Automotive STP cable measurements

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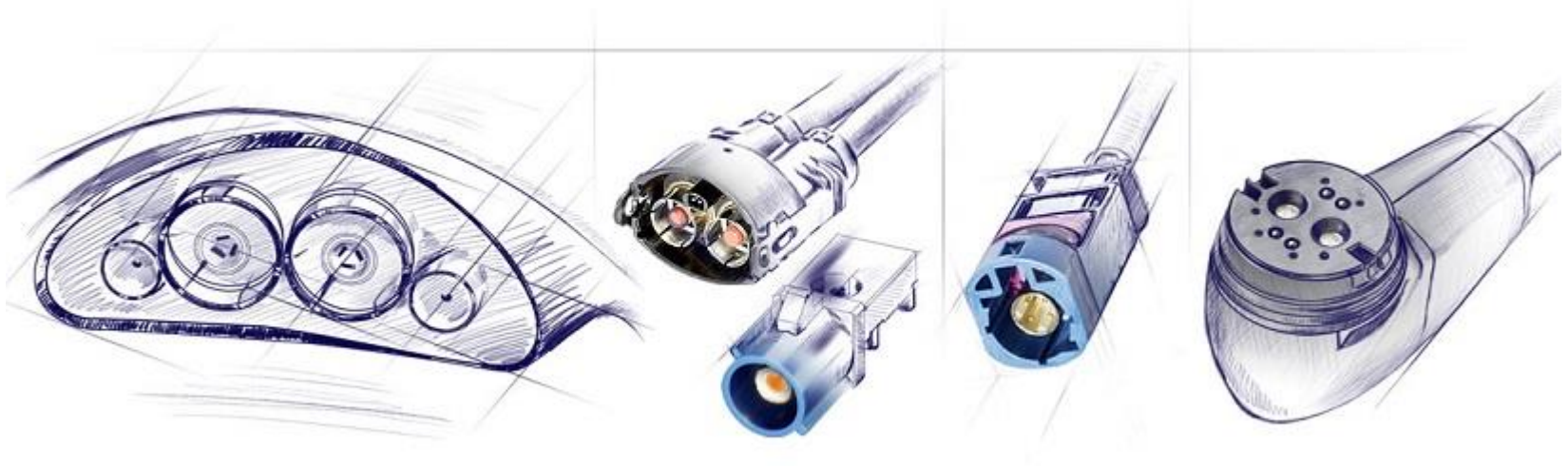

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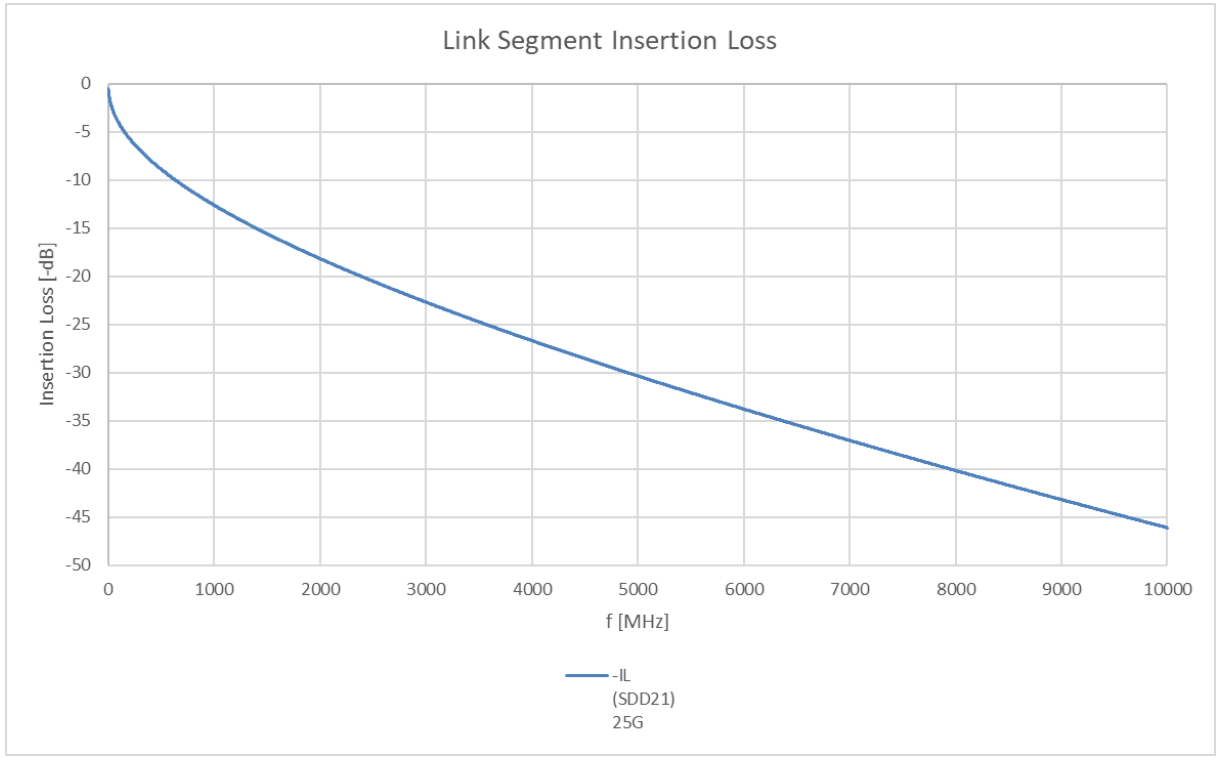
Scope

