Mission Statement

To develop scientifically based innovative methodologies that decrease life-cycle risks for the next generation of electronic products and systems, and to provide an educational and technology transfer infrastructure for their rapid dissemination and utilization.

Message from the Director

Over the past year, there was a noticeable increase in the number of reliability problems that our Center for Advanced Life Cycle Engineering (CALCE) was asked to evaluate. I would like to say that most of this increase is due to our reputation for conducting high-quality failure and root cause analysis, but I also find that there is a growing reliability concern with many of the products being made today. One reason is the increasing use of cheaper (inferior) materials, parts, processes and test methods, which arises due to the supply and demand for less costly products. Another reason is that many companies have opted to create new supply chains and have outsourced engineering and manufacturing to suppliers who may be cost effective in the short term, but whose processes are not stable or mature and may use parts and products that have less than acceptable reliability for the required application conditions. Some of the design and product development deficiencies that were masked by stable manufacturing processes in the past are laid bare when the outsourcing partner is inadequate. A third reason for the increase in reliability problems is a result of the lead-free transition and the various changes that have been made to products and the supply chain to be RoHS compliant.

It is my opinion that companies must be especially prepared for unexpected reliability problems over the next few years. To prepare yourselves, I suggest that you review our work on reliability capability assessment, supply-chain creation and management, parts selection and management, test and qualification methods, and quality assessment methods. Information on these processes can be found in the various CALCE books, including Parts Selection and Management, Contamination, and Upgrading and in our articles. You can find these at http://www.calce.umd.edu/genera/resources.html. I also suggest that you think about conducting a benchmarking of your reliability capabilities. If you need help in this matter, please feel free to contact me.

A new 2006 CALCE publication that addresses design-for-reliability concepts for next-generation products is the IEEE-Wiley publication of CALCE’s Lead-free Electronics. It is the only guide on the market for the transition to lead-free electronics that covers the details of parts selection, materials selection, quality and reliability risks; and manufacturing and maintenance issues for the successful development of lead-free electronics.

To address the reliability of today’s and tomorrow’s electronics, CALCE has three consortia. The Electronic Products and System Consortium membership includes 55 of the major international electronics companies. There are over 30 ongoing projects, and all the data is shared among the members. The Long-term Lead-free Consortium has 16 members. This program will be completed this year, with results on the reliability risks (including solder joint reliability, tin pest, tin whiskers, electrochemical migration and circuit card reliability) that can arise with the use of lead-free products for application lifetimes over 10 years. The third consortium is the Prognostics and Health Management (PHM) Consortium (see p. 3 for more information on this consortium and for a list of projects).

I invite you to become an active participant with CALCE and make use of our expertise and resources. If you are interested in our research and analysis, please visit us in person in October (see p. 2) or visit us on the web at www.calce.umd.edu. I look forward to working together with you.

Michael Pecht
CALCE Director and George Dieter Chair Professor

New CALCE Consortium Members

- Diehl BGT Defence GmbH & Co. KG, Überlingen, Germany
- ES&T, Frederick, MD
- Goodrich Sensor Systems, Burnsville, MN
- Harris Corporation, Rochester, NY, and Melbourne, FL
- Samsung Electro-Mechanics Co., Ltd., Suwon City, Korea
- Samsung Memory Division, Asan City, Korea
- Rolls-Royce plc, Derby, UK
CALCE EPS Consortium Technical Review Meeting

The Technical Review Meeting of the CALCE Electronic Products and Systems Consortium has been scheduled for October 17-19, 2006, at Greenbelt Marriott, 6400 Ivy Lane, Greenbelt, MD, tel. 301-441-3700.

All current members of the consortium are invited to attend. Organizations interested in becoming CALCE EPS Consortium members and wishing to attend the meeting should contact Joan Lee at joanyuan@calce.umd.edu. The agenda for this event is available at www.calce.umd.edu under Upcoming Events.

