Comparing 120G C2M Measurement with COM Script Computations

Richard Mellitz, Samtec
Contributions from Varun Garg, Keysight

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Agenda

- ❑ Background
- ❑ Measurement setups
- ❑ Pulse response
- ❑ VEC/EH results
- ❑ Discussion

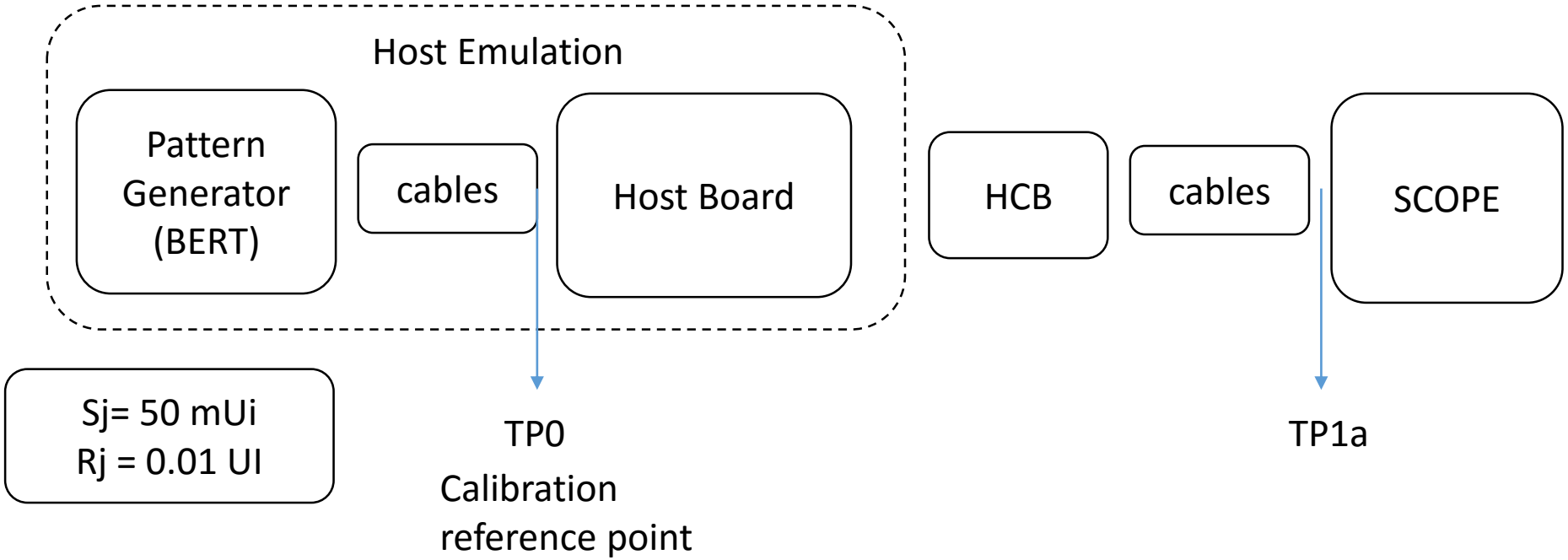
Intent

- Identify reasons for > 3 dB difference between COM 120G computations, 120G specs, and C2M instrument measurements
- Looking for input for next steps

Background

- Spawned by calvin_3ck_02a_1020, ‘Concerns with stressed input tests in Annex 120G 8023ckd1p3 V2”
  - “It is not realistic that any compliant Tx with 50mUI SJ @ 40MHz can achieve 7.5dB VEC @ TP1a”
- D 1.3 host output (TP1a) spec
  - VEC: 9 dB
  - EH: 15 mV
- D1.3 ff changed to 50 mUI window method (healey_3ck_01a_1020)
  - 120G.5.2
- D 2.0 host output spec
  - VEC: 12 dB
  - EH: 10 mV
- This work: Recheck to see if VEC/EH are justified with measurements
- Simply investigation: Crosstalk not considered a this time
- Focus on 2 cases:
  - Maximum loss – “16 dB channel”
  - Minimum loss – “Mated test fixture (MTF) channel”

Measuring output at TP1a (related to module input stressed test)



Measure J4u and J_{RMS} → Compute A_{dd} and σ_{rms}
Measure SNDR → SNR_{TX} = 31 db
Measure R_{LM}= 0.97
Measure A_v, V_f

