

# **Synthesized 2 m QSFP-DD CR Channels: End to End IL 28.5 dB and Cable Assembly and IL 19.75 dB**

Richard Mellitz, Samtec

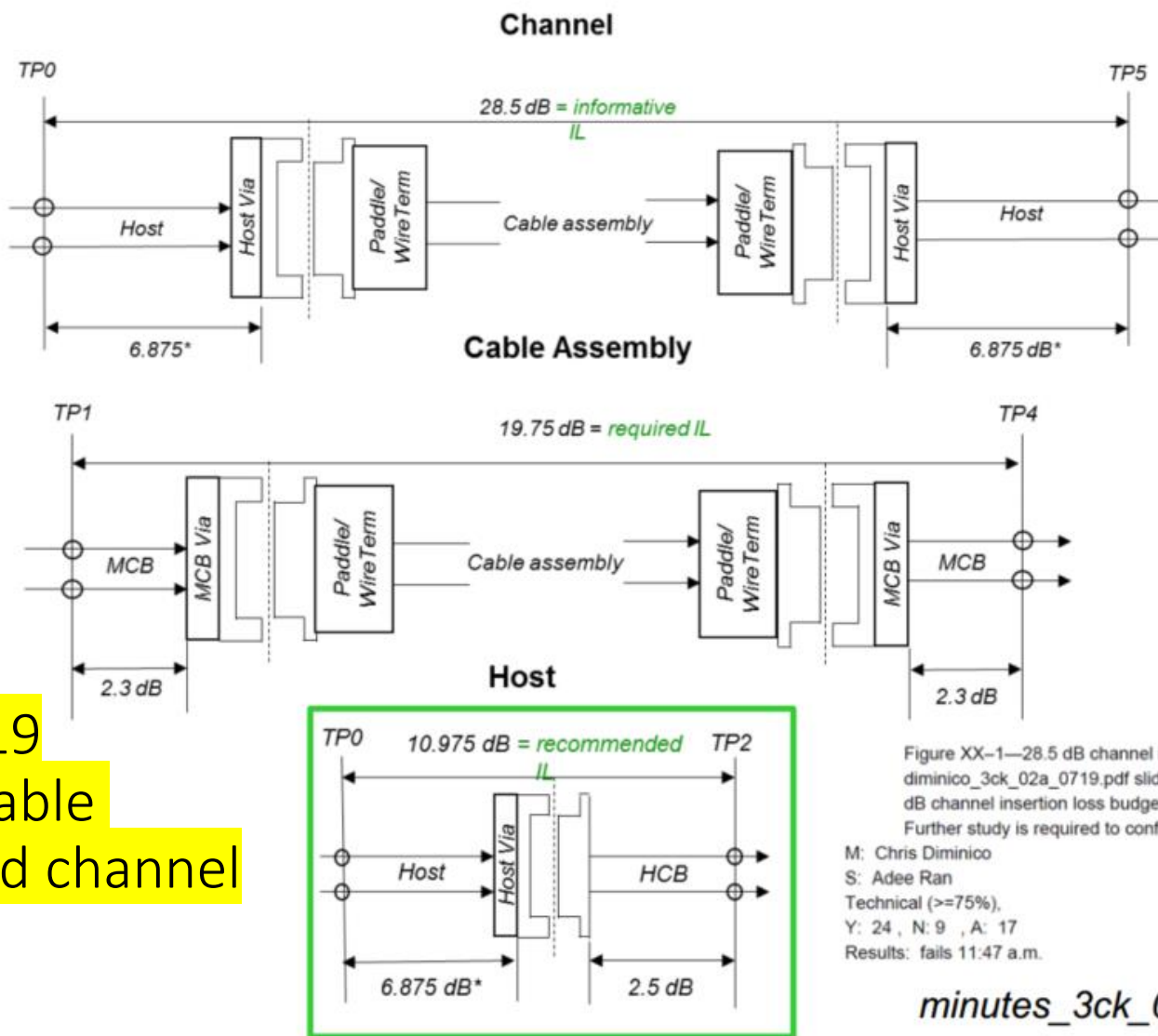
Modeling Acknowledgement: John Abbott, Samtec

