TBDs Associated with MTF

MTF ERL

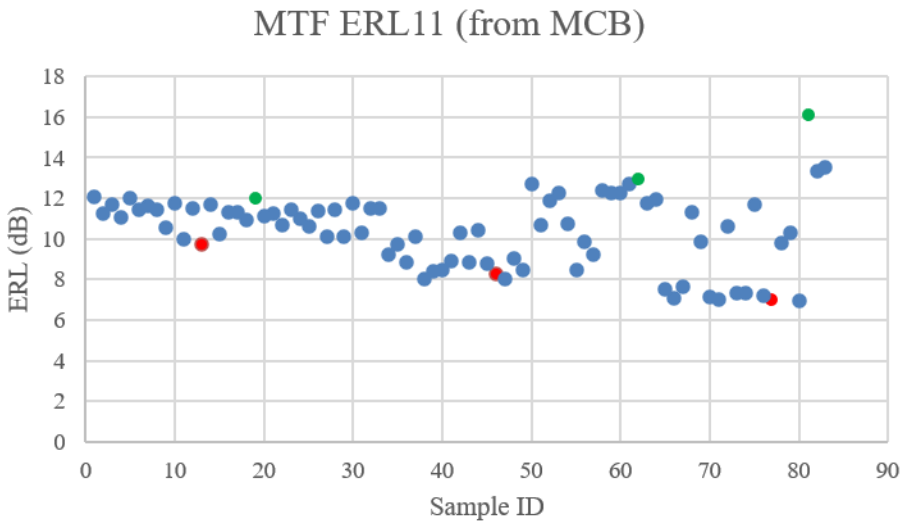
MTF FOMILD

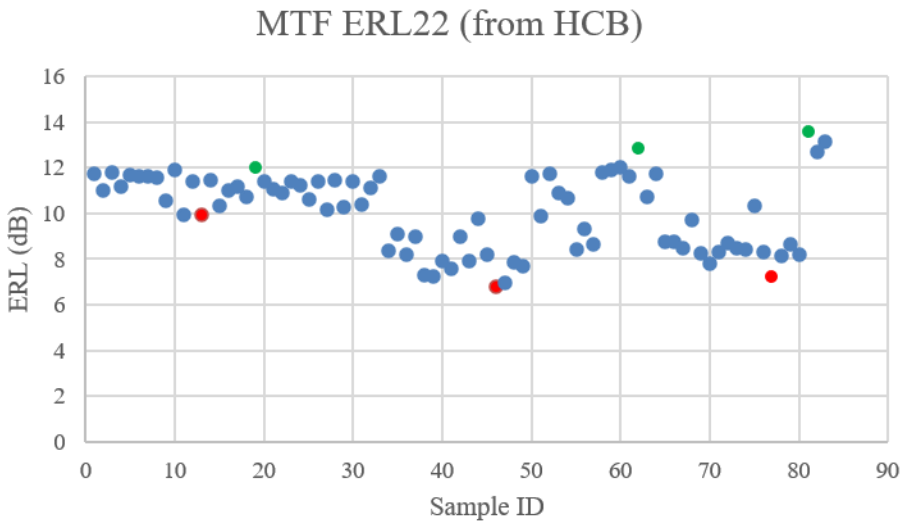
Amphenol Corporation

January 12, 2021

Amphenol

MTF ERL
From D1p3 Discussion



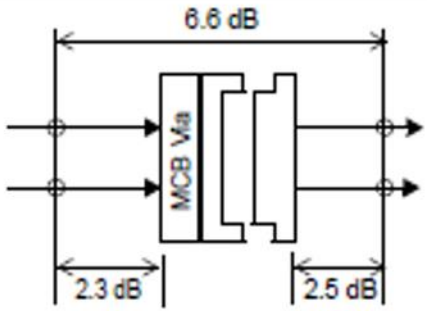


- Contribution during the D1p3 review cycle showed 83 samples of MTF data that were collected using IL compliant fixtures
- Data points on the right side of the plots are QSFP-DD800, prior to the implementation of the recent MSA changes
- MTF ERL proposed limit of 8dB was not adopted

https://www.ieee802.org/3/ck/public/20_10/kocsis_3ck_02a_1020.pdf

MTF ERL
Defining the Test Requirement

- MTF specification includes the RF connector (up to the reference plane)
- Setting T_{fx}=0 is consistent with the D1p4 definition of MTF test points
- The goal with MTF ERL was to replace the RL mask with a more useful metric for users of test fixtures



