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Power Integrity Analysis
Cascaded Radar Sensor Module

Scope : Stable and Reliable Power Distribution Network

Application : ADAS - Automotive 4D Imaging Radar

In the automotive field, the Cascaded Radar Sensor Module finds application in various safety and driver-assistance systems. This module operates by emitting radar waves and analyzing their reflections to detect objects, obstacles, or vehicles in the vicinity.

The integration of a cascaded configuration elevates the sensor's capabilities, expanding its detection range with increased precision. This advanced technology, particularly in 4D imaging radar is vital for applications like adaptive cruise control, collision avoidance and other ADAS in automotives that contribute to boosting overall safety.

Power Integrity Analysis - Challenges

The client asked to analyze the power integrity of the layout to meet out the required performance. Following are the list of challenges involved in the Power Integrity Analysis.

Challenges

- Schematic optimization
- Placement of De-coupling capacitors
- Voltage Drop, Current Density & Via Current
- PDN Impedance
- Power Rail Ripple & Noise
- Ground bounce effects
- EMI effects
- Thermal Effect
- Internal Resistance of power planes
- Frequencies Outages

Power Integrity Analysis - SoW

01 **Study of Power Circuits**
Flow and Requirements listing

02 **Analysis – HyperLynx**
Required Parameters for analysis

03 **Analysis – Performance Evaluation**
Plots and Results

04 **Recommendations**
To enhance Performance

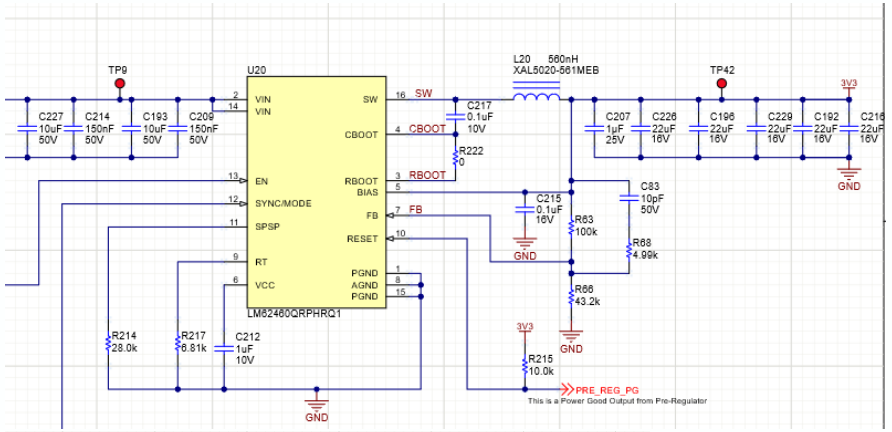
05 **Implementations**
Modifications in Layout design

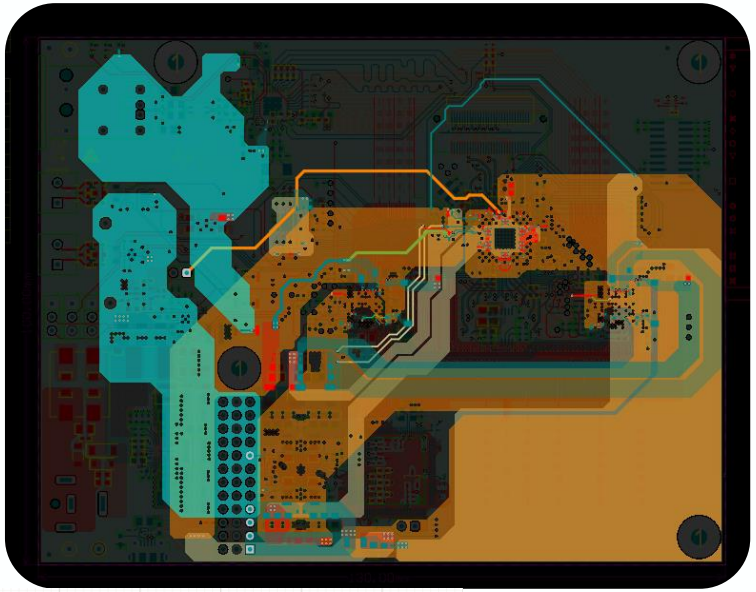
Study of Power Circuits

The power circuits in the project is studied thoroughly to evaluate the performance of the power delivery network

