



**Electrostatic discharge (ESD)  
protection in electronics**

# Electrostatic Discharge Protection For Electronics

**Albert Wang**



## **Electrostatic Discharge Protection For Electronics:**

Electrostatic Discharge Protection Juin J. Liou, 2017-12-19 Electrostatic discharge ESD is one of the most prevalent threats to electronic components In an ESD event a finite amount of charge is transferred from one object i e human body to another i e microchip This process can result in a very high current passing through the microchip within a very short period of time Thus more than 35 percent of single event chip damages can be attributed to ESD events and designing ESD structures to protect integrated circuits against the ESD stresses is a high priority in the semiconductor industry *Electrostatic Discharge Protection Advances and Applications* delivers timely coverage of component and system level ESD protection for semiconductor devices and integrated circuits Bringing together contributions from internationally respected researchers and engineers with expertise in ESD design optimization modeling simulation and characterization this book bridges the gap between theory and practice to offer valuable insight into the state of the art of ESD protection Amply illustrated with tables figures and case studies the text Instills a deeper understanding of ESD events and ESD protection design principles Examines vital processes including Si CMOS Si BCD Si SOI and GaN technologies Addresses important aspects pertinent to the modeling and simulation of ESD protection solutions *Electrostatic Discharge Protection Advances and Applications* provides a single source for cutting edge information vital to the research and development of effective robust ESD protection solutions for semiconductor devices and integrated circuits Electrostatic Discharge Neil J. Sclater, 1990-08-01 **Electrostatic Discharge** Neil Sclater, 1990 Neil Sclater offers practical advice on selecting test and control equipment handling and storing semiconductors and other components building static free workstations creating a protective environment for electronics and much more A complete listing of manufacturers and suppliers is included Prior to founding his own electronics marketing research firm Neil Sclater worked as an engineer for several leading corporations and as editor for *Electronic Design and Product Engineering* He is the author of TPR s Gallium Arsenide IC Technology No 3089 *Protecting Electronic Equipment from Electrostatic Discharge* Edward A. Lacy, 1984 **ESD from A to Z** John M. Kolyer, Donald Watson, 2012-12-06 Existing sections in ESD Frim A to Z have been thoroughly revised and updated New examples have been added to the troubleshooting chapter and new versions of model specifications for ESD safe handling and packaging can be found in the specifications chapter The Appendix now includes ten recently published papers making a total of 20 whose topics span the field of ESD control Electrostatic Discharge Protection for Electronics Neil Sclater, 1990 Neil Sclater offers practical advice on selecting test and control equipment handling and storing semiconductors and other components building static free workstations creating a protective environment for electronics and much more A complete listing of manufacturers and suppliers is included Prior to founding his own electronics marketing research firm Neil Sclater worked as an engineer for several leading corporations and as editor for *Electronic Design and Product Engineering* He is the author of TPR s Gallium Arsenide IC Technology No 3089 Electrostatic Discharge Control Handbook for Protection of

Electrical and Electronic Parts, Assemblies and Equipment (excluding Electrically Initiated Explosive Devices) (metric)  
United States. Department of Defense, 1991      **Electrostatic Discharge in Electronics** William D. Greason, 1992      *ESD*  
— *The Scourge of Electronics* Sten Hellström, 2012-12-06 This book on electrostatic discharge phenomena is essentially a translation and update of a Swedish edition from 1992. The book is intended for people working with electronic circuits and equipments in application and development. All personnel should be aware of the ESD hazards especially those responsible for quality. ESD prevention is a part of TQM Total Quality Management. The book is also usable for courses on the subject. Background It was soon realised that the MOS circuits MOS Metal Oxide Semiconductor which appeared in the beginning of the 1960s were sensitive to electrostatic discharges. But a severe accident accelerated the search for materials that do not generate electric charges. In April 1964 three people were working inside a satellite at Cape Kennedy Space Center. They suddenly screamed we are burning. They died. The satellite encapsulation was covered with untreated plastics to protect against dust. When the plastics were pulled off both this and the metal encapsulating got charged. A discharge from the metal ignited inflammable parts of the satellite. Eleven more people were injured and the cost of the accident amounted to about 55 billions USD.

**ESD Protection Architecture in Integrated Circuits** Pasquale De Marco, 2025-04-13 Electrostatic discharge ESD is a major threat to the reliability of integrated circuits ICs. ESD can cause damage to ICs during manufacturing, assembly, testing and use. As a result ESD protection is an essential part of IC design. ESD Protection Architecture in Integrated Circuits provides a comprehensive overview of ESD protection for ICs. This book covers all aspects of ESD protection from the basics to the latest advances. The book is written by a team of experts in the field of ESD protection and it is intended for a wide audience including IC designers, ESD engineers and researchers. This book begins with an introduction to ESD and its effects on ICs. It then discusses ESD protection standards and testing methods. The book then covers the different types of ESD protection devices and their applications. It also discusses ESD protection design techniques and failure analysis. The book then moves on to more advanced topics such as ESD protection for advanced technologies, 3D ICs, high speed interfaces, automotive applications and medical devices. The book also discusses ESD protection in system design, manufacturing and assembly. Finally the book concludes with a discussion of future trends in ESD protection. This includes emerging ESD threats and challenges, advanced ESD protection technologies and ESD protection for next generation technologies. ESD Protection Architecture in Integrated Circuits is an essential resource for anyone who is involved in the design, manufacture or use of ICs. It provides a comprehensive overview of ESD protection and the latest advances in the field. Key Features Comprehensive coverage of all aspects of ESD protection. Written by a team of experts in the field of ESD protection. Intended for a wide audience including IC designers, ESD engineers and researchers. Up to date coverage of the latest advances in ESD protection. Benefits Readers will gain a deep understanding of ESD protection. Readers will be able to design and implement effective ESD protection measures. Readers will be able to keep up with the

