ERL Proposals for KR and C2C

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MediaTek

For IEEE 802.3ck Ad-Hoc

Contributors

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New comparing to wu_3ck_adhoc_01_093020

Outlines

- Supporting materials for Comment #202, #203
- Background
- TX ERL sensitivity analysis
  - R_d, z_p, Z_c, C_p, C_b
- Summary & proposals

New comparing to wu_3ck_adhoc_01_093020

Background

- This is the same topic we addressed in wu_3ck_adhoc_01_093020.pdf with additional materials to support the proposal
  - More COM analysis for KR & C2C channels
- In TP0v of D1p3, it requires device/package model based on COM parameters to derive ERL reference value
  - However, device/package model was defined from COM calculation point-of-view, not ERL
  - ERL is sensitive to some parameters, reference ERL by COM parameters is NOT the case of minimum ERL within valid COM parameters
- In order to make this document self-contented, most of the content are the same as what in wu_3ck_adhoc_01_093020.pdf
  - New & modified ones are highlighted by pink text

New comparing to wu_3ck_adhoc_01_093020

Analysis & Results

- Analysis
  - Sweeping some parameters to check the minimum ERL values & derive dERL accordingly
    - z_p, C_p, C_b, Z_c, R_d
- Results
  - By considering z_p, Z_c, R_d valid ranges & test fixture variation, dERL = -3 dB is proposed

TX ERL reference values – sensitivity analysis

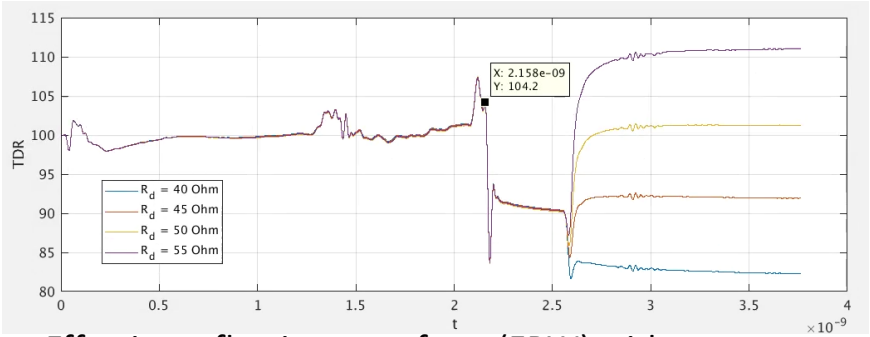
- One mesured TP0 to TP0v test fixture
  - IL = 2.12 dB @ 26.56 GHz
- Sweep device/package parameters to check ERL sensitivity & find min ERL in the valid range
  - Valid range show in right-hand-sided table
- COM spread sheet
  - In appendix

Parameters	Value in D1p3	Valid range	Note
R_d (Ohm)	50	45 ~ 55	50 +/- 10%
z_p (mm)	31	12 ~ 31	
Z_c (Ohm)	87.5	80 ~ 95	87.5 +/- 10%
C_p (fF)	87	<= 87	
C_b (fF)	30	<= 30	

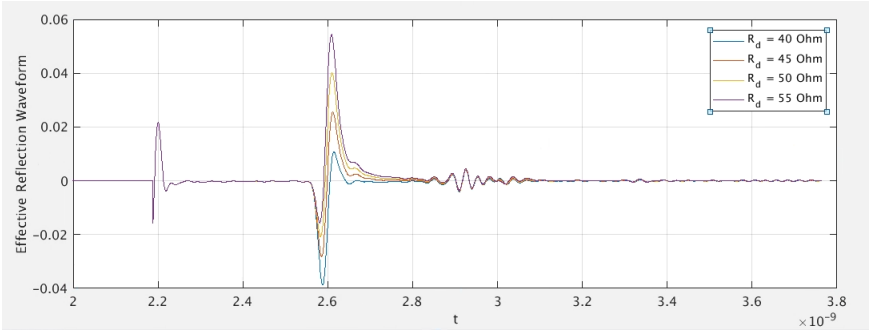
- R_d = single-ended termination resistance
- z_p = transmission line length
- Z_c = transmission line characteristics impedance
- C_p = single-ended package capacitance at package-to-board interface
- C_b = single-ended device bump capacitance

TX TDR and ERW with Sweeping R_d

- TDR with sweeping R_d (Ohm)



