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# EMI & EMC Simulation
## for Automotive Imager Module

**Scope :** EMI & EMC Simulation

**Application :** Advanced Driver Assistance System (ADAS)

EMI/EMC in automotive imager modules are a critical concern, especially with the increasing complexity of electronic systems in vehicles. To ensure compliance with industry standards like CISPR 25, engineers employ various EMI mitigation techniques. These include filtering, spread spectrum, and E-field shielding to reduce interference and protect the functionality of sensitive components such as cameras and sensors. Understanding and controlling EMI/EMC is essential for the reliability and safety of the system.

# Simulation Challenges

The client requested to perform EMI & EMC analysis (Simulation in Tool) of the layout to ensure it passes CISPR 25. The following outlines the challenges associated with EMI EMC Analysis.

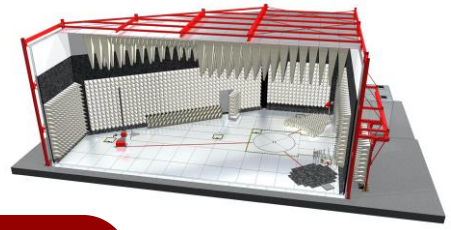
## Challenges

- Modeling Accuracy
- Computational Complexity
- Material Characterization
- Meshing and Resolution
- Multi-Physics Interactions
- Obtaining IBIS Models for Components
- Simulation Setup at the Tool
- Layout Rework Based on Commands

