Mated Test Fixture (MTF) Specifications Adding COM

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Channel Contributions from Steve Sekel, Wilder Technologies

Comment Reference# 48, 50, 56

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Supporters

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- Ray Schmelzer, Wilder Technologies
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Purpose

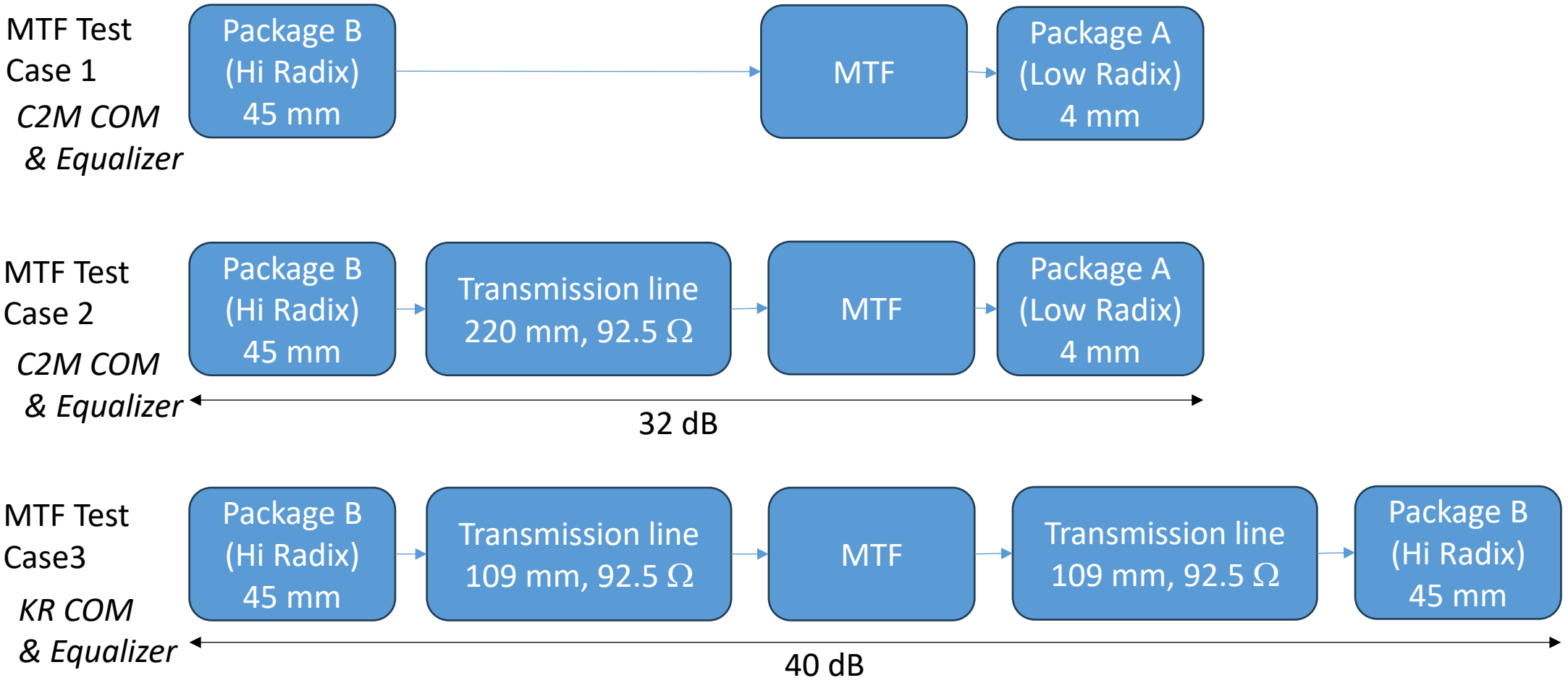
- ❑ Resolve some MTF parameter TBDs
- ❑ Propose COM specification for MTF

Propose 3 COM test cases for MTF evaluation

- MTF test Case 1
  - Only add packages to MTF
  - Basis for COM configuration is 176D.6.2 (C2M)
- MTF test case 2
  - Add transmission line loss to host side of MTF and packages which represent the highest C2M die-to-die channel loss.
  - Basis for COM configuration is 176D.6.2 (C2M)
- MTF test case 3
  - Add transmission line loss to each side of MTF and packages which represent the highest KR/CR die-to-die channel loss.
  - Basis for COM configuration is 178.10.1 (KR/CR)
- COM 4.8beta2 used

