Session 1A: Passive/Electro-Mechanical Issues
Tuesday, October 8
8:00 am – 10:00 am

1A.1 SAW Components for Automotive Applications with Enhanced Reliability
Karlheinz Rott, EPCOS AG, Munich, Germany

Surface acoustic wave (SAW) components have been implemented in automotive applications, e.g. remote-keyless-entry and tire-pressure monitoring systems. SAW filters and resonators offer high frequency precision and stability, small size, and high reproducibility. A typical SAW component comprises an aluminum layer structured as fingers forming interdigital transducers and gratings on a single crystal piezo-electric substrate. The chips are assembled into a ceramic or metal package and electrically contacted by bond wires. To eliminate this reliability problem EPCOS has introduced a technology called PROTEC®, which builds a polymer cavity covering all active structures to prevent short circuits due to conductive particles. An introduction into this new technique will be presented, including measurements and statistical evaluations. Since introduction of PROTEC® the outgoing quality of the components has been improved significantly and no failures due to short circuits by particles have been reported since.

1A.2 A Comparative Study of Plated Copper Termination and Plated Epoxy/Copper Termination in Automotive Applications of Multilayer Ceramic Capacitors
Frank Hodgkinson, AVX

The following are the major topic headings:
1. Automotive MLC product type - Dielectrics, Case Sizes, Voltages (e.g., NPO vs. X7r vs. X5R; 0603 to 1812; 16v to 1 kV)
2. Key product parameters: (a) Capacitance vs. Voltage, Temperature, Voltage coefficient; (b) Insulation Resistance and Dissipation Factor; (c) Mechanical strength (PCB Flexure criteria)
3. Defect Modes - MLC manufacture, assembly, application
4. Reliability Test Regimes - Pd/Ag vs. BME Data
5. MLC design Considerations - Dielectric thickness, Margin, Cover Layer Thickness
6. BME History - Technology Overview; Production Scale up; Quality data
7. AEC Q200 Data Summary Detailing: (a) Cu vs. Epoxy; (b) Long Term Reliability Testing; (c) Mechanical Stress Testing; (d) Thermal Cycle Testing
8. Long Term Reliability Using Highly Accelerated Test Conditions to Destruction
9. High Temperature Test Results (150C)
10. Field Data (Pd/Ag electrode systems vs. BME electrode systems)

1A.3 Reliability of Lead-Free Passive Components in View of Solder Processes and Quality
Stephan George, BC Components

World wide many large OEM have proclaimed ambitious lead-free programs, paying tribute to the environmental trend away from toxic waste. The automotive industry is under focus in this socio-environmental matrix, which is sparked up by politics. This session will deal with the properties needed for a reliable lead-free system. In particular, reliability issues like whisker growth, voids, thermal stress and stability and their effect on failure modes will be discussed. An overview on current technology trends and legislation as well as on the driving forces of lead-free will complete the presentation.

1A.4 Capacitors for High Temperature Automotive Electronic Applications
John Bultitude, Vishay

The Automotive Industry increasingly needs to use electrical components in severe temperature environments as circuitry is placed under-the-hood. Surface mount multi-layer ceramic X7R capacitors are available with stable capacitance ratings up to +125°C, but these lack stability for operation at 150°C. To address this need, a range of capacitors that meet X8R designation were developed and qualified to AEC standards. The Presentation describes the properties and reliability of these products as well as future developments for even higher operating temperatures.

