Differential Return Loss for Annex 120d

Addressing to Comments i-34, i-74, i-75

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Differential Return Loss and Package Options

- OPTION A: Go back to clause 93 and Annex 83d
- OPTION B: Do nothing keep what is in D3.0
- OPTION C: Keep packages in D3.0 and lower return loss by 3.5 dB to match packages
- OPTION D: Use lower return loss in OPTION C and specify a new 12 and 30 mm packages which matches RL even more closely

Background: Return loss in Annex 83D

Return loss for Annex 83d is specified by Equation 93-3

83D.3 CAUI-4 chip-to-chip electrical characteristics

83D.3.1 CAUI-4 transmitter characteristics

A CAUI-4 chip-to-chip transmitter shall meet the specifications defined in Table 83D–1 if measured at TP0a. While the CAUI-4 chip-to-chip transmitter requirements are similar to those in Clause 93, they differ in that they do not assume transmitter training or a back-channel communications path. Also, the transmit output waveform is not manipulated via the PMD control function described in 93.7.12, but may optionally be manipulated via the feedback mechanism described in 83D.3.3.2.

93.8.1.4 Transmitter output return loss

The differential output return loss, in dB, of the transmitter shall meet Equation (93–3) where f is the frequency in GHz. This output impedance requirement applies to all valid output levels. The reference impedance for differential return loss measurements shall be 100 Ω

$$RL_d(f) \geq \begin{cases} 12.05 - f & 0.05 \leq f \leq 6 \\ 6.5 - 0.075f & 6 < f \leq 19 \end{cases} \text{ dB} \qquad (93\text{–}3)$$

istics at TP0a

		Value	Units
		25.78125 ± 100 ppm	GBd
		30 1200	mV mV
		1.9	V
		0	V
AC common-mode output voltage (max, RMS)	93.8.1.3	12	mV
Differential output return loss (min)	93.8.1.4	Equation (93–3)	dB
Common-mode output return loss (min)	93.8.1.4	Equation (93–4)	dB