IEEE 802.3 100 Gb/s, 200 Gb/s, and 400 Gb/s Electrical Interfaces Task Force CR, small consensus group

# Purpose

- ❑ Illustrate synthesized CR channels which
  - Have 28.5 dB loss (@ 26.56 GHz) TP0 to TP5 (end to end)
    - For a cable QSFP-DD cable assembly and flyover host channel
  - Have 19.75 dB loss (@ 26.56 GHz) TP1 to TP4 QSFP-DD assembly
- ❑ Contrast COM for an end to end channel (TP0 to TP5) and KR parameter assumptions with COM for the cable assembly (TP1 to TP4) with CR (COM) parameter assumptions
- ❑ For these two determine SNR<sub>Tx</sub> and  $\eta_0$  values which KR and CR COM match
  - Use method in mellitz\_3ck\_02a\_0919

- Cable assembly and Host IL tied to channel IL



diminico\_3ck\_adhoc\_100219  
used as target loss for the cable  
assembly and the end to end channel

Figure XX-1—28.5 dB channel insertion loss budget at 26.56 GHz in diminico\_3ck\_02a\_0719.pdf slide 5 and slide 6 for Annex 162A - Figure 162A-1—28.5 dB channel insertion loss budget at 26.56 GHz with the addition of an editors note:

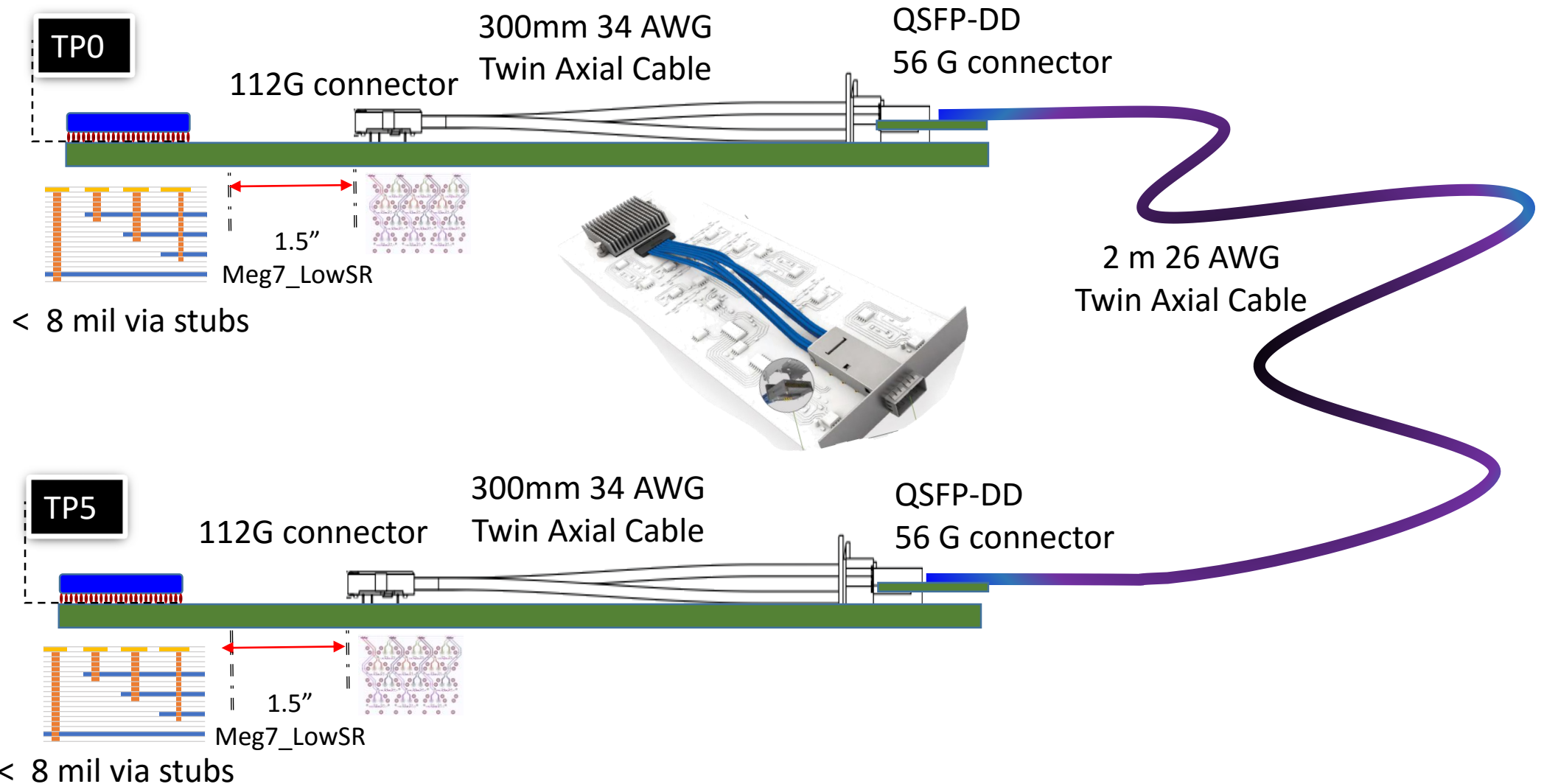
Further study is required to confirm 28.5 dB. With editorial license

