A Novel Design of Array Square Microstrip Antenna for Microwave Applications

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Abstract— A novel design of array square microstrip antenna (ASQMA) is presented for triple band operation. The magnitude of each operating bands are found to be 5.48%, 4.87% and 20.16% respectively. These triple bands are further converted to quad bands by placing four slots i.e. two slots are placed vertically and two are horizontally on the each square patch. The magnitude of each operating bands are found to be 5.58%, 18.44%, 2.9% and 7.44% respectively. The radiation characteristics are broadside in nature, these antennas may find applications in microwave communication system.

Key words: Array, Square Microstrip Antenna, Triple band, Quad band

I. Introduction

Now a days microstrip antennas have got more demands and many researchers are working on it and enormous research is been published by many researchers because it is simple in design, low cost, low profile, each to handle etc. [1]. But at the same time one has to see the radiation characteristics of the microstrip antenna because it has low bandwidth, low gain, more radiation losses etc [2]. This is another challenge to overcome these draw backs. The field radiated by single antenna may not meet the above scvaid challenges, so the field strength can be increased by designing the antennas in an array. Array is one of the common method of combining the radiations from a group or array of similar antennas. Many techniques are available in the literature to design the microstrip antennas like truncation, parasitic, arrays, slot loading [3] ect. In this paper array techniques have been used to design the array square microstrip antennas to increase the bandwidth and number of bands.

II. Design Geometries of Antennas

The antenna geometries are designed by using Auto-cad Software. The thickness of the antenna substrate are taken as 0.32 cm with a relative permittivity of the substrate as $\varepsilon r = 4.2$ and the design frequency is taken as 3.5 GHz.

Figure1 shows the geometry of ASQMA designed on a substrate area of A × B. The length and width square patch is taken as L and design by using the equation available of square patch [4]. The microstripline feed of length L50 and width W50 of 50 Ω which is connected to a microstripline feed of length L100 and width W100 of 100 Ω which is used to form a two way power divider. A matching quarter wave transformer of length Lt and width Wt is connected between 100 Ω feedline and mid-point of the radiating elements in order to ensure perfect impedance matching [1].

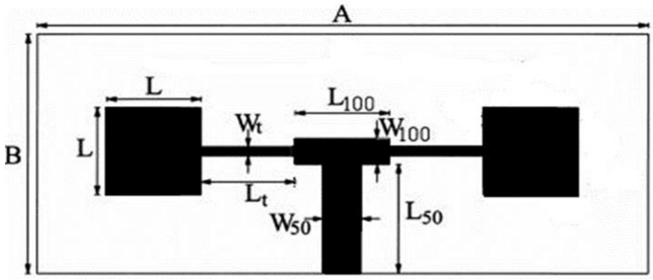

Fig. 1: Geometry of ASQMA

The figure 2 shows the geometry of slot loaded array square microstrip antenna (SLASQMA). Here four slots are placed in the same above said antenna i.e ASQMA, two slots are placed in vertical direction and two are placed in horizontal direction. The length and width of the slots are Ls and Ws respectively and are taken in terms of λo.

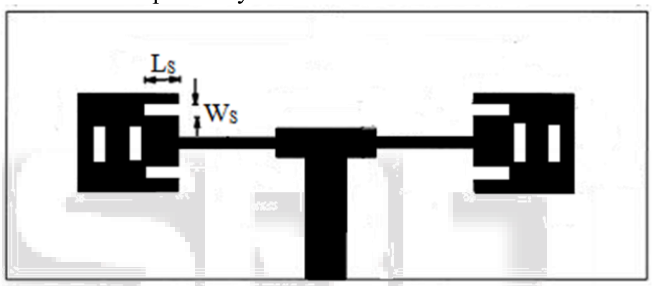

Fig. 2: Geometry of SLASQMA

III. Result Discussion

The result of these antennas are simulated by using on Ansoft HFSS (High frequency structure simulator 13.0). The variation of return loss versus frequency of ASQMA is as shown in the figure 3. From this figure it is seen that, the antenna resonates for triple band of frequencies BW1, BW2 and BW3 with the maximum bandwidth of each operating bands are found to be 5.48%, 4.87% and 20.16% respectively. Which is determined by using the equation available in the literature [5].

