EMCCompo 2007

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Using Electric and Magnetic "Moments" to Characterize IC Coupling to Cables and Enclosures

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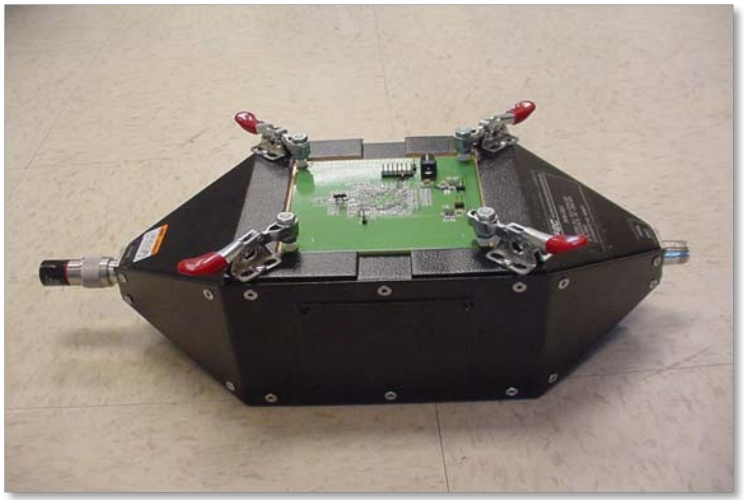
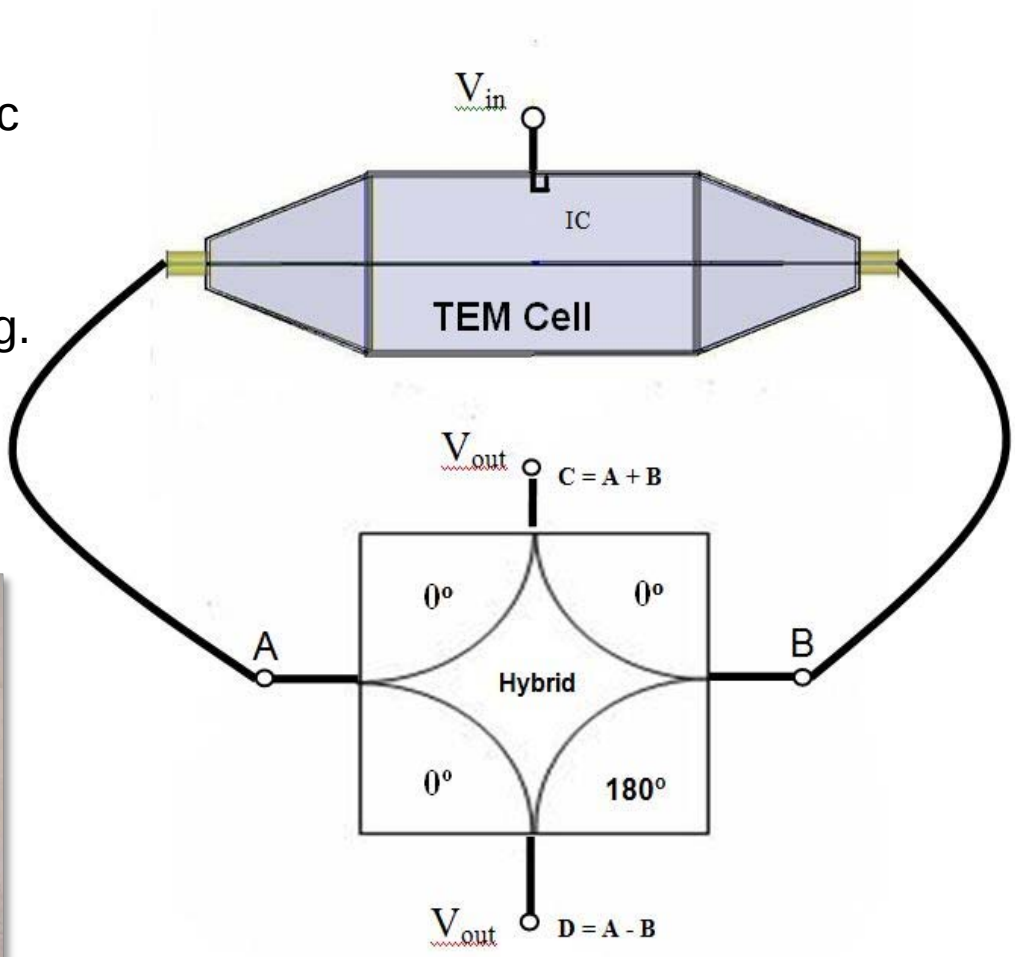
Introduction

