

112 Gbps BP and COM Investigation

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Agenda

- Proposed 112Gbps BP COM
- Test Channel
- COM Results
- Conclusions and Next Steps

Proposed 112Gbps BP COM

- **Baseline**
 - 802.3cd COM
 - http://www.ieee802.org/3/cd/public/adhoc/archive/me/litz_080217_3cd_01_adhoc.pdf
 - http://www.ieee802.org/3/cd/public/adhoc/archive/me/litz_3cd_0817_COM.zip
- **Change Summary**
 - TX
 - Scale: TX rise/fall time (T_r), jitter (A_{DD} , σ_{RJ})
 - Same: TX EQ (2 pre- + 1 post-cursor taps), RLM, noise (SNR_{TX})
 - RX
 - RX input referred noise (η_{a0}): $8.2e-9 V^2/GHz$
 - Equalization
 - CTLE
 - » Scale f_z , f_{p1} , f_{p2}
 - » F_{HP_PZ} : $0.7 GHz (=f_b / 80)$
- Support long FFE + short DFE architecture
 - **FFE Configuration**
 - 3 pre- and 12-post cursor taps
 - Main cursor: ≥ 0.7
 - Pre-cursor tap 1 coef: ≤ 0.3
 - Post-cursor tap 1 coef.: ≤ 0.3
 - Other taps: ≤ 0.1
 - FFE coef. Step size: 0.01
 - **DFE Configuration**
 - 1 post-cursor tap
 - DFE tap coef. ≤ 0.7
- **Ref package / TX/RX Capacitance and Termination**
 - Length: max 30mm
 - TL: No change
 - Cd: **100fF**
 - Cp: 110fF
 - Rd: 50 Ohms
 - **Note: Minimum changes at this time**
 - Need time to research the package 112G technology
 - Reduced/scaled die capacitance to maintain reasonable return loss performance

Preliminary 112Gbps COM Spreadsheet

Table 93A-1 parameters			
Parameter	Setting	Units	Information
f_b	56	Gbd	
f_min	0.05	GHz	
Delta_f	0.01	GHz	
C_d	[1.0e-4 1.0e-4]	nF	[TX RX]
z_p select	[1]		[test cases to run]
z_p (TX)	[30]	mm	[test cases]
z_p (NEXT)	[30]	mm	[test cases]
z_p (FEXT)	[30]	mm	[test cases]
z_p (RX)	[30]	mm	[test cases]
C_p	[1.1e-4 1.1e-4]	nF	[TX RX]
R_0	50	Ohm	
R_d	[50 50]	Ohm	[TX RX] or selected
f_r	0.75	*fb	
c(0)	0.6		min
c(-1)	[-0.28:0.025:0]		[min:step:max]
c(-2)	[0:0.025:0.1]		[min:step:max]
c(1)	[-0.28:0.025:0]		[min:step:max]
g_DC	[-20:1:0]	dB	[min:step:max]
f_z	22.4	GHz	
f_p1	22.4	GHz	
f_p2	56	GHz	
A_v	0.41	V	tdr selected
A_fe	0.41	V	tdr selected
A_ne	0.6	V	tdr selected
L	4		
M	32		
N_b	1	UI	
b_max(1)	0.7		
b_max(2..N_b)	0.2		
sigma_RJ	0.01	UI	
A_DD	0.02	UI	
eta_0	8.20E-09	V ² /GHz	
SNR_TX	32.5	dB	tdr selected
R_LM	0.95		
DER_0	1.00E-04		
Operational control			
COM Pass threshold	3	dB	
Include PCB	0	Value	0, 1, 2
g_DC_HP	[-6:1:0]		[min:step:max]
f_HP_PZ	0.7	GHz	

I/O control		
DIAGNOSTICS	0	logical
DISPLAY_WINDOW	0	logical
Display frequency domain	0	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\Dip2_(date)\	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
RUNTAG	v165_d1p0a	
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
IDEAL_TX_TERM	0	logical
T_r	0.006160714	ns
FORCE_TR	1	logical

Non standard control options		
COM CONTRIBUTION	0	logical
TDR	0	logical
ERL	0	logical
Z_t	50	ohms
ERL_ONLY	0	logical
TR_TDR	0.0189	ns
TDR_duration	5	
TDR_f_BT_3db	42	GHz
TDR_Butterworth	1	logical

