

Fadhel M. Ghannouchi
Mohammad S. Hashmi

Load-Pull Techniques with Applications to Power Amplifier Design

Load Pull Techniques With Applications To Power Amplifier Design

Emilie Sanchez



Load Pull Techniques With Applications To Power Amplifier Design:

Load-Pull Techniques with Applications to Power Amplifier Design Fadhel M. Ghannouchi, Mohammad S. Hashmi, 2012-06-06 This first book on load pull systems is intended for readers with a broad knowledge of high frequency transistor device characterization nonlinear and linear microwave measurements RF power amplifiers and transmitters Load Pull Techniques with Applications to Power Amplifier Design fulfills the demands of users designers and researchers both from industry and academia who have felt the need of a book on this topic It presents a comprehensive reference spanning different load pull measurement systems waveform measurement and engineering systems and associated calibration procedures for accurate large signal characterization Besides this book also provides in depth practical considerations required in the realization and usage of load pull and waveform engineering systems In addition it also provides procedure to design application specific load pull setup and includes several case studies where the user can customize architecture of load pull setups to meet any specific measurement requirements Furthermore the materials covered in this book can be part of a full semester graduate course on microwave device characterization and power amplifier design

The Load-pull Method of RF and Microwave Power Amplifier Design John F. Sevic, 2020-06-23 Using the load pull method for RF and microwave power amplifier design This new book on RF power amplifier design by industry expert Dr John F Sevic provides comprehensive treatment of RF PA design using the load pull method the most widely used and successful method of design Intended for the newcomer to load pull or the seasoned expert the book presents a systematic method of generation of load pull contour data and matching network design to rapidly produce a RF PA with first pass success The method is suitable from HF to millimeter wave bands discrete or integrated and for high power applications Those engaged in design or fundamental research will find this book useful as will the student new to RF and interested in PA design The author presents a complete pedagogical methodology for RF PA design starting with treatment of automated contour generation to identify optimum transistor performance with constant source power load pull Advanced methods of contour generation for simultaneous optimization of many variables such as power efficiency and linearity are next presented This is followed by treatment of optimum impedance identification using contour data to address specific objectives such as optimum efficiency for a given linearity over a specific bandwidth The final chapter presents a load pull specific treatment of matching network design using load pull contour data applicable to both single stage and multi stage PA s Both lumped and distributed matching network synthesis methods are described with several worked matching network examples Readers will see a description of a powerful and accessible method that spans multiple RF PA disciplines including 5G base station and mobile applications as well as sat com and military applications load pull with CAD systems is also included They will review information presented through a practical hands on perspective The book Helps engineers develop systematic accurate and repeatable approach to RF PA design Provides in depth coverage of using the load pull method for first pass design success

Offers 150 illustrations and six case studies for greater comprehension of topics *The Load-pull Method of RF and Microwave Power Amplifier Design* John F. Sevic, 2020-07-21 Using the load pull method for RF and microwave power amplifier design This new book on RF power amplifier design by industry expert Dr John F Sevic provides comprehensive treatment of RF PA design using the load pull method the most widely used and successful method of design Intended for the newcomer to load pull or the seasoned expert the book presents a systematic method of generation of load pull contour data and matching network design to rapidly produce a RF PA with first pass success The method is suitable from HF to millimeter wave bands discrete or integrated and for high power applications Those engaged in design or fundamental research will find this book useful as will the student new to RF and interested in PA design The author presents a complete pedagogical methodology for RF PA design starting with treatment of automated contour generation to identify optimum transistor performance with constant source power load pull Advanced methods of contour generation for simultaneous optimization of many variables such as power efficiency and linearity are next presented This is followed by treatment of optimum impedance identification using contour data to address specific objectives such as optimum efficiency for a given linearity over a specific bandwidth The final chapter presents a load pull specific treatment of matching network design using load pull contour data applicable to both single stage and multi stage PA s Both lumped and distributed matching network synthesis methods are described with several worked matching network examples Readers will see a description of a powerful and accessible method that spans multiple RF PA disciplines including 5G base station and mobile applications as well as sat com and military applications load pull with CAD systems is also included They will review information presented through a practical hands on perspective The book Helps engineers develop systematic accurate and repeatable approach to RF PA design Provides in depth coverage of using the load pull method for first pass design success Offers 150 illustrations and six case studies for greater comprehension of topics **Linear and Switch-Mode RF Power Amplifiers** Abdullah Eroglu, 2017-09-06 RF power amplifiers are implemented in communication semiconductor wafer processing magnetic resonance imaging MRI and radar systems to produce RF signal with the desired characteristics to perform several critical tasks in the entire system They can be designed to operate in linear or switch mode depending on the specific application This book explores the design and implementation methods for both linear and switch mode amplifiers with real world engineering problems The text discusses phased controlled switch mode amplifiers and distortion and modulation effects in RF amplifiers It illustrates the interface and integration of components and sub systems for RF amplifiers The material is further reinforced with MATLAB design files [RF Electronics for Electronic Warfare](#) Richard A. Poisel, 2019-08-31 This exciting new resource investigates the function of RF communication in electronic warfare systems The book provides in depth coverage of how RF signals must be constructed to perform jamming missions which prevent a receiver from properly extracting a target signal Technical descriptions of oscillators and modulators which generate the RF signals are presented

