SiGe CMOS DIFFERENTIAL LOW NOISE AMPLIFIER 100MHz - 300MHz

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I. INTRODUCTION

In the next year, several projects of large radiotelescopes will be developed. These include LOFAR (LOw Frequency ARray), SKA (Square Kilometer Array) and FASR (Frequency Agile Solar Radiotelescope). LOFAR and SKA will be made up of thousands of antennae and consequently of thousands of front-end receivers. Each front-end is constituted of a LNA (Low Noise Amplifier), a filter, a mixer, ...

In this perspective, we study a differential Low Noise Amplifier (LNA) realized in a CMOS 0.35µm technology from AustriaMicroSystems (AMS). A Silicon technology is chosen because of integration, manufacturing and cost advantages.

A bibliographical study has shown that the LNA's Noise Figure objectives, for instance in communication applications, are often of a few dB. However, radioastronomical received signals are very faint. So the required LNA must have a Noise Figure as low as possible (<1dB) and a 50 Ω input and output matching across the frequency band.

This paper will, first of all, describe a single-ended topology, based on a technique called "Thermal Noise Cancelling" [1], which allows to obtain simultaneously a low Noise Figure and a good matching. Then, in a second part, simulated and measured results of a differential circuit will be presented.

II. SINGLE-ENDED TOPOLOGY USING THE "THERMAL NOISE CANCELLING" TECHNIQUE

II. 1 Principle of the Technique

To apply this technique, a first stage with a transistor and a feedback resistor is used. The transistor in saturation is modelled as a voltage-controlled current source with transconductance gm. This source generates noise voltages with equal sign and signal voltages with opposite sign due to the feedback, at the input and output of the transistor. The technique consists in inserting a second stage, composed of two transistors in a push-pull configuration. The first one is connected at the input of the first stage and the second one at the output. This second stage performs summation of the two signals. Therefore, the noise voltages are cancelled and the signal voltages are constructively added. Fig.1a) represents the principle of this technique and Fig.1b) the final topology.

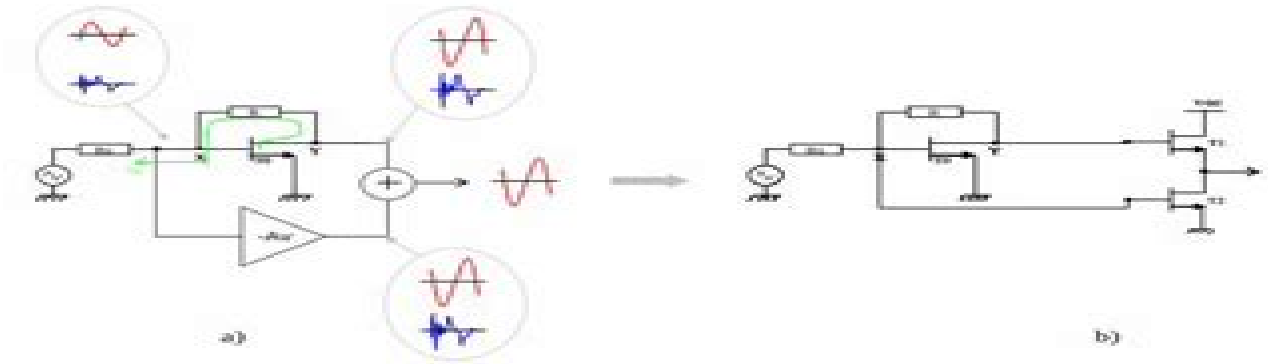

Fig. 1: Principle of the "Thermal Noise Cancelling" Technique

Design Of A 60ghz Low Noise Amplier In Sige Technology

Mohammed Ismail,Delia R. de Llera González

Design Of A 60ghz Low Noise Amplier In Sige Technology:

Millimeter-Wave Low Noise Amplifiers Mladen Božanić,Saurabh Sinha,2017-11-30 This book is the first standalone book that combines research into low noise amplifiers LNAs with research into millimeter wave circuits In compiling this book the authors have set two research objectives The first is to bring together the research context behind millimeter wave circuit operation and the theory of low noise amplification The second is to present new research in this multi disciplinary field by dividing the common LNA configurations and typical specifications into subsystems which are then optimized separately to suggest improvements in the current state of the art designs To achieve the second research objective the state of the art LNA configurations are discussed and the weaknesses of state of the art configurations are considered thus identifying research gaps Such research gaps among others point towards optimization at a systems and microelectronics level Optimization topics include the influence of short wavelength layout and crosstalk on LNA performance Advanced fabrication technologies used to decrease the parasitics of passive and active devices are also explored together with packaging technologies such as silicon on chip and silicon on package which are proposed as alternatives to traditional IC implementation This research outcome builds through innovation Innovative ideas for LNA construction are explored and alternative design methodologies are deployed including LNA antenna co design or utilization of the electronic design automation in the research flow The book also offers the authors proposal for streamlined automated LNA design flow which focuses on LNA as a collection of highly optimized subsystems *VLSI Design and Test* Ambika Prasad Shah,Sudeb Dasgupta,Anand Darji,Jaynarayan Tudu,2022-12-16 This book constitutes the proceedings of the 26th International Symposium on VLSI Design and Test VDAT 2022 which took place in Jammu India in July 2022 The 32 regular papers and 16 short papers presented in this volume were carefully reviewed and selected from 220 submissions They were organized in topical sections as follows Devices and Technology Sensors Analog Mixed Signal Digital Design Emerging Technologies and Memory System Design **Millimeter-Wave Receiver Concepts for 77 GHz Automotive Radar in Silicon-Germanium Technology** Dietmar Kissinger,2012-03-09 The book presents the analysis and design of integrated automotive radar receivers in Silicon Germanium technology for use in complex multi channel radar transceiver front ends in the 77GHz frequency band The main emphasis of the work is the realization of high linearity and low power modular receiver channels as well as the investigation of millimeter wave integrated test concepts for the receiver front end Proceedings of the 4th International Conference on Telecommunications and Communication Engineering Maode Ma,2021-09-02 The book is presents the papers presented at the 4th International Conference on Telecommunications and Communication Engineering ICTCE 2020 held on 4 6 December in Singapore It covers advanced research topics in the field of computer communication and networking organized into the topics of emerging technologies of wireless communication and networks 5G wireless communication and networks information and network security internet of things and fog computing These advanced

research topics are taking the lead and representing the trend of the recent academic research in the field of computer communication and networking It is expected that the collection and publication of the research papers with the advanced topics listed in this book will further promote high standard academic research in the field and make a significant contribution to the development of economics and human society **Wireless Technologies** Krzysztof Iniewski,2017-12-19 Advanced concepts for wireless technologies present a vision of technology that is embedded in our surroundings and practically invisible From established radio techniques like GSM 802 11 or Bluetooth to more emerging technologies such as Ultra Wide Band and smart dust motes a common denominator for future progress is the underlying integrated circuit technology Wireless Technologies responds to the explosive growth of standard cellular radios and radically different wireless applications by presenting new architectural and circuit solutions engineers can use to solve modern design problems This reference addresses state of the art CMOS design in the context of emerging wireless applications including 3G 4G cellular telephony wireless sensor networks and wireless medical application Written by top international experts specializing in both the IC industry and academia this carefully edited work uncovers new design opportunities in body area networks medical implants satellite communications automobile radar detection and wearable electronics The book is divided into three sections wireless system perspectives chip architecture and implementation issues and devices and technologies used to fabricate wireless integrated circuits Contributors address key issues in the development of future silicon based systems such as scale of integration ultra low power dissipation and the integration of heterogeneous circuit design style and processes onto one substrate Wireless sensor network systems are now being applied in critical applications in commerce healthcare and security This reference which contains 25 practical and scientifically rigorous articles provides the knowledge communications engineers need to design innovative methodologies at the circuit and system level Silicon Heterostructure Devices John D. Cressler,2018-10-03 SiGe HBTs are the most mature of the Si heterostructure devices and not surprisingly the most completely researched and discussed in the technical literature However new effects and nuances of device operation are uncovered year after year as transistor scaling advances and application targets march steadily upward in frequency and sophistication Providing a comprehensive treatment of SiGe HBTs Silicon Heterostructure Devices covers an amazingly diverse set of topics ranging from basic transistor physics to noise radiation effects reliability and TCAD simulation Drawn from the comprehensive and well reviewed Silicon Heterostructure Handbook this text explores SiGe heterojunction bipolar transistors HBTs heterostructure FETs various other heterostructure devices as well as optoelectronic components The book provides an overview characteristics and derivative applications for each device covered It discusses device physics broadband noise performance limits reliability engineered substrates and self assembling nanostructures Coverage of optoelectronic devices includes Si SiGe LEDs near infrared detectors photonic transistors for integrated optoelectronics and quantum cascade emitters In addition to this substantial collection of material the book concludes with a

