Millimeter Wave Receiver Concepts For 77 Ghz Automotive Radar In Silicon Germanium Technology Springerbriefs In Electrical And Computer Engineering

The aim of this book is to present the modern design and analysis principles of millimeter-wave communication system for wireless devices and to give postgraduates and system professionals the design insights and challenges when integrating millimeter wave personal communication system. Millimeter wave communication system are going to play key roles in modern gigabit wireless communication area as millimeter-wave industrial standards from IEEE, European Computer Manufacturing Association (ECMA) and Wireless High Definition (Wireless HD) Group, are on their way to the market. The book will review up-to-date research results and utilize numerous design and analysis for the whole system covering from Millimeter wave frontend to digital signal processing in order to address major topics in a high speed wireless system. This book emphasizes the importance and the requirements of high-gain antennas, low power transceiver, adaptive equalizer/modulation, channeling coding and adaptive multi-user detection for gigabit wireless communications. In addition, the book will include the updated research literature and patents in the topics of transceivers, antennas, MIMO, channel capacity, coding, equalizer, Modem and multi-user detection. Finally the application of these antennas will be discussed in light of different forthcoming wireless standards at V-band and E-band.

The modern communications environment is becoming an increasingly crowded place, resulting in rapidly increasing demands on current technology. Military and civilian operations require the ability to locate and decode all communication signals in the environment. However, developments in RADAR (RAdio Detection And Ranging) and communications technology are making it harder to effectively identify and maintain bandwidth usage for everyone. Millimeter waves—waves measured between one millimeter to one centimeter in wavelength—have only recently been explored as a new technology to replace the augment receiver architectures. These small wavelengths introduce many engineering challenges, such as: large atmospheric losses, poor sensitivity, and expensive electronic equipment. With growing developments in Microwave Photonics, low-noise RF amplifiers and high-speed modulators have demonstrated the ability to design RF communication links in the millimeter wave regime to counter such problems. However, despite these developments, toward a cost-effective, spatial division multiplexing (SDM) receiver concept has not proved capable of being implemented as part of the next generation 5G wireless network infrastructure. To this end, we present a novel receiver architecture utilizing an optically addressed phased-array millimeter wave receiver based on optical-upconversion and signal recovery. This receiver is capable of geolocation and spatial multiplexing of multiple Tunable Optically Paired Source (TOPS) communication

signals in its scene. Operating at 35 GHz, the receiver up-converts the received RF onto an optical sideband, which, to our advantage, contains all of the frequency, amplitude, and phase information of the received signals. Subsequent optical processing allows routing of the sideband to a free space detector port. Photomixing a coherent optical local oscillator (LO) with the optical sideband performs heterodyne down-conversion to an Intermediate Frequency (IF) where we are able to spatially resolve each signal individually to recover complex modulated formats transmitted by our TOPS generators. In this thesis, we describe the unique advantages of our receiver concept to allow for frequency re-use as well as cell sectoring methods to increase the overall data capacity bandwidth. Primarily, the use of a distrusted aperture array enables high resolution imaging, limited only by the diffraction efficiency set at the antenna array. Thus, angle-of-arrival (AoA) capabilities help deduce the position of each signal and the data it contains. Unlike IR or visible wavelengths, millimeter waves have the unique ability to penetrate dust, smoke, cloud coverage, and thin fabrics such as clothing. As such, millimeter wave receivers have the capability of achieving high signal-to-noise ratios (SNR) in obscured environments compared to their counterparts. This optically addressed communication receiver offers vast advantages over current communication receiver architectures in place today. This approach has the potential to operate as the next generation communication receiver for 5G wireless. In addition, this receiver concept appeals to many security and defense applications requiring secure communications and unwanted signal avoidance.

This book is planned to publish with an objective to provide a state-of-the-art reference book in the areas of advanced microwave, MM-Wave and THz devices, antennas and systemtechnologies for microwave communication engineers, Scientists and post-graduate students of electrical and electronics engineering, applied physicists. This reference book is a collection of 30 Chapters characterized in 3 parts: Advanced Microwave and MM-wave devices, integrated microwave and MM-wave circuits and Antennas and advanced microwave computer techniques, focusing on simulation, theories and applications. This book provides a comprehensive overview of the components and devices used in microwave and MM-Wave circuits, including microwave transmission lines, resonators, filters, ferrite devices, solid state devices, transistor oscillators and amplifiers, directional couplers, microstripeline components, microwave detectors, mixers, converters and harmonic generators, and microwave solid-state switches, phase shifters and attenuators. Several applications area also discusses here, like consumer, industrial, biomedical, and chemical applications of microwave technology. It also covers microwave instrumentation and measurement, thermodynamics, and applications in navigation and radio communication.

