Technical Feasibility for 100GBASE-CR

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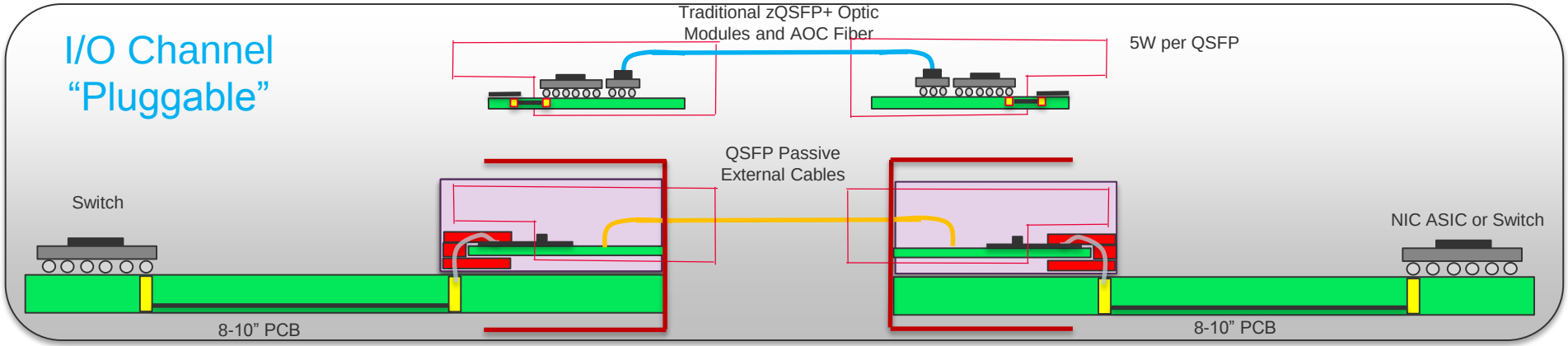
Today @ 25Gbps lanes



Assumes same trace length on both sides of interconnect

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56Gbps PAM4 Channel Link Budget (ball to ball)

Traditional
56 Gbps, f_0=14 GHz

Parameter	Loss
External cable loss (5m) (26 AWG)	16 dB
2 Host PCB trace (9” Megtron 6)	2 x 7.3 dB
2 Connectors	2 x 1.2 dB
2 Module PCB & capacitor & termination	2 x 1.5 dB
Total channel loss	**36 dB**

Traditional
112 Gbps, f_0=28 GHz

Parameter	Loss
External cable loss (2m) (26 AWG)	13 dB
2 Host PCB trace (9” Isola Tachyon)	2 x 13.5 dB
2 Connectors	2 x 1.4 dB
2 Module PCB & capacitor	2 x 2 dB
Total channel loss	**46.8 dB**

- Current 25G-generation CDR/DFE/DSPs provide -36 dB loss compensation @ 14 GHz
- The traditional PCB channel is broken at 28 GHz

