Chapter 1
A Via-Based Rectangular Patch Antenna for Narrow Band IoT Applications

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ABSTRACT

A simple asymmetric rectangular patch antenna has been projected for narrowband internet of things applications. A new via-based technique has been proposed to realize its bandwidth and increase the amount of transmitting power. And tuning aspects of this antenna has been explained for the radius of the copper via conductor. FR4 material has been utilized as dielectric material with loss tangent 0.02 with an effective dielectric constant of 4.259, and its performance has been explained under the different radius of the copper via. The designed antenna has a resonating frequency at 857.00 MHz, 879.00 MHz, 888.00 MHz, and 904.00 MHz at a different radius of the via with the bandwidths of 32.50 MHz, 29.40 MHz, 28.00 MHz, and 20.50 MHz. The proposed antenna has been simulated using HFSS and FEKO EM simulation tools.

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INTRODUCTION

Antennas becoming more popular when technology becomes increases to fulfill the requirements (H. Klaina, B. Ratni, A. V. Alejos, O. Aghzout and S. N. Burokur, 2019). In narrow band internet of things field the main issue of the designing antennas is size, since these antennas are majorly operating at 840 MHz -960 MHz as per basic antenna theory if frequency decreases geometry of the antennas becomes larger (M. Sanad and N. Hassan, 2019). To reduce its volume the best method is to create its dimensions as per the theory and reduce by adopting some technique such as inverted F antennas, substrate integrated waveguide antennas, co-planar waveguides etc. But construction of those antennas is highly difficult. Since the dimensions of the via integrating at mm range is still many industries still did not adopt to implement such antennas. Hence the requirement is to design an antenna for narrow band applications with ease fabrication complexity is needed. For offering narrow band performance patch antennas are well known and best solution at any wavelength on the microwave spectrum.

In antennas dielectric medium always occupies more volume. Because the volume of the dielectric medium is directly proportional to its radiating frictional bandwidth. So, if the requirement is large bandwidth, then compromise on the total antenna volume will take place. But narrowband antennas are exempt from the large bandwidth. Therefore, patch antennas have been chosen for implanting at the desired frequency. For implementing dielectric medium there are many materials are available in the market such as RT Droid, ceramic and FR4, etc. based on substrate loss tangent the material for the dielectric medium will be chosen. FR4 material has a loss tangent of 0.02 and RT Duriod has 0.0009. For this antenna FR4 material has been consider even though its loss tangent is worse than RT duirod based on its cost consideration. In many research papers, it has found that below 5 GHz FR4 can be used but if the desired frequency is above 5GHz then RT Duriod will be the best option (M. Raveendra, U. Saravanakumar, G. A. Kumar, P. Suresh and S. P. D. Pedapalli, 2021). Since when frequency increases substrate loss becomes large so FR4 materials cannot sustain or stable at high frequencies especially at X- band, Ku, and Ka-band applications (S. Ha, H. Seo, Y. Moon, D. Lee and J. Jeong, 2018).

The proposed antenna is covering the frequency from range 879.00 MHz to 904.00 MHz in microwave circuits the main problem is the simulation results are not exactly same as the results of the measures. So, sometimes it required to tune the antennas to the desired wavelength. And also, the simulation tools such as HFSS, IE3D, FEKO, etc will not consider the environmental effects. So, it is better to have a tuning technique whenever a microwave circuit has implemented (Y. Wang, Y. Li and Q. Zhu, 2017). Therefore, a copper via has been integrated to achieve the tuning. For narrowband operation, the tuning range would be less compared to