IEEE P802.3dg 100 Mb/s Long-Reach Single Pair Ethernet Task Force

Cable Termination For Alien Crosstalk Mitigation

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IEEE802.3dg Interim, September 11-14, 2023

BELDEN

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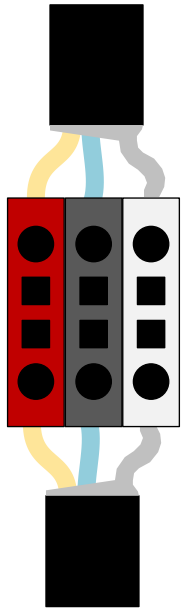
Overview



Depiction of three conductors connector known to cause variability in ANEXT

- This presentation describes a cable 4-terminals technique to improve and reduce variability in PSANEXT performance; It refers to the previous presentation (tellas_3dg_01_07_11_2023) and it meets the working group recommendation to avoid the termination of the cable shield to a common/shared ground.

  Ref. https://www.ieee802.org/3/dg/public/May_2022/tellas_3dg_01_07_11_2023.pdf

- The proposed 4-terminals technique has the potential advantage to :
  i. Reduce dependance of termination work execution,
  ii. Be more robust for different link configurations,
  iii. Use of alien crosstalk limit that does not depend on link length / insertion loss.

- The PSANEXT performance was re-tested in 4 different 6on1 configurations:
  A. 3-terminals configuration (Signal-Signal-Common)
  B. 3+1 terminals configuration (Space-Signal-Signal-Common)
  C. 3+1 terminals configuration (unused terminal-Signal-Signal-Common)
  D. 4-terminals configuration (Common-Signal-Signal-Common) note: the cable shield is divided on 2 terminals

Note : The term ‘’common’’ refers to the connection of the cable shield on a terminal block. The cable shield terminations are not shared with others cable shields and are not grounded.

- Additional information is presented for the assessment of the TCL limit.

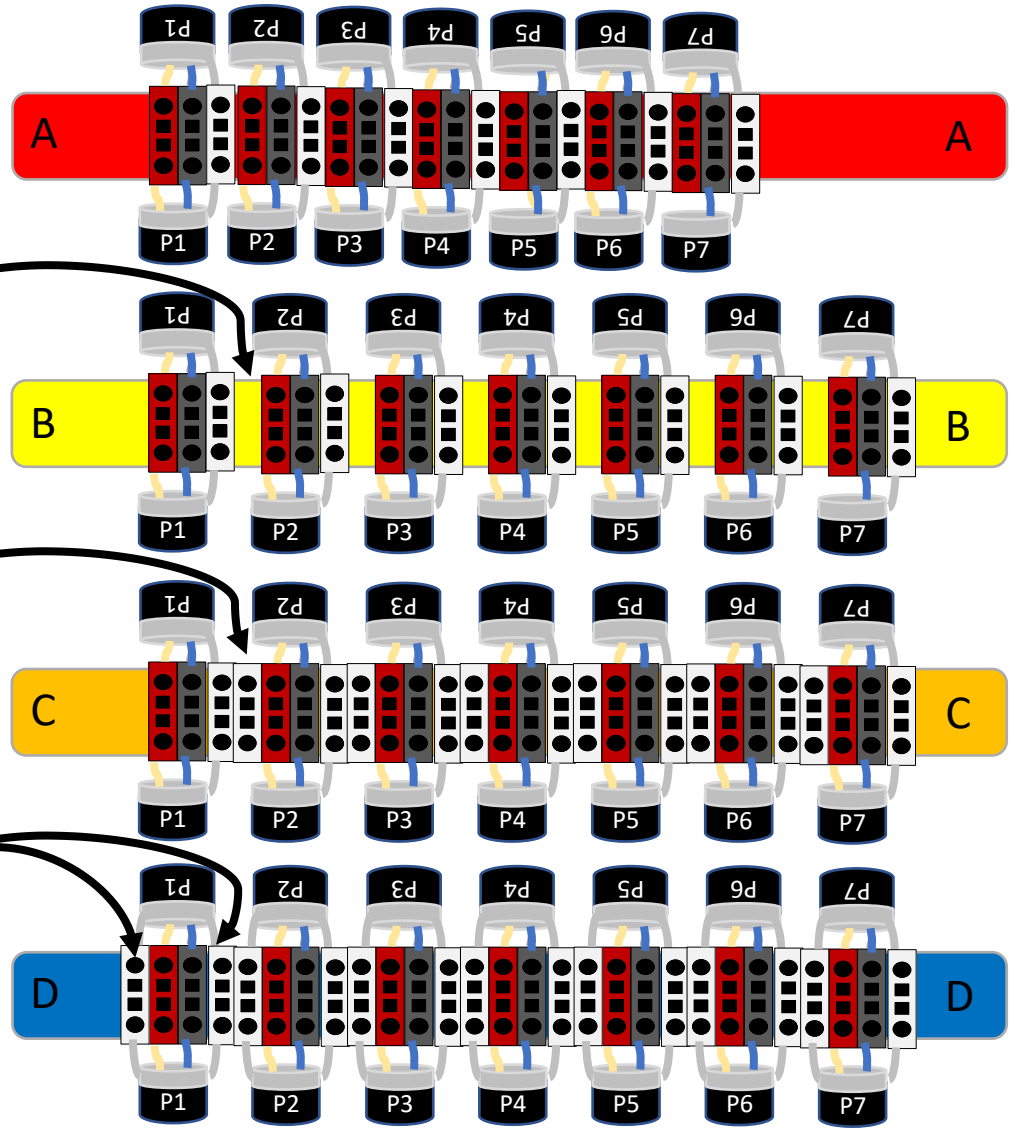
Alien Crosstalk – Cable Terminations

3 terminals configuration
(Signal, Signal, Common)

