100GAUI-1/200GAUI-2/400GAUI-4 C2M Simulation Update

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Overview

This contribution summarizes C2M study results following sun_3ck_01b_0119 and sun_3ck_01_0319. Topics include:

- Reference receivers
- Package model assumptions
- Channel information
- TP1a simulation
- Whole-link simulation
- Test point measurement and whole-link COM correlation
- Considerations for reference and real receivers
- Host/module TX FIR assumptions
- TP1a methodology

Simulations are done with COM tool v2.64

Reference Receivers

Four reference receivers have been extensively discussed:

- A: 4-tap DFE (b1max=0.5)
- B: 5-tap FFE with 1-tap DFE (FFE4post with DFE b1max=0.5)
- C: 5-tap FFE (FFE4post)
- D: 4-tap DFE (b1max=0. i.e. only three DFE taps)

sun_3ck_01_0319, ghiasi_3ck_01a_0319, and li_3ck_01_0319 concluded that performance of reference receiver C (and D) is not sufficient unless channel/package can be improved.

Package Assumption

- The following module package is used for whole link and TP4 analysis. There are discussions whether there are designs with PTH.

C_d	0.85e-4	nF
C_p	0.75e-4	nF
Package trace length Z_p	2-8	mm
Package PTH	0	mm
package_tl_gamma0_a1_a2	[0 0.0009909 0.0002772]	
package_tl_tau	6.1400E-03	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm

- Host package is the same as for KR/CR in heck_3ck_03b_0319.
  - Cd=130 fF is used in this contribution. Results of Cd=110 and 120 fF can be found in sun_3ck_01_0319.

Channel Information

ID	Channel Description	IL (dB)	ERL11 (dB)	ERL22 (dB)	ICN (mV)	FOM_ILD	RX Required for TP1a		RX Required for Modules		
							A, B	C, D	A, B	C	FFE12Post
1	mellitz_3ck_01_0518_C2M\9dB	8.95	16.35	12.82	2.28	0.10	Pass	Pass	Pass	Marginal	Pass
2	mellitz_3ck_01_0518_C2M\10dB	9.96	7.79	10.41	4.53	0.48	Fail	Fail	Fail	Fail	Fail
3	mellitz_3ck_01_0518_C2M\11dB	11.16	18.28	14.13	1.93	0.09	Pass	Pass	Pass	Marginal	Pass
4	mellitz_3ck_01_0518_C2M\12dB	12.18	8.39	11.29	3.99	0.46	Fail	Fail	Fail	Fail	Fail
5	mellitz_3ck_01_0518_C2M\13dB	13.12	20.09	14.85	1.68	0.09	Pass	Pass	Pass	Marginal	Pass
6	mellitz_3ck_01_0518_C2M\14dB	13.87	8.73	12.52	3.19	0.47	Fail	Fail	Fail	Fail	Fail
7	tracy_100GEL_02_0118\long_barrel_via\TX5	16.48	14.98	11.58	0.91	0.28	Pass	Fail	Pass	Fail	Marginal
8	tracy_100GEL_02_0118\long_barrel_via\TX6	16.08	14.35	12.61	0.90	0.37	Marginal	Fail	Fail	Fail	Fail
9	tracy_100GEL_06_0118\Microvia\RX6	14.59	15.71	12.50	0.83	0.21	Pass	Pass	Pass	Marginal	Pass
10	tracy_100GEL_06_0118\Microvia\RX5	14.57	16.20	13.45	0.93	0.23	Marginal	Fail	Pass	Marginal	Marginal
11	lim_3ck_01_0319_QDD_new_pad\ch1	14.40	15.83	20.69	0.78	0.20	Pass	Pass	Marginal	Fail	Fail
12	lim_3ck_01_0319_QDD_new_pad\ch2	14.60	14.51	20.20	0.82	0.19	Pass	Marginal	Marginal	Fail	Fail
13	lim_3ck_01_0319_QDD_legacy_pad\ch3	14.69	16.04	15.98	0.77	0.20	Pass	Marginal	Pass	Marginal	Pass
14	llim_3ck_01_0319_QDD_legacy_pad\ch4	14.84	14.77	15.72	0.86	0.18	Pass	Fail	Pass	Marginal	Pass
15	llim_3ck_01_0319_QDD_new_pad\ch5	14.77	14.70	20.57	1.42	0.16	Pass	Fail	Marginal	Fail	Fail
16	llim_3ck_01_0319_QDD_legacy_pad\ch6	15.02	15.01	15.90	1.55	0.17	Pass	Fail	Pass	Fail	Pass
17	ito_3ck_01\QSFP \bottom normal\	15.10	12.79	10.75	1.20	0.18	Pass	Pass	Pass	Marginal	Pass
18	ito_3ck_01\QSFP \bottom worst\	15.58	12.49	10.35	1.14	0.32	Marginal	Marginal	Marginal	Fail	Pass
19	ito_3ck_01\QSFP \top normal\	14.53	12.76	10.85	1.25	0.18	Pass	Pass	Pass	Pass	Pass
20	ito_3ck_01\QSFP \top worst\	14.49	12.43	10.37	1.21	0.31	Pass	Pass	Pass	Fail	Pass

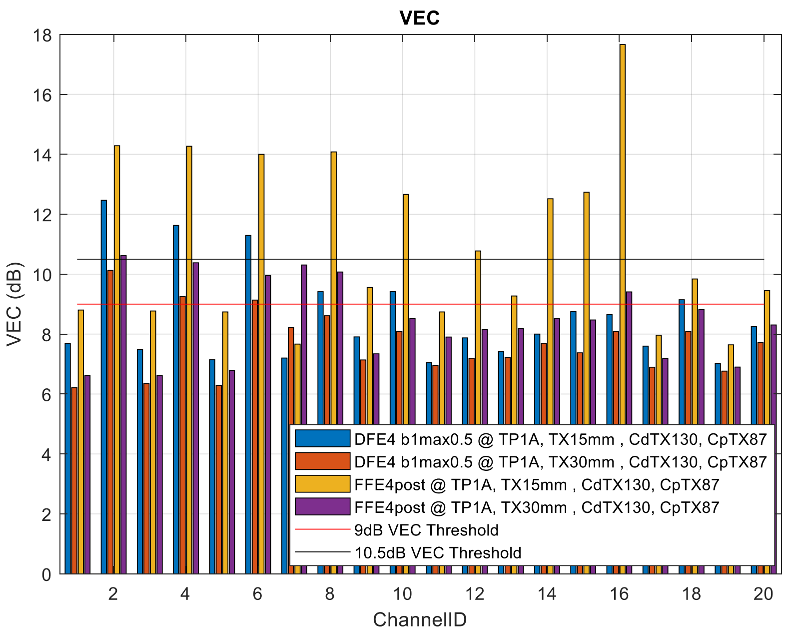
- Parameters highlighted in red are worse than 10.5dB ERL, 2.5mV ICN, or 0.35dB ILD.
- ERL is reported with the settings for reference receiver with 15mm package and 4-tap DFE at TP1a. ERL11 is for channel only. ERL22 is at TP1a including TX package.
- Channel names in red are tough channels for most of the receivers.
- For receiver pass/fail results, 15mm and 30mm host package traces are considered. Marginal means fail but close to the thresholds (violate by less than 0.5 dB).