- To define insertion loss requirements on the link segment, it is necessary to clarify what the typical insertion loss of typical automotive differential cables are, that work in the expected frequency range.
- First reference proposal as in Kadry_3cy_02_0820.pdf

$$IL \leq \underbrace{{}^{11}/_{15}}_{\text{Scaling 15 m to 11 m}} * \underbrace{(0.002\,f + 0.68\,f^{0.45})}_{\text{802.3ch}}$$



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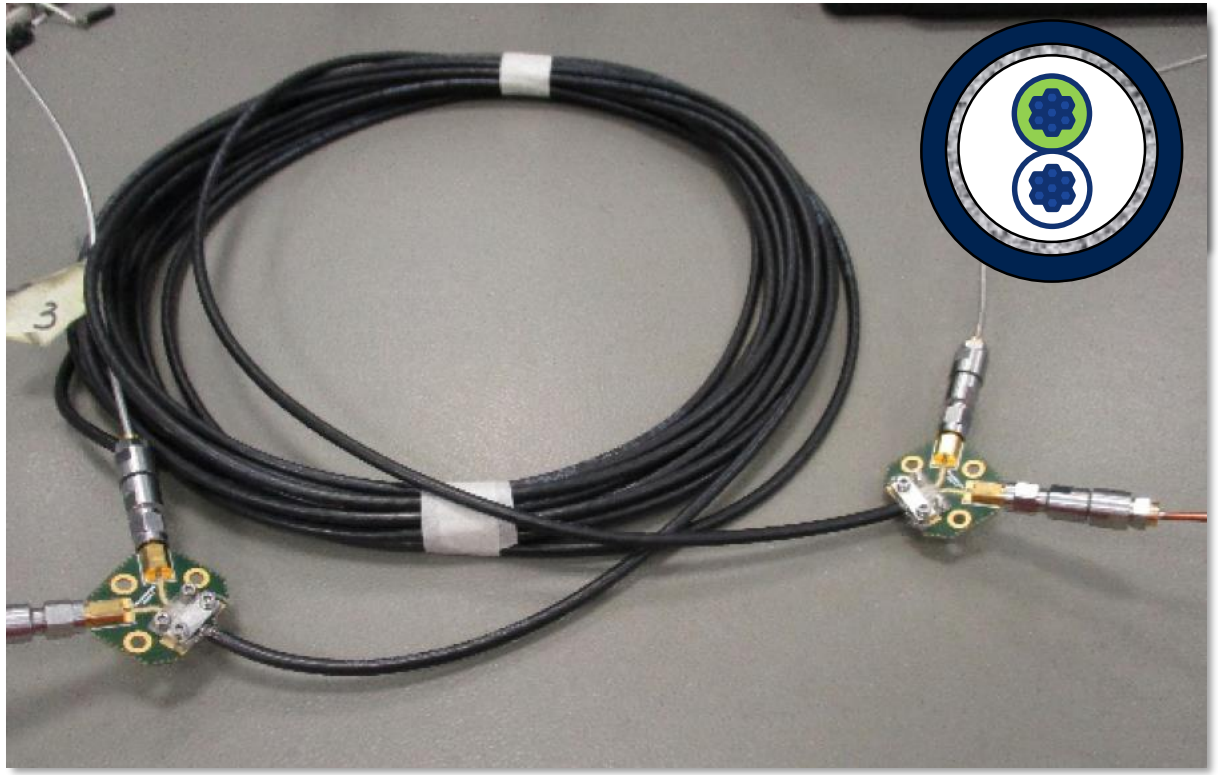
Measurement setup IL and RL