Adjust COM to match measurements pulse response at TP1a

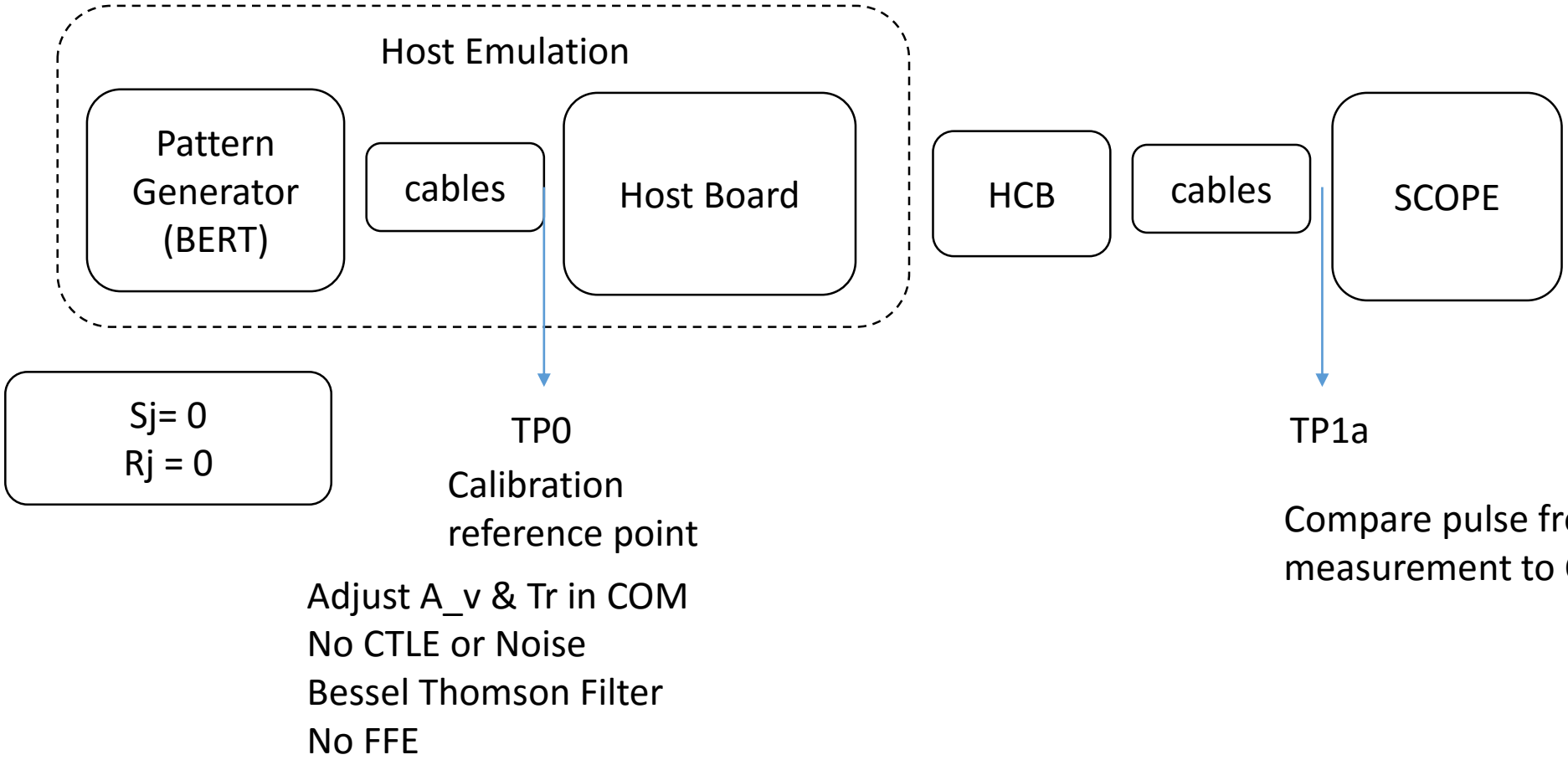


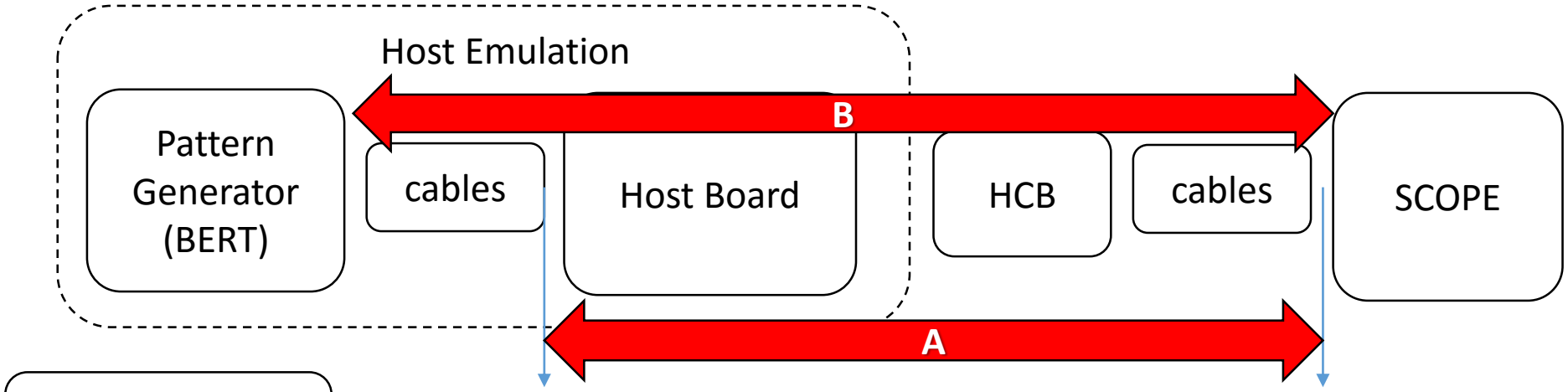
Table 93A-1 parameters							
Parameter	Setting	Units	Information				
f_b	53.125	GBd					
f_min	0.05	GHz					
Delta_f	0.01	GHz					
C_d	[0 0]	nF	[TX RX]				
L_s	[0 0]	nH	[TX RX]				
C_b	[0 0]	nF	[TX RX]				
z_p select	[1]		[test cases to run]				
z_p (TX)	[0 0; 0 0]	mm	[test cases]				
z_p (NEXT)	[0 0 ; 0 0]	mm	[test cases]				
z_p (FEXT)	[0 0; 0 0]	mm	[test cases]				
z_p (RX)	[0 0 ; 0 0]	mm	[test cases]				
C_p	[0 0]	nF	[TX RX]				
R_0	50	Ohm					
R_d	[50 50]	Ohm	[TX RX]				
A_v	0.4873	V	vp/vf=.694				
A_fe	0.4873	V	vp/vf=.694				
A_ne	0.608	V					
L	2						
M	32	Samp/UI					
samples_for_C2M	100	Samp/UI					
T_O	0	mUI					
AC_CM_RMS	0	V	[test cases]	[0.0235 0.0256]			
filter and Eq							
