802.3bp Baseline Optional Link segment

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Chris DiMinico
MC Communications/Panduit
cdiminico@ieee.org

Purpose

- **Development of baseline for the 802.3bp optional Link Segment (ScTP/Shielded) in IEEE P802.3bp.**

- **Proposal for optional link segment specifications in Clause 98**
  - **Add equations with TBD's.**

Supporters

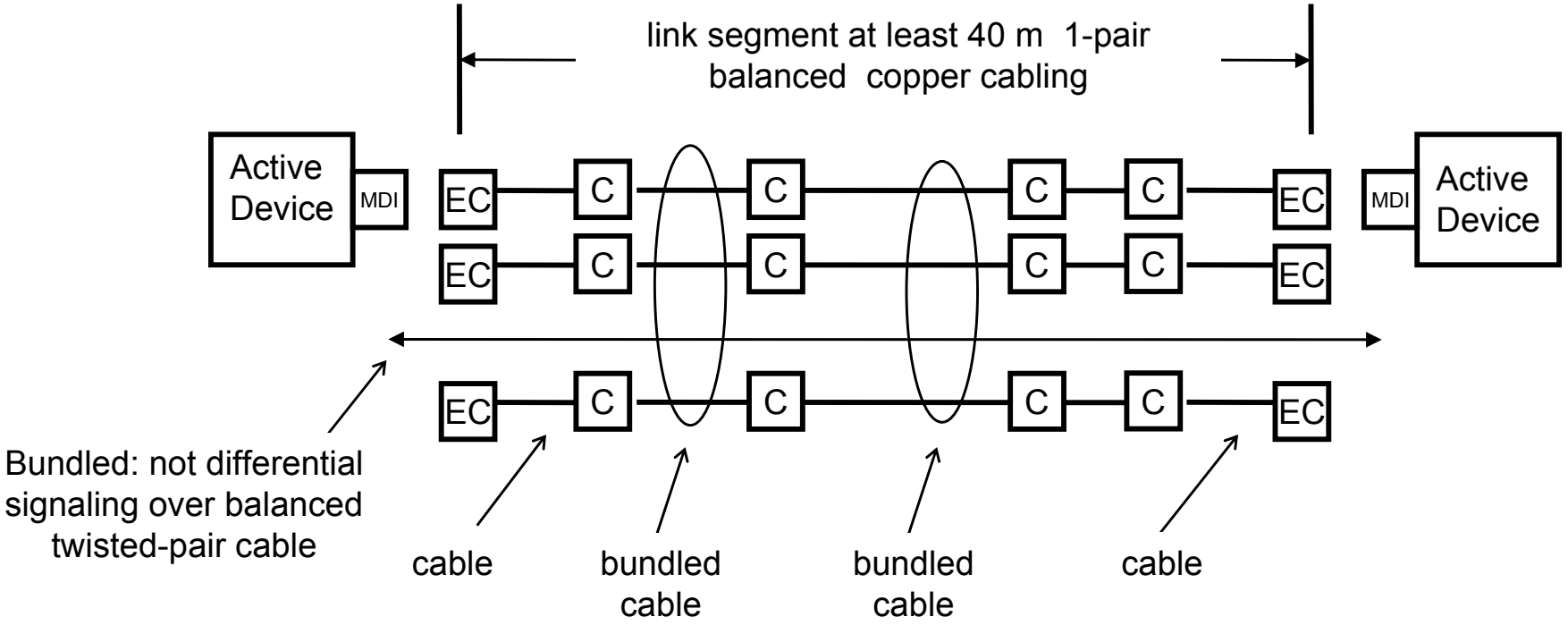
- Robert Wagner, Ronald Nordin - Panduit

Objectives - Updated (May 15, 2014)

- Preserve the IEEE 802.3/Ethernet frame format at the MAC client service interface.
- Preserve minimum and maximum frame size of the current IEEE 802.3 standard.
- Support full duplex operation only.
- Support a speed of 1 Gb/s at the MAC/PLS service interface.
- Maintain a bit error ratio (BER) of less than or equal to 10^-10 at the MAC/PLS service interface
- Support 1 Gb/s operation in automotive & industrial environments (e.g. EMC, temperature).
- Define optional Energy-Efficient Ethernet
- Define the performance characteristics of an automotive link segment and a PHY to support point-to-point operation over this link segment with a single twisted pair supporting up to four inline connectors using balanced copper cabling for at least 15m for the automotive link segment.
- Define the performance characteristics of optional link segment(s) for the above PHY for industrial controls and/or automation, transportation (aircraft, railway, bus and heavy trucks) applications with a goal of at least 40m reach
- Define optional startup procedure which enables the time from power_on=FALSE to valid data to be less than 100ms
- Support optional single-pair auto-negotiation mechanism

Note: New objective in RED text (awaiting 802.3 WG approval July 2014)

802.3bp Link Segment (optional)



The IEEE 802.3 nomenclature is bracketed to identify relationship to the IEEE 802.3 definitions.

