

SI Test and Simulation Correlation of 56G PAM4 Eye Diagram for 400G Switch

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Think Bigger.
Reach Further.

SI Analysis Report

Agenda

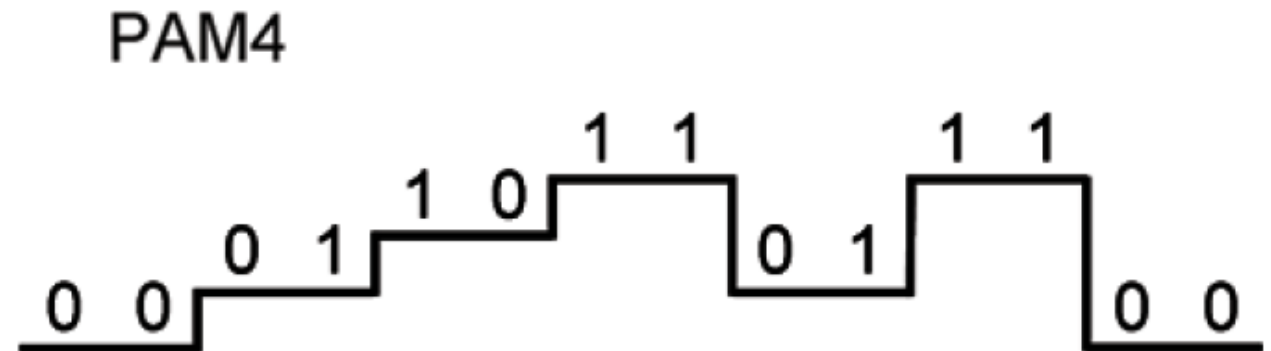
Think Bigger. Reach Further.

- About PAM-4
- Simulation Topology
- Channel Loss Simulation Results
- Eye Diagram Simulation And Test Result
- Conclusion

About PAM-4

What is PAM-4?

- PAM-4 is a modulation technique whereby 4 distinct pulse amplitudes are used to convey the information. Amplitude levels 1, 2, 3, and 4 are represented by two bits 00, 01, 11, and 10, respectively (see the figure below).

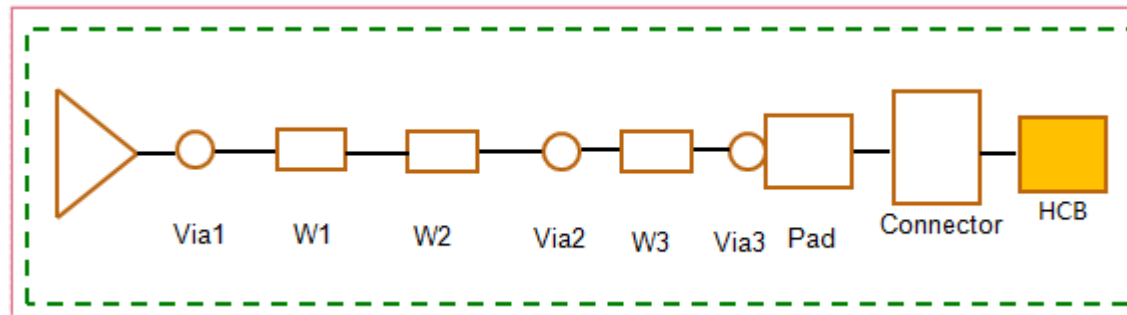


Why does industry need PAM-4?

