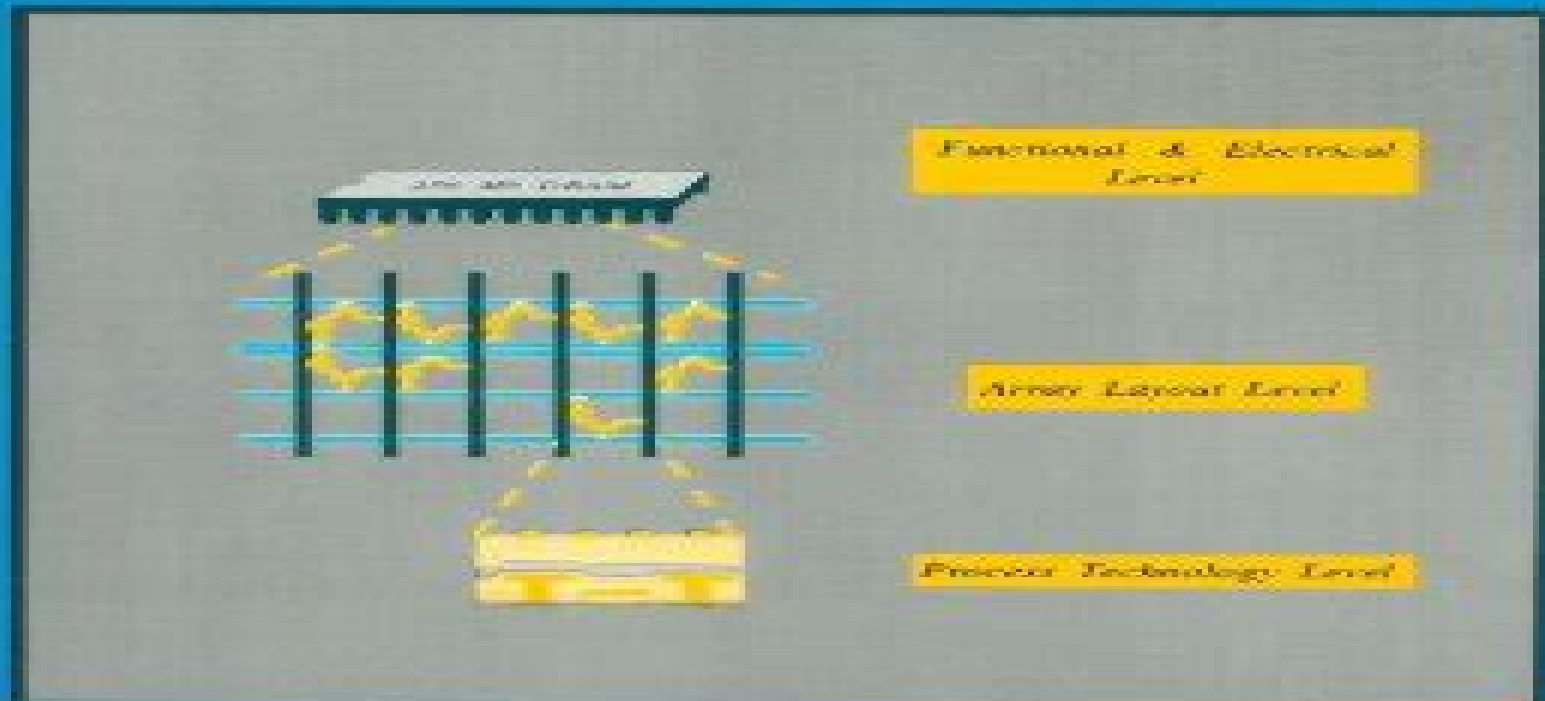


TESTING AND TESTABLE DESIGN OF HIGH-DENSITY RANDOM-ACCESS MEMORIES

PINAKI MAZUMDER
KANAD CHAKRABORTY



Testing And Testable Design Of High Density Random Access Memories

Wolfgang Kunz, Dominik Stoffel



Testing And Testable Design Of High Density Random Access Memories:

Testing and Testable Design of High-Density Random-Access Memories Pinaki Mazumder, Kanad Chakraborty, 1996-09-30 It is not in the interest of business leaders to turn public schools into vocational schools We can teach students how to be marketing people We can teach them how to manage balance sheets stated Louis V Gerstner Jr of IBM at the recent Education Summit meeting in New York He continued What is killing us is having to teach them to read and to compute and to communicate and to think TIME April 8 1996 page 40 The last sentence is most significant because it sets requirements for education and hence gives the specification for a textbook The textbook should contain all the necessary scientific information that the reader will need to practice the art in the technological world In addition to the scientific detail illustrative examples are necessary The book should teach science without restricting creativity and it should prepare the student for solving problems never encountered before In pursuing our goal of advancing the frontiers of test technology we must cover applications education and research This is the first textbook in the Frontiers series

Semiconductor memories represent the frontier of VLSI in more ways than one First memories have always used more aggressive physical design rules and higher densities than other VLSI chips thus advancing the semiconductor technology Second the availability of low cost memory chips makes numerous software applications possible by fueling the demand for all types of chips

Testing Static Random Access Memories Said Hamdioui, 2013-06-29 Testing Static Random Access Memories covers testing of one of the important semiconductor memories types it addresses testing of static random access memories SRAMs both single port and multi port It contributes to the technical knowledge needed by those involved in memory testing engineers and researchers The book begins with outlining the most popular SRAMs architectures Then the description of realistic fault models based on defect injection and SPICE simulation are introduced Thereafter high quality and low cost test patterns as well as test strategies for single port two port and any p port SRAMs are presented together with some preliminary test results showing the importance of the new tests in reducing DPM level The impact of the port restrictions e g read only ports on the fault models tests and test strategies is also discussed Features Fault primitive based analysis of memory faults A complete framework of and classification memory faults A systematic way to develop optimal and high quality memory test algorithms A systematic way to develop test patterns for any multi port SRAM Challenges and trends in embedded memory testing

High Performance Memory Testing R. Dean Adams, 2005-12-29 Are memory applications more critical than they have been in the past Yes but even more critical is the number of designs and the sheer number of bits on each design It is assured that catastrophes which were avoided in the past because memories were small will easily occur if the design and test engineers do not do their jobs very carefully High Performance Memory Testing Design Principles Fault Modeling and Self Test is based on the author's 20 years of experience in memory design memory reliability development and memory self test High Performance Memory Testing Design Principles Fault Modeling and Self

Test is written for the professional and the researcher to help them understand the memories that are being tested

Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits M. Bushnell, Vishwani Agrawal, 2006-04-11 The modern electronic testing has a forty year history Test professionals hold some fairly large conferences and numerous workshops have a journal and there are over one hundred books on testing Still a full course on testing is offered only at a few universities mostly by professors who have a research interest in this area Apparently most professors would not have taken a course on electronic testing when they were students Other than the computer engineering curriculum being too crowded the major reason cited for the absence of a course on electronic testing is the lack of a suitable textbook For VLSI the foundation was provided by semiconductor device technology circuit design and electronic testing In a computer engineering curriculum therefore it is necessary that foundations should be taught before applications The field of VLSI has expanded to systems on a chip which include digital memory and mixed signals subsystems To our knowledge this is the first textbook to cover all three types of electronic circuits We have written this textbook for an undergraduate foundations course on electronic testing Obviously it is too voluminous for a one semester course and a teacher will have to select from the topics We did not restrict such freedom because the selection may depend upon the individual expertise and interests Besides there is merit in having a larger book that will retain its usefulness for the owner even after the completion of the course With equal tenacity we address the needs of three other groups of readers

Fault-tolerance and Reliability Techniques for High-density Random-access Memories Kanad Chakraborty, Pinaki Mazumder, 2002 This book deals with primarily with reliable and fault tolerant circuit design and evaluation techniques for RAMS It examines both the manufacturing fault tolerance e g self repair at the time of manufacturing and online and field related fault tolerance e g error correction It talks a lot about important techniques and requirements and explains what needs to be done and why for each of the techniques

Design for AT-Speed Test, Diagnosis and Measurement Benoit Nadeau-Dostie, 2006-04-11 Design for AT Speed Test Diagnosis and Measurement is the first book to offer practical and proven design for testability DFT solutions to chip and system design engineers test engineers and product managers at the silicon level as well as at the board and systems levels Designers will see how the implementation of embedded test enables simplification of silicon debug and system bring up Test engineers will determine how embedded test provides a superior level of at speed test diagnosis and measurement without exceeding the capabilities of their equipment Product managers will learn how the time resources and costs associated with test development manufacture cost and lifecycle maintenance of their products can be significantly reduced by designing embedded test in the product A complete design flow and analysis of the impact of embedded test on a design makes this book a must read before any DFT is attempted

