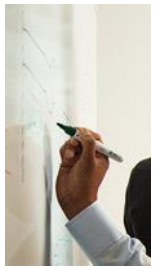
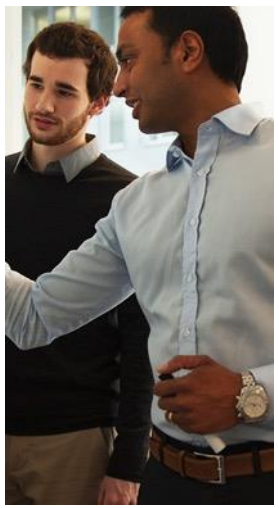




Chip to Module and Direct Attach Cable Channel Analysis

Nathan Tracy, Bruce Champion, Arturo Pachon

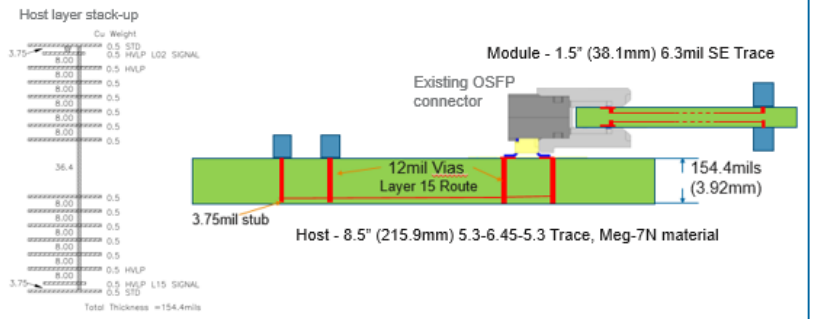
November 13, 2018

Objective: Provide Further Analysis on Chip to Module and Direct Attach Cable Channels

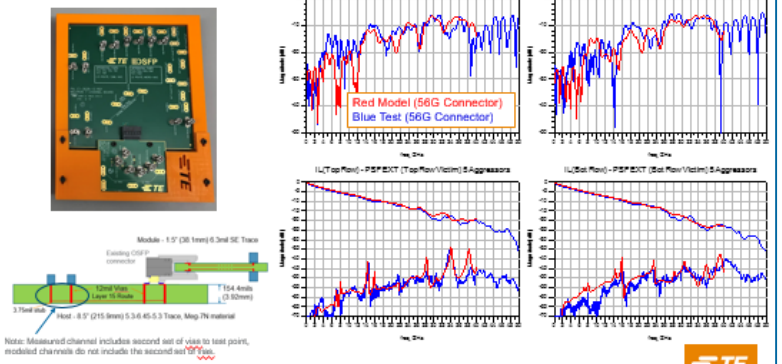
- At the September Interim meeting *tracy_3ck_01a_0918.pdf* provided 12dB and 15dB host board channel analysis
- This presentation provides the requested analysis for a 16dB host board channel (chip to module), and provides analysis of a direct attach cable (DAC) channel and considers the DAC with a host channel.
- 100 Ω and 90 Ω trace impedances are also considered.

Review of *tracy_3ck_01a_0918*

Channel Details (from *tracy_100GEL_01a_0118*)



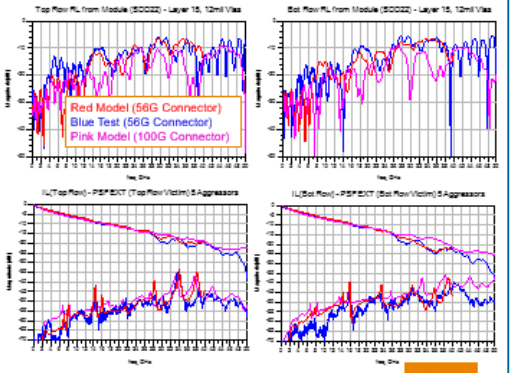
Test vs Model Results



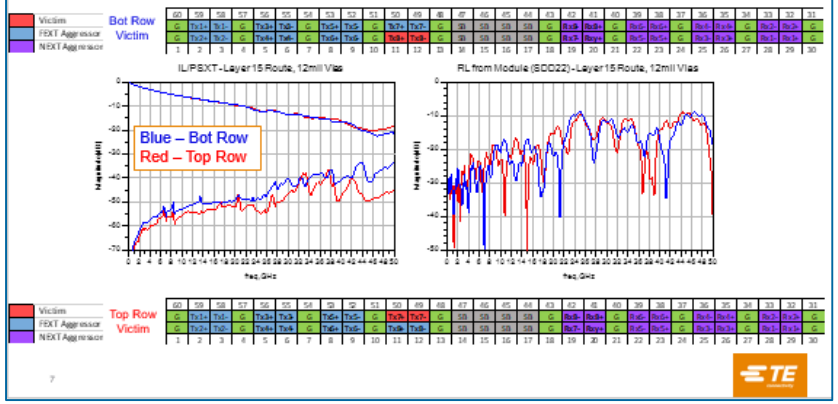
100G Connector Improvements (in the same 15dB channel)

Efforts were focused on insertion loss and return loss optimizations

Improved 100Gbps OSFP connector



Improved Connector in a 12dB Channel – Layer 15 Route-out



COM v2.41 – Improved OSFP Connector in 12/15dB Channel

15 Crosstalk Aggressors – 8 NEXT AND 7 FEXT
Maximum Frequency = 50 GHz – 10MHz Step

COM script 2.41 (FFE: 2 pre-cursor + 4 post cursor)

