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IEEE 802.3bp
Alien crosstalk measurements

Thomas Müller, Stephan Kunz, Gunnar Armbrecht (Rosenberger)

Channel measurements
Outline

- Coupling between twisted pair cables
- Alien crosstalk measurement setup
- Measurement results
- Conclusion

Alien Crosstalk
Coupling between twisted pair cables

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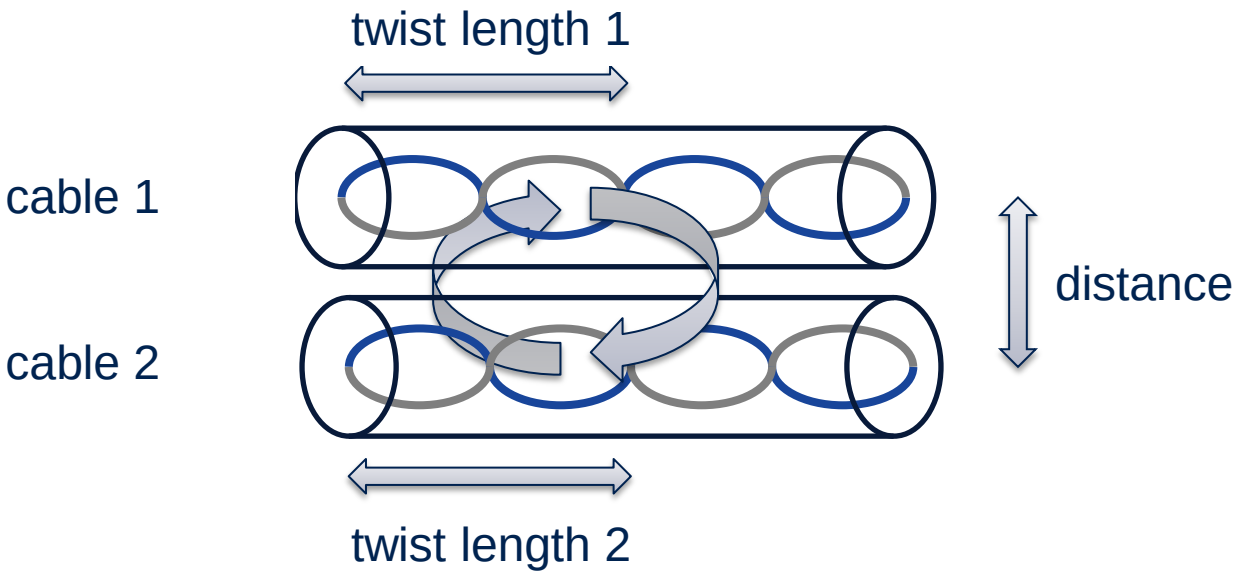
- For well balanced cables, direct differential coupling is predominant over mode conversion related coupling (diff. -> com. || com. -> diff.)
- Direct differential coupling between cables is mainly determined by distance and twist lengths per pair (e.g. CAT6 cables use different twist lengths per pair)



Alien Crosstalk

Four around one – Measurement setup

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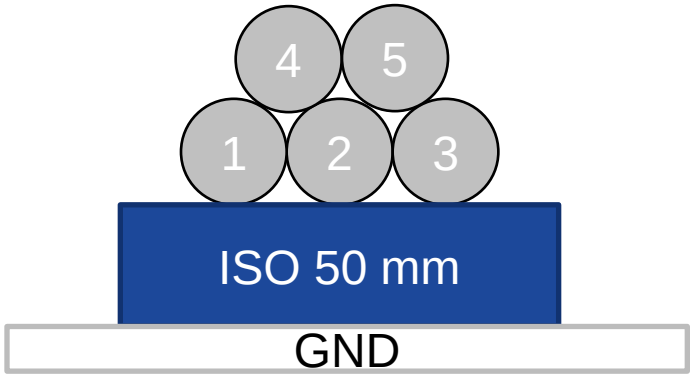
- Four port VNA measurement setup
- Four around one configuration
- With 50 mm isolation material over conducting ground
- Measurement pair feed via single adapter boards to SMA
- Termination with multi- or single-port connectors
- Breakout-Boards floating against ground



