Frequency Reconfigurable Microstrip Antenna in Mobile Phone

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Abstract
In this paper, simulation, fabrication and measurement of a simple reconfigurable microstrip slot antenna for wireless network application are proposed and investigated. In this design, the radiating part consists of a C shaped slot and switches along the length of the slot stimulated with microstrip line feed. Tuning is carried out via switches located in appropriate positions in the line feed. The design is proposed for hepta-band frequencies including GSM900, GPS 1500, GSM1800, PCS1900, UMTS 2100, Bluetooth 2400, Wimax 5200, respectively. Experimental results show that this antenna has good performance in mobile devices.

Keywords
Microstrip Antenna, mobile, frequency reconfigurable

1. Introduction

Today, researchers are looking for very simple structures that have comfortable design and efficiency as well as low cost. The antenna proposed in this paper has these characteristics in order to be used in wireless communications, instead of using multiband antennas leading to occupied frequency bandwidth and high cost filtering for separating frequency bands. Several bands are integrated using reconfigurable techniques in mobile phone. The reconfigurable microstrip slot antenna proposed in this paper may cover hepta-band in mobile applications. Resonance depends on the length of slot [1]; thus, generating different resonances is possible by changing the position of switches on the slot and feed [2, 4].When the slot is longer, the antenna resonance happens at a lower frequency. To adjust a higher frequency, the length of the slot must be shorter. in this paper, the slot's length takes values 133 mm, 99 mm, 88 mm, 85 mm, 79 mm , 75 mm, 54 mm, for resonance to happen in 900 MHz 1500 MHz 1800 MHz , 1900 MHz 2100 MHz , 2400 MHz and 5300 MHz, respectively.

2. Antenna design

Figure 1, 2 shows the geometry of the microstrip slot antenna. The substrate is roogers4003 with dielectric constant of 3.38, h=20 mil. The size of the antenna is 90mm∗90mm. The top of substrate is grounded by the C shaped slot and its bottom is fed by the microstrip line [2, 3]. The antenna has been simulated in Ansoft HFSS .Twelve pin diodes of hsmp4820 are used in the antenna, located on the switch positions. Two isolated DC-bias networks are required to control the state of the pin diode; when a forward bias is applied to the diode, the diode is on, acting as a resistance of 2.5 Ω and when the bias is reversed, the diode acts as a capacitance of 0.33 pf. According to table I and switches states, the antenna radiates in different frequency bands.

Table I: switches condition (0=Off, 1=On)

DIODE	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12
GSM900	0	0	0	0	0	0	1	1	1	1	1	1
GPS1500	1	0	0	0	0	0	0	1	1	1	1	1
GSM1800	0	1	0	0	0	0	1	0	1	1	1	1
PCS1900	0	0	1	0	0	0	1	1	0	1	1	1
UMTS2100	0	0	0	1	0	0	1	1	1	0	1	1
Bluetooth2400	0	0	0	0	1	0	1	1	1	1	0	1
Wimax5200	0	0	0	0	0	1	1	1	1	1	1	0

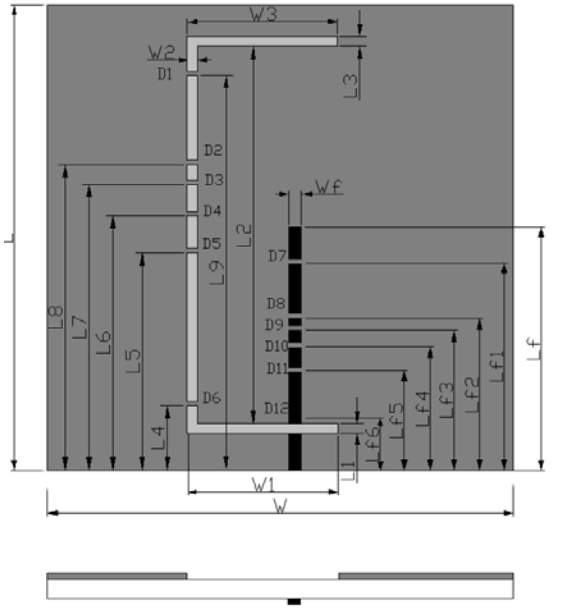

Fig.1. Configuration of the proposed antenna fed by a 50- microstrip line.

L =90, L1=2, L2=75, L3=2, L4=18, L5=44, L6=49, L7=55, L8= 59, L9=70, W =90, W1= 29, W2=2, W3=29, Wf = 2.4, Lf=47, Lf1=32, Lf2=30, Lf3=29, Lf4=26, Lf5=24, Lf6=10 (unit mm).

