100G CR Analysis

Cu Cable Channels, OSFP

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Contributors

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- Femi Akinwale, Intel

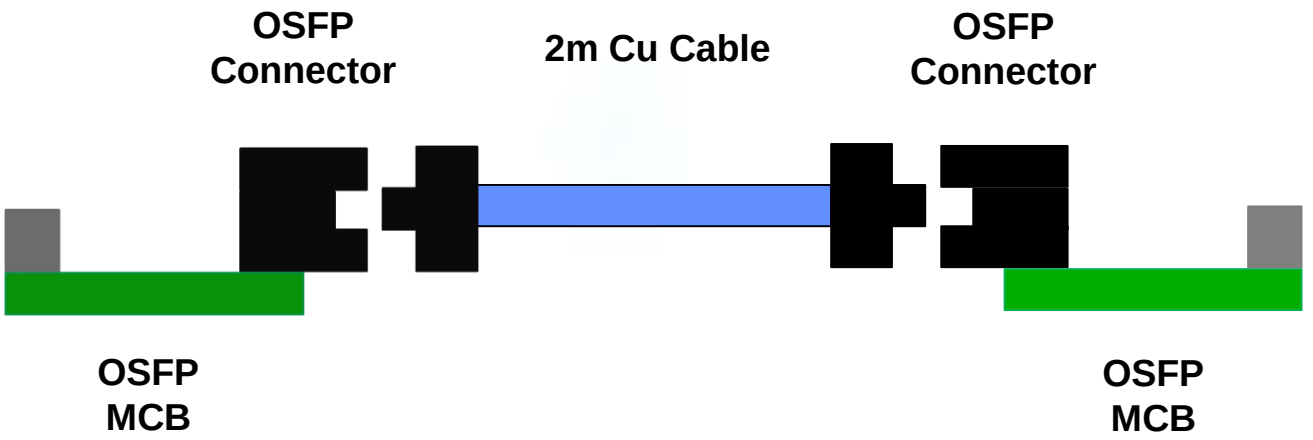
Supporters

- TBD

Objective

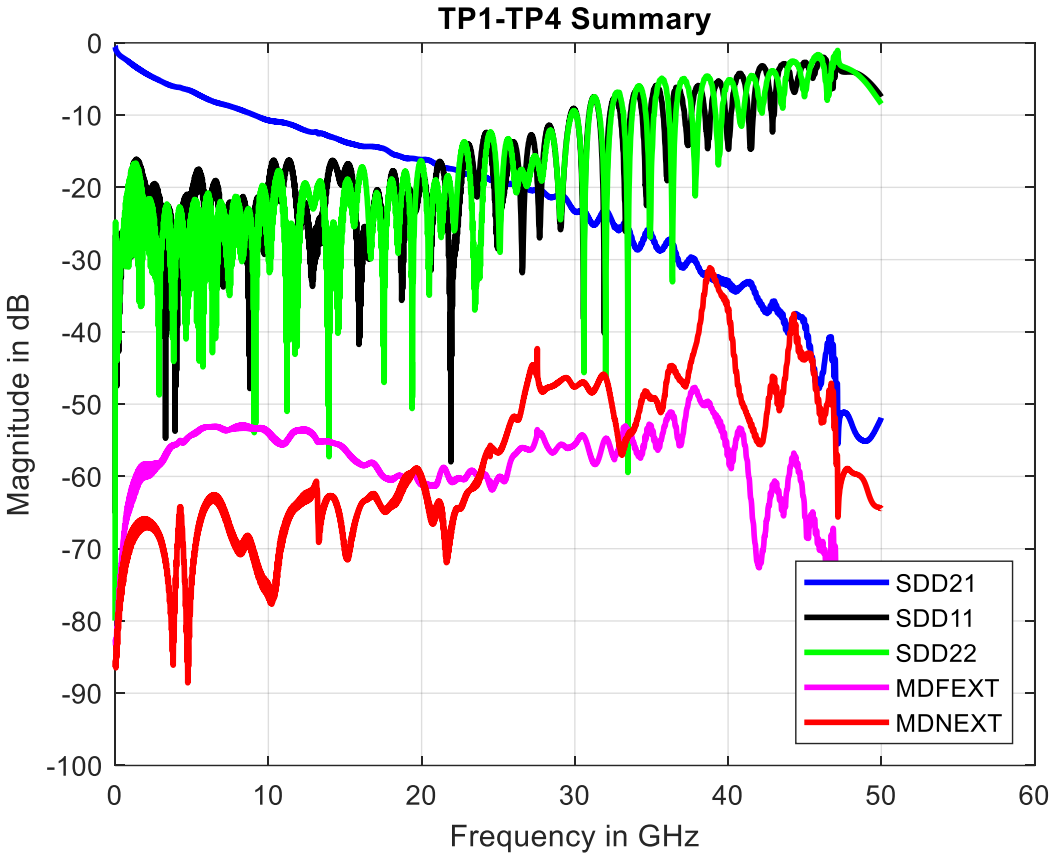
- The 3ck Copper Cable Small Group targeted the following goals for the CR Baseline:
  - 2m Cable Reach
  - TP1-TP4 IL: 19.75dB @26.56GHz, COM: 3.0dB
  - TP0-TP5 IL: 28.5dB @26.56GHz, COM: 3.0dB
- This contribution focuses on the OSFP MDI
- OSFP connector models are simulated, based on the OSFP MTF data that was presented in kocsis_3ck_01_0719
- OSFP cable assembly models are simulated, based on measurements
- TP1-TP4 models are 8-pair (4-lane), 0-50GHz, 10MHz steps
- TP0-TP5 models are 8-pair (4-lane), 0-60GHz, 10MHz steps

