

# Updated TP1-TP4 QSFP-DD 2m Reach Channel



Tom Palkert, Alex Haser, Scott Sommers  
[tpalkert1@gmail.com](mailto:tpalkert1@gmail.com)

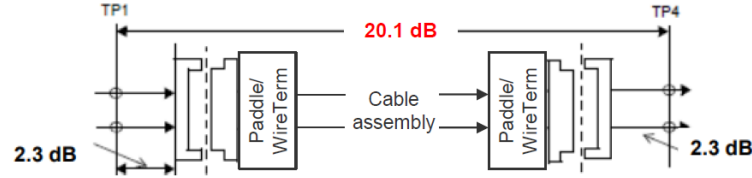
**molex**<sup>®</sup>  
one company ▶ a world of innovation

# Overview:

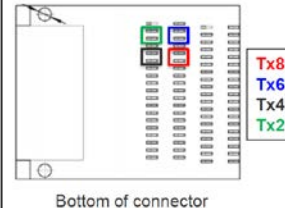
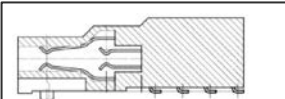
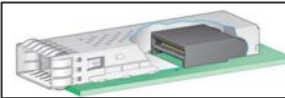
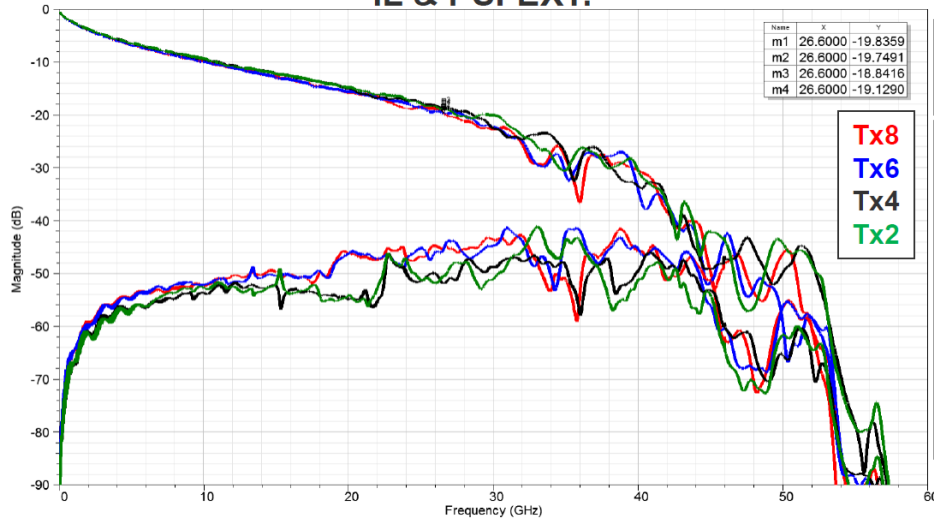
- Previously provided data on QSFP-DD:
  - Brief review of QSFP-DD contributions
- For the updated model (see subsequent slides):
  - Nominal bulk cable model was replaced with an improved model
  - This bulk cable model includes manufacturing variation
  - This s-parameter has been made available for public use
- TP0-TP5 Loss Budget

