200G AUI CR/KR Channel Analysis Updates

- A view into failed channel characteristics

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Outline (1) contd..

- Explored in kareti_3dj_01a_2407 various options of reference receivers
  - Receiver with 6 pre taps , 20 post taps (8 fixed + 3 banks of 4 floating up to 100 UI) shown as a reasonable option to consider (see config 5 Phase 1 evaluations)
  - TX package type B and RX Package type B combination posed worst case scenarios for Ref. RX.
  - Channel Analysis Updates were provided based on Draft 1.1 and with the above-mentioned Ref. RX.
    - specification:
      - ✓ RDr/RDt: 46.25 ohm
      - ✓ TX SNDR: 33.5 dB
      - ✓ F_r: 0.55 * fbaud
      - ✓ A_fe = A_v = 0.413, A_ne = 0.45V
      - ✓ Eta_0 = 1.0e-8 v^2/GHz
  - ❖ *The results shared were for A_fe= A_ne = 0.45v as a worst case.*

Straw Poll #TF-4

I would support putting the following COM parameter values for CR and KR into the P802.3dj draft specification:

- Number of floating tap groups (N_g) = 2
- Number of taps per floating tap group (N_f) = 4
- Highest allowed tap index (N_max) = 80

(choose one)

Results (all): Y: 63, N: 4, NMI: 17, A: 19

- Meanwhile in July 2024 802.3dj Plenary meeting, Group showed support for Ref. RX with only 2 banks of 4 floating taps reaching up to 80UI
  - This was Config 3 of Ref. RX explored in phase1 evaluations

Outline (2)

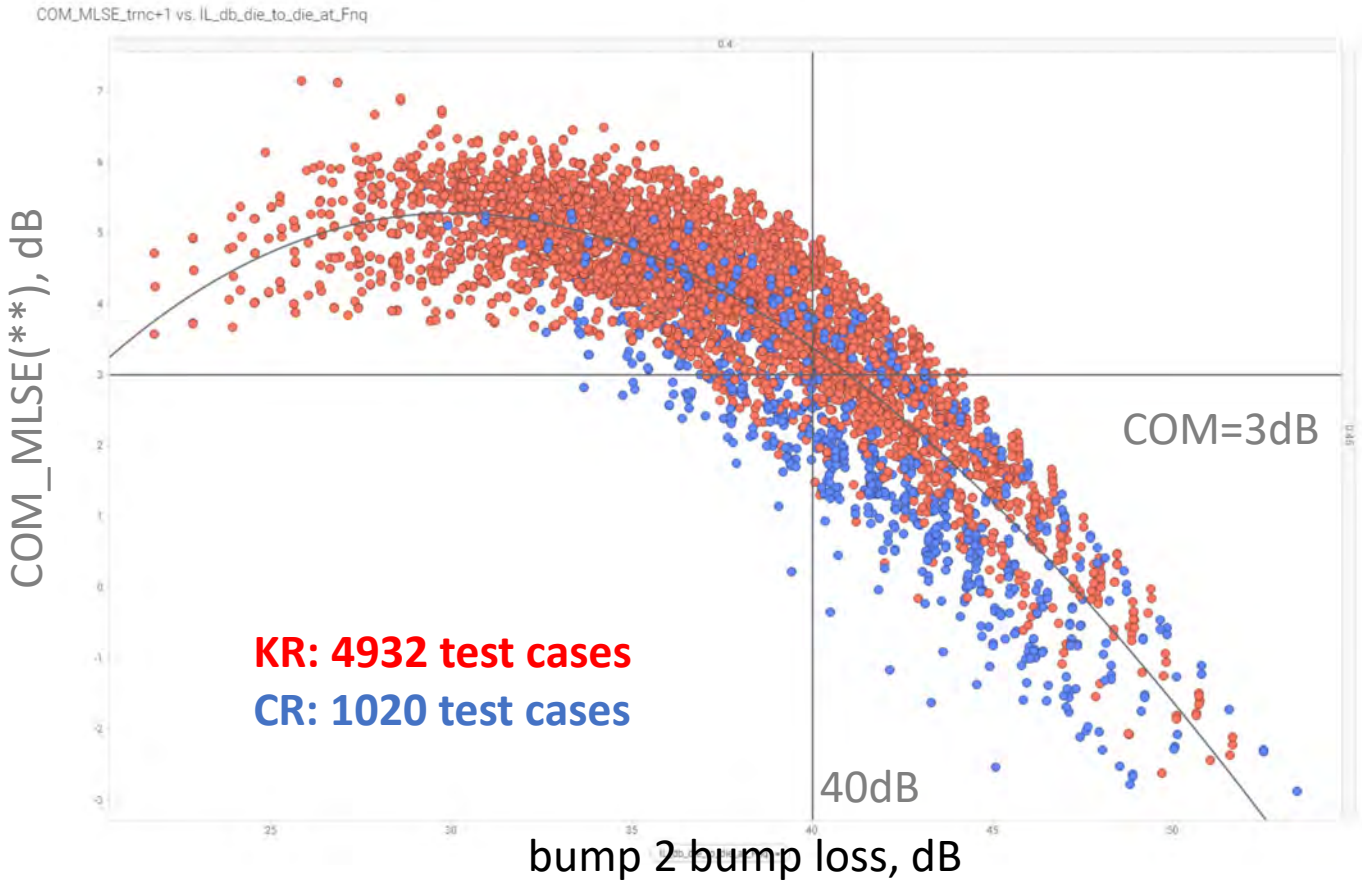
In this presentation:

- Analyze all CR/KR Channels contributed to 802.3bj project with group interested ref. RX and provide results along with list of failed channels and their characteristics – No skew added channel cases only
- Explore Floating tap options near group interested Ref.RX
  - the same 2 banks if 4 floating taps are extended up to 100 UI reach
  - 3 banks of 4 floating taps limited to 80 UI reach
- Explore different options of Signal Swing (A_v) and nearend Xtalk levels (A_ne)

Test set up changes

- Extended “num_ui_RXFF_noise” to 2048 as 1024 was not sufficient for some channels
- As per Draft 1.1 made A_v = A_fe= ~0.413v, A_ne= 0.45v

CR/KR Channel Analysis – Config 3 Ref. RX (1)



Config: 3
Receiver

- Num of RX FFE pre-cursors : 6
- Num of RX FFE fixed post cursors : 8
- Number of banks of floating up to 80 UI: 2

** Original channels only (No skew added)*
*** Both MLSE implementation penalties were considered*

CR/KR Channel Analysis – Config 3 Ref. RX (2)

Config: 3
Receiver

- Num of RX FFE pre-cursors : 6
- Num of RX FFE fixed post cursors : 8
- Number of banks of floating up to 80 UI: 2

** Original channels only (No skew added)*
*** Both MLSE implementation penalties were considered*

	Test Cases						Channels					
Ref.RX Type	Total		KR		CR		Total		KR		CR	
	Count		Count	%	Count	%	Total		Count	%	Count	%
Type3_8fixed2banks4_80	5952		4932	82.86%	1020	17.14%	167		137	82.04%	30	17.96%

Failed 3 dB COM_MLSE (Both impl.penalties considered) with bump-bump Loss < 40 dB

	Test Cases						Channels					
Ref.RX Type	Total		KR		CR		Total		KR		CR	
	Count		Count	%	Count	%	Total		Count	%	Count	%
Type3_8fixed2banks4_80	199	3.34%	64	1.30%	135	13.24%	44	26.35%	25	18.25%	19	63.33%

Microsoft Excel Worksheet

Open Excel worksheet to see list of failing channels and their characteristics.

Explore – Floating tap options near Group interested Reference Receiver (Config 3)

CR/KR Channel Analysis : Floating tap options near Ref. RX Config 3

	Test Cases						Channels					
Ref.RX Type	Total		KR		CR		Total		KR		CR	
	Count		Count	%	Count	%	Total		Count	%	Count	%
Type3_8fixed2banks4_80	5440		4635	85.20%	805	14.80%	156		133	85.26%	23	14.74%
Type3b_8fixed2banks4_100	5317		4524	85.09%	793	14.91%	153		130	84.97%	23	15.03%
Type4_8fixed3banks4_80	5442		4635	85.17%	807	14.83%	156		133	85.26%	23	14.74%
Type5_8fixed3banks4_100	5319		4524	85.05%	795	14.95%	153		130	84.97%	23	15.03%

Config: 3
Receiver

- Num of RX FFE pre-cursors : 6
- Num of RX FFE fixed post cursors : 8
- Number of banks of floating up to 80 UI: 2