TP1-TP4 Channel Topology



60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31
GND	TX1P	TX1M	GND	TX3P	TX3M	GND	TX5P	TX5M	GND	TX7P	TX7M	GND	CMIS	VCC	VCC	CMIS	GND	RX8M	RX8P	GND	RX6M	RX6P	GND	RX4M	RX4P	GND	RX2M	RX2P	GND
GND	TX2P	TX2M	GND	TX4P	TX4M	GND	TX6P	TX6M	GND	TX8P	TX8M	GND	CMIS	VCC	VCC	CMIS	GND	RX7M	RX7P	GND	RX5M	RX5P	GND	RX3M	RX3P	GND	RX1M	RX1P	GND
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

TP1-TP4 Performance Example



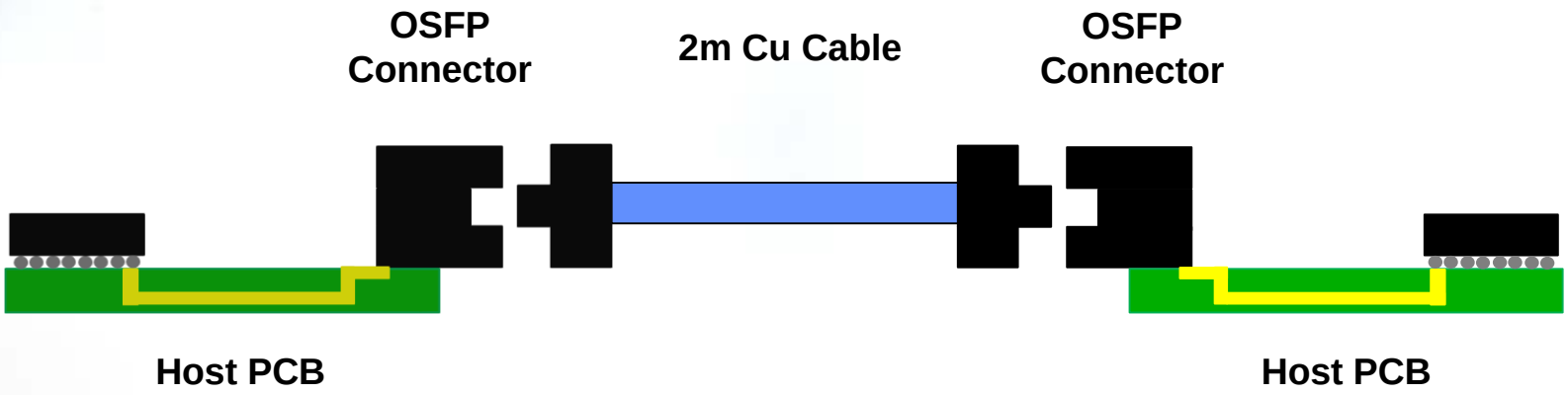
TP1-TP4 Results

	IL, model (@26.56GHz)	ILD_FOM (dB)	MDNXT (mV)	MDFXT (mV)	ERL11	ERL22	COM Case1	COM Case2
P1TX5_P2RX5	-19.6253	0.31135	1.21330	0.94553	15.6714	16.3289	4.3505	3.3240
P1TX6_P2RX6	-19.6922	0.34627	1.14710	1.18740	16.0544	15.7350	4.2937	3.2862
P1TX7_P2RX7	-20.4306	0.28449	1.02780	1.15860	15.2793	15.8635	4.1242	3.1105
P1TX8_P2RX8	-19.8298	0.34262	1.14370	0.90293	16.2892	15.2140	4.2508	3.2230
P2TX5_P1RX5	-19.6267	0.31143	1.21320	0.94741	16.3289	15.6714	4.3505	3.2989
P2TX6_P1RX6	-19.6926	0.34618	1.14660	0.88517	15.7350	16.0544	4.3219	3.2989
P2TX7_P1RX7	-20.4294	0.28455	1.02710	1.15500	15.8635	15.2793	4.1382	3.0733
P2TX8_P1RX8	-19.8296	0.34261	1.14440	0.90183	15.2140	16.2892	4.2508	3.2104