- ICs are often the source of radiated energy, but usually not not the “antenna”.
- ICs couple to the structures that serve as antennas conducted, electric-field, or magnetic-field coupling.
- The electric and magnetic field coupling from an IC can be quantified by measurements using a TEM Cell and a hybrid coupler.
- These measurement results can be expressed as electric or magnetic moments that fully describe an ICs ability to couple to nearby objects.

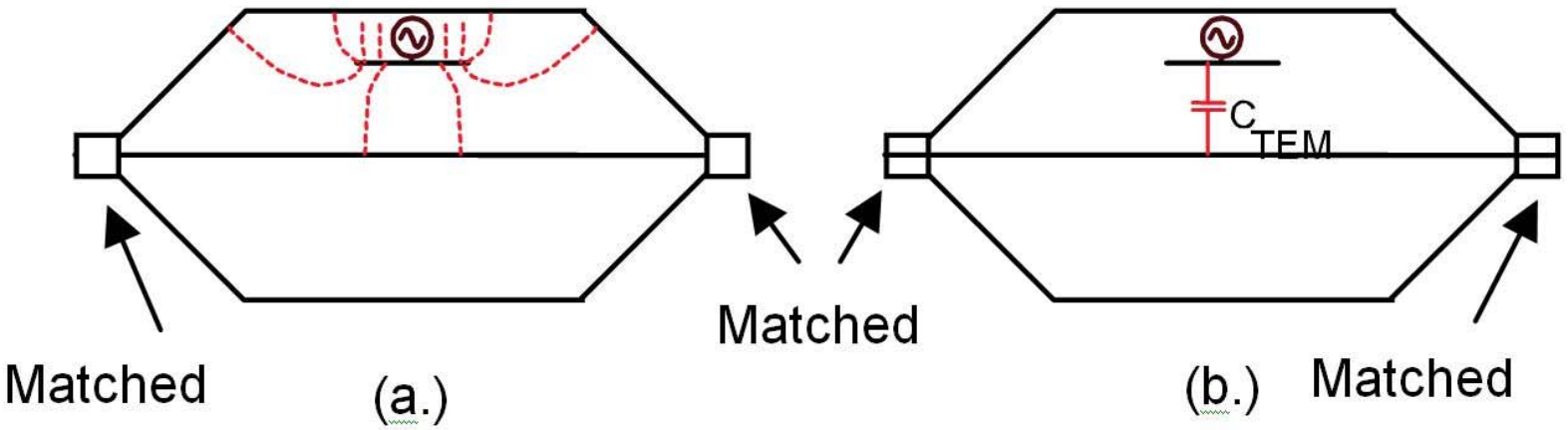
Hybrid TEM Cell Test Set-Up

- A hybrid can be used to differentiate electric and magnetic field coupling.
- The A-B output indicates the amount of magnetic field coupling.
- The A+B output indicates the amount of electric field coupling.