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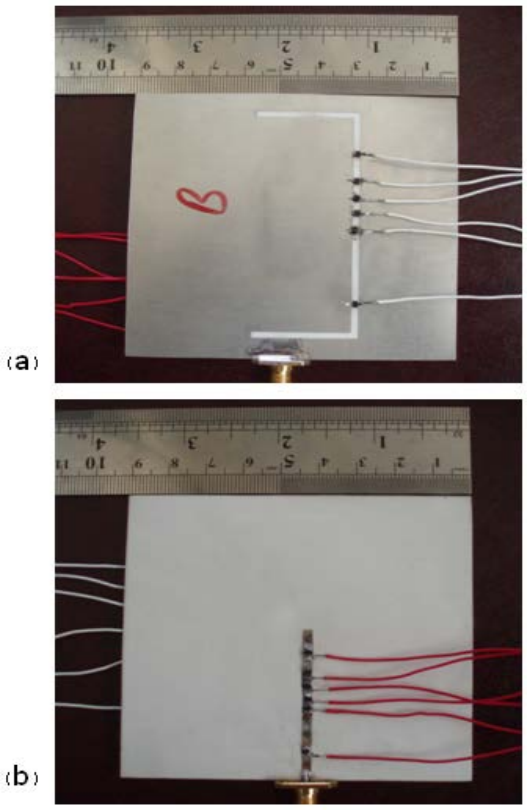


Fig.2. Photograph of fabricated prototypes.

3. Result of experiment

The return loss was measured with an Agilint hp8720b network analyser and the radiation patterns were tested in the anechoic chamber at the Laboratory of Antennas. Fig. 3 shows the measured return loss of the proposed antenna, together with the simulated one. As can be seen, there is a reasonable agreement between the measured and simulated results. In simulation, the first band resonant frequency is located about 900MHz (865 to 921MHz), with %6 impedance bandwidth. The second band resonant frequency is located at about 1500 MHz, (1350 to 1640 MHz) with %15.5 dB impedance bandwidth. The 3th band resonant frequency is located at about 1800 MHz (1630 to 1910 MHz), with %6.5 impedance bandwidth. The 4th band resonant frequency is located at about 1900MHz (1810 to 2070 MHz), with %13.6 impedance bandwidth. The 5th band resonant frequency is located at about 2100MHz (2020 to 2500 MHz), with %10.6 impedance bandwidth. The sixth band resonant frequency is located at about 2400MHz (2270 to 2500 MHz), with %9.5 impedance bandwidth. The seventh band resonant frequency is located at about 5200MHz (5190 to 5400 MHz), with %4.1 impedance bandwidth. Designed antennas are at 900, 1800, 1900, 2100, 2400 and 5200MHz respectively. The measured and simulated results show in figure3.

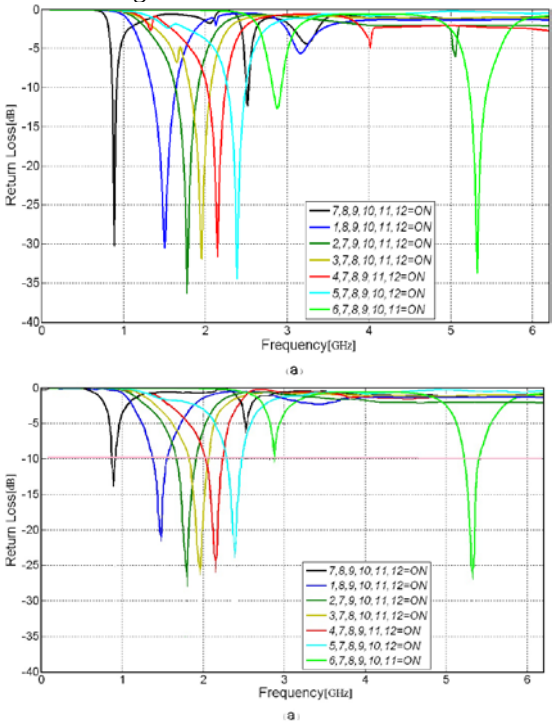
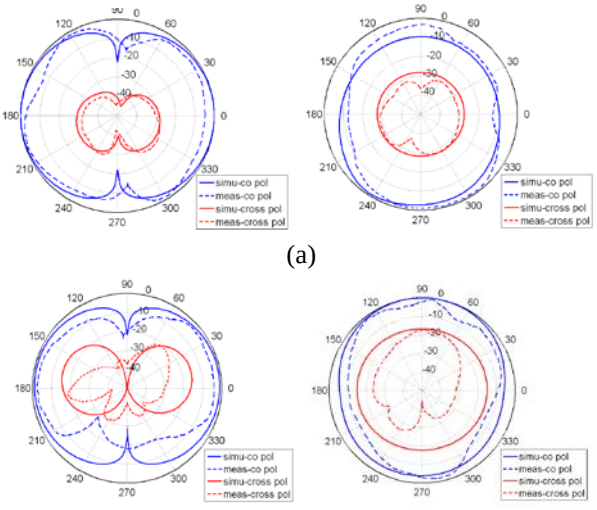


Fig.3. (a) Simulated return loss for seven resonance frequencies of 900, 1500, 1800, 1900, 2100, 2400, 5200MHz. (b) Measured return loss for the seven resonance frequencies.