Length objective [EC] to [EC] at least 40 m
Number of inline connectors [C] = 4

C = inline connector

EC = connection to equipment

MDI = Active electronics connector [Medium dependent interface (MDI)]

1000BASE-T1 Link Segments IL

98.4.4.2.1 Insertion loss

The insertion loss of each type B link segment shall meet the values determined using Equation (98–4).

$$InsertionLoss(f) \leq \text{TBD dB} \qquad (98\text{–}4)$$

where

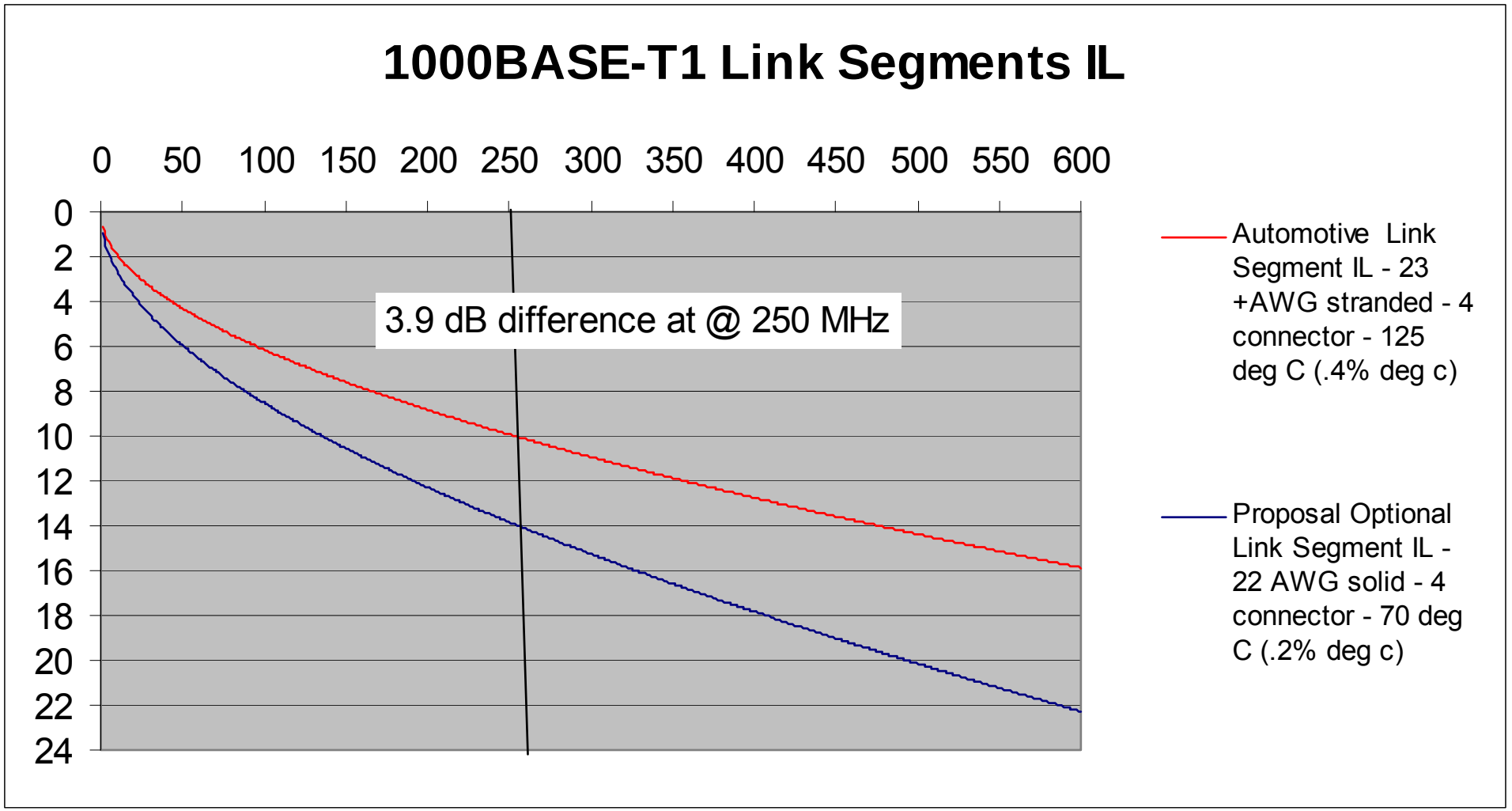
f is the frequency in MHz; $1 \leq f \leq 600$

This function InsertionLoss(f) accounts for the insertion loss of the balanced cabling pair and four inline connectors within each link segment.

Insertion loss proposal

$$InsertionLoss(f) \leq 0.7131\sqrt{f} + 0.0040 \cdot f + \frac{0.1100}{\sqrt{f}} + 0.08\sqrt{f} + 0.018\sqrt{f} \quad \text{(TBD)}$$

1000BASE-T1 Link Segments IL



1000BASE-T1 Link Segment RL

Automotive and Optional Link Segment Return Loss

98.4.4.2.3 Return loss

In order to limit the noise at the receiver due to impedance mismatches each type B link segment shall meet the values determined using Equation (98–5) at all frequencies from 1 MHz to 600 MHz. The reference impedance for the return loss specification is 100 Ω.