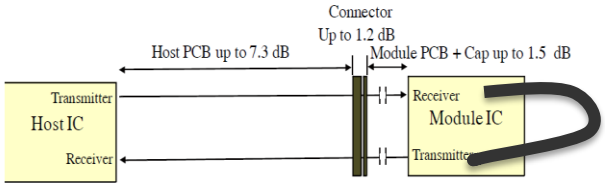

Figure 13-20. CEI-28G-VSR full Channel Reference Model

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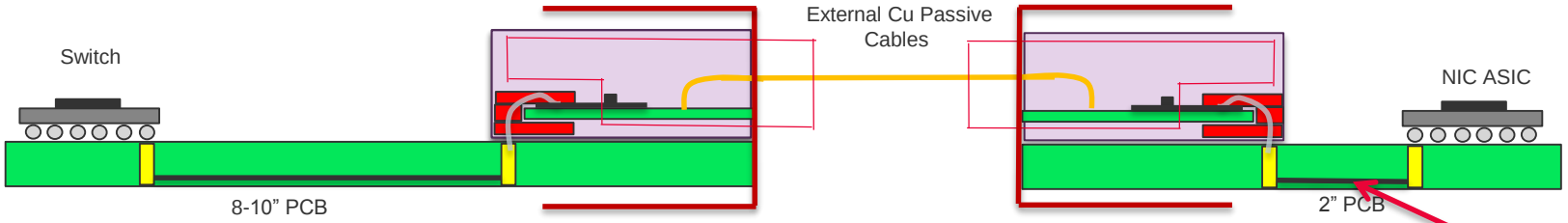
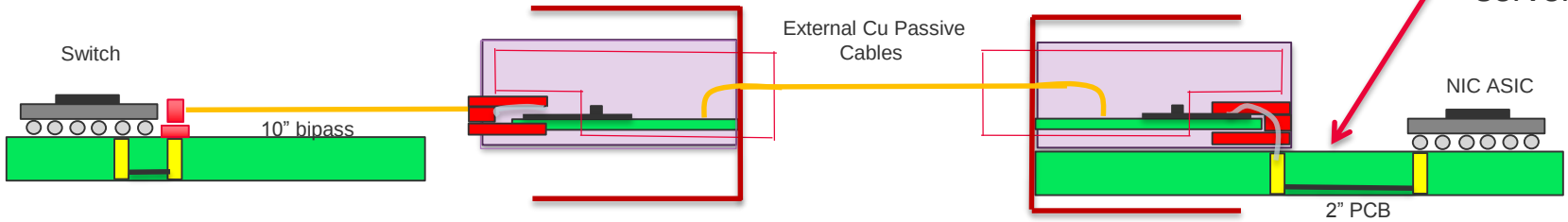
Options for 100GBASE-CR

2m external cable with PCB traces for both switch and server



Note: short trace assumed for server

2m external cable and bipass cables in switch



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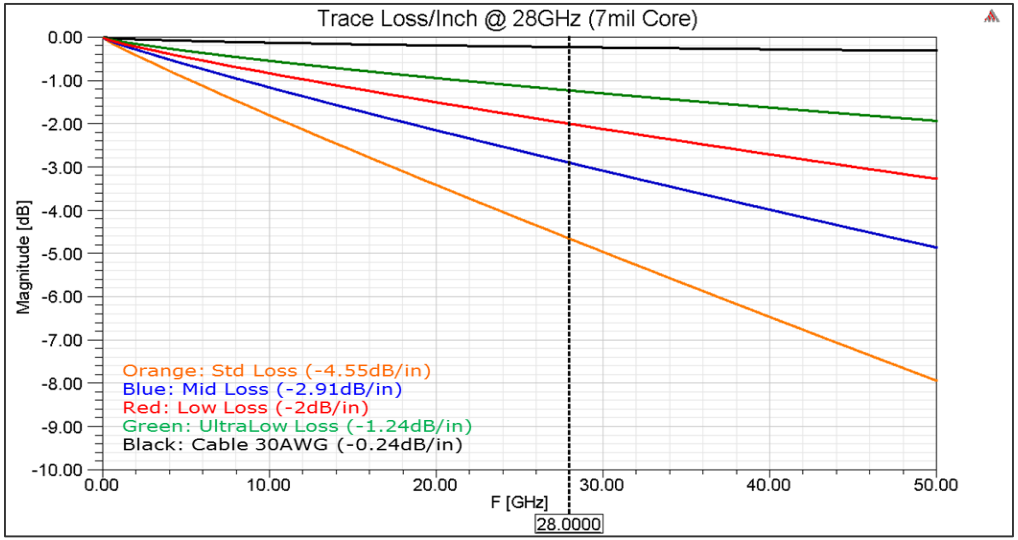
Material Loss Effect

Laminate Loss Category	Df	Loss/in @ 28GHz
Standard Loss	0.024	-4.55dB
Mid Loss	0.014	-2.91dB
Low Loss (Meg6)	0.008	-2dB
Ultra Low Loss (Meg7)	0.003	-1.0 to -1.3dB
TwinAx Cable 30AWG	0.003	-0.24dB

Loss/inch for different
PCB laminates and cable



- To characterize different available PCB laminates and determine the possible reach for each material.
- Loss per inch as functions of frequency up to 50 GHz and a tabulated summary of loss per inch at 28 GHz

