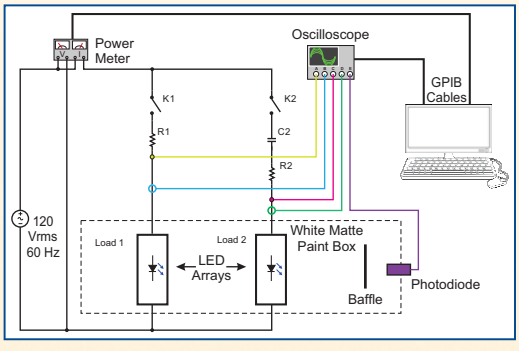
Reducing Flicker from AC LEDs

Alternating current light-emitting diodes (AC LEDs) are solid-state light sources that operate directly off line voltage rather than using a driver to convert the line voltage to direct current (DC) power. The absence of a driver creates many potential advantages, including lower cost, smaller system envelope, greater efficacy, and improved reliability. However, AC LEDs suffer from an inherent problem due to their present structure: light flicker. Typical solutions to mitigate light flicker have drawbacks and can negate the AC LED's benefits over traditional DC models.

Past LRC studies have looked at the factors leading to perception and acceptance of light flicker and have recommended threshold levels, specifically for frequency and percent flicker. In this study, LRC researchers sought to create a new circuit design for AC LEDs with targeted benchmarks to ensure acceptable flicker levels and system performance.

Circuit design and simulations

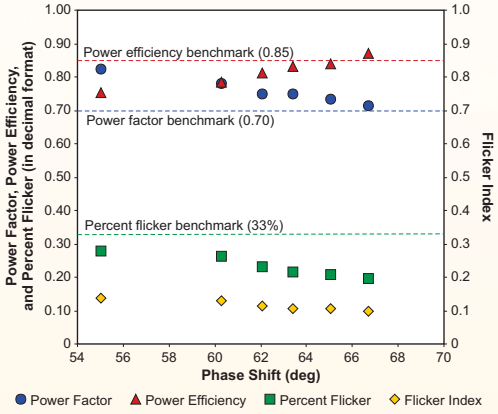
A circuit was designed for use in residential lighting applications to achieve benchmarks of 33% or lower percent flicker, power factor above 0.7, and power efficiency greater than 85%. A circuit with two branches, one resistive and one capacitive, was simulated. Load 1 was driven in the resistive branch (R-branch), and Load 2 was driven in the capacitive branch (C-branch). Theoretical equations were developed and showed that when phase shift increased, percent flicker and power factor decreased, but power efficiency increased.



Experiment apparatus setup

Experiment and results

An experiment was conducted to verify the theoretical analyses and to determine the optimal solution for the proposed circuit design. Linear fittings were conducted to show that with 95% confidence, the experimental results were consistent with the theoretical predictions. The experiment found that with a phase shift between 66° and 68°, an optimized solution can be achieved to meet the benchmarks of percent flicker < 33%, power factor > 0.7, and power efficiency > 85%.



Circuit design performance

The circuit designed in this study showed the potential for significantly reduced light flicker from AC LEDs when used in residential lighting applications. Ongoing studies are investigating circuit designs that would improve the power factor and power efficiency for use in commercial lighting applications.

Publication

Tan, J. and N. Narendran. An approach to reduce AC LED flicker. *J. Light & Vis. Env.* 38. Online at www.lrc.rpi.edu/programs/solidstate/pdf/Tan-ACLEDFlicker-JLVE2014.pdf

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