Coupling Attenuation and IL Limit Proposal for 2.5 Gbit/s

Supply current coupling attenuation measurements and an insertion loss limit line proposal for 2.5 Gbit/s

Josef Ohni (MD Elektronik)

November 13, 2018

Supporters:

Ricky Vernickel – LEONI Kabel GmbH

Motivation and Agenda

Motivation

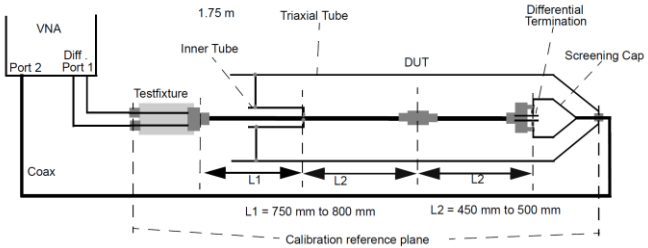
- Supply current coupling attenuation measurements
- Insertion loss limit for 2.5 Gbit/s - discussion and proposal

Agenda

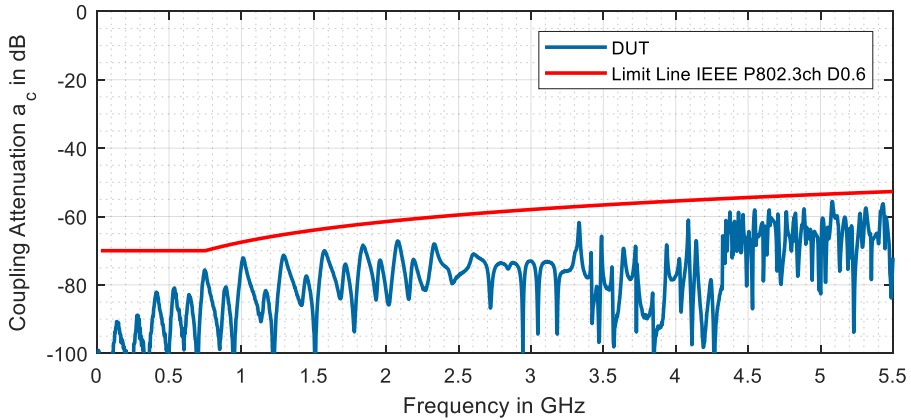
- Coupling attenuation
  - Test setup
  - Measurement results
- Insertion loss and return loss – 15 m Link (current STP cable and connector)
- Insertion loss STP cable – long term heat aging 3000h @ 105°C
- 2.5 Gbit/s Insertion loss limit proposal