** Original channels only (No skew added)*
*** Both MLSE implementation penalties were considered*

Failed 3 dB COM_MLSE (Both impl.penalties considered) with bump-bump Loss < 40 dB

	Test Cases						Channels					
Ref.RX Type	Total		KR		CR		Total		KR		CR	
	Count		Count	%	Count	%	Total		Count	%	Count	%
Type3_8fixed2banks4_80	171	3.14%	64	1.38%	107	13.29%	35	22.44%	22	16.54%	13	56.52%
Type3b_8fixed2banks4_100	152	2.86%	45	0.99%	107	13.49%	31	20.26%	18	13.85%	13	56.52%
Type4_8fixed3banks4_80	132	2.43%	55	1.19%	77	9.54%	33	21.15%	21	15.79%	12	52.17%
Type5_8fixed3banks4_100	96	1.80%	19	0.42%	77	9.69%	20	13.07%	8	6.15%	12	52.17%

Before changing “num_ui_RXFF_noise” to 2048

- KR channels see significant benefits from the additional bank and increased span of Option 5 compared to Option 3.
  - Neither increasing the span from 80UI to 100UI for 2 banks nor increasing to 3 banks with an 80UI span improves performance significantly.
  - An additional bank and an increased span of 100UI span are needed to reduce failure cases.
- CR channels are not adequately supported by the reference receivers considered above.

Explore – TX Volatge Swing Levels

CR/KR Channel Analysis :Transmitter Voltage Swing level options

Type3_8fixed2banks4_80

	Test Cases					Channels					
Voltage Levels	Total		KR		CR		Total		KR		CR	
	Count		Count	%	Count	%	Total		Count	%	Count	%
A_v=A_fe=0.4v; A_ne=0.45v	5952		4932	82.86%	1020	17.14%	167		137	82.04%	30	17.96%
A_v=A_fe=0.4v; A_ne=0.503v	5952		4932	82.86%	1020	17.14%	167		137	82.04%	30	17.96%
A_v=A_fe=0.4v; A_ne=0.608v	5951		4932	82.88%	1019	17.12%	167		137	82.04%	30	17.96%
A_v=A_fe=0.5v; A_ne=0.555v	5952		4932	82.86%	1020	17.14%	167		137	82.04%	30	17.96%
A_v=A_fe=0.5v; A_ne=0.608v	5952		4932	82.86%	1020	17.14%	167		137	82.04%	30	17.96%

Failed 3 dB COM_MLSE (Both impl.penalties considered) with bump-bump Loss < 40 dB

	Test Cases						Channels					
Voltage Levels	Total		KR		CR		Total		KR		CR	
	Count		Count	%	Count	%	Total		Count	%	Count	%
A_v=A_fe=0.4v; A_ne=0.45v	199	3.34%	64	1.30%	135	13.24%	44	26.35%	25	18.25%	19	63.33%
A_v=A_fe=0.4v; A_ne=0.503v	241	4.05%	103	2.09%	138	13.53%	46	27.54%	26	18.98%	20	66.67%
A_v=A_fe=0.4v; A_ne=0.608v	382	6.42%	234	4.74%	148	14.52%	64	38.32%	44	32.12%	20	66.67%
A_v=A_fe=0.5v; A_ne=0.555v	53	0.89%	10	0.20%	43	4.22%	17	10.18%	8	5.84%	9	30.00%
A_v=A_fe=0.5v; A_ne=0.608v	75	1.26%	30	0.61%	45	4.41%	25	14.97%	15	10.95%	10	33.33%

Open Excel worksheet to see list of failing channels and their characteristics. With A-v =0.5v and A_ne = 0.55v

Microsoft Excel Worksheet

Config: 3
Receiver
- Num of RX FFE pre-cursors : 6
- Num of RX FFE fixed post cursors : 8
- Number of banks of floating up to 80 UI: 2

** Original channels only (No skew added)*
*** Both MLSE implementation penalties were considered*

Summary

- With Group Interested Ref. RX (Config 3) still have significant channels failing
  - Shared list of Failing channels and Characteristics
    - 18.25% of KR channels fail
    - 63.33 % of CR channels failing
- Explored near Config 3 Ref. RX Floating tap options
  - With 2additional floating and extending 80UI to 100UI together combined only shown improvement in KR channel coverage , but combined floating options still fail more than 50% CR channels .
- Upon examining the failed channels, no single characteristic, such as ICN, FORM_ILD, or ERL, has been identified as the sole cause to eliminate 'bad' channels.
- Explored TX voltage level options
  - A_v of 0.5v and A_ne limited to 0.555v :