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 were: (1) Sensors, Actuators and Power Drivers for the Automotive and Industrial Environment; (2) Integrated PA's from Wireline to RF; (3) Very High Frequency Front Ends.

The Conference is the premier international meeting for the presentation of original work addressing all aspects of the theory, design, fabrication, assembly, packaging, testing and application of solid-state sensors, actuators, MEMS, and microsystems.

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

Discover the concepts, architectures, components, tools, and techniques needed to design millimeter-wave circuits for current and emerging wireless system applications. Focusing on applications in 5G, connectivity, radar, and more, leading experts in radio frequency integrated circuit (RFIC) design provide a comprehensive treatment of cutting-edge physical-layer technologies for radio frequency (RF) transceivers - specifically RF, analog, mixed-signal, and digital circuits and architectures. The full design chain is covered, from system design requirements through to building blocks, transceivers, and process technology. Gain insight into the key novelties of 5G through authoritative chapters on massive MIMO and phased arrays, and learn about the very latest technology developments, such as FinFET logic process technology for RF and millimeter-wave applications. This is an essential reading and an excellent reference for high-frequency circuit designers in both academia and industry.

The main features of high-temperature superconductors (HTSC) that define their properties are intrinsic brittleness of oxide cuprates, the layered anisotropic structure and the supershort coherence length. Taking into account these features, this treatise presents research into HTSC microstructure and properties, and also explores the possibilities of optimization of the preparation techniques and superconducting compositions. The "composition-technique-experiment-theory-model," employed here, assumes considerable HTSC defectiveness and structure heterogeneity and helps to draw a comprehensive picture of modern representations of the microstructure, strength and the related structure-sensitive properties of the materials considered. Special attention is devoted to the Bi-Sr-Ca-Cu-O and Y-Ba-Cu-O families, which currently offer the most promising applications. Including a great number of illustrations and references, this monograph addresses students, post-graduate students and specialists, taking part in the development, preparation and research of new materials. The new edition had been

updated intensively, especially experimental investigations and modeling conductive and elastic properties of HTC superconductors have been added.

The last research frontier in high frequency electronics lies in the so-called terahertz (or submillimeter wave) regime, between the traditional microwave and the infrared domains. Significant scientific and technical challenges within the terahertz (THz) frequency regime have recently motivated an array of new research activities. During the last few years, major research programs have emerged that are focused on advancing the state of the art in THz frequency electronic technology and on investigating novel applications of THz frequency sensing. This book provides a detailed review of the new THz frequency technological developments that are emerging across a wide spectrum of sensing and technology areas.Volume II presents cutting edge results in two primary areas: (1) research that is attempting to establish THz-frequency sensing as a new characterization tool for chemical, biological and semiconductor materials, and (2) theoretical and experimental efforts to define new device concepts within the “THz gap”.

This book is a printed edition of the Special Issue "Raspberry Pi Technology" that was published in Electronics

One of the main issues in microwave and wireless system design is to ensure high performance with low cost techniques. The six-port technique helps allow for this in critical network design areas. This practical resource offers you a thorough overview the six-port technique, from basic principles of RF measurement based techniques and multiport design, to coverage of key applications, such as vector network analyzers, software defined radio, and radar. The first book dedicated to six-port applications and principles, this volume serves as a current, one-stop guide offering you cost-effective solutions for your challenging projects in the field.

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This book addresses in-depth technical issues, limitations, considerations and challenges facing millimeter-wave (MMW) integrated circuit and system designers in designing MMW wireless communication systems from the complementary metal-oxide semiconductor (CMOS) perspective. It offers both a comprehensive explanation of fundamental theories and a broad coverage of MMW integrated circuits and systems.CMOS Millimeter-Wave Integrated Circuits for Next Generation Wireless Communication Systems is an excellent reference for faculty, researchers and students working in electrical and electronic engineering, wireless communication, integrated circuit design and circuits and systems. While primarily written for upper-level undergraduate courses, it is also an excellent introduction to the subject for instructors, graduate students, researchers, integrated circuit designers and practicing engineers. Advanced readers could also benefit from this book as it includes many recent state-of-the-art MMW circuits.