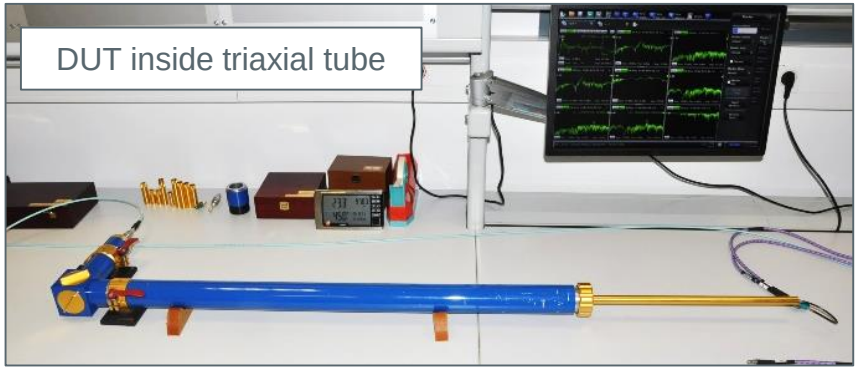
Coupling Attenuation

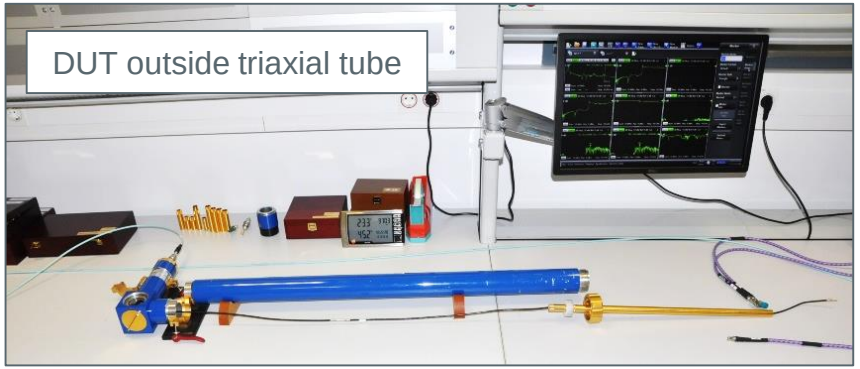
IEEE 802.ch D0.6 / Figure 149A–2 / Coupling attenuation reference cable assembly measurement setup



(1) VNA measure S-Parameter S_{SD21}
(2) Coupling Attenuation $A_c = S_{SD21} - 10*\log10((2*Z_s)/Z_{diff})$
(3) Z_s = 150 Ω and Z_{diff} = differential wave impedance of DUT





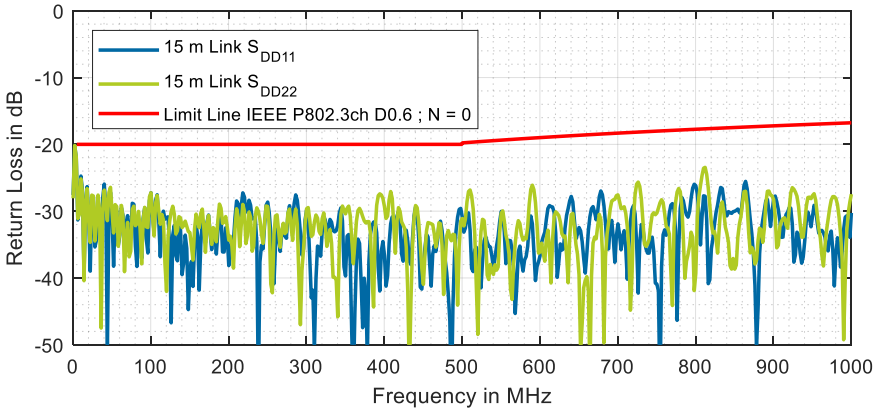


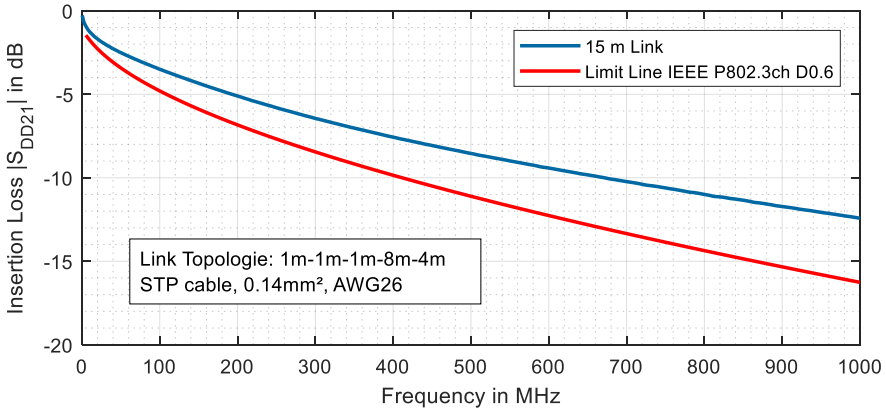
- **Current cable assemblies meet the limit line**