The following projects will be presented at the meeting:

- Effect of Manufacturing Variability on Reliability of Lead-free Solder Joints
- Accelerated Qualification of SAC Assembly: Combined Temperature Cycling and Vibration
- Effect of Characteristic Relaxation Time on Accelerated Thermal Cycling Profiles for SAC Solders
- Effect of Load Sequencing on Lead-free Solder Durability
- Effect of Temperature Cycle on the Durability of Lead-free Interconnects (Sn96.5Ag3.0Cu0.5 and SnCuNi)
- Characterization of Tin Pest Formation in Lead-free Solder Joints
- Development of Vapor Pressure Modeling Scheme for PEMS Subjected to Pb-free Solder Reflow Profile
- Damage Caused to PTH and PWB by Compliant Pin Insertion
- Electronic Component Failure Categorization under Gun-launched High-G Loading
- Stress Relaxation Effects on the Contact Resistance of High-density I/O Sockets
- Performance of Commercially Available RF Low Noise Amplifiers
- Development of CF2 Model for Today’s PWB Spacings
- Assessment of High-Temperature Technologies for SiC Packaging
- Failure Risk Assessment of LCD Modules – ACF Failures
- Effects of Mechanical and Environmental Stresses on Flexible Termination Multilayer Ceramic Capacitors
- Failure Mechanism and Reliability Assessment for System-in-package Technologies
- Electrochemical Migration on Lead-free Printed Circuit Boards with No-clean Flux Technology
- Investigation of High-temperature Green Solder Materials
- Hermeticity of Wafer Level Package Phase III
- Effect of Intermetallics on Drop Reliability and Bulk Properties of Aged Eutectic BGA Solder Joints
- Characterization of Moisture-induced Degradation of Polymer Interface
- Durability Assessment of Advanced Power Electronics Thermal Cooler
- Thermal Performance and Reliability of Thermal Interface Materials
- Heat Sink Fouling in Air-cooled Electronic Products
- Impact of Temperature on Performance and Lifetime of Plasma Panel Displays Using Natural Graphite-based Heat Spreaders
- Advanced Microstructured Surfaces for Thin-Film Evaporative Cooling
- Integrating Refresh Planning
- Uprating of Passive Components
- Connecting Lifetime Buy Forecasting with Design Refresh Planning
- MOCA Pilot Studies
- Rapid Life Model for Temperature Cycling of Underfilled BGA Packages
- Reliability Assessment and Modeling of Clinched Insertion Interconnects
- Model-based Design Guidelines for Shock and Drop Loading
- Idq Trending as Precursor to CMOS IC Failure
- Vehicle Component Prognostics in Vibration/Shock Environments
- Integrated Health and Usage Monitoring System

CALCE Long-term Lead-free Consortium Meeting

To expand the knowledge base related to long-term reliability issues introduced by lead-free electronics, the CALCE Lead-free Consortium has been conducting a collaborative research study that involves the design, manufacture, and testing of printed wiring assemblies with the objective of obtaining critical missing information related to long-term (>10 year) reliability.

On Monday, October 16, 2006, CALCE will hold a one-day session on the status of the long-term lead-free reliability study for the consortium members. The meeting will be held in 1107 Kim Bldg. on the University of Maryland College Park campus.

For more information, go to www.calce.umd.edu and click on Upcoming Events, or contact Dr. Michael Osterman at osterman@calce.umd.edu, tel. 301-405-8023.

Virtual Qualification Software Workshop

Over the past fifteen years, CALCE has developed software to assist engineers in evaluating, designing, and testing electronic hardware. The software provides an integrated design environment that incorporates reliability assessment and life-cycle costing tasks into the earliest stages of the design process. It produces designs that result in cost-effective and reliable electronic components, PWBs, and systems, and enables design and reliability engineers to implement physics-of-failure principles.

On October 16, 2006, CALCE will be offering a one-day workshop with hands-on training in the use of the current calcePWA and calceFAST software and a discussion of real-world applications, online resources, and future directions. The workshop will be held on the University of Maryland campus.

For more information go to www.calce.umd.edu and click on Upcoming Events or contact Dr. Michael Osterman at osterman@calce.umd.edu, tel. 301-405-8023.

Capacitor Workshop

On Monday, October 16, 2006, CALCE will hold a one-day workshop on capacitor technology and reliability. CALCE's research on this subject over the past ten years has encompassed the full spectrum of part types and applications. This short course will distill data and insights obtained through dozens of research and failure-analysis projects, supplemented by thorough and up-to-date research on this subject over the past ten years has encompassed the full spectrum of part types and applications. This short course will distill data and insights obtained through dozens of research and failure-analysis projects, supplemented by thorough and up-to-date analysis of the technical literature, to provide valuable guidance on the response of different capacitor types to their life-cycle environment and factors to be weighed in the capacitor selection process. The workshop will cover both electrolytic and non-polar capacitors and will include discussion of recognized manufacturer quality issues and failure mechanisms, as well as issues affecting specific applications and new capacitor materials and constructions.