latest advances in ESD protection If you like this book write a review on google books

**ESD (Electrostatics Discharge) and its Impact on Electronic Manufacturing & Rework** Ratan Sengupta, *System Level ESD Protection* Vladislav Vashchenko, Mirko Scholz, 2014-03-21 This book addresses key aspects of analog integrated circuits and systems design related to system level electrostatic discharge ESD protection It is an invaluable reference for anyone developing systems on chip SoC and systems on package SoP integrated with system level ESD protection The book focuses on both the design of semiconductor integrated circuit IC components with embedded on chip system level protection and IC system co design The readers will be enabled to bring the system level ESD protection solutions to the level of integrated circuits thereby reducing or completely eliminating the need for additional discrete components on the printed circuit board PCB and meeting system level ESD requirements The authors take a systematic approach based on IC system ESD protection co design A detailed description of the available IC level ESD testing methods is provided together with a discussion of the correlation between IC level and system level ESD testing methods The IC level ESD protection design is demonstrated with representative case studies which are analyzed with various numerical simulations and ESD testing The overall methodology for IC system ESD co design is presented as a step by step procedure that involves both ESD testing and numerical simulations

**The ESD Handbook** Steven H. Voldman, 2021-03-25 A practical and comprehensive reference that explores Electrostatic Discharge ESD in semiconductor components and electronic systems The ESD Handbook offers a comprehensive reference that explores topics relevant to ESD design in semiconductor components and explores ESD in various systems Electrostatic discharge is a common problem in the semiconductor environment and this reference fills a gap in the literature by discussing ESD protection Written by a noted expert on the topic the text offers a topic by topic reference that includes illustrative figures discussions and drawings The handbook covers a wide range of topics including ESD in manufacturing garments wrist straps and shoes ESD Testing ESD device physics ESD semiconductor process effects ESD failure mechanisms ESD circuits in different technologies CMOS Bipolar etc ESD circuit types Pin Power Pin to Pin etc and much more In addition the text includes a glossary index tables illustrations and a variety of case studies Contains a well organized reference that provides a quick review on a range of ESD topics Fills the gap in the current literature by providing information from purely scientific and physical aspects to practical applications Offers information in clear and accessible terms Written by the accomplished author of the popular ESD book series Written for technicians operators engineers circuit designers and failure analysis engineers The ESD Handbook contains an accessible reference to ESD design and ESD systems

*Practical ESD Protection Design* Albert Wang, 2022-01-06 An authoritative single volume reference on the design and analysis of ESD protection for ICs Electrostatic discharge ESD is a major reliability challenge to semiconductors integrated circuits ICs and microelectronic systems On chip ESD protection is a vital to any electronic products such as smartphones laptops tablets and other electronic devices Practical ESD Protection Design provides comprehensive and

systematic guidance on all major aspects of designs of on chip ESD protection for integrated circuits ICs Written for students and practicing engineers alike this one stop resource covers essential theories hands on design skills computer aided design CAD methods characterization and analysis techniques and more on ESD protection designs Detailed chapters examine an array of topics ranging from fundamental to advanced including ESD phenomena ESD failure analysis ESD testing models ESD protection devices and circuits ESD design layout and technology effects ESD design flows and co design methods ESD modelling and CAD techniques and future ESD protection concepts Based on the author s decades of design research and teaching experiences Practical ESD Protection Design Features numerous real world ESD protection design examples Emphasizes on ESD protection design techniques and procedures Describes ESD IC co design methodology for high performance mixed signal ICs and broadband radio frequency RF ICs Discusses CAD based ESD protection design optimization and prediction using both Technology and Electrical Computer Aided Design TCAD ECAD simulation Addresses new ESD CAD algorithms and tools for full chip ESD physical design verification Explores the disruptive future outlook of ESD protection Practical ESD Protection Design is a valuable reference for industrial engineers and academic researchers in the field and an excellent textbook for electronic engineering courses in semiconductor microelectronics and integrated circuit designs