3+1 terminals configuration
(Space-Signal-Signal-Common)

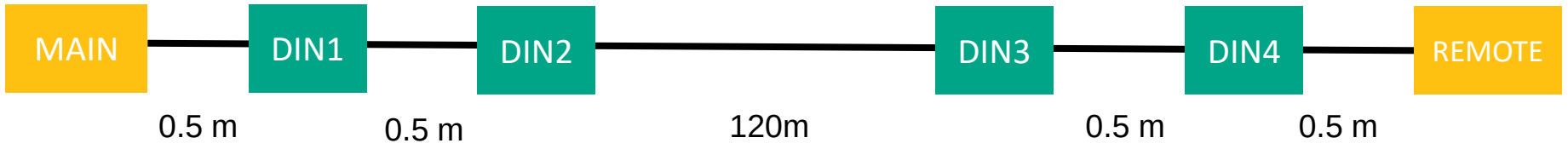
3+1 terminals configuration
(unused terminal-Signal-Signal-Common)

4 terminals configuration
(Common, Signal, Signal, Common)



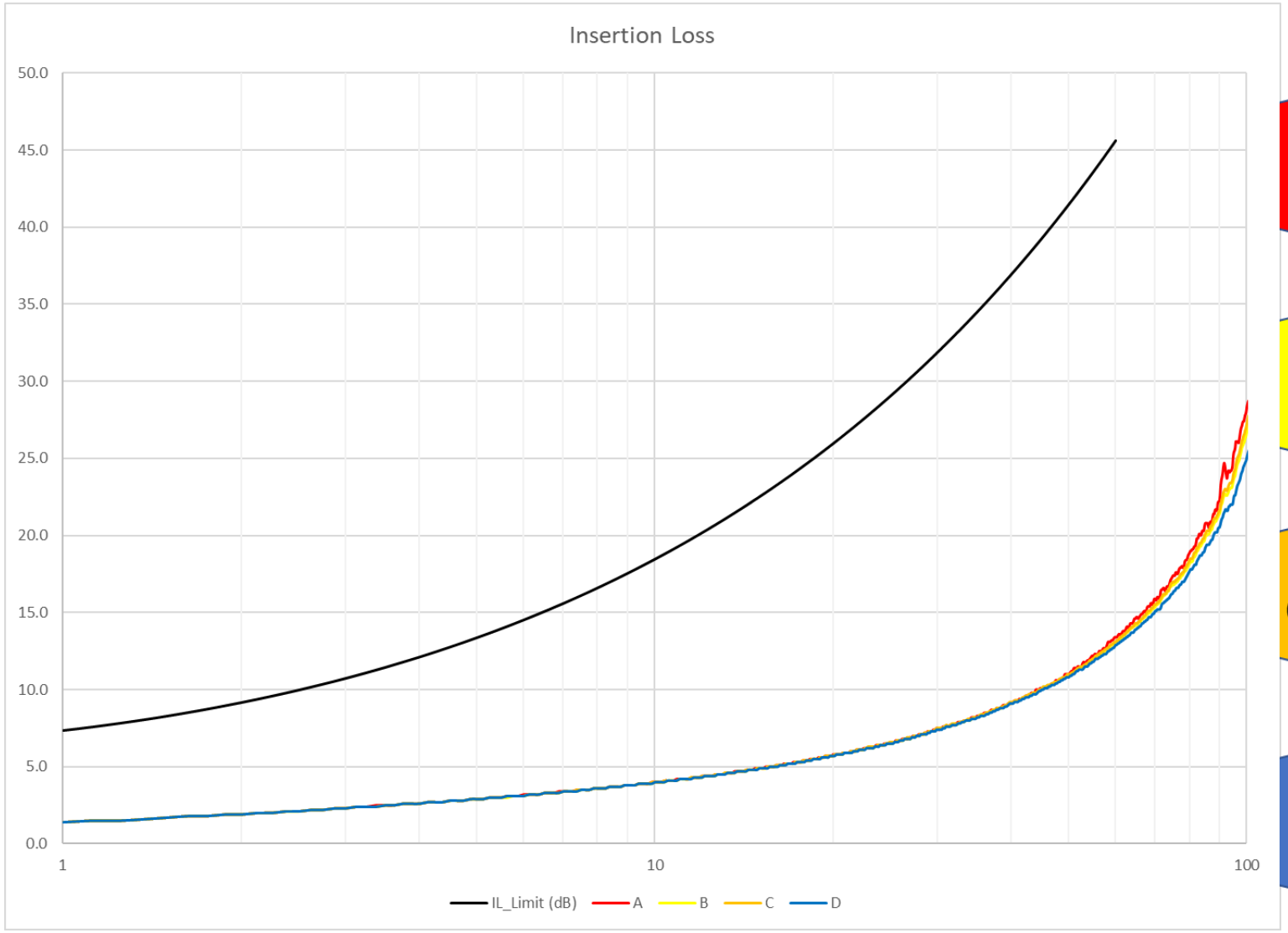
Note : The term ‘’common’’ refers to the connection of the cable shield on a terminal block. The cable shield terminations are not shared with others cables shields and not grounded.