$$\text{ReturnLoss}(f) \leq \text{TBD dB} \qquad (98\text{–}5)$$

where

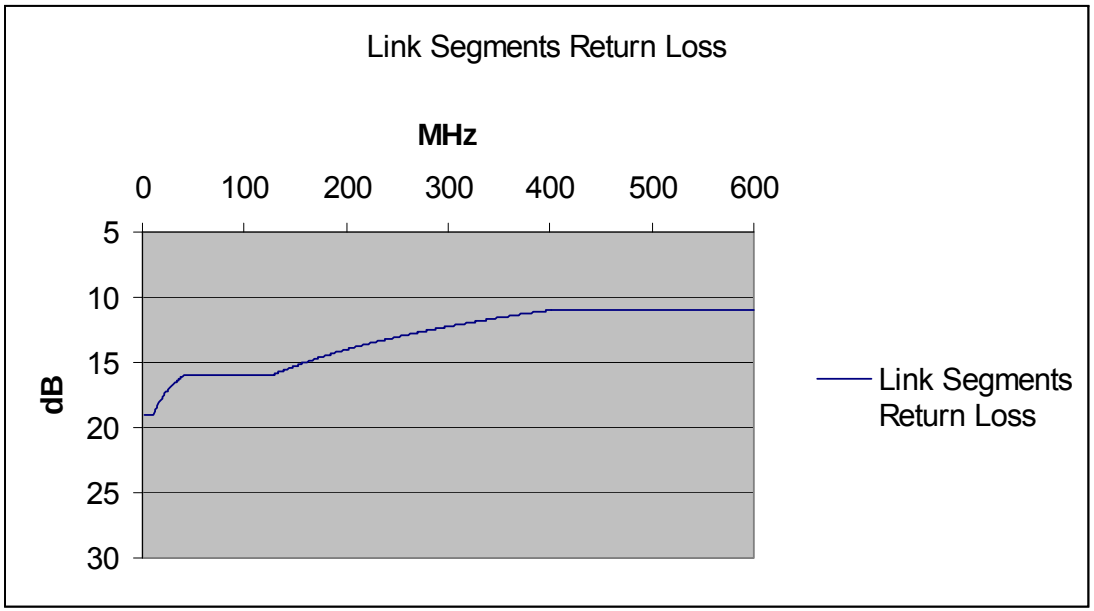
f is the frequency in MHz.

Add equation with TBD

$$\text{ReturnLoss} \geq \begin{cases} 19 & 1 \leq f < 10 \\ 24 - 5\log f & 10 \leq f < 40 \\ 16 & 40 \leq f < 130 \\ 37 - 10\log f & 130 \leq f < 400 \\ 11 & 400 \leq f \leq 600 \end{cases} \text{dB}$$

where

f is the frequency in MHz; $1 \leq f \leq 600$



Alien crosstalk - ANEXT

The power sum ANEXT loss between a disturbed type B link segment and the disturbing type B link segment shall meet the values determined using Equation (98–11).

$$PSANEXT(f) \geq TBD \text{ dB} \qquad (98–11)$$

where

f is the frequency in MHz

- PSANEXT – single port

Frequency (MHz)	PSANEXT (dB)
1 ≤ f ≤ 600	≥75 (TBD)

- PSANEXT – multi port

Frequency (MHz)	PSANEXT (dB)
1 ≤ f ≤ 600	≥65 (TBD)

Alien crosstalk - PSAACRF

The power sum AACRF between a disturbed type B link segment and the disturbing type B link segment shall meet the values determined using Equation (98–13).

