教育部高等教育司推荐
国外优秀信息科学与技术系列教学用书

PEARSON
Prentice Hall

电子电路基础

第2版 影印版

ELECTRONICS

Second Edition

ALLAN R.HAMBLEY

高等教育出版社
Higher Education Press

图字:01－2003－6734 号

English reprint edition copyright © 2003 by PEARSON EDUCATION NORTH ASIA LIMITED and HIGHER EDUCATION PRESS. (Electronics from Pearson Education' edition of the Work)

Electronics, 2*e* by Hambley, Allan R, Copyright © 2000.
All Rights Reserved.

Published by arrangement with the original publisher, Prentice Hall, publishing as Pearson Education.

This edition is authorized for sale only in the People's Republic of China (excluding the Special Administrative Regions of Hong Kong and Macau).
本书封面贴有 Pearson Education(培生教育出版集团) 激光防伪标签。无标签者不得销售。
For sale and distribution in the People's Republic of China exclusively (except Taiwan, Hong Kong SAR and Macao SAR).
仅限于中华人民共和国境内(不包括中国香港、澳门特别行政区和中国台湾地区)销售发行。

图书在版编目(CIP)数据

电子电路基础 = Electronics:第2版/(美)汉布利(Hambley, A. R.)著. —影印本. —北京:高等教育出版社, 2004.1
ISBN 7－04－013846－8

Ⅰ.电… Ⅱ.汉… Ⅲ.电子电路—高等学校—教材—英文 Ⅳ.TN710

中国版本图书馆 CIP 数据核字(2003)第 117123 号

出版发行	高等教育出版社	**购书热线**	010－64054588
社　　址	北京市西城区德外大街 4 号	**免费咨询**	800－810－0598
邮政编码	100011	**网　　址**	http://www.hep.edu.cn
总　　机	010－82028899		http://www.hep.com.cn
经　　销	新华书店北京发行所		
印　　刷	北京外文印刷厂		
开　　本	787×1092　1/16	**版　　次**	2004 年 1 月第 1 版
印　　张	57	**印　　次**	2004 年 1 月第 1 次印刷
字　　数	900 000	**定　　价**	70.00 元

本书如有缺页、倒页、脱页等质量问题,请到所购图书销售部门联系调换。

版权所有　侵权必究

前　言

20 世纪末，以计算机和通信技术为代表的信息科学和技术对世界经济、科技、军事、教育和文化等产生了深刻影响。信息科学技术的迅速普及和应用，带动了世界范围信息产业的蓬勃发展，为许多国家带来了丰厚的回报。

进入 21 世纪，尤其随着我国加入 WTO，信息产业的国际竞争将更加激烈。我国信息产业虽然在 20 世纪末取得了迅猛发展，但与发达国家相比，甚至与印度、爱尔兰等国家相比，还有很大差距。国家信息化的发展速度和信息产业的国际竞争能力，最终都将取决于信息科学技术人才的质量和数量。引进国外信息科学和技术优秀教材，在有条件的学校推动开展英语授课或双语教学，是教育部为加快培养大批高质量的信息技术人才采取的一项重要举措。

为此，教育部要求由高等教育出版社首先开展信息科学和技术教材的引进试点工作。同时提出了两点要求，一是要高水平，二是要低价格。在高等教育出版社和信息科学技术引进教材专家组的努力下，经过比较短的时间，第一批引进的 20 多种教材已经陆续出版。这套教材出版后受到了广泛的好评，其中有不少是世界信息科学技术领域著名专家、教授的经典之作和反映信息科学技术最新进展的优秀作品，代表了目前世界信息科学技术教育的一流水平，而且价格也是最优惠的，与国内同类自编教材相当。

这项教材引进工作是在教育部高等教育司和高教社的共同组织下，由国内信息科学技术领域的专家、教授广泛参与，在对大量国外教材进行多次遴选的基础上，参考了国内和国外著名大学相关专业的课程设置进行系统引进的。其中，John Wiley 公司出版的贝尔实验室信息科学研究中心副总裁 Silberschatz 教授的经典著作《操作系统概念》，是我们经过反复谈判，做了很多努力才得以引进的。William Stallings 先生曾编写了在美国深受欢迎的信息科学技术系列教材，其中有多种教材获得过美国教材和学术著作者协会颁发的计算机科学与工程教材奖，这批引进教材中就有他的两本著作。留美中国学者 Jiawei Han 先生的《数据挖掘》是该领域中具有里程碑意义的著作。由达特茅斯学院的 Thomas Cormen 和麻省理工学院、哥伦比亚大学几位学者共同编著的经典著作《算法导论》，在经历了 11 年的锤炼之后于 2001 年

