100G CR End-to-End Channel Analysis Updates

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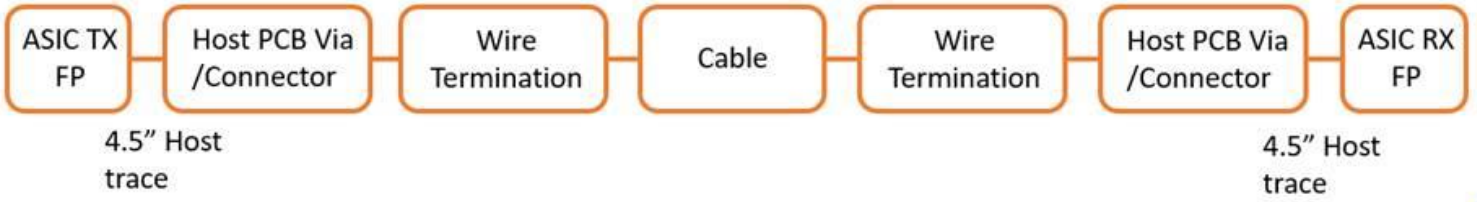
100G CR End-to-End Channel Model

- Add realistic ASIC package BGA and connector footprints as well in host PCB
- QSFP-DD and OSFP 2m 26AWG mated cable models are used to create end-to-end channel
- The mated cable models used in the analysis are simulation based, generated at nominal condition and worst case condition
- Use different die termination scheme (lumped C_d vs. with inductor), and including ref. receiver with floating taps in COM analysis
- Use latest COM scripts 2.70, with config file (see backup slide)

End-to-End Channel Model Overview

- Host PCB stack-up is 30 layers, 150mil thick, with Meg7 material
- Host PCB via stub length is modelled as 7mil
- Diff pair trace width/spacing is 4.5mil/8.5mil
- ASIC package BGA footprint is extracted in HFSS using the same PCB stack-up
- 16 pairs (8 Tx, 8 Rx) QSFP-DD or OSFP SMT Connector and host PCB footprint and wire termination are solved in HFSS

OSFP Channel Buildup



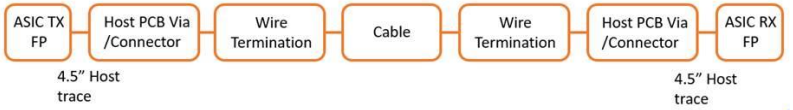
- Channel 1 – nominal case condition

  ASIC BGA footprint (mid length via) TX + host PCB trace 4.5” + [OSFP footprint & connector + wire termination + 2m 26AWG (nominal) + wire termination + OSFP footprint & connector] + host PCB trace 4.5” + ASIC BGA footprint (long via) RX

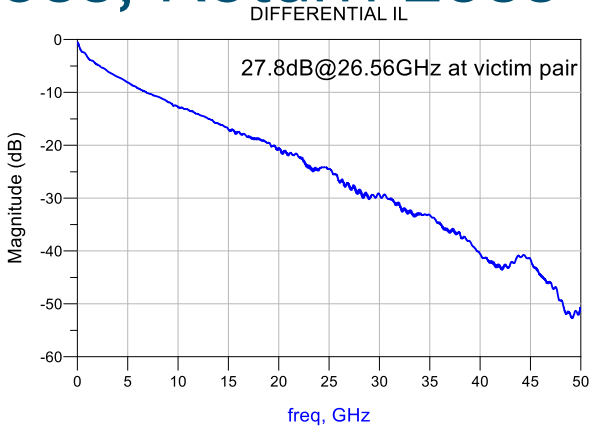
- Channel 2 – worst case condition

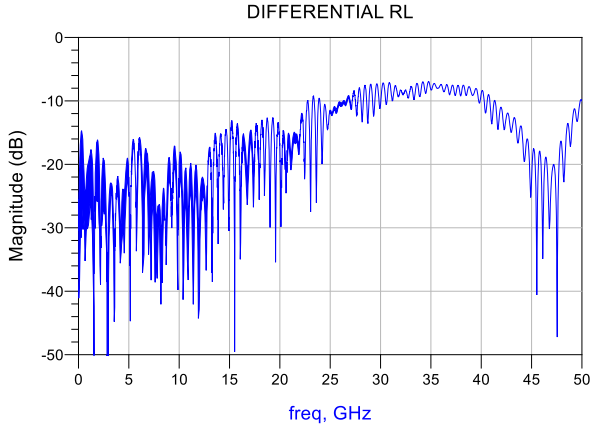
  ASIC BGA footprint (mid length via) TX + host PCB trace 4.5” + [OSFP footprint & connector + wire termination + 2m 26AWG (mfg variation) + wire termination + OSFP footprint & connector] + host PCB trace 4.5” + ASIC BGA footprint (long via) RX