$$\mathrm{PSAACRF}(f) \geq \mathrm{TBD\ dB} \qquad (98–13)$$

where

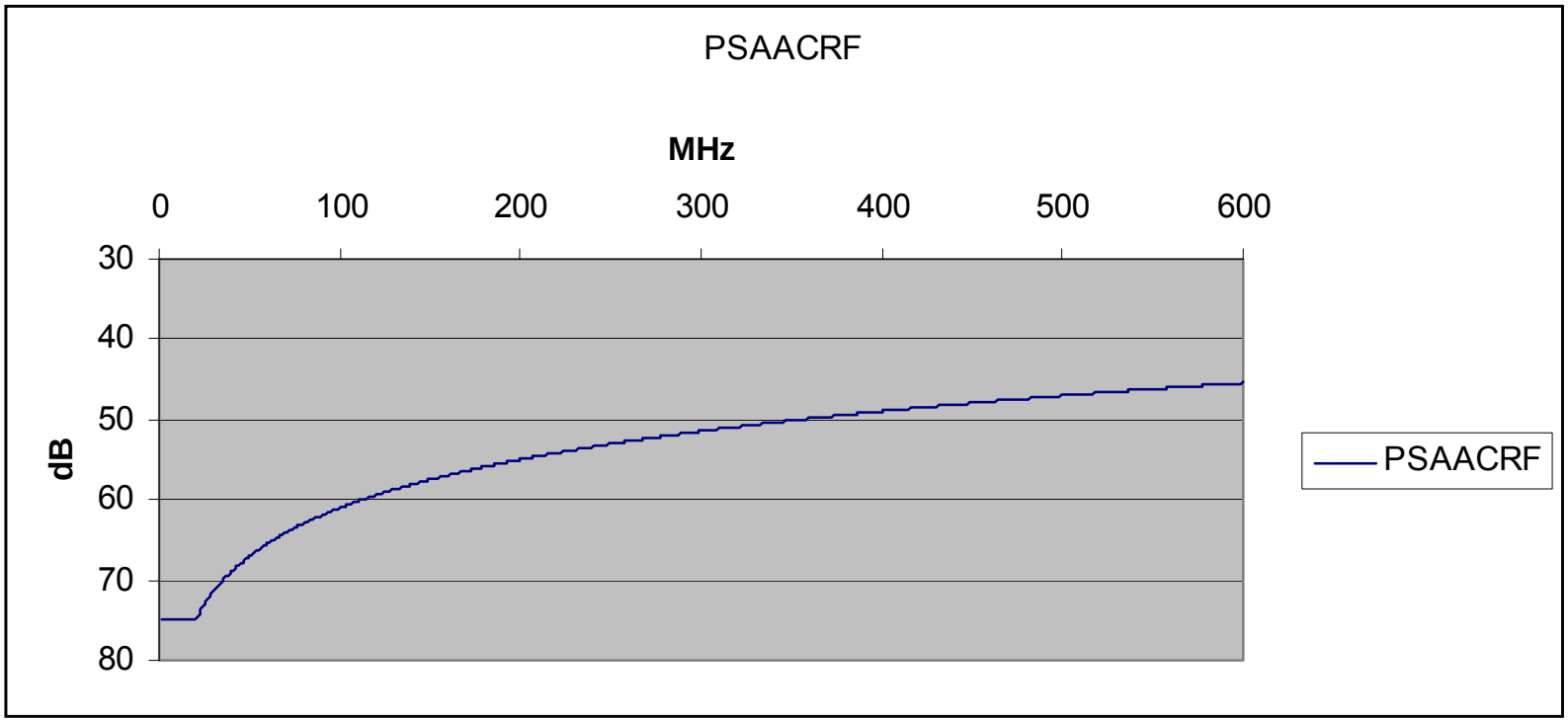
f is the frequency in MHz

•PSAACRF

Calculations that result in PSAACRF loss values greater than 75 dB (TBD) shall revert to a requirement of 75 dB minimum (TBD). PSAACRF values are for information only when PSAFEXT loss is greater than either 72-15log(f/100) dB or 67 dB (TBD).

Frequency (MHz)	PSAACRF (dB)
1 ≤ f ≤ 600	≥61-20log(f/100) (TBD)

Alien crosstalk - PSAACRF



Frequency (MHz)	PSAACRF (dB)
$1 \leq f \leq 600$	$\geq$61-20log(f/100) (TBD)

Link segment transmission parameters (ScTP/Shielded)

•Coupling attenuation - Consistent with Category 6A specified in ANSI/TIA-1005-A-2012 Telecommunications Infrastructure Standard for Industrial Premises. The coupling attenuation requirements (E1, E2, E3) depend on the electromagnetic environmental classifications specified in ANSI/TIA-568-C.0. The coupling attenuation requirements (E4) TDB depend on the electromagnetic environmental specifications for automotive applications.

•Coupling attenuation

Frequency (MHz)	Minimum (dB)			
	E1	E2	E2	E4
$30 \leq f \leq 600$	80-20Log(f) (Max 40 dB)	90-20Log(f) (Max 50 dB)	100-20Log(f) (Max 60 dB)	TBD

