



100 Gbps Copper Cable Measurement and S-Parameter File

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Supporters



Agenda

- Review of prior presentations and data
- Presentation of measured 2m, 26 AWG OSFP cable assembly data
- S-Parameter file review
- Conclusions



Measured Cable Assembly Analysis, & Simulations: Work Done To Date

TE has presented cable assembly simulation and measured data previously as our development results have progressed

- tracy_100GEL_01a_0318, recommends 30dB loss budget
- tracy_3ck_02a_1118, suggests there is going to be an issue with the 28dB 2m goal
- February 27, 2019 P802.3ck ad hoc, provided simulation and measured results for a number of cables and configurations, projecting a 19.4 to 20.4 dB loss range of loss for 2m cable assemblies
- tracy_3ck_01a_0319, March 2019, presented some of the Feb 27, 2019 data and contributed two new cable assembly channel S-Parameter simulations for a 1.5m 28AWG cable assembly and a 2m 28AWG cable assembly for working group analysis

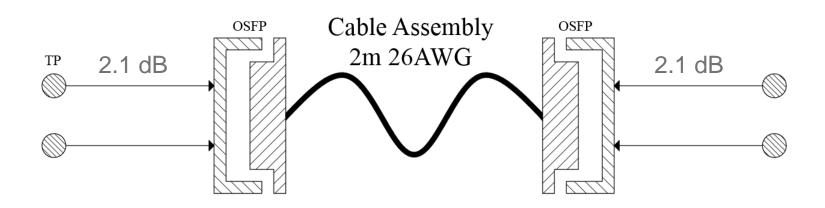


New Work Being Shared

- 2m, 26 AWG OSFP cable assemblies have been built
- Tested with prototype OSFP MCBs and connectors
- MCB trace loss is slightly below draft specification and is approx. 2.1 dB instead of the draft spec. 2.3 dB
 - Slide 7 shows per channel loss limit adjusted by 0.4 dB to 19.6 dB (vs. proposed 20dB) due to MCB loss being low (2 x 0.2 dB)
 - All S-Parameter data is raw measurement and is not adjusted
- S-Parameter files have been contributed as tracy_3ck_02_0719

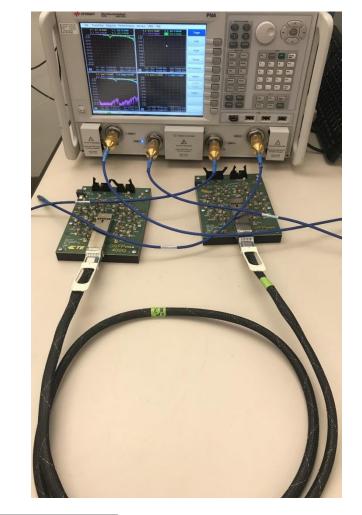


2m, 26AWG OSFP Cable: TP1-TP4 Test Data



- Data taken from TP1 to TP4
- 10 MHz to 50 GHz
- All Thru files and all XT collected





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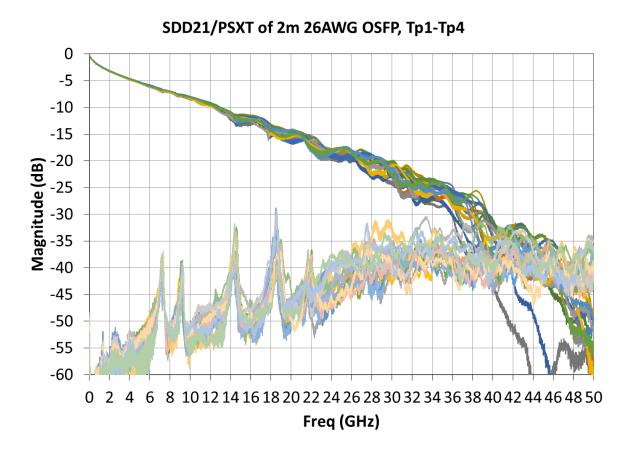
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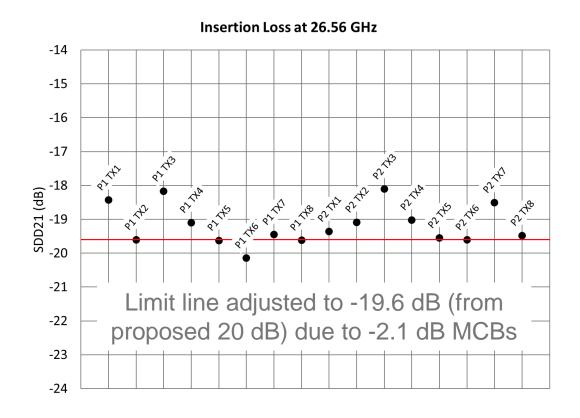
60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31
G	Tx1+	Tx1-	G	Tx3+	Tx3-	G	Tx5+	Tx5-	G	Tx7+	Tx7-	G	SB	SB	SB	SB	G	Rx8-	Rx8+	G	Rx6-	Rx6+	G	Rx4-	Rx4+	G	Rx2-	Rx2+	G
G	Tx2+	Tx2-	G	Tx4+	Tx4-	G	Tx6+	Тх6-	G	Tx8+	Tx8-	G	SB	SB	SB	SB	G	Rx7-	Rxy+	G	Rx5-	Rx5+	G	Rx3-	Rx3+	G	Rx1-	Rx1+	G
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