出版了第二版。目前任教于美国 Massachusetts 大学的 James Kurose 教授，曾在美国三所高校先后 10 次获得杰出教师或杰出教学奖，由他主编的《计算机网络》出版后，以其体系新颖、内容先进而倍受欢迎。在努力降低引进教材售价方面，高等教育出版社做了大量和细致的工作。这套引进的教材体现了权威性、系统性、先进性和经济性等特点。

教育部也希望国内和国外的出版商积极参与此项工作，共同促进中国信息技术教育和信息产业的发展。我们在与外商的谈判工作中，不仅要坚定不移地引进国外最优秀的教材，而且还要千方百计地将版权转让费降下来，要让引进教材的价格与国内自编教材相当，让广大教师和学生负担得起。中国的教育市场巨大，外国出版公司和国内出版社要通过扩大发行数量取得效益。

在引进教材的同时，我们还应做好消化吸收，注意学习国外先进的教学思想和教学方法，提高自编教材的水平，使我们的教学和教材在内容体系上，在理论与实践的结合上，在培养学生的动手能力上能有较大的突破和创新。

目前，教育部正在全国 35 所高校推动示范性软件学院的建设和实施，这也是加快培养信息科学技术人才的重要举措之一。示范性软件学院要立足于培养具有国际竞争力的实用性软件人才，与国外知名高校或著名企业合作办学，以国内外著名 IT 企业为实践教学基地，聘请国内外知名教授和软件专家授课，还要率先使用引进教材开展教学。

我们希望通过这些举措，能在较短的时间，为我国培养一大批高质量的信息技术人才，提高我国软件人才的国际竞争力，促进我国信息产业的快速发展，加快推动国家信息化进程，进而带动整个国民经济的跨越式发展。

教育部高等教育司

二〇〇二年三月

Preface

This book is intended for use in the core electronics courses for undergraduate electrical and computer engineering majors. The book frequently takes the designer's point of view in discussing circuits, illustrates design with numerous examples, shows how to test circuit designs using SPICE, and provides numerous open-ended design problems with which students can practice.

WHAT'S NEW IN THE SECOND EDITION

1. The entire book has been reorganized and rewritten with an eye toward reducing its length and making it more student friendly.
2. Integrated-circuit techniques are treated earlier and receive greater emphasis throughout.
3. The needs of computer-engineering students are addressed by treating the switching behavior of devices early in the book, adding a chapter on CMOS logic circuits, and adding a discussion of data converters.
4. Several motivational examples are provided in the "Anatomy of a Design" sections as asides from the main text to show how interesting circuits can be designed using the material learned to that point in the book. For example just after the chapters on op-amps and diodes, the design of a function generator is illustrated.
5. The introduction and the treatment of external amplifier characteristics have been condensed into the first chapter.
6. MOSFETs are emphasized over JFETs.
7. Op-amps are treated in a single chapter.
8. The treatment of device physics has been shortened and appears in the various chapters on an as needed basis.
9. The chapter on SPICE has been eliminated because most students learn to use SPICE in their circuits courses.

ASSUMED BACKGROUND AND LEVEL OF PRESENTATION

The background assumed is a first course in circuit analysis. In the beginning, the level of presentation is appropriate for an introductory core course. Starting with Chapter 7, the level gradually increases to that appropriate for juniors having a stronger interest in the subject. Circuit analysis by Laplace transform methods is helpful (but not required) background for frequency response and compensation of feedback amplifiers in Chapter 9.

此为试读,需要完整PDF请访问: www.ertongbook.com

INSTRUCTIONAL AIDS

A website located at http://www.prenhall.com/hambley contains a number of resources for instructors and students including:

- Answers to selected end-of-chapter problems
- PDF files of key figures from the book that can be used to make transparency masters
- Schematic files for the circuits discussed in the book
- Schematic files that are the answers to Exercises that call for SPICE analysis
- A selection of links to manufacturers' sites where additional data may be downloaded

A solutions manual containing complete solutions for the exercises and problems is available to instructors who adopt the textbook for classroom use. To obtain a copy, contact your local Prentice Hall sales representative or write to the publisher on your school letterhead. The address of the publisher is:

Electrical and Computer Engineering Editor
Prentice Hall
1 Lake Street,
Upper Saddle River, NJ 07458

CONTENT

This book supports a wide variety of course plans. More than enough material is provided for a two-semester (or three-quarter) course sequence, allowing topic selection suited to the interests of the instructor and students.

