<<射频电路设计>>

图书基本信息

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前言

High-frequency circuit design continues to enjoy significant industrial attention, triggered by a host of radio-frequency （RF） and microwave （MW） products. Improved semiconductor devices, new board materials, and advanced fabrication technologies have made possible a proliferation of high-speed digital and analog systems that profoundly influence wireless communication, global positioning, radar, remote sensing , and related electrical and computer engineering disciplines. As a consequence, this interest has translated into market demands for trained engineers and professionals with knowledge of high-frequency circuit design principles. Since the publication of the first edition of this textbook in January, 2000, the need for well-educated RF professionals has surged, making a text that teaches the fundamentals of high-frequency circuits even timelier. The objective of this second edition remains the same： to present the fundamental RF design aspects and the underlying distributed circuit theory with minimal emphasis on electromagnetics. We have written this book in a manner that requires no EM background beyond a first year undergraduate physics course in fields and waves. Students and practicing engineers equipped with rudimentary exposure to circuit theory and/or microelectronics can read this book and grasp the entire spectrum of high-frequency circuit principles involving passive and active discrete devices, transmission lines, filters, amplifiers, mixers, oscillators and their design procedures. Lengthy mathematical derivations are either relegated to the appendices or placed in examples, thereby separating dry theoretical details from the main text. Although de-emphasizing theory creates a certain loss in precision, it promotes readability and focus on the underlying circuit concepts. What has changed from the first edition? Besides our obvious attempt to eliminate typos and inconsistencies, the second edition was improved in several important ways. First, we have added Practically Speaking sections at the end of each chapter. In these sections, key design concepts and measurement procedures are discussed in detail. Topics such as the construction of an attenuator, a microstrip filter, or the simulation of a low noise RF amplifier with bias and matching networks, are presented similarly to a lab component that accompanies the lectures. Equipped with the right instrumentation and software simulator, the reader can easily replicate the circuits. Second, topics of interest, helpful definitions, and noteworthy observations are placed on the margins and offset from the main text. In addition to highlighting their importance, this approach allows us to emphasize and better explain items that do not directly fit into the flow of the main text. For example, the coverage of a Phase Lock Loop （PLL） system would exceed the scope of this book. However, a brief explanation of a PLL provides context and extra motivation for the underlying high-frequency circuits. It furthermore inspires the readers to explore these topics on their own. Third , more emphasis is placed on nonlinear design principles, specifically in regard to oscillators and their associated resonator circuits. Accepting the challenge to deliver a high degree of linear and nonlinear design experience, we have included a number of examples that analyze in considerable depth, often extending over several pages, the philosophy and the intricacies of various modeling approaches. While linear scattering parameter simulations are adequate under certain conditions, nonlinear simulations, for instance the harmonic balance analysis, are required for more sophisticated designs. Oscillator and mixer, as well as amplifier designs can greatly benefit from a nonlinear circuit simulation. Naturally, the use of appropriate simulation tools creates problems in terms of their capabilities, accuracies, speeds, and not least costs. The availability of circuit simulators and RF software tools has steadily increased over the years. Indeed, the authors are routinely contacted about simulators that offer exceptional?performances under particular constraints. It is not our goal to render an assessment or endorsement of a specific simulator （the authors have no commercial, nor professional ties with any vendor）. In general, professional high-frequency simulators are expensive and require familiarity to use them effectively. Several years ago, the ECE department at WPI decided after an extensive review to adopt Advanced Design Systems （ADS） of Agilent Technologies as the default high-frequency circuit simulator for its undergraduate and graduate electrical and computer engineering students. For this reason, and because of its wide-spread industrial use, we rely on ADS simulations for most of our circuits. However, for readers without access to commercial simulators, we created a number of standard MATLAB M-files that can be downloaded from our website listed in Appendix G. Because MATLAB is a popular and relatively inexpensive mathematical tool, many examples discussed in this book can be executed and the results graphically displayed in a matter of seconds. Specifically, the various Smith Chart computations of impedance transformations should appeal to the reader. Since our goal focuses on circuits, the textbook purposely omitted high-speed digital circuits as well as coding and modulation aspects. Although important, these topics would require too many additional pages and would move the book too far away from its original intent of providing a fundamental, one- or two-semester introduction to RF circuit design. In the ECE department at WPI, this does not constitute a disadvantage, as most of these topics are taught in specialized communication systems engineering courses. The organization of this text is as follows: Chapter 1 presents a general explanation of why basic circuit theory needs to be modified as the operating frequency is increased to a level where the wavelength becomes comparable with circuit dimensions. Chapter 2 then develops the fundamental concepts of distributed circuit theory. Chapter 3 introduces the Smith Chart as a generic tool for dealing with the periodic impedance behavior on the basis of the reflection coefficient. Chapter 4 presents networks and flow-graph representations, and how the terminal conditions can be described with so-called scattering parameters. The network models and their scattering parameter descriptions are utilized in Chapter 5 to develop passive RF filter configurations. To address active devices, Chapter 6 provides a review of key semiconductor fundamentals, followed by their circuit models representation in Chapter 7. The impedance matching and biasing of bipolar and field effect transistors is taken up in Chapter 8. Chapter 9 focuses on a number of key high-frequency amplifier configurations and their design intricacies, ranging from low noise to high power applications. Finally, Chapter 10 introduces the reader to nonlinear systems and their design, covering oscillator and mixer circuits. This book is used in the ECE department at WPI as a required text for its standard 7-week (5 lecture hours per week) course in RF circuit design (ECE 3113, Introduction to RF Circuit Design). The course has primarily attracted an audience of 3rd and 4th year undergraduate students with a background in microelectronics. The course does not include a separate laboratory, although a total of six practical circuits (all part of the Practically Speaking sections) are presented to the students who are then instructed to conduct their own measurements with a network analyzer. In addition, ADS simulations are incorporated as part of the regular lectures. Each chapter is self-contained, with the goal of providing wide flexibility in organizing the course material. At WPI, the content of approximately one three semester hour course is compressed into a 7-week period (consisting of a total of 28-29 lectures). The topics covered in ECE 3113 are shown in the table below. EE 3113, Introduction to RF Circuit Design Chapter 1, Introduction Sections 1.1-1.6 Chapter 2, Transmission Line Analysis Sections 2.1-2.12 Chapter 3, Smith Chart Sections 3.1-3.5 Chapter 4, Single- and Multi-Port Networks Sections 4.1-4.5 Chapter 7, Active RF Component Modeling Sections 7.1-7.2 Chapter 8, Matching and Biasing Networks Sections 8.1-8.4 Chapter 9, RF Transistor Amplifier Designs Sections 9.1-9.4