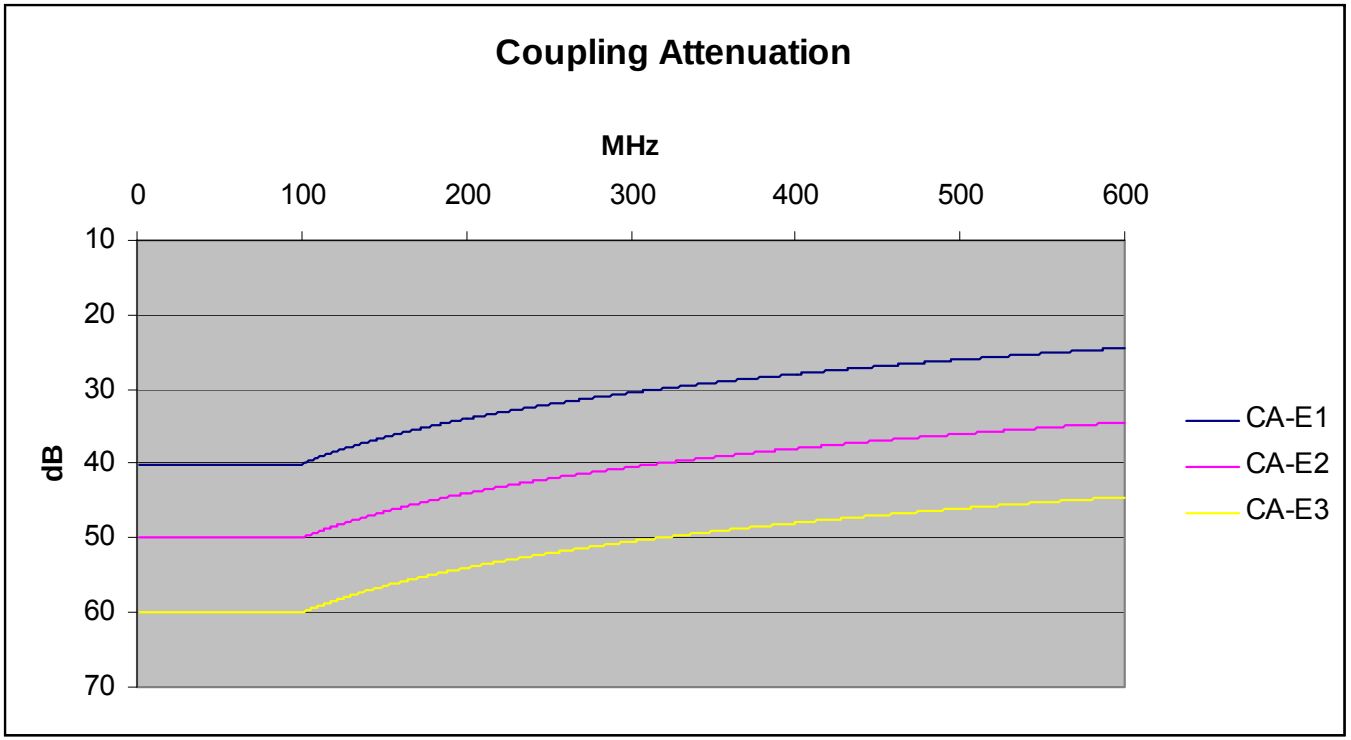
•Environmental classification

Electromagnetic	**E_1**	**E_2**	**E_3**	**E_4**
Radiated RF - AM	3 V/m at (80 to 1 000 MHz) 3 V/m at (1 400 to 2 000 MHz) 1 V/m at (2 000 to 2 700 MHz)	3 V/m at (80 to 1 000 MHz) 3 V/m at (1 400 to 2 000 MHz) 1 V/m at (2 000 to 2 700 MHz)	10 V/m at (80 to 1 000 MHz) 3 V/m at (1 400 to 2 000 MHz) 1 V/m at (2 000 to 2 700 MHz)	TBD Automotive Applications
Conducted RF	3 V at 150 kHz to 80 MHz	3 V at 150 kHz to 80 MHz	10 V at 150 kHz to 80 MHz	TBD Automotive Applications

Link segment transmission parameters (ScTP/Shielded)

- Coupling attenuation

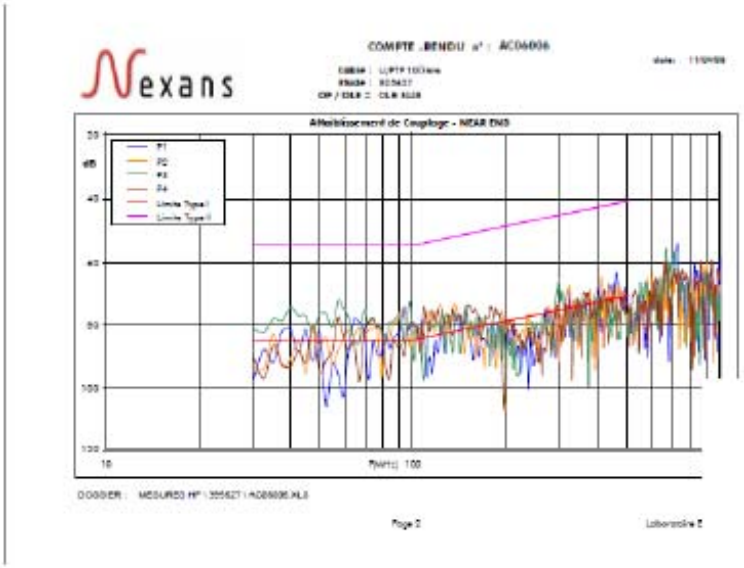
Frequency (MHz)	Minimum (dB)			
	E1	E2	E2	E4
$30 \leq f \leq 600$	80-20Log(f) (Max 40 dB)	90-20Log(f) (Max 50 dB)	100-20Log(f) (Max 60 dB)	TBD

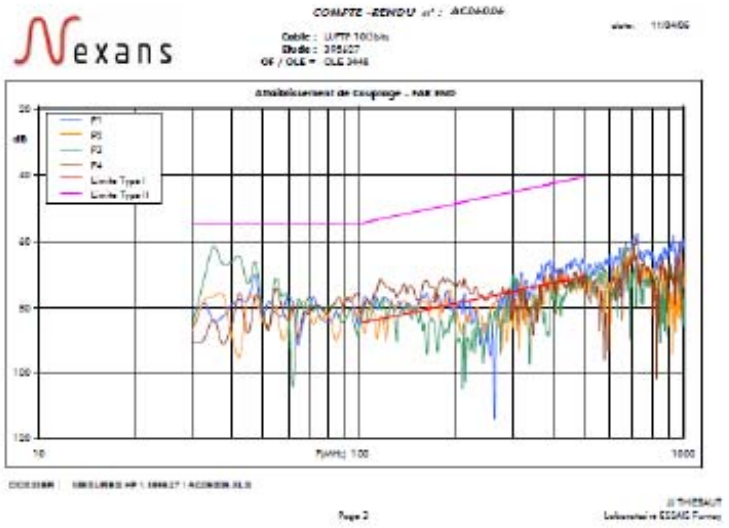


Coupling attenutation (Cat6A UFTP)

