
802.3bp Baseline Optional Link segment

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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

- Ludwig Winkel, Siemens
- Bob Lounsbury, Rockwell
- Karl Weber, Beckhoff Automation
- Bernd Horrmeyer, Phoenix Contact
- Carlos Pardo, Knowledge Development for Plastic Optical Fiber (KDPOF)
- Robert Wagner, Ronald Nordin, Panduit
- Dave Hess, Cord Data
- James Malkemus, General Cable Corp
- Bert Bergner, TE Connectivity, AD Automotive Infotainment
- Mike Gardner, Sasha Babenko, Molex Inc
- Paul Kish, Belden
- Val Maguire, Siemon Company
- Larry Matola, Delphi Corporation
- Thomas Mueller, Rosenberger
- Rainer Pohmerer, LEONI Kabel GmbH
- Alan Flatman, Independent

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 (1000BASE-T1)

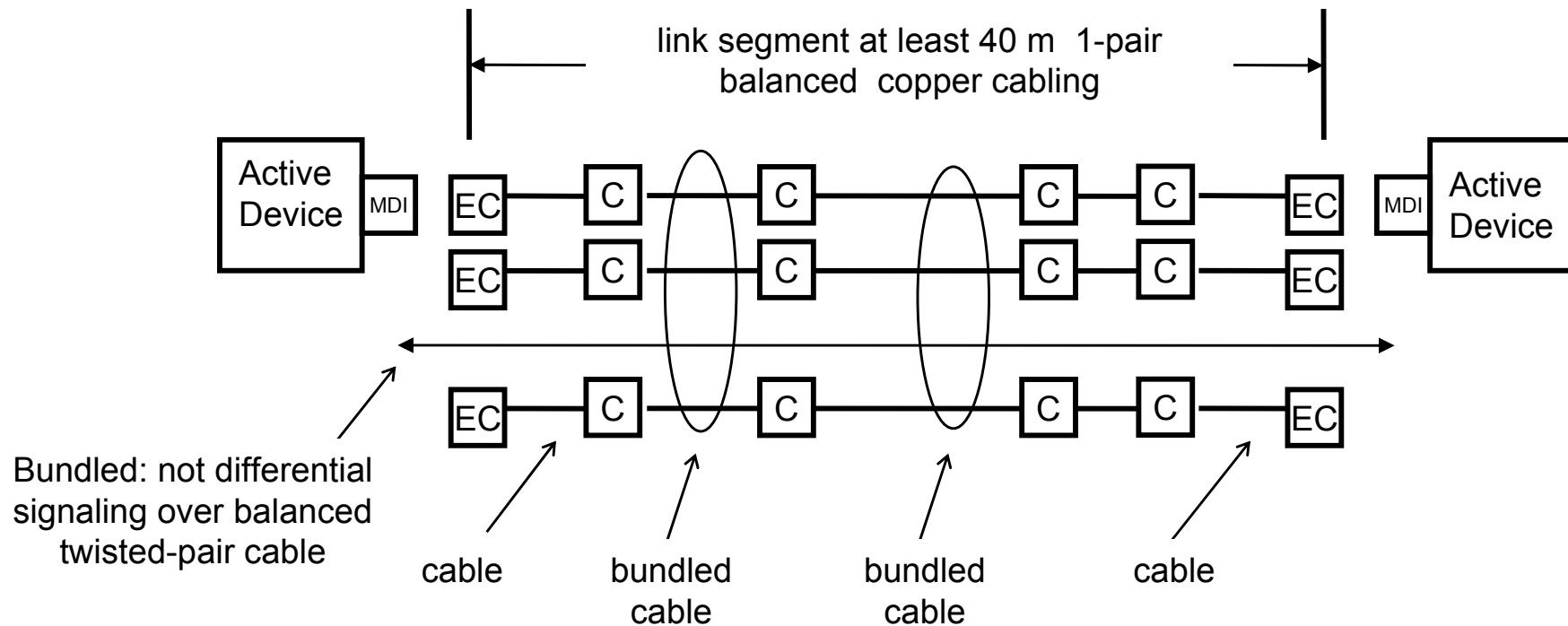
802.3bp Link Segments

Two link segments are specified:

- a) An *automotive link segment* supporting up to four inline connectors using unshielded balanced copper cabling for at least 15 m. This link segment is referred to as *link segment type A*.

- b) An *additional link segment* supporting up to four inline connectors using balanced copper cabling for at least 40 m to support applications requiring additional physical reach, such as industrial and automation controls and transportation (aircraft, railway, bus and heavy trucks). This link segment is referred to as *link segment type B*.