    5% of KR channels failing , 30% of CR channels failing

Backup

Sample COM Configuration Table

Table 93A-1 parameters			
Parameter	**Setting**	**Units**	**Information**
f_b	106.25	GBd	
f_min	0.05	GHz	
Delta_f	0.01	GHz	
C_d	[0.4e-4 0.9e-4 1.1e-4 ;0.4e-4 0.9e-4 1.1e-4]	nF	[TX RX]
L_s	[0.13 0.15 0.14; 0.13 0.15 0.14]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
R_0	5.00E+01	Ohm	
R_d	[46.25 46.25]	Ohm	[TX RX]
PKG_NAME	**PKG_HiR_CLASSB PKG_HiR_CLASSB**		TX RX
A_v	0.413	V	
A_fe	0.413	V	
A_ne	0.608	V	
z_p select	[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36]		
L	4		
M	32		
filter and Eq			
f_r	0.55	*fb	
c(0)	0.55		min
c(-1)	0		[min:step:max]
c(-2)	0		[min:step:max]
c(-3)	0		[min:step:max]
c(-4)	0		[min:step:max]
c(1)	0		[min:step:max]
N_b	1	UI	
b_max(1)	1		As/dffe1
b_max(2..N_b)	0.3		As/dfe2..N_b
b_min(1)	0		As/dffe1
b_min(2..N_b)	-0.15	S	As/dfe2..N_b
g_DC	[0]	dB	[min:step:max]
f_z	42.50	GHz	
f_p1	42.50	GHz	
f_p2	106.25	GHz	
g_DC_HP	[-10:1:0]		[min:step:max]
f_HP_PZ	1.328125	GHz	
Butterworth	1	logical	include in fr

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\CRKR_BB_{date}\	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
RUNTAG	CRKR_BB_eval_	
COM_CONTRIBUTION	1	logical
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	ns
TR_TDR	0.01	
N	4000	logical
TDR_Butterworth	1	
beta_x	0	
rho_x	0.618	
TDR_W_TXPKG	0	UI
N_bx	20	
fixture delay time	[0 0]	
Tukey_Window	1	
Noise, jitter		UI
sigma_RJ	0.01	UI
A_DD	0.02	V^2/GHz
eta_0	1.00E-08	dB
SNR_TX	33.5	
R_LM	0.95	
Batch control options		
BATCH_RUN	1	logical
CHANNEL_DIR	..\Channels\IEEE channels\All_KRCR_skew4 stds_channels\	
ENOB	32	default 32
trunc	15	default 128
baseline		

Table 93A–3 parameters			
Parameter	**Setting**	**Units**	Information
package_tl_gamma0_a1_a2	[5e-4 0.00065 0.0003]		
package_tl_tau	0.006141	ns/mm	
package_Z_c	[92 92 ; 70 70; 80 80; 100 100]	Ohm	
z_p (TX)	[8 24 30 45 ; 1 1 1 1; 1 1 1 1 ; 0.5 0.5 0.5 0.5]	mm	[test cases to run]
z_p (NEXT)	[8 24 30 45 ; 1 1 1 1; 1 1 1 1 ; 0.5 0.5 0.5 0.5]	mm	[test cases]
z_p (FEXT)	[8 24 30 45 ; 1 1 1 1; 1 1 1 1 ; 0.5 0.5 0.5 0.5]	mm	[test cases]
z_p (RX)	[8 24 30 45 ; 1 1 1 1; 1 1 1 1 ; 0.5 0.5 0.5 0.5]	mm	[test cases]
C_p	[0.4e-4 0.4e-4]	nF	[test cases]
Operational			
ERL Pass threshold	10	dB	
COM Pass threshold	3	db	
DER_0	2.00E-04		
T_r	0.00400	ns	
FORCE_TR	1	logical	
PMD_type	C2C		
EW	1		
MLSE	3	logical	
ts_anchor	1		
sample_adjustment	[-32 32]		
Local Search	0		
Filter: Rx FFE			
ffe_pre_tap_len	**6**	UI	
ffe_post_tap_len	8	UI	
ffe_pre_tap1_max	1	(normalized)	
ffe_post_tap1_max	1	(normalized)	
ffe_tapn_max	1	(normalized)	
FFE_OPT_METHOD	MMSE		FV-LMS or MMSE
num_ui_RXFF_noise	2048		
RXFFE FLOAT CTL	FOM		FOM o ISI
Floating Tap Control			
N_bg	**2**	0 1 2 or 3 groups	
N_bf	4	taps per group	
N_f	80	UI span for floating taps	
bmaxg	0.2	max DFE value for floating taps	
B_float_RSS_MAX	1	rss tail tap limit	
N_tail_start	9	(UI) start of tail taps limit	