The fee for non-members is $900, and for members is $750. To register, please go to www.calce.umd.edu/Registration or email Joan Lee at joanyuan@calce.umd.edu.

The workshop will be held in 1111 Kim Bldg. on the University of Maryland campus, starting at 9:00 am. Refreshments and lunch will be provided to participants.

For more information, contact Dr. Michael H. Azarian at mazarian@calce.umd.edu, tel. 301-405-7555.
New Prognostics and Health Management Consortium

The new Prognostics and Health Management Consortium (PHMC) commenced its operations on March 23, 2006. The PHMC is an industry- and government-supported research and education consortium located within the Center for Advanced Life Cycle Engineering (CALCE). The PHMC director is Prof. Michael Pecht.

The mission of the PHMC is to provide its members with basic research and technology for electronics prognostics and health management. Its overall objectives are to develop best practices in the use of prognostics for future designs and qualification planning and to provide:

- Proven prognostic sensors and in-situ monitoring strategies for cost-effectively recording environmental, operational, and performance parameters of new and legacy systems
- Proven models and algorithms for “health” assessment and prognostics
- Methods to integrate cost-effective prognostics with other technologies (RFID, logistics, Net-centric databases) for new and legacy systems
- Maintenance and logistical support methods that incorporate prognostic outputs
- Solution to the CND, NFF, NTF, intermittent problem
- Techniques for self-healing and system reconfiguration based on prognostics outputs
- Software to assess the return-on-investment opportunities of prognostics

Participation in the PHMC will place members at the forefront of electronics prognostics and health management. PHMC members guide the research efforts, have access to all PHMC materials (website and tool access), and receive research results. The annual membership fee is $35K. New PHMC members who are not currently CALCE members will need to complete a membership agreement posted on the PHMC website. Interested companies and organizations can obtain membership information on the PHMC website at http://www.prognostics.umd.edu. For more information, contact Prof. Michael Pecht at pecht@calce.umd.edu, tel. 301-405-5323.

CALCE Prognostics and Health Management Consortium Technical Review Meeting

The Technical Review Meeting of the CALCE Prognostics and Health Management Consortium has been scheduled for October 19, 2006. This meeting will be held on the University of Maryland campus. The agenda for this event is available at www.prognostics.umd.edu under Announcements. This meeting is open to CALCE PHM Consortium members.

The CALCE PHM Consortium focuses on research and development of the fundamental methodologies for prognostics and health management of sustainable systems. In addition, the consortium is evaluating technologies for implementing prognostics and health management solutions. The goal is to provide means of measuring the state of health (reliability) of electronic products and systems in real-time, and to forecast the onset of failure in such systems.

For more information about the CALCE Prognostics and Health Management Consortium, contact Prof. Michael Pecht at pecht@calce.umd.edu, tel. 301-405-5323.

Microelectronics Reliability: Special Issue on Prognostics and Health Management of Electronic Systems

Microelectronic Reliability journal will be publishing a special issue on “Electronic Prognostics and Health Management.” Topics of interest include, but are not limited to:

- Methodologies for electronic system prognostics
- Physics-based precursors for electronic system failure mechanisms
- Integrated sensor systems for diagnostics and prognostics
- Novel signal analysis techniques for enabling prognostics
- Innovative case-studies in prognostics implementation
- Statistical methods for accurate remaining life prediction
- Return-on-investment of prognostics implementations
- Management and maintenance decision-making based on prognostic feedback
- Integrating prognostics in the supply chain (RFID, logistics, life-cycle planning)

The special issue editors are Prof. Michael Pecht (pecht@calce.umd.edu) and Prof. Peter Sandborn (sandborn@calce.umd.edu) from CALCE. If you would like to submit a paper, please email it to the editors by October 15, 2006. Submitted papers will be peer reviewed. The tentative date for the special issue is April 2007.