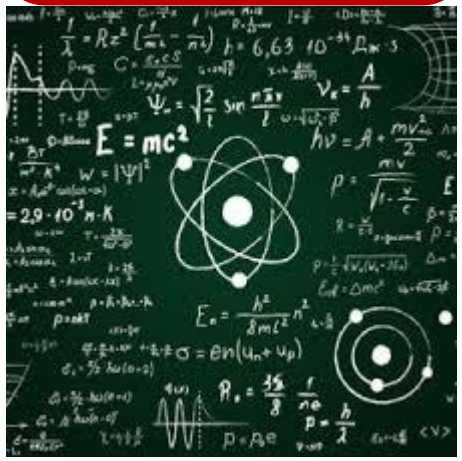
# Analysis - SoW

Input Study

Pre-Simulation Preparation



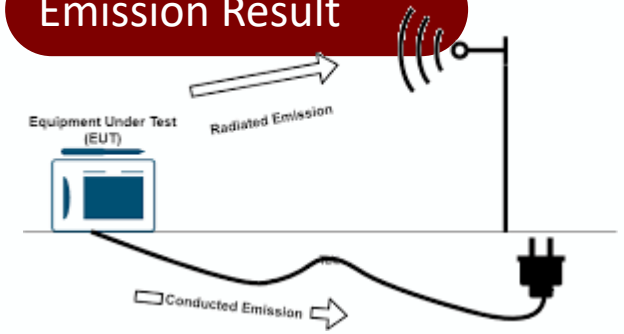
Physics Set-up



Anechoic Chamber set up

Immunity Result

Emission Result

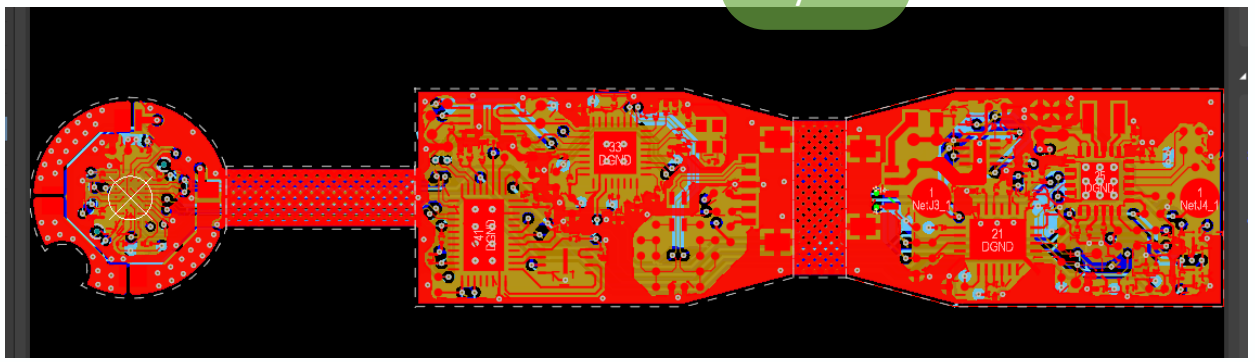



Result & Conclusion

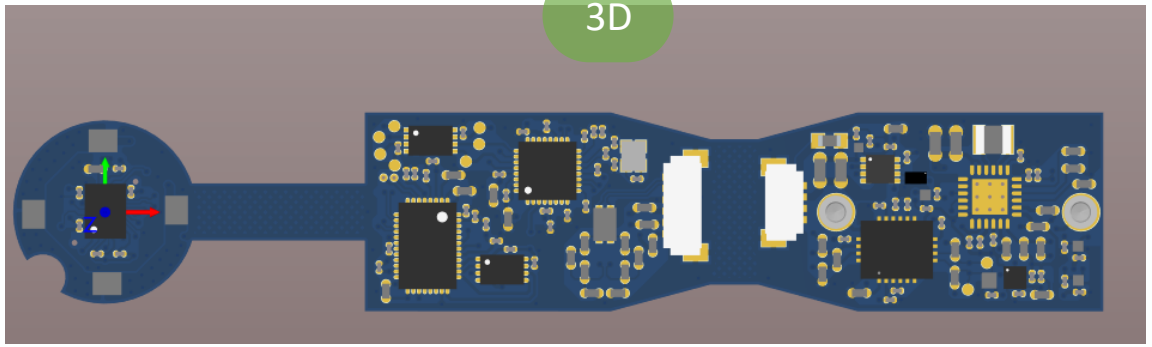
# Input Study

The circuits in the schematic of the project are studied thoroughly to check whether the board has followed the recommendation of CISPR 25 along with the layout routing.

