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Thermal management of microelectronic equipment: heat transfer theory, analysis methods, and design practices / L.-T. Yeh and R. C. Chu. p. cm. ISBN 0-7918-0168-3 1. Electronic apparatus and appliances – Cooling. 2. Electronic apparatus and appli-ances – Thermal properties. 3. Heat – Transmission. I. Chu, R. C. (Richard C.), 1933. II. Title.

THERMAL MANAGEMENT OF MICROELECTRONIC EQUIPMENT

Thermal Management of Microelectronic Equipment: Heat Transfer Theory, Analysis Methods and Design Practices (Asme Press Book Series on Electronic Packaging) 1st Edition. by Lian-Tuu Yeh (Author), Richard C. Chu (Author), Dereje Agonafer (Editor) & 0 more. 3.0 out of 5 stars 1 rating. ISBN-13: 978-0791801680.

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With an increased demand on system reliability and performance combined with the miniaturization of devices, thermal consideration has become a crucial factor in the design of electronic packaging, from chip to system levels. This new book emphasizes the solving of practical design problems in a wide range of subjects related to various heat transfer technologies. While focusing on understanding the physics involved in the subject area, the authors have provided substantial practical design data and empirical correlations used in the analysis and design of equipment. The book provides the fundamentals along with a step-by-step analysis approach to engineering, making it an indispensable reference volume. The authors present a comprehensive convective heat transfer catalog that includes correlations of heat transfer for various physical configurations and thermal boundary conditions. They also provide property tables of solids and fluids. Lian-Tuu Yeh and Richard Chu are recognized experts in the field of thermal management of electronic systems and have a combined 60 years of experience in the defense and commercial industries.

This Second Edition of a classic text is fully updated and greatly expanded, with in-depth revisions that include advancements in the component technology of microelectronics. The most noticeable one is the addition of an entirely new chapter on microwave modules and the gallium arsenide (GaAs) chips, which have seldom been discussed in any of the textbooks or publications in the area of thermal management of electronic equipment. With this new chapter, the book is complete and whole in the area of thermal design of electronics systems. With an increased demand on system reliability and performance combined with the miniaturization of devices, thermal consideration has become a crucial factor in the design of electronic packaging, from chip to system levels. This book emphasizes the solving of practical design problems in a wide range of subjects related to various heat transfer technologies. While focusing on understanding the physics involved in the subject area, the authors have provided substantial practical design data and empirical correlations used in the analysis and design of equipment. The book provides the fundamentals along with a step-by-step analysis approach to engineering, making it an indispensable reference volume.

Electronic technology is developing rapidly and, with it, the problems associated with the cooling of microelectronic equipment are becoming increasingly complex. So much so that it is necessary for experts in the fluid and thermal sciences to become involved with the cooling problem. Such thoughts as these led to an approach to leading specialists with a request to contribute to the present book. Cooling of Electronic Systems presents the technical progress achieved in the fundamentals of the thermal management of electronic systems and thermal strategies for the design of microelectronic equipment. The book starts with an introduction to the cooling of electronic systems, involving such topics as trends in computer system cooling, the cooling of high performance computers, thermal design of microelectronic components, natural and forced convection cooling, cooling by impinging air and liquid jets, thermal control systems for high speed computers, together with a detailed review of advances in manufacturing and assembly technology. Following this, practical methods for the determination of the parameters required for the thermal analysis of electronic systems and the accurate prediction of temperature in consumer electronics. Cooling of Electronic Systems is currently the most up-to-date book on the thermal management of electronic and microelectronic equipment, and the subject is presented by eminent scientists and experts in the field. Vital reading for all designers of modern, high-speed computers.

The continuing trend toward miniaturization and high power density electronics results in a growing interdependency between different fields of engineering. In particular, thermal management has become essential to the design and manufacturing of most electronic systems. Heat Transfer: Thermal Management of Electronics details how engineers can use intelligent thermal design to prevent heat-related failures, increase the life expectancy of the system, and reduce emitted noise, energy consumption, cost, and time to market. Appropriate thermal management can also create a significant market differentiation, compared to similar systems. Since there are more design flexibilities in the earlier stages of product design, it would be productive to keep the thermal design in mind as early as the concept and feasibility phase. The author first provides the basic knowledge necessary to understand and solve simple electronic cooling problems. He then delves into more detail about heat transfer fundamentals to give the reader a deeper understanding of the physics of heat transfer. Next, he describes experimental and numerical techniques and tools that are used in a typical thermal design process. The book concludes with a chapter on some advanced cooling methods. With its comprehensive coverage of thermal design, this book can help all engineers to develop the necessary expertise in thermal management of electronics and move a step closer to being a multidisciplinary engineer.

