Additions to Proposal for 1000m link specification

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1000m Link proposal

Assumptions:

- **Up to 10 connectors**
- **No derating cords (if used would result in shorter links)**
- **100 ohm nominal impedance**
- **1-20 MHz**
- **Cable used to model is deployed widely as Profibus PA; 1.05 mm copper diameter (AWG 18)**
- **Industrial environment E2 and E3**
- **Non industrial E1 for cabling outside harsh environment**
- **Connector values: Used in Industry nowadays**

Alien crosstalk (correction)

- There was a comment that alien noise is not environment dependent and should be equal for all mice E classes.
- If that is true (and at a first instance it is), it would be a value needed by the PHY.
- Then we can delete this requirement and define the EMC classes by the shielding definitions
  - Coupling attenuation
  - Transfer impedance (best for this low frequencies).
- A minimum (TBD)should be defined in case unshielded links could be used for E1

Loop resistance 1

- All link values should be valid to the max. temperature specified by the application and/or the corresponding cabling standard
- This Temperature is outside scope for IEEE 802.3dg but as an example:
- If 45 ohm would be specified:
  - therefore if the complete link is at 60°the cable resistance would increase by 16%(40x0,004)

Loop resistance 2

- 1 km of major used cable (sample measurement 42.5 Ohm, AWG 18) calculates to 49.3 Ohm
- Therefore to get to 45 Ohm the length has to be reduced to about 900m or
  - use a cable with less resistance (<AWG 17 ~ 35 Ohm/km) or
  - Realistically:
    - 200m at 60°
    - 300m at 40°
    - 500m at 25°
    - 9.4 +13.8+21.7 = 44.9

Return loss

1.1 Return loss

The return loss for the pair of a channel shall not exceed the limits computed, to one decimal place, using the formula of Table 1.

Table 1– Formula for return loss limits of a channel

Frequency MHz	Minimum return loss dB
$1 \leq f \leq 20$	19,0

The number of connection allowed is related to the link length:

- 10 connectons up to 1000m
- 8 connectons up to 750m
- 6 connectons up to 500m
- 4 connectons up to 200m

Note: This low value for return loss is to take care of cables with low impedance

Insertion loss

as presented in Rational for 1000m and Proposal for Objectives

J. Gottron L.Winkel 5 October 2016

1.2 Insertion loss

The insertion loss for the pair of a channel shall not exceed the limits computed, to one decimal place, using the formula of Table 2.

Table 2 – Formulae for insertion loss limits for a 1000 m channel

Frequency MHz	Maximum insertion loss
$1 \le f \le 20$	$10 * \left(1{,}23\sqrt{f} + 0{,}01 f + 0{,}2/\sqrt{f}\right) + 10 \times 0{,}015\sqrt{f}$

Note: to be deleted before publication: ILD is marginal for this frequencies.

Connector values even lower as presented by Chris Diminico in San Antonio

1.3 Limits involving more than one pair

All these limits are not applicable to one pair channels:
NEXT, PSNEXT, ACR_F, PSACR_F, delay skew and resistance unbalance

1.4 Unbalance

The near end unbalance (TCL) for the pair of a channel shall not exceed the limits computed, to one decimal place, using the formula of Table 3.

Table 3 – Formulae for TCL loss limits for a 1000 m channel

Frequency MHz	Minimum TCL loss dB
$1 < f \leq 20$	25 dB

Note: 1.3 just for information, to be deleted before publication

Alien crosstalk deleted

1.5 Alien (Exogenous) crosstalk

1.5.1 General

Definition and set up of alien noise measurement for one pair channels can be seen in IEC 61156-1 (in preparation).
Note:Plateau values at 20 MHz for class F_A used.

1.5.2 PSANEXT

The PS ANEXT of a channel shall meet the limits computed, to one decimal place, using the value of Table able 5.

Table 5 – Formulae for PSANEXT limits for a channel

Frequency MHz	Minimum PSANEXT dB		
	E1	E2	E3
$1 \leq f \leq 20$	57	67	67

Note: these values are met if coupling attenuation and transfer impedance are met.

1.5.3 PSAACR-F

The PS AACR-F for a channel shall meet the limits computed, to one decimal place, using the formulae of Table 6.

Table 6 – Formulae for PSAACR-F limits for a 1000 m channel

Frequency MHz	Minimum PSAACRF dB		
	E1	E2	E3
$1 \leq f \leq 20$	57	67	67

Note: these values are met if coupling attenuation and transfer impedance are met.

stays

1.6 Coupling attenuation

The coupling attenuation for the pair of a channel shall meet the limits computed, to one decimal place, using the formulae of Table 8. The limits shown in Table 9 are derived from the formulae at key frequencies.
See IEC62143-4-14 and IEC 61156-1 for testing procedures. It is possible to asses coupling attenuation by laboratory measurements of representative samples of channels assembled using their component and connector practices.

Table 8 – Coupling attenuation for a channel

environment	Frequency MHz	Minimum coupling attenuation dB
E3	$1 < f \leq 20$	70
E2	$1 < f \leq 20$	65
E1	$1 < f \leq 20$	55

Note: IEC to be asked for measurement reference for values below 30 MHz

1.7 Transfer Impedance

environment	Frequency MHz	Max mOhm/m
E3	$1 < f \leq 20$	**15**
E2	$1 < f \leq 20$	**25**
E1	$1 < f \leq 20$	**35**

1.8 DC loop Resistance

The DC loop resistance in an installation shall not exceed 45 Ohm.

1.9 Propagation delay

The propagation delay for the channel shall not exceed the limits computed, to three decimal places, using the formulae of Table 0.

Table 10 – Formulae for propagation delay limits for a 1000 m channel

Frequency MHz	Maximum propagation delay µs
$1 < f \leq 20$	$10 \times \left[0{,}534 + 0{,}036/\sqrt{(f)}\right] + 10 \times 0{,}0025$

Note: only full duplex!