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).

$$\text{InsertionLoss}(f) \leq \text{TBD} \text{ dB} \quad (98-4)$$

where

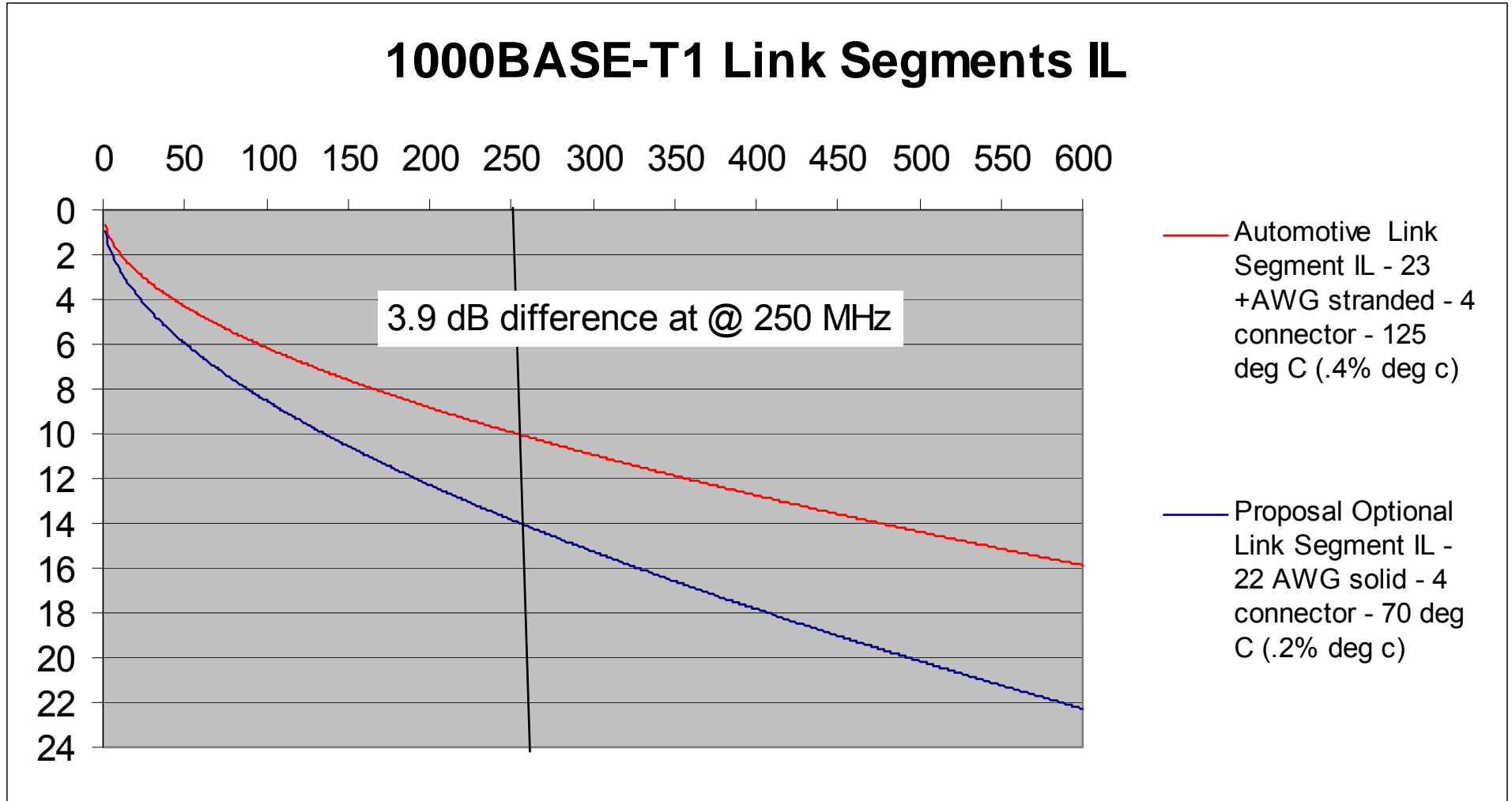
f is the frequency in MHz; $1 \leq f \leq 600$

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

Insertion loss proposal

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

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 .

$$\text{ReturnLoss}(f) \leq \text{TBD dB} \quad (98-5)$$

where

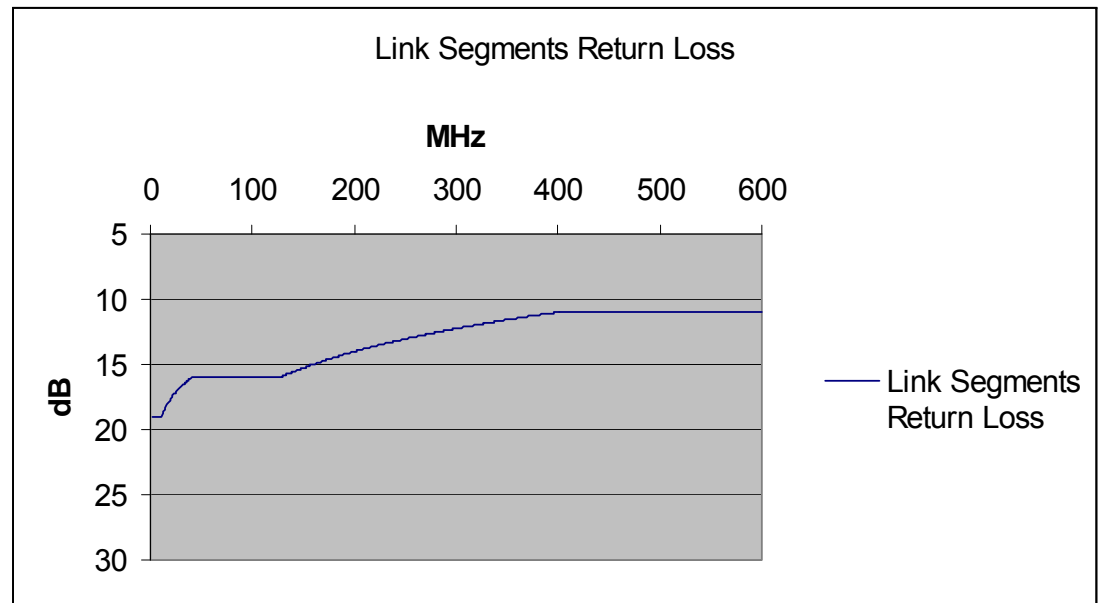
f is the frequency in MHz.

