

# **100GEL C2M Channel model Study**

## **TP0-TP1a**

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**IEEE 802.3 100 Gb/s, 200 Gb/s, and 400 Gb/s Electrical Interface Task Force**

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# Purpose

- 1) This is a study of 100G/Lane Chip to Module for Yamaichi connectors.
- 2) The connectors are CFP2, CFP8, DSFP, OSFP, QSFP and QSFP-DD.
- 3) This study was inspected including mating looseness and influence of TH.
- 4) Offers of touch stone files are all connector model. Each connector touch stone files are calculated from mass production Yamaichi connector's 3D model.

## - Connector types

CFP2, CFP8, DSFP, OSFP, QSFP and QSFP-DD

## - Prepared Simulation Channel

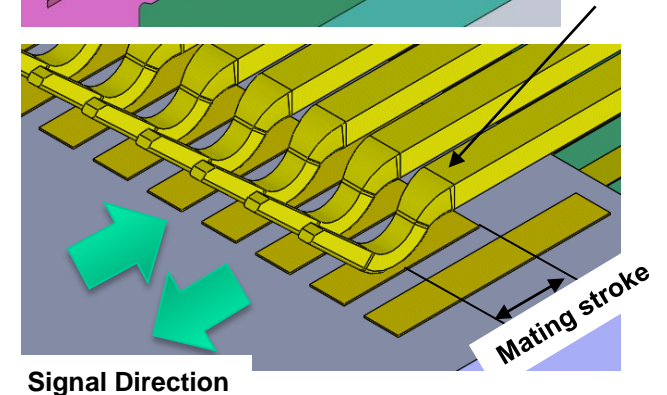
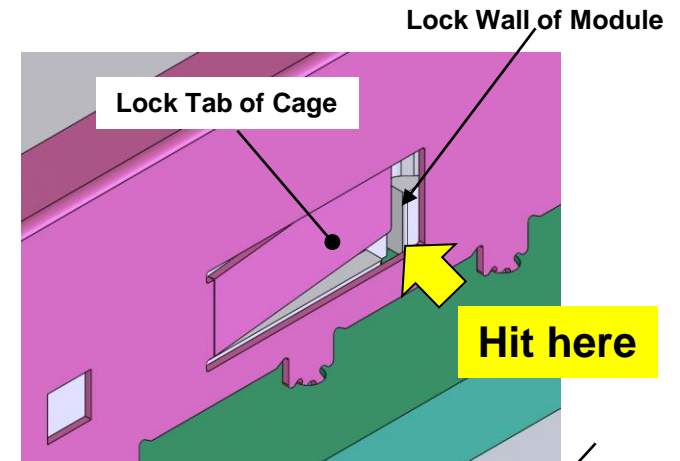
- Connector only
  - with Normal mating position
  - with Worst mating position
- 16 inch VSR channel (with  $\phi 0.3\text{mm}$  via.)
  - with Normal mating position
  - with Worst mating position
- 16 inch VSR channel (with  $\phi 0.2\text{mm}$  via.)
  - with Normal mating position
  - with Worst mating position

# C2M Channel Simulation

## - Simulation Conditions of connector :Mating Stroke

- The mating stroke was calculated when the Locking structure of module and cage were hit.
- Worst Mating stroke was calculated by R.S.S.(Root Sum)
- Mating strokes of each connectors are shown below.
- Mating stroke works as a Stub.

	[mm]	
	Normal Mating Stroke	Worst Mating Stroke
CFP2	0.65	0.9
CFP8	0.65	0.9
DSFP	0.75	1.06
OSFP	0.64	0.98
QSFP	0.80	1.10
QSFP-DD	Legacy PAD=0.80 Additional PAD=0.85	Legacy PAD=1.10 Additional PAD=1.20



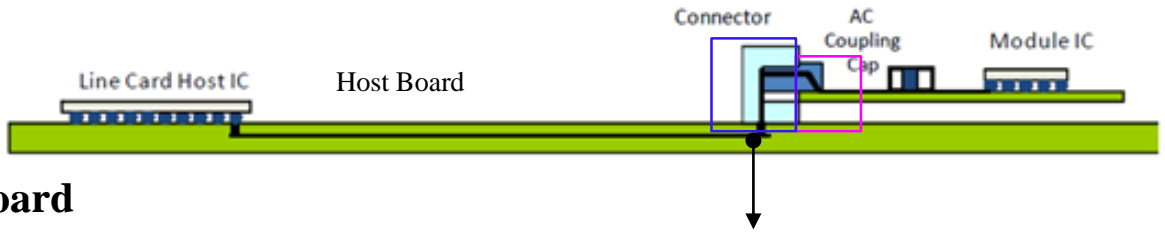
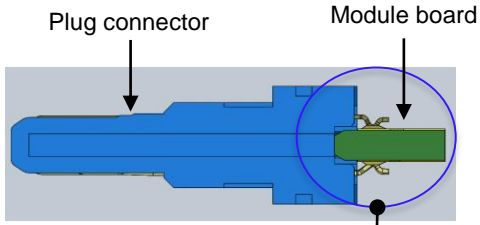
# C2M Channel Simulation

## - Simulation Conditions of connector : Host and Module Board

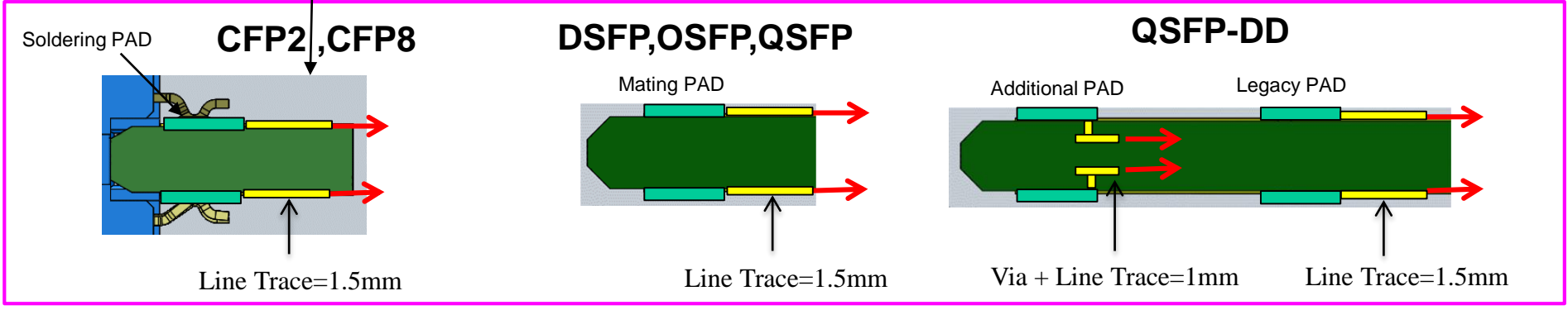
**Host board:** 1.5mm Line from the soldering PAD of connector.  $\tan \delta$  of Board is zero and Line loss is zero.

**Module board:** They are shown the figures below.  $\tan \delta$  of Board is zero and Line loss is zero.

**Via of board:** There are no Via of each boards for simulation model of connectors.



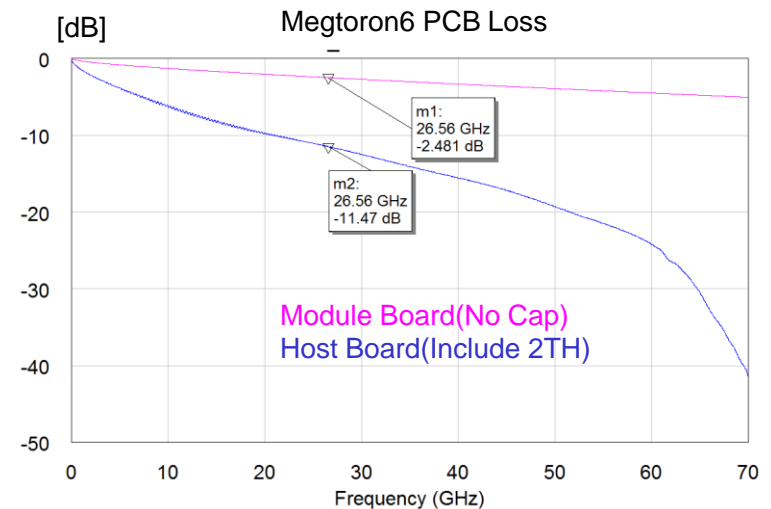
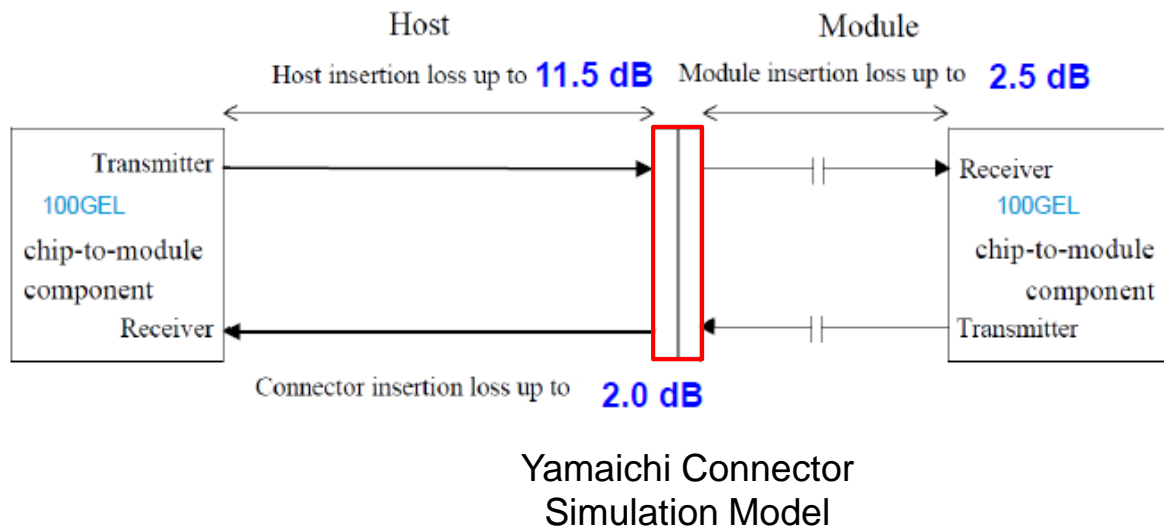
**Module Board**



# C2M Channel Simulation

## - Simulation Conditions of Channel Model

### Simulation Channel Model Loss Budget TP0 to TP1a



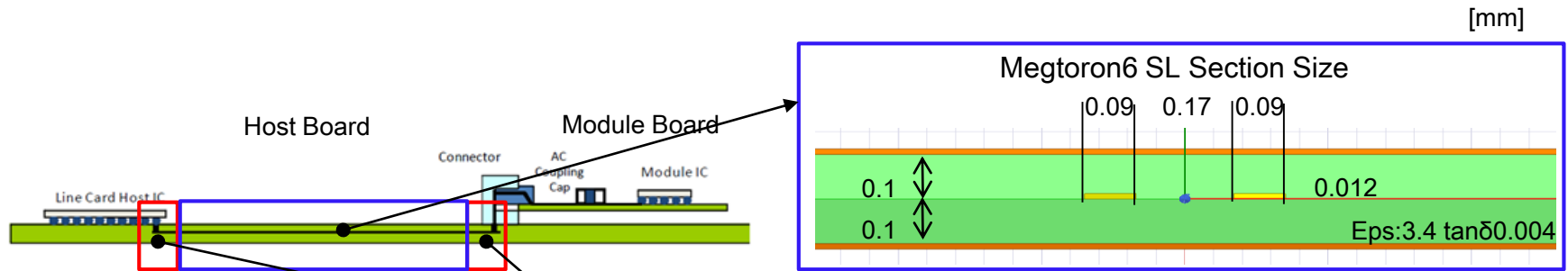
Channel Model loss budget is considered at IEEE 802.3.

