



Compact Power Transformer Design is More Efficient and Less Complex

Power Transformer Design Improves Efficiency

Technology No. z09057

IP Status: Issued US Patent; **Application #:** 12/834,437

Smaller Power Transformer with Higher Efficiency and Less Complexity

A power transformer design reduces the size and complexity while improving the efficiency by using only two semiconductor switches and not requiring a capacitor. Traditionally, power transformers are large and heavy due to the massive amounts of steel and copper windings contained inside of them. Due to operation at low-frequencies, the transformers are massive in size. Today's high-frequency transformers are smaller than the low-frequency transformers, but require multiple semiconductor switches and are less efficient. Through the complex switching, the transformer can input an AC input waveform and output an AC waveform.

Compact Power Transformers Useful When Space is Scarce

Researchers at the University of Minnesota have developed a high-frequency transformer topology with a dramatic reduction in the number of semiconductor switches that enable much simpler operation and greater reliability for high-frequency transformers. The high-frequency transformer can be implemented with only two semiconductor switches with a simpler on/off operation, which improves reliability. The conversion from AC to AC is direct, so there is no DC-conversion step, which eliminates the need for a capacitor and reduces overall weight and increases efficiency. The smaller size makes the power generator useful for wind turbines, power electronics or anywhere where transformer storage space is scarce, such as naval vessels and aircraft. Additionally, the transformer can be integrated into plug-in hybrid electric vehicles (PHEV) as a bi-directional interface for vehicle-to-grid (V2G) applications, which would allow the power grid to use PHEVs as distributed energy storage for a smart grid.

FEATURES AND BENEFITS OF THE COMPACT POWER TRANSFORMER DESIGN:

- A hundred-fold smaller and lighter than the current power transformers, e.g. a reduction from 35 tons to 450 lbs. in some applications
- Reduces the number of switches ten-fold which reduces complexity and reliability issues
- Efficiency only slightly lower than the current, large low-frequency transformer
- No intermediate DC-conversion step, therefore no bulky capacitor is used
- Applications in wind energy, power electronics, hybrid electric vehicles

Researchers: Ned Mohan, PhD Department of Electrical and Computer Engineering, College of Science and Engineering

<https://license.umn.edu/product/compact-power-transformer-design-is-more-efficient-and-less-complex>