Add equation with TBD

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

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).

$$\text{PSANEXT}(f) \geq \text{TBD dB} \quad (98-11)$$

where

f is the frequency in MHz

•PSANEXT – single port

Frequency (MHz)	PSANEXT (dB)
$1 \leq f \leq 600$	≥ 75 (TBD)

•PSANEXT – multi port

Frequency (MHz)	PSANEXT (dB)
$1 \leq f \leq 600$	≥ 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).

$$\text{PSAACRF}(f) \geq \text{TBD dB} \quad (98-13)$$

where

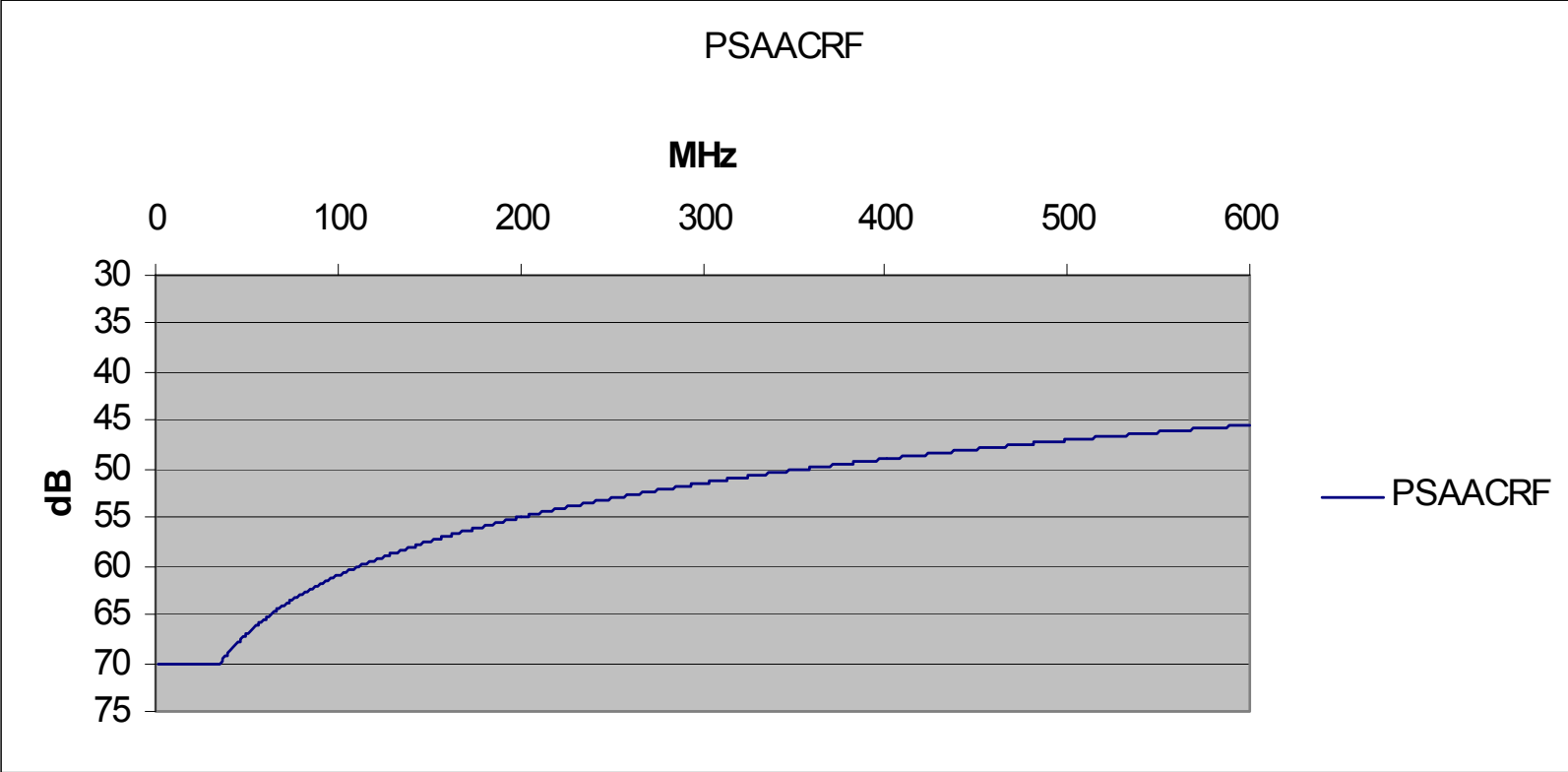
f is the frequency in MHz

•PSAACRF

Calculations that result in PSAACRF loss values greater than 70 dB (TBD) shall revert to a requirement of 70 dB minimum (TBD).