RX FFE		
ffe_enable	1	logical
ffe_pre_tap_len	3	
ffe_post_tap_len	12	
ffe_tap_step_size	0.01	
ffe_main_cursor_min	0.7	
ffe_pre_tap1_max	0.3	
ffe_post_tap1_max	0.3	
ffe_tapn_max	0.1	

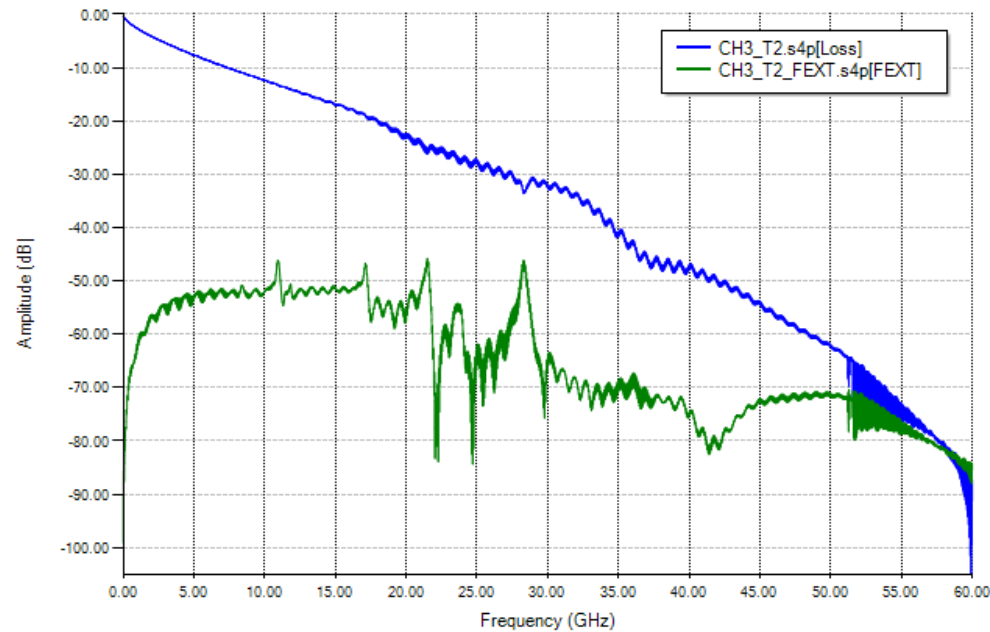
Table 93A-3 parameters		
Parameter	Setting	Units
package_tl_gamma0_a1_a2	[0 1.734e-3 1.455e-4]	
package_tl_tau	6.141E-03	ns/mm
package_Z_c	90	Ohm (tdr sel)

Table 92-12 parameters		
Parameter	Setting	Units
board_tl_gamma0_a1_a2	[0 4.114e-4 2.547e-4]	
board_tl_tau	6.191E-03	ns/mm
board_Z_c	110	Ohm
z_bp (TX)	151	mm
z_bp (NEXT)	72	mm
z_bp (FEXT)	72	mm
z_bp (RX)	151	mm

Red: New or modified entries

Test Channel

Channel Viewer: [1] FR: Sdd21



Channel	IL (dB)	ILD (dB)	RL (dB)	ICR (dB)	ICN* (mV-rms)	Notes
Test	31	-2/2	-7	10	0.91	

*Note: *: ICN is calculated using CEI 3.0 methodology. NRZ modulation scheme is assumed.*

Test Channel COM Results

Channel	FFE=16, DFE=1	FFE=20,DFE=1
Test	4.21	4.32

- Extra 4 FFE tap (16 tap to 20 tap) has small COM gain (0.11 dB) for this test channel.

Summary and Conclusions

- **Progresses so far**
 - Added RX FFE support and FFE/DFE co-adaptation in COM
 - Updated some COM parameters
- **Simulation Observations**
 - 31 dB (at 28 GHz) test channel has 4.21 dB COM with the updated COM
 - TX EQ: 4-tap FIR, 2-pre, 1-post
 - RX EQ: CTLE+16 tap FFE (3-pre, 12 post), and 1 tap DFE
- **Future works**
 - Investigate 112G package technology and update COM
 - Test new COM with more channels and further improve it

Thank You!