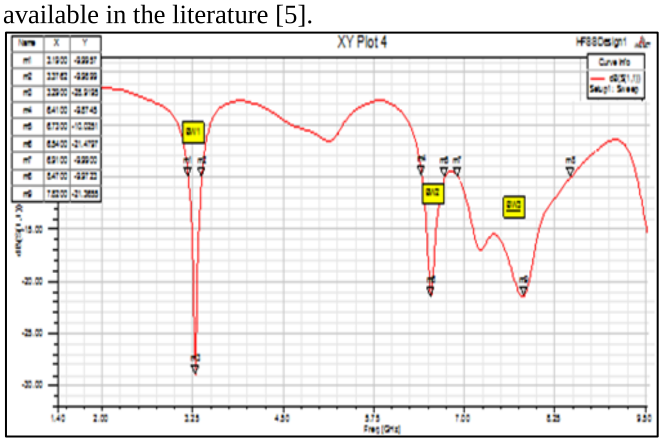

Fig. 3: Variation of Return Loss Vs Frequency

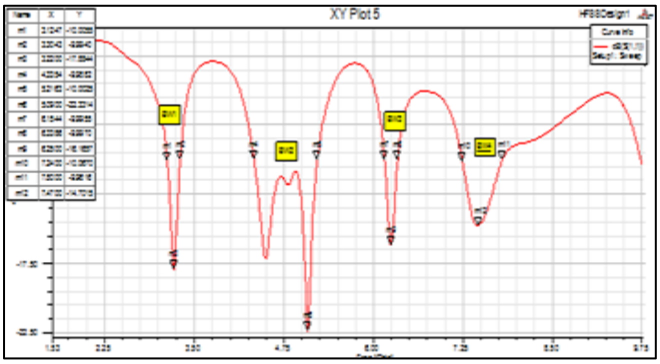

Fig. 4: Variation of Return Loss Vs Frequency

The variation of return loss versus frequency of SLASQMA is as shown in Fig. 4. From this figure it is seen that, the antenna resonates for quad bands of frequencies BW4, BW5, BW6 and BW7 with an maximum bandwidth of each operating bands are found to be 5.58%, 18.44%, 2.9%, and 7.44% respectively [6]. It is has been seen that the quad bands are due to the effect of placing a slots on the square patch, which converts the triple band to qaud band operations. [6]

Fig. 5 and 6 shows the co-polar and cross-polar radiation pattern of ASQMA measured at 6.54 GHz, and SLSQMA measured at 5.09 GHz respectively. From these figures it is clear that, the patterns are broadsided in nature.

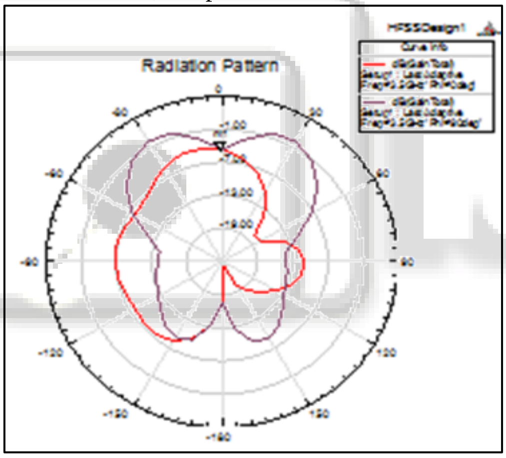

Fig. 5: Radiation pattern of ASQMA measured at 6.54 GHz

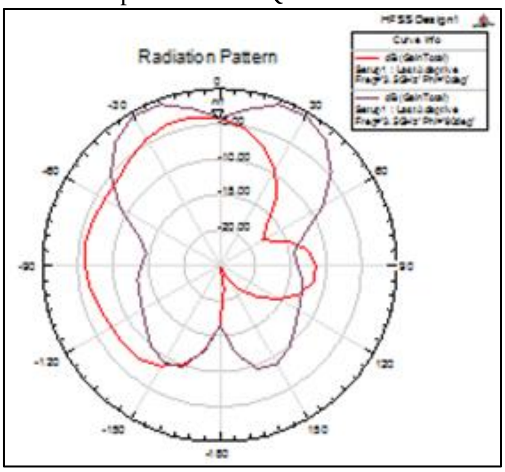

Fig. 6: Radiation pattern of SLSQMA measured at 5.09 GHz

IV. CONCLUSION

From detailed study it is concluded that, the triple bands can be obtained by designing the square microstrip antennas in the array with a maximum bandwidth of 20.16%. These triple bands can converted to quad band operation by placing four slots in the each patch of array square microstrip antennas with a maximum gain of 4.44 dB. These antennas may find applications in microwave communication systems.

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