- Automotive STP cable AWG26 (0.14 mm²)
- 10 m sample length, IL results scaled to 11 m.
- Solderless clamping test fixtures
- Network analyzer 20 GHz with test cables and calibration kit.
- Room temperature



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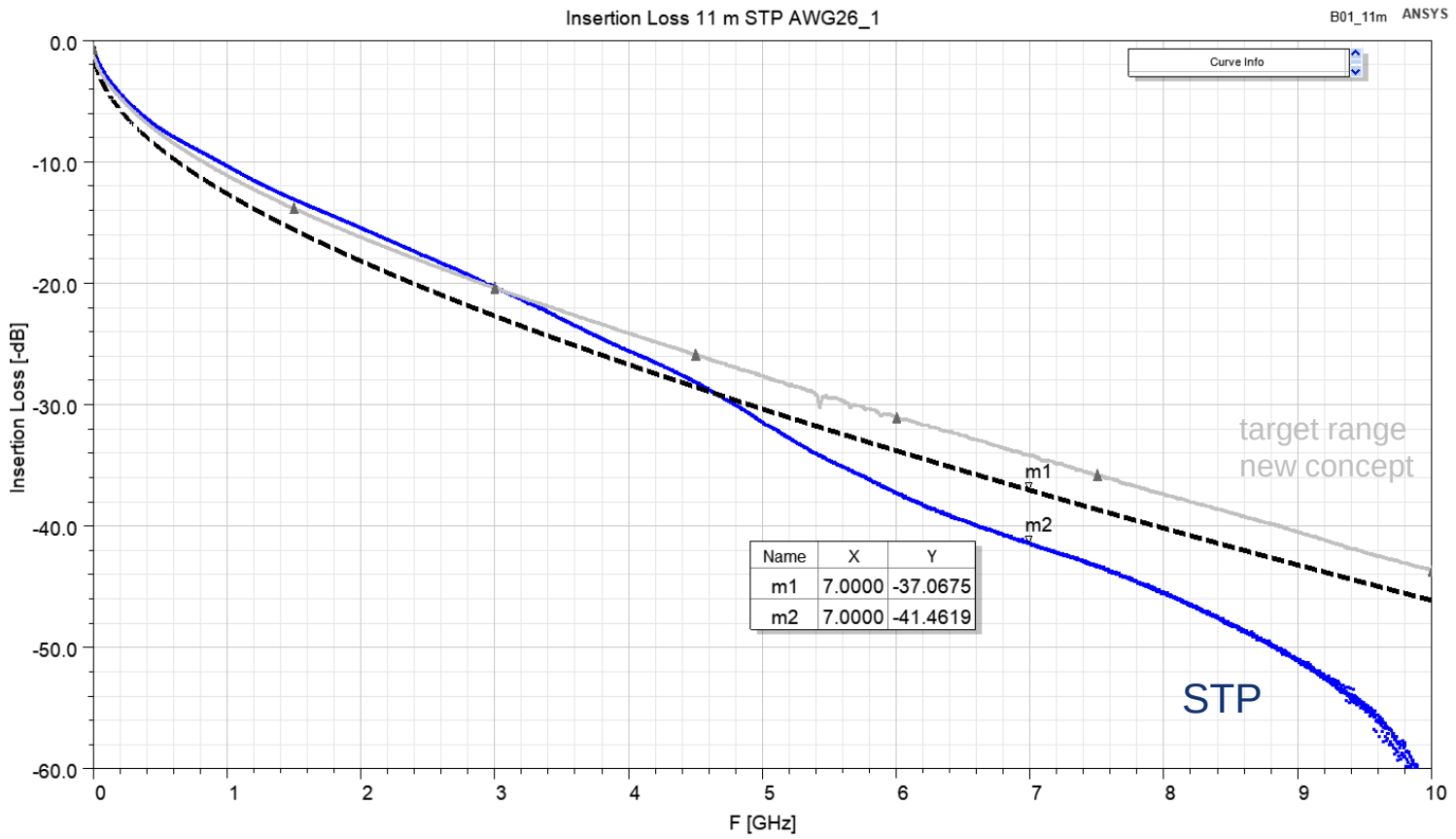
Measurement results IL

