Reliability Analysis of Drivers for High-Power LEDs

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Abstract
The research focuses on the analysis of the reliability of DC-DC switching power converter modules for high-power LED’s. LED’s make use of driver circuitry that is electronic power converters. The project aims to calculate the reliability of the converter; it involves searching research papers based on similar topics, calculating MTBF (Mean Time Before Failure) and getting equations for testing of constant-current DC-DC converters.

Methods
The method involved researching a bunch of related material and scientific papers to determine the optimum way of testing reliability of DC-DC converter.

Results
The equations to calculate the reliability of different converters varies based on the materials and components used. It even varies for the different components of the same converter. However, the general equation that gives an overview of all these equations is given by the Failure rate of the system; it is the sum of all failure rates and Reliability is inverse of failure rate.

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MTTF = \frac{1}{\sum R_i(t)} \quad [4]
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After research, this method involved calculating the failure rate and the MTBF (Mean Time Before Failure) of the whole DC-DC converter. This was done by calculating the individual reliability of the essential components of the converter- MOSFET, Diode, Capacitor, and Inductor- and then summing all their failure rates.

Future Development
The information accumulated from this project need to be applied in testing the life and the failure rate of the DC-DC converters for power LEDs and used as a means to produce converters with a comparable life to the LED, thus resulting in the increase of net life of the LED.

Problem Statement
Need:
One important advantage of LEDs is that they have very long life (50,000 Hrs). However, the electronic power (DC-DC) converters in the LED’s driver circuitry, which provide LED’s with constant current, has a shorter life compared to the LED lamp. As a result we are not able to utilize the full potential of the LED lights.

Objectives:
1. To research papers regarding analysis of Drivers for High-Power LEDs
2. To understand valid methods for analyzing the life of DC-DC converters.

Fig. 1: Constant output current of Flyback converter [4]

Fig. 2: Boost converter [4]

Fig. 3: Buck converter for power LED array [1]

Fig. 4: Bathtub curve for component failure rate [4]

References
[1] M.A Juarez; PR. Martinez; J.M. Sosa; G. Vasquez; “Comparative Analysis of the Reliability of Drivers for Power LED” Villanueva; Higher Technological Institute of Irapuato. ITESL

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