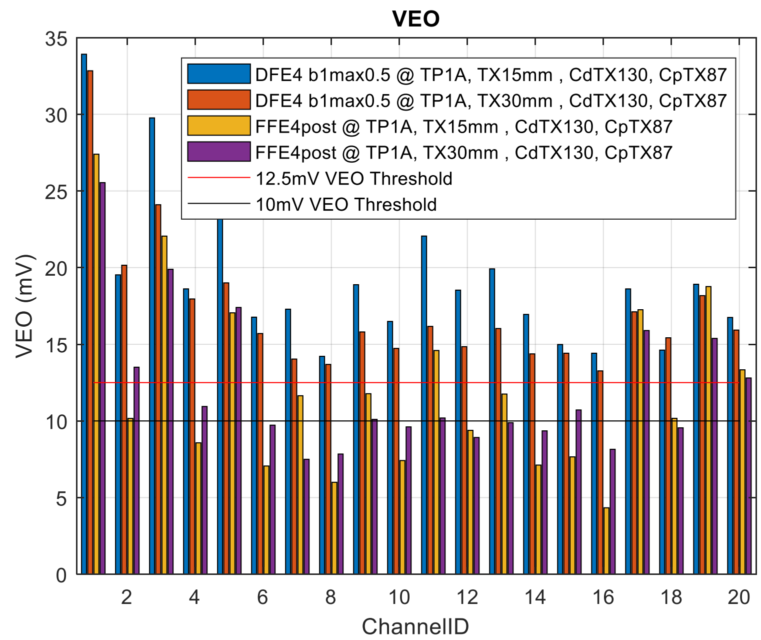
Channel Information

ID	Channel Description	IL (dB)	ERL11 (dB)	ERL22 (dB)	ICN (mV)	FOM_ILD	TP1a VEC (VEO if only VEO fails)				Whole link COM			
							RX A 15mm TX Pkg	RX A 30mm TX Pkg	RX C 15mm TX Pkg	RX C 30mm TX Pkg	RX A 15mm /8mm	RX A 30mm /8mm	RX C 15mm /8mm	RX C 30mm /8mm
1	mellitz_3ck_01_0518_C2M\9dB	8.95	16.35	12.82	2.28	0.10	7.68	6.21	8.80	6.62	3.89	4.09	3.12	2.83
2	mellitz_3ck_01_0518_C2M\10dB	9.96	7.79	10.41	4.53	0.48	12.47	10.13	14.28	10.62	1.84	2.28	0.96	1.58
3	mellitz_3ck_01_0518_C2M\11dB	11.16	18.28	14.13	1.93	0.09	7.49	6.35	8.77	6.61	3.89	4.08	3.27	2.79
4	mellitz_3ck_01_0518_C2M\12dB	12.18	8.39	11.29	3.99	0.46	11.63	9.25	14.27	10.38	1.99	2.57	1.00	1.79
5	mellitz_3ck_01_0518_C2M\13dB	13.12	20.09	14.85	1.68	0.09	7.14	6.29	8.74	6.78	4.75	4.27	3.32	2.62
6	mellitz_3ck_01_0518_C2M\14dB	13.87	8.73	12.52	3.19	0.47	11.29	9.13	14.00	9.96	2.16	2.83	1.24	2.04
7	tracy_100GEL_02_0118\long_barrel_via\TX5	16.48	14.98	11.58	0.91	0.28	7.20	8.22	7.67	10.31 (7.50)	3.71	3.32	2.84	1.38
8	tracy_100GEL_02_0118\long_barrel_via\TX6	16.08	14.35	12.61	0.90	0.37	9.41	8.61	14.08	10.07	1.95	3.18	0.89	1.79
9	tracy_100GEL_06_0118\Microvia\RX6	14.59	15.71	12.50	0.83	0.21	7.91	7.14	9.56	7.34	3.21	3.85	2.62	2.65
10	tracy_100GEL_06_0118\Microvia\RX5	14.57	16.20	13.45	0.93	0.23	9.42	8.09	12.66	8.52	3.03	3.91	2.55	2.73
11	lim_3ck_01_0319_QDD_new_pad\ch1	14.40	15.83	20.69	0.78	0.20	7.04	6.96	8.74	7.90	4.29	3.00	3.23	1.22
12	lim_3ck_01_0319_QDD_new_pad\ch2	14.60	14.51	20.20	0.82	0.19	7.87	7.19	10.77	8.16	3.93	2.68	2.83	0.74
13	lim_3ck_01_0319_QDD_legacy_pad\ch3	14.69	16.04	15.98	0.77	0.20	7.41	7.22	9.27	8.19 (9.89)	4.23	4.61	2.93	3.75
14	llim_3ck_01_0319_QDD_legacy_pad\ch4	14.84	14.77	15.72	0.86	0.18	8.00	7.69	12.51	8.52	3.68	4.23	2.86	3.24
15	llim_3ck_01_0319_QDD_new_pad\ch5	14.77	14.70	20.57	1.42	0.16	8.76	7.37	12.74	8.47	3.14	2.57	2.84	0.34
16	llim_3ck_01_0319_QDD_legacy_pad\ch6	15.02	15.01	15.90	1.55	0.17	8.65	8.09	17.66	9.41	3.36	3.98	1.98	2.98
17	ito_3ck_01\QSFP \bottom normal\	15.10	12.79	10.75	1.20	0.18	7.60	6.89	7.96	7.19	3.43	3.67	2.84	3.07
18	ito_3ck_01\QSFP \bottom worst\	15.58	12.49	10.35	1.14	0.32	9.15	8.08	9.84	8.82 (9.55)	2.51	2.89	1.71	1.94
19	ito_3ck_01\QSFP \top normal\	14.53	12.76	10.85	1.25	0.18	7.02	6.76	7.64	6.90	4.09	4.20	3.08	3.36
20	ito_3ck_01\QSFP \top worst\	14.49	12.43	10.37	1.21	0.31	8.26	7.72	9.45	8.30	3.11	3.18	1.87	2.21

- Replace pass/fail/marginal information to COM/VEC for some receivers

TP1a Simulation

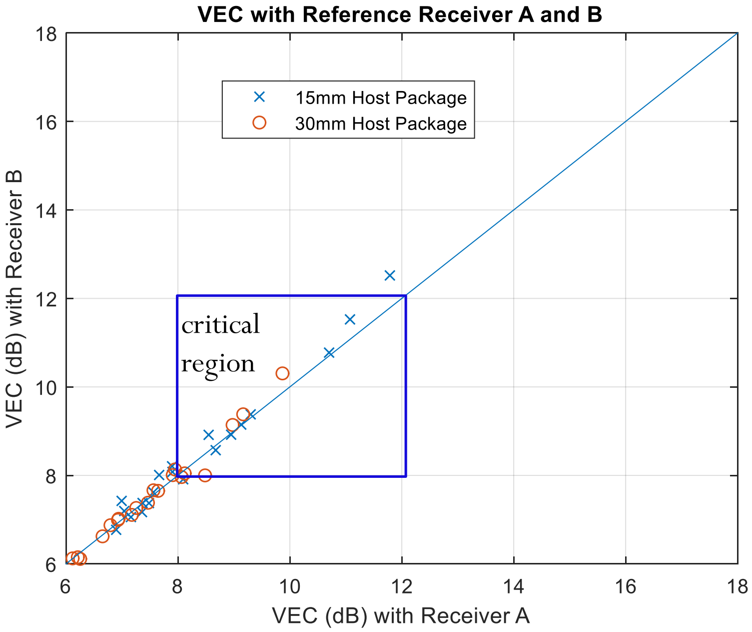


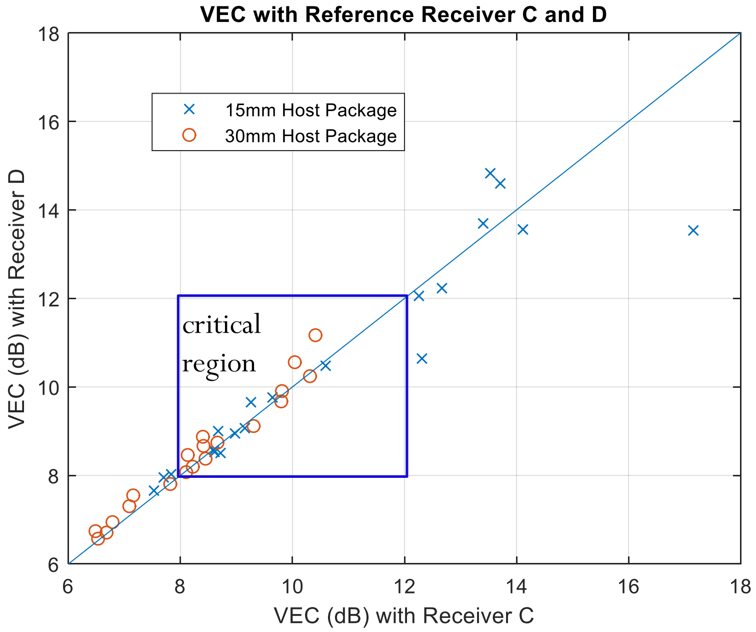


TP1a Criteria	Reference Receiver	VEC Threshold	VEO Threshold	Channels Failed
1	A, B	9dB	12.5mV	2, 4, 6, 8, 10, 18
2	C, D	10.5dB	10mV	2, 4, 6, 7, 8, 10, 12, 14, 15, 16, 18

- Only receiver A and C are plotted for clarity of figures.
- 10.5dB VEC threshold is set for receiver C and D to be equivalent to 3dB COM. Real receiver is expected to be stronger to cover module package impairment.
- Receiver A and B performance is expected to be close to a real receiver. VEC threshold is set so COM at TP1a is higher than 3dB, so real receivers have margin to tolerate module package impairment.
- VEO threshold is higher for receivers A and B than receivers C and D because A and B have higher performance.