OSFP Channel 1/2: Diff. Insertion Loss, Return Loss

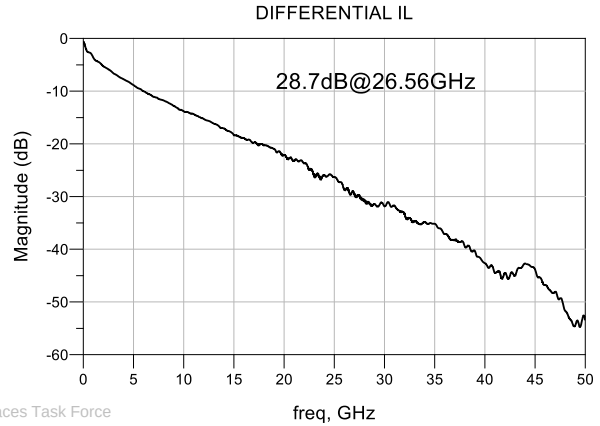


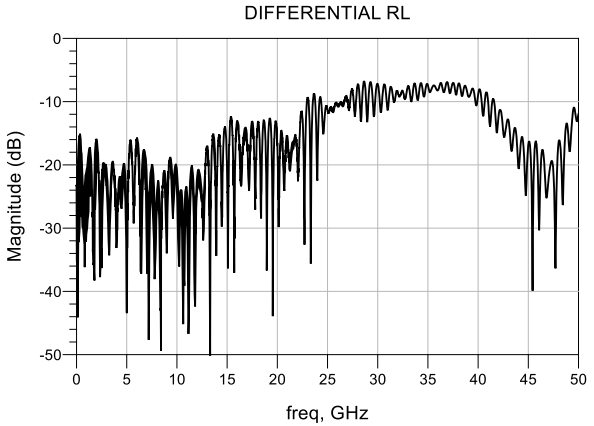
OSFP Channel 1 (nominal)



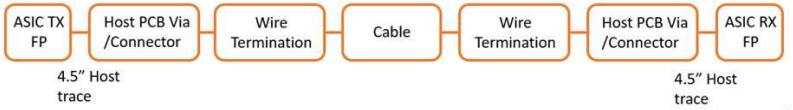


OSFP Channel 2 (mfg variation)

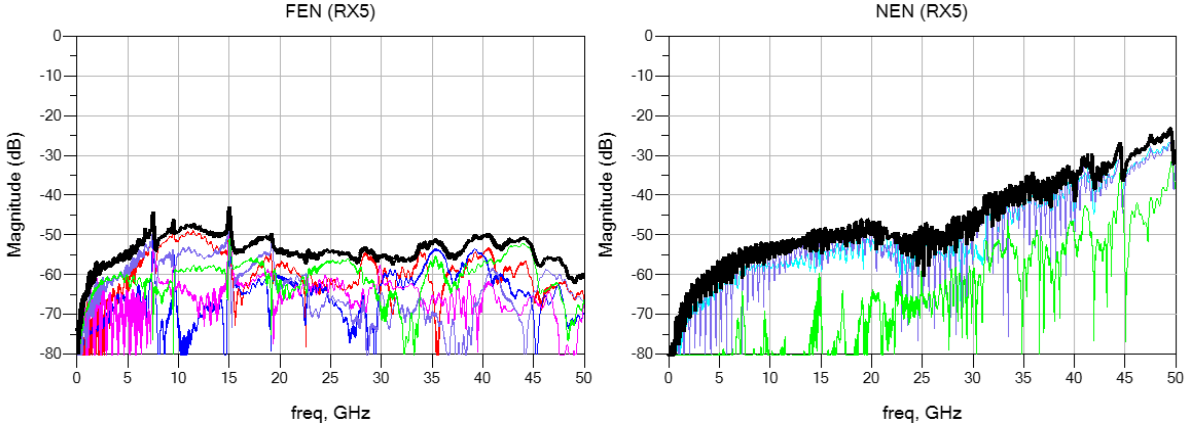




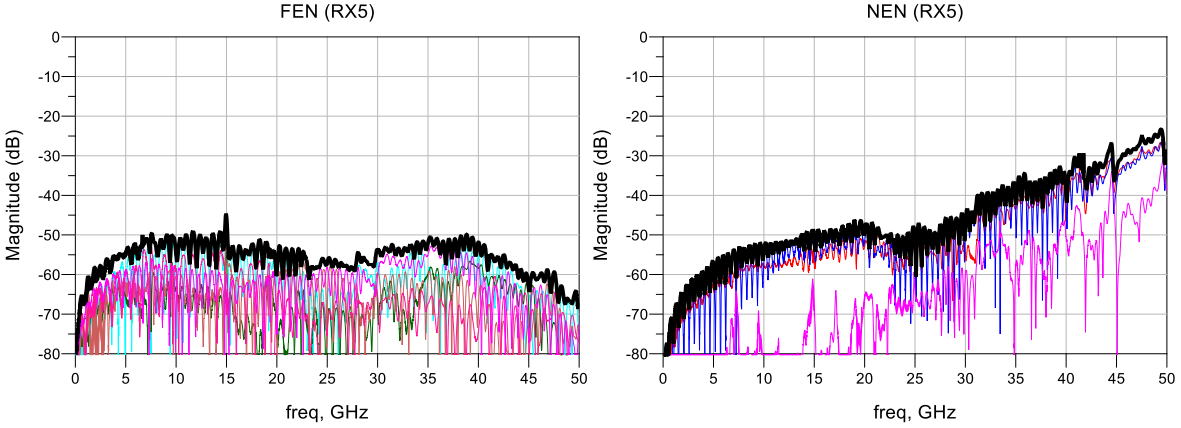
OSFP Channel 1/2: Far-end and Near-end Crosstalk



OSFP Channel 1 (nominal)



OSFP Channel 2 (mfg variation)