This research book volume offers an important learning opportunity with insights into a variety of emerging electronic circuit aspects, such as new materials, energy harvesting architectures, and compressive sensing technique. Advanced circuit technologies are extremely powerful and developed rapidly. They change industry. They change lives. And we know they can change the world. The exhibition on these new and exciting topics will benefit readers in related fields.

A NATO Advanced Research Workshop (ARW) entitled “Advanced Materials and Technologies for Micro/Nano Devices, Sensors and Actuators” was held in St. Petersburg, Russia, from June 29 to July 2, 2009. The main goal of the Workshop was to examine (at a fundamental level) the very complex scientific issues that pertain to the use of micro- and nano-electromechanical systems (MEMS and NEMS), devices and technologies in next generation commercial and defen- related applications. Micro- and nano-electromechanical systems represent rather broad and diverse technological areas, such as optical systems (micromirrors, waveguides, optical sensors, integrated subsystems), life sciences and lab equipment (micropumps, membranes, lab-on-chip, membranes, microfluidics), sensors (bio-sensors, chemical sensors, gas-phase sensors, sensors integrated with electronics) and RF applications for signal transmission (variable capacitors, tunable filters and antennas, switches, resonators). From a scientific viewpoint, this is a very multi-disciplinary field, including micro- and nano-mechanics (such as stresses in structural materials), electronic effects (e. g. charge transfer), general electrostatics, materials science, surface chemistry, interface science, (nano)tribology, and optics. It is obvious that in order to overcome the problems surrounding next-generation MEMS/NEMS devices and applications it is necessary to tackle them from different angles: theoreticians need to speak with mechanical engineers, and device engineers and modelers to listen to surface physicists. It was therefore one of the main objectives of the workshop to bring together a multidisciplinary team of distinguished researchers.

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.

Infrared and Millimeter Waves, Volume 15: Millimeter Components and Techniques, Part VI is concerned with millimeter-wave guided propagation and integrated circuits. This book covers low-noise receiver technology for near-millimeter wavelengths; dielectric image-line antennas; EHF satellite communications (SATCOM) terminal antennas; and semiconductor antennas for millimeter-wave integrated circuits. A scanning airborne radiometer for 30 and 90 GHz and a self-oscillating mixer are also described. This monograph is comprised of six chapters and begins with a discussion on the design of low-noise receivers, with emphasis on problems encountered at near-millimeter wavelengths. Optimization of the material parameters and device topology for both Schottky-barrier diodes and superconducting mixer elements are considered. Some representative examples of state-of-the-art mixers and receivers, designed to operate at frequencies of 100-1000 GHz, are given in order to illustrate the way in which practical, high-performance millimeter-wave devices can be constructed. The following chapters focus on a scanning airborne radiometer for 30 and 90 GHz; a self-

oscillating mixer; dielectric image-line antennas; and EHF SATCOM terminal antennas. The final chapter is devoted to semiconductor dipole antennas for millimeter-wave sensors, with particular reference to the basic concepts leading to the development of semiconductor dipoles. A theoretical formulation for tubular semiconductor dipoles is outlined and numerical results are presented to assess their characteristics. This text will be a valuable resource for physicists and electronics and electrical engineers.

The first and only comprehensive text on substrate-integrated mmW antenna technology, state-of-the-art antenna design, and emerging wireless applications Substrate-Integrated Millimeter-Wave Antennas for Next-Generation Communication and Radar Systems elaborates the most important topics related to revolutionary millimeter wave (mmW) technology. Following a clear description of fundamental concepts including substrate-integrated waveguides and loss analysis, the text treats key design methods, prototyping techniques, and experimental setup and testing. The authors also highlight applications of mmW antennas in 5G wireless communication and next-generation radar systems. Readers are prepared to put techniques into practice through practical discussions of how to set up testing for impedance matching, radiation patterns, gain from 24GHz up to 325 GHz, and textures for specific designs. This book will bring readers current, addressing state-of-the-art designs and recent progress in substrate-integrated mmW antennas for emerging wireless applications. Substrate-Integrated Millimeter-Wave Antennas for Next-Generation Communication and Radar Systems is the first comprehensive text on the topic, allowing readers to quickly master mmW technology. This book: Introduces basic concepts such as metamaterials Huygens's surface, zero-index structures, and pattern synthesis Describes prototyping in the form of fabrication based on printed-circuit-board, low-temperature-co-fired-ceramic and micromachining Explores applications for next-generation radar and imaging systems such as 24-GHz and 77-GHz vehicular detection radar systems Elaborates design methods including waveguide-based feeding network, three-dimensional feeding structure, dielectric loaded aperture antenna element, and low-sidelobe synthesis The millimeter wave is one of today’s most important emerging technologies. This book provides graduate students, researchers, and engineers with the knowledge they need to deploy mmW systems and develop new antenna designs with low cost, low loss, and low complexity.