2m, 26AWG OSFP Cable: TP1-TP4 Test Data

- Test data taken using 2.1dB MCBs (Chart on bottom right compensated for this by adjusting limit line by 0.4 dB)
- PSXT includes all aggressors (7 FEXT & 8 NEXT)
- Resonances in crosstalk are from receptacle connector (improvements in development)







IL, COM, ERL

Longer host

Used COM 2.70 script Config file shown later

- Cd = 120 fF
- Ls = 120 pH
- Cb = 30 fF
- 16 fixed taps with 2 banks of 4 up to 80 UI

PCB Length = 102.7 mm*

* Improvements expected
with less PCB trace

Case 1

- $z_p(Tx) = 12mm$
- $z_p(Rx) = 12mm$

Case 2

- $z_p(Tx) = 31mm$
- $z_p(Rx) = 29mm$

	IL at 26.56 GHz	COM Case 1	COM Case 2	ERL 11	ERL 22
P1_Tx1	-18.432	4.408	3.363	10.084	9.824
P1_Tx2	-19.602	3.688	2.569	9.040	9.846
P1_Tx3	-18.171	4.731	3.768	10.586	11.172
P1_Tx4	-19.097	4.524	3.453	8.610	9.889
P1_Tx5	-19.622	3.795	2.890	10.955	10.701
P1_Tx6	-20.143	4.237	3.086	9.556	10.383
P1_Tx7	-19.452	3.904	2.938	10.437	8.804
P1_Tx8	-19.619	3.890	2.902	9.314	10.089
P2_Tx1	-19.359	4.867	3.728	10.867	10.949
P2_Tx2	-19.086	4.510	3.440	10.153	10.478
P2_Tx3	-18.107	4.852	3.863	10.533	11.116
P2_Tx4	-19.017	4.408	3.440	9.562	10.100
P2_Tx5	-19.548	3.688	2.865	10.612	9.458
P2_Tx6	-19.607	3.999	3.086	10.604	11.060
P2_Tx7	-18.508	3.768	2.938	10.449	9.696
P2_Tx8	-19.479	3.836	2.950	9.854	10.117





IL, COM, ERL

Shorter host

Used COM 2.70 script Config file shown later

- Cd = 120 fF
- Ls = 120 pH
- Cb = 30 fF
- 16 fixed taps with 2 banks of 4 up to 80 UI

PCB Length = 92.7 mm

Case 1

- $z_p(Tx) = 12mm$
- $z_p(Rx) = 12mm$

Case 2

- $z_p(Tx) = 31mm$
- $z_p(Rx) = 29mm$

	IL at 26.56 GHz	COM Case 1	COM Case 2	ERL 11	ERL 22
P1_Tx1	-18.432	4.657	3.596	10.084	9.824
P1_Tx2	-19.602	3.782	2.902	9.040	9.846
P1_Tx3	-18.171	4.928	4.041	10.586	11.172
P1_Tx4	-19.097	4.702	3.755	8.610	9.889
P1_Tx5	-19.622	3.972	3.248	10.955	10.701
P1_Tx6	-20.143	4.365	3.375	9.556	10.383
P1_Tx7	-19.452	3.986	3.299	10.437	8.804
P1_Tx8	-19.619	4.096	3.160	9.314	10.089
P2_Tx1	-19.359	5.130	4.082	10.867	10.949
P2_Tx2	-19.086	4.792	3.702	10.153	10.478
P2_Tx3	-18.107	5.067	4.027	10.533	11.116
P2_Tx4	-19.017	4.642	3.755	9.562	10.100
P2_Tx5	-19.548	3.958	3.110	10.612	9.458
P2_Tx6	-19.607	4.110	3.236	10.604	11.060
P2_Tx7	-18.508	3.849	3.198	10.449	9.696
P2_Tx8	-19.479	3.945	3.160	9.854	10.117



