

On Chip ESD Protection For Integrated Circuits

An IC Design Perspective

System Level ESD Protection Electrostatic Discharge Protection On-Chip ESD Protection for Integrated Circuits On-Chip Electro-Static Discharge (ESD) Protection for Radio-Frequency Integrated Circuits ESD Protection Device and Circuit Design for Advanced CMOS Technologies ESD Practical ESD Protection Design Electrostatic Discharge Protection for Electronics Electrostatic Discharge (ESD) Protection for a Laser Diode Ignited Actuator Improved ESD Protection for High Frequency Integrated Circuits On-Chip ESD Protection for Integrated Circuits Design of Electrostatic Discharge (ESD) Protection for RF Front-End Integrated Circuits Electrical Overstress/Electrostatic Discharge Symposium Proceedings Reliability of Electrostatic Discharge (ESD) Protection Devices and Circuits ESD Protection Design of High-speed Circuit Basic ESD and I/O Design International Integrated Reliability Workshop Final Report Design and Characterization of ESD Protection for RFICs Protecting Electronic Equipment from Electrostatic Discharge On-Chip ESD Protection for Integrated Circuits Vladislav Vashchenko Juin J. Liou Albert Z.H. Wang Qiang Cui Oleg Semenov Steven H. Voldman Albert Wang Neil Sclater FREDERICK J. SALAS Jeffrey L. Johnson Albert Z.H. Wang 廖耀煌 Yupin Kawing Fong Sanjay Dabral Guang Chen Edward A. Lacy Albert Z. H. Wang System Level ESD Protection Electrostatic Discharge Protection On-Chip ESD Protection for Integrated Circuits On-Chip Electro-Static Discharge (ESD) Protection for Radio-Frequency Integrated Circuits ESD Protection Device and Circuit Design for Advanced CMOS Technologies ESD Practical ESD Protection Design Electrostatic Discharge Protection for Electronics Electrostatic Discharge (ESD) Protection for a Laser Diode Ignited Actuator Improved ESD Protection for High Frequency Integrated Circuits On-Chip ESD Protection for Integrated Circuits Design of Electrostatic Discharge (ESD) Protection for RF Front-End Integrated Circuits Electrical Overstress/Electrostatic Discharge Symposium Proceedings Reliability of Electrostatic Discharge (ESD) Protection Devices and Circuits ESD Protection Design of High-speed Circuit Basic ESD and I/O Design International Integrated Reliability Workshop Final Report Design and Characterization of ESD Protection for RFICs Protecting Electronic Equipment from Electrostatic Discharge On-Chip ESD Protection for Integrated Circuits Vladislav Vashchenko Juin J. Liou Albert Z.H. Wang Qiang Cui Oleg Semenov Steven H. Voldman Albert Wang Neil Sclater FREDERICK J. SALAS Jeffrey L. Johnson Albert Z.H. Wang 廖耀煌 Yupin Kawing Fong Sanjay Dabral Guang Chen Edward A. Lacy Albert Z. H. Wang

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

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

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

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.

ESD protection device and circuit design for advanced CMOS technologies is intended for practicing engineers working in the areas of circuit design, VLSI reliability, and testing domains as the problems associated with ESD failures and yield losses become significant in the modern semiconductor industry. The demand for graduates with a basic knowledge of ESD is also increasing. Today there is a significant demand to educate the circuits design and reliability teams on ESD issues. This book makes an attempt to address the ESD design and implementation in a systematic manner. A design procedure involving device simulators as well as circuit simulator is employed to optimize device and circuit parameters for optimal ESD as well as circuit performance. This methodology described in ESD protection device and circuit design for advanced CMOS technologies has resulted in several successful ESD circuit design with excellent silicon results and demonstrates its strengths.

With the growth of high speed telecommunications and wireless technology it is becoming increasingly important for engineers to understand radio frequency RF applications and their sensitivity to electrostatic discharge ESD phenomena. This enables the development of ESD design methods for RF technology leading to increased protection against electrical overstress EOS and ESD. ESD RF technology and circuits presents methods for co-synthesizing ESD networks for RF applications to achieve improved performance and ESD protection of semiconductor chips. Discusses RF ESD design methods of capacitance load transformation, matching network co-synthesis, capacitance shunts, inductive shunts, impedance isolation, load cancellation methods, distributed loads, emitter degeneration, buffering, and ballasting. Examines ESD protection and design of active and passive elements in RF complementary metal oxide semiconductor CMOS RF laterally diffused metal oxide semiconductor LDMOS RF BiCMOS silicon germanium SiGe RF BiCMOS silicon germanium carbon SiGeC and Gallium Arsenide technology. Gives information on RF ESD testing methodologies, RF degradation effects, and failure mechanisms for devices, circuits, and systems. Highlights RF ESD mixed signal design, integration of digital, analog, and RF circuitry, sets out examples of RF ESD design, computer aided design methodologies, covers state of the art RF ESD input circuits as well as voltage triggered to RC triggered ESD power clamps networks in RF technologies as well as off-chip protection concepts. Following the authors' series of books on ESD, this book will be a thorough overview of ESD in RF technology for RF semiconductor chip and ESD engineers, device and circuit engineers working in the RF domain, and quality, reliability, and failure analysis engineers. Will also find it a valuable reference in the rapidly growing area of RF ESD design. In addition, it will appeal to graduate students in RF microwave technology and RF circuit design.

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

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

the use of laser diodes in devices to ignite pyrotechnics provides unique new capabilities including the elimination of electrostatic discharge esd pulses entering the device the faraday cage formed by the construction of these devices removes the concern of inadvertent ignition of the energetic material however the laser diode itself can be damaged by esd pulses therefore to enhance reliability some protection of the laser diode is necessary the development of the mc4612 optical actuator has included a circuit to protect the laser diode from esd pulses including the fisher severe human body esd model the mc4612 uses a laser diode and is designed to replace existing hot wire actuators optical energy from a laser diode instead of electrical energy is used to ignite the pyrotechnic the protection circuit is described along with a discussion of how the circuit design addresses and circumvents the historic 1amp 1watt requirement that has been applicable to hot wire devices

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 ICs, 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.

This volume presents an integrated treatment of ESD I/O and process parameter interactions that both I/O designers and process designers can use. It examines key factors in I/O and ESD design and testing and helps the reader consider ESD and reliability issues up front when making I/O choices, emphasizing clarity and simplicity. This book focuses on design principles that can be applied widely as this dynamic field continues to evolve.

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