	PAM-4 [IEEE802.3ck]	
COM*	Case 1	Case 2
15dB	2.68	3.89
12dB	2.71	4.1

New C2M configuration file: *ghiasi_3ck_adhoc_01a_082918.pdf*

COM script 2.41 (FFE: 0 pre-cursor + 4 post cursor)

	PAM-4 [IEEE802.3ck]	
COM*	Case 1	Case 2
15dB	4.09	4.71
12dB	4.20	4.89

- COM script version 2.41 (com_ieee8023_93a_241a.m)
- Configuration settings (T1config_com_ieee8023_93a='100GEL_C2M_tp0_tp2_rxFFE7')
- COM > 3dB PASSES
- COM Test Case 1 and Test Case 2 differ in the value of the device package transmission line length z_p - 12mm and 30mm respectively

COM v2.41 – Improved OSFP Connector in 12/15dB Channel

15 Crosstalk Aggressors – 8 NEXT AND 7 FEXT
Maximum Frequency = 50 GHz – 10MHz Step

COM script 2.41 (FFE: 2pot cursor + 6 post cursor + DFE 16 taps)

	PAM-4 [IEEE802.3ck]	
COM	Case 1	Case 2
15dB	5.93	5.16
12dB	6.24	5.45

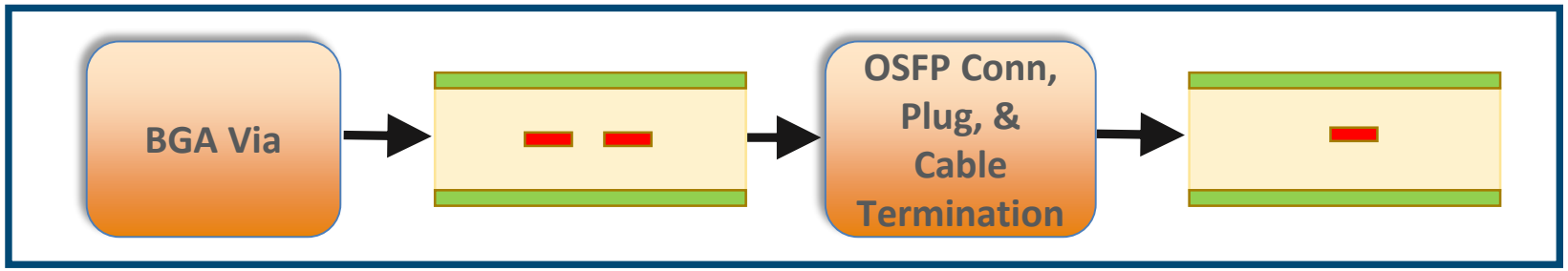
- COM script version 2.41 (com_ieee8023_93a_241a.m)
- COM > 3dB PASSES
- COM Test Case 1 and Test Case 2 differ in the value of the device package transmission line length z_p - 12mm and 30mm respectively