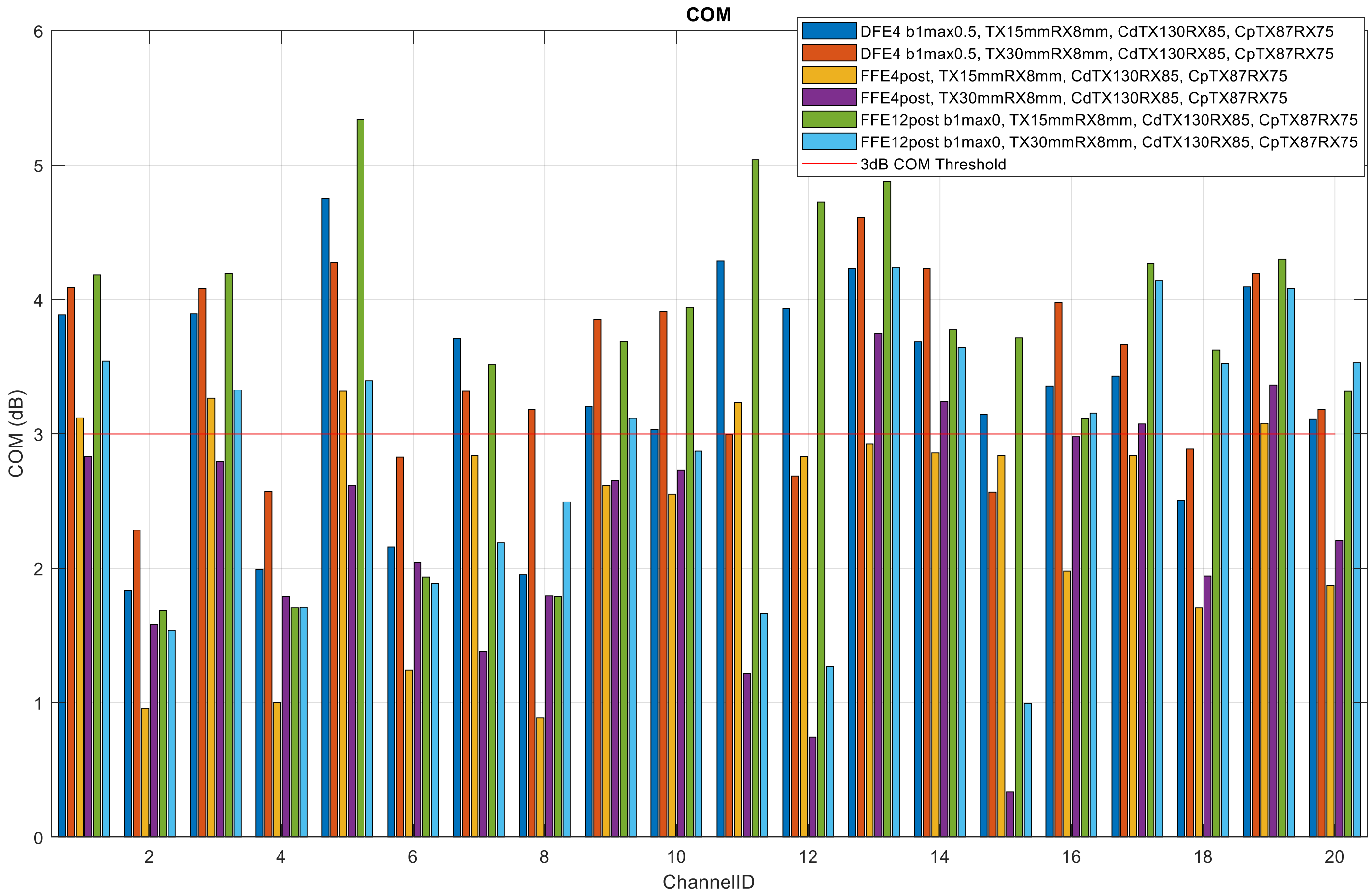
TP1a Reference Receiver Performance





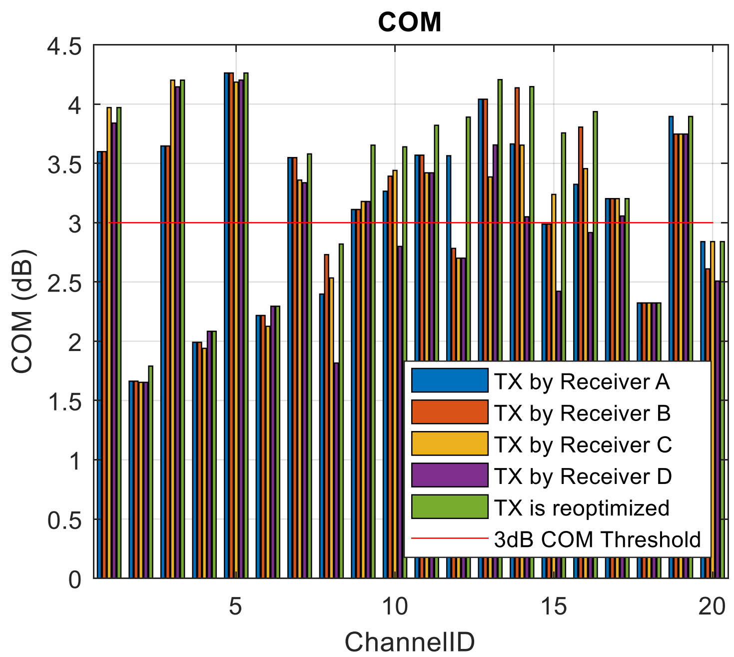
- Reference receiver A and B have similar performance. COM difference is 0.14 dB in average.
- C and D have lower performance than A and B. Average deference between C and D is 0.001 dB. Receiver C appears to behave abnormal with channel 16 and results in VEC over 16dB.

Whole-Link Simulation for Module RX

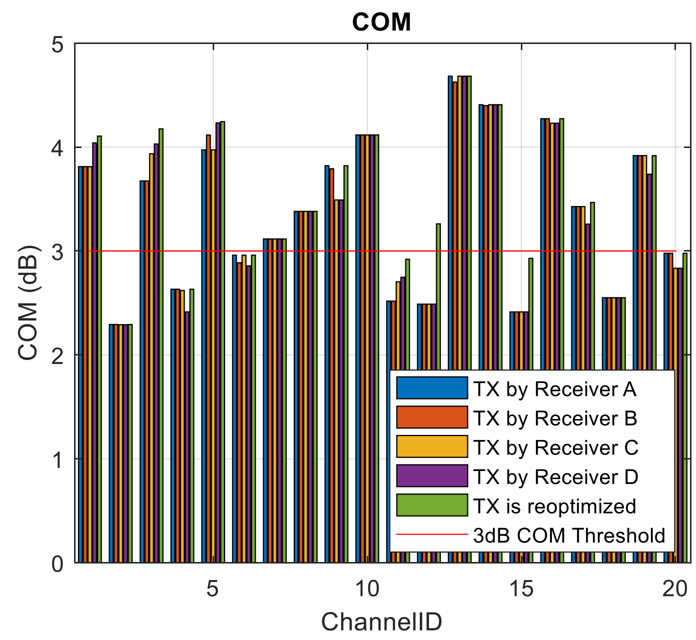


- Assuming host TX FIR have 3 precursors.
- Whole-link simulation uses TX FIR settings optimized for the same channel at TP1a.
- Reference receiver is DFE4, FFE5, DFE4 for receiver DFE4, FFE5, and FFE12post respectively.
- DFE4 supports more channels than the other two receivers.

Whole-link COM with Different TX



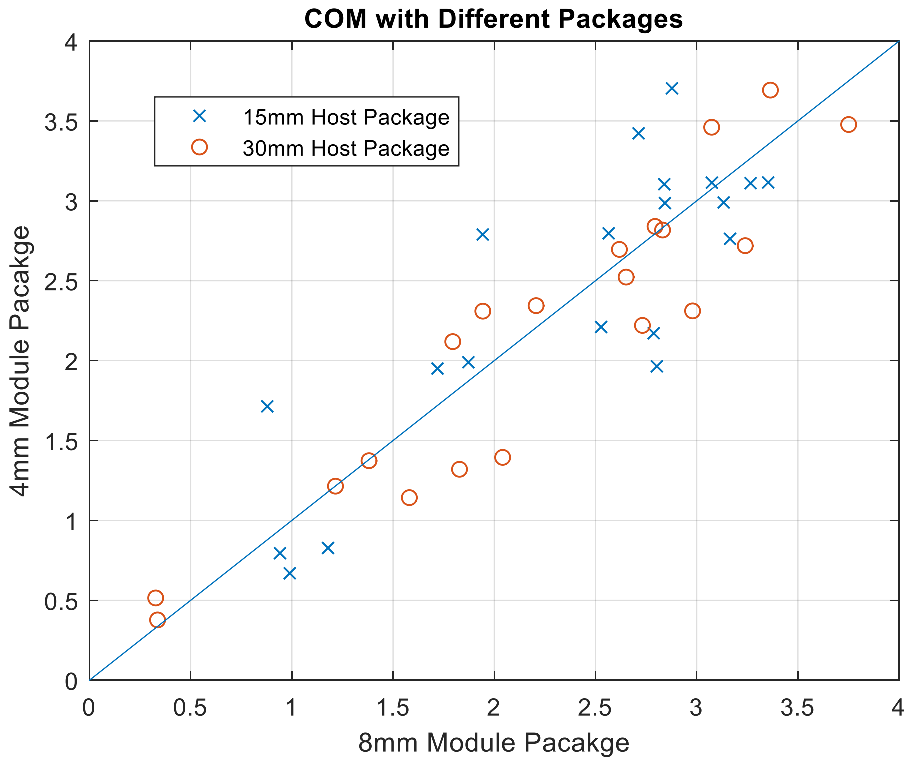
15mm host, 8mm module package trace



30mm host, 8mm module package trace

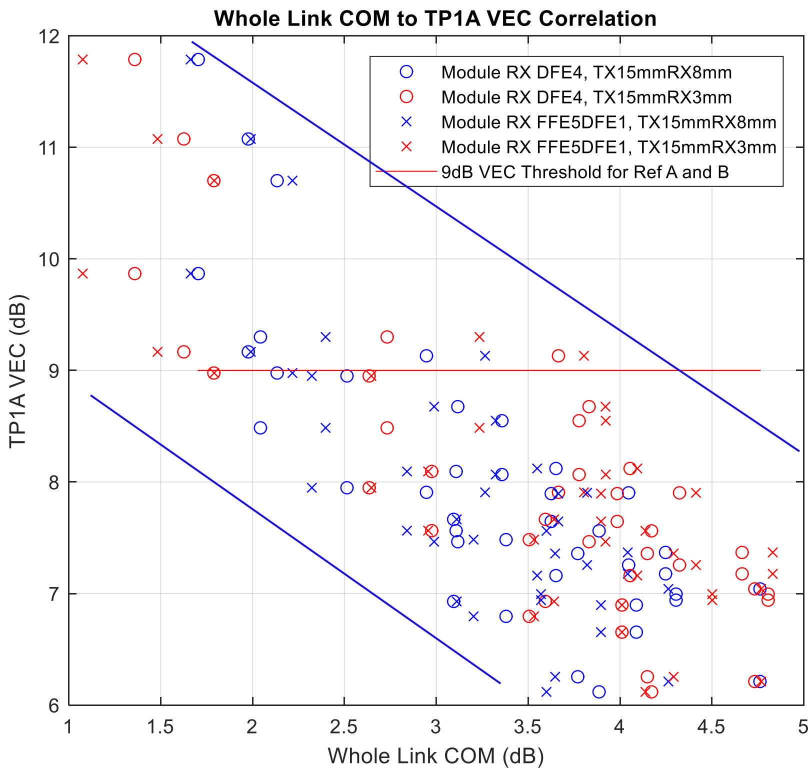
- Module RX is FFE4DFE1. b1max is relaxed to 0.75 for real receivers to compensate non-optimal TX FIR.
- Compared to reoptimized TX FIR, TX set by reference receivers results in degraded performance but not dramatic.