Channel Model is all Simulation data.

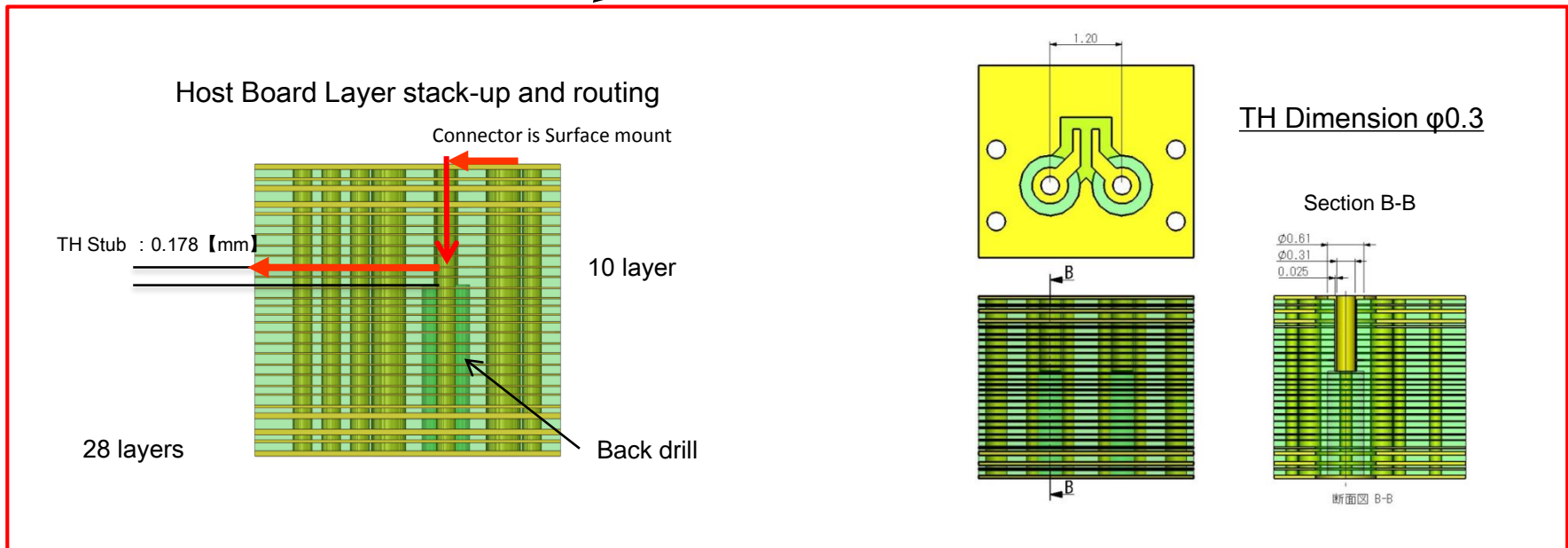
Each connector touch stone files are calculated from mass production Yamaichi connector's 3D model.

# C2M Channel Simulation

## - Simulation Conditions of Channel Model : Host Board



- Host Board model including 2\*TH.

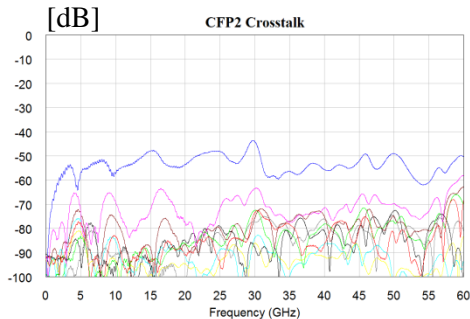
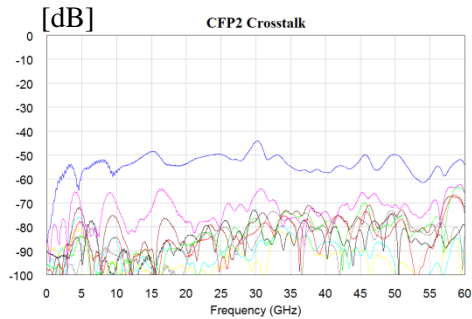
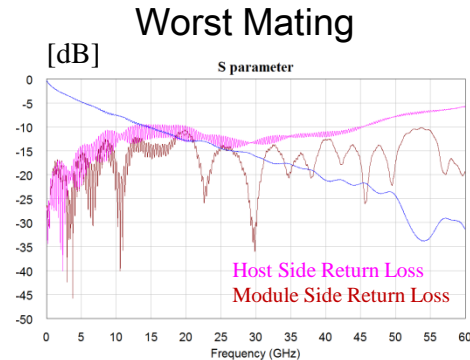
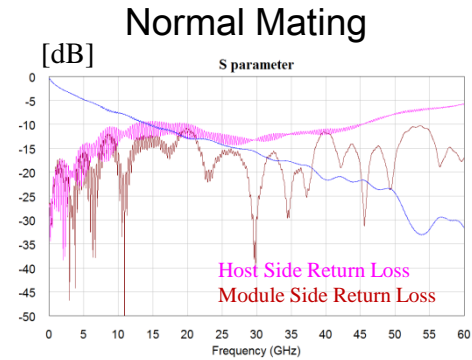






# C2M Channel Simulation

## - Simulation Result: CFP2 (Top Channel / Channel model)

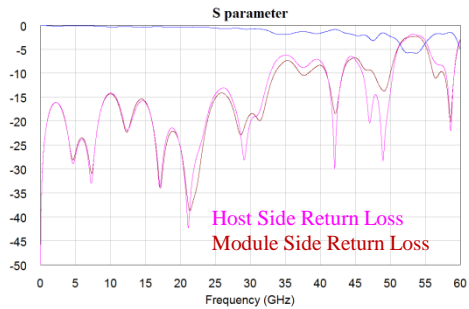


\* This S-parameter is shown the Channel model.

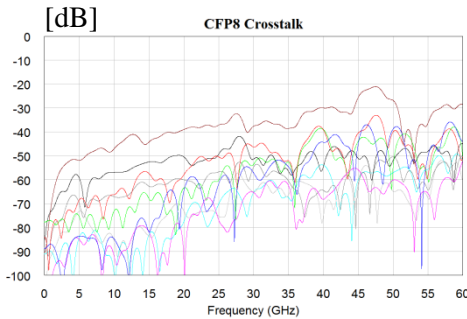
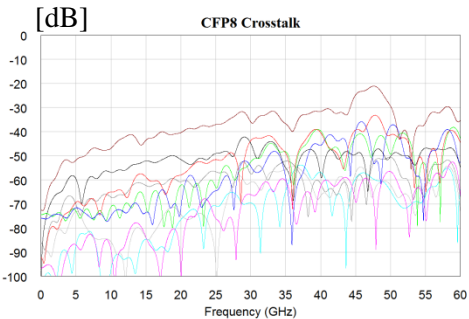
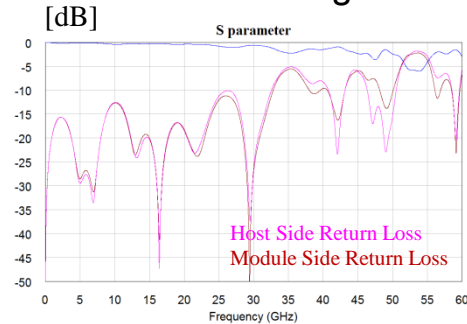
# C2M Channel Simulation

## - Simulation Result: CFP8 (Top Channel / Connector only)

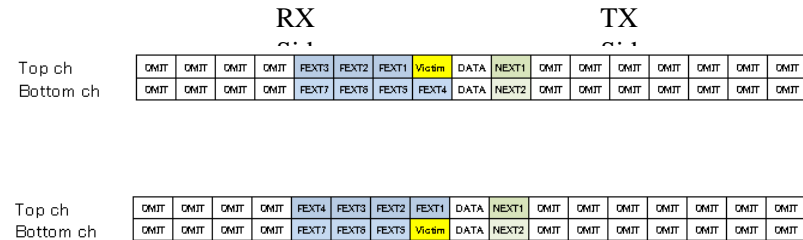
[dB] Normal Mating



Worst Mating



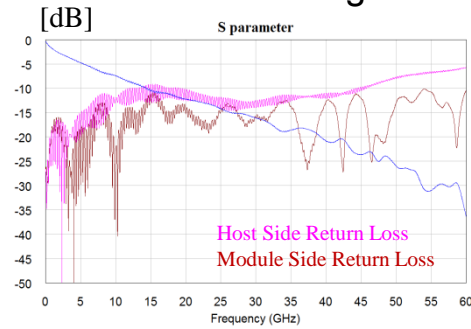
- \* This S-parameter is shown connector only.
  - \* Channel mapping is refer to following.
  - \* Crosstalk is 2 NEXT and 7 FEXT.
  - \* Bottom channel simulation files also available.
- See detail to page 29.



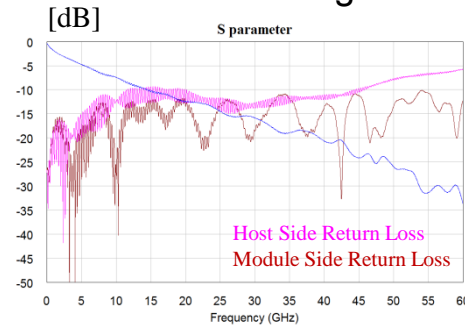
# C2M Channel Simulation

## - Simulation Result: CFP8 (Top Channel / Channel model)

Normal Mating

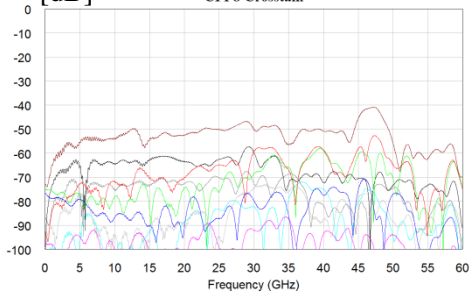


Worst Mating

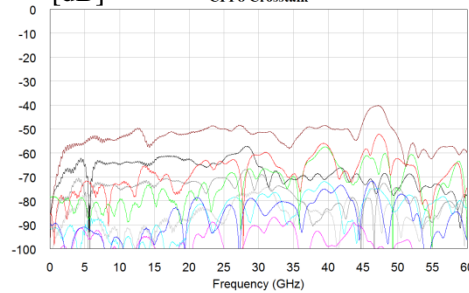


\* This S-parameter is shown the Channel model.