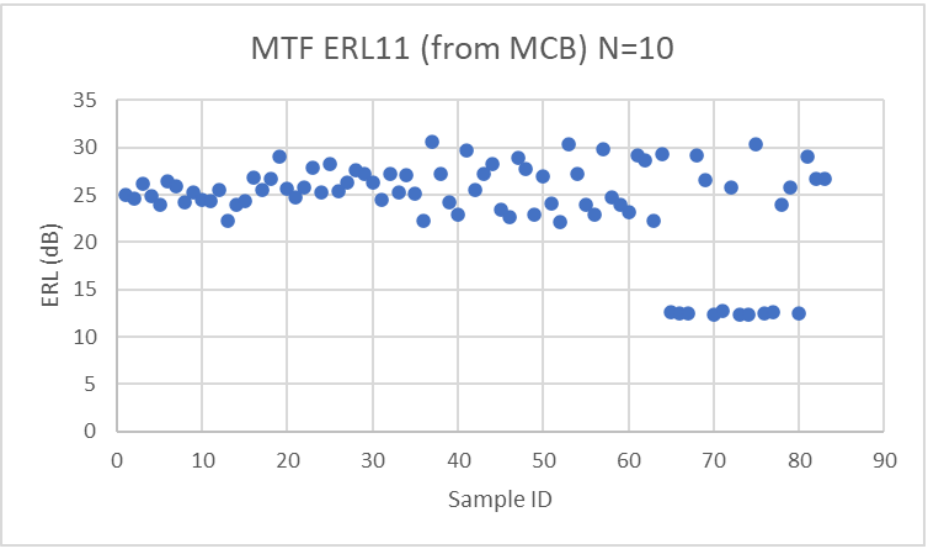
Mated cable assembly
and test point test fixture

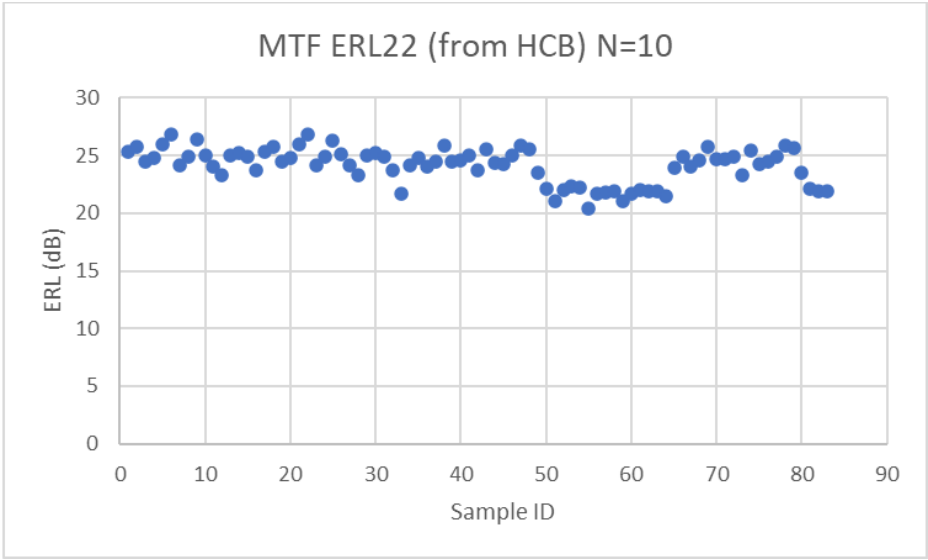
NOTE—2.3 dB MCB PCB IL includes the RF connector (up to the RF connector reference plane). The MCB via allowance is 0.2 dB.

