Automotive Camera Processor Module

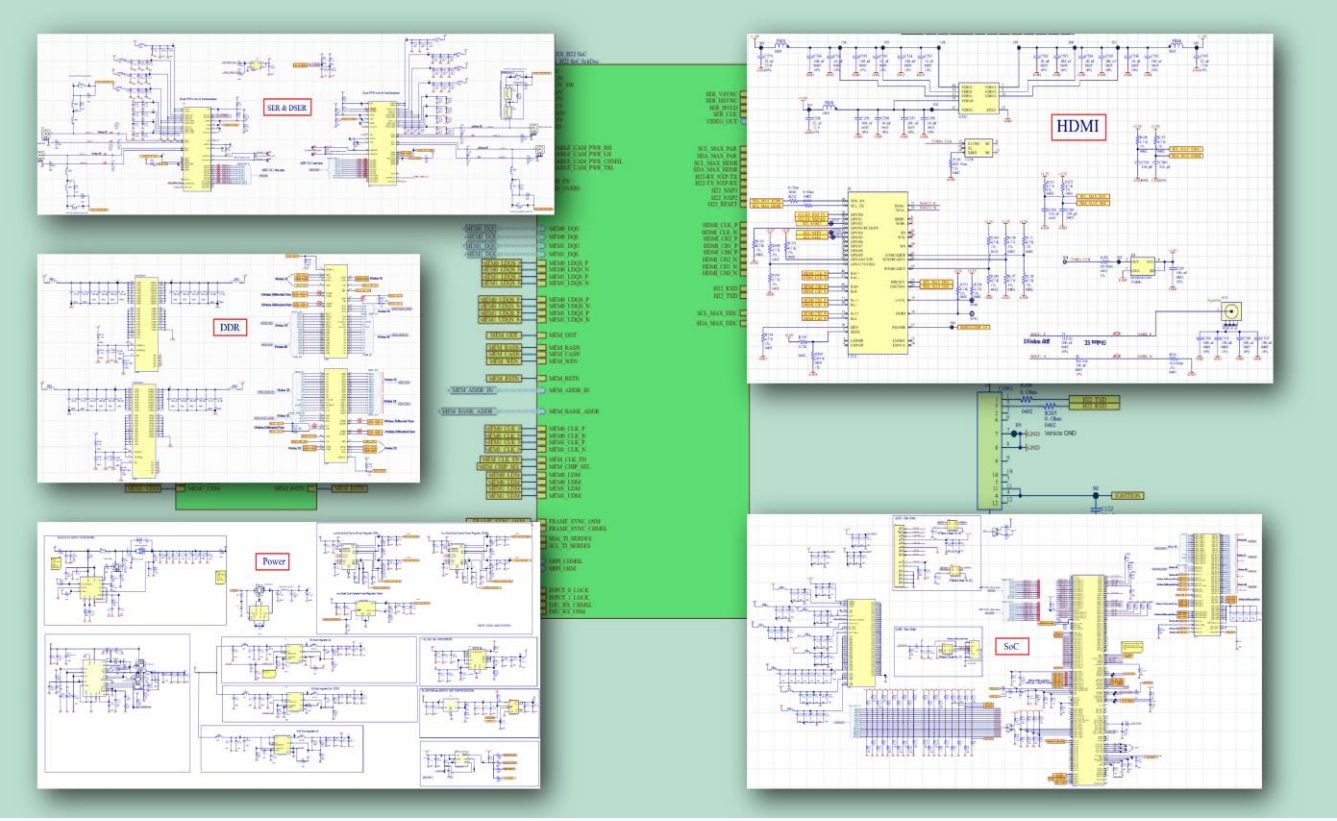
Scope: ECAD, MCAD and Analysis

Application: ADAS

An automotive camera processor module is a specialized PCB used in vehicles to process and analyze the data captured by cameras. The automotive camera processor module typically includes image sensors, image signal processors (ISPs), and powerful processors or digital signal processors (DSPs). It applies image enhancement techniques, object recognition algorithms, and computer vision algorithms to analyze the camera input and extract valuable information about the surrounding environment. The automotive camera processor module enables advanced driver assistance and autonomous driving by processing camera data for safety and convenience features.

