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Dual Band E-Shape Microstrip Antenna for GPS Application

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Abstract: *A dual band E-shape microstrip antenna has simulated and analysed at frequencies 1.625GHz and 1.725 GHz. The antenna was analysed to operate at 1.625 GHz and with reconfigurability of frequency it will operate at 1.725 GHz. The physical parameter of the structure has been analysed using Zealand IE3D simulator. Return loss (S_{11}), VSWR (voltage standing wave ratio has been carried out. The return loss of E-shape microstrip antenna has been less then -10dB at frequencies 1.625 GHz and 1.725 Hz. The E-shape microstrip antenna is very promising for various modern communication applications such as wireless and satellite application.*

Keywords: *E-shaped; microstrip patch antenna; return loss; Zealand IE3D simulator; VSWR; dual band*

I. Introduction

The dual band antennas are being given much focus for their versatility, compact size, low cost and high performance. Dual band antenna radiates more than one pattern at different frequencies and various polarizations providing more flexibility to antenna designer. Due to additional degree of freedom, there is a large potential for increased system performance [1]. The ability to switch between various systems has recently attracted special attention to dual band antennas. This class of radiator can change its operating frequency, polarization or radiation pattern with the use of GaAs FET, PIN diodes and RF MEMS [2]. The dual band characteristic of antenna are very valuable for many modern wireless communications and radar system application such as object detection, secure communications, multi frequency communications, vehicle speed test and many more. By changing the state of the switches on or off, an electrical reconfiguration of aperture can be obtained. If different switch states that lead to different radiation characteristics is designed in advance, the antenna patch dimensions are 86x74mm and cut out E-shape from the patch fig.1 below design of E-shape antenna based on desired frequency obtained.

Over the past two decades, microstrip patch antenna has received considerable attention for use in personal communication system and radar applications due to its compactness among other advantages. Intensive research has been carried out to develop new techniques to overcome the microstrip patch antenna drawbacks, the most restrictive being narrow band.

The dual band and its return loss improvement without increasing antenna size and production process is important to apply this antenna to the modern mobile communication system

Many applications in communications and radar require circular or dual polarization, and the flexibility afforded by microstrip antenna technology has lead to a wide variety of designs and techniques to fulfill this requirement [3]. In recent years, the demand for compact mobile handset has grown due to the increased demand of electronics mobility, the need for small handsets will most likely increases. A small antenna size is required as one of the important factor in portable mobile communication system. The size of MPA is basically determined by its resonance length and width. The reduction of patch size can be achieved by using patch substrate height [4]. But, in this case, the low radiation efficiency will reduce the antenna gain

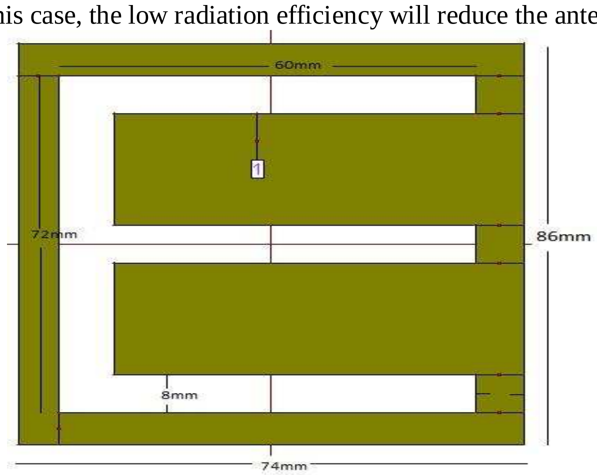

Fig.1

In this study, An E-shaped patch antenna optimized for the simplicity in design and feeding is proposed. It has characteristic which will meet 3G application.

II. Dual Band E-Shape Antenna Analysis

The result of the development of a compact dual band radiator for use in wireless communications applications are presented in this section. Bandwidth is specified as frequency bandwidth in which return loss is less then -10dB. The patch without slots allows a straight path across the patch, whereas the slots force currents to take a longer path, as in Figure 2. This longer path corresponds to a longer resonant length, thereby tuning the patch to 1.625GHz and 1.725GHz. Here the slots are placed at the midpoint of the patch, but they can be located anywhere along the patch if they change the current paths. One important consideration in placement of the slots is the polarization desired, as asymmetric slot placement can potentially cause cross-polarization levels to rise.
As the slots are moved away from the centre of the patch, in either direction, the resonant frequency rises symmetrically (independent of which direction the slots are moved). In fact, the resonant frequency tuning curve maps out the cosine current distribution that develops on the patch with respect to length, except as an inverted cosine, since the lowest frequency tuning is at the current maximum, and the highest frequency tunings are where the lowest levels of current are i.e. near the edges of the patch.

