

AUTOMOTIVE ELECTRONICS RELIABILITY HANDBOOK

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AE-9

Automotive Electronics Reliability Handbook

**R.R. Tummala, Eugene J.
Rymaszewski, Alan G. Klopfenstein**



Automotive Electronics Reliability Handbook:

Automotive Electronics Reliability Handbook, 1987 This handbook was designed to provide the automotive electronics community with an understanding of the concepts principles and methodologies concerning all aspects of automotive electronic systems reliability engineering Chapters include Reliability Terminology Associated with Automotive Electronics Reliability Theory Reliability Data Analysis Regression Analysis Reliability Specification and Allocation Reliability Prediction Reliability Design Guidelines FMEA FTA and SCA Reliability Demonstration and Reliability Growth The handbook is based upon information from several sources which are listed at the end of each chapter *Automotive Electronics Reliability* Ronald K Jurgen, 2010-08-10 Vehicle reliability problems continue to be the news because of major vehicle recalls from several manufacturers This book includes 40 SAE technical papers published from 2007 through 2010 that describe the latest research on automotive electronics reliability technology This book will help engineers and researchers focus on the design strategies being used to minimize electronics reliability problems and how to test and verify those strategies After an overview of durability risk assessment and failure mechanisms this book focuses on state of the art techniques for reliability based design and reliability testing and verification Topics include powertrain control monitoring distributed automotive embedded systems model based design x by wire systems battery durability design verification fault tree analysis The book also includes editor Ronald K Jurgen s introduction Striving for Maximum Reliability in a Highly Complex Electronic Environment and a concluding section on the future of electronics reliability including networking technology domain control units the use of AUTOSAR and embedded software **Reliability Prediction for Automotive Electronics Based on Field Return Data** Automotive Electronic Systems Reliability Standards, 2017 This document should be used as guidance for non handbook based reliability predictions conducted on automotive electronics products It presents a method that utilizes warranty and field repair data to calculate the failure rates of individual electronic components and predict the reliability of the entire electronic system It assumes that the user has access to a database containing field return data with classification of components times to failure and a total number of components operating in the field In early design activities typically before the hardware is built a reliability prediction is often required for the electronic components and systems in order to assess their future reliability and in many cases to meet customer specifications Those specifications may include the allocated reliability for a particular electronic unit and in the cases of functional safety products to meet the ASIL Automotive Safety and Integrity Level requirement specified by the international functional safety standard ISO 26262 This Recommended Practice RP document will provide guidance on performing reliability predictions for automotive electronic products utilizing field return data or any other types of failure data available to an automotive electronics supplier This document will cover the possible sources of data types of the data required ways to collect it and the methodology of how to process these data to calculate the failure rates and the expected reliability This document will also include a case study

based on the data obtained by Delphi Electronics Safety a Tier 1 automotive supplier to illustrate the process of reliability prediction based on field return data *Automotive Electronics Reliability* Ronald K Jurgen, 2010-08-10 Vehicle reliability problems continue to be the news because of major vehicle recalls from several manufacturers This book includes 40 SAE technical papers published from 2007 through 2010 that describe the latest research on automotive electronics reliability technology This book will help engineers and researchers focus on the design strategies being used to minimize electronics reliability problems and how to test and verify those strategies After an overview of durability risk assessment and failure mechanisms this book focuses on state of the art techniques for reliability based design and reliability testing and verification Topics include powertrain control monitoring distributed automotive embedded systems model based design x by wire systems battery durability design verification fault tree analysis The book also includes editor Ronald K Jurgen s introduction Striving for Maximum Reliability in a Highly Complex Electronic Environment and a concluding section on the future of electronics reliability including networking technology domain control units the use of AUTOSAR and embedded software