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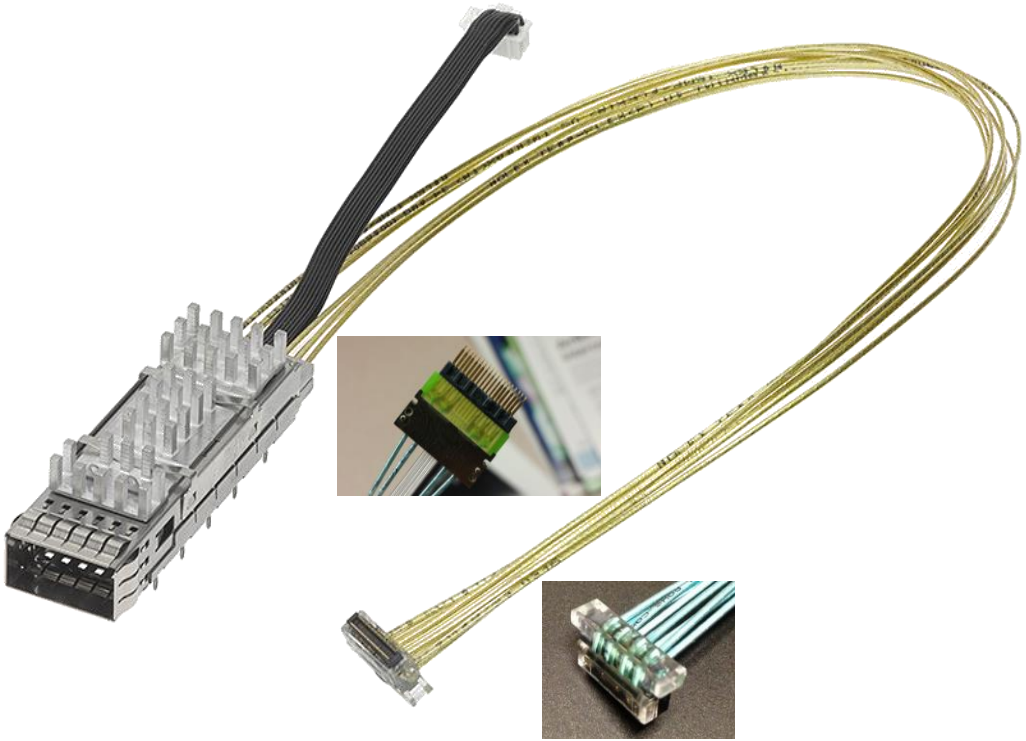
QSFP BiPass to NearStack “VSR” Cable



Key Benefits:

- Lower System-Level Costs:
  - Eliminate the need for costly PCB materials (Nelco, Megtron, Tachyon, etc)
  - Eliminate the use of additional DFE or retimer chips to drive long traces
  - Improved thermal performance with 1x1 cages (air-cooled)
- Architectural Flexibility:
  - Freedom to locate ASIC anywhere (eg. further from backplane)
  - Enable lower power ASIC
  - Extended reach from ASIC to I/O
  - Enable longer external copper I/O cables
  - Cool the ports and the ASIC better
- New ways to handle power integrity to large ASICs

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Possible 112G-CR PAM4 Channel Link Budget

‘Improved’ PCB
(112 Gbps, f_0=28 GHz)

Parameter	Loss
External cable loss (2m) (26 AWG)	13 dB
Switch PCB trace (8” Meg7) and connector	9.5 dB
NIC Host PCB trace (2” Meg6)	5 dB
2 Module PCB and capacitor and wire terminations	2x2dB
Total channel loss	**31.5 dB**

BiPass Cables
112 Gbps, f_0=28 GHz

Parameter	Loss
External cable loss (2m) (26 AWG)	13 dB
BiPass cables (10”)(30 AWG) incl ‘near ASIC’ and QSFP connectors and 2” Meg 6	7.1 dB
NIC Host PCB trace (2” Meg6)	5 dB
2 Module PCB & capacitor & wire terminations	2 x 2 dB
Total channel loss	**29.1 dB**

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100G-CR Channel S parameters

- ‘Ball to Ball’ parameters
  - i.e. Package not included
- 2” PCB traces from ASIC to Bipass connection