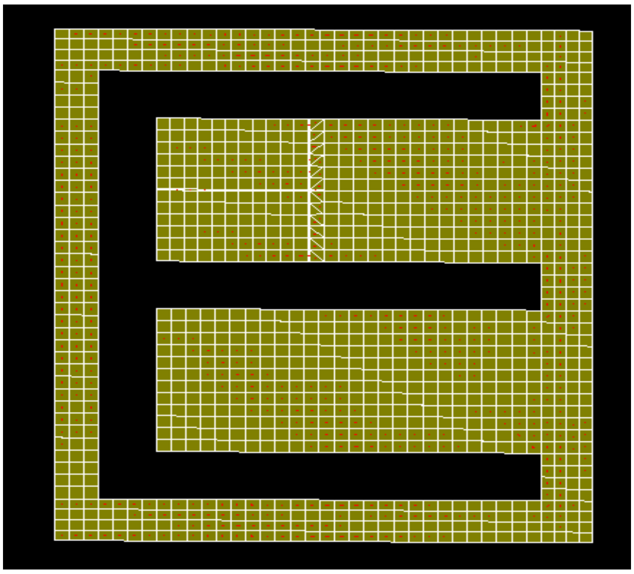

Fig.2: Simulated E-shaped antenna current distributions

A kind of reactive loading can be introduced by etching slots on the patch. The slot loading allows for a strong modification of the resonant mode of a rectangular patch, particularly when the slots are oriented to cut the current lines of the unperturbed mode [7].

The basic geometry is an E-shaped rectangular-patch antenna, with dimensions 60mm, and 72mm.The location of the slots with respect to the patch is defined by the quantities w and l .The antenna may be fed with either an aperture [2] or a probe feed [2]. The IE3D simulation engine by Zeland software has been used to design the antenna.

Table I: specification of substrate material

Substrate dielectric constant	2.2
Thickness between ground and fed patch (h)	1.5 mm
Length of the rectangular patch (L)	60 mm
Width of rectangular patch (W)	72 mm
Width of slot thickness (d)	1 mm
Feed location (x_0, y_0)	(2 mm,16mm)

This geometry can lead to an antenna with multiband characteristics and has been fabricated using a coaxial probe feed. The feed point must be located at that point on the patch, where the input impedance is 50 ohms for the resonant frequency. Hence, a trial and error method is used to locate the feed point.

III. Simulation Results And Discussions

Simulation of the proposed antenna is carried out by Zeland Inc.'s IE3D software based on Method of Moment (MoM) The simulated return loss of E-shaped antenna as shown in Fig. 1

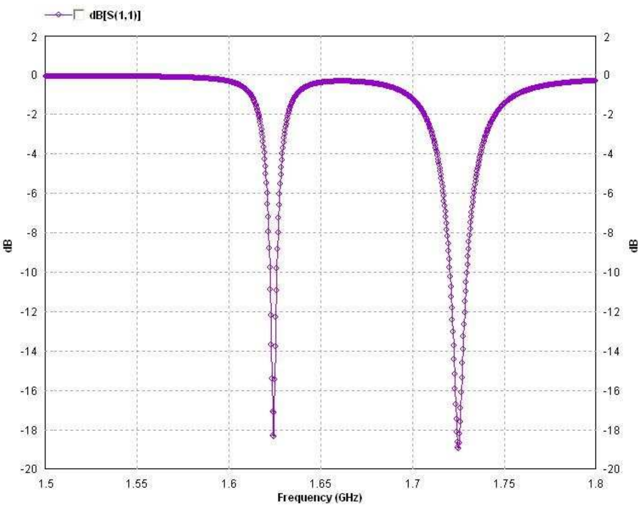

Fig 3: Simulated result of return loss of E-shaped antenna

Table II: Simulated result of E-shaped antenna

Resonant frequency (GHz)	Return loss (dB)	VSWR	Bandwidth (MHz)
1.625	-18.34	1.275	5
1.725	-18.94	1.266	5