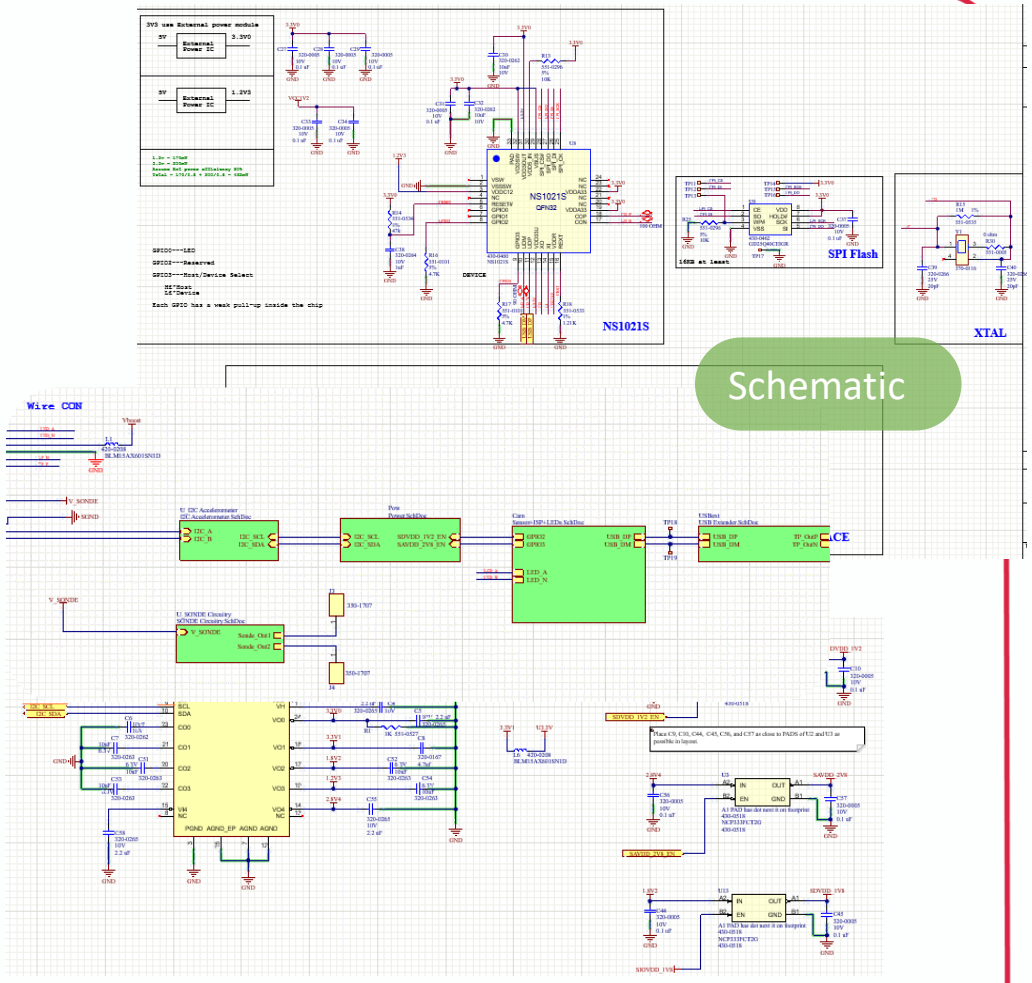
Layout



3D



Schematic



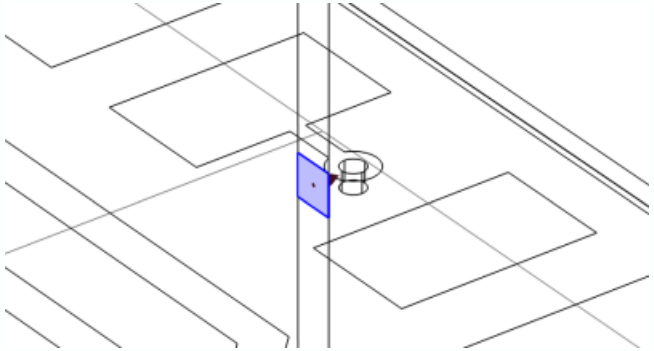
# Pre-Simulation Preparation

The necessary inputs for simulating radiated emissions and interference in COMSOL were collected and imported into the simulation setup to ensure a realistic simulation.

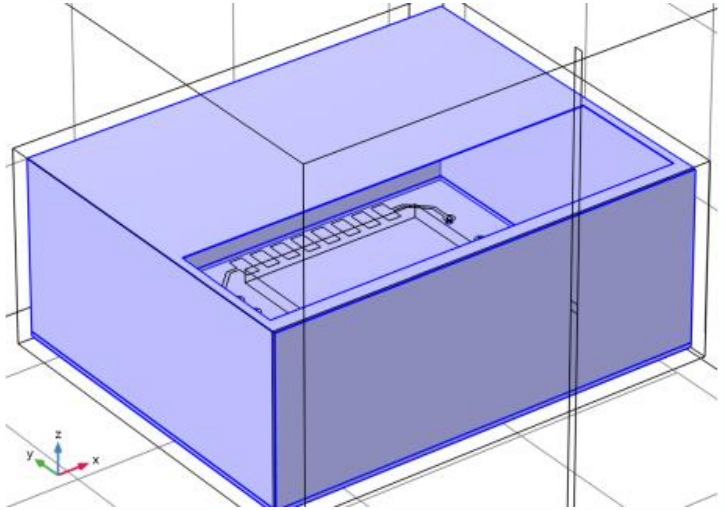
Input Parameters Listing

| # | Name | Material | Type | Weight | Thickness | Dk | Df |
|---|---|---|---|---|---|---|---|
| | Top Overlay | | Overlay | | | | |
| | Top Solder | Solder Resist | Solder Mask | | 0.4mil | 3.5 | |
| 1 | Top Layer | | Signal | 1oz | 1.4mil | | |
| | Dielectric1 | FR-4 | Core | | 6.8mil | 4.8 | |
| 2 | Layer 2 | | Signal | 1/2oz | 0.7mil | | |
| | Dielectric2 | FR-4 | Prepreg | | 7mil | 4.8 | |
| 3 | Layer 3 | | Signal | 1/2oz | 0.7mil | | |
| | Dielectric3 | FR-4 | Core | | 6mil | 4.8 | |
| 4 | Layer 4 | | Signal | 1/2oz | 0.7mil | | |
| | Dielectric4 | FR-4 | Prepreg | | 7mil | 4.8 | |
| 5 | Layer 5 | | Signal | 1/2oz | 0.7mil | | |
| | Dielectric5 | FR-4 | Core | | 6.8mil | 4.8 | |

