Chapter 5
Design and Implementation of a Low-Profile Patch Antenna for Industrial NB-IOT Applications

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ABSTRACT

For the requirement of NB-IOT applications, rectangular micro strip slot antennas have been developed with sufficient bandwidth of 112.5 MHz. The above 50% size of the antennas has been reduced by making multiple rectangular slots on the patch surface. Fr4 material has been utilized as a dielectric substrate. The position of the transmission line has been varied to match the perfect impedance matching.

DOI: 10.4018/978-1-7998-9315-8.ch005

The proposed antenna model has been simulated on HFSS software. To check the practical behavior of the designed antenna, it has been fabricated and tested by using vector network analyzer. The proposed antenna has resonance frequency band from 1718.75 MHz – 1831.25 MHz with minimum return loss performance as below -20 dB.

INTRODUCTION

The technology, Narrowband Internet of Things (NB-IOT) becoming famous to full fill the requirement of smart industries, automation sector, smart intelligence and remote sensing domains. Hence the demand of antennas is becoming increasing to operate at different frequency bands of NB-IOT such as 1710 MHz to 1780 MHz, 824 MHz to 849 MHz and 880 MHz to 915 MHz. In this work, a micro strip patch antenna with multiple slots on patch has been proposed to resonate at frequency band 1718 MHz – 1831 MHz.

In recent time many researchers proposed different types antenna prototypes for the requirement of NB-IOT applications. The main problem is facing by researches is size of the antennas. In (Zhuo et al., 2020) the authors achieved dual band characteristics by introducing U – shaped slot on the patch surface but the dimensions of the antennas length and width is 85 mm x 85 mm. in this work, rectangular slots were introduced to reduce the size of the antenna about 52% than (Zhuo et al., 2020). For real time applications of NB-IOT, the significant challenge is to reduce the size of the antenna.

Many antennas such as array antennas substrate integrated waveguide antennas can fulfill the performance requirements of NB-IOT applications. But designing such antennas at 1.755 GHz required higher dimensions. As well design and fabrication of those antennas are much complex. By changing the position of the transmission line, we can easily match the impedance requirement in micro strip antennas (Li et al., 2013; Li et al., 2016; Pan et al., 2005). Micro strip antennas also offer low profile properties at microwave frequencies. Micro strip antennas are simpler for designing (Chen et al., 2017) at any simulation tool with narrow band characteristics (Li et al., 2013). Adjustment of slot on the patch surface will make antenna to resonate at desired frequency.

For design of substrate Fr4 material has been considered with dielectric constant 4.4. Since the material FR4 is relatively cheaper than other dielectric materials (Chair et al., 2005).