- Effective reflection waveform (ERW) with sweeping R_d (Ohm) – N_bx = 21



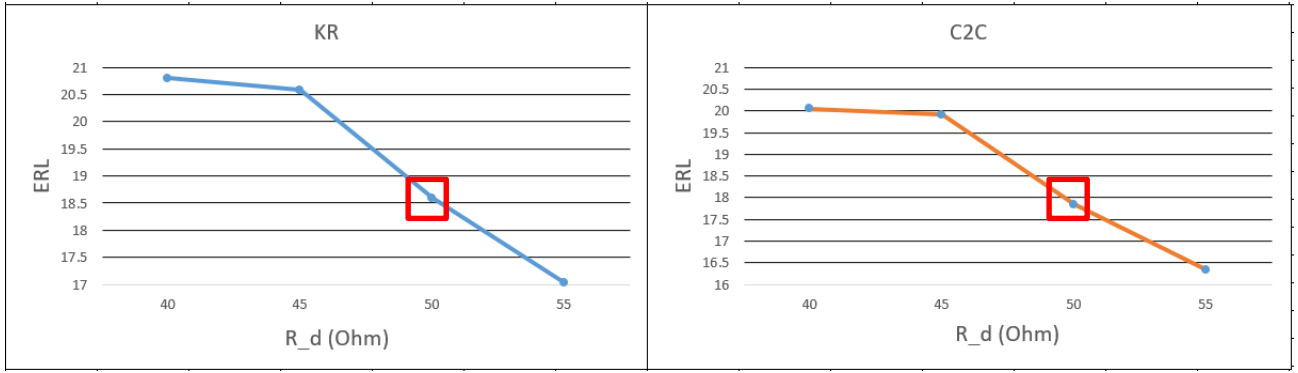
- Observing from TDR & ERW
  - It's obvious that R_d = 50 Ohm is not the case with minimum ERL
  - R_d = 55 Ohm is
- ERL parameter, Tfx, is derived from TDR
  - at the starting time of the boundary when impedance going down from around 100 Ohm (at the TP0) to 85 Ohm (due to C_p)

TX ERL with Sweeping R_d

- ERL (z_p = 31 mm, C_p = 87 fF, C_b = 30 fF)

	Reference			
R_d (Ohm)	40	45	50	55
Tfx (ns)	2.158			
KR (N_{bx} = 21)	20.80	20.59	18.60	17.04
C2C (N_{bx} = 6)	20.05	19.91	17.84	16.34

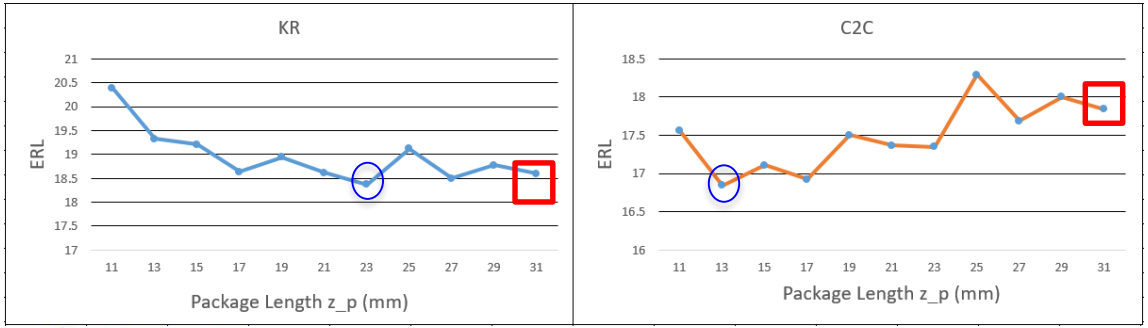
- +/- 10% manufacturing variation of R_d and Z_c shall be considered
- Reference ERL is sensitive to R_d
  - dERL shall be -1.50 ~ -1.56 dB



TX ERL with Sweeping z_p

- ERL (C_p = 87 fF, C_b = 30 fF, R_d = 50 Ohm)

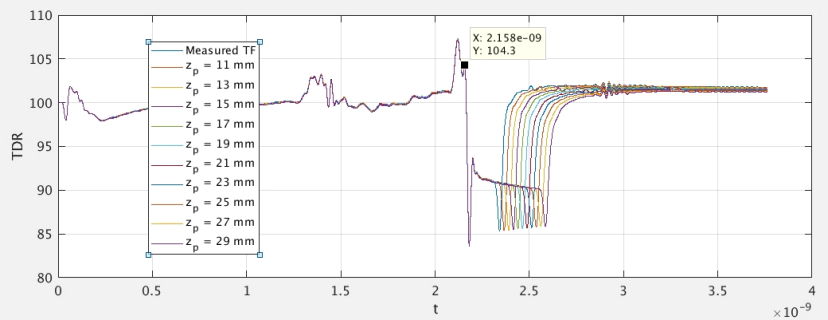
	Reference										
Pkg length (mm)	11	13	15	17	19	21	23	25	27	29	31
Rd (Ohm)	50										
Tfx (ns)	2.158										
KR (N_{bx} = 21)	20.39	19.33	19.21	18.63	18.94	18.61	18.37	19.12	18.50	18.77	18.60
C2C (N_{bx} = 6)	17.56	16.84	17.11	16.92	17.50	17.37	17.35	18.29	17.69	18.00	17.84



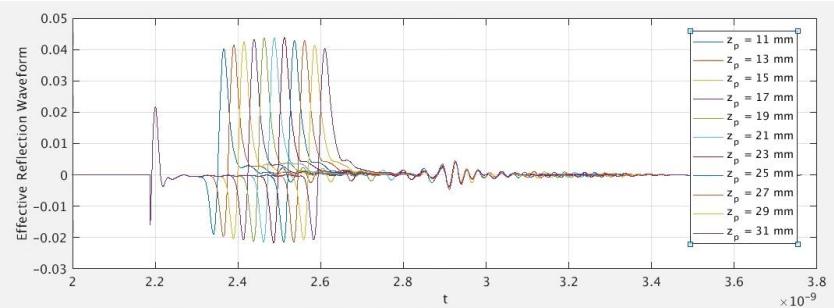
- Maximum package length doesn't mean minimum ERL
  - Let's observe ERW in next slide
- Allocate dERL to cover reference ERL variation due to package length variation
  - KR: -0.23 dB, C2C: -1.00 dB

