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Design of rectangular micro-strip patch antenna employing Flipped Swastika design for Wi-Max Application

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Abstract: *This paper presents the design and simulation of micro strip patch which involves the geometry of flipped swastika carried out on a rectangular patch. The proposed antenna structure is designed for Wi-Max application. The patch is cut in proposed shape to ensure improved results in terms of bandwidth and gain. Strip line feeding is given and the results are calculated for VSWR and return loss. The simulation and optimization is carried using HFSS software.*

Keywords: *micro strip, strip line feeding, FR4 epoxy, patch, VSWR, return loss*

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I. Introduction

Wireless communications is on the rise in the global market. The advent of sophisticated wireless products over the past few years has changed the industry standards [1]. To establish a proper communication link in space between two points, antenna is the only possible resource [2]. With the development in the wireless industry, there is a necessity for reliatble signal transmission [3]. Due to advancement in the technology there is a much need for small sized antennas now days. For many applications use of more antennas makes the system more bulk and also the cost associated will also be almost very high. For this reason micro strip antennas are used [4]. Microstrip patch antennas prove advantageous in terms of small size, highly efficient and also low cost when compared to most of the conventional antennas [5]. Also on the other hand the need for more transfer of the information there should be an increase in the bandwidth. Antenna miniaturization provides one possible way for effective use in mobiles and other wireless gadgets. When the microstrip antenna is fed with the stripline it uses less weight and space and is very much suitable for many of the applications [6]. This is the reason why these antennas are used in the areas of guidance weaponry, GPS applications and radar applications. But there are several problems associated with the conventional microstrip antennas. One such problem is low impedance [7]. Since micro strip antenna provides narrow impedance bandwidth which is serious disadvantage. Several methods are being employed to achieve wideband impedance bandwidth. To make sure we improve the bandwidth a slot is cut in the shape of flipped swastika slot [8].

II. Antenna Design

The proposed flipped swastika antenna is given in Figure 1. The material used as the dielectric is the FR4 epoxy with loss tangent 0.02 and dielectric constant 'ε_r' equal to 4.4. the entire design is carried out on a rectangular patch antenna. The important dimensions considered are: rectangular patch = 26 mm x 20mm, ground plane = 50 mm x 50mm. The height of the patch from the ground plane is 1.6 mm.

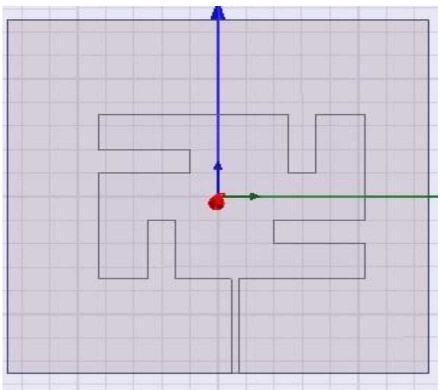

Fig 1. Proposed flipped swastika patch antenna

The proposed micro-strip patch antenna is simulated using HFSS software. The length and the shape of the proposed antenna are taken from the general rectangular patch antenna parameters discussed in [8].

III. Observations And Results

After the successful simulations performed, the return loss is calculated to be -13.25 dB at the resonant frequency of 3.38 GHz frequency. Further the VSWR is calculated which is known to be 1.55 for the 3.38 GHz frequency. For the successful performance of the patch antenna since the return loss should be less than -10dB and the VSWR should be in between 1 and 2. The proposed antenna meets the requirements.

