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Research Article

A Slot Coupled Rectangular Microstrip Patch Antenna with U-shaped Feed Linefor X-band Application

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Abstract

In this paper, a rectangular microstrip patch antenna with a rectangular shaped slot is design using Ansoft HFSS software for X-band application.[17] The resonance frequency of proposed design antenna is 9.19 GHz. The 10 dB impedance bandwidth of design antenna is 6.3%. The return loss of this antenna is -25 dB. In this paper U-shape microstrip feeding arrangement is applied. This antenna can have wide application in a great variety of wireless communication. This antenna is use in space born or airborne imaging Radars, maritime civil and military navigation radars.

Keywords: Slot Coupled Patch Antenna, Ansoft HFSS, U-shape Microstrip Feeding

Introduction

Microstrip antennas have been used widely because of their advantages such as, light weight, low cost and easy to fabricate by using printed circuits technology. But they suffer from disadvantages like low gain and narrow band width.[1-5] Techniques such as using multilayer structure, materials with low dielectric constants and utilizing stacked patches have been reported in literature for increasing gain and impedance bandwidth.[1-10] For increasing impedance bandwidth a structure with a U-shaped feed line has been reported.[11-14] An aperture coupled microstrip antenna with a non-symmetric feed line and the two slots on the ground plane operated at X-band,[15] is reported with ultra wideband impedance and gain bandwidth.

There are many configurations that can be used to feed microstrip antennas. The four most popular are the microstrip line, coaxial probe, slot coupling and proximity coupling.[18,19] The microstrip line feed is easy to fabricate but it has more Spurious feed radiation. When feeding with a coaxial probe, since a thicker substrate results in a larger probe inductance appearing in series with the patch impedance and it has more Spurious feed radiation. The slot-coupled feed is one scheme that overcomes the problem of probe inductance, at the cost of increased complexity. In this paper slot coupled feed arrangement is use for patch antenna. The major disadvantage of this feed technique is that it is difficult to fabricate due to multiple layers, which also increases the antenna thickness. This feeding scheme also provides narrow bandwidth.[18]

Degin of Proposed Antenna

In slot coupled feed technique, the radiating patch and the microstrip feed line are separated by the ground plane as shown in Figure 1. Coupling between the patch and the U-shaped feed line is made through a slot or a slot in the ground plane. The coupling slot is usually centered under the patch, leading to lower cross-polarization due to symmetry of the configuration. Since the ground plane separates the patch and the feed line, spurious radiation is minimized.[18]

Design Parameter

The patch of the antenna is rectangular with 30 millimeter width and 50 millimeter length and height of substrate is 3.2 millimeter. The width of microstrip line is 4.42 millimeter

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and length is 58 millimeter. Stub length is 20 millimeter. Here we use U-shape feeding line. U-shape feed line also increase the impedance bandwidth and gain of antenna[16] the dielectric material is FR-4 with dielectric constant 4.4 and slot width is 5.5 millimeter.

Results

The input Return loss, voltage standing wave ratio, radiated Field for simulated antenna is shown in Figure 2. (a-c). Some noteworthy observations are apparent from Figure 2. which is shown in table 1.

Table 1.Parameters and Results

Parameters	Results
Resonance Frequency	9.19GHz.
Return Loss (S11)	-25 dB
Bandwidth	6.3%
Peak Gain	4dB
Peak Directivity	6dB
Front to Back Ratio	10
VSWR	1.2
Impedance	0.8136+0.731i
Radiated Power	-28dB

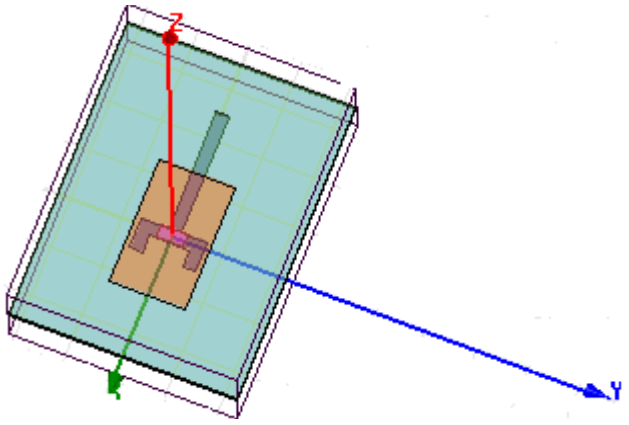

Figure 1.Geometry of Design Antenna

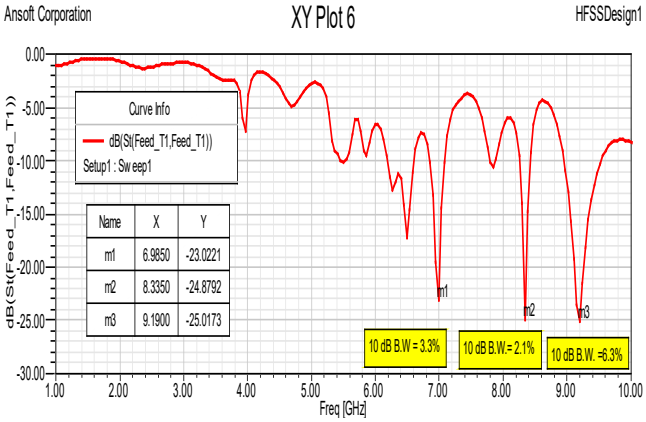

Figure 2(a).Return Loss Graph for Proposed Antenna

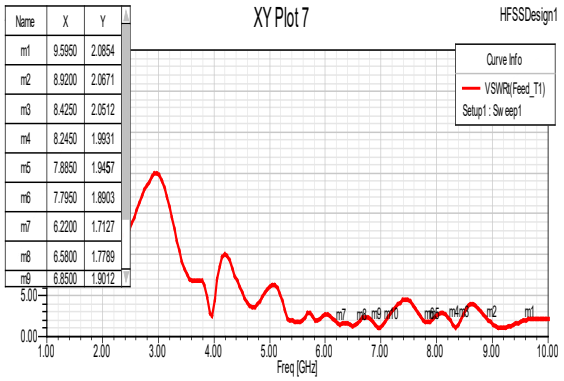

Figure 2(b).VSWR Graph for Proposed Antenna

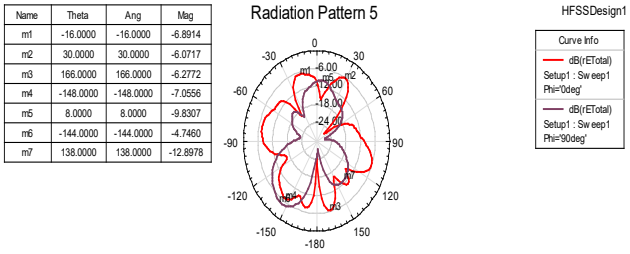

Figure 2(c).Radiation Pattern Graph for Proposed Antenna

Conclusion

A Slot Coupled Rectangular Microstrip Patch Antenna with U-shaped Feed Line for X-band Application has been proposed and simulated using HFSS software.[17] The resonance frequencies of design antenna is 9.19 GHz The 10 db bandwidth of design antenna is 6.3% and return loss is -25 dB. This antenna is designed to be used in space born or airborne imaging Radars, maritime civil and military navigation.

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