CFP8 Crosstalk



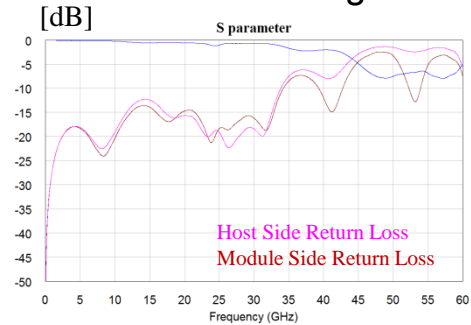
CFP8 Crosstalk



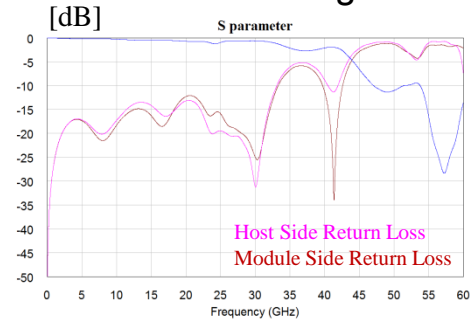
# C2M Channel Simulation

## - Simulation Result: DSFP (Top Channel / Connector only)

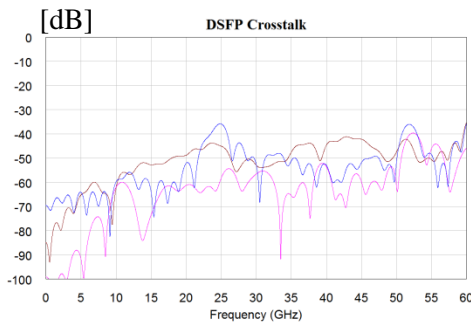
Normal Mating



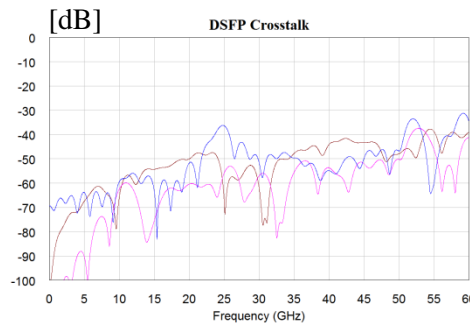
Worst Mating



DSFP Crosstalk



DSFP Crosstalk



- \* This S-parameter is shown connector only.
  - \* Channel mapping is refer to following.
  - \* Crosstalk is 1 NEXT and 2 FEXT
  - \* Bottom channel simulation files also available.
- See detail to page 30.

RX TX

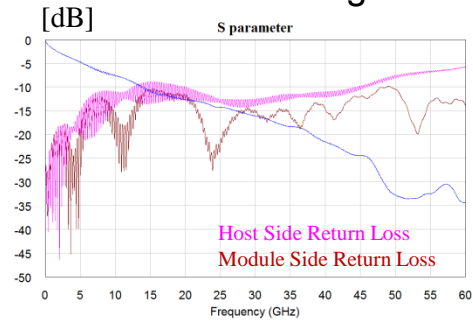
Top ch	Victim	DATA	NEXT1
Bottom ch	FEXT1	DATA	NEXT2

Top ch	FEXT1	DATA	NEXT1
Bottom ch	Victim	DATA	NEXT2

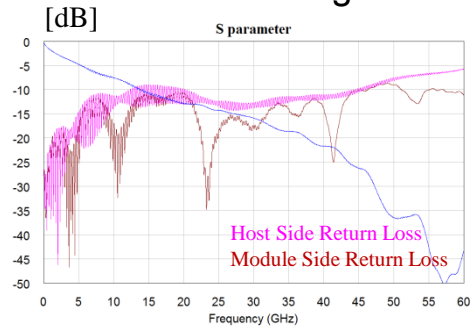
# C2M Channel Simulation

## - Simulation Result: DSFP (Top Channel / Channel model)

Normal Mating

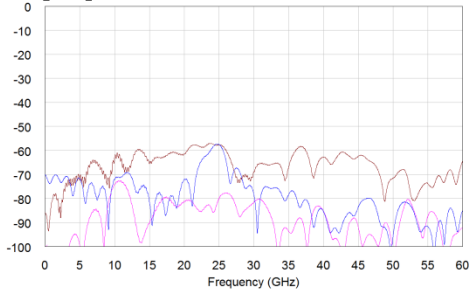


Worst Mating

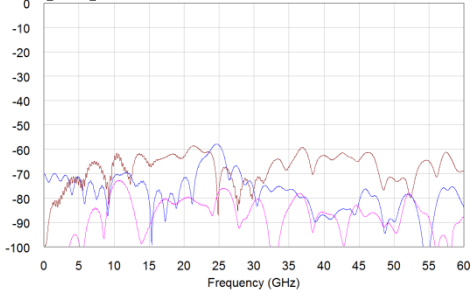


\* This S-parameter is shown the Channel model.

DSFP Crosstalk



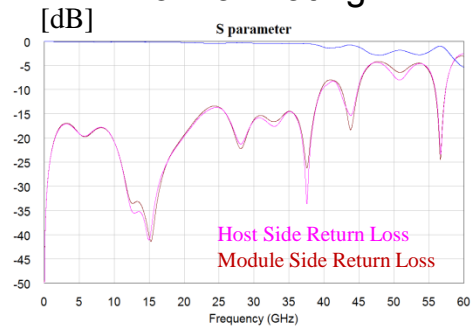
DSFP Crosstalk



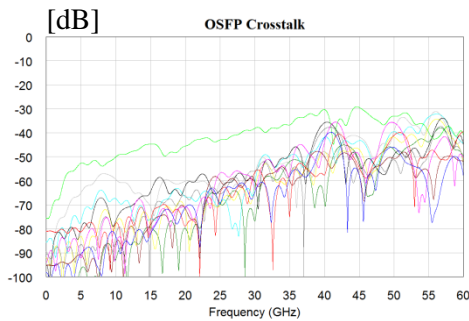
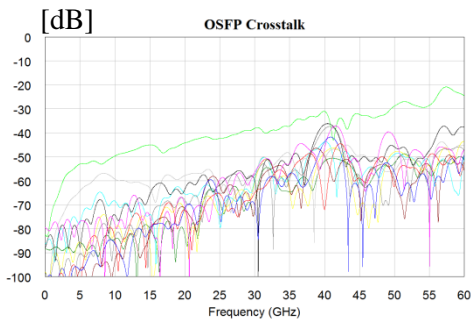
# C2M Channel Simulation

## - Simulation Result: OSFP (Top Channel / Connector only)

Normal Mating



Worst Mating



- \* This S-parameter is shown connector only.
  - \* Channel mapping is refer to following.
  - \* Crosstalk is 4 NEXT and 7 FEXT
  - \* Bottom channel simulation files also available.
- See detail to page 31.

RX

TX

Top ch  
Bottom ch

FEXT3	FEXT2	FEXT1	Victim	DATA	NEXT2	NEXT1	DMIT	DMIT
FEXT7	FEXT8	FEXT5	FEXT4	DATA	NEXT4	NEXT3	DMIT	DMIT

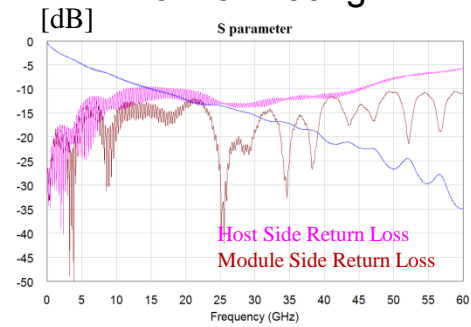
Top ch  
Bottom ch

FEXT4	FEXT3	FEXT2	FEXT1	DATA	NEXT2	NEXT1	DMIT	DMIT
FEXT7	FEXT8	FEXT5	Victim	DATA	NEXT4	NEXT3	DMIT	DMIT

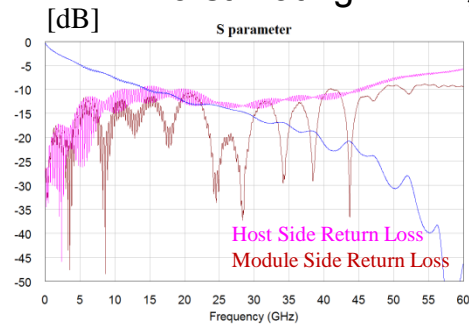
# C2M Channel Simulation

## - Simulation Result: OSFP (Top Channel / Channel model)

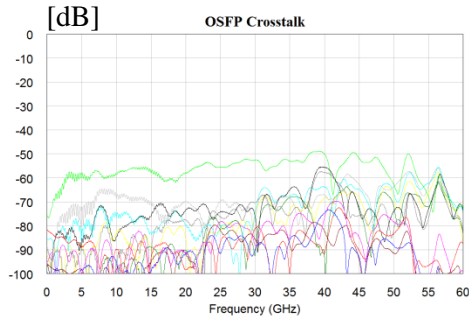
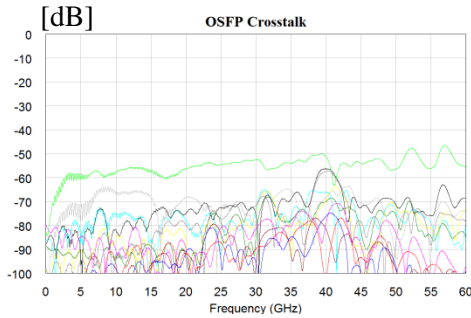
Normal Mating



Worst Mating



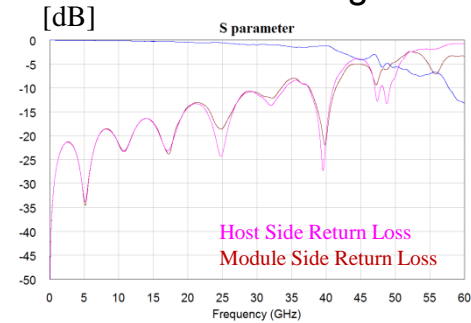
\* This S-parameter is shown the Channel model.



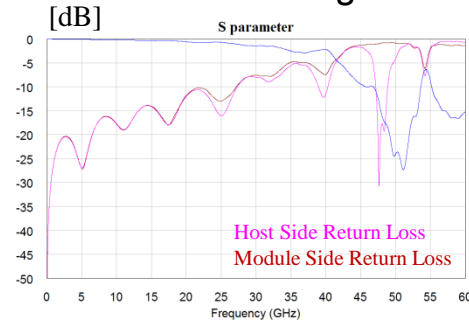
# C2M Channel Simulation

## - Simulation Result: QSFP (Top Channel / Connector only)

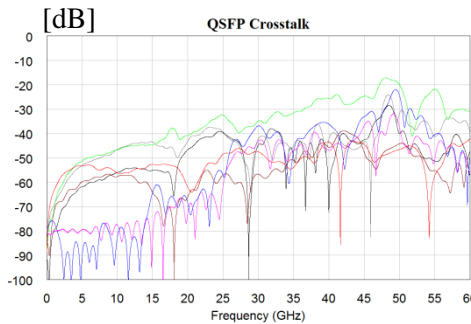
Normal Mating



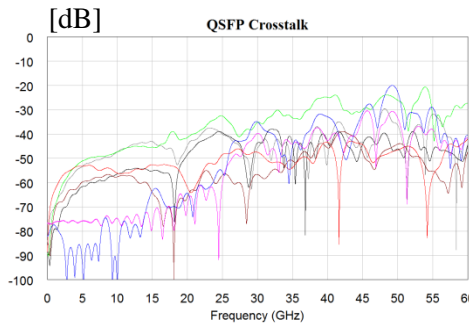
Worst Mating



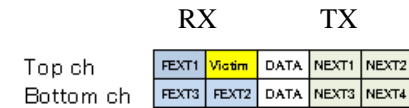
QSFP Crosstalk



QSFP Crosstalk



- \* This S-parameter is shown connector only.
  - \* Channel mapping is refer to following.
  - \* Crosstalk is 4 NEXT and 3 FEXT
  - \* Bottom channel simulation files also available.
- See detail to page 32.

