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Capacitorless Three-Phase Solid-State Power Filter (SSPF) for DC-AC Inverter Applications

Capacitorless transformer-based active filter cleans three-phase inverter output, boosting reliability and ~98.8% efficiency.

Converters are the main source of failure in power electronics systems. Engineers have investigated failure mechanisms and predicted the reliability of various power electronics converters as failure of these components will lead to system-level damage if not understood well. Capacitors are essential in almost all power electronics converters, with studies showing that the primary aging factor is due to electrochemical corrosion. Current research focuses on enhancing performance, but this comes at the cost of increased complexity and decreased efficiency of the system. Converters also require the use of filtering methods for full capabilities, and the most common combination are active output filters (AOF) with offline converters.

To address these concerns, researchers at Purdue University have designed a new active output power filter topology in which capacitors are replaced with transformers. This is known as a capacitorless active output power filter (CLAOF) topology for three-phase DC-AC inverters, and the design eliminates traditional LC filters and DC-link capacitors by using three single-phase transformers for harmonic cancellation. This technology can be used in power electronics converters for use in a variety of power electronics systems in industry.

Technology Validation:

Experimental and simulation results validate ability of three-phase inverter circuit 100 to maintain low total harmonic distortion and achieve peak efficiency of 98.8%

Advantages

-Reduced component count simplifies system architecture

-Improves reliability of power electronic converters

Technology ID
2025-KANA-71167

Category
Aerospace & Defense/Hypersonics & Propulsion Systems
Energy & Power Systems/Grid Modernization & Smart Grids
Automotive & Mobility Tech/Micromobility & Smart Urban Infrastructure

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-More compact and efficient system

Applications

-Power electronics converters for use in automotive, aerospace, industrial, energy sectors

-Aerospace power systems

-Standalone power supplies

-Automotive traction inverters

-Industrial motor drives

-Renewable energy converters

Related Publications (if none, delete this section)

H. Kanakri and E. C. Dos Santos, "Capacitorless Solid-State Power Filter for Single-Phase DC-AC Converters," inâ€¯CES Transactions on Electrical Machines and Systems, vol. 8, no. 3, pp. 367-377, September 2024, doi: 10.30941/CESTEMS.2024.00033.

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