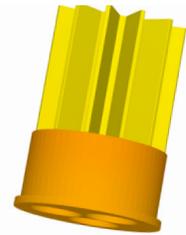


Introduction

ATS Europe used Future Facilities' 6SigmaET simulation software to model the thermal performance of a newly designed LED lamp. Different configurations of printed circuit boards (PCB) were evaluated using the software. They found that 6SigmaET was able to predict the junction temperatures within 5% of the experimental values.

The configurations included FR4 and metal core board configurations. The models predicted that temperature drop across the PCB using the FR4 board configurations would be severe and preclude the use of a natural convection heat sink. After an optimized metal core board configuration was simulated, the heat sink size was determined by analytical methods and performance was confirmed with the software. The heat sink eventually was selected from ATS' standard LED heat sink catalog. The heat sink design was optimized for a natural convection environment and coated with a highly efficient surface finish.



6SigmaET simulated model of LED

“6SigmaET allows for the rapid thermal evaluation of different designs... this is critical to the short term and long term success of our LED product.”

Norbert Engelberts
Director, ATS Europe
Optimal Thermal Solutions BV

How Difficult Can LED Lighting Be?

LED lighting can be an effective method to reduce the operating cost of a building. However, unlike traditional lighting solutions, LEDs have a maximum junction temperature of around 100°C whilst other lighting solutions are at around two thousand degrees Celsius. This means that for LED lighting, there needs to be an effective heat transfer path to the ambient air; a thermal design challenge to say the least. A better heat transfer path is normally proportional to the cost of the product. The heat sink performance can be greatly improved by adding a fan, but that adds noise and an extra reliability concern to the product. The challenge is to provide a cooling solution which is just as cost effective whilst satisfying the LED thermal requirements.

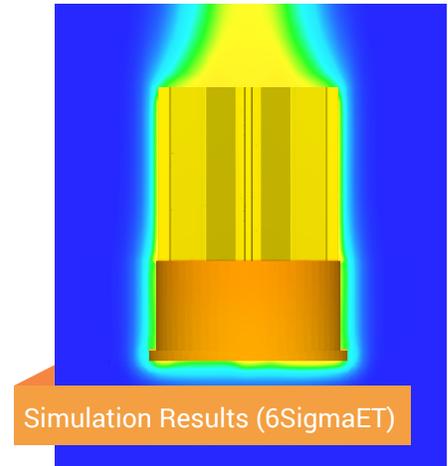
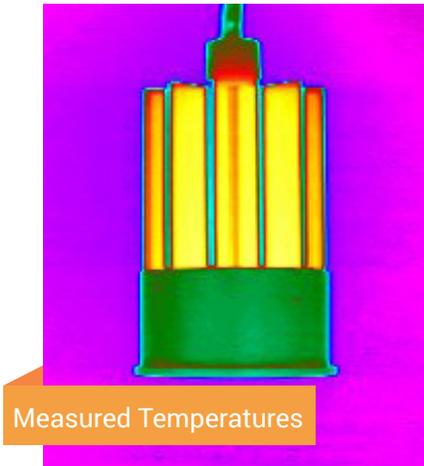
How Small Can You Go?

When designing LED cooling solutions, the size of the cooling solution can be directly related to the cost. A bigger heat sink means more weight and more material that has to be paid for. Optimization of a heat sink allows for the best possible performance for a given material cost.

Natural convection heat sinks also have the benefit being more reliable than a fan cooled solution without the extra cost of the fan. Could simulation tools be used to accurately predict the junction temperatures of LEDs and reduced hot spots while minimizing the size of the overall lighting product?

The Results

SigmaET has the modeling capabilities necessary to accurately predict heat transfer and resulting temperature distribution throughout the LED down lighter assembly for a variety of design configurations. In the configuration shown in the figures above, 6SigmaET was able to predict LED junction temperatures within 5% of the experimental values, indicating a high level of confidence in the results obtained.



	Analytical Results	Experimental Results	6SigmaET Results
Ambient (°C)	20	20	20
Heat Sink Base (°C)	76	71	66
Board (°C)	81	78	74
LED Junction (°C)	110	107	103
Comparison (%)	3.5%	Datum	-4.6%

6SigmaET, a computational fluid dynamics (CFD) simulation tool, brings new levels of productivity to electronics cooling design. Thanks to its ease-of-use, it overcomes many of the problems that have plagued analysis tools from the beginning. Boasting substantial automation and intelligence, 6SigmaET is already being used by a global community of design engineers.

ATS Europe provides leading-edge thermal management solutions to its European partners. ATS and ATS-Europe engineers have over 100 years of collective thermal management experience, 35 patents, over 70 professional publications, and receive continual requests for technical presentations at international and national conferences. Their engineers from across the globe collaborate to provide next-generation products and custom solutions to meet growing thermal management and packaging needs.