60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31
GND	TX1P	TX1M	GND	TX3P	TX3M	GND	TX5P	TX5M	GND	TX7P	TX7M	GND	CMIS	VCC	VCC	CMIS	GND	RX8M	RX8P	GND	RX6M	RX6P	GND	RX4M	RX4P	GND	RX2M	RX2P	GND
GND	TX2P	TX2M	GND	TX4P	TX4M	GND	TX6P	TX6M	GND	TX8P	TX8M	GND	CMIS	VCC	VCC	CMIS	GND	RX7M	RX7P	GND	RX5M	RX5P	GND	RX3M	RX3P	GND	RX1M	RX1P	GND
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

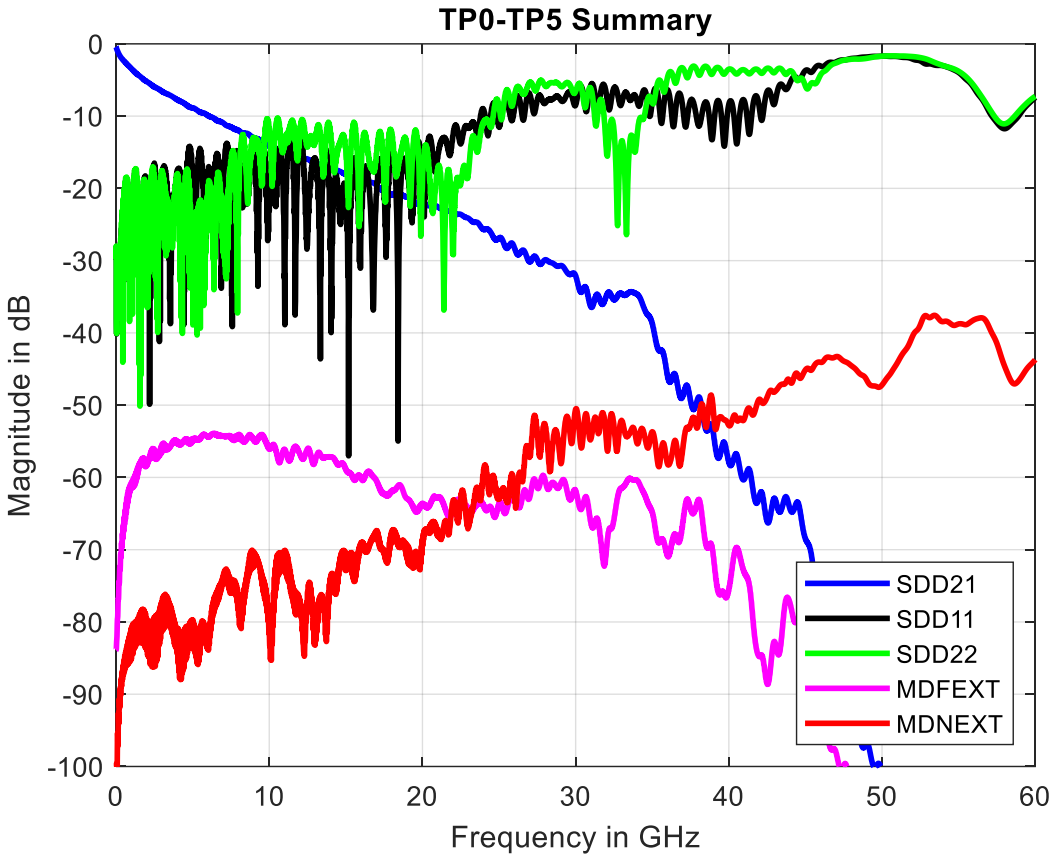
Posted as “Kocsis channels”

TP0-TP5 Channel Topology



60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31
GND	TX1P	TX1M	GND	TX3P	TX3M	GND	TX5P	TX5M	GND	TX7P	TX7M	GND	CMIS	VCC	VCC	CMIS	GND	RX8M	RX8P	GND	RX6M	RX6P	GND	RX4M	RX4P	GND	RX2M	RX2P	GND
GND	TX2P	TX2M	GND	TX4P	TX4M	GND	TX6P	TX6M	GND	TX8P	TX8M	GND	CMIS	VCC	VCC	CMIS	GND	RX7M	RX7P	GND	RX5M	RX5P	GND	RX3M	RX3P	GND	RX1M	RX1P	GND
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