Alien Crosstalk

Four around one – Five meter cable without inline

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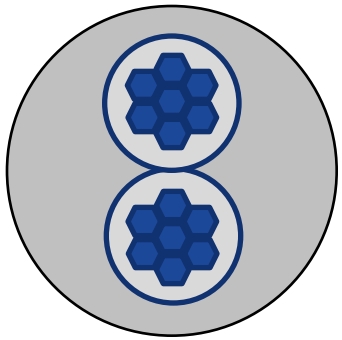
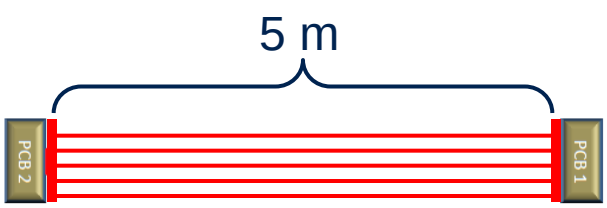
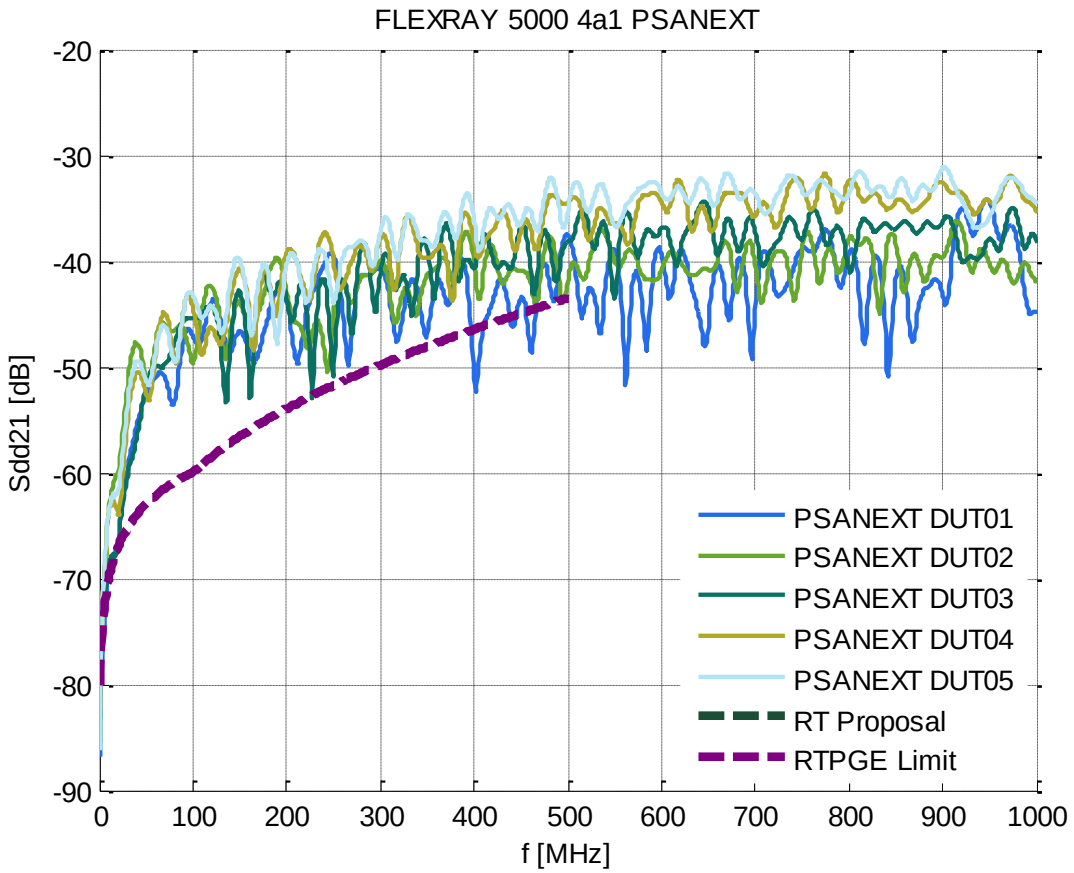
- Typical FlexRay™ cable – PSANEXT



2 x 0.35 qmm

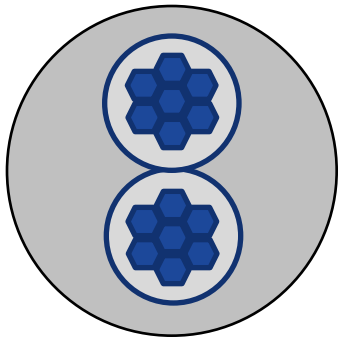
D = 4.0 mm





- Typical jacketed FlexRay™ cables fail to meet the alien crosstalk baseline proposal

- Typical FlexRay™ cable – PSAACR-F



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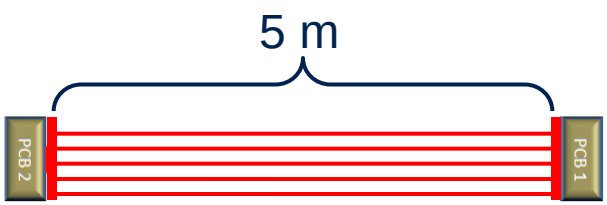