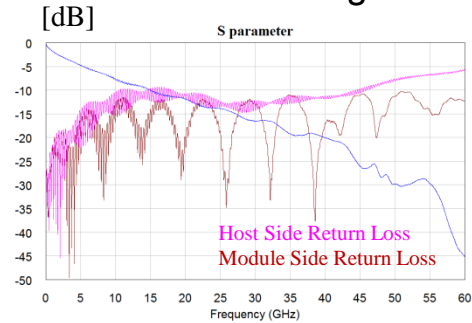




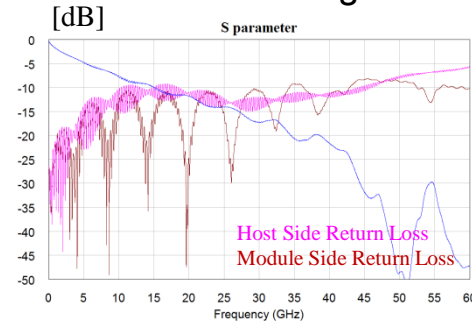
# C2M Channel Simulation

## - Simulation Result: QSFP (Top Channel / Channel model)

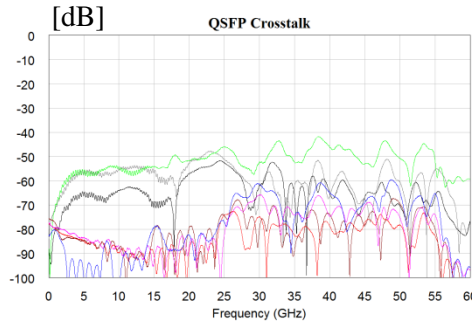
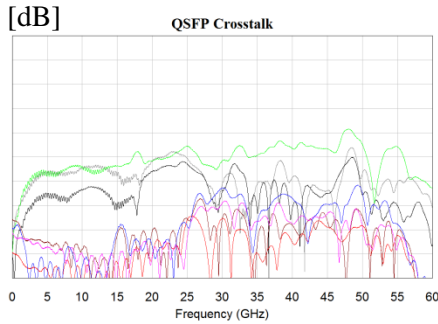
Normal Mating



Worst Mating



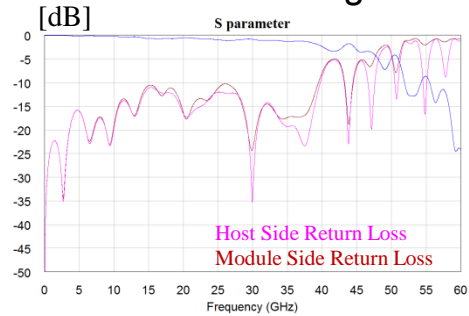
\* This S-parameter is shown the Channel model.



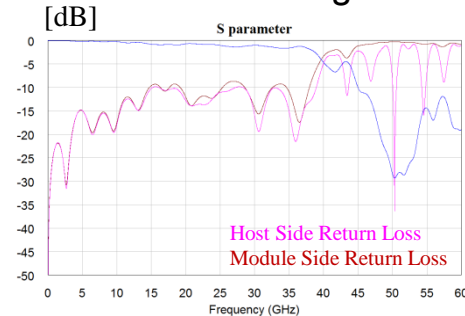
# C2M Channel Simulation

## - Simulation Result: QSFP-DD (Legacy Top Channel / Connector only)

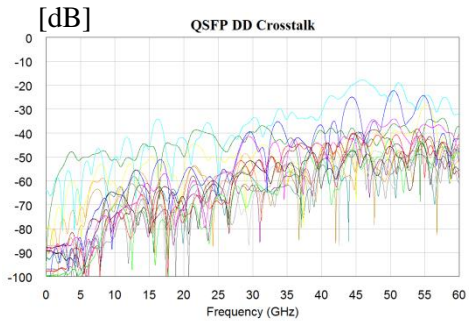
Normal Mating



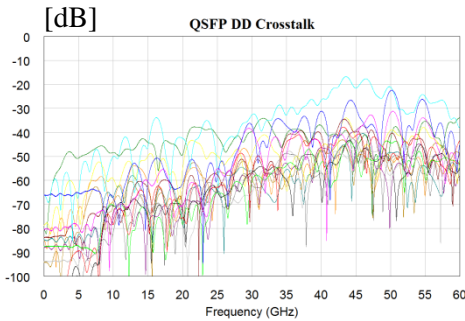
Worst Mating



QSFP DD Crosstalk



QSFP DD Crosstalk



- \* This S-parameter is shown Legacy Top channel and connector only.
  - \* Channel mapping is refer to following.
  - \* Crosstalk is 8 NEXT and 7 FEXT
  - \* Bottom channel simulation files also available.
- See detail to page 33~34.

RX Side TX Side

Legacy Top ch  
Additional Top ch  
Additional Bottom ch  
Legacy Bottom ch

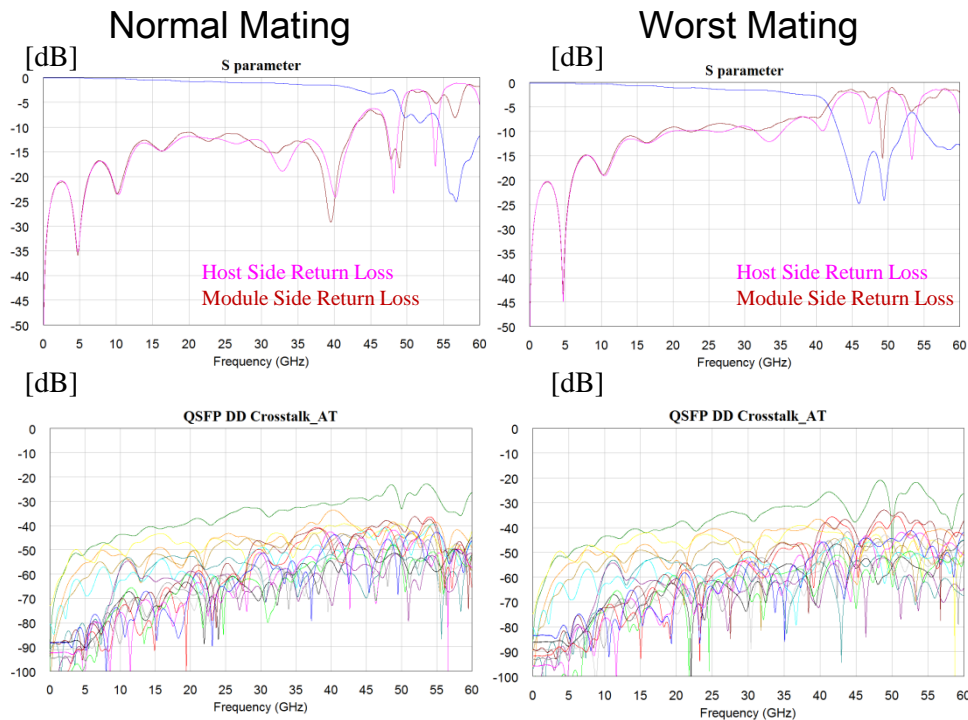
FEXT1	Victim	DATA	NEXT1	NEXT2
FEXT2	FEXT3	DATA	NEXT3	NEXT4
FEXT4	FEXT5	DATA	NEXT5	NEXT6
FEXT6	FEXT7	DATA	NEXT7	NEXT8

Legacy Top ch  
Additional Top ch  
Additional Bottom ch  
Legacy Bottom ch

FEXT1	FEXT2	DATA	NEXT1	NEXT2
FEXT3	FEXT4	DATA	NEXT3	NEXT4
FEXT5	FEXT6	DATA	NEXT5	NEXT6
FEXT7	Victim	DATA	NEXT7	NEXT8

# C2M Channel Simulation

## - Simulation Result: QSFP-DD (Additional Top Channel / Connector only)



- \* This S-parameter is shown Additional Top channel and connector only.
  - \* Channel mapping is refer to following.
  - \* Crosstalk is 8 NEXT and 7 FEXT
  - \* Bottom channel simulation files also available.
- See detail to page 33~34.

RX Side TX Side

Legacy Top ch  
 Additional Top ch  
 Additional Bottom ch  
 Legacy Bottom ch

FEXT1	FEXT2	DATA	NEXT1	NEXT2
FEXT3	Victim	DATA	NEXT3	NEXT4
FEXT4	FEXT5	DATA	NEXT5	NEXT6
FEXT6	FEXT7	DATA	NEXT7	NEXT8

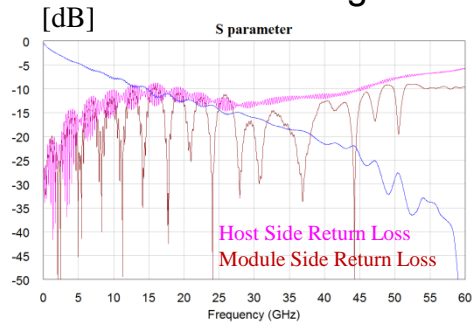
Legacy Top ch  
 Additional Top ch  
 Additional Bottom ch  
 Legacy Bottom ch

FEXT1	FEXT2	DATA	NEXT1	NEXT2
FEXT3	FEXT4	DATA	NEXT3	NEXT4
FEXT5	Victim	DATA	NEXT5	NEXT6
FEXT6	FEXT7	DATA	NEXT7	NEXT8

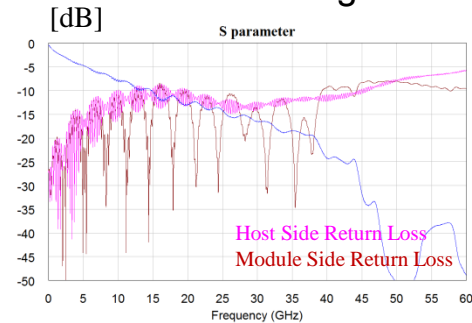
# C2M Channel Simulation

## - Simulation Result: QSFP-DD (Legacy Top Channel / Channel model)

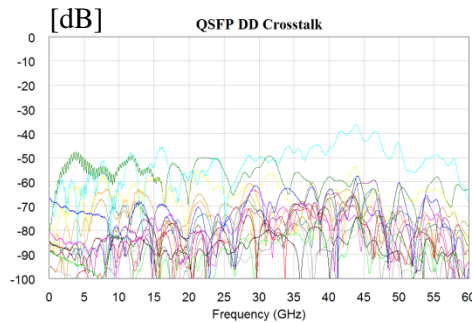
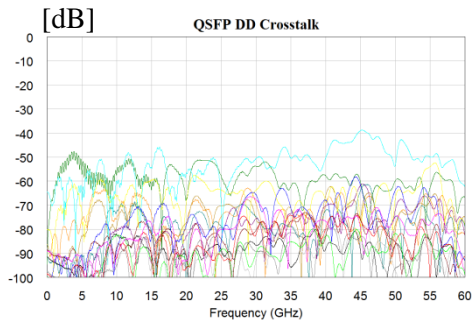
Normal Mating



Worst Mating



\* This S-parameter is shown Legacy Top channel of channel model.



RX Side TX Side

Legacy Top ch  
Additional Top ch  
Additional Bottom ch  
Legacy Bottom ch

FEXT1	Victim	DATA	NEXT1	NEXT2
FEXT2	FEXT3	DATA	NEXT3	NEXT4
FEXT4	FEXT5	DATA	NEXT5	NEXT6
FEXT6	FEXT7	DATA	NEXT7	NEXT8

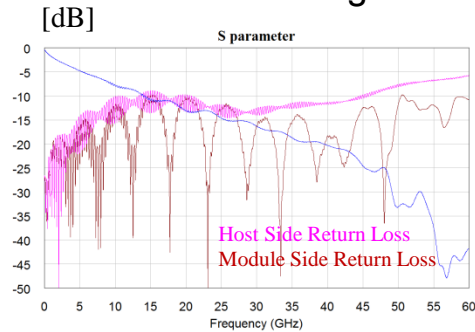
Legacy Top ch  
Additional Top ch  
Additional Bottom ch  
Legacy Bottom ch

FEXT1	FEXT2	DATA	NEXT1	NEXT2
FEXT3	FEXT4	DATA	NEXT3	NEXT4
FEXT5	FEXT6	DATA	NEXT5	NEXT6
FEXT7	Victim	DATA	NEXT7	NEXT8

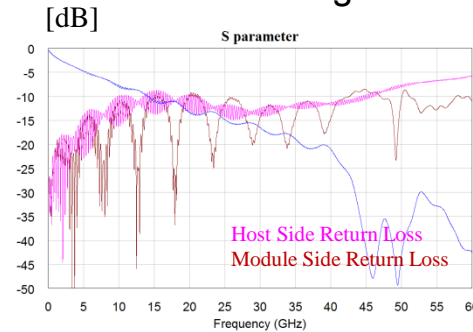
# C2M Channel Simulation

## - Simulation Result: QSFP-DD (Additional Top Channel / Channel model)

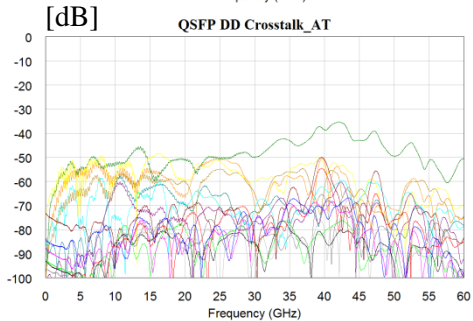
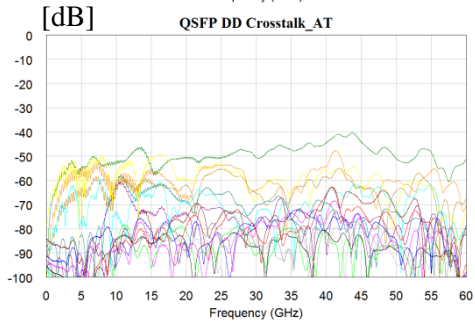
Normal Mating



Worst Mating



\* This S-parameter is shown Additional Top channel of channel model.