look at the ultimate limits of SiGe HBTs scaling It contains easy to reference appendices on topics including the properties of silicon and germanium the generalized Moll Ross relations and the integral charge control model and sample SiGe HBT compact model parameters **Batteryless mm-Wave Wireless Sensors** Hao Gao,Marion Matters-Kammerer,Dusan Milosevic,Peter G.M. Baltus,2018-01-09 This book describes the PREMISS system which enables readers to overcome the limitations of state of the art battery less wireless sensors in size cost robustness and range with a system concept for a 60 GHz wireless sensor system with monolithic sensors The authors demonstrate a system in which the wireless sensors consist of wireless power receiving sensing and communication functions in a single chip without external components avoiding costly IC interfaces that are sensitive to mechanical and thermal stress Inventive Systems and Control V. Suma,Joy Iong-Zong Chen,Zubair Baig,Haoxiang Wang,2021-06-07 This book presents selected papers from the 5th International Conference on Inventive Systems and Control ICISC 2021 held on 7 8 January 2021 at JCT College of Engineering and Technology Coimbatore India The book includes an analysis of the class of intelligent systems and control techniques that utilises various artificial intelligence technologies where there are no mathematical models and systems available to make them remain controlled Inspired by various existing intelligent techniques the primary goal is to present the emerging innovative models to tackle the challenges faced by the existing computing and communication technologies The proceedings of ICISC 2021 aim at presenting the state of the art research developments trends and solutions for the challenges faced by the intelligent systems and control community with the real world applications The included research articles feature the novel and unpublished research works on intelligent system representation and control **mm-Wave Silicon Technology** Ali M. Niknejad,Hossein Hashemi,2008-01-03 This book compiles and presents the research results from the past five years in mm wave Silicon circuits This area has received a great deal of interest from the research community including several university and research groups The book covers device modeling circuit building blocks phased array systems and antennas and packaging It focuses on the techniques that uniquely take advantage of the scale and integration offered by silicon based technologies *RFIC and MMIC Design and Technology* I.D. Robertson,S. Lucyszyn,Institution of Electrical Engineers,2001-11-30 This book gives an in depth account of GaAs InP and SiGe technologies and describes all the key techniques for the design of amplifiers ranging from filters and data converters to image oscillators mixers switches variable attenuators phase shifters integrated antennas and complete monolithic transceivers **Analog Circuit Design** Herman Casier,Michiel Steyaert,Arthur H.M. van Roermund,2008-03-19 Analog Circuit Design is based on the yearly Advances in Analog Circuit Design workshop The aim of the workshop is to bring together designers of advanced analogue and RF circuits for the purpose of studying and discussing new possibilities and future developments in this field Selected topics for AACD 2007 are 1 Sensors Actuators and Power Drivers for the Automotive and Industrial Environment Tue 27 March Chaired by Herman Casier AMI Semiconductor Fellow Belgium 2 Integrated PA s from Wireline to RF Wed 28 March Chaired by Prof

Michiel Steyaert Catholic University Leuven 3 Very High Frequency Front Ends Thu 29 March Chaired by Prof Arthur van Roermund Eindhoven University of Technology *Advanced Millimeter-wave Technologies* Duixian Liu,Ulrich Pfeiffer,Janusz Grzyb,Brian Gaucher,2009-04-06 This book explains one of the hottest topics in wireless and electronic devices community namely the wireless communication at mmWave frequencies especially at the 60 GHz ISM band It provides the reader with knowledge and techniques for mmWave antenna design evaluation antenna and chip packaging Addresses practical engineering issues such as RF material evaluation and selection antenna and packaging requirements manufacturing tolerances antenna and system interconnections and antenna One of the first books to discuss the emerging research and application areas particularly chip packages with integrated antennas wafer scale mmWave phased arrays and imaging Contains a good number of case studies to aid understanding Provides the antenna and packaging technologies for the latest and emerging applications with the emphases on antenna integrations for practical applications such as wireless USB wireless video phase array automobile collision avoidance radar and imaging **Extreme Environment Electronics** John D. Cressler,H. Alan Mantooth,2017-12-19 Unfriendly to conventional electronic devices circuits and systems extreme environments represent a serious challenge to designers and mission architects The first truly comprehensive guide to this specialized field Extreme Environment Electronics explains the essential aspects of designing and using devices circuits and electronic systems intended to operate in extreme environments including across wide temperature ranges and in radiation intense scenarios such as space The Definitive Guide to Extreme Environment Electronics Featuring contributions by some of the world s foremost experts in extreme environment electronics the book provides in depth information on a wide array of topics It begins by describing the extreme conditions and then delves into a description of suitable semiconductor technologies and the modeling of devices within those technologies It also discusses reliability issues and failure mechanisms that readers need to be aware of as well as best practices for the design of these electronics Continuing beyond just the paper design of building blocks the book rounds out coverage of the design realization process with verification techniques and chapters on electronic packaging for extreme environments The final set of chapters describes actual chip level designs for applications in energy and space exploration Requiring only a basic background in electronics the book combines theoretical and practical aspects in each self contained chapter Appendices supply additional background material With its broad coverage and depth and the expertise of the contributing authors this is an invaluable reference for engineers scientists and technical managers as well as researchers and graduate students A hands on resource it explores what is required to successfully operate electronics in the most demanding conditions **Circuits and Applications Using Silicon Heterostructure Devices** John D. Cressler,2018-10-03 No matter how you slice it semiconductor devices power the communications revolution Skeptical Imagine for a moment that you could flip a switch and instantly remove all the integrated circuits from planet Earth A moment s reflection would convince you that there is not a single field of human

