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Effect of Wide Slots on Bandwidth & Gain of Broadband Microstrip Antenna

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ABSTRACT

A single-layer single-patch microstrip antenna is develop,in this paper the pair of slotsare inserted on the radiating edges of the rectangular patch is simulated and effect of slots on bandwidth and gain observed,and radiation characteristics are studied. The antenna is designed with an air substrate of thickness about 7% of the wavelength of the center operating frequency, the antenna have an impedance bandwidth about 31.2%, with respect to center frequency. For frequencies within the impedance bandwidth, good radiation characteristics are also observed, with a peak antenna gain about 9.4dBi.

Keywords: -microstrip antenna, slots

1. INTRODUCTION

The coplanar geometry has the disadvantage of increasing the lateral size of the antenna configuration include narrow bandwidth, spurious feed radiation, poor polarization purity, limited power capacity and tolerance problems. Toovercome these problems in order to satisfy increasingly stringent systemrequirement, this effort has involved the development of novel microstripantenna configuration, and the development of accurate and versatile analytical models for understanding of the inherent limitation of microstrip antenna as well as for their design and optimization [5]. The basic form of the microstrip antenna, consisting of a conducting patch printed on a grounded substrate, has an impedance bandwidth of 1-2%. One way of improving the bandwidth to 10-20% is to use parasitic patches, either in another layer or in the same layer. However, the stacked geometry has the disadvantage of increasing the thickness of the antenna [3], while Microstrip antennas offer the advantages of thin profile, light weight, low cost, and conformability to a shaped surface and compatibility with integrated circuitry.

2. ANTENNA DESIGN & STRUCTURE

The use of probe feeding technique, multi-slotted on the patch with thick air-filled substrates provide bandwidth enhancement while the application of superstrate with inverted radiating patchand the use of parallel slots offers a gain enhancementHowever, the bandwidth and the size of an antenna are generally mutually conflicting properties, that is, improvement of one of the characteristics normally results in degradation of the other. [9] The design method that proved very effective while producing the antenna, also proved useful when producing the rectangular broadband antenna. Initially the narrowband rectangular patch was made using the copper tape and tuned to match the input impedance. The proposed multi-slotted patch antenna structure is composed of rectangular patch, air substarte and a verticalprobe connected to the patch. The 50-ohm impedance matching can be obtained by feeding the antenna at either above or below the null position at the centre of the patch, the optimum feed coordinates were found to be where the narrow band antenna returned an input impedance of 50 ohms. It obtained by a pair of rectangular slots on one of the radiating edges of a rectangular MSA is reported in Fig.1. A broadband MSA with a pair of tapered slots further increases its BW. The MSAs have been initially optimized using IE3D. The rectangular patch has dimensions of *L* x *W*.

$$L = \frac{C}{2 f_0 \sqrt{\varepsilon_r}} - 2\Delta l$$

$$W = \frac{C}{2 f_0} \sqrt{\frac{\varepsilon_r + 1}{2}}$$

First note that, for achieving good impedance matching over a wide bandwidth, the slit length (*l*) is calculated to be about 0.7 to 0.85*L*, and the spacing between outer edges of the two slots ($2W_1 + W_2$) is about 0.27 *W*. It is for the two adjacent resonant modes are excited, which leads to a wide bandwidth. And is supported by nonconducting posts of height *h*=14.3mm from the ground plane. The two wide slots are of same length *l* and same width W_1 and are inserted at the bottom edge of the patch. The separation of the two wide slots is W_2, and the two slots are placed symmetrically with respect to the patch's center line (y axis). Thus, there are only three parameters (*l*, W_1, *W2*) for the wide slots used here. Along the patch's center line, a probe feed at a distance d_p from the patch's bottom edge can be located for good excitation of the proposed antenna over a wide bandwidth. MSA with a pair of rectangular slots cut on the radiating edges of the antenna. (εr = 4.3, h = 0.159 cm, and tanδ = 0.02), which is suspended over the ground plane with an air gap (*D*) of 15.7 mm. By optimizing the slots dimensions, the separation between the two slots and the feed point location is calculated for the better response should obtain. The length of the slots is approximately *l* = 52mm. and the width of slots are W_2 = 7.5 mm.MSAis discussed;cutting a pair of tapered slots further increases its BW.

The two wide slots are of same length *l* and same width W_1 and are inserted at the bottom edge of the patch. The separation of the two wide slots is W_2, and the two slots are placed symmetrically with respect to the patch's center line (y axis). Thus, there are only three parameters (*l*, W_1, W_2) for the wide slots used here. Along the patch's center line, a probe feed at a distance d_p(52.5, 9.5) from the patch's bottom edge can be located for good excitation of the proposed antenna over a wide bandwidth. MSA with a pair of rectangular slots cut on the radiating edges of the antenna. The geometry of the antenna is illustrated in the Fig.1,The wide slots have a size of (52, 7.5) mm. The center frequency of this microstrip antenna is 1.64GHz. The co-axial feed at the patch (52.5, 9.5). The radius of the feed conductor of co-axial probe is 0.7mm.

3. RESULT & DISCUSSION

The some simulation results are as,and simulation results show that, simply by inserting a pair of wide slotson the radiating edge with reducing the distance between the slots (at the specific limit) of the rectangular patch (The same principle can used to circular, Triangular patch shape) good impedance matching over a wide bandwidth can easily be achieved for the proposed antenna, rectangular slotted patch the antenna has reached a high impedance bandwidth, high gain and stable radiation pattern. The good properties can be achieved by choosing a proper shaped & dimensions of slots In this paper, an air substrate of thickness about 7% of the wavelength of the center operating frequency, the antenna has an impedance bandwidth of about 31.2%**,** and the VSWR bandwidth is about 29.16% of the center frequency 1.64GHz.