Dipole antenna



Layout in COMSOL



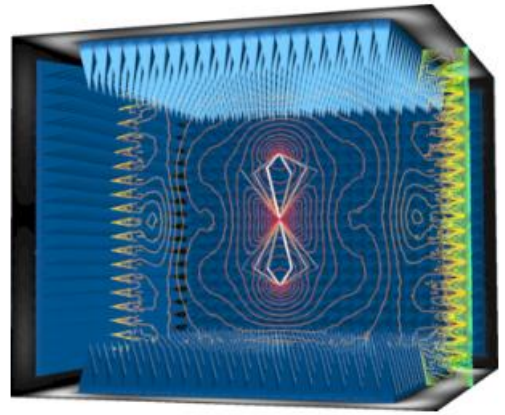
Equations

$$f_{nml} = \frac{c}{2\pi\sqrt{\varepsilon_r \mu_r}}\sqrt{\left(\frac{m\pi}{a}\right)^2 + \left(\frac{n\pi}{b}\right)^2 + \left(\frac{l\pi}{d}\right)^2}$$

# Physics Set-up

For power nets (1.8V, 1.2V, 2.8V), the S-parameter is calculated based on the simulation over the range of frequency from 2GHz to 6GHz.
As CISPR 25 is for frequency will be 30MHz to 5GHz for emission and radiation.

Anechoic Chamber set up



Physics Setting

Input Configuration

| Property | Variable | Value | Unit | Property group |
|---|---|---|---|---|
| Relative permittivity | epsilonr_iso ; epsilonrii = epsilonr_iso, epsilonrij = 0 | 12 | I | Basic |
| Relative permeability | mur_iso ; murii = mur_iso, murij = 0 | 1 | I | Basic |
| Electrical conductivity | sigma_iso ; sigmaii = sigma_iso, sigmaij = 0 | 0 | S/m | Basic |

TABLE I: PHYSICS FEATURE LIST

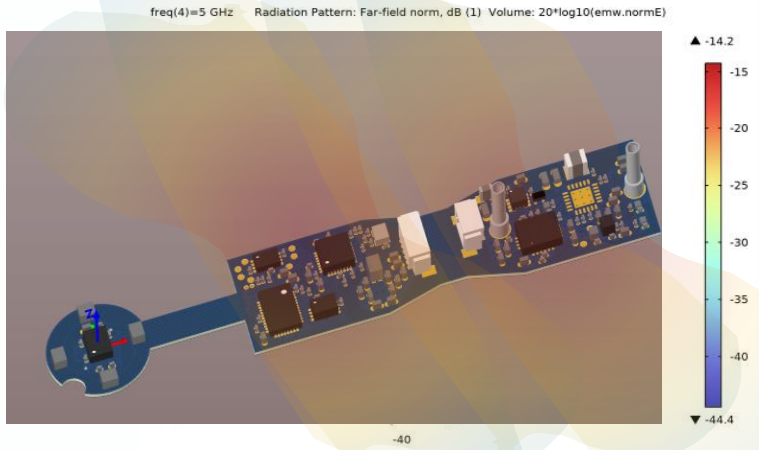
| FEATURES | PURPOSE | STUDY I | STU |
|---|---|---|---|
| Lumped Port I | Microstrip line excitation | | Dis |
| I Port 2 | Dipole antenna excitation | Disabled | |
| I Element I | 50 Ω via termination | | |
| I Element 2 | 50 Ω via termination | | |
| on Boundary Condition I | Lossy copper surfaces | | |
| Electric Conductor 2 | Printed dipole strip, lossless | Disabled | |
| Electric Conductor 3 | Metalized vias, lossless | | |
| Electric Conductor 4 | Jumpers, lossless | | |
| Electric Conductor 5 | Shielded interior walls, lossless | | |
| ng Boundary Condition I | Absorbing boundaries | | |
| d Domain I and Far-Field tion I | Near-field to far-field transformation | | Disabled |

