A Measurement Method for Estimating the Average Junction Temperature of AC LEDs

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Liu, Y., T.R. Klein, and N. Narendran. 2009. A measurement method for estimating the average junction temperature of AC LEDs. *White LEDs 2009: The Second International Conference on White LEDs and Solid State Lighting*, December 13-16, 2009, Taipei, Taiwan, WB2-3.

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Abstract — *This study investigated a method of estimating the junction temperature of AC LEDs. Laboratory experiment data from a commercial AC LED shows that with increasing junction temperature, the voltage across the LED drops linearly, thus indicating that the proposed method is a promising candidate for estimating AC LED junction temperature.*

Introduction

High-power light-emitting diodes (LEDs) have evolved rapidly over the past decade and are now used in a variety of lighting applications. Typically, an LED is a low-voltage direct current (DC) device. Therefore, to power a DC LED, an electronic driver that can convert alternating current (AC) power to DC power is needed. However, for lighting systems, the requirement of an additional component means higher costs and also introduces reliability concerns.

To address these issues, the industry has been developing and marketing AC LEDs, which are now commercially available. The potential benefits of AC LEDs are a reduced number of luminaire parts and a simplified design process.

It is well known that heat at the p-n junction affects LED performance [1–3]. Therefore, methods of measuring LED junction temperature have been widely investigated over the past several decades, especially for DC LEDs [4]. However, few publications to date have addressed the junction temperature measurement of AC LEDs [5, 6].

Experiment

In this study, we investigated a method that could allow for the estimation of AC LED junction temperature by pulsing down an applied reference current with a pulse width of less than several milliseconds, and measuring the voltage at that moment across the device, which has several p-n junctions. A schematic diagram of the experiment apparatus is shown in Figure 1.

This method was chosen because past literature shows that the potential across the junction drops with an increase in junction temperature [7]. In this study, this method will be validated for different types of AC LEDs, which have different system architectures and circuitry designs.

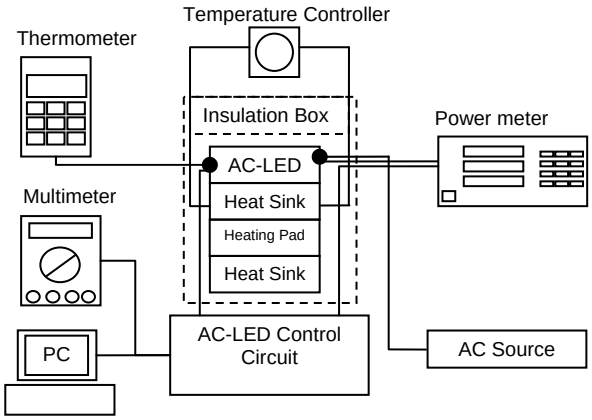

Fig. 1. Schematic of experiment apparatus.

Results

Laboratory experiment data from a commercial AC LED shows that with increasing temperature, the voltage across the LED drops linearly (Figure 2), thus indicating that the proposed method is a promising candidate for estimating AC LED junction temperature.

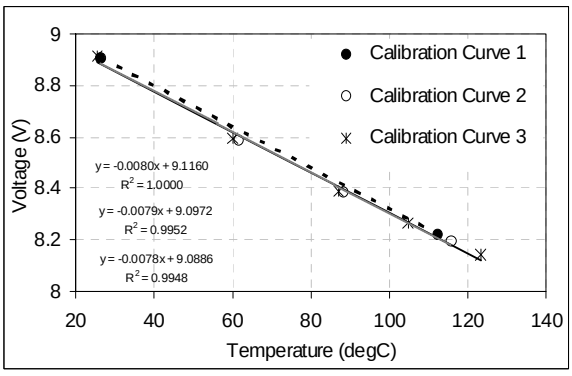

Fig. 2. Data from a commercial AC LED shows that the voltage across the LED drops linearly with increasing junction temperature.

Details regarding the theory, experimental setup and results will be presented in this paper.

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