Module Package Impact

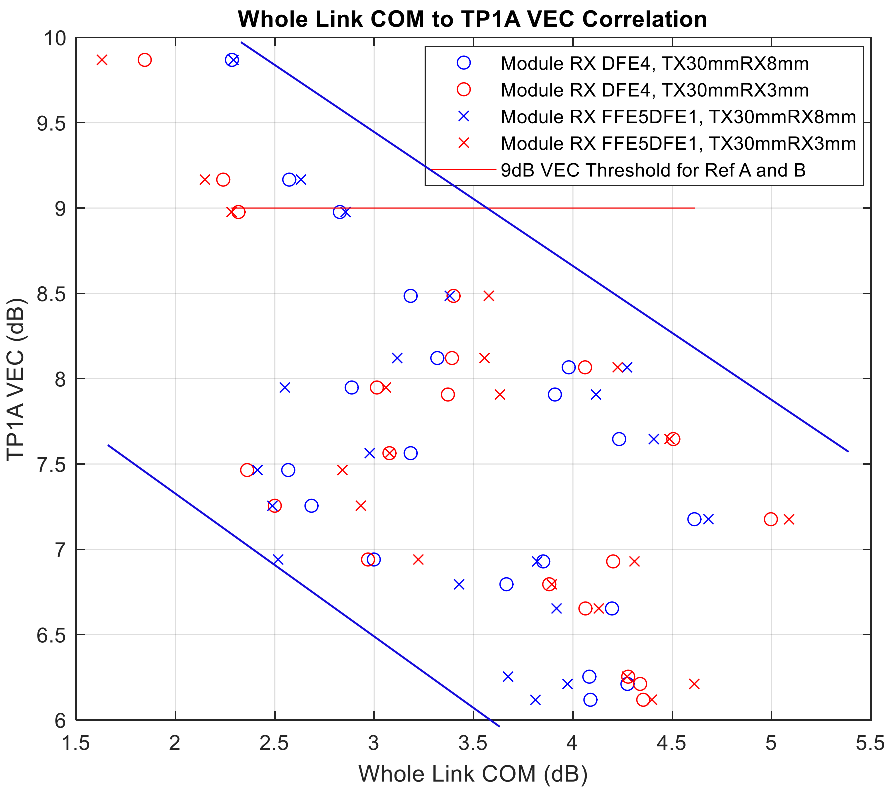


- Module RX is 5-tap FFE. Reference receiver is also 5-tap FFE to set host TX FIR.
- Average COM difference of 8 mm and 4 mm module packages is less than 0.1 dB.
- There are discussions whether module package traces can be limited to 5mm. Limiting module package trace length to 5 mm has no obvious impact on COM.

TP1a VEC and Whole-Link COM Correlation



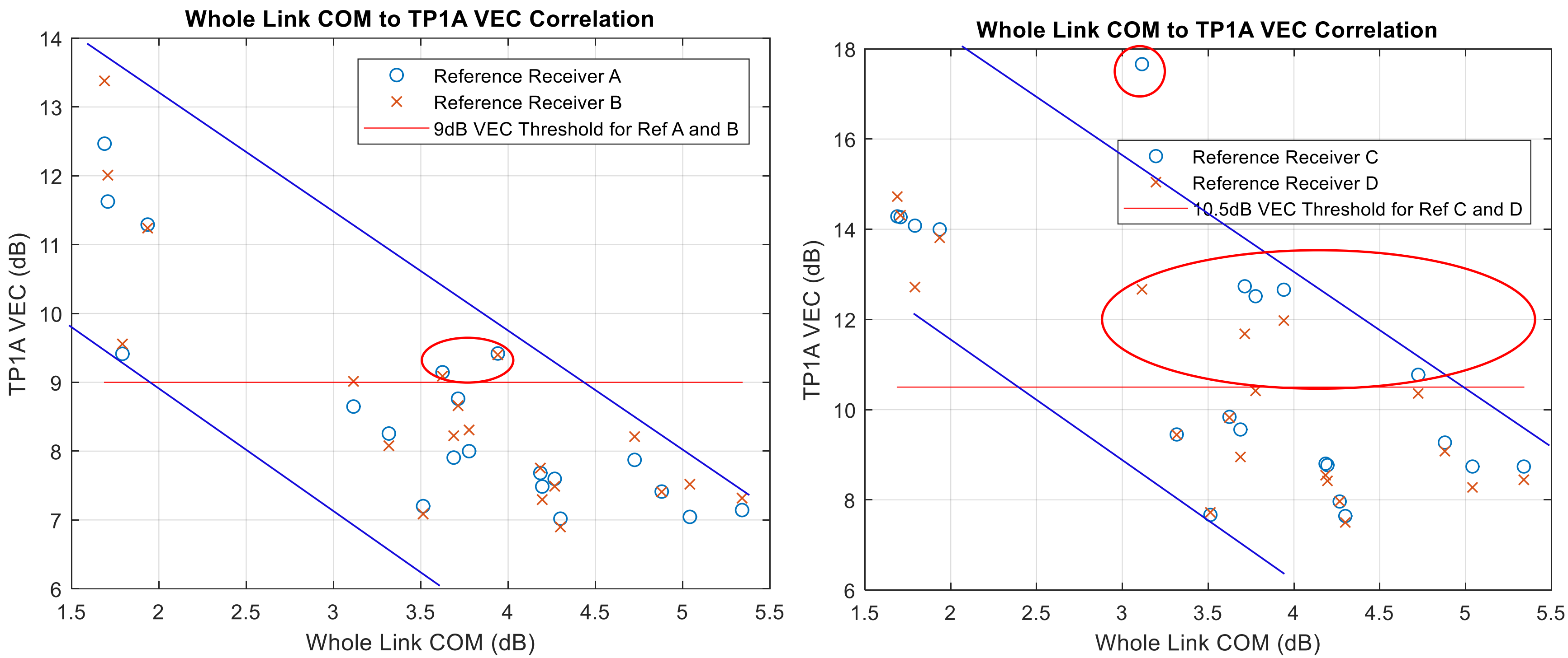
15mm Host



30mm Host

- Reference receiver A.
- Whole link module package length is 3mm and 8mm, and receiver is DFE4 or FFE4postDFE1 with b1max=0.75.
- Correlation is observed between TP1A VEC and whole-link COM.

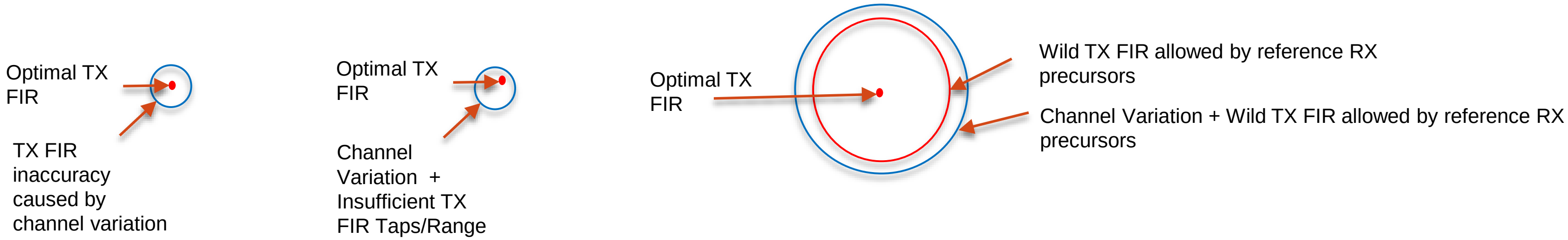
TP1a VEC and Whole-Link COM Correlation



- 15mm host. Whole link module package length is 8mm, and receiver is FFE12post.
- Reference receiver A and B have less "false fail" cases (in red circle).