Figure 4 presents the measured co-polarization and cross-polarization far-field radiation patterns. Radiation patterns are bidirectional in the E-plane and nearly Omni-directional in the H-plane



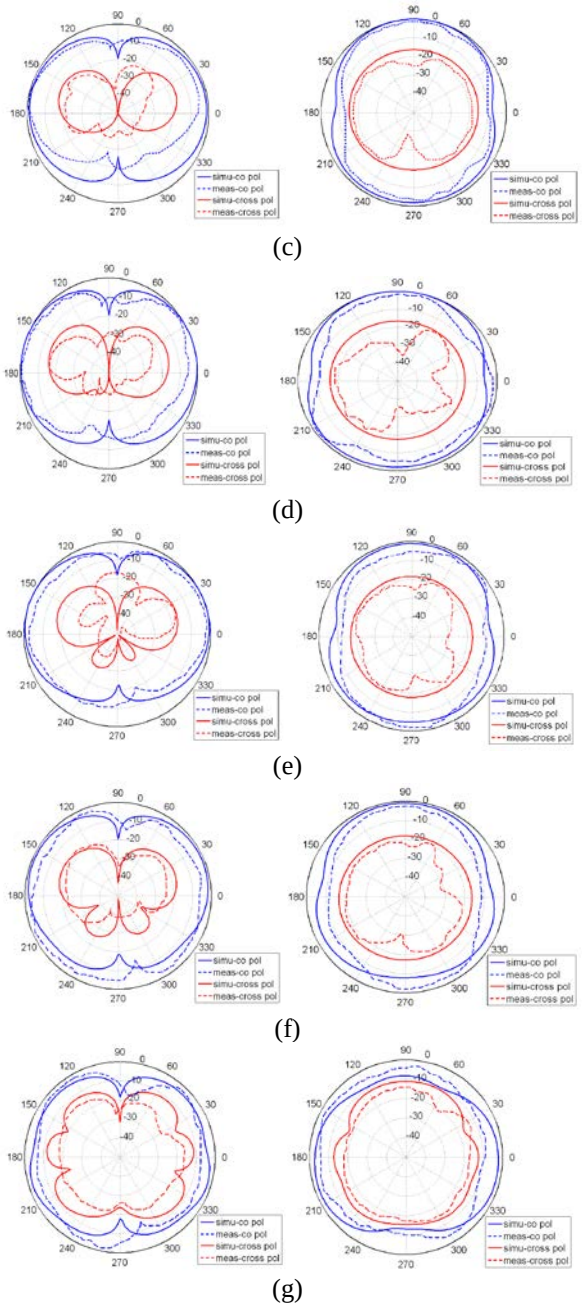


Fig.4. Measured radiation patterns for the proposed antenna at (a) 900 MHz, (b) 1500 MHz, (c) 1800 MHz, (d) 1900 MHz, (e) 2100 MHz, (f) 2400 MHz, (g) 5200 MHz

4. Conclusions

A microstrip-line fed slot antenna for mobile application in hepta-band has been proposed and implemented, introducing a C-shaped slot to the antenna. The proposed antenna may generate impedance bandwidths for the 900 MHz band. Reconfigurable Frequencies are obtained by using switches placed through the slot and feed for1500 MHz, 1800 MHz, 1900 MHz, 2100 MHz, 2400 MHz, 5200MHz, respectively. Radiation pattern in operating frequencies across the hepta- bands can also be obtained.

References

[1] Dimitrios Peroulis, Kamal Sarabandi ,Lind P.B .Katehi , “Design of Reconfigurable Slot Antennas”IEEE Transaction on Antennas and Propagation, Vol.53, No.2, Fabruary 2005.

[2] Berdi A. Cetiner, Gemma Roqueta Crusats , Lluis Jofre, Necmi Biyikli, “RF MEMS Integrated Freqency Reconfigurable Annular Slot Antenna” IEEE Transaction on Antennas and Propagation, Vol.58, No.3, March2010.

[3] Markus Berg, Mikko Komulainen, Erkki Salonen, Heli Jantunen “Frequency Reconfigurable Microstrip-Fed Annular Slot Antenna” IEEE,November 2006.

[4] Panagmua,C.J.Churaya, A.,andVardaxoglou,J.C.,”Frequency and beam reconfigurable antenna using photo contacting switch ”IEEE Transaction on Antennas and Propagation, Vol.54, pp.449-454, February 2006.