Chapter 1 contains an overview of electronics and treats the external characteristics of amplifiers. The first several sections acquaint students with the big picture and illustrate how the details studied in this book fit into that picture. Usually, I assign this material for reading but don't spend class time on it. Next, we introduce basic amplifier concepts including gain, input resistance, output resistance, frequency response, and circuit models for amplifiers. The chapter concludes with a discussion of differential amplifiers, setting the stage for op-amps.

Chapter 2 treats operational amplifier circuits including basic amplifiers, imperfections of op-amps, integrators, and differentiators. The discussion of amplifiers gives immediate application for the concepts (that were introduced in Chapter 1) of gain, input resistance, output resistance, and ideal amplifier types.

Chapter 3 treats diodes and diode circuits, including load lines, ideal diodes, rectifiers, wave shapers, logic circuits, voltage regulators, device physics, and switching behavior. The small-signal-equivalent-circuit concept is introduced in Section 3.8 setting the stage for BJT and FET amplifier analysis.

"Anatomy of a Circuit Design: A Function Generator" is set aside from the main text and appears between Chapters 3 and 4. It shows students how the material from the first three chapters can be used in designing a useful and interesting circuit.

Chapter 4 covers BJT characteristics, load-line analysis, large-signal models, biasing, small-signal equivalent circuit analysis, the common-emitter amplifier, the emitter follower, and use of the BJT as a switch in logic circuits.

Chapter 5 contains a similar treatment of FETs with the main emphasis on MOSFETs. If desired, the order of Chapters 4 and 5 can be reversed with little difficulty.

"Anatomy of a Circuit Design: A Multistage Amplifier" appears immediately after chapter 5 and illustrates how a multistage amplifier can be designed using what was learned from Chapters 4 and 5.

Chapter 6 treats digital logic circuits with very strong emphasis on CMOS. Basic logic circuit concepts, the resistor-pull-up NMOS inverter, the CMOS inverter, propagation delay, NOR and NAND gates, dynamic logic, and transmission gates are covered.

Differential and multistage integrated amplifiers including IC bias techniques are treated in Chapter 7.

Chapter 8 covers amplifier frequency response, including the Miller effect, the BJT hybrid-π model, and common amplifier configurations.

Chapter 9 examines feedback and oscillators. Sections 9.1 through 9.4 deal with types of feedback and their effects on gain and impedances. Then several design examples are given in Section 9.5. Sections 9.6 through 9.9 treat transient response, frequency response, and compensation of feedback amplifiers. Several examples of feedback amplifiers are discussed in Section 9.10. Finally, oscillator principles are discussed in Sections 9.11 and 9.12.

"Anatomy of a Circuit Design: A Cardiac Pacemaker" appears after Chapter 9 and shows an interesting application of many of the circuits and concepts discussed in the book.

Output stages and power supplies are presented in Chapter 10 including thermal considerations, power devices, Class A and B amplifiers, linear voltage regulators, and power-supply design.

Chapter 11 treats active filters, tuned circuits, impedance-matching networks, *LC* oscillators, and crystal oscillators.

Chapter 12 considers comparators, timer circuits and data converters, including the Schmitt trigger, multivibrator circuits, the 555 timer IC, digital-to-analog converters, and analog-to-digital converters.

Finally, "Anatomy of a Circuit Design: A Precision AC to DC Converter," illustrates another practical design using many of the concepts treated earlier in the book.

CHAPTER DEPENDENCY

The first five chapters form the foundation upon which the remainder of the book rests. The order of coverage of the remaining chapters is extremely flexible. Chapter 5 on MOSFETs can be covered before Chapter 4 on BJTs if desired.

ACKNOWLEDGMENTS

I wish to acknowledge my many friends at Michigan Technological University, ASEE, and elsewhere who gave help and encouragement in writing this text. I especially appreciate the enthusiastic support that I have received from my colleague Noel Schulz.

I am grateful to Dr. Orhan Soykan of Medtronic, Inc. for many helpful discussions and for contributing the section on cardiac pacemaker design that appears between Chapters 9 and 10.