Handbook for Robustness Validation of Automotive Electrical/Electronic Modules Automotive Electronic Systems Reliability Standards, 2012 This document addresses robustness of electrical electronic modules for use in automotive applications Where practical methods of extrinsic reliability detection and prevention will also be addressed This document primarily deals with electrical electronic modules EEMs but can easily be adapted for use on mechatronics sensors actuators and switches EEM qualification is the main scope of this document Other procedures addressing random failures are specifically addressed in the CPI Component Process Interaction section 10 This document is to be used within the context of the Zero Defect concept for component manufacturing and product use It is recommended that the robustness of semiconductor devices and other components used in the EEM be assured using SAE J1879 OCT2007 Handbook for Robustness Validation of Semiconductor Devices in Automotive Applications The emphasis of this document is on hardware and manufacturing failure mechanisms however other contemporary issues as shown in Figure 1 need to be addressed for a thorough Robustness Validation A Pareto of contemporary issues is shown in Figure 1 Although this document addresses many of the issues shown however some are outside the scope of this document and will need to be addressed for a thorough RV process application Examples of issues outside the scope of this document are system interactions interfaces functionality HMI Human Machine Interface and software At the time of publication of this handbook a system level Robustness Validation handbook which addresses these issues had been initiated In late 2006 Members of the SAE International Automotive Electronic Systems Reliability Standards Committee and ZVEI German Electrical and Electronic Manufacturers Association formed a joint task force to update SAE Recommended Practice J1211 NOV1978 Recommended Environmental Practices for Electronic Equipment Design The 1978 of version of SAE J1211 was written in an era when electronics were first being introduced to the automobile There was a high level of concern that the harsh environmental conditions experienced in

locations in the vehicle could have a serious negative affect on the reliability of electronic components and systems Some early engine control modules ECMs had failure rates in the 350 failures per million hours f 106 hrs range or expressed in the customer s terms a 25% probability of failure in the first 12 months of vehicle ownership At that time warranty data was presented in R 100 repairs per 100 vehicles units for example 25 R 100 at 12 months In these early years when the automotive electronics industry was in it s infancy a large percentage of these were hard catastrophic and intermittent failures exacerbated by exposure to environmental extremes of temperature 40 C to 85 C high mechanical loads from rough road vibration and rail shipment mechanical shocks of up to 100g from handling and crash impact severe electrical transients electrostatic discharge and electromagnetic interference large swings in electrical supply voltage reverse electrical supply voltage and exposure to highly corrosive chemicals e g road salt and battery acid The focus of the 1978 version of J1211 was on characterizing these harsh vehicle environment for areas of the vehicle engine compartment instrument panel passenger compartment truck under body etc and suggesting lab test methods which design engineers could use to evaluate the performance of their components and systems at or near the worst case conditions expected in the area of the vehicle where their electrical electronic components would be mounted By testing their prototypes at the worst case conditions i e at the product s specification limits described in the 1978 version of J1211 designers were able to detect and design out weaknesses and thereby reduce the likelihood of failure due to environmental factors By the mid 1980s it became common practice to specify test to pass zero failures allowed environmental conditions based reliability demonstration life tests with acceptance levels in the 90% to 95% reliability range with confidence levels of 70% to 90% This translates to approximately 5 to 20 f 106 hrs The sample size for these tests was determined using binomial distribution statistical tables and this would result in a requirement to test 6 to 24 test units without experiencing a failure If a failure occurred the sample size would have to be increased and the testing continued without another failure till the bogie was reached The environmental conditions during the test were typically defined such that the units under test were operated at specification limits based on J1211 recommended practices e g 40 C and 85 C for at least some portion of the total test time The goal of passing such a demonstration test was often very challenging and the test analyze fix programs that resulted although very time consuming and expensive produced much needed reliability growth Reliability improved significantly in the late 1980s and early 1990s and vehicle manufactures and their suppliers began expressing warranty data in R 1000 units instead of R 100 units By the turn of the century automobile warranty periods had increased from 12 months to 3 4 5 and even 10 years for some systems and most manufacturers had started specifying life expectancies for vehicle components of 10 15 and sometimes 20 years And by this time several vehicle manufacturers and their best electrical electronic component suppliers had improved reliability to the point where warranty data was being expressed in parts per million ppm in the triple double and even single digit range This translates to failure rates in the 0 05 f 106 hrs range and better The achievement of such high reliability is