f_r	0.75	*fb					
c(0)	0.5		min				
c(-1)	0		[min:step:max]				
c(-2)	0		[min:step:max]				
c(-3)	[0]		[min:step:max]				
c(1)	0		[min:step:max]				
N_b	4	UI					
b_max(1)	1		As/dffe1				
b_max(2..N_b)	[1 1 1]		As/dfe2..N_b				
g_DC	0	dB	[min:step:max]				
f_z	12000.58	GHz					
f_p1	20000	GHz					
f_p2	28000	GHz					
g_DC_HP	0		[min:step:max]				
f_HP_PZ	0.001	GHz					

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	0	logical
RESULT_DIR	.\results\100GEL_C2M_host_{date}	
SAVE_FIGURES	0	logical
Port Order	[1 2 3 4]	
RUNTAG	C2M_eval_	
COM_CONTRIBUTION	0	logical
Local Search	2	
Impulse response trun	0.000001	V
COM Pass threshold	3	dB
Operational		
DER_0	0.00001	
T_r	0.0075	ns
FORCE_TR	1	ns
PMD_type	C2C	
BREAD_CRUMBS	0	logical
SAVE_CONFIG2MAT	1	logical
PLOT_CM	0	logical
SAVE_TD	1	logical
Bessel_Thomson	1	
Butterworth	0	