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

Alien crosstalk - PSAACRF



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

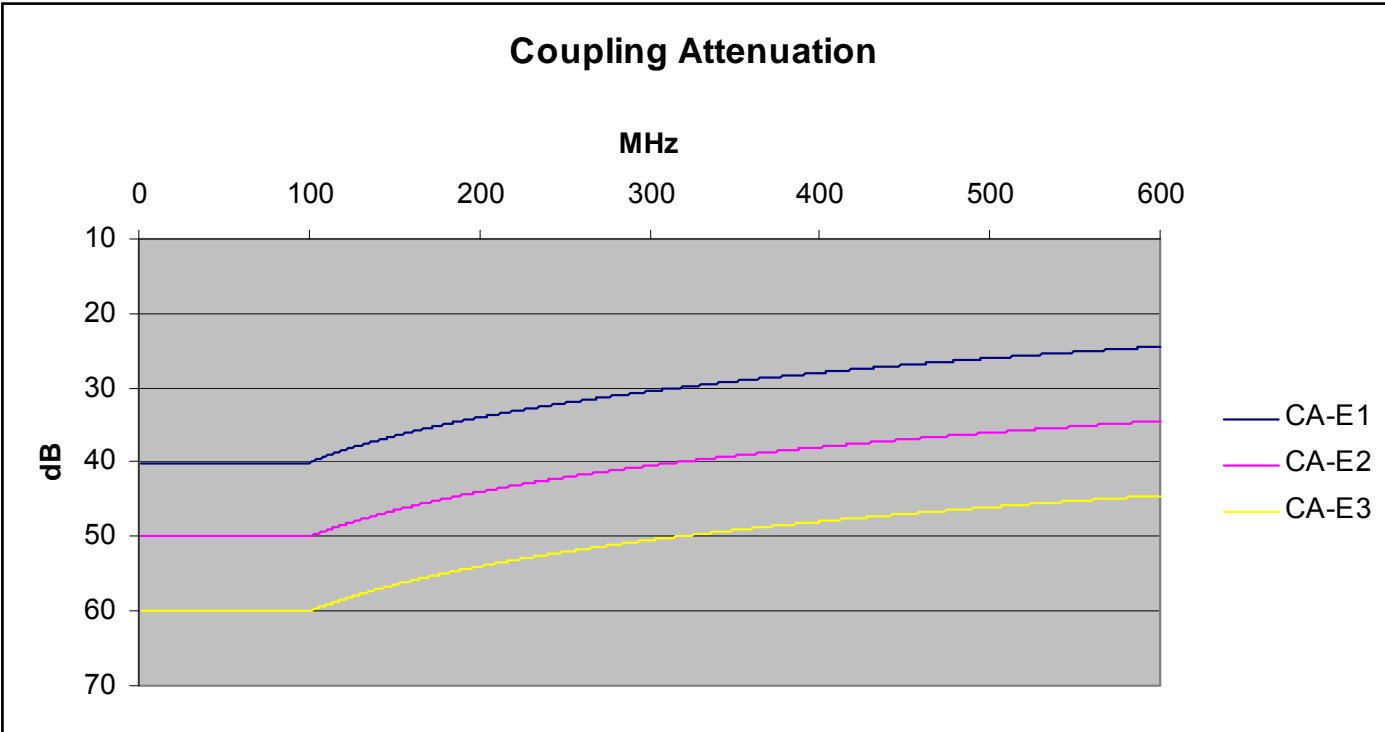
• Environmental classification

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

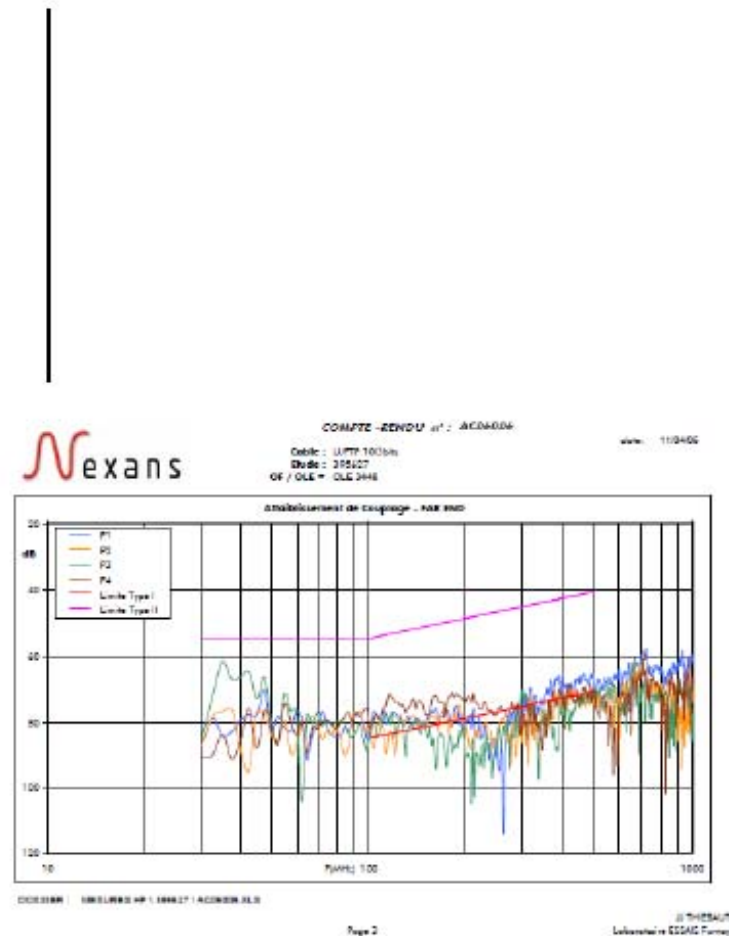
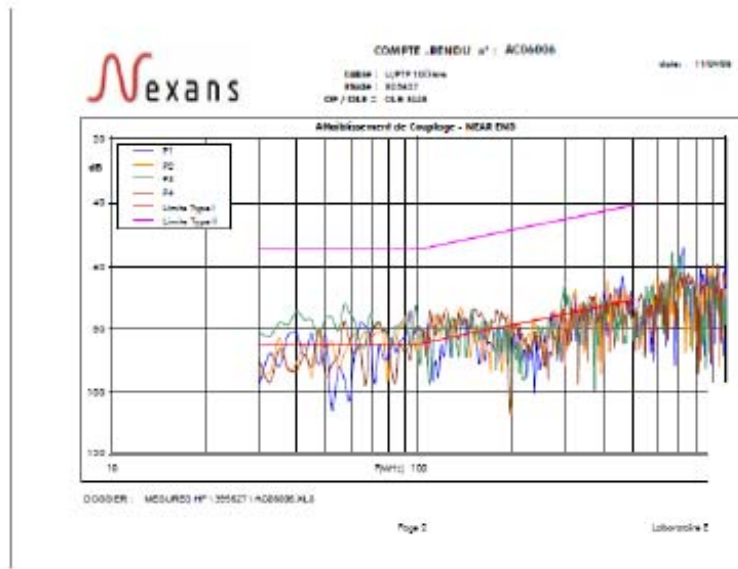