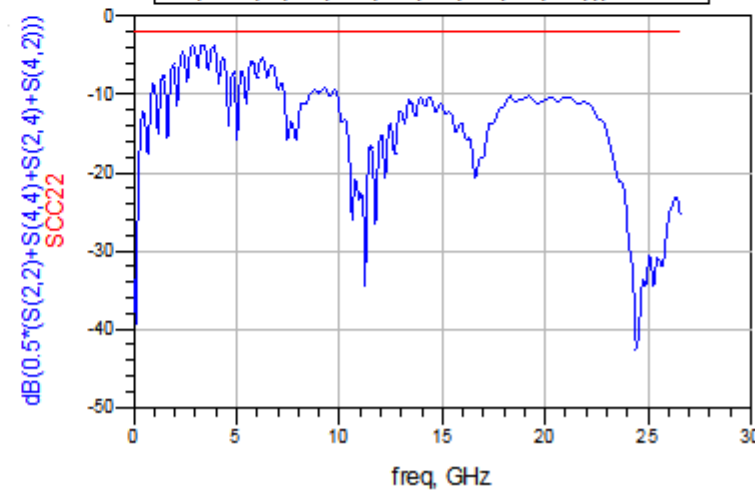
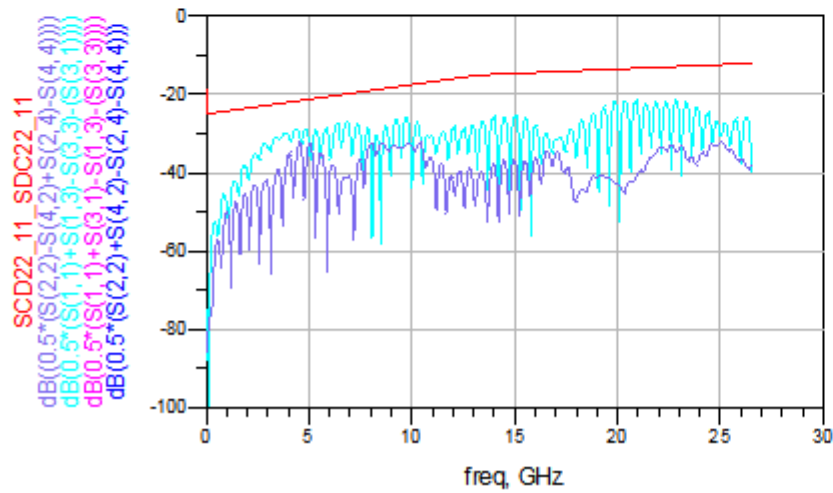
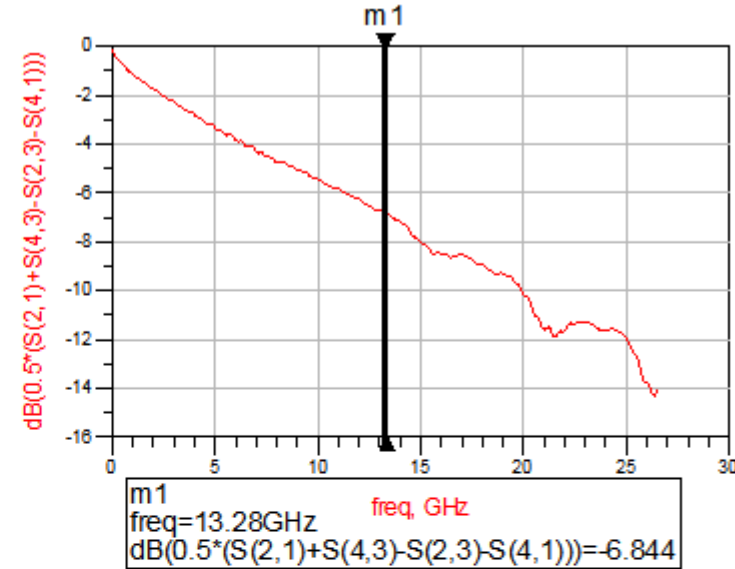
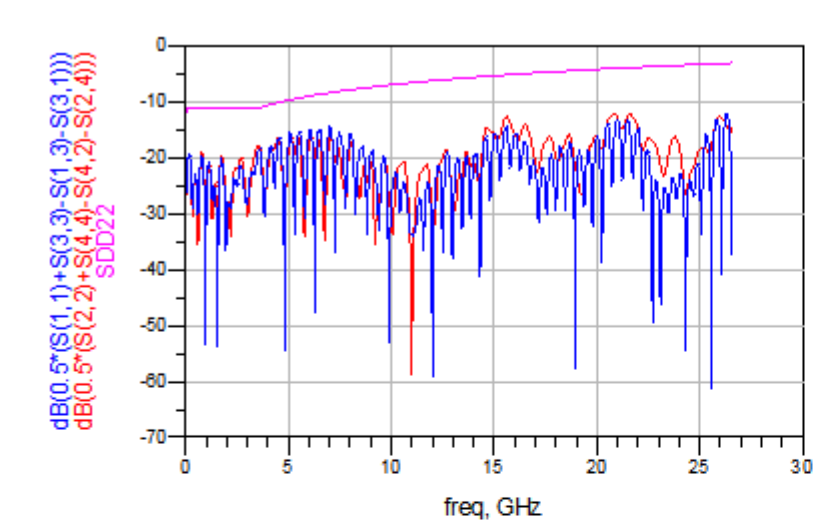
- NRZ > 28Gbps means shorter channels or costlier PCB materials.
- With the same “symbol” rate, PAM-4 will double the “baud” rate.