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	[80 95 ; 92.5 92.5]	Ohm
ICN & FOM_ILD parameters		
f_v	0.594	*Fb
f_f	0.594	GHz f_r specified in first column
f_n	0.594	GHz
f_2	40	GHz
A_ft	0.600	V
A_nt	0.600	V
TDR and ERL options		
TDR	1	logical
ERL	0	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	800	
beta_x	0	
rho_x	0.618	
fixture delay time	[0 0.2e-9]	[port1 port2]
TDR_W_TXPKG	0	
N_bx	0	UI
Tukey_Window	1	
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
Noise, jitter		
sigma_RJ	0	UI
A_DD	0	UI
eta_0	0.00E+00	V^2/GHz
SNR_TX	1000	dB
R_LM	1	

COM (v3.16) sheet for Pulse Response Correlation

Which channel to input into COM



Sj= 0
Rj = 0

TP0

Calibration reference point

Adjust A_v & Tr in COM
No CTLE or Noise
Bessel Thomson Filter
No FFE

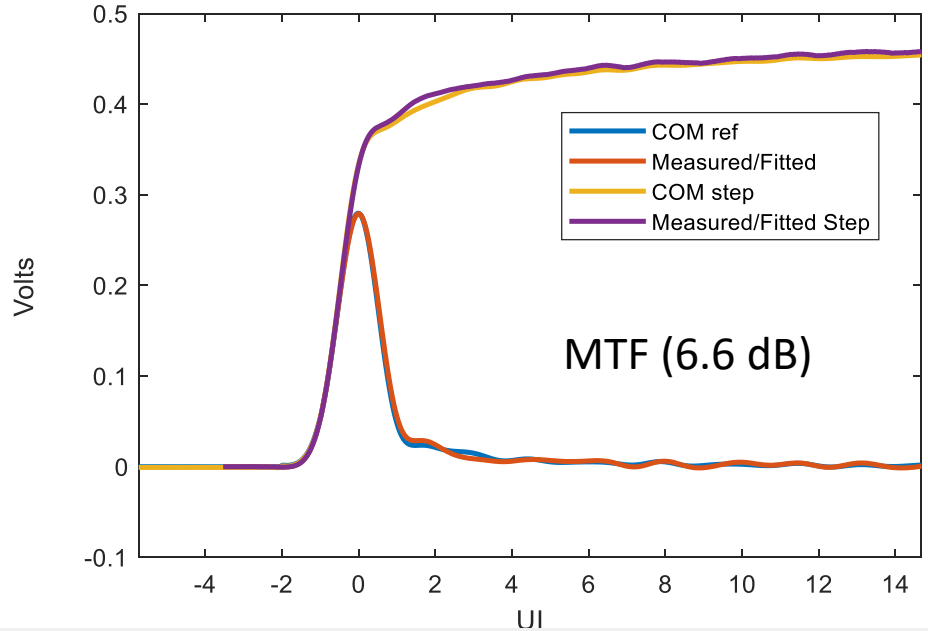
Suggestion was to use A

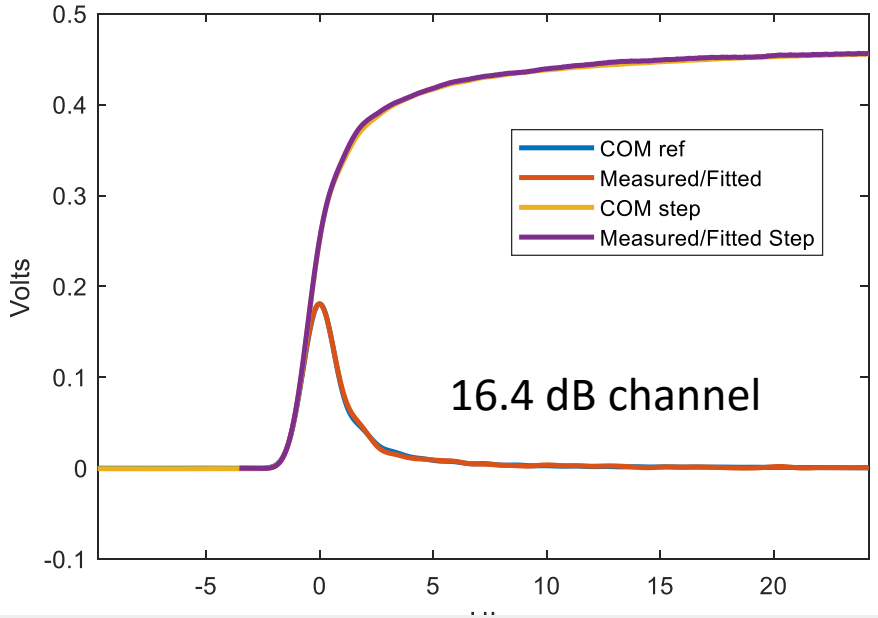
- SNDR, R_{LM}, voltage swing, Tr, and jitter are measured here but missing the real impact of cable and PG reflections