**Handbook of Automotive Power Electronics and Motor Drives** Ali Emadi,2017-12-19 Initially the only electric loads encountered in an automobile were for lighting and the starter motor Today demands on performance safety emissions comfort convenience entertainment and communications have seen the working in of seemingly innumerable advanced electronic devices Consequently vehicle electric systems require larger capacities and more complex configurations to deal with these demands Covering applications in conventional hybrid electric and electric vehicles the Handbook of Automotive Power Electronics and Motor Drives provides a comprehensive reference for automotive electrical systems This authoritative handbook features contributions from an outstanding international panel of experts from industry and academia highlighting existing and emerging technologies Divided into five parts the Handbook of Automotive Power Electronics and Motor Drives offers an overview of automotive power systems discusses semiconductor devices sensors and other components explains different power electronic converters examines electric machines and associated drives and details various advanced electrical loads as well as battery technology for automobile applications As we seek to answer the call for safer more efficient and lower emission vehicles from regulators and consumer insistence on better performance comfort and entertainment the technologies outlined in this book are vital for engineering advanced vehicles that will satisfy these criteria

*On-Chip Electro-Static Discharge (ESD) Protection for Radio-Frequency Integrated Circuits* Qiang Cui,Jun J. Liou,Jean-Jacques Hajjar,Javier Salcedo,Yuanzhong Zhou,Parthasarathy Srivatsan,2015-03-10 This book enables readers to design effective ESD protection solutions for all mainstream RF fabrication processes GaAs pHEMT SiGe HBT CMOS The new techniques introduced by the authors have much higher protection levels and much lower parasitic effects than those of

existing ESD protection devices The authors describe in detail the ESD phenomenon as well as ESD protection fundamentals standards test equipment and basic design strategies Readers will benefit from realistic case studies of ESD protection for RFICs and will learn to increase significantly modern RFICs ESD safety level while maximizing RF performance     **Robust Electronic Design Reference Book: no special title** John R. Barnes,2004 If you design electronics for a living you need Robust Electronic Design Reference Book Written by a working engineer who has put over 115 electronic products into production at Sycor IBM and Lexmark Robust Electronic Design Reference covers all the various aspects of designing and developing electronic devices and systems that Work Are safe and reliable Can be manufactured tested repaired and serviced May be sold and used worldwide Can be adapted or enhanced to meet new and changing requirements     **Applied Embedded Electronics** Jerry Twomey,2023-11-14 Embedded controller electronics are at the heart of virtually all modern electronic devices today with a market of more than 86 billion per year and growing To serve the needs of designers creating products for this huge market this practical book covers topics crucial for modern electronics design Author Jerry Twomey examines the methods necessary to help you create a trouble free integrated system for your product with an emphasis on hardware design You ll explore topics from the perspective of real world applications including discussions about non ideal components noise and methods for avoiding problematic scenarios Topics include Ideal versus actual connections components digital signals Architecting an embedded system Digital interface selection by application speed distance Multivoltage power supplies High frequency power integrity Battery and charging systems EMI reduction and ESD protection Driving and sensing peripherals Digital feedback control Optimization of power consumption and cost Specialty systems medical industrial aerospace PCB design including manufacturability yield and low noise This book guides you through all of the techniques listed which are required for a reliable integrated system Through extensive illustrations and minimal equations anyone with an interest in electronics will quickly grasp the ideas discussed     **On-Chip ESD Protection for Integrated Circuits** Albert Z.H. Wang,2006-01-03 This comprehensive and insightful book discusses ESD protection circuit design problems from an IC designer s perspective On Chip ESD Protection for Integrated Circuits An IC Design Perspective provides both fundamental and advanced materials needed by a circuit designer for designing ESD protection circuits including Testing models and standards adopted by U S Department of Defense EIA JEDEC ESD Association Automotive Electronics Council International Electrotechnical Commission etc ESD failure analysis protection devices and protection of sub circuits Whole chip ESD protection and ESD to circuit interactions Advanced low parasitic compact ESD protection structures for RF and mixed signal IC s Mixed mode ESD simulation design methodologies for design prediction ESD to circuit interactions and more Many real world ESD protection circuit design examples are provided The book can be used as a reference book for working IC designers and as a textbook for students in the IC design field     **ESD** Steven H. Voldman,2006-02-03 The scaling of semiconductor devices from sub micron to nanometer dimensions is driving the need for

understanding the design of electrostatic discharge ESD circuits and the response of these integrated circuits IC to ESD phenomena ESD Circuits and Devices provides a clear insight into the layout and design of circuitry for protection against electrical overstress EOS and ESD With an emphasis on examples this text explains ESD buffering ballasting current distribution design segmentation feedback coupling and de coupling ESD design methods outlines the fundamental analytical models and experimental results for the ESD design of MOSFETs and diode semiconductor device elements with a focus on CMOS silicon on insulator SOI and Silicon Germanium SiGe technology focuses on the ESD design optimization integration and synthesis of these elements and concepts into ESD networks as well as applying within the off chip driver networks and on chip receivers and highlights state of the art ESD input circuits as well as ESD power clamps networks Continuing the author s series of books on ESD this book will be an invaluable reference for the professional semiconductor chip and system ESD engineer Semiconductor device and process development quality reliability and failure analysis engineers will also find it an essential tool In addition both senior undergraduate and graduate students in microelectronics and IC design will find its numerous examples useful



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