Insertion Loss limit update proposal

Gerrit den Besten (NXP)
Ricky Vernickel (Leoni)
Thomas Müller (Rosenberger)
Josef Ohni (MD Elektonik)

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Insertion Loss

- What to do with the 3-4GHz range for 10Gbps operation?
- A) Extend limit line formula to 4GHz
  - All presented cable data suitable for 10Gbps operation showed well behaved characteristics beyond 4GHz
  - Easiest approach, preferable if there are no further complications
- B) Add a steep roll-off term beyond 3GHz to IL formula
  - Difficult to avoid impact on current limit line <3GHz
- C) Apply a separate formula for 3-4GHz range
  - Smoothly connecting with IL<3GHz formula for overall curve
- Proposed to use approach A

Objectives

- Cover frequency range 1MHz – 4GHz
- Resolve previous low-frequency issues
- Get a smooth physically viable limit curve
- Defined by single formula for full freq range and all speeds
- IL~0.65dB at 1MHz, similar to 1000BASE-T1 (same gauge)
- Enable 2½ and 5Gbps operation over 15m AWG26 cable with >2dB margin on shortly-aged performance
- Do not increase IL at Nyquist for 10Gbps (29.5dB)

Function format

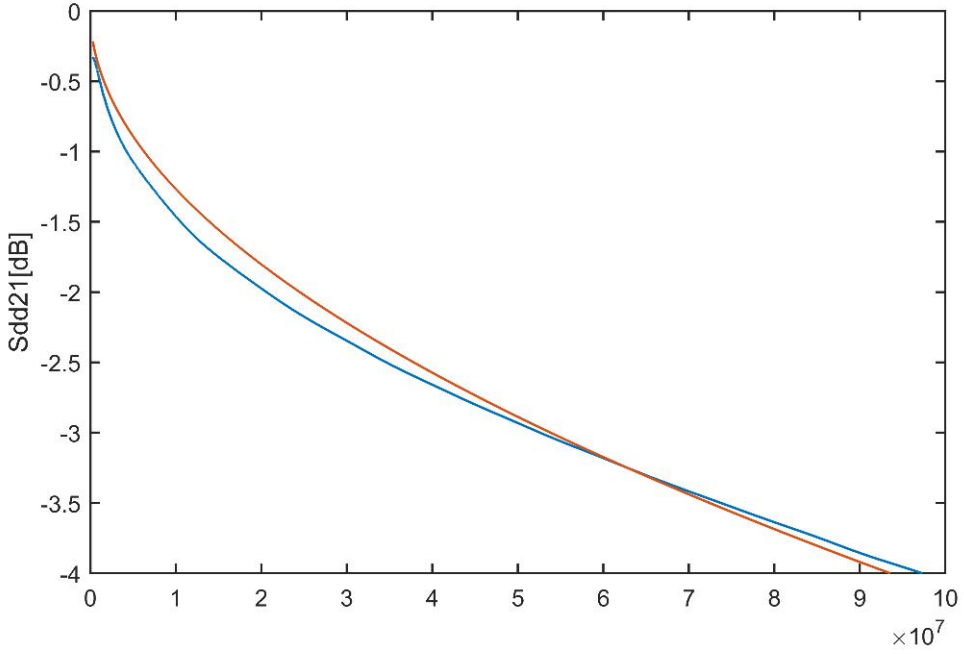
$$IL[dB] = c_1 \cdot f^{\,p} + c_2 \cdot f$$

- Low-frequency measured IL cable data shows a p<0.5
- Reason for low-frequency issues before
- Best fit:
  - C_1=0.68
  - C_2=0.002
  - p=0.45

