112G SerDes Signal Simulation and Verification

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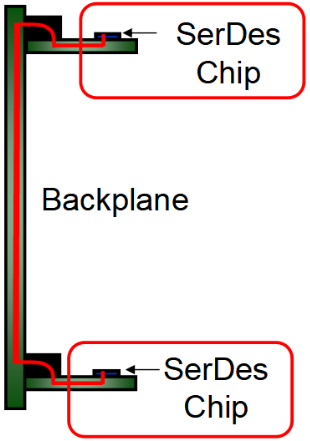
Outline

1、Background
2、112G Serdes Signal Simulation
3、112G Serdes Test Verification
4、Conclusion

Background

- SerDes speed is continuously increasing to higher level
- SerDes design faces so many challenges that engineers have a urgent demand for accurate BER prediction which can be obtained by accurate simulation and test of SNR\EH\EW
- 112G SerDes is gradually step into commercial use and signal simulation accuracy is particularly significant



Switch\Router

Server

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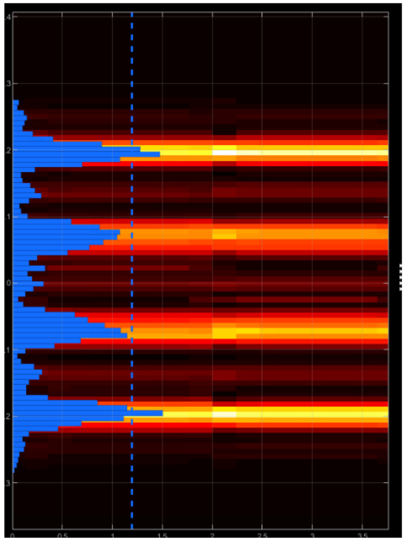
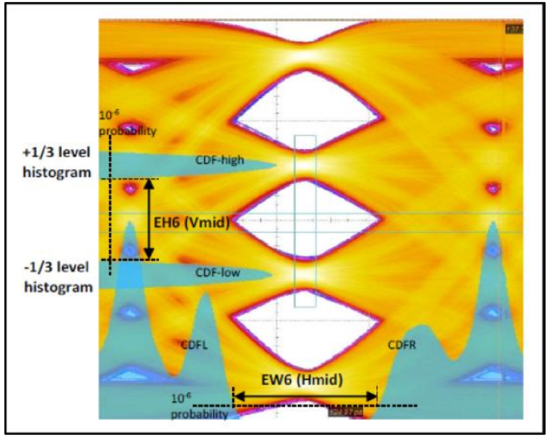
112G SerDes Signal Simulation

- For ADC-based serdes the eye diagram is not as information rich as it is for analog SerDes. Instead signal-to-noise (SNR) calculations and vertical eye slices are more useful insight into the system performance
- Use SNR\EH\EW to evaluate 112G SerDes signal integrity performance

The vertical eye slice shows the clustering of the four PAM4 symbols.





SNR value is quickly available by python-based measurement script which is activated as external tool

✓ SNR is calcaulted as shown below

$$\mathrm{SNR} = 10\log_{10}\left(\frac{\mu^2}{\sigma^2}\right)$$

✓ For PAM4, the signal and noise are defined in terms of the middle and outer sampled symbol voltages

$$\mu_1 = \frac{1}{N_1}\sum_{i=1}^{N_1} |y[i]_{\mathrm{middle}}|$$

$$\mu_2 = \frac{1}{N_2}\sum_{i=1}^{N_2} |y[i]_{\mathrm{outer}}|$$

$$\mu^2 = \frac{\left(\mu_1^2 + \mu_2^2\right)}{2}$$

$$\eta_1[i] = y[i]_{\mathrm{middle}} - \mu_1$$

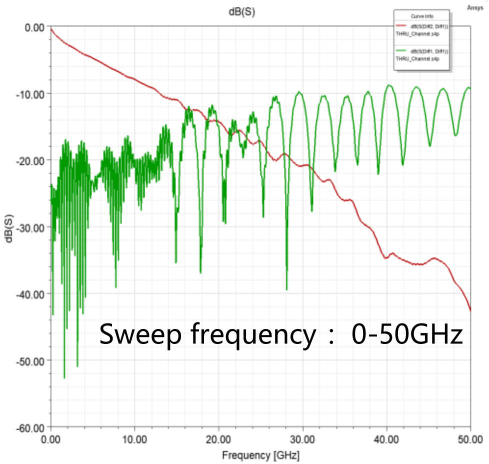
$$\eta_2[i] = y[i]_{\mathrm{outer}} - \mu_2$$

$$\sigma^2 = \frac{1}{N_1 + N_2}\sum_i \left[(\eta_1[i])^2 + (\eta_2[i])^2\right]$$