# From haser\_3ck\_adhoc\_01\_021219: Partial 2m QSFP-DD TP1-TP4 Channel

## 2m QSFP-DD Cable: TP1 to TP4



### IL & PSFEXT:



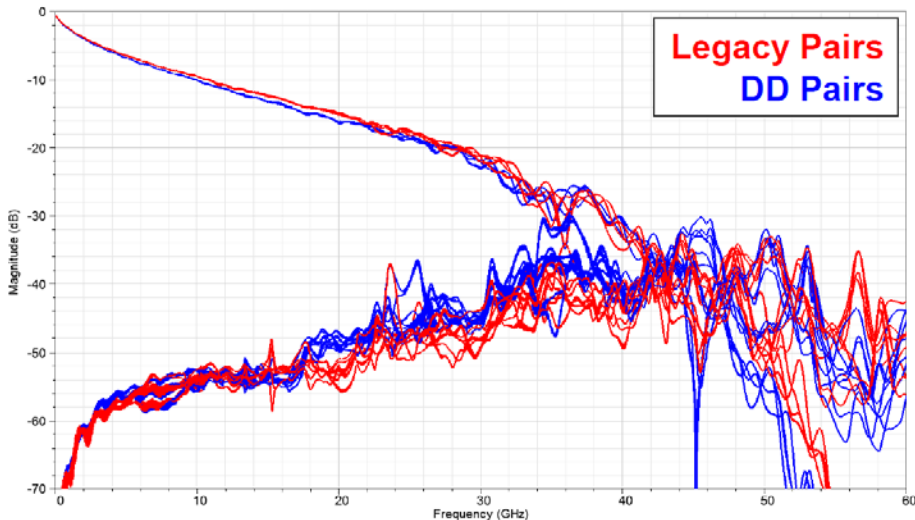
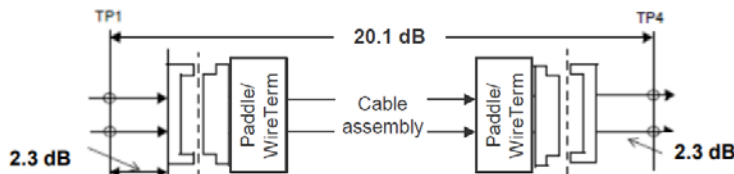
**molex**

- Max loss from simulation: 19.84 dB (only includes 2 bottom rows of connector)
- Proposed TP1-TP4 budget: 20.1 dB
- PSXT curves include contributions from 3 FEXT aggressors & 0 NEXT aggressors

**molex**

# From palkert\_3ck\_01\_0319: Full 2m QSFP-DD TP1-TP4 Channel

## 2m QSFP-DD Cable: TP1 to TP4



- Legacy pairs:
  - Minimum loss: 18.72 dB
  - Maximum loss: 19.32 dB
- DD pairs:
  - Minimum loss: 19.54 dB
  - Maximum loss: 20.47 dB

- Max loss from simulation: 20.47 dB
- Proposed TP1-TP4 budget: 20.1 dB
- PSXT curves include contributions from 7 FEXT aggressors & 8 NEXT aggressors
- Worst case COM (Version 2.58)\*: 3.531 dB

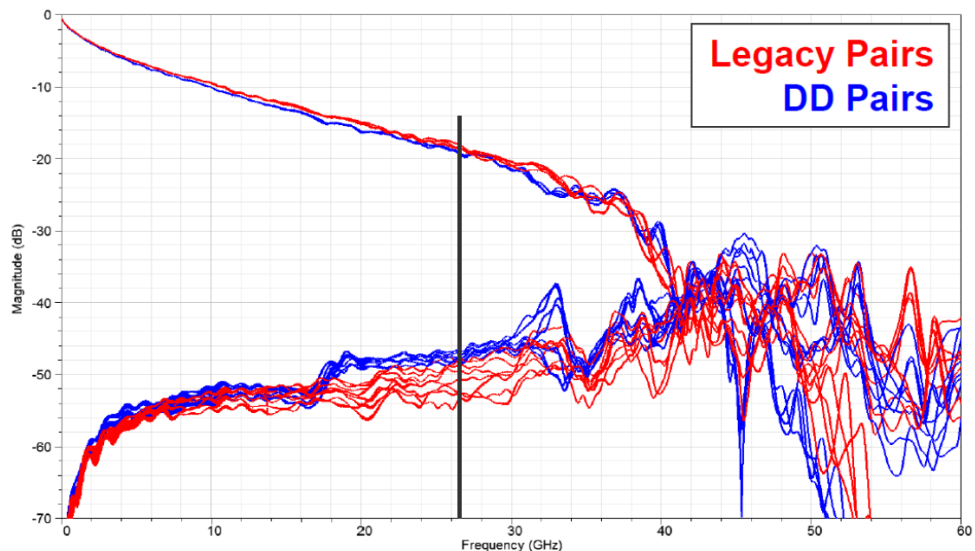
**molex**

\*config\_com\_ieee8023\_93a=100GEL-CR\_030119.xls

**molex**

# From palkert\_3ck\_01\_0519: Updated 2m QSFP-DD TP1-TP4 Channel

## 2m QSFP-DD Cable: TP1 to TP4 Simulated IL & PSXT



- Max loss from simulation: 19.5 dB
- Proposed TP1-TP4 budget: 20 dB
- Improved wire termination model
- PSXT curves include contributions from 7 FEXT aggressors & 8 NEXT aggressors
- Worst case COM (Version 2.58)\*: 3.728 dB