Nexans

Worst Case: Cat6A UFTP Cable





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Coupling attenutation (Cat6A UFTP)

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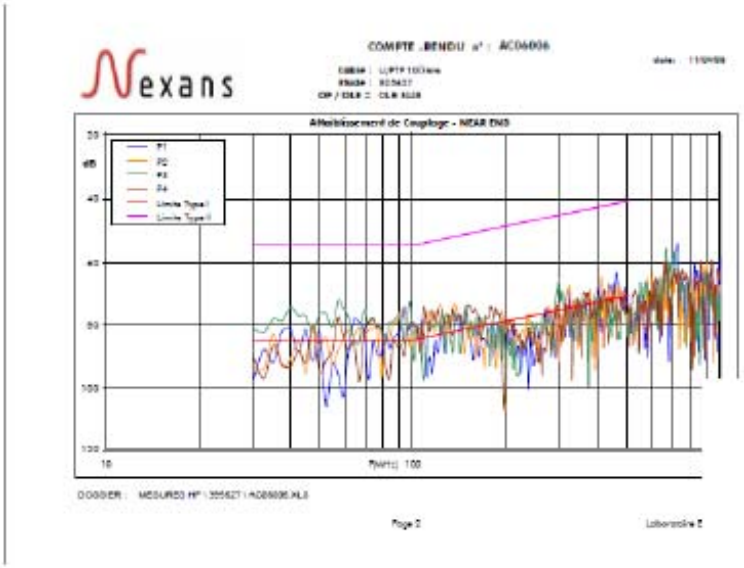
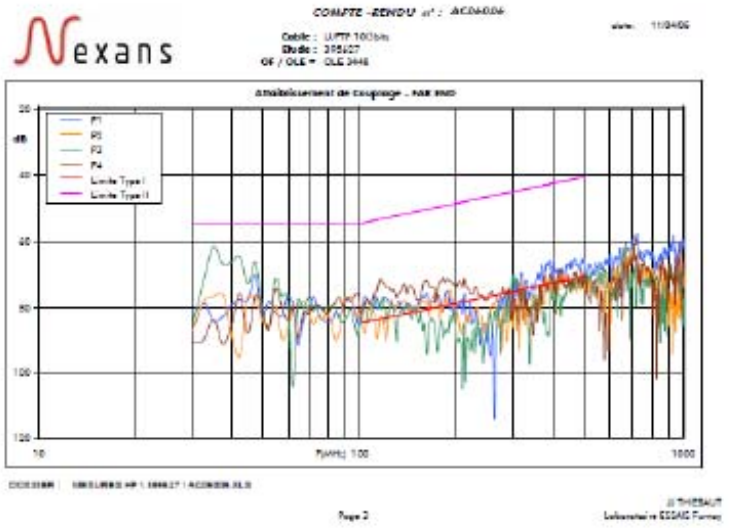
Worst Case: Cat6A UFTP Cable