Reference v.s. Real Receivers

- Reference receiver is defined at TP1a without package, while Real receiver has to cover the whole link.
  - Reference receiver could use a real receiver architecture and set higher COM threshold.
  - Another way is to use a minimum performance receiver to qualify channel and signal quality at test points.
  - It is important to have correlation between reference receiver at TP1a and signal quality for the whole link.
- Shorter reference receiver usually allows simpler and broader implementations.
  - A long reference EQ forces real receiver to have long FFE/DFE to cover reflections covered by reference equalizer.
  - A reference EQ with unnecessary precursors allows wild TX FIR range. This forces real receiver to have even more precursors with wide range which are high cost for a lot of analog based receivers.
    - TX FIR inaccuracy cannot be solved by a reference receiver with precursors. Instead real receiver has to tolerate wild range allowed by reference receiver precursors on top of TX FIR inaccuracy.
    - Tolerate TX FIR inaccuracy should be tolerated by a real receiver stronger than reference receiver.

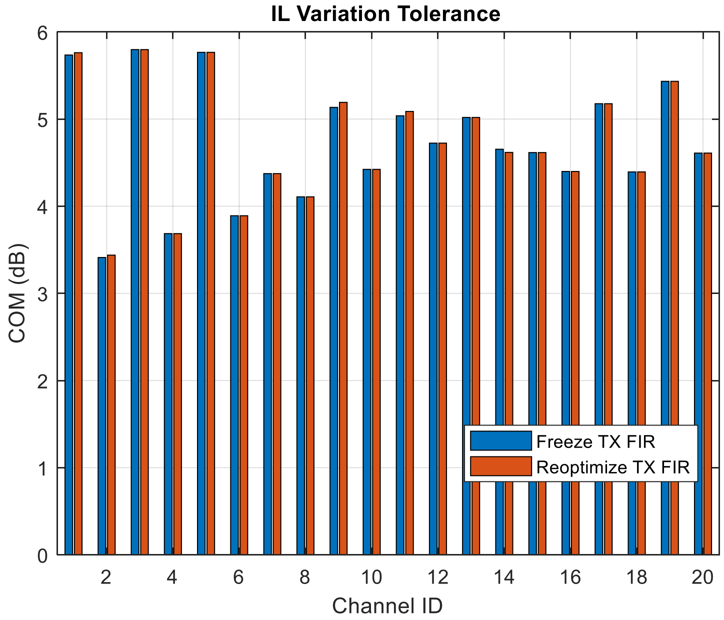


Host TX FIR Tap Weight

|C(-1)|	C(-2)	C(-3)
<=10%	0	0
>10% and <15%	2%	0
>15% < 20%	4%	0
>=20%	4 or 6%	-2%

- 2% C(-3) help TP1a VEC up to 1dB. sun_3ck_03a_0119
- C(-3) is adapted to -2% when |C(-1)| >= 20%. Figure is with FFE4post.
- As C(-3) uses very limited settings. It should be easy to set.
- C2M spec does not specify TX FIR. Host is assumed to have 3 precursors if it supports KR/CR?
- In this contribution and sun_3ck_01_0319, host TX FIR is assumed to have 3 precursors and module TX FIR is assumed to have 2 precursors.

Channel IL Variation Tolerance

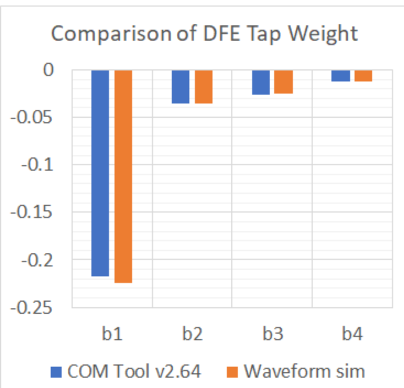


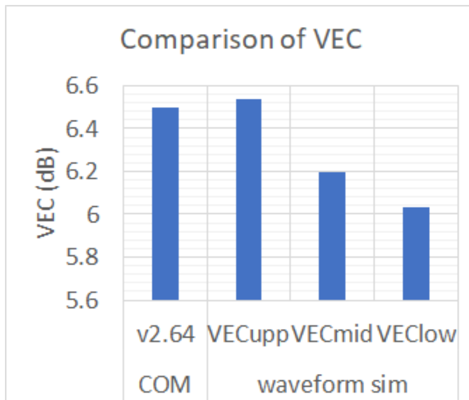
30mm Host @ TP1a

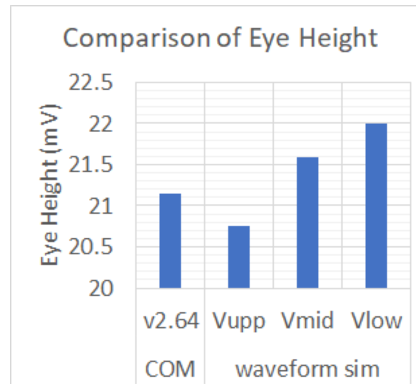
- 2dB additional PCB is added to mimic channel IL loss variation. Less than 0.1dB COM difference between frozen and re-optimized TX FIR.
- Channel variation has very little impact on precursors. That is why SERDES without precursors worked well in the field for generations.
- Receiver is 4-tap DFE.

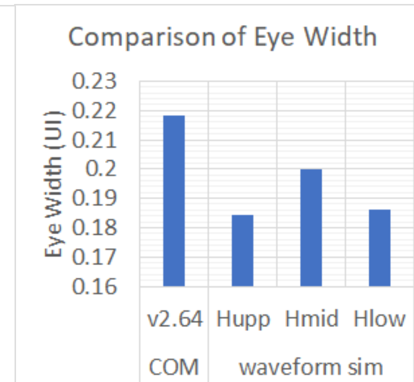
TP1a Methodology

- C2M reference receiver used to be CTLE only. Adaptive filters are introduced in this project to accommodate toucher channels. Optimization algorithms are needed to optimize adaptive filter.
- As feasibility study, we applied reference receiver A on simulated waveform and verified eye measurement methodology specified in Annex 120E.
  - For reference receiver A, DFE and phase optimization algorithms in Annex 93A are used.
  - Other reference receivers need new optimization algorithms and are still under study..









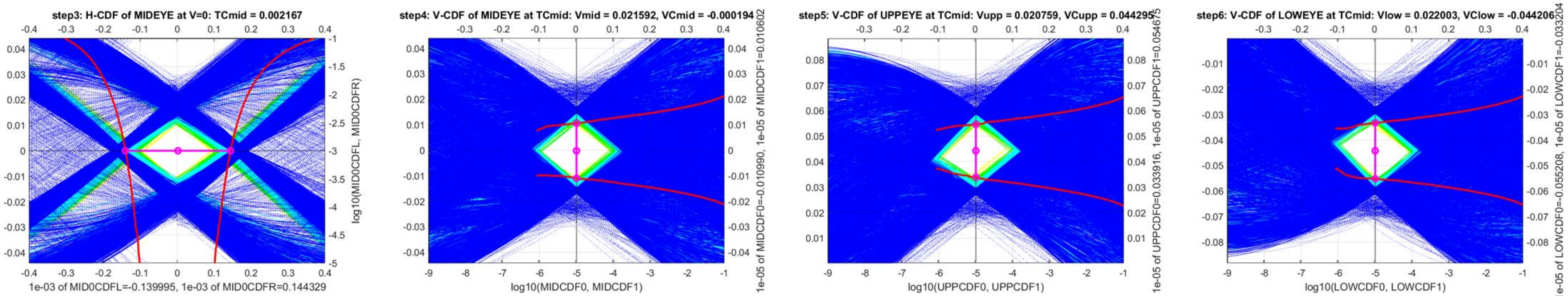
- DFE coefficients from waveform and COM tool have decent match.
- For this channel, EH and VEC from waveform and COM tool v2.64 are close to each other. EW from COM tool seems to be optimistic.

Results for CH19, TX15mm, TP1a with reference receiver A

		EW	EH	VEC
COM v2.64		0.218UI	21.14mV	6.49dB
wave-form sim	upp	0.184UI	20.76mV	6.54dB
	mid	0.200UI	21.59mV	6.20dB
	low	0.186UI	22.00mV	6.03dB