Selected CALCE Publications on PHM

CALCE Assesses Reliability of Thermal Interface Materials

CALCE is currently examining the degradation of thermal interface materials (TIMs), which play a critical role in the thermal management of electronics. TIMs provide a path of low thermal impedance between a heat-generating component, such as a chip, and a heat sink. Minimizing the interfacial thermal resistance, which can be as high as half of the total thermal resistance of a component, is crucial in maintaining component operating temperatures at acceptable levels. Due to the ever-increasing power dissipation levels and heat fluxes occurring in a variety of microelectronic applications, a wide array of TIM types, such as greases, phase-change materials, pads, films, gels, and adhesives are now commercially available.

The proper selection of a TIM requires considering not only the thermal performance, but also the long-term reliability. The selection process can become further complicated by the property data provided by vendors, which may not represent the thermal performance under actual application conditions. Characterizing TIMs experimentally can therefore be essential in assessing the applicability of a given TIM to a particular packaging design. This process can be challenging since the overall performance of a TIM depends on many factors, including process variables, assembly conditions, bulk material properties, and properties of the interface.

A variety of methods exist to measure the thermal conductivity of TIMs. CALCE has instruments that use the laser flash diffusivity method and the hot wire method, which are transient methods that have relatively fast measurement speeds and can be used to measure various TIM types, such as greases, elastomeric gap pads, and gels. Steady-state techniques, such as the guarded heat flow method and the guarded comparative longitudinal heat flow method, are widely used by TIM vendors. However, the validity of the standards associated with these measurement methods (ASTM D5470 and ASTM E1530) has been questioned, since reproducibility of vendor data is often difficult to achieve and the test conditions, such as the contact pressures and sample thicknesses, do not always correspond to typical in-use conditions. Providing usable property data to the customer can be challenging given the difficulty in accommodating different contact surface types, flatness levels, joint heights, and loading conditions.

Current work in TIMs reliability at CALCE is focused on measuring the degradation in thermal performance of diamond-filled gels and adhesives, as well as thermal gap fillers and thermal gap filler pads. While thermal greases have known reliability problems, such as "pump out" and "dry out," that arise after prolonged use, the reliability of the TIMs that CALCE is currently investigating is not as well understood. Measuring the performance degradation of the gap fillers and pads will provide insight into the potential effects caused by creep and delamination of the TIM, and investigating gels and adhesives will help quantify any improvement in reliability for cured TIMs compared to greases. Accounting for the interfacial contact resistance, which can be comparable to the bulk material resistance, is key in characterizing TIMs. To simulate realistic loading conditions, fixtures were fabricated to allow for the testing of TIMs sandwiched between two materials under a compressive load. The test samples remain undisturbed between measurements that are performed before and after reliability testing. A laser flash thermal diffusivity measurement system in conjunction with a differential scanning calorimeter (used for the specific heat measurement) are used for thermal performance characterization. Accelerated stress testing, including thermal cycling and high-temperature storage tests, is planned for evaluating the performance degradation, especially due to delamination caused by the coefficient of thermal expansion mismatch arising from the dissimilar coupon materials in the multilayer test sample stackup. It is expected that the results from this study will enable thermal analysts to make a more informed decision when selecting TIMs for long-term applications.

For more information, contact Dr. Michael Osterman at osterman@calce.umd.edu, tel. 301-405-8023.

Lifetime Buy Quantity Optimization Software

Many part obsolescence mitigation strategies exist for managing obsolescence once it occurs, including lifetime buy (also referred to as final order or life of type - LOT buy), last-time buy (also referred to as bridge buy), part replacement, aftermarket sources, emulation, re-engineering, salvage, and design refresh/redesign of the system. The opportunity to make lifetime buys is usually offered by manufacturers of electronic parts prior to part discontinuance (usually in the form of a published "last order date"). Lifetime buys play a role in nearly every electronic part obsolescence management plan.

The management strategy associated with lifetime buys of electronic parts is to determine the optimum number of parts to purchase prior to the last order date. For inexpensive parts, lifetime buys are likely to be well in excess of forecasted demand requirements due to minimum purchase requirements associated with the part delivery format. However, for more expensive parts, buying excess inventory may become prohibitively expensive. Lifetime buys are risky, as forecasting demand and spares requirements for potentially 10-20 years into the future is not an exact science. Even if the number of parts needed in the future could be accurately estimated, stockpiling parts for the future may incur significant inventory and financial expenses. In addition, the risk of parts being lost, unusable when needed, or consumed by another program, all of which are very real occurrences for electronic part lifetime buys that may need to reside in inventory for 10 years or more, increases the risk associated with the lifetime buys in the inventory. Figure 1 shows an influence diagram associated with lifetime buys of electronic parts.

