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

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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 10⁷. The antenna structure is simulated using IE3D software and significant antenna designed parameters are also studied. Simulation 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](image)

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

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.

3. Placing the tables

Table 3 Antenna performance using FR4 substrate

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.

References

A. A. Y. Ibraheem and M. Manteghi (2014) Performance of an
implanted electrically coupled loop antenna inside human
body, Progress In Electromagnetics Research, Vol. 145, 195-
202.

beam textile antenna (SBTA) for outdoor wireless body
area network (WBAN) applications. Progress In

Zhu Duan, Yong Xin Guo, Rui – feng sue et al. (2012)
Differentially fed dual band implantable antenna for
biomedical applications, *IEEE Transactions on Antenna and Wave propagation*.