A great deal of excellent advice has come from professors at other institutions who reviewed the manuscript in various stages. This advice has improved the final result very much, and I am grateful for their help. The reviewers for the first edition are: Robert Collin, Case Western University; W. T. Easter, North Carolina State University; John Pavlat, Iowa State University; Edward Yang, Columbia University; Ibrahim Abdel-Motaled, Northwestern University; Clifford Pollock, Cornell University; Victor Gerez, Montana State University; William Sayle II, Georgia Institute of Technology; Michael Reed, Carnegie Mellon University; D. B. Brumm, Michigan Technological University; Sunanda Mitra, Texas Tech University; and Elmer Grubbs, New Mexico Highlands University.

I would like to offer a special thanks to the reviewers who viewed drafts of this book, and provided their comments and insight. Our reviewers:

Gennady Gildenblat, Penn State;

Dr. Dan Moore, Rose Hulman Institute of Technology;

Art Davis, San Jose State University;

Albert H. Titus, Rochester Institue of Technology.

Finally, I thank my loving wife Judy for many good things too extensive to list.

Allan R. Hambley

策划编辑 韩 颖
责任编辑 韩 颖
封面设计 张 楠
责任印制 陈伟光

郑重声明

高等教育出版社依法对本书享有专有出版权。任何未经许可的复制、销售行为均违反《中华人民共和国著作权法》，其行为人将承担相应的民事责任和行政责任，构成犯罪的，将被依法追究刑事责任。为了维护市场秩序，保护读者的合法权益，避免读者误用盗版书造成不良后果，我社将配合行政执法部门和司法机关对违法犯罪的单位和个人给予严厉打击。社会各界人士如发现上述侵权行为，希望及时举报，本社将奖励举报有功人员。

反盗版举报电话：(010) 58581897/58581698/58581879/58581877

传　　真：(010) 82086060

E - mail：dd@hep.com.cn 或 chenrong@hep.com.cn

通信地址：北京市西城区德外大街 4 号
高等教育出版社法律事务部

邮　　编：100011

购书请拨打电话：(010)64014089　64054601　64054588

Brief Contents

Preface vii

1 ***Introduction*** 1

2 ***Operational Amplifiers*** 61

3 ***Diodes and Diode Circuits*** 131

Anatomy of a Circuit Design: A Function Generator 199

4 ***Bipolar Junction Transistors*** 211

5 ***Field-Effect Transistors*** 287

Anatomy of a Circuit Design: A Discrete Multistage Amplifier 343

6 ***Digital Logic Circuits*** 349

7 ***Differential and Multistage IC Amplifiers*** 411

8 ***Frequency Response*** 483

9 ***Feedback and Oscillators*** 555

Anatomy of a Circuit Design: A Cardiac Pacemaker 657

10 ***Output Stages and Power Supplies*** 667

11 ***Active Filters and Tuned Circuits*** 727

12 ***Waveshaping Circuits and Data Converters*** 799

Anatomy of a Circuit Design: A Precision AC-to-DC Converter 855

A ***Discrete Resistors*** 865

B ***Data Sheet for the 2N2222A BJT*** 867

References 873

Index 875

此为试读,需要完整PDF请访问: www.ertongbook.com

Contents

Preface *vii*

1 *Introduction* *1*

1.1 Electronic Systems 2
1.2 The Design Process 8
1.3 Integrated Circuits 12
1.4 Basic Amplifier Concepts 17
1.5 Cascaded Amplifiers 23
1.6 Power Supplies and Efficiency 26
1.7 Decibel Notation 29
1.8 Amplifier Models 31
1.9 Ideal Amplifiers 38
1.10 Amplifier Frequency Response 40
1.11 Differential Amplifiers 48
Summary 53
Problems 55

2 *Operational Amplifiers* *61*

2.1 The Ideal Operational Amplifier 62
2.2 The Summing-Point Constraint 63
2.3 The Inverting Amplifier 63
2.4 The Noninverting Amplifier 72
2.5 Design of Simple Amplifiers 74
2.6 Op-Amp Imperfections in the Linear Range of Operation 82
2.7 Large-Signal Operation 89
2.8 DC Imperfections 95
2.9 Computer-Aided Analysis of Op-Amp Circuits 100
2.10 A Collection of Amplifier Circuits 108
2.11 Integrators and Differentiators 115
Summary 120
Problems 121