TX TDR and ERW with Sweeping z_p

- TDR with sweeping z_p (mm)



- Effective reflection waveform (ERW) with sweeping z_p (mm) – N_bx = 21



- Observing from ERW
  - The major reflection contributes from re-reflection due to ‘C_p’ & ‘C_b’, while the location depends on z_p
  - The ERL fluctuation observed by sweeping z_p is due to ‘Time gating weighting function, Grr(t)’ to generate Effective reflection waveform

TX ERL with Sweeping Z_c, C_p, C_b

- Sweeping Z_c – similar as R_d case
  - Z_c = 80 Ohm has the minimum ERL, which requires -0.48 ~ -0.54 dERL to cover its variation
- Sweeping C_p, C_b
  - It's obviously that larger C_p & C_b cause smaller ERL
  - If we shall C_p = 87 fF & C_b = 30 fF is the maximum capacitance we can accept, we don't need to allocate dERL for these two parameters
- Detailed information of sweeping Z_c, C_p, C_b can be found in the appendix

New comparing to wu_3ck_adhoc_01_093020

ERL Sensitivity Analysis – Summary of KR

- By considering ERL variation due to z_p, Z_c, & R_d,
  - dERL shall be at least = -1.56
- By considering Z_c = 80 & R_d = 55
  - dERL is -2.13
- Take -1 dB for test fixture variation
- Proposal
  - dERL = -3 dB
- Q: What's the COM impact due to these device/package variations?

KR case (N_bx = 21)		Min calculated ERL by sweeping parameters			
Parameter settings	D1p3 *1	z_p	Z_c	R_d	Z_c=80, R_d=55 *2
z_p (mm)	31	**23**	31	31	31
C_p (fF)	87	87	87	87	87
C_b (fF)	30	30	30	30	30
Z_c (Ohm)	87.5	87.5	**80**	87.5	**80**
R_d (Ohm)	50	50	50	**55**	**55**
ERL (dB)	18.60	18.37	18.12	17.04	16.47
dERL (dB)		-0.23	-0.48	-1.56	-2.13

*1. This is "Case 1" for COM analysis in next slide

*2. This is "Case 2" for COM analysis in next slide

New comparing to wu_3ck_adhoc_01_093020

COM Analysis of 8 KR baseline Channels – Sweeping Device/Package Parameters

- 8 KR baseline channels
  - List in slide 6 of heck_3ck_01_0519.pdf
  - COM 2.95 excel sheet in appendix (D1p3)
- Observations
  - COM is not sensitive to R_d, Z_c variations
    - <= 0.33 dB for critical channels with COM ~= 3.0 dB
  - Could be included in 3 dB COM margin
- Proposal
  - No touch to COM parameters, such as R_d, Z_c, z_p
  - ERL variation due to R_d & Z_c variation could be covered by dERL = -3 dB

Channel	Case 1	Case 2	dCOM (dB)
Cable_BKP_28dB_0p575m_more_isi	2.85	2.93	0.08
Cable_BKP_16dB_0p575m_more_isi	5.75	4.85	-0.9
CaBP_BGAVia_Opt2_28dB	4.69	4.54	-0.15
Std_BP_12inch_Meg7	4.08	3.53	-0.55
DPO_IL_12dB	6.55	5.65	-0.9
OAch4	2.88	2.82	-0.06
CAch3_b2	3.90	3.86	-0.04
Bch2_b7p5_7	2.84	2.51	-0.33

PS: For COM calculation, A_v, A_ne, & A_fe are scaled by (R0+R_d)/(2*R_d) to make sure TX swing keeps the same as R_d varies

New comparing to wu_3ck_adhoc_01_093020

ERL Sensitivity Analysis – Summary of C2C

- By considering ERL variation due to z_p, Z_c, & R_d,
  - dERL shall be at least = -1.50
- With Z_c = 80 & R_d = 55
  - dERL is -2.07
- Take -1 dB for test fixture variation
- Proposal
  - dERL = -3 dB

C2C case (N_bx = 6)		Min calculated ERL by sweeping parameters			
Parameter settings	D1p3 *1	z_p	Z_c	R_d	Z_c=80, R_d=55 *2
z_p (mm)	31	**13**	31	31	31
C_p (fF)	87	87	87	87	87
C_b (fF)	30	30	30	30	30
Z_c (Ohm)	87.5	87.5	**80**	87.5	**80**
R_d (Ohm)	50	50	50	**55**	**55**
ERL (dB)	17.84	16.84	17.30	16.34	15.77
dERL (dB)		-1.00	-0.54	-1.50	-2.07