- Cable provides 9 GHz bandwidth without resonances
- Insertion loss measured as 41.5 dB @ 7 GHz for 11 m equals 3.8 dB/m
- First proposal would require 37.1 dB @ 7 GHz
- Margin for temperature and aging to be added
- Slope might be improved



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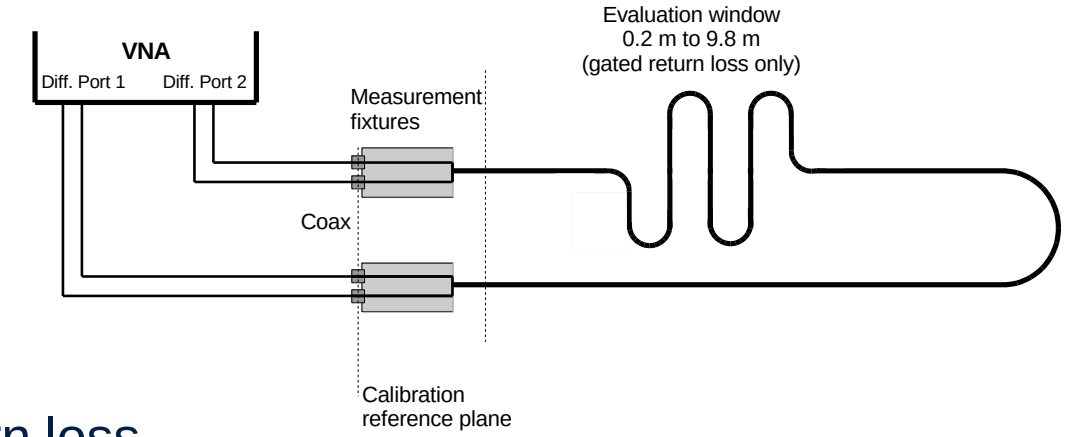
Measurement setup RL



- Distributed small reflexions caused by imperfections along the cable have been reported to cause problems with the echo canceller.
- These can be investigated in time domain as impedance variation or in frequency domain as return loss.
- At higher frequencies, the RL of the measurement fixtures become dominant over the cable.
- The link segment RL requirement is oriented on the connectors and the impedance matching of a cable segments to the connectors. Small reflexions do not contribute to this limit.
- The influence of the test fixtures can be reduced by gating or de-embedding the fixtures out of the measurement result to better see the RL of the cable itself.
- This allows defining a gated RL requirement on the cable, that is easy to measure, to limit impedance variation within the cable.