RX Side TX Side

Legacy Top ch  
Additional Top ch  
Additional Bottom ch  
Legacy Bottom ch

FEXT1	FEXT2	DATA	NEXT1	NEXT2
FEXT3	Victim	DATA	NEXT3	NEXT4
FEXT4	FEXT5	DATA	NEXT5	NEXT6
FEXT6	FEXT7	DATA	NEXT7	NEXT8

Legacy Top ch  
Additional Top ch  
Additional Bottom ch  
Legacy Bottom ch

FEXT1	FEXT2	DATA	NEXT1	NEXT2
FEXT3	FEXT4	DATA	NEXT3	NEXT4
FEXT5	Victim	DATA	NEXT5	NEXT6
FEXT6	FEXT7	DATA	NEXT7	NEXT8

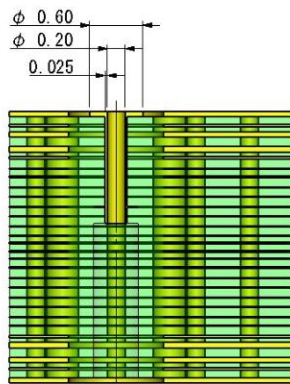
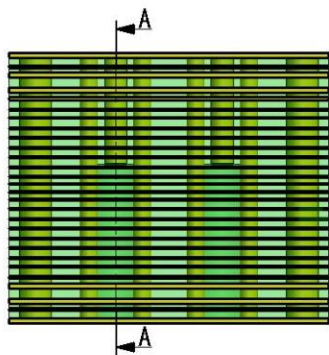
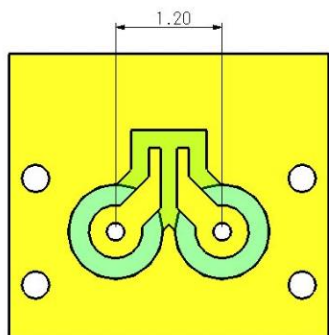
# C2M Channel Simulation

## - Comparison between $\phi 0.2\text{mm}$ and $\phi 0.3\text{mm}$ of TH

All unit [mm]

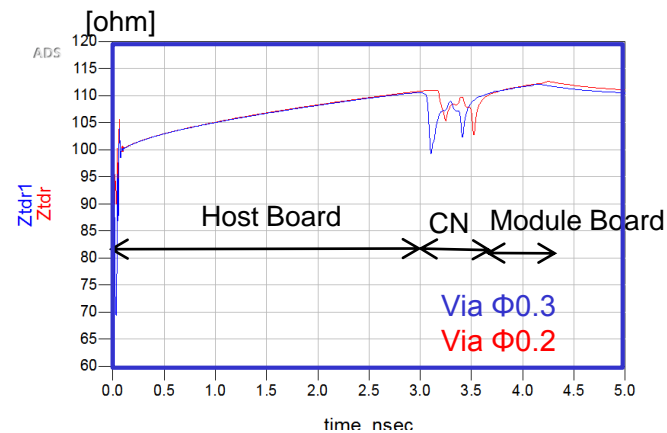
Model changed TH impedance was inspected.

PCB Condition TH Dimension  $\phi 0.2$

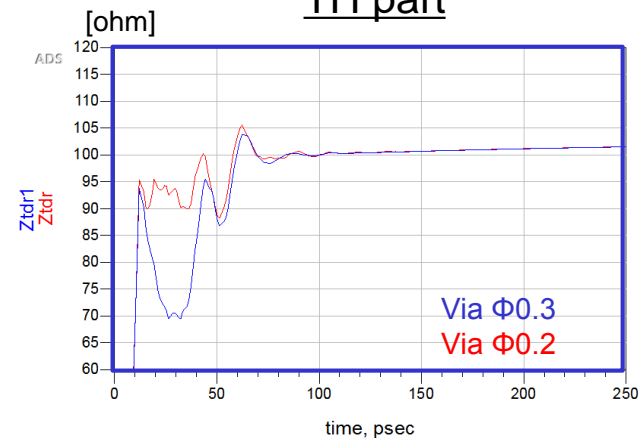


Section A-A

Channel Model TDR



TH part



\*Impedance was changed from S parameter in ADS.

# C2M Channel Simulation

## - Comparison of ILD: Connector , Mating Stroke and TH DIA

	0.3mm $\phi$ TH		0.2mm $\phi$ TH	
	Normal Mating Stroke	Worst Mating Stroke	Normal Mating Stroke	Worst Mating Stroke
CFP2_TOP	0.1699	0.1571	0.0710	0.0786
CFP2_BOTTOM	0.2476	0.2575	0.1810	0.1802
CFP8_TOP	0.1558	0.1743	0.1104	0.1286
CFP8_BOTTOM	0.1644	0.2157	0.0743	0.1052
DSFP_TOP	0.2604	0.2767	0.1450	0.1764
DSFP_BOTTOM	0.2711	0.2366	0.1870	0.1649
OSFP_TOP	0.1669	0.2254	0.0722	0.1049
OSFP_BOTTOM	0.1514	0.1976	0.0501	0.0889
QSFP_TOP	0.1779	0.3105	0.1113	0.2343
QSFP_BOTTOM	0.1814	0.3165	0.1124	0.2386
QSFP-DD_Legacy top	0.2433	0.3934	0.1317	0.3093
QSFP-DD_Additional top	0.2260	0.4955	0.1052	0.4259
QSFP-DD_Additional bottom	0.2126	0.4569	0.0975	0.3796
QSFP-DD_Legacy bottom	0.1837	0.2682	0.0917	0.1840

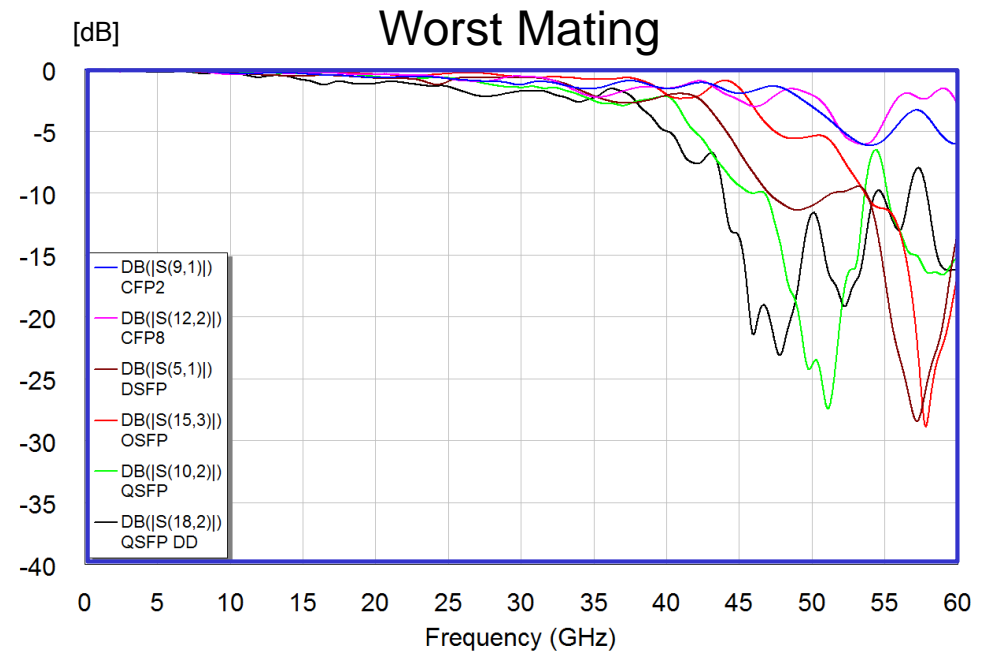
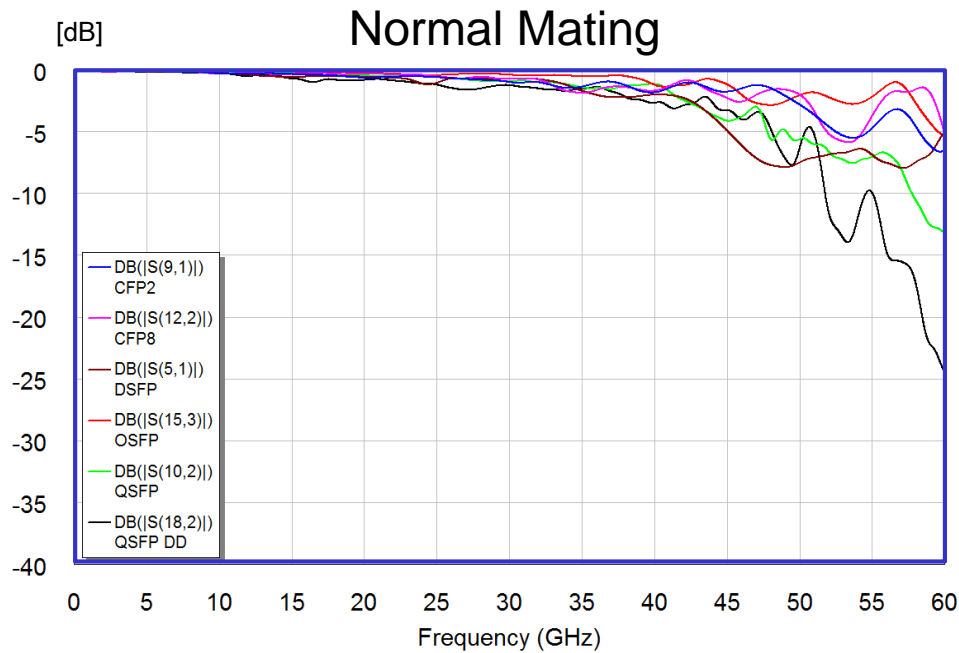
# Conclusion

- 1) Connector SI performance on both nominal and worst mating position were simulated for CFP2,CFP8,DSFP,QSFP,QSFP-DD and OSFP module form factor.
- 2) Worst mating position showed some performance degradation specially at higher than 35GHz on all module form factors. This condition should be incorporated into the 112G channel study.
- 3) Via. size makes impact to the ILD result
- 4) Yamaichi continues connector performance improvement study to make all module form factors work on 112G channel.
- 5) For more information, please contact,
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# APPENDIX