The remaining material is targeted for a second (7-week) term covering more advanced topics such as microwave filters, equivalent circuit models, oscillators and mixers. An organizational plan is provided below.

Advanced Principles of RF Circuit Design Chapter 5, A Brief Overview of RF Filter Design Sections 5.1-5.5 Chapter 6, Active RF Components Sections 6.1-6.6 Chapter 7, Active RF Component Modeling Sections 7.3-7.5 Chapter 9, RF Transistor Amplifier Designs Sections 9.5-9.8 Chapter 10, Oscillators and Mixers Sections 10.1-10.4 Obviously, the entire course organization remains subject to change depending on total classroom time, student background, and interface requirements with related courses. At the writing of this 2nd edition, a new graduate course is being designed that combines the advanced RF circuit topics of Chapters 5-10 with a classical graduate-level electromagnetics text. Pearson offers many different products around the world to facilitate learning. In countries outside the United States, some products and services related to this textbook may not be available due to copyright and/or permissions restrictions. If you have questions, you can contact your local office by visitinginternational or you can contact your local Pearson representative.

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内容概要

本书从低频电路理论到射频、微波电路理论的演化过程出发，讨论以低频电路理论为基础并结合高频电压、电流的波动特征来分析和设计射频、微波系统的方法——微波等效电路法，使不具备电磁场理论和微波技术背景的读者也能了解和掌握射频、微波电路的基本设计原则和方法。
全书共10章，涵盖传输线、匹配器、滤波器、混频器、放大器和振荡器等主要射频微波系统单元的理论分析和设计问题及电路分析工具(圆图、网络参量和信号流图)。
书中例题非常有实用价值。
全书大多数电路都经过ADS仿真，并提供标准MATLAB计算程序。
　本书适合作为通信、电子类学科学生的双语课程教材，也适合工程技术人员参考。

书籍目录

编辑推荐

涵盖传输线、匹配器、滤波器、混频器、放大器和振荡器等主要射频微波系统单元的理论分析和设计问题及电路分析工具等。
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