The lifetime buy problem has two facets: 1) demand forecasting, and 2) lifetime buy quantity determination. Demand forecasting is the process of predicting how many parts are going to be needed in the future. The forecasted demand depends on sales forecasts and sustainment expectations for fielded systems. The second part of the problem is the determination of how many parts should be purchased (lifetime buy quantity).

Prof. Peter Sandborn and his CALCE team have developed the LOTE tool, which focuses on the second part of the problem – the determination of optimum lifetime buy quantities based on uncertain demand forecasts and the other influences expressed in Figure 1. The LOTE tool (pronounced “latte” like the coffee) determines the optimal lifetime buy quantities that minimize the life-cycle cost impact on long field life electronic systems. The model takes into consideration the effects of equal run-out (matched sets), and two different types of penalties: a) loss of profit penalty, and b) part procured from non-original source penalty, as well as coupling between various parts. The present version of the tool only treats lifetime buys (not bridge buys).

For more information, contact Prof. Peter Sandborn at sandborn@calce.umd.edu, tel. 301-405-3167.
Counterfeit Electronics

That the world is awash in fake goods comes as no surprise to anyone who has ever strolled down the streets of a major city. Yet in recent years a less visible and no less insidious component of the illicit global trade has taken off: the counterfeiting of electronics components and systems, from tiny resistors to entire routers. With no systematic way to defeat counterfeiters, individual companies have been fending for themselves and learning the hard way that preventing counterfeiting requires a constant, deliberate, and multifaceted effort involving vigorous monitoring of potential trouble spots and judicious use of anti-counterfeiting technologies.

For electronic system manufacturers, it is difficult to identify counterfeits because the part or material may have been introduced several steps earlier in the supply chain. Those who manufacture and distribute them go to great lengths to duplicate materials, part numbers, and serial numbers to coincide with the original parts. Detection through certification or documentation checks may not be very helpful either. For example, in a recent case, the Japanese electronics giant NEC uncovered an elaborate chain that was, in effect, faking the entire company. Law enforcement efforts revealed that counterfeiters created a “new” NEC line of products with everything from home entertainment centers to MP3 players. Those counterfeit products included all compliance certificates, product registrations, and warranties. This level of sophistication in counterfeiting is likely to continue in overall electronics design and production.

Obviously there is an economic cost to victims of counterfeiting in lost time and sales and possible damage to their reputation. Companies whose parts are counterfeited also suffer because other legitimate parts from the company are viewed with suspicion by customers. You do not have to be a direct victim of counterfeiting to be seriously affected by it. Just the perception of possible counterfeiting may result in disruption of a large variety of systems and cause a snowball effect, making the complete supply chain suspect.

No company is immune to counterfeiting. Counterfeit electronics have turned up in every industrial sector, including computers, telecommunications, automotive electronics, avionics, and even military systems. Further, nearly every kind of component has been pirated, from low-level capacitors and resistors to pricey DRAMs and microprocessors. Whole servers, switches, and PCs have been counterfeited, but more commonly, single parts in hundreds or perhaps thousands of end products are bogus.

Is there a defense? There is no silver bullet. What is needed is a deliberate, and multifaceted effort involving vigorous monitoring of potential trouble spots and judicious use of anti-counterfeiting technologies.

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Is there a defense? There is no silver bullet. What is needed is a constant, multifaceted approach. Governments everywhere need to beef up their IP laws and, more importantly, enforce them. Industry representatives need to work together to adopt standard practices for monitoring supply chains. And companies need not only to acknowledge the extent of the problem but also to take deliberate steps to root out bogus parts. Those steps include adopting methods of tracking and authenticating electronic parts; managing their own supply chain to know where their parts come from; developing and adopting parts selection and management tools to stop the scoundrel at the gate; preparing for the eventual obsolescence of parts; and developing and implementing application-specific tests of parts and systems.

Good engineering practices that help in early identification of the problem need to be followed. Fortunately, the practices that can fend off counterfeit parts are in line with the practices that help build reliability into a product. For example (1) developing and following a design for reliability methodology in your organization; (2) knowing your environment (only when you have estimated a cradle-to-grave assessment of the life-cycle environment of your product will you know the ways your parts may fail); (3) knowing how things fail (conducting a failure modes, mechanisms, and effects analysis of your product down to the part level to develop your defenses against the critical failure mechanisms); (4) testing to precipitate failures (ensuring that the identified critical failure mechanisms are verified through testing).