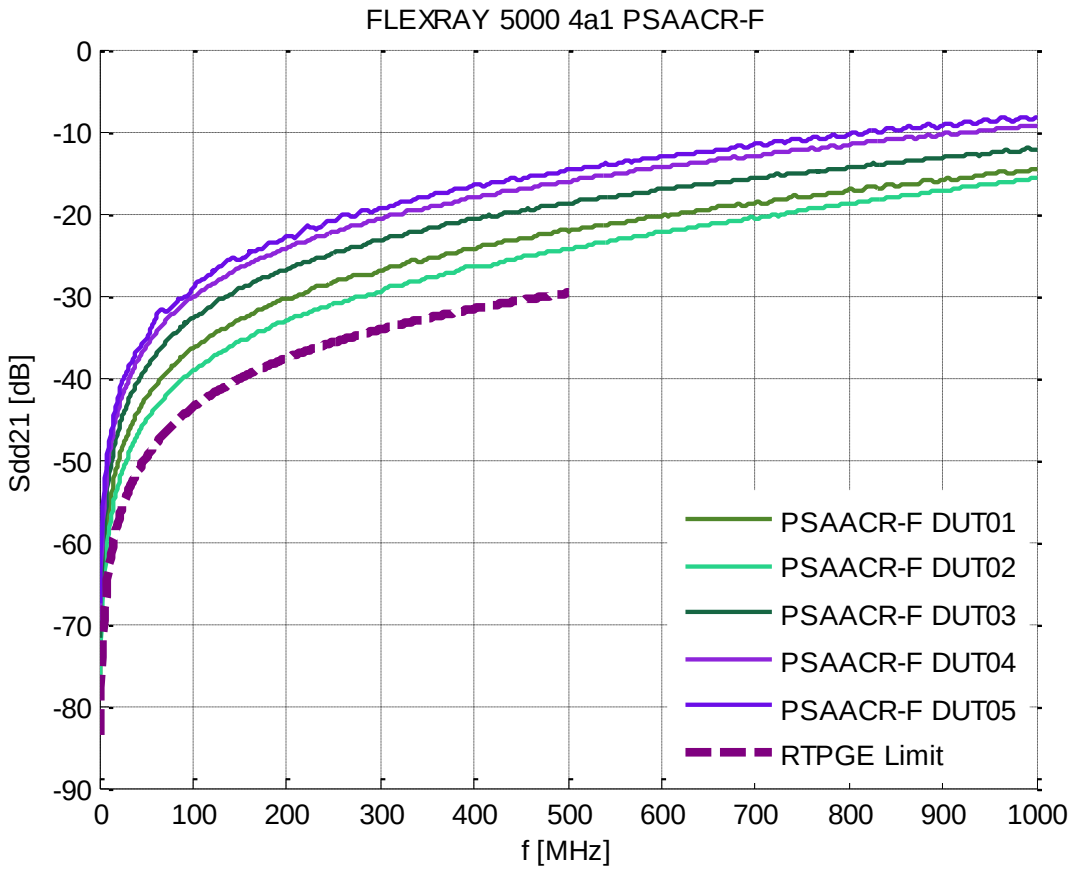

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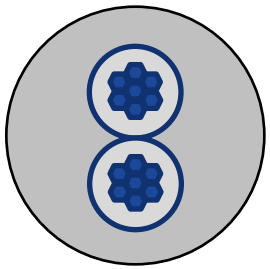
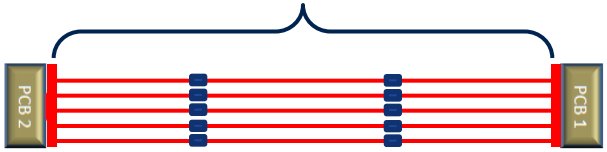
- Standard RTPGE cable – PSANEXT

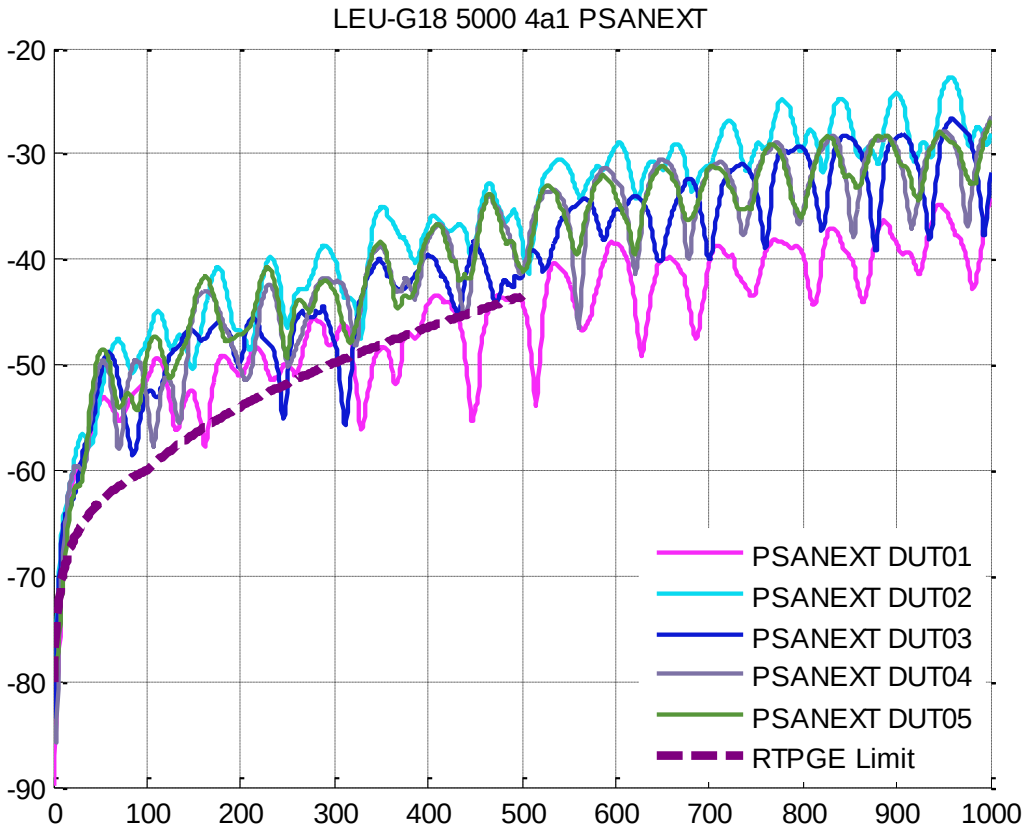


2 x 0.14 qmm

D = 3.2 mm

3 x 1.66 m





- Standard RTPGE cables don’t meet the alien crosstalk baseline proposal

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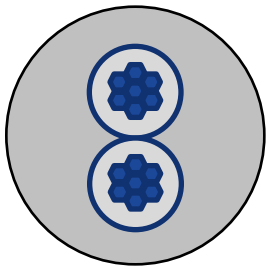