SAVE_CONFIG2MAT	0	
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
ICN parameters		
f_v	0.278	Fb
f_f	0.278	Fb
f_n	0.278	Fb
f_2	58.438	GHz
A_ft	0.450	V
A_nt	0.450	V

Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 6.44084e-4 3.6036e-05]*	1.4 db/in @ 53.125G
board_tl_tau	*5.790E-03*	ns/mm
board_Z_c	100	Ohm
z_bp (TX)	*32*	mm
z_bp (NEXT)	*32*	mm
z_bp (FEXT)	*32*	mm
z_bp (RX)	*32*	mm
C_0	[0.2e-4 0]	nF
C_1	[0.2e-4 0]	nF
Include PCB	**0**	**logical**
Seletions (rectangle, gaussian,dual_rayleigh,triangle		
Histogram_Window_Weight	gaussian	selection
Qr	*0.02*	UI

COM tool version: 4.6 Beta 2

Host Package Test Cases

.START	PKG_LowR_CLASSA	[2.44 5.7] db	
Table 93A–3 parameters			
Parameter	**Setting**	**Units**	Information
package_tl_gamma0_a1_a2	[0.0005 0.00089 0.0002]		
package_tl_tau	0.006141	ns/mm	
package_Z_c	[87.5 87.5 ; 95 95 ; 100 100; 100 100]	Ohm	
R_d	[46.25 46.25]	Ohm	[TX RX]
z_p (TX)	[8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45;1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8;0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0;0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]	mm	[test cases]
z_p (NEXT)	[8 8 8 8 8 8 15 15 15 15 15 15 24 24 24 24 24 24 30 30 30 30 30 30 40 40 40 40 40 40 45 45 45 45 45 45;1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8;0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0;0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]	mm	[test cases]
z_p (FEXT)	[8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45;1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8;0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0;0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]	mm	[test cases]
z_p (RX)	[8 8 8 8 8 8 15 15 15 15 15 15 24 24 24 24 24 24 30 30 30 30 30 30 40 40 40 40 40 40 45 45 45 45 45 45;1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8;0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0;0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]	mm	[test cases]
C_p	[0.4e-4 0.4e-4]	nF	[TX RX]
A_v	[0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192]	V	Vf=0.400
A_fe	[0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192]	V	Vf=0.399
A_ne	[0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45]	V	Vf=0.400
.END			

.START	PKG_HiR_CLASSB	[2.8 5.6 6.7 9.4] db	
Table 93A–3 parameters			
Parameter	**Setting**	**Units**	Information
package_tl_gamma0_a1_a2	[0.0005 0.00065 0.000293]		
package_tl_tau	0.006141	ns/mm	
package_Z_c	[87.5 87.5 ; 95 95 ; 100 100; 78 78]	Ohm	
R_d	[46.25 46.25]	Ohm	[TX RX]
z_p (TX)	[8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45;2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2;1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3;1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5]	mm	[test cases]
z_p (NEXT)	[8 8 8 8 8 8 15 15 15 15 15 15 24 24 24 24 24 24 30 30 30 30 30 30 40 40 40 40 40 40 45 45 45 45 45 45;2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2;1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3;1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5]	mm	[test cases]
z_p (FEXT)	[8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45 8 15 24 30 40 45;2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2;1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3;1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5]	mm	[test cases]
z_p (RX)	[8 8 8 8 8 8 15 15 15 15 15 15 24 24 24 24 24 24 30 30 30 30 30 30 40 40 40 40 40 40 45 45 45 45 45 45;2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2;1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3;1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5]	mm	[test cases]
C_p	[0.4e-4 0.4e-4]	nF	[TX RX]
A_v	[0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192]	V	Vf=0.400
A_fe	[0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192 0.4049 0.4065 0.4114 0.4132 0.4173 0.4192]	V	Vf=0.399
A_ne	[0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45]	V	Vf=0.400
.END			