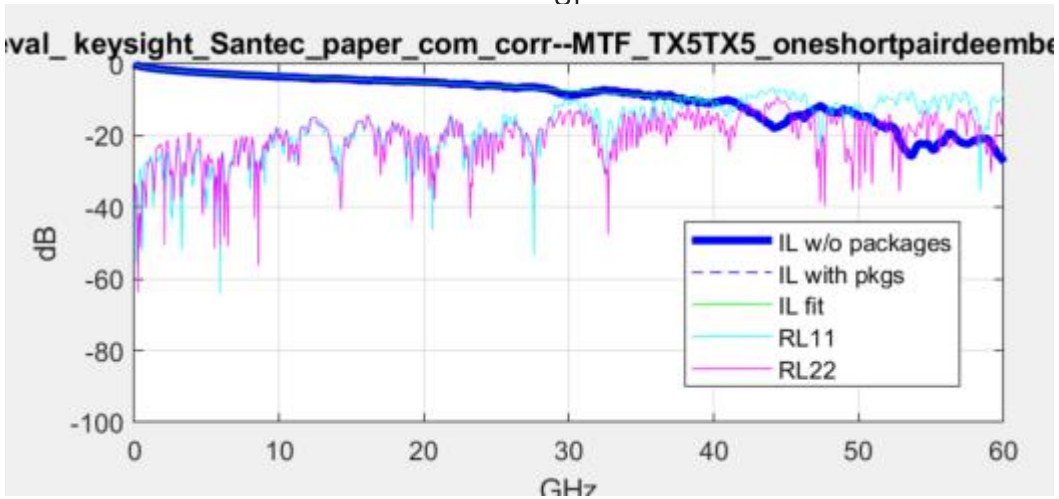
TP1a

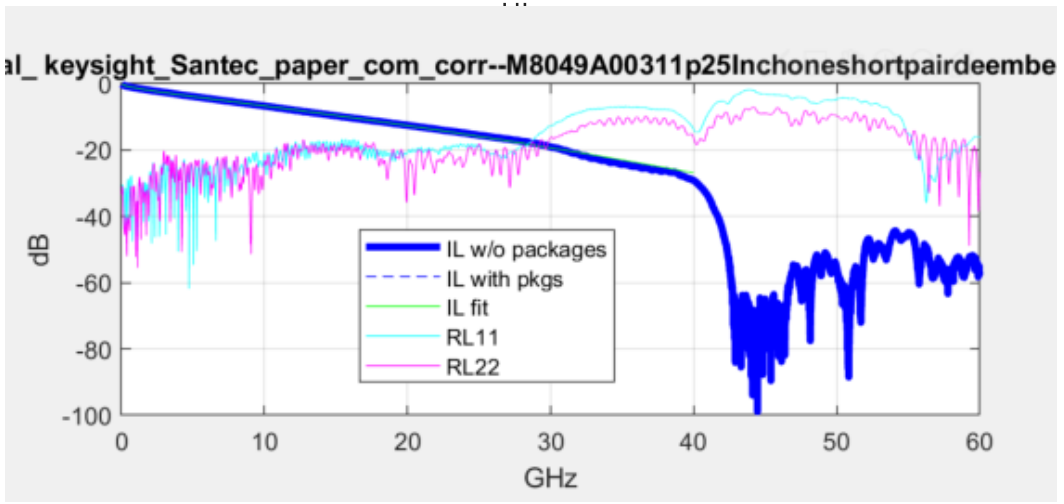
Measure with pulse fitting
Measure with COM

Best match with A_v = .4873 V and Tr=0.0075 ns









COM (v3.16) config for Pattern Generator (BERT)