September meeting requested that a 16 dB channel be included

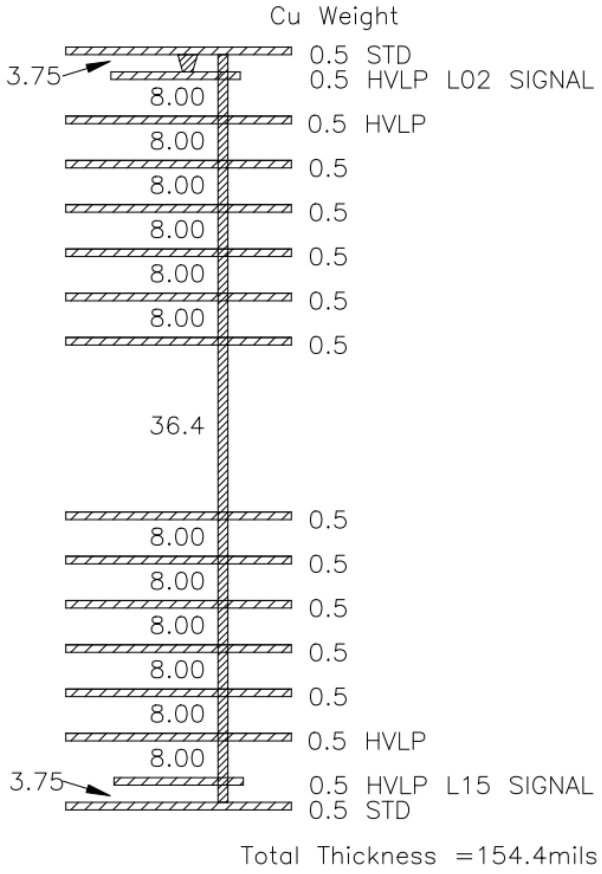
Chip to Module Channel (C2M) Simulation

New Analysis: 16dB Chip to Module Channel Created

Channel



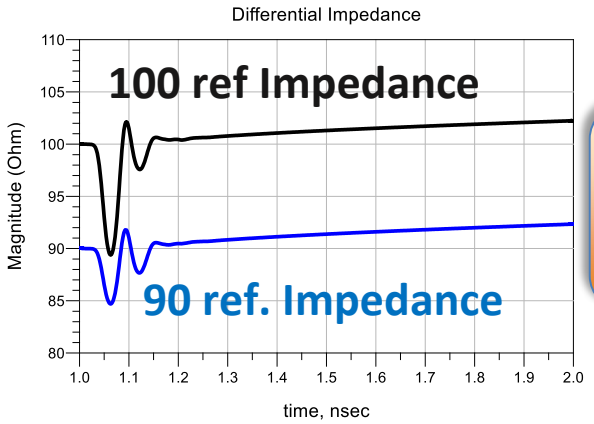
Host layer stack-up



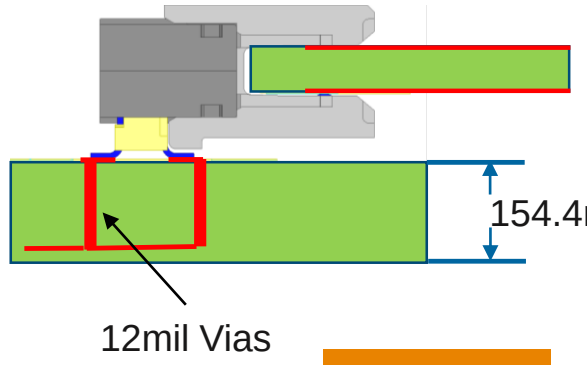
Ref Ω	Host Loss @ 26.56GHz
100 ref Ω	-12.34
90 ref Ω	-12.78