M: Chris Diminico  
S: Adee Ran  
Technical (>=75%),  
Y: 24, N: 9, A: 17  
Results: fails 11:47 a.m.

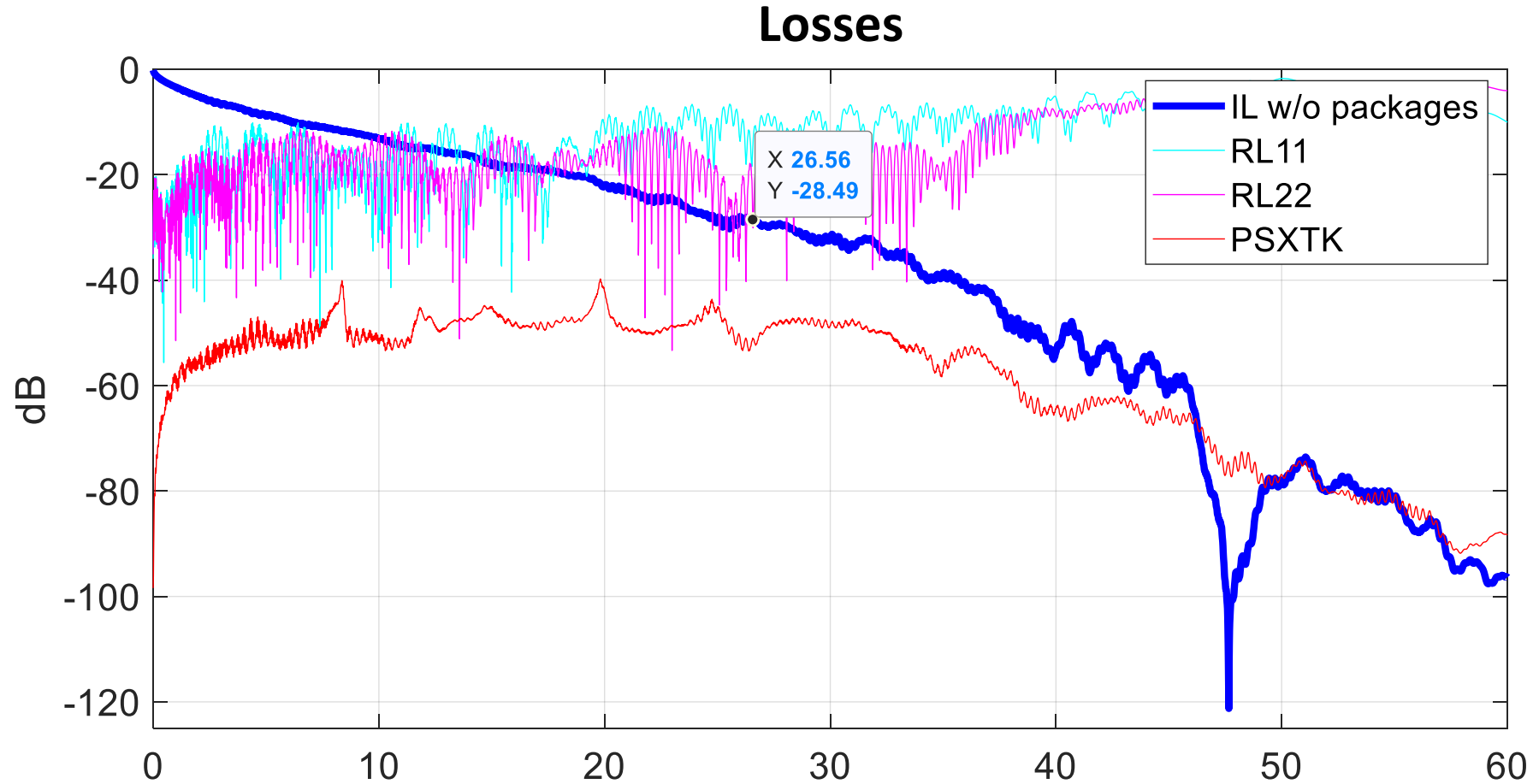
minutes\_3ck\_0719\_unapproved.pdf