Session 1B: Passive/Electro-Mechanical Issues
Tuesday, October 8
10:30 am – 12:00 noon

1B.1 Tantalum Capacitor De-Rating
Carl Postiglione, Vishay Intertechnology

As stated in the Tantalum Application Guide EIA-908, it is recommended that users de-rate applied voltage to 40 – 50% at room temperature with further derating beyond 85°C. Although using a tantalum capacitor at its rated voltage is possible it requires the circuit to have a high impedance to limit the available current. Voltage derating has been demonstrated to dramatically improve tantalum reliability in today’s demanding applications. This paper will examine the reasons and history of tantalum voltage de-rating, and review the most common failure mechanisms. Discussion of automotive applications, along with reliability calculations at various percentages of rated voltage will be presented. Finally, a comparison will be drawn between tantalum and ceramic chip capacitors regarding reliability calculations and voltage derating guidelines.
1B.2 New Professional Grade of Solid Tantalum Capacitors for Automotive Applications
Bill Millman, AVX

Specific requirements on passive components such as higher temperature, improved reliability, voltage/current spikes resistance, and environmentally friendly have been seen from automotive applications. A special grade of solid tantalum capacitors has been developed in order to optimize design to meet these requirements. The paper introduces two automotive friendly series – one for cabin electronics with improved reliability up to 125°C and the second series for “on engine electronics” that meet both requirements for 150°C continuous operation temperature and better reliability within one series. The paper explains the specific design approaches and materials that differentiate these new automotive grade tantalum capacitors from the currently available commercial parts.

1B.3 Lead Free Passive Components Solder Joint Reliability with Current Material Set
Ping Seto, DaimlerChrysler

As the push for the elimination of lead bearing material from electronic assemblies are being stepped up, many of the automotive suppliers are anticipating this upcoming changes. Especially in the area of passive components, suppliers are either planning or in the process of eliminating lead in their devices. At DaimlerChrysler Huntsville Electronics Division (DCHE) in Alabama, we anticipated a transition period where lead free devices are being used together with the current lead bearing material set. Eventually, our entire supply chain will be readied to make complete lead free electronics a reality. To fully understand the reliability impact and issues that may occur, we have undertaken a multi-phase reliability study geared toward lead free component solder joints. In cooperation of Auburn University, testing is underway to gather this data under the automotive test conditions.

2A.1 Properties and Reliability of Capacitors Made with Advanced Materials Systems Compared to Base Metals Technology
Karl Treml, Vishay

The increasing cost of precious metals has driven manufacturers to develop multilayer ceramic capacitor technologies that are less dependent on palladium. Two different approaches to reducing the dependency on use of palladium for the inner electrodes have been commercialized: (1) Base Metal-compatible material systems, usually employing nickel electrodes and requiring reducing atmospheres for processing, and (2) Advanced Materials Systems with ultra low firing temperatures. This Presentation compares the properties and reliability of multilayer ceramic capacitors made with these systems.

2A.2 Voltage Derating Rules for Solid Tantalum and Niobium Capacitors
Bill Millman, AVX

For many years whenever people have asked a tantalum capacitor manufacturer about what were the safe guidelines for using their product, they spoke with one voice “a minimum of 50% voltage derating should be applied”. This message has since become ingrained and automatic. This paper challenges this statement and explains why it is not necessarily the case. The paper and presentation will also introduce a simple to use derating software tool that has been developed as a guide for designers. A new capacitor technology based on niobium and niobium oxide powder has been introduced to the market. The paper also discusses derating principles that apply to these capacitors.

2A.3 Reliability of Electrolytic Capacitors in Harsh Environments
Stephan George, BC Components

The current voltage on the vehicle bordnet of 12/14 V has reached its limits through an increased demand of power. Modern cars in the luxury segment already rely on a power management, which by computer limits power applications and manages power distribution. This situation has spurred the development of a new standard of 42 Volt. With the introduction of 42 Volt Powernet the “electronification” in automobiles will receive a new growth impulse. At the early specification state a large number of quality and reliability related features are determined, therefore the definition of the specification together with the system partner is of utmost significance for the product reliability. Validating such custom designed products in a minimum testing time as well as simulated stress testing with a high degree of certainty is an important shared task to ensure time to market of these products.
2B.1 Ferrites & Automotive Electromagnetic Compatibility
Jeff Bruce, Steward, Inc.

