

Zhiheng Cao  
Shouli Yan

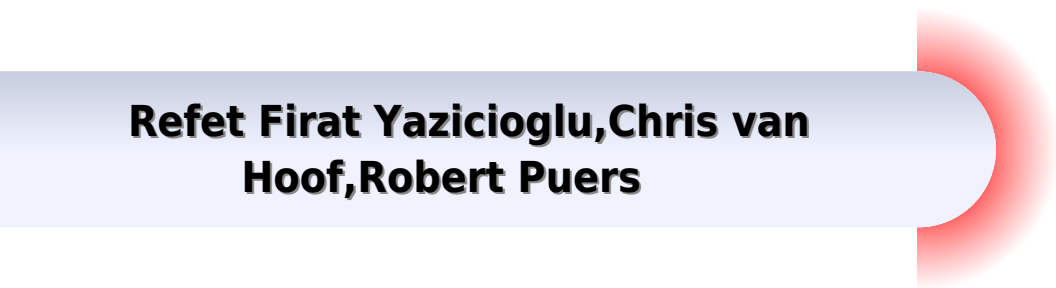
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Analog Circuits and Signal Processing

# Low-Power High-Speed ADCs for Nanometer CMOS Integration

 Springer

# Low Power High Speed Adcs For Nanometer Cmos Integration Analog Circuits And Signal Processing

**Refet Firat Yazicioglu, Chris van  
Hoof, Robert Puers**



## **Low Power High Speed Adcs For Nanometer Cmos Integration Analog Circuits And Signal Processing:**

Low-Power High-Speed ADCs for Nanometer CMOS Integration Zhiheng Cao, Shouli Yan, 2008-07-15 Low Power High Speed ADCs for Nanometer CMOS Integration is about the design and implementation of ADC in nanometer CMOS processes that achieve lower power consumption for a given speed and resolution than previous designs through architectural and circuit innovations that take advantage of unique features of nanometer CMOS processes A phase lock loop PLL clock multiplier has also been designed using new circuit techniques and successfully tested 1 A 1 2V 52mW 210MS s 10 bit two step ADC in 130nm CMOS occupying 0.38mm<sup>2</sup> Using offset canceling comparators and capacitor networks implemented with small value interconnect capacitors to replace resistor ladder multiplexer in conventional sub ranging ADCs it achieves 74dB SFDR for 10MHz and 71dB SFDR for 100MHz input 2 A 32mW 1 25GS s 6 bit ADC with 2.5GHz internal clock in 130nm CMOS A new type of architecture that combines flash and SAR enables the lowest power consumption 6 bit 1GS s ADC reported to date This design can be a drop in replacement for existing flash ADCs since it does not require any post processing or calibration step and has the same latency as flash 3 A 0.4ps rms jitter integrated from 3kHz to 300MHz offset for 2.5GHz 1 3GHz tunable phase noise programmable clock multiplier PLL for generating sampling clock to the SAR ADC A new loop filter structure enables phase error preamplification to lower PLL in band noise without increasing loop filter capacitor size

*Omnidirectional Inductive Powering for Biomedical Implants* Bert Lenaerts, Robert Puers, 2008-10-14 Omnidirectional Inductive Powering for Biomedical Implants investigates the feasibility of inductive powering for capsule endoscopy and freely moving systems in general The main challenge is the random position and orientation of the power receiving system with respect to the emitting magnetic field Where classic inductive powering assumes a predictable or fixed alignment of the respective coils the remote system is now free to adopt just any orientation while still maintaining full power capabilities Before elaborating on different approaches towards omnidirectional powering the design and optimisation of a general inductive power link is discussed in all its aspects Special attention is paid to the interaction of the inductive power link with the patient's body Putting theory into practice the implementation of an inductive power link for a capsule endoscope is included in a separate chapter

**Biopotential Readout Circuits for Portable Acquisition Systems** Refet Firat Yazicioglu, Chris van Hoof, Robert Puers, 2008-10-16 Biopotential Readout Circuits for Portable Acquisition Systems describes one of the main building blocks of such miniaturized biomedical signal acquisition systems The focus of this book is on the implementation of low power and high performance integrated circuit building blocks that can be used to extract biopotential signals from conventional biopotential electrodes New instrumentation amplifier architectures are introduced and their design is described in detail These amplifiers are used to implement complete acquisition demonstrator systems that are a stepping stone towards practical miniaturized and low power systems

