

- Table of Contents p. v
- List of Figures p. ix
- List of Tables p. xiii
- Preface p. xv
- Chapter 1 Introduction p. 1
- 1.1 Organization p. 2
- Chapter 2 Design of RF Power Amplifiers in CMOS Technology p. 5
- 2.1 Power Amplifier Fabrication Technologies p. 5
 - 2.1.1 GaAs MESFET Technology p. 6
 - 2.1.2 GaAs HBT Technology p. 8
 - 2.1.3 CMOS Technology p. 10
- 2.2 A Comparison of CMOS and GaAs HBT Technologies p. 13
 - 2.2.1 Device Characteristics p. 14
 - 2.2.2 Substrate Effects p. 16
 - 2.2.3 Interconnect Metal Layers p. 17
 - 2.2.4 Backside Vias p. 17
- 2.3 On-Chip Passive Components in CMOS Technology p. 18
 - 2.3.1 On-Chip Capacitors in CMOS p. 18
 - 2.3.2 On-Chip Spiral Inductors p. 19
- 2.4 Summary p. 23
- Chapter 3 RF Power Amplifier Specifications p. 25
- 3.1 Wireless Communication Standards p. 26
 - 3.1.1 Advanced Mobile Phone Service (AMPS) p. 26
 - 3.1.2 North American Digital Cellular (NADC) p. 27
 - 3.1.3 Global System for Mobile Communication (GSM) p. 28
 - 3.1.4 CDMA Digital Cellular Standard (IS-95) p. 28
 - 3.1.5 Digital European Cordless Telephone (DECT) p. 32
 - 3.1.6 Personal Digital Cellular (PDC) p. 34
- 3.2 Power Amplifier Performance Metrics p. 34
 - 3.2.1 Output Power p. 35
 - 3.2.2 Efficiency p. 38
 - 3.2.3 Power Gain p. 39
 - 3.2.4 Linearity p. 40
 - 3.2.4.1 AM-to-AM and AM-to-PM distortion p. 41
 - 3.2.4.2 Spectral Mask p. 43
 - 3.2.4.3 Adjacent Channel Power Ratio (ACPR) p. 43
 - 3.2.4.4 Third-Order Intercept Point (IP3) p. 45
- 3.3 Summary p. 46
- Chapter 4 RF Power Amplifier Classifications p. 47
- 4.1 Linear Power Amplifiers p. 47
 - 4.1.1 Class A Power Amplifiers p. 48
 - 4.1.2 Class B Power Amplifiers p. 52
 - 4.1.3 Class C Power Amplifiers p. 55
- 4.2 Switching Power Amplifiers p. 61

- 4.2.1 Class D Power Amplifiers p. 61
- 4.2.2 Class E Power Amplifiers p. 62
- 4.2.3 Class F Power Amplifiers p. 65
- 4.3 Comparison p. 68
- 4.4 Summary p. 69
- Chapter 5 Lumped and Distributed Matching Networks p. 71
- 5.1 Impedance Transformation p. 71
- 5.2 Passive Lumped Matching Networks p. 72
- 5.2.1 Lumped Matching Network Configurations p. 75
- 5.3 Distributed Matching Networks p. 77
- 5.3.1 Transmission Lines p. 77
- 5.3.2 Distributed Matching Network Configurations p. 82
- 5.4 Summary p. 85
- Chapter 6 RF Power Amplifier Control and Linearization Techniques p. 87
- 6.1 Power Control vs. Linearization p. 87
- 6.2 Control and Linearization at the Input p. 88
- 6.2.1 Back-Off p. 88
- 6.2.2 Predistortion p. 90
- 6.2.3 Cartesian Feedback p. 92
- 6.2.4 Polar Feedback p. 93
- 6.3 Control and Linearization at the Output p. 95
- 6.3.1 Feedforward Control and Linearization p. 95
- 6.3.2 Linear Amplification with Nonlinear Components (LINC) p. 97
- 6.4 Control and Linearization at the Power Supply p. 100
- 6.4.1 Envelope Elimination and Restoration p. 100
- 6.5 Summary p. 102
- Chapter 7 A CMOS RF Power Amplifier with Parallel Amplification for Efficient Power Control p. 103
- 7.1 Architecture p. 105
- 7.1.1 Class F Power Amplifiers p. 105
- 7.1.2 Power Control through Parallel Amplification p. 107
- 7.1.3 Power Combination p. 108
- 7.1.4 Parallel Amplifier Architecture p. 112
- 7.2 Implementation p. 115
- 7.2.1 Output Stage p. 117
- 7.2.2 Driver Stage p. 119
- 7.3 Experimental Results p. 120
- 7.4 On-Chip Power Combination p. 124
- 7.5 Summary p. 128
- Chapter 8 Conclusion p. 131
- 8.1 Recommendations for Further Investigation p. 132
- Appendix A p. 135
- Bibliography p. 139
- Index p. 147