COM parameters for 83D are the same as CL93

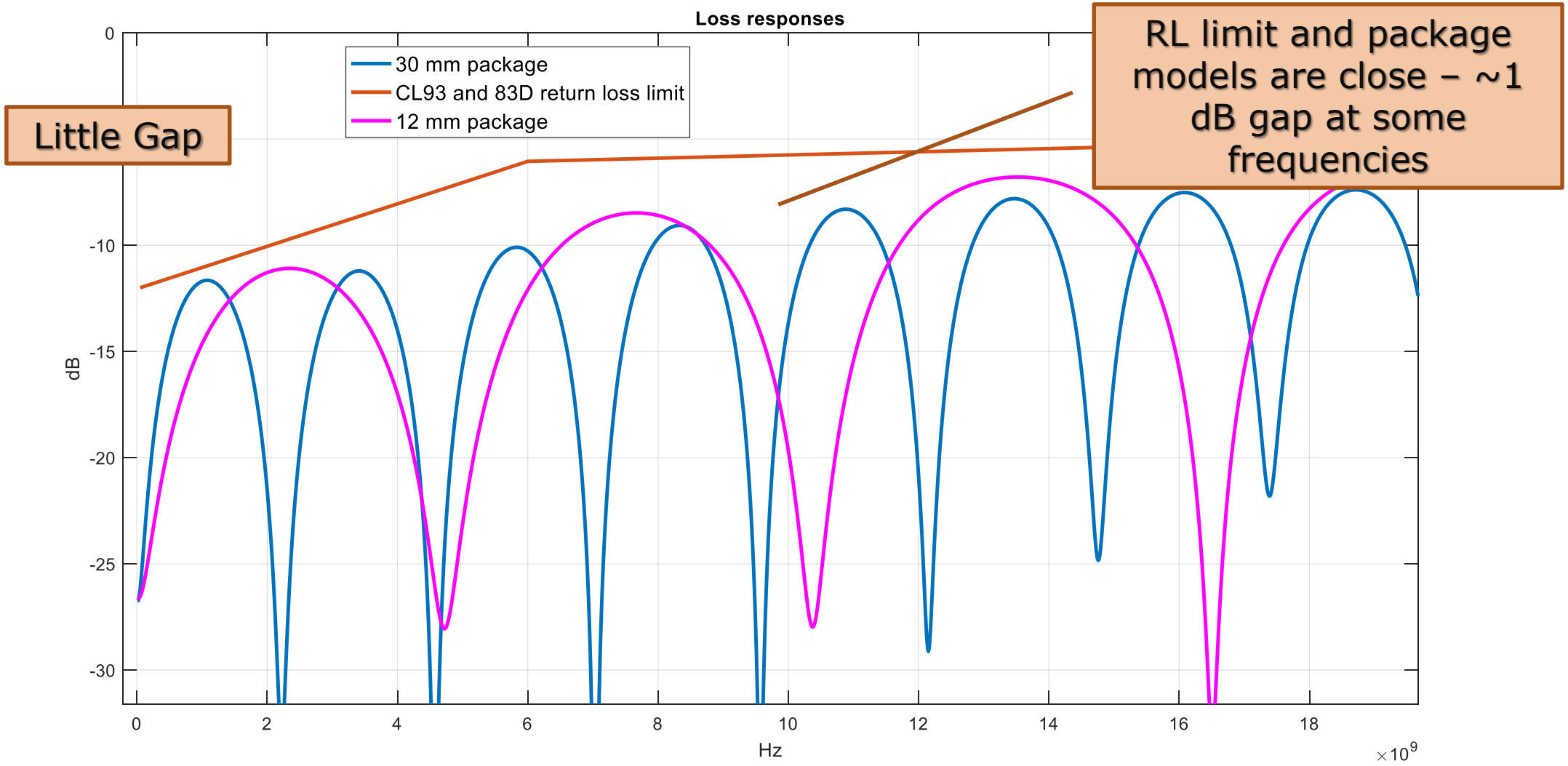
Table 83D–6—Channel Operating Margin parameters *(continued)*

Parameter	Symbol	Value	Units
Device package model			
Single-ended device capacitance	C_d	2.5×10^{-4}	nF
Transmission line length, Test 1	z_p	12	mm
Transmission line length, Test 2	z_p	30	mm
Single-ended board capacitance	C_b	1.8×10^{-4}	nF
Single-ended reference resistance	R_o	50	ohms
Single-ended termination resistance	R_d	55	ohms

Device package model uses characteristic impedance Z_c of 78.2 Ohms (does not appear in the table)

Option A: Go Back to Clause 93 and Annex 83d

COM package return loss compared to RL limit



COM parameters for 120d packages are different from CL93

Table 120D–8—Channel Operating Margin parameters

Parameter	Symbol	Value	Units
Signaling rate	f_b	26.5625	GBd
Maximum start frequency	f_{min}	0.05	GHz
Maximum frequency step	Δf	0.01	GHz
Device package model Single-ended device capacitance Transmission line length, Test 1 Transmission line length, Test 2 Single-ended package capacitance at package-to-board interface Transmission line characteristic impedance	 C_d z_p z_p C_p Z_c	 2.8×10^{-4} 12 30 1.1×10^{-4} 85	 nF mm mm nF Ω
Single-ended reference resistance	R_o	50	Ω
Single-ended termination resistance	R_d	55	Ω

Device package model uses characteristic impedance Z_c of 85 Ohms and pulled into table

Annex 120D Return Loss is Specified in Equation 93-3

Table 120D–1—200GAUI-4 and 400GAUI-8 transmitter characteristics at TP0a

		Value	Units
		5.5625 ± 100 ppm	GBd
		30 1200	mV mV
		1.9	V
		0	V
AC common-mode output voltage[a] (max, RMS)	94.3.12.3	30	mV
Differential output return loss (min)	93.8.1.4	Equation 93-3	dB
Common-mode output return loss (min)	93.8.1.4	Equation 93-4	dB