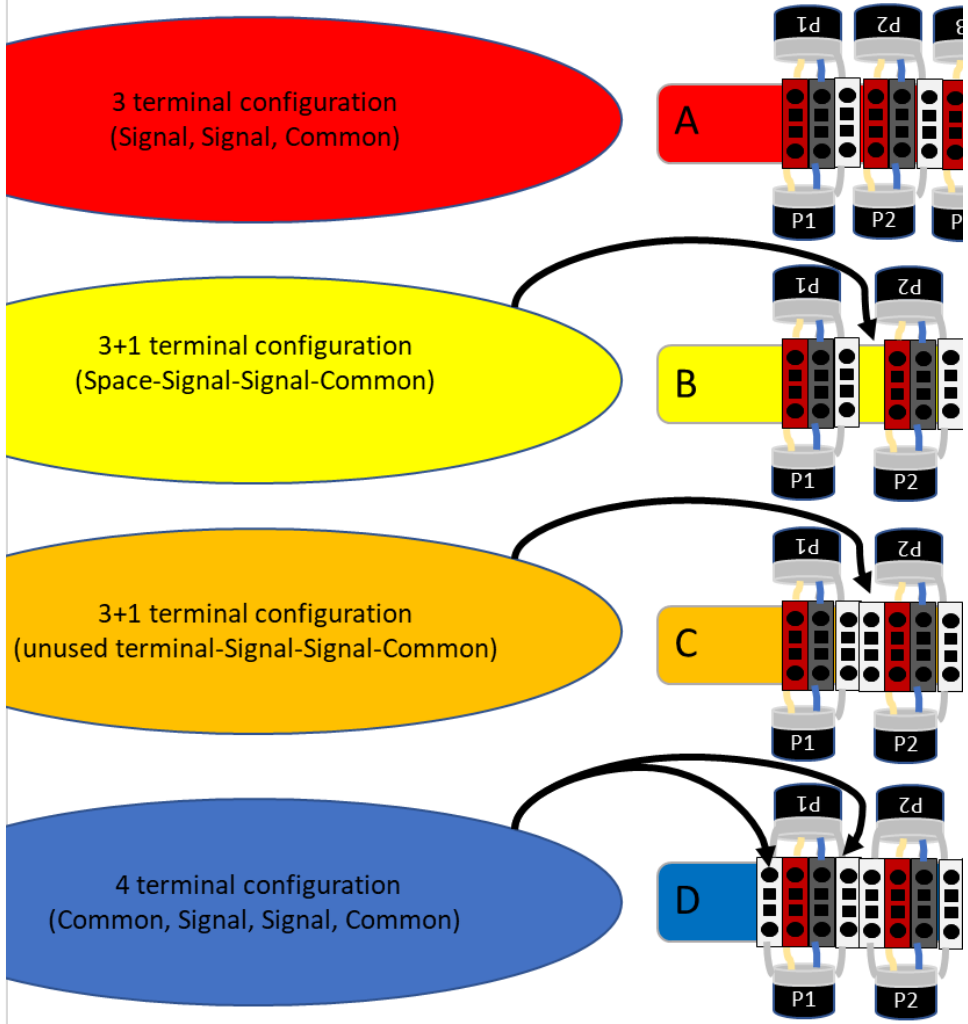
Test Setup



Tested link length	: 122 meters
Insertion Loss at 20Mhz	: 5.92 dB
N case (PSANEXT,PSAACRF)	: 0
Testing configuration	: 6 on 1 (victim P4)
Cable AWG	: 18AWG – Solid Cu

Insertion Loss





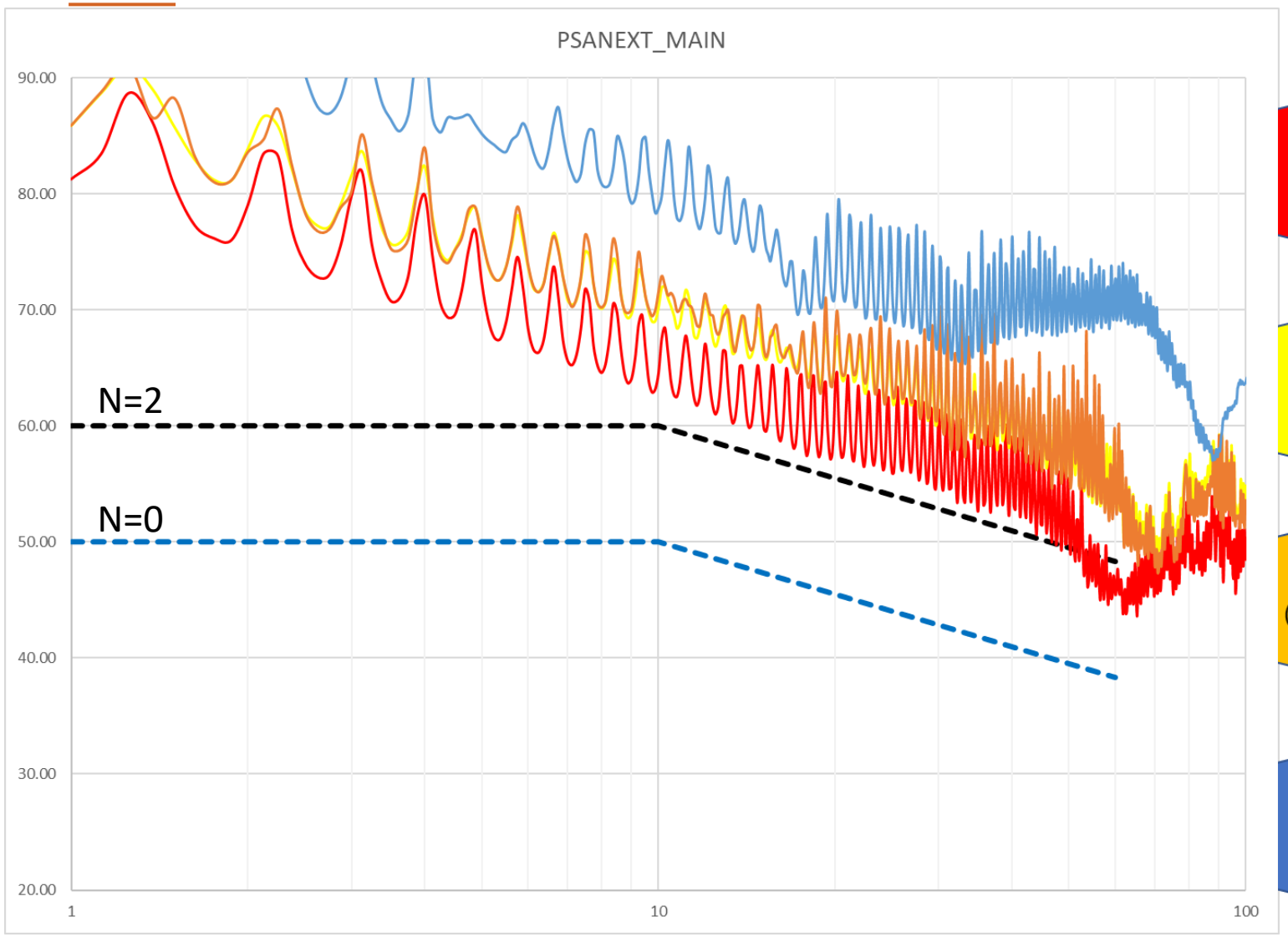
PSANEXT and PSAACRF limit (adopted)