COM Settings

	Table 93A-1 paramet	ters			control			Table 93A–3 parame	ters
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	0	logical	package_tl_tau	6.141E-03	ns/mm
Delta_f	0.01	GHz		RESULT_DIR	.\results\100GEL	_KR_{date}\	package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm
C_d	[1.2e-4 1.2e-4]	nF	[TX RX]	SAVE_FIGURES	1	logical			
L_s	[0.12, 0.12]	nH	[TX RX]	Port Order	[1 3 2 4]		1	able 92–12 parameters 5.2dB	3 at 26.56GHz
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]	RUNTAG	KR_eval_		Parameter	Setting	
z_p select	[12]		[test cases to run]	COM_CONTRIBUTION	0	logical	board_tl_gamma0_a1_a2	[0 0.000599 0.0001022]	1.286 dB/in or 0.0506 dB/mm at 100 ohms
z_p (TX)	[12 31; 1.8 1.8]	mm	[test cases]	Оре	erational		board_tl_tau	6.200E-03	ns/mm
z_p (NEXT)	[12 29; 1.8 1.8]	mm	[test cases]	COM Pass threshold	3	dB	board_Z_c	90	Ohm
z_p (FEXT)	[12 31; 1.8 1.8]	mm	[test cases]	ERL Pass threshold	10	dB	z_bp (TX)	102.7	mm
z_p (RX)	[12 29; 1.8 1.8]	mm	[test cases]	DER_0	1.00E-04		z_bp (NEXT)	102.7	mm
С_р	[0.87e-4 0.87e-4]	nF	[TX RX]	T_r	6.16E-03	ns	z_bp (FEXT)	102.7	mm
R_0	50	Ohm		FORCE_TR	1	logical	z_bp (RX)	102.7	mm
R_d	[45 45]	Ohm	[TX RX]	Include PCB	1	logical			
A_v	0.39	V	vp/vf=.694	TDR and	d ERL options				
A_fe	0.39	V	vp/vf=.694	TDR	1	logical		Floating Tap Contr	
A_ne	0.578	V		ERL	1	logical	N_bg	2	0 1 2 or 3 groups
L	4			ERL_ONLY	0	logical	N_bf	4	taps per group
M	32			TR_TDR	0.01	ns	N_f	80	UI span for floating taps
	filter and Eq			N	3000		bmaxg	0.1	max DFE value for floating taps
f_r	0.75	*fb		beta_x	2.53E+09				
c(0)	0.5		min	rho_x	0.25				
c(-1)	[-0.3:0.02:0]		[min:step:max]	fixture delay time	0	s			
c(-2)	[0:0.02:0.12]		[min:step:max]	TDR_W_TXPKG	0				
c(-3)	[-0.06:0.02: 0]		[min:step:max]	N_bx	24	UI	yellow indicates WIP		
c(1)	[-0.2:0.05:0]		[min:step:max]	Recei	ver testing				
N_b	16	UI		RX_CALIBRATION	0	logical			
b_max(1)	0.85			Sigma BBN step	5.00E-03	V			
b_max(2N_b)	0.3			Noi	se, jitter				
g_DC	[-20:1:0]	dB	[min:step:max]	sigma_RJ	0.01	UI			
f_z	21.25	GHz		A_DD	0.02	UI			
f_p1	21.25	GHz		eta_0	8.20E-09	V^2/GHz			
f_p2	53.125	GHz		SNR_TX	33	dB			
g_DC_HP	[-6:1:0]		[min:step:max]	R_LM	0.95				
f_HP_PZ	0.6640625	GHz							

Comments on *tracy_3ck_02_0719* S-Parameter File

S4P files

Data is TP1 to TP4

10MHz to 50 GHz

All thru files and all cross talk included

Included "Read Me" file provides port identification guidance

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
G	Tx1+	Tx1-	G	Tx3+	Tx3-	G	Tx5+	Tx5-	G	Tx7+	Tx7-	G	SB	SB	SB	SB	G	Rx8-	Rx8+	G	Rx6-	Rx6+	G	Rx4-	Rx4+	G	Rx2-	Rx2+	G
G	Tx2+	Tx2-	G	Tx4+	Tx4-	G	Tx6+	Тх6-	G	Tx8+	Tx8-	G	SB	SB	SB	SB	G	Rx7-	Rxy+	G	Rx5-	Rx5+	G	Rx3-	Rx3+	G	Rx1-	Rx1+	G
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Summary

2m, 26 AWG, TP1 to TP4 OSFP cable assembly measured results have been presented and contributed

Based on multiple cables built, we believe this demonstrates performance that is consistent with the inclusion of manufacturing variations

Supports 20dB loss proposal for TP1 to TP4 cable assembly

Requires 29dB for end to end link, TP0 to TP5, to enable the 20dB cable assembly channel

Further performance improvements will be required, but we have time

S-Parameter files included for working group analysis

Recommendation: use this contributed file to get COM configuration narrowed down