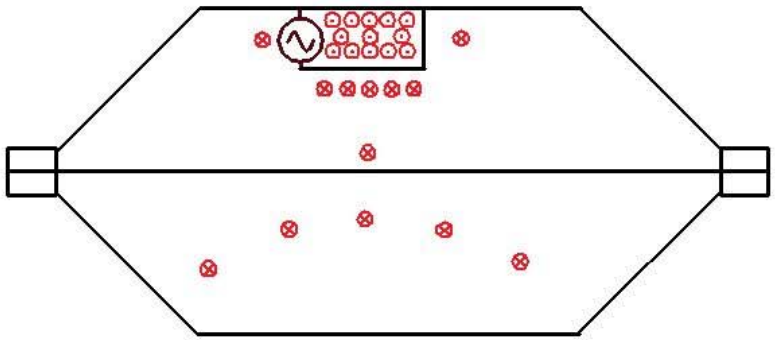
Hybrid TEM Cell Electric Field Coupling



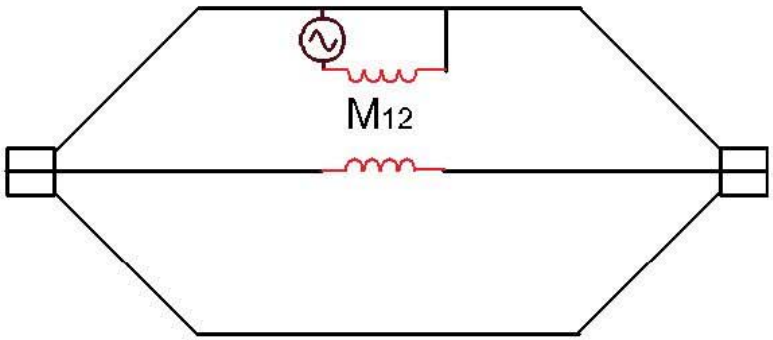
Electric Moment

$$|V_{IC}|\,\omega C_{TEM} \approx \frac{|V_{measured}|}{25}$$

Hybrid TEM Cell Magnetic Field Coupling



(a.)