Frequency (MHz)	Minimum (dB)			
	E1	E2	E3	E4
$30 \leq f \leq 600$	$80-20\text{Log}(f)$ (Max 40 dB)	$90-20\text{Log}(f)$ (Max 50 dB)	$100-20\text{Log}(f)$ (Max 60 dB)	TBD



Coupling attenuation (Cat6A UFTP)



Worst Case: Cat6A UFTP Cable



Source: rossbach_0513_40GBT-1.pdf

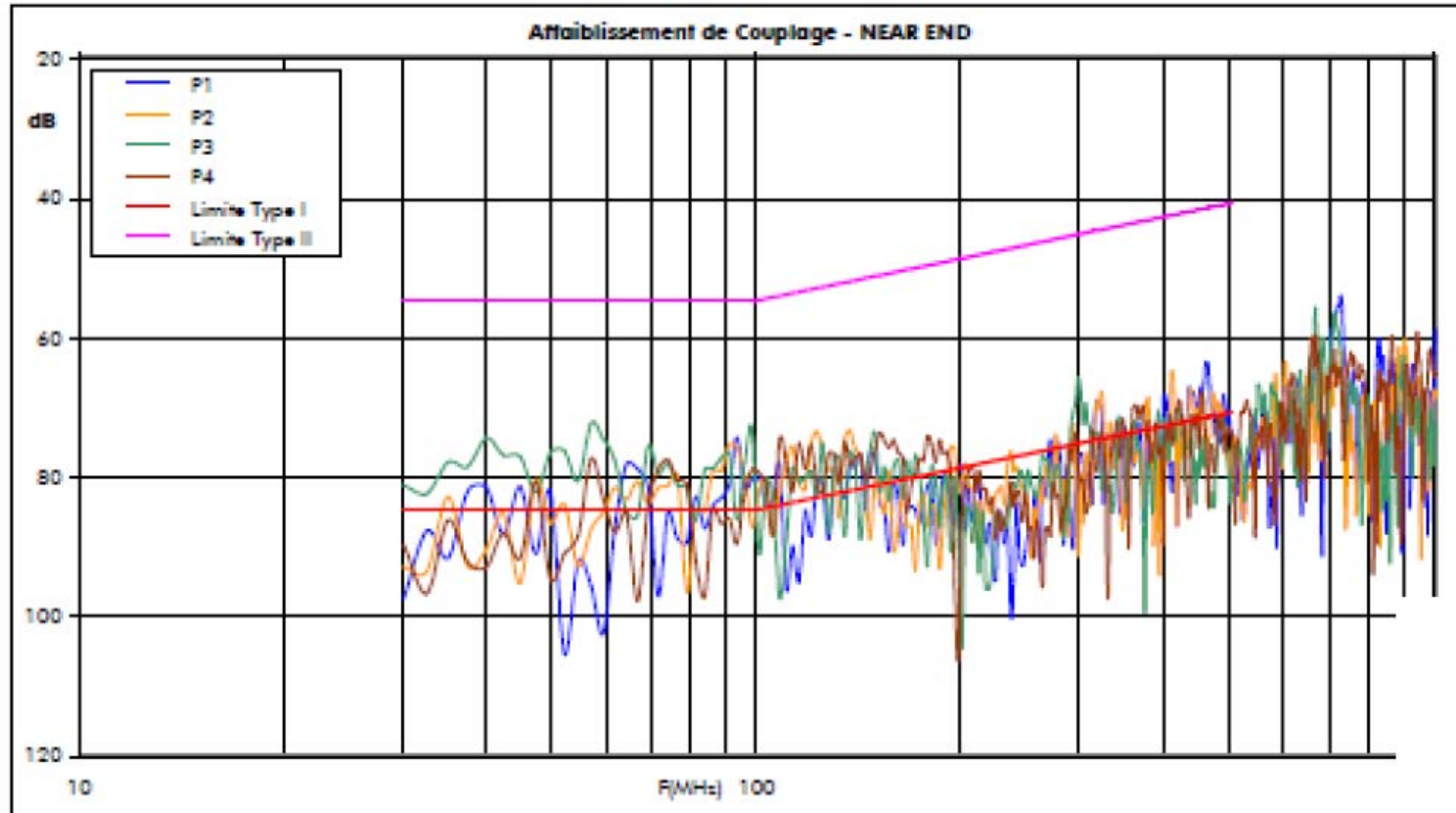
Coupling attenuation (Cat6A UFTP)