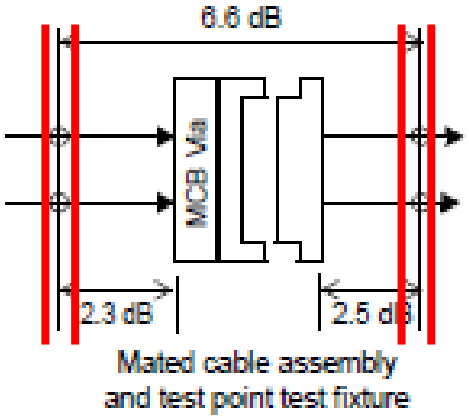
Table 162B–1—Mated test fixture ERL parameter values

Parameter	Symbol	Value	Units
Transition time associated with a pulse	T_r	0.01	ns
Incremental available signal loss factor	β_x	0	GHz
Permitted reflection from a transmission line external to the device under test	ρ_x	0.618	—
Length of the reflection signal	N	400	UI
Equalizer length associated with reflection signal	N_{bx}	0	UI
Time-gated propagation delay	T_{fx}	0	ns
Tukey window flag	tw	1	—

MTF ERL
SMA Launch Quality



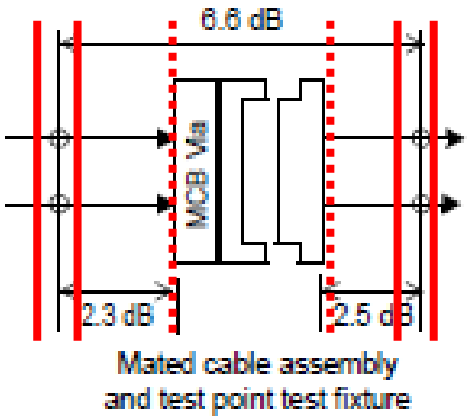


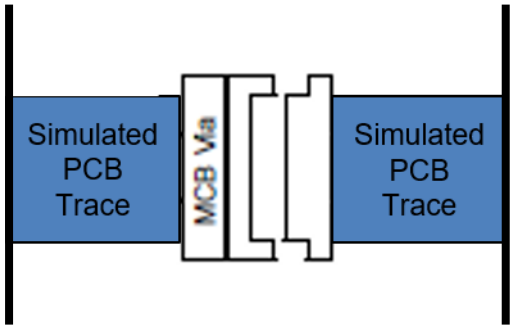


- Setting N=10 isolates the SMA launch in the ERL calculation
- The “poor quality” data points due to the SMA launch become more easily observable