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 0]	nF	[TX RX]
L_s	[0 0]	nH	[TX RX]
C_b	[0 0]	nF	[TX RX]
z_p select	[1]		[test cases to run]
z_p (TX)	[0 0; 0 0]	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)	[0 0 ; 0 0]	mm	[test cases]
C_p	[0 0]	nF	[TX RX]
R_0	50	Ohm	
R_d	[50 50]	Ohm	[TX RX]
A_v	0.4873	V	
A_fe	0.4873	V	
A_ne	0.608	V	
L	4		
M	32	Samp/UI	
samples_for_C2M	100	Samp/UI	
T_O	50	mUI	
AC_CM_RMS	0	V	[test cases]
filter and Eq			
f_r	0.75	*fb	
c(0)	0.54		min
c(-1)	[-0.2:0.02:0]		[min:step:max]
c(-2)	[0:0.02:0.1]		[min:step:max]
c(-3)	[0]		[min:step:max]
c(1)	[-0.1:0.02:0]		[min:step:max]
N_b	4	UI	
b_max(1)	**0.4**		**As/dffe1**
b_max(2..N_b)	**[0.15 0.15 0.1]**		**As/dfe2..N_b**
b_min(1)	**0.1**		**As/dffe1**
b_min(2..N_b)	**[-0.15 - 0.15 - 0.05]**		**As/dfe2..N_b**
g_DC	[-13:1:-0]	dB	[min:step:max]
f_z	12.58	GHz	
f_p1	20	GHz	
f_p2	28	GHz	
g_DC_HP	[-3:0.5:0]		[min:step:max]
f_HP_PZ	1.328125	GHz	
G_Qual	[-2 -9 ;-2 -12; -4 -12;-6 -13]	dB	ranges
G2_Qual	[0 -1 -2 -3]	dB	ranges

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_C2M_host_{date}	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
RUNTAG	C2M_eval_	
COM_CONTRIBUTION	0	logical
Local Search	2	
Operational		
VEC Pass threshold	12	db
EH_min	10	mV
ERL Pass threshold	7.3	dB
Min_VEO_Test	8	mV
SAVE_TD	1	
DER_0	0.00001	
T_r	0.0075	ns
FORCE_TR	1	5
PMD_type	C2M	
BREAD_CRUMBS	1	logical
SAVE_CONFIG2MAT	1	logical
PLOT_CM	0	logical
Bessel_Thomson	0	logical
Butterworth	1	logical