106G PAM-4 COM Results – Die Termination Options

DUT	COM case 1 (dB)	COM case 2 (dB)	ERL11 (dB)	ERL22 (dB)	FOM_{ILD} (dBrms)	ICN (mV)	IL@26G b2b/d2d (dB)
Channel 1 (OSFP, nom. case) – Die termination A	3.11	2.69	16.83	16.32	0.25	2.36	27.6/41.1
Channel 1 (OSFP, nom. case) – Die termination B	3.08	2.76	16.83	16.32	0.25	2.36	27.6/40.6
Channel 1 (OSFP, nom. case) – Die termination C	3.30	2.85	16.83	16.32	0.25	2.36	27.6/40.6
Channel 2 (OSFP, worst case) – Die termination A	2.20	1.88	16.27	16.43	0.26	2.29	28.7/43.2
Channel 2 (OSFP, worst case) – Die termination B	2.36	1.98	16.27	16.43	0.26	2.29	28.7/42.7
Channel 2 (OSFP, worst case) – Die termination C	2.58	1.92	16.27	16.43	0.26	2.29	28.7/42.7

- Die termination A: Cd 110fF
- Die termination B: Cd 90fF
- Die termination C: Cd 120fF / Ls 120pH/ Cb 30fF

Case 1: z_p (TX) = 12 mm; z_p (RX) = 12 mm
Case 2: z_p (TX) = 31 mm; z_p (RX) = 29 mm

COM script version 2.70 - **24 fixed DFE taps**

106G PAM-4 COM Results – Floating Taps Options

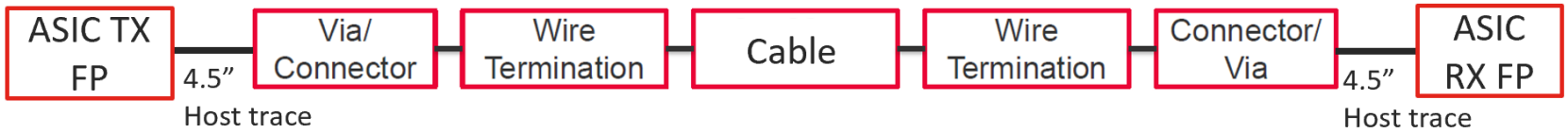
DUT	COM case 1 (dB)	COM case 2 (dB)	ERL11 (dB)	ERL22 (dB)	FOM_{ILD} (dBrms)	ICN (mV)	IL@26G b2b/d2d (dB)
Channel 1 (OSFP, nom. case) - Ref Receiver I	3.32	2.80	16.83	16.32	0.25	2.36	27.6/40.6
Channel 1 (OSFP, nom. case) - Ref Receiver II	3.32	2.80	16.83	16.32	0.25	2.36	27.6/40.6
Channel 1 (OSFP, nom. case) - Ref Receiver III	3.32	2.80	16.83	16.32	0.25	2.36	27.6/40.6
Channel 1 (OSFP, nom. case) - Ref Receiver IV	3.35	2.80	16.83	16.32	0.25	2.36	27.6/40.6
Channel 2 (OSFP, worst case) - Ref Receiver I	2.59	1.96	16.27	16.43	0.26	2.29	28.7/42.7
Channel 2 (OSFP, worst case) - Ref Receiver II	2.59	1.93	16.27	16.43	0.26	2.29	28.7/42.7
Channel 2 (OSFP, worst case) - Ref Receiver III	2.59	1.92	16.27	16.43	0.26	2.29	28.7/42.7
Channel 2 (OSFP, worst case) - Ref Receiver IV	2.67	1.93	16.27	16.43	0.26	2.29	28.7/42.7

- Ref. Receiver I: 12 fixed taps with 3 banks of 4 – up to 40 UI
- Ref. Receiver II: 20 fixed taps with 1 bank of 4 – up to 40 UI
- Ref. Receiver III: 16 fixed taps with 2 banks of 4 – up to 40 UI
- Ref. Receiver IV: 16 fixed taps with 2 banks of 4 – up to 80 UI

Case 1: z_p (TX) = 12 mm; z_p (RX) = 12 mm
Case 2: z_p (TX) = 31 mm; z_p (RX) = 29 mm

COM script version 2.70 - **Die termination C: Cd 120fF / Ls 120pH/ Cb 30fF**

QSFP-DD Channel Buildup



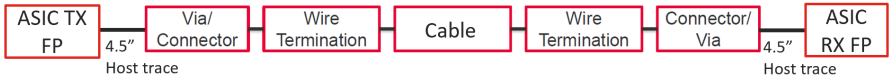
- Channels 1a (new pair) / 1b (legacy pair) – nominal case condition

ASIC BGA footprint (mid length via) TX + host PCB trace 4.5” + [QSFP-DD footprint & connector (new/legacy pair) + wire termination + 2m 26AWG cable (nominal) + wire termination + QSFP-DD footprint & connector (new/legacy pair)] + host PCB trace 4.5” + improved ASIC BGA footprint (long via) RX

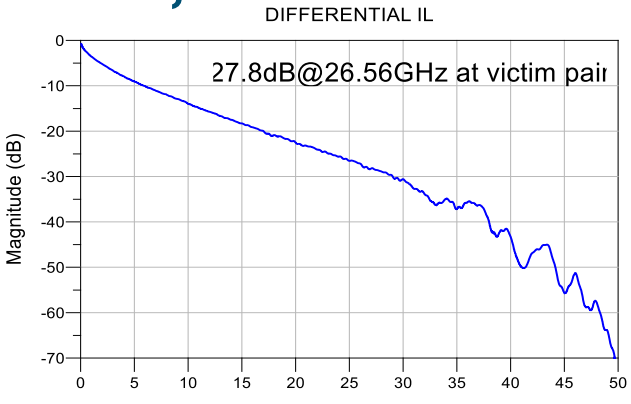
- Channels 2a (new pair) / 2b (legacy pair) – worst case condition