Power-Constrained Testing of VLSI Circuits Nicola Nicolici, Bashir M. Al-Hashimi, 2006-04-11 This text focuses on techniques for minimizing power dissipation during test application at logic and register transfer levels of abstraction of the VLSI design flow It surveys

existing techniques and presents several test automation techniques for reducing power in scan based sequential circuits and BIST data paths

On-Line Testing for VLSI Michael Nicolaidis, Yervant Zorian, Dhiraj Pradhan, 2013-03-09 Test functions fault detection diagnosis error correction repair etc that are applied concurrently while the system continues its intended function are defined as on line testing In its expanded scope on line testing includes the design of concurrent error checking subsystems that can be themselves self checking fail safe systems that continue to function correctly even after an error occurs reliability monitoring and self test and fault tolerant designs On Line Testing for VLSI contains a selected set of articles that discuss many of the modern aspects of on line testing as faced today The contributions are largely derived from recent IEEE International On Line Testing Workshops Guest editors Michael Nicolaidis Yervant Zorian and Dhiraj Pradhan organized the articles into six chapters In the first chapter the editors introduce a large number of approaches with an expanded bibliography in which some references date back to the sixties On Line Testing for VLSI is an edited volume of original research comprising invited contributions by leading researchers

Delay Fault Testing for VLSI Circuits Angela Krstic, Kwang-Ting (Tim) Cheng, 2012-12-06 In the early days of digital design we were concerned with the logical correctness of circuits We knew that if we slowed down the clock signal sufficiently the circuit would function correctly With improvements in the semiconductor process technology our expectations on speed have soared A frequently asked question in the last decade has been how fast can the clock run This puts significant demands on timing analysis and delay testing Fueled by the above events a tremendous growth has occurred in the research on delay testing Recent work includes fault models algorithms for test generation and fault simulation and methods for design and synthesis for testability The authors of this book Angela Krstic and Tim Cheng have personally contributed to this research Now they do an even greater service to the profession by collecting the work of a large number of researchers In addition to expounding such a great deal of information they have delivered it with utmost clarity To further the reader's understanding many key concepts are illustrated by simple examples The basic ideas of delay testing have reached a level of maturity that makes them suitable for practice In that sense this book is the best x DELAY FAULT TESTING FOR VLSI CIRCUITS available guide for an engineer designing or testing VLSI systems Tech niques for path delay testing and for use of slower test equipment to test high speed circuits are of particular interest

Fault Injection Techniques and Tools for Embedded Systems Reliability Evaluation Alfredo Benso, Paolo Prinetto, 2005-12-15 Fault Injection Techniques and Tools for Embedded Systems Reliability Evaluation intends to be a comprehensive guide to Fault Injection techniques used to evaluate the dependability of a digital system The description and the critical analysis of different Fault Injection techniques and tools will be authored by key scientists in the field of system dependability and fault tolerance

Multi-Chip Module Test Strategies Yervant Zorian, 2012-12-06 MCMs today consist of complex and dense VLSI devices mounted into packages that allow little physical access to internal nodes The complexity and cost associated with their test and diagnosis are major obstacles to their use

Multi Chip Module Test Strategies presents state of the art test strategies for MCMs This volume of original research is designed for engineers interested in practical implementations of MCM test solutions and for designers looking for leading edge test and design for testability solutions for their next designs Multi Chip Module Test Strategies consists of eight contributions by leading researchers It is designed to provide a comprehensive and well balanced coverage of the MCM test domain Multi Chip Module Test Strategies has also been published as a special issue of the Journal of Electronic Testing Theory and Applications JETTA Volume 10 Numbers 1 and 2

