Soft-Switching, Solid-State Transformers and Converters (#7292)

A topology for a soft-switching solid-state transformer with the ability to realize soft switching over the entire load range

Georgia Tech inventors have developed a topology for a soft-switching solid-state transformer with the ability to realize soft switching over the entire load range, and having utility for direct current (DC), single- or multi-phase alternating current (AC) at varying frequencies and power factors. The proposed architecture achieves soft switching along with providing for low electromagnetic interference (EMI). Fault and failure modes are easily controlled and the design demonstrates relative insensitivity to key parameters, such as transformer leakage inductance. Higher power densities and longer life are also realizable using this topology. The invention opens up new ways of transformer operation and applications. The components of the design allow for features, such as unidirectional control of current flow and bidirectional blocking of voltage. It enables improved high frequency isolations that generate benefits, such as savings in weight and volume of magnetic materials that are essential in traditional transformer and converter construction. The use of large electrolytic capacitors in order to minimize ripple size of the input and output voltages are not required in this design – allowing for efficient power conversion from AC to AC or AC to DC with galvanic isolation.

Benefits/Advantages

- **Cost savings**- larger transformers are expensive to build and costly to maintain
- **Space savings**- simple, symmetrical architecture with minimal device and component count
- **Higher reliability-** less power losses
- **Performance improvements**- improved voltage and power balance

Potential Commercial Applications

- Small sized transformers:
    - Electronic devices
- Large sized transformers:
    - Homes
    - Factories

Background/Context for This Invention

There is a growing movement in the electrical power industry to replace traditional power components with solid state devices, such as semiconductors and other parts mounted on circuit boards. These technologies can offer a combination of improved performance, lower costs and higher reliability. One of the issues that requires consideration in order to make this change is handling the high voltages and currents that are involved when equipment like traditional power transformers are replaced with solid state semiconductor based electronic systems.

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Publications

For more information about this technology, please visit:
https://licensing.research.gatech.edu/technology/soft-switching-solid-state-transformers-and-converters