**VLSI-SoC: Design Trends** Andrea Calimera, Pierre-Emmanuel Gaillardon, Kunal Korgaonkar, Shahar Kvatinsky, Ricardo Reis, 2021-07-14 This book contains

extended and revised versions of the best papers presented at the 28th IFIP WG 10.5 IEEE International Conference on Very Large Scale Integration VLSI SoC 2020 held in Salt Lake City UT USA in October 2020. The 16 full papers included in this volume were carefully reviewed and selected from the 38 papers out of 74 submissions presented at the conference. The papers discuss the latest academic and industrial results and developments as well as future trends in the field of System on Chip SoC design considering the challenges of nano scale state of the art and emerging manufacturing technologies. In particular they address cutting edge research fields like low power design of RF analog and mixed signal circuits, EDA tools for the synthesis and verification of heterogeneous SoCs, accelerators for cryptography and deep learning and on chip Interconnection system reliability and testing and integration of 3D ICs. The conference was held virtually.

**Low-Power High-Resolution Analog to Digital Converters** Amir Zjajo, José Pineda de Gyvez, 2010-10-29. With the fast advancement of CMOS fabrication technology more and more signal processing functions are implemented in the digital domain for a lower cost, lower power consumption, higher yield and higher reconfigurability. This has recently generated a great demand for low power low voltage A/D converters that can be realized in a mainstream deep submicron CMOS technology. However the discrepancies between lithography wavelengths and circuit feature sizes are increasing. Lower power supply voltages significantly reduce noise margins and increase variations in process device and design parameters. Consequently it is steadily more difficult to control the fabrication process precisely enough to maintain uniformity. The inherent randomness of materials used in fabrication at nanoscopic scales means that performance will be increasingly variable not only from die to die but also within each individual die. Parametric variability will be compounded by degradation in nanoscale integrated circuits resulting in instability of parameters over time eventually leading to the development of faults. Process variation cannot be solved by improving manufacturing tolerances; variability must be reduced by new device technology or managed by design in order for scaling to continue. Similarly within die performance variation also imposes new challenges for test methods. In an attempt to address these issues Low Power High Resolution Analog to Digital Converters specifically focus on i) improving the power efficiency for the high speed and low spurious spectral A/D conversion performance by exploring the potential of low voltage analog design and calibration techniques respectively and ii) development of circuit techniques and algorithms to enhance testing and debugging potential to detect errors dynamically to isolate and confine faults and to recover errors continuously. The feasibility of the described methods has been verified by measurements from the silicon prototypes fabricated in standard 180nm, 90nm and 65nm CMOS technology.

**Smart Intelligent Computing and Communication Technology** V.D. Ambeth Kumar, S. Malathi, Valentina Emilia Balas, Margarita Favorskaya, Thinagaran Perumal, 2021-10-15. Recent developments in the fields of intelligent computing and communication have paved the way for the handling of current and upcoming problems and brought about significant technological advancements. This book presents the proceedings of IConIC 2021, the 4th International Conference on Intelligent Computing held on 26 and 27 March.

2021 in Chennai India The principle objective of the annual IConIC conference is to provide an international scientific forum where participants can exchange innovative ideas in relevant fields and interact in depth through discussion with their peer group The theme of the 2021 conference and this book is Smart Intelligent Computing and Communication Technology and the 109 papers included here focus on the technological innovations and trendsetting initiatives in medicine industry education and security that are improving and optimizing business and technical processes and enabling inclusive growth The papers are grouped under 2 headings Evolution of Computing Intelligence and Computing and Communication and cover a broad range of intelligent computing research and applications The book provides an overview of the cutting edge developments and emerging areas of study in the technological fields of intelligent computing and will be of interest to researchers and practitioners from both academia and industry

*Dynamic-Mismatch Mapping for Digitally-Assisted DACs* Yongjian Tang,Hans Hegt,Arthur van Roermund,2013-02-11 This book describes a novel digital calibration technique called dynamic mismatch mapping DMM to improve the performance of digital to analog converters DACs Compared to other techniques the DMM technique has the advantage of calibrating all mismatch errors without any noise penalty which is particularly useful in order to meet the demand for high performance DACs in rapidly developing applications such as multimedia and communication systems