not the result of test to pass reliability demonstration testing based on binomial distribution statistical tables With this method reliability demonstration in the 99 99% to 99 9999% range would require thousands of test units On the contrary the methods and techniques used by engineering teams achieving such reliability excellence did not require increasingly large sample sizes more expensive and lengthy testing or more engineers It is about working smarter not harder and about systems level robust design and robustness validation thinking rather than component level test to pass thinking The task force leaders and members were of the strong opinion that the 2008 version of SAE J1211 should document the state of the art methods and techniques being used by leading companies and engineering teams to achieve ultra high reliability while at the same time reducing overall cost life cycle and shortening time to market The SAE International Automotive Electronic Systems Reliability Standards Committee and ZVEI German Electrical and Electronic Manufacturers Association are hopeful that this Handbook for Robustness Validation of Automotive Electrical Electronic Modules will help many companies and engineering teams make the transition from the 1980s cookbook reliability demonstration approach to a more effective economically feasible knowledge based Robustness Validation approach Relevant information and data from SAE J1211 NOV1978 is preserved in SAE J2837 Environmental Conditions and Design Practices for Automotive Electronic Equipment Reference Data from SAE J1211 NOV1978 Handbook of Performability Engineering Krishna B. Misra,2008-08-24 Dependability and cost effectiveness are primarily seen as instruments for conducting international trade in the free market environment These factors cannot be considered in isolation of each other This handbook considers all aspects of performability engineering The book provides a holistic view of the entire life cycle of activities of the product along with the associated cost of environmental preservation at each stage while maximizing the performance **Automotive Electronics Handbook** Ronald K. Jurgen,1999 This second edition of the widely sold title contains new and updated chapters on areas such as safety features It also includes new sections on adding electronic intelligence to automotive features Product Warranty Handbook Wallace Blischke,1995-11-03 Covering product warranties this work offers comprehensive examinations of fundamental concepts and furnishes detailed immediately applicable results It sets out to bridge the gap between theory and practice and integrates the research of various disciplines that study warranty illustrating all basic consumer warranty options **RELIABILITY ENGINEERING AND LIFE TESTING** V. N. A NAIKAN,2008-12-12 This compact and easy to understand text presents the underlying principles and practice of reliability engineering and life testing It describes the various techniques available for reliability analysis and prediction and explains the statistical methods necessary for reliability modelling analysis and estimation The text also discusses in detail the concepts of life testing its classification and methodologies as well as accelerated life tests the methodologies and models of stress related failure rates evaluation and data analysis Besides it elaborates on the principles methods and equipment of highly accelerated life testing and highly accelerated stress screening Finally the book concludes with a discussion on the parametric as well as non parametric

methods generally used for reliability estimation and the recent developments in life testing of engineering components

Key Features The book is up to date and very much relevant to the present industrial research design and development scenarios Provides adequate tools to predict the system reliability at the design stage to plan and conduct life testing on the products at various stages of development and to use the life test and field data to estimate the product reliability Gives sufficiently large number of worked out examples Primarily intended as a textbook for the postgraduate students of engineering M Tech Reliability Engineering the book would also be quite useful for reliability practitioners professional engineers and researchers

Handbook for Robustness Validation of Semiconductor Devices in Automotive Applications Automotive Electronic Systems Reliability Standards,2007 This document will primarily address intrinsic reliability of electronic components for use in automotive electronics Where practical methods of extrinsic reliability detection and prevention will also be addressed This document primarily deals with integrated circuit issues but can easily be adapted for use in discrete or passive component qualification with the generation of a list of failure mechanisms relevant to those devices Component qualification is the main scope of this document Other procedures addressing extrinsic defects are specifically addressed in the monitoring chapter This document is to be used within the context of achieving Zero Defect in component manufacturing and product use NOTE The term shall indicates a binding requirement Members of SAE International Automotive Electronic Systems Reliability Standards Committee ZVEI German Electrical and Electronic Manufacturers Association AEC Automotive Electronics Council and JSAE Japanese Society of Automotive Engineers formed a joint task force and met to update SAE Recommended Practice J1879 October 1988 General Qualification and Production Acceptance Criteria for Integrated Circuits in Automotive Applications This version did not describe methods to demonstrate that a device under test would meet the customer demand for failure levels in the single digit parts per million ppm range Additionally with the old qualification test to pass approach there is very little knowledge generated about the relevant component failure mechanisms that may occur at the boundaries of the specification limits Extending the old approach to single digit ppm levels is unfeasible with respect to both economics and time A new knowledge based approach to understanding and preventing the occurrence of the relevant component failure mechanisms was required The joint task force concluded that the J1879 Recommended Practice should be revised to encompass a Robustness Validation approach and that an Automotive Electronics Robustness Validation Handbook should be published This handbook is based on information from a wide number of sources including international Automotive OEMs and their full supply chain engineering societies and other related organizations