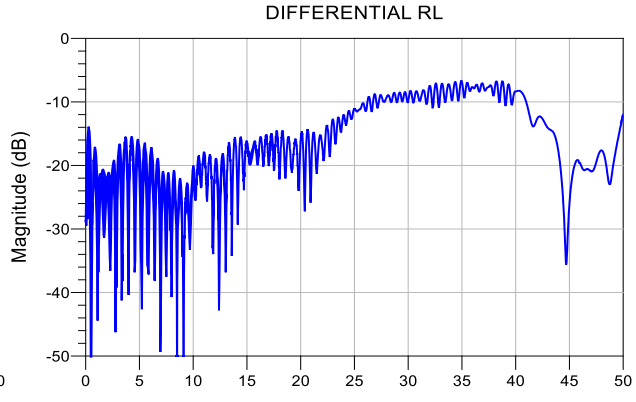
ASIC BGA footprint (mid length via) TX + host PCB trace 4.5” + [QSFP-DD footprint & connector (new/legacy pair) + wire termination + 2m 26AWG cable (mfg variation) + wire termination + QSFP-DD footprint & connector (new/legacy pair)] + host PCB trace 4.5” + improved ASIC BGA footprint (long via) RX

QSFP-DD Channel 1a/1b: Diff. Insertion Loss, Return Loss

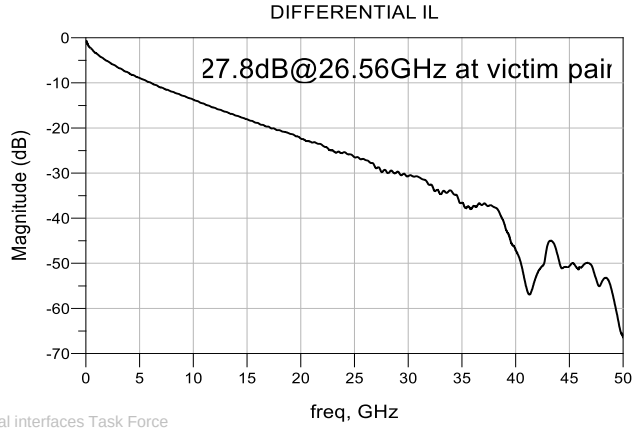


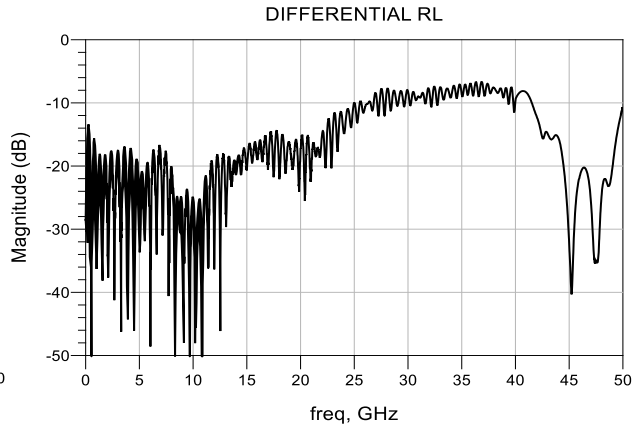
QSFP-DD Channel 1a (new pair)



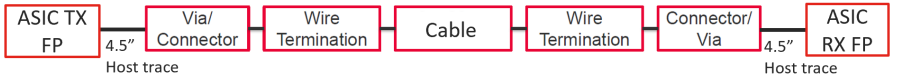


QSFP-DD Channel 1b (legacy pair)