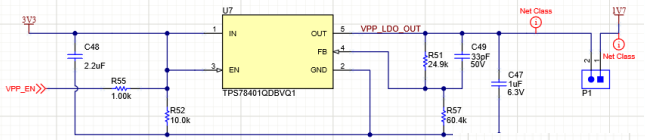
Power Circuits

- Buck Converter – 3.3V
- Boost Regulator – 5V
- 1V8
- 1V2
- 1V0_A
- 1V0_B
- 1V7

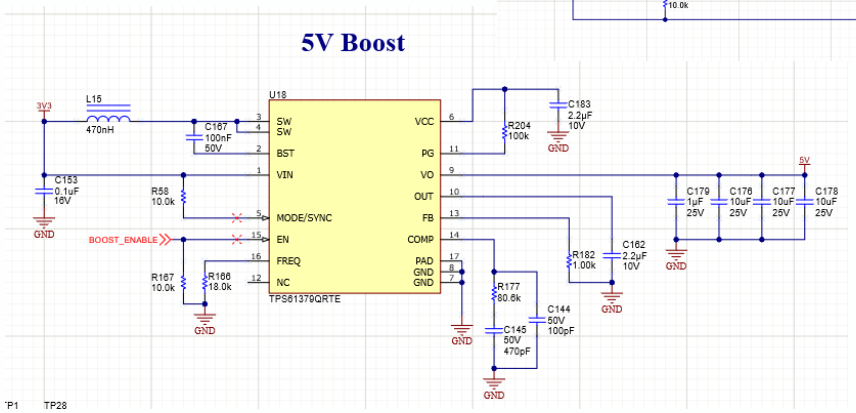




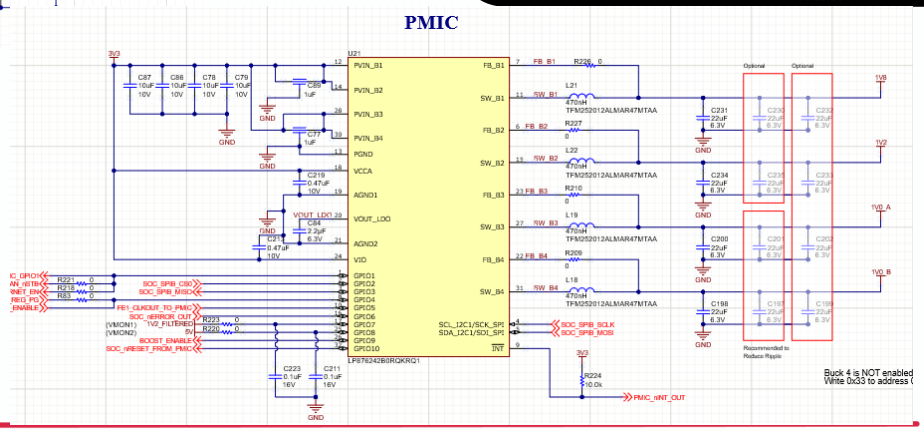
VPP LDO



5V Boost



PMIC



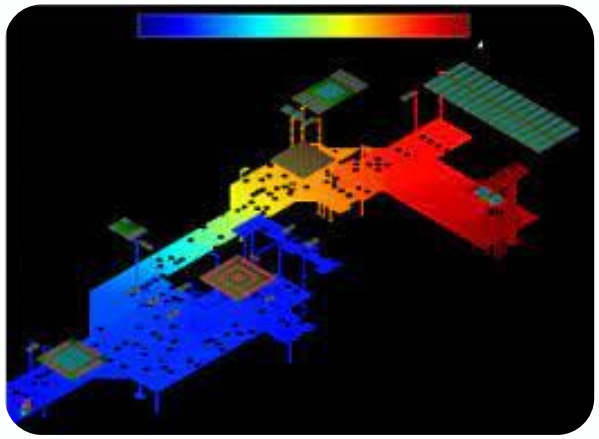
Analysis Execution

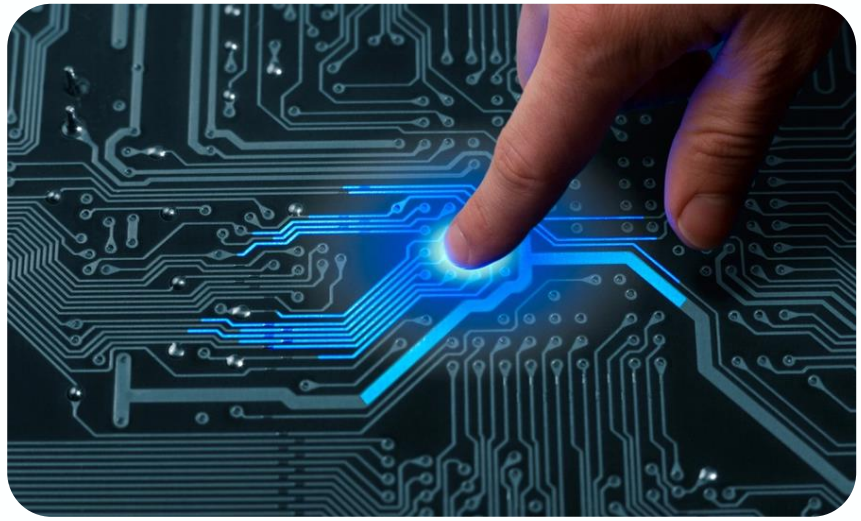
We executed the analysis in **HyperLynx** tool, to evaluate the power integrity performance of the layout.

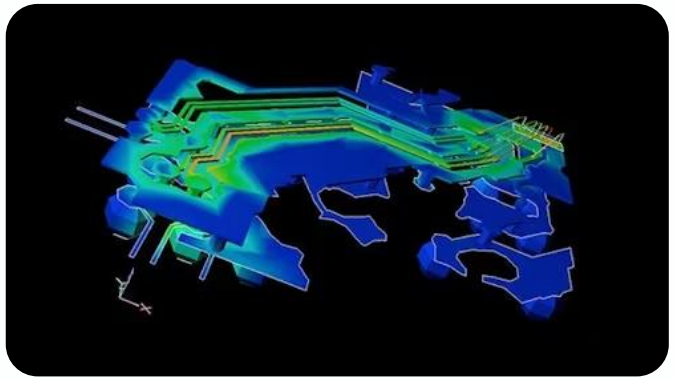
Problems of power delivery network is identified from two perspectives: DC (IR Drop) and AC (Frequency)

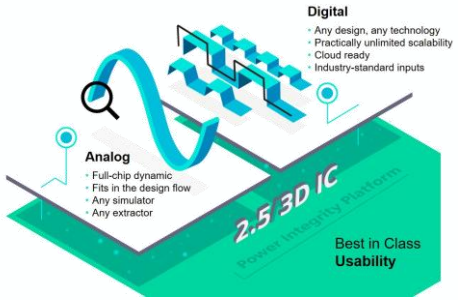
Quantities to calculate include:

- ✓ Current Density
- ✓ Voltage Drop
- ✓ Via Current









Analysis – Plots and Results

Net Name: +1V2 Voltage: 1.2V Current: 4.22A

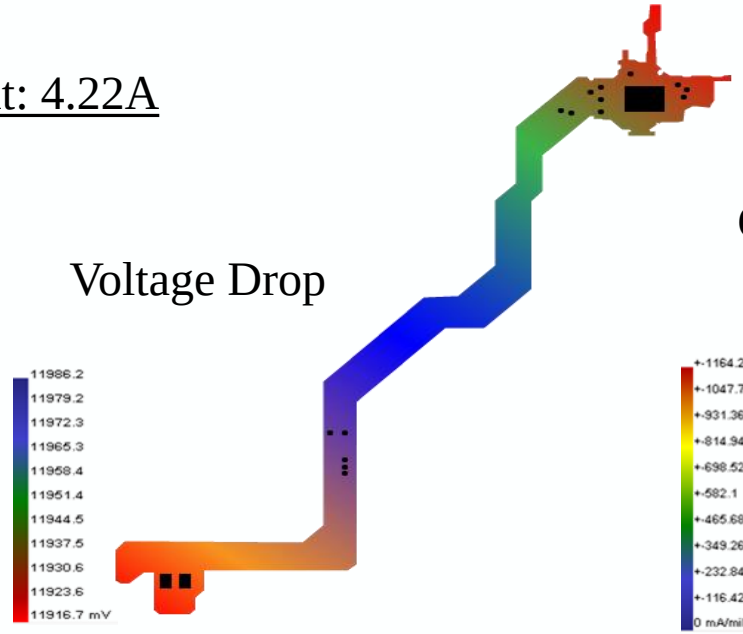
Analysis Parameters – Requirements

Max. Voltage Drop – 5.00%

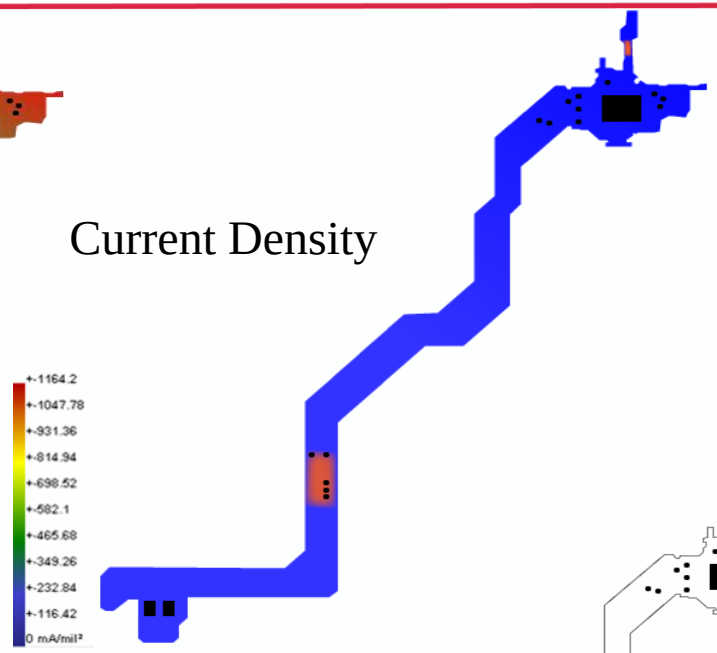
Max. Current Density – 100.00mA/mil²

Max. Via Current – 1000.0mA

Voltage Drop



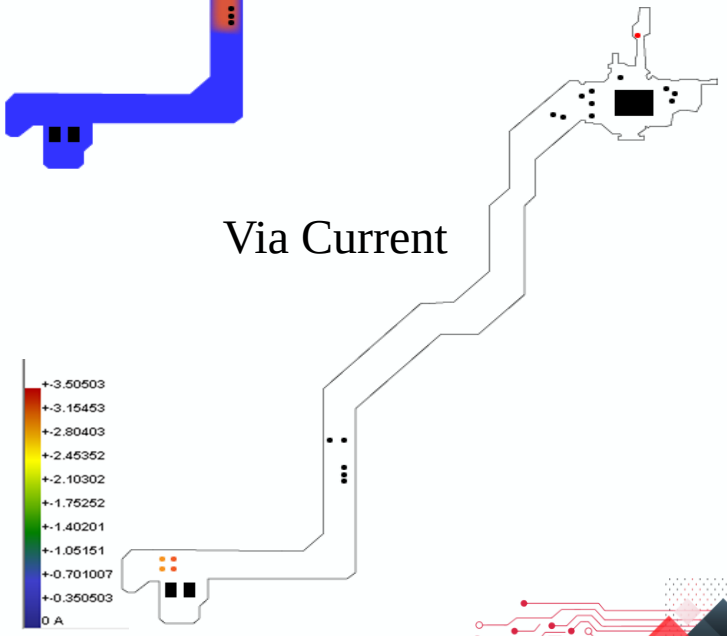
Current Density



Analysis Result

#	Measurement	Test	Constraint
	Filter	Filter	Filter
1	Max Voltage Drop	PASS	5.000%
2	Max Current Density	FAIL	100.00mA/mil2
3	Max Via Current	FAIL	1000.0mA

Via Current



Analysis – Plots and Results (Cont.)

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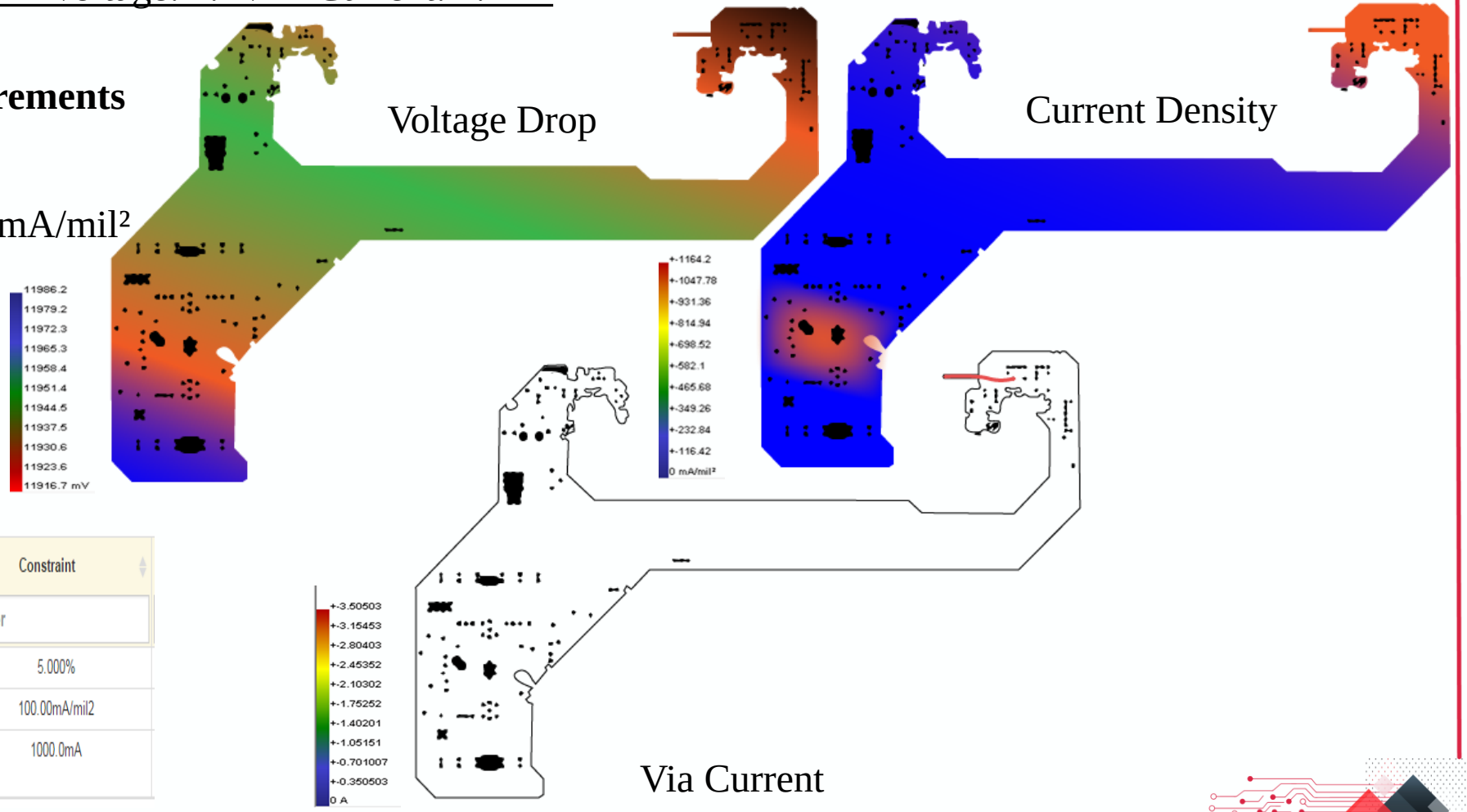
Net Name: +1V2_FILTERED Voltage: 1.2V Current: 4.22A

Analysis Parameters – Requirements

Max. Voltage Drop – 5.00%

Max. Current Density – 100.00mA/mil²

Max. Via Current – 1000.0mA



Analysis Result

#	Measurement	Test	Constraint
	Filter	Filter	Filter
1	Max Voltage Drop	PASS	5.000%
2	Max Current Density	FAIL	100.00mA/mil2
3	Max Via Current	FAIL	1000.0mA

Analysis – Plots and Results (Cont.)