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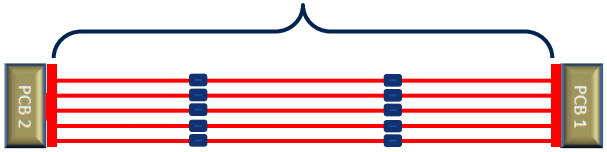
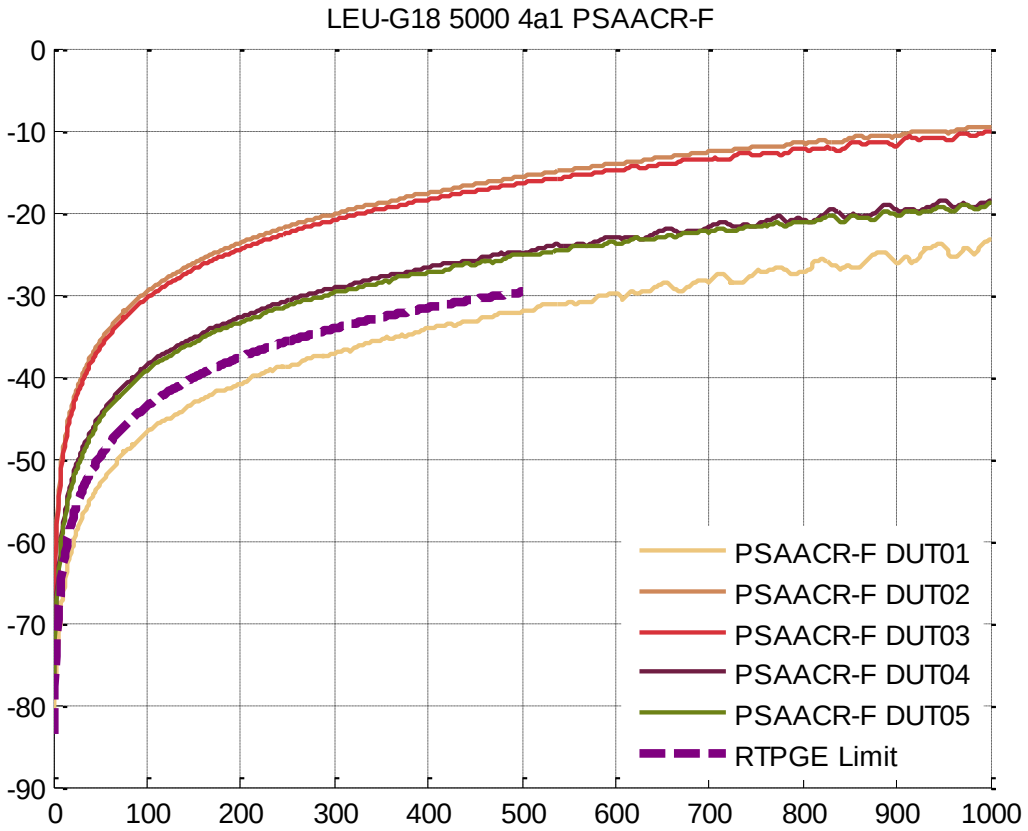
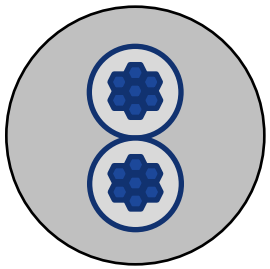




