

Automotive Link Segment Analysis for 10SPE

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TE Connectivity

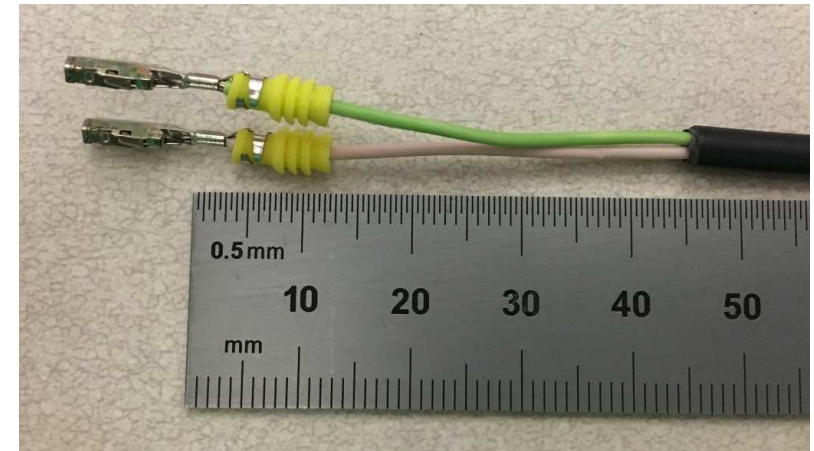
August 30, 2017

4mm Pitch, Single wire seal Connector Testing

Work continued from previous contributions

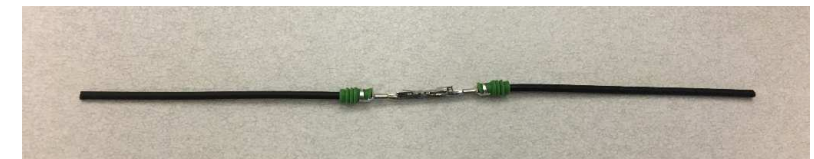
http://www.ieee802.org/3/cg/public/Mar2017/DiBiasco_Bergner_01a_0314.pdf

http://www.ieee802.org/3/cg/public/July2017/DiBiasco_Bergner_01a_0717.pdf



Untwist length for each inline connector

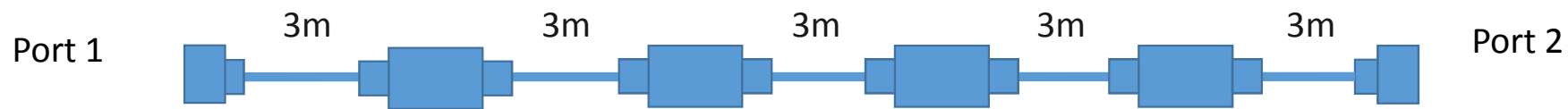
← 110mm →



← 45mm → | ↔ | ← 45mm →
20mm

- Termination requires 45mm jacket strip length on each side of the connector to insert 1 terminal at a time into the connector body

4mm Pitch, Single wire seal Connector (Link Segment Testing)

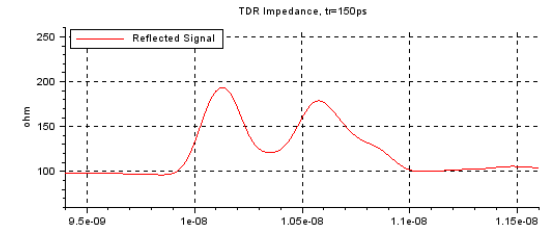
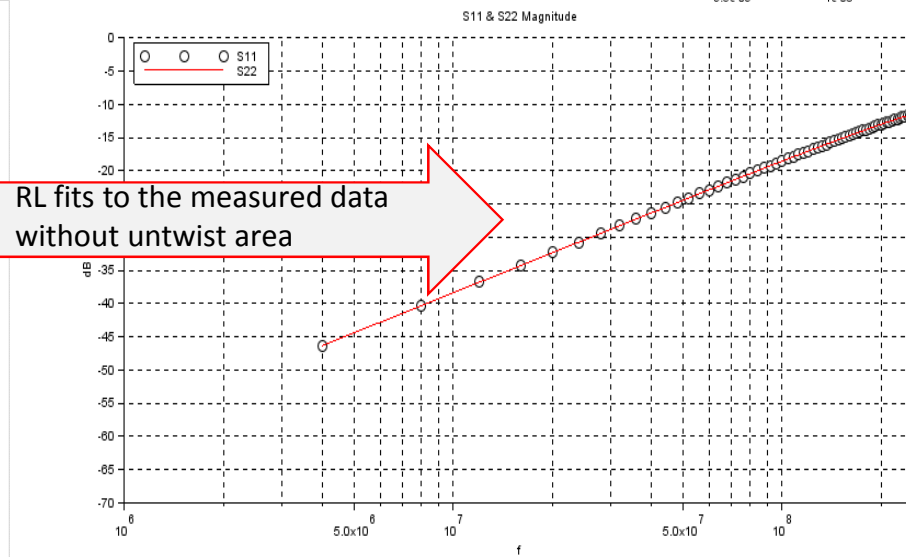
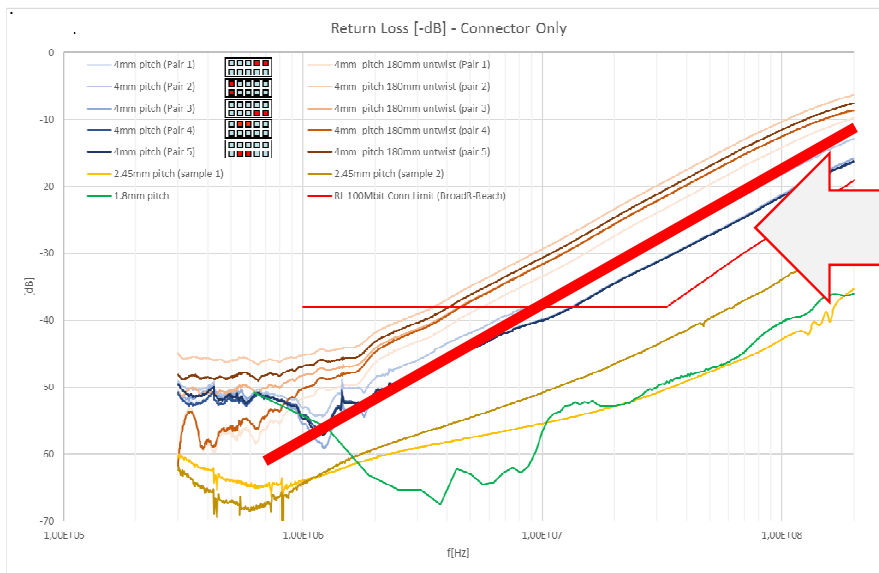


- 5x3m link segments with 45mm untwist at each termination
- Cut each cable to 3m
- Strip outer jacket to 45mm

Is this the worst case link segment for
10SPE (Short Reach)??