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CR channel summary

- Copper Cable Connector includes entire mating interface of the paddlecard including trace routing, vias, wire terminations

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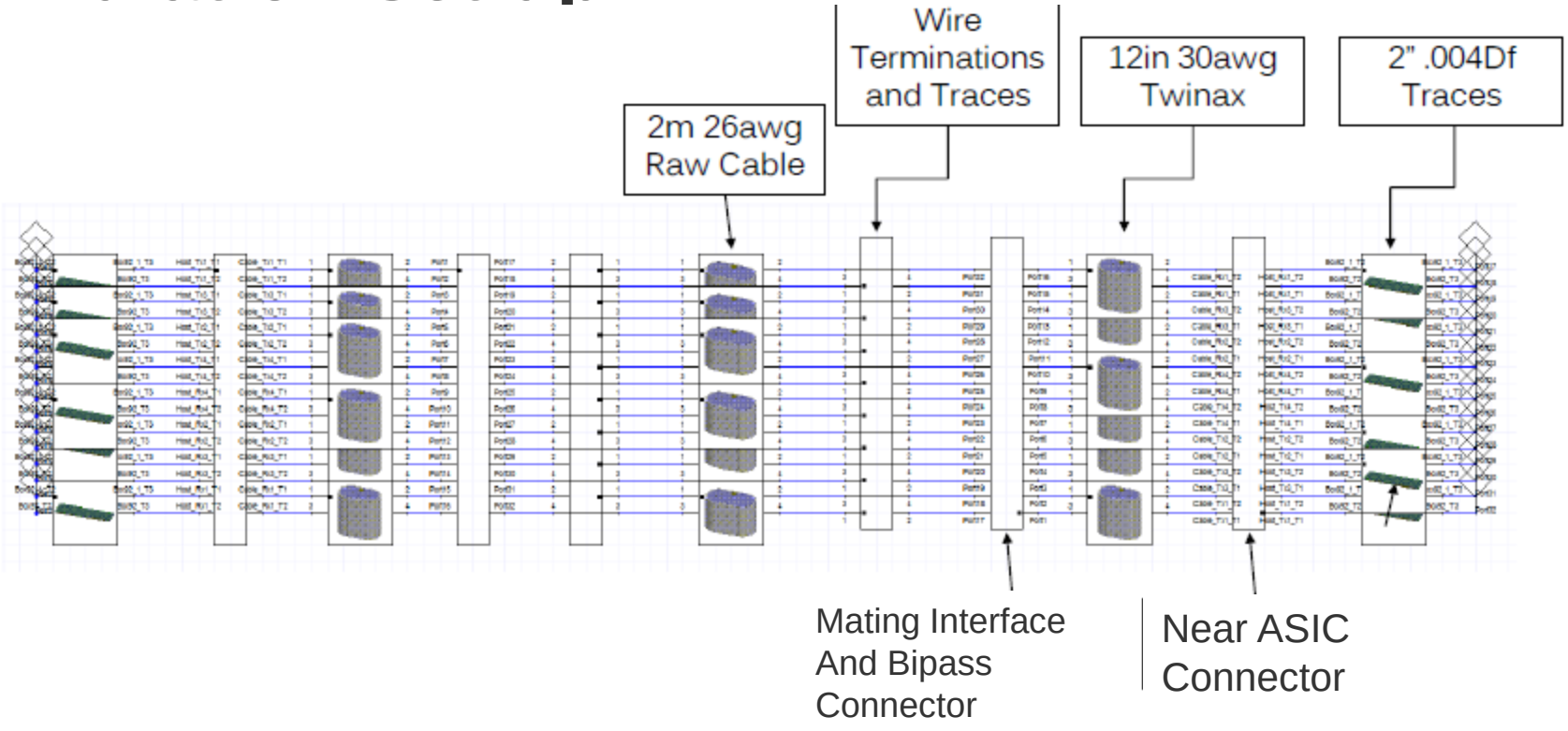
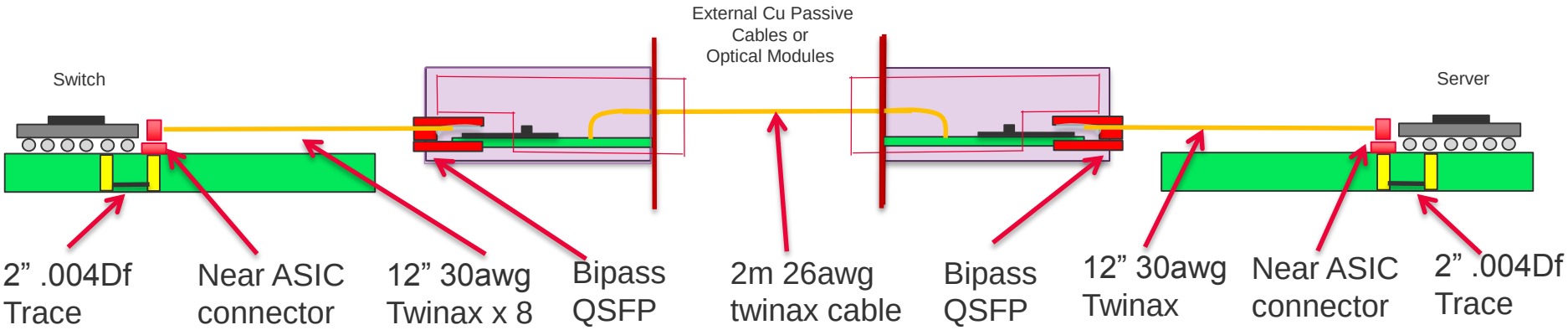
Simulation set up