Insertion Loss and Return Loss Measurement

15m link with 4 inline connectors, STP cable, 0.14mm², AWG26

SMA connector
PCB connector
male connector
female connector
STP cable AWG 26





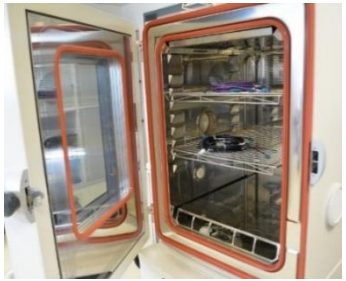
- **Use current insertion loss limit formula and parameters for 2.5GBASE-T1 and change max frequency to 1 GHz**
- **Current STP cable (AWG 26) and connector have much margin**

IEEE 802.3ch D0.6 (Current Limit for all speeds)
IL_{DB} (f) ≤ 0.002*f + 0.45*√f + 1/√f with f in MHz; 5 ≤ f ≤ 3000

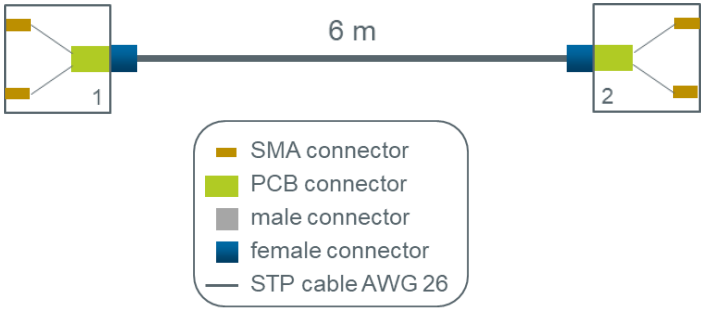
Proposal for **2.5 Gbit/s (2.5GBASE-T1)**
IL_{DB} (f) ≤ 0.002*f + 0.45*√f + 1/√f with f in MHz; 5 ≤ f ≤ **1000**

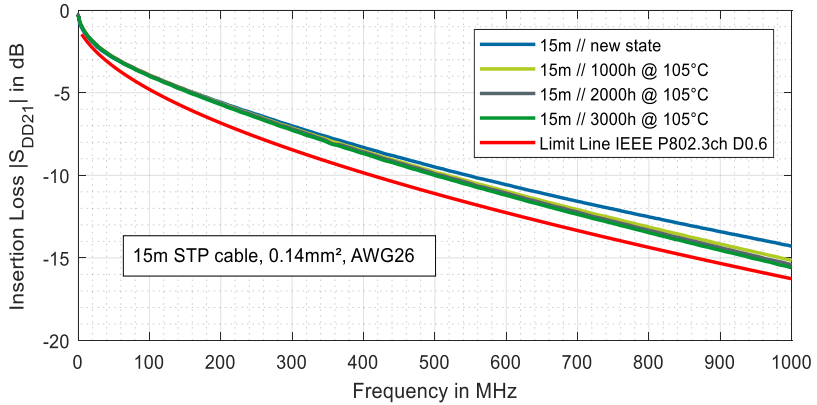
Insertion Loss Measurement

Before, Between and After Long Term Heat Aging



- STP cable, 0.14mm², AWG26 (other cable version as shown in slide before)
- 6 m measured and calculated for 15 m
- **Long term heat aging,** Dry heat 105°C for 3000h, ISO 6722





- **Use current insertion loss limit formula and parameters for 2.5GBASE-T1 and change max frequency to 1 GHz**
- **Aged STP cable (AWG 26) have margin**
- **New and aged cable should fulfill limit**

Conclusion

- ✓ Current cable assemblies meet coupling attenuation limit

- Proposal IL limit for 2.5 Gbit/s:
  - Use same formula and parameters
  - 2.5 Gbit/s - Frequency range from 5 MHz up to 1000 MHz

- ✓ Current cable assemblies meet IL limit proposal
- ✓ Cable assemblies after long term heat aging meet IL limit proposal

Insertion loss limit proposal for 2.5GBASE-T1

Insertion Loss (f) ≤ 0.002 f + 0.45 $\sqrt{f}$ + 1/$\sqrt{f}$ [dB]

where

f is the frequency in MHz; 5 ≤ f ≤ **1000**