93.8.1.4 Transmitter output return loss

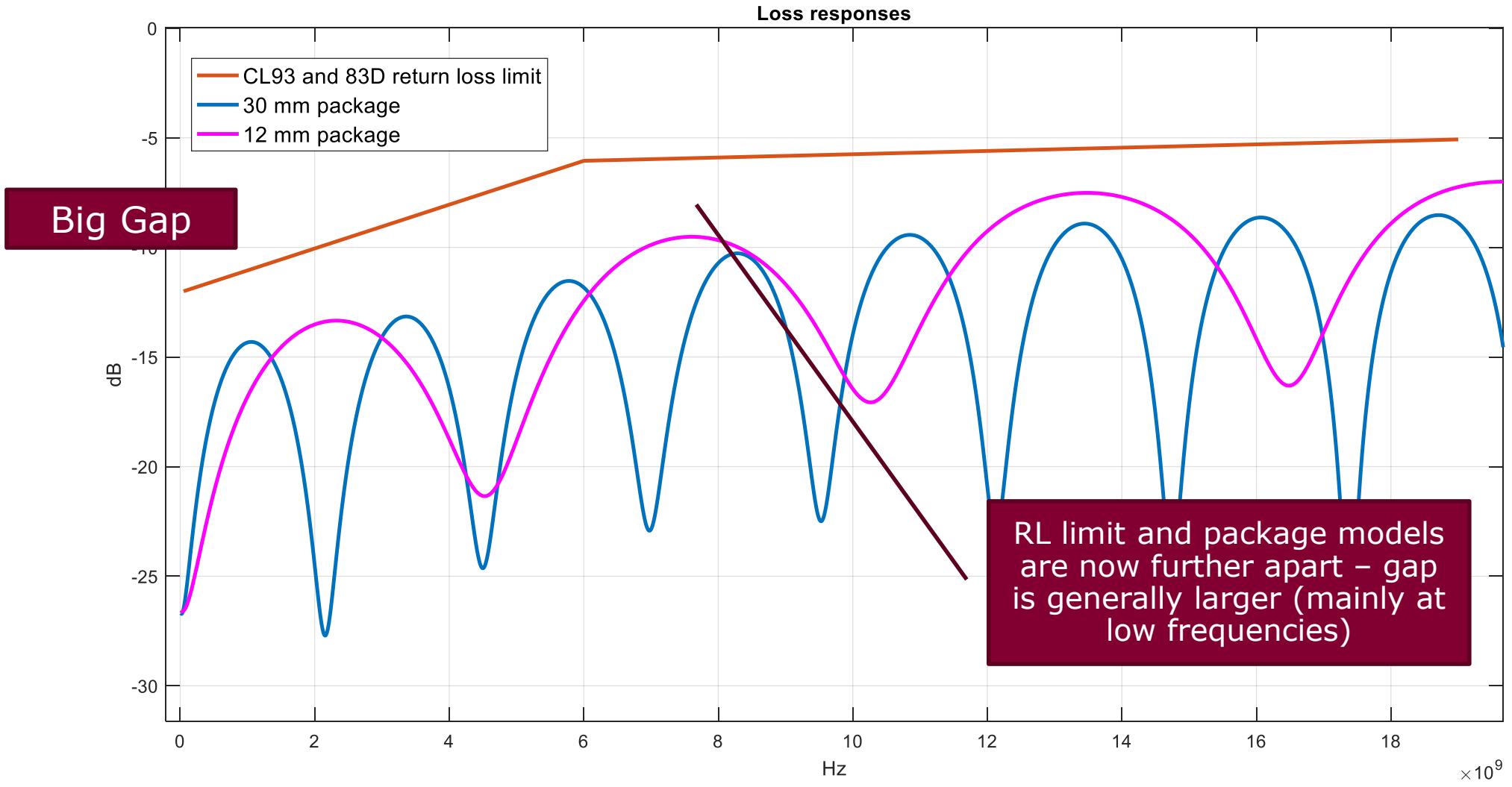
The differential output return loss, in dB, of the transmitter shall meet Equation (93–3) where f is the frequency in GHz. This output impedance requirement applies to all valid output levels. The reference impedance for differential return loss measurements shall be 100 Ω

$$RL_d(f) \geq \begin{cases} 12.05 - f & 0.05 \leq f \leq 6 \\ 6.5 - 0.075f & 6 < f \leq 19 \end{cases} \text{ dB} \qquad (93\text{–}3)$$