3 *Diodes and Diode Circuits* *131*

3.1 Diode Characteristics 132
3.2 Load-Line Analysis 134
3.3 The Ideal-Diode Model 137
3.4 Rectifier Circuits 139
3.5 Wave-Shaping Circuits 143
3.6 Diode Logic Circuits 150
3.7 Voltage-Regulator Circuits 151
3.8 Linear Small-Signal Equivalent Circuits 156
3.9 Basic Semiconductor Concepts 161
3.10 Physics of the Junction Diode 169
3.11 Switching and High-Frequency Behavior 174
3.12 Computer-Aided Analysis of Diode Circuits 182
Summary 187
Problems 189

Anatomy of a Circuit Design: A Function Generator *199*

4 Bipolar Junction Transistors 211

4.1 Basic Operation of the *npn* Bipolar Junction Transistor 212
4.2 Load-Line Analysis of a Common-Emitter Amplifier 223
4.3 The *pnp* Bipolar Junction Transistor 229
4.4 Large-Signal DC Circuit Models 232
4.5 Large-Signal DC Analysis of BJT Circuits 235
4.6 Small-Signal Equivalent Circuits 248
4.7 The Common-Emitter Amplifier 251
4.8 The Emitter Follower 258
4.9 The BJT as a Digital Logic Switch 268
Summary 278
Problems 280

5 Field-Effect Transistors 287

5.1 NMOS Transistors 288
5.2 Load-Line Analysis of a Simple NMOS Amplifier 298
5.3 Bias Circuits 301
5.4 Small-Signal Equivalent Circuits 308
5.5 The Common-Source Amplifier 313
5.6 The Source Follower 320
5.7 JFETs, Depletion-Mode MOSFETs, and *p*-Channel Devices 325
Summary 333
Problems 335

Anatomy of a Circuit Design: A Discrete Multistage Amplifier 343

6 Digital Logic Circuits 349

6.1 Basic Concepts 350
6.2 Electrical Specifications for Logic Gates 354
6.3 The Resistor-Pull-Up NMOS Inverter 365
6.4 Dynamic Response of the Resistor-Pull-Up NMOS Inverter 371
6.5 The CMOS Inverter 381
6.6 Propagation Delay of the CMOS Inverter 387
6.7 CMOS NOR and NAND Gates 391
6.8 Dynamic Logic 400
6.9 The CMOS Transmission Gate and Pass Transistor Logic 403
Summary 404
Problems 406

7 Differential and Multistage IC Amplifiers 411

7.1 Design Rules for Discrete and Integrated Circuits 412
7.2 IC Biasing with BJTs 414
7.3 IC Biasing with FETs 426
7.4 Large-Signal Analysis of the Emitter-Coupled Differential Pair 432

7.5 Small-Signal Equivalent-Circuit Analysis of the Emitter-Coupled Differential Pair 443
7.6 Design of the Emitter-Coupled Differential Amplifier 450
7.7 The Source-Coupled Differential Pair 459
7.8 Examples of Multistage IC Amplifiers 465
Summary 473
Problems 475

8 *Frequency Response* 483

8.1 Bode Plots 484
8.2 The FET Common-Source Amplifier at High Frequencies 497
8.3 The Miller Effect 504
8.4 The Hybrid-π Model for the BJT 510
8.5 Common-Emitter Amplifiers at High Frequencies 517
8.6 Common-Base, Cascode, and Differential Amplifiers 524
8.7 Emitter Followers 529
8.8 Low-Frequency Response of RC-Coupled Amplifiers 535
Summary 545
Problems 546

9 *Feedback and Oscillators* 555

9.1 Effects of Feedback on Gain 556
9.2 Reduction of Nonlinear Distortion and Noise 559
9.3 Input and Output Impedances 569
9.4 Practical Feedback Networks 577
9.5 Design of Feedback Amplifiers 580
9.6 Transient and Frequency Response 593
9.7 Effects of Feedback on Pole Locations 602
9.8 Gain Margin and Phase Margin 615
9.9 Dominant-Pole Compensation 622
9.10 Examples of IC Amplifiers with Feedback 629
9.11 Oscillator Principles 636
9.12 The Wien-Bridge Oscillator 641
Summary 646
Problems 647

