



# Planar Antennas For Wireless Communications

**Ali Abdulhadi Noaman Al-Azza**



## **Planar Antennas For Wireless Communications:**

**Planar Antennas for Wireless Communications** Kin-Lu Wong, 2003-01-06 The latest text in the Wiley Series in Microwave and Optical Engineering The first comprehensive resource on planar antenna designs Planar antennas are the newest generation of antennas boasting such attractive features as low profile light weight low cost and ease of integration into arrays These features make them ideal components of modern communications systems particularly in cellular and WLAN applications Consequently many novel designs of planar antennas for related applications have come into being within the last two to three years Until now these designs were only accessible to current and prospective antenna designers through journal articles conference papers and patent descriptions Planar Antennas for Wireless Communications organizes today's most important planar antenna designs into one easy to use reference In this the latest addition to the Wiley Series in Microwave and Optical Engineering the author presents more than seventy advanced planar antenna designs along with detailed design considerations and experimental results including PIFAs for internal mobile phone antennas Very low profile monopoles for internal mobile phone antennas Base station antennas for cellular systems Planar antennas for WLAN applications DR antennas for wireless communications Integration of antennas for different operating bands Each chapter features a multitude of illustrations for the geometries and experimental results of the featured designs as well as a complete list of related references for further study making the book an invaluable design resource for antenna scientists and engineers alike

**Broadband Planar Antennas** Zhi Ning Chen, Michael Yan Wah Chia, 2006-05-01 The increasing demand for wireless communications has revolutionised the lifestyle of today's society and one of the key components of wireless technology is antenna design Broadband planar antennas are the newest generation of antennas boasting the attractive features required such as broad operating bandwidth low profile light weight low cost and ease of integration into arrays or Radio Frequency RF circuits to make them ideal components of modern communications systems Research into small and broadband antennas has been spurred by the rapid development of portable wireless communication devices such as cell phones laptops and personal digital assistants This all encompassing volume Broadband Planar Antennas Design and Applications systematically describes the techniques for all planar antennas from microstrip patch antennas suspended plate antennas and planar inverted L F antennas to planar dipole antennas Also discussed are some of the most recent outcomes such as broadband antenna issues in promising ultra wideband applications Clearly describes the fundamentals of planar antennas and categorises them according to their radiation characteristics Introduces the advanced progress in broadband planar antennas for modern wireless communications Includes a wealth of case studies design guidelines figures and tables This text is essential reading for antenna RF and microwave engineers and manufacturers within the telecommunications industry Its highly accessible approach will also appeal to researchers postgraduate students and academic lecturers

**Reconfigurable Active and Passive Planar Antennas for Wireless Communication Systems** Shibani Kishen

Koul,Rajesh K. Singh,2022-10-14 This book presents state of the art trends in reconfigurable active and passive planar antennas and their applications in wireless communication systems operating in the frequency band 5 6 GHz Due to various key features such as multifunction antenna design compactness planar nature and low cost these technologies are becoming popular for current and future wireless applications This book discusses different novel antenna designs and their working principles in detail The modern and future wireless systems require wideband antennas to accommodate various channels in a single band or in separate bands The carrier aggregation CA has been introduced in the modern wireless systems such as LTE advanced systems and 5G 6G In CA a device can use several channels for transmission and reception The used channels can exist in the same frequency band intra band CA or in distinct bands inter band CA To accommodate more channels more bandwidth is required within the operating band For portable devices circularly polarized CP antennas are more advantageous over linearly polarized antennas since in CP antennas there is low risk of misalignment and hence encountering interference Circularly polarized antenna also provides higher link reliability for the portable devices To provide high data rates more bandwidth is needed to accommodate more channels Various multifunction compact and wideband antennas for plethora of applications are addressed in detail in this book The scope of developing reconfigurable active antennas for application in beam switching beam steering wireless charging security systems etc is described This book concludes by giving glimpses of antenna requirements for future wireless communication systems **Planar**

