Design Of A Dual Band GSM Micro-Strip Patch Antenna

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Abstract: New design of obtaining a dual frequency bands antenna operate on the dual frequency bands of the Global System for Mobile Communications (GSM) (Lower band = 900 MHz, Upper band = 1.9 GHz) with a single-feed square micro-strip antenna are proposed and experimentally studied. The proposed designs are based on the same patch dimensions configured with one rectangular slot in the form of cut inside the square patch antenna with different dimensions. The result of this work shows that the slot loaded into the square patch antennas offers further size reduction with multiband properties that can be used in GSM applications. Details of the design considerations of the proposed antenna are described, and experimental results of the obtained dual-band GSM performance are presented and discussed.

Index Terms: Micro-strip Antenna, Dual band, GSM Applications.

1 Introduction

Modern wireless communication systems and increasing of other wireless applications requires low cost and high performance multiband antennas. The demand for high performance multi-standard communication systems has led the antenna research and studies in various directions; one of them is the design of multiband micro-strip patch antennas [1, 2]. Systems such as Global System for Mobile Communications (GSM) and global position system (GPS) are required to operate at two different frequencies apart too far from each other. Micro-strip antennas can avoid the use of two different single band antennas. Variety of methods has been proposed to obtain dual frequency operation. Among them, loading slits [3], using slots in the patch [4], [5], loading the patch with shorting pins [6]-[8], using stacked patches [9]-[12], or using two feeding ports [13] are the mostly exploited ones. In addition, there are planar antennas of special geometries to achieve dual-band operation [14]. This paper has introduced and investigated the design of a multiband micro-strip antenna by studying the effect of loading rectangular slot with different dimensions inside a square MSA.

2 Results

In this paper, a square MSA with a patch size of (90 x 90 mm) designed to operate on the lower GSM frequency band (900 MHz), and then the square MSA is configured with one rectangular slot in the form of cut inside the square patch antenna as shown in Fig. 1. Length and width of the slot have been changed in order to achieve the desired performance. The proposed micro-strip patch antenna has been designed and simulated using Microwave Office simulation package.

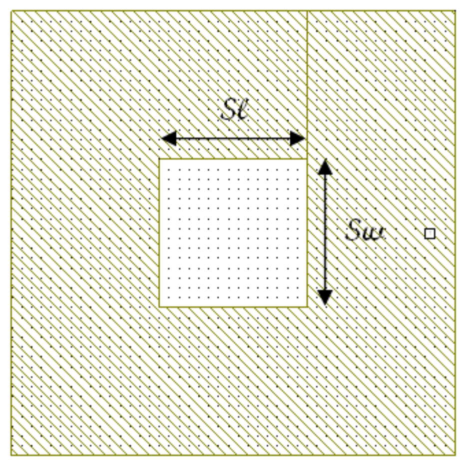

Fig. 1 Square MSA configured with one rectangular slot cut inside the patch

Where Sl is the slot length, and Sw is the slot width. Cross-linked polystyrene-glass with dielectric constant 2.62 has been used in the design of the antenna with height (h) of 5.95 mm. The antenna was fed with probe feed, the probe feed position (Xf = 40, Yf = 0 mm) was chosen in order to provide a good impedance matching between the antenna and the feed for the multiband antenna performance, with (0, 0) is the center of the patch. Table 1 shows a comparison between different slot dimensions loaded into the antenna design shown in Fig. 1 with respect to the resonance frequencies and bandwidths. Simulation results with different slot dimensions are obtained as shown in Table 1; in Set 7 dual band antenna behavior with a total BW of 135 MHz is achieved. The first resonance frequency is centered at the 940 MHz with BW of 65 MHz, while the second resonance frequency is centered at the 2.00 GHz with BW of 70 MHz; the dual frequency response of the slotted square MSA shown in Set 7 is suitable for GSM applications. Fig. 2 shows the simulated frequency response for Set 7 shown in Table 1.

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Table 1
SIMULATION RESULTS FOR DIFFERENT SLOT DIMENSIONS OF MSA CONFIGURATION

Set	Sl(mm)	Sw(mm)	f_1 (GHz)	f_2 (GHz)	Bandwidth Region (GHz)	BW (MHz)
1	22	22	0.947	2.03	(0.915 – 0.984) , (2.00 – 2.07)	79 , 70
2	22	26	0.932	2.02	(0.901 – 0.964) , (1.99 – 2.06)	63 , 70
3	22	30	0.909	2.01	(0.884 – 0.940) , (1.97 – 2.05)	56 , 80
4	22	34	0.890	2.00	(0.867 – 0.915) , (1.96 – 2.05)	48 , 90
5	26	22	0.947	2.02	(0.913 – 0.980) , (1.99 – 2.06)	67 , 70
6	30	22	0.947	2.01	(0.911 – 0.977) , (1.98 – 2.05)	66 , 70
7	34	22	0.940	2.00	(0.910 – 0.975) , (1.97 – 2.04)	65 , 70
8	26	26	0.924	2.01	(0.897 – 0.959) , (1.98 – 2.05)	62 , 70
9	30	30	0.902	1.98	(0.879 – 0.928) , (1.94 – 2.03)	49 , 90
10	34	34	0.879	1.94	(0.863 – 0.893) , (1.90 – 1.99)	30 , 90

Fig. 2 Simulated frequency response with respect to the return loss for square MSA with different slot dimensions.

3 CONCLUSION

The design of multiband micro-strip antennas introduced by studying the effect on the antenna multiband characteristics by loading one rectangular slot with different dimensions in the form of cut inside the square patch antenna. The optimum design gives a dual frequency bands that can be used in GSM Applications. Simulation results of these studies show the effect on the antenna performance when adding slot inside the patch of the antenna; adding slot introduces a size reduction in the designed antenna patch and can produce more than one resonance frequency by generating a second or even a third resonant frequency yielding a multiband antenna performance.

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