Compact Printed Inverted-F Wide Band Antenna (IFA) For Vehicle Telematics

R. Darwin, P.Sampath

Abstract: Inverted - F antenna is one of the most commonly used antennas in the area of wireless communication devices where compact size plays a huge role due to scarcity of space. Here in this paper we propose an antenna designed to work in millimeter wave which is suitable for vehicle telematics in smart cities where area coverage requirement is in the lower side. Nowadays manufacturers prefer compact antennas for such applications in a luxury vehicle for latest style and aerodynamics reasons. The antenna proposed gives us the bandwidth from 28.6 Ghz to 31.4 GHz range. The Reflection coefficient of the antenna is found to be -15.41 dB. Also the gain is measured to be 2.750 dBi.

Index Terms: Inverted F, Wide band, Telematics, Millimeter wave, Reflection coefficient.

1. INTRODUCTION

In this modern era of wireless communication vehicular telematics plays a huge role. As per the latest survey it is estimated that in the next decade so more than fifty percent of the total vehicles will become electric where vehicular telematics will be of great importance. Literature survey of the research paper[1], explains similar antenna design but in low frequency range. In another research paper antenna design for millimeter wave operation is explained[2]. Yet another paper explains the smart mobility concept[3]. Few others explained different types of antennas and systems for vehicular telematics, but most of the work has been very old[4][5][6][7]. From the above it is evident that the research in this area is lacking and it needs some upliftment.

2 PHYSICAL DESCRIPTION

The antenna design comprises of two different sections 1. The antenna element and 2. The overlapping ground plane. Whereas there will be a ground plane below the section. The antenna element is printed above the PCB with the feed line connected to both F section and ground plane. The top layer of the PCB where the antenna is printed is connected to the bottom layer ground plane through via.

3 FEED METHOD

Since the antenna is comprising of two ground planes one upper and the other at the bottom feed can be with respect to the upper ground plane. After the completion of the fabrication process the feed line may be connected with SMA connector.

4 OPERATION MECHANISM

The planar monopole antenna designed here is planned in such a way that it is placed parallel to the ground edge so that the height can be reduced to minimum. In the process an additional capacitance may be included in to the structure which can be compensated using a short circuited stub.