The Transportation Security Administration requested a study by the National Research Council (NRC) to establish the Committee on Airport Passenger Screening: Millimeter Wave Machines to evaluate two models of active millimeter wave scanners: the L3 ProVision 1 and L3 ProVision 2. Airport Passenger Screening Using Millimeter Wave Machines provides findings and recommendations on compliance with applicable health and safety guidelines and appropriateness of system design and procedures for preventing over exposure. This study addresses the issue of whether millimeter wave machines used at airports comply with existing guidelines and whether it would be possible for anything to go wrong with the machines so that, by mistake, it exposes a person to more than 10 W/m2.

The Definitive, Comprehensive Guide to Cutting-Edge Millimeter Wave Wireless Design “This is a great book on mmWave systems that covers many aspects of the technology targeted for beginners all the way to the advanced users. The authors are some of the most credible scholars I know of who are well respected by the industry. I highly

recommend studying this book in detail." —Ali Sadri, Ph.D., Sr. Director, Intel Corporation, MCG mmWave Standards and Advanced Technologies Millimeter wave (mmWave) is today's breakthrough frontier for emerging wireless mobile cellular networks, wireless local area networks, personal area networks, and vehicular communications. In the near future, mmWave products, systems, theories, and devices will come together to deliver mobile data rates thousands of times faster than today's existing cellular and WiFi networks. In Millimeter Wave Wireless Communications, four of the field's pioneers draw on their immense experience as researchers, entrepreneurs, inventors, and consultants, empowering engineers at all levels to succeed with mmWave. They deliver exceptionally clear and useful guidance for newcomers, as well as the first complete desk reference for design experts. The authors explain mmWave signal propagation, mmWave circuit design, antenna designs, communication theory, and current standards (including IEEE 802.15.3c, Wireless HD, and ECMA/WiMedia). They cover comprehensive mmWave wireless design issues, for 60 GHz and other mmWave bands, from channel to antenna to receiver, introducing emerging design techniques that will be invaluable for research engineers in both industry and academia. Topics include Fundamentals: communication theory, channel propagation, circuits, antennas, architectures, capabilities, and applications Digital communication: baseband signal/channel models, modulation, equalization, error control coding, multiple input multiple output (MIMO) principles, and hardware architectures Radio wave propagation characteristics: indoor and outdoor applications Antennas/antenna arrays, including on-chip and in-package antennas, fabrication, and packaging Analog circuit design: mmWave transistors, fabrication, and transceiver design approaches Baseband circuit design: multi–gigabit-per-second, high-fidelity DAC and ADC converters Physical layer: algorithmic choices, design considerations, and impairment solutions; and how to overcome clipping, quantization, and nonlinearity Higher-layer design: beam adaptation protocols, relaying, multimedia transmission, and multiband considerations 60 GHz standardization: IEEE 802.15.3c for WPAN, Wireless HD, ECMA-387, IEEE 802.11ad, Wireless Gigabit Alliance (WiGig)

In response to the ever-increasing global threat of terrorist attacks, the personal screening industry has been growing at a rapid rate. Many methods have been developed for detecting concealed weapons and explosives on the human body. In this important new book, the authors discuss their experiences over the last decade designing and testing microwave and millimetre wave detection and screening systems. It includes examples of actual devices that they have built and tested, along with test results that were obtained in realistic scenarios. The book focuses on the development of non-imaging detection systems, which are similar to radar. These systems do not form a conventional image of the scene and the person(s) being screened. Instead, the sensors detect and analyze the effect that the body, and any concealed objects, has on a transmitted waveform. These systems allow remote detection of both metallic and dielectric devices concealed on the human body in both indoor and outdoor environments. The book discusses a number of sensor types, including active millimetre wave sensors using the direct detection and the heterodyne approach, active microwave sensors for CNR-based object detection, passive millimetre wave sensors, and the role of shielding effects in operating non-imaging MM-wave sensors. The goal of this book is to systemize the test results obtained by the authors, helping specialists

to develop improved screening systems in the future. Another goal is to show how the use of non-imaging systems can reduce the cost of the screening process.

