

# A Novel Hybrid Fractal Loop Antenna For GSM900

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## Abstract

A novel hybrid fractal loop microstrip antenna with size of  $62 \times 62 \text{ mm}^2$  is proposed for GSM900MHz application. The proposed antenna is designed by composition of Koch and Minkowski fractal antennas in loop construction and coaxial feeding is used. This antenna has appropriate radiation pattern as well as adequate return loss along with 60MHz BW.

## Keywords:

Fractal antenna; micro strip antenna; GSM900

## 1. Introduction

The fractal micro strip antennas are used for a variety of purposes, including mobile communication, satellite communication and wireless applications. The geometry of fractal antennas has been always charming for the designers. Complex and repeatable structures contribute to increasing electrical length of the antennas while having fixed surface and bandwidth; therefore, this is the basic reason to reduce the antenna size. Some applications of different fractal antenna have been proposed.

In this paper, a mixed shape of fractal has been designed. The new structure is composed of a combination of two famous fractals called Koch and Minkowski[1]. In this algorithm, Minkowski's generator (square pulse, Fig.1) is applied to Koch's fractal antenna in each level. When the generator is applied to each line, it is divided to three identical parts called the width of dip, varying between zero and one. If the width of dip is 0.5, it means that the width of dip is half of the size of direct parts [1, 2, 3, 4, and 5].



Figure.1. Minkowski's generator

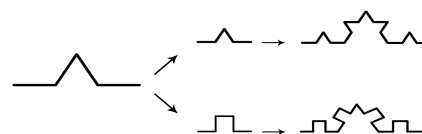
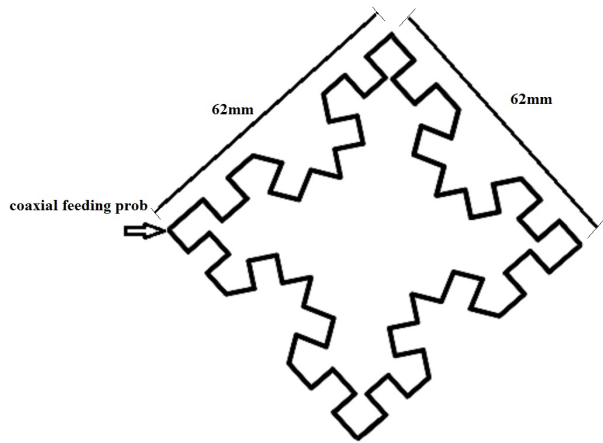


Figure.2. generating new fractal from Koch's fractal using square pulse with  $\omega = 1$

## 2. Antenna Design

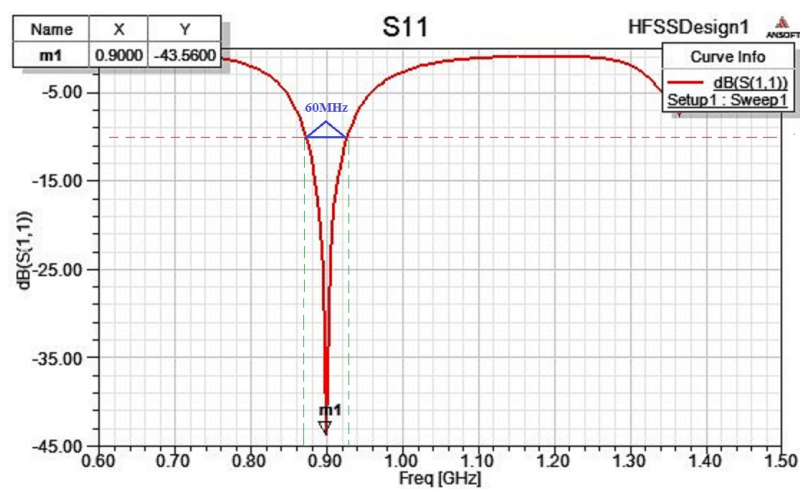
In This article, a new structure is loaded by 4 novel fractals in the loop shape antenna [2, 3]. Coaxial feeding is used at the end of an angle. The geometry of the antenna is presented in Fig. 3. The characteristics of the antenna are as follows: a substrate from Rogers 4003 with dielectric substrate  $\epsilon_r = 3.38$  and thickness  $h = 20 \text{ mil}$ . The size of the antenna is  $60 \times 60 \text{ mm}^2$ . Ansoft HFSS is used for simulations. The resonance frequency is simulated in GSM900. Some applicable antenna parameters are demonstrated (table I).