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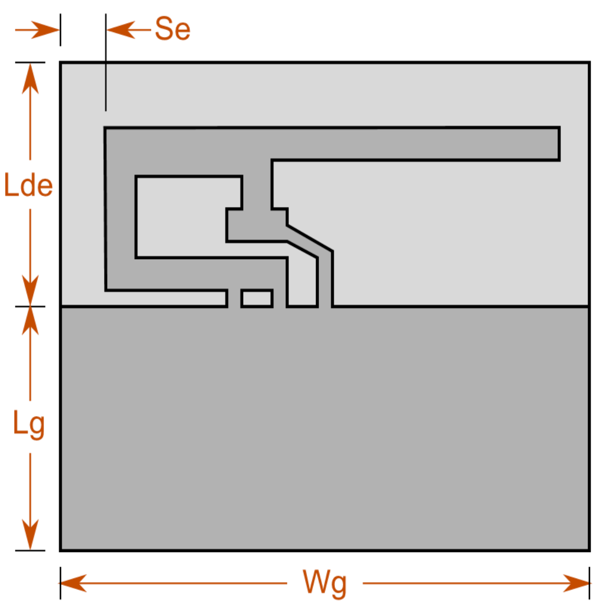
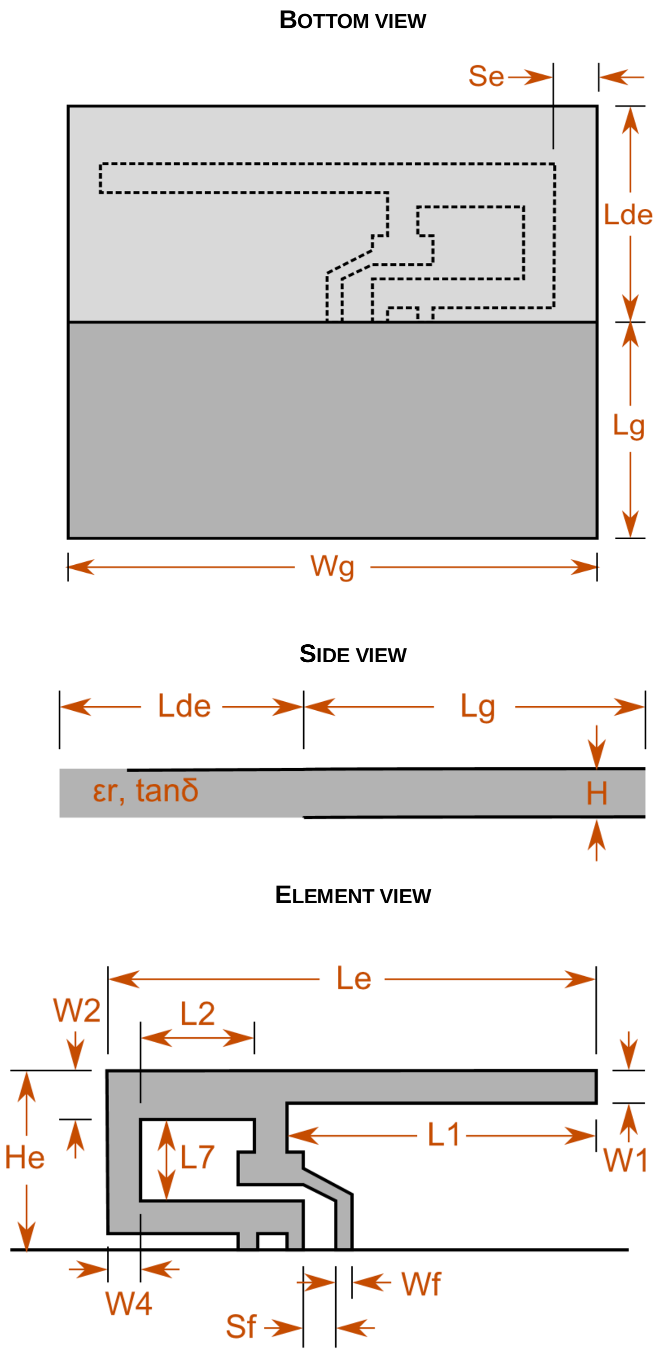
5 PERFORMANCE

The radiation pattern produced by the antenna is somewhat close to omni directional but of course with some nulls here and there. However since the environment which is going to be used in multidirectional the null cannot be a big deal in terms of requirement and performance. The bandwidth of the antenna design is having acceptable range. The substrate used for the design is Nelco with a substrate thickness of 260 µm and with relative permittivity of 3.48.