The thesis describes the development of receiver technologies for sub-millimetre astronomy instruments, focusing on high performance coherent cryogenic detectors operating close to the superconductor gap frequency. The mixer chip which comprises the SIS devices, fed by a unilateral finline and matching planar circuits was fabricated on 15 micron silicon substrate using the recently developed Silicon-On-Insulator (SOI) technology. This offered broadband IF and RF performance, with fully integrated on-chip planar circuits resulting in an easily reproducible mixer chip and a simple mixer block. An important consequence of this design is that it can be extended to the supra-THz region and making the fabrication of multi-pixel heterodyne arrays feasible. The extension of the operation of major telescopes such as ALMA, APEX and the GLT from single pixel to large format arrays is the subject of extensive research at present time since it will allow fast mapping combined with high resolution of the submillimetre sky. The technology described in this thesis makes a major contribution to this effort.

This book has addressed few challenges to ensure the success of UWB technologies and covers several research areas including UWB low cost transceiver, low noise amplifier (LNA), ADC architectures, UWB filter, and high power UWB amplifiers. It is believed that this book serves as a comprehensive reference for graduate students in UWB technologies.

This book provides a system-level approach to making packaging decisions for millimeter-wave transceivers. In electronics, the packaging forms a bridge between the integrated circuit or individual device and the rest of the electronic system, encompassing all technologies between the two. To be able to make well-founded packaging decisions, researchers need to understand a broad range of aspects, including: concepts of transmission bands, antennas and propagation, integrated and discrete package substrates, materials and technologies, interconnects, passive and active components, as well as the advantages and disadvantages of various packages and packaging approaches, and package-level modeling and simulation. Packaging also needs to be considered in terms of system-level testing, as well as associated testing and production costs, and reducing costs. This peer-reviewed work contributes to the extant scholarly literature by addressing the aforementioned concepts and applying them to the context of the millimeter-wave regime and the unique opportunities that this transmission approach offers.

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.

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.

Proceedings of the 1996 INAOE Summer School of Millimeter-Wave Astronomy held at INAOE, Tonantzintla, Puebla, México, 15-31 July 1996

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.

This invaluable resource introduces progressive techniques for the creation of sophisticated reflectionless filter topologies that have identically zero reflection coefficient at all frequencies. Practical implementations are discussed along with their advantages when compared to classical absorptive filters and their benefits in real-world systems such as up/down converters, multiplier chains, broadband amplifiers, analog-to-digital converters, and time-domain applications. This book offers insight into the innovative process of developing reflectionless filters from first principles using both lumped elements and transmission lines. Tools for the creation of reflectionless multiplexers, matched sloped equalizers, and advanced, high-order, and nonplanar topologies are also presented.

This comprehensive resource provides a thorough introduction to the principles of electronic circuits operating in the radio, microwave, and millimeter-wave frequency ranges. The book highlights the fundamental physical laws of classical electromagnetics using a foundation of Maxwell's equations to give insight into the operating principles of circuit elements of all kinds, from lumped elements to transmission lines, waveguides, optical fibers, and quasi-optical structures. Standard passive system components like filters, splitters, couplers, hybrids,

baluns, and antennas are explained to acclimate the reader to considering multiple technological solutions for common design problems. A basic overview of active circuit designs, such as amplifiers, mixers, and multipliers is also provided, along with discussion of the performance characteristics of electronic systems, including noise and linearity. Emphasis is placed on visualization and understanding of how and why electronic circuits of all frequencies are built and operate the way they do. Readers learn how to match an amplifier for optimum noise performance over the broadest bandwidth with the fewest number of elements and how to visualize the coupling of various modes in a mixed waveguide-type structure and avoid resonances due to trapped, higher-order modes. The book provides the tools needed to design and optimize a launcher from microstrip into waveguide, and whether the best characteristics can be achieved by incorporating matching elements in the microstrip section, the waveguide section, or both. Packed with references and examples, readers learn not only how to do the math but what the math means.