

RF AND MICROWAVE COUPLED-LINE CIRCUITS



Rajesh Mongia • Inder Bahl • Prakash Bhartia

Coupled Lines And Circuits For Rf And Microwave Applications

Scott Kuzdeba



Coupled Lines And Circuits For Rf And Microwave Applications:

Artificial Transmission Lines for RF and Microwave Applications Ferran Martín, 2015-07-13 This book presents and discusses alternatives to ordinary transmission lines for the design and implementation of advanced RF microwave components in planar technology This book is devoted to the analysis study and applications of artificial transmission lines mostly implemented by means of a host line conveniently modified e g with modulation of transverse dimensions with etched patterns in the metallic layers etc or with reactive loading in order to achieve novel device functionalities superior performance and or reduced size The author begins with an introductory chapter dedicated to the fundamentals of planar transmission lines Chapter 2 is focused on artificial transmission lines based on periodic structures including non uniform transmission lines and reactively loaded lines and provides a comprehensive analysis of the coupled mode theory Chapters 3 and 4 are dedicated to artificial transmission lines inspired by metamaterials or based on metamaterial concepts These chapters include the main practical implementations of such lines and their circuit models and a wide overview of their RF microwave applications including passive and active circuits and antennas Chapter 5 focuses on reconfigurable devices based on tunable artificial lines and on non linear transmission lines The chapter also introduces several materials and components to achieve tuning including diode varactors RF MEMS ferroelectrics and liquid crystals Finally Chapter 6 covers other advanced transmission lines and wave guiding structures such as electroinductive magnetoinductive wave lines common mode suppressed balanced lines lattice network artificial lines and substrate integrated waveguides **Artificial Transmission Lines for RF and Microwave Applications** provides an in depth analysis and discussion of artificial transmission lines including design guidelines that can be useful to researchers engineers and students

Lumped Elements for RF and Microwave Circuits I. J. Bahl, 2003 Annotation Due to the unprecedented growth in wireless applications over the past decade development of low cost solutions for RF and microwave communication systems has become of great importance This practical new book is the first comprehensive treatment of lumped elements which are playing a critical role in the development of the circuits that make these cost effective systems possible The book offers you an in depth understanding of the different types of RF and microwave circuit elements including inductors capacitors resistors transformers via holes airbridges and crossovers

RF and Microwave Coupled-line Circuits Rajesh Mongia, I. J. Bahl, P. Bhartia, 1999 An overview of coupled line fundamentals this text explains their applications in designing microwave and millimetre wave components used in today's personal communication audio visual microwave radar satellite communications and other systems The text provides readers with an understanding of stripline microstrip monolithic and coplanar technologies Emphasizing design analysis and modern fabrication techniques and practices it provides knowledge and guidance in helping them develop compact and low cost design solutions and components such as loose and tight couplers filters hybrids transformers and baluns

Coupled Structures for Microwave Sensing Ferran Martín, Enrique Bronchalo, 2024-04-26 This book offers a

comprehensive and timely review of planar microwave sensors based on coupled structures. Gathering chapters contributed by the most authoritative researchers on this topic, it presents various strategies for sensor performance optimization using coupled lines, directional couplers, and coupled resonators, either distributed or semi-lumped, focusing mainly on sensitivity optimization and covering chains of coupled resonators as well. The book also reports on analytical methods, design formulas, sensor validation tests with both simulation and experimental methods, describing some relevant practical applications. Mainly reflecting the research activity carried out by the different contributors in the last years, this book also includes two introductory chapters to help readers who are not very familiar with microwave sensing technologies and coupled structures. All in all, this book addresses advanced graduate students and researchers involved in microwave and sensor technologies and may be of interest for engineers and professionals as well, working in areas as diverse as wireless sensors and sensor networks, biosensing, chemical sensing, motion control, microfluidics, Internet of Things (IoT), and smart systems.

Microwave Transmission Line Circuits William T. Joines, William Devereux Palmer, Jennifer Lyn Truman Bernhard, 2013. This authoritative resource offers professionals and students valuable assistance with their work and studies involving microwave circuit analysis and design. Readers gain a thorough understanding of the properties of planar transmission lines for integrated circuits. Moreover, this practical book presents matrix and computer-aided methods for analysis and design of circuit components. Engineers find in depth details on input/output and interstage networks as well as coverage of stability, noise, and signal distortion.