Simulations to Determine Worst Case Return Loss Link Segment

Transmission Line Model – 4mm Inline Connector

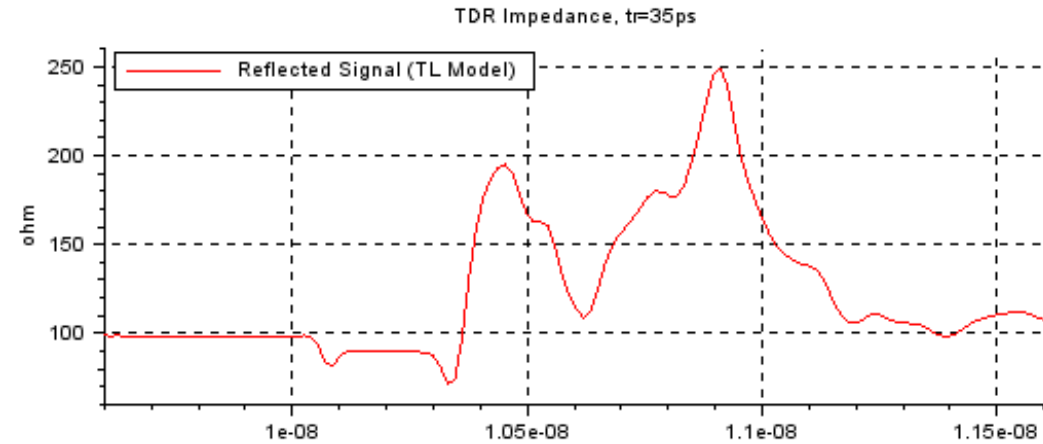
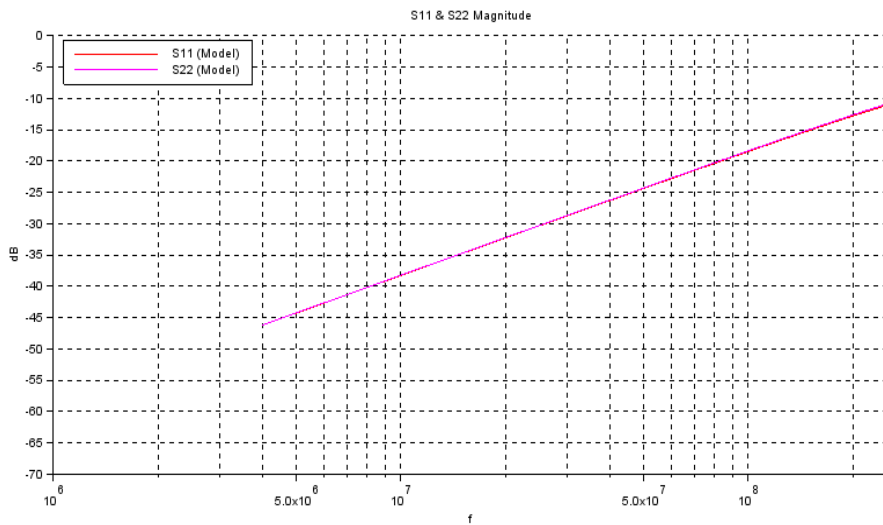


Parameter model (5 concatenated waveguides):

4mm Inliner	wire & crimp left	spring body left	pin	spring body right	wire & crimp right	Total length (mm)
Zw (Ohm)	210	85	190	85	210	
vp (m/s)	2,54E+08	2,10E+08	2,20E+08	2,10E+08	2,54E+08	
len (m)	0,03	0,008	0,004	0,008	0,03	80

TDR profile

Transmission Line Model – 4mm Header (Mated MDI Connector)

