

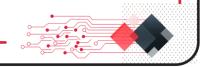




# Automotive Camera Processor Module

### 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.

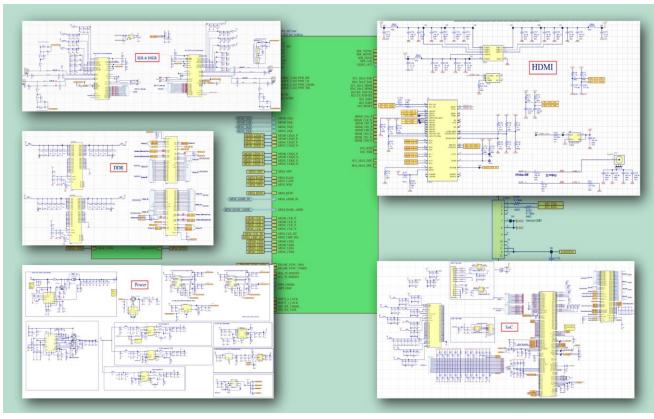




ECAD



• Schematics



### • PCB

- Total components  $\rightarrow$  968
- Layer count  $\rightarrow 14$
- Total connection  $\rightarrow 2064$
- Dimension  $\rightarrow$  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



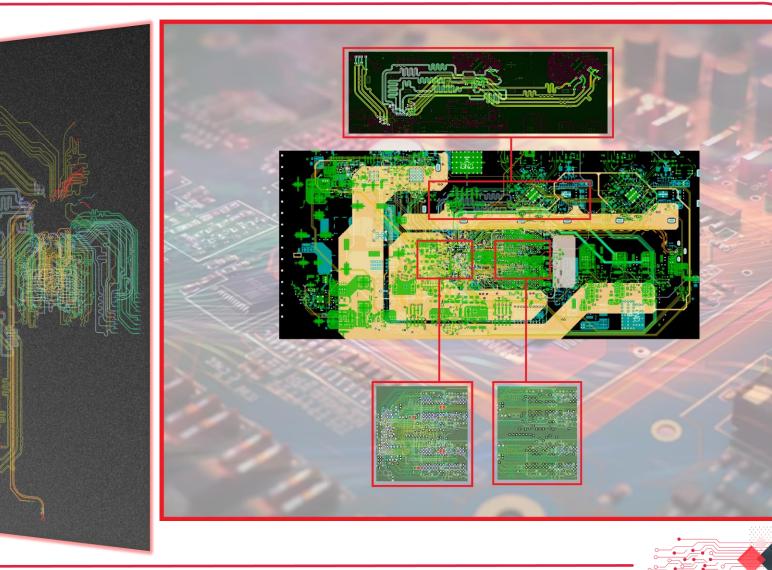




## Challenges in PCB

- Interface:
- DDR4 ٠
- MIPI ٠
- I2C ٠
- NOR ٠
- SD card ٠
- USB ٠
- advanced image sensor pipeline (ISP) ٠
- JTAG ٠
- **BGA** Pitch: •
- SoC 0.65mm ٠
- DRAM 0.35mm (Fine pitch) ٠

• Output →







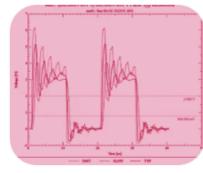
0.8

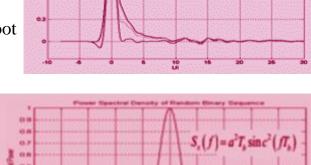
0.4



#### • SI

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

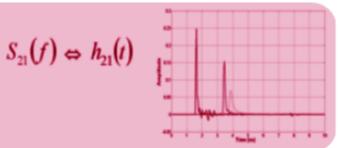




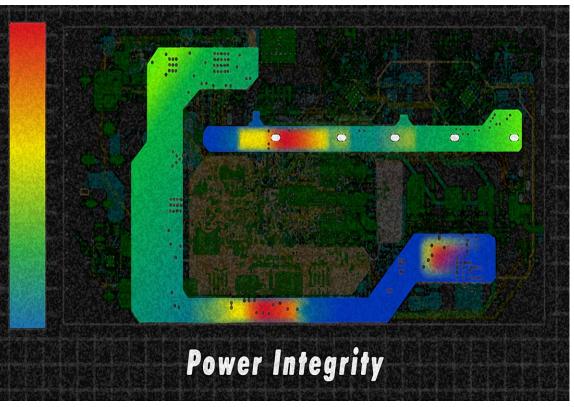
Normalized pulse response at 56Gbps

Channel TX+Channel TX+Channel+CTLE





• 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.

