

# Thermal Analysis of a Miniature Electronic Power Device Matched to a Silicon Wafer

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## Abstract

During the design of the power device, the thermal investigations are crucial for evaluating the power device performance and to ensure that the design meets the thermal requirements. The power device is attached to, and powering a silicon wafer. It is sandwiched between a silicon wafer and a heat-sink, this explain its mechanical and thermal roles in the entire WaferBoard™.

**Keywords :**  
 thermal evaluating, power device, silicon wafer, AlN substrate.

## Introduction

The WaferBoard™ is a rapid prototyping electronic system with an active surface, which called a WaferIC™. The Wafer is a wafer-scale silicon circuit with a very dense array of very fine conducting pads which can detect components pins when the components are placed on top of the wafer surface, and then the wafer can be configured to create interconnection for those components and to power them with the appropriate voltage [1, 2].

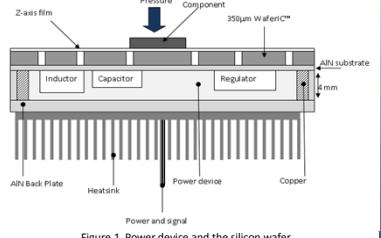


Figure.1 Power device and the silicon wafer

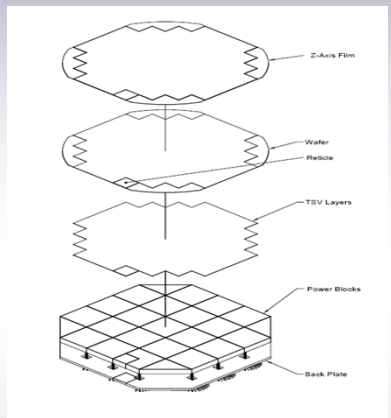


Figure.2 The power device in the WaferBoard™

## Design elements

In order to meet the wafer's requirements, several elements have been taken into consideration in the design specifications of the power device such as the choice of proper materials, dimensions of the power device and electronic components:  
 Proper materials: (TCE, Thermal conductivity, strength coefficient.)  
 Dimensions and sizes: the power device size, components size and height.  
 Electronic components: components yield, components size.

## Coupled Fluid-Heat Transfer Approach

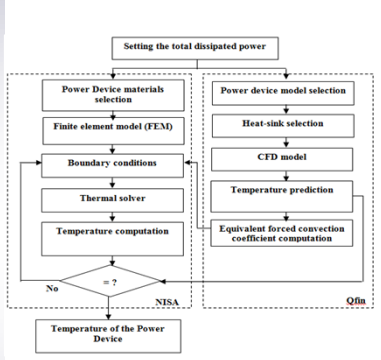


Figure.3 Flow chart of mixed fluid-heat transfer approach

The thermal analysis depends on :  
 1. the applied cooling options;  
 2. the location / power of heat dissipating devices;  
 3. the thermal conductivity of the various materials and components such as: the printed circuit board, heat sink, components package, substrate and heat spreader..

## Thermal investigation results

The thermal 3D models of the power device are created according to the schematic, the layout and the mechanical model of the power device. Two models have been proposed for the thermal investigations. The results show the temperature profile (Hot spots positions, Tmin and Tmax) in these models.

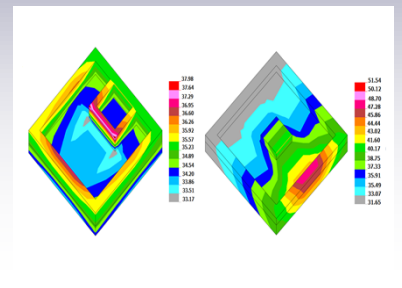


Figure.4 Thermal results of two power device models

## Conclusion

The thermal investigations allow the evaluation and validation of the design of the power device, as well as, changes that must be made to improve the power device performance.

## References

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## Acknowledgements

To Gestion TechnoCap Inc, CMC Microsystems and Resmij.