7

\*config\_com\_ieee8023\_93a=100GEL-CR\_030119.xls

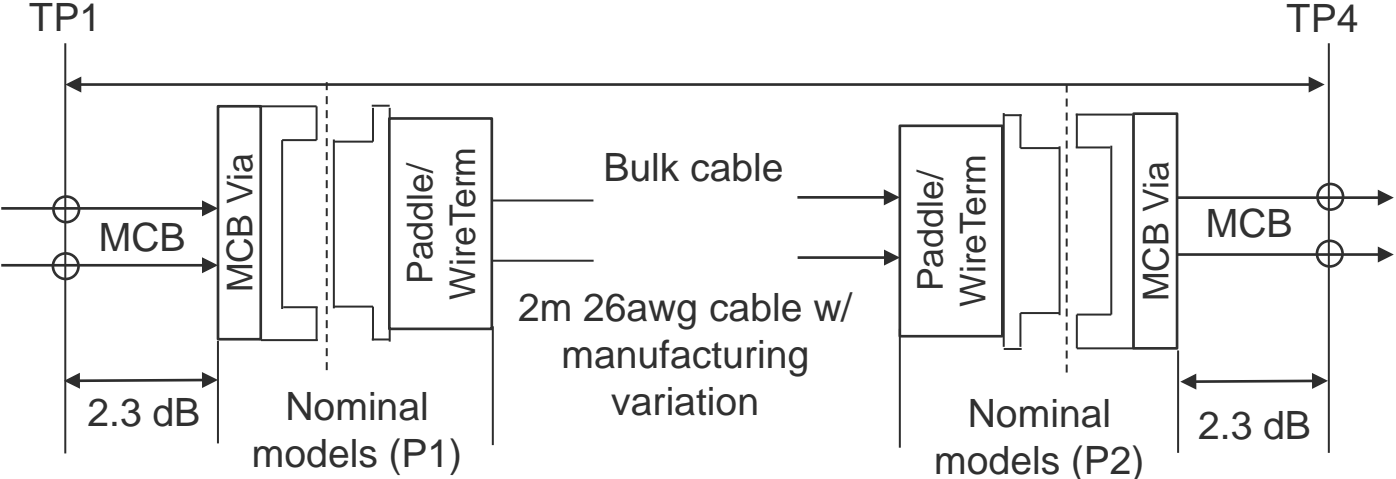


# S-Parameter Model

# Model Information:

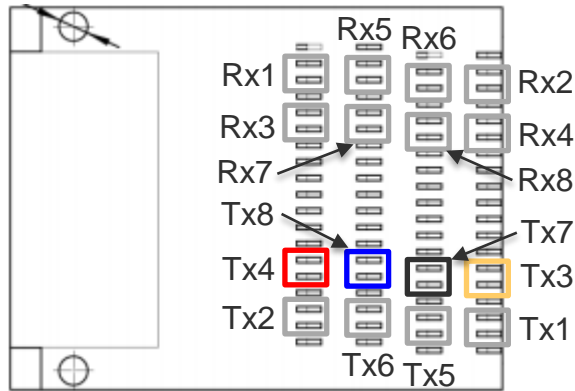
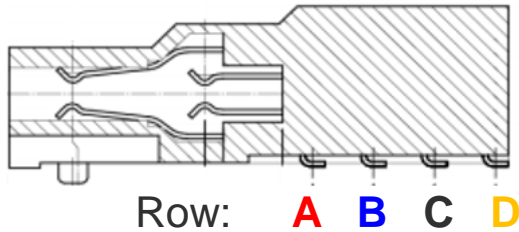
- This model captures:
  - Manufacturing variation in bulk cable
  - Connector and wire termination models are nominal
- Frequency content:
  - 50 MHz-60 GHz
  - 10 MHz steps
- See next slides for topology