Microstrip Lines and Slotlines, Fourth Edition Ramesh Garg, Inder J. Bahl, 2024-10-31. Microstrip Lines and Slotlines Fourth Edition is an indispensable resource for practicing engineers. This edition is updated to reflect the latest developments in the field, providing extensive analysis techniques and CAD design and modeling information. This volume covers approximate and full-wave analysis techniques, accurate circuit model extraction, and design information focusing on miniaturization, broadband operation, and precise design. It also incorporates the most recent information from conferences, journals, books, and personal research. New topics on Metamaterial-Based Transmission Lines and Numerical Simulation and Modeling of transmission lines are introduced, aligning with the book's core themes. Some of the key updates included in this fourth edition are the integration of significant materials, significant revisions reflecting the latest research, and the introduction of cutting-edge topics enhancing the existing content. With these comprehensive updates, Microstrip Lines and Slotlines Fourth Edition ensures that readers have access to the most relevant and cutting-edge information in the field of printed transmission lines. This book is a must-have for professionals and researchers dedicated to advancing their knowledge and expertise in this dynamic area.

Substrate Integrated Suspended Line Circuits and Systems Kaixue Ma, Yongqiang Wang, 2024-03-31. Substrate Integrated Suspended Line Circuits and Systems provides a systematic overview of the new transmission line, the substrate integrated suspension line (SISL). It details the fundamentals and classical application examples of the SISL. The basic SISL concept and structure, various passive circuits and active circuits, and front

end sub systems are systematically introduced Featuring research on topics such as high performance RF microwave mm wave circuits and system this book is ideal for researchers engineers scientists scholars educators and students Since transmission line is a fundamental component of microwave and mm wave circuits the properties of a transmission line such as losses size and dispersion are vital to the performance of the whole system Suspended line has been proved to be an excellent transmission line as it has attractive features such as low loss weak dispersion high power capacity and low effective dielectric constant However Conventional waveguide suspended line circuits require metal housing to form air cavities which is Substrate Integrated Suspended Line Circuits and Systems essential to the operation of suspended lines circuits Also the metal shell should provide mechanical support and shielding which contribute to large size and heavy weight Meanwhile precise mechanical fabrication and assembling are strongly required which brings difficulties to the design and fabrication of conventional suspended line circuits and the manufacturing cost of suspended line circuits increases correspondingly In this book we will introduce a new platform of high performance transmission line i e substrate integrated suspended line SISL SISL keeps all the merits of the suspended line while overcomes the drawbacks of conventional waveguide suspended line circuits Moreover it is self packaged and highly integrated The basic SISL concept and structure various passive circuits and active circuits and front end sub systems will be systematically introduced Featuring research on topics such as high performance RF microwave mm wave circuits and system this book is ideally designed for researchers engineers scientists scholars educators and students

Passive RF and Microwave Integrated Circuits Leo

Maloratsky,2003-12-01 The growth in RF and wireless mobile computing devices that operate at microwave frequencies has resulted in explosive demand for integrated circuits capable of operating at such frequencies in order to accomplish functions like frequency division phase shifting attenuation and isolators and circulators for antennas This book is an introduction to such ICs combining theory and practical applications of those devices In addition to this combined theory and application approach the author discusses the critical importance of differing fabrication materials on the performance of ICs at different frequencies This is an area often overlooked when choosing ICs for RF and microwave applications yet it can be a crucial factor in how an IC performs in a given application Gives reader a solid background in an increasingly important area of circuit design Emphasis on combination of theoretical discussions with practical application examples In depth discussion of critical but often overlooked topic of different fabrication material performances at varying frequencies

Microstrip Filters for RF / Microwave Applications Jia-Sheng Hong,2011-01-06 The first edition of Microstrip Filters for RF Microwave