Net Name: FE1_VRF1_FILTERED

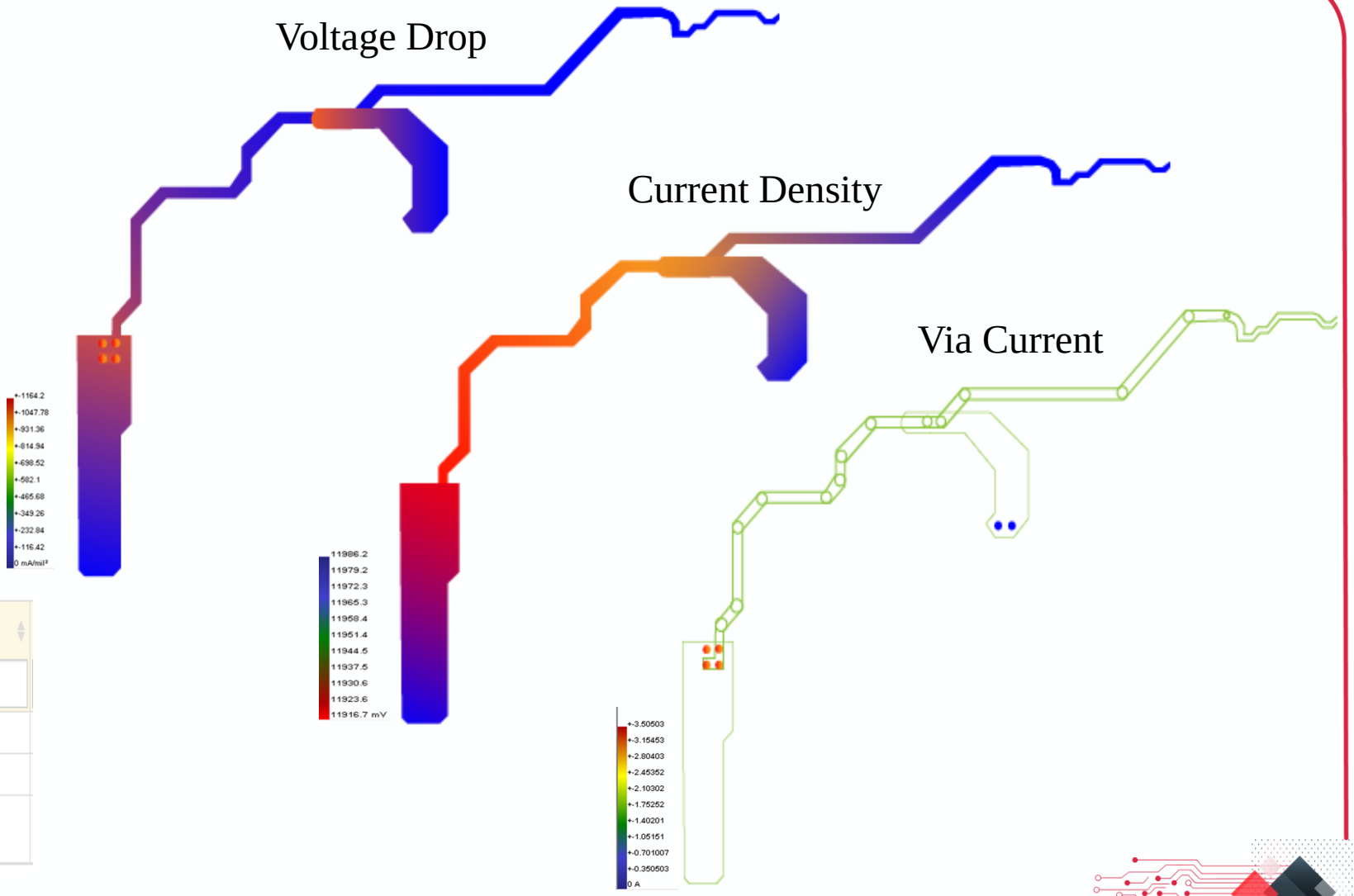
Voltage: 1.0V Current: 3.25A

Analysis Parameters – Requirements

Max. Voltage Drop – 5.00%

Max. Current Density – 50.00mA/mil²

Max. Via Current – 1000.0mA



Analysis Result

#	Measurement	Test	Constraint
	Filter	Filter	Filter
1	Max Voltage Drop	PASS	5.000%
2	Max Current Density	FAIL	50.00mA/mil2
3	Max Via Current	FAIL	1000.0mA

Analysis – Plots and Results (Cont.)

