

# Unfolder-Based Single-Stage AC-AC Conversion System for Wireless Charging Applications

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Electrical & Computer Engineering

### Abstract

Researchers at USU have developed a method to convert between AC current frequencies in a single stage, a method that has proven more effective than previous common two-stage approaches, simplifying grid-side requirements and lowering harmonic distortion.

### Problem

Conventional AC-AC converters utilize an ineffective two-stage approach, leading to bulky components and high harmonic distortion values, meaning that power output is less efficient.

### Solution

USU researchers have developed a method to convert AC-AC between frequencies using a single-stage approach. Without extra steps, harmonic distortion is kept below 5% and converters are less expensive and smaller.

### Value Proposition

This invention has the potential to give way to more efficient wireless chargers for electric vehicles that can be used on the fly, paving the way for electrified roadways and a more sustainable future in transportation.

### Benefit

Conventional AC-AC conversion systems often use a two-stage approach. This has drawbacks, including bulky components and a lower power density due to the higher grid-side filtering requirements. These two-stage converters also cause high total harmonic distortion (THD), or misaligned electrical frequencies that decrease efficacy of output.

This single-stage AC-AC converter system combines the functionalities of the two-stage approach into a single stage. It has a lower grid-side filtering requirement compared to the conventional two-stage systems and therefore has a higher power density. This AC-AC single-stage conversion system produces power with a distortion value below 5%, which is lower than any currently known AC-AC converter.

This invention has the potential to give way to more efficient wireless chargers for electric vehicles that can be used on the fly, paving the way for electrified roadways and a more sustainable future in transportation. This technology is smaller, simpler, less expensive, and provides an easier approach for quick charging.

### Market Application

The uses of this technology can be applied across several domains, reaching not only electric vehicles but anything with a large battery. Potential market sectors include Electric vehicles, ATVs, RVs, and electric tractors and construction equipment.

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### Publications

- “Unfolder-Based Single-Stage AC-AC Conversion System for Wireless Charging Applications” IEEE  
<https://ieeexplore.ieee.org/document/9235936>

### Intellectual Property

U.S. Patent No. 11,646,671 issued May 9, 2023 entitled “Unfolder-Based Single-Stage AC-AC Conversion System”

U.S. Patent No. 11,736,031 issued August 22, 2023 entitled “Unfolder-Based Single-Stage AC-AC Conversion System for Wireless Charging Applications”