Applications was published in 2001 Over the years the book has been well received and is used extensively in both academia and industry by microwave researchers and engineers From its inception as a manuscript the book is almost 8 years old While the fundamentals of filter circuits have not changed further innovations in filter realizations and other applications have occurred with changes in the technology and use of new fabrication processes such as the recent advances in RF MEMS

and ferroelectric films for tunable filters the use of liquid crystal polymer LCP substrates for multilayer circuits as well as the new filters for dual band multi band and ultra wideband UWB applications Although the microstrip filter remains as the main transmission line medium for these new developments there has been a new trend of using combined planar transmission line structures such as co planar waveguide CPW and slotted ground structures for novel physical implementations beyond the single layer in order to achieve filter miniaturization and better performance Also over the years practitioners have suggested topics that should be added for completeness or deleted in some cases as they were not very useful in practice In view of the above the authors are proposing a revised version of the Microstrip Filters for RF Microwave Applications text and a slightly changed book title of Planar Filters for RF Microwave Applications to reflect the aforementioned trends in the revised book

RF Front-End: World Class Designs Janine Love, 2009-03-13 All the design and development inspiration and direction a hardware engineer needs in one blockbuster book Janine Love site editor for RF Design Line columnist and author has selected the very best RF design material from the Newnes portfolio and has compiled it into this volume The result is a book covering the gamut of RF front end design from antenna and filter design fundamentals to optimized layout techniques with a strong pragmatic emphasis In addition to specific design techniques and practices this book also discusses various approaches to solving RF front end design problems and how to successfully apply theory to actual design tasks The material has been selected for its timelessness as well as for its relevance to contemporary RF front end design issues

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Applications of Advanced Electromagnetics Guennadi A. Kouzaev, 2012-10-30 This text directed to the microwave engineers and Master and PhD students is on the use of electromagnetics to the development and design of advanced integrated components distinguished by their extended field of applications The results of hundreds of authors scattered in numerous journals and conference proceedings are carefully reviewed and classed Several chapters are to refresh the knowledge of readers in advanced electromagnetics New techniques are represented by compact electromagnetic quantum equations which can be used in modeling of microwave quantum integrated circuits of future In addition a topological method to the boundary value problem analysis is considered with the results and examples One extended chapter is for the development and design of integrated components for extended bandwidth applications and the technology and electromagnetic issues of silicon integrated transmission lines transitions filters power dividers directional couplers etc are considered Novel prospective

interconnects based on different physical effects are reviewed as well. The ideas of topology is applicable to the electromagnetic signaling and computing when the vector field maps can carry discrete information and this area and the results in topological signaling obtained by different authors are analyzed including the recently designed predicate logic processor operating spatially represented signal units. The book is rich of practical examples, illustrations and references and useful for the specialists working at the edge of contemporary technology and electromagnetics.

Introduction To Modern Planar Transmission Lines Anand K. Verma, 2021-06-02. Provides a comprehensive discussion of planar transmission lines and their applications focusing on physical understanding, analytical approach and circuit models. Planar transmission lines form the core of the modern high frequency communication computer and other related technology. This advanced text gives a complete overview of the technology and acts as a comprehensive tool for radio frequency RF engineers that reflects a linear discussion of the subject from fundamentals to more complex arguments. *Introduction to Modern Planar Transmission Lines: Physical, Analytical, and Circuit Models Approach* begins with a discussion of waves on transmission lines and waves in material medium including a large number of illustrative examples from published results. After explaining the electrical properties of dielectric media, the book moves on to the details of various transmission lines including waveguide, microstrip line, co planar waveguide, strip line, slot line and coupled transmission lines. A number of special and advanced topics are discussed in later chapters such as fabrication of planar transmission lines, static variational methods for planar transmission lines, multilayer planar transmission lines, spectral domain analysis, resonators, periodic lines and surfaces and metamaterial realization and circuit models. Emphasizes modeling using physical concepts, circuit models, closed form expressions and full derivation of a large number of expressions. Explains advanced mathematical treatment such as the variation method, conformal mapping method and SDA. Connects each section of the text with forward and backward cross referencing to aid in personalized self study. *Introduction to Modern Planar Transmission Lines* is an ideal book for senior undergraduate and graduate students of the subject. It will also appeal to new researchers with the inter disciplinary background as well as to engineers and professionals in industries utilizing RF microwave technologies.