- Standard RTPGE cables don’t meet the alien crosstalk baseline proposal

- Crosstalk-optimised RTPGE cable – PSANEXT



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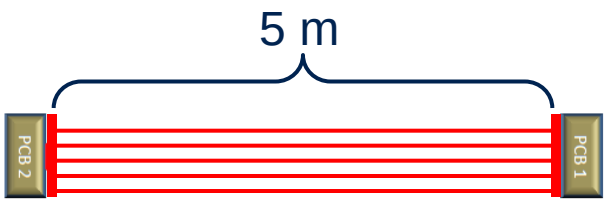
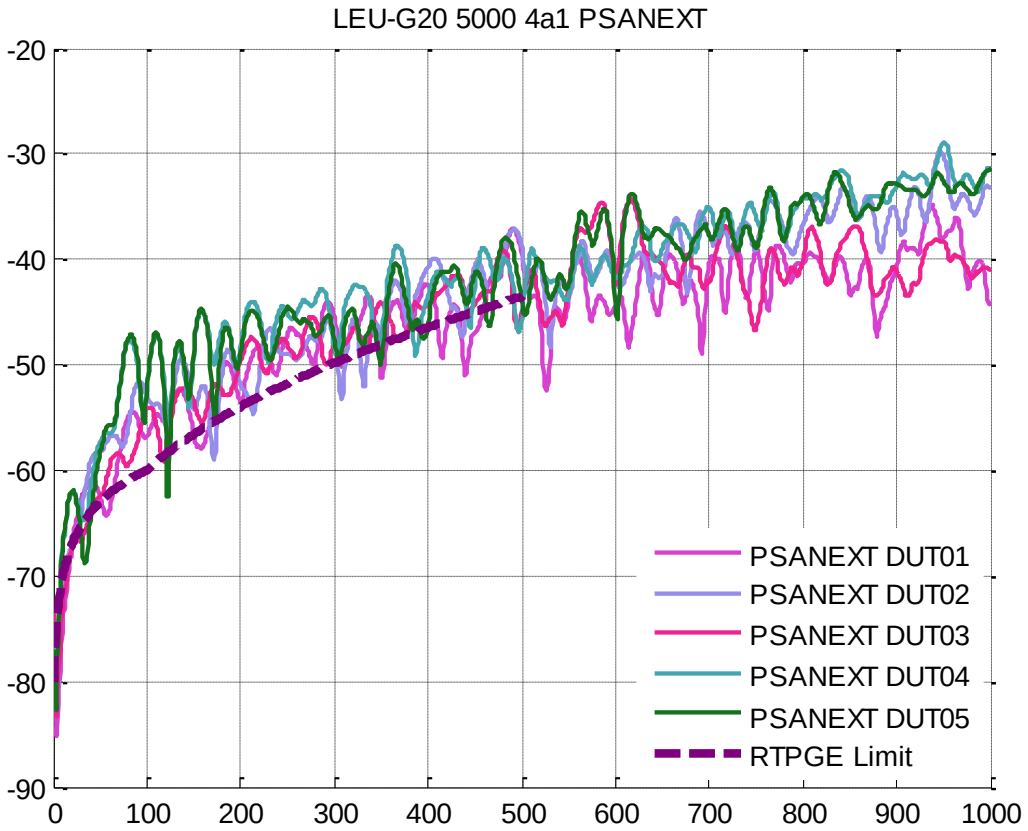
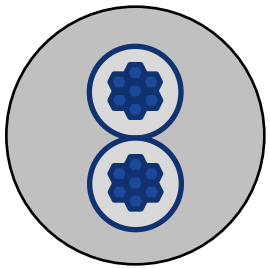




- Crosstalk-optimised RTPGE cables provide ~10 dB better performance, but still don't meet the baseline proposal

- Crosstalk-optimised RTPGE cable – PSAACR-F



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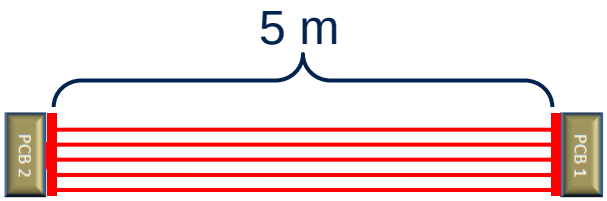

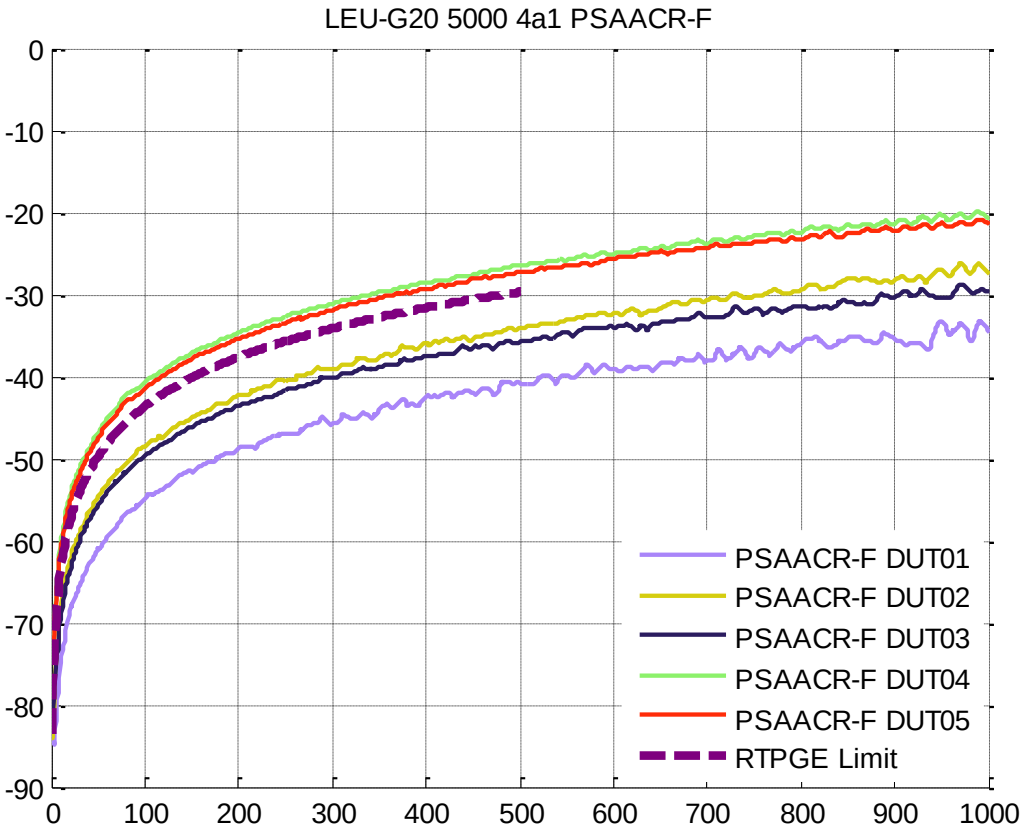

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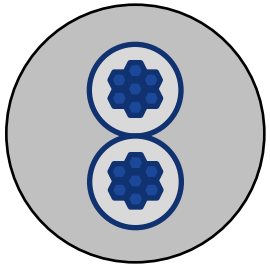