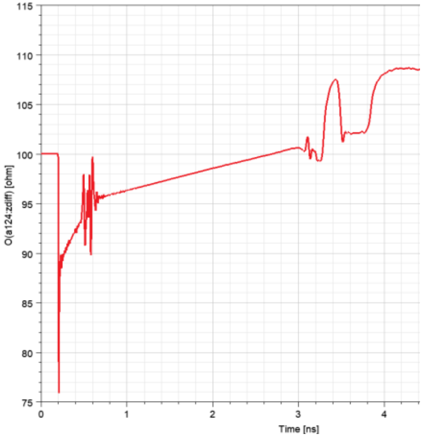
112G SerDes Passive Channel Simulation without XTALK

- This presentation gives a research on 112G C2M interface

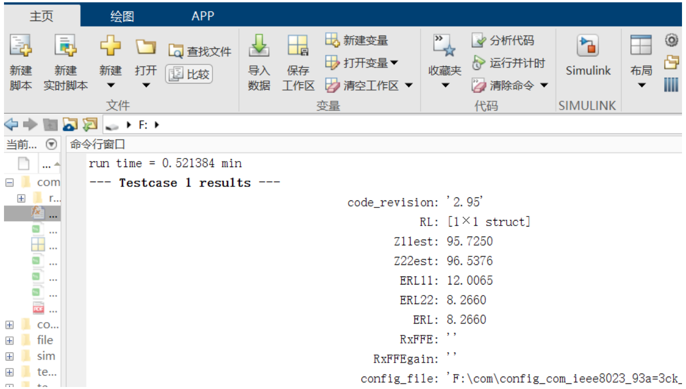
RL&IL



TDR



Metrics



COM	ERL	ICN(mV)	FOM_{ILD}(dB)
3.396	8.266	0	0.3438

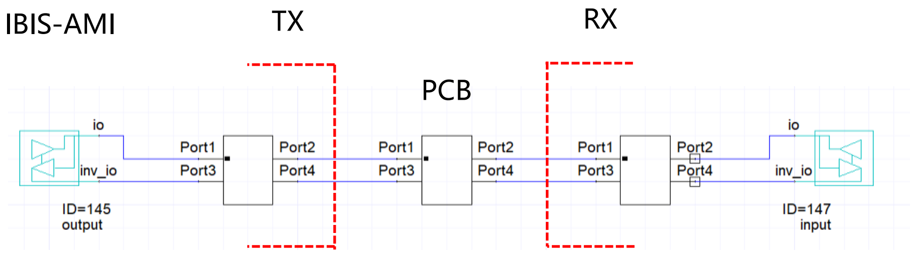
BGA

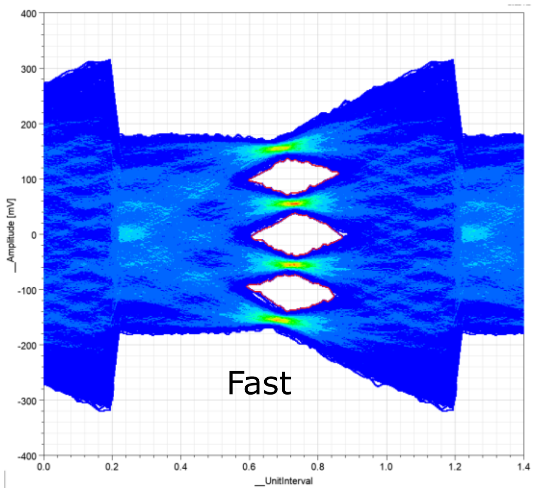
Connector

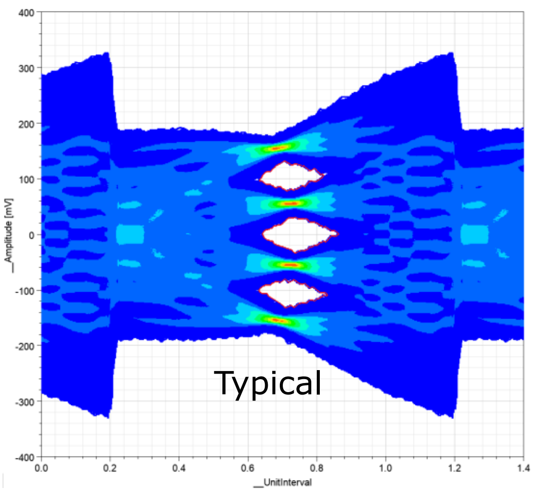
COM = channel operating margin
ERL = effective return loss
ICN = integrated crosstalk noise
FOM_{ILD} = RMS value of the insertion loss deviation