Simulation Topology

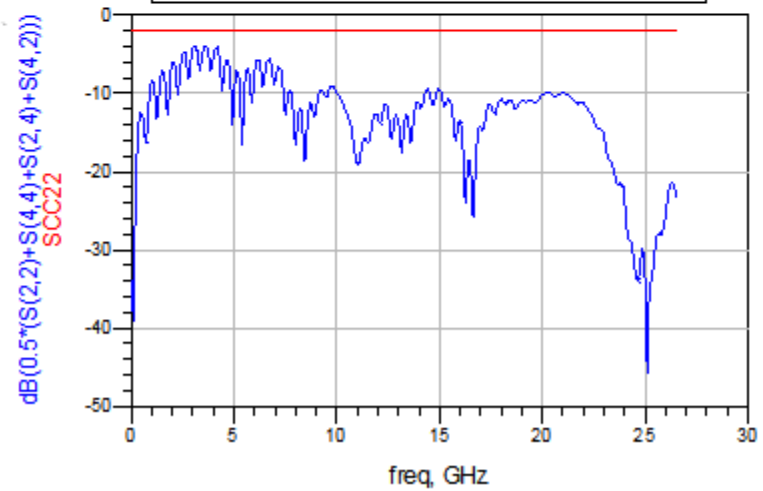
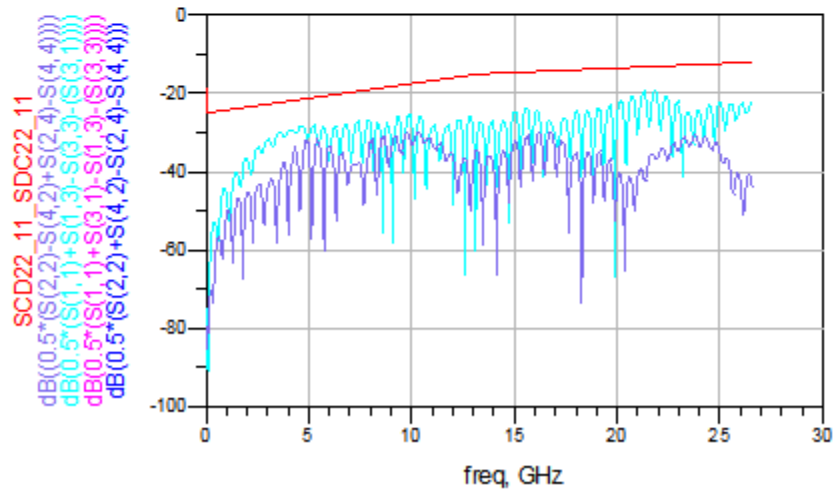
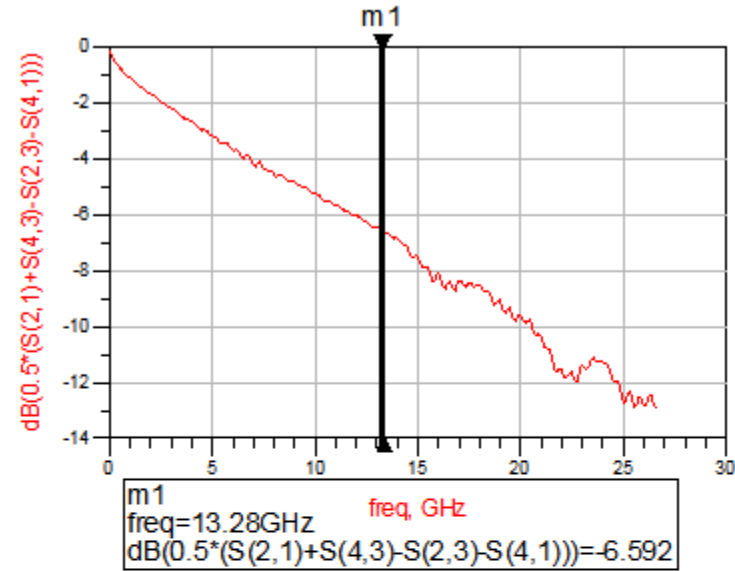
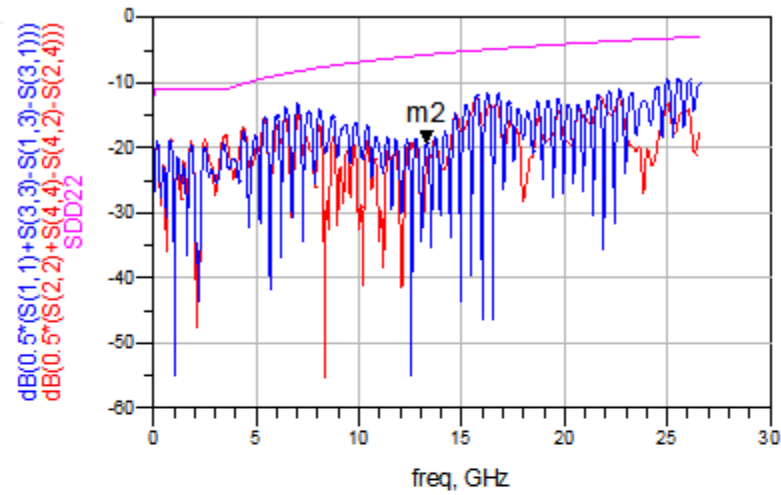
Channel	BGA Break-out Via	Neck down	Strip-line	Through hole Via	Strip-line	Blind Via	Micro Strip-Line	Connector	Test Fixture
Case 1	Top to L7	220mil	5836mil	L7 to L24	468mil	L24 to Bottom	\	QSFP-DD	HCB
Case 2	Top to L5	200mil	5480mil	L5 to L3	414mil	L3 to TOP	\	QSFP-DD	HCB
Case 3	Top to L11	440mil	7170mil	L11 to L3	390mil	L3 to TOP	\	QSFP-DD	HCB