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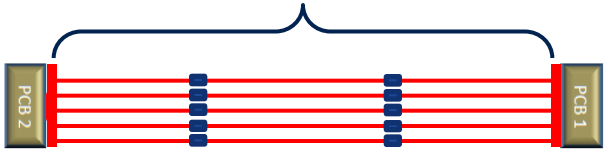
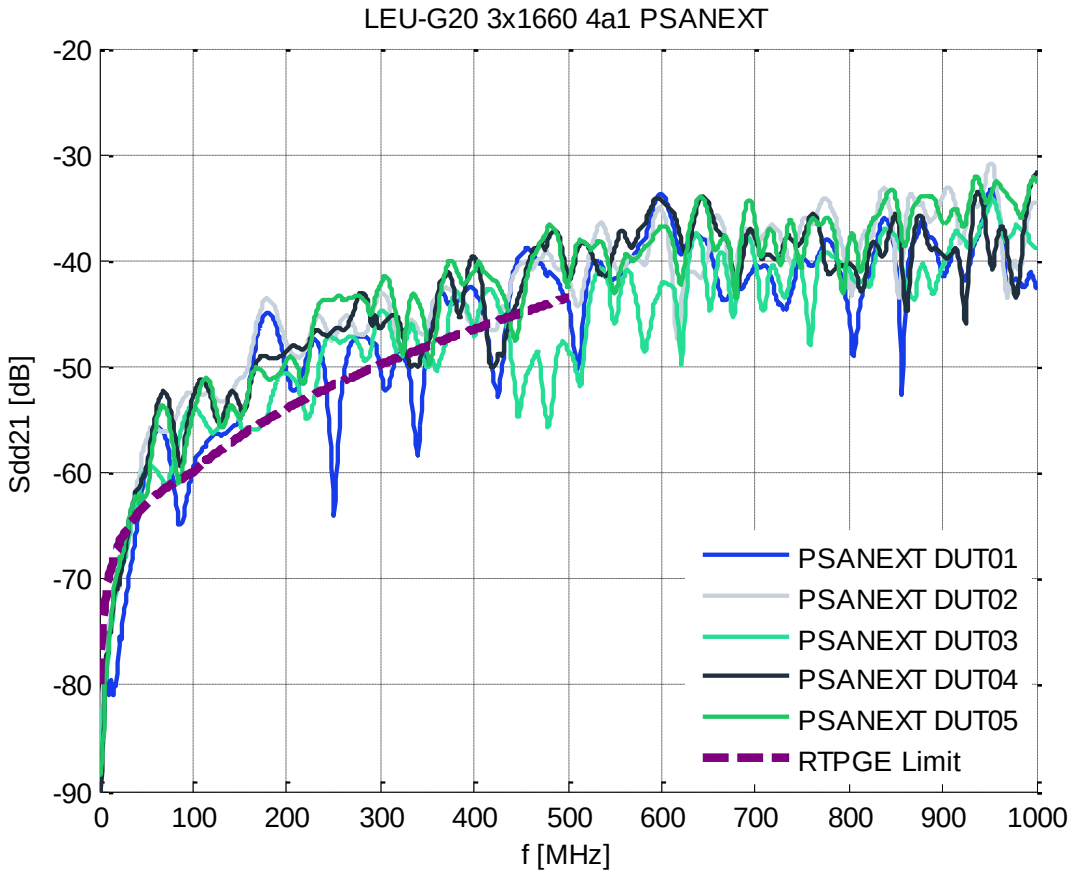
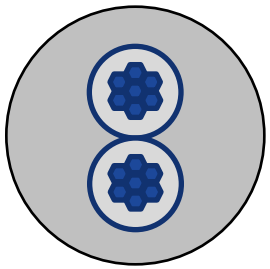




- The influence of inline-connectors on alien crosstalk is low

- Crosstalk-optimised RTPGE cable – PSAACR-F



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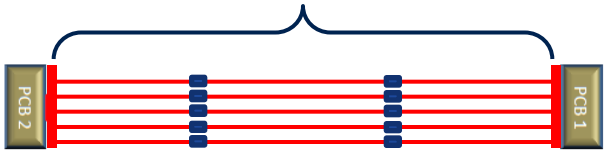