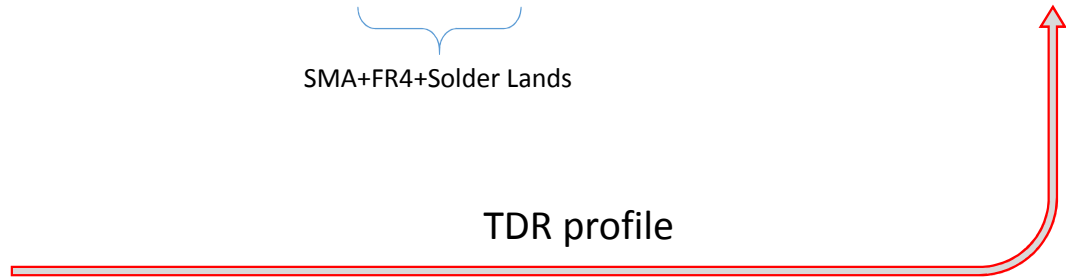


SMA+FR4+Solder Lands

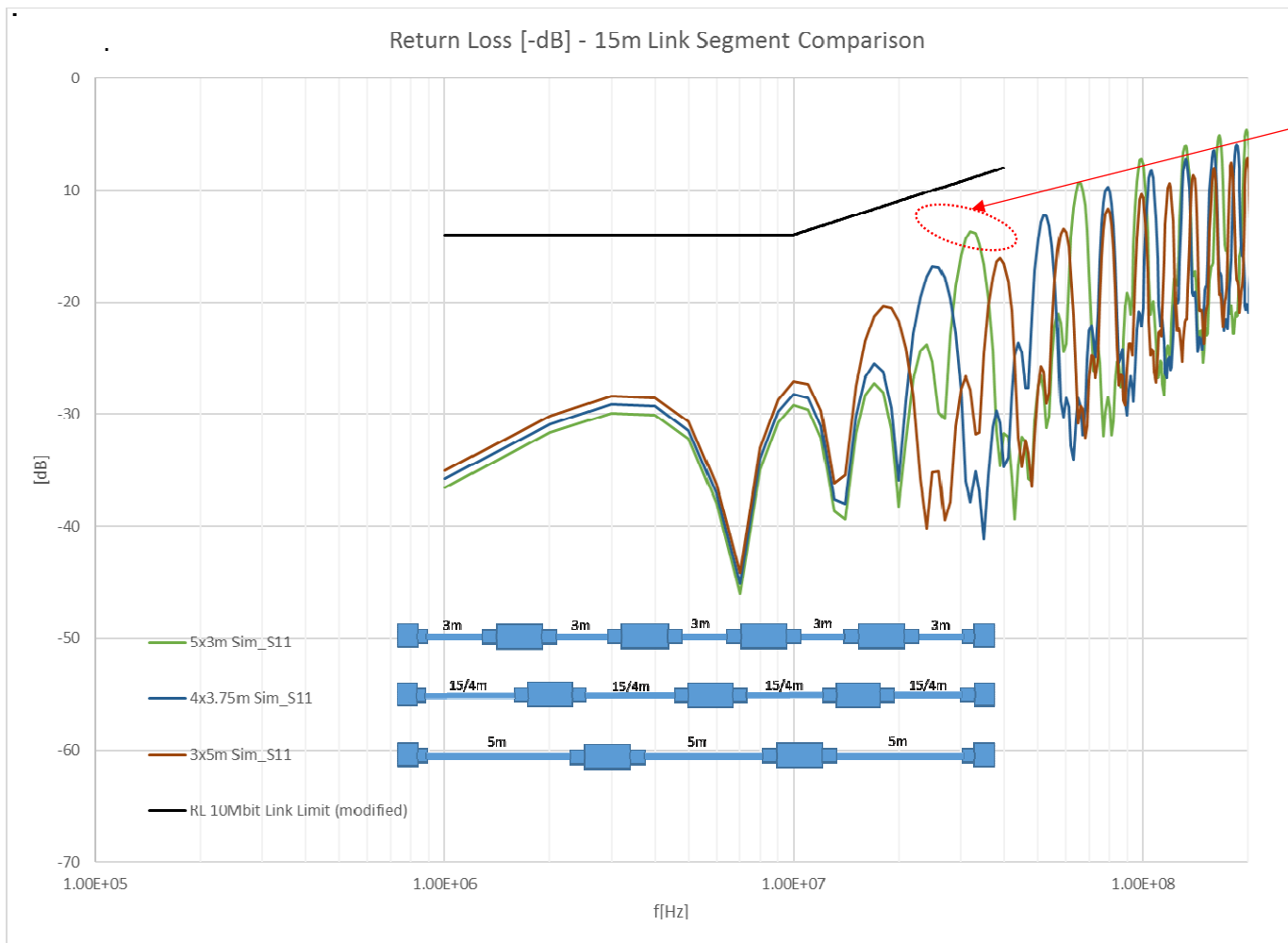
Parameter model (5 concatenated waveguides):

4mm Header (left side is PCB)						
	header leads	pin in housing	pin	spring body righth	wire & crimp right	Total length (mm)
Zw	230	150	190	85	210	
vp	2,47E+08	2,10E+08	2,20E+08	2,10E+08	2,54E+08	
len	0,015	0,005	0,004	0,008	0,03	62

TDR profile



Worst Case Link Segment Comparison



5x3m causes worst case impedance mismatch in 10SPE Frequency Band of interest (< 40MHz)

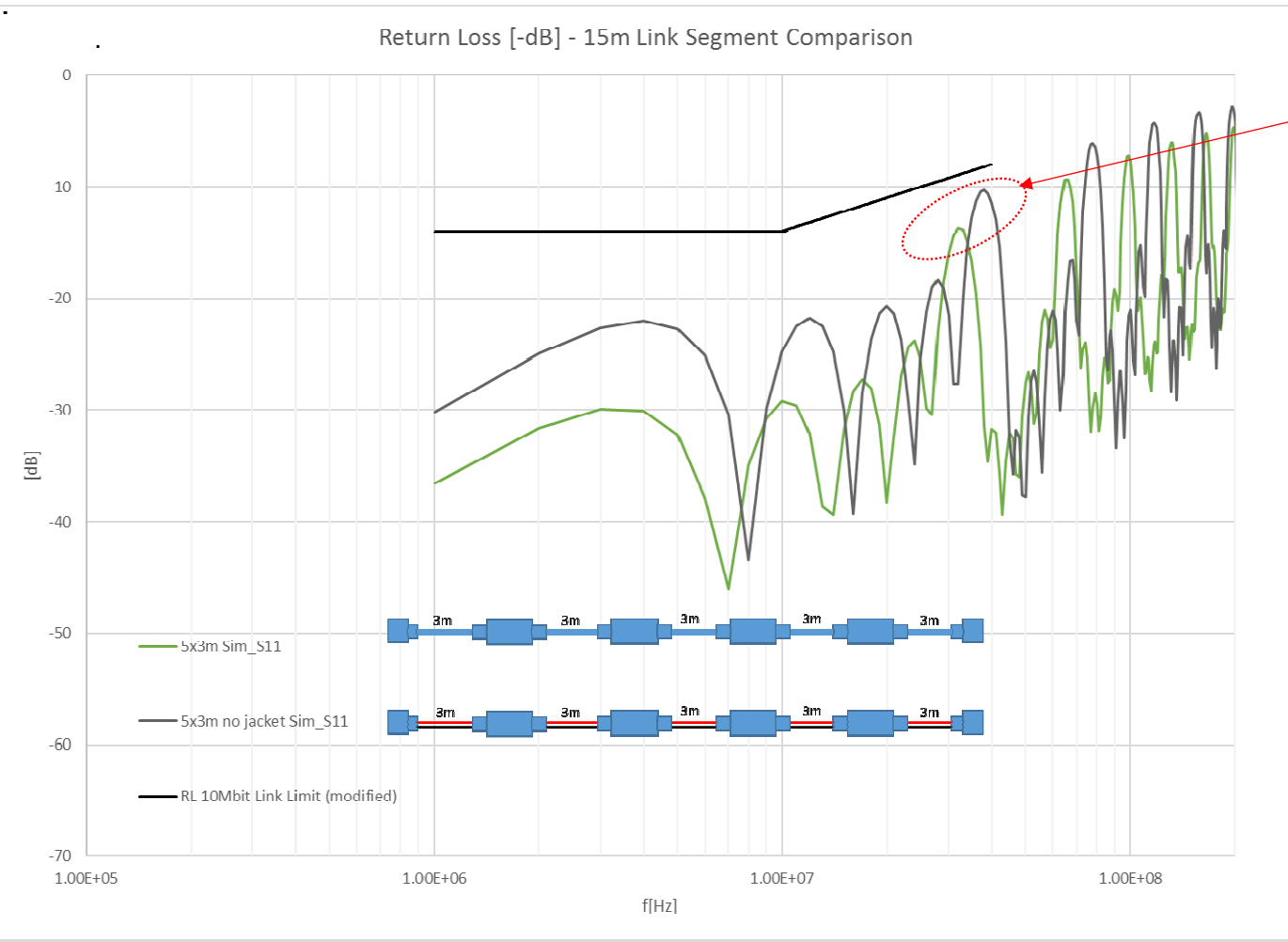
Longer length segments cause the first peak to move to the left