Amphenol

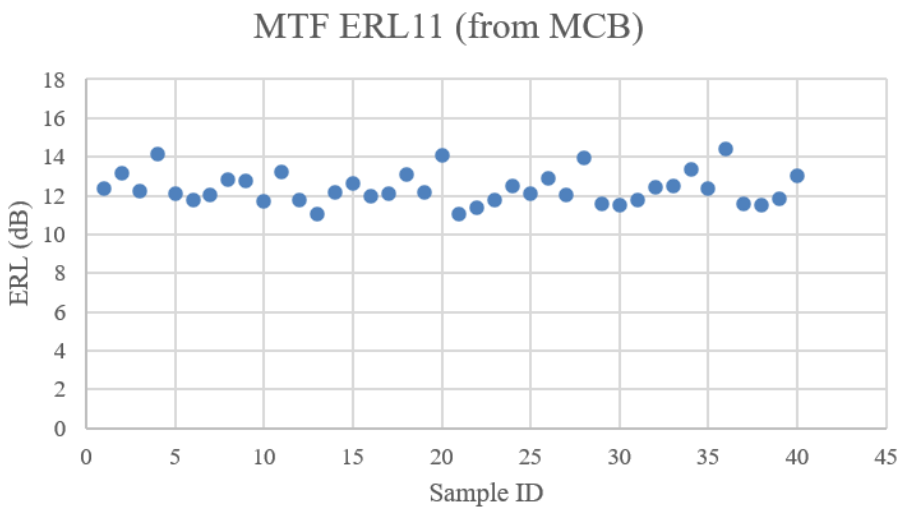
MTF ERL
Component Impact

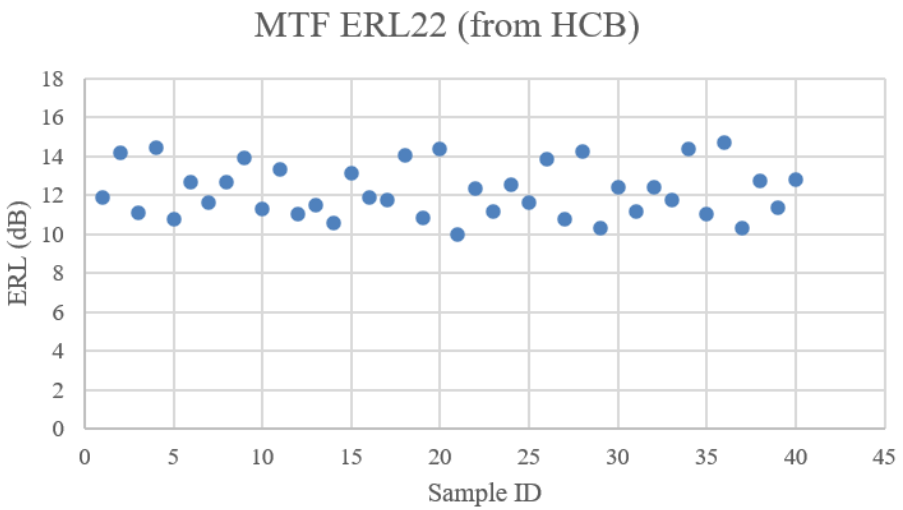




- Changing the values of N and T_{fx} allow for clearer observations of individual components impact on ERL
- Difficult to define one combination of N and T_{fx} subsets that works for all test fixture implementations and equally applies to all MDIs
  - One ERL calculation is more straightforward and probably just as efficient
- The interaction of the components cannot be perfect and cascading simulated PCB traces to any MDI model will result in very impractical ERL expectations

MTF ERL
Updated QSFP-DD800 Data

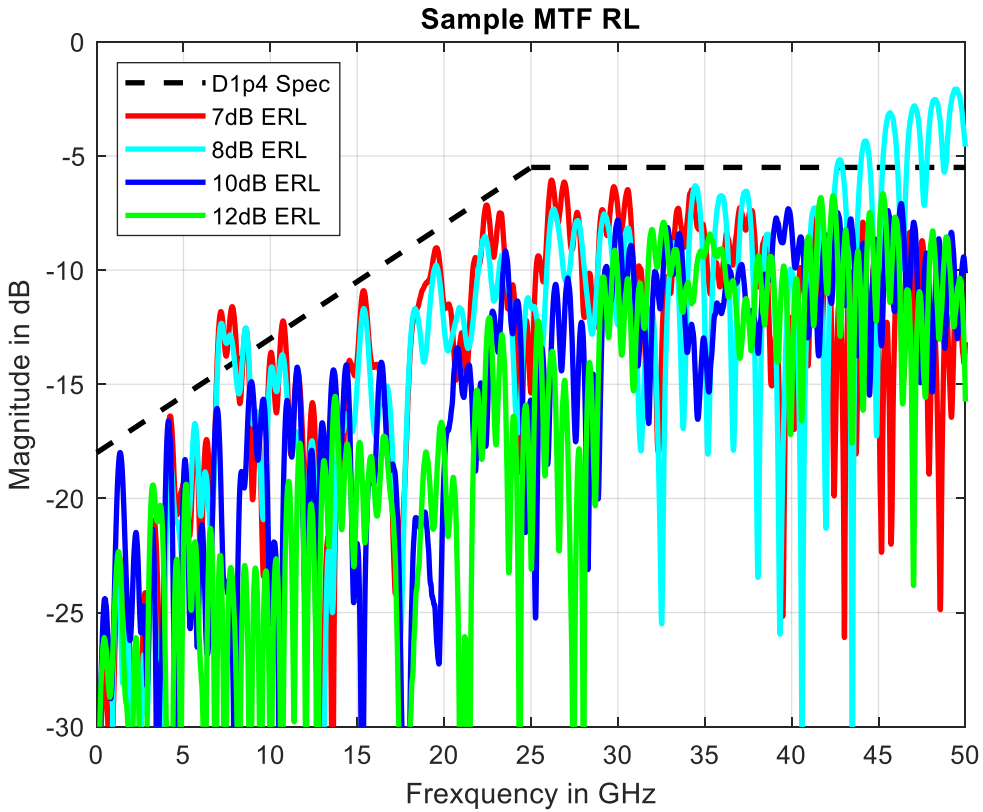




- 40 new data points collected using are QSFP-DD800, with fixtures that implement the latest MSA changes
- All data points meet previous proposal of 8dB for MTF ERL and would also meet a 9dB requirement
  - [9.8dB , 14.7dB]

