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Soft-Switching, High-Performance Single-Phase AC-DC Converter

Invention Description

Researchers at Arizona State University have developed a new circuit topology for single-stage, single-phase AC-DC power conversion with power factor correction (PFC) and galvanic isolation with a high frequency transformer. The invention improves the power conversion efficiency and power density of the converter—two of the most important metrics for a power converter. Soft switching is achieved for all high-frequency switches in the circuit leading to the projected high efficiency and lower electromagnetic interference (EMI). A wide range of variation in input and output voltages (step-up and step-down capability with duty ratio control) are supported, making it suitable for various power levels across many applications. The topology, control, and PWM methods have been fully developed and validated in detailed simulation. AC-DC power converters with PFC and isolation are required in numerous applications including electronic equipment, telecom and data centers, electric vehicle chargers and LED lighting. The invention significantly improves the efficiency and power density of these converters. Alternate configurations of the invention require only two switches for this single-stage conversion resulting in cost-effective solutions for a range of applications.

Potential Applications

- Telecom and data centers
- Electric vehicles
- LED lighting

Benefits and Advantages

- Compared to current technology, especially two stage power conversion approaches, the invention results in loss reduction by 40% to 60% with corresponding improvement in efficiency
- Uses fewer components than competing solutions that achieve PFC and high-frequency transformer isolation
- Soft-switching (zero voltage transitions) is inherent to the topology without the need for auxiliary circuits

- For low-power and cost-sensitive applications, circuit variations with only two switches (MOSFETs) can be used for a cost-effective, single-stage solution

Faculty profile of Professor Rajapandian Ayyanar