COM MTF Test Case Overview

Other combinations are possible



COM Configuration for MTF Test Case 1 & 2

Table 93A-1 parameters		
Parameter	**Setting**	**Units**
f_b	106.25	GBd
f_min	0.05	GHz
Delta_f	0.01	GHz
R_0	50	Ohm
PKG_NAME	PKG_HiR_CLASSB PKG_LowR_CLASSA	
z_p select	[1]	
L	4	
M	32	
filter and Eq		
f_r	0.55	*fb
c(0)	0.55	
c(-1)	0	[-0.34:0.02:0]
c(-2)	0	[0:.02:0.14]
c(-3)	0	
c(-4)	0	
c(1)	0	[-0.2:0.02:0]
N_b	1	UI
b_max(1)	0.75	
b_max(2..N_b)	0.3	
b_min(1)	0	
b_min(2..N_b)	-0.15	S
g_DC	0	[-20:1:0]
f_z	42.50	GHz
f_p1	42.50	GHz
f_p2	106.25	GHz
g_DC_HP	[-6:1:0]	
f_HP_PZ	1.328125	GHz

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	0	logical
RESULT_DIR	.\results\MTF_{date}\	
SAVE_FIGURES	0	logical
Port Order	[1 2 3 4]	
RUNTAG	Case1_	
COM_CONTRIBUTION	0	logical

TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	ns
TR_TDR	0.005	
N	1600	logical
TDR_Butterworth	1	
beta_x	0	
rho_x	0.618	
TDR_W_TXPKG	0	UI
N_bx	0	
fixture delay time	[0 0]	
Tukey_Window	1	
Z_t	46.25	ohm
Noise, jitter		UI
sigma_RJ	0.01	UI
A_DD	0.02	V^2/GHz
eta_0	1.00E-08	dB
SNR_TX	33.5	
R_LM	0.95	

Floating Tap Control		
N_bg	**2**	0 1 2 or 3 groups
N_bf	4	taps per group
N_f	50	UI span for floating taps
bmaxg	0.05	max DFE value for floating taps
B_float_RSS_MAX	0.1	rss tail tap limit
N_tail_start	15	(UI) start of tail taps limit
Filter: Rx FFE		
ffe_pre_tap_len	**5**	UI
ffe_post_tap_len	14	UI
ffe_main_cursor_min	1	
ffe_pre_tap1_max	0.7	
ffe_post_tap1_max	0.7	
ffe_tapn_max	0.7	
Operational		
ERL Pass threshold	10	dB
COM Pass threshold	3	db
DER_0	2.00E-05	
T_r	0.00400	ns
FORCE_TR	1	logical
PMD_type	C2C	
EW	0	
MLSD	0	logical
ts_anchor	1	
sample_adjustment	[-24 24]	
Local Search	2	
PDF bin size	0.000001	

SAVE_CONFIG2MAT	0		
Receiver testing			
RX_CALIBRATION	0	logical	
Sigma BBN step	5.00E-03	V	
ICN amd FOM ILD parameters			
f_v	0.524	55.64705882	Table 179B–4
f_f	0.550	58.4375	fft
f_n	0.550	58.4375	fnt
f_2	67.000	GHz	int lim
A_ft	0.600	V	0.481
A_nt	0.600	V	0.481

MTF Test Case 1

Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 5.95e-4 2.6e-05]*	1.4 db/in @ 53.125G
board_tl_tau	*5.790E-03*	ns/mm
board_Z_c	92.5	Ohm
z_bp (TX)	*0*	mm
z_bp (NEXT)	*0*	mm
z_bp (FEXT)	*0*	mm
z_bp (RX)	*0*	mm
C_0	[0 0]	nF
C_1	[0 0]	nF
Include PCB	**0**	**logical**

MTF Test Case 2

Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 5.95e-4 2.6e-05]*	1.4 db/in @ 53.125G
board_tl_tau	*5.790E-03*	ns/mm
board_Z_c	92.5	Ohm
z_bp (TX)	*220*	mm
z_bp (NEXT)	*0*	mm
z_bp (FEXT)	*220*	mm
z_bp (RX)	*0*	mm
C_0	[2.9e-5 0]	nF
C_1	[1.0e-5 0]	nF
Include PCB	**1**	**logical**