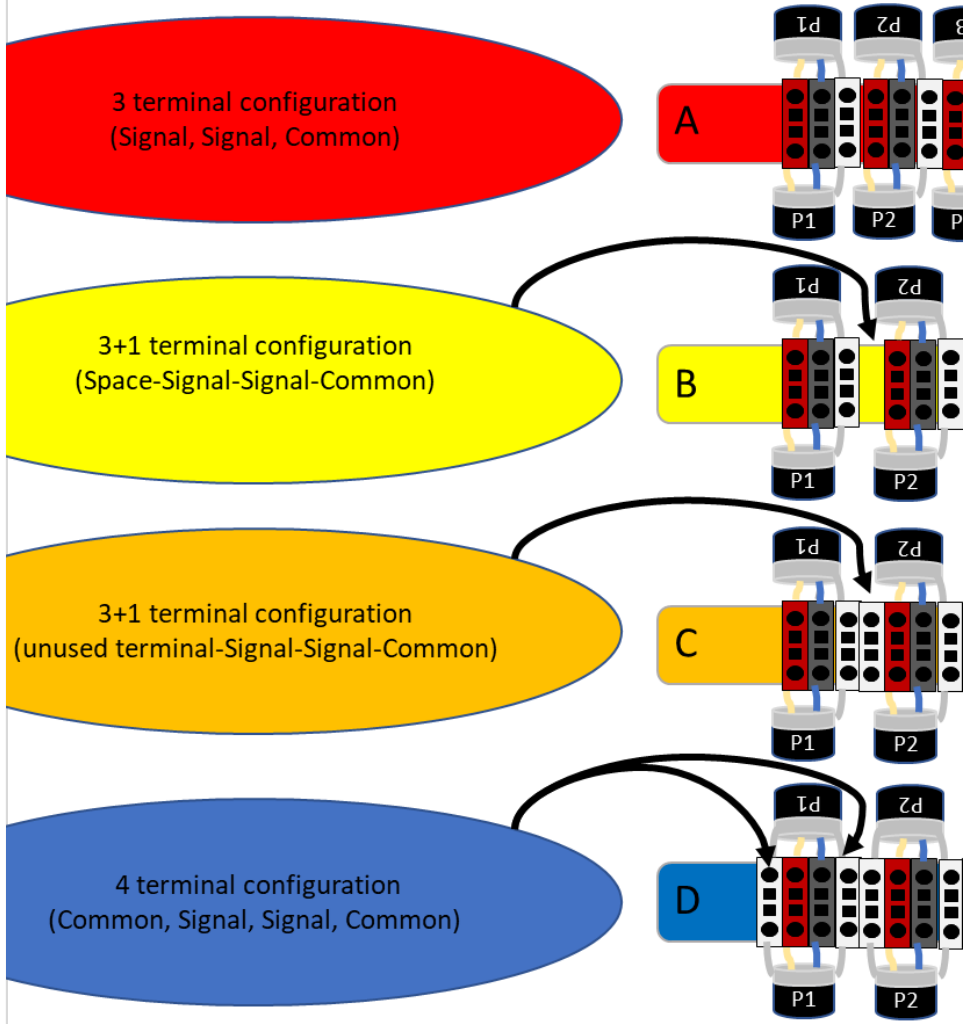
PSANEXT:	50 + 5 x N	0.1 ≤ f < 10 MHz
	50 + 5 x N - 15 x log10 (f/10)	10 ≤ f ≤ 60 MHz
PSAACRF:	50 + 5 x N	0.1 ≤ f < 2 MHz
	36 + 5 x N - 20 x log10 (f/10)	2 ≤ f ≤ 60 MHz

With N =	0	for IL_20 < 16 dB
	0.5 x (IL_20 – 16)	for 16 ≤ IL_20 < 18 dB
	1	for 18 ≤ IL_20 < 21 dB
	1 + 0.5 x (IL_20 – 21)	for 21 ≤ IL_20 < 23 dB
	2	for 23 ≤ IL_20 (dB)

