

5. Navigating Thermal and Reliability Challenges in Chip Components for Automotive High-Performance Compute Systems

Course Leader: Fen Chen -- Automotive Reliability/Validation Consultation Services

Course Description:

The landscape of driving is rapidly shifting towards fully autonomous vehicles (AV). In the absence of human drivers, the functionality and performance of a Compute system become paramount requiring it to consistently outpace human response for driving safety. AV Compute systems typically consist of multiple larger-size PCBs housing redundant CPUs, AI processors, and crucial IC components to ensure higher performance, safety, and reliability of AV driving.

Throughout the rigorous AV Compute reliability qualification process, these systems undergo various thermal and mechanical stresses. Preventing chip thermal failure under these demanding environmental conditions is a critical concern. In this short course, we will delve into several key areas. In the initial segment, we'll review fundamental chip thermal design, cooling solutions, and chip-level reliability considerations. A spotlight will be cast on comparing lidded and lidless package thermal and reliability performances, along with exploring the latest trends in chip thermal management.

In the subsequent part, we will present the thermal mission profile and diverse stress test requirements for AV hardware validation, adhering to automotive industry standards. We'll shine a light on the thermal reliability challenges associated with qualifying vehicle Compute. Moving ahead, we'll delve into the most recent advancements in vehicle thermal management technologies.

Course Outline:

1. High Performance Compute for Vehicle Applications
2. Chip Power + Temperature Trending and Reliability
3. Chip Heat Transfer Basics and Survey
4. Lidded and Lidless Package Thermal and Rel Performance Comparison
5. Chip Thermal Management Hot Trends
6. Vehicle Thermal Mission Profile Introduction
7. Vehicle-level Reliability Requirements
8. Reliability Challenges
9. Vehicle System Level Thermal Management Technologies Overview
10. Liquid Cooling Cold Plate Performance and Reliability
11. TIM Performance and Reliability
12. Board Strain and Chip Reliability
13. Heat Pipe Performance and Reliability
14. Thermal Mitigation at Chip Level, Board Level and System Level
15. Closing Remarks

Who Should Attend:

Engineers and tech managers already involved in the chip thermal design for automotive applications, and those who need a fundamental understanding or a broad overview of the chip thermal and reliability management for automotive applications.

Bio: Fen Chen received his Ph.D. degree in Electrical Engineering in 1998 from the University of Delaware. In 1997 and 1998, Fen served as a graduate intern at Intel Component Research in Santa Clara, CA, where he made significant contributions to IC interconnect reliability research. He joined IBM Microelectronics at Essex Junction, VT in 1998 and dedicated his expertise to addressing critical semiconductor technology reliability challenges until 2015. From 2015 to 2019, he worked for Apple Inc. in Cupertino, CA as a senior reliability engineer focusing

on the qualifications of various consumer electronic products. In 2019, he joined Lumileds in San Jose, CA as the director of quality and reliability and was responsible for qualifying novel μ LED MCM products for automotive applications. After 6-months of work at Lumileds, he joined Cruise LLC in 2019 and currently is a principal reliability/validation engineer & TLM. He has been working on validations of electronic, optical, and electromechanical modules for groundbreaking Cruise AV hardware systems since he joined Cruise. He holds over 50 patents and has published over 60 technical papers/invited talks in various journals and conference proceedings.