6 SKETCHES

TOP VIEW





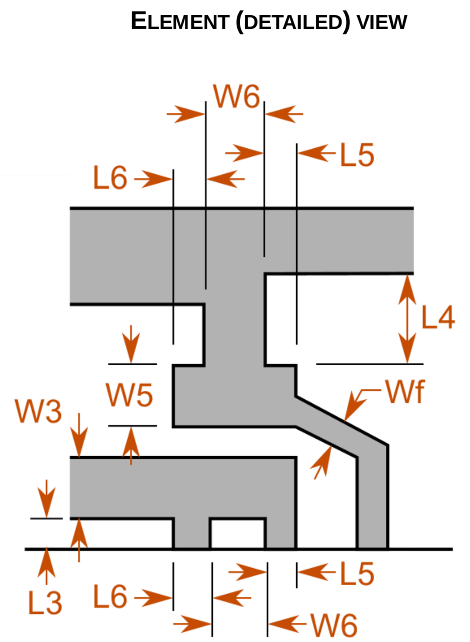
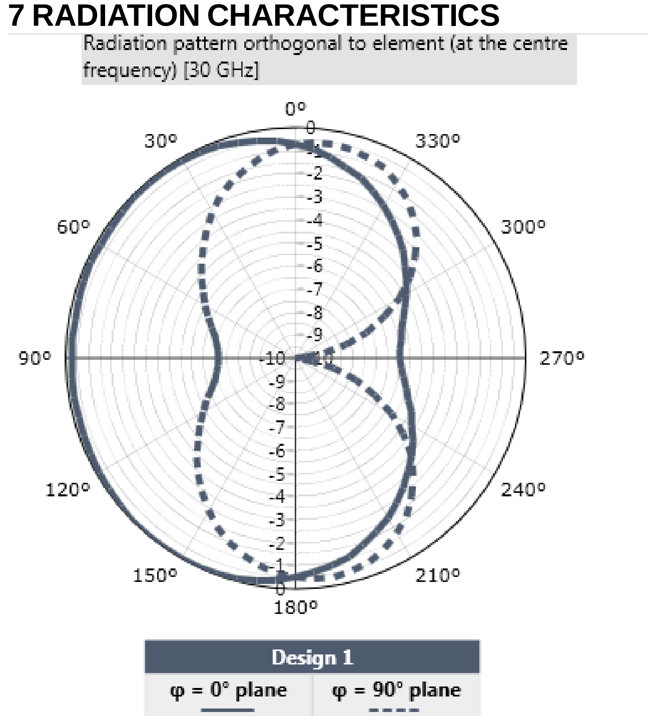
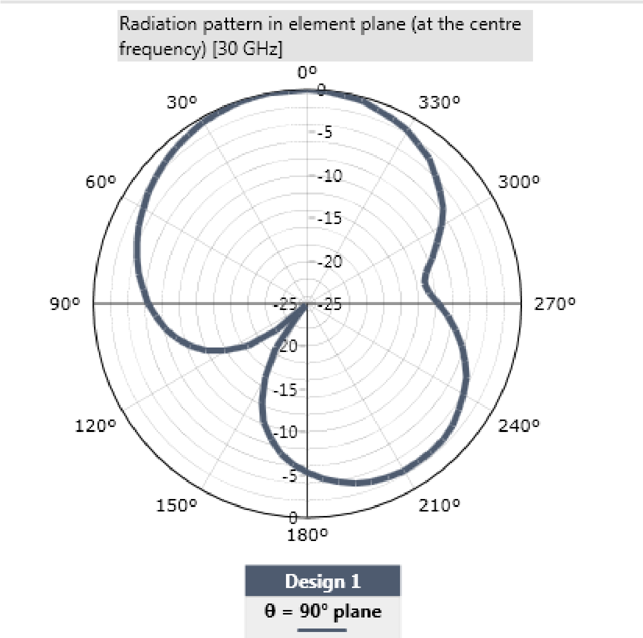


***FIG.1**. Top view, Side view, bottom view and elemental view of the antenna*

7 RADIATION CHARACTERISTICS

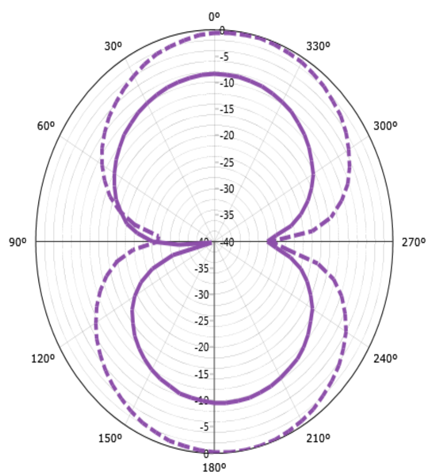


(a)

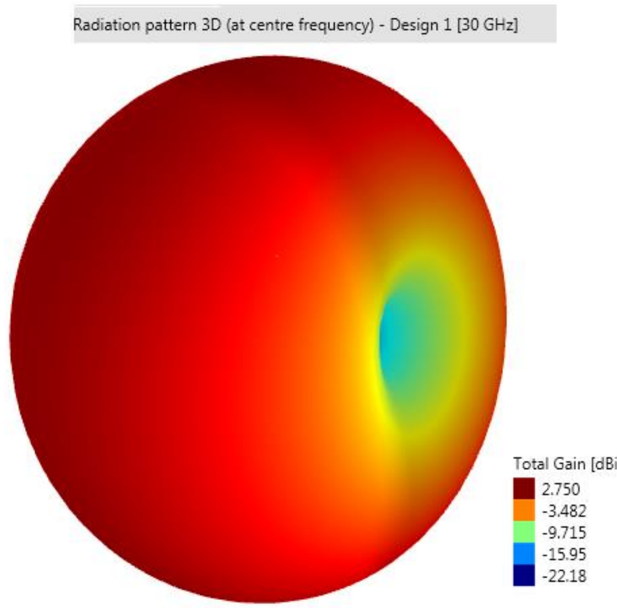


(b)

Gain (Vertical - normalised)



(c)



(d)

Fig.2.

a. Radiation pattern orthogonal to element
b. Radiation pattern in elemental plane
c. Gain vertical normalized
d. Radiation pattern 3D

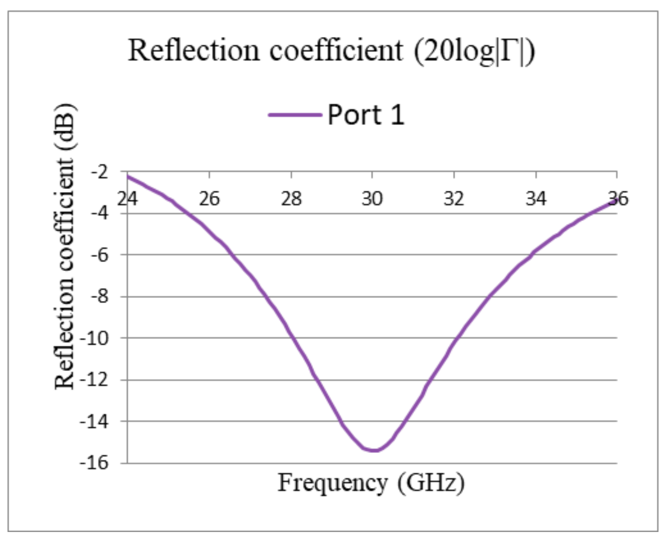


Fig.3 *Reflection Coefficient of the Antenna*

Fig.1 shows the antenna design in top view, bottom view, side view and elemental view whereas Fig.2 shows the radiation pattern in different planes and in 3D form. Fig.3 depicts the reflection coefficient of the antenna design.

TABLE 1: *ANTENNA STRUCTURE PARAMETERS*

Name of parameter	Value
fo	30 GHz
Wf	5.785 mm
Sf	5.660 mm
Se	3.936 mm
Lde	94.58 mm
L1	206.3 mm
L2	72.94 mm
L3	9.307 mm
L4	22.64 mm
L5	12.58 mm
L6	12.58 mm
L7	33.58 mm
W1	15.22 mm
W2	27.79 mm
W3	16.22 mm
W4	27.42 mm
W5	15.22 mm
W6	15.09 mm
Wg	418.2 mm
Lg	472.9 mm
H	23.06 mm
εr	3.48
tanδ	0

Table.1 shows the values in millimeter for the design of the antenna in sketches.

8 RESULTS AND DISCUSSION

From the above simulation results it has been found that the antenna proposed gives us the bandwidth from 28.6 Ghz to 31.4 GHz range. The Reflection coefficient of the antenna is found to be -15.41 dB. Also the gain is measured to be 2.750 dBi. Since the antenna design is in millimeter wave operation which is the future prospect for any application in 5G so it is recommended for smart city infrastructure[8][9].

9 CONCLUSION

The proposed antenna can be a perfect fit for the application of vehicular telematics with the observed results from the simulation of the antenna for various antenna parameters. Meanwhile the compact design of the antenna can be suitable for the automobile industry which is moving rapidly in terms of design style.

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