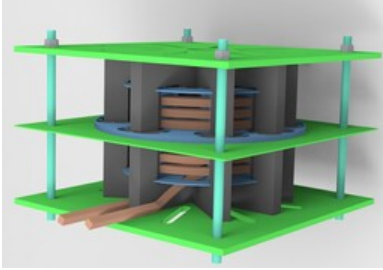


High Frequency Medium Voltage Transformer

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Electrical & Computer Engineering

Abstract

Transformers convert a high voltage from the grid to a more useful level. USU researchers have developed a high frequency, medium voltage transformer design that confines areas of high electric field stress to small areas that are easily encapsulated with an insulating potting material. Constructing the transformer using insulating barriers and potting materials provides efficient transference of power at high frequencies while addressing challenges associated with high input voltages in solid-state transformers. This technology enables the transformer to be smaller and more efficient without sacrificing performance.

Problem

Traditional transformers often have complex potting processes, extra materials which add size and weight, deficient magnetizing inductances, and high parasitic capacitances that can reduce the efficiency of power converters that use the transform

Solution

USU researchers have developed a high frequency, medium voltage transformer using insulating barriers, a potting compound for better insulation, and reorganization of the transformer core.

Value Proposition

This design provides increased efficiency by reducing size and weight, lowering parasitic capacitances, simplifying processes, and minimizing volume in transformers without sacrificing performance.

Benefit

The High Frequency Medium Voltage Transformer is intended to be used in high-efficiency resonant power converters that use zero-volt switching. Oil is often used to provide insulation for high-voltage transformers, but additional auxiliary equipment is required. The High Frequency Medium Voltage Transformer core and windings are designed to be efficiently air cooled so that the transformer is not required to be immersed in oil. The transformer design uses a central insulating disc that minimizes the locations where potting is required, which further increases the effectiveness of air cooling. The minimal required potting also reduces the weight and bulk of the transformer. It allows for a higher power density and increased efficiency. It lowers the parasitic capacitance which makes it easier to design a converter that complies with electromagnetic interference regulation and provide sufficient magnetizing inductances for transferring power at medium frequencies, especially in solid-state transformer applications.

Market Application

This technology will be of interest to the electric vehicle and electrical equipment manufacturing markets.

Inventors

Bryce Hesterman, M.A.

USU College of Engineering,
ASPIRE Engineering Research Center

Dorai Babu Yelaverthi, Ph.D.

USU College of Engineering

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Publications

- D. B. Yelaverthi, B. Hesterman, M. Mansour and R. Zane, "CLLLC Dual Active Bridge with Novel Insulation Approach for SST Applications," 2021 IEEE Applied Power Electronics Conference and Exposition (APEC), Phoenix, AZ, USA, 2021, pp. 1651-1658, doi: 10.1109/APEC42165.2021.9487105.
- Yelaverthi, Dorai Babu, "Three-Phase Unfolding Based Soft DC-Link Converter Topologies for AC to DC Applications" (2021). *All Graduate Theses and Dissertations, Spring 1920 to Summer 2023*. 8015. <https://digitalcommons.usu.edu/etd/8015>

Intellectual Property

Pending U.S. Non-Provisional Patent Application

No. 18/097,183, "High Frequency Medium Voltage Transformer with Central Insulating Divider," Filed January 13, 2023, Published July 20, 2023 as US20230230762A1 (Priority Date January 14, 2022)