Simulation element breakdown



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Pin mapping

- Cross Talk Pin Definition

  - Victim pairs are on left side, differential pairs 1-8
  - NEXT aggressors are on right side, differential pairs 9-16
  - FEXT aggressors are on left side, differential pairs 1-8
  - **For TX Victim**: all NEXT aggressors are RX and all FEXT aggressors are TX.
  - **For RX Victim**: all NEXT aggressors are TX and all FEXT aggressors are RX.

	Input Port (Differential Pairs)	Pin Number	zQSFP		Nearstack	Pin Number	Output Port (Differential Pairs)
P1	Diff 1	1,2	TX1	--->	TX1	17,18	Diff9
	Diff 2	3,4	TX3	--->	TX3	19,20	Diff10
	Diff 3	5,6	TX2	--->	TX2	21,22	Diff11
	Diff 4	7,8	TX4	--->	TX4	23,24	Diff12
	Diff 5	9,10	RX4	<---	RX4	25,26	Diff13
	Diff 6	11,12	RX2	<---	RX2	27,28	Diff14
	Diff 7	13,14	RX3	<---	RX3	29,30	Diff15
	Diff 8	15,16	RX1	<---	RX1	31,32	Diff16

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Insertion loss

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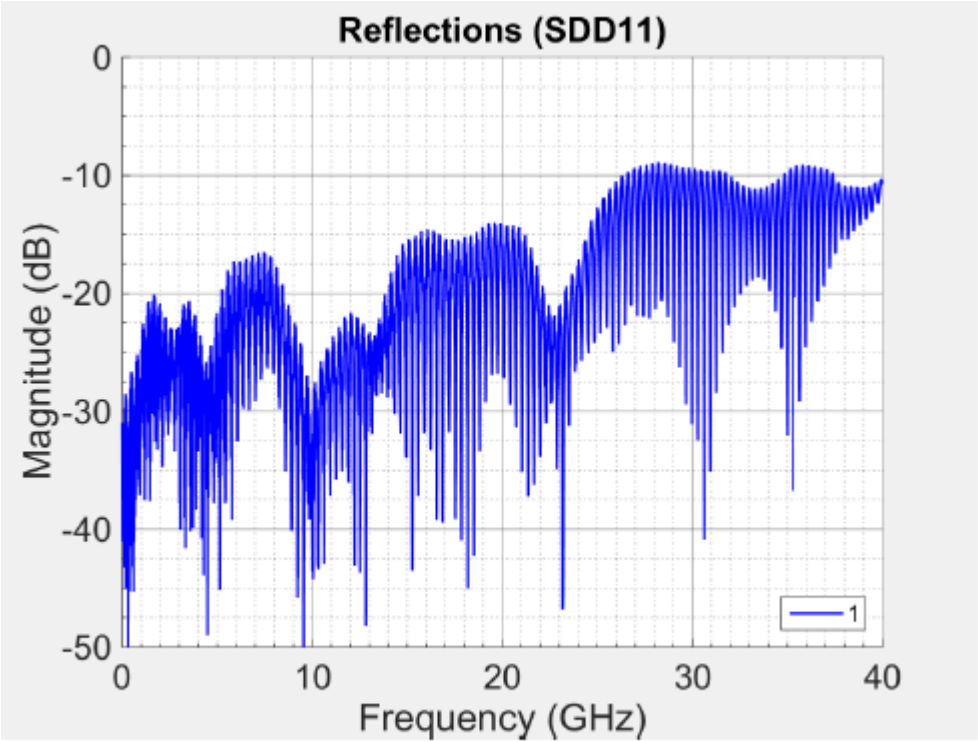
Return Loss