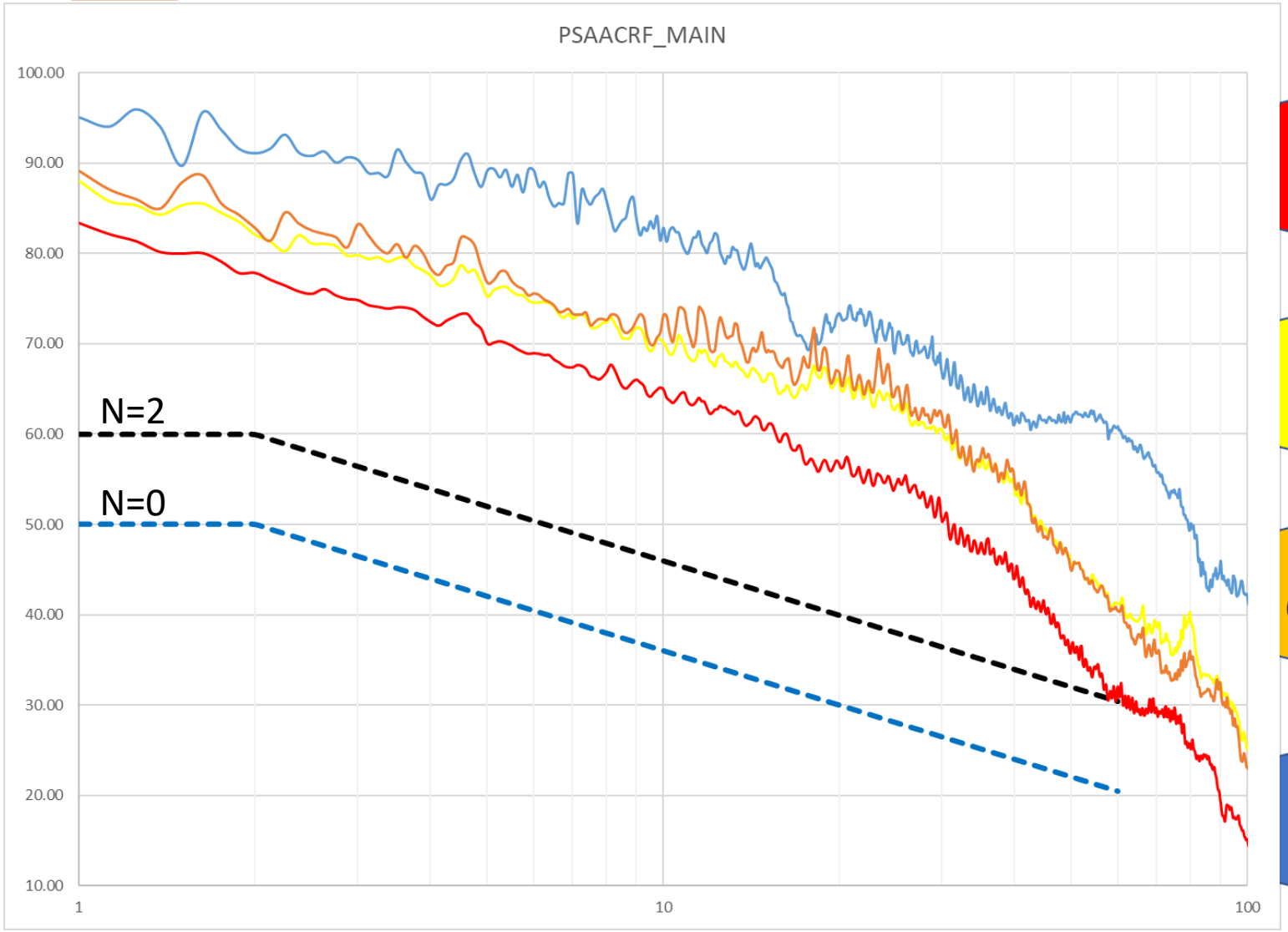
(f is in MHz)

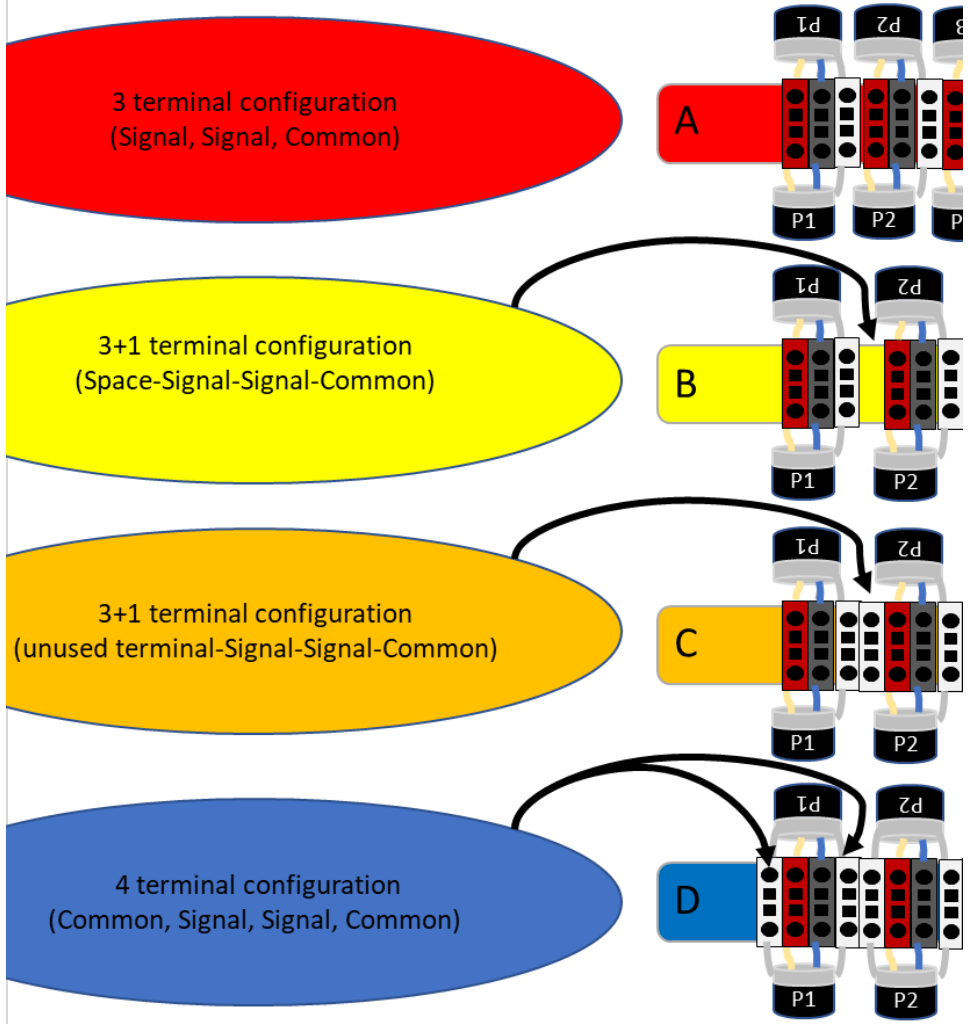
PSANEXT


PSANEXT_MAIN
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
1
10
100
N=2
N=0