Net Name: FE2_VRF2_FILTERED

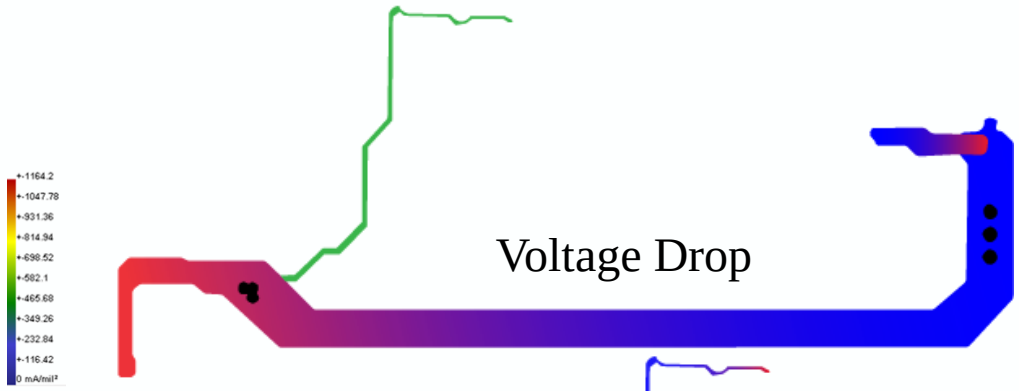
Voltage: 1.0V Current: 3.25A

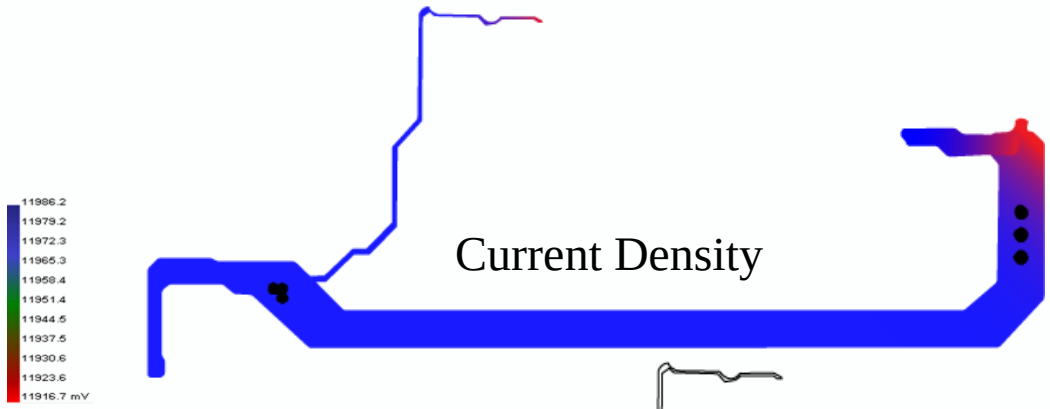
Analysis Parameters – Requirements

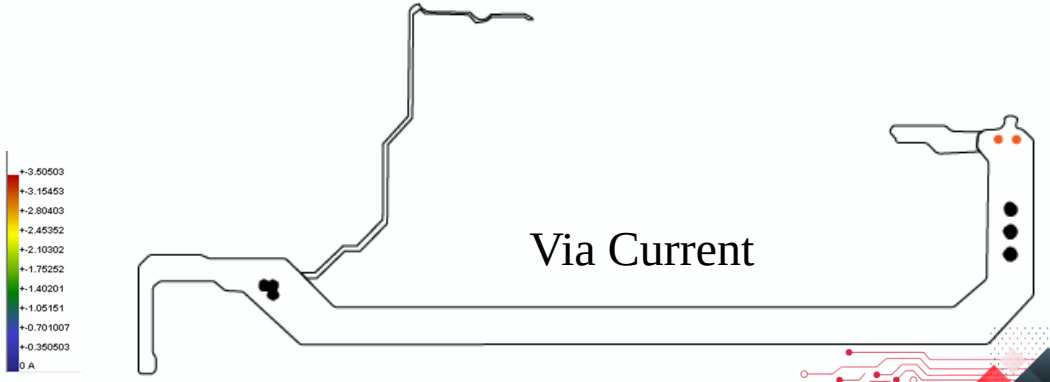
Max. Voltage Drop – 5.00%

Max. Current Density – 50.00mA/mil²

Max. Via Current – 1000.0mA







Analysis Result

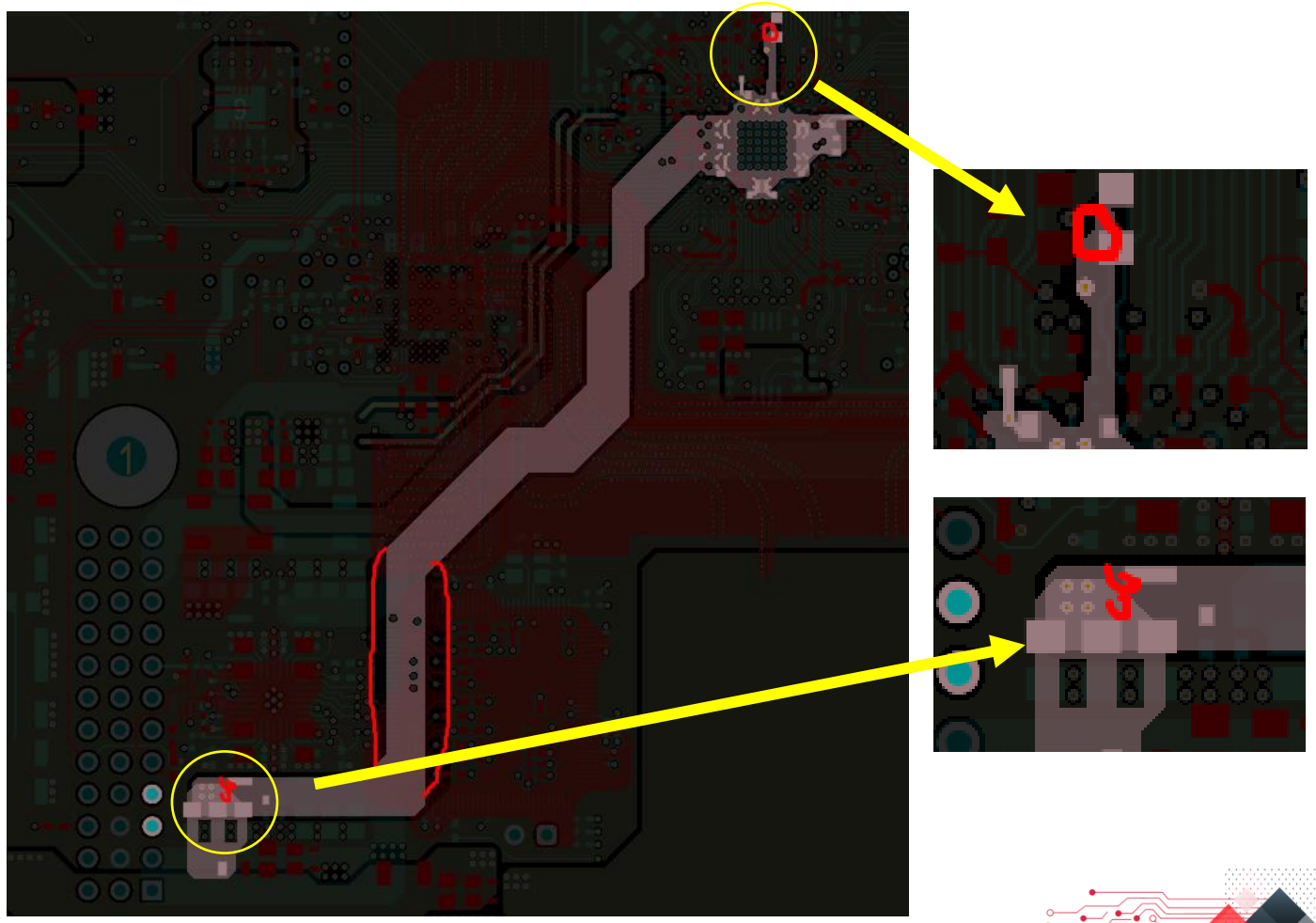
#	Measurement	Test	Constraint
	Filter	Filter	Filter
1	Max Voltage Drop	PASS	5.000%
2	Max Current Density	PASS	50.00mA/mil2
3	Max Via Current	PASS	1000.0mA

Layout Recommendations

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

Net : 1V2

1. Increase the width of Cu pour at specified locations.
2. Add additional vias at the source point.
3. Add one via near Capacitor C4.



Layout Recommendations (Cont.)