COM Configuration for MTF Test Case 3

Table 93A-1 parameters		
Parameter	**Setting**	**Information**
f_b	106.25	
f_min	0.05	
Delta_f	0.01	
R_0	50	
PKG_NAME	PKG_HiR_CLASSB PKG_HiR_CLASSB	TX RX
z_p select	[1]	
L	4	
M	32	
filter and Eq		
f_r	0.55	min
c(0)	0.55	[min:step:max]
c(-1)	0	[min:step:max]
c(-2)	0	[min:step:max]
c(-3)	0	[min:step:max]
c(-4)	0	[min:step:max]
c(1)	0	
N_b	1	As/dffe1
b_max(1)	0.75	As/dfe2..N_b
b_max(2..N_b)	0.3	NA
b_min(1)	0	As/dfe2..N_b
b_min(2..N_b)	-0.15	NA
g_DC	0	
f_z	42.50	
f_p1	42.50	
f_p2	106.25	[min:step:max]
g_DC_HP	[-6:1:0]	
f_HP_PZ	1.328125	

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	0	logical
RESULT_DIR	.\results\MTF_{date}\	
SAVE_FIGURES	0	logical
Port Order	[1 2 3 4]	
RUNTAG	Case3_	
COM_CONTRIBUTION	0	logical

TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	ns
TR_TDR	0.005	
N	1600	logical
TDR_Butterworth	1	
beta_x	0	
rho_x	0.618	
TDR_W_TXPKG	0	UI
N_bx	0	
fixture delay time	[0 0]	
Tukey_Window	1	
Z_t	46.25	ohm
Noise, jitter		UI
sigma_RJ	0.01	UI
A_DD	0.02	V^2/GHz
eta_0	1.00E-08	dB
SNR_TX	33.5	
R_LM	0.95	

Floating Tap Control			
N_bg	2	0 1 2 or 3 groups	
N_bf	4	taps per group	
N_f	80	UI span for floating taps	
bmaxg	0.05	max DFE value for floating taps	
B_float_RSS_MAX	0.1	rss tail tap limit	
N_tail_start	16	(UI) start of tail taps limit	
Filter: Rx FFE			
ffe_pre_tap_len	**6**	UI	
ffe_post_tap_len	15	UI	
ffe_main_cursor_min	1		
ffe_pre_tap1_max	0.7		
ffe_post_tap1_max	0.7		
ffe_tapn_max	0.7		
Operational			
ERL Pass threshold	10	dB	
COM Pass threshold	3	db	
DER_0	1.00E-04		
T_r	0.00400	ns	
FORCE_TR	1	logical	
PMD_type	C2C		
EW	0		
MLSD	1	logical	
ts_anchor	1		
sample_adjustment	[-24 24]		
Local Search	2		
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SAVE_CONFIG2MAT	0	
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f_v	0.524	55.6471
f_f	0.550	58.4375
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f_2	67.000	GHz
A_ft	0.600	V
A_nt	0.600	V

Parameter	Setting	
board_tl_gamma0_a1_a2	*[0 5.95e-4 2.6e-05]*	1.4 db/in @ 53.125G
board_tl_tau	*5.790E-03*	ns/mm
board_Z_c	92.5	Ohm
z_bp (TX)	*109*	mm
z_bp (NEXT)	*109*	mm
z_bp (FEXT)	*109*	mm
z_bp (RX)	*109*	mm
C_0	[2.9e-5 2.9e-5]	nF
C_1	[1e-5 1e-5]	nF
Include PCB	**1**	**logical**