History of Automotive Electronics Ronald K. Jurgen,1998 **Handbook of Sealant Technology** K.L. Mittal,A. Pizzi,2009-08-26

Sealing is an age old problem that dates back to our earliest attempts to create a more comfortable living environment Prehistoric people used natural sealants such as earth loam grass and reeds to protect the interior of their homes against the weather Today s applications extend to a myriad of uses The Handbook of Sealant Technology provide

Electronic

Materials Handbook, 1989-11-01 Volume 1 Packaging is an authoritative reference source of practical information for the design or process engineer who must make informed day to day decisions about the materials and processes of microelectronic packaging. Its 117 articles offer the collective knowledge, wisdom and judgement of 407 microelectronics packaging experts, authors, co-authors and reviewers representing 192 companies, universities, laboratories and other organizations. This is the inaugural volume of ASM's all new Electronic Materials Handbook series designed to be the Metals Handbook of electronics technology. In over 65 years of publishing the Metals Handbook, ASM has developed a unique editorial method of compiling large technical reference books. ASM's access to leading materials technology experts enables to organize these books on an industry consensus basis. Behind every article is an author who is a top expert in its specific subject area. This multi-author approach ensures the best, most timely information throughout. Individually selected panels of 5 and 6 peers review each article for technical accuracy, generic point of view and completeness. Volumes in the Electronic Materials Handbook series are multidisciplinary to reflect industry practice applied in integrating multiple technology disciplines necessary to any program in advanced electronics. Volume 1 Packaging, focusing on the middle level of the electronics technology size spectrum, offers the greatest practical value to the largest and broadest group of users. Future volumes in the series will address topics on larger integrated electronic assemblies and smaller semiconductor materials and devices size levels.

Microelectronics Packaging Handbook R.R. Tummala, Eugene J. Rymaszewski, Alan G. Klopfenstein, 2013-11-27 Electronics has become the largest industry, surpassing agriculture, auto and heavy metal industries. It has become the industry of choice for a country to prosper, already having given rise to the phenomenal prosperity of Japan, Korea, Singapore, Hong Kong and Ireland among others. At the current growth rate, total worldwide semiconductor sales will reach 300B by the year 2000. The key electronic technologies responsible for the growth of the industry include semiconductors, the packaging of semiconductors for systems use in auto, telecom, computer, consumer, aerospace and medical industries, displays, magnetic and optical storage as well as software and system technologies. There has been a paradigm shift, however, in these technologies from mainframe and supercomputer applications at any cost to consumer applications at approximately one-tenth the cost and size. Personal computers are a good example, going from 500IMIP when products were first introduced in 1981 to a projected IIMIP within 10 years. Thin, light, portable, user friendly and very low cost are therefore the attributes of tomorrow's computing and communications systems. Electronic packaging is defined as interconnection, powering, cooling and protecting semiconductor chips for reliable systems. It is a key enabling technology achieving the requirements for reducing the size and cost at the system and product level.

Automotive Engineering, 1994 **Design Reliability** B.S. Dhillon, 1999-06-18 As engineering systems become more and more complex, industry has recognized the importance of system and product reliability and places ever increasing emphasis on it during the design phase. Despite its efforts, however, industry continues to lose billions of dollars each year because of unexpected system failures. Therefore, it

becomes increasingly important for designers and engineers to have a solid grounding in reliability engineering and keep abreast of new developments and research results

Logic Application Handbook Nexperia UK (Ltd), This handbook is dedicated to application and design engineers who are developing and using electronic circuits often within embedded systems for all kind of applications The demand for discrete logic devices is widespread Many aspects of system and board design have to be addressed and the usage of logic devices is very often generating questions and support requirements which cannot be met just by data sheets In order to provide a compact and handy document condensed from application notes customer support experience and general logic knowledge this book is meant to support development engineers who are dealing with logic devices