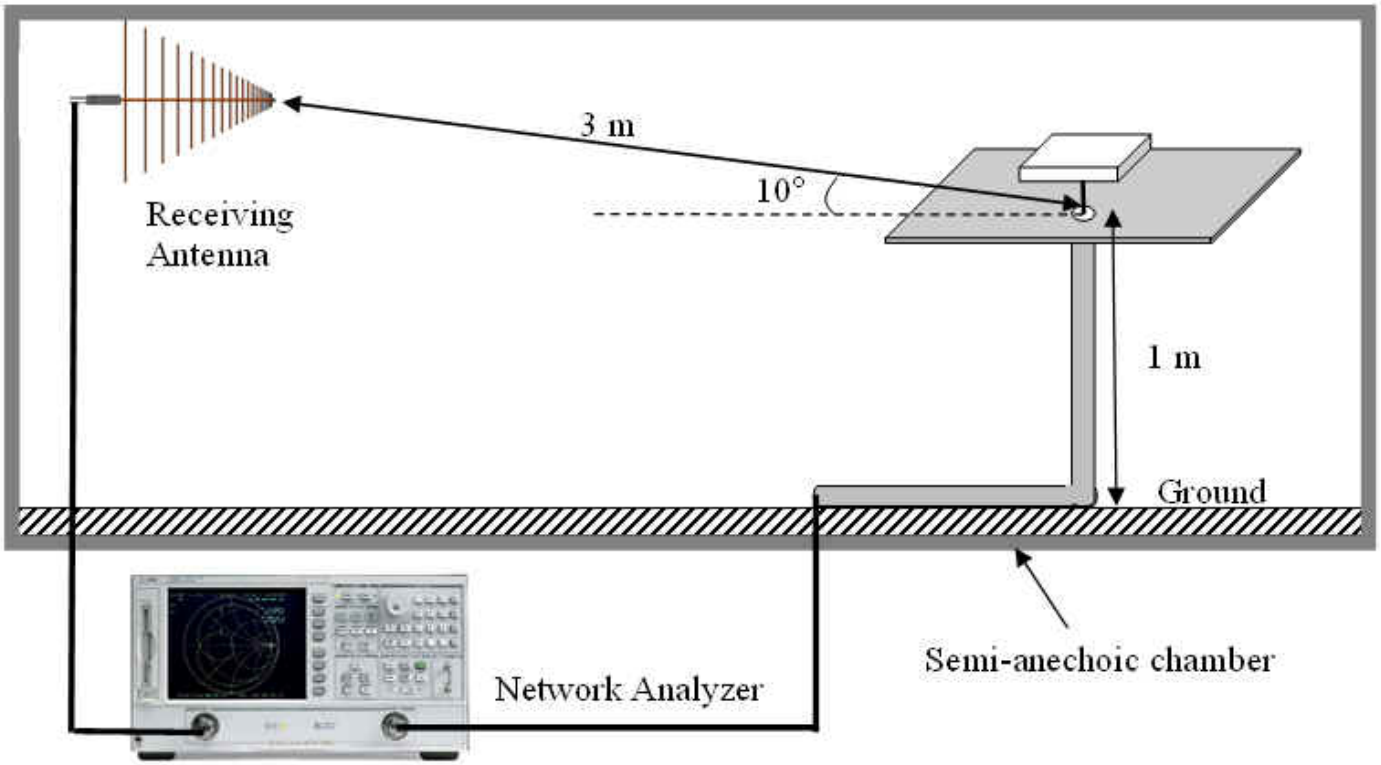


(b.)

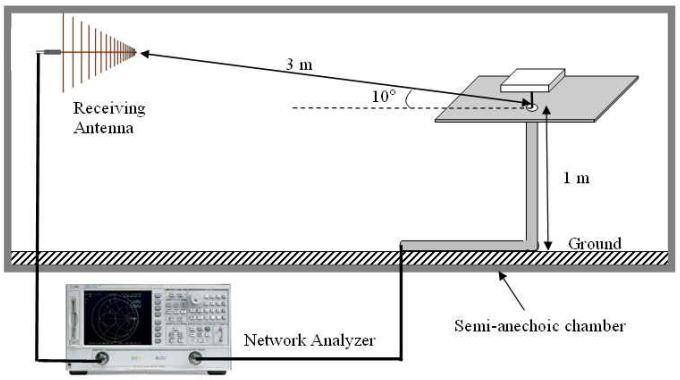
Magnetic Moment

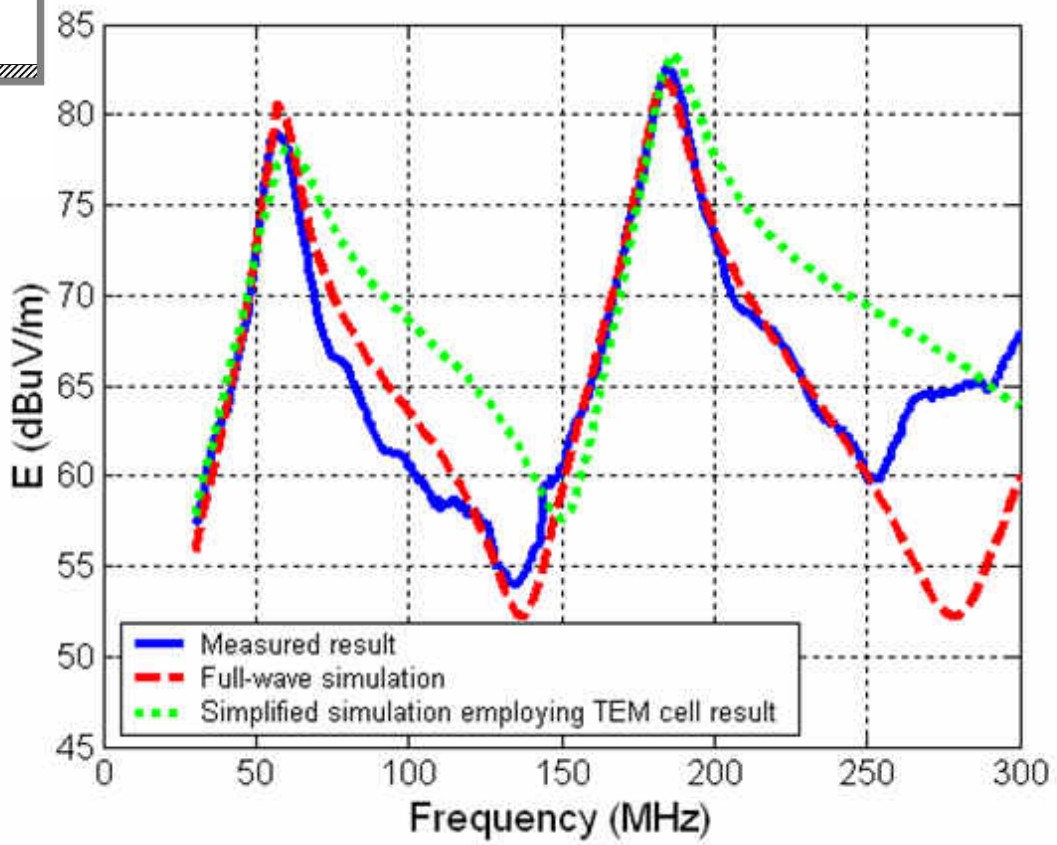
$$\left|V_{measured}\right| = \left|I_{IC}\right| \omega M_{TEM}$$