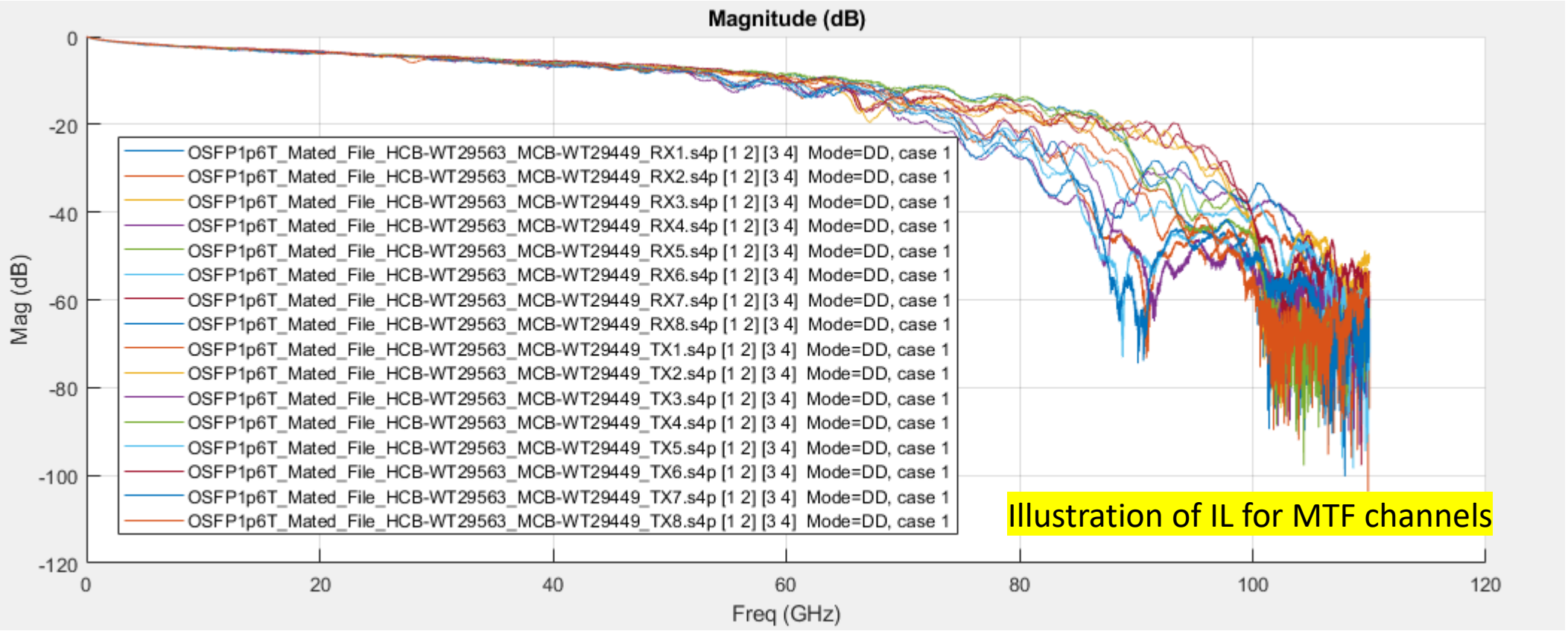
Package Configuration

.START	PKG_LowR_CLASSA		
Parameter	**Setting**	**Units**	
C_d	[0.4e-4 0.9e-4 1.1e-4 ;0.4e-4 0.9e-4 1.1e-4]	nF	[TX RX]
L_s	[0.13 0.15 0.14; 0.13 0.15 0.14]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
R_d	[46.25 46.25]	Ohm	[TX RX]
package_tl_gamma0_a1_a2	[0.0005 0.00089 0.0002]		
package_tl_tau	0.006141	ns/mm	
package_Z_c	[87.5 87.5 ; 95 95 ; 100 100; 100 100]	Ohm	[TX RX]
z_p (TX)	[4 ; 1.8 ; 0 ; 0]	mm	[test cases]
z_p (NEXT)	[4 ; 1.8 ; 0 ; 0]	mm	[test cases]
z_p (FEXT)	[4 ; 1.8 ; 0 ; 0]	mm	[test cases]
z_p (RX)	[4 ; 1.8 ; 0 ; 0]	mm	[TX RX]
C_p	[0.4e-4 0.4e-4]	nF	Vf=0.400
A_v	0.385	V	Vf=0.399
A_fe	0.385	V	Vf=0.400
A_ne	0.481	V	
.END			