As the use of sophisticated electronics in automobiles continues to grow at astounding rates, so does the issue of electromagnetic compatibility (EMC) from the standpoint of both immunity to, and radiation of, high frequency interference (RFI). When selected properly, soft ferrite products are among the most valuable and effective tools an automotive electronics design engineer can apply. One estimate indicates that the average passenger car currently contains 26 ferrite rods, while the average truck contains 12. With the ever-increasing level of vehicle sophistication, these numbers are set to grow significantly over forthcoming years. This continual development of vehicle electronics has lead to the need for improved management of EMC and as a result, we now find ferrite products in engine management units, airbags, keyless entry, CAN-Bus modules, tire pressure sensors, power supplies, occupant detection, radio antenna/defrost grids, etc. This paper will review the different types of soft ferrite devices available, the materials from which they are produced, and the design considerations that drive the proper selection. Primary considerations include signal and noise current frequency and amplitude, application temperature range, and the presence of direct current. Secondary considerations include Curie temperature and resistivity. Several materials will be selected to illustrate the effect of frequency and temperature and several part types will be selected to illustrate the effect of core configuration and current amplitude on inductance and impedance.

2B.2 FeedThru Filter Developments and Performance in ESD and RFI Fields
Ron Demcko, AVX

EMC issues in auto circuitry continue to be some of the most difficult requirements to fix in a cost effective manner. FeedThru filters have evolved greatly from the bolt in cylinders of years past. Current filters are available in both capacitor and varistor configurations. Sizes vary from 0805 single element devices to 0612 4 element array devices (which contain the equivalent of 8 inductors, 4 capacitors and 8 diodes - in the case of the varistor FeedThru array). A FeedThru capacitor filter can yield a 30 db attenuation across a several hundred Mhz window (that filter window is available across approximately 25 Mhz to 1.2Ghz of the RF spectrum). High current (1,2 and 5 amp) Feedthrus are available for use in regulators circuitry, module power optimization and enhanced IC decoupling. Varistor FeedThru filters are essentially an active filter which can yield either 50db of attenuation to a transient or a -40 db attenuation across a 100 Mhz window available from 200 mhz to 1.1 Ghz. Application guidelines are given along with ESD and RFI response characteristics.

2B.3 Lighting the World with Semiconductor Technology - Automotive Interior and Exterior Lighting with LED's
Horst Lengning, Vishay Semiconductor

Just as the vacuum tube was replaced by integrated circuits in the late 1950s, current light sources will soon be threatened by a new generation of solid-state light-emitting devices, LEDs. At a quick pace, LEDs are conquering the illumination in and on vehicles. Not only in telltale, radios or switches but in many demanding applications like clusters, navigation displays, backlighting, Turn signal, Break lighting and rear combination lights. However, the quick adoption of LED technology in and around the cars is not driven by technological or purely economical motivations. Of course, aspects like low current draw, long life times, resistance to vibration and reduced space requirements are important motivators to replace conventional lighting with solid-state based lighting. The increased brightness levels of LED chips together with innovative mounting solutions turn solid-state lighting into very powerful compact light sources for highly demanding applications like a unmatched color harmony inside the cars. With all these new developments, LEDs will easily in the focus of the car industry as a significant contributor to innovation in the vehicle.

3A.1 Conducted EMI Analysis of Planar vs. Trench Power MOSFET
Jingdong Chen, International Rectifier Co.

For Power MOSFET evaluation in automotive environment, conducted Electromagnetic Interference (EMI) is always an important aspect. However, conducted EMI roots from not only die characteristics but also device packaging, PCB layout and passive components. So it is essential to investigate the relationship between conducted EMI and system parameters, which can provide a good guidance for silicon, package and circuit design to compress EMI from a system approach. In this study, to compare planar and trench technologies for conducted EMI effects, a half bridge test circuit is carefully set up to eliminate parameter interaction and variations. Comprehensive tests are applied to obtain the relationship between conductive EMI and measured voltage and current waveforms. Numerical simulation and simplified analytic methods are used to reveal the effects of variables such as Rg, stray inductances, and ESR and ESL of passive components on conducted EMI.
3A.2 A Simplified Method of Generating Thermal Models for Power MOSFETs
Kandarp Pandya, Vishay Siliconix