The Electronic Packaging Handbook Glenn R. Blackwell, 2017-12-19 The packaging of electronic devices and systems represents a significant challenge for product designers and managers Performance efficiency cost considerations dealing with the newer IC packaging technologies and EMI RFI issues all come into play Thermal considerations at both the device and the systems level are also necessary The Electronic Packaging Handbook a new volume in the Electrical Engineering Handbook Series provides essential factual information on the design manufacturing and testing of electronic devices and systems Co published with the IEEE this is an ideal resource for engineers and technicians involved in any aspect of design production testing or packaging of electronic products regardless of whether they are commercial or industrial in nature Topics addressed include design automation new IC packaging technologies materials testing and safety Electronics packaging continues to include expanding and evolving topics and technologies as the demand for smaller faster and lighter products continues without signs of abatement These demands mean that individuals in each of the specialty areas involved in electronics packaging such as electronic mechanical and thermal designers and manufacturing and test engineers are all interdependent on each others knowledge The Electronic Packaging Handbook elucidates these specialty areas and helps individuals broaden their knowledge base in this ever growing field

The Safety of Controllers, Sensors, and Actuators Juan Pimentel, 2019-03-07 Safety has been ranked as the number one concern for the acceptance and adoption of automated vehicles since safety has driven some of the most complex requirements in the development of self driving vehicles Recent fatal accidents involving self driving vehicles have uncovered issues in the way some automated vehicle companies approach the design testing verification and validation of their products Traditionally automotive safety follows functional safety concepts as detailed in the standard ISO 26262 However automated driving safety goes beyond this standard and includes other safety concepts such as safety of the intended functionality SOTIF and multi agent safety The Safety of Controllers Sensors and Actuators addresses the concept of safety for self driving vehicles through the inclusion of 10 recent and highly relevant SAE technical papers Topics that these papers feature include risk reduction techniques in semiconductor based systems component certification and safety assessment and audits for vehicle components As the fifth title in a series on automated vehicle safety this contains introductory content by the Editor with 10

SAE technical papers specifically chosen to illuminate the specific safety topic of that book
Department of Defense Information Analysis Centers ,1997

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Table of Contents Automotive Electronics Reliability Handbook

1. Understanding the eBook Automotive Electronics Reliability Handbook
 - The Rise of Digital Reading Automotive Electronics Reliability Handbook
 - Advantages of eBooks Over Traditional Books
2. Identifying Automotive Electronics Reliability Handbook
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Automotive Electronics Reliability Handbook
 - User-Friendly Interface
4. Exploring eBook Recommendations from Automotive Electronics Reliability Handbook
 - Personalized Recommendations
 - Automotive Electronics Reliability Handbook User Reviews and Ratings

- Automotive Electronics Reliability Handbook and Bestseller Lists
- 5. Accessing Automotive Electronics Reliability Handbook Free and Paid eBooks
 - Automotive Electronics Reliability Handbook Public Domain eBooks
 - Automotive Electronics Reliability Handbook eBook Subscription Services
 - Automotive Electronics Reliability Handbook Budget-Friendly Options
- 6. Navigating Automotive Electronics Reliability Handbook eBook Formats
 - ePub, PDF, MOBI, and More
 - Automotive Electronics Reliability Handbook Compatibility with Devices
 - Automotive Electronics Reliability Handbook Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Automotive Electronics Reliability Handbook
 - Highlighting and Note-Taking Automotive Electronics Reliability Handbook
 - Interactive Elements Automotive Electronics Reliability Handbook
- 8. Staying Engaged with Automotive Electronics Reliability Handbook
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Automotive Electronics Reliability Handbook
- 9. Balancing eBooks and Physical Books Automotive Electronics Reliability Handbook
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Automotive Electronics Reliability Handbook
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Automotive Electronics Reliability Handbook
 - Setting Reading Goals Automotive Electronics Reliability Handbook
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Automotive Electronics Reliability Handbook
 - Fact-Checking eBook Content of Automotive Electronics Reliability Handbook
 - Distinguishing Credible Sources

13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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