

Design of a 377Ω Patch Antenna for Ambient RF Energy Harvesting at Downlink Frequency of GSM 900

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Abstract- A novel 377Ω patch antenna operating at GSM 900 downlink band for RF energy harvesting is proposed and analyzed in this paper. The designed antenna consists of a normal patch with two steps incorporated at the appropriate position to enhance its bandwidth. The antenna is designed and tested in Agilent advance design systems ADS environment and constructed on a FR4 substrate. The antenna yields an impedance bandwidth of 34.35% (325 MHz) at 946 MHz centre frequency with a return loss S_{11} of -29.22dB and gain of 5.2 dBi. The proposed patch antenna is suitable for ambient RF energy harvesting at downlink frequency band of GSM 900 as demonstrated by simulation and experimental results. The measured results closely agree with the simulated results.

Index terms: GSM 900, Stepped patch antenna, ADS, impedance bandwidth, return loss.

I. INTRODUCTION

Patch antennas offer effective low-profile designs for a wide range of wireless applications due to them being inexpensive to fabricate, suitable for high frequency applications and support multiple function circuits. But they have a main disadvantage of narrow bandwidth. This problem has been addressed by researchers and many configurations have been proposed in bandwidth enhancement. Several types of patch antennas such as L-shape, U-shape, star shaped with posts, E-shape, circular patch with H shaped slot, stepped patch with multiple resonators and square shaped have been designed at frequencies in the 900MHz, 2.4GHz, 4GHz, 5GHz and 6GHz regions [1-12] focusing on

bandwidth enhancement. In this paper, a wideband stepped patch antenna is designed and implemented with GSM RF ambient frequency harvesting in mind. Special feature of the design is the impedance, i.e. free space, matching network design, ground plane technique and frequency of operation, where all of these features differs from [1-12]. The antenna design is described in Section II. Section III presents the results of simulation, measurement and field test whereas Section IV concludes the findings from the work.

II. ANTENNA DESIGN

A novel 377Ω stepped patch antenna with edge feeding technique desirable for RF energy harvesting is presented. The proposed antenna geometry is shown in Fig.1, which is printed on the FR4 substrate with the thickness of 1.6 mm and dielectric constant of 3.9. The structure of the patch antenna and the pi matching network is printed on one side of the FR4 substrate with the unique partial ground plane on the other side. The patch antenna's width and length are denoted by "W" and "L" respectively and the two steps on the patch antenna are denoted by "S1" and "S2". The three components of the pi matching network are represented by L1, L2 and L3 respectively. The partial ground plane is denoted by "G1" and "Gw". An edge feed line technique is used to feed the stepped patch antenna. Wide bandwidth can be realized by appropriately adjusting the parameters of the antenna.