ECAD

- Schematics

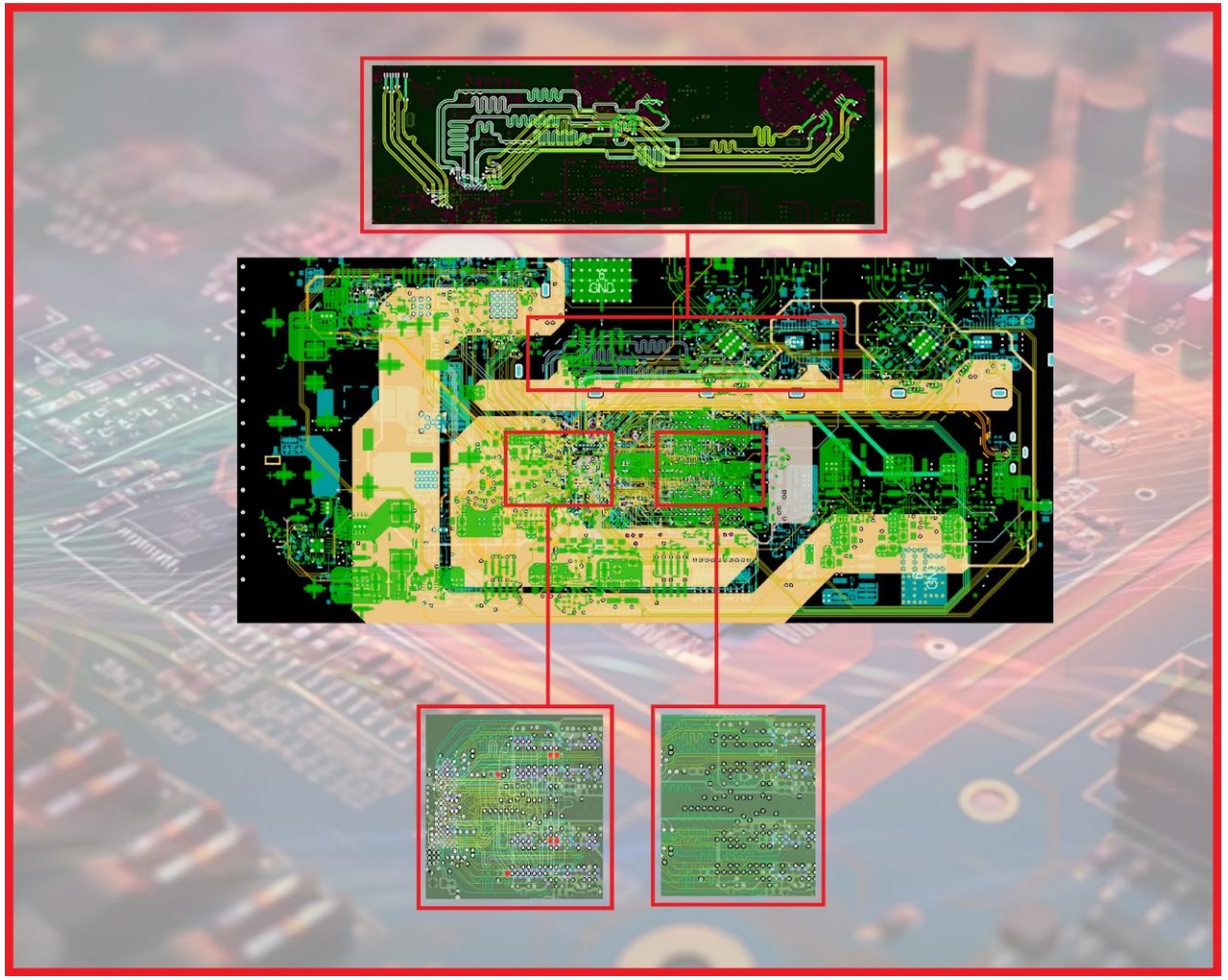


- PCB
  - Total components → 968
  - Layer count → 14
  - Total connection → 2064
  - Dimension → 130mm X 50mm
  - Pin count: 2676
  - 10 different powers
  - Devices → Video SOC (Ambarella H22), DDR4, NOR Flash, Serializer, Deserializer, Coax connector, SEPIC, Buck Converter, LDO, Supervisor