*1. This is “Case 1” for COM analysis in next slide

*2. This is “Case 2” for COM analysis in next slide

New comparing to wu_3ck_adhoc_01_093020

COM Analysis of 19 C2C Channels – Sweeping Device/Package Parameters

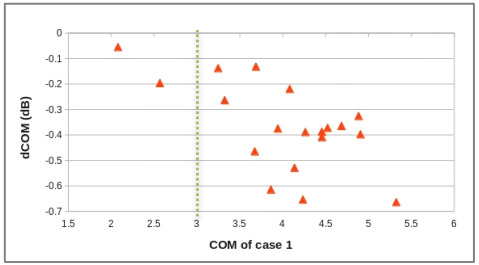
- 19 C2C channels
  - All available IEEE channels
  - COM 2.95 excel sheet in appendix (D1p3)
- Observations
  - COM is not sensitive to R_d, Z_c variations
    - <= 0.30 dB for critical channels with COM ~= 3.0 dB
    - No channels drop from >3 to <3 dB from Case 1 to Case 2
- Proposal
  - ERL variation due to R_d & Z_c variation could be covered by dERL = -3 dB

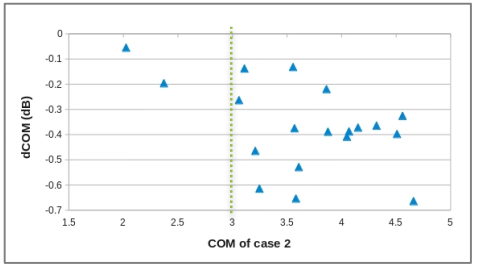
	Case 1	Case 2	dCOM (dB)
Asic_Mezz_Retimer_L10_Thru.s4p	4.14	3.61	-0.53
Asic_Mezz_Retimer_L23_Thru.s4p	4.24	3.58	-0.65
Asic_Mezz_Deep_Retimer_L10_Thru.s4p	3.68	3.21	-0.46
Asic_Mezz_Deep_Retimer_L23_Thru.s4p	3.86	3.25	-0.61
Impaired_C2C_6p75in_P1_to_P2_thru.s4p	4.46	4.07	-0.39
C2C_CA_CONN_SYSVIA_12dB_thru.s4p	4.89	4.56	-0.33
C2C_CA_CONN_SYSVIA_14dB_thru.s4p	4.69	4.32	-0.36
C2C_CA_CONN_SYSVIA_16dB_thru.s4p	4.08	3.86	-0.22
C2C_CA_CONN_SYSVIA_18dB_thru.s4p	3.69	3.56	-0.13
C2C_CA_CONN_SYSVIA_20dB_thru.s4p	3.32	3.06	-0.26
C2C_PCB_SYSVIA_12dB_thru.s4p	5.33	4.66	-0.66
C2C_PCB_SYSVIA_14dB_thru.s4p	4.91	4.51	-0.40
C2C_PCB_SYSVIA_16dB_thru.s4p	4.52	4.15	-0.37
C2C_PCB_SYSVIA_18dB_thru.s4p	4.26	3.88	-0.39
C2C_PCB_SYSVIA_20dB_thru.s4p	3.94	3.57	-0.37
Impaired_C2C_10dB_P1_to_P2_THRU_ExtPEC.s4p	4.46	4.05	-0.41
Impaired_C2C_16dB_P1_to_P2_THRU_ExtPEC.s4p	3.25	3.11	-0.14
Impaired_C2C_18dB_P1_to_P2_THRU_ExtPEC.s4p	2.57	2.37	-0.20
Impaired_C2C_20dB_P1_to_P2_thru_ExtPEC.s4p	2.08	2.03	-0.06

lim_3ck_04_0719

gore_3ck_01a_0519

rabinovich_3ck_adhoc_01a_071019





Proposals

- Propose dERL = -3 dB in Table 163-5
- Propose dERL = -3 dB in Table 120F-1

Thank You

COM spread sheet – IEEE KR for ERL

- ERL22 for TX ERL
- ERL11 for RX ERL

Table 93A-1 parameters			
Parameter	**Setting**	**Units**	**Information**
f_b	53.125	GBd	
f_min	0.05	GHz	
Delta_f	0.01	GHz	
C_d	[1.2e-4 1.2e-4]	nF	[TX RX]
L_s	[0.12, 0.12]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[31 31; 1.8 1.8]	mm	[test cases]
z_p (NEXT)	[0 0; 0 0]	mm	[test cases]
z_p (FEXT)	[0 0; 0 0]	mm	[test cases]
z_p (RX)	[29 29; 1.8 1.8]	mm	[test cases]
C_p	[0.87e-4 0.87e-4]	nF	[TX RX]
R_0	50	Ohm	
R_d	[50 50]	Ohm	[TX RX]
A_v	0.413	V	
A_fe	0.413	V	
A_ne	0.608	V	
L	4		
M	32		
filter and Eq			
f_r	0.75	*fb	
c(0)	0.54		min
c(-1)	[-0.34:0.02:0]		[min:step:max]
c(-2)	[0:0.02:0.12]		[min:step:max]
c(-3)	[-0.06:0.02: 0]		[min:step:max]
c(1)	[-0.2:0.05:0]		[min:step:max]
N_b	12	UI	
b_max(1)	0.85		
b_max(2..N_b)	[0.3 0.2*ones(1,10)]		
b_min(1)	0.3		
b_min(2..N_b)	[0.05 -0.03*ones(1,10)]		
g_DC	[-20:1:0]	dB	[min:step:max]
f_z	21.25	GHz	
f_p1	21.25	GHz	
f_p2	53.125	GHz	
g_DC_HP	[-6:1:0]		[min:step:max]
f_HP_PZ	0.6640625	GHz	