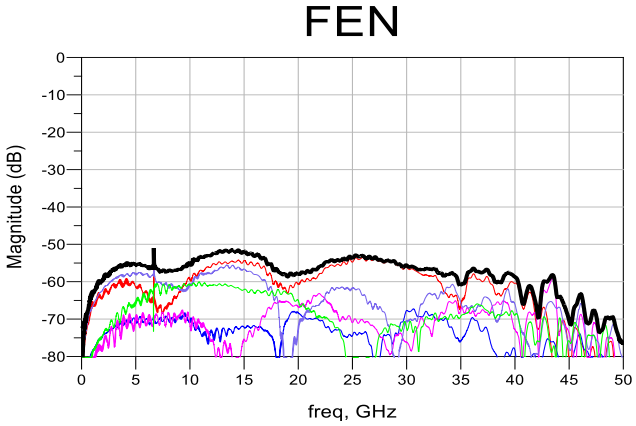


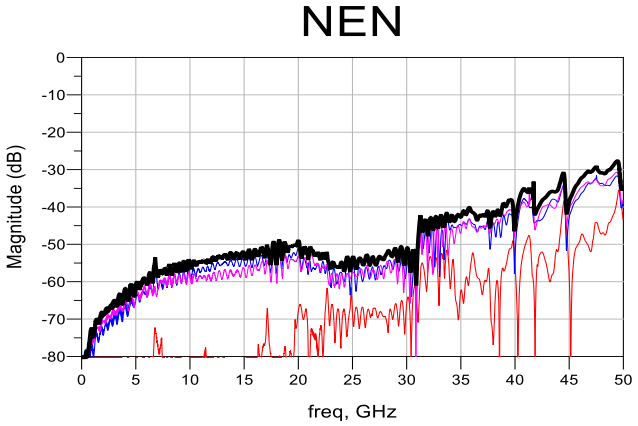


QSFP-DD Channel 1a/1b: Far-end and Near-end Crosstalk

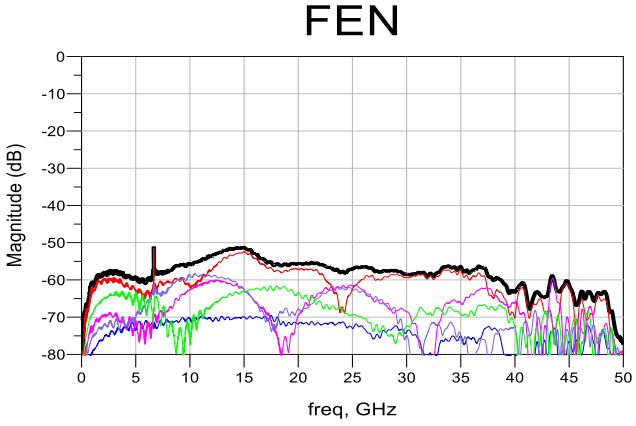


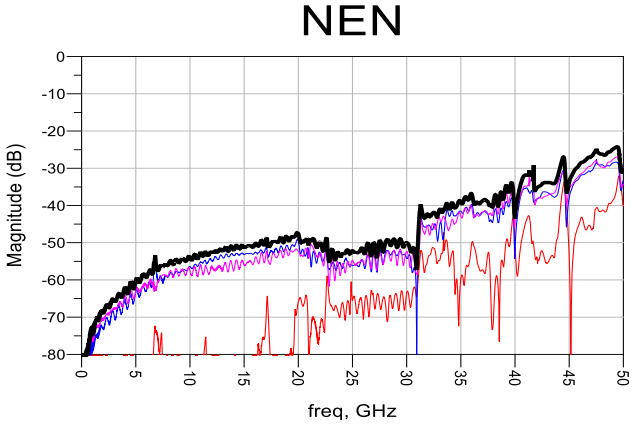
QSFP-DD Channel 1a (new pair)



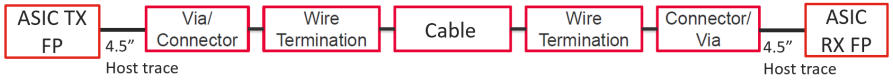


QSFP-DD Channel 1b (legacy pair)

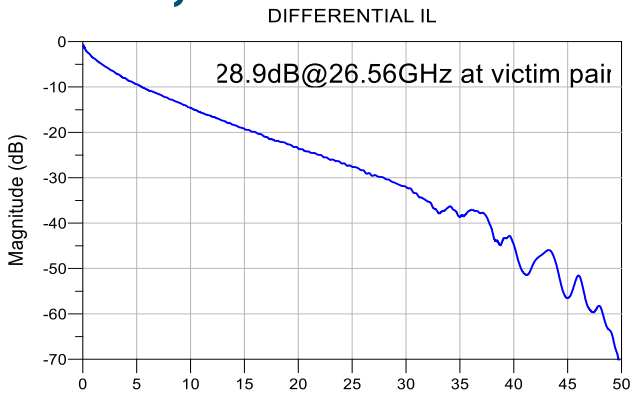


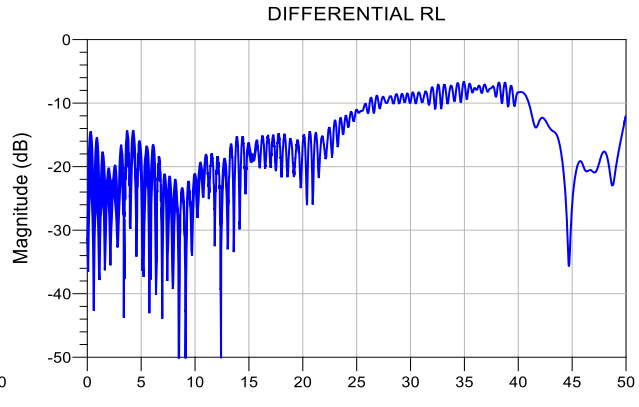


QSFP-DD Channel 2a/2b: Diff. Insertion Loss, Return Loss

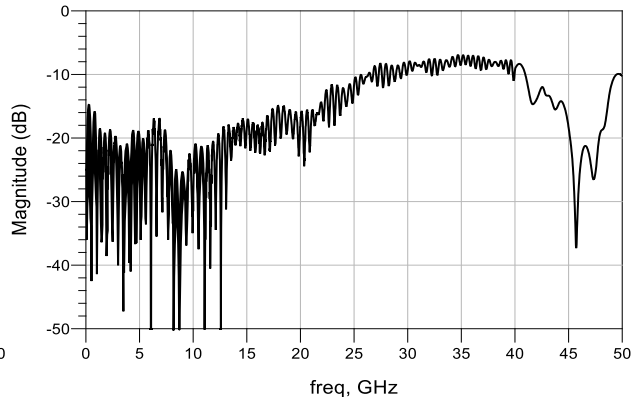


QSFP-DD Channel 2a (new pair)

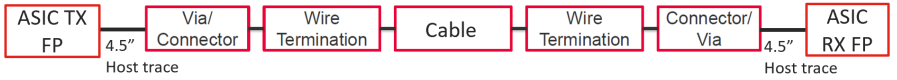




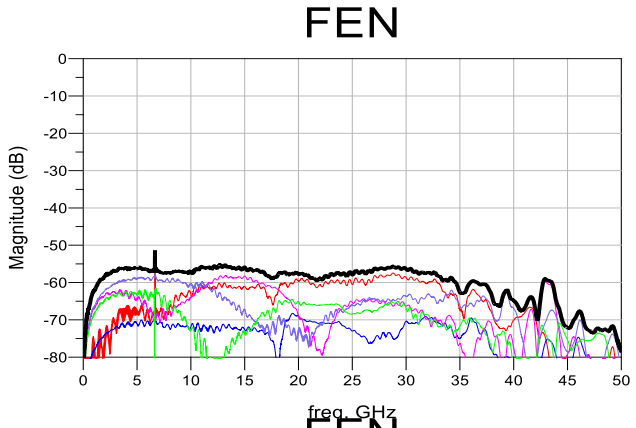
QSFP-DD Channel 2b (legacy pair)