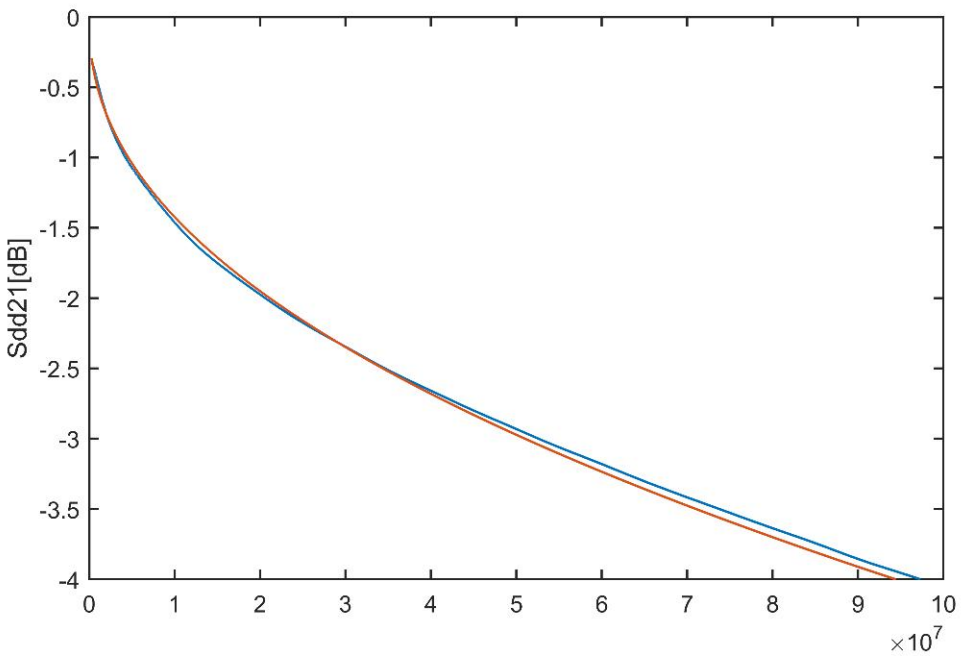
Justification for p<½

- Actual cable characteristic show this behavior

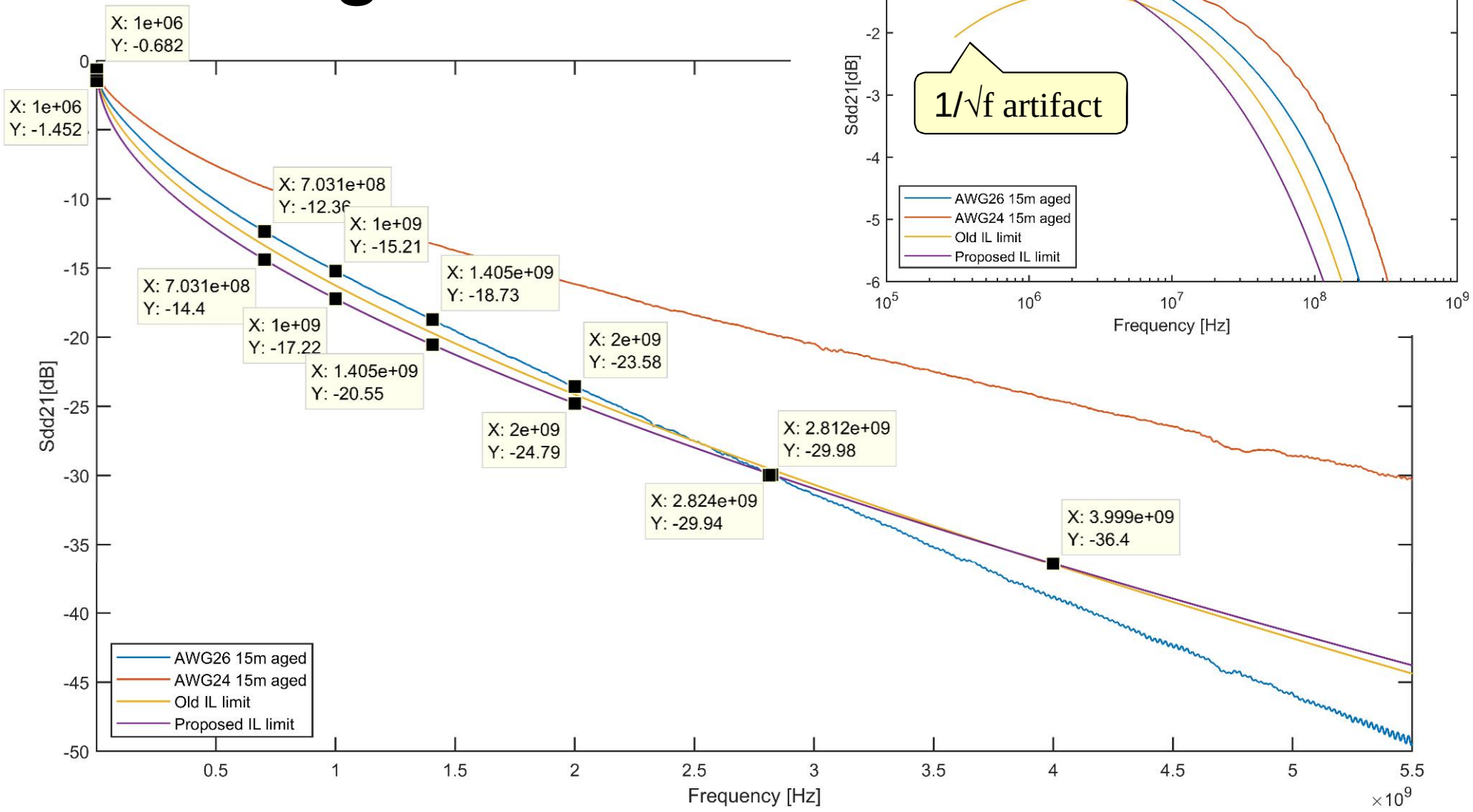
$$IL[dB] = c_1 \cdot f^{0.5} + c_2 \cdot f$$



$$IL[dB] = c_1 \cdot f^{0.45} + c_2 \cdot f$$



Resulting function



- All objectives closely approximated with simple function

Proposed IL limit

$$IL \leq 0.68 \cdot f^{0.45} + 0.002 \cdot f \ [dB]$$

- Simple formula
- Low frequency issues resolved
- Margin to ensure 2½ & 5Gbps operation over 15m AWG26 cable

Summary

- IL and RL for 2½, 5, and 10 Gbps makes up 6 cases in total
- For 5-out-of-6 cases the requirements are reduced
  - 2½Gbps (IL: 3GHz → 1GHz, RL: 5.5GHz → 1GHz)
  - 5Gbps (IL: 3GHz → 2GHz, RL: 5.5GHz → 2GHz)
  - 10Gbps (RL: 5.5GHz → 4GHz)
- Extend 10Gbps IL limit line to 4GHz
  - Note that previously the corresponding RL was specified up to 5.5GHz
  - A suck-out between 4 and 5.5GHz is also an issue with previous limits (RL tends to peak on a IL suck-out)
  - Data of 10Gbps-capable cables don't show suck-outs below 4GHz

Motion

Motion

- Move to adopt the Insertion Loss limit for all speed grades:

$$IL \leq 0.68 \cdot f^{0.45} + 0.002 \cdot f \; [dB]$$

- M: Gerrit den Besten
- S: Ricky Vernickel