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_KR_{date}\	
SAVE_FIGURES	0	logical
Port Order	[3 4 1 2]	
RUNTAG	KR_eval_	
COM_CONTRIBUTION	0	logical
Operational		
COM Pass threshold	3	dB
ERL Pass threshold	8	dB
DER_0	0.0001	
T_r	0.0075	ns
FORCE_TR	1	logical
Local Search	2	
BREAD_CRUMBS	1	logical
SAVE_CONFIG2MAT	1	logical
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	1	logical
TR_TDR	0.01	ns
N	200	
beta_x	0	
rho_x	0.618	
fixture delay time	[2.40e-9 2.14e-9]	[port1 port2]
TDR_W_TXPKG	1	
N_bx	21	UI
Tukey_Window	1	logical
Noise, jitter		
sigma_RJ	0.01	UI
A_DD	0.02	UI
eta_0	8.20E-09	V^2/GHz
SNR_TX	33	dB
R_LM	0.95	

Table 93A–3 parameters		
Parameter	**Setting**	**Units**
package_tl_gamma0_a1_a2	[0 0.0009909 0.0002772]	
package_tl_tau	0.006141	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm
Table 92 – 12 parameters		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 3.8206e-04 9.5909e-05]*	
board_tl_tau	*5.790E-03*	ns/mm
board_Z_c	100	Ohm
z_bp (TX)	*110.3*	mm
z_bp (NEXT)	*110.3*	mm
z_bp (FEXT)	*110.3*	mm
z_bp (RX)	*110.3*	mm
C_0	[0.29e-4]	nF
C_1	[0.19e-4]	nF
Include PCB	**0**	**logical**
Floating Tap Control		
N_bg	3	0 1 2 or 3 groups
N_bf	3	taps per group
N_f	40	UI span for floating taps
bmaxg	0.05	max DFE value for floating taps
B_float_RSS_MAX	0.02	rss tail tap limit
N_tail_start	25	(UI) start of tail taps limit
ICN parameters		
f_v	0.594	*Fb
f_f	0.594	*Fb
f_n	0.594	*Fb
f_2	40.000	GHz
A_ft	0.600	V
A_nt	**0.600**	V
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V

COM spread sheet – IEEE C2C for ERL

- ERL22 for TX ERL
- ERL11 for RX ERL

Table 93A-1 parameters			
Parameter	**Setting**	**Units**	**Information**
f_b	53.125	GBd	
f_min	0.05	GHz	
Delta_f	0.01	GHz	
C_d	[1.2e-4 1.2e-4]	nF	[TX RX]
L_s	[0.12, 0.12]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[31 31; 1.8 1.8]	mm	[test cases]
z_p (NEXT)	[0 0; 0 0]	mm	[test cases]
z_p (FEXT)	[0 0; 0 0]	mm	[test cases]
z_p (RX)	[29 29; 1.8 1.8]	mm	[test cases]
C_p	[0.87e-4 0.87e-4]	nF	[TX RX]
R_0	50	Ohm	
R_d	[50 50]	Ohm	[TX RX]
A_v	0.413	V	
A_fe	0.413	V	
A_ne	0.608	V	
L	4		
M	32		
filter and Eq			
f_r	0.75	*fb	
c(0)	0.54		min
c(-1)	[-0.28:0.02:0]		[min:step:max]
c(-2)	[0:0.02:0.1]		[min:step:max]
c(-3)	[-0.04:0.02: 0]		[min:step:max]
c(1)	[-0.1:0.05:0]		[min:step:max]
N_b	6	UI	
b_max(1)	0.65		
b_max(2..N_b)	[0.15 0.1*ones(1,4)]		
b_min(1)	0.3		
b_min(2..N_b)	[0.05 -0.04*ones(1,4)]		
g_DC	[-20:1:0]	dB	[min:step:max]
f_z	21.25	GHz	
f_p1	21.25	GHz	
f_p2	53.125	GHz	
g_DC_HP	[-4:1:0]		[min:step:max]
f_HP_PZ	0.6640625	GHz	

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_KR_{date}\	
SAVE_FIGURES	0	logical
Port Order	[3 4 1 2]	
RUNTAG	KR_eval_	
COM_CONTRIBUTION	0	logical
Operational		
COM Pass threshold	3	dB
ERL Pass threshold	8	dB
DER_0	1.00E-05	
T_r	0.0075	ns
FORCE_TR	1	logical
Local Search	2	
BREAD_CRUMBS	1	logical
SAVE_CONFIG2MAT	1	logical

TDR and ERL options			
TDR	1	logical	
ERL	1	logical	
ERL_ONLY	1	logical	
TR_TDR	0.01	ns	
N	200		
beta_x	0		
rho_x	0.618		
fixture delay time	[2.40e-9 2.14e-9]		[port1 port2]
TDR_W_TXPKG	1		
N_bx	6	UI	
Tukey_Window	1	logical	
Noise, jitter			
sigma_RJ	0.01	UI	
A_DD	0.02	UI	
eta_0	2.00E-08	V^2/GHz	
SNR_TX	33	dB	
R_LM	0.95		