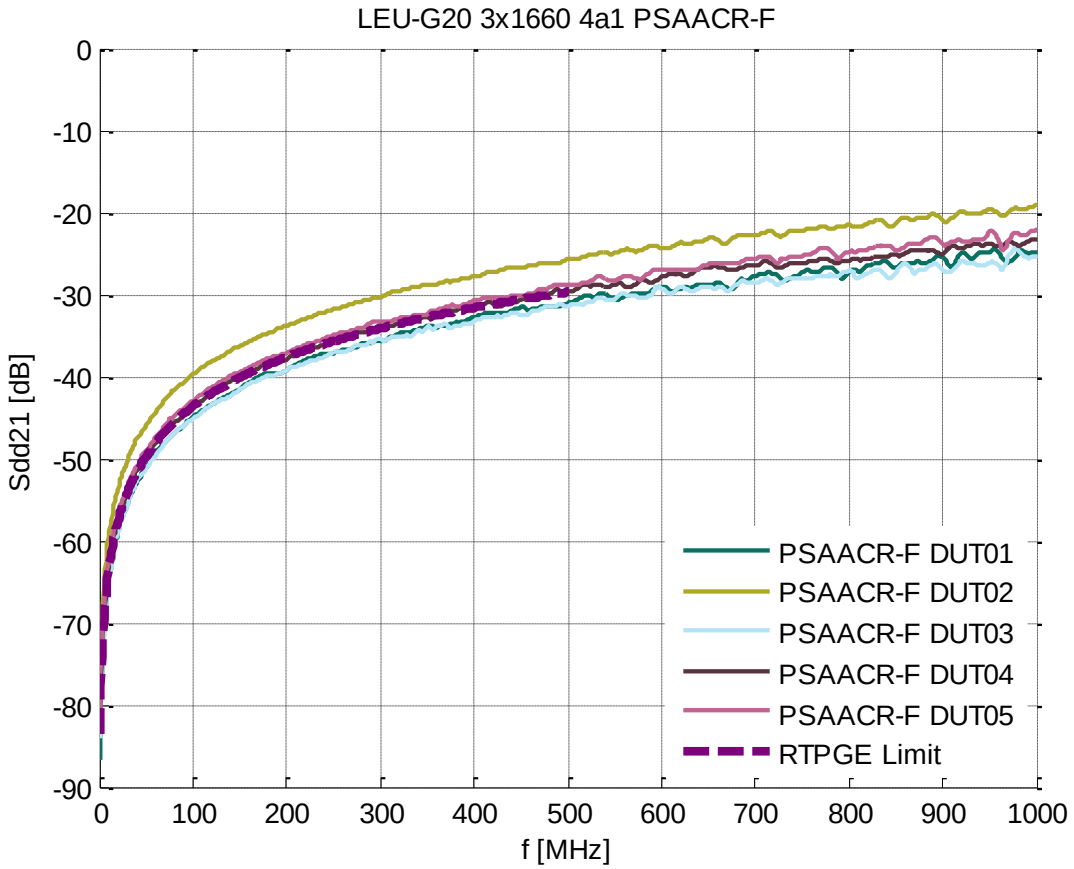

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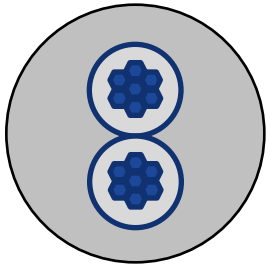

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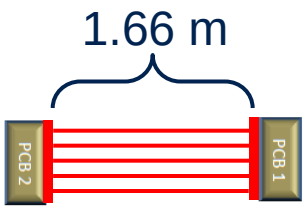

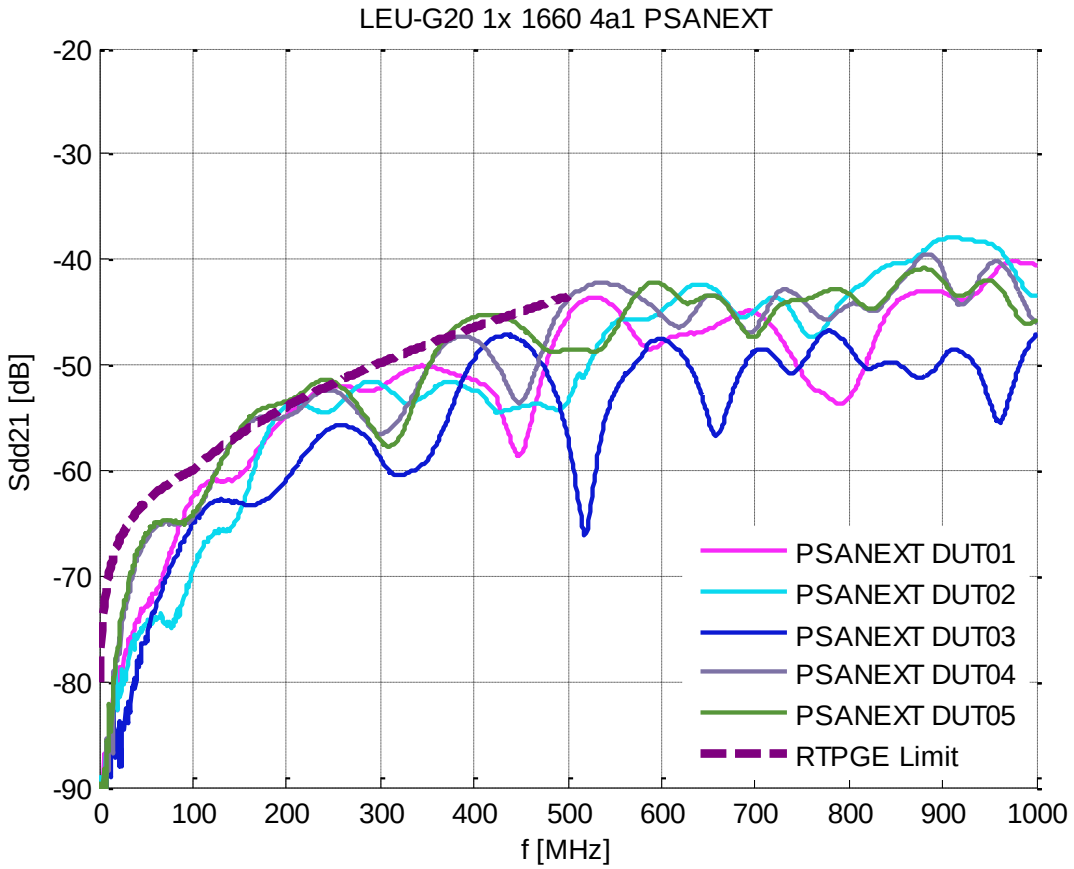

- The influence of cable length on PSAACR-F is larger than on PSANEXT

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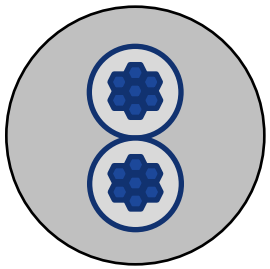

