International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161
Available at http://inpressco.com/category/ijcet

Research Article

Design of Microstrip Rectangular Patch Antenna Operating in MICS Band for Biomedical Applications

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Accepted 31 May 2015, Available online 03 June 2015, **Vol.5, No.3 (June 2015)**

Abstract

This paper presents microstrip patch antenna with microstrip feed, operating in medical implant communications service (MICS) band (402 – 405MHz). The proposed antenna has a simple rectangular structure is made up of FR4 substrate having dielectric constant 4.4 and conductivity 4.9 x 10^7. The antenna structure is simulated using IE3D software and significant antenna designed parameters are also studied. Simulatation result shows that the proposed structure covers MICS band with center frequency at 403MHz. Because of its rectangular structure the proposed antenna is very simple to design, fabricate and analyze when compared to the existing antennas (spiral, fractal etc) which require heavy numerical computations. The dimension of antenna is further miniaturized by using substrate of high dielectric constant like silver.

Keywords: *MICS band, microstrip antenna, microstrip feed, rectangular patch, dielectric constant, conductivity, implantable medical device.*

1. Introduction

Biomedical implantable devices have played a crucial role in continuous remote monitoring of significant physiological parameters, like ECG signals, sugar level, blood pressure etc. By collecting these parameters, with proper out of body recording system, the important biological signals can be transmitted to remote health centre. Thus the related person can gain effective treatment timely. In any implantable system, the antenna acts as a very important part to connect patient's information with the health centre The microstrip patch antenna is a narrowband, wide-beam antenna fabricated by etching the antenna element pattern in metal trace bonded to an insulating dielectric substrate, such as a printed circuit board, with a continuous metal layer bonded to the opposite side of the substrate which forms a ground plane. Some patch antennas do not use a dielectric substrate and instead are made of a metal patch mounted above a ground plane using dielectric spacers. Common microstrip antenna shapes are square, rectangular, circular and elliptical, but any continuous shape is possible. Some patch antennas do not use a dielectric substrate and instead are made of a metal patch mounted above a ground plane using dielectric spacers; the resulting structure is less rugged but has a wider bandwidth. Because such antennas have a very low profile, are mechanically rugged and can be shaped to conform to the curving skin of a vehicle, they are often mounted on the exterior of aircraft and spacecraft, or are incorporated into mobile radio communications devices. Microstrip antennas are relatively inexpensive to manufacture and design because of the simple 2-dimensional physical geometry. They are usually employed at UHF and higher frequencies because the size of the antenna is directly tied to the wavelength at the resonant frequency.

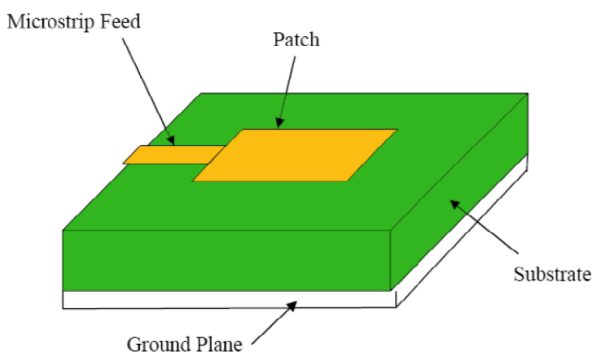

Figure 1 Microstrip Line Feed

According to the recommendation of ITU – R, MICS band is allocated to biotelemetry applications. Several studies are going on in designing miniaturized antenna

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operating in MICS band (402 – 405 MHz). It allows bi-directional communication with electronic implanted devices. The maximum transmit power requirement at this band is very low, about 25 microwatt. This reduces the risk of interference with other users of the same band. The maximum used bandwidth at a time is 300 KHz, which makes it a low bit rate system compared with Wi-Fi or Bluetooth. The main advantage of using this band is the additional flexibility compared to previously use inductive technologies, which required the external transceiver to touch the skin of the patient.

