

Signal Integrity Analysis

Automobile domain controller

Scope : Signal Integrity Analysis

Application : Advanced Driver Assistance System (ADAS)

Signal integrity is a crucial aspect in the development of automobile domain controllers, ensuring the reliability and precision of electrical signals within a vehicle's electronic systems. As vehicles become more advanced, the complexity of in-vehicle networks increases, necessitating robust domain controllers that can manage vast amounts of data and maintain seamless communication with various components.



Signal Integrity Analysis - Challenges

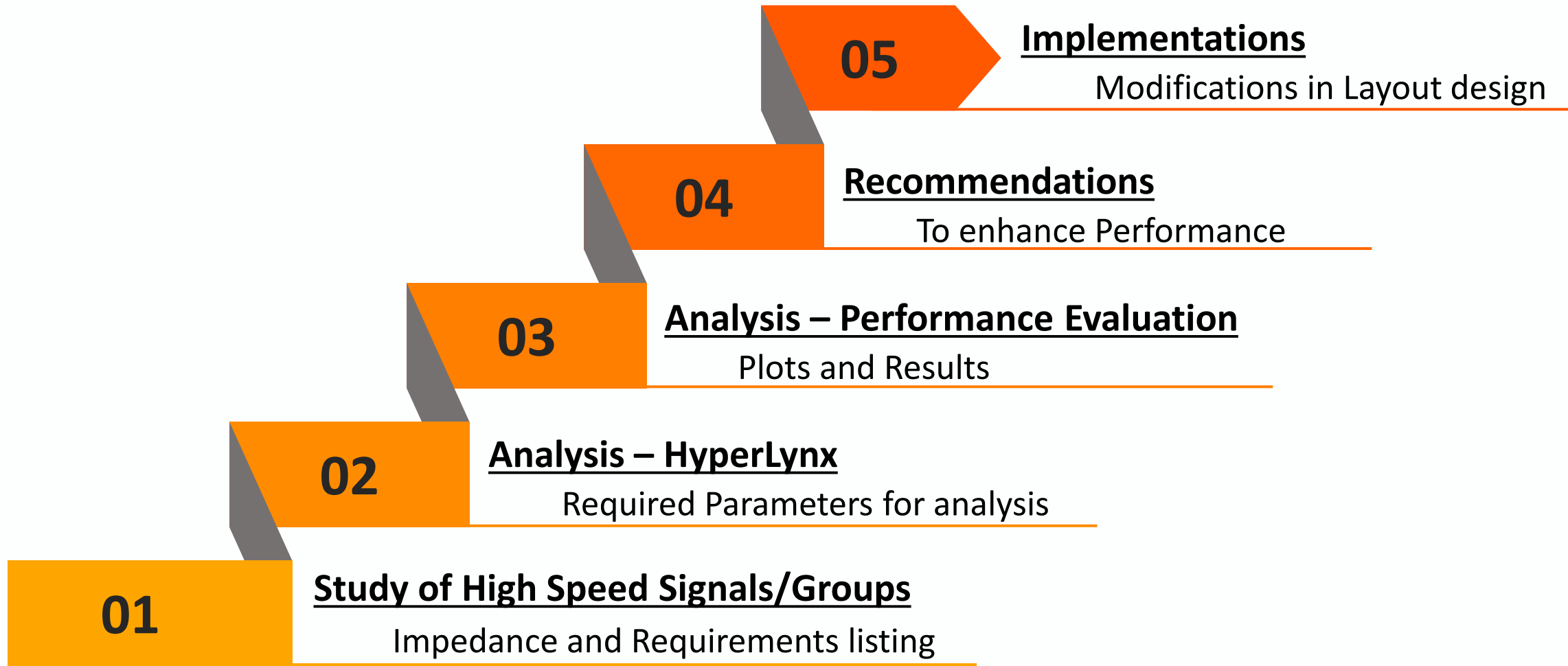
The client requested to perform signal integrity analysis of the layout to ensure optimal performance. The following outlines the challenges associated with Signal Integrity Analysis.