COMPTE -RENDU n° : AC06006

date: 11/04/05

Cable : U/FTP 10Gbits
Etude : 395627
OF / OLE = OLE 3448



DOSSIER : MESURES HF \ 395627 \ AC06006.XLS

Page 2

Laboratoire E

Source: rossbach_0513_40GBT-1.pdf – slide 10

802.3bp (1000BASE-T1)

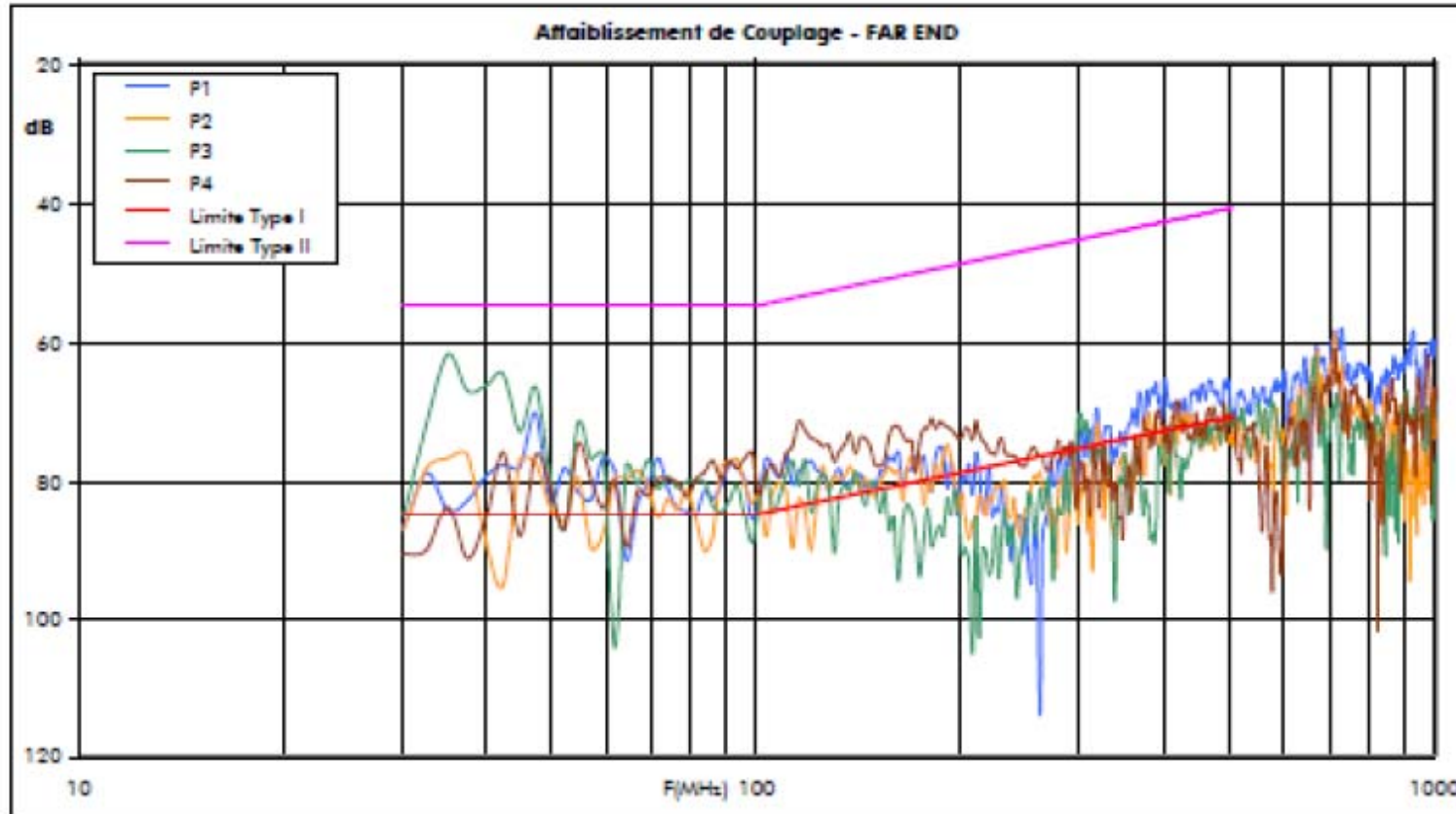
Coupling attenuation (Cat6A UFTP)