MTF RL Mask

Compared to Normative ERL Requirement

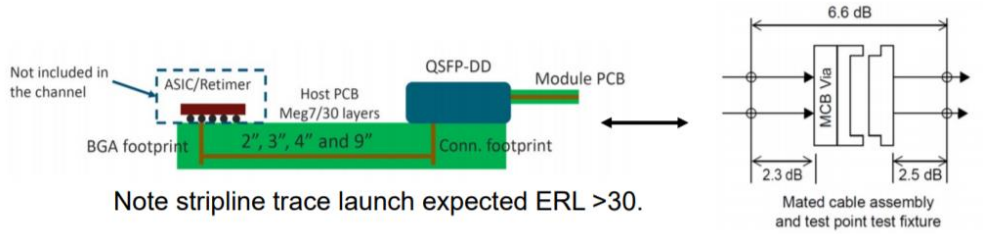


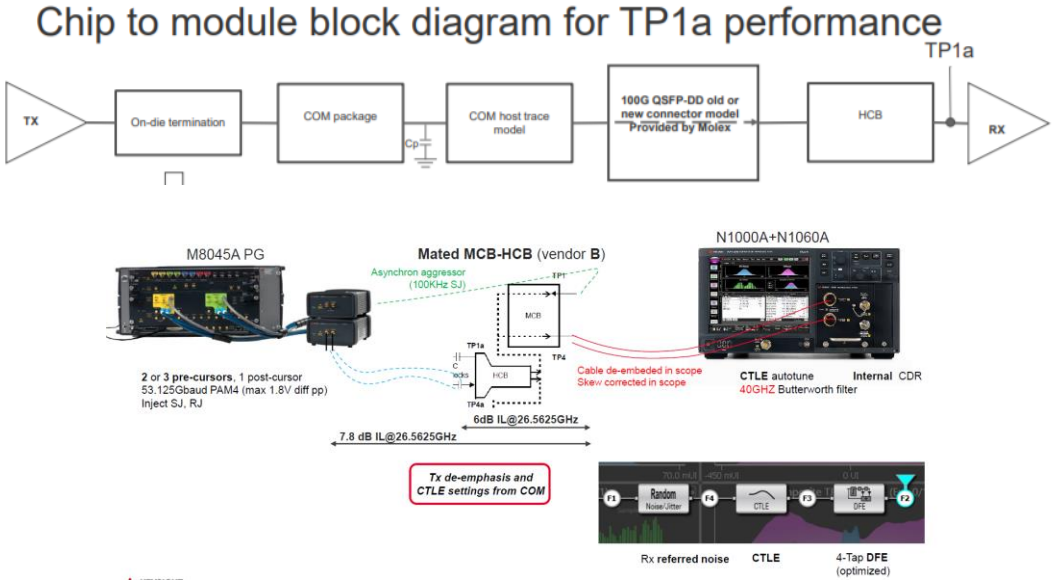
- As the ERL requirement moves away from 8dB the informative RL mask (Section 162B.1.3.3) becomes less helpful to users
- Recommend to remove the RL mask for D1p5 release

Method for Setting MTF Limits

Options used in during this Task Force

- Use published C2M channels as a baseline for MTF performance requirements
- Use connector simulation models and COM models to replicate the expected channel performance
- Use stress test results to determine acceptable performance for MTF measurements