2. Related Works

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3. Proposed Antenna and Simulated Results

Major challenge in designing implantable antenna, which is the most crucial component to transfer important biomedical signals, is the antenna size. For the realization of small size implantable antennas many works are going on. Most of the available structures are complex (like spiral, helical, rectangular spiral, and fractal) and inherently very difficult to design and implement. Complex mathematical calculations are involved in analysing these structures.
In this paper we propose a microstrip rectangular patch antenna. First we have simulated our structure by considering FR4 substrate having dielectric constant 4.4. We consider substrate height of 1.6 mm. The dimensions of the patch and the ground plane are calculated using common mathematical formulas of microstrip antenna. But the simulation result in IE3D platform using exact calculated result was unable to cover the MICS band. Therefore some modifications are done on the calculated dimensions. Finally we have used antenna structure with ground plane having dimension of 240 x 335 mm^2 and patch having dimension of 228 x 280 mm^2. The simulation result shows that the antenna covers the desired MICS band (402 – 405 MHz) with the centre frequency of 404MHz. The proposed structure is shown in Fig. 2 and the simulation result is shown in Fig. 3.

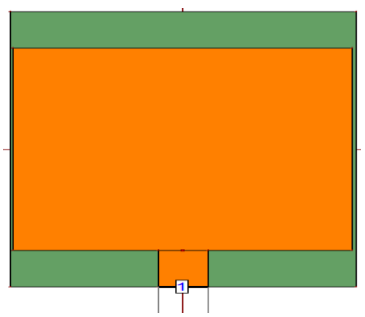

Figure 2: Proposed antenna structure

3. Placing the tables

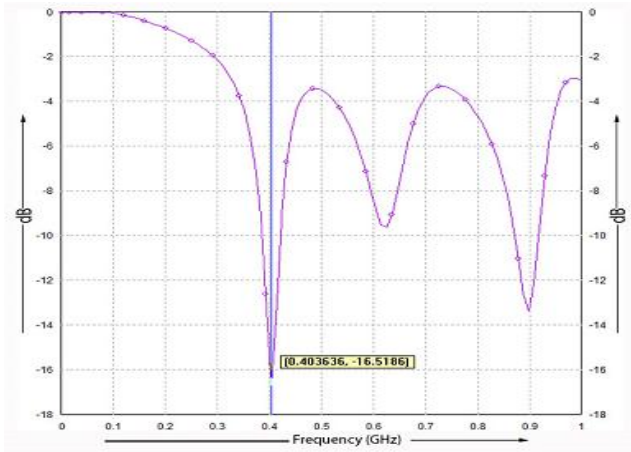

Figure 3 Antenna performance using FR4 substrate

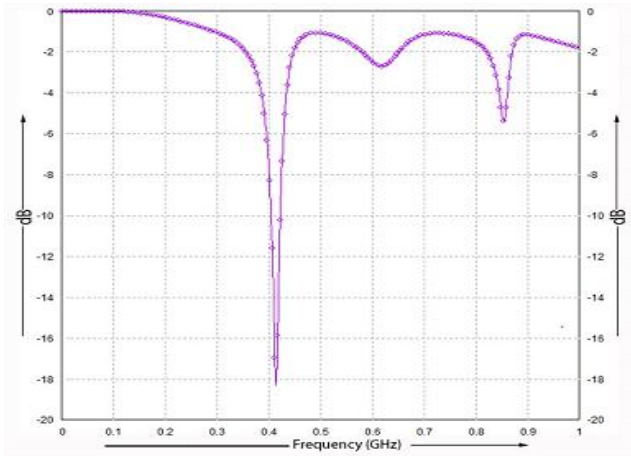

Figure 4

Conclusions

In general, Microstrip patch antenna is easy to design and implement due to its sensitivity at high gain but it is difficult to design in MICS band. However, Microstrip patch antennas give high directivity, high gain and antenna efficiency. This antenna design can be very helpful in the communication system for many applications in fields such as biomedical example-pacemaker. The demand for narrowband antenna is increasing day by day. To meet with these increasing demands, more efficient antennas such as Microstrip patch antennas are required.

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