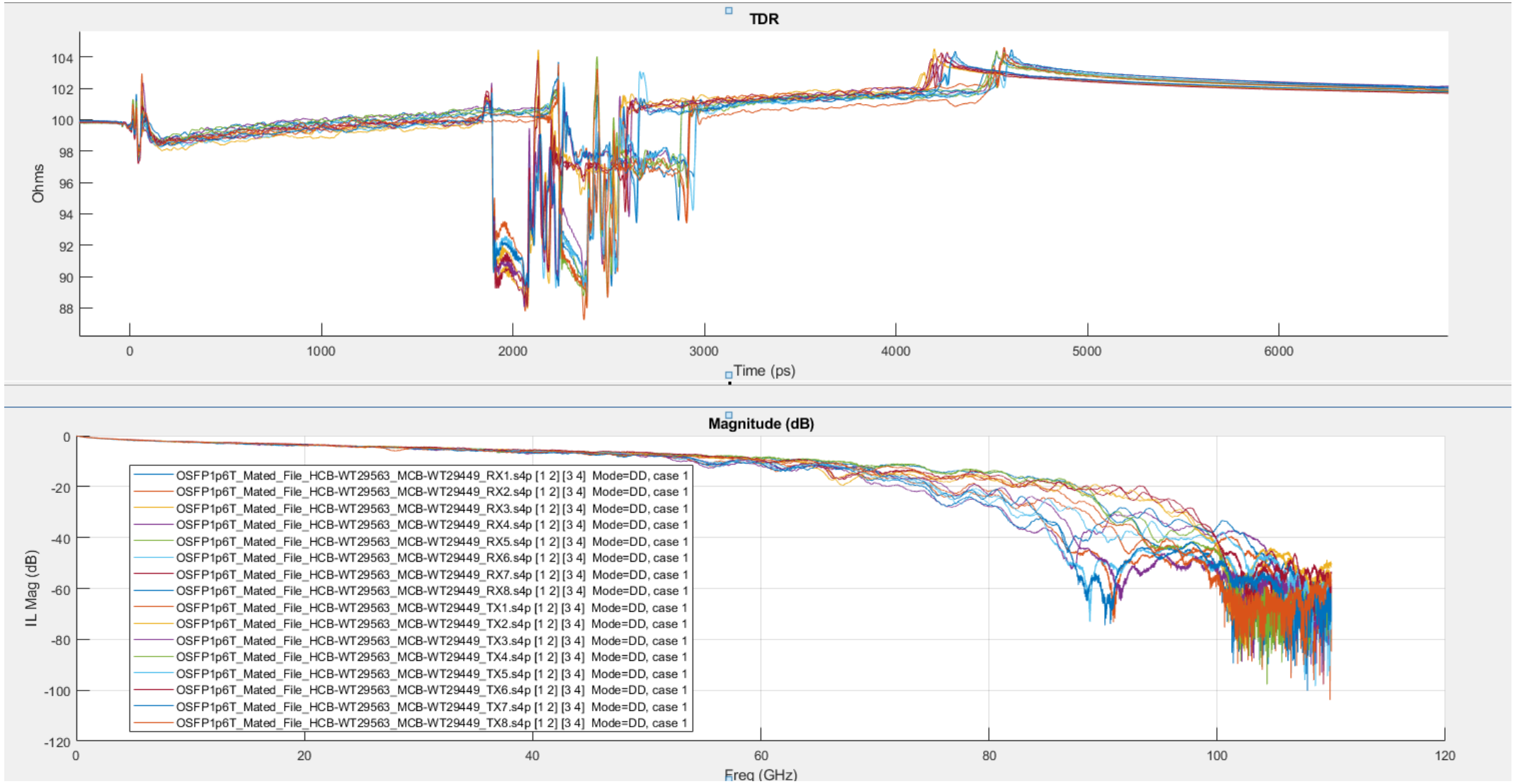
.START	PKG_HiR_CLASSB	[2.8 5.6 6.7 9.4] db	
Parameter	**Setting**	**Units**	
C_d	[0.4e-4 0.9e-4 1.1e-4 ;0.4e-4 0.9e-4 1.1e-4]	nF	[TX RX]
L_s	[0.13 0.15 0.14; 0.13 0.15 0.14]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
R_d	[46.25 46.25]	Ohm	[TX RX]
package_tl_gamma0_a1_a2	[0.0005 0.00065 0.000293]		
package_tl_tau	0.006141	ns/mm	
package_Z_c	[87.5 87.5 ; 95 95 ; 100 100; 78 78]	Ohm	[TX RX]
z_p (TX)	[45 ; 2; 1.3 ; 1.5]	mm	[test cases]
z_p (NEXT)	[45 ; 2; 1.3 ; 1.5]	mm	[test cases]
z_p (FEXT)	[45 ; 2; 1.3 ; 1.5]	mm	[test cases]
z_p (RX)	[45 ; 2; 1.3 ; 1.5]	mm	[TX RX]
C_p	[0.4e-4 0.4e-4]	nF	Vf=0.400
A_v	0.385	V	Vf=0.399
A_fe	0.385	V	Vf=0.400
A_ne	0.481	V	
.END			

MTF Channels (Measured)