and explored Power supplies that generate adequate power for fueling high power amplifiers are also described and their operations investigated Oscillator basics including principles of oscillator operation phase locked loop synthesizers and direct digital synthesis are examined Fundamentals of RF communications including power supplies for RF power amplifiers are included making it useful for both novice and advanced practitioners Written by a prominent expert in the field this authoritative book is the first available that combines the topics of electronic warfare and oscillator design and analysis

High Efficiency Power Amplifier Design for 28 GHz 5G Transmitters Nourhan Elsayed,Hani Saleh,Baker Mohammad,Mohammed Ismail,Mihai Sanduleanu,2022-02-02 This book introduces power amplifier design in 22nm FDSOI CMOS dedicated towards 5G applications at 28 GHz and presents 4 state of the art power amplifier designs The authors discuss power amplifier performance metrics design trade offs and presents different power amplifier classes utilizing efficiency enhancement techniques at 28 GHz The book presents the design process from theory simulation layout and finally measurement results

Fundamentals of RF and Microwave Transistor Amplifiers Inder Bahl,2009-06-17 A Comprehensive and Up to Date Treatment of RF and Microwave Transistor Amplifiers This book provides state of the art coverage of RF and microwave transistor amplifiers including low noise narrowband broadband linear high power high efficiency and high voltage Topics covered include modeling analysis design packaging and thermal and fabrication considerations Through a unique integration of theory and practice readers will learn to solve amplifier related design problems ranging from matching networks to biasing and stability More than 240 problems are included to help readers test their basic amplifier and circuit design skills and more than half of the problems feature fully worked out solutions With an emphasis on theory design and everyday applications this book is geared toward students teachers scientists and practicing engineers who are interested in broadening their knowledge of RF and microwave transistor amplifier circuit design

Solid-state Microwave High-power Amplifiers Franco Sechi,Marina Bujatti,2009 This practical resource offers expert guidance on the most critical aspects of microwave power amplifier design This comprehensive book provides descriptions of all the major active devices discusses large signal characterization explains all the key circuit design procedures Moreover you gain keen insight on the link between design parameters and technological implementation helping you achieve optimal solutions with the most efficient utilization of available technologies The book covers a broad range of essential topics from requirements for high power amplifiers device models phase noise and power combiners to high efficiency amplifiers linear amplifier design bias circuits and thermal design

RF and Microwave Circuit Design Charles E. Free,Colin S. Aitchison,2021-09-03 RF and Microwave Circuit Design Provides up to date coverage of the fundamentals of high frequency microwave technology written by two leading voices in the field RF and Microwave Circuit Design Theory and Applications is an authoritative highly practical introduction to basic RF and microwave circuits With an emphasis on real world examples the text explains how distributed circuits using microstrip and other planar transmission lines can be designed and fabricated for use in modern

high frequency passive and active circuits and sub systems The authors provide clear and accurate guidance on each essential aspect of circuit design from the theory of transmission lines to the passive and active circuits that form the basis of modern high frequency circuits and sub systems Assuming a basic grasp of electronic concepts the book is organized around first principles and includes an extensive set of worked examples to guide student readers with no prior grounding in the subject of high frequency microwave technology Throughout the text detailed coverage of practical design using distributed circuits demonstrates the influence of modern fabrication processes Filling a significant gap in literature by addressing RF and microwave circuit design with a central theme of planar distributed circuits this textbook Provides comprehensive discussion of the foundational concepts of RF and microwave transmission lines introduced through an exploration of wave propagation along a typical transmission line Describes fabrication processes for RF and microwave circuits including etched thick film and thin film RF circuits Covers the Smith Chart and its application in circuit design S parameters Mason s non touching loop rule transducer power gain and stability Discusses the influence of noise in high frequency circuits and low noise amplifier design Features an introduction to the design of high frequency planar antennas Contains supporting chapters on fabrication circuit parameters and measurements Includes access to a companion website with PowerPoint slides for instructors as well as supplementary resources Perfect for senior undergraduate students and first year graduate students in electrical engineering courses RF and Microwave Circuit Design Theory and Applications will also earn a place in the libraries of RF and microwave professionals looking for a useful reference to refresh their understanding of fundamental concepts in the field