Less segments of identical length causes the magnitude of the peaks to be lower

Other Simulated Parameters:

- 45mm jacket stripping length
- 2x0.35mm², 95 Ohm, FlexRay type Cable with jacket
- 20 degrees C

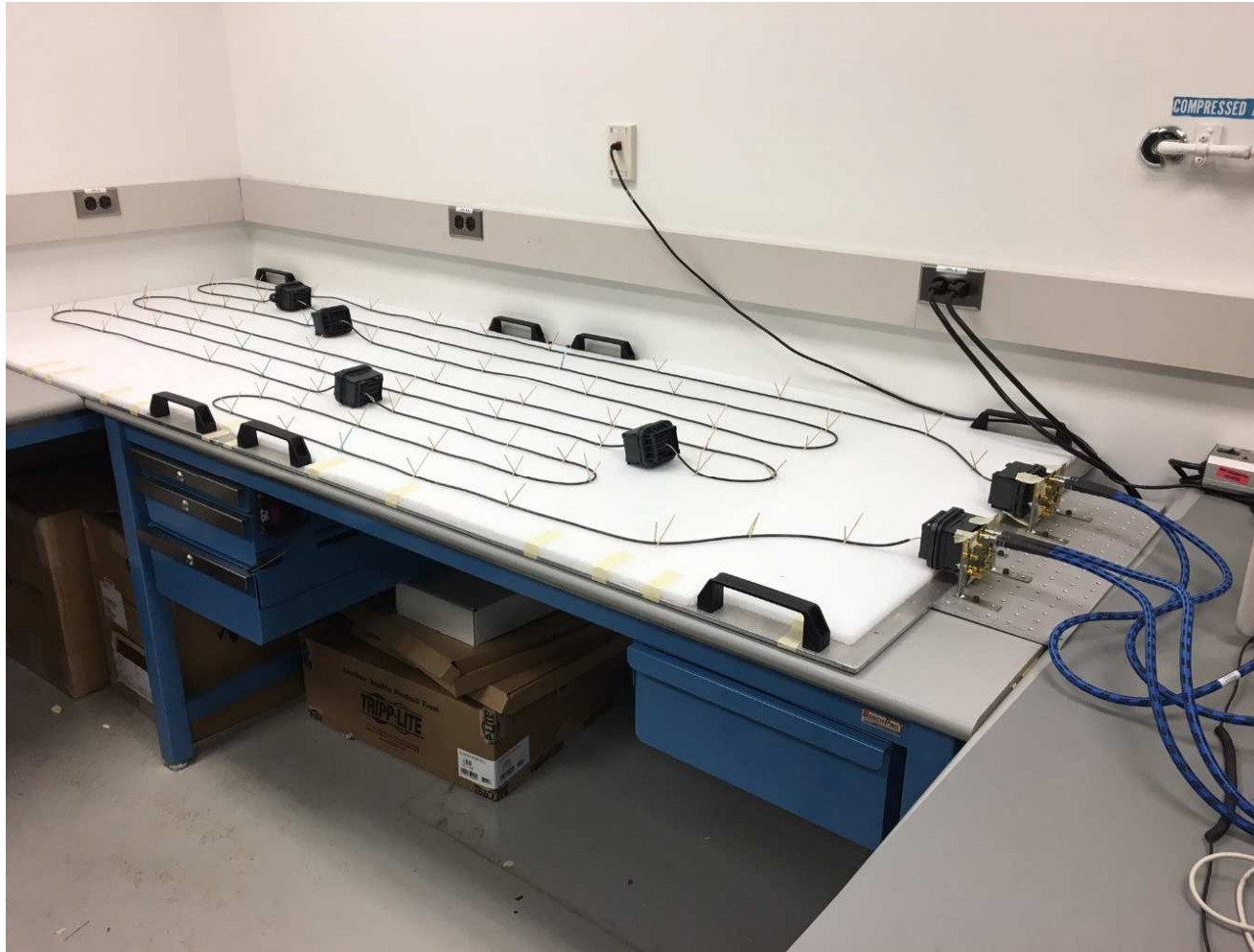
Jacketed vs. Unjacketed Cable Comparison



- Worst case cable (lower attenuation due to construction **without** jacket,
- 2x0.35mm², 90 Ohm,
 - 20 degrees C