There is an increasing need for designers to understand the thermal performance of the semiconductors they use because end-product case sizes are shrinking while products’ power levels remain the same or increase. A simulation tool such as PSpice is the most commonly available tool for engineers to use in performing thermal analysis of semiconductors. However, generating the thermal model for power semiconductors represents a major hurdle in performing such an analysis. A simplified method of model generation is needed. In this paper an Excel spreadsheet uses datasheet information published by the manufacturer to generate the R-C (resistance-capacitance) parameters for a thermal model. Implementation of the model in P-SPICE enables performance evaluation for any pre-defined operating condition. The intent is to arrive at a fair estimate of the junction temperature of the power-handling device, the MOSFET under transient high-power pulse/s. The explanation of a proposed simplified method of thermal model generation will include an example featuring a power MOSFET.

3A.3 Rugged Trench MOSFET Technology Optimized for Automotive Applications
V. Karve, International Rectifier Corp.

MOSFETs built using ultra low Rdson trench technology have finally come of age for automotive applications. This paper details the improvements in parametric performance from devices built with the new trench technology and compares them to earlier planar and trench devices. In addition, the paper reviews test results related to the ruggedness of trench and planar devices. A scheme to reliably rate devices under repetitive avalanche conditions is also discussed to demonstrate the inherent ruggedness of this new technology.

3A.4 Streamlining the FMEA Process for Semiconductor Device Manufacturing
Robert Dwyer, Fairchild Semiconductor

Semiconductor device manufacturing is uniquely noted for short product life cycles and quick design cycles. It also requires frequent updates to reflect lessons-learned and continual process improvement. Streamlining the FMEA process was therefore necessary to encourage the use of the FMEA as a “living document”, and to keep pace with the shorter product life cycles in the quick-turn industries, as well as the automotive industry. Furthermore, the increased rate of new product generation necessitates the need to generate FMEA’s on a more frequent basis with shorter and shorter time allotted for the FMEA process. However, any FMEA process streamlining activity must maintain the integrity of the generation process as well as the output of the process. The completed FMEA’s must also provide the feedback and output required by AECQ101. This requirement is even more critical for multi-market semiconductor manufacturers who serve both the quick-turn traditional semiconductor market as well as the automotive industry, which has an acute focus on the FMEA process to ensure built-in quality. In this paper, a methodology to accomplish these goals is discussed including: the critical assumptions made; a review of the refined rating system; definitions of simplified ratings criteria; an overview of the entire FMEA procedure; and examples of a completed FMEA. With this enhanced system, the FMEA generation time is dramatically reduced, there is continued compliance with AECQ101 standards, and the integrity of the process is kept in tact. Using this refined approach results in higher quality FMEA output. Efforts are focused on the FMEA content rather than the mechanics of the FMEA. The FMEA process has been shown to be an excellent tool for design, process, and control of manufacturing, and this streamlined process is designed to ensure that the FMEA will continue to be an effective tool.

Session 4A:
Integrated Circuit Issues
Wednesday, October 9
10:30 am – 12:00 noon

4A.1 Sumitomo Bakelite: Epoxy Molding Compounds in Automotive Applications
Toru Kamei, Sumitomo Bakelite Ltd.

Epoxy molding compound (EMC) strongly influences the performance of semiconductor packages, and recent requirements for EMC are becoming more difficult. Specifically, higher MSL performance is required with the rapid popularization of Pb-free solder. Additionally, removing harmful materials such as Br/Sb from the EMC has become a common way to address environmental concerns. In the case of automotive applications, we have to consider the operation of semiconductors under high temperature and high voltage conditions. In order to realize better performance in HTRB and power cycle test (TFT) in Q101, a new material design concept is necessary. Additionally, if we consider the influence of the rapid growth of communication methods on the automotive industry (ETC and car navigation system), high frequency applications may be necessary too. Sumitomo Bakelite is continually researching these new requirements. In this workshop we'll introduce our latest activities and results for these targets.

