# ACTIVE INDUCTOR BASED ON A PIEZOELECTRIC RESONATOR

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## INVENTORS

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## OTHER INFORMATION

**CATEGORIZED AS**

» **Computer**

» Hardware

» Other

» **Energy**

» Other

» Storage/Battery

» Transmission

» **Engineering**

» Engineering

» Other

**RELATED CASES**

2024-142-0

## PATENT STATUS

Patent Pending

## BRIEF DESCRIPTION

Miniaturization and performance of power electronics is fundamentally limited by magnetic components, whose power densities inherently reduce at small scales. Piezoelectric resonators (PRs), which store energy in the mechanical compliance and inertia of a piezoelectric material, offer various advantages for power conversion including high quality factors, planar form factors, opportunity for batch fabrication, and potential for integration. Contrary to magnetic components, PRs have increased power handling densities at small scales. Noteworthy advancements have been made in magnetic-less, PR-based power converter designs, demonstrating significant achievements in both power density (up to 5.7 $kW/cm^3$) and efficiency (up to >99%). However, while PRs are promising alternative passive components, they cannot be used as drag-and-drop replacements for magnetics; achieving high performance in a PR-based converter requires complicated control of multi-stage switching sequences. A need exists for more practical ways to leverage piezoelectrics in power conversion without such added complexity.

To address this challenge, UC Berkeley researchers have developed a piezoelectric component that may be leveraged to directly emulate the dynamics of a magnetic component. The “active inductor” can serve as a drag-and-drop replacement for bulky magnetic inductors in power converters. Power density and efficiency of underlying piezoelectrics are preserved while the design complexity associated with piezoelectric-based power converters is simplified. Detailed models and control strategies for the piezoelectric-based active inductors have been developed and usage demonstrated in a classic buck converter. The active inductor is further validated with closed-loop simulation results and open-loop experimental results, confirming its inductor-like behavior.

## SUGGESTED USES

Power density and efficiency of underlying piezoelectrics with a simplified converter design

## ADVANTAGES

Miniaturization of power electronics, e.g., drag-and-drop replacement of bulky magnetic inductors in power conversion

## RELATED MATERIALS

» T. J. Skinner, M. Touhami and J. D. Boles, "A Piezoelectric-Resonator-Based “Active Inductor”," 2024 IEEE Workshop on Control and Modeling for Power Electronics (COMPEL), Lahore, Pakistan, 2024, pp. 1-8.

## ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Piezoelectric Transformers For Power Conversion
- Overtone Piezoelectric Resonator For Power Conversion

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