Net : 1V2_FILTERED

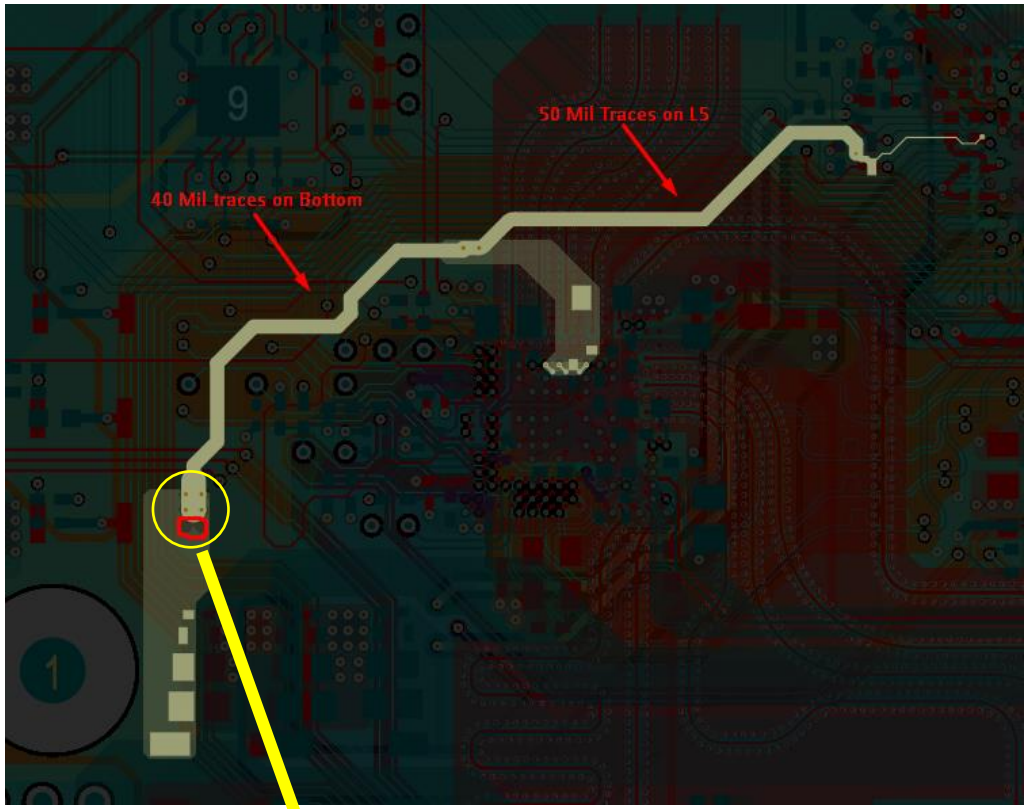
1. Increase the width of Cu pour at specified locations.

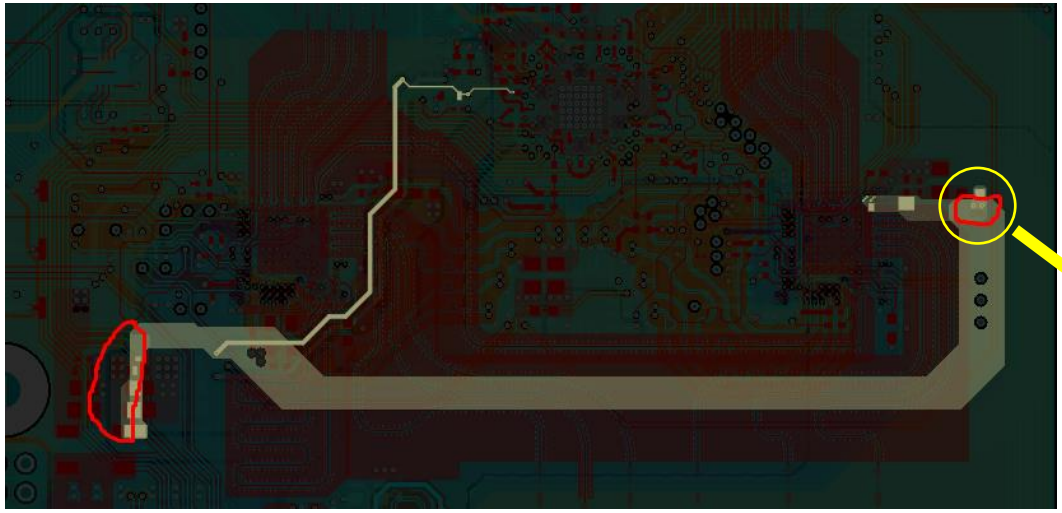
2. Increase the trace width to min. 20 mil on layer 5 under the U14 component.

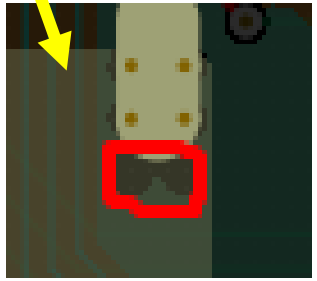
Layout Recommendations (Cont.)

Nets : FE1_VRF1_FILTERED &
FE2_VRF2_FILTERED

1. Increase the width of Cu pour at specified locations.
2. Increase the trace width in Bottom and Layer 5.
3. Add more vias to transfer power properly.