Ref Ω	Module Loss @ 26.56GHz
100 ref Ω	-1.514
90 ref Ω	-1.465

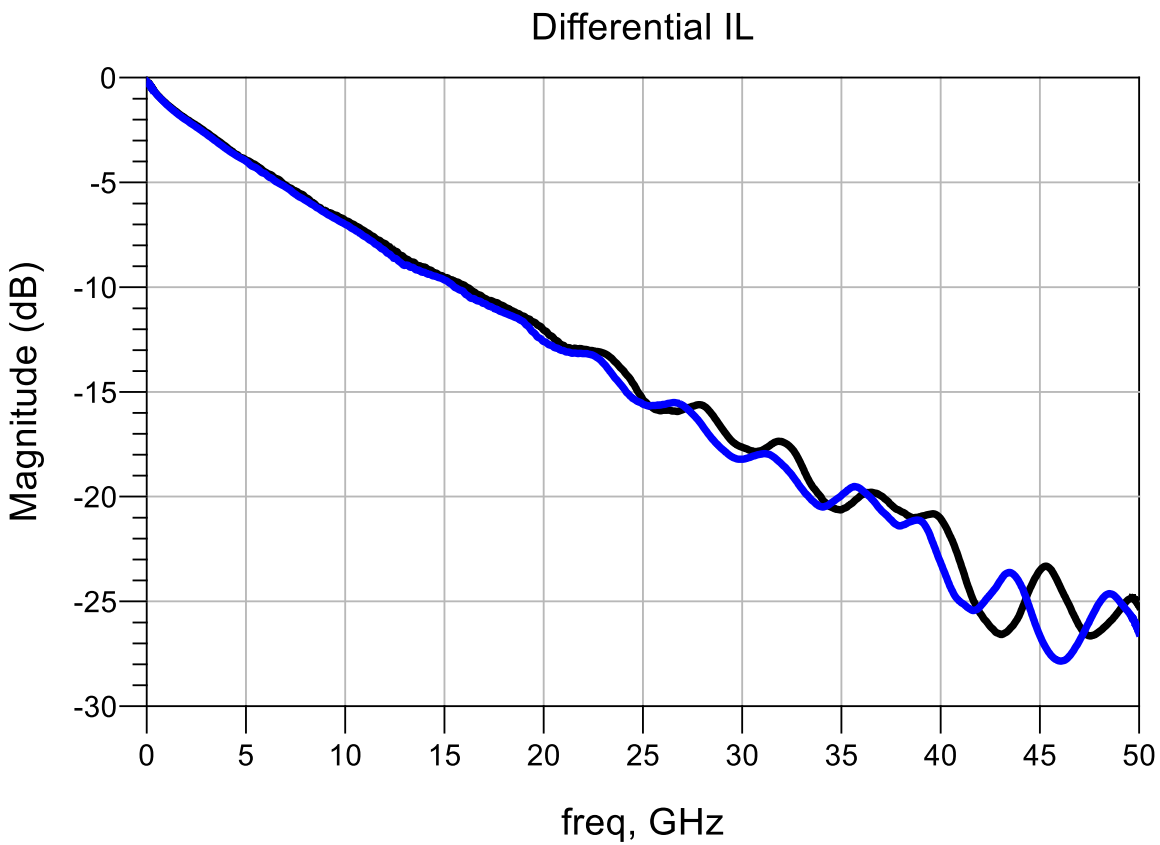
BGA Via

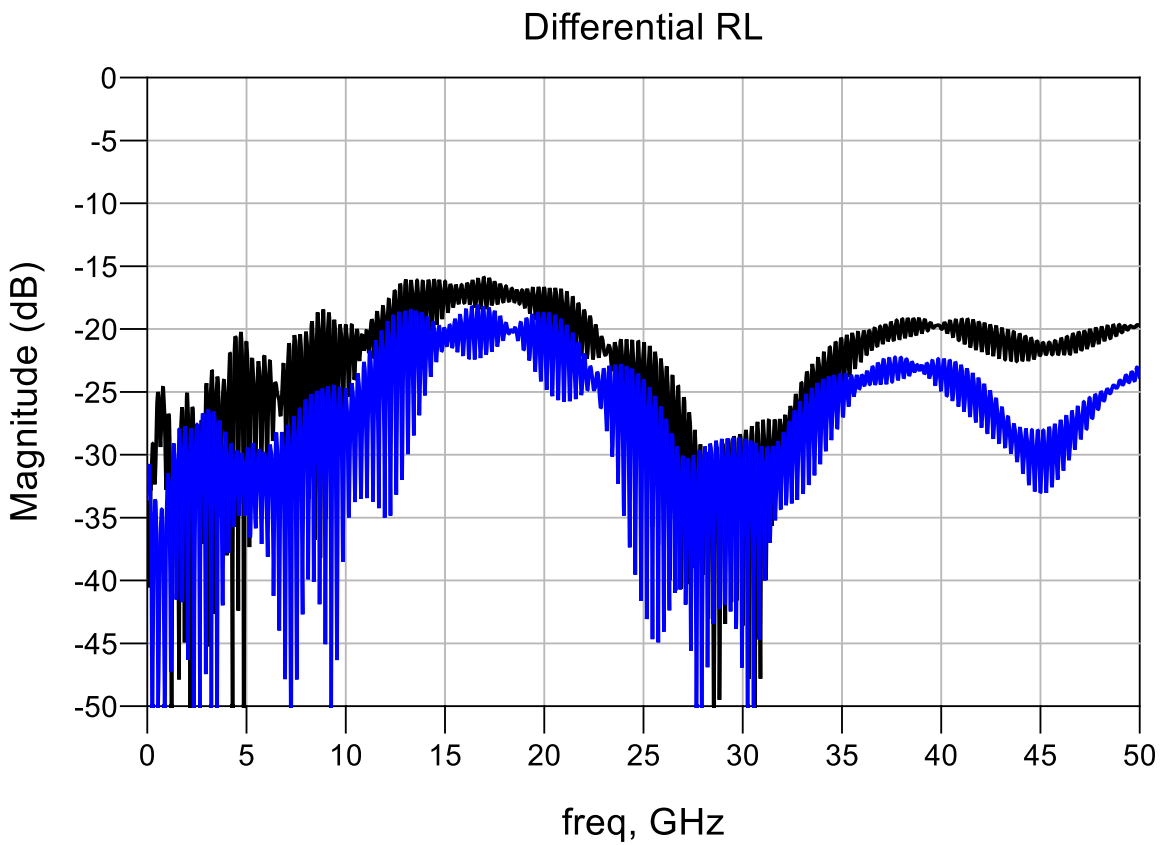


OSFP Conn, Plug, & Cable Termination



16dB C2M Channel: **100** and **90** ref. impedance comparison





COM v2.41 – C2M OSFP Connector in 16dB Channel

15 Crosstalk Aggressors – 8 NEXT AND 7 FEXT
Maximum Frequency = 50 GHz – 10MHz Step

COM script 2.41
(FFE: 2 pre-cursor + 4 post cursor + 1 DFE)

	PAM-4 [IEEE802.3ck]	
COM*	**Case 1**	**Case 2**
100 ohm 16dB	**3.96**	**4.78**
90 ohm 16dB	**3.61**	**4.46**

- COM script version 2.41 (com_ieee8023_93a_241a.m)
- Configuration settings (T1config_com_ieee8023_93a=100GEL_C2M_tp0_tp2_rxFFE7) – adjusted to include 1 DFE
- COM > 3dB PASSES
- COM Test Case 1 and Test Case 2 differ in the value of the device package transmission line length z_p - 12mm and 30mm respectively

COM v2.41 – C2M OSFP Connector in 12/15/16dB Channel

15 Crosstalk Aggressors – 8 NEXT AND 7 FEXT
Maximum Frequency = 50 GHz – 10MHz Step

COM script 2.41
(FFE: 2 pre-cursor + 4 post cursor + 1 DFE)

	PAM-4 [IEEE802.3ck]	
COM*	**Case 1**	**Case 2**
100 ohm 16dB	**3.96**	**4.78**
100 ohm 15dB	**3.81**	**4.86**
100 ohm 12dB	**4.08**	**4.91**

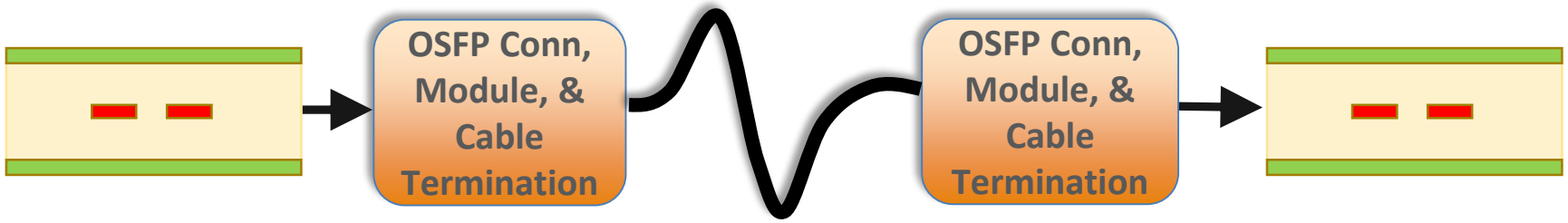
- COM script version 2.41 (com_ieee8023_93a_241a.m)
- Configuration settings (T1config_com_ieee8023_93a=100GEL_C2M_tp0_tp2_rxFFE7) – adjusted to include 1 DFE
- COM > 3dB PASSES
- COM Test Case 1 and Test Case 2 differ in the value of the device package transmission line length z_p - 12mm and 30mm respectively