5x3m Link Segment Measurements

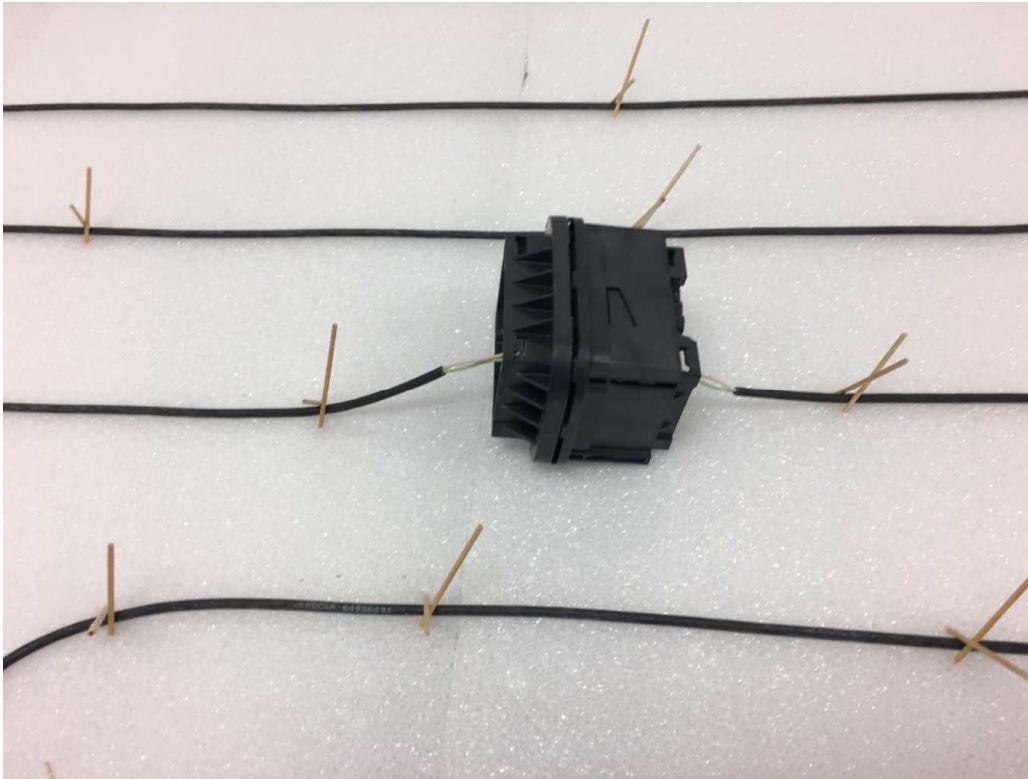
5x3m Link Segment



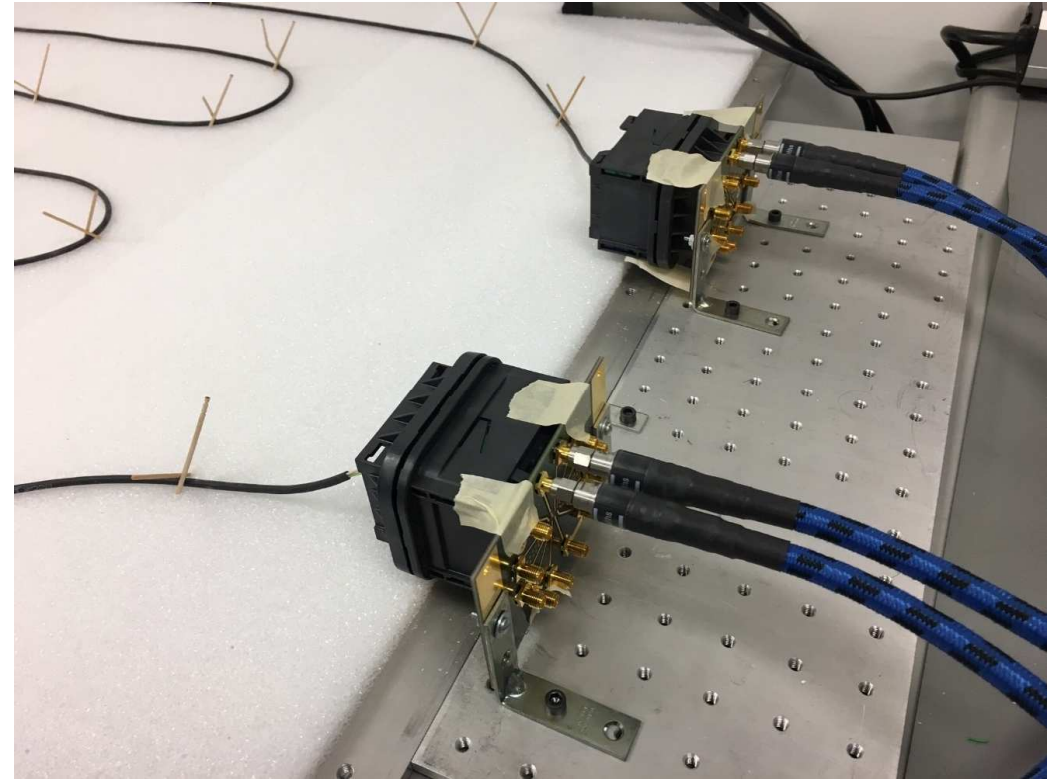
Testing Parameters:

- 35mm² FlexRay type Cable with 45mm jacket stripping length
- 4mm single wire seal connectors
- ~20 degrees C
- 10mm Styrofoam to keep UTP above GND Plane
- Distance of the meanders > 30mm
- Renormalization of the CM impedance (25Ω → 200Ω)
- Toothpicks to keep cable flat against Styrofoam.