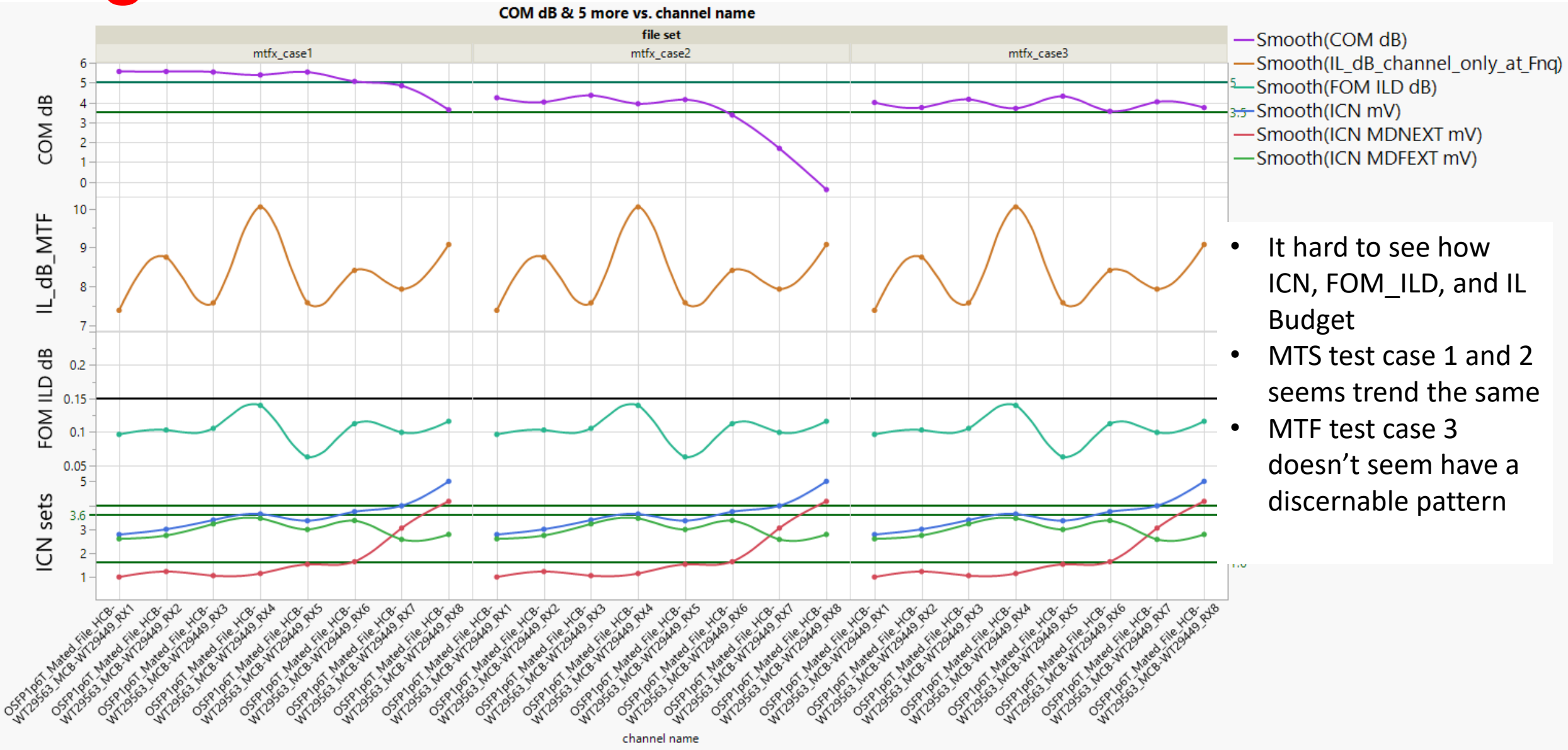
- 16 differential pairs measured to 110 GHz
  - 8 ingress and 8 egress through channels
- Each Pair has 7 FEXT and 8 NEXT channels measured to 110 GHz



