

Design a Circular Microstrip Patch Antenna for Dual Band

Arun Singh Kirar, Veerendra Singh Jadaun, Pavan Kumar Sharma

Department of Electronics, MITS, Gwalior , India

Abstract— This paper presents a circular patch microstrip antenna operate in dual band (1.66 GHz and 2.777GHz). The proposed Circular patch antenna will be in light weight, flexible, slim and compact unit compare with current antenna used in dual band [1]. The paper also presents the detail steps of designing the circular patch microstrip antenna and the simulated result. IE3D software is used to compute the gain, power, radiation pattern, and S11 of the antenna.

Keywords- Circular patch microstrip antenna, VSWR, Return loss, Bandwidth.

I. INTRODUCTION

Microstrip antennas are attractive due to their light weight, conformability and low cost. These antennas can be integrated with printed strip-line feed networks and active devices [2]. This is a relatively new area of antenna engineering. In this research paper first a microstrip line fed antenna have been modeled, designed and simulated. The analysis of dual band microstrip patch antenna is done using transmission line model for 1.66 GHz and 2.77 GHz frequency and the designing has been done in IE3D software which is an EM solver and works on the principle of Method of Moments [3].

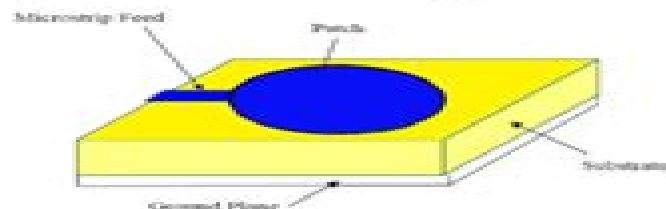


Figure 1. Microstrip Circular patch antenna

A. Antenna Parameters

An antenna is the transitional radio between free space and a guiding device. In order to be able to design a good antenna, it's crucial to consider some of the basic but yet important parameters that characterize all antenna design.

B. Gain

The gain of an antenna is the radiation intensity in a given direction divided by the radiation intensity that would be obtained if the antenna radiated all of the power delivered equally to all directions. The definition of gain requires the

concept of an isotropic radiator; that is, one that radiates the same power in all directions. Gain usually expressed in db. Gain can be obtained by using equation [4].

$$G = \eta \cdot D, \text{ where, } \eta = \text{efficiency, } D = \text{directivity}$$

C. Directivity

Directivity is the same as gain, but with one difference. It does not include the effects of power lost (inefficiency) in the antenna. If an antenna were lossless (100% efficient), then the gain and directivity (in a given direction) would be the same.

D. Radiation Pattern

Radiation pattern is defined as the power radiated or received by an antenna in a function of the angular position and radial distance from the antenna. It describes how the antenna directs the energy it radiates.

E. Antenna Efficiency

The antenna efficiency is defined as the ratio of total power radiated by the antenna to the input power of the antenna. Just like any other microwave components, an antenna may dissipate power due to conductor loss or dielectric loss.

F. Return Loss

Return loss is a convenient way to characterize the input and output signal sources. Return loss can be defined in dB

II. DESIGN AND ANALYSIS ANTENNA-

In the typical design procedure of the Microstrip-antenna, the desired resonant frequency, thickness and dielectric constant of the substrate are known or selected initially. In this design of rectangular Microstrip antenna, FR4dielectric material ($\epsilon_r=4.4$) with dielectric loss tangent of 0.02 is selected as the substrate with 1.6 mm height. Then, a patch antenna that operates at the specified operating frequency $f_0 = 1.66$ GHz and 2.77 GHz can be designed by using transmission line model equations [5]. Inset feeding used as a feeding method.