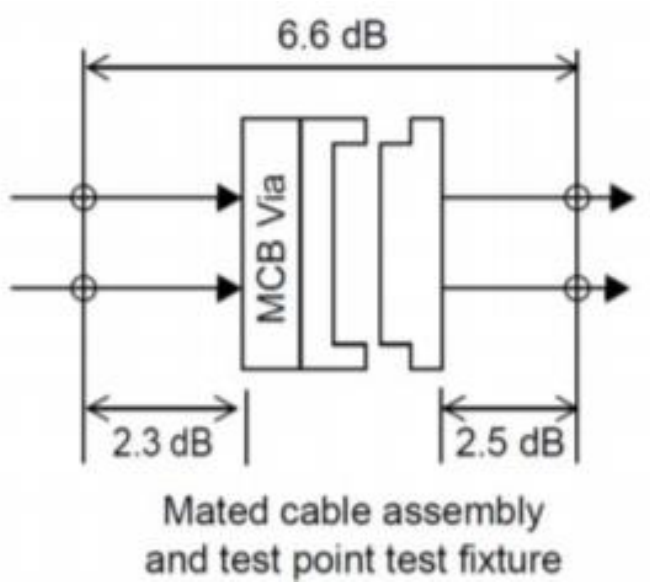


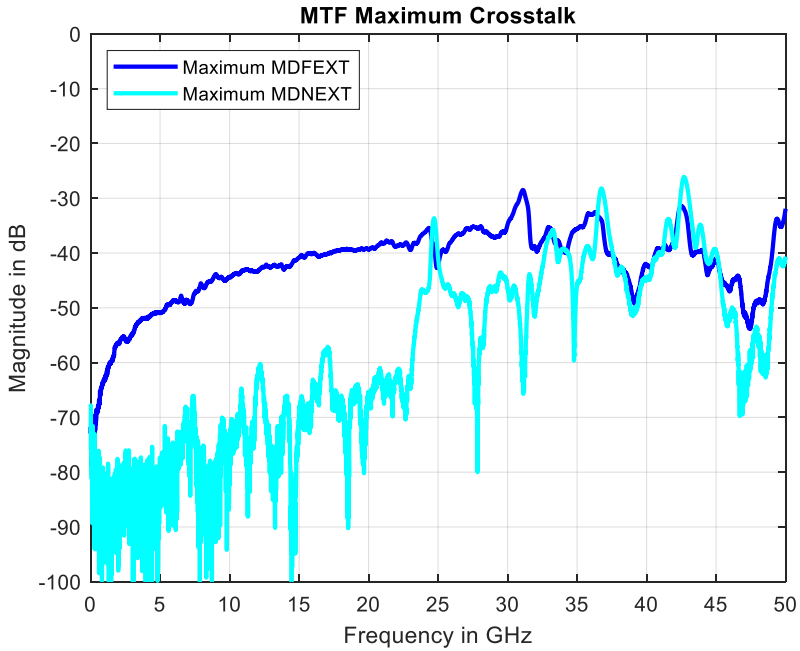


https://www.ieee802.org/3/ck/public/20_10/diminico_3ck_03a_1020.pdf
https://www.ieee802.org/3/ck/public/20_01/dudek_3ck_01_0120.pdf
https://www.ieee802.org/3/ck/public/20_10/calvin_3ck_02a_1020.pdf

Method for Setting MTF Limits

Scope of Concept





- Observe the FOM_ILD with:
  - MTF measurement using IL compliant MCB/HCB fixtures
  - MTF IL ~6.6dB
  - MTF ICN (MDNEXT) ~1.5mV (worst-case, using posted data)
  - MTF ICN (MDFEXT) ~4.2mV (worst-case, using posted data)