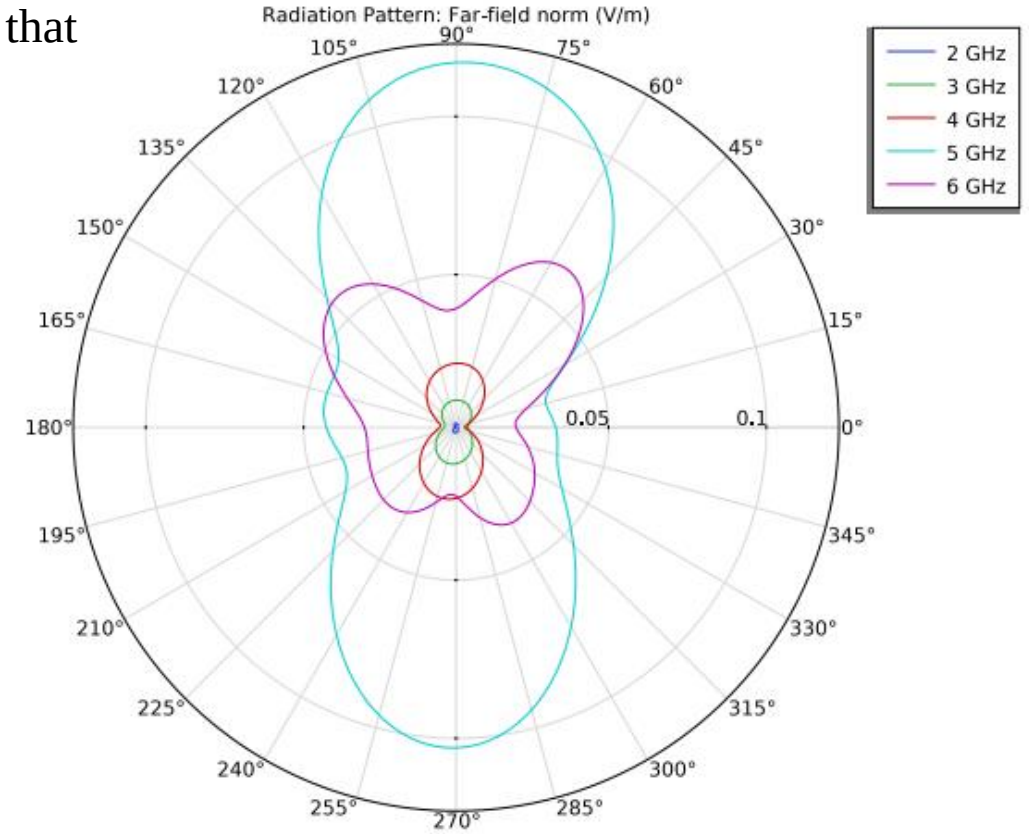
Start Simulation

# Result – Radiated Emission

Radiated emission pattern for far field analysis shows that at right angle to board shows low (0.14 V/m) value. This concluded that the emission is low in the far field.

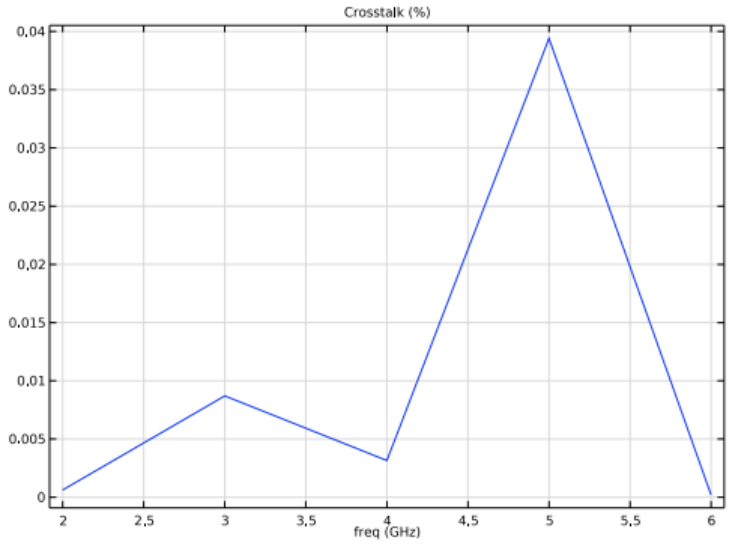
**Distance:** in all Direction. Far field