TDR and IL for each MTF lane

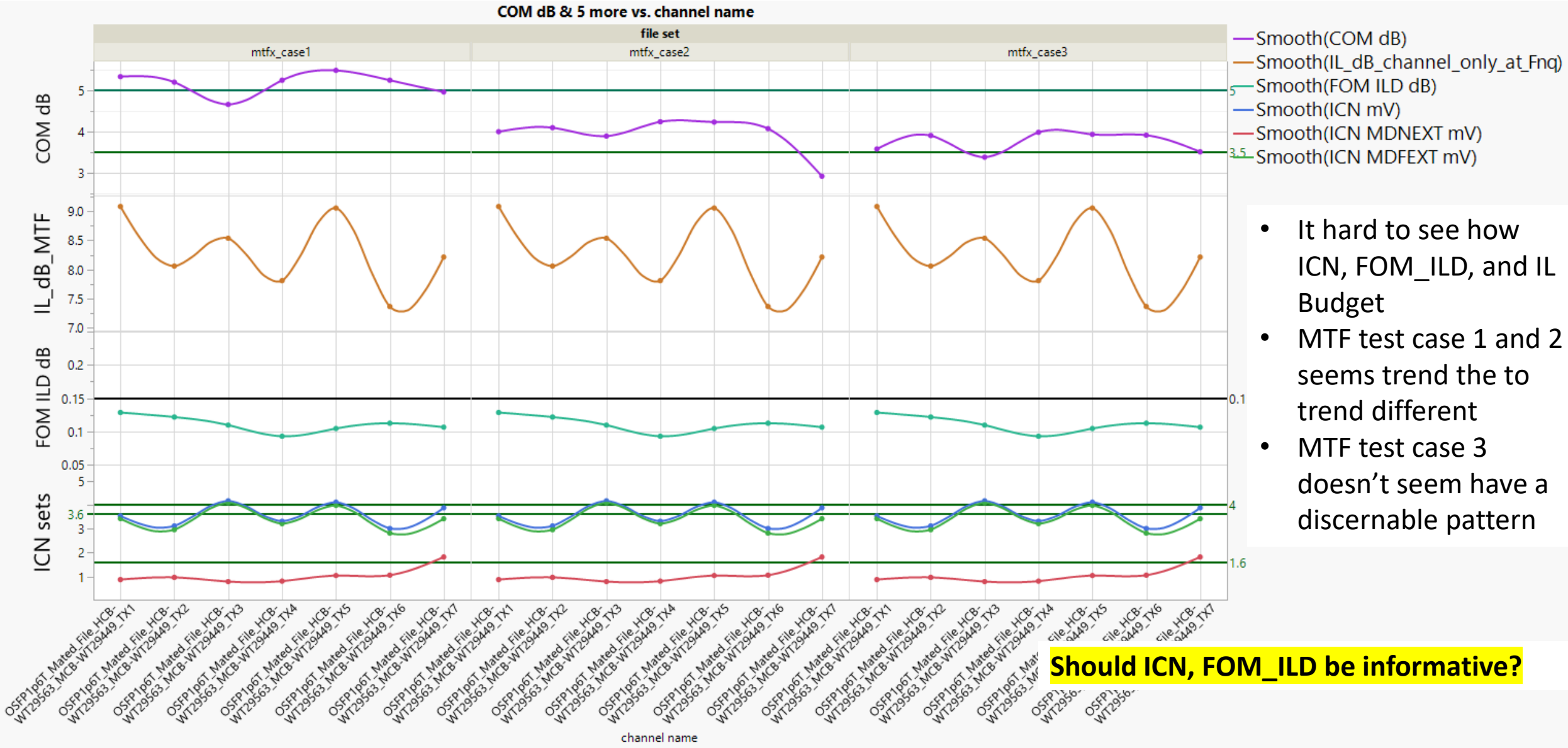


Ingress Results



- It hard to see how ICN, FOM_ILD, and IL Budget
- MTS test case 1 and 2 seems trend the same
- MTF test case 3 doesn't seem have a discernable pattern

Egress Results

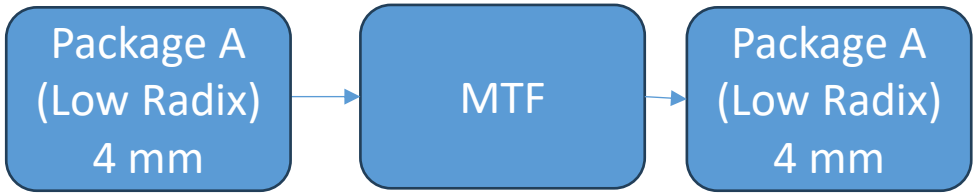


- It hard to see how ICN, FOM_ILD, and IL Budget
- MTF test case 1 and 2 seems trend the to trend different
- MTF test case 3 doesn't seem have a discernable pattern

Should ICN, FOM_ILD be informative?

