Designing of Ground Slotted Rectangular Patch Antenna for S and Ku band with use of Ansoft HFSS Simulator

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Abstract- This paper focusses at the designing of patch antenna in rectangular shape which is suitable for operating at 2.45 GHz for S and Ku band applications. During the designing of patch antenna using coaxial feed technique which is considered with its defected ground based structure. It is observed and analyzed for its various characteristics of so prepared antenna. The antenna has multiband uses as it may be applied for 3.1 GHz, 16.54 GHz and 17.5 GHz. Its properties are in agreement when validated with standard parameters. The patch is designed onto a substrate of Rogers RT/duroid 5880. The designed antenna may be found as a useful device for modern and advanced communication systems.

Index Terms- Microstrip patch antenna, DGS, coaxial feed

I. INTRODUCTION
The rapid development in technology requires antenna that are light in weight and are cheap. Microstrip element contain a part of metal located on the ground called microstrip patch which is called substrate that is sandwiched between radiating patch and ground plane. The printed antenna is constructed with help of lithographic technique. Using this IC technique, it became easy to manufacture many necessary devices by different technique on substrate. For some case output attribute of antenna depends on material of substrate and its parameters. The radiating patch can be of any shape i.e. circular, elliptical, rectangular, square, triangular. Most commonly radiating patches being used are rectangular, circular and square as they are easy to fabricate, analyze and radiation characteristics.

ANSYS HFSS is an electromagnetic software used to design and simulate antennas and PCB’s. Slots or defects may be periodic and aperiodic made on ground plane for improvement of bandwidth is called defected ground structure. The defects or slots on ground disturbs the flow of current on ground plane which changes property of transmission line. In other words defect made on ground effectively changes capacitance and inductance by including slot resistance, capacitance and inductance.

II. ANTENNA

Figure 1: Front view of antenna

Figure 2: Ground view of antenna
Table 1: Antenna Parameter Dimensions

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Dimensions (cm)</th>
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<tbody>
<tr>
<td>$L_s$</td>
<td>4.76</td>
</tr>
<tr>
<td>$W_s$</td>
<td>3.9</td>
</tr>
<tr>
<td>$T_s$</td>
<td>0.16</td>
</tr>
<tr>
<td>$L_G$</td>
<td>4.76</td>
</tr>
<tr>
<td>$W_G$</td>
<td>3.9</td>
</tr>
<tr>
<td>$L_p$</td>
<td>4</td>
</tr>
<tr>
<td>$W_p$</td>
<td>3</td>
</tr>
<tr>
<td>$L_{GS1}$</td>
<td>1.2</td>
</tr>
<tr>
<td>$W_{GS1}$</td>
<td>3</td>
</tr>
<tr>
<td>$L_{GS2}$</td>
<td>1.2</td>
</tr>
<tr>
<td>$W_{GS2}$</td>
<td>3</td>
</tr>
<tr>
<td>$R_p$</td>
<td>0.4</td>
</tr>
</tbody>
</table>

III. RESULTS AND OBSERVATION

A. Return loss: Return loss is loss in signal power due to reflection in signal when there is discontinuity in transmission line. In other term if all the power was transferred to the load, then return loss will be infinite. It is usually expressed in decibels.

B. VSWR: The VSWR is characterized as maximum and minimum voltage ratio along transmission line. This has real value which is positive. The value generally lies between 1 to 2.
C. Gain: Gain is characterized as product of directivity and efficiency. It indicates how powerful a signal can be transmitted or received in a specific direction by an antenna. Gain is evaluated in dB.

![Figure 6: Gain vs frequency](image)

D. Directivity: Directivity is defined as concentration of radiation pattern of antenna in a specific direction. It is expressed in dB. When directivity is high the beam radiated by antenna will be more focused and will travel longer. Directivity of omni directional antenna is 1 (0 dB).

![Figure 7: Directivity vs frequency](image)

E. Radiation Pattern: The term radiation pattern is a graphical picture of the radiation properties of the antenna. It is expressed by 3-D graph or polar plots. It is basically plot of electrical field strength of waves emitted by that antenna at various angles.

![Figure 8: Radiation pattern](image)

### IV. DISCUSSION OF ANTENNA AT VARIOUS FREQUENCIES:

<table>
<thead>
<tr>
<th>Table 2: Antenna Result at Various Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (GHz)</td>
</tr>
<tr>
<td>Return loss (dB)</td>
</tr>
<tr>
<td>VSWR (dB)</td>
</tr>
<tr>
<td>Gain (dB)</td>
</tr>
<tr>
<td>Directivity (dB)</td>
</tr>
</tbody>
</table>

As per results this shows that in a single design we can obtain frequencies at different bands for S and Ku band. Return loss [12] at 4.4 GHz was -28 dB & gain 2.70dB Proposed antenna at 3.1 GHz was -20.6 dB & gain12.2 dB
V. CONCLUSION:
From the above table, it can be shown that at frequency of 3.1 GHz, 16.5 GHz and 17.5 GHz, a good gain of the designed antenna can be achieved such that the return loss is also very good with feasible directivity and VSWR. Thus this paper describes the designing of a defected ground rectangular patch antenna with coaxial feed and dimensions as described above having size of patch 4 cm x 3 cm and which is suitable for mobile communication, satellite communication, wireless LAN, Bluetooth and radar.

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REFERENCES:


