

1. Record Nr.	UNINA9910809670703321
Autore	Edwards T. C. (Terence Charles)
Titolo	Foundations for microstrip circuit design / / Terry C. Edwards, Michael B. Steer
Pubbl/distr/stampa	Chichester, West Sussex, United Kingdom : , : IEEE Press, Wiley, , [2016] [Piscataqay, New Jersey] : , : IEEE Xplore, , [2016]
ISBN	1-118-93618-3 1-118-93616-7 1-118-93617-5
Edizione	[Fourth edition.]
Descrizione fisica	1 online resource (858 p.)
Collana	Wiley - IEEE
Altri autori (Persone)	SteerMichael Bernard
Disciplina	621.38132
Soggetti	Microwave integrated circuits Strip transmission lines
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Description based upon print version of record.
Nota di bibliografia	Includes bibliographical references at the end of each chapters and index.
Nota di contenuto	-- Preface xxiii -- Acknowledgements xxv -- 1 Introduction to Design Using Microstrip and Planar Lines 1 -- 1.1 Introduction 1 -- 1.2 Origins of Microstrip 2 -- 1.3 RF and Microwave Modules 4 -- 1.4 Interconnections on RF and Microwave Integrated Circuits 13 -- 1.5 High-speed Digital Interconnections 15 -- 1.6 Summary 18 -- References 18 -- 2 Fundamentals of Signal Transmission on Interconnects 19 -- 2.1 Introduction 19 -- 2.2 Transmission Lines and Interconnects 19 -- 2.3 Interconnects as Part of a Packaging Hierarchy 20 -- 2.4 The Physical Basis of Interconnects 21 -- 2.5 The Physics, a Guided Wave 23 -- 2.6 When an Interconnect Should be Treated as a Transmission Line 32 -- 2.7 The Concept of RF Transmission Lines 34 -- 2.8 Primary Transmission Line Constants 34 -- 2.9 Secondary Constants for Transmission Lines 35 -- 2.10 Transmission Line Impedances 37 -- 2.11 Reflection 38 -- 2.12 Multiple Conductors 41 -- 2.13 Return Currents 44 -- 2.14 Modeling of Interconnects 47 -- 2.15 Summary 49 -- References 50 -- 3 Microwave Network Analysis 51 -- 3.1 Introduction 51 -- 3.2 Two-port Networks 51 -- 3.3 Scattering Parameter Theory 55 -- 3.4 Signal-flow Graph Techniques and S Parameters 70 -- 3.5 Summary 74 -- References 74 -- 4

Transmission Line Theory 76 -- 4.1 Introduction 76 -- 4.2
Transmission Line Theory 76 -- 4.3 Chain (ABCD) Parameters for a Uniform Length of Loss-free Transmission Line 81 -- 4.4 Change in Reference Plane 82 -- 4.5 Working With a Complex Characteristic Impedance 83 -- 4.6 Summary 87 -- References 88 -- 5 Planar Interconnect Technologies 89 -- 5.1 Introductory Remarks 89 -- 5.2 Microwave Frequencies and Applications 89 -- 5.3 Transmission Line Structures 91 -- 5.4 Substrates for Planar Transmission Lines 98 -- 5.5 Thin-film Modules 102 -- 5.6 Thick-film Modules 104 -- 5.7
Monolithic Technology 105 -- 5.8 Printed Circuit Boards 108 -- 5.9
Multichip Modules 111 -- 5.10 Summary 116 -- References 117 -- 6 Microstrip Design at Low Frequencies 120 -- 6.1 The Microstrip Design Problem 120.
6.2 The Quasi-TEM Mode of Propagation 122 -- 6.3 Static-TEM Parameters 124 -- 6.4 Effective Permittivity and Characteristic Impedance of Microstrip 127 -- 6.5 Filling Factor 132 -- 6.6 Approximate Graphically Based Synthesis 134 -- 6.7 Formulas for Accurate Static-TEM Design Calculations 137 -- 6.8 Electromagnetic Analysis-based Techniques 139 -- 6.9 A Worked Example of Static-TEM Synthesis 140 -- 6.10 Microstrip on a Dielectrically Anisotropic Substrate 141 -- 6.11 Microstrip and Magnetic Materials 146 -- 6.12 Effects of Finite Strip Thickness, Metallic Enclosure, and Manufacturing -- Tolerances 147 -- 6.13 Pulse Propagation along Microstrip Lines 151 -- 6.14 Recommendations Relating to the Static-TEM Approaches 152 -- 6.15 Summary 154 -- References 155 -- 7 Microstrip at High Frequencies 157 -- 7.1 Introduction 157 -- 7.2 Frequency-dependent Effects 157 -- 7.3 Approximate Calculations Accounting for Dispersion 169 -- 7.4 Accurate Design Formulas 173 -- 7.5 Effects due to Ferrite and to Dielectrically Anisotropic Substrates 182 -- 7.6 Field Solutions 183 -- 7.7 Frequency Dependence of Microstrip Characteristic Impedance 186 -- 7.8 Multimoding and Limitations on Operating Frequency 190 -- 7.9 Design Recommendations 194 -- 7.10 Summary 196 -- References 196 -- 8 Loss and Power-dependent Effects in Microstrip 200 -- 8.1 Introduction 200 -- 8.2 Q Factor as a Measure of Loss 200 -- 8.3 Power Losses and Parasitic Effects 208 -- 8.4 Superconducting Microstrip Lines 216 -- 8.5 Power-handling Capabilities 219 -- 8.6 Passive Intermodulation Distortion 221 -- 8.7 Summary 224 -- References 224 -- 9 Discontinuities in Microstrip 227 -- 9.1 Introduction 227 -- 9.2 The Main Discontinuities 228 -- 9.3 Bends in Microstrip 236 -- 9.3.1 The Right-angled Bend or "Corner" 236 -- 9.3.2 Mitered or "Matched" Microstrip Bends, Compensation Techniques 238 -- 9.4 Step Changes in Width (Impedance Step) 241 -- 9.4.1 The Symmetrical Microstrip Step 241 -- 9.4.2 The Asymmetrical Step in Microstrip 243.
9.5 The Narrow Transverse Slit 243 -- 9.6 Microstrip Junctions 245 -- 9.7 Recommendations for the Calculation of Discontinuities 261 -- 9.8 Summary 266 -- References 266 -- 10 Parallel-coupled Microstrip Lines 268 -- 10.1 Introduction 268 -- 10.2 Coupled Transmission Line Theory 269 -- 10.3 Formulas for Characteristic Impedance of Coupled Lines 278 -- 10.4 Semi-empirical Analysis Formulas as a Design Aid 290 -- 10.5 An Approximate Synthesis Technique 301 -- 10.6 Summary 304 -- References 304 -- 11 Applications of Parallel-coupled Microstrip Lines 306 -- 11.1 Introduction 306 -- 11.2 Directional Couplers 306 -- 11.3 Design Example: Design of a 10 dB Microstrip Coupler 308 -- 11.4 Frequency- and Length-Dependent Characteristics of Directional Couplers 310 -- 11.5 Special Coupler Designs with Improved Performance 315 -- 11.6 Thickness Effects, Power Losses, and Fabrication Tolerances 329 -- 11.7 Choice of

Structure and Design Recommendations 331 -- 11.8 Summary 336 -- References 337 -- 12 Microstrip Passive Elements 339 -- 12.1 Introduction 339 -- 12.2 Lumped Elements 339 -- 12.3 Terminations and Attenuators 343 -- 12.4 Microstrip Stubs 345 -- 12.5 Hybrids and Couplers 348 -- 12.6 Power Combiners and Dividers 355 -- 12.7 Baluns 357 -- 12.8 Integrated Components 359 -- 12.9 Summary 365 -- References 365 -- 13 Stripline Design 369 -- 13.1 Introduction 369 -- 13.2 Symmetrical Stripline 370 -- 13.3 Asymmetrical Stripline 373 -- 13.4 Suspended Stripline 375 -- 13.5 Coupled Stripline 375 -- 13.6 Double-sided Stripline 379 -- 13.7 Discontinuities 380 -- 13.8 Design Recommendations 381 -- 13.9 Summary 382 -- References 382 -- 14 CPW Design Fundamentals 384 -- 14.1 Introduction to Properties of Coplanar Waveguide 384 -- 14.2 Modeling CPWs 389 -- 14.3 Formulas for Accurate Calculations 391 -- 14.4 Loss Mechanisms 393 -- 14.5 Dispersion 397 -- 14.6 Discontinuities 408 -- 14.7 Circuit Elements 421 -- 14.8 Variants on the Basic CPW Structure 430 -- 14.9 Summary 439 -- References 439.