Channeling or controlling the heat generated by electronics products is a vital concern of product developers: fail to confront this issue and the chances of product failure escalate. This third book in the series explores yet another method of heat management-the use of liquids to absorb and remove heat away from vital parts of the electronic systems.

The need for advanced thermal management materials in electronic packaging has been widely recognized as thermal challenges become barriers to the electronic industry’s ability to provide continued improvements in device and system performance. With increased performance requirements for smaller, more capable, and more efficient electronic power devices, systems ranging from active electronically scanned radar arrays to web servers all require components that can dissipate heat efficiently. This requires that the materials have high capability of dissipating heat and maintaining compatibility with the die and electronic packaging. In response to critical needs, there have been revolutionary advances in thermal management materials and technologies for active and passive cooling that promise integrable and

cost-effective thermal management solutions. This book meets the need for a comprehensive approach to advanced thermal management in electronic packaging, with coverage of the fundamentals of heat transfer, component design guidelines, materials selection and assessment, air, liquid, and thermoelectric cooling, characterization techniques and methodology, processing and manufacturing technology, balance between cost and performance, and application niches. The final chapter presents a roadmap and future perspective on developments in advanced thermal management materials for electronic packaging.

To celebrate Professor Avi Bar-Cohen's 65th birthday, this unique volume is a collection of recent advances and emerging research from various luminaries and experts in the field. Cutting-edge technologies and research related to thermal management and thermal packaging of micro- and nanoelectronics are covered, including enhanced heat transfer, heat sinks, liquid cooling, phase change materials, synthetic jets, computational heat transfer, electronics reliability, 3D packaging, thermoelectrics, data centers, and solid state lighting. This book can be used by researchers and practitioners of thermal engineering to gain insight into next generation thermal packaging solutions. It is an excellent reference text for graduate-level courses in heat transfer and electronics packaging. Contents:A Review of Cooling Road Maps for 3D Chip Packages (Dereje Agonafer)Thermal Performance Mapping of Direct Liquid Cooled 3D Chip Stacks (Karl J L Geisler and Avram Bar-Cohen)Dynamic Thermal Management Considering Accurate Temperature-Leakage Interdependency (Bing Shi and Ankur Srivastava)Energy Reduction and Performance Maximization Through Improved Cooling (David Copeland)Optimal Choice of Heat Sinks from an Industrial Point of View (Clemens J M Lasance)Synthetic Jets for Heat Transfer Augmentation in Microelectronics Systems (Mehmet Arik and Enes Tamdogan)Recent Advance in Thermoelectric Devices for Electronics Cooling (Peng Wang)Energy Efficient Solid-State Cooling for Hot Spot Removal (Kazuaki Yazawa, Andrei Fedorov, Yogendra Joshi and Ali Shakouri)An Overview of the Use of Phase Change Materials for the Thermal Management of Transient Portable Electronics: Benefits and Challenges (Amy S Fleischer)Estimation of Cooling Performance of Phase Change Material (PCM) Module (Masaru Ishizuka and Tomoyuki Hatakeyama)Optimization Under Uncertainty for Electronics Cooling Design (Karthik K Bodla, Jayathi Y Murthy and Suresh V Garimella)Hydrophilic CNT-Sintered Copper Composite Wick for Enhanced Cooling (Glen A Powell, Anuradha Bulusu, Justin A Weibel, Sungwon S Kim, Suresh V Garimella and Timothy S Fisher)A Cabinet Level Thermal Test Vehicle to Evaluate Hybrid Double-Sided Cooling Schemes (Qihong Nie and Yogendra Joshi)Energy Efficiency and Reliability Risk Mitigation of Data Centers Through Prognostics and Health Management (Jun Dai, Michael Ohadi and Michael Pecht)Damage Pre-Cursors Based Assessment of Accrued Thermomechanical Damage and Remaining Useful Life in Field Deployed Electronics (Pradeep Lall, Mahendra Harsha, Kai Goebel and Jim Jones)Towards Embedded Cooling — Gen 3 Thermal Packaging Technology (Avram Bar-Cohen) Readership: Researchers, practitioners, and postgraduates in mechanical engineering, nanoelectronics, computer engineering, and electrical & electronic engineering. Keywords:Electronics Cooling;Electronics Packaging;Thermal Management;Thermal Sciences;Electronics Reliability;Thermoelectrics;Computational Heat Transfer;Liquid Cooling

This book presents new design techniques that permit an engineer to design devices with predictable results, and in doing so utilize very complex shapes instead of being limited to simple shapes. Includes coverage of the material properties of the devices.