# Topology:





# Files Provided:

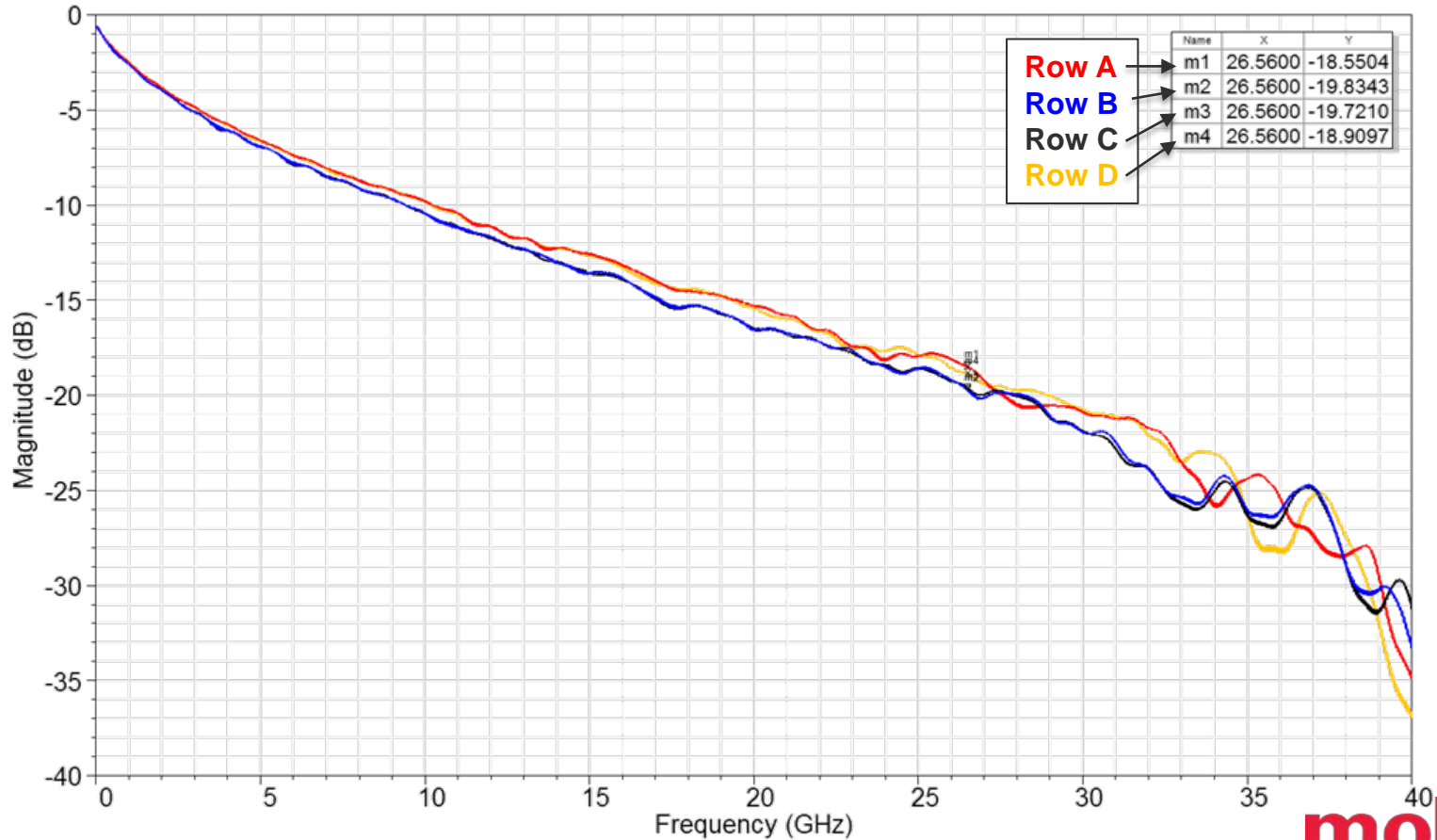


Bottom of P1 connector

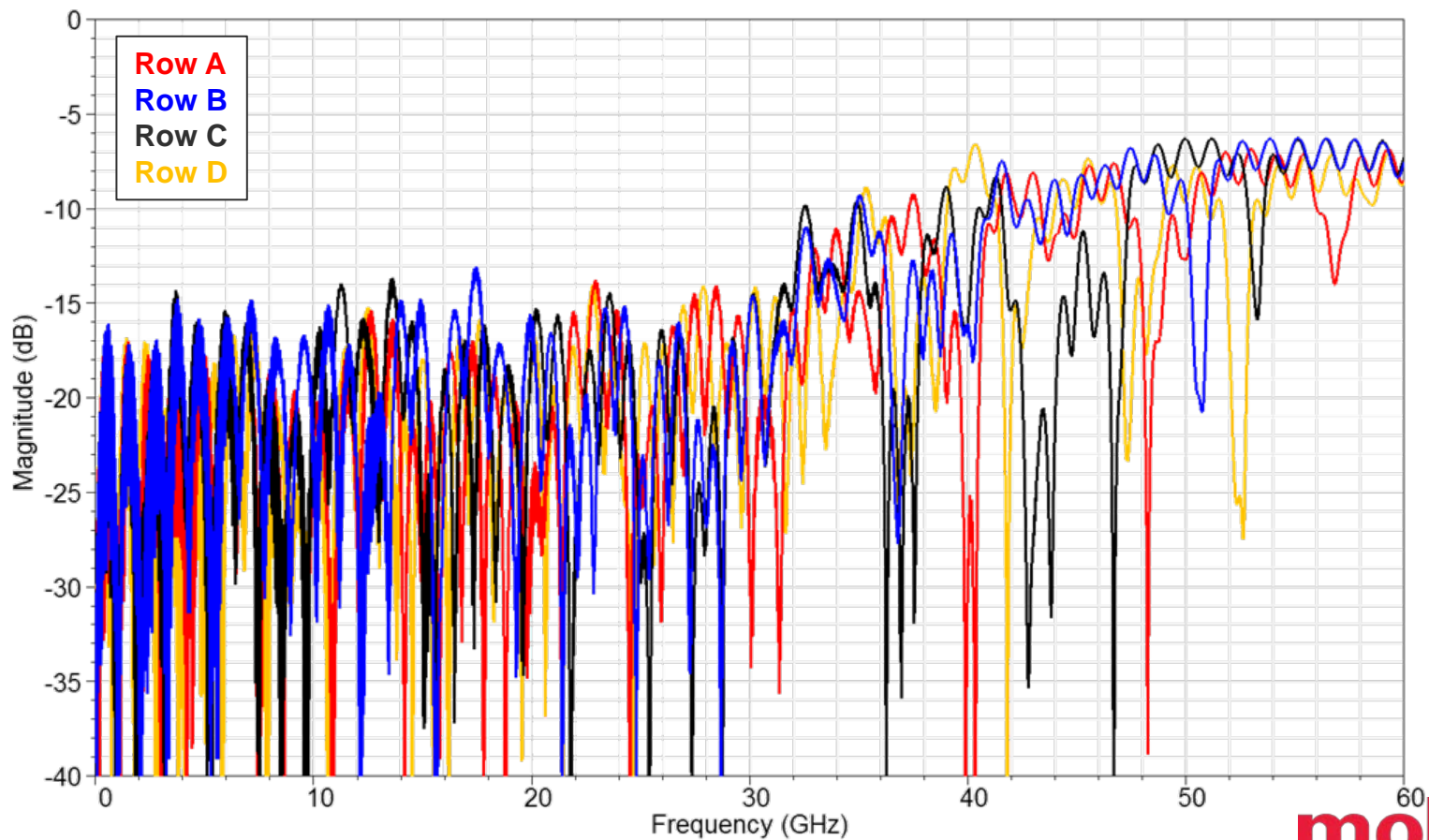
- For each row:
  - One THRU victim pair s4p
  - 7 FEXT s4ps
  - 8 NEXT s4ps
  - 16 files per row
- 64 total files provided

Note: Cables crossover from P1 connector to P2 connector (e.g. Tx4 P1 connects to Rx4 P2)