15 Slotline 443 -- 15.1 Introduction 443 -- 15.2 Basic Concept and Structure 444 -- 15.3 Operating Principles and Modes 444 -- 15.4 Propagation and Dispersion Characteristics 447 -- 15.5 Evaluation of Guide Wavelength and Characteristic Impedance 451 -- 15.6 Losses 453 -- 15.7 End-effects: Open Circuits and Short Circuits 455 -- 15.8 Summary 463 -- References 463 -- 16 Slotline Applications 465 -- 16.1 Introduction 465 -- 16.2 Comparators and Couplers 465 -- 16.3 Filter Applications 472 -- 16.4 Magic T 474 -- 16.5 The Marchand Balun 477 -- 16.6 Phase Shifters 480 -- 16.7 Isolators and Circulators 481 -- 16.8 A Double-sided, Balanced Microwave Circuit 486 -- 16.9 Summary 486 -- References 486 -- 17 Transitions 488 -- 17.1 Introduction 488 -- 17.2 Coaxial-to-microstrip Transitions 488 -- 17.3 Waveguide-to-microstrip Transitions 490 -- 17.4 Transitions between CPW and other Mediums 495 -- 17.5 Slotline Transitions 498 -- 17.6 Other Microstrip Transitions 510 -- 17.7 Summary 511 -- References 511 -- 18 Measurements of Planar Transmission Line Structures 514 -- 18.1 Introduction 514 -- 18.2 Instrumentation Systems for Microstrip Measurements 514 -- 18.3 Measurement of Scattering Parameters 515 -- 18.4 Measurement of Substrate Properties 519 -- 18.5 Microstrip Resonator Methods 523 -- 18.6 Q Factor Measurements 533 -- 18.7 Measurements of Parallel-coupled Microstrips 535 -- 18.8 Time-domain Reflectometry Techniques 537 -- 18.9 Summary 539 -- References 539 -- 19 Filters Using Planar Transmission Lines 541 -- 19.1 Introduction 541 -- 19.2 Filter Prototypes 541 -- 19.2.7 Moderate Bandwidth Transmission Line Stub Model of an Inverter 550 -- 19.3 Microstrip Filters 554 -- 19.4 Microstrip Bandpass Filters 559 -- 19.5 Parallel-coupled Line Bandpass Filters 561 -- 19.6 Filter Design Accounting for Losses 572 -- 19.7 Dielectric Resonators and Filters Using Them 572 -- 19.8 Spurline Bandstop Filters 573 -- 19.9 Summary 575 -- References 575 -- 20 Magnetic Materials and Planar Transmission Lines 576.

20.1 Introduction 576 -- 20.2 Microwave Magnetic Materials 577 -- 20.3 Effective Permeability of Magnetic Materials 587 -- 20.4 Microstrip on a Ferrite Substrate 589 -- 20.5 Isolators and Circulators 592 -- 20.6 Transmission Lines Using Metacconductors 595 -- 20.7 Frequency Selective Limiter 606 -- 20.8 Summary 607 -- References 607 -- 21 Interconnects for Digital Systems 610 -- 21.1 Introduction 610 -- 21.2 Overview of On-chip Interconnects 610 -- 21.3 RC Modeling of On-chip Interconnects 613 -- 21.4 Modeling Inductance 619 -- 21.5 Clock Distribution 622 -- 21.6 Resonant Clock Distribution 625 -- 21.7 Summary 626 -- References 627 -- A Physical

and Mathematical Properties 629 -- A.1 SI Units 629 -- A.2 SI Prefixes 629 -- A.3 Physical and Mathematical Constants 631 -- A.4 Basis of Electromagnetic SI Units 631 -- A.5 Relationship of SI Units to CGS Units 632 -- B Material Properties 635 -- References 642 -- C RF and Microwave Substrates 643 -- C.1 Hard substrates 643 -- C.2 Soft Substrates 644 -- Index 647.