# Comparison of Insertion Loss



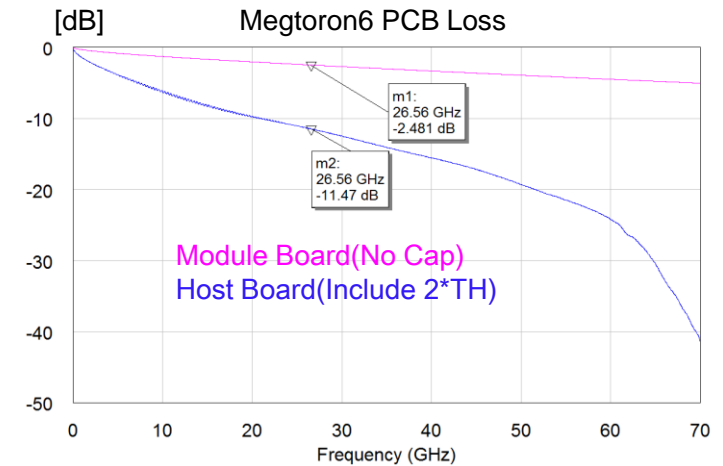
# PCB model touchstone files

Module Board and Host Board(φ0.3mm / φ0.2mm)

Module Board : Module Board.s4p



Host Board : Host Board\_2via0.3.s4p (via φ0.3mm)  
Host Board\_2via0.2.s4p (via φ0.2mm)



Maximum Frequency = 70GHz / 10MHz Step  
Minimum Frequency = 0Hz

# Connector simulation model touchstone files

## CFP2 Connector

Connector only

	Normal Mating	Worst Mating	
CFP2 top side	CFP2_S_top_normal_THRU.s4p	CFP2_S_top_worst_THRU.s4p	■
	CFP2_S_top_normal_FEXT1.s4p	CFP2_S_top_worst_FEXT1.s4p	
	CFP2_S_top_normal_FEXT2.s4p	CFP2_S_top_worst_FEXT2.s4p	
	CFP2_S_top_normal_FEXT3.s4p	CFP2_S_top_worst_FEXT3.s4p	
	CFP2_S_top_normal_FEXT4.s4p	CFP2_S_top_worst_FEXT4.s4p	■
	CFP2_S_top_normal_FEXT5.s4p	CFP2_S_top_worst_FEXT5.s4p	
	CFP2_S_top_normal_FEXT6.s4p	CFP2_S_top_worst_FEXT6.s4p	
	CFP2_S_top_normal_FEXT7.s4p	CFP2_S_top_worst_FEXT7.s4p	
	CFP2_S_top_normal_NEXT1.s4p	CFP2_S_top_worst_NEXT1.s4p	■
	CFP2_S_top_normal_NEXT2.s4p	CFP2_S_top_worst_NEXT2.s4p	
CFP2 bottom side	CFP2_S_bottom_normal_THRU.s4p	CFP2_S_bottom_worst_THRU.s4p	■
	CFP2_S_bottom_normal_FEXT1.s4p	CFP2_S_bottom_worst_FEXT1.s4p	
	CFP2_S_bottom_normal_FEXT2.s4p	CFP2_S_bottom_worst_FEXT2.s4p	
	CFP2_S_bottom_normal_FEXT3.s4p	CFP2_S_bottom_worst_FEXT3.s4p	
	CFP2_S_bottom_normal_FEXT4.s4p	CFP2_S_bottom_worst_FEXT4.s4p	■
	CFP2_S_bottom_normal_FEXT5.s4p	CFP2_S_bottom_worst_FEXT5.s4p	
	CFP2_S_bottom_normal_FEXT6.s4p	CFP2_S_bottom_worst_FEXT6.s4p	
	CFP2_S_bottom_normal_FEXT7.s4p	CFP2_S_bottom_worst_FEXT7.s4p	
	CFP2_S_bottom_normal_NEXT1.s4p	CFP2_S_bottom_worst_NEXT1.s4p	■
	CFP2_S_bottom_normal_NEXT2.s4p	CFP2_S_bottom_worst_NEXT2.s4p	

All touch stone is used at 10ch.  
 Red touch stone is used at 8ch.  
 ■ is used at 4ch.

Channel model  
 Host Board via diameter is  
 0.3mm.

	Normal Mating	Worst Mating	
CFP2 top side	CFP2_S_C_top_normal_THRU.s4p	CFP2_S_C_top_worst_THRU.s4p	■
	CFP2_S_C_top_normal_FEXT1.s4p	CFP2_S_C_top_worst_FEXT1.s4p	
	CFP2_S_C_top_normal_FEXT2.s4p	CFP2_S_C_top_worst_FEXT2.s4p	
	CFP2_S_C_top_normal_FEXT3.s4p	CFP2_S_C_top_worst_FEXT3.s4p	
	CFP2_S_C_top_normal_FEXT4.s4p	CFP2_S_C_top_worst_FEXT4.s4p	■
	CFP2_S_C_top_normal_FEXT5.s4p	CFP2_S_C_top_worst_FEXT5.s4p	
	CFP2_S_C_top_normal_FEXT6.s4p	CFP2_S_C_top_worst_FEXT6.s4p	
	CFP2_S_C_top_normal_FEXT7.s4p	CFP2_S_C_top_worst_FEXT7.s4p	
	CFP2_S_C_top_normal_NEXT1.s4p	CFP2_S_C_top_worst_NEXT1.s4p	■
	CFP2_S_C_top_normal_NEXT2.s4p	CFP2_S_C_top_worst_NEXT2.s4p	
CFP2 bottom side	CFP2_S_C_bottom_normal_THRU.s4p	CFP2_S_C_bottom_worst_THRU.s4p	■
	CFP2_S_C_bottom_normal_FEXT1.s4p	CFP2_S_C_bottom_worst_FEXT1.s4p	
	CFP2_S_C_bottom_normal_FEXT2.s4p	CFP2_S_C_bottom_worst_FEXT2.s4p	
	CFP2_S_C_bottom_normal_FEXT3.s4p	CFP2_S_C_bottom_worst_FEXT3.s4p	
	CFP2_S_C_bottom_normal_FEXT4.s4p	CFP2_S_C_bottom_worst_FEXT4.s4p	■
	CFP2_S_C_bottom_normal_FEXT5.s4p	CFP2_S_C_bottom_worst_FEXT5.s4p	
	CFP2_S_C_bottom_normal_FEXT6.s4p	CFP2_S_C_bottom_worst_FEXT6.s4p	
	CFP2_S_C_bottom_normal_FEXT7.s4p	CFP2_S_C_bottom_worst_FEXT7.s4p	
	CFP2_S_C_bottom_normal_NEXT1.s4p	CFP2_S_C_bottom_worst_NEXT1.s4p	■
	CFP2_S_C_bottom_normal_NEXT2.s4p	CFP2_S_C_bottom_worst_NEXT2.s4p	

Please use in combination a connector and board touch stone file (P25) at channel model of φ0.2.

Maximum Frequency = 70GHz / 10MHz Step  
 Minimum Frequency = 0Hz

# Connector simulation model touchstone files

## CFP8 Connector

Connector only

	Normal Mating	Worst Mating	
CFP8 top side	CFP8_S_top_normal_THRU.s4p	CFP8_S_top_worst_THRU.s4p	
	CFP8_S_top_normal_FEXT1.s4p	CFP8_S_top_worst_FEXT1.s4p	
	CFP8_S_top_normal_FEXT2.s4p	CFP8_S_top_worst_FEXT2.s4p	
	CFP8_S_top_normal_FEXT3.s4p	CFP8_S_top_worst_FEXT3.s4p	
	CFP8_S_top_normal_FEXT4.s4p	CFP8_S_top_worst_FEXT4.s4p	
	CFP8_S_top_normal_FEXT5.s4p	CFP8_S_top_worst_FEXT5.s4p	
	CFP8_S_top_normal_FEXT6.s4p	CFP8_S_top_worst_FEXT6.s4p	
	CFP8_S_top_normal_FEXT7.s4p	CFP8_S_top_worst_FEXT7.s4p	
	CFP8_S_top_normal_NEXT1.s4p	CFP8_S_top_worst_NEXT1.s4p	
	CFP8_S_top_normal_NEXT2.s4p	CFP8_S_top_worst_NEXT2.s4p	
	CFP8 bottom side	CFP8_S_bottom_normal_THRU.s4p	CFP8_S_bottom_worst_THRU.s4p
		CFP8_S_bottom_normal_FEXT1.s4p	CFP8_S_bottom_worst_FEXT1.s4p
CFP8_S_bottom_normal_FEXT2.s4p		CFP8_S_bottom_worst_FEXT2.s4p	
CFP8_S_bottom_normal_FEXT3.s4p		CFP8_S_bottom_worst_FEXT3.s4p	
CFP8_S_bottom_normal_FEXT4.s4p		CFP8_S_bottom_worst_FEXT4.s4p	
CFP8_S_bottom_normal_FEXT5.s4p		CFP8_S_bottom_worst_FEXT5.s4p	
CFP8_S_bottom_normal_FEXT6.s4p		CFP8_S_bottom_worst_FEXT6.s4p	
CFP8_S_bottom_normal_FEXT7.s4p		CFP8_S_bottom_worst_FEXT7.s4p	
CFP8_S_bottom_normal_NEXT1.s4p		CFP8_S_bottom_worst_NEXT1.s4p	
CFP8_S_bottom_normal_NEXT2.s4p		CFP8_S_bottom_worst_NEXT2.s4p	

Channel model

Host Board via diameter is 0.3mm.

	Normal Mating	Worst Mating	
CFP8 top side	CFP8_S_C_top_normal_THRU.s4p	CFP8_S_C_top_worst_THRU.s4p	
	CFP8_S_C_top_normal_FEXT1.s4p	CFP8_S_C_top_worst_FEXT1.s4p	
	CFP8_S_C_top_normal_FEXT2.s4p	CFP8_S_C_top_worst_FEXT2.s4p	
	CFP8_S_C_top_normal_FEXT3.s4p	CFP8_S_C_top_worst_FEXT3.s4p	
	CFP8_S_C_top_normal_FEXT4.s4p	CFP8_S_C_top_worst_FEXT4.s4p	
	CFP8_S_C_top_normal_FEXT5.s4p	CFP8_S_C_top_worst_FEXT5.s4p	
	CFP8_S_C_top_normal_FEXT6.s4p	CFP8_S_C_top_worst_FEXT6.s4p	
	CFP8_S_C_top_normal_FEXT7.s4p	CFP8_S_C_top_worst_FEXT7.s4p	
	CFP8_S_C_top_normal_NEXT1.s4p	CFP8_S_C_top_worst_NEXT1.s4p	
	CFP8_S_C_top_normal_NEXT2.s4p	CFP8_S_C_top_worst_NEXT2.s4p	
	CFP8 bottom side	CFP8_S_C_bottom_normal_THRU.s4p	CFP8_S_C_bottom_worst_THRU.s4p
		CFP8_S_C_bottom_normal_FEXT1.s4p	CFP8_S_C_bottom_worst_FEXT1.s4p
CFP8_S_C_bottom_normal_FEXT2.s4p		CFP8_S_C_bottom_worst_FEXT2.s4p	
CFP8_S_C_bottom_normal_FEXT3.s4p		CFP8_S_C_bottom_worst_FEXT3.s4p	
CFP8_S_C_bottom_normal_FEXT4.s4p		CFP8_S_C_bottom_worst_FEXT4.s4p	
CFP8_S_C_bottom_normal_FEXT5.s4p		CFP8_S_C_bottom_worst_FEXT5.s4p	
CFP8_S_C_bottom_normal_FEXT6.s4p		CFP8_S_C_bottom_worst_FEXT6.s4p	
CFP8_S_C_bottom_normal_FEXT7.s4p		CFP8_S_C_bottom_worst_FEXT7.s4p	
CFP8_S_C_bottom_normal_NEXT1.s4p		CFP8_S_C_bottom_worst_NEXT1.s4p	
CFP8_S_C_bottom_normal_NEXT2.s4p		CFP8_S_C_bottom_worst_NEXT2.s4p	

Please use in combination a connector and board touch stone file (P25) at channel model of φ0.2.