5x3m Link Segment

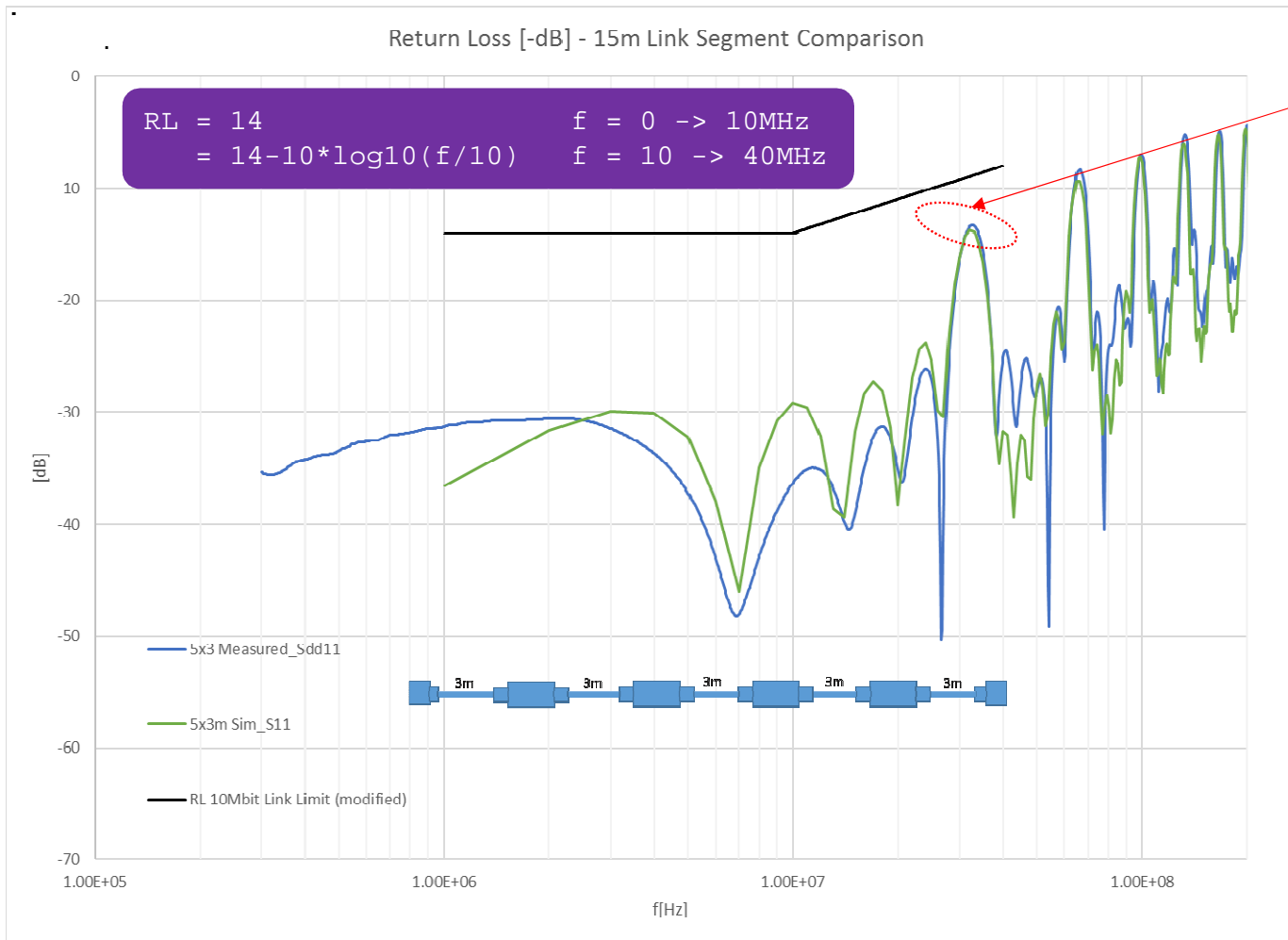


110mm total untwist length for each inline connector



Terminated wires soldered directly to PCB for SMA connections to the VNA cables

Return Loss 5x3m Link Segment



Measured data matches very well with simulations

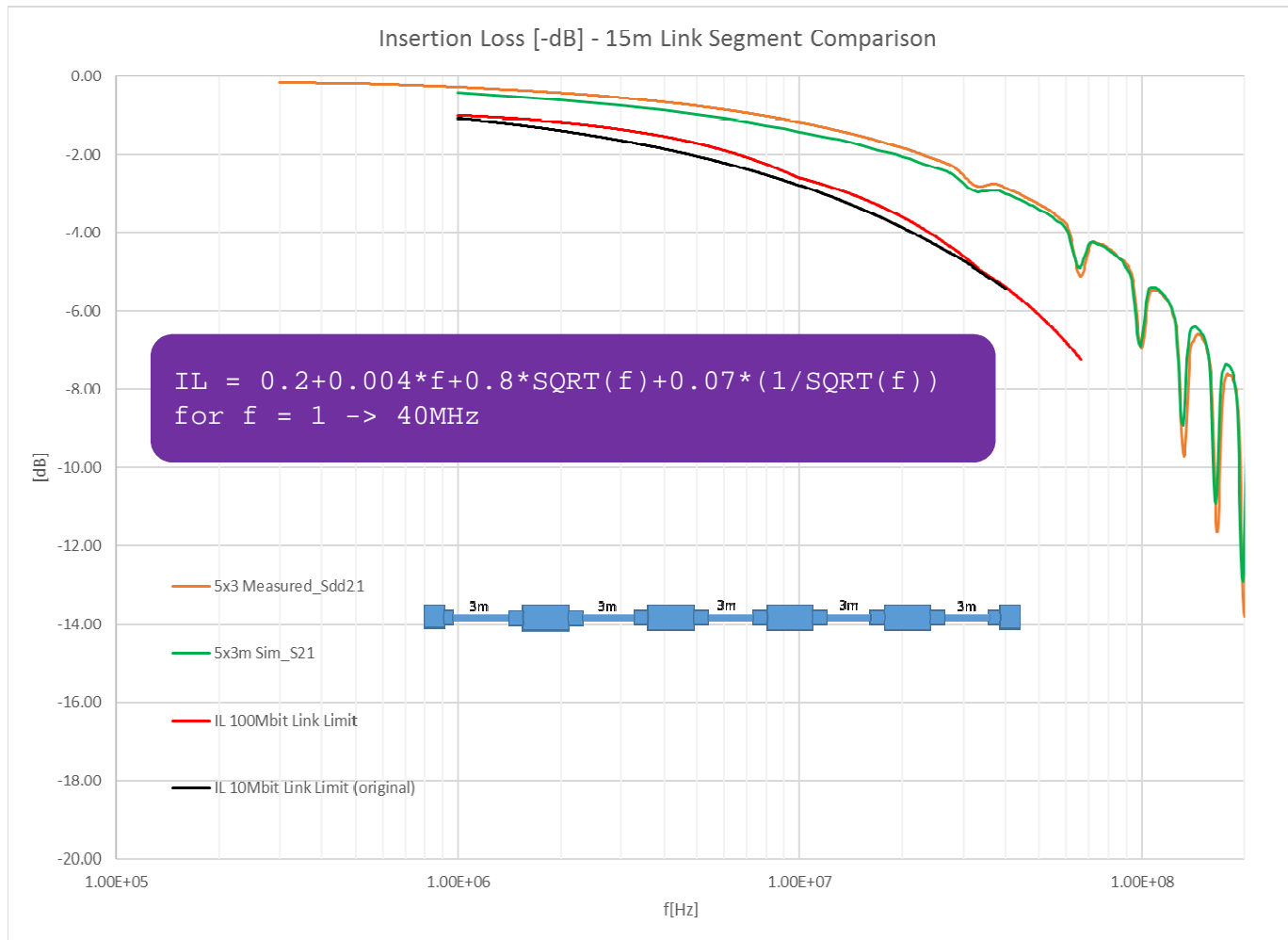
Proposed Return Loss Limits from:

http://www.ieee802.org/3/cg/public/adhoc/kaindl_matheus_3cg_01_0817.pdf

– and –

8/2/2017 Email from Oisín Ocuanchain to reflector [802.3_10SPE] Comment on 'Automotive Link Segment for 10SPE' presentation