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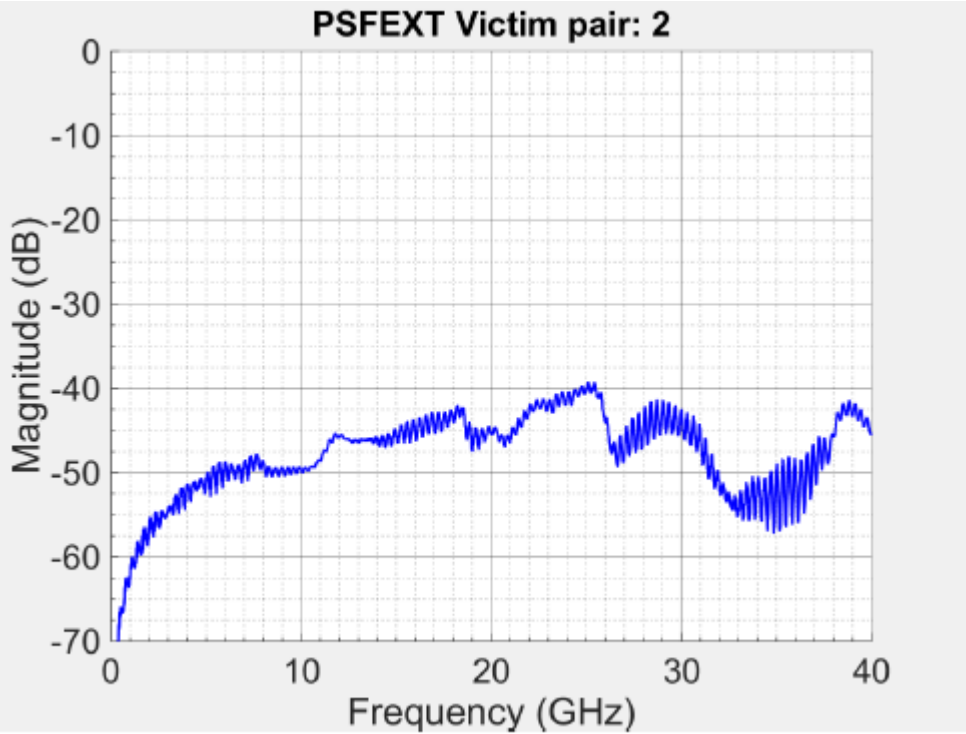
Crosstalk