Challenges

- ◆ Reflections and Impedance Mismatch
- ◆ Cross Talk
- ◆ Skew and Timing
- ◆ Ground Bounce
- ◆ Signal Termination
- ◆ Via Impacts
- ◆ Power Distribution
- ◆ Noise & EMI effects
- ◆ High-Frequency Effects
- ◆ Continuous reference planes



Signal Integrity Analysis - SoW



Study of High Speed Signals / Groups

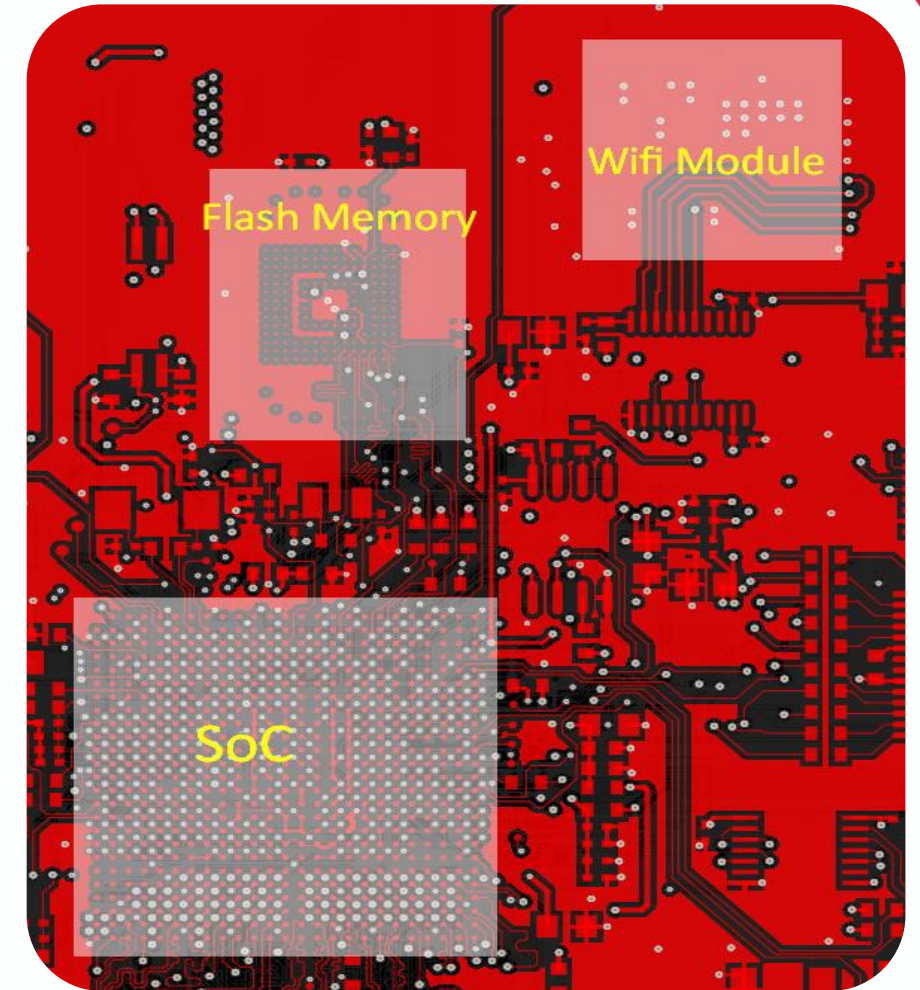
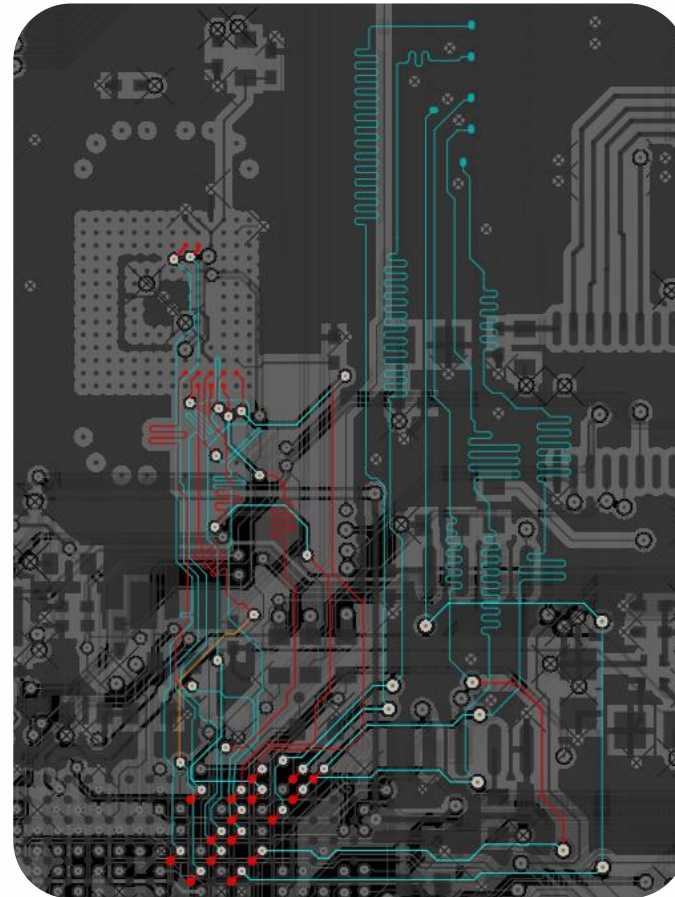
The High Speed Signal circuits in the project are studied thoroughly to evaluate the performance.