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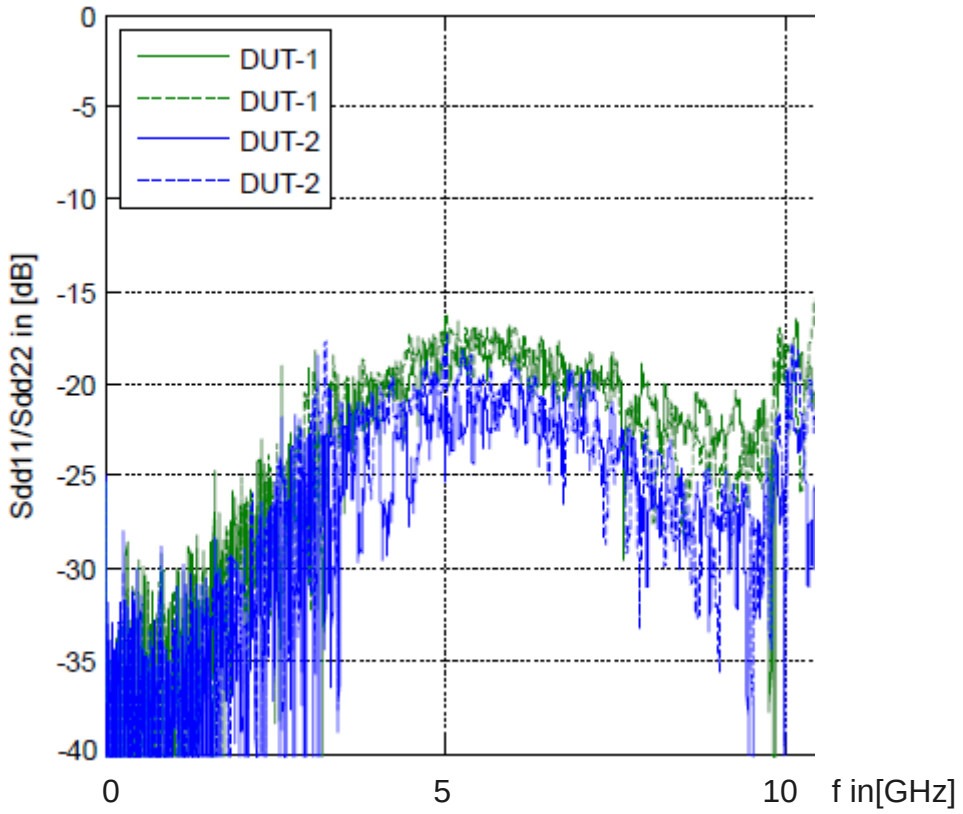
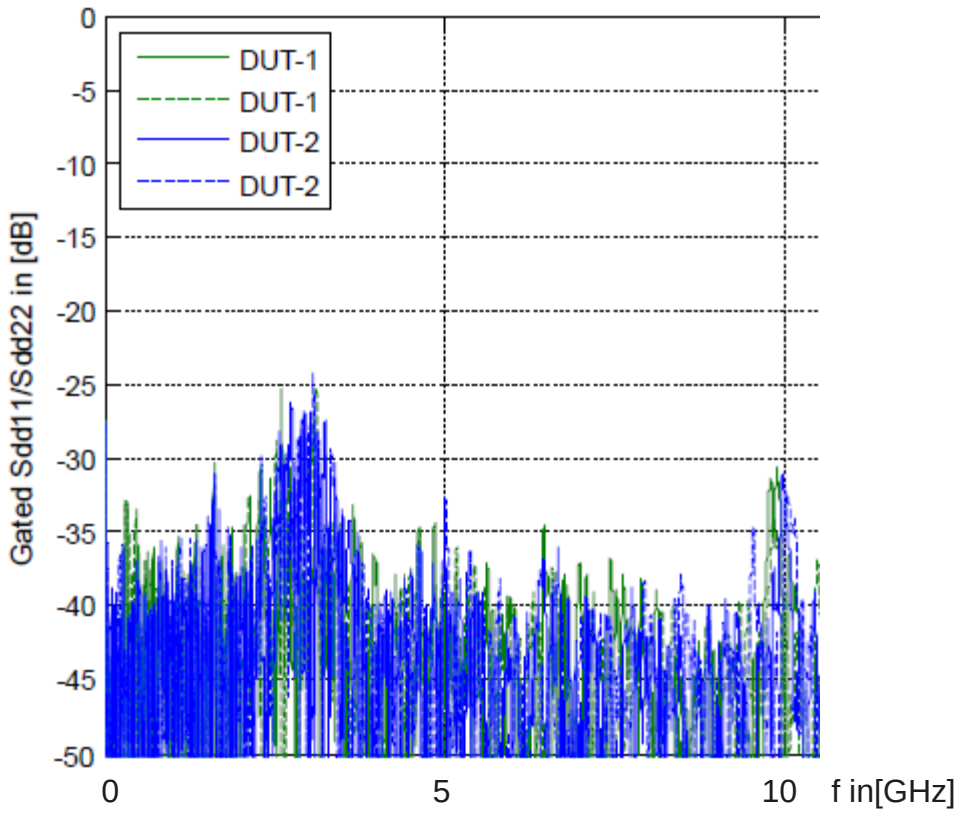
Measurement results RL