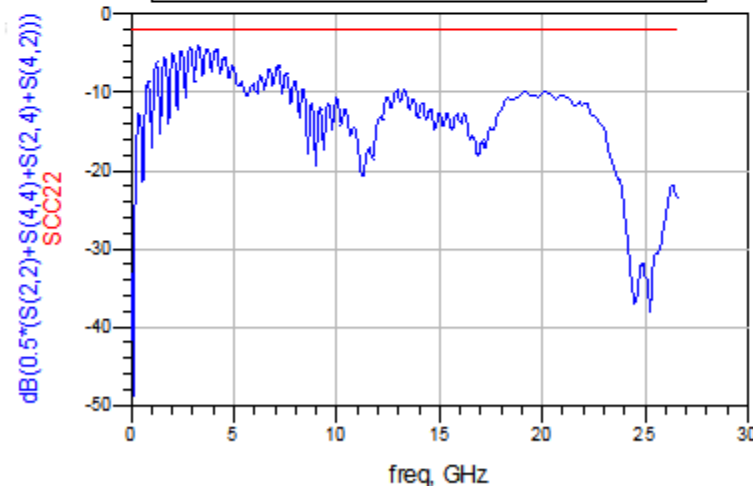
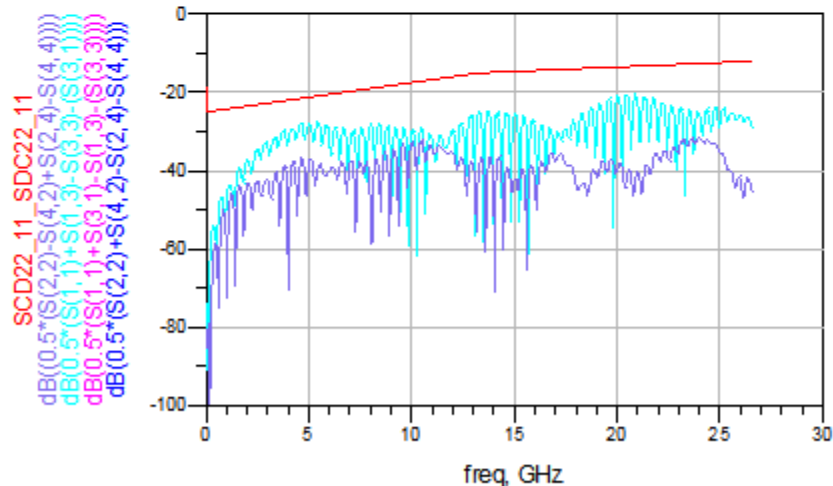
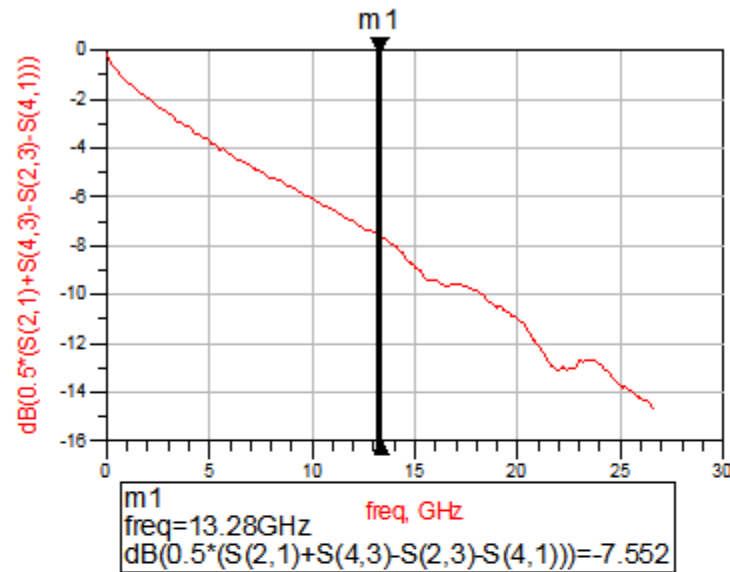
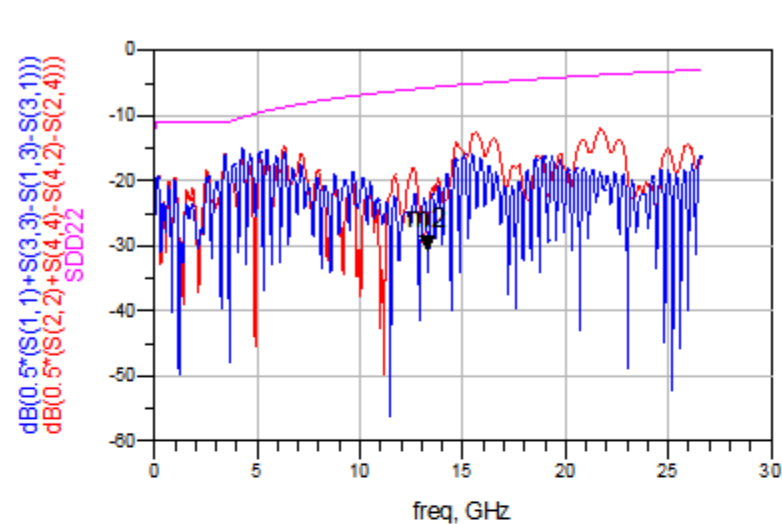
Channel Loss Simulation Results-Case 1



