Simulation Analysis of Electromagnetic Compatibility (EMC) of Enclosures

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Abstract

High switching frequencies in modern power supplies demand special attention with regard to the shielding of enclosures. From the early development stage on it is important to analyze radiated emissions in order to fulfil standards. It is necessary to consider openings like for fans, displays, cable connections, slots, grids and many more.

Simulation analysis of the enclosure requires to solve the full wave Maxwell equations. Simulation was done in the frequency domain.

$\nabla\times(\mu_r^{-1}\ \nabla\times E)-k_0^2\ (\epsilon_r-j\sigma/(\omega\epsilon_0))E=0$
$SE=20\ \log|E_1/E_2|$

The focus is on shielding effectiveness (SE, E1 without, E2 with shielding) of panels with different types of openings. One circular opening was selected, put in a simulation environment with a TEM wave excitation directed towards the panel.

Simulated fields have been virtually measured in a test chamber behind the circular hole of the plate (PEC). PML layers were used to model open boundaries. The field damping was compared to analytical calculations and results available from the literature. Figure 2 shows the shielding effectiveness of a circular opening for different frequencies calculated from analytic formula and FEM simulations. In the FEM simulation the influence of the panel thickness d can be seen.

Good agreement of simulations and analytic results could be achieved. For direct comparison of measurement and simulation the whole measurement setup has to be taken into account. Special care has to be taken on boundary conditions.

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Figures used in the abstract

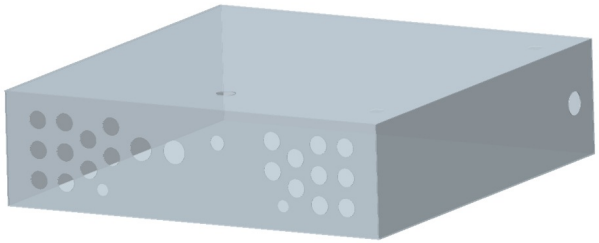

Figure 1: Typical Enclosure Concept with openings.

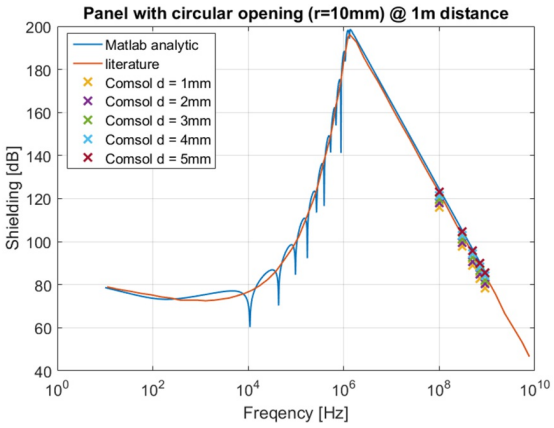

Figure 2: Results for variable panel thickness d.