Formulas used for calculating radius (a) -

$$a = F \left[1 + \frac{2h}{\pi F \epsilon_r} \left[\ln \left(\frac{\pi F}{2h} \right) + 1.7726 \right] \right]^{-1/2}$$

Where,

$$F = \frac{8.791 \times 10^9}{f_r \sqrt{\epsilon_r}}$$

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Human-Centric Integration of 6G-Enabled Technologies for Modern Society Amit Kumar Tyagi, Shrikant Tiwari, 2025-04-29 Human Centric Integration of 6G Enabled Technologies for Modern Society Fundamentals Applications Analysis and Challenges serves as a comprehensive reference addressing the information needs of professionals by providing deep information about the fundamentals and applications of 6G enabling them to make informed decisions in the dynamic landscape of advanced communication technologies In the 23 chapters this book introduces the reader to the 6G technology the evolution of wireless communication and the integration of artificial intelligence provides the use cases and applications of 6G technology and the insights into the challenges future trends and emerging technologies and includes the applications of 6G technology in remote healthcare services patient monitoring and medical diagnostics Human Centric Integration of 6G Enabled Technologies for Modern Society Fundamentals Applications Analysis and Challenges redefines the way we connect communicate and collaborate with emerging technologies in this smart era of 6G technology The title benefits from a collective wealth of knowledge and perspectives This diversity enriches the content providing readers with insights from various angles setting it apart from publications authored or edited by a limited number of individuals It discusses both the like fundamental concepts diverse applications and analytical methodologies as the challenges that come with the development and deployment of 6G enabled technologies It is designed to address the latest developments in 6G technology offering a forward looking perspective on emerging trends It ensures that readers receive up to date information and insights into the rapidly evolving landscape of next generation wireless communication **Handbook of Microstrip Antennas** James R. James, Peter S. Hall, 1989 The book reviews developments in the following fields circular microstrip antennas microstrip patch antennas circular polarisation and bandwidth microstrip dipoles multilayer and parasitic configurations wideband flat dipole and short circuit microstrip patch elements and arrays numerical analysis multiport network approach transmission line model rectangular microstrip antennas low cost printed antennas printed phased array antennas circularly polarised antenna arrays microstrip antenna feeds substrate technology computer aided design of microstrip and triplate circuits resonant microstrip antenna elements and arrays for aerospace applications mobile and satellite systems conical conformal microstrip tracking antenna and microstrip field diagnostics *Antenna Technology for Terahertz Wireless Communication* Uri Nissanov, Ghanshyam Singh, 2023-07-11 This book discusses terahertz THz wireless communication particularly for 6G enabling technologies including antenna design and channel modeling with channel characteristics for the success of reliable 6G wireless communication The authors describe THz microstrip antenna technologies with different substrates and introduce some useful substrates to reduce the conductor and substrate losses at the THz frequencies The discussion also includes the design of the THz unit cell microstrip antenna and the techniques to boost the microstrip antennas gain directivity and impedance bandwidth BW which influence the wireless communication range which is highly

affected by the path losses of atmospheric conditions and transmit and receive data rates respectively Moreover this book discusses the multi beam and beamforming THz antenna technologies with the multi user multiple input multiple output MU MIMO features Additionally this book describes the reconfigurable capabilities artificial intelligence machine learning and deep learning technologies that will influence the success of 6G wireless communication and the authors suggest a remedy for integrating multiple radios into the system on chip SoC design Issues in Applied Physics: 2011 Edition ,2012-01-09 Issues in Applied Physics 2011 Edition is a ScholarlyEditions eBook that delivers timely authoritative and comprehensive information about Applied Physics The editors have built Issues in Applied Physics 2011 Edition on the vast information databases of ScholarlyNews You can expect the information about Applied Physics in this eBook to be deeper than what you can access anywhere else as well as consistently reliable authoritative informed and relevant The content of Issues in Applied Physics 2011 Edition has been produced by the world s leading scientists engineers analysts research institutions and companies All of the content is from peer reviewed sources and all of it is written assembled and edited by the editors at ScholarlyEditions and available exclusively from us You now have a source you can cite with authority confidence and credibility More information is available at <http://www.ScholarlyEditions.com> **Microstrip Antenna Design** K. C. Gupta,Abdelaziz Benalla,1988 **Internet of Things Enabled Antennas for Biomedical Devices and Systems** Praveen K. Malik,Prasad N. Shastry,2023-04-30 The book consists of the latest research in biomedical and communication integration It discusses the fabrication and testing outcomes of the Internet of Things enabled biomedical applications The book focuses on recent advances in the field of planar antenna design and their applications in space communication mobile communication wireless communication and wearable applications Planar antennas are also used in medical applications in microwave imaging medical implants hyperthermia treatments and wireless wellness monitoring This book presents planar antenna design concepts methods and techniques to enhance the performance parameters and applications for IoT and device to device communication It provides the latest techniques used for the design of antennas in terms of their structures defected ground MIMO and fractal design This book also addresses the specific steps to resolve issues in designing antennas and how to design conformal and miniaturized antenna structures for various applications Antenna Handbook Y.T. Lo,S.W Lee,2012-12-06 Technology has advanced to such a degree over the last decade that it has been almost impossible to find up to date coverage of antennas Antenna Handbook edited by two of the world s most distinguished antenna specialists presents the most advanced antenna theory and designs and demonstrates their application in a wide variety of technical fields They offer a staggering amount of in depth data and analysis on a wide range of topics supported by formulas curves and results as well as derivations **Nanoferrites for Emerging Environmental Applications** Atul Thakur,Preeti Thakur,2024-09-25 Nanoferrites for Emerging Environmental Applications discusses the synthesis and structure of nanoferrites as well as their electrical optical and magnetic properties This book also provides a detailed discussion of the