Table 93A–3 parameters		
Parameter	**Setting**	**Units**
package_tl_gamma0_a1_a2	[0 0.0009909 0.0002772]	
package_tl_tau	0.006141	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm
Table 92 - 12 parameters		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 3.8206e-04 9.5909e-05]*	
board_tl_tau	*5.790E-03*	ns/mm
board_Z_c	100	Ohm
z_bp (TX)	*110.3*	mm
z_bp (NEXT)	*110.3*	mm
z_bp (FEXT)	*110.3*	mm
z_bp (RX)	*110.3*	mm
C_0	[0.29e-4]	nF
C_1	[0.19e-4]	nF
Include PCB	**0**	**logical**
Floating Tap Control		
N_bg	0	0 1 2 or 3 groups
N_bf	3	taps per group
N_f	40	UI span for floating taps
bmaxg	0.05	max DFE value for floating taps
B_float_RSS_MAX	0.02	rss tail tap limit
N_tail_start	25	(UI) start of tail taps limit
ICN parameters		
f_v	0.594	*Fb
f_f	0.594	*Fb
f_n	0.594	*Fb
f_2	40.000	GHz
A_ft	0.600	V
A_nt	**0.600**	V
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V

COM spread sheet – for COM Calculation of KR

Table 93A-1 parameters			
Parameter	**Setting**	**Units**	**Information**
f_b	53.125	GBd	
f_min	0.05	GHz	
Delta_f	0.01	GHz	
C_d	[1.2e-4 1.2e-4]	nF	[TX RX]
L_s	[0.12, 0.12]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[12 31;1.8 1.8]	mm	[test cases]
z_p (NEXT)	[12 29;1.8 1.8]	mm	[test cases]
z_p (FEXT)	[12 31;1.8 1.8]	mm	[test cases]
z_p (RX)	[12 29;1.8 1.8]	mm	[test cases]
C_p	[0.87e-4 0.87e-4]	nF	[TX RX]
R_0	50	Ohm	
R_d	[50 50]	Ohm	[TX RX]
A_v	0.413	V	
A_fe	0.413	V	
A_ne	0.608	V	
L	4		
M	32		
filter and Eq			
f_r	0.75	*fb	
c(0)	0.54		min
c(-1)	[-0.34:0.02:0]		[min:step:max]
c(-2)	[0:0.02:0.12]		[min:step:max]
c(-3)	[-0.06:0.02: 0]		[min:step:max]
c(1)	[-0.2:0.05:0]		[min:step:max]
N_b	12	UI	
b_max(1)	0.85		
b_max(2..N_b)	[0.3 0.2*ones(1,10)]		
b_min(1)	0.3		
b_min(2..N_b)	[0.05 -0.03*ones(1,10)]		
g_DC	[-20:1:0]	dB	[min:step:max]
f_z	21.25	GHz	
f_p1	21.25	GHz	
f_p2	53.125	GHz	
g_DC_HP	[-6:1:0]		[min:step:max]
f_HP_PZ	0.6640625	GHz	

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	0	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_KR_{date}\	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
RUNTAG	KR_eval_	
COM_CONTRIBUTION	0	logical
Operational		
COM Pass threshold	3	dB
ERL Pass threshold	8	dB
DER_0	0.0001	
T_r	0.0075	ns
FORCE_TR	1	logical
Local Search	2	
BREAD_CRUMBS	1	logical
SAVE_CONFIG2MAT	1	logical
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	3500	
beta_x	0	
rho_x	0.618	
fixture delay time	[0 0]	port1 port2]
TDR_W_TXPKG	0	
N_bx	21	UI
Tukey_Window	1	logical
Noise, jitter		
sigma_RJ	0.01	UI
A_DD	0.02	UI
eta_0	8.20E-09	V^2/GHz
SNR_TX	33	dB
R_LM	0.95	

Table 93A–3 parameters		
Parameter	**Setting**	**Units**
package_tl_gamma0_a1_a	[0 0.0009909 0.0002772]	
package_tl_tau	0.006141	ns/mm
package_Z_c	[80 80 ; 92.5 92.5]	Ohm
Table 92–12 parameters		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 3.8206e-04 9.5909e-05]*	
board_tl_tau	*5.790E-03*	ns/mm
board_Z_c	100	Ohm
z_bp (TX)	*110.3*	mm
z_bp (NEXT)	*110.3*	mm
z_bp (FEXT)	*110.3*	mm
z_bp (RX)	*110.3*	mm
C_0	[0.29e-4]	nF
C_1	[0.19e-4]	nF
Include PCB	**0**	**logical**
Floating Tap Control		
N_bg	3	0 1 2 or 3 groups
N_bf	3	taps per group
N_f	40	UI span for floating taps
bmaxg	0.05	max DFE value for floating taps
B_float_RSS_MAX	0.02	rss tail tap limit
N_tail_start	25	(UI) start of tail taps limit
ICN parameters		
f_v	0.594	*Fb
f_f	0.594	*Fb
f_n	0.594	*Fb
f_2	40.000	GHz
A_ft	0.600	V
A_nt	**0.600**	V
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V