Reuse Eye Measurement Methodology in 120E

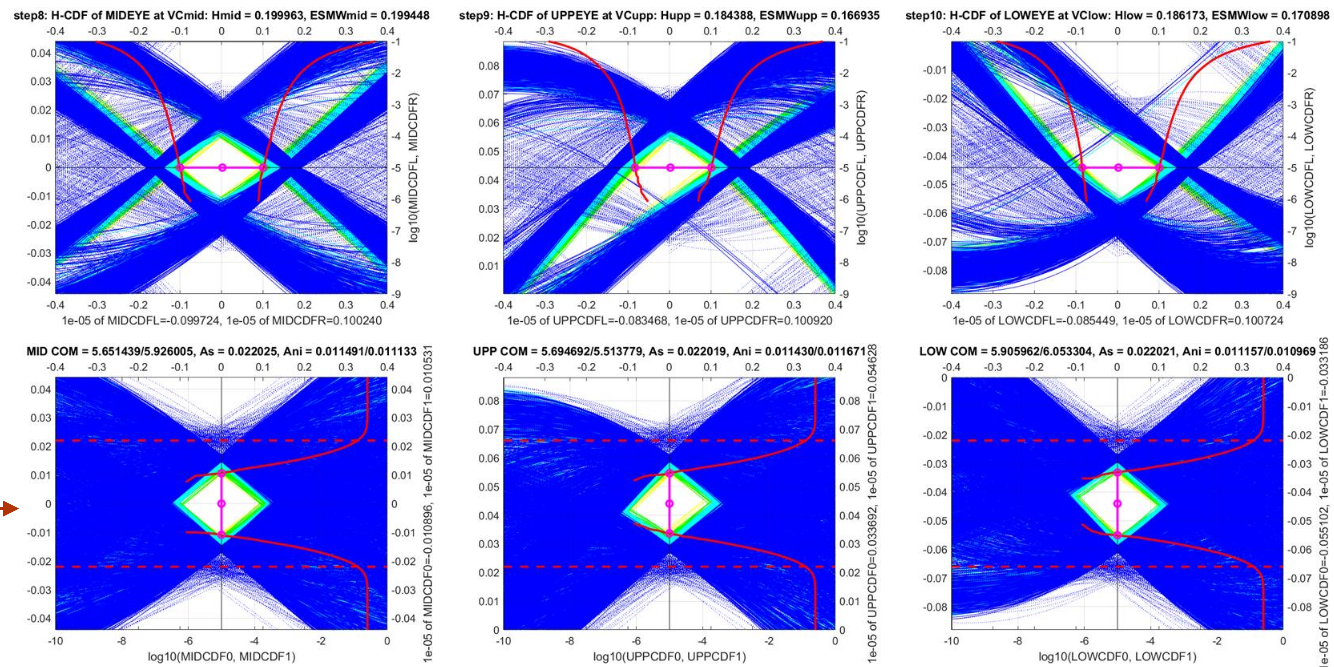
- EW and EH are extracted by following the methodology in 120E.4.2 with RX A
  - Based on simulated waveforms with 1.2M PAM4 symbols as if in the real scope



Followed steps in Annex 120E.4.2

color	probability
dotted blue:	>1E-2
solid blue:	1E-3~1E-2
cyan:	1E-4~1E-3
green:	1E-5~1E-4
yellow & white:	<1E-5

Also derived COM values from vertical CDF at sampling phase where optimization was done.



Conclusions

- Receivers A/B have higher performance than C/D because of DFE tap on postcursor 1.
  - A is a shorter version of KR/CR reference equalizer.
- If channels/packages cannot be aggressively improved, receivers C/D are too weak as TP1a reference receivers. Relaxing VEC is a bad idea as bad channels will pass.
- TP1a VEC is better correlated to whole-link COM with receivers A/B than C/D.
- Tuning algorithms need to be discussed for all reference receivers.
  - Reasonable results have been achieved by borrowing Annex 120E and 93A methodology for receiver A.
- Propose short reference receivers without precursors to enable greater implementation and reduce system power.
- TX FIR C(-3) only needs small range, but is important for module receiver to cover more channels.

Backup Slides

COM Configuration for TP1a Simulation

Parameter	Setting	Units	Information		DIAGNOSTICS	0	logical		Parameter	Setting	Units
f_b	53.125	GBd			DISPLAY_WINDOW	0	logical		package_tl_gamma0_a1_a2	[0 0.0009909 0.0002772]	
f_min	0.05	GHz			CSV_REPORT	1	logical		package_tl_tau	6.1400E-03	ns/mm
Delta_f	0.01	GHz			RESULT_DIR	.\results\100GEL_WG_{date}\			package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm
C_d	[1.3e-4 0]	nF	[TX RX]		SAVE_FIGURES	0	logical				
z_p select	[2]		[test cases to run]		Port Order	[1 3 2 4]			Table 92–12 parameters		
z_p (TX)	[32 15; 1.8 1.8]	mm	[test cases]		RUNTAG	C2M_1218			Parameter	Setting	
z_p (NEXT)	[0 0 ; 0 0]	mm	[test cases]		COM_CONTRIBUTION	0	logical		board_tl_gamma0_a1_a2	[0 3.8206e-04 9.5909e-05]	
z_p (FEXT)	[32 15; 1.8 1.8]	mm	[test cases]		Operational				board_tl_tau	5.790E-03	ns/mm
z_p (RX)	[0 0 ; 0 0]	mm	[test cases]		COM Pass threshold	3.8	dB		board_Z_c	90	Ohm
C_p	[0.87e-4 0]	nF	[TX RX]		ERL Pass threshold	10.5	dB		z_bp (TX)	119	mm
R_0	50	Ohm			DER_0	1.00E-05			z_bp (NEXT)	119	mm
R_d	[45 50]	Ohm	[TX RX]		T_r	6.16E-03	ns		z_bp (FEXT)	119	mm
A_v	0.41	V			FORCE_TR	1	logical		z_bp (RX)	119	mm
A_fe	0.41	V			Include PCB	0	logical				
A_ne	0.6	V			TDR and ERL options						
L	4				TDR	1	logical				
M	32				ERL	1	logical				
filter and Eq					ERL_ONLY	0	logical				
f_r	0.75	*fb			TR_TDR	0.01	ns				
c(0)	0.6		min		N	400					
c(-1)	[-0.3:0.02:0]		[min:step:max]		TDR_Butterworth	1	logical				
c(-2)	[0:.02:0.1]		[min:step:max]		beta_x	0.00E+00					
c(-3)	[-0.04:.02:0.0]		[min:step:max]		rho_x	0.32					
c(1)	[-0.1:0.05:0]		[min:step:max]		fixture delay time	0					
N_b	4	UI			TDR_W_TXPKG	1					
b_max(1)	0.5				N_bx	4	UI				
b_max(2..N_b)	0.3				Receiver testing						
g_DC	[-14:1:-3]	dB	[min:step:max]		RX_CALIBRATION	0	logical				
f_z	12.58	GHz			Sigma BBN step	5.00E-03	V				
f_p1	20	GHz									
f_p2	28	GHz			Noise, jitter						
g_DC_HP	[-3:1:0]		[min:step:max]		sigma_RJ	0.01	UI				
f_HP_PZ	1.328125	GHz			A_DD	0.02	UI				
ffe_pre_tap_len	0	UI			eta_0	8.20E-09	V^2/GHz				
ffe_post_tap_len	0	UI			SNR_TX	32.5	dB				
Include PCB	0	logical			R_LM	0.95					
ffe_tap_step_size	0										
ffe_main_cursor_min	0.7										
ffe_pre_tap1_max	0.3										
ffe_post_tap1_max	0.3										
ffe_tapn_max	0.125										
ffe_backoff	1										

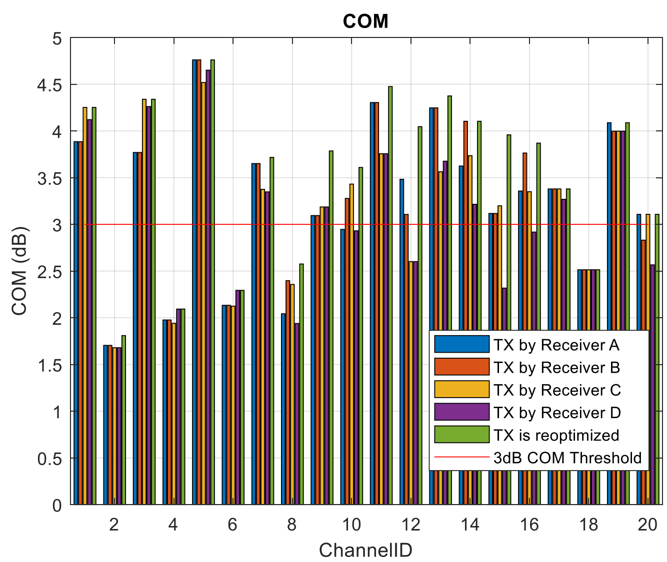
- This spread sheet is for TP1a simulation with reference receiver A

