Characteristic Design of TEM Cell for IC Radiation Analysis

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ABSTRACT

The evolution of IC manufacturing technology and system chip design integration has changed rapidly in the recent years and the clock speed of circuit design has also entered into the Giga Hz era. These progresses had accentuated the EMC problem and IC was most certainly the main source of EMI interference from the system. In order to solve IC ’ s EMC issue effectively, IEC61967-2 TEM cell measurement method had been implemented to evaluate IC electromagnetic interference level. The same device can also be used for testing the IC electromagnetic susceptibility. This study utilized Maxwell equations, basic transmission line theory and parallel plate waveguide theory to illustrate the electromagnetic propagation mode of TEM cell, then employing electromagnetic field simulation software (CST MICROWAVES STUDIO) to simulate the structural design of TEM cell. Finally, the optimum characteristics that conform to IEC61967-2 requirement of TEM cell is designed by using the test data from simulation analysis. Furthermore, we also utilized the structure of a micro-strip to design a 50Ω linear dipole and circular loop impedance for the simulation of the radiation rule of IC common mode noise and differential mode noise. A conversion function for corresponding common mode noise and differential mode noise radiation has been deduced. In addition, by mean of changing the wiring location of the linear dipole, we can study the field uniformity in the electromagnetic susceptibility area. Finally, we performed measurement and assessed the IC electromagnetic radiated interference level based on the criterion of IEC61967-2.

Keywords : Integrated Circuit (IC), Electromagnetic Interference (EMI), Electromagnetic Susceptibility (EMS), Transverse Electromagnetic Mode Cell (TEM Cell), Characteristic Impedance

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REFERENCES

[1] IEC 61967-2,Integrated circuits-Measurement of electromagnetic emissions, 150 kHz to 1 GHz-Part 2:TEM cell and wideband TEM cell method [2] IEC 62132-2,Integrated circuits-Measurement of electromagnetic immunity,150 kHz to 1 GHz-Part 2:TEM cell and wideband TEM cell method [3] IEC 61967-1,Integrated circuits-Measurement of electromagnetic emissions, 150 kHz to 1 GHz-Part 1:General conditions and definitions [4] IEC 62132-3,Integrated circuits-Measurement of electromagnetic immunity,150 kHz to 1 GHz-Part 3:Surface scan method [5] David M. Pozar, “ Microwave Engineering ”, 2nd Edition, Chapter 3, John Wiley & Sons, 1998 [6] David K. Cheng, “ Field and Wave Electromagnetic ”, 2nd Edition, Chapter 9, Chapter 10, Addison Wesley Longman, 1998 [7] Weil, C.M.and Gruner, L. “ High-Order Mode Cutoff In Rectangular Striplines. ” Microwave Theory and Techniques ”, IEEE Transactions on Vol 32, Issue 6, Jun 1984 pp:638 – 641 [8] Beom Jun Park, Jae Cheol Ju, Hyun Young Lee, Dong Chul Park, “ Experimental Verification for Field to Transmission Line Coupling Using TEM Cell ”, Electromagnetic Compatibility, 2000. IEEE International Symposium on Vol 1, Aug. 2000 pp:213 - 217 vol.1 [9] Zhengwei Du, Jeffrey S. Fu, and Chengli Ruan, “ Exact Solution for The Characteristic Impedance of Rectangular Coaxial Cone Transmission Line ”, IEEE

Transactions on EMC, vol.39, No.3, pp.233-235, Aug. 1997.
[10]Lubineau, M.; Sicard, E.; Huet, C.; Pourtau, J.C.; Ollitrault, S.; Marot, Ch. “ Improvement of the TEM cell measurement set-up for the EMC characterization of integrated circuits ”, IERSET EMC component project, 1nd Edition, 1998 [11]Pouhe, D. “ RF radiation properties of printed-circuits boards in a GTEM cell ”, Electromagnetic Compatibility, IEEE Transactions on Vol 48, Issue 3, Aug. 2006 pp:468 - 475
[12]Fiori, F. and Musolino, F. ” Measurement of integrated circuit conducted emissions by using a transverse electromagnetic mode (TEM) cell Electromagnetic Compatibility ”, IEEE Transactions on Vol 43, Issue 4, Nov. 2001 pp:622 - 628