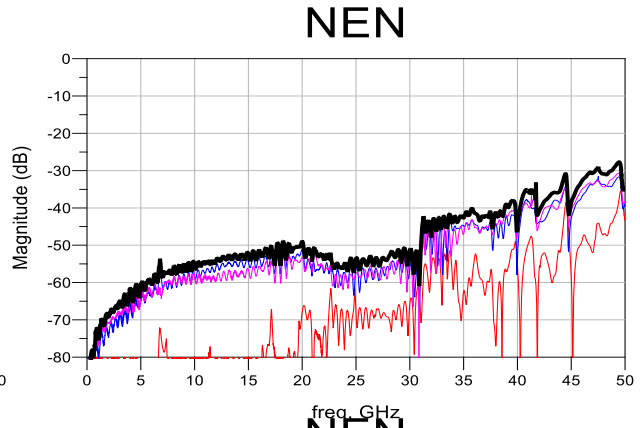


QSFP-DD Channel 2a/2b: Far-end and Near-end Crosstalk

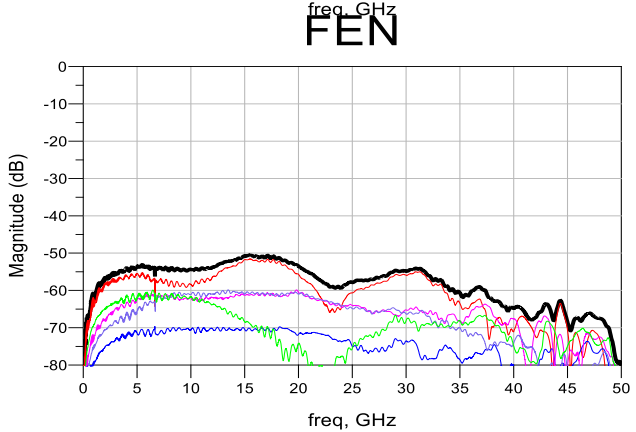


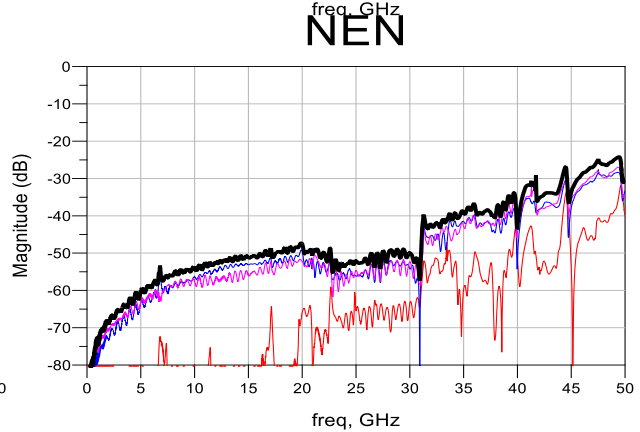
QSFP-DD Channel 2a (new pair)





QSFP-DD Channel 2b (legacy pair)





106G PAM-4 COM Results – with Improved BGA Footprint

DUT	COM case 1 (dB)	COM case 2 (dB)	ERL11 (dB)	ERL22 (dB)	FOM_{ILD} (dBrms)	ICN (mV)	IL@26G b2b/d2d (dB)
Channel 1a (QSFPDD, new pair)	3.31	2.56	17.24	17.26	0.44	1.59	27.7/40.3
Channel 1b (QSFPDD, legacy pair)	3.45	2.81	18.37	19.01	0.53	1.54	27.8/40.5
Channel 2a (QSFPDD, new pair)	2.86	2.01	17.15	17.48	0.47	1.54	28.9/41.5
Channel 2b (QSFPDD, legacy pair)	2.90	2.20	18.79	18.95	0.57	1.59	28.9/41.7

COM script version 2.70
- **Die termination C: Cd 120fF / Ls 120pH/ Cb 30fF**
- **24 fixed DFE taps**

Case 1: z_p (TX) = 12 mm; z_p (RX) = 12 mm
Case 2: z_p (TX) = 31 mm; z_p (RX) = 29 mm

Summary

- 2m CR channels with cable assemblies manufacturing variation have IL close to 29 dB
  - Data shows ~0.80 impact in COM compared to that of nominal condition cable channels (~28 dB)
- Trying different die termination methods doesn't help much to improve COM results
  - Lowering C_d value from 110 fF to 90 fF shows upto ~0.2 dB reduction
  - With inductor method shows upto ~0.3 dB reduction
- Using floating taps options as being considered in KR small group show negligible change in COM results compared to 24 fixed DFE taps
- With improved ASIC RX footprint (~0.5mV ICN reduction), and the new inductor termination model can reach close to 3.0 dB COM for nominal condition cable channels, but still missing nearly ~1 dB for worst condition cable channels
  - … more work must be done

Backup Slides

Config_com_ieee8023_93a_3ck_KR_mellitz_06_12_2019 COM 2.70 Die termination A - Fixed 24 DFE taps

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	[1.1e-4 1.1e-4]	nF	[TX RX]
L_s	[0, 0]	nH	[TX RX]
C_b	[0 0]	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	[45 45]	Ohm	[TX RX]
A_v	0.39	V	vp/vf=.694
A_fe	0.39	V	vp/vf=.694
A_ne	0.578	V	
L	4		
M	32		
filter and Eq			
f_r	0.75	*fb	
c(0)	0.5		min
c(-1)	[-0.3:0.02:0]		[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	24	UI	
b_max(1)	0.85		
b_max(2..N_b)	0.3		
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]