Unfortunately, in most cases a counterfeit part can only be detected when there is a failure. CALCE has world-class capabilities to identify and locate failure causes and to determine if the failure is brought in by a counterfeit part. We also have expertise and capabilities to identify, from bills of materials, parts most susceptible to counterfeiting, based on our extensive research on incidents of counterfeit parts. In addition to on-the-spot assessments, CALCE is also able to benchmark your supply chain development and management methodologies to ensure that your methodologies are not contributing to your being a victim of counterfeit parts. We are also partnering with industry leaders on anti-piracy tools and techniques for developing technology and processes to make it harder for counterfeiters to succeed. These efforts are related to the development of a trusted supply chain for electronics and development of tamper-proof electronic parts.

Companies interested in utilizing CALCE expertise and resources in identifying and preventing counterfeiting can contact Prof. Michael Pecht at pecht@calce.umd.edu, or Dr. Diganta Das at diganta@calce.umd.edu, or Dr. Diganta Das at diganta@calce.umd.edu, tel. 301-405-5323.

Calce-Rwtt RoHS Testing

CALCE and RWTT (RoHS and WEEE Test Technology) have now formed an agreement to provide extensive RoHS compliance testing for companies wishing to assess the RoHS compliance of their supplier’s materials, parts, and sub-assemblies, as well as their own products. This capability was developed as a result of concerns that suppliers may not fully understand the legislation requirements and testing obligations. In fact, we have already found products with RoHS compliance labels which have NOT been RoHS-compliant. We have also seen poor RoHS analysis conducted by companies that did not understand the RoHS requirements. CALCE realizes that the costs to a company can be significant if there is mislabeling.

If you are interested in having your parts and products assessed for RoHS compliance, please check our RoHS website at www.calce.umd.edu/RoHS or contact Prof. Michael Pecht at pecht@calce.umd.edu, tel. 301-405-5323.
History Channel Features CALCE Tin Whisker Research

Prof. Michael Pecht and Dr. Michael Osterman have been interviewed by the History Channel for the channel’s feature on “Modern Marvels: Engineering Disasters,” which aired on March 22, 2006, at 10pm. The episode featuring CALCE focused on tin whiskers which are being widely investigated at the center.

Tin whisker research at CALCE has been led by Prof. Pecht and Dr. Osterman and is focused on the establishment of test methods and microstructural analysis for tin whiskers in an attempt to further understand the tin whisker growth phenomenon. CALCE has also been working with the Government Electronics Industry Association to develop standards for transition to lead-free electronics, including GEIA-STD-0005-2, Standard for Mitigating the Risk of Tin in High-Reliability Electronic Systems. This document focuses on the criteria for accepting the use of tin-finished parts, methods for mitigation failure risk posed by tin whisker, and the actual assessment of whisker risk.

In addition, CALCE has developed whisker risk software. This software program is based on research into tin whisker formation conducted by CALCE over the past three years and uses a stochastic approach to estimate the probability of failure due to tin whisker bridging. The software also allows users to define their own whisker growth characteristics. It provides the probability of failure due to whisker bridging for each defined structure and the total probability of failure for a defined assembly.

For more information, contact Prof. Michael Pecht at pecht@calce.umd.edu, or Dr. Michael Osterman at osterman@calce.umd.edu, tel. 301-405-5323.

Motorola Adopts CALCE MOCA Design Refresh Plan for GTR8000 Hardware Platform

As a result of CALCE and Motorola’s joint work to evaluate and optimize the life-cycle management plan for the GTR8000 hardware platform, Motorola has announced that it will adopt the CALCE MOCA-generated hardware design refresh plan for the future management of the GTR8000 system.

GTR8000 is a COTS-based 700-800 MHz RF base station communications system that replaces several older base station products, and provides a radio frequency hardware platform for a variety of systems and communications modes.

The life-cycle management planning for the GTR8000 was performed using the MOCA (Mitigation of Obsolescence Cost Analysis) tool previously developed by CALCE to optimize the dates and content of design refreshes over the product’s 15+ year life. The optimum plan developed using MOCA resulted in a forecasted life-cycle cost avoidance of over $33M when compared to managing the system using lifetime buys of parts as they become obsolete. Motorola plans to expand the refresh derivatives.