Challenges in PCB

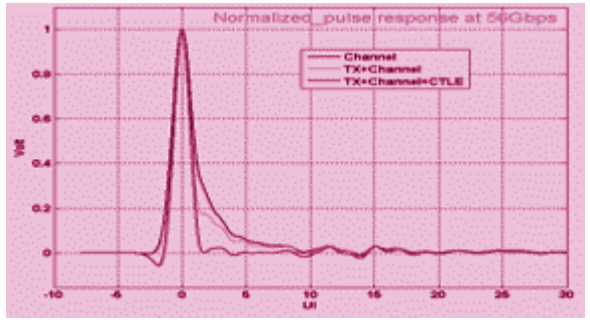
- Interface:
  - DDR4
  - MIPI
  - I2C
  - NOR
  - SD card
  - USB
  - advanced image sensor pipeline (ISP)
  - JTAG
- BGA Pitch:
  - SoC – 0.65mm
  - DRAM – 0.35mm (Fine pitch)

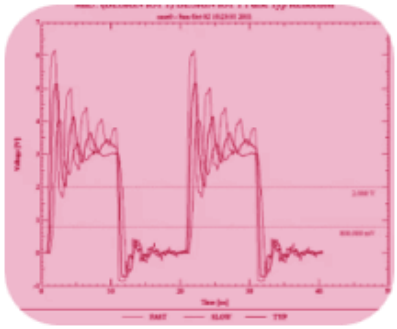
- Output ➔

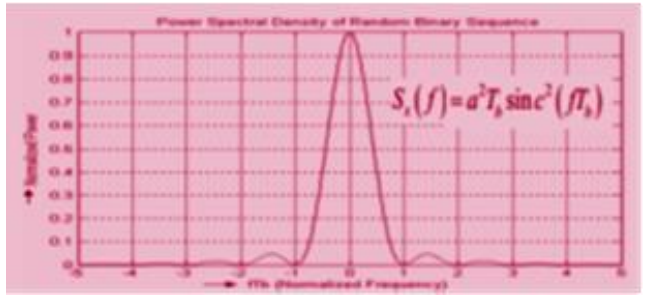


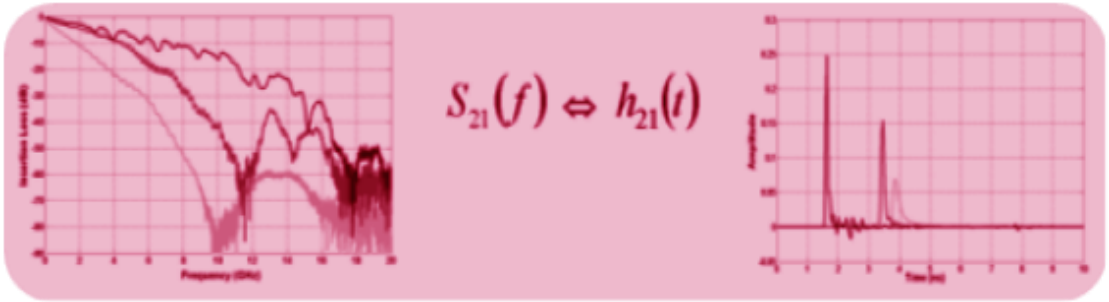
Analysis

- SI
- Challenge – Overshoot in DDR Address Group
- Tool: Altium
- Result - To remove overshoot routing style changed from 45º to Arc.

