A Study on Integrated Active Magnetic Probes for Near-field Measurement

2008

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For the reliable chip-level electromagnetic interference (EMI) measurement, novel magnetic probes, namely "active probes", are developed based on Silicon-on-Insulator CMOS technology. Due to the CMOS circuit techniques, the active probes achieve the high sensitivity, high spatial resolution, and wide bandwidth.

On-chip differential detecting coil and wideband differential amplifiers having the high common-mode rejection characteristics enable the probe to amplify the magnetic field (m-field), and remove the electric field (e-field) at the same time.

The experimental results show that the fabricated probe discriminates the m-field effectively from the electromagnetic emissions , and gains the e-field suppression ratio of 38.0dB at 50MHz, which is by far superior to that of the conventional shielded loop coil on the same fabrication chip.

Furthermore, a 2-dimensional m-field distribution map is successfully drawn by the three aligned active probes. It should be noted that this is the first result obtained by multiple-point concurrent measurement using micron-sized probe array.

Expanding the probe bandwidth towards the gigahertz range is a next challenge. In order to avoid the unwanted parasitics effect at the high frequency, a frequency conversion technique is applied for the probe. By this method, noise spectrum is down converted to a low frequency, at which signals can be easy to deal with. Although a measurable frequency range is limited due to the operation range of an on-chip oscillator, simulation results verify that the spectrum over 1GHz is successfully identified at the translated frequency.

The developed active probes are well applicable for the modern chip-level EMI measurement.