The MOCA study was conducted in summer and fall 2005 by Prof. Peter Sandborn and graduate student Jessica Myers. More information on the MOCA design refresh planning tool is available http://www.calce.umd.edu/contracts/MOCA/MOCA_Page.htm.

Prof. Pecht Wins Distinguished International Service Award

Prof. Michael Pecht is the 2006 recipient of the University of Maryland Distinguished International Service Award. This award, presented annually, is designed to recognize significant contributions to the development of international programs at UMD and to recognize a distinguished international career. The award will be presented by UMD President Prof. C. D. Mote at the international awards ceremony on November 28, 2006, on the University of Maryland campus.

Dr. Han Promoted to Rank of Professor

CALCE faculty Dr. Bongtae Han was promoted to the rank of Professor of Mechanical Engineering on July 1, 2006. Prof. Han’s expertise in photomechanics has underpinned significant contributions to the technical literature and his leadership positions in the mechanics and electronic packaging communities.

CALCE PhD Students Win Best Poster Awards

CALCE PhD candidate Leila Ladani, whose thesis advisor is Prof. Bongtae Han, has won the 14th Motorola-IEEE CPMT Society Graduate Student Fellowship for her paper titled “Ultra-Fine Leak Detection of Hermetic Wafer Level Packages.” This paper was selected as the best of 22 submissions.

CALCE PhD Student Wins Amelia Earhart International Award

CALCE PhD candidate Leila Ladani, whose thesis advisor is Prof. AbhijitDasgupta, has received the 2006–2007 Amelia Earhart International Award in recognition of and in support for her aerospace engineering research. Her research focus is on the mechanics of materials and in particular on fatigue and damage properties of materials used in electronic products. This award is granted annually by the Zonta International Foundation to highly qualified women pursuing a doctoral degree in aerospace-related sciences and engineering.

CALCE PhD Students Win Best Poster Awards

CALCE PhD candidates Joseph Varghese and Gayatri Cuddalorepatta have won the first and third place awards, respectively, in the best student poster competition (electronic and photonics packaging division) from 2005 ASME International Mechanical Engineering Congress and Exposition, which was held in Orlando, Florida. Both PhD candidates are advised by Prof. Abhijit Dasgupta.
**CALCE Books (Can be ordered on [www.amazon.com](http://www.amazon.com)):**

**China's Electronics Industry, ISBN: 0-815-51536-7**

*China's Electronics Industry* is a comprehensive and current report on the technologies, manufacturing capabilities, and infrastructure that have made China a major player in the electronics industry. Not only does it cover the past, present, and future of important electronic technologies, but also the pros and cons of conducting business in China. This book will be an important reference for any company planning a venture in China, as well as those who have already taken their first steps. It will also be of great interest to researchers and policymakers who need to know more about the role of central government in promoting strategic industries and assisting national science and technology development. Much of the data contained in the report is from 2006.

No country has burst onto the economic scene as dramatically as China has in the past decade. It is the world’s largest producer of many electronic products and has a leading-edge semiconductor industry. This timely and comprehensive book by Prof. Michael Pecht is a critical read for anyone who is interested in working with China in the electronics field, including business managers, academics, government institutes, foreign investors, and readers interested in the past, present and future growth of China’s electronics industry.

**Lead-free Electronics, ISBN: 0-471-78617-9**

With the 2006 deadline looming over the electronics industry, this guide for the transition to lead-free electronics is a must. *Lead-free Electronics* edited by S. Ganesan and M. Pecht is the ONLY book that covers the details of parts selection, materials selection, quality and reliability risks and manufacturing and maintenance issues for the successful development of lead-free electronics.

**Parts Selection and Management, ISBN: 0-471-47605-6**

With today’s move to lead-free electronics, electronic parts selection and management program is becoming a critical task in product development. *Parts Selection and Management* edited by Michael Pecht teaches you how to implement an effective parts assessment process that will use the skills of your engineering team, together with the data and information from the part manufacturer, to select parts that are cost-effective, technologically compatible, reliable and manageable. The book provides timely and technically validated information on how to create, gather, analyze, and utilize data from within and from outside your organization for selecting and managing parts. It also provides guidance on how to best utilize the latest technology without taking undue risks. An indispensable guide if you no longer want to rely on outdated handbooks or unverified catalog claims to select your parts.

**Selected Recent CALCE Publications**


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