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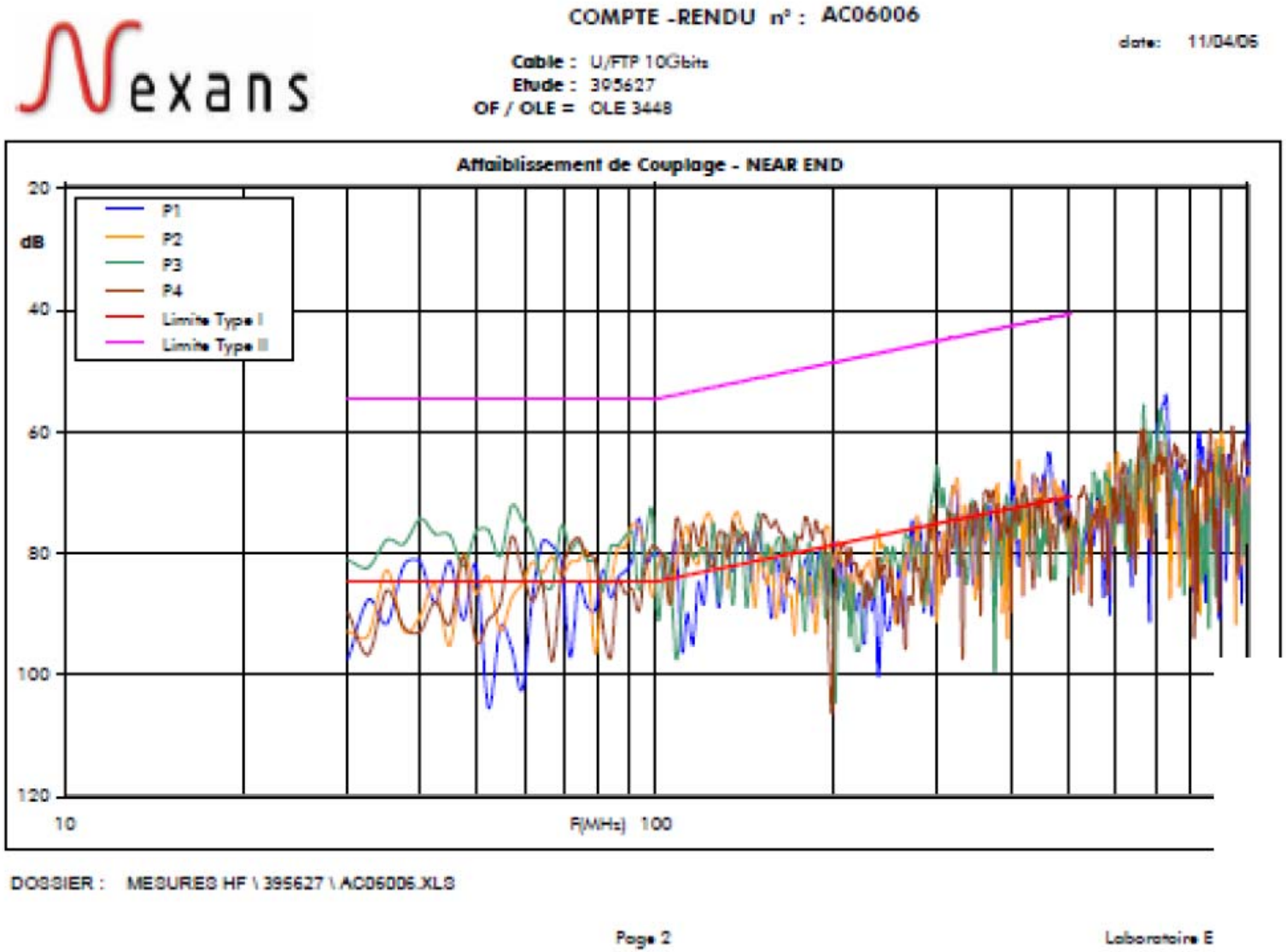
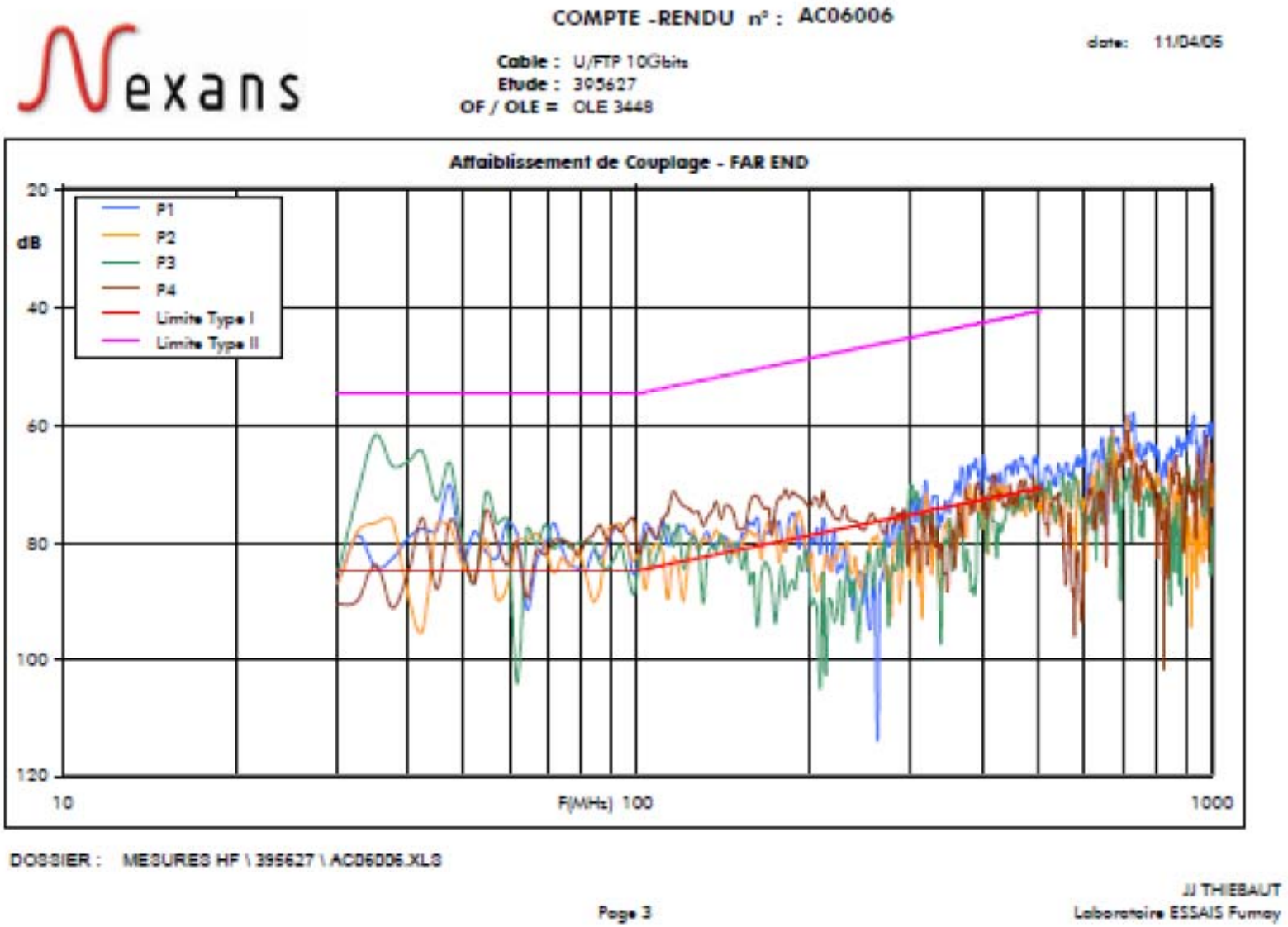
Coupling attenuation (Cat6A UFTP)