4A.2 Packaging and Reliability Paradoxes from Advanced Powertrain Control Architecture Requirements
Mark Christopher, Daimler-Chrysler

Emerging powertrain applications are pushing component requirements into seemingly paradoxical realms. Worldwide powertrain markets demand electronics integrated into engine and transmission systems with common bus interface across, not only a particular manufacturers group of products but, product lines within manufacturers
consortiums. This approach allows application of “known good” engine and transmission systems across market boundaries. The packaging envelopes for electronic controllers physically integrated into these systems are more easily compared to pagers, cell phones, and PDAs than to the bulky underhood modules to which we are all familiar. There are no substantial reductions in functionality associated with these smaller envelopes, and the operating ambient temperatures are significantly increased over standard underhood applications. This paper presents component packaging requirements and reliability data for component packaging that address the real estate constraints associated with these controller requirements. Operating environments from vehicle measurements and life test thermal cycle requirements will also be presented. Finally, design techniques that address the seemingly self contradictory design paradigms will be presented.

4A.3 High Temperature Flip Chips for Automotive Modules in the Harsh Environment
Peter Sommerfeld, TechnoFusion GmbH – International Rectifier Automotive

Electronic modules for automotive application have to be especially robust if placed under the hood. This harsh environment requires a special packaging and interconnection technology to fulfill the reliability requirements of the automotive industry. Temperature ranges can be quite severe and therefore standard packaged components often do not have the necessary specification for use in these modules. Silicon ICs therefore are not processed in packaged but in bare die form. This ensures that the plastic of the package is not the limiting factor in the temperature specification of components. In this paper we will show how the use of flip chip IC has been successfully employed for electronic modules in under-the-hood applications. Special emphasis is placed on the processing of these parts to achieve the required reliability requirements. Major contributors in the bumping technology of the flip chip device and the substrate technology to achieving the reliability target are identified. The overall advantages to alternative technologies e.g. chip and wire are discussed and compared to data derived from high volume production quantities. The paper also gives recommendations for the key processes and their control in a high volume production scenario. An outlook is given for future packaging technologies and compared in terms of cost and investment.

Session 5A: Integrated Circuit Issues
Wednesday, October 9
1:30 pm – 3:00 pm

5A.1 Moisture Sensitivity in Plastic Packaged Integrated Circuits
Bob Knoell, Visteon

The diffusion of moisture into the plastic encapsulant of a surface mounted integrated circuit can adversely affect its reliability. The high temperatures used during board assembly will superheat this embedded moisture and, if adhesion of the plastic encapsulant to the die or leadframe is sufficiently low, can create delamination of these materials. This delamination can then lead to device failure by inducing die stress cracking, open pins by dislodging wire bonds, current leakage by ionic contamination, or functional failure by die metal corrosion. Thus, it is important to keep these devices as dry as practicable before board assembly. This presentation will illustrate the mechanisms of moisture ingress, the types of failures that can be induced, how these devices should be qualified and classified as to their sensitivity to moisture, and how users should handle these parts so as to not induce latent field failures. The impact of higher temperatures needed to reflow Pb-free solder and improvements in plastic materials will also be reviewed.

5A.2 One Study of QFD Implementation
Takeshi Kuijrai, Sanyo

For these several years, QS-9000 quality system has been implemented among Semiconductor Industry. Some quality methodology such as FMEA and Control Plan has been used. To seek further ensuring of QUALITY, QFD should be focused and utilized more. QFD is one of the required skills for design control element of QS-9000. The purpose of this procedure is to make sure input and develop customer requirement into design system. On the other hand, QA issues at our customers are difficult to make it PERFECT ZERO. But this is current requirement for us. SANYO has reviewed and analyzed Quality System. And summarized the key points as follows. First, timing and application of conducting QFD must be significantly important. Second, input data and information to QFD must be collected from many fields. Third, cooperation between semiconductor supplier and customer is necessary. To reduce defects at ZERO PPM level, we must improve quality system and hit the target of potential root cause during design phase. For this purpose utilization of QFD has become significantly important.
5A.3 Re-Evaluating Moisture Sensitivity Level Test Conditions for New-Generation Packages
Lei Mercado, Motorola