Anatomy of a Circuit Design: A Cardiac Pacemaker 657

10 *Output Stages and Power Supplies* 667

10.1 Thermal Considerations 668
10.2 Power Devices 674
10.3 Class-A Output Stages 679
10.4 Class-B Amplifiers 689
10.5 Linear Voltage Regulators 700
10.6 Linear-Power-Supply Design 708
Summary 719
Problems 720

11 *Active Filters and Tuned Circuits* 727

11.1 Active Low-Pass Filters 728
11.2 Active High-Pass Filters 734
11.3 Active Bandpass Filters 736

11.4 The Series Resonant Circuit 743
11.5 The Parallel Resonant Circuit 751
11.6 Series–Parallel Transformations 753
11.7 Impedance-Matching Networks: A Design Example 765
11.8 Tuned Amplifiers 771
11.9 *LC* Oscillators 777
11.10 Crystal-Controlled Oscillators 785
Summary 790
Problems 791

12 *Waveshaping Circuits and Data Converters* 799

12.1 Comparators and Schmitt Trigger Circuits 800
12.2 Astable Multivibrators 809
12.3 The 555 Timer 817
12.4 Precision Rectifiers 822
12.5 Precision Peak Detector 827
12.6 Sample-and-Hold Circuits 829
12.7 Precision Clamp Circuits 830
12.8 Data Conversion 833
12.9 Digital-to-Analog Converters 837
12.10 Analog-to-Digital Converters 843
Summary 849
Problems 850

Anatomy of a Circuit Design: A Precision AC-to-DC Converter 855

A *Discrete Resistors* 865

B *Data Sheet for the 2N2222A BJT* 867

References 873

Index 875

List of Examples

Chapter 1

1.1 Using the Voltage-Amplifier Model 21
1.2 Analysis of a Cascaded Amplifier 23
1.3 Determining the Overall Model for a Cascaded Amplifier 25
1.4 Determining the Power Efficiency of an Amplifier 28
1.5 Converting a Voltage Amplifier to a Current Amplifier 32
1.6 Determining the Transconductance-Amplifier Model Parameters 33
1.7 Determining the Transresistance-Amplifier Model Parameters 35
1.8 Determining Voltage Gain as a Complex Number 42
1.9 Determination of CMRR Specification 51

Chapter 2

2.1 Analysis of an Inverting Amplifier 66
2.2 Noninverting-Amplifier Design 77
2.3 Amplifier Design 79
2.4 Summing-Amplifier Design 80
2.5 Closed-Loop Gain Versus Frequency of a Noninverting Amplifier 85
2.6 Calculation of Gain–Bandwidth Product 86
2.7 Bandwidths of Inverting and Noninverting Amplifiers 87
2.8 Determination of Signal Amplitude at the Onset of Clipping 90
2.9 Determination of Full-Power Bandwidth 94
2.10 Worst-Case DC Output Voltage of an Inverting Amplifier 96

Chapter 3

3.1 Load-Line Construction for a Diode Circuit 135
3.2 Construction When One End of the Line Falls Outside the Plot 136
3.3 Circuit Solution by Assumed Diode States 137
3.4 Analysis of a Zener-Diode Regulator Circuit 152
3.5 Analysis of a Zener-Diode Regulator Circuit with Load 154
3.6 Calculation of Hole and Free-Electron Concentrations 166
3.7 Plotting V–I Diode Characteristics with SPICE 182
3.8 Switching Behavior of the 1N4148 Diode 185

Chapter 4

4.1 Using Device Curves to Determine α and β 217
4.2 Graphical Determination of Q-Point and Peak Signal Swings 225
4.3 Determination of BJT Operating Region 234
4.4 The Fixed-Base Bias Circuit 235
4.5 The Fixed-Base Bias Circuit with Higher Beta 238
4.6 A Bias Circuit with Two Voltage Sources 240
4.7 The Four-Resistor Bias Circuit 243
4.8 A Bias Circuit Containing Current Sources 246
4.9 Calculation of Common-Emitter Amplifier Performance 255
4.10 Calculation of Emitter-Follower Performance 261

Chapter 5

5.1 Plotting the Characteristics of an NMOS Transistor 293
5.2 Using SPICE to Plot Drain Characteristics 294
5.3 Determination of Q-Point for the Fixed-Plus Self-Bias Circuit 303
5.4 NMOS Bias-Circuit Design 306
5.5 Determination of g_m and r_d from the Characteristic Curves 311
5.6 Gain and Impedance of a Common-Source Amplifier 315
5.7 SPICE Analysis of a Common-Source Amplifier 317
5.8 Gain and Impedance Calculations for a Source Follower 322