3 terminal configuration
(Signal, Signal, Common)
A
3+1 terminal configuration
(Space-Signal-Signal-Common)
B
3+1 terminal configuration
(unused terminal-Signal-Signal-Common)
C
4 terminal configuration
(Common, Signal, Signal, Common)
D
P1
P2

PSAACRF


PSAACRF_MAIN
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
1
10
100
N=2
N=0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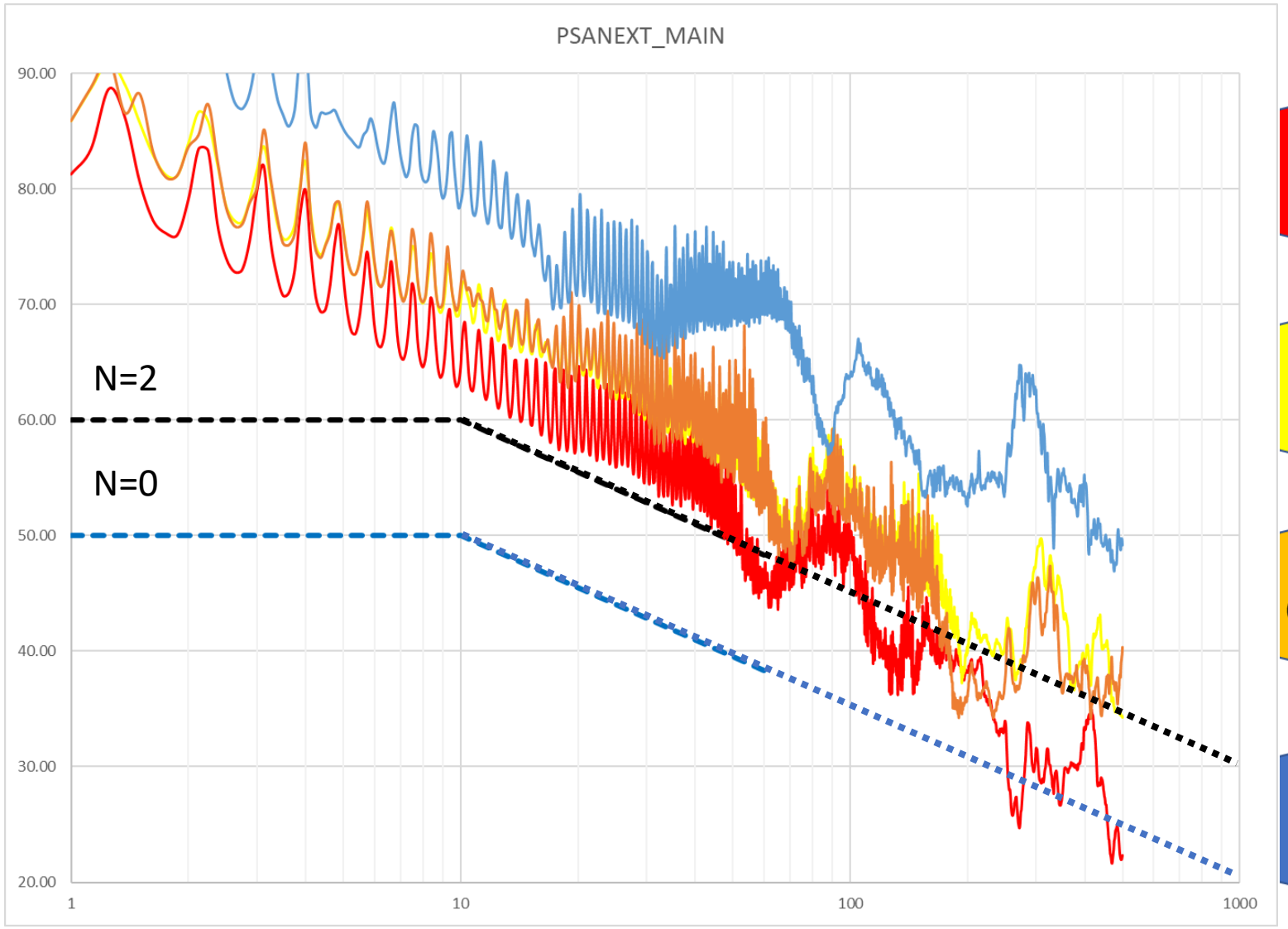
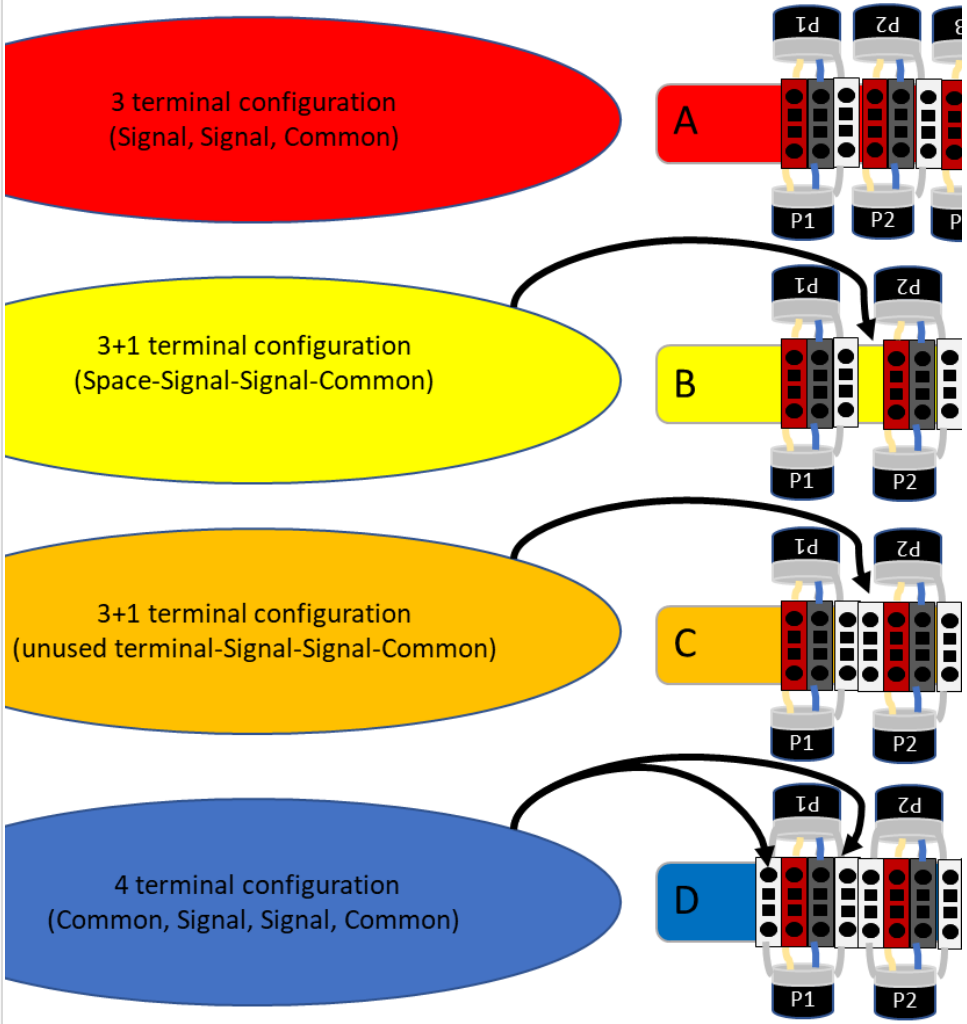
D
P1
P2