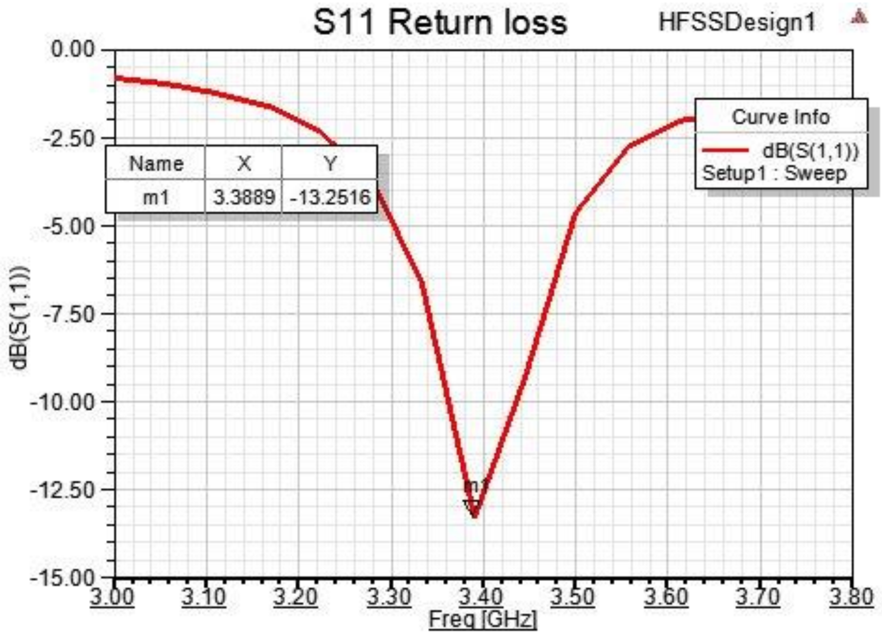

Fig 2. Return loss v/s Frequency curve

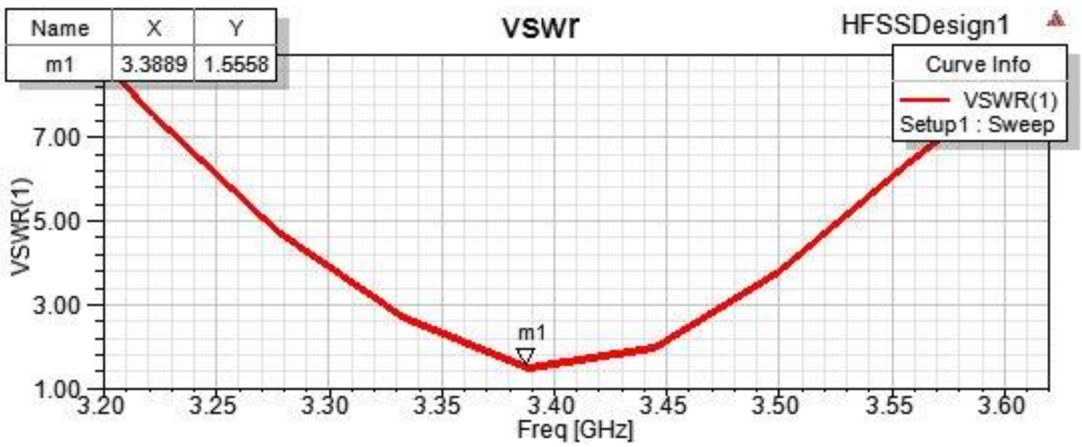

Fig 3. The VSWR calculation curve

S.No	Proposed Antenna parameter	Value
1.	W x L	26 x 20(mm)
2.	Resonant Frequency	3.38 GHz
3.	Return loss	-13.251 dB
4.	VSWR	1.55

Table 1. The tabulated values for the proposed antenna

From the above observations, further more calculations are carried for the reflection coefficient, reflected power and mismatch loss. These are given by the following formulas.

$$VSWR = \frac{1+|\Gamma|}{1-|\Gamma|} \tag{1}$$

$$|\Gamma| = \frac{VSWR - 1}{VSWR + 1} \tag{2}$$

These values are tabulated in the following way.

S.No	Parameters	Values
1.	Reflection Coefficient	0.22
2.	Reflected Power (%)	4.7
3.	Reflected Power (dB)	-13.25
4.	Mismatch loss	0.21

Table 2. Tabulated antenna parameter values

The 3D radiation plot for the proposed patch antenna is given in the following way.

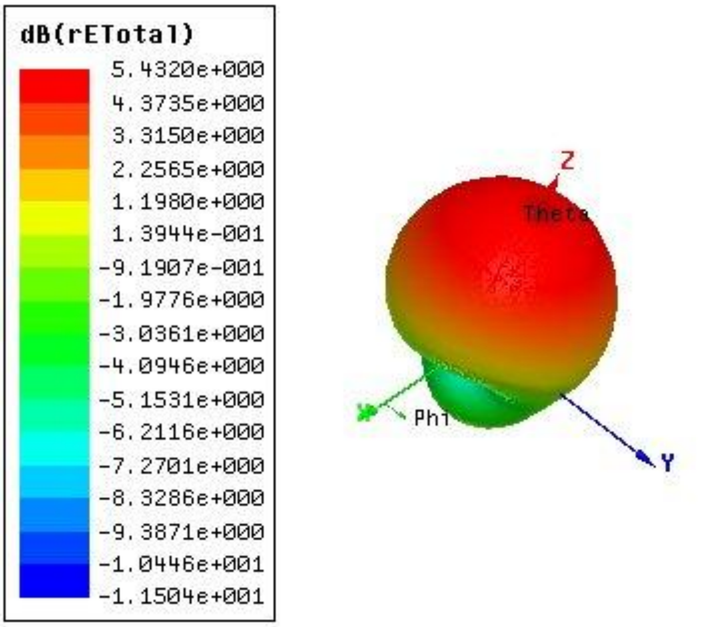

Fig 4. The radiation plot for the proposed antenna

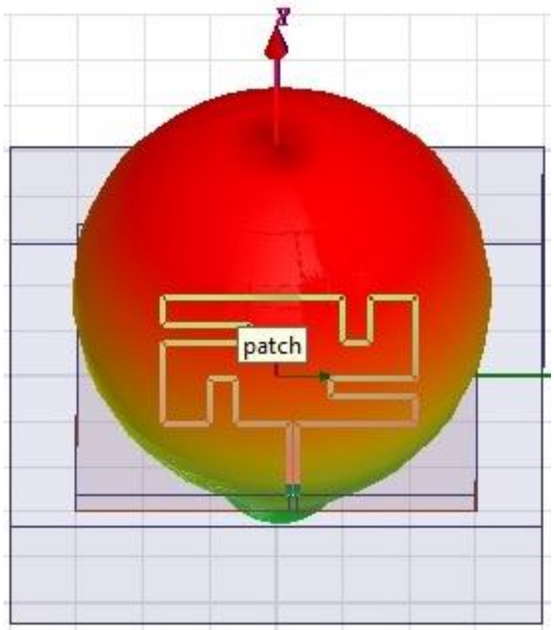

Fig 5. Plot showing the radiation pattern from the patch

IV. Conclusion

Since the proposed antenna is operating in the 3.38 GHz frequency with good return loss, it is useful for the WiMax application which has the frequency range of 3.300 GHz to 3.800 GHz. Thus the proposed structure is fully intended for successful operations in the wireless communication industry.

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