*High-Performance AD and DA Converters, IC Design in Scaled Technologies, and Time-Domain Signal Processing* Pieter Harpe,Andrea Baschiroto,Kofi A. A. Makinwa,2014-07-23 This book is based on the 18 tutorials presented during the 23rd workshop on Advances in Analog Circuit Design Expert designers present readers with information about a variety of topics at the frontier of analog circuit design serving as a valuable reference to the state of the art for anyone involved in analog circuit research and development

**Hybrid and Advanced Technologies** S. Prasad Jones Christydass,Nurhayati Nurhayati,S. Kannadhasan,2025-03-21 The proceedings of the International Conference on Hybrid and Advanced Technologies ICHAT 2024 present a rich repository of cutting edge research on the various applications of machine learning deep learning and AI in cybersecurity healthcare agriculture and communication systems It highlights the revolutionary potential of data science in transforming traditional practices improving efficiency and accuracy across diverse domains and addressing complex real world challenges These proceedings contains innovative neural network models for agriculture that can predict tractor fuel consumption and optimize smart irrigation besides suggesting greenhouse automation for enhanced agricultural productivity It also provides a roadmap for IoT based monitoring systems for asthma patients and machine learning approaches for early detection of diabetes cancer and aquatic plant ailments Through an array of practical examples and comparative studies the book further highlights advancements in machine learning for enhancing palm vein authentication combating fake news keeping data safe and improving customer segmentation in e commerce The findings would be instrumental in combating critical global issues and foster a deeper understanding of the role of AI in image processing cybersecurity medical diagnostics and intelligent systems in the future

This will be a highly interesting guide to researchers data scientists and practicing professionals in the fields of artificial intelligence machine learning and cybersecurity It will also be of interest to healthcare professionals agricultural scientists and technology enthusiasts in fostering global collaborations exploring future challenges and opportunities and introducing state of the art technologies to streamline processes

*Proceedings of the 11th International Conference on Robotics, Vision, Signal Processing and Power Applications* Nor Muzlifah Mahyuddin, Nor Rizuan Mat Noor, Harsa Amylia Mat Sakim, 2022-02-11 The proceeding is a collection of research papers presented at the 11th International Conference on Robotics Vision Signal Processing Power Applications RoViSP 2021 The theme of RoViSP 2021 Enhancing Research and Innovation through the Fourth Industrial Revolution IR 4.0 served as a platform for researchers scientists engineers academicians as well as industrial professionals from all around the globe to present and exchange their research findings and development activities through oral presentations The book covers various topics of interest including Robotics Control Mechatronics and Automation Telecommunication Systems and Applications Electronic Design and Applications Vision Image and Signal Processing Electrical Power Energy and Industrial Applications Computer and Information Technology Biomedical Engineering and Applications Intelligent Systems Internet of things Mechatronics Mobile Technology

*Analog Circuit Design* Arthur H.M. van Roermund, Herman Casier, Michiel Steyaert, 2009-12-01 Analog Circuit Design contains the contribution of 18 tutorials of the 18th workshop on Advances in Analog Circuit Design Each part discusses a specific to date topic on new and valuable design ideas in the area of analog circuit design Each part is presented by six experts in that field and state of the art information is shared and overviewed This book is number 18 in this successful series of Analog Circuit Design providing valuable information and excellent overviews of Smart Data Converters Chaired by Prof Arthur van Roermund Eindhoven University of Technology Filters on Chip Chaired by Herman Casier AMI Semiconductor Fellow Multimode Transmitters Chaired by Prof M Steyaert Catholic University Leuven Analog Circuit Design is an essential reference source for analog circuit designers and researchers wishing to keep abreast with the latest development in the field The tutorial coverage also makes it suitable for use in an advanced design

