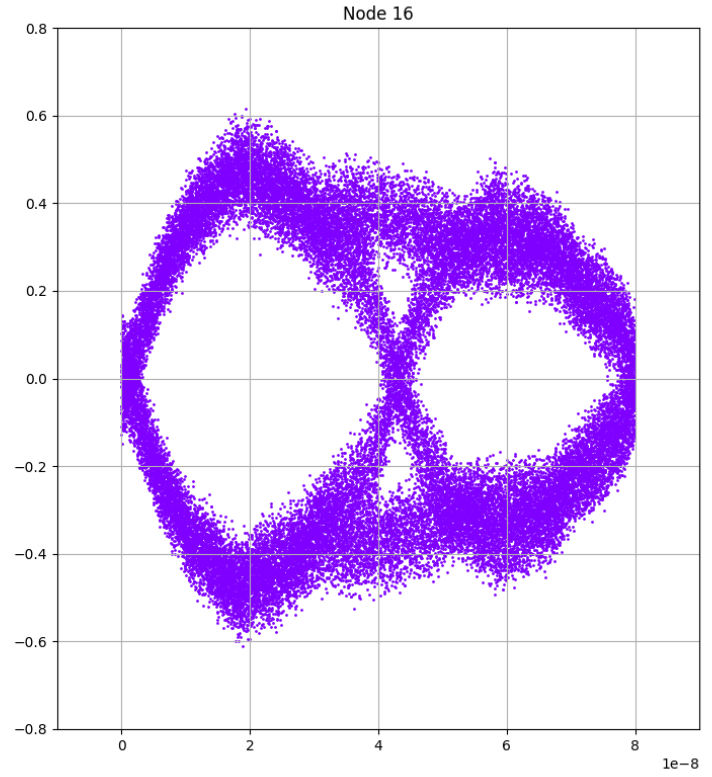




24pF, Node 2 8m from Clump Compensated (Cnode -20%, Lcomp +5%)

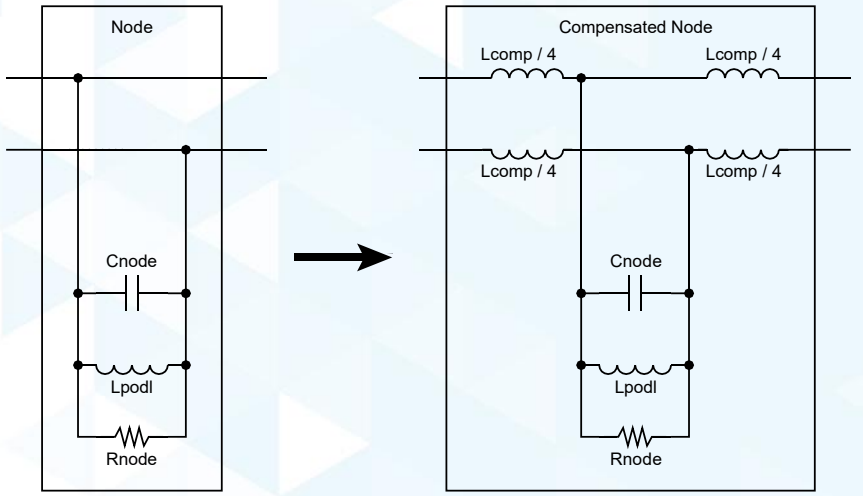






Conclusion

- 30pF Cnode Required for modeling
- IL / RL is not predicting data integrity
- Adjust or discard table 147-4
  - Cnode = 15pF is not realistic
- Require nodes to be compensated
  - Lcomp = Zo^2 * Cnode
- Continue looking for worst case configurations



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