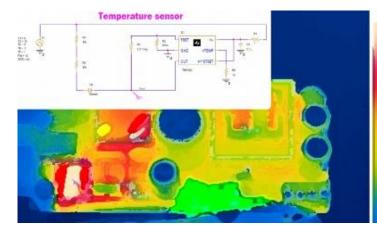


Image: bit image:		Analysis Report:			230V AC input is converted into Nominal Output Voltage 12V with following characters.
Numation featureNumation of Principal Numation of Principal Numation of Principal Numation of Principal <b< td=""><td></td><td>[ 77]</td><td>100</td><td>087</td><td></td></b<>		[ 77]	100	087	
Simulation Results:Immuni mai mai mai mai mai mai mai mai mai ma					
Here, temperature sweep was done in order to check turn for nominal condition, Romentation condition, Raperature range > 80-120°C (for all condition) R = 221mg; R2 = 613;Condition The uncreat constinuation of resistor's tolerance is not say of can reduce the talerance of resistor to 1% and the simulation R = 2.221mg; R2 = 613;Can can conclude that the current done manual done to antit turbul turn of power when testing, the temperature cosces 100°C.Here done manual done to antit turbul turn of power when testing, the temperature and the marked area goes up to 80°C (approx.). Here, we added a temperature monitoring circuit near the marked area goes up to 80°C (approx.). Here, we added a temperature monitoring circuit near the marked area goes up to 80°C (approx.). Here, we added a temperature monitoring circuit near the marked area goes up to 80°C (approx.). Here, we added a temperature monitoring circuit near the marked area goes up to 80°C (approx.). Here, we added a temperature accords 100°C.Here done marked area goes up to 80°C (approx.). Here, we added a temperature accords 100°C.Here done marked area goes up to 80°C (approx.). Here, we added a temperature accords 100°C.Here done marked area goes up to 80°C (approx.). Here, we added a temperature accords 100°C.Here done marked area goes up to 80°C (approx.). Here, we added a temperature accords 100°C.Here done marked area goes up to 80°C (approx.). Here, we added a temperature accords 100°C.Here done marked area goes up to 80°C (approx.). Here, we added a temperature accords 100°C.Here done marked area goes up to 80°C (approx.). Here, we added a temperature accords 00°C.Here done marked area goes up to 80°C (approx.). Here, we added a temperature accords 00°C.Here done marked area goes up to 80°C (approx.). Here we added a temperature accords	Simulation Results:				그는 그는 그는 것은 이 것을 수 있는 것을 수 있는 것을 하는 것을 하는 것을 수 있는 것을 수 있는 것을 하는 것을 수 있는 것을 하는 것을 수 있는 것을 하는 것을 수 있다. 것을 하는 것을 하는 것을 하는 것을 수 있는 것을 수 있는 것을 하는 것을 수 있다. 것을 하는 것을 수 있는 것을 하는 것을 수 있는 것을 수 있는 것을 수 있는 것을 하는 것을 수 있다. 것을 수 있는 것을 수 있다. 것을 것 같이 것 않는 것을 것 같이 않는 것 않는 것을 수 있는 것 않는 것
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For nonal condition,       Conduston & Saggestion:					Contract Street Contract Street
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R1 = 221mg; 82 = 61%       Grame and combination of resider's tolerance in of so one of the combination of resider's tolerance in of so one of the combination of resider's tolerance in of so one of the combination of resider's tolerance in of so one of the combination of resider's tolerance in of so one of the combination of resider's tolerance in of so one of the combination of resider's tolerance in of so one of the combination of resider's tolerance in of so one of the combination of resider's tolerance in of so one of the combination of resider's tolerance in of so one of the combination of resider's tolerance in of so one of the combination of resider's tolerance in the combination of resider in the combinatin the combin of the combination of resider in the combin of the c	Temperature range → 80-120°C (For all condition)	concusion a suggestion.			