Introduction to IDDQ Testing S. Chakravarty, Paul J. Thadikaran, 2012-12-06 Testing techniques for VLSI circuits are undergoing many exciting changes The predominant method for testing digital circuits consists of applying a set of input stimuli to the IC and monitoring the logic levels at primary outputs If for one or more inputs there is a discrepancy between the observed output and the expected output then the IC is declared to be defective A new approach to testing digital circuits which has come to be known as IDDQ testing has been actively researched for the last fifteen years In IDDQ testing the steady state supply current rather than the logic levels at the primary outputs is monitored Years of research suggests that IDDQ testing can significantly improve the quality and reliability of fabricated circuits This has prompted many semiconductor manufacturers to adopt this testing technique among them Philips Semiconductors Ford Microelectronics Intel Texas Instruments LSI Logic Hewlett Packard SUN microsystems Alcatel and SGS Thomson This increase in the use of IDDQ testing should be of interest to three groups of individuals associated with the IC business Product Managers and Test Engineers CAD Tool Vendors and Circuit Designers Introduction to IDDQ Testing is designed to educate this community The authors have summarized in one volume the main findings of more than fifteen years of research in this area

An Introduction to Mixed-signal IC Test and Measurement Gordon W. Roberts, Friedrich Taenzler, Mark Burns, 2012 With the proliferation of complex semiconductor devices containing digital analog mixed signal and radio frequency circuits the economics of test has come to the forefront and today s engineer needs to be fluent in all four circuit types Having access to a book that covers these topics will help the evolving test engineer immensely and will be an invaluable resource In addition the second edition includes lengthy discussion on RF circuits high speed I Os and probabilistic reasoning Appropriate for the junior senior university level this textbook includes hundreds of examples exercises and problems

Defect-Oriented Testing for Nano-Metric CMOS VLSI Circuits Manoj Sachdev, José Pineda de Gyvez, 2007-06-04 Defect oriented testing methods have come a long way from a mere interesting academic exercise to a hard industrial reality Many factors have contributed to its industrial acceptance Traditional approaches of testing modern integrated circuits have been found to be inadequate in terms of quality and economics of test In a globally competitive semiconductor market place overall product quality and economics have become very important objectives In addition electronic systems are becoming increasingly complex and demand components of the highest possible quality Testing in general and defect oriented testing in particular help in realizing these objectives For contemporary

System on Chip SoC VLSI circuits testing is an activity associated with every level of integration However special emphasis is placed for wafer level test and final test Wafer level test consists primarily of dc or slow speed tests with current voltage checks per pin under most operating conditions and with test limits properly adjusted Basic digital tests are applied and in some cases low frequency tests to ensure analog RF functionality are exercised as well Final test consists of checking device functionality by exercising RF tests and by applying a comprehensive suite of digital test methods such as I delay fault testing DDQ stuck at testing low voltage testing etc This partitioning choice is actually application dependent

Counterfeit Integrated Circuits Mark (Mohammad) Tehranipoor,Ujjwal Guin,Domenic Forte,2015-02-12 This timely and exhaustive study offers a much needed examination of the scope and consequences of the electronic counterfeit trade The authors describe a variety of shortcomings and vulnerabilities in the electronic component supply chain which can result in counterfeit integrated circuits ICs Not only does this book provide an assessment of the current counterfeiting problems facing both the public and private sectors it also offers practical real world solutions for combatting this substantial threat Helps beginners and practitioners in the field by providing a comprehensive background on the counterfeiting problem Presents innovative taxonomies for counterfeit types test methods and counterfeit defects which allows for a detailed analysis of counterfeiting and its mitigation Provides step by step solutions for detecting different types of counterfeit ICs Offers pragmatic and practice oriented realistic solutions to counterfeit IC detection and avoidance for industry and government

Models in Hardware Testing Hans-Joachim Wunderlich,2009-11-12 Model based testing is the most powerful technique for testing hardware and software systems Models in Hardware Testing describes the use of models at all the levels of hardware testing The relevant fault models for nanoscaled CMOS technology are introduced and their implications on fault simulation automatic test pattern generation fault diagnosis memory testing and power aware testing are discussed Models and the corresponding algorithms are considered with respect to the most recent state of the art and they are put into a historical context by a concluding chapter on the use of physical fault models in fault tolerance

