Aligning specifications to module insertion loss allocation

(comments #58 and #60)

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Chip-to-module reference insertion loss budget

- The D2.3 reference insertion loss budget allocates 3.8 dB to the module

- This allocation is from the mating point of the MDI connector to TP1d or TP4d (it includes the module device package)

- Note that the reference insertion loss of a host compliance board is also 3.8 dB

- Some module specifications in D2.3 are not consistent with this insertion loss allocation
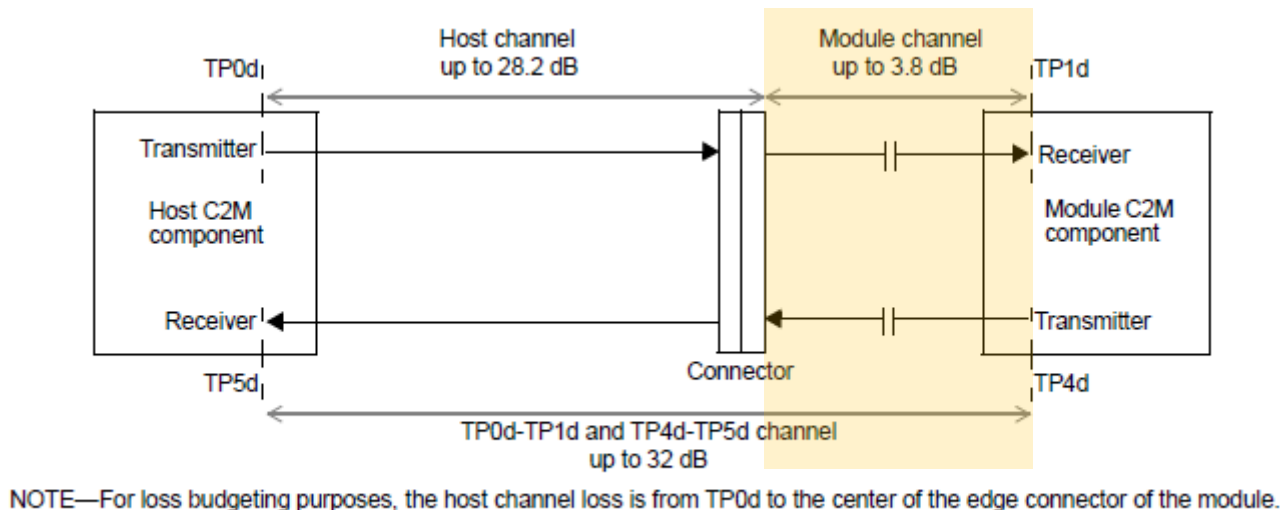
NOTE—For loss budgeting purposes, the host channel loss is from TP0d to the center of the edge connector of the module.

Figure 176D–6—Reference insertion loss budget at 53.125 GHz

D2.3 interference tolerance test calibration

176D.8.13.2 Test channel calibration

The COM of the test channel is calculated using the method defined in Annex 178A and the parameters of 176D.7.2, with the following considerations:
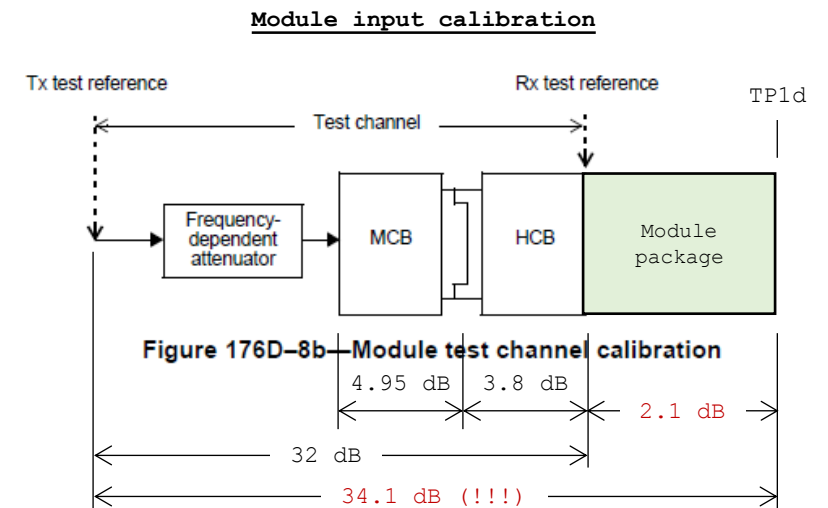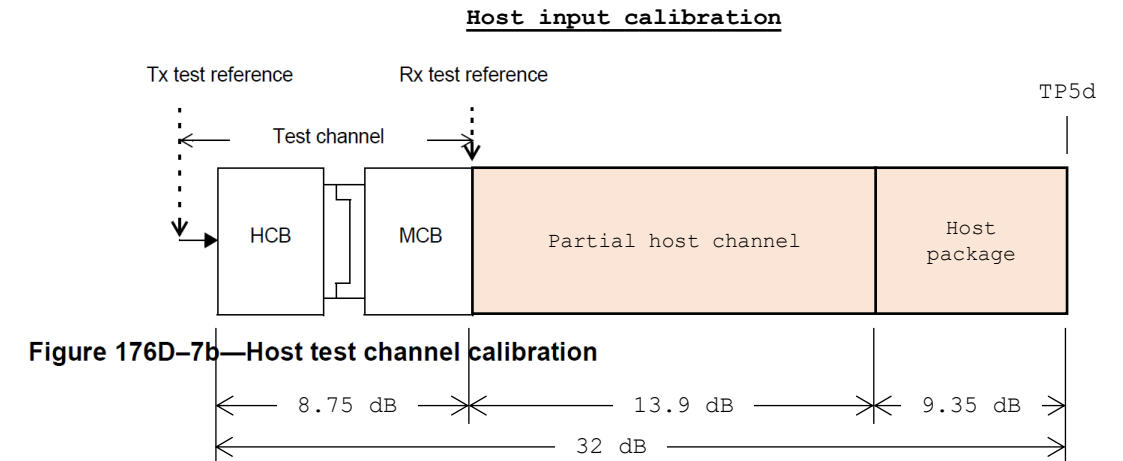
a) For the host test, the test channel is measured between the Tx and Rx test references shown in Figure 176D–7b, and COM is calculated using the partial host channel, device package, and device termination models in Table 176D–6 for the receiver S-parameter model.

b) For the module test, the test channel is measured between the Tx and Rx test references shown in Figure 176D–8b, and COM is calculated using the module device package and device termination models in Table 176D–6 for the receiver S-parameter model. Calculation is performed for both case 1 and case 2 of the package transmission line 1 length, and the value of COM is taken as the lower of the two calculated values.

Table 176D–11—Interference tolerance test parameters

Parameter	Host test	Module test L (low loss)[a]	Module test H (high loss)	Units
Test channel insertion loss at 53.125 GHz	9 ± 2	9 ± 2	32 ± 0.5	dB

Table 176D–6—Host and module model parameters *(continued)*

Parameter	Symbol	Value	Units
Device package model, module			
Transmission line parameter γ_0	γ_0	5×10^{-4}	1/mm
Transmission line parameter a_1	a_1	8.9×10^{-4}	ns$^{1/2}$/mm
Transmission line parameter a_2	a_2	2×10^{-4}	ns/mm
Transmission line parameter τ	τ	6.141×10^{-3}	ns/mm
Transmission line 1 length, case 1	$z_p^{(1)}$	4	mm
Transmission line 1 length, case 2	$z_p^{(1)}$	10	mm
Transmission line 1 characteristic impedance	$Z_c^{(1)}$	87.5	Ω
Transmission line 2 length	$z_p^{(2)}$	1.8	mm
Transmission line 2 characteristic impedance	$Z_c^{(2)}$	92.5	Ω
Single-ended package capacitance at package-to-board interface	C_p	40×10^{-6}	nF

Host input calibration

Figure 176D–7b—Host test channel calibration

Module input calibration

Figure 176D–8b—Module test channel calibration

Assumed module loss is too high!

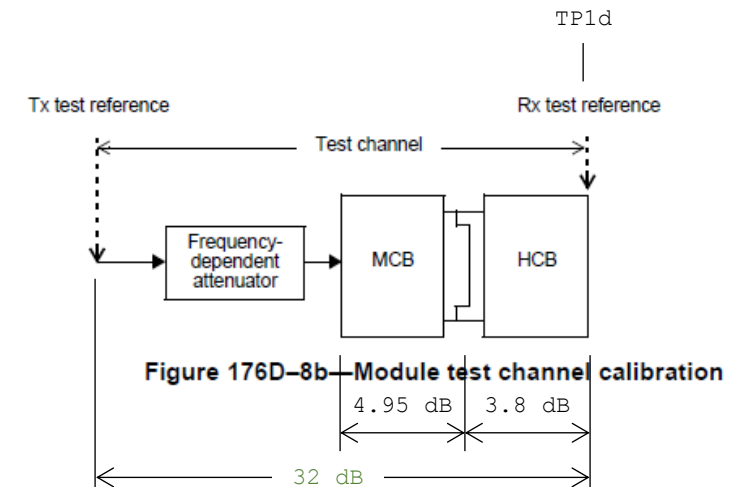# Correction to interference tolerance test calibration

176D.8.13.2 Test channel calibration

The COM of the test channel is calculated using the method defined in Annex 178A and the parameters of 176D.7.2, with the following considerations:

a) For the host test, the test channel is measured between the Tx and Rx test references shown in Figure 176D–7b, and COM is calculated using the partial host channel, device package, and device termination models in Table 176D–6 for the receiver S-parameter model.

b) For the module test, the test channel is measured between the Tx and Rx test references shown in Figure 176D–8b, and COM is calculated using the ~~module device package and~~ device termination models~~~~ in Table 176D–6 for the receiver S-parameter model. ~~Calculation is performed for both case 1 and case 2 of the package transmission line 1 length, and the value of COM is taken as the lower of the two calculated values~~.

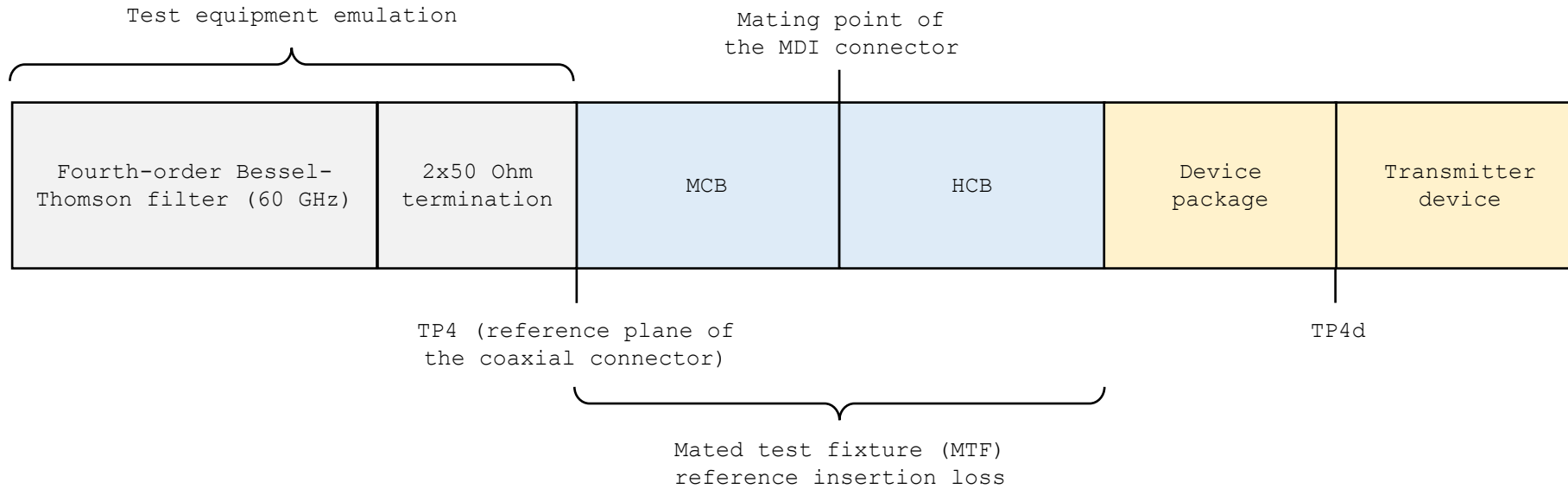### Table 176D–11—Interference tolerance test parameters

Parameter	Host test	Module test L (low loss)[a]	Module test H (high loss)	Units
Test channel insertion loss at 53.125 GHz	9 ± 2	9 ± 2	32 ± 0.5	dB

TP1d

Tx test reference

Rx test reference

Test channel

Frequency-dependent attenuator

MCB

HCB

Figure 176D–8b—Module test channel calibration
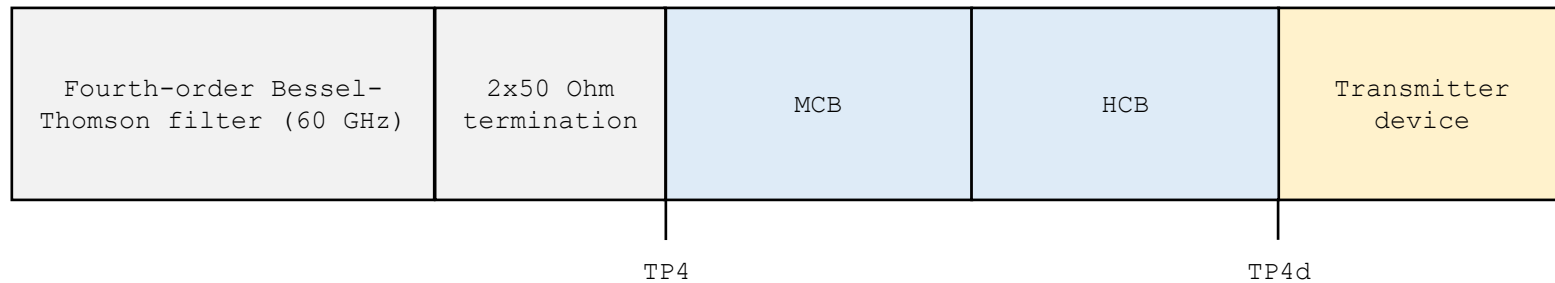
4.95 dB   3.8 dB

32 dB

Module output R_{peak} and v_f

- In healey_3dj_01a_2511, module output specification limits were derived from the Channel Operating Margin (COM) model of a module transmitter and the mated test fixture reference insertion loss

- Limits were computed with a module device package model in addition to the host compliance board

- This was consistent with the interference tolerance test calibration but not consistent with the module loss allocation

- If the interference tolerance test calibration is corrected, then the module output specification limits should also be revisited

Model of a module transmitter

Test equipment emulation

Mating point of
the MDI connector

Model used to compute
D2.3 module output R_{peak}
and v_f specification limits

Fourth-order Bessel-Thomson filter (60 GHz)	2x50 Ohm termination	MCB	HCB	Device package	Transmitter device

TP4 (reference plane of
the coaxial connector)

TP4d

Mated test fixture (MTF)
reference insertion loss

Corrected model

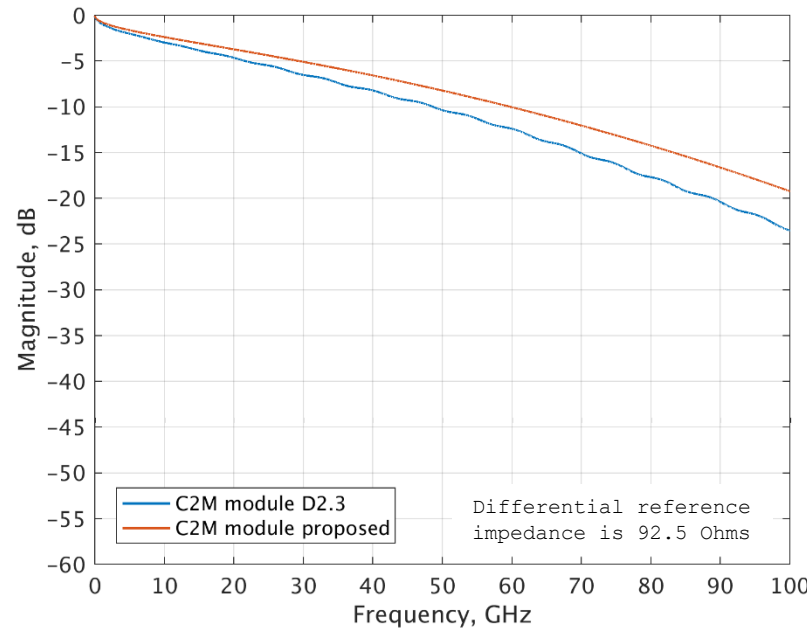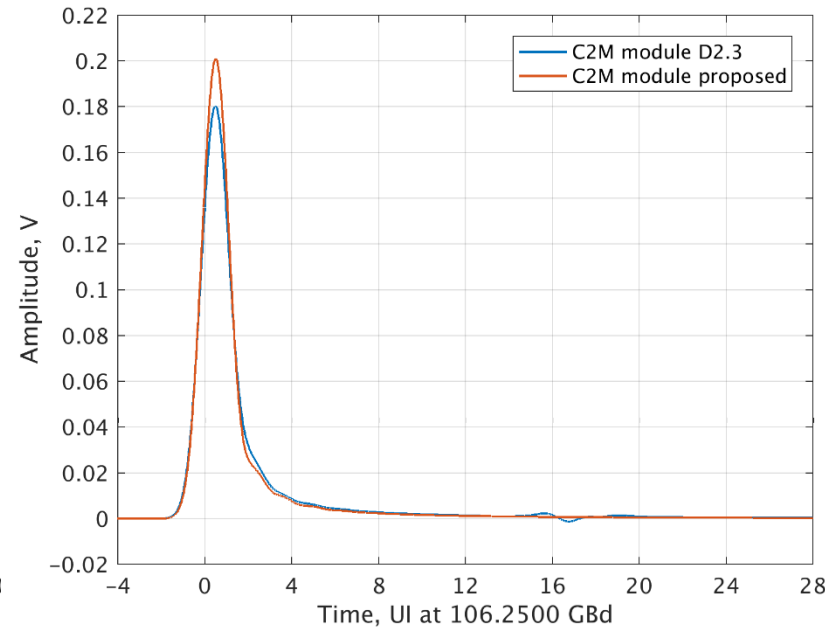| Fourth-order Bessel-Thomson filter (60 GHz)	2x50 Ohm termination	MCB	HCB	Transmitter device

TP4

TP4d

Note that the transmitter device model includes the device termination model and the input rise time filter

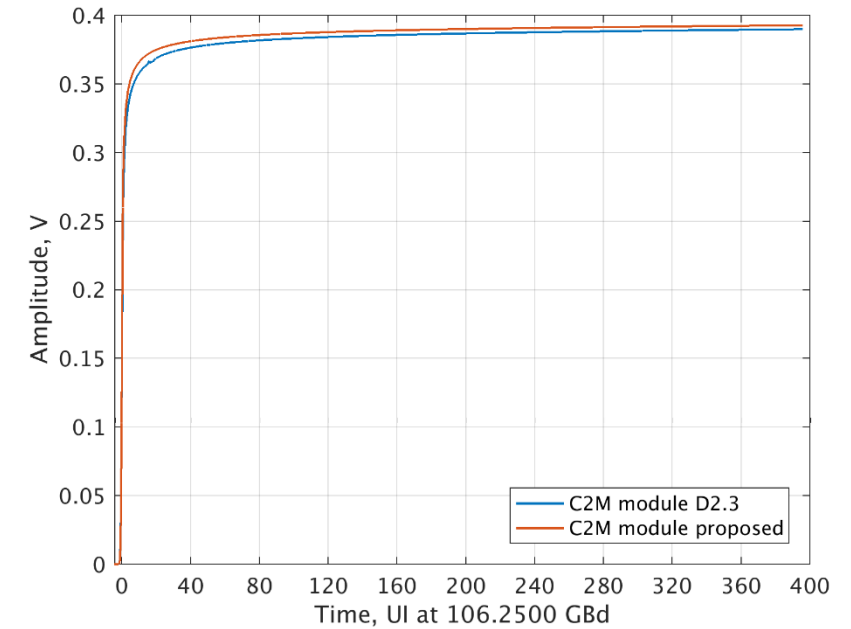# Specification limits recalculated using the corrected model

Case	Package		Insertion loss, dB		p_{max}, v	v_f, v	R_{peak}
	Class	Length, mm	Mated test fixture	TP4d-to-TP4			
C2M module, D2.3	A	10	8.75	10.82	0.179	0.389	0.46
C2M module, proposed	n/a	n/a	8.75	8.75	0.2	0.392	0.51

Corrected specification limits

Recommendations

- Remove module device package model from module interference and jitter tolerance test calibration

- Update module output R_{peak} and v_f limits to be consistent with its insertion loss allocation