endeavor that would not come to a grinding halt be it commerce agriculture education medicine or entertainment Life as we have come to expect it would simply cease to exist Drawn from the comprehensive and well reviewed Silicon Heterostructure Handbook this volume covers SiGe circuit applications in the real world Edited by John D Cressler with contributions from leading experts in the field this book presents a broad overview of the merits of SiGe for emerging communications systems Coverage spans new techniques for improved LNA design RF to millimeter wave IC design SiGe MMICs SiGe Millimeter Wave ICs and wireless building blocks using SiGe HBTs The book provides a glimpse into the future as envisioned by industry leaders **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 Proceedings of the Fourth International Conference on Microelectronics, Computing and Communication Systems Vijay Nath,J. K. Mandal,2020-09-19 This book presents high quality papers from the Fourth International Conference on Microelectronics Computing Communication Systems MCCS 2019 It discusses the latest technological trends and advances in MEMS and nanoelectronics wireless communication optical communication instrumentation signal processing image processing bioengineering green energy hybrid vehicles environmental science weather forecasting cloud computing renewable energy RFID CMOS sensors actuators transducers telemetry systems embedded systems and sensor network applications It includes papers based on original theoretical practical and experimental simulations development applications measurements and testing The applications and solutions discussed here provide excellent reference material for future product development *Radio Design in Nanometer Technologies* Mohammed Ismail,Delia R. de Llera González,2007-06-16 Radio Design in Nanometer Technologies addresses

current trends and future directions in radio design for wireless applications As radio transceivers constitute the major bottleneck in a wireless chipset in terms of power consumption and die size the radio must be designed in the context of the entire system end to end Therefore the book will address wireless systems as well as the DSP parts before it gets into coverage of radio design issues As such the book is the first volume that looks at the integrated radio design problem as a piece of a big puzzle namely the entire chipset or single chip that builds an entire wireless system This is the only way to successfully design radios to meet the stringent demands of today s increasingly complex wireless systems **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 ciruits 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 reknown 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 Millimeter Wave Technology in Wireless PAN, LAN, and MAN Shao-Qiu Xiao,Ming-Tuo Zhou,2008-05-28 Driven by the demand for high data rate millimeter wave technologies with broad bandwidth are being explored in high speed wireless communications These technologies include gigabit wireless personal area networks WPAN high speed wireless local area networks WLAN and high speed wireless metropolitan area networks WMAN As a result of this *Silicon-Germanium Heterojunction Bipolar Transistors for Mm-wave Systems Technology, Modeling and Circuit Applications* Niccolò Rinaldi,Michael Schröter,2022-09-01 The semiconductor industry is a fundamental building block of the new economy there is no area of modern life untouched by the progress of nanoelectronics The electronic chip is becomingan ever increasing portion of system solutions starting initially from less than 5% in the 1970 microcomputer era to more than 60% of the final cost of a mobile telephone 50% of the price of a personal computer representing nearly 100% of the functionalities and 30% of the price of a monitor in the early 2000 s

Interest in utilizing the sub mm wave frequency spectrum for commercial and research applications has also been steadily increasing Such applications which constitute a diverse but sizeable future market span a large variety of areas such as health material science mass transit industrial automation communications and space exploration Silicon Germanium Heterojunction Bipolar Transistors for mm Wave Systems Technology Modeling and Circuit Applications provides an overview of results of the DOTSEVEN EU research project and as such focusses on key material developments for mm Wave Device Technology It starts with the motivation at the beginning of the project and a summary of its major achievements The subsequent chapters provide a detailed description of the obtained research results in the various areas of process development device simulation compact device modeling experimental characterization reliability sub mm wave circuit design and systems

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