JEDEC Standard J-STD-020 test conditions have been widely in the electronic industry to rate packages for Moisture Sensitivity Level and to qualify package performance under temperature and humidity conditions. Demands for high packaging density of low pin-count packages have driven the development of a new generation of packages to replace the Quad Flat Packages (QFP). Package size has been reduced drastically. Package reflow temperature has been considerably increased due to the application of lead-free solder. Consequently, the JEDEC standard testing on these packages needs to be re-evaluated. In this paper, moisture diffusion analysis, heat transfer analysis, as well as an interface fracture mechanics-based thermo mechanical analysis have been conducted. The impact of different reflow profiles was investigated. Due to the smaller package size and higher reflow temperature, the new packages are more sensitive to the reflow parameters such as peak temperature and cooling rate. For the reliability testing of the new-generation packages, modification of the JEDEC standards may be necessary to ensure that these packages are not subjected to more stringent criteria than their previous counterparts.

5B.2 IST – Interconnect Stress Test
Ulrich Zimmer, RMCtech-DaimlerChrysler Germany

The rapidly increasing complexity and subsequent demands of the end use environment of the interconnect structure, have established that traditional accelerated stress testing methodologies are limited in their ability to quantify manufacturing, component assembly and field use environments, in a timely manner. Interconnect Stress Testing (IST) Technology is presently becoming established as the electronics industries preferred test methodology for the assessment of different elements of the interconnect structures. The first part of the presentation will deal with the test fundamentals, generic IST test strategy related to design and product baselining, achievable test results and benefits in terms of rapid problem solving. The second part will give an outlook into the 2nd generation of the IST methodology, currently under development, related with detection, quantification and assessment of failure mechanisms of all types of assembly technologies such as SMD, XBGA, LGA and Flip Chip as well as reliability monitoring of continuous manufacturing environments.

5B.3 Scan vs. Functional Testing Methodology: Microcontroller Case Studies
Matthew Stout, Motorola

This paper presents the challenges associated with testing high-volume consumer microcontrollers. The consumer market demands integrated circuits of high quality while offering best value to the consumer. A “design-for-test” methodology based on scan testing offers an attractive method to meet these criteria. High-quality and economic testing can be obtained by relying primarily on scan testing. This approach is similar to the current AEC requirement specified in AEC-Q100 (REV-E, January 31, 2001) Attachment 7, Section 3.6.5. Data from two case studies on microcontrollers is presented showing the effectiveness of scan testing over functional testing. These case studies support a full scan approach with only supplemental functional patterns, as required.

5B.1 Embedded Non-Volatile Memory Qualification Methodologies for Automotive Applications
John Bridwell, Motorola

The reliability requirements from the automotive market place are demanding lower and lower lifetime failure rates. The market covers a wide range of applications from window controllers to safety critical applications such as air bag controllers. To meet customer demands of zero warranty failures, the successful introduction of embedded non-volatile memory requires a rigorous development methodology. This methodology must support the statistics necessary to meet the market expectations. A development methodology has been defined that encompasses technology feasibility and certification in support of product qualifications. In following this method, the typical product qualification requirements can be met while enhancing the overall insight into the eNVM module’s reliability. This methodology and the typical data that must be gathered and modeled during the development and product phases will be presented.

6A.1 Laser Decapsulation at Plastic Molding Compounds for Bond Stability Characterization
Dietmar Sigmann, Atmel

Low adhesion of mold compound onto the silver plated die paddles promotes die paddle delamination. Different thermal extensions can than mechanically stress the down bonds and can cause damages like broken or lifted down bond. Question: How to verify bond quality of gold wedge bonds or down bonds onto the die paddle (e.g., stitch on
ball) after soldering process/preconditioning and after temperature cycling? Facts: Chemical decapsulation degrading the down bonding or die bonding. Integrity and quality of such bonds can not be evaluated on such decapsulated ICs. Solution: Atmel Germany GmbH developed a laser decapsulation process to inspect and to perform wire pull tests on wedge and down bonds. The presentation includes laser decap process description, experimental results and suggested design rules for ground bonds. Laser decap can not replace completely the chemical decap as the electrical chip function can be influenced by the laser energy.

