

**An Accelerated Test Method for Predicting the Useful Life of an LED
Driver**

By

Lei Han

An Abstract of a Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the degree of

MASTER OF SCIENCE

Major Subject: LIGHTING

The original of the complete thesis is on file
In the Rensselaer Polytechnic Institute Library

Approved:

Nadarajah Narendran, Ph.D., Thesis Adviser

Jean Paul Freyssinier, M.S., Member

Rensselaer Polytechnic Institute
Troy, New York

December, 2009

ABSTRACT

This study demonstrated an accelerated life test method for off-line LED drivers that use electrolytic capacitors at the output stage. Estimating the failure rate of power components suggests that the electrolytic capacitor used at the output stage of an off-line light emitting diode (LED) driver is the weakest link among all components. As an electrolytic capacitor degrades, its capacitance decreases and its equivalent series resistance (ESR) increases, both effects contributing to the increase of output current ripple of the LED drivers. Thus, the amplitude of the output current ripple is a good indicator of the degradation level of the output electrolytic capacitor. This study focuses on the parametric type of failure of the LED driver. In this study, temperature was selected as the acceleration factor because LED drivers are usually exposed to elevated temperatures in typical application environments. The current ripple is experimentally found to have a negative impact on light output and efficacy. So the useful life for LED drivers is proposed as the time it takes to reach a point when the rate of change of output current ripple reaches a maximum. Then the relationship between the capacitor's positive pin temperature and the useful life of the LED driver was established using the proposed useful life definition. The accelerated life test shows that the LED driver's useful life is shortened exponentially as the output electrolytic capacitor's operating temperature increases. Although this method may not be applicable to every LED driver on the market, it begins to identify methods that can be used for predicting the useful life of LED drivers of similar topologies.