MODELING AND CHARACTERIZATION OF EMC BEHAVIOR OF FLASH MEMORY DEVICES

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Smaller size, lower power supply voltages, and higher operating frequencies enhance the performance of devices but increase electromagnetic compatibility (EMC) issues [1]. As for the radiated emissions problem, the device is usually regarded as the source of transient currents. Radiated fields are usually assumed to be generated by the flow of such currents in PCB traces and connecting cables. Recently, more attention has been given to emissions coming directly from the device itself (from microcontrollers [2] and Flash memory devices [3]). EMC analysis of ICs is usually carried out by means of experimental characterization and numerical simulation [2-4].

This paper deals with the modeling and experimental characterization of a Flash memory device in a PQFP80 package. This activity was carried out in the frame of a collaboration between the Cassino Unit and Micron Semiconductors, Catania and Napoli sites. This system was mounted on a specially-designed test-board for experimental characterization. More details may be found in [5]-[6].

Figure 1 shows the ICEM model used to describe the system [7]. This model is divided into two subparts: the first describes the internal activity (switching) and the second takes into account the passive structures (package, power distribution network (PDN), and decoupling capacitors). The test board was modeled by means of a distributed circuit model in terms of S-parameters. The currents provided by the circuit model were used as known terms for the far-field emitted field, which was derived from a superposition of the fields emitted by each elementary current loop in the package.

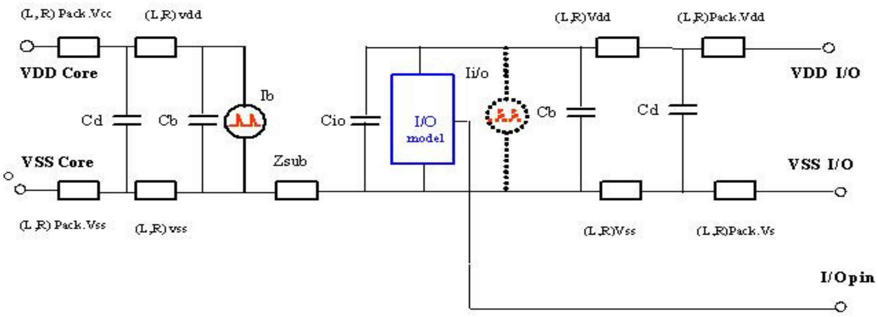

Figure 1. ICEM model of the Flash memory and package

The experimental characterization was finalized to measure some of the currents and the emitted field. The measured currents refer to pins of type DQ, VDD, and VSS. Radiated emissions were measured in a shielded, semi-anechoic chamber in the frequency range of 30 MHz to 1 GHz.

Peak-to-peak values, periods, and rise times for VDQ and VDDQ currents were in excellent agreement between simulated and measured currents. For example, Figure 2 shows the time-domain waveform of VDQ current.

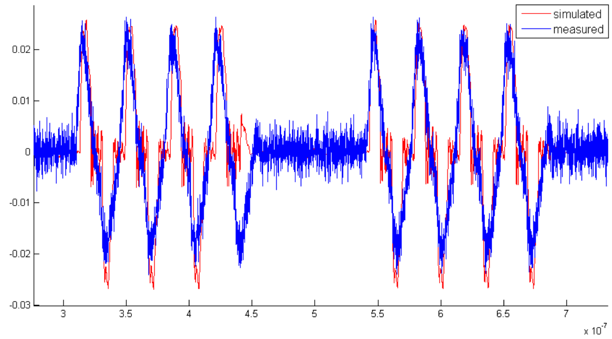

Figure 2. Time-domain waveforms of the package currents: simulations vs measurements

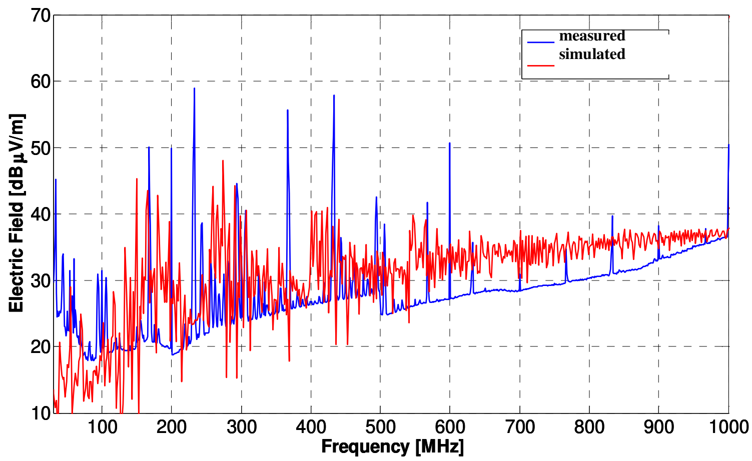

Figure 3. Far field emission from the IC: simulations vs measurements

Figure 3 shows the far-field electric field evaluated for a 110nm device. The experimental results were compared to simulated data and the agreement was satisfactory. In particular, the simulations were able to predict the average level of emissions in this range, and many emission peaks.

References

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