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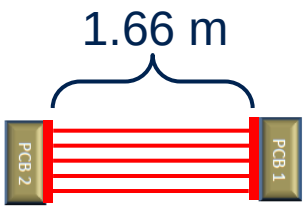

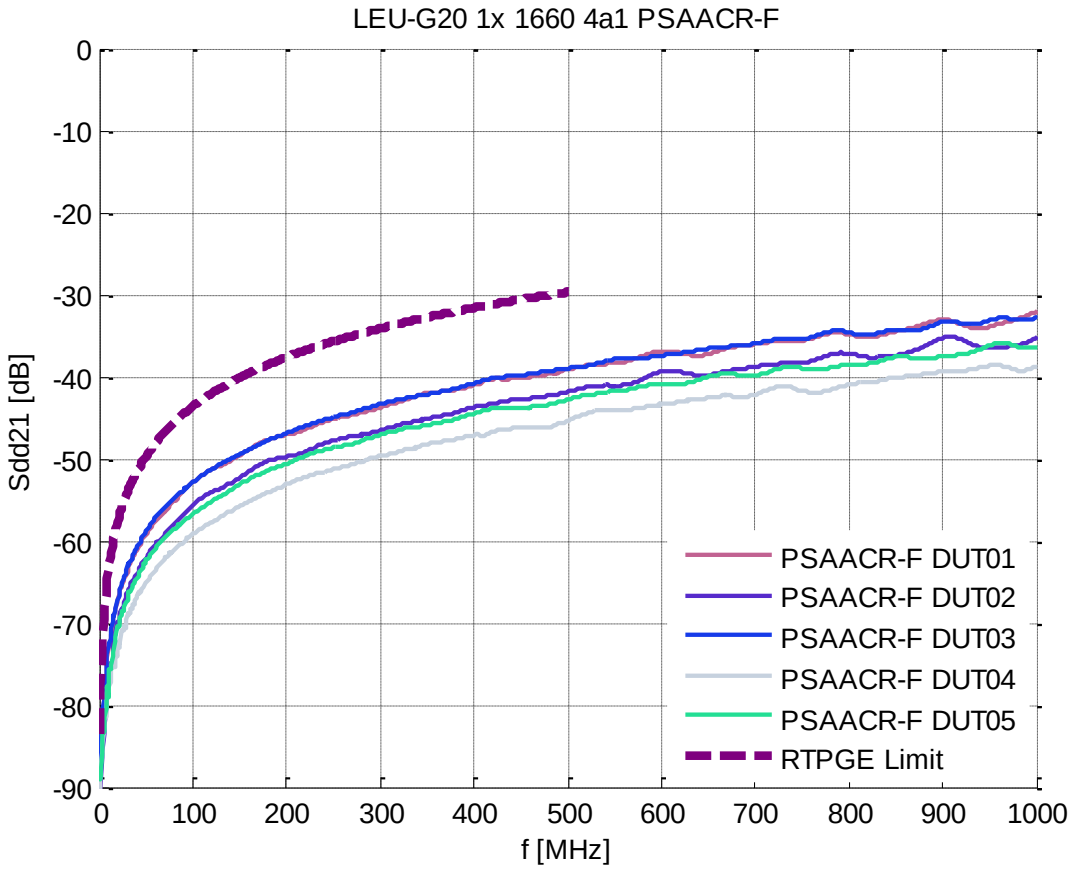

- The influence of cable length on PSAACR-F is larger than on PSANEXT

Alien Crosstalk
Conclusion

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- Alien crosstalk is mainly caused by differential than common mode crosstalk, which is highly depended on distance between cables
- Alien crosstalk between differential pairs can be improved by using different twist-lengths, as used in in structured wiring LAN cables, which is not an option for automotive
- Current cables are optimised for low attenuation and high balance while maintaining minimum size, weight and cost
- Increasing the distance between cables by increasing the jacket diameter will substantially increase space, weight, attenuation and cost
- Baseline proposal should not end up in a single source for cables
- Is this strict alien crosstalk limit really technically needed for reliable link operation?
- Request to change the baseline proposal for PSNEXT to more generally attainable values

Backup

- PSANEXT scenario to be verified

Existing baseline

$60 - 10\log\left(\frac{f}{100}\right)$ [1 to 100 MHz]

$60 - 15\log\left(\frac{f}{100}\right) - 6 * \left(\frac{f-100}{400}\right)$ [100 to 600 MHz]

Proposed baseline

$\mathbf{54} - 10\log\left(\frac{f}{100}\right)$ [1 to 100 MHz]

$\mathbf{54} - 15\log\left(\frac{f}{100}\right) - 6 * \left(\frac{f-100}{400}\right)$ [100 to 600 MHz]