Low-Loss Zero-Voltage-Transition Methods for High-Frequency Power Conversion

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Inventors

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Background

Power electronic converters (both DC-DC and DC-AC) are being developed with higher switching frequencies in order to reduce filter size, resulting higher power density, improved transient performance, and less electromagnetic interference (EMI). However, higher switching frequencies also result in proportionally higher switching losses. A solution to lower switching loss is to implement a soft switching design, but that leads to higher conduction losses and variable frequencies that require more complex transmission control, often involving multiple soft switches that contribute to a lower but still significant switching loss.

Invention Description

Researchers at ASU have developed a method for achieving zero-voltage transition using a low-loss and easy-to-implement auxiliary circuit formed by a low-voltage zero-current switch, diode, and an inductor that optimize conversion efficiencies for high switching frequencies. The auxiliary circuit reduces conduction losses by only conducting during required transition periods, and further mitigates overall losses by balancing non-equal currents, giving more flexibility in transistor design over a wider range of operating voltages. This can be applied to any power electronic converter including applications in DC-DC, DC-AC, and AC-DC power conversion. The circuit's zero-current switch ensures minimal switching loss throughout the system, reaping the full benefits of higher switching frequencies without penalty.

Intellectual Property Status:
Pending

Potential Applications

- Automotive Amplifiers
- DC-DC Power Converters
- DC-AC Power Inverters
- Integrated Circuits
- Power Supply for
  - Circuit Boards
  - Medical Devices
  - Telecommunication
- Resistors
- Voltage Regulators

Benefits and Advantages

- **Efficient** – Minimizes switching loss without sacrificing benefits from higher switching frequencies.
- **Effective** – Higher power densities, improved transient performance, and less EMI all result in less energy waste.
- **Flexible** – Design accommodates wider range of operating voltages.
- **Versatile** – Can be used in DC-DC, DC-AC, and AC-DC power conversion.

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