use of nanoferrites for various environmental applications such as for water and air pollution detection and remediation This book covers almost every aspect of nanoferrites for environmental applications and will be of great use to researchers working in multidisciplinary areas Nanoferrites superior electronic optical and magnetic properties make them promising agents in a wide spectrum of applications After looking at the fundamentals of nanoferrites this book proceeds to analyze their application in a comprehensive range of environmental applications Topics covered include wastewater treatment the removal of heavy metal ions remediation of organic and inorganic pollutants and their use in the detection and remediation of both air and solid pollution Future opportunities for research are also addressed Focuses on nanoferrite applications for air and water pollution detection and remediation through purification Includes detailed synthesis procedures and advanced characterization methods for nanoferrites Explores ways that nanoferrites can be used in various environmental applications and then be recovered after use

Optical and Wireless Technologies Vijay Janyani, Ghanshyam Singh, Manish Tiwari, Tawfik Ismail, 2020-04-28 This volume presents selected papers from the 3rd International Conference on Optical and Wireless Technologies conducted from 16th to 17th March 2019 It focuses on extending the limits of currently used systems encompassing optical and wireless domains and explores the latest developments in applications like photonics high speed communication systems and networks visible light communication nano photonics wireless and MIMO systems The proceedings contain high quality scholarly articles giving insight into the analytical experimental and developmental aspects of systems techniques and devices in these spheres This volume will prove useful to researchers and professionals alike

Wideband, Multiband, and Smart Reconfigurable Antennas for Modern Wireless Communications Matin, Mohammad A., 2015-08-26 Modern society thrives on communication that is instant and available at all times a constant exchange of information that encompasses everything from video streaming to GPS navigation Experts even suggest that in the near future everything from our cars to our kitchen appliances will be connected to the internet a feat that would not be possible without advanced wireless technology Wideband Multiband and Smart Reconfigurable Antennas for Modern Wireless Communications showcases current trends and novel approaches in the design and analysis of the antennas that make wireless applications possible while also identifying unique integration opportunities for antennas and wireless applications to work together By featuring both theoretical and experimental approaches to integration this book highlights specific design issues to assist a wide range of readers including students researchers academics and industry practitioners This publication features chapters on a broad scope of topics including algorithms and antenna optimization wireless infrastructure development wireless applications of intelligent algorithms antenna architecture and antenna reconfiguration techniques