High Speed Signals that need to analysis are SD Signals

- SoC to Flash
- SoC to WiFi

High Speed Signal Circuits

- Flash Memory
- SoC
- WiFi Module

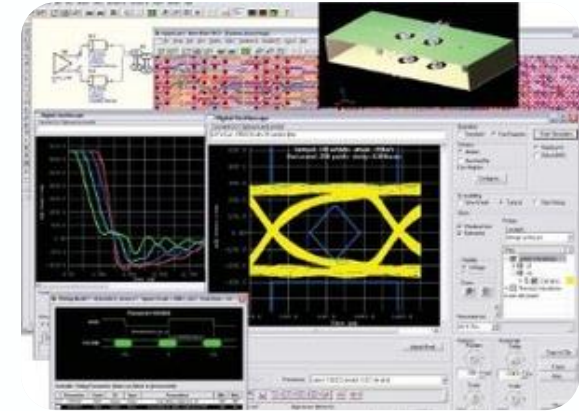
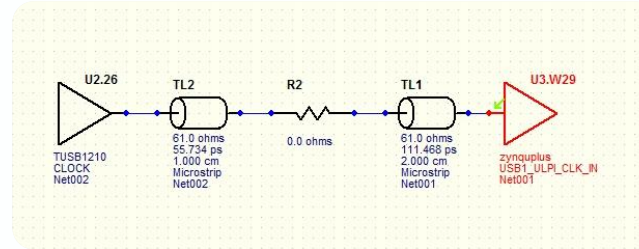


Analysis Execution

We executed the analysis in **HyperLynx** tool, to evaluate the signal integrity performance of the layout.

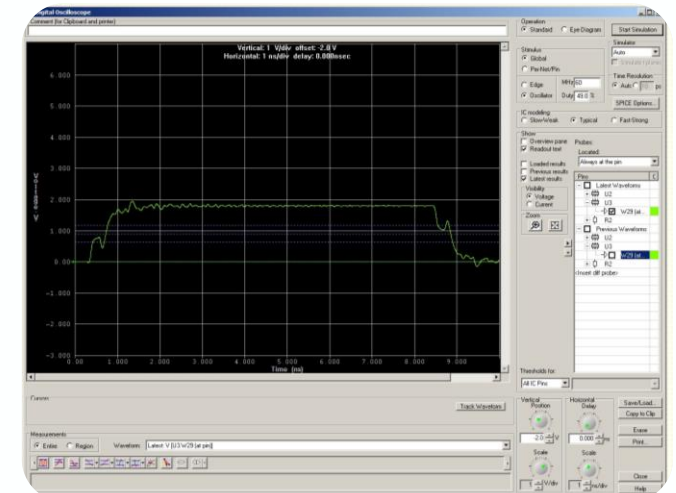
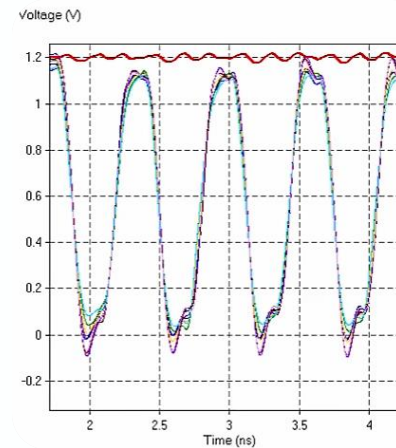
Problems of Signal Integrity is identified from two levels:

Interconnect level and
Systems-level



Quantities to calculate include:

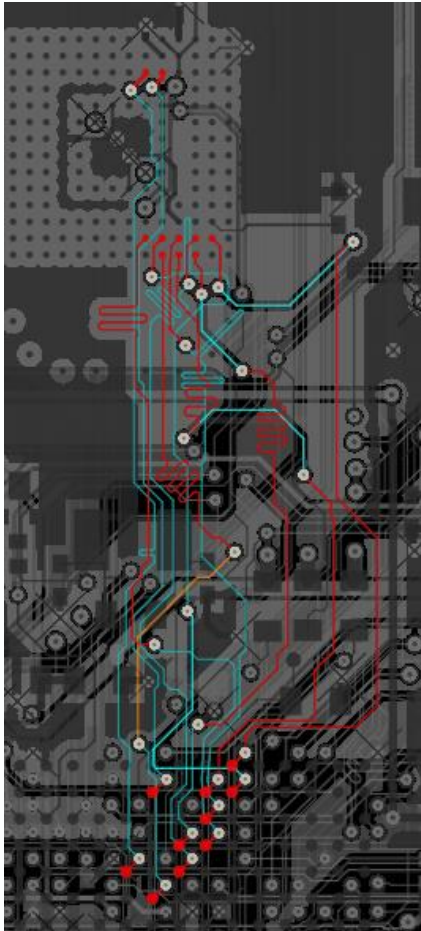
- ✓ Stack Up based on Manufacturer recommendation
- ✓ Transfer Rate – 96 Mbps



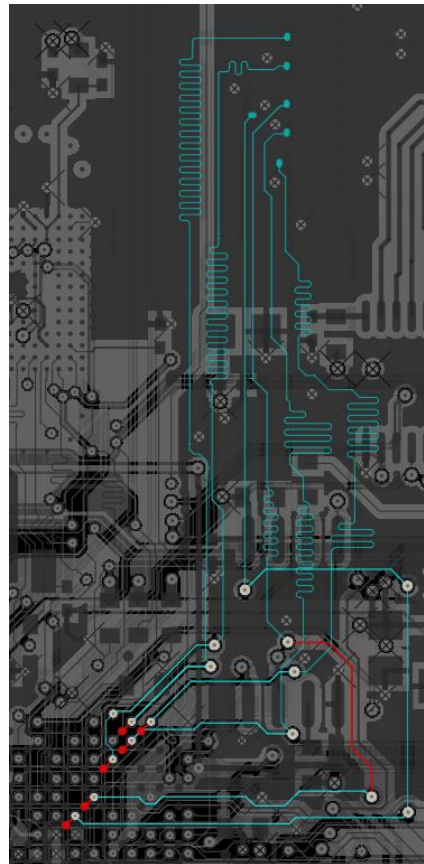
Analysis Execution (Cont.)

SD signals – Has lots of unwanted layer switching in its routing as shown below.

SoC - Flash



SoC - WiFi



Trace Lengths

Name	Nod...	Signal Le...	Total...	Routed Len...	Unrout...
SD4_CLK	2	1178.265	0	1177.6	0
SD4_CMD	2	1049.234	0	1048.411	0
SD4_DATA0	2	1176.985	0	1173.462	0
SD4_DATA1	2	1090.764	0	1149.762	0
SD4_DATA2	2	1177.189	0	1177.211	0
SD4_DATA3	2	1093.592	0	1152.625	0
SD4_DATA4	2	1178.583	0	1176.89	0
SD4_DATA5	2	1174.312	0	1173.523	0
SD4_DATA6	2	1177.304	0	1178.161	0
SD4_DATA7	2	1177.64	0	1178.281	0

Name	Nod...	Signal Le...	Total...	Routed Len...	Unrout...
SD2_CLK	2	2292	0	2291.861	0
SD2_CMD	2	2214.085	0	2214.085	0
SD2_DAT0	2	2334.21	0	2339.166	0
SD2_DAT1	2	2117.249	0	2117.145	0
SD2_DAT2	2	2279.289	0	2279.408	0
SD2_DAT3	2	2300.472	0	2299.886	0