RF/Microwave Circuit Design for Wireless Applications Ulrich L. Rohde, David P. Newkirk, 2004-03-24. A unique state of the art guide to wireless integrated circuit design. With wireless technology rapidly exploding, there is a growing need for circuit design information specific to wireless applications. Presenting a single source guidebook to this dynamic area, industry expert Ulrich Rohde and writer David Newkirk provide researchers and engineers with a complete set of modeling, design and implementation tools for tackling even the newest IC technologies. They emphasize practical design solutions for high performance devices and circuitry incorporating ample examples of novel and clever circuits from high profile companies. They also provide excellent appendices containing working models and CAD based applications. *RF Microwave Circuit Design for Wireless Applications* offers *Introduction to wireless systems and modulation types*. A systematic approach that differentiates between designing for

battery operated devices and base station design A comprehensive introduction to semiconductor technologies from bipolar transistors to CMOS to GaAs MESFETs Clear guidelines for obtaining the best performance in discrete and integrated amplifier design Detailed analysis of available mixer circuits applicable to the wireless frequency range In depth explanations of oscillator circuits including microwave oscillators and ceramic resonator based oscillators A thorough evaluation of all components of wireless synthesizers

Radio Frequency Machine Learning: A Practical Deep Learning Perspective

Scott Kuzdeba, 2025-01-31 Radio Frequency Machine Learning A Practical Deep Learning Perspective goes beyond general introductions to deep learning offering a focused exploration of how modern deep learning techniques can be applied directly to radio frequency RF challenges It covers a wide range of applications including classification tasks where deep learning is used to label and categorize signals based on a labeled training dataset as well as clustering tasks that group similar signals together without labels Additionally it expands into deep learning generative AI for waveform synthesis and how reinforcement learning can be used within the domain This book also investigates advanced topics like RF sensor control feedback mechanisms and real time system operations offering a comprehensive understanding of how deep learning can be integrated into dynamic RF environments This resource addresses the practical concerns of deploying machine learning in operational RF systems It goes beyond applications and techniques covering how to ensure the robustness of solutions with insights into data sources augmentation techniques and strategies for integrating ML with existing RF infrastructure The full development process is examined from data collection to deployment along with numerous case studies throughout Looking to the future the book explores emerging trends like edge computing and federated learning offering a forward looking perspective on the continued evolution of RF machine learning Whether the reader is just beginning the journey into RF machine learning or is looking to refine skills this book provides an essential resource for understanding the intersection of deep learning and RF technology This is a must have resource for anyone interested in the cutting edge of wireless technologies and their potential to shape the future of communication

Electromagnetic Metamaterials Christophe

Caloz, Tatsuo Itoh, 2005-11-22 Electromagnetic metamaterials from fundamental physics to advanced engineering applications This book presents an original generalized transmission line approach associated with non resonant structures that exhibit larger bandwidths lower loss and higher design flexibility It is based on the novel concept of composite right left handed CRLH transmission line metamaterials MMs which has led to the development of novel guided wave radiated wave and refracted wave devices and structures The authors introduced this powerful new concept and are therefore able to offer readers deep insight into the fundamental physics needed to fully grasp the technology Moreover they provide a host of practical engineering applications The book begins with an introductory chapter that places resonant type and transmission line metamaterials in historical perspective The next six chapters give readers a solid foundation in the fundamentals and practical applications Fundamentals of LH MMs describes the fundamental physics and exotic properties of left handed

metamaterials TL Theory of MMs establishes the foundations of CRLH structures in three progressive steps ideal transmission line LC network and real distributed structure Two Dimensional MMs develops both a transmission matrix method and a transmission line method to address the problem of finite size 2D metamaterials excited by arbitrary sources Guided Wave Applications and Radiated Wave Applications present a number of groundbreaking applications developed by the authors The Future of MMs sets forth an expert view on future challenges and prospects This engineering approach to metamaterials paves the way for a new generation of microwave and photonic devices and structures It is recommended for electrical engineers as well as physicists and optical engineers with an interest in practical negative refractive index structures and materials