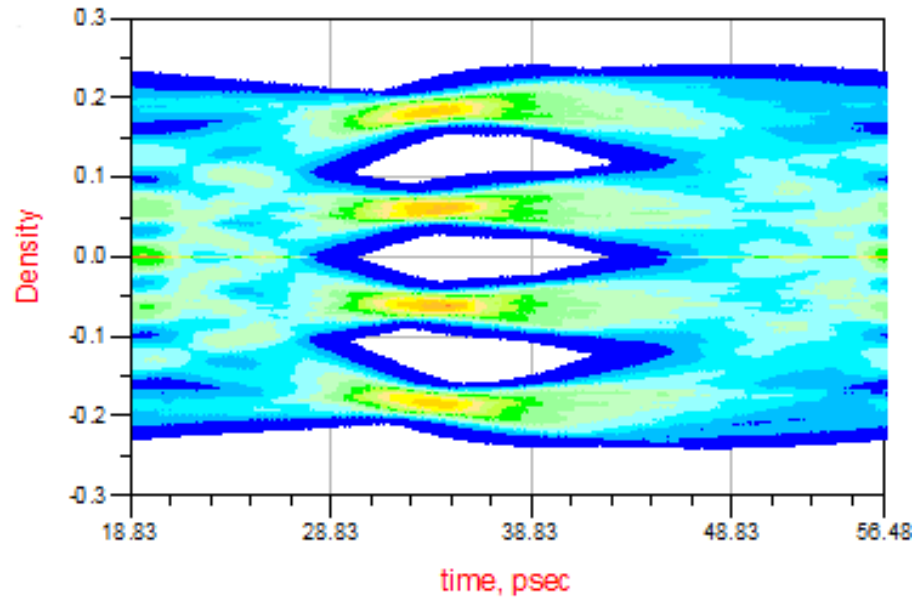
Channel Loss Simulation Results-Case 2



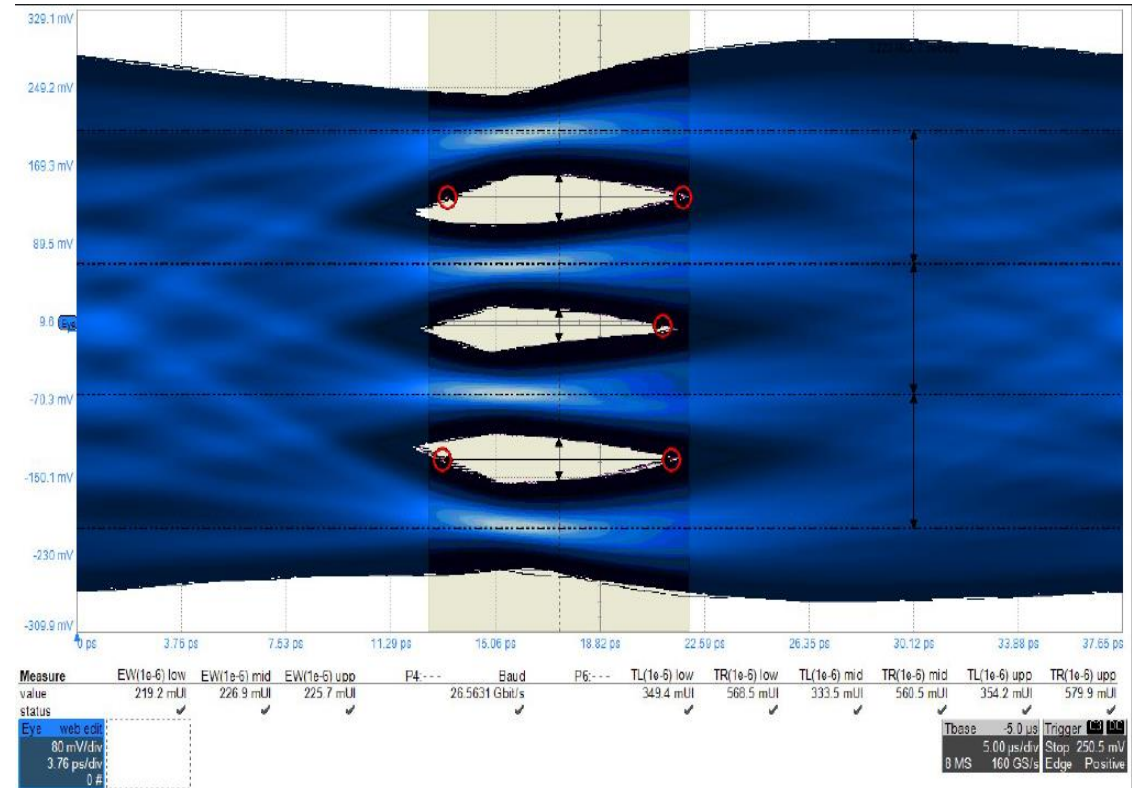
Channel Loss Simulation Results-Case 3



Eye Diagram Simulation Result-Case 1