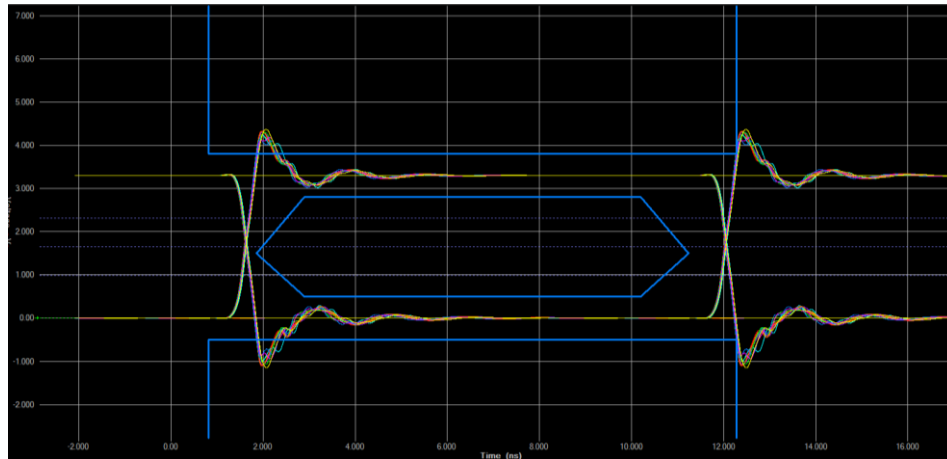
CLK and Data's are not routed with same trace length (closely)



Analysis - Plots and Results

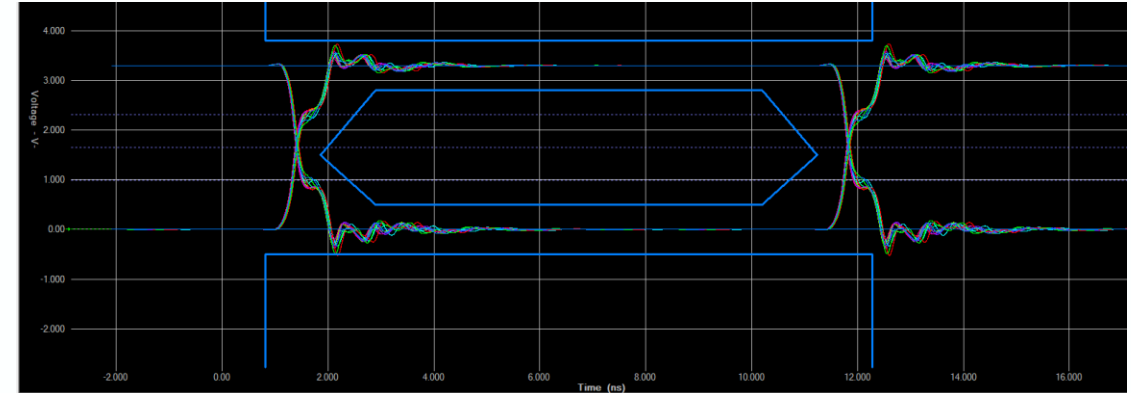
Analysis Parameters – Requirements

For Analysis, SoC is kept as output and Flash & WiFi module is kept as input.



Output

Analysis Result



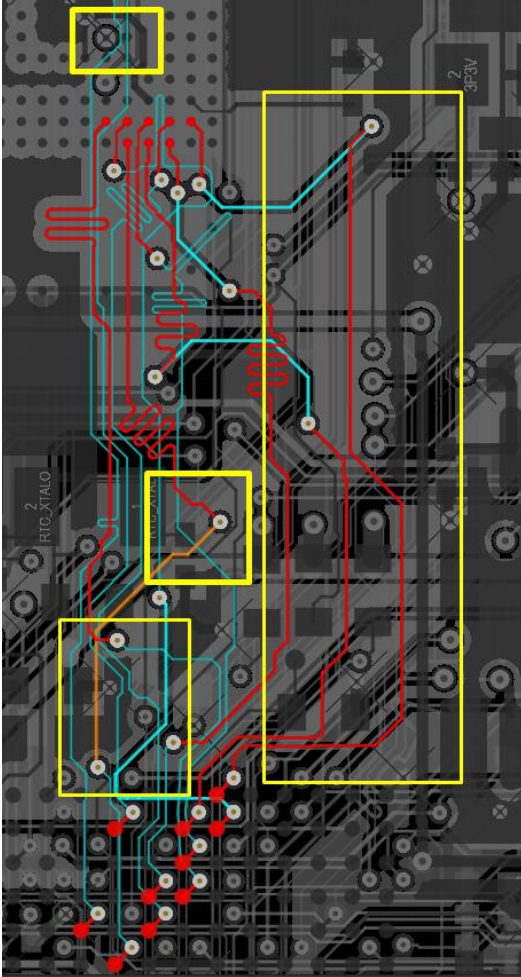
Input

Based on the analysis result, the output side has large overshoot and undershoot present in all the signals.