Principles and Applications of Vector Network Analyzer Calibration Techniques J. Apolinar Reynoso Hernández, Manuel Alejandro Pulido Gaytan, 2024-12-19 This book summarizes the work developed over more than two decades in the field of advanced calibration techniques for vector network analyzers by the RF and Microwave Group at The Center for Scientific Research and Higher Education of Ensenada Baja California Mexico which is led by Dr J Apolinar Reynoso Hernández author of this book This book is written so that every electrical engineer with knowledge of electrical circuits and linear algebra basics can understand the principles of VNA calibration techniques Vector network analyzers are normally used by engineers and researchers working in the RF and microwave field which usually requires advanced and specialized courses at graduate level The reader should be able to implement any VNA calibration technique decide the most adequate calibration for a given measurement condition and interpret the measurement results as a seasoned RF metrology expert Principles and Applications of Vector Network Analyzer Calibration Techniques is a useful book for beginners and professionals working on Microwave de embedding and test fixture characterization Characterization of uniform transmission lines Load pull measurements It is also An ideal tutorial for professionals and postgraduate research students taking courses in microwave calibration techniques A useful textbook for practicing electronics engineering and researchers working in the RF microwave field calibration techniques and load pull measurements

Switchmode RF and Microwave

Power Amplifiers Andrei Grebennikov, Marc J. Franco, 2021-03-19 Switchmode RF and Microwave Power Amplifiers Third Edition is an essential reference book on developing RF and microwave switchmode power amplifiers. The book combines theoretical discussions with practical examples allowing readers to design high efficiency RF and microwave power amplifiers on different types of bipolar and field effect transistors design any type of high efficiency switchmode power amplifiers operating in Class D or E at lower frequencies and in Class E or F and their subclasses at microwave frequencies with specified output power also providing techniques on how to design multiband and broadband Doherty amplifiers using different bandwidth extension techniques and implementation technologies. This book provides the necessary information to understand the theory and practical implementation of load network design techniques based on lumped and transmission line elements. It brings a unique focus on switchmode RF and microwave power amplifiers that are widely used in cellular wireless satellite and radar communication systems which offer major power consumption savings. Provides a complete history of high efficiency Class E and Class F techniques. Presents a new chapter on Class E with shunt capacitance and shunt filter to simplify the design of high efficiency power amplifier with broader frequency bandwidths. Covers different Doherty architectures including integrated and monolithic implementations which are and will be used in modern communication systems to save power consumption and to reduce size and costs. Includes extended coverage of multiband and broadband Doherty amplifiers with different frequency ranges and output powers using different bandwidth extension techniques. Balances theory with practical implementation avoiding a cookbook approach and enabling engineers to develop better designs including hybrid integrated and monolithic implementations.

Practical RF Amplifier Design and Performance Optimization with SPICE and Load- and Source-pull Techniques Amal Banerjee, 2021-03-01 This book explains and demonstrates with an exhaustive set of design examples how common types of radio frequency RF amplifiers classes A B AB C D E F G and H can be designed and then have their performance characteristics evaluated and optimized with SPICE. The author demonstrates the transient analysis features of SPICE along with industry standard load and source pull techniques to simulate the steady state long term time domain behavior of any test RF amplifier. Describes methods for designing and evaluating optimizing the performance characteristics of an RF amplifier that circumvent the issues involved with existing traditional methods and don't require expensive high end software tools. Includes C language executables for each RF amplifier type eliminating errors that might creep in while computing passive component capacitor inductor resistor values for a given RF amplifier type. Demonstrates industry standard load and source pull schemes that can be included easily in text SPICE netlists allowing accurate calculation of impedance matching and impedance values at the input and output ports of the test RF amplifier eliminating messy error prone S parameter based calculations.