Measurement Test Set-Up

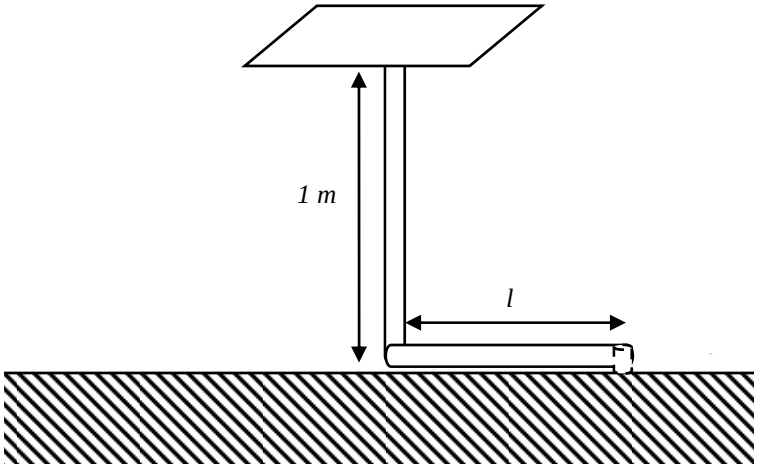


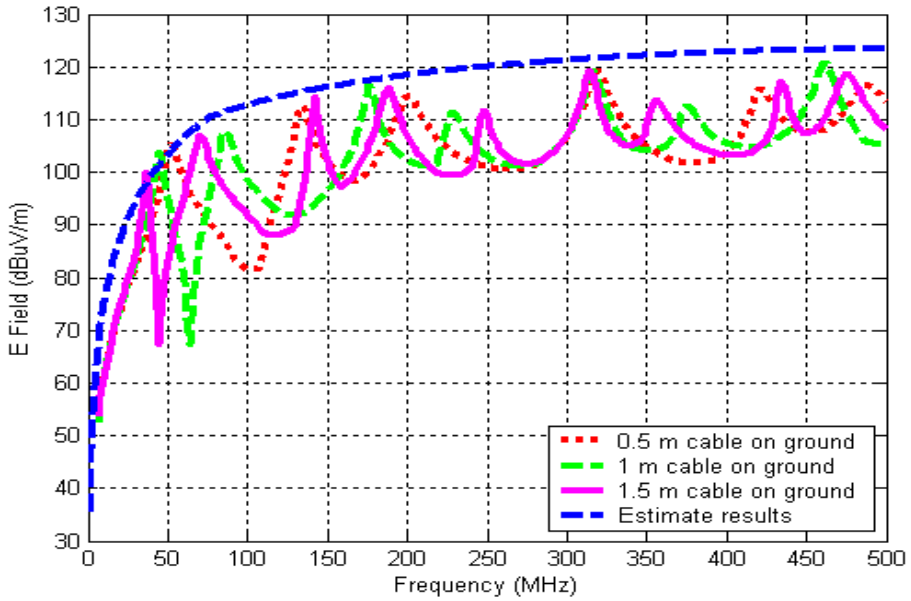
Model vs. Measurement





Maximum Emissions Estimate





Conclusions

- Measurements of an integrated circuit in a hybrid TEM cell configuration can be used to obtain values for the "electric moment" and "magnetic moment" associated with an IC as it is configured on a given circuit board.
- ICs with smaller moments are less likely to couple to other parts of a system resulting in unintentional radiated emissions.
- Electric and magnetic moments can be used in full-wave electromagnetic models of a system, replacing complex IC-package geometries with simple equivalent sources.