

Circuits and Passive Components for Radio-Frequency Power Conversion

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Abstract

The need for greater energy efficiency and improved performance of electronic devices demands power electronics with greatly increased capabilities. The physical size and cost of power electronic equipment are major limitations preventing improved energy utilization and efficiency in many applications. An important method of reducing the size (and ultimately cost) of power electronics is through increasing switching frequency. Design at radio frequencies (RF, ≥ 30 MHz) reduces energy storage requirements and permits the use of smaller passive components. However, there have traditionally been practical obstacles to the use of higher frequencies, such as low efficiency and a lack of suitable circuits and components. This talk describes new developments enabling improved power conversion at RF. A new type of matching network - termed a resistance compression network - is introduced that greatly improves the soft switching operating range of resonant RF inverters and dc-dc converters. Methods and measurements of low permeability RF magnetic materials are introduced that enable the design of improved magnetic components at RF. It is demonstrated that these techniques can enable one to achieve orders of magnitude increase in frequency over the current state-of-art while maintaining high efficiency. This research, in turn, opens up new possibilities for how power electronics can be designed and applied.

BioSketch

Mr. Yehui Han received the B.S. and M.S. degrees from Tsinghua University, Beijing, China, in 200 and 2002, respectively, and is currently a Ph.D. candidate at the Massachusetts Institute of Technology, Cambridge, MA. In 2003, he worked for DATEL, Inc. designing dc-dc converters. His primary research interests are power electronics and their applications in renewable energy and energy efficiency.

Mr. Han received MIT Landsman Fellowship in 2007, IEEE Power Electronics Society Transactions Prize Paper Award, and IEEE Power Electronics Specialists Conference Prize Paper Award, both in 2008.