Insertion Loss - 5x3m Link Segment



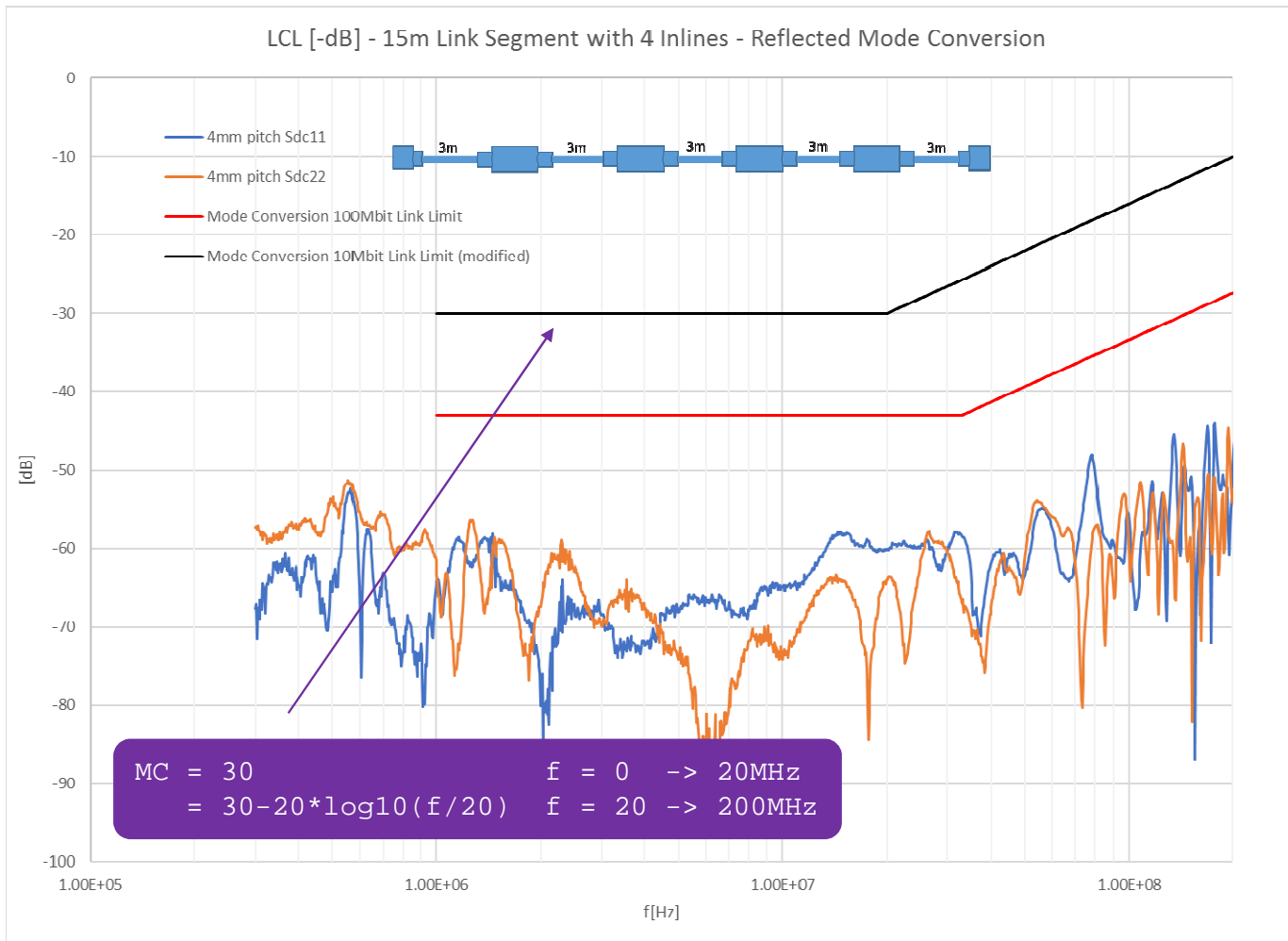
Measured data matches very well with simulations

Proposed Insertion Loss Limits from:

http://www.ieee802.org/3/cg/public/adhoc/kaindl_matheus_3cg_01_0817.pdf

Keep 100Mbit Link Limit but just lower to 40MHz

Reflected Mode Conversion - 5x3m Link Segment



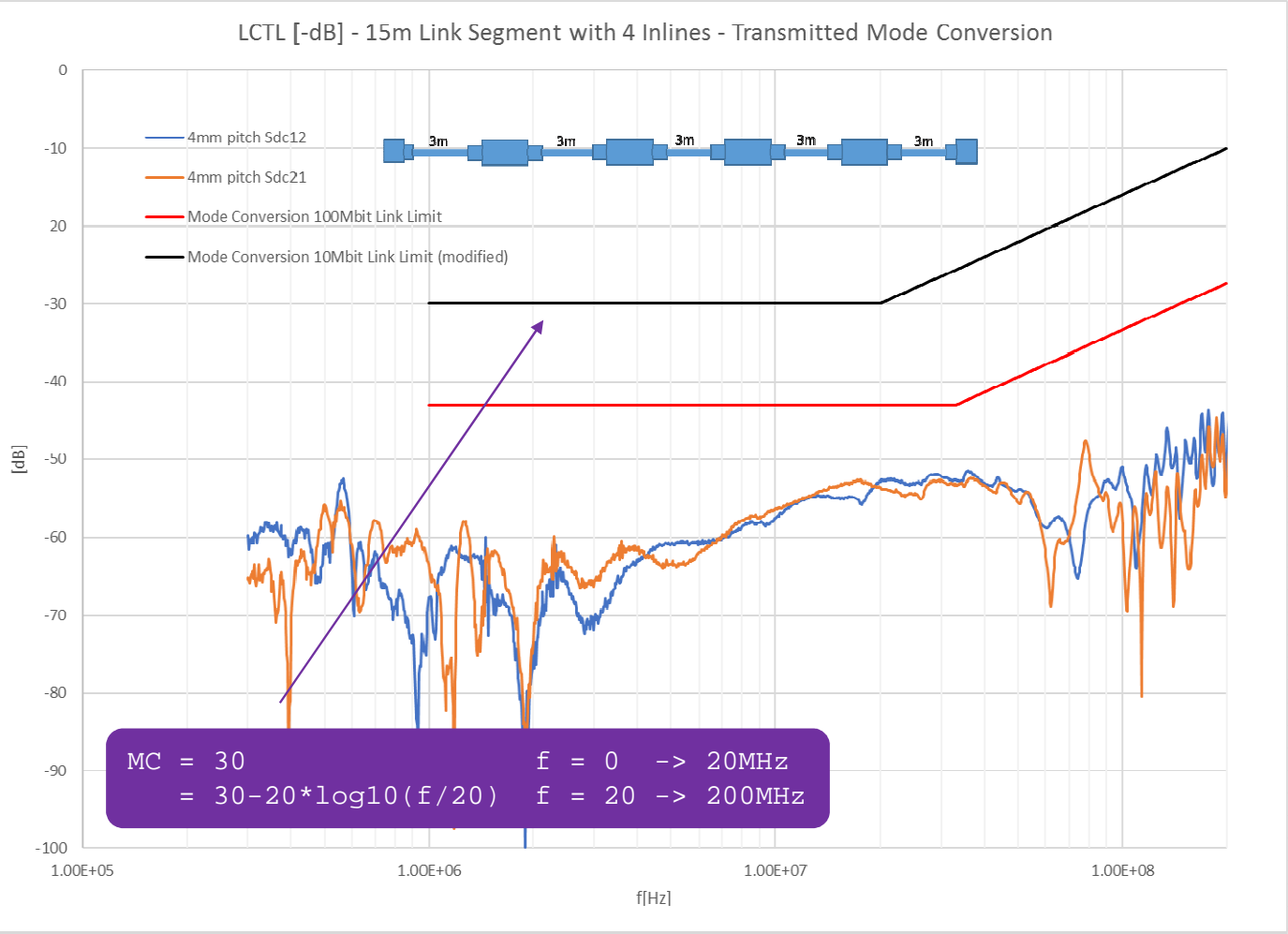
Proposed Mode Conversion Limit from:

http://www.ieee802.org/3/cg/public/adhoc/kaindl_matheus_3cg_01_0817.pdf

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Transmitted Mode Conversion - 5x3m Link Segment