COM Configuration for Whole-Link Simulation

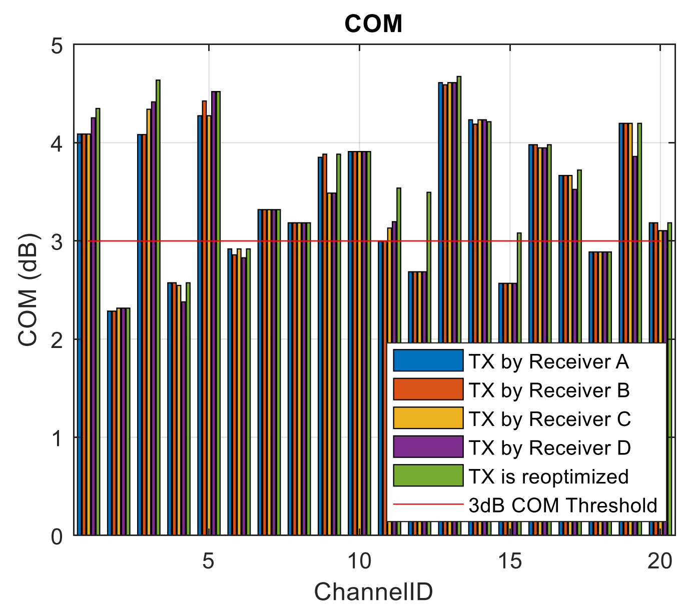
Table 93A-1 parameters					I/O control				Table 93A–3 parameters		
Parameter	Setting	Units	Information		DIAGNOSTICS	0	logical		Parameter	Setting	Units
f_b	53.125	GBd			DISPLAY_WINDOW	0	logical		tx_package_tl_gamma0_a1_a2	[0 0.0009909 0.0002772]	
f_min	0.05	GHz			CSV_REPORT	1	logical		tx_package_tl_tau	6.1400E-03	ns/mm
Delta_f	0.01	GHz			RESULT_DIR	.\results\100GEL_WG_{date}\			package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm
C_d	[1.3e-4 0.85e-4]	nF	[TX RX]		SAVE_FIGURES	0	logical				
z_p select	[1]		[test cases to run]		Port Order	[1 3 2 4]			Table 92–12 parameters		
z_p (TX)	[30 15 ; 1.8 1.8]	mm	[test cases]		RUNTAG	C2M_1218			Parameter	Setting	
z_p (NEXT)	[8 2 ; 0 0]	mm	[test cases]		COM_CONTRIBUTION	0	logical		board_tl_gamma0_a1_a2	[0 3.8206e-04 9.5909e-05]	
z_p (FEXT)	[30 2 ; 1.8 1.8]	mm	[test cases]		Operational				board_tl_tau	5.790E-03	ns/mm
z_p (RX)	[8 10 ; 0 0]	mm	[test cases]		COM Pass threshold	3.8	dB		board_Z_c	90	Ohm
C_p	[0.87e-4 0.75e-4]	nF	[TX RX]		ERL Pass threshold	10.5	dB		z_bp (TX)	119	mm
R_0	50	Ohm			DER_0	1.00E-05			z_bp (NEXT)	119	mm
R_d	[45 45]	Ohm	[TX RX]		T_r	6.16E-03	ns		z_bp (FEXT)	119	mm
A_v	0.41	V			FORCE_TR	1	logical		z_bp (RX)	132	mm
A_fe	0.41	V			Include PCB	0	logical				
A_ne	0.6	V			TDR and ERL options						
L	4				TDR	1	logical				
M	32				ERL	1	logical				
filter and Eq					ERL_ONLY	0	logical				
f_r	0.75	*fb			TR_TDR	0.01	ns				
c(0)	0.6		min		N	400					
c(-1)	[-0.3:0.02:0]		[min:step:max]		TDR_Butterworth	1	logical				
c(-2)	[0:.02:0.1]		[min:step:max]		beta_x	0.00E+00					
c(-3)	[-0.04:.02:0.0]		[min:step:max]		rho_x	0.32					
c(1)	[-0.1:0.05:0]		[min:step:max]		fixture delay time	0					
N_b	4	UI			TDR_W_TXPKG	0					
b_max(1)	0.5				N_bx	4	UI				
b_max(2..N_b)	0.2				Receiver testing						
g_DC	[-14:1:-3]	dB	[min:step:max]		RX_CALIBRATION	0	logical				
f_z	12.58	GHz			Sigma BBN step	5.00E-03	V				
f_p1	20	GHz									
f_p2	28	GHz			Noise, jitter						
g_DC_HP	[-3:1:0]		[min:step:max]		sigma_RJ	0.01	UI				
f_HP_PZ	1.328125	GHz			A_DD	0.02	UI				
					eta_0	8.20E-09	V^2/GHz				
					SNR_TX	32.5	dB				
					R_LM	0.95					

- This spread sheet is for whole-link simulation with reference receiver A

Whole-link COM with Different TX



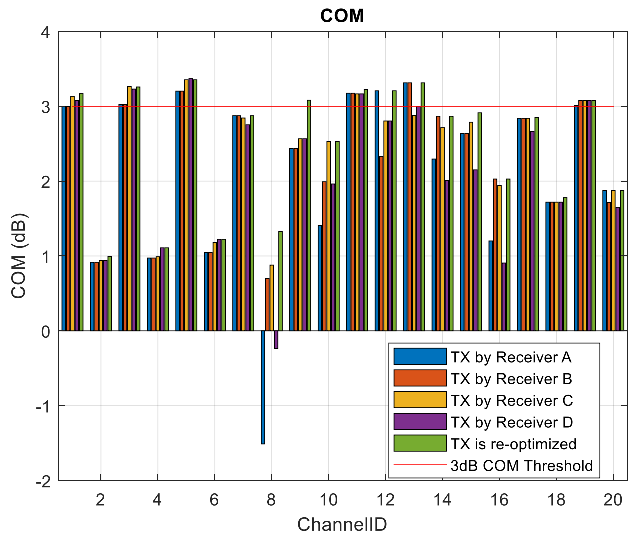
15mm host, 8mm module package trace



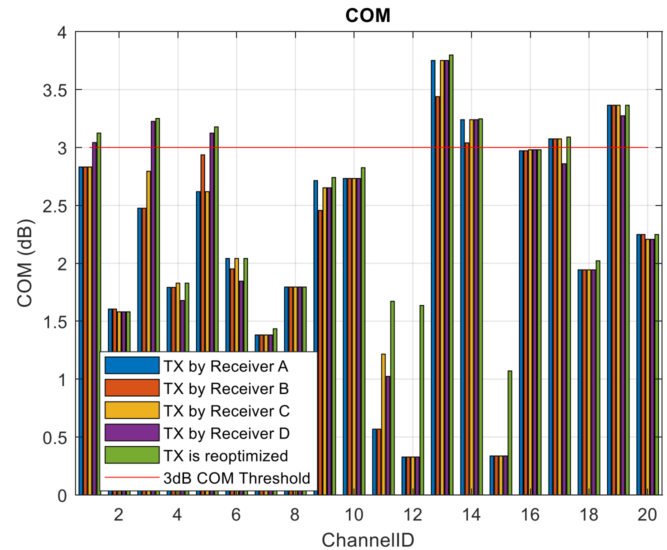
30mm host, 8mm module package trace

- Module RX is DFE4. b1max needs to be relaxed to 0.75 for real receiver to compensate non-optimal TX FIR.
- Cd TX=130fF, RX=85fF
- Cp TX=87fF, RX=75fF

