

Mitsubishi and Cadence

Mitsubishi Electric Corporation Addresses EMC of DIATONE System Using AWR Design Environment Platform

Company Profile

The Mitsubishi Electric Group operates on the corporate principle of contributing to creating a vibrant and affluent society by enhancing its technologies, services, and creative powers as a leader in the manufacture and sales of electric and electronic equipment used in energy and electric systems, industrial automation, information and communication systems, electronic devices, and home appliances.

The Design Challenge

Mitsubishi Electric Corporation brings fun and comfort to the in-car environment with car navigation systems that display easy-to-read maps with simple operations, car audio systems that produce high-quality sound, and infotainment systems that provide a host of useful information. These systems, marketed under the DIATONE brand name, require the highest sound quality, which can be compromised through electromagnetic interference (EMI) among these electronic systems. Therefore, electromagnetic compatibility (EMC) analysis is extremely important. In the past, the design team performed manual EMC analysis, which took a long time and required repeated empirical prototyping in order to obtain acceptable quality. This approach led to design uncertainty, cost overruns, and product release date delays.

Application

- ▶ Mitsubishi DIATONE Automotive Navigation/Audio System

Software

- ▶ Cadence® AWR Design Environment® Platform, including:
 - Cadence Microwave Office® software
 - Cadence AXIEM® 3D Planar analysis

Results

- ▶ Reduced cost
- ▶ Save design time
- ▶ Strong customer support

The Solution

Mitsubishi chose Cadence's AWR Design Environment platform, specifically Microwave Office circuit design software and AXIEM EM analysis software, to perform rigorous analysis of the audio electronics of the navigation system's circuit board design. The new EMC solution addressed the following areas: specification of the radiated noise through noise measurements obtained from a specially developed automatic measurement system,

analysis of the transmission path and all of the system's EM radiation noise using Microwave Office software and AXIEM analysis, and the design of countermeasures to reduce EM radiation and susceptibility. The new methodology decreased overall analysis times by a factor of 10, which reduced design costs by more than 50%.

An EMC automatic measurement system (Figure 1) was developed to measure EMI and electromagnetic sensitivity (EMS). Typically, an anechoic chamber—a non-reflective, echo-free chamber that completely absorbs reflections of either sound or EM waves—would be used for this type of analysis. However, the existing Mitsubishi anechoic chamber has limited availability, so the designer developed the EMC automatic measurement system and simulation

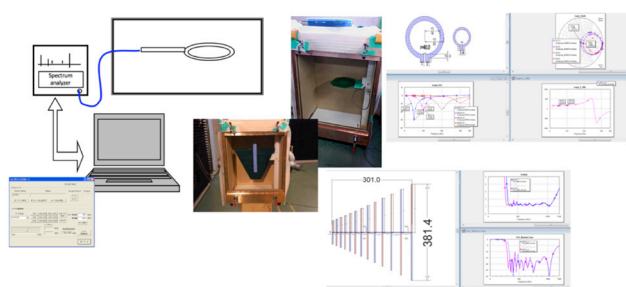


Figure 1: EMC measurement system with antenna probes designed using AXIEM analysis

approach as an alternative.

The new measurement system was composed of a shield box, two types of antenna probes (a log-periodic HUF band antenna and a FM/VHF band loop antenna, both designed using AXIEM EM simulation software), a spectrum analyzer, and a notebook PC. The shield box was made of wood with EM absorber material inserted along the inner walls. A spectrum analyzer was programmed by the designer to automatically control the entire process, including measurement, data processing, and generation of graphics.

The designer analyzed the transmission path and the section of the PCB responsible for EM radiation with AXIEM

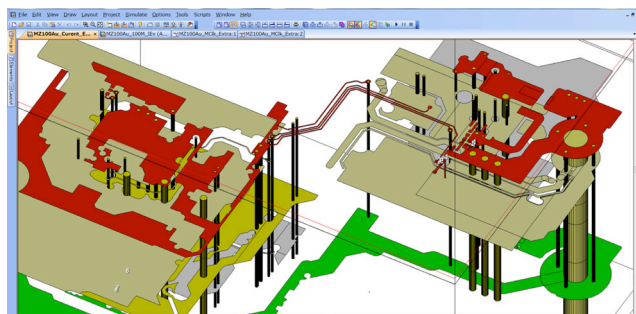


Figure 2: AXIEM model of power control, main board, and interconnecting transmission lines for EMC analysis

analysis and Microwave Office software (Figure 2). The source of noise radiation that had typically been analyzed manually was more easily analyzed over a virtually unlimited number of trials through parametric simulation studies.

The designer replicated the measured noise radiating from the board using several different simulation methods, recreating the noise issue within the AWR Design Environment platform based on measured noise data from the test setup. Microwave Office software and AXIEM analysis show the currents and radiating fields throughout the EM structure populated with the circuit components within the EM structure. This feature allowed the designer to visually identify the probable source of the noise within the EM model through field hotspots. With this information, layout modifications could be made directly to these trouble regions on the PCB, enabling a more efficient means for addressing problematic design features. As a result, design respins were reduced significantly, enabling the final product design to be completed much more quickly while at the same time cutting design costs by half.



Thanks to the Cadence AWR Design Environment platform's ability to perform circuit simulation and EM analysis in one environment and to easily modify the circuit layout to identify the source of the noise, we were able to quickly improve the sound quality of our automotive navigation system while at the same time reducing development costs by 50%

Hajime Koyama, Manager,
Design-C Section, Car Multimedia
Manufacturing-B Dept

Why AWR Design Environment Platform

Mitsubishi chose Cadence's AWR Design Environment platform because of its integration of high-frequency circuit and EM simulation technologies, advanced design automation, and readily available support. One of the most important features of the software for this application was its ability to link the circuit simulation with EM analysis in a single cohesive and seamless environment (Figure 3). Thanks to the use of the AWR Design Environment platform, the designer was able to automate many manual tasks, enabling him to meet the goals of the project, which were to reduce the cost of improving sound quality in Mitsubishi automobile sound systems while at the same time reducing development time and product release date delays.

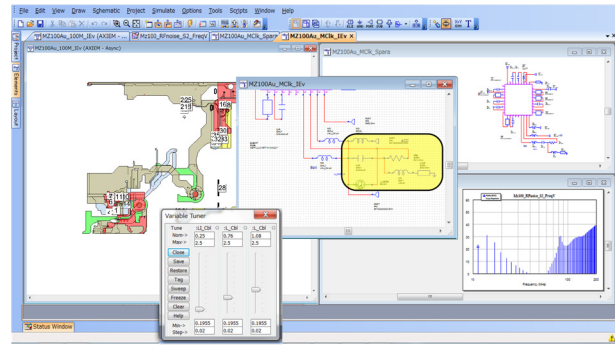


Figure 3: AWR Design Environment platform for EMC analysis with integrated circuit/EM co-simulation

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