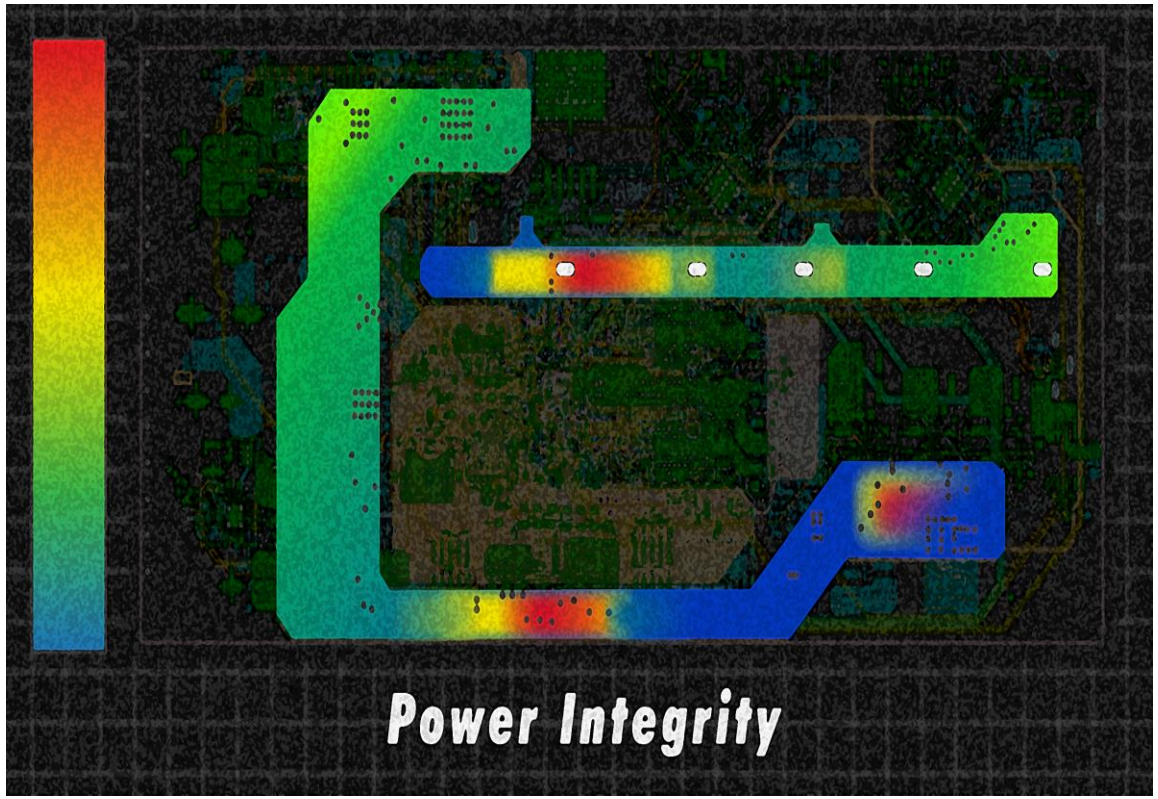






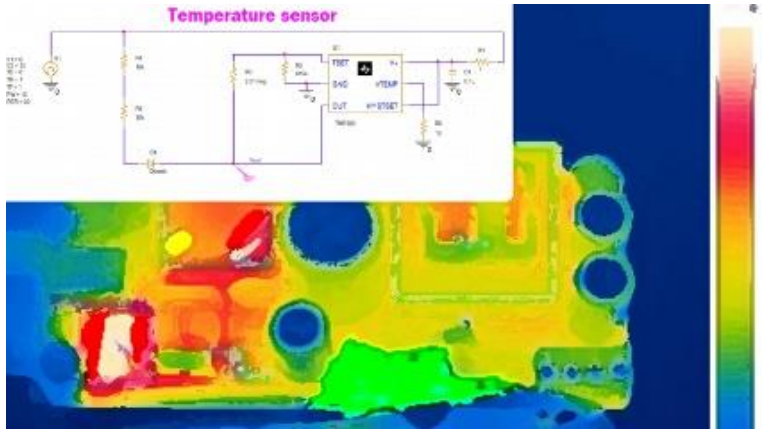


- PI



Analysis

- WCCA
- At worst Condition Power not turned off under 100°C.
- Tool: Pspice
- Tolerance of the resistor decreased from 5% to 1%. So, at Worst Condition Power turned off under 100°C.