Cable Assembly Channel (CR) Simulation

17.6dB Cable assembly (TP1-TP4) - description

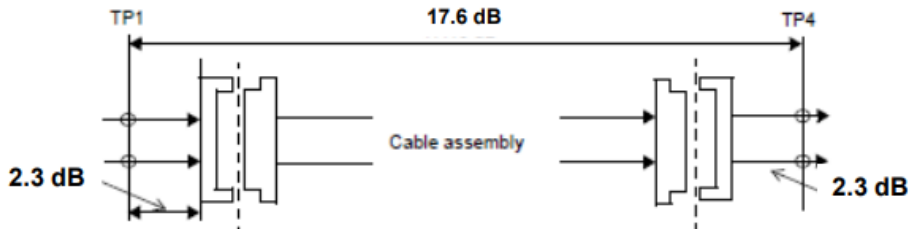
-2.3@26.56GHz – 100 ref. Impedance
-2.3@26.56GHz – 90 ref. Impedance

-2.3@26.56GHz – 100 ref. Impedance
-2.3@26.56GHz – 90 ref. Impedance

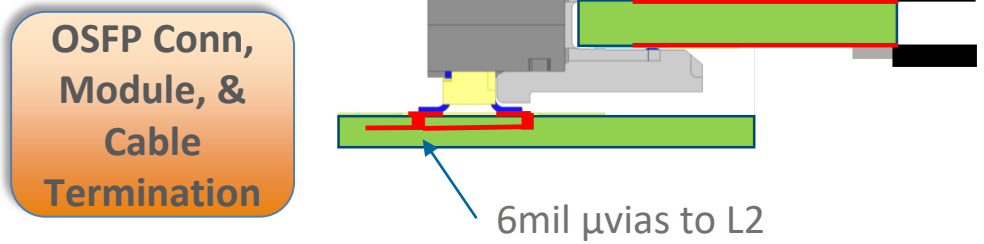


2.0m 26 AWG Twinax Cable
(100 Ohm and 90 Ohm)