Layout Recommendations

The PCB layout's performance can be increased by the following recommendations

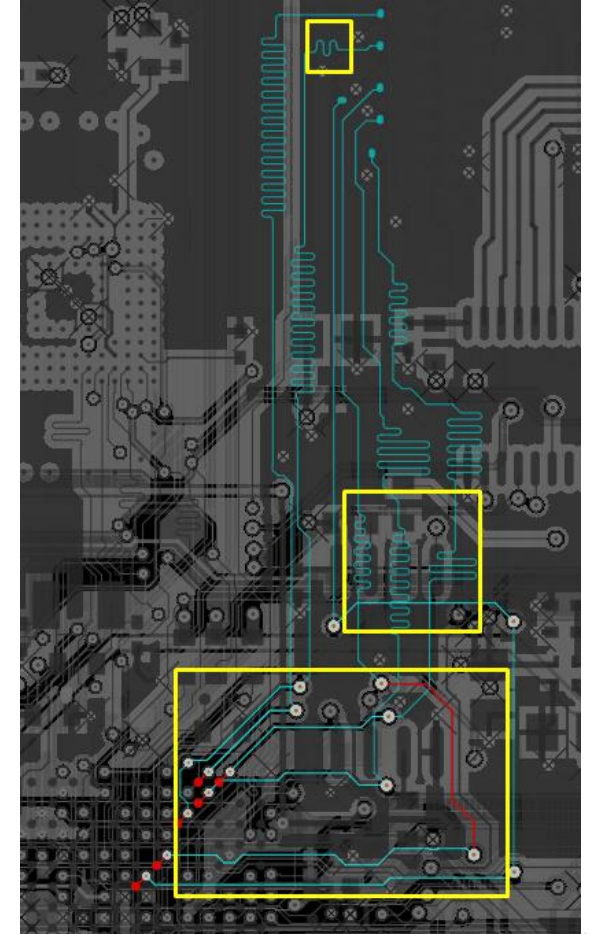


Image

- Left ← SoC to Flash
- SoC to WiFi → Right

Recommendation:

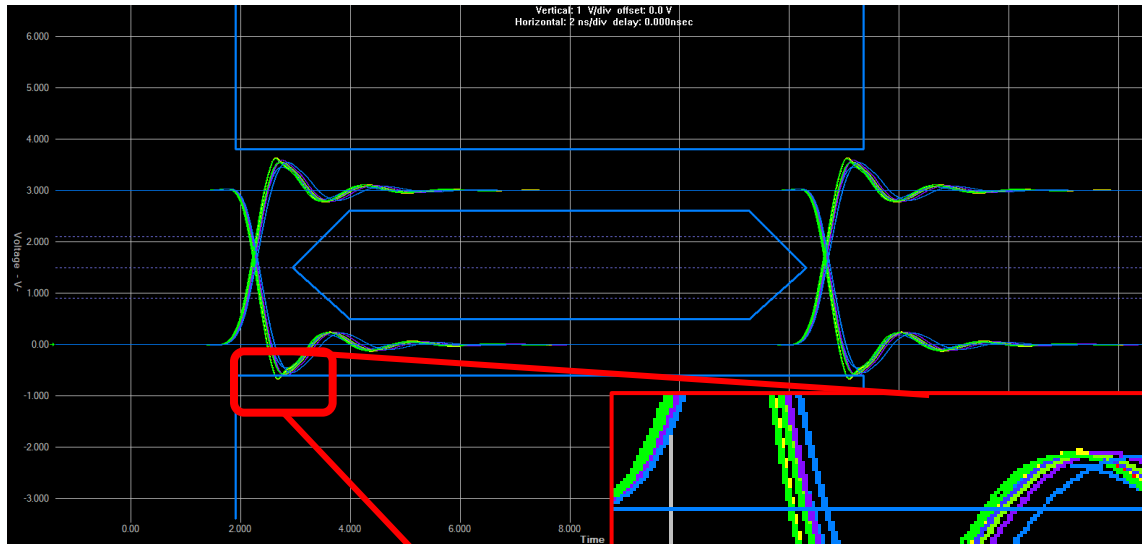
1. Traces has many bends need to be adjusted to have minimum bends.
2. Signals need to be routed as group.
3. Tunning of same signal in multiple location can be avoided.
4. Signals can be routed as arc, if needed in the 45° bend.