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_KR_{date}\	
SAVE_FIGURES	1	logical
Port Order	[1 3 2 4]	
RUNTAG	KR_eval_	
COM_CONTRIBUTION	0	logical
Operational		
COM Pass threshold	3	dB
ERL Pass threshold	10	dB
DER_0	1.00E-04	
T_r	6.16E-03	ns
FORCE_TR	1	logical
Include PCB	0	logical
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	3000	
beta_x	2.53E+09	
rho_x	**0.25**	
fixture delay time	0	s
TDR_W_TXPKG	0	
N_bx	24	UI
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
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	6.141E-03	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm

Table 92–12 parameters 5.2dB at 26.56GHz		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 0.000599 0.0001022]*	1.286 dB/in or 0.0506 dB/mm at 100 ohms
board_tl_tau	*6.200E-03*	ns/mm
board_Z_c	90	Ohm
z_bp (TX)	*102.7*	mm
z_bp (NEXT)	*102.7*	mm
z_bp (FEXT)	*102.7*	mm
z_bp (RX)	*102.7*	mm

Floating Tap Control		
N_bg	**0**	**0 1 2 or 3 groups**
N_bf	*0*	taps per group
N_f	40	UI span for floating taps
bmaxg	0.1	max DFE value for floating taps

yellow indicates WIP

Config_com_ieee8023_93a_3ck_KR_mellitz_06_12_2019 COM 2.70 Die termination B – Fixed 24 DFE taps

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	[0.9e-4 0.9e-4]	nF	[TX RX]
L_s	[0, 0]	nH	[TX RX]
C_b	[0 0]	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	[45 45]	Ohm	[TX RX]
A_v	0.39	V	vp/vf=.694
A_fe	0.39	V	vp/vf=.694
A_ne	0.578	V	
L	4		
M	32		
filter and Eq			
f_r	0.75	*fb	
c(0)	0.5		min
c(-1)	[-0.3:0.02:0]		[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	24	UI	
b_max(1)	0.85		
b_max(2..N_b)	0.3		
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]

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_KR_{date}\	
SAVE_FIGURES	1	logical
Port Order	[1 3 2 4]	
RUNTAG	KR_eval_	
COM_CONTRIBUTION	0	logical
Operational		
COM Pass threshold	3	dB
ERL Pass threshold	10	dB
DER_0	1.00E-04	
T_r	6.16E-03	ns
FORCE_TR	1	logical
Include PCB	0	logical
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	3000	
beta_x	2.53E+09	
rho_x	**0.25**	
fixture delay time	0	s
TDR_W_TXPKG	0	
N_bx	24	UI
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
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	6.141E-03	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm

Table 92–12 parameters 5.2dB at 26.56GHz		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 0.000599 0.0001022]*	1.286 dB/in or 0.0506 dB/mm at 100 ohms
board_tl_tau	*6.200E-03*	ns/mm
board_Z_c	90	Ohm
z_bp (TX)	*102.7*	mm
z_bp (NEXT)	*102.7*	mm
z_bp (FEXT)	*102.7*	mm
z_bp (RX)	*102.7*	mm

Floating Tap Control		
N_bg	**0**	**0 1 2 or 3 groups**
N_bf	*0*	taps per group
N_f	40	UI span for floating taps
bmaxg	0.1	max DFE value for floating taps

yellow indicates WIP

Config_com_ieee8023_93a_3ck_KR_mellitz_06_12_2019 COM 2.70 Die termination C – Fixed 24 DFE taps

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	[45 45]	Ohm	[TX RX]
A_v	0.39	V	vp/vf=.694
A_fe	0.39	V	vp/vf=.694
A_ne	0.578	V	
L	4		
M	32		
filter and Eq			
f_r	0.75	*fb	
c(0)	0.5		min
c(-1)	[-0.3:0.02:0]		[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	24	UI	
b_max(1)	0.85		
b_max(2..N_b)	0.3		
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]

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_KR_{date}\	
SAVE_FIGURES	1	logical
Port Order	[1 3 2 4]	
RUNTAG	KR_eval_	
COM_CONTRIBUTION	0	logical
Operational		
COM Pass threshold	3	dB
ERL Pass threshold	10	dB
DER_0	1.00E-04	
T_r	6.16E-03	ns
FORCE_TR	1	logical
Include PCB	0	logical
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	3000	
beta_x	2.53E+09	
rho_x	**0.25**	
fixture delay time	0	s
TDR_W_TXPKG	0	
N_bx	24	UI
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
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	6.141E-03	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm

Table 92–12 parameters 5.2dB at 26.56GHz		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 0.000599 0.0001022]*	1.286 dB/in or 0.0506 dB/mm at 100 ohms
board_tl_tau	*6.200E-03*	ns/mm
board_Z_c	90	Ohm
z_bp (TX)	*102.7*	mm
z_bp (NEXT)	*102.7*	mm
z_bp (FEXT)	*102.7*	mm
z_bp (RX)	*102.7*	mm

Floating Tap Control		
N_bg	**0**	**0 1 2 or 3 groups**
N_bf	*0*	taps per group
N_f	40	UI span for floating taps
bmaxg	0.1	max DFE value for floating taps

yellow indicates WIP

Config_com_ieee8023_93a_3ck_KR_mellitz_06_12_2019 COM 2.70
Die termination C – 12 fixed taps with 3 banks of 4 – up to 40 UI