Maximum Frequency = 70GHz / 10MHz Step  
Minimum Frequency = 0Hz

# Connector simulation model touchstone files

## DSFP Connector

Connector only

	Normal Mating	Worst Mating
DSFP top channel	DSFP_S_top_normal_THRU.s4p	DSFP_S_top_worst_THRU.s4p
	DSFP_S_top_normal_FEXT1.s4p	DSFP_S_top_worst_FEXT1.s4p
	DSFP_S_top_normal_NEXT1.s4p	DSFP_S_top_worst_NEXT1.s4p
	DSFP_S_top_normal_NEXT2.s4p	DSFP_S_top_worst_NEXT2.s4p
DSFP bottom channel	DSFP_S_bottom_normal_THRU.s4p	DSFP_S_bottom_worst_THRU.s4p
	DSFP_S_bottom_normal_FEXT1.s4p	DSFP_S_bottom_worst_FEXT1.s4p
	DSFP_S_bottom_normal_NEXT1.s4p	DSFP_S_bottom_worst_NEXT1.s4p
	DSFP_S_bottom_normal_NEXT1.s4p	DSFP_S_bottom_worst_NEXT2.s4p

Channel model

Host Board via diameter is 0.3mm.

	Normal Mating	Worst Mating
DSFP top channel	DSFP_S_C_top_normal_THRU.s4p	DSFP_S_C_top_worst_THRU.s4p
	DSFP_S_C_top_normal_FEXT1.s4p	DSFP_S_C_top_worst_FEXT1.s4p
	DSFP_S_C_top_normal_NEXT1.s4p	DSFP_S_C_top_worst_NEXT1.s4p
	DSFP_S_C_top_normal_NEXT2.s4p	DSFP_S_C_top_worst_NEXT2.s4p
DSFP bottom channel	DSFP_S_C_bottom_normal_THRU.s4p	DSFP_S_C_bottom_worst_THRU.s4p
	DSFP_S_C_bottom_normal_FEXT1.s4p	DSFP_S_C_bottom_worst_FEXT1.s4p
	DSFP_S_C_bottom_normal_NEXT1.s4p	DSFP_S_C_bottom_worst_NEXT1.s4p
	DSFP_S_C_bottom_normal_NEXT1.s4p	DSFP_S_C_bottom_worst_NEXT2.s4p

Please use in combination a connector and board touch stone file (P25) at channel model of  $\phi 0.2$ .

Maximum Frequency = 70GHz / 10MHz Step  
 Minimum Frequency = 0Hz

# Connector simulation model touchstone files

## OSFP Connector

Connector only

	Normal Mating	Worst Mating	
OSFP top side	OSFP_S_top_normal_THRU.s4p	OSFP_S_top_worst_THRU.s4p	
	OSFP_S_top_normal_FEXT1.s4p	OSFP_S_top_worst_FEXT1.s4p	
	OSFP_S_top_normal_FEXT2.s4p	OSFP_S_top_worst_FEXT2.s4p	
	OSFP_S_top_normal_FEXT3.s4p	OSFP_S_top_worst_FEXT3.s4p	
	OSFP_S_top_normal_FEXT4.s4p	OSFP_S_top_worst_FEXT4.s4p	
	OSFP_S_top_normal_FEXT5.s4p	OSFP_S_top_worst_FEXT5.s4p	
	OSFP_S_top_normal_FEXT6.s4p	OSFP_S_top_worst_FEXT6.s4p	
	OSFP_S_top_normal_FEXT7.s4p	OSFP_S_top_worst_FEXT7.s4p	
	OSFP_S_top_normal_NEXT1.s4p	OSFP_S_top_worst_NEXT1.s4p	
	OSFP_S_top_normal_NEXT2.s4p	OSFP_S_top_worst_NEXT2.s4p	
	OSFP_S_top_normal_NEXT3.s4p	OSFP_S_top_worst_NEXT3.s4p	
	OSFP_S_top_normal_NEXT4.s4p	OSFP_S_top_worst_NEXT4.s4p	
	OSFP bottom side	OSFP_S_bottom_normal_THRU.s4p	OSFP_S_bottom_worst_THRU.s4p
		OSFP_S_bottom_normal_FEXT1.s4p	OSFP_S_bottom_worst_FEXT1.s4p
OSFP_S_bottom_normal_FEXT2.s4p		OSFP_S_bottom_worst_FEXT2.s4p	
OSFP_S_bottom_normal_FEXT3.s4p		OSFP_S_bottom_worst_FEXT3.s4p	
OSFP_S_bottom_normal_FEXT4.s4p		OSFP_S_bottom_worst_FEXT4.s4p	
OSFP_S_bottom_normal_FEXT5.s4p		OSFP_S_bottom_worst_FEXT5.s4p	
OSFP_S_bottom_normal_FEXT6.s4p		OSFP_S_bottom_worst_FEXT6.s4p	
OSFP_S_bottom_normal_FEXT7.s4p		OSFP_S_bottom_worst_FEXT7.s4p	
OSFP_S_bottom_normal_NEXT1.s4p		OSFP_S_bottom_worst_NEXT1.s4p	
OSFP_S_bottom_normal_NEXT2.s4p		OSFP_S_bottom_worst_NEXT2.s4p	
OSFP_S_bottom_normal_NEXT3.s4p		OSFP_S_bottom_worst_NEXT3.s4p	
OSFP_S_bottom_normal_NEXT4.s4p		OSFP_S_bottom_worst_NEXT4.s4p	

Please use in combination a connector and board touch stone file (P25) at channel model of  $\phi 0.2$ .

Channel model  
Host Board via diameter is 0.3mm.

	Normal Mating	Worst Mating	
OSFP top side	OSFP_S_C_top_normal_THRU.s4p	OSFP_S_C_top_worst_THRU.s4p	
	OSFP_S_C_top_normal_FEXT1.s4p	OSFP_S_C_top_worst_FEXT1.s4p	
	OSFP_S_C_top_normal_FEXT2.s4p	OSFP_S_C_top_worst_FEXT2.s4p	
	OSFP_S_C_top_normal_FEXT3.s4p	OSFP_S_C_top_worst_FEXT3.s4p	
	OSFP_S_C_top_normal_FEXT4.s4p	OSFP_S_C_top_worst_FEXT4.s4p	
	OSFP_S_C_top_normal_FEXT5.s4p	OSFP_S_C_top_worst_FEXT5.s4p	
	OSFP_S_C_top_normal_FEXT6.s4p	OSFP_S_C_top_worst_FEXT6.s4p	
	OSFP_S_C_top_normal_FEXT7.s4p	OSFP_S_C_top_worst_FEXT7.s4p	
	OSFP_S_C_top_normal_NEXT1.s4p	OSFP_S_C_top_worst_NEXT1.s4p	
	OSFP_S_C_top_normal_NEXT2.s4p	OSFP_S_C_top_worst_NEXT2.s4p	
	OSFP_S_C_top_normal_NEXT3.s4p	OSFP_S_C_top_worst_NEXT3.s4p	
	OSFP_S_C_top_normal_NEXT4.s4p	OSFP_S_C_top_worst_NEXT4.s4p	
	OSFP bottom side	OSFP_S_C_bottom_normal_THRU.s4p	OSFP_S_C_bottom_worst_THRU.s4p
		OSFP_S_C_bottom_normal_FEXT1.s4p	OSFP_S_C_bottom_worst_FEXT1.s4p
OSFP_S_C_bottom_normal_FEXT2.s4p		OSFP_S_C_bottom_worst_FEXT2.s4p	
OSFP_S_C_bottom_normal_FEXT3.s4p		OSFP_S_C_bottom_worst_FEXT3.s4p	
OSFP_S_C_bottom_normal_FEXT4.s4p		OSFP_S_C_bottom_worst_FEXT4.s4p	
OSFP_S_C_bottom_normal_FEXT5.s4p		OSFP_S_C_bottom_worst_FEXT5.s4p	
OSFP_S_C_bottom_normal_FEXT6.s4p		OSFP_S_C_bottom_worst_FEXT6.s4p	
OSFP_S_C_bottom_normal_FEXT7.s4p		OSFP_S_C_bottom_worst_FEXT7.s4p	
OSFP_S_C_bottom_normal_NEXT1.s4p		OSFP_S_C_bottom_worst_NEXT1.s4p	
OSFP_S_C_bottom_normal_NEXT2.s4p		OSFP_S_C_bottom_worst_NEXT2.s4p	
OSFP_S_C_bottom_normal_NEXT3.s4p		OSFP_S_C_bottom_worst_NEXT3.s4p	
OSFP_S_C_bottom_normal_NEXT4.s4p		OSFP_S_C_bottom_worst_NEXT4.s4p	

Maximum Frequency = 70GHz / 10MHz Step  
Minimum Frequency = 0Hz

# Connector simulation model touchstone files

## QSFP Connector

Connector only

	Normal Mating	Worst Mating
QSFP top side	QSFP_S_top_normal_THRU.s4p	QSFP_S_top_worst_THRU.s4p
	QSFP_S_top_normal_FEXT1.s4p	QSFP_S_top_worst_FEXT1.s4p
	QSFP_S_top_normal_FEXT2.s4p	QSFP_S_top_worst_FEXT2.s4p
	QSFP_S_top_normal_FEXT3.s4p	QSFP_S_top_worst_FEXT3.s4p
	QSFP_S_top_normal_NEXT1.s4p	QSFP_S_top_worst_NEXT1.s4p
	QSFP_S_top_normal_NEXT2.s4p	QSFP_S_top_worst_NEXT2.s4p
	QSFP_S_top_normal_NEXT3.s4p	QSFP_S_top_worst_NEXT3.s4p
	QSFP_S_top_normal_NEXT4.s4p	QSFP_S_top_worst_NEXT4.s4p
QSFP bottom side	QSFP_S_bottom_normal_THRU.s4p	QSFP_S_bottom_worst_THRU.s4p
	QSFP_S_bottom_normal_FEXT1.s4p	QSFP_S_bottom_worst_FEXT1.s4p
	QSFP_S_bottom_normal_FEXT2.s4p	QSFP_S_bottom_worst_FEXT2.s4p
	QSFP_S_bottom_normal_FEXT3.s4p	QSFP_S_bottom_worst_FEXT3.s4p
	QSFP_S_bottom_normal_NEXT1.s4p	QSFP_S_bottom_worst_NEXT1.s4p
	QSFP_S_bottom_normal_NEXT2.s4p	QSFP_S_bottom_worst_NEXT2.s4p
	QSFP_S_bottom_normal_NEXT3.s4p	QSFP_S_bottom_worst_NEXT3.s4p
	QSFP_S_bottom_normal_NEXT4.s4p	QSFP_S_bottom_worst_NEXT4.s4p

Channel model

Host Board via diameter is 0.3mm.