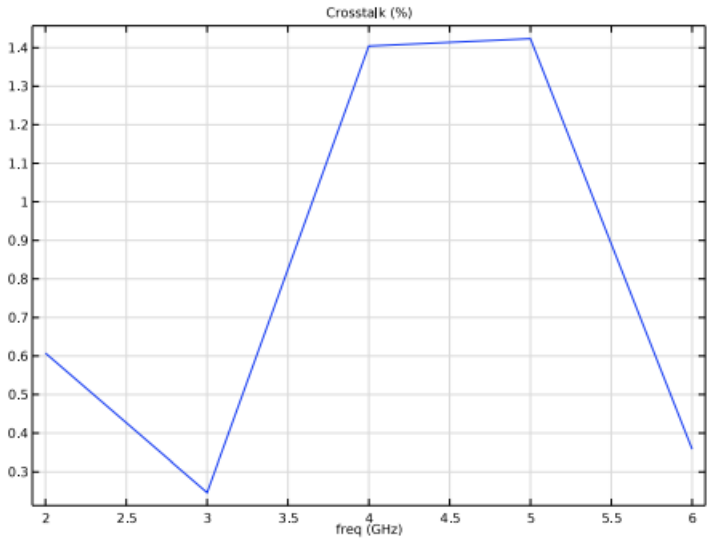


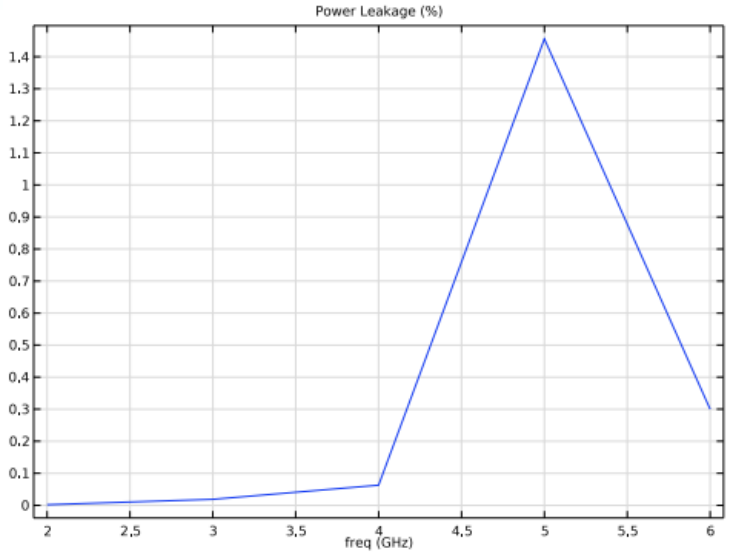



# Result - Immunity

Based on the results, it is observed that the strongest coupled field, crosstalk, and radiation happen around 5GHz even when the printed dipole antenna is supposed to be better for the Wi-Fi frequency. But this is not high as per CISPER 25 condition.




*Crosstalk ratio, the coupled power (adjacent line) to the input power (signal path).*

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# Customer Testimonial

Excited to present a testimonial from a content client, emphasizing the success and positive impact of our EMI & EMC Analysis.

*We are thrilled with the results of our recent EMI & EMC simulation project. The team delivered exceptional performance, achieving accurate and reliable simulation results at a remarkably low cost. Despite the complexity of the task, they completed the project within a tight timeframe without compromising on quality. Their expertise and efficiency have significantly contributed to our product's compliance with regulatory standard (CISPR-25), all while staying well within budget. We highly recommend them for their dedication to excellence and cost-effective solutions.*

# Conclusion

Our commitment to excellence and technical expertise was evident in the successful delivery of tailored EMI/EMC handling solutions that met the CISPR 25 requirements.

We simulate the PCB with real time simulation to verify the circuit will pass the CISPR 25 EMI & EMC test, that reduce the product testing cost.

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