Whole-link COM with Different TX



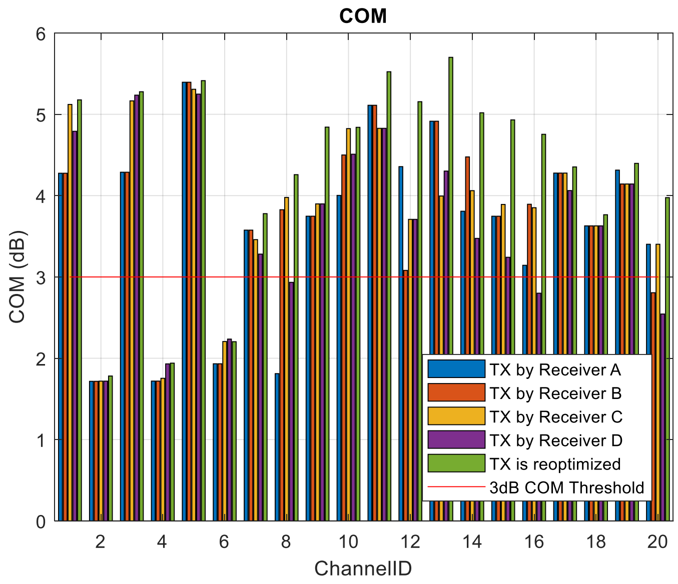
15mm host, 8mm module package trace



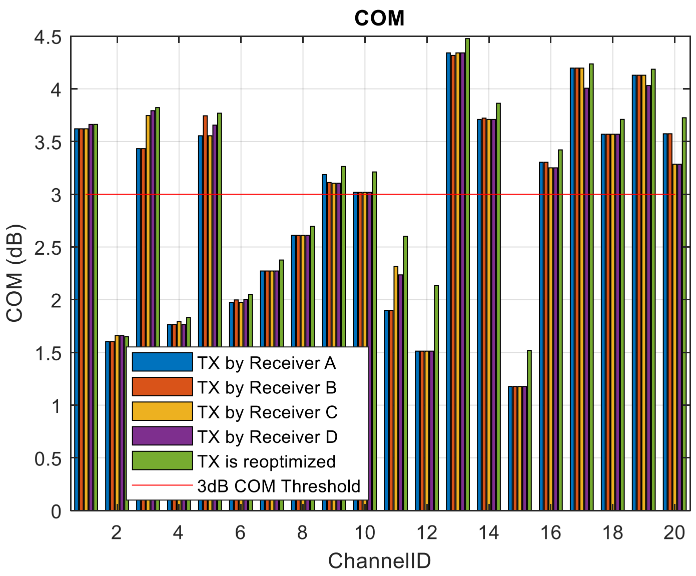
30mm host, 8mm module package trace

- Module RX is FFE4post.
- Cd TX=130fF, RX=85fF
- Cp TX=87fF, RX=75fF

Whole-link COM with Different TX



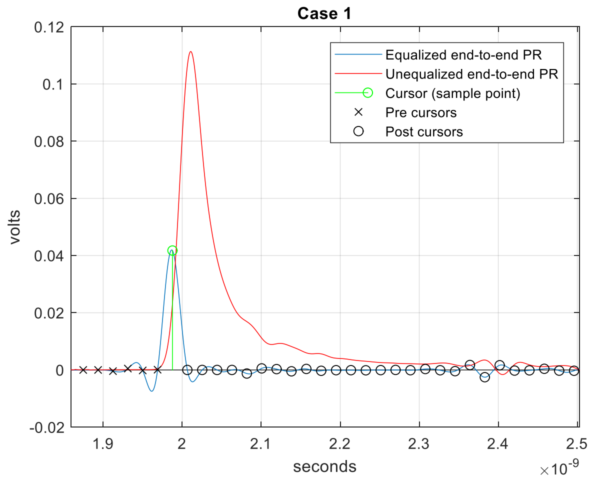
15mm host, 8mm module package trace

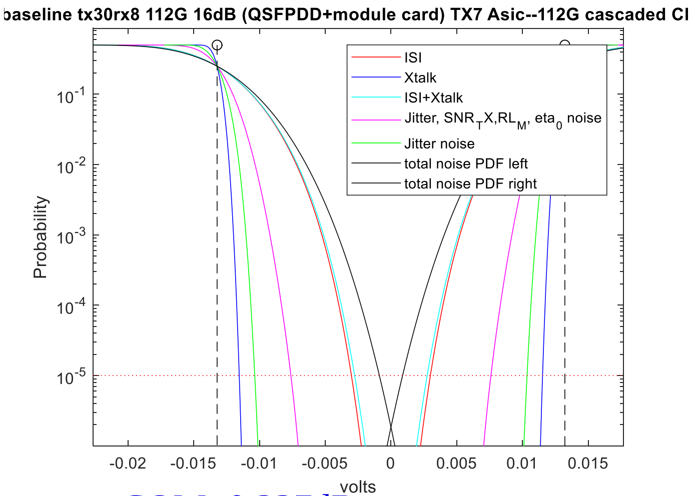


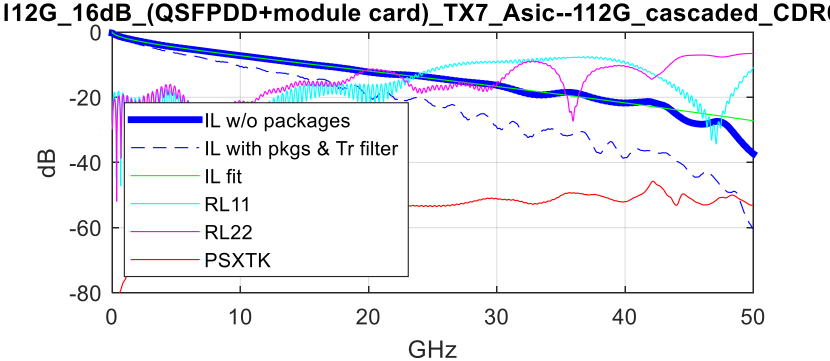
30mm host, 8mm module package trace

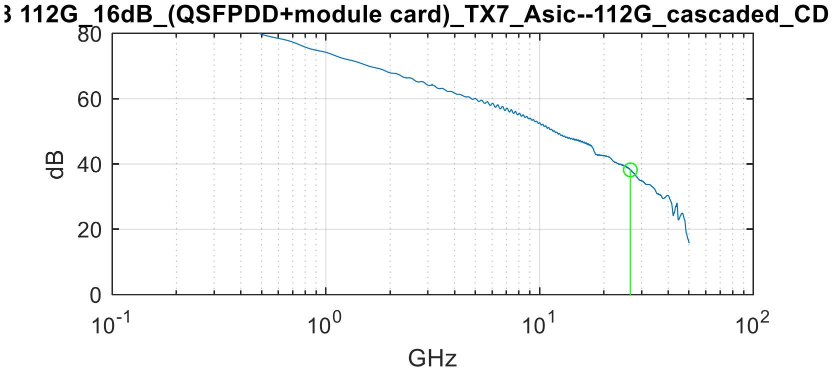
- Module RX is FFE3pre12post
- Cd TX=130fF, RX=85fF
- Cp TX=87fF, RX=75fF

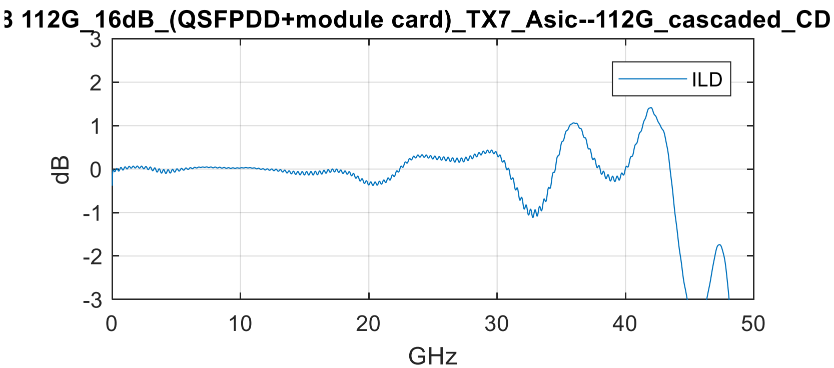
Channel 15





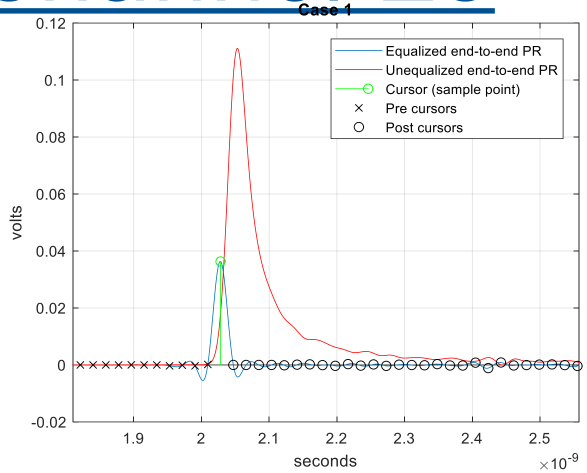


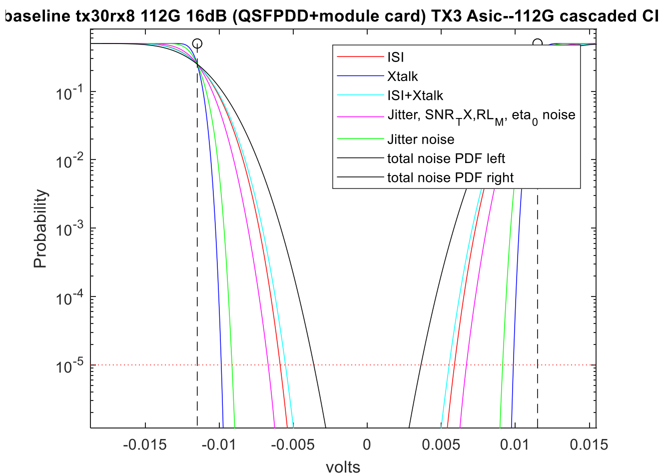


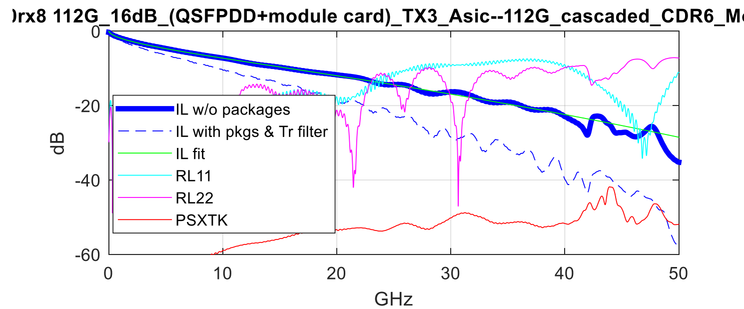


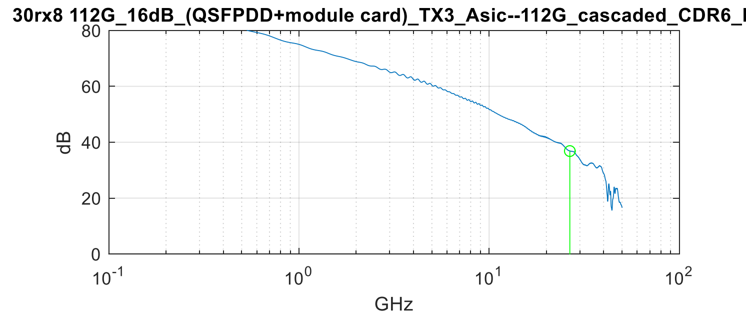
- COM=0.337dB
- Module receiver is C
- TX is set by ref receiver C
- 30mm host package , 8 mm module package.

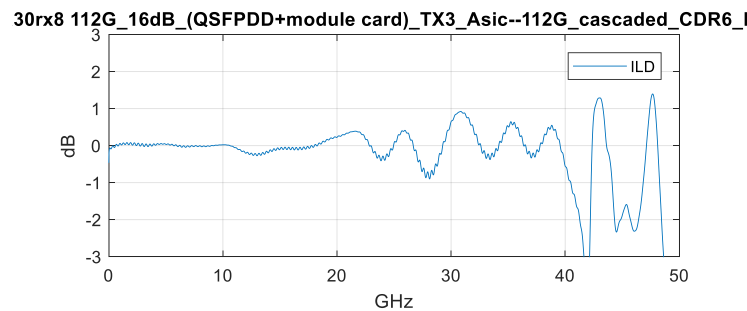
Channel 16











- COM=2.98dB
- Module receiver is C
- TX is set by ref receiver C
- 30mm host package, 8 mm module package.