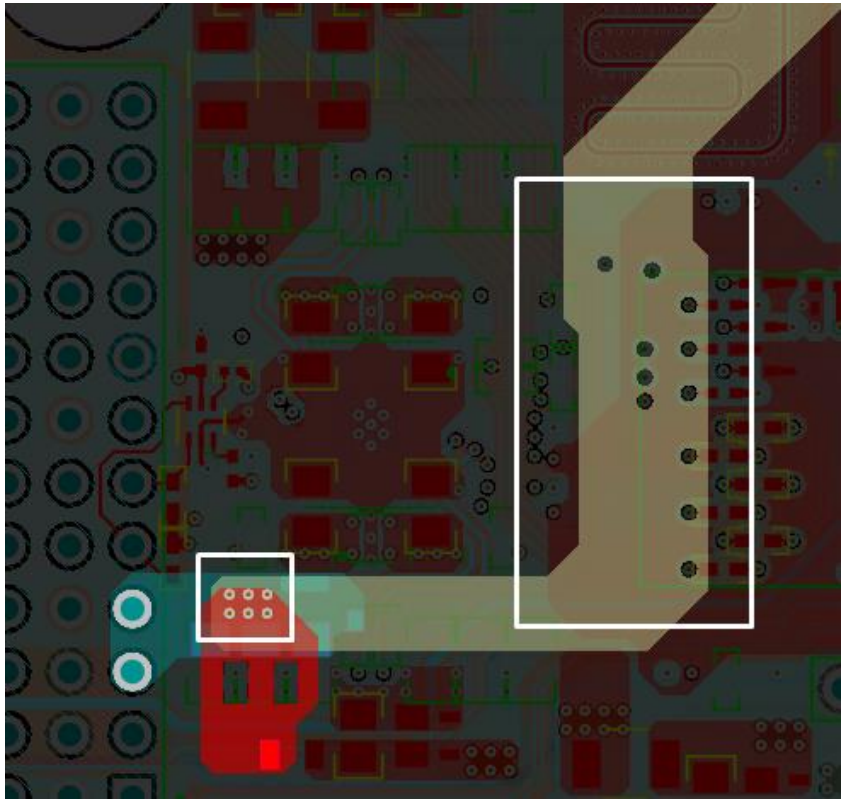


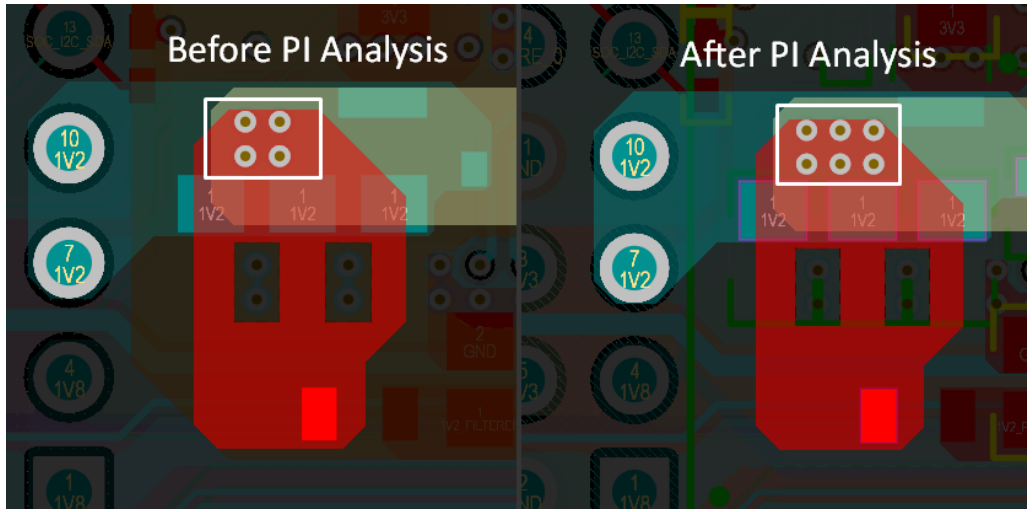
Layout Implementations

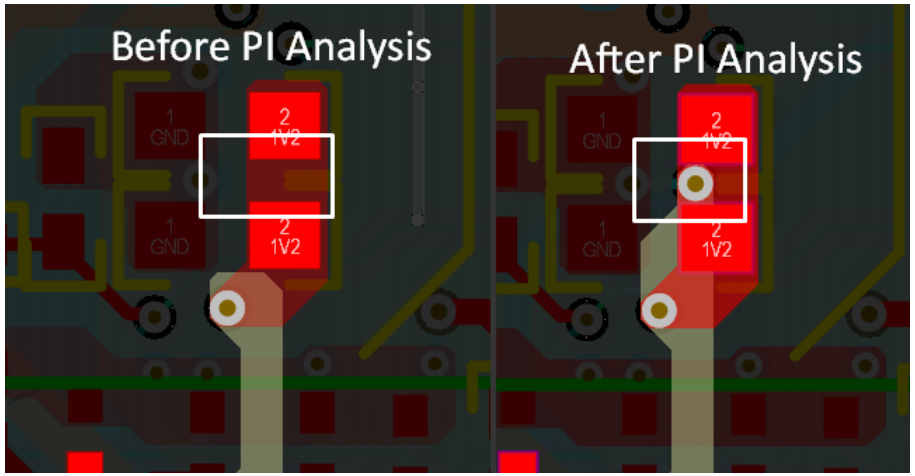
Suggested recommendations are incorporated to the PCB layout to enhance its performance.

