

MTF FOM Alignment Proposal

Sam Kocsis, Hansel D'Silva Amphenol

July 2025

Related to comments #604, 605

Motivation

The FOM_{ILD} is calculated according to 93A.4 with $f_b = 106.25$ GHz, $T_t = 6$ ps, and $f_r = 0.55 \times f_b$. The fitted insertion loss and insertion loss deviation are computed over the range $f_{min} = 0.05$ GHz to $f_{max} = 67$ GHz. FOM_{ILD} shall be less than or equal to 0.15 dB.

Table 179B-1—Mated test fixtures ERL parameter values

Parameter	Symbol	Value	Units
Transition time associated with a pulse	T_r	0.005	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	1600	UI
Equalizer length associated with reflection signal	N_{bx}	0	UI
Time-gated propagation delay	T_{fx}	0	ns
Tukey window flag	hw	1	—
Target detector error ratio	DER_0	2×10^{-5}	—
NOTE—The mated test fixtures test connector and transmission line are not time-gated (by setting T_{fx} to 0) in order to include the entire test fixture.			

Table 179B-2—Mated test fixtures integrated crosstalk noise parameters

Description	Symbol	Value	Units
Symbol rate	f_b	106.25	GBd
3 dB reference receiver bandwidth	f_r	58.4375	GHz
Near-end disturber peak differential output amplitude	A_{nt}	600	mV
Far-end disturber peak differential output amplitude	A_{ft}	600	mV
Near-end disturber 20% to 80% rise and fall times	T_{nt}	4.25	ps
Far-end disturber 20% to 80% rise and fall times	T_{ft}	4.25	ps

- All references in Annex179B are related to normative MTF FOM calculations

Context

Table 178–13—COM parameter values

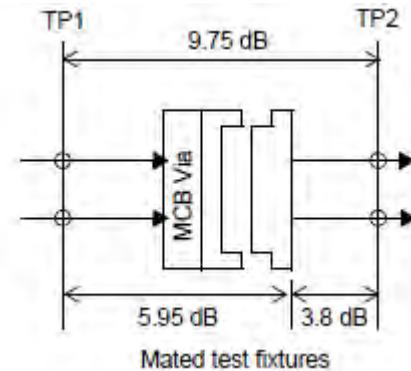
1
2
3
4
5
6
7
8
9
10
11

Parameter	Symbol	Value	Units
Signaling rate	f_b	106.25	GBd
Transmitter differential peak output voltage			
Victim	A_v	0.385	V
Far-end aggressor	A_{fe}	0.385	V
Near-end aggressor	A_{ne}	0.481	V
Transmitter transition time	T_r	0.004	ns

IEEE Project	COM Transmitter Transition Time – Tt (ps)	FOM Transition Time - Tt, Tr, Tnt, Tft (ps)	Delta Time (%)
802.3ck	6	7.5* (Tt for ERL)	25
802.3dj	4	6, 5, 4.25	TBD

- The basis for the FOM transition time is often the COM transition time

Determining a Practical Transition Time



MTF FOM calculations will be applied to TP1-TP2 measurements

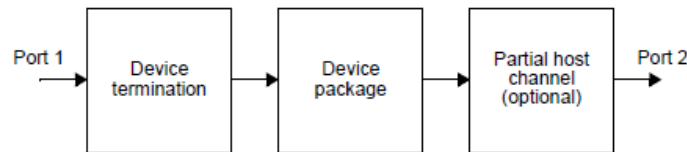


Figure 178A-2—Transmitter S-parameter model

Table 179A-1—Recommended differential insertion loss limits at 53.125 GHz

Host class	Host channels	TP0d to TP2 or TP3 to TP5d
	Range (dB)	Max (dB)
Host-Low (HL)	4.45 to 8.95	12.75
Host-Nominal (HN)	4.45 to 13.95	17.75
Host-High (HH)	4.45 to 18.5	22.75

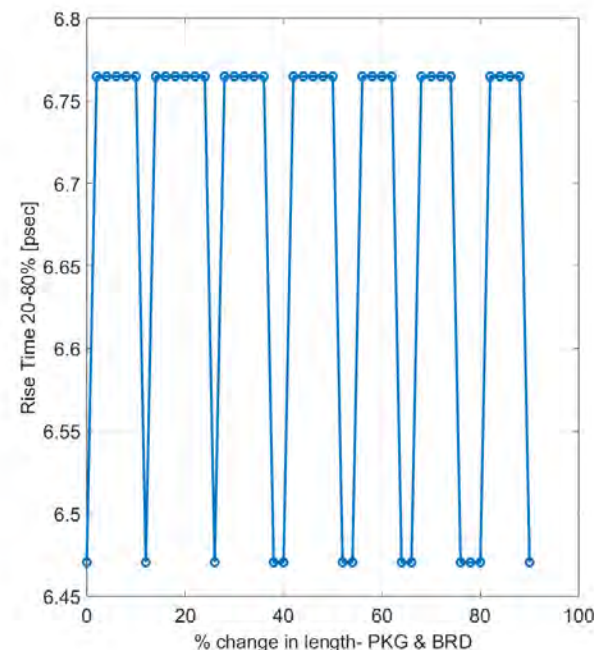
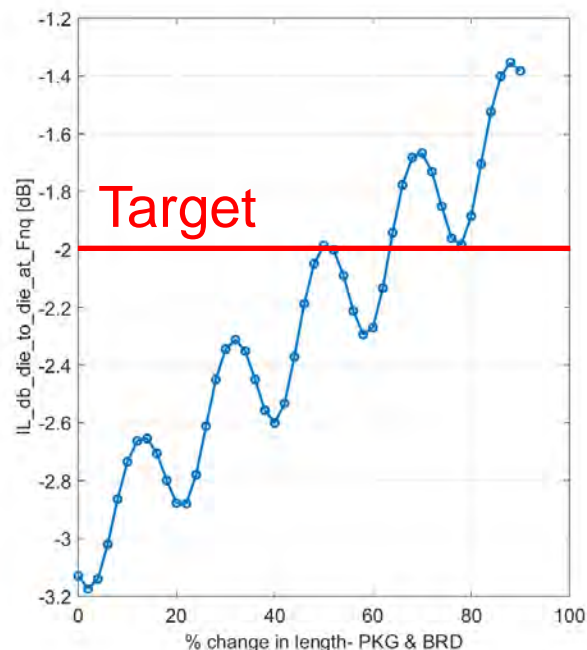
Table 179-17—Partial host channel model parameters per Host class