Just like the background slides

OPTION B: do nothing and keep what is in D3.0

COM package return loss compared to RL limit



Review of COM Packages in D3.0 Table

Table 83D–6—Channel Operating Margin parameters *(continued)*

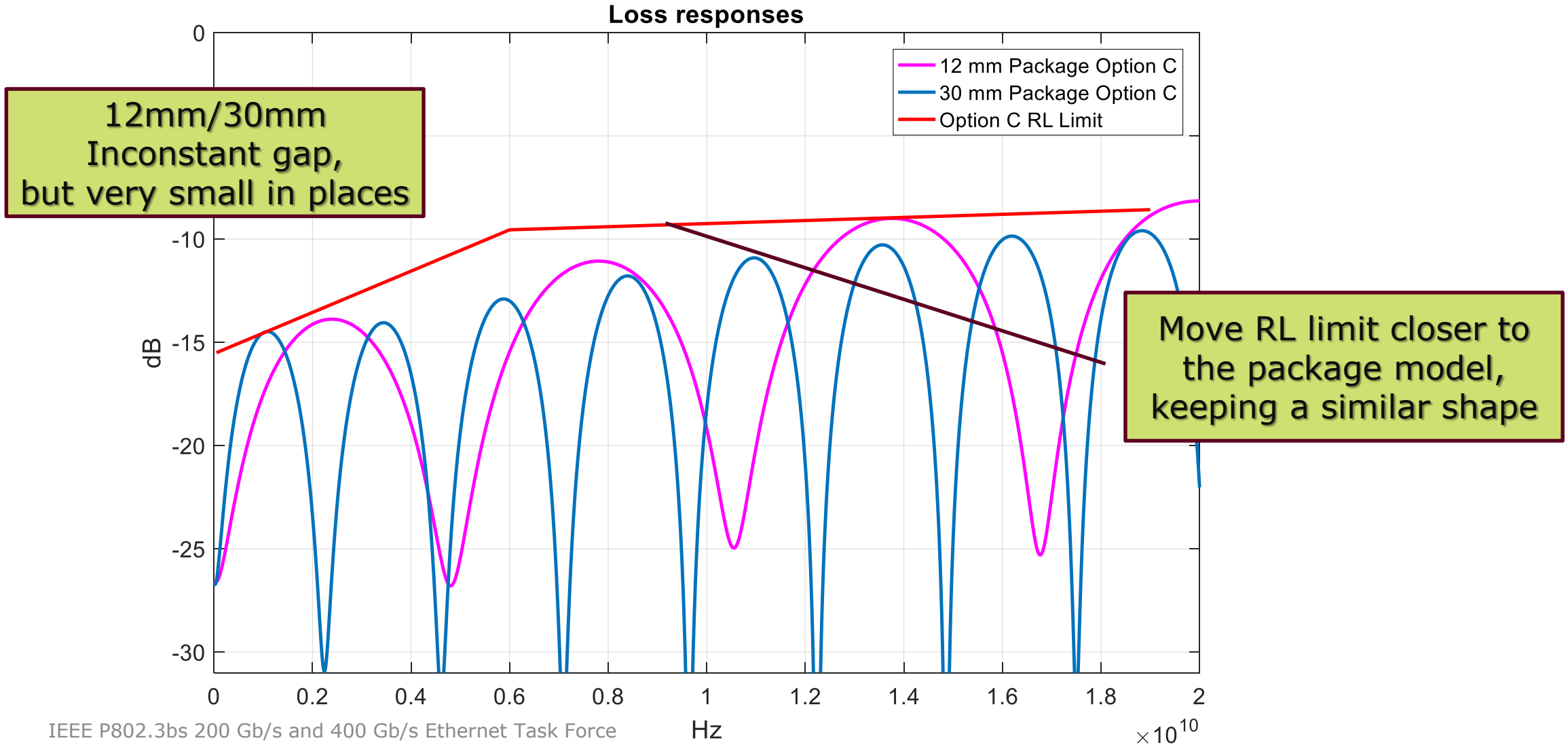
Parameter	Symbol	Value	Units
Device package model			
Single-ended device capacitance	C_d	2.5×10^{-4}	nF
Transmission line length, Test 1	z_p	12	mm
Transmission line length, Test 2	z_p	30	mm
Single-ended board capacitance	C_b	1.8×10^{-4}	nF
Single-ended reference resistance	R_o	50	ohms
Single-ended termination resistance	R_d	55	ohms

(not aligned with Clause 137 P802.3cd Draft 1.2)

OPTION C: keep packages in D3.0 and lower return loss by 3.5 dB to match package

$$RL_d(f) \geq \begin{cases} 15.55 \text{ (was } 12.05) - f & 0.05 \leq f \leq 6 \\ 10 \text{ (was } 6.5) - 0.075f & 6 < f \leq 19 \end{cases} \quad \text{dB}$$

OPTION C D3.0 packages and lower RL to match package
COM package return loss compared to RL limit



Option D: Pedantic COM package parameters for Option C Return Loss

Table 120D–8—Channel Operating Margin parame

Parameter	Symbol	V	
Signaling rate	f_b	26.5625	
Maximum start frequency	f_{min}	0.05	
Maximum frequency step	Δf	0.01	GHz
Device package model			
Single-ended device capacitance	C_d	2.8×10^{-4}	
Transmission line length, Test 1	z_p	12	
Transmission line length, Test 2	z_p	30	
Single-ended package capacitance at package-to-board interface	C_p	1.1×10^{-4}	nF
Transmission line characteristic impedance	Z_c	85	Ω
Single-ended reference resistance	R_o	50	Ω
Single-ended termination resistance	R_d	55	Ω

Device package model			
Single-ended device capacitance Test 1	Cd	1.78×10^{-4}	nF
Single-ended device capacitance Test 2	Cd	2.7×10^{-4}	nF
Transmission line length, Test 1	Zp	12	mm
Transmission line length, Test 2	Zp	30	mm
Single-ended package capacitance at package-to-board interface	Cp	1.1×10^{-4}	nF
Package transmission line characteristic impedance Test 1	Zc	84.5	Ω
Package transmission line characteristic impedance Test 2	Zc	82	Ω

