802.3dj - CR Considerations for Test Fixture Specifications

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Purpose

- Review methodology for accounting for the effects of the differences between the insertion loss of an actual test fixture and the reference 802.3dj test fixture insertion losses.
  - Consider IEEE 370 specification methods "for quantifying and validating test fixture accuracy"
  - Procedures for TP2 (TX) and TP3 (RX) measurements with "accounting".

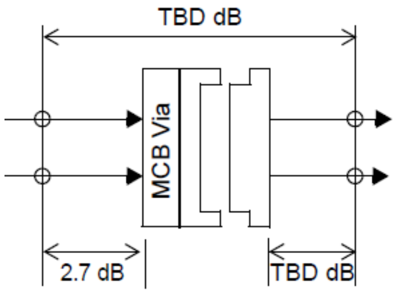
Background

- **Baseline adoption**
  - **TP1-TP4 and MCB IL adopted**
  - **MTF and HCB TBD**

Motion #13

Move to adopt the “TP1-TP4 IL” column in the table and MCB insertion loss (2.7 dB) on slide 9 of diminico_3dj_01_2311 for 200GBASE-CR1, 400GBASE-CR2, 800GBASE-CR4 and 1.6TBASE-CR8 PHYs.

M: Chris Diminico
S: Nathan Tracy
Technical (>=75%)
802.3 voters only
Result: passed by unanimous consent. 9:02 a.m.
Task Force: 3dj



Mated cable assembly
and test point test fixture

- Flexible host architectures and cable assemblies HN-HN depicted

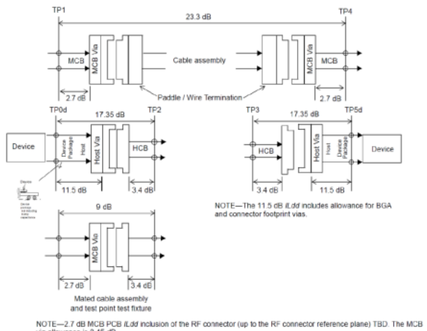
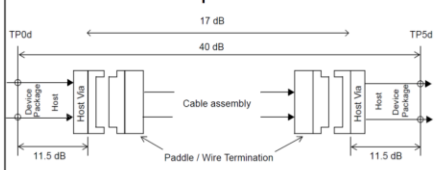


Figure XXXA–3—Cable assembly, host, and test fixture insertion loss at 53.125 GHz

Adopted



Die-to-die ILdd = 40 dB @ 53.125 GHz = 2*(11.5+2.45)+12.1

NOTE—Die-to-die ILdd derived from cable assembly host, and mated test fixture

Figure XXXA–4—Die-to-die insertion loss at 53.125 GHz

- Informative annex with inclusion of flexible host architectures and cable assemblies IL dB @53.125 GHz

Cable Assembly	Link Configurations IL	TP0d-TP2 IL (dB)	TP3-TP5d IL (dB	Cable +2*connectors IL (dB)	TP1-TP4 IL (dB)	MTF IL (dB)	Die-to-die IL (dB)
CA-A	HH-HN	22.35	17.35	12	18.3	9	40
CA-B	HH-HL	22.35	12.35	17	23.3	9	40
CA-B - depicted	HN-HN	17.35	17.35	17	23.3	9	40
CA-C	HN-HL	17.35	12.35	22	28.3	9	40
CA-D	HL-HL	12.35	12.35	27	33.3	9	40

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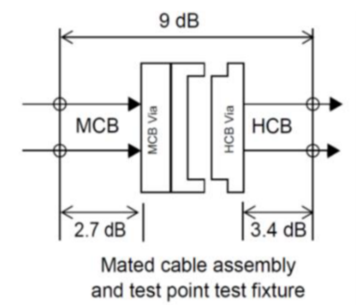
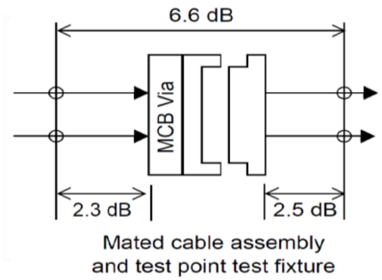
HCB IL

- HFSS model results presented; feasibility - HCB 3.4 dB @53.125 GHz
- Achieving 3.4 dB HCB TF meeting SI that's mechanically reliable (cycle life) challenging
- Considerable interest in minimizing HCB IL for TP2/TP3 measurements

Mated test fixture insertion loss - HFSS model



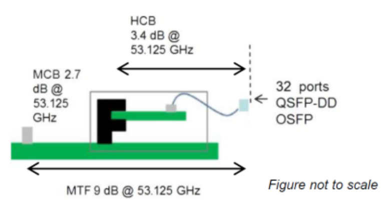
insertion loss @ 53.125 GHz



insertion loss @ 26.56 GHz

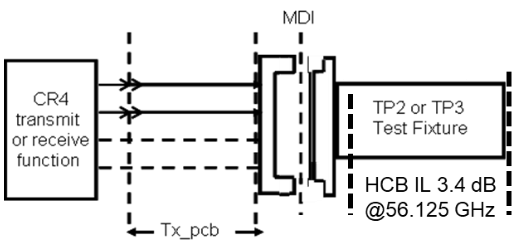
Figure source:
IEEE Draft
P802.3ck/D3.1

Component	Insertion Loss (dB)
Module Compliance Board (MCB) PCB - 2" of ~1.35 dB/in	2.7
Host Compliance Board (HCB) - 1inch*1.35dB/in + 6inch coax * .28dB/inch + 0.5dB via and co-ax transitions.	3.4
Mated Test Fixture (MTF)	9
MTF connector + 2 via's	2.9



Mated test fixture and host insertion loss allocations @ 53.125 GHz

Source: https://www.ieee802.org/3/df/public/adhoc/electrical/22_0502/diminico_3df_01_220502.pdf



802.3ck - TP2/TP3 TF (HCB) and CATF (MCB) reference IL

- 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 without guidance.

162B.2 TP2 or TP3 test fixture

The TP2 or TP3 test fixture (also known as Host Compliance Board) is required for measuring the transmitter and receiver specifications at TP2 and TP3. The TP2 and TP3 test points are illustrated in Figure 162–2.

162B.2.1 TP2 or TP3 test fixture insertion loss

The TP2 or TP3 test fixture printed circuit board (PCB) insertion loss values determined using Equation (162B–1) shall be used as the TP2 or TP3 test fixture reference insertion loss. 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.

$$ILdd_{tfref}(f) = 1.02(0.001 + 0.24\sqrt{f} + 0.046f) \qquad (162B\text{–}1)$$

for $0.01 \text{ GHz} \le f \le 50 \text{ GHz}$

where

$ILdd_{tfref}(f)$	is the test fixture PCB reference insertion loss in dB at frequency f
f	is the frequency in GHz

The TP2 or TP3 test fixture PCB reference insertion loss is illustrated in Figure 162B–1.

162B.3.1 Cable assembly test fixture insertion loss

The cable assembly test fixture PCB and test point insertion loss values determined using Equation (162B–2) shall be used as the test fixture reference insertion loss. 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.

$$ILdd_{catf}(f) = 1.073(-0.00125 + 0.12\sqrt{f} + 0.0575f) \qquad (162B\text{–}2)$$

for $0.01 \text{ GHz} \le f \le 50 \text{ GHz}$

where

$ILdd_{catf}(f)$	is the test fixture PCB reference insertion loss in dB at frequency f
f	is the frequency in GHz

The cable assembly test fixture reference insertion loss is illustrated in Figure 162B–1.

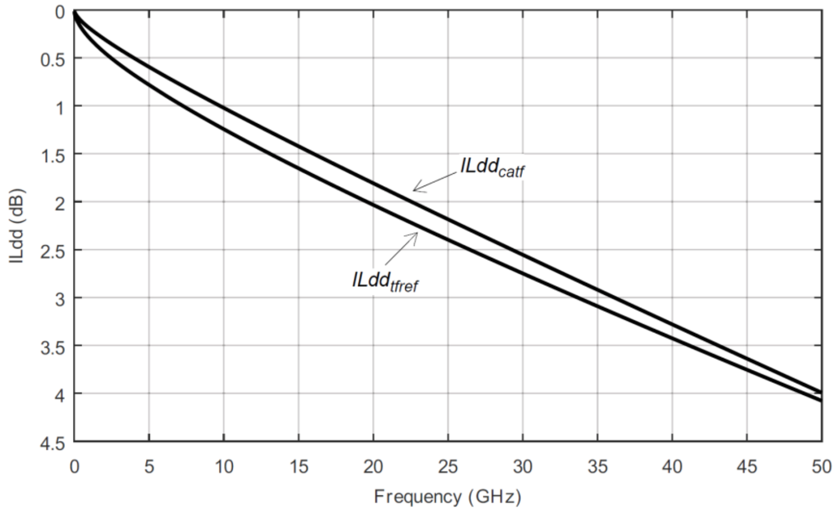
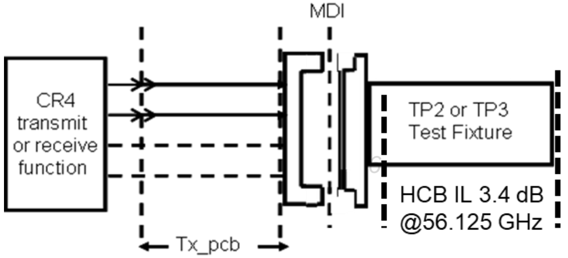
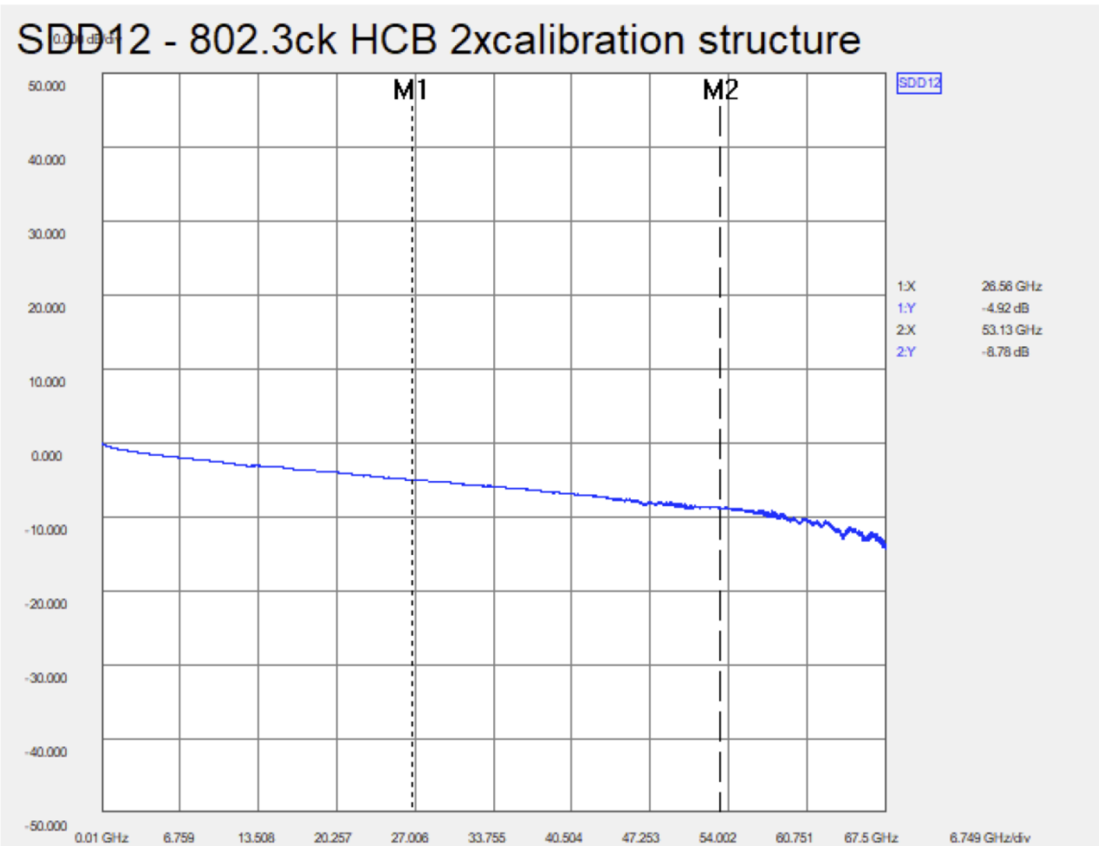


Figure 162B–1—Test fixtures PCB reference insertion losses



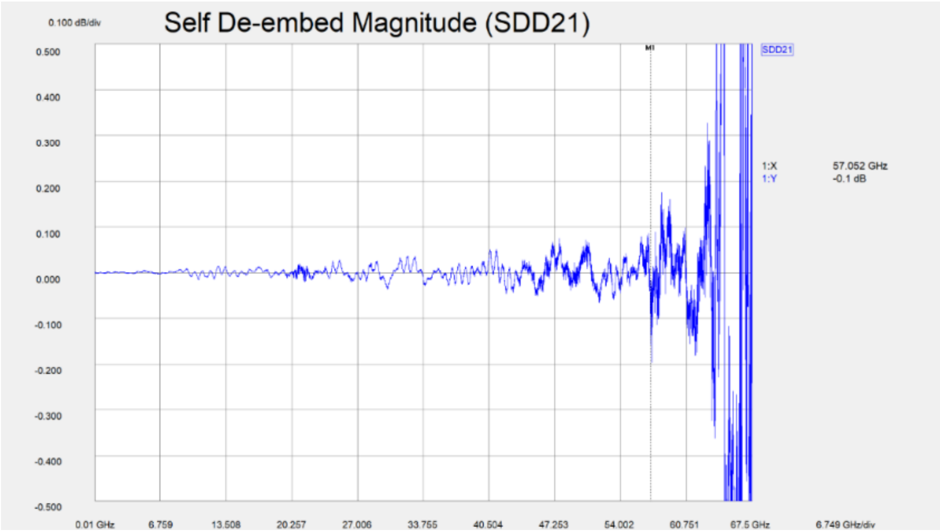
IEEE 370 specification test fixture accuracy

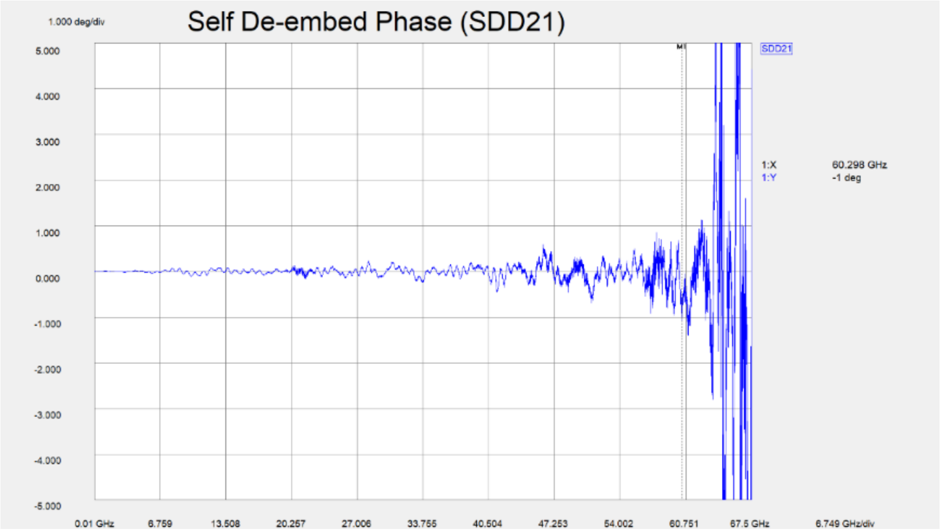
- 802.3ck HCB measured to 67.5 GHz
  - 2xcal IL @ 53.125 - ~ 8.8 dB
  - HCB IL @ 53.125 - ~ 4.4 dB



- One of the initial tests mentioned in IEEE 370 is the self de-embed, or residual test.
- This test will show how well a 2x thru fixture can be de-embedded from itself.
- Measurements of a 2x thru cal structure of a 802.3ck host compliance board (HCB) was used in the self-de-embed test.

IEEE 370 - self de-embed, or residual test





- The ‘residual’ results would ideally be a perfect 0 dB transmission and 0 degrees phase response.

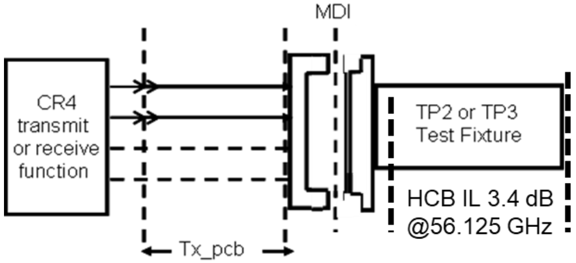
- Due to measurement and calculation uncertainties, there will be some artifacts remaining from the process. To bound the response the recommended limits of +/- 0.1 dB for magnitude and +/- 1 degree for phase are applied.

- 802.3ck signaling rate 56.125 GHz. Nyquist 26.56 GHz

IEEE 370 - FER1, FER2, and FER3

- HCB 2x-thru measurement is compared against FER1, FER2, and FER3.
- Limit lines are added to show the fixture meets these requirements to at least the Nyquist frequency of 200G PAM4 serial data, 53.125 GHz. Examining the data at higher frequencies, the HCB exceeds FER 3 near 62 GHz.

- *Validated test fixtures are deemed suitable to be used to account for differences in measurement to reference IL (de-embedding).*



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Summary

- Review methodology for accounting for the effects of the differences between the insertion loss of an actual test fixture and the reference 802.3dj test fixture insertion losses.
  - Consider IEEE 370 specification methods "for quantifying and validating test fixture accuracy"
  - Procedures for TP2 (TX) and TP3 (RX) HCB measurements to adjust HCB IL to reference IL.