Chapter 6

6.1 Resistor-Pull-Up-MOS-Inverter Design 367
6.2 Transfer Characteristic using SPICE 368
6.3 Determination of Noise Margin 370
6.4 Determination of t_{PLH} for the Resistor-Pull-Up NMOS Inverter 373
6.5 Determination of Propagation Delay with SPICE 375
6.6 Transfer Characteristic of an NMOS-Pull-Up Inverter 378

6.7 Calculation of CMOS Inverter Propagation Delay 389
6.8 SPICE Simulation of CMOS Inverter Propagation Delay 390
6.9 CMOS-NAND-Gate Design 394
6.10 Effects of Back-Gate and Channel-Length Modulation 394
6.11 Effects of Back-Gate and Channel-Length Modulation 398

Chapter 7

7.1 Current-Source Output Characteristic Using SPICE 418
7.2 Manual Analysis of a Current Source 420
7.3 Widlar-Current-Source Design 423
7.4 Emitter-Coupled-Differential-Amplifier Design 452
7.5 Analysis of a Source-Coupled Differential Amplifier 463
7.6 CMOS-Op-Amp Analysis 469

Chapter 8

8.1 Bode Plot for an RC Circuit with One Pole and One Zero 488
8.2 Bode Plot for a High Pass RC Filter 492
8.3 Common-Source-Amplifier Analysis 500
8.4 SPICE Analysis of a Common-Source Amplifier 502
8.5 Using the Miller Effect to Determine Input Impedance 506
8.6 Upper Half-Power Frequency Using the Miller Effect 508
8.7 Determining the Hybrid-π Parameters by Using the Data Sheet 514
8.8 High-Frequency Response of the Common-Emitter Amplifier 520
8.9 SPICE Analysis of a Cascode Amplifier 527
8.10 High-Frequency Response of an Emitter Follower 532
8.11 Low-Frequency Analysis of a Circuit with Coupling Capacitors 538
8.12 Selecting Coupling Capacitor Values 543

Chapter 9

9.1 Feedback-Amplifier Design 582
9.2 Design of a Driver for an Optical Isolator Using Feedback 585
9.3 Design of the Output Amplifier for an Optical Isolator 588
9.4 Design of a Current Amplifier Using Feedback 590
9.5 Bode Plots for a Dominant-Pole Amplifier with Feedback 603
9.6 Two-Pole Feedback Amplifier 608
9.7 Three-Pole Feedback Amplifier 611
9.8 Instability in a Feedback Amplifier 613
9.9 Determination of Gain and Phase Margins 617
9.10 SPICE Analysis of a Feedback Amplifier 619
9.11 Dominant-Pole Compensation 623
9.12 Analysis of an Oscillator Circuit 638
9.13 Wien-Bridge-Oscillator Design 642

Chapter 10

10.1 Junction-to-Case Thermal Resistance 670
10.2 Using a Power-Derating Curve 670
10.3 Maximum Allowed Power Dissipation 672
10.4 Transfer Characteristics of an Emitter-Follower Output Stage 681
10.5 Emitter-Follower Output Stage Design 684
10.6 Class-B Amplifier Performance Calculations 695
10.7 Transformer Equivalent Circuit 710
10.8 Design of a 5-V, 1-A Power Supply 712
10.9 Thermal Design for a Power Supply 718

Chapter 11

11.1 Fourth-Order Low-Pass Butterworth Filter Design 730
11.2 Filter Design 737
11.3 Bandpass-Filter Design 740
11.4 Square-Wave-to-Sine-Wave-Converter Design 748
11.5 Conversion of a Series R–L Circuit to a Parallel Circuit 755
11.6 Circuit Model for a Real Inductor 758
11.7 Reduction of a Complex Resonant Circuit 759
11.8 Design of a Class-D-Amplifier Coupling Network 768
11.9 Design of a Tuned Amplifier 772
11.10 Design of a Hartley Oscillator 781

Chapter 12

12.1 Schmitt-Trigger Design 805
12.2 Astable-Multivibrator Analysis 810
12.3 Astable-Multivibrator Design 813

此为试读,需要完整PDF请访问: www.ertongbook.com