COM spread sheet – for COM Calculation of C2C

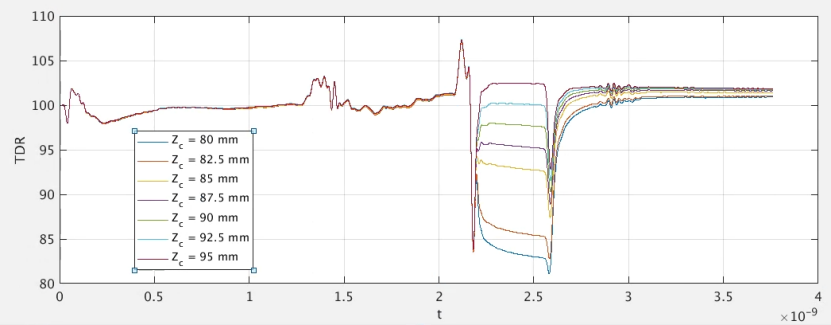
Table 93A-1 parameters			
Parameter	**Setting**	**Units**	**Information**
f_b	53.125	GBd	
f_min	0.05	GHz	
Delta_f	0.01	GHz	
C_d	[1.2e-4 1.2e-4]	nF	[TX RX]
L_s	[0.12, 0.12]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[13 31;1.8 1.8]	mm	[test cases]
z_p (NEXT)	[11 29;1.8 1.8]	mm	[test cases]
z_p (FEXT)	[13 31;1.8 1.8]	mm	[test cases]
z_p (RX)	[11 29;1.8 1.8]	mm	[test cases]
C_p	[0.87e-4 0.87e-4]	nF	[TX RX]
R_0	50	Ohm	
R_d	[50 50]	Ohm	[TX RX]
A_v	0.413	V	
A_fe	0.413	V	
A_ne	0.608	V	
L	4		
M	32		
filter and Eq			
f_r	0.75	*fb	
c(0)	0.54		min
c(-1)	[-0.28:0.02:0]		[min:step:max]
c(-2)	[0:0.02:0.1]		[min:step:max]
c(-3)	[-0.04:0.02: 0]		[min:step:max]
c(1)	[-0.1:0.05:0]		[min:step:max]
N_b	6	UI	
b_max(1)	0.65		
b_max(2..N_b)	[0.15 0.1*ones(1,4)]		
b_min(1)	0.3		
b_min(2..N_b)	[0.05 -0.04*ones(1,4)]		
g_DC	[-20:1:0]	dB	[min:step:max]
f_z	21.25	GHz	
f_p1	21.25	GHz	
f_p2	53.125	GHz	
g_DC_HP	[-4:1:0]		[min:step:max]
f_HP_PZ	0.6640625	GHz	

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	0	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_KR_(date)\	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
RUNTAG	KR_eval_	
COM_CONTRIBUTION	0	logical
Operational		
COM Pass threshold	3	dB
ERL Pass threshold	8	dB
DER_0	1.00E-05	
T_r	0.0075	ns
FORCE_TR	1	logical
Local Search	2	
BREAD_CRUMBS	1	logical
SAVE_CONFIG2MAT	1	logical
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	2000	UI
beta_x	0	
rho_x	0.618	
fixture delay time	[0 0]	port1 port2]
TDR_W_TXPKG	0	
N_bx	6	UI
Tukey_Window	1	logical
Noise, jitter		
sigma_RJ	0.01	UI
A_DD	0.02	UI
eta_0	2.00E-08	V^2/GHz
SNR_TX	33	dB
R_LM	0.95	

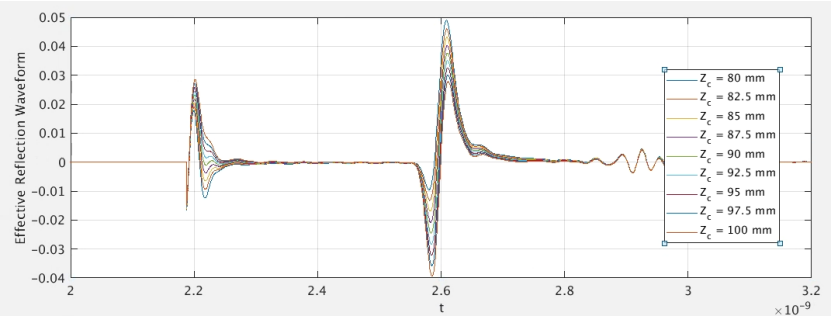
Table 93A–3 parameters		
Parameter	**Setting**	**Units**
package_tl_gamma0_a1_a	[0 0.0009909 0.0002772]	
package_tl_tau	0.006141	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm
Table 92–12 parameters		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 3.8206e-04 9.5909e-05]*	
board_tl_tau	*5.790E-03*	ns/mm
board_Z_c	100	Ohm
z_bp (TX)	*110.3*	mm
z_bp (NEXT)	*110.3*	mm
z_bp (FEXT)	*110.3*	mm
z_bp (RX)	*110.3*	mm
C_0	[0.29e-4]	nF
C_1	[0.19e-4]	nF
Include PCB	**0**	**logical**
Floating Tap Control		
N_bg	0	0 1 2 or 3 groups
N_bf	3	taps per group
N_f	40	UI span for floating taps
bmaxg	0.05	max DFE value for floating taps
B_float_RSS_MAX	0.02	rss tail tap limit
N_tail_start	25	(UI) start of tail taps limit
ICN parameters		
f_v	0.594	*Fb
f_f	0.594	*Fb
f_n	0.594	*Fb
f_2	40.000	GHz
A_ft	0.600	V
A_nt	**0.600**	V
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V