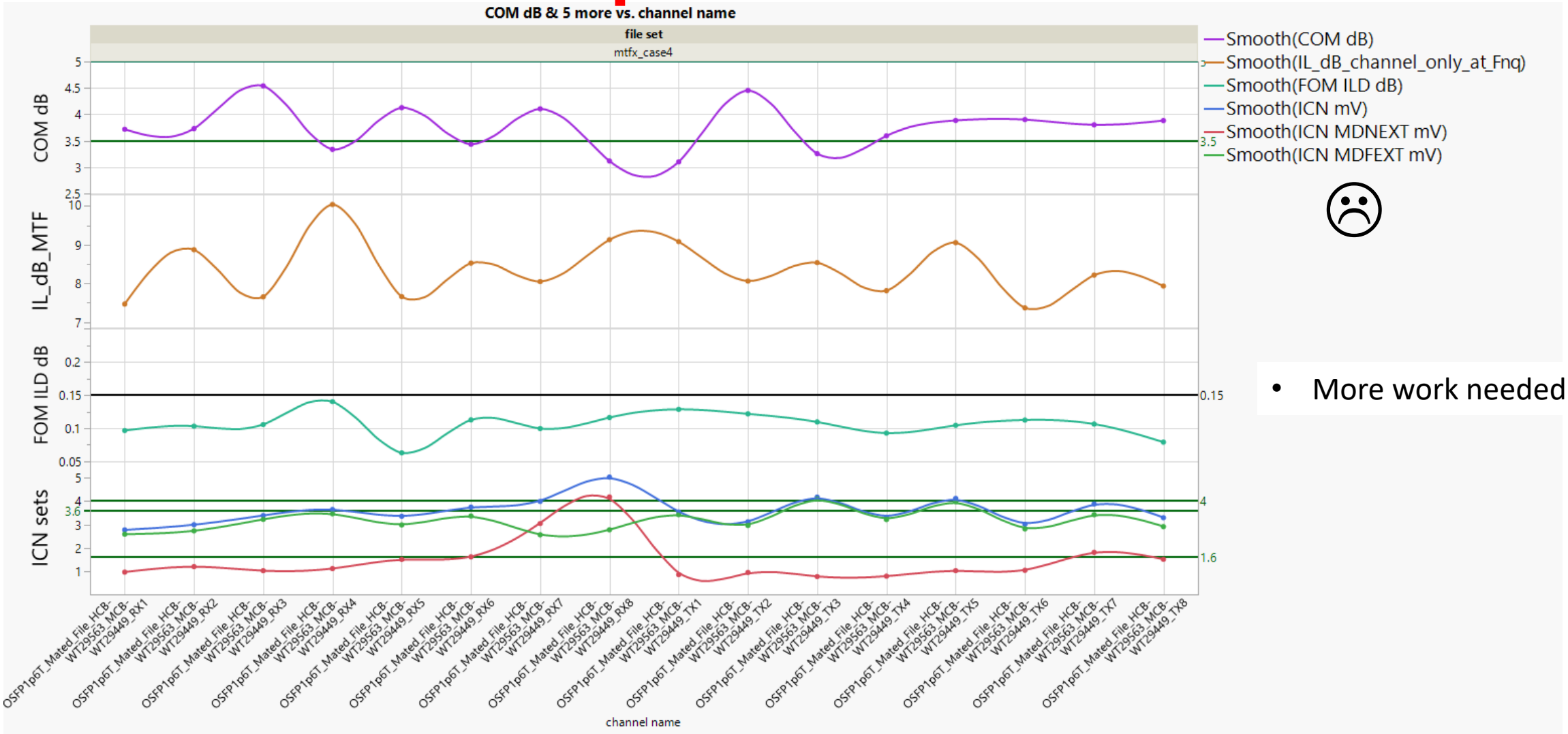
After thought… Evaluate COM, ICN, etc. for MTF with little equalization

MTF Test
Case4
C2M COM with Rx FFE (3 pre 4 post) no float SNDR=35



- The thought is that very limited equalization and less noise will improve COM sensitivity to MTF impairments

Results show little correlation between COM and MTF impairments.



- More work needed

Pam 4 Adjustment

- Crosstalk is reduced for PAM 4 signaling
- $\sigma_x = \sqrt{{(L^2-1)}/{3(L-1)^2}}$ = 0.7454 (L=4)
- Crosstalk thus reduces by 0.7454
- Suggest multiplying ICN by 0.7454 for PAM4
- Should we look closer at transition time and amplitude too?
  - Need data
  - Next draft maybe
- Using Table 179B–4 for this work

Summary and Recommendations

- Consider these recommendations
  - ICN MD NEXT <= 1.6 mV (1.19 mV PAM4)
  - ICN MD FEXT <= 3.6 mV (2.7 mV PAM4)
  - ICN <= 4 mV (3 mV PAM4)
  - FOM_ILD <= 0.15 dB
- Consider these to be normative
  - IL (at 53.125 GHz) between 7.3 dB and 10 dB
  - COM >= 5 dB for MTF test case 1
  - COM >= 3.5 dB for MTF test case 2

Thank You!