# IL:

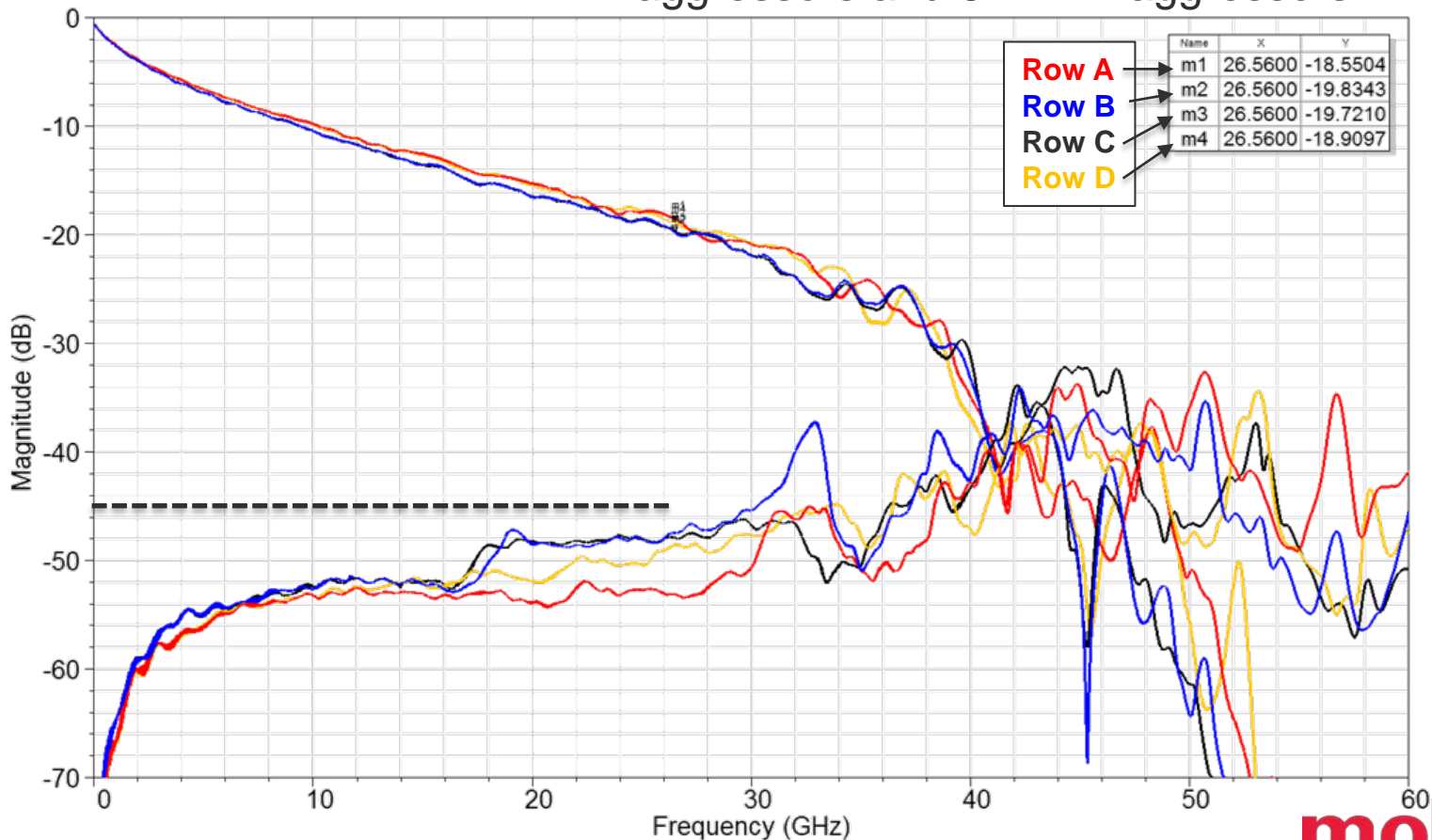


# RL:



# IL & PSXT:

Each PSXT curve contains contributions from 7 FEXT aggressors and 8 NEXT aggressors



# Row B COM Results:

- Ran on Row B data (most lossy pair)

COM Version	IL (dB)	ERL11	ERL22	FOM <sub>ILD</sub>	ICN (mV)	ICN <sub>NEXT</sub> (mV)	ICN <sub>FEXT</sub> (mV)	COM (dB)
2.6	29.280	11.781	12.020	0.724	0.583	0.313	0.492	3.622
2.6 (see Note)	28.977	11.781	12.020	0.721	0.598	0.325	0.502	3.675

COM 2.60 config: config\_com\_ieee8023\_93a=100GEL-CR\_030119

NOTE: PCB length changed from 92.7mm to 90 mm (to hit 29 dB IL)

(See back up slides for config sheets)

