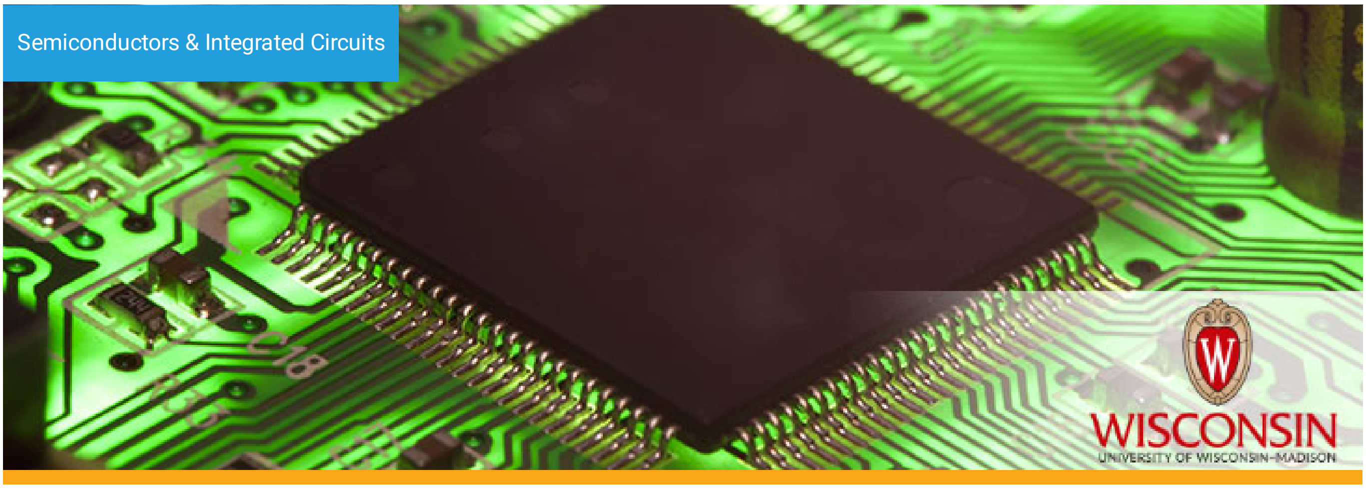

Semiconductor Interconnect Design for Small, Inexpensive, Integrated Current Sensing with Improved Reliability

View U.S. Patent No. 9,116,197 in PDF format.

WARF: P120254US01

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method for combining the design goals of integrating a current sensor into a semiconductor module while maintaining or improving interconnect reliability and electrical parasitics.

Overview

Semiconductors, which regulate power flow in many modern electronic devices, use interconnects such as bond wires or lead frames to integrate different components: chip, substrate and terminals. Interconnects are a main source of problems, responsible for up to 75 percent of all semiconductor device failures. These failures usually are the result of thermally induced mechanical fatigue. Conventional interconnect designs have focused on improving cyclic thermal strain and minimizing unwanted electrical properties, but have not focused on integrating current sensing.

Current sensing is a very useful function to integrate into semiconductor devices. However, commercially available current sensors each pose significant barriers to integrating into modules. LEM sensors, for example, are expensive, bulky and fairly low bandwidth. A more practical approach could transform how power modules and high voltage electronics are manufactured.

The Invention

UW–Madison researchers have developed a design for integrated current sensing that is comprised of semiconductor interconnects with a loop configuration, instead of a straight bar, and point magnetic field detectors specially located to detect current flowing in the interconnect from DC to high frequency (MHz). Giant magnetoresistive (GMR) detectors serve as these point-field detectors.

Applications

- Semiconductor modules – industrial motor control, hybrid or electric vehicles, power supplies and wireless power transfer
- High frequency electronics requiring current sensing
- Electronics requiring current sensing in a small area or at a low cost

Key Benefits

- GMR sensors are cheaper, more reliable, take up less space and have higher bandwidth.
- Interconnect loop shaping has many design advantages, including mechanical strain relief.

Tech Fields

- Semiconductors & Integrated Circuits : Components & materials
- Semiconductors & Integrated Circuits : Design & fabrication

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867