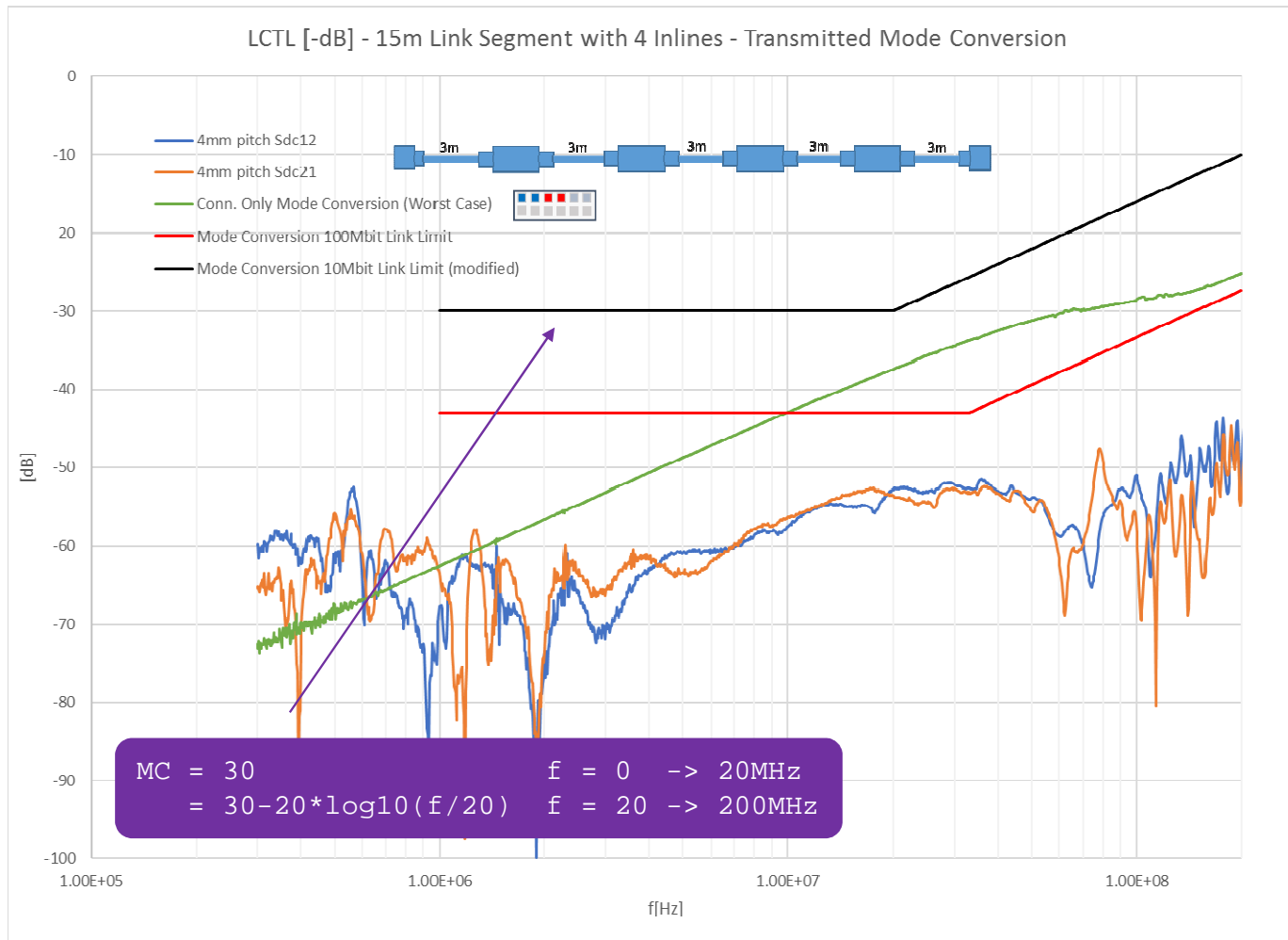
Proposed Mode Conversion Limit from:

http://www.ieee802.org/3/cg/public/adhoc/kaindl_matheus_3cg_01_0817.pdf

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Worst Case Connector Cross Mode Conversion



Proposed Mode Conversion Limit from:

http://www.ieee802.org/3/cg/public/adhoc/kaindl_matheus_3cg_01_0817.pdf

– and –

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Conclusions

- 4mm pitch connectors used for CAN and FlexRay applications can also be used for 10SPE
- Such connectors were not designed for RF applications and are not being used for 100Base-T1
- Worst case return loss link segment was found by simulation (5x3m, 4 inlines)
- Simulations shown to correlate to measurement results
- Previously proposed link segment limits align well to test results
- Some margin is assumed for temperature and component tolerances

Conclusion – Proposed Link Limits

Return Loss (f) > 14 dB for f (0.3MHz -> 10MHz)
> 14 - 10*log10(f/10) dB for f (10MHz -> 40MHz)

Same as previously
proposed with modified
lower frequency limit

Insertion Loss (f) < 1.0 + 1.6*(f-1)/9 dB for f (0.3MHz -> 10MHz)
< 2.6 + 2.3*(f-10)/23 dB for f (10MHz -> 33MHz)
< 4.9 + 2.3*(f-33)/33 dB for f (33MHz -> 40MHz)

Same as 802.3bw but
limited to 40MHz

Mode Conversion Loss (f) > 30 dB for f (0.3MHz -> 20MHz)
> 30-20*log10(f/20) dB for f (20MHz -> 200MHz)

Same as previously
proposed with modified
lower frequency limit

Discussion

- What should be the lower Frequency limit for 10SPE short reach?
- What needs to be considered?
 - Alignment to 10SPE long reach
 - PoDL performance
 - Lower frequency limit of test equipment

Thank You!!