	Normal Mating	Worst Mating
QSFP top side	QSFP_S_C_top_normal_THRU.s4p	QSFP_S_C_top_worst_THRU.s4p
	QSFP_S_C_top_normal_FEXT1.s4p	QSFP_S_C_top_worst_FEXT1.s4p
	QSFP_S_C_top_normal_FEXT2.s4p	QSFP_S_C_top_worst_FEXT2.s4p
	QSFP_S_C_top_normal_FEXT3.s4p	QSFP_S_C_top_worst_FEXT3.s4p
	QSFP_S_C_top_normal_NEXT1.s4p	QSFP_S_C_top_worst_NEXT1.s4p
	QSFP_S_C_top_normal_NEXT2.s4p	QSFP_S_C_top_worst_NEXT2.s4p
	QSFP_S_C_top_normal_NEXT3.s4p	QSFP_S_C_top_worst_NEXT3.s4p
	QSFP_S_C_top_normal_NEXT4.s4p	QSFP_S_C_top_worst_NEXT4.s4p
QSFP bottom side	QSFP_S_C_bottom_normal_THRU.s4p	QSFP_S_C_bottom_worst_THRU.s4p
	QSFP_S_C_bottom_normal_FEXT1.s4p	QSFP_S_C_bottom_worst_FEXT1.s4p
	QSFP_S_C_bottom_normal_FEXT2.s4p	QSFP_S_C_bottom_worst_FEXT2.s4p
	QSFP_S_C_bottom_normal_FEXT3.s4p	QSFP_S_C_bottom_worst_FEXT3.s4p
	QSFP_S_C_bottom_normal_NEXT1.s4p	QSFP_S_C_bottom_worst_NEXT1.s4p
	QSFP_S_C_bottom_normal_NEXT2.s4p	QSFP_S_C_bottom_worst_NEXT2.s4p
	QSFP_S_C_bottom_normal_NEXT3.s4p	QSFP_S_C_bottom_worst_NEXT3.s4p
	QSFP_S_C_bottom_normal_NEXT4.s4p	QSFP_S_C_bottom_worst_NEXT4.s4p

Please use in combination a connector and board touch stone file (P25) at channel model of  $\phi 0.2$ .

Maximum Frequency = 70GHz / 10MHz Step  
Minimum Frequency = 0Hz





# Connector simulation model touchstone files

## QSFP-DD Connector (2)

### Channel model

	Normal Mating	Worst Mating
QSFP-DD legacy top channel	QSFPDD_S_C_legacy_top_normal_THRU.s4p	QSFPDD_S_C_legacy_top_worst_THRU.s4p
	QSFPDD_S_C_legacy_top_normal_FEXT1.s4p	QSFPDD_S_C_legacy_top_worst_FEXT1.s4p
	QSFPDD_S_C_legacy_top_normal_FEXT2.s4p	QSFPDD_S_C_legacy_top_worst_FEXT2.s4p
	QSFPDD_S_C_legacy_top_normal_FEXT3.s4p	QSFPDD_S_C_legacy_top_worst_FEXT3.s4p
	QSFPDD_S_C_legacy_top_normal_FEXT4.s4p	QSFPDD_S_C_legacy_top_worst_FEXT4.s4p
	QSFPDD_S_C_legacy_top_normal_FEXT5.s4p	QSFPDD_S_C_legacy_top_worst_FEXT5.s4p
	QSFPDD_S_C_legacy_top_normal_FEXT6.s4p	QSFPDD_S_C_legacy_top_worst_FEXT6.s4p
	QSFPDD_S_C_legacy_top_normal_FEXT7.s4p	QSFPDD_S_C_legacy_top_worst_FEXT7.s4p
	QSFPDD_S_C_legacy_top_normal_NEXT1.s4p	QSFPDD_S_C_legacy_top_worst_NEXT1.s4p
	QSFPDD_S_C_legacy_top_normal_NEXT2.s4p	QSFPDD_S_C_legacy_top_worst_NEXT2.s4p
	QSFPDD_S_C_legacy_top_normal_NEXT3.s4p	QSFPDD_S_C_legacy_top_worst_NEXT3.s4p
	QSFPDD_S_C_legacy_top_normal_NEXT4.s4p	QSFPDD_S_C_legacy_top_worst_NEXT4.s4p
	QSFPDD_S_C_legacy_top_normal_NEXT5.s4p	QSFPDD_S_C_legacy_top_worst_NEXT5.s4p
	QSFPDD_S_C_legacy_top_normal_NEXT6.s4p	QSFPDD_S_C_legacy_top_worst_NEXT6.s4p
	QSFPDD_S_C_legacy_top_normal_NEXT7.s4p	QSFPDD_S_C_legacy_top_worst_NEXT7.s4p
	QSFPDD_S_C_legacy_top_normal_NEXT8.s4p	QSFPDD_S_C_legacy_top_worst_NEXT8.s4p
QSFP-DD additional top channel	QSFPDD_S_C_additional_top_normal_THRU.s4p	QSFPDD_S_C_additional_top_worst_THRU.s4p
	QSFPDD_S_C_additional_top_normal_FEXT1.s4p	QSFPDD_S_C_additional_top_worst_FEXT1.s4p
	QSFPDD_S_C_additional_top_normal_FEXT2.s4p	QSFPDD_S_C_additional_top_worst_FEXT2.s4p
	QSFPDD_S_C_additional_top_normal_FEXT3.s4p	QSFPDD_S_C_additional_top_worst_FEXT3.s4p
	QSFPDD_S_C_additional_top_normal_FEXT4.s4p	QSFPDD_S_C_additional_top_worst_FEXT4.s4p
	QSFPDD_S_C_additional_top_normal_FEXT5.s4p	QSFPDD_S_C_additional_top_worst_FEXT5.s4p
	QSFPDD_S_C_additional_top_normal_FEXT6.s4p	QSFPDD_S_C_additional_top_worst_FEXT6.s4p
	QSFPDD_S_C_additional_top_normal_FEXT7.s4p	QSFPDD_S_C_additional_top_worst_FEXT7.s4p
	QSFPDD_S_C_additional_top_normal_NEXT1.s4p	QSFPDD_S_C_additional_top_worst_NEXT1.s4p
	QSFPDD_S_C_additional_top_normal_NEXT2.s4p	QSFPDD_S_C_additional_top_worst_NEXT2.s4p
	QSFPDD_S_C_additional_top_normal_NEXT3.s4p	QSFPDD_S_C_additional_top_worst_NEXT3.s4p
	QSFPDD_S_C_additional_top_normal_NEXT4.s4p	QSFPDD_S_C_additional_top_worst_NEXT4.s4p
	QSFPDD_S_C_additional_top_normal_NEXT5.s4p	QSFPDD_S_C_additional_top_worst_NEXT5.s4p
	QSFPDD_S_C_additional_top_normal_NEXT6.s4p	QSFPDD_S_C_additional_top_worst_NEXT6.s4p
	QSFPDD_S_C_additional_top_normal_NEXT7.s4p	QSFPDD_S_C_additional_top_worst_NEXT7.s4p
	QSFPDD_S_C_additional_top_normal_NEXT8.s4p	QSFPDD_S_C_additional_top_worst_NEXT8.s4p

	Normal Mating	Worst Mating
QSFP-DD additional bottom channel	QSFPDD_S_C_additional_bottom_normal_THRU.s4p	QSFPDD_S_C_additional_bottom_worst_THRU.s4p
	QSFPDD_S_C_additional_bottom_normal_FEXT1.s4p	QSFPDD_S_C_additional_bottom_worst_FEXT1.s4p
	QSFPDD_S_C_additional_bottom_normal_FEXT2.s4p	QSFPDD_S_C_additional_bottom_worst_FEXT2.s4p
	QSFPDD_S_C_additional_bottom_normal_FEXT3.s4p	QSFPDD_S_C_additional_bottom_worst_FEXT3.s4p
	QSFPDD_S_C_additional_bottom_normal_FEXT4.s4p	QSFPDD_S_C_additional_bottom_worst_FEXT4.s4p
	QSFPDD_S_C_additional_bottom_normal_FEXT5.s4p	QSFPDD_S_C_additional_bottom_worst_FEXT5.s4p
	QSFPDD_S_C_additional_bottom_normal_FEXT6.s4p	QSFPDD_S_C_additional_bottom_worst_FEXT6.s4p
	QSFPDD_S_C_additional_bottom_normal_FEXT7.s4p	QSFPDD_S_C_additional_bottom_worst_FEXT7.s4p
	QSFPDD_S_C_additional_bottom_normal_NEXT1.s4p	QSFPDD_S_C_additional_bottom_worst_NEXT1.s4p
	QSFPDD_S_C_additional_bottom_normal_NEXT2.s4p	QSFPDD_S_C_additional_bottom_worst_NEXT2.s4p
	QSFPDD_S_C_additional_bottom_normal_NEXT3.s4p	QSFPDD_S_C_additional_bottom_worst_NEXT3.s4p
	QSFPDD_S_C_additional_bottom_normal_NEXT4.s4p	QSFPDD_S_C_additional_bottom_worst_NEXT4.s4p
	QSFPDD_S_C_additional_bottom_normal_NEXT5.s4p	QSFPDD_S_C_additional_bottom_worst_NEXT5.s4p
	QSFPDD_S_C_additional_bottom_normal_NEXT6.s4p	QSFPDD_S_C_additional_bottom_worst_NEXT6.s4p
	QSFPDD_S_C_additional_bottom_normal_NEXT7.s4p	QSFPDD_S_C_additional_bottom_worst_NEXT7.s4p
	QSFPDD_S_C_additional_bottom_normal_NEXT8.s4p	QSFPDD_S_C_additional_bottom_worst_NEXT8.s4p
QSFP-DD legacy bottom channel	QSFPDD_S_C_legacy_bottom_normal_THRU.s4p	QSFPDD_S_C_legacy_bottom_worst_THRU.s4p
	QSFPDD_S_C_legacy_bottom_normal_FEXT1.s4p	QSFPDD_S_C_legacy_bottom_worst_FEXT1.s4p
	QSFPDD_S_C_legacy_bottom_normal_FEXT2.s4p	QSFPDD_S_C_legacy_bottom_worst_FEXT2.s4p
	QSFPDD_S_C_legacy_bottom_normal_FEXT3.s4p	QSFPDD_S_C_legacy_bottom_worst_FEXT3.s4p
	QSFPDD_S_C_legacy_bottom_normal_FEXT4.s4p	QSFPDD_S_C_legacy_bottom_worst_FEXT4.s4p
	QSFPDD_S_C_legacy_bottom_normal_FEXT5.s4p	QSFPDD_S_C_legacy_bottom_worst_FEXT5.s4p
	QSFPDD_S_C_legacy_bottom_normal_FEXT6.s4p	QSFPDD_S_C_legacy_bottom_worst_FEXT6.s4p
	QSFPDD_S_C_legacy_bottom_normal_FEXT7.s4p	QSFPDD_S_C_legacy_bottom_worst_FEXT7.s4p
	QSFPDD_S_C_legacy_bottom_normal_NEXT1.s4p	QSFPDD_S_C_legacy_bottom_worst_NEXT1.s4p
	QSFPDD_S_C_legacy_bottom_normal_NEXT2.s4p	QSFPDD_S_C_legacy_bottom_worst_NEXT2.s4p
	QSFPDD_S_C_legacy_bottom_normal_NEXT3.s4p	QSFPDD_S_C_legacy_bottom_worst_NEXT3.s4p
	QSFPDD_S_C_legacy_bottom_normal_NEXT4.s4p	QSFPDD_S_C_legacy_bottom_worst_NEXT4.s4p
	QSFPDD_S_C_legacy_bottom_normal_NEXT5.s4p	QSFPDD_S_C_legacy_bottom_worst_NEXT5.s4p
	QSFPDD_S_C_legacy_bottom_normal_NEXT6.s4p	QSFPDD_S_C_legacy_bottom_worst_NEXT6.s4p
	QSFPDD_S_C_legacy_bottom_normal_NEXT7.s4p	QSFPDD_S_C_legacy_bottom_worst_NEXT7.s4p
	QSFPDD_S_C_legacy_bottom_normal_NEXT8.s4p	QSFPDD_S_C_legacy_bottom_worst_NEXT8.s4p

Please use in combination a connector and board touch stone file (P25) at channel model of φ0.2.

Maximum Frequency = 70GHz / 10MHz Step  
Minimum Frequency = 0Hz