TX TDR and ERW with Sweeping Z_c

- TDR with sweeping Z_c (Ohm)



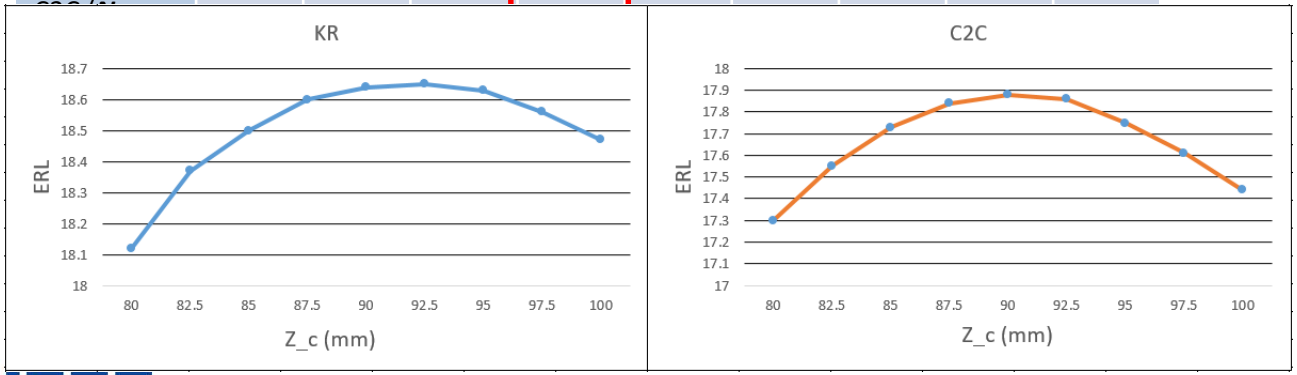
- Effective reflection waveform (ERW) with sweeping Z_c (Ohm) – N_bx = 21



TX ERL with Sweeping Z_c

- ERL (z_p = 31 mm, C_p = 87 fF , C_b = 30 fF)

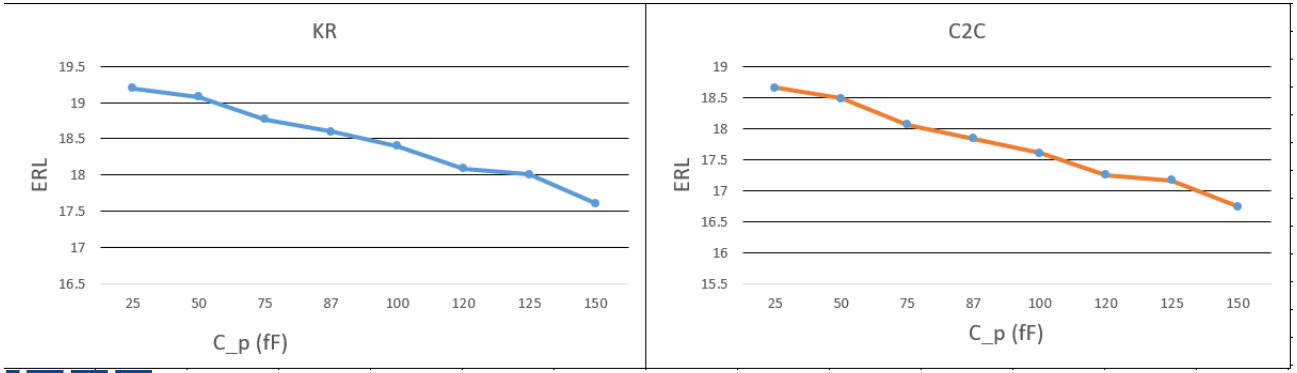
	Reference								
Z_c (mm)	80	82.5	85	87.5	90	92.5	95	97.5	100
R_d (Ohm)					50				
Tfx (ns)					2.158				
KR (N_{bx} = 21)	18.12	18.37	18.50	18.60	18.64	18.65	18.63	18.56	18.47



TX ERL with Sweeping C_p

- ERL (z_p = 31 mm, C_b = 30 fF)

	Reference						
C_p (fF)	25	50	75	87	100	125	150
R_d (Ohm)				50			
Tfx (ns)				2.158			
KR (N_{bx} = 21)	19.20	19.08	18.77	18.60	18.40	18.01	17.61
C2C (N_{bx} = 6)	18.66	18.48	18.06	17.84	17.60	17.16	16.74



TX ERL with Sweeping C_b

- ERL (z_p = 31 mm, C_p = 87 fF)

	Reference						
C_b (fF)	25	30	50	75	100	125	150
R_d (Ohm)			50				
Tfx (ns)			2.37				
KR (N_{bx} = 21)	18.84	18.60	17.64	16.57	15.63	14.82	14.10
C2C (N_{bx} = 6)	18.08	17.84	16.91	15.87	14.96	14.17	13.47