COMPTE -RENDU n° : AC06006

date: 11/04/05

Cable : U/FTP 10Gbits
Etude : 395627
OF / OLE = OLE 3448

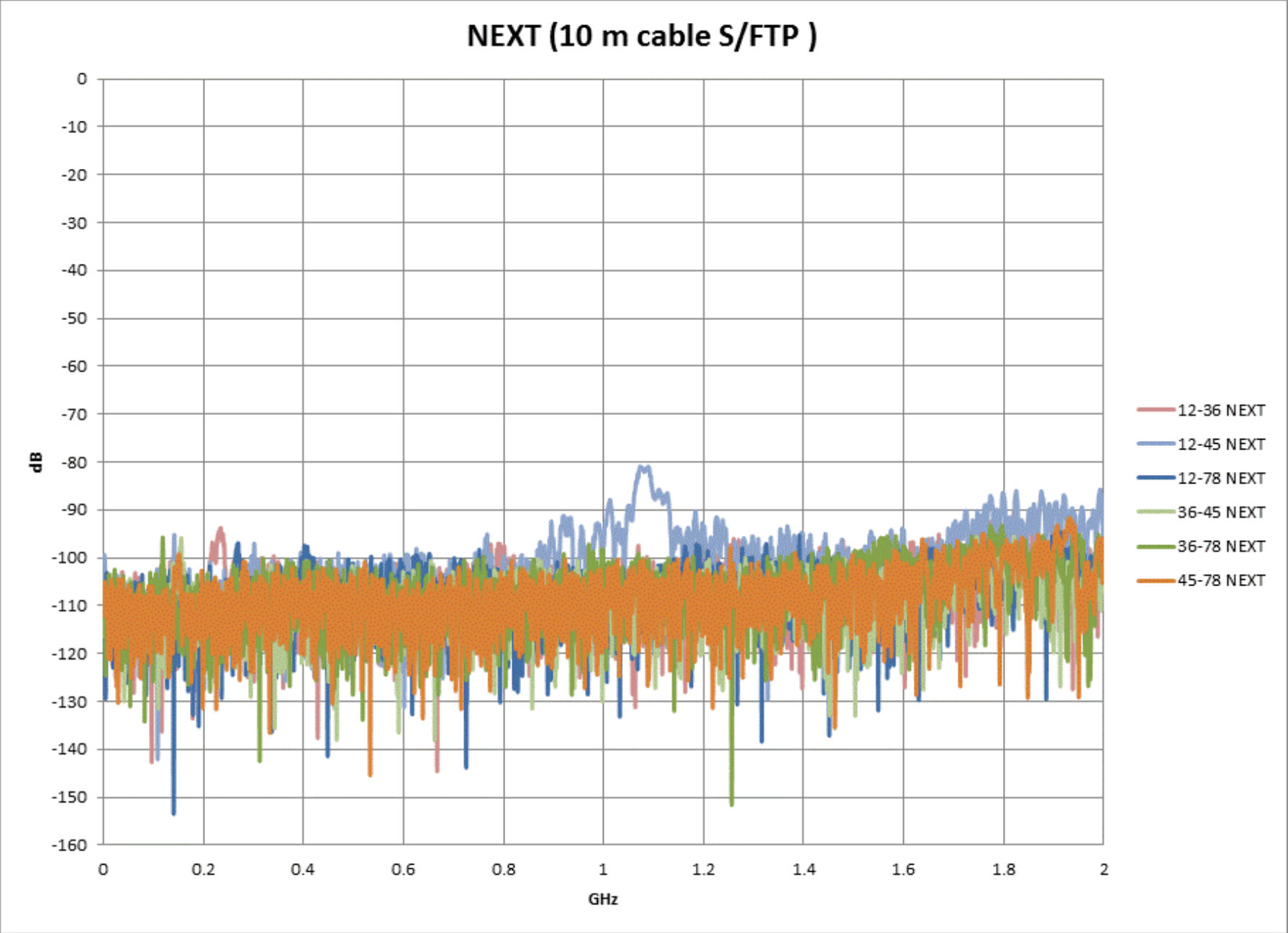


DOSSIER : MESURES HF \ 395627 \ AC06006.XLS

Source: rossbach_0513_40GBT-1.pdf – slide 10

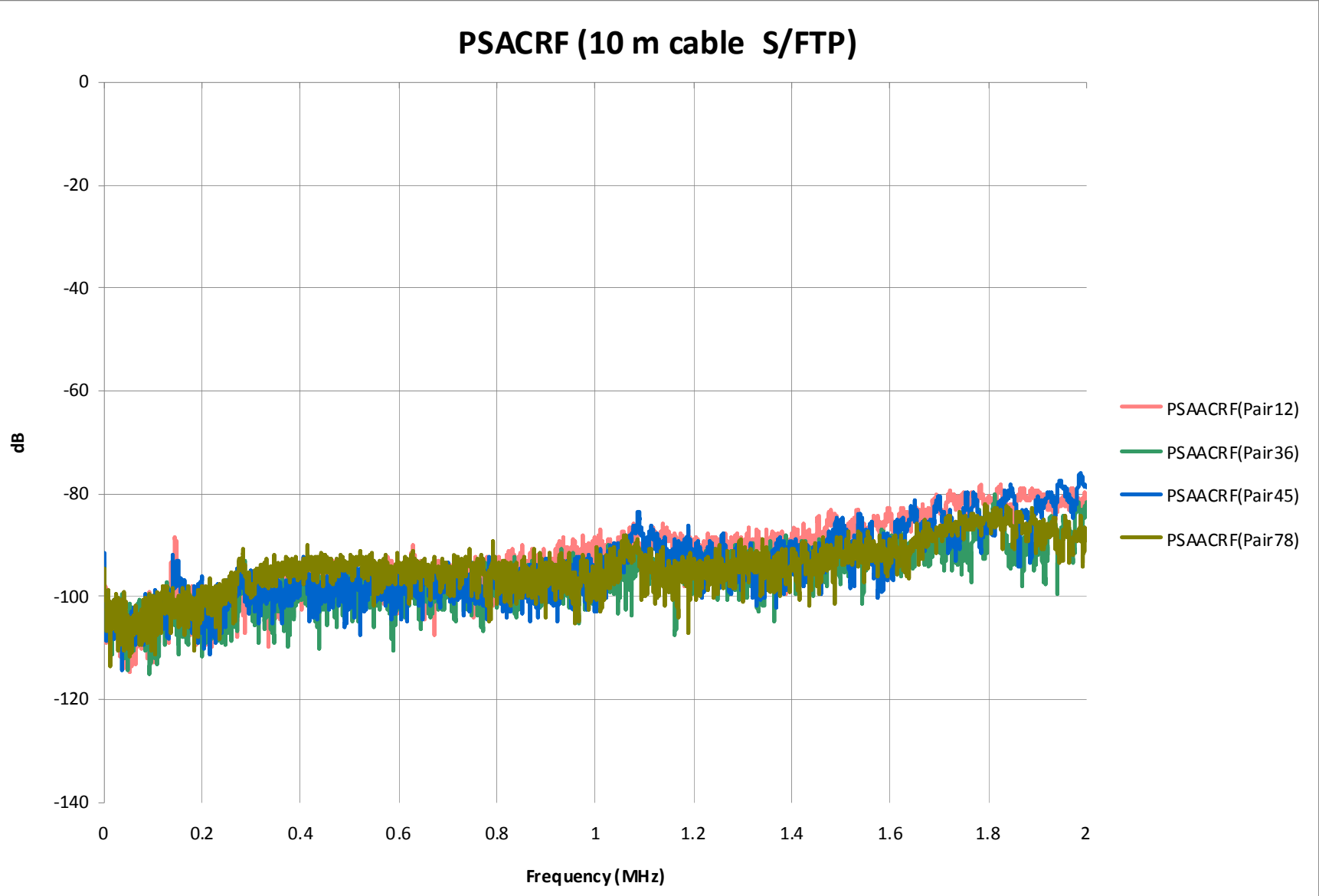
802.3bp (1000BASE-T1)

Feasibility - Alien crosstalk - ANEXT



802.3bp (1000BASE-T1)

Feasibility - Alien crosstalk - PSACRF



802.3bp (1000BASE-T1)

Backup

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

$$60 - 10 \log\left(\frac{f}{100}\right) \quad [1 \text{ to } 100 \text{ MHz}]$$
$$60 - 15 \log\left(\frac{f}{100}\right) - 6 * \left(\frac{f-100}{400}\right) \quad [100 \text{ to } 600 \text{ MHz}]$$

Proposed baseline

$$54 - 10 \log\left(\frac{f}{100}\right) \quad [1 \text{ to } 100 \text{ MHz}]$$
$$54 - 15 \log\left(\frac{f}{100}\right) - 6 * \left(\frac{f-100}{400}\right) \quad [100 \text{ to } 600 \text{ MHz}]$$

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

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

where

f := frequency_in_MHz

Link segment transmission parameters (UTP)

•Return Loss

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

$$-50_{\text{dB}} \quad 10 < f_{\text{MHz}} < 80$$

$$[5 \log_n (f_{\text{MHz}}) - 72]_{\text{dB}} \quad 80 < f_{\text{MHz}} < 600$$

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