4. CONCLUSION

Increasing in the slots size at the specific limit, the bandwidth increase.From the results, it is seen that resonant modes are excited, which leads to a wide bandwidth. The impedance bandwidth, determined from a 10-dB return loss, is 578.4 MHz about 31.2 % and the VSWR bandwidth is 553 MHz or about 29.16% with respect to the center frequency at 1.64 GHz, average of the simulated lower and higher frequencies with a 10-dB return loss. And the peak gain is 9.4, with the radiating efficiency 94.7%. Radiation characteristics of the antenna are also studied.

Table 1.Comparison of Change in the Slots Size

L	W	BW, %	Gain
46	6.2	409.6, 21.8	6.91
46	6.1	494.7, 24.6	7.3
49	5.4	494.0, 24.2	7.2
49	6.9	521.2, 26.6	8.3
54	7.3	564.1, 30.8	7.2
59	7.4	523.2, 26.1	9.4
51	7.4	578.4, 31.2	8.8

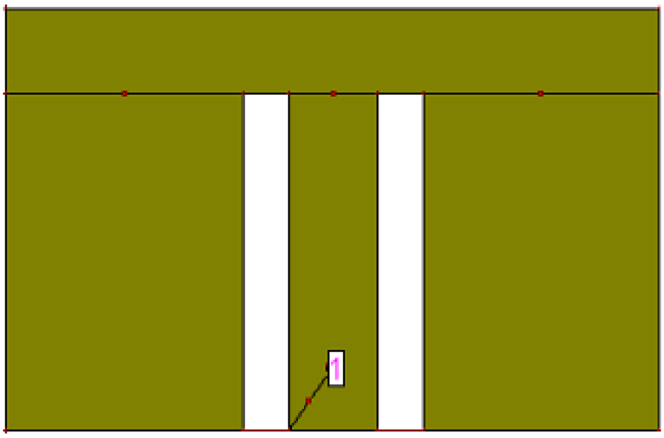

Figure 1: Antenna Geometry

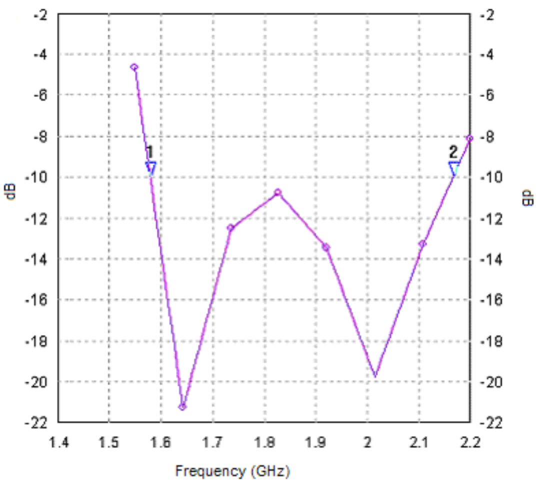

Figure 2: Impedance Bandwidth

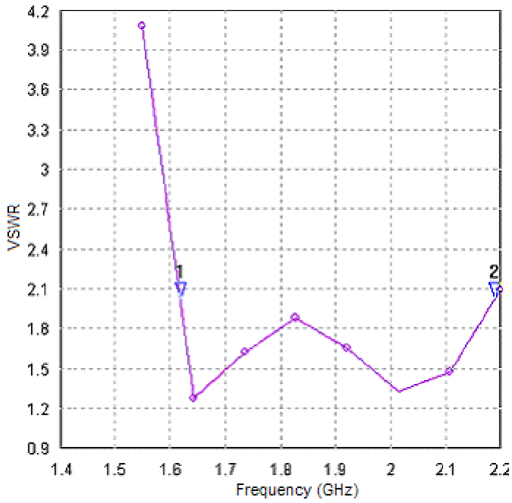

Figure 3: VSWR Plot

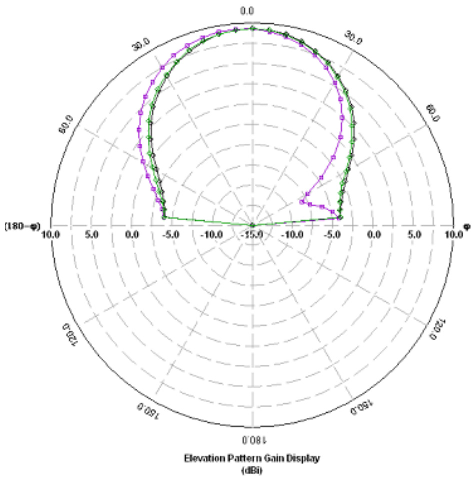

Figure 4: Elevation Pattern Gain Display

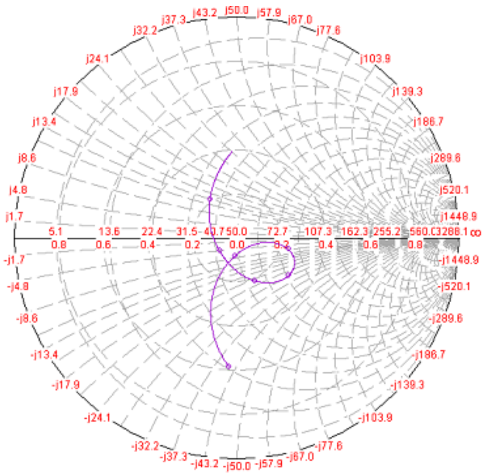

Figure 5: Impedance smith chart

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