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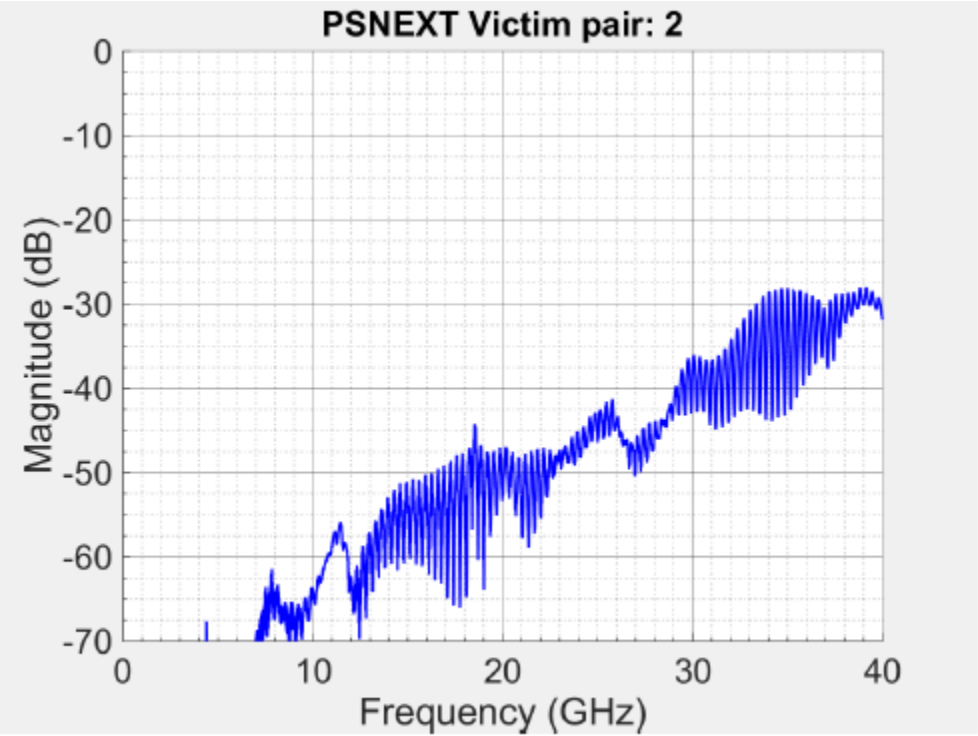
More crosstalk



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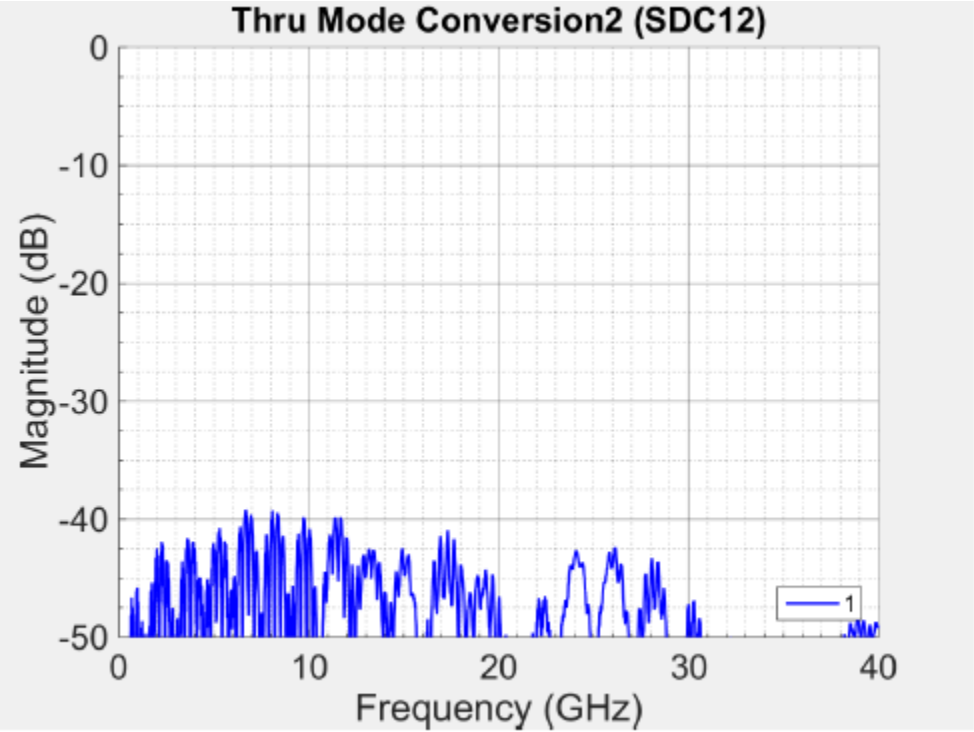
Mode Conversion



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Thank you

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