Note: The 6.875 dB includes via allowances for BGA and connector

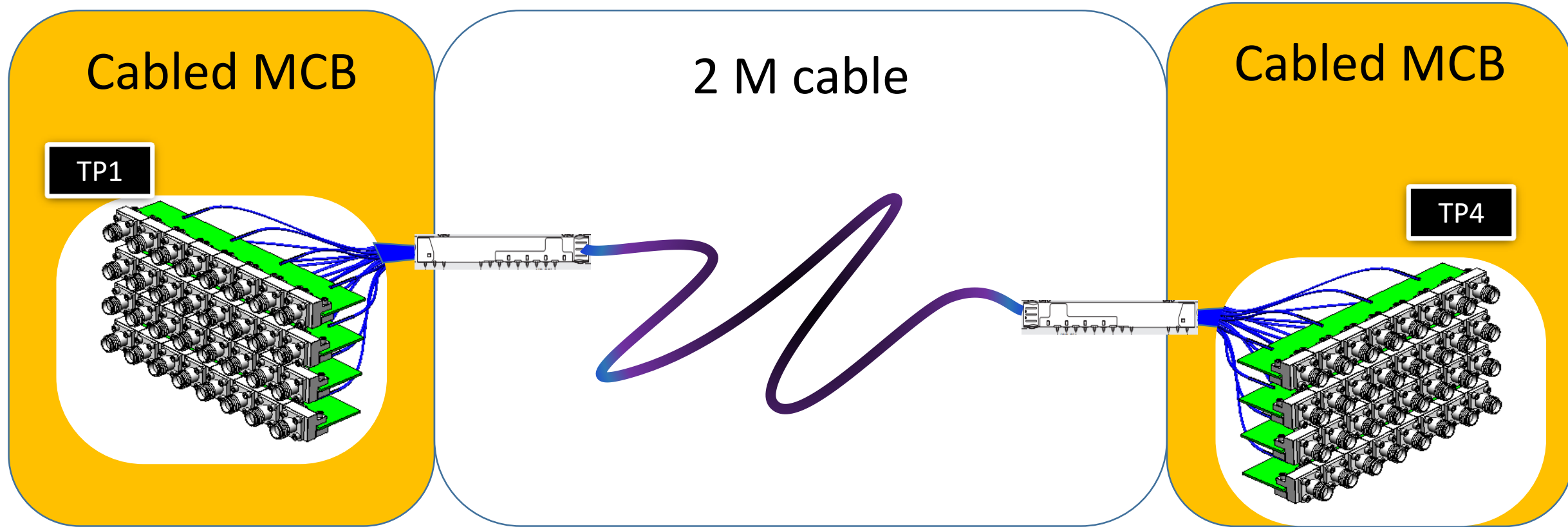
# TP0 to TP5 model: 28.5 dB IL at 26.56 GHz