Test Resource Partitioning for System-on-a-Chip Vikram Iyengar,Anshuman Chandra,2012-12-06 Test Resource Partitioning for System on a Chip is about test resource partitioning and optimization techniques for plug and play system on a chip SOC test automation Plug and play refers to the paradigm in which core to core interfaces as well as core to SOC logic interfaces are standardized such that cores can be easily plugged into virtual sockets on the SOC design and core tests can be plugged into the SOC during test without substantial effort on the part of the system integrator The goal of the book is to position test resource partitioning in the context of SOC test automation as well as to generate interest and motivate research on this important topic SOC integrated circuits composed of embedded cores are now commonplace Nevertheless There remain several roadblocks to rapid and efficient system integration Test development is seen as a major bottleneck in SOC design and test challenges are a major contributor to the widening gap between design capability and manufacturing capacity Testing SOCs is especially

challenging in the absence of standardized test structures test automation tools and test protocols Test Resource Partitioning for System on a Chip responds to a pressing need for a structured methodology for SOC test automation It presents new techniques for the partitioning and optimization of the three major SOC test resources test hardware testing time and test data volume Test Resource Partitioning for System on a Chip paves the way for a powerful integrated framework to automate the test flow for a large number of cores in an SOC in a plug and play fashion The framework presented allows the system integrator to reduce test cost and meet short time to market requirements

Defect Oriented Testing for CMOS Analog and Digital Circuits Manoj Sachdev, 2013-06-29 Defect oriented testing is expected to play a significant role in coming generations of technology Smaller feature sizes and larger die sizes will make ICs more sensitive to defects that can not be modeled by traditional fault modeling approaches Furthermore with increased level of integration an IC may contain diverse building blocks Such blocks include digital logic PLAs volatile and non volatile memories and analog interfaces For such diverse building blocks traditional fault modeling and test approaches will become increasingly inadequate Defect oriented testing methods have come a long way from a mere interesting academic exercise to a hard industrial reality Many factors have contributed to its industrial acceptance Traditional approaches of testing modern integrated circuits ICs have been found to be inadequate in terms of quality and economics of test In a globally competitive semiconductor market place overall product quality and economics have become very important objectives In addition electronic systems are becoming increasingly complex and demand components of highest possible quality Testing in general and defect oriented testing in particular help in realizing these objectives Defect Oriented Testing for CMOS Analog and Digital Circuits is the first book to provide a complete overview of the subject It is essential reading for all design and test professionals as well as researchers and students working in the field A strength of this book is its breadth Types of designs considered include analog and digital circuits programmable logic arrays and memories Having a fault model does not automatically provide a test Sometimes design for testability hardware is necessary Many design for testability ideas supported by experimental evidence are included from the Foreword by Vishwani D Agrawal

Reasoning in Boolean Networks Wolfgang Kunz, Dominik Stoffel, 2013-03-09 Reasoning in Boolean Networks provides a detailed treatment of recent research advances in algorithmic techniques for logic synthesis test generation and formal verification of digital circuits The book presents the central idea of approaching design automation problems for logic level circuits by specific Boolean reasoning techniques While Boolean reasoning techniques have been a central element of two level circuit theory for many decades Reasoning in Boolean Networks describes a basic reasoning methodology for multi level circuits This leads to a unified view on two level and multi level logic synthesis The presented reasoning techniques are applied to various CAD problems to demonstrate their usefulness for today s industrially relevant problems Reasoning in Boolean Networks provides lucid descriptions of basic algorithmic concepts in automatic test pattern generation logic synthesis and verification and elaborates their intimate

relationship to provide further intuition and insight into the subject Numerous examples are provide for ease in understanding the material Reasoning in Boolean Networks is intended for researchers in logic synthesis VLSI testing and formal verification as well as for integrated circuit designers who want to enhance their understanding of basic CAD methodologies

SOC (System-on-a-Chip) Testing for Plug and Play Test Automation Krishnendu Chakrabarty, 2013-04-17

System on a Chip SOC integrated circuits composed of embedded cores are now commonplace Nevertheless there remain several roadblocks to rapid and efficient system integration Test development is seen as a major bottleneck in SOC design and manufacturing capabilities Testing SOC is especially challenging in the absence of standardized test structures test automation tools and test protocols In addition long interconnects high density and high speed designs lead to new types of faults involving crosstalk and signal integrity

SOC System on a Chip Testing for Plug and Play Test Automation is an edited work containing thirteen contributions that address various aspects of SOC testing SOC System on a Chip Testing for Plug and Play Test Automation is a valuable reference for researchers and students interested in various aspects of SOC testing

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