MTF ILdd Revisited

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D2.3 comment #85

Introduction – comment #85 from D2.3

Cl **179B** *SC* **179B.4.1** *P* **912** *L* **10** # 85

Ran, Adee — Cisco Systems

Comment Type **T** *Comment Status* **R** *Test fixtures (E)*

The difference between minimum and maximum ILdd for mated test fixtures is about 3 dB at the Nyquist frequency.
This difference allows significant variations in cable assembly test fixture (MCB), which can have a double effect (up to 6 dB) if used to measure a cable.

SuggestedRemedy

Reduce the allowed variablility of test fixtures, or its effect on measurements.
A detailed proposal is planned.

Response *Response Status* **C**

REJECT.
This comment does not apply to the substantive changes between IEEE P802.3dj D2.2 and D2.3. However, the commenter indicated that it is related to unsatisfied comment #306 against D2.2 (see <https://www.ieee802.org/3/dj/comments/D2p2/8023dj_D2p2_comments_final_id.pdf#page=84>), so it is considered in scope.

The CRG has reviewed the following contributions:
<https://www.ieee802.org/3/dj/public/26_01/ran_3dj_02_2601.pdf>
<https://www.ieee802.org/3/dj/public/26_01/mammenga_3dj_01_2601.pdf>

Note the the draft states that "The effects of differences between the insertion loss of an actual test fixture and the reference insertion loss are to be accounted for in the measurements".

The comment suggests changes that are a potential improvement, but the specific details are not clear.

The discussion did not show consensus for any of the directions in the presentation.

Future work and consensus building on this topic are encouraged.
There was no consensus to make a change.

Also, there was a previously unsatisfied comment against D2.2 on the topic.

Cl **179B** *SC* **179B.4.2** *P* **905** *L* **20** # 306

Noujeim, Leesa — Google

Comment Type **TR** *Comment Status* **R** *test fixtures (E)*

Ildd_MTFmin is, at fNyquist, 4dB lower than Ildd_MTFmax. This large allowed variation in MTF IL introduces too much uncertainty as to whether a given DUT (host or cable assembly) passes or fails due to variation in the test fixture.

SuggestedRemedy

Decrease the spread between ILddMTFmin and ILddMTFmax to ~2dB, by adjusting equations 179B-3 and 179B-4.

Response *Response Status* **U**

REJECT.
The comment identifies an area for potential improvement in the current draft. However, the suggested remedy does not provide sufficient detail to implement.
A contribution with a detailed proposal would be helpful for the CRG to drive consensus on a specific change.

Ran Contribution from January 2026

Test fixture ILdd specifications

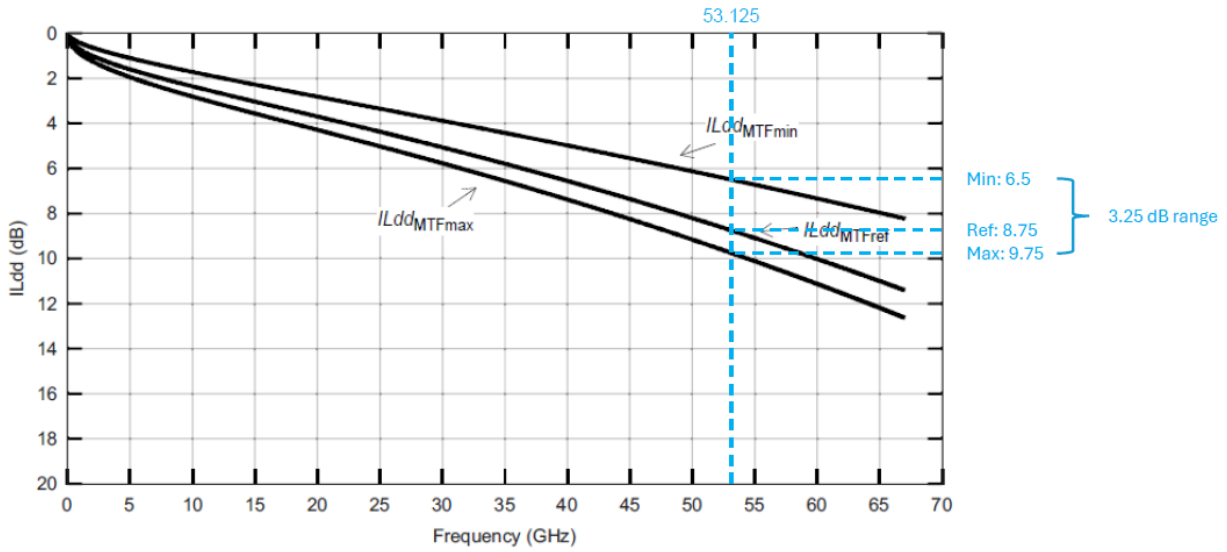

Figure 179B–2—Mated test fixtures insertion loss

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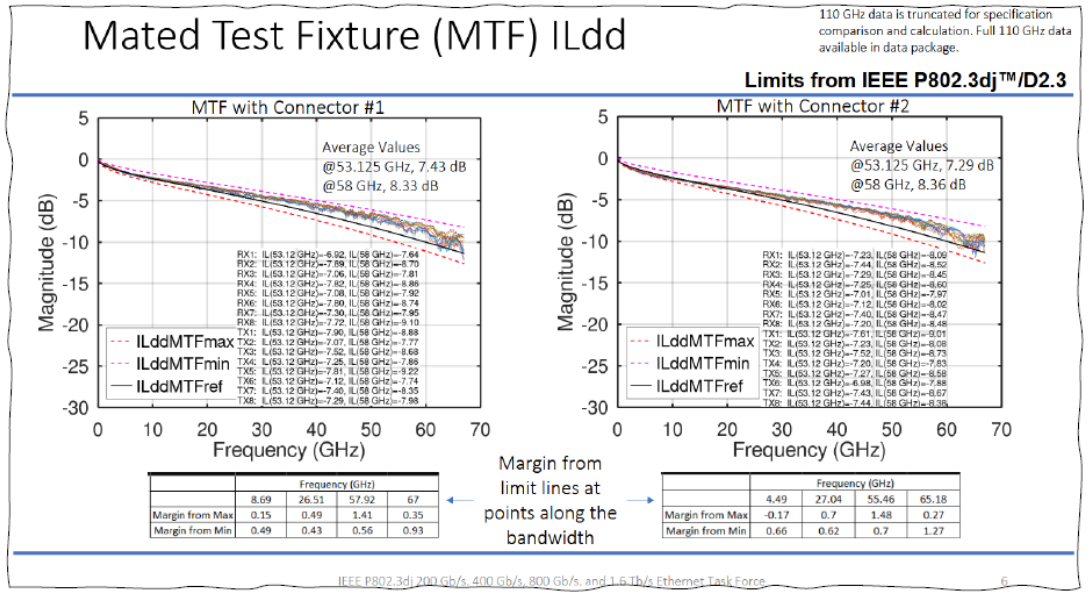
https://www.ieee802.org/3/dj/public/26_01/ran_3dj_02_2601.pdf

Ran Contribution from January 2026

MTF measurement data



	Frequency (GHz)			
	8.69	26.51	57.92	67
Margin from Max	0.15	0.49	1.41	0.35
Margin from Min	0.49	0.43	0.56	0.93

	Frequency (GHz)			
	4.49	27.04	55.46	65.18
Margin from Max	-0.17	0.7	1.48	0.27
Margin from Min	0.66	0.62	0.7	1.27

Variation between lanes on the same MTF is significant – at 53.125 GHz, 0.98 dB for "connector #1", 0.69 dB for "connector #2". There is a larger variation above 53.125 GHz

The differences seem mainly in the ripple.

The range can be tightened somewhat by raising the "max" line (and the reference line)…
But this might coincide with manufacturing variations and yield

Source: mammenga_3dj_adhoc_01_251216, slide 6 (Kevin Mammenga, Wilder Technologies)

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https://www.ieee802.org/3/dj/public/26_01/ran_3dj_02_2601.pdf

Ran Contribution from January 2026

What can we do

- One direction is to reduce variability, but without causing actual test fixtures to fail
- Since the ripple is limited by another specification (FOM_{ILD}) we can apply a tighter mask to the **fitted** ILdd (which should be less variable)
- The following piecewise-linear equations (with ±0.5 dB tolerance) create a possible mask based on the Mammenga dataset:
  - Min fitted ILdd: $\begin{cases} 1.8 + 0.11(f - 10) & 10 < f \leq 40 \\ 5.1 + 0.15(f - 40) & 40 < f \leq 60 \end{cases}$
  - Max fitted ILdd: $\begin{cases} 2.8 + 0.11(f - 10) & 10 < f \leq 40 \\ 6.1 + 0.15(f - 40) & 40 < f \leq 60 \end{cases}$
- Visualized on the next slide

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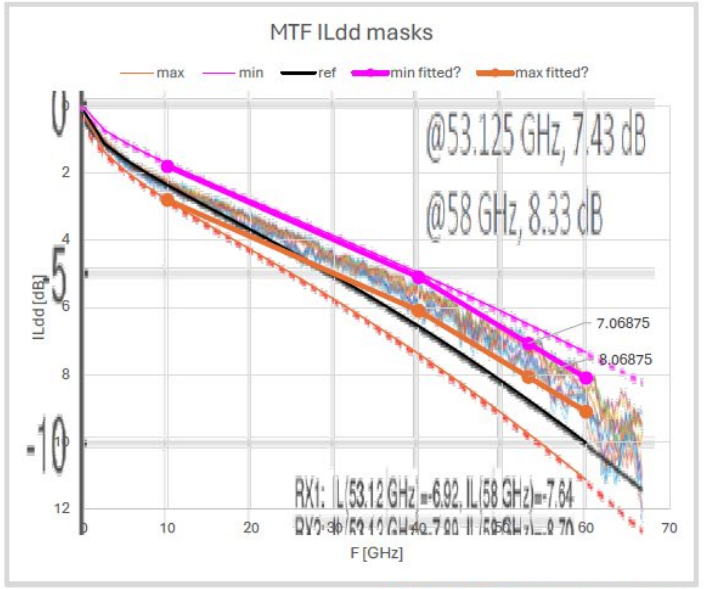
https://www.ieee802.org/3/dj/public/26_01/ran_3dj_02_2601.pdf

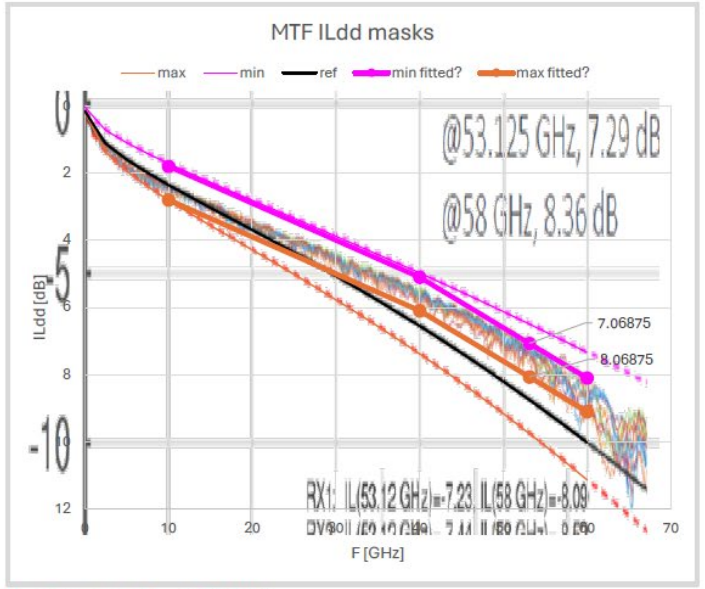
Ran Contribution from January 2026

Example fitted ILdd masks

Mask overlaid on "MTF with Connector #1" plots



Mask overlaid on "MTF with Connector #2" plots



Data from mammenga_3dj_adhoc_01_251216

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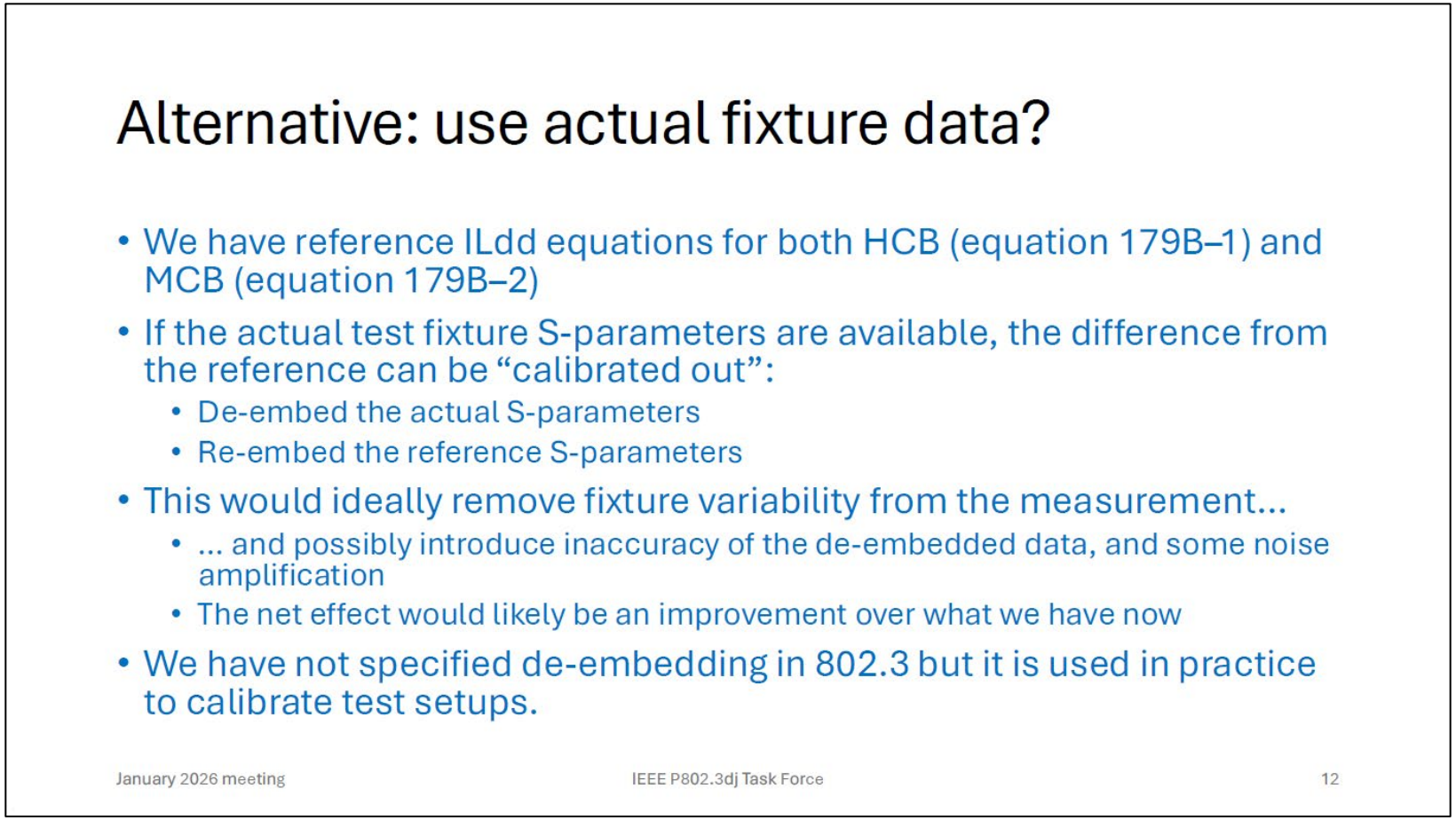
https://www.ieee802.org/3/dj/public/26_01/ran_3dj_02_2601.pdf

Ran Contribution from January 2026



Alternative: use actual fixture data?

- We have reference ILdd equations for both HCB (equation 179B–1) and MCB (equation 179B–2)
- If the actual test fixture S-parameters are available, the difference from the reference can be “calibrated out”:
  - De-embed the actual S-parameters
  - Re-embed the reference S-parameters
- This would ideally remove fixture variability from the measurement…
  - … and possibly introduce inaccuracy of the de-embedded data, and some noise amplification
  - The net effect would likely be an improvement over what we have now
- We have not specified de-embedding in 802.3 but it is used in practice to calibrate test setups.

https://www.ieee802.org/3/dj/public/26_01/ran_3dj_02_2601.pdf

Offline Discussion Points that I Hear

- Current fixture specs are too loose, causing significant measurement variability across vendors and labs.
- Reference definitions are incomplete (IL-only, no S-parameters), making calibration and de-embedding impractical today.
- Cable results depend heavily on host-side connectors, which makes true cable-only compliance difficult.
- Two main paths forward:
  - Fitted mask or
  - de-embed/re-embed calibration using fixture S-parameters.

Summary & Discussion

- A comment was filed on this topic against D3.0
- What is the consensus?

Thanks !