Promising result for development beyond 100Base-T1





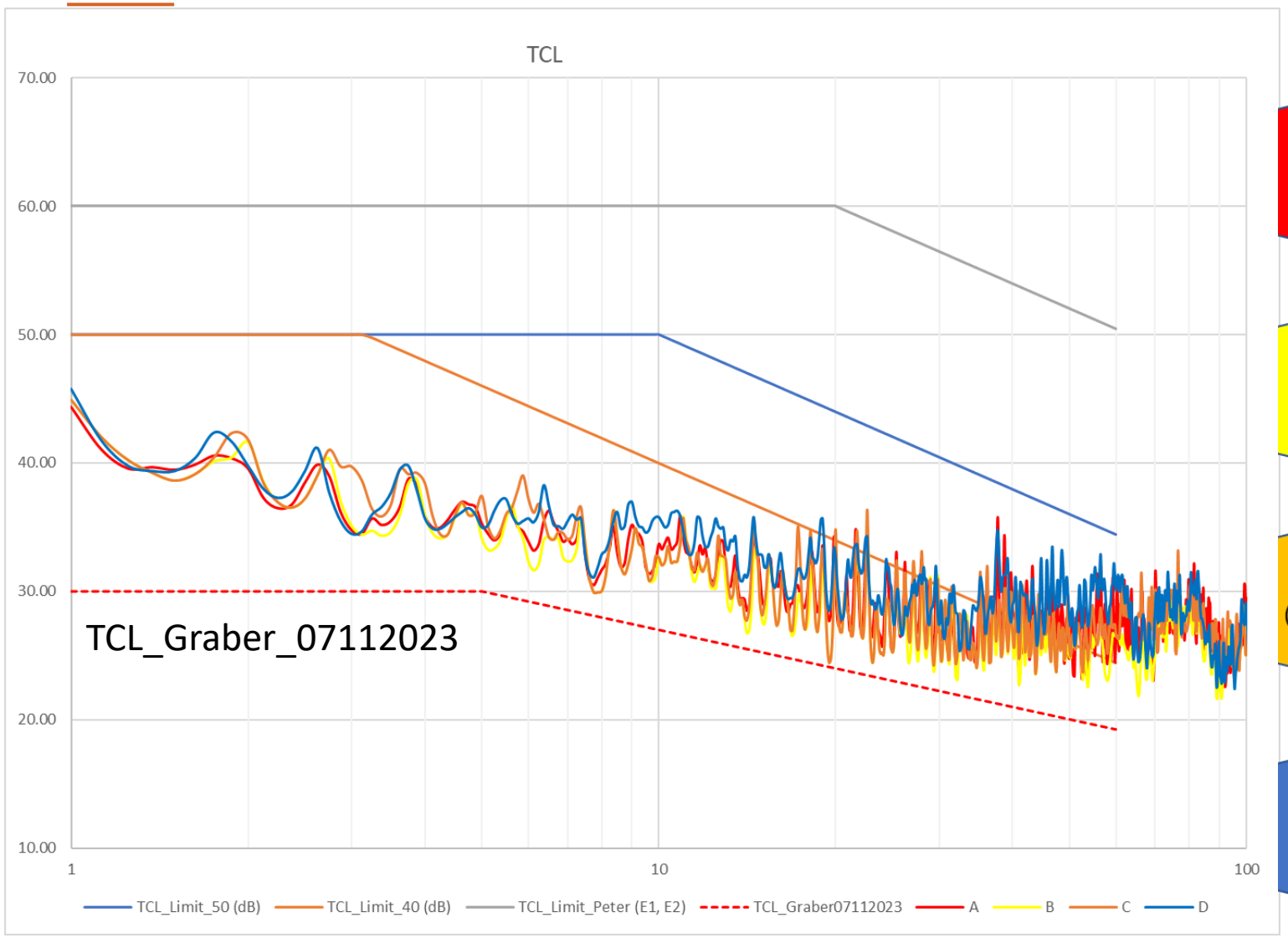
TCL limit (adopted)