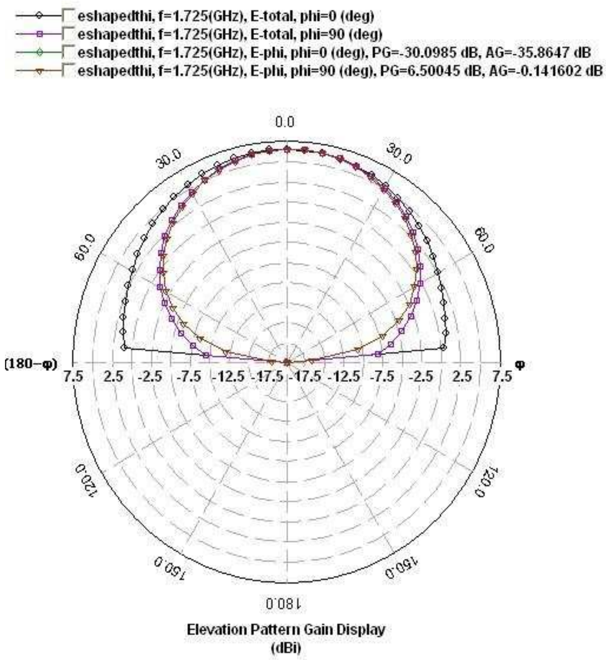

Fig. 4: Elevation pattern at 1.725GHz of gain

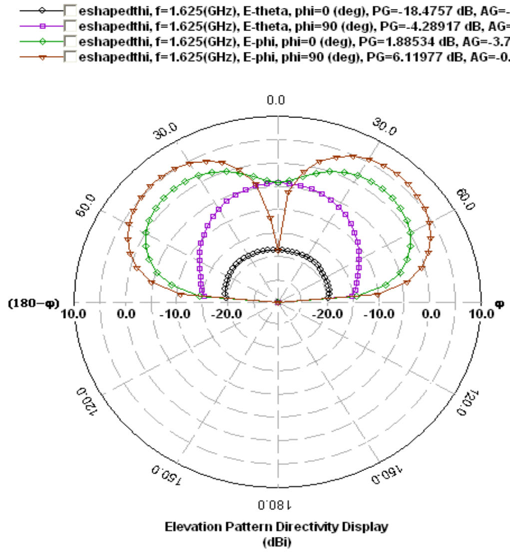

Fig. 5: Elevation pattern of directivity at 1.625GHz

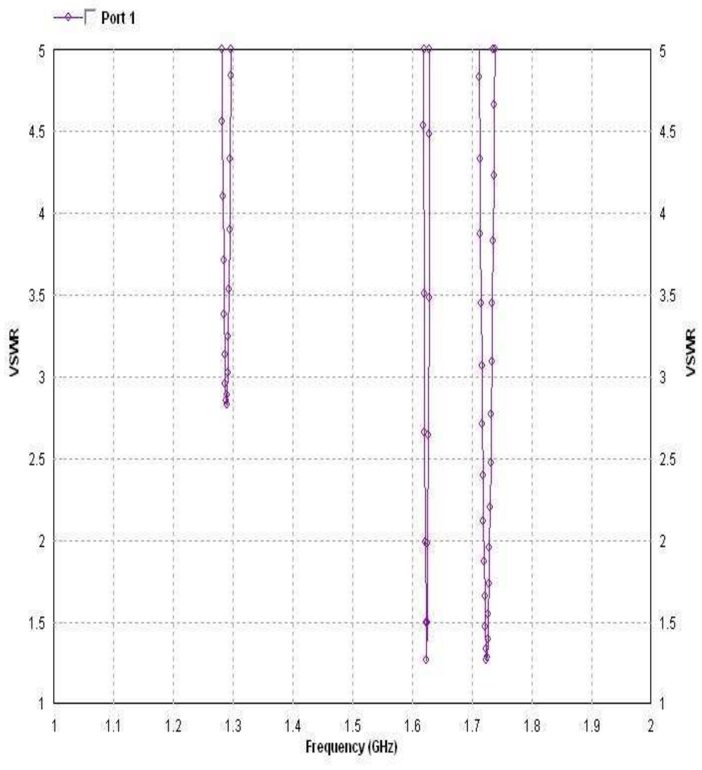

Fig.6: VSWR Vs Frequency characteristics

Proposed antenna resonates at frequencies 1.625 and 1.725GHz as shown in Fig.3 with the VSWR of 1.275 and 1.266 respectively.

IV. Conclusions

The E-shaped slot loaded antenna is observed to posses dual band behavior. The antenna has designed for dual band frequencies 1.625 and 1.725GHz. The proposed antenna shows significant size reduction compared to conventional microstrip antenna.

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