https://www.ieee802.org/3/ck/public/tools/cucable/kocsis_3ck_02_0719_MTFosfp.zip

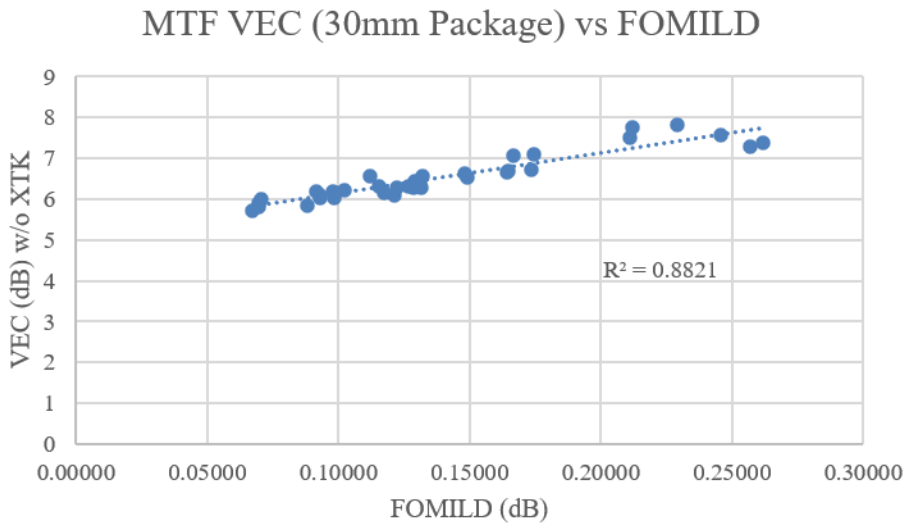
Method for Setting MTF Limits

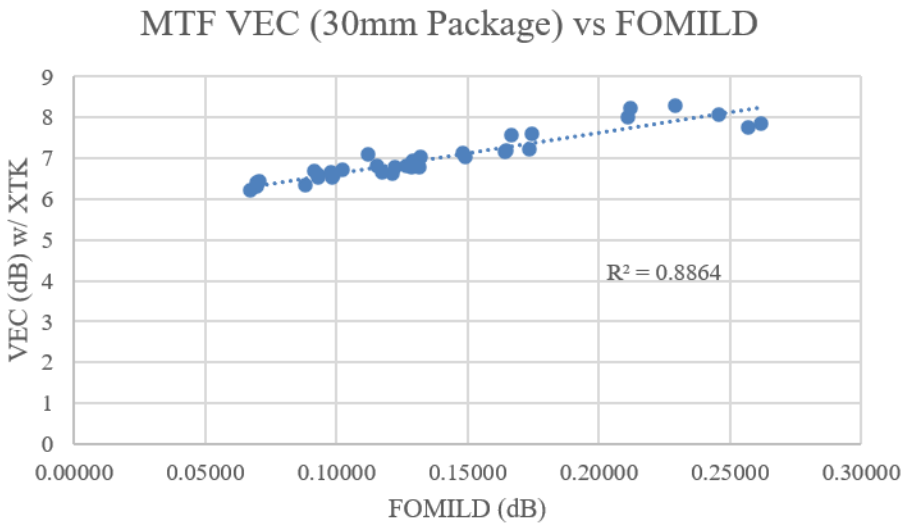
Additional Notes

- VEC chosen to define the pass/fail threshold as it presents a challenge for shorter channels
  - COM, SNR_ISI, other metrics could be useful too
- From posted Lim channels, VEC does not increase significantly as IL increases towards 16dB (slightly improves)
  - COM, SNR_ISI would change significantly as loss increases
- Choose VEC <7.5dB as a threshold for FOM_ILD
- The method in this contribution:
  - Provides margin needed for practical stressed input measurements
  - Does not take advantage of any new VEC/EH techniques proposed since D1p4 release