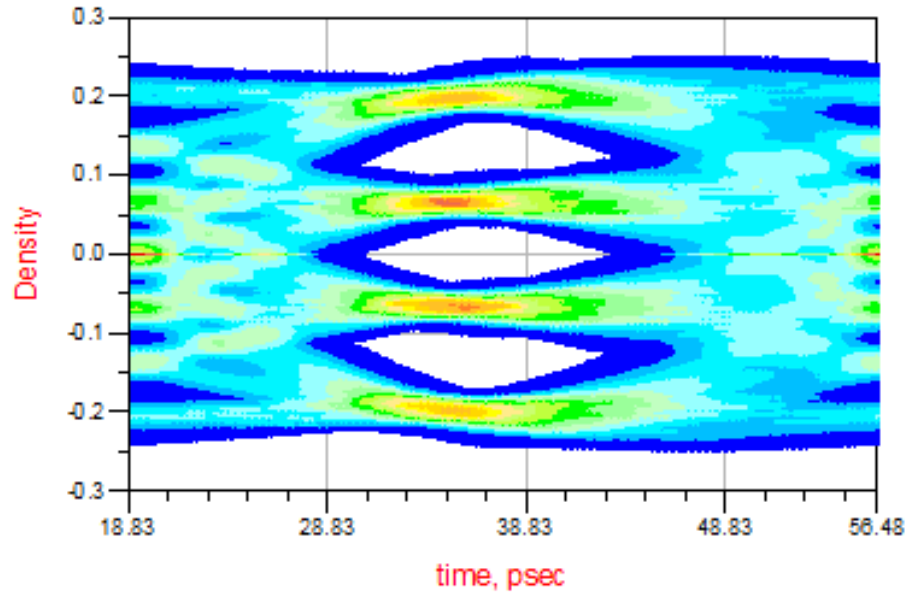


measurement	Summary
WidthAtBER0	1.299E-11
WidthAtBER1	1.318E-11
WidthAtBER2	1.374E-11
HeightAtBER0	0.064
HeightAtBER1	0.064
HeightAtBER2	0.059

