A novel S-shaped frequency and pattern reconfigurable patch antenna for 4G LTE, WLAN/Wi-Max application

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Abstract

Purpose

In wireless communication system, use of multiple antennas for different requirements of system will increase the system complexity. However, reconfigurable antenna is maximizing the connectivity to cover different wireless services that operate different frequency range. Pattern reconfigurable antenna can improve security, avoid noise and save energy. Due to their compactness and better performance at different applications, reconfigurable antennas are very popular among the researchers. The purpose of this work, is to propose a novel design of S-shaped antenna with frequency and pattern diversity. The pattern and frequency reconfiguration are controlled via ON/OFF states of the PIN diode.

Design/methodology/approach

The geometrical structure of the proposed antenna dimension is $18 \times 18 \times 0.787$ mm^3 with εr = 2.2 dielectric constant. Three S-shaped patches are connected to a ring patch through PIN diodes. The approximate circumference of ring patch is 18.84 mm and length of patch is 5 mm, so approximate length of radiating patch is 14.42 mm and effective dielectric constant is 1.93. Conductor backed coplanar waveguide (CPW) is used for feeding. The proposed antenna is designed and simulated on CST microwave studio and fabricated using photolithography process. Measurements have been done in anechoic chamber.

Findings

Antenna shows the dual band operation at 2.1 and 3.4 GHz frequency. The first band remains constant at 2.1 GHz resonant frequency and 200–400 MHz impedance bandwidth. Second band is switched at seven different resonant frequencies as 3.14, 3.45, 3.46, 3.68, 3.69, 3.83 and 3.86 GHz with switching of the diodes. The −10 dB bandwidth is

more than 1.4 GHz.

Research limitations/implications

Pattern reconfigurability can be achieved using mechanical movement of antenna easily but it is not a reliable approach for planar antennas. Electronic switching method is used in proposed antenna. Antenna size is very small so fabrication is very crucial task. Measured results are deviated from simulation results due to fabrication error and effect of leads of diodes, connecting wires and battery.

Practical implications

The reconfiguration of the proposed antenna is controlled via ON/OFF states of the three PIN diodes. The lower band of 2.1 GHz is fixed, while second band is switched at five different resonant frequencies as 3.27, 3.41, 3.45, 3.55 and 3.88 GHz, with switching of the PIN diodes with all state of diodes and exhibit pattern reconfigurability at 2.1 GHz frequency. At second band center frequency is significantly changed with state of diodes and at 3.4 GHz pattern is also changed with state of diodes, hence antenna exhibits frequency and pattern reconfigurability.

Originality/value

A novel design of pattern and frequency reconfigurable antenna is proposed. Here, work is divided into two parts: first is frequency reconfiguration and second is radiation pattern reconfiguration. PIN diodes as switch are used to select the frequency band and reconfigure the radiation pattern. This proposed antenna design is novel dual band frequency and pattern reconfigurable antenna. It resonates at two distinct frequencies, i.e. 2.1 and 3.4 GHz, and has a pattern tilt from 0° to 355°. The conductor backed CPW feed technique is used for impedance matching.

Keywords

Pattern reconfigurable | Frequency reconfigurable | Conductor backed CPW

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