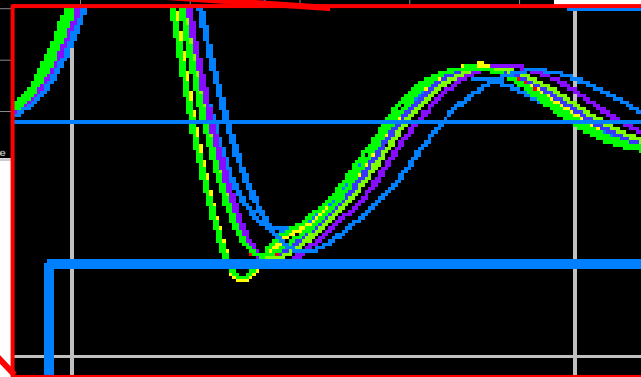
After Analysis - Plots and Results

Analysis Parameters – Requirements

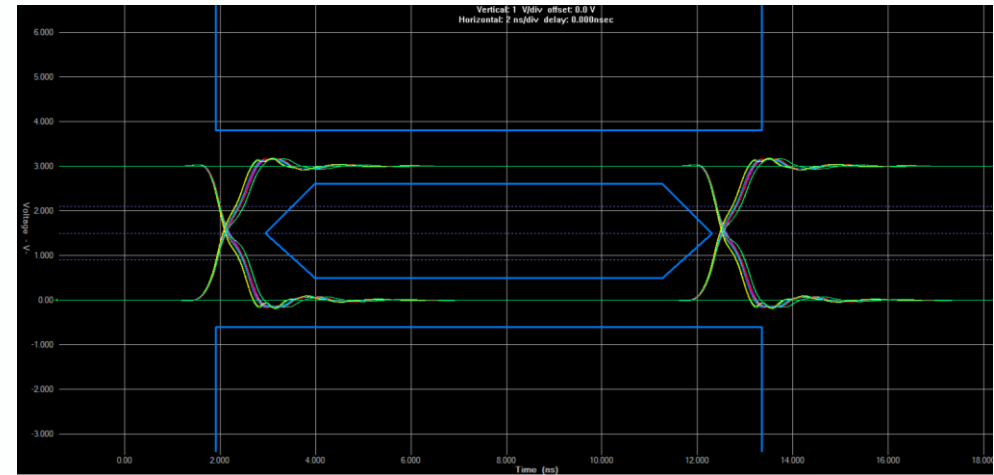
For Analysis, SoC is kept as output and Flash & WiFi module is kept as input.



Output



Analysis Result



Input

Based on the analysis result, only two signal appears to cross lower undershoot mark by 10mV.

This will not affect the Signal Integrity.



Customer Testimonial

Excited to present a testimonial from a content client, emphasizing the success and positive impact of our Signal Integrity Analysis.

“Engaging the team for Signal Integrity (SI) Analysis was a game-changer for our project. Their meticulous approach ensured top-notch quality, uncovering potential issues and providing effective solutions. The detailed insights provided during the analysis were invaluable, contributing significantly to the overall success of our project. The cost-effective modifications to copper pours demonstrated their commitment to optimizing resources. Moreover, the timely delivery showcased their efficiency. We are highly satisfied with the quality, and timely delivery of the SI analysis, marking a significant enhancement in the reliability and efficiency of our electronic design!”



Conclusion

We delivered the client with a list of recommendations to make the HS signals work better and implemented changes in the layout design to boost overall performance. This demonstrated our unwavering commitment to delivering high-quality work and our technical expertise.

Our collaboration extends beyond technical aspects; it involves optimizing the signals in the layout for improved performance, by integrating our expertise with in-depth understanding of the client's specific requirements.

Our commitment is focused to delivering top-tier Analysis services, showcasing our unparalleled skills and unwavering reliability in achieving outstanding results.