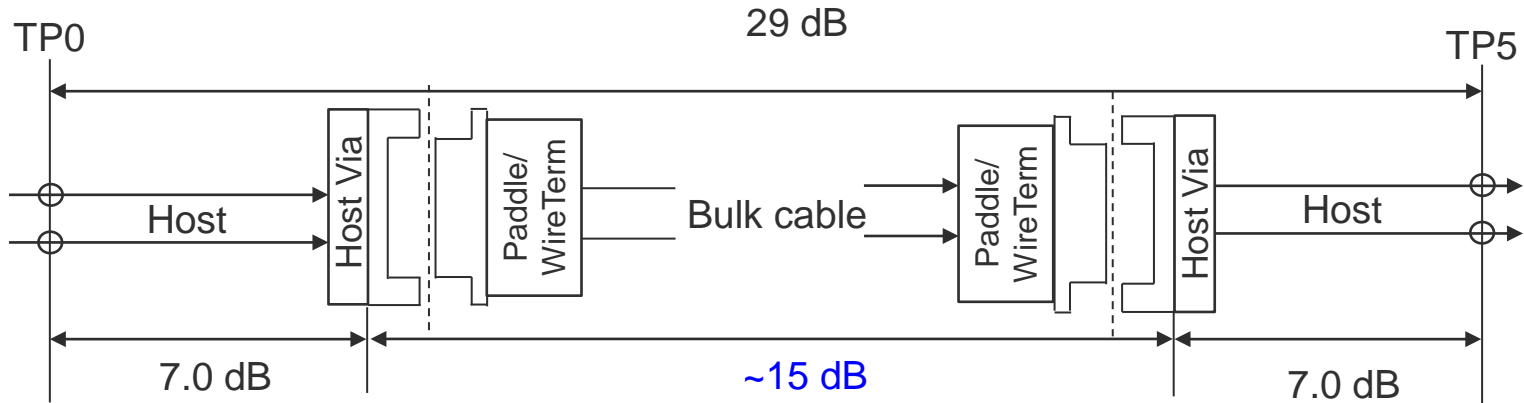
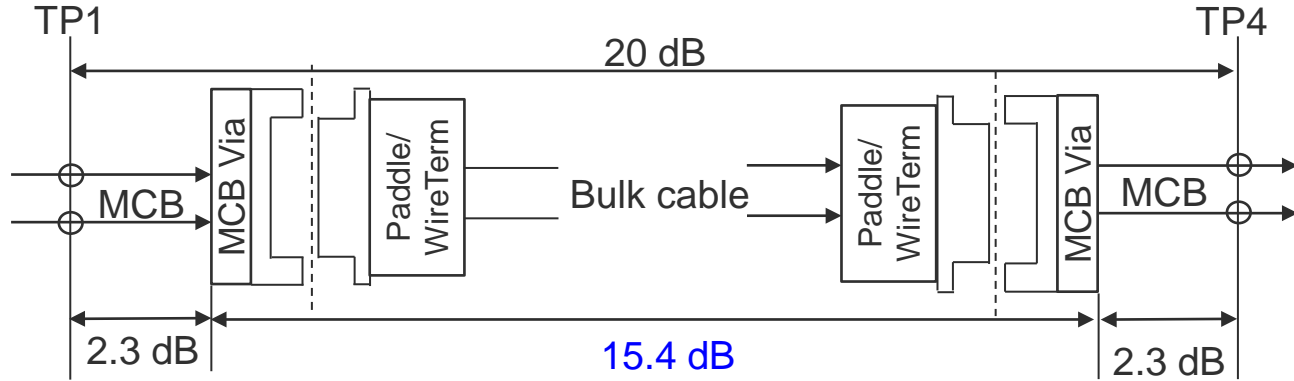
# Summary:

- Previously supplied nominal data on QSFP-DD estimated TP1-TP4 loss to be 19.84 dB
- Bulk cable design was improved and expected manufacturing variation was added to it  
→ Maximum TP1-TP4 channel loss is 19.83 dB
- **20 dB is needed for the TP1-TP4 budget to realistically support 2m reach objective**
- **29dB is needed to support the 20 dB TP1-TP4 budget**



TP0-TP5 Budget:

# Loss Budget:







Back Up

**molex**

# Original:

Table 93A-1 parameters				I/O control		
Parameter	Setting	Units	Information	DIAGNOSTICS		logical
f_b	53.125	GBd		DISPLAY_WINDOW	0	logical
f_min	0.05	GHz		CSV_REPORT	1	logical
Delta_f	0.01	GHz		RESULT_DIR	results\100GEL_WG_{date}	
C_d	[1.1e-4 1.1e-4]	nF	[TX RX]	SAVE_FIGURES	1	logical
z_p select	[2]		[test cases to run]	Port Order	[1 3 2 4]	
z_p (TX)	[12 32; 1.8 1.8]	mm	[test cases]	RUNTAG	CR_eval_	
z_p (NEXT)	[12 32; 1.8 1.8]	mm	[test cases]	COM_CONTRIBUTION	0	logical
z_p (FEXT)	[12 32; 1.8 1.8]	mm	[test cases]	Operational		
z_p (RX)	[12 32; 1.8 1.8]	mm	[test cases]	COM Pass threshold	3	dB
C_p	[0.87e-4 0.87e-4]	nF	[TX RX]	ERL Pass threshold	10.5	dB
R_0	50	Ohm		DER_0	1.00E-04	
R_d	[ 50 50]	Ohm	[TX RX]	T_r	6.16E-03	ns
A_v	0.413	V	vp/vf=.694	FORCE_TR	1	logical
A_fe	0.413	V	vp/vf=.694	Include PCB	1	logical
A_ne	0.608	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)	0.54		min	N	1000	
c(-1)	[-0.34:0.02:0]		[min:step:max]	TDR_Butterworth	1	logical
c(-2)	[0:0.02:0.12]		[min:step:max]	beta_x	1.70E+09	
c(-3)	[-0.06:0.02:0]		[min:step:max]	rho_x	0.25	
c(1)	[-0.1:0.05:0]		[min:step:max]	fixture delay time	0	enter sec
N_b	24	UI		Receiver testing		
b_max(1)	0.85			RX_CALIBRATION	0	logical
b_max(2..N_b)	0.3			Sigma BBN step	5.00E-03	V
g_DC	[-20:1:0]	dB	[min:step:max]	Noise, jitter		
f_z	21.25	GHz		sigma_RJ	0.01	UI
f_p1	21.25	GHz		A_DD	0.02	UI
f_p2	53.125	GHz		eta_0	8.20E-09	V^2/GHz
g_DC_HP	[-6:1:0]		[min:step:max]	SNR_TX	33	dB
f_HP_PZ	0.6640625	GHz		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
Table 92-12 parameters		
Parameter	Setting	
board_tl_gamma0_a1_a2	[0 0.000599 0.0001022]	
board_tl_tau	6.200E-03	ns/mm
board_Z_c	90	Ohm
z_bp (TX)	92.7	mm
z_bp (NEXT)	92.7	mm
z_bp (FEXT)	92.7	mm
z_bp (RX)	92.7	mm

# Modified:

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	[1.1e-4 1.1e-4]	nF	[TX RX]
z_p select	[ 2]		[test cases to run]
z_p (TX)	[12 32; 1.8 1.8]	mm	[test cases]
z_p (NEXT)	[12 32; 1.8 1.8]	mm	[test cases]
z_p (FEXT)	[12 32; 1.8 1.8]	mm	[test cases]
z_p (RX)	[12 32; 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	0.413	V	vp/vf=.694
A_fe	0.413	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)	[-0.1:0.05:0]		[min:step:max]
N_b	24	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	0	logical
DISPLAY_WINDOW	0	logical
CSV_REPORT	1	logical
RESULT_DIR	results\100GEL_WG_{date}\	
SAVE_FIGURES	1	logical
Port Order	[1 3 2 4]	
RUNTAG	CR_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
Include PCB	1	logical
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	1000	
TDR_Butterworth	1	logical
beta_x	1.70E+09	
rho_x	0.25	
fixture delay time	0	enter sec
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	8.20E-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
Table 92-12 parameters		
Parameter	Setting	
board_tl_gamma0_a1_a2	[0 0.000599 0.0001022]	
board_tl_tau	6.200E-03	ns/mm
board_Z_c	90	Ohm
z_bp (TX)	90	mm
z_bp (NEXT)	90	mm
z_bp (FEXT)	90	mm
z_bp (RX)	90	mm