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An energy-recycling three-switch single-inductor dual-input buck/boost DC-DC converter with 93% peak conversion efficiency and 0.5mm^2 active area for light energy harvesting

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Abstract

Energy harvesting (EH) can be used in wireless sensor networks (WSNs) since the sensors can be powered by ambient energy in conjunction with rechargeable batteries to achieve near-perpetual operation [1-4]. One common solution is to harvest energy from ambient light through photovoltaic (PV) modules. In such a system, a battery supplements energy when the power provided by the environment is insufficient or when the WSN is active, and stores surplus energy for future use when the WSN is inactive. Accordingly, power management in an EH system involves a balance among the PV module, battery and load. Previous work [1] has implemented an EH system for moving vehicles and portable devices, but it is not suitable for indoor light energy harvesting. Although a single-inductor multi-input multi-output (SIMIMO) topology is one solution, the efficiencies of existing implementations [2-4] are degraded by additional conduction and switching losses due to the inductor-sharing switches in series with the inductor. In response, this paper proposes an energy-recycling strategy and implements the corresponding power converter with fewer switches.

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Dive into the research topics of 'An energy-recycling three-switch single-inductor dual-input buck/boost DC-DC converter with 93% peak conversion efficiency and 0.5mm² active area for light energy harvesting'. Together they form a unique fingerprint.

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- Energy harvesting — Chemical Compounds
- DC-DC converters — Chemical Compounds
- Recycling — Chemical Compounds
- Switches — Chemical Compounds
- Wireless sensor networks — Chemical Compounds
- Secondary batteries — Chemical Compounds
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Buck-boost DC-DC converter. Operating input voltage range from 2.0 V to 5.5 V. 2% DC feedback voltage tolerance. Synchronous rectification. Shutdown function. 1.5 MHz switching frequency. Power save mode at light load. Typical efficiency: > 94%. 2.3 A switches peak current limit at 3.3 V. Shutdown current < 1 µA. Available in DFN10 (3 x 3 mm). Read more. Read less. A buck converter (step-down converter) is a DC-to-DC power converter which steps down voltage (while stepping up current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination While [3] compares various DC-DC Converter topologies for Power Factor Correction. The basic purpose of a Power Factor Correction circuit is to make the line current follow the waveform of the line voltage so that the input to the power supply becomes purely resistive or behaves like a resistor and hence to improve the power factor. The above drawbacks of Boost Converter in Power Factor Correction circuit can be overcome by using Buck Converter with output voltage in 135 Volts range which has higher efficiency throughout the line. Also the lower input voltage to the DC-DC output stage can now be operated with lower voltage rated semiconductors, optimized loss and size of isolation transformer and better performance. 24. CHAPTER 3. The TPS6300x DC–DC converters are intended for systems powered by one-cell Li-ion or Li-polymer battery with a typical voltage between 2.3 V and 4.5 V. They can also be used in systems powered by a double or triple cell alkaline, NiCd, or NiMH battery with a typical terminal voltage between 1.8 V and. For high efficiencies, the inductor should have a low DC resistance to minimize conduction losses. Especially at high-switching frequencies, the core material has a high impact on efficiency. When using small chip inductors, the efficiency is reduced mainly due to higher inductor core losses.