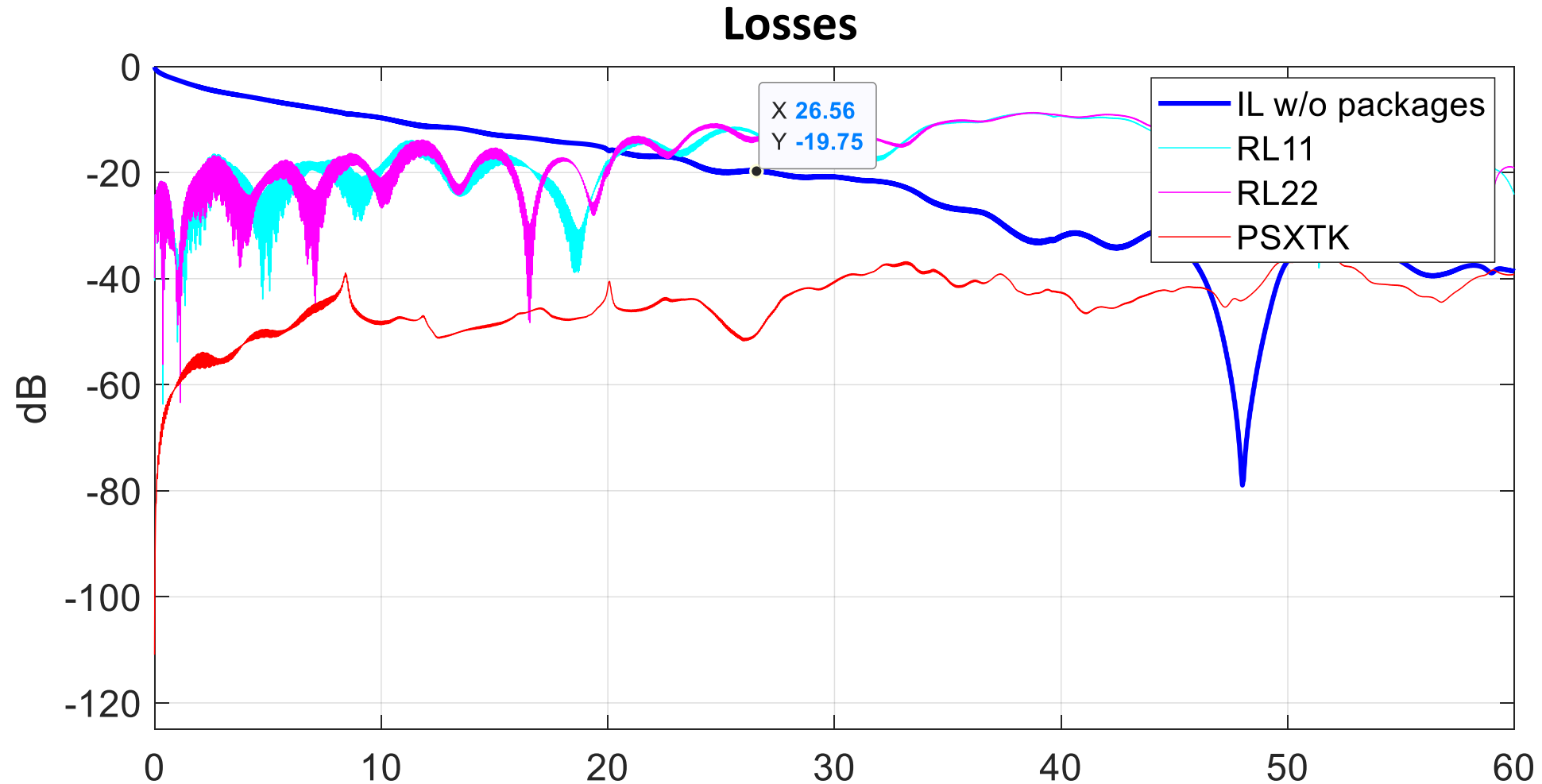
TP0 to TP5 model is 28.5 dB IL at 26.56 GHz  
New pairs (additional DD)