RL (fixtures included)



Gated RL (fixtures removed)



- Gating allows to reduce the influence of the measurement fixtures on the RL result

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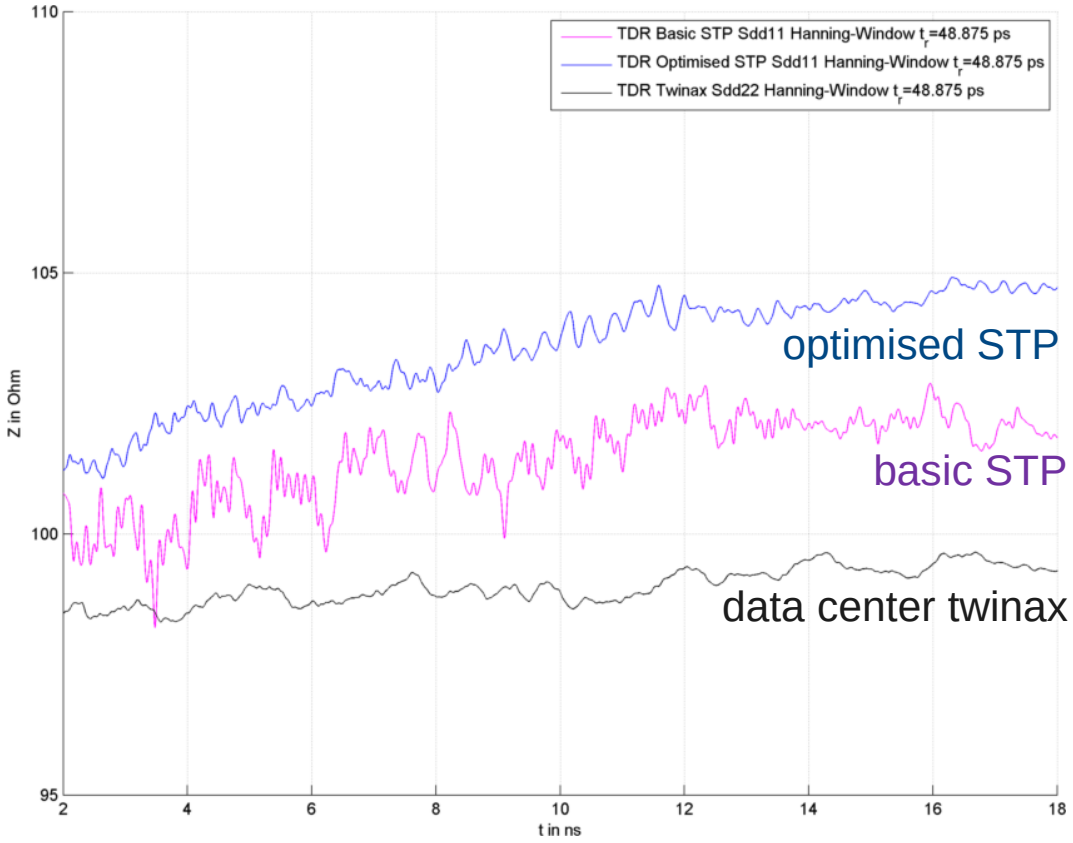
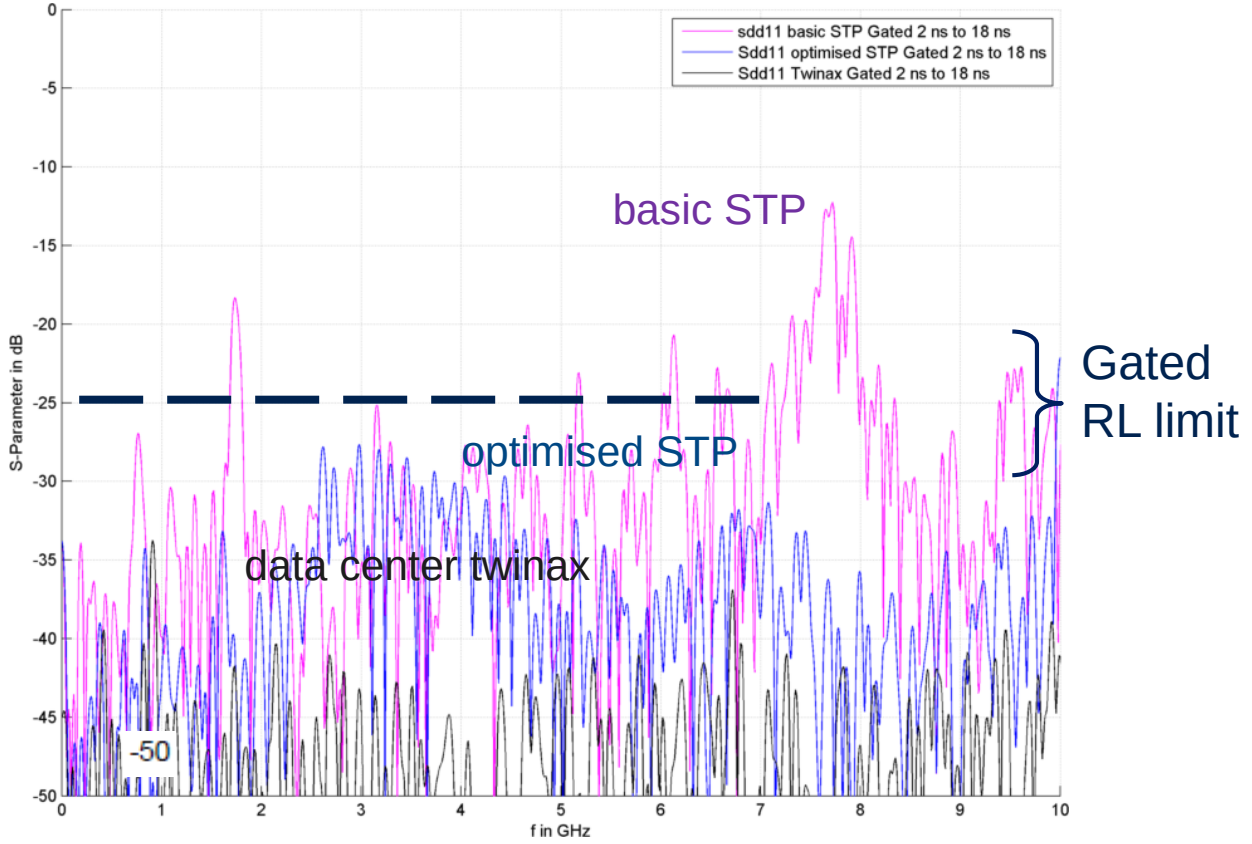
Measurement results Impedance vs. gated RL

Impedance (TDR)



Gated RL



- Define cable gated RL requirement to limit micro-reflexions along the link segment

Conclusion

- STP cables AWG26 (0.14 mm²) with usable ≥ 7 GHz bandwidth are achievable.
- Insertion loss is ~3.8 dB @ 7 GHz per meter at room temperature.
- New cable concepts are under development to combine higher bandwidth and lower loss.
- A gated RL requirement on the cable will limit micro-reflexions.