Space Antenna Handbook William A. Imbriale, Steven Shichang Gao, Luigi Boccia, 2012-05-02 This book addresses a broad range of topics on antennas for space applications First it introduces the fundamental methodologies of space antenna design modelling and analysis as well as the state of the art and anticipated future technological

developments Each of the topics discussed are specialized and contextualized to the space sector Furthermore case studies are also provided to demonstrate the design and implementation of antennas in actual applications Second the authors present a detailed review of antenna designs for some popular applications such as satellite communications space borne synthetic aperture radar SAR Global Navigation Satellite Systems GNSS receivers science instruments radio astronomy small satellites and deep space applications Finally it presents the reader with a comprehensive path from space antenna development basics to specific individual applications Key Features Presents a detailed review of antenna designs for applications such as satellite communications space borne SAR GNSS receivers science instruments small satellites radio astronomy deep space applications Addresses the space antenna development from different angles including electromagnetic thermal and mechanical design strategies required for space qualification Includes numerous case studies to demonstrate how to design and implement antennas in practical scenarios Offers both an introduction for students in the field and an in depth reference for antenna engineers who develop space antennas This book serves as an excellent reference for researchers professionals and graduate students in the fields of antennas and propagation electromagnetics RF microwave millimetrewave systems satellite communications radars satellite remote sensing satellite navigation and spacecraft system engineering It also aids engineers technical managers and professionals working on antenna and RF designs Marketing and business people in satellites wireless and electronics area who want to acquire a basic understanding of the technology will also find this book of interest

Nano Dielectric Resonator Antennas for 5G Applications Rajveer S. Yaduvanshi, Gaurav Varshney, 2020-05-26 We are always surrounded by electromagnetic waves and fields of various spectra This book explains basic electromagnetic theory with the help of design formulations i e mathematical background on antennas along with experimentations which has made this book unique The main purpose of this book is to embed mathematical EM theory of dielectric resonator antennas with experimental validation so that understanding of concepts takes place Initially basic understanding of philosophy of dielectric resonators has been discussed then it is supported with mathematical modeling and later same is implemented with its prototype model along with experimentations The modes theory gives important analysis on currents distribution impedance analysis and radiation pattern in DRA Circular polarization can built signal robustness case studies on circular polarization has been included Equivalent RLC circuit concept has been introduced Challenges of switching from microwave to terahertz has been briefly discussed Nano DRA will revolutionize the wireless technology Nano DRA Terahertz DRA and Quantum DRA have analyzed and studied

Emerging Innovations in Microwave and Antenna Engineering Zbitou, Jamal, Errkik, Ahmed, 2018-10-12 Continuing advancements in electronics creates the possibility of communicating with more people at greater distances Such an evolution calls for more efficient techniques and designs in radio communications Emerging Innovations in Microwave and Antenna Engineering provides innovative insights into theoretical studies on propagation and microwave design of passive and active

devices The content within this publication is separated into three sections the design of antennas the design of the antennas for the RFID system and the design of a new structure of microwave amplifier Highlighting topics including additive manufacturing technology design application and performance characteristics it is designed for engineers electricians researchers students and professionals and covers topics centered on modern antenna and microwave circuits design and theory

Electromagnetic Fields Jean G. Van Bladel, 2007-05-23 Professor Jean Van Bladel an eminent researcher and educator in fundamental electromagnetic theory and its application in electrical engineering has updated and expanded his definitive text and reference on electromagnetic fields to twice its original content This new edition incorporates the latest methods theory formulations and applications that relate to today s technologies With an emphasis on basic principles and a focus on electromagnetic formulation and analysis *Electromagnetic Fields Second Edition* includes detailed discussions of electrostatic fields potential theory propagation in waveguides and unbounded space scattering by obstacles penetration through apertures and field behavior at high and low frequencies

Microwave Integrated Circuits Based on Spoof Surface Plasmon Polariton Shibani K Koul, Somia Sharma, 2025-07-19 This book bridges the gap between the conventional technology based on microstrip transmission line and futuristic technology based on Spoof Surface Plasmon Polariton based transmission line This book covers in detail the study of different components such as filters power dividers and antennas etc using Spoof Surface Plasmon Polariton This book also focusses on the study of SSPP technology for biomedical applications Textile and Flexible antennas are gaining popularity these days because of their applications in defence and daily use gadgets These important aspects are also studied in this book using SSPP technology