Cable assembly and Channel IL - Baseline

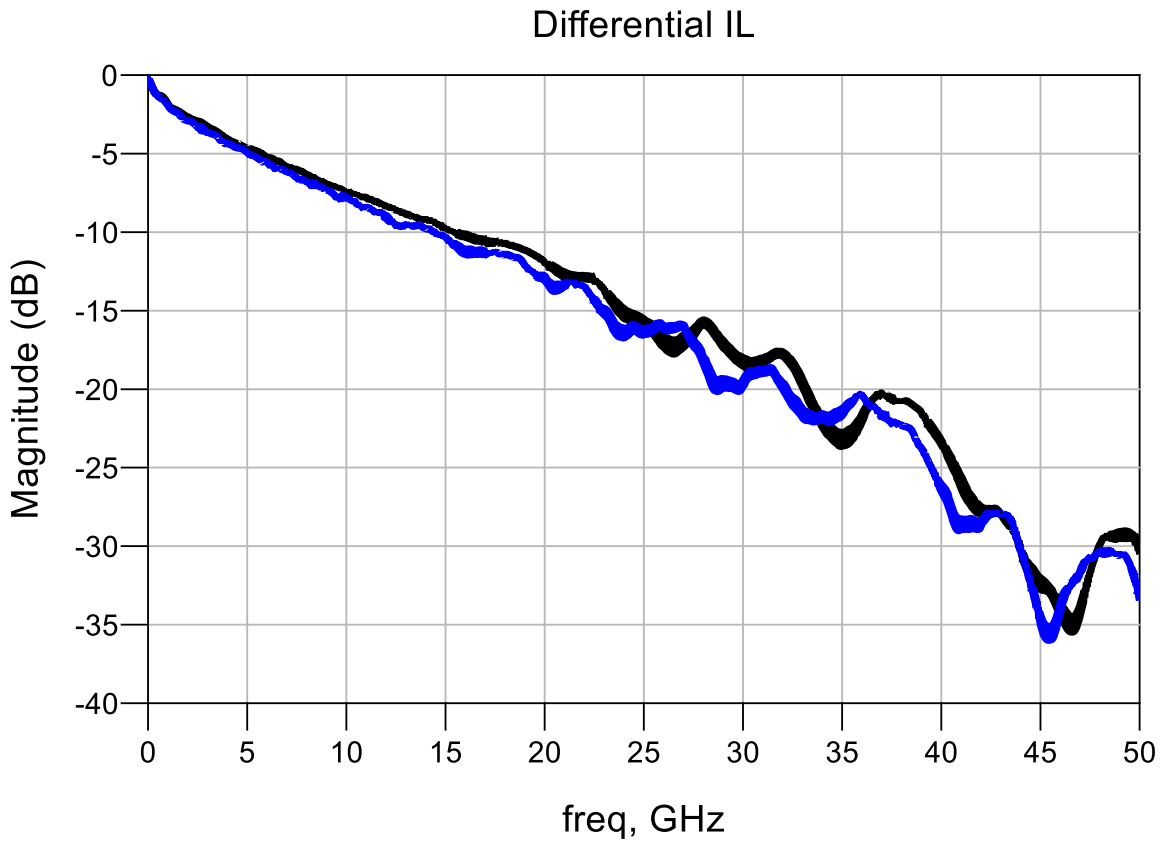


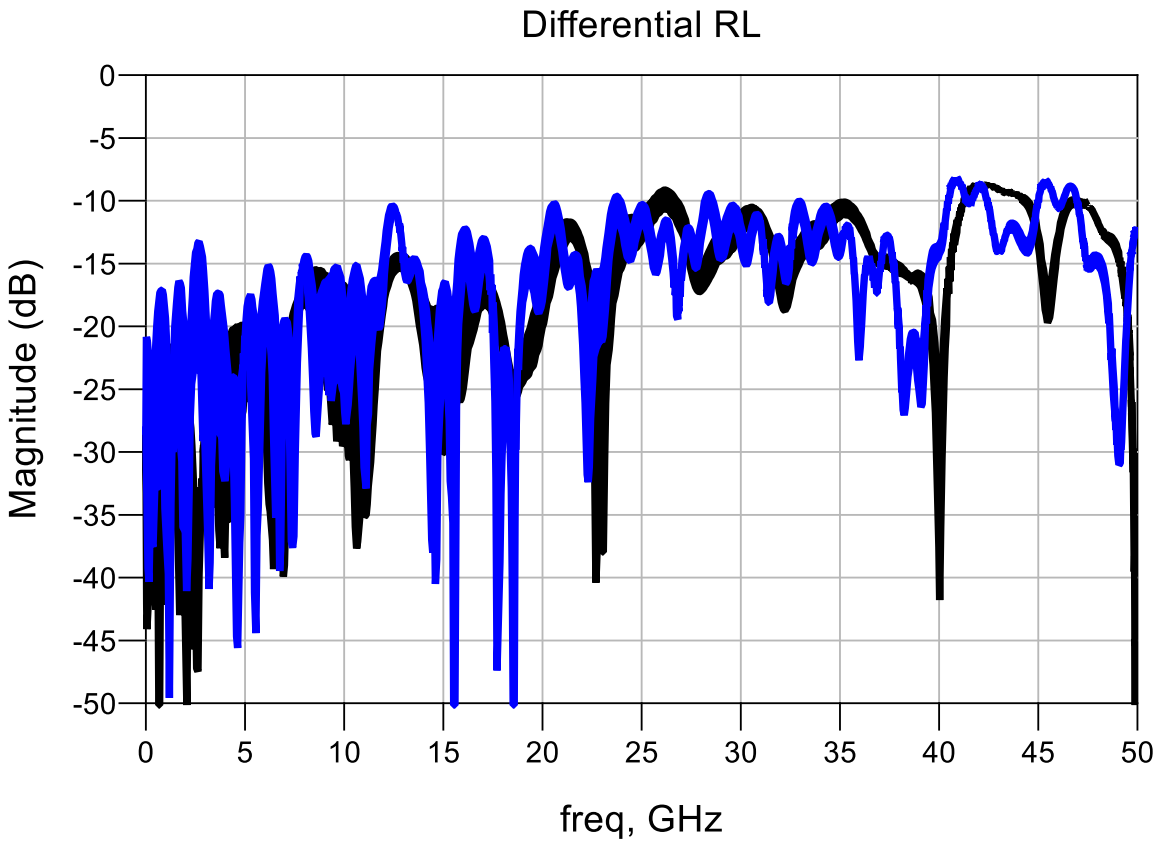
http://www.ieee802.org/3/ck/public/18_09/diminico_3ck_01_0918.pdf



17.6dB CR Channel comparison: 100 Ohm and 90 Ohm

Nominal simulation design hits 17.7dB @26.56GHz – There is no margin included in the simulation for manufacturing tolerances (cable/connector/PCB) which will impact IL variation





COM v2.51 – CR OSFP Conn in 17.6dB Channel

15 Crosstalk Aggressors – 8 NEXT AND 7 FEXT
Maximum Frequency = 50 GHz – 10MHz Step

COM script 2.51
(FFE: 24 DFE)

	PAM-4 [IEEE802.3ck]	
COM*	Case 1	Case 2
CR – OSFP 100 ohm	**5.89**	**4.85**
CR – OSFP 90 ohm	**5.02**	**4.66**

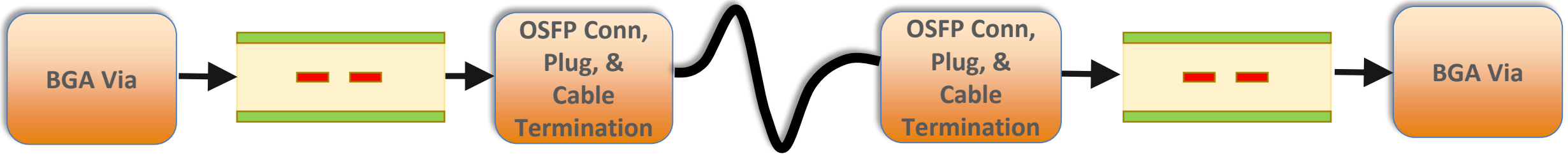
- COM script version 2.51 (com_ieee8023_93a_251a.m)
- Configuration settings (config_com_ieee8023_93a=100GEL-CR_DFE_100118)
- COM > 3dB PASSES
- COM Test Case 1 and Test Case 2 differ in the value of the device package transmission line length z_p - 12mm and 30mm respectively