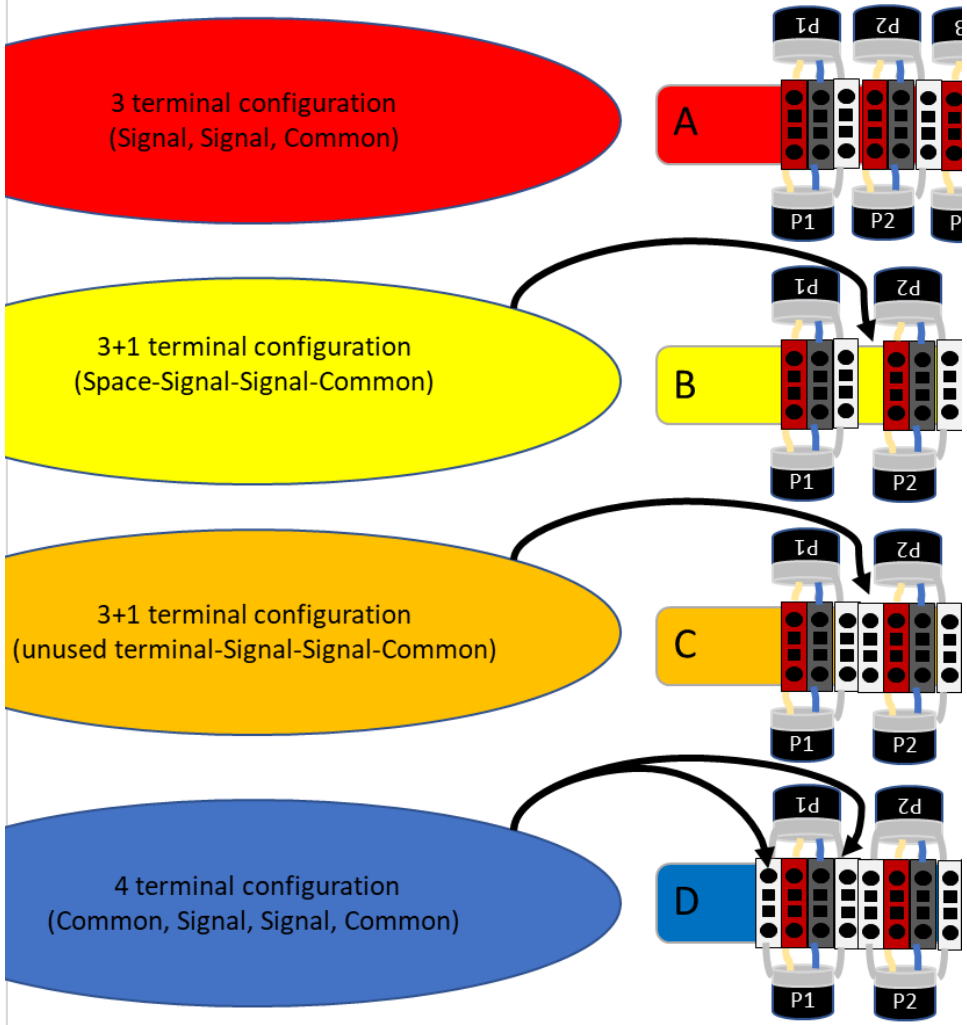
TCL = 30 dB for 0.1 MHz <= f < 5 MHz

TCL = 30 – 10 * log10(f / 5) for 5 MHz <= f <= 60 MHz

(f is in MHz)

TCL


TCL
70.00
60.00
50.00
40.00
30.00
20.00
10.00
1
10
100
TCL_Graber_07112023
TCL_Limit_50 (dB)
TCL_Limit_40 (dB)
TCL_Limit_Peter (E1, E2)
TCL_Graber07112023
A
B
C
D


3 terminal configuration
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A
3+1 terminal configuration
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B
3+1 terminal configuration
(unused terminal-Signal-Signal-Common)
C
4 terminal configuration
(Common, Signal, Signal, Common)
D
P1
P2

Results

1. Termination A, B and C.
   - (3+1) termination (B, C) helps to reduce the PSANEXT and PSAACRF.
   - Spaced and un-terminated terminal (3+1 terminations B and C) shows similar ANEXT performance.
   - PSANEXT, PSAACRF limit is reasonable for termination A, B and C

2. Termination D using four (4) connected terminal blocks.
   - The proposed 4-terminals technique complies largely with PSANEXT/PS-AACRF with N=2
   - Termination D has the same density as termination (B and C).
   - Technique D shows promises for development beyond 100Base-T1.

Discussions

The 4-terminals technique :

- Provides a balanced termination on DIN rail. It would allow to reduce risk of sensitivity to nonstationary, EMC or unmodeled noises.
- Would allow to simplify the alien limits by removing the length / insertion loss dependent limits

The WG should consider a balanced termination technique for:

- Facilitating the deployment and the testing of the solution;
- Supporting standard development beyond 100Base-T1

Thank you