Parameter Extraction and Complex Nonlinear Transistor Models Gunter Kompa, 2019-12-31 All model parameters are fundamentally coupled together so that directly measured individual parameters although widely used and accepted may initially only serve as good estimates This comprehensive resource presents all aspects concerning the modeling of semiconductor field effect device parameters based on gallium arsenide GaAs and gallium nitride GaN technology Metal semiconductor field effect transistors MESFETs high electron mobility transistors HEMTs and heterojunction bipolar transistors HBTs their structures and functions and existing transistor models are also classified The Shockley model is presented in order to give insight into semiconductor field effect transistor FET device physics and explain the relationship between geometric and material parameters and device performance Extraction of trapping and thermal time constants is discussed A special section is devoted to standard nonlinear FET models applied to large signal measurements including static pulsed DC and single two tone stimulation High power measurement setups for signal waveform measurement wideband source load pull measurement including envelope source load pull are also included along with high power intermodulation distortion IMD measurement setup including envelope load pull Written by a world renowned expert in the field this book is the first to cover of all aspects of semiconductor FET device modeling in a single volume

High-Speed Circuit Board Signal Integrity, Second Edition Stephen C. Thierauf, 2017-04-30 This thoroughly updated leading edge circuit design resource offers the knowledge needed to quickly pinpoint transmission problems that can compromise the entire circuit design This new edition demonstrates how to apply EM theory to solve signal integrity problems with a practical application oriented approach Discussing both design and debug issues at gigabit per second data rates the book serves as a practical reference for projects involving high speed serial signaling on printed wiring boards Step by step this book goes from reviewing the essentials of linear circuit theory to examining practical issues of pulse propagation along lossless and lossy transmission lines It provides detailed guidelines for crosstalk attenuation power supply decoupling and layer stackup tradeoffs including pad antipad tradeoffs Other key topics include the construction of etched conductors analysis of return paths and split planes microstrip and stripline characteristics and SMT capacitors Filled with on the job proven examples this hands on reference is the book that engineers can turn to time and again to design out and

troubleshoot circuit signal loss and impedance problems

Multiband RF Circuits and Techniques for Wireless Transmitters

Wenhua Chen, Karun Rawat, Fadhel M. Ghannouchi, 2016-06-07 This book introduces systematic design methods for passive and active RF circuits and techniques including state of the art digital enhancement techniques As the very first book dedicated to multiband RF circuits and techniques this work provides an overview of the evolution of transmitter architecture and discusses current digital predistortion techniques Readers will find a collection of novel research ideas and new architectures in concurrent multiband power dividers power amplifiers and related digital enhancement techniques This book will be of great interest to academic researchers R D engineers wireless transmitter and protocol designers as well as graduate students who wish to learn the core architectures principles and methods of multiband RF circuits and techniques

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

Microstrip Filters for RF / Microwave Applications

Jia-Shen G. Hong, M. J. Lancaster, 2004-03-24 Advanced specialized coverage of microstrip filter design Microstrip Filters for RF Microwave Applications is the only professional reference focusing solely on microstrip filters It offers a unique and comprehensive treatment of filters based on the microstrip structure and includes full design methodologies that are also applicable to waveguide and other transmission line filters The authors include coverage of new configurations with advanced filtering characteristics new design techniques and methods for filter miniaturization The book utilizes numerous design examples to illustrate and emphasize computer analysis and synthesis while also discussing the applications of commercially available software Other highlights include Lowpass and bandpass filters Highpass and bandstop filters Full wave electromagnetic simulation Advanced materials and technologies Coupled resonator circuits Computer aided design for low cost high volume production Compact filters and filter miniaturization Microstrip Filters for RF Microwave Applications is not only a valuable design resource for practitioners but also a handy reference for students and researchers in microwave engineering

Unveiling the Energy of Verbal Artistry: An Psychological Sojourn through **Coupled Lines And Circuits For Rf And Microwave Applications**

In a world inundated with screens and the cacophony of fast transmission, the profound energy and emotional resonance of verbal beauty frequently diminish in to obscurity, eclipsed by the regular barrage of sound and distractions. However, nestled within the lyrical pages of **Coupled Lines And Circuits For Rf And Microwave Applications**, a fascinating perform of literary splendor that impulses with raw feelings, lies an memorable trip waiting to be embarked upon. Written with a virtuoso wordsmith, that enchanting opus books visitors on an emotional odyssey, lightly revealing the latent potential and profound affect stuck within the delicate internet of language. Within the heart-wrenching expanse of the evocative examination, we can embark upon an introspective exploration of the book is key themes, dissect its fascinating writing design, and immerse ourselves in the indelible impression it leaves upon the depths of readers souls.

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