MTF FOMILD Requirement

Replacing the TBD

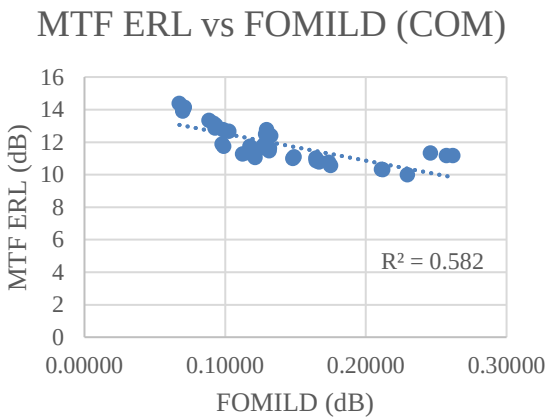


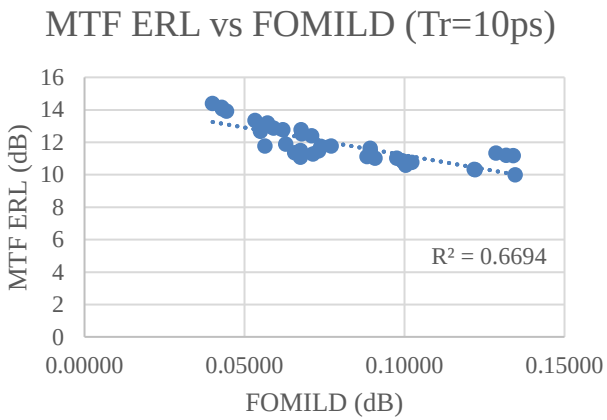


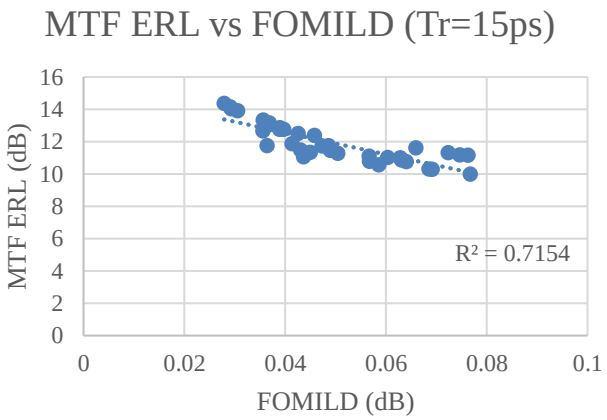
- Adding maximum crosstalk to the MTF results in ~ +0.5dB VEC
- VEC and FOMILD are well correlated and VEC<7.5dB results in and FOMILD<0.187dB
- Recommend setting the MTF FOMILD requirement to 0.18dB for D1p5 release
  - Can be adjusted in future drafts if VEC requirements change or more MTF data becomes available

MTF ERL and FOMILD

Are they tracking? Are they redundant?







- MTF ERL and FOMILD are not as well correlated, suggesting the ERL calculation is not consistent with the FOMILD fitting function or rise time
- The correlation improves as the rise time slows, but to what goal?
  - It may be possible to remove FOMILD and rely on the MTF ERL and IL mask

COM Configuration (2.95)

C2M, modified ERL options per Table 162B-1

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 0]	nF	[TX RX]
L_s	[0.12 0]	nH	[TX RX]
C_b	[0.3e-4 0]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[15 30; 1.8 1.8]	mm	[test cases]
z_p (NEXT)	[0 0 ; 0 0]	mm	[test cases]
z_p (FEXT)	[15 30; 1.8 1.8]	mm	[test cases]
z_p (RX)	[0 0 ; 0 0]	mm	[test cases]
C_p	[0.87e-4 0]	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		
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	0	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_C2M_host_{da	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
RUNTAG	C2M_eval_	
COM_CONTRIBUTIO	0	logical
Local Search	2	
Operational		
VEC Pass threshold	9	db
EH_min	15	mV
ERL Pass threshold	7	dB
DER_0	0.00001	
T_r	0.0075	ns
FORCE_TR	1	logical
PMD_type	C2M	
BREAD_CRUMBS	1	logical
SAVE_CONFIG2MAT	1	logical
TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	400	
beta_x	0	
rho_x	0.618	
fixture delay time	[0 0]	[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	0.01	UI
A_DD	0.02	UI
eta_0	0.000000041	V^2/GHz
SNR_TX	32.5	dB
R_LM	0.95	

Table 93A-3 parameters		
Parameter	**Setting**	**Units**
package_tl_gamma0_a1_a	[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 parameters (v2.73+)		
f_f	0.594	GHz f_r specified in first column
f_n	0.594	GHz
f_2	40	GHz
A_ft	0.6	V
A_nt	0.6	V

Table 92-12 parameters		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	3.8206e-04 9.5909e-05]	
board_tl_tau	0.00579	ns/mm
board_Z_c	100	Ohm
z_bp (TX)	407	mm
z_bp (NEXT)	407	mm
z_bp (FEXT)	407	mm
z_bp (RX)	407	mm
C_0	0	nF
C_1	0	nF
Include PCB	0	logical