**Figure.3.** Geometry of proposed antenna

**TABLE 1.** ANTENNA DESIGN DETAILS

| <i>Material</i>            | <i>Rogers</i>        |
|----------------------------|----------------------|
| <i>Dielectric constant</i> | $\epsilon_r = 3.38$  |
| <i>Los tangent</i>         | $\delta = 0.02$      |
| <i>Substrate thickness</i> | $h = 20 \text{ mil}$ |
| <i>Centre frequency</i>    | $900 \text{ MHz}$    |



**Figure.4.** S11, simulated antenna

#### A. Return Loss

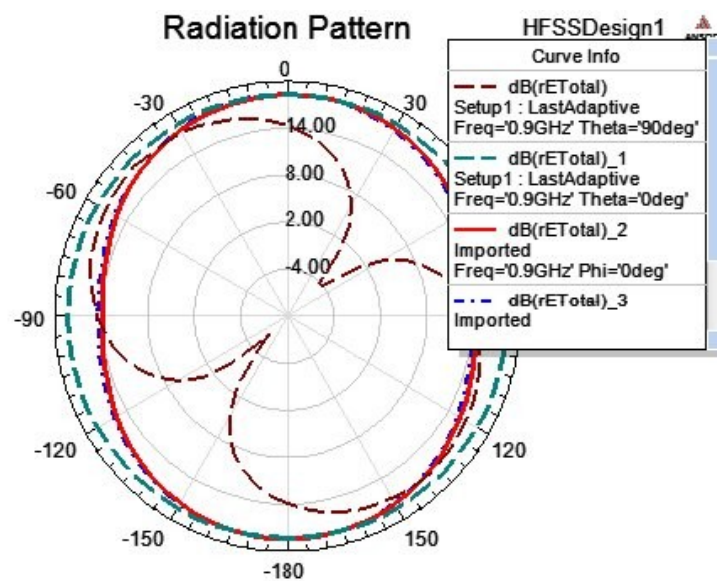
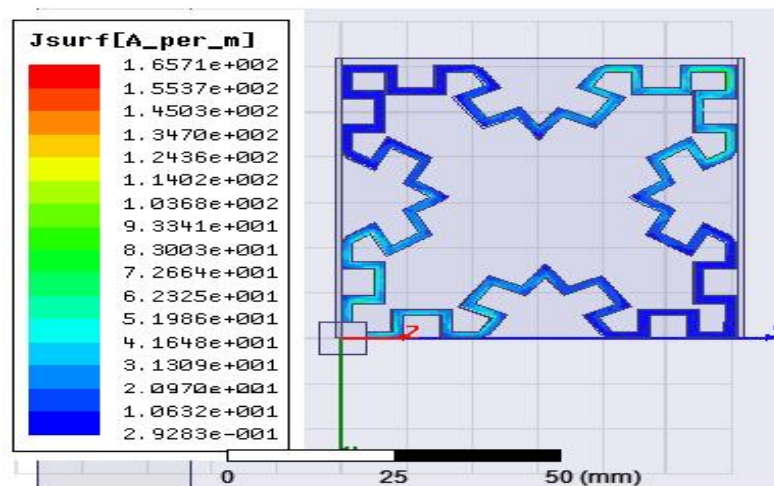
The simulated S11 Parameter is illustrated in Fig. 4. The level of return loss is -43db for band width (862-922,60mhz), according to the simulations.

**TABLE 2.** FREQUENCY AND BANDWIDTH

|        | <i>Frequency Range</i> | <i>Bandwidth MHz</i> | <i>%</i> |
|--------|------------------------|----------------------|----------|
| GSM900 | 862-922                | 60                   | 7.5      |

**B. Radiation Pattern**

By studying Radiation pattern simulations, it can be seen that directivity and radiation levels are reasonable.

**Figure.5.** Radiation pattern (E-Plane, H-Plane) antenna**Figure.6.** J Surface of proposed antenna

### C. VSWR

According to the simulated VSWR, this antenna is matched to  $50\Omega$  in 900 MHz frequency (VSWR<2).

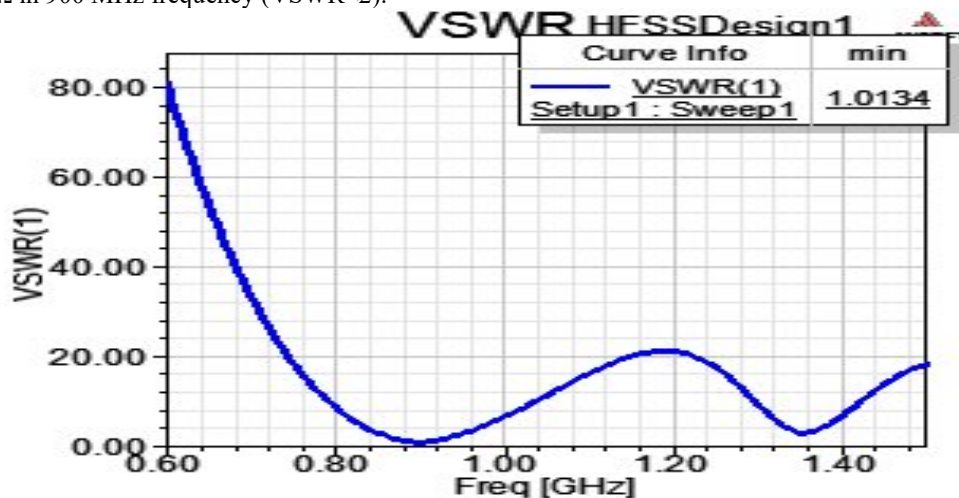


Figure.7. VSWR for proposed antenna

### 3. Conclusion

A hybrid fractal loop antenna has been investigated. According to the fractal theory, this antenna has appropriate size and it is capable of operating in 1350 MHz frequency [5]. The simulated antenna is composed of four new Koch fractal antennas applied to a loop microstrip antenna. The results obtained from HFSS simulations show that the proposed antenna is suitable for GSM900 in 60MHz BW.

### References

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