Parameter	Host class			Units
	HL	HN	HH	
Package class	A	B	B	—
Package transmission line 1 length, $z_p^{(1)}$	8	15	45	mm
Partial host PCB transmission line length, $z_p^{(h)}$	9	70	60	mm

- What is the fastest rise time that we could see at TP1?

Determining a Practical Transition Time

1. Start with HL case,
PKG= 8 mm
BRD= 9 mm
2. Reduce loss to
informative minimum
3. Observe transition time
at MDI connector input



IEEE Project	COM Transmitter Transition Time – Tt (ps)	FOM Transition Time - Tt, Tr, Tnt, Tft (ps)	Delta Time (%)
802.3ck	6	7.5* (Tt for ERL)	25
802.3dj	4	5	25

Proposal

The FOM_{ILD} is calculated according to 93A.4 with $f_b = 106.25$ GHz, $Tt = 5ps$ and $f_r = 0.55 \times f_b$. The fitted insertion loss and insertion loss deviation are computed over the range $f_{min} = 0.05$ GHz to $f_{max} = 67$ GHz. FOM_{ILD} shall be less than or equal to 0.15 dB.

Table 179B-1—Mated test fixtures ERL parameter values

Parameter	Symbol	Value	Units
Transition time associated with a pulse	T_r	0.005	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	1600	UI
Equalizer length associated with reflection signal	N_{bx}	0	UI
Time-gated propagation delay	T_{fx}	0	ns
Tukey window flag	tw	1	—
Target detector error ratio	DER_0	2×10^{-5}	—
NOTE—The mated test fixtures test connector and transmission line are not time-gated (by setting T_{fx} to 0) in order to include the entire test fixture.			

Table 179B-2—Mated test fixtures integrated crosstalk noise parameters

Description	Symbol	Value	Units
Symbol rate	f_b	106.25	GBd
3 dB reference receiver bandwidth	f_r	58.4375	GHz
Near-end disturber peak differential output amplitude	A_{nt}	600	mV
Far-end disturber peak differential output amplitude	A_{ft}	600	mV
Near-end disturber 20% to 80% rise and fall times	T_{nt}	5	ps
Far-end disturber 20% to 80% rise and fall times	T_{ft}	5	ps

- Set the transition times for MTF FOM calculations to the same value

Proposal – Compliance Requirements

The FOM_{ILD} is calculated according to 93A.4 with $f_b = 106.25$ GHz, $Tt = 5ps$ and $f_r = 0.55 \times f_b$. The fitted insertion loss and insertion loss deviation are computed over the range $f_{min} = 0.05$ GHz to $f_{max} = 67$ GHz. FOM_{ILD} shall be less than or equal to **0.175 dB**

Table 179B-1—Mated test fixtures ERL parameter values

Parameter	Symbol	Value	Units
Transition time associated with a pulse	T_r	0.005	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	1600	UI
Equalizer length associated with reflection signal	N_{bx}	0	UI
Time-gated propagation delay	T_{fx}	0	ns
Tukey window flag	hw	1	—
Target detector error ratio	DER_0	2×10^{-5}	—
NOTE—The mated test fixtures test connector and transmission line are not time-gated (by setting T_{fx} to 0) in order to include the entire test fixture.			

Table 179B-2—Mated test fixtures integrated crosstalk noise parameters

Description	Symbol	Value	Units
Symbol rate	f_b	106.25	GBd
3 dB reference receiver bandwidth	f_r	58.4375	GHz
Near-end disturber peak differential output amplitude	A_{nt}	500	mV
Far-end disturber peak differential output amplitude	A_{ft}	500	mV
Near-end disturber 20% to 80% rise and fall times	T_{nt}	5	ps
Far-end disturber 20% to 80% rise and fall times	T_{ft}	5	ps

Table 179B-4—Multi-lane mated test fixtures integrated crosstalk noise voltage

Parameters	Value	Units
MDFEXT integrated crosstalk noise voltage (max)	3.2	mV
MDNEXT integrated crosstalk noise voltage (max)	1.2	mV
Total integrated crosstalk noise voltage (max)	3.4	mV

- Set the transition times for MTF FOM calculations to the same value

Summary

- D2P0 while technically complete has some inconsistencies related to the FOM calculations in Annex 179B
- Other metrics may be considered for Annex 179B, but if there is no consensus to remove/replace metrics we should clean up the current methods
- Propose to adopt the changes to the transition time, parameter settings, and compliance criteria on Slide 7