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	[45 45]	Ohm	[TX RX]
A_v	0.39	V	vp/vf=.694
A_fe	0.39	V	vp/vf=.694
A_ne	0.578	V	
L	4		
M	32		
filter and Eq			
f_r	0.75	*fb	
c(0)	0.5		min
c(-1)	[-0.3:0.02:0]		[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		
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]

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_KR_{date}\	
SAVE_FIGURES	1	logical
Port Order	[1 3 2 4]	
RUNTAG	KR_eval_	
COM_CONTRIBUTION	0	logical
Operational		
COM Pass threshold	3	dB
ERL Pass threshold	10	dB
DER_0	1.00E-04	
T_r	6.16E-03	ns
FORCE_TR	1	logical
Include PCB	0	logical
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	3000	
beta_x	2.53E+09	
rho_x	**0.25**	
fixture delay time	0	s
TDR_W_TXPKG	0	
N_bx	24	UI
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
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	6.141E-03	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm

Table 92–12 parameters 5.2dB at 26.56GHz		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 0.000599 0.0001022]*	1.286 dB/in or 0.0506 dB/mm at 100 ohms
board_tl_tau	*6.200E-03*	ns/mm
board_Z_c	90	Ohm
z_bp (TX)	*102.7*	mm
z_bp (NEXT)	*102.7*	mm
z_bp (FEXT)	*102.7*	mm
z_bp (RX)	*102.7*	mm

Floating Tap Control		
N_bg	**3**	**0 1 2 or 3 groups**
N_bf	*4*	taps per group
N_f	40	UI span for floating taps
bmaxg	0.1	max DFE value for floating taps

yellow indicates WIP

Config_com_ieee8023_93a_3ck_KR_mellitz_06_12_2019 COM 2.70
Die termination C – 16 fixed taps with 2 banks of 4 – up to 80 UI

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	[45 45]	Ohm	[TX RX]
A_v	0.39	V	vp/vf=.694
A_fe	0.39	V	vp/vf=.694
A_ne	0.578	V	
L	4		
M	32		
filter and Eq			
f_r	0.75	*fb	
c(0)	0.5		min
c(-1)	[-0.3:0.02:0]		[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	16	UI	
b_max(1)	0.85		
b_max(2..N_b)	0.3		
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]

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_KR_{date}\	
SAVE_FIGURES	1	logical
Port Order	[1 3 2 4]	
RUNTAG	KR_eval_	
COM_CONTRIBUTION	0	logical
Operational		
COM Pass threshold	3	dB
ERL Pass threshold	10	dB
DER_0	1.00E-04	
T_r	6.16E-03	ns
FORCE_TR	1	logical
Include PCB	0	logical
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	3000	
beta_x	2.53E+09	
rho_x	**0.25**	
fixture delay time	0	s
TDR_W_TXPKG	0	
N_bx	24	UI
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
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	6.141E-03	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm

Table 92–12 parameters 5.2dB at 26.56GHz		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 0.000599 0.0001022]*	1.286 dB/in or 0.0506 dB/mm at 100 ohms
board_tl_tau	*6.200E-03*	ns/mm
board_Z_c	90	Ohm
z_bp (TX)	*102.7*	mm
z_bp (NEXT)	*102.7*	mm
z_bp (FEXT)	*102.7*	mm
z_bp (RX)	*102.7*	mm

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	0.1	max DFE value for floating taps

yellow indicates WIP

Package Proposal with LC Termination Compensation (single sided model)

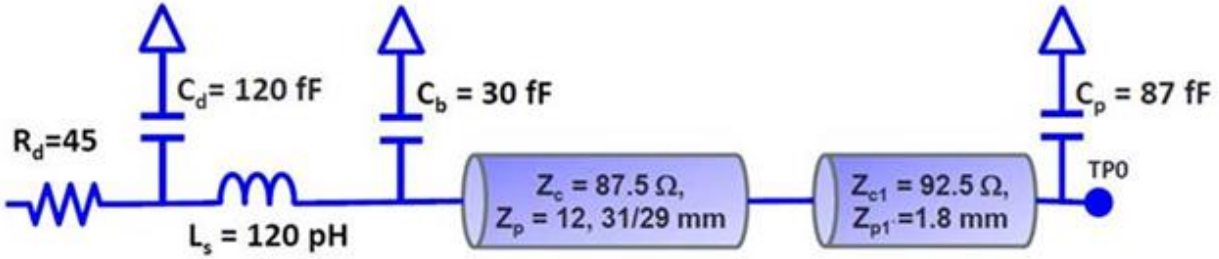


Table 93A-1 parameters			
Parameter	**Setting**	**Units**	**Information**
C_d	[1.2e-4 1.2e-4]	nF	[TX RX]
L_s	[0.12, 0.12]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[12 31; 1.8 1.8]	mm	[test cases]
z_p (NEXT)	[12 29; 1.8 1.8]	mm	[test cases]
z_p (FEXT)	[12 31; 1.8 1.8]	mm	[test cases]
z_p (RX)	[12 2990; 1.8 1.8]	mm	[test cases]
C_p	[0.87e-4 0.87e-4]	nF	[TX RX]
R_0	50	Ohm	
R_d	[45 45]	Ohm	[TX RX]
A_v	0.39	V	vp/vf=.694
A_fe	0.39	V	vp/vf=.694
A_ne	0.578	V	

Table 93A–3 parameters		
Parameter	**Setting**	**Units**
package_tl_gamma0_a1_a2	[0 0.0009909 0.0002772]	
package_tl_tau	6.141E-03	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm