Channel Budgeting: "dB or not dB"

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Supporters

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- Kent Lusted – Intel Corporation

Premise

- 3 meter cables can operate without FEC
- Passing COM (channel operating margin) without FEC can be achieved on at least one test channel with 30dB loss.
- Explore cable loss budgeting and applicability for 30dB tp0-tp5 insertion loss
- Compare various Clause 91 RS-FEC options in regards to loss budgeting
- Recommend informative host loss targets
- Follow on to:
  - http://www.ieee802.org/3/25GSG/public/Sept14/mellitz_25GE_01_0914a.pdf
  - http://www.ieee802.org/3/25GSG/public/adhoc/architecture/mellitz_01_081914a_25GE_adhoc.pdf
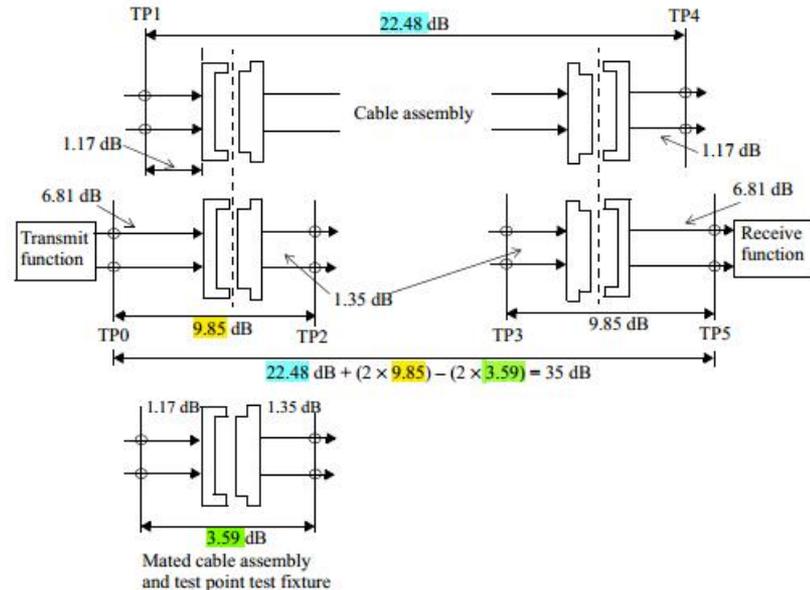
The 5 Meter Cable Loss Budget Is 35db

- 22.48 dB + (2 × 9.85dB) – (2 × 3.59dB) = 35 dB

IEEE P802.3bj/D3.2
11th April 2014

Draft Amendment to IEEE Std 802.3-2012

NOTE—The connector insertion loss is 1.07 dB for the mated test fixture. The host connector is allocated 0.62 dB of additional margin.

Figure 92A–2—35 dB channel insertion loss budget at 12.8906 GHz

Explanation of Host Budget Method based on Clause 92.10.7 and Annex 92A

- An informative estimate of host loss is 6.81dB
- COM calculations add 6.26dB to of trace to each side of the fixture cable assembly
  The test fixture trace is 1.17dB
  - Note on figure 92A–2: "The host connector is allocated 0.62 dB of additional margin."
- Hence: 6.26dB+1.17dB–0.62dB = 6.81dB
- COM is expected to pass with the added 6.26dB.
- The host loss addition my be adjusted by scaling Z_b.
- Example: If we find COM just passes by scaling Z_b to say 3.26dB, that would mean the host board should be reduced by 3dB resulting in a host loss of 3.81dB
- Passing COM limit is 3dB.
  - Clause 93.9.1

A 5 Meter Cable (26awg) Passes with FEC and Clause 92 Host

- ▸ **COM passes with 3.2 dB as expected**
- ▸ Amphenol QSFP28 5m 26AWG NDAAFJ0004 APN14270043HFM–– P1TX1_P2RX1
 - ◦ matoglu_25GE_01_1114

TP0→TP5 IL @ 12.89GHz : 34.5dB
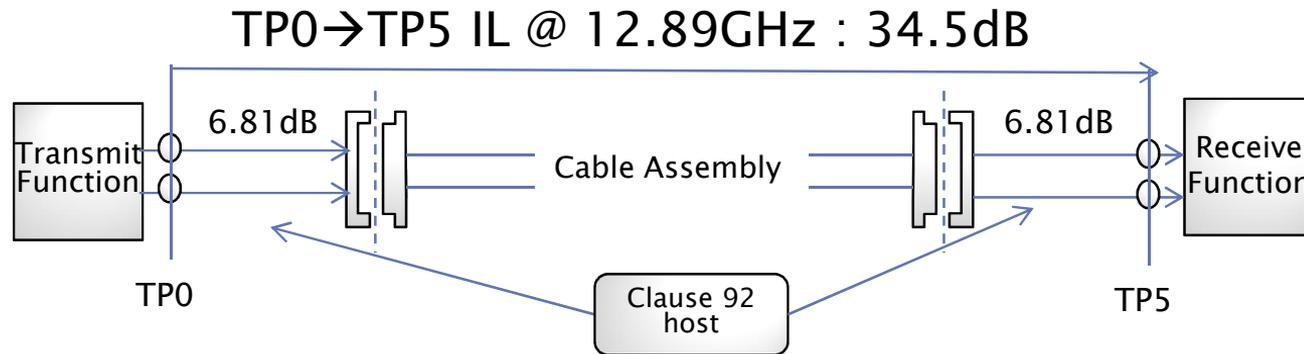
A 3 Meter Cable Passes COM with FEC and Clause 92 Host Loss

- COM passes with 5.7 dB as expected
- Amphenol 3m 26AWG QSFP–4SFP APN43140033HXJ--P2TX1 P1RX1
  - matoglu_25GE_01_1114

TP0→TP5 IL @ 12.89GHz : 27.44dB
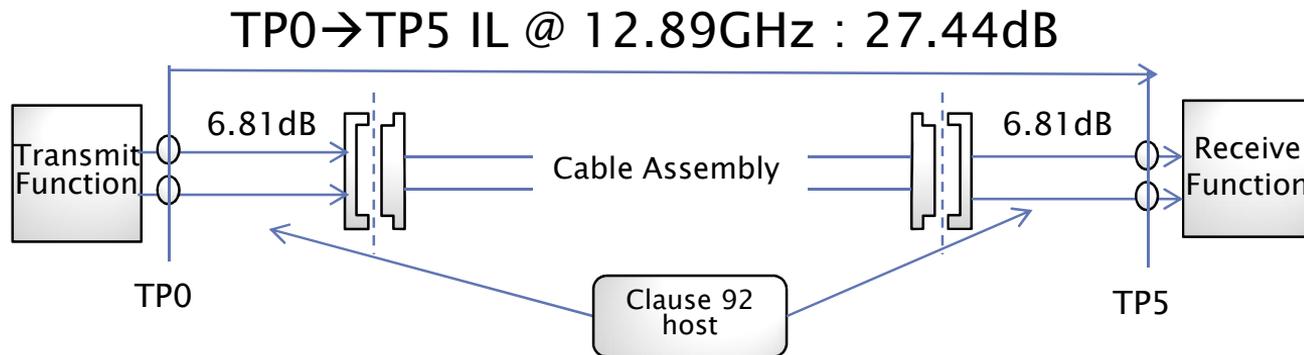
A 3 Meter Cable Fails COM without FEC using Clause 92 Host loss

‣ **COM fails with 1.9dB**

‣ Amphenol 3m 26AWG QSFP−4SFP APN43140033HXJ−−P2TX1 P1RX1

· matoglu_25GE_01_1114

TP0→TP5 IL @ 12.89GHz : 27.44dB
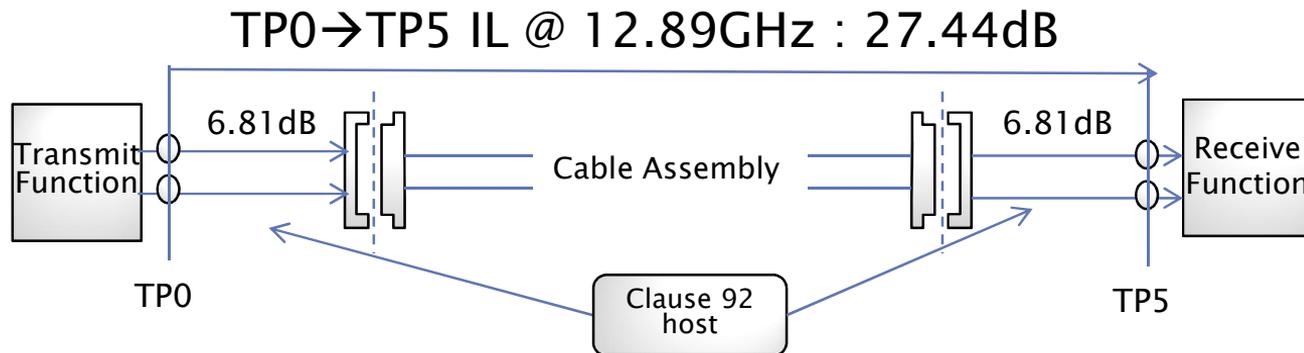
Just Checking... A 30dB Differential Stripline Model for a DER=1e-12 Test Case Passes COM with 3.2 dB
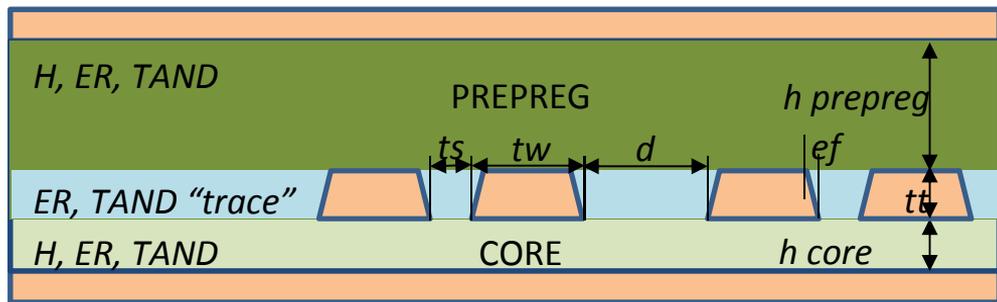
16.1 inches of "enhanced FR4"
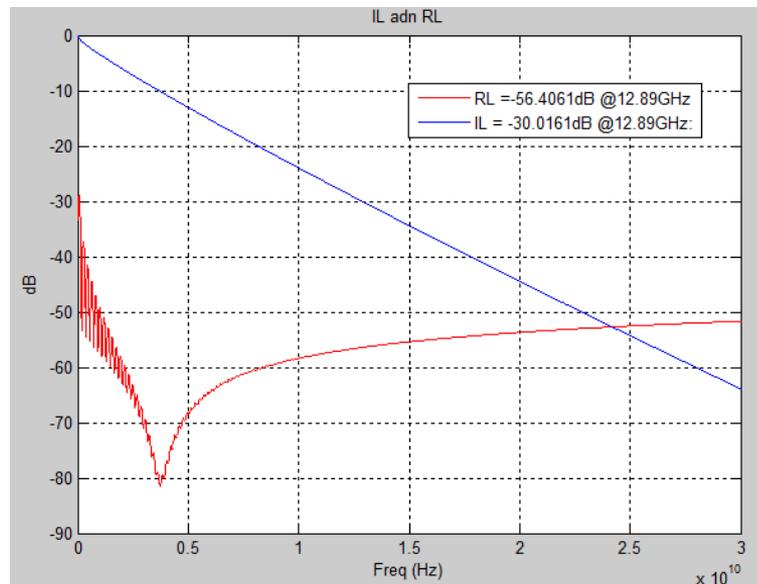
Geometry in mils	tw	ts	d	h	er	tand	trace height (tt)	trace er	trace tand	h	er	tand	etch factor	conductivity s (S/m)	er & tand ref freq	rough-ness model	model impedance	IL db\inch @ 12.89GHz
Z_100d_as_5x15x5_1p9_dBpi	4.981	15.019	12.00	4	3.9	0.0172	1.2	3.07	0.0270	20.2	4	0.0172	0.3	4.70E+07	1E+09	huray	100.15	-1.866

Review of:
3 Meter Cable (26awg) Assembly Losses

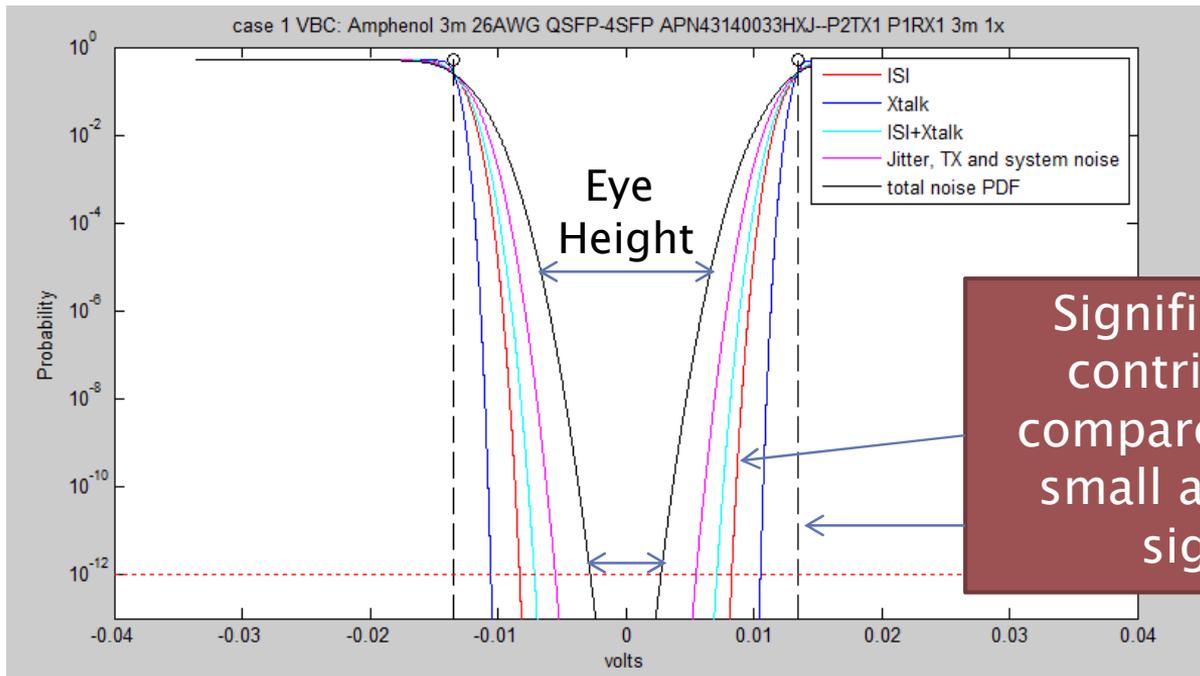Amphenol 3m 26AWG QSFP-4SFP APN43140033HXJ--P2TX1_P1RX1
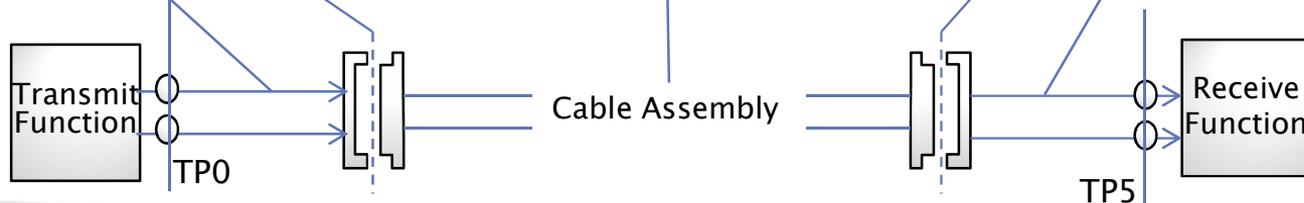
X: 12.9
Y: -14.93
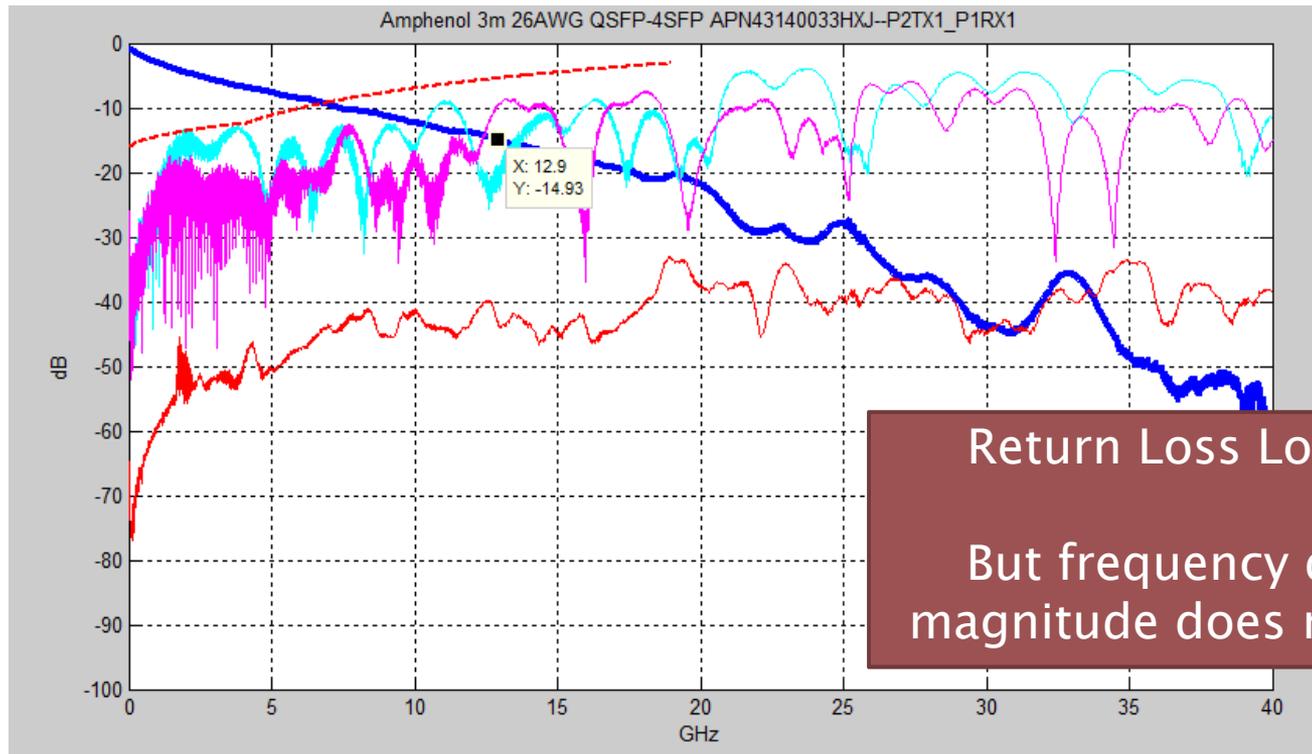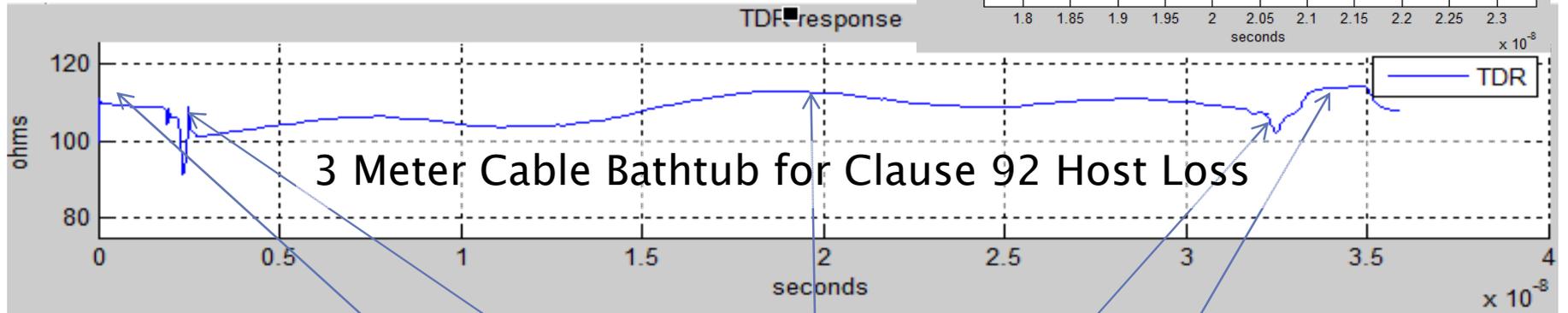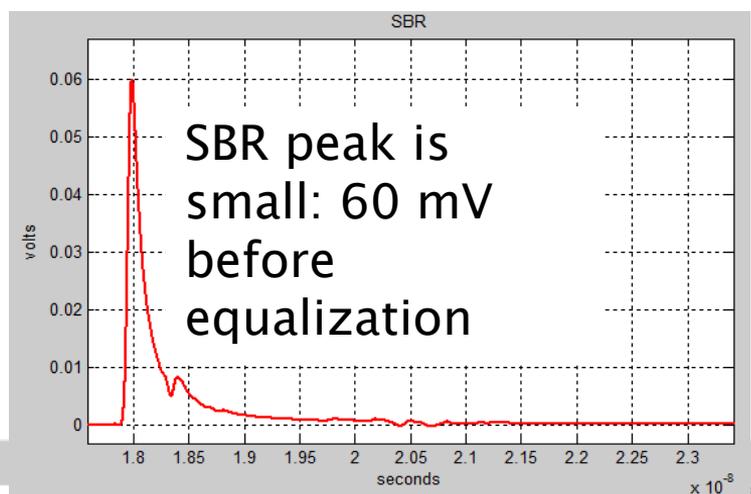
Return Loss Looks OK