6A.2 Signature Failure Analysis Implementation: An Update on Method and Results
Roger Newkirk, Motorola

Signature Failure Analysis is a process for creating a link between the electrical data taken on failed parts and the physical failure mechanism identified as the root cause of the failure. Once the root cause of a failure type has been identified and corrective action taken, continued analysis of failed parts with the same type of failure yield diminishing returns on the effort expended. Appropriate use of Signature Analysis reduces routine (repeat) failure analysis thereby allowing concentration of resources on identification of other types of failure mechanisms. The success the Signature Analysis methodology depends on the degree of correlation between electrical failure mode and physical failure mechanism (defect cause). JEDEC, with support from SEMATECH has published a document (JEP136) describing a Signature Analysis approach. The approach has not been extensively implemented with complexity been the most frequently given reason. Motorola has defined, what is believed to be a more a more pragmatic way, based on simple rules, engineering consensus and customer acceptance of the rules. The Motorola methodology will be reviewed with examples example of the validation procedures and the use of the validated signatures for Failure analysis.

6A.3 3D X-Ray Laminography, A Non-Destructive Technique with A Big Future for The Evaluation of Dense Multi-Layer PCB's and BGA Solder Joints
Daniel Vanderstraeten, Alcatel

In recent years the market for BGA-like packages together with dense multi-layer boards has been growing very fast creating new challenges for the responsible engineers in the evaluation and assessment of these new products. One of the topics is the use of non-destructive evaluation techniques during the evaluations and assessments of these products. The traditional use of 2D X-ray is no longer sufficient enough because the combination of multiple layers of tracks, power planes, stacked dies, solder balls and other items are masking each other. If we need to see details of one specific layer we need to go over to destructive analysis techniques risking to loose important information. The other possibility is to invest in new non-destructive techniques. Such a technique with a big future is 3D X-ray laminography. We have experienced that 3D Xray laminography is a very helpful tool and major improvement during the evaluation and assessment of BGA solder joints and dense multi-layer boards. Recent developments in 3D Xray laminography have upgraded it (the technique was originally used in the medical world) to a technique that can be used in the microelectronics world avoiding the time consuming and costly destructive analysis of high density IC’s and PCB’s to the strict minimum. Features as small as 5 micron (in all directions) can be examined today revealing details that not could be seen before and by this helping to improve the end product in a fast and adequate way. In this abstract we are showing images of two cases where 3D X-ray laminography helped us a lot during the evaluation. As a conclusion we can say that 3D X-ray laminography is very helpful non-destructive tool. It reveals items that not could be visualized before except by doing destructive analysis. As the technique is recently introduced for the inspection of IC’s and giving such nice results we are sure that it has a big future.

6A.4 A Unique Method of Using Weibull Analysis for Burn-In Reduction
Lisa A. Gunderman, Motorola Semiconductor Products Sector

In this work, we have derived a form of Weibull analysis which allows the determination of a failure rate at any point in time to a specified confidence level, e.g. 90%, from burn-in and lifetest data. By using the early burn-in readpoints, where there are more failures, we are able to accurately define the shape of the Weibull curve. Once the shape is accurately defined, the curve can be used to determine ELFR failure rate as a function of burn-in time. Burn-in time is then defined as the minimum burn- in time that still meets the failure rate criteria at the specified confidence level. While Weibull statistics have been around for many years, we are not aware of a means of applying a confidence level in making a failure rate determination from Weibull. This finding allows the same burn-in reduction study to be performed with a much smaller sample size of only ~4,000 vs. 46,000 for Poisson statistics. Thus, application of the Weibull confidence level method to burn-in reduction data should result in significant cost reduction and time savings. Case studies using the Weibull confidence level method are presented.
Diverging Automotive & Semiconductor Industries … The Shrinking Supply Base
Morris Blowers, Global One Associates