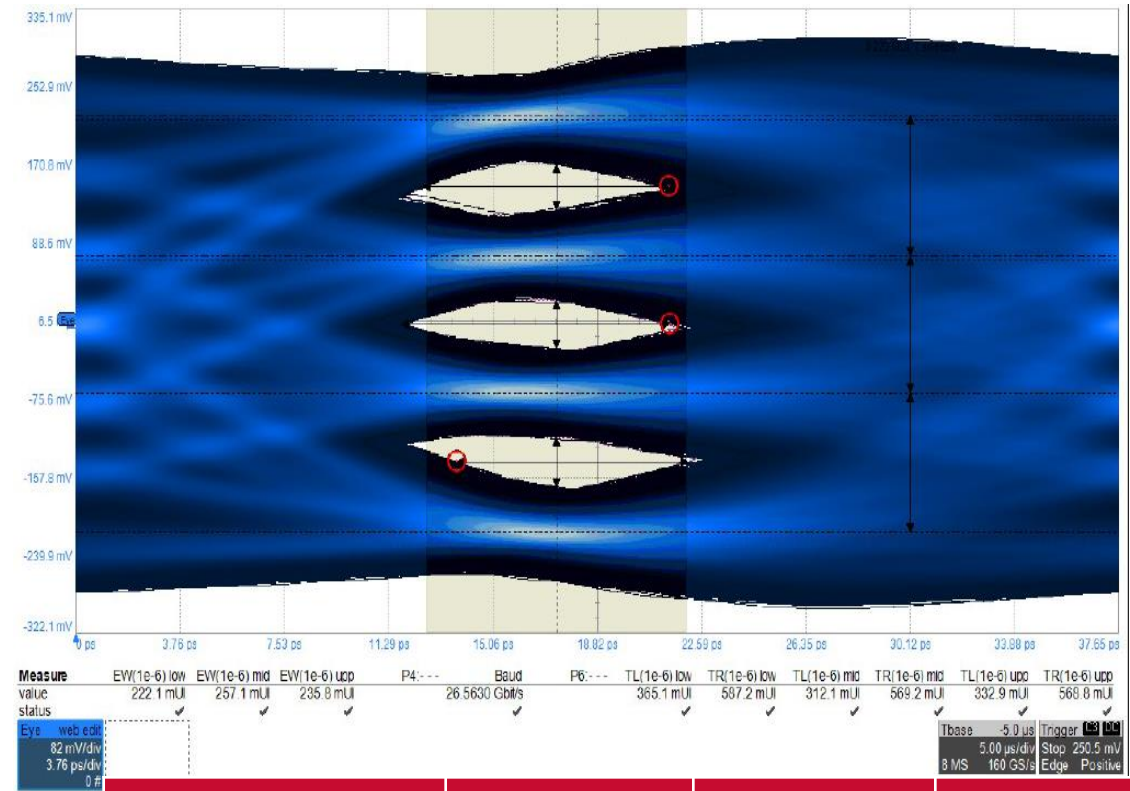


	Upper-Eye	Mid-Eye	Lower-Eye
Simulation Result	12.99ps/64mV	13.2ps/64mV	13.7ps/59mV
Test Result	8.24ps/44mV	8.55ps/35mV	8.54ps/49mV