*Advanced Data Converters* Gabriele Manganaro, 2011-11-17 Need to get up to speed quickly on the latest advances in high performance data converters Want help choosing the best architecture for your application With everything you need to know about the key new converter architectures this guide is for you It presents basic principles circuit and system design techniques and associated trade offs doing away with lengthy mathematical proofs and providing intuitive descriptions upfront Everything from time to digital converters to comparator based zero crossing ADCs is covered and each topic is introduced with a short summary of the essential basics Practical examples describing actual chips along with extensive comparison between architectural or circuit options ease architecture selection and help you cut design time and engineering risk Trade offs advantages and disadvantages of each option are put into perspective with a discussion of future trends showing where this field is heading

what is driving it and what the most important unanswered questions are      Circuits at the Nanoscale Krzysztof Iniewski, 2018-10-08 Circuits for Emerging Technologies Beyond CMOS New exciting opportunities are abounding in the field of body area networks wireless communications data networking and optical imaging In response to these developments top notch international experts in industry and academia present Circuits at the Nanoscale Communications Imaging and Sensing This volume unique in both its scope and its focus addresses the state of the art in integrated circuit design in the context of emerging systems A must for anyone serious about circuit design for future technologies this book discusses emerging materials that can take system performance beyond standard CMOS These include Silicon on Insulator SOI Silicon Germanium SiGe and Indium Phosphide InP Three dimensional CMOS integration and co integration with Microelectromechanical MEMS technology and radiation sensors are described as well Topics in the book are divided into comprehensive sections on emerging design techniques mixed signal CMOS circuits circuits for communications and circuits for imaging and sensing Dr Krzysztof Iniewski is a director at CMOS Emerging Technologies Inc a consulting company in Vancouver British Columbia His current research interests are in VLSI circuits for medical applications He has published over 100 research papers in international journals and conferences and he holds 18 international patents granted in the United States Canada France Germany and Japan In this volume he has assembled the contributions of over 60 world renowned experts who are at the top of their field in the world of circuit design advancing the bank of knowledge for all who work in this exciting and burgeoning area      **3D Integration in VLSI Circuits** Katsuyuki Sakuma, 2018-04-17 Currently the term 3D integration includes a wide variety of different integration methods such as 2.5 dimensional 2.5D interposer based integration 3D integrated circuits 3D ICs 3D systems in package SiP 3D heterogeneous integration and monolithic 3D ICs The goal of this book is to provide readers with an understanding of the latest challenges and issues in 3D integration TSVs are not the only technology element needed for 3D integration There are numerous other key enabling technologies required for 3D integration and the speed of the development in this emerging field is very rapid To provide readers with state of the art information on 3D integration research and technology developments each chapter has been contributed by some of the world's leading scientists and experts from academia research institutes and industry from around the globe Covers chip wafer level 3D integration technology memory stacking reconfigurable 3D and monolithic 3D IC Discusses the use of silicon interposer and organic interposer Presents architecture design and technology implementations for 3D FPGA integration Describes oxide bonding Cu SiO<sub>2</sub> hybrid bonding adhesive bonding and solder bonding Addresses the issue of thermal dissipation in 3D integration      **Silicon Analog Components** Badih El-Kareh, Lou N. Hutter, 2015-06-04 This book covers modern analog components their characteristics and interactions with process parameters It serves as a comprehensive guide addressing both the theoretical and practical aspects of modern silicon devices and the relationship between their electrical properties and processing conditions Based on the authors extensive experience in the development of analog

devices this book is intended for engineers and scientists in semiconductor research development and manufacturing The problems at the end of each chapter and the numerous charts figures and tables also make it appropriate for use as a text in graduate and advanced undergraduate courses in electrical engineering and materials science

**Mixed-Signal Circuits**  
 Thomas Noulis, 2018-09-03 Mixed Signal Circuits offers a thoroughly modern treatment of integrated circuit design in the context of mixed signal applications Featuring chapters authored by leading experts from industry and academia this book Discusses signal integrity and large scale simulation verification and testing Demonstrates advanced design techniques that enable digital circuits and sensitive analog circuits to coexist without any compromise Describes the process technology needed to address the performance challenges associated with developing complex mixed signal circuits Deals with modeling topics such as reliability variability and crosstalk that define pre silicon design methodology and trends and are the focus of companies involved in wireless applications Develops methods to move analog into the digital domain quickly minimizing and eliminating common trade offs between performance power consumption simulation time verification size and cost Details approaches for very low power performances high speed interfaces phase locked loops PLLs voltage controlled oscillators VCOs analog to digital converters ADCs and biomedical filters Delineates the respective parts of a full system on chip SoC from the digital parts to the baseband blocks radio frequency RF circuitries electrostatic discharge ESD structures and built in self test BIST architectures Mixed Signal Circuits explores exciting opportunities in wireless communications and beyond The book is a must for anyone involved in mixed signal circuit design for future technologies

