Application Note

TPIC7218-Q1 Thermal Design Considerations and Solution

ABSTRACT

This application note describes a methodology to predict the thermal response of the TPIC7218-Q1 in a realistic ABS environment. The methodology presented provides system and hardware engineers a clear and insightful method to analyze a system that adequately cools the TPIC7218-Q1 before PCBs are manufactured. Ideas are presented that explain how to convert electrical behavior during an ABS event into a format useful for thermal analysis. The resulting power profile, in conjunction with the system hardware profile are then used estimate junction temperatures. Finally, junction and PCB temperature data provide a view into a system's likely thermal performance.

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Trademarks

1 Introduction

As automotive systems are refined to reduce cost and size, power densities invariably increase. Holding semiconductor efficiency constant, more power equates to higher junction temperatures. Junction temperatures above the specified limits can reduce system reliability and shorten module life span. To avoid such problems and costly system redesigns, early thermal analysis is critical.

Accurately predicting junction temperatures is not an easy task. Many factors become data inputs that influence thermodynamic behavior. The problem becomes more challenging because some of the key data inputs, such as PCB layout, are only accurately known after the design is complete! Without a reliable way of predicting thermal properties, system designers can become locked in an inefficient cycle; a cycle where failed designs lead to redesigns in an iterative an unnecessarily protracted process.

To prevent lengthy design times, expensive development costs, and system unreliability it is imperative that system designers understand how to quickly get a feel for, and determine the thermal properties of a system.

This application report identifies and demystifies system components and other less tangible quantities that fuel input to the thermal analysis engine. The components of the engine are presented and their function is explained. The engine’s output propels efficient system design, as temperature data becomes available.

2 Understanding the Process and Methodology to Achieve a Solution

Thermal analysis of an ABS system is an important component of the design and verification process. Like most complex problems it is helpful to break the task into smaller pieces to simplify and clarify the process.

First, critical IC and system specifications must be identified to provide quantitative data inputs. Second, calculations are made using the system inputs to find current, time, and power. Third, printed circuit board (PCB), heat sink, plastic module case, and other hardware components must be identified, and analyzed to calculate hardware data inputs. Fourth, a thermal simulation software tool can be used to convert the system's profile into heat and temperature data. Finally, the loop is closed when the resulting heat and temperature data are compared against specified limits for each system component, including the TPIC7218-Q1.

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3 Revision History

Changes from Revision * (April 2011) to Revision A (April 2023)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document	1
• Updated contact information for full data sheet	3

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