International Conference on Intelligent Computing and Smart Communication 2019 Geetam Singh Tomar, Narendra S. Chaudhari, Jorge Luis V. Barbosa, Mahesh Kumar Aghwariya, 2020-01-07 This book gathers high quality research papers presented at the First International Conference ICSC 2019 organised by THDC Institute of Hydropower Engineering and Technology Tehri India from 20 to 21 April 2019 The book is divided into two major sections Intelligent Computing and Smart Communication Some of the areas covered are Parallel and Distributed Systems Web Services Databases and Data Mining Applications Feature Selection and Feature Extraction High Performance Data Mining Algorithms Knowledge Discovery Communication Protocols and Architectures High speed Communication High Voltage Insulation Technologies Fault Detection and Protection Power System Analysis Embedded Systems Architectures Electronics in Renewable Energy CAD for VLSI Green Electronics Signal and Image Processing Pattern Recognition and Analysis Multi Resolution Analysis and Wavelets 3D and Stereo Imaging and Neural Networks

Proceedings of Second International Conference on Computational Electronics for Wireless Communications Sanyog Rawat, Sandeep Kumar, Pramod Kumar, Jaume Anguera, 2023-01-27 This book includes high quality papers presented at Second International Conference on Computational Electronics for Wireless Communications ICCWC 2022 held at National Institute of Technology Surathkal Karnataka India during June 9 10 2022 The book presents original

research work of academics and industry professionals to exchange their knowledge of the state of the art research and development in computational electronics with an emphasis on wireless communications The topics covered in the book are radio frequency and microwave signal processing microelectronics and wireless networks

Sustainable Energy and Fuels Piush Verma,Ahmed Boubakeur,Leila Mokhnache,Balwinder Raj,2024-10-30 Sustainability refers to the concept that all people should be able to meet their basic needs indefinitely without compromising future generations Sustainability in terms of energy embraces the same principles One day the world will run out of fossil fuels We need to realize how important sustainable energy is and its significance when it comes to the future of our planet Sustainable energy includes any energy source that cannot be depleted and can remain viable forever It does not need to be renewed or replenished sustainable energy meets our demand for energy without any risk of failing or running out This is why sustainable energy is the answer to our energy needs Furthermore sustainable energy doesn't harm the environment or at most there is a minimal risk increase climate change or cost a heavy price Although there is a cost associated with creating and building ways to capture sustainable energy the energy sources themselves are typically free The main objective of this book is to provide an up to date review of conduction mechanisms structure construction operation performance evaluation and applications of various renewable energies and fuels The current trend in innovation is likely to explore the potential to connect novel materials design methods and new techniques which would allow us to maintain existing resources and develop new methods by employing smart technologies This book provides a complete insight into recent advancements in nanomaterials renewable energy design and applications The purpose of this book is to provide relevant theoretical frameworks that include materials modeling circuit design and the latest developments in experimental work in the field of renewable energy and fuels This book Presents solar energy conversion including photovoltaics and artificial photosynthesis Discusses important topics such as energy management standards biofuels biorefining and capacitive desalination Illustrates the importance of novel materials and process improvements for sustainable energy and fuels Includes research problem statements with specifications and commercially available industry data Covers catalysis for energy technologies including the sustainable synthesis of fuels and chemicals molecular and bioinspired catalysis The text is primarily written for senior undergraduates and graduate students and academic researchers in the fields of electrical engineering electronics and communication engineering environmental engineering and renewable energy

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 Electromagnetic Metamaterials and Metasurfaces: From Theory To Applications
Long Li,Yan Shi,Tie Jun Cui,2024-02-18 The subject of this book is the fast developing area of research known as metamaterials metasurfaces and some of their engineering applications This book comprehensively presents the state of the art of metamaterials metasurfaces from theory to applications The theoretical side includes electrodynamics of left handed medium generalized Snell s law digital coding metamaterials metasurfaces group theory of metamaterials information metamaterials and metasurfaces etc On the application side a wide range of design examples are discussed including metamaterial antennas electromagnetic interference frequency selective surfaces wireless power transmission and energy harvesting cloaking and radar cross section reduction orbital angular momentum wireless communication imaging etc The book provides researchers engineers and graduate students with a variety of new discoveries results information and knowledge in the field of metamaterials and metasurfaces

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