Dissertation Abstracts International ,2006      Comprehensive Semiconductor Science and Technology ,2011-01-28 Semiconductors are at the heart of modern living Almost everything we do be it work travel communication or entertainment all depend on some feature of semiconductor technology Comprehensive Semiconductor Science and Technology Six Volume Set captures the breadth of this important field and presents it in a single source to the large audience who study make and exploit semiconductors Previous attempts at this achievement have been abbreviated and have omitted important topics Written and Edited by a truly international team of experts this work delivers an objective yet cohesive global review of the semiconductor world The work is divided into three sections The first section is concerned with the fundamental physics of semiconductors showing how the electronic features and the lattice dynamics change drastically when systems vary from bulk to a low dimensional structure and further to a nanometer size Throughout this section there is an emphasis on the full understanding of the underlying physics The second section deals largely with the transformation of the conceptual framework of solid state physics into devices and systems which require the growth of extremely high purity nearly defect free bulk and epitaxial materials The last section is devoted to exploitation of the knowledge described in the previous sections to highlight the spectrum of devices we see all around us Provides a comprehensive global picture of the semiconductor world Each of the work s three sections presents a complete description of one aspect of the whole Written and Edited by a truly international

team of experts      **Multi-Gigahertz Nyquist Analog-to-Digital Converters** Athanasios T. Ramkaj, Marcel J.M. Pelgrom, Michiel S. J. Steyaert, Filip Tavernier, 2023-01-12 This book proposes innovative circuit architecture and system solutions in deep scaled CMOS and FinFET technologies which address the challenges in maximizing the accuracy speed power of multi GHz sample rate and bandwidth Analog to Digital Converters ADC s A new holistic approach is introduced that first identifies the major error sources of a converter building blocks and quantitatively analyzes their impact on the overall performance establishing the fundamental circuit imposed accuracy speed power limits The analysis extends to the architecture level by introducing a mathematical framework to estimate and compare the accuracy speed power limits of several ADC architectures and variants To gain system level insight time interleaving is covered in detail and a framework is also introduced to compare key metrics of interleaver architectures quantitatively The impact of technology is also considered by adding process effects from several deep scaled CMOS technologies The validity of the introduced analytical approach and the feasibility of the proposed concepts are demonstrated by four silicon prototype Integrated Circuits IC s realized in ultra deep scaled CMOS and FinFET technologies Introduces a new holistic approach for the analysis and design of high performance ADCs in deep scaled CMOS technologies from theoretical concepts to silicon bring up and verification Describes novel methods and techniques to push the accuracy speed power boundaries of multi GHz ADCs analyzing core and peripheral circuits trade offs across the entire ADC chain Supports the introduced analysis and design concepts by four state of the art silicon prototype ICs implemented in 28nm bulk CMOS and 16nm FinFET technologies Provides a useful reference and a valuable tool for beginners as well as experienced ADC design engineers      **Design of 3D Integrated Circuits and Systems** Rohit Sharma, 2018-09-03 Three dimensional 3D integration of microsystems and subsystems has become essential to the future of semiconductor technology development 3D integration requires a greater understanding of several interconnected systems stacked over each other While this vertical growth profoundly increases the system functionality it also exponentially increases the design complexity Design of 3D Integrated Circuits and Systems tackles all aspects of 3D integration including 3D circuit and system design new processes and simulation techniques alternative communication schemes for 3D circuits and systems application of novel materials for 3D systems and the thermal challenges to restrict power dissipation and improve performance of 3D systems Containing contributions from experts in industry as well as academia this authoritative text Illustrates different 3D integration approaches such as die to die die to wafer and wafer to wafer Discusses the use of interposer technology and the role of Through Silicon Vias TSVs Presents the latest improvements in three major fields of thermal management for multiprocessor systems on chip MPSoCs Explores ThruChip Interface TCI NAND flash memory stacking and emerging applications Describes large scale integration testing and state of the art low power testing solutions Complete with experimental results of chip level 3D integration schemes tested at IBM and case studies on advanced complementary metal oxide semiconductor CMOS integration for 3D integrated circuits ICs

Design of 3D Integrated Circuits and Systems is a practical reference that not only covers a wealth of design issues encountered in 3D integration but also demonstrates their impact on the efficiency of 3D systems

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### **Introduction**

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