

Efficient Resonant Converters for Power Factor Correction in Solid State Lighting Applications

Lamps based on LED-technology require power electronic drivers to control the power delivered to the LEDs and to provide the needed current with a low ripple in order to ensure consistent lighting with no flicker. For lamps supplied from mains electricity, these drivers also need to provide power factor correction and shape their input current to minimize the power losses they inflict on the electricity grid. The driver is often a major contributor in terms of size, weight, and cost of a lighting system, and with the increasing demand and popularity of LED-based lighting technology, the commercial demand for small and efficient LED drivers is larger than ever. The size of electronic power converters can generally be reduced by increasing their operating frequency, but to do this without sacrificing conversion efficiency, the converter must be designed from a resonant topology with soft switching.

This study investigates methods for employing resonant converters as power factor correction stages for LED drivers. The study covers different topologies of resonant converters and how they can efficiently be operated from mains voltage and used to shape their input current as desired. In addition, techniques for reducing the power loss in the magnetic components of the converters through new core structures have been studied and presented in order enable higher conversion efficiencies.

A prototype of a power factor correcting class DE resonant converters for 50 W is designed and demonstrated. This prototype achieves a conversion efficiency above 92 % and comply with current standards and regulation of the power factor of LED drivers.

With the proper application of the knowledge gained, and techniques presented through this work, it is possible to design LED drivers for higher frequencies than previously possible, and potentially reduce their sizes while maintaining high conversion efficiency.