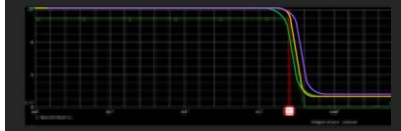
Simulation Results:

Here, temperature sweep was done in order to check turn of

For nominal condition,

Temperature range → 80-120°C (For all condition)

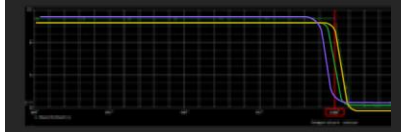
R3 = 2.21meg; R2 = 619k



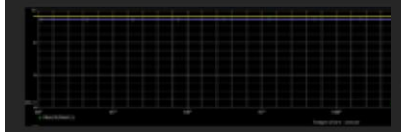
Worst condition

In this circuit, R3 & R2 are the components that has the impa
Therefore, it is simulated for only 10% tolerance of those con

$R3_{Max}$ = 2.431meg; R2 = 619k



$R3_{Max}$ = 2.431meg; $R2_{Max}$ = 680.9k



$R3_{Max}$ = 2.21meg; $R2_{Max}$ = 680.9k

Analysis Report:

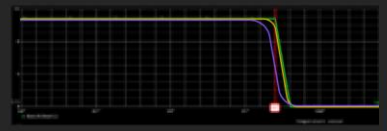
R3	R2	Off Temperature
Nominal	Nominal	97
Max	Nominal	100
Max	Max	112
Nominal	Max	108

From the above result, we can conclude that the current circu
off power when the temperature crossed 100°C.

Conclusion & Suggestion:

The current combination of resistor's tolerance is not so good
can reduce the tolerance of resistor to 1% and the simulation

$R3_{Max}$ = 2.2321meg; R2 = 619k



$R3_{Max}$ = 2.2321meg; $R2_{Max}$ = 625.19k

$R3_{Max}$ = 2.21meg; $R2_{Max}$ = 625.19k

R3	R2	Off Temperature
Nominal	Nominal	97
Max	Nominal	97
Max	Max	99
Nominal	Max	98

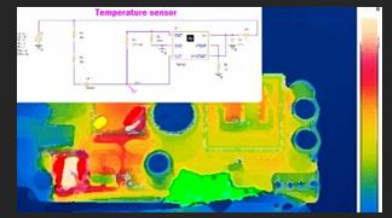
Circuit operation:

230V AC input is converted into Nominal Output Voltage 12V with following characters.

- Regulation Tolerance +/- 5%
- Ripple and Noise - 120mV
- Low Frequency Ripple - 200mV
- Minimum Current - 0A
- Continuous Current - 10.8A
- Peak Current - 14.4A
- Maximum Step Load - 7A @ 0.5A/µS

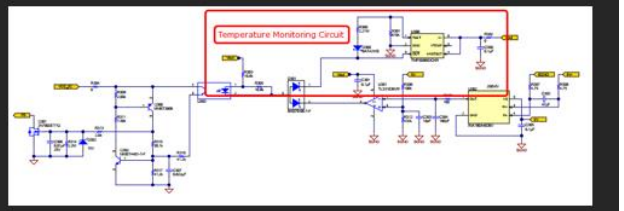
Need of WCCA:

We already manufacture this pcb for testing purpose. when testing, the temperature near the marked area goes up to 80°C(approx.). Hence, we added a temperature monitoring circuit near the inductor and diode so that it will turn off power when it goes above 100°C. We need you to check whether even in worst condition it will turn off power when temperature crosses 100°C.



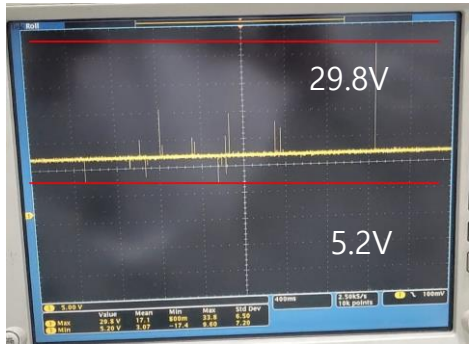
Temperature monitoring ICs, also known as temperature sensor ICs or temperature sensor integrated circuits, are electronic devices designed to accurately measure temperature and provide temperature-related information. These ICs typically incorporate a temperature sensor, analog-to-digital converter (ADC), and additional circuitry for calibration and communication.

