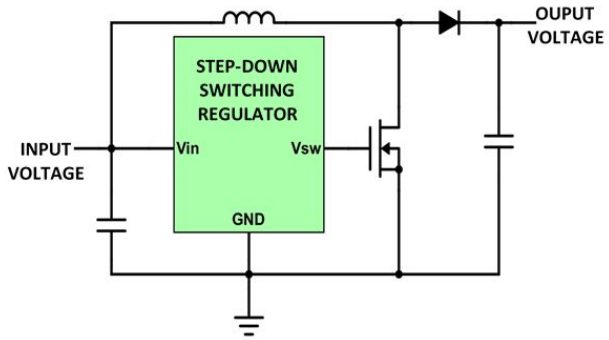
NANOSCALE-ENABLED MICROINDUCTORS

Patent Pending
SD# 14470.1
Technology Readiness Level: 2-3
Concept Demonstrated Analytically or Experimentally

Nanoscale enabled microinductors with reduced SWaP-C for broad-ranging applications in defense, transportation, and power electronics.

Scaling of magnetic passive components such as inductors and transformers has not kept pace with advances in high power semiconductor devices employing wide/ultra-wide band gap SiC, GaN, and AlN in terms of size or performance. While higher switching frequencies are enabled by these devices (100 kHz for SiC; 1 MHz or more for nitride-based devices), magnetic passive elements have not scaled accordingly due to a variety of energy loss mechanisms that increase at higher frequencies. These larger and heavier passive components limit the power density that can be achieved in power electronic systems. A new effort is needed to explore next generation mesoscale (i.e., mm size) magnetic passive components that go beyond the limits of current technology.



Simplified switched mode boost converter circuit design. The inductor stores magnetic energy with current generated from the input voltage source when the switching transistor is in the "on" state and supplies boosted power to the load when the switching transistor is in the "off" state.

Sandia researchers have created a novel inductor with significantly lower losses by using a nano-scale enabled magnetic material that is nonconducting, non-hysteretic, and has a high saturation magnetization. This new device will combine this nanocomposite material with microsystems technology, both developed at Sandia. These technologies will be combined in an advanced integration scheme to reduce the effects of these loss mechanisms while enabling performance improvements afforded by scaling to smaller dimensions. This technology is expected to achieve a minimum of 10X improvement in device performance (>1 MHz, 10 μH) or a 10X reduction in device size compared to a device made with current technology.

TECHNICAL BENEFITS

- Lower energy losses achieved using a nano-enabled magnetic core material
- 10X improvement in device performance (> 1 MHz, Q's > 100) and 10X reduction in device size compared to existing technology
- Monolithic integration possible for chip-scale power converters

INDUSTRIES & APPLICATIONS

- Automotive
- Defense/security
- Integrated microinductors / transformers for chip-scale power converters
- Microelectronics
- Stand-alone microinductors and transformers for power electronics

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