Eye Diagram Simulation Result-Case 2

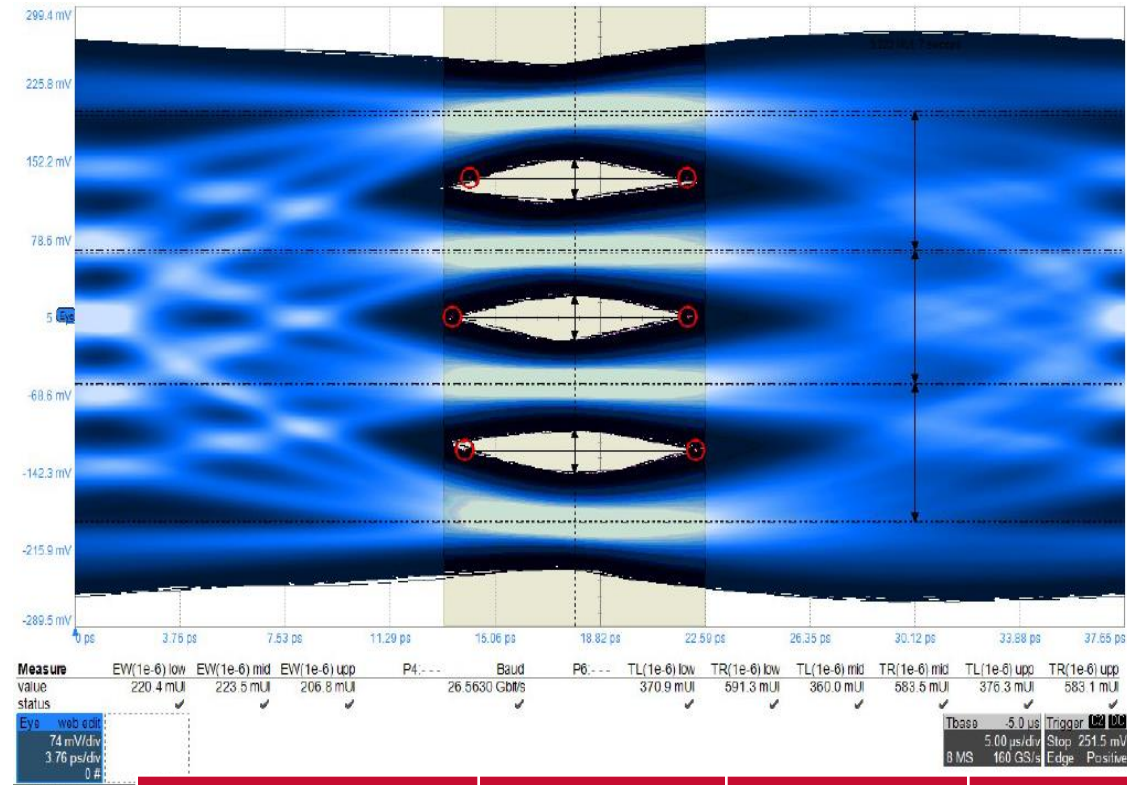
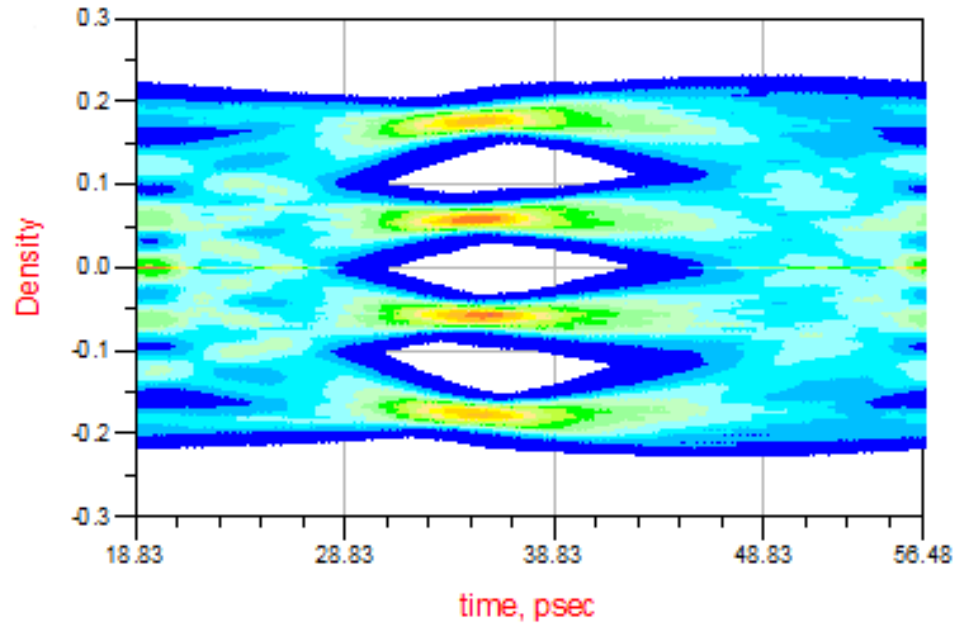


measurement	Summary
WidthAtBER0	1.336E-11
WidthAtBER1	1.355E-11
WidthAtBER2	1.336E-11
HeightAtBER0	0.071
HeightAtBER1	0.074
HeightAtBER2	0.066



	Upper-Eye	Mid-Eye	Lower-Eye
Simulation Result	13.4ps/71mV	13.6ps/74mV	13.4ps/66mV
Test Result	8.36ps/54mV	9.68ps/51mV	8.88ps/48mV

Eye Diagram Simulation Result-Case 3



measurement	Summary
WidthAtBER0	1.205E-11
WidthAtBER1	1.261E-11
WidthAtBER2	1.299E-11
HeightAtBER0	0.059
HeightAtBER1	0.066
HeightAtBER2	0.060

	Upper-Eye	Mid-Eye	Lower-Eye
Simulation Result	12ps/59mV	12.6ps/66mV	12.99ps/60mV
Test Result	8.28ps/41mV	8.4ps/43mV	7.79ps/37mV

- Although the eye diagrams' trend between simulation and test is similar, the eye height and width @BER $1e-6$ still have a large difference.
- Simulation results are much better.
- We will continue to optimize both the simulation and test accuracy.

Thank You