$R_{hun} = 2.232 \text{ Image}, R 2 = 619 \text{ K}$ $R_{hun} = 2.232 \text{ Image}, R 2 = 619 \text{ K}$ $R_{hun} = 2.232 \text{ Image}, R 2 = 619 \text{ K}$ $R_{hun} = 2.232 \text{ Image}, R 2 = 619 \text{ K}$ $R_{hun} = 2.232 \text{ Image}, R 2 = 619 \text{ K}$ $R_{hun} = 2.232 \text{ Image}, R 2 = 619 \text{ K}$ $R_{hun} = 2.232 \text{ Image}, R 2 = 619 \text{ K}$ $R_{hun} = 2.232 \text{ Image}, R 2 = 619 \text{ K}$ $R_{hun} = 2.232 \text{ Image}, R 2 = 619 \text{ K}$ $R_{hun} = 2.232 \text{ Image}, R 2 = 619 \text{ K}$ $R_{hun} = 2.232 \text{ Image}, R 2 = 619 \text{ K}$ $R_{hun} = 2.232 \text{ Image}, R 2 = 625 \text{ 19} \text{ K}$ $R_{hun} = 2.232 \text{ Image}, R 2 = 625 \text{ 19} \text{ K}$ $R_{hun} = 2.231 \text{ Image}, R 2 = 625 \text{ 19} \text{ K}$ $R_{hun} = 2.231 \text{ Image}, R 2 = 625 \text{ 19} \text{ K}$ $R_{hun} = 2.23 \text{ Image}, R 2 = 625 \text{ 19} \text{ K}$ $R_{hun} = 2.23 \text{ Image}, R 2 = 625 \text{ 19} \text{ K}$ $R_{hun} = 2.23 \text{ Image}, R 2 = 625 \text{ 19} \text{ K}$ $R_{hun} = 2.23 \text{ Image}, R 2 = 625 \text{ 19} \text{ K}$ $R_{hun} = 2.23 \text{ Image}, R 2 \text{ Image}, R$	P3 = 3 21mmo P2 = 619k				
Image: provide the structureImage: provide the structure <td>NO-LITTHER AL-OTHE</td> <td colspan="3">can reduce the tolerance of resistor to 1% and the simulation</td> <td>whether even in worst condition it will turn off power when temperature crosses 100°C.</td>	NO-LITTHER AL-OTHE	can reduce the tolerance of resistor to 1% and the simulation			whether even in worst condition it will turn off power when temperature crosses 100°C.
In this circuit, R3 & R2 are the components that has the inpact therefore, it is simulated for only 10% tolerance of those or $R_{hun} = 2.431 \text{meg}; R2 = 619k$ Image: R2 = 619kImage: R2 = 619kImage: R2 = 619kImage: R2 = 625.19kImage: R2 =		R3 <sub>84a</sub> = 2.2321meg; R2 = 619k			
Therefore, it is simulated for only 10% tolerance of those on $R_{3um} = 2.431 \text{meg}; R^2 = 619k$ $\int_{0}^{1} \int_{0}^{1} \int_{$	Worst condition	Tenders			
$R_{3m_{m}} = 2.431 meg; R_{2m_{m}} = 680.9k$ $R_{3m_{m}} = 2.21 meg; R_{2m_{m}} = 680.9k$		R3 <sub>eta</sub> = 2.2321meg	; R2 <sub>444</sub> = 625.19k		
$R_{3kuu} = 2.21meg; R_{2kuu} = 680.9k$	R3.es. = 2.431meg; R2 = 619k	R3 <sub>mm</sub> = 2.21meg; R2 <sub>mm</sub> = 625.19k			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.
R3 <sub>bess</sub> = 2.431meg; R2 <sub>Mes</sub> = 680.9k     R3     R2     Off Temperature       R3 <sub>bess</sub> = 2.21meg; R2 <sub>Mess</sub> = 680.9k     R3     R2     Off Temperature       R3 <sub>bess</sub> = 2.21meg; R2 <sub>Mess</sub> = 680.9k     Max     Max     99					
Nominal         97           R3 <sub>winn</sub> = 2.21meg; R2 <sub>winn</sub> = 680.9k         Max         Nominal         97	R3 <sub>Max</sub> = 2.431meg; R2 <sub>Max</sub> = 680.9k				
Nominal         Nominal         97           R3 <sub>win</sub> = 2.21meg; R2 <sub>win</sub> = 680.9k         Max         Nominal         97		R3	R2	Off Temperature	
R3 <sub>win</sub> = 2.21meg; R2 <sub>win</sub> = 680.9k Max 99	(Author) Internet and	Nominal	Nominal		
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Nominal Max 98	South = 2.3.4000; Kilma = 000.90	Max	Max		
		Nominal	Max	98	

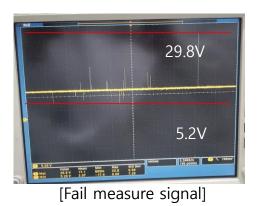
Circuit operation







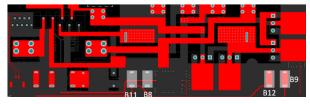
• Noise exist



• Tool: EMI/EMC Lab

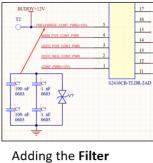
#### PCB Layout Implementation:

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

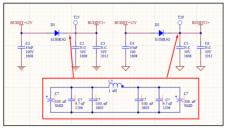


Design Level: Solution

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.



3. Adding the **Filter capacitors** near the **EN** pins of IC's (U1,U2) will filter the noise as shown in picture. 2. Adding the **PI filter** sections after the diodes (D1, D2) will reduce the Noise in Buddy signals as shown below.



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



MC+ HV SENSING

DCFC+ HV SENSING







- "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.