TP0-TP5 Performance Example



TP0-TP5 Results

	IL, model (@26.56GHz)	ILD_FOM (dB)	MDNXT (mV)	MDFXT (mV)	ERL11	ERL22	COM Case1	COM Case2
P1TX5_P2RX5	-26.9313	0.81816	0.26994	0.87568	16.5363	16.5421	4.7165	3.7017
P1TX6_P2RX6	-27.0948	0.83178	0.28232	0.77055	16.6596	16.2778	4.8673	3.8493
P1TX7_P2RX7	-27.8029	0.74725	0.37133	0.80884	16.1766	16.3917	4.3362	3.4139
P1TX8_P2RX8	-27.3267	0.82300	0.76904	0.68611	16.8147	16.1042	4.1382	3.4655
P2TX5_P1RX5	-28.7556	0.99348	0.27249	0.97374	16.3346	16.3346	4.7916	3.7284
P2TX6_P1RX6	-28.6019	1.05560	0.26355	0.85075	16.1153	16.4724	4.8218	3.7953
P2TX7_P1RX7	-29.0368	1.02100	0.69364	0.87494	16.2158	16.0049	4.4081	3.2230
P2TX8_P1RX8	-28.5337	1.04720	0.42019	0.73627	15.8797	16.5655	4.6866	3.6752

60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31
GND	TX1P	TX1M	GND	TX3P	TX3M	GND	TX5P	TX5M	GND	TX7P	TX7M	GND	CMIS	VCC	VCC	CMIS	GND	RX8M	RX8P	GND	RX6M	RX6P	GND	RX4M	RX4P	GND	RX2M	RX2P	GND
GND	TX2P	TX2M	GND	TX4P	TX4M	GND	TX6P	TX6M	GND	TX8P	TX8M	GND	CMIS	VCC	VCC	CMIS	GND	RX7M	RX7P	GND	RX5M	RX5P	GND	RX3M	RX3P	GND	RX1M	RX1P	GND
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

Posted as “Akinwale channels”

COM Version 2.75 - CR

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	0.415	V	vp/vf=.694
A_fe	0.415	V	vp/vf=.694
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		
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_CR_{date}\	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
RUNTAG	CR_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
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	3000	
beta_x	2.3407E+09	
rho_x	0.21	
fixture delay time	[0 0]	[port1 port2]
TDR_W_TXPKG	0	
N_bx	12	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	8.37E-09	V^2/GHz
SNR_TX	32.5	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
benartsi_3ck_01_0119 & mellitz_3ck_01_0119		
Table 92–12 parameters		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 3.8206e-04 9.5909e-05]*	1 dB / in
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	**1**	**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
cable assemblies require this for each HCB		
ICN parameters (v2.73)		
f_f	12.919	
f_n	12.919	
f_2	39.844	
A_ft	0.600	
A_nt	**0.600**	
heck_3ck_03b_0319	**Adopted Mar 2019**	
walker_3ck_01d_0719	**Adopted July 2019**	
result of R_d=50		
benartsi_3ck_01a_0719	**require COM 2.72 or later**	
mellitz_3ck_03_0919		
mellitz_3ck_02_0919		
under consideration		

COM Version 2.75 - 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	0.415	V	
A_fe	0.415	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)	0.2		
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	[1 3 2 4]	
RUNTAG	KR_eval_	
COM_CONTRIBUTION	0	logical
Operational		
COM Pass threshold	3	dB
ERL Pass threshold	10.5	dB
DER_0	1.00E-04	
T_r	6.16E-03	ns
FORCE_TR	1	logical
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	3000	
beta_x	2.3407E+09	
rho_x	0.19	
fixture delay time	[0 0]	[port1 port2]
TDR_W_TXPKG	0	
N_bx	12	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	8.2E-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
benartsi_3ck_01_0119 & mellitz_3ck_01_0119		
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	0.2	max DFE value for floating taps
cable assemblies require this for each HCB		
ICN parameters (v2.73)		
f_f	12.919	
f_n	12.919	
f_2	39.844	
A_ft	0.600	
A_nt	**0.600**	
heck_3ck_03b_0319	**Adopted Mar 2019**	
walker_3ck_01a_0719	**Adopted July 2019**	
result of R_d=50		
benartsi_3ck_01a_0719	**no used for KR**	
mellitz_3ck_03_0919		
under consideration		