The semiconductor industry and the automotive industry are diametrically opposed to each other. What one needs the other doesn’t want to provide in the manner needed. The future relationship is only going to get worse not better. The arrogance & misunderstanding of each other’s business models makes it very difficult to negotiate long term business planning. Is there such a thing as a partner in the Automotive-Semiconductor world? The two industries, automotive & semiconductor, have been thrown together in a technology battle without either one understanding the other and without the infrastructure to deal with the others business model. My intention in this paper is to give new meaning to relationships between the semiconductor/electronics industry and automotive OEM’s in shaping tomorrow’s automotive OEM managers to manage what they don’t know and mostly what they don’t really care about, that is until it becomes a crisis. Additional subject to be covered include: Aligning the design and supply chains; Reliability problems scale up as Technology scales down; QS/ISO9000-9001; Emerging Industries … The Shrinking Supply Base

Session 6: Break
Thursday, October 10
10:00 am – 10:30 am

6B.1 Easy Characterization of E-M Actuator Dynamic Inductance
Tom Kotowski, Delphi Delco Electronics

A vital engine controller power load is an Electro-Mechanical actuator. A primary factor determining the reliability of the power device that switches this load is peak junction temperature during turnoff. Because the duration of the turnoff power pulse is often larger than the thermal time constant of the driver, peak junction temperature is very dependent on the rate of falloff of the power pulse; i.e. it differentiates the input. Because of changing flux linkage and material properties, the inductance of an actuator changes with position, time, and current. Conventional modeling with a static inductance gives a current with roughly a constant rate of fall and typical junction temperature estimate errors of about 30%. Plotting the dynamic inductance versus current of several actuators reveals that the inductance decreases by about 90% and falls off linearly in the high current region. During current fall, the falloff rate typically changes from five times as fast to twice as slow as static inductance. The current response equation for linear “saturation” of dynamic inductance and the equations for the dynamic inductance parameters, Lo and Lsat, are solved. These characterization parameters can be obtained from measurement of a single central and the two end current points.

6B.2 Environment Friendly Products Issues: An Update
Nick Lycoudes, Motorola

Interest in products that do not harm the environment is increasing continuously. Elimination of Lead from the Electronics Equipment, Parts and Materials has received the major emphasis in the last few years. However interest in reduction of other potential hazardous materials has also increased. At present, the interest is focused in identification, control and elimination of potentially hazardous materials, through the use of product content surveys. Legislation and other drivers for use of environment friendly materials will be reviewed. The issues such as alternative materials, economics, Quality/Reliability, etc. around use of environment friendly materials will be reviewed using as an example “Lead reduction/elimination” efforts as described in recent conferences.

6B.3 Reconfigurable Vehicles
Karen Parnell, Xilinx

When we envisage automotive electronics we automatically consider electric windows, central locking systems, safety systems, climate control and electronic ignition systems, all of which require stringent qualification, temperature cycling and certification. The new emerging automotive electronics boon has now shifted from under the hood or bonnet to in-cabin multimedia applications. The trend towards mobile offices and entertainment on the move has meant a large portion of the electronic or semiconductor content has moved into this expanding area. Due to time to market and cost pressures the increased electronics content in vehicles can only be achieved by integrating electronics with electrical and mechanical systems. Additionally car manufacturers are increasingly reliant on independent electronics system suppliers or third party suppliers to provide these new functions. The third party suppliers have to produce a different model of system for each different OEM. This has lead to many different PCBs, new front displays and mouldings, different connectors and wiring and dedicated software. The trend therefore for these third party suppliers is to base every model they produce on a common platform which can be ‘tweaked’ through minimal changes for each OEM. Programmable logic cannot only be used for prototyping systems but can also be used in full production to allow for system personalization. Time to market pressures can be alleviated by using programmable logic; thus providing shorter development time scales over traditionally used ASICs (Application Specific Integrated Circuits).