Source: rossbach_0513_40GBT-1.pdf – slide 10

Coupling attenuation (Cat6A UFTP)



Source: rossbach_0513_40GBT-1.pdf – slide 10

Backup

Link segment transmission parameters (ScTP/Shielded)

Link segment transmission and coupling parameters (ScTP/Shielded)

- Insertion loss - 22 AWG stranded copper at 70 degrees C (0.2% deg C)
- Return loss (UTP proposal)
- Alien Crosstalk
  - –PSANEXT (Category 8), PSAACRF (Category 8)
- Coupling attenuation - ANSI/TIA-1005-A-2012 Telecommunications Infrastructure Standard for Industrial Premises. Electromagnetic environmental classifications specified in ANSI/TIA-568-C.0.

- Insertion loss

$$InsertionLoss(f) \le \underbrace{0.8558\sqrt{f} + 0.0048 \cdot f + \frac{0.1320}{\sqrt{f}}}_{\text{23.73 dB @500 MHz}} + \underbrace{0.08\sqrt{f}}_{\text{40 meters cable}} + \underbrace{0.018\sqrt{f}}_{\text{four connectors}} + \underbrace{}_{\text{ILD}}$$

Link segment transmission parameters (UTP)

Link segment transmission and coupling parameters (UTP)

- Insertion loss
- Return loss
- Alien Crosstalk
  - PSANEXT, PSAACRF
- Common to differential conversion loss (SDC12/SDC21)

•Insertion loss

•Amended Motion #2 - Move that The IEEE P802.3bp Task Force affirms the proposed
•Baseline IL Channel Performance for link segment insertion to establish the absolute
•value across the frequency range through 600MHz. (herman_3bp_01_0913.pdf)
•Technical 75%
•Vote
•Y: 25 N: 0 A: 4
•MOTION: Passes

$$IL = .4927\sqrt{f} + 0.0023f + (0.0639 / \sqrt{f}) + 0.08\sqrt{f} + 0.018\sqrt{f}$$

where

f := frequency_in_MHz

Link segment transmission parameters (UTP)

- Alien Crosstalk -PSANEXT

Motion 4: Move that 802.3bp adopt the “Proposed baseline” Alien NEXT specification on slide 8 of mueller_01a_3bp_0314.pdf
M: Thomas Müller S: Chris Mash
Y: 29 N:0 A: 9

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

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

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

Link segment transmission parameters (UTP)

- Alien Crosstalk -PSAACRF

Motion #8 - Move that The IEEE P802.3bp Task Force affirms the proposed Baseline PSANEXT (in slide 11 in herman_3bp_01_0913.pdf) and PSAACRF (in slide 13 in herman_3bp_01_0913.pdf) for link segment specification over frequency range 1MHz - 600MHz. (alien crosstalk configuration in http://www.ieee802.org/3/bp/public/jul13/moffitt_3bp_01_0713.pdf)
M: Todd Herman S: Xiaofeng Wang
Technical 75%
Vote
Y: 18 N: 1 A: 10
MOTION: Passes

PSAACRF

$$PSAACRF := -20\cdot\log\left(10^{\frac{-10\cdot\log\left(\frac{15}{100}\right)+38.2-20\cdot\log\left(\frac{f}{100}\right)}{-20}} + 4\cdot 10^{\frac{67-20\cdot\log\left(\frac{f}{100}\right)}{-20}}\right)$$

where

$f := frequency\_in\_MHz$

Link segment transmission parameters (UTP)

- Return Loss

Frequency range	Requirement
1-10 MHz	19 dB
10-40 MHz	24-5log(f) dB
40-130 MHz	16 dB
130-400 MHz	37-10log(f) dB
400-600 MHz	11 dB

Motion #2: Move that the IEEE P802.3bp Task Force affirms that proposed RL specifications for the automotive link segment in herman_3bp_01_1113.pdf for inclusion in the 802.3bp baseline specification.

Moved by: Xiaofeng Wang

Seconded by: Mehmet Tazebay

Technical 75%

Link segment transmission parameters (UTP)

- Mode conversion

Frequency, MHz

-50_{dB}	$10 < f_{MHz} < 80$
$[\,5 \log_n (f_{MHz}) - 72\,]_{dB}$	$80 < f_{MHz} < 600$

Motion #3: Move that The IEEE P802.3bp Task Force affirms the proposed Mode Conversion limit line for the automotive link segment in Slide # 13 of tazebay_3bp_01a_0913.pdf for inclusion in 802.3bp baseline specification.
Moved by: Mehmet Tazebay
Seconded by: Gary Yurko
Technical 75%
Y: 33 N: 0 A: 5
MOTION: Passes