**Antennas** Praveen Kumar Malik,2021-10-21 This comprehensive reference text discusses fundamental concepts applications design techniques and challenges in the field of planar antennas The text focuses on recent advances in the field of planar antenna design and their applications in various fields of research including space communication mobile communication wireless communication and wearable applications This resource presents planar antenna design concepts methods and techniques to enhance the performance parameters and applications for IoTs and device to device communication The latest techniques used in antenna design including their structures defected ground MIMO and fractal design are discussed comprehensively The text will be useful for senior undergraduate students graduate students and academic researchers in fields including electrical engineering electronics and communication engineering *Compact Antennas for Wireless Communications and Terminals* Jean-Marc Laheurte,2012-12-27 Compact Antennas for Wireless Communications and Terminals deals with compact microwave antennas and more specifically with the planar version of these antennas Planar antennas are the most appropriate type of antenna in modern communication systems and more generally in all applications requiring miniaturization integration and conformation such as in mobile phone handsets The book is suitable for students engineers and scientists eager to understand the principles of planar and small antennas their design and fabrication issues and modern aspects such as UWB antennas reconfigurable antennas and diversity issues **Planar Antennas** Praveen

Kumar Malik,2021-10-21 This comprehensive reference text discusses fundamental concepts applications design techniques

and challenges in the field of planar antennas The text focuses on recent advances in the field of planar antenna design and their applications in various fields of research including space communication mobile communication wireless communication and wearable applications This resource presents planar antenna design concepts methods and techniques to enhance the performance parameters and applications for IoTs and device to device communication The latest techniques used in antenna design including their structures defected ground MIMO and fractal design are discussed comprehensively The text will be useful for senior undergraduate students graduate students and academic researchers in fields including electrical engineering electronics and communication engineering

**Multifunctional and Multiband Planar Antennas for Emerging Wireless Applications** Jayshri Kulkarni,Chow-Yen-Desmond Sim,Jawad Yaseen Siddiqui,Anisha M. Apte,Ajay Kumar Poddar,Ulrich L. Rohde,2023-12-19 This work focuses on designing multiband printed single Multiple Input Multiple Output MIMO CP antennas for WLAN V2X and NR Sub 6GHz 5G applications It also delves into the design and implementation of a Four Port MIMO antenna for wireless applications addressing theoretical foundations and challenges Additionally the book explores critical aspects of software defined radios SDR including modulation signal processing radio systems TX RX blocks SDR enabled phased arrays and beam hopping techniques with relevance to 5G 6G and IoT applications Features Explores advancements in planar monopole antennas including bandwidth enhancement techniques Analyzes innovative antenna design structures like miniaturized and conformal monopole antennas and discusses modeling and implementation Spotlights WLAN and Wi Fi 6 E antenna design for next gen laptops with practical insights Addresses the use of triple band antenna arrays for MIMO applications in laptops Focuses on planar antenna advancements for diverse wireless bands and applications Explores multiband printed single MIMO CP antennas for WLAN V2X and NR Sub 6GHz 5G Covers the design and implementation of a Four Port MIMO antenna for wireless applications including theoretical foundations and challenges Explores SDR modulation signal processing radio systems TX RX blocks SDR enabled phased arrays and beam hopping techniques for 5G 6G and IoT applications This book is aimed at graduate students and researchers in electrical and electronic engineering antennas and wireless communication systems

Antennas for Base Stations in Wireless Communications Zhi Ning Chen,Kwai-Man Luk,2009-07-01 Design Antennas for Modern Wireless Communications Systems Written by a global team of expert contributors this book offers complete details on the wide range of antennas used in today s wireless communication networks Coverage includes the most popular applications in WWAN GSM CDMA and WCDMA WLAN Bluetooth and WiFi WMAN WiMAX and WPAN UWB and RFID Antennas for Base Stations in Wireless Communications presents a full picture of modern base station antenna technology from fundamentals and parameters to engineering and advanced solutions and highlights new technologies in antenna design with enhanced performance Real world case studies provide you with practical examples that can be applied to your own system designs Apply measurement techniques for various parameters Enable frequency re use and channel capacity optimization in mobile radio networks

Design antennas for mobile communications CDMA GSM and WCDMA Implement advanced antenna technologies for GSM base stations Facilitate enhanced system capacity Design unidirectional antennas including directed dipole wideband patch and complementary antennas Optimize antenna designs for WLAN WiFi applications Design antennas for Wireless Personal Area Network WPAN applications including RFID and UWB      *Terahertz Planar Antennas for Next Generation*

*Communication* Kumud Ranjan Jha, Ghanshyam Singh, 2014-01-10 This book describes various methods to enhance the directivity of planar antennas enabling the next generation of high frequency wireless communication The authors discuss various applications to the terahertz regime of the electromagnetic spectrum with an emphasis on gain enhancement mechanisms The numerical models of these antennas are presented and the analytical results are supported using commercial simulators The multilayer substrate microstrip transmission line at terahertz frequency is also explored and a method to obtain the various parameters of this interconnect at high frequency is described This book will be a valuable resource for anyone needing to explore the terahertz band gap for future wireless communication in an effort to solve the bandwidth spectrum scarcity problem      Microstrip Antennas Sudipta Chattopadhyay, 2017-11-15 The progress in modern tiny multifunctional wireless devices has dramatically increased the demand for microstrip antennas in recent years Furthermore in the last few years such microstrip antennas found numerous applications in both the military and the commercial sectors Therefore microstrip patch antenna has become a major focus to the researchers in the field of antenna engineering In this book some recent advances in microstrip antennas are presented This book contains mainly three sections In the first section some new approaches to modern analytical techniques rather than the conventional cavity model transmission line model or spectral domain analysis have been discussed In the second section of the book a light has been showered on some new techniques for bandwidth enhancement of microstrip radiators In the last section of the book the recent trends in microstrip antenna research have been showcased Some newfangled application oriented approach to this field is vividly discussed The books main objective is to facilitate the microstrip antenna researchers for exploring the subject in more vibrant manner and also to revolutionize wireless communications A sufficient number of topics have been covered some for the first time in a research handbook I hope that the book will surely be beneficial for scientists practicing engineers and researchers working in the field of microstrip antennas

**Printed Planar Antenna Designs Based on Metamaterial Unit- Cells for Broadband Wireless Communication Systems** Mohammad Alibakhshikenari, 2017 With the continuing development of mobile communications the communication standards which include operating frequencies and protocols are also evolving In order to accommodate these and future changes antennas with characteristics of wideband and multiband are becoming a necessity Hence wireless communications industries are now demanding broadband antennas that are low profile and low volume structures Conventional planar microstrip antennas are the most common form of printed antennas that have been used for many years This is because these antennas offer advantages of low cost conformability and

ease of manufacturing however the bandwidth of these types of antennas is highly restricted Among different types of planar antennas the slotted structure that offers the simplest structure is compact and radiates omnidirectionally these features make it an excellent candidate for broadband applications Implanted Antennas in Medical Wireless Communications Yahya Rahmat-Samii, Jaehoon Kim, 2022-06-01 One of the main objectives of this lecture is to summarize the results of recent research activities of the authors on the subject of implanted antennas for medical wireless communication systems It is anticipated that ever sophisticated medical devices will be implanted inside the human body for medical telemetry and telemedicine To establish effective and efficient wireless links with these devices it is pivotal to give special attention to the antenna designs that are required to be low profile small safe and cost effective In this book it is demonstrated how advanced electromagnetic numerical techniques can be utilized to design these antennas inside as realistic human body environment as possible Also it is shown how simplified models can assist the initial designs of these antennas in an efficient manner

*Multifunctional Ultrawideband Antennas* Chinmoy Saha, Jawad Y Siddiqui, Y M M Antar, 2019-03-19 Multifunctional Antennas MFA are comparatively a new area for antenna research and finds applications in various modern wireless radios like Cognitive Radio CR in Software Defined Radio SDR technology and MIMO technology This book is first attempt and an invaluable resource which deals with the design and realization of various kinds of multifunctional antennas After clearly explaining the exclusive features of MFAs the book presents various designs of such antennas considering versatile modern and upcoming applications Written by three internationally known researchers Multi Functional Ultra Wideband Antennas Trends Techniques and Applications Provides a lucid introduction on UWB systems historical perspective and discusses various applications of such systems Discusses fundamentals of antennas and its characterization in time and frequency domains primarily aimed for the beginners in the area Revisits the design and realization of various classical UWB antennas Discusses various techniques of designing frequency notched UWB antennas and provide detailed comparison of the techniques Deals with the techniques of deriving multiple antenna functionalities from a single antenna Incorporates exclusive discussions on modern reconfigurable antennas and printed and dielectric resonator based MIMO antennas with clear focus on recent and upcoming technological requirements With Multi Functional Ultra Wideband Antennas Trends Techniques and Applications antenna engineers communication system engineers graduate students academic industry researchers will gain a thorough knowledge on design of such antennas with clear physical insight and understanding Chinmoy Saha PHD is an associate Professor in the Department of Avionics at Indian Institute of Space Science and Technology Thiruvananthapuram Kerala India His current research interest includes Microwave Circuits Engineered Materials Metamaterial Inspired Antennas and Circuits reconfigurable and multi functional antennas for modern wireless applications Dielectric Resonator antennas THz antennas and wireless power transfer He is the author or coauthor of several books scientific journals and recipient of several prestigious awards Jawad Yaseen Siddiqui PHD is an associate Professor in

the Department of Radio Physics and Electronics at University of Calcutta Kolkata India His current research interest includes ultra wideband antennas frequency reconfigurable antennas tapered slot antennas and multi functional antennas for cognitive radio application He is the author or coauthor of several books scientific journals and recipient of prestigious awards He is a Co Principal Investigator on Stratosphere Troposphere ST Radar Project at the University of Calcutta Kolkata India Yahia M M Antar PHD is a Professor in the Department of Department of Electrical and Computer Engineering at the Royal Military College of Canada Kingston ON Canada He is the author or coauthor of several books scientific journals and recipient of prestigious awards which includes IEEE Antennas and Propagation Society prestigious Chen To Tai Distinguished Educator Award for 2017 2015 IEEE Canada J M Ham outstanding Engineering Education Award 2014 IEEE Canada RA Fessenden Silver Medal 2012 Queen s Diamond Jubilee Medal from the Governor General of Canada and many more

*Printed Antennas for Wireless Communications* Rod Waterhouse, 2008-03-11 Printed antennas also known as microstrip antennas have a variety of beneficial properties including mechanical durability conformability compactness and cheap manufacturing costs As such they have a range of applications in both the military and commercial sectors and are often mounted on the exterior of aircraft and spacecraft as well as incorporated into mobile radio communication devices Printed Antennas for Wireless Communications offers a practical guide to state of the art printed antenna technology used for wireless systems Contributions from renowned global experts within both academia and industry enable the reader to design printed antennas and associated technologies and offer valuable insights into important breakthroughs in these areas Divided into 3 sections covering fundamental wideband printed radiating elements for wireless systems small printed antennas for wireless systems and advanced concepts and applications in wireless systems Provides experimental data and applies theoretical models to present design performance trends and to give the reader an in depth coverage of the area Presents summaries of different approaches used in solving wireless systems such as WPAN wireless personal area network and MIMO multi input multi output offering the reader an overall perspective of the pros and cons of each Focuses on practical design examples and real world solutions Printed Antennas for Wireless Communications offers an excellent insight on printed antennas from the theoretical to the practical hence it will appeal to practicing design engineers within commercial and governmental military organisations as well as postgraduate students and researchers in communications technology

Planar Spiral Inductors, Planar Antennas and Embedded Planar Transformers Amal Banerjee, 2022-08-26 This book presents a novel automated accurate and unified scheme to design and determine the performance characteristics of standalone planar spiral inductors and multiple coupled planar spiral inductors as in embedded transformers for RF microwave MMIC designers The author demonstrates with a set of analysis design examples a novel scheme that exploits judiciously the existing transmission theory and concepts organizing and condensing available scattered information knowledge about planar spiral inductor embedded planar transformer and planar antenna design and performance



evaluation into one coherent and unified electronic circuit model easily used by radio frequency electronic circuit engineers

A dedicated chapter contains an exhaustive 19 set of design examples Presents a bottom up scheme starting with Maxwell's equations of classical electrodynamics and transmission line theory Telegrapher's equation specifically microstrips

Demonstrates design of standalone planar spiral inductors and multiple coupled planar spiral inductors Includes a set of ready to use C executables for both Linux and Windows that accept predefined input parameters for each of the sub circuits discussed and generate SPICE netlists for the equivalent electrical circuit Automates execution of multi step design calculations to guarantee their accuracy and reliability

Antenna Engineering Handbook, Fourth Edition John Volakis, 2007-06-08 The bible of antenna engineering fully updated to provide state of the art coverage in antenna design and applications Edited by John L Volakis one of the world's leading authorities in antenna engineering this trusted resource covers all the classic antenna types plus many new types and designs used in communications systems satellites radars and emerging applications from WLAN to automotive systems to biomedical to smart antennas You will also find expert discussion of topics critical to successful antenna design and engineering such as measurement techniques and computational methods a materials guide wave propagation basics microwave circuits and matching techniques as well as diversity and MIMO propagation models frequency selective surfaces and metamaterials Packed with 1 500 illustrations the 4th Edition of Antenna Engineering Handbook presents Step by step guidance on most antennas modern and classic 59 chapters with 21 new chapters and 38 fully updated chapters from the previous edition Contributions from over 80 well known antenna experts Full color insert illustrating many commercial and military antennas Get Quick Access to All of Today's Cutting Edge Antennas Printed and Conformal Antennas Wideband Patch Antennas Wideband Arrays Leaky Wave Antennas EBG Antennas UWB Antennas and Arrays Portable TV Antennas Reconfigurable Antennas Active Antennas Millimeter Wave and TeraHertz Antennas Fractal Antennas Handset and Terminal Antennas Biomedical Antennas ECM and ESM antennas Dielectric Resonator Antennas Lens Antennas Radiometer Antennas Satellite Antennas Reflector and Earth Station Antennas and Dozens More

*Antenna Engineering Handbook* John Volakis, 2018-11-05 The gold standard reference on the design and application of classic and modern antennas fully updated to reflect the latest advances and technologies This new edition of the bible of antenna engineering has been updated to provide start to finish coverage of the latest innovations in antenna design and application You will find in depth discussion of antennas used in modern communication systems mobile and personal wireless technologies satellites radar deployments flexible electronics and other emerging technologies including 5G terahertz and wearable electronics Antenna Engineering Handbook Fifth Edition is bolstered by real world examples hundreds of illustrations and an emphasis on the practical aspects of antennas Featuring 60 chapters and contributions from more than 80 renowned experts this acclaimed resource is edited by one of the world's leading antenna authorities This edition features all of the classic antenna types plus new and emerging designs with 13 all new chapters and important

updates to nearly all chapters from past editions Antenna Engineering Handbook Fifth Edition clearly explains cutting edge applications in WLANs automotive systems PDAs and handheld devices making it an indispensable companion for today's antenna practitioners and developers Coverage includes Antenna basics and classic antennas Design approaches for antennas and arrays Wideband and multiband antennas Antennas for mobile devices and PDAs automotive applications and aircraft Base station and smart antennas Beamforming and 5G antennas Millimeter wave and terahertz antennas Flexible wearable thin film origami dielectric and on chip antennas MIMO antennas and phased arrays Direction finding and GPS antennas Active antennas Low profile wideband antennas Nanoantennas Reflectors and other satellite and radio telescope antennas Low frequency HF VHF UHF ECM and ESM antennas Impedance matching techniques and material characteristics Metastructured and frequency selective surfaces Propagation and guided structures Computational techniques and toolsets Indoor and outdoor measurements

Optimal Antenna Designs for Wireless Communication Applications Ali Abdulhadi Noaman Al-Azza, 2016 Antennas design procedure especially in portable devices has been influenced by the growing demand for development of modern wireless communications Hence antennas that are wideband compact low profile low cost and easy to integrate into printed circuits are required The research described in this dissertation focuses on optimally design and analysis of compact low profile and planar wideband patch antennas for modern wireless communications namely an open slot wideband planar antenna a dielectric loaded wideband antenna a planar antenna with ultra wideband performance and an E shaped patch antenna A novel very compact planar antenna with wideband performance is proposed and investigated The proposed antenna has a size of only 9.2 mm x 9.8 mm x 1.52 mm The size miniaturization is achieved by inserting an open slot in the ground plane to reduce the phase velocity The antenna has achieved an impedance bandwidth of 52.16% and a stable radiation patterns over a wider bandwidth with a size reduction about 88% Optimization of a dielectric loaded antenna by using Covariance Matrix Adaptation Evolutionary Strategy CMA ES technique to achieve wideband and ii symmetrical broadside radiation performance is presented Simulation is used to investigate the frequency domain performance regarding return loss gain and radiation pattern Experimental measurements have also been performed to validate the performance of the proposed antenna The obtained results show that the proposed dielectric loaded antenna achieves a good impedance matching and radiation characteristics in the entire band of WLAN IEEE 802.11a A new ultra wideband low profile microstrip antenna is presented for wireless applications The proposed antenna has a compact size of 20x16 mm<sup>2</sup> and an impedance bandwidth of 134.88% 3.5 GHz to 18 GHz With the compact ultra wideband and low profile the proposed antenna can be a very good candidate for a wide range of communication applications Spider Monkey Optimization SMO method is introduced for the first time for solving electromagnetic problems The SMO is a new swarm intelligence technique which models the foraging behavior of spider monkeys To show the efficiency of the SMO different examples are presented and the results are compared with the results obtained using other popular optimization techniques

The optimization procedure is used to synthesis the array factor of a linear antenna array and to optimally design a rectangular and an E shaped patch antenna for wireless applications By comparing to traditional optimization techniques that reported in the literature it is evident that SMO is efficient in reaching the optimum solutions with less number of experiments The performance results obtained from study of these antennas show that these antennas can be an excellent choice for a wide range of wireless communication applications

**Radio Propagation and Adaptive Antennas for Wireless Communication Links** Nathan Blaunstein,Christos Christodoulou,2007 Antennas and Propagation for Wireless Communication covers the basics of wireless communication system design with emphasis on antennas and propagation It contains information on antenna fundamentals and the latest developments in smart antennas as well as the radiation effects of hand held devices Antennas and Propagation for Wireless Communication provides a complete discussion of all the topics important to the design of wireless communication systems Written by acknowledged authorities in their respective fields the book deals with practical applications and presents real world examples A solutions manual for college adopters accompanies the text Ideal for engineers working in communication antennas and propagation for telecomm military and aerospace applications as well as students of electrical engineering this book covers all topics needed for a complete system design

**Theory and Experiment of Planar Inverted F-antennas for Wireless Communications Applications** Vadim Antonchik,2007 The planar inverted F antenna PIFA is a compact element for wireless applications There is little theory available on this subject This dissertation investigates simple theoretical models for two most popular types of PIFA rectangular and semicircular PIFA s The PIFA s three slot cavity model CM and transmission line model TLM are presented here along with numerical and physical experimental techniques and results for the PIFA far field and impedance behavior The CM is used to predict PIFA s far field pattern polarization impedance Q factor and bandwidth from an equivalent resonant cavity with perfect magnetic and electric boundaries The TLM represents the PIFA as an equivalent transmission lines arrangement with three branches representing its radiating slots and one short circuited branch Extensive measurements and numerical simulations confirmed that PIFA s radiation and impedance characteristics can be predicted with simple theoretical calculations described here The measurements also showed PIFA s pattern and impedance dependence on the sideslot radiation

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