# Cable assembly model: 19.75 dB IL at 26.56 GHz



# Cable assembly model is 19.75 dB IL at 26.56 GHz New pairs (additional DD)



# Results

- ❑ COM KR end to end 3.56 dB
- ❑ COM CR cable 3.57 dB
  - SNR\_Tx = 32 dB
  - Eta\_0 = 9e-9



# Question

- ❑ How do the value of SNR<sub>Tx</sub> and  $\eta_0$  compare to similar channels

**THANK YOU!**

# Files

- ❑ CA\_19p75dB\_fext6.s4p
- ❑ CA\_19p75dB\_fext7.s4p
- ❑ CA\_19p75dB\_next1.s4p
- ❑ CA\_19p75dB\_next2.s4p
- ❑ CA\_19p75dB\_next3.s4p
- ❑ CA\_19p75dB\_next4.s4p
- ❑ CA\_19p75dB\_next5.s4p
- ❑ CA\_19p75dB\_next6.s4p
- ❑ CA\_19p75dB\_next7.s4p
- ❑ CA\_19p75dB\_next8.s4p
- ❑ CA\_19p75dB\_thru.s4p
- ❑ CA\_19p75dB\_fext1.s4p
- ❑ CA\_19p75dB\_fext2.s4p
- ❑ CA\_19p75dB\_fext3.s4p
- ❑ CA\_19p75dB\_fext4.s4p
- ❑ CA\_19p75dB\_fext5.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_next2.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_next3.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_next4.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_next5.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_next6.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_next7.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_next8.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_thru.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_fext1.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_fext2.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_fext3.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_fext4.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_fext5.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_fext6.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_fext7.s4p
- ❑ Tp0\_Tp5\_28p5db\_FQSFP\_next1.s4p

# KR COM configuration

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	[1.2e-4 1.2e-4]	nF	[TX RX]
L_s	[0.12, 0.12]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
z_p select	[ 1 2 ]		[test cases to run]
z_p (TX)	[12 31; 1.8 1.8]	mm	[test cases]
z_p (NEXT)	[12 29; 1.8 1.8]	mm	[test cases]
z_p (FEXT)	[12 31; 1.8 1.8]	mm	[test cases]
z_p (RX)	[12 29; 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	0.415	V	
A_fe	0.415	V	
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)	[-0.2:0.05:0]		[min:step:max]
N_b	12	UI	
b_max(1)	0.85		
b_max(2..N_b)	0.2		
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	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_KR_{date}\	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
RUNTAG	KR_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

TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	3000	
beta_x	2.3407E+09	
rho_x	0.19	

fixture delay time	[ 0 0 ]	[ port1 port2 ]
TDR_W_TXPKG	0	
N_bx	12	UI
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	8.2E-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
benartsi_3ck_01_0119 & mellitz_3ck_01_0119		
Table 92-12 parameters		
Parameter	Setting	
board_tl_gamma0_a1_a2	[0 3.8206e-04 9.5909e-05]	
board_tl_tau	5.790E-03	ns/mm
board_Z_c	100	Ohm
z_bp (TX)	110.3	mm
z_bp (NEXT)	110.3	mm
z_bp (FEXT)	110.3	mm
z_bp (RX)	110.3	mm
C_0	[0.29e-4]	nF
C_1	[0.19e-4]	nF
Include PCB	0	logical

Floating Tap Control		
N_bg	3	0 1 2 or 3 groups
N_bf	3	taps per group
N_f	40	UI span for floating taps
bmaxg	0.2	max DFE value for floating taps

cable assemblies require this for each HCB

ICN parameters (v2.73)	
f_f	12.919
f_n	12.919
f_2	39.844
A_ft	0.600
A_nt	0.600
heck_3ck_03b_0319	Adopted Mar 2019
walker_3ck_01d_0719	Adopted July 2019
result of R_d=50	
benartsi_3ck_01a_0719	no used for KR
mellitz_3ck_03_0919	
under consideration	

# COM CR Configuration

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	[1.2e-4 1.2e-4]	nF	[TX RX]
L_s	[0.12, 0.12]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
z_p select	[ 1 2 ]		[test cases to run]
z_p (TX)	[12 31; 1.8 1.8]	mm	[test cases]
z_p (NEXT)	[12 29; 1.8 1.8]	mm	[test cases]
z_p (FEXT)	[12 31; 1.8 1.8]	mm	[test cases]
z_p (RX)	[12 29; 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	0.415	V	vp/vf=.694
A_fe	0.415	V	vp/vf=.694
A_ne	0.608	V	
L	4		
M	32		
<b>filter and Eq</b>			
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)	[-0.2:0.05:0]		[min:step:max]
N_b	12	UI	
b_max(1)	0.85		
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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	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	0	logical
RESULT_DIR	.\results\100GEL_CR_{date}\	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
RUNTAG	CR_eval_	
COM_CONTRIBUTION	0	logical
<b>Operational</b>		
COM Pass threshold	3	dB
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DER_0	1.00E-04	
T_r	6.16E-03	ns
FORCE_TR	1	logical

TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	3000	
beta_x	2.3407E+09	
rho_x	0.21	
fixture delay time	[ 0 0 ]	[ port1 port2 ]
TDR_W_TXPKG	0	
N_bx	12	UI
<b>Receiver testing</b>		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
<b>Noise, jitter</b>		
sigma_RJ	0.01	UI
A_DD	0.02	UI
eta_0		V^2/GHz
SNR_TX		dB
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benartsi_3ck_01_0119 & mellitz_3ck_01_0119		
<b>Table 92-12 parameters</b>		
Parameter	Setting	
board_tl_gamma0_a1_a2	[0 3.8206e-04 9.5909e-05]	1 dB / in
board_tl_tau	5.790E-03	ns/mm
board_Z_c	100	Ohm
z_bp (TX)	110.3	mm
z_bp (NEXT)	110.3	mm
z_bp (FEXT)	110.3	mm
z_bp (RX)	110.3	mm
C_0	[0.29e-4]	nF
C_1	[0.19e-4]	nF
<b>Include PCB</b>	<b>1</b>	<b>logical</b>

Floating Tap Control		
N_bg	3	0 1 2 or 3 groups
N_bf	3	taps per group
N_f	40	UI span for floating taps
bmaxg	0.2	max DFE value for floating taps

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f_n	12.919	
f_2	39.844	
A_ft	0.600	
<b>A_nt</b>	<b>0.600</b>	
heck_3ck_03b_0319	<b>Adopted Mar 2019</b>	
walker_3ck_01d_0719	<b>Adopted July 2019</b>	
result of R_d=50		
benartsi_3ck_01a_0719	<b>require COM 2.72 or later</b>	
mellitz_3ck_03_0919		
Result reported		