Host + Cable Assembly Channel Simulation

28dB Host/DAC Channel (TP0-TP5) - description

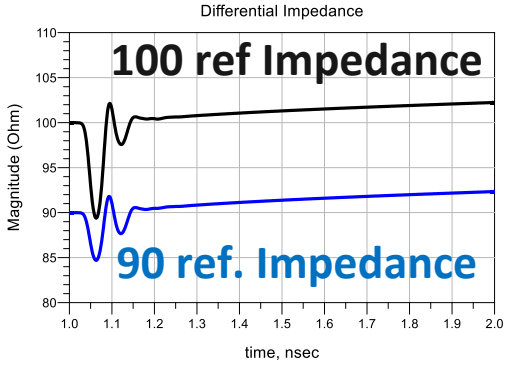
-6.54dB@26.56GHz – 100 ref. Impedance
-6.76dB@26.56GHz – 90 ref. Impedance

-6.54dB@26.56GHz – 100 ref. Impedance
-6.76dB@26.56GHz – 90 ref. Impedance

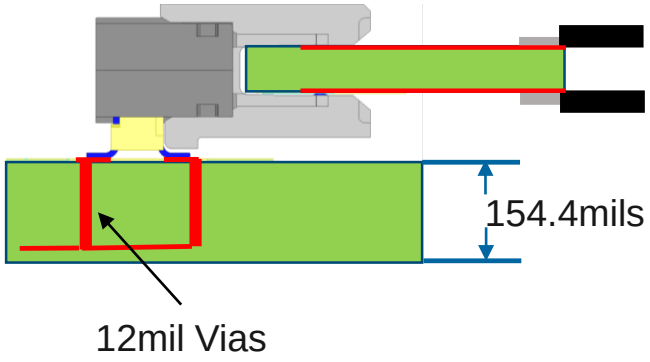


2.0m 26 AWG Twinax Cable
(100 Ohm and 90 Ohm)