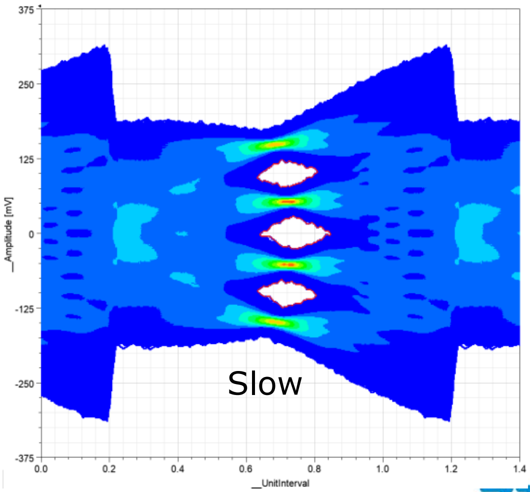
112G SerDes IBIS-AMI Simulaiton without XTALK

Corner	SNR(dB)	EH(mV)	EW(UI)
Fast	24.94	21.94 33.73 21.03	0.1427 0.1781 0.1380
Typ	24.65	20.12 31.91 20.12	0.1315 0.1716 0.1219
Slow	24.39	18.39 29.68 19.26	0.1299 0.1604 0.1283





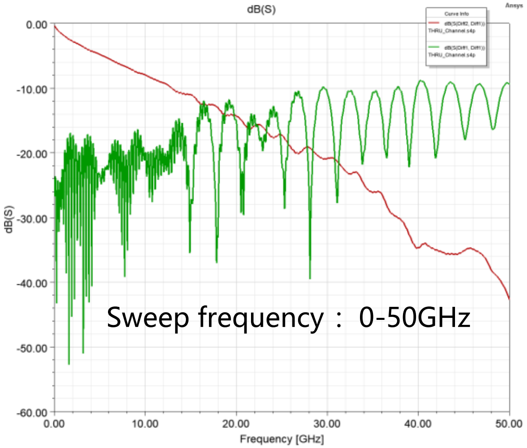




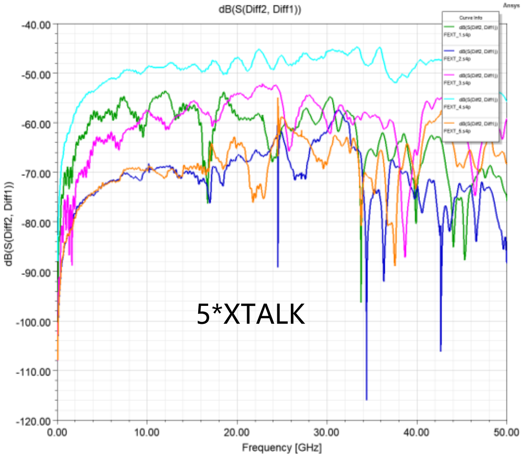
ZTE

112G SerDes Passive Channel Simulation with XTALK

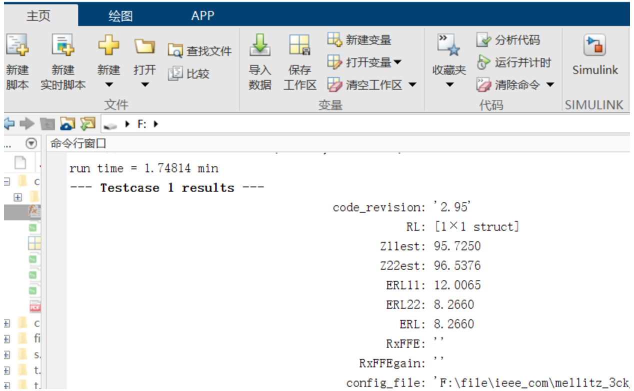
RL&IL



SDD21



Metrics

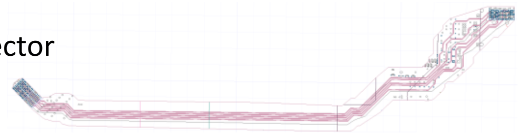


COM	ERL	ICN(mV)	FOM_{ILD}(dB)
3.0275	8.266	2.2962	0.3438

5*XTALK+1*Victim

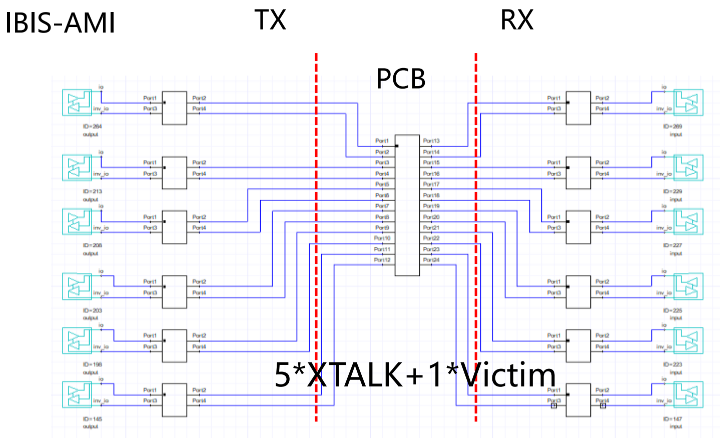
BGA

Connector

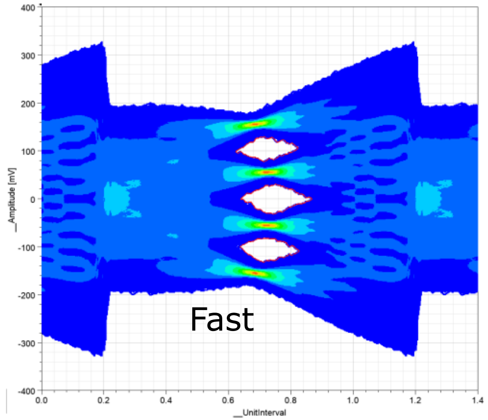


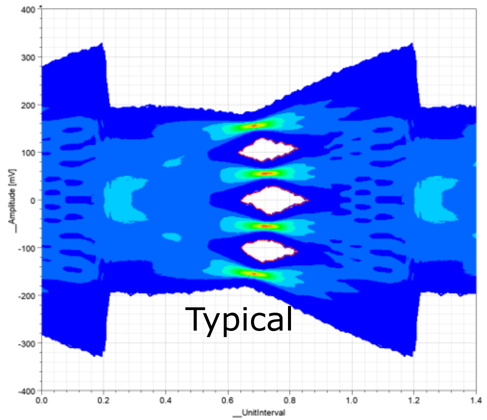
COM = channel operating margin
ERL = effective return loss
ICN = integrated crosstalk noise
FOM_{ILD} = RMS value of the insertion loss deviation

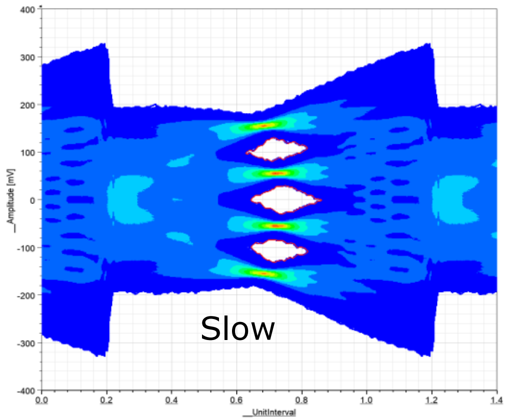
112G SerDes IBIS-AMI Simulation with XTALK



Corner	SNR(dB)	EH(mV)	EW(UI)
Fast	24.68	18.87 33.15 22.46	0.1443 0.1844 0.1380
Typ	24.42	17.22 31.64 21.76	0.1348 0.1700 0.1348
Slow	24.23	17.30 31.70 19.08	0.1251 0.1700 0.1315







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112G SerDes Active Test Verification with XTALK

Typ	Simulation	Test
EH(mV)	17.22 31.64 21.76	22.45 23.00 20.80
EW(UI)	0.1348 0.1700 0.1348	0.2479 0.2677 0.2337

- Simulation results meet expection by test verification

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Conclusion

- 112G SerDes passive channel requires rational design to meet IEEE\OIF specifications and simulation value is consistent with test result
- To get accurate result, parameters of 112G SerDes active simulation must be configured reasonably
- Evaluation of 112G SerDes signal integrity performance can be obtained accurately by SNR\EH\EW simulation

Thank you

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