Schematic:



EMI/EMC

- Noise exist

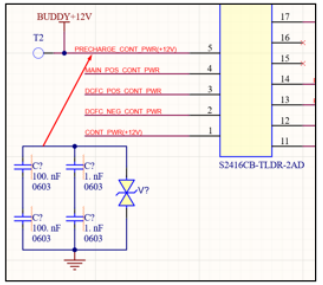


[Fail measure signal]

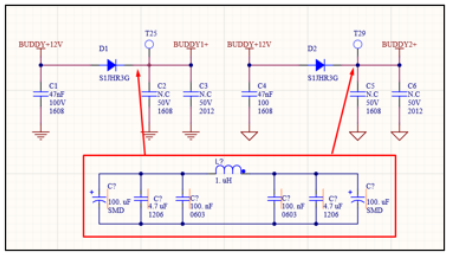
- Tool: EMI/EMC Lab

Design Level: Solution

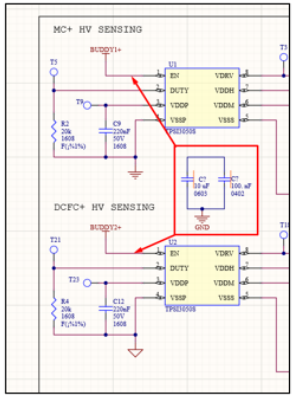
1. Adding the **TVS diode and capacitor filter section** near the **Pin 5 of CON J1** will reduce the noise in entry level as shown below.



2. Adding the **PI filter** sections after the diodes (D1, D2) will reduce the Noise in Buddy signals as shown below.



3. Adding the **Filter capacitors** near the **EN** pins of IC's (U1,U2) will filter the noise as shown in picture.

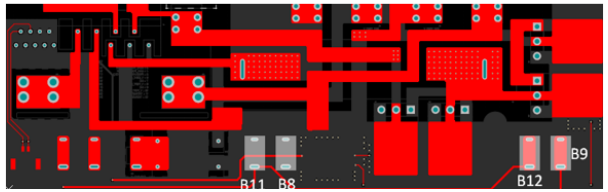


Schematic

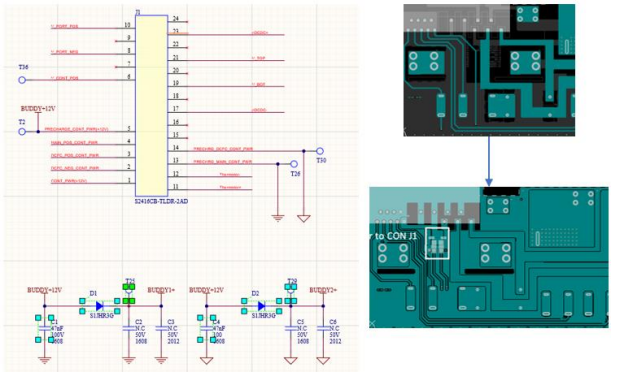
PCB

PCB Layout Implementation:

Components placement optimization based on LV side and HV side components. For that, components B8, B9, B11 and B12 placement modified as shown below.



Power net (+12V) components placed closer to CON J1 as shown below



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- "*We approached this company for outsourcing due to their reputed quality control processes, and we are extremely pleased with the outcome. Their work was completed to a high standard, exceeding our expectations. Delegating tasks to their expert team saved us valuable time, enabling us to focus on core functions. The utilization of their state-of-the-art technology and infrastructure eliminated the need for costly investments. We highly recommend their efficient and reliable outsourcing services.*“

- *North American – Tier I* Automotive supply

Conclusion

- Amidst the design process for this board, we confronted significant hurdles.
- The intricate task of accommodating a multitude of connections within a limited space, coupled with the imperative of achieving the desired impedance profile for a wide range of signals, demanded our unwavering focus.
- Drawing upon our extensive expertise and research in PCB design, we passionately persevered and triumphed.
- We proudly present a meticulously crafted PCB that has garnered the resounding approval of our esteemed customers, marking a significant milestone in our journey.