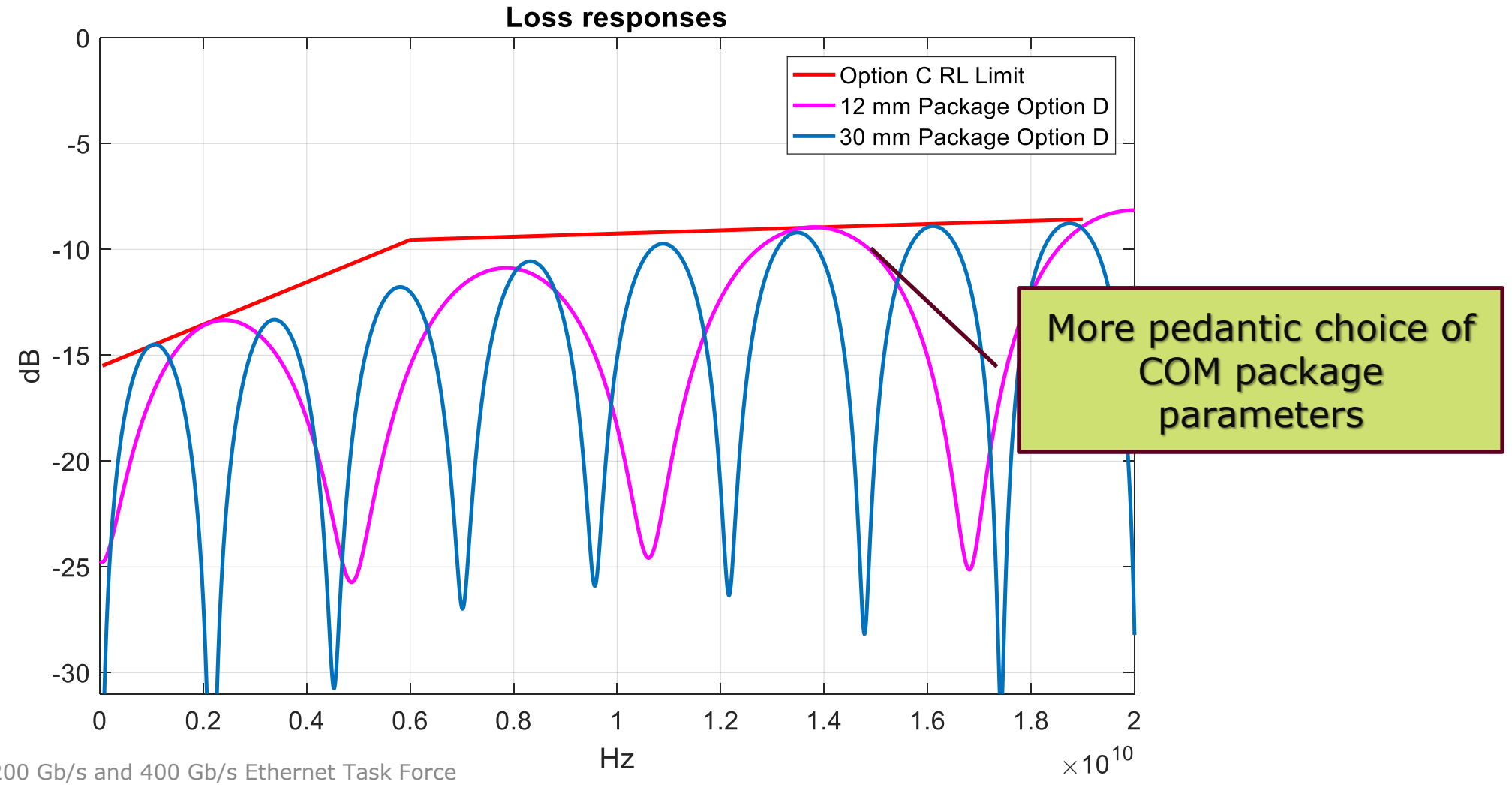
Single-ended termination resistance Test 1	Rd	45	Ω
Single-ended termination resistance Test 2	Rd	50.5	Ω

Option D: Pedantic COM associated voltage amplitude parameters for Option C Return Loss

	f_{p2}	f_b / 40	GHz
Transmitter differential peak output voltage			
Victim	A_v	0.45	V
Far-end aggressor	A_{fe}	0.45	V
Near-end aggressor	A_{ne}	0.63	V

Transmitter differential peak output voltage			
Victim Test 1	A_v	0.42	V
Far-end aggressor Test 1	A_{fe}	0.42	V
Near-end aggressor Test 1	A_{ne}	0.61	V
Victim Test 2	A_v	0.39	V
Far-end aggressor Test 2	A_{fe}	0.39	V
Near-end aggressor Test 2	A_{ne}	0.58	V

Option D: Pedantic COM parameters for 120d package
COM package return loss compared to RL limit



Summary of choices

- Choose OPTION A
  - Go back to clause 93 and Annex 83d
  - Wait for measurement product data
- Choose OPTION B
  - Do nothing. Keep what is in D3.0
  - Wait to align with clause 137
- Choose OPTION C
  - Keep packages in D3.0 and lower return loss by 3.5 dB to match package
  - Aligns with requirements from prior COM analyses
- Choose OPTION D
  - Use lower return loss in OPTION C and specify a new 12 and 30 mm package which matches RL more closely.
  - Lower impact of package proliferations on COM
  - Expected slightly lower COM than for Option B and option C.