High-Speed Heterostructure Devices Patrick Roblin, Hans Rohdin, 2002-03-07 Fuelled by rapid growth in communications technology silicon heterostructures and related high speed semiconductors are spearheading the drive toward smaller faster and lower power

devices High Speed Heterostructure Devices is a textbook on modern high speed semiconductor devices intended for both graduate students and practising engineers This book is concerned with the underlying physics of heterostructures as well as some of the most recent techniques for modeling and simulating these devices Emphasis is placed on heterostructure devices of the immediate future such as the MODFET HBT and RTD The principles of operation of other devices such as the Bloch Oscillator RITD Gunn diode quantum cascade laser and SOI and LD MOSFETs are also introduced Initially developed for a graduate course taught at Ohio State University the book comes with a complete set of homework problems and a web link to MATLAB programs supporting the lecture material Microwave Wireless Communications Antonio Raffo,Giovanni

Crupi,2016-03-01 To design and develop fast and effective microwave wireless systems today involves addressing the three different levels Device circuit and system This book presents the links and interactions between the three different levels rather than providing just a comprehensive coverage of one specific level With the aim of overcoming the sectional knowledge of microwave engineers this will be the first book focused on explaining how the three different levels interact by taking the reader on a journey through the different levels going from the theoretical background to the practical applications Explains the links and interactions between the three different design levels of wireless communication transmitters device circuit and system Presents state of the art challenges and future trends in the field of wireless communication systems Covers all aspects of both mature and cutting edge technologies for semiconductor devices for wireless communication applications Many circuit designs outlining the limitations derived from the available transistor technologies and system requirements Explains how new microwave measurement techniques can represent an essential tool for microwave modellers and designers *Envelope Tracking Power Amplifiers for Wireless Communications* Zhancang

Wang,2014-06-01 Envelope tracking technology is seen as the most promising efficiency enhancement technology for RF power amplifiers for 4G and beyond wireless communications More and more organizations are investing and researching on this topic with huge potential in academic and commercial areas This is the first book on the market to offer complete introduction theory and design considerations on envelope tracking for wireless communications This resource presents you with a full introduction to the subject and covers underlying theory and practical design considerations **Efficiency**

Enhancement of Linear GaN RF power Amplifiers Using the Doherty Technique , Modern RF and Microwave Measurement Techniques Valeria Teppati,Andrea Ferrero,Mohamed Sayed,2013-06-20 A comprehensive hands on review of the most up to date techniques in RF and microwave measurement including practical advice on deployment challenges

Fundamentals of Terahertz Devices and Applications Dimitris Pavlidis,2021-08-02 An authoritative and comprehensive guide to the devices and applications of Terahertz technology Terahertz THz technology relates to applications that span in frequency from a few hundred GHz to more than 1000 GHz Fundamentals of Terahertz Devices and Applications offers a comprehensive review of the devices and applications of Terahertz technology With contributions from a range of experts on

the topic this book contains in a single volume an inclusive review of THz devices for signal generation detection and treatment Fundamentals of Terahertz Devices and Applications offers an exploration and addresses key categories and aspects of Terahertz Technology such as sources detectors transmission electronic considerations and applications optical photonic considerations and applications Worked examples based on the contributors extensive experience highlight the chapter material presented The text is designed for use by novices and professionals who want a better understanding of device operation and use and is suitable for instructional purposes This important book Offers the most relevant up to date research information and insight into the future developments in the technology Addresses a wide range of categories and aspects of Terahertz technology Includes material to support courses on Terahertz Technology and more Contains illustrative worked examples Written for researchers students and professional engineers Fundamentals of Terahertz Devices and Applications offers an in depth exploration of the topic that is designed for both novices and professionals and can be adopted for instructional purposes

RF and Microwave Transmitter Design Andrei Grebennikov, 2011-09-19 RF and Microwave Transmitter Design is unique in its coverage of both historical transmitter design and cutting edge technologies This text explores the results of well known and new theoretical analyses while informing readers of modern radio transmitters practical designs and their components Jam packed with information this book broadcasts and streamlines the author's considerable experience in RF and microwave design and development

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 all aspects of semiconductor FET device modeling in a single volume

Embark on a transformative journey with is captivating work, Grab Your Copy of **Load Pull Techniques With Applications To Power Amplifier Design** . This enlightening ebook, available for download in a convenient PDF format , invites you to explore a world of boundless knowledge. Unleash your intellectual curiosity and discover the power of words as you dive into this riveting creation. Download now and elevate your reading experience to new heights .

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