BGA Via

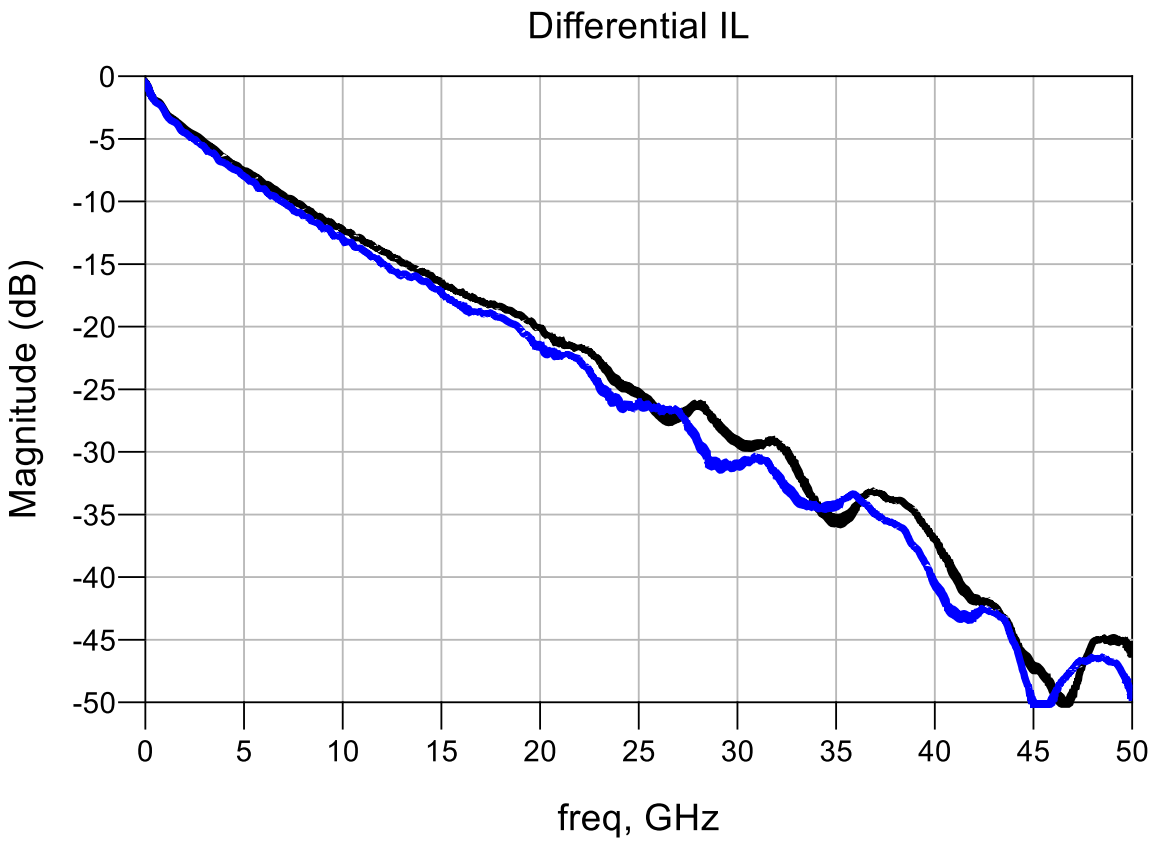


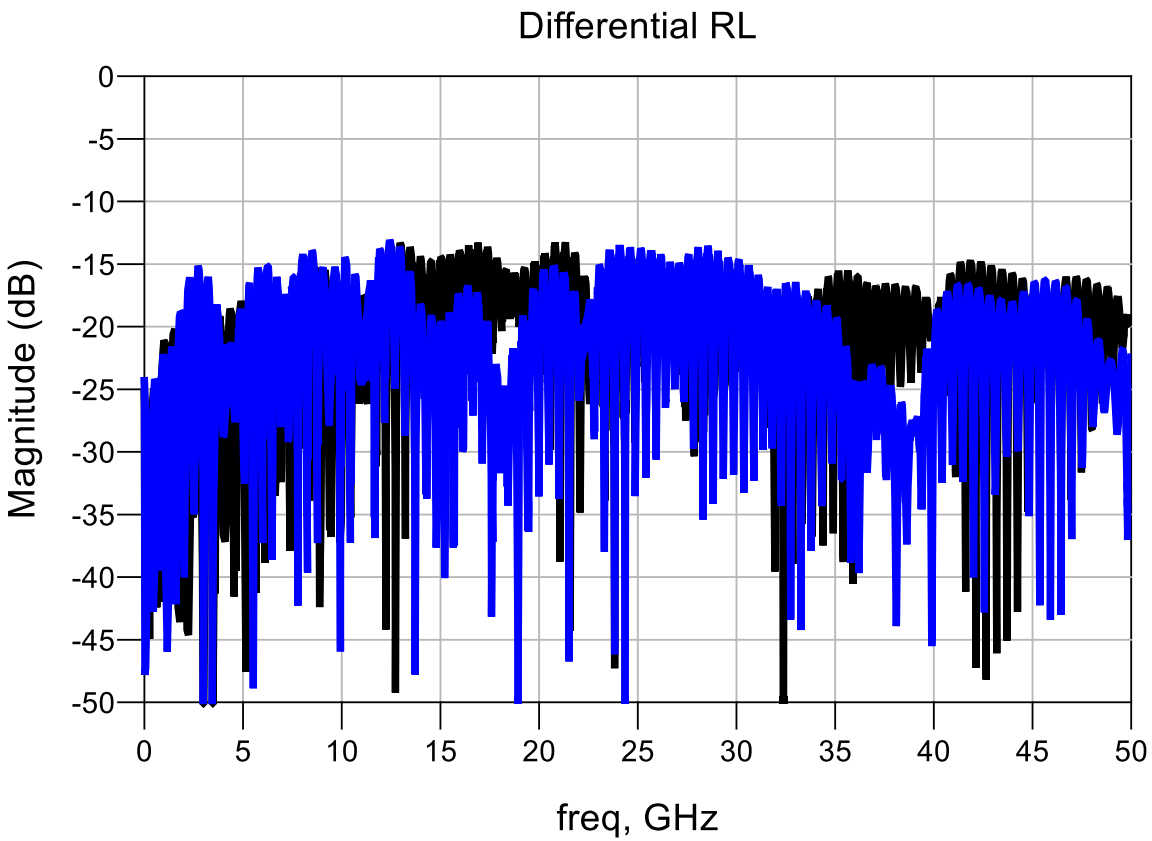
OSFP Conn, Plug, & Cable Termination



28.0dB CR Channel comparison: 100 Ohm and 90 Ohm

Nominal simulation design hits 28dB @26.56GHz – There is no margin included in the simulation for manufacturing tolerances (cable/connector/PCB) which will impact IL variation





COM 2.51: 28db Direct Attach Cable on a Host

15 Crosstalk Aggressors – 8 NEXT AND 7 FEXT
Maximum Frequency = 50 GHz – 10MHz Step

COM script 2.51
(FFE: 24 DFE)

	PAM-4 [IEEE802.3ck]	
COM*	**Case 1**	**Case 2**
28dB DAC – OSFP 100 ohm	**5.44**	**4.61**
28dB DAC – OSFP 90 ohm	**5.09**	**4.04**

- COM script version 2.51 (com_ieee8023_93a_251a.m)
- Configuration settings (config_com_ieee8023_93a=100GEL-CR_DFE_100118)
- COM > 3dB PASSES
- COM Test Case 1 and Test Case 2 differ in the value of the device package transmission line length z_p - 12mm and 30mm respectively

Host PCB was not included in the spreadsheet, since it is already included in the simulation

Summary

- 16dB Chip to Module channel has been modeled with both 100 and 90 Ω reference impedances traces
  - Promising results shown using COM 2.41
  - 100 Ω reference impedance provides better COM result by about ~0.3dB
- 17.6dB Direct Attach Copper cable channel simulated with both 100 and 90 Ω reference impedance traces/cable/connector (CR)
  - 100 Ω reference impedance provides better COM result by about ~0.8dB (Case1=12mm) and ~0.2dB (Case2=30mm)
  - Reported numbers are based on nominal Connector/Cable/PCB simulation design. Cable, connector and PCB manufacturing deviation is not considered in this study

Summary - 2

- 100/90Ω Thick Host + DAC + Thick Host
  - 100 Ω ref provides better COM result by about ~0.35dB, Case 1 & ~0.6dB, Case2
  - MCBs are normally constructed on thin stack-ups so that via loss is not included (microstrip trace is sometimes uses)
    - The IL budget on Thick Host + Cable Assembly + Thick Host Channel should account for the 4 via/stub losses (2xBGA Via + 2x Connector Via, ~0.5dB/via at 28GHz)
    - Current IL budget does not account for these losses
  - Reported numbers are based on nominal Connector/Cable/PCB simulation design. Any cable, connector, and PCB manufacturing deviation is not considered in this study
  - Considering current proposed budgets/allocations and simulations, a budget higher than 28dB is likely to be required for cable assembly channels (2m)
- 100 Ω provides the best performance
  - Improved impedance match from 90 Ω reference is overcome by higher losses