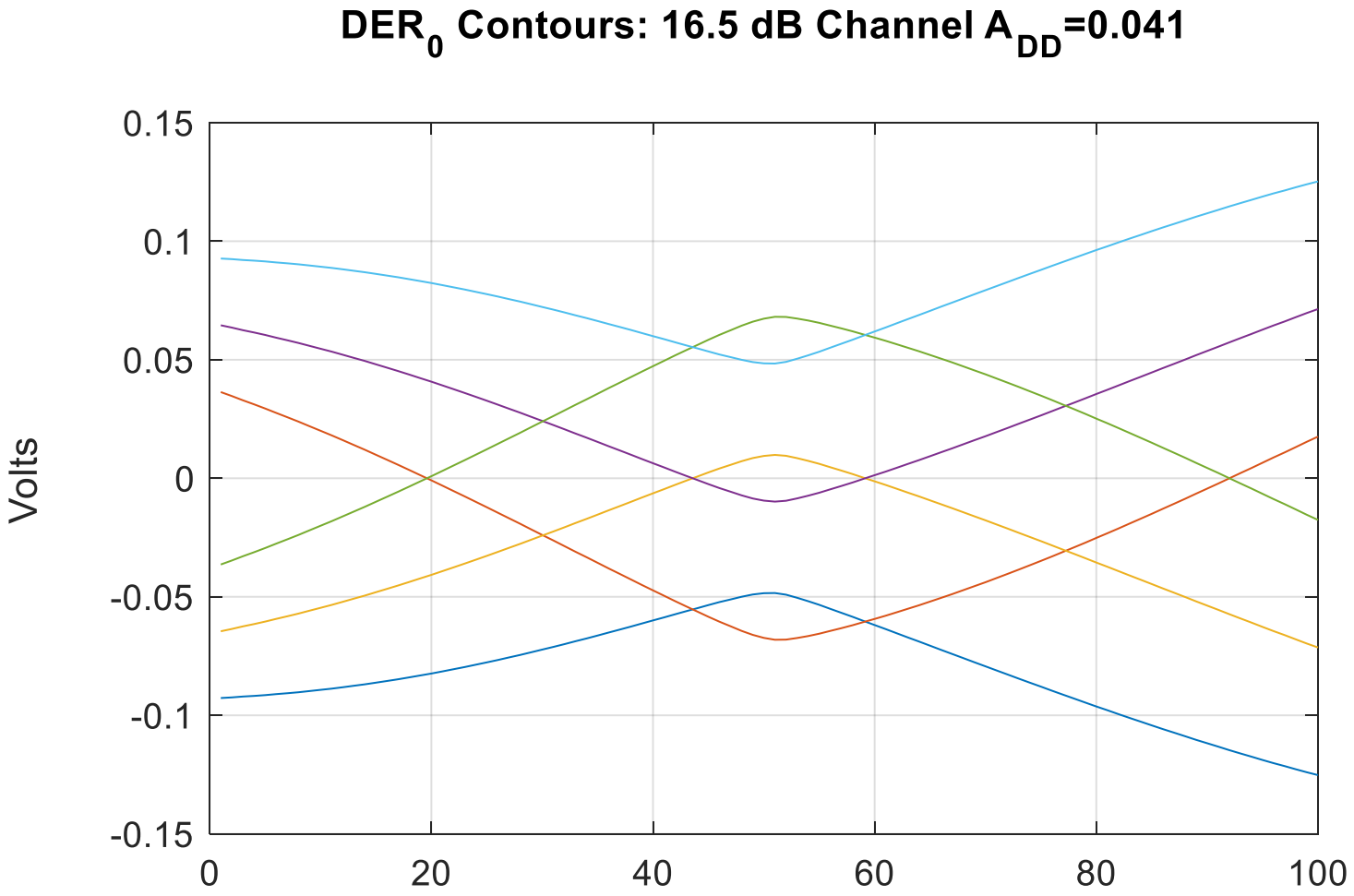
adjustment for measurements

new

upodated for D1.5

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
ICN & FOM_ILD parameters		
f_v	0.594	*Fb
f_f	0.594	GHz f_r specified in first column
f_n	0.594	GHz
f_2	40	GHz
A_ft	0.600	V
A_nt	0.600	V
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	800	
beta_x	0	
rho_x	0.618	
fixture delay time	[0 0.2e-9]	**[port1 port2]**
TDR_W_TXPKG	1	
N_bx	0	UI
Tukey_Window	1	
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
Noise, jitter		
sigma_RJ	0.01	UI
A_DD	0.034	UI
eta_0	4.10E-08	V^2/GHz
SNR_TX	31	dB
R_LM	0.97	

COM V3.1+ does consider “tilted eyes”



3 eye Contour from COM

Results (16.4 dB channel)

	COM EH Add = 0	COM VEC Add=0	Meas. EH Sj=0	Meas. VEC Sj=0	Spec. EH	Spec VEC
16.5 dB Channel	19.7 mV	9.4 VEC	17.3 mV	10.2 dB	10 mV	12 dB

No EOJ included in COM but instrument inherently has 9 mUI of EOJ.

	COM EH Add = 0.034	COM VEC Add=.034	Meas. EH Sj=50mUI	Meas. VEC Sj=50mUI	Spec. EH	Spec VEC
16.5 dB Channel	12.4 mV	13.4 VEC	9 mV	15.7 dB	10 mV	12 dB

VEC measured is 3.7 dB higher than spec!

Increase A_dd to 0.043 in COM.
Then VEC/EH are comparable to measurements

	COM EH Add = 0.043	COM VEC Add=.043	Meas. EH Sj=50mUI	Meas. VEC Sj=50mUI	Spec. EH	Spec VEC
16.5 dB Channel	9.27 mV	15.97 VEC	9 mV	15.7 dB	10 mV	12 dB

So Far

- ❑ COM and measurement pulse response compare fairly well.
  - Measurements have a small amount more of ISI
- ❑ For the 16.4 dB channel without Sj, COM VEC/EH and measurements VEC/EH are somewhat comparable.
  - Measurement device has a small amount of EOJ which is not included in COM
- ❑ For the 16.4 dB channel with Sj, COM VEC/EH and measurements VEC/EH do not compare well

Observations

- ❑ EOJ not included in COM computation
- ❑ Simulation and measurement histogram differ
  - The scope takes all points in the timing window and are not necessarily synchronized to UI sampling.
  - COM and simulation used only points synchronized to UI sampling

Next steps

Discussion

- ❑ Change VEC/EH specification to match measurements?
- ❑ Simulation in COM with Add=0.043?
- ❑ Add a host and module output jitter spec?
  - Refine Sj used for Rx stress test to reflect host output jitter spec
- ❑ Small session interest group to refine?