But frequency domain magnitude does not tell all

The Eye Height Closes Rapidly as DER Decreases

3 Meter Cable Bathtub EH for Clause 92 Host loss

case 1 VBC: Amphenol 3m 26AWG QSFP-4SFP APN43140033HXJ--P2TX1 P1RX1 3m 1x

Eye Height

Significant ISI contribution compared to the small available signal

TDR and SBR also illustrate reflections which may play a significant role.

SBR peak is small: 60 mV before equalization

TDR response

3 Meter Cable Bathtub for Clause 92 Host Loss

Transmit Function
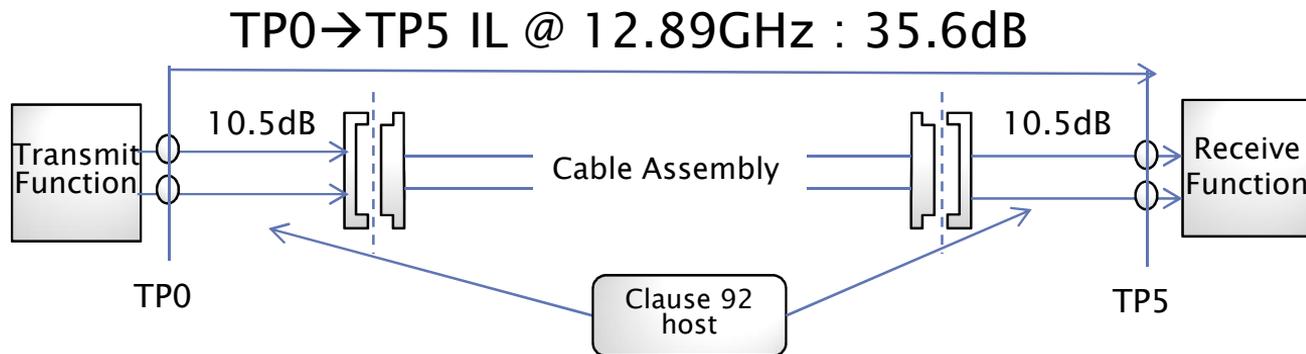
TP0

Cable Assembly

Receive Function

TP5

A 3 Meter Cable Passes COM without FEC but Less Host Loss

- **COM passes with 3.0dB**
- Amphenol 3m 26AWG QSFP–4SFP APN43140033HXJ––P2TX1 P1RX1
  - matoglu_25GE_01_1114

TP0→TP5 IL @ 12.89GHz : 20.5dB

Transmit Function — 3.4dB — Cable Assembly — 3.4dB — Receive Function

TP0

Clause 92 host

TP5
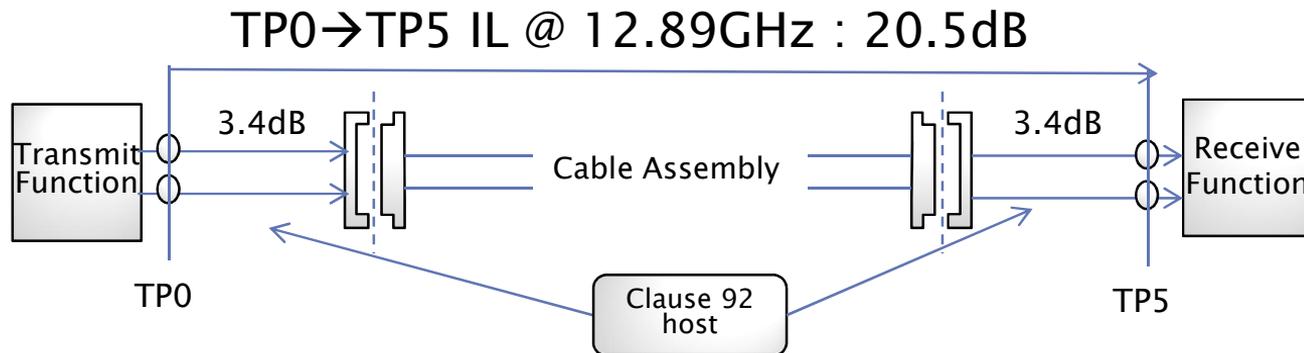
A 3 Meter Cable Passes COM with FEC and Even More Host Loss

- **COM passes with 3.2dB**
- Amphenol 3m 26AWG QSFP–4SFP APN43140033HXJ--P2TX1 P1RX1
  - matoglu_25GE_01_1114

TP0→TP5 IL @ 12.89GHz : 35.6dB

Transmit Function	10.5dB	Cable Assembly	10.5dB	Receive Function

TP0

Clause 92 host

TP5

Summary

- Loss Allocation (dB) is useful for host budgeting
    - A 30dB test channel can pass COM and allow successful operation
    - CR Loss budgeting based on 30dB non-FEC test case operation is not recommended.
- Recommendation: Use scaled host loss determined from COM calculations
    - Determine host loss allocation for each desired FEC variation and cable reach variation
    - An number possibilities exist
- A 3 meter cable is feasible for 25Gb/s link which has
    - Less host loss of than 100GBASE-CR4 for no RS-FEC operation
        - Recommendation: informative loss of 3.4dB
    - More host loss than 100GBASE-CR4 for RS-FEC operation
        - Recommendation: informative loss of 10.5dB
- More publically available 3 meter cable channel models would be useful for refining recommendations