Net : 1V2

1. Increased the width of Cu pour.
2. Vias added at source point and near capacitor C4.



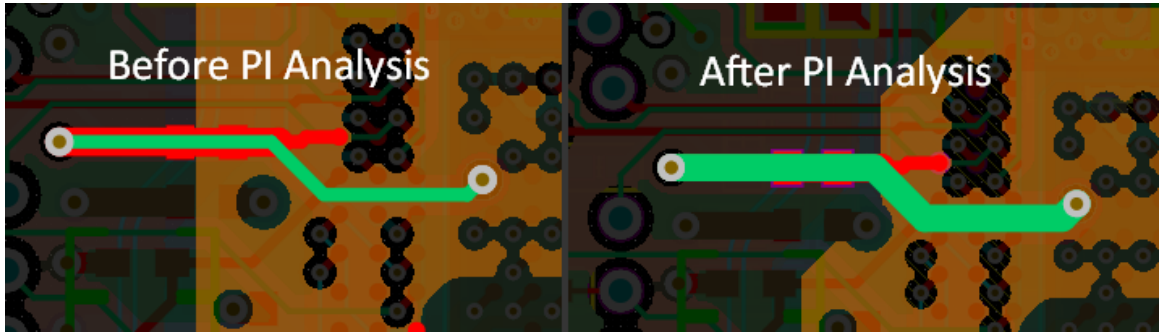


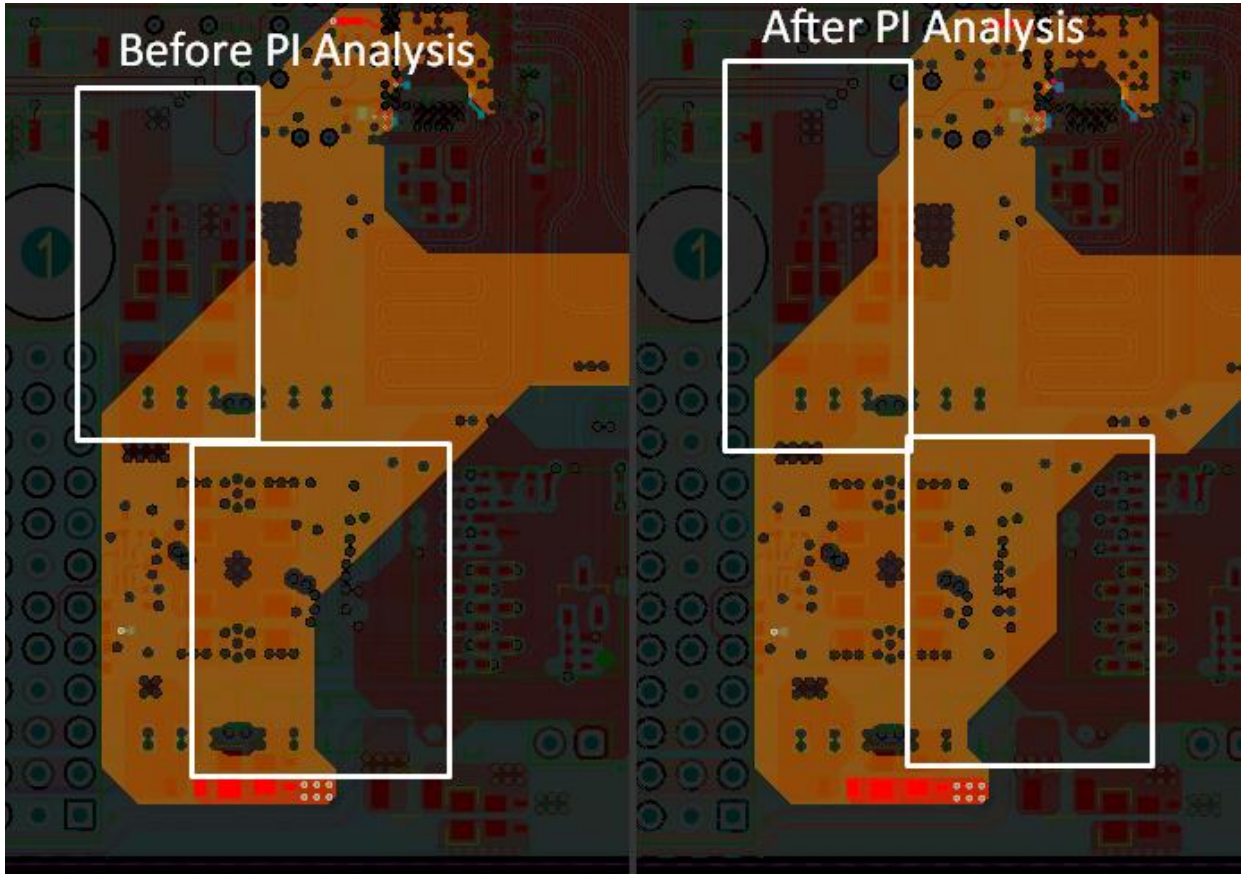


Layout Implementations (Cont.)

Net : 1V2_FILTERED

1. Increased the width of Cu pour.
2. Trace width increased to 20mil on Layer 5.

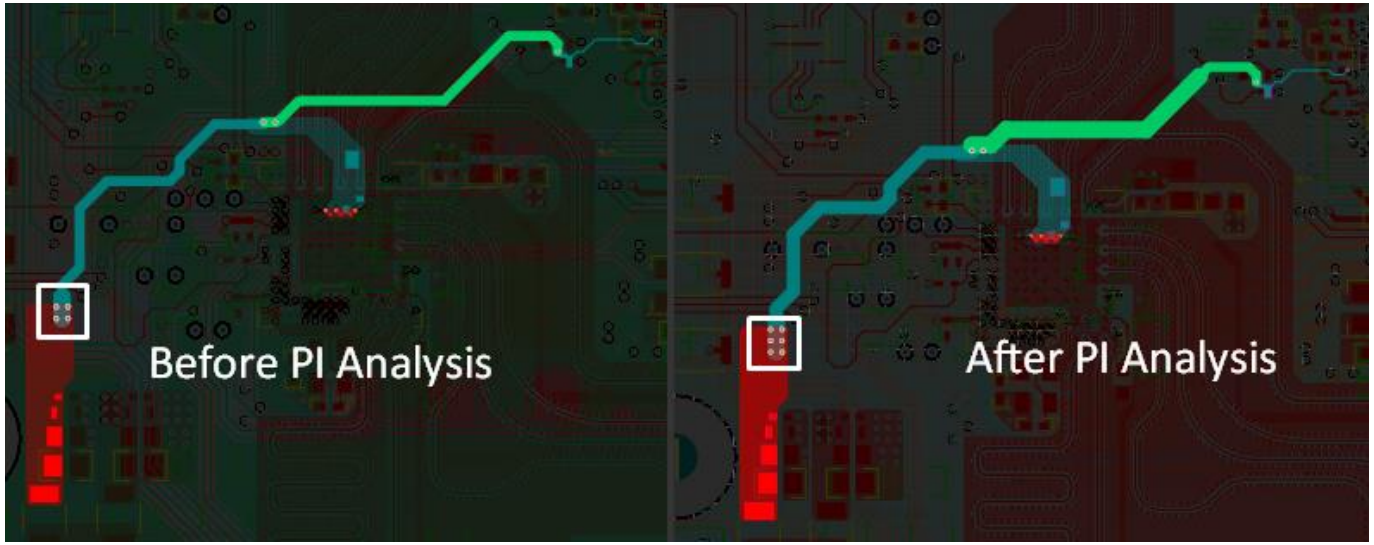


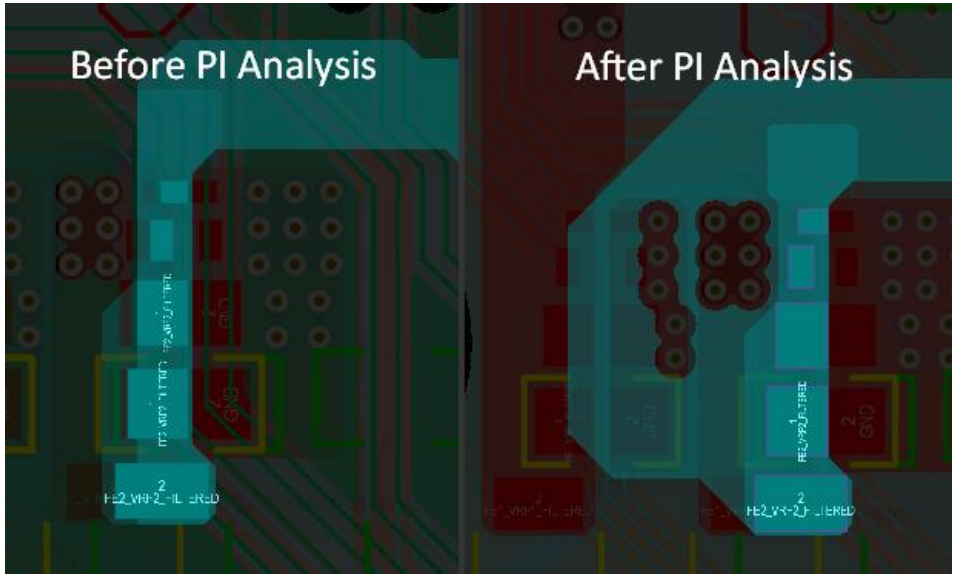


Layout Implementations (Cont.)

Nets : FE1_VRF1_FILTERED &
FE2_VRF2_FILTERED

1. Increased the width of Cu pour.
2. Trace width increased on Layer 5 & Bottom Layer.
3. Vias added for proper transfer of power.





Customer Testimonial

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

"We engaged the team for Power Integrity Analysis of PCB layout, and the results were exceptional. Their in-depth analysis uncovered potential issues that could have impacted the overall performance. The detailed insights provided, coupled with their practical recommendations along with cost-effective modifications to cu pours, allowed us to make informed decisions for optimizing our power distribution network. The team's expertise and commitment to delivering high-quality results were evident throughout the process. We are extremely satisfied with the quality, and timely delivery outcome of the analysis, and it has undoubtedly elevated the reliability and efficiency of our design!"

Conclusion

We delivered the client with an optimized PDN layout design, incorporating layout enhancements 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 PDN 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.